YASKAWA

A World of Automation Solutions™

MotionSuite™ MP940 Machine Controller Reference Manual

WARNING

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Contents

SAFETY INFORMATION

PRECAUTIONS

1. Read this instruction manual in its entirety before using the MP940.
2. The following symbols are used to indicate precautions of which the user must be aware to safely use this equipment.

CAUTION

The symbol above indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury."

WARNING

The symbol above indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury."

Chapter 1: General Functions

This chapter describes the general functions and characteristics of the MP940.

Outline of the MP940

This section provides a general outline of theMP940.

Exterior of the MP940 module

The MP940 is a single-axis controller with communication, local I/O, external encoder, and motion functions bus connected with an SGDH servo amplifier.

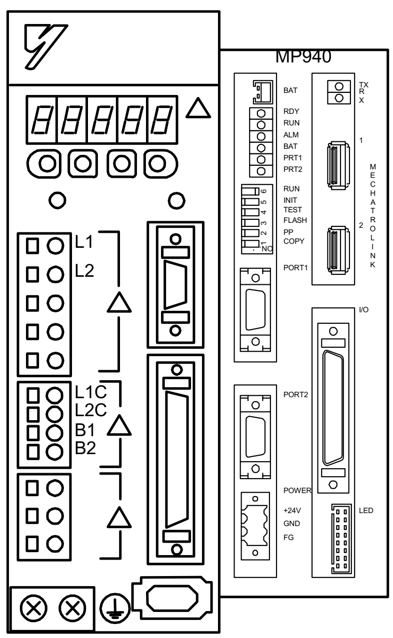


Figure 1.1: MP940 Machine Control and SGDH Servo Amplifier

Features of the MP940

The MP940 machine controller functions in a variety of machine control modes, from simple positioning to high-speed/high-precision synchronous control.

■ A single controller

The MP940 is composed of the following modules.

Function Module	Content
MP940	CPU
SERIAL	Serial communication RS-232C, RS-422/485
LIO	Control I/O, DI 8points, DO 8points, AO 1CH
SVA	Motion function
CNTR	Counter function
MLINK or DeviceNet	Mechatrolink I/F function or DeviceNet I/F function

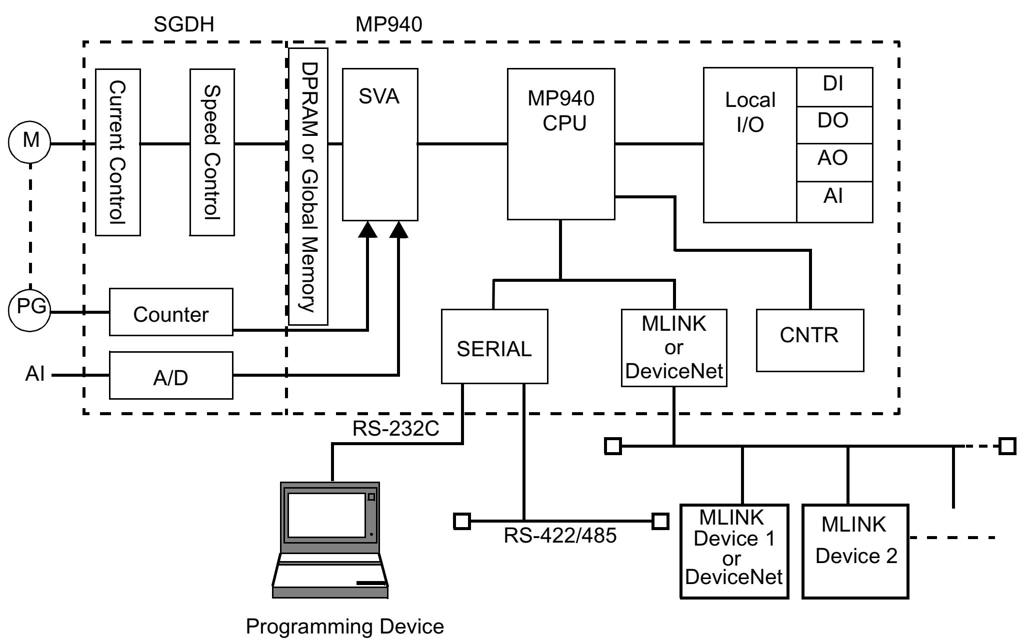


Figure 1.2: MP940 Functions

- Synchronized controller and servo amplifier

High-speed/high-prescision control is possible because the controller and SGDH servo amplifier are bus connected. There is no lag in startup or monitor time, and execution is accomplished in perfect synchronization.

The control period settings can be set to the following periods:

500 μs, 1 ms, 2 ms 4 ms

- Reduced wiring/Smaller size

The combination controller/servo amplifier result in wiring reduction and space savings.

- Variety of motion control modes, including:

  - Positioning, linear interpolation motion program commands
  - High-speed processing position/synchronous phase/speed control/torque control
  - Excellent for electronic shaft and electronic gear applications

The four control modes (speed, synchronous phase, torque, and position) are illustrated below..

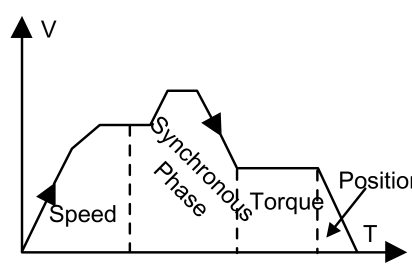


Figure 1.3 Four Control Modes

The following figure provides an example of a synchronous phase control application.

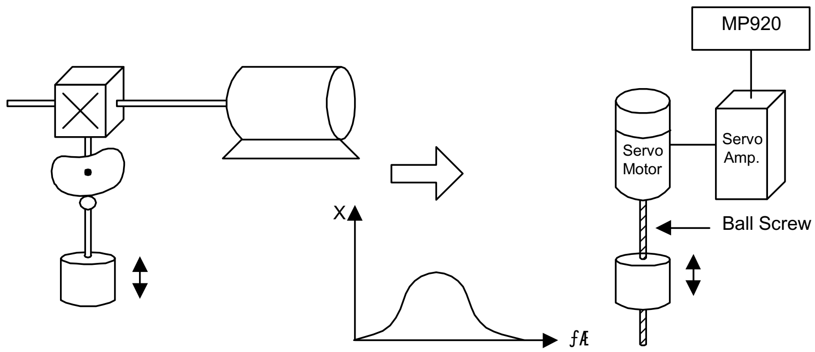


Figure 1.4: Electronic Camming

- High-precision synchronous control

User parameter change is executed at high speed for monitor and servo amplifier data. High-precision synchronous control is possible through the READ/WRITE function of this data in both ladder and motion programs.

- Mode switching during operation

  Switching between position control, torque control, speed control, and synchronous phase control is possible during operation.

- Run commands

  P/PI switching, external torque limit, and speed limit during torque control can be commanded from the MP940 during operation.

- READ/WRITE function of servo amplifier user parameters

  User parameters such as Servo Amplifier Position Loop Gain, Speed Loop Gain, Speed Loop Integral Time Constant, etc. may be modified during operation.

- Position data monitor

  The various position data, reference speed, speed monitor, and external encoder data can be referenced at high speed within the program, as depicted below.

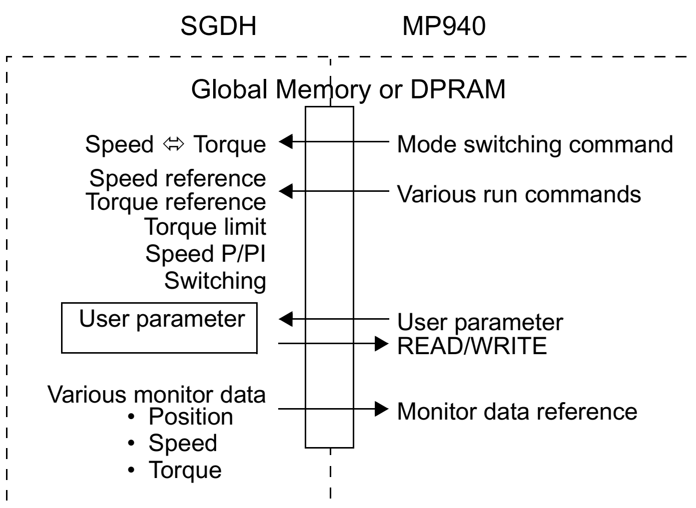


Figure 1.5: Position data monitor

Chapter 2: Specifications

This chapter describes the general specifications and functions of the MP940.

Specifications and Functions

This section describes the general specifications and functions of the MP940.

General Specifications

Item		Specification
Physical Environment	Ambient Usage Temperature	0 ~ +55ºC
	Storage Temperature	-20 ~ +85º
	Ambient Usage Humidity	30 ~ 95% RH (no condensation)
	Ambient Storage Temperature	5 ~ 95% RH (no condensation)
	Pollution Level	JIS B3501 standard pollution level 1
	Corrosion Resistance	No flammable or corrosive gas
	Usage Altitude	less than 2000M above sea level
Electrical Drive Characteristics	Noise Resistance	JIS B3502 standard Normal Mode 1500Vp-p Common Mode 1500Vp-p Pulse Width 100ns/ 1 Boot-up time 1ns (according to noise simulator)
Mechanical Drive Characteristics	Vibration Resistance	JIS B3502 standard Vibration Amplitude/Acceleration : 10≤ f<57Hz Half-wave Amplitude 0.075mm 57≤ f ≤150Hz set acceleration 9.8m/s^2 Scan in each of the X, Y, Z directions (1 octave/ min.) × Number of scans 10
	Shock Resistance	JIS B3502 standard Peak Acceleration 147m/s^2 work time 11ms Twice in each direction (X, Y, and Z)
Ground Conditions	Grounding Cooling Method	Class 3 Grounding Natural Cooling

Hardware Specifications

Hardware Specifications

<table>
<tr><th>Item</th><th colspan="2">Specification</th></tr>
<tr><td>Name</td><td>MP940 (Mechatrolink)</td><td>MP940D (DeviceNet)</td></tr>
<tr><td>Model</td><td>JEPMC-MC400</td><td>JEPMC-MC410</td></tr>
<tr><td>Memory</td><td colspan="2">FLASH 2MB
SRAM 2MB (battery backup)</td></tr>
<tr><td rowspan="2">Communication Port</td><td colspan="2">1 RS-232C Port (Port1)
Baud Rate Setting 9.6k/19.2kbps
MDR-14 (dedicated pin assignment)
Protocol
• Memobus
• No Protocol
• Melsec Communication</td></tr>
<tr><td colspan="2">1 RS-422/485 Port (Port2)
Baud Rate Setting 9.6k/19.2kbps
MDR-14 (dedicated pin assignment)
Protocol
• Memobus
• No Protocol
• Melsec Communication</td></tr>
<tr><td>Network</td><td>Baud rate: 4Mbps
Cycle: 1ms, 2ms, 4ms
Maximum # of Slaves: 6 @ 1ms, 14 @ 2ms, 29 @4ms</td><td>Baud rate: 125Kbps, 250 Kbps, 500Kbps
Mode: Slave
Node: 63 maximum</td></tr>
<tr><td rowspan="2">Display LEDs</td><td colspan="2">Status Display LEDs
READY (Green)
RUN (Green)
ALM (Red)
BATALM (Red)
PRT1 (Green)
PRT2 (Green)</td></tr>
<tr><td>Mechatrolink Operation Display LEDs
RX (Green)
TX (Green)</td><td>DeviceNet operation display LEDs
M9 (Red/Green)
N9 (Red/Green)</td></tr>
<tr><td>Setting Switches</td><td colspan="2">DIP switches for mode setting
RUN/STOP
INITIAL
TEST
FLASH
PP_INIT
MREG_CPY</td></tr>
</table>

Hardware Specifications (Continued)

<table>
<tr><th>Item</th><th colspan="2">Specification</th></tr>
<tr><td>DeviceNet Setting Switch</td><td>—</td><td>DR0.DR1: Baud rate
<table><tr><td>DR0</td><td>DR1</td><td></td></tr><tr><td>OFF</td><td>OFF</td><td>125Kbps</td></tr><tr><td>OFF</td><td>ON</td><td>250Kbps</td></tr><tr><td>ON</td><td>OFF</td><td>500Kbps</td></tr><tr><td>ON</td><td>ON</td><td>Do not use</td></tr></table>
X1: Slave/Master
X2: Reserved</td></tr>
<tr><td>Input Signals</td><td colspan="2">Number of Inputs: 8/Common
Input Type: Combined sink/source
Input Type: Type 1 (JIS-B3501)
Insulation Type: Photocoupler Insulation
Base Voltage: 17.4VDC ~ 28.8VDC
35VDC (at peak)
Rated Current: 5.3mA
Input Impedance: approximately 4.4kΩ
Operating Voltage: ON Voltage 15VDC or higher
OFF Voltage 5VDC or less
OFF Current: 0.9mA or less
Response Time: OFF → ON 0.5ms or less
ON→ OFF 1.5ms or less</td></tr>
<tr><td>Output Signals</td><td colspan="2">Number of Outputs: 8/Common
Output Type: Sinking Output
Output Type: Transistor Output
Insulation Type: Photocoupler Insulation
Load Voltage: 19.2 ~ 28.8V_{DC}
35VDC (at peak)
Load Current: 0.1A/Circuit 0.8A/Common
ON Voltage: 1.0V or less
External Source Voltage: 24V_{DC} ±20%
15mA
Output Protection:1 common fuse
Fuse Rating:1.5A (Fusing Time: 5s or less at 3A)
Response Time: OFF → ON 0.25ms or less
ON → OFF 1ms or less</td></tr>
</table>

Hardware Specifications (Continued)

Item	Specification
Pulse Input	Pulse Input Circuit: 5V Deviation 1MHz input maximum Pulse Input Circuit: A/B phase input (1×, 2×, 4× multiples can be selected) AB Format, Sign Format, Add/Subtract Format Pulse Counter Latch: (the external signal can be switched between 5V/12V/24V)
Analog Input	SGDH Servo Amplifier
Analog Output	Resolution:16-bit Output Range: 0 ~ 10V
Power Input	Input Signal: $24V_{DC}$ ±20% ($19.2V_{DC}$ ~ $28.8V_{DC}$) Input Current: 0.4A Fuse Rating: 1.5A Safety Criteria: UL, CSA standard
External Dimensions	W44mm H142mm D128mm

Function List

■ MP940 Motion Control Function Specificationss

Item		Specification
Number of Control Axes		1
Contour Specifications	PTP Control	Linear, Rotary, Unlimited
	Interpolation	Linear
	Speed Reference Output	Yes
	Torque Reference Output	Yes
	Position Control	Positioning, External Positioning, Zero-point Return, Interpolation, Interpolation with position detection function, set feed speed, stepping
	Phase Control	Yes
Position Control	Command Unit	mm, inch, degree, pulse
	Minimum Command Setting Unit	1, 0.1, 0.01, 0.001, 0.0001, 0.00001
	Maximum Command Value	-2147483648~+2147483647 (with 32-bit sign)
	Speed Reference Unit	mm / min., inch / min., deg / min., pulse / min.
	Acceleration Type	Linear, Asymmetric, S-curve
	Override Function	0.01 ~ 327.67%
Coordinates		Linear Coordinates
Zero-point Return		8 Types 1. DEC1+C phase 2. DEC2+C phase 3. DEC1+LMT 4. C-phase 5. DEC1+ZERO 6. DEC2+ZERO 7. DEC1+LMT+ZERO 8. ZERO
Properties	Language	Dedicated motion language ladder
	Number of Tasks	A maximum of 8 parallel programs can be simultaneously executed.
	Number of Programs	32 maximum
	Program Capacity	80kb
Applied Servo Amplifier		Analog Type: SGDH-**AE
Encoder		Incremental/Absolute
Speed Control	Speed Reference	-327.68 ~ +327.67 %/Rated Speed With torque limit function
	Acceleration Type	Linear, asymmetric, S-curve (motion average)
Torque Control	Torque Reference	-327.68 ~ +327.67 %/Rated Torque With speed limit function
Phase Control	Speed Reference Unit	-327.68 ~ +327.67 %/Rated Speed
Speed Correction		-327.68 ~ +327.67 %/Rated Speed
Position Correction		-2147483648 ~ +2147483647 pulses

<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Command Language</td><td>Axis Motion Commands 5
MOV, MVS, ZRN, SKP, EXM
Basic Control Commands 5
ABS, INC, POS, MVM, PLD
Speed, Accel/decel commands 8
ACC, DCC, SCC, VEL, IAC, IDC, IFP, FMX
Upper-level Control Commands 4
PFN, INP, SNG, UFC
Control Commands 10
MSEE, TIM, IOW, END, RET, EOX, IF, ELSE, IEND, WHILE WEND, SFORK, JOINTO, SJOINT
Operations/Sequence Control Commands 32
=, +, -, *, /, MOD, |, ^, &, !, (), S{}, R{}, SIN, COS, TAN, ASN, ACS, ATN, SQRT, BIN, BCD, ==, <>, >, <, >=, <=, SFR, SFL, BLK, CLR</td></tr>
</table>

■ PLC Function Specifications

Item	Specification
Program Capacity	For every 2k steps (varies according to the size of the motion program. 40k steps maximum)<H>
Control Format	Sequence: Scan Format
Program Language	CP Code Ladder Diagram: Relay Circuit Text-type language: Numerical operations, logical operations, etc.
Scan	Servo Control Scan Time Setting: 0.5 / 1.0 / 2.0 / 4.0 ms High-speed Scan Time Setting: 0.5 ~ 32.0ms (0.01ms units) S scan integer multiples Low-speed Scan Time Setting: 2.0 ~ 200.0ms (0.01ms units) S scan integer multiples
User Diagrams Functions, Motion Programs	Start Drawing (DWG.A):Maximum of 4 drawings, with up to 3 layers per drawing System Scan Drawing (DWG.S): Maximum of 16 drawings, with up to 3 layers per drawing High-speed Scan Drawing (DWG.H) :Maximum of 16 drawings, with up to 3 layers per drawing Low-speed Scan Drawing (DWG.L) :Maximum of 32 drawings, with up to 3 layers per drawing Interrupt Drawing (DWG.I) :Maximum of 8 drawings, with up to 3 layers per drawing Number of steps :Maximum 500 steps/drawing User Functions :Maximum 32 functions Motion Programs :Maximum 32 Drawing, Motion Program Modification History Drawing, Motion Program Secure Holding Function

Item	Specification		
Data Memory	Global Data (M) Register System (S) Register DWG Local (D) Register DWG Setting (#) Register Input (I) Register Output (I) Register Constant (C) Register		: 32 kwords : 1 kwords : Maximum 16 words/DWG : Maximum 16 words/DWG : 2 kwords (including internal input register) : 2 kwords (including internal output register) : 32 kwords
Trace Memory	Data Trace	:4k words (4k words × 1 group)	
Memory Backup	Program Memory	:CMOS Battery Backup	
Data Type	Bit (Relay) Integer Double-length Integers Real Numbers		: ON/OFF : -32768 ~ +32767 : -2147483648 ~ 2147483648 : ±(1.175E-38 ~ 3.402E+38)
Register Attribute	Register Number Designation Symbol Designation	: Direct Register Number Designation : A maximum of 8 alphanumeric characters. (200 symbols/DWG maximum) Autonumbering and auto-symbols available	
Command Language	Program Control Commands During Direct I/O Commands Relay Circuit Commands Logical Operation Commands Numerical Operation Commands Numerical Conversion Commands Numerical Comparison Commands Data Operation Commands Basic Function Commands Display Data Operation Commands DDC Commands System Functions	:14 : 2 :14 (including set, reset coils) : 3 :16 : 9 : 7 :14 :10 :11 :13 :9	Command Language

■ Motion Command List

Command Language Types	Commands	Function
Axis Motion Commands	MOV	Positioning
	MVS	Linear Interpolation
	ZRN	Zero-point return
	SKP	Skip command
	EXM	External Positioning
Basic Control Commands	ABS	Absolute mode
	INC	Incremental mode
	POS	Current Variation
	MVM	Machine Coordinate Designation
	PLD	Program Current Position Update
Speed/Acceleration Commands	ACC	Acceleration Time Change
	SCC	S-curve Parameter Change
	VEL	Feed Speed Change
	IAC	Interpolation Acceleration Time Change
	IDC	Interpolation Deceleration Time Change
	IFP	Interpolation Feed Speed Ratio Setting
	FMX	Interpolation Feed High-speed Setting
Upper-level Control Commands	PFN	In-position Check
	INP	2nd in-position check
	SNG	Ignore Single Block
	UFC	User Function Call-out
Control Commands	MSEE	Sub-program Call-out
	TIM	Timed Wait
	IOW	I/O Variable Wait
	END	Program Close
	RET	Sub-program Close
	EOX	1 scan WAIT command
	IF ELSE IEND	Branching Commands
	WHITE WEND	Repetition Commands
	SFORK JOINTO SJOINT	Selection Execution Commands

Command Language Types	Commands	Function
Sequence Commands	=	Replacement
	+, -, ×, /, MOD	Numerical Operations
	|, ^, &, !	Logical Operations
	SIN, COS, TAN, ASN, ACS, ATN, SQRT, BIN, BCD	Function Commands
	==, <>, >, <, >=, <=	Numerical Comparison Commands
	SFR, SFL, BLK, CLR	Data Operation
	(), S{}, R{}	Other

■ Motion Command List

Type	Command	Name	Command Format	Function/Meaning
Axis Motion Commands	MOV	Positioning	MOV [axis1]—; *	Executes fast feed positioning.
	MVS	Linear Interpolation	MVS [axis1]—F;	Executes linear interpolation at interpolation feed speed F.
	ZRN	Zero-point return	ZRN [axis1] ;	Returns to zero-point.
	SKP	Skip Command	SKP [axis1]SSF;	When turned on during linear interpolation execution, the machine skips the remaining motion and proceeds onto the next block.
	EXM	External Positioning	EXM [axis1] D;	Upon input of an external positioning signal during positioning execution, the machine proceeds to the next block after positioning only in increments of the motion designated in “D”.

Type	Command	Name	Command Format	Function/Meaning
Basic Control Commands	ABS	Absolute mode	ABS;	The following coordinate expressions are handles as absolute values.
	INC	Incremental mode	INC:	The following coordinate expressions are handles as incremental values.
	POS	Current Variation	POS [axis1];	Changes the current value to a desired coordinate.Subsequent motion commands execute motion on the basis if the new coordinates.
	MVM	Machine Coordinate Command	MVM MOV [axis1]; or MVM MVS [axis1];	These commands are issued when motion is desired based on the machine coordinate.The coordinates automatically set at zero-point return completion are called the machine coordinates.These coordinates are not affected by POS commands.
	PLD	Program Current Position Update	PLD [axis1] ;	Updates the current position of a program shifted by manual feed, etc.
Speed/Accel/Decel Commands	ACC	Acceleration Time Change	ACC [axis1];	Sets the acceleration time for linear acceleration
	DCC	Deceleration Time Change	DCC [axis1];	Sets the deceleration time for linear acceleration
	SCC	S-curve Parameter Change	SCC [axis1];	Sets parameters during motion average accel/decel.
	VEL	Feed Speed Change	VEL [axis1] ;	Sets feed speed.
	IAC	Interpolation Acceleration Time Change	IAC T;	Sets acceleration time for linear accel/decel during interpolation motion.
	IDC	Interpolation Deceleration Time Change	IDC T;	Sets deceleration time for linear accel/decel during interpolation motion.
	IFP	Interpolation Feed Speed Ratio Setting	IFP P;	Executes speed designation during interpolation feed in % of maximum speed.
	FMX	Interpolation Feed High-speed Setting	FMX T;	Sets the maximum speed during interpolation feed. This is the time taken in interpolation acceleration to go from zero to this speed.

Type	Command	Name	Command Format	Function/Meaning
Sequence Commands	/	Division	MW = MW / MW; MW = MW / 123456; MW = 123456 / MW;	Executes integer/real number division.Operates as real numbers when integers and real numbers are intermixed.
	MOD	Modulus	MW = MW / MW; MW = MOD;	MOD is stored as a modulus into a designated register when designated in the next block of the modulus.
	|	OR (Logical OR)	MB = MB | MB; MB = MB | 1; MW = MW | MW; MW = MW | H00FF;	Creates a logical OR in bits or integers.
	^	XOR (Exclusive Logical OR)	MW = MW ^ MW; MW = MW ^ H00FF;	Creates an exclusive logical OR in integers.
	&	AND (Logical AND)	MB = MB & MB; MB = MB & 1; MW = MW & MW; MW = MW & H00FF;	Creates a logical AND in bits or integers.
	!	NOT (Inversion)	MB = !MB; MB = !1; MW = !MW; MW = !H00FF;	Creates an inverse value in bits.
	()	Parentheses	MW = MW— & (MW— | MW—);	Logical operations within parentheses have priority.
	S{}	Designated bit ON	S{MB} = MB & MB;	The designated bit goes ON if the logical operation result is “Valid”.The designated bit goes OFF when the result of a logical operation is “Invalid”.
	R{}	Designated bit OFF	R{MB} = MB & MB;	The designated bit goes OFF if the logical operation result is “Valid”.The designated bit goes ON when the result of a logical operation is “Invalid”.
	SIN	Sine	SIN(MW) ;SIN(90);	Obtains the sine in integers/real numbers (deg), and returns a real number value.
	COS	Cosine	COS(MW) ;COS(90);	Obtains the cosine in integers/real numbers (deg), and returns a real number value.
	TAN	Tangent	TAN(MF) ;TAN(45.0);	Obtains the tangent in real numbers (deg), and returns a real number value.
	ASN	Arc Sine	ASN(MF) ;ASN(90.0);	Obtains the arc sine in real numbers, and returns a real number value.

Type	Command	Name	Command Format	Function/Meaning
Sequence Commands	ACS	Arc Cosine	ACS(MF) ;ACSi_90.0);	Obtains the arc cosine in real numbers, and returns a real number value.
	ATN	Arc Tangent	ATN(MW) ;ATNi_45j_;	Obtains the arc tangent in integers/real numbers, and returns a real number value (deg).
	SQT	Square Root	SQT(MW) ;SQT(100);	Obtains the square root in integers/real numbers (deg), and returns a real number value.
	BIN	BCD¨_BIN	BIN (MW);	Converts BCD data to BIN data.
	BCD	BIN¨_BCD	BCD (MW);	Converts BIN data to BCD data.
	==	Coincidence	IF MW == MW; WHILE MW == MW ;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left and right sides coincide.
	<>	Non-coincidence	IF MW <> MW; WHILE MW <> MW;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left and right sides do not coincide.
	>	Larger than	IF MW > MW; WHILE MW > MW;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left side is larger than the right side.
	<	Smaller than	IF MW < MW; WHILE MW < MW;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left side is smaller than the right side.
	>=	Equal to or greater than	IF MW >= MW; WHILE MW >= MW;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left side equal to or greater than the right side.
	<=	Equal to or less than	IF MW <= MW; WHILE MW <= MW;	Used in the IF or WHILE condition formula.The formula is assumed to be “Valid” if the left side equal to or less than the right side.
	SFR	Right Shift	SFR MB N W;	Shifts the word variables to the right by an exponent.
	SFL	Left Shift	SFL MB N W;	Shifts the word variables to the left by an exponent.
	BLK	Block Transfer	BLK MW MW W;	Treats a designated bit (word) variable as opened, and executes transfer by block (parameter designation) unit.

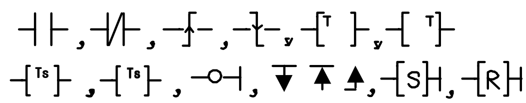
Type	Command	Name	Command Format	Function/Meaning
Control Commands	CLR	Clear	CLR MB W;	The parameter designator number goes OFF (0) for a variable group in which the designated bit (word) variables are assumed to be started.
	MSEE	Sub-program Call-out	MSEE MPS ;	Executes MPS sub-program.
	TIM	Timed Wait	TIM T;	Waits for the time designated in "T", and proceeds to the next block.
	IOW	I/O Variable Wait	IOW MB == ***;	Stops motion control program execution until the conditional formula is satisfied.
	END	Program Close	END;	Closes the motion program.
	RET	Sub-program Close	RET;	Closes the sub-program.
	EOX	1 scan WAIT command	EOX;	This command is for cutting into a continuing sequence command during operation, and forcing a single scan wait.

	IF
	ELSE
	IEND
		Branching Commands	IF (conditional formula);
			(process 1)
			ELSE;
			(process 2)
			IEND;
				(Process 1) is performed if the conditional formula is satisfied, and (process 2) if it is not.

	WHILE WEND	Repetition Commands	WHILE (conditional formula); ••• WEND;	Repeats execution of WHILE~WEND processing the conditional formula is satisfied and continues operating.
	SFORK JOINTO SJOINT	Selection Execution Commands	SFORK conditional formula 1? label 1, conditional formula 2? label 2, •••; label 1: Process 1 JOINTO label xlabel 2: Process 2 JOINTO label xlabel • •label x: SJOINT;	(Process 1) is performed if the conditional formula 1 is satisfied, and (process 2) if conditional formula 2 is satisfied.

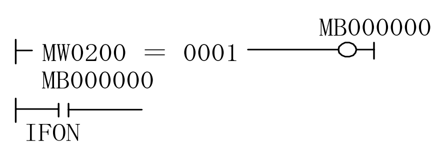
The "—" symbol in MOV [axis1]— •••; signifies where the numerical data for [axis1] is recorded.

■ Ladder Command List

Command Language Types	Symbol
Program Control Command	SEE, FOR FEND, WHILE ON/OFF WEND , IFON/IFOFF ELSE IEND, DEND FSTART, FIN, FOUT, XCALL, comment
Direct I/O Commands	INS, OUTS
Relay Circuit Commands	
Logical Operation Commands	∧, ∨, ⊕
Numerical Operation Commands	+, -, ++, --, ×, ÷, INC, DEC, MOD, REM, TMADD, TMSUB, SPEND
Numerical Conversion Commands	INV, COM, ABS, BIN, BCD, PARITY, ASCII, ASCBIN, BINASC,
Numerical Comparison Commands	<, ≤, ≠, ≥, >, RCHK
Data Operation Commands	ROTL, ROTR, MOVB, MOVW, XCHG, SETW, BETD, BPRESS, BSRCH, SORT, SHFTL, SHFTR, COPYW, BSWAP
Basic Function Commands	SQRT, SIN, COS, TAN, ASIN, ACOS, ATAN, EXP, LN, LOG
DDC Commands	DZA, DZB, LIMIT, PI, PD, PID, LAG, LLAG, FGN, IFGN, LAU, SLAU, PWM
Display Data Operation Commands	TBLBR, TBLBW, TBLSRL, TBLSRC, TBLCL TBLMV, QTBLR, QTBLRI, QTBLW, QTBLWI QTBLCL
System Functions	COUNTER, FINFOUT, TRACE, DTRC-RD, MSG-SND, MSG-RCV

■ Ladder Command List

Type	Name	Symbol	Content
Program Control Commands	Sub-program Reference	SEE	After “SEE”, designate the sub-program, or sub-sub-program number to be referenced. SEE H01
	Motion Drawing Reference	MSEE	After “MSEE”, designate the motion program number or status work address to be referenced. MSEE MPM001 DA00000
	FOR expression	FOR : : FEND	Repeat Execution Expression 1 FOR V = a to b by c V : Either integer register I or J may be designated as desired. a, b, c :Any desired integer value can be designated (b>a>0, c>0) FEND:END of FOR command
	WHILE expression	WHILE : ON/OFF : WEND	Repeat Execution Expression 2 WEND:END of WHILE-ON/OFF command
	IF expression	IFON/ IFOFF : ELSE : IEND	Execution expression with conditions IEND:END of IFON/IFOFF command
	Drawing END	DEND	END of drawing (DWG)
	Comments	“nnnnnnn”	Characters surrounded by quotation marks (“ “) are treated as comments.
	Function I/F	FSTART	Function Reference Command
		FIN	Function Input Command Saves input data from a designated input register to the function input register.
		FOUT	Function Output Command Saves output data from a designated output register to the function output register.
		XCALL	Extended Program Reference Command
Direct I/O Commands	Input Commands	INS	INS MA00100 ———o——| Executes data input and storage by interrupt prohibit.
	Output Commands	OUTS	OUTS MA00100 ———O——| Executes data setting and output by interrupt prohibit.

Type	Name	Symbol	Content
Relay Circuit Commands	A Contact	┤├	No limit on series circuits All register bit types can be designated as relay numbers.
	B Contact	┤/├	No limit on series circuits All register bit types can be designated as relay numbers.
	Rising Edge Pulse	┤↑├	No limit on series circuits All register bit types can be designated as relay numbers.
	Falling Edge Pulse	┤↓├	No limit on series circuits All register bit types can be designated as relay numbers.
Relay Circuit Commands	ON Delay Timer (10ms)	┤[T]├	Setting count register Setting = all registers, parameters (setting unit: 10ms) Count register = registers M,D
	OFF Delay Timer (10ms)	┤[T]├	
	ON Delay Timer (1s)	┤[Ts]├	Setting count register Setting = all registers, parameters (setting unit: 1s) Count register = registers M,D
	OFF Delay Timer (1s)	┤[Ts]├	
	Coil	─○┤	
	Setting Coil	┤[S]┤	 MB000010 is ON when MB000000 is ON. Subsequently, ON is obtained even if MB000000 goes OFF.
	Reset Coil	┤[R]┤	 MB000020 is ON when MB000010 is OFF. Subsequently, OFF is obtained even if MB000020 goes OFF.
	Branching/ Joining	▼ ▲ ▲	All of the above relay commands can be connected to branching/ joining symbols.

Type	Name	Symbol	Content
Logical Operation Commands	Logical AND	∧	All registers and parameters can be designated in integer form.
	Logical OR	∨	All registers and parameters can be designated in integer form.
	Exclusive Logical OR	⊕	All registers and parameters can be designated in integer form.
	Addition	+	├ Normal numerical addition (with operation error generation) MW00280 +00100 ⇒ MW00220
	Subtraction	-	Normal numerical subtraction (with operation error generation) ├ MW00280 -00100 ⇒ MW00220
	Extended Addition	++	Adds closed values (no operation error generation) 0¨→ 32767¨→ -32768¨→ 0
	Extended Subtraction	--	Subtracts closed values (no operation error generation) 0~-32767, -32768~0
Numerical Operation Commands	Integer Replacement	├	Integer Operation Start ├ MW00280 + 00100 ⇒ MW00220
	Real Number Replacement	‖├	Real Number Operation Start ‖├ MW00280 + 00100 ⇒ MW00220
	Storage	⇒	Stores operation results to a designated register.
	Multiplication	×	Used with × and ÷ in combination for integers and double-length integers.
	Division	÷	
	Increment	INC	Adds 1 to a designated register. INC MW00100
	Decrement	DEC	Subtracts 1 from a designated register. DEC MW00100
	Integer Remainder	MOD	Obtains the remainder from the results of division. ├ MW00100 × 01000 ÷ 00121 MOD ⇒ MW00101
	Real Number Remainder	REM	Obtains the remainder from the results of division. MF00200 REM 1.5 ⇒ MF00202
	Time Addition	TMADD	Addition of Hr/Min/Sec TMADD MW00000, MW00100
	Time Subtraction	TMSUB	Subtraction of Hr/Min/Sec TMSUB MW00000, MW00100
	Time Spent	SPEND	Requests the elapsed time for two time measures. SPEND MW00000, MW00100

Type	Name	Symbol	Content
Numerical Conversion Commands	Sign Inversion	INV	├ MW00100 INV Operation result = -99 when MW00100=99
	Complement of 1	COM	├ MW00100 CON Operation result = 0000H when MW00100= FFFFH
	Absolute Conversion	ABS	├ MW00100 ABS Operation result = 99 when MW00100= -99
	Binary Conversion	BIN	├ MW00100 BIN Operation result = 1234 (decimal) when MW00100 = 1234H (hexadecimal)
	BCD Conversion	BCD	├ MW00100 BCD Operation result = 1234H (hexadecimal) when MW00100 = 1234 (decimal)
	Parity Conversion	PARITY	Calculates the number binary expression bits ON. The operation result = 8 when ├ MW00100 PARITYMW00100 = F0F0H
	ASCII Conversion 1	ASCII	Converts a designated character string into ASCII, and replaces it into the register ASCII MW00200 “ABCDEFG”
	ASCII Conversion 2	BINASC	Converts 16-bit binary data into four hexadecimal digits in ASCII code. BINASC MW00100
	ASCII Conversion 3	ASCBIN	Converts numbers displayed as four hexadecimal digits in ASCII code into 16-bit binary data. ASCBIN MW00100
Numerical Comparison Commands	<	<	Leaves the results of the comparison command ON or OFF in the B register. ├ MW00000 < 10000 ──○┤ MB000010 MB000010 ├─┤├── IFON
	≤	≤	
	=	=	
	≠	≠	
	≥	≥	
	>	>	
	Range Check	RCHK	Checks whether the A register value is within range. ├ MW00100 RCHK -1000, 1000

Type	Name	Symbol	Content
Data Operation Command	Right Bit Rotation	ROTR	Bit-addr Count Width ROTR MB00100A ¨_ N=1 W=20
	Bit Transfer	MOVB	Source Destination. Width MOVB MB00100A ¨_ MB00200A W=20
	Word Transfer	MOVW	Source Distribution. Width MOVW MB00100 ¨_ MB00200 W=20
	Replacement Transfer	XCHG	Source1 Source2 Width XCHG MB00100 ¨_ MB00200 W=20
	Data Initialization	SETW	Destination. Data Width SETW MW00200 D=00000 W=20
	Byte _ Word Display	BEXTD	Displays byte data stored into the word register area as words. BEXTD MW00100 to MW00200 B=10
	Word _ Byte Compres-sion	BPRESS	Concatenates lower-level bytes of word data stored into the word register area as words. BPRESS MW00100 to MW00200 B=10
	Data Scan	BSRCH	Searches within a designated register range for register positions coinciding to the data. BSRC MW00000 W=20 D=100 R=MW00100
	Sort	SORT	Sorts the register within a designated register range. SORT MW00000 W=100
	Left Shift	SHFTL	Shifts a designated bit queue to the left. SHFTL MB00100A N=1 W=20
	Bit Right Shift	SHFTR	Shifts a designated bit queue to the right. SHFTR MB00100A N=1 W=2
	Word Copy	COPYW	Copies a designated register range. COPYW MW00100 ¨_ MW00200 W=20
	Byte Swap	BSWAP	Swaps the upper and lower-level bytes of designated word vari-ables. BSWAP MW00100

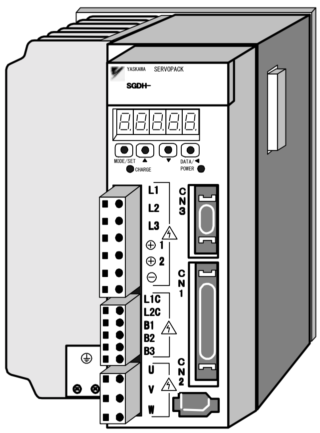
Type	Name	Symbol	Content
Basic Function Commands	Square Root	SQRT	The square roots of negative values are the square roots of the absolute value multiplied by -1. ⊩ MF00100 SQRT
	Sine	SIN	Input = degrees ⊩ MF00100 SIN
	Cosine	COS	Input = degrees ⊩ MF00100 COS
	Tangent	TAN	Input = degrees ⊩ MF00100 TAN
	Arc Sine	ASIN	⊩ MF00100 ASIN
	Arc Cosine	ACOS	⊩ MF00100 ACOS
	Arc Tangent	ATAN	⊩ MF00100 EXP e **MF00100**
	Exponent	EXP	⊩ MF00100 LN $\log_e$(FM00100)
	Naturalized Logarithm	LN	⊩ MF00100 LOG $\log_{10}$(FM00100)
	Common Logarithm	LOG	

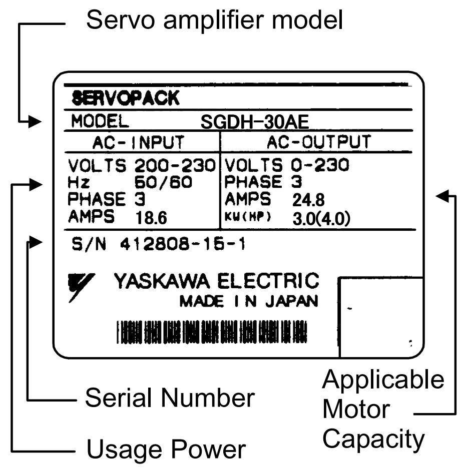
Type	Name	Symbol	Content
DDC Commands	Dead Zone A	DZA	├ MW00100 DZA 00100
	Dead Zone B	DZB	├ MW00100 DZB 00100
	Upper Limit	LIMIT	├ MW00100 LIMIT -00100 00100
	PI Control	PI	├ MW00100 PI MA00200
	PD Control	PD	├ MW00100 PD MA00200
	PID Control	PID	├ MW00100 PID MA00200
	First-order Lag	LAG	├ MW00100 LAG MA00200
	Phase Lead/Lag	LLAG	├ MW00100 LLAG MA00200
	Function Generator	FGN	├ MW00100 FGN MA00200
	Inverse Function Generator	IFGN	MW00100 IFGN MA00200
	Linear Accelerator 1	LAU	MW00100 LAU MA00200
	Linear Accelerator 2	SLAU	MW00100 SLAU MA00200
	Pulse Width Modulation	PWM	MW00100 PWM MA00200

Type	Name	Symbol	Content
Display Data Operation Commands	Block Write	TBLBR	TBLBR TBL1, MA00000, MA00100
	Block Read	TBLBW	TBLBW TBL1, MA00000, MA00100
	Row Search (Vertical)	TBLSRL	TBLSRL TBL1, MA00000, MA00100
	Column Search (Horizontal)	TBLSRC	TBLSRC TBL1, MA00000, MA00100
	Block Clear	TBLCL	TBLCL TBL1, MA00000
	Block Move	TBLMV	TBLMV TBL1, TBL2, MA00000
	Queue Table Read (invariable pointer)	QTBLR	QTBLR TBL1, MA00000, MA00100
	Queue Table Read (pointer stepping	QTBLRI	QTBLRI TBL1, MA00000, MA00100
	Queue Table Write (invariable pointer)	QTBLW	QTBLW TBL1, MA00000, MA00100
	Queue Table Write (pointer stepping	QTBLWI	QTBLWI TBL1, MA00000, MA00100
	Queue Pointer Clear	QTBLCL	QTBLCL TBL1
System Functions	First-in First-out	FINFOUT	First-in/First-out
	Trace Function	TRACE	Data Trace Execution Control
	Data Trace Read	DTRC-RD	Data read from data trace memory into the user memory.
	Message Send	MSG-SND	Send message from controller.
	Message Receive	MSG-RCV	Receive message from controller.

Servo Amplifier Specifications

■ External Appearence and Nameplate





Σ-II Series
SGDH Servo Amplifier

■ Interpretation of Model

SGDH– 10 A E– □

ΣII Series
SGDH Servo Amp

Applicable Motor Capacity
(see following table)

Voltage
A:200V
B:100V *
D:400V

* for 100V usage
for 0.2kW or lower motors only

Designation
Option and compatability function integrated

Option Specs
Name: Base-mount type
R: Rack mount type (compatible with 5kW or lower only)
P: Rack mount type (compatible with 6kW, 7kW only)

Maximum applicable motor capacity symbol	Capacity (kW)	Maximum applicable motor capacity	Capacity (kW)
A3	0.03	08	0.75
A5	0.05	10	1.0
01	0.10	15	1.5
02	0.20	20	2.0
04	0.40	30	3.0
05	0.50	—	—

Only SGMAH and SGMPH servo motors of 0.2kW or less can be used with 100V.

■ Servo Motor and Amplifier Combination

Combinations of servo motors and amplifiers, as well as MCCB and phase capacity with regard to power source capacity are shown below.

Main Power	Capacity (kW)	Servo Amplifier Mode 1 SGDH-	Applicable Motor Model	Power Capacity per Servo Amplifier (kVA)*	Current Capacity of Wiring Breaker or Fuse (A_{rms})*†	Recommended Noise Filter† Model	Recommended Noise Filter† Specification	Open/Close Type
200V single-phase	0.03	A3AD	SGMAH–A3A	0.20	4	LF-205A	Single-phase current 200V -class 5A	HI–15E5 (30A) Compatible device
	0.05	A5AD	SGMAH–A5A	0.25				
	0.10	01AD	SGMAH–01A	0.40				
			SGMPH–01A					
	0.20	02AD	SGMAH–02A	0.75				
			SGMPH–02A					
	0.40	04AD	SGMAH–04A	1.2	8	LF-210A	Single-phase current 200V class 10A	
			SGMPH–04A					

Main Power	Capacity (kW)	Servo Amplifier Mode 1 SGDH-	Applicable Motor Model	Power Capacity per Servo Amplifier (kVA)*	Current Capacity of Wiring Breaker or Fuse (A_{rms})*†	Recommended Noise Filter†		Open/Close Type
						Model	Specification	
200V Three-phase	0.50	05AD	SGMGH–05A _A	1.4	4	LF-310	Three-phase current 200V-class 10A	HI–15E5 (30A) Compatible device
			SGMGH–03A _B					
	0.75	08AD	SGMAH–08A	1.9	7	LF-315	Three-phase current 200V-class 15A	
			SGMPH–08A					
			SGMGH–06A _B					
	1.0	10AD	SGMGH–09A _A	2.3				
			SGMGH–09A _B					
			SGMSH–10A					
	1.5	15AD	SGMPH–15A	3.2	10			
			SGMGH–13A _A					
			SGMGH–12A _B					
			SGMSH–15A					
	2.0	20AD	SGMGH–20A _A	4.3	13	LF-320	Three-phase current 200V-class 20A	HI–18E (35A) Compatible device
			SGMGH–20A _B					
			SGMSH–20A					
	3.0	30AD	SGMGH–30A _A	5.9	17	LF-330	Three-phase current 200V-class 30A	
			SGMGH–30A _B					
			SGMSH–30A					
	5.0	50ADA	SGMDH–32A	7.5	28	LF-340	Three-phase current 200V-class 40A	
			SGMDH–40A					
			SGMSH–40A					
			SGMGH–44A _A					

Main Power	Capacity (kW)	Servo Amplifier Mode 1 SGDH-	Applicable Motor Model	Power Capacity per Servo Amplifier (kVA)*	Current Capacity of Wiring Breaker or Fuse (A_{rms})*†	Recommended Noise Filter†		Open/Close Type
						Model	Specification	
200V Three-phase	5.0	50ADA	SGMDH–44A _B	7.5	28	LF-340	Three-phase current 200V-class 40A	HI–18E (35A) Compatible device
			SGMSH–50A					HI–25E (50A) Compatible device Hi-30E
	6.0	60ADA	SGMGH–55A _A	12.5	32	LF-350	50A	
			SGMGH–60A _B					
	7.5	75ADA	SGMGH–75A _A	15.5	41	LF-360	60A	
			SGMSH–15A					
100V Single-phase	0.03	A3BD	SGMAH–A3B	0.15	4	LF-205F	Single-phase current 200V-class 5A	HI–15E5 (30A) Compatible device
	0.05	A5BD	SGMAH–A5B	0.25				
	0.10	01BD	SGMAH–01B	0.40				
			SGMPH–01B					
	0.20	02BD	SGMAH–02B	0.60	6	LF-210	Single-phase current 200V-class 10A	
			SGMPH–02B					

All values are given at rated load.When selecting the actual fuse, determine the capacity after performing the proper derating.

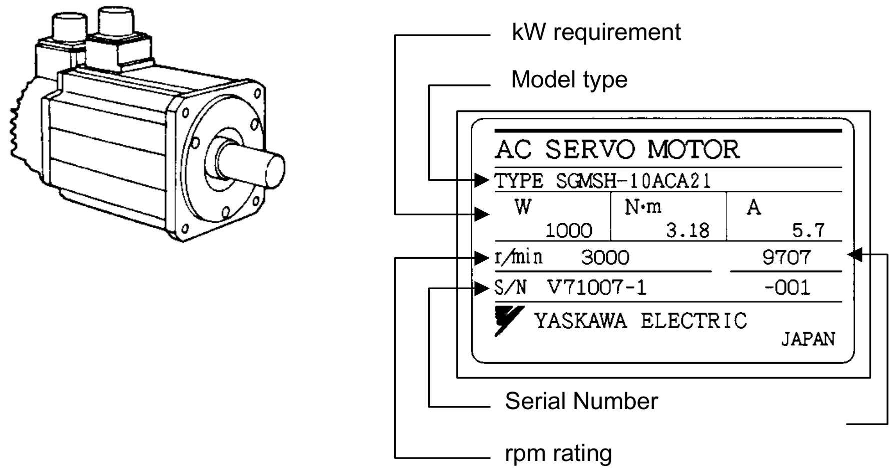
Breaker Characteristics (25ºC):200“_ 2s or more, 700“_ 0.01s or more

High-speed fuses cannot be used.Because the servo amplifiers power supplies are of a capacitor input-type, high-speed fuses may fuse upon power input.

SGDH servo amplifiers are equipped with a ground fault protection circuit.To create a safer system, connect a ground fault protection-dedicated leak current breaker in combination with a combined overload/short protection leak current breaker or a wiring breaker.

Servo Motors

■ Example of External Appearence and Nameplate



■ Interpretation of Model

Standard Servo Motors

SGMPH - 01 A A A 2 S

Sigma-II Series Servo Motor Name
- SGMAH
- SGMPH
- SGMGH
- SGMSH
- SGMDH

Servo Motor Capacity (See table 1.1)

Voltage
- A : 200V
- B : 100V *

* 100V is for SGMAH and SGMPH servo motors or 0.2kW or less.

Serial Encoder Specification (See Table 1.2)

Design Hierarchy
- A : SGMAH
  SGMPH
  SGMGH(1500 r/min)
  SGMSH
  SGMDH
- B: SGMGH(1000 r/min)
- C: SGMGH(1500r/m)

Shaft Specifications (See Table 1.3)

Brake, Oil Seal Specifications
- 1: No brake or oil seal
- S: With oil seal
- B: With DC90V brake
- C: With DC24V brake
- D: S + B
- E: S + C

Servo Motor Capacities (kW)

Code	SGMAH	SGMPH	SGMGH		SGMSH	SGMDH	Code	SGMAH	SGMPH	SGMGH		SGMSH	SGMDH
	3000 rpm	3000 rpm	1500 rpm	1000 rpm	3000 rpm	2000 rpm		3000 rpm	3000 rpm	1500 rpm	1000 rpm	3000 rpm	2000 rpm
A3	0.03	—	—	—	—	—	15	—	1.5	—	—	1.5	—
A5	0.05	—	—	—	—	—	20	—	—	1.8	2.0	2.0	—
01	0.1	0.1	—	—	—	—	22	—	—	—	—	—	2.2
02	0.2	0.2	—	—	—	—	30	—	—	2.9	3.0	3.0	—
03	—	—	—	0.3	—	—	32	—	—	—	—	—	3.2
04	0.4	0.4	—	—	—	—	40	—	—	—	—	4.0	4.0
05	—	—	0.45	—	—	—	44	—	—	4.4	4.4	—	—
06	—	—	—	0.6	—	—	0	—	—	—	—	5.0	—
08	0.75	0.75	—	—	—	—	55	—	—	5.5	—	—	—
09	—	—	0.85	0.9	—	—	60	—	—	—	6.0	—	—
10	—	—	—	—	1.0	—	75	—	—	7.5	—	—	—
12	—	—	—	1.2	—	—	—	—	—	—	—	—	—
13	—	—	1.3	—	—	—	—	—	—	—	—	—	—

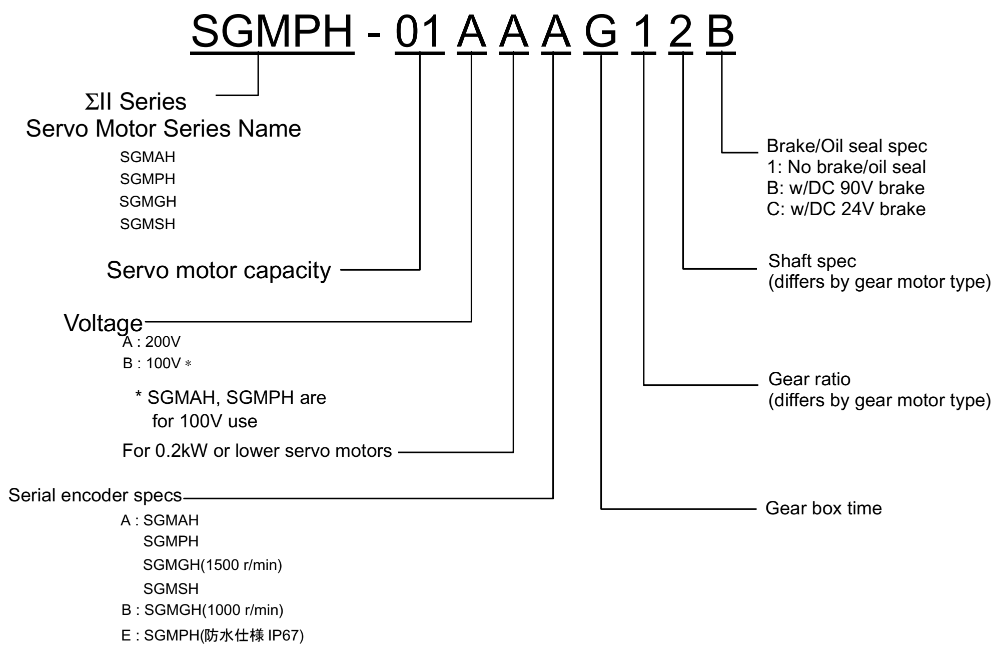
Serial Encoder (•:Standard ♦:Optional)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH	SGMDH
1	16-bit absolute	•	•			
2	17-bit absolute			•	•	•
A	13-bit incremental	•	•			
B	16-bit incremental	♦	♦			
C	17-bit incremental			•	•	•

Shaft End Specification (•:Standard♦:Optional)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH	SGMDH
2	Straight, no key	•	•	•	•	•
3	Taper: 1/10, w/ Parallel key			♦	♦	♦
4	Straight, w/ key	♦	♦			
5	Taper: 1/10, w/ half-moon key			♦	♦	
6	Straight, w/ key and tap	♦	♦	♦	♦	♦
8	Straight, w/ tap	♦	♦			

Servo Motors with Gearbox



Servo Motor Capacities (kW)

Code	SGMAH	SGMPH	SGMGH		SGMSH	Code	SGMAH	SGMPH	SGMGH		SGMSH
	3000 rpm	3000 rpm	1500 rpm	1000 rpm	3000 rpm		3000 rpm	3000 rpm	1500 rpm	1000 rpm	3000 rpm
A3	0.03	—	—	—	—	15	—	1.5	—	—	1.5
A5	0.05	—	—	—	—	20	—	—	1.8	2.0	2.0
01	0.1	0.1	—	—	—	22	—	—	—	—	—
02	0.2	0.2	—	—	—	30	—	—	2.9	3.0	3.0
03	—	—	—	0.3	—	32	—	—	—	—	—
04	0.4	0.4	—	—	—	40	—	—	—	—	4.0
05	—	—	0.45	—	—	44	—	—	4.4	4.4	—
06	—	—	—	0.6	—	0	—	—	—	—	5.0
08	0.75	0.75	—	—	—	55	—	—	5.5	—	—
09	—	—	0.85	0.9	—	60	—	—	—	6.0	—
10	—	—	—	—	1.0	75	—	—	7.5	—	—
12	—	—	—	1.2	—	—	—	—	—	—	—
13	—	—	1.3	—	—	—	—	—	—	—	—

The number of encoder pulses for the SGM_H servo motor is shown below:

Serial Encoder (•:Standard ♦:Optional)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH	Number of Encoder Pulses
1	16-bit absolute	•	•			16384
2	17-bit absolute			•	•	32768
A	13-bit incremental	•	•			2048
B	16-bit incremental	♦	♦			16384
C	17-bit incremental			•	•	32768

The number of bits displaying the resolution of the applied encoder is not the same as the number of pulses of the encoder signal output (phases A, B) from the servo amplifier. In the MP940, the number of encoder pulses is quadrated (×4).

Types with Gearboxes (•:Standard)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH
G	HDS High-precision Planetary Gearbox	•	•		
J	General-purpose Gearbox	•	•		
S	With mount			•	
T	Flange type			•	
L	IMT High-precision Planetary Gearbox			•	•

Gearbox (differs according to gearbox type)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH
A	1/6	—	—	S, T*	—
B	1/11 or 1/11.13	G	—	S, T	—
C	1/21	G, J	G, J	S, T	—
1	1/5	G, J	G, J	L	L
2	1/9	G	—	L	L
3	1/10 or 1/10.3	J	J	—	—
5	1/20	—	—	L*	L
7	1/29 or 1/33	G, J	G, J	L, S, T*	L*
8	1/45	—	—	L*	L*

(Some parts lack compatible devices.)

Shaft End Specifications (differ according to gearbox type)

Sign	Specification	SGMAH	SGMPH	SGMGH	SGMSH
0	Straight, no key	G, J	G, J	—	—
2	Straight, no key	G, J	G, J	—	—
4	Straight, w/ key	G, J	G, J	L	L
6	Straight, w/ key and tap	G, J	G, J	S, T	—
8	Straight, w/ tap	G, J	G, J	—	—

Chapter 3: Basic System Operation

An explanation of the basic system operation of the MP940 is given in this chapter.

Operation Mode

This section describes both of the MP940 operation modes: the run mode and the stop mode.

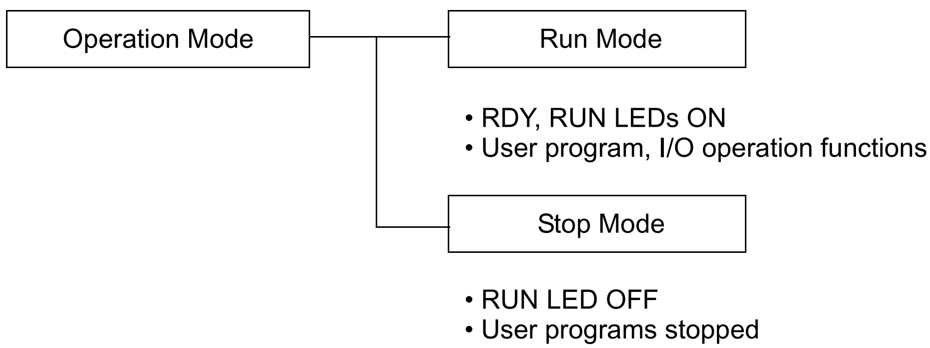


Figure 3.1: MP940 Operation Mode Classifications

Run Mode

When power is fed into the MP940, the READY (RDY) and RUN (RUN) LEDs light up (the ALARM (ALM) LED is off), and the unit is in the run mode. This means that there are no errors or failures in the MP940, and that user programs and I/O operations can be executed. The run mode also continues when an I/O conversion error, user operation error, or when a user program is stopped; however, the ALARM (ALM) LED lights. See Chapter 10 "Troubleshooting" for error contents and countermeasures.

Stop Mode

During the stop mode, user program execution is halted, and all outputs are reset (the digital output = 0).This state is displayed by the RUN LED being OFF. Drawing programs (DWG.H or DWG.L) are not executed in this state.

The stop mode results in the following four situations:

1. When the program memory is not initialized.
2. When a major fault such as watchdog time-out occurs.
3. When a STOP operation is executed from the MotionWorks™.
4. When power is fed with the RUN/STOP switch set to OFF (STOP).

Note: 1 ~ 2 are user program errors or MP940 errors or failures. (See Chapter 10 Troubleshooting for error contents and countermeasures.)

In 3, the run mode can be entered by executing the RUN operation.

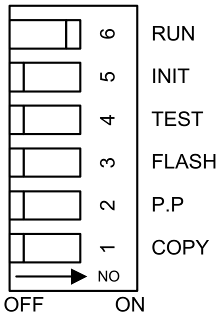
In 4, the run mode can be entered by turning the RUN/STOP switch to ON (RUN).

Start, Stop Sequence

This section describes the starting and stopping sequences of the MP940, the attendant dip switch setting method, as well as the types of self-diagnosis and display light (LED) patterns.

DIP Switch Setting Method

The DIP switches on the CPU are used for start/stop sequence operation control. The CPU module has six switches as shown in the figure below. The function of each switch is shown in the following table.

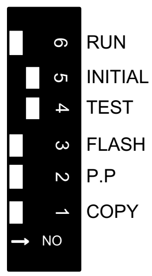
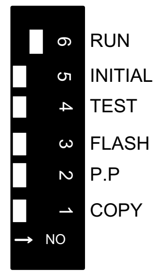


Number	Name	Setting	Operation at Setting	Default Setting
6	RUN	ON	User Program Run	ON
		OFF	User Program Stop	
5	INITIAL	ON	When SW4 is ON: Clear Memory	OFF
		OFF	When SW4 is ON: Terminal mode	
4	TEST	ON	Terminal Mode/Initialization Mode	OFF
		OFF	Online	
3	FLASH	ON	Program copy from FLASH to RAM	OFF
		OFF	No program copy from FLASH to RAM	
2	P.P Default	ON	Default Port 1 only	OFF
		OFF	Serial port setting	
1	COPY	ON	M Register Copy when SW3 is ON Turn the power ON when only SW1 is ON. SGDH servo parameter in the controller is transferred to SGDH . → to replace SGDH.	OFF
		OFF	No M Register Copy when SW3 is ON. M Register has a battery backup.	

Although “NO” is displayed on the arrow at the lower right side of the DIP switches, flipping the switches to the right turns them ON, and left turns them OFF.

■ Memory Initialization

The memory as initialized, and the user programs and configuration data are deleted upon setting the DIP switches in the following order, and cycling the power OFF/ON.

1	2	3	4	5
Turn MP940 power OFF	Turn DIP switches INITIAL and TEST ON. 	Check that the RDY and RUN LEDs blink when power is fed (approximately 3 seconds).	Return the RUN DIP switch to the ON setting 	Turn the power ON again

Note: The memory is cleared if the battery is removed with the module power OFF.

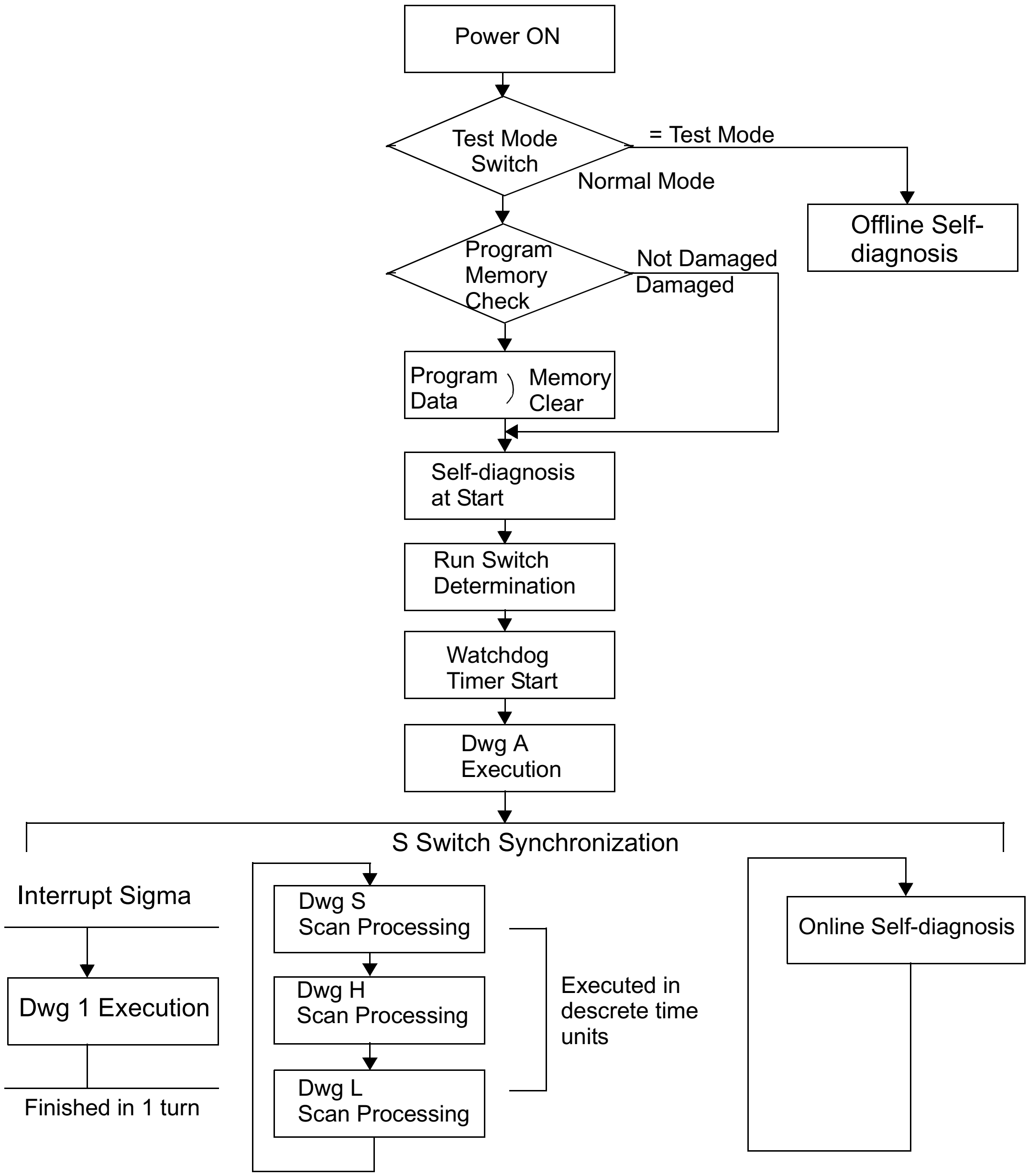
Start Sequence

The MP940 makes various determinations at start-up, and upon recognizing an error, flashes the ERR LED, showing the content of the error by the number of flashes. MotionWorks™ cannot be operated while the LEDs are flashing. The following table shows a partial list of the MP940 display LEDs.

Type	LED				Display Content
	RDY	RUN	ALM	BAT ALM	
Normal	○	●	●	●	User program stopped
	○	○	●	●	User program executing normally
Error	●	●	○	●	Hardware reset state (when display continues)
	●	●	●	●	Initializing (when display continues)
	●	○	○	●	Major fault
	●	●	☆	●	2 flashes: RAM error 3 flashes: ROM error 4 flashes: Peripheral LSI error
Warning	?	?	?	○	Battery alarm
	○	○	○	●	Operation error (I/O error)
	No LED display. Reports to system (S) register.				Hardware status (momentary stop, START/ STOP, testing mode, etc.)
Other	☆	☆	●	●	Memory initialization by DIP switch setting complete.
	RDY and RUN flash simultaneously				
	●	●	–	●	Offline testing mode

●:OFF, ○:ON, ☆:Flash, ?:Undefined

MP940 Start Sequence and Basic Operation



The starting sequence and basic operation of the MP940 are as follows:

1. Self-diagnosis at start-up

   The following menu is displayed in self-diagnosis at start-up.

   - Memory (RAM) Read/Write Determination
   - System Program (ROM) Diagnosis
   - Main Processor (CPU) Function Diagnosis
   - Numerical Operation Processor (FCPU) Function Diagnosis

   The RDY LED flashes the designated number of times when there is an error in the diagnostic results.

2. Online Self-diagnosis

   The following menu is displayed in online self-diagnosis

   - System Program (ROM) Diagnosis
   - Main Processor (CPU) Function Diagnosis
   - Numerical Operation Processor (FCPU) Function Diagnosis

   The RDY LED flashes the designated number of times when there is an error in the diagnostic results.

3. Start New Run

   Sets the run format to New Run in the CP717 system definition screen. A new run starts. Unlike the start of a continuous run, self-diagnostic processing occurs prior to DWG.A execution.

4. Operation Stop

   The MP940 stops operation in the following situations:

   - When power is interrupted
   - When power loss occurs
   - When a fatal error is generated
   - When a STOP operation is executed from MotionWorks™.

Note: Restart is not possible in the first and second items above without restarting the power.

Restart is possible in the third item above by turning off the power.The cause of the error can be deduced by checking the LED display.

Restart is possible in the fourth item above by executing the RUN operation in CP717.

Scan Processing

Outline of Scan Processing

There are three types of MP940 scan processing: S (system) scans, H (High-speed) scans, and L (Low-speed) scans. Scan processing segments all S scan periods into descrete time elements and then executes the S scan as a base period.

When setting the proportion of assignments into the background within the S scan period, ensure the "Background Processing Time" for PP processing.

■ Scan Types

Type	Content
S Scan (System Scan)	Select a base period for scan processing: 0.5, 1.0, 2.0, 4.0ms. S, H and L scan processing segments all S scan periods into discrete time elements and then executes the S scan as a base period.
H Scan (High-speed Scan)	Set the S scan period in integer multiples. The scan is broken into discrete time elements and executed within the S scan period.
L Scan (Low-speed Scan)	Set the S scan period in integer multiples. The scan is broken into discrete time elements and executed within the S scan period.

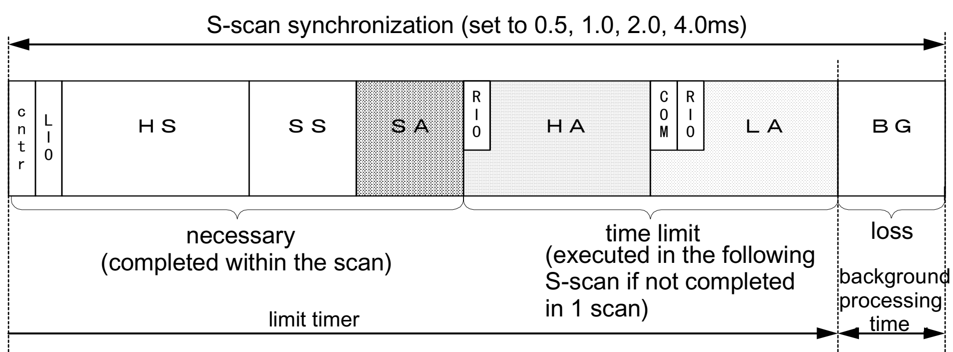
■ Service Scan of each Function

Except for SVA, a scan can be selected to execute I/O processing for each function.

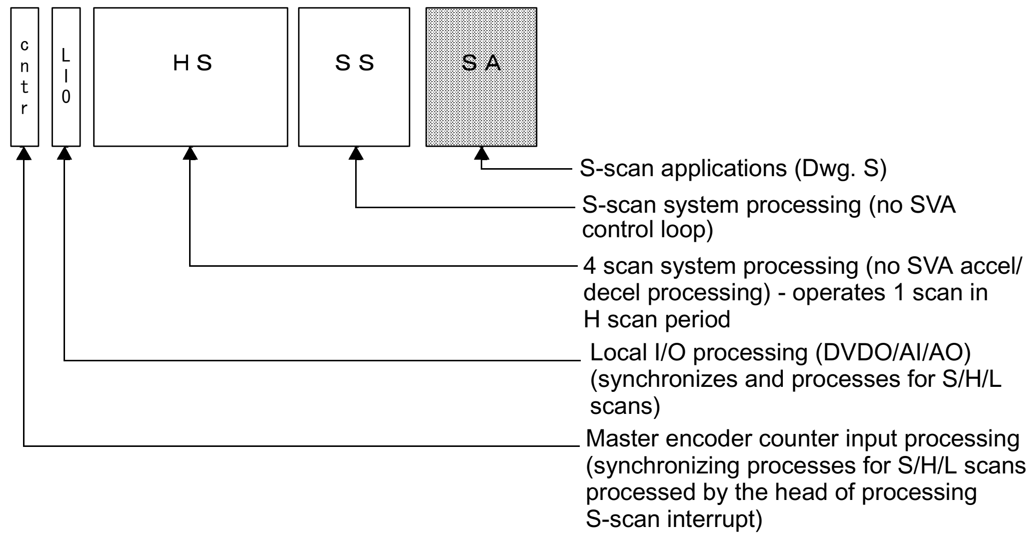
Function	Serviceable Scans	Notes
CNTR	S/H/L	Simultaneous processing with S, H, or L
LIO (DI/DO/AI/AO)	S/H/L	Simultaneous processing with S, H, L
Mechatrolink (distributed I/O, etc.)	H/L	Simultaneous processing with either H or L.
SVA	S/H	Scan Fixation (unselectable) Synchronous selection of phase control mode and position control mode is possible in the setup parameter settings. Synchronous Selection of Phase Control Mode (OBC0016) 0:H Scan (default)/1: S Scan Synchronous Selection of Position Control Mode(OBC0017) 0:H Scan/1: S Scan (default)

Content of S Scan

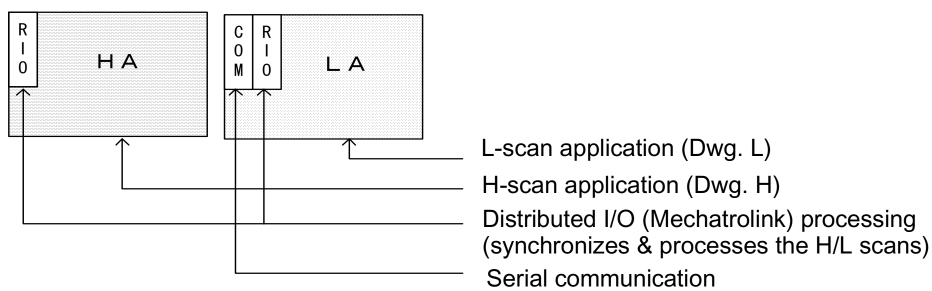
The processing content, as well as procedure, within the S scan is as follows:



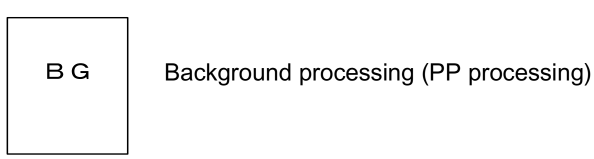
■ Items Completed within the S Scan



■ Time-shared Items



■ Background

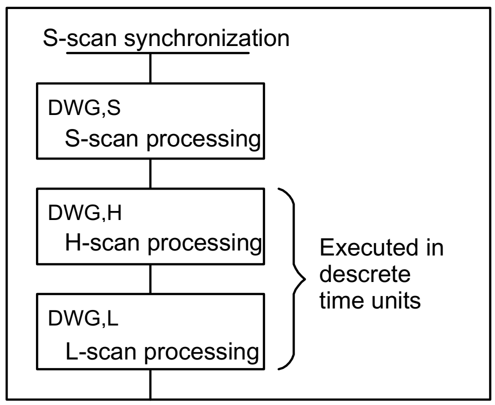


■ Notes on Scan Processing

1. Complete item processing within the S scan in approximately half the time of the S scan period setting.
2. Set an assignment ratio in the background processing.

■ Scan Operation

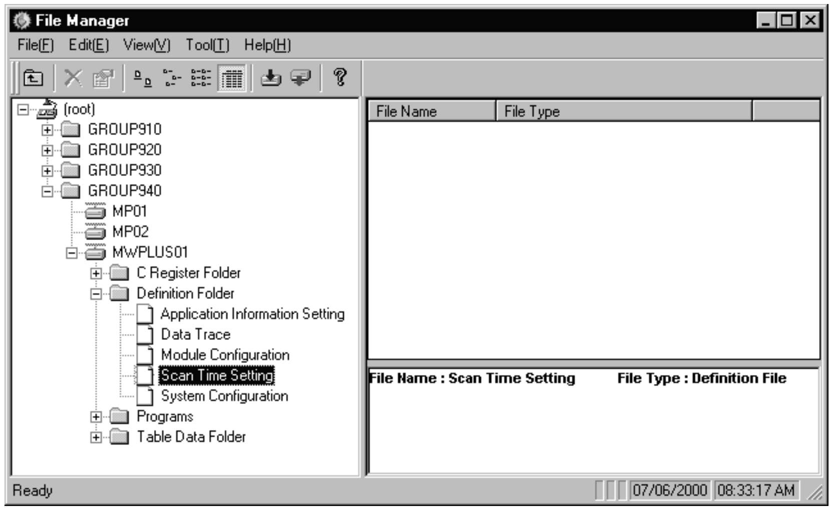
Each scan process is executed as shown below:



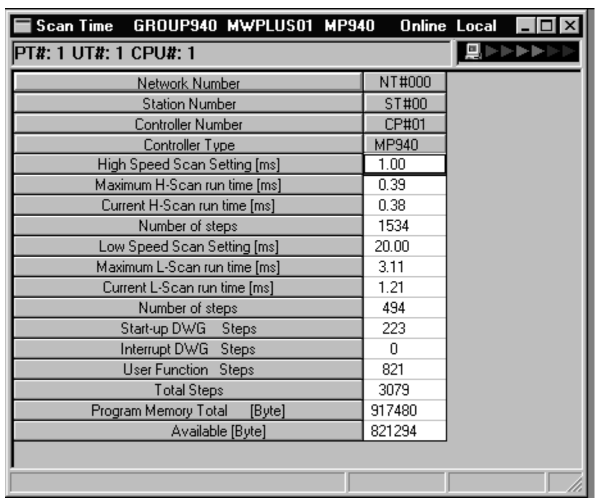
Scan Time Setting Method

■ Opening the Scan Time Setting Window

From the MotionWorks™ File Manager, click the Scan Time Setting tab in the Definition Folder.



The ScanTime Setting window is displayed.



System Scan Time Setting

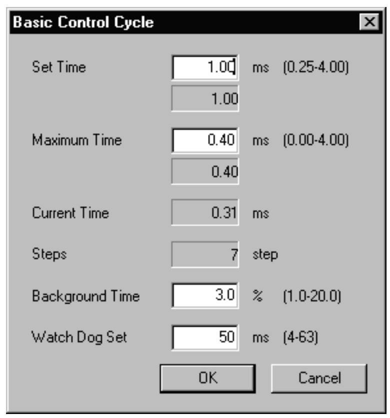
The MP940 has three scan time levels (System/High-speed/Low-speed), which determine the flow of the program execution format. Among these, the system scan time must be set first. The high-speed/low-speed scans are then set based upon the system scan.

The following relationship exists in the setting criteria for the various scan times. For details, see the MotionSuite™ MP940 Machine Controller Hardware Manual.

Scan Time Level	Setting Criteria
System Scan	Select from 0.5, 1, 2, and 4ms.
High-speed scan	0.5 ~ 32ms (system scan integer multiple)
Low-speed Scan	2.0 ~ 100ms (system scan integer multiple)

- Opening the Setup Window

Select **Setup (S)**, > **Base Control Synchronization (B)**.

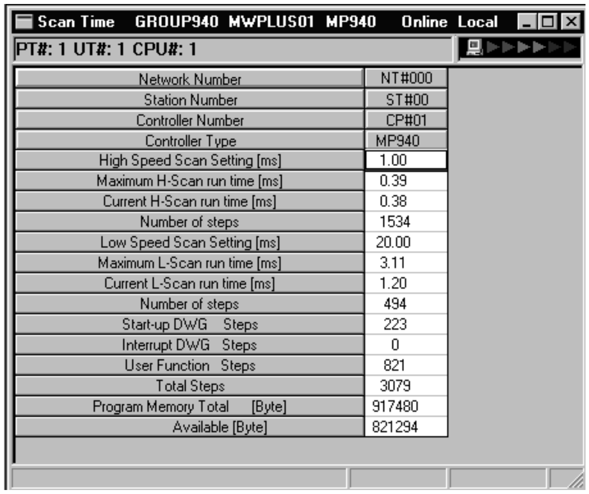


Setting Item	Content
Set Time	Sets the system scan time. The value of the previous step is the current setting value.
Maximum Time	Sets the maximum system scan time. The previous value is the maximum time measured by the system to this point.
Current Time	Displays the current value of the system scan time.
Steps	Displays the number of steps of the system scan time.
Background Time	Shows the percentage of the total system which is consumed by the background.
Watch Dog Set	Sets the watchdog time which provides system scan time limits.

Restart the power if the base control synchronization has been changed.

The base control synchronization continues to be applied at its current value and does not return to defaults even if the memory is cleared. Restart power to return to defaults.

Scan Time Definition Setting



The machine controller high-speed scan time is displayed in the online mode. The scan time data stored on the hard drive is displayed in the offline mode.

Setting Item	Content
High-speed scan setting	Setting: Input the scan setting
	Max: Displays the maximum value of the scan. Input “0” here to reset the maximum scan time value. “0” is displayed in the offline mode.
	Current Value: Displays the current value of the scan. “0” is displayed in the offline mode.
	The total number of steps in the scan processing drawing is displayed in the Number of Steps box.
Low-speed scan setting	Sets the low-speed scan time. See the content of the high-speed scan time box for the meaning of the various data.
Startup DWG steps	Displays the total number of steps in the start scan drawing.
Interrupt DWG steps	Displays the total number of steps in the interrupt scan drawing.
User function steps	Displays the total number of user function steps.
Total steps	Displays the total number of steps for all drawings.
Program memory total (bytes)	Displays the amount of the total program memory (total of drawings, functions, and motion programs) used. “0” is displayed in the offline mode.
Available (bytes)	Displays the amount of free space in the program memory. “0” is displayed in the offline mode.

In the online mode, the maximum value may be cleared to "0" by inputting "0" to the maximum scan time box, and executing the save operation. Adoption of a new maximum value begins after being cleared.

Saving Scan Time Definitions

The procedure for saving the scan time definitions is shown below.

1. Select **File (F)** > **Save (S)**.
2. Click the **Yes (Y)** button in the Scan Time message box.
3. Click **OK** in the message box.

Completion of Scan Time Definition

Complete scan time setting by closing the scan time window. Close the window by selecting **File (F)** > **Close (C)** from the menu.

User Programs

This section describes user program types, priority, processing formats, etc. for basic operation of the MP940.

DWG (drawing)

User programs are controlled in drawing units classified by drawing number (DWG number). These drawings form the basis of the user program.

Drawings consist of source drawings, sub-drawings, and sub-sub-drawings. Drawings can be either functions which seperately and freely reference individual drawings, or motion programs which reference an H drawing only.

- Source Drawing
  This is automatically executed by the system program at establishment of the execution conditions in the following table.
- Sub-drawing
  These are executed by reference from a source drawing using the SEE command.

- Sub-sub-drawing
  These are executed by reference from a sub-drawing using the SEE command.
- Operation Error Processing Drawing
  These are automatically executed by the system program at operation error generation.
- Functions
  These are executed by referencing a source drawing, sub-drawing, or sub-sub-drawing using an FSTART command.
- Motion Programs
  These can only reference H drawings. They are executed by referencing a source drawing, sub-drawing, or sub-sub-drawing using an MSEE command.

■ Types and Priority of Source Drawings

Source drawings are classified by their first letters (A, I, S, H, L) in accordance with their processing objective. Priority and execution conditions are determined as follows.

Types and Priority of Source Drawings

Type of Source Drawing	Drawing Role	Priority	Execution Conditions	Number of Drawings (Note)
DWG.A	Start Processing	1	Power Feed (executed once at power ON)	4
DWG.I	Interrupt Processing	2	Generated by DI interrupt and counter coincidence interrupt for option modules executed by external interrupt	8
DWG.S	System Scan	3	Set Interval Start (executed at each servo control scan time)	16
DWG.H	High-speed Scan Processing	4	Divides the servo control scan (S scan) period into discrete time elements to execute the scan.	16
DWG.L	Low-speed Scan Processing	5	Divides the servo control scan (S scan) period into discrete time elements to execute the scan.	32

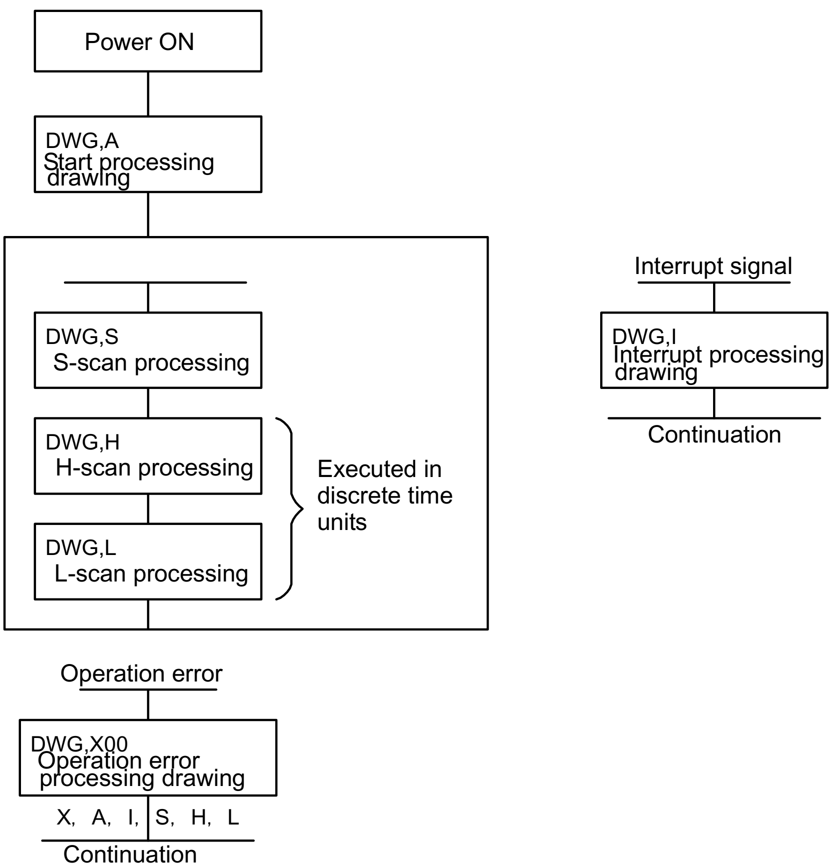
An annotated description of the number of drawings for each type of drawing is given below.

Drawing	Number of Drawings				
	DWG.A	DWG.I	DWG.S	DWG.H	DWG.L
Source Drawing	1 (A)	1 (I)	1 (S)	1(H)	1 (L)
Operation Error Processing Drawing	1 (A00)	1 (I00)	1 (S00)	1 (H00)	1 (L00)
Sub-drawing	Maximum of 2 drawings combined	Maximum of 6 drawings combined	Maximum of 14 drawings combined	Maximum of 14 drawings combined	Maximum of 30 drawings combined
Sub-sub-drawings					

Source Drawing Execution Control

■ Source Drawing Execution Control

Each drawing is displayed as shown below based on its priority.

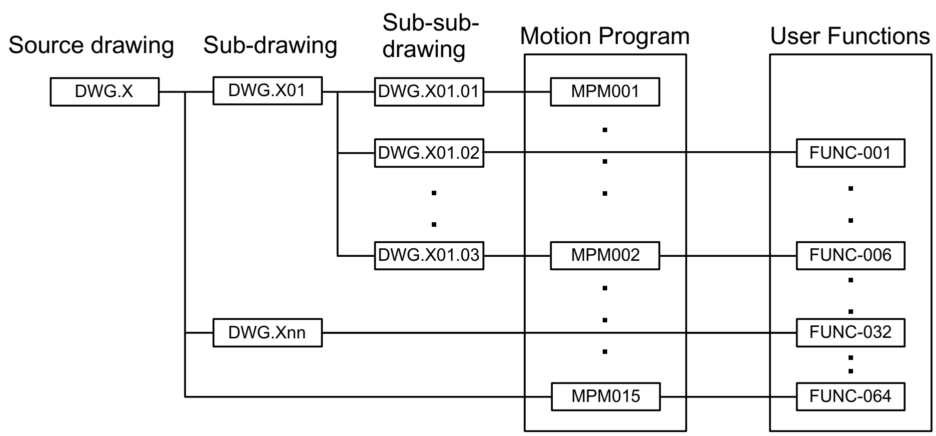


- Layer Structure of Drawings

Each drawing comprises source, sub-, and sub-sub-drawings. It is not possible to reference sub-drawings of a different type from the source drawing, nor is it possible to reference sub-sub-drawings of a different type from the sub-drawing. It is also impossible to reference sub-sub-drawings directly from source drawings. A structure wherein sub-drawings are referenced from source drawings, and sub-sub-drawings from sub-drawings is neccessary. This is called the layer structure of the drawing.

- Drawing Execution

Create user programs as shown below by layering processing programs into source drawings, sub-drawings, and sub-sub-drawings.



Note: “x” substitutes for A, I, H, and L.

Note: The system automatically executes the source drawing since the execution conditions for each function have been decided according to Table XXX. This means that source drawings are automatically called by the system.It is therefore possible for the customer to execute various sub-drawings and sub-sub-drawings by programming drawing reference commands (SEE commands) in the source and sub-drawings.

Functions can be referenced from any drawing.Functions can also be referenced from any function.

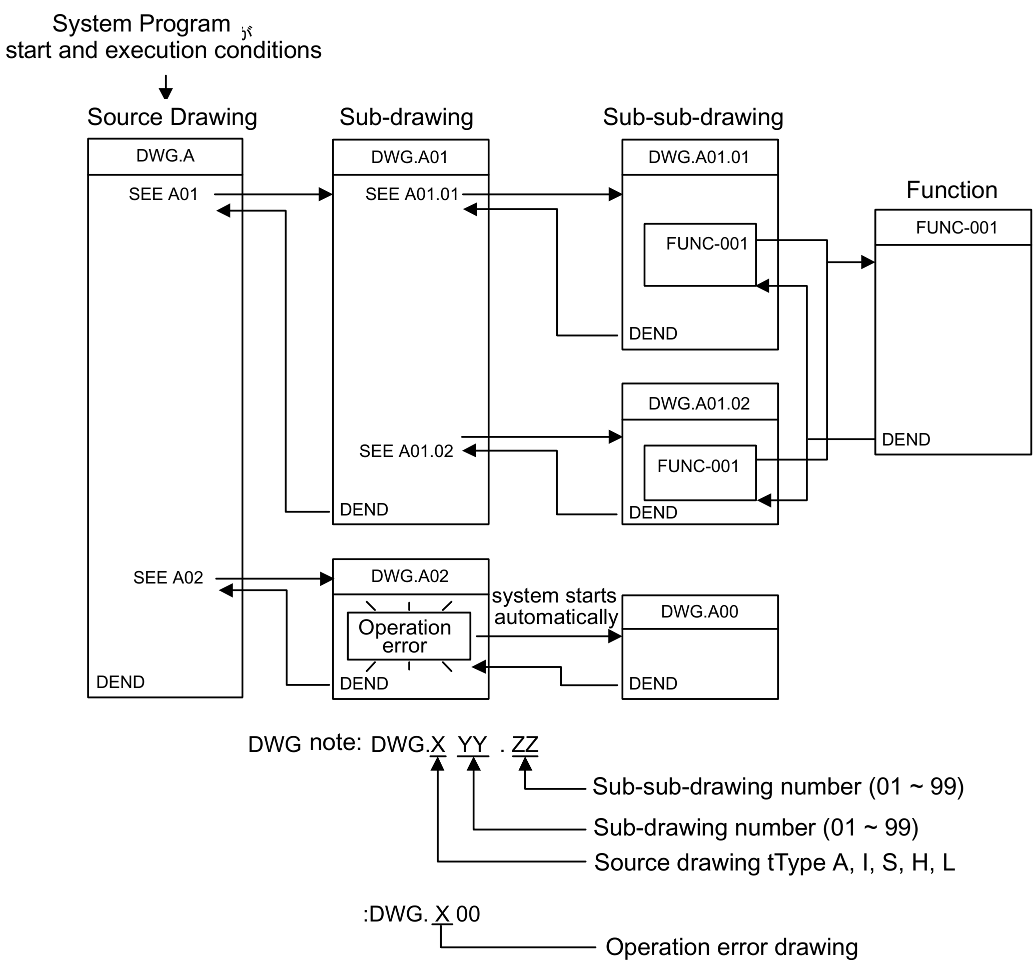
An operation error drawing starts, corresponding to a given drawing when an operation error occurs within that drawing.

Reference motion programs from the H drawing with an MSEE command. Source drawings, sub-drawings, or sub-sub-drawings can be referenced in an H drawing.

Source drawings are automatically called by the system. Sub-drawings are referenced from a source drawing using the SEE command. Therefore, user programs cannot be executed using only sub-drawings and sub-sub-drawings.

■ Drawing Execution Processing Format

The execution processing of each layered drawing is processed in a format which references from the upper-level drawings to the lower-level drawings.The DWG (drawing) layer structure is shown in the following diagram using DWG.A as an example.



Motion Programs

■ Outline of Motion Programs

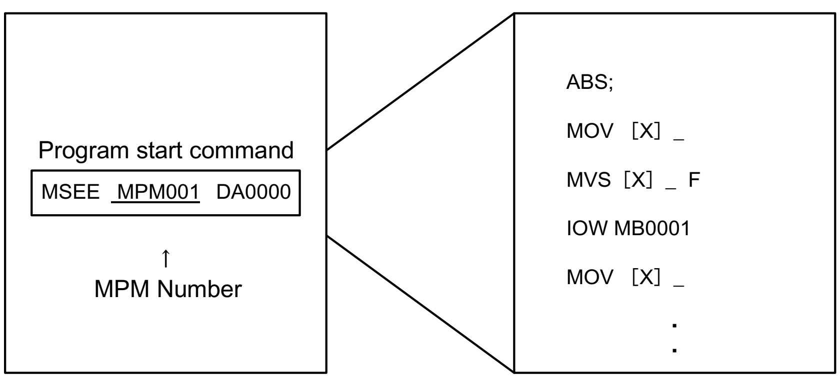
1. A motion program is a program written in a text format motion language. Unlike ladder programs, up to 256 motion programs can be created.

2. There are two types of motion programs: main programs that can be called from DWG.H (MPMooo), and sub-programs that can be called from the main program (MPSooo).

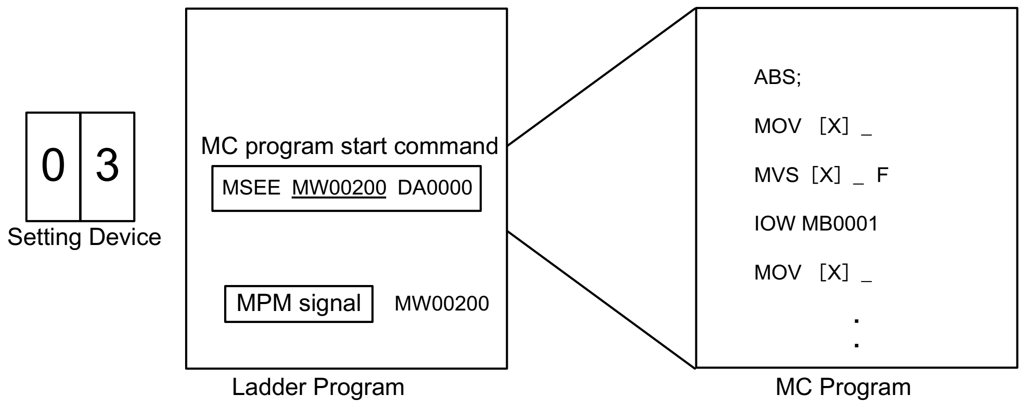
Classification	Designation Method	Characteristics	No. of Programs
Main Program	MPMooo 1 ~ 32	Can be called from DWG.H	A combined maximum of main and sub-programs, up to 32, can be created
Sub-program	MPSooo 1 ~ 32	Can be called from main program	

Ensure that the program numbers for MPMooo and MPSooo are different.

3. There are two methods of motion program designation, direct designation (in which the program number is designated), and indirect designation (in which a register number containing the program number is stored is designated). Examples of direct designation and indirect designation (respectively) appear below.

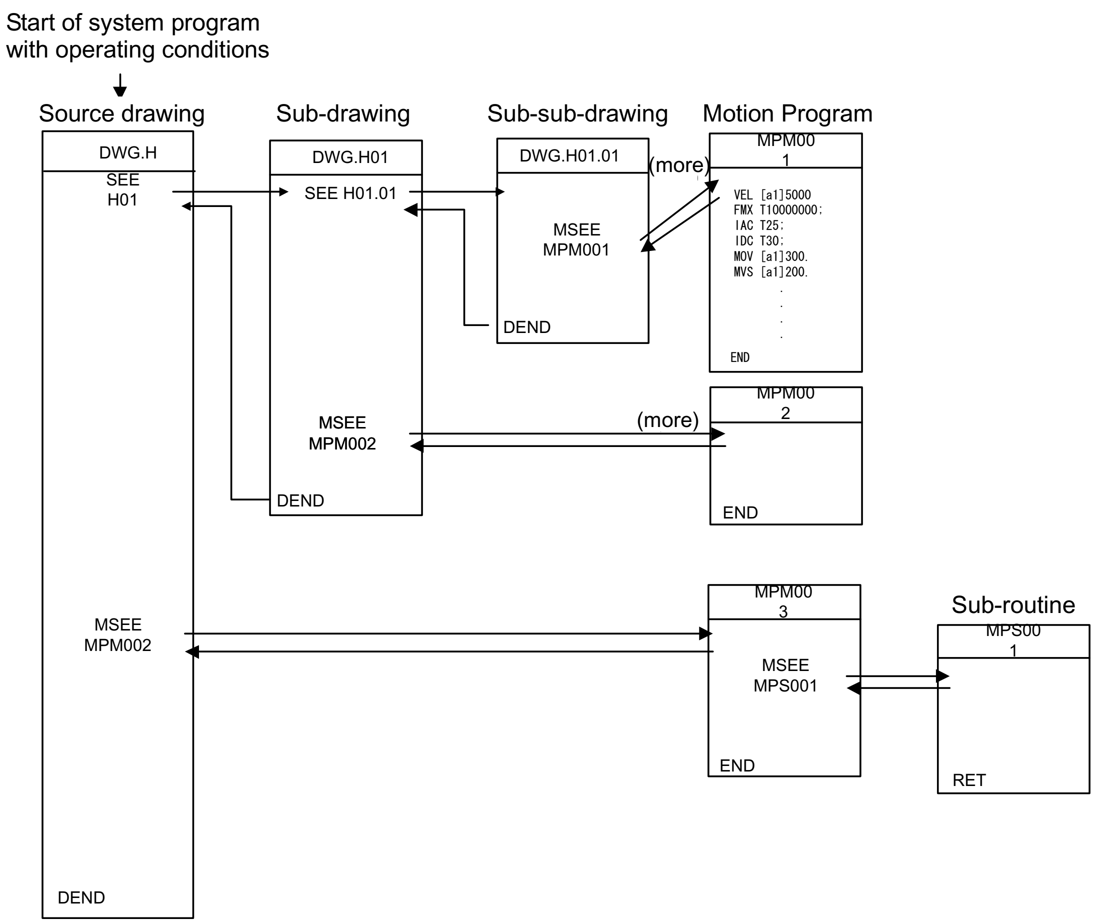


Ladder Program MC Program



■ Motion Program Execution Processing Formats

Reference motion programs from the H drawing with an MSEE command. Source drawings, sub-drawings, or sub-sub-drawings can be referenced in an H drawing.



1. The ladder commands of the H drawing are executed at each high-speed scan period in the order of source drawing/sub-drawing/sub-sub-drawing.
2. Although motion programs are referenced in the scan period, they cannot be referenced in a single scan. Motion programs execute an execution control dedicated to motion programs through the motion control functions of the system.
3. Although motion programs are referenced in the scan period, they cannot be executed simply by reference. A control signal set in the group definition screen must be set.

Ensure the following restrictions are observed in referencing motion programs.

1. Multiple reference of motion programs with the same number is not possible with the MSEE command.
2. Subroutines (MPSxxx) cannot be referenced from ladder MSEE commands. These can only be referenced from within the motion program (MPMxxx, MPSxxx).
3. The same subroutine cannot be simultaneously referenced.

■ Motion Program Execution

Input program control signals (program run start requests, program stop requests, etc.) in order to execute the motion programs called from DWG.H by the MSEE command. Operation is possible by inputting the external control signal defined in the group definition screen into the program control signal.

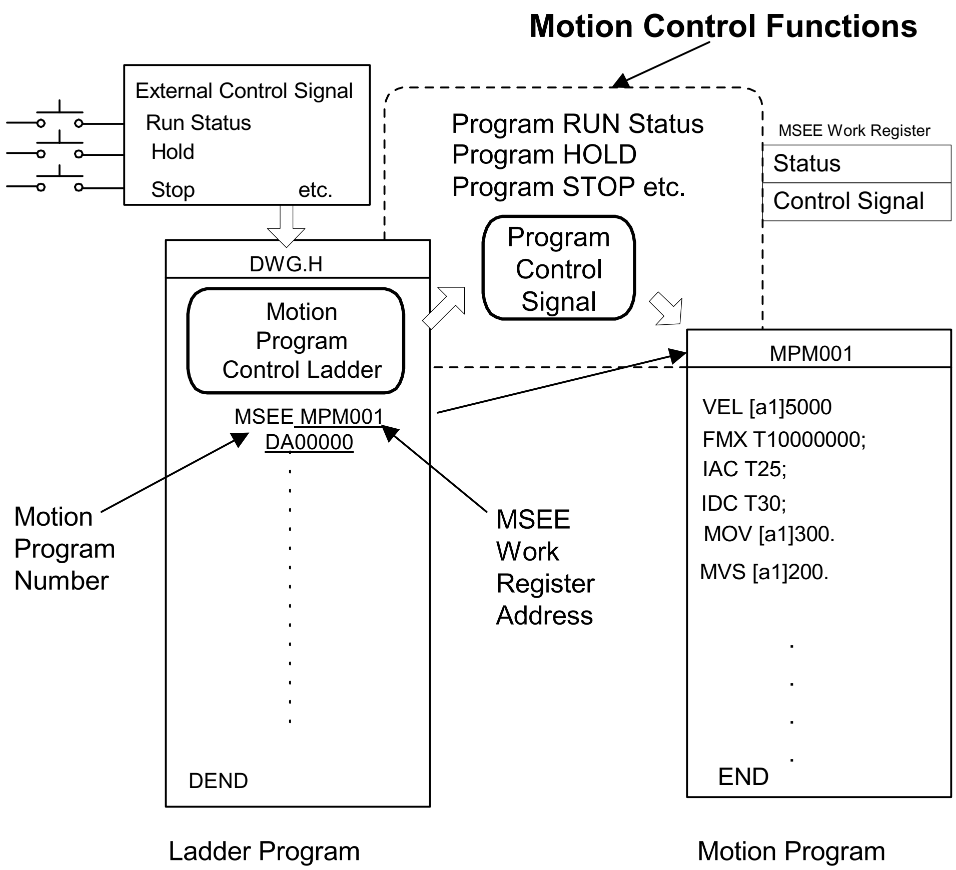
1. The following signal types are for motion program control.

bit	Signal Name	Signal Type
b0:	Program Run Start Request	Bit Input
b1:	Program Hold Request	A Contact
b2:	Program Stop Request	A Contact
b3:	Program Debug Mode Selection	A Contact
b4:	Program Debug Start Request	Bit Input
b5:	Alarm Reset Request	A Contact
b8:	Skip 1 Data	A Contact
b9:	Skip 2 Data	A Contact

2. Control of motion program run/stop/hold, etc., is possible by inputting these signals in a ladder program into a work register +1 designated by the MSEE command. Convert the ladder program input to a signal in accordance with the signal types in step 1, above.

   The program restarts after program close if the start signal is input to the A contact.The program does not operate with the start signal on an ON state at power ON.

3. The motion program execution processing method is shown below.



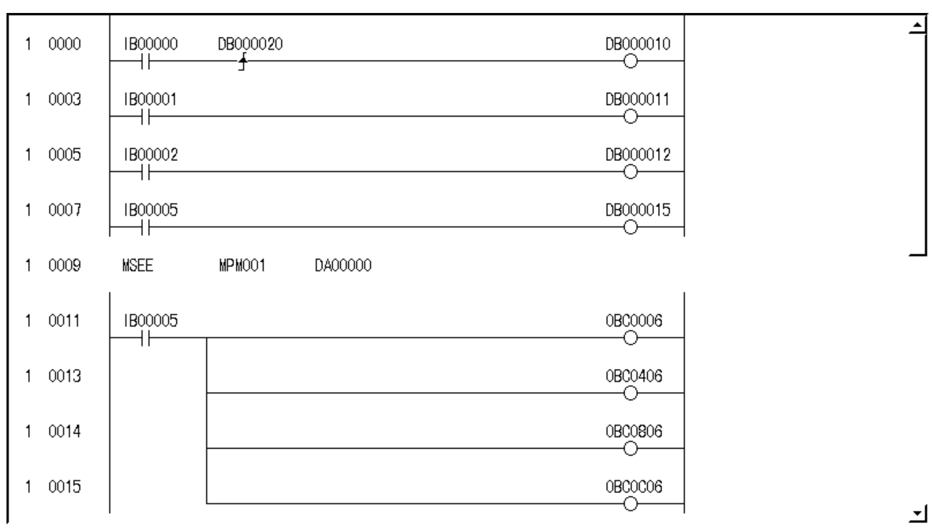
■ Motion Program Status Flags

The first word of the MSEE work register is a motion program status flag which tells the user the execution status of the motion program. The detailed contents of the status flag are shown below.

bit	Status
b0:	Program Running
b1:	Program Hold
b2:	(used by system)
b3:	(used by system)
b4:	Program Debug Running
b8:	Program Alarm Generated
bB:	In Debug Mode (EWS debug run)
bE:	Main Program Duplication Error
bF:	Excessive Main Program Number Error

■ Example of Motion Program Control Ladder

1. The minimum necessary ladder program to control a motion program is shown below.



2. The content of the above ladder program is as follows:

Step Number	Program Content
1 ~ 7	Stores the signal connected to the external input signal of the MP940 into the motion program control signal. IW0000 (External Input Signal) ¨_ DW00001 (27th word of MSEE work register) Program Run Start Program Hold Program Stop Alarm Reset
9	Call-out of motion program MPM001 MSEE MPM001 DA00000 (1) (2) (1) Motion Program Number (2) MSEE Work Register Address
11 ~ 15	Reset the run mode setting alarm reset (B6 of OWxx00) for each axis setting parameter and clear the alarms on each axis by the alarm reset signal (IB00005).

3. Motion program run/hold/stop, etc., operation by the system motion control function is possible when the external I/O signals (IB00000 ~ IB00007) connected in the MP940 by the above ladder program are input as motion program control signals (word 27 of the MSEE work register).

The following table provides an example of the external input signals required to create the minimum neccessary in order to operate a motion program in the MP940.

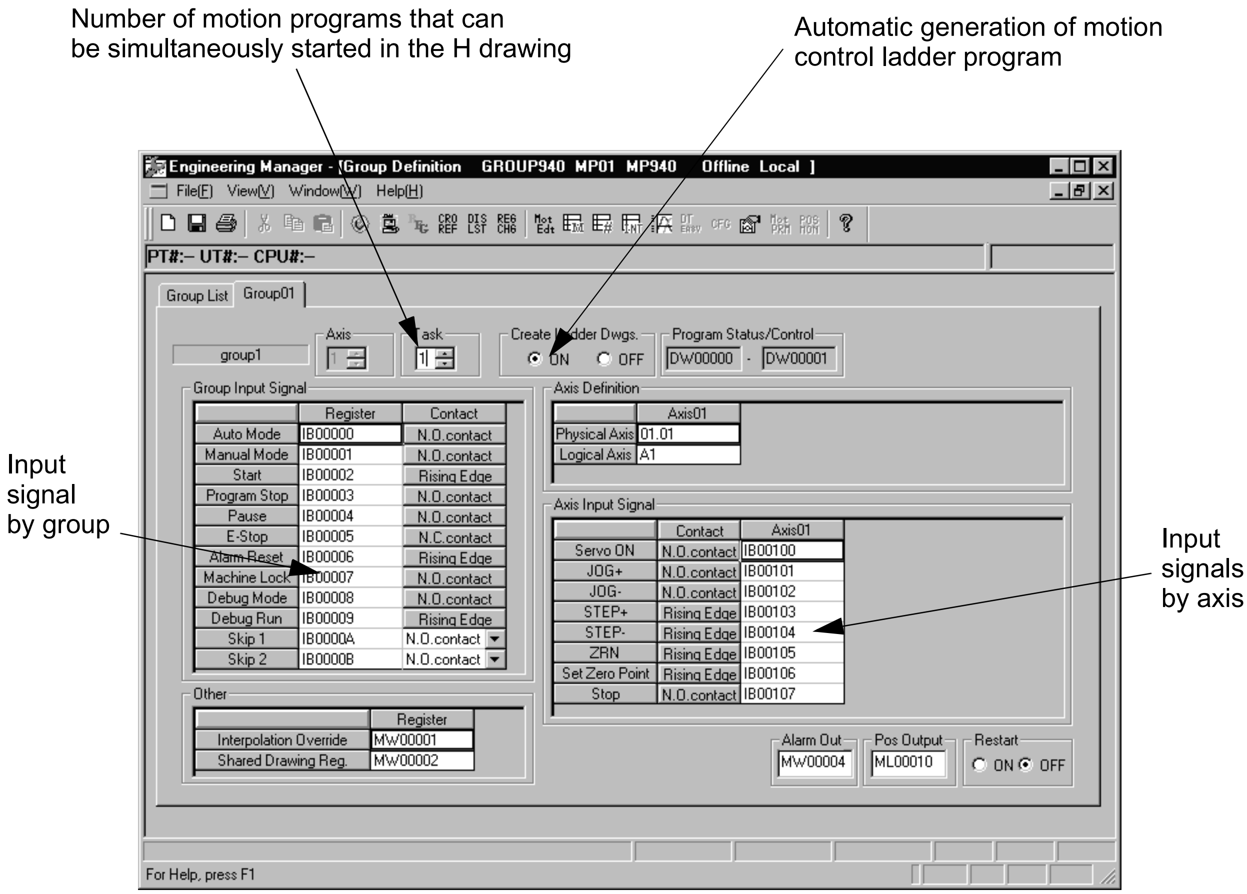
External Signal Address	External Signal Name
IB00000:	Program Run Start
IB00001:	Program Hold
IB00002:	Program Stop
IB00003:	Program Debug Mode
IB00004:	Program Debug Start
IB00005:	Alarm Reset

⇨

BIT	Motion Programs Control Signal
B0:	Program Run Start Request
b1:	Program Hold Request
b2:	Program Stop Request
b3:	Program Debug Mode Selection
b4:	Program Debug Start Request
b5:	Alarm Reset Request

■ Motion Control Ladder Autotmatic Generation Function

An automatic generation function for motion control ladders is standard equipment in the MP940. Using this function, both jog operations and programmed runs may be performed without having to create a dedicated ladder program. Additionally, the system boot-up time is greatly reduced.



The motion control ladders are automatically generated according to external input signals assigned in the group definition screen. They can be used as; however, use of this ladder as a template is recommended (but only after optimization/modification to match the system).

Functions

This section describes the usage method, characteristics, etc. of the MP940 functions. Functions are executed by referencing a source drawing, sub-drawing, or sub-sub-drawing using an FSTART command. Unlike sub-drawings and sub-sub-drawings, function references can be freely executed from the various drawings. The same function can also be referenced simultaneously from different drawing types and layers. Functions created from other functions can also be referenced. The following advantages are derived from using functions.

- Program componentization can be easily achieved.
- Program creation/saving is easy.

There are two types of functions: standard system functions provided with the system, and user functions defined by the user.

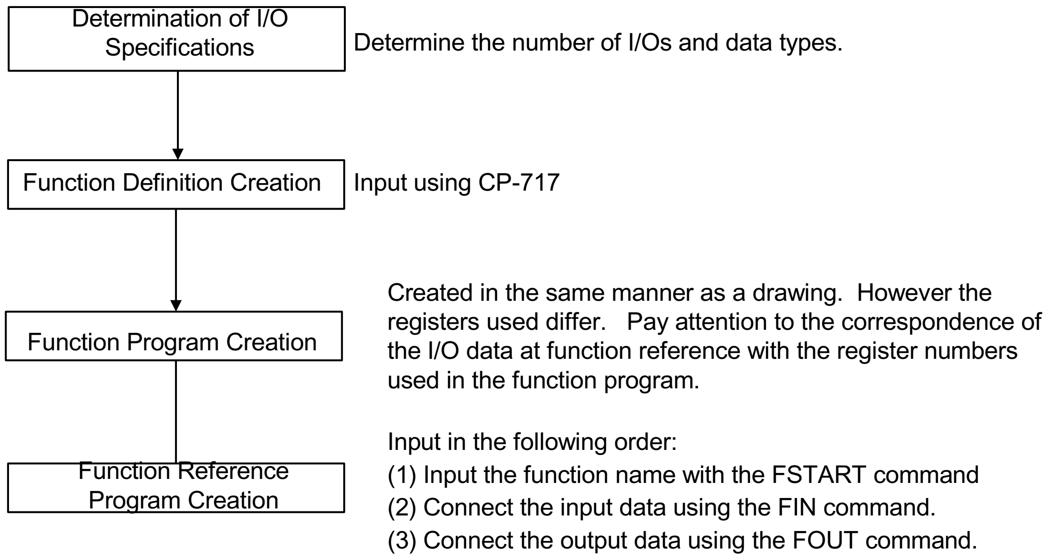
Standard System Functions

Nine functions are installed as standard system functions.The user cannot modify the standard system functions, listed below.

Type	Name	Symbol	Content
System Functions	Counter	COUNTER	Up/Down Counter
	First-in/First-out	FINFOUT	First-in/First-out
	Trace Function	TRACE	Data Trace Execution Control
	Data Trace Read-out	DTRC-RD	Data read from data trace memory into the user memory.
	Message Sent	MSG-SND	Send message from controller.
	Message Receive	MSG-RCV	Receive message to controller.

User Functions

The function itself (program) can be freely defined (programed) by the user. Up to 32 user program definitions can be created. The technique for creating user programsby using the user function creation procedure is described below.



1. See the following manual for details on MotionWorks™ operating methods. MP9xx Programming Unit Software Manual (volumes 1 and 2) (SIZA-C887-2.2-1/2.2-2).
2. See the following manual for details on the FSTART command and other commands.
   MP9xx Programming Manual (SI-C887-1.2C)

Determination of I/O Specifications

When creating a user funtion, determine the number of I/Os needed to meet the specifications required, as detailed in the table below.

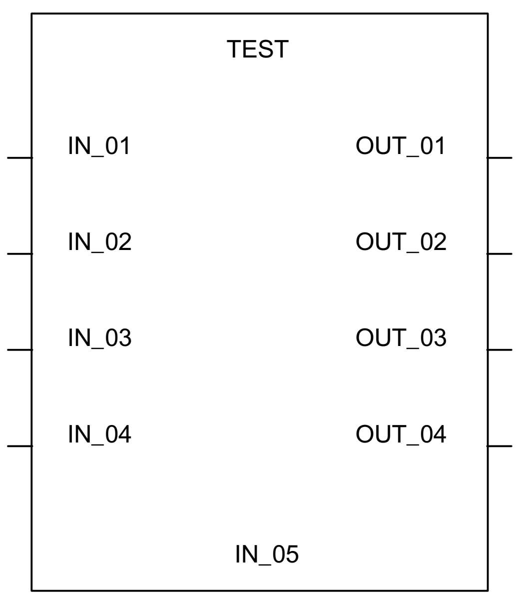
User Determined Specifications	Outline
Function Name	Input a name of up to 8 characters.
Number of Inputs	Up to 16 input indices for the functions can be input. Up to 17 can be input along with the number of address inputs.
Number of Address Inputs*	Up to 1 of these can be input in the exponent of the addresses needed in the function.
Number of Outputs	Up to 16 outputs from a function can be input.

• This shows how many pointers have been provided to the external function register used in the function.

Creation of External Function Definitions

1. Defines the specifications determined in the "Determination of I/O Specifications" section, such as function name in MotionWorks™. For details on the operation method, see MP9xx Programming Unit Software Manual (vol. 1 and 2) (SIZ-C887-2.2-1/2.2-2).

   Example: Graphical Function Display Format defined as Function Name = "TEST", No. of Inputs = "4", No. of Address Inputs = "1", No. of Outputs = "4".

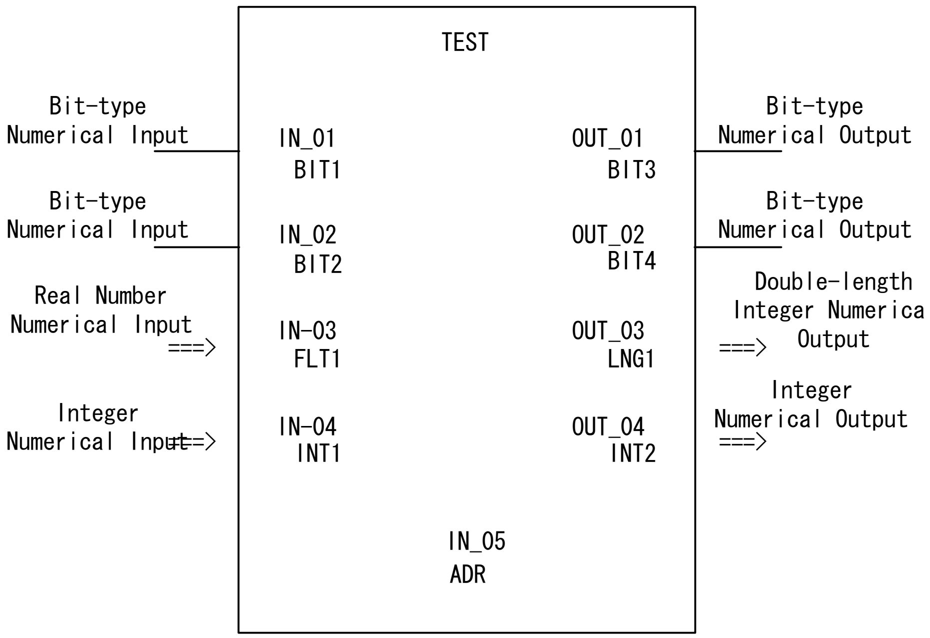


Note: After the graphical display format of the function has been created, define the data types of the function inputs, outputs, and address inputs.

There are three types of definable data types: bit, integer, and double-length integer.

Upon defining the data types, these are automatically assigned according to the system where input = X register, output = Y register, address input = A register.

2. An example of the function input definitions is given below:



3. The I/O signal addresses are automatically assigned from the signals on the graphical expression. Each of the I/O address assignments in the example above are as follows:

Name	Data Type	I/O Register
IN_01 (BIT1)	Bit type	XB000000
IN_02 (BIT2)	Bit type	XB000001
IN_03 (FLT1)	Real number type	XF00001
IN_04 (INT1)	Integer type	XW00003
IN_05 (ADR)	Address input type	AW00000
OUT_01 (BIT3)	Bit type	YB000000
OUT_02 (BIT4)	Bit type	YB000001
OUT_03 (LNG1)	Double-length integer type	YL00001
OUT_04 (INT2)	Integer type	YW00003

- XW00000 and YW00000 of the X and Y registers are used as bit type data.

4. The function input register is automatically assigned for “Graphical Function Display Format 2”. The general structure of the function is created at this stage.

Creation of the Function Program

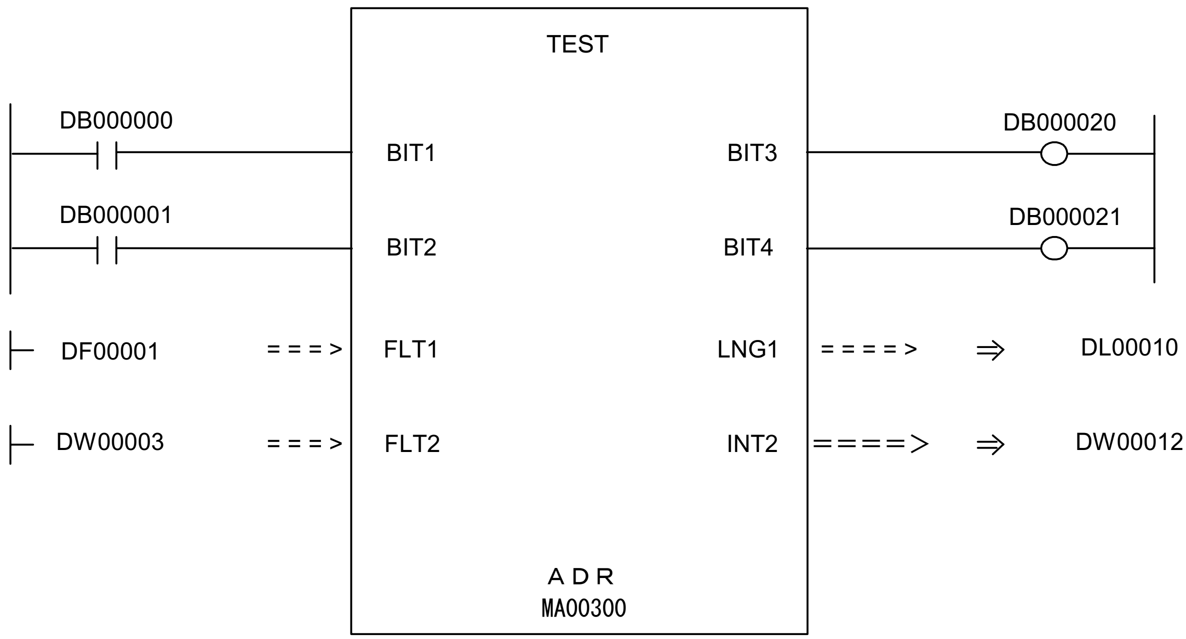
The creation method is the same as for a drawing. However, the register type used differs. For details on the registers, see the Register Types section.

Creation of the Function Reference Program

The user function is complete upon creation of the graphical function display format and program. Referencing is possible, just as in standard system functions, from source drawings, sub-drawings, and sub-sub-drawings, in addition to other functions. Functions may be called-out within both drawing and user function programs by the following procedure. For details on the operation method, see “MP9xx Ladder Programming Manual” (SI-C887-1.2C).

1. Input the function name with the FSTART command.
   For example, input FSTART, press the **Enter** key, input TEST, and press the **Enter** key. Already defined graphical function display formats are then displayed.
2. Use the FIN command to create the input data program. This imparts the input data to both the function inputs and address inputs.

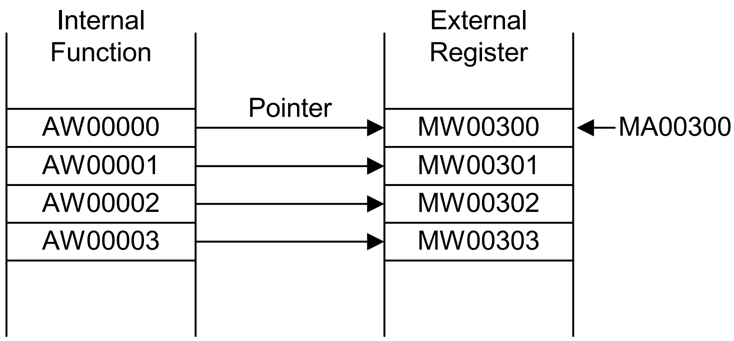
3. Use the FOUT command to create the output data program. For example, the I/O data is imparted as follows to graphical display format.



The relationship between I/O data and the internal function registers is listed below.

Name	I/O Data		Internal Function Register
BIT1	DB000000	→	XB000000
BIT2	DB000001	→	XB000001
FLT1	DF00001	→	XF00001
INT1	DW00003	→	XW00003
ADR	MA00300	↔	AW00000
BIT3	OB00020	←	YB000000
BIT4	OB00021	←	YB000001
LNG1	DL00010	←	YL00001
INT2	DW0012	←	YW00003

The address input register AW00000 in the above table is assigned to MW00300. AW00000, AW00001... used within the function test, correspond to the external registers MW00300, MW00301.... Therefore, if a value in AW00000 is stored in a function, that value is stored in MW00300, as shown below.



- Creation of function reference programs from motion programs

User functions can be called out from motion programs. For example, the following results when the user function on the previous page is called out from the motion program.

```
UFC TEST DB000000 DB000001 DF00001 DW00003,MA00300,
         DB000020 DB000021 DL00010 DW00012;
```

- User program conditions referenced in motion programs

The first bit of the I/O data is always in bit form. This output data is assumed to be the "completion" signal for shifting the following motion commands.

```
UFC DB000000..., MA00300, DB000020...;      Conditions@_DB000020==ON
MVS  [X]100.  [Y]200.  F10000;
.
..
```

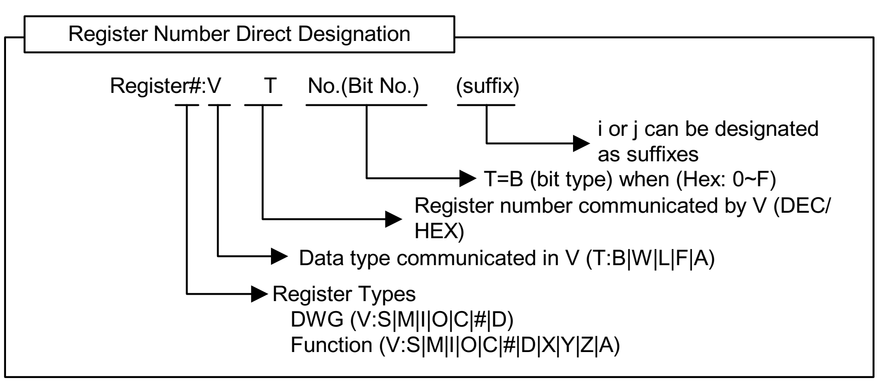
Register

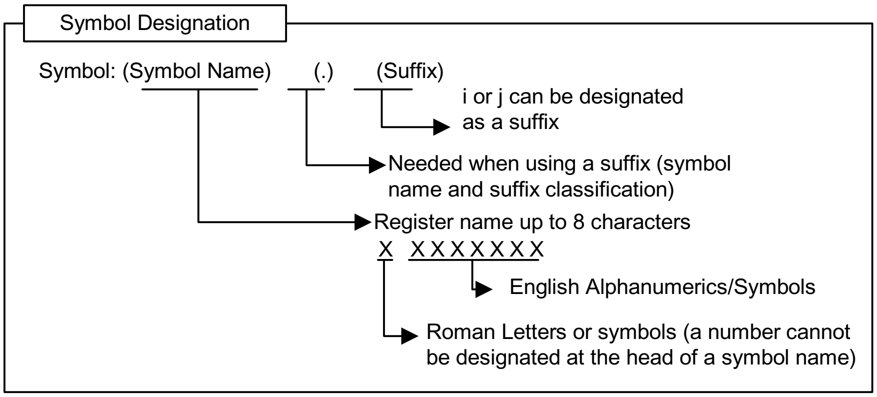
This section describes register types and usage formats used in MP940 user programs.

Register Designation Method

There are two methods for register designation: direct designation of register numbers, and symbol designation. These methods may be used together in a user program. When symbol deignation is used, the relationship between symbols and register numbers is defined in the symbol table given later. The register designation method is shown below.

Designation Method	Designation Method
Direct Register Number Designation	Bit type Register Designation: MB00100AX Integer Type Register Designation: MW00100X Double-length Integer Type Register Designation: ML00100X Real Number Type Register Designation: MF00100X Address Type Register Designation: MA00100X X: In suffix designation, attach a suffix or a J after the register number.
Symbol Designation	Bit type Register Designation: RESET1-A.X Integer Type Register Designation: STIME-H.X Double-length Integer Type Register Designation: POS-REF.X Real Number Type Register Designation: IN-DEF.X Address Type Register Designation: PID-DATA.X ↓ Up to 8 alphanumeric characters X: In suffix designation, attach a period "." after the symbol up to 8 alphanumeric characters, then add a suffix or a J.

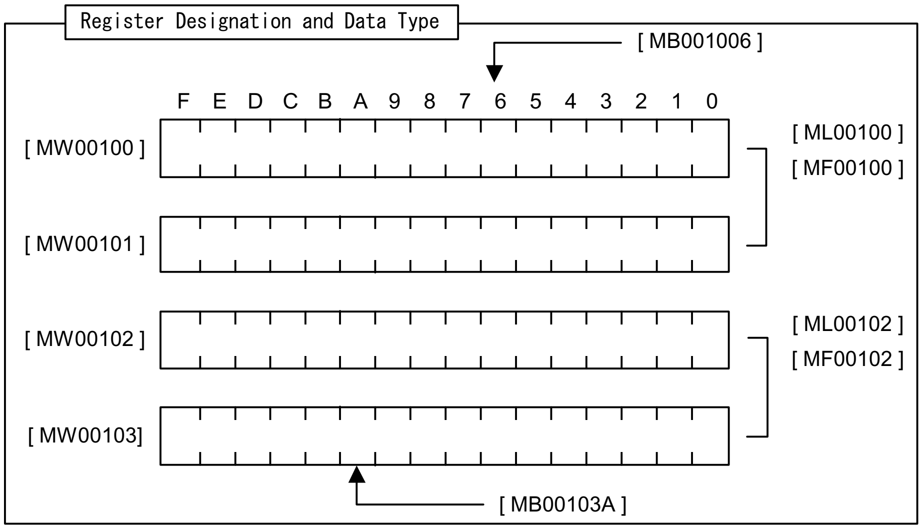


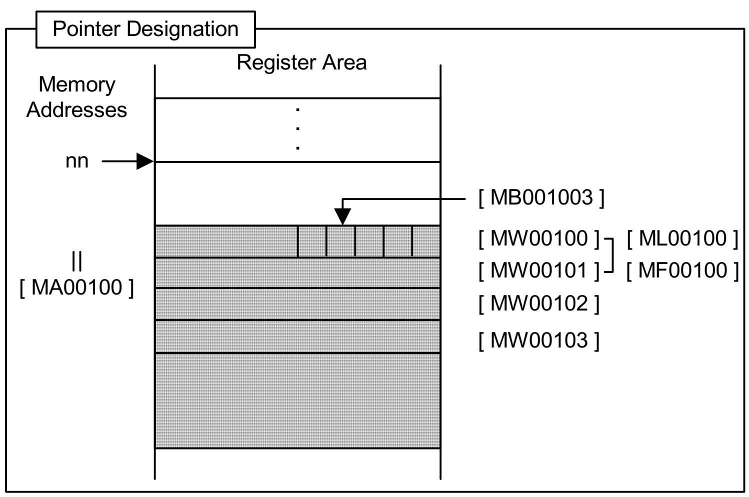


Data Types

There are five data types used according to purpose: bit, integer, double-byte integer, real number, and address. Address type data is only used for bottom designation within a function. For details, see MP9xx Ladder Programming Manual (SI-C887-1.2C). The data types are shown below.

Type	Data Type	Numerical Range	Notes
B	Bit	ON, OFF	Used in relay circuits.
W	Integer	-32768 ~ +32767 (8000H) (7FFFH)	Used in numerical calculations. Data in parentheses “( )” indicates use in logical calculations.
L	Double-length integers	-2147483648 ~ +2147483647 (80000000H) (7FFFFFFFH)	Used in numerical calculations. Data in parentheses “( )” indicates use in logical calculations.
F	Real numbers	±(1.175E -38 ~ 3.402E +38), 0	Used in numerical calculations.
A	Address	0 ~ 32767	Used only in pointer designations.

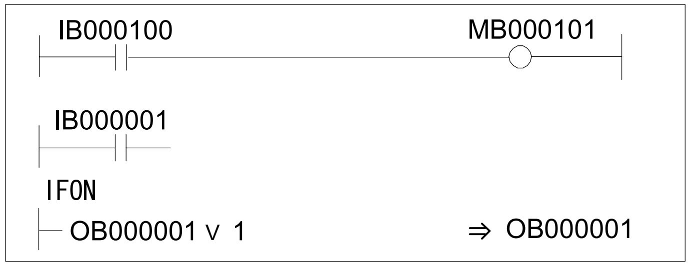

Register Designation and Data Type
[MB001006]
F E D C B A 9 8 7 6 5 4 3 2 1 0
[MW00100]
[MW00101]
[MW00102]
[MW00103]
[ML00100]
[MF00100]
[ML00102]
[MF00102]
[MB00103A]


Pointer Designation
Register Area
Memory Addresses
nn
||
[MA00100]
[MB001003]
[MW00100]
[MW00101]
[MW00102]
[MW00103]
[ML00100]
[MF00100]

■ Usage examples by data type

1. Bit

   Used in relay circuit ON/OFF or logical calculation.

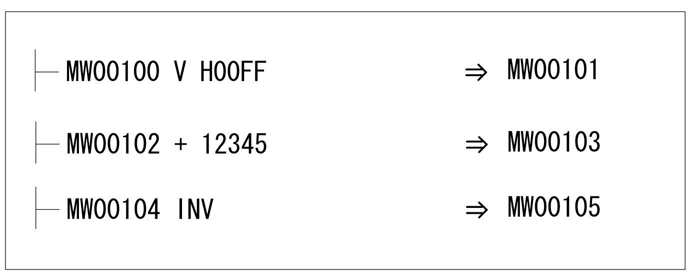


• Sample motion program

```
MB000101=IB000100;
IF IB000001==1;
DB000001=DB000001|1
```

2. Word

   Used in numerical calculations and logical calculations.



• Sample motion program

```
MW00101=MW00100|00FFH;
MW00103=MW00102+12345;
MW00105=MW00104;
```

3. Double-length Integers

   Used in numerical calculations and logical calculations.

```
├─ML00100 + ML00102            ⇒ ML00104
├─ML00106 × ML00108 ÷÷18000    ⇒ ML00110
├─ML00112 BIN                  ⇒ ML00114
```

- Sample motion program

```
ML00104=ML00100+ML00102;
ML00110=ML00106*ML00108/18000;
ML00114=BIN (ML00112);
```

4. Real Numbers

   Used in numerical calculations with floating points.

```
├─1.23456              ⇒ DF00100
                          (1.23456)
├─DF00102 SIN          ⇒ DF00104
   (30.0)                 (0.5)
├─DF00200 TAN          ⇒ DF00202
   (45.0)                 (1.0)
```

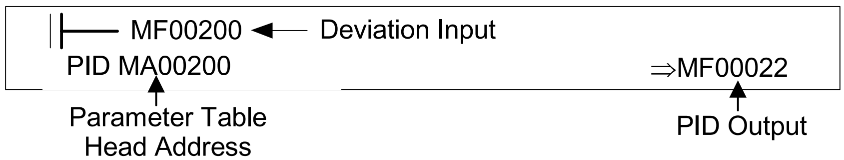
- Sample motion program

```
DF00100=1.23456;
DF00104=SIN (DF00102);
DF00202=TAN (DF00200);
```

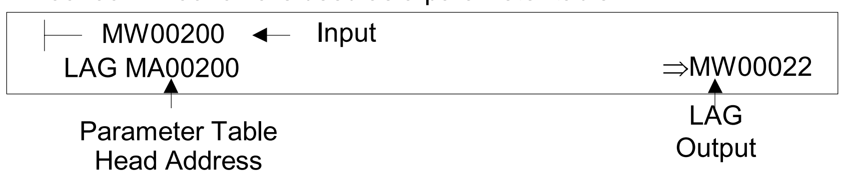
5. Address

   Used only in pointer designation.

MF00200~MF00228 are used as a parameter table.



MF00200~MF00204 are used as a parameter table.



Register Types

■ DWG Register

Each drawing or motion program can use the seven registers shown below.

Type	Name	Designation Method	Range	Content	Characteristics
S	System Register	SB, SW, SL, SFnnnnn (SAnnnnn)	SW00000 ~ SW01023	Register prepared by the system. Register number nnnnn is displayed in decimal format. SW00000 ~ SW00049 are cleared to 0 at system start.	Common DWG
M	Data Register	MB, MW, ML , MFnnnnn (MAnnnnn)	MW00000 ~ MW32767	Common registers between each drawing. Used in I/Fs between drawings, register number nnnnn is displayed in decimal format.	
I	Input Register	IB, IW, IL, IFhhhh (IAhhhh)	IW0000 ~ IW07FF	Register used in input data. Register number nnnnn is displayed in hexadecimal format.	
O	Output Register	OB, OW, OL, OFhhhh (OAhhhh)	OW0000OW 07FF ~ OW07FF	Register used in output data. Register number hhhh is displayed in hexadecimal format.	
C	Constant Register	CB, CW, CL, CFnnnnn (CAnnnnn)	CW00000 ~ CW32767	This register can only be referenced in programs. Register number nnnnn is displayed in decimal format.	
#	# Register	#B, #W, #L, #Fnnnnn (Annnnn)	#W00000 ~ #W16383	This register can only be referenced in programs. Only given drawings can be registered. The actual usage range is designated by the user in MotionWorks™. The register number nnnnn is displayed in decimal format.	By Drawing
D	D Register	DB, DW, DL, DFnnnnn (DAnnnnn)	DW00000 ~ DW16383	This is an internal register intrinsic to each drawing. Only given drawings can be registered. The actual usage range is designated by the user in the MotionWorks™. Register number nnnnn is displayed in decimal format.	

1. # registers cannot be used in motion programs.
2. The following registers are saved in flash memory.
   - M Registers
   - C Registers
   - # Registers (saved with user programs)
   - D Registers (saved with user programs)

■ Function Registers

The 11 types of registers shown below can be used in each function.

Function Registers

Type	Name	Designation Method	Range	Content	Characteristics
X	Function Input Register	XB, XW, XL, XFnnnnn	XW00000 ~ XW00016	Input to Function Bit Input: XB000000 ~ XB00000F Integer Input: XW00001 ~ XW00016 Double-length Integer Input: XL00001 ~ XL00015 Register number nnnnn is displayed in decimal format.	By Function
Y	Function Output Register	YB, YW, YL, YFnnnnn	YW00000 ~ YW00016	Output from function Bit Output: YB000000 ~ YB00000F Integer Output: YW00001 ~ YW00016 Double-length Integer Output: YL00001 ~ YL00015 Register number nnnnn is displayed in decimal format.	
Z	Internal Function Register	ZB, ZW, ZL, ZFnnnnn	ZW0000 ~ ZW00063	This is an internal register intrinsic to each function. These can be used as internal function processes. Register number nnnnn is displayed in decimal format.	
A	External Function Register	AB, AW, AL, AFhhhh	AW0000 ~ AW32767	This external address assumes the value of the address input to be the base address. For linking with (S, M, I, O, #, DAnnnnn). Register number nnnnn is displayed in decimal format.	
#	# Register	#B, #W, #L, #Fnnnnn (Annnnn)	#W00000 ~ #W16383	This register can only be referenced in functions. Only given functions can be registered. The actual usage range is designated by the user in MotionWorks™. Register number nnnnn is displayed in decimal format.	
D	D Register	DB, DW, DL, DFnnnnn (DAnnnnn)	DW00000 ~ DW16383	This is an internal register intrinsic to each function. Only given functions can be registered. The actual usage range is designated by the user in MotionWorks™. Register number nnnnn is displayed in decimal format.	

Function Registers (Continued)

Type	Name	Designation Method	Range	Content	Characteristics
S	System Register	SB, SW, SL, SFnnnnn (SAnnnnn)	Same as DWG register Because this register is common to drawings and functions, use this register carefully when referencing identical functions from drawings of different priority levels.		By function
M	Data Register	MB, MW, ML, MFnnnnn (MAnnnnn)			
I	Input Register	IB, IW, IL, IFhhhh (IAhhhh)			
O	Output Register	OB, OW, OL, OFhhhh (OAhhhh)			
C	Definition Register	CB, CW, CL, CFhhhh (CAhhhh)			

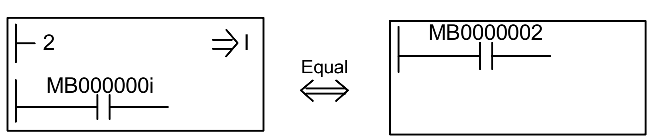
SA, MA, IA, OA, DA, A, and CA can be used within functions as well.

Usage Method for Suffixes I and J

Two types of dedicated register, I and J, have been provided for modification of relay numbers and register numbers. The functions of I and J are exactly the same. Examples of each register data type follow below.

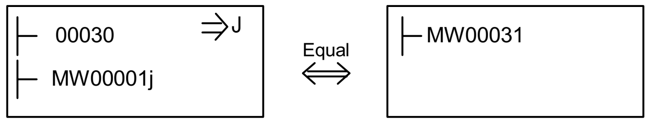
- If the suffix is in bit form

The value of I is the same as the value of J when added to a relay number. For example, when I = 2 MB000000l is the same as MB000002. When J = 27 MB000000J is the same as MB00001B.



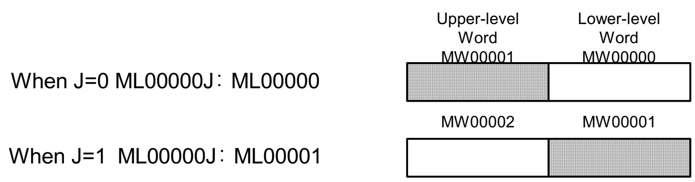
- If the suffix is in integer form

The value of I is the same as the value of J when added to a register number. For example, when I = 3 MW000010l is the same as MW00013. When J = 30 MW00001J is the same as MW00031.



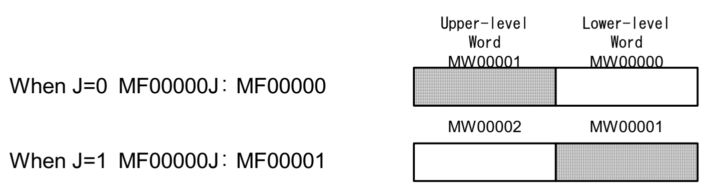
■ If the suffix is in double-length integer form

The value of I is the same as the value of J when added to a register number. For example, when I = 1 ML00000l is the same as ML0000I. Be aware that ML0000J is as follows when J = 0 and when J = 1.



■ If the suffix is in real number form

The value of I is the same as the value of J when added to a register number. For example, when I = 1 MF00000l is the same as MF0000I. Be aware that MF0000J is as follows when J = 0 and when J = 1.



■ Example of Program Using Suffixes

Using suffix J, this program requests a total of 100 registers from MW00100 to MW0199 into MW00200.

```
├ 00000                          ⇒ MW00200
FOR  J = 00000 to 00099 by 00001
├ MW00200 + MW00100j             ⇒ MW00200
FEND
```

Suffixes I and J cannot be used in motion programs.

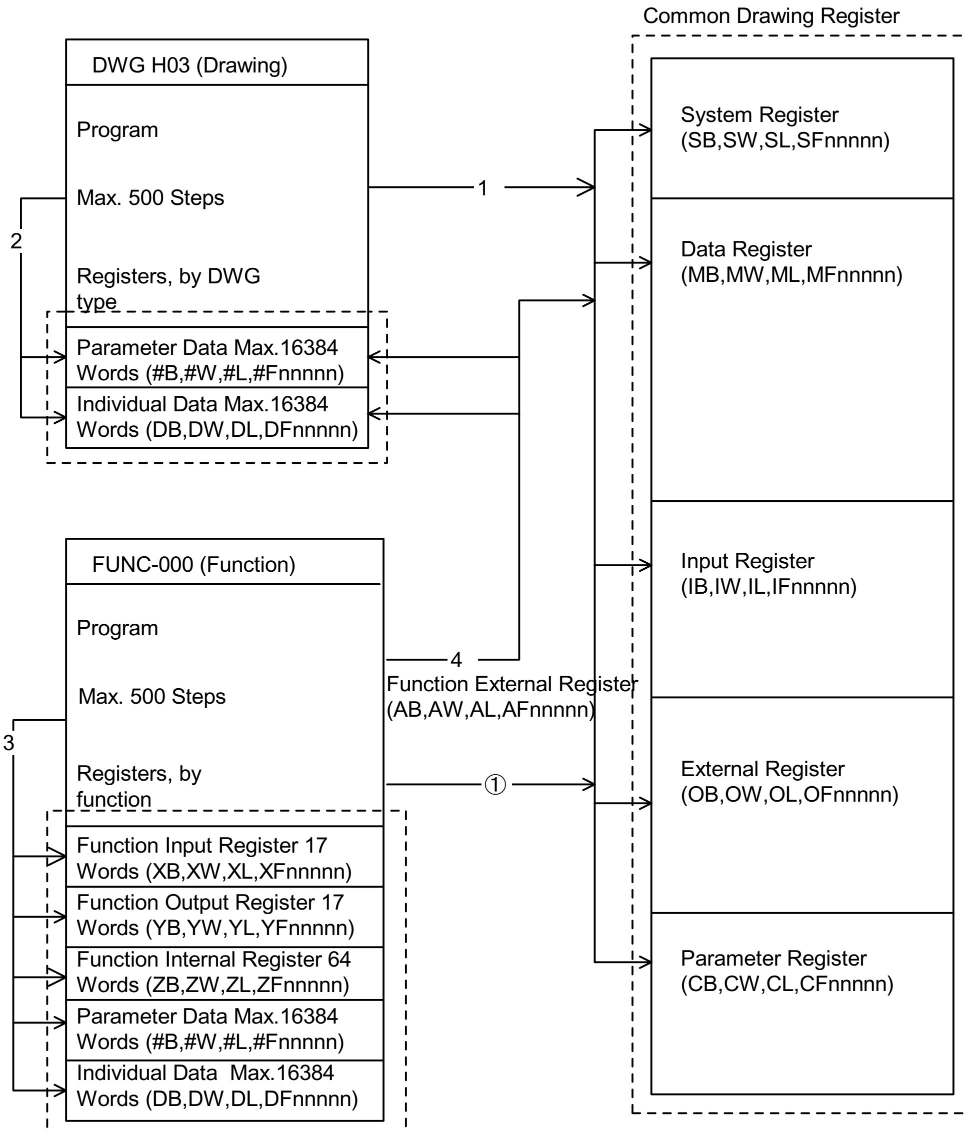
- I and J require initialization.
- I and J are handled in unsigned form. Do not allow their values to drop below zero.

Function I/O and Function Registers

The I/Os referencing the function and the function registers correspond as shown in the table below.

Function I/O	Function Register
Bit input	The order of bit input continually increases the bit number from XB00000. (XB000000, XB000001, XB000002, ..., XB00000F)
Integer/Double-length integer/Real number input	The input order for integers, double-length integers, and real numbers continuously increases the register numbers from XW00001, XL00001, and XF00001. (XW00001, XW00002, XW00003, ..., XW00016) (XL00001, XL00003, XL00005, ..., XL00015) (XF00001, XF00003, XF00005, ..., XF00015)
Address input	The address input corresponds to register number 0 of the external register. (Input = MA00100: MW00100 = AW00000, MW00101 = AW00001... ...)
Bit output	The order of bit output continually increases the bit number from YB000000. (YB000000, YB000001, YB000002, ..., YB00000F)
Integer/Double-length integer/Real number output	The input order for integers, double-length integers, and real numbers continuously increases the register numbers from YW00001, YL00001, and YF00001. (YW00001, YW00002, YW00003, ..., YW00016) (YL00001, YL00003, YL00005, ..., YL00015) (YF00001, YF00003, YF00005, ..., YF00015)

Program Register Reference Range



(1): The common drawing register can be referenced from any drawing or function.
(2): The common drawing register can only be accessed with in the drawing.
(3): The individual function register can only be accessed within the function.
(4): The common drawing register and indivdual drawing register can be accessed from a function by using the function external register.

Symbol Management

Symbol Management in Drawings

Manage all symbols used in drawings according to the symbol table shown below. For details, see MP9xx Ladder Programming Manual (SI-C887-1.2C).

Number	Register Number	Symbol	Size*	Notes
0	IB0000	STARTPBL	1	Register number is displayed in hexadecimal format.
1	OB0000	STARTCOM	1	Register number is displayed in hexadecimal format.
2	MW00000	SPDMAS	1	—
3	MB000010	WORK–DB	16	—
4	MW00010	PIDDATA	10	—
5	MW00020	LAUIN	1	—
6	MW00021	LAUOUT	1	—
: :	—	—	—	—
N	—	—	—	—

- Define the size used in the data structure when a program is created using data structures such as arrays, index process data, etc.
  For example, in PIDDATA_I, the size is 10 if the referenced data varies within a range of 0 ~ 9.

Symbol Management in Functions

Manage all symbols used in functions according to the function symbol table shown below. For details, see MP9xx Ladder Programming Manual (SI-C887-1.2C).

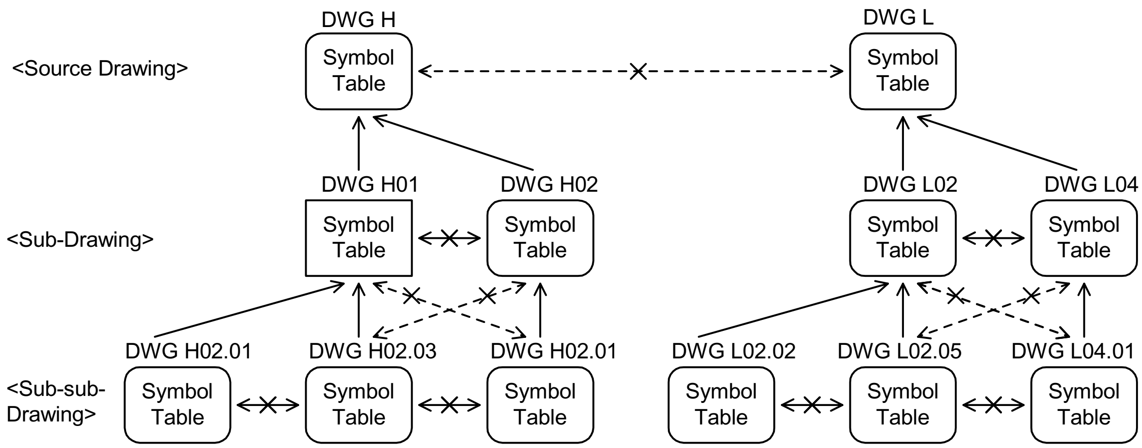
Number	Register Number	Symbol	Size*
0	XB000000		1
1	XW00001		1
2	AW00001		1
3	AB00000F		1
4	YB000000		1
5	YW00001		1
6	ZB000000		4
8	ZW00001		1
9	ZW00002		1
: :	—	—	—
N	—	—	—

- Define the size used in the data structure when a program is created using data structures such as arrays, index process data, etc.
  For example, in PIDDATA_I, the size is 10 if the referenced data varies within a range of 0~9.

Upper-level Symbol Link

The following table is a table for linkable symbols and symbol link objects. For details on the upper-level symbol link, see the MP9xx Ladder Programming Manual (SI-C887-1.2C) and the MP9xx Software Manual (Vol. 1 & 2) (SIZ-C887-2.2-1/2.2-2).

	Symbol Table		
	Source Drawing	Sub-drawing	Sub-sub-drawing
Source Drawing Symbols	x	—	—
Sub-drawing Symbols	>_	—	—
Sub-sub-drawing Symbols	>_	>_	—
Symbols in Functions	x	—	—



Automatic Register Numbering

The following table shows where register autonumbering is possible and not possible.For details on register autonumbering, see the MP9xx Ladder Programming Manual (SI-C887-1.2C) and the MP9xx Software Manual (Vol. 1 & 2) (SIZ-C887-2.2-1/2.2-2).

Drawing Symbol Table		Autonumbering	Function Symbol Table		Autonumbering
—		MotionWorks	—		MotionWorks
System Register	S	O	System Register	S	O
Input Register	I	O	Input Register	I	O
Output Register	O	O	Output Register	O	O
Data Register	M	O	Data Register	M	O
# Register	#	O	# Register	#	O
C Register	C	O	C Register	C	O
D Register	D	O	D Register	D	O
—		—	Function Input Register	X	X
—		—	Function Output Register	Y	X
—		—	Internal Function Register	Z	O
—		—	External Function Register	A	X

O: Autonumbering Possible X: Autonumbering not possible

Chapter 4: MP940 Functions

An explanation of the various MP940 functions is given in this chapter.

Outline of MP940 Functions

Module Structure

The MP940 is a single-axis controller bus-connected to an SGDH servo amplifier with function unit modules such as local I/O built into a single box.

The MP940 consists of the following function modules, centering around servo control. Each of these modules must be initially set-up according to the module definition described in this chapter.

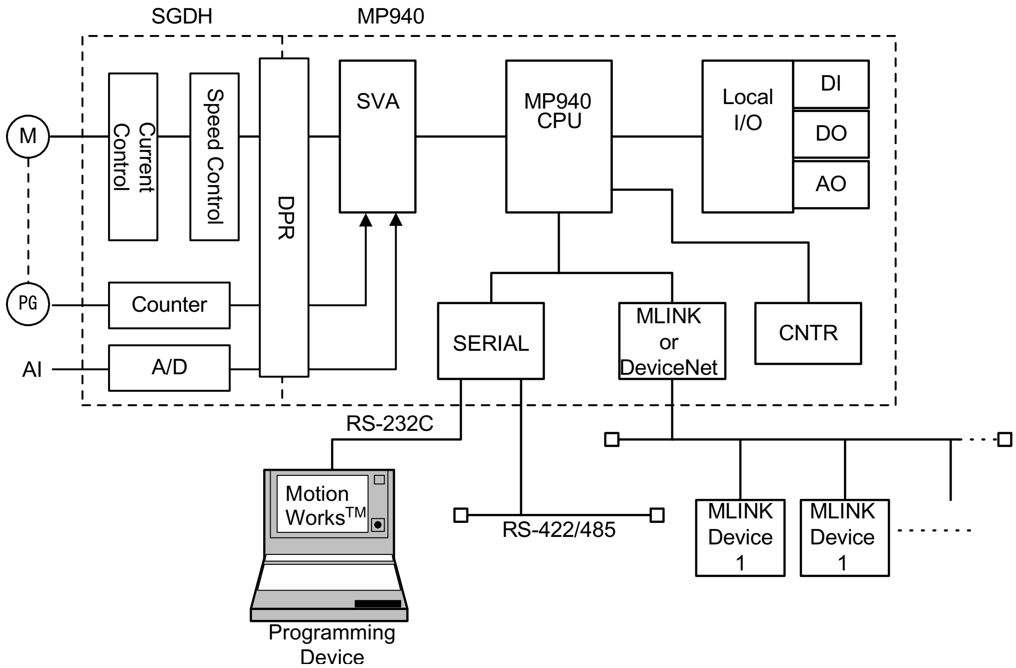
■ MP940 Function Module List

The MP940 Function Module List is shown below:

Function Modules	Content
MP940	CPU Unit
SERIAL	Serial Communication RS-232C, RS-422/485
LIO	Local I/O DI 8-points DO 8-points AO 1CH
SVA	Motion Functions
CNTR	Counter Function
MLINK	Mechatrolink I/F Function

■ Block Diagram of MP940 Functions

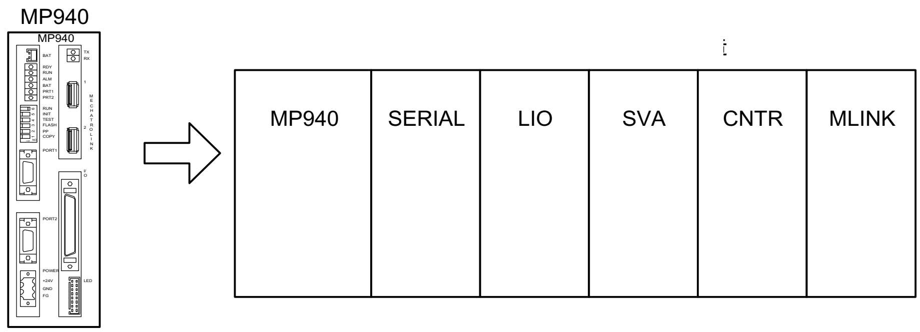
A block diagram of the MP940 functions is shown in the figure below:



MP940 Virtual Building Block Structure

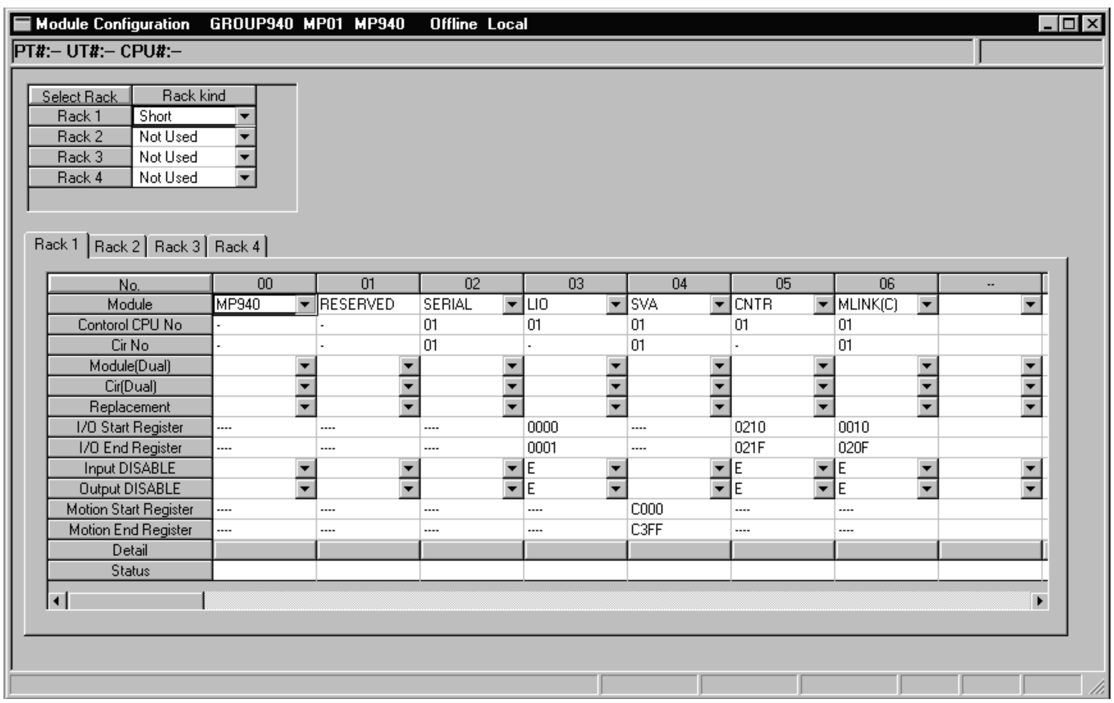
The MP940 is an all-in-one machine controller wherein function unit hardware modules have been miniatureized and placed in a single case.

The parameter setting of each function module realizes an operating environment identical to a building block type machine controller. For this reason, definitions are easy when you think of deploying an all-in-one structure in virtual building blocks. The MP940 is deployed in virtual building blocks as shown below.



■ Main Module Structure Definiton Window

Set slots 00 through 06 in rack 1. Slot 1 however, is reserved for the system.



Select Rack	Rack kind
Rack 1	Short
Rack 2	Not Used
Rack 3	Not Used
Rack 4	Not Used

No.	00	01	02	03	04	05	06	--
Module	MP940	RESERVED	SERIAL	LIO	SVA	CNTR	MLINK(C)	
Contorol CPU No	-	-	01	01	01	01	01	
Cir No	-	-	01	-	01	-	01	
Module(Dual)								
Cir(Dual)								
Replacement								
I/O Start Register	----	----	----	0000	----	0210	0010	
I/O End Register	----	----	----	0001	----	021F	020F	
Input DISABLE				E		E	E	
Output DISABLE				E		E	E	
Motion Start Register	----	----	----	----	C000	----	----	
Motion End Register	----	----	----	----	C3FF	----	----	
Detail								
Status								

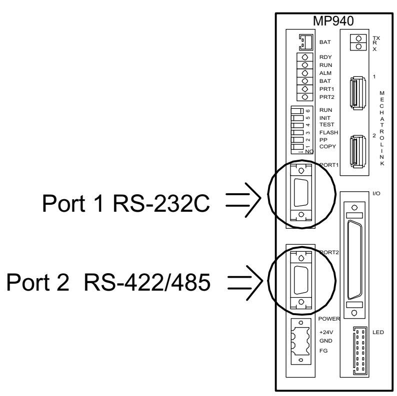
Serial Transmission Function

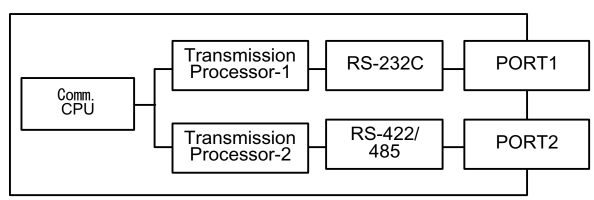
Outline of Serial Transmission Function

The MP940 is equipped with a serial transmission interface containing (1) RS-232C and (1) RS-422/485.1. This arrangement is compatible with several transmission protocols, starting with Yaskawa's proprietary Memobus protocol, as well as with various interfaces. The PORT1RS-232 can be used as an engineering port. MP940 engineering is possible by connection to MotionWorks™.

MP940works as either a master or slave in a set program according to the serial transmission setting.

Serial Transmission executes data send/receive by using the MSG-SND and MSG-RCV functions within the DWG/ function program.



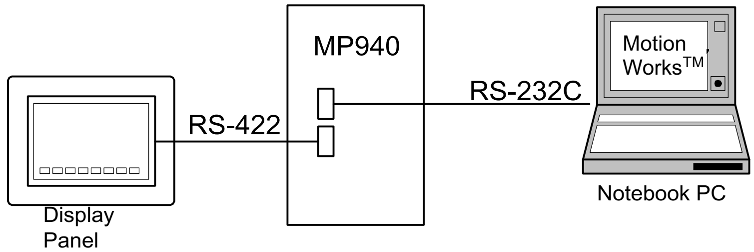


System Configuration

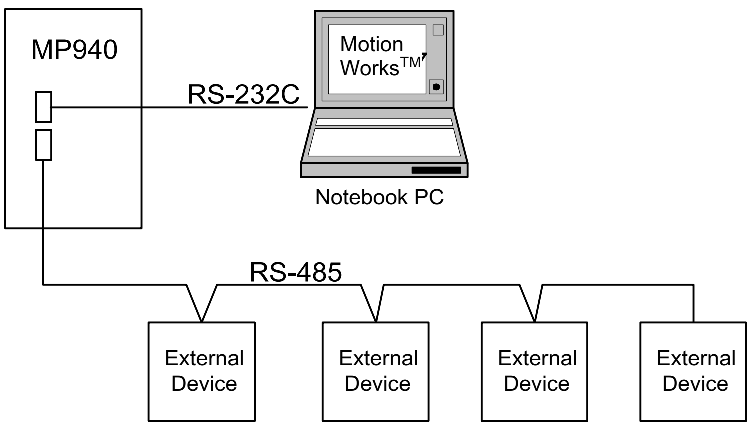
■ Standard System Configuration

The following is an example of connecting the MotionWorks™

programming device and the display panel in a serial MP940.



Below is an example of connection of the MotionWorks™ programming device to the RS-232C port and branched connection of peripheral devices from the RS-485 port.



Communication Specifications

A description of the serial communication function specification follows.

The table below shows the MP940 module transmission specifications.

Item	Specification
Interface	RS-232, 1Line RS-422/485 1Line
Connector	RS-232 PORT1 MDR-14pin/female RS-422/485 PORT2 MDR-14pin/female
Transmission Range	RS-232: 15m Maximum RS-422/485: 300m Maximum
Baud Rate	RS-232 PORT1 9600, 14400, 19200bps RS-422/485 PORT2: 9600, 14400, 19200bps
Synchronization Type	Asynchronous (start-stop synchronization)
Transmission Protocol	Memobus (Master/Slave, MELSEC communication, non-procedural)
Connection Status	RS-232 1:1 RS-422 1:1 RS-485 1:N
Transmission Format (Settable)	Data Bit Length :7/8Bit Stop Bit :1/2Bit (port 1only):port 2 is fixed at 1 Parity Bit :Even/Odd/None

Connector Hookup

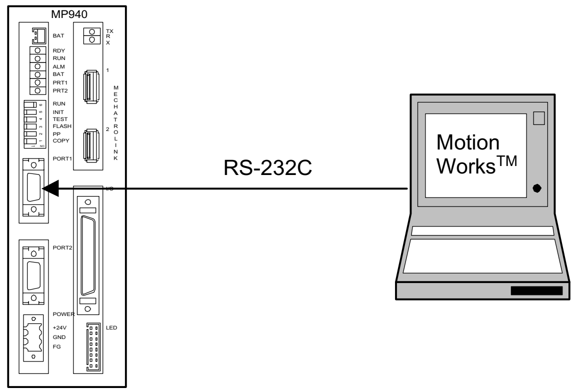
■ Serial Port 1

MP940 can communicate between tranmission devices on the Memobus network using RS-232C via serial port 1.

A programming device (a PC equipped with an RS-232C interface) is connected to serial port 1.

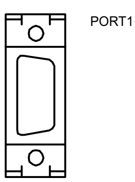
■ Connection with Programming Device

The following is an example of connecting serial port 1 to the programming device.



■ Connector pin array and signal name

An example is shown below of the connector pin array and signal names in serial port 1.

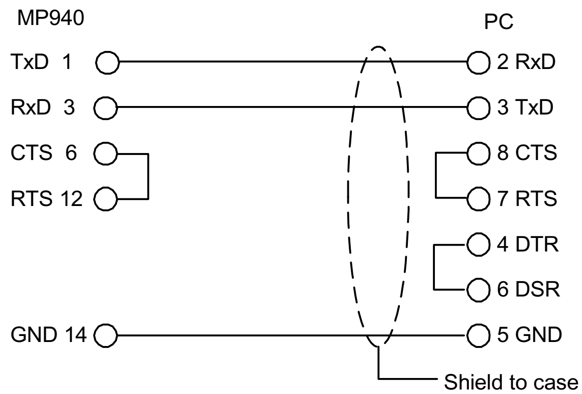


Number	Signal Name	Reference	Number	Signal Name	Reference
1	TxD	Transmit data	8	—	—
2	—	—	9	—	—
3	RxD	Receive data	10	—	—
4	—	—	11	—	—
5	—	—	12	RTS	—
6	CTS	—	13	—	—
7	—	—	14	GND	Ground

- Module Side Connector : 10214-52A2JL (3M)
- Cable Side Connector Unit : 10114-3000VE (3M)
- Shell : 10314-52A0-008 (3M)

■ Connection of Serial Port 1 (RS-232C)

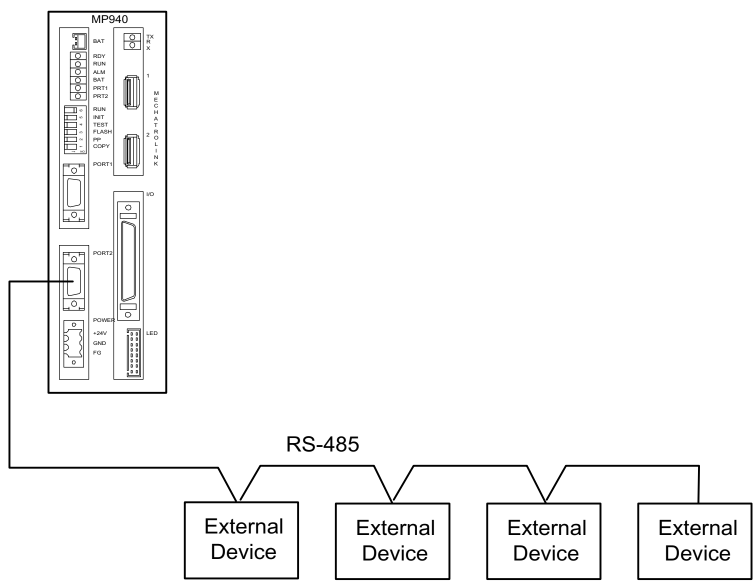
The following is an example of connecting serial port (RS-232C):



■ Serial Port 2

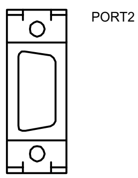
This is the port used in RS-422/485 connection.

An example is given of branch connection of peripheral devices with serial port 2.



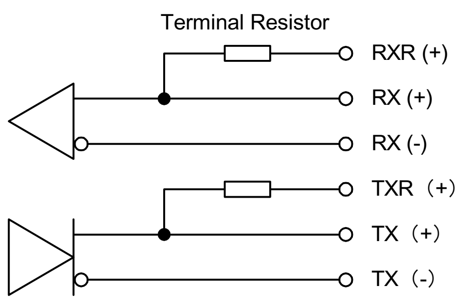
■ Connector pin array and signal name

The table below shows details of programming device connection to serial port 2.



No.	Signal Name	Reference	No.	Signal Name	Reference
1	TX+	+ side of transmission data	8	TX+	+ side of transmission data
2	TX-	- side of transmission data	9	TX-	- side of transmission data
3	RX+	+ side of received data	10	RX+	+ side of received data
4	RX-	- side of received data	11	TXR	Transmission data terminal resistor
5	—	—	12	—	—
6	RX-	- side of received data	13	VCC	Power+5V
7	RXR	Reception data terminal resistance	14	GND	Ground

Insert the terminal resistor to the (+) pole.



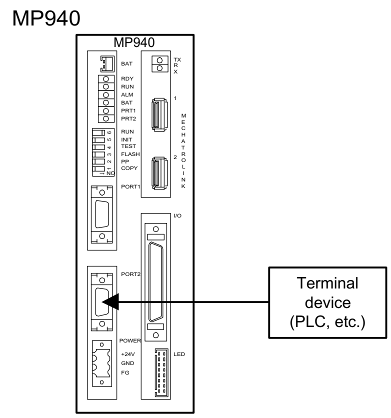
If inserting the terminal resistor, connect to the RXR(+) and RX(-), as well as TXR(+) and TX(-) signals.
If not inserting the terminal resistor, connect to the RX(+) and RX(-) as well as TX(+) signals.

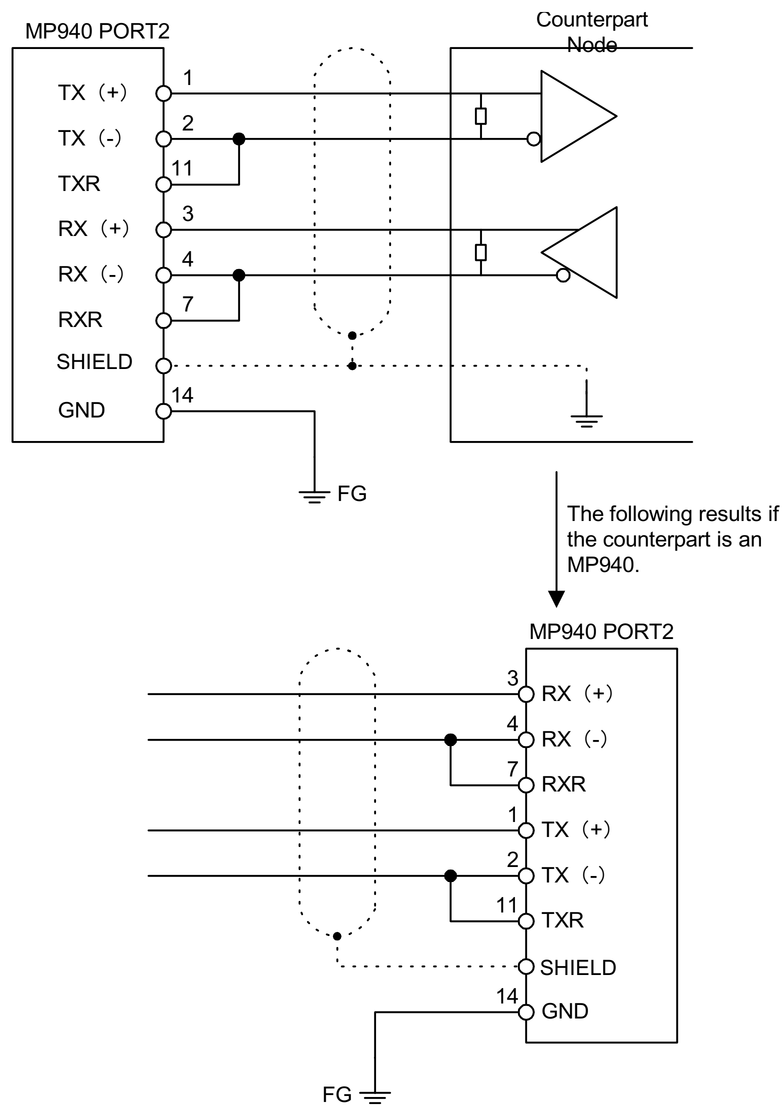
- Module Connector: 10214-52A2JL (3M)
- Cable Connector Unit: 10114-3000VE (3M)
- Shell: 10314-52A0-008 (3M)

■ RS422/485 Interface Cable

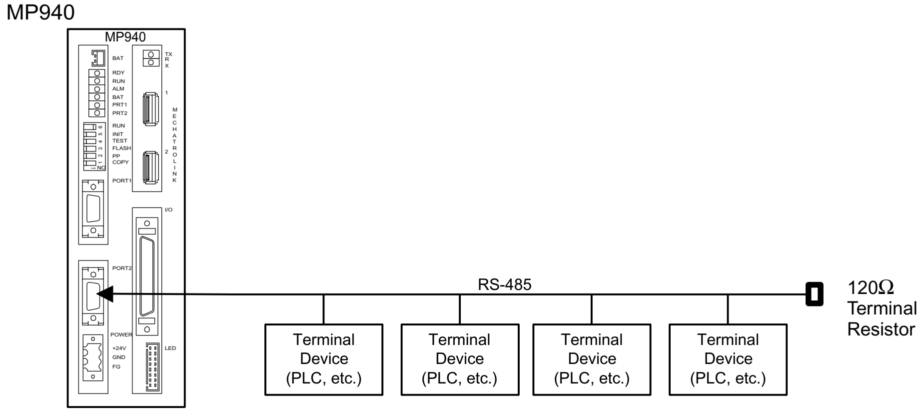
1. Ensure that the drive system, control system, power system, and other transmission systems are separate from each other.
2. The MP940 interface module RS422/485 interface is an MDR-14 female pin (Port 2).
3. The RS422/485 cable length is 300m maximum. Use the minimum length necessary.
4. The MP940 module RS422/485 interface is a non-isolated system. Errors may occur from noise in the connected terminal. If so, reduce the noise by using a shield-type cable and modem.
5. In the case of RS422, insert a terminal resistor as needed. Make the terminal on the receiving side.
6. In the case of RS-485, attach a terminal resistor to both ends of the transmission line.

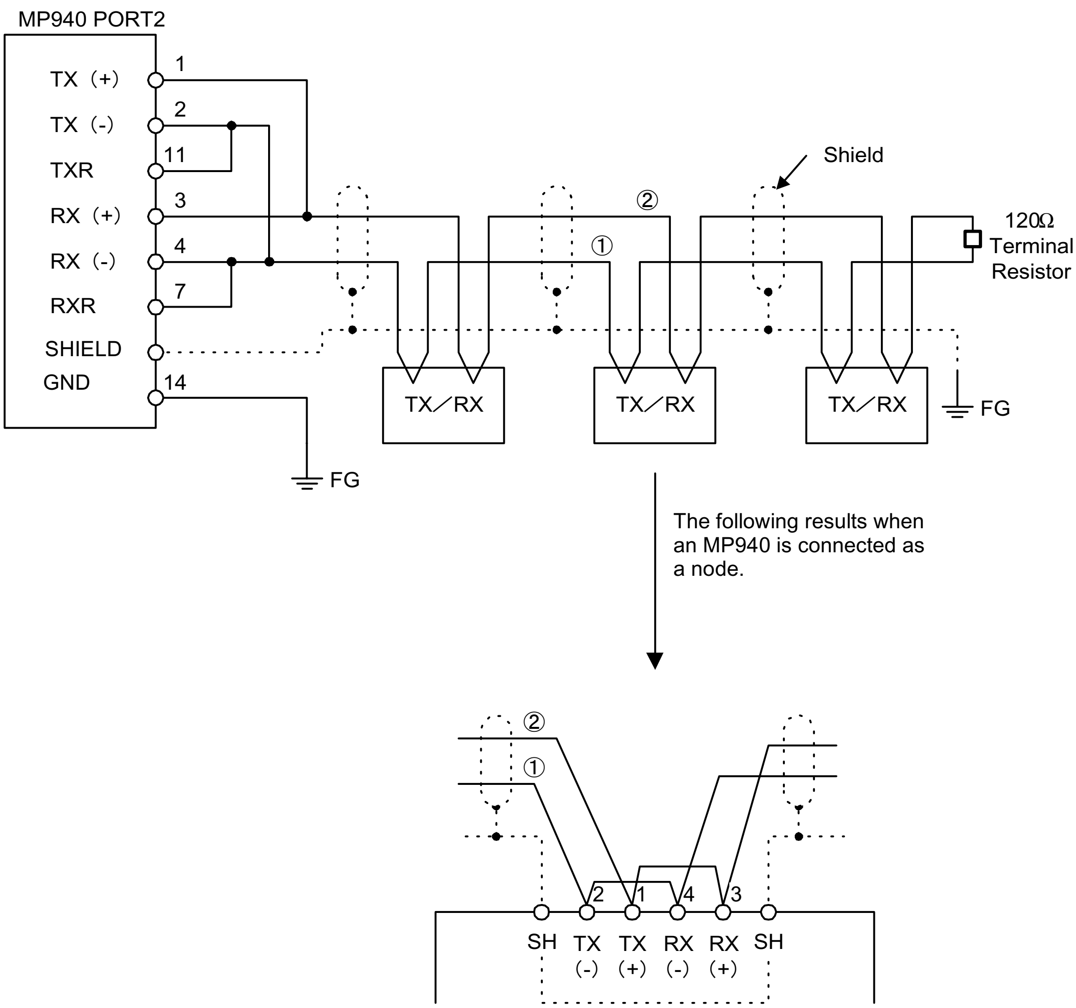
■ RS422 Wiring





■ RS-485 Wiring





Enable the terminal resistor in the MP940 Port2 by connecting pin 2 to pin 11 and pin 4 to pin 7.

Time Needed for Transmission

The types and content of the time needed for signal transmission between master and slave using the Memobus protocol as an example are described below.

■ Outline

The time needed for signal transmission between master and slave in a Memobus system can be calculated.

- Transmission processing time for command messages by the master
- Modem delay time on master side
- Command message transmission time
- Slave processing time
- Modem delay time on slave side
- Response message transmission time
- Transmission processing time for response messages by the master

For total time needed when a number of slaves are connected to the same master port, calculate the time needed for each slave, and use the sum thereof.

■ Scale of time needed by external units

Each of these times is described in detail below.

■ Transmission processing time for command messages by the master

- Time until the PC sends the command message into the Memobus port.
- This time depends on each of the master processing times. (This is normally 1 scan, and depends on the machine controller scan time.)

■ Modem Delay Time on Master Side

- This is the time which transpires between the receipt of a Request Transmission Signal (RTS) by the modem, and the Confirm Transmission Signal (CTS) return to the master.
- This can be ignored if a Yaskawa modem is used, because this time is 5ms or less. This delay time does not exist if no modem is used.

- Command Message Transmission Time

  - This is the time for transmitting a command message from the master communication port.
  - This time depends on the command message length and baud rate, and can be calculated by the following formula.

$$\text{Transmission Time} = \frac{\text{No. of Command Message Characters} \times \text{No. of bits per character} \times 1000}{\text{Baud Rate}} \text{ (ms)}$$

  - Use the following additions to the data bit number (8 or 7) as bit numbers corresponding to single characters: status bit (1), step bit (1 or 2), parity bit (1 or 0).

- Slave Processing Time

  - This is the time which transpires between the receipt of a command message by the slave, through process execution, to preparation of a return message through the Memobus port.
  - This time relates to the machine controller scan time as well as the number of coils and registers designated during command messaging, in addition to the number of processes in each machine controller scan.
  - This time is a single scan time, as all functions are executed in a single scan.

- Modem Delay Time on Slave Side

  - This is the time which transpires between the receipt of a Request Transmission Signal (RTS) by the modem on the slave side, and the return of a Confirm Transmission Signal (CTS).
  - This can be ignored in the case of a Yaskawa modem, because this time is 5ms or less.
  - This delay does not exist if no modem is used.

- Response Message Transmission Time

  - This is the time in which a response message is transmitted from a slave communication port. Just as in command messaging, it is possible to calculate this by the following formula.

$$\text{Transmission Time} = \frac{\text{No. of Response Message Characters} \times \text{No. of bits per character} \times 1000}{\text{Baud Rate}} \text{ (ms)}$$

  - Use the following additions to the data bit number (8 or 7) as bit numbers corresponding to single characters: status bit (1), step bit (1 or 2), parity bit (1 or 0).

■ Transmission Processing Time for Response Messages by the Master

- This is the time needed to execute processing after a response message from a slave has been received by a master, such as a computer.
- This time depends on each of the master processing times.
- This is normally 1 ~ 2 scans, and depends on the machine controller scan time.

Serial Transmission Protocol

The MP940 module starts with the Yasakawa standard Memobus transmission protocol, and is compatible with a variety of transmission protocols.

We have prepared standard functions for the Melsec communication protocol for connection with controllers made by Mitsubishi Electric, Inc.

■ Memobus Communication

Memobus communication is a form of message transmission that obeys the Memobus protocol. A table is given below of the commands and registers which correspond to Memobus.

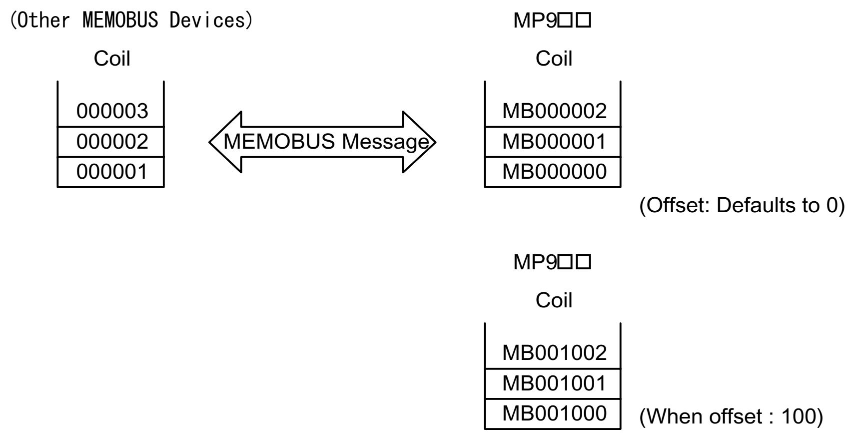
Type	Memobus Reference Number *1	Memobus Command *2	MP940	
			Start Number *3	Register Number *4
Coil	000001 - 0XXXXX	01H, 05H, 0FH	000000-	MB000000-
Input Relay	100001 - 1XXXXX	02H	00000-	IB00000-
Input Register	300001 - 3XXXXX	04H	00000-	IW0000-
Storage Register7	400001 - 4XXXXX	05H	00000-	MW00000-

*1 Memobus reference number
This assigns a start number range for coils, input relays, input registers, and storage registers. The start number is used in Yaskawa standard Memobus protocol messaging.

*2. Memobus command
This is the command identification number set in the Memobus protocol.

*3. Start Number
Start numbers used in MP940 start from zero (0) in any event.

*4. Register Number
This is a register number corresponding to the start number. This register number can designate offsets in coils, input relays, input registers, storage registers, as well as the MSG-SND and MSG-RCV of system functions. For example, in the case of a Yaskawa GL:

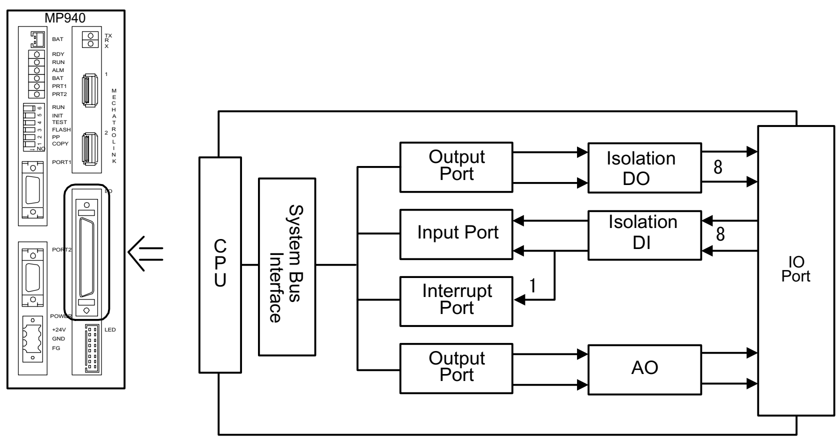


LI/O Function

The Counter (CNTR) functions of the MP940 are explained below.

Outline of LI/O Definition

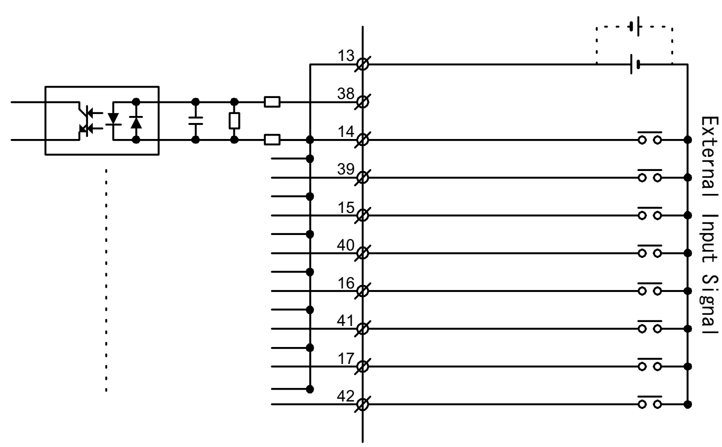
The LI/O module is equipped with eight digital inputs (DI), eight digital outputs (DO), and one analog output channel (AO). The I/O is updated at each MP940 system (S) high speed/low speed scan.



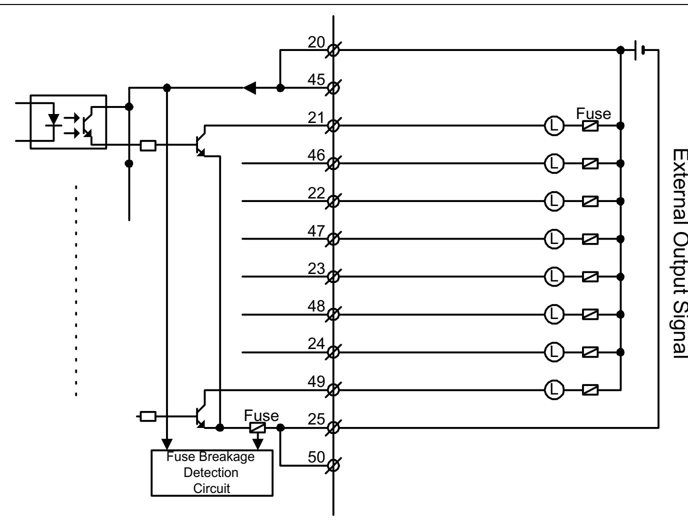
Local Digital I/O Specifications

The hardware specifications of the local digital I/O are as shown below.

■ Digital Input Circuit

Item	Specifications
Number of Input Points	8/Global
Input Format	Combined sink/source
Input Type	Type 1 (JIS-B3501)
Insulation Type	Photocoupler Insulation
Applied Voltage	$17.4V_{DC}/28.8V_{DC}$ $35V_{DC}$ (at peak)
Rated Current	5.3mA
Input Impedance	approximately 4.4kΩ
Operation Voltage	ON Voltage: DC15V_{DC} or higher OFF Voltage: $5V_{DC}$ or lower
OFF Current	0.9mA or less
Response Time	OFF→ON: 0.5ms or less ON→OFF: 1.5ms or less
Digital Input Circuit	
Register Number	Can be set in the IW0000 (default) module configuration definition screen. IB00000 can set the use/non-use of an interrupt input.

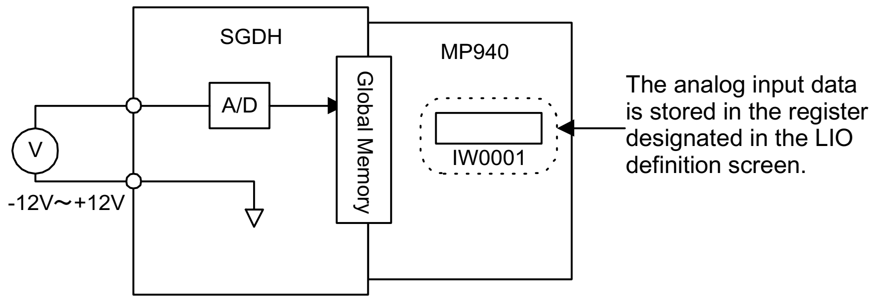
■ Digital Output Circuit

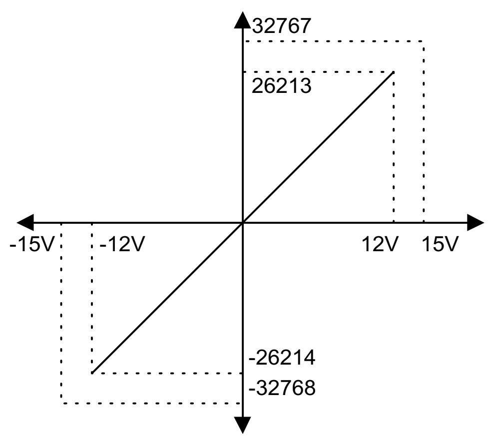
Item	Specifications
Number of Output Points	8/Global
Output Form	Sinking Output
Output Classification	Transistor Output
Insulation Type	Photocoupler Insulation
Load Voltage	$19.2V_{DC}$ ~ $28.8V_{DC}$ $35V_{DC}$ (at peak)
Load Current	0.1A/Circuit,0.8A/Common
ON Voltage	1.0V or less
External Common Power	$24V_{DC}$ ±20% 15mA
Output Protection	1 fuse in the common input
Fuse Rating	1.5A (Fusing Time: 5s or less at 3A)
Response Time	OFF→ON 0.25ms or less ON→OFF 1.0ms or less
Digital Output Circuit	
Register Number	OW0000 (default) Setting is possible in the module confutation definition screen.

* See the LIO function. DO-07 becomes the coincidence output when the CNTR fixed parameter is set to the Conformance Detection Function Use Selection.
A fuse is included on the common output line of the MP940 module as a protection circuit. However, there is a risk of the fuse not breaking if the output layer shorts.

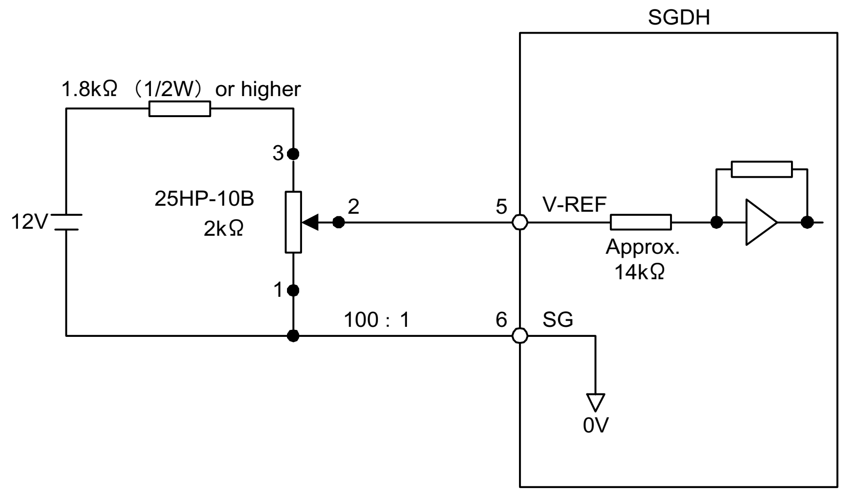
■ Analog Input

The analog input uses the SGDH analog input circuit. The input data is stored in a register designated in the definition screen via the port 2 RAM.



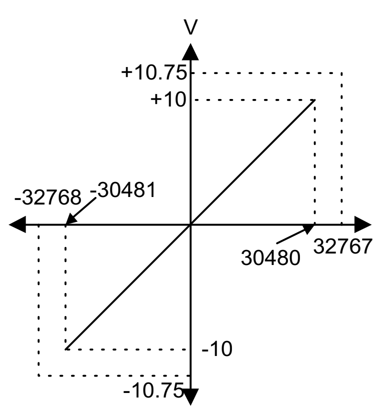
<table>
<tr><th>Item</th><th>Content</th></tr>
<tr><td>Input Voltage</td><td>12V Maximum</td></tr>
<tr><td>Input Impedance</td><td>Approximately 14kΩ</td></tr>
<tr><td>Resolution</td><td>

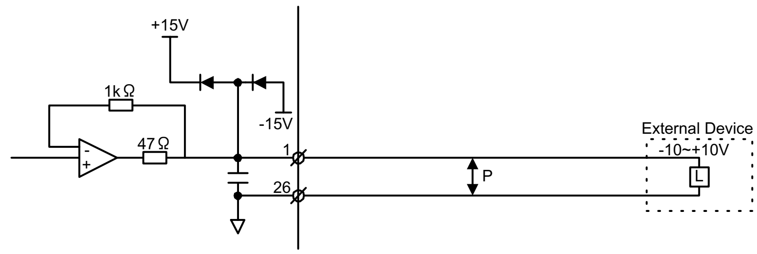
V Data = Output RegisterData ×10.75/32767
Output Register Data = V Data ×32767/10.75</td></tr>
</table>

Item	Content
Analog Input Circuit	
Register Number	IW0001 (default) Setting is possible in the Module Configuration Definition Screen.

* The linearity of the analog input is guaranteed only within the range of +/-12.0V.

■ Analog Output

Item	Content
D/A Output Resolution	+15 Bit 0-±10.5V 16Bit over a +/-10V range, or 328mV
Resolution	 V Data = Output RegisterData ×10.75/32767 Output Register Data = V Data ×32767/10.75

Item	Content
Analog Output Circuit	
Register No.	OW0001 (default) Setting is possible in the Module Configuration Definition Screen.

* The linearity of the analog output is guaranteed only within the range of +/-10.0V.

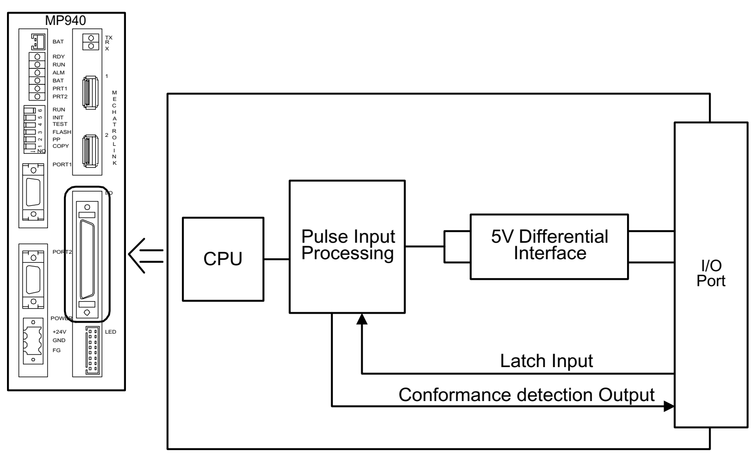
CNTR Function

The counter (CNTR) functions of the MP940 are explained below.

Outline of CNTR Function

The MP940 counter function employs one pulse input (PI). The pulse can integrate a 5V differential interface.

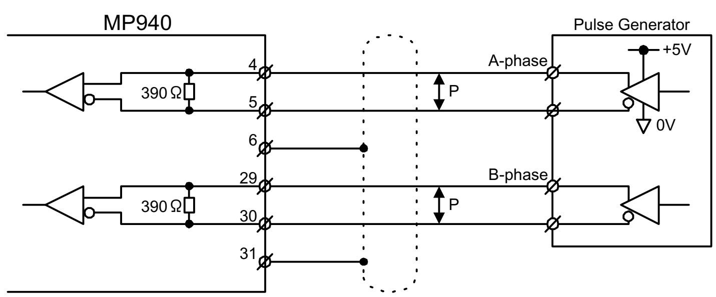
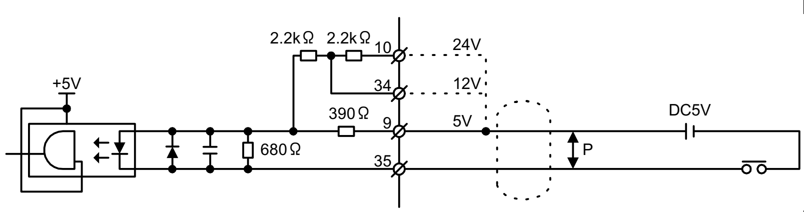
Counter values can be latched onto at latch signal generation because there is a latch input signal. Furthermore, output can be made to external devices in tandem with CPU recognition if the internal setting values coincide to the counter calculation values because there is a coincidence detection signal output function.



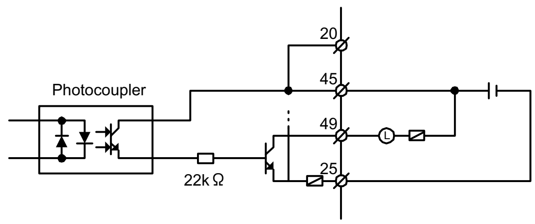
External Encoder Specifications

The hardware specifications of the external encoder hardware are as shown below.

Hardware Specifications

	Item	Content	Reference
Pulse Input	Number of I/O Circuits	1	—
	Input Format	A/B Format (1/2/4 multiples) UP/DOWN Format (1/2/4 multiples) Notation Format (1/2 multiples)	Soft Switching
	Counter Function	Reversible Counter	Fixed
	Response Frequency	1MHz	—
	Pulse Input Circuit		—
Latch Input	Number of I/O Circuits	1	—
	Input Type	Current Source Photocoupler Insulation	—
	Input Voltage	Can be switched between 24VDC: 12VDC: 5VDC	—
	Input Current	—	—
	Latch Circuit		—

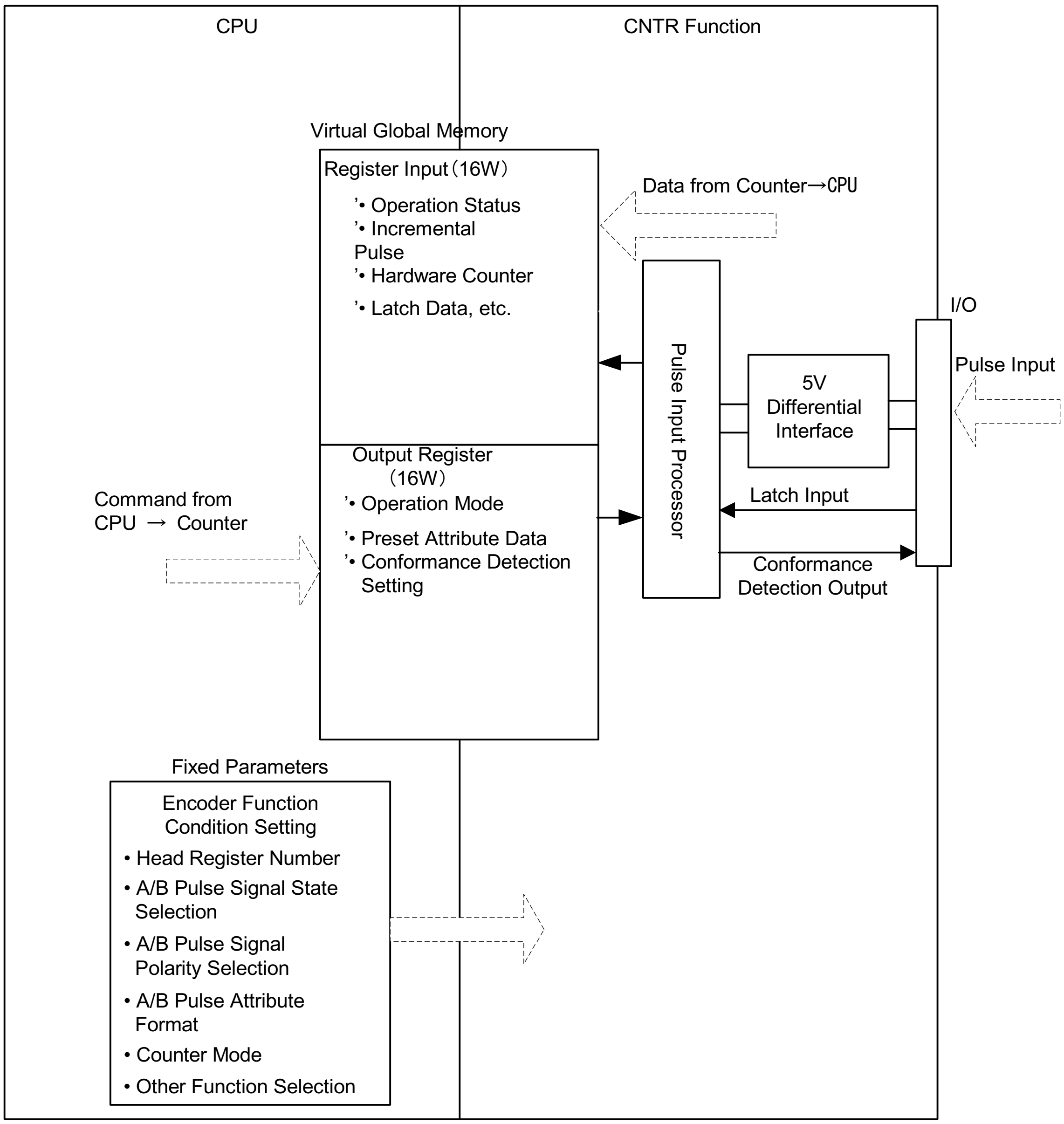
Hardware Specifications (Continued)

	Item	Content	Reference
Conformance Output	Number of Output Circuits	1 point (Uses the digital output at DO-07).	—
	Output Form	Sinking Output Photocoupler Insulation	—
	Rated Voltage/ Current	DC24V/100mA	—
	General Output Circuit	See the LIO function specifications. DO-07 becomes the coincidence output when the CNTR fixed parameter uses Conformance Detection Function Use Selection. 	—

Structure of the External Encoder Function

The counter function executes functions selected according to the fixed parameters and output registers, and messages the status and counter to the input register.

The data flow of the counter function is shown in the figure below.



Pulse Calculation Format

The following formats can be selected by setting fixed parameter 5 (Pulse Calculation Method).

Table 1: Pulse Calculation Format Type

Measurement Type	Pulse Calculation Format *1	Multiple *2	Note
Reversible Counter	Sign Format	×1	—
		×2	
	A/B format	×1	
		×2	
		×4	
	UP/DOWN format	×1	
		×2	

■ Pulse calculation format

A pulse

B pulse

- Sign Format

  Positive logic 5V during differential input
  UP count in A pulse input when B pulse input is LOW. DOWN count in A pulse input when B pulse input is HIGH.

  Negative logic 5V during differential input
  DOWN count in B pulse input when A pulse input is HIGH. UP count in B pulse input when A pulse input is LOW.

- A/B format

  Positive Logic/Negative Logic
  UP count by the A pulse input phase delay according to the B pulse input. DOWN count by the A pulse input phase progress according to the B pulse input.

- UP/DOWN format

  Positive Logic/Negative Logic
  The pulse input is the addition pulse. The B pulse input is the subtraction pulse.

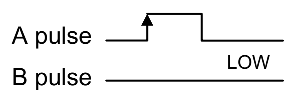
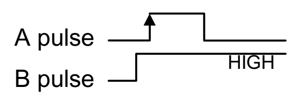
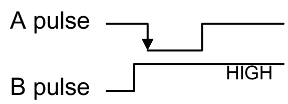
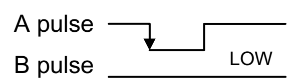
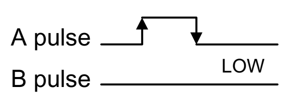
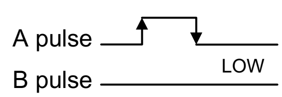
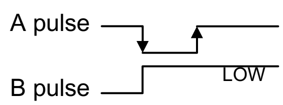
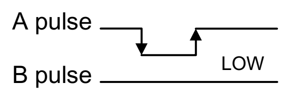
■ Signal Calculation Format

(Positive Logic)
×1 : Calculation at A pulse rise
×2 : Calculation at A pulse rise and fall
×4 : Calculation at A and B pulse rise and fall

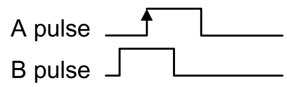
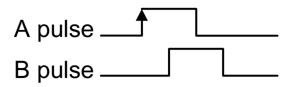
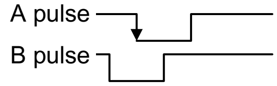
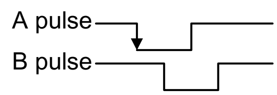
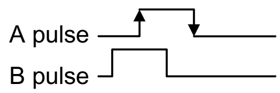
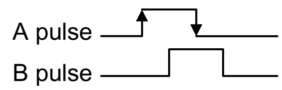
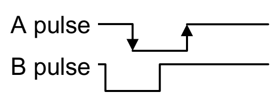
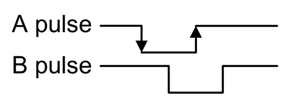
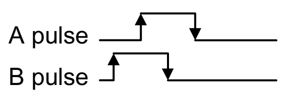
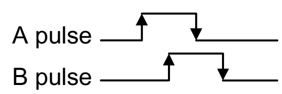
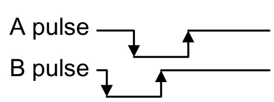
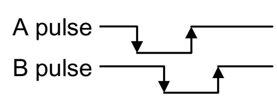
(Negative Logic)
~1 : Calculation at A pulse fall
~2 : Calculation at A pulse fall and rise
~4 : Calculation at A and B pulse fall and rise

The external input pulse timing is shown below.

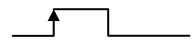
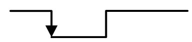
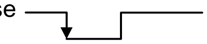
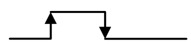
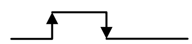
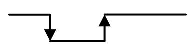
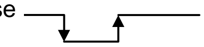
External Pulse Timing

Pulse Calculation Format		Polarity	UP Count (Fwd)	DOWN Count (Rev.)
Sign Format (5V during differential input)	×1	Positive Logic		
		Negative Logic		
	×2	Positive Logic		
		Negative Logic		

External Pulse Timing (Continued)

Pulse Calculation Format		Polarity	UP Count (Fwd)	DOWN Count (Rev.)
A/B Format	×1	Positive Logic		
		Negative Logic		
	×2	Positive Logic		
		Negative Logic		
	×4	Positive Logic		
		Negative Logic		

External Pulse Timing (Continued)

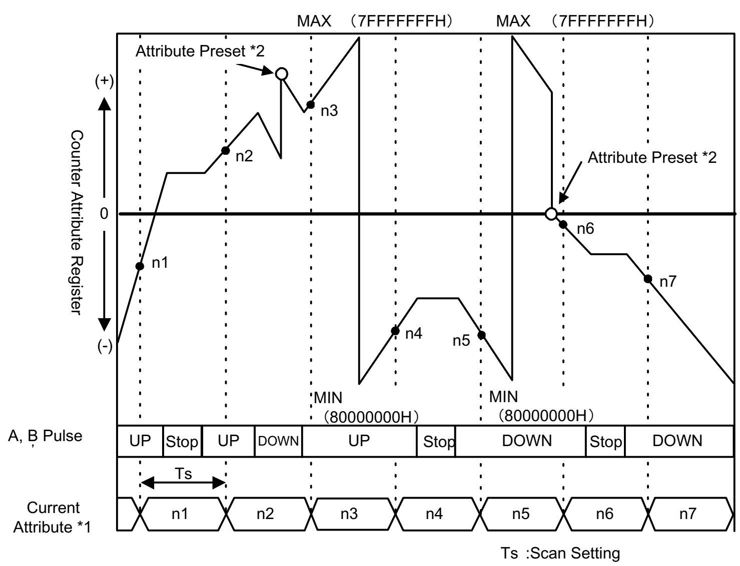
Pulse Calculation Format		Polarity	UP Count (Fwd)	DOWN Count (Rev.)
UP/DOWN Format	×1	Positive Logic	A pulse  B pulse	A pulse B pulse 
		Negative Logic	A pulse  B pulse	A pulse B pulse 
	×2	Positive Logic	A pulse  B pulse	A pulse B pulse 
		Negative Logic	A pulse  B pulse	A pulse B pulse 

Reversible Counter Mode

This is the mode in which UP or DOWN counts are executed according to the A/B pulse input.

The following functions are possible by output register designation in the reversable counter mode.

- Attribute Prohibition :
  Prohibits counter attributes.
- Attribute Presetting :
  Forcibly changes the counter values.
- PI Latch Detection :
  Places the counter value in memory when an external signal is input.
- Conformance Detection :
  Outputs an external output signal when the output register conformance detection setting value and the current counter value coincide.



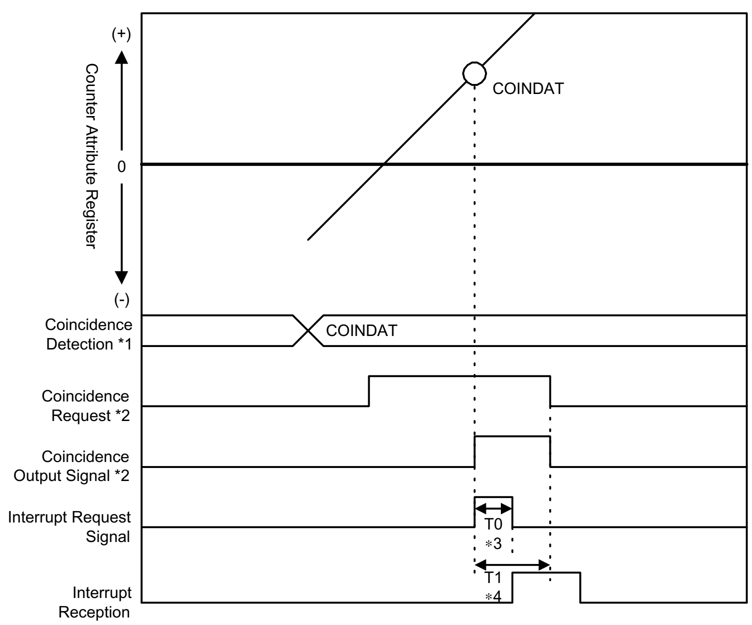
*1. Current Attribute Value = Hardware Counter (ILxxxx+4)
*2. Attribute Pre-setting = Attribute Pre-setting Data (OLxxxx+2)

Conformance Output/Interrupt Function

The coincidence output/interrupt function outputs an external output signal (coincidence detection signal) when the preset output register (coincidence detection signal : OL0006) and the current counter value coincide, and outputs a CPU interrupt signal.

The coincidence output function selection is enabled when fixed parameter 6 "Conformanace Detection Function Use Selection" is set to "Use".

The coincidence interrupt function selection is further enabled when fixed parameter 7 (conformance interrupt detection function use selection) is set to "Use".



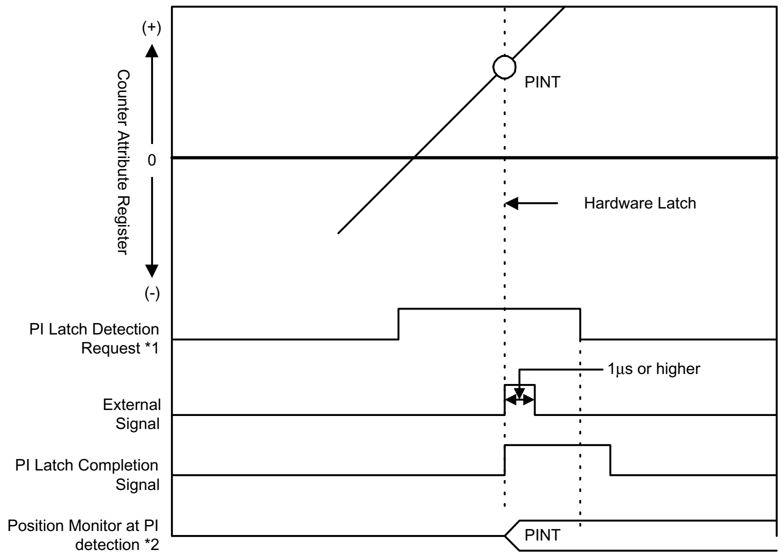
*1. Coincidence Detection Value = Conformance Detection Setting (OL0004).
*2. Coincidence Detection Request = Operation Mode (OW0002 Bit 3).
*3. T0: Maximum time from when the CPU module receives an INT signal until interrupt processing starts (70 ~ 120ms).
*4. T1: Time from when an interrupt request signal is received until DWG.I (interrupt drawing) execution starts.

During Normal Program Execution	Approximately 90 ~ 170ms
During Direct I/O Command Execution	Approximately 90 ~ (1460 + 40 + N)ms
N	Number of Direct I/O Words (maximum 8)

PI Latch Function

The PI latch function records (latches onto) the current position at the moment an external signal is input (rising edge).

This selects a dedicated discrete input (PI input) as an external signal.



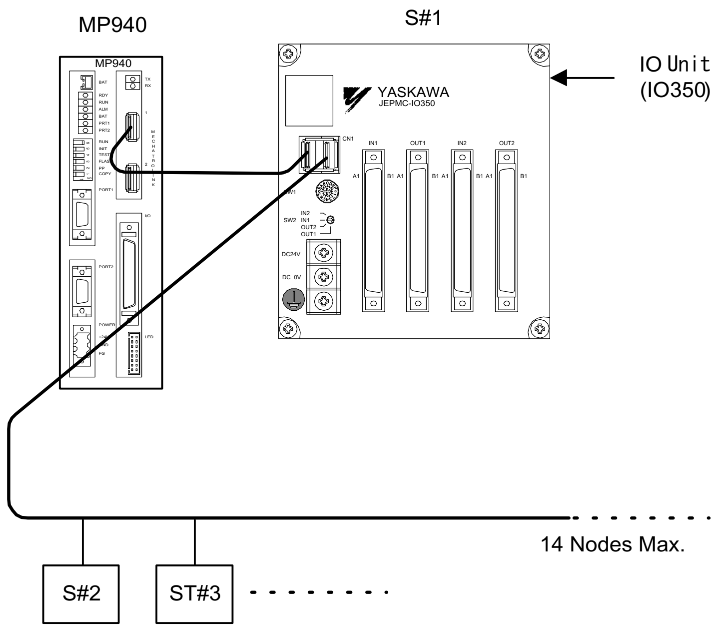
*1. PI Latch Detection request = Operation Mode (OW0002 Bit 2).
*2. Position Monitor at PI Detection = PI Latch Data (IL0008).

Mechatrolink Function

This section describes the MP940 high-speed field network communication function, Mechatrolink.

Outline of Mechatrolink

An example of a network-compatible I/O module connected to an MP940 machine controller by high-speed field network commmunication (Mechatrolink) is shown below as a schematic drawing.



Mechatrolink Connection Example

This figure is an example of connecting a Mechatrolink I/O device from a remote I/O module (S#2) to station 1 (S#1).

Mechatrolink Specifications

■ Mechatrolink Communication Specifications

The Mechatrolink communication specifications in MP940 are shown below.

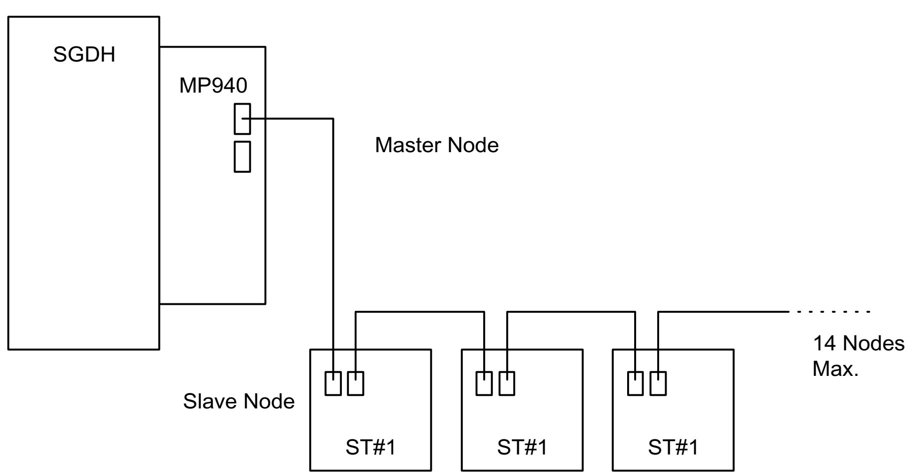
Number	Item	Specification
1	Transmission Path Status	Bus Type
2	Transmission Path	Electrical Bus
3	Baud Rate	4Mbps
4	Communication Period	1ms/2ms/4ms
5	Number of Nodes Connected	14
6	Transmission Control Format	Cyclic
7	Data Conversion	1:N
8	Transmission Mode	Control transmission
9	Error Control	CRC check, number of expressions check, timer

Master/Slave

The MP940 can be selected for use as a master or slave node. An axample is given below of master/slave connection.

■ When the MP940 is used as a master

Connection Example



■ Connectable Slave Functions

The slave functions that can be connected to an MP940 selected by a master are shown in the table below.

Device Name	TYPE	SIZE (Word)	SCAN
CP-816 remote I/O (RIO-01)	RIO-01	1	L/H
MP940	MP940	8	L/H
Absolute Encoder	ABS-CODER	4	L/H
MP930 I/O Unit	JEPMC-IO3008	4	L/H

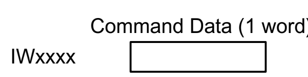
Note SCAN is set in the Mechatrolink definition parameter setting window.

This function is used only as a simple I/O supported by the MP940 Mechatrolink. Mechatrolink servos and 216IF inverters cannot be connected.

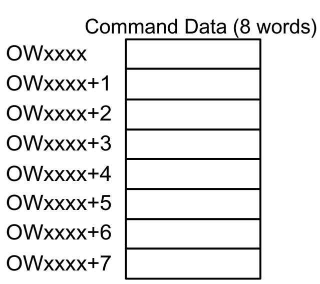
■ Control Data Structure

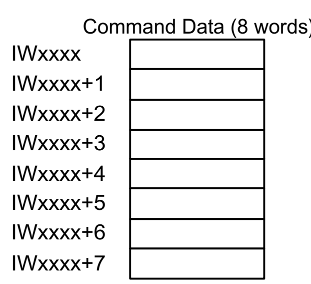
The data structure used in data transmission with each of the slave nodes is shown below:

1. RIO-01



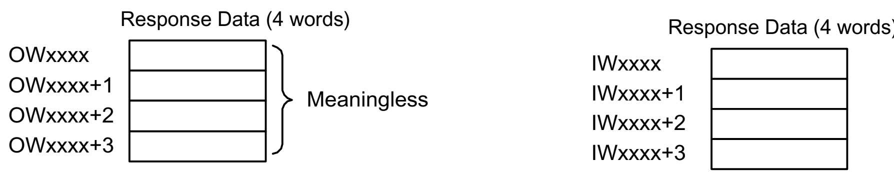
2. MP940





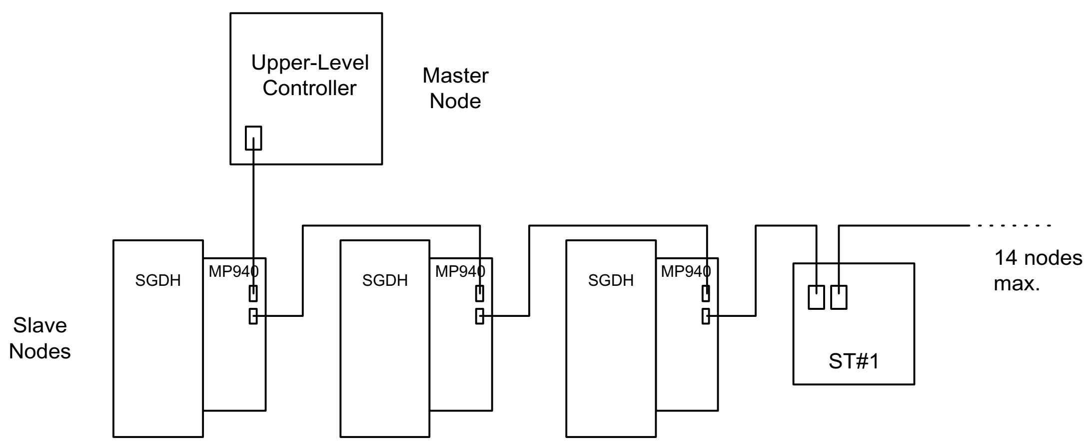
3. MP930I/O Unit (IO350)

4. Absolute Encoder



■ When the MP940 is used as a slave node:

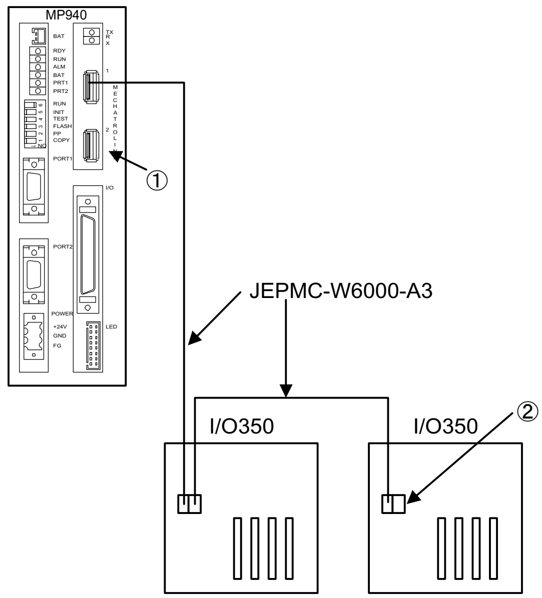
Connection Example



The MP940 cannot connect to the IO350 or distributed I/O if a slave node is selected.

Mechatrolink Connection

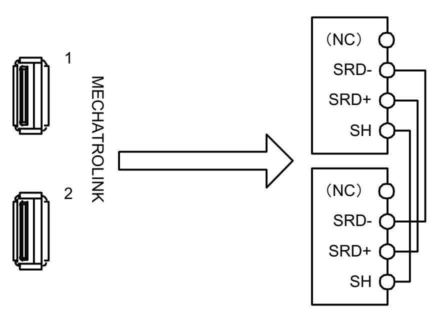
The following shows the conneciton of the MP940 module to an IO350 unit. Use the standard cable (JEPMC-W6000-A3) when connecting an MP940 module to an IO350, or when connecting an IO350 to another IO350.



Be sure to insert the USB terminator (JEPMC-W6020) into the terminal connector ((1) or (2) in the figure above). See the item on cables for external appearances and internal connection.

The Mechatrolink conectors 1 and 2 are the same. The terminator may be inserted into either one.

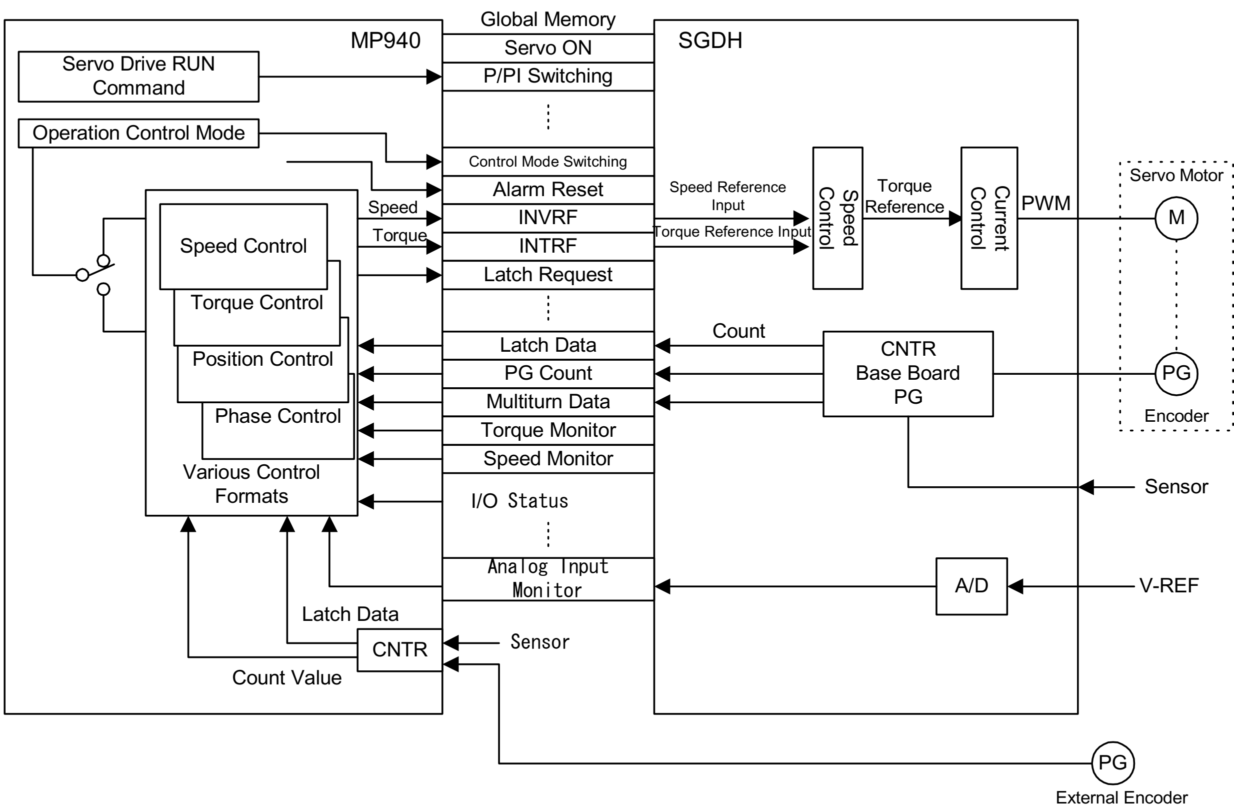
Insert a USB terminator (JEPMC-W6020) into unused ports.



There is only one channel per Mechatrolink port in the MP940 module. As shown in the figure above, the top and bottom of the connector are the same even though it has two receptacles.

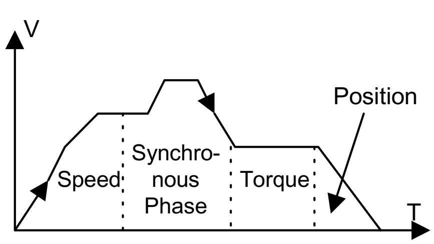
MP940 Servo Control Function

The MP940 and SGDH servo amplifier is a unified servo motion controller connected with a global memory. Commands to the servo amplifier such as Servo ON, control mode switching, speed reference, torque control, etc., are direcly commanded to the SGDH via the global memory, thereby executing motion control.



The MP940 has the following servo control functions enabling hi-speed and high-precision control.

1. Position, speed, torque, and phase control switching are possible during operation.

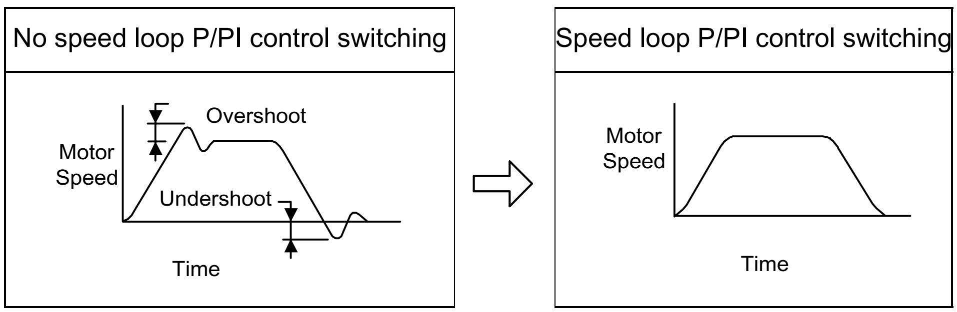


Operation mode switching is executed according to the motion setting parameter Operation Mode Setting (OWC000 Bit0 ~ Bit4).

2. P/PI switching of the servo amplifier (SGDH) speed loop is possible during operation.

A usage example is given below.

- To Suppress Overshoot During Acceleration
- To suppress Undershoot and Shorten Settling Time



Speed loop P/PI switching is executed according to the motion setup parameter RUN Command (OBC0011).

3. Parameter change is possible during operation.

The following parameters can still be changed during operation by the ladder or motion program.

Changeable Parameters

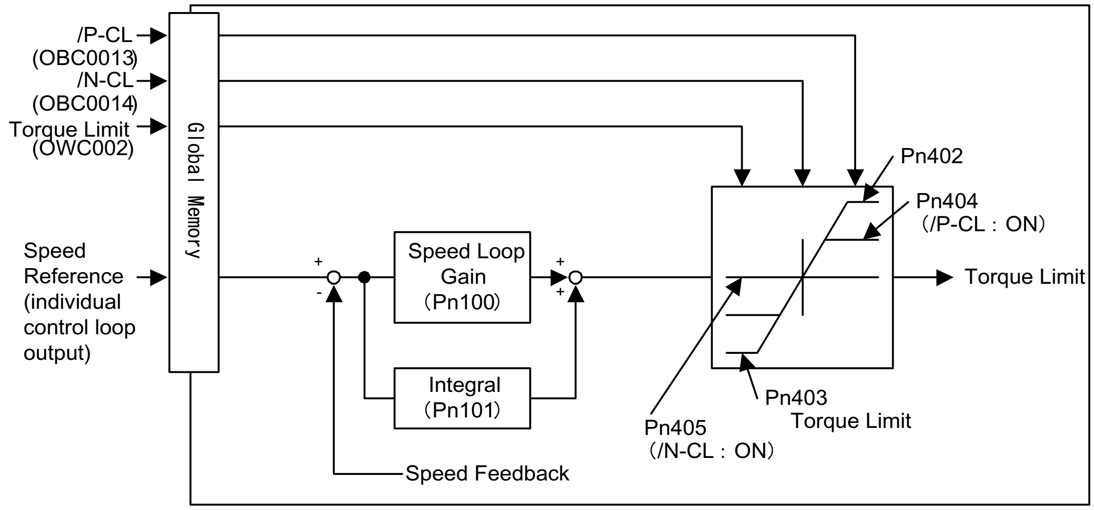
Parameter Type	Change Method
Target Position	Still changeable by the motion setting parameter position reference setting (OLC012)
Speed	Still changeable by the motion setting parameters speed reference setting (OWC015) and speed reference setting (OWC022).
Accel/Decel Time Constant	Still changeable by the motion setting parameters linear acceleration time constant (OWC00C) and linear deceleration time constant (OWC00D).
Position Loop Gain	Still changeable by the motion setting parameter position loop gain (OWC010).
Feed Forward Gain	Still changeable by the motion setting parameter feed forward gain (OWC010).

Changeable Parameters (Continued)

Speed Loop Gain	Set the following user parameters for SGDH beforehand. Pn100: Speed Loop Gain Pn101: Speed Loop Integral Time Constant Pn104: 2nd Speed Loop Gain Pn105: 2nd Speed Loop Integral Time Constant This is switched by Gain Switching (OWC001) of the motion setup parameter Servo RUN Command (OBC0012). Note: Change SGDH user parameters Pn100, Pn101, Pn104, Pn105 by command communication with the SGDH.
Speed Loop Integration Time Constant	—
Position Loop Integration Time Constant	Still changeable by the motion setting parameter Position Control Integral Time Constant (OWC035).
Soft Start Acceleration Time Constant	Change the SGDH user parameters Pn305 Soft Start Acceleration Time Constant and Pn305 Soft Start Deceleration Time Constant with SGDH command communication.
Soft Start Deceleration Time Constant	—
Positive Torque Limit	There are two types of torque limit switching. Method with Control by Torque Limit Command from MP940 Set the limit using the emotion setting parameter Forward Torque Limit Setting (OWC002). Method Using the SGDH User Parameters Changes the user parameters through SGDH command communication. Pn402: Forward Torque Limit Pn403: External Input Forward Torque Limit Pn405: Reverse Torque Limit Pn406: External Input Reverse Torque Limit Perform Forward/Reverse switching with Forward External Torque Limit Input (OBC0013) and Reverse External Torque Limit Input (OBC0014) of the motion set-up parameter Servo Drive RUN Command (OWC001).
Reverse Torque Limit	—

4. Designating a Desired Torque.

Torque limit control is possible according to the motion parameter setting during speed reference, position control, and phase control.



5. The monitor data of the servo amplifier (SGDH) can be referenced at high speed. The following parameters can be referenced from the ladder or motion program.

Ladder/Motion Program Referenced Parameters

Monitor Data	Reference Method
Feedback Position	Motion Monitor Parameter Machine Coordinate Feedback Position (ILC008).
Position Deviation	Motion Monitor Parameter Position Offset (ILC00A)
Command Position	Motion Monitor Parameter Machine Coordinate Command Position (ILC002)
Reference Speed	Motion Monitor Parameter Speed Reference Output Monitor (IWLC00C).
Motor Speed	Motion Monitor Parameter Speed Monitor (IWLC00D).
External Encoder Count	CNTR I/O Data Setting Current Hardware Value (IL0004) Current Counter Value (IL0010)

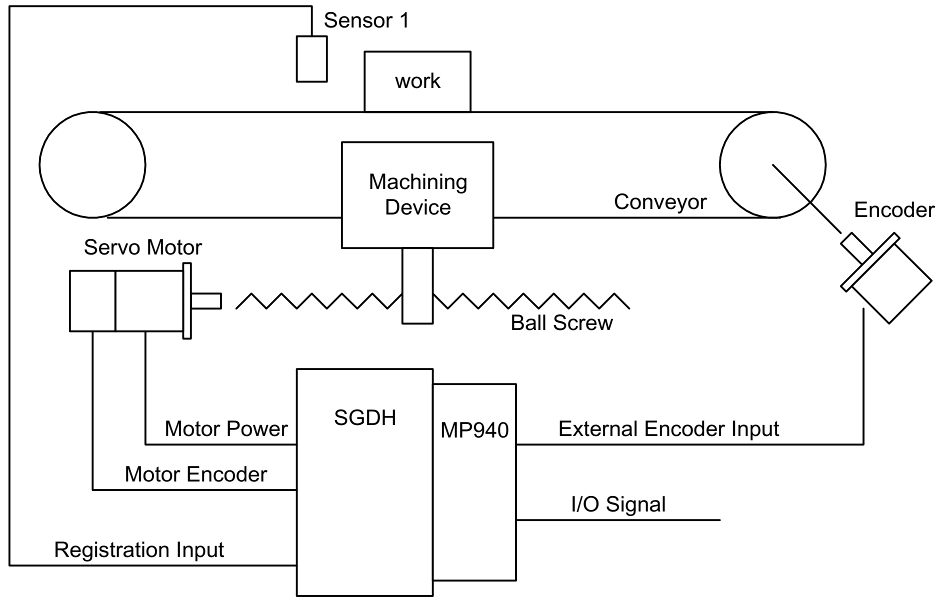
Ladder/Motion Program Referenced Parameters (Continued)

Monitor Data	Reference Method
Servo Amplifier Status	The following signals can be referenced with the motion monitor parameter Servo Drive Status (IWC001). Bit0: ALM: Servo Alarm Bit1: WARN: Warning Bit2:V-CMP: Speed Conformance Bit3: TGON: Motor Rotation Detection Bit4: S-RDY Servo Ready Bit5: CLT: Torque Limit Detection Bit6: VLT: Speed Limit Detection Bit7: BK Brake Interlock Bit8: SVON: Servo ON Completion Bit9: PON:Main Circuit Completion
Servo Amplifier I/O Status	The following signals can be referenced with the motion monitor parameter Servo Drive I/O Status (IWC025). Bit0: SIO: General-purpose Input Signal Bit1: DEC:Deceleration LS Signal Bit2: P-OT: Forward OT Signal Bit3: N-OT: Reverse OT Signal Bit4: EXT1: External Input Signal 1 Bit5: EXT1: External Input Signal 2 Bit6: EXT1: External Input Signal 3

6. 1.5 Axis Control by External Encoder Input is Possible

External encoder synchronous control such as conveyor follow-up, arrangers, labelers, etc., is possible using the pulse input of the MP940 CNTR function as an external encoder.

- Application Example: Conveyor Follow-up Machining Device



SGDH User Parameter Setting

Always execute these settings using either the front operator or digital operator prior to connection with the MP940 module. The following SGDH user parameter settings are used, when needed, only in combination with the MP940 module.

Pn004.0 Option Port Selection is automatically set to “1” upon power ON with the MP940 module mounted to the SGDH.

SGDH User Parameter Settings

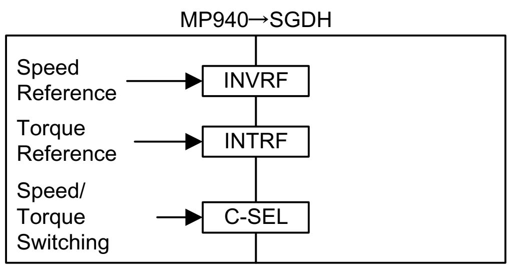
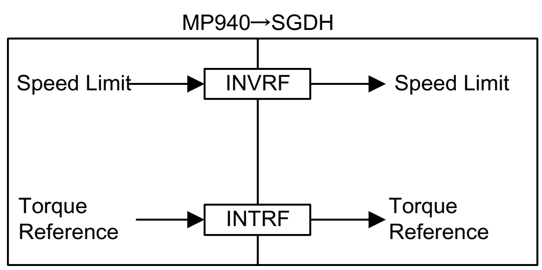
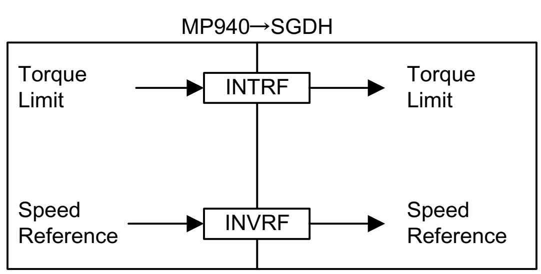
Parameter Number	Name	Setting	Setting Content	Reference
Pn000.1	Control Format	9	Torque Control ¤ Speed Control	—
Pn002.0	Speed Control Option	1	TREF is used as an external torque limit input	—
Pn002.1	Torque Control Option	1	VREF is used as an external speed limit input	—
Pn003.0	Monitor 1	2	Torque Reference Monitor	—
Pn003.1	Monitor 2	0	Motor Speed Monitor	—

SGDH User Parameter Settings (Continued)

Parameter Number	Name	Setting	Setting Content	Reference
Pn004.0	Option Board Selection	1	Option Board-compatible	Automatically set to “1” at power ON
Pn005.0	Brake Control Function Selection	0	Brake Control by Servo	—
Pn50A.0	I/O Assignment Mode	1	Signals may be assigned freely	—
Pn50A.1	/S-ON Signal Mapping	8	Disabled	/S-ON uses the signals on the global memory.
Pn50A.2	/P-CON Signal Mapping	8	Disabled	/P-CON uses the signals on the global memory.
Pn50A.3	/P-OT Signal Mapping	2	Assigned to SI2(CN1-43)	—
Pn50B.0	N-OT Signal Mapping	3	Assigned to SI3(CN1-43)	—
Pn50B.1	/ALM-RST Signal Mapping	8	Disabled	/ALM-RST uses the signals on the global memory.
Pn50B.2	/P-CL Signal Mapping	8	Disabled	/P-CL uses the signals on the global memory.
Pn50B.3	/N-CL Signal Mapping	8	Disabled	/N-CL uses the signals on the global memory.
Pn50C.0	/SPD-D Signal Mapping	8	Disabled	—
Pn50C.1	/SPD-A Signal Mapping	8	Disabled	—
Pn50C.2	/SPD-B Signal Mapping	8	Disabled	—
Pn50C.3	/C-SEL Signal Mapping	8	Disabled	/C-SEL uses the signals on the global memory.
Pn50D.0	/ZCLAMP Signal Mapping	8	Disabled	/Z-CLAMP uses the signals on the global memory.
Pn50D.1	/INHIBIT Signal Mapping	8	Disabled	—
Pn50D.2	/G-SEL Signal Mapping	8	Disabled	/G-SEL uses the signals on the global memory.
Pn511.0	/DEC Signal Mapping	1	Assigned to SI1(CN1-41)	Enabled in “L”
Pn511.1	/EXT1 Signal Mapping	4	Assigned to SI4(CN1-44)	Enabled in “L”
Pn511.2	/EXT2 Signal Mapping	5	Assigned to SI5(CN1-45)	Enabled in “L”
Pn511.3	/EXT3 Signal Mapping	6	Assigned to SI6(CN1-46)	Enabled in “L”

■ Pn000.1 Pn002 Control Format

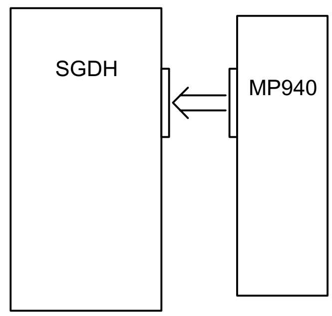
The conditions assumed when using the MP940 in combination are shown in detail below:

User Parameter	Setting	Content	Factory Setting
Pn000.1 Control Format	9	Torque Control⇔Speed Control (analog) It is possible to switch between torque control and speed control. 	0
Pn002.1 Torque Control Option	1	During torque control (when C-SEL = 0) Executes torque control in accordance to the INTRF command. It is possible to apply speed limits with INVRF. 	0
Pn002.0 Speed Control Option	1	During speed control (when C-SEL = 1) Executes speed control in accordance to the INVRF command. It is possible to apply torque limits with INTRF. 	0

■ Pn003.0 Monitor 1/ Pn003.1 Monitor 2

<table>
<tr><th>User Parameter</th><th>Setting</th><th>Content</th><th>Factory Setting</th></tr>
<tr><td>Pn003.0
(Analog Monitor 1)</td><td>2</td><td>Selects the signal for analog monitoring.
A maximum of two signals can be monitored.</td><td>2</td></tr>
<tr><td>Pn003.1
(Analog Monitor 2)</td><td>0</td><td>
<table>
<tr><th></th><th colspan="2">Content</th></tr>
<tr><td></td><td>Monitor Signal</td><td>Observation Gain</td></tr>
<tr><td>0</td><td>Motor Speed</td><td>1V/1000rpm</td></tr>
<tr><td>1</td><td>Speed Reference</td><td>1V/1000rpm</td></tr>
<tr><td>2</td><td>Torque Reference</td><td>1V/100% Rated Torque</td></tr>
<tr><td>3</td><td>Position Deviation</td><td>0.05V/1 Command Unit</td></tr>
<tr><td>4</td><td>Position Devia-tion</td><td>0.05V/100 Command Unit</td></tr>
<tr><td>5</td><td>Command Pulse Fre-quency</td><td>1V/1000rpm</td></tr>
<tr><td>6</td><td>Motor Speed</td><td>1V/250rpm</td></tr>
</table>
Set the following when using in combination with the MP940.
Pn003.0 = 2: Torque Reference (1V/100% Rated Torque)
Pn003.1 = 0: Motor Speed (1V/1000rpm)
The data in monitors 1 and 2 can be referenced with the MP940 monitor parameters.
Torque Reference Monitor = IWC00E
Motor Speed Monitor = IWC00D</td><td>—</td></tr>
</table>

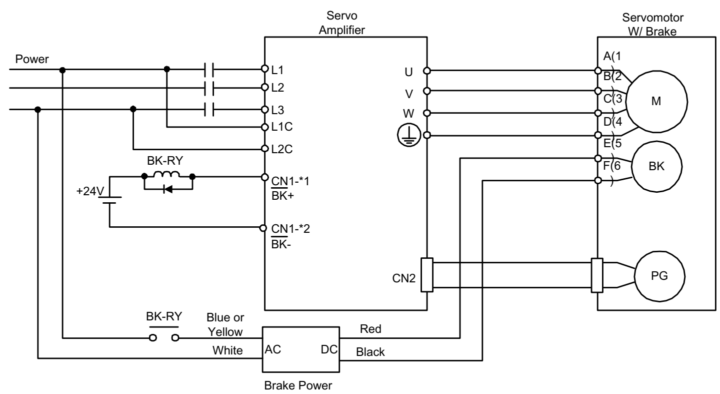
■ Pn004.0 Option Board Selection

User Parameters	Setting	Content	Factory Setting
Pn004.0 Option Board Selection*	1	Option Board-compatible  Set to option board-compatible (SGDH-□□AE). Connect with the MP940 and execute the interface via the global memory.	0

* These user parameters are automatically set after connecting the MP940 to CN10 in the SGDH.

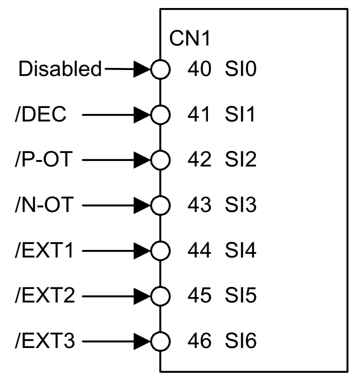
■ Pn005.0 Brake Control

<table>
<tr><th>User Parameters</th><th>Setting</th><th>Content</th><th>Factory Setting</th></tr>
<tr><td>Pn005.0</td><td>0</td><td>Brake Control Selection
Pn005.0 = 0 uses the brake sequence on the servo amplifier side.
The brake ON/OFF circuit is configured using the servo amplifier sequence output signal “/BK” and the “brake power”. A standard connection example is given in the figure below.

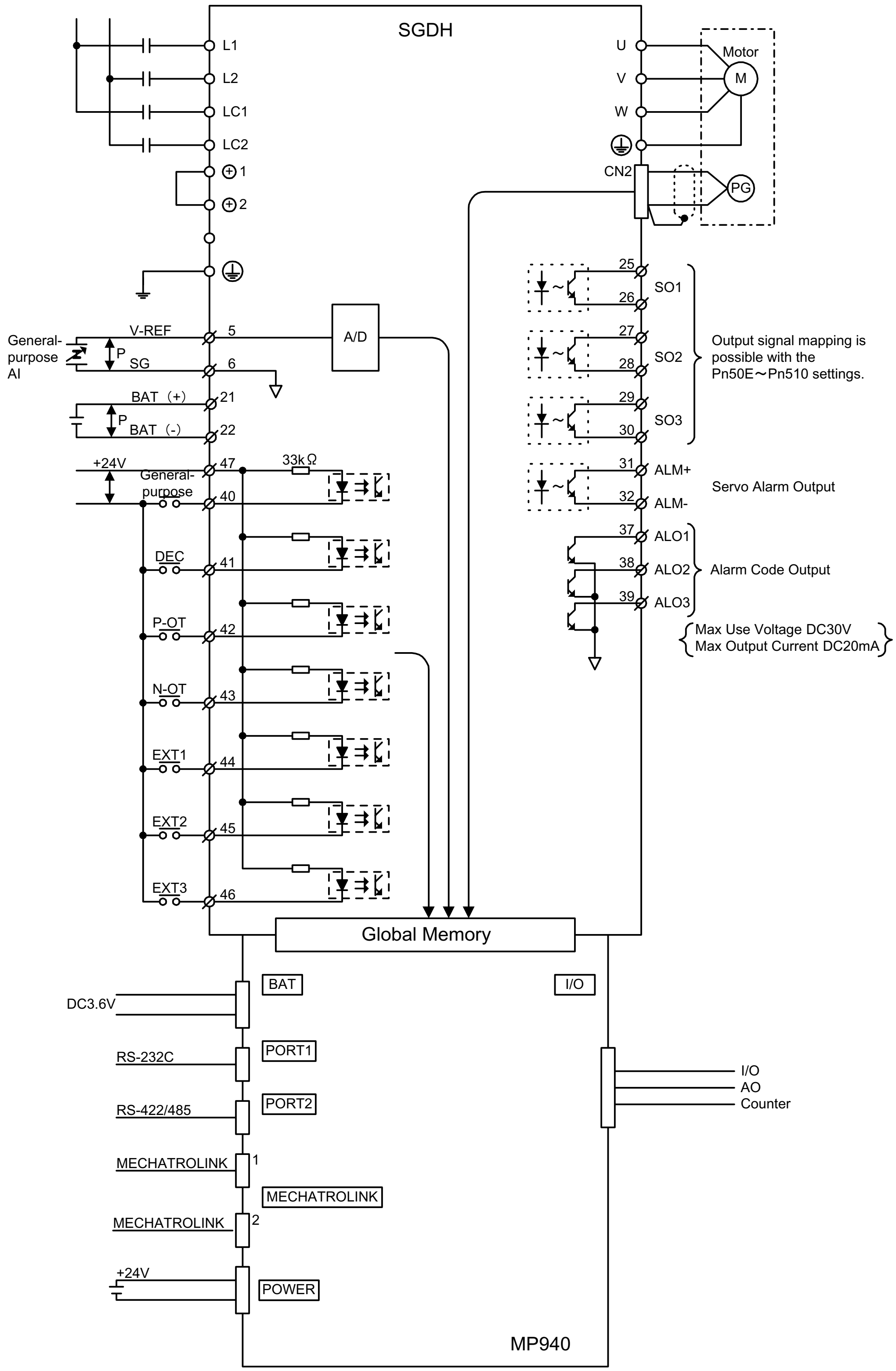


BK-RY : Brake control relay Brake power is either 100 or 200 V
*1,*2 :Output terminal number assigned in user parameter Pn50F.2
Related Parameters
<table>
<tr><td>Pn50F2</td><td>Output Signal Selection 2</td></tr>
<tr><td>Pn506</td><td>Time lag from brake command to servo OFF</td></tr>
<tr><td>Pn507</td><td>Speed level outputting the brake command during motor rotation</td></tr>
<tr><td>Pn508</td><td>Timing outputting the brake command during motor rotation</td></tr>
<tr><td colspan="2">See the chapter on parameters for details.</td></tr>
</table>
</td><td>0</td></tr>
</table>

■ Pn50A.0~Pn50.B, Pn511

<R> User Parameters	Name	Setting	Content	Factory Setting
—	—	—	Set the following sequence input signal circuit assignments when using in connection with the MP940. 	—
Pn50A.0	—	1	The sequence input signal can be set as desired.	0
Pn50A.167	/S-ON Signal Mapping	8	The signal is fixed at “Disabled” /S-ON uses signals on the global memory	0
Pn50A.2	/P-CON Signal Mapping	8	The signal is fixed at “Disabled” /P-ON uses signals on the global memory	1
Pn50A.3	/P-OT Signal Mapping	2	Inputs the P-OT signal from the SI2 (CN1-42) input terminal.	2
Pn50B.0	N-OT Signal Mapping	3	Inputs the P-OT signal from the SI3 (CN1-43) input terminal.	3
Pn50B.1	/ALM-RST Signal Mapping	8	Signal is fixed at “disabled”	4
Pn50B.2	/P-CL Signal Mapping	8	Signal is fixed at “disabled”	5
Pn50B.3	N-CL Signal Mapping	8	Signal is fixed at “disabled”	6
Pn511.0	/DEC Signal Mapping	1	Inputs the /DEC signal from the SI1 (CN1-41) Input terminal.	8
Pn511.1	/EXT 1 Signal Mapping	4	Inputs the /EXT 1 signal from the SI4 (CN1-44) input terminal.	8
Pn511.2	/EXT 2 Signal Mapping	5	Inputs the /EXT 2 signal from the SI5 (CN1-45) input terminal.	8
Pn511.3	/EXT 3 Signal Mapping	6	Inputs the /EXT 3 signal from the SI6 (CN1-46) input terminal.	8

The following I/O specifications result upon executing SGDH user parameter setting when used in combination with the MP940.



Chapter 5: System Start

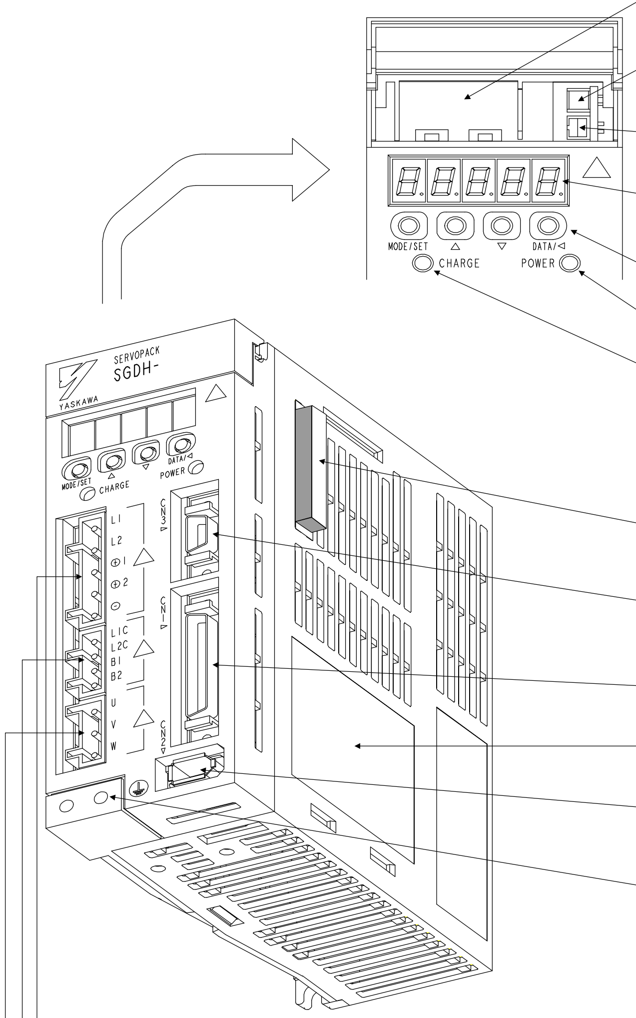
A description follows of the system start-up method for an MP940 used in combination with a servo amplifier.

Handling Each Part

This section describes the handling of each of the parts.

Handling of the Servo Amplifier

The following figure shows the names of the servo amplifier parts.



Battery Holder
This stores the backup battery when an absolute encoder is used.

Analog Monitor Connector (CN5)
This enables monitoring of the motor speed, torque reference, etc., through the use of a dedicated cable.

Battery Connector (CN8)
This connector connects the absolute encoder backup battery.

Panel Display
This 5-digit 7-segment LED is used to display servo status and alarm numbers, as well as during user parameter input.

Panel Switch
Used during user parameter setting.

Power ON Lamp
Lights when braking power is fed.

Charge Lamp
Lights when main power is fed. This lamp remains ON while a charge remains in the main capacitor following power OFF. DO NOT touch the servo amplifier at this time.

Option Unit Connector (CN10)
This connector connects option units for function expansion.

PC Monitor Connector (CN3)
This connector connects a PC monitor connector (CN3) either for PC communication or a digital operator.

I/O Signal Connector (CN1)
This is the connector for command input signals and sequence I/O signals.

Nameplate
The nameplate shows the servo amplifier model and ratings.

Encoder Connector (CN2)
This connector connects with the encoder mounted on the servo motor.

Ground Terminal
This is a grounding terminal for protection against electric shock. ALWAYS be sure to connect this.

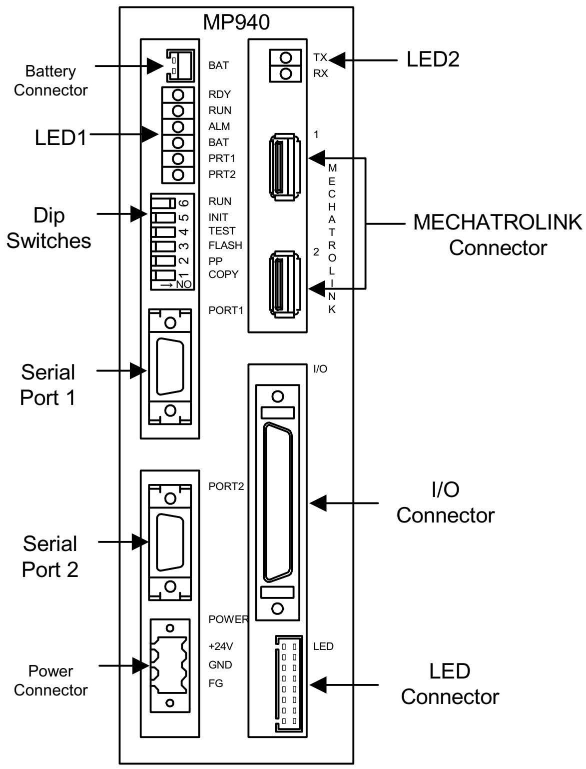
Main Power Terminal
This is the main power input terminal.

Braking Power Terminal
This terminal connects to the prake power or an external regen resistor.

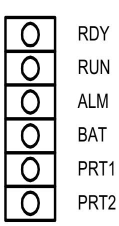
Servo Motor Connection Terminal
This terminal connects to the servo motor power line.

Handling the MP940 Module

An external view of the MP940 module (MC400) is shown below.

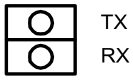


■ LED 1 shows the module status



Name	Display Light Color	Meaning when Lit
RDY	Green	System normal
RUN	Green	Program running
ERR	Red	On/Flashing (or ON) at minor (or major) system fault/error
BAT	Red	On at battery voltage drop
PRT 1	Green	Transmitting to Serial Port 1
PRT 2	Green	Transmitting to Serial Port 2

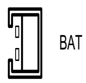
- LED 2 shows the Mechatrolink status.



Name	Display Light Color	Meaning when Lit
RX	Green	Data reception
TX	Green	Data transmission

- The battery connector connects the program memory backup battery.

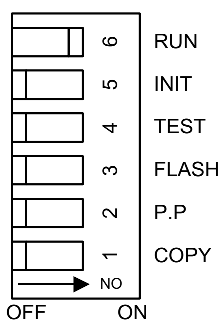
  - Connector Model:DF3-2P-2DS (HIROSE)
  - Battery :ER6VLY+DF3.CONNECTOR



Terminal Name	Function
BAT IN	Battery Input
GND	Ground

- DIP Switches

There are six DIP switches, numbered 1 ~ 6 as shown in the figure below. Each switch is ON when flipped to the right. Each switch setting is enabled at the next timing. The function of each switch is shown in the following table.



Number	Name	Setting	Operation at Setting	Default Setting
6	RUN	ON	User Program Run	ON
		OFF	User Program Stop	
5	INITIAL	ON	When SW4 is ON: Clear Memory	OFF
		OFF	When SW4 is ON: Terminal mode	
4	TEST	ON	Terminal Mode/Initialization Mode	OFF
		OFF	Online	
3	FLASH	ON	Program copy from FLASH to RAM	OFF
		OFF	No program copy from FLASH to RAM	
2	P.P Default	ON	Default Port 1 only	OFF
		OFF	Serial port setting	
1	COPY	ON	M Register Copy when SW3 is ON Turn the power ON when only SW1 is ON. SGDH servo parameter in the controller is transferred to SGDH . → to replace SGDH.	OFF
		OFF	No M Register Copy when SW3 is ON. M Register has a battery backup.	

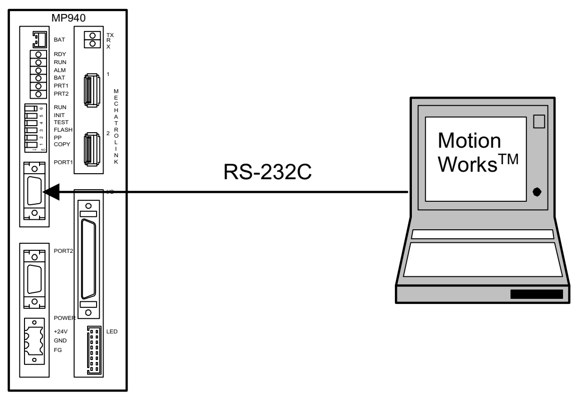
■ Serial Port 1

MP940 can communicate between tranmission devices on the Memobus network using RS-232C via serial port 1.

A programming device (i.e., a PC equipped with an RS-232C interface) is connected to serial port 1.

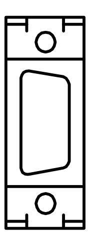
■ Connection with Programming Device

The following is an example of connecting serial port 1 to the programming device.



■ Connector pin array and signal name

An example is shown below of the connector pin array and signal names in serial port 1.


PORT1

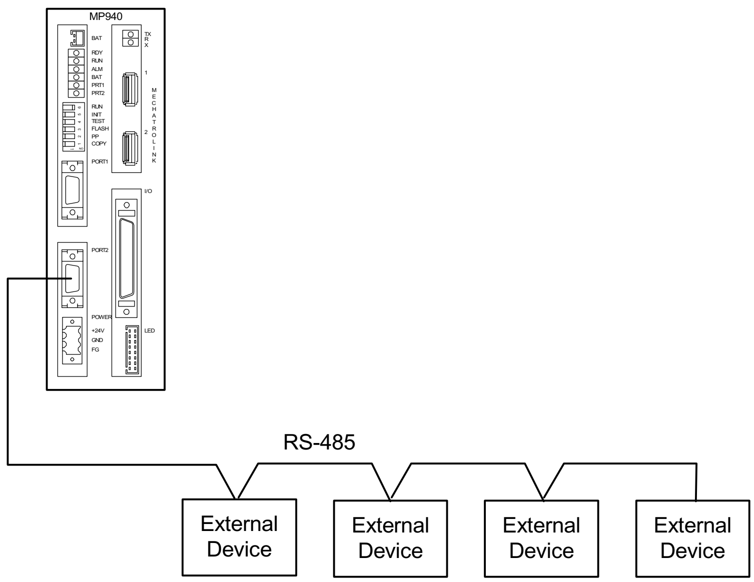
Number	Signal Name	Reference	Number	Signal Name	Reference
1	TxD	Transmit data	9	—	—
2	—	—	9	—	—
3	RxD	Receive data	10	—	—
4	—	—	11	—	—
5	—	—	12	RTS	—
6	CTS	—	13	—	—
7	—	—	14	GND	Ground

■ Serial Port 2

This is the port used in RS-422/485 connection.

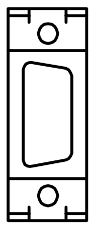
■ Branched connection of peripheral devices

The figure below illustrates a branch connection of peripheral devices with serial port 2.



■ Connector pin array and signal name

The example below depicts the programming device connection to serial port 2.

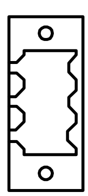


Number	Signal Name	Reference	Number	Signal Name	Reference
1	TX+	+ side of transmission data	8	TX+	+ side of transmission data
2	TX-	- side of transmission data	9	TX-	- side of transmission data
3	RX+	+ side of received data	10	RX+	+ side of received data
4	RX-	- side of received data	11	TXR	Transmission data terminal resistor
5	—	—	12	—	—
6	RX-	- side of received data	13	VCC	Power+5V
7	RXR	Data Reception Terminal Resistance	14	GND	Ground

■ Power Connector

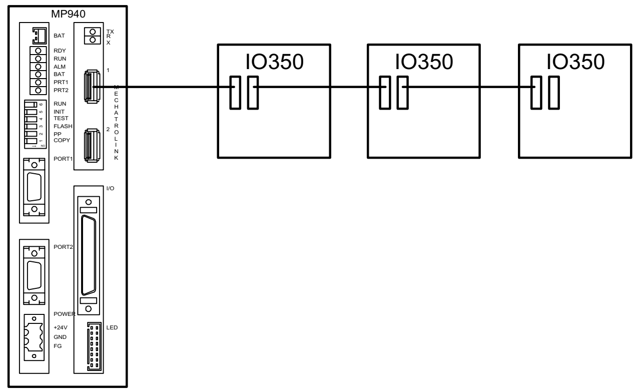
Supplies +24VDC power to the MP940 module.

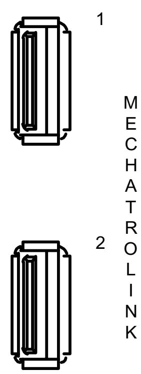
The connectors use a screw-mount terminal block BL3.,5/3F-AU (Weidmuller, Inc.).



Terminal Name	Function
+24V	+24VDC
0V	0VDC
FG	Protective grounding terminal

- The Mechatrolink Connector connects a distributed I/O via Mechatrolink.

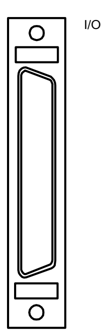




Number	Function
1	N.C
2	SRD-
3	SRD+
4	Shield

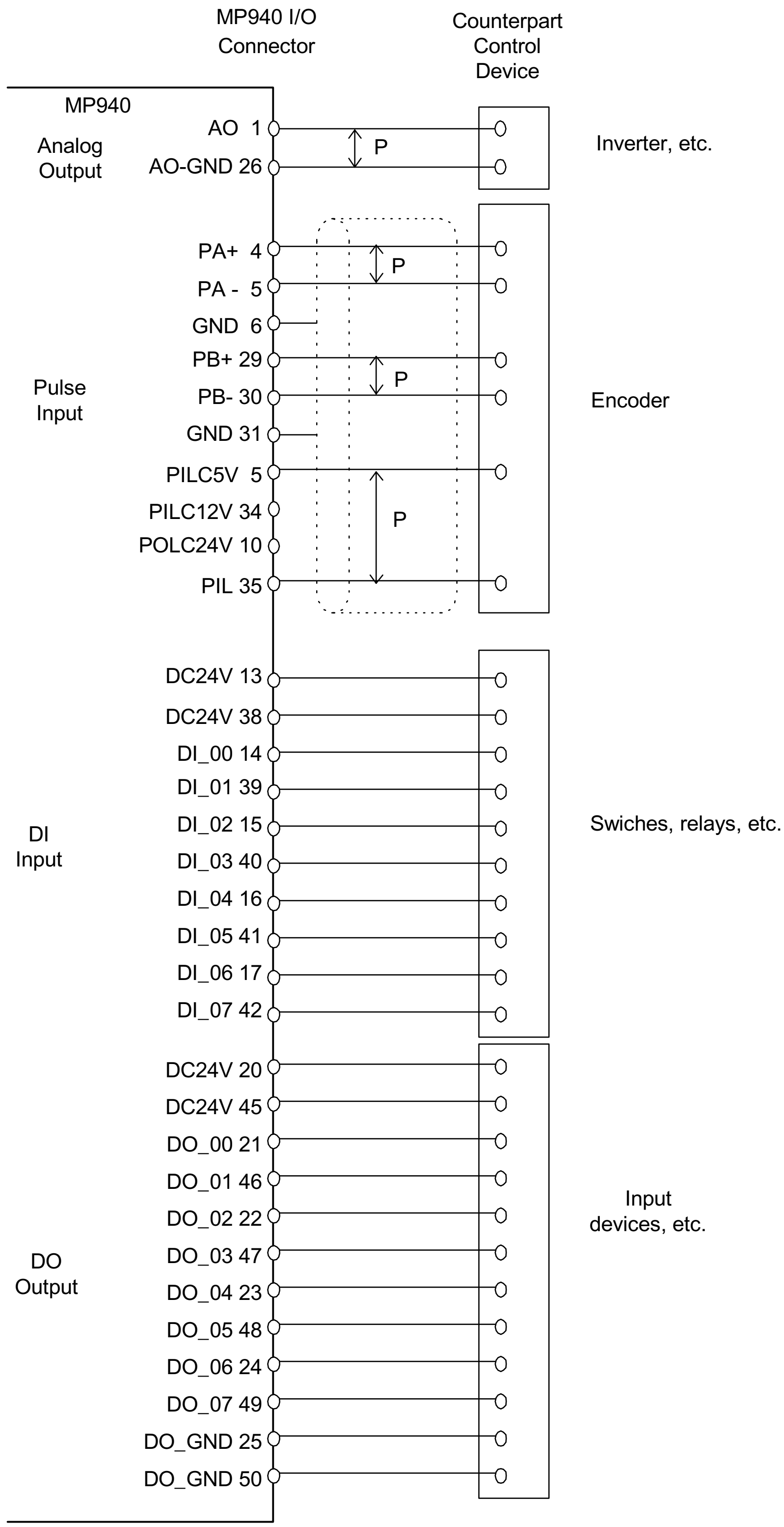
- I/O Connector

This is a connector used to join the MP940 module with external input signals as well as analog outputs and pulse inputs.



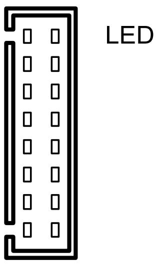
External Input:8 points
External Output:8 points
Analog Input:0~±10V
Pulse Input:5V deviation, AB format, Counter Latch Input

■ Example of I/O Connection

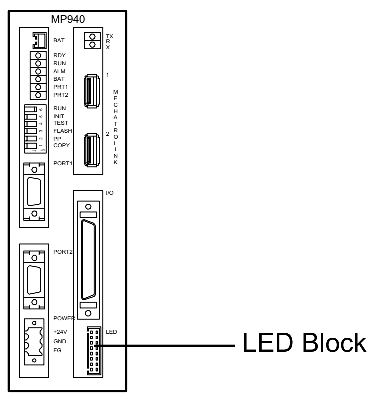


■ LED Connector

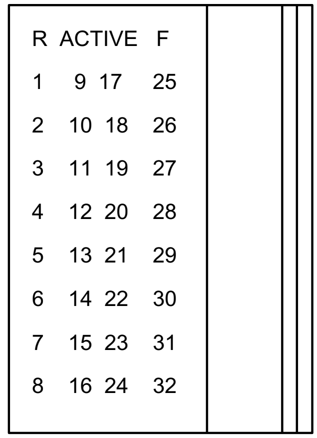
The status of the DI/DO connected to the I/O connector can be displayed by connecting the following LED blocks.



Number	Signal Name	Reference	Number	Signal Name	Reference
1	VCC	Power(+5V)	2	—	—
3	—	—	4	LED 0*	—
5	LED 1*	—	6	—	—
7	LED 2*	—	8	LEDPW 0	—
9	LEDPW 3	—	10	LEDPW 2	—
11	LED 3*	—	12	LED 4*	—
13	LED 5*	—	14	LEDPW 1	—
15	LED 7*	—	16	LED 6*	—



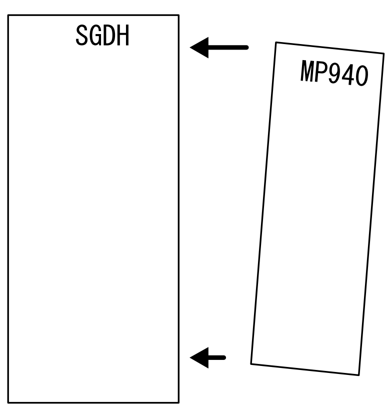
■ Schematic diagram of the LED block



Number	Signal Name	Meaning when Lit	Number	Signal Name	Meaning when Lit
1	DI 0	DI 0 Input	9	DO 0	DO 0 Output
2	DI 1	DI 1 Input	10	DO 1	DO 1 Output
3	DI 2	DI 2 Input	12	DO 2	DO 2 Output
4	DI3	DI 3 Input	13	DO 3	DO 3 Output
5	DI 4	DI 4 Input	13	DO 4	DO 4 Output
6	DI 5	DI 5 Input	14	DO 5	DO 5 Output
8	DI 6	DI 6 Input	15	DO 6	DO 6 Output
9	DI 7	DI 7 Input	16	DO 7	DO 7 Output

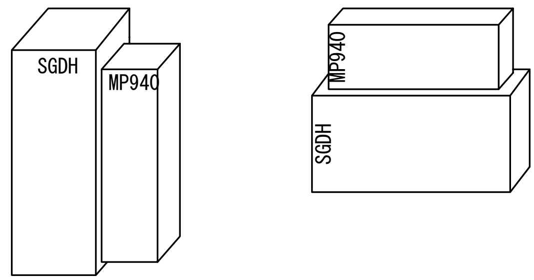
Other numbers and symbols are unused.

Note: The MP940 is mounted to the side of an SGDH servo amplifier. Securely mount the MP940 in the correct direction with regard to the SGDH amplifier.



Turn the power ON in the SGDH within 10 seconds of turning the power ON in the MP940. If the SGDH amplifier power is not tuned ON within ten seconds, the MP940 will not operate synchronously with the SGDH, and stand-alone operation results.

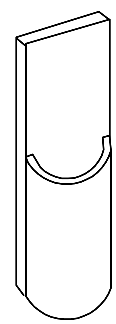
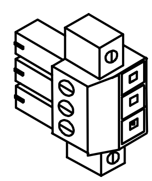
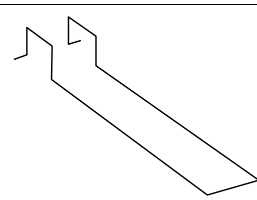
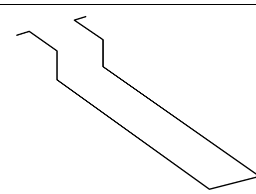
Install the MP940 and SGDH in the correct direction when using a cooling fan.



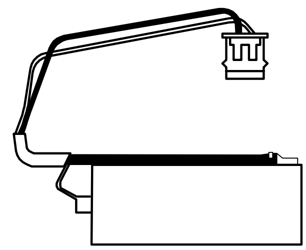
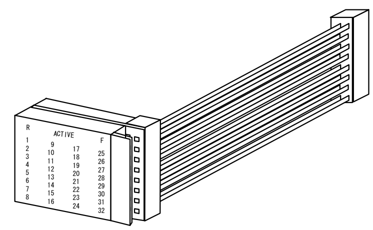
Connect the grounding line securely to a class three ground.

Accessories/Options

■ MP940 Accessories List

Model	Name	
DF9402712	Battery Holder	
UFS-0118	Power Connector Counterpart POWER connector	
DF9402713 DF9402714	Fixing Spring: 2 types Spring A: 2 Spring B: 1	 A  B

■ Options

Model	Name	
BA000518	MP940 Module Memory Backup Battery	
	LED Block	

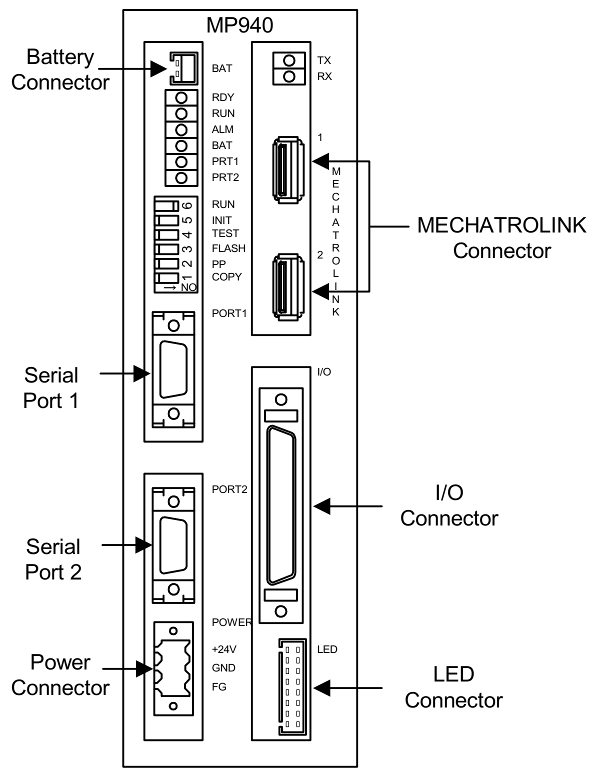
Connection Method

This section describes the connection method for the MP940.

Connector Names and Positions

The names and positions for connectors on all sides of the MP940 module are given below.

JEPMC-MC400



JEPMC-MC410

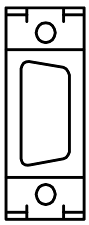
Connector Specifications

Name	Connector Name	Number of Pins	Connector Model			Cable Model
			Module Side	Cable Side	Manufacturer	
Battery Connector	BAT	2	DF3-2P-2DS	Battery ER6VLY+DF3, CON-NECTOR	HIROSE	BA000518
Serial Port (RS-232C)	PORT 1	14	10214-52A2JL	Connector Unit 10114-3000VE Shell 10314-52A0-008	3M	YS-15
Serial Port (RS-422/485)	PORT 2	14	10214-52A2JL	Connector Unit 10114-3000VE Shell 10314-52A0-008	3M	YS-14
Power Connector	POWER	3	3L3.5/3/90F	BL3.5/3F-AU	Weidmuller	—
Mechatrolink Connector	Mechatrolink	4	DUSB-APA41-T11	Connector unit DUSB-APA41-B1-C50 USB-USB type	DDK	JEPMC-W6000-A3
				Connector unit DUSB-APA41-B1-C50 USB-loose type	DDK	JEPMC-W6010-01, JEPMC-W6010-03, JEPMC-W6010-05
				Connector unit DUSB-APA41-B1-C50 USB terminator	DDK	JEPMC-W6020
I/O Connector	I/O	50	10250-52A2JL	Connector Unit 10150-3000VE Shell 10350-52A0-008	3M	JEPMSZ-120W0402-01, JEPMSZ-120W040-03, JEPMSZ-120W0402-05
LED Connector	LED	16	IMSA-9220B-16A	—	—	—

Serial Port Connector Pin Array and I/O Circuit

■ Serial Port 1 Connector pin array and signal name

The connector pin array and signal names in serial port 1 appear below



PORT1

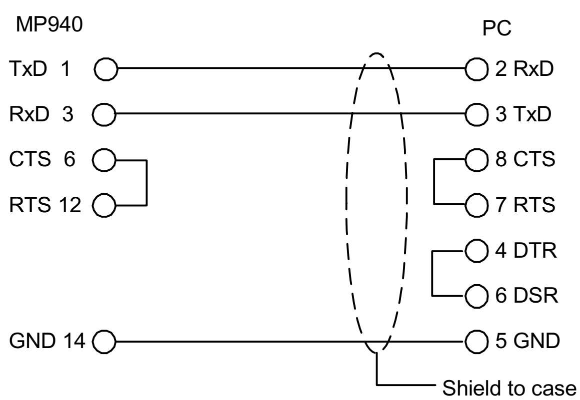
Number	Signal Name	Reference	Number	Signal Name	Reference
1	TxD	Transmit data	8	—	—
2	—	—	9	—	—
3	RxD	Receive data	10	—	—
4	—	—	11	—	—
5	—	—	12	RTS	—
6	CTS	—	13	—	—
7	—	—	14	GND	Ground

Module Connector:10214-52A2JL (3M)

- Cable Connector Unit:10114-3000VE (3M)
- Shell:10314-52A0-008 (3M)

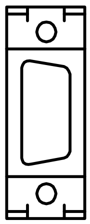
■ Connection of Serial Port 1(RS-232C)

The following is an example of connecting Serial Port RS-232C.



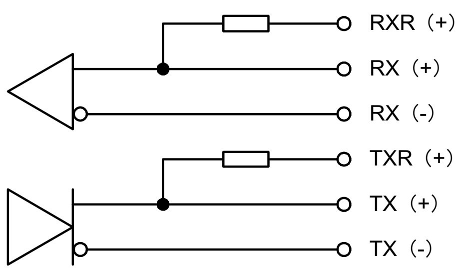
■ Serial Port 2

The connector pin array and signal names in serial port 2 appear below.



Number	Signal Name	Reference	Number	Signal Name	Reference
1	TX+	+ side of transmission data	8	TX+	+ side of transmission data
2	TX-	- side of trans-mission data	9	TX-	- side of transmission data
3	RX+	+ side of received data	10	RX+	+ side of received data
4	RX-	- side of received data	11	TXR	Transmission data terminal resistor
5	—	—	12	—	—
6	RX-	- side of received data	13	VCC	Power (+5V)
7	RXR	Received Data Terminal Resistor	14	GND	Ground

Insert the terminal resistor at the (+) pole.



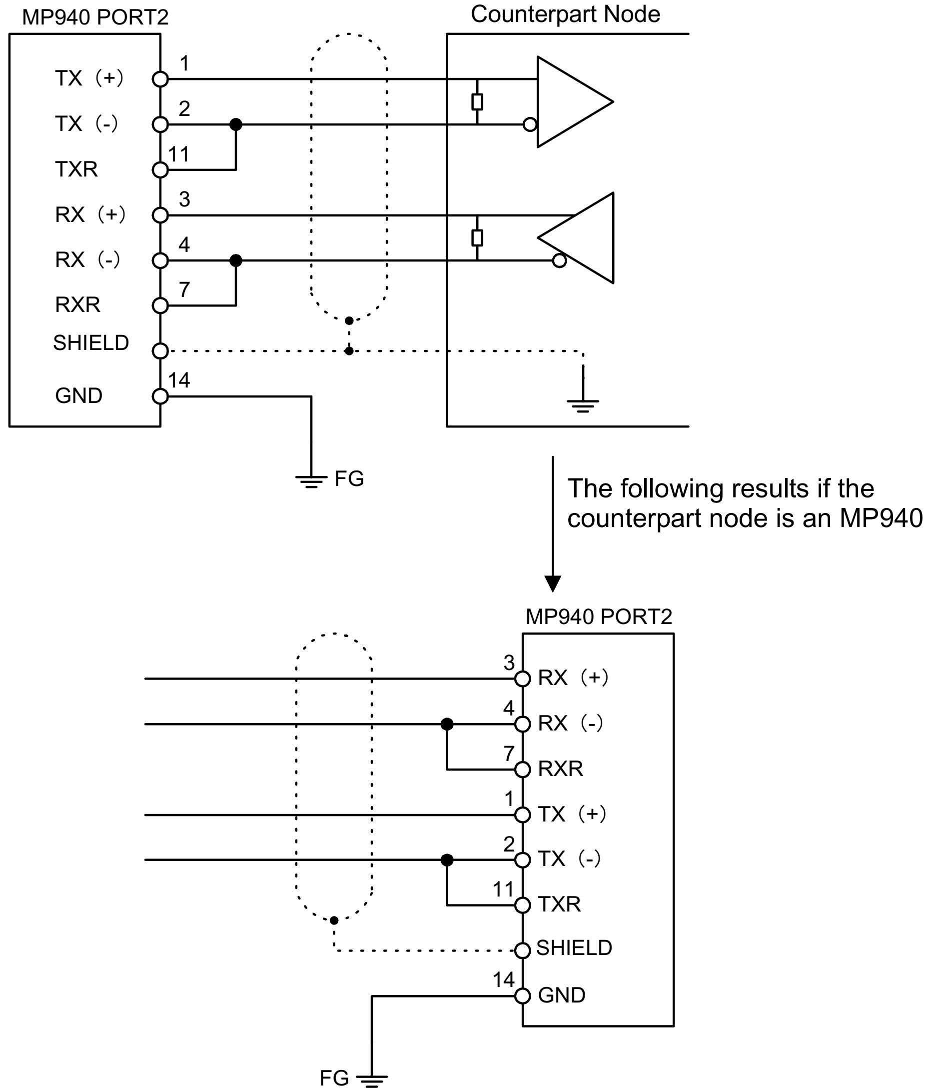
If a terminal resistor is inserted, connect the RXR (+) to the RX (-) signal, and the TXR (+) to the TX (-) signal.
If a terminal resistor is not inserted, connect the RX (+) to the RX (-) signal, and the TX (+) to the TX (-) signal.

- Module Connector:10214-52A2JL (3M)
- Cable Connector Unit:10114-3000VE (3M)
- Shell:10314-52A0-008 (3M)

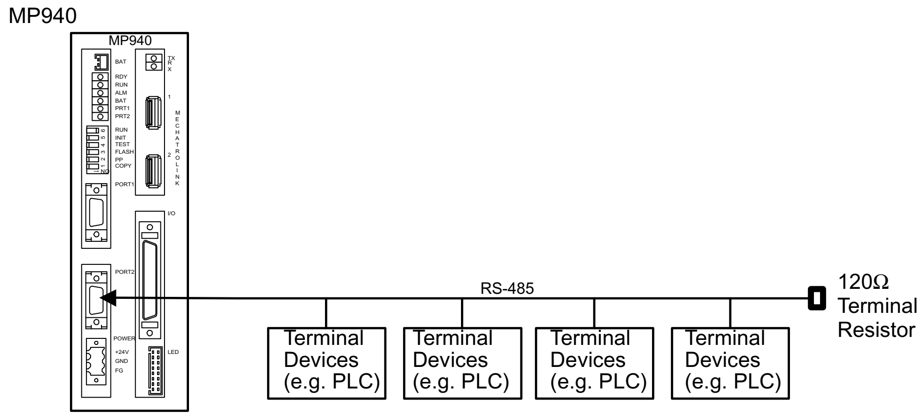
■ RS422/485 Interface Cable

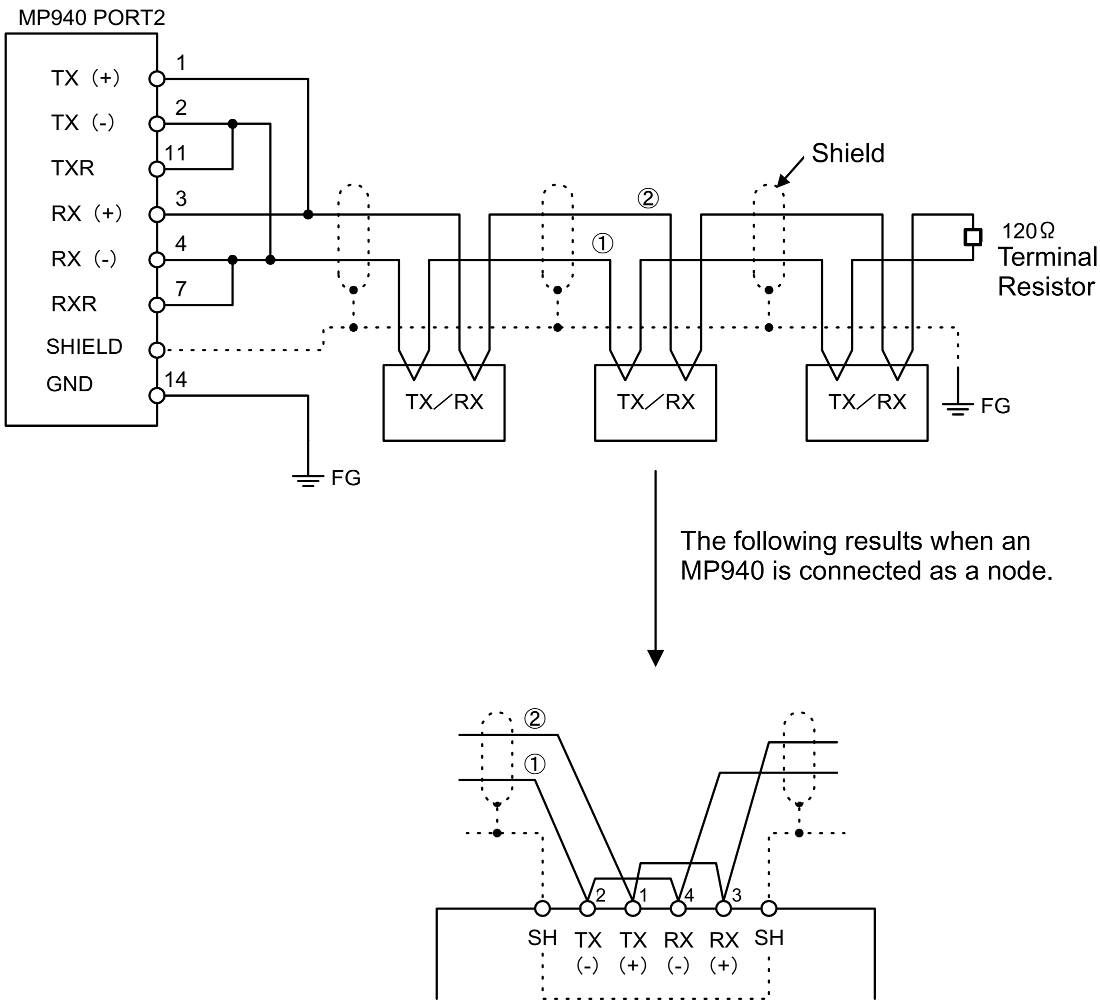
1. Make sure that the drive system, control system, power system, and other transmission systems are separate from each other.
2. The MP940 interface module RS422/485 interface is an MR-8-pin (CN3).
3. The RS422/485 cable length is 300m maximum. Use the minimum length necessary.
4. The RS422/485 interface on the MP940 is non-insulated. Misoperation may result due to noise in the connected terminal. In this case, reduce the noise by using a shielded cable, modem, etc.
5. In the case of RS422, insert a terminal resistor as needed. Place the terminal on the receiving side.
6. In the case of RS-485, attach a terminal resistor to both ends of the transmission line.

■ RS422 Wiring



■ RS-485 Wiring





Enable the terminal resistor in the MP940 Port2 by connecting pin 2 to pin 11, and pin 4 to pin 7.

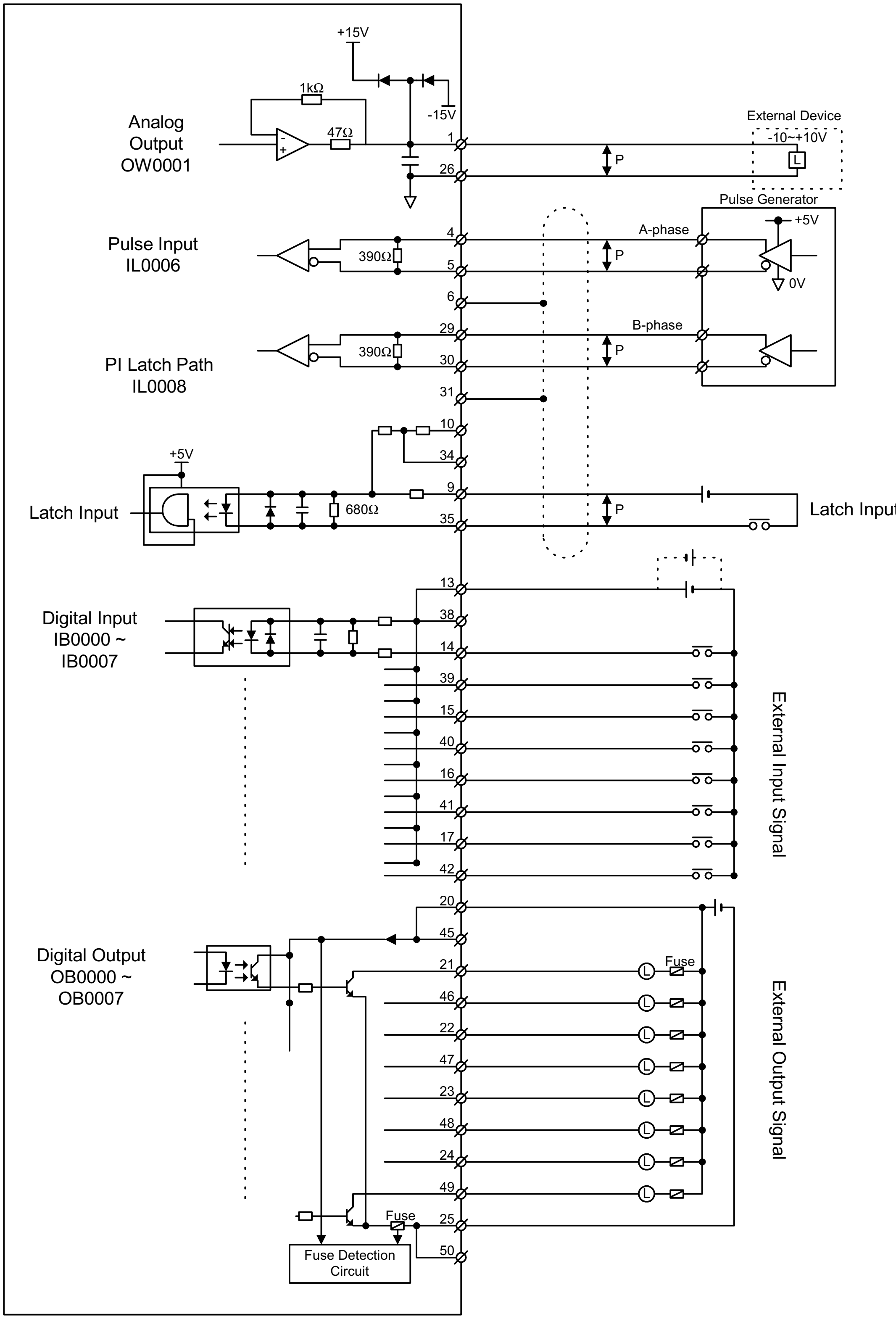
I/O Connector Pin Array and I/O Circuit

The names and content of each of the I/O connector terminals is shown in the table below.

Number	Signal Name	Reference		Number	Signal Name	Reference
1	AO	Analog Output		26	AO_GND	Analog Output Ground
2	—	—		27	—	—
3	—	—		28	—	—
4	PA+	A_ Pulse +		29	PB+	B_Pulse +
5	PA-	A_ Pulse -		30	PB-	B_Pulse -
6	GND	Pulse Input Ground		31	GND	Pulse Input Ground
7	—	—		32	—	—
8	—	—		33	—	—
9	PILC 5V	PI Latch Input Common (5V)		34	PILC 12V	PI Latch Input Common (12V)
10	PILC 24V	PI Latch Input Common (24V)		35	PIL	PI Latch Input
11	—	—		36	—	—
12	—	—		37	—	—
13	DC 24V	DI Power (input)		38	DC 24V	DI Power (input)
14	DI_00	DI_00 Input (DI interrupt)		39	DI_01	DI_01 Input
15	DI_02	DI_02 Input		40	DI_03	DI_03 Input
16	DI_04	DI_04 Input		41	DI_05	DI_05 Input
17	DI_06	DI_06 Input		42	DI_07	DI_07 Input
18	—	—		43	—	—
19	—	—		44	—	—
20	DC 24V	DO Power (input)		45	DC 24V	DO Power (input)
21	DO_00	DO_00 Output		46	DO_01	DO_01 Output
22	DO_02	DO_02 Output		47	DO_03	DO_03 Output
23	DO_04	DO_04 Output		48	DO_05	DO_05 Output
24	DO_06	DO_06 Output		49	DO_07	DO_07 Output (Counter coincidence output)
25	DO_GND	DO Ground(0V)		50	DO_GND	DO Ground(0V)

■ I/O Connector I/O Circuit

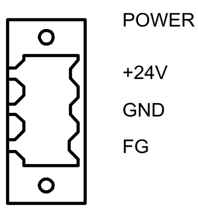
The I/O connections, and each of the I/O Circuits is shown below.



Power Connector Cable

■ Power Connector (POWER)

Supplies DC +24V power supply to the MP940 module. The connectors use a screw-mount terminal block BL3.,5/3F-AU (Weidmuller, Inc.).



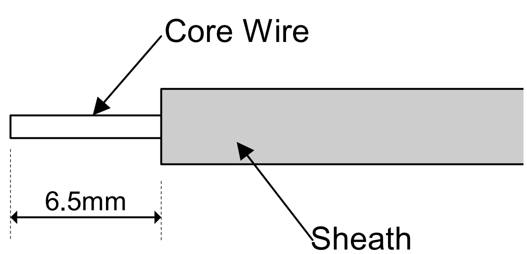
Pin#	Signal Name	Name
3	+24V	+24VDC input
2	GND	0V
1	FG	—

■ Creating 24V Power Cable

When connecting the 24VDC power source and MP940 power connector, use a twisted-pair cable of wire size AWG #24~AWG#20 ($0.2mm^2$~$0.51mm^2$).

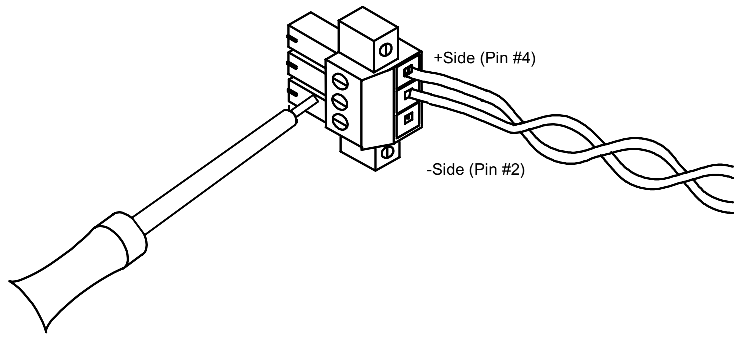
Create the cables as follows:

1. Strip approximately 6.5mm of sheathing from the end of the line.



2. Screw down the wires.

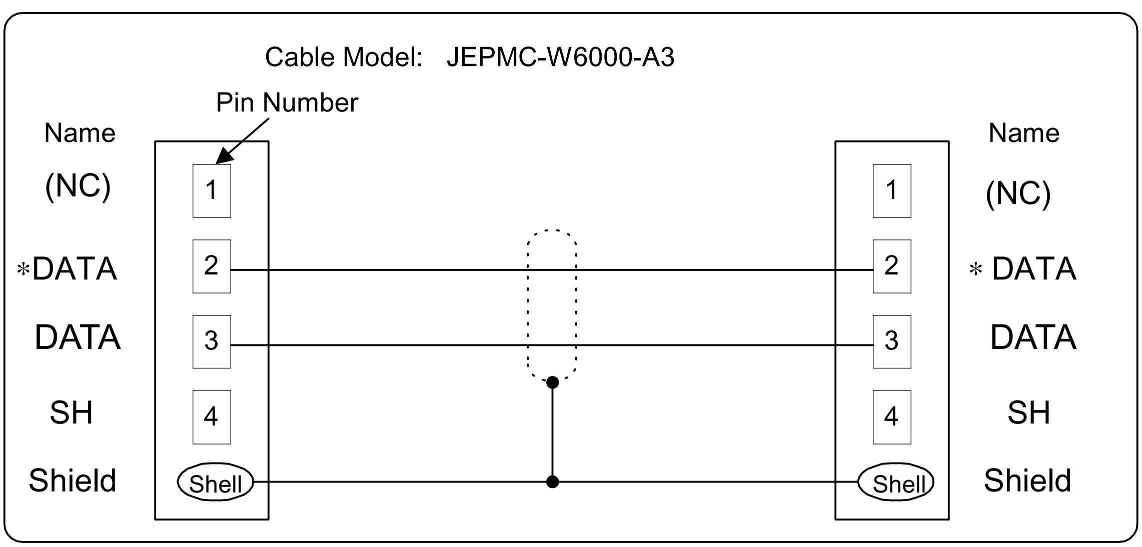
   Insert the wire core deep within the plug, and tighten firmly with a tightening torque of 0.3Nm ~ 0.4Nm.



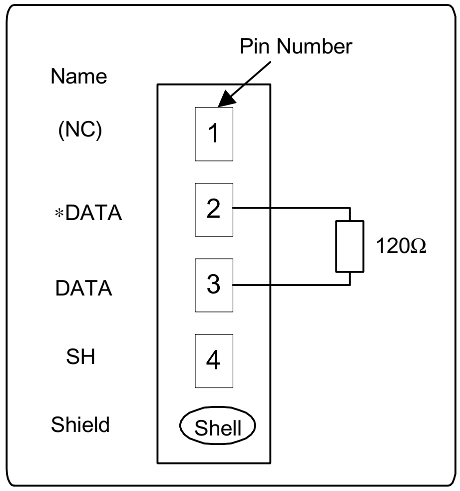
Pin #	Signal Name	Name
3	+24V	+24VDC input
2	GND	GND
1	FG	FG

Mechatrolink Cable

The internal cable connections between the MP940 module and the I/O unit (IO350) are shown below.



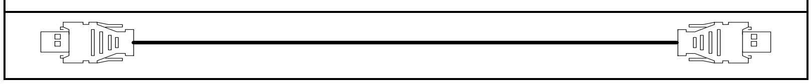
Below is a wiring diagram for the USB terminator.



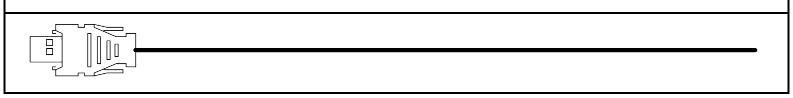
Red Lead: DATA
Black Lead: ∗DATA

The external view of the Mechatrolink cable is shown below.

Model: JEPMC-W6000-A3

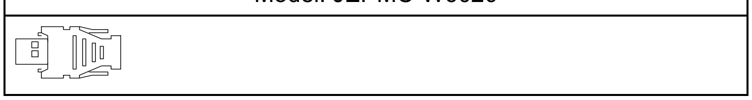


Model: JEPMC-W6010-∗∗



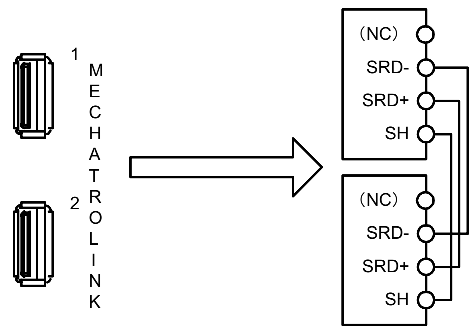
The USB terminator is shown below.

Model: JEPMC-W6020



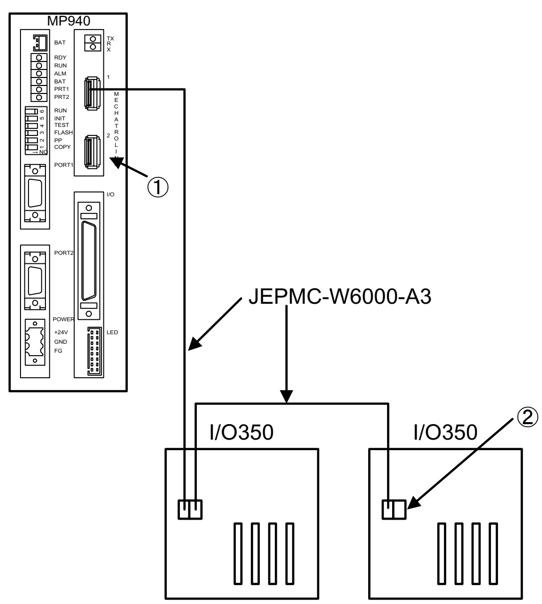
The Mechatrolink conectors 1, 2 are the same. The terminator may be inserted into either one.

Insert a USB terminator (JEPMC-W6020) into unused ports.



There is only one channel set aside for the Mechatrolink port in the MP940 module. Although there are two connector orifices, they are identical, as shown in the figure above.

The Mechatrolink connection to an IO350 unit is shown below.



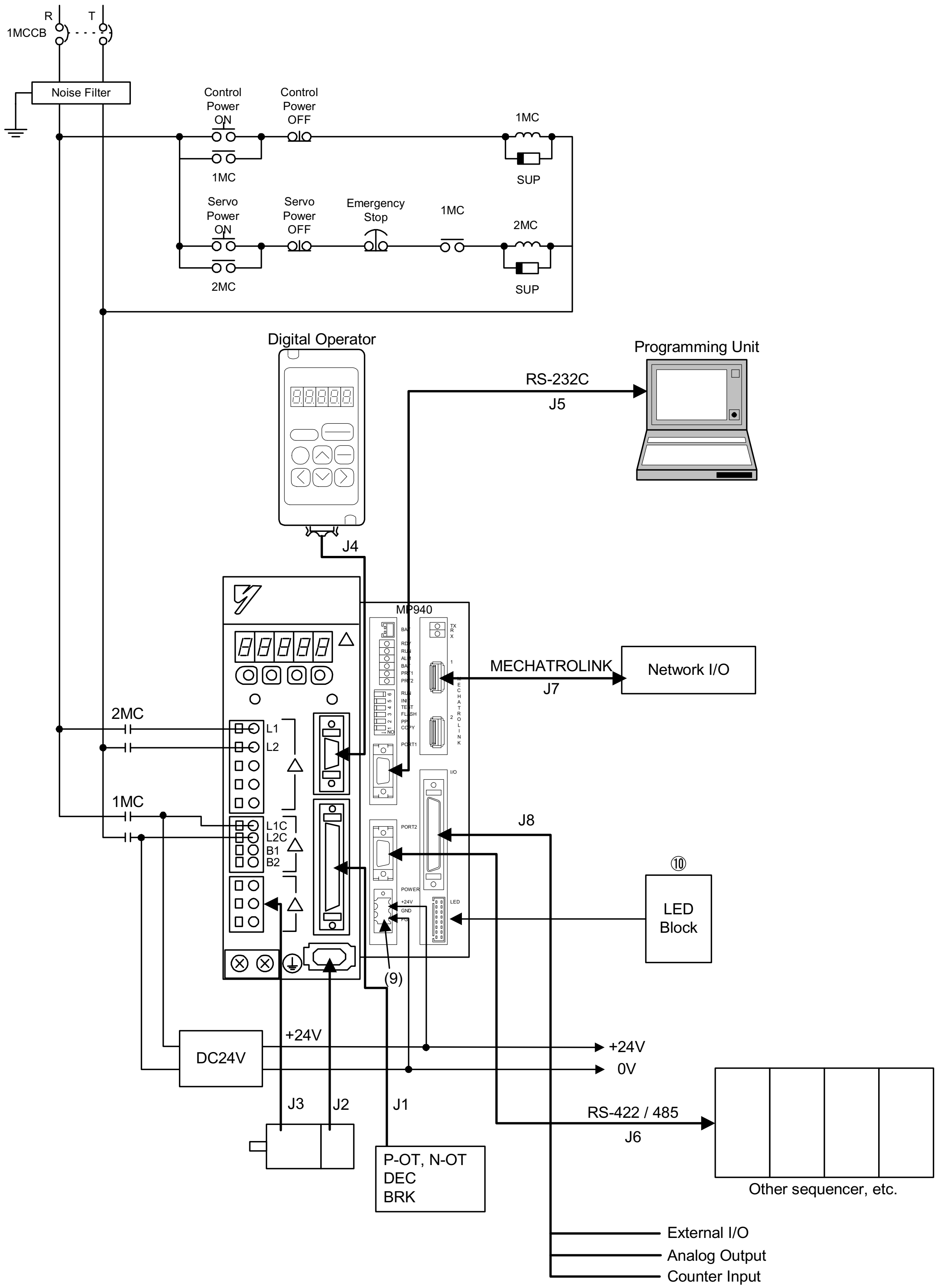
Use the standard cable (JEPMC-W6000-A3) when connecting an MP940 module to an IO350, or an IO350 to another IO350.

Be sure to insert a USB terminator (JEPMC-W6020) into the terminal connector (1 or 2 in the figure above). See the section on cables for external drawings and internal connection diagrams.

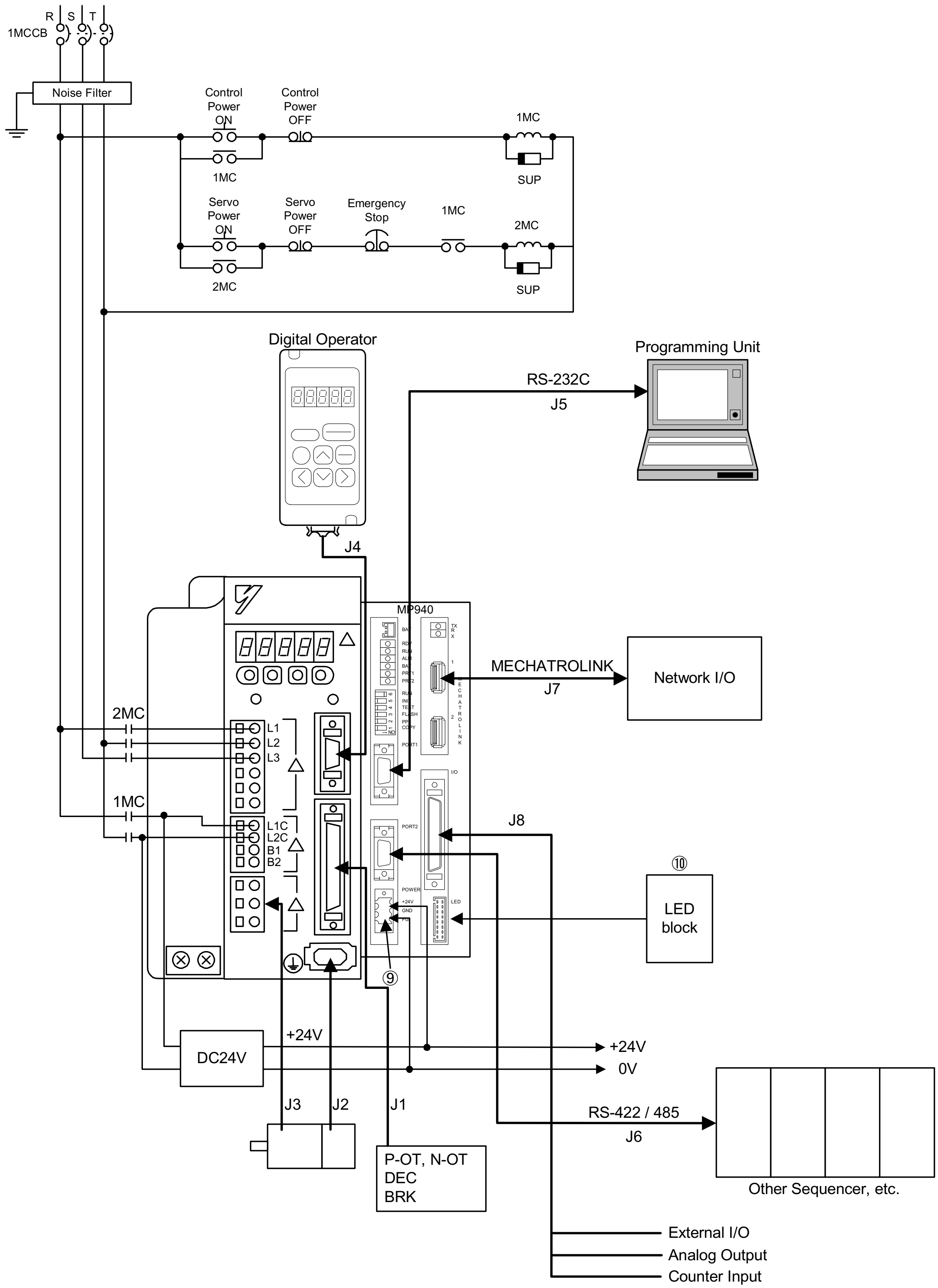
Connection with Peripheral Devices

The MP940 is used in combination with an SGDH amplifier, as illustrated in the figures on the following two pages.

Single-phase Power Specifications



Three-phase Power Specifications



Standard Cable List

Yaskawa supplies standard cables used for connecting the MP940 to external I/O devices as well as to servo amplifiers. A list is given below of the cables neccessary to configure a system with theMP940.

Servo Amplifier-Related Cables

Number	Connector Name	Specification	Model	Length
J1	CN1	I/O Signal (CN1) Connection Cable MDR (50 pin) connector on servo amplifier side pigtail	JZSP-CK101-1	1m
			JZSP-CK101-2	2m
			JZSP-CK101-3	3m
		Connector Terminal Block Exchange Unit • Terminal Block + Connection Cable (0.5m)	JZSP-TA50P	—
	Connector Kit	Connector Parts List (Sumitomo/3M) Connector 10150-3000VE (1) Case 10350-52A0-008 (1)	JZSP-CK19	—
J2	CN2	Encoder Cable Connector with terminals on both encoder and amplifier sides. For SGMGH, SGMSH (w/ straight plug)	JZSP-CMP00-03	3m
			JZSP-CMP00-05	5m
			JZSP-CMP00-10	10m
			JZSP-CMP00-15	15m
			JZSP-CMP00-20	20m
		Encoder Cable Connector with terminals on both encoder and amplifier sides. For SGMAH, SGMPH (w/ L plug)	JZSP-CMP01-03	3m
			JZSP-CMP01-05	5m
			JZSP-CMP01-10	10m
			JZSP-CMP01-15	15m
			JZSP-CMP01-20	20m
		Encoder Cable Connector with terminals on both encoder and amplifier sides.	JZSP-CMP02-03	3m
			JZSP-CMP02-05	5m
			JZSP-CMP02-10	10m
			JZSP-CMP02-15	15m
			JZSP-CMP02-20	20m
		Encoder Cable Connector on servo amplifier side , pigtail on encoder side	JZSP-CMP03-03	3m
			JZSP-CMP03-05	5m
			JZSP-CMP03-10	10m
			JZSP-CMP03-15	15m
			JZSP-CMP03-20	20m

Servo Amplifier-Related Cables (Continued)

Number	Connector Name	Specification	Model	Length
J2	Cable Materials	Standard Cables (can be wired up to 20m)	JZSP-CMP09-05	5m
			JZSP-CMP09-10	10m
			JZSP-CMP09-15	15m
			JZSP-CMP09-20	20m
		Standard Cables (can be wired up to 50m)	JZSP-CMP09-30	30m
			JZSP-CMP09-40	40m
			JZSP-CMP09-50	50m
J2	Connector Kit	Servo Amplifier Side Encoder Connector (CN2) Plug Manufacturer Set Number:55100-0600 Manufacturer: Molex Japan, Inc.	JZSP-CMP09-1	—
		Motor Side Encoder connector socket for SGMAH, SGMPH motors Manufacturer Set:54280-0600 Manufacturer: Molex Japan, Inc.	JZSP-CMP09-2	—
J3	Motor Cable	200V:For 30W~750W No brake 100V:For 30W~200W	JZSP-CMM00-03	3m
			JZSP-CMM00-05	5m
			JZSP-CMM00-10	10m
			JZSP-CMM00-15	15m
			JZSP-CMM00-20	20m
		200V:For 30W~750W With brake 100V:For 30W~200W	JZSP-CMM10-03	3m
			JZSP-CMM10-05	5m
			JZSP-CMM10-10	10m
			JZSP-CMM10-15	15m
			JZSP-CMM10-20	20m
		SGMPH-15:For 1.5KW No brake	JZSP-CMM20-03	3m
			JZSP-CMM20-05	5m
			JZSP-CMM20-10	10m
			JZSP-CMM20-15	15m
			JZSP-CMM20-20	20m
		SGMPH-15:For 1.5KW With brake	JZSP-CMM30-03	3m
			JZSP-CMM30-05	5m
			JZSP-CMM30-10	10m
			JZSP-CMM30-15	15m
			JZSP-CMM30-20	20m

Servo Amplifier-Related Cables (Continued)

Number	Connector Name	Specification	Model	Length
J3	Connector Kit	200V:For 30W~750W No brake 100V:For 30W~200W	JZSP-CMM9-1	—
		200V:For 30W~750W With brake 100V:For 30W~200W	JZSP-CMM9-2	—
		SGMPH-15:For 1.5KW No brake	JZSP-CMM9-3	—
		SGMPH-15:For 1.5KW With brake	JZSP-CMM9-4	—
J4	CN3	Digital Operator (unit + cable (1m))	JUSP-OP02A-2	—
		Cable only	JZSP-CMS00-1	1m
			JZSP-CMS00-2	1.5m
			JZSP-CMS00-3	2m
		Analog Monitor Cable	DE9404559	1m
		Battery for absolute encoder	JZSP-BA01	—
		Brake Power AC200V Power Input	LPSE-2H01	—
		Brake Power AC100V Power Input	LPSE-1H01	—

MP940-Related Cables

Number	Connector Name	Specification	Mode	Length
J5	PORT 1	RS-232C MDR14-pin	YS-15	1m
J6	PORT 2	RS-422/485	YS-14	1m
J7	Mecha-trolink 1, 2	Mechatrolink Cable USB connector - USB connector	JEPMC-W6000-A3	0.3m
			JEPMC-W6000-01	1m
			JEPMC-W6000-03	3m
			JEPMC-W6000-05	5m
			JEPMC-W6000-10	10m
			JEPMC-W6000-20	20m
			JEPMC-W6000-30	30m
		Mechatrolink Cable USB Connector - pigtail	JEPMC-W6010-07	7m
			JEPMC-W6010-10	10m
			JEPMC-W6010-15	15m
			JEPMC-W6010-20	20m
			JEPMC-W6010-30	30m
			JEPMC-W6010-40	40m
			JEPMC-W6010-50	50m
		USB Terminator	JEPMC-W6020	—
J8	I/O	—	—	—
(9)	POWER	DC24V Power Connector	—	—
(10)	LED	I/O Monitor LED Block (option)	—	—

Servo Amplifier Main Circuit Connection

Main Circuit Terminal Names and Functions

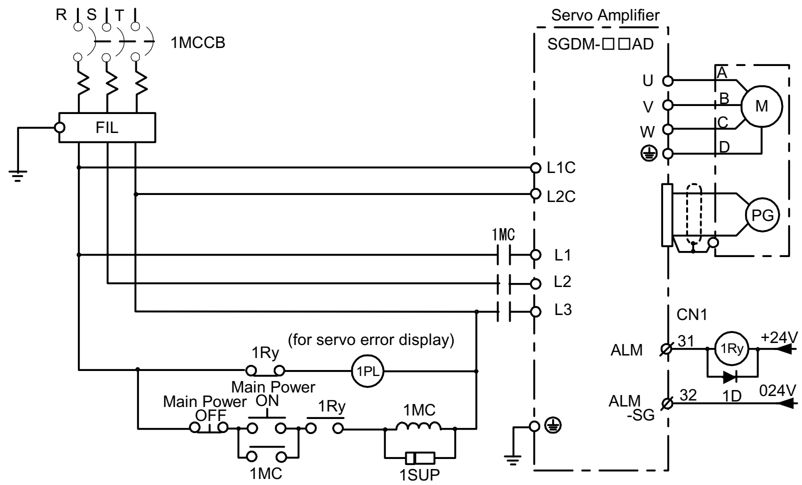
The names and functions of the main circuit terminals are shown in the table below:

Terminal Mark	Name	Function	
L1, L2 or L1, L2 , L3	Main Circuit Power Input Terminal	30W ~ 200W	Single-phase 100 ~115V +10%, -15% (50/60Hz)
		30W ~ 400W	Single-phase 200 ~ 230V +10%, -15% (50/60Hz)
		0.5kW ~ 7.5kW	Three-phase 200 ~ 230V +10%, -15% (50/60Hz)
U, V, W	Motor Connection Terminal	Connects with motor.	
L1C, L2C	Control Power Input Terminal	30W ~ 200W	Single-phase 100 ~ 115V +10%, -15% (50/60Hz)
		30W ~ 7.5kW	Single-phase 200 ~ 230V +10%, -15% (50/60Hz)
⏚ (2 places)	Ground Terminal	Installed by connecting to either the power grounding terminal or the motor grounding terminal.	
B1, B2, or B1, B2, B3	External Regen Resistor Connection Terminal	30W ~ 40W	This is not normally connected. Connect an external regen resistor (provided by customer) between B1-B2 if the regen capacity is insufficient.*1
		0.5kW ~ 5.0kW	Normally, B2-B3 is shorted (using an internal regen resistor). When the capacity of the internal regen resistor is insufficient, open B2-B3 (remove the wiring), and connect an external regen resistor (provided by customer) between B1 - B2.
		6.0kW, 7.5kW	Connect an external regen resistor (provided by customer) between B1-B2.*1
⊕ 1 ⊕ , 2	High Power Frequency Suppression DC Reactor Connection Terminal	1 - 2 are normally shorted. ⊕ ⊕ When a countermeasure for high power frequency suppression is needed, connect a DC reactor between 1 - 2. ⊕ ⊕ *2	
⊕	Main Circuit Positive Terminal	This is not normally connected.*3	
⊖	Main Circuit Negative Terminal	This is not normally connected.	

*1 There is no terminal B3.
*2 This connection terminal does not exist on servo amplifiers of 6kW capacity or higher.
*3 Servo amplifiers of 6kW or higher capacity have only the servo amplifier terminals.

Representative Main Circuit Wiring

An example is given in the figure below of typical wiring of the main circuit.



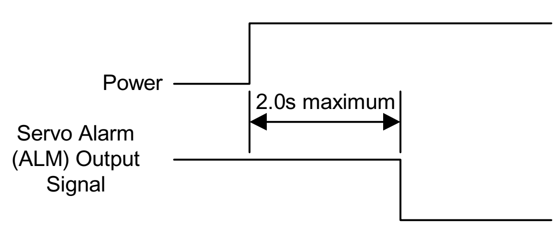
1MCCB: Wiring Breaker (for inverters)
FIL: Noise Filter
1MC: Connector

1Ry: Relay
1PL: Display Lamp
1SUP: Surge Suppressor
1D: Flywheel Diode

- Power Feed Sequence Setting

Keep the following points in mind when designing the power feed sequence:

- Design the power sequence so that the power goes OFF when a servo alarm signal is output (see the above circuit).
- Push the **POWER** button continuously for at least 2 seconds. The servo amplifier outputs a servo alarm signal within a maximum of two seconds of power ON. This is necessary for initial setting of the servo amplifier.



Main Circuit Terminal Block Wiring

Observe the following cautionary items when performing the wiring.

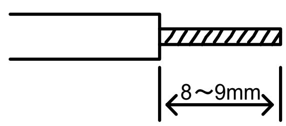
⚠ CAUTION

- Perform the wiring after removing the terminal block from the servo amplifier.
- Insert a wire into one of the wiring apertures of the terminal block.
- When inserting the wire, be sure that adjacent parts are not shorted by the wire core.
- Restrip wires that have been mistakenly or improperly removed before reconnecting them.

The main circuit terminals of servo amplifiers of less than 1.5kW capacity consist of connector type terminal blocks. Wire the terminal block as follows:

■ Connection Method

1. Strip the cover from the wires used.



2. Open the wire insertion aperture of the terminal block with a tool. Open the terminal by either method A or B (below).
   - Method A uses the accessory lever to pry open.
   - Method B uses a commercial flathead screwdriver (head width 3.0 ~ 3.5mm) to press on the aperture. An alternate screwdriver is that corresponding to the 210-120J series driver from Wago Japan, Inc. Either of the methods above may be employed.

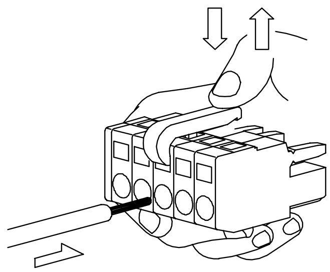


Figure A

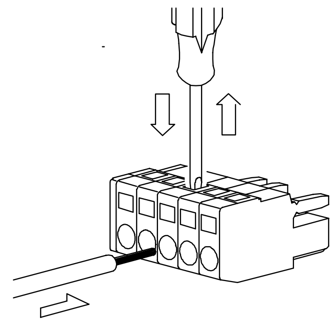


Figure B

3. Insert the wiring core into the aperture. After insertion, release the lever or apply pressure with a flathead screwdriver.

■ Wire Terminal Processing

Remove the wire shield, and use as is. The useable wire sizes are as follows:

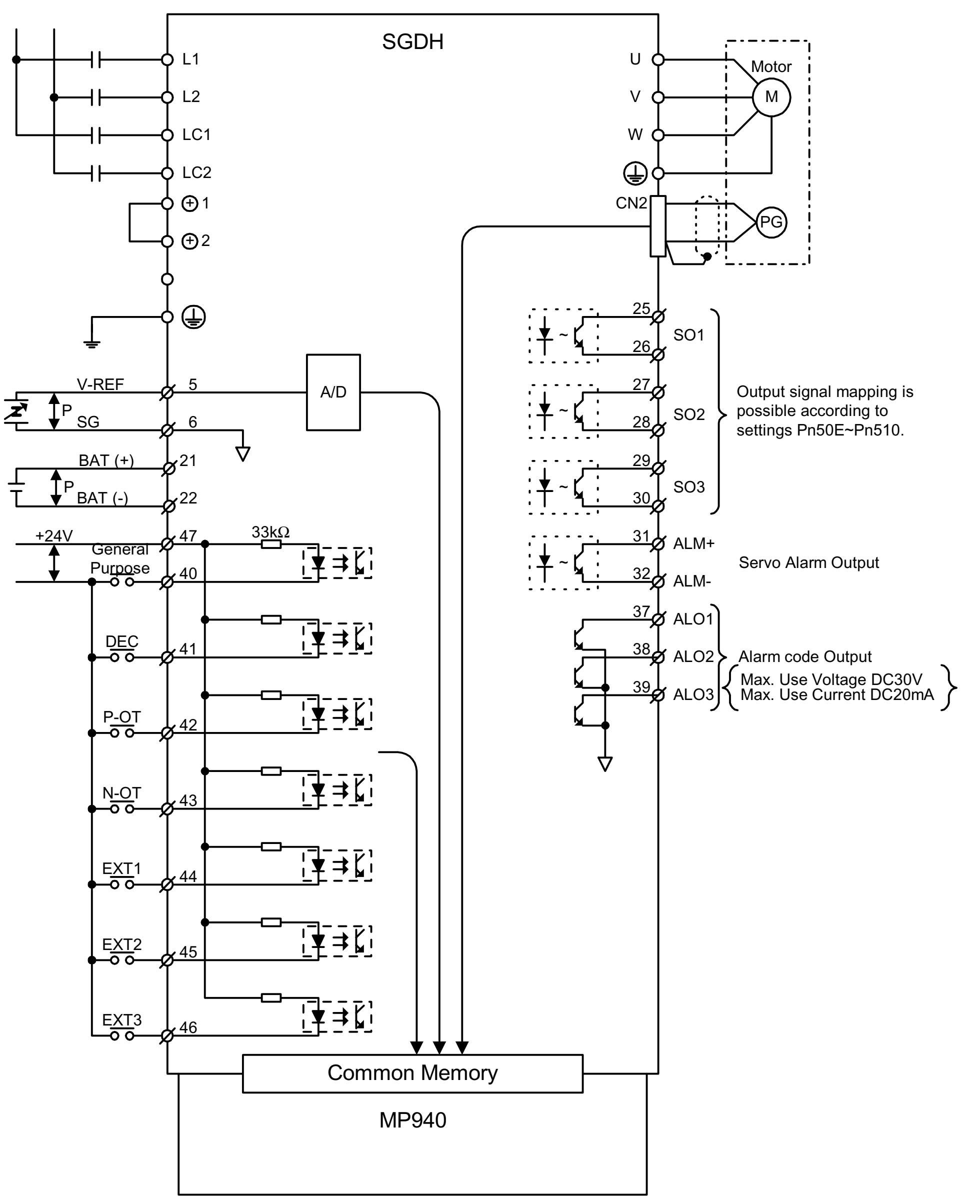
- Single Wire: f0.5 ~ 1.6mm
- Twisted Wire: AWG28 ~ AWG12

Servo Amplifier I/O Signal

In this section, a description is given of the SGDH-E servo amplifier I/O signals as they are used in combination with an MP940.

Schematic Diagram of I/O Signals

The typical connection of the I/O signals is shown below:



Note: EXT3 is used for latch signal

Connector (CN1) terminal array list.

The CN1 terminal array and specifications are shown below.

■ CN1 Terminal Array

2	SG	GND
4	—	—
6	SG	GND
8	—	—
10	—	—
12	---	---
14	—	—
16	—	—
18	—	—
20	—	—
22	BAT(-)	Battery (-)
24	—	—

1	SG	GND
3	—	—
5	V-REF	General purpose AI
7	—	—
9	—	—
11	—	—
13	—	—
15	—	—
17	—	—
19	—	—
21	BAT(+)	Battery (+)
23	—	—
25	/V-CMP+ (/COIN+)	Speed Coinci-dence Detec-tion Output

27	/TGON+	TGON Signal Output
29	/S-RDY+	Servo Ready Output
31	ALM+	Servo Alarm Output
33	—	—
35	—	—
37	—	—
39	—	—
41	/DEC---	—
43	N-OT	Reverse Over-travel Input
45	/EXT2	Forward
47	+24V -IN	External Input Power
49	—	—

26	/V-CMP- (/COIN-)	Speed Coincidence Detection Output
28	/TGON-	TGON Signal Out-put
30	/S-RDY -	Servo Ready Output
32	ALM -	Servo Alarm Output
34	—	—
36	—	—
38	—	—
40	—	—
42	P-OT	Forward Over-travel Input
44	/EXT1	—
46	/EXT3	—
48	—	—
50	—	—

Do not use empty terminals for relays.
Insert the shield wire of the I/O signal cable into the connector shell.
Connect the ground (frame ground) to the servo amplifier connector.

■ CN1 Specifications

Connector Specifications Used in Servo Amplifiers	Applied Receptacle Model		
	Soldered Type	Case	Manufacturer's Name
10250-52A2JL Compatible Right Angle 50P	10150-3000VE	10350-52A0-008	Sumitomo/3M, Inc.

I/O Signal Names and Functions

The names and functions of the servo amplifier I/O signals are shown below.

Input Signal

Signal Name		Pin#	Function	
Common	SIO	40	General-use Input Signal	
	/DEC	41	Zero-point Return Deceleration LS Signal	
	P-OT N-OT	42 43	Forward Travel Prohibition Reverse Travel Prohibition	Overtravel Prevention: Motor driving stops when a mobile part of the machine exceeds its mobile range.
	/EXT1 /EXT2 /EXT3	44 45 46	External Input Signal 1 External Input Signal 2 External Input Signal 3	EXT1 is a general-use input signal EXT2 and EXT3 are used DI latch detection signals. (Can be used as a general-purpose input signal if not used for DI latch detection)
	+24VIN	47	Control Power Input for Sequence Signal: A +24V power source is supplied by the customer.	
	SEN	4 (2)	This is an initial data request signal for absolute encoder use.	
	BAT (+) BAT (-)	21 22	This is a connector pin for the absolute encoder backup battery.	
Analog Input	V-REF	5 (6) 9 (10)	Used as a general-purpose analog input. Do not use.	
		7 8 11 12 15 14 3 13 18	Do not use.	

The function assignments of the /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed by user parameter settings.
Pin numbers in parentheses show a signal ground.
The input voltage setting ranges for the speed reference and torque reference are ±12V (maximum).

Output Signal

Signal Name		Pin#	Function
Common	ALM+ ALM-	31 32	Servo Alarm: OFF due to error detection
	/TGON+ /TGON-	27 28	Motor Rotation Detection: Detects whether a motor is rotating at a speed above the set value. The detection speed can be set in the user parameters.
	/S-RDY+ /S-RDY-	29 30	Servo Ready: ON when an alarm is generated with the control/main power ON.
		33 (1) 34 35 36 19 20	Do not use.
		48 49	Do not use.
	ALO1 ALO2 ALO3	37 38 39 (1)	Alarm Code Output: Outputs a 3-bit alarm code.
	FG	Shell	Connect the frame ground after attaching the I/O signal cable shell wire to the connector shell.
	/V-CMP+ /V-CMP-	25 26	Speed Coincidence (output in speed control mode): Detects coincidence of the motor speed with the speed referenced in the setting range.
Prepara- tion		16 17 23 24 50	Empty Terminal Note: Do not use empty terminals for relays.

Pin numbers in parentheses are signal grounds.
The output signals /TGON, /S-RDY, and /V-CMP (/COIN) can have their function assignments changed by the setting of user parameters. They can be changed to /CLT, /VCT, /BK, /WARN, and /NEAR signals.

Interface Circuit

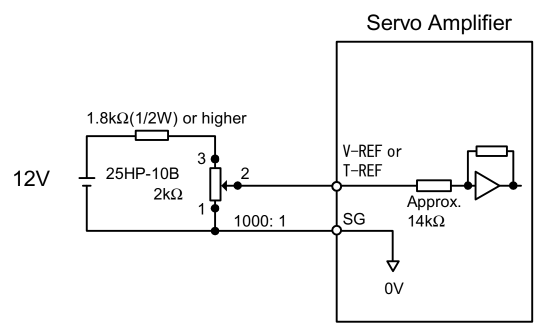
An example of connecting the servo amplifier I/O signals to an upper-level device is shown below.

Interface with Command Input Circuit

■ Analog Input Circuit

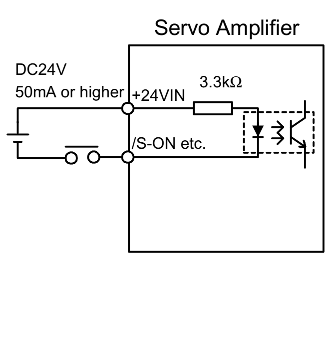
The analog signal is either the speed reference or torque reference signal. The input impedance is as follows:

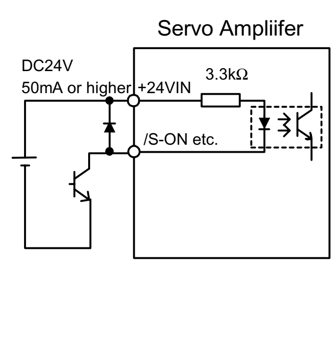
- Speed Reference Input: approximately 14k
- Torque Reference Input: approximately 14k
- The maximum allowable voltage of the input signal is ±12V.



■ Interface with Sequence Input Circuit

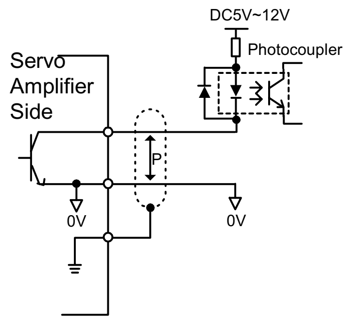
Connect this with a relay or open collector transisitor circuit. Select a relay for use in minimal current. Use of a relay unsuited for minimal current may result in poor connection.

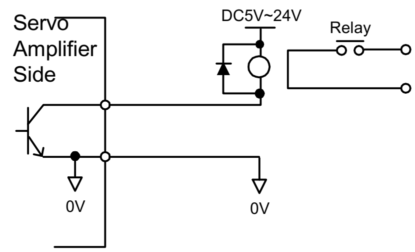


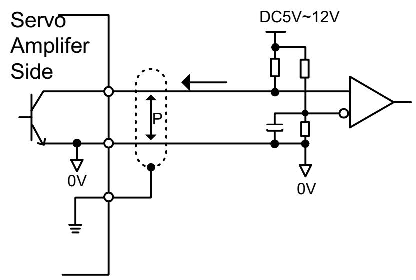


■ Connection with Open Collector Output Circuit.

Alarm code output signals use open collector transistor output circuits. Connect this with a photocoupler, relay, or line reciever circuit.





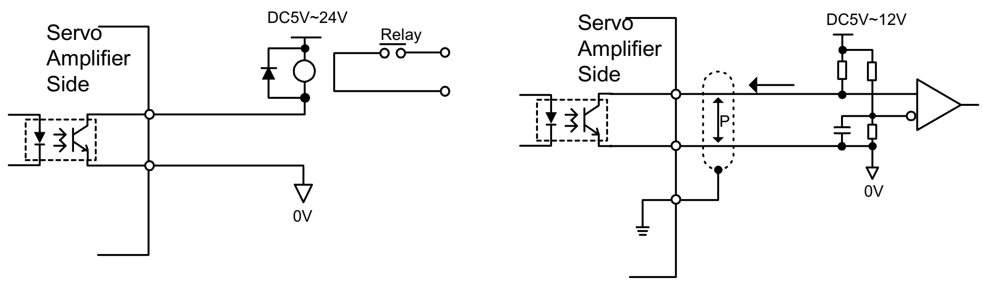


The maximum allowable voltage and current capacities of the open collector circuit are as follows:

- Voltage: 30VDC (maximum)
- Current: 20mADC (maximum)

■ Connection with Photocoupler Output Circuit

Other sequence output signals such as the servo alarm, servo ready, etc., are configured as photocoupler output circuits. Connect this with a relay or line reciever circuit.



The maximum allowable voltage and current capacities of the photocoupler output circuit are as follows:

- Voltage: 30VDC (maximum)
- Current: 50mADC (maximum)

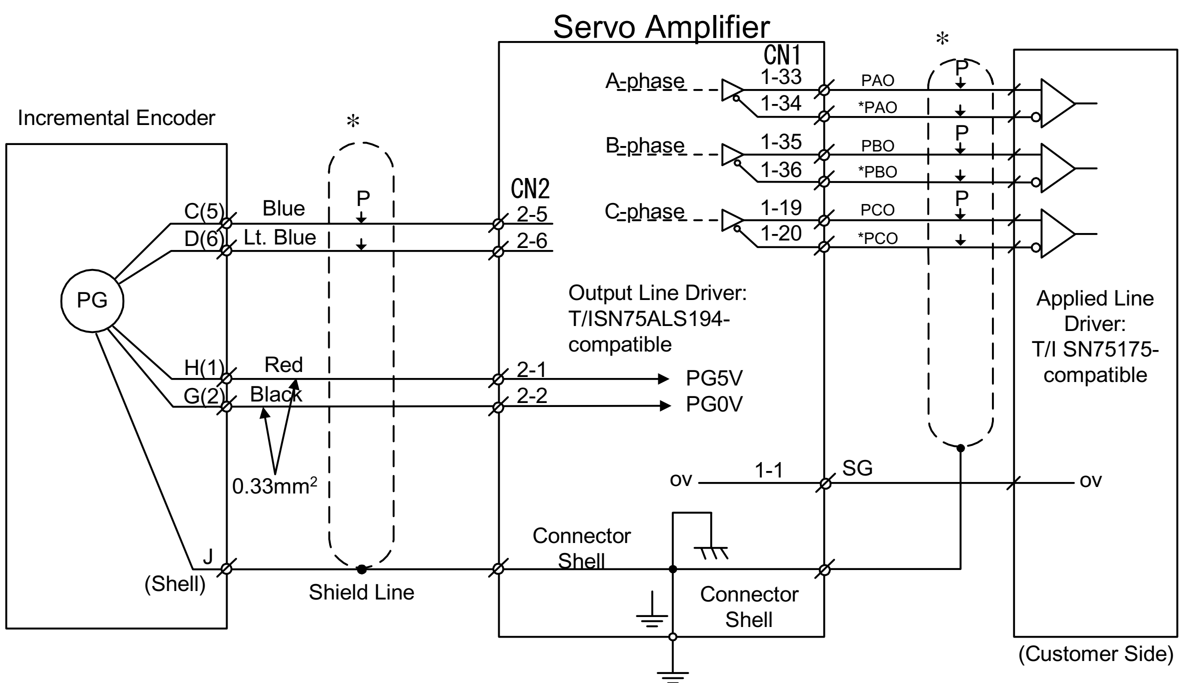
Encoder Wiring

The wiring of the servo amplifier to the encoder is described below.

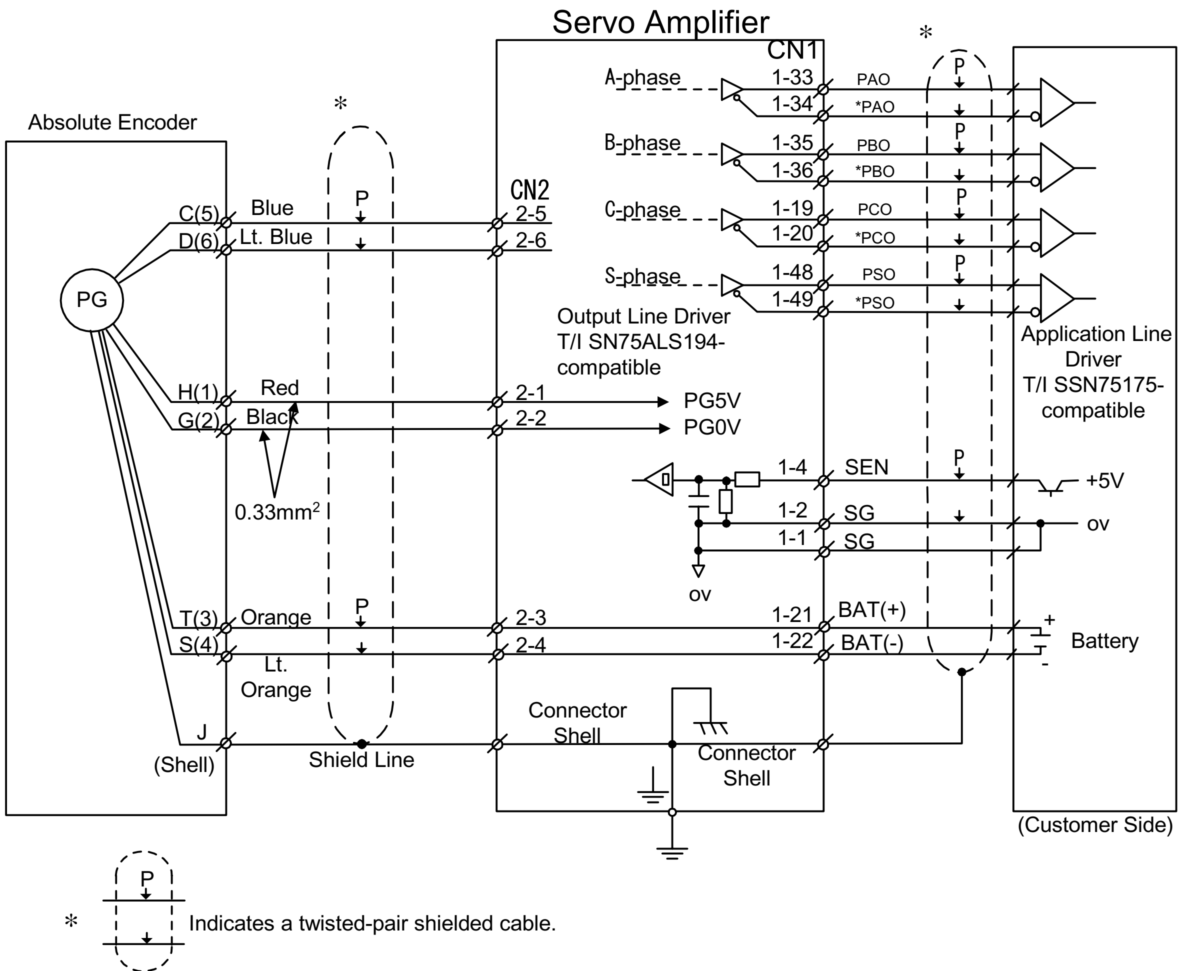
Connection with the Encoder (CN2) and Output Signal Processing from the Servo Amplifier (CN1)

The examples below illustrate both an incremental encoder and an absolute encoder.

- Incremental Encoder



■ Absolute Encoder



Terminal Array and Model of Encoder Connector (CN2)

The terminal array and model for CN2 are shown below.

CN2 Terminal Array

1	PG5V	PG Power +5V	2	PG 0V	Encoder Power 0V
3	BAT (+)	Battery (+) (for use with absolute encoder)	4	BAT (-)	Battery (-) (for use with absolute encoder)
5	PS	Encoder Serial Number Input	6	*PS	Encoder Serial Number Input

1

CN2 Mode

Connector Model Used in Servo Amplifier	Applied Plug (or socket) Model		
	Relay Plug Soldered Type (Servo Amplifier-side Connector)	Relay Socket Soldered Type (Motor-side Connector)	Manufacturer's Name
53460-0611	55100-0600	54280-0600	Molex Japan, Inc.

- The amplifier-side plug and motor-side socket have the Molex Japan set number of FA 1394.
- The relay socket on the motor side connects to an SGMAH, SGMPH servo motor encoder connector.

The SGMGH, SGMSH servo motor encoder connectors are shown below.

- Plug L-type: MS3108B20-29S
  or Straight: MS3106B20-29S
  Cable Clamp: MS3057-12A

Yaskawa provides dedicated cabled for encoders. Refer to the following materials for details.

- Σ-II Series SGM_H/SGDM Users Manual "Servo Selection and Data Sheets" (Document Number: SI-S800-31.1B)

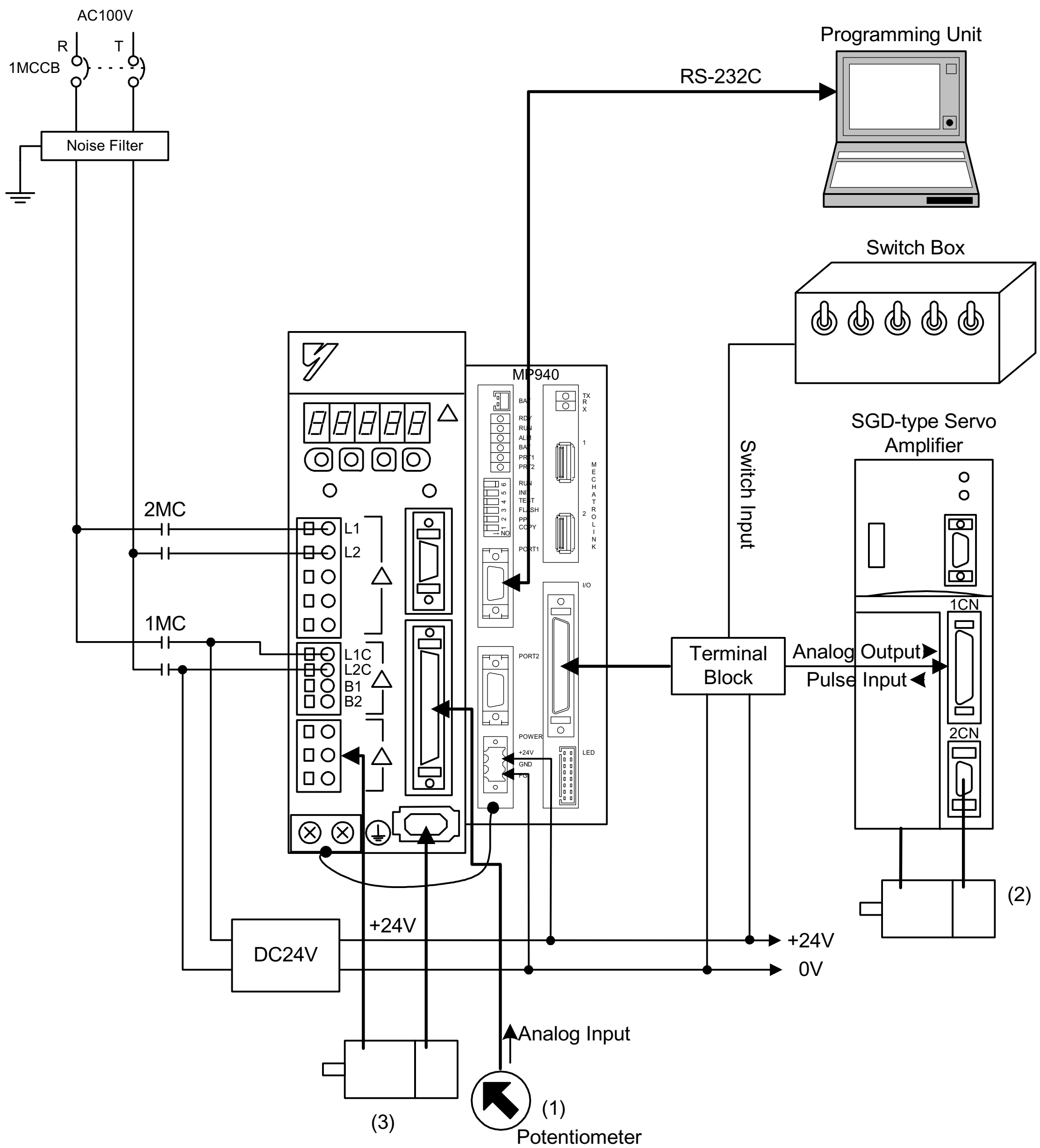
Outline of the Start-up Procedure

An outline of the system start-up procedure is as follows:

1. Prepare the devices to be used.
2. Mount the MP940 module to an SGDH servo amplifier.
3. Connect the programming unit, and wire the external I/O signals, servo motor, and servo amplifier.
4. Execute system definitions (i.e., module definition, group definition, scan time setting)
5. Set the mechanical parameters for the test device, using the programming device.
6. Create a motion program for the test operation, using the programming device.
7. Transmission of definitions, parameters, and programs
8. Verify the operation by running the program and checking the test operation.

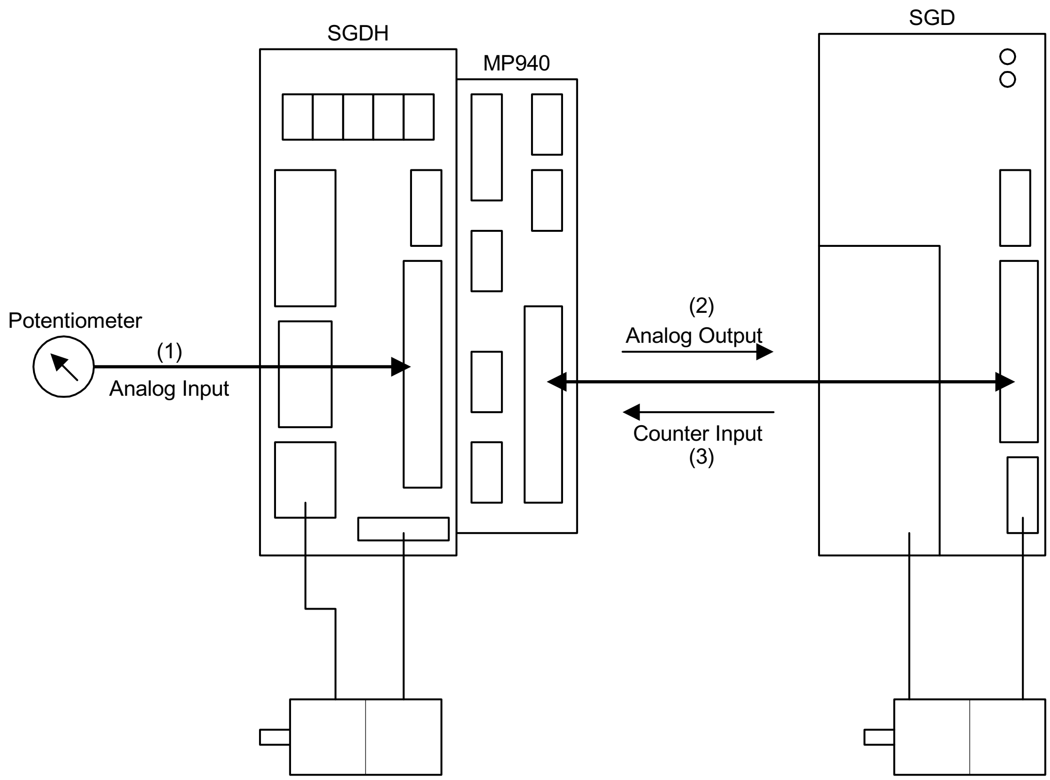
Test Device Configuration

The configuration of the test device is shown in the figure below:



Outline of Test Device Configuration

Outline of Control



Outline of Operation

1. The potentiometer is connected to the SGDH analog input terminal.
2. Output is made to the servo amplifier (SGD) connected to the analog output (AO), turning the motor according to the read potentiometer.
3. Using the MP940 counter, the encoder pulses of the servo motor moved in item 2 are read, and the servo motor connected to the SGDH moves the number of pulses read in each scan period only.

Preparation of Devices Used

Prepare the following devices.

Controller-related Devices

Name	Model
MP940	
I/O Signal Cable	
Connector Terminal Block Exchange Unit (Terminal Block + Connection Cable)	JZSP-TA50P

Servo-related Devices

Name	Model
SGDH Servo Amplifier	
Servo Motor	
Motor Cable	JZSP-CMM00-03
Encoder Cable	JZSP-CMP00-03
Servo Amplifier (SGD)	—
Servo Motors	—
Motor Cable	—
Encoder Cable	—

Programming-related Devices

Name	Model
PC	Windows95/98/NT
Software	MotionWorks™
Serial Programming Cable	YS-15

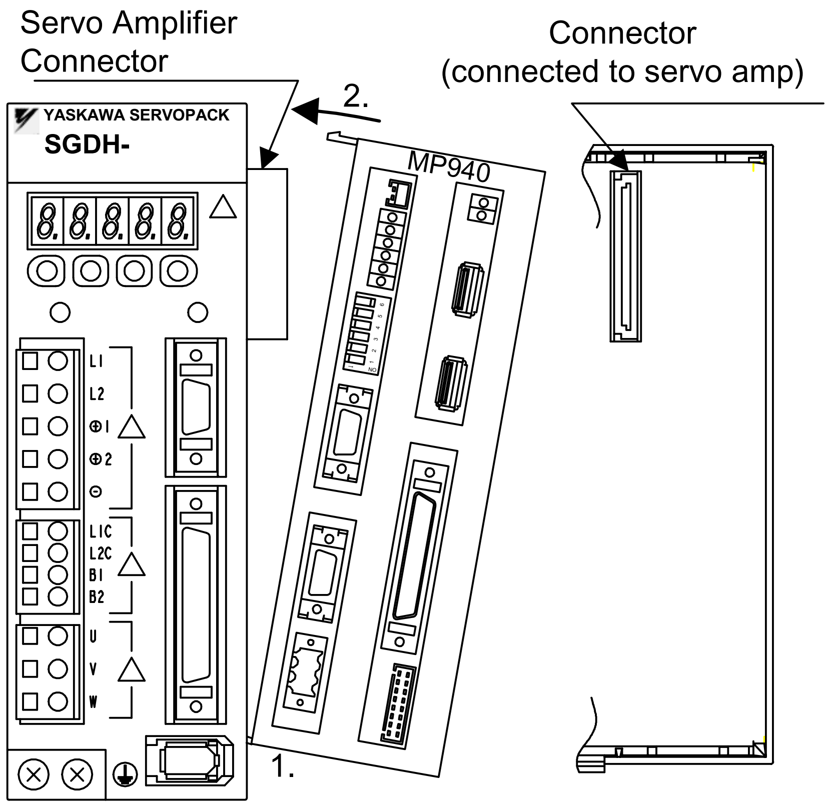
Other Necessary Items

Name	Model
Switch Box	——
24VDC Power Supply	——
12VDC Power Supply	——
No-fuse Breaker	——
Switch	——
Potentiometer	——
Wiring Materials	——

Handling of the MP940 Module

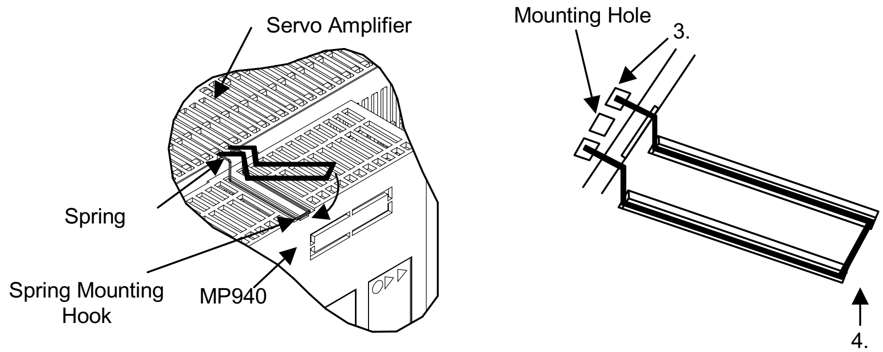
The procedure for mounting the MP940 module to an SGDH servo amplifier is shown below.

1. Insert the two mounting tabs on the bottom of the MP940 into the mounting holes on the lower right side of the SGDH.



2. Pressing in the direction of the arrows, insert the mounting tabs on the top of the MP940 into the mounting holes on the top right side of the SGDH.

3. Insert the MP940 module fixing spring into the hole on the top of the SGDH.

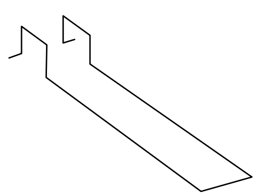


4. While pulling on the fixing spring, pull the spring mounting hook on the top of the MP940 case.
5. Mount the bottom spring in the same manner as in step 4.

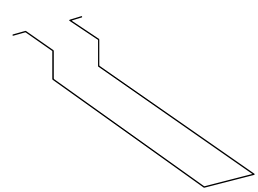
Refer to the following diagrams when mounting the MP940 to a servo amplifier. There are two kinds of mounting springs; they differ in shape according to the servo amplifier capacity.

Spring Type

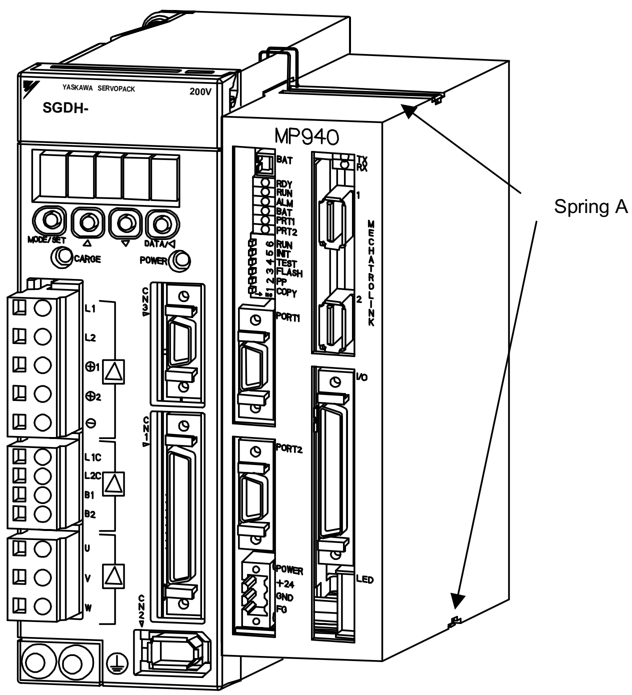
Spring A x 2



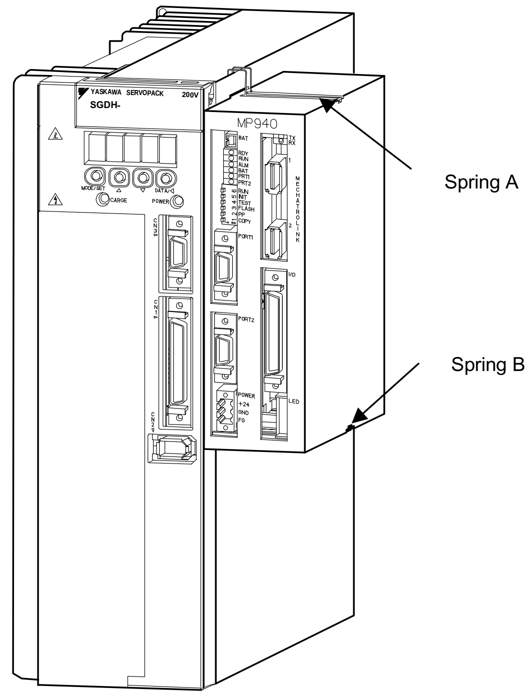
Spring B x 1



Servo Amplifier Capacities and Mounting Springs



Top/Bottom: Spring A



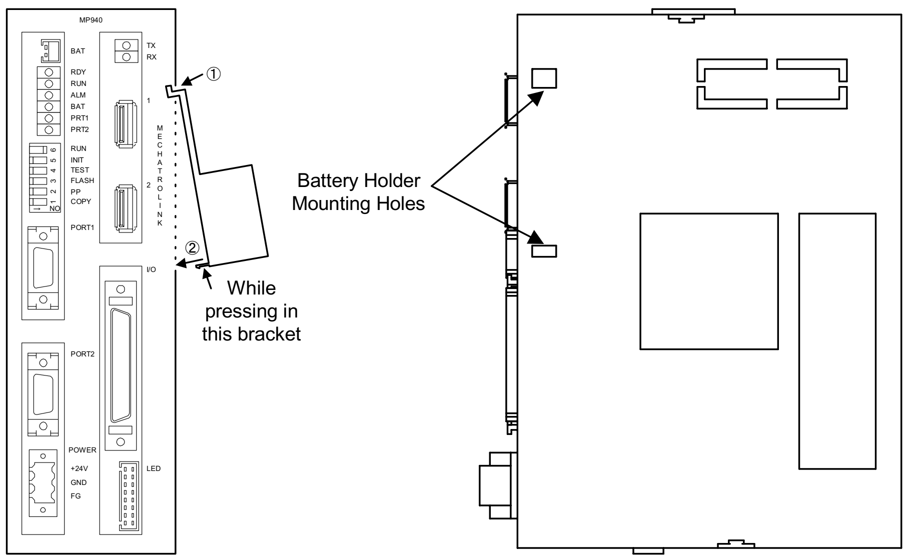
Top Spring: A
Bottom Spring: B

SGDH-A3	SGDH-05	SGDH-20
SGDH-A5	SGDH-08	SGDH-30
SGDH-01	SGDH-10	SGDH-50
SGDH-02	SGDH-15	
SGDH-04		

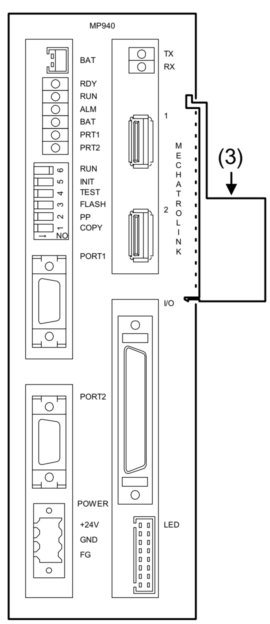
Mounting of Battery Holder

The method for mounting the MP940 battery holder is shown below:

1. Insert the battery holder into the MP940 battery holder mounting aperture (at the top).
2. Insert the battery holder into the bottom mounting aperture while pressing up on the battery holder in order to push up the hooks on the top of the holder.

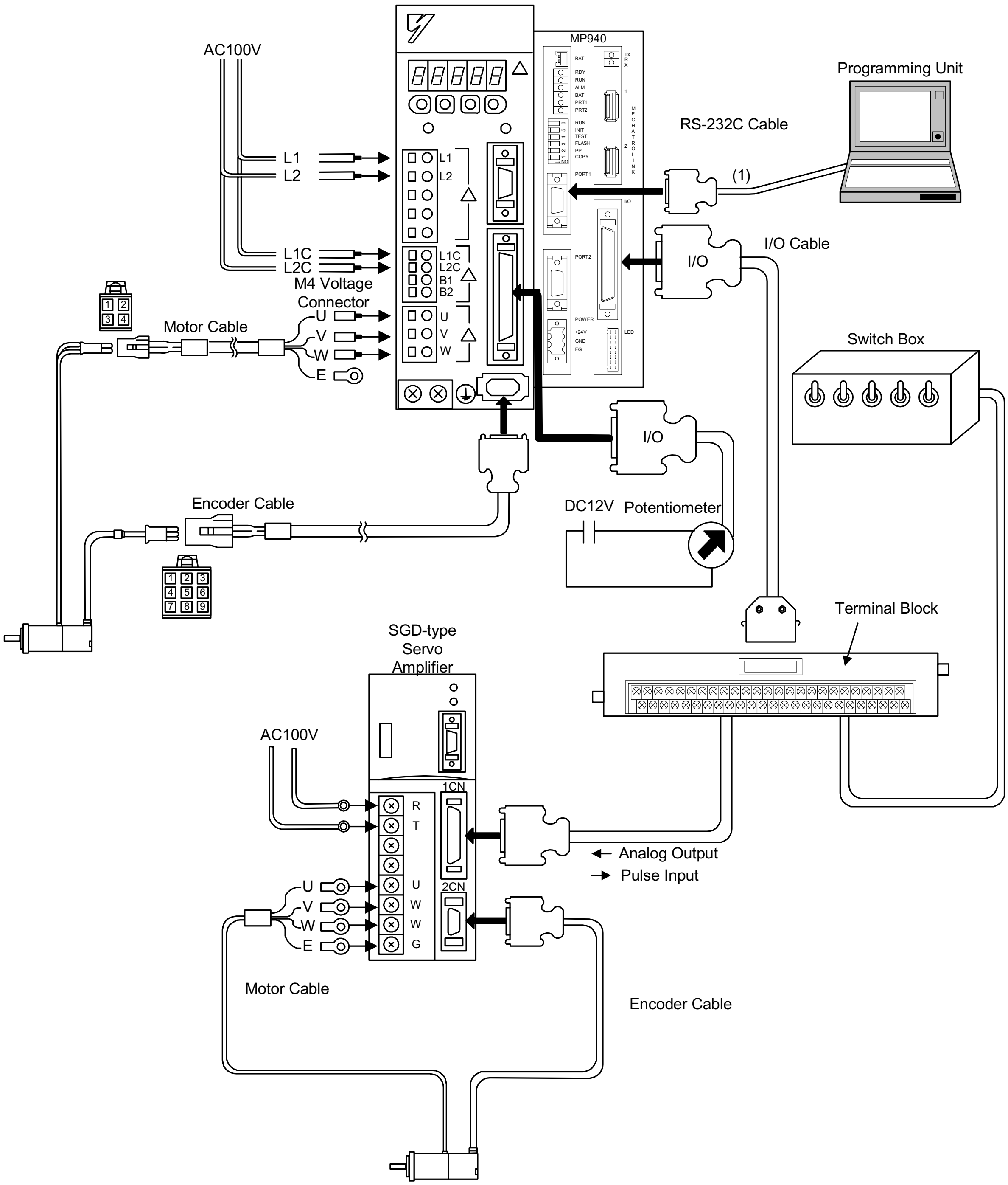


3. Ensure the battery holder is securely inserted.

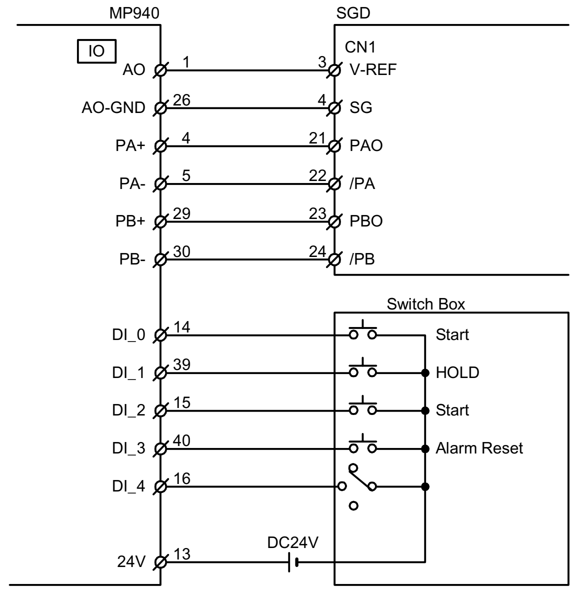


Connection and Wiring

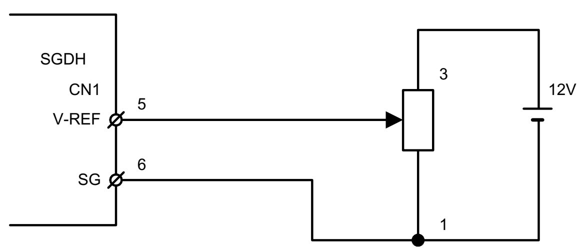
Connection of Peripheral Devices



Connection of the Servo Amplifier (SGD) and Switch Box



Potentiometer Connection with the SGDH V-REF Terminal as a General-purpose AI Input



Chapter 6: Parameters

The parameter setting methods (which are needed for the MP940 system operation) are explained in this chapter.

Parameter Outline

This section describes the parameter outline which is needed for the MP940 motion modules. Read this thoroughly for a complete understanding of the parameters.

Parameter Types and Classifications

The parameters are the "specified constants" which are needed for the motion function of the MP910 modules. Set up the most suitable parameter values so that the performance of the applied servo drives (= motor + amplifier) corresponds to machine specifications. To create or edit the parameters, use the MotionWorks™ Programing Unit.

Parameters are classified into the following four types:

Parameter Types

Classification	Register Number	Setting Contents
Fixed Parameters	No Register	Sets up mechanical condition of machine, motor, encoder, etc. These cannot be changed during operation because they cannot normally be changed once set.
Setup Parameters	OWC000 ~ OWC03F	Used for commanding the servo controller.They can be set up from the motion program or ladder program while running.
Monitor Parameters	IWC000 ~ IWC03F	User constants of the servo amplifier. They can be set up in the Motion Parameter window.
Servo Amplifier Parameters	Pn000 ~ Pn602	These are servo amplifier user parameters. They are set in the motion parameter setup screen.

To create, edit, or change the parameters, use the following methods:

Parameter Editing

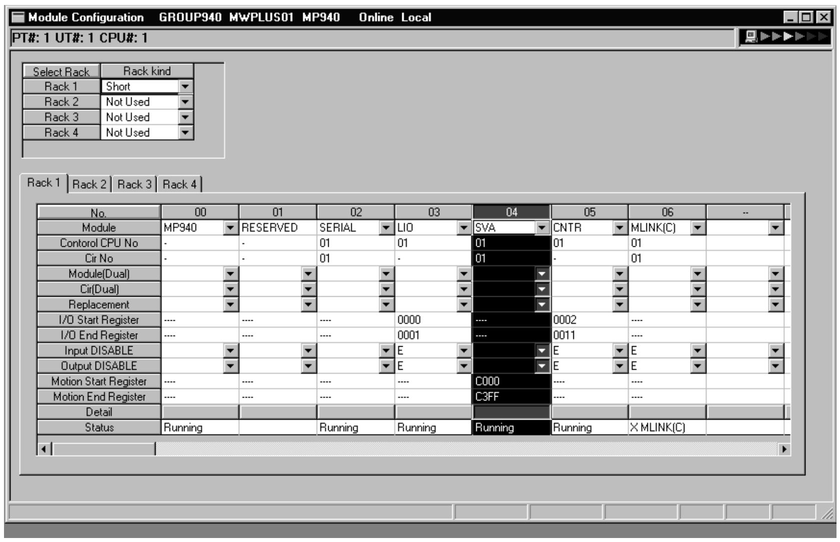
Tool	Method	Settable Parameters
PC Programing Unit	From the Definition folder, edits the parameters in Parameter Settings window.	Fixed Parameters Setup Parameters Servo Amplifier Parameters
Motion Program	<F17>In the motion program, sets up the parameters by substituting for setup parameter (output register <F18>OWC000 ~ OWC03F<F17>).	Setup Parameters
Ladder Program	From the ladder program, stores the parameters directly to setup parameters.	Setup Parameters

Parameter Setting

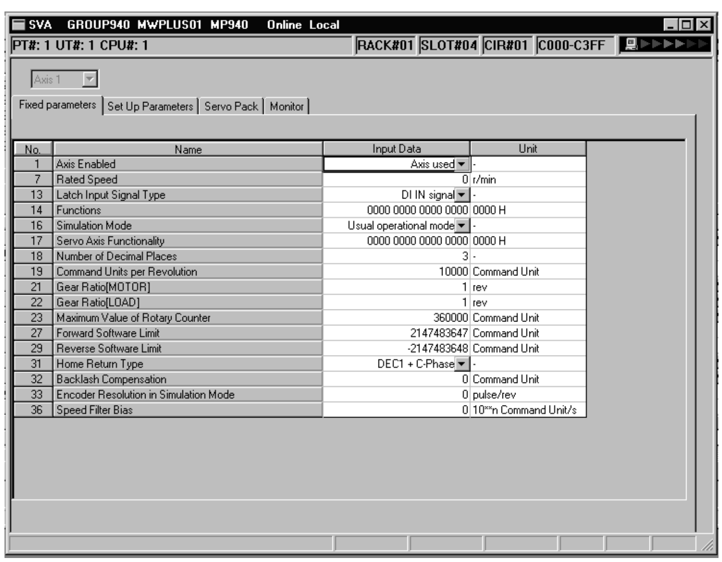
The parameter setting methods are explained here in detail.

Open the Parameter window

Double-click slot 4 (SVA) of the Module Structure Definition window.



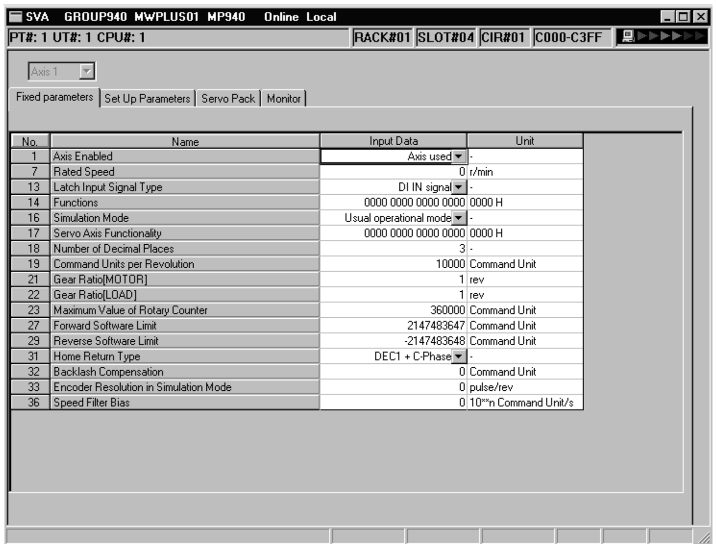
The New Program message box is displayed if an unset SVA definition window is opened. Proceed to the next operation by clicking **OK** in the Automatic Edit message box. The Motion Parameter window appears.



Parameter Setting

■ Fixed Parameter Setting

Set the parameters needed for servo adjustment in the Fixed Parameters tab.



Fixed Parameters Tab

Item Name	Content
Axis Number	The axis number shown in the combo box.Setting for “Axis1”
No.	Fixed Parameter Number
Name	Name of parameter to be set.
Input Data	Input (select) the parameter value.See the “Fixed Motion Parameters” list.
Unit	Setting data unit

See “Details of Fixed Parameters” for the setting content of the individual parameters.

The default values may be set without inputting each fixed parameter. Display the default values of the various fixed parameters in the fixed parameter setting table.

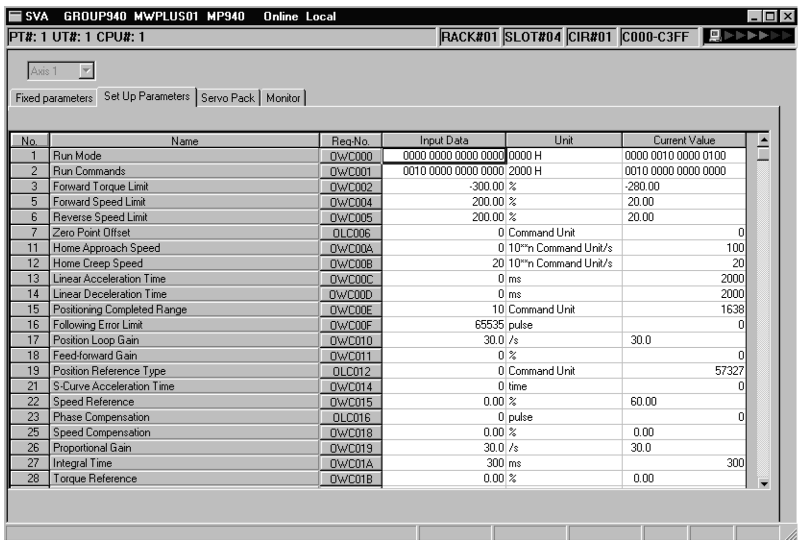
Set the default values as follows:

1. Select **Edit (E)** > **Default Setting (R)** in the Parameters menu.
2. Click the **Yes (Y)** button in the message box.
3. The default values are set for the fixed parameters.

These default settings apply to the fixed parameters of the currently displayed servo axis.

■ Set-up Parameter Setting

Click the Set-up Parameters tab.



Set-up Parameters Tab

Item Name	Content
Axis Number	The axis number shown in the combo box. Setting for Axis1.
No.	Set-up Parameter Number
Name	Name of parameter to be set.
Reg.-No.	The register number corresponding to the parameter name is displayed.
Input Data	Input (select) the parameter value. See the Motion Set-up Parameters list.
Unit	Setting data unit
Current Value	The current parameter values are displayed in the online mode. Nothing is displayed in the offline mode.

- See Details of Fixed Motion Parameters for the setting content of the individual motion set-up parameters.
- The input setting values are immediately saved into the machine controller register upon pressing the **Enter** key.The current value is then displayed.

The default values may be set without inputting each parameter. See the default values in the Fixed Parameters list.

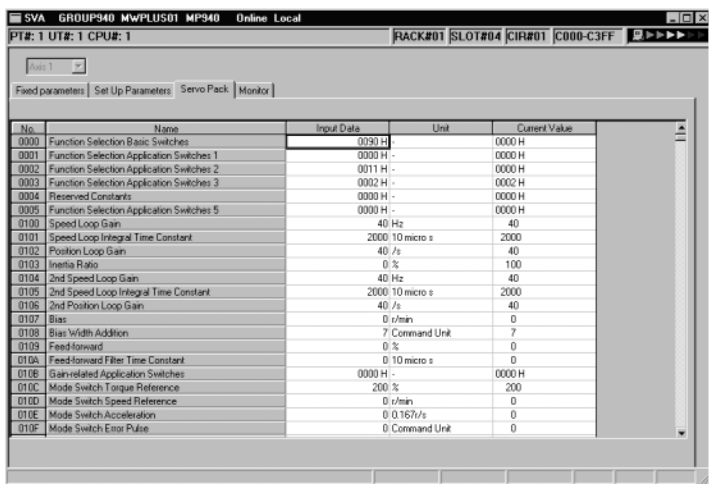
Set the default values as follows:

1. Select **Edit (E)** > **Default Setting (R)** in the Parameters menu.
2. Click the **Yes (Y)** button in the message box.
3. The default values are set for the fixed parameters.

These default settings apply to the parameters of the currently displayed servo axis. The setting values are immediately saved into the machine controller register upon executing the default setting. The current value is then displayed.

■ Servo Parameter Setting

Click the Servo Pack tab.



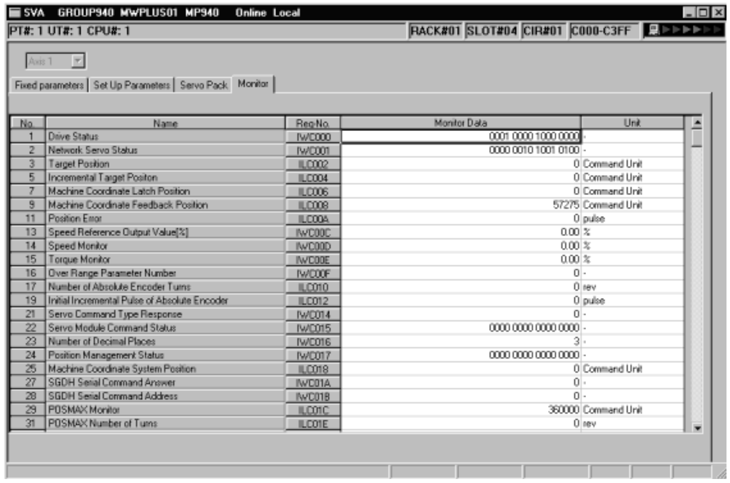
Servo Pack Tab

Item Name	Content
Axis Number	The axis number shown in the combo box. Setting for Axis1.
No.	These are servo amplifier parameter numbers.
Name	Name of the servo amplifier parameter
Input Data	Input (select) the Servo Amplifier parameter value. See the Servo Amplifier Parameters list.
Unit	Setting data unit
Current Value	The current parameter values are displayed in the online mode. Nothing is displayed in the offline mode.

• See SGDH User Parameters for the setting content of the individual servo amplifier parameters.

■ Monitor Display

Click the Monitor tab. The settings cannot be changed; they are read only.



Monitor Tab

Item Name	Content
Axis Number	The axis number shown in the combo box. Setting for Axis1.
No.	Monitor Parameter Number
Name	Name of Monitor parameter
Reg.-Number	This is the register number corresponding the monitor parameter.
Monitor Data	The current parameter values are displayed in the online mode. Nothing is displayed in the offline mode.
Unit	Setting data unit

- See Details of Fixed Parameters for the setting content of the individual servo parameters for motion monitoring.

Parameter Deletion

Click **File** > **Delete** in the Parameters menu.

Click the **Yes** button in the message box.

The fixed parameters and setup parameters for all axes are deleted upon executing the delete operation.

Saving Parameters

Select **File** > **Save** in the Parameters menu.

Click the **Yes** button in the message box.

Click **Y** in the message box.

Modified parameters cannot be saved if bit 1 (during servo drive operation) of the current value is ON in parameter No. 2 Servo drive operation command on the Setup Parameter tab. The save operation is possible after setting bit 1 to OFF.

The fixed parameters for all servo axes whose numbers are currently displayed, are saved upon executing the save function. The error detection message box is displayed if the save fails. Remove the cause of the error and repeat the save operation after referring to the Error Message List.

Parameter Details

Each of the MP940 parameters are explained here in detail.

Details of Fixed Parameters

The fixed parameters cannot be changed when the current value of bit 0 of the setup parameter "Run Command Setting (OWC001)" is ON. Care is required, because the position data is initialized upon changing the fixed parameters. Details of the fixed parameters appear below.

Fixed Parameters

Number	Name	Content		Default Value
1	Axis Enabled	Axis Use/Non-use Designation. 0: Unused; 1: Used When unused is selected, control of that axis is immediately discontinued, and monitor parameters (IWC00~IWC03F) are not updated. 0 is stored in the operation status (IWC000).		0 (Unused)
7	Rated Speed	Motor rpm		0
13	Latch Input Signal Type	Set the external signal executing DI latch detection. 0: The DI signal is used as the latch detection signal. 1: The C pulse is used as the latch detection signal.		0
14	Functions	Selects additional functions for the types and meanings of the signals used.		—
	Bit 0 ~ 1	Unused	—	—
	Bit 2	Limit Switch Signal Selection (LIMITSEL)	During zero point return, select whether to use OBC001F , or the DI signal D105 as the limit switch signal. 0: use OBC001F; 1: use DI Signal (D105 deceleration limit signal) When using OBC001F it is necessary to connect (program) the external signal (DI signal integrated into the LIO-01 module, etc.)in the user program to OBC001F.	0
	Bit 3 ~ 6	Unused	—	—
	Bit 7	Motion Command Use Selection (MCMDSEL)	During position control mode selection (OWC000 b2), set whether the motion command code (OWC020) is used. 0: Unused; 1: Used	1 (Used)
	Bit 8 ~ 15	Unused	—	—
15	Unused	—		—

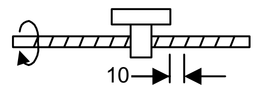
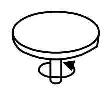
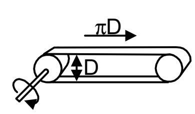
Fixed Parameters (Continued)

Number	Name	Content		Default Value
16	Simulation Mode	0Bit 0 ~ 1	0: Normal Run Mode 1: Simulation Mode	0 (Normal Run)
17	Servo Axis Functionality	Selects whether each function is enabled/disabled during motion command use.		
	Bit 0~3	Command Unit Selection (CMD_UNIT)	Select the input command units. 0:pulse(electronic gearing disabled) 1: mm 2: deg 3: inch Set a number between 0~3. Minimum command unit is determined by this command unit selection as well as fixed motion parameter No. 18 Decimal Place.	0 (pulse)
	Bit 4	Electronic Gearing Selection (USE_GEAR)	Selects whether electronic gearing is enabled. 0:Disabled1:Enabled When there is a Command Unit Selection pulse, electronic gearing is disabled even though this flag is enabled.	0 (disabled)
	Bit 5	Axis Selection (PMOD_SEL)	Linear Axis/Rotary Axis Set whether the control axis ha a motion limit. 0:Linear Axis This is an axis with a motion limit. _ Soft limit function enabled. 1:Rotary Axis This is an axis without a motion limit. _ Soft limit function disabled	0 (Linear Axis)
	Bit 6	Backlash Compensation Selection (USE_BKRSH)	Selects whether backlash compensation is executed. 0: Disabled; 1: Enabled	0 (Disabled)
	Bit 7	Soft Limit (Forward) Selection (USE_SLIMP)	Selects whether a positive soft limit is used during motion command (OWC020) usage. 0: Disabled; 1: Enabled Set the soft limit value with fixed parameter 27. The soft limit function is enabled after the timing becomes the zero point return completion state (IBC0156 is ON).	0 (Disabled)

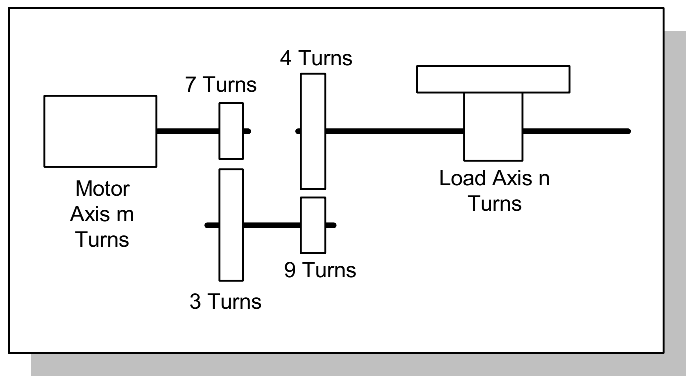
Fixed Parameters (Continued)

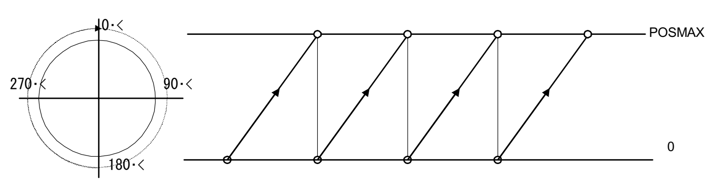
Number	Name	Content		Default Value
17	Bit 8	Soft Limit (Reverse) Selection (USE_SLIMN)	Selects whether a reverse soft limit is used during motion command (OWC020) usage. 0: Disabled; 1: Enabled Set the soft limit value with fixed parameter 29. The soft limit function is enabled after the timing becomes the zero point return completion state ((IBC0156) is ON).	0 (Disabled)
	Bit 9	Override Selection (USE_OV)	Selects whether the override function is used. 0: Disabled; 1: Enabled Setting value of the OWC02C [Override] is enabled when 1 (enabled) is selected. [Override] becomes 100% fixed when 0 (disabled) is selected. Note: Override is a function in which the feed speed setting is modified and used.	
	Bit 10	Deceleration LS Inverse Selection (INV_DEC)	During zero point return, select whether to use an inverse limit switch (decelerationLS). 0: Disabled; 1: Enabled	
	Bit 11~12	Unused	—	
	Bit 13	Forward Overtravel Selection (OVT1-SEL)	Selects whether the forward overtravel function is used. 0: Disabled; 1: Enabled	
	Bit 14	Reverse Overtravel Selection (OVT2-SEL)	Selects whether the reverse overtravel function is used. 0: Disabled; 1: Enabled	
	Bit 15	Unused	—	
18	Number of Decimal Places	Set the number of places below the decimal point for the input command unit. The minimum designatable unit in parameter and command selection (Bit 0 ~ 3 of the motion controller function selection flag) is determined here.		

Fixed Parameters (Continued)

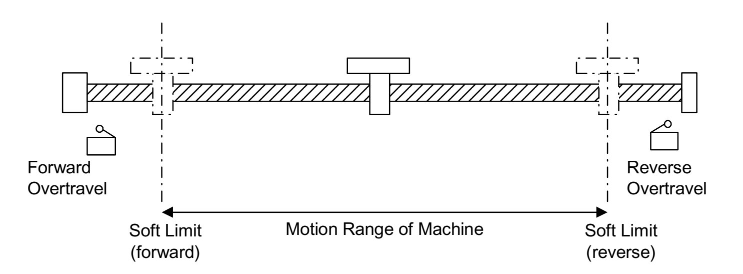
Number	Name	Content	Default Value
19	Command Units per Revolution	Parameter that sets up the load motion amount (command unit) of 1 load axis rotation. ï Setting range: 1~231-1	—
		Ball Screw  Ball Screw Pitch = 10mm Set Ball Screw Pitch = 10mm Command Unit Selection = mm Decimal Place = 3 Å´ Motion per1Machine Rotation = 10,000	—
		Rotation Table  1 Turn = 360° Set Table 1Rotation =360_ Command Unit Selection =deg Decimal Place =3 Å´ Motion per Machine Rotation = 360,000	—
		Belt  Set Roller Rotation1 = 360_ Command Unit Selection = mm Decimal Place = 3 ´ Motion per 1 Machine Rotation = ~ 1000	—

Fixed Parameters (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Content</th><th>Default Value</th></tr>
<tr><td>21</td><td>Gear Ratio (Motor)</td><td rowspan="2">Parameter that sets up gear ratio between the motor and load. Set up the following 2 values in the configuration so that if motor axis rotates m rotations, then load axis rotates n rotations.
Gear ratio (motor side) = m
Gear ratio (load side) = n
Setting Example


In the above diagram: Set Decel Ratio = n/m = 3/7~4/9 = 4/21
Then set: Gear Ratio (Motor Side) = 21
Gear Ratio (Load Side) = 4</td><td>1</td></tr>
<tr><td>22</td><td>Gear Ratio (Load)</td><td>1</td></tr>
<tr><td>23</td><td>Maximum Value of Rotary Counter</td><td>When a rotary axis is set, set the reset position upon 1 rotation. This is disabled in the case of linear axes.
Setting range: 1 ~ 2^{31-1}(Command Unit)
(Ex.) Reset at each 360 degree in a rotating unit.

</td><td>360000</td></tr>
<tr><td>27</td><td>Forward Software Limit</td><td>Sets the position at which the soft limit function operates.
Setting range: 1 ~ 2^{31}-1(Command Unit)
Set up using or not using the soft limit function in b7 and b8 of Fixed Parameter No. 17 [Motion Controller Function Selection Flag].</td><td>2^{31}-1</td></tr>
</table>

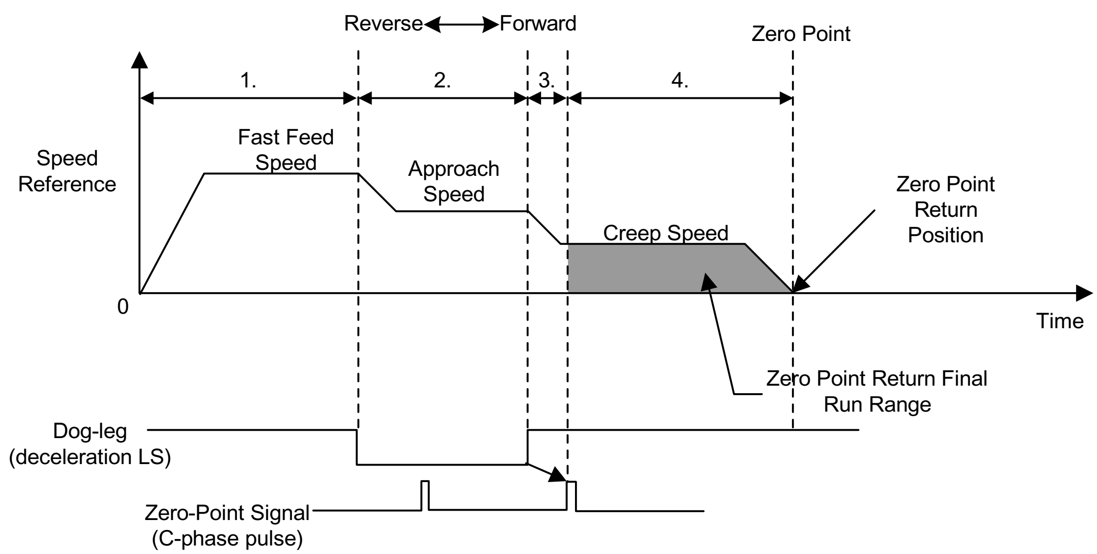
Fixed Parameters (Continued)

Number	Name	Content	Default Value
29	Reverse Software Limit	The Soft Limit function constantly monitors the range in which the controller operates the machine by setting the upper/lower limits of the mechanical system operation range in the fixed parameters.  	-2^{31}
31	Home Return Type	Sets the zero point return format during Zero-point Return (ZRET) when using the Motion Command (OWC020). See the following pages for zero-point return formats.	0 (DEC1+C-phase Pulse)
32	Backlash Compensation	Sets up the amount of backlash compensation when backlash compensation is enabled (Bit 6 of fixed parameter No. 17, Servo Axis Functionality).	0
33	Encoder Resolution in Simulation Mode	Sets the encoder resolution in pulses per revolution.	0 pulse/rev
36	Speed Filter Bias	Sets the bias speed during exponent accel/decel w/bias.	0
37~48	Unused	—	—

The zero-point return formats are as follows:

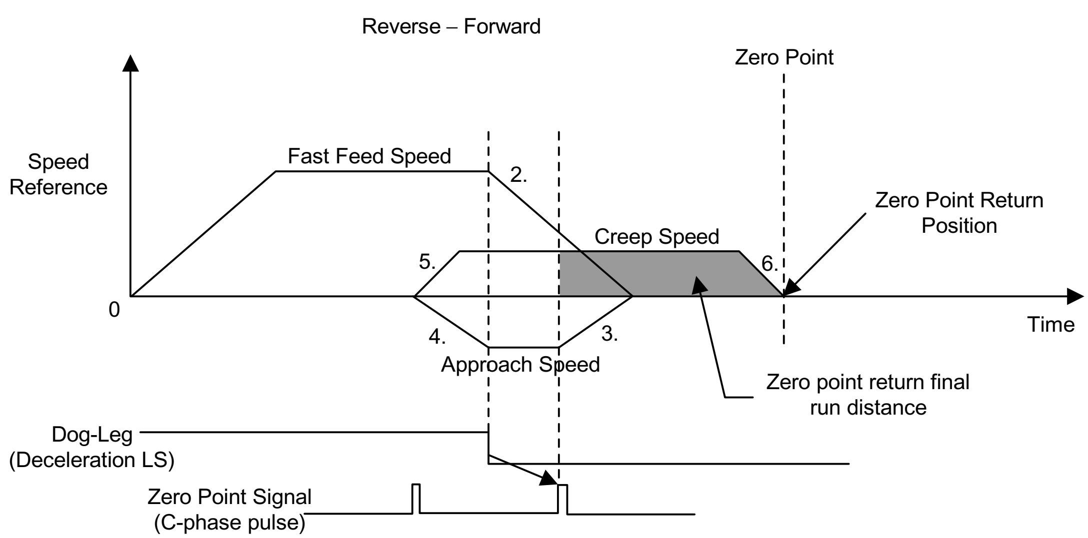
- 0: DEC1 + C-phase Pulse Format

Executes zero-point return in 3-stage speed switching format.



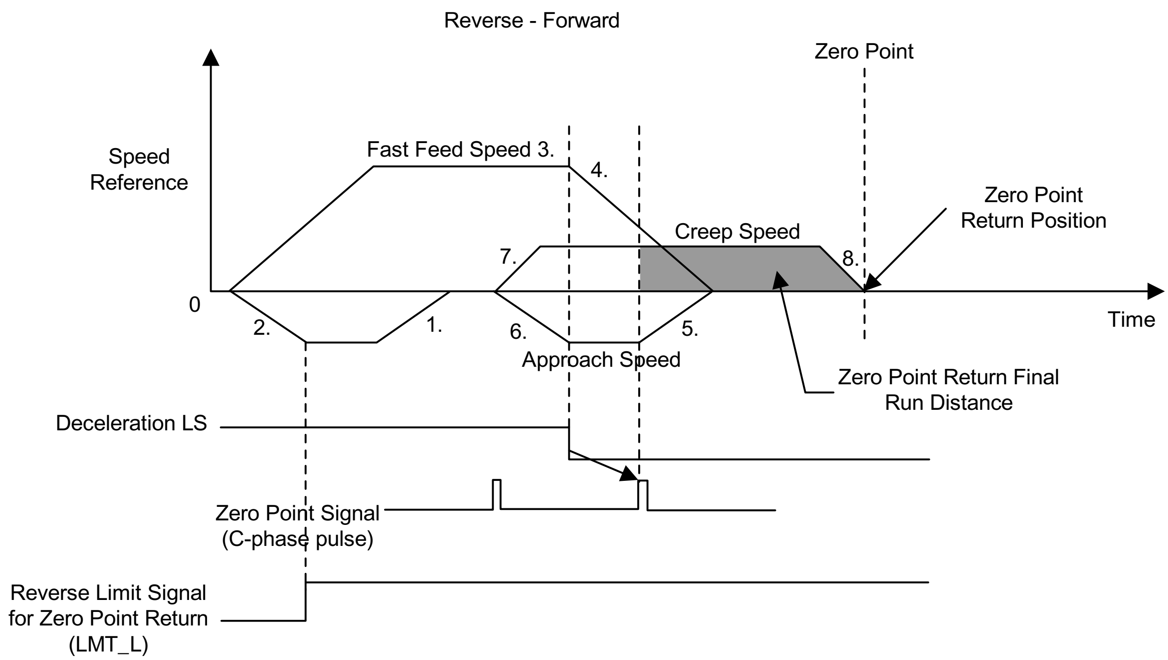
- 6: DEC2 + C-phase Pulse Format

Exectes zero-point return by reversing at approach speed, then searching for the zero-point at creep speed. This format is used in machines that require repeat precision.



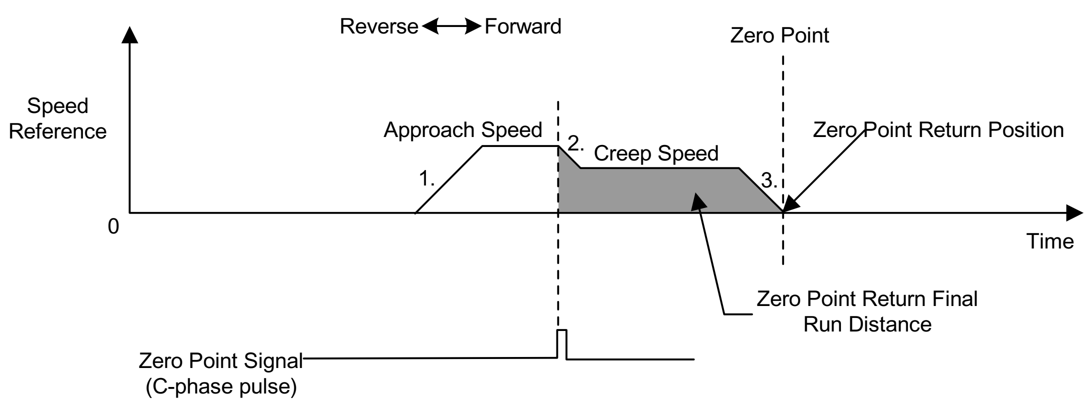
■ 7:DEC1+LMT+C-phase Pulse Format

This format knows the current position by the Fwd/RevLMT signal, and automatically executes retreival. Zero point return is possible from any position in this format.



■ 3:C-phase Pulse Format

Executes zero-point return using only the motor C-phase pulse in machines where deceleration LS, etc. is not incorporated.



- 2:DEC1+ZERO Signal Format

  Executes zero-point return using the ZERO signal instead of the C-phase pulse of the “DEC1+C-phase pulse format”.

- 4:DEC2+ZERO Signal Format

  Executes zero-point return using the ZERO signal instead of the C-phase pulse of the “DEC2+C-phase pulse format”.

- 5:DEC1+LMT+ZERO Signal Format

  Executes zero-point return using the ZERO signal instead of the C-phase pulse of the “DEC1+LMT+C-phase pulse format”.

- 1:ZERO Signal Format

  Executes zero-point return using the ZERO signal instead of the C-phase pulse of the “C-phase pulse format”.

Details of Setup Parameters

Machine Coordinate Zero-point Position Offset Setting (ABSOFF). This data structures the position control managed by the module. Erroneous settings in this register affect subsequent motion operations. Always ensure the data settings are correct prior to operation. Failure to conduct these checks may result in tool damage and/or physical injury, due to the intervention of the tool.

Run Mode Setting (RUNMOD)

Register Number	Bit Name	Content	Default Value
OWC000	Sets control modes and operation modes such as alarm reset, etc. The bit structure is shown below.		—
Bit 0	Speed Reference Output Mode (NCON)	Selects the speed reference output mode.	0
Bit 1	Torque Reference Output Mode (TCON)	Selects the torque reference output mode.	0
Bit 2	Position Control Mode (PCON)	Selects position control mode.	1
Bit 3	Phase Control Mode (PHCON)	Selects phase control mode.	0
Bit 4	Zero-point Return Mode (ZRN)	Selects the zero-point return mode.	0

■ Supplemental Explanation

The order of priority in operation mode setting (OWC000), and run commands (OWC001), is as follows:

When ON at the same time, control modes are executed in order of priority.

(High) Order of Priority (Low)

←

RUN>ZRN>NCON>TCON>PCON>PHCON

Operation differs according to the control mode when a RUN signal (Bit 0 of OWC001) is turned OFF while running.

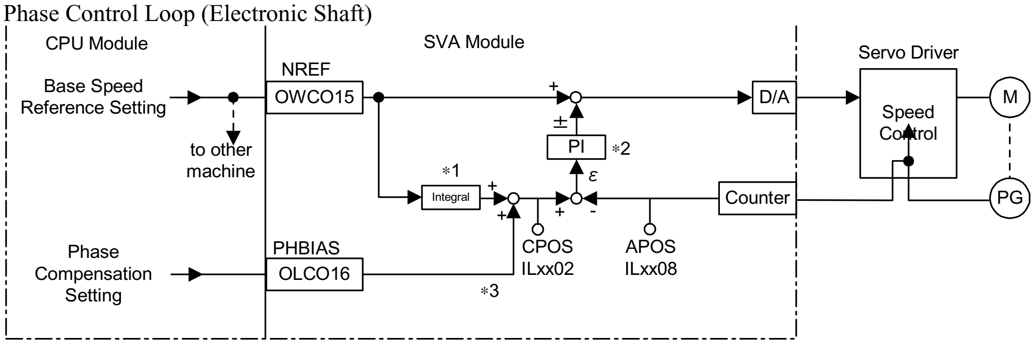
- When Selecting Position/Speed/Phase Control/Zero-point Return Modes
  The RUN signal remains ON until the axis decelerates to stop according to the linear deceleration parameter set from the current speed reference.
- If Torque Reference Output Mode
  When the RUN signal is OFF, 0 is output immediately as a speed reference, and outputs an OFF signal in the case of a servo amplifier.

RUN Mode Setting (RUNMOD) (Continued)

Register Number	Bit Name	Content	Default Value
Bit 5	Phase Control Test Signal (PHTEST)	Selects whether the phase reference generation operation or the results of the In the phase control mode PI control operation are enabled/disabled. 0: Disabled; 1: Enabled When Disabled is selected, the settings during filtering and deceleration are equivalent to the speed reference output mode in 0.	0
Bit 6	Alarm Clear (ACR)	The following monitor parameters are cleared when this bit is ON. Offset Error (bit 0) of the run status (IWC000) and servo parameter setting error (bit 1). Alarm (ILC022)	0
Bit 7	Phase Reference Generation Operation Disabled (PHREFOFF)	Selects whether to use phase control as an electronic shaft or electronic gear. 0: Electronic Shaft 1: Electronic Gear Ratio	0

RUN Mode Setting (RUNMOD) (Continued)

<table>
<tr><td>Bit 7 (contin-ued)</td><td colspan="3">
Phase Control Loop (Electronic Shaft)

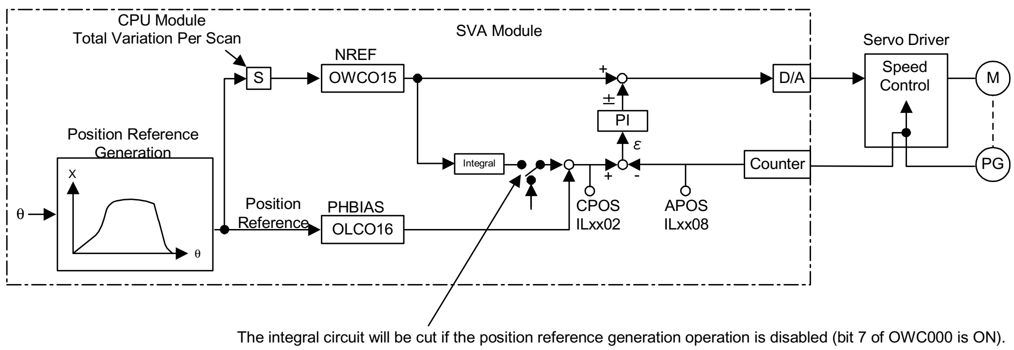


*1.Integrates the base speed reference, and calculates the matching position (pulse).

*2.Generates the speed reference from the deviation e between the target position (CPOS) and the current position (APOS).This becomes the position (phase) compensation.

*3.If phases are to be displaced, add the amount of displacement (convert the angle of rotation of the motor axis into number of pulses) as the phase compensation setting.

Electronic Cam Control Loop



The electronic cam control loop cuts the integral circuit of the base speed reference, and sends the position reference according to the phase compensation setting.
</td></tr>
<tr><td>Bit 8</td><td>Motion Command Mode Enabled/Disabled (MCDSEL)</td><td>Selects whether a motion command code (OWC020) is used or not.
0: Disabled; 1: Enabled
Enabled only when the motion command usage selection (fixed parameter, No. 14, bit 7) is Used (= 1).</td><td>1</td></tr>
<tr><td>Bit 9</td><td>Zero-point Return Direc-tion Selection (ZRNDIR)</td><td>Designates the zero-point return direction.
0:Reverse Direction (Position pulse decreases)
1: Forward Direction (Position pulse increases)</td><td>0</td></tr>
<tr><td>Bit 10</td><td>Absolute Position Readout Request (ABSRD)</td><td>When this bit is turned ON, absolute position data is read out from the absolute encoder.The absolute position readout completion signal (Bit 10 ofIWC000) is ON upon completion of readout.
This is used when servo drive power is turned ON while the MP940 is in a power ON state.</td><td>0</td></tr>
<tr><td>Bit 11</td><td>Unused</td><td>Set 0</td><td>0</td></tr>
<tr><td>Bit 12</td><td>Unused</td><td>Set 0</td><td>0</td></tr>
</table>

RUN Mode Setting (RUNMOD) (Continued)

Bit 13	DI Latch Detection Request (DINTREQ)	When this bit is set to ON, immediate position at the time that the DI latch signal went ON is messaged to the machine coordinate latch position (ILC006).The DI latch completion signal (Bit 11 of IWC000) goes ON upon completion of DI latch detection.	0
Bit 14	Unused	—	0
Bit 15	Phase Control Integral Reset (IRESET)	In phase control mode, the PI control integral is reset when this bit is ON.	0

■ Supplemental Explanation

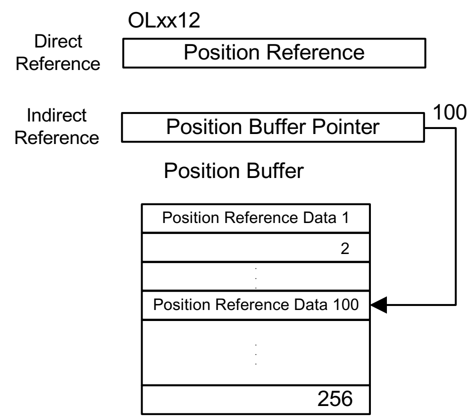
The latch selection is one of the following according to fixed parameter No. 13 (DI Latch Detection Signal Selection).

- (DI Latch Detection Signal Selection = 0) :EXT3 (SGDH External Input Signal 3)
- (DI Latch Detection Signal Selection = 1) :C-phase (encoder C-phase)

Run Command Setting (SVRUNCMD)

Number	Register Number	Bit Name	Content	Default Value
2	OWC001	Sets the operation modes necessary for signal output from the module to the SGDH as well as motion control.The bit structure is shown below.		
	Bit 0	Servo ON (RUN) (DO0)	This is used as a servo ON signal for the drive. 1 is output from DO0 when SVCRDY (IBC0007) is ON and this bit is 1.	0
	Bit 1	P-CON	Speed Loop P/PI Switching	0
	Bit 2	G-SEL	Gain Switching	0
	Bit 3	P-CL	Forward External Torque Limit Input	0
	Bit 4	N-CL	Reverse External Torque Limit Input	0
	Bit 5	ZCLAMP	Zero Clamp Input	0
	Bit 6	PHSCANSEL	Phase Control Mode Synchronous Scan Selection 0: H Scan; 1: S Scan	0
	Bit 7	PSCANSEL	position control Mode Control Loop Synchronous Scan Selection 0: H Scan; 1: S Scan	1
	Bit 8	ACCSEL	Position Control Mode Selection of Accel/Decel Function Use in Simple Position-ing 0:Used 1:Unused	0
	Bit 9	SEGSEL	Position Control Mode Segment Assignment Function Use Selection 0:Used 1:Unused	0
	Bit 10	Unused	—	—
	Bit 11	Unused	—	—

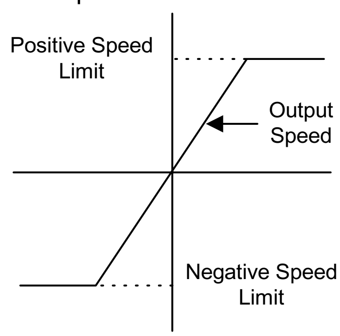
Run Command Setting (SVRUNCMD) (Continued)

Number	Register Number	Bit Name	Content	Default Value
2	Bit 12	Position Reference Selection (USE_BUF)	Selects the position reference data designation method. Enabled only when the motion command (OWC020) is used in the position control mode. 0: The direct designation (OLC012) data is assumed to be the position reference data. 1: The indirect designation (OLC012) data is assumed to be the position buffer number.  The position buffer is inside the MP940 module, and must be written into the startup drawing at power ON. For writing to the position buffer, see OBC012E, OBC012F, and OLC03A.	0
	Bit 13	Speed Reference Selection (SPDTYPE)	Selects the speed designation method such as feed speed, approach speed, creep speed, etc. Enabled only when the motion command (OWC020) is used in the position control mode. 0: Designate the speed in command units, and set the fast feed speed into OLC022. The approach speed (OWC00A) and creep speed (OWC00B) setting units are also 1 = 10n command units/min. 1: Designate the speed in percentage (%), and set the fast feed speed into OLC015. The approach speed (OWC00A) and creep speed (OWC00B) setting units are also 1 = 0.01%.	0
	14	Position Reference Type (XREFTYPE)	Selects the data type for position reference data OLC012 when motion command (OWC020) is used in position control mode. 0: Absolute Position Format Sets the absolute position in OLC012. 1: Incremental Addition Format Sets data into OLC012 in which the current movement is added to the previous value of OLC012. Note: The absolute position format is assumed when indirect designation is selected for the position reference.	1

Run Command Setting (SVRUNCMD) (Continued)

Number	Register Number	Bit Name	Content	Default Value
2	15	Zero-point Return Deceleration Limit Switch Number (LSDEC)	This functions as a limit switch signal (deceleration LS) in the zero-point return operation. Fixed Parameter No. 14 “Additional Function Use Selection” This is enabled when the bit 2 limit switch signal selection in OFF. It is necessary to connect (program) external signals (DI signals integrated into the LIO-01 module) to OBC001F.	0

Other Command/Mode Settings

Number	Name	Register Number	Bit Name	Content	Default Value
3	Forward Torque Limit	OWC002	-32768~32767	Sets the torque limit referenced to a servo amplifier, or inverter. Unit:0.01% Set to a positive value (units of 0.01%) for VS-866, and a negative value (units of 0.01%) for servo amplifiers.	-300.00 (-300.00%)
4	Unused	OWC003	—	Set 0	0
5	Forward Speed Limit	OWC004	0 ~ 32767	Sets forward and reverse speed limits. Designated in percentage (%) of rated speed. The limit is output if the result if the result of adding the compensation speed to the designated speed exceeds the limit.  	150.00 (150.00%)
6	Reverse Speed Limit	OWC005	0 ~ 32767		150.00 (150.00%)
7	Zero-point Offset	OLC006	-2^{31} ~ 2^{31-1}	It is possible to offset the position data by the setting value of this register only. Although this is also enabled during RUN, use this during OFF. This register OLC006 is data which structures the position control managed by the MP940 module.Erroneous settings in this register affect the following motion operations.Always be sure to check that the data settings are correct prior to operation. Failure to conduct these checks may result in tool damage, and physical injury, due to the intervention of the tool.	0
8 ~ 10	Unused	OLC008	—	Set 0	0

■ Supplemental Explanation

The usage method for zero-point offset is shown below.

- When used in applications where the absolute encoder moves in only one direction:

  Using the motion parameter zero-point posiiton offset setting (OLC006), an absolute encoder may be used in single direction applications by creating a user program which manages the absolute position.

- When initializing an absolute encoder:

  Pulse reset in less than 1 rotation is not possible when an absolute encoder is initialized. For example, when stopping at 95.5 rotations, an incremental pulse is sent corresponding to the 0.5 rotation even though an absolute encoder was initialized. Position data corresponding to the 0.5 rotations, rather than 0, is thereby messaged to the position monitor (ILC008).

Set the following to set the position monitor to 0.

(Assumed Conditions)

The 120 pulse initial incremental pulse is assumed to be sent after the absolute encoder has been initialized and the MP940 turned ON. The number displayed on the position monitor is 120.

(Countermeasures)

Countermeasures can be adjusted with the zero-point position offset. The position monitor shows 0 if -120 is set into the zero-point position offset. This setting is recommended for drawing A (start processing drawing) as the value set in the zero-point position offset is reset to 0 upon turning the power OFF.

(Exp. 1) DWG.A

OLC006 - | 0000000120 > OLC006

(Exp. 2) DWG.A

OLC006 -| DL00022 > OLC006

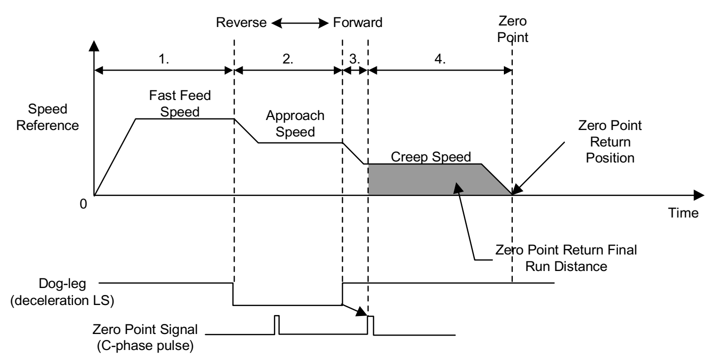
Set the above, then open the register list screen, and set 120 in DL00022 using the MP940 programming panel. Once set, this program is automatically executed, and -120 set into OLC006 at MP940 power ON because DL00022 (D register of DWG.A) has battery backup.

Although DL00022 was used in this example, another D register (DLC0C0x) or M register (MLC0C0x) can also be used. The -120 value must be changed each time the absolute encoder is initialized because the initial incremental pulse within a single rotation changes.

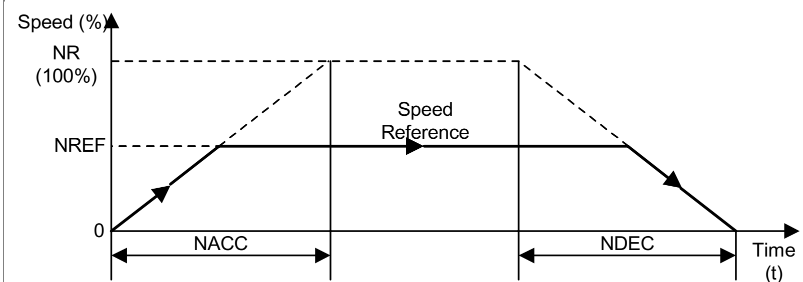
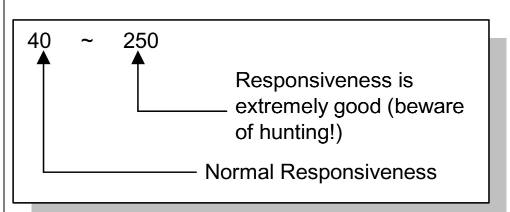
In the case of Example 1, the user program must be modified using the programming panel. In Example 2, there is no need to mmodify the user program, and only the register data is modified using the programming panel. Example 2 is more convenient in the case of repeating machines.

Set as command units when the motion command usage selection (fixed parameter) is "Used" and the motion command enablement is 1 (= enabled). Set as a pulse in all other cases. See the section on "Absolute Encoder Initialization" for the absolute encoder initialization procedure.

Other Command/Mode Settings (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Register Number</th><th>Setting Range</th><th>Content</th><th>Default Value</th></tr>
<tr><td>11</td><td>Home Approach Speed</td><td>OWC00A</td><td>0 ~ 32767</td><td>Sets the approach speed and creep speed during zero-point return (ZRET). Be aware that the setting units differ according to the speed reference selection (OBC001D).
When OBC001D = 0 (designated in command units), 1 =10^n command units/min.
(n = decimal places below 1)
Pulse Units: 1 = 1000 Pulses/min.
mm Units: 1 = 1mm/min.
deg Units: 1 = 1deg/min.
Inch Units: F 18>
1 = 1 inch/min.
When OBC001D = 1 (% designation)
1 = 0.01% (ratio of rated speed)
Note: In zero-point return mode, a percentage (%) command results regardless of the setting of OBC01D.</td><td>0</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Home Creep Speed</td><td rowspan="2">OWC00B</td><td>0 ~ 32767</td><td>—</td><td>0</td></tr>
<tr><td colspan="3">
</td></tr>
<tr><td>13</td><td>Linear Acceleration Time</td><td>OWC00C</td><td>0 ~ 32767</td><td>Sets the linear accel/decel time constant in the speed, position control, and zero-point return modes.
Unit: ms
Sets the acceleration time from 0% to 100% (rated speed).</td><td>0</td></tr>
</table>

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
14	Linear Deceleration Time	OWC00D	0 ~ 32767	—	0
					
15	Positioning Completed Range	OWC00E	0 ~ 65535	Used in position control zero-point return modes. Sets the range in which the positioning completion signal (bit 13 of IWC000) or zero-point return completion signal (bit 15 of IWC000) turns ON. Command Unit: See the description of bit D of IWC000.	10
16	Following Error Limit	OWC00F	0 ~ 65535	Used in the position, phase control, and zero-point return modes. Sets the limits outputting deviation error (bit 0 of IWC000). Upon exceeding this range, the deviation error goes ON, and position control is executed using this value as the deviation. Deviation error is not detected if 0 is set.	65535
17	Position Loop Gain	OWC010	0 ~ 32767	Parameter that sets up servo [Position Loop Gain]. The [Position Loop Gain] is an important constant that determines servo response performance. The scale of the setting value is shown as follows:  Set up the most suitable value according to machine rigidity, inertia, servo motor, etc. • Setting range:1 ~ 32767 [0.1/s]	300 (30.0)

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
18	Feed Forward Gain	OWC011	0 ~ 200	Positioning time can be shortened by executing the feed forward control. • Setting range: 0 ~ 200 [%] The bigger the setting value, the less the error between reference position and actual position. Vibration may result if the setting is too high.	0
19	Position Reference Type	OLC012	$-2^{31} \sim 2^{31-1}$	Sets the position reference. Be aware that the meaning of the set data differs according to the position reference selection (OBC001C) and the position reference type (OBC001E). Explanation Uses OLC012as the position reference of the absolute position reference format. OBC001C = 0: Direct Designation OBC001E = 0: Absolute Position Reference Format Uses OLC012as the position reference of the integral addition format. OBC001C = 0: Direct Designation OBC01E = 1: Integral Addition Format Uses OLC012 as the position buffer pointer. OBC01E = 1: Indirect Designation OBC001E = 0: Absolute Position Reference Format Note: A setup parameter error results if OBC01E = 1 is set.	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
21	S-curve Acceleration Time	OWC014	Average Motion Filter 0 ~ 255 (0 = 1 = no filter) Exponent Accel/Decel 0 ~ 32767	Sets simple execution of S-curve accel/decel in the speed reference output mode and position control mode. During Speed Reference Output Mode, calculates the average motion of the speed reference (Vr), and makes this the speed reference. During Position Control Mode, calculates the feed pulse at each scan, and makes this the position reference. The averaging operation is not executed in the following operations: When switching to speed or position control mode from another control mode during operation. When the number of averaging iterations is changed during operation. When motion commands have been used in the position control mode The filter time constant setting range varies according to the filter type selection (bit 4 ~ 7 of OWC021). When Filter Type 1 = Exponent Accel/Decel Filter, 0 ~ 32767 When Filter Type 2 = Motion Average Filter, 0 ~ 255 Note: This is enabled at feed completion (IBC0152 = ON) if the filter time constant has been changed.	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
22	Speed Reference	OWC015	-32768 ~ 32767	During Speed Reference Output Mode Sets the speed reference in units of 0.01%. During Position Control Mode, sets the speed reference in units of 0.01% in the normal status. When motion commands have been used in the position control mode, sets the feed speed in units of 0.01% (ratio of rated speed) when speed reference selection (OBC001D) is set to 1. During Phase Control, sets the base speed reference in units of 0.01%. D/A output = (Speed Reference (OWC015) ~ D/A Output Voltage Setting (Fixed Parameter 9) at 100% speed)/ 10000. Example: (10000 ~ 6V)/10000 = 6.0V is output if the D/A Output Voltage setting = 6V, and the Speed Reference = 100% at 100% speed.	0
23	Phase Compensation	OLC016	-2^{31} ~ 2^{31-1}	Set the number of compensation pulses in single pulse units in the phase control mode. Used when compensating reference pulses in control systems without taking rigidity and gain into account.	0
25	Speed Compensation Setting (NLIM)	OWC018	-32768 ~ 32767	Set the speed compensation in units of 0.01% in the phase control mode. The speed compensation (OWC018) is enabled even in position control mode when speed compensation enablement (bit 10 of OWC018) is ON during position control.	0
26	Proportional Gain	OWC019	0 ~ 32767	Set the PI control proportional gain in units of 0.1 when in phase control mode.	300 (30.0)
27	Integral Time	OWC01A	0 ~ 32767	Set the PI control integral time in units of 1ms in the phase control mode. The integral is reset if 0 is set as the integral time.	300 (300ms)

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
28	Torque Reference	OWC01B	-32768 ~ 32767	Set the torque reference in units of 0.01% when in the torque reference output mode. D/A Output Value = (Torque Reference (OWC01B) ~ D/A Output Voltage Setting (Fixed Parameter 10) when the Torque Limit is 100%)/10000 Example: (5000 ~ 3V)/10000 = 1.5V is output if the D/A Output Voltage setting = 3V and the Torque Reference = 50% when the torque limit is 100%.	0
29	Speed Limit	OWC01C	-32768 ~ 32767	Set the speed limit in units of 0.01% when in the torque reference output mode. D/A output = (Speed Limit (OWC015) ~ D/A Output Voltage Setting (Fixed Parameter 9) at 100% speed)/10000. Example: (15000 ~ 6V)/10000 = 9.0V is output if the D/A Output Voltage setting = 6V, and the Speed Limit = 150% at 100% speed.	15000 (150.00 %)
31	Pulse Compensation	OLC01E	$-2^{31} \sim 2^{31-1}$	Used in the position control mode. During Position Control Mode, set the number of compensation pulses in single pulse units. When motion commands have been used in the position control mode, set in single pulse units so as to compensate for reference pulses such as the backlash compensation amount, etc. Not compensated during machine lock (IbC0170 is ON).	0

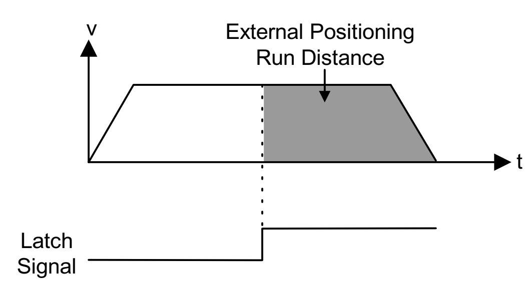
Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
33	Motion Command Code	OWC020	0 ~ 65535	Sets motion commands into the MP940 module.This can be used under the following conditions: Motion Command Use Selection (bit 7 of fixed parameter No. 14) Position Control Mode Selection (ObC0002) Enable Operation Mode Setting Motion Command (ObC0008) Motion Command Types0:NOP(no command) 1: Positioning (POSING) 2: External Positioning (EX-POSING) 3: Zero-point Return (ZRET) 4: Interpolation (INTERPOLATE) 5: Unusable (used by system) 6: Interpolation with Position Detection Function (LATCH) 7: Set Speed Feed (FEED) 8: Stepping (STEP) 9: Zero-point Setting (ZSET) 10 ~ 65535: Unused	0
34	Motion Command Options	OWC021	Sets the motion command supplemental function.		—
		Bit 0	Command Hold (HOLD)	The axis decelerates to stop if this bit goes ON during operation with the motion command code (OWC020) in positioning or stepping. Hold Complete (IBC0151) goes ON when holding is complete. The hold is released, and the positioning operation restarted if this bit is returned to OFF in this state.	—
		Bit 1	Abort Command (ABORT)	The axis decelerates to stop if this bit goes ON during operation with the motion command code (OWC020) in positioning, zero-point return, or stepping. BUSY (IBC0150) goes ON during abort processing, and OFF at abort completion. The same function can be executed when aborting during fixed speed feed by making NOP the motion command.	0
		Bit 2	Direction of Motion (DIRECTION)	Designates the motion direction. Motion command (OWC020) is enabled during set speed feed and stepping. 0:Forward 1:Reverse	0 (Forward)

Other Command/Mode Settings (Continued)

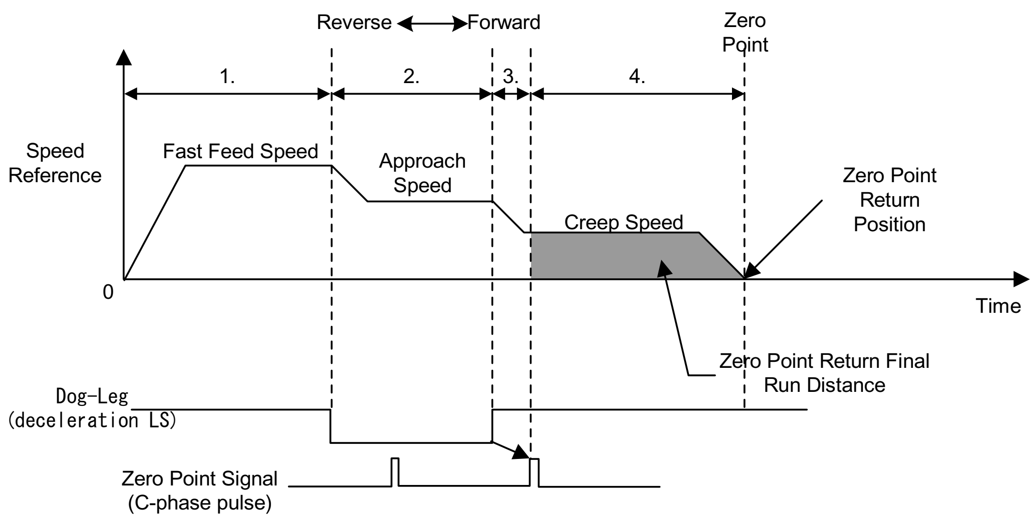
Number	Name	Register Number	Setting Range	Content	Default Value
34	Motion Command Options	Bit 3	No 1-dimension Lag (LAGRST)	The 1-dimension lag is reset when this bit is turned ON in the position loop.The operation is the same as when the 1-dimensional lag time constant (OWC037) is set to 0. This is used in the position control mode and zero-point return control mode.	0
		Bit 4 ~ 7	Filter Type Selection (FILTER TYPE)	Selects the accel/decel filter type. 0: No Filter 1: Exponent Accel/Decel Filter 2: Average Motion Filter The filter time constant (OWC014) is enabled when set to 1 or 2.	0 (No Filter)
		Bit 8	Position Loop P/PI Switching (POS_PPI)	Sets whether position control is executed by P control or PI control. 0: P Control 1: PI Control Used in the position control mode or zero-point return mode.	0 (P Control)
		Bit 9	Position Control Integral Reset (POS_IRST)	The PI control integral is reset if this bit is turned ON when using a position loop with PI control (bit 8 of OWC021). Used in the position control mode or zero-point return mode.	0
		Bit 10	Speed Compensation during Position Control (OWC018) Enabled (NCOMSEL)	Upon this bit going ON, the data set in the speed compensation setting (OWC018) is added to the position loop operation as the speed compensation amount (1 = 0.01%). Used in the position control mode or zero-point return mode.	0
		Bit 11	SCMD	SGDH Serial Command Enable Flag 1:Enabled 0:Disabled	0
		Bit 12	Zero-point Return Reverse Limit Signal (LMT_L)	This bit functions as a reverse limit signal in zero-point return (ZRET). It is therefore necessary to connect (program) an external signal (DI signal integrated into the LIO_01 module, etc.) in the user program to OBC021C.	0
		Bit 13	Zero-point Return Forward Limit Signal (LMT_R)	This bit functions as a forward limit signal in zero-point return (ZRET).It is therefore necessary to connect (program) an external signal (DI signal integrated into the LIO_01 module, etc.) in the user program to OBC021C.	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
34	Motion Command Options	Bit 14	Position Buffer Write-in (BUF_W)	The data set in position buffer write-in data (OLC03A) is stored in the position buffer set in the position buffer access number (OLC038) as absolute position data.	0
		Bit 15	Position Buffer Read-out (BUF_R)	This reads out data from a position buffer designated in the position buffer access number (OLC038), and stores it in position buffer read-out data (ILC028). This is used when verifying position data stored in the position buffer. Be aware that 2 scans are required from the time that read-out is commanded until the data is stored in position buffer read-out data (ILC028).	0
35	Feed Speed	OLC022	0 ~ 2^{31-1}	Set the fast feed speed in 10n command units/min. (n: dumber of decimal places) when the speed reference selection (OBC001D) is set to 0. When displayed by setting unit: Pulse Unit Time: 1 = 1000 pulse/min. When unit is mm: 1 = 1mm/min. deg Units: 1 = 1deg/min. Inch Units: F 18> 1 = 1inch/min. Used when a motion command (OWC020) is used in the position control mode.	0
37	External Positioning Move Distance	OLC024	-2^{31} ~ 2^{31-1}	Sets the distance from where the latch signal is input (external positioning signal) to stoppage during external positioning (EX_POSING).	0
				 Used when a motion command (OWC020) is used in position control mode.	
39	Stopping Distance	OLC026	-2^{31} ~ 2^{31-1}	Used as a system. Do not use this parameter.	0

Other Command/Mode Settings (Continued)

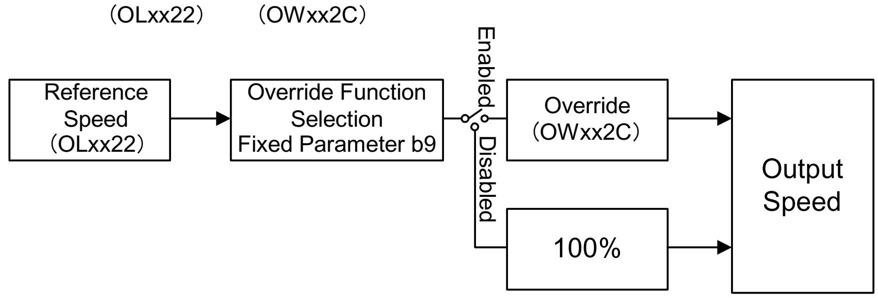
Number	Name	Register Number	Setting Range	Content	Default Value
41	STEP Distance	OLC028	$0 \sim 2^{31-1}$	Sets the amount of motion in motion command (OWC020) stepping feed in command units. Unit: Command Unit	0
43	Home Offset	OLC02A	$-2^{31} \sim 2^{31-1}$	When the motion command (OWC020) is Zero-point Return (ZRET), the axis moves for a set distance after detection of an enabled zero-return pulse, and then stops. This position is the machine coordinate zero point. Unit: Command Unit	0



Number	Name	Register Number	Setting Range	Content	Default Value
45	Speed Override	OWC02C	0 ~ 32767	Override sets the output ratio with regard to the feed speed (OWC022) setting in outs of 0.01%.	10000

■ Fast Feed Speed Output

Reference Speed × Override = Output Speed
(OLxx22) (OWxx2C)



Enabled when the override selection of fixed parameter No. 17 (Bit 9 of motion controller function selection flag) is enabled.

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
46	Position Management Control	OWC02D	Selects functions related to positioning data managed my the motion module. The bit structure is shown below.		
		Bit 0	Machine Lock Mode Setting (MLK)	In the machine lock mode, the Mechanical Coordinate Calculation Position (IwC002) is updated without actually moving the axis. Enabled at feed completion (IBC0152 = ON) if this bit has been changed. Used when a motion command (OWC020) is used in the position control mode.	0
		Bit 1	Number of POSMAX Turns Presetting Request (TPRSREQ)	Number of Posmax Turns Presetting Request In rotary length, counts the number of turns each time the position value exceeds POSMAX, and stores it in monitor parameter ILC01E (Number of POSMAX Turns). Presetting is possible by turning the number of POSMAX turns preset request flag from OFF to ON in setting parameter OLxx30 (number of POSMAX turns preset data). Related Parameters Fixed parameter 22 (maximum value of rotary counter) Setup Parameter OLC030 (Number of POSMAX turns preset request) Setup Parameter ILC01E (number of POSMAX turns)	0
		Bit 2	ABS System Rotary Position Management Data LOAD Request (ABSLDREQ)	In a rotary axis using an absolute encoder, the position data managed by the motion module is updated upon this bit going ON by data set into the encoder position at power OFF (OLC038, OLC03A) or the pulse position at power OFF (OLC03C, OLC03E). Used when a motion command (OWC020) is used in the position control mode. (Conditions) Fixed Parameter No. 3 Encoder Selection 1 Fixed Parameter No. 17 Bit 5 1 Rotary Axis	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
46	Position Management Control	Bit 3	Position Monitor 2 (ILC034) Unit Selection	Select the data units to be messaged in Position Monitor 2 (ILC034). 0: Command Unit 1 = Messaged at 1 command unit 1: Pulse Units 1 = Messaged at 1 pulse unit Used when a motion command (OWC020) is used in the position control mode.	
		Bit 4 ~ 15	Unused	Set to 0	0
47	Work Coordinate Offset	OLC02E	$-2^{31} \sim 2^{31-1}$	Always set to 0. Used as a system.	0
49	Preset Data of POSMAX Turn	OLC030	$-2^{31} \sim 2^{31-1}$	It is possible to preset a number of POSMAX turns (ILC01E) in set data by turning the number of POSMAX turns presetting request (OBC02D1) to ON. Used when resetting to 0, and when a motion command (OWC020) is used in the position control mode.	0
51	2nd In-position Width	OWC032	0 ~ OWC032	Sets the range in which the 2nd INP completion (Bit 2 of IWC017) goes ON. The 2nd INP completion (IBC0172) goes ON if the difference between the reference position and the feedback position in feed output completion (when IBC0152 is ON) is within the setting range of this parameter. Used when a motion command (OWC020) is used in the position control mode.	0
52	Home Window	OWC033	0 ~ 65535	Sets the zero-point position range. In the Zero-point Return Completion State (IBC0156 is ON): The zero-point position (IBC0171) is ON when Machine Coordinate Reference Position (ILC018) Zero-point Position Output Width Used when a motion command (OWC020) is used in the position control mode.	10

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
53	Position Complete Timeout	OWC034	0 ~ 66535	Set the positioning time-over (Bit 6 of ILC0022) detection limit (1 = 1ms). A positioning time-over results after feed completion (Bit 2 of IWC015 is ON) if the positioning completion signal (Bit 13 of IWC000) is not ON even though this range has been exceeded. This check is not performed if set to 0. Used when a motion command (OWC020) is used in the position control mode.	0
54	Position Control Integral Time	OWC035	0 ~ 32767	Set the integral time (1 = 1ms) when used in a position loop or PI control (Bit 8 of OWC021). The integral operation is not executed if 0 is set. Used in position control mode or zero-point return mode.	300
55	Integral Upper/ Lower Limit for Position Control	OWC036	0 ~ 32767	Set the upper/lower limit of the integral in cases of use in position loop or PI control (Bit 8 of OWC021). The limit is applied to this range when the integral output exceeds this range. Used in position control mode or zero-point return mode.	32767
56	First Order Lag Constant	OWC037	0 ~ 32767	Sets the one-time delay time constant (1 = 1ms) in the position loop. The one-time delay operation is not executed if 0 is set. Used in position control mode or zero-point return mode.	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
57	Absolute Position at Power Off (low value)	OLC038	$-2^{31} \sim 2^{31-1}$	The following 2 usage methods exist. Exercise care in using either one. Encoder Position at Power Cut-off (lower 2 words) 2 Enabled when either the fixed motion parameter Encoder Selection is set to Absolute Encoder (= 1), or the fixed motion parameter Axis Selection (Bit 5 of the Motion Controller Function Selection Flag) is set to Rotary Axis = 1. When the ABS system rotary position management data LOAD request (Bit 2 of OWC02D) is ON, the data set in this parameter is handled as the lower 2 words of the encoder position at power cutoff. Position Buffer Access Number The position data set in this parameter is handled as the position buffer number when either the Position Buffer Write (Bit 14 of OWC021) or Position Buffer Read (Bit 15 of OWC021) is ON. In this case, the setting range is 1 ~ 256. It is disabled if 0 is set. Used when a motion command (OWC020) is used in the position control mode.	0
	SGDH Serial Command Setting	OWC038		Motion Command Control Flag executes SGDH parameter Read/Write when (ObC021B) = 1. 1: Data Read 2: Data Write	
	SGDH Serial Command Address Setting	OWC039		Executes SGDH parameter Read/Write when (OWC021B) = 1 Motion Command Control Flag (OWC021B).	

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
59	Absolute Position at Power Off (high value)	OLC03A	-2^{31} ~ 2^{31-1}	The following 2 usage methods exist. Exercise care in using either one. Upper 2 Words of Encoder Position at Power Cutoff Enabled when either the fixed motion parameter Encoder Selection is set to Absolute Encoder = 1, and the fixed motion parameter Axis Selection (Bit 5 of the motion controller function selection flag is set to Rotary = 1. When the ABS system rotary position management data LOAD request (Bit 2 of OWC02D) is ON, the data set in this parameter is handled as the upper 2 words of the encoder position at power cutoff. Position Buffer Write Data The position data set in this parameter is written as absolute position data into the position buffer designated in OLC038 when the Position Buffer Write Bit 14 of OWC021 is ON. Used when a motion command (OWC020) is used in the position control mode.	0
	SGDH Serial Command Data Setting	OWC03A		Sets the command data to be sent to the SGDH when the motion command control flag SCMD (ObC021B) = 1 and the data write command (OWC038) = 2.	
61	Modularized Position at Power Off (low value)	OLC03C	-2^{31} ~ $2^{31}-1$	\ When the load command (OWC02D 2 bit) of the infinite position control information is ON, the data which has been set for this parameter is processed as a low 2WORD pulse position when the power is cut. Enabled when the fixed motion parameter Encoder Setting is set to Absolute (=1), or when the fixed motion parameter Axis Selection (bit 5 of the motion controller function selection axis flag is set to Rotary =1. Used when a motion command (OWC020) is used in the position control mode.	0

Other Command/Mode Settings (Continued)

Number	Name	Register Number	Setting Range	Content	Default Value
63	Modularized Position at Power Off (high value)	OLC03E	-2^{31} ~ 2^{31}-1	When the ABS system rotary Position Management Data LOAD Request (bit 2 of OWC02D) is ON, the data set in this parameter is handled as the upper 2 words of the pulse position at power cut-off. Enabled when the fixed motion parameter Encoder Setting is set to Absolute =1, or when the fixed motion parameter Axis Selection (bit 5 of the motion controller function selection axis flag is set to Rotary =1. Used when a motion command (OWC020) is used in the position control mode.	0

Monitor Parameter Details

Number 1 - Run Status (RUNSTS)

Register Number	Bit Name	Content
IWC000	Messages the run status of the MP940 Module. The bit structure is shown below.	
Bit 0	Deviation Error (EOVER)	This bit is ON when the position deviation (ILC00A) exceeds the Deviation Error Detection Setting (OWC00F). Note: Because control continues in its current state, create a user program to execute a different process by observing this bit when processing is necessary in response to such applications as emergency stop. The following items may cause offset errors. The Deviation Detection Value Setting (OWC00F) is too small. Motor does not turn. Motion is not done as per command because the machine load is too heavy. Enabled in the position control mode, zero-point return mode, or phase control mode.
Bit 1	Setup Parameter Setting Error (PRMERR)	This bit goes ON when the setting range is exceeded in the setup parameter (OWC000~OWC03F). The parameters with the most recent setting range errors are messaged to Over Parameter No. (IWC00F).
Bit 2	Fixed Parameter Setting Error (FPRMERR)	This bit is ON when the setting of a fixed parameter exceeds the setting range. The most recent fixed parameter in which a setting range error has occurred has 100 added, and is messaged to the Over Range Parameter No. (IWC00F). This bit automatically goes OFF when a normal fixed parameter is set from MotionWorks™.
Bit 3	Unused	—
Bit 4	Unused	—
Bit 5	Unused	—
Bit 6	Unused	—
Bit 7	Motion Controller Run Preparation Complete (SVCRDY)	ON when motion module run preparations are complete. The following are possible reasons for the run preparation not completing. Major Fault Axis not selected for use (fixed parameter setting) Fixed parameter setting error Cumulative Turns Reception Error Fixed parameter change underway Absolute position readout underway from absolute encoder

Number 1 - Run Status (RUNSTS) (Continued)

Register Number	Bit Name	Content
Bit 8	Motion Controller Run (SVCRUN)	This bit goes ON under the following conditions Run Preparation Complete (IBC0007) is ON Control Mode Flag (OBC0000~OBC0004) Servo ON (OBC0010) is ON In the position control mode using motion commands (OWC020), the axis does not move when a motion command is issued during an alarm, even when this bit is ON. After clearing the alarm, reset the motion command after setting the motion command do NOP from the 1st scan on.
Bit 9	Rotation Direction Selection Messaging During Absolute Encoder Use (DIRINV)<	Rotation Direction During Absolute Encoder Use Monitors the fixed motion parameter Rotation Direction Selection. 0: Forward; 1: Reverse
Bit 10	Absolute Position Read Completion Signal (ABSRDC)	ON at completion of absolute position data readout from the absolute encoder when the Absolute Position Readout Request (bit 10 of OWC000) is ON. The cumulative rotation signal error (bit 4 of IWC000) is ON upon error occurrence.
Bit 11	DI Latch Completion Signal (DIINT)	ON when the DI Latch Detection Request (bit 13 of OWC000) is ON or when the DI Latch signal is input. Messages the current position to the Machine Coordinate Latch Position (ILC006).
Bit 12	Feedback Pulse 0 (FBP0)<HR>	Displays when there is no feedback pulse.This is always ON when the motor is not rotating. The feedback signal line from the encoder may be cut off if this bit is ON even though a command is output.
Bit 13	Positioning Completion Signal (POSCOMP)	ON when positioning is completed in the position control mode. When no motion commands are used : ON when the Current Value (ILC008) - Position Reference (OLC012) Positioning Completion Range (OWC00E) When motion commands are used : ON when Feed Completion (bit 2 of IWC015) is ON, or when Current Value (ILC008) - Machine Coordinate Command Position (ILC018) Positioning Completion Range (OWC00E)
Bit 14	Unused	—
Bit 15	Zero-point Return Signal (ZRNC)	ON at completion of zero-point return in the zero-point return mode. ON when Current Value (ILC008) - Zero-point Position ÅÖ Positioning Completion Range (OWC00E).

Number 2 - Servo Amplifier Status (SYSTS)

IWC001	Messages servo amplifier status data. This status data is not used in internal motion module control. Control with a user program, when needed. The bit structure is shown below:	
Bit 0	ALM	Servo Alarm
Bit 1	WARN	Warning
Bit 2	V-CMP	Speed Coincidence
Bit 3	TGON	Motor Rotation Detection
Bit 4	S-RDY	Servo Ready
Bit 5	CLT	Torque Limit Detection
Bit 6	VLT	Speed Limit Detection
Bit 7	BK	Brake Interlock
Bit 8	SVON	Servo ON Completion
Bit 9	PON	Main Circuit Completion
Bit 10~15	—	Unused

Other Monitor Parameters

Number	Name	Register Number	Bit Name	Content
3	Target Position	ILC002	-2^{31} ~ 2^{31-1}	Messages the calculated machine coordinate position managed by the MP940. The position data messaged to this register is the target position at each scan.
5	Incremental Target Position	ILC004	-2^{31} ~ 2^{31-1}	Messages the feed amount at each scan.
8	Machine Coordinate Latch Position (LPOS)	ILC006	-2^{31} ~ 2^{31-1}	Messages the current latch position the moment the DI latch signal is ON.
9	Machine Coordinate Feedback Position	ILC008	-2^{31} ~ 2^{31-1}	Messages the current position monitor value. (note: Enabled during A Drawing execution. Enabled from H Drawing or L Drawing execution.
11	Position Error	ILC00A	-2^{31} ~ 2^{31-1}	Messages the position deviation (accumulation pulse). (Position Deviation = Target Position - Current Position at each scan) Enabled in the zero-point return mode, position control mode, and phase control mode.
13	Speed Reference Output	IWC00C	-32768 ~ 32767	Messages the value output by the servo amplifier as the speed reference output.

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
14	Speed Monitor	IWC00D	-32768 ~ 32767	Scales and messages the A/D conversion results for the input analog signal at the value set in Input Voltage at 100% Speed Monitor (A/D). Speed Monitor = (A/D Input Voltage X 10000)/ Speed Monitor (A/D) Input Voltage Setting at 100% Example: Input Voltage Setting = 6V at 100% Speed Monitor (A/D) Messages (3V X 10000)/6V = 5000 when the actual A/D input voltage = 3V
15	Torque Monitor	IWC00E	-32768 ~ 32767	1 = 0.01%
16	Over Range Parameter Number	IWC00F	1 ~ 65 At Motion Parameter Setting 101 ~ 148 for Fixed Motion Parameters	Messages the most recent parameter set outside the setting range in either the motion setting parameters (OWC000 ~ OWC03F) or the fixed motion parameters. Motion Setting Parameters: 1 ~ 65 Fixed Motion Parameters: 101 ~ 148 Messages values where 100 was added to the parameter number for fixed motion parameters.
17	Number of Absolute Encoder Turns	ILC010	-2^{31} ~ 2^{31-1}	Messages the cumulative number of rotations received from the absolute encoder. Enabled only when an absolute encoder is used.
19	Initial Incremental Pulse of Absolute Encoder	ILC012	-2^{31} ~ 2^{31-1}	Messages the number of initial incremental pulses received from the absolute encoder. Enabled only when an absolute encoder is used.
21	Servo Command Type Response	IWC014	0 ~ 65535	Messages the currently executed motion command (OWC020). See OWC020 for the motion command. Enabled when a motion command (OWC020) is used in the position control mode.
22	Servo Module Command Status	IWC015	Messages the execution state of the motion command (OWC020). Enabled when a motion command (OWC020) is used in the position control mode. The bit structure is shown below:	
		Bit 0	Command Execution Flag (BUSY)	Messages the motion command status. 0: Ready (Done)1: BUSY (Processing) This bit is used as a status during interruption.
		Bit 1	Command Hold completion flag (HOLDL)	ON at hold completion. Refer to the motion function “Hold “ itself for details.

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
22	Servo Module Command Status	Bit 2	Feed Completion (DEN)	ON upon completion of the feed distance.
		Bit 3	Zero-point Setting Completion (ZSET)	ON when zero-point setting (ZSET) execution is completed by a motion command (OWC020). Also ON at completion of loading ABS system rotary axis management data.
		Bit 4	External Positioning Signal LATCH Completion (EX_LATCH)	ON at external positioning signal input during external positioning (EX_POSING) execution.
		Bit 5	Command Error Completion Status (FAIL)	ON when an error occurs during motion command (positioning, fast feed, etc.) execution. Operation is not possible while this bit is ON. NOP from the 1st motion command (OWC020) scan on.
		Bit 6	Zero-point Return Completion State (ZRNC)	ON at zero-point return completion or zero-point setting completion. OFF at the start of zero-point return.
		Bit 7 ~ 15	Unused	—
23	Number of Decimal Places	IWC016	0 ~ 5	Messages Decimal Points of fixed motion parameter No. 18. Enabled when a motion command (OWC020) is used in the position control mode.
24	Position Management Status	IWC017	Messages statuses related to the position managed by the MP940Module. Enabled when a motion command (OWC020) is used in the position control mode. The bit structure is shown below:	
		Bit 0	Machine Lock (MLKL)	ON during machine lock. Analog output not possible when this bit is ON. The actual control axis locks-up and stops.
		Bit 1	Zero Position (ZERO)	ON in the Zero-point Return Completion state (IBC0156 is ON), or when Machine Coordinate Command Position Zero-point Position Output Width (OWC033).
		Bit 2	2nd INP Completion (PSET2)	ON when Feed Completion (bit 2 of IWC015) is ON, or when Current Position (ILC008) - Machine Coordinate Command Position 2nd In-position Width (OWC032).

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
24	Position Management Status	Bit 3	ABS System Rotary Position Management LOAD Completion (ABSLDE)	ON at load completion when the ABS System Rotary Position Management Data Load Request (OBC02D2) is ON. OFF when the ABS System Rotary Position Management Data Load Request (OBC02D2) is OFF. Enabled when a rotary axis is set in an absolute encoder.
		Bit 4	Number of POSMAX Turns Presetting Completion (TPRSE)	ON at completion of presetting when the No. of POSMAX Turns Presetting Request (OBC02D1) is ON. OFF when the No. of POSMAX Turns Presetting Request (OBC02D1) is OFF. Enabled when a rotary axis is set.
		Bit 5	Electronic Gearing Selection (GEARM)	Messages the fixed motion parameter “Electronic Gearing Selection” (bit 4 of No. 17).
		Bit 6	Axis Selection (MODSELM)	Messages the fixed motion parameter “Axis Selection” (bit 5 of No. 17).
		Bit 7~15	Unused	—
25	Machine Coordinate System Position	ILC018	$-2^{31} \sim 2^{31-1}$	This is the machine coordinate command position (MPOS). It is essentially identical to ILC002 (CPOS). This position data cannot be updated in the machine lock state (IBC0170 is ON). Enabled when a motion command (OWC020) is used in the position control mode.
27	SGDH Serial Command Answer	ILC01A	—	Answer monitor during SGDH serial command execution. During Data Read01H: Normal41H: Data Error81H:Address Error During Data Write 02H: Normal42H: Data Error82H: Address ErrorC2H:Answer Time-out
28	SGDH Serial Command Address	IWC01B	—	Data monitor during SGDH serial command execution
29	POSMAX Monitor	ILC01C	$-2^{31} \sim 2^{31-1}$	Messages fixed motion parameter No. 23 “Rotary Axis Reset Position (POSMAX)”. Enabled when a motion command (OWC020) is used in the position control mode.

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
31	POSMAX Number of Turns	ILC01E	$-2^{31} \sim 2^{31-1}$	This goes up/down each time the value in fixed motion parameter No. 23 “Rotary Axis Reset Position (POSMAX)”. This can be preset by either of the motion setting parameters “Number of POSMAX Turn Presetting Data (OLC030)” or “Number of POSMAX Turns Presetting Request (OBC02D1).” Enabled when a motion command (OWC020) is used in the position control mode.
33	SGDH Serial Command Data	ILC020		Data monitor during SGDH serial command execution
35	Servo Alarms	ILC022	Enabled when a motion command (OWC020) is used in the position control mode. Messages alarm data. Motion is not possible when this register is set to other than 0. Clears to 0 at boot-up of Alarm Clear.	
		Bit 0	Unused	—
		Bit 1	Forward Overtravel	ON when forward motion is commanded in an ON direction overtravel signal input state. Enabled when bit 13 “Overtravel Forward Direction Enable/Disable Selection” of the motion controller function selection flag for fixed motion parameter 17 is selected as Enabled.
		Bit 2	Reverse Overtravel	ON when a reverse motion command is executed in a reverse direction overtravel signal input state. Bit 14 “Overtravel Reverse Direction Enable/Disable Selection” of the motion controller function selection flag for fixed motion parameter 17 is enabled when Enabled is selected.
		Bit 3	Forward Soft Limit (SOTF)	Enabled when in the zero-point return completion state (IBC0156 is ON), under conditions with the axis selection as Linear and the forward direction soft limit enabled. This bit goes ON during motion command (OWC020) interpolation when the machine coordinate command position (ILC018) + stopping distance (OLC026) positive soft limit (fixed motion parameter no.27) This bit goes ON when the machine coordinate command position (ILC018) positive soft limit (fixed motion parameter no. 27) during positioning, set speed feed, stepping, etc.

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
35	Servo Alarms	Bit 4	Negative Soft Limit (SOTR)	Enabled when in the zero-point return completion state (IBC0156 is ON), under conditions with the axis selection as Linear and the negative direction soft limit enabled. This bit goes ON during motion command (OWC020) interpolation when the machine coordinate command position (ILC018) + stopping distance (OLC026) negative soft limit (fixed motion parameter no.29) This bit goes ON when the machine coordinate command position (ILC018) negative soft limit (fixed motion parameter no.29) during positioning, set speed feed, stepping, etc.
		Bit 5	Unused	—
		Bit 6	TIMEOVER	This goes ON if positioning completion (bit 13 of IWC000) is not done even though the positioning completion check time (OWC034) is exceeded after feed completion (bit 2 of IWC015 is ON).
		Bit 7	Positioning Distance Exceeded (DISTOVER)	A motion command was executed in which the positioning motion exceeded the limit value.
		Bit 8 ~ 9	Unused	—
		<Bit 1018>Bit 10	Control Mode Error (MOD-ERR)	ON when a motion command (positioning, set speed feed, etc.) is set into Motion Command (OWC020) in other than position control mode (OBC0002 is OFF).
		Bit 11	Zero-point Not Set (ZSET_NRDT)	ON upon attempting to execute the next motion command in the zero-point setting completion signal (bit 3 of IWC015) OFF state. POSING EX-POSING INTERPOLATE ENDOF-INTERPOLATE LATCH Enabled when a rotary axis is set while using an absolute encoder.
		Bit 12~16	Unused	—
		Bit 17	Excessive Absolute Encoder Rotation	ON when the range in which absolute encoder rotations can be handled by the motion module is exceeded. Enabled when a rotary axis is set while using an absolute encoder.
		Bit 18	Encoder Disconnection Error	ON when an encoder disconnection is detected. Enabled when the fixed motion parameter “Pulse Attribute Format Selection is set to A/B Type.
35	Servo Alarms	Bit 19~31	Unused	—

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
37	Network Servo Alarm Code	IWC024	-32768 ~ 32767	Messages the code of the alarm currently occurring in the servo amplifier.
38	Network Servo I/O Monitor	IWC025	Bit 0: SIO	General-use Input Signal
			Bit 1: DEC	Deceleration Dog-leg Switch
			Bit 2:P-OT	Forward Limit Switch Input
			Bit 3:N-OT	Reverse Limit Switch Input
			Bit 4:EXT1	External Input Signal 1
			Bit 5:EXT2	External Input Signal 2
			Bit 6:EXT3	External Input Signal 3
			Bit 7:~15F	Unused
39	Speed Reference Output Value	ILC026	$-2^{31} \sim 2^{31-1}$	Messages the feed amount at each scan. 0 when machine lock (IBC0170 is ON). Enabled when a motion command (OWC020) is used in the position control mode.
41	Position Buffer Data	ILC028	$-2^{31} \sim 2^{31-1}$	Reads out the position data designated in the Position Buffer Access Number (OLC038), and stores it in this register when the motion setting parameter "Position Buffer Readout (OBC021F)" is ON. Be aware that 2 scans are required from the time that the position buffer read-out command (OBC021F) goes ON until the data is stored in this register. Enabled when a motion command (OWC020) is used in the position control mode.
43	Unused	IIC02A	—	—
45	Integral Output Value	ILC02C	$-2^{31} \sim 2^{31-1}$	Messages the integral output when a position loop is used in PI control (see bit 8 of OWC021). Enabled in position control mode or zero-point return mode.
47	Reference Coordinate Calculation Position	ILC02E	$-2^{31} \sim 2^{31-1}$	This is significant when a rotary axis (= 1) is selected for the fixed motion parameter "Axis Selection" (bit 5 of the motion controller function selection flag).It messages the target position at each scan of the rotary axis. Enabled when a motion command (OWC020) is used in the position control mode.
49	First Order Lag	ILC030	$-2^{31} \sim 2^{31-1}$	Messages (PI Output - One-time Lag Output). Enabled in position control mode or zero-point return mode.
51	Position Loop Output Value	ILC032	$-2^{31} \sim 2^{31-1}$	Messages the position loop output (value prior to addition of feed-forward operation). Enabled in position control mode or zero-point return mode.

Other Monitor Parameters (Continued)

Number	Name	Register Number	Bit Name	Content
53	Position Monitor 2	ILC034	$-2^{31} \sim 2^{31-1}$	Enabled when Motion Command Use Selection (fixed parameter) is used. Messages the value prior to addition of the zero-point position offset (OLC006). Use this parameter after adding the zero-point offset converted to the currently used units (command units or pulses). The content differs from that messaged in Position Monitor 2 (OBC02D3). Messages the current position monitor in 1= 1 command units when OBC02D3 = 0. This parameter cannot be used when a rotary axis has been selected (fixed parameter), and when the zero-point position offset (OLC002) = 0. Changes the position monitor (ILC008) to pulse units and then executes messaging when OBC02D3 = 1.
55	Unused	IWC036	—	—
56	Unused	IWC037	—	—
57	Absolute Position at Power Off (low value)	ILC038	$-2^{31} \sim 2^{31-1}$	These are parameters used when executing rotary position management of an absolute system. “Encoder Position at Power OFF” and “Pulse Unit Position at Power OFF” are paired data, and together are called “ABS System Rotary Position Management Data”, which must be periodically stored in the M register in low-speed drawings (DWG.L).
59	Absolute Position at Power Off (high value)	ILC03A	$-2^{31} \sim 2^{31-1}$	—
61	Modularized Position at Power Off (low value)	ILC03C	$-2^{31} \sim 2^{31-1}$	
63	Modularized Position at Power Off (high value)	ILC03E	$-2^{31} \sim 2^{31-1}$	

SGDH User Parameters

Structure of User Parameters

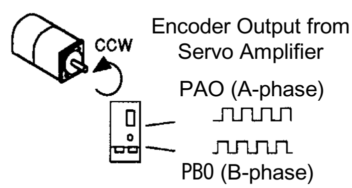
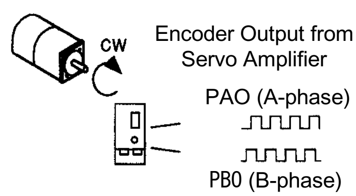
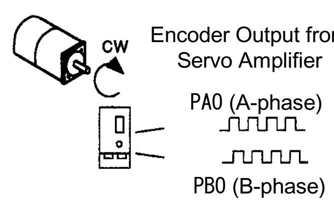
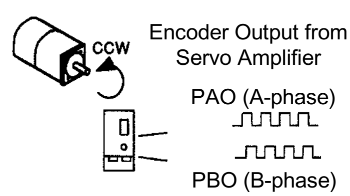
The user parameters consist of the following types.

Function/Name	User Parameter Number	Summary
Function Selection Switch Setting	Pn000 ~ Pn003	Selects the control format, stopping method at alarm generation, basic functions, and applied functions.
Setting of Servo Gain, etc.	Pn100 ~ Pn118	Sets the values for the speed loop gain and position loop gain.
Position Control-Related Parameters	Pn200 ~ Pn205	Sets position control-related parameters such as the command pulse input state, electronic gear ratio, etc.
Speed Control-Related Parameters	Pn300 ~ Pn308	Sets speed control-related parameters such as the speed reference input gain, accel/ decel time setting for soft start, etc.
Torque Control-related Parameters	Pn400 ~ Pn407	Sets torque control-related parameters such as the torque reference input gain, fwd/rev torque limit setting, etc.
Sequence-related Parameters	Pn500 ~ Pn510	Changes the selection and assignment of the various sequence signal output condition settings and I/O signals.
Other	Pn000 ~ Pn601	Designates and reserves the external regen resistor capacity.

Parameters for Function Selection

A detailed list of function selection parameters follows.

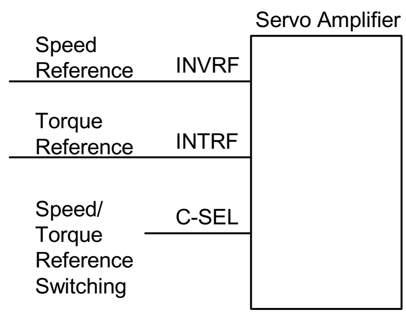
User Parameters

User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn000 Function Selection Basic Switch	0	Direction Selection (0, 1)	The direction of servo motor rotation can be changed without changing the wiring of the servo motor. 0: Forward is counterclockwise when viewed from the motor load side.(Standard Setting) 1: Forward is clockwise when viewed from the motor load side.(Reverse Mode) Forward Rotation Command: Standard Setting  Reverse Mode  Reverse Rotation Command:  	—	—

User Parameters (Continued)

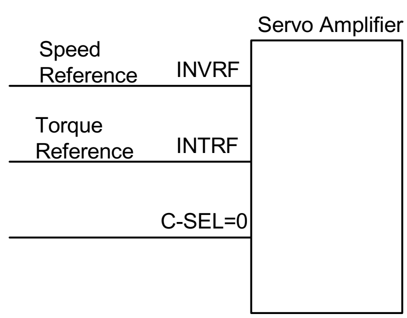
<table>
<tr><th>User Parameter Number</th><th>Digit Position</th><th>Name (Setting Range)</th><th>Contents</th><th>Default Setting</th><th>Control Mode</th></tr>
<tr><td>Pn000
Function Selection Basic Switch (continued)</td><td>1</td><td>Control Format Selection (0~B)</td><td>

The SGDH Servo Amplifier can seperately use a total of 12 control formats starting with speed control, position control, and torque control. Be sure to set: Torque Control (analog command) Speed Control (analog command) when integrated with the MP940.



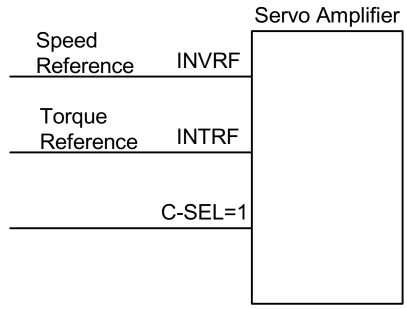
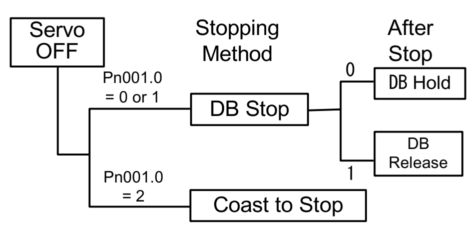
The above commands and switching are executed via the 2-port RAM.

In Torque Control: When C-SEL is OFF: Executes torque control in accordance with the INTRF command. It is possible to apply speed limits with INVRF (when Pn002.1=1. Limits the forward or reverse speed according to the INVRF command.

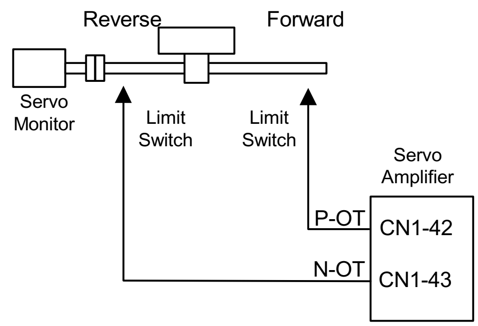


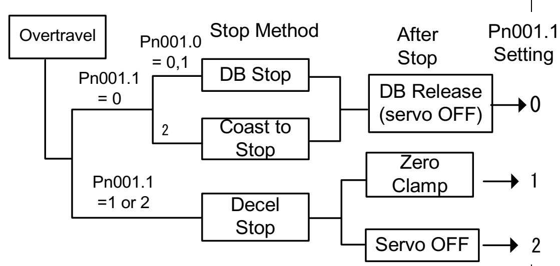
</td><td>9</td><td>Speed
Torque
Position</td></tr>
</table>

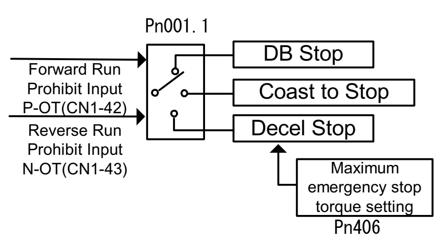
User Parameters (Continued)

User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn000 Function Selection Basic Switch (continued)	1	Control Format Selection (0~B)	A maximum speed limit is posible in user parameter Pn407. In Speed Control: When C-SEL is ON Executes speed control in accordance to the INVRF command. It is possible to apply torque limits with INTRF. (when Pn002.0 = 1) 	9	Speed Torque Position
	2	Axis Address			
	3	Unused			
Pn001 Function Selection Application Switch 1	0	Stop method at servo OFF or alarm genera-tion (0, 1, 2)	Selects the stopping method during motor operation by the servo amplifier at servo OFF under the following conditions: When the Servo ON command is OFF At servo alarm generation At power OFF 0: Stops by dynamic braking.The dynamic braking is maintained after stopping. 1: Stops by dynamic braking.The dynamic braking is released, and a free-run state results after stopping. 2: Coasts to stop. The motor is in an unpow-ered state. Stoppage is by mechanical fric-tion.  Dynamic braking is a function in which electrical braking is applied by consuming the rotational energy of the motor with a resistor.	0	Speed Torque Position

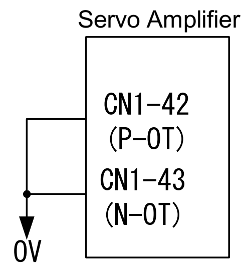
User Parameters (Continued)

<table>
<tr><th>User Parameter Number</th><th>Digit Position</th><th>Name (Setting Range)</th><th>Contents</th><th>Default Setting</th><th>Control Mode</th></tr>
<tr><td>Pn001 Function Selection Application Switch 1 (continued)</td><td>1</td><td>Motor stop method at overtravel (0, 1, 2)</td><td>Selects the stopping method used during motor operation when the following signals are input.


0: The same stopping method (according to Pn001.01) is assumed at servo OFF.
1: Decelerates to stop at or below the set torque, and then a base block is done with the zero clamp mode. (Torque Setting: Pn406 Emergency Stop Torque.
2: Decelerates to stop at or below the set torque, and then coasts to stop. (Torque Setting:Pn406 Emergency Stop Torque.j


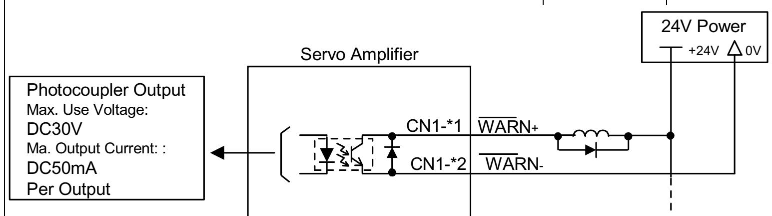
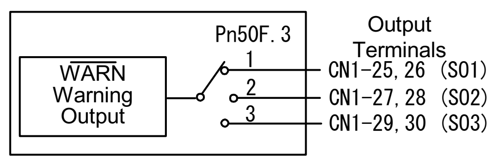

</td><td>0</td><td>Speed
Torque
Position</td></tr>
</table>

User Parameters (Continued)

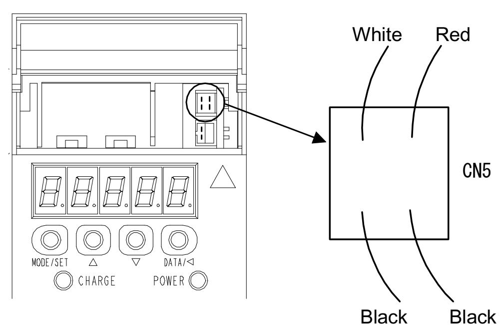
User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn001 Function Selection Application Switch 1 (continued)	1	Motor stop method at overtravel (0, 1, 2) (continued)	Related Parameters Switching between use/non-use of over-travel input signals is set by the following user parameters. Pn50A.3: Use/non-use of P–OT forward prohibit input signal Pn50B.0: Use/non-use of N–OT reverse prohibit input signal.  The short wiring in the figure at left can be omitted if P-OT and N-OT are not used. Sets the stopping torque at overtravel (forward prohibit input, reverse prohibit input). Pn406: Emergency Stop Torque	0	Speed Torque Position
	2	AC/DC power input selection (0, 1)	0: DC power input non-compatibility: Inputs AC power via terminals L1, L2, (L3). 1: DC power input compatibility: Inputs DC power via (+) 1 - (-) power input. 1	0	
	3	Warning Code Output Selection (0, 1)	Sets the warning content when outputting alarm codes. 0: ALO1, ALO2, and ALO3 output alarm codes only. 1: ALO1, ALO2, and ALO3 output both alarm codes and warning codes. Alarm signal output remains ON (normal) during warning code output. /WARN Signal: Overload, Regen Overload The warning code is output by the following three bits:	0	

Warning Indicator	Warning Code Output Signal			Meaning
	AL01	AL02	AL03	
A.91	ON	OFF	OFF	overload
A.92	OFF	ON	OFF	Regenerative overload

User Parameters (Continued)

User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn001 Function Selection Application Switch 1 (continued)	3	Warning Code Output Selection (continued)	 (Note)*1, *2 are the output terminals assigned in user parameter Pn503F.3. Related Parameters Pn50F.3: Select which CN1 terminal outputs the /WARN signal. 	0	Speed Torque Position
Pn002 Function Selection Application Switch 2	0	Speed Control Option (0, 1, 2)	In Speed Control: When /P-CON(/C-SEL) is ON, The command to the torque reference input becomes the torque reference limit. Always be sure to set 1 when using with the MP940. 0: Do not set. 1: Speed control with torque limit according to the analog voltage reference. 2: Do not set.	1	Speed Torque Position
	1	Torque Control Option (0, 1)	In Torque Control: When /P-CON(/C-SEL) is OFF, the command to the speed reference input becomes the speed limit. Always be sure to set 1 when using with the MP940. 0: Do not set. 1: Torque control with speed limit according to the analog voltage reference. 2: Do not set.	1	

User Parameters (Continued)

User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn002 Function Selection Application Switch 2	2	Absolute Encoder Usage Method (0, 1)	Selects the usage method of the absolute encoder. 0: The absolute encoder is used as an absolute encoder. 1: The absolute encoder is used as an incremental encoder. Related Parameters Pn205: Multi-turn limit setting Multi-turn limit setting: This is the upper limit of the multi-turn data. When Pn002.2 = 0, the multi-turn data varies within the range of Pn205 (multi-turn limit setting) starting from 0.	0	Speed Torque Position
	3	Preparation		0	
Pn003 Function Selection Application Switch 3	0	Analog Monitor 1 (0 ~ 7)	 The analog monitor signal can be varied by setting user parameters Pn003.0 and Pn003.1. Set the following when using with the MP940: Pn003.0: 2 Torque Reference Monitor Pn003.1: 0 Motor Speed Monitor	2	Speed Torque Position
				0	
	1	Analog Monitor 2 (0 ~ 7)	Cable Color: / Signal Name / Content White / Analog Monitor 1 / TorqueReference 1W100% Rated Torque Red / Analog Monitor 2 / Motor Speed: 1W1000rpm Black / GND (0V) / —		
	2	Unused		0	
	3	Unused		0	

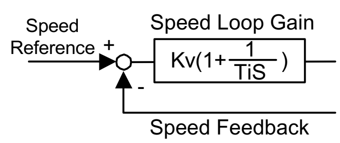
User Parameters (Continued)

User Parameter Number	Digit Position	Name (Setting Range)	Contents	Default Setting	Control Mode
Pn004 Function Selection Application Switch 4	0	Optional Board Selection (0, 1)	Set to 0 at power input when connected to the MP940. 0: Do not use the 2 port RAM 1: Use the 2 port RAM (option board compatible)	1	Speed Torque Position
	1	Unit Conversion (0, 1)	0: No unit conversion 1: Execute unit conversion	0	
	2	Unused		0	
	3	Unused		0	
Pn005 Function Selection Application Switch 5	0	Brake Control Function Selection (0, 1)	Set to 0 when used in connection with the MP940. 0: Use the brake sequence on the servo amplifier side. 1: Use the brake sequence on the upper-level controller side.	0	Speed Torque Position
	1	Unused		0	
	2	Unused		0	
	3	Unused		0	

Gain-related Parameters

A detailed list of gain-related parameters appears below.

Gain Related Parameters

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn100 Speed Loop Gain		Hz 1 ~ 2000	This is the parameter that determines the responsiveness of the speed loop. Set within a range that does not result in vibration in the machine system.The higher the value, the more responsive the system becomes; however, limits apply in accordance with the function characteristics.  This is the value of the speed loop gain (Kv) units (Hz) when the user parameter Pn103 Inertia Ratio is set correctly. See Pn103 for details on the inertia ratio.	40	Speed Torque Position

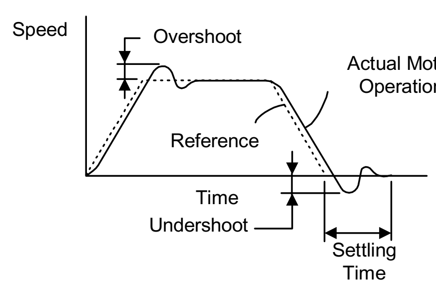
Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn101 Speed Loop Integral Time Constant		0.01ms 15 ~ 51200	Integral elements are kept in the speed loop so that response can be obtained even for minute inputs. These integral elements are delaying elements from the viewpoint of the servo system. For this reason, an increase in the time constant results in lengthened settling time for positioning, and degradation of responsiveness. Failure to increase the integral time constant to some degree results in a machine prone to vibration if the load inertia is too large, or if vibratory elements are included in the machine system. Use the following scales. $\mathrm{Ti} \geq 2.3 \times \frac{1}{2\pi \times \mathrm{Kv}}$ Ti: Integral Time Constant [s] Kv: Speed Loop Gain (value calculated in 1) [Hz]	2000	Speed Torque Position
Pn102 Position Loop Gain		1/s 1 ~ 2000	This parameter is not used. (Do not set.) Set the position loop gain in the SVA setting parameter OWC010.	40	Position
Pn103 Inertia Ratio		% 0 ~ 10000	$\text{Inertia Ratio} = \frac{\text{Load inertia of motor axis conversion (JL)}}{\text{Servo motor rotor inertia (JM)}} \times 100\%$ The factory setting is Motor Axis Conversion Load Inertia = Servo Motor Load Inertia. Obtain the inertia ratio by the above formula, and set the user parameter Pn103. This user parameter is set automatically in the autotuning operation.	0	Speed Torque Position
Pn104 2nd Speed LoopGain		Hz 1 ~ 2000	It is possible to switch between the speed loop gain, speed loop integral time constant, and position loop gain using Pn100 ~ Pn102, and Pn104 ~ Pn106, by the G-SEL (gain switching (OBC0012)) command of the MP940 setting parameters. OBC0012 = 0: Use Pn100 ~ Pn102 = 1: Use Pn104 ~ Pn106	40	Speed Torque Position

Gain Related Parameters (Continued)

<table>
<tr><th>User Parameter Number</th><th>Digital Position</th><th>Name (setting range)</th><th>Content</th><th>Default Setting</th><th>Control Mode</th></tr>
<tr><td colspan="2">Pn105
2nd Speed Loop Integral Time Constant</td><td>0.01ms
15 ~ 51200</td><td>—</td><td>2000</td><td>Speed
Torque
Position</td></tr>
<tr><td colspan="2">Pn106
2nd Position LoopGain</td><td>1/s
1 ~ 2000</td><td>—</td><td>40</td><td>Position</td></tr>
<tr><td colspan="2">Pn107
Bias</td><td>r/min
0 ~ 450</td><td>Use this user parameter when using in connection with the MP940.</td><td>0</td><td>Position</td></tr>
<tr><td colspan="2">Pn108
Bias Width Addition</td><td>Command Unit
0 ~ 250</td><td>Use this user parameter when using in connection with the MP940.</td><td>7</td><td>Position</td></tr>
<tr><td colspan="2">Pn109
Feed Forward</td><td>%
0 ~ 100</td><td>Use this user parameter when using in connection with the MP940.</td><td>0</td><td>Position</td></tr>
<tr><td colspan="2">Pn10A
Feed Forward
Filter Time Constant</td><td>0.01ms
0 ~ 6400</td><td>Use this user parameter when using in connection with the MP940.</td><td>0</td><td>Position</td></tr>
<tr><td>Pn10B
Gain-related Application Switches</td><td>0</td><td>Mode Switch Selection
(0 ~ 4)</td><td>The mode switch function automatically switches the speed control mode within the servo amplifier from PI Control to P Control while given conditions are established. The mode switch function is used in the following situations:

Suppressing accel/decel overshoot in speed control.
Suppressing undershoot during positioning operation and reducing settling time in position control.

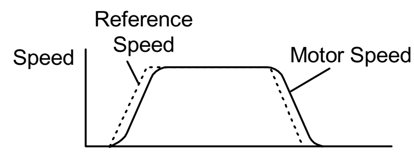
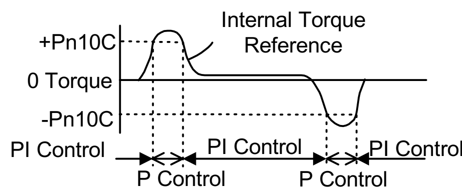
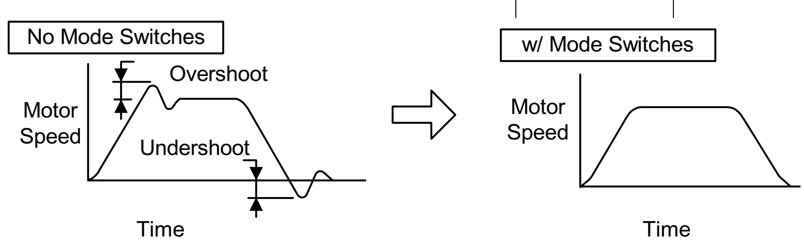


Mode Switch Selection
The following four mode switches can be selected for this servo amplifier. Select with the following user parameter (Pn10B.0).</td><td>0</td><td>Speed
Torque
Position</td></tr>
</table>

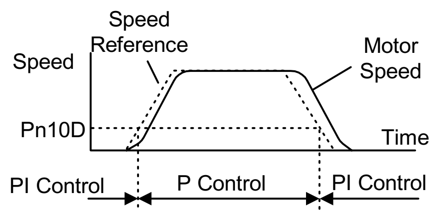
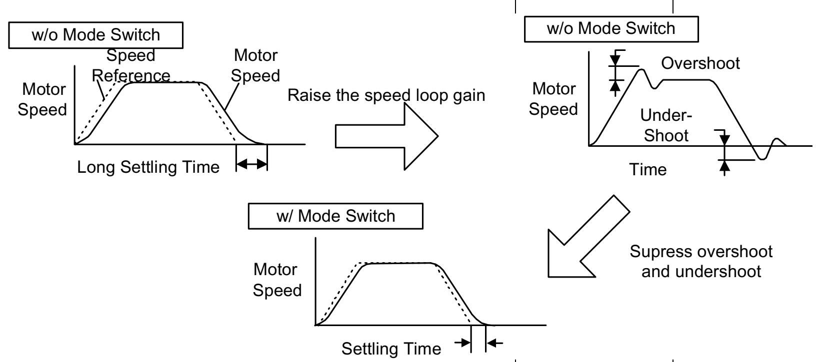
Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn10B Gain-related Application Switches (continued)	0	Mode Switch Selection (0 ~ 4)	Pn 10B 0 Setting / Mode Switch Selection / Detection Point Setting User Parameter 0 / Assuming the torque reference to be the detection point (standard setting) / Pn10C 0 / Assuming the speed reference as the detection point. / Pn10D 2 / Assuming the acceleration as the detection point / Pn10E 3 / Assuming the deviation pulse as the detection point / Pn10F 4 / Mode switch not used. / — For details of each mode, see the descriptions of Pn10C, Pn10D, and Pn10E.		
	1	Speed Loop Control Method (0, 1)	0: PI Control 1: IP Control	0	—
	2	Prepara-tion	—	0	
	3	Reserved Parameter	Do not handle	0	

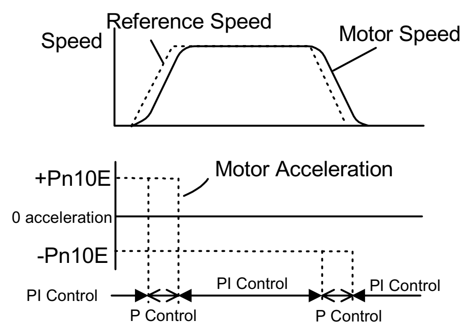
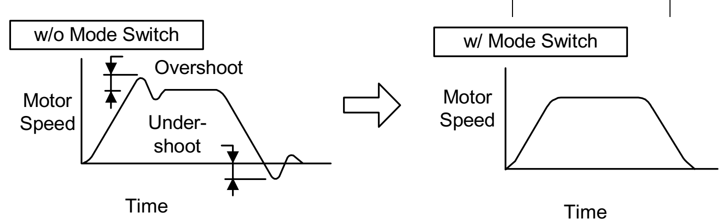
Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn10C Mode Switch (torque reference)		% 0 ~ 800	When Pn10B.0 = 0 assuming torque reference as the detection point, the speed loop is in P control when the torque reference is at or above the torque set in user parameter Pn10C. This mode is the standard factory setting for the servo amplifier. (Pn10C = 200)   Usage Example During accel/decel, torque saturation may occur, resulting in motor speed undershoot or overshoot when constant PI control without the use of mode switches is assumed. Supress torque saturation and eliminate motor speed overshoot and undershoot by using the mode switches. 	200	Speed Torque Position

Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn10D Mode Switch (speed reference)		rpm 0 ~ 10000	When Pn10B.0 = 1 assuming speed reference as the detection point, the speed loop is in P control when the speed reference is at or above the speed set in user parameter Pn10D.  Usage Example Used to shorten the settling time. Although this is generally needed to shorten the settling time, it suppresses overshoot and undershoot at this time.  	0	Speed Torque Position

Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn10E Mode Switch (acceleration)		10rpm/s 0 ~ 3000	When Pn10B.0 = 2 assuming acceleration as the detection point, the speed loop is in P control when the motor acceleration is at or above the speed set in user parameter Pn10E.  Usage Example During accel/decel, torque saturation may occur, resulting in motor speed undershoot or overshoot when constant PI control without the use of mode switches is assumed.Supress torque saturation ans eliminate motor speed overshoot and undershoot by using the mode switches.  	0	Speed Torque Position
Pn10F Mode Switch (error pulse)		Command Unit 0 ~ 10000	Cannot be used when used in connection with an MP940.	0	Position

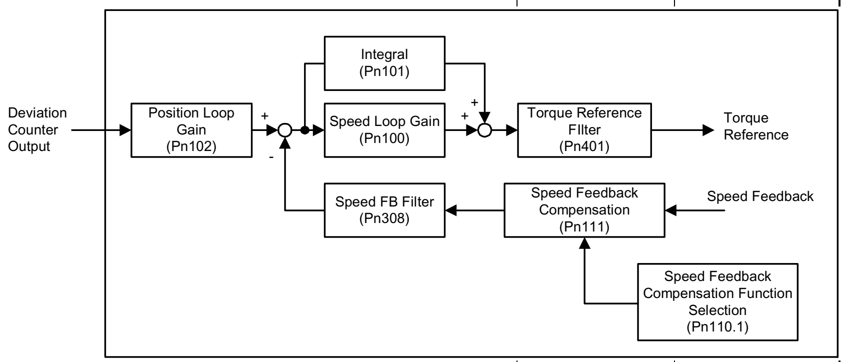
Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn110 Online Autotuning Switches	0	Online Autotuning Method (0, 1, 2)	Sets the conditions at autotuning execution. 0: Tuning is executed only at the initial run after power feed. Calculated data cannot be modified after load inertia calculation. There is no need for constant inertia calculations in applications where the torque inertia variation is small, or does not vary much. In this case the value calculated at initial run can be used continuously. 1: Constant tuning (inertia value calculation) This is used when the load inertia conditions constantly vary. Consistent responsiveness can be maintained by constantly updating the inertia calculation data and reflecting this update in the servo gain. If the load inertia variation occurs in a time frame of 200ms or less, it is sometimes impossible to correctly update the inertia calculation result. In this case, set Pn110.0 = 0 or 2. 2: Online autotuning function not used. Select if online autotuning is not used as follows: Cases In Which Autotuning Cannot be Used: When the load inertia is known beforehand, the inertia ratio data is set into Pn103, and tuning is done manually.	0	Speed Position
	1	Speed Feedback Compensation Function Selection (0, 1)	Selects whether the speed feedback compensation function is used/unused in the autotuning operation. Special adjustment is not necessary if online autotuning is used.The manually adjusted values of the speed feedback compensation function user parameters are reflected in the tuning operation. 0: Enabled; 1: Disabled See “Speed Feedback Compensation (Pn111)” for the speed feedback compensation function.	1	

Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn110 Online Autotuning Switches	2	Viscous Friction Compensation Function Selection (0, 1, 2)	Selects whether the load inertia calculations in online autotuning are to consider the influence of viscous friction on the servo system. Upon entering this compensation function, select the degree of compensation in accordance with the conceivable amount of viscous friction.It is possible to raise the load inertia calculation accuracy. 0: Viscous Friction Compensation: None 1: Viscous Friction Compensation: Small 2: Viscous Friction Compensation: Large	0	Speed Position
	3	Reserved Parameter	Do not adjust.	0	

Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn111 Speed Feedback Compensation*2		%1 ~ 500	The speed feedback compensation function is used to shorten the positioning settling time.  Adjustment Method When adding speed feedback compensation, be sure to adjust the servo gain while observing the position deviation and torque reference using the analog monitor.The adjustment procedure is shown below. The online auto-tuning function is unused if user parameter Pn110 is set to 0002. Adjust using the normal servo gain adjustment procedure without feedback compensation.The value of the speed loop integral time constant (Pn101) becomes smaller as the speed loop gain (Pn100) gradually rises. At this time, the values of the speed loop gain (Pn100) and the position loop gain (Pn102) are made equal. The relationship between the speed loop gain and the integral time constant is as follows: Use the value obtained in the following formula as the scale for the speed loop integral time constant (Pn101) setting. $\text{Speed loop integral time constant} = \frac{4}{2\pi\ \text{Speed loop gain}}$ seconds	100	Speed Position

Gain Related Parameters (Continued)

User Parameter Number	Digital Position	Name (setting range)	Content	Default Setting	Control Mode
Pn111 Speed Feedback Compensation*2 (continued)		%1 ~ 500	Speed loop gain unit: Hz Verify the unit when setting the speed loop integral time constant (Pn101). The setting unit of Pn101 is 0.01ms. The setting values for the speed loop gain and torque loop gain are equivalent even though their respective setting units are (Hz) and (1/S).	100	Speed Position
			Repeat procedure 2, then raise the speed gain while observing the settling time in position deviation as well as the occurrence of vibration in the torque command.If a vibration noise is generated, or if the vibrations increase, increase the torque reference filter time constant (Pn104) in small increments. Then, in small increments, raise the position gain only. Raise the gain to approximately the assumed limit, and enter the next step. Lower the speed feedback compensation (Pn111) from 100% to 90%. In the above state, repeat procedures 2 and 3. Further reduce the speed feedback compensation from 90%, and repeat procedures 2 ~ 4, thereby shortening the settling time. However, the response waveform becomes prone to oscillation if the speed feedback compensation is lowered too much.		
			Search for conditions where the shortest setting time is achieved within a range a vibratory or unstable state does not arise in either the position deviation or torque waveform observed in the analog monitor. Servo gain adjustment is complete when a shorter positioning time cannot be obtained.		

Position-related Constants

A detailed list of position-related parameters appears below.

Position Related Parameters

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn200 Position Control Reference Selection Switches *3	0	Command Pulse Form	Cannot be used in connection with an MP940.	0	Position
	1	CLEAR Signal Form	Cannot be used in connection with an MP940.		
	2	CLEAR Operation	Cannot be used in connection with an MP940.		
	3	Filter Selection	Cannot be used in connection with an MP940.		
Pn201 PG Divider Ratio *3		p/r 16 ~ 16384	Cannot be used in connection with an MP940	16384	Speed Torque Position
Pn202 Electronic Gearing Ratio (Numerator)*3		1 ~ 65535	Cannot be used in connection with an MP940.	4	Position
Pn203 Electronic Gearing Ratio (denominator)*3		1 ~ 65535	Cannot be used in connection with an MP940.	1	Position
Pn204 Position Reference Accel/Decel Time Constant		0.01ms 0 ~ 6400	Cannot be used in connection with an MP940.	0	Position

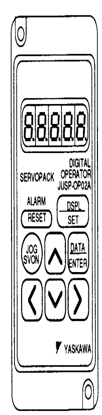
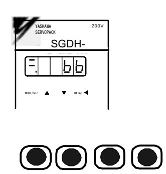
Position Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn205 Multi-turn Limit Setting *3		rev 0 ~ 65535	In systems where an absolute encoder is desired, such as circular tables, etc., it is more convenient to return the multi-turn data from the encoder to 0 every m rotations in machines where the motors rotate m times when the additional axes rotate n times. The multi-turn data varies within a range of -32768 ~ +32767 when the multi-turn limit setting is 65535 (factory setting). When a servomotor rotates in a negative direction from 0, the multi-turn data varies in the Pn205 setting.When a servomotor rotates in a positive direction from the Pn205 setting, the multi-turn data changes to 0.Set (m-1) into Pn205. Note: Recycle power after modifying user parameters Pn001.0 and Pn205. Related Parameters The multi-turn limit setting is enabled when Pn002.2 Absoute Encoder Usage Method is set to 0. 0: The absolute encoder is used as an absolute encoder. 1: The absolute encoder is used as an incremental encoder.	65535	Speed Torque Position
Pn206 Reserved Constant		p/rev 5/3 ~ 32768	Cannot be used in connection with an MP940.	16384	Position
Pn207 Position Control Function Switches *3	0	Position Reference Filter Selection	Cannot be used in connection with an MP940.	0	Position
	1	Position Reference Option			
	2	Unused			
	3	Unused			
Pn208 Position Reference Movement Averaging Time		—	Cannot be used in connection with an MP940.	0	Position

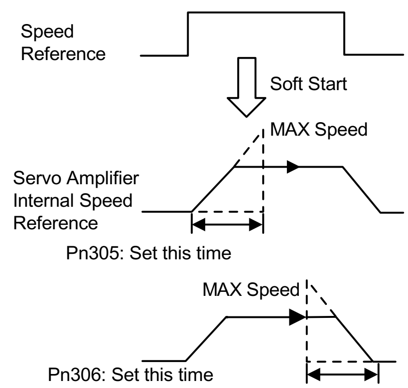
Speed-related Parameters

A detailed list of speed-related parameters appears below.

Speed Related Parameters

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn300 Speed Reference Input Gain		0.01V / Rated Speed150 ~ 3000	This parameter is not used.	600	Speed Torque Position
Pn301 Speed 1		rpm 0 ~ 10000	This user parameter is not used due to the fact that it is used by the MP940 in the control type selection Pn000. 1 = 9 (torque speed).	100	Speed Torque Position
Pn302 Speed 2		rpm 0 ~ 10000	This user parameter is not used due to the fact that it is used by the MP940 in the control type selection Pn000.1 = 9 (torque speed).	200	Speed Torque Position
Pn303 Speed 3		rpm 0 ~ 10000	This user parameter is not used due to the fact that it is used by the MP940 in the control type selection Pn000.1 = 9 (torque speed).	300	Speed Torque Position
Pn304 Jog Speed		rpm 0 ~ 10000	Sets the motor speed in running motors using the panel operator or digital operator. A motor rotates at maximum speed if a value higher than the maximum speed is set.  Digital Operator  Panel Operator	500	Speed Torque Position

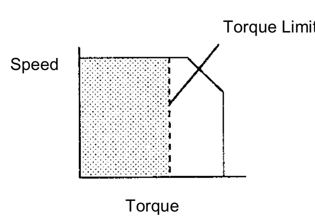
Speed Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn305 Soft Start Acceleration Time		ms 0 ~ 10000	Speed control is performed by applying the accel/decel value of this setting to the speed reference within the servo amplifier.  Smooth speed control is possible upon selecting the internal setting speed when inputting a step-type speed reference. Set 0 in normal speed control. Set the following times: Pn305: The time from stoppage to maximum speed Pn306: The time from maximum speed to stoppage	0	Speed
Pn306 Soft Start Deceleration Time		ms 0 ~ 10000	—	—	—
Pn307 Speed Reference Time Constant		0.01ms 0 ~ 65535	—	0	Speed
Pn308 Speed Feed-forward Filter Time Constant		0.01ms 0 ~ 65535	—	0	Speed

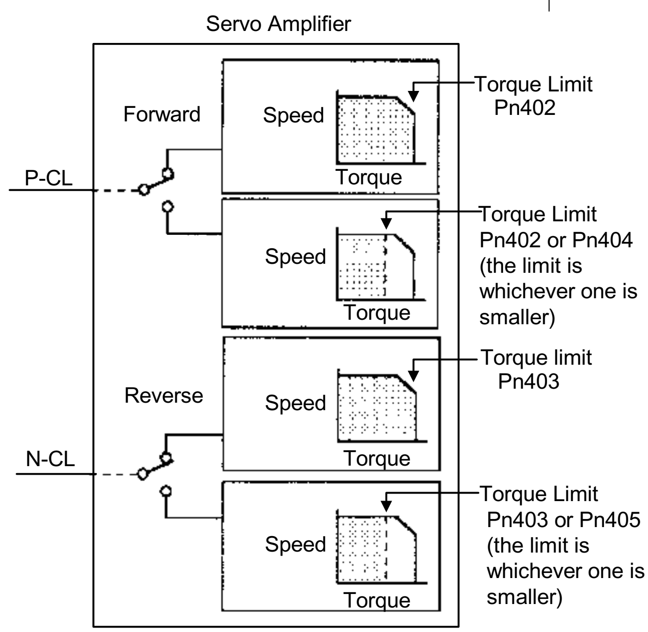
Torque-related Constants

A detailed list of torque-related constants appears below.

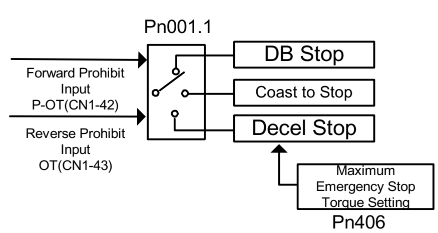
Torque Related Constants

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn400 Torque Reference Input Gain		0.1V /Rated Torque 10 ~ 100	Cannot be used in connection with an MP940.	30	Speed Torque Position
Pn401 Torque Reference Filter Time Constant		0.01ms 0 ~ 65535	Adjust the Filter Time Constant below when vibration believed to be caused by the servo drive occurs in the machine.There are cases where vibration is obtained. This is where the torque filter time constant within the servo amplifier is used.The smaller the value, the better the attainable control responsiveness; however, limits apply in accordance with the machine conditions.	100	Speed Torque Position
Pn402 Forward Torque Limit		% 0 ~ 800	This is used when an upper output torque limit is desired to protect both the machine and the work (Internal Torque Limit). It sets the torque limits in both the forward and reverse sides. The limits are always active, and output the following signal when their value is reached. The output signal is as follows when the torque limit is reached. /CLT /CLT Signal Output Condition: Assign Pn50F.0 to any of the output terminals S01~03. Monitor Mode: Un006 The setting unit is in % of rated torque. Note: The motor is limited to the maximum torque if a value higher than the maximum torque is set. Application Example: Machine Protection  An excessively small setting will result in insufficient torque during accel/decel.	800	Speed Torque Position

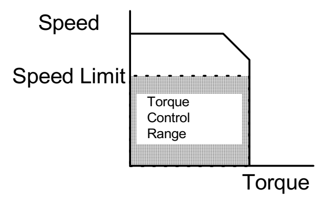
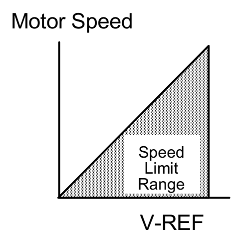
Torque Related Constants (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn403 Reverse Torque Limit		—	—	—	—
Pn404 Forward External Torque Limit		% 0 ~ 800	Used when applying a torque limit after moving the machine to a given position. (External Torque Limit) Using a contact input signal, enables the torque (current) limit set beforehand in the user parameters. Independent settings can be made for both the forward and reverse directions.  Input the external torque (current) limit for both the forward and reverse directions.	100	Speed Torque Position

Torque Related Constants (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn405 Reverse External Torque Limit			P-CL at ON OBC0013 = 1 — Applies the torque limit to the forward direction P-CL at OFF OBC0013 = 0 — Does not apply the torque limit to the forward direction. N-CL at ON OBC0014 = 1 — Applies the torque limit to the reverse direction N-CL at OFF OBC0014 = 0 — Does not apply the torque limit to the reverse direction. Normal run.	Limit Value: Pn404 — Limit Value: Pn405 —	—
			The following signal is output during torque limit application. CLT=IBC001B (Bit 11 of motion monitor parameter Servo Drive Status) Monitor Mode Un005: No. 6, No. 7(for factory settings) Un006: According to output signal assignment conditions. Application Example Pushing Stop Operation Robot Work Protection	—	—
Pn406 Emergency Stop Torque		% 0 ~ 800	Sets the stopping torque at overtravel (forward prohibit input, reverse prohibit input). Enabled when 1 or 2 is set in Stopping Method at Overtravel (Pn001.1). The setting unit is in % of rated torque.  For details on overtravel, see Pn001.1.	800	Speed Position

Torque Related Constants (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn407 Speed Limit During Torque Control		rpm 0 ~ 10000	Sets a motor speed limit in torque control. Used to prevent machine overspeed in torque control. (Control Range in Torque Control)  The limit is the maximum speed of the servo motor if a value higher than the maximum speed of the applied motor is set into Pn407. Note: Principle of Speed Limit Values outside the limit speed range return to be within the limit speed range by returning a negative torque proportionate to the speed differential with the limit speed.Therefore, the actual motor speed limit generates a band according to the load conditions. 	10000	Torque

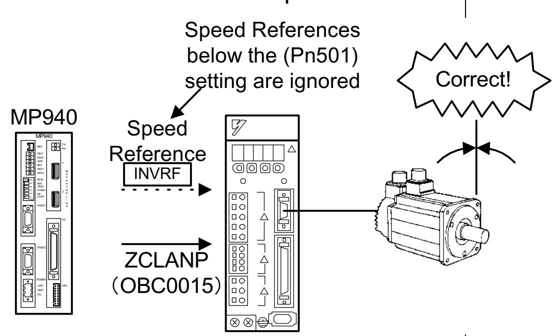
Torque Related Constants (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn408 Torque Function Switches	0	Notch Filter Function Selection	Selects whether the notch filter for reducing machine vibration is enabled/disabled. 0: None: Notch filter used in the torque reference (sets the vibration frequency in Pn409).	0	Speed Torque Position
	1	Unused	—	0	
	2	Unused	—	0	
	3	Unused	—	0	
Pn409 Notch Filter Frequency		Hz 50~2000	Sets the machine vibration frequency. Enabled when Pn408.0 “Notch Filter Function Selection” = 1.	2000	

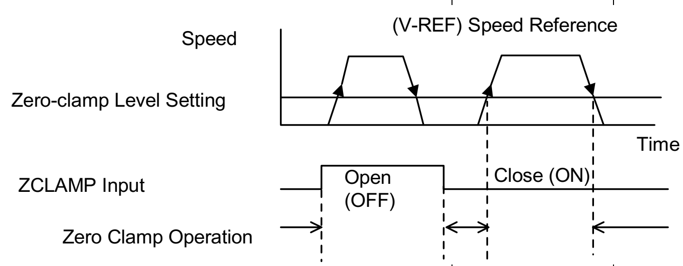
Sequence-related Parameters

Below is a detailed list of sequence-related parameters.

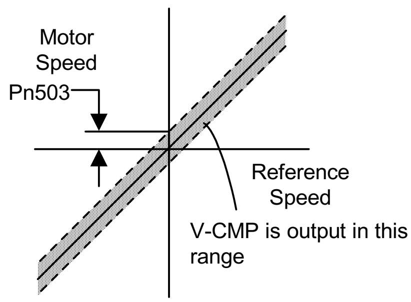
Sequence Related Parameters

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn500 Positioning Completed Width		Command Unit 0 ~ 250	Cannot be used with an MP940	7	Position
Pn501 Zero Clamp Level		rpm 0 ~ 10000	This function is used in systems where the upper-level device uses a Speed Reference input, and no Position Loop is integrated.For example, this is used when motor stoppage and servo lock are desired without the speed reference input voltage (INVRF) being 0. When the zero-clamp function is turned ON, a position loop is temporarily integrated within the servo amplifier, resulting the motor being clamped to within 1 pulse of the current position. Even if turned by an outside force, the shaft returns to the zero-clamp position. Zero Clamp Function This is speed control which is capable of setting the zero-clamp function during stopping./The speed reference is input from INVRF.ZCLAMP(OBC0015) is used in turning ON/OFF the zero-clamp function. ZCLAMP = 0: Zero-clamp function OFF ZCLAMP = 1: Zero-clamp ON 	10	Speed

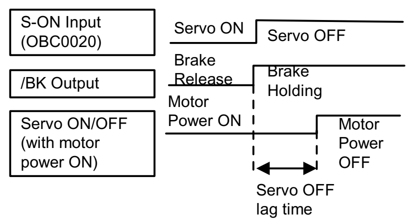
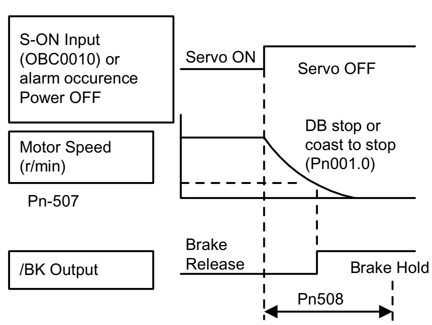
Sequence Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn501 Zero Clamp Level (continued)		rpm 0 ~ 10000	The motor enters the zero-clamp operation when both of the following two conditions are enabled. Condition 1: ZCLAMP is ON Condition 2: Motor speed is below set value Setting: Pn501 Sets the speed at which the zero-clamp operation is entered, when speed control with zero-clamp is selected.Even though an speed higher than the motor maximum speed is set, the actual setting is the motor maximum speed. Zero-clamp Operation Conditions The unit enters into the zero-clamp operation when the following conditions are instated. ZCLAMP(OBC0015) is ON. The motor speed is at or below this setting.  	10	Speed
Pn502 Rotation Detection Level		rpm 1 ~ 10000	Determines that the servo amplifier is currently driving a motor, and sets the speed level at which signal output (TGON) is done. The following signal is output at speeds higher than this setting. Output Signal at Run Detection TGON (IBC0019) TGON (IBC0019) = 1: Motor Running TGON (IBC0019) = 0: Motor Stopped Status Display mode Monitor Mode: Un006	20	Speed Torque Position
		rpm 1 ~ 10000	—	20	Speed Torque Position

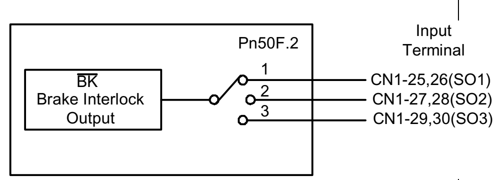
Sequence Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn503 Speed Coincidence Signal Output Width		rpm 1 ~ 1000	Sets the output conditions range for the speed coincidence signal V-CMP. The V-CMP signal is output when the difference between the speed reference and the actual motor speed is at or below this setting. V-CMP is on between 1900~2100rpm when the setting = 100, and the speed reference is 2000rpm.  V-CMP(IBC0018) = 1: Speeds coincide. V-CMP(IBC0018) = 0: Speeds do not coincide.	10	Speed
Pn504 NEAR Signal Width		Command Unit 1 ~ 250	Cannot be used in connection with an MP940.	7	Position
Pn505 Overflow Level		256 Command Units 1 ~ 32767	Cannot be used in connection with an MP940.	1024	Position

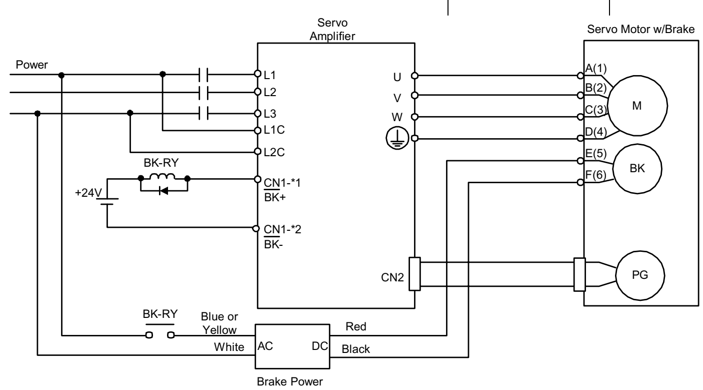
Sequence Related Parameters (Continued)

<table>
<tr><th>User Parameter Number</th><th>Digit Position</th><th>Name (setting range)</th><th>Content</th><th>Default Setting</th><th>Control Mode</th></tr>
<tr><td colspan="2">Pn506
Brake Reference - Servo OFF Delay Time</td><td>10ms
0 ~ 50</td><td>Brake ON Timing
(Timing in the motor STOP state)
Get the timing in Pn506 when the machine has mode a minute amount due to gravity, etc., in accordance with the brake ON timing.
Sets the brake control output signal (/BK) and the servo OFF operation (motor output stop) timing when a servomotor with brake is used.

In the standard setting, the servo is assumed to be OFF at the same time as the /BK output (brake operation).The machine may move slightly due to gravity in accordance with the machine structure and brake characteristics.At this time, it is possible to lose motion by slowing the servo OFF operation using the user parameters.
Holding Brake Setting (brake operation during motor rotation)
To stop the motor during operation, get the timing in Pn507 and Pn508 so as to apply the holding brake.
When using a servo motor with brake, set the brake timing for servo OFF during motor operation due to input signal S-ON (OBC0010) and alarm generation.
</td><td>0</td><td>Speed
Torque
Position</td></tr>
</table>

Sequence Related Parameters (Continued)

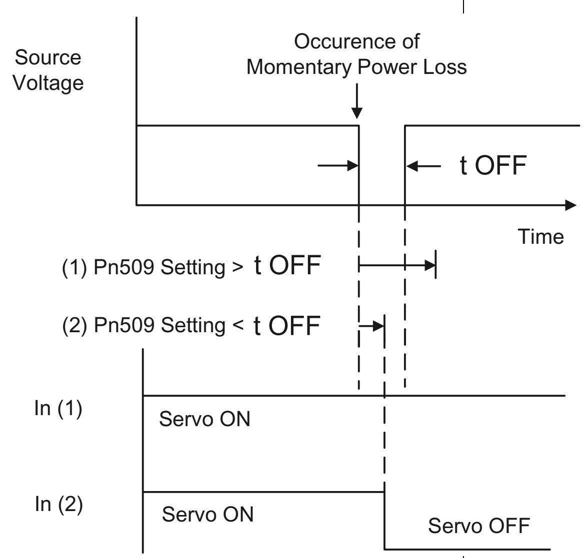
User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn506 Brake Reference - Servo OFF Delay Time (continued)		10ms 0 ~ 50	The braking must be applied at a proper timing with the motor stopped since the servo motor brake was designed for use as a holding brake.Adjust the user parameters while observing the operation of the machine. /BK Signal Output Conditions During Motor Rotation The output is assumed to be open under any of the following conditions: When the motor speed is at or below the setting of Pn507 after servo OFF. When the time has exceeded the setting in Pn508 after servo OFF. Even if the value set in Pn507 is higher than the maximum speed, the actual setting is the maximum speed of the motor.	0	Speed Torque Position
			Related Parameters The output signal in Pn50F.2 must be selected when a /BK signal is used. This is the brake control output when a brake motor is used. This need not be connected if the motor used has no brake. ON State (Open or L Level): Releases Brake OFF State (Open or H Level): Engages Brake  Select the terminal to which the /BK signal is to be output.	0	Speed Torque Position

Sequence Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn507 Brake Command Output Speed Level		rpm 0 ~ 10000	—	100	Speed Torque Position
Pn508 Timing for Brake Reference during Motor Operation (continued)		10ms 10 ~ 100	— User Output Parameter Setting Terminal (CN1) *1*2 Pn50F.20— 1 25 26 2 27 28 3 29 30 Connection Example The brake ON/OFF circuit is configured using the servo amplifier sequence output signal /BK and the brake power. A standard connection example is given in the figure below.  BK-RY : Brake Control Relay Brake power is either 200V or 100V *1,*2 : The output terminal numbers assigned in user parameter Pn50F.2.	50	Speed Torque Position

Sequence Related Parameters (Continued)

User Parameter Number	Digit Position	Name (setting range)	Content	Default Setting	Control Mode
Pn509 Momentary Hold Time		ms 20 ~ 1000	When the power voltage to the servo amplifier is momentarily turned OFF, the servo amplifier detects this condition, and shuts off the servo.The 20ms factory setting means that operation continues as is if a momentary power loss is 20ms or less. However, in the following cases, this has nothing to do with the setting of the Momentary Hold Time, but is rather related to servo alarms or control not possible states (these are handled in the same way as normal power OFF operations). When the servo motor load is excessive, and a low voltage alarm (A.41) is generated in a momentary power loss; when control becomes impossible (handled in the same way as a normal power OFF operation) during a momentary loss of control power. Momentary power loss detection detects an ON/OFF state in the main circuit power. The off state is ignored and operation continues if the recovery form OFF to ON is occurs within the time set in user parameter Pn509.	20	Speed Torque Position



Input Signal Selection

A detailed list of sequence-related parameters appears below.

Sequence Related Parameters - Input Signal Selection

User Parameter Number	Digit Position	Name	Setting Range	Content	Default Setting	Control Mode
Pn50A Input Signal Selections 1	0	Input Signal Assignment Mode	0 1	The assignment of the input signals for sequencing is the same as in the SGDB servo amplifier. The assignment of the above input signal can be set as desired.	1	Speed Torque Position
	1	/SVON Signal Mapping Set to 8 - disabled	0 1 2 3 4 5 6 7 8 9 A B C D E F	Enabled when the SI0 (CN1-40) input signal is ON (L level). Enabled when the SI1 (CN1-41) input signal is ON (L level). Enabled when the SI2 (CN1-42) input signal is ON (L level). Enabled when the SI3 (CN1-43) input signal is ON (L level). Enabled when the SI4 (CN1-44) input signal is ON (L level). Enabled when the SI5 (CN1-45) input signal is ON (L level). Enabled when the SI6 (CN1-46) input signal is ON (L level). The signal is always set to enabled. The signal is always set to disabled. Enabled when the SI0 (CN1-40) input signal is OFF (H level). Enabled when the SI1 (CN1-41) input signal is OFF (H level). Enabled when the SI2 (CN1-42) input signal is OFF (H level). Enabled when the SI3 (CN1-43) input signal is OFF (H level). Enabled when the SI4 (CN1-44) input signal is OFF (H level). Enabled when the SI5 (CN1-45) input signal is OFF (H level). Enabled when the SI6 (CN1-46) input signal is OFF (H level).	8:disabled	

Sequence Related Parameters - Input Signal Selection (Continued)

User Parameter Number	Digit Position	Name	Setting Range	Content	Default Setting	Control Mode
Pn50A (continued)	2	/P-CON Signal Mapping	0 ~ F	Set to 8 - disabled	8:disabled	Speed Torque Position
	3	/P-OT Signal Mapping	0 ~ F	Set to 2 - this assigns the /P-OT signal to SI2 (CN1-2)	2:SI2	
Pn50B Input Signal Selections 2	0	N-OT Signal Mapping	0 ~ F	Set to 3 - this assigns the /P-OT signal to SI2 (CN1-3)	3:SI3	
	1	/ALM-RST Signal Mapping	0 ~ F	Set to 8 - disabled	8:disabled	
	2	/P-CL Signal Mapping	0 ~ F	Set to 8 - disabled	8:disabled	
	3	N-CL Signal Mapping	0 ~ F	Set to 8 - disabled	8:Disabled	
Pn50C Input Signal Selections 3	0	/SPD-D Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	Speed Torque Position
	1	/SPD-A Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	
	2	/SPD-B Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	
	3	/C-SEL Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	
Pn50D Input Signal Selections 4	0	/ZCLAMP Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	Speed Torque Position
	1	/INHIBIT Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	
	2	/G-SEL Signal Mapping	0 ~ F	Set to 8 - disabled	8: disabled	
	3	Unused	0 ~ F	Set to 8 - disabled	8: disabled	

Sequence Related Parameters - Input Signal Selection (Continued)

User Parameter Number	Digit Position	Name	Setting Range	Content	Default Setting	Control Mode
Pn511 Input Signal Selections 5	0	/DEC Signal Mapping	0 ~ F	Set to 1 - this assigns the /DEC signal to SI1 (CN1-44)	1/Dec	Speed Torque Position
	1	/EXT 1 Signal Mapping	0 ~ F	Set to 4 - this assigns the /EXT1 signal to SI4 (CN1-44)	4:/Ext1	
	2	/EXT 2 Signal Mapping	0 ~ F	Set to 5 - this assigns the /EXT2 signal to SI5 (CN1-45)	5:/Ext2	
	3	/EXT 3 Signal Mapping	0 ~ F	Set to 6 - this assigns the /EXT3 signal to SI6 (CN1-46)	6:/Ext3	

Output Signal Selection

A detailed list of sequence-related parameters appears below.

Sequence Related Parameters - Output Signal Selection

User Parameter Number	Digit Position	Name	Setting Range	Content	Default Settings	Control Mode
Pn50E Output Signal Selections 1	0	Positioning Completion Signal Mapping	0 1 2 3	Disabled (Do not use the signal output on the left.) Output the signal on the left using output terminal SO1 (Cn1-25, 26), Outputs the signal on the left using output terminal SO2 (CN1-27, 28), Outputs the signal on the left using output terminal SO3 (CN1-29, 30).	1:SO1	Speed Torque Position
	1	Speed Coincidence Detection Signal Mapping (/V-CMP)	0 ~ 3	As above	1:SO1	
	2	Run Detection Signal Mapping (/TGON)	0 ~ 3	As above	2:SO3	
	3	Servo Ready Signal Mapping (/S-RDY)	0 ~ 3	As above	3:SO3	
Pn50F Output Signal Selections 2	0	Torque Limit Detection Signal Mapping (/CLT)	0 ~ 3	As above	0:Unused	Speed Torque Position
	1	Speed Control Signal Mapping)	0 ~ 3	As above	0:Unused	
	2	Brake Interlock Signal Mapping (/BK)	0 ~ 3	As above	0:Unused	

Sequence Related Parameters - Output Signal Selection (Continued)

User Parameter Number	Digit Position	Name	Setting Range	Content	Default Settings	Control Mode
Pn50F (continued)	3	Warning Signal Mapping (/WARN)	0 ~ 3	As above	0:Unused	Speed Torque Position
Pn510 Output Signal Selections 3	0	NEAR Signal Mapping (?NEAR)	0 ~ 3	As above	0: Unused	Speed Torque Position
	1	Similar C Signal Mapping (/C-PULS)	0 ~ 3	As above	0: Unused	
	2	Unused	—	—	0	
	3	Unused	—	—	0	
Pn512 output Signal Reversal Settings	0	SO1 (CN1-25, 26) Terminal Output Signal Inversion	0 1	Not inverted Inverted	0: Not inverted	Speed Torque Position
	1	SO2 (SN1-27, 28) Terminal Output Signal Inversion	0 1	Not inverted Inverted	0: Not inverted	
	2	SO3(CN1-29, 30) Terminal Output Signal Inversion	0 1	Not inverted Inverted	0: Not inverted	
	3	Unused		—	0	

Note: Output by OFF logic if a number of signals have been assigned to the same output circuit.
Signals not detected by the control mode are assumed to be OFF. For example, in speed control, the /COIN signal is assumed to be off.
/WARN Signal Types: Overload, regen overload, optional warnings

Chapter 7: Absolute Encoder

This chapter explains the absolute encoder system.

Outline of Absolute Encoder Functions

The absolute encoder functions are detailed below.

Overview

By detecting the machine position even with the power OFF, the absolute encoder system makes it possible to automatically set the machine coordinates and immediately execute an automatic run following power ON without zero return.

The advantages of the absolute encoder system are as follows:

- " Zero-point Return" is not necessary after power re-feed.
- The " soft limit" function is enabled immediately after power ON.
- Zero-point dog-legs, and overtravel limit switches become unnecessary.

Any of the following three systems may be selected by setting the parameters in this function.

① Operated as an "Incremental Encoder System" using an incremental encoder.
② Operated as an "Absolute Encoder System" using an absolute encoder.
③ Operated as an "Incremental Encoder System" using an absolute encoder.。

Absolute Encoder Basics

Absolute Encoder <F *13>

Absolute value detection is executed in a semi-closed loop by using an absolute encoder mounted on the motor. The device consists of the encoder itself, which detects the absolute position within one turn, and a counter, which counts the number of turns.

Absolute Data <F *13>

The absolute data recorded by the absolute encoder consists of the “No. of Turns From Absolute Base Position (P)” and the “Position Within Single Motor Turn (PO)”. This absolute data is read as serial data upon powering on the device. The device operates thereafter in the same manner as an incremental encoder.

That means, assuming

Number of rotations from absolute standard position	: N
Number of Pulses per motor rotation	: RP
Position within motor rotation	: PO

The absolute value (P) is derived by:

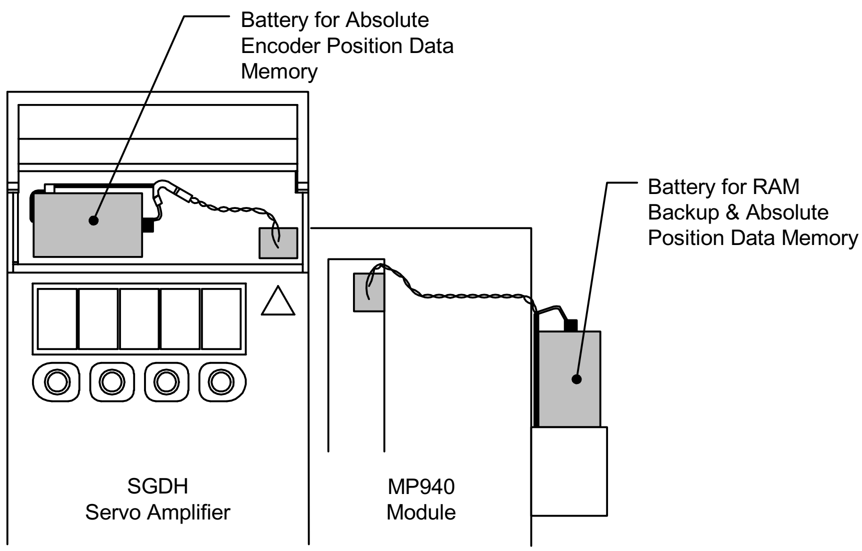
Absolute Position (P) = N x RP + PO

Absolute Data Storage

The absolute encoder uses a battery to save the absolute data at power cutoff. Changes are also updated.

Battery

When using an absolute encoder, a battery is needed to record position data to the MP940 unit and the SGDH.



The following table shows the conditions under which a battery is needed.

SGDH	MP940	Usage Method
No	No	Flash Operation Incremental Encoder Use Using absolute data as incremental data.
No	Yes	No Flash Operation Incremental Encoder Use Using absolute data as incremental data.
Yes	Yes	No Flash Operation Absolute Encoder Use

Initialization of Absolute Data

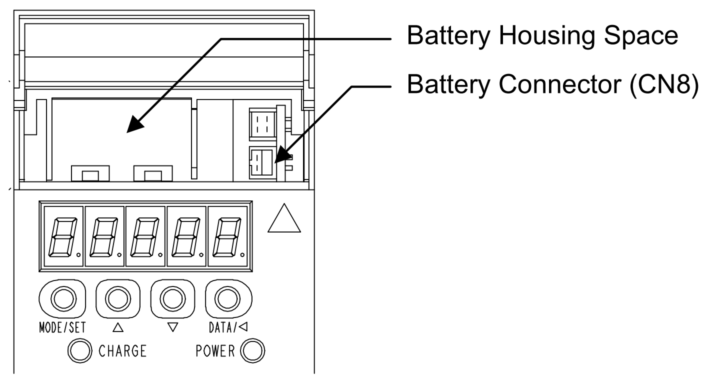
At power ON, the absolute data is sent to the servo amplifier as well as the MP940 module, the absolute position is calculated, and the machine coordinates are automatically set. In this way, the absolute machine position can be detected immediately after power ON, and automatic run immediately performed.

Handling of SGDH Battery

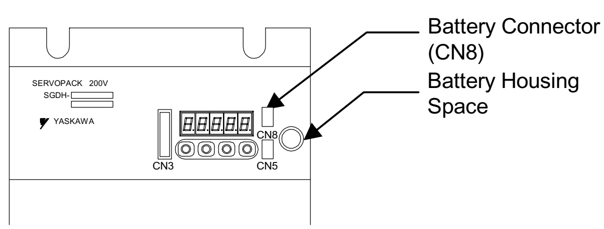
A battery backup is needed so that the absolute encoder can record the position data even when the power is OFF. Obtain the following recommended battery.

Lithium Battery Model: JZSP-BA01 (Battery and connector)

Battery: Toshiba Battery ER3V 3.6V 1000mA



When a 30 ~ 5.0kW Servo Amplifier is Used



When a 6.0kW, 7.5kW Servo Amplifier is Used

Status Shift of the Absolute Encoder System

The status shift of the absolute encoder system is shown in the figure below:

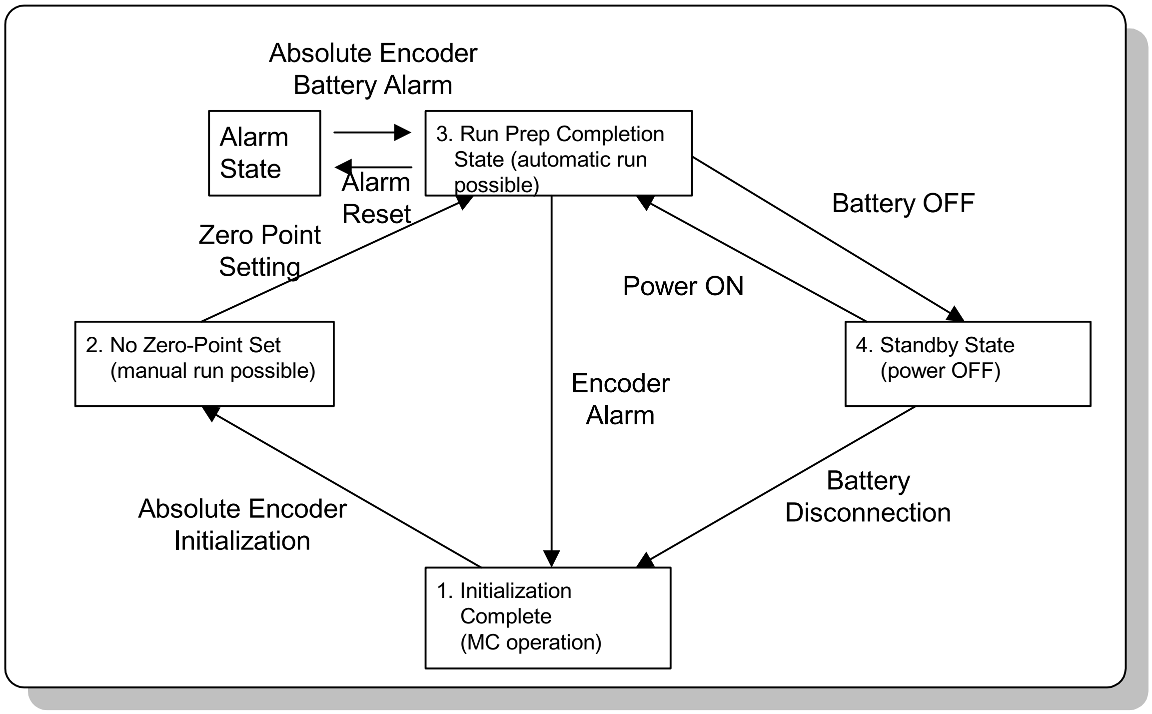


Figure Status Shift Diagram of Absolute Encoder System

Each of the states is as follows:

1. Initialization Incomplete State

   Absolute encoder operation cannot be assured in this state.

   Initialization of the absolute encode must be executed because an error results if the absolute encoder backup battery is completely drained or if the absolute encoder is being used for the first time.

   Zero-point setting is not possible in this state.

2. Zero-Point Unset State

   In this state, the zero-point setting, which determines the zero-point of the machine coordinate system, is not set. Because an alarm results upon powering on the device, execute zero-point setting after alarm reset. Axial motion in a zero-point unset state is of a manual jog or step run only.

3. Run Preparation Complete State

   In this state, zero-point setting is complete, the absolute encoder functions, and normal operation is possible.

4. Standby Mode

   This state detects machine motion while the power is OFF. Data is modified and updated by the turning of the absolute encoder.

   At this time, the battery is the power source for the absolute encoder.

Starting the Absolute Encoder Function

This section explains the startup procedure for the absolute encoder system.

System Startup Procedure

When starting up the absolute encoder system, peripheral devices such as the servo amplifier and motor must be checked. The following procedure is necessary when starting up the absolute encoder system.

(1)	Device Verification	Verify that the servo amplifier, servo motor and cables are all absolute encoder-compatible
(2)	Verify Servo Amp-related parameters	Verify that the servo amplifier parameters (user parameters) are set for absolute encoder use.
(3)	Set MP940 module-related parameters	Set parameters related to the absolute encoder function.
(4)	Absolute encoder initialization	Set up absolute encoder initialization B
(5)	Zero-point Setting	Execute " zero point setting" , and ser the " absolute zero point" which is th e" Machine Coordinate Zero Point" .

When items 1 ~ 5 (above) have been completed properly, the run preparations complete state results, and the absolute encoder system functions normally. Execute the absolute encoder system startup procedure under the following conditions:

(1) When the absolute encoder system is first started
(2) When the servo motor is replaced
(3) When an absolute encoder-related alarm is generated

Setting of Related Parameters

An explanation is given below of the absolute encoder-related parameters in the MP940 module. Set the following related parameters before starting the absolute encoder system.

Parameter Number	Name	Setting Range	Unit	Initial Value
Fixed Parameter 17 b5	Linear/Rotary Axis	0: Designates a linear axis 1: Designates a rotary axis	—	0
Fixed Parameter 23	Rotary Axis Reset Position	1 ~ 2^{31-1}	1 = 1 Command unit	360000
Setting parameter 7 (OLxx06)	Machine Coordinate Zero-point Position Offset Setting	0 ~ ± 2^{31-1}	Command Unit	0

Servo amplifier user parameters are listed below.

User Parameter	Name	Setting Range	Unit	Initial Value
Pn002.2	Absolute Encoder Usage Method	0: Using an absolute encoder as an absolute encoder 1: Using an absolute encoder as an incremental encoder	—	0
Pn205	Multi-turn Limit Setting	0 ~ 65535	rev	65535

Encoder Selection Setting (Pn202.2)

Set the SGDH user parameter Pn002.2 Absolute Encoder Usage Method for the axis governed by the absolute encoder.

- Linear/Rotary Axis Selection (fixed parameter 17, bit 5)
  Set whether the control axis has a motion limit.
- Maximum Number of Absolute Encoder Rotations (fixed parameter 23)
  An Absolute Encoder Over-rotation Error results if the difference between the pulse value of the machine coordinates stored at power OFF and the pulse value of the machine coordinates at the next power ON is greater than half the total number of pulses of the absolute encoder maximum rotation.
- Multi-turn Limit Setting (Pn205)
  Sets the rotary axis synchronization in command units. This parameter is enabled when a rotary axis is selected using an absolute encoder.

- Machine Coordinate Zero-point Position Offset Setting (OLC006)
  This is a parameter for determining the zero-point of the machine coordinates. The meaning of this parameter differs according to the type of encoder used and the linear/rotary axis selection.

Linear Axis	INC Axis	Parameter (OIxx06) ABS OFF is always enabled
—	ABS Axis	Parameter (OIxx06) ABS OFF is always enabled
Rotary Axis	INC Axis	Parameter (OIxx06) ABS OFF is always enabled
—	ABS Axis	Enabled only in zero-point return (used for defining the ABS System Rotary Position Management Data)

For an ABS Linear Axis

Setting parameter OLxx06 Zero-point Position Offset Setting is always enabled. It is possible to change the zero-point of the machine coordinate system by simply changing the Zero-point Position Offset Setting. The zero-point setting operation is unnecessary for ABS linear axes.

For an ABS Rotary Axis

Setting parameter OLxx06 Zero-point Position Offset Setting is enabled only during the zero-point setting operation. The electronic gearing value which positively converts the zero-point position offset setting is assumed to be the current position of the machine coordinates. Set parameter OLxx06 Zero-point Position Offset Setting to the desired position.

Absolute Encoder Initialization

Perform the setup operation for the absolute encoder in the following situations.

- At first startup of the machine
- When an encoder backup alarm is generated
- When servo amplifier power is OFF and the encoder cable is disconnected.

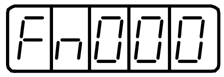
Setup can be executed using either the handheld digital operator, or the panel operator on the servo amplifier. Setup is also possible using the PC monitor software.

The setup operation for the absolute encoder is possible with the servo OFF.

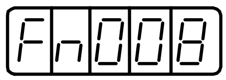
Restart power after the setup process.

Setup with the Handheld Digital Operator

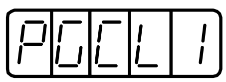
1. Select the auxiliary function execution mode by pushing the **DSPL/SET** key.



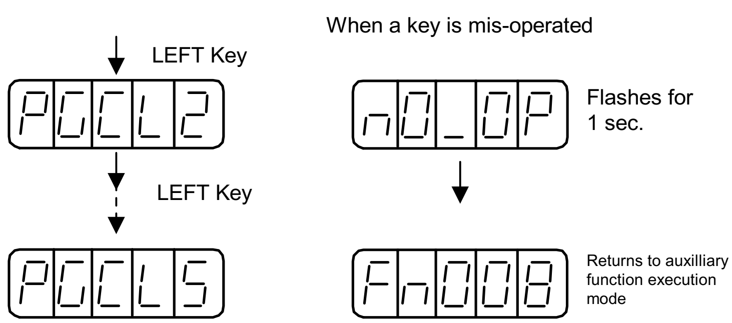
2. Select the user parameter Fn008. Select the setting digit by pressing the **LEFT** (<) key or the **RIGHT** (>) key. Change the value by pressing the UP and DOWN keys.



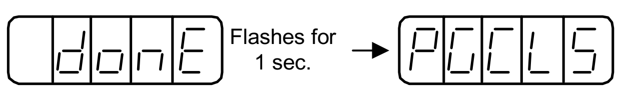
3. Press the **DATA/ENTER** key. The following is displayed.



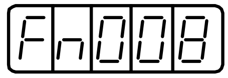
4. The display changes as follows when the **UP** key is pressed. Keep pressing the **LEFT** key until “PGCL5” is displayed. If a keying mistake is made, “nO_OP” flashes for 1 second, and the display returns to the Auxiliary Function Execution mode. Return to item 3 (above) and redo.



5. Keep pressing the **DSPL/SET** key until PGCL5 is displayed. The display changes as follows, and the multi-turn data in the absolute encoder is cleared.



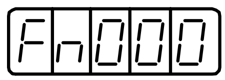
6. Press the **DATA/ENTER** key. The unit returns to the Auxiliary Function Execution mode.



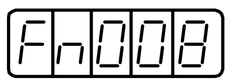
The absolute encoder setup operation is now complete. Turn the power OFF then ON again.

Setup with the Integrated Panel Operator

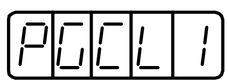
1. Select the auxiliary function execution mode by pushing the **MODE/ SET** key.



2. Select user parameter Fn008 by pressing the **UP** and **DOWN** keys.

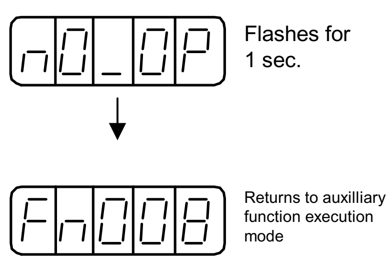


3. Press the **DATA/SHIFT** key for at least 1 second. The following is displayed.

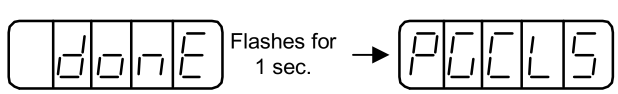


4. The display changes as follows when the **UP** key is pressed. Keep pressing the **UP** key until PGCL5 is displayed. If a keying mistake is made, nO_OP flashes for 1 second, and the display returns to the Auxiliary Function Execution mode. Return to item 3 (above) and redo.

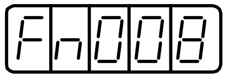
When a key is mis-operated



5. Continue pressing the **MODE/SET** key until PGCL5 is displayed. The display changes as follows, and the multi-turn data on the absolute encoder is cleared.



6. Press the DATA/SHIFT key for at least 1 second. The unit returns to the Auxiliary Function Execution mode.



The absolute encoder setup operation is now complete. Turn the power OFF then ON again.

When any of the absolute encoder alarms shown below are displayed, the alarm must be released by the same method as shown in the Setup Operation section on the previous pages. Release cannot be performed by the MP940 alarm reset (OBC0005).

- Encoder Backup Alarm (A.81)
- Encoder Sum Check Alarm (A.82)

When other alarms observed within the encoder are generated, the alarms must be released by the power OFF operation.

Multi-turn Limit Setting

CAUTION

- Modification of multi-turn limits is not necessary outside of specific applications. Casual modification of the data may be dangerous.
- Ensure that the value of the servo amplifier user parameter Pn205 is correct when a “Multi-turn Limit Nonconformance Check” alarm is generated. If Fn013 is operated with an incorrect Pn205 value, the mistaken value is set into the encoder. Although the alarm goes away, a highly deviated position is detected, and the machine moves to incorrect positions.

In systems in which an absolute encoder is desired, such as circular tables, returning the multi-turn data from the encoder to 0 every *m* rotations in machines where the motors rotate *m* times when the load axes rotate *n* times, may be convenient. Multi-turn limit setting is a function that sets the value “m” into the encoder.[1]

1. Multi-turn Limit: This is the upper limit of the multi-turn data. When Pn002.2 = 0, the multi-turn data varies within the range of 0 ~ Pn205 (multi-turn limit setting).

Select the absolute encoder usage method by the following user parameter.

Pn002.2	Absolute Encoder Usage Method	Factory Setting 0	Speed Control/Torque Control/Position Control

Set the following to 0 to enable the absolute encoder.

Pn002.2 Setting	Content
0	The absolute encoder is used as an absolute encoder.
1	The absolute encoder is used as an incremental encoder.

Set the multi-turn limit into the servo amplifier by the user parameters.

Pn205	Multi-turn Limit Setting	Unit rev	Setting Range 0 ~ 65535	Factory Setting 65535	Speed Control/ Torque Control/ Position Control

The multi-turn data varies within a range of -32768 ~ +32767 when the multi-turn limit setting is 65535 (factory setting). In all other settings, the multi-turn data varies within a range of 0 ~ (value set in Pn205).

When a servomotor rotates in a negative direction from 0, the multi-turn data varies in the Pn205 setting. When a servomotor rotates in a positive direction from the Pn205 setting, the multi-turn data changes to 0. Set (m-1) into Pn205. Recycle the power after modifying user parameters Pn002.2 and Pn205.

The multi-turn limit value in the encoder is set at delivery to 65535, as in the servo amplifier. The following alarm is generated if the servo amplifier power is cycled after modifying the servo amplifier multi-turn limit value in Pn205.

Alarm Name: Multi-turn Limit Non-coincidence

Alarm Display	Alarm Code Output			Alarm Content
—	ALO1	ALO2	ALO3	—
A.CC	On	Off	On	The multi-turn limit values in the encoder and servo amplifier do not match.

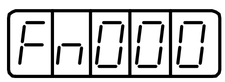
On = low signal; Off = high signal

Next, the multi-turn limit within the encoder must be modified. Execute the conversion of these settings in the Auxiliary Function Execution mode of the digital operator. Setup is also possible using the PC monitor software. The operating procedure using the digital operator is shown below:

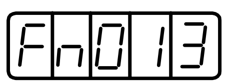
The setting modification operation for multi-turn limits within the encoder can be performed during a Multi-turn Limit Non-coincidence alarm. After modifications are completed, turn the power OFF then ON again.

Setting Modification with the Handheld Digital Operator

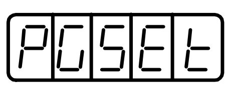
1. Select the auxiliary function execution mode by pushing the **DSPL/SET** key.



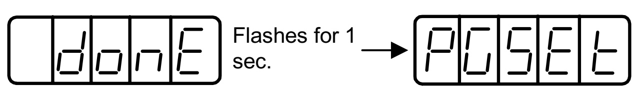
2. Select the user parameter Fn013. Select the setting digit by pressing the **LEFT** (<) key or the **RIGHT** (>) key. Change the value by pressing the **UP** key and **DOWN** key.



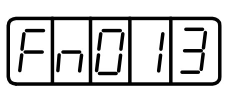
3. Press the **DATA/ENTER** key. The following is displayed.



4. Press the **DSP/SET** key. The display changes as follows, and the multi-turn limit in the absolute encoder is set.



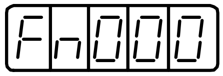
5. Press the **DATA/ENTER** key. The unit returns to the Auxiliary Function mode.



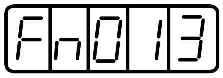
Modification of the absolute encoder multi-turn limit is now complete. Turn the power OFF then ON again.

Setting Modification with the Integrated Panel Operator

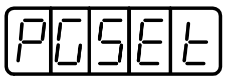
1. Select the auxiliary function execution mode by pushing the **MODE/ SET** key.



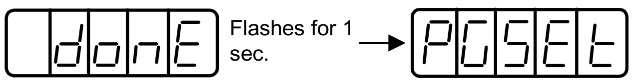
2. Select user parameter Fn013 by pressing the **UP** key and **DOWN** key.



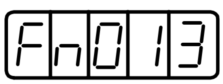
3. Press the **DATA/SHIFT** key for at least 1 second. The following is then displayed.



4. Press the **MODE/SET** key.The display changes as follows, and the multi-turn limit in the absolute encoder is set.



5. Press the **DATA/SHIFT** key for at least 1 second.The unit returns to the Auxiliary Function Execution mode.



Modification of the absolute encoder multi-turn limit is now complete. Turn the power OFF then ON again.

Absolute Encoder Usage Method

This section explains various cautionary items in absolute encoder usage, as well as the zero-point setting method. The usage of the absolute encoder differs for linear axes and rotary axes.

When Used with Linear Axes

CAUTION

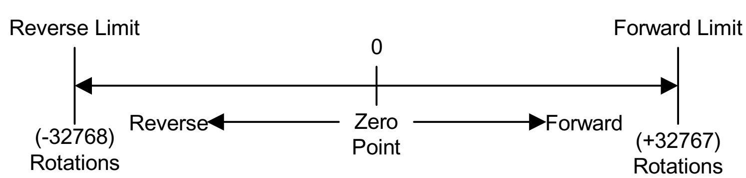
- Do not modify Zero-point Position Offset (OIxx06) while the machine is running in a linear axis. This may result in damage to the machine or injury to personnel.

Overview

The absolute encoder records the rotation from encoder zero-point into the internal battery backup memory. Therefore, the coordinate system zero-point may be obtained without executing a zero-point return operation after system start. After system startup, the device operates in exactly the same manner as an incremental encoder.

Because the rotations from the encoder zero-point can only be managed within a range of -32768 ~ +32768 rotations, the rotations can be reset to "0" when -32768~+32768 rotations are exceeded. The positions managed by the MP940 before and after power ON differ if the system power is cycled in this state.

A linear axis is an axis which has a range of motion using the absolute encoder range of -32768 ~ +32767.



Pay attention to the following items when using an absolute encoder with a linear axis.

- Be sure to execute encoder initialization before zero-point setting.
- Use the absolute encoder in the range of -32768 ~ +32767 rotations. (The actual range of machine operation varies according to such conditional parameters as gear ratio.)

Position Management when Using a Linear Axis

When used as a linear axis, the initialization of the position at power ON proceeds as follows:

Current Machine Coordinate Position = Encoder Position at Servo Power ON + Setting Parameter OLxx06 “Zero-point Position Offset”*

- Multi-turn Data × number of Encoder Pulses + Initial Increment
  Setting parameter OLxx06 “Zero-point Position Offset Setting” is always enabled in linear axes. The current position of the machine coordinates (zero-point setting) may be changed. The meaning of setting parameter OLxx06 differs in linear/rotary axes.

Linear

Set the current position of the machine coordinate system to “0” by setting as follows: -(ILxx02) + OLxx06 into OLxx06.

Example: When ILxx02 = 10000, OLxx06 = 100,

To change the current position of the machine coordinate system to “0” during zero-point setting execution:

-(10000) + 100 = -9900 Set -9900 into OLxx06

ILxx02: Machine Coordinate Calculation Position Monitor

Rotary

Set the desired position into OLxx06, and set the current machine coordinate position with that setting value upon executing zero-point setting.

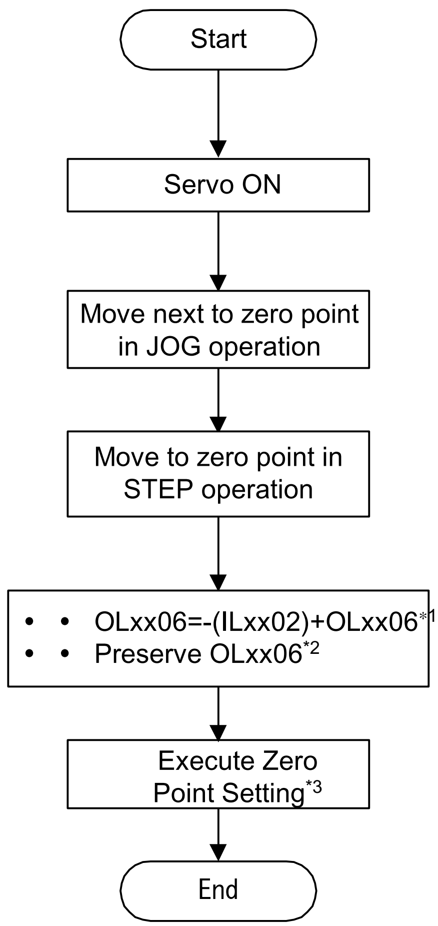
Example: When Setting the Current Machine Coordinate Position to “0” during Zero-point Setting Execution:

Set 0 into OLxx06

Procedure for Setting a Zero-point for a Linear Axis

After executing absolute encoder initialization, set the machine coordinate zero-point and create the machine coordinate system by executing zero-point setting.

The operating procedure for executing zero-point setting in a linear axis is shown below:



*1 The OLxx06 value must be saved at the same time as setting OLxx6.
*2 See the following supplemental item on saving OLxx06.
*3 Execute with the ZSET command.

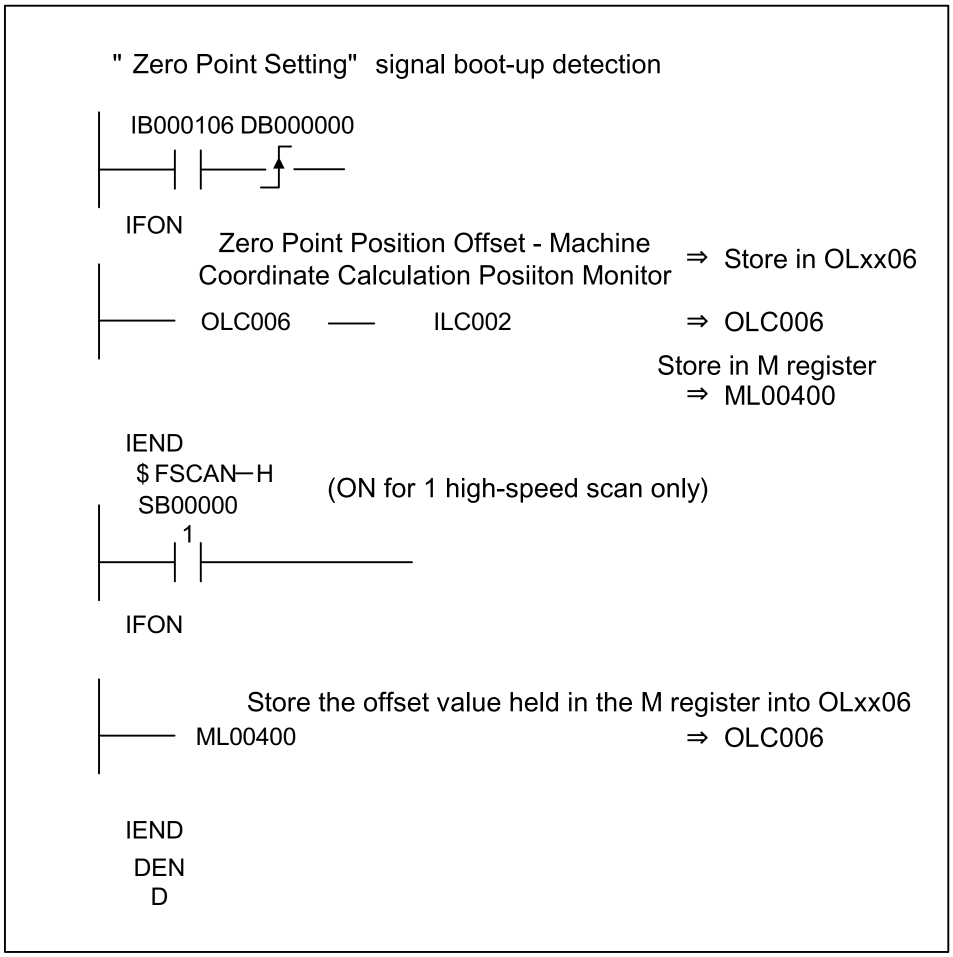
- Save the zero-point position offset as follows:

  Saving to the M Register in Ladder Programs

  Calculate (- (machine coordinate calculation position monitor) + zero-point position offset setting), and save to the M register at the same time as storing into OLxx06.

  Save the content stored in the M register into setting parameter OLxx06 “Zero-point Position Offset” at power restart or servo power ON.

The program necessary for linear axis abs system linear axis is as follows:



- Saving the Zero-point Position Offset (OLxx06) setting in the Motion-Works^{TM} parameter screen

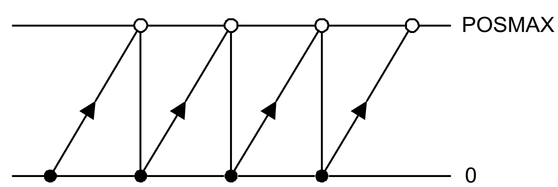
  After execution of zero-point setting, set the value (current value) of the zero-point position offset (OLxx06) and save to the controller by the

"Save" operation. Upon turning power ON again, the value of the zero-point position offset (OLxx06) at "Save" is automatically stored.

When Used as a Rotary Axis

Outline

Rotary positioning is a function in which the current values of the machine position and program position (absolute value occurring in the program coordinate system) are periodically and automatically updated according to the settings in the fixed parameters. Repeated positioning in the same direction can be executed by the rotary axis positioning function.



Because the rotations from encoder zero-point can only be managed within a range of rotations of 0 ~ Pn205 (multi-turn limit setting), the number of rotations can be reset to "0" if the number of rotations exceeds Pn205 (multi-turn limit setting). The positions managed by the MP940 before and after power ON differ if the system power is cycled in this state. This problem can be resolved by the following method.

Position Management when Using a Rotary Axis

At system power ON, the position managed by the MP940 derives the pulse unit position from the encoder phase position by the following formula.

The pulse position and encoder position are always saved as paired data to the battery backup memory. At the next power ON, this data is used as the "Pulse Position at Power OFF" and "Encoder Position at Power OFF", respectively, and the pulse unit is derived from the encoder phase position by the following formula.

Pulse Position = Pulse Position at Power OFF + (Encoder Position - Encoder Position at Power OFF)*

- Motion during power OFF is significant (phase position of encoder position)
- The meaning of the terms used is as follows:
  - Encoder Position: Absolute Encoder Position Data

    (Multi-turn Data × number of Encoder Pulses + Initial Incremental Pulses)

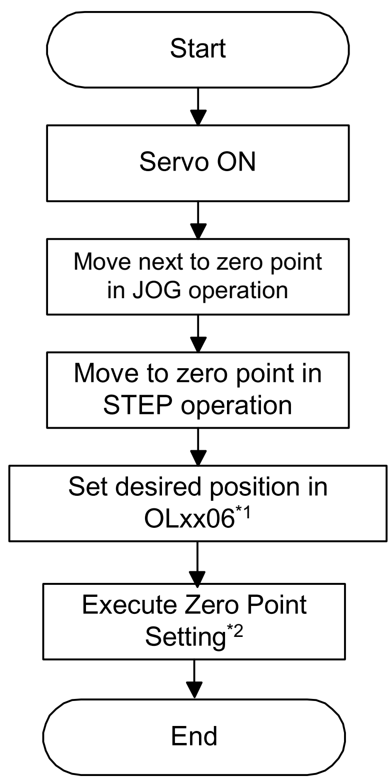
  - Pulse Position: Position at which position data managed by the MP940 is converted to pulses.

Procedure for Setting a Zero-point for a Rotary Axis

Execute the ZSET (zero-point setting) for the motion command.

The system assures the pulse position at power OFF, encoder position at power OFF, and all position data by the zero-point setting operation.

The operating procedure for zero-point setting in a rotary axis is shown below:



In a rotary axis, the setting parameter "zero-point setting offset" (OLxx06) is only enabled during ZSET command execution. It is therefore not necessary to save OIxx06 to the M register. For rotary axes, set the desired coordinates in "zero-point position offset" (OIxx06).

Example: When Setting the Current Stop Position to the Machine Coordinate Zero-point Position (0)

Set 0 into OLxx06

Note: Execute with the ZSET command.

Creation of Ladder Program for Rotary Axis Position Management

When using an absolute encoder as a rotary axis, a dedicated ladder program for absolute rotary position management is needed at normal run or for restarting the system power.

At Normal Run

1. Verification of Zero-point Setting Completion Status
   Verify that the monitor parameter "Zero-point Setting Completion" (bit 3 of IWxx15) is ON. If ON, execute step 2.
   If OFF, the system cannot assure the pulse position at power OFF, encoder position at power OFF, or any position data.In this situation, execute system power restart, and set up the position data again, or assure the new position data by executing the ZSET command (zero-point setting).
2. Saving the Pulse Position At Power OFF and Encoder Position at Power OFF
   Saves the following monitor parameters to a battery backed-up M register at high-speed scan timing according to the customer's ladder program.

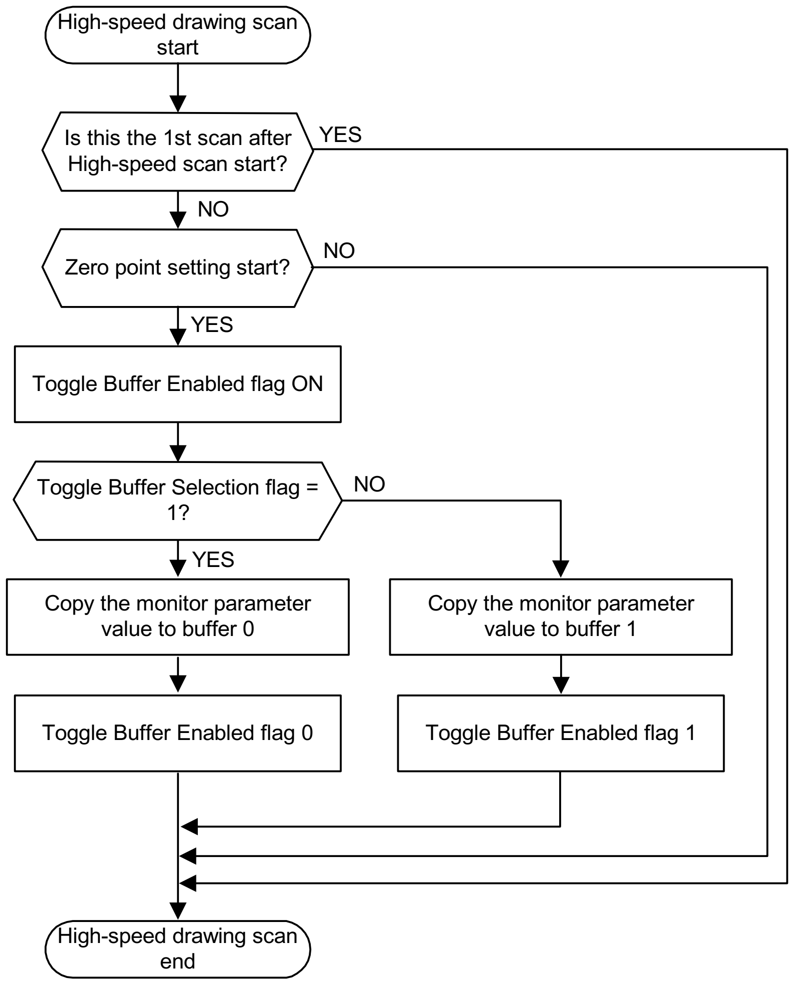
Monitor Parameter "Encoder Position at Power OFF" (all four words of ILxx38/ILxx3A)
Monitor Parameter "Pulse Position at Power OFF" (all four words of ILxx3C/ILxx3E)

Configure the M register into which the above monitor parameters are saved as follows:

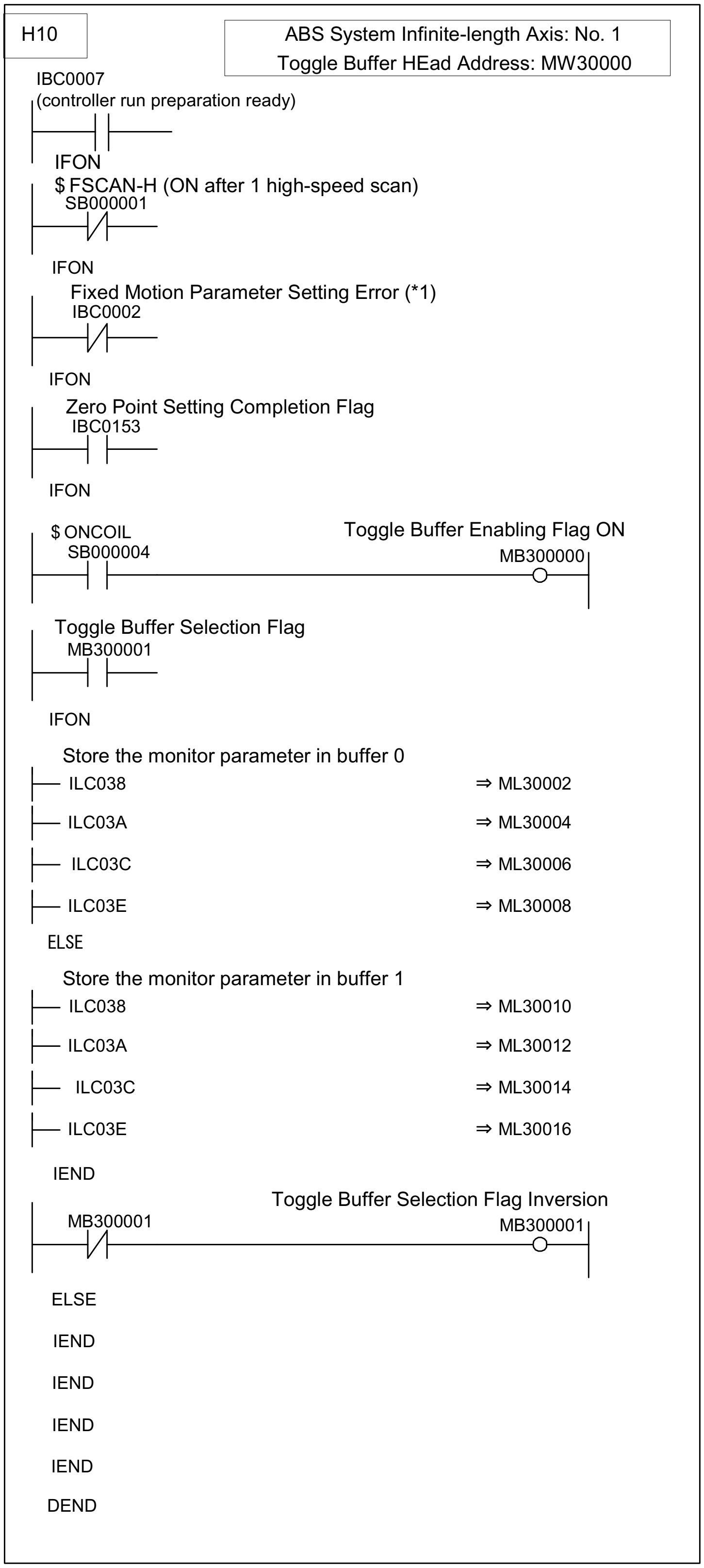
<table>
<tr><td rowspan="3">MWxxxxx</td><td>bit 0</td><td colspan="2">Toggle Buffer Enable Flag (0 = enabled/1 = disabled)</td></tr>
<tr><td>bit 1</td><td colspan="2">Toggle Buffer Selection Flag (0 = buffer 0/1 = buffer 1)</td></tr>
<tr><td>bit 2</td><td colspan="2">Position Data Repeat Setup Request Flag (0 = complete/1 = Request)</td></tr>
<tr><td>MWxxxxx +1</td><td colspan="3">Empty</td></tr>
<tr><td rowspan="2">MLxxxxx +2
MLxxxxx +4</td><td rowspan="4">Buffer 0</td><td rowspan="2">Monitor Parameter
“Encoder Position at Power OFF”</td><td>Lower 2 words (ILxx38)</td></tr>
<tr><td>Upper 2 words (ILxx3A)</td></tr>
<tr><td rowspan="2">MLxxxxx +6
MLxxxxx +8</td><td rowspan="2">Monitor Parameter
“Pulse Position at Power OFF”</td><td>Lower 2 words (ILxx3C)</td></tr>
<tr><td>Upper 2 words (ILxx3E)</td></tr>
<tr><td rowspan="2">MLxxxxx +10
MLxxxxx +12</td><td rowspan="4">Buffer 1</td><td rowspan="2">Monitor Parameter
“Encoder Position at Power OFF“</td><td>Lower 2 words (ILxx38)</td></tr>
<tr><td>Upper 2 words (ILxx3A)</td></tr>
<tr><td rowspan="2">MLxxxxx +14
MLxxxxx +16</td><td rowspan="2">Monitor Parameter
“Pulse Position at Power OFF”</td><td>Lower 2 words (ILxx3C)</td></tr>
<tr><td>Upper 2 words (ILxx3E)</td></tr>
</table>

Note: Two buffers are needed because the buffer saving the encoder position at power OFF and pulse position at power OFF may close without assuring the 4-word position data if there is a power cutoff during high-speed scan.

Observe the following flowchart as a procedure for saving values to the buffer.



An example for programming (ladder program) the above flow is depicted below. The axis used is the first axis of module number 1. Overwrite the motion parameter register number if the module number and axis number differ.


H10
ABS System Infinite-length Axis: No. 1
Toggle Buffer HEad Address: MW30000
IBC0007
(controller run preparation ready)
IFON
$ FSCAN-H (ON after 1 high-speed scan)
SB000001
IFON
Fixed Motion Parameter Setting Error (*1)
IBC0002
IFON
Zero Point Setting Completion Flag
IBC0153
IFON
$ ONCOIL
SB000004
Toggle Buffer Enabling Flag ON
MB300000
Toggle Buffer Selection Flag
MB300001
IFON
Store the monitor parameter in buffer 0
ILC038 ⇒ ML30002
ILC03A ⇒ ML30004
ILC03C ⇒ ML30006
ILC03E ⇒ ML30008
ELSE
Store the monitor parameter in buffer 1
ILC038 ⇒ ML30010
ILC03A ⇒ ML30012
ILC03C ⇒ ML30014
ILC03E ⇒ ML30016
IEND
Toggle Buffer Selection Flag Inversion
MB300001
MB300001
ELSE
IEND
IEND
IEND
IEND
DEND

When Restarting System Power (including turning servo power ON again)

Set up the position data again as follows at high-speed scan timing according to the customer's ladder program. Perform this operation when power is returned to the system, or when power is returned to the servo.

1. Saving to the “Pulse Position at Power ON” and “Encoder Position at Power ON” setting parameters

   Save the “Pulse Position at Power ON” and “Encoder Position at Power ON” stored in the M register into the following setting parameters.

Setting Parameter “Encoder Position at Power OFF” (all four words of OLxx38/OLxx3A)
Setting Parameter “Pulse Position at Power OFF” (all four words of OLxx3C/OLxx3E)

   At this time, save the buffer content selected in the previously mentioned toggle buffer selection flag.

2. “ABS System Rotary Position Management Data LOAD Request” operation
   Turn the setting parameter “ABS System Rotary Position Management Data LOAD Request (bit 3 of OWxx2D)” OFF¨→ ON¨→ OFF. All position data is assured by this operation. The monitor parameter “Zero-point Setting Completion (bit 3 of IWxx15)” goes ON, and the following monitor parameter is enabled.

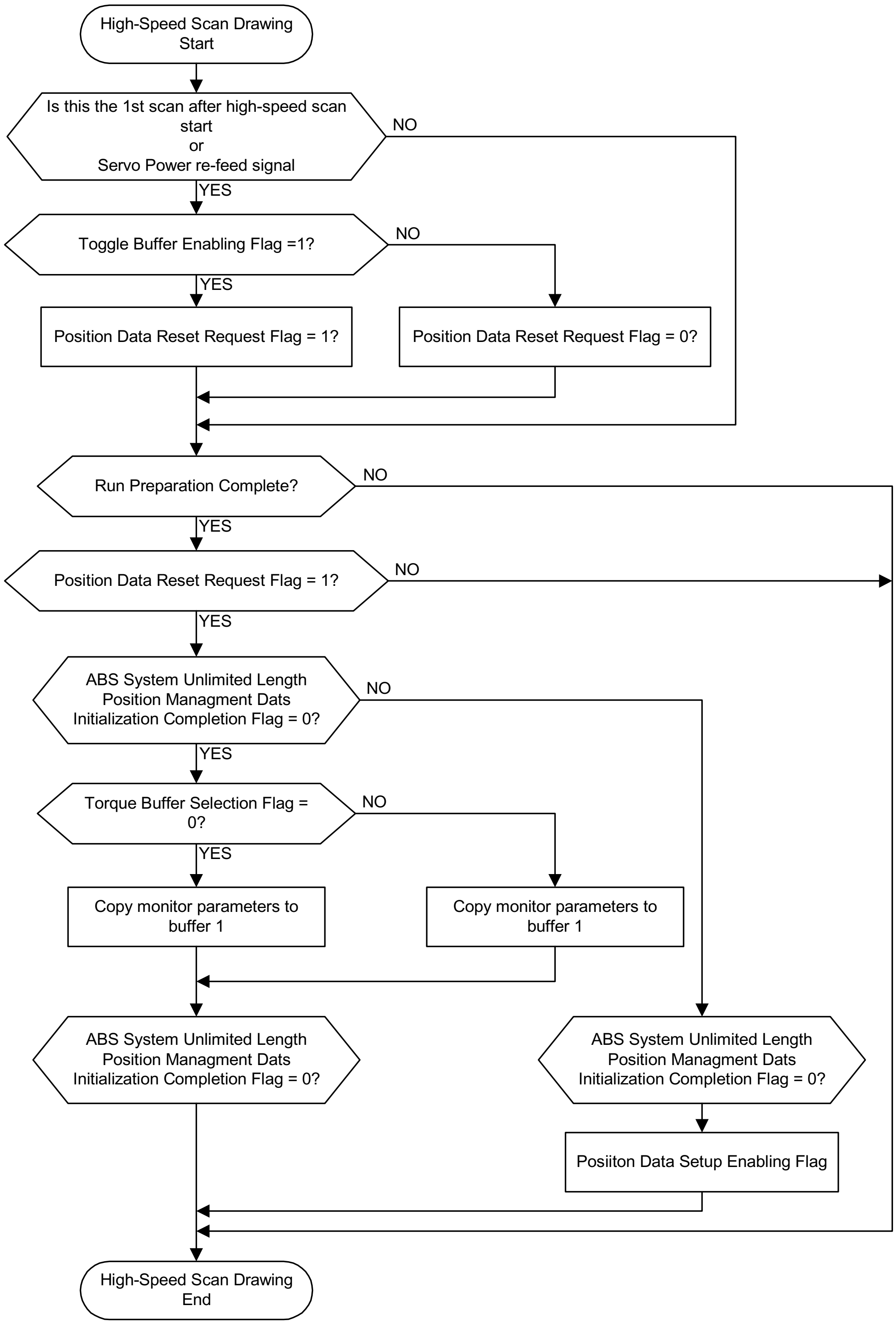
Monitor Parameter “Encoder Position at Power OFF” (all four words of ILxx38/ILxx3A)
Monitor Parameter “Pulse Position at Power OFF” (all four words of ILxx3C/ILxx3E)

   The system generates the position data by the following formula during an ABS system rotary position management data LOAD request.

Pulse Position = Pulse Position at Power OFF + (Encoder Position - Encoder Position at Power OFF)*

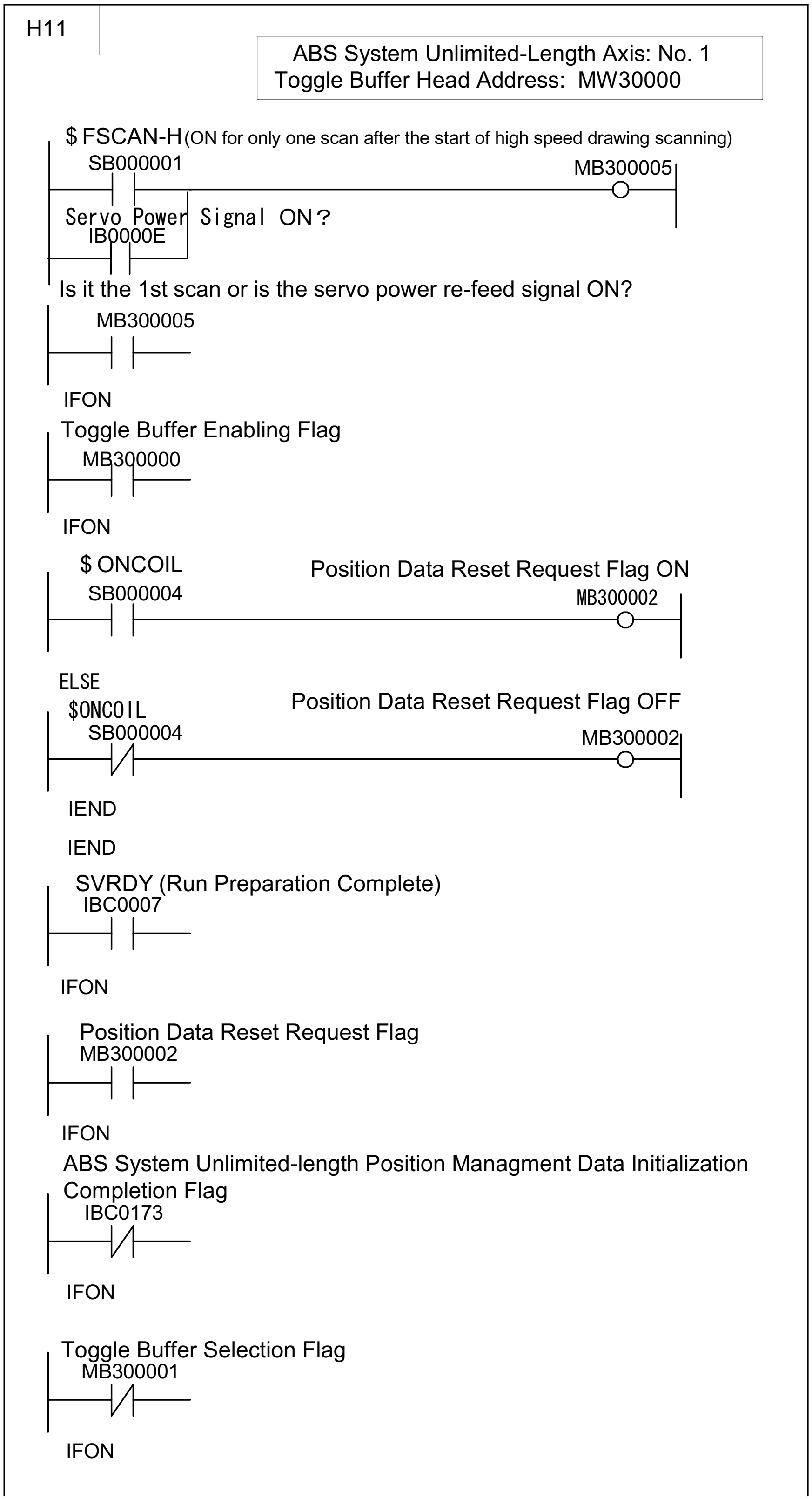
- Motion is significant while power is OFF.

The following flowchart shows how to perform this by turning the position data setup request ON. Observe the following flowchart as a procedure for setting up the position data.


High-Speed Scan Drawing Start
Is this the 1st scan after high-speed scan start or Servo Power re-feed signal
NO
YES
Toggle Buffer Enabling Flag =1?
NO
YES
Position Data Reset Request Flag = 1?
Position Data Reset Request Flag = 0?
Run Preparation Complete?
NO
YES
Position Data Reset Request Flag = 1?
NO
YES
ABS System Unlimited Length Position Managment Dats Initialization Completion Flag = 0?
NO
YES
Torque Buffer Selection Flag = 0?
NO
YES
Copy monitor parameters to buffer 1
Copy monitor parameters to buffer 1
ABS System Unlimited Length Position Managment Dats Initialization Completion Flag = 0?
ABS System Unlimited Length Position Managment Dats Initialization Completion Flag = 0?
Posiiton Data Setup Enabling Flag
High-Speed Scan Drawing End

The following shows an example for programming (ladder program) the above flow.

The axis used is the first axis of module number. Overwrite the motion parameter register number if the module number and axis number differ.



Continued on next page

```
Save the buffer 0 value into the setting parameter
├── ML30002                              ⇒ OLC038
├── ML30004                              ⇒ OLC03A
├── ML30006                              ⇒ OLC03C
├── ML30008                              ⇒ OLC03E
ELSE
Save the buffer 1 value into the setting parameter
├── ML30010                              ⇒ OLC038
├── ML30012                              ⇒ OLC03A
├── ML30014                              ⇒ OLC03C
├── ML30016                              ⇒ OLC03E
IEND
$ONCOIL     ABS system unlimitied length position management data
SB000004        initialization request flag ON
                                         OBC02D2
ELSE
$ONCOIL     ABS system unlimitied length position management data
SB000004        initialization request flag OFF
                                         OBC02D2
$ONCOIL         Position data setup request flag OFF
SB000004                                 MB300002
IEND
IEND
IEND
DEND
```

When using the absolute encoder as a rotary axis, there is no restriction on the order of execution for the necessary ladder programs H10 and H11.

Chapter 8: Maintenance Inspection

This chapter explains the daily and periodic inspection items necessary for optimum use of the MP940.

Inspection Items

This section describes the daily and periodic inspections to be executed by the customer.

Daily Inspection

The necessary items for daily inspection are shown in the table below:

Item	Inspection Items		Inspection Content	Determination Standard	Installation
1	Mounting State of Module		Check for looseness in the screws and misplacement of the cover.	These should be securely mounted.	Tighten screws.
2	Connection State		Looseness in terminal screws	There should be no looseness.	Tighten the terminal screws.
			Connector	Connectors should not be loose.	Tighten the connector fixing screws.
			Adjacent to contact terminals	Separation should be normal.	Straighten
3	Display LEDs	RDY LED	Check lights.	ON (light OFF indicates errors)	See the chapter on “Troubleshooting”.
		RUN LED	Verify that the light is ON in the RUN state.	ON (light OFF indicates errors)	See the chapter on “Troubleshooting”.
		ALM LED	Verify that the light is OFF.	OFF (light ON indicates errors)	See the chapter on “Troubleshooting”.
		“BAT” LED	Verify that the light is OFF.	Battery disconnected if ON	Change Battery.
		“PRT1” LED	Verify that lights are ON, OFF.	Transmitting to Serial Port 1	—
		“PRT2” LED	Verify that lights are ON, OFF.	Transmitting to Serial Port 2	—

Periodic Inspection

The spot inspection items that must be executed once or twice every six months to a year are detailed below. Execute these spot checks whenever the installation has been moved or altered, if the wiring has been modified, etc.

CAUTION

- **Do not change the internal fuse.**
  Customer replacement of the internal fuse may result in damage to the module or misoperation. Replacement of the internal fuse is to be performed by Yaskawa service department personnel only.

Periodic Inspection Items

Item	Inspection Items		Inspection Content	Determination Standard	Installation
1	Surrounding Environment	Ambient Temperature	Measure corrosive gas with thermometer/ hydrometer	0 ~ 55ºC	When used in a panel, the temperature within the panel is the ambient temperature.
		Ambient Humidity		30 ~ 95%RH	
		Atmosphere		No corrosive gas	
2	Power Voltage Check		Voltage measurement between 24VDC terminals	DC19.2 ~ 28.8V	Changing of supplied power
3	Mounting State	Looseness, rattling	Try running the module.	These should be securely mounted.	Tighten screws
		Attachment of grime, foreign material[2],	Appearance	Nothing stuck to unit	Removal, cleaning
4	Connection State	Looseness in terminal screws	Tighten with screwdriver.	There must be no looseness.	Tighten
		Adjacent to contact terminals	Appearance	Separation should be normal.	Straighten
		Connector looseness	Appearance	There should be no looseness.	Tighten the connector fixing screws.
5	Battery		Check the “BAT” LED on the front panel of the MP940.	The “BAT” LED must be OFF.	Change the battery if the “BAT” LED is ON.

MP940 Module Battery

One replaceable battery is integrated into the MP940 module. This battery is for back-up purposes so that programs and data stored in the MP940 module are not lost in a power outage (when the power supply to the MP940 module is cut OFF).

Battery Life

The internal battery can perform power loss backup of memory content for up to one year of total power loss time. The battery storgae life is five years. These values can differ however, according to ambient temperature and usage conditions.

Change the battery (model: BA000518) within two weeks when the “BAT” display light is ON on the MP940 module. Delay in replacing the battery results in loss of the programs and data stored in the MP940 module memory.

If two weeks have passed since the “BAT” light has gone ON, replace the battery (Model: BA000518) immediately.

The above explanation presupposes the following:

² This occurs when the “BAT” light is ON prior to continuous rest, and power is cut off during the continuous rest so that the “BAT” display lights up when power is fed again after the rest period.

Changing the Battery

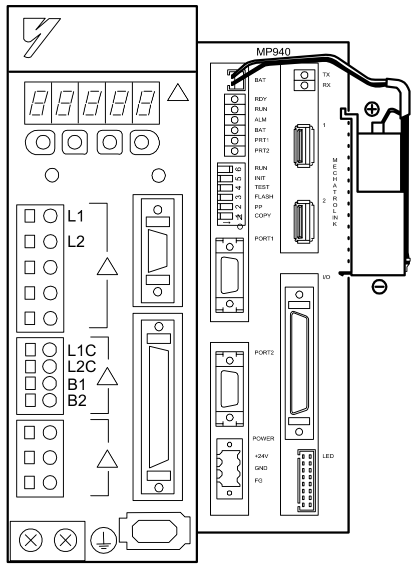
The method for changing the battery is shown below.

- Saving Memory Content

Prior to changing the battery, save the programs and data stored in the MP940 module memory to floppy disk or hard disk. The saved programs and data are used if the programs and data are mistakenly deleted due to a mistake in the battery change operation.

■ Preparation for Battery Replacement

Prepare the replacement battery (Model: BA000518). This battery is not commercially available; it must be ordered from Yaskawa. The appearence of the replacement battery is shown in the figure below.



BA000518 (battery w/ cables)

■ Battery Change Procedure

Change the battery as follows:

1. Check that the “POWER” display light on the MP940 module is ON.
2. Remove the ends of the connectors attached to the battery leads from the MP940 module connectors, and remove the internal battery from the battery holder.
3. Firmly insert the connectors attached to the ends of the replacement battery leads into the MP940 module connectors. Then place the replacement battery into the battery holder.
4. Check that the “BAT” display light on the MP940 module is OFF.

Battery replacement is now complete.

Be sure to feed power to the MP940 module during battery replacement. Cutting off the power to the MP940 module while replacing the battery risks loss of the programs and data stored in the module memory.

Chapter 9: Troubleshooting

This chapter deals with the content of various errors occurring in system use, and the methods for dealing with them.

Troubleshooting Outline

This section contains basic troubleshooting methods and a list of errors.

Troubleshooting Methods

There are three methods to verify the content of an error should one occur in the system: from the phenomenon, by error code, and by the monitor function of a peripheral device. The causes can be quickly verified by using each of these methods in accordance with the situation.

- Phenomenological Verification

This is the execution of causal analysis and recovery by observing the LED display on the front of the module and the operational status of each device.

- Verification by Error Code

This is causal analysis and recovery which occur by monitoring the error code upon error generation. Errors are classified into the following types:

Classification	Error Code Type
Error Codes in Sequence Control	System Register (S register) SW00040 ~
Error Codes in Motion Control	Motion Program Error Codes Servo Errors by Axis

■ Verification by Peripheral Device Monitors

In this method, the cause of the error is analyzed by ascertaining the control state according to the monitor functions of the peripheral devices. The status of the following functions may be verified:

- Program Monitor
- Position Monitor
- Error Monitor
- Trace

Basic Troubleshooting Flow

When an error is generated, the cause which generated the problem must be found as soon as possible, countermeasures taken, and the system restarted quickly. The basic troubleshooting flow is as follows:

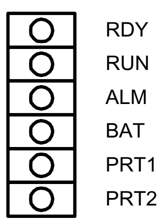
No.	Point	Specific Investigation Content
1	Visual Verification	Machine motion (state when stopped) Power status Status of I/O devices Wiring state Status of the various displays (LEDs on each module) Status of each setting switch (e.g., DIP switches) Verification of parameter and program content
2	Malfunction Verification	Perform the following operations to determine whether there has been any change in the malfunction: Put the controller to the STOP state Execute alarm reset Turn power ON again
3	Narrow the range	Ascertain the failure location by performing steps 1 and 2 above. Controller or external? Sequence control or motion control? Software or hardware?

LED Error List

The content of errors can be verified by the LED display status on the front of the MP940 module. Pinpoint the location to correct the program by checking the drawings which generate the errors, as well as the function numbers. Then, review the content of the operation error (by reading the general error from the content of the LED display) and refer to the content of the system (S) register.

■ LED Display Light

The LEDs displaying the MP940 operation status and error content are shown below.



Name	Display Light Color	Meaning when Lit
RDY	Green	System normal
RUN	Green	Program running
ERR	Red	On/flashing at minor system fault/error
BAT	Red	On at battery voltage drop
PRT 1	Green	Transmitting to Serial Port 1
PRT 2	Green	Transmitting to Serial Port 2

■ Content of LED Display

The display content and countermeasure methods for the LEDs displaying the MP940 operation status and error content are shown below.

Type	Display Light Name				Display Content	Countermeasure
	RDY	RUN	ALM	BAT		
Normal	×	×	✱	×	Hardware Reset State	The CPU normally starts within 1 second. If this state continues, there is a software error/ hardware fault. Execute system error countermeasures.
	×	×	×	×	Initial Execution	
	✱	×	×	×	User Program Stopped (online stop mode)	When a STOP operation is executed by MotionWorks™. This state results when the RUN switch is turned OFF.
	✱	✱	×	×	User Program Executing Normally	This state results during normal execution.
Error	×	✱	✱	×	Major Fault Generation	—
	✱	×	✱	×	Program Memory Initialization Complete Scan Time Setting Error	Execute the program memory clear operation in the MotionWorks™ system definition screen. A hardware failure is suspected if the system does not recover.
	×	×	§	×	Hardware Error Number of Flashes 2: RAM Diagnostic Error 3: ROM Diagnostic Error 4: CPU Function Diagnostic Error 5: FPU Function Diagnostic Error	Hardware fault. Execute system error countermeasures.
Warning	—	—	—	✱	Battery Alarm	Replace the battery.
	✱	✱	✱	§	Operation Error	—
					I/O Error	—
					Invalid Assignment Error	—
	Report to system register (no LED display)				MotionWorks™ Connection Data	See the System Status Display table.
					Hardware Status (momentary stop, RUN/ STOP, testing mode, etc.)	See the System Status Display table.

Note: In the display light LED ×: OFF; ✱:ON; §:Flash; —:Undefined

System Errors

This section deals with the content of system errors and their countermeasures.

Outline of System Errors

The operation state and error state of the MP940 can be gathered from the LED display on the front of the CPU module. See the System (S) resgister to obtain the detailed contents of an error. By ckecking the detailed contents of the system register, the fault location may be pinpointed and the countermeasures executed. The details of the system register are shown below:

■ System Register Assignment

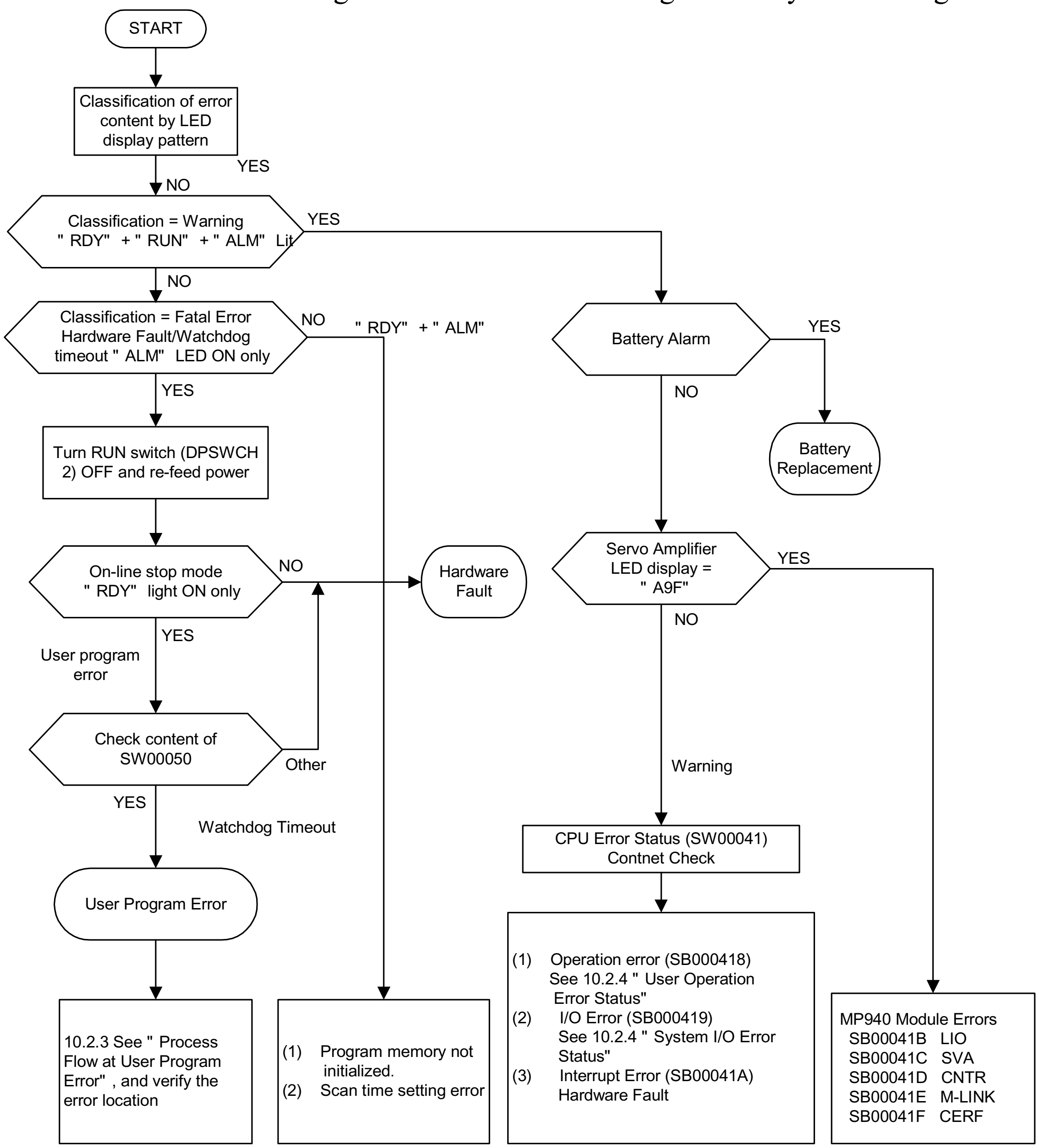
The total configuration of the system register is as follows:

SW00000	System/Service Register	
SW00030	System Status	*
SW00050	System Error Status	*
SW00080	User Operation Status	*
SW00090	System Service Execution Status	
SW00100	Interrupt Input Error Status	
SW00110	User Operation Error Status (details)	*
SW00200	System I/O Error Status	
SW00424	Reserved for System	
SW00500	System Analysis Status	
SW00530	Reserved for System	
SW00600	System Operation Error Status	
SW00620	Reserved for System	
SW00698	Interrupt Status	
SW00800	Reserved for Option Module	

* For details, see the section on “Configuration of System Registers”.

Processing Flow at System Error Generation

The following shows the troubleshooting flow at system error generation.



- For the LED display patterns, see “Content of LED Display” in the “LED Error List”.

Processing Flow at User Program Error Generation

When both the RUN and ERR LEDs on the front of the MP940 module are ON, a major fault has likely been generated. Inspect the error program as follows:

(1) Inspection by major fault error types	Check the content of SW00050 (error type), and determine whether the major fault is a system error or a user program error.

⬇

(2) Investigation by error program type	Check the content of SW00055 (Program Type) to determine whether the error was generated in a drawing or in a function.

⬇

(3) Inspection of erroneous drawings	Check SW00054 (error status) and the numbers in SW00056 (drawing number) to obtain the erroneous drawing.

⬇

(4) Inspection of erroneous functions	An error has occurred in a function when SW00056 (DWG number) is 01zzH. Check SW00057 (error status) and the numbers in SW00058 (drawing number) to obtain the erroneous drawing. Check the step number of the operation error generation in SW00059 (function reference drawing step number).

⬇

(5) Operation error occurrence inspection	Check the error count for each drawing in SW00080 ~ SW00088. An operation error is generated during count-up. See (6).

⬇

(6) Investigation of Operation error content and location	a) Investigation of Error Content Investigate the error code is drawings where the error count was counted up. DWG.A:SW00111 DWG.H:SW00143 DWG.I:SW00127 DWG.L:SW00175 b) Investigation of Drawing Number Check the error drawing number for which the drawing number error is generated. DWG.A:SW00122 DWG.H:SW00154 DWG.I:SW00138 DWG.L:SW00186 c) When an error is generated within a function, check the function reference drawing number and the function reference step number. DWG.A:SW00123,4 DWG.H:SW00155,6 DWG.I:SW00139,40 DWG.L:SW00187,8

⬇

(7) Program correction	Correct the program at the location in which the error was generated.

Configuration of System Register

The system status display indicates the system operation status and error content. Determine whether the error is due to software or hardware, according to the content of the system status.

System Status Display

Name	Register Number	Contents		
Reserved by System	SW00030 ~ SW00039	(Unused)		
CPU Status	SW00040	SB000400	READY	0: Conversation/Self-diagnostic Error; 1: Normal
		SB000401	RUN	0: Run Stop; 1: Running
		SB000402	ALARM	0: Normal; 1: Warning
		SB000403	ERROR	0: Normal; 1: Error
		SB000404	RESUME	0: New Run
		SB000405	Start Status	0: Normal Power Recovery
		SB000406	Reserved for System	(Unused)
		SB000407	WEN	0: Write Prohibit; 1: Write Possible
		SB000408	Reserved for System	(Unused)
		SB000409	Reserved for System	(Unused)
		SB00040A	Reserved for System	(Unused)
		SB00040B	—	—
		SB00040C		
		SB00040D		
		SB00040E	Run Stop Request	0: RUN Selection; 1: STOP Selection
		SB00040F	Reserved for System	(Unused)

System Status Display (Continued)

Name	Register Number	Contents		
CPU Error Status	SW00041	SB000410	Major Fault	1: WDGE, undefined command For details, see SW00050
		SB000411	Program Memory Error	1: Program Memory Error
		SB000412		
		SB000413	Reserved for System	(Unused)
		SB000414	—	—
		SB000415		
		SB000416		
		SB000417		
		SB000418	User Operation Error	1: User Operation Error
		SB000419	I/O Error	1: I/O Error
		SB00041A	Invalid Assignment Error	1: Invalid Assignment Error
		SB00041B	Transmission Error	1: LIO Transmission Error
		SB00041C	SVA	1: Error Detection
		SB00041D	CNTR	1: Error Detection
		SB00041E	Communication Options i_M-Link/DeviceNet	1: Error Detection
		SB00041F	MotionWorks™ Fault	1: Error Detection

Although there is no ALARM LED on the front of the MP940, there is an alarm bit in the CPU status. When this bit is ON while the ERR LED is ON, a warning is issued.

CPU Status Alarm Bit

Name	Register Number	Content		
H-Scan Timeout Counter	SW00044	Number of H-scan Time-outs		
S-Scan Timeout Counter	SW00045	Number of S-scan Time-outs		
L-Scan Timeout Counter	SW00046	Number of L-scan Time-outs		
Software Switch Selection Status	SW00047	SB000470	Momentary Power Loss Recovery Start Format	0: New Start
		SB000471 ~ SB000472	Reserved for System	(Unused)
		SB000473	Program Write Selection	0: Write Possible 1: Write Prohibit :
		SB000474	Normal Power Recovery Start Format	0:New Start
		SB000475	Reserved for System	(Unused)
		SB000476 ~ SB00047F	Reserved for System	(Unused)
Hardware Status Configura-tion	SW00048	SB000480	RUN	DIP Switch Message 0: ON 1: OFF
		SB000481	INIT	
		SB000482	TEST	
		SB000483	FLASH	
		SB000484	PP	
		SB000485	COPY	
		SB000486	—	
		SB000487	Battery Alarm	1: Battery Alarm
Reserved for System	SW00049	SW000490 ~ SW00049F	Reserved for System	(Unused)

■ The list containing the system error status appears below.

System Error Status

Name	Register Number	Content	
Error Type	SW00050	0001H	Watchdog Timeout
		0002H	Bus Timeout
		0006H	Break-point Interrupt Execution
		0007H	BOUND Error (boundary check error)
		0008H	Undefined Command Execution
		000CH	Duplication Fault
		000DH	Invalid TSS
		000EH	Segment Invalidity
		000FH	Stack Error
		0010H	General Protection Error
		0011H	Page Fault
		0012H	Data Alignment Error
		0014H	Time Allocation Error
		0041H	ROM Diagnostic Error
		0042H	RAM Diagnostic Error
		0043H	CPU Diagnostic Error
		0044H	FPU Diagnostic Error
Error Code	SW00051	For system error analysis	
Error IP	SW00052	For system error analysis	
Error CS	SW00053	For system error analysis	
Error Task	SW00054	0000H: System	0003H: DWG.H
		0001H: DWG.A	0004H: DWG.S
		0002H: DWG.I	0005H: DWG.L
By Program Type	SW00055	0000H: System	0004H: DWG.S
		0001H: DWG.A	0005H: DWG.L
		0002H: DWG.I	0008H: Functions
		0003H: DWG.H	
		0010H: Main motion program	0011H: Motion sub-program
Error Drawing Number	SW00056	Source Drawing: FFFFH Function: 8xxxH Sub-drawing: xx00H (Hxx: Sub-drawing Number) Motion Program Number: FxxxH Sub-sub- Drawing: xxyyH (Hyy: Sub-sub-drawing Number)	

System Error Status (Continued)

<table>
<tr><th>Name</th><th>Register Number</th><th colspan="2">Content</th></tr>
<tr><td rowspan="2">Function Reference by DWG Type</td><td rowspan="2">SW00057</td><td colspan="2">Types of function reference drawings occurring during error generation within a function</td></tr>
<tr><td>0001H:DWG.A
0002H:DWG.I
0003H:DWG.H
0004H:DWG.S</td><td>0005H:DWG.L
0008H: Function
0010H: Main Motion Program
0011H: Motion Sub-program</td></tr>
<tr><td>Function Reference DWG Number</td><td>SW00058</td><td colspan="2">Function reference drawings occurring during error generation within a function
Source Drawing: FFFFH Function: 8xxxH
Sub-drawing: xx00H (Hxx: Sub-drawing Number)
Motion Program Number: FxxxH
Sub-sub- Drawing: xxyyH (Hyy: Sub-sub-drawing Number)</td></tr>
<tr><td>Function Reference DWG Number</td><td>SW00059</td><td colspan="2">Function reference drawing step numbers occurring during error generation within a function
“0” when an erroneous drawing occurs in a motion program</td></tr>
<tr><td rowspan="11">Error Data</td><td rowspan="11">SW00060</td><td>SW00060</td><td>For system analysis (ES)</td></tr>
<tr><td>SW00061</td><td>For system analysis (DS)</td></tr>
<tr><td>SW00062</td><td>For system analysis (DI)</td></tr>
<tr><td>SW00063</td><td>For system analysis (SI)</td></tr>
<tr><td>SW00064</td><td>For system analysis (BP)</td></tr>
<tr><td>SW00065</td><td>For system analysis (SP)</td></tr>
<tr><td>SW00066</td><td>For system analysis (BX)</td></tr>
<tr><td>SW00067</td><td>For system analysis (DX)</td></tr>
<tr><td>SW00068</td><td>For system analysis (CX)</td></tr>
<tr><td>SW00069</td><td>For system analysis (AX)</td></tr>
<tr><td>SW00070 ~ SW00079</td><td>Reserved for system</td></tr>
</table>

User Operation Error Status - 1

Name	Register Number	Setting Contents
DWG.A Error Count Error Code	SW00080 SW00081	Operation Error Code: See “User Operation Error Status-3” Error Code at Index Error Occurrence: See “User Operation Error Status-4”
DWG.I Error Count Error Code	SW00082 SW00083	
DWG.H Error Count Error Code	SW00084 SW00085	
DWG.S Error Count Error Code	SW00086 SW00087	
DWG.L Error Count Error Code	SW00088 SW00089	

User Operation Error Status - 2

<table>
<tr><th rowspan="2">Name</th><th colspan="5">Register Number</th><th rowspan="2">Notes</th></tr>
<tr><th>DWG A</th><th>DWG I</th><th>DWG H</th><th>DWG S</th><th>DWG L</th></tr>
<tr><td>Error Count</td><td>SW00110</td><td>SW00126</td><td>SW00142</td><td>SW00158</td><td>SW00174</td><td rowspan="16">Error Drawing Number
Source Drawing: FFFFH
Sub- Drawing: xx00H
Hxx: Sub-drawing Number)
Sub-sub-Drawing: xxyyH
Hyy: Sub-drawing Number)
Function: 8xxxH
Motion: FxxxH

Function Reference DWG Number
Function Reference Drawing Number Upon Occurrence of an Operation Error in a Function

Function Reference Drawing Step Number
Step number of function reference drawing when an operation error has occurred within a function.

“0” when an error occurs within a drawing</td></tr>
<tr><td>Error Code</td><td>SW00111</td><td>SW00127</td><td>SW00143</td><td>SW00159</td><td>SW00175</td></tr>
<tr><td rowspan="2">Error A Register</td><td>SW00112</td><td>SW00128</td><td>SW00144</td><td>SW00160</td><td>SW00176</td></tr>
<tr><td>SW00113</td><td>SW00129</td><td>SW00145</td><td>SW00161</td><td>SW00177</td></tr>
<tr><td rowspan="2">Modification A Register</td><td>SW00114</td><td>SW00130</td><td>SW00146</td><td>SW00162</td><td>SW00178</td></tr>
<tr><td>SW00115</td><td>SW00131</td><td>SW00147</td><td>SW00163</td><td>SW00179</td></tr>
<tr><td rowspan="2">Error F Register</td><td>SW00116</td><td>SW00132</td><td>SW00148</td><td>SW00164</td><td>SW00180</td></tr>
<tr><td>SW00117</td><td>SW00133</td><td>SW00149</td><td>SW00165</td><td>SW00181</td></tr>
<tr><td rowspan="2">Modification F Register</td><td>SW00118</td><td>SW00134</td><td>SW00150</td><td>SW00166</td><td>SW00182</td></tr>
<tr><td>SW00119</td><td>SW00135</td><td>SW00151</td><td>SW00167</td><td>SW00183</td></tr>
<tr><td>Error IP</td><td>SW00120</td><td>SW00136</td><td>SW00152</td><td>SW00168</td><td>SW00184</td></tr>
<tr><td>Error CS</td><td>SW00121</td><td>SW00137</td><td>SW00153</td><td>SW00169</td><td>SW00185</td></tr>
<tr><td>Error Drawing Number</td><td>SW00122</td><td>SW00138</td><td>SW00154</td><td>SW00170</td><td>SW00186</td></tr>
<tr><td>Function Reference DWG Number</td><td>SW00123</td><td>SW00139</td><td>SW00155</td><td>SW00171</td><td>SW00187</td></tr>
<tr><td>Function Reference DWG Step Number</td><td>SW00124</td><td>SW00140</td><td>SW00156</td><td>SW00172</td><td>SW00188</td></tr>
<tr><td>Reserved by System</td><td>SW00125</td><td>SW00141</td><td>SW00157</td><td>SW00173</td><td>SW00189</td></tr>
</table>

User Operation Error Status - 3

	Error Code	Error Content	User	System Default
Integer Operation	0001H	Integer operation - underflow	✶	-32768 (-32768)
	0002H	Integer operation - overflow	✶	32767 (32767)
	0003H	Integer Operation - Division Error	✶	The A register remains the same
	0009H	Double-length Integer operation - underflow	✶	-2147483648 (2147483648)
	000AH	Double-length Integer operation - overflow	✶	2147483647 (2147483648)
	000BH	Double-length Integer operation - division error	✶	The A register remains the same
	010xH	Integer Operation Error within Operation Error Drawing (x = 1~B)	✶	Default indicated above
Real Number Operation	0010H	Integer Storage - Non-numeric error	✶	Storage non-execution (00000)
	0011H	Integer storage - underflow	✶	Storage non-execution (-32768)
	0012H	Integer storage - overflow	✶	Storage non-execution (+32767)
	0021H	Real-number storage - underflow	✶	Storage non-execution (-1.0E+38)
	0022H	Real number storage - overflow	✶	Storage non-execution (1.0E+38)
	0023H	Real number Operation - Zero Division Error	✶	Operation non-execution (the F register remains the same)
	0030H	Real Number Operation - invalid operation (non-numeric)	×	Operation non-execution
	0031H	Real number operation - exponent underflow	×	0.0
	0032H	Real number operation - exponent overflow	×	Maximum value
	0033H	Real-number operation - division error (non-numeric 0/0)	×	Operation non-execution

User Operation Error Status - 3 (Continued)

<table>
<tr><th></th><th>Error Code</th><th colspan="2">Error Content</th><th>User</th><th colspan="2">System Default</th></tr>
<tr><td rowspan="20">Real Number Operation</td><td>0034H</td><td colspan="2">Real number storage - exponent underflow</td><td>×</td><td colspan="2">Stores 0.0</td></tr>
<tr><td>0034H</td><td colspan="2">Real number storage - exponent underflow</td><td>×</td><td colspan="2">Stores 0.0</td></tr>
<tr><td>0035H</td><td colspan="2">Real number operation - stack error</td><td>—</td><td colspan="2">—</td></tr>
<tr><td rowspan="17">0040H
~
0059H</td><td colspan="2">Real Number Operation Error Within a Standard System Function</td><td>×</td><td colspan="2">Operation Hold and Output = 0.0</td></tr>
<tr><td>0040H: SQRT</td><td>0041H:SIN</td><td colspan="2">0042H: COS</td><td colspan="2">0043H: TAN</td></tr>
<tr><td>0044H: ASIN</td><td>0045H: ACOS</td><td colspan="2">0046H: ATAN</td><td colspan="2">0047H: EXP</td></tr>
<tr><td>0048H: LN</td><td>0049H: LOG</td><td colspan="2">004AH: DZA</td><td colspan="2">004BH: DZB</td></tr>
<tr><td>004CH:LIM</td><td>004DH: PI</td><td colspan="2">004EH: PD</td><td colspan="2">004FH: PID</td></tr>
<tr><td>0050H: LAG</td><td>0051H: LLAG</td><td colspan="2">0053H: FGN</td><td colspan="2">0054H: IFGN</td></tr>
<tr><td>0054H: LAU</td><td>0055H: SLAU</td><td colspan="2">0056H: REM</td><td colspan="2">0057H: RCHK</td></tr>
<tr><td>0058H: BSRCH</td><td>0059H: SQRT</td><td colspan="2">—</td><td colspan="2">—</td></tr>
<tr><td colspan="6">1000H or 2000H are added in index errors.</td></tr>
<tr><td colspan="6">Operation Errors in Motion Functions
The number of the function in which the error was generated + 200H is stored.</td></tr>
<tr><td>0200H: MOV</td><td>0201H: MVS</td><td colspan="2">0202H: MCC</td><td colspan="2">0203H: MCW</td></tr>
<tr><td>0204H:</td><td>0205H: SKP</td><td colspan="2">0206H:</td><td colspan="2">0207H:</td></tr>
<tr><td>0208H: POS</td><td>0209H:</td><td colspan="2">020AH: ACC</td><td colspan="2">020BH: DCC</td></tr>
<tr><td>020CH: SCC</td><td>020DH: VEL</td><td colspan="2">020EH:I NP</td><td colspan="2">020FH: IAC</td></tr>
<tr><td>0210H: IDC</td><td>0211H: IFP</td><td colspan="2">0212H: FMX</td><td colspan="2">0213H:</td></tr>
<tr><td>0214H: MVT</td><td>0215H: EXM</td><td colspan="2">—</td><td colspan="2">—</td></tr>
</table>

Note: ×: OFF; ✱:ON; —:Undefined

User Operation Error Status - 4

<table>
<tr><th></th><th>Error Code</th><th colspan="2">Error Content</th><th>User</th><th>System Default</th></tr>
<tr><td rowspan="2">Integer/Real Number Operation</td><td>1000H</td><td colspan="2">Index errors within drawing</td><td>—</td><td>Re-execute with i, j = 0</td></tr>
<tr><td>2000H</td><td colspan="2">Index errors within function</td><td>—</td><td>Re-execute with i, ,j = 0</td></tr>
<tr><td rowspan="4">Integer Operation</td><td rowspan="4">x060H
~
x077H
(x=1,2)</td><td colspan="2">Integer-type System Functions Index Error</td><td>—</td><td>Operation Hold and Output = Input
The A register remains the same</td></tr>
<tr><td>x06DH:PI</td><td>x06DH:PD</td><td>x06FH:PID</td><td>x070H:LAG</td></tr>
<tr><td>x071H:LLAG</td><td>x072H:FGN</td><td>x073H:IFGN</td><td>x074H:LAU</td></tr>
<tr><td>x075H:SLAU</td><td>x076H:FGN</td><td>x077H:IFGN</td><td>—</td></tr>
</table>

System Service Execution Status

Name	Register Number	Reference
System Error Count	SW00090	—
System Error Codes	SW00091	—
Fault Occurrence Count	SW00092	—
Fault Recovery Count	SW00093	—
Reserved by System	SW00094 ~ SW00097	(Unused)
Existence of Data Trace Definition	SW00098	bit0 ~ 3 = Group1 Defined = 1; Undefined = 0
Data Trace Execution Status	SW00099	bit0 ~ 3 = Group 1 Trace Executing = 1; Trace Stopped = 0

The latest data trace record number appears below.

Name	Register Number	Reference
Data Trace Group 1	SW00100	Latest Record Number

System I/O Error Status

Name	Register Number	Reference	
I/O Error Count	SW00200	Number of I/O Errors	
Number of Input Errors	SW00201	Number of Input Errors	
Input Error Address	SW00202	Latest Input Error Address (register number for OWxxxx)	(for future use)
Number of Output Errors	SW00203	Number of Output Errors	
Output Error Address	SW00204	Latest Output Error Address (register number for OWxxxx)	(for future use)
Reserved by System	SW00205	(Unused)	
	SW00206		
	SW00207		
I/O Error Status	SW00208 ~ SW00211	Slot 2 Error Status	
	SW00212 ~ SW00215	Slot 3 Error Status	
	SW00420 ~ SW00423	Slot 55 Error Status	

■ Transmission Error Countermeasures

The error status is messaged in the system register when a transmission error occurs in the system I/O, as shown in the following table.

Name	Register Number	Notes
Slot 2 Error Status	SW00208~SW00211	—
Slot 3 Error Status	SW00212~SW00215	LIO
Slot 6 Error Status	SW00224~SW00227	Mechatrolink/DeviceNet Transmission Error Status
Slot 55 Error Status	SW00420~SW00423	Differs according to module mounted.

1. LIO Error Status For Slot 3

Bit Number	F	3	2	1	0
DI SW00212	Unused	Unused	Unused	Unused	Error
DO SW00213	Unused	—		Unused	Error (fuse breakage)
AI SW00214	Unused	—		Unused	SVA Error
AO SW00215	Unused	—		SUM Check Error	Unadjusted Data

2. Mechatrolink Station Error Status For Slot 6

(bit number)	F	E	D	9	8	1	0
SW00224	Unused	ST#14	ST#13	—		ST#1	Unused
SW00225	Unused	—					Unused
SW00226	Unused	—					Unused
SW00227	Unused	—					Unused

■ System Operation Error Status

System Operation Error Status - 1

Name	Register Number	Reference
Error Count	SW00600	Messaged when an operation error occurs in a system program
Error Code	SW00601	
Error A Register	SW00602	
	SW00603	
Modification A Register	SW00604	
	SW00605	
Error F Register	SW00606	
	SW00607	
Modification F Register	SW00608	
	SW00609	
Error IP	SW00610	
Error CS	SW00611	
Error Drawing Number	SW00612	
Function Reference Drawing Number	SW00613	
Function Reference Drawing Step Number	SW00614	
Reserved by System	SW00615	(Unused)

System Operation Error Code Status - 2

	Error Code	Error Content	System Default
Integer Operation	0001H	Integer operation - underflow	-32768
	0002H	Integer operation - overflow	+32767
	0003H	Integer Operation - Division Error	0

■ Interrupt Status

Name	Register Number	Reference
Interrupt Detection Count	SW00698	Number of Interrupts
Module in which interrupt occurred	SW00699	Number of Modules with 1 Interrupt
Interrupt Module	SW00700	Interrupt Module 1
	SW00701	—
	SW00702	Reserved for System
	SW00703	—
	—	—
	SW00798	Reserved for System
	SW00799	—

Interrupt Module Details

	15 — 8	7 — 0	
SW00700	Module *1	Slot *2	mmssH
SW00701	Status *3		xxxxH

Note: Model = 01H~05H:Reserved by System
mm = 06H:MP940/LIO is fixed at 6
mm = 07H:MP940/Counter (PI) is 07H

Slot
ss = slot number of interrupt module
MP940/LIO is in slot 3, and thus 03H
MP940/Counter is in slot 5, and thus 05H

Cause of Interrupt
xxxx = DI interrupt of the MP940/LIO is fixed at 1CH
The interrupt of the MP940/Counter is also fixed at 1CH

Motion Error

This section deals with the content of errors occurring in the motion functions, and the methods for dealing with them.

Outline of Motion Errors

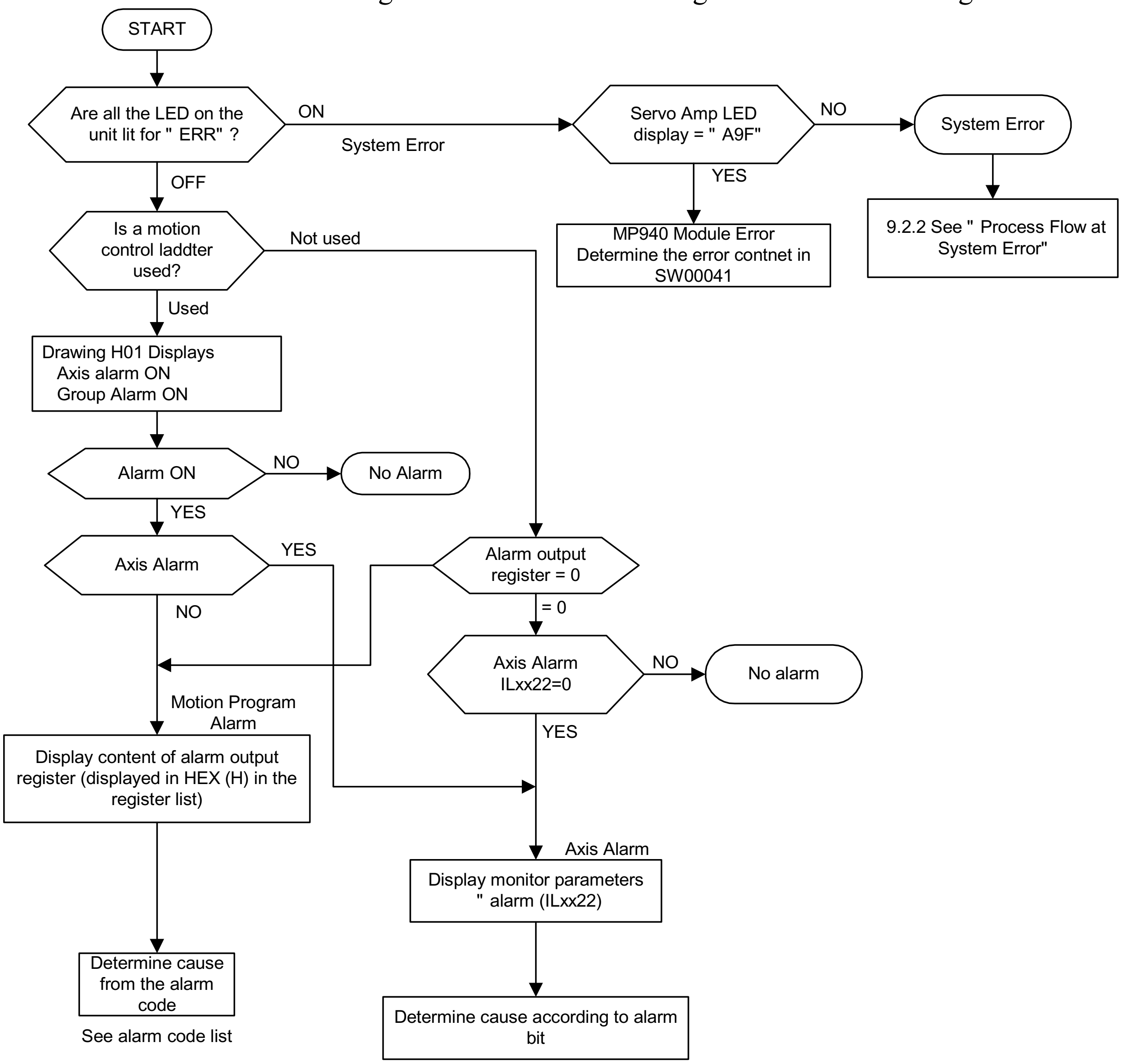
Errors related to MP940 motion are classified as either of two types: motion program detection alarms, and axis alarms detected in servo amplifier units.

Fault locations may be pinpointed, and countermeasures executed by checking the content of the alarm output register (set the register in the group definition screen) for motion program alarms, and the monitor parameter "Alarm (ILxx22)" for axis alarms.

Processing Flow at Motion Error Generation

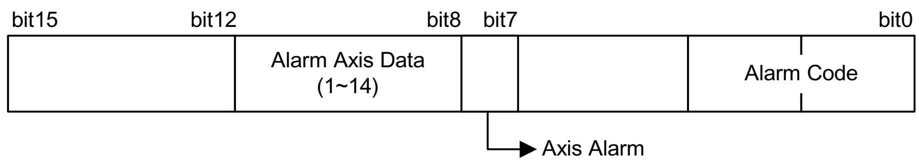
■ Troubleshooting Flow

The following shows the troubleshooting flow at motion error generation.



■ Structure of Motion Alarms

The structure of motion alarms stored in the alarm output register set in the group definition screen is shown below.



■ Motion Program Alarm Code List

A list of the motion program alarm codes is shown below. Convert the display mode to hexadeciamls (HEX) when displaying the register list.

Motion Program Alarm Codes

	Alarm Code	Content	Installation
Program Alarm	0	No alarm	Check the command content (related to alarms) of the motion program executed at alarm occurrence.
	1	—	
	2	0 Division Error	
	3	—	
	4	—	
	10H	—	
	11h	Excessive Compensation Feed Speed	
	12h	No Compensation Feed Speed Specified	
	13h	Range Exceeded after Accel/Decel Parameter Change	
	14h	—	
	15h	—	
	16h	—	
	17h	Excessive Exponent Axes	
	18h	Number of Turns Designation Exceeded	
	19h	—	
	1Ah	—	
	1Bh	Emergency Stop Command Executing	
	1Ch	Linear interpolation block motion has exceeded LONG_MAX	
	1Dh	FMX not defined	
Program Alarm	1Eh	Out of address T range	
	1Fh	Out of address P range	
	20h	REG Data Error H:	

Motion Program Alarm Codes (Continued)

	Alarm Code	Content	Installation
Axis Alarm*	80h	Logical Axis Use Prohibited	Check the content of commands related to the alarm content of the motion program executed at alarm occurrence.
	81h	Value exceeding POSMAX indicated in a rotary axis	
	82h	Axis motion range has exceeded LONG_MAX	
	83h	Invalid Control Mode	
	84h	Motion Command Duplication	
	85h	Motion Command Response Duplication	
	86h	Invalid Motion Command Mode	
	87h	Outside the VEL setting data range	
	88h	Outside the INP setting data range	
	89h	Outside the ACC/SCC/DCC setting data range	
	8Ah	T designation in MVT command is “0”	
	8Bh	Designated command not executable by the motion module type	

Note: The axis number is stored in bit8 ~ bit11 for axis alarms.

■ Content of Motion Parameter Alarm (ILxx22)

The detailed content of the axis alarm flag (ILxx22) is shown below.

Motion Parameter Alarm (ILxx22)

Parameter Number	Content
b0:	Unused
b1: OTF	Positive Overtravel Servo amplifier has detected positive overtravel (P-OT signal is ON)
b2: OTR	Negative Overtravel Servo amplifier has detected negative overtravel (N-OT signal is ON)
b3: SOTF	Positive Soft Limit Detects motion into the positive soft limit field
b4: SOTR	Negative Soft Limit Detects motion into the negative soft limit field
b5:	Unused
b6: TIMEOVER	Positioning Timeout Positioning was not completed within the time set in OWxx34 “Positioning Completion Check Time” following feed completion.
b7: DISTOVER	Excessive positioning distance A motion command was executed in which the positioning motion exceeded the limit value.
b8:	Unused
b9:	Unused
b10: MODERR	Control Mode Error A position control mode motion command was used outside of the position control mode.
b11: ZSET_NRDY	Zero-point not set Motion was designated while using an absolute encoder with no zero-point set.
b12:	Unused
b13:	Unused
b14:	Unused
b15:	Unused
b16:	Unused
b17:	Excessive Absolute Encoder Rotation The rotation of the absolute encoder has exceeded the range that can be handled by the MP940.
b18: PGLEFT	Encoder Cutoff Encoder cutoff was detected upon selection of the A/B pulse calculation formula.
b19~b31:	Empty

Chapter 10: Servo Amplifier Maintenance and Inspection

This chapter deals with basic maintenance and spot inspection of servo amplifiers, as well as the error diagnosis and corrective countermeasures thereof. Corrective countermeasures are given both for errors in the alarm display, as well as for those to which the alarm display does not apply.

Servo Amplifier Maintenance/Inspection

The basic inspection items for servo motors and servo amplifiers, as well as the replacement of the absolute encoder battery, appear in this section.

Servo Motor Inspection

For inspection and maintenance of servo motors, follow the simple, daily inspection process in the table below. The inspection and mainteneance frequencies in this table are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment. AC servo motors are brushless; simple daily inspection is sufficient.

Do not disassemble the servo motor during maintenance inspection. Contact an authorized Yaskawa agent or sales office.

Item	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen.	Levels higher than normal?
Appearance	According to degree of contamination	Clean with cloth or compressed air.	—
Insulation Resistance Measurement	Yearly	Disconnect the servo amplifier and test insulation resistance at 500V. Must exceed 10MOhms (measuring across the servo motor FG and the U-phase, V-phase, or W-phase power lead).	Contact your Yaskawa customer service representative if the insulation resistance is below 10MΩ.
Replace Oil Seal	Every 5,000 hours	Remove servo motor from machine and replace oil seal.	Applies only to motors with oil seal.
Overhaul	Every 20,000 hours or 5 years	Contact your Yaskawa representative.	The customer should not disassemble and clean the servomotor.

Servo Amplifier Inspection

The inspection of the servo amplifier is outlined in the table below. Although daily inspection is not necessary, carry out an inspection at least once a year.

Inspection Items	Frequency	Procedure	Remedy
Clean unit interior and circuit boards	Yearly	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose screws	Yearly	Check for loose terminal block and connector screws.	Tighten any loose screws.
Defective parts in unit or on circuit boards	Yearly	Check for damage, discolor-ation, or discontinuities due to heating	Contact your Yaskawa rep-resentative.

■ Part Replacement Schedule

The following parts are subject to wear and mechnical deterioration over time. To avoid failure, replace these parts at the frequency indicated.

If the servo amplifier has already been overhauled at Yaskawa, its user parameters are set back to the standard setting at shipment. Always check the user parameters before operating the motor.

Periodic parts inspection guidelines appear below.

Part	Standard Replacement Period	Replacement Method
Cooling fan	4 to 5 years	Replace with new part.
Smoothing Capacitor	7 to 8 years	Test. Replace with new part if necessary.
Relays	—	Test. Replace if necessary.
Fuse	10 years	Replace with new part.
Aluminium Electrolytic Capacitor on Circuit Board	5 years	Test. Replace with new circuit board if necessary.

■ Operating Conditions

- Ambient Temperature: annual average 30ºC
- Load Factor: 80% maximum
- Operation Rate: 20 hours/day maximum

Replacing the Absolute Encoder Battery

The servo amplifier issues an “Absolute Encoder Battery Alarm (A.83)” if the absolute encoder battery voltage falls below 2.7V (approximately). The servo amplifier only receives the warning signal for this alarm from the absolute encoder and outputs the alarm at amplifer power-up. No alarm is output if the battery voltage drops while the servo amplifier power is ON.

■ Battery Replacement Procedure

1. Replace the battery only when the servo amplifier control power is ON.
2. After replacing the battery, turn the servo amplifier power OFF to release the “Absolute Encoder Battery Alarm (A.83)”.
3. Battery replacement is complete if there are no operational errors following the servo amplifier power being turned ON again.

The absolute encoder data is lost if the servo amplifier control power is turned OFF and the battery is disconnected (i.e., when removing the encoder cable). Absolute encoder setup must be performed in this situation.

Troubleshooting

This section describes causes and remedies for problems which result in an alarm display, as well as for those not resulting in an alarm display.

Troubleshooting Problems with an Alarm Display

The panel operator displays “A.oo” or “CPF.oo” if an alarm is generated in the servo amplifier. Note that A.-- does not indicate an alarm. The alarm display and remedy are shown in the table below.

Contact your Yaskawa customer service representative if the problem cannot be solved by the described procedures.

■ A.02

A.02 is the alarm display for user parameter breakdown.

The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: x indicates the output transistor is OFF (alarm state)

■ Status when Alarm Occurred

An alarm occurs at power ON — **A, B**

Cause		Remedy
A	Power turned OFF during parameter write. Alarm occurred at the next power ON.	Replace servo amplifier.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.03

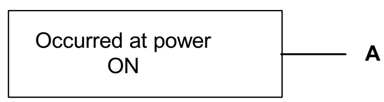
A.03 is a main circuit detection alarm.

The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Circuit board (1PWB or 2PWB) defective.	Replace servo amplifier.

■ A.04

A.04 is the alarm display for user parameter setting errors. The alarm output appears below:

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state)

■ Status when Alarm Occurred

Rises at Power ON — **A, B**

C		Remedy
A	An out-of-range parameter was previously set or loaded.	Reset all user parameters in the range, or re-load the correct user parameters.
B	Circuit board (1PEB) defective.	Replace servo amplifier.

■ A.05

A.05 is the alarm display for sizing errors. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x designates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Rises at Power ON —— A, B

Cause		Remedy
A	Exceeds the capacity range of matching servo motors.	Replace with properly sized servo motor.
B	Defective encoder parameter write.	Replace servo motor.

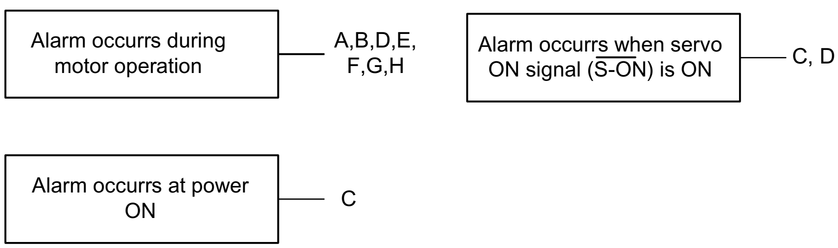
■ A.10

A.10 is the overcurrent or heat sink overheat alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	x	x	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Wiring grounded between servo amplifier and servo motor.	Check and correct the wiring.
B	Servo motor U, V, or W phase grounded.	Replace servo motor.
C	Circuit board (1PEB) defective. Power transistor defective.	Replace servo amplifier.
D	Current feedback circuit, power transistor, DB circuit, or circuit board defective.	Replace servo amplifier.
E	The ambient temperature of the servo amplifier exceeds 55ºC.	Lower the ambient temperature to below 55ºC.
F	Poor airflow around heat sink.	Make the mounting, peripheral space as per manual.
G	Fan stopped.	Replace servo amplifier.
H	Running above rated load.	Lighten load.

Note: E ~ H may cause alarms in 1.5kW ~ 3kW servo amplifiers.

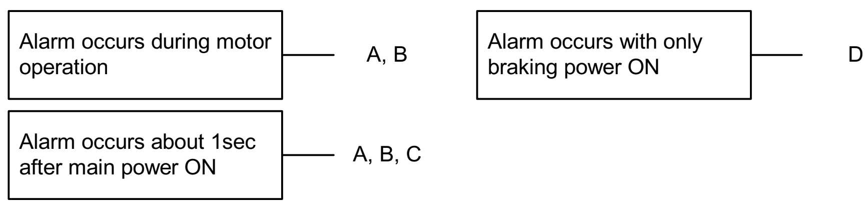
■ A.30

A.30 is the alarm display for regenerative error detection. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	x	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Regenerative transistor is abnormal.	Replace servo amplifier.
B	Disconnection of the regenerative resistance unit.	Replace servo amplifier or regenerative resistance unit.
C	Regenerative resistor unit discon-nected (for more than 6.0kW).	Check wiring of regenerative resistor unit.
D	Servo amplifier defective.	Replace servo amplifier.

■ A.32

A.32 is the alarm display for regenerative overload. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	x	x

Note: ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occrs during motor operation —**A, B**

Cause		Remedy
A	Regen power exceeds tolerances.	Use a regenerative resistor matched to the regen power capacity.
B	A regenerative resistor is used, but an alarm results no matter how little the regenerative resistor temperature rises.	Incorrect setting for user parameter Pn600. Reset.

■ A.40

A.40 is the alarm display for DC overvoltage error detection. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs during motor operation — **A, B, C, D**

Alarm occurs with only brake power ON — **E**

Alarm occrs at main power ON — **A, D**

Cause		Remedy
A	The power supply voltage is not within the range of specifications.	Check power supply.
B	Load exceeds capacity of the regen- erative unit.	Check the specifications of load inertia and overhanging load.
C	Regenerative transistor is abnormal.	Replace servo amplifier.
D	Rectifying diode defective	—
E	Servo amplifier defective.	—

■ A.41

A.41 is the alarm display for DC undervoltage error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	› _	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs during motor operation	A, B, C
Alarm occurs with only control power ON	D
Alarm occurs at main power ON	A, B, C

Cause		Remedy
A	The power supply voltage is not within the range of specifications.	Check power supply voltage.
B	Fuse is blown.	Replace servo amplifier.
C	Rectifying diode defective	
D	Servo amplifier defective.	

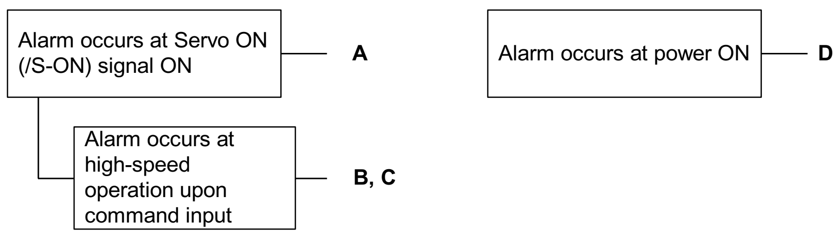
■ A.51

A.51 is the overspeed alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	x	✓	x

Note: The ✓ indicates the output transistor ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Mistaken servo motor wiring.	Check and correct the wiring. (Check for wiring mistakes in the motor U, V, and W phases.)
B	Excessive position/speed reference input.	Lower the reference value.
C	Mistaken reference input gain setting.	Check the user parameter settings.
D	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.71

A.71 is the overload alarm display. The alarm display and status when alarm occurs are the same in A.71 as for A.72.

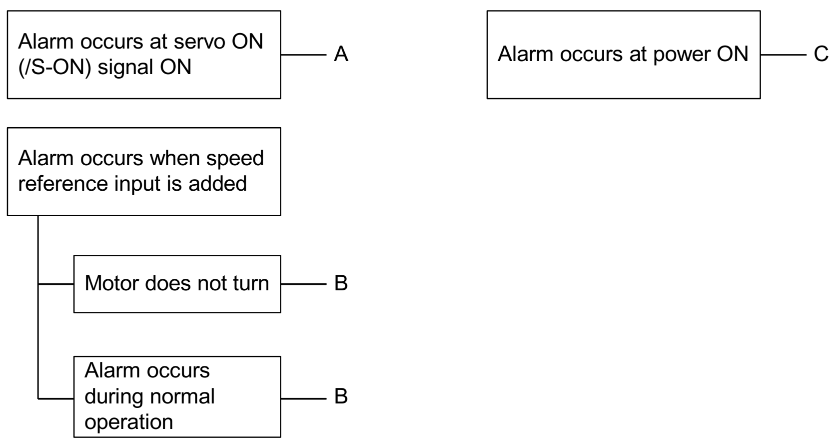
■ A.72

A.72 is the underload alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the X indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Servo wiring is incorrect or disconnected.	Check wiring and connections at servo motor.
B	Load greatly exceeds rated torque.	Reduce load torque and inertia. Otherwise replace with larger capacity servo motor.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

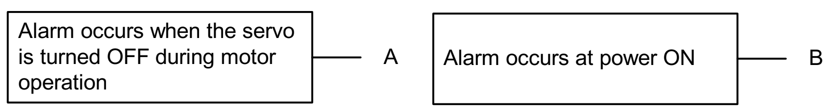
■ A.73

A.73 is the alarm display DB (dynamic brake) overload. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the X indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	The product of the motor speed × 2 divided by the combined inertia of motor and load (rotational energy) is greater than the capacity that can be processed by the dynamic braking (DB) resistor in the servo amplifier.	Lower the speed Decrease the load inertia Do not frequently use dynamic braking
B	Circuit board (1PWB) defective.	Replace servo amplifier.

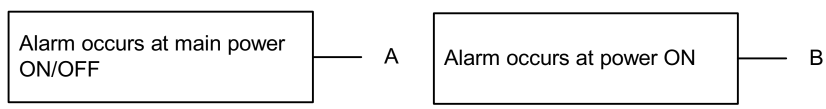
■ A.74

A.74 is the overload alarm display for the surge current limit resistor. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
>_	>_	>_	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	The main circuit power has been frequently turned ON/OFF.	Do not repeatedly turn main circuit power ON/OFF.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.7A

A.7A is the heat sink overheat alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs during motor operation — A, B, C, D

Alarm occurs only at power ON — E

Cause		Remedy
A	The ambient temperature of the servo amplifier exceeds 55ºC.	Lower the ambient temperature to below 55ºC.
B	Poor airflow around heat sink.	Make the mounting, peripheral space as per manual.
C	Fan stopped.	Replace servo amplifier.
D	Running above rated load.	Lighten load.
E	Servo amplifier defective.	Replace servo amplifier.

Note: This alarm display occurs only in 30W ~ 1000W servo amplifiers.

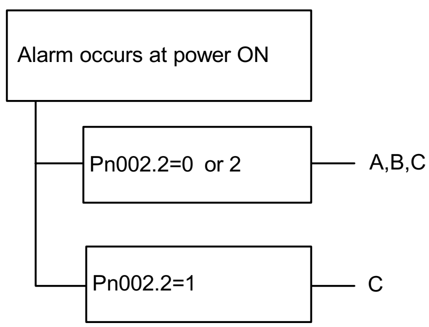
■ A.81

A.81 is the alarm display for an absolute encoder backup error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	The entire power supply is down to the following absolute encoders: +5V Power Supply (supplied to servo amplifier) Battery power	Initialize (setup) the absolute encoder.
B	Absolute encoder malfunctioned	Replace servo motor.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

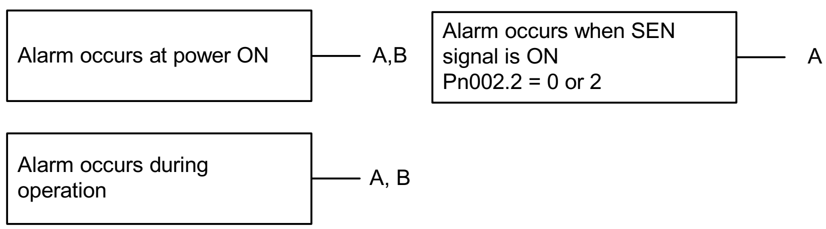
■ A.82

A.82 is the alarm display for an encoder checksum error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Abnormality during encoder memory check.	• Initialize (setup) the absolute encoder. • Replace servo amplifier if error occurs frequently.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

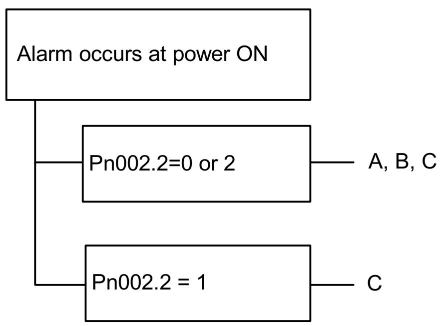
- A.83

A.83 is the alarm display for an absolute encoder battery error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

- Status when Alarm Occurred



Cause		Remedy
A	Battery not connected. Battery connection defective.	Check and correct the battery connection.
B	Battery voltage below specified value. Specified value:2.7V	Replace the battery with only the servo amplifier control power ON.Turn power ON again after replacing the battery.
C	Circuit board (1PWB) defective.	Replace servo motor.

Note: No alarm occurs in the servo amplifier while running even if a battery error occurs.

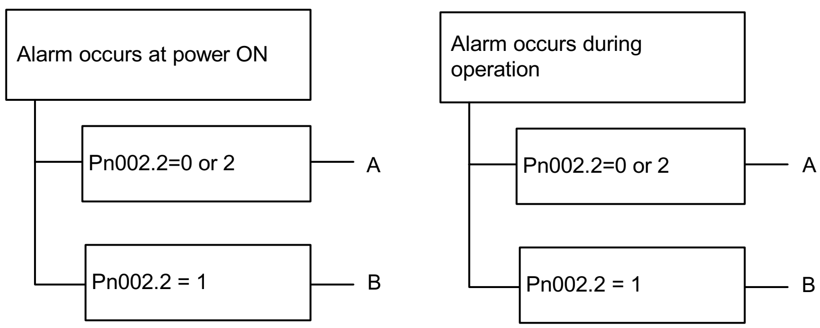
■ A.84

A.84 is the absolute encoder data alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Absolute encoder malfunctioned	Replace servo amplifier if error occurs frequently.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.85

A.85 is the alarm display for an encoder overspeed. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at power ON — A, B

Cause		Remedy
A	Absolute encoder turned ON at a speed exceeding 200rpm.	Turn the encoder power ON with the servo motor stopped.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.86

A.86 is the alarm display for an encoder overheat. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs during motor operation — A, B

Alarm occurs at power ON — C, D

Cause		Remedy
A	The servo motor usage environment is too hot.	Lower the ambient temperature of the servo motor to less than 40ºC.
B	Running above rated load.	Lighten the load.
C	Circuit board (1PWB) defective.	Replace servo amplifier.
D	Encoder defective.	Replace servo motor.

■ A.9F

A.9F is the MP940 module alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Occurs at MP940 power ON — A

Cause		Remedy
A	A system error occurred in the MP940 module. The CPU error status (SW00041) is ON.	Check the content of SW00041 and the error, the remove the cause of the error.

■ A.b1

A.b1 is the alarm display for the speed reference input read error alarm. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs during motor operation — A,B

Alarm occurs at power ON — C

Cause		Remedy
A	Part malfunctioned in reference read-in unit (A/D converter, etc.).	Reset alarm and restart operation.
B	Part defective in reference read-in unit (A/D converter, etc.).	Replace servo amplifier.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

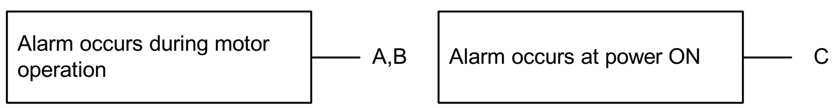
■ A.b2

A.b2 is the alarm display for the torque reference input read error alarm. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Part malfunctioned in reference read-in unit (A/D converter, etc.).	Reset alarm and restart operation.
B	Part defective in reference read-in unit (A/D converter, etc.).	Replace servo amplifier.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

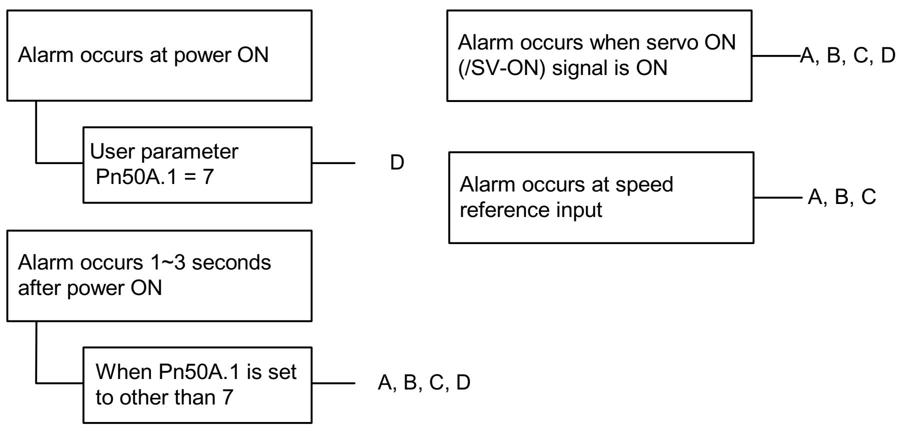
■ A.C1

A.C1 is the alarm display for servo overrun. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	x	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Mistaken servo motor wiring.	Check wiring and connections at servo motor.
B	Mistaken encoder wiring.	Check wiring and connections at encoder.
C	Encoder defective.	Replace servo motor.
D	Circuit board (1PWB) defective.	Replace servo amplifier.

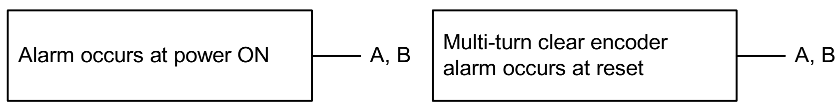
■ A.C8

A.C8 is the alarm display for absolute encoder clear errors and multi-turn limit setting errors. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
>_	x	› _	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Encoder defective.	Replace servo motor.
B	Servo amplifier defective.	Replace servo amplifier.

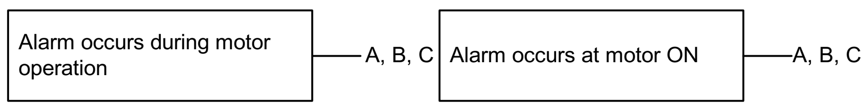
■ A.C9

A.C9 is the alarm display for an encoder communication error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
>_	x	› _	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Mistaken encoder wiring.	Review the encoder wiring.
B	Encoder defective.	Replace servo motor.
C	Servo amplifier defective.	Replace servo amplifier.

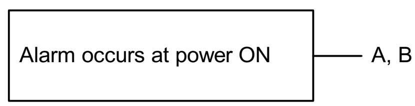
- A.CA

A.CA is the alarm display for encoder parameter errors. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
>_	x	› _	x

Note: The x indicates the output transistor is OFF (alarm state).

- Status when Alarm Occurred



Cause		Remedy
A	Encoder defective.	Replace servo motor.
B	Servo amplifier defective.	Replace servo amplifier.

■ A.Cb

A.Cb is the alarm display for encoder echoback errors. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
>_	x	› _	x

Note: The x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at power ON —A, B, C

Cause		Remedy
A	Mistaken encoder wiring.	Review the encoder wiring.
B	Encoder defective.	Replace servo motor.
C	Servo amplifier defective.	Replace servo amplifier.

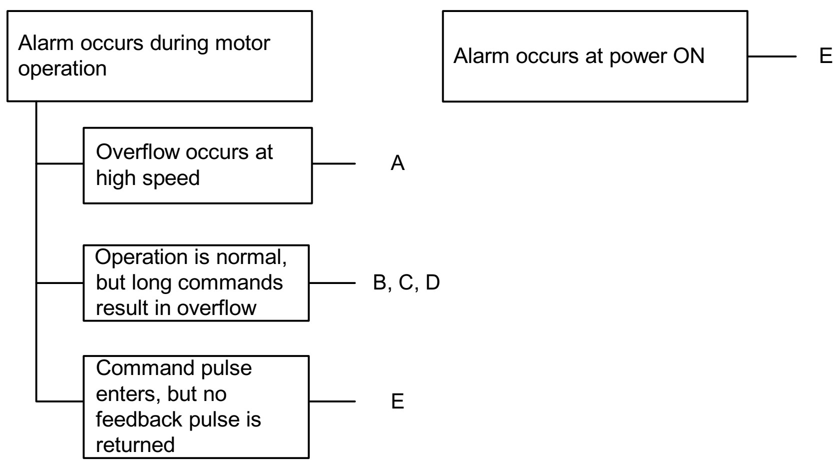
■ A.d0

A.d0 is the alarm display for position deviation pulse overflow. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
✓	✓	x	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred



Cause		Remedy
A	Mistaken servo motor wiring.	Check and correct the wiring.
B	Poor servo amplifier tuning.	Raise the speed loop gain (Pn100) and position loop gain (Pn102).
C	Excessive motor load.	Reduce load torque and inertia. Otherwise replace with larger capacity servo motor.
D	Position reference pulse frequency too high.	Slow-up or slow-down the reference pulse frequency. Install the smoothing function. Review the electronic gear ratio.
E	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.E0

A.E0 is the alarm display for MP940 non-response. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at power ON — A

Cause		Remedy
A	The MP940 is either not mounted or defective. Power (DC 24V) is not being supplied to the MP940. User Program Error	Supply power (DC 24V) to the MP940. MP940 User Program Repair MP940 Module Memory Initialization Replace MP940 Module.

■ A.E1

A.E1 is the option timeout alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at power ON — A

Cause		Remedy
A	Option unit defect.	Replace option unit.

■ A.E2

A.E2 is the alarm display for an option WDC error. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	✓	✓	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at power ON — A

Cause		Remedy
A	Option unit defect.	Replace option unit.

■ A.F1

A.F1 is the power line open phase alarm display. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	✓	x	x

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

■ Status when Alarm Occurred

Alarm occurs at main power ON — A, B

Alarm occurs at brake power only ON — C

Cause		Remedy
A	One phase (L1, L2, L3) of the main circuit power supply is disconnected.	Check power supply. Check wiring of the main circuit power supply. Check MCCB, noise filter, magnetic contactor.
B	One phase line has low voltage.	Check power supply.
C	Servo amplifier defective.	Replace servo amplifier.

Note: Alarm A and B displays occur only in servo amplifiers of 500W or greater.

■ CPF00

CPF00 is the alarm display for Digital Operator Transmission Error-1. This alarm is not stored in the alarm trace-back function memory. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
Not specified			

■ Status when Alarm Occurred

Alarm occurs at power ON. However, this is when a digital operator was connected before servo amp power ON	A, B, C, D
Alarm occurs after power ONwhen digital operator is attached to the servo amplifier	A, B, C, D

Cause		Remedy
A	Cable defective, or poor contact between digital operator and servo amplifier.	Check connector connections. Replace cable.
B	Malfunction due to external noise.	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ CPF01

CPF01 is the alarm display for Digital Operator Transmission Error-2.This alarm is not stored in the alarm trace-back function memory. The alarm output appears below.

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
Not specified			

■ Status when Alarm Occurred

Alarm is displayed during operation — A, B, C, D

Cause		Remedy
A	Cable defective, or poor contact between digital operator and servo amplifier.	Check connector connections. Replace cable.
B	Malfunction due to external noise.	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ A.--

This is not an alarm display, but rather indicates normal operation.

■ Alarm Output

Alarm Output			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
x	x	x	0

Note: The ✓ indicates the output transistor is ON; the x indicates the output transistor is OFF (alarm state).

Troubleshooting Problems with No Alarm Display

Refer to the table below to identify the cause of a problem for which no alarm is displayed; perform the remedy described. Turn OFF the servo system power supply before beginning the shaded procedures. Contact a Yaskawa customer service representative immediately if the problem cannot be solved by the described procedures.

Symptom	Cause	Inspection	Remedy
Motor does not start	Power not connected.	Check voltage between power supply terminals.	Correct the power circuit.
	Loose connection.	Check terminals of connectors (1CN, 2CN).	Tighten any loose parts.
	Connector (1CN) external wiring incorrect.	Check connector (1CN) external wiring.	Refer to connection diagram and correct wiring.
	Servo motor or encoder wiring disconnected.	—	Reconnect wiring.
	Overloaded.	Run under no load.	Reduce load or replace with larger capacity servo motor.
	Speed/position references not input	Check reference input pins.	Correctly input speed/position references.
	S-ON is turned OFF.	Check the settings of user parameters Pn50A.0 and Pn50A.1.	Turn S-ON input ON.
	P-CON input function setting incorrect.	Check user parameter Pn000.1.	Set user parameters to match application.
	Reference pulse mode selection incorrect.	—	Select correct user parameter Pn200.0.
	Encoder type differs from user parameter setting.	Incremental or absolute encoder?	Set the user parameter Pn002.2 to the encoder type used.
	P—OT and N—OT inputs are turned OFF.	—	Turn the P—OT and N—OT input signals ON.
	CLR input is turned ON.	Check status of error counter clear input.	Turn CLR input OFF.
	SEN input is turned OFF.	When using an absolute encoder:	Turn SEN input ON.

Symptom	Cause	Inspection	Remedy
Servo motor moves momentarily, then stops.	Servo motor or encoder wiring incorrect.	—	Refer to Chapter 3, and correct the wiring.
Suddenly stops during operation and does not restart.	Alarm reset signal (ALM-RST) is turned ON because an alarm occurred.	—	Remove cause of alarm.Turn alarm reset signal (ALM-RST) from ON to OFF.
Servomotor speed unstable.	Wiring connection to motor defective.	Check connection of power lead (U, V, and W phase) and encoder connectors.	Tighten any loose terminals or connectors.
Servo motor vibrates at approximately 200 ~ 400Hz.	Speed loop gain value too high.	—	Reduce user parameter Pn100 (Speed Loop Gain) setting.
	Speed/position reference input lead too long.	—	Minimize length of speed/position reference input lead, with impedance not exceeding several hundred Ohms.
	Speed/position reference input lead is bundled with power cables.	—	Separate reference input lead at least 30cm from power cables.
High rotation speed overshoot on starting and stopping.	Speed loop gain value too high.	—	Reduce user parameter Pn100 (Speed Loop Gain) setting. Integral Time Constant (Pn101) is too large.
Servo motor overheated.	Ambient temperature too high.	Measure servo motor ambient temperature.	Reduce ambient temperature to below 40ºC.
	Servo motor surface dirty.	Visual check	Clean dust and oil from motor surface.
	Overloaded.	Run under no load.	Reduce load or replace with larger capacity servo motor.
Abnormal noise.	Machine mounting incorrectly.	Servo motor mounting screws loose?	Tighten mounting screws.
		Coupling not centered?	Center coupling.
		Coupling unbalanced?	Balance coupling.
	Bearing defective.	Check noise and vibration near bearing	Consult your Yaskawa representative if defective.
	Machine causing vibration.	Foreign object intrusion, damage or deformation of sliding parts of the machine.	Consult with machine manufacturer.
Speed reference 0V but servomotor rotates.	Speed reference voltage offset applied.	—	Adjust the reference offset. Refer to sections 7.2.4 and 7.2.5 .

Alarm Display List

The ON/OFF relationship between the “Alarm Display” and the “Alarm Code Output” is shown in the table below:

Alarm Display and Alarm Code Output Relationship

Alarm Display	Alarm Code Output			Servo Alarm (ALM) Output	Alarm Name	Alarm Content
	ALO1	ALO2	ALO3			
A.02	x				Parameter Breakdown*2	Servo amplifier EEPROM data error
A.03	—	—	—	—	Main Circuit Detector Error	Some power circuit detection data is corrupt.
A.04	—	—	—	—	Parameter Setting Error*2	A user parameter value has been set outside the setting range.
A.05	—	—	—	—	Mismatch Error	The capacities of the motor and amplifier do not match.
A.10	✓				Overcurrent or Heat Sink Overheat*2	Excessive current has flowed to the IGBT, or the servo amplifier heat sink has overheated.
A.30	✓	✓			Regen Error	Regen Resistor Disconnection Regen Transistor Fault
A.32	—	—	—	—	Regen Overload	The regen energy exceeds the capacity of the regen resistor.
A.40	x		✓		Overvoltage	The main circuit DC voltage is extremely high.
A.41	—	—	—	—	Undervoltage	The main circuit DC voltage is too low.
A.51	✓		✓		Overspeed	Servo motor speed is extremely high.
A.71	✓	✓	✓		Overload (Momentary Maximum Load)	Motor has run for several seconds or tens of seconds at a torque greatly exceeding the rated value.
A.72	—	—	—	—	Overload (Continuous Maximum Load)	The servo motor has operated continuously at a torque exceeding the rated value.

Alarm Display and Alarm Code Output Relationship (Continued)

Alarm Display	Alarm Code Output			Servo Alarm (ALM) Output	Alarm Name	Alarm Content
	ALO1	ALO2	ALO3			
A.73	—	—	—	—	DB Overload	The rotational energy has exceeded the capacity of the dynamic braking resistor during the dynamic braking operation.
A.74	—	—	—	—	Surge Resistance Over-load	The main circuit power has been frequently turned ON/OFF.
A.7A	—	—	—	—	Heat Sink Overheat*1	The heat sink of the servo amplifier has over-heated.
A.81	x				Encoder Backup Alarm*2	All encoder power is down. Position data has been cleared.
A.82	—	—	—	—	Encoder Sum-check Alarm*2	The results of the encoder memory sum check are invalid.
A.83	—	—	—	—	Encoder Battery Alarm	The voltage of the absolute encoder backup battery has dropped.
A.84	—	—	—	—	Encoder Absolute Alarm*2	The absolute data received is faulty.
A.85	—	—	—	—	Encoder Overspeed	The encoder was rotated at an excessively high speed at power ON.
A.86	—	—	—	—	Encoder Overheat	The temperature within the encoder is too high.
A.9F	—	—	—	—	Option Warning	A warning has been issued in an option (MP940).
A.b1	—	—	—	—	Speed Reference A/D Error	The speed reference A/ D converter is faulty.
A.b2	—	—	—	—	Torque Reference A/D Error	The torque reference A/ D converter is faulty.
A.bF	—	—	—	—	System Alarm*2	—
A.C1	¸		› _		Servo Overrun Detected	Servo motor overrun has occurred.
A.C8	—	—	—	—	Encoder CLEAR Error Multi-turn Limit Setting Error	The multi-turn number of the absolute encoder has been cleared, or the settings are incorrect.

Alarm Display and Alarm Code Output Relationship (Continued)

Alarm Display	Alarm Code Output			Servo Alarm (ALM) Output	Alarm Name	Alarm Content
	ALO1	ALO2	ALO3			
A.C9	—	—	—	—	Encoder Communication Error*2	Communication cannot be achieved between the encoder and the servo motor.
A.CA	—	—	—	—	Encoder Parameter Error*2	An encoder parameter is corrupted.
A.Cb	—	—	—	—	Encoder Echoback Error*2	The content of the encoder communication is mistaken.
A.d0	✓	✓			Excessive Position Deviation	The position deviation pulse exceeds the value set in user parameter Pn505.
A.E0	x	✓	✓		No options	No options (MP940) have been mounted.
A.E1	—	—	—	—	Option Timeout	No response from the option port
A.E2	—	—	—	—	Option WDC Error	There is an error in the option (MP940) WDC.
A.F1	x	✓			Power Lines Open Phase	One of the three main power supply phases is not connected.
CPF00	Not specified				Digital Operator Transmission Error	Communication cannot be established between the digital operator (JUSP-0PO2A-2) and the servo amplifier.
CPF01	—	—	—	—	—	—
A.- -	x			✓	Not an error display	Indicates normal operation.

Note: ✓ indicates ON (“L”) signal; x indicates OFF (“H”) signal

(*1) Occurs in 30W ~ 1000W servo amplifiers.

(*2) Cannot be released by the alarm reset (/ALM-RST) signal. Release by powering off the device after removing the cause of the alarm.

Chapter 11: Motion Control

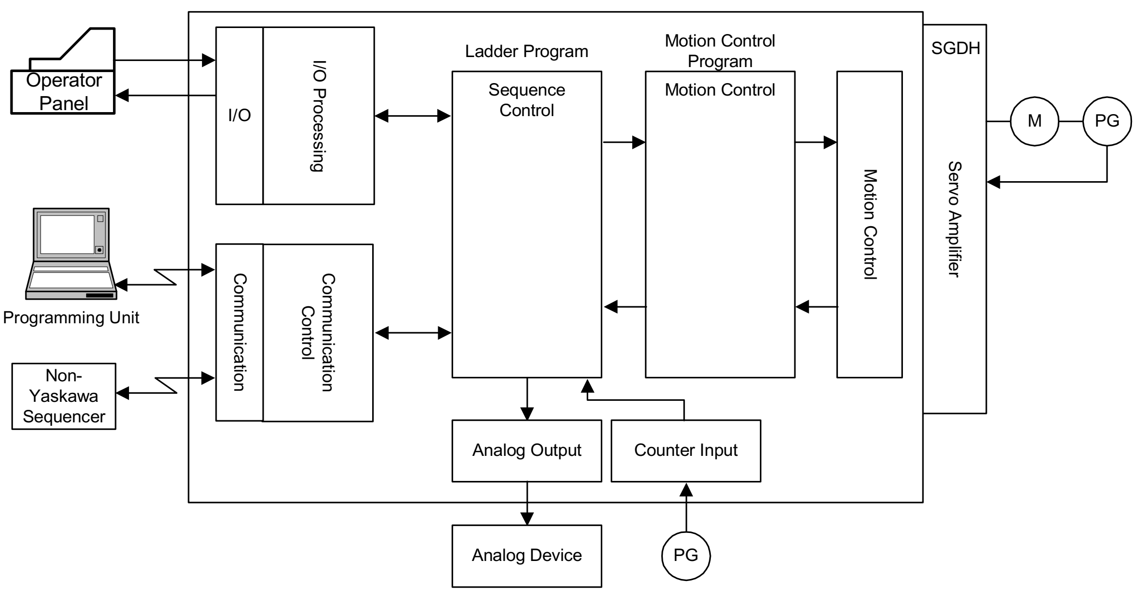
This chapter presents an outline of motion control and details of the motion commands.

Outline of Motion Control

This section describes the motion control methods and provides application examples.

MP940 Motion Control

The MP940 is a machine controller wherein sequence control and motion control are completely unified. This single-axis controller combined with a common memory (bus) with the SGDH-ooAE servo amplifier achieves not only simple positioning, but also high-speed and high-precision synchronization. A schematic of the MP940 system is shown below.

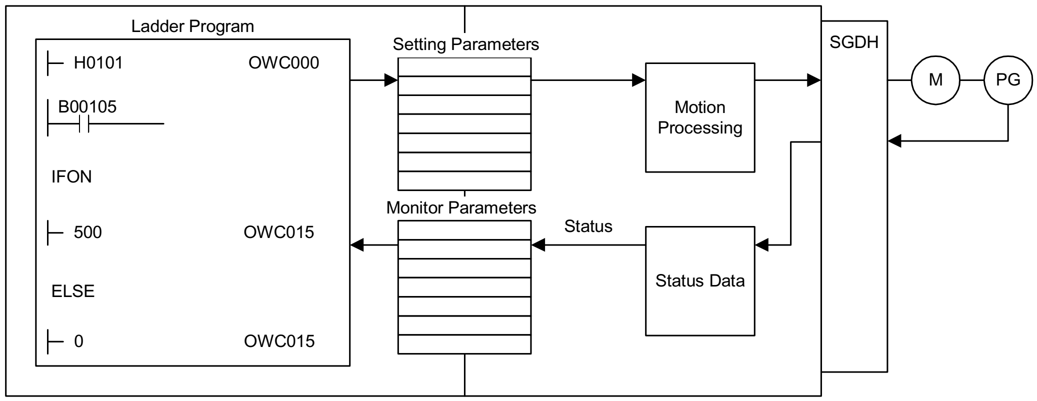


Motion Control Techniques

Using the MP940 module, motion control is possible for a variety of applications. There are two motion control techniques: the ladder program format, and the motion program format. An outline of each program follows.

Ladder Program Format

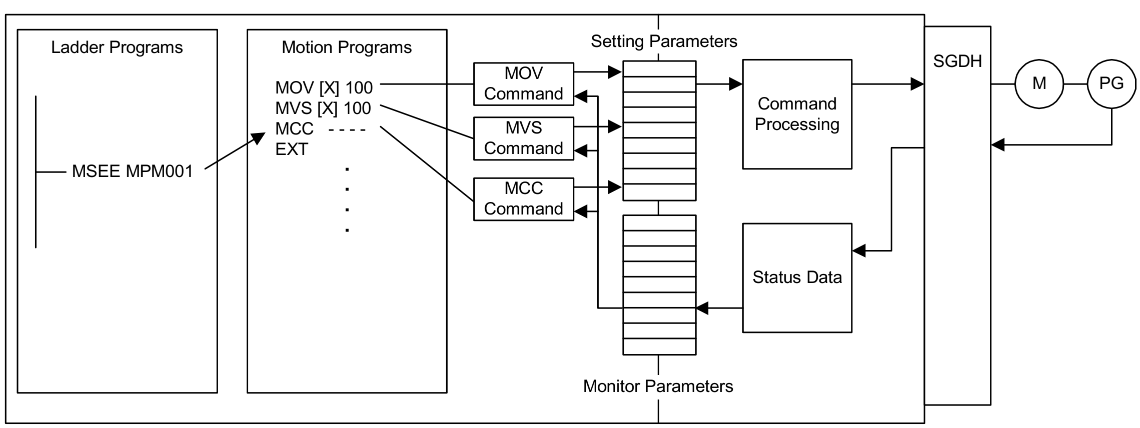
The program which is the focus of sequence control executes motion control by directly reading/writing the setting parameters and monitor parameters using the motion module I/F.



It is also always possible to program special operations and concatenate these as user functions. For details on the parameters, see Chapter 4 and the various sections on motion module parameters.

Motion Program Formats

Motion control is executed by motion programs created in a dedicated motion language. Up to 32 of these motion programs can be created and executed in parallel.



Using the dedicated motion language, complex motions within programs are easily created. All systems execute command termination checks. The following motion commands are provided as standard in the MP9xx series.

<table>
<tr><td>Command
Language</td><td>Axial Motion Commands: 8
MOV, MVS, MCW, MCC, ZRN, SKP, MVT, EXM

Basic Control Commands: 6
ABS, INC, POS, PLN, MVM, PLD

Speed and Accel/Decel Commands: 7
ACC, DCC, SCC, VEL, IAC, IDC, IFP, FMX

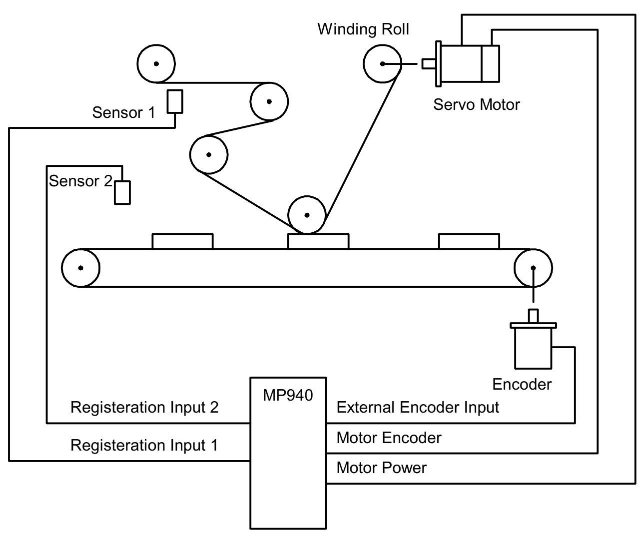
High-level Control Commands: 4
PFN, INP, SNG, UFC

Control Commands: 10
MSEE, TIM, IOW, END, RET, EOX, IF ELSE IEND
, WHILE WEND, PFORK JOINTO PJOINT
, SFORK JOINTO SJOINT

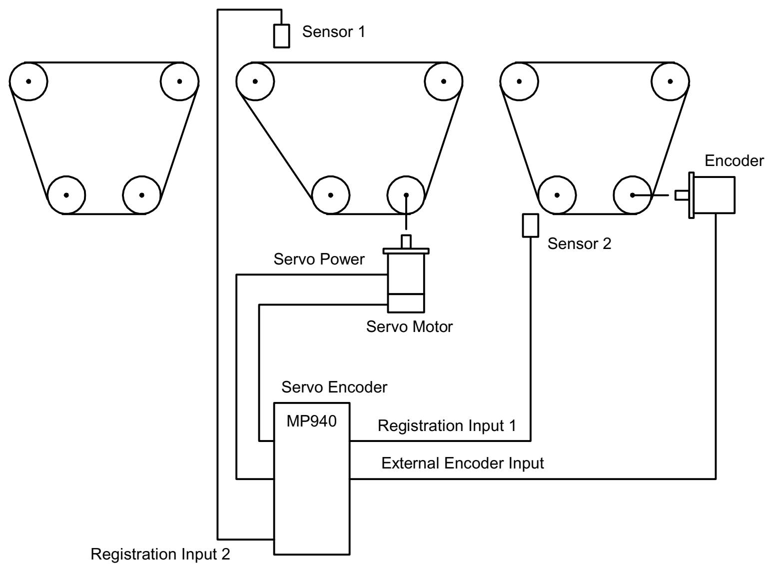
Operations/Sequence Control Commands: 32
=, +, -, *, /, MOD, |, ^, &, !, (), S{}, R{}, SIN, COS, TAN, ASN, ACS, ATN,
SQRT, BIN, BCD, ==, <>, >, <, >=, <=, SFR, SFL, BLK, CLR</td></tr>
</table>

Examples of Motion Control Applications

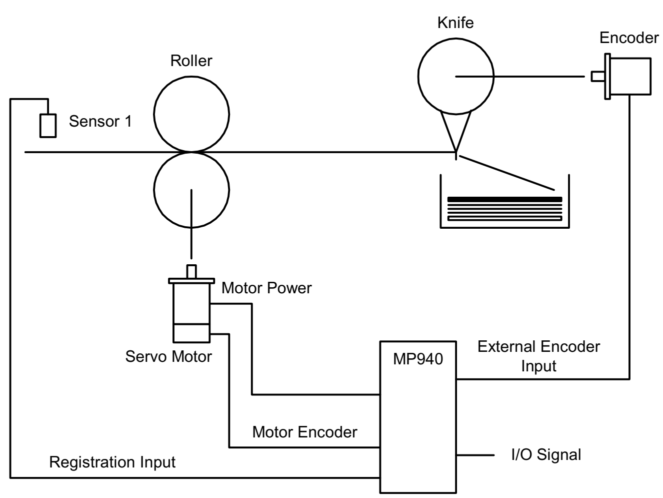
Application Example 1 - Labeler



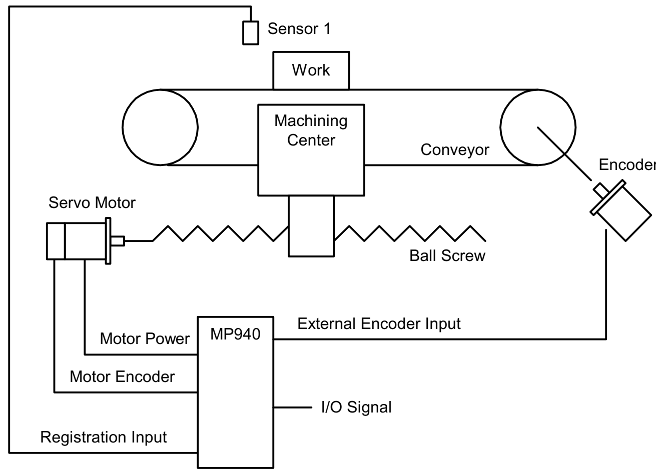
Application Example 2 - Alignment Machine



Application Example 3 - Step Cutting Device



Application Example 4 - Conveyor Follow-on Machine Tool



Control Mode

This section provides details on the motion control modes used in the MP940.

Outline of Control Modes

There are five control modes in the MP940 motion module which can be switched in real time according to the application. The control mode types, an outline thereof, and an application example, are shown in the following table.

Control Mode	Summary	Application Example
Speed Control Mode	Turns the motor at a designated speed.	Conveyors, Spindles
Torque Control Mode	Outputs a designated torque.	Extrusion forming machines, presses
Position Control Mode*	Designate a target position and a speed.This creates a position loop, measures deviation from the target position from the encoder, converts this to a speed reference, and executes position control.	Conveyor, XY Table
Phase Control Mode	Executes phase control by creating a target position from the speed reference while executing speed control according to the basic speed reference.	Electronic Camming, Electronic Shaft
Zero-point Return Mode*	Matches the axis to the zero-point position during incremental encoder use.	—

There are two methods of zero-point return operation: using the zero-return mode, and using the zero-point return commands for position control.

Speed Control Mode

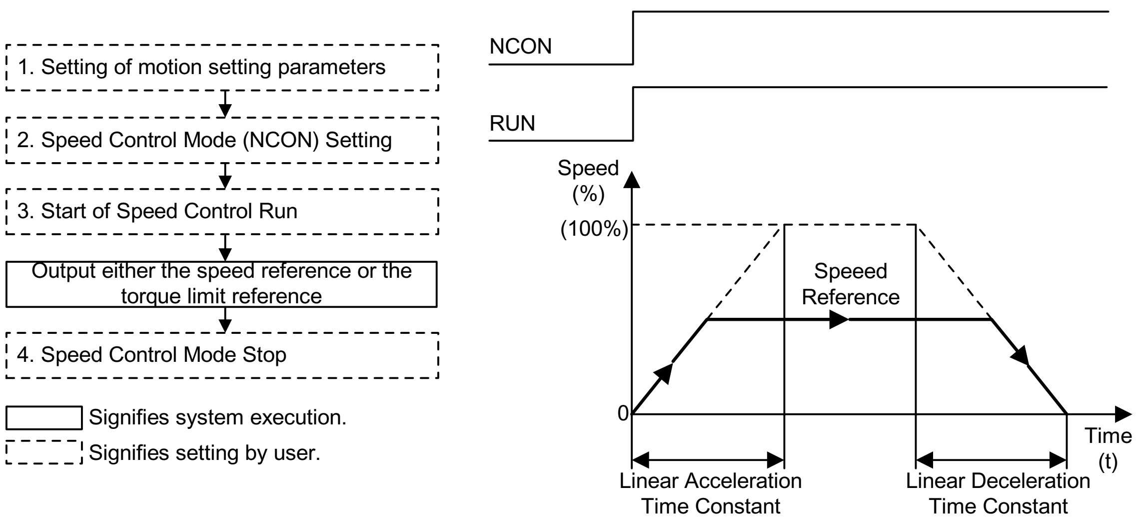
Outline

- Used for turning a motor at a desired speed.
- Outputs the speed reference to a servo amplifier according to a designated speed reference, linear accel/decel time constant, and filter time constant.
- The accel/decel time may be set to any desired value.
- S-curve accel/decel can be easily achieved in user programs (one command).

- This can also be used as a general-purpose D/A converter. In this case, set both the linear accel/decel time constant and the filter time constant to “0”.

Detailed Description

The order of operations in the speed control mode is shown below.



Due to the bus connection with the servo amplifier, parameters related to the servo amplifer which have been set as conventional fixed parameters on the controller side (such as controller pulse, rated speed, number of feedback pulses per rotation, etc.) are automatically read from the servo amplifier at power ON.

Therefore, the following parameters do not exist among MP940 fixed motion parameters.

- Encoder Selection
- Rotation Direction During Absolute Encoder Use
- Rated Speed
- Number of Feedback Pulses Per Rotation
- Maximum Number of Absolute Encoder Rotations

The following parameters are fixed in the MP940:

- Pulse Counting Mode Selection: A/B format, fixed at quadrature

There are three parameter setting methods:

1. Setting motion parameters used in the speed control mode.
   - Setting by the MotionWorks™ "Setting Parameter Screen"
   - Setting by ladder program
   - Setting by motion program

An example of parameter setting appears below.

Name	Register Number	Setting Range	Meaning	Setting Example
Forward Torque Limit (TLIMP)	OWC002	-327.68~327.67	0.01 = 0.01 %1 = 1%	-100.00 (-100.00%)
Positive Speed Limiter (NLIMP)	OWC004	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Negative Speed Limiter (NLIMN)	OWC005	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Linear Acceleration Time (NACC)	OWC00C	0 ~ 32767	Linear acceleration time constant at speed parameter generation (ms)	1000 (1s)
Linear Deceleration Time (NDEC)	OWC00D	0 ~ 32767	Linear deceleration time constant at speed parameter generation (ms)	1000 (1s)
Filter Time Constant (NNUM)	OWC014	0 ~ 255	For simple S-curve accel/decel	0
Speed Reference (NREF)	OWC015	-327.68~327.67	Speed Reference 0.01 = 0.01% 1 = 1%	50.00 (50.00%)

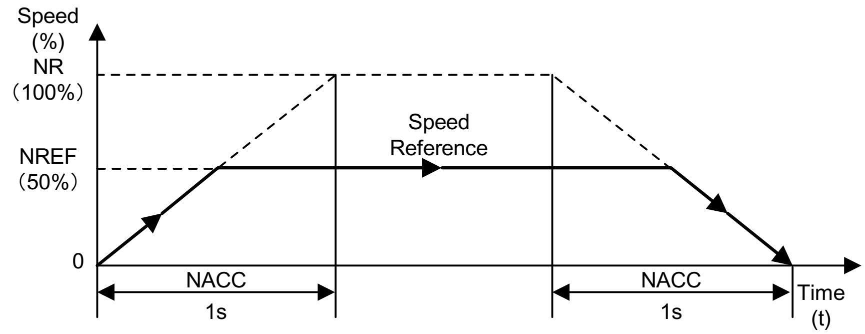
2. Selecting the speed control mode (NCON) (Bit 0 of OWC000).
3. Speed control mode run start
   - Turns the RUN command (Bit 0 of OWC001) ON.
   - The axis outputs the speed reference by a designated motion parameter.
   - The settings of any motion parameter can be changed even during speed control mode selection.

Speed control mode stop

- Turns the RUN command or the speed control mode (NCON) OFF.

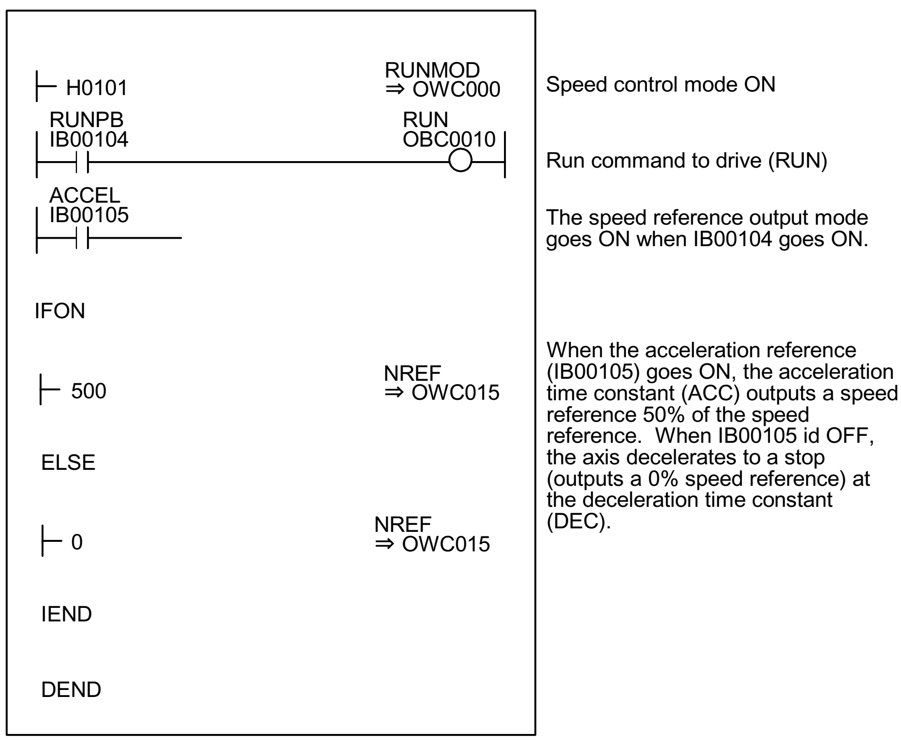
User Program Examples

Example of Running Desired Operation



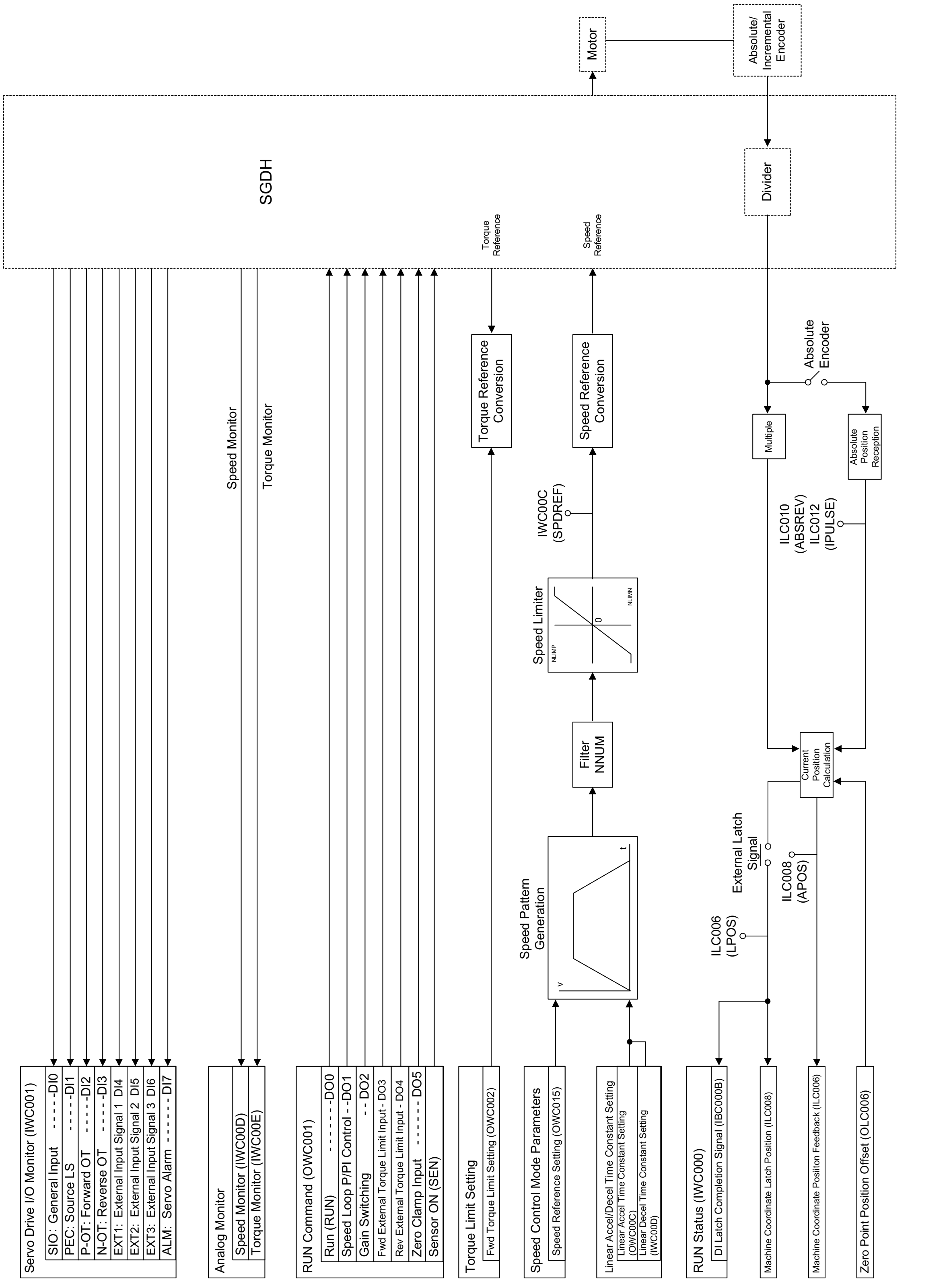
1 Speed Pattern

Ladder Program Example (Run Command Drawing H01)



Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

A block diagram of the MP940 SVA speed control mode appears on the following page.


Motor
Absolute/ Incremental Encoder
SGDH
Divider
Torque Reference
Speed Reference
Absolute Encoder
Multiple
Absolute Position Reception
Torque Reference Conversion
Speed Reference Conversion
Speed Monitor
Torque Monitor
IWC00C (SPDREF)
ILC010 (ABSREV) ILC012 (IPULSE)
Speed Limiter
NLIMP
NLIMN
0
Filter NNUM
Current Position Calculation
Speed Pattern Generation
v
t
External Latch Signal
ILC008 (APOS)
ILC006 (LPOS)
Servo Drive I/O Monitor (IWC001)
SIO: General Input - - - - -DI0
PEC: Source LS - - - - -DI1
P-OT: Forward OT - - - - -DI2
N-OT: Reverse OT - - - - -DI3
EXT1: External Input Signal 1 DI4
EXT2: External Input Signal 2 DI5
EXT3: External Input Signal 3 DI6
ALM: Servo Alarm - - - - - - DI7
Analog Monitor
Speed Monitor (IWC00D)
Torque Monitor (IWC00E)
RUN Command (OWC001)
Run (RUN) - - - - - - -DO0
Speed Loop P/PI Control - -DO1
Gain Switching - - DO2
Fwd External Torque Limit Input - DO3
Rev External Torque Limit Input - DO4
Zero Clamp Input - - - - - - DO5
Sensor ON (SEN)
Torque Limit Setting
Fwd Torque Limit Setting (OWC002)
Speed Control Mode Parameters
Speed Reference Setting (OWC015)
Linear Accel/Decel Time Constant Setting
Linear Accel Time Constant Setting (OWC00C)
Linear Decel Time Constant Setting (IWC00D)
RUN Status (IWC000)
DI Latch Completion Signal (IBC000B)
Machine Coordinate Latch Position (ILC008)
Machine Coordinate Positon Feedback (ILC006)
Zero Point Position Offset (OLC006)

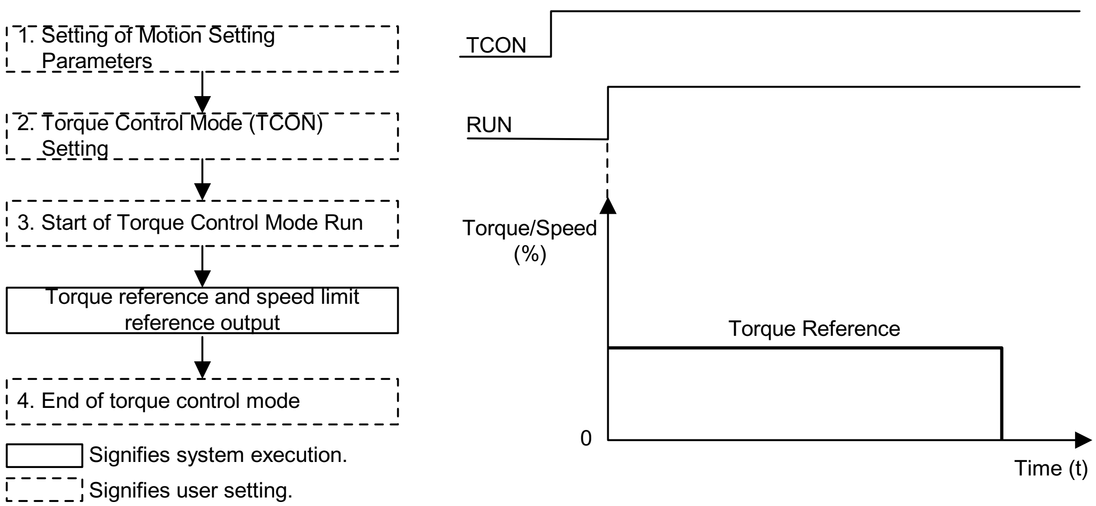
Torque Control Mode

Outline

Use the torque control mode to generate a fixed torque, regardless of the speed. Select this mode when applying a constant pressure to the molds of plastic-forming machines such as extruders. This mode is used to output the designated torque reference and speed limit command to the servo amplifier when the torque control mode is selected.

Detailed Description

The order of operations in the torque control mode is shown below.



1. This mode is used to set motion parameters used in the torque control mode. An example of parameter setting appears in the table below.

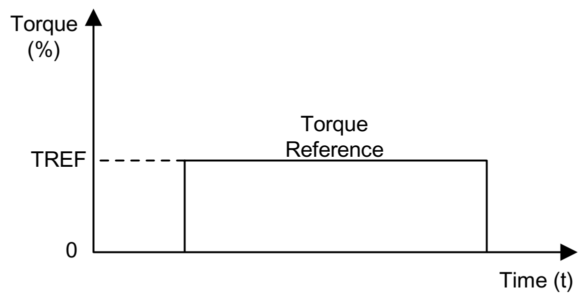
Name	Register Number	Meaning	Setting Example
Torque Reference Setting (TREF)	OWC01B	Sets the torque reference in units of 0.01%.	50.00 (50.00%)
Speed Limit Setting (NLIM)	OWC01C	Sets the speed limit in units of 0.01%.	50.00 (50%)

2. The torque control mode setting (TCON) is bit 1 of OWC000.

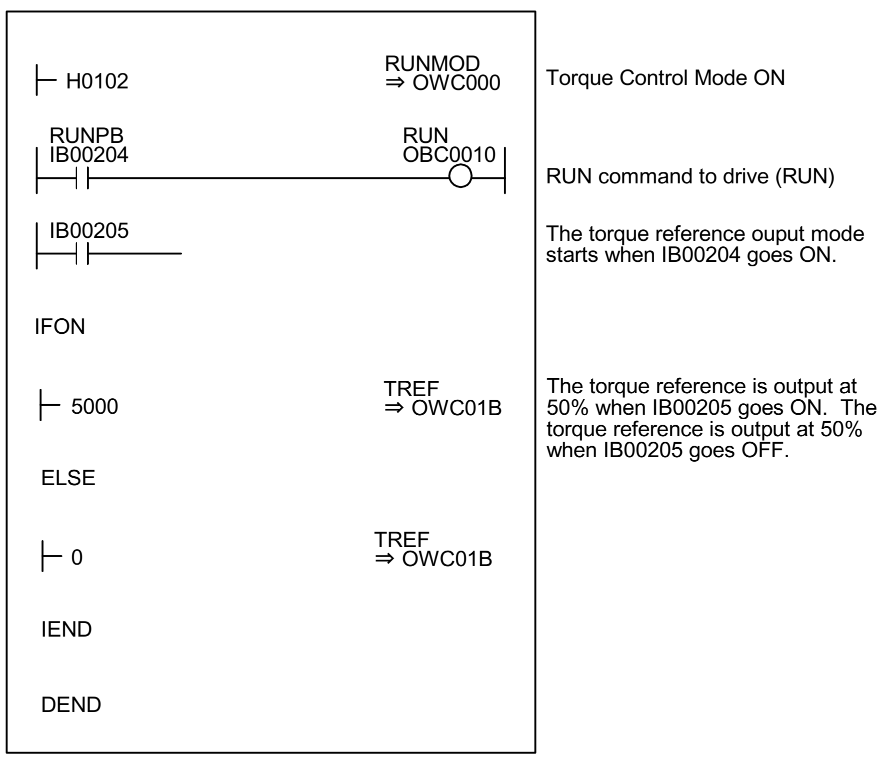
3. Torque control mode run start operates as follows:
   - Turns the RUN command (Bit 0 of OWC001) ON.
   - The axis outputs the torque reference and speed limit command designated in the motion parameters.
   - The settings of any motion parameter can be changed even during torque control mode selection.
4. Torque control mode stop operates as follows:
   - Turns the RUN command or the torque control mode (TCON) OFF.

User Program Examples

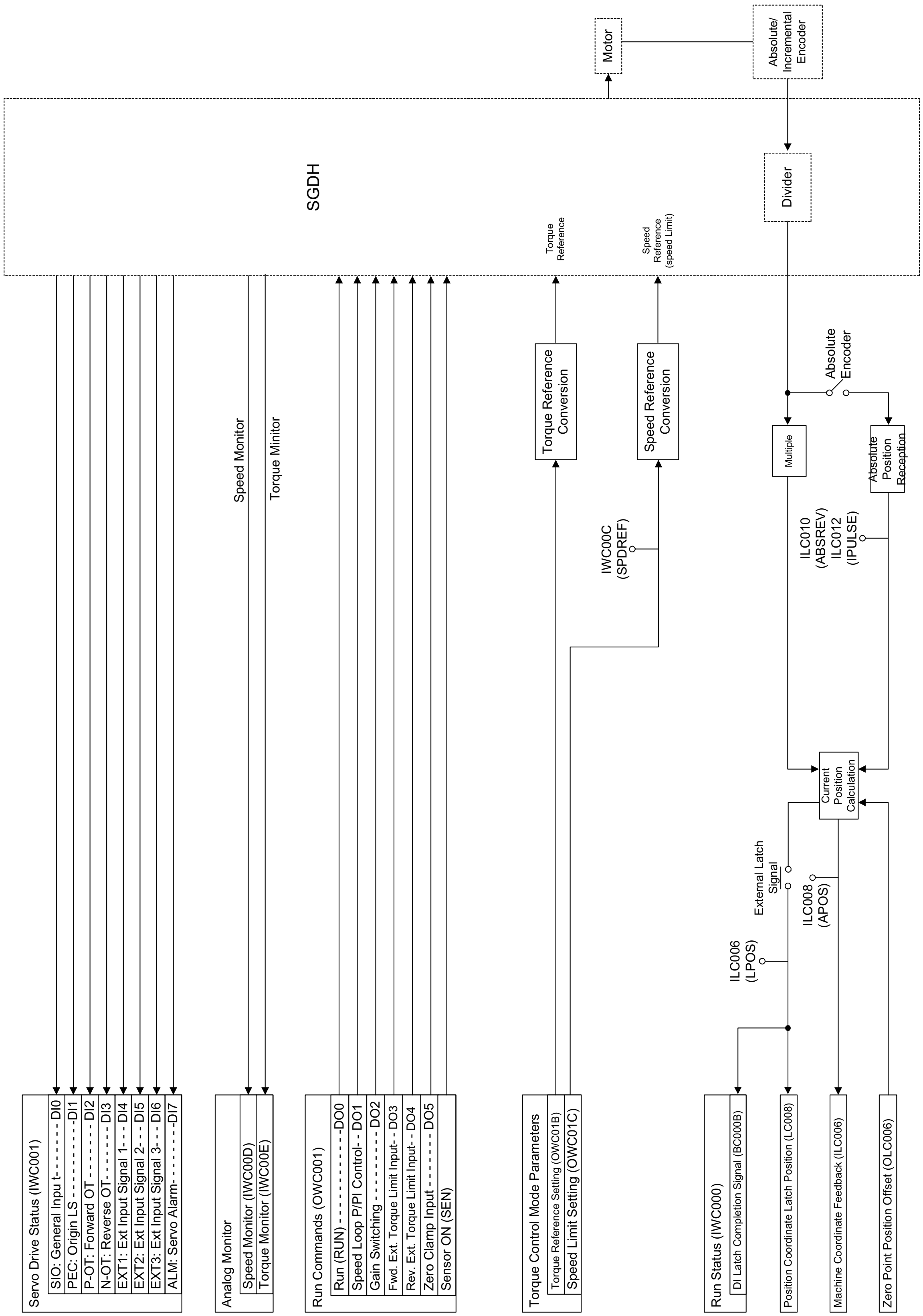
Example of Running an Operation



Ladder Program Example (Run Command - Drawing H02)



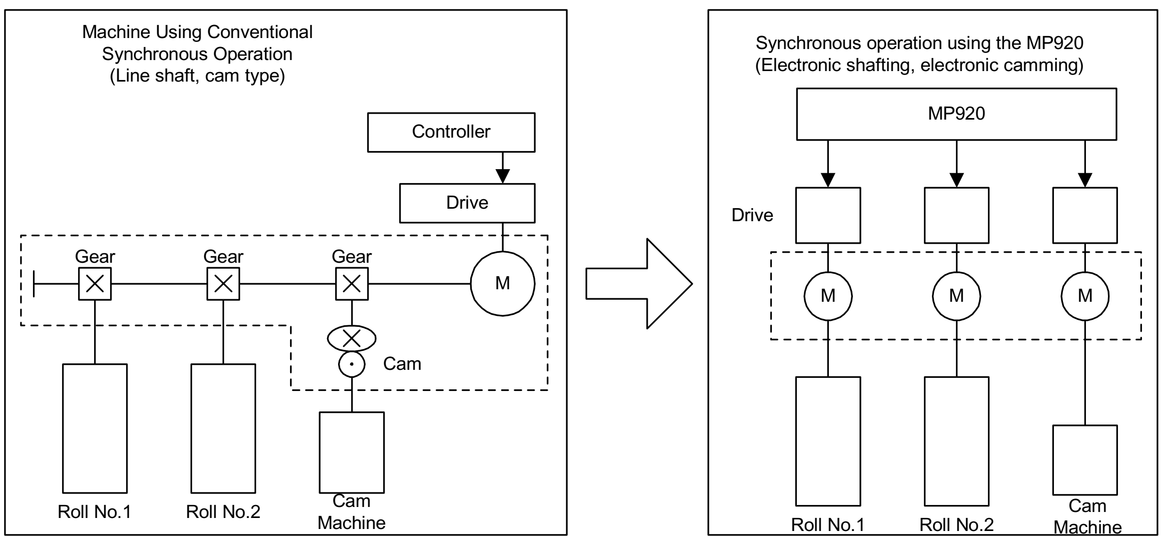
Although the examples in the above figures illustrating torque pattern are extremely simplified, in reality each of the register types can be freely controlled by the user program. A block diagram of the MP940 SVA torque control mode appears on the next page.


Motor
Absolute/ Incremental Encoder
SGDH
Divider
Torque Reference
Speed Reference (speed Limit)
Absolute Encoder
Multiple
Absolute Position Reception
Torque Reference Conversion
Speed Reference Conversion
Speed Monitor
Torque Minitor
IWC00C (SPDREF)
ILC010 (ABSREV)
ILC012 (IPULSE)
Current Position Calculation
External Latch Signal
ILC008 (APOS)
ILC006 (LPOS)
Servo Drive Status (IWC001)
SIO: General Input t- - - - - - - DI0
PEC: Origin LS - - - - - - - - - -DI1
P-OT: Forward OT - - - - - - - DI2
N-OT: Reverse OT- - - - - - - DI3
EXT1: Ext Input Signal 1- - - DI4
EXT2: Ext Input Signal 2- - - DI5
EXT3: Ext Input Signal 3- - - DI6
ALM: Servo Alarm- - - - - - - -DI7
Analog Monitor
Speed Monitor (IWC00D)
Torque Monitor (IWC00E)
Run Commands (OWC001)
Run (RUN) - - - - - - - - - - - -DO0
Speed Loop P/PI Control- - DO1
Gain Switching - - - - - - - - DO2
Fwd. Ext. Torque Limit Input- - DO3
Rev. Ext. Torque Limit Input- - DO4
Zero Clamp Input - - - - - - - DO5
Sensor ON (SEN)
Torque Control Mode Parameters
Torque Reference Setting (OWC01B)
Speed Limit Setting (OWC01C)
Run Status (IWC000)
DI Latch Completion Signal (BC000B)
Position Coordinate Latch Position (LC008)
Machine Coordinate Feedback (ILC006)
Zero Point Position Offset (OLC006)

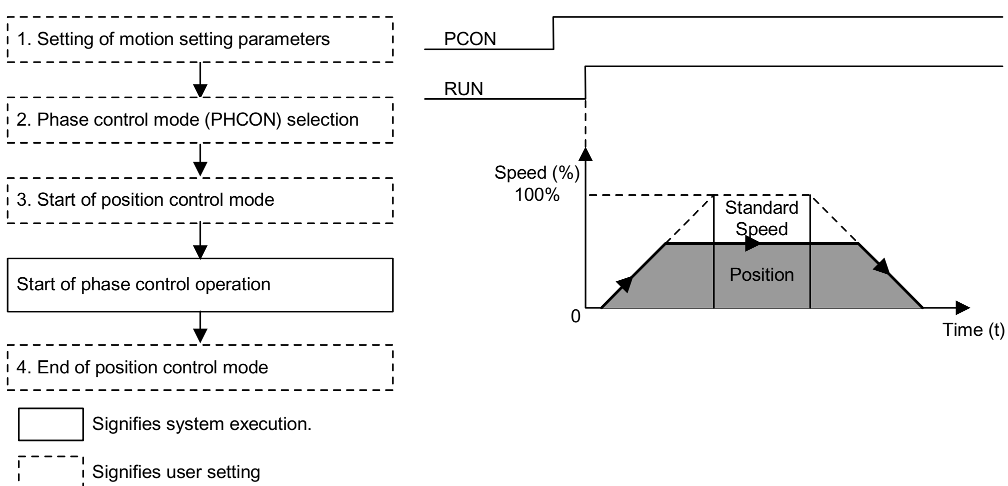
Phase Control

Phase control is used to rotate an axis according to the transmitted speed command, while at the same time excersizing strict control to a given number of rotations. Electronic camming and electronic shafting can be achieved using this control mode.

Complex device configurations can be alternated by the servo motors, and phase matching, synchronous run, proportional run, and variable-speed cam run can all be switched by the software. The figure below depicts a schematic diagram of electronic camming/electronic shafting.



The order of operations in the phase control mode is shown below.



This item sets motion parameters used in the phase control mode, and executes control in the user program so that shock does not occur.

There are three setting parameter setting methods:

- Setting by the MotionWorks™ "Setting Parameter Screen"
- Setting by ladder program
- Setting by motion program

Parameters related to the phase control mode are shown below.

1. Parameter setting

Name	Register Number	Setting Range	Meaning	Electronic Shaft Setting Example	Electronic Cam Setting Example
Forward Torque Limit (TLIMP)	OWC002	-327.68 ~ 327.67	0.01 = 0.01 %1 = 1%	-100.00 (-100.00%)	-100.00 (-100.00%)
Positive Speed Limiter (NLIMP)	OWC004	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)	130.00 (130.00%)
Negative Speed Limiter (NLIMN)	OWC005	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)	130.00 (130.00%)
Position Deviation Error Detection Threshold (EOV)	OWC00F	0 ~ 65535	1 = 1 pulse	65535	65535
Speed Reference (NREF)	OWC015	-327.68 ~ 327.67	0.01 = 0.01 %1 = 1%	50.00 (50.00%)	Set in ladder
Phase Bias Setting (PHBIAS)	OLC016	-231 ~ 231-1	1 = 1 pulse	Set in ladder	Set in ladder
Speed Compensa-tion Setting (NLIM)	OWC018	-327.68 ~ 327.67	0.01 = 0.01 %1 = 1%	0.00	0.00
Proportional Gain Setting (PGAIN)	OWC019	0.0 ~ 3276.7	0.1 = 0.1 /s 1 = 1 /s	1.5 (1.5)	250.0 (250.0)
Integral Time Setting (TI)	OWC01A	0 ~ 32767	1 = 1ms	300 (300ms)	0 (0ms)

2. Phase control mode (PHCON) (Bit 3 of OWC000).

The control mode is set together with the disable phase reference generation operation (PHREFOFF: Bit 7 of OWC000). This is normally OFF when used as an electronic shaft, and ON when used as an electronic cam.

3. Phase control mode run start

- Turns the RUN command (Bit 0 of OWC001) ON.
- The axis executes phase control by a designated motion parameter.
- The settings of any motion parameter can be changed even during phase control.

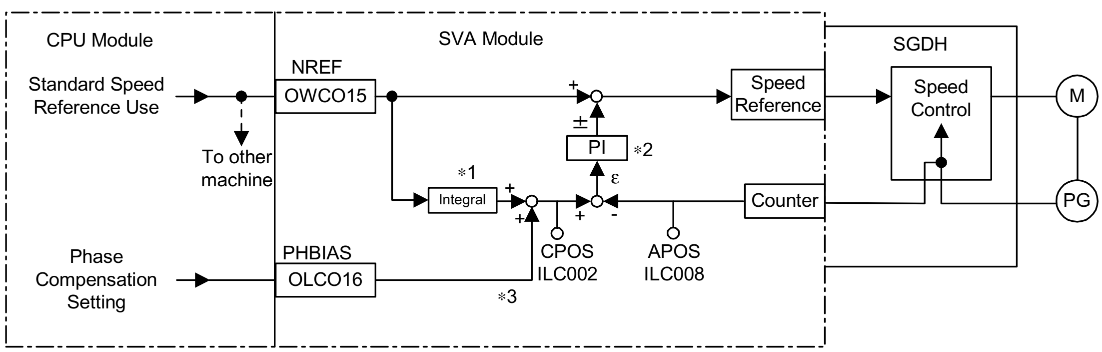
4. Phase control mode stop

- Turns the RUN command or the phase control mode (PHCON) OFF.

User Program Example 1 (Electronic Shafting)

Phase control can also be called “speed control with position bias” or “position control with 100% speed feed forward”. It is called “phase control” because “position” refers to the rotational angle of the motor. An electronic shaft can be configured using this control mode.

The following shows a block diagram of the phase control loop.

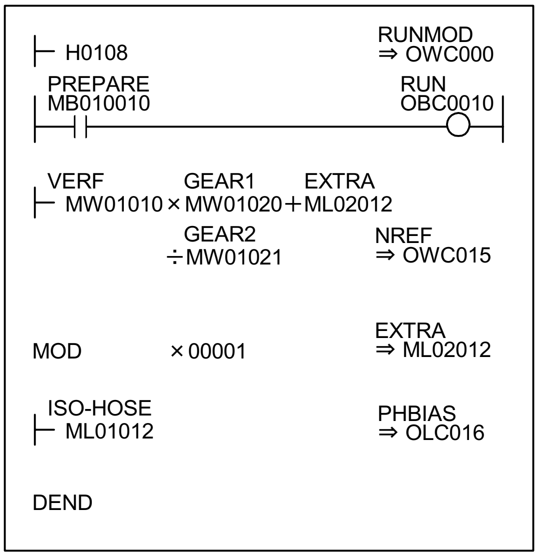


- Integrates the base speed reference, and calculates the matching position (pulse).
- Generates the speed reference from the deviation between the target position (CPOS) and the current position (APOS). This becomes the position (phase) bias.
- If phases are to be displaced, adds the amount of displacement (convert the angle of rotation of the motor axis into number of pulses) as the phase bias setting.

This makes possible the control of the motor rotation phase.

The processing of these control loops inside the SVA module permits the customer to easily direct the electronic shaft control supply, selecting phase control mode on the CPU module side, and sending the necessary parameters to the SVA module.

Ladder Program Example

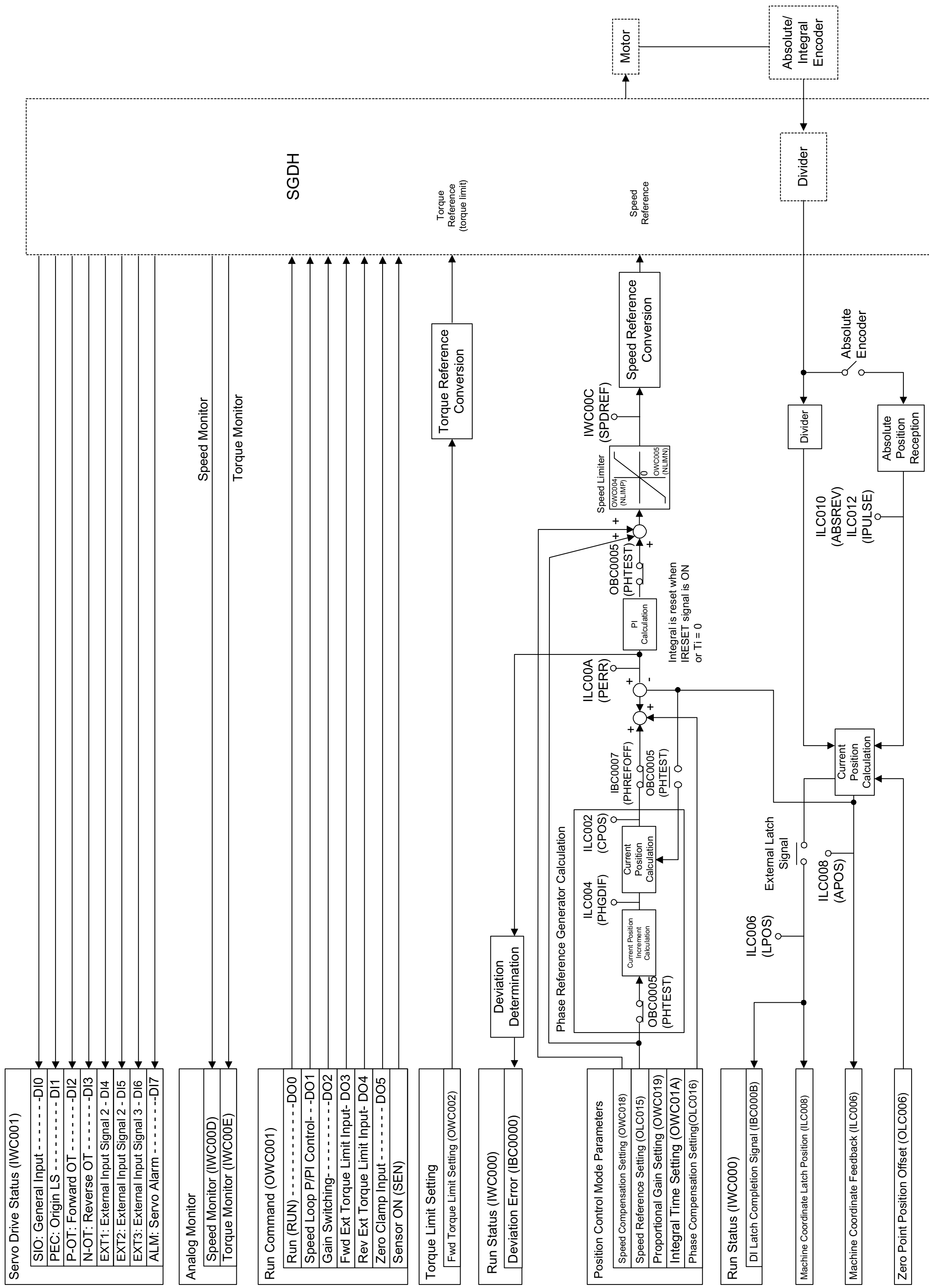


Phase control mode ON
Disable Phase Reference Generator Calculation OFF
Phase control starts when the run command to the driver (RUN) MB01010 is turned ON.
This sets the basic speed reference (NREF).
The speed reference is stored in MW01010. Gear ratios are stored in MW01020 and MW01021. " 1" is stored if gearing is not needed.

To deviate the phase, set the phase compensation (OLC016). Store the deiation amount (converted to pulses from the rotation angle of the motor axis) in ML01012.

Although the above example of the run command (DWG H04) is extremely simplified, in reality each of the register types can be freely controlled by the user program.

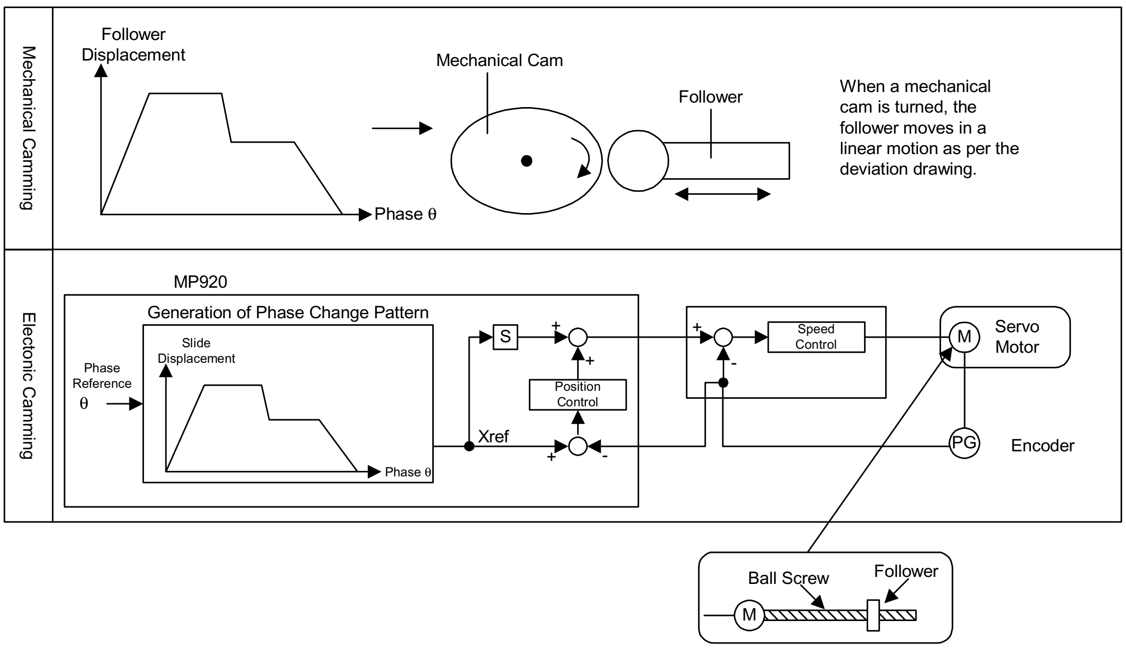
The block diagram of the MP940 SVA phase control mode follows.


Motor
Absolute/ Integral Encoder
SGDH
Torque Reference (torque limit)
Speed Reference
Divider
Speed Reference Conversion
Torque Reference Conversion
Absolute Encoder
Divider
Absolute Position Reception
Speed Monitor
Torque Monitor
IWC00C (SPDREF)
Speed Limiter
OWC004 (NLIMP)
OWC005 (NLIMN)
OBC0005 (PHTEST)
PI Calculation
Integral is reset when IRESET signal is ON or Ti = 0
ILC010 (ABSREV) ILC012 (IPULSE)
ILC00A (PERR)
IBC0007 (PHREFOFF)
OBC0005 (PHTEST)
Current Position Calculation
Phase Reference Generator Calculation
ILC004 (PHGDIF)
ILC002 (CPOS)
Current Position Calculation
Current Position Increment Calculation
OBC0005 (PHTEST)
External Latch Signal
ILC008 (APOS)
ILC006 (LPOS)
Deviation Determination
Servo Drive Status (IWC001)
SIO: General Input - - - - - - -DI0
PEC: Origin LS - - - - - - - - - DI1
P-OT: Forward OT - - - - - - -DI2
N-OT: Reverse OT - - - - - - -DI3
EXT1: External Input Signal 2 - DI4
EXT2: External Input Signal 2 - DI5
EXT3: External Input Signal 3 - DI6
ALM: Servo Alarm - - - - - - - -DI7
Analog Monitor
Speed Monitor (IWC00D)
Torque Monitor (IWC00E)
Run Command (OWC001)
Run (RUN) - - - - - - - - - - -DO0
Speed Loop P/PI Control- - -DO1
Gain Switching- - - - - - - - - -DO2
Fwd Ext Torque Limit Input- DO3
Rev Ext Torque Limit Input- DO4
Zero Clamp Input - - - - - - - DO5
Sensor ON (SEN)
Torque Limit Setting
Fwd Torque Limit Setting (OWC002)
Run Status (IWC000)
Deviation Error (IBC0000)
Position Control Mode Parameters
Speed Compensation Setting (OWC018)
Speed Reference Setting (OLC015)
Proportional Gain Setting (OWC019)
Integral Time Setting (OWC01A)
Phase Compensation Setting(OLC016)
Run Status (IWC000)
DI Latch Completion Signal (IBC000B)
Machine Coordinate Latch Position (ILC008)
Machine Coordinate Feedback (ILC006)
Zero Point Position Offset (OLC006)

User Program Example 2 (Electronic Camming)

From the beginning, camming has been a means of converting rotary motion to linear motion, and has been used to obtain the desired motion curves (displacement graph) in one cycle.

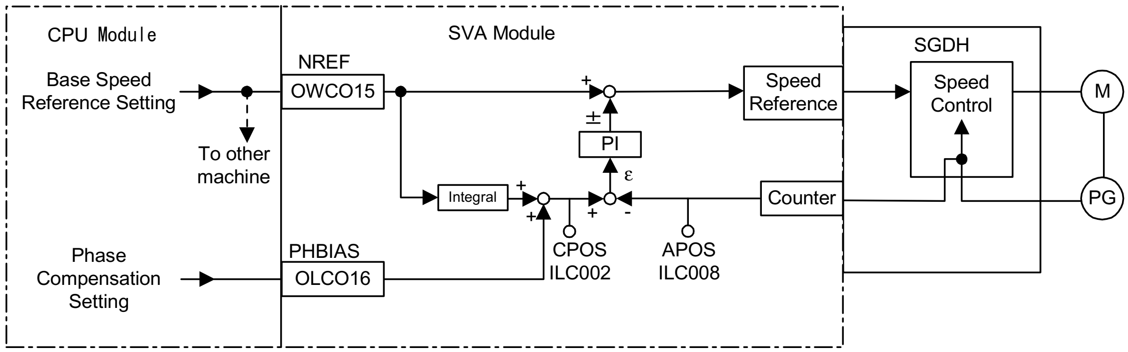
- Machine camming creates a cam in a form corresponding to this displacement graph, places runners along its path, then obtains a desired linear motion by rotating this cam.
- In electronic camming, the displacement graph data itself is held inside the controller as a position pattern and executes continuous position control (also called Continuous Path (CP) control) by shifting the position.



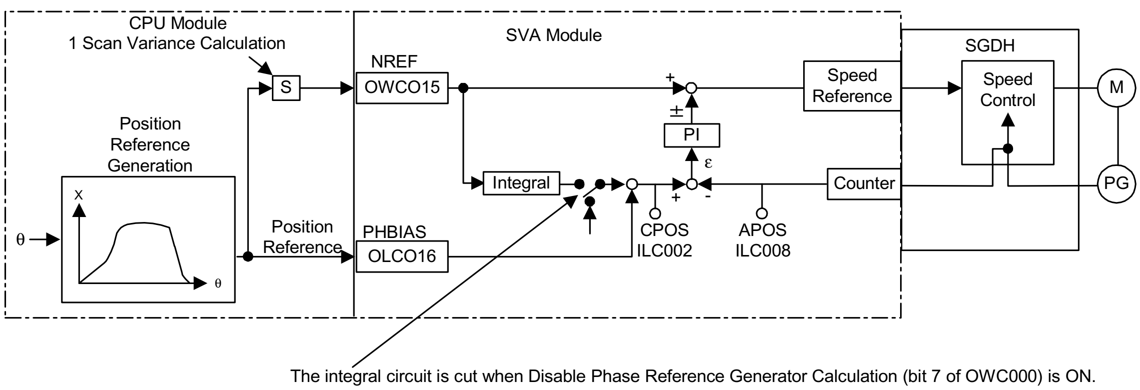
Configure the electronic camming control loop by using phase control. Normal position control generates the position reference by integrating the base speed reference in the SVA module.

On the other hand, the electronic camming control loop cuts out the integration circuit of the base speed reference, and transmits the position reference according to the phase bias setting.

The following shows a block diagram of the phase control loop.



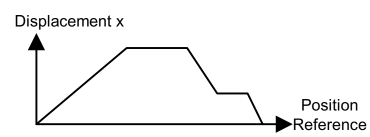
A block diagram of the electronic camming control loop appears below.



The processing of electronic camming control loops inside the SVA module, allows the user to easily direct the electronic cam control simply by selecting phase control mode on the CPU module side, and sending the necessary parameters to the SVA module.

Ladder Program Example

Ladder Program	Description
├ H0188 RUNMOD ⇒ OWC000	Position Control Mode ON Disable Phase Reference Generator Calculation ON
K1 TsH ├ MW00040 × SW00004 K2 ÷MW00041 KS ⇒ ML03010	Calculates the speed scaling parameter (ks) Speed Scan Setting: SW0004 $\frac{NR \times FBppr \times n}{60 \times 10^4}$ → Numerator *MW00040 / Denominator *MW00041 NR= Rated Speed FBppr= No. of Feedback Pulses` n=Pulse Multiplication (1, 2, or 4) *keep this to one word.
├ 10000 FFGAIN ⇒ MW03012	Feed Forward Gain (100000/100%)
PREPARE MB010010 ├┤├──── RUN OBC0010 ─○─	Run Command to driver (RUN) Phase control starts when MB010010 is ON.
Phase Reference ├ ML03030	
FGN Displacement Pattern MA03050 Displacement X ⇒ ML03020	Displacement (pulses) from phase reference read out from FG function.
Displacement X ├ ML03020 Rotation Position -ML03024 Variation ⇒ ML03022	Variation perscan (pulses).
├ 00000	
RUN Command MB010020 ├┤├────	Operation occurs at the base speed NREF when the run command MB010020 is ON. When OFF, the base speed NREF becomes 0.
Variation FFGAIN [├ ML03022] × MW03012 KS ÷ML03010 NREF ⇒ OWC015	Base Speed Reference Setting (0.01%)
Position BIAS Displacement X [├ ML03022] [+MW03020] PHBIAS [⇒ OLC016]	Phase Compensation Setting (pulses)
Displacement X ├ ML03020 Rotation Position ⇒ ML03024	Previous phase reference deviation (pulsers)
DEND	



The FGN pattern is set beforehand.

Although the example above of the run command (Dwg H04) is extremely simplified, in reality each of the register types can be freely controlled by the user program.

Zero-point Return Mode

The zero-point return operation returns the machine to a fixed zero-point.

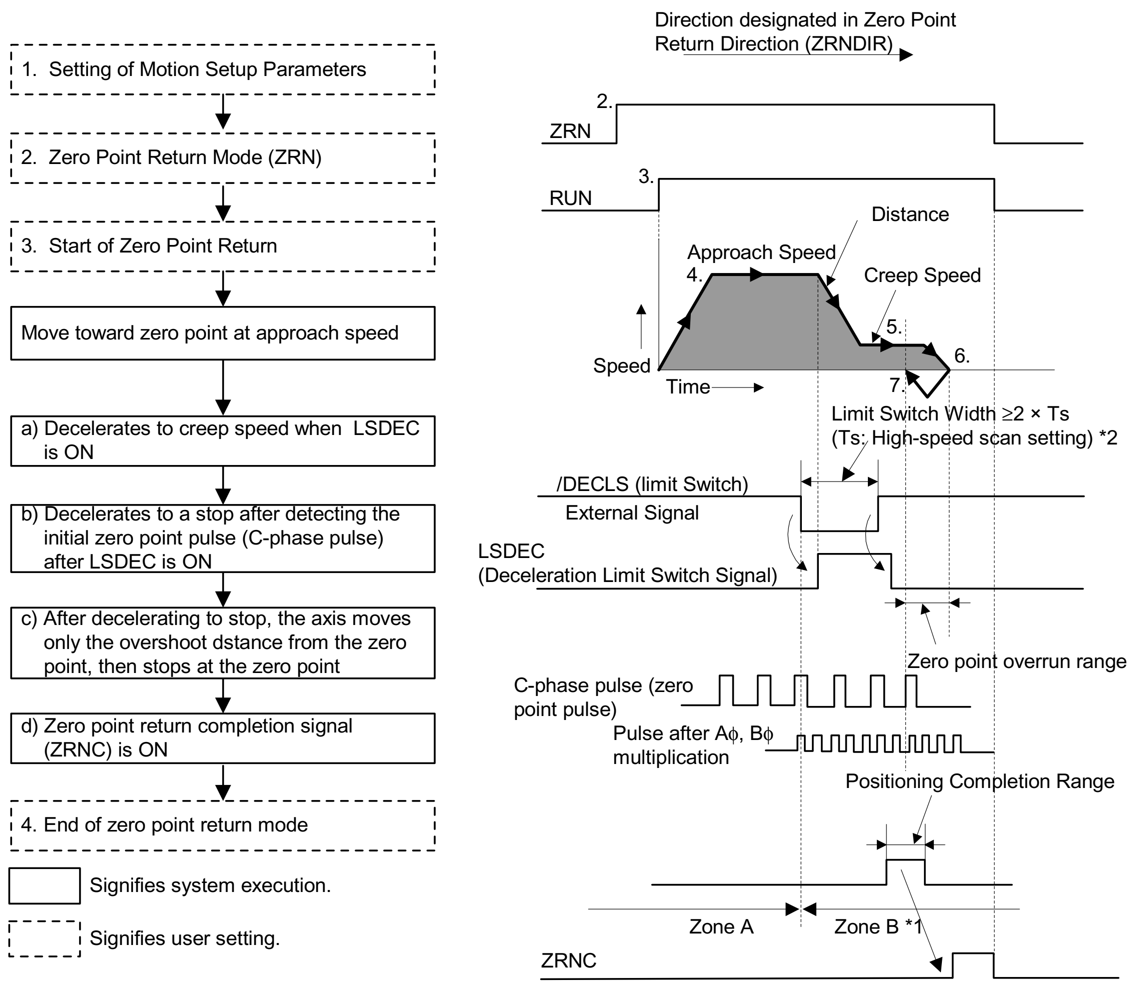
When an incremental encoder is used, the system zero-point position data is deleted if power is cut off. Therefore a new system zero point must be determined after power ON. Generally this zero-point is determined by using an encoder with a zero pulse and a limit switch showing the zero-point range.

There are two methods of zero-point return operation: the zero-return mode, and the motion commands. Keep in mind that these zero-point return operations differ.

When an absolute encoder is used, position control with a position reference of 0 results upon selecting “Zero-point Return”.

Detailed Description

The order of operations for zero-point return is shown in the following figure.



- After power ON, the machine will not be able to return correctly if in range B. Perform zero-point return after returning the machine to range A.
- The limit switch (/DECLS) band must be at least 2× the high-speed scan setting.

1. Setting motion parameters used in the zero-point return operation

There are three setting parameter setting methods:

- Setting by the MotionWorks™ “Setting Parameter Screen”
- Setting by ladder program
- Setting by motion program

Name	Register Number	Setting Range	Meaning	Setting Example
Forward Torque Limit (TLIMP)	OWC002	-327.68 ~ 327.67	0.01 = 0.01 %1 = 1%	-100.00 (-100.00%)
Positive Speed Limiter (NLIMP)	OWC004	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Negative Speed Limiter (NLIMN)	OWC005	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Zero-point Position Offset (ABSOFF)	OLC006	$-2^{31} \sim 2^{31-1}$	1 = 1 command unit During pulse 1 = 1 pulse	100 pulses
Approach Speed Setting (NAPR)	OWC00A	0 ~ 32767	% of Rated Speed 1 = 0.01%	2000 (20.00%)
Creep Speed Setting (NCLP)	OWC00B	0 ~ 32767	% of Rated Speed 1 = 0.01%	1000 (10.00%)
Linear Acceleration Time (NACC)	OWC00C	0 ~ 32767	Linear acceleration time constant at speed parameter generation (ms)	1000 (1s)
Linear Deceleration Time (NDEC)	OWC00D	0 ~ 32767	Linear deceleration time constant at speed parameter generation (ms)	1000 (1s)
Positioning Completion Range Setting (PEXT)	OWC00E	0 ~ 65535	1 = 1 command unit During pulse 1 = 1 pulse	10 pulses
Deviation Error Detection Setting (EOV)	OWC00F	0 ~ 32767	1 = 1 command unit During pulse 1 = 1 pulse	65535 pulses
Position Loop Gain Setting (KP)	OWC010	0.0 ~ 3276.7	0.1 = 0.1 /s 1 = 1 /s	30.0 (30.0 /s)
Filter Time Constant (NNUM)	OWC014	0 ~ 255	For simple S-curve accel/decel	0

2. Turning the zero-point return mode (ZRN) (Bit 4 of OWC000) ON.

3. Zero-point Return Run Start

   a.) Turn the RUN command ON (Bit 0 of OWC001). The axis moves in the direction specified in “Zero-point Return Direction Selection” (ZRNDIR) (Bit 9 of OWC000).

   b.) The axis decelerates to creep speed when the “Zero-point Return Deceleration Point Limit Switch” (LSDEC) (Bit 15 of OWC001) goes ON.

c.) A user program must be created to connect the limit switch signal DECLS (DI signal integrated in LIO, etc.) to the zero-point return deceleration point limit switch LSDEC (Bit 15 of OWC001).

d.) The point at which the first zero-point pulse (C-phase pulse) after LSEDC goes from ON to OFF is the zero-point position. The axis decelerates to a stop after the first zero-point pulse is detected.

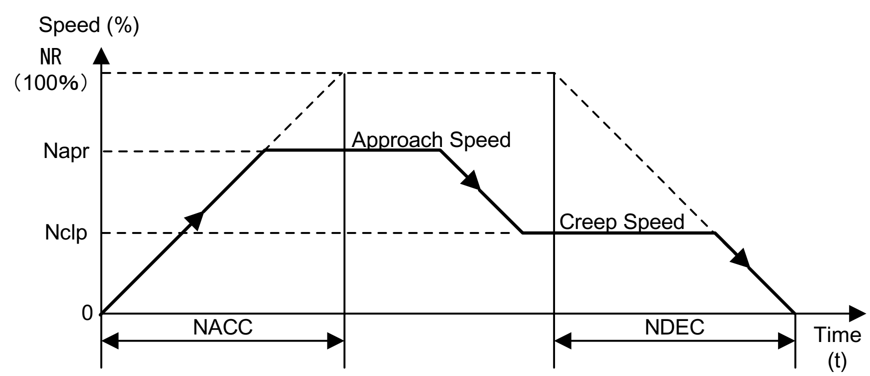
e.) After decelerating to stop, the axis moves at creep speed in the direction of the zero-point position for the zero-point overrun distance only, and then stops at the zero-point position. A zero-point offset can also be set (the position data is 100 when the zero-point position offset OLC006 is set to 100).

Zero-point Return Mode Stop

The zero-point return operation is complete when the axis enters the positioning completion range. The zero-point return completion signal ZRNC (Bit F of IWC000) goes ON upon completion of the zero-point return operation. The RUN command and zero-point return mode (ZRN) both go OFF after it has been verified that the zero-point return completion signal (ZRNC) is ON.

User Program Examples

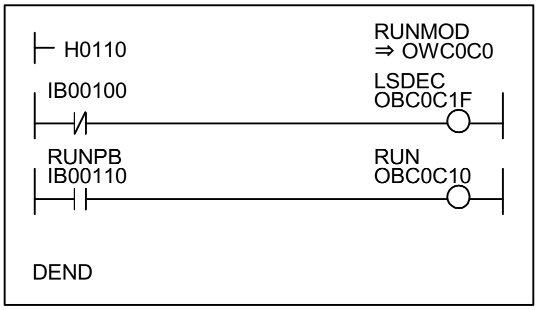
Program Run Examples (zero-point return pattern)



Operation Conditions

Input a limit switch signal band at least 2× the high-speed scan setting.

Ladder Program Example (Run Command Dwg H01)



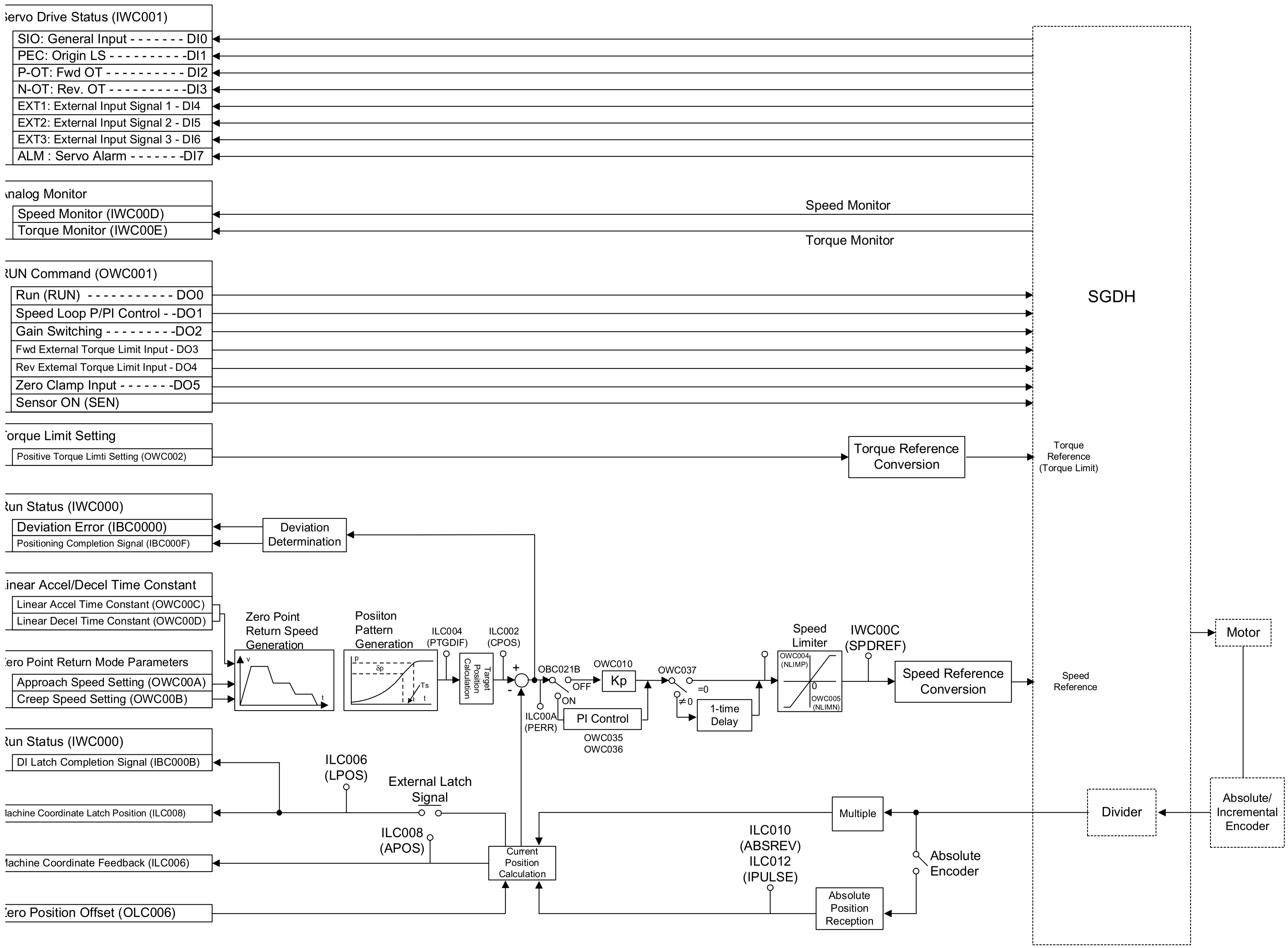
Zero point return mode ON

IB00100: Limit Switch Signal (DECLS)

The zero point return operation starts when the run command to the driver (RUN) is ON. The zero point completion signal IBC0C0F (ZRNC) goes ON at completion of the zero point return operation.

Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

The 940 SVA zero-point return mode block diagram appears on the next page.


Servo Drive Status (IWC001)
SIO: General Input - - - - - - - DI0
PEC: Origin LS - - - - - - - - - - -DI1
P-OT: Fwd OT - - - - - - - - - - DI2
N-OT: Rev. OT - - - - - - - - - - -DI3
EXT1: External Input Signal 1 - DI4
EXT2: External Input Signal 2 - DI5
EXT3: External Input Signal 3 - DI6
ALM : Servo Alarm - - - - - - -DI7
Analog Monitor
Speed Monitor (IWC00D)
Torque Monitor (IWC00E)
RUN Command (OWC001)
Run (RUN) - - - - - - - - - - - DO0
Speed Loop P/PI Control - -DO1
Gain Switching - - - - - - - - -DO2
Fwd External Torque Limit Input - DO3
Rev External Torque Limit Input - DO4
Zero Clamp Input - - - - - - -DO5
Sensor ON (SEN)
Torque Limit Setting
Positive Torque Limti Setting (OWC002)
Run Status (IWC000)
Deviation Error (IBC0000)
Positioning Completion Signal (IBC000F)
Linear Accel/Decel Time Constant
Linear Accel Time Constant (OWC00C)
Linear Decel Time Constant (OWC00D)
Zero Point Return Mode Parameters
Approach Speed Setting (OWC00A)
Creep Speed Setting (OWC00B)
Run Status (IWC000)
DI Latch Completion Signal (IBC000B)
Machine Coordinate Latch Position (ILC008)
Machine Coordinate Feedback (ILC006)
Zero Position Offset (OLC006)
Speed Monitor
Torque Monitor
SGDH
Torque Reference Conversion
Torque Reference (Torque Limit)
Deviation Determination
Zero Point Return Speed Generation
Posiiton Pattern Generation
ILC004 (PTGDIF)
ILC002 (CPOS)
Target Position Calculation
OBC021B
OFF
ON
OWC010
Kp
ILC00A (PERR)
PI Control
OWC035
OWC036
OWC037
=0
≠0
1-time Delay
Speed Limiter
OWC004 (NLIMP)
OWC005 (NLIMN)
IWC00C (SPDREF)
Speed Reference Conversion
Speed Reference
Motor
ILC006 (LPOS)
External Latch Signal
ILC008 (APOS)
Current Position Calculation
Multiple
ILC010 (ABSREV)
ILC012 (IPULSE)
Absolute Encoder
Absolute Position Reception
Divider
Absolute/ Incremental Encoder

Position Control

This section deals with preparatory knowledge for position control and position control methods not using motion commands.

Preparatory Knowledge for Position Control

Outline of Position Control

Position control is used when proceeding to, and stopping at, a target position, as well as for maintaining (servo clamp) that position.

Either an incremental encoder, or a Yaskawa-made absolute encoder can be used for position detection.When a Yaskawa-made absolute encoder is used, the zero-point return operation is not necessary at power ON because the absolute position is stored in memory at machine (positioning device) power OFF.

There are two methods of position control: that which uses the motion command (OWC020), and that which does not use motion commands.

Set the following parameters to determine whether the motion command (OWC020) is used or not.

Motion Parameters	When Motion Command (OWC020) Is Not Used	When Motion Command (OWC020) Is Used
Bit 7 of Fixed Motion Parameter 14 “Additional Function Usage Selection” (Motion Command Usage Selection)	Unused (= 0)	Used (= 1)
Bit 8 of Motion Setting Parameter “Operation Mode Setting (OWC000)” (Motion Command Code Enablement Selection)	Disabled (= 0)	Enabled (= 1)

Note: When bit 7 (Motion Command Use Selection) of fixed motion parameter 14 “Additional Function Usage Selection” is selected for non-use, the system will operate as if the motion command OWC020 is not used even if bit 8 (Motion Command Enablement Selection) of the motion setting parameter “Operation Mode Setting (OWC000)” is set to “1” (enabled).

When using motion programs, set bit 14 “position reference type” of the fixed motion parameter “Run Command Setting (OWC001)” to “1” (Incremental Calculation Formula).

The following table shows the different conditions under which motion commands (OWC020) are used or not used.

Item	When Motion Command (OWC020) Is Not Used	When Motion Command (OWC020) Is Used
Command Unit	Pulses	Any of the following can be selected: pulse/mm/inch/deg
Electronic Gearing Function	Not possible	Possible
Linear Position Control	Possible	Possible
Rotary positioning control in one direction only without reset after one rotation	Possible	Possible
Rotary position control with resetting after one rotation	Not possible	Possible
Position Reference	Absolute Position Format	Either Absolute Position Form at Incremental Calculation Format can be selected
Position Buffer	Not possible	Possible
Position Monitor	Pulse Unit	Command Unit
Speed Reference	% Command	Either % Command/Command Unit can be selected

The meanings and usage of the terms in the above table are shown below.

Command Unit

The command units input to this module depend on the following fixed motion parameter settings.

Command units can be in pulses, millimeters, degrees, or inches. Designate the command unit in bits 0 ~ 3 of fixed motion parameter 17 “Motion Control Function Selection Flag”.

The minimum command unit that can be designated in this module is set in the above unit setting, or in fixed motion parameter 18 “Number of Digits Below Decimal Point”. Refer to the table below.

Pulse units are used if motion commands (OWC020) are not used.

Unit Number of Digits Following Decimal Point	Bits 0 ~ 3 of Fixed Motion Parameter 17 “Motion Controller Function Selection Flag”			
	Pulses (= 0)	mm (= 1)	deg (= 2)	inch (= 3)
0	1 Pulse	1mm	1deg	1inch
1	1 Pulse	0.1mm	0.1deg	0.1inch
2	1 Pulse	0.01mm	0.01deg	0.01 inch
3	1 Pulse	0.001mm	0.001deg	0.001 inch
4	1 Pulse	0.0001mm	0.0001deg	0.0001inch
5	1 Pulse	0.00001mm	0.00001deg	0.00001 inch

Note: Set the minimum command unit in fixed motion parameter number 18 “Number of Digits Below Decimal Point”.

Electronic Gear Ratio

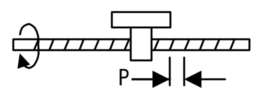
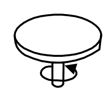
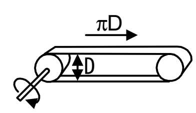
With regard to the command units input to the module, the mechanical motion units are called “Output Units”. Electronic gearing is a function that converts position or speed units from command units (mm, deg, inch) to output units (mm, deg, inch). In a machine configuration in which the load axis rotates amount “n” when the motor axis rotates amount “m,” “command unit = output unit” can be assumed by using this electronic gearing function.

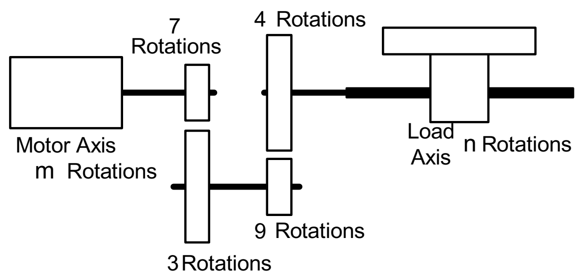
Set the electronic gearing function by the motion setting parameters in the following table.

Fixed Motion Parameters	Name/Meaning
Bit 4 of No.17 “Motion Controller Function Selection Flag”	Electronic Gearing Selection (0: Disabled/ 1: Enabled) Disabled when “pulses” is selected for the unit selection. Set to “Disabled” (0).
No.19 “Distance Travelled per Machine Rotation”	Distance Travelled per Machine Rotation This parameter setting is disabled when “Disabled” (0) is selected in the electronic gearing selection.
No.21 “Servomotor Gear Ratio”	Servomotor Gear Ratio This parameter setting is disabled when “Disabled” (0) is selected in the electronic gearing selection.
No.22 “Machine Gear Ratio”	Machine Gear Ratio This parameter setting is disabled when “Disabled” (0) is selected in the electronic gearing selection.

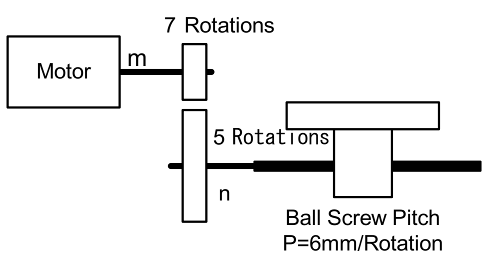
Note: The electronic gearing function is disabled when the unit selection is pulses, or when motion commands (OWC020) are not used.

The meaning and setting examples of the electronic gearing parameters are shown in the table below.

<table>
<tr><th>Fixed Servo Parameter Number</th><th>Name</th><th colspan="2">Content</th><th>Initial Value</th></tr>
<tr><td rowspan="6">Number 19</td><td rowspan="6">Amount of motion per machine rotation 1</td><td colspan="2">Parameter* that shows the load motion amount (command unit) of 1 load axis rotation.
Shows the assigned value of the load motion in the minimum command unit.
$$\text{No. 19} = \frac{\text{Rotation of load per rotation of load axis}}{\text{Minimum command unit}}$$
* An example of the load motion is given below.</td><td>1000</td></tr>
<tr><td>Distance Travelled per Machine Rotation</td><td colspan="2">Example of Load Configuration</td></tr>
<tr><td>P (mm)</td><td colspan="2">Ball Screw

P= Ball Screw Pitch</td></tr>
<tr><td>360 (°)</td><td colspan="2">Circular Table

1 Turn = 360 deg.</td></tr>
<tr><td>piD (mm)</td><td colspan="2">Belt
</td></tr>
<tr><td colspan="3">• Setting Range of No. 19:1~2^{31}-1(1 = 1 Command Unit)
Setting Example
• Distance Travelled per Load Axis Rotation = 12mm
When minumum command unit = 0.001mm (command unit: mm, number of digits following decimal point: 3)
$$\text{No.19} = \frac{12\text{mm}}{0.001\text{mm}} = \text{Set 12000}$$</td></tr>
</table>

Fixed Servo Parameter Number	Name	Content	Initial Value
Number 21	Servomotor Gear Ratio	• Parameter that sets up gear ratio between the motor and load. When configured so that the load axis rotates ' n' times when the servo motor axis rotates ' m' times. $\left.\begin{array}{l}\text{No. 21 = m rotation}\\ \text{No. 22 = n rotation}\end{array}\right\}$ are set • Setting range:1 ~ 65535 (rotations) Setting Example  Deceleration $= \frac{n}{m} = \frac{3}{7} \times \frac{4}{9} = \frac{4}{21}$ Therefore, set $\left\{\begin{array}{l}\text{No.21} = 21\\ \text{No.22} = 4\end{array}\right\}$	1
Number 22	Machine Gear Ratio		1

In the case of Electronic Gearing Parameter Setting Example (A) "Ball Screw"



The various parameter settings are as follows when "command unit" = "output unit" = 0.001mm in the above mechanical system.

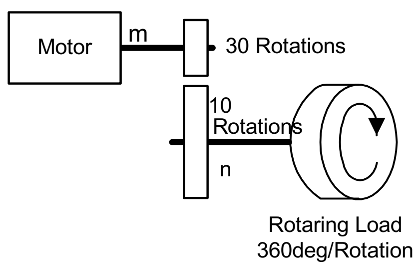
$$\text{No.}19 = \frac{6\text{mm}}{0.001\text{mm}} = 6000$$

$$\text{Deceleration} = \frac{n}{m} = \frac{5}{7}$$

No. 21 = 7

No. 22 = 5

In the case of Electronic Gearing Parameter Setting Example (B) "Rotating Load"



In the mechanical system above, "command unit" = "output unit" = 0.1. The parameter settings are as follows in this instance.

$$\text{No.}19 = \frac{360^\circ}{0.1^\circ} = 3600$$

$$\text{Deceleration} = \frac{n}{m} = \frac{10}{30} = \frac{1}{3}$$

No. 21 = 3

No. 22 = 1

Axis Selection

There are two types of position control: linear positioning control which takes place within a specified area for back-and-forth operations, etc., and infinite length position control for rotation in a single direction.

There are also two types of infinite-length position control: a form in which the axis resets to 0 after one rotation (used in conveyor belts, for example), and simple unidirecitonal rotation which does not reset after one rotation.

Position control is selected during axis selection. (Refer to the following table) Set axis selection in Bit 5 of fixed motion parameter 17 “Motion Controller Function Selection Flag”.

This is disabled when motion commands (OWC020) are not used (set linear axis (= 0).

Position Control Type	Axis Selection Setting
Linear Position Control	Linear Axis (= 0)
Rotary positioning control in one direction only without reset after one rotation	Linear Axis (= 0)
Rotary position control with reset after one rotation*	Infinite Length Axis (= 1)

* Set the reset position in fixed motion parameter 23 “Infinite Length Axis Reset Position”.

Position Reference

There are two methods for position reference setting: direct designation (in which the position reference is direcly set into OLC012), and indirect designation (in which number of the position buffer where the position reference is stored in is designated in LOC012).

There are two types of direct designation: absolute position reference type in which the absolute position is set in LOC012, and the incremental addition type in which the current motion is added to the previous position reference (previous value of OLC012), and set into OLC012.

The parameters related to the position reference are shown in the table below.

Parameter Type	Parameter Number (Register Number)	Name	Content	Initial Value
Motion Setting Parameters	Bit 12 of OWC001	Position Reference Selection	Sets the position reference designation method. 0: Direct Designation Direct setting of position data into OLC012. Designate whether the position data is in absolute position format or incremental addition format in bit 14 of OWC001. 1: Indirect Designation Set the position buffer number into OLC012. The absolute position must be stored beforehand into the designated position buffer.	0
	Bit 14 of OWC001	Position Reference Type	Designates position data type. 0: Absolute Position Format Sets the absolute position in OLC012. 1: Integral Addition Format Sets the previous value of OLC012 to which the current motion amount has been added into OLC012.*1	1
	OLC012	Position Reference Setting	Sets position data.*2	0

*1 Disabled when the position reference selection is “position buffer” (indirect designation).

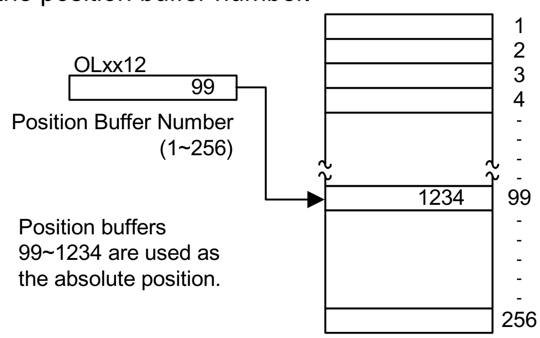
*2 The setting data differs according to the position reference selection (bit 12 of OBC001) and the position reference type (bit 14 of OBC001).

1. In indirect designation, in which the number of the position buffer is designated, the position stored in the position buffer is handled as an absolute position.

   The position reference set in OLC012 is handled as an absolute position when no motion command (OWC020) is used.

2. Set bit 14 of OWC001 “Position Reference Type” to the incremental addition format when a motion program is used.

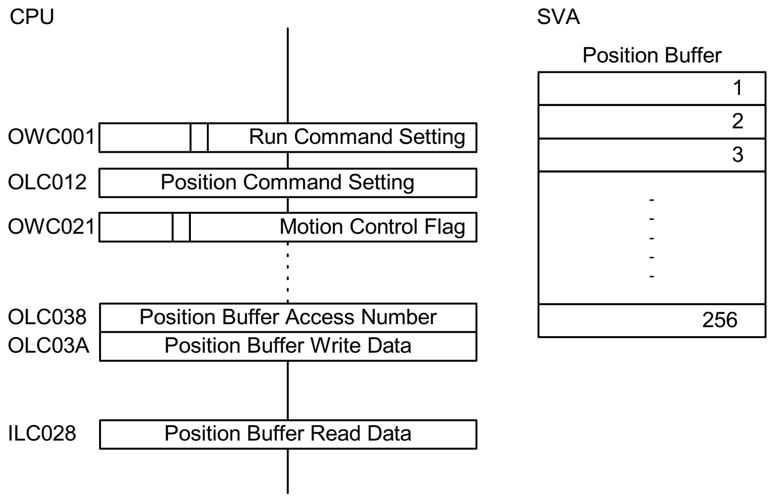
   The system does not operate normally if a motion program is executed in the absolute position format.

Position Reference Selection (Bit 12 of OWC001)	Position Reference Type (bit 14 of OWC001)	Position Reference (OLC012)
0 (direct designation)	0 (absolute position type)	Sets the absolute position (moves to the set position). Example: OLC012 ← 10000 OLC012 ← 20000
	1 (incremental addition format)	Sets the current distance travelled (incremental amount) to be added to the previous value of OLC012. OLC012 ← Previous OLC012 value + incremental motion distance (Example) When previous value of OLC012 = 1000 and the current travel distance is 500: OLC012 ← 1000 + 500 = 1500
1 (Indirect Designation)	0 (absolute position type)	Sets the position buffer number.  The absolute position must be stored beforehand in the position buffer of the designated number.

In infinite length axis position references, add the current travel distance (incremental travel distance) to the the previous position reference (OLC012), and set the new value as the position reference (OLC012). Note: The position reference is not necessarily set in the range of 0 ~ (reset position of infinite length axis -1).

Position Buffer

A position data group maintained within the SVA module keeps a maximum capacity of 256 points per axis. These are used as position data during execution of motion programs. If the position data is stored beforehand, continuous run becomes possible with only a simple program designating the points.

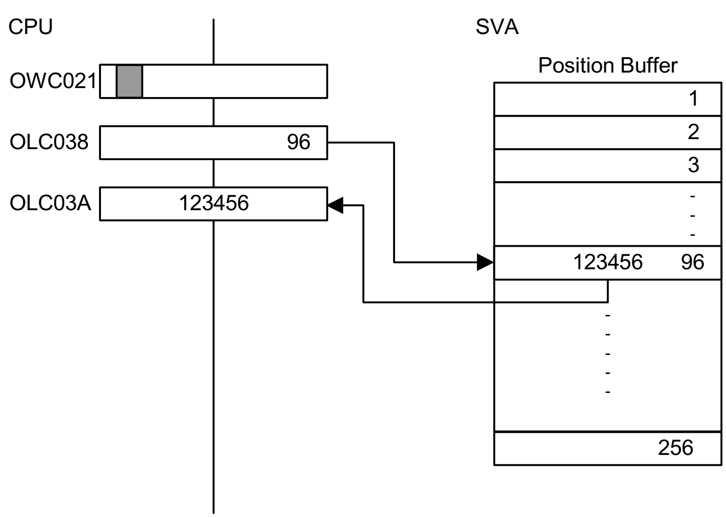


Position Buffer Usage Method

In machines in which the motion pattern has been determined beforehand, the position data can be stored into the position buffer and continuous positioning is possible up to a maximum of 256 points merely by updating the buffer pointer at the completion of one operation block.

Position Buffer Read/Write Data

Write Method

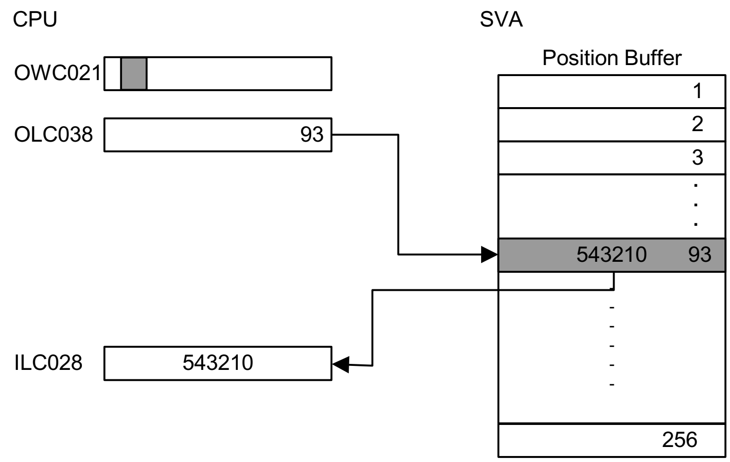


a.) Sets the position buffer access number OLC038.1 ~ 256

b.) Sets the position buffer write (OLC03A) data.

c.) Turns position buffer write (OBC021E) of the motion control flag ON.

Read Method



a.) Sets the position buffer access number OLC038.1 ~ 256

b.)Turns position buffer read (OBC021F) of the motion control flag ON.

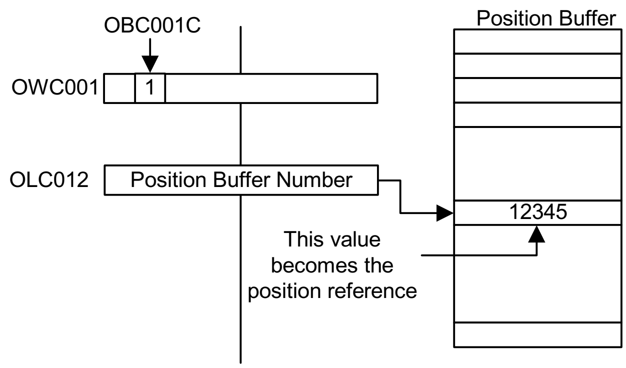
c.) Stores the position data designated in the position buffer read data two scans later.

Cautionary Items

- Enabled only when a motion command is used in the position control mode.
- The position data designated in the position buffer is assumed to be the absolute position reference.

Delete the position buffer data by turning OFF the power or resetting the CPU module mask. Set this before turning the power ON or using the position buffer.

1. Method for Use as a Position Reference



1. Set the RUN command setting (bit 12 of OWC001) to ON.
2. In the position reference setting (OLC012), set a position buffer number between 1 ~ 256 instead of the position reference.

By doing so, the data of the position buffer number designated in OLC012 will function as a position reference.

Position Monitor

The following parameters exist for position monitoring.

Motion Monitoring Parameter Number (register number)	Name	Content
ILC002	Machine Coordinate [a]Calculation Position (CPOS).	Messages the calculated machine coordinate position managed by the SVA module.The position data messaged to this parameter is the target position at each scan. *1
ILC008	Machine Coordinate Feedback Position (APOS)	Messages the machine ccordinate feedback position.*2
ILC018	Machine Coordinate Command Position (MPOS)	Messages the position output by the SVA module to the outside and the machine coordinate reference position. This position data cannot be updated in the machine lock state (no output to peripherals in the machine lock state). This is the same as ILC002 when the machine lock function is not used.
ILC02E	Command Coordinate Calculation Position (POS)	Significant when the axis selection is “infinite length axis”. In an infinite length axis, the target position for each scan is messaged to the position reference in this parameter.*3

a. The “Machine Coordinate System” refers to the following: the basic system of system coordinates set by the execution of the zero return mode, execution of the “Zero-Point Return (ZRET)” motion command, or the operation of the “Zero-Point Setting (ZSET)” motion command.The SVA module manages the position based on this machine coordinate system.

1 Messages a range of 0 ~ (unlimited length axis reset position-1) when the axis selection is set to “infinite length axis”.
In infinite length axis position references, add the current travel distance (incremental travel distance) to the previous position reference (OLC012), and set the new value as the position reference (OLC012).
Be aware that the position reference is not necessarily set in the range of 0 ~ (reset position of infinite length axis -1).

2 Messages a range of 0 ~ (unlimited length axis reset position-1) when the axis selection is set to “infinite length axis”.

3 Same as ILC002 for linear axes.

Speed Reference

There are two methods for setting speed references (fast feed speed, approach speed, and creep speed): setting in command units, and setting as a percentage of the rated speed. The speed reference related parameters are shown in the table below.

Parameter Type	Parameter Number (Register Number)	Name	Content
Motion Setting Parameters	Bit 13 of OWC001	Speed Reference Selection	Designate the setting units for the fast feed speed, approach speed, and creep speed, as well as the register number for the fast feed speed. 0: Designates the speed in command units, and sets the fast feed speed into OLC022. 1: Designates the fast feed speed as a percentage of the rated speed, and sets the fast feed speed into OWC015.
	OWC00A	Approach Speed Setting	Sets the zero-point return (ZRET) approach speed. The units differ according to the speed reference selection (bit 13 of OWC001) setting.
	OWC00B	Creep Speed Setting	Sets the zero-point return (ZRET) creep speed. The units differ according to the speed reference selection (bit 13 of OWC001) setting.
	OWC015	Speed Reference Setting	Enabled when the speed reference selection (bit 13 of OWC001) is “1”. Sets a percentage of the rated speed (1 = 0.01%) as the fast feed speed.
	OLC022	Fast Feed Speed	Enabled when the speed reference selection (bit 13 of OWC001) is “0”. Sets the fast feed speed in command units.
	OWC02C	Override	Allows the fast feed speed setting in the servo amplifier to be overridden by the system software.

If no Motion Commands are Used

If motion commands are not used, the speed reference selection flag is disabled and the speed-related parameters have the meanings shown in the following table.

Parameter No.	Name	Content
Bit 3 of OWC001	Speed Reference Selection	Disabled
OWC00A	Approach Speed Setting	Designate as a percentage of the rated speed.
OWC00B	Creep Speed Setting	Designate as a percentage of the rated speed.
OWC015	Speed Reference Setting	Designates the fast feed speed as a percentage of the rated speed.
OLC022	Fast Feed Speed	Disabled
OWC02C	Override	Disabled

If Motion Commands are Used

If motion commands are used, the speed-related parameters differ in accordance with the speed reference selection (bit 13 of OWC001).

Bit 13 of OWC001	Parameter Number	Name	Content
0	OWC00A	Approach Speed Setting	Designated in command units.
	OWC00B	Creep Speed Setting	Designated in command units.
	OWC015	Speed Reference Setting	Disabled
	OWC022	Fast Feed Speed	Designated in command units.
	OWC02C	Override	Enabled
1	OWC00A	Approach Speed Setting	Designated as a percentage of the rated speed.
	OWC00B	Creep Speed Setting	Designate as a percentage of the rated speed.
	OWC015	Speed Reference Setting	Designates the fast feed speed as a percentage of the rated speed.
	OWC022	Fast Feed Speed	Disabled
	OWC02C	Override	Enabled

Setting examples of the parameters are shown in the table below:

Parameter Type	Parameter Number (Register Number)	Name	Initial Value
Motion Setting Parameters	Bit 13 of OWC001	Speed Reference Selection	0
	OWC00A	Approach Selection	0
	OWC00B	Creep Speed	0
	OWC015	Speed Reference Setting	0
	OLC022	Fast Feed Speed	0
	OWC02C	Override	100%
	Conditions Pulse Calculation Format = A/B format (fixed at quadrature) Rated Speed = 3000rpm Motor Rotation Feedback Pulse = 2048P/R Rated Speed = 3000 rpm = 3000×2048×4 = 2575000ppm Setting examples for various parameters are shown below:		

Note: Select “enabled” (=1) in bit 9 “Override Selection” of fixed motion parameter 17.

Rated speed and number of feedback pulses per rotation are automatically transmitted to the MP940 at power ON as data on the motor connected to the SGDH.

Pulse counting mode selection: A/B format, fixed at quadrature

Examples of Parameter Setting

If the Speed Reference Selection is set to “0”

a.) When “pulses” is designated as the unit

When operating with fast feed speed = 1500rpm, approach speed = 300rpm, creep speed = 150rpm in the parameter settings

- OWC00A = 300(rpm)×2048×4(ppr)÷1000 = 2457(=2457000ppm)
- OWC00B = 150(rpm)×2048×4(ppr)÷1000 = 1228(=2457000ppm)
- OWC015 = --- --- --- (disabled)
- OLC022 = 1500(rpm)×2048×4(ppr)÷1000 = 12288(=12288000ppm)
- OWC02C = 10000(100%)

b.) When “mm” is designated as the unit

When operating with fast feed speed = 900mm/min, approach speed = 180mm/min, and creep speed = 90mm/min in the fixed parameter settings in a machine configuration that moves 10mm per rotation.

- OWC00A = 180
- OWC00B = 90
- OWC015 = --- --- --- (disabled)
- OLC022 = 900
- OWC02C = 10000(100%)

When operating with fast feed speed = 1500rpm, approach speed = 300rpm, creep speed = 150rpm while the speed reference selection is set to "1".

- $\mathrm{OWxx0A} = \dfrac{300\ (\mathrm{r/min})}{3000\ (\mathrm{r/min})} \times 10000 = 1000\ (10.00\%)$
- $\mathrm{OWxx0B} = \dfrac{150\ (\mathrm{r/min})}{3000\ (\mathrm{r/min})} \times 10000 = 500\ (5.00\%)$
- $\mathrm{OWxx15} = \dfrac{1500\ (\mathrm{r/min})}{3000\ (\mathrm{r/min})} \times 10000 = 5000\ (50.00\%)$
- OLC022 = --- --- --- (disabled)
- OWC02C = 10000(100%)

When the speed reference setting is left as is, and the operation speed is halved

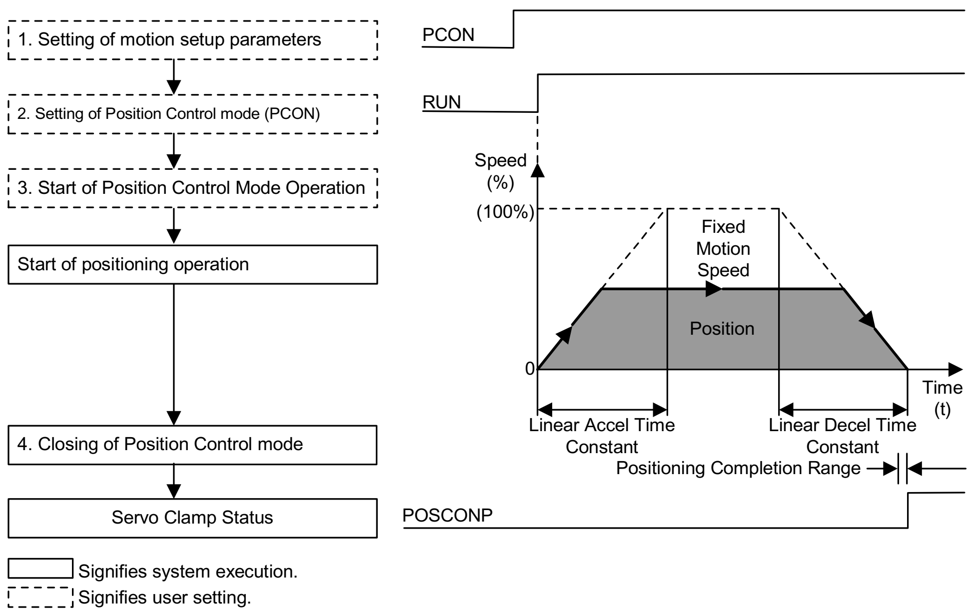
- OWC02C=5000(50.00%)

Position Control without the Use of Motion Commands

In accordance with the instructions in the related parameters, the system executes speed accel/decel, and positions at the target location in the position referetence setting parameter OLC012.

Detailed Description

The run procedure for position control not using motion commands is shown below.



1. Set the motion parameters used in the position control mode.

There are three methods for setting the parameters:

- Setting by the MotionWorks™ “Setting Parameter Screen”
- Setting by ladder program
- Setting by motion program

Name	Register No.	Setting Range	Meaning	Setting Example
Forward Torque Limit (TLIMP)*	OWC002	-327.68 ~ 327.67	0.01 = 0.01 %1 = 1%	-100.00 (-100.00%)
Positive Speed Limiter (NLIMP)	OWC004	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Negative Speed Limiter (NLIMN)	OWC005	0.00 ~ 327.67%	0.01 = 0.01 %1 = 1%	130.00 (130.00%)
Zero-point Position Offset (ABSOFF)	OLC006	$-2^{31} \sim 2^{31-1}$	1 = 1 command unit During pulse 1 = 1 pulse	100 pulses
Linear Acceleration Time (NACC)	OWC00C	0 ~ 32767	Linear acceleration time constant at speed parameter generation (ms)	1000 (1s)
Linear Deceleration Time (NDEC)	OWC00D	0 ~ 32767	Linear deceleration time constant at speed parameter generation (ms)	1000 (1s)
Positioning Completion Range Setting (PEXT)	OWC00E	0 ~ 65535	1 = 1 command unit During pulse 1 = 1 pulse	10 pulses
Deviation Error Detection Setting (EOV)	OWC00F	0 ~ 32767	1 = 1 command unit During pulse 1 = 1 pulse	65535 pulses
Position Loop Gain Setting (KP)	OWC010	0.0 ~ 3276.7	0.1 = 0.1/s 1 = 1/s	30.0 (30.0/s)
Filter Time Constant (NNUM)	OWC014	0 ~ 255	For simple S-curve accel/decel	0
Feed-forward Gain Setting (Kf)	OWC011	0 ~ 200	1 = 1%	0
Position Reference Setting (XREF)	OLC012	$-2^{31} \sim 2^{31-1}$	1 = 1 command unit If Pulse: 1 = 1 pulse	10000 pulses
Speed Reference (NREF)	OWC015	-327.68 ~ 327.67	Speed Reference 0.01 = 0.01 %1 = 1%	50.00 (50.00%)

Note: This parameter is only enabled in SVA-02 modules.

2. Select the position control mode (PCON) (Bit 2 of OWC000).
3. Run start for position control mode (not using motion commands).

Turn the RUN command (Bit 0 of OWC001) ON.

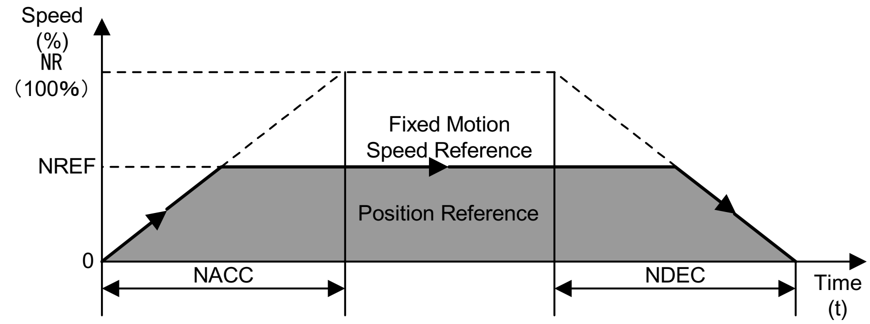
The axis executes the positioning operation by a designated motion parameter. The settings of any motion parameter can be changed even during the positioning operation.

4. Position control mode run close

The positioning completion signal POSCOMP (bit D of IWC000) goes ON when the axis enters the positioning completion range. Control will continue even after entrance into the positioning completion range. To stop position control, turn the RUN command or position control mode (PCON) OFF.

User Program Examples

Example of Running Desired Operation (Position Pattern)

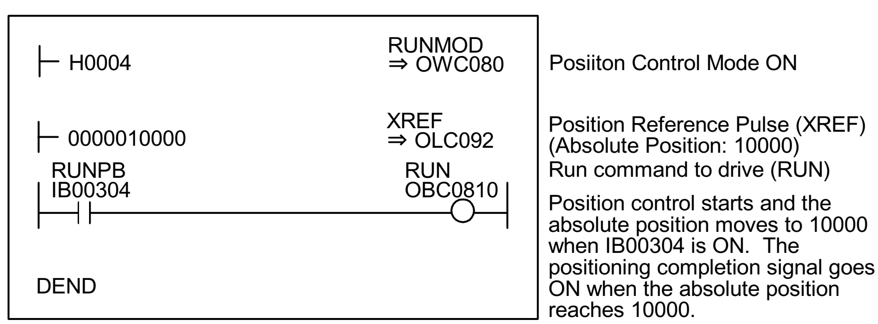


Operation Conditions

In the above figure, stoppage occurs at an absolute position of 10,000 pulses.

- Position Reference: XREF = 10000 pulses

Ladder Program Example (Run Command Dwg H03)



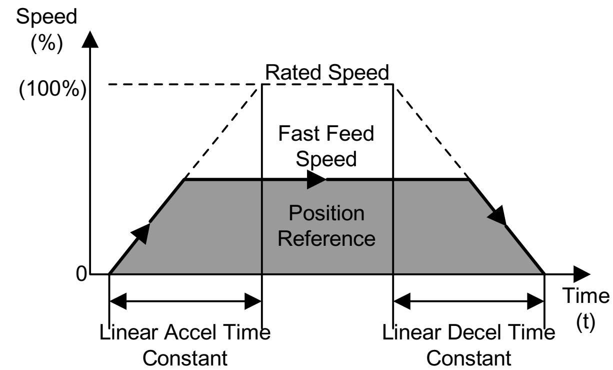
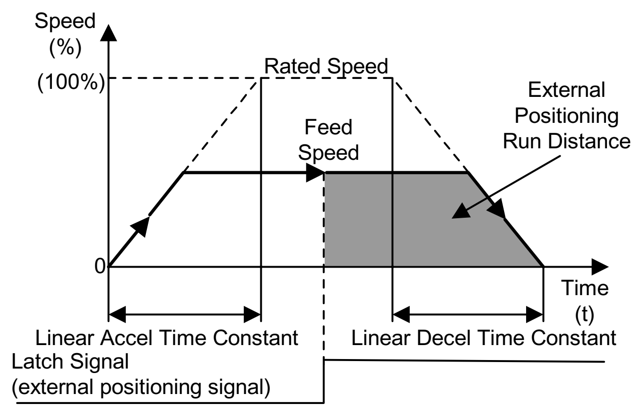
Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

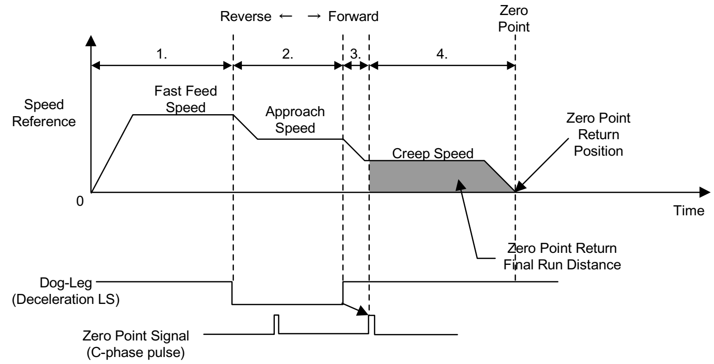
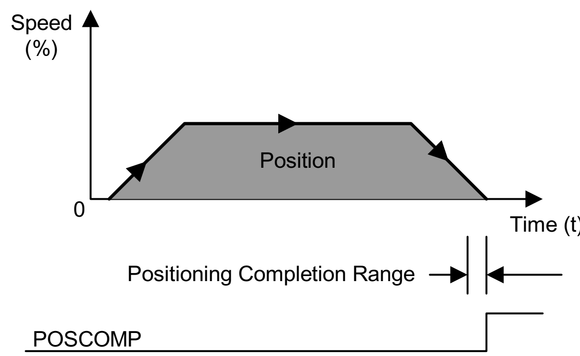
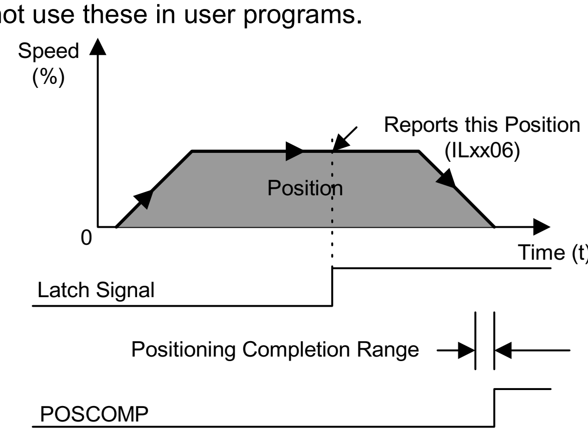
Position Control by Motion Commands

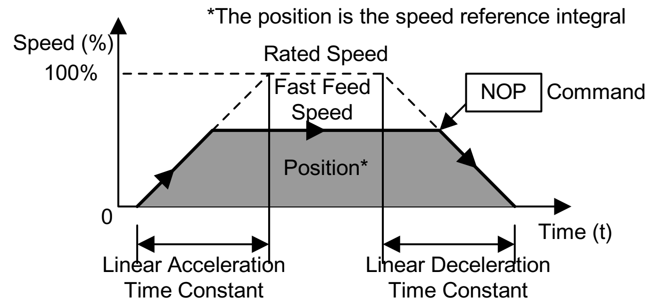
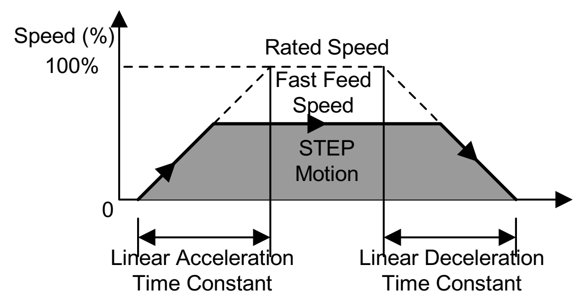
This section deals with methods for position control using motion commands.

Motion Command Types and Outlines:

A list of the motion command types, and brief descriptions of them, is given below.

Command	Name	Summary
1	Positioning (POSING)	Positions to a designated position at a designated accel/decel time constant and speed. 
2	External Positioning (EX-POSING)	In the positioning (POSING) operation, counter latching is executed upon input of a latch signal (external positioning signal), then the axis executes positioning at a position moved the exact external positioning run distance from this latch position. 

<table>
<tr><th>Command</th><th>Name</th><th>Summary</th></tr>
<tr><td>3</td><td>Zero-point Return
(ZRET)</td><td>Operation for retuning to the machine coordinate zero-point.There are 8 zero-point return formats provided.

</td></tr>
<tr><td>4</td><td>Interpolation
(INTERPOLATE):</td><td>Executes interpolation feed according to position data continually fed from the CPU module.

</td></tr>
<tr><td>5</td><td>Unused</td><td>Commands Used by System
Do not use these in user programs.

</td></tr>
</table>

Command	Name	Summary
6	Interpolation with Position Detection (LATCH):	Upon input of a latch signal during interpolation feed operation, executes counter latch, and messages the latch position converted into command units. 
7	Set Speed Feed (FEED):	Executes fast feed speed in one unbounded direction at a designated speed and acceleration time. 
8	Fixed Length Feed (STEP):	Executes stepping positioning in a designated direction at a designated speed and acceleration time constant.
9	Zero-Point Setting (ZSET)	Determines the “machine coordinate zero-point” and enables a soft limit check.

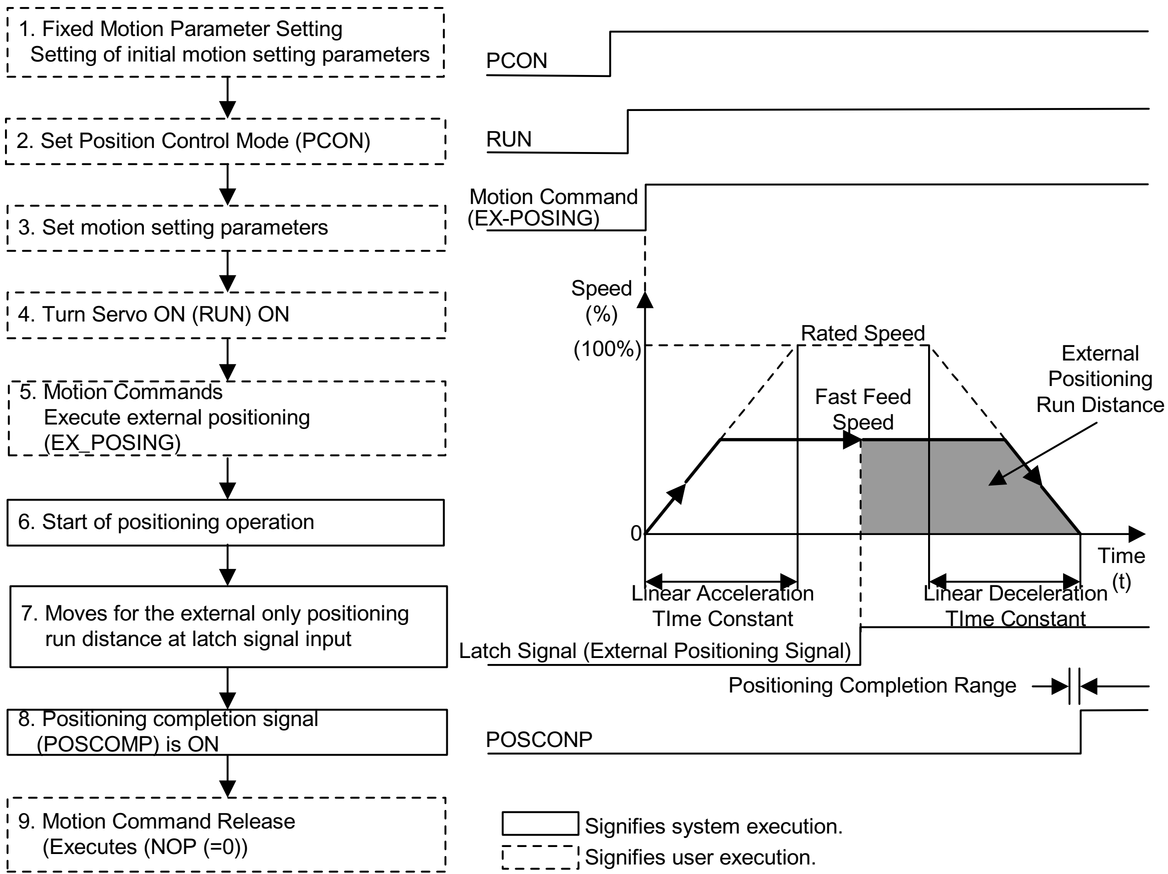
Positioning (POSING)

The MP940 positions to a designated location at a designated accel/decel speed and designated fast feed speed. The fast feed speed and position reference can even be changed during operation.

If the modified position reference has insufficient deceleration distance, or reverses, the axis decelerates to a stop at one end, then executes positioning anew to the position reference.

Detailed Description

The order of operations in the positioning is shown below.

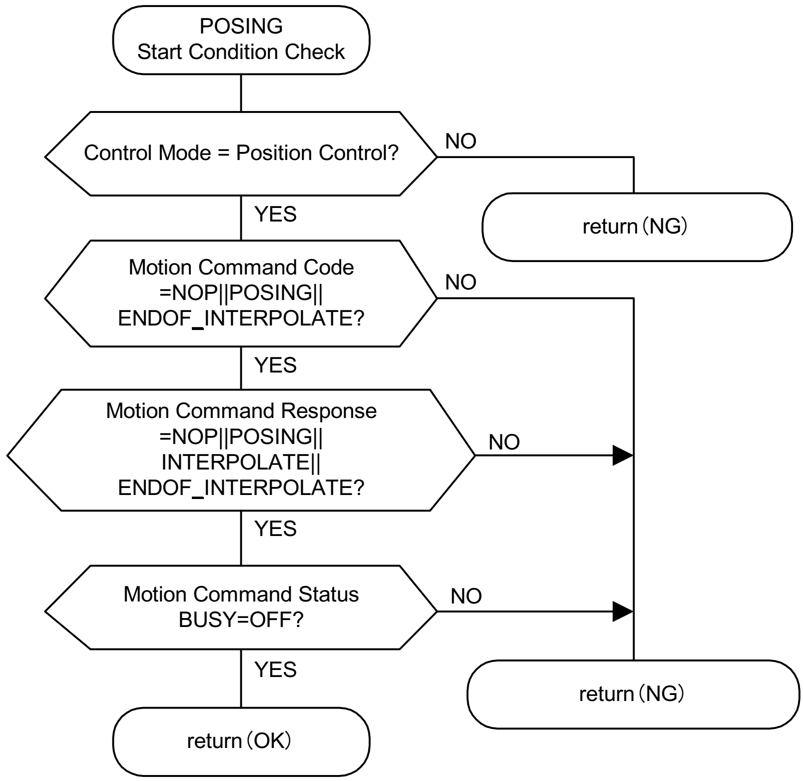


1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.

   Be sure to set the following parameters when executing position control with motion commands.

   - Set bit 7 “Motion Command Use Selection” of fixed motion parameter 14 “Additional Function Selections” to “Use” (= 1).
   - Set bit 8 “Motion Command Code Selection” of fixed motion parameter 14 “Additional Function Selections” to “Enabled” (= 1).

2. Select the position control mode (PCON) (Bit 2 of OWC000).
3. Set the motion setting parameters used in positioning (POSING).
4. Turn the RUN command (Bit 0 of OWC001) ON.
5. Set positioning (POSING = 1) in the motion commands (OWC020).



6. Positioning Command Run Start

The axis executes the positioning operation by a designated motion parameter. The settings of any motion parameter can be changed even during the positioning operation.

The operation of the positioning command is as follows:

a. Run Start

   RUN (bit 0 of OWC001)

   Set positioning (POSING = 1) in the motion commands (OWC020).

b. Command Hold

   Turns the HOLD command (bit 0 of OWC021) ON.

   HOLDL (bit 1 of IWC015) is ON at command hold completion.

c. Program Hold Release

   Turns the HOLD command (bit 0 of OWC021) OFF. The positioning operation restarts.

d. Command Abort

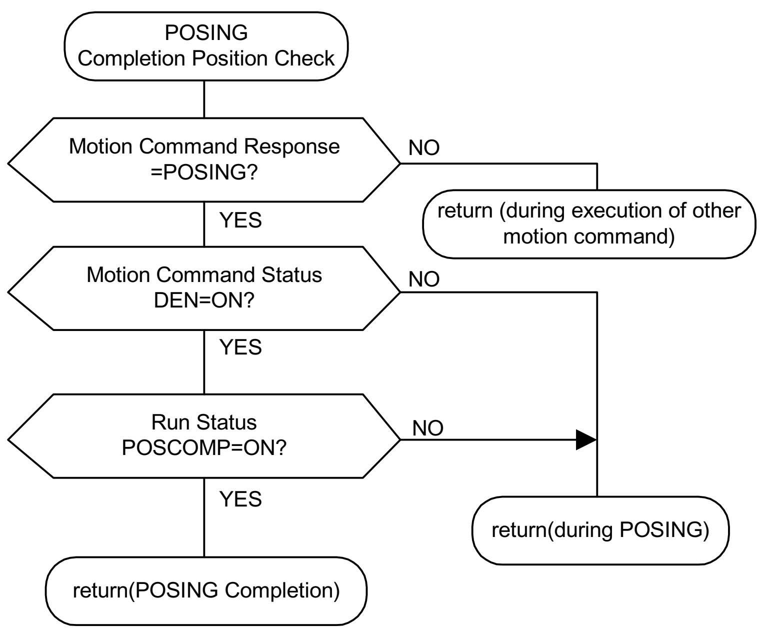
Turns the ABORT command (bit 1 of OWC021) ON or sets NOP (= 0) into the motion commands.

BUSY (bit 0 of IWC0150) will go ON during abort processing, and OFF at abort completion.

Note: The following results upon release of ABORT (ABORT OFF) at abort completion.

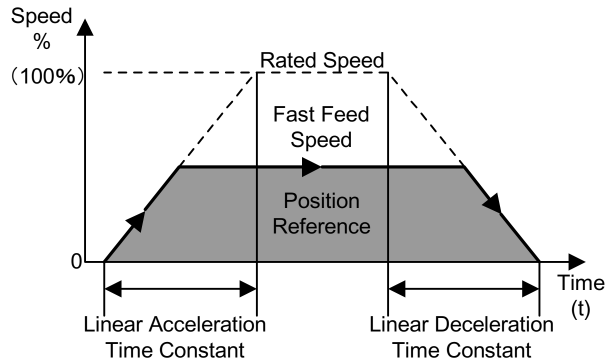
- Positioning will restart in the direction of the position reference (OLC012) when the position reference type (bit 14 of OWC001) is “absolute position type (= 0)”.
- The axis will remain stopped until a new position reference (OLC012) is set when the position reference type (bit 14 of OWC001) is “incremental addition type (= 1)”.

7. The positioning completion signal POSCOMP (bit D of IWC000) is ON upon entering the positioning completion range (OWC00E) following feed completion (bit 2 of IWC015 is ON).

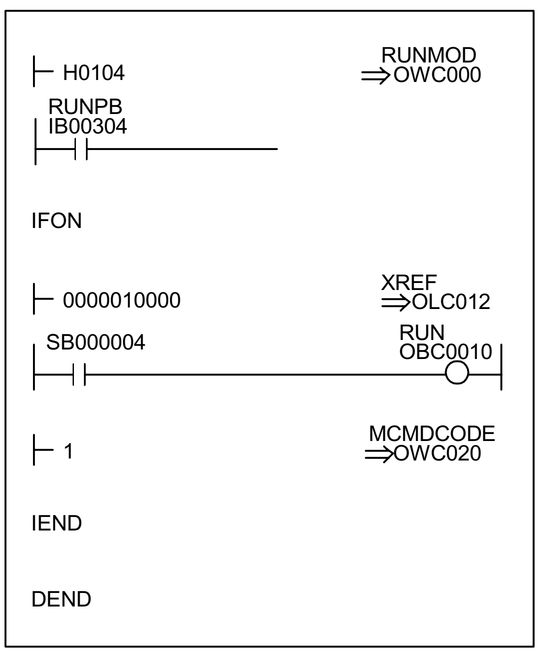


User Program Example (positioning)

Example of Running Desired Operation (Positioning Pattern)



Ladder Program Example (Positioning Program Example Dwg H03)



Position control mode ON

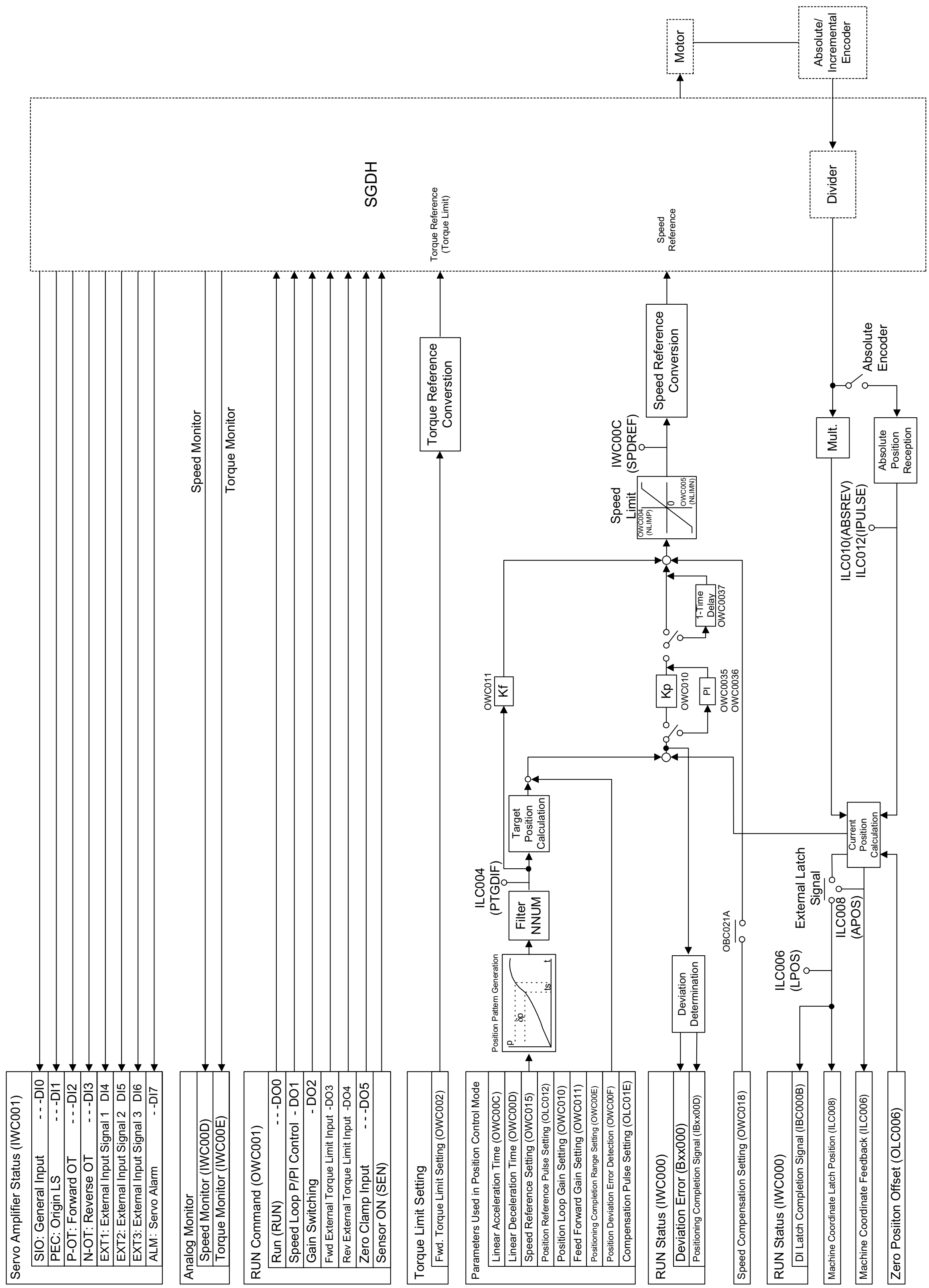
Position Control Pulse (XREF)
(Absolute Position: 10000)

Executing Positioning (POSING) as a Motion Command

Position control begins when IB00304 turns ON. The axis then moves to the absolute position 10000.
The absolute positioning completion signal IBC000D goes ON upon reaching absolute position 10000.

Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

The block diagram of the MP940 SVA position control mode appears on the following page.


SGDH
Motor
Absolute/
Incremental
Encoder
Divider
Torque Reference
(Torque Limit)
Speed
Reference
Torque Reference
Converstion
Speed Reference
Conversion
Absolute
Encoder
Mult.
Absolute
Position
Reception
ILC010(ABSREV)
ILC012(IPULSE)
Speed
Limit
IWC00C
(SPDREF)
OWC004
(NLIMP)
OWC005
(NLIMN)
1-Time
Delay
OWC0037
Kp
OWC010
PI
OWC0035
OWC0036
Kf
OWC011
Target
Position
Calculation
ILC004
(PTGDIF)
Filter
NNUM
Position Pattern Generation
Deviation
Determination
OBC021A
External Latch
Signal
ILC008
(APOS)
ILC006
(LPOS)
Current
Position
Calculation
Speed Monitor
Torque Monitor
Servo Amplifier Status (IWC001)
SIO: General Input - - -DI0
PEC: Origin LS - - -DI1
P-OT: Forward OT - - -DI2
N-OT: Reverse OT - - -DI3
EXT1: External Input Signal 1 DI4
EXT2: External Input Signal 2 DI5
EXT3: External Input Signal 3 DI6
ALM: Servo Alarm - - -DI7
Analog Monitor
Speed Monitor (IWC00D)
Torque Monitor (IWC00E)
RUN Command (OWC001)
Run (RUN) - - -DO0
Speed Loop P/PI Control - DO1
Gain Switching - DO2
Fwd External Torque Limit Input -DO3
Rev External Torque Limit Input -DO4
Zero Clamp Input - - -DO5
Sensor ON (SEN)
Torque Limit Setting
Fwd. Torque Limit Setting (OWC002)
Parameters Used in Position Control Mode
Linear Acceleration Time (OWC00C)
Linear Deceleration Time (OWC00D)
Speed Reference Setting (OWC015)
Position Reference Pulse Setting (OLC012)
Position Loop Gain Setting (OWC010)
Feed Forward Gain Setting (OWC011)
Positioning Completion Range Setting (OWC00E)
Position Deviation Error Detection (OWC00F)
Compensation Pulse Setting (OLC01E)
RUN Status (IWC000)
Deviation Error (Bxx000)
Positioning Completion Signal (IBxx00D)
Speed Compensation Setting (OWC018)
RUN Status (IWC000)
DI Latch Completion Signal (IBC000B)
Machine Coordinate Latch Position (ILC008)
Machine Coordinate Feedback (ILC006)
Zero Positon Offset (OLC006)

External Positioning (EX_POSING)

Just as in positioning (POSING), external positioning is executed to the position reference using the designated accel/decel time constant and designated fast feed speed.

When a latch signal (external positioning signal) is input during feed execution, latch is executed at the current position according to the latch signal, and positioning is done to a position advanced from that position by only the external positioning run distance set in the parameters. The fast feed speed and position reference can even be changed during operation.

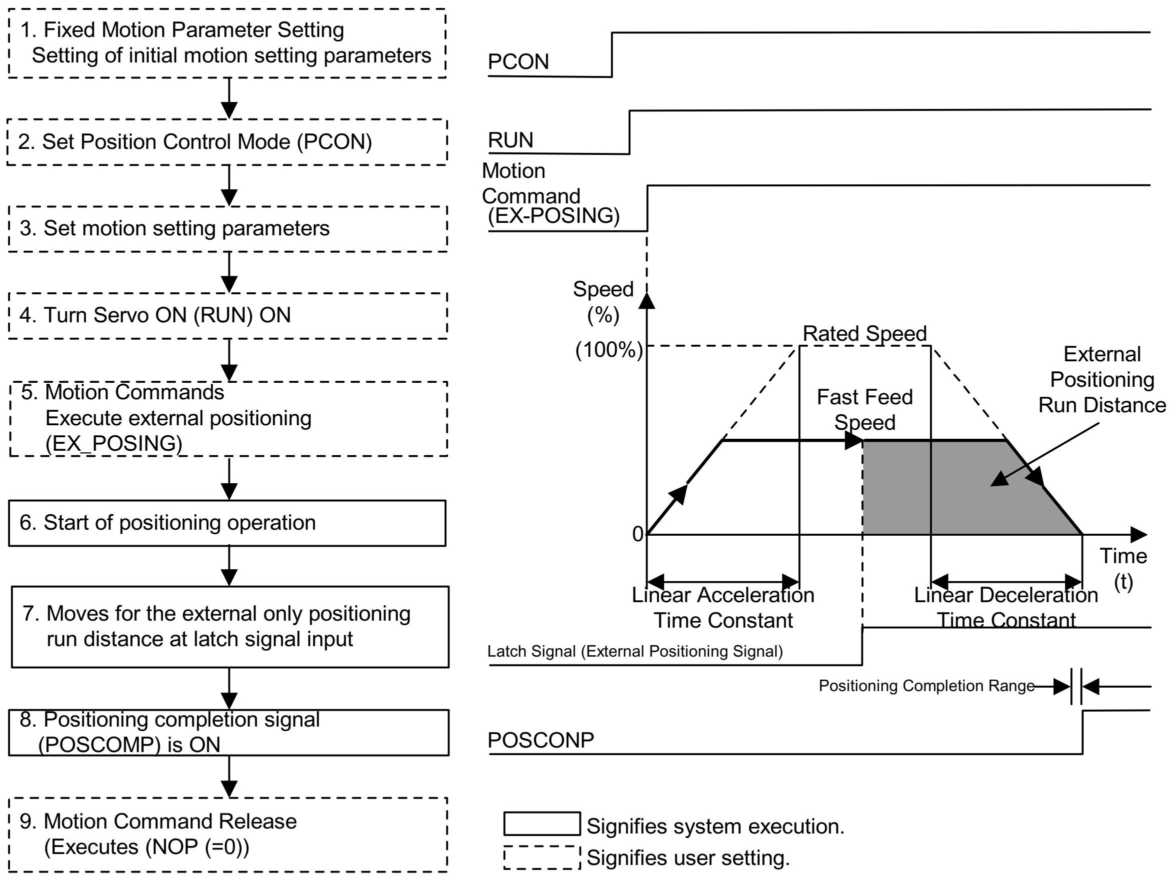
If there is insufficient deceleration distance in the external positioning run distance that was set, the axis will decelerate to stop at one end, then execute positioning anew to the position reference.

The external positioning run distance can be changed until the latch signal (external positioning signal) is input.

Use a dedicated discrete input (DI) as the latch signal (external positioning signal).

Detailed Description

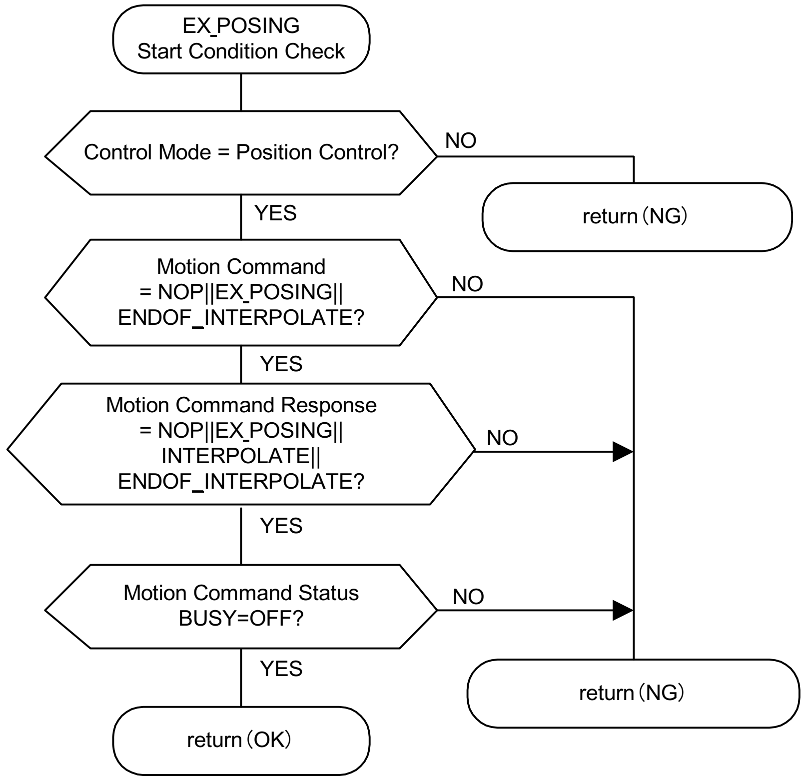
The order of operations in external positioning is shown below.



1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.
2. Select the position control mode (PCON) (Bit 2 of OWC000).
3. Set the motion setting parameters used in external positioning (EX_POSING).
4. Turn the RUN command (Bit 0 of OWC001) ON.

   Set external positioning (EX_POSING = 2) in the motion commands (OWC020).

   a. External Positioning Command Run Start



b. The axis executes the external positioning operation by a designated motion parameter. The settings of any motion parameter can be changed even during the external positioning operation.

   The operation of the external positioning command is as follows:

c. Run Start

   RUN (bit 0 of OWC001)

d. Set external positioning (EX_POSING = 2) in the motion commands (OWC020).

e. Command Hold

   Turns the HOLD command (bit 0 of OWC021) ON.

   HOLD (bit 1 of IWC015) is ON at command hold completion.

f. Program Hold Release

   Turns the HOLD command (bit 0 of OWC021) OFF. The positioning operation restarts.

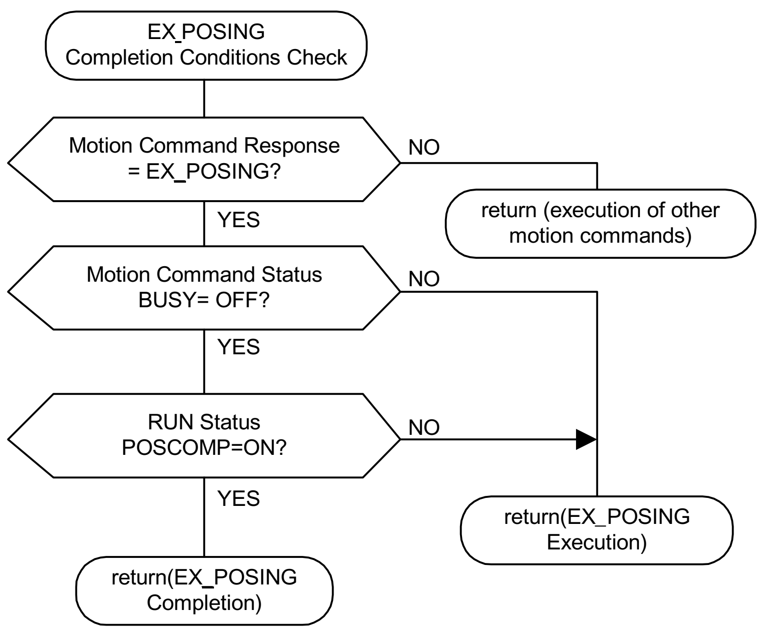
g. Command Abort

Turns the ABORT command (bit 1 of OWC021) ON or sets NOP (= 0) into the motion commands.

BUSY (bit 0 of IWC0150) will go ON during abort processing, and OFF at abort completion.

Upon input of the latch signal, the axis shifts by the external positioning run distance (OLC024). The axis remains stopped even if ABORT is released (ABORT OFF) at abort completion. The axis remains stopped whether the position reference type (bit 14 of OWC001) is set to “absolute position type (= 0)” or “incremental addition type (= 1)”.

The positioning completion signal POSCOMP (bit D of IWC000) is ON upon entering the positioning completion range (OWC00E) following feed completion (bit 2 of IWC015 is ON).

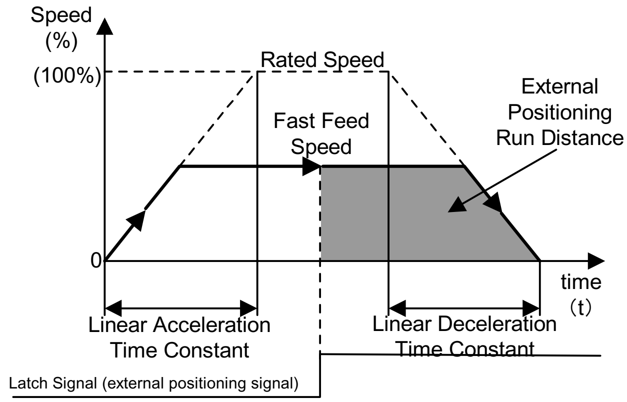


Release external positioning in the motion commands when positioning is complete.

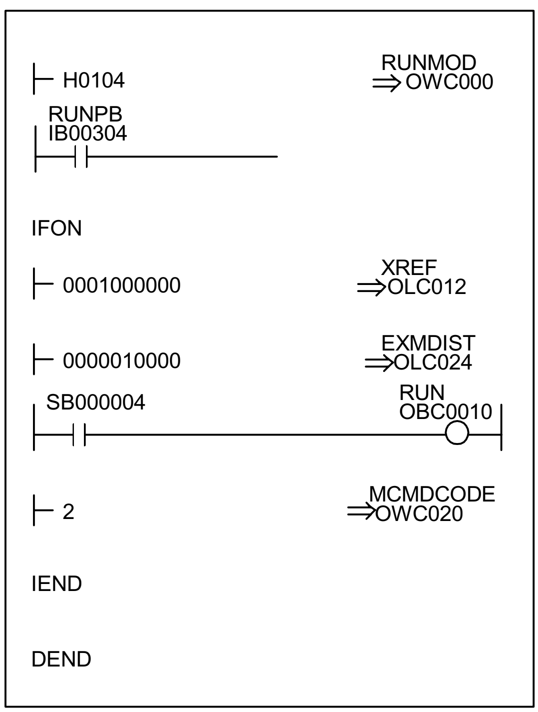
External positioning detects the boot-up. Therefore, the motion commands must be set to NOP for at least one scan, and to reset external positioning into the motion commands once external positioning has been executed.

User Program Example (external positioning)

Example of Running Desired Operation (External Positioning Pattern Example)



Ladder Program Example (External Positioning Program Example - Dwg H03)



Position control mode ON

Position Control pulse (XREF)
(Absolute Position: 1000000)

External Positioning Run Distance
(EXMDIST)

RUN Command to driver (RUN)

Execute external positioning
(EX_POSING) as a motion command

Starts position control and moves to the absolute position1000000 when IB00304 is ON.
the axis will move by only the external positioning run distance (10000 pulses) at latch signal input (external positioning signal) during feed motion execution. The positioning completion signal IBC000D goes ON at the completion of motion. If the latch signal is not input, then the posiitioning completion signal IBC000D goes ON when absolute position 10000 is reached.

Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

Zero-point Return (ZRET)

The zero-point return operation returns the axis to the machine coordinate zero-point. The machine coordinate zero-point position data is deleted upon power OFF. Therefore, the machine coordinate zero point must be determined anew at power ON. Generally the zero-point is determined by using an encoder with a zero pulse (C-phase pulse) and a limit switch showing the zero-point range. There are two methods of zero-point return operation: using the zero-return mode and using the motion commands. Keep in mind that these zero-point return operations differ.

Zero-Point Return Format

Zero-point return (ZRET) consists of the following formats using motion commands.

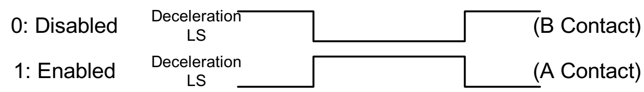
Zero-Point Return Format	Setting of Fixed Parameter 31
DEC1+C-phase Pulse	0
DEC2+C-phase Pulse	6
DEC1+LMT+C-phase Pulse	7
C-phase Pulse	3
DEC1+ZERO Signal	2
DEC2+ZERO Signal	4
DEC1+LMT+ZEROSignal	5
ZERO Signal	1

Note: The limit switch (deceleration LS) and zero-point return limit signal require the creation of a user program which connects external DI signals such as LIO-01 to the following motion setting parameters.

Limit Switch Signals	:OBC001F
Zero-point Return Reverse Limit Signal	:OBC021C
Zero-point Return Forward Limit Signal	:OBC021D

Note: DI5 (DI signal) may be used in the SVA-01 (4 axis) module. Set in bit 2 of fixed motion parameter 14 “Additional Function Selections” whether the DI signal or OBC001F will be used as the limit switch signal.

The polarity of the limit switch signal can be reversed by bit 10 “Deceleration Limit Switch Inversion Selection” of fixed motion parameter 17 “Motion Controller Function Selection Flags”.



See the section on “Zero-Point Return Mode” for details.

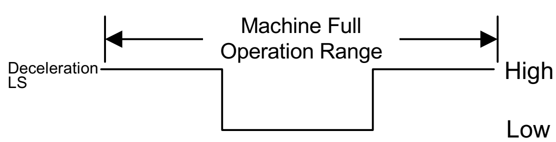
- Set the zero-point return format by numbers 0 ~ 7 in fixed motion parameter 31 “Zero-Point Return Method”.

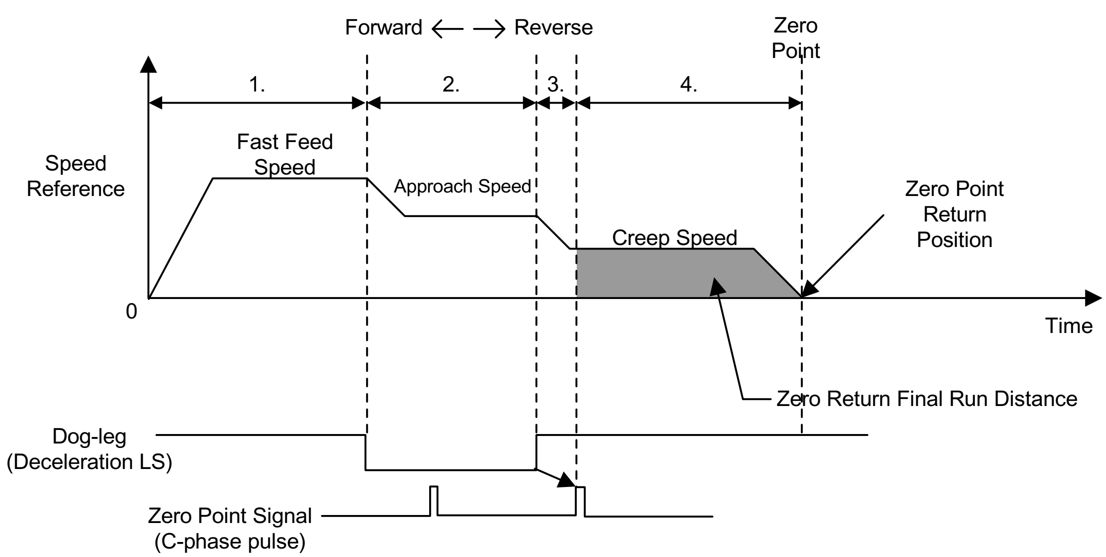
The details of each method are shown below.

DEC1+C-phase Pulse Format

Executes zero-point return using a limit switch (deceleration LS) and a zero-point signal (c-phase pulse) after fast feed by linear accel/decel (with a transition band).

Limit switches are used with the following machine configurations.





1. Moves at fast feed speed in the direction designated in the motion setting parameter (OBC009).
2. Decelerates to approach speed at the downward transfer of the transition (deceleration LS) signal.
3. Decelerates to creep speed at the upward transfer of the transition (deceleration LS) signal.
4. The axis will move from the initial zero-point signal (C-phase pulse) by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stop, then assume that position as the machine coordinate zero point.

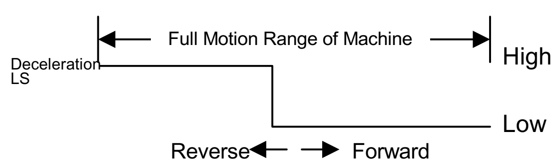
Automatic return is not executed in this zero-point return method. Return the axis manually if it does not return to the zero-point position.

DEC2+C-phase Pulse Format

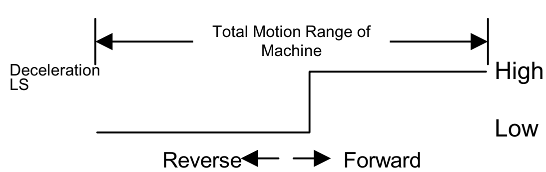
Executes zero-point return using a limit switch (deceleration LS) and a zero-point signal (c-phase pulse) after fast feed by linear accel/decel (no transition band).

Limit switches are used with the following machine configurations:

Pattern (A)



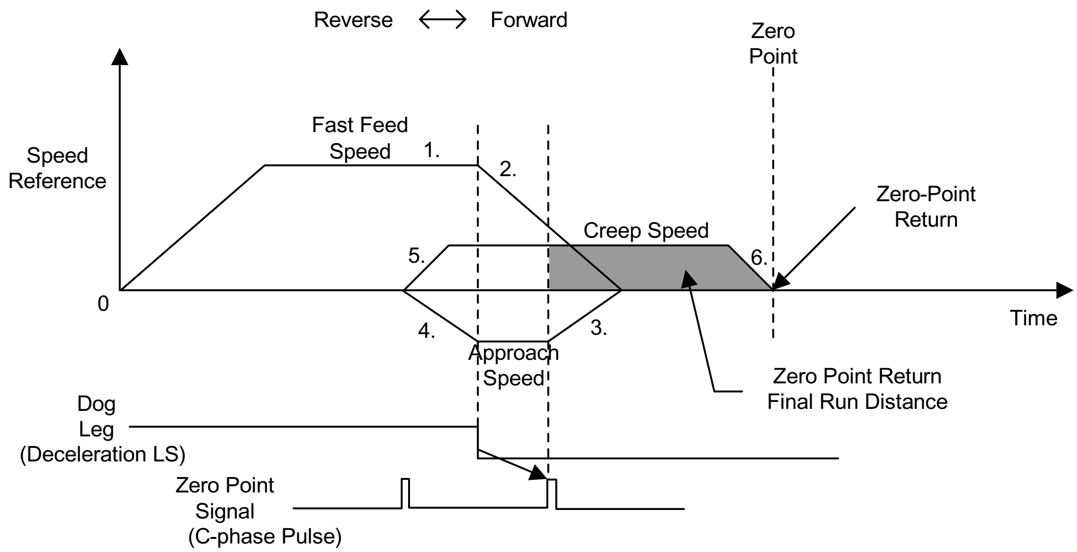
Pattern (B)



In pattern A, the machine position is recognized by the deceleration LS ON/OFF state, an automatic return operation is executed, and zero-point return is always executed under the same conditions.

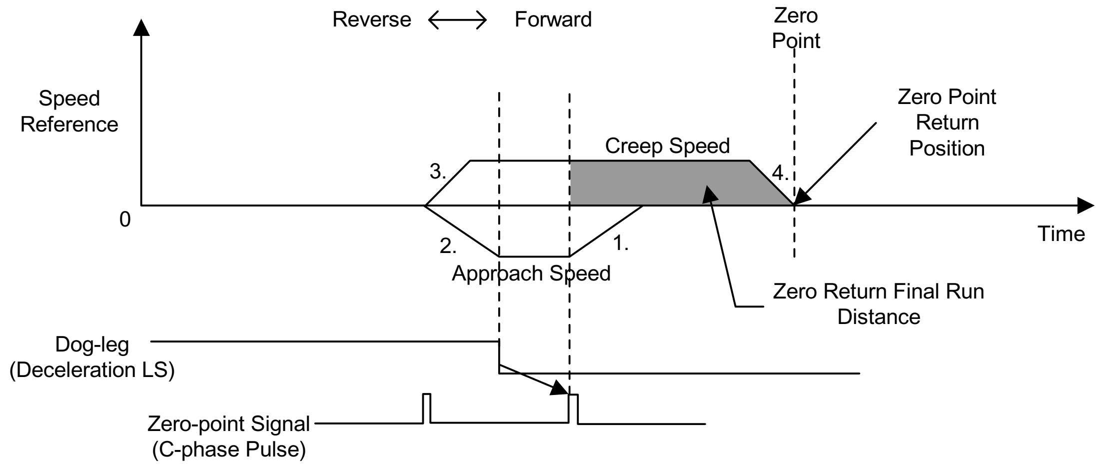
In Pattern (B), set bit 10 "Deceleration LS Inversion Selection" of fixed motion parameter 17 to "ON".

Operation when the transition signal (deceleration LS) is in the *high* range at zero-point return operation start



1. Moves in a positive direction at fast feed speed.
2. Decelerates at the downward transfer of the transition (deceleration LS) signal.
3. Moves in a reverse direction at approach speed.
4. Decelerates at the upward transfer of the transition (deceleration LS) signal.
5. Moves in a forward direction at approach speed.
6. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero point.

Operation when the transition signal (deceleration LS) is in the *low* range at zero-point return operation start

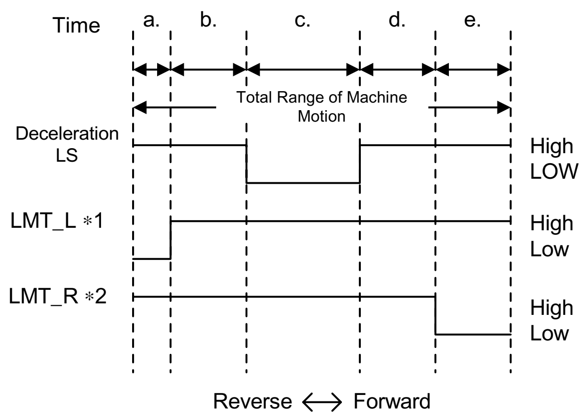


1. Moves in a reverse direction at approach speed.
2. Decelerates at the upward transfer of the transition (deceleration LS) signal.
3. Moves in a forward direction at approach speed.
4. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero-point.

DEC1+LMT+C-phase Pulse Format

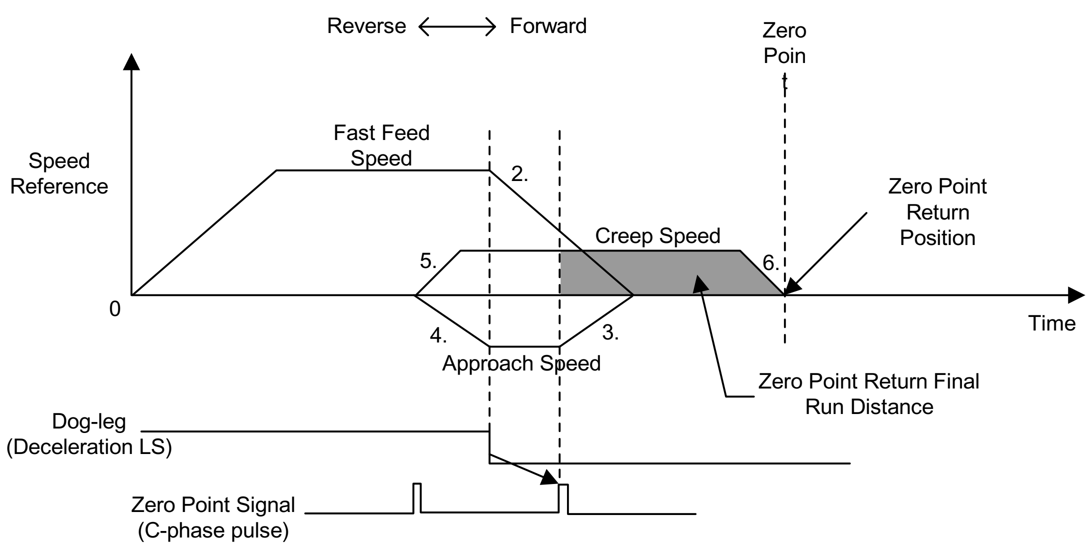
Executes zero-point return using a limit switch (deceleration LS), a zero-point return limit signal, and a zero-point signal (c-phase pulse) after fast feed by linear accel/decel.(with a transition band)

Limit switches (deceleration LS) and zero-point return limit signals are used in the following machine configurations.



- Zero-point Return Reverse Limit Signal (OBC021C)
- Zero-point Return Forward Limit Signal (OBC021D)

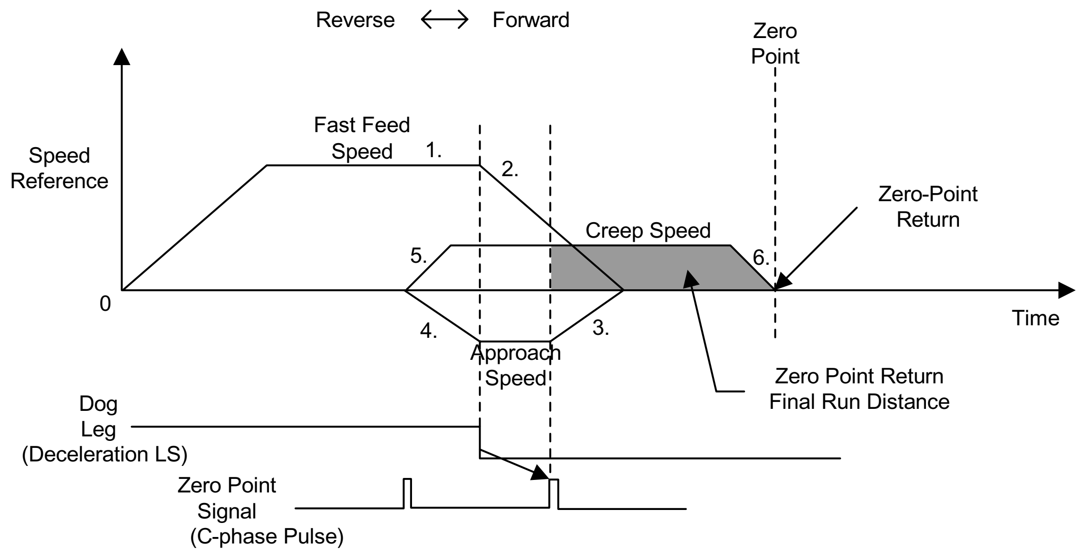
Operation in Area (a) at Zero-point Return Operation Start



1. Moves in a positive direction at fast feed speed.
2. Decelerates at the downward transfer of the transition (deceleration LS) signal.
3. Moves in a reverse direction at approach speed.
4. Decelerates at the upward transfer of the transition (deceleration LS) signal.

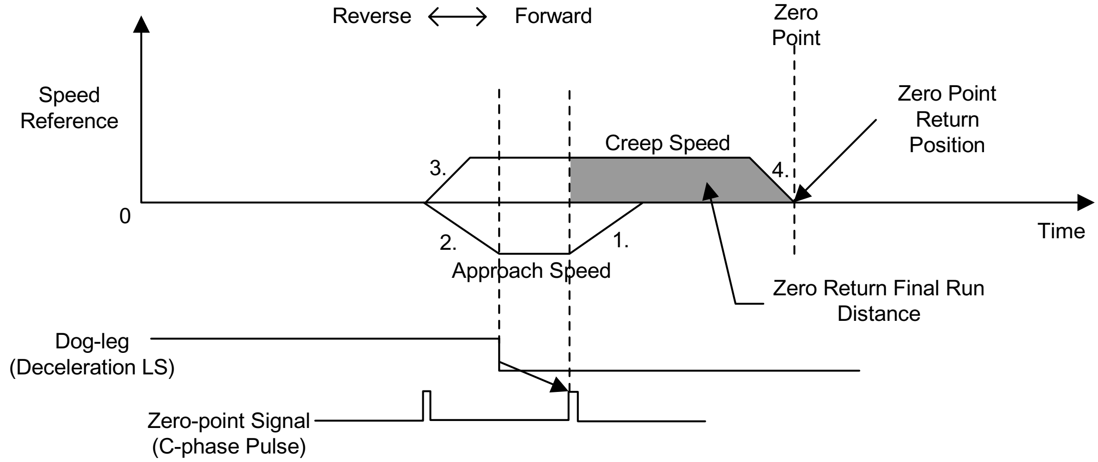
5. Moves in a forward direction at approach speed.
6. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero point.

Operation in Area (b) at Zero-point Return Operation Start



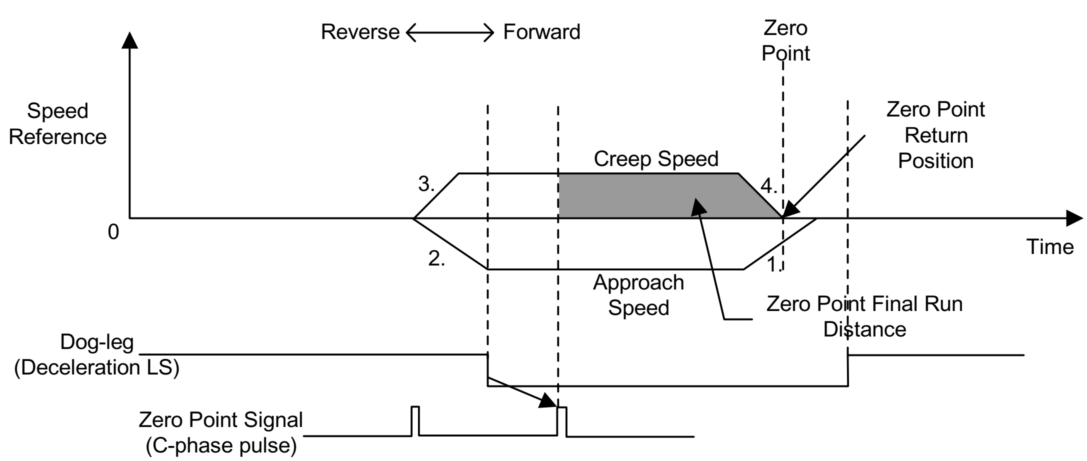
1. Moves in a reverse direction at approach speed.
2. Decelerates at the downward transfer of the zero-point return reverse limit signal (LMT_L).
3. Moves in a positive direction at fast feed speed.
4. Decelerates at the downward transfer of the transition (deceleration LS) signal.
5. Moves in a reverse direction at approach speed.
6. Decelerates at the upward transfer of the transition (deceleration LS) signal.
7. Moves in a forward direction at approach speed.
8. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero-point.

Operation in Area (c) at Zero-point Return Operation Start



1. Moves in a reverse direction at creep speed.
2. Decelerates at the upward transfer of the transition (deceleration LS) signal.
3. Moves in a forward direction at approach speed.
4. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero-point.

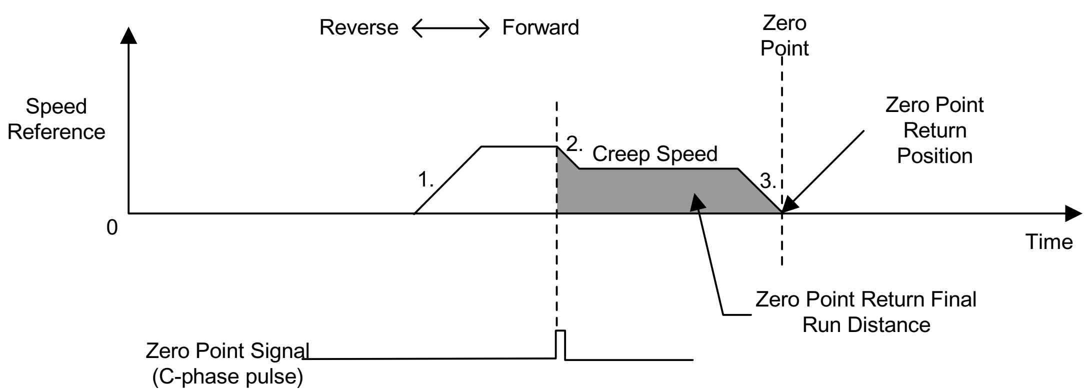
Operation in Areas (d) and (e) at Zero-Point Return Operation Start



1. Moves in a reverse direction at approach speed.
2. Decelerates at the upward transfer of the transition (deceleration LS) signal.
3. Moves in a forward direction at approach speed.
4. After detecting the downward transfer of the transition pulse (deceleration LS), the axis moves from the initial zero-point signal by the zero-point return run distance at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero-point.

C-phase Pulse Format

Execute zero-point return in which only the zero-point signal (C-phase pulse) following feed by linear accel/decel is used.



1. Moves at approach speed in the direction designated in the motion setting servo parameter (OBC009).
2. Decelerates to creep speed after detection of the initial zero-point signal.
3. The axis will move from the initial zero-point signal by the zero-point return run distance, stop, then assume that position as the machine coordinate zero point.

DEC1+ZEROSignal Format

Executes zero-point return using the ZERO signal (DI signal) instead of the C-phase pulse in the aforementioned “DEC1+C-phase Pulse Format”.

For details, see the aforementioned “DEC1+C-phase Pulse Format”.

DEC2+ZEROSignal Format

Executes zero-point return using the ZERO signal (DI signal) instead of the C-phase pulse in the aforementioned “DEC2+C-phase Pulse Format”.

For details, see the aforementioned “DEC2+C-phase Pulse Format”.

DEC1+CMT+ZEROSignal Format

Executes zero-point return using the ZERO signal (DI signal) instead of the C-phase pulse in the aforementioned “DEC1+CMT+C-phase Pulse Format”.

For details, see the aforementioned “DEC1+CMT+C-phase Pulse Format”.

ZERO Signal Format

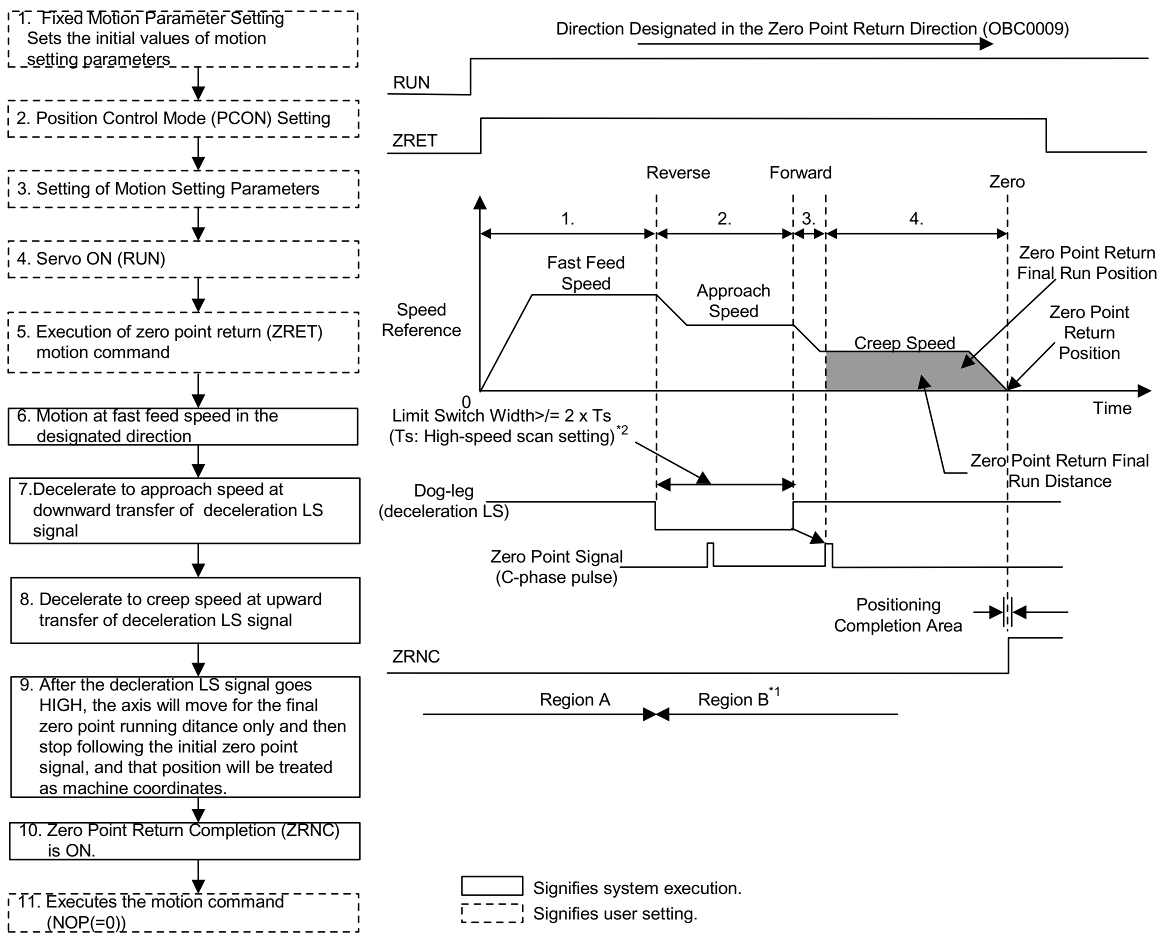
Executes zero-point return using the ZERO signal (DI signal) instead of the C-phase pulse in the aforementioned “C-phase Pulse Format”.

For details, see the aforementioned “C-phase Pulse Format”.

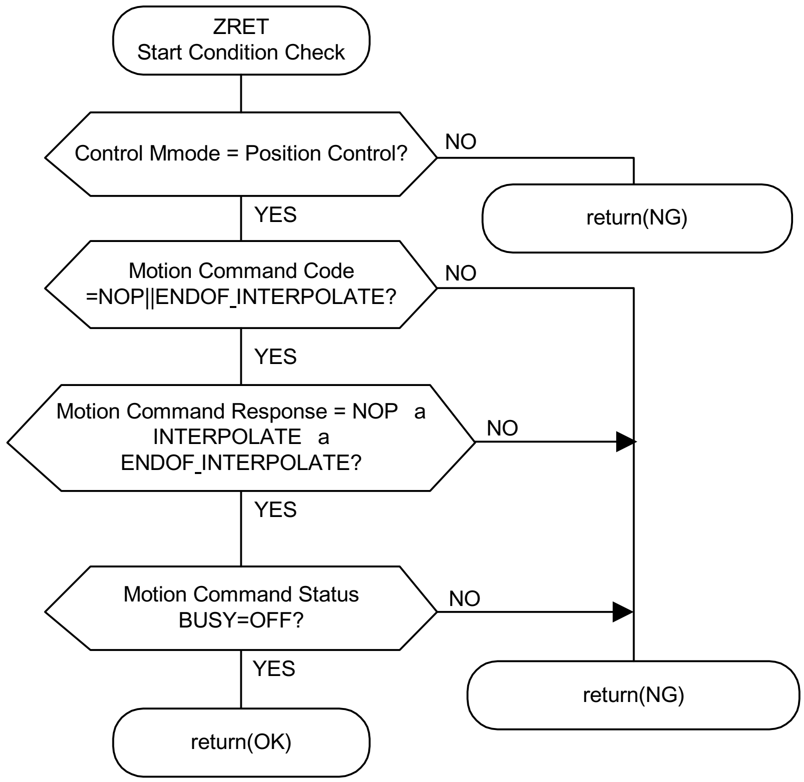
Example of Zero-Point Return Operation Method

The order of operations for zero-point return is shown below.

Next, let us give an example of the DEC1+C-phase pulse format.



1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.
2. Select the position control mode (PCON) (bit 2 of OWC000).
3. Set the motion setting parameters used in zero-point return (ZRET).
4. Turn the RUN command (Bit 0 of OWC001) ON.
5. Set zero-point return (ZRET = 3) in the motion commands (OWC020).
6. Zero-point Return (ZRET) Operation Start



The axis moves at fast feed speed in the direction specified in “Zero-point Return Direction Selection” (OWC0009).

The motion parameter settings cannot be modified during zero-point return execution.

The operation of the zero-point return command is as follows:

a. Run Start

   RUN (bit 0 of OWC001)

b. Set zero-point return (ZRET = 3) in the motion commands (OWC020).

c. Command Hold

   Not possible

d. Command Abort

   Turns the ABORT command (bit 1 of OWC021) ON or sets NOP (=0) into the motion commands. BUSY (bit 0 of IWC0150) goes ON during abort processing, and goes OFF at abort completion.

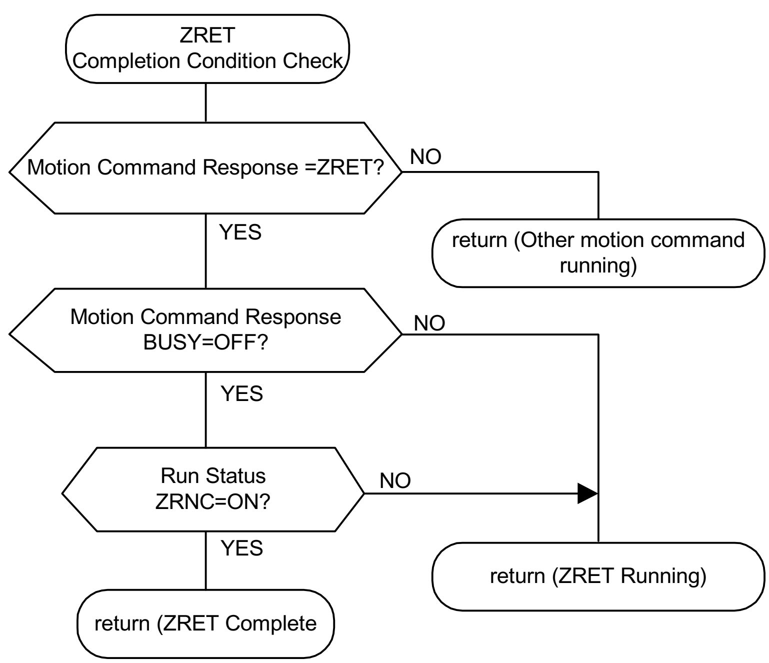
The axis remains stopped even if ABORT is released (ABORT OFF) at abort completion.

e. Decelerates to approach speed at the downward transfer of the transition (deceleration LS) signal.

f. Decelerates to creep speed at the upward transfer of the transition (deceleration LS) signal.

g. The axis moves from the initial zero-point signal (C-phase pulse) by the final zero-point return run distance (OLC02A) at the upward transfer of the pulse transition, stops, then assumes that position as the machine coordinate zero-point.
A zero-point offset can also be set (the position data will be 100 when the zero-point position offset OLC006 is set to 100).

After feed completion (bit 2 of IWC015 is ON), the zero-point return operation will be assumed to be finished when the axis enters the positioning completion range (OWC00E). The zero-point return completion statel ZRNC (Bit 6 of IWC015) goes ON upon completion of the zero-point return operation.



The motion commands (OWC020) go to NOP (= 0) after it is recognized that the zero-point return completion state ZRNC (bit 6 of IWC015) is ON.

- After power ON, the machine cannot return correctly if it is in range B. Perform zero-point return after returning the machine to range A.
- The deceleration LS band needs to be at least 2× the high-speed scan setting.Calculate the scale of the deceleration LS band (L) by the following formula.

Ts(s)= High-speed Scan Setting (ms)/1000

F(m/s)= k×{NR×n×FBppr}/60

F	:	100% Speed (m/s)
K	:	Weight of 1 Pulse1 (m/pulse)
NR	:	Rated Speed (rpm)
FBppr	:	Feedback Pulse Resolution (ppr)
N	:	Pulse Multiple (1, 2, 4)

t(s)= Linear Accel/Decel Time (s)

#alpha#(m/s^2)= f/t

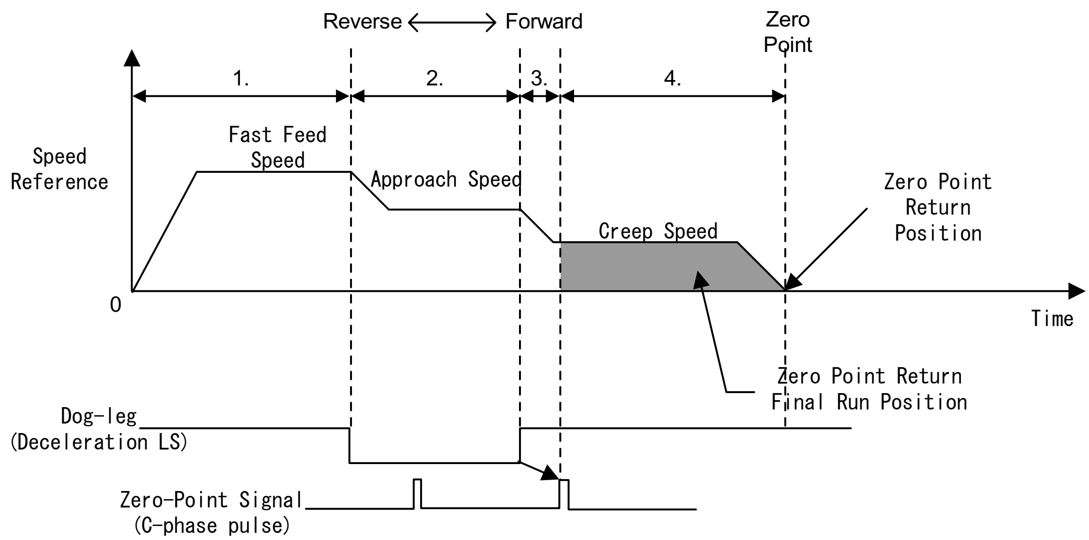
#alpha# : when an accel/decel time constant of (m/s 2) is assumed,

is obtained by L = 1/2·#alpha#(2×Ts$)^2$ = 2#alpha#Ts^2.

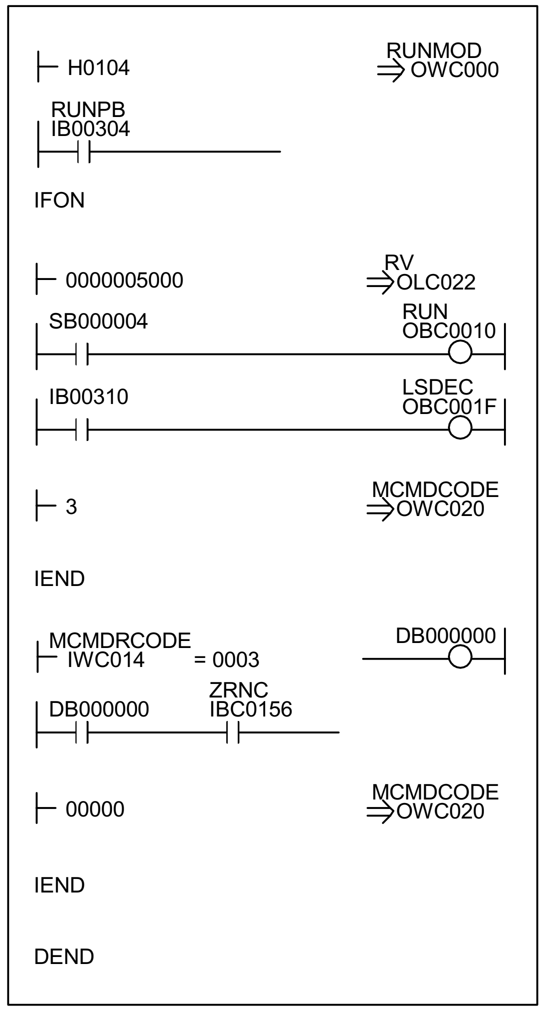
When the range set in “zero-point return final run distance” is too short, overrun occurs at one end, and an operation takes place to return to the zero-point.

User Program Example (zero-point return DEC1+C-phase pulse signal format)

Example of Running Desired Operation



Ladder Program Example (zero-point return program example dwg H03)



Position control mode ON

Fast feed speed (RV)
(5000000 pulses/min)

Run commad (RUN) to drive

IB00310: Limit Switch Signal

Executes zero point return (ZRET) as a motion command

Zero point return starts when IB00304 is ON.

The zero point return completion state (IBC0156) goes ON at zero point return completion.

The motion command code becomes NOP(=0) after the the zero point return completion satatus (IBC0156) goes ON.

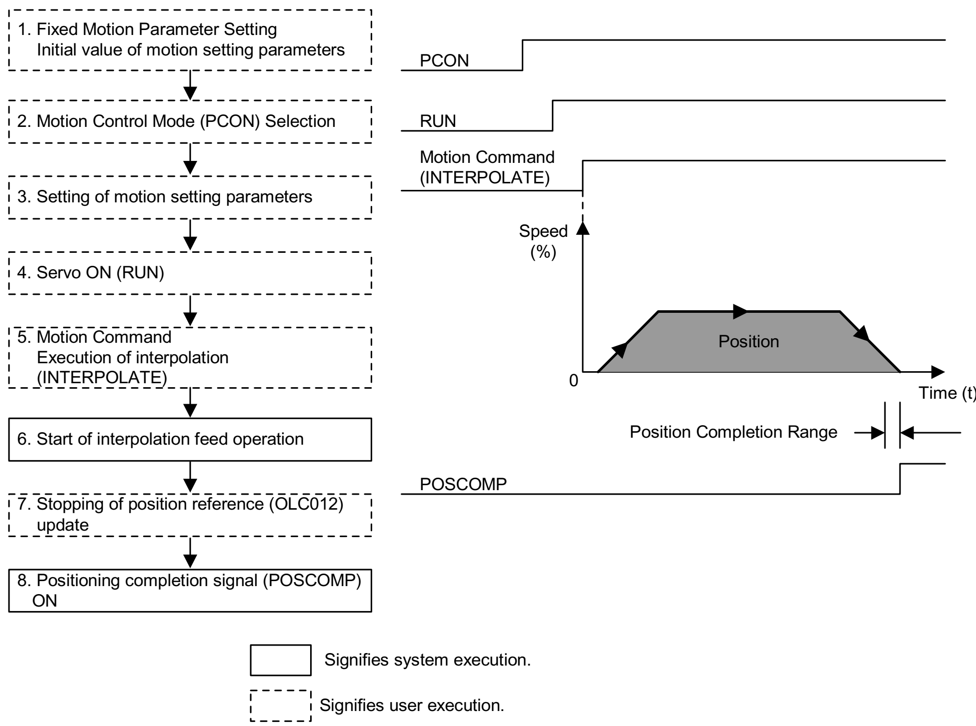
Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

Interpolation (INTERPOLATE)

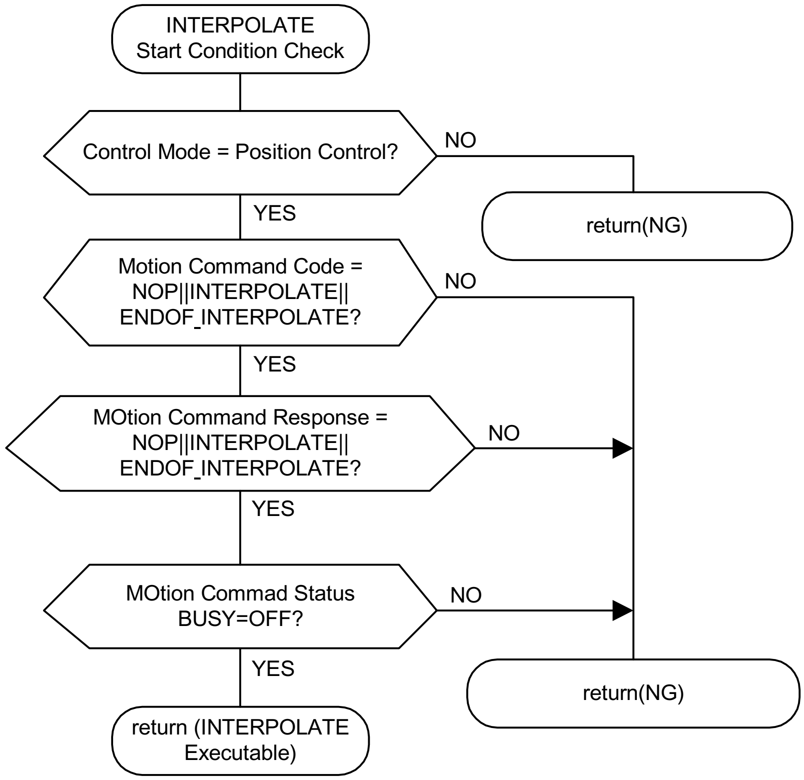
Executes interpolation feed according to position data continually fed from the CPU module.

Detailed Description

The order of operations in the interpolation feed is shown below.



1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.
2. Select the position control mode (PCON) (bit 2 of OWC000).
3. Set the position reference setting (OLC012). If necessary, set the motion setting parameters used during interpolation, such as the filter time constant (OWC014).
4. Turn the RUN command (Bit 0 of OWC001) ON.
5. Set interpolation (INTERPOLATE = 4) in the motion commands (OWC020).



6. The axis executes interpolation feed by the designated motion parameters when interpolate is set in the motion commands.
7. Updates the position reference (OLC012) and stops the axis.
8. The positioning completion signal POSCOMP (bit D of IWC000) is ON upon entering the positioning completion range (OWC00E) following feed completion (bit 2 of IWC015 is ON).

Interpolation with Position Detection (LATCH)

Executes interpolation feed in the same manner as Interpolation Feed, and at the same time executes current position latching according to the latch signal, and messages the latch position converted into command units. Use a dedicated discrete input (DI) as the latch signal.

Detailed Description

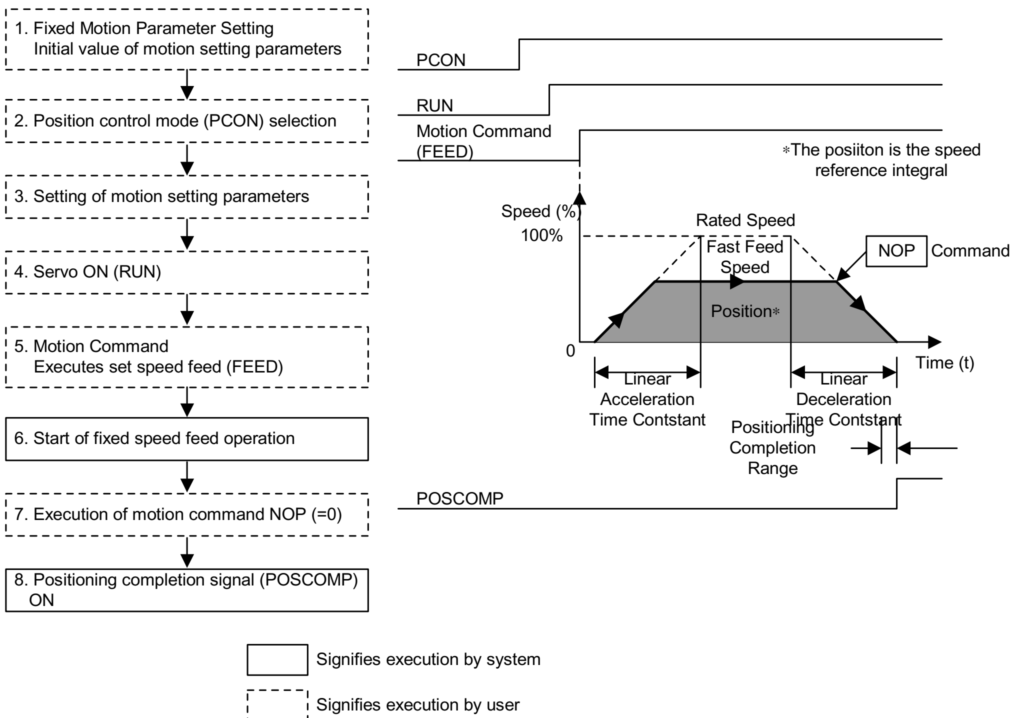
To execute current position counter latching by a single latch signal, and then execute latching again, issue the latch command setting the motion commands after the first scan to NOP (according to fixed parameter 13 "DI Latch Detection Function Selection" 0:EXT3_1:C-phase).

Set Speed Feed (FEED)

Executes fast feed in an unbounded direction at a designated accel/decel time constant and a designated fast feed speed. The fast feed speed can even be changed during operation. This function sets NOP (=0) into the motion commands (OWC020), and then decelerates to a stop.

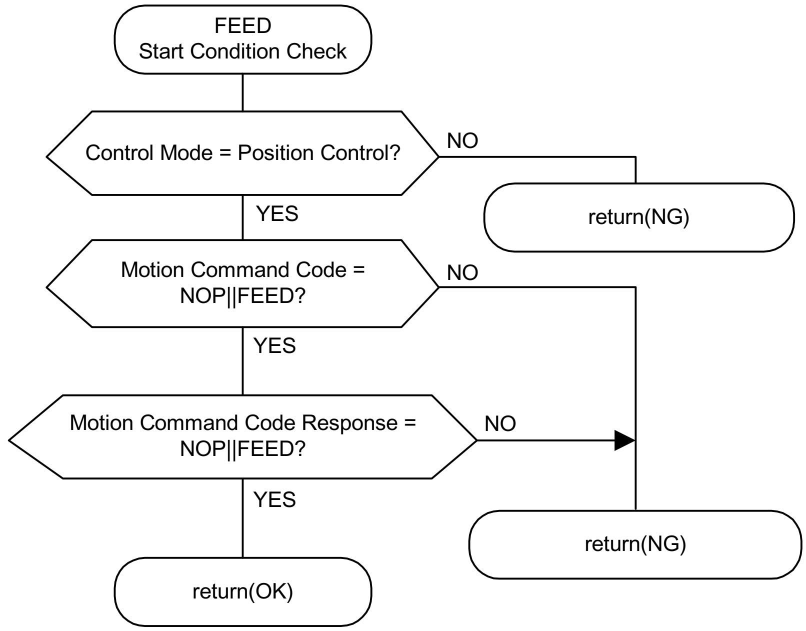
Detailed Description

The order of operations in the set speed feed is shown below.



1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.
2. Select the position control mode (PCON).(bit 2 of OWC000)

   Sets the fast feed speed (OLC022 or OWC015).
3. Set the motion setting parameters used in set speed feed (FEED).
4. Turn the RUN command (Bit 0 of OWC001) ON.
5. Set set speed feed (FEED =7) in the motion commands (OWC020).
6. Set Speed Feed (FEED) Operation Start

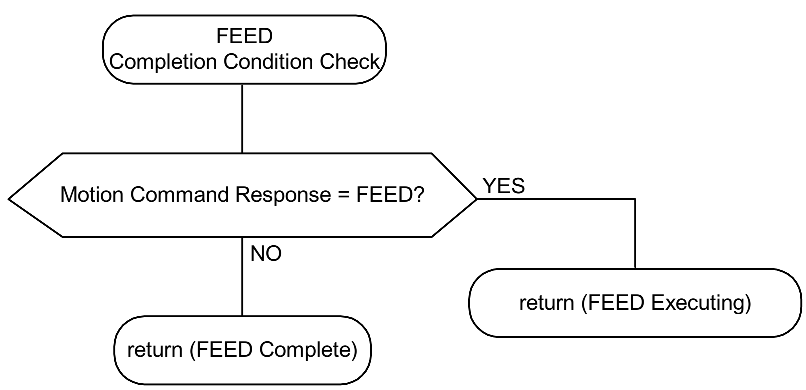


7. The axis executes the fast feed operation by a designated motion parameter.

   It is not possible to HOLD set speed feed.

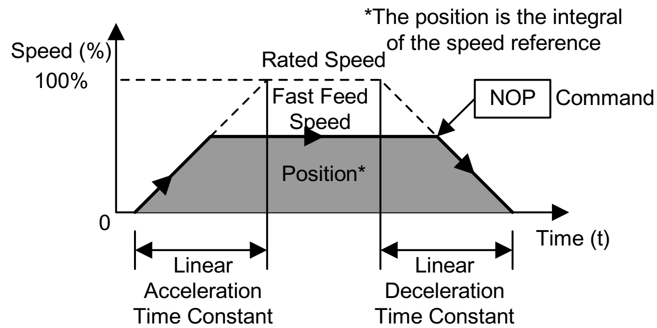
8. Set NOP (= 0) into the motion commands (OWC020) to stop (abort) set speed feed.

   The positioning completion signal POSCOMP (bit D of IWC000) will be ON upon entering the positioning completion range (OWC00E) following feed completion (bit 2 of IWC015 is ON).

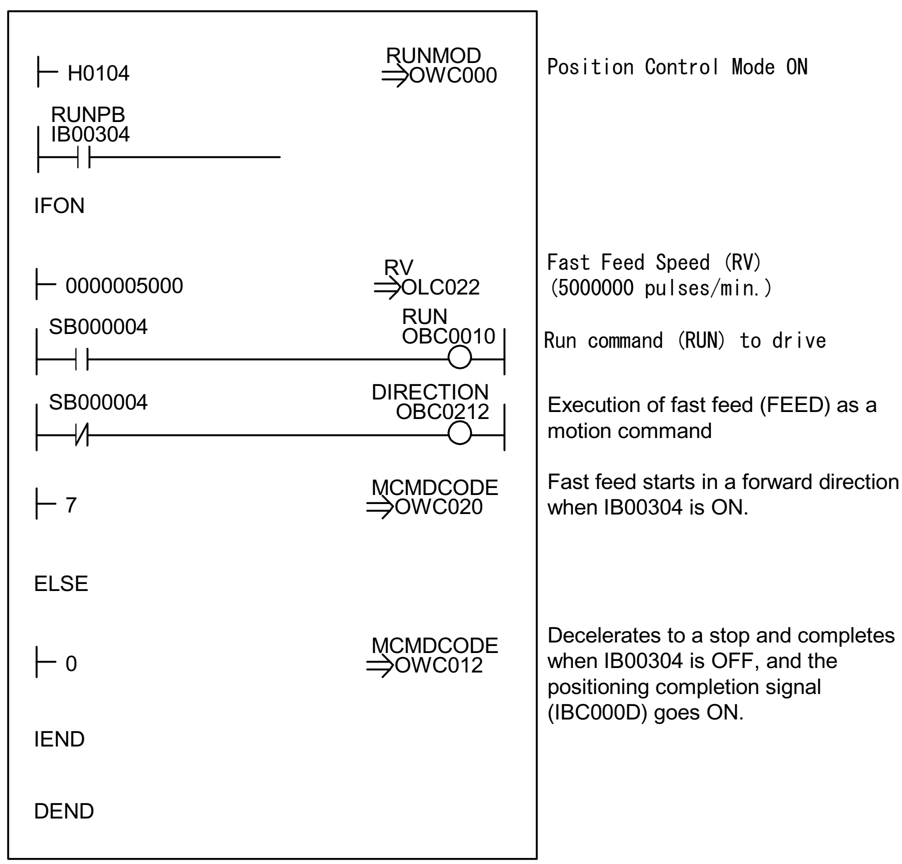


User Program Example (set speed feed)

Example of Running Desired Operation (Set Speed Feed Pattern)



Ladder Program Example (Speed Feed Program Example Dwg H03)



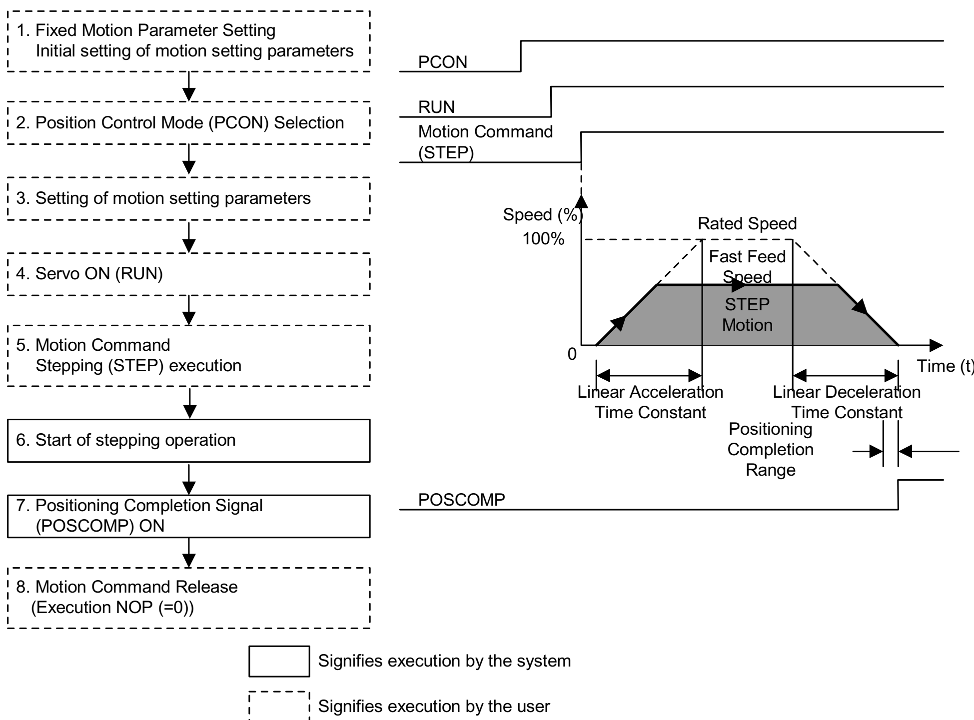
Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

Stepping (STEP)

Executes positioning at fast feed speed in a designated direction according to a designated accel/decel time constant for a designated motion range (STEP motion). The fast feed speed can even be changed during operation. When the travel distance is modified during operation, the value is reflected in the following step (STEP) execution.

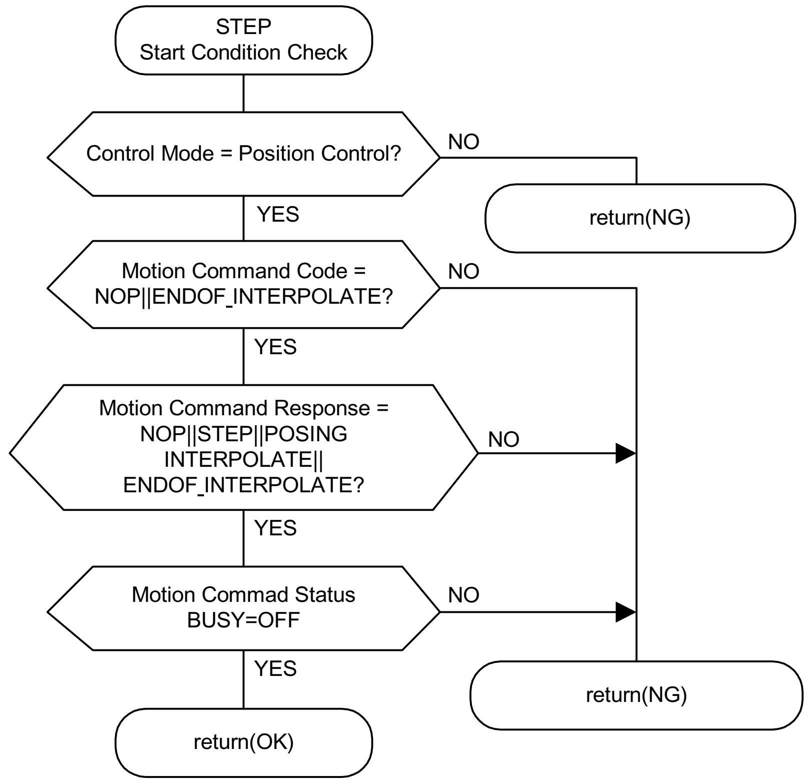
Detailed Description

The order of operations in step feed is shown below.



1. Set initial fixed motion parameter and motion setting parameter values to match the customer's machine.
2. Select the position control mode (PCON) (bit 2 of OWC000).
3. Sets the STEP travel distance (PLC028) and fast feed speed (OLC022 or OWC015).
4. Set the motion setting parameters used in step feed (STEP).
5. Turn the RUN command (Bit 0 of OWC001) ON.

6. Set stepping (STEP = 8) in the motion commands (OWC020). Step Feed (STEP) Operation starts.



The axis executes the external positioning operation by a designated motion parameter. The settings of any motion parameter can be changed even during the stepping operation. The operation of the stepping command is as follows:

1. Run Start

   Turn RUN (bit 0 of OWC001) ON

   Set stepping (STEP = 8) in the motion commands (OWC020).

2. Command Hold

   Turns the HOLD command (bit 0 of OWC021) ON.

   HOLDL (bit 1 of IWC015) is ON at command hold completion.

3. Program Hold Release

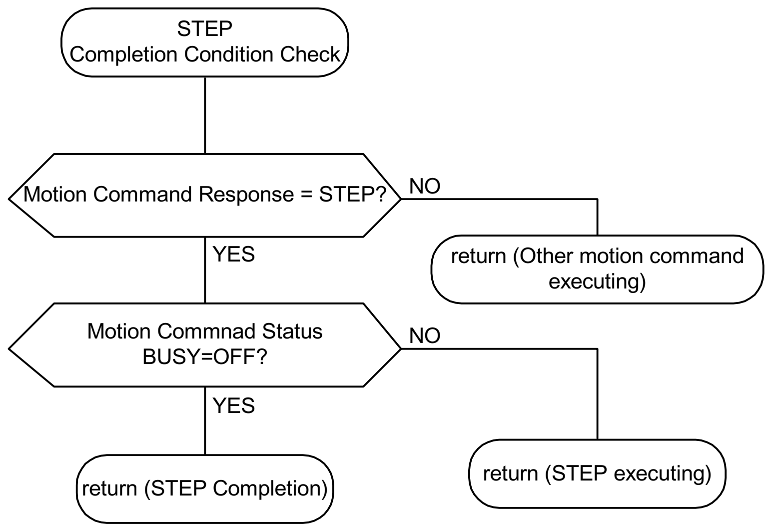
   Turns the HOLD command (bit 0 of OWC021) OFF.The positioning operation restarts.

4. Command Abort

Turns the ABORT command (bit 1 of OWC021) ON or sets NOP (= 0) into the motion commands.

Note: The axis remains stopped even if ABORT is released (ABORT OFF) at abort completion.

5. The positioning completion signal POSCOMP (bit D of IWC000) is ON upon entering the positioning completion range (OWC00E) following feed completion (bit 2 of IWC015 is ON).

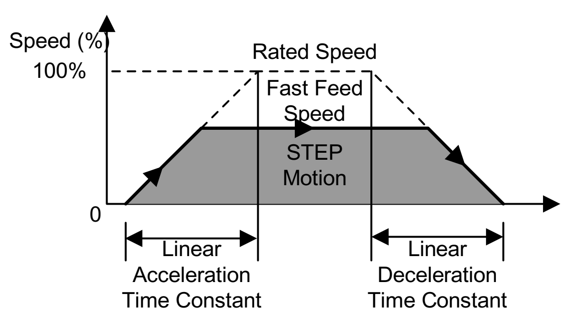


6. Release stepping in the motion commands when positioning is complete.

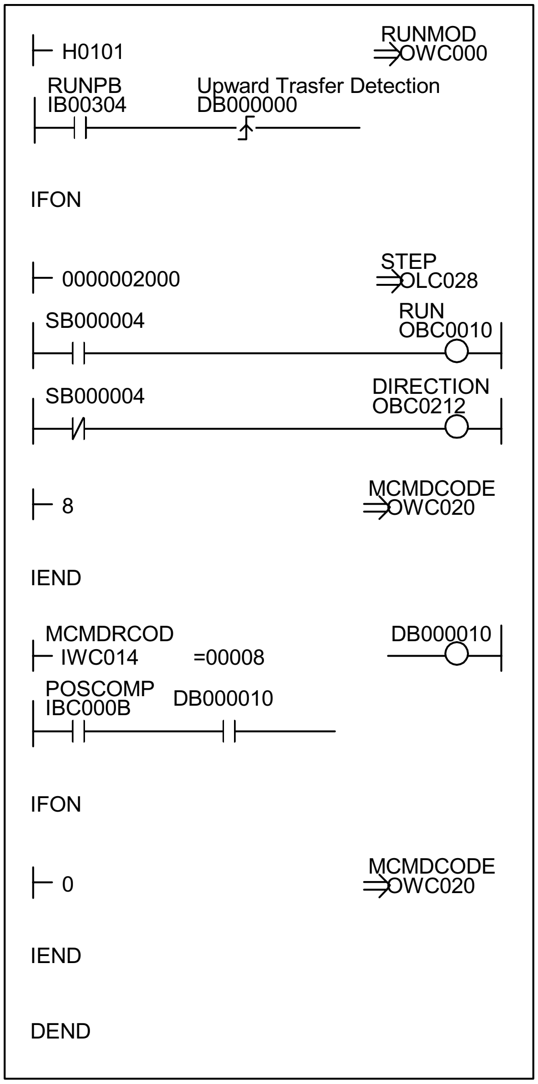
Note: Stepping detects the boot-up. Therefore, it is necessary to set the motion commands to NOP for at least one scan, and to reset stepping into the motion commands once stepping has been executed.

User Program Example (stepping)

Example of Running a Stepping Pattern



Ladder Program Example



Position control mode ON

STEP Motion (STEP)
(2000 pulses)

Run Command (RUN) to Drive
Executes stepping (STEP) as a motion command
Stepping (STEP) begins when IB00304 is ON. The axis moves for the stepping motion only in a forward direction.

When motion is complete, the positioning completion signal IBC000D goes ON.

The next motion command is cleared (=NOP command) after motion completion.

Although the examples in the above figures are extremely simplified, in reality each of the register types can be freely controlled by the user program.

Zero-point Setting (ZSET)

⚠ CAUTION

"Zero-Point Setting (ZSET)" is a command for setting the machine coordinate origin. When the setting position of the zero-point setting is incorrect, the motion operations in subsequent runs differ from the actual position. Always verify that the machine coordinate origin setting is correct prior to operation.
Failure to conduct these checks may result in tool damage, and physical injury, due to the intervention of the tool. Exercise sufficient caution.

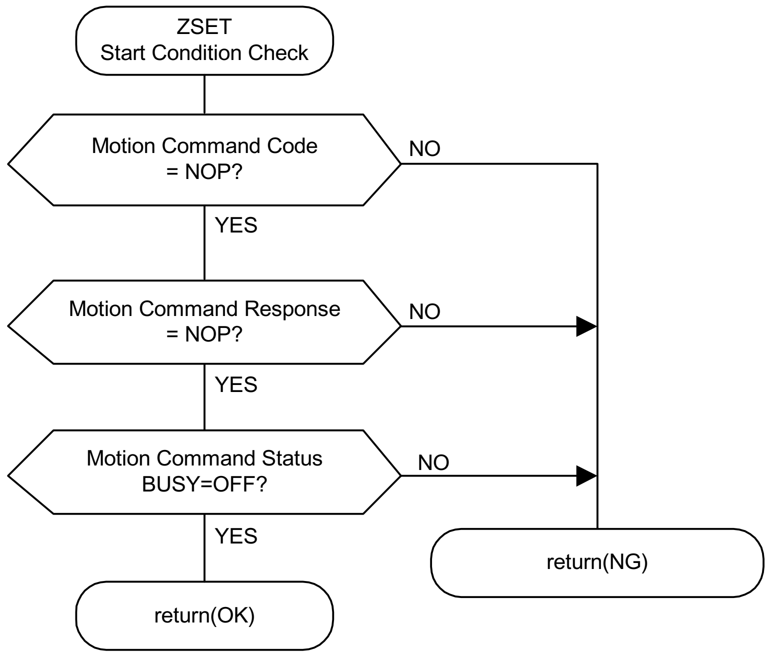
When executing zero-point setting, assume that position to be the machine coordinate origin point. The zero point can thus be set without the zero-point return operation. When using a soft limit check, execute the zero-point return operation or zero-point setting.

Detailed Description

The zero-point setting operation procedure is as follows:

1. Move the machine to the zero point by set speed feed, stepping, or manual motion.

2. Select the position control mode (PCON) (Bit 2 of OWC000).



Note: Set bit 7 “Motion Command Use Selection” of fixed motion parameter 14 “Additional Function Selections” to “Use” (= 1). Alternately, set bit 8 “Motion Command Code Selection” of fixed motion parameter 14 “Additional Function Selections” to “Enabled” (= 1).

3. Set zero-point setting (ZRET = 9) in the motion commands (OWC020).

Note: The RUN command (bit 1 of OWC001) can be either ON or OFF. It is possible to execute zero-point setting (ZSET) during axis motion if fixed motion parameter 3 “Encoder Selection” is set to “absolute encoder (= 1)”, and bit 5 “Axis Selection” of fixed motion parameter 17 “Motion Controller Function Selection Flag” is set to “Infinite Length Axis (= 1)”.

4. Upon feed completion, zero-point setting completion (bit 3 of IWC015) and zero-point return completion state (bit 6 of IWC015) are both ON.

Appendix A

User Parameter List

A list of SGDH servo amplifier user parameters, switches, input signal selections, output signal selections, auxiliary functions and monitor modes appears in this appendix.

Structure of User Parameters

The user parameters consist of the following types:

Type	User Parameter Number	Outline
Function Selection Switch Setting	Pn000 ~ Pn005	Selects the control format, stopping method at alarm generation, basic functions, and applied functions.
Setting of Servo Gain	Pn100 ~ Pn123	Sets the values for the speed loop gain and position loop gain.
Position Control-related Parameters	Pn200 ~ Pn208	Sets position control-related parameters such as the command pulse input state, electronic gear ratio, etc.
Speed Control-related Parameters	Pn300 ~ Pn308	Sets speed control-related parameters such as the speed reference input gain, accel/decel time setting for soft start, etc.
Torque Control-related Parameters	Pn400 ~ Pn409	Sets torque control-related parameters such as the torque reference input gain, fwd/rev torque limit setting, etc.
Sequence-related Parameters	Pn500 ~ Pn512	Changes the selection and assignment of the various sequence signal output condition settings and I/O signals.
Other	Pn600 ~ Pn601	Designates and reserves the external regen resistor capacity.
Auxiliary Function Execution	Fn000 ~ Fn012	Executes auxiliary functions such as jog mode, run, etc.
Monitor Mode	Un000 ~ Un00D	Monitors the speed and torque references, as well as verification of the I/O signal ON/OFF.

User Parameter List

Table 1: User Parameters

Type	User Parameter Number	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Parameters for Function Selection	Pn000	Function selection basic switch*3	—	—	—	0000
	Pn001	Function Selection Application Switch 1	—	—	—	0000
	Pn002	Function Selection Application Switch 2*3	—	—	—	0000
	Pn003	Function Selection Application Switch 3	—	—	—	0002
	Pn004	Function Selection Application Switch 4	—	—	—	1
	Pn005	Function Selection Application Switch 5	—	—	—	0
Gain-related Parameters	Pn100	Speed Loop Gain	Hz	1	2000	40
	Pn101	Speed Loop Integral Time Constant	0.01ms	15	51200	2000
	Pn102	Position Loop Gain	1/s	1	2000	40
	Pn103	Inertia Ratio	%	0	10000	100
	Pn104	2nd Speed Loop Gain	Hz	1	2000	40
	Pn105	2nd Speed Loop Integral Time Constant	0.01ms	15	51200	2000
	Pn106	2nd Position Loop Gain	1/s	1	2000	40
	Pn107	Bias	rpm	0	450	0
	Pn108	Bias Width Addition	Command Unit	0	250	7

Table 1: User Parameters (Continued)

Type	User Parameter Number	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Gain-related Parameters (continued)	Pn109	Feed Forward	%	0	100	0
	Pn10A	Feed Forward Filter Time Constant	0.01ms	0	6400	0
	Pn10B	Gain-related Application Switch	—	—	—	0000
	Pn10C	Mode Switch (torque reference)	%	0	800	200
	Pn10D	Mode Switch (speed reference)	rpm	0	10000	0
	Pn10E	Mode Switch (acceleration)	10rpm/s	0	3000	0
	Pn10F	Mode Switch (error pulse)	Command Unit	0	10000	0
	Pn110	Online Autotuning Switch	—	—	—	0000
	Pn111	Speed Feedback Compensation*2	%	1	100	100
	Pn112	Reserved Parameters (do not adjust)	%	0	1000	100
	Pn113		—	0	10000	1000
	Pn114		—	0	400	200
	Pn115		—	0	1000	32
	Pn116		—	0	1000	16
	Pn117		%	20	100	100
	Pn118		%	50	100	100
	Pn119		1/s	1	2000	50
	Pn11A		0.1%	1	2000	1000
	Pn11B		Hz	1	150	50
	Pn11C		Hz	1	150	70
	Pn11D		%	0	150	100
	Pn11E		%	0	150	100
	Pn11F	Reserved Parameters (do not adjust)	ms	0	2000	0
	Pn120		0.01ms	0	51200	0
	Pn121		Hz	10	250	50
	Pn122		Hz	0	250	0
	Pn123		%	0	100	0

Table 1: User Parameters (Continued)

Type	User Parameter Number	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Position-related Parameters	Pn200	Position Control Reference Selection*3	—	—	—	0000
	Pn201	PG Divider*3	P/r	16	16384	16384
	Pn202	Electronic Gearing Ratio (Numerator)*3	—	1	65535	4
	Pn203	Electronic Gearing Ratio (Denominator)*3	—	1	65535	1
	Pn204	Position Reference Accel/Decel Time Constant	0.01ms	0	6400	0
	Pn205	Multi-Turn Limit Setting*3	rev	0	65535	65535
	Pn206	Reserved Constant (do not adjust)	P/r	513	32768	16384
	Pn207	Position Control Function Switch*3	—	—	—	0000
	Pn208	Position Reference Movement Averaging Time	0.01ms	0	6400	0
Speed-related Parameters	Pn300	Speed Reference Input Gain	0.01V/Rated Speed	150	3000	600
	Pn301	Speed 1	rpm	0	10000	100
	Pn302	Speed 2	rpm	0	10000	200
	Pn303	Speed 3	rpm	0	10000	300
	Pn304	Jog Speed	rpm	0	9999	500
	Pn305	Soft Start Acceleration Time	ms	0	10000	0
	Pn306	Soft Start Deceleration Time	ms	0	10000	0
	Pn307	Speed Reference Filter Time Constant	0.01ms	0	65535	40
	Pn308	Speed Feed-forward Filter Time Constant	0.01ms	0	65535	0

Table 1: User Parameters (Continued)

Type	User Parameter Number	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Torque-related Parameters	Pn400	Torque Reference Input Gain	0.1V/Rated Torque	10	100	30
	Pn401	Torque Reference Filter Time Constant	0.01ms	0	65535	100
	Pn402	Forward Torque Limit	%	0	800	800
	Pn403	Reverse Torque Limit	%	0	800	800
	Pn404	Forward External Torque Limit	%	0	800	100
	Pn405	Reverse External Torque Limit	%	0	800	100
	Pn406	Emergency Stop Torque	%	0	800	800
	Pn407	Speed Limit During Torque Control	rpm	0	10000	10000
	Pn408	Torque Function Switches	—	—	—	0000
	Pn409	Notch Filter Frequency	Hz	50	2000	2000

Table 1: User Parameters (Continued)

Type	User Parameter Number	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Sequence-related Parameters	Pn500	Positioning Completed Width	Command Unit	0	250	7
	Pn501	Zero Clamp Level	rpm	0	10000	10
	Pn502	Rotation Detection Level	rpm	1	10000	20
	Pn503	Speed Coincidence Signal Output Width	rpm	0	100	10
	Pn504	Near Signal Width	Command Unit	1	250	7
	Pn505	Overflow Level	256 command units	1	32767	1024
	Pn506	Brake Reference — Servo OFF Delay Time	10ms	0	50	0
	Pn507	Brake Reference Output Speed Level	rpm	0	10000	100
	Pn508	Timing for Brake Reference during Motor Operation	10ms	10	100	50
	Pn509	Momentary Hold Time	ms	20	1000	20
	Pn50A	Input Signal Selection 1*3	—	—	—	2100
	Pn50B	Input Signal Selection 2*3	—	—	—	6543
	Pn50C	Input Signal Selection 3*3	—	—	—	8888
	Pn50D	Input Signal Selection 4*3	—	—	—	8888
	Pn50E	Output Signal Selection 1*3	—	—	—	3211
	Pn50F	Output Signal Selection 2*3	—	—	—	0000
	Pn510	Output Signal Selection 3*3	—	—	—	0000
	Pn511	Input Signal Selection 5*3	—	—	—	—
	Pn512	Output Signal Reversal Setting	—	—	—	0
Other Parameters	Pn600	Regenerative Resistor Capacity*4	10W	0	1000	0
	Pn601	Reserved Constant (do not adjust)	—	0	1000	0

*1 The multi-turn limit is only enabled when the absolute encoder usage method Pn002.2 is set to “2”. The limit is processed as 65535 under any other setting, even if the multi-turn limit setting data is changed. The multi-turn limit need not be changed except for special applications. Careless modification of this data is dangerous.

*2 The setting in user parameter Pn111 is enabled when the setting of user parameter Pn110.1 is “0”.

*3 When this user parameter has been changed, the main and control power must be turned OFF and then ON again (re-feed main power) in order to enable the function.

*4 This is normally set to zero. Set the regenerative resistor capacity (W) if an external regenerative resistor is used.

Switch List

A list of switches is shown below.

Table 2: Switches

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn000 Function Selection Basic	0	Rotation Direction Selection	0	The counter-clockwise direction is assumed to be forward.	0
			1	The clockwise direction is assumed to be forward (reverse run mode).	
	1	Control Format Selection	0	Speed Control (analog reference)	0
			1	Position Control (digital reference)	
			2	Torque Control (analog reference)	
			3	Internal Setting Speed Control (contact command)	
			4	Internal Setting Speed Control (contact command) Speed Control (analog reference)	
			5	Internal Setting Speed Control (contact command) Position Control (digital reference)	
			6	Internal Setting Speed Control (contact command) Torque Control (analog reference)	
			7	Position Control (digital reference) Speed Control (analog reference)	
			8	Position Control (digital reference) Torque Control (analog reference)	
			9	Torque Control (analog reference) Speed Control (analog reference)	
			A	Speed Control (analog reference) Zero Clamp	
			B	Position Control (digital reference) Position Control (inhibit)	
	2	Axis Address	0~F	—	0
	3	Reserved	—	—	0

Table 2: Switches (Continued)

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn001 Function Selection Application	0	Stop Method at Servo OFF and Alarm Occurrence	0	Stop the motor by dynamic braking (DB).	0
			1	Stop the motor by DB, then release DB.	
			2	Do not use DB, coast to stop instead.	
	1	Stop Method at Overtravel (OT)	0	Stop the motor by dynamic braking. (same stopping method as in Pn001.0)	0
			1	The motor assumes the torque set in Pn406 to be the maximum, decelerates to a stop, and then goes to a servo lock state.	
			2	The motor assumes the torque set in Pn406 to be the maximum, decelerates to a stop, and then goes to a free run state.	
	2	AC/DC Power Input Selection	0	Not Compatible with DC Input: Inputs AC power from the L1, L2, (L3) terminals	0
			1	DC Input-compatible: Inputs DC power from the (+)1 — (-) power input.	
	3	Warning Code Output Selection	0	ALO1, ALO2, and ALO3 output alarm codes only.	0
			1	AL01, AL02, and AL03 output both alarm codes and warning codes. However, the ALM signal output remains in an ON (normal) state when a warning code is output.	
Pn002 Function Selection Application	0	Speed Control Option (T-REF assignment)	0	None	0
			1	Uses T-REF as an external torque limit input.	
			2	Uses T-REF as the torque feed-forward input.	
	1	Torque Control Option (V-REF assignment)	0	None	0
			1	Uses V-REF as an external speed limit input.	
	2	Absolute Encoder Usage Method	0	Uses an absolute encoder as an absolute encoder.	0
			1	Uses an absolute encoder as an incremental encoder.	
			2	Uses an absolute encoder as an absolute encoder. Uses a multi-turn limit.	
	3	Reserved	0	—	0

Table 2: Switches (Continued)

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn003 Function Selection Applica-tion	0,1	Analog Monitor 1 Torque Reference Monitor Analog Monitor 2 Speed Reference Monitor	0	Motor Speed: 1V/1000rpm	20
			1	Speed Reference : 1V/1000rpm	
			2	Torque Reference: 1V/100%	
			3	Position Deviation: 0.05V/Command Unit	—
			4	Position Deviation: 0.05V/100 Command Units	—
			5	Command Pulse Frequency [rpm calculation] : 1V/1000rpm	—
			6	Motor Speed: × 4 :1V/250rpm	—
			7	Motor Speed: × 8 :1V/125rpm	—
			8	Reserved Parameter (do not adjust)	—
			9	—	—
			A	—	—
			B	—	—
			C	—	—
			D	—	—
			E	—	—
			F	—	—
	2	Reserved	—	—	0
	3	Reserved	—	—	0
Pn004 Function Selection Applica-tion	0	Option Board Selection	0	Does not use the 2 port RAM:	0
			1	Uses the 2 port RAM:	0
	1	Unit Conversion	0	No unit conversion	0
			1	Execute unit conversion	0
	2	Reserved	0	—	0
	3	Reserved	0	—	0
Pn005 Function Selection Applica-tion	0	Brake Control Function Selection	0	Use the brake sequence on the servo amplifier side.	0
			1	Use the brake sequence on the upper-level controller side.	0
	1	Reserved	0	—	0
	2	Reserved	0	—	0
	3	Reserved	0	—	0

Table 2: Switches (Continued)

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn10B Gain-related Application	0	Mode Switch Selection	0	Assumes the internal torque reference as a condition. (Level Setting: Pn10C)	0
			1	Assumes the speed reference as a condition. (Level Setting: Pn10D)	—
			2	Assumes the speed as a condition. (Level Setting: Pn10E)	—
			3	Assumes the deviation pulse as a condition. (Level Setting: Pn10F)	—
			4	No mode switch function.	—
	1	IP Control	0	PI Control	0
			1	IP Control	—
	2	Reserved	0	—	0
	3	Reserved	0	—	0
Pn110 Online Autotuning	0	Online Autotuning Method	0	Perform auto-tuning at run initialization only.	0
			1	Always tune.	—
			2	No auto-tuning.	—
	1	Speed Feedback Compensation Function Selection	0	Yes	0
			1	None	—
	2	Viscous Friction Compensation Function Selection	0	Friction Compensation: None	0
			1	Friction Compensation: Small	—
			2	Friction Compensation: Large	—
	3	Reserved Parameter (do not adjust)	0	—	0
			1	—	—

Table 2: Switches (Continued)

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn200 Position Control	0	Command Pulse Form	0	Sign + pulse, positive logic	0
			1	CWCCW, positive logic	—
			2	A-phase + B-phase (no multiplier), positive logic	—
			3	A-phase + B-phase (2× multiplier), positive logic	—
			4	A-phase + B-phase (quadrature), positive logic	—
			5	Sign + pulse, negative logic	—
			6	CWCCW, negative logic	—
			7	A-phase + B-phase (no multiplier), negative logic	—
			8	A-phase + B-phase (2× multiplier), negative logic	—
			9	A-phase + B-phase (quadrature), negative logic	—
	1	CLEAR Signal Form	0	Clear the deviation counter with the signal “H” level.	0
			1	Clear the deviation counter with the upward transition of the signal.	—
			2	Clear the deviation counter with the signal “L” level.	—
			3	Clear the deviation counter with the downward transition of the signal.	—
	2	CLEAR Operation	0	Clear the deviation counter during base block.	0
			1	Does not clear the deviation counter. (cleared only by the CLR signal)	—
			2	Clear the deviation counter at alarm occurrence.	—
	3	Filter Selection	0	Command Input Filter for Line Driver Signal	0
			1	Command Input Filter for Open Collector Signal	—

Input Signal Selection List

An input signal selection list is shown below.

Table 3: Input Signal Selection

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn50A Input Signal Selection	0	Input Signal Assignment Mode	0	Assigns sequence input signal to SGDB***************	0
			1	The assignment of the above input signal can be set as desired.	
	1	/S-ON Signal Mapping (the servo is turned ON by "L")	0	Input from input terminal SI0(CN1-40)	0: SI0
			1	Input from input terminal SI1 (CN1-41)	
			2	Input from input terminal SI2 (CN1-42)	
			3	Input from input terminal SI3 (CN1-43)	
			4	Input from input terminal SI4 (CN1-44)	
			5	Input from input terminal SI5 (CN1-45)	
			6	Input from input terminal SI6 (CN1-46)	
			7	Signal is fixed at "enabled"	
			8	Signal is fixed at "disabled"	
			9	Enabled when the SI0 (CN1-40) input signal is "OFF (H level)".	
			A	Enabled when the SI1 (CN1-41) input signal is "OFF (H level)".	
			B	Enabled when the SI2 (CN1-42) input signal is "OFF (H level)".	
			C	Enabled when the SI3 (CN1-43) input signal is "OFF (H level)".	
			D	Enabled when the SI4 (CN1-44) input signal is "OFF (H level)".	
			E	Enabled when the SI5 (CN1-45) input signal is "OFF (H level)".	
			F	Enabled when the SI6 (CN1-46) input signal is "OFF (H level)".	
	2	/P-CON Signal Mapping (P control is executed by L)	0~F	As above	1: SI1
	3	/P-OT Signal Mapping (Overtravel at H)	0~F	As above	2: SI2

Table 3: Input Signal Selection (Continued)

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn50B Input Signal Selection	0	N-OT Signal Mapping (Overtravel at H)	0~F	As above	3: SI3
	1	/ALM-RST Signal Mapping (alarm reset at L)	0~F	As above	4: SI4
	2	/P-CL Signal Mapping (torque limit at L)	0~F	As above	5: SI5
	3	/N-CL Signal Mapping (torque limit at L)	0~F	As above	6: SI6
Pn50C Input Signal Selection	0	/SPD-D Signal Mapping (internal setting speed selection)	0~F	As above	8: Disabled
	1	/SPD-A Signal Mapping (internal setting speed selection)	0~F	As above	8: Disabled
	2	/SPD-B Signal Mapping (internal setting speed selection)	0~F	As above	8: Disabled
	3	/C-SEL Signal Mapping (control mode switching)	0~F	As above	8: Disabled
Pn50D Input Signal Selection	0	/ZCLAMP Signal Mapping (zero clamp)	0~F	As above	8: Disabled
	1	/INHIBIT Signal Mapping (command pulse inhibition)	0~F	As above	8: Disabled
	2	/G-SEL Signal Mapping (gain switching)	0~F	As above	8: Disabled
	3	(reserved)	0~F	As above	8: Disabled
Pn511 Input Signal Selection	0	/DEC Signal Mapping (DEC when ON (L))	0~F	As above	8: Disabled
	1	/EXT Signal Mapping (external latch when ON (L))	0~F	As above	8: Disabled
	2	/EXT Signal Mapping (external latch when ON (L))	0~F	As above	8: Disabled
	3	/EXT Signal Mapping (external latch when ON (L))	0~F	As above	8: Disabled

Only Pn50A.1 = 7, Pn50A.3 = 8, and Pn50B.0 = 8 can be set in the SGDB servo amplifier function conversion mode where Pn50A.0 = 0.

Output Signal Selection

Table 4: Output Signal Selection

User Parameter Number	Decimal Place	Name	Setting	Content	Factory Setting
Pn50E Output Signal Selection	0	/COIN Signal Mapping	0	Unused.	1: SO1
			1	Outputs from output terminal SO1(CN1-25, 26)	
			2	Outputs from output terminal SO2(CN1-27, 28)	
			3	Outputs from output terminal SO3(CN1-29, 30)	
	1	/V-CMP Signal Mapping	0~3	As above	
	2	/TGON Signal Mapping	0~3	As above	2: SO2
	3	/S-RDY Signal Mapping	0~3	As above	3: SO3
Pn50F Output Signal Selection	0	/CLT Signal Mapping	0~3	As above	0: Unused
	1	/VLT Signal Mapping	0~3	As above	0: Unused
	2	/BK Signal Mapping	0~3	As above	0: Unused
	3	/WARN Signal Mapping	0~3	As above	0: Unused
Pn510 Output Signal Selection	0	/NEAR Signal Mapping	0~3	As above	0: Unused
	1	Reserved	0	—	0
	2	Reserved	0	—	0
	3	Reserved	0	—	0
Pn512 Output Signal Reversal	0	SO1(CN1-25, 26) Terminal Output Signal Inversion	0	Not inverted	0: Not inverted
			1	Inverted	
	1	SO2(CN1-27, 28) Terminal Output Signal Inversion	0	Not inverted	0: Not inverted
			1	Inverted	
	2	SO3(CN1-29, 30) Terminal Output Signal Inversion	0	Not inverted	0: Not inverted
			1	Inverted	
	3	Reserved	—	—	0

Notes: Output by OFF logic if a number of signals have been assigned to the same output circuit.
Undetected signals are assumed to be OFF according to the control mode. For example, the /COIN signal is assumed to be OFF in the speed control mode.
/WARN signal type: Overload, Regen Overload

Auxiliary Functions List

A list of the auxiliary functions is shown below.

Table 5: Auxiliary Functions

User Parameter Number	Function
Fn000	Alarm Trace-back Data Display
Fn001	Rigidity Setting During Online Autotuning
Fn002	Jog Mode Run
Fn003	Zero-point Search Mode
Fn004	(reserved parameter)
Fn005	Initialization of User Setting Parameters
Fn006	Alarm Trace-back Data Clear
Fn007	Writes the servo gain parameters obtained as a result of the online auto-tuning operation into the EEPROM.
Fn008	Absolute encoder multi-turn limit setting (setup operation) and encoder alarm reset
Fn009	Automatic adjustment of the analog (speed torque) reference offsets.
Fn00A	Manual Adjustment of the Speed Reference Offset
Fn00B	Manual Adjustment of the Torque Reference Offset
Fn00C	Manual Zero Adjustment of the Analog Monitor Output
Fn00D	Manual Gain Adjustment of the Analog Monitor Output
Fn00E	Automatic Adjustment of Motor Current Detection Signal Offset
Fn00F	Manual Adjustment of Motor Current Detection Signal Offset
Fn010	Password Setting (user parameter overwrite prohibition processing)
Fn011	Verification of Motor Type
Fn012	Servo Amplifier Software Version Display

Monitor Mode List

A list of the monitor modes is shown below.

Table 6: Monitor Modes

User Parameter Number	Display Content	Unit	Notes
Un000	Actual Motor Speed	rpm	—
Un001	Input Speed Reference	rpm	—
Un002	Internal Torque Reference	%	Percent of rated torque
Un003	Rotation Angle 1	Pulse	Number of pulses from 0
Un004	Rotation Angle 2	deg	Angle from zero point (electrical angle)
Un005	Input Signal Monitor	—	—
Un006	Output Signal Monitor	—	—
Un007	Input Reference Pulse Speed	rpm	—
Un008	Deviation Counter	Com-mand Unit	Position Deviation
Un009	Cumulative Load Factor	%	Value assuming 100% of rated torque displays real torque at 10s intervals
Un00A	Regen Load Factor	%	Value assuming 100% processable regen power Displays regen consumption power in 10s intervals
Un00B	DB Resistor Consumption Power	%	Value at 100% processable power dur-ing dynamic brake operation displays DB consumption current at 10s interval
Un00C	Input Reference Pulse Counter	—	Displayed in hexadecimals
Un00D	Feedback Pulse Counter	—	Displayed in hexadecimals

Parameters

The following table details the meaning of each parameter, and the difference between use/non-use.

Fixed Parameters

These parameters are normally not changed after being set, insofar as the machine configuration/specifications do not change. Set these in the MotionWorks™ Fixed Parameter Setting screen.

Table 7: Fixed Parameters

No.	Name	Setting Range (Bit Name)	Meaning	Note
1	Axis Enabled	0 or 1 (default = 6)	0: Non-use selection 1: Use selection	—
13	Latch Input Signal Type	0 or 1 (default = 0)	0: DI input signal 1: C-pulse input signal	—
14	Functions	Bit 0~1: Unused	—	—
		Bit 2: LIMITSEL	Limit Switch Signal Selection	0: OBC001F use 1: DI Signal Use
		Bit 3~6: Unused	—	—
		Bit 7: MCMDSEL	Motion Command Use Selection	0: Unused / 1: Used
		Bit 8~15: Unused	—	—
15	Unused	—	—	—
16	Simulation Mode	0~2 (default =0)	0: Normal Run Mode	—
			1: Simulation Mode	
17	Servo Axis Functionality	Bit 0~3: 0~7 CMD_UNIT	Command Unit Selection	0: pulse (electronic gearing disabled)
				1: mm
				2: deg
				3: inch
		Bit 4: USE_GEAR	Electronic Gearing Selection	0: Enable / 1: Disable
		Bit 5: PMOD_SEL	Axis Selection	0: Limited-length Axis 1: Infinite-length Axis
		Bit 6: USE_BKRSH	Enable Backlash Compensa-tion Selection	0: Enable / 1: Disable
		Bit 7: USE_SLIMP	Enable Soft Limit (forward Selection	0: Enable / 1: Disable

Table 7: Fixed Parameters (Continued)

No.	Name	Setting Range (Bit Name)	Meaning	Note
17 (cont)	Servo Axis Functionality	Bit 8: USE_SLIMN	Enable Soft Limit (reverse) Selection	0: Enable / 1: Disable
		Bit 9: USE_OV	Enable Override Selection	0: Enable / 1: Disable
		Bit 10: INV_DEC	Deceleration LS Inversion Selection	0: Not inverted 1: Inverted
		Bit 11: Unused	—	—
		Bit 12:	—	—
		Bit 13: OVT1_SEL	Positive Overtravel Selection	0: Enable / 1: Disable
		Bit 14: OVT2_SEL	Negative Overtravel Selection	0: Enable / 1: Disable
18	Number of Decimal Places	0~5 (default = 3)	Sets the number of laces below the decimal point in a command (Exp.) When the Number of Decimal Places = 3 mm: 1 Command Unit = 0.001mm deg: 1 Command Unit = 0.001 deg inch: 1 Command Unit = 0.001 inch	The minimum command unit is determined by this parameter and command unit selection (see fixed servo parameter 17).
19	Command Units per Revolution	$1\sim2^{31}-1$ (default = 10000)	1 = 1 command unit	—
21	Gear Ratio (motor)	1~65535 (default = 1)	1~1 (rotations)	—
22	Gear Ratio (load)	1~65535 (default = 1)	1~1 (rotations)	—
23	Maximum Value of Rotary Counter	$1\sim2^{31}-1$ (default =360000)	1 = 1 command unit	—
27	Forward Software Limit	$-2^{31}\sim2^{31}-1$ (Default = $2^{31}-1$)	1 = 1 command unit	—
29	Reverse Software Limit	$-2^{31}\sim2^{31}-1$ (Default = $2^{31}-1$)	1 = 1 command unit	—
31	Home Return Type	0~7 (default = 0)	0: DEC1 Signal + C-pulse	
			1: ZERO Signal	
			2: DEC1 Signal + ZERO Signal	
			3: C-pulse	
			4: DEC2 Signal + ZERO Signal	
			5: DEC1 Signal + LMT Signal + ZERO Signal	
			6: DEC2 Signal + C-pulse	
			7: DEC1 Signal + LMT Signal + ZERO Signal	

Table 7: Fixed Parameters (Continued)

No.	Name	Setting Range (Bit Name)	Meaning	Note
32	Backlash Compensation	0~32767 (default = 0)	1 = 1 command unit	—
37~ 48	Unused	—	—	—

Motion Setup Parameters

The setup parameters are used as commands to the motion module. They are transferred as a group to the motion module at the start of high-speed scanning. Motion control can be executed simply by setting the parameters into this register area.

Table 8: Setup Parameters

No.	Name	Register Number	Setting Range (Bit Name)	Meaning
1	Run Mode	OWC000	Bit 0: NCON	Speed Reference Output Mode
			Bit 1: TCON	Torque Reference Output Mode
			Bit 2: PCON	Position Control Mode
			Bit 3: PHCON	Phase Control Mode
			Bit 4: ZRN	Zero-point Return Mode*
			Bit 5: PHTEST	Phase Control Test Signal
			Bit 6: ACR	Alarm Clear
			Bit 7: PHREFOFF	Disable Phase Reference Generation Operation
			Bit 8: MCDSEL	0: Motion Command Code (OWC020) disabled 1: Motion Command Code (OWC020) enabled
			Bit 9: ZRNDIR	Zero Point Return Direction 0: Negative (decreasing) 1: Positive (increasing)
			Bit 10: ABSRD	Absolute Position Readout Request
			Bits 11~12:	Unused
			Bit 13: DIINTREQ	DI Latch Detection Request
			Bit 14:	Unused
			Bit 15: IRESET	Phase Control Integral Reset

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning
2	Run Commands	OWC001	Bit 0: RUN (D00)	Run (Servo ON)
			Bit 1: P-CON	Speed Loop P/PI Switching
			Bit 2: G-SEL	Gain Switching
			Bit 3: P-CL	Forward External Torque Limit Input
			Bit 4: N-CL	Reverse External Torque Limit Input
			Bit 5: ZCLAMP	Zero Clamp Input
			Bit 6: PHSCZNSEL	Phase Control Mode Synchronous Scan Selection
			Bit 7: PSCANSEL	Position Control Mode Control Loop Synchronous Scan Selection
			Bit 8: ACCSEL	Position Control Mode Selection of Accel/Decel Function Use in Simple Positioning
			Bit 9: SEGSEL	Position Control Mode Segment Assignment Function Use Selection
			Bit 10:	Unused
			Bit 11:	Unused
			Bit 12: USE_BUF	Position Reference Selection 0: OLC012 1: Position Buffer
			Bit 13: SPDTYPE	Speed Reference Selection 0: The units for approach speed (OWC00A) and creep speed (OWC00B) are 1 = 10n command units/min when the fast feed speed is in OLC022. 1: The units for approach speed (OWC00A) and creep speed (OWC00B) are 1 = 0.01% when the fast feed speed is in OLC015.
			Bit 14: XREFTYPE	Position Reference Type 0: Position reference (OLC012) is absolute position type 1: Position reference (OLC012) is incremental addition type
			Bit 15: LSDEC	Zero-point Return Deceleration Limit Signal
3	Forward Torque Limit	OWC002	-32768~32767 (default =-30000)	1 = 0.01%(-30000 = -300.00%)
4	Unused	OWC003	—	Set “0”

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning
5	Forward Speed Limit	OWC004	0~32767 (default = 15000)	1 = 0.01% (15000 = 150.00%)
6	Reverse Speed Limit	OWC005	0~32767 (default = 15000)	1 = 0.01% (15000 = 150.00%)
7	Zero-point Offset	OLC006	-2^{31}~2^{31}-1 (default = 0)	1 = 1 command unit 1 = 1 pulse when pulse units
9	Unused	OLC008	—	Set “0”
11	Home Approach Speed	OWC00A	0~32767 (default = 0)	The units differ according to the speed reference selection (OWC001D). When speed reference selection = 0 1 = 10^{n} Command Units/min (n = number of decimal places) In pulse units: 1 = 1000 pulses/min (PO-01: 1 = 100 pulses/min) In mm units: 1 = 1mm/min In deg units: 1 = 1deg/min In inch units: 1 = 1inch/min When Speed Reference Selection = 1 1 = 0.01% (1000 = 10.00%)
12	Home Creep Speed	OWC00B	0~32767 (default = 0)	—
13	Linear Accelera-tion Time	OWC00C	0~32767 (default = 0)	1 = 1ms (300ms)
14	Linear Decelera-tion Time	OWC00D	0~32767 (default = 0)	1 = 1ms (300ms)
15	Positioning Completed Range	OWC00E	0~65535 (absolute value) (default =10)	1 = 1 command unit 1 = 1 pulse when pulse units
16	Following Error Limit	OWC00F	0~65535 (absolute value) (default = 65535)	1 = 1pulse (0 = no deviation error detection)
17	Position Loop Gain	OWC010	0~32767 (default = 300)	1 = 0.1% (300 = 30.0%)
18	Feed Forward Gain	OWC011	0~200 (default = 0)	1 = 1% (10 = 10%)
19	Position Reference Type	OLC012	-2^{31}~2^{31-1} (default = 0)	1 = 1 command unit 1 = 1 pulse when pulse units When Position Reference Selection (OBC001C) =1 Position Buffer Number (1~256)

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning	
21	S-curve Acceleration Time	OWC014	The S-curve time constant is 0~255 (1 = 1 turn) (0 = 1 = no averaging) when the speed reference output mode and motion commands are disabled in the position control mode.		
			The S-curve time constant is 0~255 (1 = 1 turn) (0 = 1 = no averaging) and SVB is 0~65535 (1 = 0.1ms) when bits 4~7 of OWC021 are “2”.		
			The exponent accel/decel time constant is 0~32767 (1 = 1ms) and SVB is 0~65535 (1 = 0.1ms) when bits 4~7 of OWC021 are “1”.		
22	Speed Reference	OWC015	-32768~32767 (default = 0)	1 = 0.01% (5000 = 50.00%)	
23	Phase Compensation	OLC016	-2^{31}~2^{31-1} (default = 0)	1 = 1pulse	
25	Speed Compensation	OWC018	-32768~32767 (default = 0)	1 = 0.01% (100 = 1.00%)	
26	Proportional Gain	OWC019	0~32767 (default = 300)	1 = 0.1% (300 = 30.0%)	
27	Integral Time	OWC01A	0~32767 (default = 300)	1 = 1ms (0 = no integral) (300 = 0.300s)	
28	Torque Reference	OWC01B	-32768~32767 (default = 0)	1 = 0.01% (10000 = 100.00%)	
29	Speed Limit	OWC01C	-32768~32767 (default = 15000)	1 = 0.01% (15000 = 150.00%)	
31	Pulse Compensation	OLC01E	-2^{31}~2^{31-1} (default = 0)	1 = 1 pulse	
33	Motion Command Code	OWC020	0~65535 (default = 0)	0: NOP	No command
				1: POSING	Positioning
				2: EX_POSING	External Positioning
				3: ZRET	Zero-point return
				4: FINTERPOLATE	Interpolation
				5: ENDOF_ INTERPOLATE	Interpolation Final Segment
				6: LATCH	Interpolation with Position Detection Function
				7: FEED	Set Speed Feed
				8: STEP	Stepping
				9: ZSET	Zero-point Setting
				10~65535: Unused	

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning	
34	Motion Command Options	OWC021	Bit 0: HOLD	Command Hold	
			Bit 1: ABORT	Command Abort	
			Bit 2: DIRECTION	Direction of Motion 0: Fwd 1: Rev	
			Bit 3: LAGRST	No one-time delay (Same as when one-time delay time constant = 0)	
			Bits 4~7: FILTERTYPE	Filter Type 0: No FIlter 1: Exponent Filter (exponent accel/decel) 2: Motion Averaging Filter (simple S-curve accel/decel)	
			Bit 8: POS_PPI	Position Loop P/PI Switching 0: P 1: PI	
			Bit 9: POS_IRST	Position Control Integral Reset	
			Bit 10: NCOMSEL	Enables speed compensation (OWC018) during position control	
			Bit 11: SCMD	SGDH Serial Command Enablement Flag (0, 1)	
			Bit 12: LMT_L	Zero-point Return Reverse Limit Signal	Fixed Parameter 14 “Additional Function Selection” is only enabled when setting parameter OBC021x is set for use.
			Bit 13: LMT_R	Zero-point Return Forward Limit Signal	
			Bit 14: BUF_W	Position Buffer Write	0: No Processing 1: Writing
			Bit 15: BUF_R	Position Buffer Read	0: No Processing 1: Readout
35	Feed Speed	OLC022	$0 \sim 2^{31-1}$ (default = 3000)	1 = 10^n Command units/min (n = number of places below decimal point) In Pulse Units: 1 = 1000 pulses/min In mm Units: 1 = 1mm/min In deg Units: 1 = 1deg/min In inch Units: 1 = 1inch/min	
37	External Positioning Move Distance	OLC024	$-2^{31} \sim 2^{31-1}$ (default = 0)	1 = 1 command unit	1 = 1 pulse when pulse units
39	Stopping Distance	OLC026	$-2^{31} \sim 2^{31-1}$ (default = 0)	1 = 1 command unit	For motion management

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning	
41	Step Distance	OLC028	0~2^{31-1} (default = 0)	1 = 1 command unit	
43	Home Offset	OLC02A	-2^{31}~2^{31-1} (default = 0)	1 = 1 command unit	
45	Speed Override	OWC02C	0~32767 (default = 10000)	1 = 0.01% (10000 = 100.00%)	
46	Position Management Control	OWC02D	Bit 0: MLK	Machine Lock Mode Setting 0: OFF 1: ON (machine lock mode)	
			Bit 1: TPRSREQ	Posmax Turns Presetting Request 1: Request ON	
			Bit 2: ABSLDREQ	ABS System Rotary Position Management Data LOAD Request 1: Request ON	
			Bit 3: PUNITSEL	Position Monitor 2 (ILC034) Display Unit 0: Command Unit 1: Pulse Unit	
			Bits 4~11:	Unused	
47	Work Coordinate Offset	OLC02E	-2^{31}~2^{31-1} (default = 0)	1 = 1 command unit	1 = 1 pulse when pulse units
49	Preset Data of POSMAX Turn	OLC030	-2^{31}~2^{31-1} (default = 0)	1~1 (rotations)	
51	2nd In-position Width	OLC032	0~65535 (default = 0)	1 = 1 command unit	1 = 1 pulse when pulse units
52	Home Window	OWC033	0~65535 (default = 10)	1 = 1 command unit	
53	Position Complete Timeout	OWC034	0~65535 (default = 0)	1 = 1ms	
54	Position Control Integral Time	OWC035	0~32767 (default = 300)		
55	Integral Upper/Lower Limit for Position Control	OLC036	-2^{31}~2^{31-1} (default = 32767)		
56	First Order Lag Constant	OWC037	0~32767 (default = 0)		

Table 8: Setup Parameters (Continued)

No.	Name	Register Number	Setting Range (Bit Name)	Meaning
57	Absolute Position at Power Off (low value)	OLC038	-2^{31}~2^{31-1} (default = 0)	Encoder Position at Power OFF when the ABS System Infinite Length Position Management Data LOAD request (OBC02D2) is ON Lower 2 words (1 = 1 pulse)
	Position Buffer Access No. (eposL)			When the Motion Command Control Flag BUF_W (OBC021E) = 1 or BUF_R(OBC021F) = 1 The position buffer access number is 1~256 (0 = disabled)
	SGDH Serial Command Command Setting	OWC038	0~2	Executes parameter read/write when the motion command control flag SCMD (OBC021B) = 1. 1: Data Read 2: Data Write
	SGDH Serial Command Address Setting	OWC039		Sets SGDH parameter Read/Write address when Motion Command Control Flag SCMD (OWC021B) = 1.
59	Absolute Position at Power Off (high value)	OLC03A	-2^{31}~2^{31}-1 (default = 0)	Encoder Position at Power OFF when the ABS System Infinite Length Position Management Data LOAD request (OBC02D2) is ON Upper 2 words (1 = 1 pulse)
	Position Buffer Write Data			Position buffer write data when Motion Command Control Flag BUF_W (OBC021E) = 1.
	SGDH Serial Command Data Setting	OWC03A	—	Sets setting data when Motion Command Control Flag SCMD (OWC021B) = 1 and the data write code (OWC038) = 2.
61	Modularized Position at Power Off (low value)	OLC03C	-2^{31}~2^{31-1} (default = 0)	Pulse Position at Power OFF when the ABS System Infinite Length Position Management Data LOAD request (OBC02D2) is ON Lower 2 words(1 = 1 pulse)
63	Modularized Position at Power Off (high value)	OLC03E	-2^{31}~2^{31-1} (default = 0)	Pulse Position at Power OFF when the ABS System Infinite Length Position Management Data LOAD request (OBC02D2) is ON Upper 2 words (1 = 1 pulse)

Monitor Parameters

The monitor parameters are sent to the controller as a group at the start of each high-speed scan. Use them for application control, user program debugging, etc.

Table 9: Monitor Parameters

No.	Name	Register Number	Bit Name (Setting Range)	Meaning	Note
1	Drive Status	IWC000	Bit 0: EOVER	Deviation Error	
			Bit 1: PRMERR	Motion setting parameter setting error	
			Bit 2: FPRMERR	Motion setting parameter setting error	
			Bit 3: Unused	—	
			Bit 4: Unused	—	
			Bit 5: Unused	—	
			Bit 6: Unused	—	
			Bit 7: SVCRDY	Motion controller run preparation complete	
			Bit 8: SVCRUN	Motion controller run	
			Bit 9: DIRINV	Rotation direction messaging during absolute encoder use	
			Bit 10: ABCRDC	Absolute position readout completion signal	
			Bit 11: DIINT	DI Latch completion signal	
			Bit 12: FBPO	Feedback pulse 0	
			Bit 13: POSCOMP	Positioning completion signal	
			Bit 14: Unused	—	
			Bit 15: ZRNC	Zero-point return completion	
2	Network Servo Status	IWC001	Bit 0: ALM	Servo alarm	
			Bit 1: WARN	Warning	
			Bit 2: V-CMP	Speed coincidence	
			Bit 3: TGON	Motor rotation detection	
			Bit 4: S-RDY	Servo Ready	
			Bit 5: CLT	Torque limit detection	
			Bit 6: VLT	Speed limit detection	
			Bit 7: BK	Brake interlock	
			Bit 8: SVON	Servo ON completion	
			Bit 9: PON	Main circuit completion	
			Bit10~Bit15	Unused	

Table 9: Monitor Parameters (Continued)

No.	Name	Register Number	Bit Name (Setting Range)	Meaning	Note
3	Target Position	ILC002	-2^{31}~2^{31-1}	1 = 1 pulse or 1 = 1 command unit Update will occur even in machine lock when 1 = 1 pulse unit	
5	Incremental Target Position	ILC004	-2^{31}~2^{31-1}	1 = 1 pulse or 1 = 1 command unit When pulse units 1 = 1 pulse unit	
7	Machine Coordinate Latch Position	ILC006	-2^{31}~2^{31-1}	1 = 1 command unit (1 = 1 pulse when pulse units)	
9	Machine Coordinate Feedback Position	ILC008	-2^{31}~2^{31-1}	1 = 1 command unit (1= 1 pulse when pulse units) Note) Not updated during machine lock	
11	Position Error	ILC00A	-2^{31}~2^{31-1}	1 = 1pulse	
13	Speed Reference Output Value	IWC00C	-32768~32767	1 = 0.01%	
14	Speed Monitor	IWC00D	-32768~32767	1 = 0.01%	
15	Torque Monitor	IWC00E	-32768~32767	1 = 0.01%	
16	Over Range Parameter Number	IWC00F	1~65 101~148	Motion Setting Parameter Error Number Fixed Motion Parameter Error Number +100	
17	Number of Absolute Encoder Turns	ILC010	0~±99999	1~1 (rotations)	
19	Initial Incremental Pulses of Absolute Encoder	ILC012	-2^{31}~2^{31-1}	1 = 1pulse	
21	Servo Command Type Response	IWC014	0~65535	Currently executed motion command (for details, see OWC020)	
22	Servo Module Command Status	IWC015	Bit 0: BUSY	Command execution flag	
			Bit 1: HOLDL	Command hold completion	
			Bit 2: DEN	Feed completion	
			Bit 3: ZSET	Zero point setting completion	
			Bit 4: EX_LATCH	External positioning signal latch completion	
			Bit 5: FAIL	Command error termination state	
			Bit 6: ZRNC	Zero point return completion state	
			Bits 7~15:	Unused	
23	Number of Decimal Places	IWC016	0~5	Fixed motion parameter Copy of “Number of Decimal Places Below Decimal Point”	

Table 9: Monitor Parameters (Continued)

No.	Name	Register Number	Bit Name (Setting Range)	Meaning	Note
24	Position Management Status	IWC017	Bit 0: MLKL	Machine lock	
			Bit 1: ZERO	Zero-point position	
			Bit 2: PSET2	2nd INP completion	
			Bit 3: ABSLDE	ABS System Rotary Position Management Data Load Completion	
			Bit 4: TPRSE	Number of POSMAX turns presetting completion	
			Bit 5: GEARM	Copy of fixed parameter “Electronic Gearing Selection”.	
			Bit 6: MODSELM	Copy of fixed parameter “Axis Selection”	
			Bits 7~11:	Unused	
			Bits 12~15:	Unused	
25	Machine Coordinate System Position	ILC018	-2^{31}~2^{31-1}	1 = 1 command unit Update will not occur in machine lock when 1 = 1 pulse unit	
27	SGDH Serial Command Answer	IWC01A	—	SGDH Serial Command Answer Monitor Data Read 01H: Normal 41H: Data error 81H: Address error Data Write 02H: Normal 42H: Data error 82H: Address error C2H: Answer timeout	
28	SGDH Serial Command Address	ILC01B	—	Address monitor during SGDH serial command execution	
29	POSMAX Monitor	ILC01C	1~2^{31-1}	1 = 1 Command Units Copy of fixed motion command “POSMAX”	
31	POSMAX Number of Turns	ILC01E	-2^{31}~$^{231-1}$	1 = 1 Turn The count goes UP/DOWN each time POSMAX is exceeded. (initialized to 0 at power ON)	
33	SGDH Serial Command Data	IWC020	—	Data monitor during SGDH serial command execution	

Table 9: Monitor Parameters (Continued)

No.	Name	Register Number	Bit Name (Setting Range)	Meaning	Note
35	Servo Alarms	ILC022	Bit 0: SVERROR	Servo amplifier error	
			Bit 1: OTF	Positive overtravel	
			Bit 2: OTR	Negative overtravel	
			Bit 3: SOTF	Positive soft limit	
			Bit 4: SOTR	Negative soft limit	
			Bit 5:	—	
			Bit 6: TIMEOVER	Positioning time-out	
			Bit 7: DISTOVER	Excessive positioning distance	
			Bit 8:	—	
			Bit 9:	—	
			Bit 10: MODERR	Control mode error	
			Bit 11: ZSET_NRDY	Zero-point not set	
35	Servo Alarms	ILC022	Bit 12:	—	
			Bit 13:	—	
			Bit 14:	—	
			Bit 15:	—	
			Bit 16:	—	
			Bit 17: ABSOVER	Excessive absolute encoder rotation	
			Bit 18: PGLFLT	Encoder disconnection error	
			Bit 19:	Unused	
			Bits 20~31	Unused	
37	Network Servo Alarm Code	IWC024	-32768~32767	Currently occurring alarm code	
38	Network Servo I/O Monitor	IWC025	Bit 0: SIO	General-use input signal	
			Bit 1: DEC	Deceleration dogleg switch	
			Bit 2: P-OT	Forward limit switch input	
			Bit 3: N-OT	Reverse limit switch input	
			Bit 4: EXT1	External input signal 1	
			Bit 5: EXT2	External input signal 2	
			Bit 6: EXT3	External input signal 3	
			Bits 7~15:	Unused	
39	Speed Reference Output Value	ILC026	-2^{31}~2^{31-1}	Enabled when speed reference selection 1 = 1 Command unit/H scan	
41	Position Buffer Data	ILC028	-2^{31}~2^{31-1}	Copies the position buffer data when the motion command control flag BUF_R (OBC021F) =1.	
43	Unused	—	—	—	

Table 9: Monitor Parameters (Continued)

No.	Name	Register Number	Bit Name (Setting Range)	Meaning	Note
45	Integral Output Value	ILC02C	-2^{31}~2^{31-1}	—	
47	Reference Coordinate Calculation Position	ILC02E	-2^{31}~2^{31-1}	1 = 1 command unit	
49	First Order Lag	ILC030	-2^{31}~2^{31-1}	(PI Output ^dash one-time delay output)	
51	Position Loop Output Value	ILC032	-2^{31}~2^{31-1}	Position loop output (value prior to addition of feed-forward operation)	
53	Position Monitor 2	ILC034	-2^{31}~2^{31-1}	Differs in position monitor 2 unit selection (OBC02D3) OBC02D3 = 0 (at command unit selection) 1 = 1 command unit OBC02D3 = 1 (at pulse unit selection) 1 = 1 pulse	
55	Unused	IWC036	—	—	
56	Unused	IWC037	—	—	
57	Absolute Position at Power Off (low value)	ILC038	-2^{31}~2^{31-1}	1 = 1pulse (*for ABS system infinite length position management)	
59	Absolute Position at Power Off (high value)	ILC03A	—	1 = 1pulse (*for ABS system infinite length position management)	
61	Modularized Position at Power Off (low value)	ILC03C	-2^{31}~2^{31-1}	1 = 1pulse (*for ABS system infinite length position management)	
63	Modularized Position at Power Off (high value)	ILC03E	-2^{31}~2^{31-1}	1 = 1pulse (*for ABS system infinite length position management)	

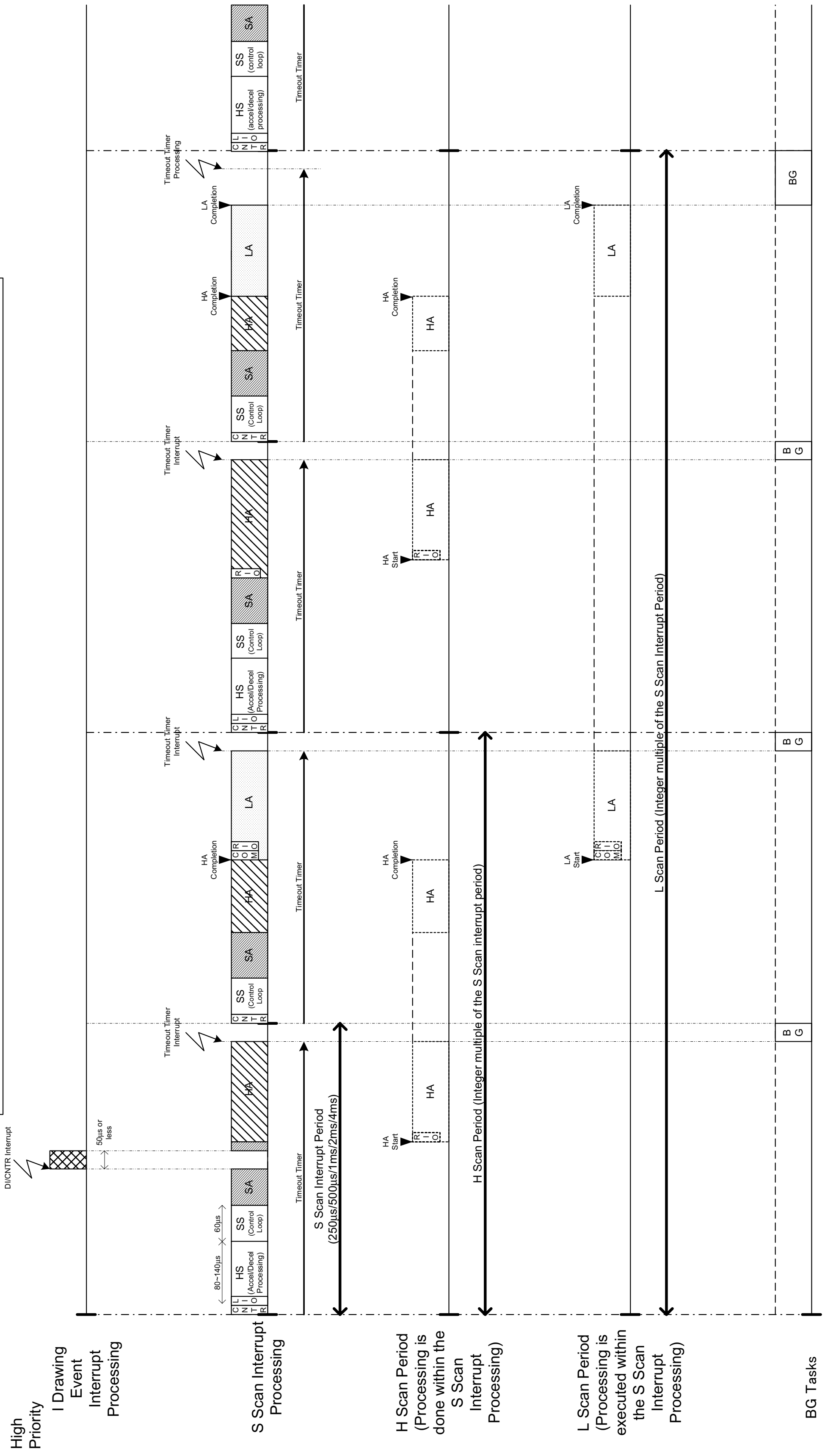
Scan Processing

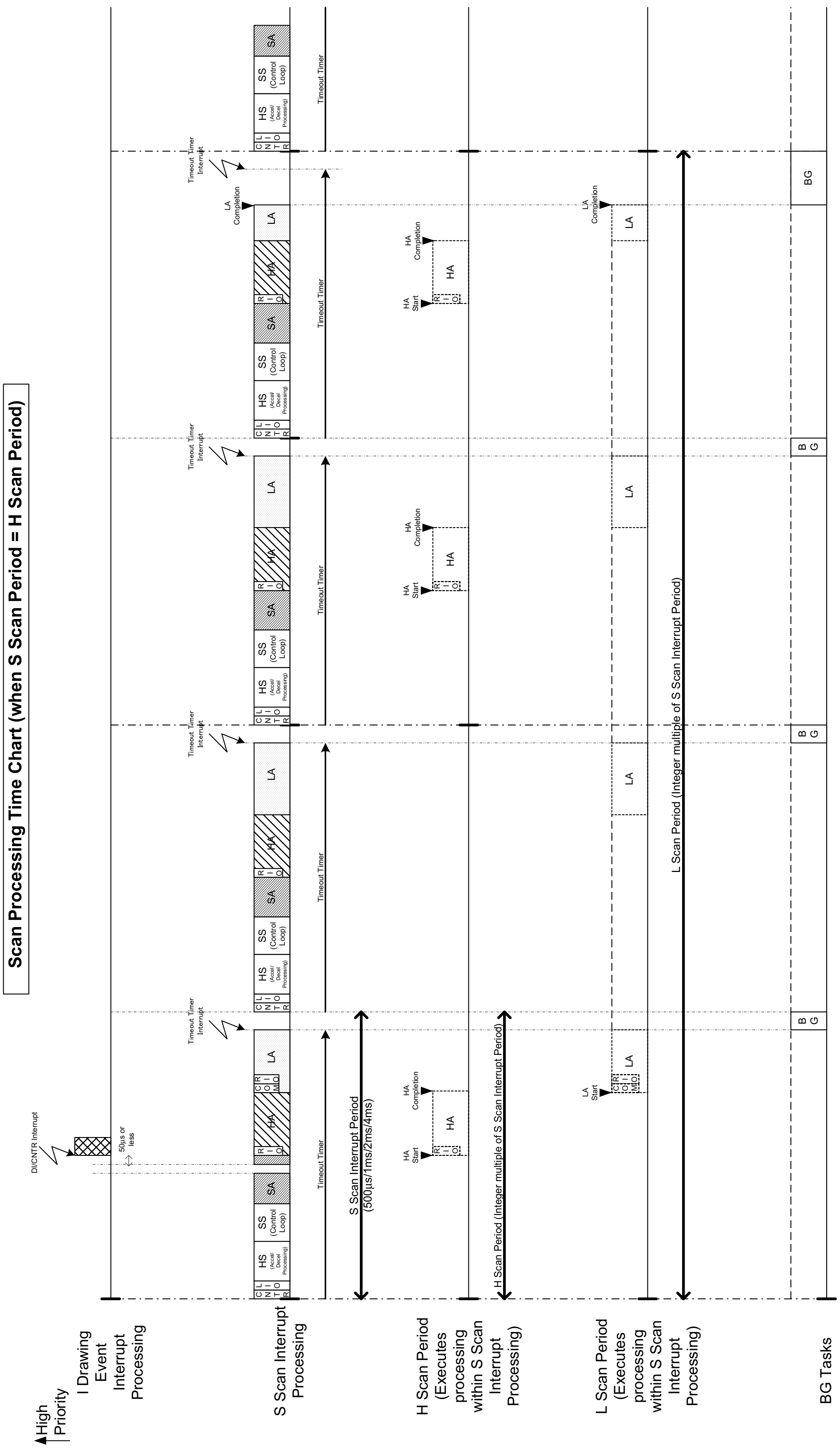
Scan Processing Timing Chart

When the H-scan is 2× the S-scan period and the L-scan is 4× the S-scan period, the timing chart is shown on the next page.

When the S-scan Period = H-scan Period
The timing chart is shown on the following two pages.

Scan Processing Timing Chart (with H Scan Period 2x S Scan Period) L Scan 4x




Scan Processing Time Chart (when S Scan Period = H Scan Period)
High Priority
I Drawing Event Interrupt Processing
S Scan Interrupt Processing
H Scan Period (Executes processing within S Scan Interrupt Processing)
L Scan Period (Executes processing within S Scan Interrupt Processing)
BG Tasks
DI/CNTR Interrupt
50µs or less
HS (Accel/Decel Processing)
SS (Control Loop)
SA
HA
LA
BG
Timeout Timer
Timeout Timer Interrupt
HA Start
HA Completion
LA Start
LA Completion
S Scan Interrupt Period (500µs/1ms/2ms/4ms)
H Scan Period (Integer multiple of S Scan Interrupt Period)
L Scan Period (Integer multiple of S Scan Interrupt Period)

M

O

P

R

S

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