Preface

We appreciate very much for your purchasing of Sharp servo products. This manual will be a helpful instruction to install, wire, inspect, and operate your Sharp servo drive and motor. Before using the servo drive and motor, please read this user manual to prevent from electric shock, fire, and injury.

■ In this manual, the safety instruction levels are classified into "DANGER" and "CAUTION".

DANGER	It indicates that incorrect operation may cause hazardous conditions, resulting in death or injury.
CAUTION	It indicates that incorrect operation may cause hazards, resulting in injury to person or damage to the product.

Note that the CAUTION level may lead to a serious consequence by cases. Be sure to follow the instructions of both levels to keep personnel safety well.

■ What must not be done and what must be done are indicated by the following marks.

	It indicates what must *NOT* be done.
	It indicates what must be done.

In this manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "NOTE".

※**After reading this user manual, always keep it accessible to the operator.**

1. To prevent electric shock, please confirm the followings.

⚠️ **DANGER**

🚫 *Do not operate the power switches with wet hand.*

❗ *Before wiring or inspection, switch power off and wait for more than 20 minutes. Check if the power indicator is off or the voltage is safe with voltage meter.*

❗ *Connect the servo drive and motor to ground.*

🚫 *Do not attempt to wire the servo drive and motor until they have been installed.*

🚫 *The cables should not be damaged, stressed, loaded, or punched.*

🚫 *Do not open the front cover of servo drive when the servo drive is running.*

🚫 *Do not try to operate the servo drive when the front cover of servo drive is removed.*

🚫 *Beside wiring or inspection, do not open the front cover of servo drive even when the power is off.*

❗ *Connect the "PE" (with⏚ mark)of servo drive to the protection earth of distribution box.*

❗ *Afford a good insulation for the power terminals (R,S,T /U,V,W...) of servo drive and motor.*

2. To prevent fire, note the followings.

⚠️ **CAUTION**

❗ *Install the servo drive, motor and regenerative brake resistor in a clean and dry location free from corrosive and inflammable gases or liquids. Otherwise a fire may be caused.*

❗ *With a faulty of servo drive, switch off the supplied power of servo drive.*

❗ *When an external regenerative brake resistor is used, connect the regenerative alarm output to trigger the main power switch.*

🚫 *Do not allow the foreign object such as oil, grease, screw or conductive dust intrude the servo drive and motor.*

❗ *The NFB circuit breaker should be applied between the main power and the servo drive.*

3. To prevent injury, note the followings.

⚠️ **CAUTION**

❗ *Apply the proper voltage specified in this manual to each power terminal of servo drive.*

🚫 *Do not confuse the connection of each power terminal.*

🚫 *Ensure that polarity (＋,－) of each power terminal is correct.*

🚫 *Do not touch the heat sink or regenerative resistor or motor while the servo drive is running or the servo drive is just powered down*

4. Other instructions

The following instructions should also be fully noted. Improper operation may cause a damage, fault, injury or electric shock, etc.

(1) Delivering and installation

⚠ CAUTION
🛈 *Delivery the products correctly according to their weights.*
🚫 *It is not allowed to stack the products in excess of the specified layers.*
🛈 *Do not carry the motor by the cables, shaft or encoder.*
🛈 *Install the servo drive and motor in a place where strong enough to withstand their weight.*
🚫 *Do not drop or strike servo drive or servo motor. Keep from all impact loads.*
🛈 *Install the servo drive and motor in the specified direction.*
🛈 *Keep enough space between the servo drive and other devices inside the distribution box.*
🚫 *Do not try to install or operate the damaged servo drive or the damaged motor.*
🚫 *Do not block the ventilation of servo drive. Otherwise, it results in damage of servo drive.*
🛈 *Use the servo drive and motor under the specified environmental conditions.*
🛈 *When this servo system has been stored for a long period time, please consult Sharp.*

(2) Wiring

⚠ CAUTION
🛈 *Make sure the wirings are correct. Otherwise, the servo motor may not work properly.*
🚫 *Do not cascade the power capacitor, surge absorber or noise filter from the drive output.*
🚫 *Do not apply a electromagnetic contactor between the servo drive and motor.*
🚫 *The surge absorbing diode installed on the DC output relay must be wired in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.*
🛈 *Ensure that all screws, connectors and wire terminations are fixed on the power supply, servo drive and motor to prevent from a burst, damage, or personal injury.*

(3) Trial run

⚠ CAUTION
🛈 *Before trial run, check if the parameters are set properly to prevent unexpected operation.*
🛈 *Trial run for servo motor should be under the no-load conditions. (no gear or belt coupled)*
🛈 *Ensure to perform trial run before your normal operation to prevent unexpected accident.*

(4) Duty operation

CAUTION

⚠ *Set an external emergency stop circuit so that to stop operation immediately as unexpected accidents occurred.*

🚫 *Do not disassemble or repair or even modify the servo drive and motor by yourself.*

⚠ *Before resetting an alarm, make sure that the run signal is off to prevent a sudden restart.*

⚠ *Use a noise filter to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo drive.*

🚫 *Do not burn or disassemble the servo drive, it may cause to generate some toxic gases.*

⚠ *Ensure that the servo drive and motor in capacity are compliance.*

🚫 *The electromagnetic brake inside the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.*

(5) Maintenance and Inspection

CAUTION

⚠ *Ensure that the power indicator is off before maintenance or inspection performed.*

🚫 *Only personnel who have been trained should conduct maintenance and inspection*

⚠ *Do not try to disassemble the servo drive or motor which any fault occurred*

⚠ *Do not connect or disconnect the servo drive with motor while power is still applied.*

⚠ *Some parts inside the servo drive are consumable and should be replaced periodically. For parts replacement, please consult Sharp.*

NOTE : This manual may be revised without prior notice. Please consult our agent or download the most updated version at https://sharp-industries.com/

1. Product descriptions

1.1 Summary

The control modes for Sharp communication type SDP series AC servo could be classified into the single operation and hybrid operation. There are 3 control modes for single operation: EtherCAT mode, position mode with inner command, speed mode. Only one mode is included in hybrid operation: position mode with inner command/speed mode. Therefore, the Sharp servo is suitable for the general industry machinery that requires the high precision and smooth speed control, or machine tools, or tension control.

SDP series AC servo drive is a slave station compliant with CAN application protocol over EtherCAT (CoE) standards. It is also compatible with the CiA 402 drive profile. SDP series drive equips "USB" port which could be connected to the personal computer performing parameters setting, trial run, gain value adjustment, and others.

SDP series AC servo drive with the enhance auto tuning function makes it easy to set the control gain values rapidly and accurately according to various mechanism. The encoder of servo motor is with 24-bit(16,777,216) pulse/rev resolution.

1.2 Drive model designation

Followings are the SDP series AC servo drive model designation.

S D P - ☐☐☐ ΔΔ ☐

Symbol	Function type
C	Full-close function

Symbol	Power voltage (Vac)
E2	*200~240Vac*

Symbol	Rated output (kW)
010	0.1
020	0.2
040	0.4
075	0.75
100	1
150	1.5
200	2
300	3
500	5
700	7

Sharp general purpose AC servo drive SDP series
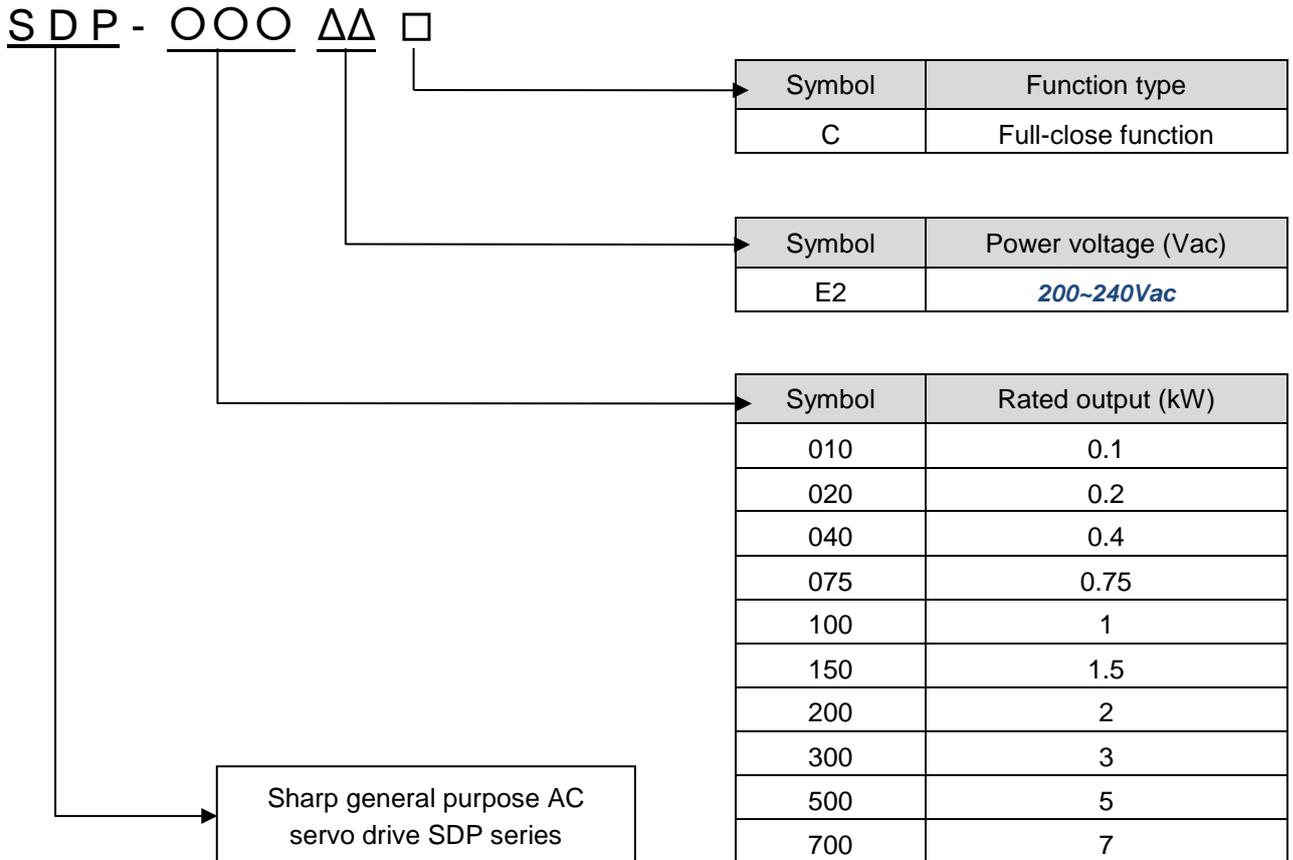
1.3 Motor model designation

(1) SMP series AC servo motor model designation

SMP-□○○○ △△○□□

Sharp Servo motor
SMP series

Symbol	Inertia class
L	low
M	medium

Symbol	Rated output (kW)
005	0.05
010	0.1
020	0.2
040	0.4
075	0.75
100	1
150	1.5
200	2
300	3
500	5
700	7

Symbol	Back side cable	Keyway shaft
A	X	X
B	X	○
C	○	X
D	○	○

Symbol	Oil seal	brake
A	X	X
B	X	○
C	○	X
D	○	○

Symbol	Encoder type
S	Single turn, 24bit/rev(*)
M	65536 turns, 24bit/rev(*)

Symbol	Rate speed
20	2000 rpm
30	3000 rpm
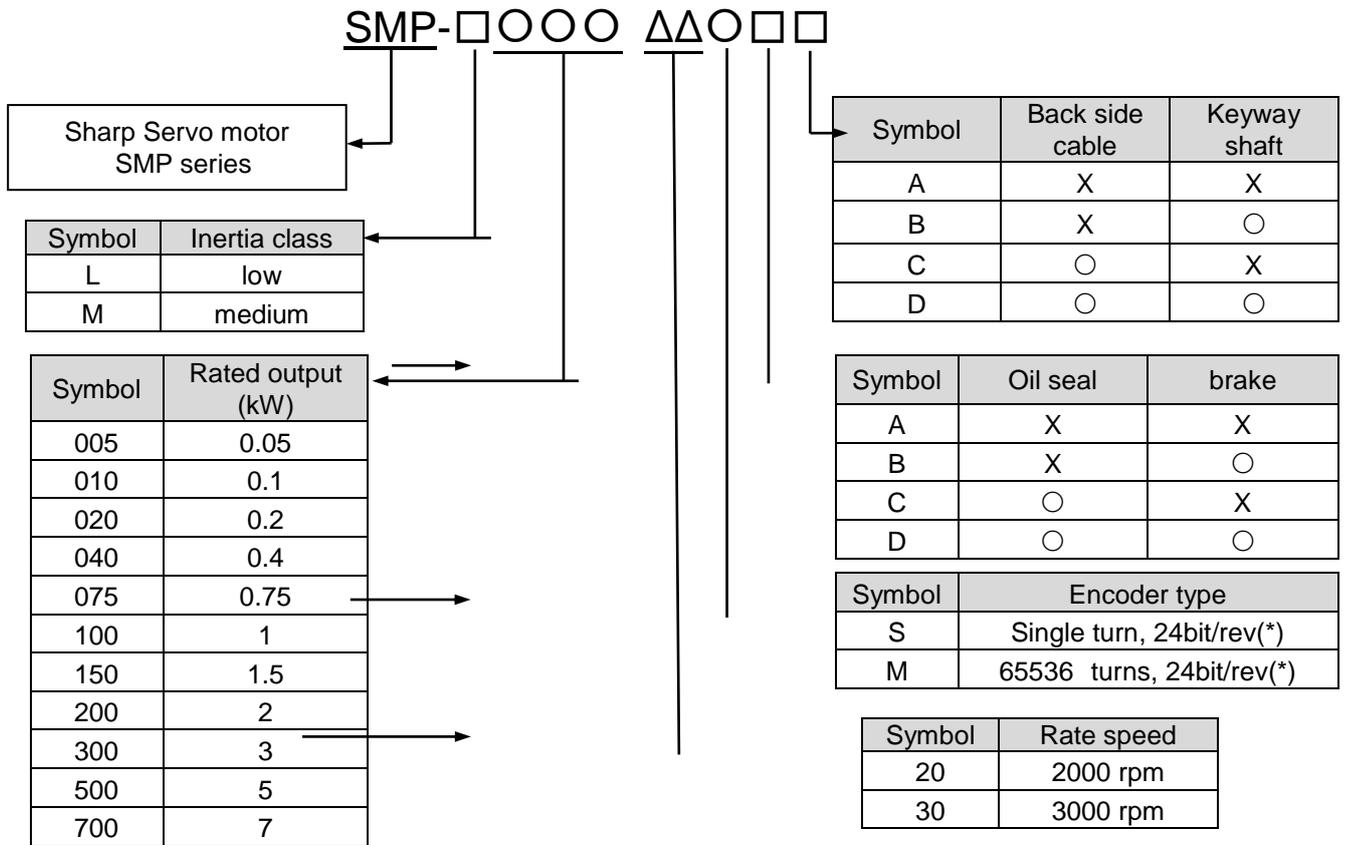
(*) Motors which capacity is 1kW or above equip with 23bit resolution, *65535 turns* encoder,.

(2) SME series AC servo motor model designation

When the SME motors are applied with the SDP drives, the resolution of servo system is **24-bit(*1)**. The higher resolution is necessary in some occasions, for example: high grade lathe, CNC and semiconductor manufactory application.

SME-□○○○ △△○□□□−XY → Sharp definition/ Customer ID code

Sharp servo motor SME series

Symbol	Inertia class
L	low
M	medium
H	high

Symbol	Rated output (kW)
005	0.05
010	0.1
020	0.2
040	0.4
075	0.75
100	1
150	1.5
200	2
300	3

Symbol	Rate speed (rpm)
20	2000
30	3000

Symbol	CE approval	UL approval
-	○	X
U	○	○

Symbol	Back side cable	Keyway shaft
A	X	X
B	X	○
C	○	X
D	○	○

Symbol	Oil seal	brake
A	X	X
B	X	○
C	○	X
D	○	○

Symbol	Encoder type
S	Single turn, 22bit/rev*(*2)*
M	65536 turns, 22bit/rev*(*2)*

*(*1)The actual resolution of SME is 22-bit, when it is paired with SDP-E, there are 2-bit didital augmented.*
*(*2) Motors which capacity is 1kW or above equip with 23bit resolution, 65535 turns encoder.*

1.4 Combinations of servo drive and motor

(1) <u>SMP series</u>

Servo drive	Servo motor	
	Low inertia series	Medium inertia series
SDP-010E2	SMP-L00530○□□	-
SDP-010E2C	SMP-L01030○□□	-
SDP-020E2C	SMP-L02030○□□	-
SDP-040E2C	SMP-L04030○□□	-
SDP-075E2C	SMP-L07530○□□	-
SDP-100E2C	SMP-L10030○□□	SMP-M10020○□□
SDP-150E2C	SMP-L15030○□□	SMP-M15020○□□
SDP-200E2C	SMP-L20030○□□	SMP-M20020○□□
SDP-300E2C	SMP-L30030○□□	SMP-M30020○□□
SDP-500E2C	-	SMP-M50020○□□
SDP-700E2C	-	SMP-M70020○□□

(2) <u>SME series</u>

Servo drive	Servo motor		
	Low inertia series	Medium inertia series	High inertia series
SDP-010E2C	SME-L00530○□□-		
SDP-010E2C	SME-L01030○□□-		
SDP-020E2C	SME-L02030○□□-		SME-H02030○□□
SDP-040E2C	SME-L04030○□□-		SME-H04030○□□
SDP-075E2C	SME-L07530○□□-		SME-H07530○□□
SDP-100E2C	SME-L10020○□□-	SME-M10020○□□	SME-H08515○□□
SDP-150E2C	SME-L15020○□□-	SME-M15020○□□	
SDP-200E2C	SME-L20020○□□-	SME-M20020○□□	
SDP-300E2C	SME-L30020○□□-	SME-M30020○□□	SME-H13015○□□
			SME-H18015○□□

1.5 Drive appearance and panel descriptions

Drive capacity *400W or less*

Operation keys:
Parameter setting, monitoring etc. are executed with 4 keys.
MODE: mode selection
- ▲ : +1 incremental key
- ▼ : -1 decreased key

SET : confirm key

Power indicator:
To indicate the remainder voltage of servo drive.

Brake resistor terminals:
Install an external resistor if large inertia load applied and frequent regeneration. **(Note 1)**

Auxiliary power input:
Connect L1/L2 to the single phase AC 200~240 volt power 50/60 Hz.

Main power input:
Connect R/S/T to commercial 3 phase AC 200~240 volt 50/60Hz

Output power terminals:
Connect U/V/W to servo motor in sequence. Do not confuse U/VW with R/S/T, it cause damage.

Ground terminals:

Display:
Drive status, parameter set, alarm code are displayed.

USB port:
Connect a PC or compatible superior controller.

26-pin DI/DO socket:
An I/O signal socket with particular signals for various applications

STO socket:
STO function related I/O

EtherCAT input port

EtherCAT output port

Motor encoder socket:
Used to connect the servo motor encoder

Secondary encoder input:
Used to connect the servo motor encoder

Note: 1.If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

Drive capacity 750W, 1kW, 1.5kW, 2kW. 3KW

Operation keys:
Parameter setting, monitoring etc. are executed with 4 keys.
MODE: mode selection
- ▲ : +1 incremental key
- ▼ : -1 decreased key

SET : confirm key

Power indicator:
To indicate the remainder voltage of servo drive.

Brake resistor terminals:
Install an external resistor if large inertia load applied and frequent regeneration. **(Note 1)**

Auxiliary power input:
Connect L1/L2 to the single phase AC 200~240 volt power 50/60 Hz.

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Connect R/S/T to commercial 3 phase AC 200~240 volt 50/60Hz

Output power terminals:
Connect U/V/W to servo motor in sequence. Do not confuse U/VW with R/S/T, it cause damage.

Ground terminals:

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EtherCAT input port

EtherCAT output port

Motor encoder socket:
Used to connect the servo motor encoder

Secondary encoder input:
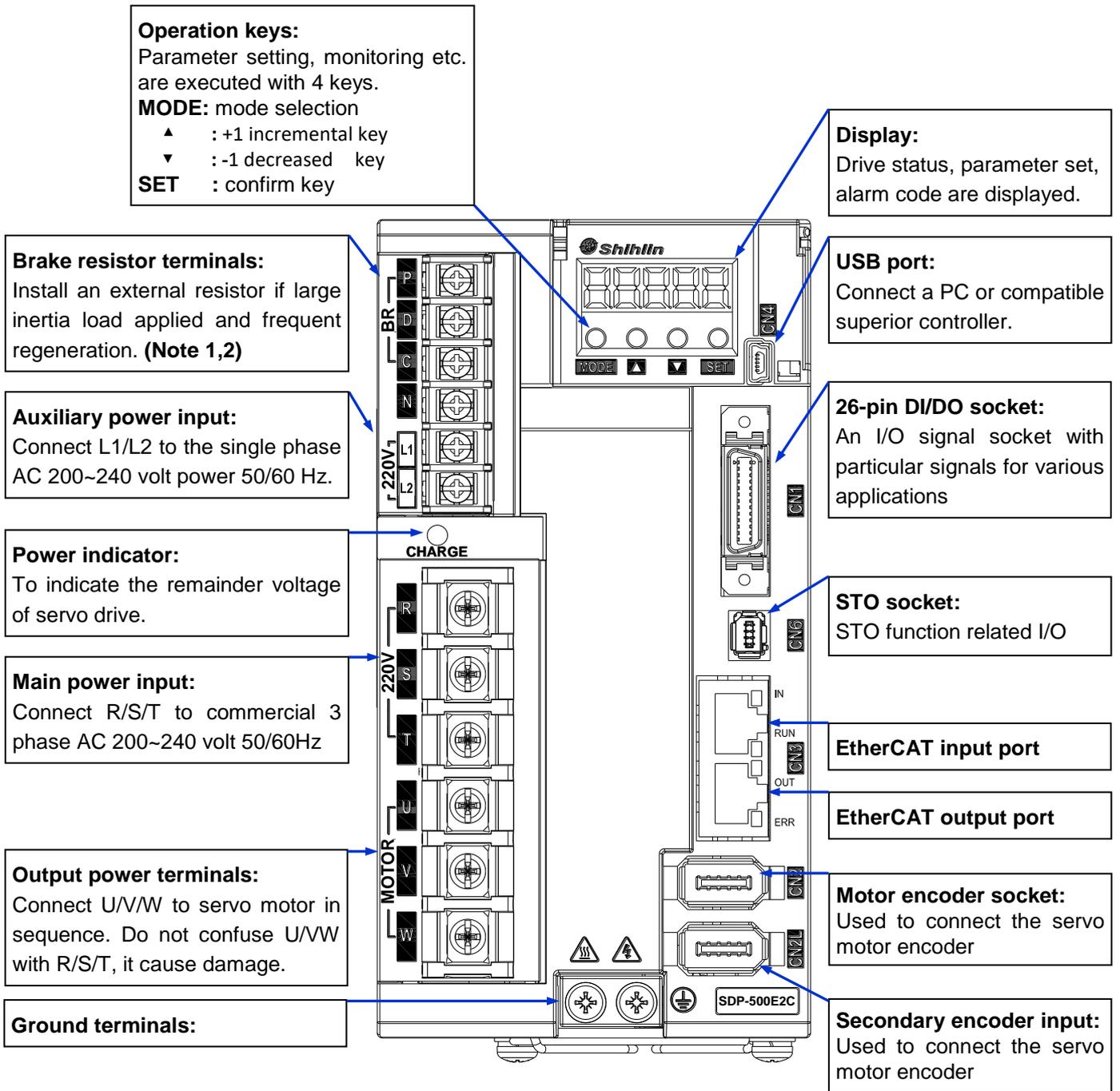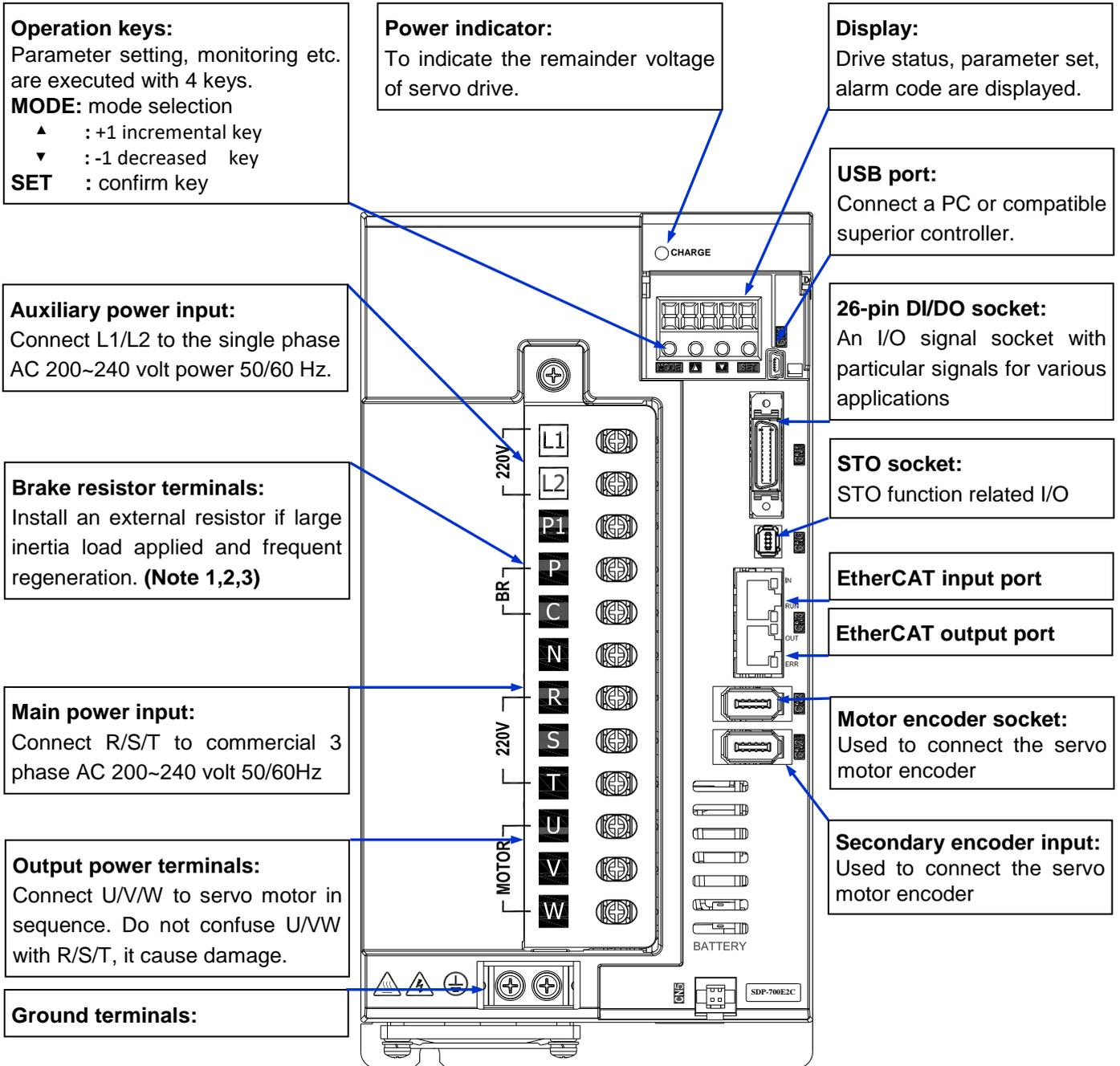Used to connect the servo motor encoder

Note: 1.If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

Drive capacity 5kW

Operation keys:
Parameter setting, monitoring etc. are executed with 4 keys.
MODE: mode selection
  ▲ **:** +1 incremental key
  ▼ **:** -1 decreased key
SET **:** confirm key

Display:
Drive status, parameter set, alarm code are displayed.

Brake resistor terminals:
Install an external resistor if large inertia load applied and frequent regeneration. **(Note 1,2)**

USB port:
Connect a PC or compatible superior controller.

Auxiliary power input:
Connect L1/L2 to the single phase AC 200~240 volt power 50/60 Hz.

26-pin DI/DO socket:
An I/O signal socket with particular signals for various applications

Power indicator:
To indicate the remainder voltage of servo drive.

STO socket:
STO function related I/O

Main power input:
Connect R/S/T to commercial 3 phase AC 200~240 volt 50/60Hz

EtherCAT input port

EtherCAT output port

Output power terminals:
Connect U/V/W to servo motor in sequence. Do not confuse U/VW with R/S/T, it cause damage.

Motor encoder socket:
Used to connect the servo motor encoder

Ground terminals:

Secondary encoder input:
Used to connect the servo motor encoder

Note: 1. If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.
2. If an active brake unit is applied, connect "P" and "N" to the unit and make "P" and "C" and "D" open.
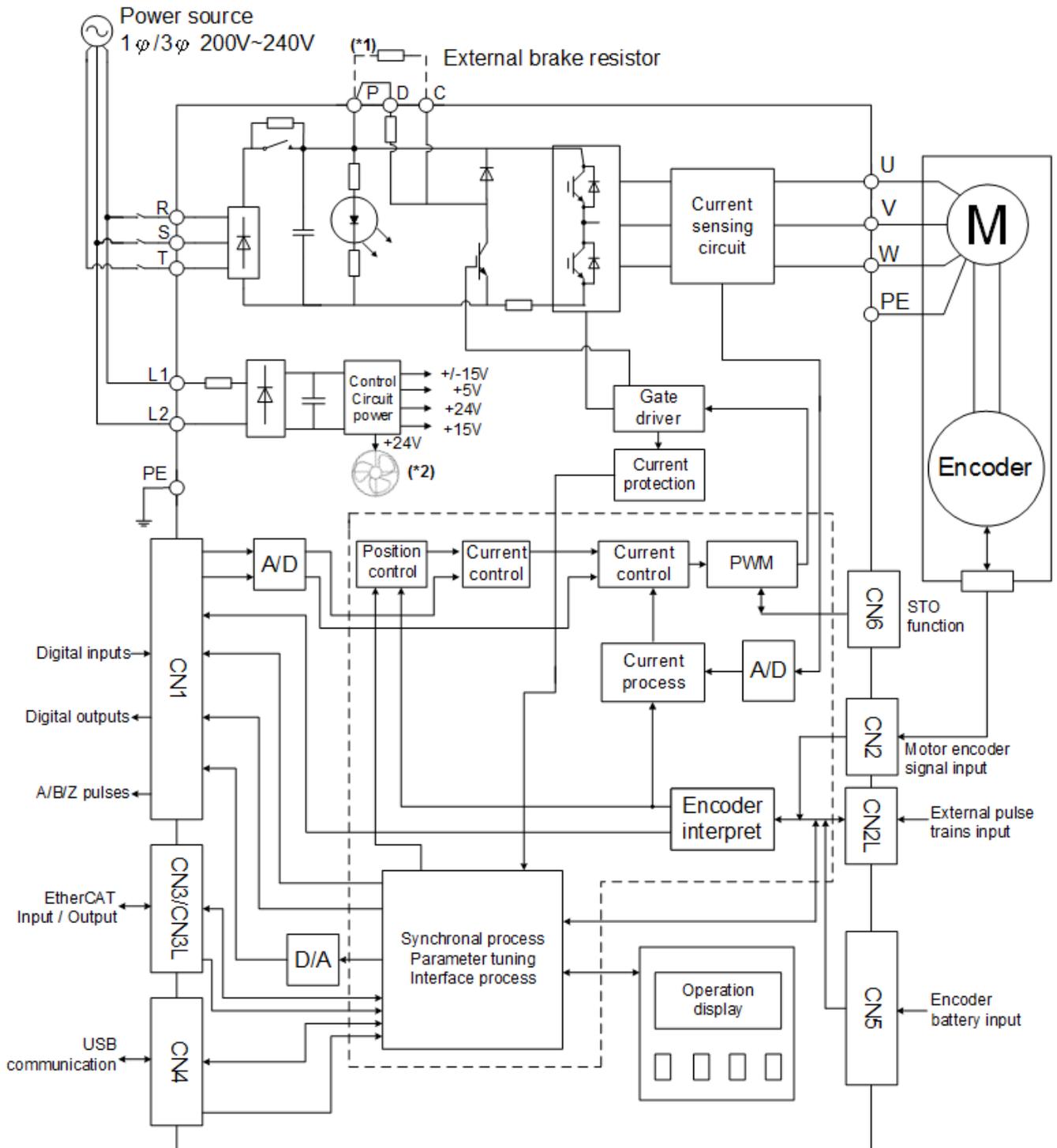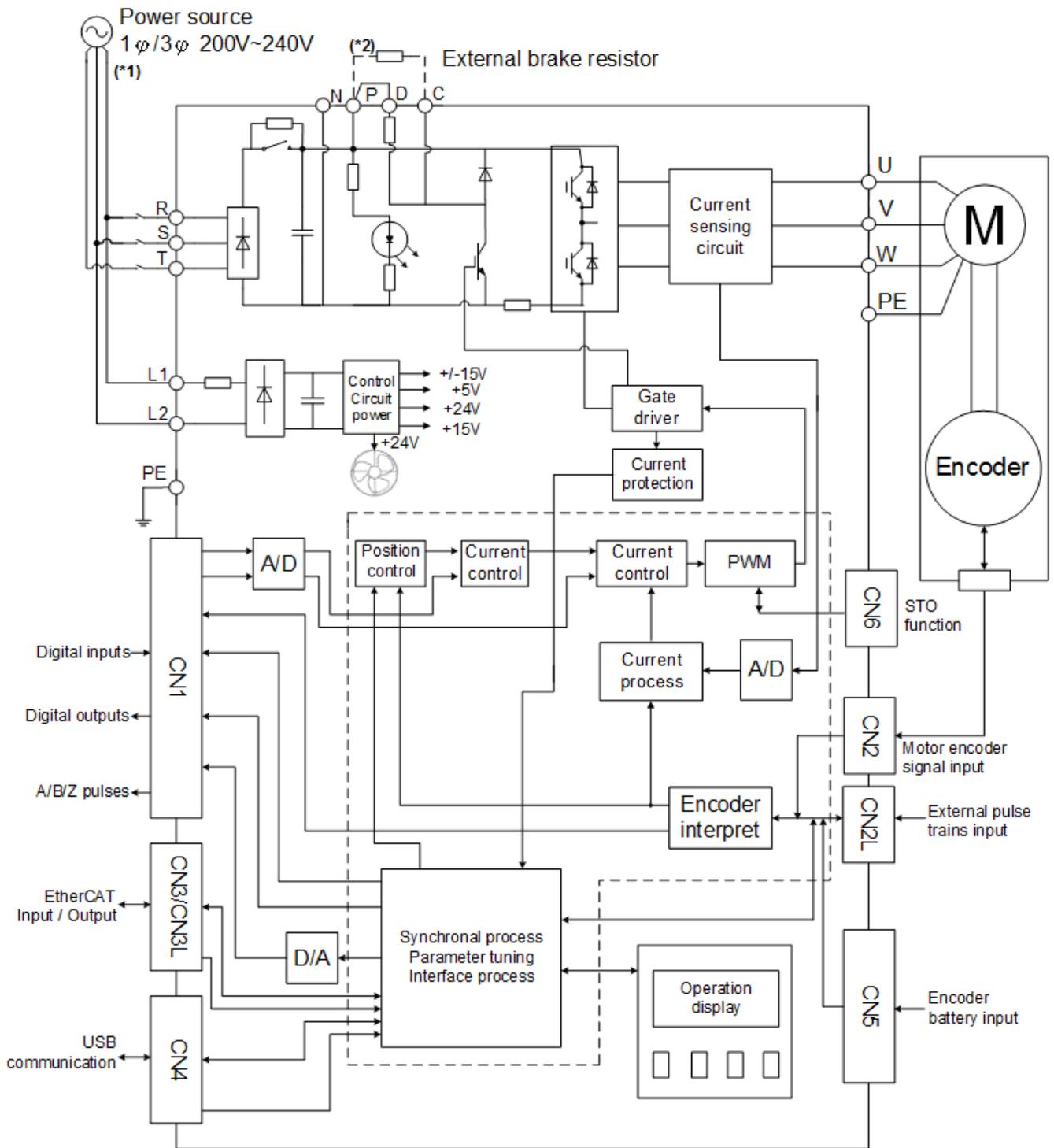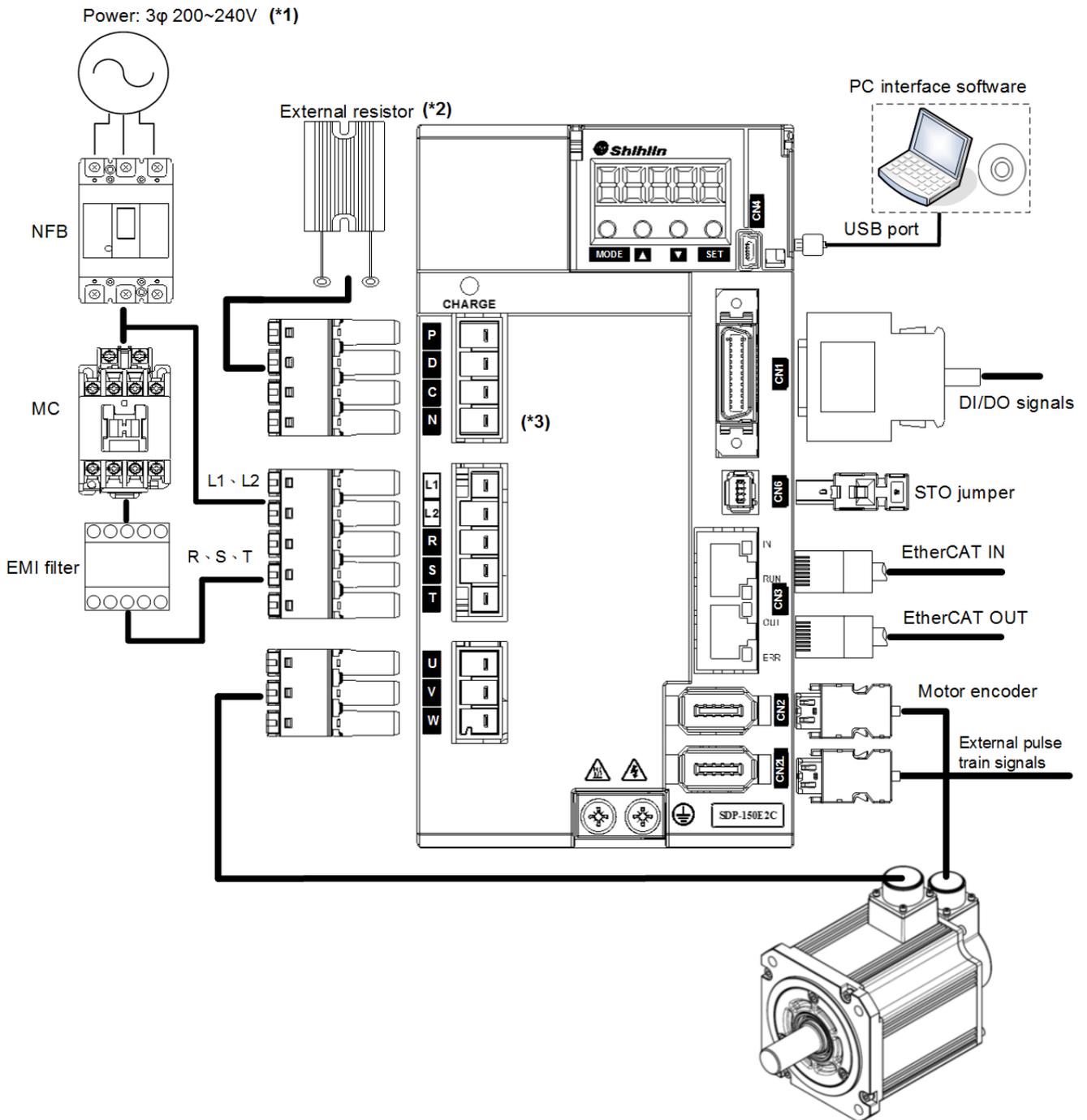
Drive capacity 7kW

Operation keys:
Parameter setting, monitoring etc. are executed with 4 keys.
MODE: mode selection
- ▲ : +1 incremental key
- ▼ : -1 decreased key
SET : confirm key

Power indicator:
To indicate the remainder voltage of servo drive.

Display:
Drive status, parameter set, alarm code are displayed.

USB port:
Connect a PC or compatible superior controller.

Auxiliary power input:
Connect L1/L2 to the single phase AC 200~240 volt power 50/60 Hz.

26-pin DI/DO socket:
An I/O signal socket with particular signals for various applications

Brake resistor terminals:
Install an external resistor if large inertia load applied and frequent regeneration. **(Note 1,2,3)**

STO socket:
STO function related I/O

EtherCAT input port

EtherCAT output port

Main power input:
Connect R/S/T to commercial 3 phase AC 200~240 volt 50/60Hz

Motor encoder socket:
Used to connect the servo motor encoder

Output power terminals:
Connect U/V/W to servo motor in sequence. Do not confuse U/VW with R/S/T, it cause damage.

Secondary encoder input:
Used to connect the servo motor encoder

Ground terminals:

CHARGE

220V — L1, L2
BR — P1, P, C
220V — N, R, S, T
MOTOR — U, V, W

BATTERY

SDP-700E2C

Note: 1. If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

2. If an active brake unit is used, connect "P" and "N" to the active brake unit and make "P" and "C" and "D" open.

3. If an external DC reactor is applied, please remove the short circuiting jumper between "P" and "P1", then connect the external DC inductor to "P1" and "P".

1.6 Function block diagram

Drive capacity *1kW or less*

Note: 1. If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

    2. Drive capacity 400W or less equips without cooling fan.

Drive capacity *1.5kW, 2kW, 3KW, 5kW*

Note: 1.Drive capacity 3kW or 5kW is suitable for 3-phase power source.

2.If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

Drive capacity *7kW*
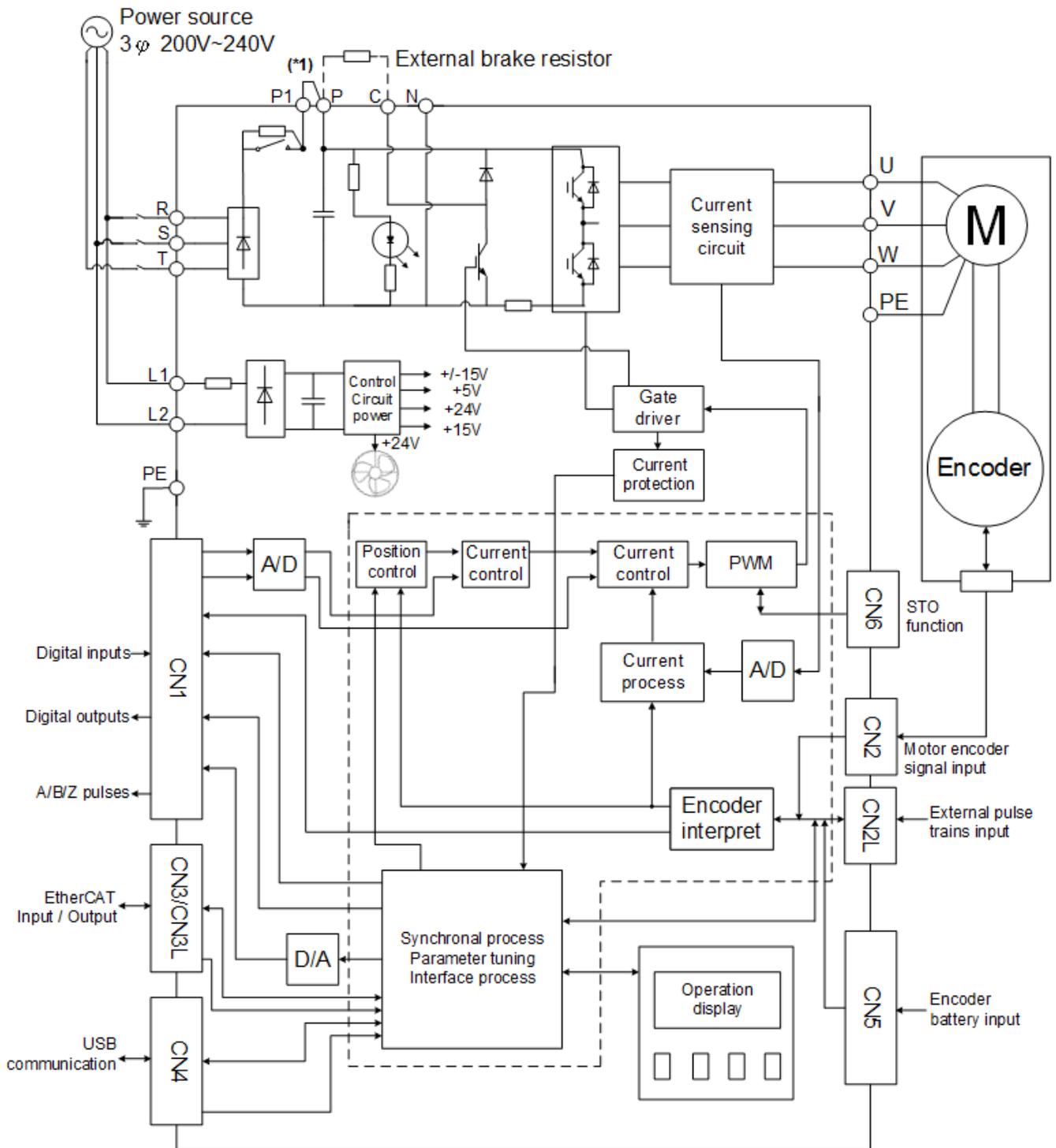
Note: 1.For aplying an external DC reactor, please remove the jumper between P1 and P and then connect P1 and P to the DC reactor. Not to remove the jumper between P1 and P if there is no DC reactor applied.

1.7 Wires with peripheral equipment
Drive capacity 5kW or less

Power: 3φ 200~240V **(*1)**

External resistor **(*2)**

PC interface software

USB port

NFB

MC

EMI filter

L1、L2

R、S、T

CHARGE

P
D
C
N

(*3)

L1
L2
R
S
T

U
V
W

SDP-150E2C

CN4

CN1

CN6

CN3

CN2

CN2L

IN
RUN
OUT
ERR

DI/DO signals

STO jumper

EtherCAT IN

EtherCAT OUT

Motor encoder

External pulse train signals

Note: 1.Drive capacity 2kW or less is suitable for single phase power source.

2. If an external brake resistor is applied, please make sure that "P" and "C" connect to the resistor, and make "P" and "D" open.

3.Drive capacity 1kW or less equips without "N" terminal.

Drive capacity 7kW
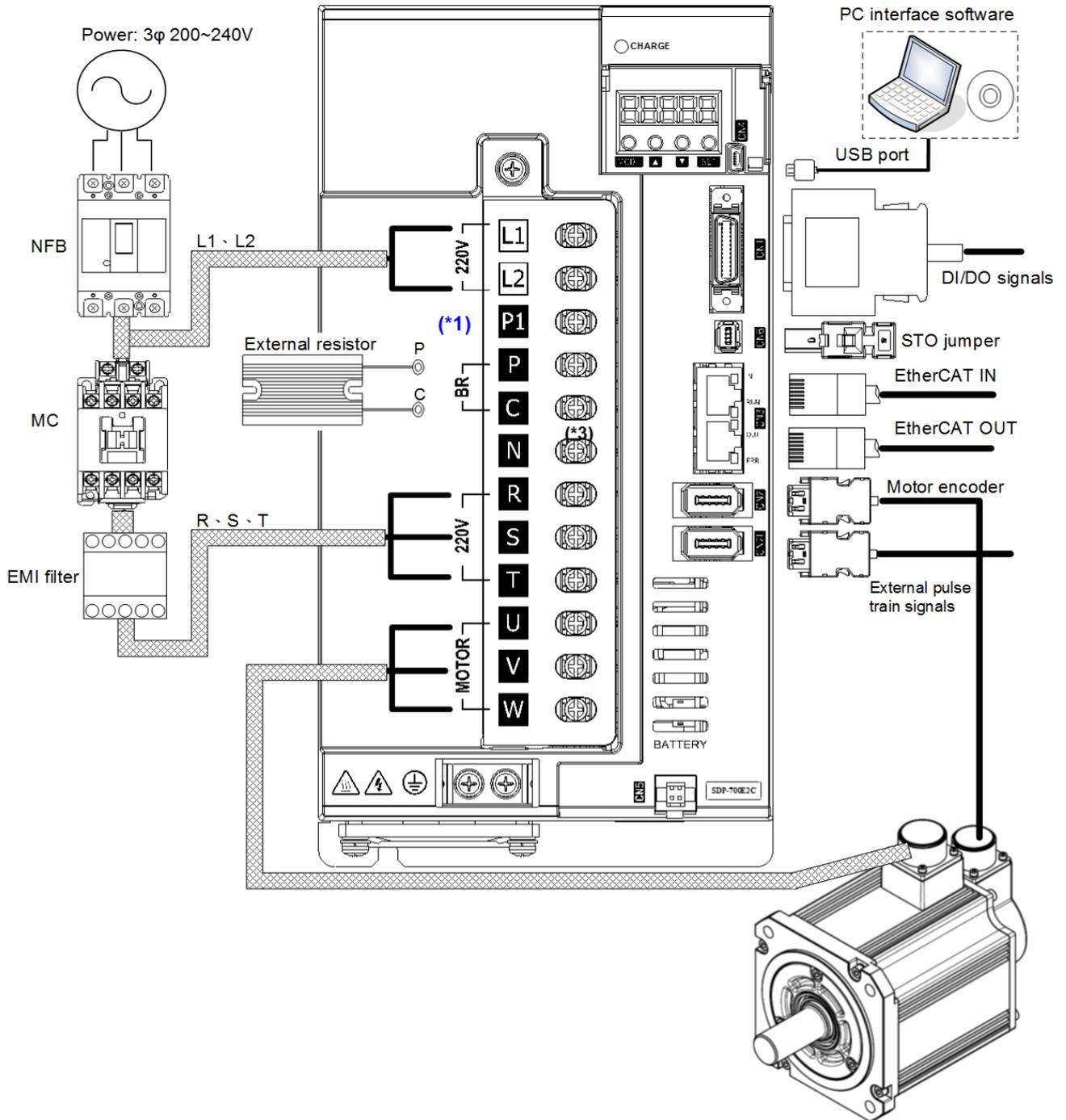
Note: 1.For aplying an external DC reactor, please remove the jumper between P1 and P and   then connect P1 and P to the DC reactor. Not to remove the jumper between P1 and P if there is no DC reactor applied.

1.8 Description of drive operation mode

SDP series servo drives afford a multiple control modes which are described as follows.

Operation Mode		Sign	Description
Basic	EtherCAT	CoE	Drive receives the command modes from the superior controller which is compatible for EtherCAT protocol. There are 8 modes: **CSP, CSV, CST, PP, PV, PT, HM, IP.**
	Position (inner command)	Pr	According to the parameters setting and DI signals, the drive runs the servo motor to reach the assigned position.
	Speed	S	Drives run the motor to attain the target speed with the inner r registers.
Switched		Pr-S	Pr and S are switched mutually via the DI signal.

★ Modify the PA01 value to switch the operation mode. The change is not valid until re-power on.

★ If the default definition of DI is preferred, please set the PA01 as "1XXX".

1.9 Drive spcifications

■ Drive electronic specification

SDP-□□□E2C			010	010	020	040	075	100	150	200	300	500	700
SMP-□□□□(*1) (matched motor)			L005	L010	L020	L040	L075	L100 M100	L150 M150	L200 M200	L300 M300	M500	M700
Motor power			50W	100W	200W	400W	750W	1KW	1.5KW	2KW	3KW	5KW	7KW
Main circuit power	Input	Voltage/Frequency	3φ or 1φ 200~240Vac, 50/60Hz (3kW or above is suitable for only 3φ power)										
		Allowable voltage Range	3φ or 1φ 170~264Vac, 50/60Hz (3kW or above is suitable for only 3φ power)										
		Allowable frequency Range	Within ±5%										
	Output	Voltage	110V					140V				208V	
		Current [A]	1.0	1.0	1.8	3.2	5.4	6.4	9.4	12.1	17.6	21.2	30.2
		Voltage/Frequency	0~250Hz					0~167Hz					
Control circuit power	Input	Voltage/Frequency	1φ AC200~240V 50/60Hz										
		Allowable voltage Range	1φ 170~264Vac										
		Allowable frequency Range	Within ±5%										
	Power consumption		30W										
Control mode			3φ full-wave rectification, IGBT-PWM control (SVPWM)										
Dynamic brake			electronic circuit built-in (hardware)										
Protection			Over current, over voltage, overload, fan failure protection, output short-circuit protection, abnormal encoder protection, abnormal regeneration protection, low voltage, power interruption protection, over speed protection, error excessive										
Communication interface			EtherCAT, USB										
Position control mode		Command source	EtherCAT protocol, inner register										
		Command smoothing	Low-pass filter/Linear acceleration and deceleration pattern/S-pattern smoothing										
		Electronic gear ratio	Electronic gear ratio A/B-time, A: 1~67,108,864; B:1~67,108,864; 1/50 < A/B < 64000										
		Position error excessive	±3 revolutions										
		Torque limit	EtherCAT protocol										
		Feed-forward function	Parameter setting: 0~200%										
Speed control mode		Speed control range	1:5000										
		Command source	EtherCAT protocol/Parameter command										
		Command smoothing	Low-pass filter/Linear acceleration and deceleration pattern/S-pattern smoothing										
		Speed fluctuation (*2)	Load change: 0~100%; maximum ±0.01%, Power source change ±10%; maximum 0.01%,										
		Torque limit	Inner limit or torque analog limit (0~+10Vdc/Maximum torque)										
		Bandwidth	Maximum 2.5kHz										

SDP-□□□E2		010	010	020	040	075	100	150	200	300	500	700
SMP-□□□□ (matched motor)		L005	L010	L020	L040	L075	L100	L150	L200	L300	M500	M700
							M100	M150	M200	M300		
Motor power		50W	100W	200W	400W	750W	1KW	1.5KW	2KW	3KW	5KW	7KW

Torque mode	Command source	EtherCAT protocol
	Command smoothing	Low-pass filter
	Speed limit	EtherCAT protocol
Digital input/output signal	Digital input (DI)	Servo ON, forward and reverse rotation limit switch, pulse error clearing, torque direction option, speed command option, position command option, forward and reverse rotation command, proportional control switched, torque limit switched, abnormal alarm reset, emergency stop, stroke limit, control mode switching, electric gear ratio options, gain switching, origin return, E-CAM engage
	Digital output (DO)	Torque limit attain, speed limit attain, ready signal, zero speed attained, position attained, speed attained, alarm signal, home moving completed, overload level attain, software stroke attain, Capture completed, E-CAM primary axis area

Environment	Temperature	operating	0℃~ 55℃(If it is above 45℃, forced cooling would be required)
		storage	-20~65℃(non-freezing)
	Humidity	operating	90%RH or less (non-condensing)
		storage	90%RH or less (non-condensing)
	Installation site		Indoor(no direct sunlight), no corrosive gas, no oil mist or dust, no flammable gas
	Altitude		Max.1000m (3280ft) or lower above sea level
	Vibration		Maximum 5.9 m/s^2

Cooling method, (structure)	Nature cooling, (IP20)	Force cooling, (IP20)		
Weight(kg)	1.4	1.7	2.6	5.9
Approval	CE			

(*1): SDP series drives are capable of running the SME series motors.

(*2): $Speed\ fluctuation = \dfrac{speed\ without\ load - speed\ with\ full\ load}{rate\ speed}$

■ **Drive dimensions**

SDP-010E2C、SDP-020E2C、SDP-040E2C (100W~400W)

unit: mm

單位[mm]

50
38
2-φ5.5
150
162

CNP1
CNP2
CNP3

(80)
150
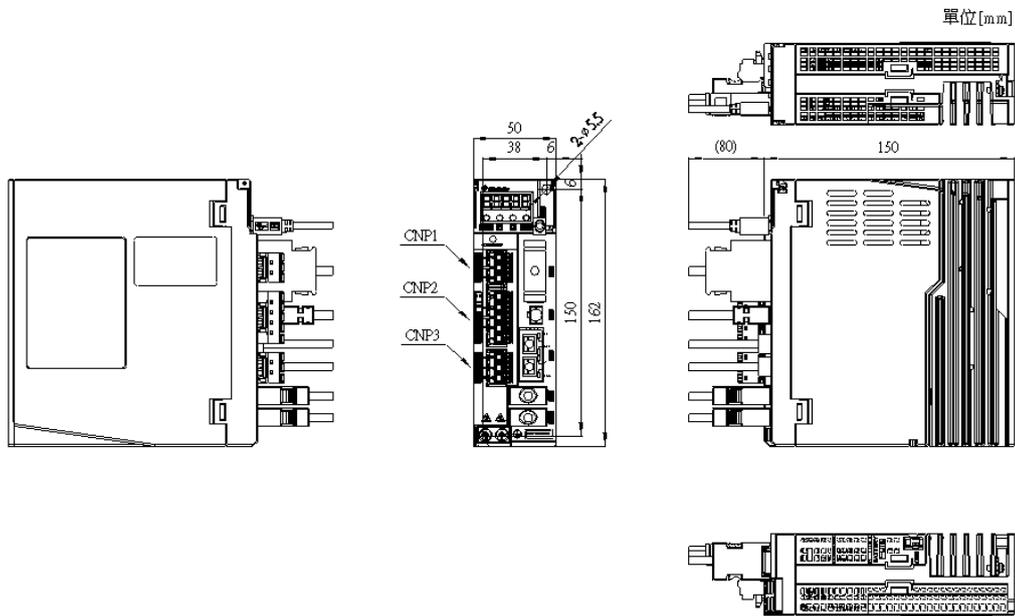
 *Dimensions of the servo drive may be revised without prior notice.

SDP-075E2C、SDP-100E2C (750W, 1KW)

unit: mm

單位[mm]

70
58
3-φ5.5
150
162

CNP1
CNP2
CNP3

(80)
170

air flow
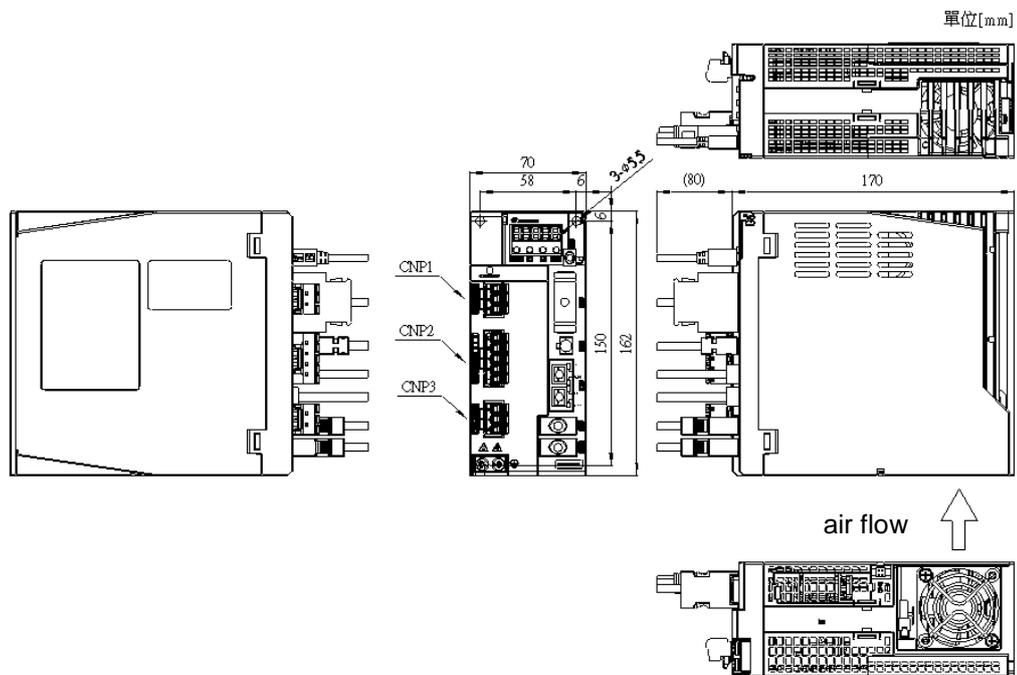
 *Dimensions of the servo drive may be revised without prior notice.
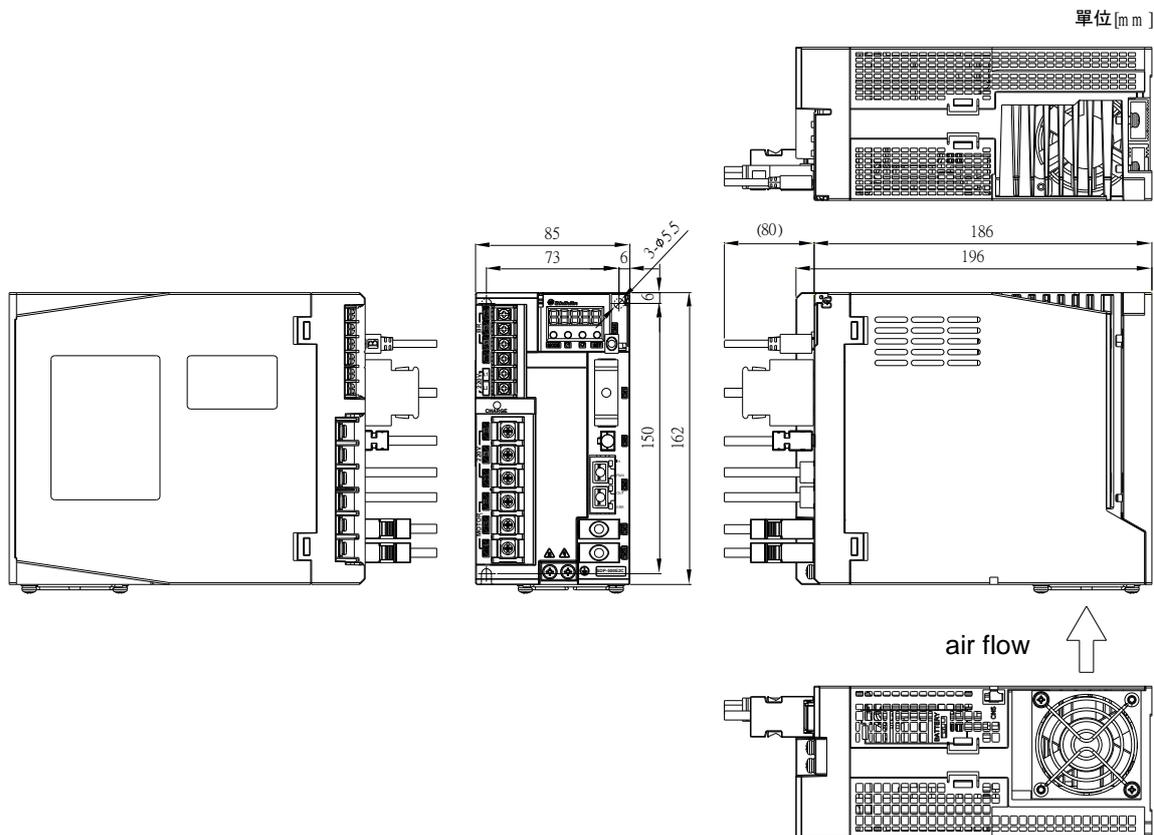
SDP-150E2C、SDP-200E2C、SDP-300E2C (1.5KW~3KW)

unit: mm
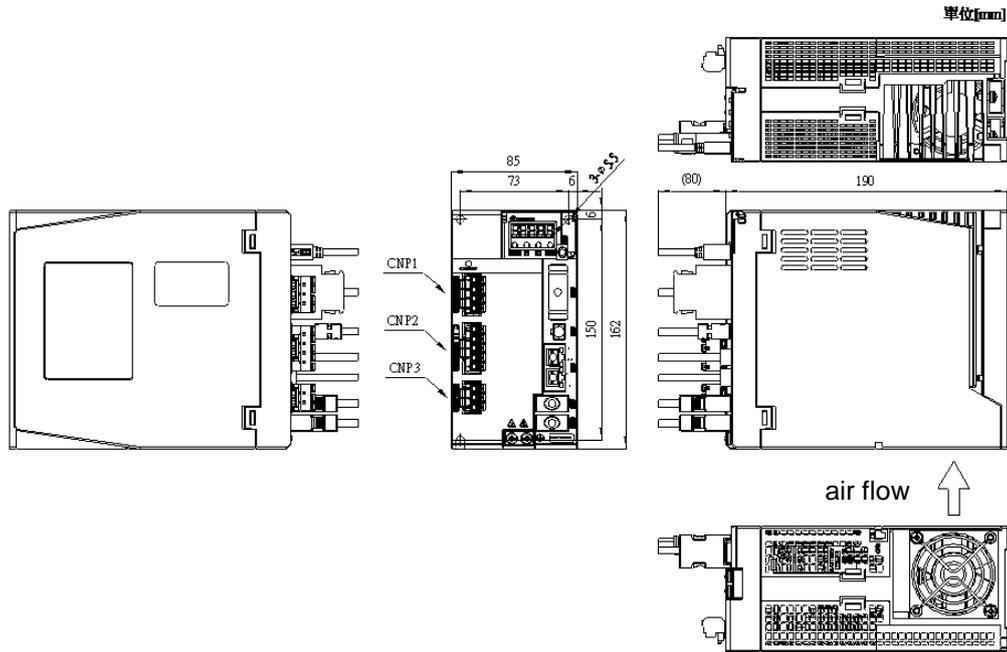
*Dimensions of the servo drive may be revised without prior notice.

SDP-500E2C(5KW)

unit:mm

*Dimensions of the servo drive may be revised without prior notice.

SDP-700E2C(7KW)

unit:mm

單位[m m]

air flow
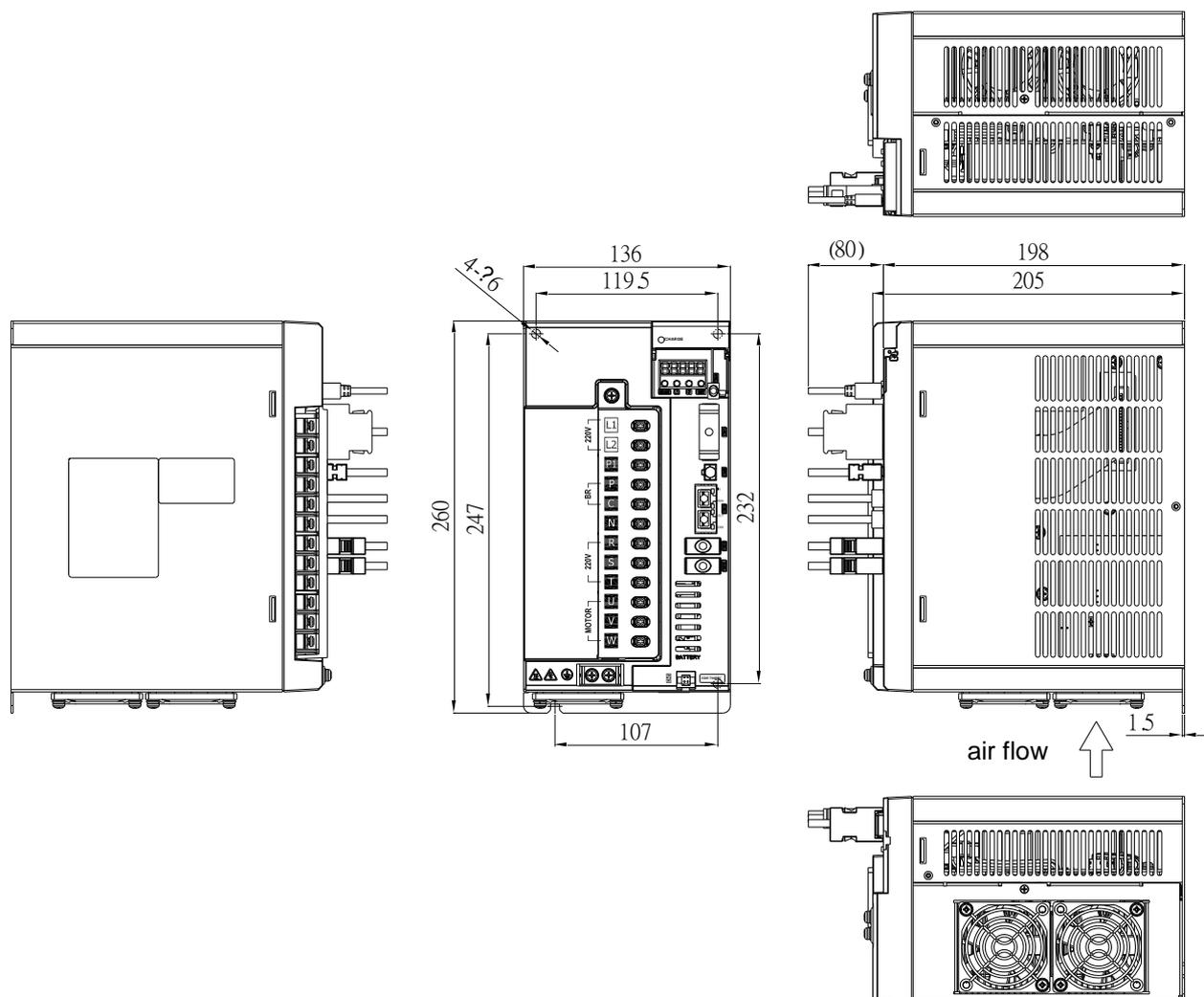
*Dimensions of the servo drive may be revised without prior notice.

1.10 Motor spcifications

■ Motor electric specification (Low inertia, small capacity)

SMP-L□□□30	Unit	005	010	020	040	075
Flange	mm	40		60		80
Rated output capacity	W	50	100	200	400	750
Rated torque	Nm	0.16	0.32	0.64	1.27	2.4
Maximum torque	Nm	0.48	0.96	1.92	3.81	7.2
Rated speed	rpm	3000				
Maximum speed	rpm	6000				
Rated current	A	0.85	0.85	1.7	2.8	5.8
Maximum current	A	2.7	2.7	5.2	9.0	18.5
Rotor inertia J (x10^{-4}) **(*1)**	kg-m^2	0.0295 (0.0299)	0.0518 (0.0523)	0.161 (0.178)	0.277 (0.294)	1.07 (1.11)
Continuous running power	kw/s	8.6	19.6	25.2	58.5	53.3
Installation mental plate size	mm	250 x 250 x 6				
Isolation class	-	CE(B) & UL(A)				
Isolation impedance	-	100MΩ @ DC500V				
Isolation withstand voltage	-	60sec @ AC1500V				
Encoder resolution **(*2)**	-	Singe turn 24bit (16,777,216); multi turn 16bit (65,536 turns)				
Structure	-	Totally enclosed, natural cooling (IP rating: IP65)				
Vibration rank	-	V-15				
Environment	Surrounding temperature	-	0 °C to 40 °C (non-freezing) / storage: -15 °C to 70 °C (non-freezing)			
	Surrounding humidity	-	80 %RH maximum (non-condensing) / storage: 90 %RH maximum (non-condensing)			
	Altitude	-	1000 m or less above sea level			
	Environment condition	-	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust			
	Vibration resistance	-	X/Y: 5G			
Shaft	Fd	mm	20		25	35
	Radial Fr	N	68.6		245	392
	Axial Fa	N	39.2		98	147
Electromagnetic brake	Input voltage	V	DC 24V ± 10%			
	Brake torque	Nm	0.3		1.3	2.4
	Power consumption	W	6.3		7.9	8.6
	Current consumption	A	0.24		0.32	0.35
	Impedance at 20°C	Ω	92.4		75.4	67
	Release time	ms	20		30	50
	Bind time	ms	20		20	20
Weight (*1)	Kg	0.33 (0.55)	0.45 (0.67)	0.85 (1.23)	1.23 (1.59)	2.24 (2.87)

*1**:** ( ) inside value indicates the inertia of servo with electromagnetic brake.
*2**:** *If SME motors are applied, the resolution is 22-bit.*

■ Motor electric specification (Low inertia, medium capacity)

SMP-L□□□20	Unit	100	150	200	300
Flange	mm	130			
Rated output capacity	W	1000	1500	2000	3000
Rated torque	Nm	4.78	7.16	9.55	14.3
Maximum torque	Nm	14.4	21.6	28.5	43.0
Rated speed	rpm	2000			
Maximum speed	rpm	3500			
Rated current	A	5.8	8.5	11	16
Maximum current	A	17.4	25.5	33	48
Rotor inertia J (x10^{-4}) **(*1)**	kg-m^2	6.1 (8.0)	8.8 (10.7)	11.5 (13.5)	16.7 (18.7)
Continuous running power	kw/s	37.6	58.3	79.3	122.9
Installation mental plate size	mm	300 x 300 x 12			
Isolation class	-	CE(F) / CE(B)			
Isolation impedance	-	100MΩ @ DC500V			
Isolation withstand voltage	-	60sec @ AC1500V			
Encoder resolution **(*2)**	-	Singe turn *23bit* (*8,388,608*); multi turn 16bit (65,536 turns)			
Structure	-	Totally enclosed, natural cooling (IP rating: IP65)			
Vibration rank	-	V-15			
Environment / Surrounding temperature	-	0 °C to 40 °C (non-freezing) / storage: -15 °C to 70 °C (non-freezing)			
Environment / Surrounding humidity	-	80 %RH maximum (non-condensing) / storage: 90 %RH maximum (non-condensing)			
Environment / Altitude	-	1000 m or less above sea level			
Environment / Environment condition	-	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust			
Environment / Vibration resistance	-	X/Y: 2.5G			
Shaft / Fd	mm	50			
Shaft / Radial Fr	N	490			
Shaft / Axial Fa	N	196			
Electromagnetic brake / Input voltage	V	DC 24V ± 10%			
Electromagnetic brake / Brake torque	Nm	8.5			15
Electromagnetic brake / Power consumption	W	19.3			19.3
Electromagnetic brake / Current consumption	A	0.8			0.8
Electromagnetic brake / Impedance at 20°C	Ω	29.8			29.8
Electromagnetic brake / Release time	ms	40			40
Electromagnetic brake / Bind time	ms	25			25
Weight (*1)	Kg	5.2 (7.0)	6.5 (8.3)	7.7 (9.5)	10.2 (12.0)

*1**:** (　) inside value indicates the inertia of servo with electromagnetic brake.

*2**:** *If SME motors are applied, the resolution is 22-bit.*

■ Motor electric specification (Medium inertia, medium capacity)

SMP-M□□□20	Unit	100	150	200	300	500	700
Flange	mm	130		176			
Rated output capacity	W	1000	1500	2000	3000	5000	7000
Rated torque	Nm	4.78	7.16	9.55	14.3	23.9	33.4
Maximum torque	Nm	14.4	21.6	28.5	43.0	71.7	100.2
Rated speed	rpm	2000					
Maximum speed	rpm	3500				2300	
Rated current	A	5.8	8.5	11	16	22	30
Maximum current	A	17.4	25.5	33	48	66	90
Rotor inertia J (x10⁻⁴) (*1)	kg-m²	10.3 (12.2)	15.0 (17.0)	32.1 (42.4)	61.2 (71.6)	84.6 (95)	121.6 (132)
Continuous running power	kw/s	22.1	34.2	28.4	33.5	68	92
Installation mental plate size (H x W x D)	mm	300 x 300 x 12		400 x 400 x 20		400 x 400 x 35	
Isolation class		CE(F)/ CE(B)				CE(F)	
Isolation impedance	-	100MΩ @ DC500V					
Isolation withstand voltage	-	60sec @ AC1500V					
Encoder resolution (*2)	-	Singe turn *23bit (8,388,608)*; multi turn 16bit (65,536 turns)					
Structure	-	Totally enclosed, natural cooling (IP rating: IP65)					
Vibration rank	-	V-15					
Environment	Surrounding temperature	-	0 °C to 40 °C / storage: -15 °C to 70 °C, non-freezing				
	Surrounding humidity	-	80 %RH maximum / storage: 90 %RH maximum, non-condensing				
	Altitude	-	1000 m or less above sea level				
	Environment condition	-	Indoors no direct sunlight; no corrosive gas, inflammable gas, oil mist or dust				
	Vibration resistance	-	X/Y: 2.5G				
Permissible load for the shaft	Fd	mm	50	50	70	70	78	78
	Radial Fr	N	490	490	980	980	980	980
	Axial Fa	N	196	196	392	392	392	392
Electromagnetic brake	Input voltage	Nm	8.5	8.5	45	45	45	45
	Brake torque	W	19.3	19.3	34	34	34	34
	Power consumption	A	0.8	0.8	1.41	1.41	1.41	1.41
	Current consumption	Ω	29.8	29.8	17	17	17	17
	Impedance at 20°C	ms	40	40	110	110	110	110
	Release time	ms	25	25	30	30	30	30
Weight (*1)	Kg	5.6/5.8 (7.4/7.6)	6.9/7.2 (8.7/9.0)	10.5/11.0 (15.8/16.3)	15.3/15.8 (20.6/21.1)	19.1 (24.4)	24.5 (29.8)

*1: ( ) inside value indicates the inertia of servo with electromagnetic brake.

*2: *If SME motors are applied, the resolution is 22-bit.*

■ <u>Motor electric specification</u> (High inertia, small capacity)

SME-H□□□20		Unit	020	040	075
Flange		mm	60		80
Rated output capacity		W	200	400	750
Rated torque		Nm	0.64	1.27	2.4
Maximum torque		Nm	2.24	4.45	8.4
Rated speed		rpm	3000		
Maximum speed		rpm	6000		
Rated current		A	1.7	3.0	5.8
Maximum current		A	5.95	10.5	20.3
Rotor inertia J (x10^{-4}) (**1**)		kg-m^2	0.354 (0.371)	0.619 (0.636)	1.655 (1.713)
Continuous running power		kw/s	11.58	26.15	34.33
Installation mental plate size (H x W x D)		mm	250 x 250 x 6		
Isolation class			CE(B)		
Isolation impedance		-	100MΩ @ DC500V		
Isolation withstand voltage		-	60sec @ AC1500V		
Encoder resolution (**2**)		-	Singe turn **24bit** (16,777,216); multi turn 16bit (65,536 turns)		
Structure		-	Totally enclosed, natural cooling (IP rating: IP65)		
Vibration rank		-	V-15		
Environment	Surrounding temperature	-	0 °C to 40 °C / storage: -15 °C to 70 °C, non-freezing		
	Surrounding humidity	-	80 %RH maximum / storage: 90 %RH maximum, non-condensing		
	Altitude	-	1000 m or less above sea level		
	Environment condition	-	Indoors no direct sunlight; no corrosive gas, inflammable gas, oil mist or dust		
	Vibration resistance	-	X/Y: 5G		
Permissible load for the shaft	Fd	mm	25		35
	Radial Fr	N	245		392
	Axial Fa	N	98		147
Electromagnetic brake	Input voltage	Nm	DC 24V ± 10%		
	Brake torque	W	1.3		2.5
	Power consumption	A	7.9		8.0
	Current consumption	Ω	0.32		0.33
	Impedance at 20°C	ms	75.4		72
	Release time	ms	30		60
Weight (*1)		Kg	0.86 (1.23)	1.25 (1.63)	2.27 (3.10)

*1**:** (   ) inside value indicates the inertia of servo with electromagnetic brake.

■ Notification of Motor specification

1. If the lifting or rapid back and forth motion is applied, the average load ratio of motor should be 75% or less.
2. For the IP65 rating of motor constructure, the motor shaft and sockets are not excluded.
3. The electromagnetic brake of motor is only used to fix the mechanism which has stopped.
4. Motors which capacity is 1kW or above equip with 23bit resolution encoder.
5. Refer to the diagram below for the permissible load for the shaft.
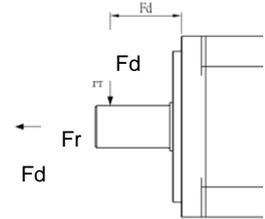
■ Motor dimensions
3000rpm Rated Speed Motor
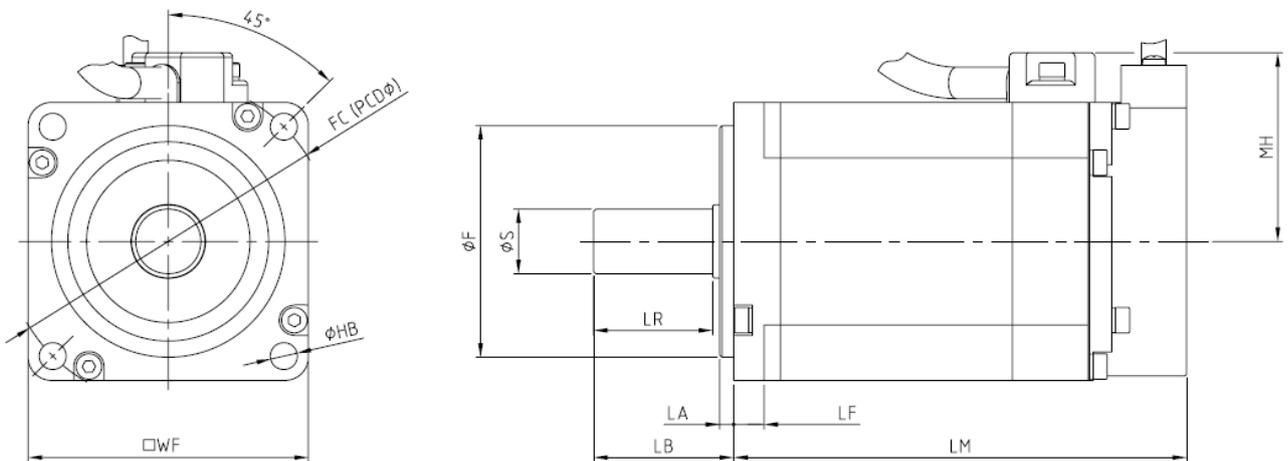
Model	Dimensions (mm)										
	WF	φS	φF	LA	LB	LF	LR	MH	LM(*1)	FC	HB
SMP-L005	40	$\varphi 8\ ^{0}_{-0.009}$	$\varphi 30\ ^{0}_{-0.03}$	2.5	25.5	5.5	21.5	31	64.5 (99.2)	46	2-φ4.5
SMP-L010									80.0 (114.7)		
SMP-L020 SME-H020 SMP-L040 SME-H020	60	$\varphi 14\ ^{0}_{-0.011}$	$\varphi 50\ ^{0}_{-0.03}$	3	30	6.5	25	41	77.0 (112) 97.0 (132)	70	4-φ5.8
SMP-L075	80	$\varphi 19\ ^{0}_{-0.013}$	$\varphi 70\ ^{0}_{-0.03}$	3	40.7	7.5	35.5	51	102.0 (141)	90	4-φ6.6
SME-H020									102.0 (145.5)		

*1: ( ) inside value indicates the inertia of servo motor with electromagnetic brake.

2000rpm Rated Speed Motor
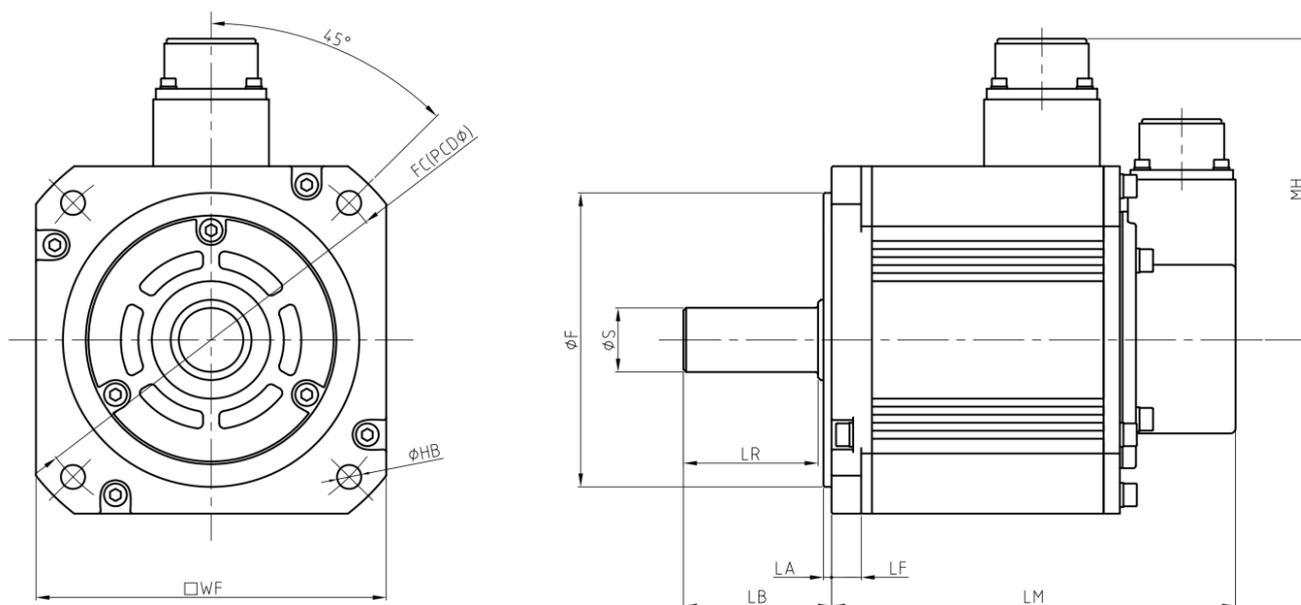
適用機種	Dimensions (mm)										
	WF	φS	φF	LA	LB	LF	LR	MH	LM *1	FC	HB
SMP-L100	130	$\varphi 24 \, {}^{0}_{-0.013}$	$\varphi 110 \, {}^{0}_{-0.035}$	3	55	11	50	113	127 (161)	145	4-φ9.0
SMP- L150									141.5 (175.5)		
SMP- L200									156 (190)		
SMP- L300									185 (219)		
SMP-M100	130	$\varphi 24 \, {}^{0}_{-0.013}$	$\varphi 110 \, {}^{0}_{-0.035}$	3	55	11	50	113	127 (161)	145	4-φ9.0
SMP-M150									141.5 (175.5)		
SMP-M200	176	$\varphi 35 \, {}^{0}_{-0.016}$	$\varphi 114.3 \, {}^{0}_{-0.025}$	3	78	18.5	74	139	139 (189)	200	4-φ13.5
SMP-M300									169 (219)		
SMP-M500	176	$\varphi 35 \, {}^{0}_{-0.016}$	$\varphi 114.3 \, {}^{0}_{-0.025}$	3	78	18.5	74	139	189 (239)	200	4-φ13.5
SMP-M700									229 (279)		

*1: ( ) inside value indicates the inertia of servo motor with electromagnetic brake.

■ **Motor connectors**

(a). Small capacity motor power line connectors (under 750W)

Power	Motor type
100W	SMP-L01030○□□
200W	SMP-L02030○□□
400W	SMP-L04030○□□
750W	SMP-L07530○□□
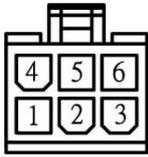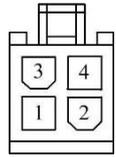
With brake | Without brake

Pin	Sign	Wire color
1	U	Red
2	V	White
3	W	Black
4	PE	Green/Yellow
5	B1	Black (with brake)
6	B2	Black (with brake)

(b). Medium capacity motor power line connectors (1KW~3KW)

Power	Low inertia	Medium inertia
1KW	SMP-L10020○□□	SMP-M10020○□□
1.5KW	SMP-L15020○□□	SMP-M15020○□□
2KW	SMP-L20020○□□	
3KW	SMP-L30020○□□	
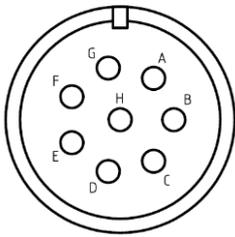
Pin	Sign	Description
A	NC	-
B	U	U phase power
C	V	V phase power
D	W	W phase power
E	PE	Earth
F	B1	Brake wiring
G	B2	Brake wiring
H	NC	-

(c). Medium capacity motor power line connectors (2KW, 3KW)

Power	Medium inertia
2KW	SMP-M2020○□□
3KW	SMP-M30020○□□

Pin	Sign	Description
A	NC	-
B	U	U phase power
C	V	V phase power
D	W	W phase power
E	PE	Earth
F	B1	Brake wiring
G	B2	Brake wiring
H	NC	-

(d). Medium capacity motor power line connectors (5KW, 7KW)

Power	Medium inertia	Power connector	Brake connector	Pin	Sign	Description
				A	U	U phase power
				B	V	V phase power
5KW	SMP-M2020○□□			C	W	W phase power
				D	PE	Earth
7KW	SMP-M30020○□□			A	B1	Brake wiring
				B	B2	Brake wiring
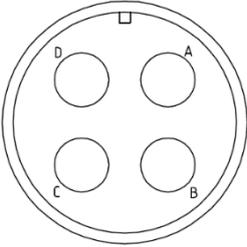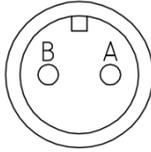
Note: The connector specifications are the same between SME and SMP

1.11 Motor characteristic

The only difference between SMP and SME series motors is the motor's resolution

T-N curve / S-T curve

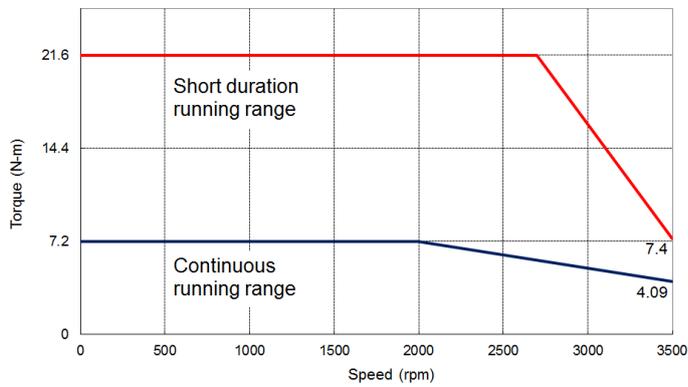Once the applied voltage of motor is insufficient, the torque generated will reduce.
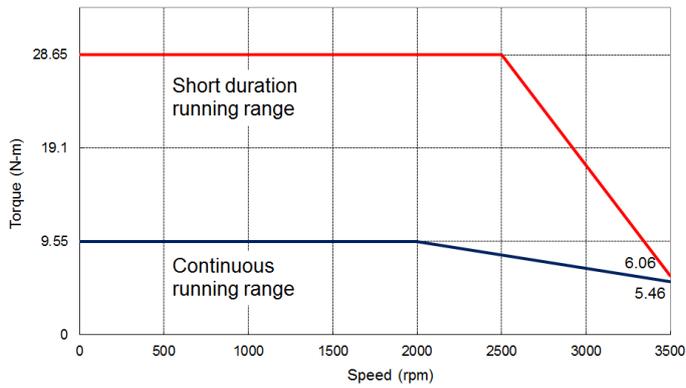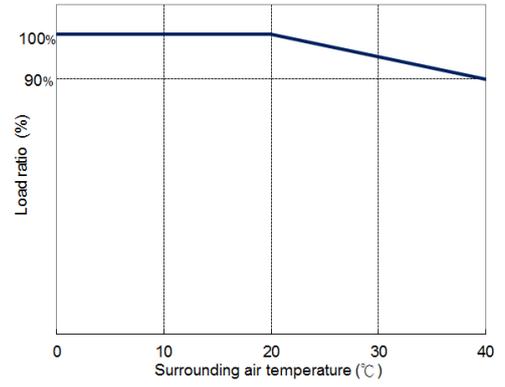
【SMP-L005】
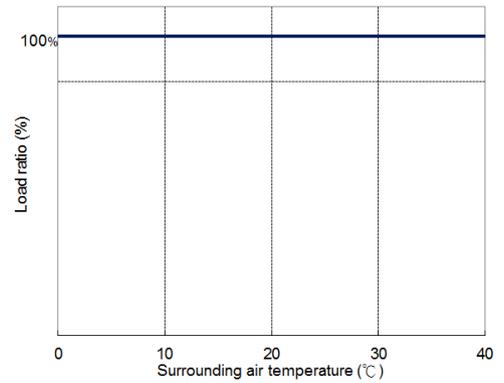
【SMP-L010】

【SMP-L020】

【SME-H020】

SME-H020

Torque (N-m) vs Speed (rpm)
- Short duration running range (2.24)
- Continuous running range (0.64 to 0.32)

Load ratio (%) vs Surrounding air temperature (℃) — 100%

【SME-H040】

SME-H040

Torque (N-m) vs Speed (rpm)
- Short duration running range (4.45)
- Continuous running range (1.27 to 0.64)

Load ratio (%) vs Surrounding air temperature (℃) — 100%
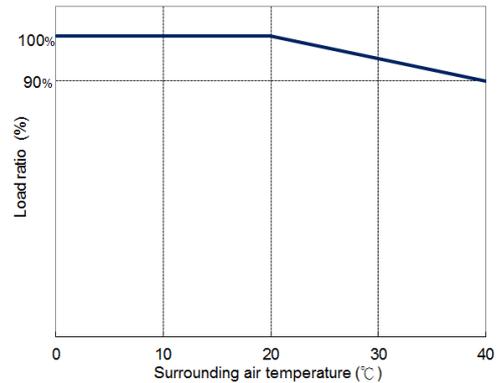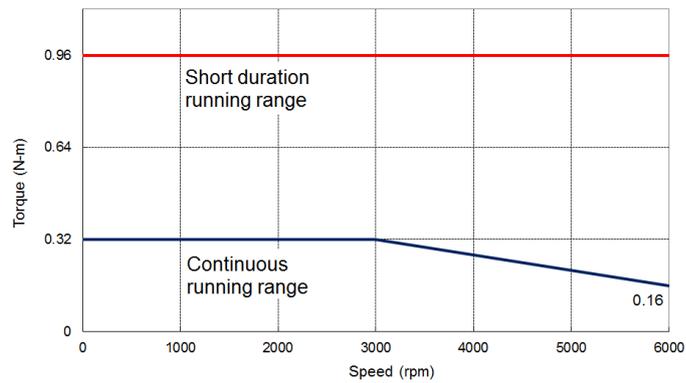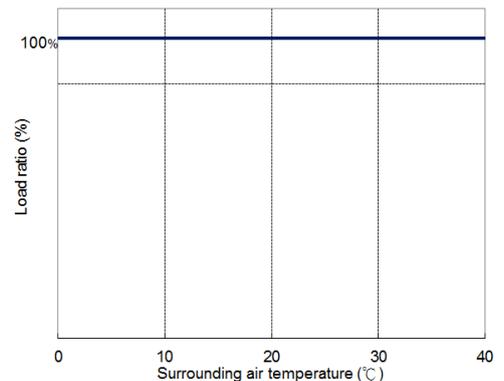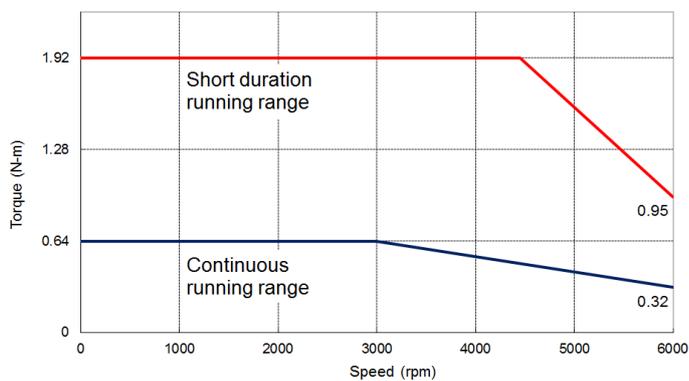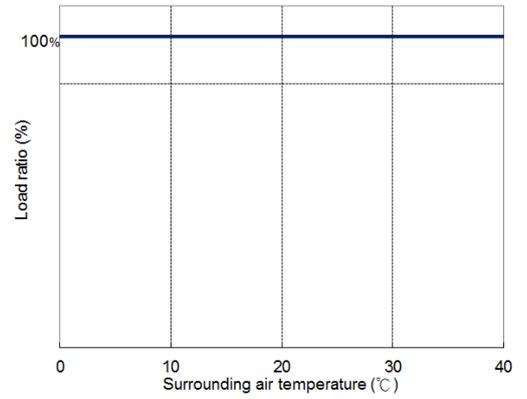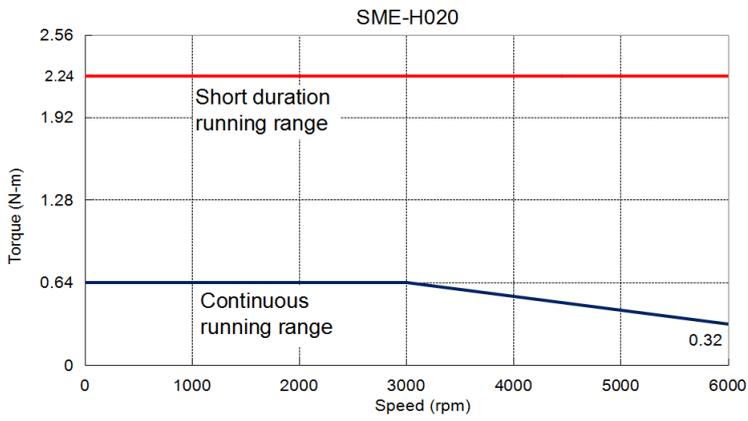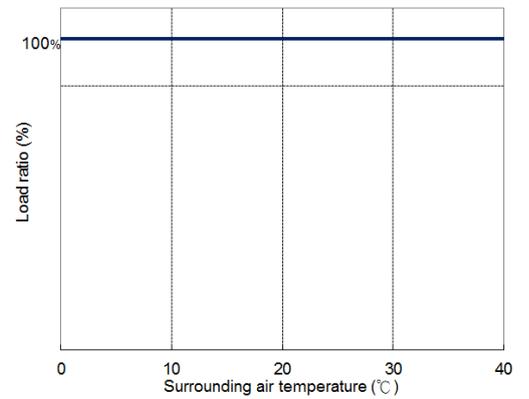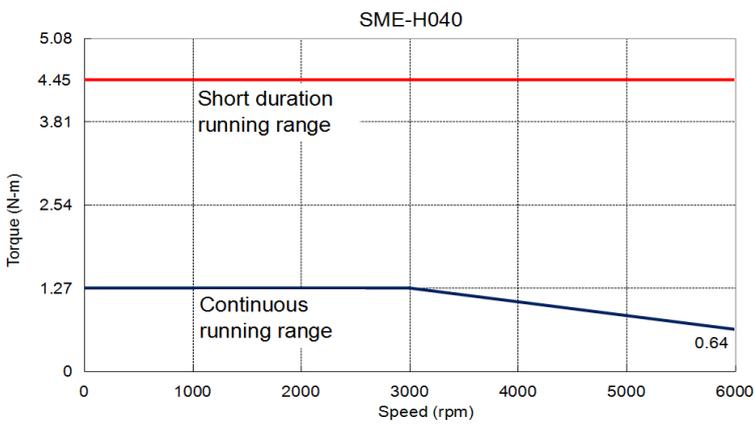
【SME-H075】

SME-H075
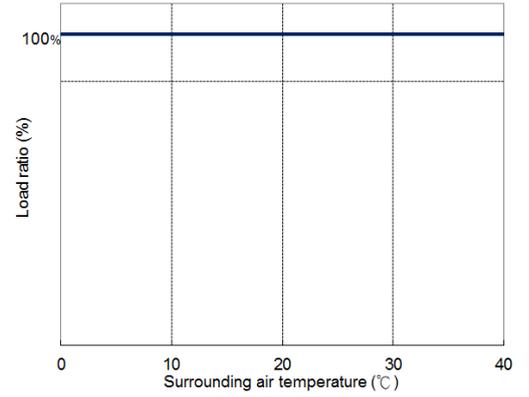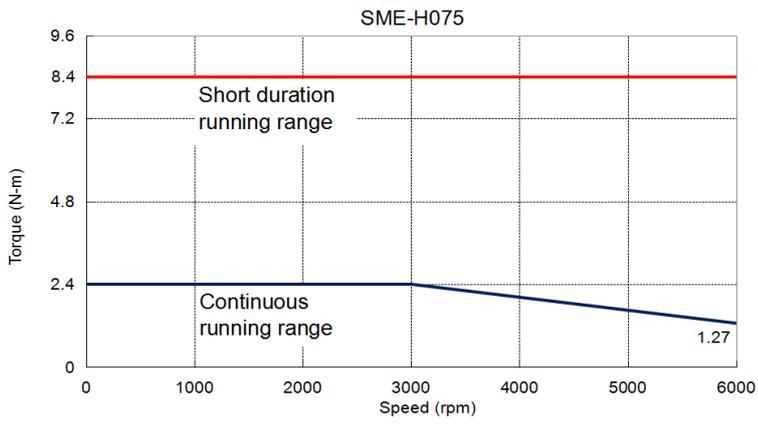
【SMP-L040】

【SMP-L075】

【SMP-L100】

Torque (N-m): 14.4, 9.6, 4.8, 0
Speed (rpm): 0, 500, 1000, 1500, 2000, 2500, 3000, 3500
Short duration running range
Continuous running range
4.06
2.73

Load ratio (%): 100%
Surrounding air temperature (℃): 0, 10, 20, 30, 40

【SMP-L150】

Torque (N-m): 21.6, 14.4, 7.2, 0
Speed (rpm): 0, 500, 1000, 1500, 2000, 2500, 3000, 3500
Short duration running range
Continuous running range
7.4
4.09

Load ratio (%): 100%
Surrounding air temperature (℃): 0, 10, 20, 30, 40

【SMP-L200】

Torque (N-m): 28.65, 19.1, 9.55, 0
Speed (rpm): 0, 500, 1000, 1500, 2000, 2500, 3000, 3500
Short duration running range
Continuous running range
6.06
5.46

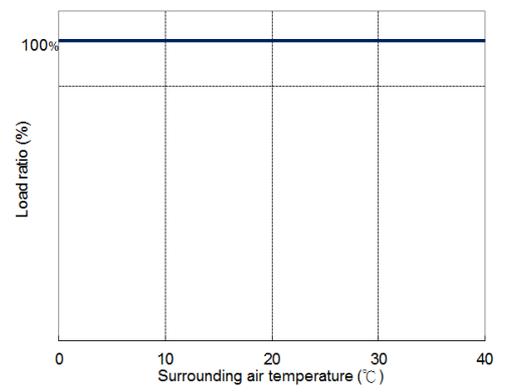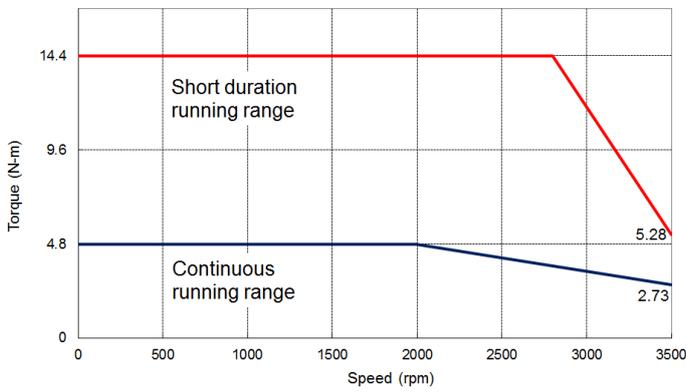Load ratio (%): 100%
Surrounding air temperature (℃): 0, 10, 20, 30, 40
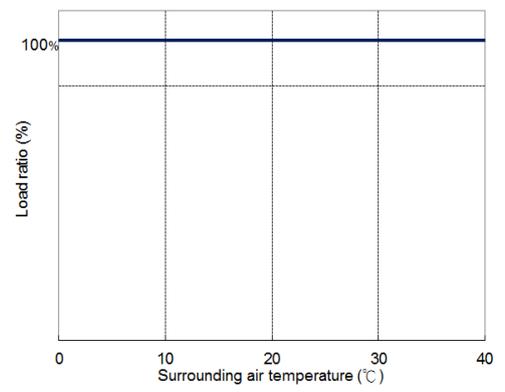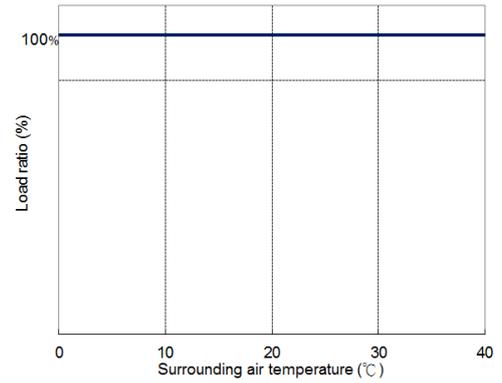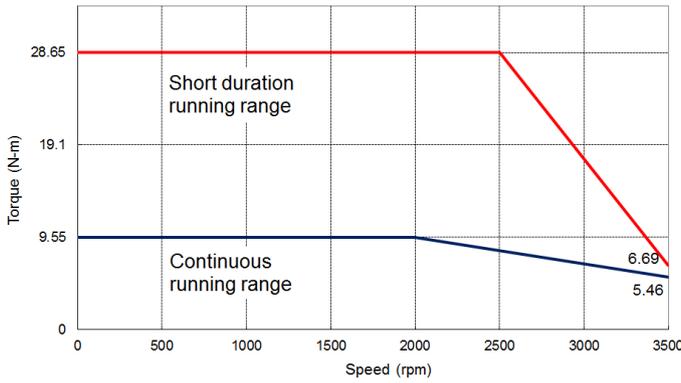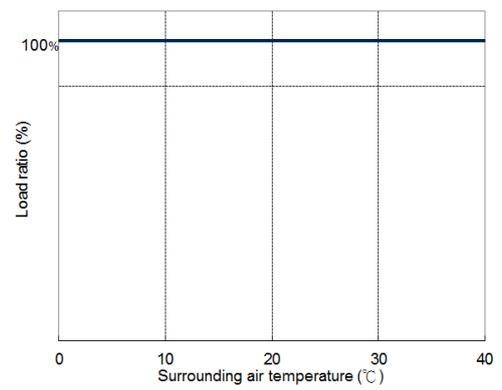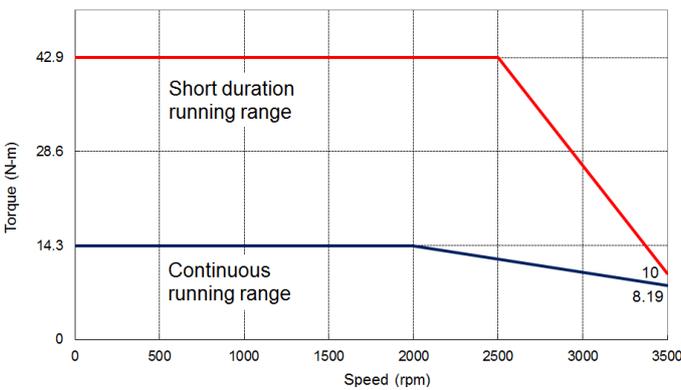
【SMP-L300】

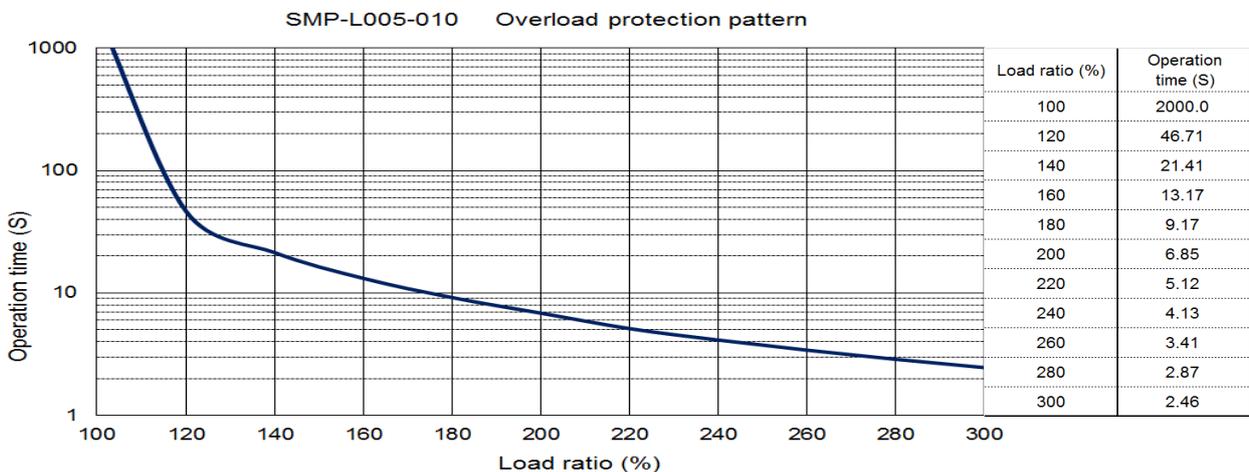【SMP-M100】

【SMP-M150】

【SMP-M200】

【SMP-M300】

NOTE: These characteristic plots above are measured in case of 3φ 200~240V power supplied.

Motor overload protection

Overload protection is to prevent motor from damage during instantaneous over rated operation.
Some cases are described as follows.
(1) Load to motor inertia ratio is too large.
(2) During acceleration or deceleration process, the time constant is set too small.
(3) The operation time of heavy torque over the rated torque is too long.
(4) Mechanism vibration occurred due to improper gain is ignored but the motor is still performed.
(5) Wrong connection between drive and motor, or the encoder is faulty.
If case mentioned above met, the permissible operating time is plotted below.

SMP-L005-010   Overload protection pattern

Load ratio (%)	Operation time (S)
100	2000.0
120	46.71
140	21.41
160	13.17
180	9.17
200	6.85
220	5.12
240	4.13
260	3.41
280	2.87
300	2.46

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SMP-L020~075 / SME-H020~075 Overload protection pattern
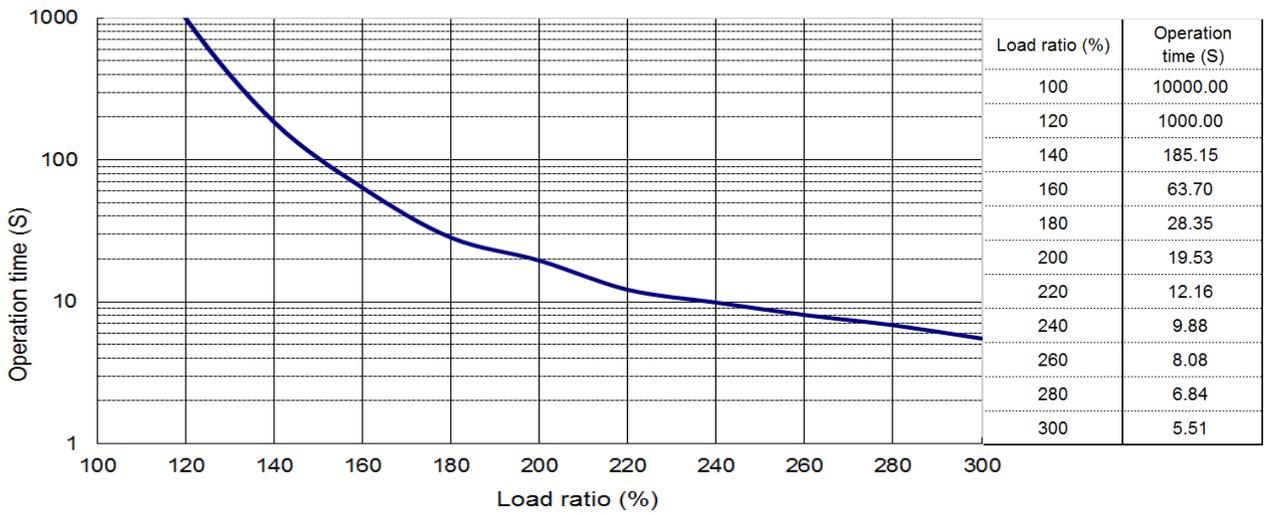
Load ratio (%)	Operation time (S)
100	2000.00
120	313.60
140	71.14
160	31.76
180	20.30
200	13.02
220	8.74
240	6.65
260	5.13
280	4.09
300	3.33
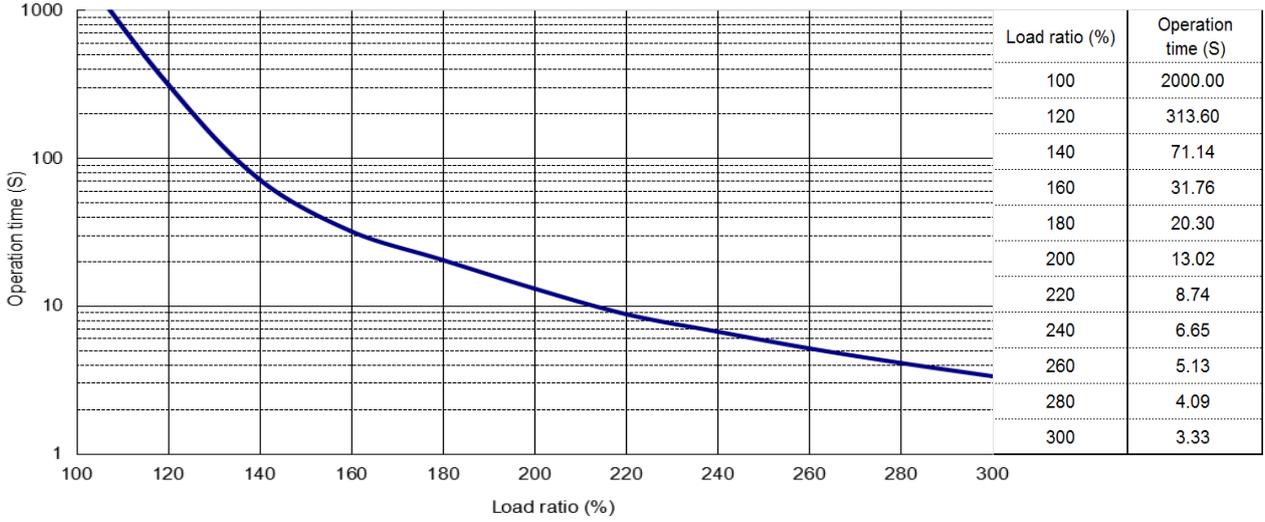
SMP-100-150   Overload protection pattern

Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	185.15
160	63.70
180	28.35
200	19.53
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

SMP-200~700   Overload protection

Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	185.15
160	63.70
180	28.35
200	19.53
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

42
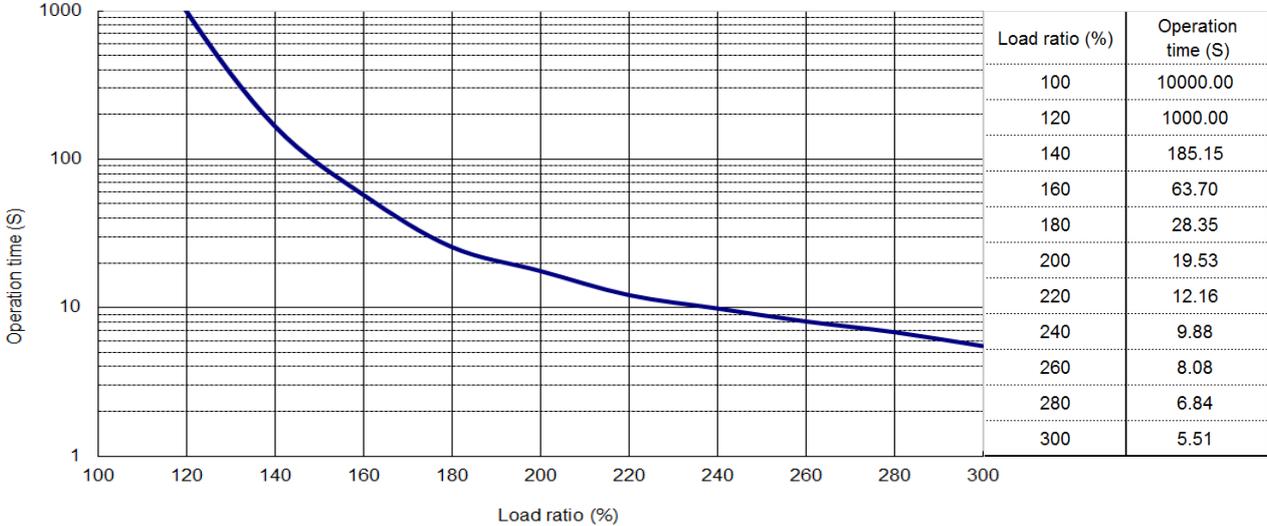
2. Installation and Wirings

2.1. Cautions

◆ Do not install the product on inflammable matters or close to inflammable matters.

◆ Do not over tighten the wire between the drive and the motor.

◆ Do not place heavy objects on the top of the drive.

◆ Be sure to tight lock every screw when fixed the drive.

◆ Install the drive at a location where could bear the weight of the drive..

◆ Upgrade the diameter of the U/V/W wires and the encoder cable if the length between the drive and the motor is over 20m.

◆ Do not clog up the vent of the drive or breakdown may be occurred.

◆ Do not drop or clash the drive.

◆ Not try to run the drive which something has been damaged.

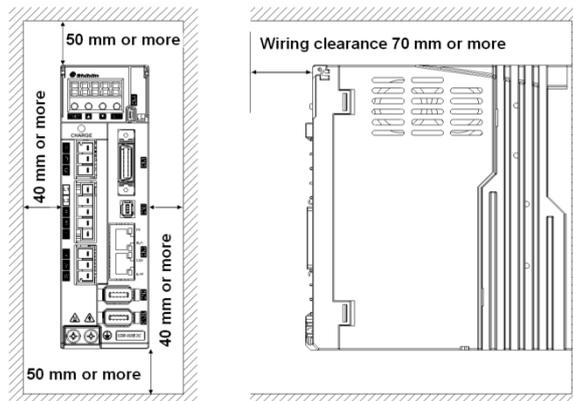## 2.2. Installation direction and clearance

⚠ CAUTION	◆ The drive must be installed in the specified direction. Otherwise, it may cause a malfunction. ◆ Leave specified clearances between the drive and the cabinet walls or other devices. Otherwise, it may cause a malfunction.

(1) Installation direction

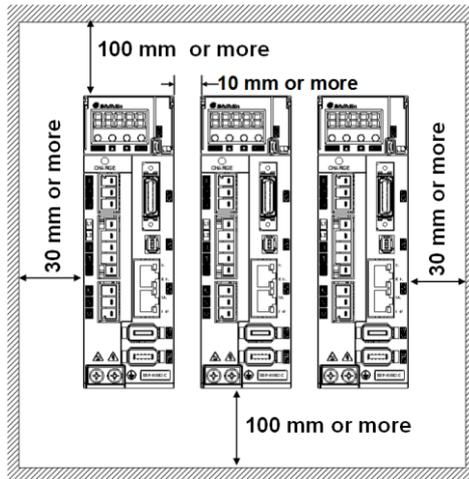Correct   Incorrect
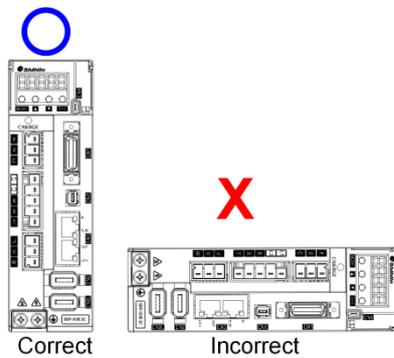
(2) Installation clearance of one drive

(3) Installation clearances of two or more drives

Leave a large clearance between the top of the servo drive and the cabinet walls. When mounting the servo amplifiers closely, a cooling fan is helpful **to** prevent the internal temperature of the cabinet from exceeding the endurance of servo drive.


2.3. Description of drive terminals and sockets

| Name	Sign	Description
Main power input terminal	R,S,T	Connect to 3-phase AC power source
Secondary power input	L1,L2	Connect to single phase AC power source
Power output terminal	U,V,W	<table><tr><td>Sign</td><td>Wire color</td></tr><tr><td>U</td><td>Red</td></tr><tr><td>V</td><td>White</td></tr><tr><td>W</td><td>Black</td></tr></table>
Brake resistor terminal	P,D,C	External resistor : P & D are open-circuiting, P & C connected to the resistor. Built-in resistor : P & D are short-circuiting, P & C are open-circuiting.
Ground terminal	⏚	To connect the power ground with the motor ground.
P: + terminal N: - terminal	P,N	When an active brake device is used for 1.5KW or above, please check the polarity of power terminals carefully.
DI/DO connector	CN1	Connect to the host controller.
Encoder socket	CN2/CN2L	Motor encoder / External pulse train signal.
EtherCAT port	CN3	EtherCAT IN & EtherCAT OUT
USB port	CN4	Connect to the USB port of PC.
ABS encoder battery port	CN5	Connect to the encoder battery set (option)
STO socket	CN6	A STO function jumper is attached.

2.3.1. CN1 I/O socket

The CN1 equips with 7 digital inputs (DI) and 4 digital outputs (DO) which make the flexible application with the superior controller. The DI relevant parameters are PD02~PD08. The DO relevant parameters are PD10~PD13. In addition, it affords encoder differential output signals.

(1) CN1 socket (drive side)
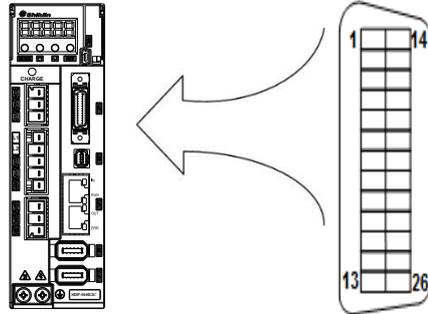
(2) CN1 connector (cable side)
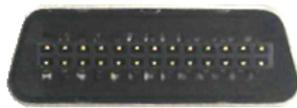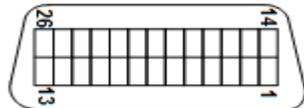
Front view	Pin order	Rear view & Pin name
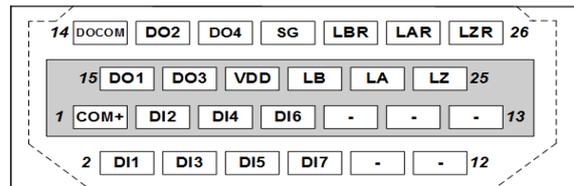
(3) CN1 pin name list

1	COM+	Digital input midway		14	DOCOM	Digital output midway
2	DI1	Digital input 1					15	DO1	Digital output 1
3	DI2	Digital input 2		16	DO2	Digital output 2
4	DI3	Digital input 3					17	DO3	Digital output 3
5	DI4	Digital input 4		18	DO4	Digital output 4
6	DI5	Digital input 5					19	VDD	+24V power output (digital I/O)
7	DI6	Digital input 6							
8	DI7	Digital input 7		21	LB	Encoder B pulse output	20	SG	Digital I/O signal ground
9						
10				23	LA	Encoder A pulse output	22	LBR	Encoder B pulse reverse output
11						
12				25	LZ	Encoder Z pulse output	24	LAR	Encoder A pulse reverse output
13						
							26	LZR	Encoder Z pulse reverse output

(4) CN1 DI wirings

■ Sink mode:

With the inner power supply	With the external power supply

■ Source mode:

With the inner power supply	With the external power supply
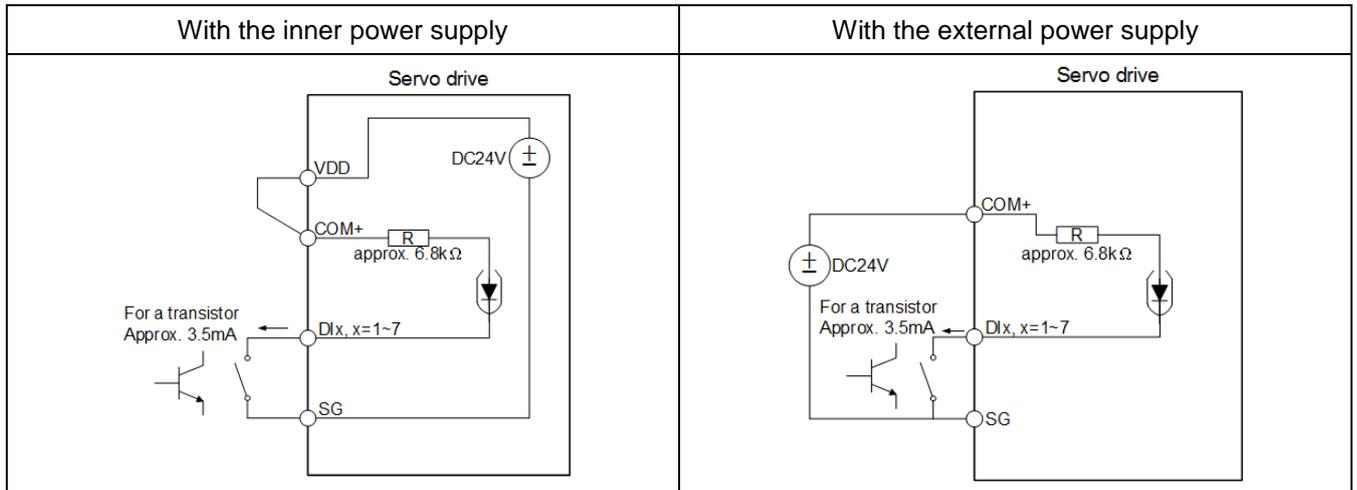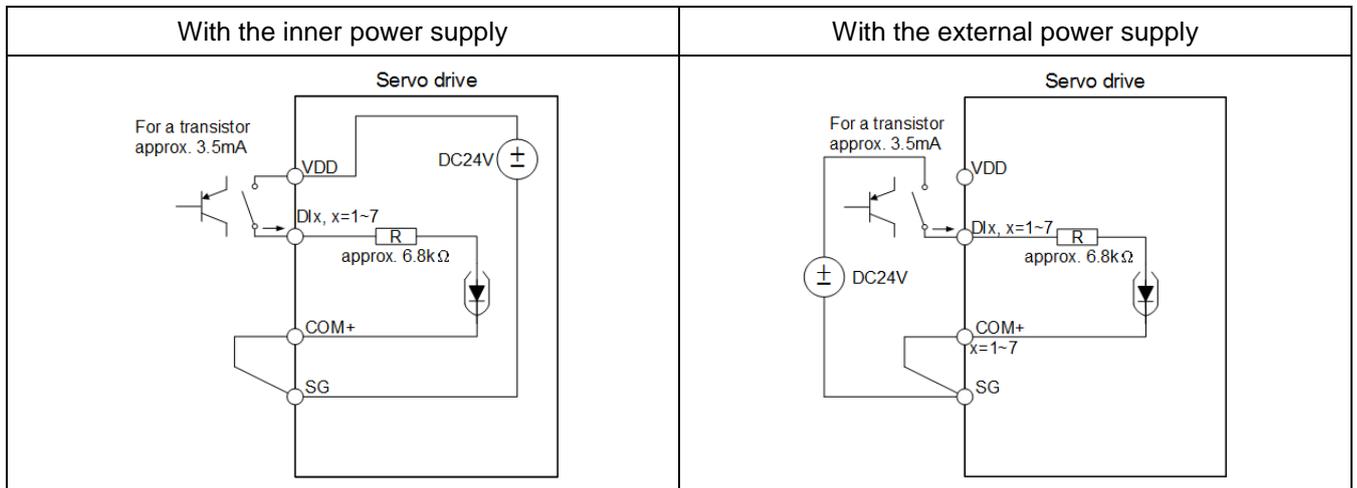
(5) CN1 DO wirings

■ Sink mode:

With the inner power supply	With the external power supply

■ Source mode:

With the inner power supply	With the external power supply
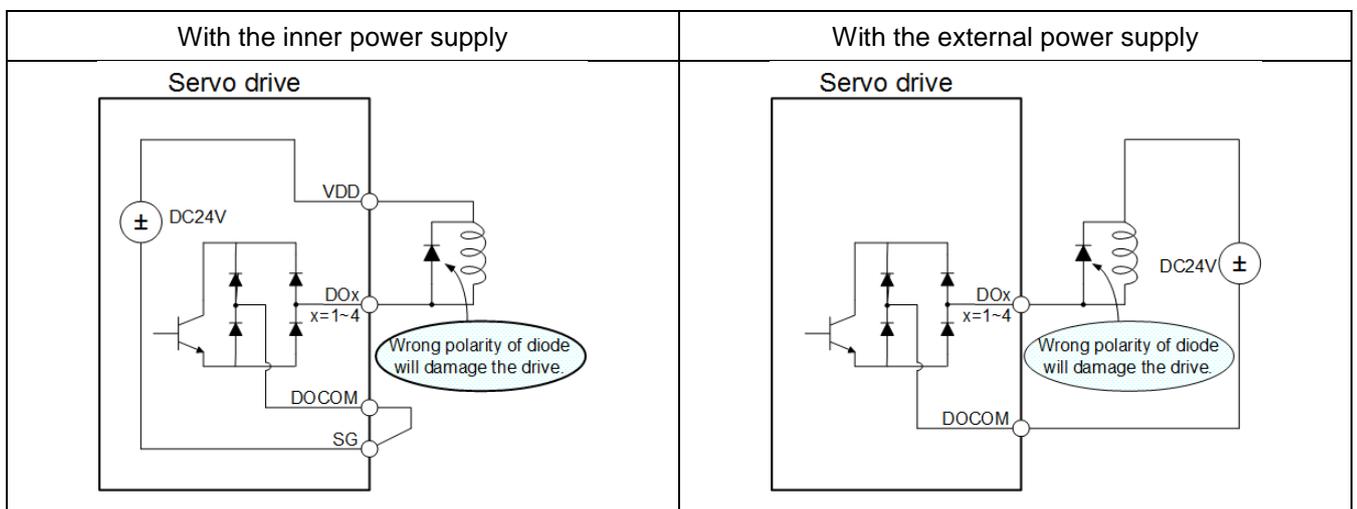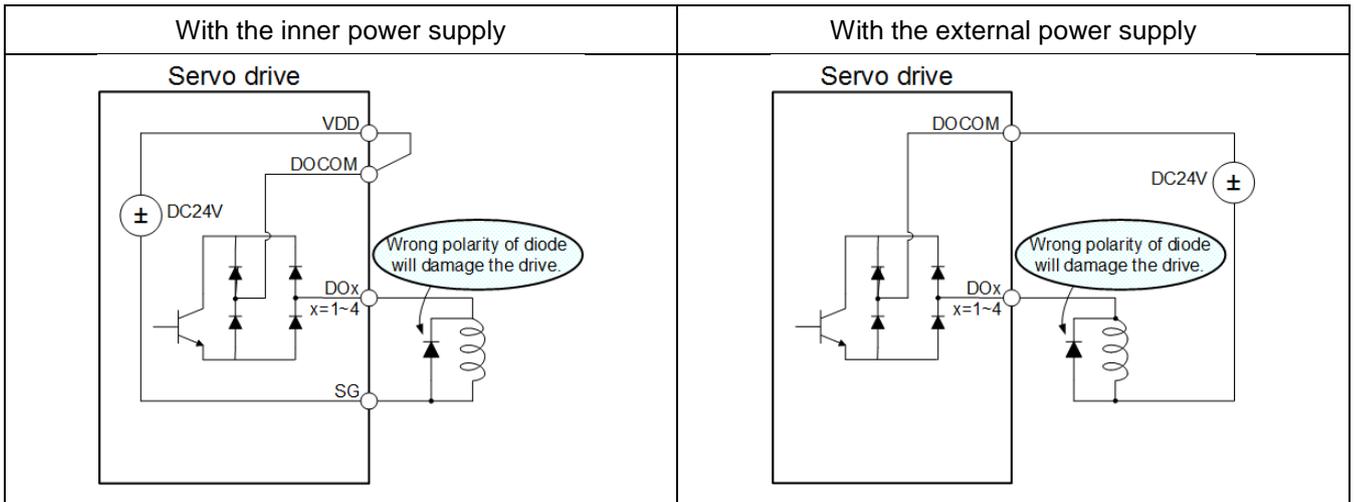
(6) Encoder pulse output

For a differential line drive system, the maximum output current is 20mA.

Differential line drive pulse output	Differential line drive pulse output (photo coupler)
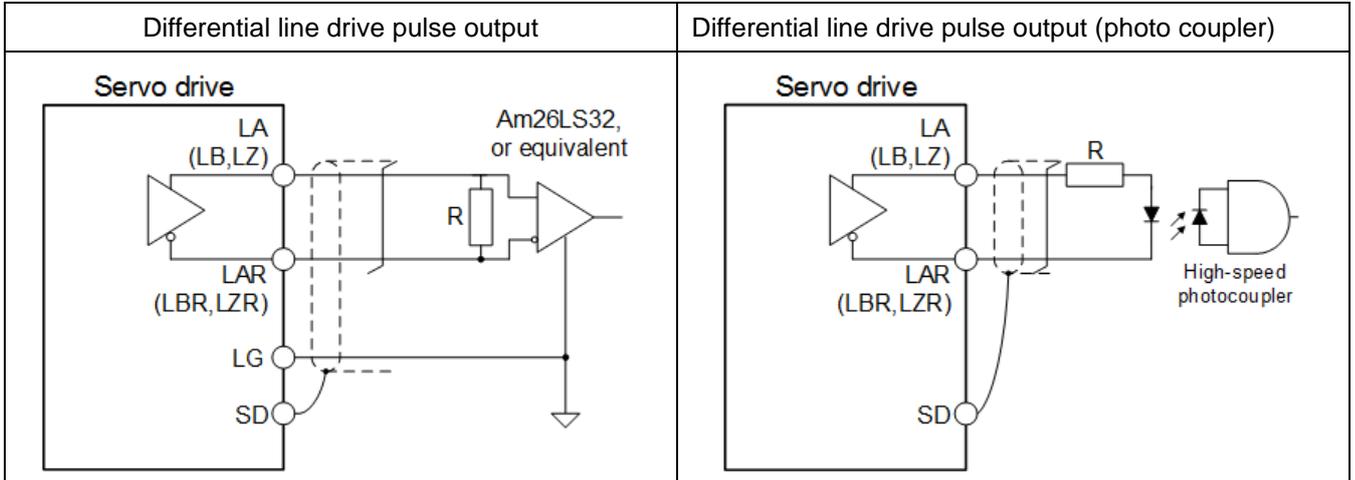
2.3.2. CN1 DI/DO functions description

(1) DI functions

There are 39 digital input functions could be assigned to the particular DI pin by modifying PD02 ~ PD08, The value from 0x01 to 0x24 is defined as the function described below.

Function	Sign	Value	Functions/Applications description	Control mode
Servo ON	SON	0x01	Make SON and SG conductive, the drive is ready to run. (motor shaft is locked)	All
Reset	RES	0x02	Make RES and SG conductive over 50mS to reset the drive. Set PD20 as □□□1, the reset function would not work.	All
Proportion control	PC	0x03	Conduct PC and SG to switch the proportion-integral control to the proportion control.(speed mode) It is helpful to stable the motor from unnecessary jitter due to the external disturbance.	Pr, S
Torque limit option	TL	0x04	Open TL-SG to make inner torque limit 1 valid(PA05), or turn TL-SG on to make analog torque limit(TLA) valid. For details, refer to section 6.3.4.	Pr, S
Inner torque limit option	TL1	0x05	Turn TL1-SG on to make inner torque limit 2 valid(PC25). For details, refer to section 6.3.4.	All
Speed option 1	SP1	0x06	< Speed control mode > Used to select the speed command. When using SP3, make it usable by making the setting of PD02~PD09. (see table below)	S
Speed option 2	SP2	0x07		S
Speed option 3	SP3	0x08		S

Speed option table:

Setting of PD02~PD09	SP3	SP2	SP1	Speed command
SP3 isn't used. (initial status)		0	0	Speed analog command (VC)
		0	1	Inner speed command 1 (PC05)
		1	0	Inner speed command 2 (PC06)
		1	1	Inner speed command 3 (PC07)
SP3 is used.	0	0	0	Zero speed
	0	0	1	Inner speed command 1 (PC05)
	0	1	0	Inner speed command 2 (PC06)
	0	1	1	Inner speed command 3 (PC07)
	1	0	0	Inner speed command 4 (PC08)
	1	0	1	Inner speed command 5 (PC09)
	1	1	0	Inner speed command 6 (PC10)
	1	1	1	Inner speed command 7 (PC11)

Note. 0：off (with SG)
1：on (with SG)

Function	Sign	Value	Functions/Applications description	Control mode
Forward rotation activated	ST1	0x09	Used to start the servo motor in the following instruction. (see table below)	S
Reverse rotation activated	ST2	0x0A	If both ST1 and ST2 are switched on or off during operation, the servo will be decelerated to a stop according to the value of PC18, and the motor will be locked.	S
Origin position	ORGP	0x0B	In position control with inner registers, this signal activated would assign current position to the origin.	Pr, *CoE*
Start Home moving	SHOM	0x0C	This signal starts the origin return process.	Pr

Motor rotation table:

Input signals		Motor rotary direction
ST2	ST1	
0	0	Stop(servo lock)
0	1	CCW
1	0	CW
1	1	Stop(servo lock)

Note. 0：off (with SG)
1：on (with SG)

Function	Sign	Value	Functions/Applications description	Control mode
Electronic gear option 1	CM1	0x0D	The combination of CM1 and CM2 gives you a choice of 4 numerators. CM1 and CM2 are invalid in the absolute position system. <table><tr><td>CM2</td><td>CM1</td><td>Electronic gear molecule</td></tr><tr><td>0</td><td>0</td><td>The value of parameter PA07 (CMX)</td></tr><tr><td>0</td><td>1</td><td>The value of parameter PC32(CMX2)</td></tr><tr><td>1</td><td>0</td><td>The value of parameter PC33(CMX3)</td></tr><tr><td>1</td><td>1</td><td>The value of parameter PC34(CMX4)</td></tr></table>Note. 0：off (with SG), 1：on (with SG)	Pr
Electronic gear option 2	CM2	0x0E		
Clear	CR	0x0F	Turn CR on to clear the position control counter drop pulses on its leading edge. The pulse width should be 10mS or longer. When the PD18 setting is □□□1, the pulse are always cleared while CR is on.	Pr
Gain switch option	CDP	0x10	Turn CDP on to switch the gain values.	All
Control mode switch	LOP	0x11	Used to switch the position mode and speed mode. <table><tr><td>(Note) LOP</td><td>Control mode</td></tr><tr><td>0</td><td>Position</td></tr><tr><td>1</td><td>Speed</td></tr></table>Note. 0：off (with SG), 1：on (with SG)	Pr
External emergency stop	EMG	0x12	Turn EMG off (open EMG/SG) to bring the motor an emergency stop state, in which the electromagnetic brake works. Turn EMG on (short EMG/SG) to release the emergency stop state. To set the value of PD01 as 1□□□, this signal would be normal on.	All
Pr command 1	POS1	0x13	<table><tr><td>Position</td><td>POS6</td><td>POS5</td><td>POS4</td><td>POS3</td><td>POS2</td><td>POS1</td><td>CTRG</td></tr><tr><td>P0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>↑</td></tr><tr><td>P1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>↑</td></tr><tr><td colspan="8">~</td></tr><tr><td>P50</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>↑</td></tr><tr><td>P51</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>↑</td></tr><tr><td colspan="8">~</td></tr><tr><td>P62</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>↑</td></tr><tr><td>P63</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>↑</td></tr></table>Note. 0：off (with SG), 1：on (with SG)	Pr
Pr command 2	POS2	0x14		
Pr command 3	POS3	0x15		
Pr command 4	POS4	0x1A		
Pr command 5	POS5	0x1B		
Pr command 6	POS6	0x1C		
Position command trigger	CTRG	0x16	Turn CTRG on to load the position command into inner controller. The command is the combination of POS1~POS6.	Pr
Limit of forward rotation	LSP	0x18	Turn LSP on to make the forward rotation command valid.	All
Limit of reverse rotation	LSN	0x19	Turn LSN on to make the reverse rotation command valid.	All
Event trigger Pr command 1	EV1	0x1E	There are 4 events with rising or falling edges can be set to trigger a specific PR command. PF83: Event Rising-edge Trigger Command (OFF → ON) PF84: Event Falling-edge Trigger Command (ON → OFF) Suitable case: sensor, preset trigger procedure	Pr
Event trigger Pr command 2	EV2	0x1F		
Event trigger Pr command 3	EV3	0x20		
Event trigger Pr command 4	EV4	0x21		
E-CAM engage control	CAM	0x25	E-CAM engage control (Refer to parameter PC66 description)	Pr
Touch probe 1	EXT1	0x29	Trigger source 1 to latch the current position from the motor encoder.	CoE
Touch probe 2	EXT2	0x2A	Trigger source 2 to latch the current position from the motor encoder.	CoE

(2) DO functions

There are 14 output functions could be assigned to the particular DO pin by modifying PD10 ~ PD13

The value from 0x01 to 0x2F is defined as the function described below.

Signal function	Sign	Value	Functions/Applications description	Control mode
Ready	RD	0x01	When the drive is ready to operate, RD signal is activated.	All
Alarm signal	ALM	0x02	ALM is a normal closed signal. It means that ALM is activated if there is not abnormal alerted.	All
In-position ready	INP	0x03	INP is activated when the drop pulses of position command are within the in-position range.	Pr
Speed attained	SA		SA turns on when the speed has nearly reached the preset command.	S
Home moving completion	HOME	0x04	HOME is activated after the completion of origin return.	Pr
Torque limiting control	TLC	0x05	TLC is activated when the motor generated torque has reaches the torque limit.	Pr, S
Electromagnetic brake interlock	MBR	0x06	When MBR is applied, make it usable by setting PA01 as □1□□. MBR is off when the power of drive is off or the drive alerts.	All
Warning	WNG	0x07	WNG is activated if the drive sent any warning.	All
Zero speed detection	ZSP	0x08	ZSP is activated if the motor speed is under the zero speed (50r/min),	All
Pr command output completion	CMDOK	0x09	CMDOK is activated when the inner position command is completed or stopped.	Pr
Overload output warning	OLW	0x0A	OLW is activated when the drive output reached the overload level.	Pr
Motion control completed	MC_OK	0x0B	MC_OK is activated when CMDOK and INP are both ON.	Pr
Pr command overflow	OVF	0x0C	OVF is activated if the inner position command overflow occurred.	Pr
Software positive limit	SWPL	0x0D	When the position command exceeds the PF86 setting value, SWPL is activated.	Pr
Software negative limit	SWNL	0x0E	When the position command exceeds the PF87 setting value, SWNL is activated.	Pr
Capture completion	CAP_OK	0x11	CAP_OK is activated when the capture function has done.	All
E-CAM assigned region output 1	CAM_AREA1	0x12	This DO is activated to indicate the region where E-CAM is engaged	Pr
E-CAM assigned region output 2	CAM_AREA2	0x13	This DO is activated to indicate the region where E-CAM is engaged	Pr
Software DO1 ~DO16	S_DO0 ~ S_DOF	0x20 ~ 0x2F	PD33 is the data register that every software digital output ON/OFF status is corresponded. For example, S_DO0 is corresponded to bit0 of PD33, if bit0 of PD33 is 1 then S-DO0 is ON, otherwise S_DO0 is OFF. So on and so forth, S_DOF is controlled by the bit15 of PD33.	All

2.3.3. CN2 encoder socket

The encoder resolution attached to SMP 50W to 750W motor is 24-bit, the encoder resolution attached to SMP 1KW to 7KW motor is 23-bit. The CN2 instructions are described as follows.

(1) CN2 socket on drive
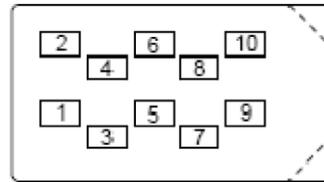
Front view   Rear view & pin number

(2) CN2 compatible connector for encoder cable

Side view   Rear view

(3) Connectors of motor encoder cable
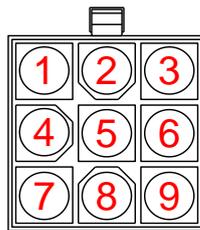
Type A   Type B
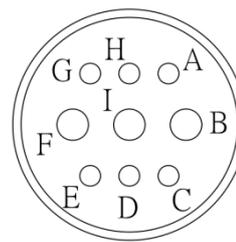
The pin names and descriptions are listed below.

Function	Sign	Corresponded pin NO.			Function description
		CN2	Type A	Type B	
5V power	Vcc (5V)	1,3	7	B	5V power for encoder
5V ground	GND(5V)	4	8	F	5V ground
3.6V power	Vcc (3.6V)	5	3	H	3.6V battery power for encoder
3.6V ground	GND(3.6V)	2	4	A	3.6V ground
ENCP	ENCP	6	6	D	Serial communication signal ENCP
ENCN	ENCN	7	5	E	Serial communication signal ENCN
Invalid	-	8,9,10	1,2	C,G	-
Shielding	-	-	9	I	Copper Braid Shield

2.3.4. CN2L External pulse trains input socket

The CN2L socket is used for receiving the position signals of user's mechanical position scale. With these external signals, it is possible to operate the full-close loop position control to obtain a precision compensation. The pin function and descriptions are listed below.

No.	Sign	Function description
1	Vcc (5V)	5V power for external position scale
2	GND (5V)	5V ground
3	Vcc (5V)	3.6V battery power for encoder
4	GND (5V)	3.6V ground
5	A	A phase pulse signal input
6	/A	/A phase pulse signal input
7	B	B phase pulse signal input -
8	/B	/B phase pulse signal input
9	Z	Z phase pulse signal input
10	/Z	/Z phase pulse signal input

2.3.5. CN3 socket instructions

The CN3 socket of SDP servo drive is an industry Ethernet socket. With the Ethernet cable, the SDP servo drive could be connected to the host computer or superior controller which is compatible for EtherCAT communication protocol. Furthermore, PA01 parameter should be set the proper value to switch to EtherCAT mode. In EtherCAT communication mode, the cable length between one slave to the others is limited within 50 meters. The attenuation of signal should be considered if a long distance communication applied or a multiple drives linked application.

(1) EtherCAT communication instruction

Host
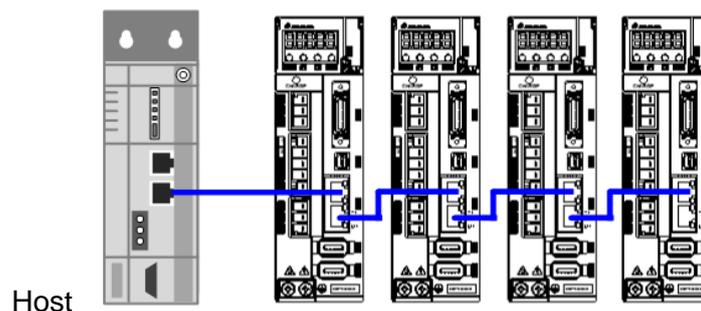
(2) CN3 EtherCAT terminal
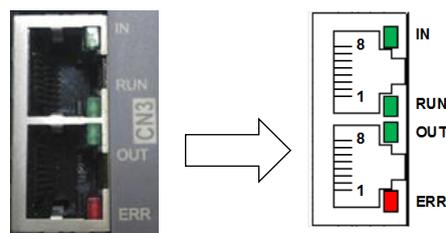
(3) CN3 pin function

No.	Sign	Function description
1	TX+	Transmit +
2	TX-	Transmit -
3	RX+	Receive +
4	-	-
5	-	-
6	RX-	Receive -
7	-	-
8	-	-

※ Be sure to use shielded twisted pair (STP) that meets the TIA/EIA-568 5e specification.

(4) LED indicator

There are 4 LEDs attached to the dual RJ-45 socket: IN/OUT LED, RUN LED, ERR LED. The communication status could be displayed with these LEDs. The LED indicator timing sequence are described as follows.

LED status	Timing sequence
OFF	ON ⎯⎐ OFF
Blinking	ON ⎍⎍⎍⎍ 200mS OFF
Single Flash	ON ⎍ 1000mS ⎍ OFF
ON	ON ⎎⎯⎯⎯ OFF
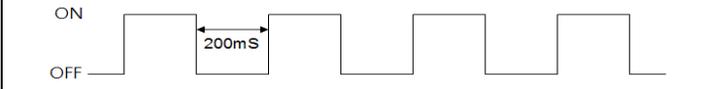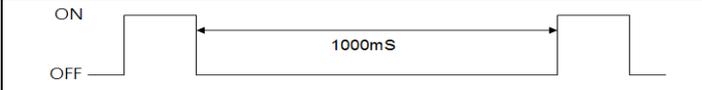
■ IN/OUT LED:

This LED shows the physical link interaction status.

LED status	Description
OFF	Link not yet established in physical layer
ON	Link established in physical layer
Blinking	In operation after link established

■ RUN LED:

This LED shows the communications states between the host and slave.

LED status	Slave status	Description
OFF	Initial	After power on, the drive starts to initiate the communication. Only the accessing from the host is available at this step.
Blinking	Pre-Operational	The host could interchange data via the mailbox of drive.
Single Flash	Safe-Operational	The drive could use SDO and TxPDO to send cyclic data to the host.
ON	Operational	SDO, TxPDO and RxPDO are working.

■ ERR LED:

This LED shows the error status of EtherCAT communication.

LED status	Slave status	Description
OFF	No error	-
Blinking	State change error	The state change is not allowed due to the wrong parameter setting.
Single Flash	Synchronization error	The synchronization between master clock and slave clock is failed.
	SyncManager error	The data is lost when receiving process.
ON	PDI Watchdog timeout	SDO, TxPDO and RxPDO are working.

2.3.6. CN4 USB communication port

With the Sharp servo communication software, users could connect it to the computer then to set parameters, monitor the status, operate and test, etc. CN4 socket is a Mini-USB type.
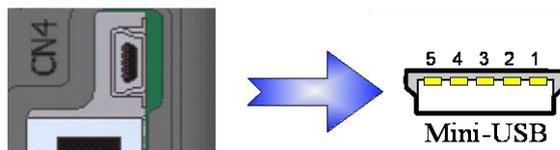
Pin No.	Function description
1	+5V
2	D-
3	D+
4	NC
5	GND

2.3.7. CN5 Encoder battery power socket

When the absolute encoder servo motor is performed, the backup power for absolute encoder is necessary. This SDP drive provides a socket which the power wires of battery box could plug in.
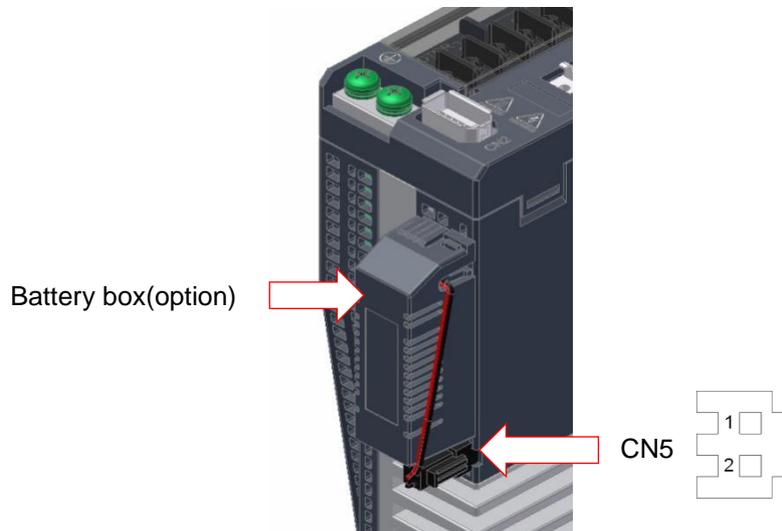
The following table describes the pin assignment of CN5.

Pin NO	Sign	Function description
1	Vcc(3.6V)	The battery power voltage is 3.6 volt.
2	GND	The battery power ground.

2.3.8. CN6 STO socket

The pin definitions of CN6 are described as follows.
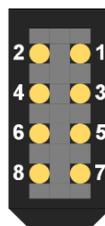
Pin NO	Sign	Function description
1	-	-
2	-	-
3	STOCOM	The ground of STO1 and STO2.
4	STO1	STO input 1
5	STO2	STO input 2
6	TOFB1	STO alarm output 1
7	TOFB2	STO alarm output 2
8	TOFCOM	The signal ground of TOFB1 and TOFB2.

2.4. Wirings

⚠ DANGER	◆ Any person who wires should be fully capable to do the work.
	◆ Before wiring, turn off the power and wait until the charge LED turns off. Then, confirm that the voltage between +P and -N is safe with a voltage meter. Otherwise, an electric shock may occur. In addition, when confirming the charge LED, always check it from the front of the servo drive.
	◆ Make the ground of the servo drive and motor securely.
	◆ Not to wire the servo drive and motor until they have been fixed. Otherwise, it may cause an electric shock.
	◆ Be sure that the cable is completed, there is no any damaged. Otherwise, it may cause an electric shock.

2.4.1. Input power source circuit
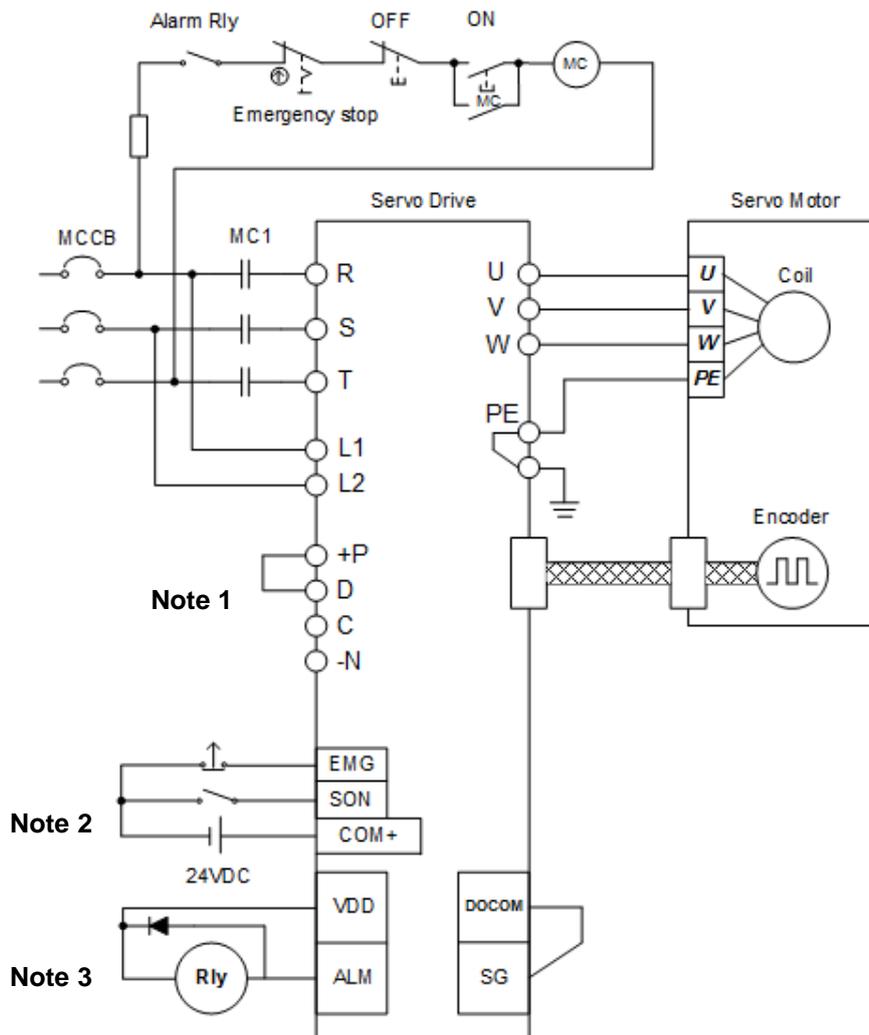
Note: 1. Make "P" and "C" connect to the resistor when an external brake resistor is applied. And be sure to release the jumper between P and D.

2. This diagram is for sink input wiring.

3. For source type output , .connect " DOCOM" and "SG" together. Use "VDD" as a 24V$_{DC}$ powe.

2.4.2. Cable specification of wirings

(1) Fuse and Circuit breaker**:**

SDP-□□□E2C	010	020	040	075	100	150	200	300	500	700
Class T fuse blow-out current (A)	3	6	10	20	25	35	45	70	80	110
Circuit breaker Interrupt current (A)	5	5	10	10	15	20	30	30	50	100

(2) Power wiring**:**

Drive model	Wire size: AWG (mm^2)			
	R, S, T	L1, L2	U, V, W, PE	P, D, C, N,B1,B2
SDP-010E2C	14 AWG (2.1)	14 AWG14 (2.1)	14 AWG (2.1)	14 AWG (2.1)
SDP-020E2C				
SDP-040E2C				
SDP-075E2C				
SDP-100E2C				
SDP-150E2C				
SDP-200E2C	12 AWG (3.3)		12 AWG (3.3)	
SDP-300E2C				
SDP-500E2C	10 AWG (5.3)		10 AWG10 (5.3)	12 AWG (3.3)
SDP-700E2C	8 AWG (8.4)		8 AWG (8.4)	

(3) Encoder cable specification**:**

Drive model	Encoder cable specification (AWG)			
	Regulation	Cable length (m)	Wire count	Wire size
SDP-010E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-020E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-040E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-075E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-100E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-150E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-200E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-300E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)
SDP-500E2C	UL Style 1332	2	10	26 AWG (0.13mm^2)

SDP-700E2C	UL Style 1332	2	10	26 AWG (0.13mm²)

2.4.3. EtherCAT (CoE) mode wiring
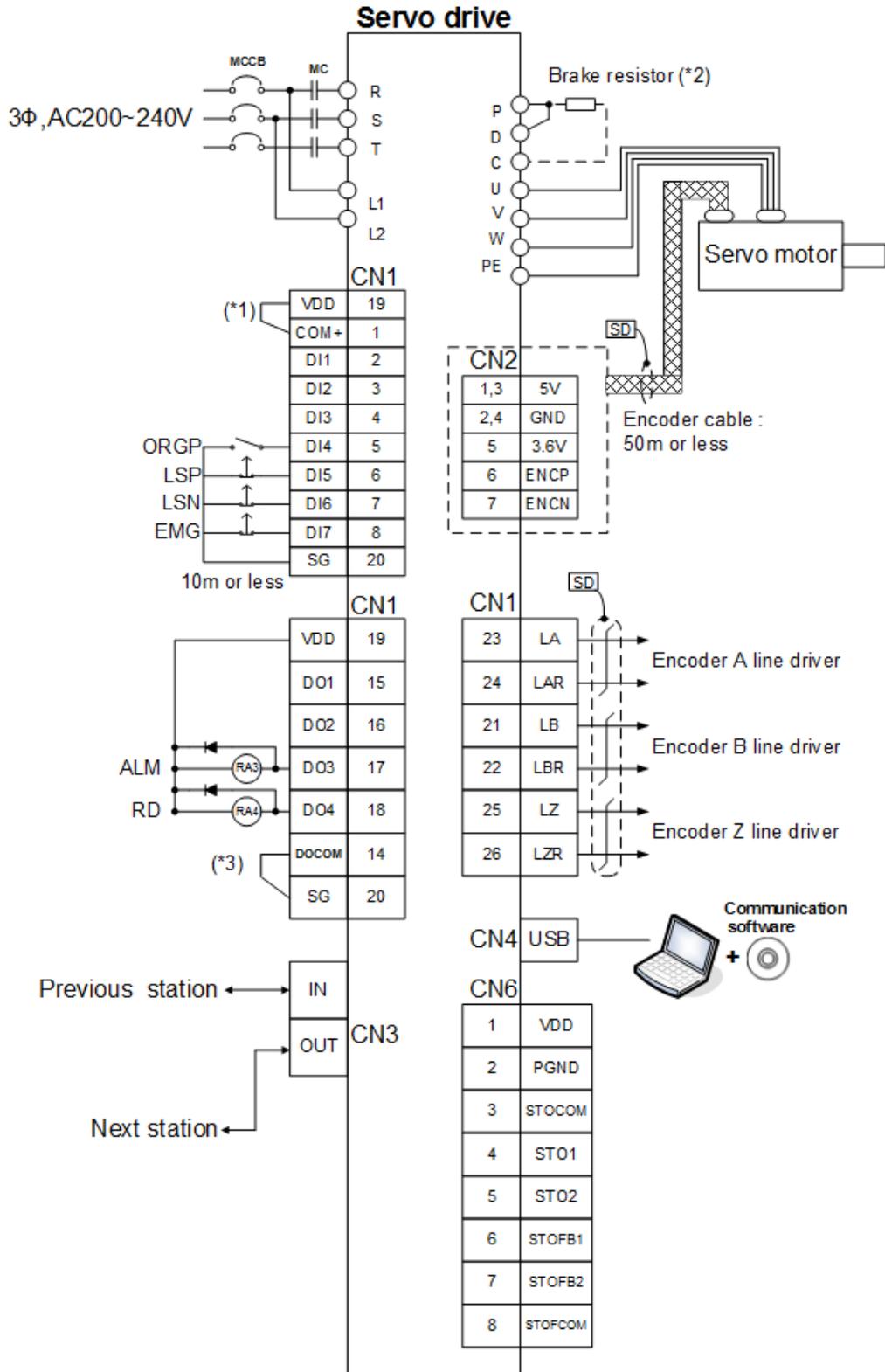
Note: 1. If the external power is applied for DI wirings, do not connect VDD with COM+.

2. Be sure to remove the jumper between P and D terminal if an external resistor is applied.
3. Refer to 2.3.1 for DO sink type or source type wiring.

2.4.4. Pr mode wiring
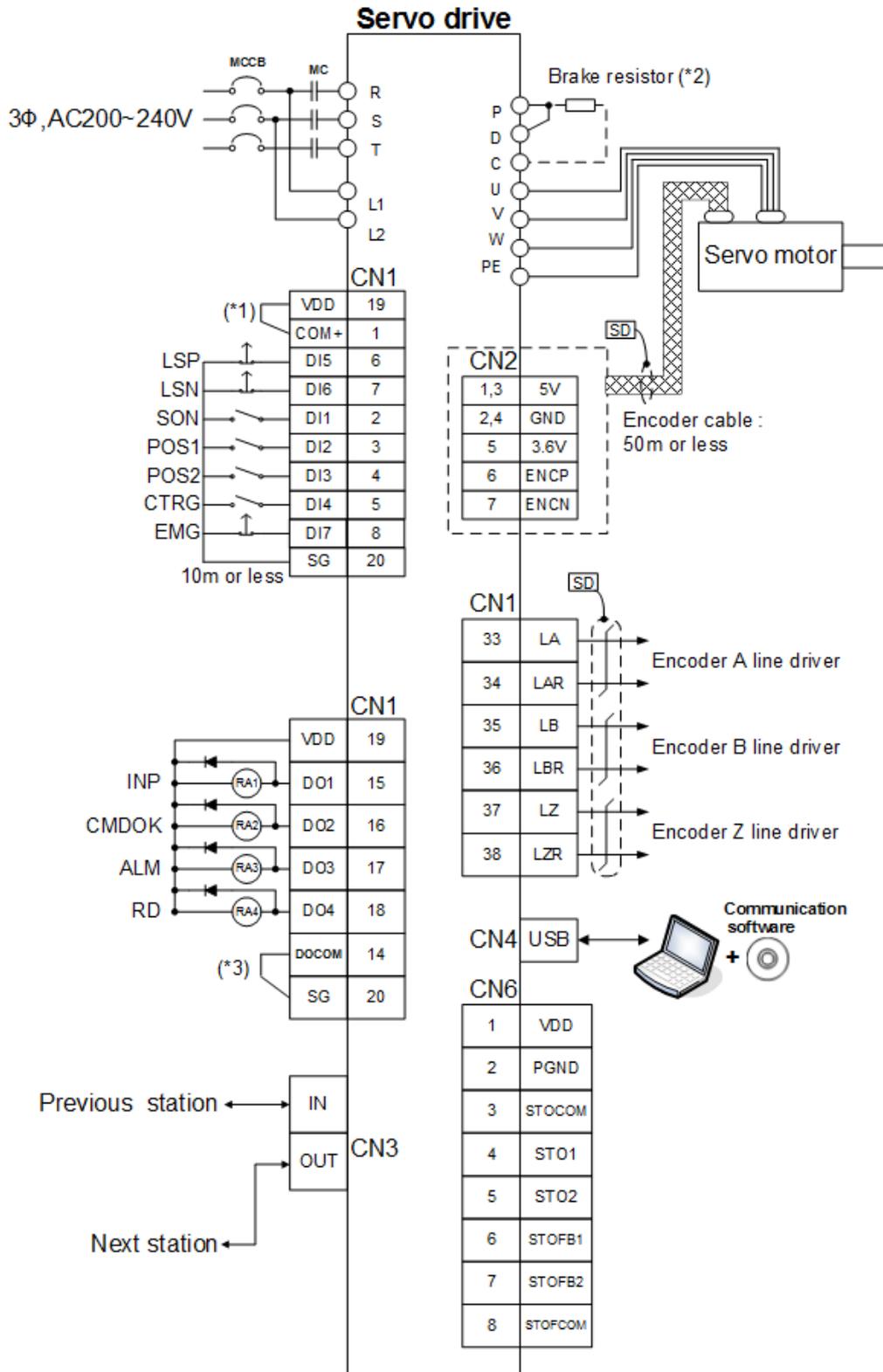
Note: 1. If the external power is applied for DI wirings, do not connect VDD and COM+.
2. Be sure to remove the jumper between P and D terminal if an external resistor is applied.
3. Refer to section 2.3.1 for DO sink type or source type wiring.

2.4.5. S mode wiring
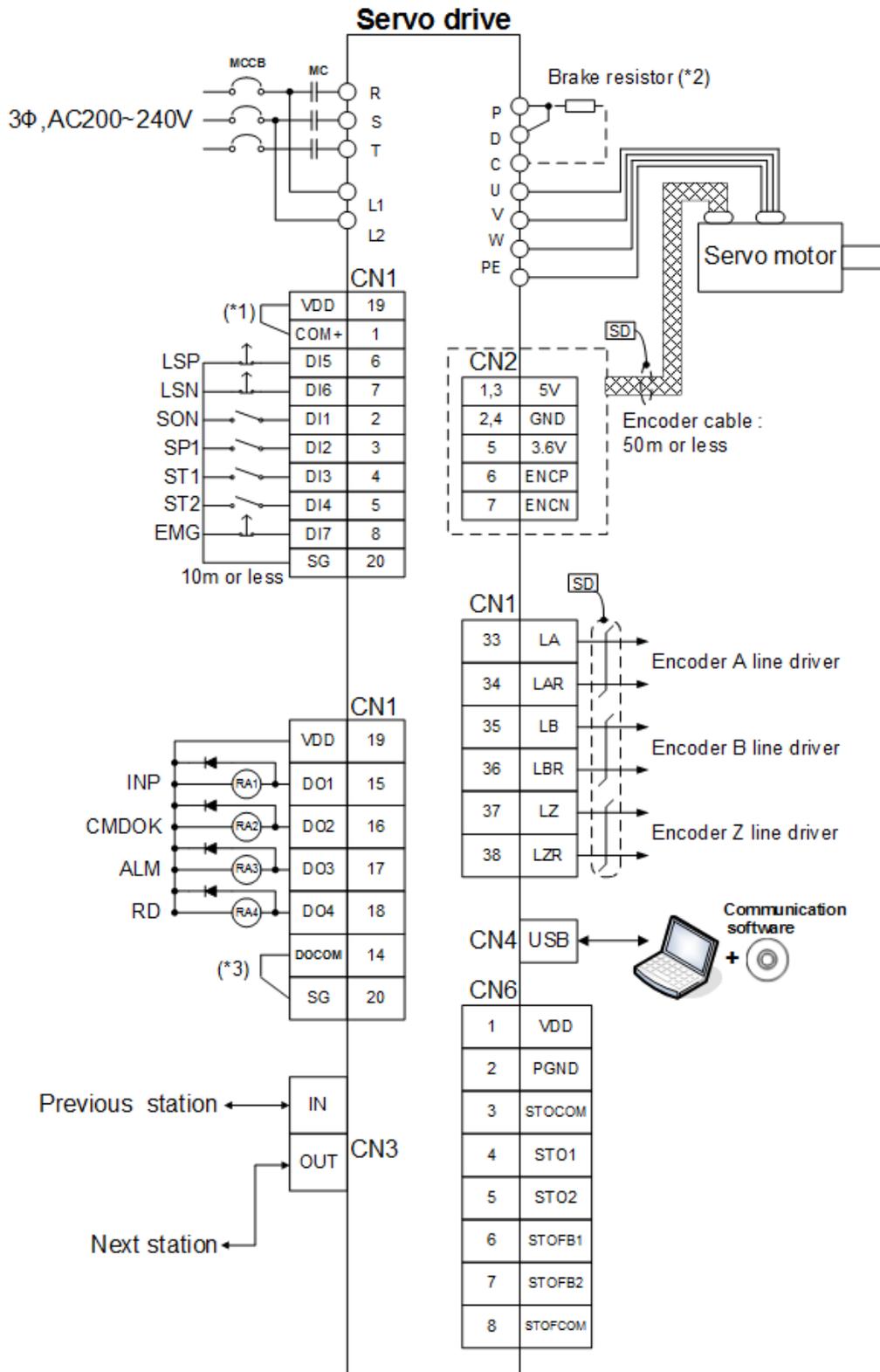
Note: 1. If the external power is applied for DI wirings, do not connect VDD and COM+.
2. Be sure to remove the jumper between P and D terminal if an external resistor is applied.
3. Refer to section 2.3.1 for DO sink type or source type wiring.

2.5. Display

The SDP servo drive equips a 5-digit, 7-segment LED display and 4 pushbuttons for servo drive status display, alarm display, parameter setting, etc. The operation of display are described below.

(1) Operation panel instruction
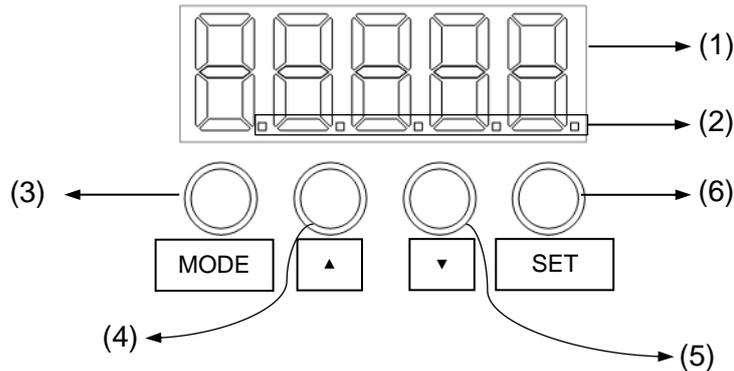
No	Name	Function description
(1)	5-digit, 7-segment LED	To display motor status, parameters, and abnormal messages.
(2)	Decimal LED	To displays the decimal points, negative value, etc.
(3)	MODE key	Display mode change, low/high switching.
(4)	UP Key	This key is used to scroll up the display or data.
(5)	DOWN key	This key is used to scroll down the display or data.
(6)	SET key	To show or save the value which is operated.

(2) Display examples

Item	Status	5-digit, 7-segment LED
Motor rotation speed	Reverse rotation at 3000r/min	-3000
Load to motor inertia ratio	15.5 times	15.5
Motor feedback revolution	-12345 turns	1.2.3.4.5. To light the 5 decimal points.

parameter setting accomplished	a successful EEPROM write-in	-End-
parameter setting failed	a failed EEPROM write-in	Error

2.5.1. Display flowchart

Press "MODE" key once to shift to the next display mode. Refer to section 4.4 and later for related display. To read or set the extension parameters, make them valid with the PA42 setting.

Display process	Initial Screen	Function description	Reference
Status	FPH .1	Servo status display This message appears at power-on	Page 52-
One touch auto tuning	AUTo	One touch auto tuning function	Page 118
Alarm	AL. --	Display current alarm and history records	Page 53
Diagnosis	rd-oF	Sequence display, external signal display, DO forced output, test operation, inertia estimated , software version display.	Page 54
Basic parameters	P .A01	Display and setting of basic parameters.	Page 73
Gain/Filter parameters	P .b01	Display and setting of Gain/Filter parameters.	Page 80
Extended parameters	P .C01	Display and setting of extended parameters.	Page 84
I/O setting parameters	P .d01	Display and setting of I/O related parameters.	Page 93
Pr related parameters	P .E01	Pr mode related parameters group 1	Page 97
Pr related parameters	P .F01	Pr mode related parameters group 2	Page 105
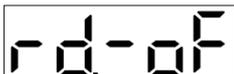
2.5.2. Status display

Press the "UP" or "DOWN" key to change the display data as desired. When the required data is selected, the corresponding data appears. Press the "SET" key to display the information.

Status message	Screen	unit	Description
Motor feedback pulses (High 5-digit)	FPH .I	pulse	Feedback pulses from the motor encoder are displayed. Ex: A cumulated value of motor feedback pulses 123456789, FPHI=1234, FPLI=56789.
Motor feedback pulses (Low 5-digit)	FPL .I		
Command pulses (High 5-digit)	CPH .I	pulse	The external command pulses are displayed. Ex: The number of drop pulses 123456789, CPHI=1234, CPLI=56789.
Command pulses (Low 5-digit)	CPL .I		
Accumulative pulses error (Low 5-digit)	E .I	pulse	Only the low 5-digit difference between command and motor feedback pulses are shown.
Translated motor feedback pulses (High 5-digit)	FPH .o	pulse	The motor feedback pulses are multiplied by the electronic gear then displayed.
Translated motor feedback pulses (Low 5-digit)	FPL .o		
Translated command pulses (High 5-digit)	CPH .o	pulse	The command pulses are re-counted by the electronic gear ratio then displayed.
Translated command pulses (Low 5-digit)	CPL .o		
Translated accumulative pulses error(Low 5-digit)	E .o	pulse	The low 5-digit errors between command and feedback pulses are multiplied by the electronic gear then displayed.
Command pulse frequency	CPF	kHz	The frequency of command pulses is counted and displayed.
Motor speed	r .	rpm	The current speed of servo motor is displayed.
Speed input command/limit	U .	rpm	Speed: It denotes the speed command. Torque: It denotes the speed limit.
Effective load ratio	J .	%	The continuous and effective load torque is displayed relative to the rated torque of 100%.
Peak load ratio	b .	%	The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.
DC bus voltage	Pn	V	It shows DC bus voltage. Lo-dC means voltage insufficient.
Load to motor inertia ratio	dC.	times	Load to motor inertia ratio is displayed.
Instantaneous torque	┌ .	%	The Instantaneous torque value is displayed relative to the rated torque of 100%.
Regeneration load ratio	L .	%	The permissible percentage of regenerated power is shown.
Pulses of Z phase reference acknowledged	ZP.███	pulse	Z phase pulses reference acknowledged are shown.

2.5.3. Alarm display

It displays the current alarm and the alarm history record. The lower two digits display the abnormal alarm number which has occurred.

Name	Screen	Description
Current alarm	AL --	No alarm occurred
	AL 01	Over voltage 「AL 01」 occurred, the screen flickers synchronously
Alarm history	A0 01	The last alarm is over voltage 「AL 01」
	A1 02	The 2nd alarm in the past is low voltage 「AL 02」
	A2 03	The 3rd alarm in the past is over current 「AL 03」
	A3 04	The 4th alarm in the past is regenerative error 「AL 04」
	A4 05	The 5th alarm in the past is overload 1 「AL 05」
	A5 06	The 6th alarm in the past is over speed 「AL 06」
	A6 07	The 7th alarm in the past is pulse command abnormal 「AL 07」
	A7 08	The 8th alarm in the past is position error excessive 「AL 08」
	A8 09	The 9th alarm in the past is communication abnormal 「AL 09」
	A9 10	The 10th alarm in the past is overload 2 「AL 10」

Functions when abnormal alarm occurred:

(1) Any mode screen would display the current alarm.

(2) The other screen could be viewed during the occurrence of an alarm.

(3) Remove the cause of alarm and clear it by one of the following methods:

   (a) Switch the power OFF, then ON.

   (b) Press the "SET" button on the current alarm screen.

   (c) Turn on the abnormal alarm reset signal (RES).

(4) Move to the next screen by pressing "UP" or "DOWN".

2.5.4. Diagnostic display

The following table provides information related to the operation of diagnostic display.

Name		Screen	Description
Control status		`rd-oF`	Not ready: The drive is being initialized or an alarm has occurred.
		`rd-on`	Ready: The initialization of drive is completed, ready for operation.
I/O monitor		`8.8.-L`	To show the I/O signals' ON/OFF states. Upper segments correspond to the input signals and lower segments to the output signals.
Forced output		`do-on`	DO signals could be force ON/OFF with this screen operation.
Test mode	JOG	`rESr1`	JOG trial run could be executed when there is no external command.
	Position trial run	`rESr2`	Position trial run could be executed once when there is no external command. This operation could not be performed with the operation panel but with the PC communication software.
	Load inertia estimation	`rESr3`	The load to motor inertia estimation could not be executed with the operation panel but with the PC communication software.
Software version		`SP103`	Indicates the software version of the drive.
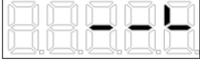
3. Startup and Parameters

> ⚠ **DANGER** ◆ Not operate the switches with wet hands. Otherwise, it may cause an electric shock.

> ⚠ **CAUTION** ◆ Before running the servo motor, check the parameters. Any improper settings may cause machines some unexpected operation
> ◆ The servo drive heat sink, regenerative resistor, servo motor, etc. may be hot while power is on or for an interval after power off. Not to touch them mentioned above to avoid burns

3.1. Startup procedure

Wiring check	Check whether the servo drive and servo motor are wired correctly.
Ambient check	Check the ambient environment of the servo drive and servo motor.
Parameter setting	Set the parameters properly, such as the regenerative option.
Idle test	Decouple the servo motor from the machine and run at the speed as low as possible, check whether the servo motor rotates correctly. Then give commands to the servo drive and check whether the servo motor rotates correctly.
Load test	After coupling the servo motor with the machine, check machine motions are correct or not by sending operation commands from the superior controller.
Gain adjustment	Make gain adjustment to optimize the machine motions.
Repetitive run	Observe the motion of machine, check if any vibration occurred then to suppress it.
Stop	Stop the servo motor.

3.2. Parameter list

(1) Basic parameters

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA01(★)	STY	Control mode option	1020h	-	○	○	○
PA02(▲)	ATUM	Gain tuning mode option	0002h	-	○	○	○
PA03	ATUL	Auto-tuning response level setting	10	-	○	○	○
PA04	HMOV	Home moving option	0000h	-		○	
PA05	TL1	Inner torque limit 1	100	%	○	○	○
PA06	CMX	Electronic gear numerator	1	-	○	○	
PA07(▲)	CDV	Electronic gear denominator	1	-	○	○	
PA08	HSPD1	Home moving high speed option 1	100	rpm		○	
PA09	HSPD2	Home moving high speed option 2	20	rpm		○	
PA10	RES1	Regenerated resistor value	-	ohm		○	
PA11	RES2	Regenerated resistor capacity	-	watt		○	
PA12	INP	In-position range	-	pulse	○	○	
PA13	-	Reserved					
PA14(★)	ENR	Encoder output pulses	10000	pulse/rev	○	○	○
PA15	CRSHA	Motor crash protection level (percentage)	0	%	○	○	○
PA16	CRSHT	Motor crash protection (time)	1	ms	○	○	○
PA17	OVL	Output overload warning level	120	%	○	○	○
PA18	OVS	Overspeed warning	5500	rpm	○	○	○
PA19	OVPE	Position error excess	3×2^{24}	pulse	○	○	
PA20	-	Reserved					
PA21	-	Reserved					
PA22(★)	DBF	Dynamic brake control	0	-	○	○	○
PA23(■)	MCS	Memory write-inhibit function	0	-	○	■	○
PA24(★)	PRES	Linear scale resolution of full-closed loop	5000	pulse/rev	○	★	
PA25	PERR	Error protection range of full-closed loop	30000	pulse	○	○	
PA26(▲)	FCON	Full-closed loop control option	0000h	-	○	▲	
PA27	FELP	Low-pass filter of full-closed loop	100	mS	○	○	
PA28(★)	ABS	Absolute encoder settings	0000h	-	○	○	○
PA29(■)	CAP	Absolute homing position	0000h	-	○	■	○
PA30(■)	UAP	Update encoder absolute position	0	-	○	○	○
PA31	APST	Absolute coordinate system state	0000h	-	○	○	○
PA32	APR	Encoder absolute position (rev)	0	rev	○	○	○

PA33	APP	Encoder absolute position (pulse)	0	pulse	○	○	○
PA34(★)	-	Reserved					
PA35	ATST	One touch gain tuning option	0	-	○	○	○
PA36	AOP3	One touch gain tuning function option	0	-	○	○	○
PA37	FNO3	Function option 3 (not user's function)					
PA38(★)	FNO1	Motor rotation option	0000h				
PA39(★)	POL	Motor rotary direction option	0000h	-	○	○	○
PA40(▲)	SPW	Special parameter write-enable	0000h	-	○	▲	○
PA41	POSPD	Max. speed setting of pulse output	5500	rpm	○	○	○
PA42(★)	BLK	Parameter write-inhibit	0000h	-	○	○	○
PA43(★)	ENB	Encoder brand	0001h	-	○	★	○
PA44(★)	EGM	Electronic gear ratio option	0	-	○	○	
PA45(▲)	FBP	Output pulse number per revolution	10000	pulse	○	▲	
PA46	CYCL	Cyclic control option	0	-	○	○	○
PA47	TLP	Positive torque limit value	5000	0.1%	○	○	○
PA48	TLN	Negative torque limit value	5000	0.1%	○	○	○
PA49	-	Reserved					
PA50	-	Reserved					

(★) denotes the setting is valid by power off once and power on again.

(■) denotes the setting is vanished once power off.

(▲) denotes the invalid change as the Servo ON activated.

(2) Gain, filter parameters

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PB01	NHF1	Machine resonance suppression filter 1	1000	Hz	○	○	○
PB02	NHD1	Machine resonance suppression attenuation 1	0	dB	○	○	○
PB03	NLP	Resonance suppression low-pass filter	0	0.1ms	○	○	○
PB04	PST	Position command filter time constant	3	ms	○	○	
PB05	FFC	Position feed-forward gain	0	%	○	○	
PB06	GD1	Load to motor inertia ratio	70	0.1time	○	○	○
PB07	PG1	Position loop gain	45	rad/s	○	○	
PB08	VG1	Speed loop gain	183	rad/s	○	○	○
PB09	VIC	Speed integral gain	34	ms	○	○	○
PB10	VFG	Speed feed-forward gain	0	%			○
PB11(★)	CDP	Gain switch condition	0000h	-	○	○	○
PB12	CDS	Gain switch condition value	10	depends	○	○	○
PB13	CDT	Gain switch time constant	1	ms	○	○	○

PB14	GD2	The ratio 2 of load inertia to motor shaft	70	0.1time	○	○	○
PB15	PG2	Position loop gain change ratio	100	%	○	○	
PB16	VG2	Speed loop gain change ratio	100	%	○	○	○
PB17	VIC2	Speed integral gain change ratio	100	%	○	○	○
PB18	SFLT	Speed low-pass filter smooth time constant	0	ms			○
PB19	TQC	Torque command filter time constant	0	ms			
PB20	SJIT	Speed feedback filter time constant	0	0.1ms	○	○	○
PB21	NHF2	Machine resonance suppression filter 2	1000	Hz	○	○	○
PB22	NHD2	Machine resonance suppression attenuation 2	0	dB	○	○	○
PB23	NDF	Motor noise suppression option	0	-	○	○	
PB24	VDC	Speed differential compensation	980	-	○	○	○
PB25	NHF3	Machine resonance suppression filter 3	1000	Hz	○	○	○
PB26	NHD3	Machine resonance suppression attenuation 3	0	dB	○	○	○
PB27	ANCF	Auto resonance suppression mode	1	-	○	○	○
PB28	ANCL	Resonance suppression detection level	50	%	○	○	○
PB29	AVSM	Auto vibration suppression mode	0	-	○	○	
PB30	VCL	Low-frequency vibration detection level	50	pulse	○	○	
PB31	VSF1	Vibration suppression frequency 1	100	0.1Hz	○	○	
PB32	VSG1	Vibration suppression gain 1	0	-	○	○	
PB33	VSF2	Vibration suppression frequency 2	100	0.1Hz	○	○	
PB34	VSG2	Vibration suppression gain 2	0	-	○	○	
PB35	FRCL	Friction compensation level	0	%	○	○	○
PB36	FRCT	Friction compensation filter time constant	0	ms	○	○	○
PB37	FRCM	Friction compensation option	0	-	○	○	○
PB38	FFCT	Position feed forward filter time constant	0	ms	○	○	
PB39	-	Reserved					
PB40	-	Reserved					
PB41	-	Reserved					
PB42	-	Reserved					
PB43	-	Reserved					
PB44	PPD	Position loop differential gain	0	rad/s	○	○	
PB45	NHF4	Machine resonance suppression filter 4	1000	Hz	○	○	○
PB46	NHD4	Machine resonance suppression attenuation 4	0	dB	○	○	○
PB47	NHF5	Machine resonance suppression filter 5	1000	Hz	○	○	○
PB48	NHD5	Machine resonance suppression attenuation 5	0	dB	○	○	○
PB49	DST	Disturbance observer gain	0	-	○	○	○
PB50	MVF	Position command average filter time constant	0	ms	○	○	

(★) denotes the setting is valid by power off once and power on again.

(3) Expansion parameters

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PC01	STA	Acceleration time constant	200	ms		◯	◯
PC02	STB	Deceleration time constant	200	ms		◯	◯
PC03	STC	S-pattern acc./dec. time constant	0	ms		◯	◯
PC04	JOG	JOG speed command	300	rpm	◯	◯	◯
PC05	SC1	Inner speed command/limit 1	100	rpm			◯
PC06	SC2	Inner speed command/limit 2	500	rpm			◯
PC07	SC3	Inner speed command/limit 3	1000	rpm			◯
PC08	SC4	Inner speed command/limit 4	200	rpm			◯
PC09	SC5	Inner speed command/limit 5	300	rpm			◯
PC10	SC6	Inner speed command/limit 6	500	rpm			◯
PC11	SC7	Inner speed command/limit 7	800	rpm			◯
PC12	-	Reserved					
PC13	-	Reserved					
PC14	-	Reserved					
PC15	-	Reserved					
PC16	MBR	Electromagnetic brake output delay time	100	ms	◯	◯	◯
PC17	ZSP	Zero speed acknowledged range	50	rpm	◯	◯	◯
PC18(★)	COP1	Stop option and power interruption restart option	0010h	-	◯	◯	◯
PC19(★)	COP2	*Alarm history clear and overload early warning option*	0000h	-	◯	◯	◯
PC20(★)	SNO	Communication device number	1	-	◯	◯	◯
PC21(★)	CMS	Communication mode option	0010h	-	◯	◯	◯
PC22	-	Reserved					
PC23	SIC	Communication time-out process option	0	s	◯	◯	◯
PC24(★)	DMD	Status display option	0000h	-	◯	◯	◯
PC25	TL2	Inner torque limit 2	100	%	◯	◯	◯
PC26	-	Reserved					
PC27	-	Reserved					
PC28	-	Reserved					
PC29	-	Reserved					
PC30	-	Reserved					
PC31	-	Reserved					
PC32	CMX2	Electronic gear numerator 2	1	-	◯	◯	
PC33	CMX3	Electronic gear numerator 3	1	-	◯	◯	

PC34	CMX4	Electronic gear numerator 4	1	-	○	○	
PC35	-	Reserved					
PC36	-	Reserved					
PC37	-	Reserved					
PC38	ESYC	EtherCAT sync abnormal count option	0	-	○	○	○
PC39	ESS	EtherCAT communication node option	0	-	○		
PC40	-	Reserved					
PC41	CAST	Capture start address of data array	0	-	○	○	○
PC42(■)	CAAX	Capture axis position	0	-	○	■	○
PC43(■)	CAND	Capture amount	1	-	○	■	○
PC44(■)	CACT	Capture control start option	2010h	-	○	■	○
PC45	CPRS	Capture position 1 reset data	0	-	○	○	○
PC46	CPMK	Capture mask range setting	0	-	○	○	○
PC47	CMST	Compare start address of data array	0	-	○	○	○
PC48(■)	CMAX	Compare axis position	0	-	○	■	○
PC49(■)	CMNO	Compare number	1	-	○	■	○
PC50(■)	CMCT	Compare control start	640010h	-	○	■	○
PC51	CMOF1	Compare offset 1	0	pulse	○	○	○
PC52(■)	CMOF2	Compare offset 2 (resettable to zero)	0	pulse	○	■	○
PC53	-	Reserved					
PC54	-	Reserved					
PC55	CPEX	Capture/Compare extra function	0x0000	-	○	○	○
PC56	-	Reserved					
PC57	-	Reserved					
PC58	-	Reserved					
PC59	ECHD	E-CAM head of data array	100	-		○	
PC60	ECMN	E-CAM area number N	5	-		○	
PC61	ECMM	E-CAM cycle number M	1	-		○	
PC62	ECMP	E-CAM primary axis pulse number P	3600	-		○	
PC63	ECME	E-CAM engage area number	0	-		○	
PC64(■)	ECAX	E-CAM primary axis position	0	-		○	
PC65	PLED1	E-CAM lead command length	0	-		○	
PC66(■)	ECON	E-CAM ON control	0000h	-		■	
PC67	ECRD	E-CAM disengage time data	0	-		○	
PC68	CPCT	E-CAM Pulse phase compensation time	0	us		○	
PC69	CPCL	E-CAM Pulse phase compensation frequency	0	Kpps		○	
PC70	CMAP1	E-CAM Area 1 start point	0	degree		○	

PC71	CMAN1	E-CAM Area 1 end point	0	degree		○	
PC72	CMAP2	E-CAM Area 2 start point	0	degree		○	
PC73	CMAN2	E-CAM Area 2 end point	0	degree		○	
PC74	PLEDC2	E-CAM lead command length cyclic	0	-		○	
PC75~PC90							
PC91(■)	PCTL	Parameter write-in control	0	-	○	○	○
PC92	AYSZ	Data array size (read only)	800	-	○	○	○
PC93(■)	AYID	Data array read/write index	0	-	○	○	○
PC94(■)	AYD0	Data array read/write domain 0	0	-	○	○	○
PC95(■)	AYD1	Data array read/write domain 1	0	-	○	○	○
PC96	TBS	E-CAM curve scaling	1000000	×10^{-6}		○	
PC97	-	Reserved					
PC98	-	Reserved					
PC99	-	Reserved					

(★) denotes the setting is valid by power off once and power on again.

(■) denotes the setting is vanished once power off.

(▲) denotes the invalid change as the Servo ON activated.

(4) I/O setting parameters

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PD01(★)	DIA1	Digital input signal auto-ON option 1	0000h	-	○	○	○
PD02(★)	DI1	Digital input 1 option	0001h	-	○	○	○
PD03(★)	DI2	Digital input 2 option	000Dh	-	○	○	○
PD04(★)	DI3	Digital input 3 option	0003h	-	○	○	○
PD05(★)	DI4	Digital input 4 option	0004h	-	○	○	○
PD06(★)	DI5	Digital input 5 option	0002h	-	○	○	○
PD07(★)	DI6	Digital input 6 option	000Fh	-	○	○	○
PD08(★)	DI7	Digital input 7 option	0012h	-	○	○	○
PD09		Reserved					
PD10(★)	DO1	Digital output 1 option	0003h	-	○	○	○
PD11(★)	DO2	Digital output 2 option	0008h	-	○	○	○
PD12(★)	DO3	Digital output 3 option	0007h	-	○	○	○
PD13(★)	DO4	Digital output 4 option	0005h	-	○	○	○
PD14		Reserved					
PD15(★)	DIF	Digital input filter time option	0002h	-	○	○	○
PD16(■)	SDI	Digital input on/off control source option	0000h	-	○	○	○

PD17(★)	DOP1	LSP/LSN triggered stop option	0000h	-	○	○	○
PD18(★)	DOP2	CR signal clear option	0000h	-	○	○	
PD19(★)	DOP3	Alarm code output option	0000h	-	○	○	○
PD20(★)	DOP4	Alarm reset triggered process	0000h	-	○	○	○
PD21		Reserved					
PD22		Reserved					
PD23		Reserved					
PD24		Reserved					
PD25(■)	ITST	Communication control DI on/off	0000h	-	○	■	○
PD26		Reserved					
PD27(★)	DOD	DO signal contact definition	*0004h*	-	○	○	○
PD28	MCOK	Motion completion option	0000h	-		○	
PD29(★)	DID	Software DI contact definition	0000h	-	○	○	○
PD30(■)		Reserved					
PD31(■)		Reserved					
PD32(★)		Reserved					
PD33	SFDO	Software DO setting	0000h		○	○	○
PD34		Reserved					
PD35		Reserved					
PD36		Reserved					
PD37		Reserved					
PD38		Reserved					
PD39		Reserved					
PD40		Reserved					

(★) denotes the setting is valid by power off once and power on again.

(■) denotes the setting is vanished once power off.

(▲) denotes the invalid change as the Servo ON activated.

(5) Pr stroke 1 programming parameters

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PE01	ODEF	Origin return definition	0000h	-		○	
PE02	ODAT	Origin offset value definition	0	-		○	
PE03	PDEF1	PATH#1 definition	0000h	-		○	
PE04	PDAT1	PATH#1 data	0	-		○	
PE05	PDEF2	PATH#2 definition	0000h	-		○	
PE06	PDAT2	PATH#2 data	0	-		○	

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PE07	PDEF3	PATH#3 definition	0000h	-		○	
PE08	PDAT3	PATH#3 data	0	-		○	
PE09	PDEF4	PATH#4 definition	0000h	-		○	
PE10	PDAT4	PATH#4 data	0	-		○	
PE11	PDEF5	PATH#5 definition	0000h	-		○	
PE12	PDAT5	PATH#5 data	0	-		○	
PE13	PDEF6	PATH#6 definition	0000h	-		○	
PE14	PDAT6	PATH#6 data	0	-		○	
PE15	PDEF7	PATH#7 definition	0000h	-		○	
PE16	PDAT7	PATH#7 data	0	-		○	
PE17	PDEF8	PATH#8 definition	0000h	-		○	
PE18	PDAT8	PATH#8 data	0	-		○	
PE19	PDEF9	PATH#9 definition	0000h	-		○	
PE20	PDAT9	PATH#9 data	0	-		○	
PE21	PDEF10	PATH#10 definition	0000h	-		○	
PE22	PDAT10	PATH#10 data	0	-		○	
PE23	PDEF11	PATH#11 definition	0000h	-		○	
PE24	PDAT11	PATH#11 data	0	-		○	
PE25	PDEF12	PATH#12 definition	0000h	-		○	
PE26	PDAT12	PATH#12 data	0	-		○	
PE27	PDEF13	PATH#13 definition	0000h	-		○	
PE28	PDAT13	PATH#13 data	0	-		○	
PE29	PDEF14	PATH#14 definition	0000h	-		○	
PE30	PDAT14	PATH#14 data	0	-		○	
PE31	PDEF15	PATH#15 definition	0000h	-		○	
PE32	PDAT15	PATH#15 data	0	-		○	
PE33	PDEF16	PATH#16 definition	0000h	-		○	
PE34	PDAT16	PATH#16 data	0	-		○	
PE35	PDEF17	PATH#17 definition	0000h	-		○	
PE36	PDAT17	PATH#17 data	0	-		○	
PE37	PDEF18	PATH#18 definition	0000h	-		○	
PE38	PDAT18	PATH#18 data	0	-		○	
PE39	PDEF19	PATH#19 definition	0000h	-		○	
PE40	PDAT19	PATH#19 data	0	-		○	

NO	Abbr.	Name	Default	Unit	Control mode CoE	Control mode Pr	Control mode S
PE41	PDEF20	PATH#20 definition	0000h	-		○	
PE42	PDAT20	PATH#20 data	0	-		○	
PE43	PDEF21	PATH#21 definition	0000h	-		○	
PE44	PDAT21	PATH#21 data	0	-		○	
PE45	PDEF22	PATH#22 definition	0000h	-		○	
PE46	PDAT22	PATH#22 data	0	-		○	
PE47	PDEF23	PATH#23 definition	0000h	-		○	
PE48	PDAT23	PATH#23 data	0	-		○	
PE49	PDEF24	PATH#24 definition	0000h	-		○	
PE50	PDAT24	PATH#24 data	0	-		○	
PE51	PDEF25	PATH#25 definition	0000h	-		○	
PE52	PDAT25	PATH#25 data	0	-		○	
PE53	PDEF26	PATH#26 definition	0000h	-		○	
PE54	PDAT26	PATH#26 data	0	-		○	
PE55	PDEF27	PATH#27 definition	0000h	-		○	
PE56	PDAT27	PATH#27 data	0	-		○	
PE57	PDEF28	PATH#28 definition	0000h	-		○	
PE58	PDAT28	PATH#28 data	0	-		○	
PE59	PDEF29	PATH#29 definition	0000h	-		○	
PE60	PDAT29	PATH#29 data	0	-		○	
PE61	PDEF30	PATH#30 definition	0000h	-		○	
PE62	PDAT30	PATH#30 data	0	-		○	
PE63	PDEF31	PATH#31 definition	0000h	-		○	
PE64	PDAT31	PATH#31 data	0	-		○	
PE65	PDEF32	PATH#32 definition	0000h	-		○	
PE66	PDAT32	PATH#32 data	0	-		○	
PE67	PDEF33	PATH#33 definition	0000h	-		○	
PE68	PDAT33	PATH#33 data	0	-		○	
PE69	PDEF34	PATH#34 definition	0000h	-		○	
PE70	PDAT34	PATH#34 data	0	-		○	
PE71	PDEF35	PATH#35 definition	0000h	-		○	
PE72	PDAT35	PATH#35 data	0	-		○	
PE73	PDEF36	PATH#36 definition	0000h	-		○	
PE74	PDAT36	PATH#36 data	0	-		○	

NO	Abbr.	Name	Default	Unit	Control mode CoE	Control mode Pr	Control mode S
PE75	PDEF37	PATH#37 definition	0000h	-		○	
PE76	PDAT37	PATH#37 data	0	-		○	
PE77	PDEF38	PATH#38 definition	0000h	-		○	
PE78	PDAT38	PATH#38 data	0	-		○	
PE79	PDEF39	PATH#39 definition	0000h	-		○	
PE80	PDAT39	PATH#39 data	0	-		○	
PE81	PDEF40	PATH#40 definition	0000h	-		○	
PE82	PDAT40	PATH#40 data	0	-		○	
PE83	PDEF41	PATH#41 definition	0000h	-		○	
PE84	PDAT41	PATH#41 data	0	-		○	
PE85	PDEF42	PATH#42 definition	0000h	-		○	
PE86	PDAT42	PATH#42 data	0	-		○	
PE87	PDEF43	PATH#43 definition	0000h	-		○	
PE88	PDAT43	PATH#43 data	0	-		○	
PE89	PDEF44	PATH#44 definition	0000h	-		○	
PE90	PDAT44	PATH#44 data	0	-		○	
PE91	PDEF45	PATH#45 definition	0000h	-		○	
PE92	PDAT45	PATH#45 data	0	-		○	
PE93	PDEF46	PATH#46 definition	0000h	-		○	
PE94	PDAT46	PATH#46 data	0	-		○	
PE95	PDEF47	PATH#47 definition	0000h	-		○	
PE96	PDAT47	PATH#47 data	0	-		○	
PE97	PDEF48	PATH#48 definition	0000h	-		○	
PE98	PDAT48	PATH#48 data	0	-		○	
PE99		Reserved					

(6) Pr stroke 2 programming parameters

NO	Abbr.	Name	Default	Unit	Control mode CoE	Control mode Pr	Control mode S
PF01	PDEF49	PATH#49 data	0000h	-		○	
PF02	PDAT49	PATH#49 definition	0	-		○	
PF03	PDEF50	PATH#50 data	0000h	-		○	
PF04	PDAT50	PATH#50 definition	0	-		○	
PF05	PDEF51	PATH#51 definition	0000h	-		○	

NO	Abbr.	Name	Default	Unit	Control mode CoE	Control mode Pr	Control mode S
PF06	PDAT51	PATH#51 data	0	-		○	
PF07	PDEF52	PATH#52 definition	0000h	-		○	
PF08	PDAT52	PATH#52 data	0	-		○	
PF09	PDEF53	PATH#53 definition	0000h	-		○	
PF10	PDAT53	PATH#53 data	0	-		○	
PF11	PDEF54	PATH#54 definition	0000h	-		○	
PF12	PDAT54	PATH#54 data	0	-		○	
PF13	PDEF55	PATH#55 definition	0000h	-		○	
PF14	PDAT55	PATH#55 data	0	-		○	
PF15	PDEF56	PATH#56 definition	0000h	-		○	
PF16	PDAT56	PATH#56 data	0	-		○	
PF17	PDEF57	PATH#57 definition	0000h	-		○	
PF18	PDAT57	PATH#57 data	0	-		○	
PE19	PDEF58	PATH#58 definition	0000h	-		○	
PF20	PDAT58	PATH#58 data	0	-		○	
PF21	PDEF59	PATH#59 definition	0000h	-		○	
PF22	PDAT59	PATH#59 data	0	-		○	
PF23	PDEF60	PATH#60 definition	0000h	-		○	
PF24	PDAT60	PATH#60 data	0	-		○	
PF25	PDEF61	PATH#61 definition	0000h	-		○	
PF26	PDAT61	PATH#61 data	0	-		○	
PF27	PDEF62	PATH#62 definition	0000h	-		○	
PF28	PDAT62	PATH#62 data	0	-		○	
PF29	PDEF63	PATH#63 definition	0000h	-		○	
PF30	PDAT63	PATH#63 data	0	-		○	
PF31~PF32		Reserved					
PF33	POV1	Inner position 1 velocity	50	rpm		○	
PF34	POV2	Inner position 2 velocity	10	rpm		○	
PF35	POV3	Inner position 3 velocity	200	rpm		○	
PF36	POV4	Inner position 4 velocity	300	rpm		○	
PF37	POV5	Inner position 5 velocity	500	rpm		○	
PF38	POV6	Inner position 6 velocity	800	rpm		○	
PF39	POV7	Inner position 7 velocity	1000	rpm		○	
PF40	POV8	Inner position 8 velocity	1200	rpm		○	

NO	Abbr.	Name	Default	Unit	Control mode CoE	Pr	S
PF41	POV9	Inner position 9 velocity	1500	rpm		○	
PF42	POV10	Inner position 10 velocity	1800	rpm		○	
PF43	POV11	Inner position 11 velocity	2000	rpm		○	
PF44	POV12	Inner position 12velocity	2200	rpm		○	
PF45	POV13	Inner position 13 velocity	2400	rpm		○	
PF46	POV14	Inner position 14 velocity	2700	rpm		○	
PF47	POV15	Inner position 15 velocity	3000	rpm		○	
PF48	POV16	Inner position 16 velocity	3000	rpm		○	
PF49	POA1	Inner position 1 acc./dec. time	200	ms		○	
PF50	POA2	Inner position 2 acc./dec. time	300	ms		○	
PF51	POA3	Inner position 3 acc./dec. time	500	ms		○	
PF52	POA4	Inner position 4 acc./dec. time	600	ms		○	
PF53	POA5	Inner position 5 acc./dec. time	800	ms		○	
PF54	POA6	Inner position 6 acc./dec. time	900	ms		○	
PF55	POA7	Inner position 7 acc./dec. time	1000	ms		○	
PF56	POA8	Inner position 8 acc./dec. time	1200	ms		○	
PF57	POA9	Inner position 9 acc./dec. time	1400	ms		○	
PF58	POA10	Inner position 10 acc./dec. time	1600	ms		○	
PF59	POA11	Inner position 11 acc./dec. time	2000	ms		○	
PF60	POA12	Inner position 12 acc./dec. time	2500	ms		○	
PF61	POA13	Inner position 13 acc./dec. time	3000	ms		○	
PF62	POA14	Inner position 14 acc./dec. time	4000	ms		○	
PF63	POA15	Inner position 15 acc./dec. time	5000	ms		○	
PF64	POA16	Inner position 16 acc./dec. time	6000	ms		○	
PF65	DLY1	Inner position 1 completion delay time	0	ms		○	
PF66	DLY2	Inner position 2 completion delay time	100	ms		○	
PF67	DLY3	Inner position 3 completion delay time	200	ms		○	
PF68	DLY4	Inner position 4 completion delay time	300	ms		○	
PF69	DLY5	Inner position 5 completion delay time	500	ms		○	
PF70	DLY6	Inner position 6 completion delay time	600	ms		○	
PF71	DLY7	Inner position 7 completion delay time	800	ms		○	
PF72	DLY8	Inner position 8 completion delay time	1000	ms		○	
PF73	DLY9	Inner position 9 completion delay time	1200	ms		○	
PF74	DLY10	Inner position 10 completion delay time	1600	ms		○	

NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PF75	DLY11	Inner position 11 completion delay time	2000	ms		○	
PF76	DLY12	Inner position 12 completion delay time	2500	ms		○	
PF77	DLY13	Inner position 13 completion delay time	3000	ms		○	
PF78	DLY14	Inner position 14 completion delay time	4000	ms		○	
PF79	DLY15	Inner position 15 completion delay time	5000	ms		○	
PF80	DLY16	Inner position 16 completion delay time	6000	ms		○	
PF81	PDEC	Protection trigger deceleration time	0000h	ms	○	○	○
PF82(■)	PRCM	PR trigger register	0	-		○	
PF83	EVON	Event raising edge trigger	0000h	-		○	
PF84	EVOF	Event falling edge trigger	0000h	-		○	
PF85(■)	PMEM	PATH#1 to PATH#2 memory invalid	0000h	-	○	○	○
PF86	SWLP	Software forward stroke limit	2^{31}-1	-		○	
PF87	SWLN	Software reverse stroke limit	-2^{31}+1	-		○	
PF88(★)	BLSF	Backlash compensation option	0	-	○	○	
PF89	BLSP	Backlash compensation rectified pulses	0	-	○	○	
PF90	BLST	Backlash compensation time constant	0	-	○	○	

(7) Parameter groups of varied control modes

Torque control related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA01(★)	STY	Control mode option	1020h	-	○	○	○
PA05	TL1	Inner torque limit 1	100	%	○	○	○
PC05	SC1	Inner speed command/limit 1	100	rpm			○
PC06	SC2	Inner speed command/limit 2	500	rpm			○
PC07	SC3	Inner speed command/limit 3	1000	rpm			○
PC08	SC4	Inner speed command/limit 4	200	rpm			○
PC09	SC5	Inner speed command/limit 5	300	rpm			○
PC10	SC6	Inner speed command/limit 6	500	rpm			○
PC11	SC7	Inner speed command/limit 7	800	rpm			○
PC25	TL2	Inner torque limit 2	100	%	○	○	○

Speed control related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA01(★)	STY	Control mode option	1020h	-	○	★	○
PA05	TL1	Inner torque limit 1	100	%	○	○	○
PA14(★)	ENR	Encoder output pulses	10000	pulse/rev	○	○	○
PB18	SFLT	Speed low-pass filter smooth time constant	0	ms			○
PC05	SC1	Inner speed command/limit 1	100	rpm			○
PC06	SC2	Inner speed command/limit 2	500	rpm			○
PC07	SC3	Inner speed command/limit 3	1000	rpm			○
PC08	SC4	Inner speed command/limit 4	200	rpm			○
PC09	SC5	Inner speed command/limit 5	300	rpm			○
PC10	SC6	Inner speed command/limit 6	500	rpm			○
PC11	SC7	Inner speed command/limit 7	800	rpm			○
PC25	TL2	Inner torque limit 2	100	%	○	○	○

Position control related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA01(★)	STY	Control mode option	1020h	-	○	○	○
PA04	HMOV	Home moving option	0000h	-		○	
PA05	TL1	Inner torque limit 1	100	%	○	○	○
PA06	CMX	Electronic gear numerator	1	-	○	○	
PA07(▲)	CDV	Electronic gear denominator	1	-	○	▲	
PA14(★)	ENR	Encoder output pulses	10000	pulse/rev	○	○	○
PA39(★)	POL	Motor rotary direction option	0000h	-	○	○	○
PC25	TL2	Inner torque limit 2	100	%	○	○	○
PC32	CMX2	Electronic gear numerator 2	1	-	○	○	
PC33	CMX3	Electronic gear numerator 3	1	-	○	○	
PC34	CMX4	Electronic gear numerator 4	1	-	○	○	
PE01	ODEF	Origin return definition	0000h	-		○	
PE02	ODAT	Origin offset value definition	0	-		○	
PE03~PE98		Pr stroke related parameters		-	○	○	

NO	Abbr.	Name	Default	Unit	CoE	Pr	S
PF01~PF87		Pr stroke related parameters		-	○	○	

Smoothing filter and resonance suppression related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PB01	NHF1	Machine resonance suppression filter 1	1000	Hz	○	○	○
PB02	NHD1	Machine resonance suppression attenuation 1	0	dB	○	○	○
PB03	NLP	Resonance suppression low-pass filter	0	0.1mS	○	○	○
PB04	PST	Position command filter time constant	3	Ms	○	○	
PB19	TQC	Torque command filter time constant	0	ms			
PB20	SJIT	Speed feedback filter time constant	0	0.1mS	○	○	○
PB21	NHF2	Machine resonance suppression filter 2	1000	Hz	○	○	○
PB22	NHD2	Machine resonance suppression attenuation 2	0	dB	○	○	○
PB23(★)	IVSF	Current vibration suppression filter	0000h	-	○	○	○
PB25	NHF3	Machine resonance suppression filter 3	1000	Hz	○	○	○
PB26	NHD3	Machine resonance suppression attenuation 3	0	dB	○	○	○
PB27	ANCF	Auto resonance suppression mode	1	-	○	○	○
PB28	ANCL	Resonance suppression detection level	50	%	○	○	○
PB29	AVSM	Auto vibration suppression mode	0	-	○	○	
PB30	VCL	Low-frequency vibration detection level	50	pulse	○	○	
PB31	VSF1	Vibration suppression frequency 1	100	0.1Hz	○	○	
PB32	VSG1	Vibration suppression gain 1	0	-	○	○	
PB33	VSF2	Vibration suppression frequency 2	100	0.1Hz	○	○	
PB34	VSG2	Vibration suppression gain 2	0	-	○	○	
PB35	FRCL	Friction compensation level	0	%	○	○	○
PB36	FRCT	Friction compensation filter time constant	0	ms	○	○	○
PB37	FRCM	Friction compensation option	0	-	○	○	○
PB38	FFCT	Position feed forward filter time constant	0	ms	○	○	
PB45	NHF4	Machine resonance suppression filter 4	1000	Hz			
PB46	NHD4	Machine resonance suppression attenuation 4	0	dB			
PB47	NHF5	Machine resonance suppression filter 5	1000	Hz			
PB48	NHD5	Machine resonance suppression attenuation 5	0	dB			
PC01	STA	Acceleration time constant	200	Ms		○	○
PC02	STB	Deceleration time constant	200	Ms		○	○
PC03	STC	S-pattern acc./dec. time constant	0	ms		○	○
PD17(★)	DOP1	LSP/LSN triggered stop option	0000h	-	○	○	○

Gain and gain switch related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA02(▲)	ATUM	Gain tuning mode option	0002h	-	○	▲	○
PA03	ATUL	Auto-tuning response level setting	0005h	-	○	○	○
PB05	FFC	Position feed-forward gain	0	0.0001	○	○	
PB07	PG1	Position loop gain	35	rad/s	○	○	
PB08	VG1	Speed loop gain	817	rad/s	○	○	○
PB09	VIC	Speed integral gain	48	ms	○	○	○
PB10	VFG	Speed feed-forward gain	0	0.0001			○
PB11(★)	CDP	Gain switch condition	0000h	-	○	★	○
PB12	CDS	Gain switch condition value	10	depends	○	○	○
PB13	CDT	Gain switch time constant	1	ms	○	○	○
PB14	GD2	The ratio 2 of load inertia to motor shaft	70	0.1time	○	○	○
PB15	PG2	Position loop gain change ratio	100	%	○	○	○
PB16	VG2	Speed loop gain change ratio	100	%	○	○	○
PB17	VIC2	Speed integral gain change ratio	100	%	○	○	○
PB24	VDC	Speed differential compensation	980	-	○	○	○

Digital I/O settings related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA12	INP	In-position range	100	Pulse	○	○	
PC16	MBR	Electromagnetic brake output delay time	100	ms	○	○	○
PC17	ZSP	Zero speed acknowledged range	50	rpm	○	○	○
PD01(★)	DIA1	Digital input signal auto-ON option 1	0000h	-	○	★	○
PD02(★)	DI1	Digital input 1 option (CN1-2)	0000h	-	○	★	○
PD03(★)	DI2	Digital input 2 option (CN1-3)	0000h	-	○	★	○
PD04(★)	DI3	Digital input 3 option (CN1-4)	0000h	-	○	★	○
PD05(★)	DI4	Digital input 4 option (CN1-5)	000Bh	-	○	★	○
PD06(★)	DI5	Digital input 5 option (CN1-6)	0018h	-	○	★	○
PD07(★)	DI6	Digital input 6 option (CN1-7)	0019h	-	○	★	○
PD08(★)	DI7	Digital input 7 option (CN1-8)	0012h	-	○	★	○
PD10(★)	DO1	Digital output 1 option (CN1-15)	0000h	-	○	○	○
PD11(★)	DO2	Digital output 2 option (CN1-16)	0000h	-	○	○	○

NO	Abbr.	Name	Default	Unit	CoE	Pr	S
PD12(★)	DO3	Digital output 3 option (CN1-17)	0002h	-	○	○	○

NO	Abbr.	Name	Default	Unit	CoE	Pr	S
PD13(★)	DO4	Digital output 4 option (CN1-18)	0001h	-	○	○	○
PD15(★)	DIF	Digital input filter time option	0002h	-	○	○	○
PD16(★)	SDI	Digital input on/off control source option	0000h	-	○	○	○
PD17(★)	DOP1	LSP/LSN triggered stop option	0000h	-	○	○	○
PD18(★)	DOP2	CR signal clear option	0000h	-	○	○	
PD19(★)	DOP3	Alarm code output option	0000h	-	○	○	○
PD20(★)	DOP4	Alarm reset triggered process	0000h	-	○	○	○
PD25(■)	ITST	Communication control DI on/off	0000h	-	○	○	○
PD27(★)	DOD	DO signal contact definition	0004h	-	○	○	○

Communication related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA01(★)	STY	Control mode option	1020h	-	○	○	○
PA46	CYCL	Cyclic control option	0	-	○	○	○
PC38	ESYC	EtherCAT sync abnormal count option	0	-	○	○	○
PC39	ESS	EtherCAT communication node option	0	-	○		

Other functions related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PA40(▲)	SPW	Special parameter write-enable	0000h	-	○	○	○
PA42(★)	BLK	Parameter write-inhibit	0000h	-	○	○	○
PB06	GD1	Load to motor inertia ratio	10	0.1time	○	○	○
PB14	GD2	The ratio 2 of load inertia to motor shaft	70	0.1time	○	○	○
PC18(★)	COP1	Stop option and power interruption restart option	0010h	-	○	○	○
PC19(★)	COP2	Alarm history clear and overload early warning option	0000h	-	○	○	○
PD20(★)	DOP4	Alarm reset triggered process	0000h	-	○	○	○

E-CAM related parameters							
NO	Abbr.	Name	Default	Unit	Control mode		
					CoE	Pr	S
PC41	CAST	Capture start address of data array	0	-	○	○	○
PC42(■)	CAAX	Capture axis position	0	-	○	○	○
PC43(■)	CAND	Capture amount	1	-	○	○	○
PC44(■)	CACT	Capture control start option	0x2010	-	○	○	○
PC45	CPRS	Capture position 1 reset data	0	-	○	○	○
PC46	CPMK	Capture mask range setting	0	-	○	○	○
PC47	CMST	Compare start address of data array	0	-	○	○	○
PC48(■)	CMAX	Compare axis position	0	-	○	○	○
PC49(■)	CMNO	Compare number	1	-	○	○	○
PC50(■)	CMCT	Compare control start	0x0064 0010	-	○	○	○
PC51	CMOF1	Compare offset 1	0	Pulse	○	○	○
PC52(■)	CMOF2	Compare offset 2 (resettable to zero)	0	pulse	○	○	○
PC55	CPEX	Capture/Compare extra function	0x0000	-	○	○	○
PC59	ECHD	E-CAM head of data array	100	-		○	
PC60	ECMN	E-CAM head of data array	5	-		○	
PC61	ECMM	E-CAM area number N	1	-		○	
PC62	ECMP	E-CAM cycle number M	3600	-		○	
PC63	ECME	E-CAM primary axis pulse number P	0	-		○	
PC64(■)	ECAX	E-CAM engage area number	0	-		○	
PC65	PLED	E-CAM primary axis position	0	-		○	
PC66(■)	ECON	E-CAM lead command length	0x0000	-		○	
PC67	ECRD	E-CAM ON control	0	-		○	
PC68	CPCT	E-CAM disengage time data	0	ms		○	
PC69	CPCL	E-CAM Pulse phase compensation time	0	Kpps		○	
PC70	CMAP1	E-CAM Pulse phase compensation frequency	0	degree		○	
PC71	CMAN1	E-CAM Area 1 start point	0	degree		○	
PC72	CMAP2	E-CAM Area 1 end point	0	degree		○	
PC73	CMAN2	E-CAM Area 2 start point	0	degree		○	
PC74	PLED2	E-CAM Area 2 end point	0	-		○	
PC91(■)	PCTL	Parameter write-in control	0	-	○	○	○

3.3. Parameter detail description

3.3.1. PA: Basic parameters

No	Abbr.	Function description	Control mode	Setting range	Unit
PA01	STY	Setting value of Control mode option: [u | z | y | x] x：control mode select 　0：position 　1：position/speed 　2：speed y：position command select 　0：invalid 　1：inner register(absolute type) 　2：EtherCAT communication command z：electromagnetic brake enabled option Assign the DO function of brake sequence with PD10~PD13. 　0：disabled 　1：enabled.(Motor with electromagnetic brake applied) u：DI/DO setting option 　0：Every DI/DO function is programmable individually. 　1：DI/DO functions are assigned according to control modes.	All	0000h ~1125h	-
PA02	ATUM	Gain tuning mode option: [0 | 0 | 0 | x] x：gain tuning mode option 0：manual-gain tuning(PI control) 1: manual-gain tuning(PI control + interference compensator) 2: Auto-gain tuning(load inertia ratio and bandwidth estimated) 3: Auto-gain tuning(fixed load inertia ratio) 4: Interpolation mode(*PB07* is fixed, other gain value estimated)	All	0000h ~0004h	-
PA03	ATUL	Auto-tuning response level setting: [0 | 0 | 0 | x] x：response level setting 	Value	Rigidity	Response frequency	Value	Rigidity	Response frequency
1	Low	10.0Hz	17	Middle	67.1Hz
2		11.3Hz	18		75.6Hz
3		12.7Hz	19		85.2Hz
4		14.3Hz	20		95.9Hz
5		16.1Hz	21		108.0Hz
6		18.1Hz	22		121.7Hz
7		20.4Hz	23		137.1Hz
8		23.0Hz	24		154.4Hz
9		25.9Hz	25		173.9Hz
10		29.2Hz	26		195.9Hz
11		32.9Hz	27		220.6Hz
12		37.0Hz	28		248.5Hz
13		41.7Hz	29		279.9Hz
14		47.0Hz	30		315.3Hz
15		52.9Hz	31		355.1Hz
16	Middle	59.6Hz	32	High	400.0Hz		All	1 ~32	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PA04	HMOV	Home moving option: `0  z  y  x` x：origin detector and rotation option y：origin attained shortcut moving option z：route limit trigger option **z column:** 0：stops then alerts. 1：keeps completing the home moving **y column:** 0：backward to Z pulse. 1：forward to to Z pulse. 2：followed x setting. (upper) 0：backward to Z pulse. 1：forward to Z pulse. 2:followed x setting. (lower) **x column:** 0: CCW run, LSP is as origin. 1: CW run, LSN is as origin. 2: CCW run, ORGP↑is as origin. 3: CW run, ORGP↑is as origin. 4: CCW run, Encoder Z pulse is as origin. 5: CW run, Encoder Z pulse is as origin. 6: CCW run, ORGP↓ is as origin. 7: CW run, ORGP↓ is as origin. 8: Current position is as origin.	Pr	0000h ~0128h	-
PA05	TL1	Inner torque limit 1: Motor generated torque is restricted by this parameter which unit is %. The generated torque is calculated as below. *Torque limit =Motor maximum current / motor rated current *PA05* If DI function TL1 is activated, the comparison between PA05 and PC25 decides the actual torque limit. The destination of torque limit with TL and TL1 signal are listed below. Note. 0 : off (with SG), 1 : on (with SG)	Pr,S	0 ~100	%
PA06	CMX	Electronic gear numerator See the description of PA07 below. Note： 1.This PA06 is equivalent to Object 6091-01h of CoE mode. 2.Also, this modification of PA06 in valid only after re-power on.	Pr	1 $\sim 2^{26}$	-
PA07	CDV	Electronic gear denominator The improper setting could lead to unexpected fast rotation so make sure to set this ratio in SERVO OFF state. The setting limit is：*1/50 < (CMX/CDV) < 64000*	Pr	1 $\sim 2^{26}$	-

Torque limit table (within PA05):

TL1	TL	Valid torque limit
0	0	PA05
1	0	If PC25 > PA05, limit value=PA05 If PC25 < PA05, limit value=PC25
1	1	PC25

PA07 diagram:

$$\text{pulse command } f1 \rightarrow \frac{CMX}{CDV} \rightarrow \text{Position command } f2 = CMX/CDV*f1$$

No	Abbr.	Function description	Control mode	Setting range	Unit
PA08	HSPD1	Home moving high speed option 1 As home moving action are triggered, motor runs at the PA08 speed to search the origin.	Pr	1 ~2000	rpm
PA09	HSPD2	Home moving high speed option 2 As the origin is acknowledged, motor would keep running or turns back at the PA09 speed to search the Z phase pulse.	Pr	1 ~500	rpm
PA10	RES1	Regenerative resistor value 	Drive capacity	Default
---	---
400W below	100Ω
750W~1KW	40Ω
1.5KW~5KW	13Ω
7KW	8Ω		All	10 ~750	ohm
PA11	RES2	Regenerative resistor capacity 	Drive capacity	Default
---	---
400W below	20W
750W~1KW	40W
1.5KW~5KW	100W		All	0 ~3000	watt
PA12	INP	In-position range To define the permissible pulse error range of position pulse commands. The default setting is varied due to the motor capacity.	Pr	0 ~2^{24}	pulse
PA14	ENR	Encoder output pulses Used to set the A/B-phase pulses encoder output. Users could set the PA39 to choose the output pulse setting or output division ratio. Set the value 4 times greater than the A-phase or B-phase pulses. The number of A/B-phase pulses actual output is 1/4 times. The maximum output frequency is 20MHz. (after multiplication by 4). Use this parameter within this range. For output pulse setting Set " □0□□ " in the PA39, then set PA14 to decide the number of pulses per servo motor revolution. If PA39=0000h and PA14=1024, the actual output pulses per motor revolution is 1024. For output division ratio setting Set " □1□□ " in parameter PA39. Set the output division ratio(PA14) per motor revolution. $$Output\ pulses = \frac{Resolution\ per\ motor\ revolution}{PA14\ setting\ value}$$ If PA39=0100h and PA14=512, the actual output pulses per motor revolution is (2^{22}/512)=32768.	Pr	4 ~2^{24}	pulse/rev
PA15	CRSHA	Motor crash protection level To prevent the motor running from crashing the mechanism. If PA15 is 0, the function is disabled. Any non-zero value setting will enable this function.	All	0 ~300	%

No	Abbr.	Function description	Control mode	Setting range	Unit
PA16	CRSHT	Motor crash protection When the PA15 level is reached and the PA16 setting time has taken, then the AL20 will occur.	All	0 ~1000	ms

No	Abbr.	Function description	Control mode	Setting range	Unit
PA17	OVL	Output overload warning level Used to set output overload level. If PA17 setting is within 0 ~ 100, when the motor has reached this level, a warning will be activated. If PA17 setting exceeds 100, the function is disabled.	All	0 ~120	%
PA18	OVS	Overspeed warning When the motor feedback speed exceeds this PA18 setting, the AL06 will occur.	All	1 ~6500	rpm
PA19	OVPE	Position error excess When the position error exceeds this PA19 setting, the AL08 will occur.	Pr, CoE	1 $\sim 2^{31}-1$	rev
PA22	DBF	Dynamic brake control Used to enable or disable the dynamic brake if an alarm occurred. 0: DBF enabled, the motor stops immediately. 1: DBF disabled, the motor coasts to stop gradually.	All	0 ~1	-
PA23	MCS	Memory write-inhibit function Used to permit or prohibit memory-write. 0: EEPROM is writable. 1: EEPROM is prohibited to be written. Parameter modification will vanish after power off.	All	0 ~1	-
PA24	PRES	Linear scale resolution of full-closed loop It denotes the A/B pulse number that correspond to the full-close loop when the motor turns one turn. (by 4 multiplication)	All	200 $\sim 2^{24}$	pulse
PA25	PERR	Error protection range of full-closed loop It defines the error protection range between motor feedback pulses and linear scale A/B pulses.	All	1 $\sim(2^{31}-1)$	pulse
PA26	FCON	Full-closed loop control option | 0 | z | y | x | x：full-close loop function switch 0：invalid 1：valid y：pulse output source option(LA/LB/LZ) 0：motor encoder pulse 1：linear scale pulse z：linear scale pulse phase option 0：phase A leading is as forward 1：phase B leading is as forward	All	0000h ~0111h	-
PA27	FELP	Low-pass filter of full-closed loop If the rigidity of transmission mechanical is insufficient when the full closed loop control is performed, an appropriate time constant can be set to improve the stability of the system. If the rigidity of transmission mechanical is sufficient, set PA27 as 0 to turn off this low pass filter.	All	0 ~1000	mS

No	Abbr.	Function description	Control mode	Setting range	Unit
PA28	ABS	Absolute encoder settings Used to permit that the motor with absolute encoder but is operated as an incremental motor. 0: Incremental mode. (motor capacity is less than 750W) 1: Absolute mode. (This setting is only available for the servo motor with absolute encoder, otherwise the AL24 will occur.	All	0000h ~0001h	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PA29	CAP	Absolute homing position When the PA29 is set as 1, the current position will be set as origin position. This function is the same as the DI function ABSC.	All	0000h ~0001h	-
PA30	UAP	Update encoder absolute position Used to update the absolute position data of the encoder. 1: Update the encoder data to PA31~PA33 only 2: Update the PA31~PA33 and clear the position error as well. As this setting is activated, the current position of the motor will be reset as the goal of position command.	All	0 ~2	-
PA31	APST	ABS position status (read only) bit0：0：normal ／ 1：absolute position has lost bit1：0：normal ／ 1：low voltage bit2：0：normal ／ 1：overflow bit3：reserved bit4：0：normal ／ 1：absolute coordinate system has not yet been set bit5~bit15：reserved	All	0000h ~001Fh	rpm
PA32	APR	Encoder absolute position (rev) (read only) To display the absolute encoder turn number. This parameter is valid only when the PA28 is set as 1.	All	$2^{17}-1$ ~ -2^{17}	rev
PA33	APP	Encoder absolute position (pulse) (read only) To display the absolute encoder pulse number. This parameter is valid only when the PA28 is set as 1.	All	0 ~ (2^{24}-1)	pulse
PA35	ATST	One touch gain tuning option This is used for factory test, user needn't to set.	All	0000h ~FF21h	-
PA36	AOP3	One touch gain tuning function option <table><tr><td>0</td><td>z</td><td>y</td><td>x</td></tr></table> x：auto gain tuning option 0：invalid 1：valid y：auto resonance suppression option 0：invalid 1：valid z：auto vibration suppression option 0：invalid 1：valid	All	0000h ~1111Fh	-
PA37	FNO3	Function option1 (not user's function)	All	0000h ~FFFFh	-

PA38	FNO1	Motor rotation option | 0	0	0	x | x：definition of motor rotary direction | x	motor rotary direction	
	forward	reverse
0	CCW	CW
1	CW	CCW	 When the absolute encoder system is perform, if PA38 has been modified, please re-power on the servo drive then to execute the origin return process.	All	0000h ~0001h	-

No	Abbr.	Function description	Control mode	Setting range	Unit

PA39	POL	Motor rotary direction and encoder pulse output option
		The relation between motor rotary direction and encoder output pulse direction is described below.
		
		| 0
			z	y	0 |
					
					y：motor rotary direction and encoder pulse output option
					
					z：encoder output option
					  0：output pulse
					  1：output division ratio
						All	0000h
							~0110h
								-

PA40	SPW	Special parameter write-enable As this parameter is set as 0088h, the drive would take 2 seconds to recover factory-set. This change is valid by power off once and power on again.	All	0000h ~00FFh	-
PA41	POSPD	Max. speed output setting of encoder According the actual application, users can set this PA41 to optimize the encoder outputs (LA, LB). If this setting value is exceeded during the motor running, the AL30 will occur. "0" is to disable this function.	All	0 ~6500	rpm

PA42	BLK	Parameter read/write inhibit option	All	0000h ~0006h	-

PA42	PA□□	PB□□	PC□□	PD□□	PE□□	PF□□
0000h	◎					
0001h	◎					X
0002h	◎				X	
0003h	◎			X		
0004h	◎		X			
0005h	◎	X				
0006h	X, but PA42 excepts, it is writable.					

◎：R/W enable，○：R enable W inhibit，X：R/W inhibit

Note: When the parameter group is assigned to R/W inhibit, it mean that the display will not show.

PA43	ENB	Encoder resolution	All	-	-

PA43 ENB — Encoder resolution
This is a read-only parameter.
0 : The encoder resolution of motor is 2^{20} pulse/rev
1 : The encoder resolution of motor is 2^{22} pulse/rev
2 : The encoder resolution of motor is 2^{23} pulse/rev
3 : The encoder resolution of motor is 2^{24} pulse/rev

No	Abbr.	Function description	Control mode	Setting range	Unit
PA44	EGM	Electronic gear ratio mode 0：「normal」, ratio=PA06/PA07 1：「conversion 1」, ratio= PA45 setting value 2：「conversion 2」, ratio=2 x PA06/PA07 Pt means the encoder resolution per revolution	Pr, CoE	0 ~2	-
PA45	FBP	Position command pulse number per revolution It is used to set the position command pulse number per revolution when the PA44 is set as 1.	Pr	10^3 ~10^6	pulse
PA46	CYCL	Cyclic control option PA46=0, the control period is 50 uS. PA46=1, the control period is 62.5 uS.	All	0 ~1	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PA47	TLP	Positive torque limit value It is used to limit the motor generated torque when motor runs forward. $$Positive\ torque\ limit\ = \frac{motor\ max\ current}{motor\ rated\ current} * \frac{PA47}{30}$$	All	0 ~65535	0.1%
PA48	TLN	Negative torque limit value It is used to limit the motor generated torque when motor runs forward. $$Negative\ torque\ limit\ = \frac{motor\ max\ current}{motor\ rated\ current} * \frac{PA48}{30}$$	All	0 ~65535	0.1%

3.3.2. PB: GainFilter parameters

No	Abbr.	Function description	Control mode	Setting range	Unit
PB01	NHF1	Machine resonance suppression filter 1 To set a specific frequency which the controls gain is decreased to suppress the mechanism resonance. 	All	10 ~4000	Hz
PB02	NHD1	Machine resonance suppression attenuation 1 To set the attenuation at the PB01 frequency. The setting of "0" value denotes the disabled of this notch filter.	All	0 ~32	dB
PB03	NLP	Resonance suppression low-pass filter To set low-pass filter time constant for suppress resonance.	All	0 ~10000	0.1ms
PB04	PST	Position command filter time constant Used to smooth the running of motor in position control mode.	CoE, Pr	0 ~20000	ms
PB05	FFC	Position feed-forward gain To reduce the position error and position settling time, but if the value is set too large, a sudden acceleration or deceleration may cause overshoots.	CoE, Pr	0 ~200	%
PB06	GD1	The ratio of load inertia to motor shaft (load inertia ratio) See section 5.3.3 for more details.	All	0 ~1200	0.1time
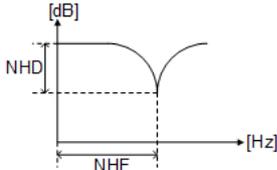
PB07	PG1	Position loop gain Used to decide response level of position loop. Increasing PG1 improves traceability, but a too high value makes overshooting or vibration occurred.	CoE, Pr	4 ~1024	rad/s
PB08	VG1	Speed loop gain Increasing VG1 improves traceability to a speed command but a too high value will make machine resonance. It will be set when auto-gain tuning mode is applied.	All	40 ~9000	rad/s
PB09	VIC	Speed integral gain Used to eliminate stationary deviation against a command.	All	1 ~1000	ms
PB10	VFG	Speed feed-forward gain To set the proper gain would reduce the tracking time of speed command.	S	0 ~200	%
PB11	CDP	Gain switch option <table><tr><td>0</td><td>0</td><td>0</td><td>x</td></tr></table> x：changing condition 　0：Invalid 　1：Gain switched as the CDP signal of DI is ON 　2：Position command frequency >= PB12 setting 　3：Position command pulse error >=PB12 setting 　4：Motor speed >= CDS(PB12) setting 　5：Gain switched as the CDP signal of DI is OFF 　6：Position command frequency <= PB12 setting 　7：Position command pulse error <= PB12 setting 　8：Motor speed <= PB12 setting	All	0000h ~0008h	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PB12	CDS	Gain switch condition value The CDS's unit is varied according to the settings of CDP.	All	0 ~4000000	depends
PB13	CDT	Gain switch time constant Used to smooth the motor running at gain switching moment to suppress vibration if the gain difference is large.	All	0 ~1000	ms
PB14	GD2	The ratio 2 of load inertia to motor shaft Set the demand ratio of load inertia to motor shaft after switching. This value is valid as gain switch function preformed.	All	0 ~1200	0.1time
PB15	PG2	Position loop gain change ratio The gain values would be changed as: 　*gain after switched = PG1 x PB15(%)* This change is valid only if auto-gain tuning disabled.	CoE, Pr	10 ~500	%
PB16	VG2	Speed loop gain change ratio These changes are valid only if auto-gain tuning disabled.	All	10 ~500	%
PB17	VIC2	Speed integral gain change ratio These changes are valid only if auto-gain tuning disabled.	All	10 ~500	%

PB18	SFLT	Speed low-pass filter smooth time constant If it is set as zero, this function is disabled. The required time to catch the command is 5-time of SELT.	S	0 ~1000	ms
PB19	TQC	Torque command filter time constant If it is set as zero, this function is disabled. The required time to catch the command is 5-time of TQC.	CoE	0 ~5000	ms
PB20	SJIT	Speed feedback filter time constant Used to set the filter time constant of motor speed feedback.	All	0 ~1000	0.1ms

No	Abbr.	Function description	Control mode	Setting range	Unit
PB21	NHF2	Machine resonance suppression filter 2 The second notch filter frequency to suppress the resonance.	All	10 ~4000	Hz
PB22	NHD2	Machine resonance suppression 2 The second notch filter attenuation option	All	0 ~32	dB
PB23	NDF	Motor noise suppression filter 0：disable 1：enable	All	0 ~1	-
PB24	VDC	Speed differential compensation This function is valid when the PC signal activated.	All	0 ~1000	-
PB25	NHF3	Machine resonance suppression filter 3 The third notch filter frequency to suppress the resonance.	All	10 ~4000	Hz
PB26	NHD3	Machine resonance suppression attenuation 3 The third notch filter attenuation option	All	0 ~32	dB

No	Abbr.	Function description	Control mode	Setting range	Unit
PB27	ANCF	Auto resonance suppression mode (for NHF1 and NHF2) 0：manual set 1：After an auto-scan then the resonance frequency is fixed. 2：Always auto-scan to search the resonance frequency.	All	0 ~2	-
PB28	ANCL	Resonance suppression detection level The high value setting denotes a less sensitivity detection.	All	1 ~300	%
PB29	AVSM	Auto vibration suppression mode 0：manual set 1：After auto-suppression then the vibration frequency is fixed. Note：When users set the PB29 as 1, the servo drive will find the vibration frequency and suppress it, and the frequency will be recorded to PB31, then the PB29 will recover to "0".	CoE, Pr	0 ~1	-
PB30	VCL	Low-frequency vibration detection level The low value setting denotes high sensitivity detection. Users set the proper value to prevent from erroneous detection.	CoE, Pr	1 ~8000	pulse
PB31	VSF1	Vibration suppression frequency 1 To record the manual set or the result of auto-suppression. If PB32 is 0, it denotes the 1st vibration suppression filter is off.	CoE, Pr	1 ~3000	0.1Hz
PB32	VSG1	Vibration suppression gain 1 The high gain setting denotes a high position response. but may cause a cogging motion.	CoE, Pr	0 ~15	-
PB33	VSF2	Vibration suppression frequency 2 Used to record the manual set or the result of auto-suppression. If PB34 is 0, it denotes the 2nd vibration suppression filter is off.	CoE, Pr	1 ~3000	0.1Hz
PB34	VSG2	Vibration suppression gain 2 The high gain setting denotes a high position response. but may cause a cogging motion.	CoE, Pr	0 ~15	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PB35	FRCL	Friction compensation level Used to compensate the friction torque loss. 0 is disable and 1 or above is to enable the friction compensation.	All	0 ~100	%
PB36	FRCT	Friction compensation filter time constant Used to set the smooth time constant of friction compensation.	All	0 ~1000	ms
PB37	FRCM	Friction compensation option 0：Compensation is remained if motor speed is less than PC17. 1：Compensation is zero if motor speed is less than PC17.	All	0 ~1	-
PB38	FFCT	Position feed forward filter time constant Used to set the feed forward filter time constant.	All	0 ~1000	0.1ms
PB44	PPD	Position loop compensation gain To increase this parameter to improve trackability in response to the position command.	All	0 ~500	rad/s

PB45	NHF4	Machine resonance suppression filter 4 The third notch filter frequency to suppress the resonance.	All	10 ~4000	Hz
PB46	NHD4	Machine resonance suppression attenuation 4 The third notch filter attenuation option	All	0 ~32	dB
PB47	NHF5	Machine resonance suppression filter 5 The third notch filter frequency to suppress the resonance.	All	10 ~4000	Hz
PB48	NHD5	Machine resonance suppression attenuation 5 The third notch filter attenuation option	All	0 ~32	dB
PB49	DOB	Disturbance observer gain To increase this parameter to decrease the positioning overshot when the position mode is applied. To increase this parameter to decrease the speed overshot when the speed mode is applied ※: A high gain adjustment may cause the system resonance.	All	0 ~100	-
PB50	MVF	Position command average filter time constant	CoE,Pr	0 ~50	ms

3.3.3. PC: Expansion parameters

No	Abbr.	Function description	Control mode	Setting range	Unit
PC01	STA	Acceleration time constant This is the time spent for the motor from 0 rpm to the rated speed and it is defined as "acceleration time constant". 	Pr, S	0 ~20000	ms

PC02	STB	Deceleration time constant The time spent for the motor to decelerate from the rated speed to 0 rpm is called "deceleration time constant".	Pr, S	0 ~20000	ms
PC03	STC	S-pattern acceleration/deceleration time constant The S-pattern acceleration/deceleration function is to employ a three-step curve of acceleration or deceleration moving to soothe the vibration during starting or stopping the motor. 	Pr, S	0 ~10000	ms
PC04	JOG	JOG speed command As JOG mode applied, this PC04 is used as speed command.	All	0 ~6000	rpm
PC05	SC1	Inner speed command/limit 1 PC05 is used as inner speed command 1.	S	-6000 ~6000	rpm
PC06	SC2	Inner speed command/limit 2 PC06 is used as inner speed command 2.	S	-6000 ~6000	rpm
PC07	SC3	Inner speed command/limit 3 PC07 is used as inner speed command 3.	S	-6000 ~6000	rpm
PC08	SC4	Inner speed command/limit 4 PC08 is used as inner speed command 4.	S	-6000 ~6000	rpm
PC09	SC5	Inner speed command/limit 5 PC09 is used as inner speed command 5.	S	-6000 ~6000	rpm
PC10	SC6	Inner speed command/limit 6 PC10 is used as inner speed command 6.	S	-6000 ~6000	rpm
PC11	SC7	Inner speed command/limit 7 PC11 is used as inner speed command 7.	S	-6000 ~6000	rpm
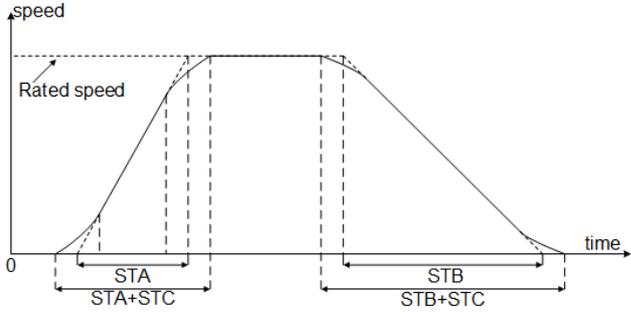
No	Abbr.	Function description	Control mode	Setting range	Unit
PC16	MBR	Electromagnetic brake output delay time The parameter PC16 could be used to decide the delay time of the SON signal off to the MBR signal activated.	All	0 ~1000	ms
PC17	ZSP	Zero speed acknowledged range As motor feedback speed is less than the setting value of PC17, the servo drive would treat it as zero speed and the ZSP of DO would be outputted.	All	0 ~10000	rpm

No	Abbr.	Function description	Control mode	Setting range	Unit
PC18	COP1	Stop option and power interruption restart option The voltage level drop would cause drive to alarm and stop. Auto-restart function could be applied by the setting of PC18. | 0	0	y	x | x：power interruption restart option 0：invalid 1：valid y：motor stop option *0：decelerates to stop* *1：stops instantaneously*	All	0000h ~0011h	-
PC19	COP2	Alarm history clear and overload early warning option | u	z	y	x | x：Alarm history clear option 0：does not clear 1：to clear the histories after power off once and restart y：overload pre-warn option 0：invalid 1：to stop the motor when the early warning occurred *z：AL.13 message code option (only CoE mode)* *0：to display AL.13 message code* *1：not to display AL.13 message code* *u：Display option after troubleshooting* *0：to show 「AL.--」* *1：to recover the previous display status*	All	0000h *~1111h*	-
PC20	SNO	Communication device number To set different device number for varied devices is necessary. If two drives occupy the same number, the communication could not be performed.	All	1 ~65535	-
PC21	CMS	Communication mode option | 0	0	0	x | x：communication reply delay time 0：reply within 1 ms 1：reply after 1 ms	All	0000h ~0011h	-
PC23	SIC	Communication time-out process option Time-out inspection could be set from 1 to 60 seconds. If it is set as 0, the inspection function is invalid.	All	0 ~60	S

No	Abbr.	Function description	Control mode	Setting range	Unit

No	Abbr.	Function description	Control mode	Setting range	Unit

PC24	DMD	Status display option
		
		`| 0
			0	y	x |`
					
					x：display option after power on
					  0：*Translated motor feedback pulses (high 5-digit)*
					  1：*Translated motor feedback pulses (low 5-digit)*
					  2：Cumulative pulses of command *(high 5-digit)*
					  3：Cumulative *pulses* of command *(low 5-digit)*
					  4：Accumulative pulses error
					  5：Command pulse frequency
					  6：Motor speed
					  8：Speed input command/limit
					  A：Torque input command/limit
					  B：Effective load ratio
					  C：Peak load ratio
					  D：DC bus voltage
					  E：*Load to motor inertia ratio*
					  F：Instantaneous torque
					  10：Regenerative load ratio
					  11：Full close loop feedback pulses (high 5-digit)
					  12：Full close loop feedback pulses (low 5-digit)
					  13：Z phase reference absolute pulse
					y：assigned display after power on
					  1：display option according the x-digit of PC24
					  0：display option according varied control modes
					
					Control mode / Initial display after power on:
					position — *Translated motor feedback pulses*
					position/speed — *Translated motor feedback pulses* /motor speed
					speed — motor speed
						All	0000h
							~0115h
								-

PC25	TL2	Inner torque limit 2 Refer to description of PA05.	All	0 ~100	%
PC32	CMX2	Electronic gear numerator 2 Refer to the description of PA06.	CoE, Pr	1 ~2^{26}	-
PC33	CMX3	Electronic gear numerator 3	CoE, Pr	1 ~2^{26}	-
PC34	CMX4	Electronic gear numerator 4	CoE, Pr	1 ~2^{26}	-
PC38	ESYC	EtherCAT sync abnormal count option Set to decide the permission counts of EtherCAT communication fault. PC38=0：EtherCAT communication detection invalid PC38>0：To set the permission counts of communication fault. As a nonzero PC38 is set and if the communication faults exceed the PC38, the drive would alert AL.84.	CoE	0 ~65535	-
PC39	ESS	EtherCAT communication node option The SDP drive is a slave, when the EtherCAT communication is performed, the node number of drive could be assigned by the drive itself or the superior host. This PC39 is used to decide the slave node number. PC39=0：SII (assigned by the superior host) PC38>1：node number	CoE	0 ~65535	-
No	Abbr.	Function description	Control mode	Setting range	Unit

PC41	CAST	Capture start address of data array This PC41 is used to assign the start address which captures the first point data and save it into data array. It could be set only when the capture function is stopped.	All	0 ~799	-
PC42	CAAX	Capture axis position To display the source of capture pulses. Please note： 1. Not to change this setting only when the capture function is stopped. 2. If the capture source is motor encoder, PC42 is forbidden written.	All	$-2^{31}+1$ $\sim 2^{31}-1$	-
PC43	CAND	Capture amount If the compare function is stopped, PC43 denotes the capture amount. If capture function is performed, PC43 decreases once one position is captured. When the PC43 is equal to 0, it indicates that the capture operation has finished. The DO CAP_OK becomes activated. When the value of PC43 is zero, it denotes the capture function invalid.	All	1 ~800	-
PC44	CACT	Capture control start option | u | z | y | x | x：capture start 	x	Function description
---	---
bit0	Set bit0 as 1 to start the capture function. If the capture function has done, bit 0 would reset to 0 automatically.
bit1	When bit1 is set as 1 and the first point has captured, the captured position coordinate would be set to PC45.
bit2	When bit2 is set as 1 and the first position has captured, the compare function would be enabled (PC50 x-digit bit0 is set as 1 and the PC49 is set to the last compare amount). If the compare function is enabled already, this setting will become ineffective.
bit3	When bit3 is set as 1 and all the captures have done, the PATH#50 route would be executed immediately	 y：capture command source option 0：invalid 1：secondary encoder signals 2：motor encoder feedback z：DI7 state fetch option 0：rising edge 1：both rising edge & falling edge u：trigger time option (unit：ms) 1~255ms	All	0 ~F12Fh	-
PC45	CPRS	Capture position 1 reset data Refer to PC44 x- digit bit1 for explanation. Note the value should not exceed the settable range.	All	$-2^{30}+1$ $\sim 2^{30}-1$	-
PC46	CPMK	Capture mask range setting This PC46 is used to define the mask range so that some assigned points would not be captured when the multiple points capture is performed. The mask range is : The latest captured coordinate ± PC46	All	0 ~ 1000000	-
PC47	CMST	Compare start address of data array This PC47 is used to specify the start address of the first compare point data and save it into data array. Note that the PC47 could set only when the compare function is disabled (Refer to PC50 x-digit).	All	0 ~799	-

No	Abbr.	Function description	Control mode	Setting range	Unit

PC48	CMAX	Compare axis position This PC48 displays the position data of compare pulse source. Please note the followings: 　1. PC48 could be set only when compare function is disabled. (Refer to PC50 x-digit) 　2. Do not change PC48 when the compare source is the capture axis. (Refer to PC50 y-digit) 　3. Do not change PC48 when the compare source is the motor encoder feedback.(PC50 y-digit is 2) When it is performed, the PC48 is reset to the motor encoder feedback. If the motor encoder feedback position is different from this PC48 due to home return or the capture function performed, the users could set PC50 y-digit as 3 to make PC48 to be equivalent to the motor encoder feedback.	All	$-2^{31}+1$ $\sim 2^{31}-1$	-
PC49	CMNO	Compare number When the compare function is not enabled, this PC49 denotes the estimated compare number. (able to read and write). When the compare function is enabled, this PC49 denotes the rest compare number. (read-only). The PC49 would decrease once one position is compared. When the PC49 is equal to 0, it indicates that the compare operation has finished. Note that the total amount of COMPARE, CAPTURE and E-Cam data can not exceed the number of 800.	All	1 ~ 800	-
PC50	CMCT	Compare control start | 0	c	b	a	u	z	y	x | x：compare start | x	Function description
---	---
bit0	Set bit0=1 to start the compare function. If the compare function has done, bit 0 would reset to 0 automatically.
bit1	When bit1 is set as 1, the cyclic compare mode would be performed. The PC49 would be reset automatically.
bit2	When bit2 is set as 1 and the last position has compared, the capture function would be enabled (PC44 x-digit bit0 is set as 1 and the PC43 is set to the last capture amount). If the capture function is enabled already, this setting will become ineffective.
bit3	When bit3 is set as 1 and all the compare have done, the PC48 would be reset to 0.	 y：compare command source option 0：capture axis position 1：secondary encoder signals 2：motor encoder feedback z：DO4 polarity option 0：normal open 1：normal closed u：PATH trigger option 1：to execute the PATH#45 after the last position is compared cba：length of output pulse (unit：ms)	All	00010000h $\sim$ 0FFF312Fh	-

No	Abbr.	Function description	Control mode	Setting range	Unit

PC51	CMOF1	Compare offset 1
		This PC51 is used to add an offset value to compare data as actual compare data.
		Actual compare data = data array[*] + PC51 + PC52
		Please note:
		  1.PC51 is always unchangeable.
		  2.If PC52 is set and PC55 z-digit = 1, PC52 would only be effective once and reset to 0 automatically.
			All	-10000000
				~
				10000000
					pulse

PC52	CMOF2	Compare offset 2 (resettable to zero) Refer to PC51 for explanation.	All	-10000000 ~ 10000000	pulse
PC55	CPEX	Capture/Compare extra function 0 z 0 x x：capture extra function 1：enable the cyclic mode. After the last position is captured, the drive would automatically repeat this capture function. z : compare extra function 1：PC52 would only be effective once and reset to 0 automatically!	All	0000h ~0101h	-
PC59	ECHD	E-CAM head of data array This PC60 is used to set the head address which specifies the first point data of E-Cam table and save it into data array. It is effective only when the electronic gear is engaged.	Pr	0 ~794	-
PC60	ECMN	E-CAM area number N The E-Cam graph is divided into N areas. The E-Cam table should include N+1 data. $$N \le (PC92 - PC59)$$ $$PC60 \times PC62 \le 2^{31}-1$$ The PC60 could be set only when E-Cam function is stopped.	Pr	5 ~720	-
PC61	ECMM	E-CAM cycle number M After receiving the pulse number P of primary axis, the shaft of E-Cam will rotate M cycles. $$PC60 \times PC61 \le PC62$$ $$PC60 \times PC62 \le 231-1$$	Pr	1 ~32767	-
PC62	ECMP	E-CAM primary axis pulse number P Refer to PC61 for explanation.	Pr	10 ~2^{30}-1	-
PC63	ECME	E-CAM engage area number This PC63 is used to set the E-Cam area number when the electronic gear is engaged.	Pr	0 ~719	-
PC64	ECAX	E-CAM primary axis position This PC64 is used to set the position of E-Cam primary axis. It could be set only when E-Cam function is stopped. (PC66 x-digit = 0)	Pr	$-2^{31}+1$ ~2^{31}-1	-
PC65	PLED1	E-CAM lead command length Once E-Cam engage conditions are satisfied, the electronic gear would be engaged truly when the pulse number sent by primary axis is higher than this PC65 setting. In other words, the electronic gear would be engaged only after the lead command specified by PC65 is ignored. Positive PC65：the forward pulses are regarded as lead command. Negative PC65：the reverse pulses are regarded as lead command	Pr	$-2^{30}+1$ ~2^{30}-1	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PC66	ECON	E-CAM ON control | d | 0 | b | a | u | z | y | x | x: E-CAM function option 	x	Function description
---	---
bit0	Set bit0=1 to start the E-CAM function. This could be set only when the E-CAM function is stopped.
bit1	0 : E-CAM disengages when Servo-OFF or alarm or home return is executed. 1 : E-CAM remain engaged when Servo-OFF or alarm or home return is executed.
bit2	0: After modification, the new PC96 would be enforced after E-CAM re-engage. 1: PC96 is enforced immediately after modification..	 y: command source of primary axis 0: capture axis position 1: secondary encoder signals 2: Pr command (inner register) 3:1 ms clock z: engage timing 0: immediately 1: DI of CAM ON 2: any point of capture axis, suitable for the moving primary axis case u: disengage timing 0: do not disengage 1: DI of CAM OFF 2: primary axis reaches the PC67 setting 6: function is as same as u=2, but the speed remains when electronic gear is disengaged and the engage length will exceed the PC67 a little. This option is suitable for the application which needs to use PR command immediately after the electronic gear is disengaged. 4: primary axis exceeds the PC67, PC74 is the lead command length 8: Disable E-CAM function after the electronic gear is disengaged with condition 1, 2, and 6. ba: disengage method When the disengage timings are satisfied (u= 2, 4,6), the system would execute PATH#xx (hexadecimal) automatically d: engage status display 0: stop 1: engage 2: lead state (before the electronic gear is engaged)	Pr	0 ~ 203FF247h	-
PC67	ECRD	E-CAM disengage time data Refer to PC66 u-digit for explanation.	Pr	$-2^{30}+1$ $\sim 2^{30}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PC68	CPCT	E-CAM Pulse phase compensation time This PC68 is used to compensate the delay pulse phase when the electronic cam function is performed. Computation: $step1= PC68 \times$ (primary axis pulse frequency [Kpps] – *PC69*) compensation time(ms)= step1 x primary axis pulse period This PC68 setting is proportioned to the pulse frequency of E-CAM primary axis. Please note: 1.If the polarity of primary axis pulse frequency is "+", the compensation would be executed only the following condition satisfied: *primary axis pulse frequency > PC69 $\geqq$ 0* 2.If the polarity of primary axis pulse frequency is "-", the compensation would be executed only the following condition satisfied: *primary axis pulse frequency < PC69 $\leqq$ 0*	Pr	-20000 ~20000	us
PC69	CPCL	E-CAM Pulse phase compensation frequency Refer to PC68 for explanation.	Pr	-32767 ~32767	Kpps
PC70	CMAP1	E-CAM Area 1 start point This PC70 is used to set the start degree of DO CAM_AREA1 when E-CAM is engaged.	Pr	0 ~360	degree
PC71	CMAN1	E-CAM Area 1 end point This PC71 is used to set the end degree of DO CAM_AREA1 when E-CAM is engaged.	Pr	0 ~360	degree
PC72	CMAP2	E-CAM Area 2 start point This PC72 is used to set the start degree of DO CAM_AREA2 when E-CAM is engaged.	Pr	0 ~360	degree
PC73	CMAN2	E-CAM Area 2 end point This PC73 is used to set the start degree of DO CAM_AREA2 when E-CAM is engaged.	Pr	0 ~360	degree
PC74	PLEDC2	E-CAM lead command length cyclic This PC74 is related to the PC66 u-digit setting.(u=4) When the E-CAM is disengaged, it would not stop, it would enter into the lead state and the lead command length at this time is determined by PC74. The E-CAM would be engaged again when the pulse number sent by primary axis is higher than PC74. In other words, the E-CAM would be engaged after the negligence of lead command specified by PC74. Positive PC74：the forward pulses are regarded as lead command. Negative PC74：the reverse pulses are regarded as lead command	Pr	-100000000 ~ 100000000	-
PC91	PCTL	Parameter write-in control 30：enable the EEPROM to store the current values of data array 999：enable the initialization of EEPROM	*All*	0 ~65535	-
PC92	AYSZ	Data array size (read only) The relevant data of capture, compare and E-CAM are stored in a data array. This PC92 shows the capacity (N x 32 bits) of this data array. N= 800	*All*	-32767 ~32767	-
PC93	AYID	Data array read/write index The PC93 is used to be a pointer for reading or writing in the data array.	*All*	0 ~799	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PC94	AYD0	Data array read/write domain 0 This PC94 is used to read the data block 0 of data array. PC94=array[PC93++] Only data reading performed through the panel of servo drive, the destination of PC93 would not add 1. Other access method would make a "PC93+1" result. For example： If the PC servo software is performed, when PC93 is set as 100, the first read data displayed via PC94 is the 100th data, the second read data would be 101+1=102th data, the third read data would be 102+1 = 103th data and vice versa. By the same logic, when PC93 is set to 100, the first written data displayed by PC94 is the 100th data, the second written data is 101+1=102th data, the third written data is 102+1 = 103th data and vice versa.	*All*	$-2^{31}+1$ $\sim 2^{31}-1$	-
PC95	AYD1	Data array read/write domain 1 This PC95 is used to read the data block 1 of data array. PC95=array[PC93++] Any access method would make a "+1" result. But the panel operation of servo drive could not write into the data array.	*All*	$-2^{31}+1$ $\sim 2^{31}-1$	-
PC96	TBS	E-CAM curve scaling This PC96 is used to magnify or minify the E-CAM table without changing the setting value of the E-Cam table. For example: If the data of the table is 0,10,20,30,40,20, when the magnification is set to 2.000000, it is equal to the data 0,20,40,60,80,40 with the 1.000000 magnification. When using the same pulse frequency of primary axis to run E-CAM operation, increasing the PC96 would magnify the E-CAM operation route and so does the operation speed. Please note: This PC96 could be set a negative value to run reversely. It could be set any time. However, it is valid only when the E-CAM is engaged.	Pr	-2.147×10^9 $\sim$ 2.147×10^9	$\times 10^{-6}$

3.3.4. PD: I/O setting parameters

No	Abbr.	Function description	Control mode	Setting range	Unit

PD01	DIA1	Digital input signal auto-ON option 1
		
		| u | z | y | x |
		
		x：SON open/short option
		  0：controlled by external actual wiring
		  1：SON-SG is short-circuit without actual wiring
		y：LSP open/short option
		  0：controlled by external actual wiring
		  1：LSP-SG is short-circuit without actual wiring
		z：LSN open/short option
		  0：controlled by external actual wiring
		  1：LSN-SG is short-circuit without actual wiring
		u：EMG open/short option
		  0：controlled by external actual wiring
		  1：EMG-SG is short-circuit without actual wiring
			All	0000h ~1111h	-

PD02	DI1	Digital input 1 option The 12 DI input pins of CN1 are programmable. The default pin functions are different corresponding to varied control modes. Please refer to section 2.3.2 for explanation.	All	0000h ~003Fh	-
PD03	DI2	Digital input 2 option	All	0000h ~003Fh	-
PD04	DI3	Digital input 3 option	All	0000h ~003Fh	-
PD05	DI4	Digital input 4 option	All	0000h ~003Fh	-
PD06	DI5	Digital input 5 option	All	0000h ~003Fh	-
PD07	DI6	Digital input 6 option	All	0000h ~003Fh	-
PD08	DI7	Digital input 7 option	All	0000h ~003Fh	-
PD10	DO1	Digital output 1 option The DO output pins of CN1 are programmable. The default pin functions are different corresponding to varied control mode. Please refer to section 2.3.2 for explanation.	All	0000h ~002Fh	-
PD11	DO2	Digital output 2 option	All	0000h ~002Fh	-
PD12	DO3	Digital output 3 option	All	0000h ~002Fh	-
PD13	DO4	Digital output 4 option	All	0000h ~002Fh	-
PD15	DIF	Digital input filter time option | 0 | 0 | 0 | x | x : filter time constant 0：invalid 1：2ms 2：4ms 3：6ms 4：8ms 5：10ms	All	0000h ~0005h	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PD16	SDI	Digital input on/off control source option The assigned bit of PD16 chooses the control source of corresponded DI. The bit0 to bit7 correspond the DI1 to DI7. The bit value is described as follows. 0：The specified DI is controlled by the actual wirings. 1: The specified DI is controlled by communication software (PD25)	All	0000h ~0FFFh	-

PD17	DOP1	LSP/LSN triggered stop option
		
		| 0 | 0 | 0 | x |
		
		x：motor stop option
		  0：stops immediately
		  1：decelerates to stop according to PF81 setting
			All	0000h ~0001h	-

PD18	DOP2	CR signal clear option
		As CR signal is activated, the deference between position pulses and motor feedback pulses would be cleared.
		
		| 0 | 0 | 0 | x |
		
		x：clear option
		  0：CR rising edge trigger
		  1: keeps clearing while CR=1
		  2: As CR is triggered, the motor would decelerate to stop. The remainder of pulse commands would be neglected. If CTRG signal is triggered again, the present commands would be executed. Here is the process chart.
		
			Pt, Pr	0000h ~0002h	-

PD19	DOP3	Alarm code output option | 0 | 0 | 0 | x | x：output option 0：DO function according to PD10 ~ PD13 setting 1: to show alarm codes while alarms occurred	All	0000h ~0001h	-

CN1			code	Alarm name
15	16	18		
0	0	0	AL 09	Communication abnormal
			AL. 0A	Communication time-out
			AL. 0E	IGBT overheat
			AL. 0F	Memory error
			AL. 10	Overload 2
0	0	1	AL. 02	Low voltage
0	1	0	AL. 01	Over voltage
			AL. 04	Regenerative alarm
0	1	1	AL. 03	Over current
1	0	0	AL. 05	Overload 1
1	0	1	AL. 06	Over speed
			AL. 07	Pulse command abnormal
			AL. 08	Position error excessive
1	1	0	AL. 0B	Encoder error 1
			AL. 0C	Encoder error 2
1	1	1	AL. 11	Motor mismatch

No	Abbr.	Function description	Control mode	Setting range	Unit
PD20	DOP4	Alarm reset triggered process `0 0 0 x` x：clear option 0：PWM signal off(If the motor is running, it would coast to stop. If the motor is shaft-lock, it would become rotatable. 1：invalid	All	0000h ~0001h	-
PD25	ITST	Communication control DI on/off 0：denotes the DI state is OFF 1：denotes the DI state is ON To set this PD25 to determine ON/OFF state of DI. if the PC communication software is applied, The bit0~ bit6 correspond with DI1~ DI7. The PD16 determines whether if the source is the external signals or PC communication software. To read the PD25, if the value is 0011h, it means that the state of DI1 and DI5 are ON. If to write 0011h to the PD25, it means that the command state of DI1 and DI5 are ON. Example : If the setting of PD16 is 007fh, the setting of PD25 is 0000h, it denotes the PC communication software determines all DI are OFF via the PD25 setting. Even the external actual hardware pins are all activated.	All	0000h ~0FFFh	-
PD27	DOD	Digital output logic option To define the logic of DO1~ DO6. The bit0~ bit5 corresponds to DI1~ DI6. Contact A or contact B is selectable. 0 : normal open contact A 1 : normal close contact B	All	0000h ~003Fh	-
PD28	MCOK	Motion completion (DO: MC_OK) option `0 0 y x` x : output option 0 : not to hold 1 : to hold y : potion error option 0 : AL1B is invalid 1 : AL1B is valid 	Pr	0000h ~0011h	-
PD29	DID	Software DI contact definition To define the input logic of DI. Bit 0~ bit 6 corresponds to DI1~ DI7. 0：normal open contact A, but LSP/LSN/EMG function excluded 1：normal close contact B, but LSP/LSN/EMG function excluded Note: If any DI is assigned to be controlled by the PC communication software, this application is invalid. Refer to the parameter PD16 description.	All	0000h ~0FFFh	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PD33	SFDO	Software DO setting When the bit value of PD33 is： 0：denotes the normal-close 1：denotes the normal-open bit00：DO corresponded code is 0x20 bit01：DO corresponded code is 0x21 bit02：DO corresponded code is 0x22 bit03：DO corresponded code is 0x23 bit04：DO corresponded code is 0x24 bit05：DO corresponded code is 0x25 bit06：DO corresponded code is 0x26 bit07：DO corresponded code is 0x27 bit08：DO corresponded code is 0x28 bit09：DO corresponded code is 0x29 bit10：DO corresponded code is 0x2A bit11：DO corresponded code is 0x2B bit12：DO corresponded code is 0x2C bit13：DO corresponded code is 0x2D bit14：DO corresponded code is 0x2E bit15：DO corresponded code is 0x2F	All	0000h ~FFFFh	-

3.3.5. PE: Pr stroke 1 parameters

No	Abbr.	Function description	Control mode	Setting range	Unit
PE01	ODEF	Origin return definition Bit definition of PE01 parameter is described as below. **PE01** <table><tr><td>31-28</td><td>27-24</td><td>23-20</td><td>19-16</td><td>15-12</td><td>11-8</td><td>7-0</td></tr><tr><td>BOOT</td><td>-</td><td>DLY</td><td>-</td><td>DEC1</td><td>ACC</td><td>PATH</td></tr></table> PATH：stroke option 0：stop after the origin return 1~63：to execute a assigned stroke after the origin return ACC：acceleration time option 0~F：corresponded to PF49~PF64 DEC1：deceleration time option 0~F：corresponded to PF49~PF64 DLY：delay time option 0~F：corresponded to PF65~PF80 BOOT：origin return option after the drive is power on 0：Not to execute origin return 1：To execute origin return The relevant parameters for origin return are also described. PA04：Home moving option PA08~PA09： Home moving high speed option 1 & 2 PE02：Define a offset numeric value for origin Please refer to the relevant chapter for a more detail description.	Pr	00000000h ~10FFFF3Fh	-
PE02	ODAT	Origin offset value definition To define an offset numeric value for origin.	Pr	$-2^{31}+1$ ~$2^{31}-1$	-
PE03	PDEF1	PATH#1 definition <table><tr><td></td><td>31~28</td><td>27~24</td><td>23~20</td><td>19~16</td><td>15~12</td><td>11~8</td><td>7~4</td><td>3~0</td></tr><tr><td>PE03</td><td>-</td><td>-</td><td>DLY</td><td>-</td><td>-</td><td>-</td><td>OPT</td><td>TYPE</td></tr><tr><td>PE04</td><td colspan="8">DATA (32bit)</td></tr></table> Bit definition of PE03 parameter is described as below. <table><tr><td colspan="4">OPT</td><td colspan="1">TYPE</td></tr><tr><td>bit7</td><td>bit6</td><td>bit5</td><td>bit4</td><td>bit3~bit0</td></tr><tr><td>-</td><td>UNIT</td><td>AUTO</td><td>INS</td><td>1：SPEED constant speed control</td></tr><tr><td colspan="2" rowspan="2">CMD</td><td rowspan="2">OVLP</td><td rowspan="2">INS</td><td>2：SINGLE one stroke execution</td></tr><tr><td>3：AUTO reload next executed strokes</td></tr><tr><td>-</td><td>-</td><td>-</td><td>INS</td><td>7：JUMP to an assigned stroke</td></tr><tr><td>-</td><td>-</td><td>AUTO</td><td>INS</td><td>8：WRITE an parameter modification</td></tr></table> TYPE：for setting value 1~3, DI STOP and SWLPSWLN are recognized. INS：insertion command of an assigned stroke OVLP：a permission to overlap the next stroke AUTO：reload the next stroke execution CMD：reload the next stroke execution DLY：0~F delay time setting	Pr	00000000h ~ FFFFFFFFh	-
PE04	PDAT1	PATH#1 data PE03 defines the attributes of destination point. PE04 is a corresponded location or goal PATH# NO. which is going to jump.	Pr	Non-index: $-2^{31}+1$~$2^{31}-1$ Index: 0~4194304	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE05	PDEF2	PATH#2 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE06	PDAT2	PATH#2 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE07	PDEF3	PATH#3 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE08	PDAT3	PATH#3 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE09	PDEF4	PATH#4 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE10	PDAT4	PATH#4 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE11	PDEF5	PATH#5 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE12	PDAT5	PATH#5 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE13	PDEF6	PATH#6 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE14	PDAT6	PATH#6 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE15	PDEF7	PATH#7 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE16	PDAT7	PATH#7 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE17	PDEF8	PATH#8 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE18	PDAT8	PATH#8 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE19	PDEF9	PATH#9 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE20	PDAT9	PATH#9 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE21	PDEF10	PATH#10 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE22	PDAT10	PATH#10 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE23	PDEF11	PATH#11 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE24	PDAT11	PATH#11 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE25	PDEF12	PATH#12 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE26	PDAT12	PATH#12 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE27	PDEF13	PATH#13 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE28	PDAT13	PATH#13 data Please refer to PE04 instruction.	Pr	$--2^{31}+1$ $\sim 2^{31}-1$	-
PE29	PDEF14	PATH#14 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE30	PDAT14	PATH#14 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE31	PDEF15	PATH#15 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE32	PDAT15	PATH#15 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE33	PDEF16	PATH#16 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE34	PDAT16	PATH#16 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE35	PDEF17	PATH#17 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE36	PDAT17	PATH#17 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE37	PDEF18	PATH#18 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE38	PDAT18	PATH#18 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE39	PDEF19	PATH#19 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE40	PDAT19	PATH#19 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE41	PDEF20	PATH#20 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE42	PDAT20	PATH#20 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE43	PDEF21	PATH#21 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE44	PDAT21	PATH#21 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE45	PDEF22	PATH#22 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE46	PDAT22	PATH#22 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE47	PDEF23	PATH#23 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE48	PDAT23	PATH#23 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE49	PDEF24	PATH#24 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE50	PDAT24	PATH#24 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE51	PDEF25	PATH#25 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE52	PDAT25	PATH#25 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE53	PDEF26	PATH#26 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE54	PDAT26	PATH#26 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE55	PDEF27	PATH#27 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE56	PDAT27	PATH#27 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE57	PDEF28	PATH#28 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE58	PDAT28	PATH#28 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE59	PDEF29	PATH#29 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE60	PDAT29	PATH#29 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE61	PDEF30	PATH#30 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE62	PDAT30	PATH#30 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE63	PDEF31	PATH#31 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE64	PDAT31	PATH#31 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE65	PDEF32	PATH#32 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE66	PDAT32	PATH#32 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE67	PDEF33	PATH#33 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE68	PDAT33	PATH#33 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE69	PDEF34	PATH#34 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE70	PDAT34	PATH#34 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE71	PDEF35	PATH#35 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE72	PDAT35	PATH#35 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE73	PDEF36	PATH#36 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE74	PDAT36	PATH#36 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE75	PDEF37	PATH#37 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE76	PDAT37	PATH#37 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE77	PDEF38	PATH#38 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE78	PDAT38	PATH#38 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE79	PDEF39	PATH#39 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE80	PDAT39	PATH#39 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE81	PDEF40	PATH#40 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE82	PDAT40	PATH#40 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE83	PDEF41	PATH#41 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE84	PDAT41	PATH#41 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE69	PDEF34	PATH#34 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE70	PDAT34	PATH#34 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE71	PDEF35	PATH#35 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE72	PDAT35	PATH#35 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE73	PDEF36	PATH#36 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE74	PDAT36	PATH#36 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE75	PDEF37	PATH#37 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE76	PDAT37	PATH#37 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE77	PDEF38	PATH#38 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE78	PDAT38	PATH#38 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE79	PDEF39	PATH#39 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE80	PDAT39	PATH#39 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE81	PDEF40	PATH#40 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE82	PDAT40	PATH#40 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE83	PDEF41	PATH#41 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE84	PDAT41	PATH#41 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE85	PDEF42	PATH#42 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE86	PDAT42	PATH#42 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PE87	PDEF43	PATH#43 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE88	PDAT43	PATH#43 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE89	PDEF44	PATH#44 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE90	PDAT44	PATH#44 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE91	PDEF45	PATH#45 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE92	PDAT45	PATH#45 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE93	PDEF46	PATH#46 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE94	PDAT46	PATH#46 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE95	PDEF47	PATH#47 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE96	PDAT47	PATH#47 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PE97	PDEF48	PATH#48 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PE98	PDAT48	PATH#48 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

3.3.6. PF: Pr stroke 2 parameters

No	Abbr.	Function description	Control mode	Setting range	Unit
PF01	PDEF49	PATH#49 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF02	PDAT49	PATH#49 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF03	PDEF50	PATH#50 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF04	PDAT50	PATH#50 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF05	PDEF51	PATH#51 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF06	PDAT51	PATH#51 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF07	PDEF52	PATH#52 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF08	PDAT52	PATH#52 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF09	PDEF53	PATH#53 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF10	PDAT53	PATH#53 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF11	PDEF54	PATH#54 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF12	PDAT54	PATH#54 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF13	PDEF55	PATH#55 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF14	PDAT55	PATH#55 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF15	PDEF56	PATH#56 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF16	PDAT56	PATH#56 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PF17	PDEF57	PATH#57 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF18	PDAT57	PATH#57 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF19	PDEF58	PATH#58 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF20	PDAT58	PATH#58 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF21	PDEF59	PATH#59 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF22	PDAT59	PATH#59 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF23	PDEF60	PATH#60 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF24	PDAT60	PATH#60 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF25	PDEF61	PATH#61 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF26	PDAT61	PATH#61 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF27	PDEF62	PATH#62 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF28	PDAT62	PATH#62 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF29	PDEF63	PATH#63 definition Please refer to PE03 instruction.	Pr	00000000h ~ FFFFFFFFh	-
PF30	PDAT63	PATH#63 data Please refer to PE04 instruction.	Pr	$-2^{31}+1$ $\sim 2^{31}-1$	-
PF33	POV1	Inner position 1 velocity	Pr	1 ~6000	rpm
PF34	POV2	Inner position 2 velocity	Pr	1 ~6000	rpm

No	Abbr.	Function description	Control mode	Setting range	Unit
PF35	POV3	Inner position 3 velocity	Pr	1 ~6000	rpm
PF36	POV4	Inner position 4 velocity	Pr	1 ~6000	rpm
PF37	POV5	Inner position 5 velocity	Pr	1 ~6000	rpm
PF38	POV6	Inner position 6 velocity	Pr	1 ~6000	rpm
PF39	POV7	Inner position 7 velocity	Pr	1 ~6000	rpm
PF40	POV8	Inner position 8 velocity	Pr	1 ~6000	rpm
PF41	POV9	Inner position 9 velocity	Pr	1 ~6000	rpm
PF42	POV10	Inner position 10 velocity	Pr	1 ~6000	rpm
PF43	POV11	Inner position 11 velocity	Pr	1 ~6000	rpm
PF44	POV12	Inner position 12velocity	Pr	1 ~6000	rpm
PF45	POV13	Inner position 13 velocity	Pr	1 ~6000	rpm
PF46	POV14	Inner position 14 velocity	Pr	1 ~6000	rpm
PF47	POV15	Inner position 15 velocity	Pr	1 ~6000	rpm
PF48	POV16	Inner position 16 velocity	Pr	1 ~6000	rpm
PF49	POA1	Inner position 1 acc./dec. time	Pr	1 ~65550	ms
PF50	POA2	Inner position 2 acc./dec. time	Pr	1 ~65550	ms

No	Abbr.	Function description	Control mode	Setting range	Unit
PF51	POA3	Inner position 3 acc./dec. time	Pr	1 ~65550	ms
PF52	POA4	Inner position 4 acc./dec. time	Pr	1 ~65550	ms
PF53	POA5	Inner position 5 acc./dec. time	Pr	1 ~65550	ms
PF54	POA6	Inner position 6 acc./dec. time	Pr	1 ~65550	ms
PF55	POA7	Inner position 7 acc./dec. time	Pr	1 ~65550	ms
PF56	POA8	Inner position 8 acc./dec. time	Pr	1 ~65550	ms
PF57	POA9	Inner position 9 acc./dec. time	Pr	1 ~65550	ms
PF58	POA10	Inner position 10 acc./dec. time	Pr	1 ~65550	ms
PF59	POA11	Inner position 11 acc./dec. time	Pr	1 ~65550	ms
PF60	POA12	Inner position 12 acc./dec. time	Pr	1 ~65550	ms
PF61	POA13	Inner position 13 acc./dec. time	Pr	1 ~65550	ms
PF62	POA14	Inner position 14 acc./dec. time	Pr	1 ~65550	ms
PF63	POA15	Inner position 15 acc./dec. time	Pr	1 ~65550	ms
PF64	POA16	Inner position 16 acc./dec. time	Pr	1 ~65550	ms
PF65	DLY1	Inner position 1 completion delay time	Pr	0 ~32767	ms
PF66	DLY2	Inner position 2 completion delay time	Pr	0 ~32767	ms

No	Abbr.	Function description	Control mode	Setting range	Unit
PF67	DLY3	Inner position 3 completion delay time	Pr	0 ~32767	ms
PF68	DLY4	Inner position 4 completion delay time	Pr	0 ~32767	ms
PF69	DLY5	Inner position 5 completion delay time	Pr	0 ~32767	ms
PF70	DLY6	Inner position 6 completion delay time	Pr	0 ~32767	ms
PF71	DLY7	Inner position 7 completion delay time	Pr	0 ~32767	ms
PF72	DLY8	Inner position 8 completion delay time	Pr	0 ~32767	ms
PF73	DLY9	Inner position 9 completion delay time	Pr	0 ~32767	ms
PF74	DLY10	Inner position 10 completion delay time	Pr	0 ~32767	ms
PF75	DLY11	Inner position 11 completion delay time	Pr	0 ~32767	ms
PF76	DLY12	Inner position 12 completion delay time	Pr	0 ~32767	ms
PF77	DLY13	Inner position 13 completion delay time	Pr	0 ~32767	ms
PF78	DLY14	Inner position 14 completion delay time	Pr	0 ~32767	ms
PF79	DLY15	Inner position 15 completion delay time	Pr	0 ~32767	ms
PF80	DLY16	Inner position 16 completion delay time	Pr	0 ~32767	ms
PF81	PDEC	Protection trigger deceleration time The bit definition of PF81 is described as follows. **PF81** 31~28: STP, 27~24: -, 23~20: CTO, 19~16: -, 15~12: SNL, 11~8: SPL, 7~4: NL, 3-0: PL STP: The secondary deceleration time for home moving CTO: Communication time-out, ABS error deceleration time SNL: Software reverse stroke limit trigger deceleration time SPL: Software forward stroke limit trigger deceleration time NL : LSN trigger deceleration time PL : LSP trigger deceleration time The choice of PF49 to PF 64 is assigned to 0~F bit value.	All	0 ~ F0F0FFFFh	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PF82	PRCM	PR trigger register WRITE operation： To write 0 into PF82 to execute "origin return". To write 1~63 into PF82 to execute PATH#1~PATH#63 64~999 is prohibited to write into PF82. To write 1000 into PF82 to execute "stop" READ operation： If the route is not completed, the original command would be read. If the route is completed, The original command +10000 would be read. If the route is completed and the DI :STOP ON motor position arrives, the original command +20000 would be read. The read value of PF82 indicates the executed situation of PATH#. To write 3 into PF82 to executed PATH#3 is as an example, if the read value of PF82 is: 　　3: means that PATH#3 is being executed 1003: means that PATH#3 command is completed 2003: means that PATH#3 positioning is completed	Pr	0 ~1000	-
PF83	EVON	Event raising edge trigger | PF83			| |---|---|---|---| | U | Z | Y | X | To assign the PATH# number to be executed when EVx is ON X：PATH# execution when EV1 is ON 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Y：PATH# execution when EV2 is ON 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Z：PATH# execution when EV3 is ON 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Z：PATH# execution when EV4 is ON 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63	Pr	0000h ~DDDDh	-
PF84	EVOF	Event falling edge trigger To assign the PATH# number to be executed when EVx is OFF X：PATH# execution when EV1 is OFF 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Y：PATH# execution when EV2 is OFF 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Z：PATH# execution when EV3 is OFF 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63 Z：PATH# execution when EV4 is OFF 　0：null 1~D：to execute the one assigned route of PATH#51~PATH#63	Pr	0000h ~DDDDh	-

No	Abbr.	Function description	Control mode	Setting range	Unit
PF85	PMEM	PATH#1 to PATH#2 memory invalid | 0 | 0 | y | x | x：PATH#1 memory option 　0：memory is hold when drive is power off 　1：memory is not hold when drive is power off y：PATH#2 memory option 　0：memory is hold when drive is power off 　1：memory is not hold when drive is power off	All	0000h ~0011h	-
PF86	SWLP	Software forward stroke limit When Pr mode is applied and the motor runs at CCW, if the position command pulses exceed this parameter, AL.14 would occur. ※： position command means the original format which before electronic gear ratio process	Pr	$-2^{31}+1$ ~$(2^{31}-1)$	pulse
PF87	SWLN	Software reverse stroke limit When Pr mode is applied and the motor runs at CW, if the position command pulses exceed this parameter, AL.15 would occur. ※： position command means the original format which before electronic gear ratio process	Pr	$-2^{31}+1$ ~$(2^{31}-1)$	Pulse
PF88	BLSF	Backlash compensation option 0：invalid 1：Forward compensation 2：Reverse compensation	CoE, Pr	0 ~2	-
PF89	BLSP	Backlash compensation rectified pulses	CoE, Pr	-32767 ~32767	pulse
PF90	BLST	Backlash compensation time constant	CoE, Pr	0 ~10000	0.1ms

3.4. JOG idle test

The servo motor rotates while pressing the "UP" key to start CCW rotation or the "DOWN" key to start CW rotation. The servo motor stops rotating by releasing the key. Before this operation, make sure that SON and SG are open.

Step 1: Check whether the servo drive and servo motor are wired correctly.

Corresponded wirings in sequence   Necessary earthed
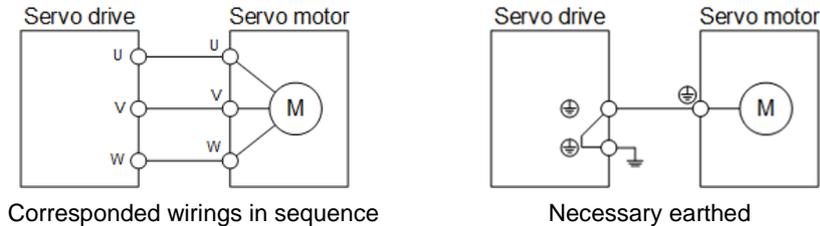
Step 2: Call this ⌐d⁻oF screen to perform JOG idle test. The panel operation is described as follows.

Press the "MODE" to call the diagnostic screen after power on.

Press "UP" key three times.

Press "SET" key more than 2s.

··· call this screen then execute the JOG operation.

The lowest decimal point will flicker.
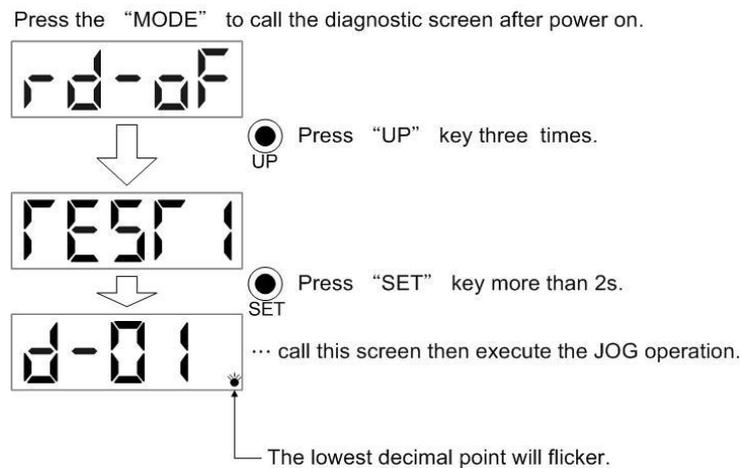
Set the rotation speed of JOG by the PC04, set the acceleration time by the PC01, and set the deceleration time by the PC02.

Pr.No	Sign	Function description	Setting range	Unit
PC01	STA	Acceleration time constant The time required to reach the rated speed from 0 rpm.	0 ~20000	ms
PC02	STB	Deceleration time constant The time required to reach 0 rpm from the rated speed.	0 ~20000	ms
PC04	JOG	JOG speed command To decide the JOG speed by sett this PC04 value.	-6000 ~6000	rpm

When the JOG operation is performed, if an emergency stop signal is required, please enable the EMG function by setting the related PD group parameter. To terminate the JOG operation, turn off the power or press the "SET" key in operation test mode for more than 2 seconds to terminate the JOG operation.

3.5. Positioning idle test

The Sharp PC communication software is required to perform this positioning operation. Before this operation, make sure that SON and SG are open.

Step 1: Check whether the servo drive and servo motor are wired correctly.

Corresponded wirings in sequence   Necessary earthed
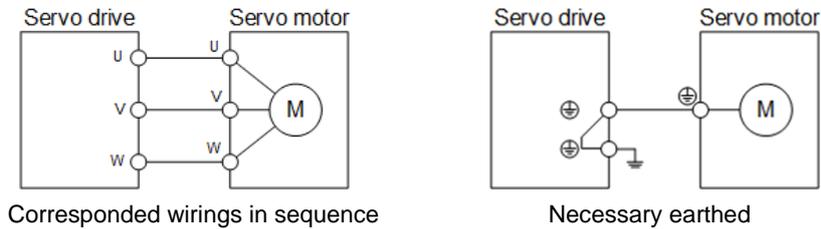
Step 2: Link PC and servo drive with a USB cable via CN4 socket. Then set a proper PC20 value.

Step 3: Double click the "Position" icon to call the application window.

Step 4: Set motor speed and Acc./Dec. time. The moving distance is performed with the entered pulses. Click "Forward" to perform a CCW rotation. Click "Reverse" to perform a CW rotation. Click "Pause/Clear" to halt the rotation then click again to run the remainder distance. Double click the Pause/Clear icon to reset the motion.
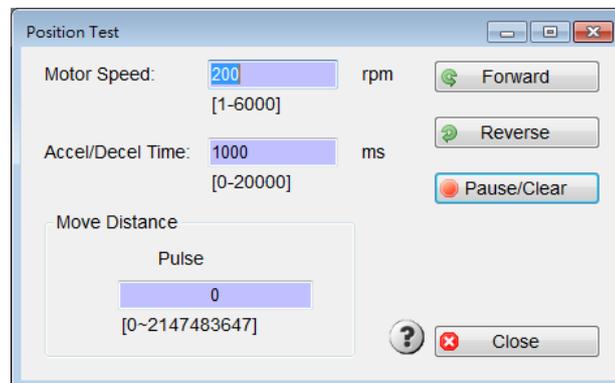
Step 5: Click "Close" to quit this application window.

3.6. Startup in speed mode

(1) Power on

Switch off SON before the servo drive has powered on. After power on, the display shows "⌐ . ".

(2) Test operation

Confirm the servo motor status with a JOG test.

(3) Parameters setting

After wiring for speed mode, the following parameters should be set for this operation.

Parameter	Name	Setting value	Description
PA01	Control mode option	□□□2	Speed control mode
PC01	Acceleration time constant	1000	A 1000mS time constant
PC02	Deceleration time constant	500	A 500ms time constant
PC03	S-pattern acc./dec. time constant	0	Disabled
PC05	Inner speed command/limit 1	1000	Speed command is 1000 rpm.
PC06	Inner speed command/limit 2	1500	Speed command is 1500 rpm.
PC07	Inner speed command/limit 3	2000	Speed command is 2000 rpm
PD15	Digital input filter time option	□□□2	Filter time constant is "4ms"

normal

(4) Servo on

Turn on SON then the motor shaft is locked and ready to run.

(5) Start

Choose the speed command with SP1 and SP2 signals.

DI signal		Speed command
SP2	SP1	
0	0	Stop
0	1	PC05 setting value
1	0	PC06 setting value
1	1	PC07 setting value

The rotary direction is decided with ST1 and ST2 signals.

DI signal		Rotary direction
ST2	ST1	
0	0	Stop
0	1	CCW
1	0	CW
1	1	Stop

(6) Stop

Take one of the following steps to stop running the motor.

a. Turn off SON

The motor shaft becomes rotatable.

b. ST1 and ST2 are both "ON" or both "OFF".

3.7. Gain adjustment

<table>
<tr><td rowspan="3">CAUTION</td><td>● The extreme adjustments will your machine vibrate or operate unexpectedly.</td></tr>
<tr><td>● Make the adjustment with a safety margin, a maximum 90% generated torque is recommended.</td></tr>
</table>

3.7.1. Adjustment methods

With auto gain tuning, load to motor inertia could be estimated soon and accurately, the proper gain corresponded to different loads could be computed. If the auto gain tuning function could not meet the users' needs, they could perform the manual mode.

(1) Gain adjustment mode explanation

Gain tuning mode	PA02 setting	Estimation rule	Automatically set parameter	Manually set parameter
Manual gain tuning mode 1 (PI control)	0000h	PB06 is fixed		GD1(PB06) PG1 (PB07) VG1 (PB08) VIC (PB09)
Manual gain tuning mode 2 (PI control + interference compensator)	0001h			GD1(PB06) PG1 (PB07) VG1 (PB08) VIC (PB09)
Auto-gain tuning mode 1	0002h	Always estimated.	GD1(PB06) PG1 (PB07) VG1 (PB08) VIC (PB09)	ATUL(PA03)
Auto-gain tuning mode 2	0003h	A fixed PB06.	PG1 (PB07) VG1 (PB08) VIC (PB09)	ATUL(PA03) GD1(PB06)
Interpolation mode	0004h	Always estimated.	GD1(PB06) VG1 (PB08) VIC (PB09)	ATUL(PA03) PG1(PB07)

The PA02 is not changeable when the SON is activated. Make the SON signal invalid then set the proper values.

(2)Gain adjustment method determination

```
                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           │
                    ╱──────┴──────╲
                   ╱  2 or more    ╲─────────────────────────────┐
                   ╲    axes?      ╱                              │
                    ╲──────┬──────╱                              │
                          No                                      │
                    ╱──────┴──────╲                              │
                   ╱  Large load   ╲────→ (A)                    │
                   ╲  variation    ╱                              │
                    ╲──────┬──────╱                              │
                          No                                      │
              ┌──────────────────┐      ┌───────────────┐        │
              │ One touch tuning │←─────│ Error remedy  │←──┐    │
              └────────┬─────────┘      └───────────────┘   │    │
                       │                                     │    │
                ╱──────┴──────╲      ╱──────────────╲        │    │
               ╱  Completed?   ╲─No─╱ Error message? ╲─Yes───┘    │
               ╲──────┬──────  ╱    ╲────────┬───────╱            │
                     Yes              (A)→    No                   │
                      │                ┌──────────────────┐       │
                      │                │ Auto tuning mode 1│  ┌──────────────────┐
                      │                └────────┬─────────┘   │ Interpolation mode│
                      │                ╱──────────────╲       └──────────────────┘
                      │               ╱  Meet user     ╲─Yes──┐
                      │               ╲   needs?       ╱       │
                      │                ╲───────┬──────╱        │
                      │                       No                │
                      │                ┌──────────────────┐     │
                      │                │ Auto tuning mode 2│     │
                      │                └────────┬─────────┘     │
                ╱──────┴──────╲        ╱──────────────╲         │
               ╱  Meet user    ╲─No─┐ ╱  Meet user     ╲─Yes───┤
               ╲   needs?      ╱     │ ╲   needs?       ╱        │
                ╲──────┬──────╱      │  ╲───────┬──────╱         │
                     Yes             └─→       No                │
                      │                ┌──────────────────┐      │
                      │                │   Manual mode    │      │
                      │                └────────┬─────────┘      │
                      │                         │                │
                      └─────────────────────────┴────────────────┘
                      │
                    ┌─────────────┐
                    │    END      │
                    └─────────────┘
```

130
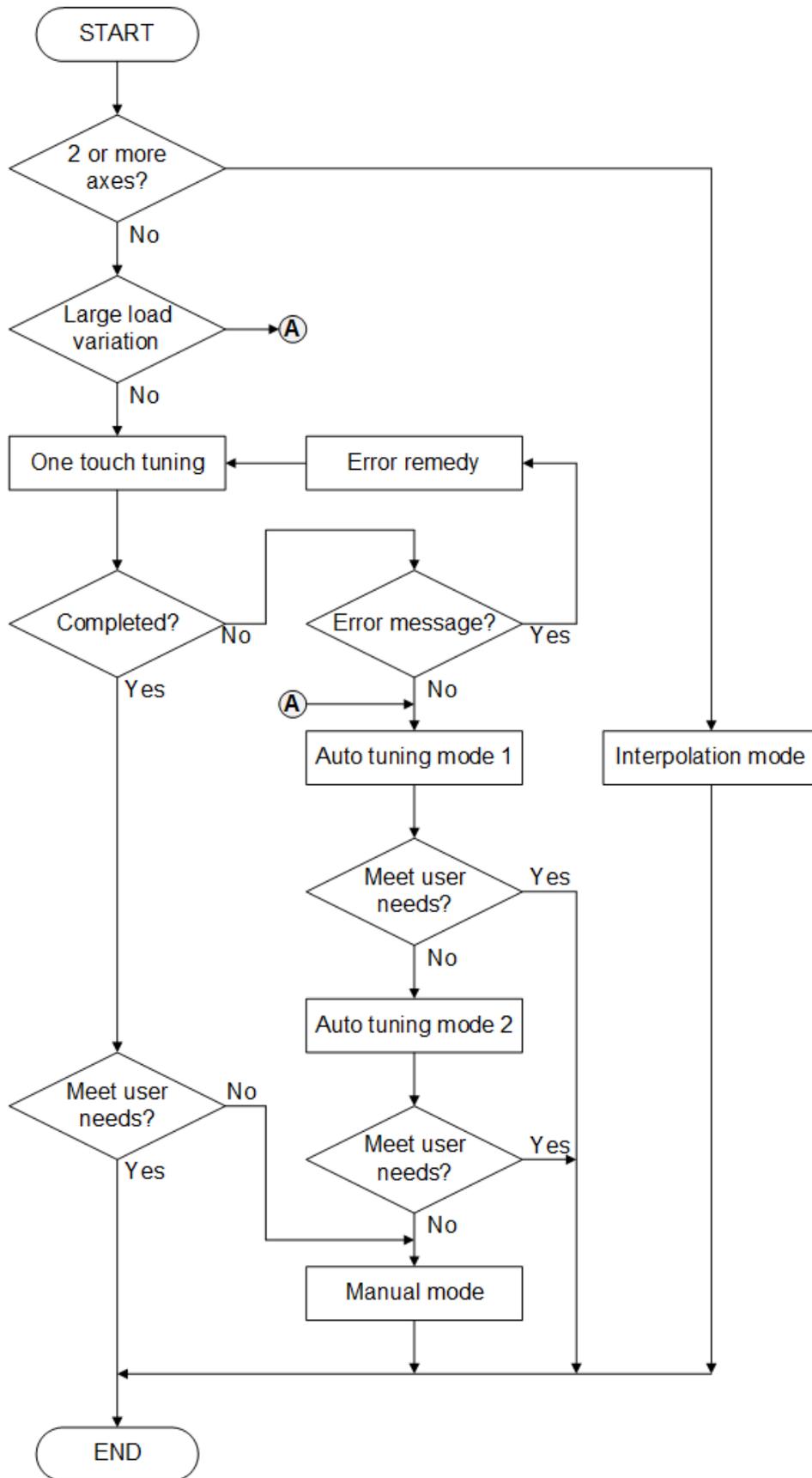
3.7.2. One touch tuning function

With the Sharp PC communication software or the panel operation of drive, this one touch gain tuning function could be performed. The related parameters set automatically by this function are listed below.

NO.	Abbr.	Name	Operation
PA03	ATUL	Auto-tuning response level setting	Auto approximated
PB01	NHF1	Machine resonance suppression filter 1	Auto approximated
PB02	NHD1	Machine resonance suppression attenuation 1	Auto approximated
PB03	NLP	Resonance suppression low-pass filter	Auto approximated
PB06	GD1	Load to motor inertia ratio	Auto approximated
PB07	PG1	Position loop gain	Auto approximated
PB08	VG1	Speed loop gain	Auto approximated
PB09	VIC	Speed integral gain	Auto approximated
PB21	NHF2	Machine resonance suppression filter 2	Auto approximated
PB22	NHD2	Machine resonance suppression attenuation 2	Auto approximated
PB27	ANCF	Auto resonance suppression mode	Auto approximated
PB28	ANCL	Resonance suppression detection level	Auto approximated
PB29	AVSM	Auto vibration suppression mode	Auto approximated
PB30	VCL	Low-frequency vibration detection level	Auto approximated
PB31	VSF1	Vibration suppression frequency 1	Auto approximated
PB32	VSG1	Vibration suppression gain 1	Auto approximated
PB33	VSF2	Vibration suppression frequency 2	Auto approximated
PB34	VSG2	Vibration suppression gain 2	Auto approximated
PB35	FRCL	Friction compensation level	Auto approximated
PB36	FRCT	Friction compensation filter time constant	Auto approximated
PB45	NHF4	Machine resonance suppression filter 4	Auto approximated
PB46	NHD4	Machine resonance suppression attenuation 4	Auto approximated

(1) One touch tuning function operation flowchart

	Sharp PC communication software	Panel operation
START	Check whether the servo drive and servo motor are wired correctly.	
Run the servo motor	To run the servo motor with the command from the host or from the drive inner.	
Enable one touch tuning function	Double click the "One Touch" icon to enable this function.	Call the [AUTo] screen
Response level setting	Choose the response level then click the "start" icon.	Choose the response level with the "Up" or "Down" key. Push "Set" key to start the tuning process.
One touch tuning execution	The progress is shown in percentage. An error code would be shown if failed.	Every digit decimal point light in turn. The completion is indicated as "Fin".
END	There are 2 options for the tuning result.	Clear mode/ back mode : I. Default recovery [bACH] II. Previous recovery [CLEAr]
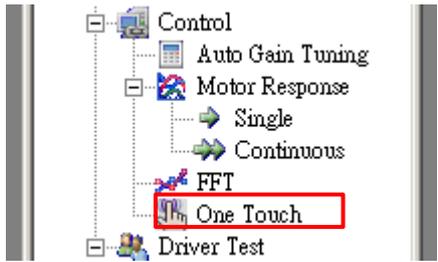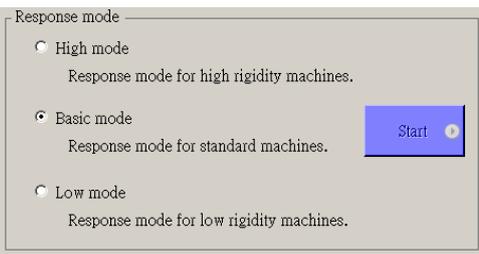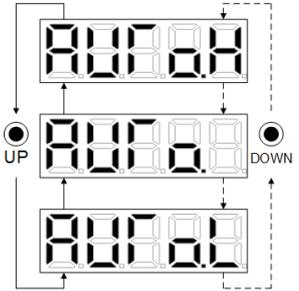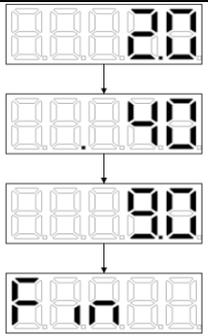
(2) One touch tuning Error code and remedy

Code	Name	Instruction	Remedy
C000	Tuning cancellation	"stop" icon clicked or "set" key pushed	-
C001	Position overshot excess	Position overshot exceeds PA12	Increase the PA12 setting value
C002	Servo-off	Servo-off is activated	Before tuning, recover the Servo-on
C003	Control mode abnormal	Tuning execution is under torque mode	Switch to position or speed mode
C003	Control mode abnormal	Switched to other mode during tuning	Not to switch any mode during tuning
C004	Time out	Command period exceeds 30 seconds	Reduce the command period
C004	Time out	Motor speed is too low	More than 100 rpm is recommend
C004	Time out	Tuning interval is too short	Tuning interval more than 500mS
C005	Inertia estimation abnormal	Load to motor inertia estimation failure	Shorten Acc./Dec. time
C005	Inertia estimation abnormal	Load to motor inertia estimation failure	More than 250 rpm is recommend
C005	Inertia estimation abnormal	Load to motor inertia estimation failure	Load inertia is less than 100 times.
C005	Inertia estimation abnormal	Load to motor inertia estimation failure	Huge load change is not suitable for this tuning algorithm.
C005	Inertia estimation abnormal	Load to motor inertia estimation failure	Make transient torque generated are greater than the 10% rated torque.
C005	Inertia estimation abnormal	Gain tuning fail due to resonance	Set the PA02 as 3 to disable the load to motor inertial ratio estimation. Then try this one touch function again.
C00F	One touch function invalid	An improper PA36 setting	Set the proper value of PA36

3.7.3. Manual gain tuning function

This manual gain tuning mode is executed when the result of auto-gain tuning is not suitable for the user's demand. For the applications of position control or speed control, the bandwidth is highly related with the machinery rigidity. For machine tools which the high precision required, a high bandwidth system response is necessary. However, a high response level setting could cause the machine resonance easily. Therefore, a high rigidity machine should be used for occasions that require a high response to avoid machine resonance. If users have no idea about the permissible response of the machine, they should adopt a smaller gain value at first and then gradually increase the gain values until machine resonance occurred. Then users could reduce the gain values accordingly. The related parameter to adjust are listed in the following table.

Name	Name Abbr.	Sign	Setting range	Unit	Default	Control mode
Resonance suppression low-pass filter	NLP	PB03	0~10000	0.1mS	10	ALL
Position feed-forward gain	FFC	PB05	0~200	%	0	CoE, Pr
Load to motor inertia ratio	GD1	PB06	0~1200	0.1time	70	ALL
Position loop gain	PG1	PB07	4~1024	rad/s	45	CoE, Pr
Speed loop gain	VG1	PB08	40~9000	rad/s	183	ALL
Speed integral gain	VIC	PB09	1~1000	ms	34	ALL
Speed feed-forward gain	VFG	PB10	0~200	%	0	ALL

➢ Position loop gain (PG1)

This parameter determines the response level of the position loop. Increasing PG1 improves traceability, settling time and position error but a too high value will make overshooting or vibration.

$$PG1 \text{ setting value} \leq \frac{VG1 \text{ setting value}}{1 + \text{ratio of load inertial to motor shaft}} \times \frac{1}{4}$$

$$PG1 \text{ setting value} \approx \text{speed loop bandwidth} \times \frac{1}{4}$$

➢ Speed loop gain (VG1)

This parameter determines the response level of the speed loop. Increasing VG1 improves traceability to a speed command but a too high value will make machine resonance. The Speed loop gain is usually 4~6 times bigger than the position loop gain. As the position loop gain is greater than the speed loop gain, machine resonance or overshoot would be occurred easily.

$$Speed \text{ loop response frequency(Hz)} = \frac{VG1 \text{ setting value}}{(1 + \text{ratio of load inertial to motor shaft}) \times 2\pi}$$

➢ Speed integral gain (VIC)

This parameter is to eliminate stationary deviation against a command. The smaller it is, the better capability for the drive to eliminate stationary deviation. However, the machine with a large load inertia ratio or any vibration causing, the small value would cause vibration easily.

$$VIC\ setting\ value(ms) \geq \frac{3000\text{\textasciitilde}5000}{VG1\ setting\ value\,/\,(1+\ GD1\ setting\ value\ \times 0.1)}$$

➢ Resonance suppression low-pass filter (NLP)

The larger the load inertia ratio is, the lower the system bandwidth is. To keep a relatively high bandwidth, a higher gain value may be required. Also the probability of resonance for the same machine would be increased. Thus the resonance suppression low-pass filter could be applied to eliminate the resonance. The higher setting value affords a better improvement about high frequency noises. Also a too large value could probably cause the entire system to be instable. A higher setting value would cause a larger phase lags of the servo drive.

$$VIC\ setting\ value(ms) \geq \frac{3000\text{\textasciitilde}5000}{VG1\ setting\ value\,/\,(1+\ GD1\ setting\ value\ \times 0.1)}$$

➢ Position feed-forward gain (FFC)

To reduce the position error and position settling time, but if the value is set too large, a sudden acceleration or deceleration may cause overshoots. Also, a too large electronic gear ratio would cause noises.

➢ Speed feed-forward gain (VFG)

To set the proper gain value would reduce the tracking time of speed command. Also, a too big value would cause overshoots during the sudden acceleration/deceleration command.

3.7.4. Interpolation mode

This mode is suitable for the occasion where 2 or more axes are controlled synchronously. Only PB07 (PG1) needs to be input manually, other gain parameters are estimated automatically. Increasing the PB07 will reduce the tracking time or settling time. Also, a too big value would cause overshoots or vibration. Please refer to the previous section to calculate the PB07.

3.7.5. Resonance and vibration suppression filter

The SDP servo drive provides "auto resonance suppression function". The relevant parameters and settings are described below. There are 5 sets of resonance suppression filter and one low-pass filter to suppress resonance, in which the users could manually or automatically set the relevant parameters to suppress unnecessary resonance or vibration phenomenon.

(1) Resonance suppression

Name	Abbr.	Sign	Setting range	Unit	Control mode
Machine resonance suppression filter 1	NHF1	PB01	50 ~1000	Hz	ALL
Machine resonance suppression attenuation 1	NHD1	PB02	0 ~32	dB	ALL
Resonance suppression low-pass filter	NLP	PB03	0 ~10000	0.1mS	ALL
Machine resonance suppression filter 2	NHF2	PB21	50 ~1000	Hz	ALL
Machine resonance suppression attenuation 2	NHD2	PB22	0 ~32	dB	ALL
Machine resonance suppression filter 3	NHF3	PB25	10 ~4000	Hz	ALL
Machine resonance suppression attenuation 3	NHD3	PB26	0 ~32	dB	ALL
Auto resonance suppression mode	ANCF	PB27	0 ~32	-	ALL
Resonance suppression detection level	ANCL	PB28	0 ~10000	%	ALL
Machine resonance suppression filter 4	NHF4	PB45	10 ~4000	Hz	ALL
Machine resonance suppression attenuation 4	NHD4	PB46	0 ~32	dB	ALL
Machine resonance suppression filter 5	NHF5	PB47	10 ~4000	Hz	ALL
Machine resonance suppression attenuation 5	NHD5	PB48	0 ~32	dB	ALL

(a) Manual mode

If the resonance frequency of mechanism is known, users could input the filter frequency and attenuation degree manually. Increase these parameters gradually and observe the effect until the resonance erased. To eliminate the resonance means the reduction of mechanism system bandwidth. The PB01, PB21, PB25, PB45, PB47 are used to determine the particular frequency to be suppressed. The PB02, PB22, PB26, PB46, PB48 are used to determine the attenuation rate.

(b) Auto mode

The SDP servo drive provides 3 sets of auto resonance suppression filters. When the resonance is occurred, user could set PB27 to enable the auto mode. (PB27=1 or PB27=2) In auto mode, the drive will detect the resonance frequency then will decide the attenuation rate. The detection results would be stored into PB01/PB02 and PB21/PB22. If PB27 is set as 1 to perform the auto mode, after the resonance detection, the PB27 will automatically recover to 0. If PB27 is set as 2, the resonance detection and suppression will always keep going.

After trying auto mode once, if the resonance phenomenon still exists, check the PB02, PB22 and PB46. If one of them is 32, it means the resonance could not be compensated in current response level. It is recommended to reduce response level then try auto mode again. If the value is a non-zero value but less than 32, it means the attenuation degree is not sufficient to compensate the resonance magnitude. Thus, users can try a higher value of PB02, PB22 and PB46. If PB02, PB22 and PB46 are zero, it means the resonance frequency is not detected due to a too high setting value of PB28. Try to reduce the PB28 value then run auto mode again. The resonance suppression flowchart of auto mode is described below.
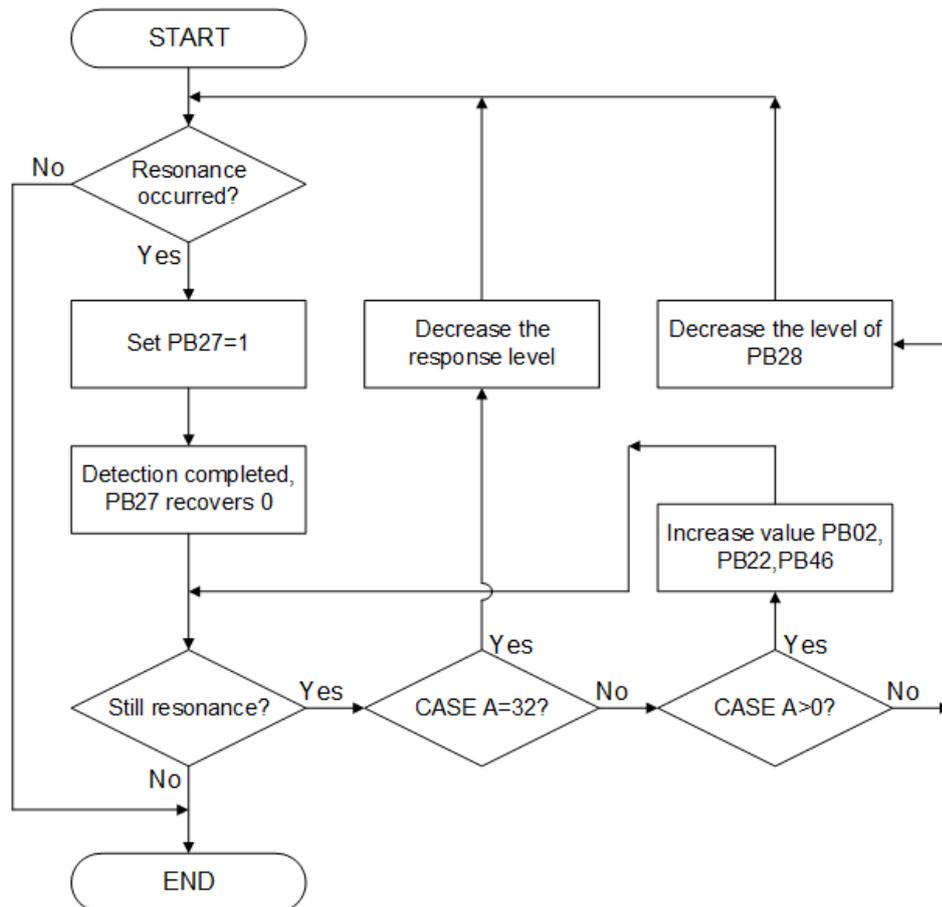
Note: CASE A means one of PB02, PB22, and PB46

(2) Vibration suppression

Vibration often occurs in a mechanism which the rigidity is poor. In such system, the settling time of position control becomes longer. For some application, a shorter settling time is necessary; vibration suppression function could satisfy this demand. The relevant parameters are described below.

No	Name	Abbr.	Sign	Setting range	Unit	Control mode
Auto vibration suppression mode		AVSM	PB29	0 ~1	-	CoE, Pr
Low-frequency vibration detection level		VCL	PB30	1 ~8000	Pulse	CoE, Pr
Vibration suppression frequency 1		VSF1	PB31	1 ~3000	0.1Hz	CoE, Pr
Vibration suppression gain 1		VSG1	PB32	0 ~15	-	CoE, Pr
Vibration suppression frequency 2		VSF2	PB33	1 ~3000	0.1Hz	CoE, Pr
Vibration suppression gain 2		VSG2	PB34	0 ~15	-	CoE, Pr

(a) Manual mode

When vibration suppression manual mode is performed, the relevant parameters PB31/PB32 and PB33/PB34 are used to suppress the vibration. For the known vibration situation, users could set the vibration frequency into PB31、PB33, then set PB32、PB34 as 1 to enable the suppression function. The 0 value of PB32 and PB34 mean the vibration suppression disabled.

(b) Auto mode

The SDP servo drive provides 2 sets of auto vibration suppression filters: PB31/PB32 and PB33/PB34. When the auto suppression is performed, please set PB29 as 1 to enable the auto mode. Even though the vibration frequency of mechanical system is unknown, the drive would find the system vibration frequency, and then records the results into PB31 and PB33, and set PB32 and PB34 as1 to determine the suppression gain. After the completion of auto mode, PB29 recovers 0.

After the auto vibration suppression execution, if the vibration phenomenon still exists, check PB32 and PB34 value whether they are 0. The zero value means that auto mode did not find the vibration frequency due to a higher value setting of PB30. Users could decrease PB30 then run auto mode again to find the vibration frequency. A non-zero PB29 value means auto detection fails, the result frequency is not the exact vibration frequency, users could increase PB30 then run auto mode again to find the vibration frequency.

The PB29 transient state is described below.

Transient state of PB29	
State change	Description

0 → 1	Clear the previous data of PB31~PB34 and enable the auto vibration suppression.
1 → 0	Store the detection results into PB31~PB34 and disable the auto vibration suppression.
1 → 1	Clear the previous data of PB31~PB34 and enable the auto vibration suppression.

The vibration suppression flowchart of auto mode is plotted below.
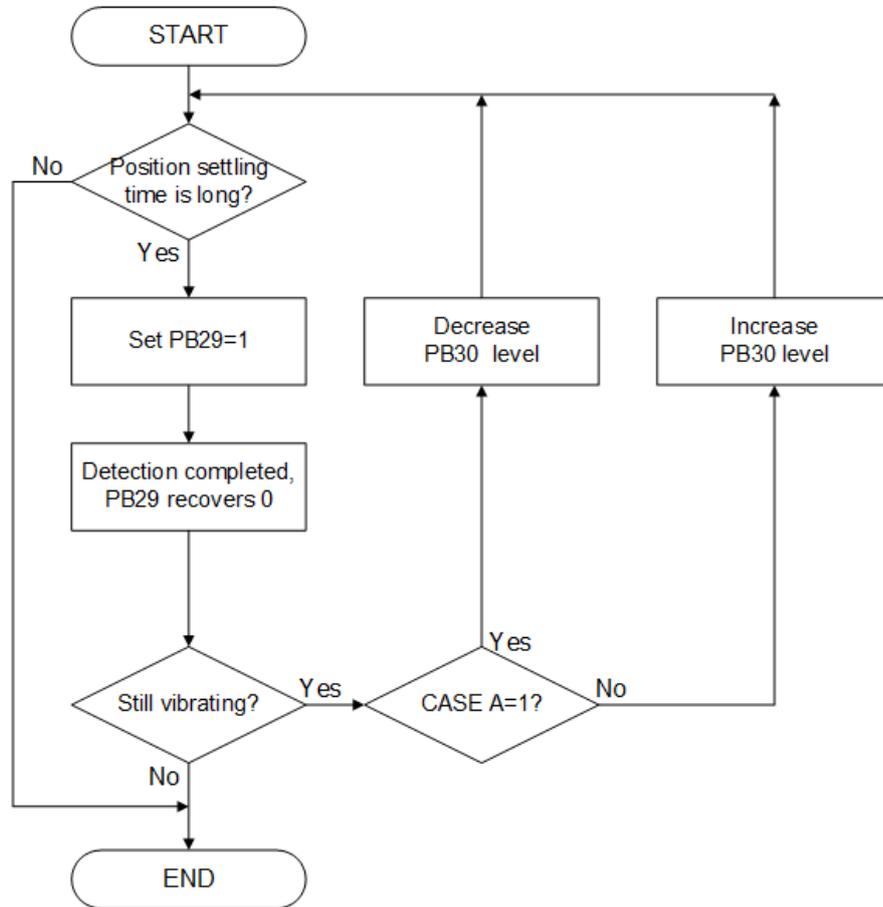
3.8. Electric gear

Users could set different electronic gear ratios to enable the mechanism to move different distances. Relevant parameters are presented below.

Name	Name Abbr.	Sign	Setting range	Unit	Default	Control mode
Electronic gear numerator	CMX	PA06	$1 \sim 2^{26}$			CoE, Pr
Electronic gear denominator	CDV	PA07	$1 \sim 2^{26}$			CoE, Pr
Electronic gear numerator 2	CMX2	PC32	$1 \sim 2^{26}$	-	1	CoE, Pr
Electronic gear numerator 3	CMX3	PC33	$1 \sim 2^{26}$			CoE, Pr
Electronic gear numerator 4	CMX4	PC34	$1 \sim 2^{26}$			CoE, Pr

The improper setting could lead to unexpected fast rotation so make sure to set them in SERVO OFF state. The range of the electronic gear ratio is $\frac{1}{50} \leq \frac{CMX}{CDV} (electronic\ gear\ ratio) \leq 64000$. If the setting value is outside this range, the operation of motor may not be performed. The relationship of electronic gear numerator and electronic gear denominator is plotted below.
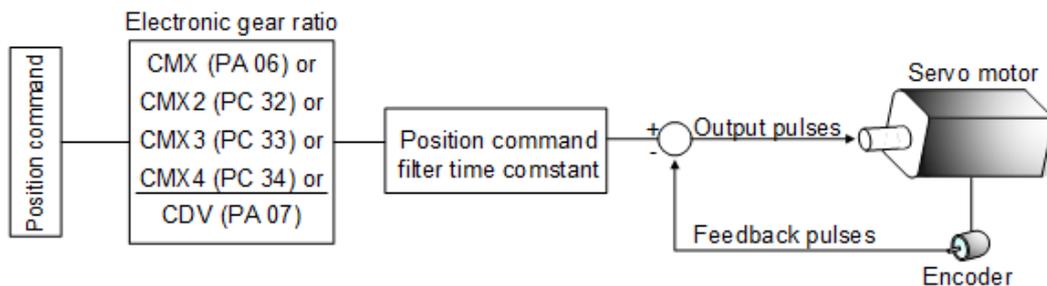
Enable the CM1 / CM2 DI function to switch 4 electronic gear numerators. See the table below.

Name	CM1	CM2	Control mode
Electronic gear numerator (PA06)	0	0	
Electronic gear numerator 2 (PC32)	1	0	
Electronic gear numerator 3 (PC33)	0	1	CoE, Pr
Electronic gear numerator 4 (PC34)	1	1	

Note: 0: OFF (CMx-SG is open-circuit), 1: ON (CMx-SG is short-circuit), x=1,2

Calculation of electronic gear ratio

Before calculating this value, users have to know the specifications the motor encoder resolution ($2^{24}=16,777,216$)(*), the reduction rate, gear ratio of machine. Use the following equation to calculate the electronic gear ratio.

$$Electronic\ gear\ ratio = \frac{Motor\ encoder\ resolution}{Load\ distance\ per\ revolution(angle)\ /\ Distance\ pulses\ to\ be\ shifted\ entered}$$

If a reducer is applied between motor and loads, it needs to multiply a factor :

$$\text{factor} = \frac{\text{motor shaft turns}}{\text{per mechanism revolution}}$$

The following example explains the method for setting the electronic gear ratio.
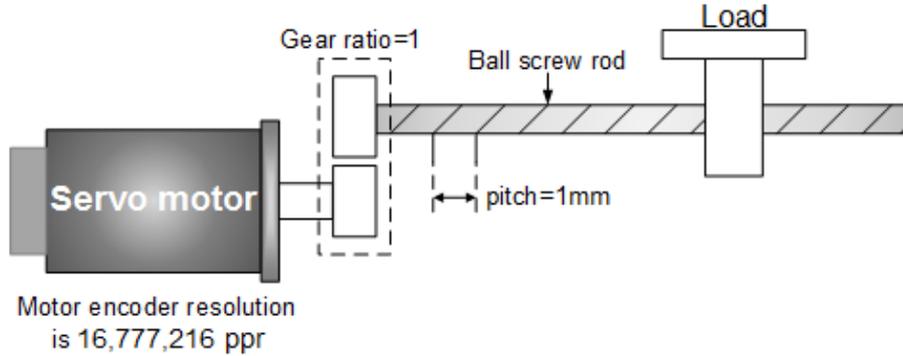
Load distance per revolution is 1mm, the resolution of motor encoder is 16,777,216 ppr, the gear ratio of load mechanism to motor shaft is 1, if the demand distance to be shifted is 5μm, the calculation is listed below :

$$\text{Electronic gear ratio} = \frac{16{,}777{,}216}{1\ \text{mm}/5\ \mu\text{m}} \times \frac{1}{1} = \frac{16{,}777{,}216}{200}$$

From above, it could be known that by setting the electronic gear numerator as 16,777,216 and set the electronic gear denominator as 200, and then the ball screw rod would be shift a 5-μm distance after a position pulse command.

3.9. Brake function

⚠ DANGER	• Before wiring, turn off the power and wait for 10 minutes or more until the charge LED turns off. Otherwise, an electric shock may occur.

⚠ CAUTION	• Use the specified auxiliary equipment and options to prevent a malfunction or a fire.

3.9.1. Selection of brake resistor

⚠ CAUTION	• Match the capacity of drive and its brake resistor to prevent a fire.

As the direction of motor generated torque is opposite to the rotary direction of motor, it becomes a power generator. The regenerative energy would be turned back to the servo drive. To prevent from P-N voltage exceeded, a voltage stabilized protection is necessary. The IGBT switch and brake resistors constitute this protection. Regenerative energy is consumed by the brake resistor.

There is a built-in brake resistor inside the drive (below 3.5KW). If the regenerative energy is too large, it is not recommended to use. Instead, use an external one to avoid overheating. When using the built-in brake resistor, make sure that the P/D terminals is short-circuit. If the external brake resistor applied, make P/D terminals open while the external resistor is connected to the P/C terminals.

Built-in brake resistor specifications for the Sharp servo drive are described below.

Drive(W)	Built-in brake resistor specification		Minimum permissible	Consumption power of
	resistor (Ω)	Capacity (W)	(Ω)	built-in resistor (W)
100	100	20	100	10
200	100	20	100	10
400	100	20	100	10
500	100	20	100	10
750	40	40	40	20
1000	40	40	40	20
1500	13	100	13	50
2000	13	100	13	50
3500	13	100	13	50
5000	13	100	13	50
7000	(Without built-in brake)		8	(Without built-in brake)

Note: The average regenerative power that could be consumed is at 50% rated power of the built-in brake resistor. So are the external brake resistors.

As external brake resistor is applied, the same resistance value mentioned above is required. If serial or parallel wiring are applied to increase resistor's power, be sure that the resistance meets the minimum permissible specification. The brake resistor with a thermal switch or a cooling fan would be helpful to

tell users that the capacity of brake resistor is insufficient or to reduce the temperature of brake resistor. Please contact the manufacturer of brake resistor to know the detail load characteristic.

To let users easily calculate the power of external brake resistor, the calculations are described below.

(a) Without external load

If the motor is repeated running forward and reverse, the braking regenerative energy would return to the aluminum capacitors of servo drive. When the P-N voltage exceeds a particular value, the brake IGBT switch is turn on and the brake resistor would dissipate the regenerative energy. The following statement and table provide the calculation of regenerative power.

The Es and Ec of various drive capacity are listed below.

Drive (W)		Motor type	Rotor inertia, J ($\times 10^{-4}$ kg·m^2)	(*1)Regenerative Energy **Es** (joule)	(*2)Regenerative Energy **Ec** (joule)	Max. motor speed (rpm)
Low inertia	100	SMP-L00530○□□	0.03	0.15	9.90	3000
		SMP-L01030○□□	0.052	0.26	9.90	3000
	200	SMP-M02030○□□	0.161	0.79	9.90	3000
	400	SMP-M04030○□□	0.277	1.37	9.90	3000
	750	SMP-M07530○□□	1.07	5.28	16.80	3000
	1K	SMP-M10020○□□	6.1	13.38	16.80	2000
	1.5K	SMP-M15020○□□	8.8	19.30	40.80	2000
	2K	SMP-M20020○□□	11.5	25.22	40.80	2000
	3K	SMP-M30020○□□	16.7	36.63	40.80	2000
Medium inertia	1K	SMP-M10020○□□	10.3	22.59	16.80	2000
	1.5K	SMP-M15020○□□	15	32.90	40.80	2000
	2K	SMP-M20020○□□	32.1	70.40	40.80	2000
	3K	SMP-M30020○□□	61.2	134.23	40.80	2000
	5K	SMP-M50020○□□	84.6	185.93	140.00	2000
	7K	SMP-M70020○□□	121.6	267.25	140.00	2000

Note1: Es is the regenerated energy of a motor without loading that runs a rated speed then stops.

Note2: Ec is the motor deceleration energy that charges into the DC capacitors.

The capacity of brake resistor is calculated as follows:

$$P_{BR} = 2 \times ((N+1) \times E_S - E_C)/T$$

Where:

P_{BR}: Power of brake resistor

N: The ratio of load to motor shaft

T: Duty cycle (defined by users)

If the ratio of load inertia to motor shaft is N, deceleration from the rated speed to stop; the regenerative energy is (N +1) × Es. The brake resistor consumption is (N +1)× Es - Ec joules. Assuming the duty cycle is T second, then the recommend power of brake resistor is 2 × ((N +1) × Es-Ec) / T. The calculation procedure is as follows. J is the motor inertia. (unit: kg·m2)

Step	Item	Calculation or procedure
1	Choose the duty cycle T	With user's application to decide the repeat operation cycle.
2	Set motor speed	Panel operation to read/write this value.
3	Set load to motor inertia ratio N	Panel operation to read/write this value.(PA02=0002h)
4	Compute the Es	Refer to the previous table or calculation $Es = J \times Wr^2 / 182$
5	Compute the Ec	Refer to the previous table
6	Compute the P_{BR}	$2 \times ((N+1) \times E_S - E_C)/T$

Example 1
The drive capacity is 400W, duty cycle T is 0.5 second, revolution speed is 3000 rpm, load to motor inertia ratio is 10, then the necessary power of brake resistor = 2 x ((10 + 1) x 1.33 -9.90) / 0.5 = 13.6W. So, an external resistor which capacity is greater than 30W is recommended.
Note: Due to 3000rpm is the rate speed of 400W servo drive; we could find the Es on the previous table is 1.37J.

Example 2
The drive capacity is 2KW, duty cycle T is 1 second, revolution speed is 1000 rpm, load to motor inertia ratio is 20. Since the revolution speed 1000rpm is less than the rated speed (2000rpm), we need to compute E_S, $E_S =32.1 \times 10^{-4} \times 1000^2/182 = 17.6J$, then the necessary power of brake resistor = 2 x ((20 + 1) x 17.6 - 40.8) /1 = 658W. These are more than the capacity (50W) of 2KW servo drive's built-in brake resistor. So, a 1500W brake resistor is recommended.
Generally, if the load inertia ratio is small (N<=5), the capacity is sufficient. If the brake resistor capacity is too small, the heat accumulated is growing easily and the temperature of brake resistor rises soon. When the temperature is higher than a certain value, the brake resistor will be burn out.

(b) With external load
When the external load torque is greater than motor torque, it makes the servo motor output torque direction is opposite to the rotary direction of servo motor. In this case, the external energy is delivered to the servo drive through the servo motor. The following figure is an example that the motor runs in CCW rotation at constant speed when a sudden external load torque change.

(b) With external load

When the external load torque is greater than motor torque, it makes the servo motor output torque direction is opposite to the rotary direction of servo motor. In this case, the external energy is delivered to the servo drive through the servo motor. The following figure is an example that the motor runs in CCW rotation at constant speed when a sudden external load torque change.
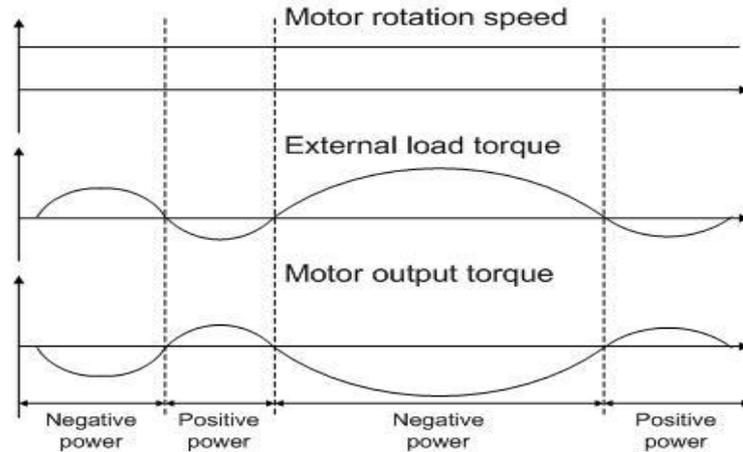
Power of the external load torque: $P_L = T_L \times \omega$

Where: P_L is the power of external load torque

       T_L is the external load torque. (Unit: Nt-m)

       ω is the motor rotation speed. (Unit: rad/s)

For example:

If an external load torque of +50% rated torque is applied and the servo motor speed is 3000r/min, the servo drive is 400W capacity(rated torque: 1.27Nt-m), then the users need to connect an external brake resistor which power is 2 x (0.5 x 1.27) x (3000 x 2 x π/ 60) = 399W, 100Ω.

Note: 1rpm = 2π/60 (rad/s)

3.9.2. Operation of electromagnetic brake interlock

MBR is described: (1) MBR OFF, the brake locks the motor shaft. (2) MBR ON, the brake releases the motor shaft. The PC16 defines the delay time when the SON OFF to MBR OFF.

1.MBR enables/disables electromagnetic contactor to release/lock the motor shaft.

2.The coil of electromagnetic brake is without polarity.

3.Do not use the inner +24V power (VDD) to drive the electromagnetic brake.

4.If users control the electromagnetic brake without MBR, refer to the operation sequence below.

5.If DO MBR function is applied, make it valid by PA01=01□□ setting.

The operation sequence of electromagnetic brake is plotted below.
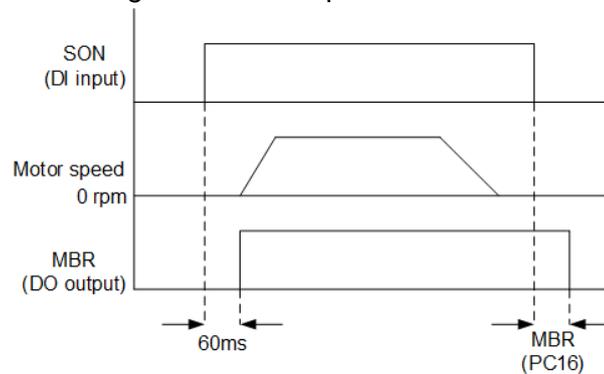
Wiring diagram of electromagnetic brake (MBR DO applied)
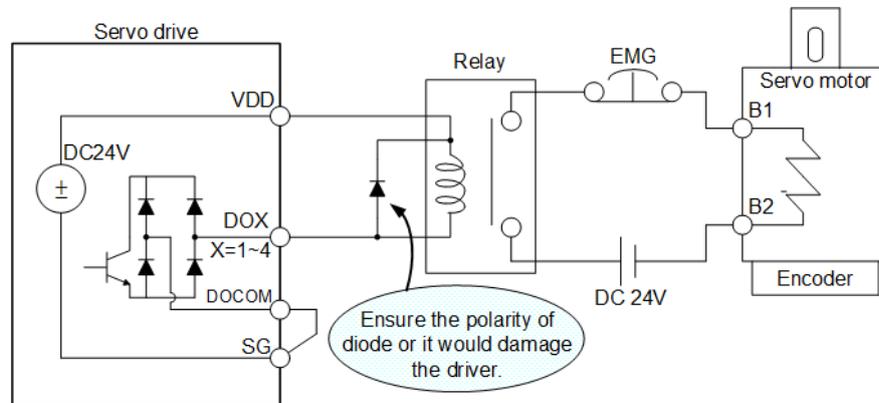
Specification of electromagnetic brake

Motor type	SMP series					
	L00530B/ L01030B	L02030B/ L04030B	L07530B	M10020B/ M15020B	M20020B/ M30020B	M50020B/ M70020B
Brake type	Spring brake (Normal locked)					
Rated voltage (V)	DC 24V					
Rated power (W)	6.3	7.9	8.6	19.3	34	34
Rated current (A)	0.24	0.32	0.35	0.8	1.41	1.41
Friction Tq (N·m)	0.3	1.3	2.4	8.5	45	45

| | CAUTION | • Not attempt to use the electromagnetic brake of motor to decelerate a running motor. |

4. EtherCAT communication

EtherCAT slave information(ESI)
Use the ESI file (obtained at https://sharp-industries.com/) to configure the EtherCAT master.

4.1. Parameters setting & specification
Parameters settings:

(1) PA01(STY) : Set PA01 as "□□20" to enable the EtherCAT communication function.

(2) PC38(ESYC) : Set PC38 to permit the synchronous error counts when EtherCAT communication is performed. PC38 setting range is 0 to 65535, "0 " setting means synchronous error detection is invalid.

(3) PC39(ESS) : Set PC39 to define the station number. The 0 default means that the host controller would assign the slave station number in wiring sequence.
　　　　　　　　0：SII (Slave Information Interface)
　　　　　　　　1~65535：User's individual assignment

(4) Specification

	Item	Description
EtherCAT communication	Physical Layer	100BASE-TX
	Baud rate	2 x 100Mbps (full duplex)
	Network topology	Line casecade
	Connectors	RJ45 X 2 (CN3 IN, CN3 OUT)
	Distance	50m between nodes
	Slave nodes	Max. 65535
	LED indicators	RUN (Green)
		ERR (RED)
		L/A IN (Green)
		L/A OUT (Green)
	FMMU	3 sets
	SyncManager	4 sets
	Application layer	IEC61800-7 CiA402 Drive profile
	Operation mode	Profile Position (PP)
		Profile Velocity (PV)
		Profile Torque (PT)
		Cyclic Synchronous Position (CSP)
		Cyclic Synchronous Velocity (CSV)
		Cyclic Synchronous Torque (CST)
		Homing (HM)
		Interpolated Position (IP)
	Synchronization mode	DC synchronization (Sync0)

		Non-synchronized (Free Run)
	Communication object	PDO / SDO
	PDO mapping	TxPDO : 4 sets
		RxPDO : 4 sets

4.2. EtherCAT data frame

EtherCAT communication is a serial transmission protocol. To use the commercially available network cable to link the host and drives. The slave station number could be assign by users' setting or by the host's named.

(a) Introduction

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Its full name is "Ethernet for Control Automation Technology". The ETG (EtherCAT Technology Group) is an international organization to provide support for developing EtherCAT technologies and to promote the spread of EtherCAT technologies.

(b) Data frame

EtherCAT uses standard IEEE 802.3 Ethernet frames, thus a standard network controller could be used and no special hardware is required on master side. The following is an Ethernet frame containing EtherCAT data is assembled.
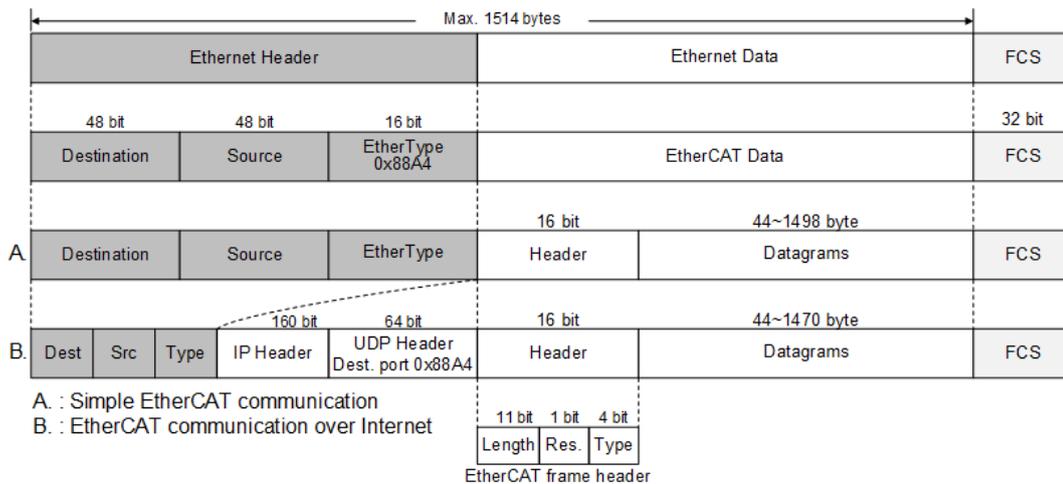
An EtherCAT data frame is composed with Ethernet Header, Ethernet Data and FCS(frame check sequence). The Ethernet Header is subdivided into source, destination and Ether type. EtherCAT communication mode should be defined in this Ether type frame. The Ethernet Data is subdivided into Header and Datagrams. The Datagram also has its Header definition to set the transmission mode or status, etc. The structure of datagram is shown as follows.
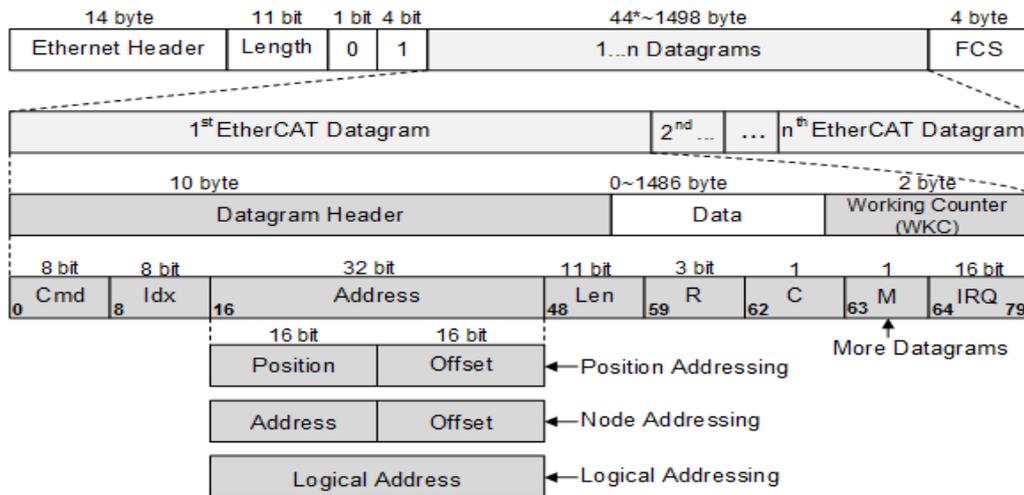
Multiple datagrams could be assembled into an EtherCAT frame which its maximum length is 1514 bytes. Datagram Header defines the data transmission mode and the node addressing tag. By addressing the node, data could be read from or written into the EtherCAT registers.

Field	Data Type	Description
Cmd	Byte	EtherCAT Command Type
Idx	Byte	A identifier to denote duplicates/lost datagram that shall not be changed
Address	Byte[4]	To configure the slave address
Len	11 bit	Length of the following data within this datagram
R	3 bit	Reserved, 0
C	1 bit	Circulating frame, 0: Frame is not circulating; 1: Frame has circulated once
M	1 bit	More EtherCAT datagrams, 0: Last datagram; 1: More datagrams will follow
IRQ	WORD	EtherCAT Event Request registers of all slaves combined with a logical OR
Data	Byte [n]	Read/Write Data
WKC	WORD	Working Counter

4.3. CoE structure

The structure of the CAN application protocol over EtherCAT (CoE) for SDP series Servo Drive with built-in EtherCAT communications is described here. Normally, multiple protocols can be transmitted by using EtherCAT. The IEC 61800-7 (CiA 402) drive profile is used for SDP series Servo Drives with Built-in EtherCAT Communications.
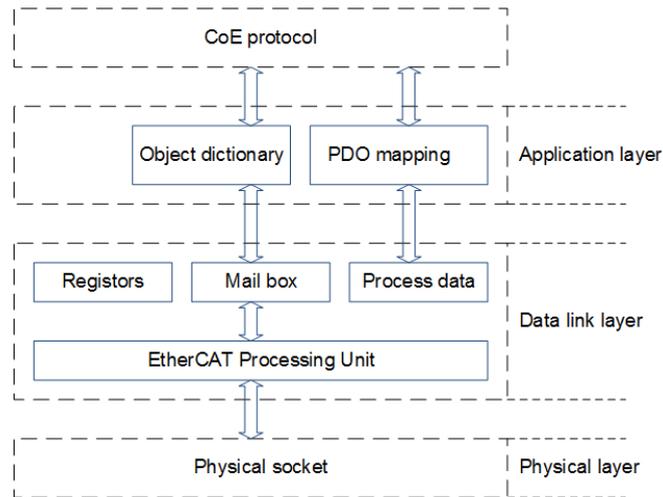
The object dictionary in the application layer contains parameters and application data as well as information on the PDO mapping between the process data servo interface and Servo Drive application. The process data object (PDO) consists of objects in the object dictionary that can be mapped to the PDO. The contents of the process data are defined by the PDO mapping.

Process data communications cyclically reads and writes the PDO. Mailbox communications (SDO) uses asynchronous message communications where all objects in the object dictionary can be read and written.

4.4. State machine

The EtherCAT State Machine (ESM) of the EtherCAT slave is controlled by the EtherCAT Master with the Int state, Pre-OP state, Safe-OP state and OP state.
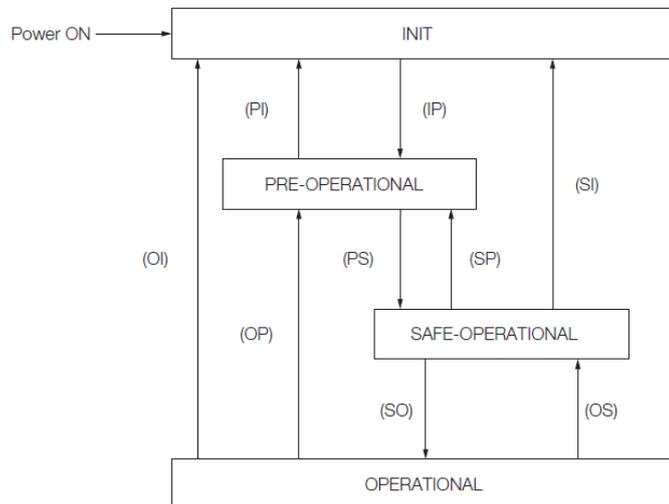
According to the flow chart above; the top to bottom flow need to be switched in sequence but the bottom to top flow could be switched arbitrary.

State	Description
INIT	• The master initiates the registers of data link layer

INIT -> PRE_OP	• The master sets the SyncManager channels for mailbox communications. • The master initializes Distributed clock synchronization. • The master requests the Pre-Operational state.
PRE_OP	• SDO data transmissions are possible.
PRE_OP -> SAFE_OP	• The master sets the SyncManager channels and parameters for PDO process. • The master sets the FMMU channels for the data link layer. • The master requests the Safe-Operational state.
SAFE_OP	• SDO data transmission and PDO communication are possible.
SAFE_OP -> OP	• The master sends valid output data and requests the Operational state.
OP	• Mailbox communications & data process communications are possible.

4.5. PDO mapping and Object instruction

The process data communications is defined in the PDO mappings. According to variable application, choose the particular PDO mappings channels with the PDO default of ESI profile. The PDO mapping tables are in indexes 1600h to 1603h for the RxPDOs and indexes 1A00h to 1A03h for the TxPDOs in the object dictionary. The following figure shows an example of PDO mappings.

(1) 1st PDO mapping: (Cyclic Synchronous Position)

RxPDO (1600h)	Controlword (6040h)	Target Position (607Ah)	Target Velocity (60FFh)	Target Torque (6071h)	Max. Torque (6072h)	Mode of Operation (6060h)	Touch Probe Function (60B8h)
TxPDO (1A00h)	Statusword (6041h)	Position Actual Value (6064h)	Torque Actual Value (6077h)	Following Error Actual Value (60F4h)	Mode of Operation Display (6061h)	Touch Probe Status (60B9h)	Touch Probe Value (60BAh)

(2) 2nd PDO mapping: (Cyclic Synchronous Position)

RxPDO (1600h)	Controlword (6040h)	Target Position (607Ah)	-	-	-	-	-

TxPDO (1A00h)	Statusword (6041h)	Position Actual Value (6064h)	-	-	-	-	-

(3) 3rd PDO mapping: (Cyclic Synchronous Velocity)

RxPDO (1600h)	Controlword (6040h)	-	Target Velocity (60FFh)	-	-	-	-
TxPDO (1A00h)	Statusword (6041h)	Position Actual Value (6064h)	-	-	-	-	-

(4) 4th PDO mapping: (Cyclic Synchronous Torque)

RxPDO (1600h)	Controlword (6040h)	-	-	Target Torque (6071h)	-	-	-
TxPDO (1A00h)	Statusword (6041h)	Position Actual Value (6064h)	Torque Actual Value (6077h)	-	-	-	-

Set object 1C12h (Sync Manager PDO Assignment 2) for RxPDO default channel.

Set object 1C13h(Sync Manager PDO Assignment 3) for TxPDO default channel,

The default RxPDO / TxPDO of SDP servo drive is 1601h / 1A01h.

Object 1C32h (Sync Manager 2 Synchronization) and 1C33h (Sync Manager 3 Synchronization) are for synchronization parameters settings.

4.5.1. Object list

For CANopen over EtherCAT application, there are two objects need to be defined: the transmission (1000h~1FFFh) and the drive (6000h~6FFFh). With the particular object written, the drive status setting and commands execution could be done to complete the control task.

(1) Objects 1□□□h list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
1000h	0	Device Type	UDINT	RO	-	0x00020192	-	-
1001h	0	Error Register	USINT	RO	-	-	-	-
1008h	0	Manufacturer Device Name	STRING	RO	-	-	-	-
100Ah	0	Manufacturer Software Version	STRING	RO	-	-	-	-
1010h	Store Parameter							
	0	Largest subindex supported	USINT	RO	-	4	-	-
	1	Save all parameters	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
	2	Save communication	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
	3	Save application parameters	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
	4	Save manufacturer defined parameters	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
1011h	Restore Default Parameters							
	0	Largest subindex supported	USINT	RO	-	4	–	–
	1	Restore all default	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
	2	Restore communication default parameters	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
	3	Restore application default parameters	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
	4	Restore manufacturer	UDINT	RW	-	0x0001	0x00000000	0xFFFFFFFF
1018h	Identity Object							
	0	Number of entries	USINT	RO	-	4	-	-
	1	Vendor ID	UDINT	RO	-	0x05BC	-	-
	2	Product code	UDINT	RO	-	0xxxxx	-	-
	3	Revision number	UDINT	RO	-	-	-	-
	4	Serial number	UDINT	RO	-	0	-	-
10F3h	Diagnosis history							
	0	Number of entries	USINT	RO	-	19	-	-
	1	Maximum messages	USINT	RO	-	14	-	-
	2	Newest message	USINT	RO	-	-	-	-
	3	Newest acknowledged message	USINT	RW	-	0	0	0
	4	Newest message available	UDINT	RO	-	0	-	-
	5	Flags	UINT	RW	-	0x0007	0	0xFFFF
	6	Diagnosis message 1	STRING	RO	-	-	-	-
	7	Diagnosis message 2	STRING	RO	-	-	-	-
	8	Diagnosis message 3	STRING	RO	-	-	-	-
	9	Diagnosis message 4	STRING	RO	-	-	-	-
	10	Diagnosis message 5	STRING	RO	-	-	-	-
	11	Diagnosis message 6	STRING	RO	-	-	-	-
	12	Diagnosis message 7	STRING	RO	-	-	-	-
	13	Diagnosis message 8	STRING	RO	-	-	-	-
	14	Diagnosis message 9	STRING	RO	-	-	-	-
	15	Diagnosis message 10	STRING	RO	-	-	-	-
	16	Diagnosis message 11	STRING	RO	-	-	-	-
	17	Diagnosis message 12	STRING	RO	-	-	-	-
	18	Diagnosis message 13	STRING	RO	-	-	-	-
	19	Diagnosis message 14	STRING	RO	-	-	-	-

(2) RxPDO Objects 1600h~1603h list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
1600h	1nd Receive PDO Mapping							
	0	Number of objects in this PDO	USINT	RW	-	8	0	8

	1	Mapping entry 1	UDINT	RW	-	0x60400010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x607A0020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0x60FF0020	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0x60710010	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0x60720010	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0x60600008	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0x00000008	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0x60B80010	0	0xFFFFFFFF
1601h	2nd Receive PDO Mapping							
	0	Number of objects in this PDO	USINT	RW	-	2	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60400010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x607A0020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF
1602h	3rd Receive PDO Mapping							
	0	Number of objects in this PDO	USINT	RW	-	2	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60400010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60FF0020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF
1603h	4th Receive PDO Mapping							
	0	Number of objects in this PDO	USINT	RW	-	2	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60400010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60710010	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF

(3) TxPDO Objects 1A00h~1A03h list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
1A00h		1st Transmit PDO Mapping						
	0	Number of objects in this PDO	USINT	RW	-	8	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60410010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60640020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0x60770010	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0x60F40020	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0x60610008	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0x60FD0020	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0x60B90010	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0x60BA0020	0	0xFFFFFFFF
1A01h		2nd Transmit PDO Mapping						
	0	Number of objects in this PDO	USINT	RW	-	3	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60410010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60640020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0x60FD0020	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF
1A02h		3rd Transmit PDO Mapping						
	0	Number of objects in this PDO	USINT	RW		3	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60410010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60640020	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0x60FD0020	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF
1A03h		4th Transmit PDO Mapping						
	0	Number of objects in this PDO	USINT	RW	-	4	0	8
	1	Mapping entry 1	UDINT	RW	-	0x60410010	0	0xFFFFFFFF
	2	Mapping entry 2	UDINT	RW	-	0x60770010	0	0xFFFFFFFF
	3	Mapping entry 3	UDINT	RW	-	0x60640020	0	0xFFFFFFFF
	4	Mapping entry 4	UDINT	RW	-	0x60FD0020	0	0xFFFFFFFF
	5	Mapping entry 5	UDINT	RW	-	0	0	0xFFFFFFFF
	6	Mapping entry 6	UDINT	RW	-	0	0	0xFFFFFFFF

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
	7	Mapping entry 7	UDINT	RW	-	0	0	0xFFFFFFFF
	8	Mapping entry 8	UDINT	RW	-	0	0	0xFFFFFFFF

(4) SyncManager objects

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
1C00h		Sync Manager Communication Type						
	0	Number of used SyncManager channels	USINT	RO	-	4	-	-
	1	Communication type sync	USINT	RO	-	1	-	-
	2	Communication type sync manager 1	USINT	RO	-	2	-	-
	3	Communication type sync manager 2	USINT	RO	-	3	-	-
	4	Communication type sync	USINT	RO	-	4	-	-
1C12h		Sync Manager PDO Assignment2						
	0	Number of assigned PDOs	USINT	RW	-	1	0	4
	1	Index of assigned RxPDO 1	UINT	RW	-	0x1601	0x1600	0x1603
	2	Index of assigned RxPDO 2	UINT	RW	-	0x0000	0x1600	0x1603
	3	Index of assigned RxPDO 3	UINT	RW	-	0x0000	0x1600	0x1603
	4	Index of assigned RxPDO 4	UINT	RW	-	0x0000	0x1600	0x1603
1C13h		Sync Manager PDO Assignment3						
	0	Number of assigned PDOs	USINT	RW	-	1	0	4
	1	Index of assigned TxPDO 1	UINT	RW	-	0x1A01	0x1A00	0x1A03
	2	Index of assigned TxPDO 2	UINT	RW	-	0x0000	0x1A00	0x1A03
	3	Index of assigned TxPDO 3	UINT	RW	-	0x0000	0x1A00	0x1A03
	4	Index of assigned TxPDO 4	UINT	RW	-	0x0000	0x1A00	0x1A03

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
1C32h		Sync Manager 2 (process data output) Synchronization						
	0	Number of synchronization parameters	USINT	RO	-	32	-	-
	1	Synchronization type	UINT	RO	-	-	-	-
	2	Cycle time	UDINT	RO	-	-	-	-
	3	Shift time	UDINT	RO	-	0	-	-
	4	Synchronization types supported	UINT	RO	-	0x0017	-	-
	5	Minimum cycle time	UDINT	RO	-	50000	-	-
	6	Calc and copy time	UDINT	RO	-	50000	-	-
	7	Reserved	UDINT	RO	-	0	-	-
	8	Reserved	UINT	RO	-	0	-	-
	9	Delay time	UDINT	RO	-	0	-	-
	10	Sync0 cycle time	UDINT	RO	-	-	-	-
	11	Reserved	UINT	RO	-	0	-	-

	12	SM2 event miss count	UINT	RO	-	-	-	-
	13	Shift time too short	UINT	RO	-	-	-	-
	14	RxPDO toggles failed	UINT	RO	-	-	-	-
	32	Sync error	BOOL	RO	-	-	-	-
1C33h	Sync Manager 3 (process data input) Synchronization							
	0	Number of synchronization	USINT	RO	-	32	-	-
	1	Synchronization type	UINT	RO	-	-	-	-
	2	Cycle time	UDINT	RO	-	-	-	-
	3	Shift time	UDINT	RW	-	0	0	*Sync0 event cycle - 100000*
	4	Synchronization types supported	UINT	RO	-	0x0017	-	-
	5	Minimum cycle time	UDINT	RO	-	0	-	-
	6	Calc and copy time	UDINT	RO	-	0	-	-
	7	Minimum delay time	UDINT	RO	-	0	-	-
	8	Command	UINT	RO	-	0	-	-
	9	Delay time	UDINT	RO	-	0	-	-
	10	Sync0 cycle time	UDINT	RO	-	0	-	-
	11	Cycle time too short	UINT	RO	-	-	-	-
	12	SM2 event miss count	UINT	RO	-	-	-	-
	13	Shift time too short	UINT	RO	-	-	-	-
	14	RxPDO toggles failed	UINT	RO	-	-	-	-
	32	Sync error	BOOL	RO	-	-	-	-

(5) SDP drive parameters

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
2000h ~ 27FFh	0	Servo parameter PA01~PH99 object list	-	-	-	-	-	-

(6) Objects 6□□□h list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6007h	0	Abort connection option code	INT	RW	-	0	0	3
603Fh	0	Error Code	UINT	RO	-	-	-	-
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
605Ah	0	Quick Stop Option Code	INT	RW	-	2	0	7

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
605Bh	0	Shutdown Option Code	INT	RW	-	0	0	1
605Ch	0	Disable Operation Option Code	INT	RW	-	1	0	1
605Dh	0	Halt Option Code	INT	RW	-	1	0	4
605Eh	0	Fault Reaction Option Code	INT	RW	-	0	0	2
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	-	-
6062h	0	Position Demand Value	DINT	RO	-	-	-	-
6063h	0	Position Actual Internal Value	DINT	RO	-	-	-	-
6064h	0	Position Actual Value	DINT	RO	-	-	-	-
6065h	0	Following Error Window	UDINT	RW	-	5242880	0	1073741823
6066h	0	Following Error Time Out	UINT	RW	ms	0	0	65535
6067h	0	Position Window	UDINT	RW	-	30	0	1073741823
6068h	0	Position Window Time	UINT	RW	ms	0	0	65535
6069h	0	Velocity sensor actual value	DINT	RO	-	-	-	-
606Ah	0	Sensor selection code	INT	RO	-	-	-	-
606Bh	0	Velocity Demand Value	DINT	RO	-	-	-	-
606Ch	0	Velocity Actual Value	DINT	RO	-	-	-	-
606Dh	0	Velocity Window	UINT	RW	-	20000	0	65535
606Eh	0	Velocity Window Time	UINT	RW	ms	0	0	65535
606Fh	0	Velocity threshold	UINT	RW	-	0	0	65535
6070h	0	Velocity threshold time	UINT	RW	ms	0	0	65535
6071h	0	Target Torque	INT	RW	0.1%	0	-32768	32767

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6072h	0	Max. Torque	UINT	RW	0.1%	3000	0	65535
6073h	0	Max current	UINT	RO	0.1%	3000	0	65535
6074h	0	Torque Demand Value	INT	RO	0.1%	-	-	-
6075h	0	Motor rated current	UDINT	RO	mA	-	-	-
6076h	0	Motor Rated Torque	UDINT	RO	Nm	-	-	-
6077h	0	Torque Actual Value	INT	RO	0.1%	-	-	-
6078h	0	Current Actual Value	INT	RO	0.1%	-	-	-
6079h	0	DC link circuit voltage	INT	RO	mV	-	-	-
607Ah	0	Target Position	DINT	RW	-	0	-2147483648	2147483647
607Bh		Position range limit						
	0	Number of entries	USINT	RO	-	2	-	-

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
	1	Min. position range limit	DINT	RW	-	-2147483647	-2147483648	2147483647
	2	Max. position range limit	DINT	RW	-	2147483647	-2147483648	2147483647
607Ch	0	Home Offset	DINT	RW	-	0	-2147483648	2147483647
607Dh	Software Position Limit							
	0	Number of entries	USINT	RO	-	2	-	-
	1	Min. position limit	DINT	RW	-	0	-2147483648	2147483647
	2	Max. position limit	DINT	RW	-	0	-2147483648	2147483647
607Eh	0	Polarity	USINT	RW	-	0	0	255
607Fh	0	Max. Profile Velocity	UDINT	RW	-	2147483647	0	4294967295
6080h	0	Max. Motor speed	UDINT	RW	-	4294967295	0	4294967295
6081h	0	Profile Velocity	UDINT	RW	-	0	0	4294967295
6082h	0	End Velocity	UDINT	RW	-	0	0	4294967295
6083h	0	Profile Acceleration	UDINT	RW	-	10000000	0	4294967295
6084h	0	Profile Deceleration	UDINT	RW	-	10000000	0	4294967295
6085h	0	Quick Stop Deceleration	UDINT	RW	-	4000000000	0	4294967295
6086h	0	Motor profile type	INT	RW	-	0	-32767	32767
6087h	0	Torque Slope	UDINT	RW	-	1000	0	4294967295
6088h	0	Torque profile type	INT	RW	-	0	-32767	32767
608Fh	Position encoder resolution							
	0	Number of entries	USINT	RO	-	2	-	-
	1	Encoder increments	UDINT	RO	-	1	1	4294967295
	2	Motor revolutions	UDINT	RO	-	1	1	4294967295

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6091h	Gear Ratio							
	0	Number of entries	USINT	RO	-	2	-	-
	1	Motor revolutions	UDINT	RW	-	PA06	0	4294967295
	2	Shaft revolutions	UDINT	RW	-	PA07	1	4294967295
6092h	Feed constant							
	0	Number of entries	USINT	RO	-	2	-	-
	1	Feed	UDINT	RW	-	1	1	4294967295
	2	Shaft revolutions	UDINT	RW	-	1	1	4294967295
6098h	0	Homing Method	SINT	RW	-	35	0	37
6099h	Homing Speeds							
	0	Number of entries	USINT	RO	-	2	-	-

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
	1	Speed during search for switch	UDINT	RW	-	500000	0	4294967295
	2	Speed during search for zero	UDINT	RW	-	100000	0	4294967295
609Ah	0	Homing Acceleration	UDINT	RW	-	10000000	0	4294967295
60A3h	0	Profile jerk use	USINT	RW	-	1	1	255
60A4h	Profile jerk							
	0	Number of entries	USINT	RO	-	2	-	-
	1	Speed during search for switch	UDINT	RW	-	0	0	4294967295
	2	Speed during search for zero	UDINT	RW	-	0	0	4294967295
60B0h	0	Position Offset	DINT	RW	-	0	-2147483648	2147483647
60B1h	0	Velocity Offset	DINT	RW	-	0	-2147483648	2147483647
60B2h	0	Torque Offset	INT	RW	0.1%	0	-32768	32767
60B8h	0	Touch Probe Function	UINT	RW	-	0	0	0xFFFF
60B9h	0	Touch Probe Status	UINT	RO	-	-	-	-
60BAh	0	Touch Probe 1 position pos Value	DINT	RO	-	-	-	-
60BBh	0	Touch Probe 1 position neg Value	DINT	RO	-	-	-	-
60BCh	0	Touch Probe 2 position pos Value	DINT	RO	-	-	-	-
60BDh	0	Touch Probe 2 position neg Value	DINT	RO	-	-	-	-
60C0h	0	Interpolation sub mode	INT	RW	-	0	-3	0
60C1h	Interpolation Data Record							
	0	Number of entries	USINT	RO	-	1	-	-
	1	Interpolation data record	DINT	RW	-	0	-2147483648	2147483647

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
60C2h	Interpolation Time Period							
	0	Highest sub-index supported	USINT	RO	-	2	-	-
	1	Interpolation time period	USINT	RW	-	1	1	250
	2	Interpolation time index	SINT	RW	-	-3	-6	-3
60C4h	Interpolation data configuration							
	0	Highest sub-index supported	USINT	RO	-	6	-	-
	1	Maximum buffer size	UDINT	RW	-	0	0	4294967295
	2	Actual buffer size	UDINT	RW	-	0	0	4294967295
	3	Buffer organization	USINT	RW	-	0	0	1
	4	Buffer position	UINT	RW	-	0	0	32767
	5	Size of data record	USINT	RO	-	1	1	254
	6	Buffer clear	USINT	RO	-	0	0	1

60C5h	0	Max acceleration	UDINT	RW	-	4294967295	0	4294967295
60C6h	0	Max deceleration	UDINT	RW	-	4294967295	0	4294967295
60E0h	0	Positive torque limit value	UDINT	RW	0.1%	5000	0	65535
60E1h	0	Negative torque limit value	UDINT	RW	0.1%	5000	0	65535
60E3h	Supported homing method							
	0	Highest sub-index supported	USINT	RO	-	32	-	-
	1	1st supported homing method	UINT	RO	-	1	0	32767
	n	nth supported homing method	UINT	RO	-	-	0	32767
	32	32nd supported homing method	UINT	RO	-	37	0	32767
60F2h	0	Position option code	UINT	RW	-	0	0	65535
60F4h	0	Following Error Actual Value	DINT	RO	-	-	-	-
60FAh	0	Control effort	DINT	RO	-	-	-2147483648	2147483647
60FCh	0	Position Demand Internal Value	DINT	RO	-	-	-	-
60FDh	0	Digital Inputs	UDINT	RO	-	-	-	-
60FEh	Digital outputs							
	0	Highest sub-index supported	USINT	RO	-	2	-	-
	1	Physical outputs	UDINT	RW	-	0	0	0xFFFFFFFF
	2	Mask bit	UDINT	RW	-	0	0	0xFFFFFFFF
60FFh	0	Target Velocity	DINT	RW	-	0	-2147483648	2147483647
6502h	0	Supported Drive Modes	UDINT	RO	-	0x03ED	-	-

4.5.2. Object instructions

By changing the value of object 6040h (Controlword) and monitoring the value of object 6041h (Statusword), users could realize the execution that the drive currently performs and its corresponded drive status.
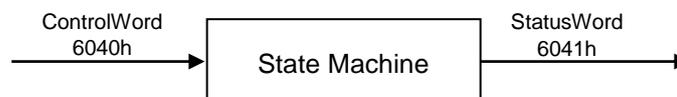
Drive's switch flow of state machine:
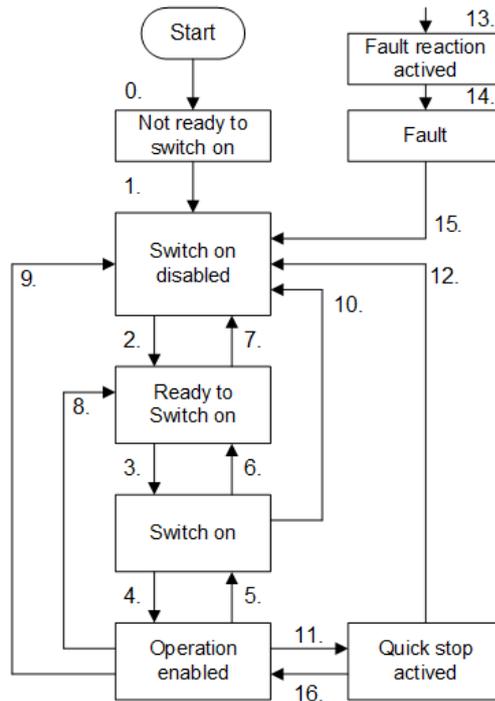
State machine switch instruction:

State	Event	Execution description
0:Reset	Reset applied	Drive is reset then start to initiate
1:Initialization	Initialization completed	Communication enabled
2:Shutdown	Shutdown Received	-
3:Switch on	Switch On Received	Power module turned ON
4:Enable operation	Enable operation Received	Servo ON
5:Disable operation	Disable operation Received	Servo OFF
6:Shutdown	Shutdown Received	Power module turned OFF
7:Disable voltage	State machine Init recovery	-
8:Shutdown	Shutdown Received	Servo OFF
9:Disable voltage	Power module turned OFF	Servo OFF
10:Disable voltage	State machine Init recovery	-
11:Quick stop	Quick stop Received	Quick stop function activated
12:Disable voltage	Quick stop completed	Servo OFF
13:Error occurs	Error detected	Operation correspond to Error
14:Fault reset	Error response operation	Servo OFF
15:Fault	Fault reset Received	Fault reset completed
16:Enable operation	Enable operation Received	Servo ON

(1) **Object 6040h: Controlword**

This object controls the device and operation mode. By modifying this value, users could run the drive or reset the drive with faults.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
6040h	0	Controlword	UINT	RW	Yes	0~FFFFh	No

Controlword Bits

15~11	10~9	8	7	6~4	3	2	1	0
N/A	Reserved	Halt	Fault reset	Operation mode specific	Enable Operation	Quick Stop	Enable Voltage	Switch on

■ Details on Bit 0, 1, 2, 3, 7 (Switched status of servo drive corresponded)

Command	Controlword Bit					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3+4
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	0 -> 1	X	X	X	X	15

■ Details on Bit 4, 5, 6, 8 (CoE mode instruction)

Operation mode	Bit 8	Bit 6	Bit 5	Bit 4
Profile position mode	Halt	absolute/relative	Change set Immediately	New set-point
Profile velocity mode	Halt	-	-	-
Profile torque mode	Halt	-	-	-
Cyclic Synchronous Position mode	Halt	-	-	-
Cyclic Synchronous Position mode	Halt	-	-	-
Cyclic Synchronous Position mode	Halt	-	-	-
Homing mode	Halt	-	-	Start homing
Interpolation position mode	Halt	-	-	Enable interpolation

(2) **Object 6041h: Statusword**

Statusword contains the bits that give the current state of the Servo Drive and the operating state of the operation mode.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
6041h	0	Statusword	UINT	**RO**	Yes	0	No

Statusword Bits definition

Bit	State	Description
0	Ready to switch on	Refer to ▪Details on Bits 0~7
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	Reserved	1: Active mode function execution is in progress.
9	Remote	Controlword (6040h) is being processed
10	Target reached	Refer to ▪Details on Bits 10, 12,13
11	Internal limit active	Refer to ▪Details on Bits 11
12,13	Operation mode specific	Refer to ▪Details on Bits 10, 12, 13
14	Torque limit active	0: Torque limit is disabled; 1: Torque limit is enabled.
15	Reserved	-

■ Details on Bit 0~7

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Drive status
X	0	X	X	0	0	0	0	Not ready to switch on
X	1	X	X	0	0	0	0	Switch on disabled
X	0	1	X	0	0	0	1	Ready to switch on
X	0	1	X	0	0	1	1	Switched on
X	0	1	X	1	1	1	1	Operation enabled
X	0	0	X	1	1	1	1	Quick stop active
X	0	X	X	1	1	1	1	Fault reaction active
X	0	X	X	0	0	0	0	Fault

■ Details on Bit 11

The internal limit is activated in the following cases:

• Software Position Limit is activated by a target position.

• The external limit signal LSN or LSP was activated.

■ Details on Bit 10, 12, 13 (CoE mode instruction)

According to different operation mode, Bit 10, 11, 12 perform different function.

Operation mode	Bit 13	Bit 12	Bit 10
Profile position mode (Pp)	Following error	Set-point acknowledge	Target reached
Profile velocity mode (Pv)	-	Speed	Target reached

Profile torque mode (Pt)	-	-	Target reached
Homing mode (Hm)	Homing error	Homing attained	Target reached
Interpolated position mode (Ip)	-	Ip mode active	Target reached
Cyclic synchronous position mode (CSP)	Following error	(Note 1)	-
Cyclic synchronous velocity mode (CSV)	-	(Note 1)	-
Cyclic synchronous torque mode (CST)	-	(Note 1)	-

Note 1: Bit12=0→the servo does not run Target position/Target velocity/Target torque command.

Bit12=0→the servo does runs Target position/Target velocity/Target torque command.

(3) **Object 6060h: Mode of operation**

This object is for operation mode option. Users enable their demand mode according their setting.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
6060h	0	Mode of operation	SINT	RW	Yes	0~10 (default: 0)	Yes

Value	Description
1	Profile position mode
3	Profile velocity mode
4	Profile torque mode
6	Homing mode
7	Interpolated position mode
8	Cyclic synchronous position mode
9	Cyclic synchronous velocity mode
10	Cyclic synchronous torque mode

(4) **Object 6502h: Supported Drive mode**

This object gives the operation modes which are supported by this SDP drive.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
6502h	0	Supported drive mode	UDINT	RO	No	default**:**3EDh	No

Bit	Mode description	Support
0	Profile position mode	Yes
1	Velocity mode	No
2	Profile velocity mode	Yes
3	Profile torque mode	Yes
5	Homing mode	Yes
6	Interpolated position mode	Yes
7	Cyclic synchronous position mode	Yes
8	Cyclic synchronous velocity mode	Yes
9	Cyclic synchronous torque mode	Yes

(5) **Object 6061h: Mode of operation display**

This object shows the current mode of operation.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
6061h	0	Mode of operation display	SINT	RO	Yes	-	No

(6) **Object 603Fh: Error code**

This object shows the alarm code of current error. The 0000h value denotes no error currently.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
603Fh	0	Error code	UINT	RO	Yes	-	No

(7) **Object 605Ah: Quick stop option code**

This object performs how to decelerate then stop if a quick stop is executed.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
605Ah	0	Quick stop option code	INT	RW	No	0~7	Yes

The definition of object 605Ah in different operation mode would perform different results.

Operation mode for PP/PV/HOME/CSP/CSV/IP:

Value	Description	
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to switch on disabled.	
1	-	Deceleration rate refers to Object Profile Deceleration 6084h, status moves to switch on disabled.
	Home	Deceleration rate refers to Object Home Acceleration 609Ah, status moves to switch on disabled.
2	Deceleration rate refers to Object Quick Stop Deceleration 6085h, status moves to switch on disabled.	
3	Deceleration rate refers to Object Max Deceleration 60C6h, status moves to switch on disabled.	
4	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Quick stop active.	
5	-	Deceleration rate refers to Profile linear deceleration 6084h,, status moves to Quick stop active.
	Home	Deceleration rate refers to Object Home acceleration 609Ah, status moves to Quick stop active.
6	Deceleration rate refers to Object Quick stop deceleration 6085h, status moves to Quick stop active.	
7	Deceleration rate refers to Object Max deceleration 60C6h, status moves to Quick stop active.	

Operation mode for CST/PT:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to switch on disabled.
1	Deceleration rate refers to Object Torque Slope 6087h, status moves to switch on disabled.
2	Deceleration rate refers to Object Torque Slope 6087h, status moves to switch on disabled.
3	Due to Torque=0, motor is stopped. The status is moved to switch on disabled.
4	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Quick stop active.
5	Deceleration rate refers to Object Torque Slope 6087h, status moves to Quick stop active.
6	Deceleration rate refers to Object Torque Slope 6087h, status moves to Quick stop active.
7	Due to Torque=0, motor is stopped. The status is moved to Quick stop active.

(8) **Object 605Bh: Shutdown Option Code**

This object performs how to decelerate then stop if a shutdown is executed. The definition of object 605Bh in different operation mode would perform different results.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM

| 605Bh | 0 | Shutdown Option Code | INT | RW | No | 0~1 | Yes |

Operation mode for PP/PV/HOME/CSP/CSV/IP:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Ready to switch on.
1	-	Deceleration rate refers to Profile linear deceleration 6084h, status moves to Ready to switch on.
	Home	Deceleration rate refers to Object Home acceleration 609Ah, status moves to Ready to switch on.

Operation mode for CST/PT:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Ready to switch on.
1	Deceleration rate refers to Object Torque Slope 6087h, status moves to Ready to switch on.

(9) **Object 605Ch: Disable Operation Option Code**

This object performs how to decelerate then stop if a Disable operation is executed. The definition of object 605Ch in different operation mode would perform different results.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
605Ch	0	Disable Operation Option Code	INT	RW	No	0~1	Yes

Operation mode for PP/PV/HOME/CSP/CSV/IP:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Switched on.
1	-	Deceleration rate refers to Profile linear deceleration 6084h, status moves to Switched on.
	Home	Deceleration rate refers to Object Home acceleration 609Ah, status moves to Switched on.

Operation mode for CST/PT:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Switched on.
1	Deceleration rate refers to Object Torque Slope 6087h, status moves to Switched on.

(10) **Object 605Dh: Halt Option Code**

This object performs how to decelerate then stop if the Halt (bit8 of controlword) is active. The value in different operation mode would perform different results.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
605Dh	0	Halt option code	INT	RW	No	0~3	Yes

Operation mode for PP/PV/HOME/CSP/CSV/IP:

Value	Description
1	-	Deceleration rate refers to Profile linear deceleration 6084h, status moves to Operation enabled.
	Home	Deceleration rate refers to Object Home acceleration 609Ah, status moves to Operation enabled.

2	Deceleration rate refers to Object Quick stop deceleration 6085h, status moves to Operation enabled.
3	Deceleration rate refers to Object Max deceleration 60C6h, status moves to Operation enabled.

Operation mode for CST/PT:

Value	Description
1	Deceleration rate refers to Object Torque slope 6087h, status moves to Operation enabled.
2	Deceleration rate refers to Object Torque slope 6087h, status moves to Operation enabled.
3	Due to Torque=0, motor is stopped. The status is moved to Operation enabled.

(11) Object 605Eh: Fault Reaction Code
This object defines the deceleration operation when an alarm is detected.

Index	Sub-index	Name	Data type	Access	PDO mapping	Value	EEPROM
605Eh	0	Reaction option code	INT	RW	No	0~2	Yes

Operation mode for PP/PV/HOME/CSP/CSV/IP:

Value	Description	
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Fault.	
1	-	Deceleration rate refers to Profile linear deceleration 6084h, status moves to Fault.
	Home	Deceleration rate refers to Object Home acceleration 609Ah, status moves to Fault.
2	Deceleration rate refers to Quick stop deceleration 6085h, status moves to Fault.	

Operation mode for CST/PT:

Value	Description
0	Deceleration rate refers to parameter PF81(bit28~bit31), status moves to Fault.
1	Deceleration rate refers to Object Torque slope 6087h, status moves to Fault.
2	Deceleration rate refers to Object Torque slope 6087h, status moves to Fault.

4.6. Objects Functions
■ Following error function (PP/CSP)

Object 6065h: Following Error Window
This object defines the detection range for the following error.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6065h	0	Following Error Window	UDINT	RW	No	0~4,294,967,295	Yes

Object 6066h: Following Error Time Out

This object defines the duration time of object 60F4h is exceeded object 6065h.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6066h	0	Following Error Time Out	UINT	RW	No	0~65,535[mS]	Yes

Object 60F4h: Following Error Actual Value

If the position deviation exceeds object 6065h setting value, bit 13 of statusword changes to 1. The position deviation is difference between object 6062h and 6064h.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60F4h	0	Following Error Actual Value	DINT	RO	Yes	-	No

■ Target reached function

Object 6067h: Position Window

This object defines the positioning completed width for the target position

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6067h	0	Position Window	UDINT	RW	No	0~4,294,967,295	Yes

Object 6068h: Position Window time

This object specifies the duration time that object 60F4h is within 6067h setting value.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6068h	0	Position Window time	UINT	RW	No	0~65,535[mS]	Yes

When the Servo Drive has completed outputting the reference to the target position and the time specified in this object has passed after the following error actual value is within the position window (6067h), bit 10 (target reached) in statusword changes to 1.

■ Velocity reached function

Object 606Dh: Velocity Window

This object sets the speed coincidence detection width.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Dh	0	Velocity Window	UINT	RW	No	0~65,535	Yes

Object 606Eh: Velocity Window time

It defines the duration time that Object (60FFh+60B1h-606C) is within Object 606Dh.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Eh	0	Velocity Window time	UINT	RW	No	0~65,535	Yes

■ Speed function (PV)

Object 606Ch: Velocity Actual Value

It gives the feedback of motor speed.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Fh	0	Velocity actual value	DINT	RO	Yes	-	No

Object 606Fh: Velocity Threshold

It defines the detection range of motor speed.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Fh	0	Velocity threshold	UINT	RW	No	0~65,535	Yes

Object 6070h: Velocity Threshold Time

It defines the duration time that the velocity actual value (object 606Ch) is not within the 606Fh settings.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Fh	0	Velocity threshold	UINT	RW	No	0~65,535	Yes

■ Position function

Object 607Ah: Target Position

It denotes the target position.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
607Ah	0	Target position	DINT	RW	Yes	-	No

Object 607Ah: Target Position

It denotes the target position.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
607Ah	0	Target position	DINT	RW	Yes	-	No

Object 6062h: Position Demand Value

This object specifies the current reference position in user position reference units.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6062h	0	Position Demand Value	DINT	RO	Yes	-	No

Object 6063h: Position Actual Internal Value

This object gives the current feedback position in encoder pulse units.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6063h	0	Position actual internal value	DINT	RO	Yes	-	No

Object 6064h: Position Actual Value

This object gives the current feedback position in user position reference units.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6064h	0	Position actual value	DINT	RO	Yes	-	No

Object 60FCh: Position Demand Internal Value

This object indicates an internal position command.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FCh	0	Position demand internal value	DINT	RO	Yes	-	No

■ Velocity function

Object 60FFh: Target Velocity

This object indicates the target velocity.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FFh	0	Target velocity	DINT	RW	Yes	-	No

Object 606Bh: Velocity Demand Value

This object indicates the internal command velocity.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Bh	0	Velocity Demand Value	DINT	RO	Yes	-	No

Object 606Ch: Velocity Actual Value

This object indicates the motor of actual velocity.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
606Ch	0	Velocity Actual Value	DINT	RO	Yes	-	No

Object 607Fh: Max Profile Velocity

This object indicates the maximum speed during a profile mode operation.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
607Fh	0	Max Profile Velocity	DINT	RW	Yes	-	Yes

Object 6080h: Max Motor Velocity

This object indicates the motor max. speed limit.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM

6080h	0	Max Motor Velocity	UDINT	RW	Yes	-	Yes

Object 6081h: Profile Velocity

This object indicates the final movement speed during accelerating process.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6081h	0	Profile Velocity	UDINT	RW	Yes	-	Yes

Object 6083h: Profile Acceleration

This object defines the acceleration rate for profile mode operation.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6083h	0	Profile Acceleration	UDINT	RW	Yes	-	Yes

Object 6084h: Profile Deceleration

This object defines the deceleration rate for profile mode operation.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6084h	0	Profile Deceleration	UDINT	RW	Yes	-	Yes

Object 6085h: Quick Stop Deceleration

This object defines the deceleration rate for the quick stop option code.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6085h	0	Quick stop deceleration	UDINT	RW	Yes	0~4,294,967,295	Yes

Object 60C5: Max Acceleration

This object defines the maximum acceleration rate.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60C5h	0	Max Acceleration	UDINT	RW	Yes	0~4,294,967,295	Yes

Object 60C6h: Max Deceleration

This object defines the maximum deceleration rate.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60C6h	0	Max Deceleration	UDINT	RW	Yes	0~4,294,967,295	Yes

■ Torque function

Object 6071h: Target Torque (unit: 0.1%)

This object defines the input torque value for Torque Control Mode in user-defined reference units.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6071h	0	Target torque	INT	RW	Yes	-32,768~32,767	No

Object 6074h: Torque Demand Value (unit: 0.1%)

This object defines the currently motor output torque value in user-defined reference units.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM

| 6074h | 0 | Torque demand value | INT | RO | Yes | - | No |

Object 6077h: Torque Actual Value (unit: 0.1%)
This object defines the currently motor output torque value.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6077h	0	Torque actual value	INT	RO	Yes	-	No

Object 6072h: Max Torque (unit: 0.1%)
This object defines the maximum motor output torque value.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6072h	0	Max torque	UINT	RW	Yes	-	No

Object 6073h: Max Current (unit: 0.1%)
This object sets the maximum current of motor.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6073h	0	Max current	UINT	RO	No	-	No

Object 6075h: Motor Rated Current (unit: mA)
This object automatically sets the rated current of motor when the drive is power on.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6075h	0	Motor rated current	UINT	RO	No	0~4,294,967,295	No

Object 6076h: Motor Rated Torque (unit: mNm)
This object automatically sets the rated torque of motor when the drive is power on.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6076h	0	Motor rated torque	UINT	RO	Yes	0~4,294,967,295	No

Object 6078h: Current Actual Value (unit: 0.1%)
This object gives the actual current value.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6078h	0	Current Actual Value	INT	RO	Yes	-32,768~32,767	No

Object 6079h: DC Link Circuit Voltage (unit: mV)
This object gives the PN voltage of main circuit power.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6079h	0	DC link circuit voltage	UDINT	RO	Yes	0~4,294,967,295	No

Object 6087h: Torque Slope (unit: 0.1%/sec)
This object specifies the slope to a torque command.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6087h	0	Torque slope	UDINT	RW	Yes	0~4,294,967,295	Yes

■ Command offset function
Object 60B0h: Position Offset

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60B0h	0	Position offset	DINT	RW	Yes	-2,147,483,648 ~2,147,483,647	No

Object 60B1h: Velocity Offset

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60B1h	0	*Velocity offset*	DINT	RW	Yes	-2,147,483,648 ~2,147,483,647	No

Object 60B2h: Torque Offset

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60B2h	0	Torque offset	INT	RW	Yes	-32,768~32,767	No

Object *607Ch: Home Offset*

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
607Ch	0	Home offset	DINT	RW	No	-2,147,483,648 ~2,147,483,647	Yes

■ Homing function
Object 6098h: Homing Method

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6098h	0	Homing method	SINT	RW	No	0~37	Yes

Object 6099h: Homing Speeds

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
	0	Number of entries	USINT	RO	No	2	No
6099h	1	speed during search for switch	UDINT	RW	Yes	0~4,294,967,295	Yes
	2	Speed during search for zero	UDINT	RW	Yes	0~4,294,967,295	Yes

Object 6098h: Homing Acceleration

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
609Ah	0	Homing acceleration	UDINT	RW	Yes	0~4,294,967,295	Yes

Object 60E3h: Supported Homing Method

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60E3h	0	Supported homing method	UINT	RO	No	0~37	No

■ Touch probe function
Object 60B8h: Touch Probe Function

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60B8h	0	Touch probe Function	UINT	RW	Yes	0~0xFFFF	No

Object 60B9h: Touch Probe Status

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60B9h	0	Touch probe Status	UINT	RO	Yes	0~0xFFFF	No

Object 60BAh: Touch Probe 1 Position Pos Value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60BAh	0	Touch probe1 position pos value	DINT	RO	Yes	-	No

Object 60BBh: Touch Probe 1 Position Neg Value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60BBh	0	Touch probe1 position neg value	DINT	RO	Yes	-	No

Object 60BCh: Touch Probe 2 Position Pos Value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60BCh	0	Touch probe 2 position pos value	DINT	RO	Yes	-	No

Object 60BDh: Touch Probe 2 Position Neg Value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60BDh	0	Touch probe 2 position neg value	DINT	RO	Yes	-	No

■ **Digital Inputs Function**

Object 60FDh: Digital Inputs

This object gives the DI status of CN1 on the SDP drive.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FDh	0	Digital inputs	UDINT	RO	Yes	-	No

Object 60FDh bit description

Bit	DI signal	Value	Description
0	LSN_OFF	0	Limit of reverse rotation is not activated.
	LSN_ON	1	Limit of reverse rotation is activated.
1	LSP_OFF	0	Limit of forward rotation is not activated.
	LSP_ON	1	Limit of forward rotation is activated.
2	ORGP_OFF	0	Origin position is not activated.
	ORGP_ON	1	Origin position is activated.
24	INP_OFF	0	In-position ready is not activated.
	INP_ON	1	In-position ready is activated.

■ **Digital Outputs Function**

Object 60FEh: Digital Outputs

This object gives the DI status of CN1 on the SDP drive.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FEh	0	Digital outputs	USINT	RO	No	-	No

Index 60FE-01h: To set the DO option which to be utilized

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FEh	1	Physical outputs	UDINT	RW	Yes		No

Bit description of Physical outputs

										bit of Physical outputs									
19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DO4	DO3	DO2	DO1																MBR

If the corresponded bit is set as 1, it means the assigned DO is enabled.

Index 60FE-02h: To set the DO option which to be utilized

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60FEh	1	Bit mask	UDINT	RW	Yes		No

Bit description of Bit mask

										bit of Bit mask									
19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DO4	DO3	DO2	DO1																MBR

If the corresponded bit is set as 1, it means the assigned DO is activated. For example, if bit0 is set as 1, it means that DO MBR is activated.

■ **Encoder information**
Object 608Fh: Position Encoder Resolution
This object gives the encoder information.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
608Fh	0	Digital outputs	USINT	RO	No	-	No
	1	Encoder increments	UDINT	RO	No		No
	2	Motor revolutions	UDINT	RO	Yes		No

■ **Gear Ratio Function**
Object 608Fh: Position Encoder Resolution
This object defines the gear ratio.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
6091Fh	0	Gear ratio	USINT	RO	No	-	No
	1	Gear ratio numerator	UDINT	RW	Yes		No
	2	Gear ratio denominator	UDINT	RW	Yes		No

It defines the relationship between the rotating speed of motor and shaft after the gearbox output.

$$Gear\ ratio\ = \frac{\text{Gear ratio numerator(6091h\_01h)}}{\text{Gear ratio denominator(6091h\_02h)}}$$

Users could use object 1010h(store parameters) to store the set value of gear ratio into EEPROM.

Object 1010h: Store Parameters

This object recovers to 1 to indicate the completion of EEPROM accessed.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
1010h	0	Store parameters	USINT	RO	No	-	No
	1	Save all parameters	UDINT	RW	No		No
	2	Save communication	UDINT	RW	No		No
	3	Save application parameters	UDINT	RW	No		No
	4	Save manufacturer defined parameters	UDINT	RW	No		No

Object 1011h: Restore Default Parameters

Write 0x64616F6C into object 1011h to recover the modified objects to the defaults then it would recover to 1 to indicate the accessed completion.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
1011h	0	Default Parameters	USINT	RO	No	-	No
	1	Restore all default	UDINT	RW	No		No
	2	Restore communication default parameters	UDINT	RW	No		No
	3	Restore application default parameters	UDINT	RW	No		No
	4	Restore manufacturer default parameters	UDINT	RW	No		No

Object 60F2h: Position option code

This object is an additional option to determine the operational specifications for positioning operation in PP mode.

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60F2h	0	Position option code	UDINT	RW	Yes	-	Yes

Data value descriptions

Value	Bit 1	Bit 0	Relative mode	Description
0	0	0	Mode 0	Related to the Target Position (Object 607Ah)
1	0	1	Mode 1	Related to the Position Demand Value (Object 6062h)
2	1	0	Mode 2	Related to the Position Actual Value (Object 6064h)

Object 10F3h: Diagnosis History

This object gives the Drive alarm history.

Index	Sub-index	Name	Data type	Access	PDO mapping	EEPROM
10F3h	00h	Number of entries	USINT	RO	No	No
	01h	Maximum messages	USINT	RO	No	No
	02h	Newest message	USINT	RO	No	No
	03h	Newest acknowledged message	USINT	RW	No	No
	04h	Newest message available	USINT	RO	No	No
	05h	Flags	UINT	RW	No	Yes
	06h	*Diagnosis message1*	STRING	RO	No	No
	07h	*Diagnosis message2*	STRING	RO	No	No
	08h	*Diagnosis message3*	STRING	RO	No	No
	09h	*Diagnosis message4*	STRING	RO	No	No
	0Ah	*Diagnosis message5*	STRING	RO	No	No
	0Bh	*Diagnosis message6*	STRING	RO	No	No
	0Ch	*Diagnosis message7*	STRING	RO	No	No
	0Dh	*Diagnosis message8*	STRING	RO	No	No
	0Eh	*Diagnosis message9*	STRING	RO	No	No
	0Fh	*Diagnosis message10*	STRING	RO	No	No
	10h	*Diagnosis message11*	STRING	RO	No	No
	11h	*Diagnosis message12*	STRING	RO	No	No
	12h	*Diagnosis message13*	STRING	RO	No	No
	13h	*Diagnosis message14*	STRING	RO	No	No

Users could read this object 10F3h value to know the abnormal records of drive. The sequence of alarm records is described below.

There are 6 alarms occurred

02h	0Bh
	~
06h	The 5th alarm past
07h	The 4th alarm past
08h	The 3rd alarm past
09h	The 2nd alarm past
0Ah	The last alarm
0Bh	The current alarm
0Ch	0
0Dh	0
0Eh	0
0Fh	0
10h	0
11h	0
12h	0
13h	0

There are 14 alarms occurred

02h	0Bh
	~
06h	The 13th alarm past
07h	The 12th alarm past
08h	The 11th alarm past
09h	The 10th alarm past
0Ah	The 9th alarm past
0Bh	The 8th alarm past
0Ch	The 7th alarm past
0Dh	The 6th alarm past
0Eh	The 5th alarm past
0Fh	The 4th alarm past
10h	The 3rd alarm past
11h	The 2nd alarm past
12h	The last alarm
13h	The current alarm

Object 60E0h: Positive torque limit value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60E0h	0	Positive torque limit value	UDINT	RW	Yes	-	Yes

Object 60E1h: Negative torque limit value

Index	Subindex	Name	Data type	Access	PDO mapping	Value	EEPROM
60E1h	0	Negative torque limit value	UDINT	RW	Yes	-	Yes

■ Other Objects list (partial objects are not supported)

Index	Sub-index	Name	Data type	Access	PDO mapping	EEPROM
6007h	0	Abort connection option code	INT	RW	No	Yes
6069h	0	Velocity sensor actual value	DINT	RO	Yes	No
606Ah	0	Sensor selection code	INT	RO	Yes	No
607Bh	0	Position range limit	USINT	RO	No	No
607Eh	0	Polarity	USINT	RW	No	Yes
6082h	0	End Velocity	UDINT	RW	Yes	Yes
6086h	0	Motor profile type	INT	RW	Yes	Yes
6088h	0	Torque profile type	INT	RW	Yes	Yes
6092h	0	Feed constant	USINT	RO	No	No
60A3h	0	Profile jerk use	USINT	RW	No	Yes
60A4h	0	Profile jerk	INT	RO	No	No
60C4h	0	Interpolation data configuration	USINT	RO	No	No
60FAh	0	Control effort	DINT	RO	Yes	No

■ Drive Parameters and EtherCAT Objects Comparison table

Index	Object	Parameter	Abbr.	Description

2001h		PA01	STY	Control mode option
2002h		PA02	ATUM	Gain tuning mode option
2003		PA03	ATUL	Auto-tuning response level setting
~		~	~-	~
200Bh		PA11	RES2	Regenerated resistor capacity
~		~	~	~
2010h		PA16	CRSHT	Motor crash protection (time)
~		~	~	~
2030h		PA48	TLN	Negative torque limit value
2101h		PB01	NHF1	Machine resonance suppression filter 1
~		~	~	~
2130h		PB48	NHD5	Machine resonance suppression attenuation 5
2201h	VAR	PC01	STA	Acceleration time constant
~		~	~	~
2260h		PC96	TBS	E-CAM curve scaling
2301h		PD01	DIA1	Digital input signal auto-ON option 1
~		~	~	~
2321h		PD33	SFDO	Software DO setting
2401h		PE01	ODEF	Origin return definition
~		~	~	~
2462h		PE98	PDAT48	PATH#48 data
2501h		PF01	PDEF49	PATH#49 data
~		~	~	~
255Ah		PF90	BLST	Backlash compensation time constant

4.7. Synchronous Communication Mode

The synchronization of EtherCAT communications is based on a mechanism called a distributed clock.
With the distributed clock, all devices are synchronized with each other by sharing the same reference

clock. The SDP series affords 2 synchronous modes: DC Synchronous and Free Run. The attributes of these 2 modes are defined in the ESI profile, mode option and period time setting are included.

■ DC Synchronous mode

In order to synchronize the communication time between the host and the slaves, it is necessary to consider the offset and delay time between the slaves. The host has would calculate the propagation delay and write it to the corresponding slave's register, then correct the communication time of individual slave. Finally, there is a consistent cycle time between slaves
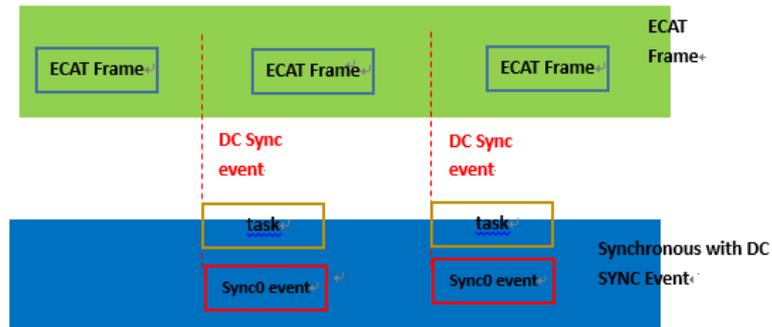
■ Free Run mode

The time between the host and the slaves is not synchronized, and all have their own individual clock to calculate time. The reception and transmission command between the host and slaves is sequential exchange, there is not accurate synchronization.
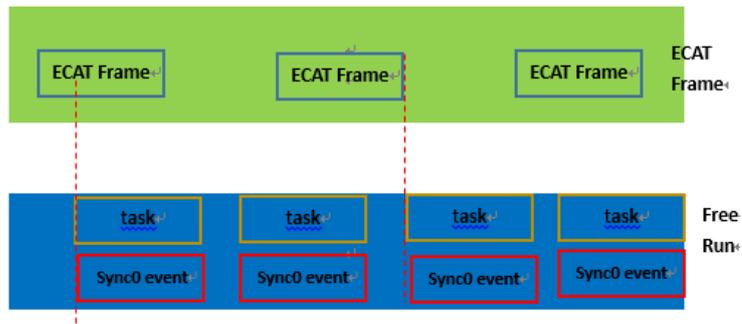
5. CANopen Drive Profile

5.1. Profile Position Mode

The profile position mode is used to locate to the target position with inputting the profile velocity and the profile acceleration.
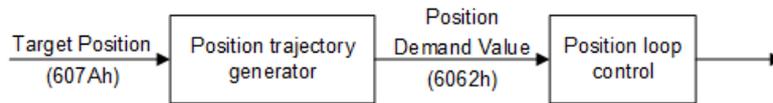
5.1.1. Operation step

1. Set object 6060h(Mode of operation) as 0x01.
2. Set object 607Ah(Target position) a destination in pulse unit.
3. Set object 6081h(Profile velocity) to define the profile velocity in pulse per second unit.(pulse/s).
4. Define the acceleration: and deceleration by setting the object 6083h and 6084h.(pulse/s^2)
5. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is activated. When the transient state from 0x0F to 0x1F is done, it triggers the position mode.
6. Use the object 6067h(Position window) setting value to define the allowable tolerance of in position. Besides, set the object 6068h(Position window time) to duration time that the final location remains in the position window range. The above conditions are completed, it means that "Target Reached".
7. Object 6065h(Following error window) defines the detection range for the following error. Object 6068h is used to specify the duration time that the final position remains in the following error window setting range.

5.1.2. Controlword and Statusword bit settings

■ Controlword bit description (Bit 4~6)

| Bit	Name	Value	Description
4	New set-point	0	Target position(607Ah) is not yet imported.
		1	Imports the Target position.(607Ah)
5	Change set immediately	0	After the current position operation is completed, the next one starts.
		1	Suspends the current position operation and run the next one at once.
6	Absolute/relative	0	Treats the Target position(607Ah) as an absolute position.
		1	Treats the Target position(607Ah) as a relative position.

■ Statusword bit description (Bit 4~6)

Bit	Name	Value	Description
10	Target reached	0	The target position has not been reached.
		1	The target position was reached.
13	Following error	0	No following error has occurred.
		1	A following error occurred.

5.1.3. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	–	–
6062h	0	Position Demand Value	DINT	RO	Pos.unit	-	-	-
6064h	0	Position Actual Value	DINT	RO	Pos.unit	-	-	-
6065h	0	Following Error Window	UDINT	RW	Pos.unit	5242880	0	1073741823
6066h	0	Following Error Time Out	UINT	RW	ms	0	0	65535
6067h	0	Position Window	UDINT	RW	Pos.unit	30	0	1073741823
6068h	0	Position Window Time	UINT	RW	ms	0	0	65535
606Ch	0	Velocity Actual Value	DINT	RO	Vel.unit	-	-	-
6072h	0	Max. Torque	UINT	RW	0.1%	*1	0	65535
607Ah	0	Target Position	DINT	RW	Pos.unit	0	-2147483648	2147483647
607Dh		Velocity Offset						
	0	Number of entries	USINT	RO	-	2	-	-
	1	Min. position limit	DINT	RW	Pos.unit	0	-2147483648	2147483647
	2	Max. position limit	DINT	RW	Pos.unit	0	-2147483648	2147483647
6081h	0	Profile Velocity	UDINT	RW	Vel.unit	0	0	4294967295
6083h	0	Profile Acceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6084h	0	Profile Deceleration	UDINT	RW	Acc.Unit	10000000	0	4294967295
60F4h	0	Following Error Actual Value	DINT	RO	Pos.unit	-	-	-
60FCh	0	Position Demand Internal Value	DINT	RO	Inc	–	–	–

*1. The default value of object 6072h is the corresponding motor maximum torque.

5.2. Interpolation Position Mode

In this mode, every command from the host needs to include an interpolation data for the next position value. During the interpolation position execution period, the drive uses the interpolation data to compute the demand destination.

5.2.1. Operation step

1. Set object 6060h(Mode of operation) as 0x07.
2. Use the default of object 60C0Ah(Interpolation sub mode select) to run a linear interpolated.
3. Use object 60C2h(Interpolation time period) to define the execution period which is same as the synchronous period of SYNC0 signal.

   602Ch Sub_1: Interpolation time period is between 1 and 250.

   602Ch Sub_2: Interpolation time index has a default "-3", it means a 10^{-3} second unit.(mS)

5.2.2. Controlword and Statusword bit settings

■ Controlword bit description (Bit 4,8)

Bit	Name	Value	Description
4	Enable IP mode	0	Interpolation mode enabled
		1	Interpolation mode disabled
8	Halt	0	The position command is executed.
		1	The position command is temporarily stopped..

■ Statusword bit description (Bit 10, 12)

Bit	Name	Value	Description
10	Target reached	0	The target position has not been reached.
		1	The target position was reached.
12	IP mode active	0	Interpolation mode disabled
		1	Interpolation mode enabled

5.2.3. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	–	–
60C0h	0	Interpolation sub mode	INT	RW	-	0	-3	0

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
60C1h		Interpolation Data Record						
	0	Number of entries	USINT	RO	-	1	-	-
	1	Interpolation data record	DINT	RW	Pos.unit	0	-2147483648	-2147483648
60C2h		Interpolation Time Period						
	0	Highest sub-index supported	USINT	RO	-	2	-	-
	1	Interpolation time period	USINT	RW	-	1	1	250
	2	Interpolation time index	SINT	RW	-	-3	-6	-3
60C4h		Interpolation data configuration						
	0	Highest sub-index supported	USINT	RO	-	6	-	-
	1	Maximum buffer size	UDINT	RW	-	0	0	4294967295
	2	Actual buffer size	UDINT	RW	-	0	0	4294967295
	3	Buffer organization	USINT	RW	-	0	0	1
	4	Buffer position	UINT	RW	-	0	0	32767
	5	Size of data record	USINT	RO	-	1	1	254
	6	Buffer clear	USINT	RO	-	0	0	1

5.3. Cyclic Synchronous Position Mode

In this mode, users could only set the target position. The internal programing function would send the synchronous position command to the slave periodically.

5.3.1. Operation step

1. Set object 6060h(Mode of operation) as 0x08 and write object 607Ah(Target position) a target position in pulse unit.
2. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is activated to run the positioning mode.

5.3.2. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min,	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	-	-
607Ah	0	Target Position	DINT	RW	Pos.unit	0	-2147483648	2147483647
607Dh		Software Position Limit						
	0	Number of entries	USINT	RO	-	2	-	-
	1	Min. position limit	DINT	RW	Pos.unit	0	-2147483648	2147483647
	2	Max. position limit	DINT	RW	Pos.unit	0	-2147483648	2147483647
6083h	0	Profile Acceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6084h	0	Profile Deceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6085h	0	Quick Stop Deceleration	UDINT	RW	Acc.unit	4000000000	0	4294967295
60B0h	0	Position Offset	DINT	RW	Pos.unit	0	-2147483648	2147483647
60B1h	0	Velocity Offset	DINT	RW	Vel.unit	0	-2147483648	2147483647
60B2h	0	Torque Offset	INT	RW	0.1%	0	-32768	32767

5.4. Homing Mode

This mode is used to return home position with the speed, acceleration and deceleration assigned.

5.4.1. Operation step

1. Set object 6060h(Mode of operation) as 0x06. Then set object 6099h Sub_1 to define the homing speed for switch and set 6099h Sub_2 to define the homing speed for origin. (unit: pulse/S)
2. Set object 609Ah (Homing acceleration) to define the homing acceleration. (unit: pulse/S^2)
3. Choose the homing method by setting object 6098h. (range: 1~37)
4. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is activated. When the transient state from 0x0F to 0x1F is done, it triggers the homing mode.

5.4.2. Controlword and Statusword bit setting

■ Controlword bit description (Bit 4,8)

Bit	Name	Value	Description
4	Homing operation start	0	Homing mode disabled
		1	Homing mode enabled
8	Halt	0	The position command is executed.
		1	The position command is temporarily stopped..

■ Statusword bit description (Bit 10, 12, 13)

Bit 13	Bit 12	Bit 10	
Homing error	Homing attained	Target reached	Description
0	0	0	Homing is in progress.
0	0	1	Homing was interrupted or has not yet started
0	1	0	Home has been defined, but the operation is still in progress.
0	1	1	Homing was completed normally.
1	0	0	Homing error occurred and motor still runs.
1	0	1	Homing error occurred and motor stops.

5.4.3. Related object list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW	–	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	–	–	–	–
6060h	0	Modes of Operation	SINT	RW	–	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	–	0	–	–
607Ch	0	Home Offset	DINT	RW	Pos. unit	0	-2147483648	2147483647
6098h	0	Homing Method	SINT	RW	–	35	0	37
6099h		Quick Stop Deceleration						
	0	Number of entries	USINT	RO	–	2	–	–
	1	Speed during search for switch	UDINT	RW	Vel.	500000	0	4294967295
	2	Speed during search for zero	UDINT	RW	Vel. Unit	100000	0	4294967295
609Ah	0	Homing Acceleration	UDINT	RW	Acc. unit	10000000	0	4294967295

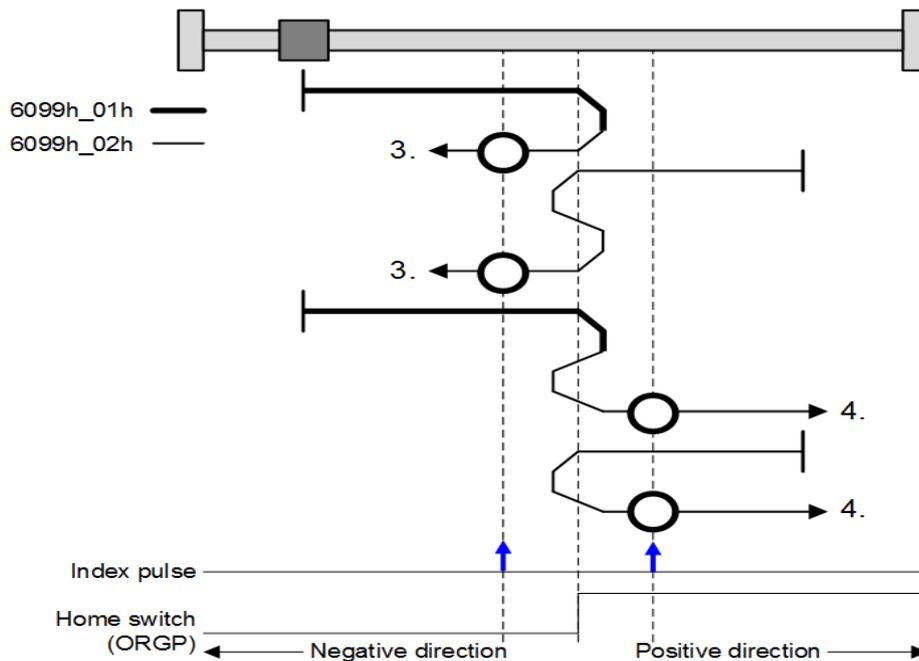## 5.4.4. Homing method detail description (Object: 6098h)

Homing method	Description
Method 1	Home return starts in the negative direction, the negative limit switch activated to reverse then find the first Z-phase pulse to be as the origin.
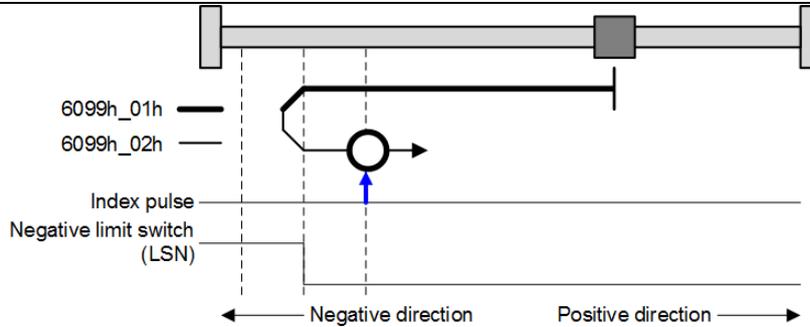
Homing method	Description
Method 2	Home return starts in the positive direction, the positive limit switch activated to reverse then find the first Z-phase pulse to be as the origin.
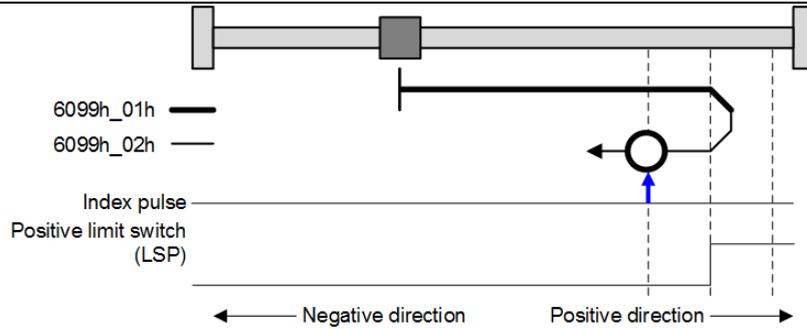
Homing method	Description
Method 3	Home return starts in the positive direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.
Method 4	Home return starts in the positive direction, the ORGP rising edge activated to reverse then find the first Z-phase pulse to be as the origin where the ORGP is activated.

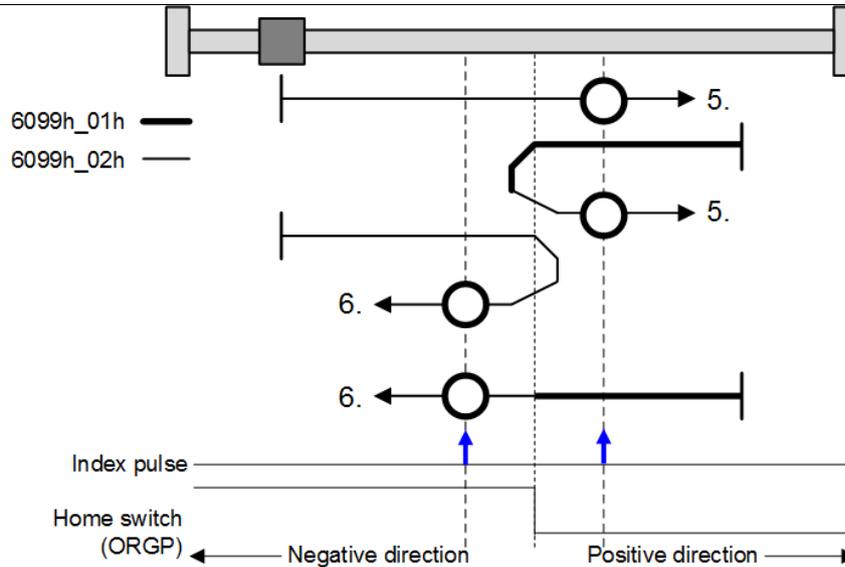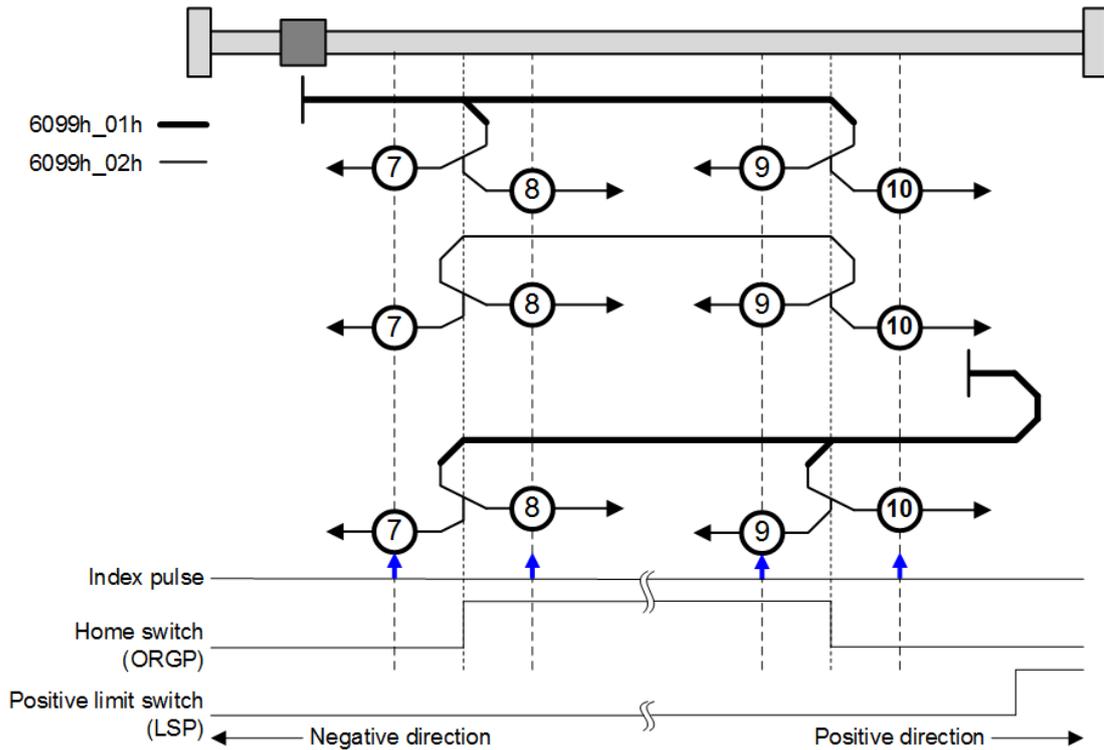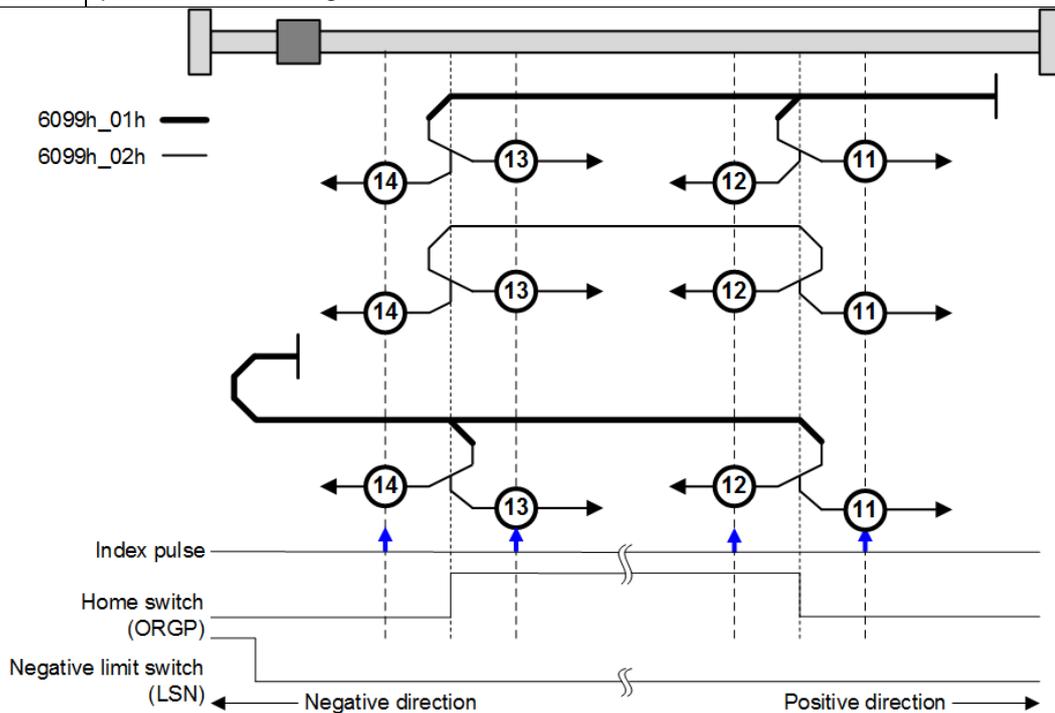| Homing method	Description
Method 5	Home return starts in the negative direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.
Method 6	Home return starts in the negative direction, the ORGP rising edge activated to reverse then find the first Z-phase pulse to be as the origin where the ORGP is activated.

Homing method	Description
Method 7	Home return starts in the positive direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.
Method 8	Home return starts in the positive direction, the ORGP rising edge activated to find the first Z-phase pulse to be as the origin where the ORGP is activated.
Method 9	Home return starts in the positive direction, the ORGP rising edge activated to find the first Z-phase pulse to be as the origin where the ORGP is activated.
Method 10	Home return starts in the positive direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.

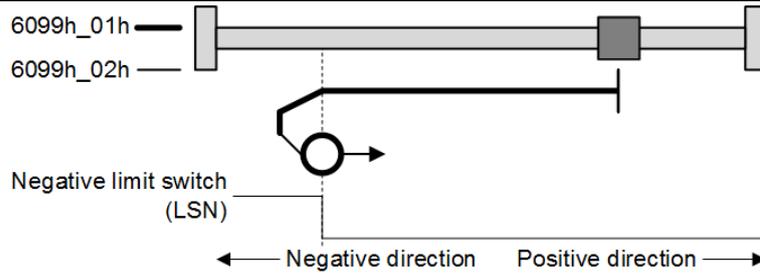| Homing method	Description
Method 11	Home return starts in the negative direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.
Method 12	Home return starts in the negative direction, the ORGP rising edge activated to find the first Z-phase pulse to be as the origin where the ORGP is activated.
Method 13	Home return starts in the negative direction, the ORGP rising edge activated to find the first Z-phase pulse to be as the origin where the ORGP is activated.
Method 14	Home return starts in the negative direction, the ORGP falling edge activated to find the first Z-phase pulse to be as the origin where the ORGP is inactivated.

Homing method	Description

Method 17	Home return starts in the negative direction, the LSN falling edge activated point to be as the origin.

Homing method	Description
Method 18	Home return starts in the positive direction, the LSP falling edge activated point to be as the origin.
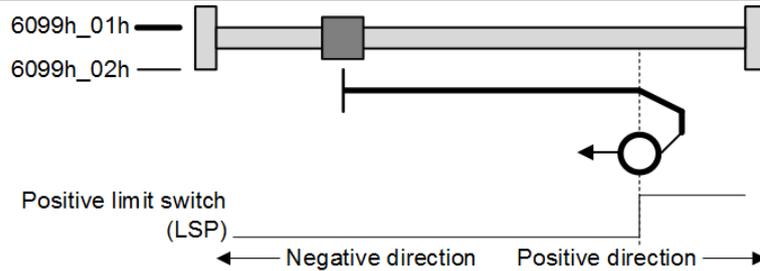
Homing method	Description
Method 19	Home return starts in the positive direction, the ORGP falling edge activated point to be as the origin.
Method 20	Home return starts in the positive direction, the ORGP rising edge activated point to be as the origin.
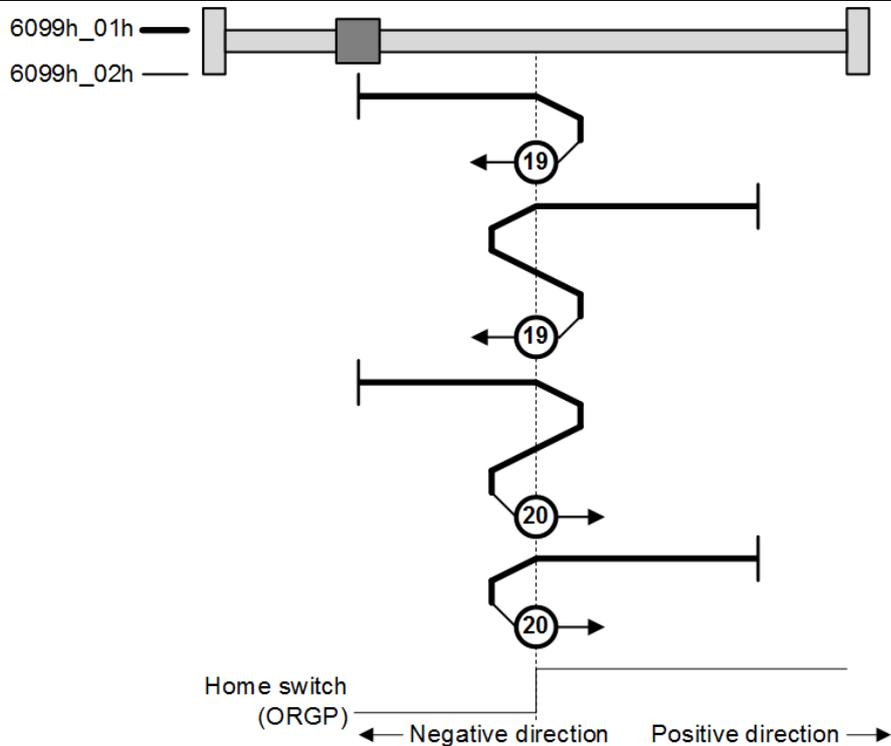
Homing method	Description

Method 21	Home return starts in the negative direction, the ORGP falling edge activated point to be as the origin.
Method 22	Home return starts in the negative direction, the ORGP rising edge activated point to be as the origin.
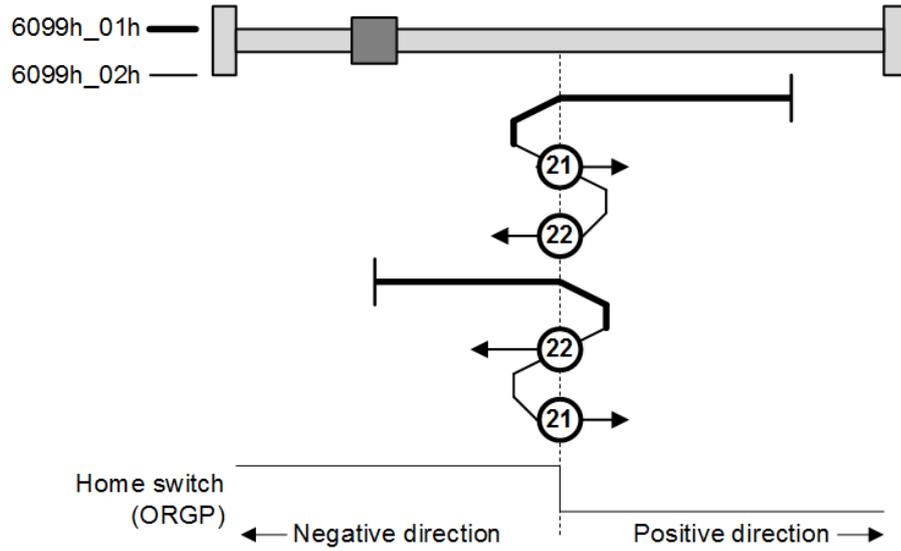
Homing method	Description
Method 23	Home return starts in the positive direction, the ORGP falling edge activated point to be as the origin.
Method 26	Home return starts in the positive direction, the ORGP falling edge activated point to be as the origin.
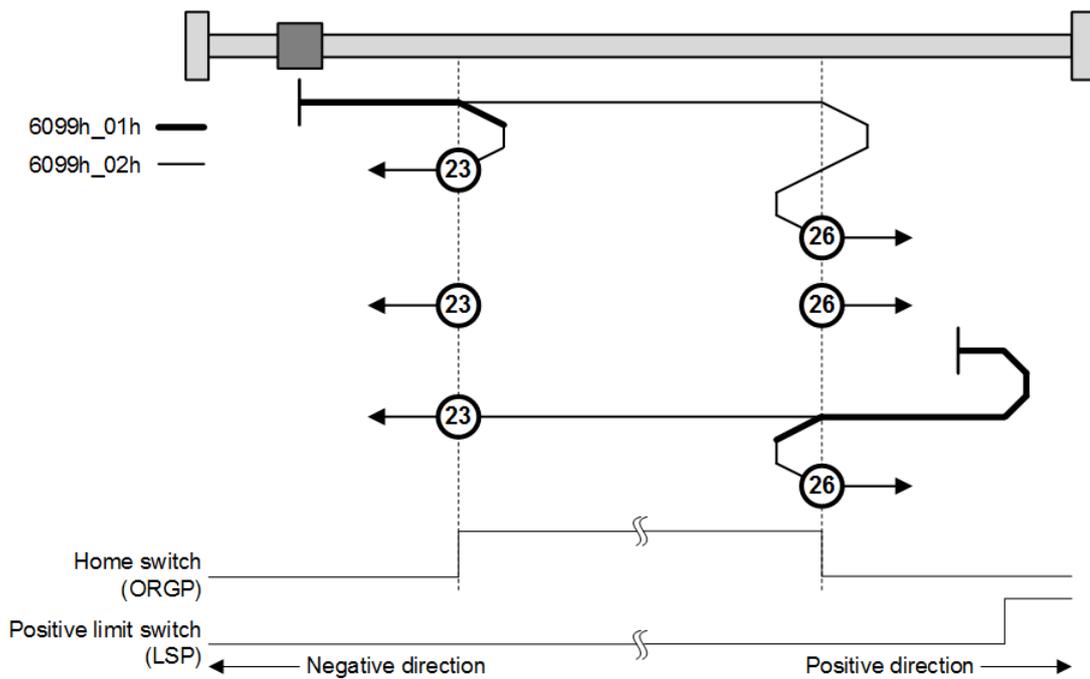
Homing method	Description
Method 27	Home return starts in the negative direction, the ORGP rising edge activated point to be as the origin.

Method 30	Home return starts in the positive direction, the ORGP rising edge activated point to be as the origin.
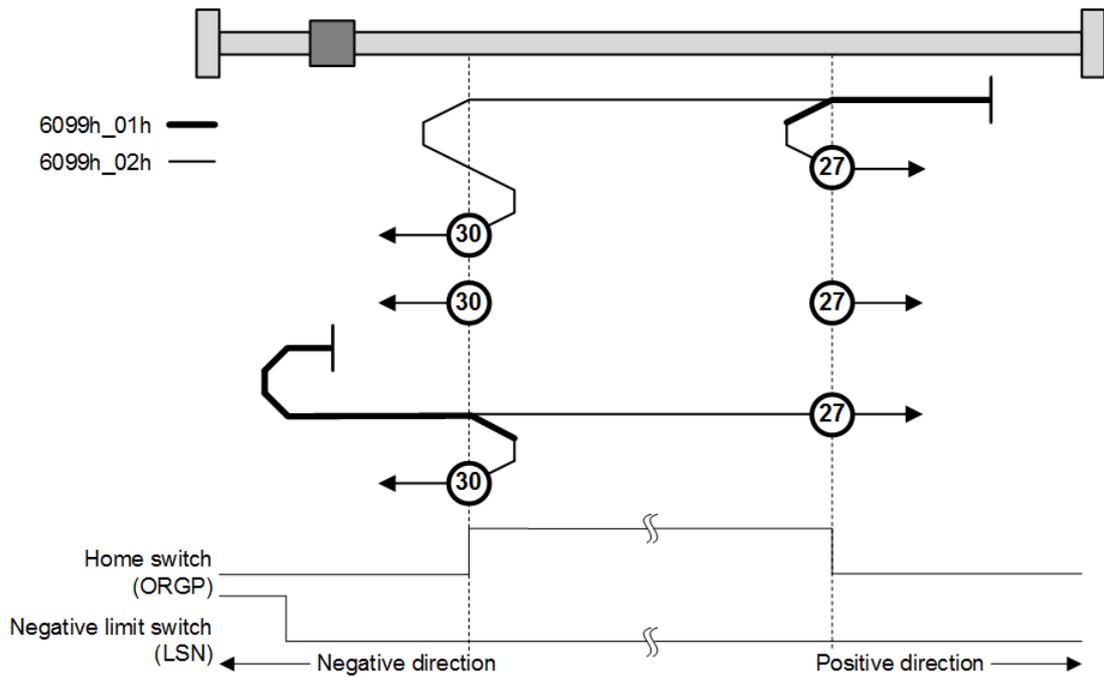
Homing method	Description
Method 33	Home return starts in the negative direction, finds the first Z-phase pulse to be as the origin.
Method 34	Home return starts in the positive direction, finds the first Z-phase pulse to be as the origin.
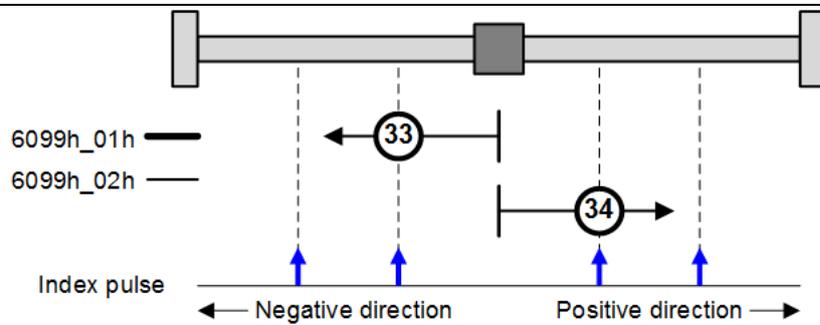
Homing method	Description
Method 35	In this Homing method, the present position is considered to be as the origin.
Method 37	In this Homing method, the present position is considered to be as the origin.
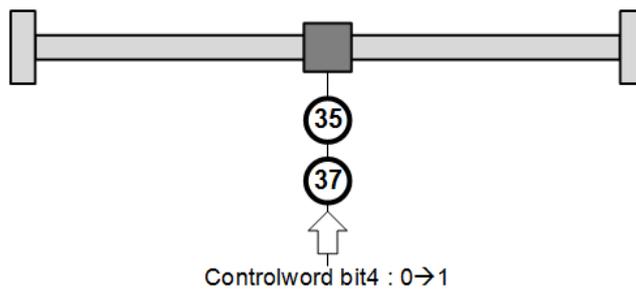
5.5. Profile Velocity Mode

This mode is used to set the target speed, acceleration, deceleration to archive the velocity profile.

5.5.1. Operation step

1. Set object 6060h(Mode of operation) as 0x03.
2. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is ready to run.
3. Set object 6083h(Profile acceleration) and object 6084h(Profile deceleration).(unit: pulse/S^2)
4. Set object 60C5h(Max acceleration) and object 60C6h(Max deceleration).(unit: pulse/S2)
5. Set object 60FFh(Target velocity)

5.5.2. Statusword bit description

Bit	Name	Value	Description
10	Target reached	0	The target speed has not been reached.
		1	The target speed was reached.
12	Speed	0	Speed is not zero.
		1	Speed is not zero.

5.5.3. Related object list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF

6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	-	-
606Bh	0	Velocity Demand Value	DINT	RO	Vel.unit	-	-	-
606Ch	0	Velocity Actual Value	DINT	RO	Vel.unit	-	-	-
606Dh	0	Velocity Window	UINT	RW	Vel.unit	20000	0	65535
606Eh	0	Velocity Window Time	UINT	RW	ms	0	0	65535
607Fh	0	Max. Profile Velocity	UDINT	RW	Vel.unit	2147483647	0	4294967295
6081h	0	Profile Velocity	UDINT	RW	Vel.unit	0	0	4294967295
6083h	0	Profile Acceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6084h	0	Profile Deceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6085h	0	Quick Stop Deceleration	UDINT	RW	Acc.unit	4000000000	0	4294967295
60FFh	0	Target Velocity	DINT	RW	Vel.unit	0	-2147483648	2147483647

5.6. Cyclic Synchronous Velocity Mode

Users just set the target speed. The synchronous speed command would send to the slave periodically.

5.6.1. Operation step

1. Set object 6060h as 0x09 and write object 60FFh(Target velocity) a target speed.(unit: pulse/S)
2. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is activated to run the speed mode.

5.6.2. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW		0	0	0xFFFF

6041h	0	Statusword	UINT	RO				
6060h	0	Modes of Operation	SINT	RW		0	-128	128
6061h	0	Modes of Operation Display	SINT	RO		0		
606Bh	0	Velocity Demand Value	DINT	RO	Vel.unit			
606Ch	0	Velocity Actual Value	DINT	RO	Vel.unit			
606Dh	0	Velocity Window	UINT	RW	Vel.unit	20000	0	65535
606Eh	0	Velocity Window Time	UINT	RW	ms	0	0	65535
6083h	0	Profile Acceleration	UDINT	RW	Acc.unit	10000000	0	4294967295
6084h	0	Profile Deceleration	UDINT	RW	Acc.Unit	10000000	0	4294967295
6085h	0	Quick Stop Deceleration	UDINT	RW	Acc.unit	4000000000	0	4294967295
60B1h	0	Velocity Offset	DINT	RW	Vel.unit	0	-2147483648	2147483647
60B2h	0	Torque Offset	INT	RW	0.1%	0	-32768	32767
60FFh	0	Target Velocity	DINT	RW	Vel.unit	0	-2147483648	2147483647

5.7. Profile Torque Mode

This mode is used to run a torque output required with setting the motor speed.

5.7.1. Operation step

1. Set object 6060h (Mode of operation) as 0x04.
2. Set object 6071h (Target torque) to define torque generated desired.
3. Set object 6087h (Torque slope) to adjust the torque generated slope. (unit: 0.1%)
4. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is ready to perform.

5.7.2. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	-	-
6071h	0	Target Torque	INT	RW	0.1%	0	-32768	32767
6072h	0	Max. Torque	UINT	RW	0.1%	*1	0	65535
6074h	0	Torque Demand Value	INT	RO	0.1%	-	-	-
6075h	0	Motor rated current	UDINT	RO	mA	-	-	-
6077h	0	Torque Actual Value	INT	RO	0.1%	-	-	-
6078h	0	Current Actual Value	INT	RO	0.1%	-	-	-
6085h	0	Quick Stop Deceleration	UDINT	RW	Acc.unit	4000000000	0	4294967295
6087h	0	Torque Slope	UDINT	RW	0.1%/S	1000	0	4294967295

*1. The default value of object 6072h is the corresponding motor maximum torque.

5.8. Cyclic Synchronous Torque Mode

Users just set the target torque. The synchronous torque command would send to the slave periodically.

5.8.1. Operation step

1. Set object 6060h as 0x10 and write object 6071h(Target torque) a target torque. The object 6080h (Max motor speed) is the speed limit for torque generated output.
2. Modify the Controlword(6040h) from 0x06 to 0x07, then to 0x0F. So that, the Servo On state of drive is activated to run the torque mode.

5.8.2. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	-	-
6064h	0	Position Actual Value	DINT	RO	Pos.unit	-	-	-
606Ch	0	Velocity Actual Value	DINT	RO	Vel.unit	-	-	-
6071h	0	Target Torque	INT	RW	0.1%	0	-32768	32767
6072h	0	Max. Torque	UINT	RW	0.1%	*1	0	65535
6077h	0	Torque Actual Value	INT	RO	0.1%	-	-	-
6087h	0	Torque Slope	UDINT	RW	0.1%/S	1000	0	4294967295
60B2h	0	Torque Offset	INT	RW	0.1%	0	-32768	32767

5.9. Touch Probe Function

This function selects a DI trigger source EXT1/EXT2 or z-phase signal then latch the position actual value. EXT1/EXT2 function could be assigned if the set value of corresponding DI is 0x29 or 0x2A.

5.9.1. Operation step

Set object 60B8h(Touch probe function) to configure the object 60B9h(Touch probe status) for various monitoring items. The position information latched would be stored in object 60BAh (Touch probe pos1 pos value), object 60BBh (Touch probe pos1 neg value), object 60BCh (Touch probe pos2 pos value), object 60BDh (Touch probe pos2 neg value).

■ **Object 60B8 bit description (Touch probe function)**

Bit	Value	Description
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	Continuous
2	0	Trigger with touch probe 1 input
	1	Trigger with zero impulse signal of encoder

Bit	Value	Description
3	-	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6	-	Reserved
7	-	Reserved
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continuous
10	0	Trigger with touch probe 2 input
	1	Trigger with zero impulse signal of encoder
11	-	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14	-	Reserved
15	-	Reserved

■ **Object 60B9 bit description** (Touch probe status)

Bit	Value	Description
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 has no positive edge value stored
	1	Touch probe 1 has positive edge value stored
2	0	Touch probe 1 has no negative edge value stored
	1	Touch probe 1 has negative edge value stored
3~7	-	Reserved
8	0	Touch probe 2 is switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 has no positive edge value stored
	1	Touch probe 2 has positive edge value stored
10	0	Touch probe 2 has no negative edge value stored
	1	Touch probe 2 has negative edge value stored
11~15	-	Reserved

5.9.2. Related objects list

Index	Sub-index	Name	Data type	Access	Unit	Default	Min.	Max.
6040h	0	Controlword	UINT	RW	-	0	0	0xFFFF
6041h	0	Statusword	UINT	RO	-	-	-	-
6060h	0	Modes of Operation	SINT	RW	-	0	-128	128
6061h	0	Modes of Operation Display	SINT	RO	-	0	–	–
60B8h	0	Touch Probe Function	UINT	RW	-	0	0	0xFFFF
60B9h	0	Touch Probe Status	UINT	RO	-	-	-	-
60BAh	0	Touch Probe 1 position pos Value	DINT	RO	Pos.unit	-	-	-
60BBh	0	Touch Probe 1 position neg Value	DINT	RO	Pos.unit	-	-	-
60BCh	0	Touch Probe 2 position pos Value	DINT	RO	Pos.unit	-	-	-
60BDh	0	Touch Probe 2 position neg Value	DINT	RO	Pos.unit	-	-	-

6. STO Function

6.1. Introduction

SDP series servo drive affords the stop torque output function to reduce the risk associated with using the machine by protecting workers from the hazards of moving machine parts.

6.1.1. STO terms instruction

STO means to cut off the power supply to the servo motor and stop the torque output.

The purpose of this safety functions is as follows.

(1) Compliance with IEC/EN 60204-1 Type 0 non-control stopped.

(2) To prevent accidental restart.

6.1.2. Precautions for STO function

⚠ CAUTION	◆ Read and understand instructions below to prevent injury or product damaged. ◆ Installation, operation, repairmen and adjusting must be performed only by

	qualified engineers.
◆	Only personnel well known at the related official laws to execute this directive.
◆	Improper installation can not only fail to operate the machine normally, but may also cause major accidents or fatal accidents.

SDP series servo drive supplying power to the servo motor implements the STO function described in IEC/EN 61800-5-2 with non-control stopped. When the STO function is activated, it is necessary to equip with the mechanical brake or balance block to prevent motor rotating.

6.1.3. Residual risks of STO function

We Sharp & Engineering Corp. company is not liable for any injuries or damages caused by residual risks described below.

(1) STO function could not prevent exposure to electric shock.

(2) STO function does not guarantee the stop control or deceleration control of servo motor.

(3) Any device used in this safety function circuit should meet the safety specification or standards.

(4) STO function could not prevent the rotation of motor shaft due to the external force or factors.

(5) STO function could not be ensured until the safety related circuits have been installed.

(6) To prevent from malfunction of STO circuit, at least, an annual check is necessary.

(7) Perform all risk assessments to the machine or whole system.

(8) Supply the power for STO1 and STO2 in the same power source. Otherwise, the safety function may not be operated normally due to a sneak current.

(9) Use the safety extra low voltage(SELV) with reinforced insulation for the STO I/O signals.

(10) For proper installation, wiring, and adjustment, thoroughly read the manual related safety parts.

6.1.4. Specification

(1) STO function diagram
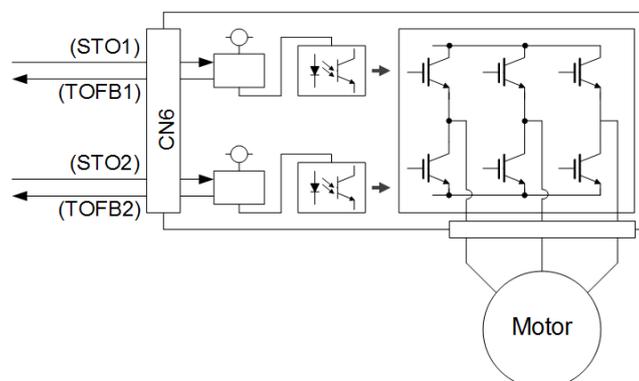
(2) STO Timing sequence
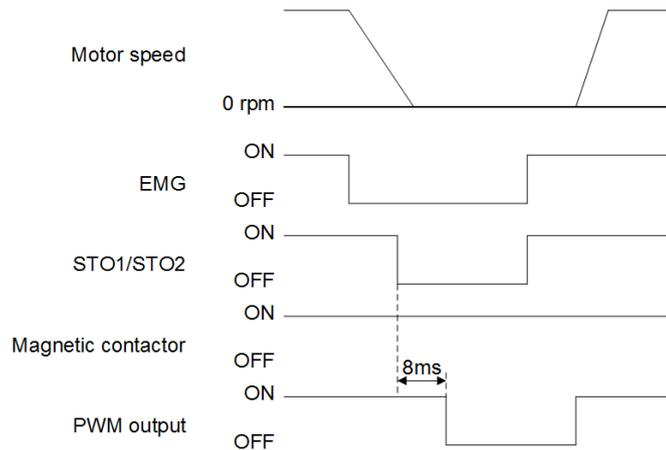
(3) STO Wiring
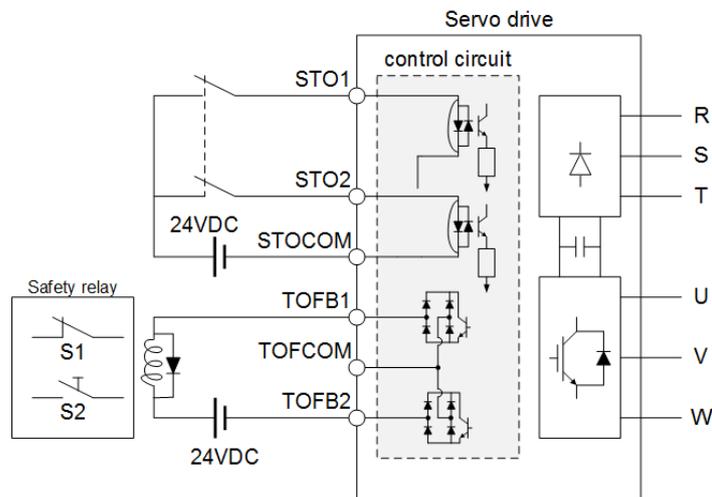
S1**:** STO shut-off switch

S2**:** STO release switch

Note**:** To enable the STO function of the servo drive by using "Emergency stop ", change S1 to EMG. The stop category at this time is "0". If STO is turned off while the servo drive is running, AL. 35 would occur.

6.2. STO Signal Description

■ **I/O signal**

Pin No.	Name	Description
CN6-3	STOCOM	The ground of STO1, STO2, TOFB1 and TOFB2.
CN6-4	STO1	STO1 state**:** STO1 enabled (PWM OFF)：STO1 and STOCOM are open-circuit. STO1 disabled (PWM ON)：STO1 and STOCOM are short-circuit. Not to recover STO1until the Servo OFF or EMG signal is activated.

CN6-5	STO2	STO2 state**:** STO2 enabled (PWM OFF)：STO2 and STOCOM are open-circuit. STO2 disable　(PWM ON)：STO2 and STOCOM are short-circuit. Not to recover STO2until the Servo OFF or EMG signal is activated.
CN6-8	TOFCOM	The ground of TOFB1 and TOFB2.
CN6-6	TOFB1	TOFB1 state**:** STO1 enabled (PWM OFF)：TOFB1 and TOFCOM are open-circuit. STO1 disabled (PWM ON)：TOFB1 and TOFCOM are short-circuit.
CN6-7	TOFB2	TOFB1 state: STO2 enabled (PWM OFF)：TOFB2 and TOFCOM are open-circuit. STO2 disabled (PWM ON)：TOFB2 and TOFCOM are short-circuit.

■ **I/O signal state summary list**

Input		Output					
STO1	STO2	STO1 state	TOFB1-TOFCOM	STO2 state	TOFB2-TOFCOM	Drive STO state	TOFB1-TOFB2
OFF	OFF	Enabled	OFF	Enabled	OFF	Enabled	OFF
OFF	ON	Enabled	OFF	Disabled	ON	Enabled	OFF
ON	OFF	Disabled	ON	Enabled	OFF	Enabled	OFF
ON	ON	Disabled	ON	Disabled	ON	Disabled	ON

■ **STO input signal test pulse**

The test pulse off time is 1ms or less.
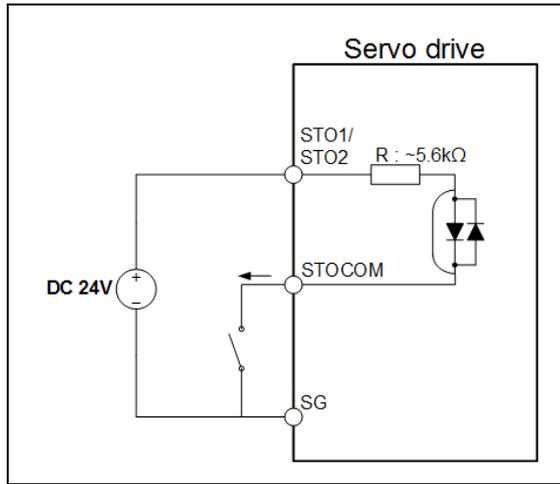
6.3. Wirings interface of STO function

Refer to section 2.3.1 for I/O interface wiring.

6.3.1. Sink interface

(1). DI interface

　　Switched by the external relay or the open collector transistor output of superior host.

External power source is applied

(2). DO interface

The lamp or relay or photo-couple could be driven. For the relay wiring, confirm the polarity of diode.

For the lamp wiring, use a resistor to suppress in-rush current.(continuous : 40mA or less, in-rush : 100mA or less)

External power source is applied	
Individual output	**Serial output**

6.3.2. Source interface

SDP series servo drive affords the source interface. At that time, all I/O signals are in source type.
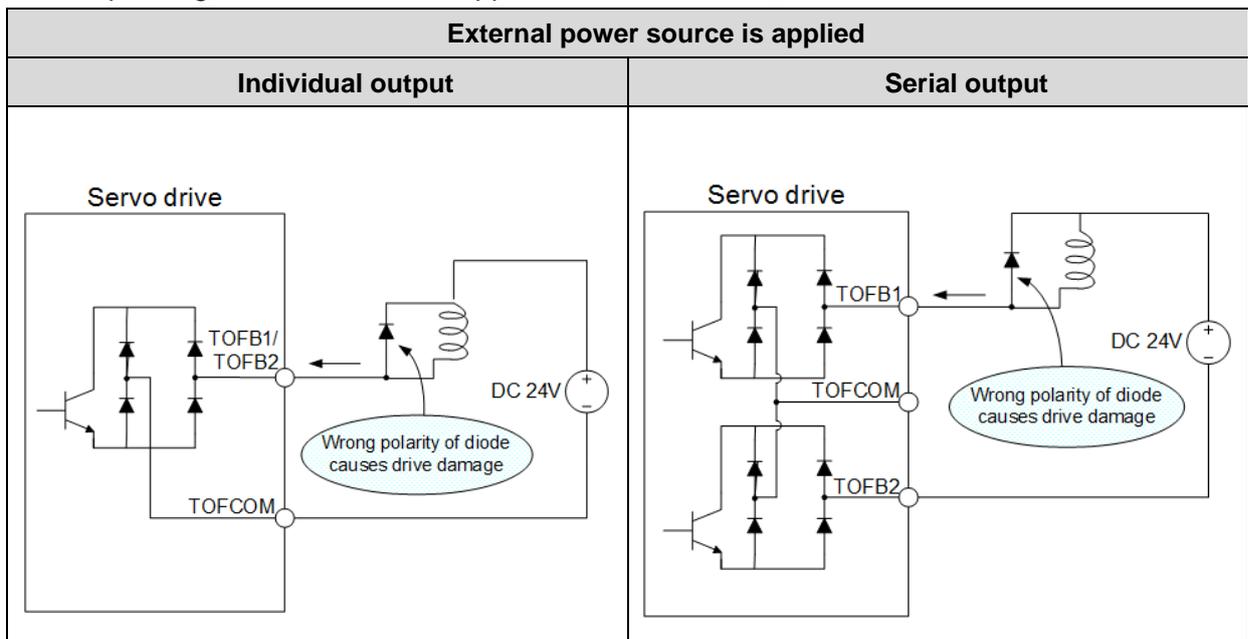
(1). DI interface

External power source is applied
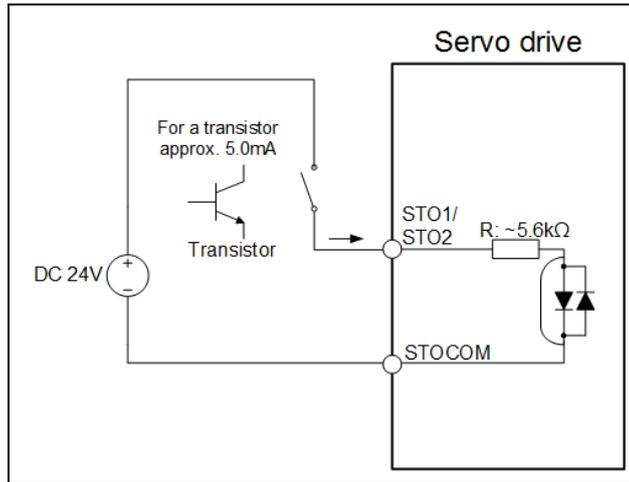
(2). DO interface

The lamp or relay or photo-couple could be driven. For the relay wiring, confirm the polarity of diode. For the lamp wiring, use a resistor to suppress in-rush current. (continuous : 40mA or less, in-rush : 100mA or less)

External power source is applied	
Individual output	**Serial output**
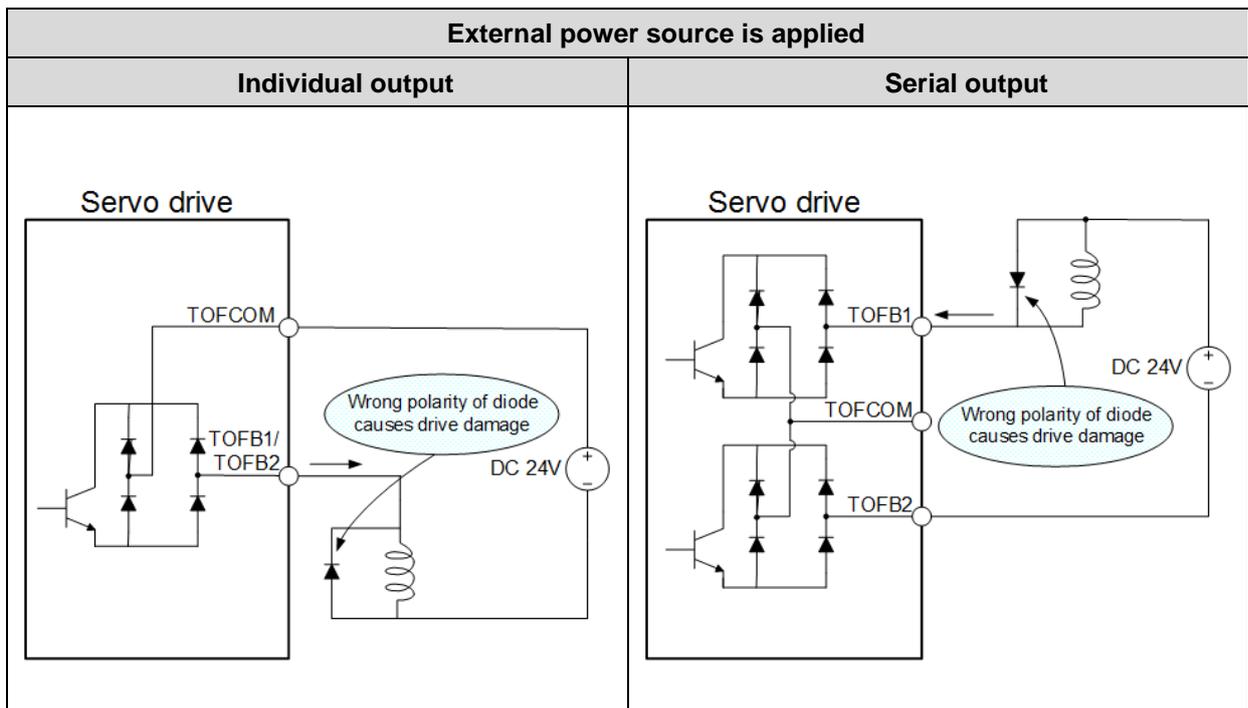
7. Troubleshooting

⚠ CAUTION	● When the drive alerted, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.

7.1. Alarm list

Once an alarm or a warning occurred, please remedy the fault according to the instruction mentioned in section 7.2. When the PD19 is set as □□□1, alarm codes could be represented by the ON/OFF states of DO1(CN1_15), DO2(CN1_16), and DO4(CN1_18)

	Alarm code	CN1			Name	Clear		
		15	16	18		Power OFF→ON	Press "SET"	RES signal
Alarm	AL01	0	1	0	Over voltage	O		
	AL02	0	0	1	Low voltage	O	O	O
	AL03	0	1	1	Over current	O		
	AL04	0	1	0	Regenerative alarm	O	O	O
	AL05	1	0	0	Overload 1	O	O	O
	AL06	1	0	1	Over speed	O	O	O
	AL08	1	0	1	Position error excessive	O	O	O
	AL09	0	0	0	Communication abnormal	O	O	O
	AL0A	0	0	0	Communication time-out	O	O	O
	AL0B	1	1	0	Encoder error 1	O		
	AL0D	1	1	0	Fan error	O		
	AL0E	0	0	0	IGBT overheat	O		
	AL0F	0	0	0	Memory error	O		
	AL10	0	0	0	Overload 2	O		
	AL11	1	1	1	Motor mismatched	O		
	AL20	1	1	1	Motor crash error	O		
	AL21	1	1	1	Motor U,V,W lines disconnected	O		
	AL22	1	1	0	Encoder communication error	O		
	AL23	0	1	0	Full-close position error excess	O	O	O
	AL24	0	0	0	Encoder type error	O		
	AL25	1	1	0	Linear scale disconnected	O		
	AL26	1	1	0	Encoder error 3	O		
	AL27	1	1	0	Encoder error 4	O		
	AL28	1	1	0	Encoder overheat	O		

	Alarm code	CN1			Name	Recovery		
		41	42	45		Power OFF→ON	Press "SET"	RES signal
A	AL29	1	1	0	Encoder error 5	Recover after remedy		

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	AL2A	1	1	0	ABS encoder abnormal 1			
	AL2B	1	1	0	ABS encoder abnormal 2			
	AL2E	0	1	1	Control circuit abnormal	O		
	AL2F	0	1	1	Regenerative energy abnormal	O		
	AL30	0	1	1	Pulse output frequency excess	O	O	O
	AL31	0	1	1	Over current 2	O		
	AL32	0	1	1	Control circuit abnormal 2	O		
	AL34	0	0	0	Overload 4	O		
	AL35	1	0	1	STO error	O	O	O
	AL.80				Sync Manager WDT abnormal	O	O	O
	AL.81				EtherCAT state switch abnormal	O	O	O
	AL.82				EtherCAT state abnormal	O	O	O
	AL.84		-		Synchronousion abnormal	O	O	O
	AL.85				ESC initiated abnormal	O	O	O
	AL.87				SII verified abnormal	O	O	O
	AL.88				Communication setting abnormal	O	O	O
	AL.89				Command error	O	O	O
Warning	AL12				Emergency stop			
	AL13				LSP/LSN activated			
	AL14				Software positive limit		Recover after remedy	
	AL15				Software negative limit			
	AL16				Overload early warning			
	AL17				ABS time out warning	O	O	O
	AL19				Pr command abnormal		Origin return	
	AL1A		-		Index coordinate undefined			
	AL1B				Position shifting error			
	AL1C				Pre-overload 4		Recover after remedy	
	AL2C				ABS encoder abnormal 3			
	AL2D				Encoder battery voltage low			
	AL61				Parameter group range excess	O	O	O
	AL62				Parameter number range excess	O	O	O
	AL63				Pr mode parameter range excess	O	O	O
	AL64				Pr mode parameter write error	O	O	O

7.2. Alarm cause and remendy

AL01 Over voltage

Cause	Inspection	Remedy
Power supply voltage excess	Review the power voltage.	Use the proper power source.

Input power error (incorrect power).	Review the power supply.	Use proper power source.
Drive hardware damaged.	Use voltmeter to check if the power voltage is within rated voltage while error still occurred.	Contact agent for proper service.
Lead of built-in regenerative brake resistor or regenerative brake option is disconnected.	Check the P,D terminals connected well or not. Check built-in regenerative brake resistor or regenerative brake option is disconnected well.	Connect correctly.
Built-in regenerative brake resistor or regenerative brake option is damaged.	Check if it is burn out or damaged.	Change the built-in resistor or option.
Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Check if the capacity insufficient.	Add regenerative brake option or increase capacity.

AL02 Low voltage

Cause	Inspection	Remedy
Input voltage of main circuit is lower than permissible value.	Review the power supply.	Use proper power source.
Capacity of power supply is insufficient.	Check if it occurred as motor torque regenerated huge.	Increase power supply capacity.
Input power error (incorrect power).	Review the power supply.	Use proper power source.
Jumper between P1 and P is removed	Check if the jumper is removed or not.	Connect the jumper well.

AL03 Over current

Cause	Inspection	Remedy
Improper motor wirings.	Check the wirings.	Correct the wirings.
Short occurred in drive output phases U, V and W.	Check if the connection between drive and motor is short.	Correct the wirings to prevent from short-circuit or cable naked.
IGBT of servo drive faulty.	AL03 occurs if power is switched on after U,V and W are disconnected.	Contact agent for proper service.
Improper parameters setting.	Check relevant parameters which have modified.	Recover factory-set then re-define user's demand.

AL04 Regenerative alarm

Cause	Inspection	Remedy
Brake transistor fault.	Set PC36 to be 0 and re-power on, if AL04 is occurred soon, it means the brake transistor broken.	Contact agent for proper service.
Built-in brake resistor or brake option is disconnected.	Check the wirings.	Correct the wirings.

AL05 Overload 1

Cause	Inspection	Remedy

Operate the servo drive in heavy duty continually.	Check if mechanism load is huge.	Upgrade the capability of servo or reduce the duty.
Improper gain values setting.	Check if vibration of mechanism is occurred.	Re-operate the auto-gain tuning job to obtain the proper gain value.
Servo system is instable.	Check if acceleration/deceleration time constant is proper.	Extend these setting values.
Encoder faulty.	As motor shaft is rotated slowly with Servo OFF, the pulses feedback should vary in proportion to rotary angle. I	Contact agent for proper service.

AL06 Over speed

Cause	Inspection	Remedy
Command pulses frequency exceeded the permissible instantaneous speed frequency.	Check the frequency of command pulses whether exceeds the permissible range.	Set the command pulses frequency correctly.
Improper acceleration/deceleration time constant settings.	Check if these values are too small.	Increase acceleration/deceleration time constant.

Servo system is instable to cause overshoot.	Observe if the mechanism is with vibration.	1. Re-set proper servo gain value.
		2. If gain could not be set to proper:
		  1) Reduce load inertia ratio; or
		  2) Set acceleration/deceleration time constant to proper value.

AL07 Pulse command abnormal

Cause	Inspection	Remedy
Pulse frequency of the command pulse is too high.	Check the frequency of command pulses whether exceeds the permissible range.	1. Set the command pulses frequency correctly. 2. After RD output signal activated, the host starts to send command.
Command device failure.	Check if the command device is normal or not.	Change the command device.

AL08 Position error excessive

Cause	Inspection	Remedy
Improper acceleration/deceleration time constant settings.	Check if these values are too small.	Increase acceleration/deceleration time constant.
Improper torque limit setting.	Check if PA05 setting is too small.	Increase the torque limit value.
Position loop gain value is small.	Check if PB07 setting is too small.	Increase the gain value and adjust to ensure proper operation.
Mechanism load is huge.	Check if mechanism load is huge.	Reduce load, or to use servo drive and motor provide larger output.

AL09 Communication abnormal

Cause	Inspection	Remedy
Improper protocol setting.	Check if the protocol is matched.	Set the protocol correctly.
Improper address setting.	Check the communication address.	Set the address correctly.
Improper data content transmitted.	Check the value accessed.	Correct the data content accessed.

AL0A Communication time-out

Cause	Inspection	Remedy
Cable broken or loosen.	Check if cable broken or loosen.	Replace or re-connect the cable.
Communication cycle is longer than parameter PC23 setting.	Check if PC23 setting is proper.	Set the PC23 correctly.

AL0B Encoder error 1

Cause	Inspection	Remedy
Wirings are in wrong sequence.	Check if wirings sequence is correct or not.	Correct the wirings.
CN2 connector is loosened or disconnected.	Check if CN2 connector is loosen or disconnected.	Re-connect CN2 connector.
Encoder faulty	Check the encoder feedback pulses continuity of motor while Servo OFF	Contact agent for proper service.

AL0C Encoder error 2

Cause	Inspection	Remedy
Encode initial index fault.	Rotate the shaft of motor then power on the drive to check if the abnormal is solved. If the remedy is useless, contact your agent for service.	
Encoder wiring fault.	Check if PC23 setting is proper.	Set the PC23 correctly.

AL0D Fan error

Cause	Inspection	Remedy
Cooling fan stops working.	Change the fan by user or contact agent for proper service.	

AL0E IGBT overheat

Cause	Inspection	Remedy
Operate the drive in over-rate duty continuously.	Check if mechanism is overload or motor current is huge.	Reduce load, or to use servo drive and motor provide larger output.

AL0F Memory error

Cause	Inspection	Remedy
Data read-out/write-in abnormally.	To execute the parameter recovery or power on reset and check if it still null.	Contact agent for proper service.

AL10 Overload 2

Cause	Inspection	Remedy
Mechanical impact	Check if the moving route is proper.	1. Correct the moving route. 2. Install limit switches.
Wrong connection of servo motor.	Check the wirings.	Correct the wirings.
Mechanism vibration.	Check if mechanism is instable and humming.	1. Change response level setting. 2. Make gain adjustment manually.
Encoder faulty.	To rotate motor shaft and check the continuity of encoder feedback pulses while Servo OFF.	Contact agent for proper service.

AL11 Motor mismatch

Cause	Inspection	Remedy
The capacity of drive and motor are not compatible.	Check if they match for each other in capacity.	Use the proper combination.

AL12 Emergency stop

Cause	Inspection	Remedy
EMG signal is activated.	Check if EMG signal is applied and triggered.	Release the trigger after removal of some emergency conditions.

AL13 LSP/LSN activated

Cause	Inspection	Remedy
LSP activated.	Check if the limit switch is activated.	Release the activated cause of limit switch.
LSN activated.		

AL14 Software positive limit

Cause	Inspection	Remedy
Command pulses exceeds PF86	Check whether the PF86 is proper.	Set the proper PF86 value.

AL15 Software negative limit

Cause	Inspection	Remedy
Command pulses exceeds PF86	Check whether the PF86 is proper.	Set the proper PF86 value.

AL16 Overload early warning

Cause	Inspection	Remedy
The actual load exceeds the PA17 setting level. (Refer to the motor characteristic chapter)	1. Check whether overload has occurred. 2. Check whether the PA17 setting is low.	1. Refer the AL05 remedy. 2. Set the PA17 value higher or set a value which excess 100 to disable this early warning.

AL17 ABS time out warning

Cause	Inspection	Remedy
Absolute position communication waiting time out.	1. Check whether overload has occurred. 2. Check whether the PA17 setting is low.	1. Refer the AL05 remedy. 2. Set the PA17 value higher or set a value which excess 100 to disable this early warning.

AL19 ABS time out warning

Cause	Inspection	Remedy
Position command counter overflow	Incremental system When the motor keeps rotating in the same direction, the feedback pulse register would overflow. Absolute system 1. Feedback pulse register overflow. 2. Change electronic gear ratio without executing origin return. 3. Execute the absolute position command when the HOME is off.	Execute the origin return.

AL20 Motor crash error

Cause	Inspection	Remedy
Motor current exceeds the PA15 setting and the duration is over PA16.	1. Check the PA15 is valid or not. 2. Check the PA15 whether it is too low or PA16 is too soon.	1. Disable the PA15. 2. To set the proper level of these 2 parameters according to the actual load condition.

AL21 Motor U, V, W lines disconnected

Cause	Inspection	Remedy
Drive detects the disconnection of motor power lines.	Check the power lines of motor whether are loosen or not.	Re-connect the power lines well.

AL22 Encoder communication error

Cause	Inspection	Remedy
The encoder send 3 times CRC message to the servo drive.	1. Check the grounding of motor. 2. Check the encoder cable whether are wired together with the motor power lines.	1. Ground the motor to obtain a good immunity of noise. 2. Separate the encoder cable from motor power lines.

AL23 Full-close position error excess

Cause	Inspection	Remedy
The position error exceeds PA25 in the full-close mode.	1. Check if PA25 is improper.	1. Increase the PA25.
	2. Check the wirings of full-close mode or the mechanical installation.	

AL24 Encoder type error

Cause	Inspection	Remedy
Try to enable the absolute encoder function with an incremental type of encoder.	1. Check the encoder whether it is absolute type or not. 2. Check the PA28 setting.	1. Choose the proper type of encoder. 2. If the absolute position function is not performed, set "0" value into PA28.

AL25 Linear scale disconnected

Cause	Inspection	Remedy
When PA26 =□□□1 and Servo ON is active, if the linear scale cable is disconnected then it occurs.	Check if the linear scale cable is connected well then re-connect the cable.	

AL26 Encoder error 3

Cause	Inspection	Remedy
The LED attenuation of encoder or encoder feedback pulses abnormal.	Power off the drive and power on again to check this phenomenon.	If there is still a recurrence, please contact your agent for repair service.

AL27 Encoder error 4

Cause	Inspection	Remedy
Encoder memory abnormal	1. Check the grounding of motor. 2. Check the encoder cable whether are wired together with motor power lines. 3. Check the shield of encoder.	1. Link drive's & motor ground together. 2. Separate the encoder cable from the motor power lines. 3. Use the shield cover encoder cable to obtain a better noise immunity.

AL28 Encoder overheat

Cause	Inspection	Remedy
The surrounding air temperature of encoder operation environment is higher than 95℃.	Check surrounding air temperature of encoder operation environment.	1. To prevent the heat source nearby. 2. To reduce the output torque. 3. If the remedies do not work, contact your agent for service.

AL29 Encoder error 5

Cause	Inspection	Remedy
The stroke revolutions are excess than the encoder specification.	1. Check the stroke revolutions. The revolutions limit is within -32768 ~+32767 turns.	Execute the origin return.

AL2A ABS encoder abnormal 1

Cause	Inspection	Remedy
The voltage of encoder battery is low.	1. Check the voltage of encoder battery whether is less than 2.45 volt.	After replacing battery, execute the origin return.
The bad contact between encoder and battery, or the battery power lines disconnected.	1. Check the encoder wirings. 2. Check the contacts between the encoder power lines and battery box.	After the wirings repairing, execute the origin return.

AL2B ABS encoder abnormal 2

Cause	Inspection	Remedy
The counter of encoder revolutions is abnormal.	Power off the servo drive, and then run the servo motor, check whether it is a recurrence.	If there is still a recurrence, please contact your agent for service.

AL2C ABS encoder abnormal 3

Cause	Inspection	Remedy
Replace the encoder batter when the power of servo drive has turned off.	Not to replace the encoder battery unless the power of servo drive is on.	Execute the origin return.
The absolute coordinate initialization has not executed when the absolute coordinate system operated.	---	Execute the origin return.

AL2D Encoder battery voltage low

Cause	Inspection	Remedy
The voltage of encoder battery is low.	1. Check the LED display whether AL2D message is shown. 2. Measure the battery voltage.	Please keep the power of servo drive and then replace the battery of encoder.

AL2E Control circuit abnormal

Cause	Inspection	Remedy
The SON signal is malfunction.	Check the SON signal whether is disturbed.	Prevent the noise interference.
Current feedback circuit is abnormal.	Power reset the servo drive, if it is a recurrence; please contact your agent for service.	

AL2F Regenerative energy abnormal

Cause	Inspection	Remedy
The regenerative load ratio is more than 100%.	1. Check whether the deceleration time setting is too short. 2. To prevent the occasion where forward rotation and reverse rotation are performed frequently.	1. Set the proper deceleration time to reduce voltage regenerated. 2. Consult your agent to check whether the drive capacity is sufficient or not.

AL30 Pulse output frequency excess

Cause	Inspection	Remedy
The encoder is breakdown.	Check the alarm histories whether these AL0B, AL0C, AL22, AL26, AL27 had occurred.	Follow the remedy AL0B, AL0C, AL22, AL26, and AL27.
Pulse output frequency exceeds the hardware ability.	Confirm if the following cases occurred: 1. Motor speed is excess than PA41. 2. (Motor speed/60)*PA14>20x10^6	Set the PA41 and PA14 properly.

AL31 Over current 2

Cause	Inspection	Remedy
The current feedback circuit of servo drive is abnormal.	Power reset the servo drive, if it is a recurrence; please contact your agent for service.	

AL32 Control circuit abnormal 2

Cause	Inspection	Remedy
FPGA hardware abnormal	Power reset the drive, if it is a recurrence; please contact your agent for service.	

AL34 Overload 4

Cause	Inspection	Remedy
The external load exceeds the rate of drive capacity in continuous used	Check if the reciprocating stroke is too fast	Upgrade the motor capacity or reduce the reciprocating stroke frequency
The mechanical system is unstable	Check whether the acc./dec. time setting is too fast	Increase the acc./dec. time setting

AL35 STO error

Cause	Inspection	Remedy
STO safety function enabled.	Check the STO related safety function circuit to find any abnormal phenomenon.	

AL61 Parameter group range excess

Cause	Inspection	Remedy

Parameter group request exceeds A~F range.	Check the communication command whether is correct or not.	Execute any one instruction below 1. Power off the drive. 2. Press "SET" key at the alarm message screen. 3. Activate the RES signal.

AL62 Parameter number range excess

Cause	Inspection	Remedy
Parameter group number request exceeds the specific range.	Check the communication command whether is correct or not.	Execute any one instruction below 1. Power off the drive. 2. Press "SET" key at the alarm message screen. 3. Activate the RES signal.

AL63 Pr mode parameter range excess

Cause	Inspection	Remedy
Parameter command request exceeds the specific range.	Check the communication command whether is correct or not.	Execute any one instruction below 1. Power off the drive. 2. Press "SET" key at the alarm message screen. 3. Activate the RES signal.

AL64 Pr mode parameters write error

Cause	Inspection	Remedy
To write parameter modification when SON is activated.	Check the SON status when Pr command is going to be changed.	

AL80 Sync Manager WDT abnormal

Cause	Inspection	Remedy
PDO data transmission failed.	Check the EtherCAT cable if it is connected well or not. Then give the reset code from the host, or re-power on the drive.	
Watchdog failed	Set ESC registers which address are 0x0400 and 0x0420 to increase PDO watchdog error detection time.	

AL81 EtherCAT state switch abnormal

Cause	Inspection	Remedy
EtherCAT state machine executes an abnormal process	Check the switch sequence of EtherCAT state machine then reset the drive to observe if the abnormal phenomenon.is solved.	

AL82 EtherCAT state abnormal

Cause	Inspection	Remedy
EtherCAT state machine executes an undefined process	Check the state command value from the host if it is correct or not. Then reset the drive to observe if the abnormal phenomenon.is solved.	

AL84 Synchronization abnormal

Cause	Inspection	Remedy

	Confirm PC38 value and check the Sync initial setting. Then relink the EtherCAT communication again to observe if the abnormal phenomenon.is solved. If this remedy is not work, please contact your agent for inspection.
Synchronization detection activated	

AL85 ESC initiated abnormal

Cause	Inspection	Remedy
Control PCB fault	Re-power ON to observe if the abnormal phenomenon.is solved. Otherwise, contact your agent for service.	

AL87 SII verified abnormal

Cause	Inspection	Remedy
SII version conflict	Contact your agent for version updated service.	

AL88 Communication setting abnormal

Cause	Inspection	Remedy
Undefined status value or parameter	Check if PDO transmission period is proper or not. Reset the drive then observe if the abnormal phenomenon.is solved or not.	
EtherCAT transmission channel error	Check the content of object 1C32h and 1C33h, cycle time, shift time. Avoid a greater setting of shift time than cycle time.	
DC register settings abnormal	Inspect the related Distributed Clocks register settings.	

AL89 Command error

Cause	Inspection	Remedy
An un-supported object 6060h value	Re-send the EtherCAT operation mode or reset the drive. Then observe if the abnormal phenomenon.is solved not. If not, contact your agent for service.	

AL1A Index coordinate undefined

Cause	Inspection	Remedy
The origin initialization has not executed when the index coordinate operated.	1. To execute the origin return before the index coordinate is operated. 2. To activate RES to release the alarm status. 3. SON: off→on	

AL1B Position shifting error

Cause	Inspection	Remedy
MC_OK signal ON/OFF state changes.	After positioning completion, check whether any external force causes the final position to be shifted.	1. Activate the RES signal. 2. Press "SET" key at the alarm message screen. 3.SON: off→on

AL1C Overload 4 early warning

Cause	Inspection	Remedy

Overload duration exceeds the pre-warning of protection curve.	Check if the external load exceeds the rated capacity of motor.	Refer to the remedy of AL.34.

8. Appendix

8.1. Options list

| Category	Name	Type	Length [mm]
CN1 related	I/O connector	SDP-CN1	--
	I/O cable (5M)	SDP-TBL05M	500±10
	I/O cable (10M)	SDP-TBL1M	1000±10
	I/O cable (20M)	SDP-TBL2M	2000±10
	I/O terminal adaptor block	SDP-TB26	
CN2 related	Low inertia motor (100W~750W) encoder connector	SDH-ENCNL	--
	Medium capacity motor (1~7KW) encoder connector	SDH-ENCNM	--
Encoder cable	Low inertia motor (100W~750W) encoder cable (2M)	SDH-ENL-2M-L/H	2000±100
	Low inertia motor (100W~750W) encoder cable (5M)	SDH-ENL-5M-L/H	5000±100
	Low inertia motor (100W~750W) encoder cable (10M)	SDH-ENL-10M-L/H	10000±100
	Medium capacity motor (1~7KW) encoder cable (2M)	SDH-ENM-2M-L/H	2000±100
	Medium capacity motor (1~7KW) encoder cable (5M)	SDH-ENM-5M-L/H	5000±100
	Medium capacity motor (1~7KW) encoder cable (10M)	SDH-ENM-10M-L/H	10000±100
Power connector	(50W~750W) power cable connector without brake	SDA-PWCNL1	--
	(100W~750W) power cable connector with brake	SDA-PWCNL2	--
	L(1~3KW)/M(1KW/1.5KW) power cable connector	SDA-PWCNM1	--
	M(2KW/3KW) power cable connector	SDA-PWCNM2	--
	M(5/7KW) power cable connector	SDA-PWCNM4	--
Power cable	(50W~750W) power cable without brake (2M)	SDA-PWCNL1-2M-L/H	2000±100
	(50W~750W) power cable without brake (5M)	SDA-PWCNL1-5M-L/H	5000±100
	(50W~750W) power cable without brake (10M)	SDA-PWCNL1-10M-L/H	10000±100
	(50W~750W) power cable with brake (2M)	SDA-PWCNL2-2M-L/H	2000±100
	(50W~750W) power cable with brake (5M)	SDA-PWCNL2-5M-L/H	5000±100
	(50W~750W) power cable with brake (10M	SDA-PWCNL2-10M-L/H	10000±100
	L(1~3KW)/M(1KW/1.5KW) power cable without brake (2M)	SDA-PWCNM1-2M-L/H	2000±100
	L(1~3KW)/M(1KW/1.5KW) power cable without brake (5M)	SDA-PWCNM1-5M-L/H	5000±100
	L(1~3KW)/M(1KW/1.5KW) power cable without brake (10M)	SDA-PWCNM1-10M-L/H	10000±100
	L(1~3KW)/M(1KW/1.5KW) power cable with brake (2M)	SDA-PWCNM1B-2M-L/H	2000±100
	L(1~3KW)/M(1KW/1.5KW) power cable with brake (5M)	SDA-PWCNM1B-5M-L/H	5000±100
	L(1~3KW)/M(1KW/1.5KW) power cable without brake (10M)	SDA-PWCNM1B-10M-L/H	10000±100
	Medium inertia (2KW/3KW) power cable without brake (2M)	SDA-PWCNM2-2M-L/H	2000±100
	Medium inertia (2KW/3KW) power cable without brake (5M)	SDA-PWCNM2-5M-L/H	5000±100
	Medium inertia (2KW/3KW) power cable without brake (10M)	SDA-PWCNM2-10M-L/H	10000±100
	Medium inertia (2KW/3KW) power cable with brake (2M)	SDA-PWCNM2B-2M-L/H	2000±100
	Medium inertia (2KW/3KW) power cable with brake (5M)	SDA-PWCNM2B-5M-L/H	5000±100
	Medium inertia (2KW/3KW) power cable with brake (10M)	SDA-PWCNM2B-10M-L/H	10000±100
	Medium inertia (5KW) power cable without brake (2M)	SDH-PWCNM4-2M-L	2000±100

	Medium inertia (5KW) power cable without brake (5M)	SDH-PWCNM4-5M-L	5000±100
	Medium inertia (5KW) power cable without brake (10M)	SDH-PWCNM4-10M-L	10000±100
	Medium inertia (7KW) power cable without brake (2M)	SDH-PWCNM5-2M-L	2000±100
	Medium inertia (5KW) power cable without brake (5M)	SDH-PWCNM5-5M-L	5000±100
	Medium inertia (5KW) power cable without brake (10M)	SDH-PWCNM5-10M-L	10000±100

Category	Name	Type	Length [mm]
Brake related	Medium inertia (5KW/7KW) brake connector	SDH-BKCNS1	--
Brake power cable	Medium inertia (5/7KW) power cable with brake (2M)	SDH-BKCNS1-2M-L	2000±100
	Medium inertia (5/7KW) power cable with brake (5M)	SDH-BKCNS1-5M-L	5000±100
	Medium inertia (5/7KW) power cable with brake (10M)	SDH-BKCNS1-10M-L	10000±100
CN4 related	USB communication cable	SDA-USB3M	3000
CN5 related	Encoder battery cover set	SDH-BAT-SET	--
	Encoder battery	SDH-BAT	--
CN6 related	STO cable	SDP-CN6-05M	

8.2. Options Figure

Encoder connectors

Parts number: SDH-ENL (suitable for 100W, 200W, 400W, 750W motors)
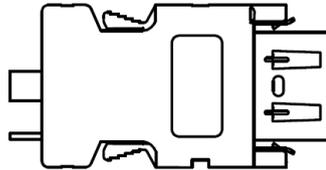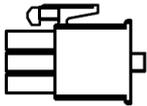
Parts number: SDH-ENM   (suitable for 1.0KW, 1.5KW, 2.0KW, 3.0KW, 5.0KW, 7.0KW motors)
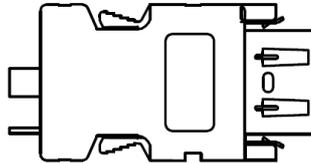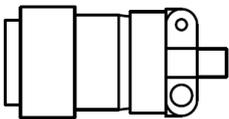
Encoder cable

Parts number: SDH-ENL-□M-L/H ; □=2,5, 10 (m)
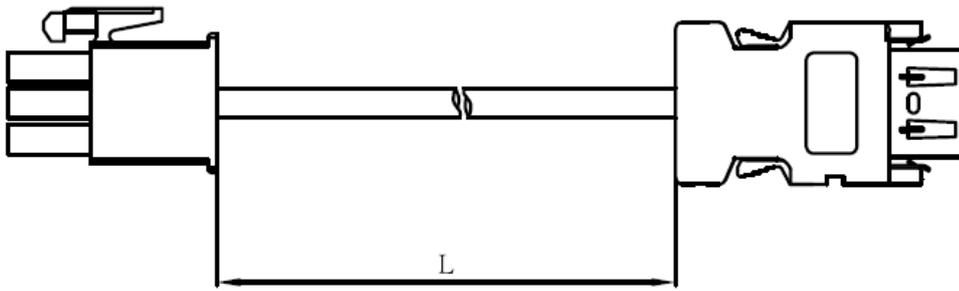
Parts number: SDH-ENM-□M-L/H; □=2,5, 10 (m)
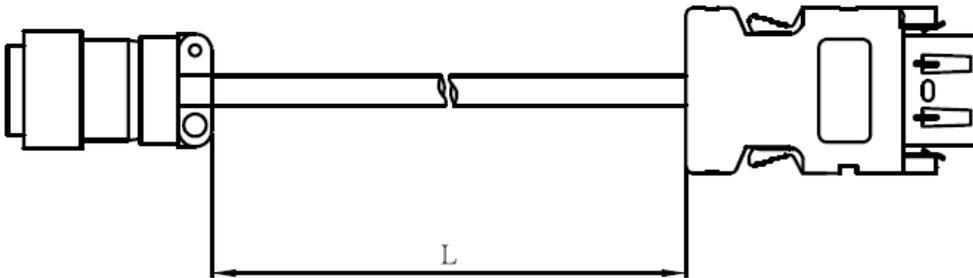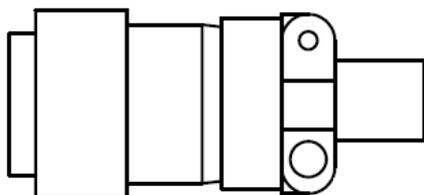

Power cable connectors

Parts number: SDA-PWCNL1 (suitable for 100W, 200W, 400W, 750W motors without brakes)
　　　　　　　SDA-PWCNL2 (suitable for 100W, 200W, 400W, 750W motors with brakes)
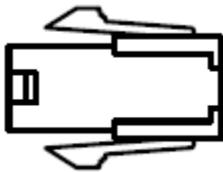
Parts number: SDA-PWCNM1 (for low inertia 1.0KW, 1.5KW, 2.0KW, 3.0KW / medium inertia 1.0KW, 1.5KW)
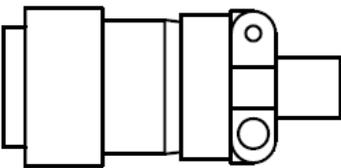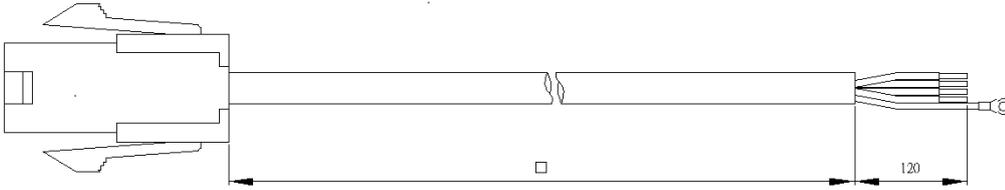

Parts number: SDA-PWCNM2 (suitable for medium inertia 2.0KW, 3.0KW)
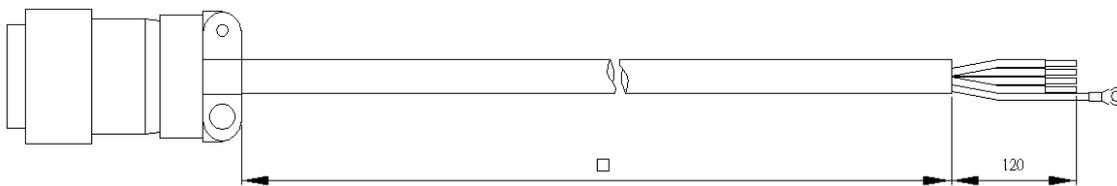　　　　　　　SDA-PWCNM4 (suitable for medium inertia 5.0KW, 7.0KW)

Power cables

Low inertia motor

Parts number: SDA-PWCNLΔ-□M-L/H

120

Low/medium inertia motor

Parts number: SDA-PWCNM1Δ-□M-L/H

120

Medium inertia motor
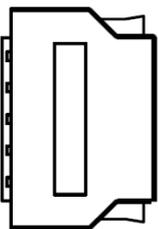
Parts number: SDA-PWCNM2Δ-□M-L/H

120
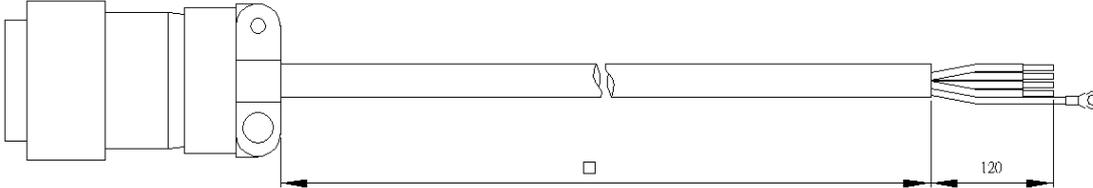
USB communication cable
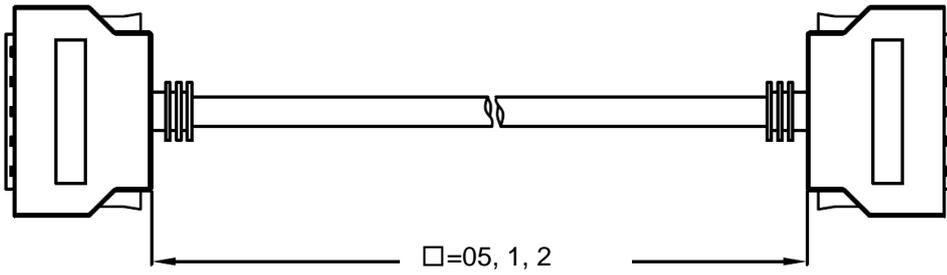
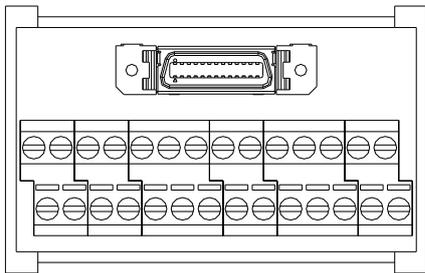Parts number: SDA-USB3M

L
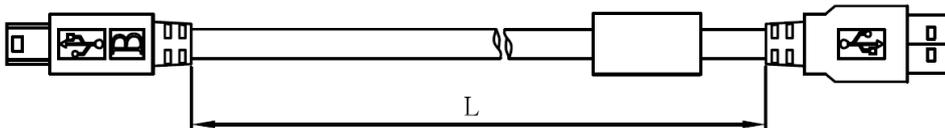
CN1 I/O connector

Parts number: SDA-CN1

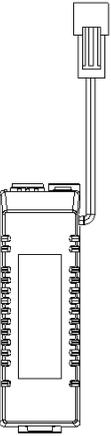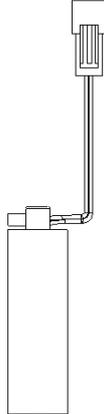CN1 I/O cable

Parts number: SDA-TBL□M, □=05,1,2

□=05, 1, 2

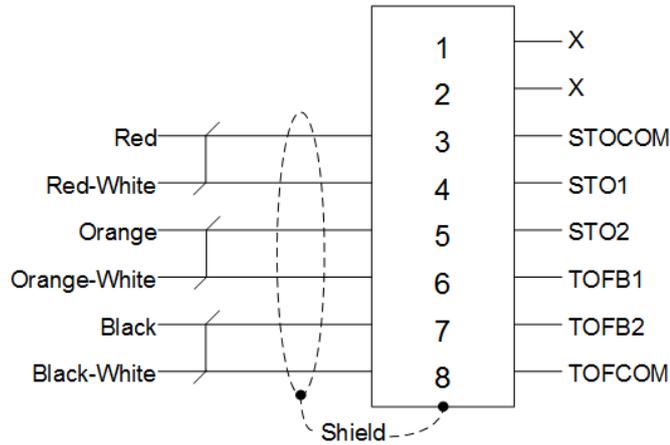CN1 I/O terminal adaptor block

Parts number: SDP-TBL26

Absolute encoder option

Absolute encoder battery cover set	Absolute encoder battery
Parts number: SDH-BAT-SET	Parts number: SDH-BAT

STO cable

Parts number: SDP-CN6-05M

Red — Red-White — Orange — Orange-White — Black — Black-White — Shield

1 — X
2 — X
3 — STOCOM
4 — STO1
5 — STO2
6 — TOFB1
7 — TOFB2
8 — TOFCOM

8.3. Revisions

Version	Date	Page	Section	Revision content
V1.00	Apr.18'	-	-	First edition
V1.03	Mar.19'	-		Synchronize the English version number with Chinese language version
		-	5.4.5	The diagrams of Homing method are changed.
		-	1.11	This section is added.
		-	1.9	The table and note are changed.
		-	1.10	The table and notes are change
		-	3.3	This section is added.
		-	3.7.5	This section is added.
		-	3.8	This section is added.
		-	6.1.4	The diagrams are changed.
		-	6.3	The diagrams are changed.
		-	8.3	Add the revision information.
V1.04	Jun.20'	10	1.3	New page to explain the SME series motors.
		11	1.4	New table to describe the combinations of SDP drives and SME motors.
		19	1.9	Add explanation for the capable of SDP drive running SME motor.
		26	1.10	New Page to describe the High Inertia Motor SME-H020, H040,H075.
		27	1.10	Add the new dimensions of High inertia motor 200W, 400W, 750W
		30	1.10	Describe that the connectors of SME motors are the same with SMP motors.
		31	1.11	Declare the characteristics of SME motors are same with SMP motors'.
		32	1.11	New page to describe the T-N patterns of High inertia motor.
		36	1.11	SME high inertia motors are compatible of SMP 200/400/750W protection curve.
		43	2.3.2	Add DI function description of EXT1/EXT2.
		51	2.4.2	New page to explain the cable specification of wiring.
		187	5.9	Add new descriptions of EXT1/EXT2.
V1.05	Jul.26	-	-	Edition to apply UL approval : p8, p55, p213
		10	1.3	Add the resolution description of SME paired with SDP-E.

		46	2.3.2	ORGP is not only suitable for Pr mode but also CoE mode.
		71,81	3.3	Correct PD27 default value as 「*0004h*」
		83	3.3	Modify the description of PA02=4, *PB07* is fixed…
		95	3.3	Correct the description of PC18 y-bit.
		95	3.3	Add new description of PC19, u-bit and z-bit
		96	3.3	x-bit is zero, the status display indicates 「Translated motor feedback pulses」 ...
		101	3.3	Correct the applicable mode of PC91 to PC95.
		136	3.8	Insert a new section of electronic gear
		169	4.6	Correct the name of object 60B1h as 「*Velocity offset*」
				Correct the name of object 607Ch as 「*Home offset*」

8.4. Version information

Version : V1.05

Issue date : Jul. 2021

Proofreader : Yaochou Shu