User Manual

LITEON Industrial Automation You Can Trust

ISA-7 Servo Drive series

Standard General Purpose Servo Drive Technical Manual

Revision History

Contents

PREFACE

Thank you for using our product. The manual provides the information for the use of the ISA-7 servo drive and motor.

The manual is provided as a reference for the following users:

- Designer of the system integration for the machine
- Personnel for installation or wiring
- Personnel for commissioning and tuning
- Personnel for maintenance or inspection

The content includes:

- The steps for installation and inspection of the drive and motor
- Description for the formation of wiring for the drive
- Steps for commissioning
- Introduction for the control function and the tuning method of the servo drive
- Description for the parameter function
- Description for the protocol
- Method for inspection and maintenance
- Troubleshooting
- Explanation for the application example

Contact the dealer or our customer service center for any problem with our product.

Safety precautions

The ISA-7 series is an open type servo drive that must be installed in a shielded control box for operation. The drive uses precise feedback control and combines a digital signal processor (DSP) with high-performance computing. It controls the IGBT to generate current output to drive the three-phase permanent-magnet synchronous motor (PMSM) to achieve precise positioning.
The ISA-7 series can be used for industrial application. It is recommended to install it in the distribution box specified in the manual. (The drive, filament and motor must be installed in an environment that meets the minimum specifications for UL50 Type 1 or NEMA 250 Type 1.)

- **Acceptance inspection**
  - ✧ The servo motor and drive must be used according to specified methods to avoid fire or equipment breakdown.

- **Installation notes**
  - ✧ It is prohibited to use the product in the place exposed to the steam, corrosive or flammable gases, otherwise it may result in electric shock or fire.

- **Wiring notes**
  - ✧ The earth terminal must be connected to Class 3 earthing (below 100Ω). Poor earthing may cause electric shock or fire.
  - ✧ Do not connect the three-phase power supply to U, V and W motor output terminal; otherwise it may result in personal injury or fire.
  - ✧ Secure the set screw of the power supply and motor output terminal, otherwise it may cause fire.

- **Operation notes**
  - ✧ Before the operation of the machinery equipment, the setting value must be adjusted according to the user parameter of the machinery equipment. The machinery equipment might lose control or breaks down if the setting value is not adjusted to the adequate setting value.
  - ✧ Before the operation of the machine, check if the emergency button can be activated anytime for shutdown.
  - ✧ It is prohibited to touch any motor part that is in rotation during motor operation, otherwise it may result in personal injury.
  - ✧ To avoid accidents, separate the coupling from the belt of the machinery equipment and keep them separate before the first commissioning.
  - ✧ When the servo motor and machinery equipment are connected and in operation, operating error may result in the damage of the machinery equipment and occasional personal injury.
  - ✧ Strongly recommended: Test the operation of the servo motor under the unloaded condition and connect the motor to the load afterwards to avoid danger.
  - ✧ Do not touch the radiator of the servo drive in operation, otherwise it may result in burn injuries due to heat.

- **Maintenance and inspection**
  - ✧ Do not touch the interior of the servo drive and motor, otherwise it may cause electric shock.
  - ✧ Do not remove the drive panel when the power is on, otherwise it may result in electric shock.
  - ✧ Do not touch the wiring terminal within 10 minutes after the power is off. The residual may cause electric shock.
  - ✧ Do not remove the servo motor, otherwise it may cause electric shock or personal injury.
  - ✧ Do not change the wiring while the power is on, otherwise it may result in electric shock or personal injury.
  - ✧ The installation, wiring, repair and maintenance of the servo drive and motor are only allowed for qualified personnel specialized in electrical engineering.

- **Wiring of the main circuit**
  - ✧ Do not thread the power and signal cable into the same channel or bind them. For wiring, the distance between the power and signal cables must be above 30 cm (11.8 in.).
  - ✧ As for the signal cable and the encoder signal cable, use the multi-stranded twisted-pair wires and multi-core shielded-pair wires. The length of the signal input cable is up to 3 m (9.84 ft.); the length of the encoder signal cable is up to 20 m (65.62 ft.).
  - ✧ High power might remain in the interior of the servo drive after the power is off. Do not touch the power supply terminal for 10 minutes. Check that the "CHARGE" indicator is off before the inspection.

- **Wiring for the terminal block of the main circuit**
  - ✧ Only insert one piece of wire into a wire socket of the terminal block.
  - ✧ As for wire insertion, do not short the core wire to the wire nearby.
  - ✧ Use the Y terminal to secure the thread of the core wire.
  - ✧ Check the wiring for accuracy before power on.

Chapter 1Panel and Operation

1.1. Product check

Damages may be caused by negligence and during delivery when the product is purchased. Check the following items.

Contact the factory or agent for the following.

Inspection item	Contents
Accuracy of the product number	Check if the model number of the motor and drive is the same as the one on the order. Refer to the subsequent chapters for the description of the model number.
Smooth rotation of the motor shaft	Turn the motor by hand. The motor operates normally if it can be rotated smoothly.
Damage of the appearance	Visually check the appearance of the product for damage.

The complete parts and components of the server should include:

A servo drive and motor

A power cable of the motor should be available. Connect the cable to the drive in the order of red (U), white (V) and black (W). The green earth line is connected to the earth of the drive.

A signal cable for the motor encoder should be available. One end of the cable is connected to the motor encoder and another end to the CN2 drive.

The 44PIN connector is used for CN1.

The 9PIN connector is used for CN2.

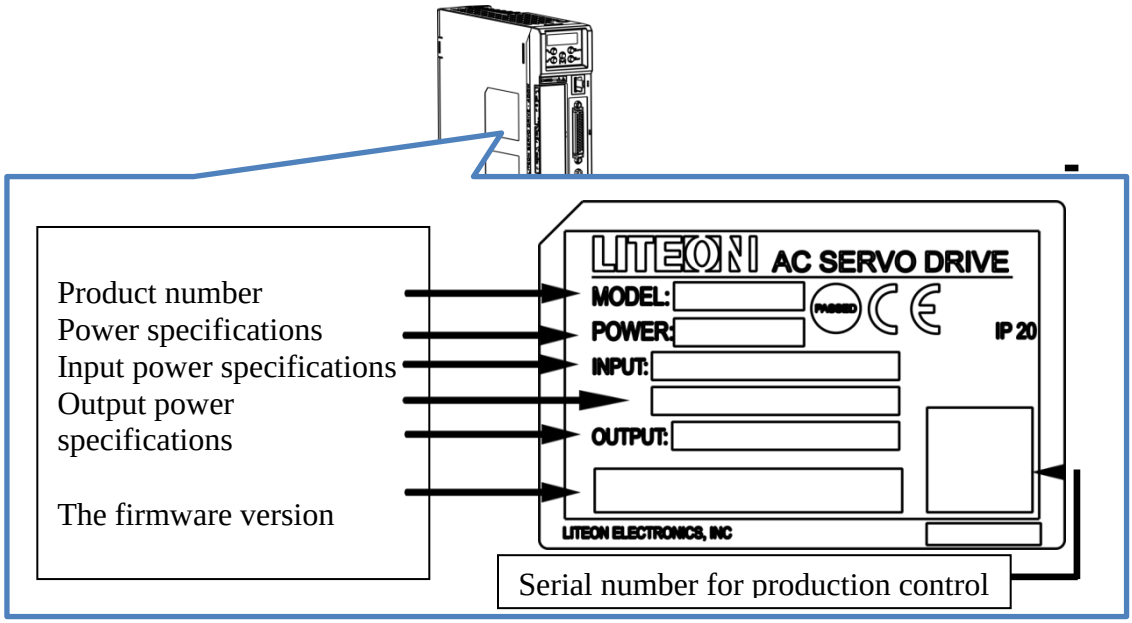
The 8PIN connector is used for CN3.

1.2. Comparison of the product numbers

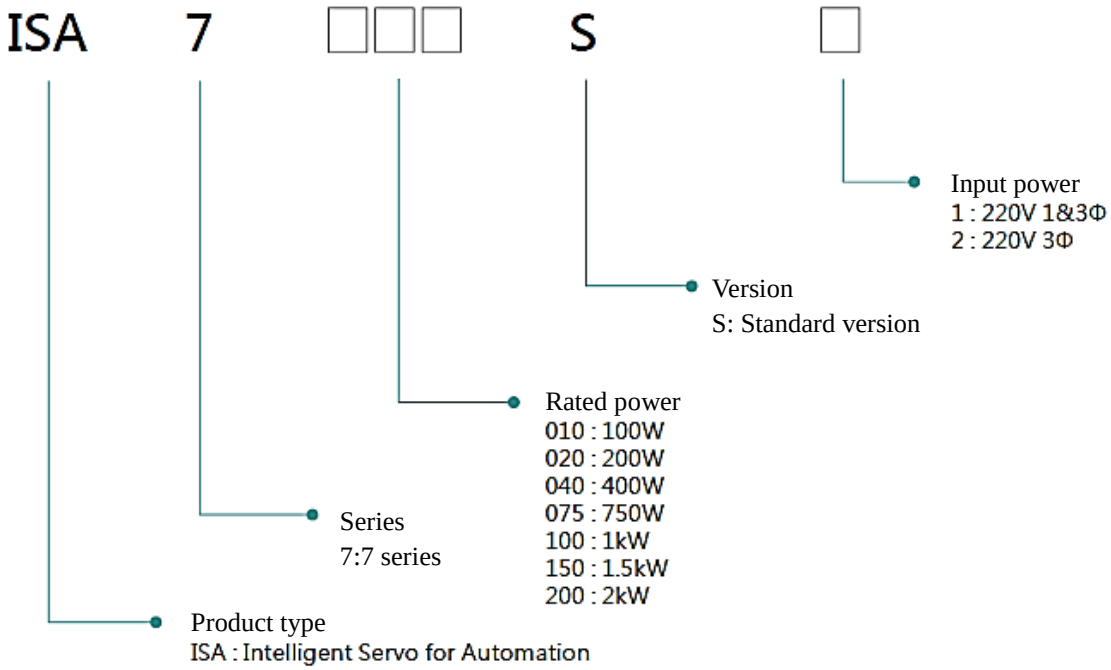
1.2.1. Description for the name plate

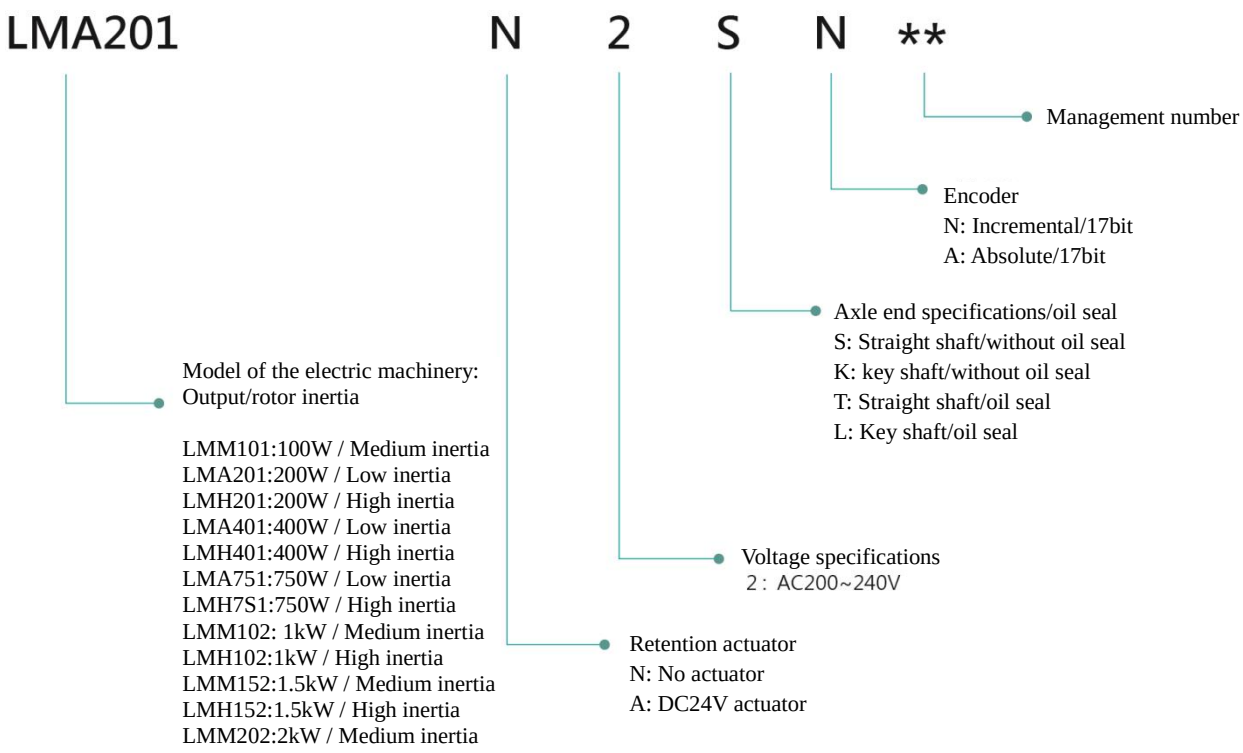
ISA-7 series servo drive

- Description for the name plate

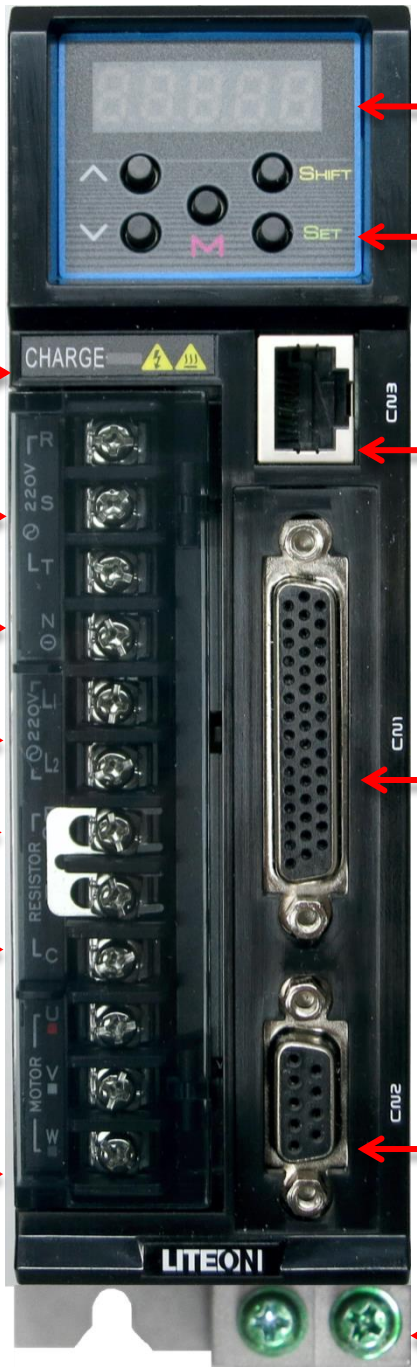


1.2.2. Description for the model number





1.3. Name of each part in the servo drive



Seven-segment display: It has five digits and shows the drive status or alarm.

Operating button: It can be used to switch the parameter/function and execute the monitoring setting.
MODE: It is used to return to the previous level or switch the status.
UP／DOWN: It is used to add or minus one.
SET: It is used to confirm the setting.
SHIFT: It is used to move the digit to the left.

CN3: It is used to connect to the PC software.

CN1: It is used to connect to the upper controller, such as the PLC or industrial computer.

CN2: It is used to connect to the motor encoder.

Earth terminal

Power indicator: There is voltage remained in the main circuit when the light is on.

Power supply of the main circuit: R, S and T are connect to the commercial power supply (AC 200~230 V 50/60 Hz).

N - : DCV BUS–

Power supply of the control circuit: The L1 and L2 supply for the single-phase 100~230Vac and 50/60 Hz power supply

P + : DCV BUS+

Regenerative resistor:
1) When the external regenerative resistor is used, the P and C ends connect to the resistor and the P and D ends are open-circuit.
2) When the internal regenerative resistor is used, the P and C ends are open-circuit and the P and D ends must be short-circuit.

Motor power output: It is used to connect to the motor UVW cable.

Do not connect to the power supply of the main circuit. Wrong connections may result in drive damage!

1.4. Operating mode

This drive provides numerous operating modes for the user. These modes are shown as follow:

Mode name		Mode code	Description
Single mode	Position mode (Terminal input)	P	The drive receives the position command and controls the motor to move to the target position. The position command is input from the terminal block. The signal type is pulse.
	Speed mode	S	The drive receives the speed command and controls the motor to reach the target rotational speed. The internal register provides the speed command (three registers available) or the external terminal block inputs the analog voltage (-10V ~ +10V). The command selection is based on the DI signal.
	Speed mode (no analog input)	Sn	The drive receives the speed command and controls the motor to reach the target rotational speed. The speed command can only be provided by the internal register (three registers available). It can't be provided by the external terminal block. The command selection is based on the DI signal. The DI status of the external input in the original S mode is the speed command zero.
	Torque mode	T	The drive receives the torque command and controls the motor to reach the target torque. The torque command can be provided by the internal register (three registers available). It is also possible to input the analog voltage from the external terminal block (-10V ~ +10V). The command selection is based on the DI signal.
	Torque mode (no analog input)	Tn	The drive receives the torque command and controls the motor to reach the target torque. The torque command can only be provided by the internal register (three registers available). It can't be provided by the external terminal block. The command selection is based on the DI signal. The DI status of the external input in the original T mode is the torque command zero.
Mixed mode		S-P	S and P can be switched via the DI signal.
		T-P	T and P can be switched via the DI signal.
		S-T	S and T can be switched via the DI signal.

The mode can be selected via the PA-01 parameter. After the new mode is set, the power is transmitted to the drive. The new mode then becomes effective!

Chapter 2 Steps for Commissioning and Tuning

2.1. Notes

The user must pay attention to the following:

- Do not pull the connecting line between the servo drive and motor tight.
- The servo drive must be fastened at every securing spot.
- The axle center of the servo motor must be centered to the axle rod adequately.
- If the connecting line between the servo drive and motor exceeds 20 m (65.62 ft.), the UVW line must be thickened. The connecting line of the encoder shall also be thickened.
- The four set screws of the servo motor must be fastened.

2.2. Condition of the storage environment

The product must be placed in the packing box before installation. Pay attention to the following for storage to make sure that the product condition is applicable to our warranty and future maintenance if the drive wouldn't be used for the moment:

- The product must be placed in a dustless and dry place.
- The ambient temperature of the storage location must be kept within -20°C ~ +65°C (-4°F ~ 149°F).
- The relative humidity of the storage location must be kept within 0% and 90%without condensation.
- Do not store the product in the environment with corrosive gas or liquid.
- The product should be packed properly and stored on the shelf or platform.

2.3. Condition of installation environment

Operating temperature:

- ISA-7 series servo drive: 0°C ~ 55°C (32°F ~ 131°F)
- ISA-7 series servo motor: 0°C ~ 40°C (32°F ~ 104°F)

The product must be placed in a well ventilated area if the ambient temperature exceeds 45°C. If the product is placed in the distribution box, the size and ventilation of the distribution box must be able to prevent the electronic device in the distribution box from overheating. Pay attention to see if the machine vibration affects the electronic device of the distribution box.
Besides, the following must be observed for the selection of the installation location. If not, our server product might not be applicable to our warranty and future maintenance:

- Our server product can be installed in places without heat emitting device, water drop, steam, dust, oil dust, corrosive or flammable gas or liquid, floating dust or metal particle. It can also be installed in stable places without vibration or interference of electromagnetic noise.
- Keep the temperature and humidity of the place where the servo drive and motor are installed within the specified range.
- Do not store the servo drive or motor in the place with the vibration exceeding the specified degree.
- Make sure that the servo drive and motor are stored in locations that conform to the environmental specifications stated in our manual.

2.4. Direction of and space for installation

Notes:

- The direction for installation must conform to the specifications to prevent malfunction.
- To ensure the cooling circulation remains effective, it is required to keep a sufficient space between the upper, lower, left and right sides of the servo drive and the object and guard plate (wall) nearby for the installation of the AC servo drive. If not, it may cause breakdown.
- Do not seal the air inlet and outlet of the servo drive during installation or tilt the servo drive, otherwise it may result in malfunction.

Correct

Wrong

Drive installation:

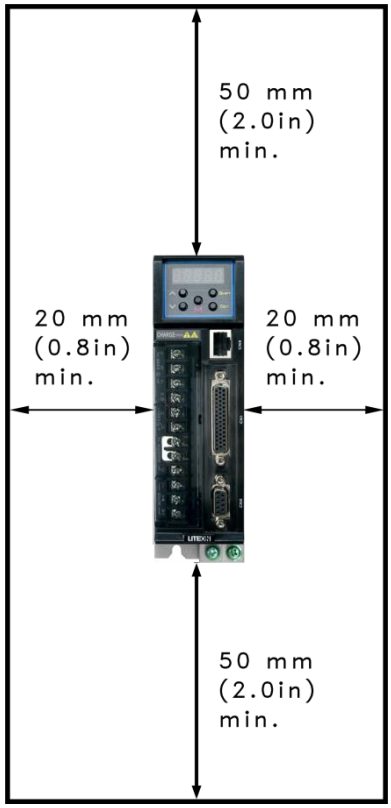
- The ISA-7 series server drive must be installed vertically on a dry and stable platform complying to the NEMA standard. To ensure the circulation of ventilation air and heat radiation remain effective, it is required to keep a sufficient space between the upper, lower, left and right sides of the servo drive and the object and guard plate (wall) nearby for the installation of the AC servo drive. (It is recommended to leave a free space of 50 mm, which is about 2 in.) Leave the space required for wiring, if necessary. Besides, the bracket or platform for drive installation must be made of materials with great thermal conductivity to prevent the platform and drive from overheating.

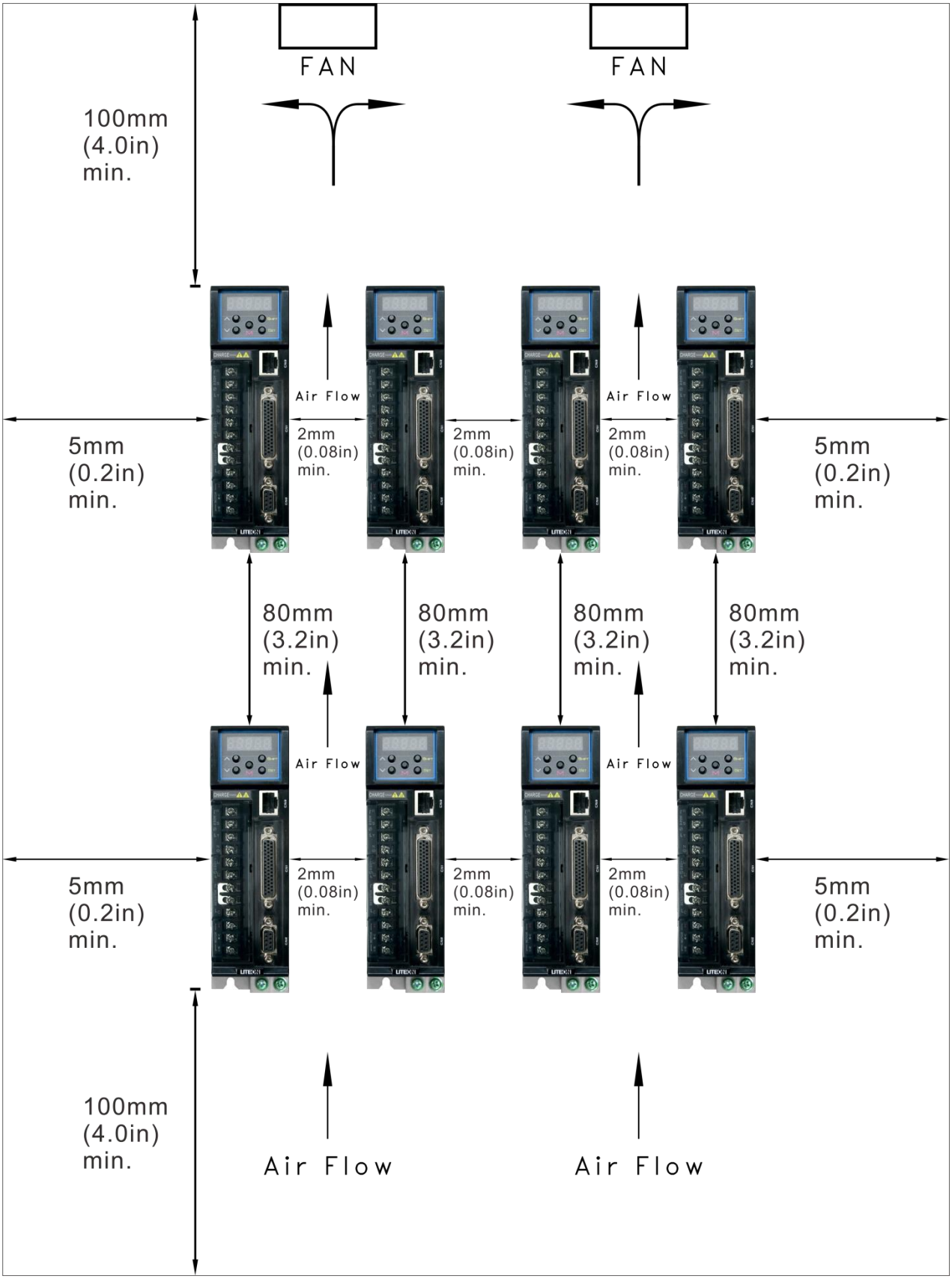
Motor installation:

- The ECMA series servo motor must be installed properly on a dry and stable platform. Ensure the circulation of the ventilation air and heat radiation remain effective for installation and keep the earth adequate.

Installation diagram

The windage of the radiator fan must be reduced for effective heat emission. The suggested distance for one-to-many AC servo drives must be observed. (Refer to the figure below.)




FAN
FAN
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5mm
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100mm
(4.0in)
min.
Air Flow
Air Flow

2.5. Recommended specifications for the circuit breaker and fuse

Strongly recommended: CSA / UL certified fuse and circuit breaker

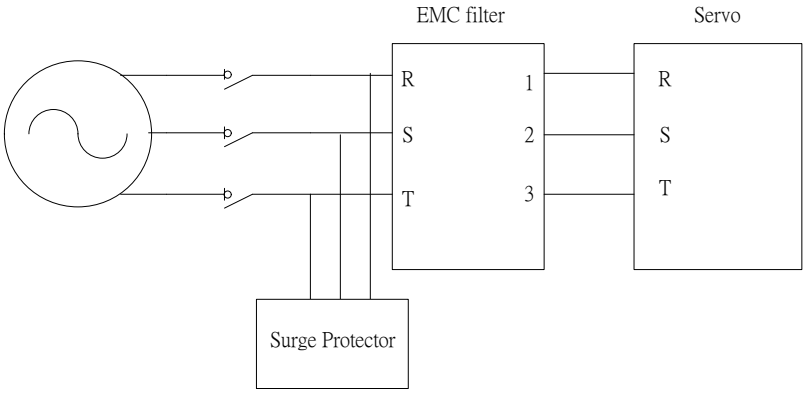
Drive model	Circuit breaker	Fuse
Operating Mode	Normal	Normal
ISA-7-020-S1	5A	6A
ISA-7-040-S1	10A	10A
ISA-7-075-S1	10A	20A
ISA-7-100-S1	15A	25A
ISA-7-150-S2	20A	40A
ISA-7-200-S2	30A	50A

2.6. EMI filter selection

Notes for the installation of the EMI filter

All electronic equipment (including the servo drive) generates certain high or low frequency noises during normal operation. Such noises interfere with the peripheral equipment via transmission or radiation. The interference can be minimized with correct installation of an appropriate EMI filter. Suppose that the servo drive and EMI filter are installed and wired according to the manual, we can be sure that they comply with the following standards:

1. EN61000-6-4（2001）
2. EN61800-3 （2004） PDS of category C2
3. EN55011+A2（2007） Class A Group 1

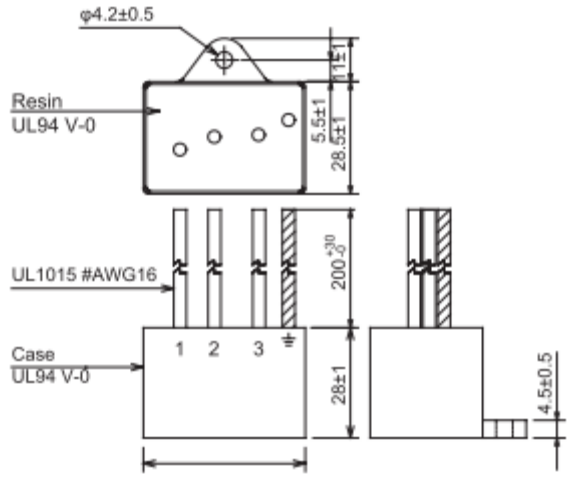


Surge Protector

Model	Rated Voltage	DC Breakdown	Current Life 8/20μs-1,000A	Marker
RSPD-250-U4	250Vac	700+-25%	Approx. 300times	OKAYA

RSPD-□□□-U series (Three-Phase)

Wire terminal type (-4)



EMC Filter

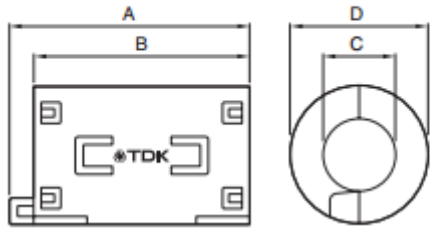
Item	Power	Servo Drive	EMI Filter model number		Marker
			1PH	3PH	
1	200W	ISA-7-020-S1	B84113C0000x110	B84143A0008R105	EPCOS
3	400W	ISA-7-040-S1	B84113C0000x110	B84143A0008R105	EPCOS
4	750W	ISA-7-075-S1	B84113C0000x110	B84143A0008R105	EPCOS
5	1000W	ISA-7-100-S1	B84113C0000x110	B84143A0016R105	EPCOS
6	1500W	ISA-7-150-S2	-	B84143A0016R105	EPCOS
7	2000W	ISA-7-200-S2	-	B84143A0025R105	EPCOS

Item	Power	Servo Drive	EMI Filter model number		Marker
			1PH	3PH	
1	200W	ISA-7-020-S1	TBD	FN 351 H-8-29	Schaffner
3	400W	ISA-7-040-S1	TBD	FN 351 H-8-29	Schaffner
4	750W	ISA-7-075-S1	TBD	FN 351 H-8-29	Schaffner

5	1000W	ISA-7-100-S1	TBD	FN 351 H-16-29	Schaffner
6	1500W	ISA-7-150-S2	-	FN 351 H-16-29	Schaffner
7	2000W	ISA-7-200-S2	-	FN 351 H-36-33	Schaffner

Clamp filter
<24V Power cable, Motor cable, Encoder cable, Interface cable>

■SHAPE & DIMENSIONS



Manufacture's Part No.	Manufacturer	A	B	C	D
ZCAT3035-1330	TDK	39 +- 1	34 +- 1	13 +- 1	30 +- 1

Installation notes

We hope that the EMI filter elaborates the maximum suppression against the interference from the servo drive. Therefore the servo drive must be installed and wired according to the manual. Furthermore, the following must be noted:

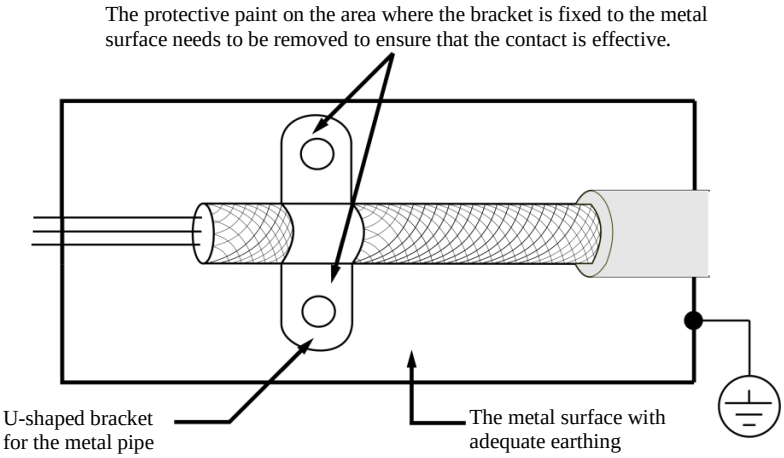
1. The servo drive and EMI filter must be installed on the same metal surface.
2. For the installation of the servo drive and EMI filter, the servo drive should be installed above the EMI filter, if possible.
3. The wiring must be as short as possible.
4. Adequate earthing is required for the metal surface.
5. The metal case or earth of the servo drive and EMI filter must be fixed firmly to the metal surface. The contact surface between the metal case or earth and the metal area must be as large as possible.

Selection of and installation notes for the motor wire

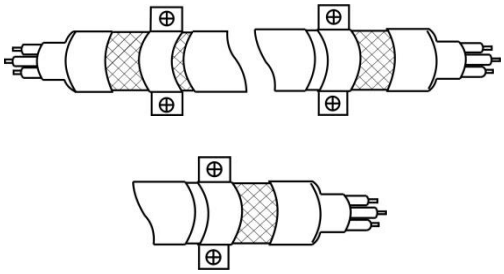
The selection and installation of the motor wire are associated with whether the EMI filter can elaborate the maximum suppression against the interference from the servo drive. Note the following:

1. The cable with copper mesh for separation must be used (double separation preferred).
2. The copper mesh for separation on both ends of the motor wire must be grounded with shortest distance and largest contact area.

The protective paint on the area where the U-shaped bracket for the metal pipe is fixed to the metal surface needs to be removed to ensure that the contact is effective. Refer to the figure as follows.



3. The copper mesh for separation of the motor wire must be connected adequately to the metal surface. The U-shaped bracket for the metal pipe should be used to fix the copper mesh for separation at both ends of the motor wire to the metal surface. See the figure below for the correct connection.



2.7. Selection for the regenerative resistor

If the output torque and rotating speed are in opposite directions, the energy is transmitted from the loading end into the drive. The energy entered the capacitor of the DC bus so that the voltage of the capacitor increases. The energy recharged can only be consumed by the regenerative resistor when the voltage rises to a certain value. The regenerative resistor is included in the drive and available for external connection.

The table below lists the specifications of the regenerative resistor offered by the ISA-7 series.

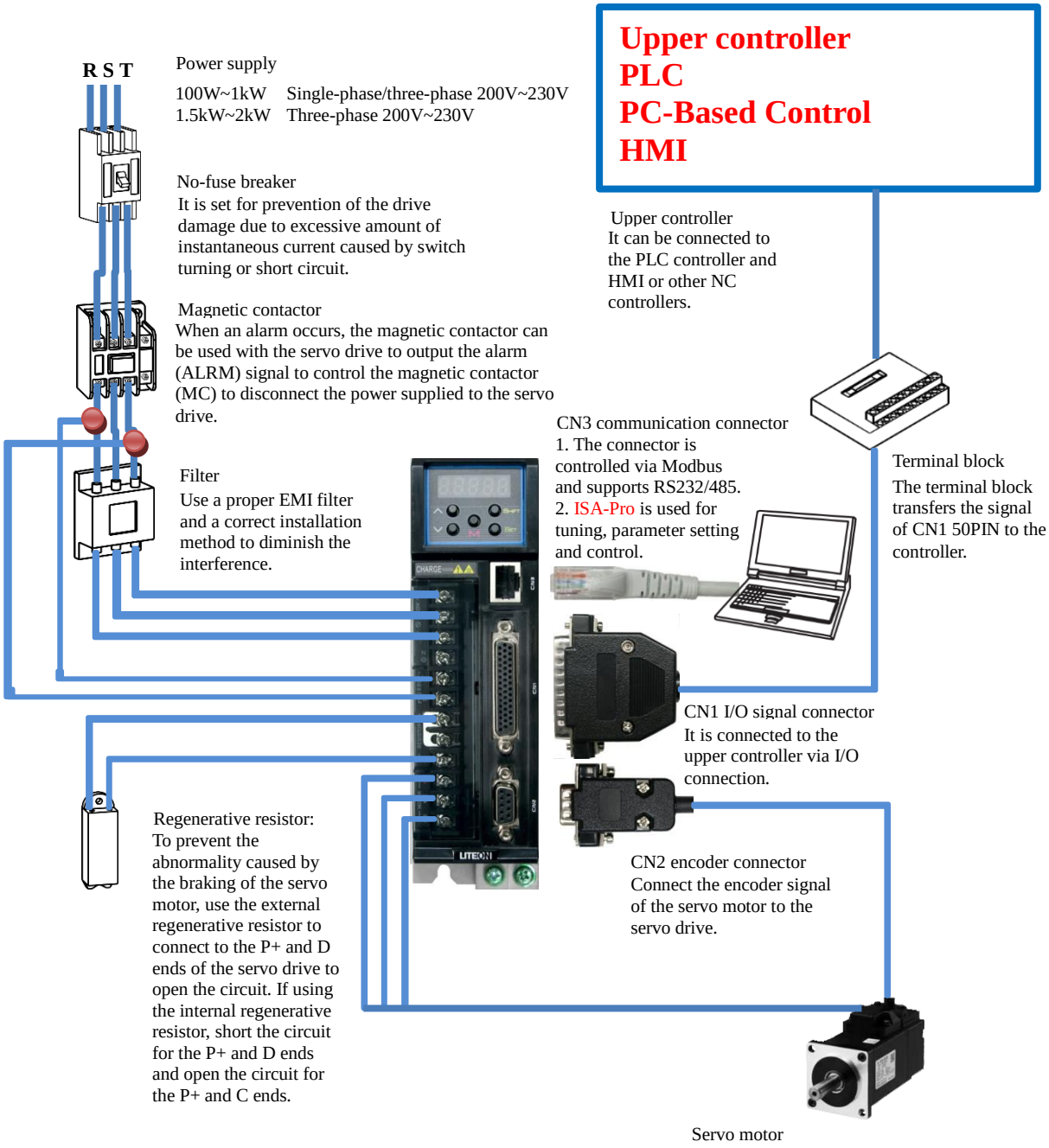
Drive (kW)	Specifications of the built-in regenerative resistor		The regenerative capacity processed by the built-in regenerative resistor	Minimum resistance tolerable
	Resistance (PD-45)	Capacity (PD-46)		
0.2	--	--	--	40
0.4	40	40	20	40
0.75	40	40	20	40
1.0	40	40	20	40
1.5	20	100	50	20
2.0	20	100	50	20

Chapter 3 Wiring

The chapter explains the connecting method of the servo drive and the meaning of all signals. It also lists the illustration of the standard wiring in various modes.

3.1. Connection for the peripheral device and main power circuit

3.1.1. Wiring diagram of the peripheral device



Installation notes:

1. Make sure that the power supply and wiring for the R S T and L1 and L2 must be accurate.
2. Make sure that the phase sequence regarding the wiring for the servo motor output U V W is correct. The motor will not work if the connection is wrong and an alarm will occur.
3. When using the external regenerative resistor, open the circuit for the P and D ends and connect the external regenerative resistor to the P and C ends. When using the internal external regenerative resistor, short the circuit for the P and D ends and open the circuit for the P and C ends.
   If using the external braking unit, connect P+ and P- of the braking unit to the P and N ends of the servo motor. Open the circuit for the P and D ends, as well as the P and C ends.
4. For the alarm or emergency stop, use ALM or WARN output to disconnect the magnetic contactor (MC) to cut off the power supply of the servo drive.

3.1.2. Connector and terminal of the drive

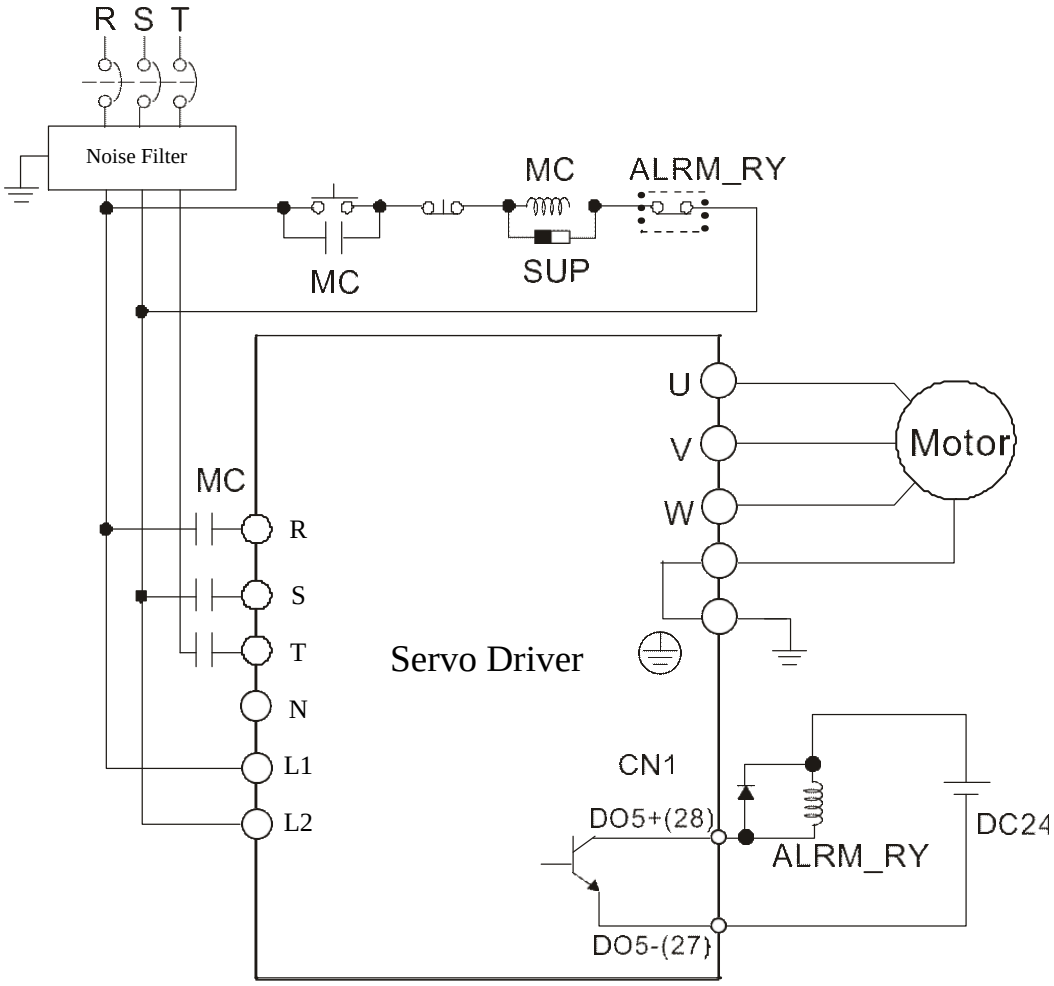
Indication	Name	Description	
R, S, T	Three-phase main circuit for RST power input	Connect the three-phase AC power supply. (Select adequate input voltage based on the product number.)	
L1, L2	Control power input end	Connect the single-phase AC power supply. (Select adequate input voltage based on the product number.)	
U, V, W **FG**	Motor power cable	Connect the cable to the motor. U (red) V (white) W (black) and FG (green) connect to the grounding area of the drive. ⏚	
P, D, **C,**	Regenerative resistor (braking resistor) contact	Use the internal resistor.	Make sure that it is short circuited between P and D and it is open circuited between P and C.
		Use the external resistor.	Connect the regenerative resistor to P and C. Make sure that it is open circuited between P and D.
		Use the external braking unit.	Connect P+ and P- of the braking unit to the P and N ends of the servo motor. Open the circuit for the P and D ends, as well as the P and C ends.
⏚	Electrical connection terminal	The contact for the earth wire of the power supply and motor	
CN1	I/O connector cable	It connects to the upper controller.	
CN2	Encoder connector	It connects to the motor encoder.	
CN3	Communication connector	It connects to the computer.	
CN5	*Analog voltage output terminal*	The monitoring (output) of the analog data, including MON1, MON2, GND	

The following must be noted for wire connecting:

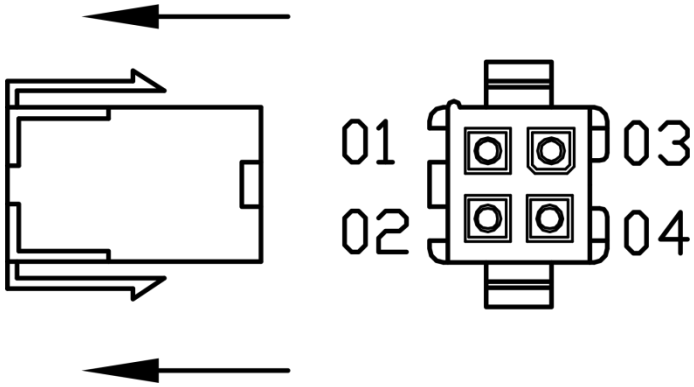
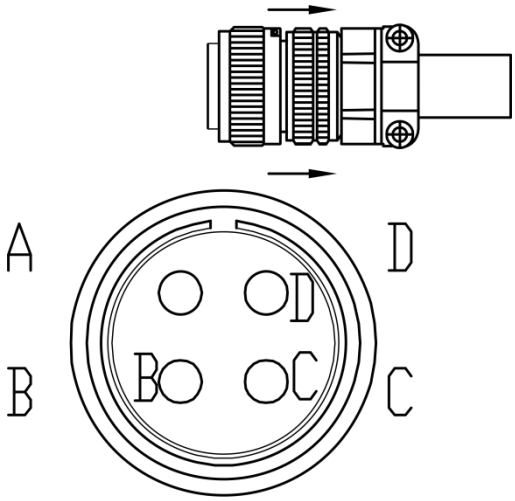
1. When the power is cut off, do not touch the six major power lines R, S, T and U, V, W. It is allowed to touch the lines after the charging light goes off.
2. Keep the six major power linesR, S, T and U, V, W away from other signal cables. Try to keep the distance above 30 cm.
3. For extending the connecting line for encoder CN2, use the twisted-pair signal cable with isolated grounding. Keep the cable within 20 m. If its length exceeds 20 m, use the one with the wire diameter twice larger than the current one to keep the signal level from excessive attenuation.

3.1.3. Power wiring

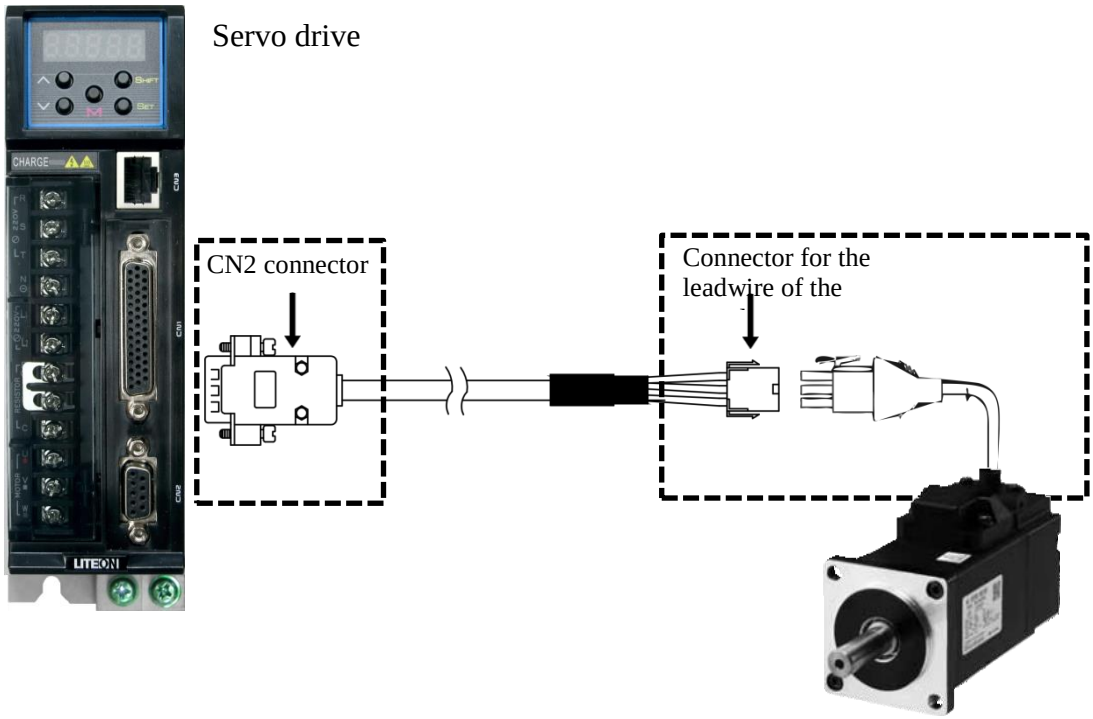
The servo drive and power wiring can be divided into the single- and three-phase. The single-phase can only be used for models with the power equal to 1kW or below. In the diagram, Power On is for Point a. Power Off and ALRM_RY are for Point b. MC indicates the coil of the magnetic contactor and self-holding power. It connects to the power supply of the main circuit.



3.1.4. Specifications for the U, V, W connectors of the motor

Motor number	U, V, W electromagnetic braking connector	
LMA201, LMH201 Series LMA401, LMH401 Series LMA751, LMH751 Series		
LMM102, LMH102 Series LMM152, LMH152 Series LMM202, LMH202 Series	 Front view	

3.1.5. Specifications regarding the connector for the leadwire of the encoder



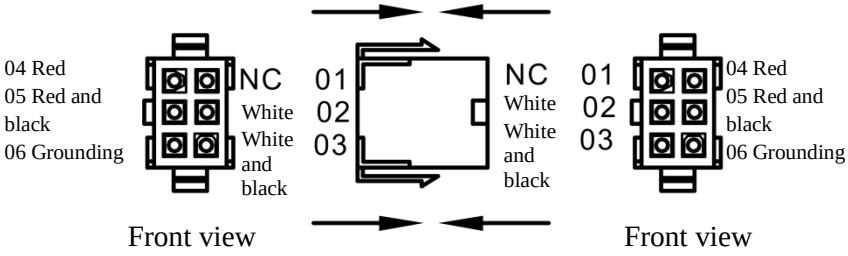
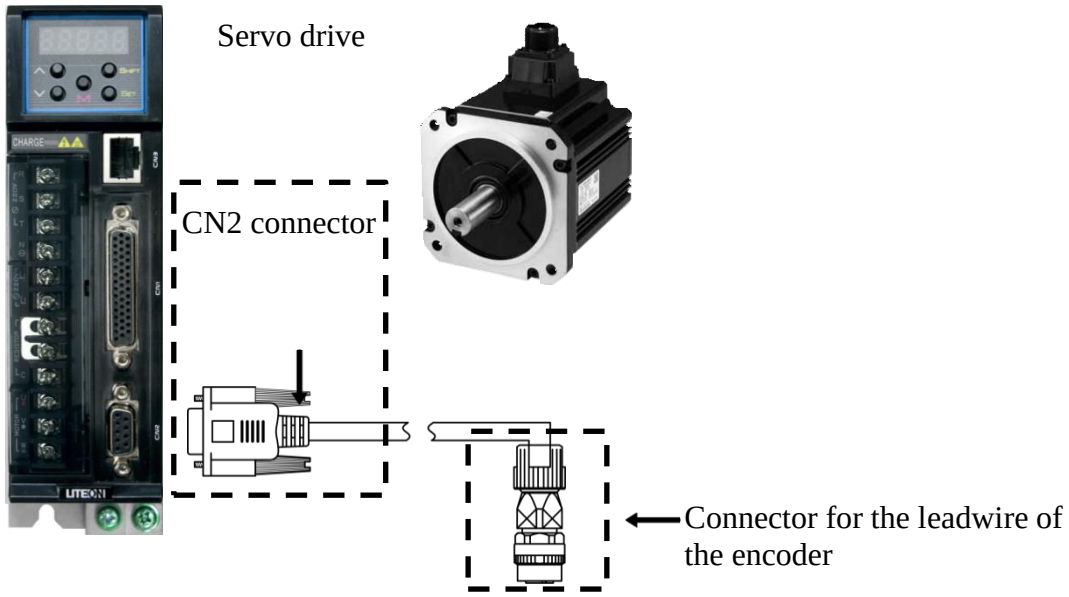
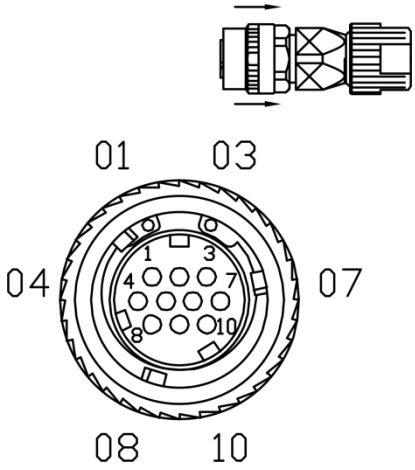
Motor number	Encoder connector
LMA201, LMH201 Series LMA401, LMH401 Series LMA751, LMH751 Series	

Diagram II for encoder connection:



Refer to Sec. 3.4 "CN2 Wiring for the encoder signal".

Motor number	Encoder connector
LMM102, LMH102 Series LMM152, LMH152 Series LMM202, LMH202 Series	

Select the multi-core wire with the knitted wire mesh for the filament. The knitted wire mesh must be connected to the SHIELD end.

3.1.6. Filament selection

The following table shows the filament recommended for each terminal and signal wiring of the LITEON ISA-7 drive:

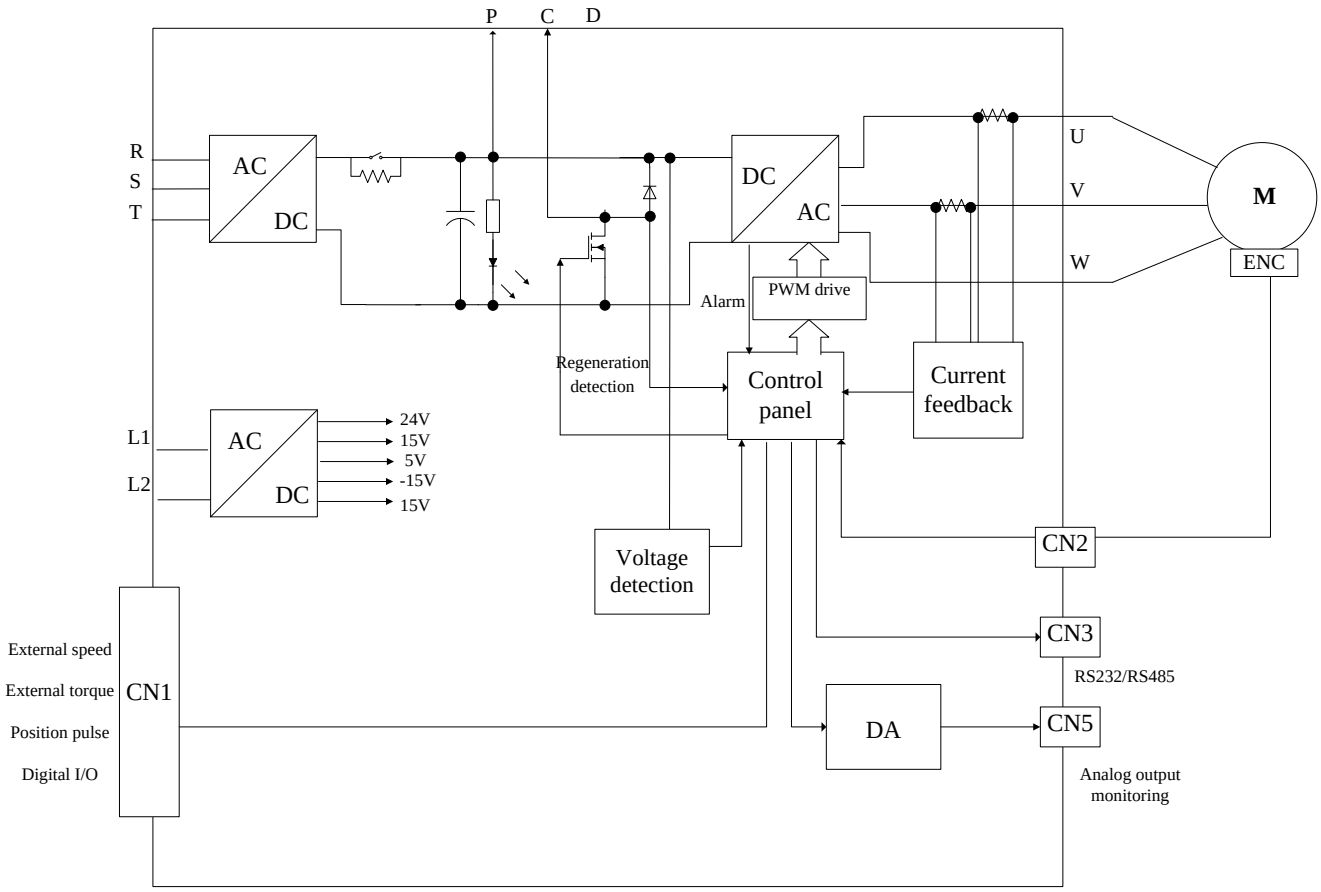
Drive and corresponding motor number		Power wiring- wire diameter (mm^2) (AWG)			
		L1, L2	R, S, T	U, V, W	P, C
ISA-7-020-S1	MA201, MH201	1.3(AWG16)	2.1(AWG14)	0.82(AWG18) UL2517	2.1(AWG14)
ISA-7-040-S1	MA401, MH401	1.3(AWG16)	2.1(AWG14)	0.82(AWG18) UL2517	2.1(AWG14)
ISA-7-075-S1	MA751, MH751	1.3(AWG16)	2.1(AWG14)	0.82(AWG18) UL2517	2.1(AWG14)
ISA-7-100-S1	MM102, MH102	1.3(AWG16)	2.1(AWG14)	2.1(AWG14) UL2733	2.1(AWG14)
ISA-7-150-S2	MM152, MH152	1.3(AWG16)	2.1(AWG14)	2.1(AWG14) UL2733	2.1(AWG14)
ISA-7-200-S2	MM202, MH202	1.3(AWG16)	2.1(AWG14)	2.1(AWG14) UL2733	2.1(AWG14)

Drive model	Encoder wiring - wire diameter (mm^2) (AWG)			
	Size of core wire	Number of core wires	Standards for wire type	Standard wire length
ISA-7-020-S1	0.21（AWG24）	5 (2 pairs)	UL2464	3M
ISA-7-040-S1	0.21（AWG24）	5 (2 pairs)	UL2464	3M
ISA-7-075-S1	0.21（AWG24）	5 (2 pairs)	UL2464	3M
ISA-7-100-S1	0.21（AWG24）	5 (2 pairs)	UL2464	3M
ISA-7-150-S2	0.21（AWG24）	5 (2 pairs)	UL2464	3M
ISA-7-200-S2	0.21（AWG24）	5 (2 pairs)	UL2464	3M

1. Use the shielded twisted-pair cable for the wiring of the encoder to mitigate the interference of the noise.
2. The wire mesh ⏚ must be connected to the SHIELD end.
3. The wiring depends on the filament selected to avoid accidents.

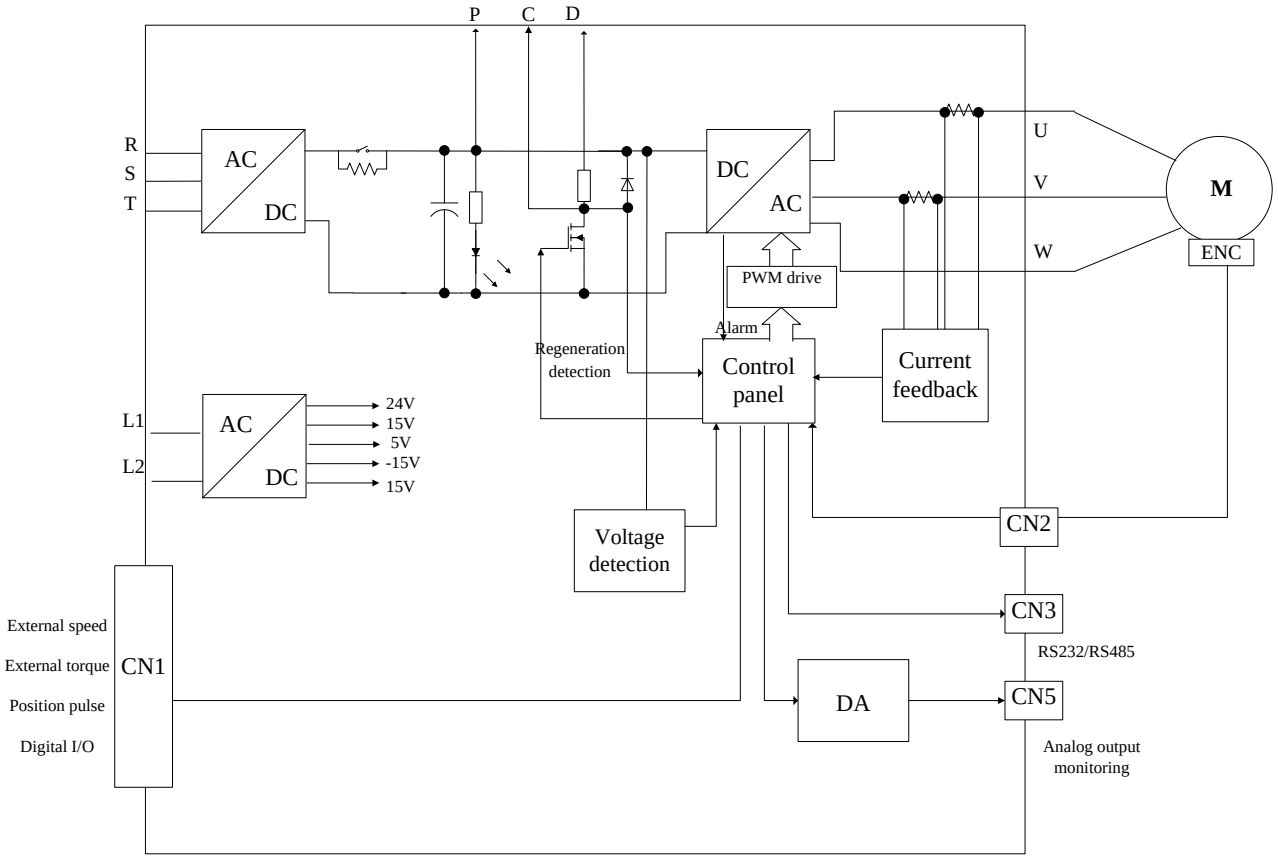
3.2. Basic block diagram of the server system

3.2.1. Models with the power equal to or below 200W (no built-in regenerative resistor or fan)



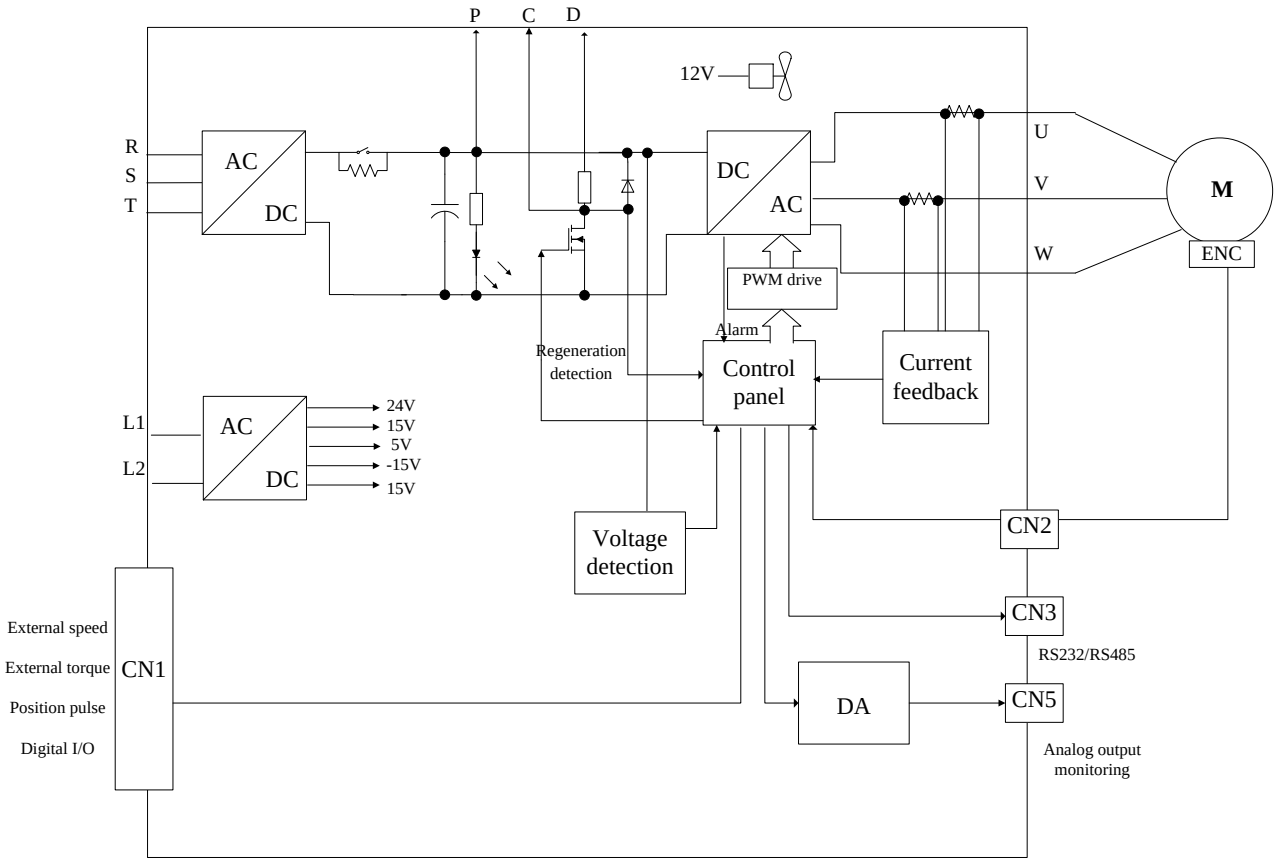
Note: When power input in single phase, connect power cable to whichever 2 of RST.

3.2.2. 400W / 750W model (with regeneration resistor but no fan)



Note: When power input in single phase, connect power cable to whichever 2 of RST.

3.2.3. 1kW ~ 2kW model (with regeneration resistor and fan)



3.3. CN1 I/O Signal wiring

3.3.1. CN1 I/O layout of the connector terminal

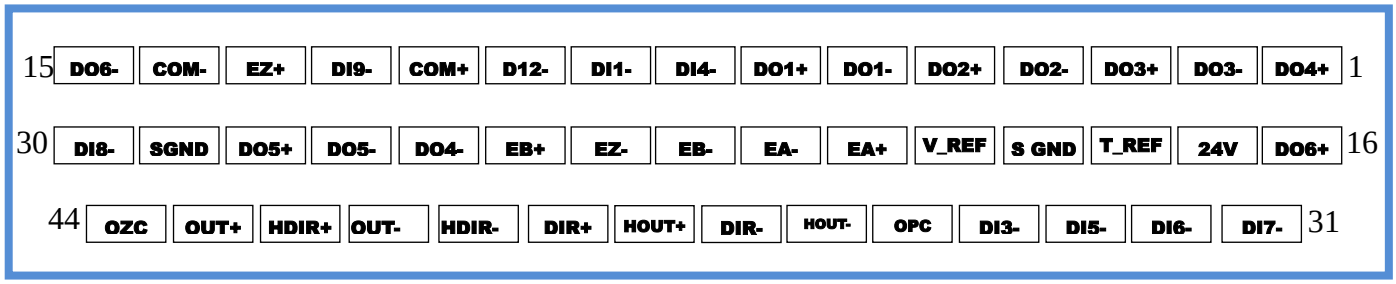
ISA-7 provides 6 sets of outputs and 9 sets of inputs that can be planned as wish. ISA-7 also offers the signals of the differential output encoder, which are A+, A-, B+, B-, Z+ and Z-. In addition, it providesthe analog torque command input, analog speed/position command input and pulse position command input. Its pin-out diagram is as follows:

Front view

Side view

15 1
30 16
44 31

Rear view



1	DO4+	Digital output	**23**	EB-	Encoder B pulse output
2	DO3-	Digital output	**24**	EZ-	Encoder Z pulse output
3	DO3+	Digital output	**25**	EB+	Encoder B pulse output
4	DO2-	Digital output	**26**	DO4-	Digital output
5	DO2+	Digital output	**27**	DO5-	Digital output
6	DO1-	Digital output	**28**	DO5+	Digital output
7	DO1+	Digital output	**29**	S GND	Grounding of the analog input signal

8	DI4-	Digital Input	**30**	DI8-	Digital Input
9	DI1-	Digital Input	**31**	DI7-	Digital Input
10	DI2-	Digital Input	**32**	DI6-	Digital Input
11	COM+	Power input end (12~24V)	**33**	DI5-	Digital Input
12	DI9-	Digital Input	**34**	DI3-	Digital Input
13	EZ+	Encoder Z pulse Differential output	**35**	OPC	External power supply of the command pulse
14	COM-	VDD (24V) Grounding of the power supply	**36**	HOUT-	High speed position Command pulse (-)
15	DO6-	Digital output	**37**	DIR-	Position command symbol (-)
16	DO6+	Digital output	**38**	HOUT+	High speed position Command pulse (+)
17	24V	+24V power output (for external I/O)	**39**	DIR+	Position command symbol (+)
18	T Ref	Analog command input torque	**40**	HDIR-	High speed position Command symbol (-)
19	S GND	Grounding of the analog input signal	**41**	OUT-	Position command pulse (-)
20	V Ref	Analog command input speed (+)	**42**	HDIR+	High speed position Command symbol (+)
21	EA+	Encoder A pulse output	**43**	OUT+	Position command pulse (+)
22	EA-	Encoder/A pulse output	**44**	OZC	Encoder Z pulse Open collector

3.3.2. CN1 I/O Connector signal

General signal

Name		Pin No	Function	Remark
Analog command (input)	V Ref	20	(1) The speed command of the motor -10V ~ +10V indicates the rotation speed -3000~ +3000 r/min (default). The corresponding range can be changed via the parameter.	
	T Ref	18	The torque command of the motor -10V ~ +10V indicates the rated torque command -100% ~+100%.	
Position pulse command (input)	OUT+ OUT- DIR+ DIR- OPC(PULL HI)	43 41 39 37 35	The position pulse can be input via the line driver (maximum single-phase pulse frequency 500KHz) or open collector (maximum single-phase pulse frequency 200KHz). Three command forms are available (forward reverse pulse, pulse and direction, as well as AB phase pulse) and can be selected via the parameter. When the position pulse is input via the open collector, the terminal must be connected to an external power supply for level increasing.	
High speed position pulse command (input)	HOUT+ HOUT- HDIR+ HDIR-	38 36 42 40	The high speed position pulse only allows the input via the line driver (+5V). The maximum single-phase pulse frequency is 4 MHz. For the command forms, three pulse types are available, which are AB phase, CW+CCW, as well as plus and direction.	
Position pulse command (output)	EA+ EA-	21 22	The A, B and Z signals of the encoder are output via the line driver.	
	EB+ EB-	25 23		
	EZ+ EZ-	13 24		
	OZC	44	The encoder Z-phase with the open collector	
Power supply	24V	17	The VDD is the +24V power supply provided by the drive. It can be used for the DI and DO signals and it has a resistor of 500mA.	
	COM+ COM-	11 14	The COM+ is the command end for DI voltage input. When the VDD is used for the voltage, the VDD must be connected to COM+. If the VDD is not used, the user must provide the external power supply (+12V ~ +24V). The positive pole of the external power supply must connect to COM+ and the negative pole to COM-.	
	S GND	19	Grounding of the analog input signal	

The user selects the operating mode based on his or her own need and refers to the DI/DO table to find out the default DI/DO signal in the selected mode and the Pin No of the signal for wiring. The following table lists the default DI/DO signal function and pin number:

Description for the default DO signal

DO Name	Operating Mode	Pin No		Function	Remark
		+	-		
SRDY	ALL	7	6	After the drive is electrified, this input is ON if there is no alarm (ALRM) for the control circuit and motor power circuit.	
SVON				If the input SVON is ON, this input is ON after it is confirmed that the motor servo circuit operates smoothly.	
ZSPD	ALL	5	4	If the rotation speed of the motor is less than the setting value of the parameter (PC-20), this input is ON.	
RSPD	ALL (P excluded)			If the actual rotation speed (r/min) of the motor exceeds the setting value of the parameter (PD-43), this input is ON.	
INP	P, P-S, P-T	16	15	If the error (PULSE) between the motor command and the actual position is less than the setting value of the parameter (PA-20), this input is ON.	
ALM	ALL	28	27	An alarm occurs for the servo drive. (The WARN is input when the positive and negative limits, emergency stop, communication abnormality and low voltage occur.)	
BREAK	ALL			The control contact of the electromagnetic brake	
OLW	ALL			When the overload level setting is reached, the input is ON.	
WARN	ALL			Warning output of the servo drive The warning output is generated when the positive and negative limits, emergency stop, communication abnormality and low voltage occur.	
S_CMP	S, Sn			If the error value between the speed command and motor feedback speed is below the setting value of the parameter (PC-23), this input is ON.	

The following describes the default DI signal.

<table>
<tr><th>DI Name</th><th>Operating Mode</th><th>Pin No</th><th>Function</th><th>Remark</th></tr>
<tr><td>SVON</td><td>ALL</td><td>9</td><td>If the mode is ON, the servo circuit is activated and the motor coil is excited.</td><td></td></tr>
<tr><td>ARST</td><td>ALL</td><td>33</td><td>After the alarm (ALRM) occurs, this signal is used to reset the drive to output the Ready (SRDY) signal again.</td><td></td></tr>
<tr><td>GAINUP</td><td>ALL</td><td></td><td>It is used to switch the controller gain.</td><td></td></tr>
<tr><td>CCLR</td><td>P</td><td></td><td>It is used to clear the error counter.</td><td></td></tr>
<tr><td>ZCLMP</td><td>ALL</td><td></td><td>If this signal is ON and the motor speed is below the setting value of the parameter PC-20, the position of the motor is locked to the one that the signal is generated instantly.</td><td></td></tr>
<tr><td>CMDV</td><td>T, S</td><td></td><td>If this signal is ON, the direction that the motor moves to is reversed.</td><td></td></tr>
<tr><td>TRQL</td><td>S, Sn</td><td>10</td><td>ON indicates that the torque limiting command is effective.</td><td></td></tr>
<tr><td>SPDL</td><td>T, Tn</td><td>10</td><td>ON indicates that the speed limiting command is effective.</td><td></td></tr>
<tr><td>SPD0</td><td rowspan="2">S, Sn,
PT-S,
S-T</td><td>34</td><td rowspan="2">The source of the speed command is selected:
<table>
<tr><th>SPD1</th><th>SPD0</th><th>Command Source</th></tr>
<tr><td>0</td><td>0</td><td>The S mode is the analog input;</td></tr>
<tr><td>0</td><td>1</td><td>Parameter setting</td></tr>
<tr><td>1</td><td>0</td><td>Parameter setting</td></tr>
<tr><td>1</td><td>1</td><td>Parameter setting</td></tr>
</table></td><td rowspan="2"></td></tr>
<tr><td>SPD1</td><td>8</td></tr>
<tr><td>TCM0</td><td>PT,T, Tn,
PT-T</td><td>34</td><td rowspan="2">The source of the torque command is selected:
<table>
<tr><th>TCM1</th><th>TCM0</th><th>Command Source</th></tr>
<tr><td>0</td><td>0</td><td>The T mode is the analog input;</td></tr>
<tr><td>0</td><td>1</td><td>Parameter setting</td></tr>
<tr><td>1</td><td>0</td><td>Parameter setting</td></tr>
<tr><td>1</td><td>1</td><td>Parameter setting</td></tr>
</table></td><td rowspan="2"></td></tr>
<tr><td>TCM1</td><td>S-T</td><td>8</td></tr>
<tr><td>S-P</td><td>P-S</td><td>31</td><td>It is used for switching of the mixed mode. OFF: Speed; ON: Position</td><td></td></tr>
<tr><td>S-T</td><td>S-T</td><td>31</td><td>It is used for switching of the mixed mode. OFF: Speed; ON: Torque</td><td></td></tr>
<tr><td>T-P</td><td>P-T</td><td>31</td><td>It is used for switching of the mixed mode. OFF: Torque; ON: Position</td><td></td></tr>
<tr><td>EMG</td><td>ALL</td><td>30</td><td>B contact is used. This mode must be conducted (ON) often, otherwise the drive shows an alarm (ALRM).</td><td></td></tr>
<tr><td>NL</td><td>P, S, T
Sn, Tn</td><td>32</td><td>This mode indicates the CCW-limit. B contact is used. This mode must be conducted (ON) often, otherwise the drive shows an alarm (ALRM).</td><td></td></tr>
<tr><td>PL</td><td>PT, S, T
Sn, Tn</td><td>31</td><td>This mode indicates the CW-limit. B contact is used. This mode must be conducted (ON) often, otherwise the drive shows an alarm (ALRM).</td><td></td></tr>
<tr><td>TLLM</td><td></td><td></td><td>It indicates the reverse torque limit.</td><td></td></tr>
<tr><td>TRLM</td><td></td><td></td><td>It indicates the forward torque limit.</td><td></td></tr>
<tr><td>JOGEN</td><td>ALL</td><td></td><td>It allows the selection of the jog function for external terminals.
This signal must be connected to use the jog function for external terminals.</td><td></td></tr>
<tr><td>JOGU</td><td>ALL</td><td></td><td>When the signal is connected, the motor moving forward changes to inching rotation.</td><td></td></tr>
<tr><td>JOGD</td><td>ALL</td><td></td><td>When the signal is connected, the motor moving in</td><td></td></tr>
</table>

			reverse changes to inching rotation.	
GNUM0	P, P-S		Select 0 for the electronic gear ratio. (The numerator of the gear ratio available (PA-11 ~ PA-13))	
GNUM1	P, P-S		Select 1 for the electronic gear ratio. (The numerator of the gear ratio available (PA-11 ~ PA-13))	
INHP	P, P-S		The pulse input is prohibited. In the position mode, the external pulse input command is ineffective when this signal is connected.	

The default DIs and DOs under each operating mode are arranged as follows:

Table for definitions of the default DI input

Name	DI Code	Input function	P	S	T	Sn	Tn	PS	PT	ST
DISABLE	0x00	No function	DI9	DI9	DI9	DI9	DI9			
SVON	0x01	Servo on	DI1	DI1	DI1	DI1	DI1	DI1	DI1	DI1
ARST	0x02	Error reset	DI5	DI5	DI5	DI5	DI5	DI5	DI5	DI5
GAINUP	0x03	Gain switching								
CCLR	0x04	Pulse cleaning	DI2					DI2	DI2	
ZCLMP	0x05	Zero speed clamping								
CMDV	0x06	Command input reverse control								
TRQL	0x07	Torque limit		DI2		DI2				DI2
SPDL	0x08	Speed limit			DI2		DI2			
SPD0	0x09	Selection of Speed Command 0		DI3		DI3		DI3		DI3
SPD1	0x0A	Selection of Speed Command 1		DI4		DI4		DI4		DI4
TCM0	0x0B	Selection of Torque Command 0	DI3		DI3		DI3		DI3	DI6
TCM1	0x0C	Selection of Torque Command 1	DI4		DI4		DI4		DI4	DI7
S-P	0x0D	Switching of the speed/position mixed mode						DI9		
S-T	0x0E	Switching of the speed/torque mixed mode								DI9
T-P	0x0F	Switching of the torque/position mixed mode							DI9	
EMG	0x15	Emergency stop	DI8	DI8	DI8	DI8	DI8	DI8	DI8	DI8
NL	0x16	Limit of reverse inhibition	DI6	DI6	DI6	DI6	DI6	DI6	DI6	
PL	0x17	Limit of forward inhibition	DI7	DI7	DI7	DI7	DI7	DI7	DI7	
JOGEN	0x19	Selection of the jog control for the terminal								
JOGU	0x1A	Forward jog input								
JOGD	0x1B	Reverse jog input								
GNUM0	0x21	Selection of the Numerator of the Electronic Gear Ratio 0								
GNUM1	0x22	Selection of the Numerator of the Electronic Gear Ratio 1								
TLLM	0x23	Reverse torque limit								
TRLM	0x24	Forward torque limit								
INHP	0x25	Pulse input inhibited								
Reserved		Reserved								
Reserved		Reserved								
Reserved		Reserved								
Reserved		Reserved								

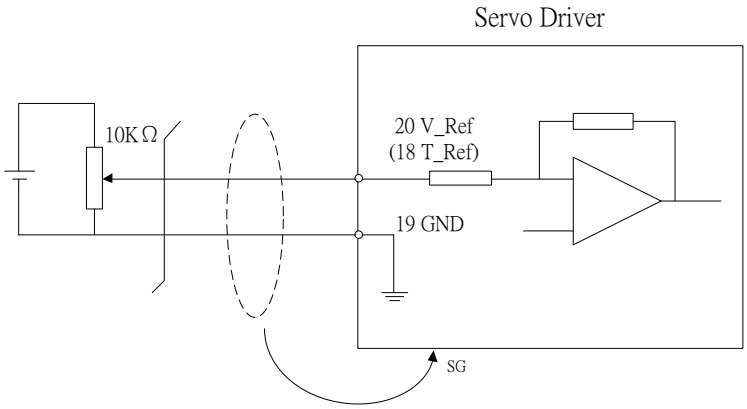
Table for definitions of the default DO output

Name	DO code	Output Function	P	S	T	Sn	Tn	PS	PT	ST
SRDY	0x01	Servo ready	DO1	DO1	DO1	DO1	DO1	DO1	DO1	DO1
SVON	0x02	Servo on	DO4	DO4	DO4	DO4	DO4	DO4	DO4	DO4
ZSPD	0x03	Zero speed detection	DO2	DO2	DO2	DO2	DO2	DO2	DO2	DO2
RSPD	0x04	Target speed reached	DO3	DO3	DO3	DO3	DO3	DO3	DO3	DO3
INP	0x05	Target position reached	DO6					DO6	DO6	
ALM	0x06	Servo alarm	DO5	DO5	DO5	DO5	DO5	DO5	DO5	DO5
BREAK	0x07	Electromagnetic brake								
OLW	0x08	Overload alert								
WARN	0x0A	Servo warning								
SNL	0x0B	Software limit (reverse direction)								
SPL	0x0C	Software limit (forward direction)								
SP_IN	0x0F	Speed reaching output								

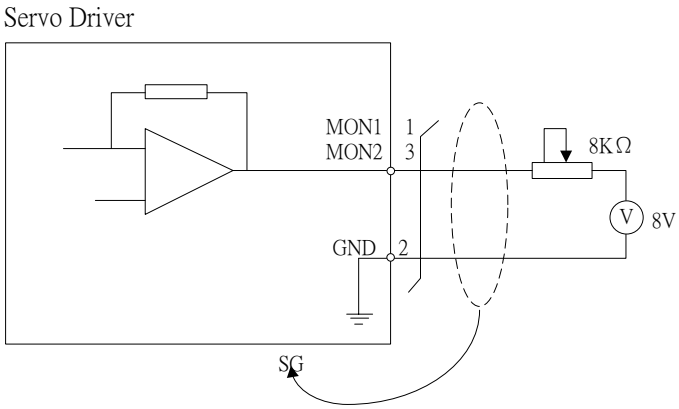
3.3.3. Interface wiring diagram (CN1)

The analog monitoring output relates to MON1 and MON2. The effective voltage range for the speed and torque analog command input is -10V ~ +10V. The command value corresponding to the voltage range may be set via the relevant parameter. The input impedance is 10K.

Analog command input for the speed and torque

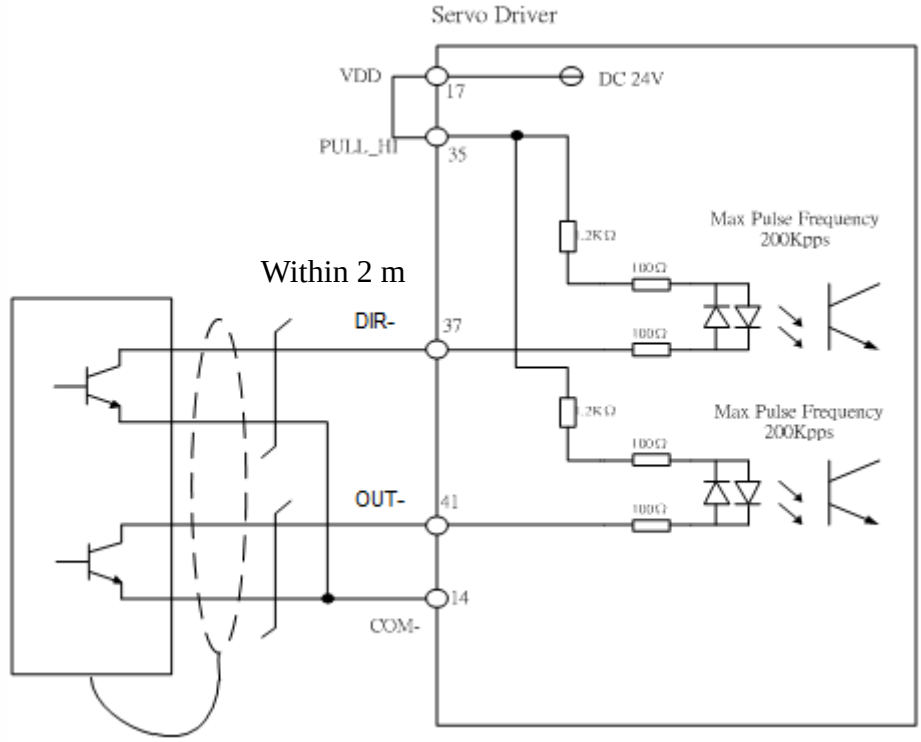


Analog monitoring output MON1, MON2

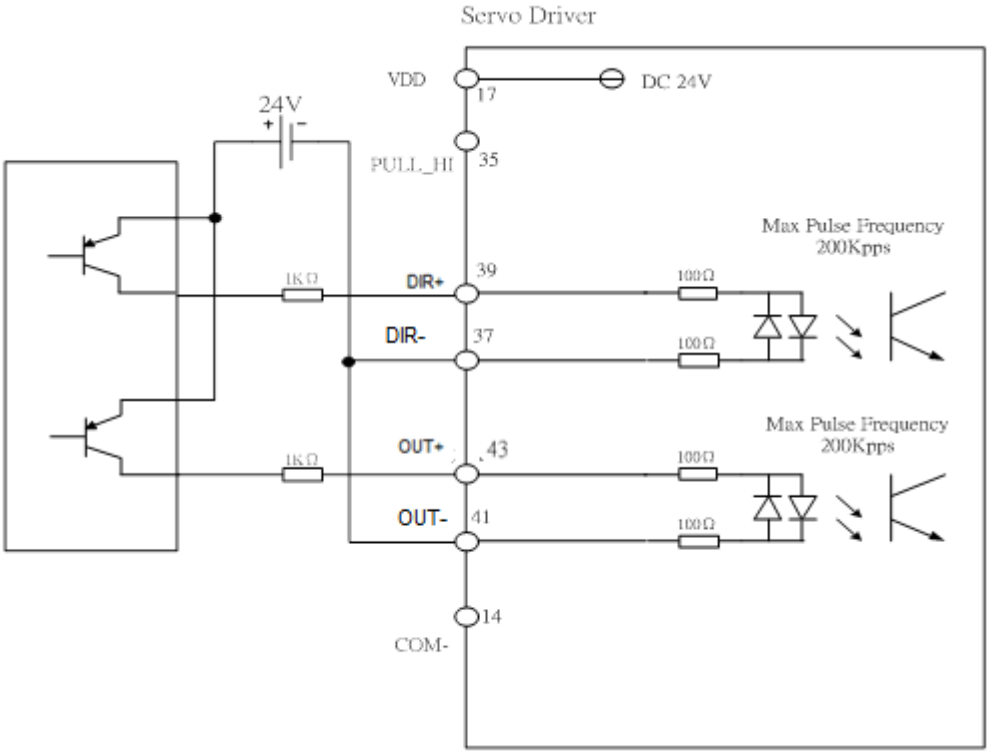


The pulse command can be input via the open collector or line driver. The maximum input pulse for the input via the line driver is 500 Kpps. The maximum input pulse for the open collector is 200 Kpps. The wire length is within 2m.

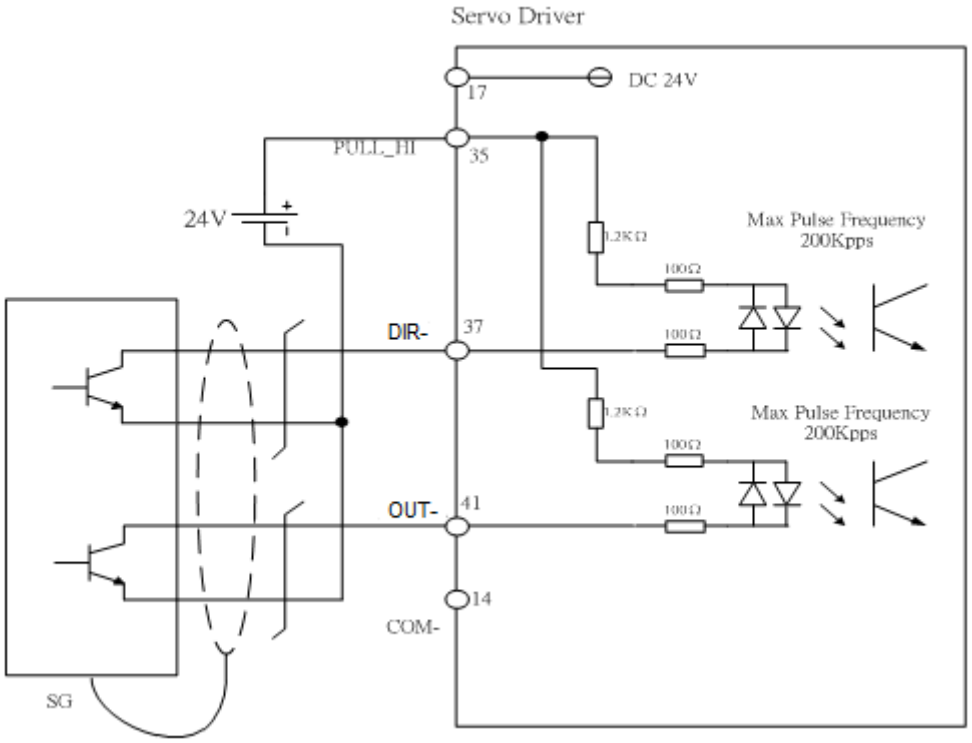
The pulse input source is the NPN type open collector. The power supply in the drive is used.



The pulse input source is the PNP type open collector. The power supply in the drive is used.

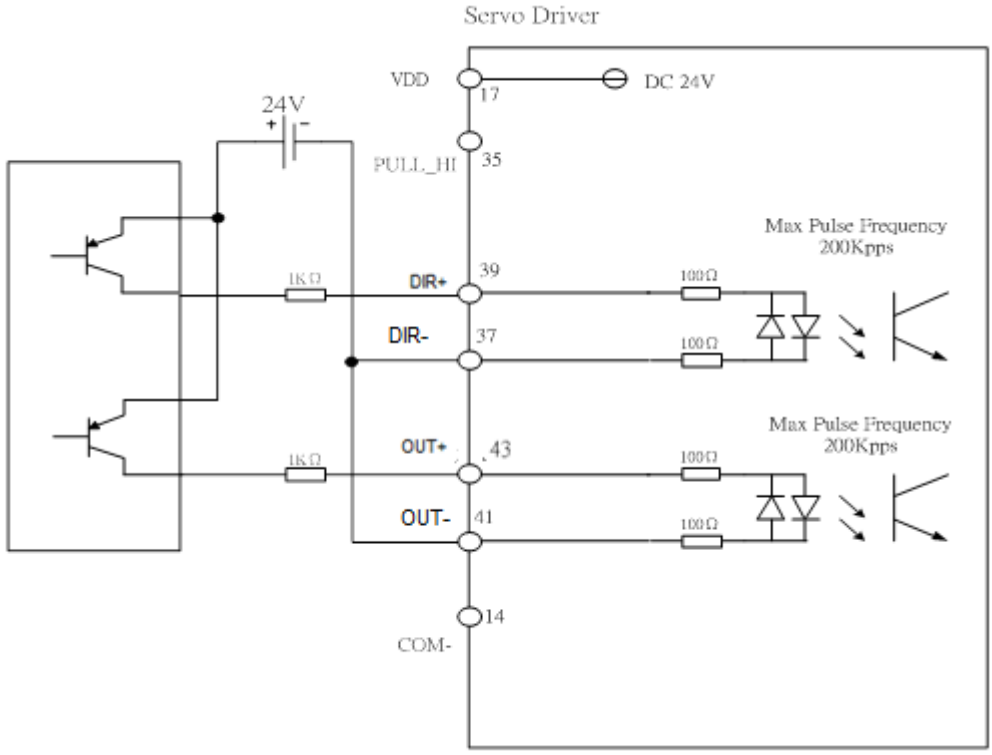


The pulse input source is the NPN type open collector. The external power supply is used.



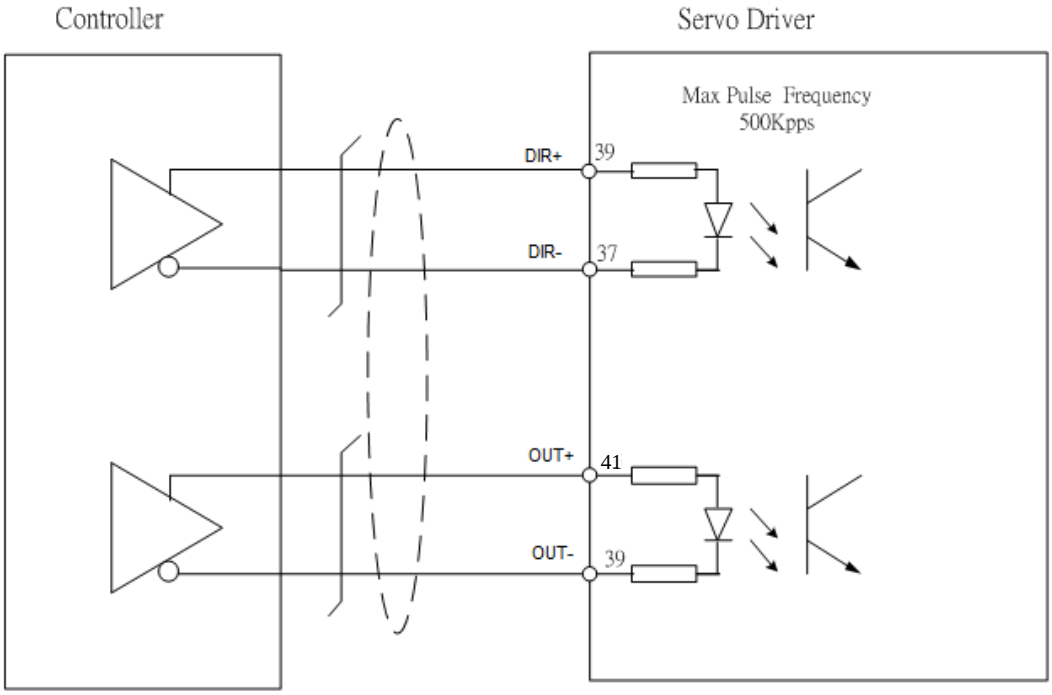
Note: The double power input is not allowed, otherwise the burning may occur.

The pulse input source is the PNP type open collector. The external power supply is used.

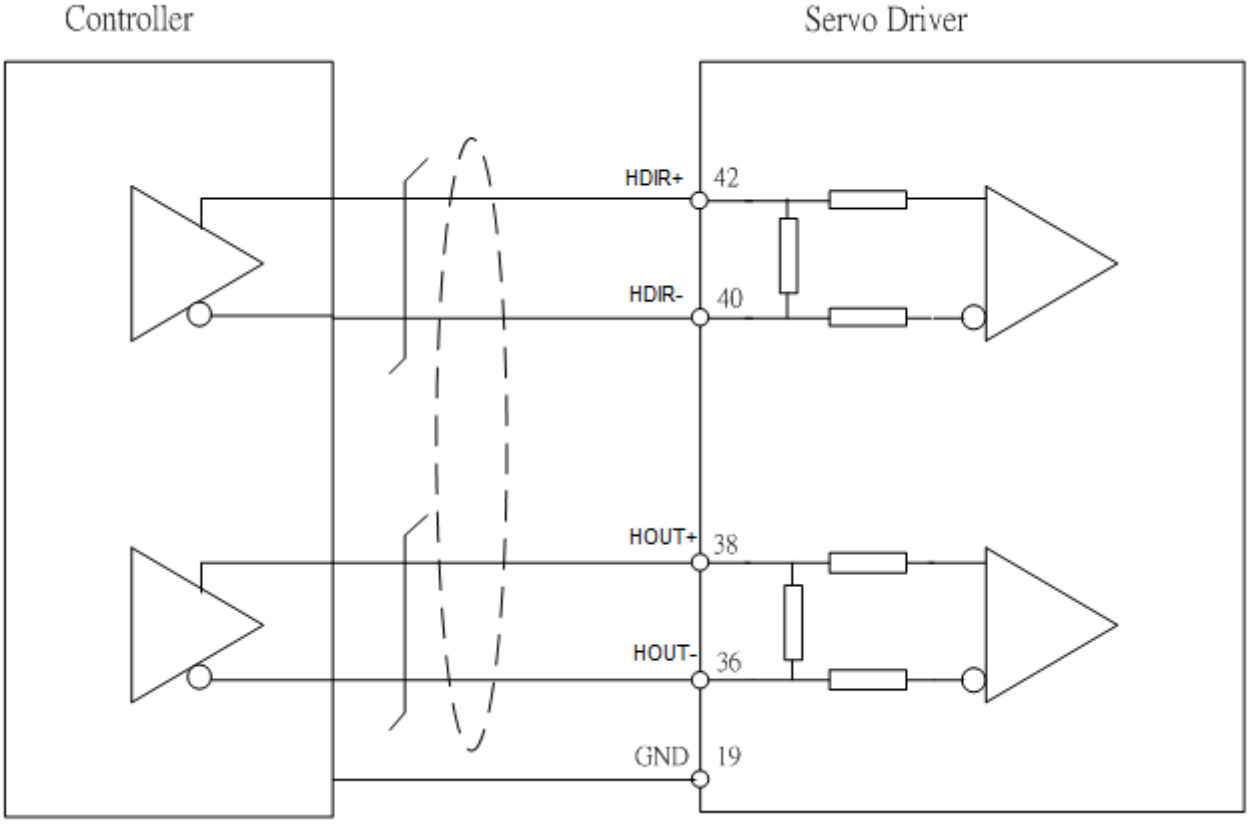


Note: The double power input is not allowed, otherwise the burning may occur.

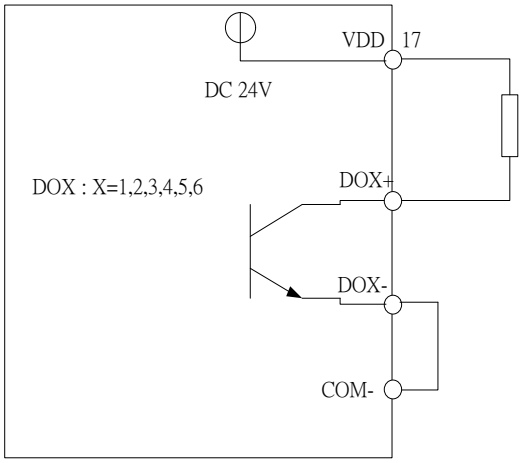
This is the pulse command input (differential input). This is a 5V system. The 24V power supply is not allowed for input.



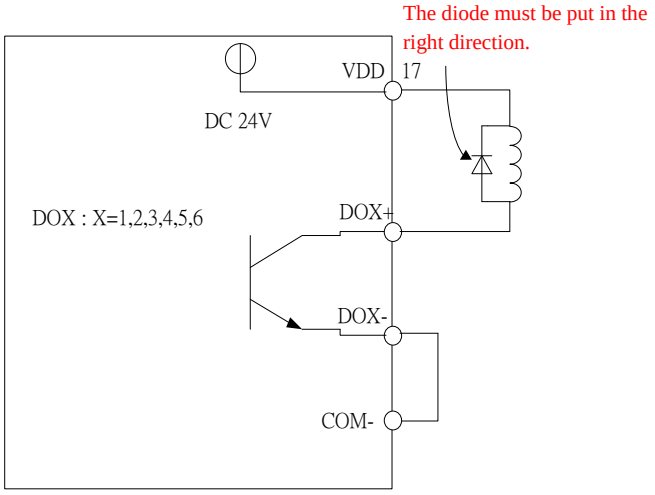
This is the pulse command input with high speed (differential input). This is a 5V system. The 24V power supply is not allowed for input.



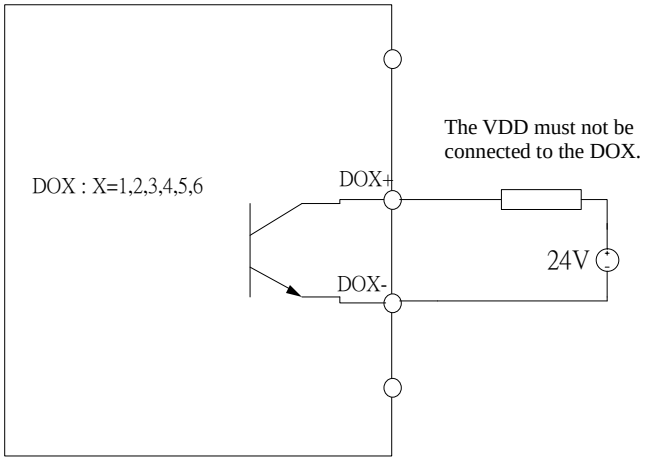
DO wiring, internal power supply, normal load



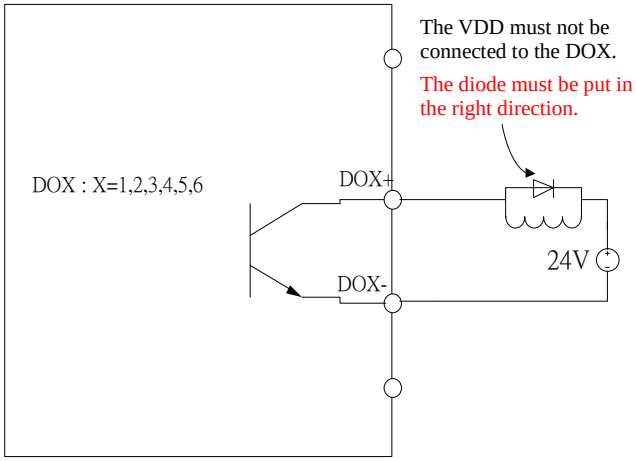
DO wiring, internal power supply, inductive load



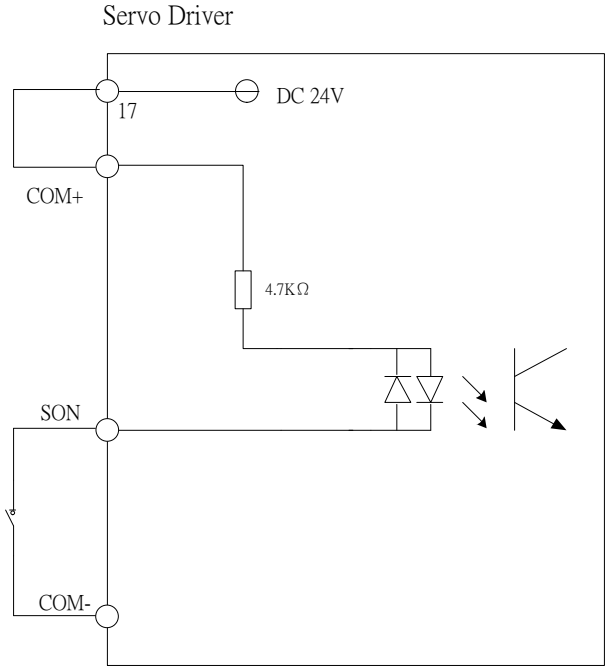
DO wiring, external power supply, normal load



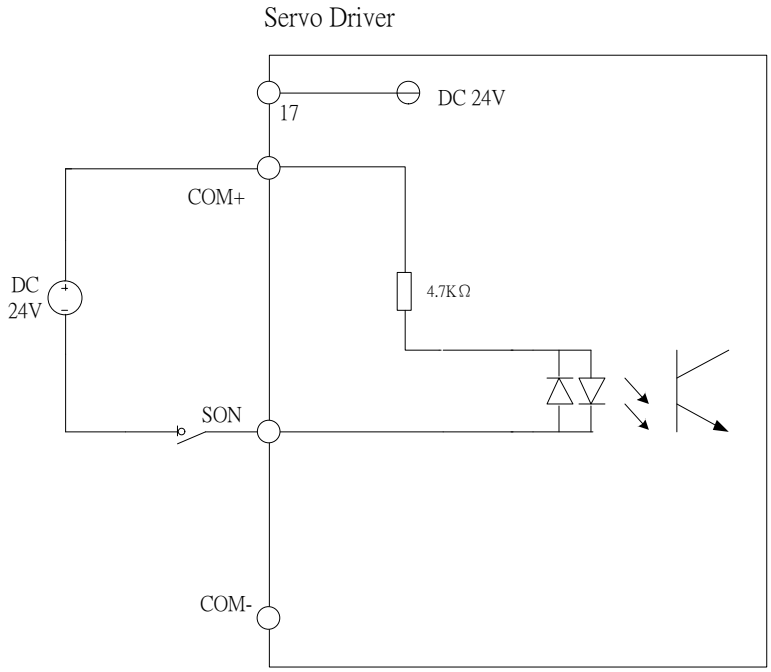
DO wiring, external power supply, inductive load



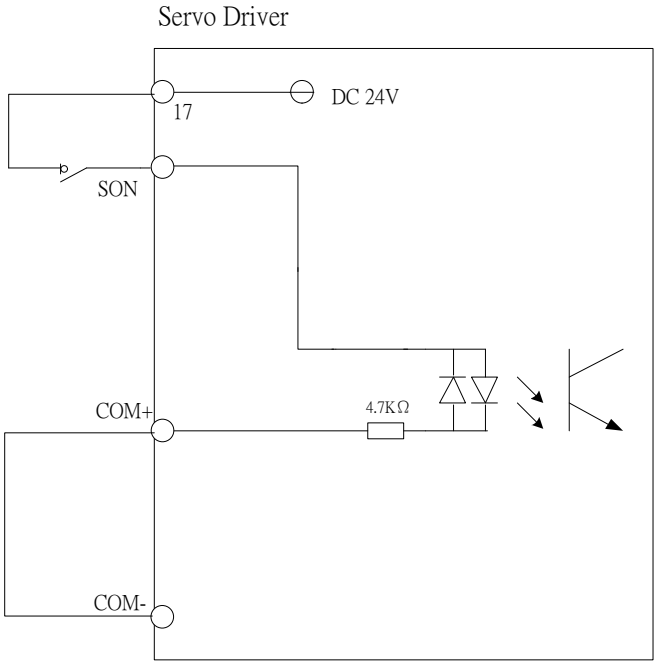
DI wiring, internal power supply, SINK mode



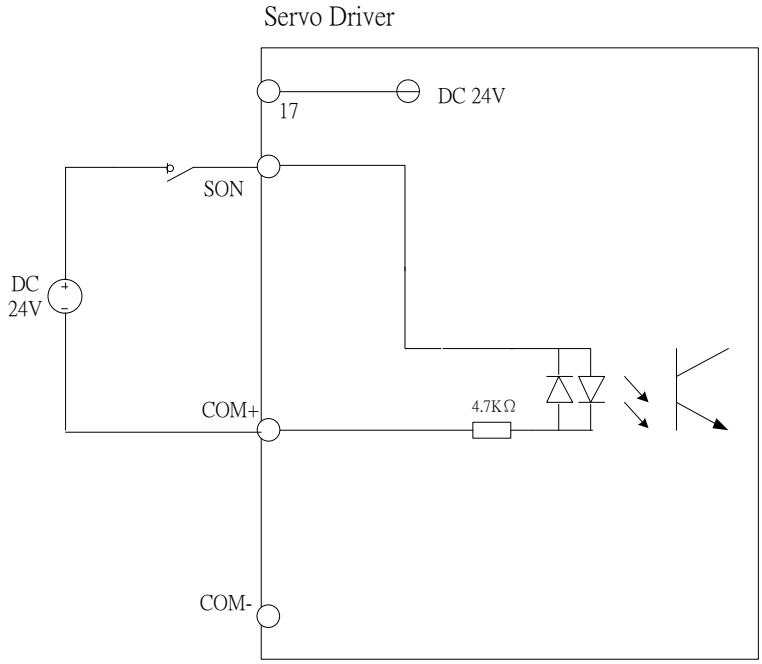
DI wiring, external power supply, SINK mode



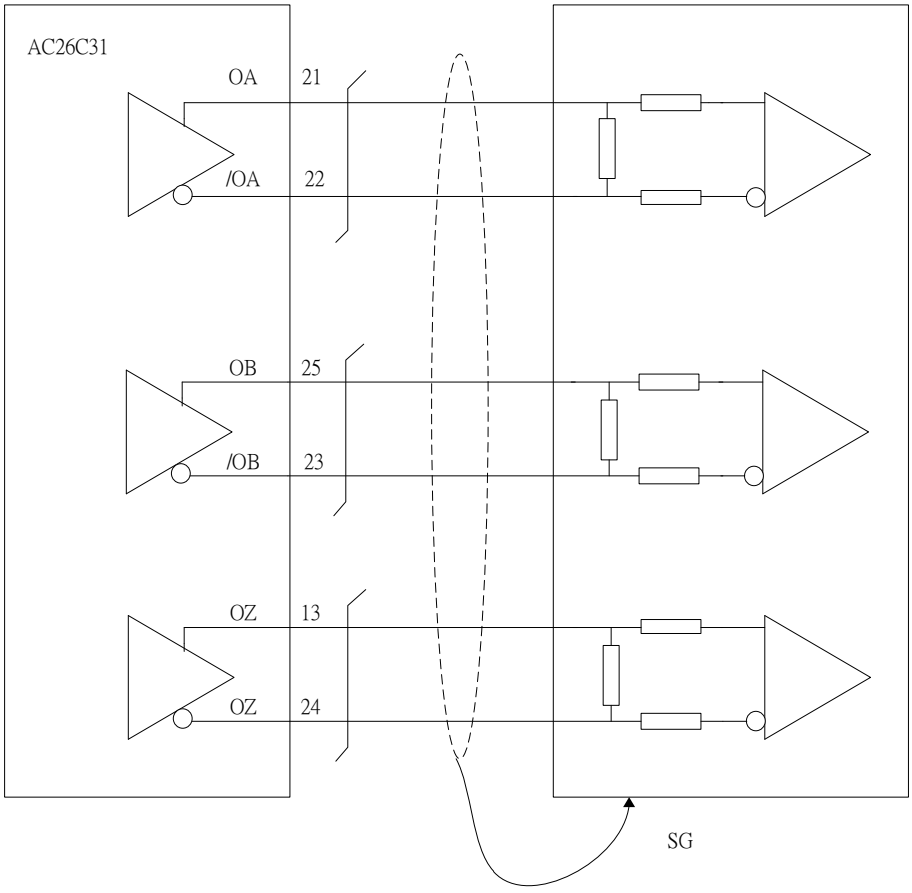
DI wiring, internal power supply, SOURCE mode



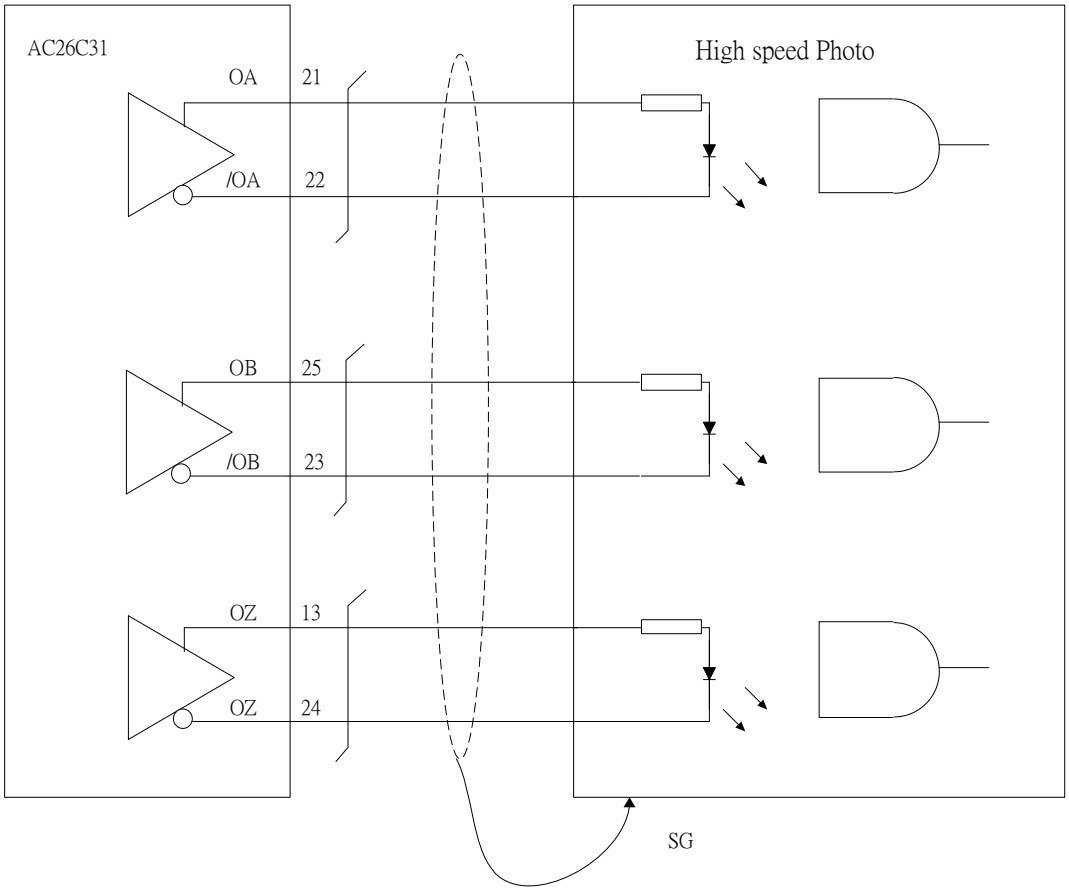
DI wiring, external power supply, SOURCE mode



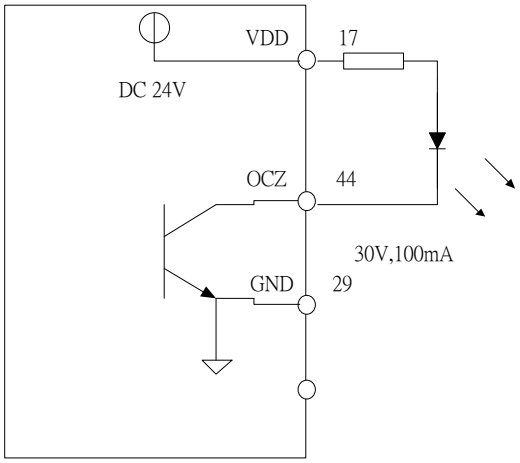
Encoder position output (line driver)



Encoder position output (photo coupler)



Encoder OCZ output (Z pulseoutput for the open collector)



3.3.4. User-specified DI and DO signals

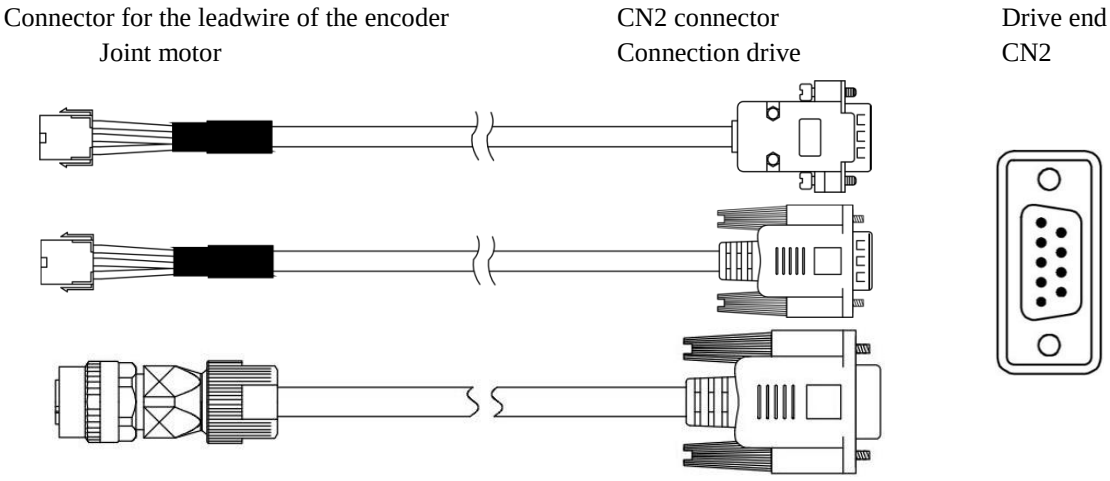
If the desired DI/DO signal can't be found among the default ones, the user may set new DI/DO. The function of the DI1~9 and DO1~6 signals depend on the parameters PC-01~PC-09 and PC-10~PC-15. Refer to the following table. Input the DI or DO code in the corresponding parameter to set the function of this DI/DO.

Signal Name		Pin No	Corresponding parameter
Standard DI	DI1-	CN1-9	PC-01
	DI2-	CN1-10	PC-02
	DI3-	CN1-34	PC-03
	DI4-	CN1-8	PC-04
	DI5-	CN1-33	PC-05
	DI6-	CN1-32	PC-06
	DI7-	CN1-31	PC-07
	DI8-	CN1-30	PC-08
	DI9	CN1-12	PC-09

Signal Name		Pin No	Corresponding parameter
Standard DO	DO1+	CN1-7	PC-10
	DO1-	CN1-6	
	DO2+	CN1-5	PC-11
	DO2-	CN1-4	
	DO3+	CN1-3	PC-12
	DO3-	CN1-2	
	DO4+	CN1-1	PC-13
	DO4-	CN1-26	
	DO5+	CN1-28	PC-14
	DO5-	CN1-27	
	DO6+	CN1-16	PC-15
	DO6-	CN1-15	

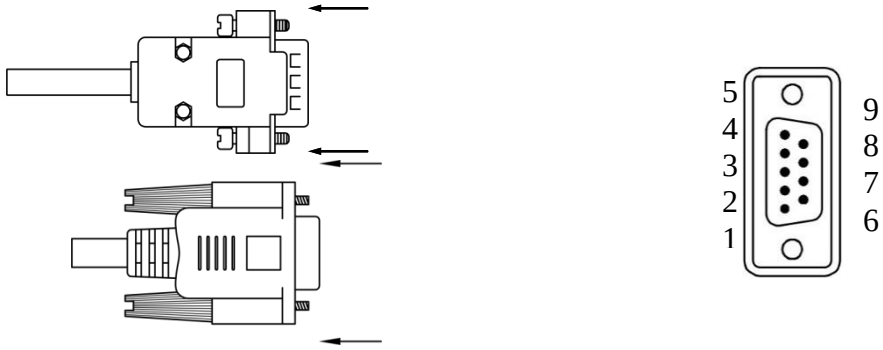
3.4. CN2 Wiring of the the encoder signal

The following shows the signal cable of the CN2 encoder:

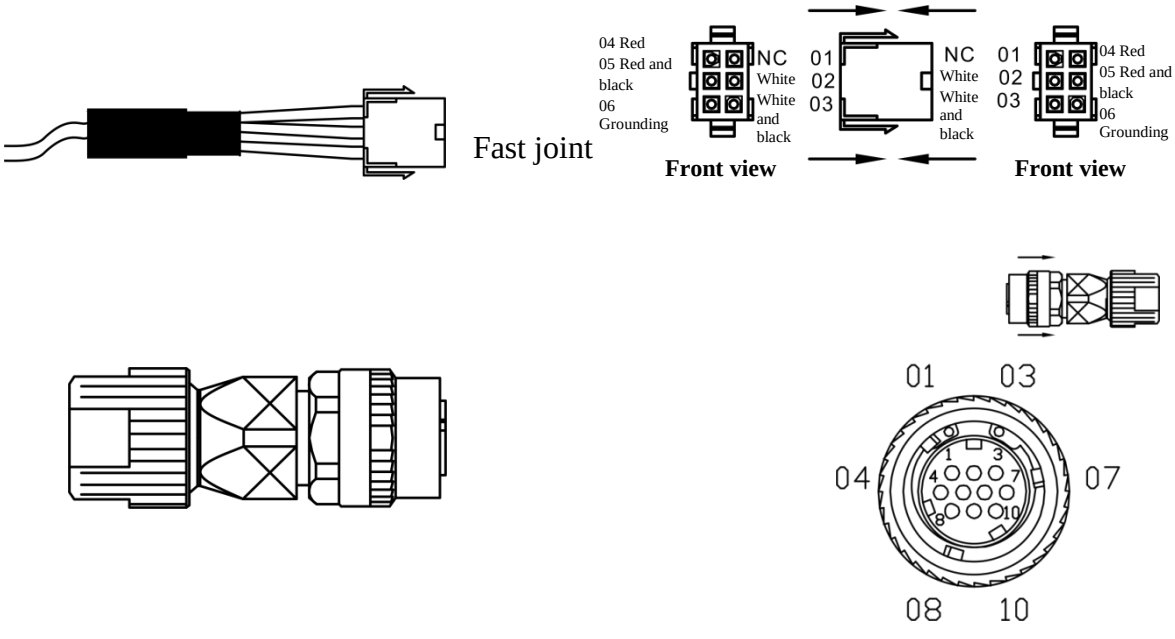


Definition of the connectors on both sides:

(1). CN2 connector



(2). Connector for the leadwire of the encoder



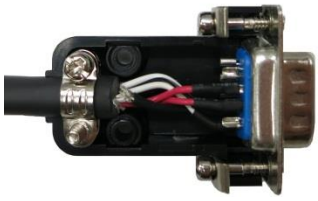
The description for the definition of each signal is as follows:

Connector end of the drive			Connector for the leadwire of the encoder		
Pin No	Terminal signal	Function and description	Military connector	Fast joint	Color
4	D-	Serial communication signal input/output(-)	6	3	White and black
5	D+	Serial communication signal input/output(+)	5	2	White
7	+5V	+5V power supply	1	4	Red
8	GND	Earth wire of the power supply	2	5	Red and white
Shell	Shielding	Shielded	10	6	-

Refer to the following for the way to make the the shield for the connector of the CN2 encoder:

(1) Weld the core wire of the metal mesh to the metal part of the connector so that the connector is metal shielded.

(2) Fit the connector into its case as illustrated.

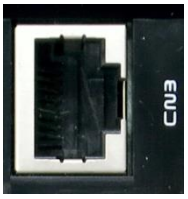


(3) Fasten the case to complete the shielding.

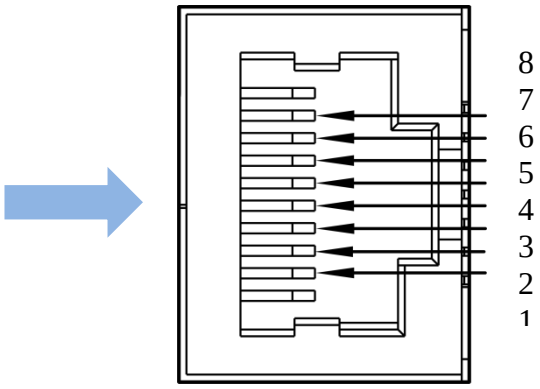
3.5. CN3 Wiring for the signal of the communication connector

CN3 Layout for the terminal of the communication connector

The drive is connected to the computer via the communication connector. The user uses the MODBUS communication and combines with the assembly language to operate the drive. The user may also use PLC and HMI to operate the drive. We offer two communication interfaces that are commonly used: (1) RS-232 and (2) RS-485. The RS-232 is used more often. The communication distance is about 15 m. If using the RS-485, the transmission distance would be longer. The RS-485 can support simultaneous connections for multiple drives.



CN3 connector (female)



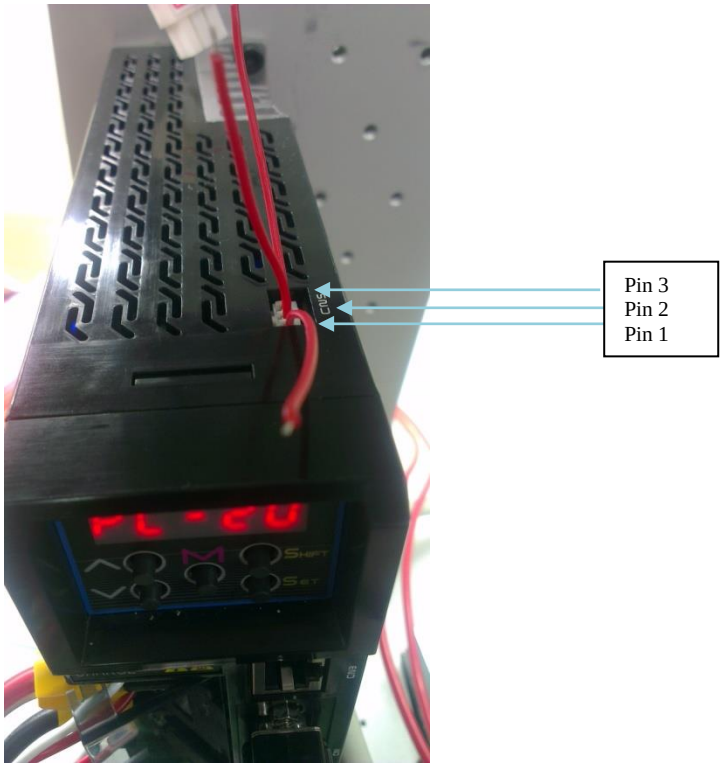
Pin No	Signal Name	Terminal signal	Function and description
1	RS-232 data transmission	RS-232_TX	Data transfer at the drive end Connected to the receiving end RS-232 of the PC
2	RS-232 data receiving	RS-232_RX	Data receipt at the drive end Connected to the sending end RS-232 of the PC
3	Signal grounding	GND	+5V ground to the signal end
4	RS-485 data transmission	RS-485(-)	Differential data transfer at the drive end -
5	RS-485 data transmission	RS-485(+)	Differential data transfer at the drive end +
6	Signal grounding	GND	+5V ground to the signal end
7	-	-	
8	-	-	

3.6. CN5 Analog voltage output terminal

The CN5 output terminal provides the monitoring analog data. For example, the analog voltage can be used to indicate the rotation speed and current of the motor. ISA-7 provides two channel outputs. The user uses Parameter PD-22 to select the data to be monitored. The signal is based on the grounding (GND) of the power supply.

CN5 output terminal of the drive:

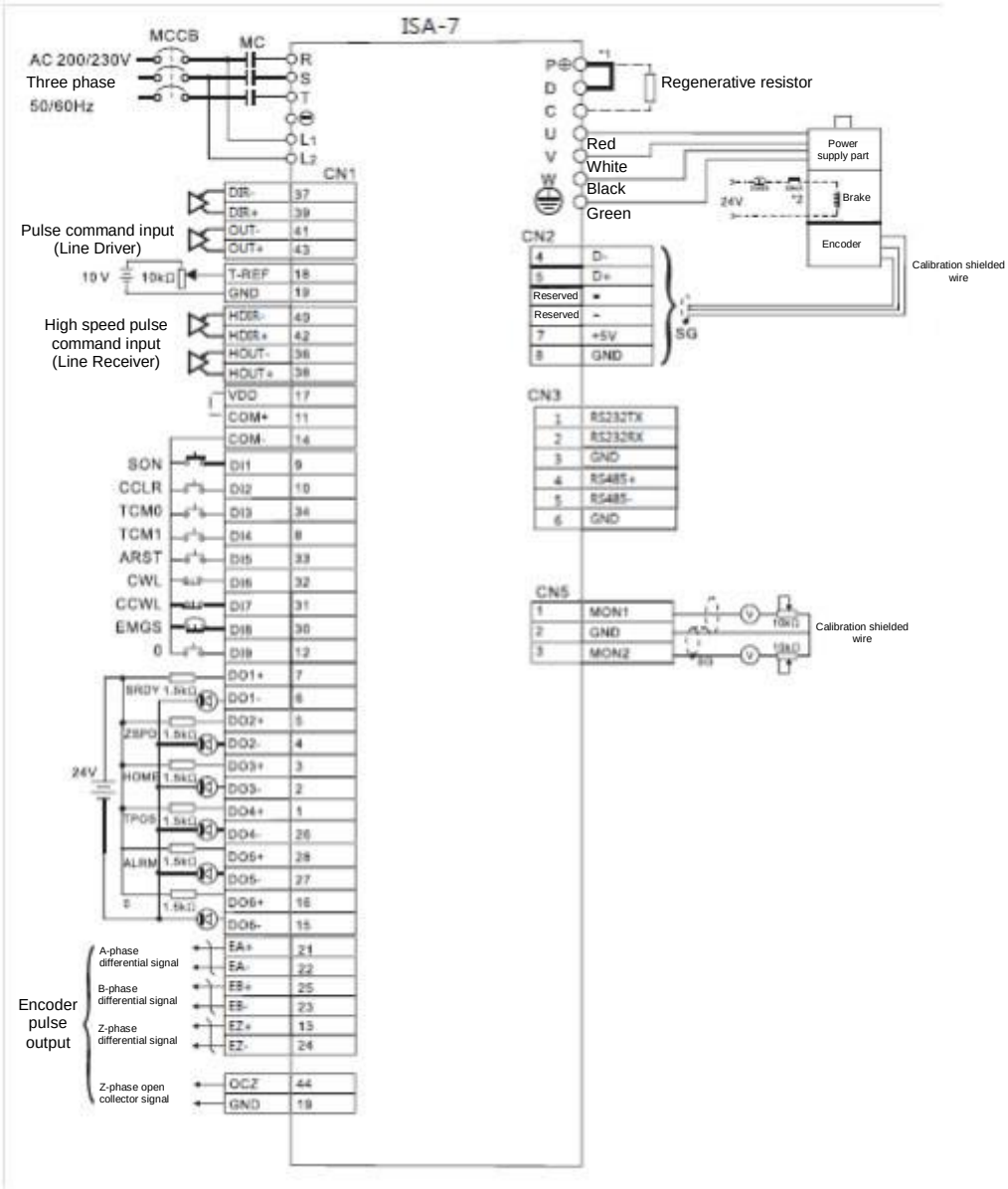
CN5 analog voltage output signal cable:



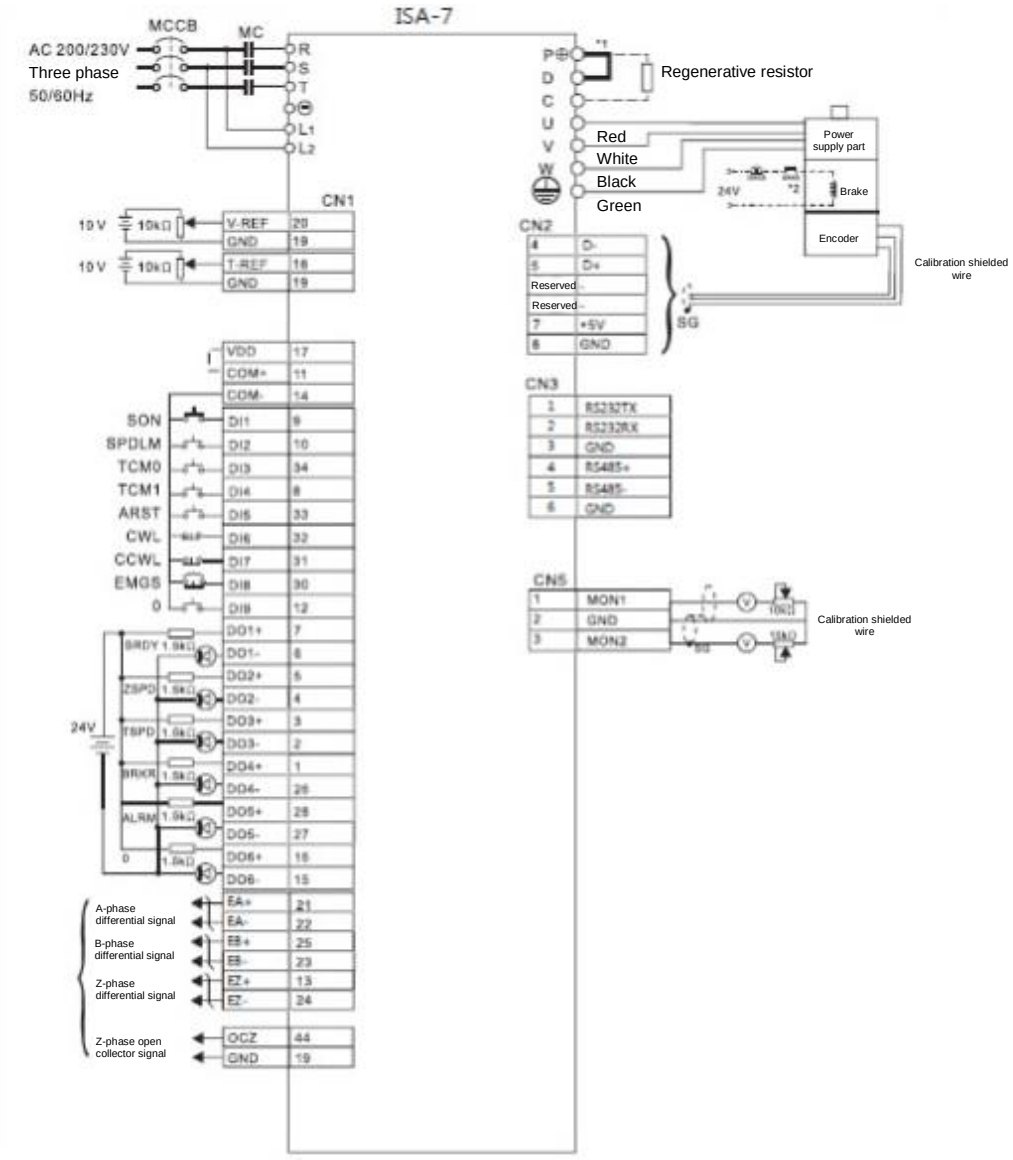
Pin No	Signal Name	Function and description	Color	Remark
1	MON1	Monitoring analog data 1	Red	
2	GND	Earth wire of the power supply	Red	
3	MON2	Monitoring analog data 2	Red	

3.7. Standard wiring

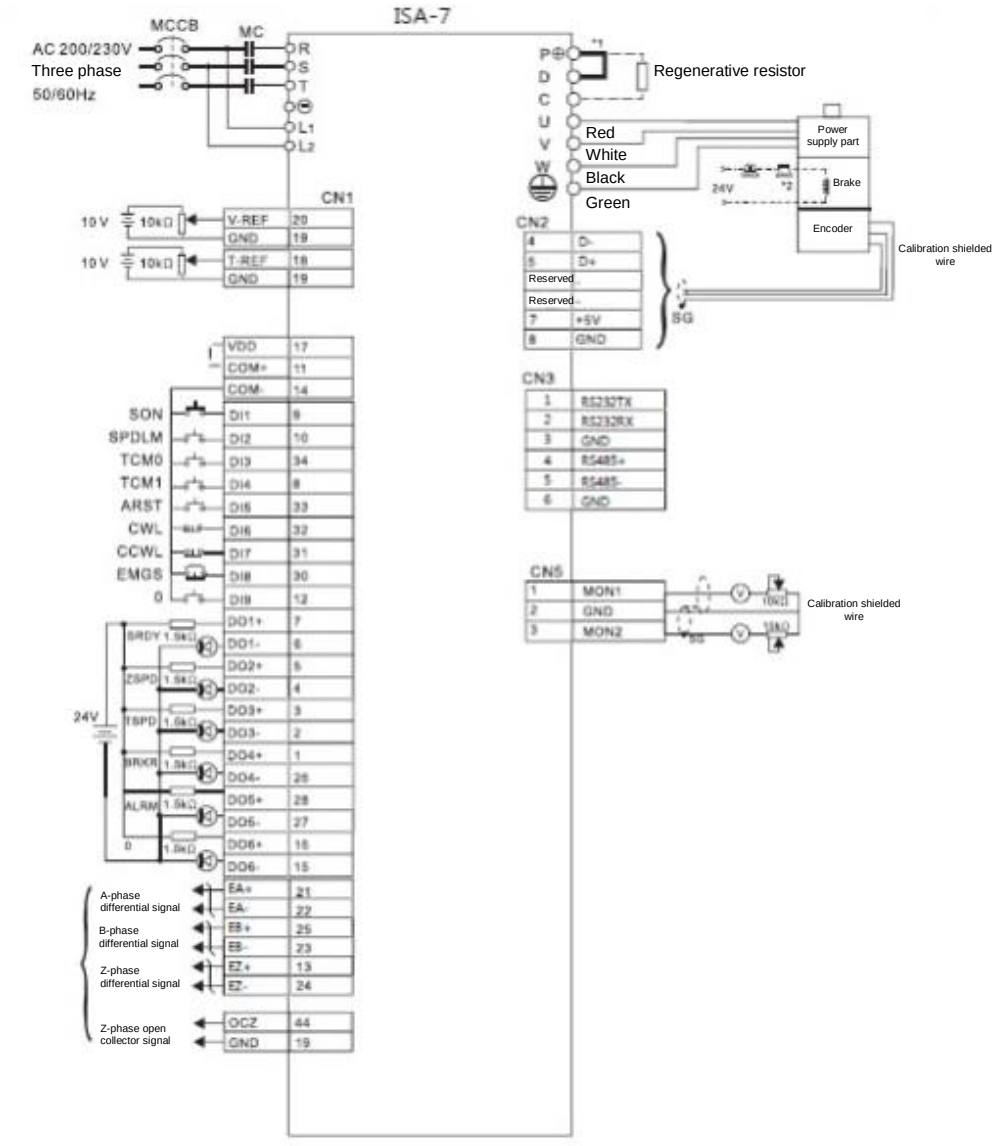
3.7.1. Standard wiring for the position mode



3.7.2. Standard wiring for the speed mode



3.7.3. Standard wiring for the torque mode

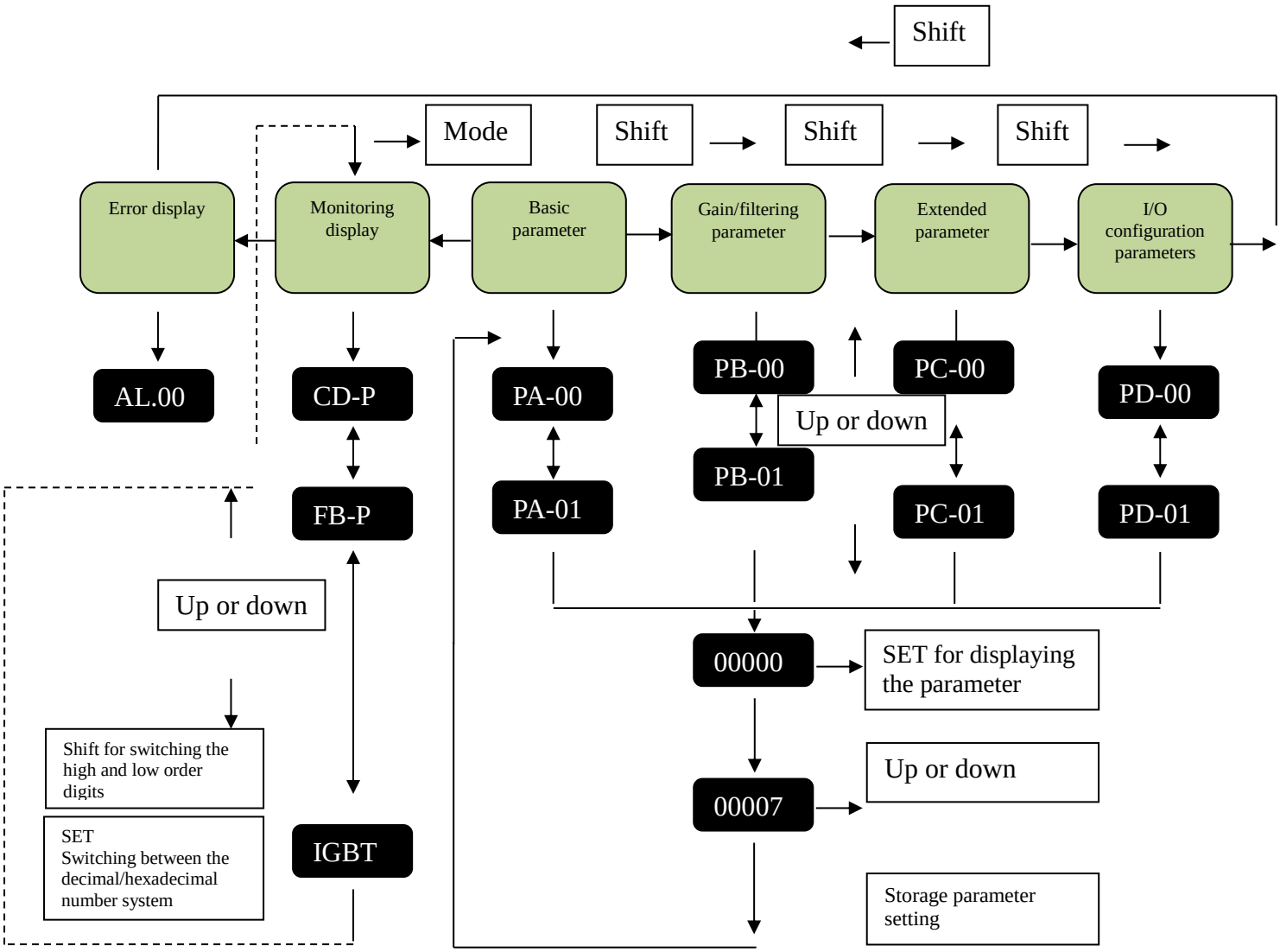


Chapter 4Panel and Operation

4.1. Panel display and key description

Name	Function
Display	Five seven-segment displays are used to show the monitoring, parameter and setting values.
MODE key	It is used to switch between the monitoring mode, parameter mode and alarm display. When editing the mode, press the MODE key to exit to the parameter mode.
SHIFT key	The group code can be changed in the parameter mode. In the editing mode, shift the blinking character to the left would be able to modify the higher character value that is set. In the monitoring mode, the display of the high/low order digit can be switched.
UP key	It is used to change the monitoring code, parameter code or setting value.
DOWN key	It is used to change the monitoring code, parameter code or setting value.
SET key	It is used to display and store the setting value. In the monitoring mode, it is possible to switch to the decimal/hexadecimal number system. In the parameter mode, press the SET key to enter the editing mode.

4.2. Panel operating process



1. When the power supply of the drive is input, the display continues to display the monitoring mode (the monitoring parameter set by the PD-21) first. The alarm code shows up first if there is any alarm.
2. Press the MODE key to switch the parameter display → monitoring display → error display. The alarm mode is omitted if there is no alarm.
3. For any new alarm, it is possible to switch the current mode to the alarm mode instantly. Press the MODE key to switch to other modes.
4. In the monitoring display, switch the monitoring variable to press the UP or DOWN key. After selecting the monitoring variable, press the SET key to confirm to enter the display.
5. In the parameter display, press the SHIFT key to switch the group code. Press the UP/DOWN key to change the last two character parameter codes.
6. In the parameter display, press the SET key to enter the editing setting mode. The display shows the setting value of the current parameter. Use the UP/DOWN key to modify the parameter value or press the MODE key to exit the editing setting mode and return to the parameter mode.

7. In the editing setting mode, press the SHIFT key to shift the blinking character to the left and use the UP/DOWN key to amend the high byte quickly.
8. After revising the setting value, press the SET key to save the parameter or execute the command.
9. After the parameter setting is finished, the display shows the exit code "SAVED" and returns to the parameter code automatically.

Table4.2.1 Display code

Display text	LED display	Display text	LED display	Display text	LED display	Display text	LED display
0		9		i		r	
1		A		J		S	
2		b		K		t	
3		c		L		U	
4		d		M	N/A	v	
5		E		n		W	N/A
6		F		o		X	N/A
7		G		P		y	
8		H		q		Z	

4.3. Status display

4.3.1. Description for the display of status value

Example for the numerical display	Description for the display of status value	
 (Dec)	Hexadecimal data	If the numerical value is 1234, it displays as 01234 (decimal numerical system).
 (Hex)		If the numerical value is 0x1234, it displays as 1234. (For the hexadecimal numerical system, the first digit does not show.)
 (Dec high)  (Dec low)	32-bit data	If the numerical value is 1234567890, the high byte displays as 1234.5 and the low byte as 67890 (decimal numerical system).
 (Hex high)  (Hex low)		If the numerical value is 0x12345678, the high byte displays as h1234 and the low byte as L5678 (hexadecimal numerical system).
	This is the way to display negative values. If the numerical value is -12345, it displays as 1.2.345. (Only the decimal numerical system is available. No positive or negative sign shows for the hexadecimal numerical system.)	

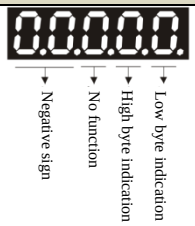
1) Dec indicates the decimal numerical system and Hex the hexadecimal numerical system.
2) The above ways of displaying numerical values are applicable to the monitoring and editing setting modes.
3) The Data format of all monitoring variables is 32-bit. For data display, it is possible to switch between the high/low byte and Dec/Hex. Each parameter only supports one display type and no switchover is allowed.

4.3.2. Display of storage setting

After finishing the parameter editing and pressing the SET storage setting key, the panel display continues to show the symbol of setting status for 1 second based on the setting status.

LED display	Content description
Saved	The setting value is stored adequately (Saved).
R-Only	It is a read-only parameter (Read-Only).
Lock	The entered password is wrong or no password is entered (Locked).
Err	The setting value is wrong or the reserved setting value is entered (Write NG).
S-off	The servo is activated and no input is allowed (Please Servo off).
Re-On	The parameter is effective only after restart (Power On).

4.3.3. Display of decimal point

Display symbol	Content description
	High/low byte indication: If the data type is 32-bit and the data is in the decimal format, the function indicates whether the numerical value displayed is in the high or low byte format. Negative sign: If the data is in the decimal format, the two decimal points on the left indicate the negative sign, regardless the 16- or 32-bit. The value displayed in the hexadecimal format is always positive. No negative sign is displayed.

4.3.4. Display of the warning message

Display symbol	Content description
	When the drive generates an error, the warning sign 'AL' and code 'nnn' appear. Refer to the description for the PD-20 parameter in Chapter 7 or Chapter 9 Warning Troubleshooting for the meaning of the sign and code.

4.3.5. Monitoring display

In the monitoring mode, press the UP or DOWN key to select the variable to be monitored and press the SET key for confirmation. Parameter PD-21 can also be modified to designate the monitoring code. For example, "PD-21=4" indicates the motor rotation speed.

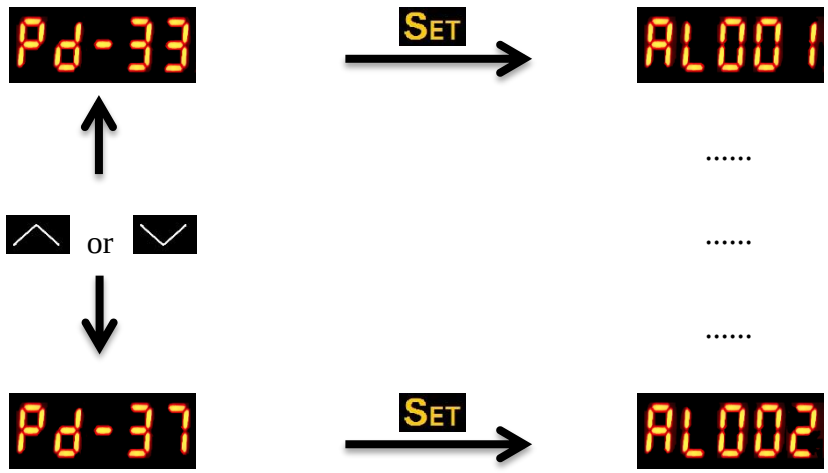
PD-21	LED display	Content description	Unit
0	Cd-P	The number of pulses entered for the pulse command (the number of pulses for the command entered to the upper controller)	[user unit]
1	Fb-P	The number of pulses for the motor feedback (the number of pulses fed to the upper controller from the drive)	[user unit]
2	Err-P	The number of differential pulses for the Cd-P and Fb-P	[user unit]
3	Efb-P	The number of pulses for the motor feedback (the number of pulses for the encoder feedback) (131072 pulse/rev)	[pulse]
4	SPEED	Motor rotation speed	[r/min]
5	ECd.P	The number of pulses for the pulse command input (The number of pulses for the command entered to the upper controller * electronic gear ratio)	[pulse]
6	Eer-P	The number of differential pulses for the ECd-P and EFb-P	[pulse]
7	CP-Fr	The pulse command input frequency	[Kpps]
8	C-SP1	The speed input command	[Volt]
9	C-SP2	The speed input command	[r/min]
10	C-tq1	The torque input command	[Volt]
11	C-tq2	The torque input command	[%]
12	PK-L	The peak torque	[%]
13	AvG-L	The average torque	[%]
14	U-buS	The voltage of the main circuit	[Volt]

15	J-L	The load/motor inertia ratio	[double]
16	rSn.fr	The resonance frequency (The low byte is the first resonance point and the high byte is the second resonance point.)	[Hz]
17	diFF.2	This indicates the number of absolute pulses with respect to the encoder Z-phase. Which means, the numerical value at the origin of the Z-phase is 0. The encoder rotates clockwise or counterclockwise for positive/negative 5000 pulses.	[pulse]
18	Drv-t	Drive temperature	[°C]

4.4. Operation of the general function

4.4.1. Operation for displaying the record of the abnormal status

After entering the parameter modes PD-33 ~ PD-37, press the SET key to display the corresponding code of the error history.



The first recent error

The second recent error

The third recent error

The fourth recent error

The fifth recent error

4.4.2. Operation for the jog mode

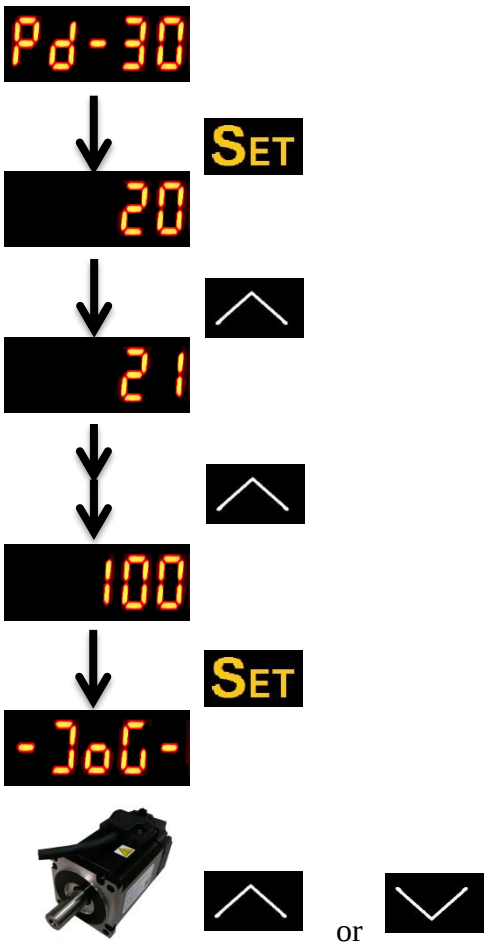
After entering the parameter mode PD-30, execute the jog operating mode according to the following setting methods.

(1) Press the SET key to display the jog speed. The initial value is 20 r/min.

(2) Press the UP or DOWN key to modify the jog speed to the desired value. For the example, the speed is adjusted to 100r/min.

(3)Press the SET key to display JOG and enter the jog mode.

(4) After entering the jog mode, press the UP or DOWN key to make the servo motor to rotate clockwise or counterclockwise. Release the button and the servo motor stops immediately. The jog operation is only effective in the Servo On mode.



Press : The servo motor rotates counterclockwise.
Press : The servo motor rotates clockwise.
Press to return.
Release the key and the motor stops instantly.
If there is no reaction, check the wiring for the motor UVW and encoder.

4.4.3. Enforced operation of the digital output

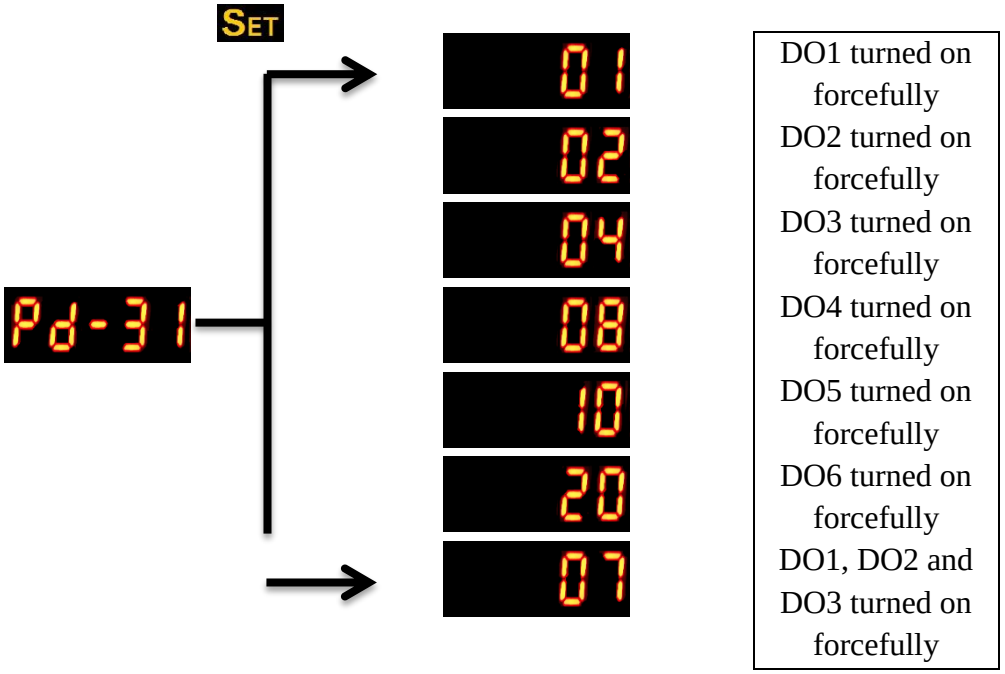
Enter the output diagnosis mode according to the setting method below.

Set "PD-44=006" first and turn on the enforced DO mode. Use the PD-31 to set the enforced DO output via the binary system.

E.g.: DO2 is turned on forcefully when the value is set to 2.

DO1 and DO3 are turned on forcefully when the value is set to 5.

No memory is saved for this mode after power off. The regular DO mode can be resumed after power on or setting "PD-44=106".



The PD-31 is in the hexadecimal format. The numerical value 0 at the fifth digit does not appear.

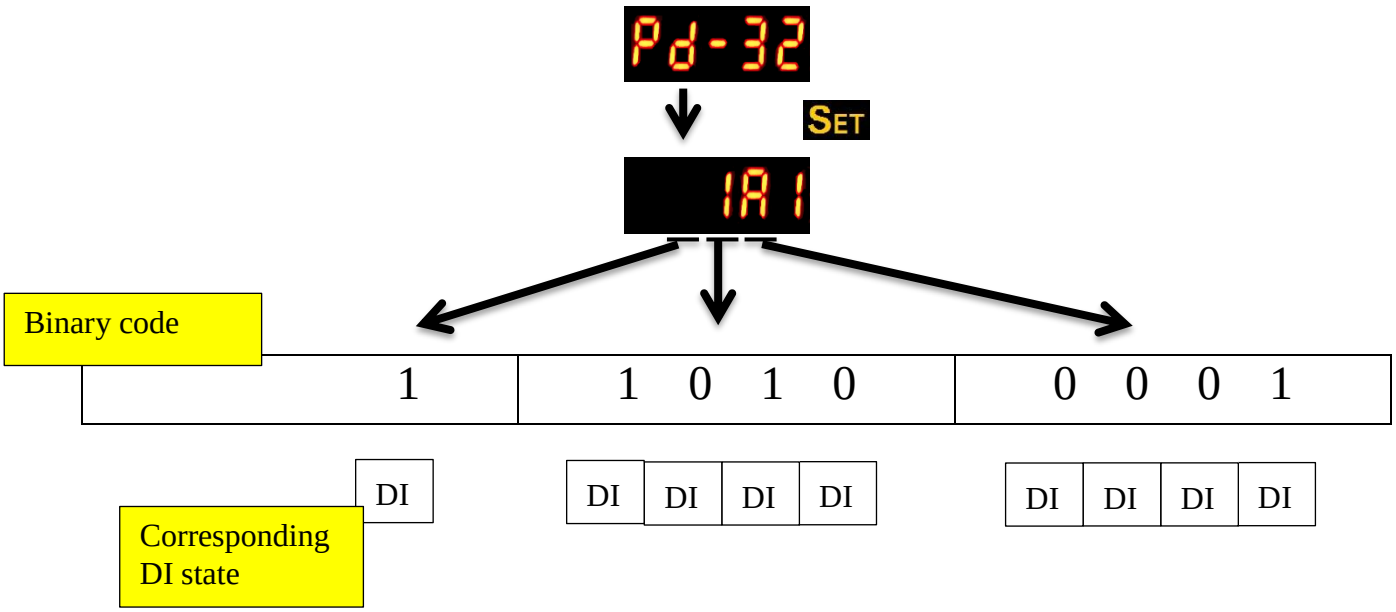
4.4.4. Operation for the diagnosis of digital input

Enter the input diagnosis mode according to the setting method below.

When the triggering is executed via the external input signals DI1 ~ DI9 , the panel display shows the corresponding signal. The signal is displayed in the hexadecimal character format.

bit0 corresponds to DI1; bit1 to DI2...etc. The value 1 indicates triggering.

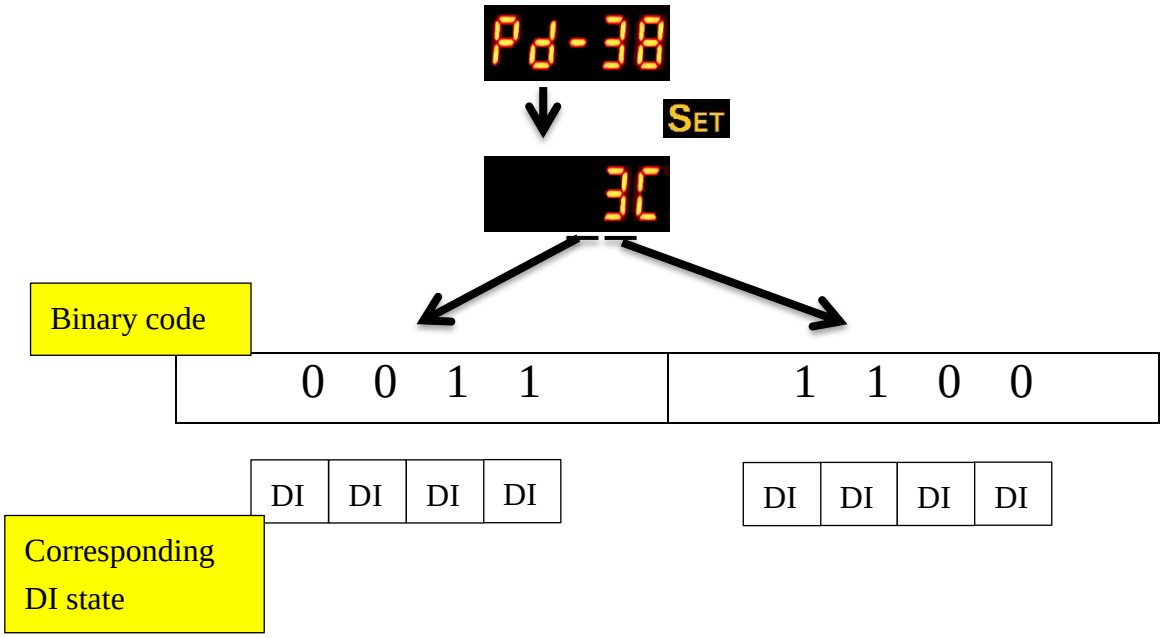
E.g.: If "1A1" shows on the display, the binary value is 110100001b, indicating the triggering for DI1, DI6, DI8 and DI9.



(Hexadecimal display)

4.4.5. Operation for the diagnosis of digital output

Enter the output diagnosis mode according to the setting method below.
As for the electrical conductivity of the output signals DO1 ~ DO6, the signal corresponding to these output signals shows on the panel display. The signal is displayed in the hexadecimal format. bit0 corresponds to DO1; bit1 to DO2...etc. The value 1 indicates triggering.
E.g.: If "3C" shows on the display, the binary value is 00111100b, indicating the triggering for DO3, DO4, DO5 and DO6.



(Hexadecimal display)

Chapter 5 Steps for Commissioning and Tuning

The chapter is divided into two parts for explaining the commissioning operation. The first part is the no-load detection and the second one is the detection for installation in the machine. For safety reasons, the user must conduct the testing for the first part.

5.1. No-load detection

To avoid the damage to the servo drive or mechanism, remove the load connected to the servo motor first. (The coupling and relevant accessories on the axle of the servo motor must also be removed. The reason is to avoid the situation that the accessory not removed from the axle of the servo motor flies off, indirectly causing the personal injury or equipment damage.) If the servo motor operates normally according to the normal operating procedure after the removal of the load connected to the servo motor, connect the load back to the servo motor afterwards.

Strongly recommended: Make the servo motor to go into the normal operation under the unloaded condition and connect the motor to the load afterwards to avoid danger.

Check the items listed below one by one to find out problems and solve them before the motor operation to prevent the damage afterwards:

Detection before operation (no control power supply provided)	● Check the servo drive for evident damage. ● Insulate the connecting part of the distribution terminal. ● Check the wiring for completion and accuracy to prevent damage or abnormality. ● Check if there is any conductive object such as the screw or a sheet metal or any flammable object in the servo drive. ● Check if the control switch is OFF. ● The regenerative resistor of the servo drive or the external regenerative resistor must not be placed on any flammable object. To prevent the electromagnetic actuator from becoming ineffective, check if the circuit causing the immediate termination of operation and cutting the power off operates normally. ● If the electronic instrument near the servo drive suffers from the electromagnetic interference, use an instrument for mitigation. ● Check if the applied voltage level of the drive is accurate.

Detection before operation (control power supply provided)	● Excessive stress should be avoided for the cable of the encoder. During motor operation, notice whether the connecting cable contacts the machine part, causing wear or dragging. ● For the servo motor, contact the supplier for any vibration or loud noise during operation. ● Check the setting of each parameter for accuracy. Unexpected movements might occur due to mechanical characteristics. Do not make excessive adjustments to the parameter. ● When resetting the parameter, check if the drive operates while the servo is turned off (Servo Off), otherwise the drive would cause malfunction. ● When the relay operates, contact the supplier if no contact sound is heard or there is any abnormal sound is generated. ● Check if any abnormality occurs to the power indicator and LED display.

5.2. Power transmission for the drive

The user must follow the steps below.

I. Check the relevant wiring between the motor and drive:
   - ■ U, V, W and FG must be connected to red, white, black and green wires, respectively. If the wiring is wrong, the motor operates abnormally. The earth wire FG of the motor must be connected to the grounding protection terminal of the drive.
   - ■ The encoder of the motor is connected to the CN2 correctly.

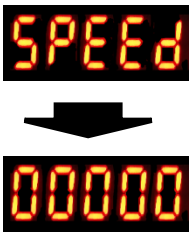
Warning: Do not connect the power supply end (R, S, T) to the output of the servo drive (U, V, W), otherwise it may result in the damage of the servo drive.

II. Connection for the power line of the drive: Connect the power supply to the drive. Refer to 3.1.3 for the wiring of the power supply.

III. Power on: For the power supply of the control circuit (L_1, L_2) and main circuit (R, S,T), the drive shows the following when the power is turned on:

The digital inputs (DI6~DI8) of the factory setting are the CCW-limit (NL), CW-limit (PL) and emergency stop (EMGS) signals. If the digital inputs (DI6~DI8) of the factory setting are not used, the setting of the parameters PC-06~PC-08 of the digital inputs (DI) must be adjusted. Set the parameter to 0 (the function of this DI disabled) or change it to other functional definitions.

If the parameter (PD-21) showed for the status of the drive is set to the motor speed (04) when the last operation ends, the normal screen should look like:



If no text shows on the screen, check if the voltage is too low for L1 and L2.

1) When the screen shows:

Overvoltage warning:
The input voltage of the main circuit exceeds the allowable voltage or the input power supply is inaccurate.
Solution:

- Use the electricity meter to check the input voltage and adjust it to the allowable range.

2) When the screen shows:

Abnormality of the encoder:
The drive does not receive any encoder data or a data error occurs.
Solution:

- Check if the wire distribution for the encoder conforms to the description.
- Check if the connector or line of the encoder is loose.
- Check if the encoder is damaged.

3) When the screen shows:

Emergency stop:
The contact of the digital input is set to emergency stop and it is not conducted.
Solution:

- Make sure that the emergency stop (EMGS) signal is conducted. The default setting is DI8.
- If not using the emergency stop function, set the input to Contact b and the default PC-08 to 115. Another way is to set DI8 (which is PC-08) to other functions.

4) When the screen shows:

Abnormality of the CCW-limit:
The contact of the digital input is set to CCW-limit and it is not conducted.
Solution:

- Make sure that the CCW-limit (NL) signal is conducted. The default setting is DI6.
- If not using the emergency stop function, set the input to Contact b and the default PC-06 to 116. Another way is to set DI6 (which is PC-06) to other functions.

5) When the screen shows:

Abnormality of the CW-limit:
The contact of the digital input is set to CW-limit and it is not conducted.
Solution:

- Make sure that the CW-limit (PL) signal is conducted. The default setting is DI7.
- If not using the emergency stop function, set the input to Contact b and the default PC-07 to 117. Another way is to set DI7 (which is PC-07) to other functions.

6) When the screen shows:

Overcurrent warning:
The output current of the drive is too high.
Solution:

- Check the connection of the motor.
- Check if the lead wire or motor is shorted.

7) When the screen shows:

Low voltage warning:
The input voltage of the main circuit is too low.
The input voltage of the main circuit exceeds the allowable voltage or the input power supply is inaccurate.
Solution:

- Use the electricity meter to check the input voltage and adjust it to the allowable range.

5.3. No-load jog test

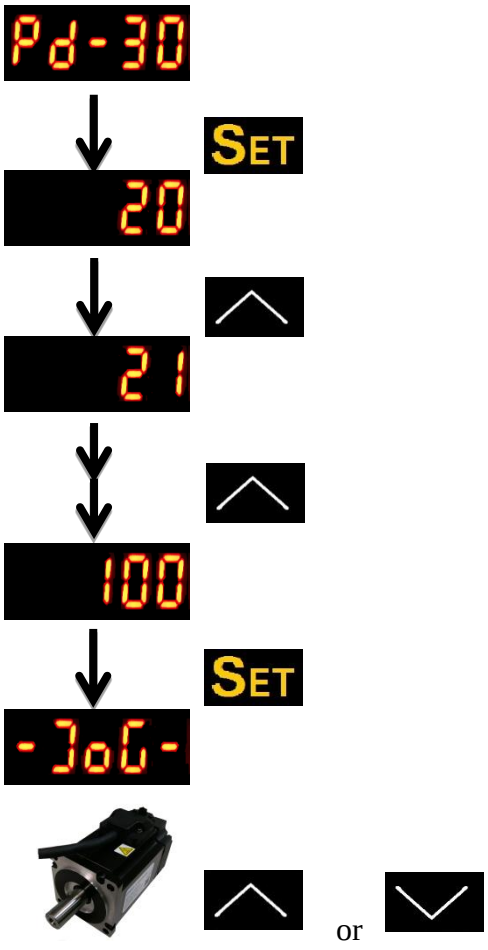
We propose the jog method to trial the motor and drive. The user does not need any extra distribution line, which is really convenient. For safety reasons, it is suggested to jog the motor at low rotation speed. As for the jog mode, the motor is set to move in constant velocity based on the set jog speed. The following is the description we provided.

STEP 1: Set Parameter PD-30. Enter the jog speed (unit: r/min) and press the SET key so that the drive enters JOG mode.

STEP 2: Press the Up key so that the motor turns clockwise. Press the "Down" key so that the motor turns counterclockwise.

STEP 3: Press the MODE key to exit JOG mode.

The following figure demonstrates the operation of the jog mode. Adjust the default initial value 20 rpm to 100rpm.



Press ^: The servo motor rotates counterclockwise.
Press v: The servo motor rotates clockwise.
Press M to return:
Release the key and the motor stops instantly.
If there is no reaction, check the wiring for the motor UVW and encoder.

5.4. No-load speed test

Before the no-load speed test, secure the motor base as tight as possible to prevent the danger caused by the counter force generated due to the variation in motor rotation speed.

STEP 1： Set the control mode of the drive to the speed mode (PA-00 set to 1). Restart the machine after alteration to update the operating mode.

STEP 2： After restart, modify the setting of the digital input DI as follows:

Digital Input	Parameter Setting Value	Description for the Functional Definition	CN1 Pin No
DI1	PC-01 = 101	Servo on	Pin9
DI2	PC-02 = 107	Torque limit	Pin10
DI3	PC-03 = 109	Selection of the speed command	Pin34
DI4	PC-04 = 10A	Selection of the speed command	Pin8
DI5	PC-05 = 102	Error reset	Pin33
DI6	PC-06 = 0	No function	Pin32
DI7	PC-07 = 0	No function	Pin31
DI8	PC-08 = 0	No function	Pin30
DI9	PC-09 = 0	No function	Pin12

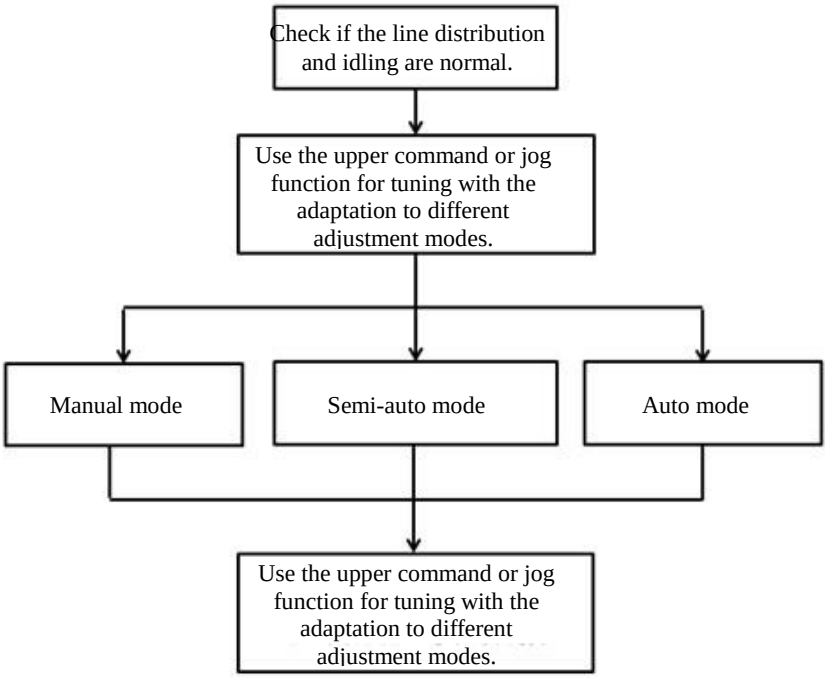
In the table above, the functions of the factory setting values CCW-limit (DI6), CW-limit (DI7) and emergency stop (DI8) are canceled. The parameters PC-06~PC-09 are set to 0 (Disabled).
After the setting is complete, the motor must be restarted or the abnormality must be reset if any irregular signal appears for the drive. If the abnormality is reset, the DI5 pin must be conducted to eliminate the abnormality. The restart or reset is required because the factory setting value includes the CCW-limit, CW-limit and emergency stop functions.

STEP 3：

1) The user makes the digital input DI1 conducted and the servo activated (Servo On).
2) Open the circuit for the digital inputs DI3 (SPD0) and DI4 (SPD1). The motor operates based on the analog voltage command.
3) Only the digital input DI3 (SPD0) is conducted. The command of the motor rotation speed is the setting value of PA-14.
4) Only the digital input DI4 (SPD1) is conducted. The command of the motor rotation speed is the setting value of PA-15.
5) The digital input DI3 (SPD0) and DI4 (SPD1) are conducted simultaneously. The command of the motor rotation speed is the setting value of PA-16.
6) Steps (3), (4) and (5) may be repeated as wish. The user may also alter the setting values of PA-14~PA-16 to change the rotation speed.
7) To stop the drive, open the circuit for the digital input DI1 (Servo Off).

5.5. Tuning steps

5.5.1. Process of the tuning steps



5.5.2. Flowchart of the tuning steps in the semi-auto gain mode

Set PB-32 (response bandwidth of the speed loop in the auto and semi-audit gain adjustment mode). The bandwidth value is 80 (by default).

Set PB-33 to 2 (semi-auto mode, non-persistent adjustment). The adjustment starts after the the revolution speed command is entered manually.(The Jogmode or the upper controller can be used to enter the rotation speed command). LEDwill display the calculated inertia value during the process. After the adjustment is performed for a while, stop the calculation when the the inertia of the system becomes stable and save the calculated load inertia ratio toPB-35. The rigidity and bandwidth settings in PB-32 are referred to during the process of the calculation.

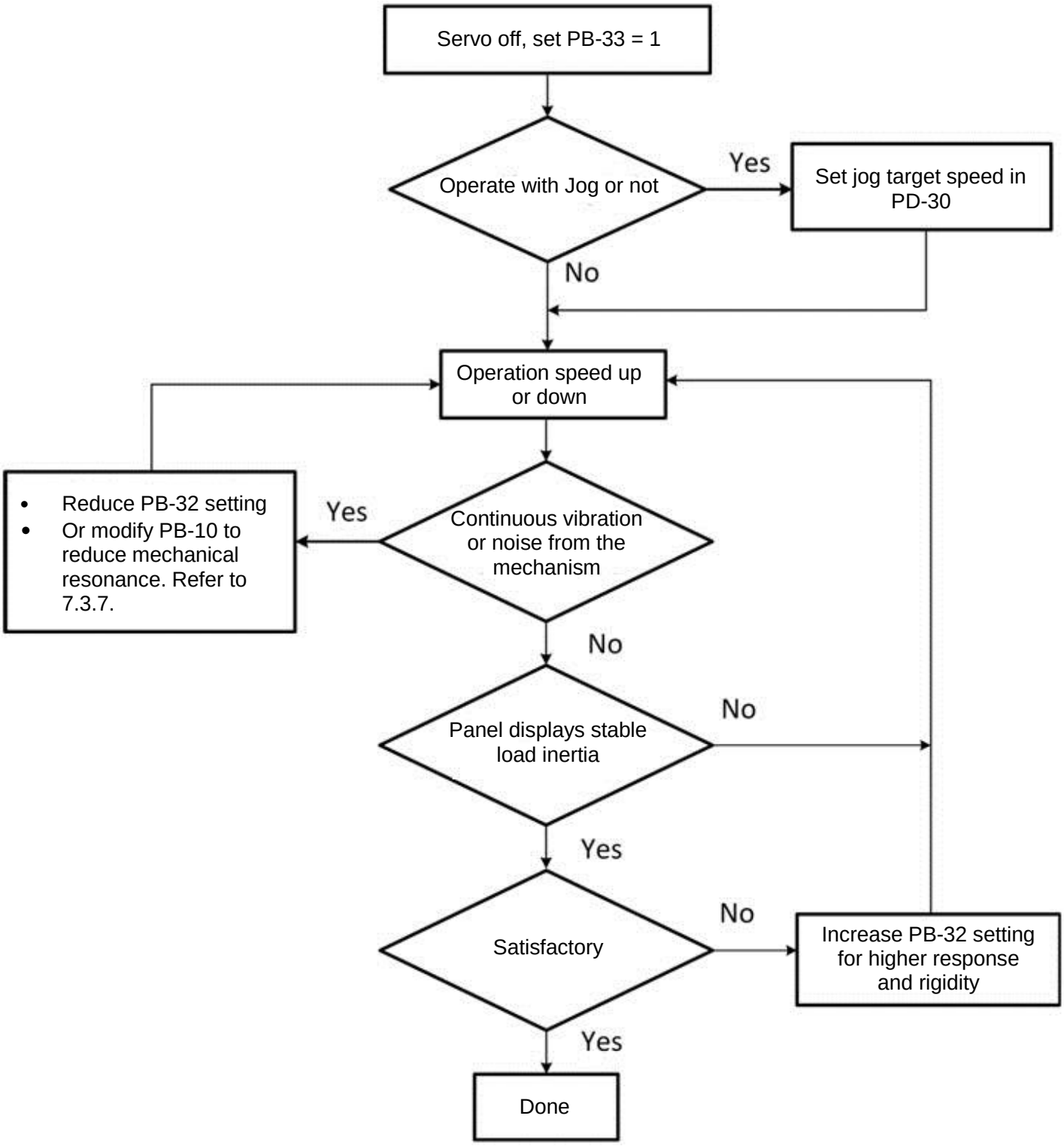
PB-32 is the setting of the response bandwidth for the speed loop in the auto and semi-auto gain adjustment mode:

1~50Hz: Low rigidity, low response.

51~250Hz: Intermediate rigidity, intermediate response.

251~550Hz: High rigidity, high response.

Higher value for faster response

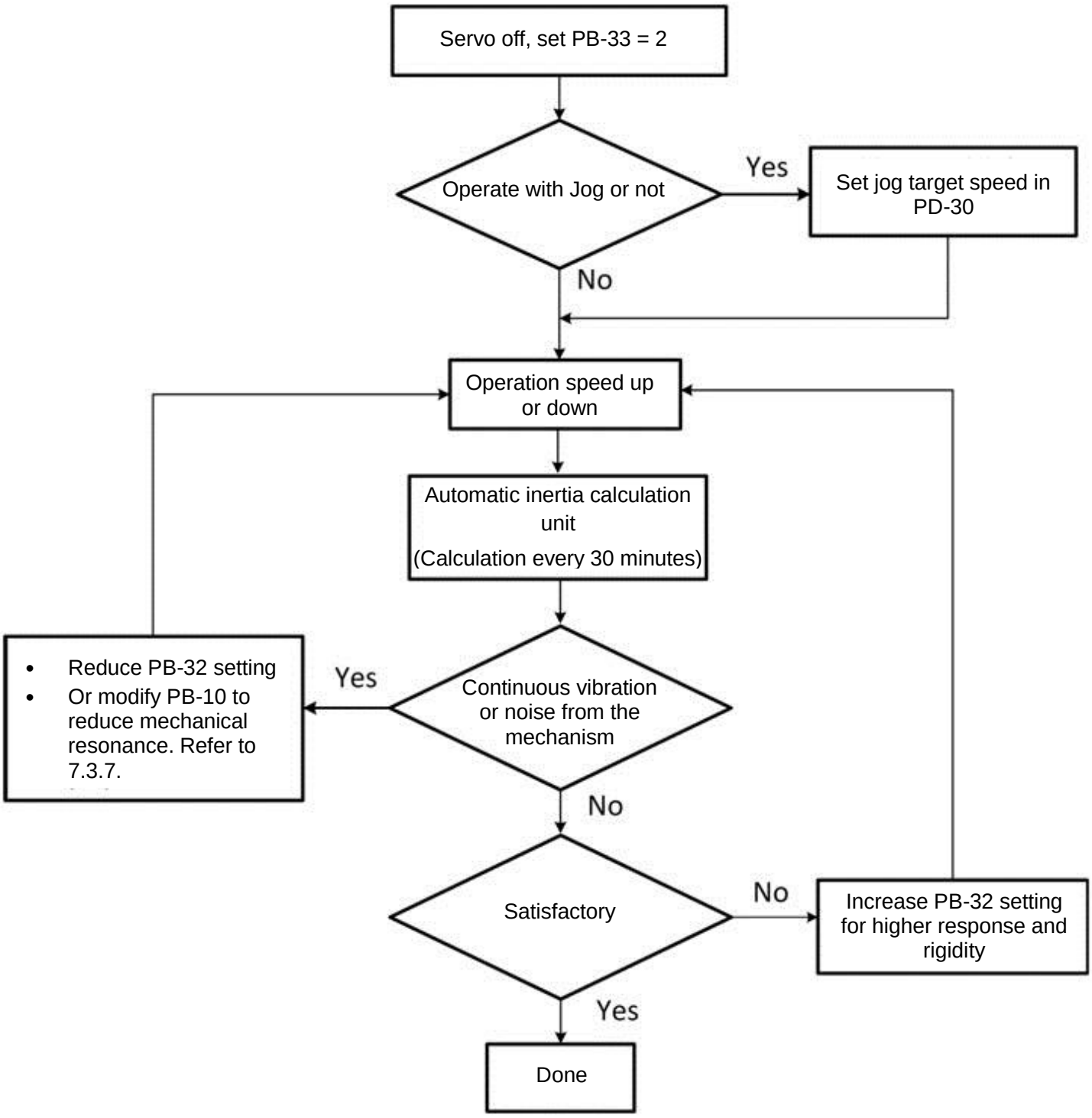

Servo off, set PB-33 = 1
Operate with Jog or not
Yes
Set jog target speed in PD-30
No
Operation speed up or down
Continuous vibration or noise from the mechanism
Yes
Reduce PB-32 setting
Or modify PB-10 to reduce mechanical resonance. Refer to 7.3.7.
No
Panel displays stable load inertia
No
Yes
Satisfactory
No
Increase PB-32 setting for higher response and rigidity
Yes
Done

Use the Jog mode to enter the speed command

PB-32 sets the target respond bandwidth for the speed loop.
PB-33 is set to 2.
PD-30 sets the jogspeed to enter semi-auto adjustment gain mode.
Press the "Up/ Down" key repeatedly (at least held for 2 seconds) to speed up/down the motor operation.
LED displays the present calculation of the inertia value during the process. Keep pressing until the value becomes stable.
Press MODEto exit from the semi-auto gain adjustment mode.

5.5.3. Flowchart of the tuning steps in the automatic gain mode

Set PB-32 (response bandwidth of the speed loop in the auto and semi-audit gain adjustment mode). The bandwidth value is 80 (by default).
Set PB-33 to 1 (semi-auto mode, non-persistent adjustment).
The server system will calculate the load inertia every half an hour and set gain parameters automatically according to the bandwidth settings.
PB-32 is the setting of the response bandwidth for the speed loop in the auto and semi-auto gain adjustment mode:
1~50Hz: Low rigidity, low response.
51~250Hz: Intermediate rigidity, intermediate response.
251~550Hz: High rigidity, high response.
Higher value for faster response


Servo off, set PB-33 = 2
Operate with Jog or not
Yes
Set jog target speed in PD-30
No
Operation speed up or down
Automatic inertia calculation unit
(Calculation every 30 minutes)
Continuous vibration or noise from the mechanism
Yes
Reduce PB-32 setting
Or modify PB-10 to reduce mechanical resonance. Refer to 7.3.7.
No
Satisfactory
No
Increase PB-32 setting for higher response and rigidity
Yes
Done

5.5.4. Manual adjustment of gain parameters

In addition to the automatic/semi-auto adjustment mode, the user can enter the control gains for the position and speed loops manually.

Generally, precise machining needs higher rigidity and response frequency, but higher response frequency may cause mechanical resonance easily.

Therefore, the gain must be increased gradually during the tuning process and trial run must be conducted. Reduce the gain value when resonance is generated.

The tuning principles in terms of the gain are described below:

- The proportion gain for position control (KPP,PB-20)
  The KPP parameter determines the characteristic of the position loop response. The higher the numerical value, the faster the position loop response, the lower the command following and tuning errors, and the shorter the tuning duration. However, when the value is set to high, the machine may jitter or overshoot may occur.
  The calculation method of the position loop response frequency is described below:
  Position loop response frequency (Hz)$=\frac{KPP}{2\pi}$
- Position feed-forward gain(PFG, PB-22)
  Position feed-forward gain can increase the response when the command changes and reduce the command following error and the tuning duration.
  However, overshoot or vibration may occur if the setting value is too high.
- The proportion gain for speed control (KVP, PB-24)
  The KVP parameter determines the feature of the speed loop response. The higher the value, the faster the response and the lower the command following error. However, mechanical resonance if the value is set too high. The speed loop response frequency must be 4~6times the position loop response frequency. The machine may jitter or overshoot may occur if both frequencies are too close.
  The calculation method of the position loop response frequency is described below:
  Position loop response frequency (Hz)$=\frac{KVP}{2\pi}$
- The proportion gain for speed control (KVI, PB-26)
  Higher KVI is better at removing the speed steady-state error, but the machine may jigger if the value is set to high.
  The suggested setting is:
  KVI $\leq$ 1.5 $\times$speed loop response frequency

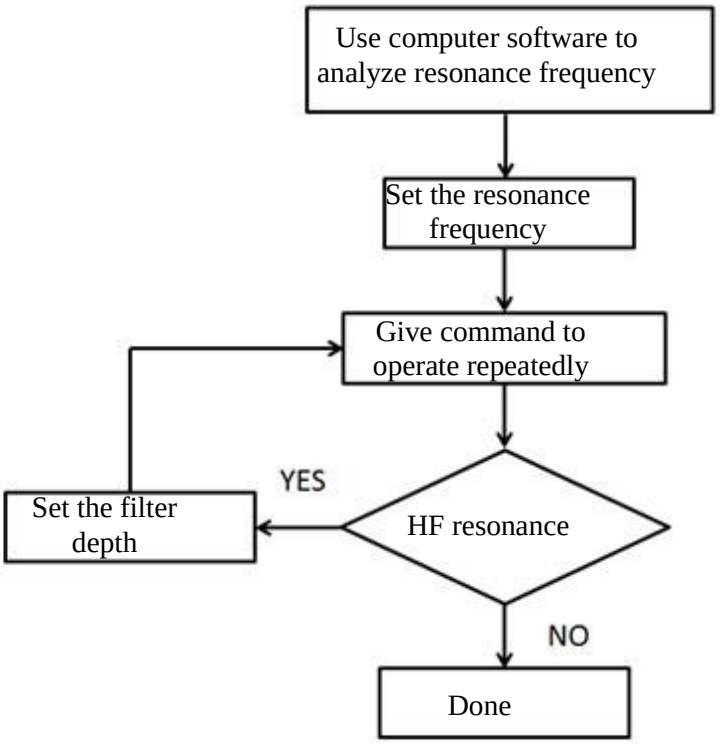
5.5.5. Relationship of the gain adjustment mode with the parameters

Gain adjustment mode	PB-33	Automatic parameter setting	User-adjusted parameter	Gain state
Manual gain adjustment	0 (Default value)	None	PB-35 (Motor load inertia ratio) PB-20 (Position control proportion gain) PB-24 (Speed control proportion gain) PB-26 (Speed control integration compensation) PB-17 (Resonance suppression low-pass filter) PB-28 (External interference resistance gain)	Fixed
Automatic gain adjustment (Persistent calculation of the inertia ratio)	1	PB-35 PB-20 PB-22 PB-24 PB-26 PB-17 PB-28 PB-19	PB-32 Automatic adjustment mode and responsive setting (Response level)	Persistent adjustment (Adjusted automatically every30 minutes)
Semi-auto gain adjustment (Non-persistent inertia calculation)	2	PB-35 PB-20 PB-22 PB-24 PB-26 PB-17 PB-28 PB-19	PB-32 Automatic adjustment mode and responsive setting (Response level)	Non-persistent adjustment (The user adjusts after entering the operation command.)

When the semi-auto mode (PB-33=2) is changed to the manual mode (PB-33= 0), PB-20, PB-22, PB-24, PB-26, PB-17, PB-28 and PB-19 will be automatically updated to the parameters adjusted in the semi-auto mode.

5.5.6. Solutions for mechanical resonance

ISA-7 provides three sets of Notch filters for users to suppress the mechanical HF resonance.
Analyze the resonance frequency using the computer software and enter the frequency value in PB-10, PB-12 or PB-14. Try to keep the machine running repeatedly to test the effect on the resonance suppression. If the resonance remains, use PB-11, PB-13 and PB-15 to increase the filter depth.
Please note that the system will be unstable if the filter depth is excessive and the resonance won't be suppressed efficiently. In this case, it is suggested to reduce the speed bandwidth.



Chapter 6 Parameters and Functions

6.1. Definitions of parameters

Definitions of parameters are grouped into four. The first letter behind the initial code of the parameter P is the group character and the two letters after the group character are parameter characters. The communication address is a 16-bit value comprised of the group character and two parameter characters. Definitions of the parameters are described below:

GroupA: Basic parameters (e.g. PA-xx)
GroupB: Gain/filter parameters (e.g. PB-xx)
GroupC: I/O configuration parameters (e.g. PC-xx)
GroupD: Expansion parameters (e.g. PD-xx)

Control mode description:

P is the position control mode. (The position command is entered via the CN1 Port.)
S is the speed control mode
T is the torque control mode

Description of the special symbols behind the parameter code:

(R-only)	This is a read-only register for the state value, e.g. PD-15, PD-16 etc.
(S-off)	Setting is possible only when Servo Off is set to Off, e.g. PA-01, PA-02 etc.
(Re-on)	The parameter is valid only after reboot, e.g. PA-00 and PD-00 etc.
(N-keep)	This parameter does not memorize the property value of the setting when power is turned off, e.g. PD-06 and PD-20 etc.

6.2. Parameters overview

6.2.1. Parameter list

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-00	CTLM	Setting for the input source of the control mode and command	0		O	O	O	(Re-on)
PA-01	CMPT	Setting for the input format of the external pulse train	2		O		O	(S-off)
PA-02	STL	The setting for the speed and torque limit	0		O	O	O	(S-off)
PA-03	ITQ1	Internal Torque Limit 1/Internal Torque Command 1	100	%	O	O	O	
PA-04	ITQ2	Internal Torque Limit 2/Internal Torque Command 2	100	%	O	O	O	
PA-05	ITQ3	Internal Torque Limit 3/Internal Torque Command 3	100	%	O	O	O	
PA-06	EOUT	The setting for the detector output of the pulse value	2048	pulse	O	O	O	(S-off)
PA-07	MSPL	Maximum speed limit	Rated	r/min	O	O	O	
PA-08	PCLR	Pulse cleaning mode	0		O			
PA-09	GRM1	Numerator of the Electronic Gear Ratio (N1)	1	pulse	O			(S-off)
PA-10	GRD	Denominator of the Electronic Gear Ratio (M)	1	pulse	O			(S-off)
PA-11	GRM2	Numerator of the Electronic Gear Ratio (N2)	1	pulse	O			(S-off)
PA-12	GRM3	Numerator of the Electronic Gear Ratio (N3)	1	pulse	O			(S-off)
PA-13	GRM4	Numerator of the Electronic Gear Ratio (N4)	1	pulse	O			(S-off)
PA-14	ISP1	Internal Speed Command 1/Internal Speed Limit 1	10000	0.1 r/min		O	O	
PA-15	ISP2	Internal Speed Command 2/Internal Speed Limit 2	20000	0.1 r/min		O	O	
PA-16	ISP3	Internal Speed Command 3/Internal Speed Limit 3	30000	0.1 r/min		O	O	
PA-17	CVM	The maximum rotation speed of the analog speed command	Rated	r/min		O	O	(S-off)
PA-18	CTM	The limited maximum output of the analog torque	100	%	O	O	O	(S-off)
PA-20	INP	Confirmation of the range when the position is reached	1000	pulse	O			
PA-21	ATL	Response level for automatic negotiation	20		O	O		(S-off)
PB-00	SFIL	The acceleration-deceleration smoothing constant of the analog speed command	0	ms		O		
PB-01	TFIL	Smoothing constant of the analog torque command	0	ms			O	

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PB-02	PFIL	Constant of the low-pass filtering for the position command	0	10ms	O			
PB-03	STAC	Acceleration constant of the smooth S-curve	200	ms		O		
PB-04	STDC	Deceleration constant of the smooth S-curve	200	ms		O		
PB-05	STL	Smooth constant of the smooth S-curve	0	ms		O		
PB-06	MFIL	The constant of the linear filtering for the analog speed command	0	0.1ms		O		
PB-07	FRCL	Ratio of friction compensation	0	%	O	O		
PB-08	FRCT	Smooth constant of friction compensation	0	ms	O	O		
PB-09	PFLT2	The constant of the linear filtering for the position command	0	ms	O			
PB-10	NCF1	Notch filter for resonance suppression (1)	1000	Hz	O	O	O	
PB-11	NCD1	Notch filter for the attenuation rate of the resonance suppression (1)	0	dB	O	O	O	
PB-12	NCF2	Notch filter for resonance suppression (2)	1000	HZ	O	O	O	
PB-13	NCD2	Notch filter for the attenuation rate of the resonance suppression (2)	0	dB	O	O	O	
PB-14	NCF3	Notch filter for resonance suppression (3)	1000	Hz	O	O	O	
PB-15	NCD3	Notch filter for the attenuation rate of the resonance suppression (3)	0	dB	O	O	O	
PB-16	NCFA	Setting for the suppression mode of auto-resonance	1	N/A	O	O	O	
PB-17	NCLA	The setting for the sensitivity suppression of auto-resonance	100	N/A	O	O	O	
PB-18	NLP	The low-pass filtering for resonance suppression	9	0.1ms	O	O	O	
PB-19	SCJT	The filter bandwidth for the speed detection	2500	Hz	O	O	O	
PB-20	KPP	The gain of the position control	125	rad/s	O			
PB-21	PGR	Ratio for the gain variation of the position control	100	%	O			
PB-22	PFG	The feed forward gain for the position control	50	%	O			
PB-23	PFC	The smooth constant of the feed forward gain for the position control	5	ms	O			
PB-24	KVP	The proportional gain for speed control	502	rad/s	O	O	O	
PB-25	SPR	The ratio for the gain variation of the speed control	100	%	O	O	O	
PB-26	KVI	The integral compensation for the speed control	50	rad/s	O	O	O	
PB-27	KVF	The feed forward gain for the speed control	0	%	O	O	O	
PB-28	DSG	The resistance gain for the external interference	50	0.001	O	O	O	

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PB-29	GCM	Condition of the gain switch and the selection for the switch method	10		O	O	O	
PB-30	GCT	The time constant for the gain switch	1	10ms	O	O	O	
PB-31	GCC	The condition of the gain switch	0	Pulse, Kpps, rmin	O	O	O	
PB-32	AUTB	The setting for the response bandwidth of the speed loop in the automatic and semi-automatic modes	80	Hz	O	O	O	
PB-33	AUTM	The method for gain adjustment	0		O	O	O	N-keep
PB-35	GSI	The ratio of load inertia to servo motor inertia	0	0.1 times	O	O	O	
PB-36	VSF1	Frequency for the vibration suppression of low frequency (1)	1000	0.1Hz	O			
PB-37	VSG1	Gain for the vibration suppression of low frequency (1)	0	dB	O			
PB-38	VSF2	Frequency for the vibration suppression of low frequency (2)	1000	0.1Hz	O			
PB-39	VSG2	Gain for the vibration suppression of low frequency (2)	0	dB	O			
PB-40	KPI	The integral compensation of the position	0	Hz	O	O	O	
PB-41	JSL	The level for the stability determination of inertia estimation	15	1 times	O	O	O	
PB-42	AVSM							
PB-43	VCL							
PB-44	NCBW1							
PB-45	NCBW2							
PB-46	NCBW3							
PC-00	DIRT	The time for response filtering of the digital input	2	2ms	O	O	O	
PC-01	DI1	The function planning for Pin DI1 of the digital input	Based on the control mode		O	O	O	
PC-02	DI2	Function planning for Pin DI2 of the digital input	Based on the control mode		O	O	O	
PC-03	DI3	Function planning for Pin DI3 of the digital input	Based on the control mode		O	O	O	
PC-04	DI4	Function planning for Pin DI4 of the digital input	Based on the control mode		O	O	O	
PC-05	DI5	The function planning for Pin DI5 of the digital input	Based on the control mode		O	O	O	
PC-06	DI6	The function planning for Pin DI6 of the digital input	Based on the control mode		O	O	O	
PC-07	DI7	The function planning for Pin DI7 of the digital input	Based on the control mode		O	O	O	
PC-08	DI8	The function planning for Pin DI8 of the digital input	Based on the control mode		O	O	O	

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PC-09	DI9	The function planning for Pin DI9 of the digital input	Based on the control mode		O	O	O	
PC-10	DO1	Function planning for Pin DO1 of the digital output	Based on the control mode		O	O	O	
PC-11	DO2	Function planning for Pin DO2 of the digital output	Based on the control mode		O	O	O	
PC-12	DO3	Function planning for Pin DO3 of the digital output	Based on the control mode		O	O	O	
PC-13	DO4	Function planning for Pin DO4 of the digital output	Based on the control mode		O	O	O	
PC-14	DO5	Function planning for Pin DO5 of the digital output	Based on the control mode		O	O	O	
PC-15	DO6	Function planning for Pin DO6 of the digital output	Based on the control mode		O	O	O	
PC-16								
PC-17								
PC-18								
PC-19								
PC-20	ZSPD	The level for zero speed detection	100	0.1 r/min	O	O	O	
PC-21	BTOD	The turn-on delay time for the electromagnetic brake	0	ms	O	O	O	
PC-22	BTCD	The turn-off delay time for the electromagnetic brake	0	ms	O	O	O	
PC-23	SPOK	The level for detection of the speed comparison	10	r/min		O		
PC-24								
PC-25	POL	The output level for the expected overload	0	%	O	O	O	
PD-00	ADR	The setting of the branch number	7F		O	O	O	(Re-on)
PD-01	BRT	The communication transmission rate	33		O	O	O	
PD-02	PTL	The protocol	6		O	O	O	
PD-03	CFP	The handling of the communication error	0		O	O	O	
PD-04	COT	The setting for the communication timeout	0	sec	O	O	O	
PD-05								
PD-06	SWDI	Control switch for the source of the input contact (DI)	0		O	O	O	
PD-07	CDT	The time for the delay of the communication response	0	1ms	O	O	O	
PD-08								
PD-09								
PD-10								
PD-11	VER	The firmware version	The factory setting		O	O	O	(R-only)
PD-12								
PD-13								
PD-14								

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PD-15	MON1	Display for Status Monitoring Register 1			O	O	O	(R-only)
PD-16	MON2	Display for Status Monitoring Register 2			O	O	O	(R-only)
PD-17	MON3	Display for Status Monitoring Register 3			O	O	O	(R-only)
PD-18	MON4	Display for Status Monitoring Register 4			O	O	O	(R-only)
PD-19	MON5	Display for Status Monitoring Register 5			O	O	O	(R-only)
PD-20	ALD	The display for the error status of the drive			O	O	O	(N-keep)
PD-21	SSD	Display for the status of the drive	0		O	O	O	
PD-22	VMON	The analog output monitoring	01		O	O	O	
PD-23	CM1	The selection for the content of the display for Status Monitoring Register 1	0		O	O	O	
PD-24	CM2	The selection for the content of the display for Status Monitoring Register 2	0		O	O	O	
PD-25	CM3	The selection for the content of the display for Status Monitoring Register 3	0		O	O	O	
PD-26	CM4	The selection for the content of the display for Status Monitoring Register 4	0		O	O	O	
PD-27	CM5	The selection for the content of the display for Status Monitoring Register 5	0		O	O	O	
PD-28	VMR1	The ratio for MON1 analog monitoring output	100	%	O	O	O	
PD-29	VMR2	The ratio for MON2 analog monitoring output	100	%	O	O	O	
PD-30	JOG	The jog control of the servo motor	20	r/min	O	O	O	
PD-31	FDO	The status and setting of the digital output	0		O	O	O	(S-off) (N-keep)
PD-32	DISF	The status and setting of the digital input	0		O	O	O	(N-keep)
PD-33	ALH1	Record of the Abnormal Status (N)	0		O	O	O	(R-only)
PD-34	ALH2	The record of the abnormal condition (N-1)	0		O	O	O	(R-only)
PD-35	ALH3	The record of the abnormal condition (N-2)	0		O	O	O	(R-only)
PD-36	ALH4	The record of the abnormal condition (N-3)	0		O	O	O	(R-only)
PD-37	ALH5	The record of the abnormal condition (N-4)	0		O	O	O	(R-only)
PD-38								
PD-39	AOUT	The setting for the polarity of the pulse output for the detector						
PD-40	PCM	The status monitoring register (for PC software)						
PD-41	PCMS	The content selection of the status monitoring register (for PC software)						
PD-42	MSTP	The function of the motor stop mode	0		O	O	O	
PD-43	TSPD	The level for the detection of the target rotation speed	The rated value	r/min	O	O	O	

Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PD-44	RegMisc1	The write-in of the special parameter	0		O	O	O	(S-off) (N-keep)
PD-45	RES	The value of the regenerative resistor	Based on the model	ohm	O	O	O	
PD-46	RESC	The capacity of the regenerative resistor	Based on the model	watt	O	O	O	
PD-47	CRSR	The collision protection for the motor (torque percentage)		%				
PD-48	CRST	The collision protection for the motor (protection time)		ms				
PD-49	EXREG	The selection of the external braking unit	0	N/A	O	O	O	
PD-50	AUTS	The status of inertia adjustment in the semi-auto mode	0	N/A	O	O	O	(N-keep)
PD-51	INH	The auxiliary function	0	N/A	O	O	O	
PD-52	PLOSS	The detection of the input phase failure	1		O	O	O	
PD-53	OSPW	The condition for the overspeed warning	max. speed	rpm	O			
PD-54	PCF	The condition for giving warnings of the excessive error regarding the position control	480000	pulse	O			
PD-55	LVF	The level for the error of the low voltage	160	V(rms)	O	O	O	
PD-56	ENCType							
PD-57	INFOS							
PD-58	ABSRST							
PD-59	AENCSTS							
PD-60	APREV							
PD-61	APREV							
PD-62	ZPWID							

6.2.2. Classification of the parameter function

Parameters for the monitoring and the general output setting								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PD-11	VER	The firmware version	0	N/A	O	O	O	(R-only)
PD-15	MON1	Display for Status Monitoring Register 1	0	N/A				(R-only)
PD-16	MON2	Display for Status Monitoring Register 2	0	N/A				(R-only)
PD-17	MON3	Display for Status Monitoring Register 3	0	N/A				(R-only)
PD-18	MON4	Display for Status Monitoring Register 4	0	N/A				(R-only)
PD-19	MON5	Display for Status Monitoring Register 5	0	N/A				(R-only)
PD-20	ALD	The display for the error status of the drive (seven-segment display)	0x2	N/A	O	O	O	(N-keep)
PD-21	SSD	Display for the status of the drive	0	N/A	O	O	O	
PD-22	VMON	The analog output monitoring	01	N/A	O	O	O	
PD-23	CM1	The selection for the content of the display for Status Monitoring Register 1	0	N/A				
PD-24	CM2	The selection for the content of the display for Status Monitoring Register 2	0	N/A				
PD-25	CM3	The selection for the content of the display for Status Monitoring Register 3	0	N/A				
PD-26	CM4	The selection for the content of the display for Status Monitoring Register 4	0	N/A				
PD-27	CM5	The selection for the content of the display for Status Monitoring Register 5	0	N/A				
PD-28	VMR1	The ratio for MON1 analog monitoring output	100	%	O	O	O	
PD-29	VMR2	The ratio for MON2 analog monitoring output	100	%	O	O	O	

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters related to the filter smoothness and resonance suppression								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PB-00	SFIL	The acceleration-deceleration smoothing constant of the analog speed command	0	ms		O		
PB-01	TFIL	Smoothing constant of the analog torque command	0	ms			O	
PB-02	PFIL	Constant of the low-pass filtering for the position command	0	10ms	O			
PB-03	STAC	The acceleration constant of the S-shaped speed curve	200	ms		O		
PB-04	STDC	The deceleration constant of the S-shaped speed curve	200	ms		O		
PB-05	STL	The smoothing constant of the S-shaped speed curve	0	ms		O		
PB-06	MFIL	The constant of the linear filtering for the analog speed command	0	0.1ms		O		
PB-07	FRCL	The friction compensation	0	%	O	O	O	
PB-08	FRCT	The friction compensation	0	ms	O	O	O	
PB-09	PFLT2	The constant of the linear filtering for the position command	0	ms	O			
PB-10	NCF1	Notch filter for resonance suppression (1)	1000	Hz	O	O	O	
PB-11	NCD1	Notch filter for the attenuation rate of the resonance suppression (1)	0	dB	O	O	O	
PB-12	NCF2	Notch filter for resonance suppression (2)	1000	HZ	O	O	O	
PB-13	NCD2	Notch filter for the attenuation rate of the resonance suppression (2)	0	dB	O	O	O	
PB-14	NCF3	Notch filter for resonance suppression (3)	1000	Hz	O	O	O	
PB-15	NCD3	Notch filter for the attenuation rate of the resonance suppression (3)	0	dB	O	O	O	
PB-16	NCFA	Setting for the suppression mode of auto-resonance	1	N/A	O	O	O	
PB-17	NCLA	The setting for the sensitivity suppression of auto-resonance	100	N/A	O	O	O	
PB-18	NLP	The low-pass filtering for resonance suppression	9	0.1ms	O	O	O	
PB-19	SCJT	The filtering for the speed detection and the suppression of micro-vibration	2500	sec	O	O	O	

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters related to gain and switch								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-21	ATL	Response level for automatic negotiation	20		O	O		
PB-20	KPP	The gain of the position control	125	rad/s	O			
PB-21	PGR	Ratio for the gain variation of the position control	100	%	O			
PB-22	PFG	The feed-forward gain for location	50	%	O			
PB-23	PFC	The smooth constant of the feed-forward gain for the position	5	ms	O			
PB-24	KVP	The gain of the speed control	502	rad/s	O	O	O	
PB-25	SPR	The ratio for the gain variation of the speed control	100	%	O	O	O	
PB-26	KVI	The integral compensation of the speed	50	rad/s	O	O	O	
PB-27	KVF	The feed-forward gain for speed	0	%	O	O	O	
PB-28	DSG	The resistance gain for the external interference	50	0.001	O	O	O	
PB-29	GCM	Condition of the gain switch and the selection for the switch method	10	N/A	O	O	O	
PB-30	GCT	The time constant for the gain switch	10	10ms	O	O	O	
PB-31	GCC	The condition of the gain switch	1280000	pulse Kpps r/min	O	O	O	
PB-32	AUTB	The setting for the response bandwidth of the speed loop in the automatic and semi-automatic modes	80	Hz	O	O	O	
PB-33	AUTM	Gain adjustment mode	0	N/A	O	O	O	(S-off) N-keep
PB-40	KPI	The integral compensation of the position	0	rad/s	O	O	O	

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters related to the position control								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-00	CTLM	Setting for the input source of the control mode and command	0	pulse r/min N-M	O	O	O	(Re-on)
PA-01	CMPT	The setting for the input format of the external pulse	2	N/A	O			(S-off)
PA-02	STL	The setting for the speed and torque limit	0	N/A	O	O	O	(S-off)
PA-03	ITQ1	Internal Torque Limit 1	100	%	O	O	O	
PA-04	ITQ2	Internal Torque Limit 2	100	%	O	O	O	
PA-05	ITQ3	Internal Torque Limit 3	100	%	O	O	O	
PA-06	EOUT	The setting for the detector output of the pulse value	2048	pulse	O	O	O	(S-off)
PA-07	MSPL	Maximum speed limit	rated	r/min	O	O	O	
PA-09	GRM1	Numerator of the Electronic Gear Ratio (N1)	1	pulse	O			(S-off)
PA-10	GRD	Denominator of the Electronic Gear Ratio (M)	1	pulse	O			(S-off)
PA-11	GRM2	Numerator of the Electronic Gear Ratio (N2)	1	pulse	O			(S-off)
PA-12	GRM3	Numerator of the Electronic Gear Ratio (N3)	1	pulse	O			(S-off)
PA-13	GRM4	Numerator of the Electronic Gear Ratio (N4)	1	pulse	O			(S-off)
PA-21	ATL	Response level for automatic negotiation	20		O	O		(S-off)

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters related to the speed control								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-00	CTLM	Setting for the input source of the control mode and command	0	pulse r/min N-M	O	O	O	(Re-on)
PA-02	STL	The setting for the speed and torque limit	0	N/A	O	O	O	(S-off)
PA-03	ITQ1	Internal Torque Limit 1	100	%	O	O	O	
PA-04	ITQ2	Internal Torque Limit 2	100	%	O	O	O	
PA-05	ITQ3	Internal Torque Limit 3	100	%	O	O	O	
PA-06	EOUT	The setting for the detector output of the pulse value	2048	pulse	O	O	O	(S-off)
PA-07	MSPL	Maximum speed limit	rated	r/min	O	O	O	
PA-14	ISP1	Internal Speed Command 1	10000	0.1 r/min		O	O	
PA-15	ISP2	Internal Speed Command 2	20000	0.1 r/min		O	O	
PA-16	ISP3	Internal Speed Command 3	30000	0.1 r/min		O	O	
PA-17	CVM	The maximum rotation speed of the analog speed command	rated	r/min		O	O	(S-off)
PA-18	CTM	The limited maximum output of the analog torque	100	%	O	O	O	(S-off)
PA-21	ATL	Response level for automatic negotiation	20		O	O		

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters related to the torque control								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-00	CTLM	Setting for the input source of the control mode and command	0	pulse r/min N-M	O	O	O	(Re-on)
PA-02	STL	The setting for the speed and torque limit	0	N/A	O	O	O	(S-off)
PA-03	ITQ1	Internal Torque Limit 1	100	%	O	O	O	
PA-04	ITQ2	Internal Torque Limit 2	100	%	O	O	O	
PA-05	ITQ3	Internal Torque Limit 3	100	%	O	O	O	
PA-06	EOUT	The setting for the detector output of the pulse value	2048	pulse	O	O	O	(S-off)
PA-07	MSPL	Maximum speed limit	rated	r/min	O	O	O	
PA-14	ISP1	Internal Speed Command 1	10000	0.1 r/min		O	O	
PA-15	ISP2	Internal Speed Command 2	20000	0.1 r/min		O	O	
PA-16	ISP3	Internal Speed Command 3	30000	0.1 r/min		O	O	
PA-17	CVM	The maximum rotation speed of the analog speed command	rated	r/min		O	O	(S-off)
PA-18	CTM	The limited maximum output of the analog torque	100	%	O	O	O	(S-off)

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Parameters for the planning of the digital I/O pin and for the setting related to the output								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PA-20	INP	Confirmation of the range when the position is reached	1000	pulse	O			
PC-00	DIRT	The time for response filtering of the digital input	2	2ms	O	O	O	
PC-01	DI1	The function planning for Pin DI1 of the digital input	101	N/A	O	O	O	
PC-02	DI2	Function planning for Pin DI2 of the digital input	104	N/A	O	O	O	
PC-03	DI3	Function planning for Pin DI3 of the digital input	116	N/A	O	O	O	
PC-04	DI4	Function planning for Pin DI4 of the digital input	117	N/A	O	O	O	
PC-05	DI5	Function planning for Pin DI5 of the digital input	102	N/A	O	O	O	
PC-06	DI6	Function planning for Pin DI6 of the digital input	22	N/A	O	O	O	
PC-07	DI7	Function planning for Pin DI7 of the digital input	23	N/A	O	O	O	
PC-08	DI8	Function planning for Pin DI8 of the digital input	21	N/A	O	O	O	
PC-09	DI9	Function planning for Pin DI9 of the digital input	0	N/A	O	O	O	
PC-10	DO1	Function planning for Pin DO1 of the digital output	101	N/A	O	O	O	
PC-11	DO2	Function planning for Pin DO2 of the digital output	103	N/A	O	O	O	
PC-12	DO3	Function planning for Pin DO3 of the digital output	109	N/A	O	O	O	
PC-13	DO4	Function planning for Pin DO4 of the digital output	105	N/A	O	O	O	
PC-14	DO5	Function planning for Pin DO5 of the digital output	7	N/A	O	O	O	
PC-15	DO6	Function planning for Pin DO6 of the digital output	7	N/A	O	O	O	
PC-21	BTOD	The turn-on delay time for the electromagnetic brake	0	ms	O	O	O	
PC-22	BTCD	The turn-off delay time for the electromagnetic brake	0	ms	O	O	O	
PC-23	SPOK	The level for detection of the speed comparison	10	r/min		O		
PC-25	POL	The output level for the expected overload	0	%	O	O	O	
PD-43	TSPD	The level for the detection of the target rotation speed	The rated value	r/min	O	O	O	

(R-only) This indicates the read-only register, which can only be used for reading status values.

(S-off)	This indicates Servo Off, which can be set only when the servo is off.
(Re-on)	This implies that the parameter is valid when the servo is booted again.
(N-keep)	The set content value won't be memorized by the parameter after power off.

Communication parameters								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PD-00	ADR	The setting of the branch number	0x7F	N/A	O	O	O	(Re-on)
PD-01	BRT	The communication transmission rate	0x33		O	O	O	
PD-02	PTL	The protocol	6	N/A	O	O	O	
PD-03	CFP	The handling of the communication error	0	N/A	O	O	O	
PD-04	COT	The setting for the communication timeout	0	sec	O	O	O	
PD-06	SWDI	Control switch for the source of the input contact (DI)	0	N/A	O	O	O	(N-keep)
PD-07	CDT	The time for the delay of the communication response	0	1ms	O	O	O	

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

Diagnostic parameters								
Parameter	Abbr.	Function	Initial value	Unit	Control mode			Remark
					P	S	T	
PD-30	JOG	The jog control of the servo motor	20	r/min	O	O	O	
PD-31	FDO	The DO data register of the software (readable and writable)	0	N/A	O	O	O	(S-off) (N-keep)
PD-32	DISF	The multi-function for the contact of the digital input	0	N/A	O	O	O	(N-keep)
PD-33	ALH1	Record of the Abnormal Status (N)	0	N/A	O	O	O	(R-only)
PD-34	ALH2	The record of the abnormal condition (N-1)	0	N/A	O	O	O	(R-only)
PD-35	ALH3	The record of the abnormal condition (N-2)	0	N/A	O	O	O	(R-only)
PD-36	ALH4	The record of the abnormal condition (N-3)	0	N/A	O	O	O	(R-only)
PD-37	ALH5	The record of the abnormal condition (N-4)	0	N/A	O	O	O	(R-only)
PD-38	MDO	The display regarding the status for the contact of the digital output	N/A	N/A	O	O	O	(R-only)

(R-only) This indicates the read-only register, which can only be used for reading status values.
(S-off) This indicates Servo Off, which can be set only when the servo is off.
(Re-on) This implies that the parameter is valid when the servo is booted again.
(N-keep) The set content value won't be memorized by the parameter after power off.

6.3. Parameter description

PA-XX (Basic parameter)

PA-00 (Re-on)	CTLM	Setting for the input source of the control mode and command	Communication address: 0000H 0001H

	Initial value	0
	Control mode	ALL
	Unit	N/A
	Configuration range	000 ~ 0x109
	Data size	16bit
	Data format	Hex

□□□■■: The setting of the control mode

□□■□□: The control over the direction of torque output

➢ Setting of the control mode

Mode	Setting value	Description
P	00	Single mode
S	01	
T	02	
PS	05	Mixed mode
PT	06	
ST	07	
Sn	08	Single mode
Tn	09	

■ Single mode:

P: Position control mode

S: Speed control mode (The command comes from the external analog voltage/internal register, and can be selected with D1: SPD0, SPD1.)

T: Torque control mode (The command comes from the external analog voltage/ the internal register, and can be selected with D1: TCM0, TCM1.)

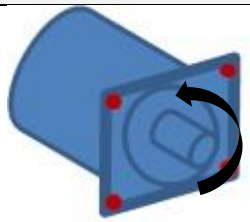
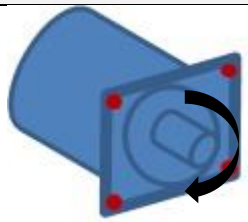
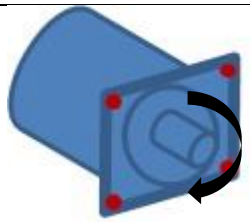
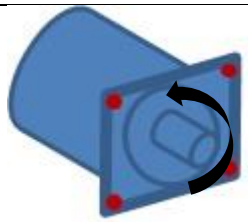
Sn: Speed control mode (The command source comes from the the internal register and can be selected with D1: SPD0, SPD1. If (SPD0,SPD1) = (0,0), the speed command is zero.)

Tn: Torque control mode (the command source comes from the internal register, and can be chosen with D1: TCM0, TCM 1. If (TCM0,TCM1) = (0,0), the torque command is zero.)

■ Mixed mode:

Modes can be switched using the external DI (Digital Input). For example, when the PS mode is set (with the control mode setting 05), DI:S-P (Table 7.1) can be used to switch between modes.

➢ Control over the direction of the torque output

	0	1
Clockwise direction		
Counterclockwise direction		

PA-01 (S-off)	CMPT	Setting for the input format of the external pulse train	Communication address: 0002H 0003H

Initial value	0002
Control mode	T / P
Unit	N/A
Configuration range	0 ~ 0x1142
Data size	16bit
Data format	Hex

□□□□■: Pulse type

□□□■□: Filter width

□□■□□: Logic type

□■□□□: Source of the external pulse input

➢ Pulse type

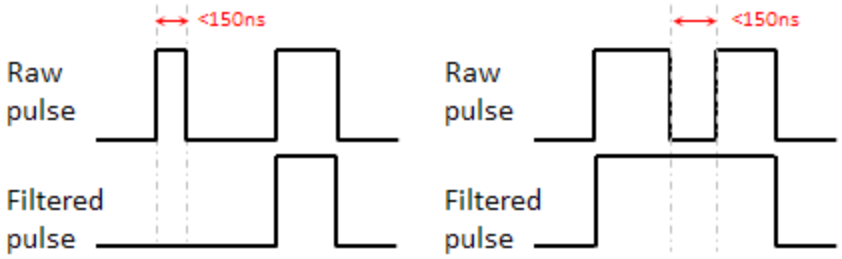
0: AB-phase pulse train (4x)

1: CW-pulse and CCW-pulse trains

2: Pulse train and symbol

- Filter width

Setting value	Low-speed filter width (minimum pulse width *Note 1)	High-speed filter width (minimum pulse width *Note 1)
0	0.83Mpps(600ns)	3.33Mpps(150ns)
1	208Kpps(2.4us)	0.83Mpps(600ns)
2	104Kpps(4.8us)	416Kpps(1.2us)
3	52Kpps(9.6us)	208Kpps(2.4us)
4	No filtering	No filtering



The high-level pulse will be ignored when its width is less than 150 ns.

The low-level pulse of the pulse will be ignored when its length is less than 150 ns.

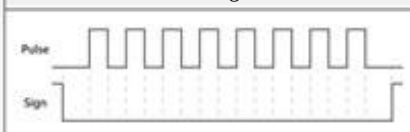
Note 1: The pulse reception can be ensured if the signal comes with the 4Mpps high-speed pulse and the setting value of the pulse is 4.

- Logic type

High- and low-speed pulse input				
Logic		Pulse type	Clockwise rotation	Counterclockwise rotation
0	Positive logic	AB-phase pulse train	Pulse phase advance	Pulse phase delay
		CW-pulse and CCW-pulse trains		

High-speed pulse input				
Logic		Pulse type	Clockwise rotation	Counterclockwise rotation
0	Positive logic	Pulse train + Symbol	High sign	Low sign

Low-speed pulse input				
Logic		Pulse type	Clockwise rotation	Counterclockwise rotation
0	Positive logic	Pulse train + Symbol	Low sign	High sign



In a digital circuit, 0 and 1 usually represent for the high and low voltage. 1 and 0 represent high and low voltage in "Positive Logic", respectively. On the other hand, 1 and 0 represent low and high voltage in "Negative Logic", respectively.

- Source of the external pulse input

  0: Low-speed optical coupling (CN1 pin: OUT, DIR)

  1: High-speed differential (CN1 pin: HOUT, HDIR)

PA-02 (S-off)	STL	Setting for the speed and torque limit	Communication address: 0004H 0005H

	Initial value	0
	Control mode	ALL
	Unit	N/A
	Configuration range	0 ~ 0x11
	Data size	16bit
	Data format	Hex

□□□□■: Start and stop of the speed limit function (valid only in T mode)

□□□■□: On and off for torque limit function (valid in P / S mode)

- On and off for speed limit function(1: on; 0: off)
  - Speed limit function can be turned on and off with DI terminal (SPDLM) Parameters and DI (SPDLM) belong to OR operation.
  - The speed limit configuration source is determined by DI terminal (SPD0, SPD1) state Can select the speed analog command or the parameter value PA-14 ~ PA-16.
- Start and stop of the torque limit function (1: on; 0: off)
  - The torque limit function can be turned on and off by DI terminal (TRQLM). Parameters and DI (TRQLM) belong to OR operation.
  - The source of the torque limit setting is determined by the state of the DI terminals (TCM0,TCM1). Can select the torque analog command or the parameter value PA-03 ~ PA-05.

PA-03	ITQ1	Internal torque limit1/Internal Torque Command 1	Communication address: 0006H 0007H

Initial value	100
Control mode	T / P/ S
Unit	%
Configuration range	-300 ~ +300
Data size	16bit
Data format	Dec

Internal Torque Command 1: The setting of the internal torque command in the first segment (TCM0,TCM1) = (1,0).

Internal Torque Limit 1: The setting of the internal torque limit in the first segment (TCM0,TCM1) = (1,0).

PA-04	ITQ2	Internal torque limit 2/internal torque command 2	Communication address: 0008H 0009H

Initial value	100
Control mode	T / P / S
Unit	%
Configuration range	-300 ~ +300
Data size	16bit
Data format	Dec

Internal Torque Command 2: The setting of the internal torque command in the second segment (TCM0,TCM1) = (0,1).

Internal torque limit 2: The second configuration for the internal torque limit (TCM0,TCM1) = (0,1).

PA-05	ITQ3	Internal torque limit 3/internal torque command 3	Communication address: 000AH 000BH

Initial value	100
Control mode	T / P / S
Unit	%
Configuration range	-300 ~ +300
Data size	16bit
Data format	Dec

Internal torque command 3: The setting of the internal torque command in the third segment (TCM0, TCM1) = (1,1).

Internal torque limit 3: The setting of the internal torque limit in the third segment (TCM0, TCM1) = (1,1).

PA-06 (S-off)	EOUT	The setting for the detector output of the pulse value	Communication address: 000CH 000DH

Initial value	2048
Control mode	ALL
Unit	pulse
Configuration range	4 ~ 32768
Data size	16bit
Data format	Dec

PA-07	MSPL	Maximum speed limit	Communication address: 000EH 000FH

Initial value	By Rated
Control mode	ALL
Unit	r/min
Configuration range	0 ~ max. Speed
Data size	16bit
Data format	Dec

This is the maximum operating speed of the servo motor. The initial value is set to the rated rotation speed.

PA-08	PCLR	Pulse cleaning mode	Communication address: 0010H 0011H

Initial value	00
Control mode	P
Unit	N/A
Configuration range	0 ~0x11
Data size	16bit
Data format	Hex

□□□□■: Trigger method

□□□■□: Function selection

The pulse cleaning function is valid when the control input contact (DI) is set as PCLR.

When the signal of the CCLR is conducted, the accumulated pulse error magnitude of the drive position is cleaned up as 0.

Setting of the trigger method:

0: CCLR trigger method is the positive edge type

1: CCLR trigger method is the level type

Function selection:

0: The accumulated pulse error magnitude of the drive position is cleaned up as 0 when the CCLR is conducted.

1: The Feed Back PUU of the drive is cleaned up to 0 when CCLR is being conducted.

PA-09 (S-off)	GRM1	Numerator of the Electronic Gear Ratio (N1)	Communication address: 0012H 0013H

Initial value	1
Control mode	P
Unit	pulse
Configuration range	1 ~（2^{26}-1）
Data size	32bit
Data format	Dec

Multi-step configuration for the numerator of electronic gear ratio

The numerator of the electronic gear ratio can be selected and switched via these two input pins: GNUM0, GNUM1. It is set to PA-09 if they are not defined. Switch the numerator when the machine stops to avoid vibration during switching.

PA-10 (S-off)	GRD	Denominator of the Electronic Gear Ratio (M)	Communication address:

			0014H 0015H

	Initial value	1
	Control mode	P
	Unit	pulse
	Configuration range	1 ~ (2^{31}-1)
	Data size	32bit
	Data format	Dec

The servo motor is easy to rotate violently when there is a configuration error. The setting must follow the rules below.

Setting for the input ratio of the command pulse

$$\text{Command pulse input(p1)} \times \frac{N}{M} = \text{Position command(p2)}\ ;\ (\text{p1}) \times \frac{N}{M} = (\text{p2})$$

Scope for the input ratio of the command pulse: $1/50 < \frac{N_x}{M} < 25600$ (x =1, 2, 3, 4)

PA-11 (S-off)	GRM2	Numerator of the Electronic Gear Ratio (N2)	Communication address: 0016H 0017H

	Initial value	1
	Control mode	P
	Unit	pulse
	Configuration range	1 ~ (2^{26}-1)
	Data size	32bit
	Data format	Dec

Refer to PA-09.

PA-12 (S-off)	GRM3	The numerator of the electronic gear ratio (N3)	Communication address: 0018H 0019H

	Initial value	1
	Control mode	P
	Unit	pulse
	Configuration range	1 ~ (2^{26}-1)
	Data size	32bit
	Data format	Dec

Refer to PA-09.

PA-13	GRM4	Numerator of the Electronic Gear Ratio (N4)	Communication

(S-off)			address: 001AH 001BH

Initial value	1
Control mode	P
Unit	pulse
Configuration range	1 ~（2^{26}-1）
Data size	32bit
Data format	Dec

Refer to PA-09.

PA-14	ISP1	Internal Speed Command 1/Internal Speed Limit 1	Communication address: 001CH 001DH

Initial value	10000
Control mode	T / S
Unit	0.1 r/min
Configuration range	-50000 ~ +50000
Data size	32bit
Data format	Dec

Internal Speed Command 1: The setting of the internal torque command in the first segment (SPD0,SPD1) = (1,0).

Internal Speed Limit 1: The setting of the internal torque limit in the first segment (SPD0,SPD1) = (1,0).

PA-15	ISP2	Internal Speed Command 2/Internal Speed Limit 2	Communication address: 001EH 001FH

Initial value	20000
Control mode	T / S
Unit	0.1 r/min
Configuration range	-50000 ~ +50000
Data size	32bit
Data format	Dec

Internal Speed Command 2: The setting of the internal torque command in the second segment (SPD0,SPD1) = (0,1).

Internal Speed Limit 2: The setting of the internal torque limit in the second segment (SPD0,SPD1) = (0,1).

PA-16	ISP3	Internal Speed Command 3/Internal Speed Limit 3	Communication address: 0020H 0021H

Initial value	30000
Control mode	T / S
Unit	0.1 r/min
Configuration range	-50000 ~ +50000
Data size	32bit
Data format	Dec

Internal Speed Command 3: The setting of the internal torque command in the third segment (SPD0,SPD1) = (1,1).

Internal Speed Limit 3: The setting of the internal torque limit in the third segment (SPD0,SPD1) = (1,1).

PA-17 (S-off)	CVM	The maximum rotation speed of the analog speed command	Communication address: 0022H 0023H

Initial value	By Rated
Control mode	T / S
Unit	r/min
Configuration range	0 ~ max. Speed
Data size	16bit
Data format	Dec

Maximum rotation speed of the analog speed command:

- In the speed mode, this indicates the setting of the rotation speed while the maximum voltage (10V) is input for the analog speed command.

  If the speed is set to 3000 and 10V is input for external voltage, the speed control command is 3000r/min. 5V implies that the speed control command is 1500r/min.

  Speed control command = Input voltage value x Setting value/10

- In the torque mode, the parameter represents the command for analog speed limit.

  Speed limit command = Input voltage value x Setting value/10

PA-18 (S-off)	CTM	Limited maximum output of the analog torque	Communication address: 0024H 0025H

	Initial value	100
	Control mode	ALL
	Unit	%
	Configuration range	0 ~ 300
	Data size	16bit
	Data format	Dec

Maximum output of the analog torque command:

- In the torque mode, this indicates the setting of the torque while the maximum voltage (10V) is input for the analog torque command.

  If the initial value is set to 100 and 10 V is input for external voltage, the torque control command is 100% rated torque. 5V implies that the torque control command is 50% rated torque.

  Torque control command = Input voltage value x Setting value/10 (%)

- In the speed and position modes, the parameter represents the command for analog torque limit.

  Torque limit command = Input voltage value x Setting value/10 (%)

PA-20	INP	Confirmation of the range when the position is reached	Communication address: 0028H 0029H

	Initial value	1000
	Control mode	P
	Unit	pulse
	Configuration range	0 ~ 131072
	Data size	32bit
	Data format	Dec

In the position mode (P) and the number of differential pulses is below the position range for the setting value of the parameter, the signal for position reaching (TPOS) is output.

PA-21 (S-off)	ATL	Response level for automatic negotiation	Communication address: 002AH 002BH

	Initial value	20
	Control mode	S / P
	Unit	N/A
	Configuration range	1 ~ 40
	Data size	16bit
	Data format	Dec

The parameter is the setting for the response bandwidth.

Based on the setting value of the parameter and the value of PB-35 (the ratio of load inertia to servo motor inertia), the corresponding gain value is calculated automatically.

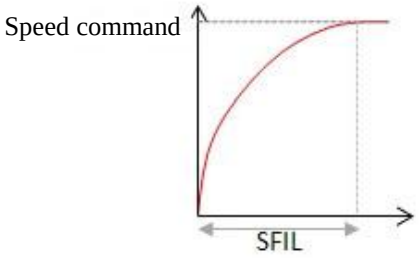
The parameters affected are PB-18(NLPF), PB-19(SCJT), PB-20(KPP), PB-24(KVP), PB-26(KVI) and PB-28(DSG). The setting value and corresponding bandwidth are shown in the following table.

Setting value	Response bandwidth value Hz	Setting value	Response bandwidth value Hz
1	5	21	100
2	6	22	120
3	8	23	140
4	10	24	160
5	13	25	180
6	15	26	200
7	18	27	220
8	21	28	240
9	24	29	260
10	27	30	280
11	30	31	310
12	33	32	340
13	36	33	370
14	40	34	400
15	45	35	430
16	50	36	460
17	55	37	490
18	60	38	520
19	70	39	550
20	80	40	600

PB-XX (Gain/filtering parameter)

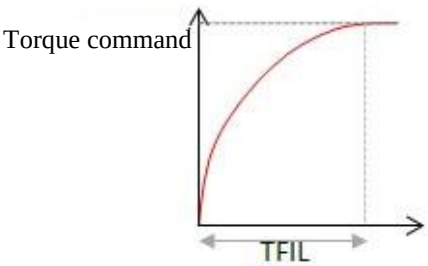
PB-00	SFIL	The acceleration-deceleration smoothing constant of the analog speed command	Communication address: 0100H 0101H

Initial value	0
Control mode	S
Unit	ms
Configuration range	0 ~ 1000 (0: The function is turned off.)
Data size	16bit
Data format	Dec



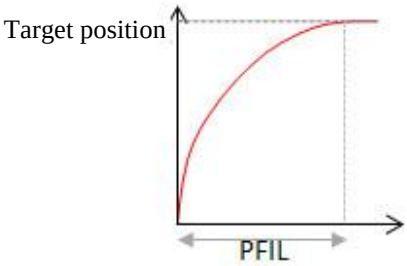
PB-01	TFIL	Smoothing constant of the analog torque command	Communication address: 0102H 0103H

Initial value	0
Control mode	T
Unit	ms
Configuration range	0 ~ 1000 (0: The function is turned off.)
Data size	16bit
Data format	Dec



PB-02	PFIL	Constant of the low-pass filtering for the position command	Communication address: 0104H 0105H

	Initial value	0
	Control mode	P
	Unit	10ms
	Configuration range	0 ~ 1000 (0: The function is turned off.)
	Data size	16bit
	Data format	Dec



PB-03	STAC	Acceleration constant of the smooth S-curve	Communication address: 0106H 0107H

	Initial value	200
	Control mode	S
	Unit	ms
	Configuration range	1 ~ 20000
	Data size	16bit
	Data format	Dec

Constant for speed acceleration: As for PB-03, PB-04 and PB-05, the time required for acceleration from 0 to 3000r/min can be set separately.

NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

PB-04	STDC	Deceleration constant of the smooth S-curve	Communication address: 0108H 0109H

	Initial value	200
	Control mode	S
	Unit	ms
	Configuration range	1 ~ 20000
	Data size	16bit
	Data format	Dec

Constant for speed acceleration: As for PB-03, PB-04 and PB-05, the time required for acceleration from 0 to 3000r/min can be set separately.

NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

PB-05	STL	Smooth constant of the smooth S-curve	Communication address: 010AH 010BH

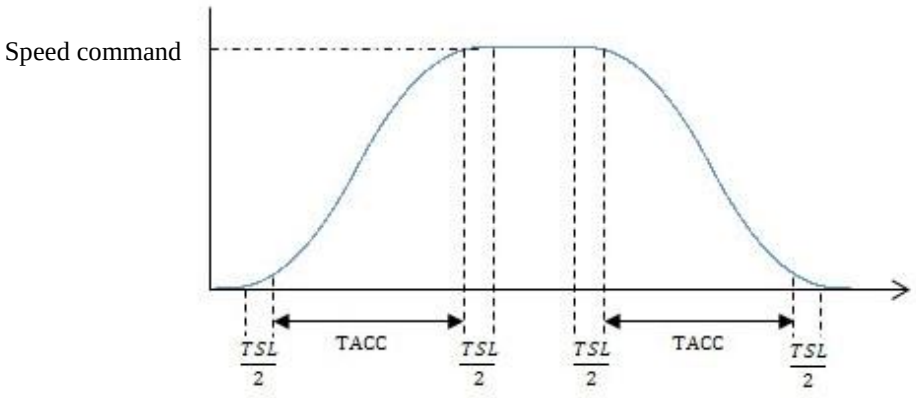
	Initial value	0
	Control mode	S
	Unit	ms
	Configuration range	0 ~ 10000
	Data size	16bit
	Data format	Dec

PB-03: It is used to set the acceleration time for trapezoidal speed command.

PB-04: It is used to set the deceleration time for trapezoidal speed command.

PB-05: It is used to set the smooth time of the S-shaped acceleration-deceleration.

PB-03, Pb-04 and PB-05 can be configured independently.



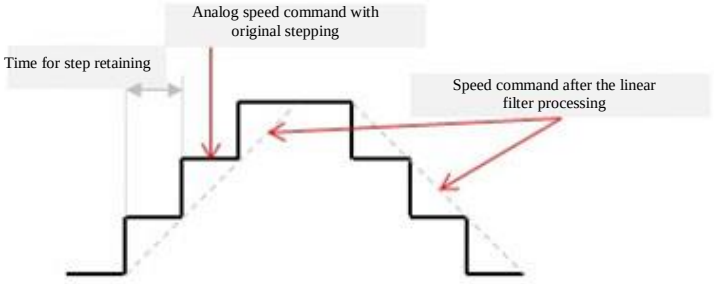
NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

PB-06	MFIL	The constant of the linear filtering for the analog speed command	Communication address: 010CH 010DH

Initial value	0
Control mode	S
Unit	0.1ms
Configuration range	0 ~ 40
Data size	16bit
Data format	Dec
Input example	10 = 1.0 ms

The filter is a moving filter. The parameter PB-00 is a low-pass filter. The difference is that the smoothing effect occurs at the beginning and end of the step command for the moving filter. On the other hand, the smoothing effect only occurs at the end of the step command for the low-pass filter.

Recommendation: If the speed loop receives the command from the upper computer to form the control of the position loop, the low-pass filter can be used. For simple speed control, the moving filter can be used for better smoothing effects.



PB-07	FRCL	Ratio of friction compensation	Communication address: 010EH 010FH

Initial value	0
Control mode	P / S
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

This indicates the value for friction compensation. (As for the percentage of the rated torque, set 0 to turn off the function for friction compensation and set 1 to turn it on.)

PB-08	FRCT	Smooth constant of friction compensation	Communication address: 0110H 0111H

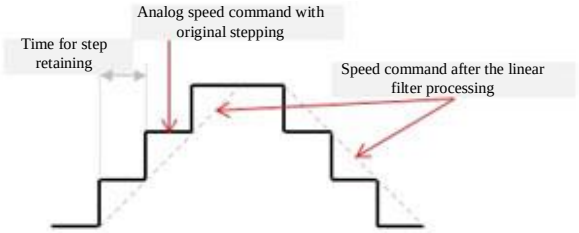
Initial value	0
Control mode	P / S
Unit	ms
Configuration range	0 ~ 1000
Data size	16bit
Data format	Dec

This is used to set the smooth constant of friction compensation.

PB-09	PFLT2	The constant of the linear filtering for the position command	Communication address: 0112H 0113H

Initial value	0
Control mode	P
Unit	ms
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

For the moving filter, the smoothing effect occurs at the beginning and end of the step command. However, the effect results in the delay of the command.



PB-10	NCF1	Notch filter for resonance suppression (1)	Communication address: 0114H 0115H

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-11	NCD1	Notch filter for the attenuation rate of the resonance suppression (1)	Communication address: 0116H 0117H

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-12	NCF2	Notch filter for resonance suppression (2)	Communication Address: 0118H 0119H

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-13	NCD2	Notch filter for the attenuation rate of the resonance suppression (2)	Communication address: 011AH 011BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-14	NCF3	Notch filter for resonance suppression (3)	Communication address: 011CH 011DH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-15	NCD3	Notch filter for the attenuation rate of the resonance suppression (3)	Communication address: 011EH 011FH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-16	NCFA	Setting for the suppression mode of auto-resonance	Communication address: 0120H 0121H

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-17	NCLA	The setting for the sensitivity suppression of auto-resonance	Communication address: 0122H 0123H

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-18	NLPF	The low-pass filtering for resonance suppression	Communication address: 0124H 0125H

Initial value	9
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-19	SCJT	The filter bandwidth for the speed detection	Communication address: 0126H 0127H

Initial value	2500
Control mode	ALL
Unit	Hz
Configuration range	10 ~ 2500
Data size	16bit
Data format	Dec

This is used to set the filter bandwidth for speed estimation.

PB-20	KPP	The gain of the position control	Communication address: 0128H 0129H

Initial value	125
Control mode	P
Unit	rad/s
Configuration range	0 ~ 2047
Data size	16bit
Data format	Dec

When the gain of the position control is increased, the position response is increased and the error magnitude of the position control is reduced. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-21	PGR	Ratio for the gain variation of the position control	Communication address: 012AH 012BH

Initial value	100
Control mode	P
Unit	%
Configuration range	10 ~ 500
Data size	16bit
Data format	Dec

This is used to switch the change rate regarding the gain of the position control based on the condition of gain switch.

PB-22	PFG	The feed forward gain for the position control	Communication address: 012CH 012DH

Initial value	50
Control mode	P
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

For smooth change of the position control command, the increase in gain improves the magnitude of the following error for the position. For unsmooth change of the position control command, the decrease in gain mitigates the vibration of the mechanism during operation.

PB-23	PFC	The smooth constant of the feed forward gain for the position control	Communication address: 012EH 012FH

Initial value	5
Control mode	P
Unit	ms
Configuration range	2 ~ 100
Data size	16bit
Data format	Dec

For smooth change of the position control command, the decrease in smooth constant improves the magnitude of the following error for the position. For unsmooth change of the position control command, the increase in smooth constant mitigates the vibration of the mechanism during operation.

PB-24	KVP	The proportional gain for speed control	Communication address: 0130H 0131H

Initial value	502
Control mode	ALL
Unit	rad/s
Configuration range	0 ~ 8191
Data size	16bit
Data format	Dec

The speed response is increased when the gain of the speed control is increased. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-25	SPR	The ratio for the gain variation of the speed control	Communication address: 0132H 0133H

Initial value	100
Control mode	ALL
Unit	%
Configuration range	10 ~ 500
Data size	16bit
Data format	Dec

This is used to switch the change rate regarding the gain of the speed control based on the condition of gain switch.

PB-26	KVI	The integral compensation for the speed control	Communication address: 0134H 0135H

Initial value	50
Control mode	ALL
Unit	rad/s
Configuration range	0 ~ 1023
Data size	16bit
Data format	Dec

When the integral value of the speed control is increased, the position response is increased and the error magnitude of the speed control is reduced. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-27	KVF	The feed forward gain for the speed control	Communication address: 0136H 0137H

Initial value	0
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

For smooth change of the speed control command, the increase in gain improves the magnitude of the following error for the speed. For unsmooth change of the speed control command, the decrease in gain mitigates the vibration of the mechanism during operation.

PB-28	DSG	The resistance gain for the external interference	Communication address: 0138H 0139H

	Initial value	50
	Control mode	ALL
	Unit	0
	Configuration range	0 ~ 1023
	Data size	16bit
	Data format	Dec

If the parameter is increased, the resistance of the speed circuit increases. It is suggested to set the value of the parameter equal to that of PB-26 (KVI).

It is suggested to refer to the rules below for adjustment:

1. In the speed mode, increase the parameter could reduce the speed overshoot.

2. In the position mode, decrease the parameter could reduce the position overshoot

PB-29	GCM	Condition of the gain switch and the selection for the switch method	Communication address: 013AH 013BH

	Initial value	10
	Control mode	ALL
	Unit	N/A
	Configuration range	0 ~ 18
	Data size	16bit
	Data format	Dec

Condition of the gain switch:

0: The gain switch function is off.

1: The signal (GAINUP) for gain switch is ON.

2: In the position control mode, the magnitude of the position error is greater than the setting value of the parameter PB-31 (GCC).

3: The frequency of the position command is greater than the setting value of the parameter PB-31 (GCC).

4: The rotation speed of the servo motor is greater than the setting value of the parameter PB-31 (GCC).

5: The signal (GAINUP) for gain switch is OFF.

6: In the position control mode, the magnitude of the position error is less than the setting value of the parameter PB-31 (GCC).

7: The frequency of the position command is less than the setting value of the parameter PB-31 (GCC).

8: The rotation speed of the servo motor is less than the setting value of the parameter PB-31 (GCC).

Method for gain switching:

00: Switching of the gain scale

10: Switching of the integrator (P -> PI)

PB-30	GCT	The time constant for the gain switch	Communication address: 013CH 013DH

Initial value	1
Control mode	ALL
Unit	10ms
Configuration range	0 ~ 1000 (0: The function is turned off.)
Data size	16bit
Data format	Dec

The switch time constant is used for the change of the smooth gain.

PB-31	GCC	The condition of the gain switch	Communication address: 013EH 013FH

Initial value	0
Control mode	ALL
Unit	pulse，Kpps，r/min
Configuration range	0 ~ 3840000
Data size	32bit
Data format	Dec

The setting of the switching condition (pulse error, Kpps and r/min) depends on the item (PB-29) selected for switching condition.

PB-32	AUTB	The setting for the response bandwidth of the speed loop in the automatic and semi-automatic modes	Communication address: 0140H 0141H

Initial value	80
Control mode	ALL
Unit	Hz
Configuration range	1 ~ 1000
Data size	16bit
Data format	Dec

1~50 Hz: Low rigidity and response

51~250 Hz: Medium rigidity and response

251~550 Hz: High rigidity and response

NOTE 1) The function is turned on through the parameter PB-33. For the bandwidth corresponding to the setting, refer to Secs. 5 and 6 in Chapter 5 for the description of tuning steps.

PB-33 (S-off)	AUTM	The method for gain adjustment	Communication address: 0142H 0143H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 2
Data size	16bit
Data format	Dec

0: Manual mode

1: Auto mode (persistent adjustment)

2: Semi-auto mode (non-persistent adjustment)

PB-35	GSI	The ratio of load inertia to servo motor inertia	Communication address: 0146H 0147H

Initial value	0
Control mode	ALL
Unit	0.1 times
Configuration range	0 ~ 2000
Data size	16bit
Data format	Dec

Ratio of load inertia to servo motor inertia (rotation motor): (J_load/J_motor)

J_motor: The moment of inertia for the servo motor

J_load: The moment of inertia for the overall equivalence of the external mechanical load

PB-36	VSF1	Frequency for the vibration suppression of low frequency (1)	Communication address: 0148H 0149H

Initial value	1000
Control mode	P
Unit	0.1Hz
Configuration range	10 ~ 10000
Data size	16bit
Data format	Dec

This is the parameter for setting the frequency of the first filter for vibration suppression of low frequency. If PB-37 is set to 0, the first filter for vibration suppression of low frequency is turned off.

PB-37	VSG1	Gain for the vibration suppression of low frequency (1)	Communication address: 014AH 014BH

Initial value	0
Control mode	P
Unit	dB
Configuration range	0 ~ 32
Data size	16bit
Data format	Dec

This is the parameter for setting the gain of the first filter for vibration suppression of low frequency. The greater the gain the better the vibration suppression. The excessive setting may result in uneven operation of the motor. It is suggested to increase the setting gradually.

PB-38	VSF2	Frequency for the vibration suppression of low frequency (2)	Communication address: 014CH 014DH

Initial value	1000
Control mode	P
Unit	0.1Hz
Configuration range	10 ~ 10000
Data size	16bit
Data format	Dec

This is the parameter for setting the frequency of the second filter for vibration suppression of low frequency. If PB-39 is set to 0, the second filter for vibration suppression of low frequency is turned off.

PB-39	VSG2	Frequency for the vibration suppression of low frequency (2)	Communication address: 014EH 014FH

Initial value	0
Control mode	P
Unit	dB
Configuration range	0 ~ 32
Data size	16bit
Data format	Dec

This is the parameter for setting the gain of the second filter for vibration suppression of low frequency. The greater the gain the better the vibration suppression. The excessive setting may result in uneven operation of the motor. It is suggested to increase the setting gradually.

PB-40	KPI	The integral compensation of the position	Communication address: 0150H 0151H

Initial value	0
Control mode	ALL
Unit	Hz
Configuration range	0 ~ 1023
Data size	16bit
Data format	Dec

If the integral value of the position control increases, the magnitude of the steady-state error of the position is reduced. If the setting is excessive, position overshoot and noise may occur.

PB-41	JSL	The level for the stability determination of inertia estimation	Communication address: 0152H 0153H

Initial value	15
Control mode	ALL
Unit	times
Configuration range	0 ~ 200
Data size	16bit
Data format	Dec

Parameter function: In the semi-auto mode, the inertia estimated is assumed complete if the scope of the variation in inertia estimation is less than the one for PB-41 for a period of time.

PC-XX (I/O configuration parameters)

PC-00	DIRT	The time for response filtering of the digital input	Communication address: 0200H 0201H

Initial value	2
Control mode	ALL
Unit	2ms
Configuration range	0 ~ 20
Data size	16bit
Data format	Dec

For louder ambient noise, the control reliability may be enhanced by the increase in setting. The response time may be affected if the setting is too high.

PC-01	DI1	The function planning for Pin DI1 of the digital input	Communication address: 0202H 0203H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

□□□■■: Selection of the input function

□□■□□: Attribute of the input contact

- Selection of the input function: Refer to "Table for definitions of the default DI input" for the function this selection represents.
- Attribute of the input contact: The attribute is Contact a or b.

  0: The input contact is set as NC Contact b.

  1: The input contact is set as NO Contact a.

  After modifying the parameter, restart the power supply to ensure that the function is in normal operation.

  Parameter PD-06 may be used to plan whether DI is controlled by the external terminal or Communication Method PD-32.

Name	DI Code	Input function	P	S	T	Sn	Tn	PS	PT	ST
DISABLE	0x00	No function	DI9	DI9	DI9	DI9	DI9			
SVON	0x01	Servo on	DI1	DI1	DI1	DI1	DI1	DI1	DI1	DI1
ARST	0x02	Error reset	DI5	DI5	DI5	DI5	DI5	DI5	DI5	DI5
GAINUP	0x03	Gain switching								
CCLR	0x04	Pulse cleaning	DI2					DI2	DI2	
ZCLMP	0x05	Zero speed clamping								
CMDV	0x06	Command input reverse control								
TRQL	0x07	Torque limit		DI2		DI2				DI2
SPDL	0x08	Speed limit			DI2		DI2			
SPD0	0x09	Selection of Speed Command 0		DI3		DI3		DI3		DI3
SPD1	0x0A	Selection of Speed Command 1		DI4		DI4		DI4		DI4
TCM0	0x0B	Selection of Torque Command 0	DI3		DI3		DI3		DI3	DI6
TCM1	0x0C	Selection of Torque Command 1	DI4		DI4		DI4		DI4	DI7
S-P	0x0D	Switching of the speed/position mixed mode						DI9		
S-T	0x0E	Switching of the speed/torque mixed mode								DI9
T-P	0x0F	Switching of the torque/position mixed mode							DI9	
EMG	0x15	Emergency stop	DI8	DI8	DI8	DI8	DI8	DI8	DI8	DI8
NL	0x16	Limit of reverse inhibition	DI6	DI6	DI6	DI6	DI6	DI6	DI6	
PL	0x17	Limit of forward inhibition	DI7	DI7	DI7	DI7	DI7	DI7	DI7	
JOGEN	0x19	Selection of the jog control for the terminal								
JOGU	0x1A	Forward jog input								
JOGD	0x1B	Reverse jog input								
GNUM0	0x21	Selection of the Numerator of the Electronic Gear Ratio 0								
GNUM1	0x22	Selection of the Numerator of the Electronic Gear Ratio 1								
TLLM	0x23	Reverse torque limit								
TRLM	0x24	Forward torque limit								
INHP	0x25	Pulse input inhibited								
Reserved		Reserved								
Reserved		Reserved								
Reserved		Reserved								
Reserved		Reserved								

PC-02	DI2	Function planning for Pin DI2 of the digital input	Communication address: 0204H 0205H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-03	DI3	Function planning for Pin DI3 of the digital input	Communication address: 0206H 0207H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-04	DI4	Function planning for Pin DI4 of the digital input	Communication address: 0208H 0209H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-05	DI5	The function planning for Pin DI5 of the digital input	Communication address: 020AH 020BH

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-06	DI6	The function planning for Pin DI6 of the digital input	Communication address: 020CH 020DH

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-07	DI7	The function planning for Pin DI7 of the digital input	Communication address: 020EH 020FH

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-08	DI8	The function planning for Pin DI8 of the digital input	Communication address: 0210H 0211H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-09	DI9	The function planning for Pin DI9 of the digital input	Communication address: 0212H 0213H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x12D
Data size	16bit
Data format	Hex

Refer to the description for PC-01.

PC-10	DO1	Function planning for Pin DO1 of the digital output	Communication address: 0214H 0215H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x10F
Data size	16bit
Data format	Hex

□□□■■: Selection of the input function

□□■□□: Attribute of the input contact

- Selection of the input function: Refer to "Table for definitions of the default DO output" for the function this selection represents.
- Attribute of the input contact: The attribute is Contact a or b.

  0: The input contact is set as NC Contact b.

  1: The input contact is set as NO Contact a.

  After modifying the parameter, restart the power supply to ensure that the function is in normal

operation.

Parameter PD-44 may be used to plan whether DO is controlled by the external terminal or Communication Method PD-31.

Name	DO code	Output Function	P	S	T	Sn	Tn	PS	PT	ST
SRDY	0x01	Servo ready	DO1	DO1	DO1	DO1	DO1	DO1	DO1	DO1
SVON	0x02	Servo on	DO4	DO4	DO4	DO4	DO4	DO4	DO4	DO4
ZSPD	0x03	Zero speed detection	DO2	DO2	DO2	DO2	DO2	DO2	DO2	DO2
RSPD	0x04	Target speed reached	DO3	DO3	DO3	DO3	DO3	DO3	DO3	DO3
INP	0x05	Target position reached	DO6					DO6	DO6	
ALM	0x06	Servo alarm	DO5	DO5	DO5	DO5	DO5	DO5	DO5	DO5
BREAK	0x07	Electromagnetic brake								
OLW	0x08	Overload alert								
WARN	0x0A	Servo warning								
SNL	0x0B	Software limit (reverse direction)								
SPL	0x0C	Software limit (forward direction)								
SP_IN	0x0F	Speed reaching output								

PC-11	DO2	Function planning for Pin DO2 of the digital output	Communication address: 0216H 0217H

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x10F
Data size	16bit
Data format	Hex

Refer to the description for PC-10.

PC-12	DO3	Function planning for Pin DO3 of the digital output	Communication address: 0218H 0219H

	Initial value	Based on the control mode
	Control mode	ALL
	Unit	N/A
	Configuration range	0 ~ 0x10F
	Data size	16bit
	Data format	Hex

Refer to the description for PC-10.

PC-13	DO4	Function planning for Pin DO4 of the digital output	Communication address: 021AH 021BH

	Initial value	Based on the control mode
	Control mode	ALL
	Unit	N/A
	Configuration range	0 ~ 0x10F
	Data size	16bit
	Data format	Hex

Refer to the description for PC-10.

PC-14	DO5	Function planning for Pin DO5 of the digital output	Communication address: 021CH 021DH

	Initial value	Based on the control mode
	Control mode	ALL
	Unit	N/A
	Configuration range	0 ~ 0x10F
	Data size	16bit
	Data format	Hex

Refer to the description for PC-10.

PC-15	DO6	Function planning for Pin DO6 of the digital output	Communication address: 021EH 021FH

Initial value	Based on the control mode
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x10F
Data size	16bit
Data format	Hex

Refer to the description for PC-10.

PC-20	ZSPD	The level for zero speed detection	Communication address: 0228H 0229H

Initial value	100
Control mode	ALL
Unit	0.1 r/min
Configuration range	0 ~ 2000
Data size	16bit
Data format	Dec

This is used to set the output range for the zero speed signal (ZSPD). If the clockwise and counterclockwise rotation speed of the motor is below the setting value, the zero speed signal is formed and the output pin is enabled.

PC-21	BTOD	The turn-on delay time for the electromagnetic brake	Communication address: 022AH 022BH

Initial value	0
Control mode	ALL
Unit	ms
Configuration range	0 ~ 1000
Data size	16bit
Data format	Dec

Parameter function: It sets the time delayed from the the time servo is activated to the time that the interlock signal of the electromagnetic brake (DO code 0x07, BREAK) is turned on.

PC-22	BTCD	The turn-off delay time for the electromagnetic brake	Communication address: 022CH 022DH

Initial value	0
Control mode	ALL
Unit	ms
Configuration range	-1000 ~ 1000
Data size	16bit
Data format	Dec

Parameter function: It sets the time delayed from the the time servo is ready and turned off to the time that the interlock signal of the electromagnetic brake (DO code 0x07, BREAK) is turned off. (Refer to 7.5.4 for the use of the electromagnetic brake.)

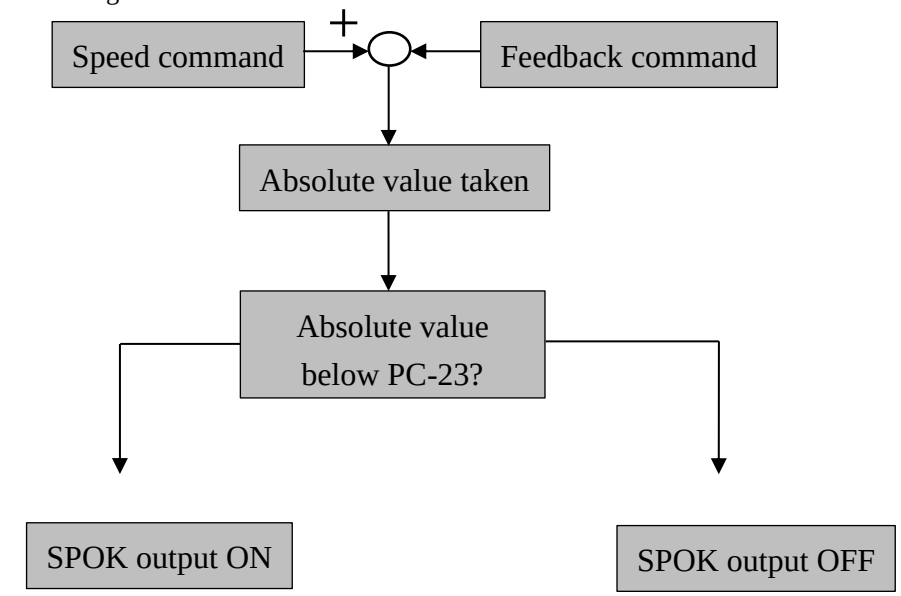
1) When the BTCD delay time is not over and the motor rotation speed is below the one for PC-20, the interlock signal of the electromagnetic brake (BREAK) is turned off.
2) When the BTCD delay time is over and the motor rotation speed is above the one for PC-20, the interlock signal of the electromagnetic brake (BREAK) is turned off.
3) If the alarm or EMGS occurs causes the servo to be turned off, the negative value of BTCD will not become effective if a negative value is assigned to BTCD.
   This is equivalent to the situation that BTCD is set to zero.

PC-23	SPOK	The level for detection of the speed comparison	Communication address: 022EH 022FH

Initial value	10
Control mode	S/ Sn
Unit	r/min
Configuration range	0 ~ 300
Data size	16bit
Data format	Dec

When the error value between the speed command and motor feedback speed is below the one for this parameter, the digital output DO: SP_OK (DO code 0x0F) is on.

Block diagram:



PC-25	POL	The output level for the expected overload	Communication address: 0232H 0233H

Initial value	0
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

If the setting is between 0 and 100 and the continuous output load of the servo motor is above the set ratio (PC-25), the warning signal for expected overload will be output (DO set to 10, OLW). Cancel the function if the setting value is above 100.

PD-XX (Expansion parameter)

PD-00 (Re-on)	ADR	The setting of the branch number	Communication address: 0300H 0301H

Initial value	7F
Control mode	ALL
Unit	N/A
Configuration range	1 ~ 0x7F
Data size	16bit
Data format	Hex

When RS-232/RS-485 is used for communication, only one branch number may be set per servo drive. If one branch number is set for multiple drives, the communication would not work properly. The station number implies the absolute address communication network. It is also applicable to RS-232/485.

PD-01	BRT	The communication transmission rate	Communication address: 0302H 0303H

Initial value	33
Control mode	ALL
Unit	Bps
Configuration range	0 ~ 0x55
Data size	16bit
Data format	Hex

□□□□■: RS232

□□□■□: RS485

The following shows the definition of the setting value:

0：4800

1：9600

2：19200

3：38400

4：57600

5：115200

PD-02	PTL	The protocol	Communication address: 0304H 0305H

Initial value	6
Control mode	ALL
Unit	N/A
Configuration range	6 ~ 8
Data size	16bit
Data format	Dec

RS232 and RS485 share the same setting.

The following shows the definition of the setting value:

6 = 8, N, 2(MODBUS, RTU)

7 = 8, E, 1(MODBUS, RTU)

8 = 8, O, 1(MODBUS, RUT)

PD-03	CFP	The handling of the communication error	Communication address: 0306H 0307H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 1
Data size	16bit
Data format	Dec

The following shows the definition of the setting value:

0: A warning is issued and the operation proceeds.

1: A warning is issued and the operation is decelerated to stop. (The termination mode is set in Parameter PD-42.)

PD-04	COT	The setting for the communication timeout	Communication address: 0308H 0309H

Initial value	0
Control mode	ALL
Unit	Sec
Configuration range	0 ~ 20
Data size	16bit
Data format	Dec

If the setting value is not 0, turn on the communication timeout immediately; otherwise, turn it off.

PD-06 (N-keep)	SWDI	Control switch for the source of the input contact (DI)	Communication address: 030CH 030DH

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 1
Data size	16bit
Data format	Dec

0: The DI status is controlled by the external contact.

1: The DI status is controlled by the software. (The DI status can be set via PD-32.)

PD-07	CDT	The time for the delay of the communication response	Communication address: 030EH 030FH

Initial value	0
Control mode	ALL
Unit	1ms
Configuration range	0 ~ 1000
Data size	16bit
Data format	Dec

This delays the communication time needed for the drive to respond to the upper controller.

PD-08	MNS	Monitoring mode	Communication address: 0310H 0311H

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

PD-11 (R-only)	VER	The firmware version	Communication address: 0316H 0317H

Initial value	The factory setting
Control mode	ALL
Unit	N/A
Configuration range	N/A
Data size	16bit
Data format	Dec

PD-15 (R-only)	MON1	The display for Condition Monitoring Register 1	Communication address: 031EH 031FH

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	-
Data size	32bit
Data format	Dec

The status value to be read by PD-23 can be set via the panel or communication. (Refer to PD-21.) The status data must be read from the communication address through the port.

Example:

If PD-23 is set to 3, the "total pulse numbers for the motor with encoder feedback" is read when PD-15 is read. If the content displayed is read via the MODBUS communication, two sets of 16-bit data from communication addresses 0012H and 0013H is read, respectively. The contents of these two sets form the 32-bit data.

PD-16 (R-only)	MON2	The display for Condition Monitoring Register 2	Communication address: 0320H 0321H

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	-
Data size	32bit
Data format	Dec

The status value to be read by PD-24 can be set via the panel or communication. (Refer to PD-21.) The status data must be read from the communication address through the port.

PD-17 (R-only)	MON3	The display for Condition Monitoring Register 3	Communication address: 0322H 0323H

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	-
Data size	32bit
Data format	Dec

The status value to be read by PD-25 can be set via the panel or communication. (Refer to PD-21.) The status data must be read from the communication address through the port.

PD-18 (R-only)	MON4	The display for Condition Monitoring Register 4	Communication address: 0324H 0325H

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	-
Data size	32bit
Data format	Dec

The status value to be read by PD-26 can be set via the panel or communication. (Refer to PD-21.) The status data must be read from the communication address through the port.

PD-19 (R-only)	MON5	The display for Condition Monitoring Register 5	Communication address: 0326H 0327H

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	-
Data size	32bit
Data format	Dec

The status value to be read by PD-27 can be set via the panel or communication. (Refer to PD-21.) The status data must be read from the communication address through the port.

PD-20 (N-keep)	ALD	The display for the error status of the drive	Communication address: 0328H 0329H

Initial value	-
Control mode	ALL
Unit	N/A
Configuration range	0~58 (The alarm can be cleared by writing in 0.)
Data size	16bit
Data format	Dec

Display of the hexadecimal value: The alarm code is displayed. (Refer to Chapter 9 Warning Troubleshooting for the code definition.)

PD-21	SSD	Display for the status of the drive	Communication address: 032AH 032BH

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

Setting of the default monitoring parameter after power on:

Parameter function:

00 :	Cd-P ,	The number of pulses entered for the pulse command (the number of pulses for the command entered to the upper controller)	[user unit]
01 :	Fb-P ,	The number of pulses for the motor feedback (the number of pulses fed to the upper controller from the drive)	[user unit]
02 :	Err-P ,	The number of differential pulses for the Cd-P and Fb-P	[user unit]
03 :	Efb-P ,	The number of pulses for the motor feedback (the number of pulses for the encoder feedback)	[pulse]
04 :	SPEED ,	Motor rotation speed	[r/min]
05 :	ECd.P ,	The number of pulses entered for the pulse command (the number of pulses for the command entered to the upper controller* the electronic gear ratio)	[pulse]
06 :	Eer-P ,	The number of differential pulses for the ECd-P and EFb-P	[pulse]
07 :	CP-Fr ,	The pulse command input frequency	[Kpps]
08 :	C-SP1 ,	The speed input command	[Volt]
09 :	C-SP2 ,	The speed input command	[r/min]
10 :	C-tq1 ,	The torque input command	[Volt]
11 :	C-tq2 ,	The torque input command	[%]
12 :	PK-L ,	The peak torque	[%]
13 :	AvG-L ,	The average torque	[%]
14 :	U-buS ,	The voltage of the main circuit	[Volt]
15 :	J-L ,	The load/motor inertia ratio	[double]
16 :	rSn.fr,	The resonance frequency (The low byte is the first resonance point and the high byte is the second resonance point.)	[Hz]
17 :	diFF.2,	This indicates the number of absolute pulses with respect to the encoder Z-phase. Which means, the numerical value at the origin of the Z-phase is 0. The encoder rotates clockwise or counterclockwise for positive/negative 5000 pulses.	[pulse]
18 :	Drv-t ,	Drive temperature	[°C]

PD-22	VMON	The analog output monitoring	Communication address: 032CH 032DH

Initial value	01
Control mode	ALL
Unit	N/A
Configuration range	00 ~ 0x55
Data size	16bit
Data format	Hex

□□□□■: MON2

□□□■□: MON1

Settings of MON1 and MON2	Description
0	Motor speed (+/-8 volts/maximum rotation speed)
1	Motor torque (+/-8 volts/maximum torque)
2	Pulse command frequency (+8 volts/4.5 Mpps)
3	Speed command (+/-8 volts/maximum speed command)
4	Torque command (+/-8 volts/maximum torque command)
5	VBUS voltage (+/-8 volts/464 V)

PD-23	CM1	Selection for the content of the display for Status Monitoring Register 1	Communication address: 032EH 032FH

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

For the settings, refer to PD-21.

Example:

If PD-23 is set to 04, the "motor rotation speed (r/min)" is read if PD-23 is read.

PD-24	CM2	Selection for the content of the display for Status Monitoring Register 2	Communication address: 0330H 0331H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

For the settings, refer to PD-21.

PD-25	CM3	Selection for the content of the display for Status Monitoring Register 3	Communication address: 0332H 0333H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

For the settings, refer to PD-21.

PD-26	CM4	Selection for the content of the display for Condition Monitoring Register 4	Communication address: 0334H 0335H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

For the settings, refer to PD-21.

PD-27	CM5	The display content of Condition Monitoring Register 5 is selected.	Communication address: 0336H 0337H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 18
Data size	16bit
Data format	Dec

For the settings, refer to PD-21.

PD-28	VMR1	The ratio for MON1 analog monitoring output	Communication address: 0338H 0339H

Initial value	100
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

Example:

PD-22 = 01 (MON1 is the analogue output of motor speed while MON2 is the analogue output of motor torque.)

MON1 output voltage= $8 * \frac{\text{Motor rotation speed}}{(\text{Max.speed} * \frac{PD-28}{100})}$ unit: volts

MON2 output voltage= $8 * \frac{\text{Motor torque}}{(\text{Max.torque} * \frac{PD-29}{100})}$ unit: volts

PD-29	VMR2	The ratio for MON2 analog monitoring output	Communication address: 033AH 033BH

Initial value	100
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

Example:

PD-22 = 01 (MON1 is the analogue output of motor speed while MON2 is the analogue output of motor torque.)

MON1 output voltage= $8 * \frac{\text{Motor rotation speed}}{(\text{Max.speed} * \frac{PD-28}{100})}$ unit: volts

MON2 output voltage= $8 * \frac{\text{Motor torque}}{(\text{Max.torque} * \frac{PD-29}{100})}$: volts

PD-30	JOG	The jog control of the servo motor	Communication address: 033CH 033DH

Initial value	20
Control mode	ALL
Unit	r/min
Configuration range	0 ~ 5000
Data size	16bit
Data format	Dec

Parameter function:

When a jog speed is set for the drive panel control parameter PD-30, the "JOG" icon will display on the panel. Press the "UP" key to control normal jog running. Press the DOWN key to control reverse jog running. Release the key to stop jog running. No running is possible if any error is displayed in this setting. The max. jog speed is the max. servo motor speed.

PD-31 (S-off) (N-keep)	FDO	The status and setting of the digital output	Communication address: 033EH 033FH

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x3F
Data size	16bit
Data format	Hex

For the setting not configured when the software specifies a DO status (PD-44 is not set to 006), this parameter displays the DO status (read-only).

For the setting configured when the software specifies a DO status (PD-44 = 006), this parameter may force to specify the DO status. Bit0 ~Bit5 corresponds to DO1~DO6, respectively.

PD-32	DISF	The status and setting of the digital input	Communication address: 0340H 0341H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x1FF
Data size	16bit
Data format	Hex

For the setting not configured when the software specifies a DI status (PD-06 = 0), this parameter displays the DI status (read-only).

For the setting configured when the software specifies a DI status (PD-06 = 1), this parameter may force to specify the DI status. Bit0 ~Bit8 corresponds to DI1~DI9, respectively.

PD-33 (R-only)	ALH1	The record of the abnormal condition (N)	Communication address: 0342H 0343H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	
Data size	16bit
Data format	Dec

Parameter function: The latest abnormal status record

LED displays ALXXX. XXX is an alarm code. Refer to the Drive Alarm List in 9.1.

PD-34 (R-only)	ALH2	The record of the abnormal condition (N-1)	Communication address: 0344H 0345H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	
Data size	16bit
Data format	Dec

Parameter function: The second-last abnormal status record.

LED displays ALXXX. XXX is an alarm code. Refer to the Drive Alarm List in 9.1.

PD-35 (R-only)	ALH3	The record of the abnormal condition (N-2)	Communication address: 0346H 0347H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	
Data size	16bit
Data format	Dec

Parameter function: The third-last abnormal status record.

LED displays ALXXX. XXX is an alarm code. Refer to the Drive Alarm List in 9.1.

PD-36 (R-only)	ALH4	The record of the abnormal condition (N-3)	Communication address: 0348H 0349H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	
Data size	16bit
Data format	Dec

Parameter function: The fourth-last abnormal status record.

LED displays ALXXX. XXX is an alarm code. Refer to the Drive Alarm List in 9.1.

PD-37 (R-only)	ALH5	The record of the abnormal condition (N-4)	Communication address: 034AH 034BH

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	
Data size	16bit
Data format	Dec

Parameter function: The fifth-last abnormal status record.

LED displays ALXXX. XXX is an alarm code. Refer to the Drive Alarm List in 9.1.

PD-40	PCM	The condition monitoring register (for PC software)	Communication address: 0350H 0351H

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

PD-41	PCMS	The content selection of the condition monitoring register (for PC software)	Communication address: 0352H 0353H

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

PD-42	MSTP	The function of the motor stop mode	Communication address: 0354H 0355H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0x21
Data size	16bit
Data format	Hex

□□□□■: Motor stop mode

□□□■□: Dynamic brake execution options

- Motor stop mode: When CWL, CCWL, EMGS or communications errors are generated, the motor stop mode functions (no support for the position mode).

  0: Stop immediately

  1: Stop gradually

- Dynamic brake execution options: The stop mode for Servo Off or Alarm.

  0: Execution of dynamic brake

  1: Motor free run

  2: Execution of dynamic brake and then free run when the motor stops thoroughly (motor speed less than

PC-20).

PD-43	TSPD	The level for the detection of the target rotation speed	Communication address: 0356H 0357H

Initial value	The rated value
Control mode	ALL
Unit	r/min
Configuration range	0 ~ 5000
Data size	16bit
Data format	Dec

The digital output (TSPD) is enabled when the speed reaches to the preset target speed. If the clockwise and counterclockwise rotation speed of the motor exceeds the setting value, the target speed signal is formed and the output pin is enabled.

PD-44	RegMisc1	The write-in of the special parameter	Communication address: 0358H 0359H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 0xFFFF
Data size	16bit
Data format	Hex

Settings:

Parameter code	Function
4	Parameter reset (Power needs to be reconnected after reset.)
6	Activation of the compulsory DO mode
106	After the compulsory DO mode is activated, it is possible to switch back to the normal DO mode.

PD-45	RES	The value of the regenerative resistor	Communication address: 035AH 035BH

Initial value	See the table below.
Control mode	ALL
Unit	Ohm
Configuration range	10 ~ 750
Data size	16bit
Data format	Dec

Settings:

Model	Initial value
750W	40Ω
1KW ~ 2KW	40Ω

PD-46	RESC	The capacity of the regenerative resistor	Communication address: 035CH 035DH

Initial value	See the table below.
Control mode	ALL
Unit	Watt
Configuration range	30 ~ 3000
Data size	16bit
Data format	Dec

Model	Initial value
750W	40W
1KW ~ 3KW	40W

PD-47	CRSR	The collision protection for the motor (torque percentage)	Communication address: 035EH 035FH

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

PD-48	CRST	The collision protection for the motor (protection time)	Communication address: 0360H 0361H

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

PD-49	EXREG	The selection of the external braking unit	Communication address: 0362H 0363H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 1
Data size	16bit
Data format	Dec

Parameter function: An external braking unit can be used when the capacity of the built-in brake resistor is low.
For the information about the connection, refer to Section 3.1.
Set PD-49 to 0 when an internal or external braking resistor is used.
Set PD-49 to 1 when an external braking unit is used.
Erroneous settings will generate AL004 (Regeneration Error).

PD-50	AUTS	The status of inertia adjustment in the semi-auto mode	Communication address: 0364H 0365H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 1
Data size	16bit
Data format	Dec

Semi-auto setting:

1: The inertia estimation in the semi-auto mode is completed. Refer to PB-35 for the load inertia value.

0: When 0 is displayed, the inertia adjustment is still underway.

When 0 is set, the inertia adjustment is still underway.

PD-51 (N-keep)	INH	The auxiliary function	Communication address: 0366H 0367H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	Read only
Data size	16bit
Data format	Dec

PD-52	PLOSS	The detection of the input phase failure	Communication address: 0368H 0369H

Initial value	1
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 1 (0: Deactivation of the input phase failure detection)
Data size	16bit
Data format	Dec

PD-53	OSPW	The condition for the overspeed warning	Communication address: 036AH 036BH

Initial value	5000
Control mode	S
Unit	r/min
Configuration range	1 ~ 6000
Data size	16bit
Data format	Dec

PD-54	PCF	The condition for giving warnings of the excessive error regarding the position control	Communication address: 036CH 036DH

Initial value	480000
Control mode	P
Unit	Pulse
Configuration range	1 ~ 16000000
Data size	32bit
Data format	Dec

PD-55	LVL	The level for the error of the low voltage	Communication address: 036EH 036FH

Initial value	160
Control mode	ALL
Unit	Volt.(rms)
Configuration range	140 ~ 190
Data size	16bit
Data format	Dec

This parameter set the low-voltage detection level. The low-voltage alarm is released when the mains supply is lower than this setting. (After the low-voltage error is eliminated, power must be reconnected to the drive to clear the alarm.)

Chapter 7 Control Function

7.1. Selection of operating mode

ISA drive provides three basic operating modes, position, speed and torque modes. You can use a single control mode or the mixed mode for control. The following table lists all the operating modes and relevant description:

Mode name		Mode code	Mode number	Description
Single mode	Position mode (Terminal input)	P	00	The drive receives the position command and controls the motor to move to the target position. The position command is input from the terminal block. The signal type is pulse.
	Speed mode	S	01	The drive receives the speed command and controls the motor to reach the target rotational speed. The internal register provides the speed command (three registers available) or the external terminal block inputs the analog voltage (-10V ~ +10V). The command selection is based on the DI signal.
	Torque mode	T	02	The drive receives the torque command and controls the motor to reach the target torque. The internal register provides the torque command (three registers available) or the external terminal block inputs the analog voltage (-10V ~ +10V). The command selection is based on the DI signal.
	Speed mode (no analog input)	Sn	08	The drive receives the speed command and controls the motor to reach the target rotational speed. The speed command can only be provided by the internal register (three registers available). It cannot be provided by the external terminal block. The command selection is based on the DI signal.
	Torque mode (no analog input)	Tn	09	The drive receives the torque command and controls the motor to reach the target torque. The torque command can only be provided by the internal register (three registers available). It cannot be provided by the external terminal block. The command selection is based on the DI signal.

Mixed mode	Position-Speed	PS	05	P and S is switched via the DI signal.
	Position-Torque	PT	06	P and T is switched via the DI signal.
	Speed-Torque	ST	07	S and T is switched via the DI signal.

The steps for mode change are as follows:

1. Switch the drive to Servo Off by turning the SON signal of DI off.
2. Fill the mode number from the table above into the setting of the control mode in Parameter PA-00. Refer to the description from Chapter 6.
3. After finish setting, disconnect the drive and connect the power to the drive.

7.2. Position mode

The position mode for control is used for the device requiring precise positioning, such as the industrial machinery. The directional input of the command pulse operates the rotation angle of the motor through the external pulse. The device accepts the pulse input up to 4Mpps. The closed-loop system of the position focuses on the speed mode. The gain position controller and lead compensation are added externally. Two operating modes (manual and auto) are available for the user, just like the speed mode. The section explains the gain position controller, lead compensation and processing of position command.

7.2.1. Command of position mode

The command of the position mode for control (P) comes from the input pulse of the terminal block. Three types are available for the pulse and each type is divided into positive and negative logic. The pulse is set in Parameter PA-01. Refer to the table below:

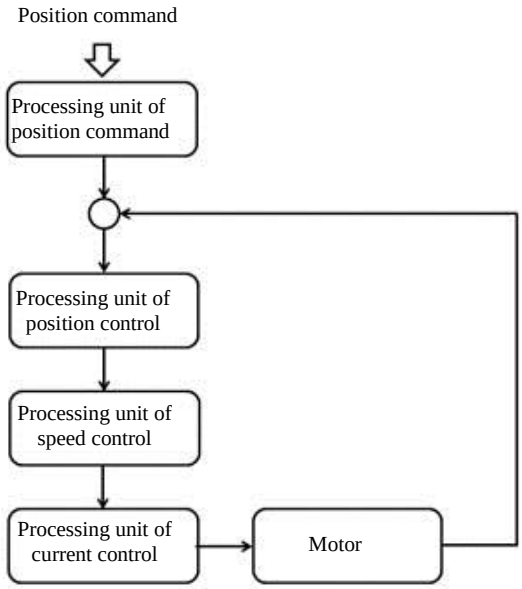
PA-01 (S-off)	CMPT	Setting for the input format of the external pulse train	Communication address: 0002H 0003H

Initial value	0002
Control mode	T / P
Unit	N/A
Configuration range	0 ~ 0x1142
Data size	16bit
Data format	Hex

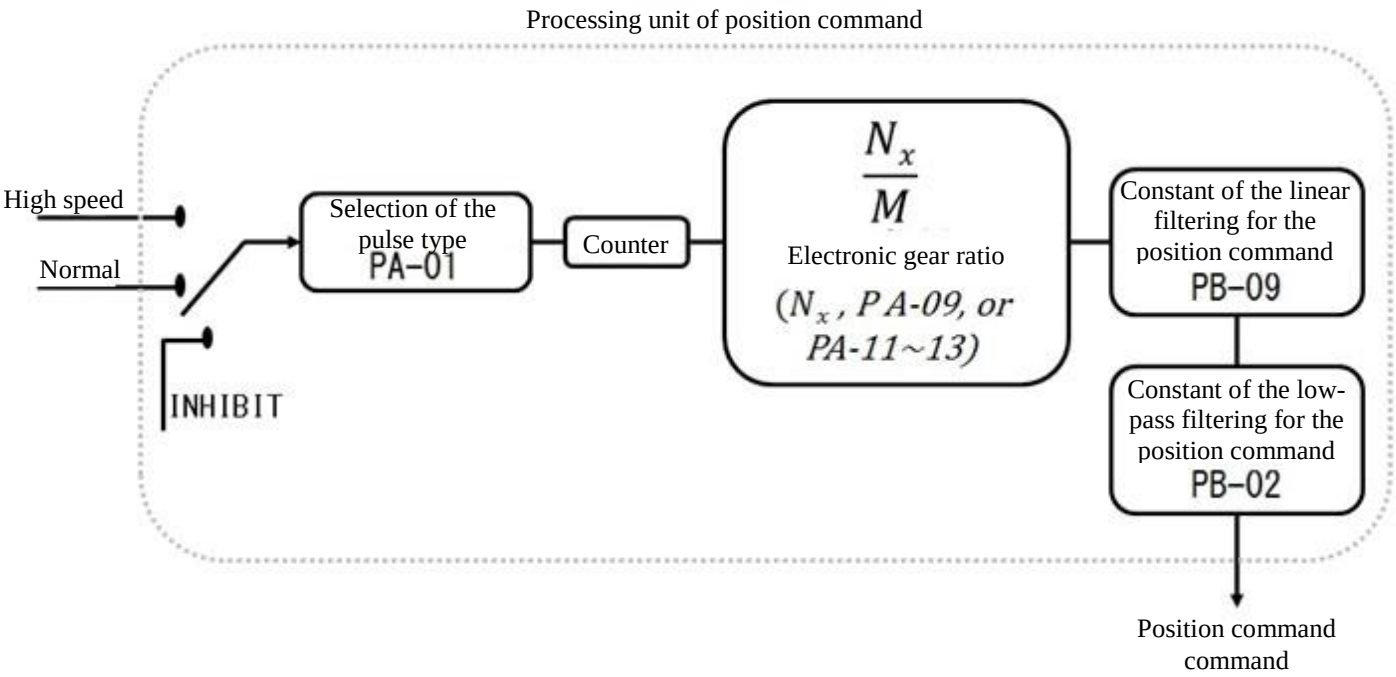
□□□□■: Pulse type
□□□■□: Filter width
□□■□□: Logic type
□■□□□: Source of the external pulse input
Refer to Chapter 6 for setting in details.

7.2.2. Control structure of the position mode

The diagram below shows the basic control structure:



For better control, the pulse signal is processed and modified through the processing unit of the position command. The following diagram shows the structure:



The graph shows P Mode. The selection is made by using PA-00. The electronic gear ratio can set in P Mode to set proper positioning resolution. The command smoothing can be achieved via the low-pass filter.

Inhibit input (INHP)

INHP must be selected through DI before the function is used. (Refer to PC-01~09.) The function won't be used if it is not selected in DI. After selection, the calculation of the pulse command signal in the position mode for control is terminated after the INHP input is on. The motor remains locked.

7.2.3. Electronic gear ratio

The change of travel ratio can be conducted simply and easily via the electronic gear. Higher electronic gear ratio usually leads to stepping of the position command. The condition can be improved by smoothing the ratio through the low-pass filter. If the electronic gear ratio equals 0.5, the ratio of each two pulses from the command end to the pulse of the motor rotation is 1 pulse.

Relevant parameters:

PA-09 (S-off)	GRM1	Numerator of the Electronic Gear Ratio (N1)	Communication address: 0012H 0013H

	Initial value	1
	Control mode	P
	Unit	pulse
	Configuration range	1 ~ (2^{26}-1)
	Data size	32bit
	Data format	Dec

Multi-step configuration for the numerator of electronic gear ratio.

The numerator of the electronic gear ratio can be selected and switched via these two input pins: GNUM0, GNUM1. It will be set to PA-09 as default if the two input pins are not defined. Switch the numerator when the machine stops to avoid vibration during switching.

PA-10 (S-off)	GRD	Denominator of the Electronic Gear Ratio (M)	Communication address: 0014H 0015H

	Initial value	1
	Control mode	P
	Unit	pulse
	Configuration range	1 ~ (2^{31}-1)
	Data size	32bit
	Data format	Dec

The servo motor is easy to rotate violently when there is a configuration error. The setting

must follow the rules below.

Setting for the input ratio of the command pulse

$$\text{Command for pulse input } (p1) \times \frac{N}{M} = \text{Command position } (p2);\ (p1) \times \frac{N}{M} = (p2)$$

Scope for the input ratio of the command pulse: $1/50 < \frac{N_x}{M} < 25600$ (x =1、2、3、4)

7.2.4. Adjustment for the gain of position circuit

Before setting the position control unit, the user must select the operating mode for gain adjustment first manually (PB-33) for the speed control unit. As a result, the setting of speed control unit is complete. The speed control unit must be set before the setting of the position control unit because the speed circuit is included in the internal circuit of the position circuit.

Parameter PB-33 allows the user to select the operating mode for gain adjustment. If the user decides to adjust the gain manually, the gain of the speed circuit must be adjusted before setting the proportional gain (PB-20) and feed-forward gain (PB-22) of the position circuit.

Proportional gain(PB-20) : The gain increase would expand the response bandwidth of the position circuit.

Feed-forward gain (PB-22): This reduces the phase-lag error.

The bandwidth of the position circuit must not exceed that of the speed circuit. It is suggested that response bandwidth of position circuit (Hz) ≤ response bandwidth of speed circuit.(Hz)

Fp: Response bandwidth of position (Hz)

Fv: Response bandwidth of speed (Hz)

$$Fp \le \frac{Fv}{4}$$

E.g.: For setting the response bandwidth of position to 10Hz, Parameter KPP(PB-20) is designed as KPP= $2 \times \pi \times Fp = 2 \times \pi \times 10 = 62.8$

Relevant parameters:

PB-20	KPP	Gain of the position control	Communication address: 0128H 0129H

	Initial value	125
	Control mode	P
	Unit	rad/s
	Configuration range	0 ~ 2047
	Data size	16bit
	Data format	Dec

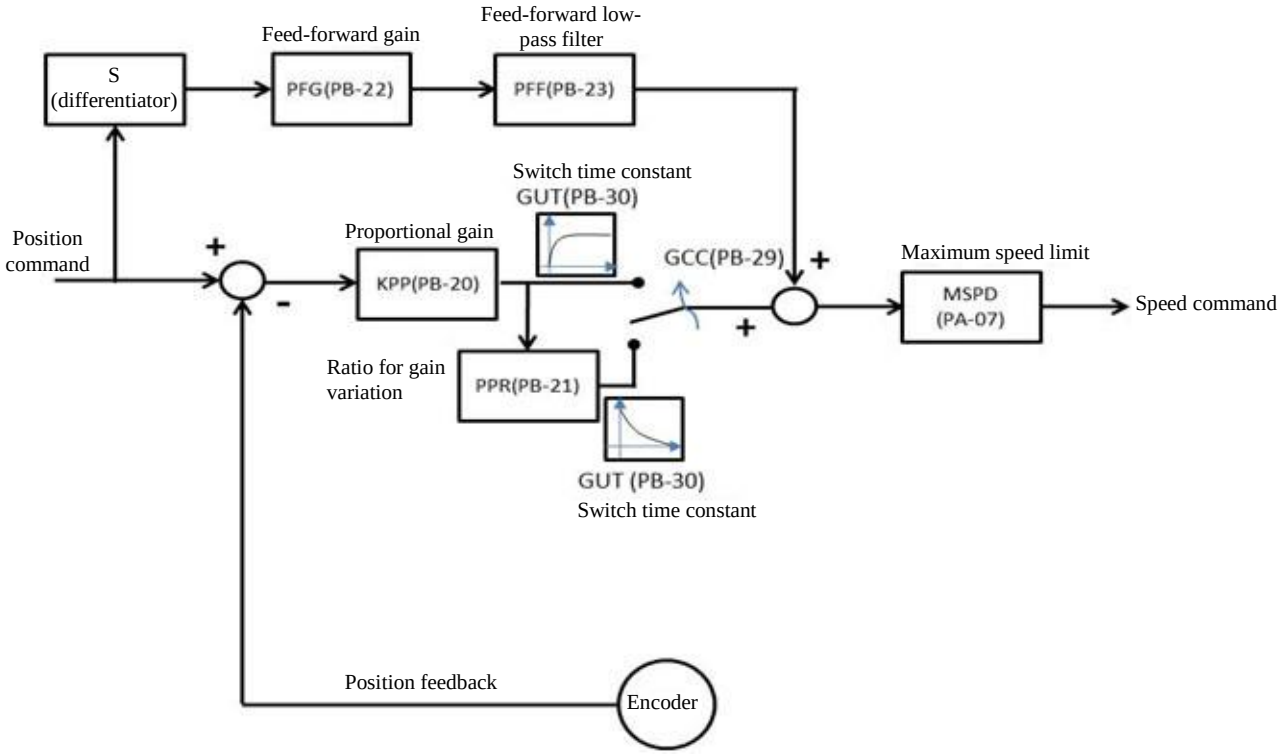
When the gain of the position control is increased, the position response is increased and the error magnitude of the position control is reduced. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-22	PFG	Feed-forward gain for the position control	Communication address: 012CH 012DH

Initial value	50
Control mode	P
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

For smooth change of the position control command, the increase in gain improves the magnitude of the following error for the position. For unsmooth change of the position control command, the decrease in gain mitigates the vibration of the mechanism during operation.

Position control unit:



If the KPP of proportional gain is adjusted to an excessive degree, the open-loop bandwidth of the position is expanded, which results in the reduction of phase margin and the motor vibration. The KPP must be lowered until the motor rotor no longer vibrates. With the interference of the external torque, excessively low KPP cannot meet reasonable requirements of the following error for the position. By adjusting the PFG of the feed-forward gain properly, the dynamic following error of position can be reduced effectively.

7.3. Speed mode

The speed mode for control (S or Sn) is used for the device requiring precise speed control, such as the CNC processing machine. Two modes for command input are available for the drive, which are the analog and register input.

- The input of analog command is used to manipulate the rotation speed of motor through the external voltage.
- Two application methods are available for the input of command register:
  - For the first method, the user sets different values of speed command to three command registers (PA-14~PA-16) before activation and switches them through SP0 and SP1 of DI in CN1.
  - As for the second one, the content value of the command register is changed through communication. For the incoherence generated due to the switching in command register, the device provides complete S-curve planning.

In the closed-loop control system for speed, two gain adjustment modes (PB-33, manual and auto) are available for the user.

- Manual gain mode: The user sets all parameters for speed loop and all auto or auxiliary functions are turned off.
- Automatic gain mode: The estimation of load inertia is provided. The parameter of the drive is adjusted simultaneously. The parameter set by the user is regarded as the initial value.

7.3.1. Selection of speed command

The source of the speed command can be divided into the analog voltage input externally and the internal parameter. The selection depends on the DI signal of CN1. The correspondence between the speed command and signal is shown in the following table:

<table>
<tr><th rowspan="2">Speed command no.</th><th colspan="2">DI signal of CN1</th><th colspan="3" rowspan="2">Command Source</th><th rowspan="2">Contents</th><th rowspan="2">Scope</th></tr>
<tr><th>SPD1</th><th>SPD0</th></tr>
<tr><td rowspan="2">S1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">Mode</td><td>S</td><td>External analog command</td><td>Voltage difference between V-REF and GND</td><td>-10 V ~ +10V</td></tr>
<tr><td>Sn</td><td>None</td><td>The speed command is 0.</td><td>0</td></tr>
<tr><td>S2</td><td>0</td><td>1</td><td colspan="3" rowspan="3">Parameter of internal register</td><td>PA-14</td><td>-5000.0 ~ 5000.0</td></tr>
<tr><td>S3</td><td>1</td><td>0</td><td>PA-15</td><td>-5000.0 ~ 5000.0</td></tr>
<tr><td>S4</td><td>1</td><td>1</td><td>PA-16</td><td>-5000.0 ~ 5000.0</td></tr>
</table>

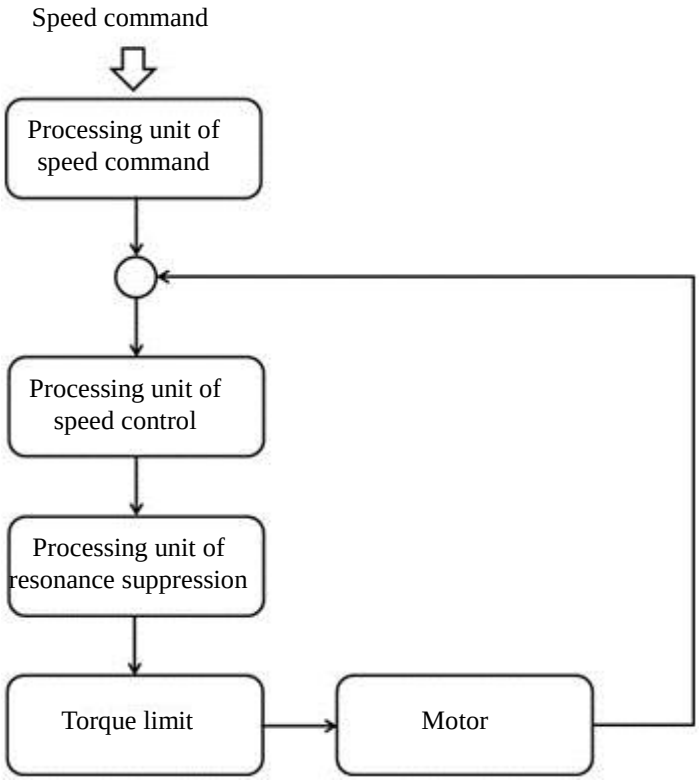
- PD0 ~ SPD1 status: 0 represents open circuit (Open) and 1 represents close circuit (Close).
- In the situation that SPD0=SPD1=0, the command is 0 if the mode is Sn. If the user does not need to use the analog voltage as the speed command, he or she may adopt Sn Mode to make sure that the analog voltage is without zero drift. For S Mode, the command is the analog voltage difference

between V-REF and GND. The voltage range input is -10V ~ +10V. The rotation speed corresponding to the voltage is adjustable (PA-17).

- If either SPD0 or SPD1 is not 0, the speed command is the internal parameter. The command becomes effective right after the change between SPD0 and SPD1.
- The setting for the parameter of the internal register is between -50000 and 50000. Setting value = Setting range x unit (0.1r/min)
  E.g.: PA-14 = +30000. Setting value of rotation speed = +30000 x 0.1r/min = +3000r/min

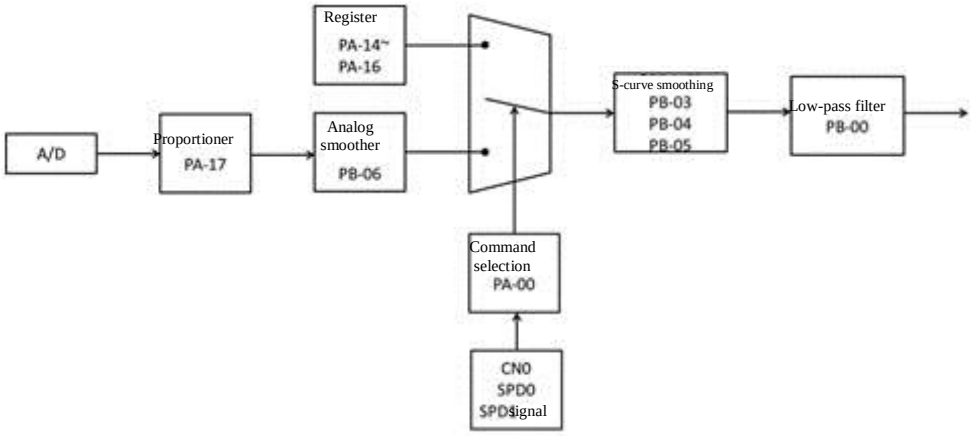
The speed command discussed in this section can be treated as the speed command under the speed mode (S or Sn). It can also be input as the command of speed limit under the torque mode (T or Tn).

7.3.2. Control structure of the speed mode



The processing unit of speed command selects the source of speed command based on 7.3.1. The selection includes the size of command represented by the analog voltage set by the proportioner (PA-17), as well as the S-curve used for smoothing the speed command. The speed control unit manages the gain parameter of the drive and computes the command of the current supplied to the motor promptly. The resonance suppression unit is used to suppress the resonance of machinery structure. The units are explained as follows:

First, the functions regarding the Processing unit of speed command are introduced. The structure diagram is as below:



7.3.3. Smoothing of speed command

Smoothing of S-curve command

The command generator of S-curve smoothing for the speed adopts the planning of the three-phase acceleration curve during acceleration and deceleration. It enables smoothing of the motion control and generates continuous acceleration to avoid excessive jerk (acceleration differentiation) due to rapid change of the command entered. The jerk may stimulate the vibration and noise of the machinery structure. The user may use the speed constant of S-curve acceleration (PB-03) to adjust the slope of speed change during acceleration. The speed constant of S-curve deceleration (PB-04) is used to adjust the slope of speed change during deceleration. The smoothing constant of S-curve acceleration and deceleration (PB-05) is used to improve the stability during start and stop of motor. The device provides the calculation for the time required for the completion of command. T (ms) indicates the operating time. S (r/min) represents the command of absolute speed, which is the absolute value calculated by subtracting the final speed from the initial speed. When PB-05 is set to 0, the command generator of S-curve smoothing is turned off. No smoothing effect is available for the speed command at this moment.

Relevant parameters:

PB-03	STAC	Acceleration constant of the smooth S-curve	Communication address: 0106H 0107H

	Initial value	200
	Control mode	S
	Unit	ms
	Configuration range	1 ~ 20000
	Data size	16bit
	Data format	Dec

Constant for speed acceleration: As for PB-03, PB-04 and PB-05, the time required for acceleration from 0 to 3000r/min can be set separately.

NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

PB-04	STDC	Deceleration constant of the smooth S-curve	Communication address: 0108H 0109H

Initial value	200
Control mode	S
Unit	ms
Configuration range	1 ~ 20000
Data size	16bit
Data format	Dec

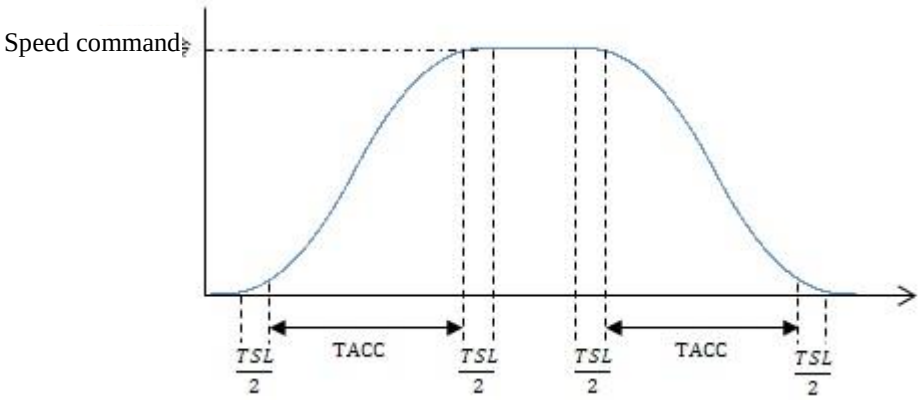
Constant for speed acceleration: As for PB-03, PB-04 and PB-05, the time required for acceleration from 0 to 3000r/min can be set separately.

NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

PB-05	STL	Smooth constant of the smooth S-curve	Communication address: 010AH 010BH

Initial value	0
Control mode	S
Unit	ms
Configuration range	0 ~ 10000
Data size	16bit
Data format	Dec

PB-03: It is used to set the acceleration time for trapezoidal speed command.
PB-04: It is used to set the deceleration time for trapezoidal speed command.
PB-05: It is used to set the smooth time of the S-shaped acceleration-deceleration.
PB-03, PB-04 and PB-05 can be set separately.



NOTE 1) If the source of the speed command is an analog source or PB-05 is set to 0, turn off the smooth function for S-shaped acceleration-deceleration.

- **Analog command smoother**

The analog command smoother is provided primary to offer the buffering when the analog input signal changes too fast.

The S-curve generator for analog speed allows the smoothing of the analog input command. Its time planning is the same as the one for the S-curve of general speed. The speed and acceleration curves are continuous. The graph above illustrates the schematic diagram for the S-curve generator for analog speed. The slopes of the rotation speed command referred during acceleration and deceleration are different. It is evident that how the command is followed. The poor following property shows in the graph. The user may

adjust the time setting (PB-03, PB-04 and PB-05) based on the actual situation for improvement.

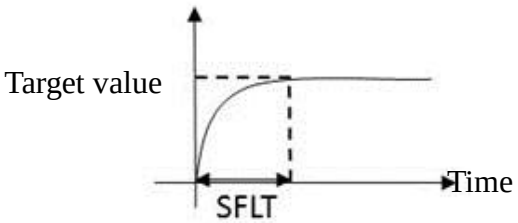
- **Low-pass filter at the command end**

The low-pass filter at the command end is usually used to attenuate unneeded high-frequency response or noise while smoothing the command.

Relevant parameters:

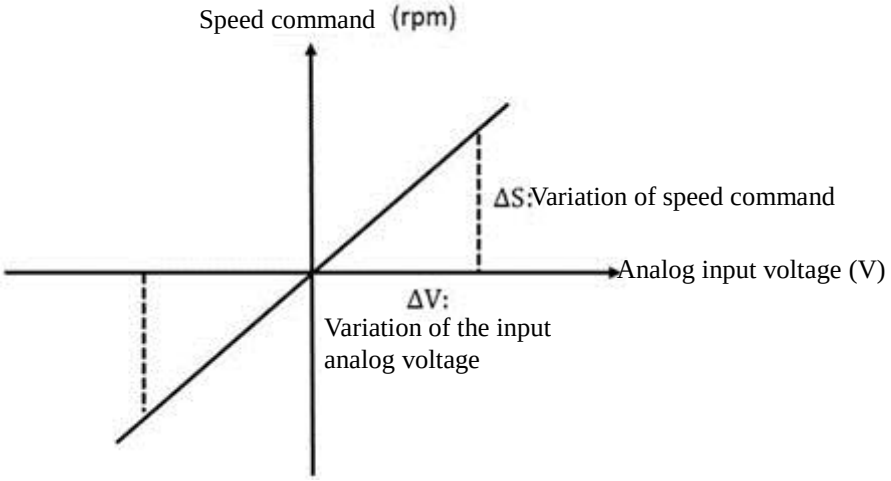
PB-00	SFIL	Acceleration-deceleration smoothing constant of the analog speed command	Communication address: 0100H 0101H

	Initial value	0
	Control mode	S
	Unit	ms
	Configuration range	0 ~ 1000 (0: The function is turned off.)
	Data size	16bit
	Data format	Dec



7.3.4. Proportioner at the analog command end

The speed command of motor is controlled by the analog voltage difference between V_REF and VGND. The slope and range of speed control is adjusted by adapting to the proportioner of Internal Parameter PA-17.



Relevant parameters:

PA-17 (S-off)	CVM	Maximum rotation speed of the analog speed command	Communication address: 0022H 0023H

	Initial value	By Rated
	Control mode	T / S
	Unit	r/min
	Configuration range	0 ~ max. Speed
	Data size	16bit
	Data format	Dec

Maximum rotation speed of the analog speed command:

- In the speed mode, this indicates the setting of the rotation speed while the maximum voltage (10V) is input for the analog speed command.

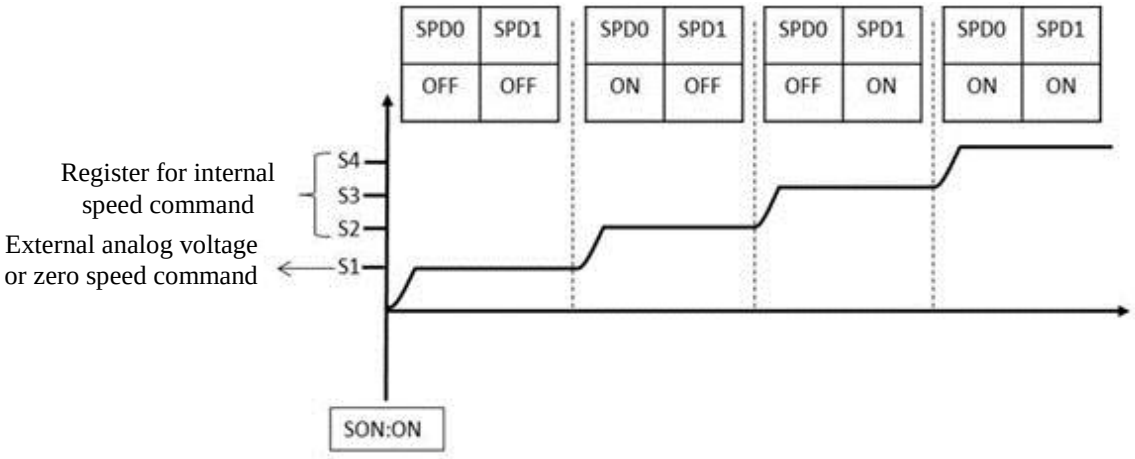
If the speed is set to 3000 and 10V is input for external voltage, the speed control command is 3000r/min. 5V implies that the speed control command is 1500r/min.

Speed control command = Input voltage value x Setting value/10

- In the torque mode, the parameter represents the command for analog speed limit.

Speed limit command = Input voltage value x Setting value/10

7.3.5. Timing diagram of speed mode



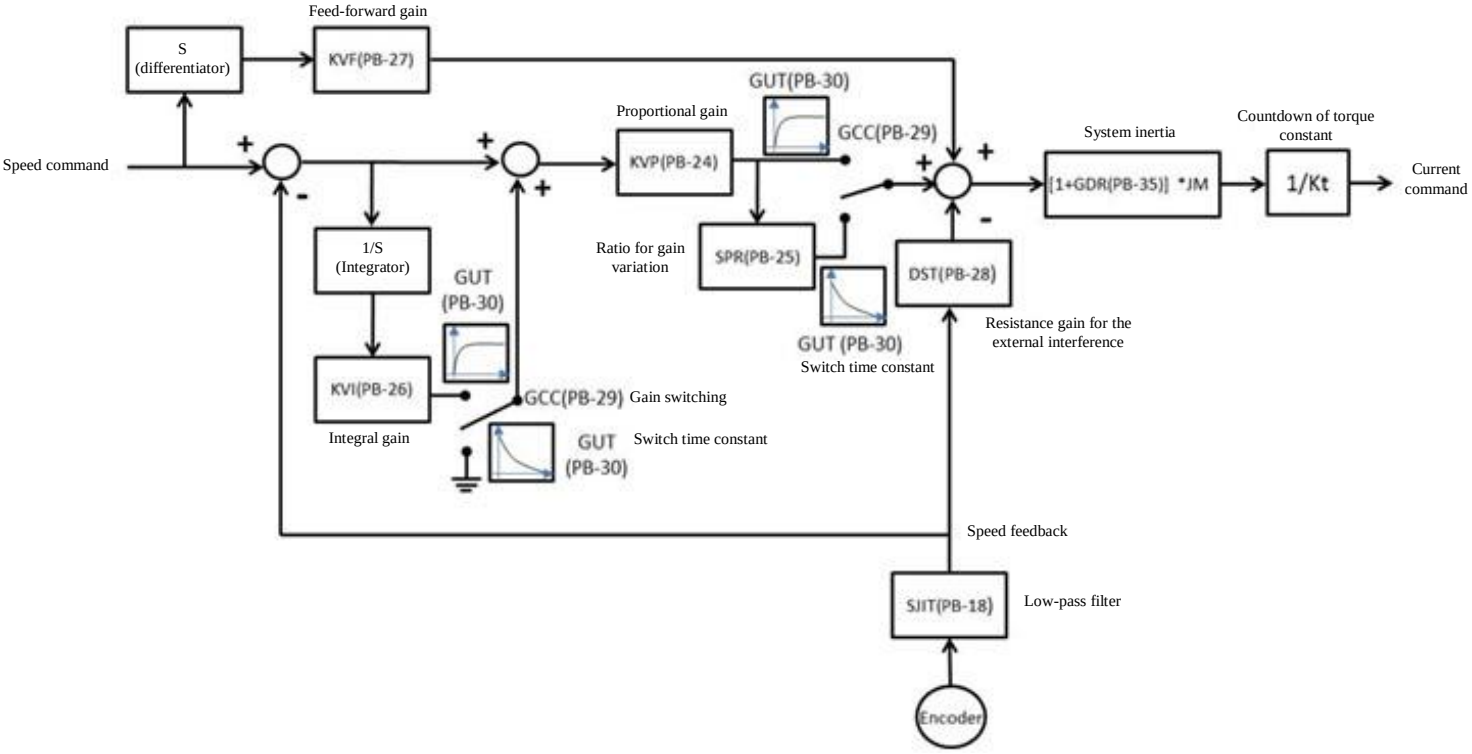
1) OFF represents open circuit (Open) and ON represents close circuit (Close).

2) For Sn Mode, Speed Command S1=0. For S Mode, Speed Command S1 is the analog voltage of external input.

3) After Servo On, the command is selected based on the status of SPD0~SPD1.

7.3.6. Adjustment for the gain of speed circuit

The following is the structure diagram for the speed control unit:



Select the way to adjust the gain through Parameter PB-33.

PB-33 (S-off)	AUTM	Method for gain adjustment	Communication address: 0141H 0142H

Initial value	0
Control mode	ALL
Unit	N/A
Configuration range	0 ~ 2
Data size	16bit
Data format	Dec

0: Manual Mode

1: Auto Mode (persistent adjustment)

2: Semi-auto Mode (non-persistent adjustment)

0: Description for Manual Mode

- If PB-33 is set to 0, the user is allowed to set all parameters related to control gain. The parameters are PB-20, PB-23, PB-24, PB-26, PB-27, PB-17 and PB-28.
- Relevant parameters are updated automatically when Auto or Semi-auto Mode is switched to the manual mode.

1: Description for Auto Mode

- The system inertia is estimated continuously. The load inertia ratio estimated is stored automatically to PB-35 every 30 minutes. Refer to the rigidity and bandwidth setting of PB-32.
- When switching from Auto Mode 1 or Semi-auto Mode 2 to Manual Mode 0, the system stores the measured load inertia ratio automatically to PB-35 and sets corresponding control parameter based on the load inertia ratio.
- When switching from Manual Mode 0 directly to Semi-auto Mode 1 or Auto Mode 2, enter the proper load inertia ratio in PB-35.
- When switching from Auto Mode 1 to Manual Mode 0, the values of PB-20, PB-24 and PB-26 are altered to the corresponding parameter value in Auto Mode.
- When switching from Semi-Auto Mode 2 to Manual Mode 0, the values of PB-20, PB-24, PB-26, PB-17 and PB-28 are altered to the corresponding parameter value in Semi-auto Mode.

2: Description for Semi-auto Mode

- When the system inertia is stabilized, the estimation stops after PB-50 shows 1. The load inertia ratio estimated is stored in PB-35. The adjustment continues when switching from other modes (Manual or Auto Mode) to Semi-auto Mode.
- If the range of system inertia is too large, PB-50 shows 0 and the adjustment continues.

Manual mode

When PB-33 is set to 0, the proportional gain (PB-24), integral gain (PB-26) and feed-forward gain (PB-27) are set by the user. The impacts caused by each parameter in general are as follows:
Proportional gain (PB-24): The gain increase would expand the response bandwidth of the position circuit.
Feed-forward gain (PB-27): This reduces the phase-lag error.
Integral gain (PB-26): The gain increase would enhance the low-frequency rigidity of the speed-loop and reduce the steady-state error. In the meantime, the phase margin value is sacrificed. Excessive integral gain may result in system instability.

Relevant parameters:

PB-24	KVP	Proportional gain for speed control	Communication address: 0130H 0131H

	Initial value	502
	Control mode	ALL
	Unit	rad/s
	Configuration range	0 ~ 8191

	Data size	16bit
	Data format	Dec

The speed response is increased when the gain of the speed control is increased. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-26	KVI	Integral compensation for the speed control	Communication address: 0134H 0135H

	Initial value	50
	Control mode	ALL
	Unit	rad/s
	Configuration range	0 ~ 1023
	Data size	16bit
	Data format	Dec

When the integral value of the speed control is increased, the position response is increased and the error magnitude of the speed control is reduced. Vibration and noise occurs easily if the gain is set to an excessive value.

PB-27	KVF	Feed-forward gain for the speed control	Communication address: 0136H 0137H

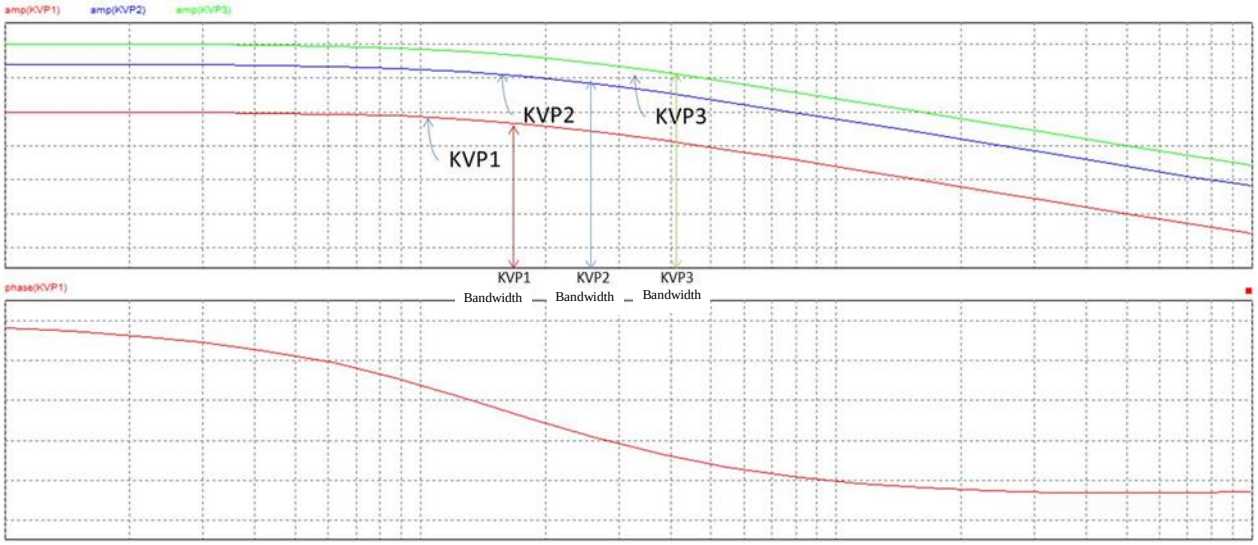
	Initial value	0
	Control mode	ALL
	Unit	%
	Configuration range	0 ~ 100
	Data size	16bit
	Data format	Dec

For smooth change of the speed control command, the increase in gain improves the magnitude of the following error for the speed. For unsmooth change of the speed control command, the decrease in gain mitigates the vibration of the mechanism during operation.

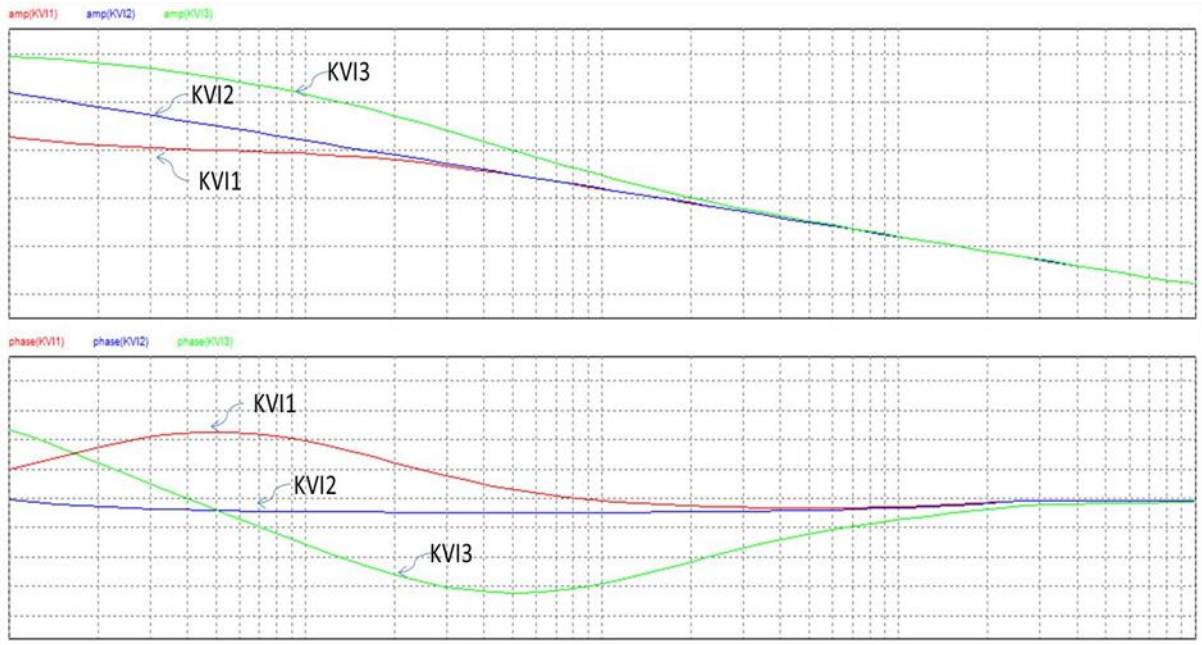
For academic principles, the step response can be used to interpret the proportional gain (KVP), integral gain (KVI) and feed-forward gain (KVF).
We explain the basic principles based on frequency and time domain.

- **Principle of frequency domain**

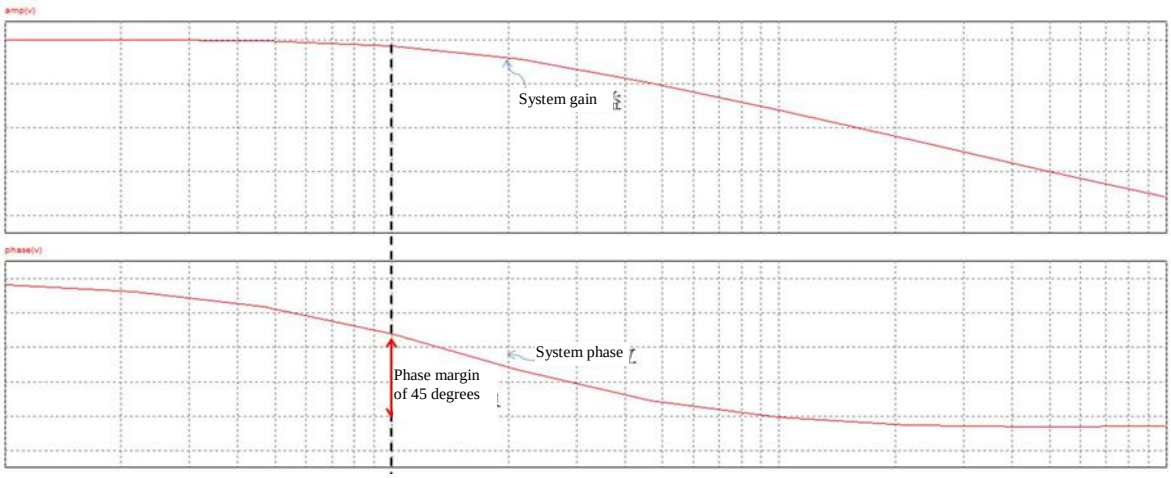
1. STEP 1: KVI =KVF=0. Make an adjustment so that KVP3>KVP2>KVP1. The higher the KVP the wider the bandwidth and the lower the phase margin.



2. STEP 2: Fix the KVP and adjust the KVI (KVI3>KVI2>KVI1).

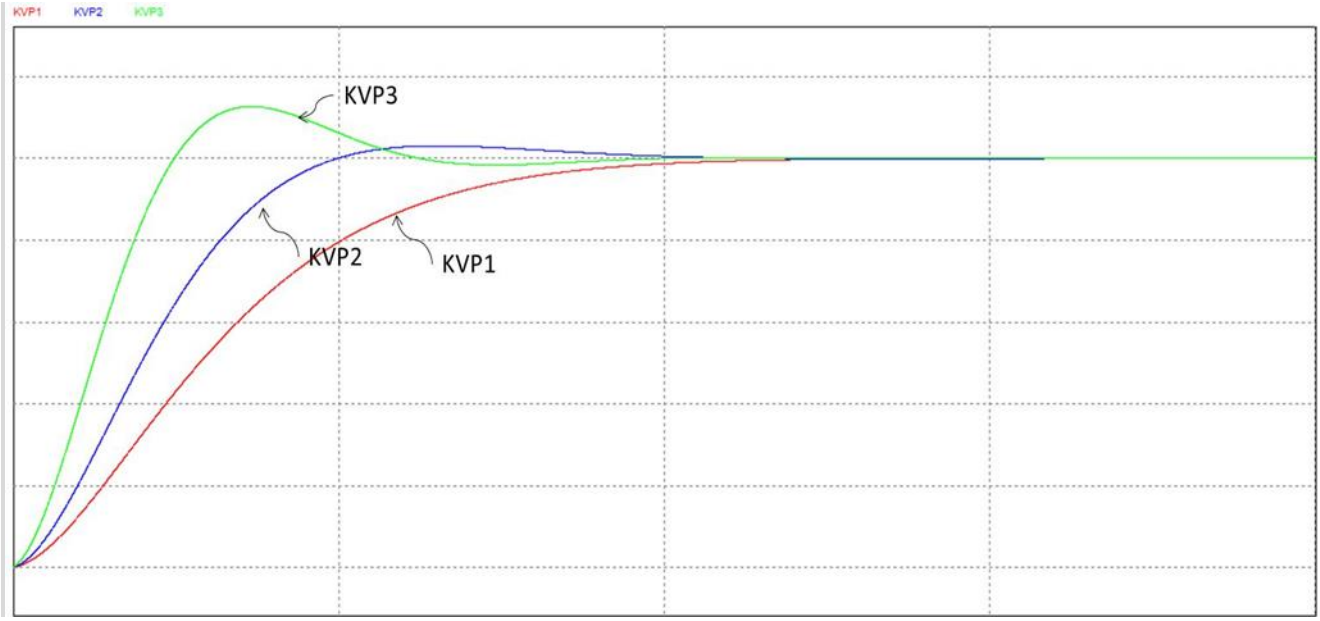


3. STEP 3: Select the KVI. If the phase margin is too low (relatively unstable), adjust the KVP again so that the phase margin reaches 45 degrees.

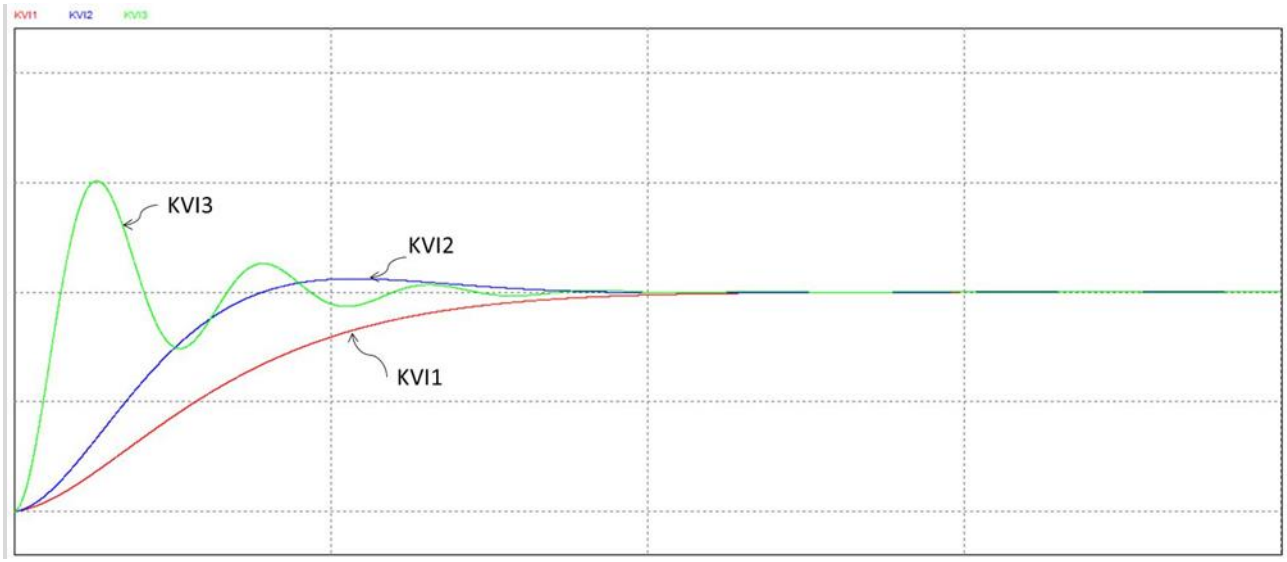


➢ **Principle of time domain**

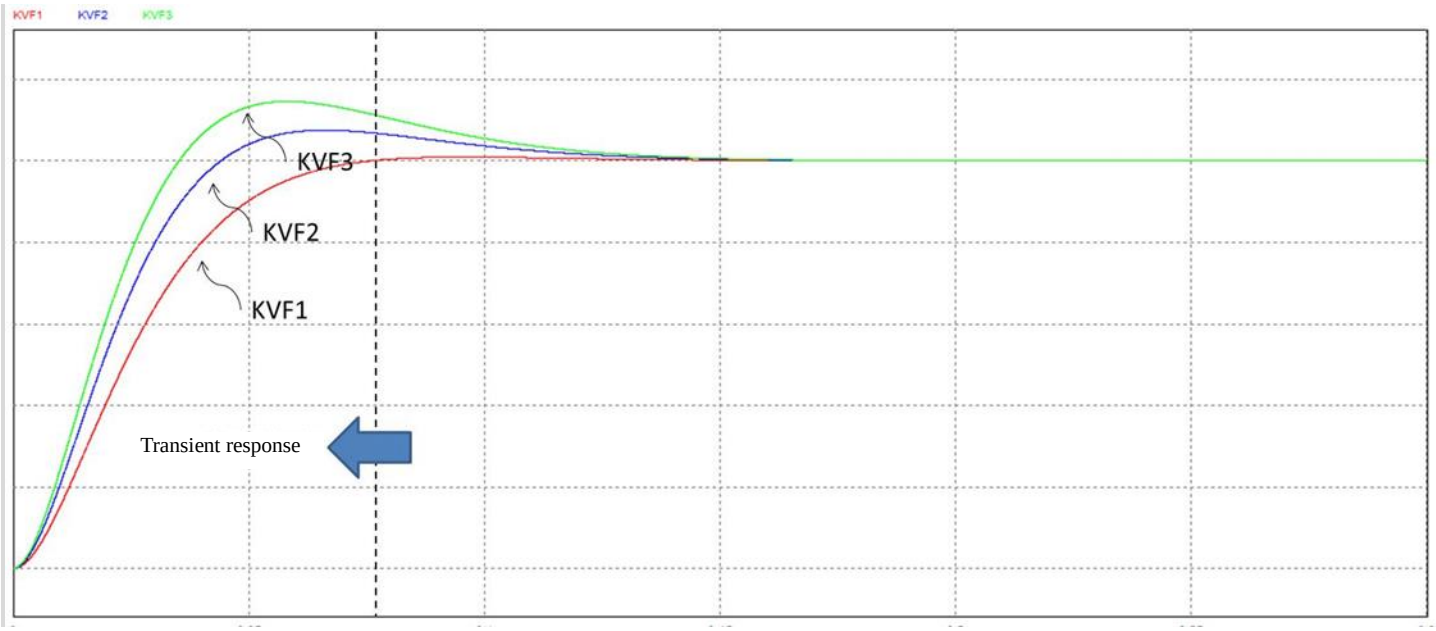
1. The higher the KVP is, the broader the bandwidth and the shorter time required for rising. If the KVP is too high, the phase margin of the system is low and the relevant stability would also be low. For fixing the steady-state following error, this is not more evidently helpful than the KVI. Refer to the following illustration (KVP3>KVP2>KVP1).



2. The higher the KVI is, the faster the steady-state error can be eliminated. It is obviously helpful for the steady-state error of KVI. If the KVI is too high, the phase margin of system would be too low. Refer to the following diagram (KVI3> KVI 2> KVI 1).



3. The higher the KVF is, the higher the feed-forward compensation. The dynamic following error during the transient state can be reduced. If the KVF is too high, it may result in system swing. Refer to the diagram below (KVF3>KVF2>KVF1).

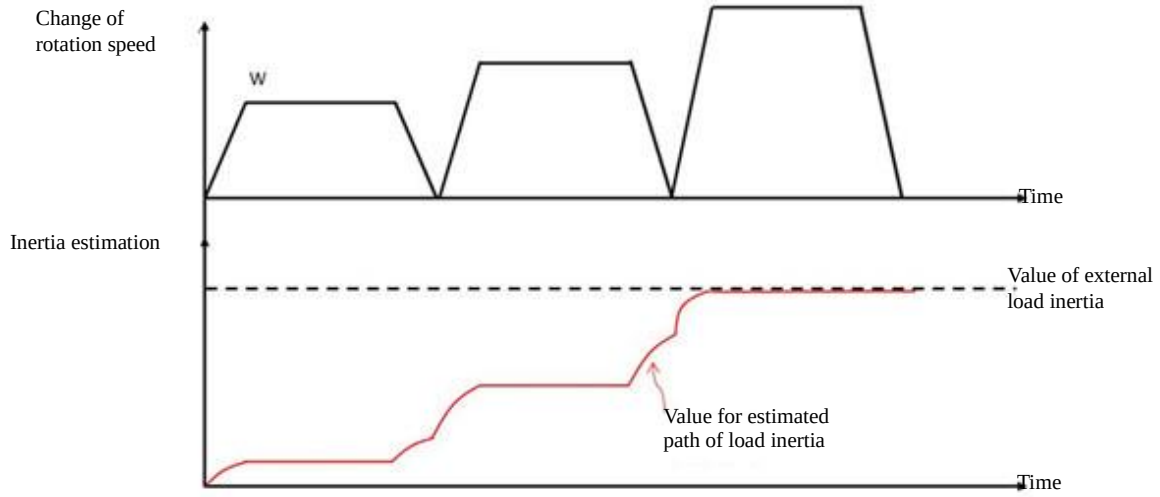


Generally the measurement requires the use of instrument if the frequency domain method is used. The user must have the relevant measurement equipment at hand. The time domain method only requires one oscilloscope. By using the analog input and output terminals provided by the drive in the meantime, the user can utilize the time domain method conveniently to adjust the parameter of PI controller.

Auto mode

The self-adaptive learning rule is used for the automatic gain adjustment. The internal parameter of the control unit is adapted automatically to the variation in external load inertia. Certain convergence time is required for adaptive learning. If the load changes too fast, it is not applicable to the auto mode. It is

suggested that the variation in external load inertia should be stable or slow. The convergence time tuned in the auto mode varies by the speed of the change in motor rotation speed.



7.3.7. Resonance suppression unit

The excessive rigidity (system bandwidth set too high) of the drive control system could result in the mechanical resonance generated by the drive combined with the machinery structure. The drive provides the low-pass filter (PB-17), Notch Filter 1 (PB-10) and (PB-11), Notch Filter 2 (PB-12) and (PB-13), as well as Notch Filter 3 (PB-10) and (PB-11). The resonance suppression is achieved without affecting the original control parameter.

Relevant parameters:

PB-10	NCD1	Notch filter for resonance suppression (1)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-11	NCD1	Notch filter for the attenuation rate of the resonance suppression (1)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-12	NCF2	Notch filter for resonance suppression (2)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-13	NCD2	Notch filter for the attenuation rate of the resonance suppression (2)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-14	NCF3	Notch filter for resonance suppression (3)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

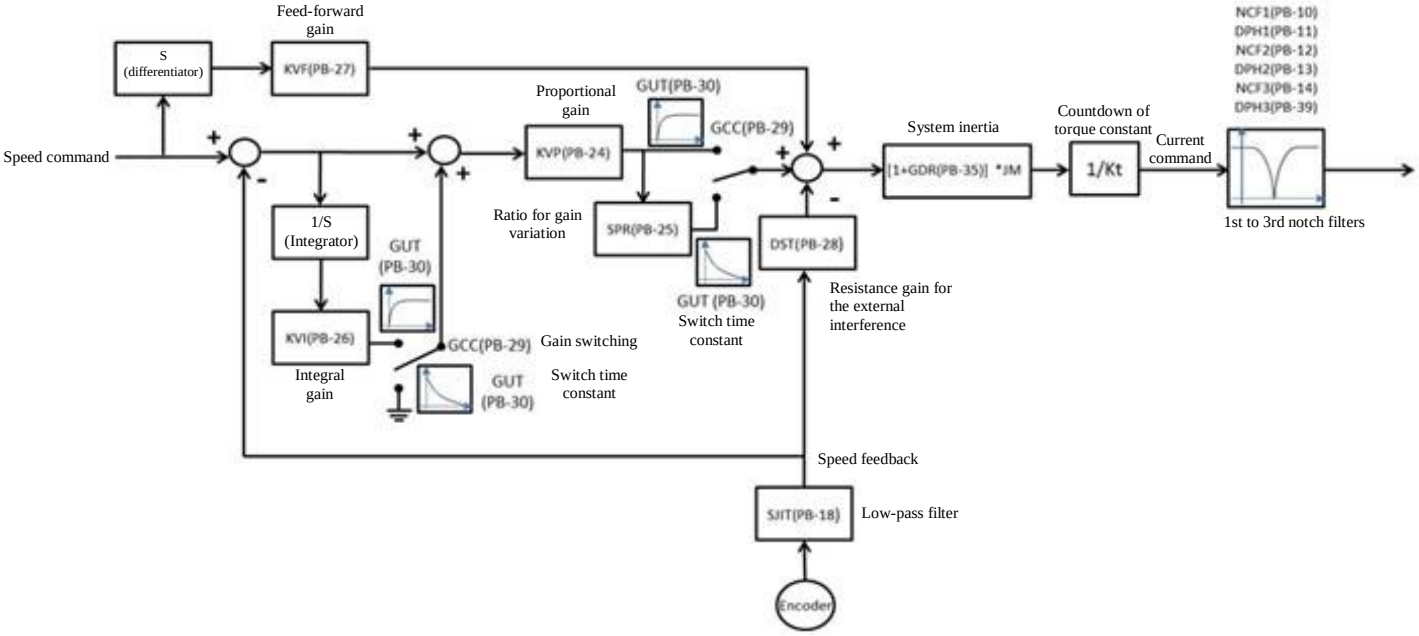
PB-15	NCD3	Notch filter for the attenuation rate of the resonance suppression (3)	Communication address: 010AH 010BH

Initial value	0
Control mode	P
Unit	
Configuration range	
Data size	
Data format	

PB-18	NLPF	Low-pass filtering for resonance suppression	Communication address: 010AH 010BH

	Initial value	9
	Control mode	P
	Unit	
	Configuration range	
	Data size	
	Data format	

➢ Resonance suppression unit



The drive is equipped with two notch filters with automatic resonance suppression, which can be turned on by setting PB-15 to 1 or 2. The drive searches for and suppresses the resonance point automatically. The found frequency point and attenuation rate will be filled in Resonance Filter 1 (PB-10) and (PB-11) and Resonance Filter 2 (PB-12) and (PB-13) sequentially.

When PB-15 is set to 1, it is set to 0 (auto resonance suppression turned off) automatically after system suppression. When PB-15 is set to 2, the search of resonance point continues.

The resonance exists if PB-15 is set to 1 or 2. If either the value of PB-11 or PB13 is 32, it is suggested to reduce the speed bandwidth and reactivate the auto resonance suppression.

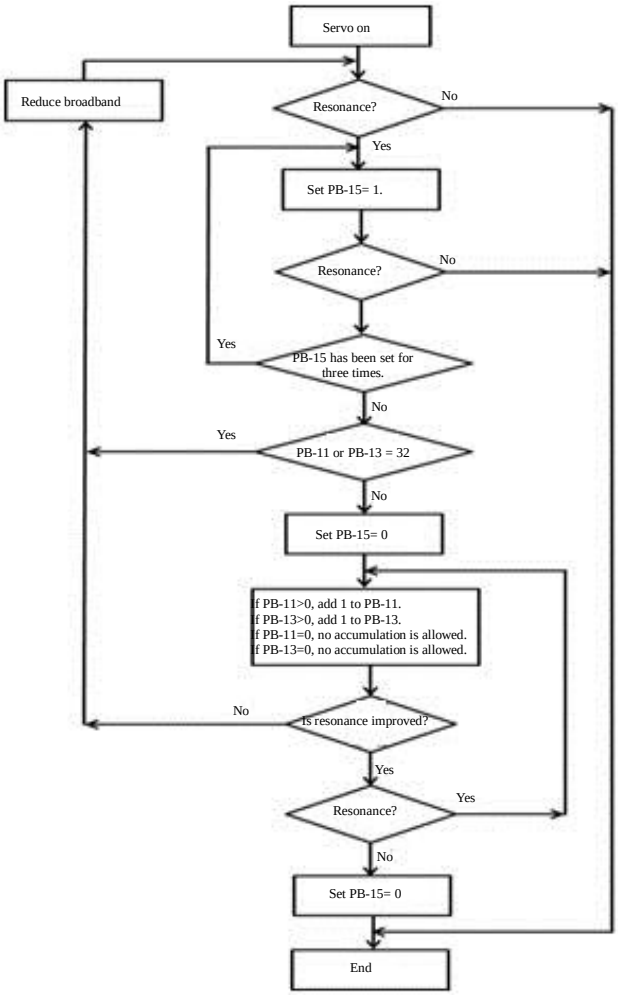
If values of both PB-11 and PB-13 are below 32 but resonance still exists, set PB-15 to 0 (auto resonance suppression turned off) and adjust PB-11 and PB-13 manually to higher values. If the resonance still cannot be suppressed, it is suggested to reduce the speed bandwidth and reuse the auto resonance suppression.

Before the manual adjustment of PB-11 and PB-13, check if the values of PB-11 and PB-13 are greater than

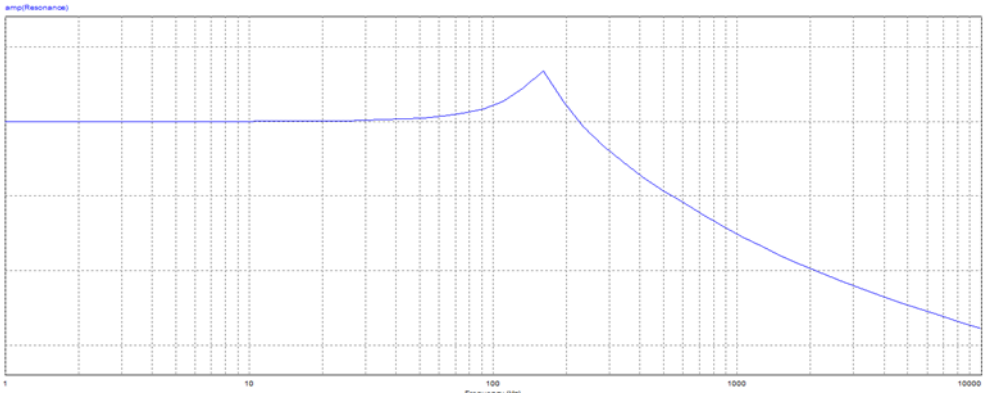
0. If these equal to 0, the resonance frequency point is not found. Do not increase the values of PB-11 and PB-13 manually; otherwise the system deterioration might occur.

PB-15 Function Table		
PB-15 Current value	PB-15 Value to be modified	Function
0	1	Clear the values of PB-12~ PB-1x to activate the auto resonance suppression.
0	2	Clear the values of PB-12~ PB-1x to activate the auto resonance suppression.
1	0	Store the current values of PB-12~ PB-1x to deactivate the auto resonance suppression.
1	1	Clear the values of PB-12~ PB-1x to activate the auto resonance suppression.
1	2	Do not clear the values of PB-12~ PB-1x and keep the auto resonance suppression active.
2	0	Store the current values of PB-12~ PB-1x to deactivate the auto resonance suppression.
2	1	Clear the values of PB-12~ PB-1x to activate the auto resonance suppression.
2	2	Do not clear the values of PB-12~ PB-1x and keep the auto resonance suppression active.

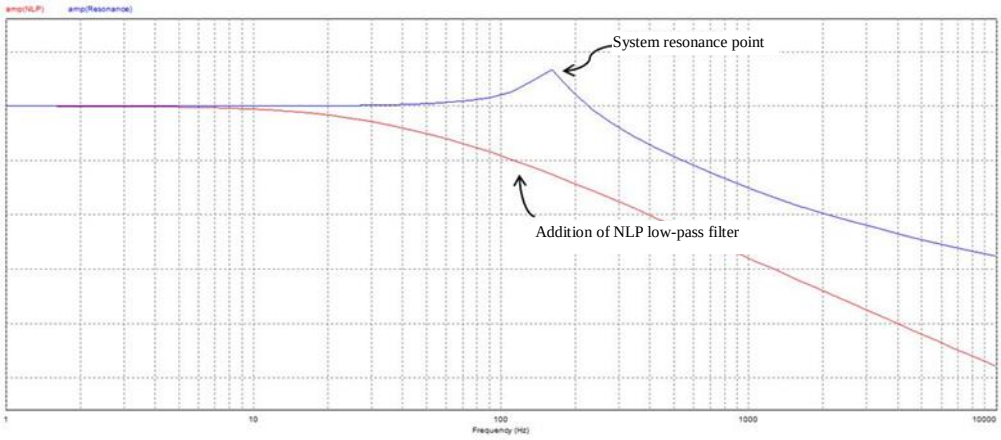
➢ Flow Chart for Resonance Suppression



The low-pass filter NLP (PB-17) is used to describe the resonance suppression. The Bode plot of the system for resonance is as below.

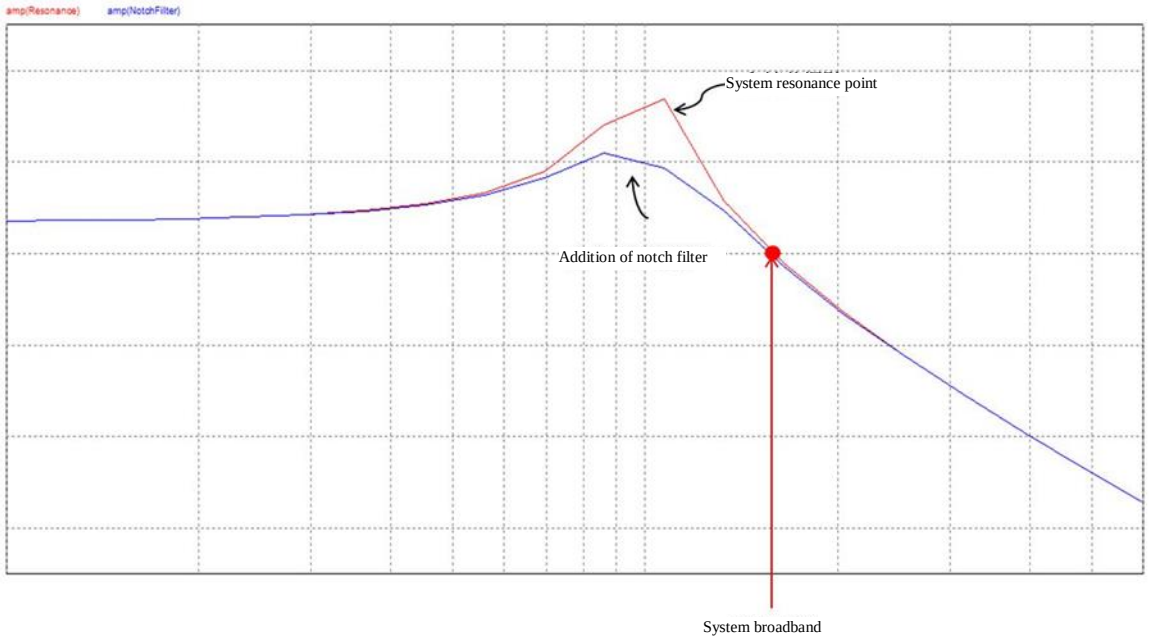


When NLP starts to increase, the effect is illustrated in the Bode plot below. The resonance point will be filtered by the resonant low-pass filter.

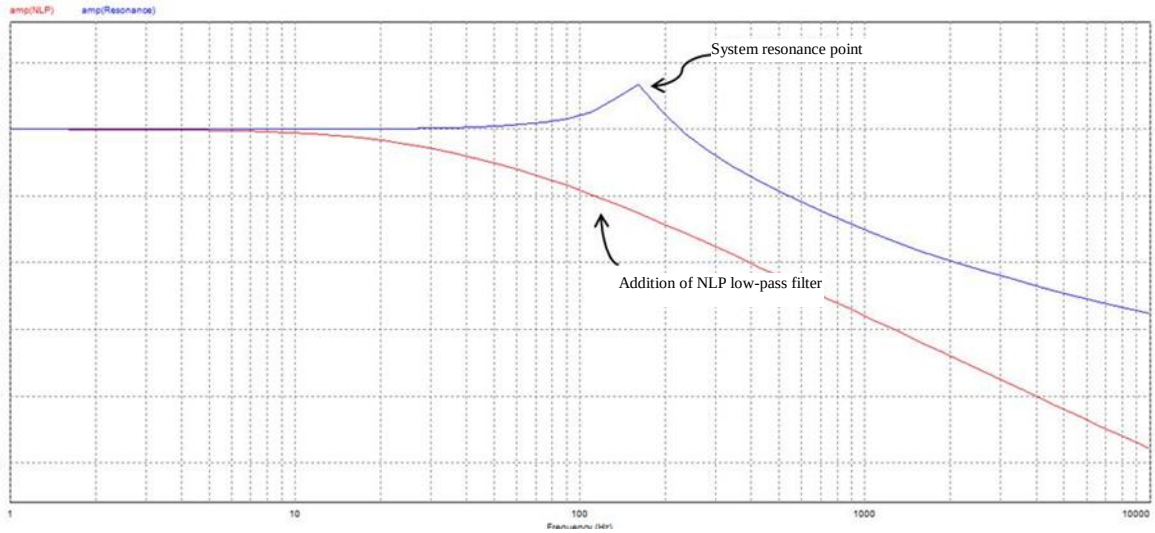


If the user knows the resonance frequency, set the notch filter parameter directly for resonance suppression. Set the frequency of the notch filter to 50~1000Hz. If the resonance frequency falls out of this range, it is suggested to use the resonant low-pass filter (PB-17) to reduce the resonance effect.

Next, we want to find out effect of the notch and low-pass filters in the resonance system.
First, let's explore the effect created by applying the notch filter to the resonance system. In the following Bode plot, the resonance system suppresses the resonance point effectively after the notch filter is added to the system. The system bandwidth is not much affected.



Next, we can see that the system broadband is smaller when using the resonant low-pass filter to increase the NLP (PB-17). According to the graph below, the resonant low-pass filter can solve the resonance problem but the phase margin of system is lower, as well as the system stability.


amp(NLP)
amp(Resonance)
System resonance point
Addition of NLP low-pass filter
1
10
100
1000
10000

7.4. Torque mode

The torque mode for control (T or Tn) is used for the device requiring torque control, such as the printing machine and coil winding machine...etc. Two modes for command input are available for the drive, which are the analog and register input.

The input of analog command is used to manipulate the torque performance of motor through the external voltage. As for the register input, the data of the internal parameter (PA-03~PA-05) is treated as the torque command.

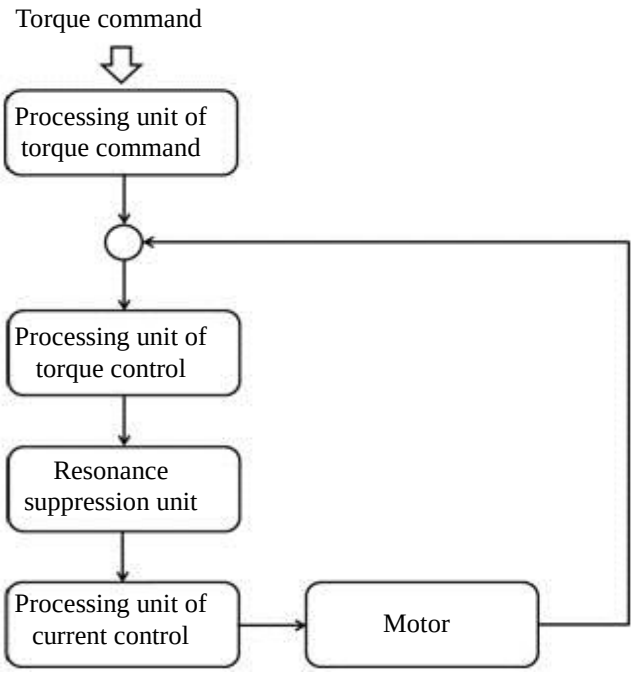
7.4.1. Selection of torque command

The source of the torque command can be divided into the analog voltage input externally and the internal parameter. The selection depends on the DI signal of CN1. Refer to the table below:

Torque command no.	DI signal of CN1		Command Source			Contents	Scope
	TCM1	TCM0					
T1	0	0	Mode	T	External analog command	Voltage difference between T-REF and GND	-10 V ~ +10V
				Tn	None	The torque command is 0.	0
T2	0	1	Parameter of internal register			PA-03	-300.0% ~ 300.0%
T3	1	0				PA-04	-300.0% ~ 300.0%
T4	1	1				PA-05	-300.0% ~ 300.0%

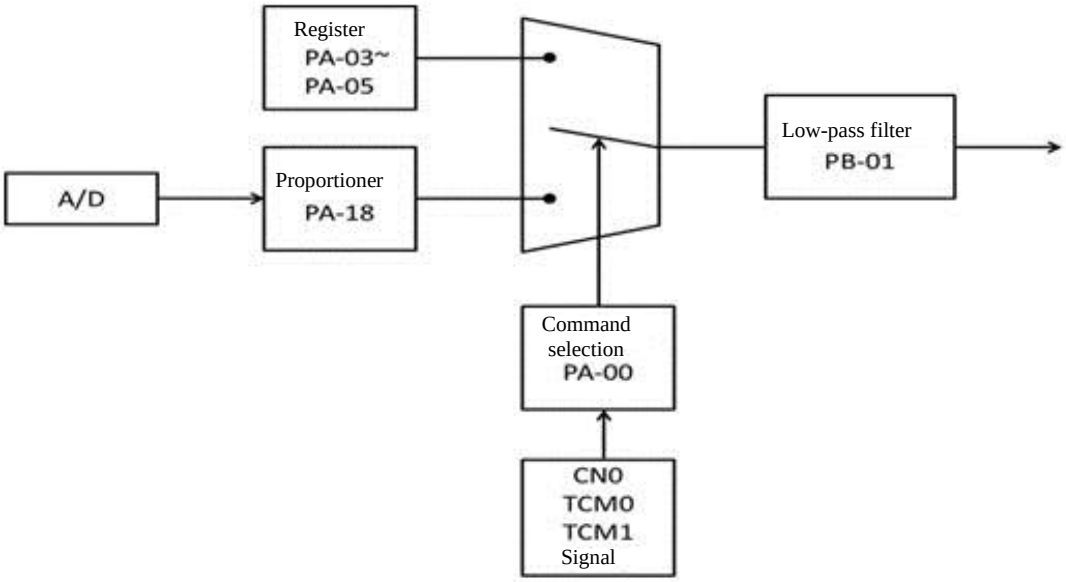
- TCM0 ~ TCM1 status: 0 represents open circuit (Open) and 1 represents close circuit (Close).
- In the situation that TCM0=TCM1=0, the command is 0 if the mode is Tn. Therefore, if the user does not need to use the analog voltage as the torque command, he or she may adopt Tn Mode to make sure that the analog voltage is without zero drift. For T Mode, the command is the analog voltage difference between T-REF and GND. The voltage range input is -10V ~ +10V. The torque corresponding to the voltage is adjustable (PA-18).
- If either TCM0 or TCM1 is not 0, the torque command is the internal parameter. The command is effective right after the change of TCM0 ~ TCM1 and CTRG is not needed for triggering. The torque command discussed in this section can be treated as the torque command under the torque mode (T or Tn). It can also be input as the command of torque limit under the speed mode (S or Sn).

7.4.2. Control structure of the torque mode



The diagram above illustrates the basic control structure of torque. The processing unit of torque command selects the source of torque command based on 7.4.1. The selection includes the size of command represented by the analog voltage set by the proportioner (PA-18), as well as the smoothing of the torque command. The torque control unit manages the gain parameter of the drive and computes the magnitude of the current supplied to the motor promptly.

The following chart shows the structure diagram regarding the processing unit of torque command.



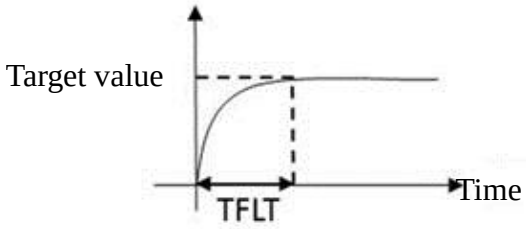
The path above is the command of internal register and the one below is the external analog command. The selection is based on the TCM0 and TCM1 statuses and PA-00 (T or Tn). The proportioner can be used to adjust the torque size represented by the analog voltage command. The low-pass filter may be applied to ensure smooth response of the command signal.

7.4.3. Smoothing of torque command

Relevant parameters:

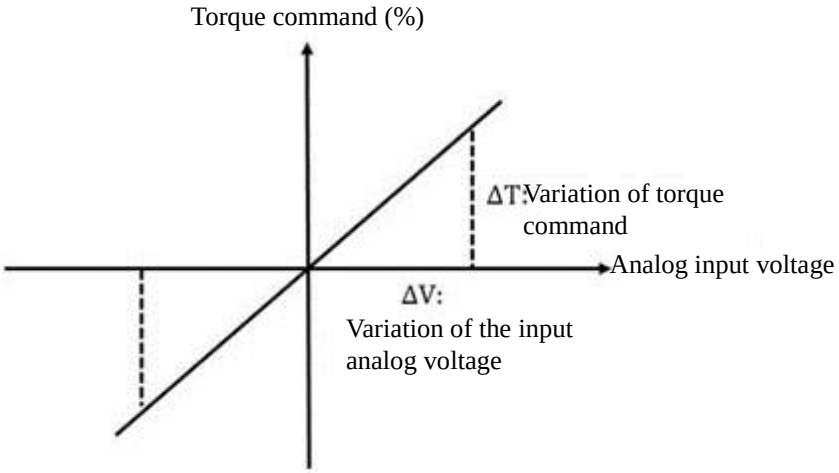
PB-01	TFIL	Smoothing constant of the analog torque command	Communication address: 0102H 0103H

Initial value	0
Control mode	T
Unit	ms
Configuration range	0 ~ 1000 (0: The function is turned off.)
Data size	16bit
Data format	Dec



7.4.4. Proportioner at the analog command end

The torque command of motor is controlled by the analog voltage difference between T_REF and GND. The slope and range of torque control is adjusted by adapting to the proportioner of Internal Parameter PA-18.



PA-18 (S-off)	CTM	Limited maximum output of the analog torque	Communication address: 0024H 0025H

Initial value	100
Control mode	ALL
Unit	%
Configuration range	0 ~ 300
Data size	16bit
Data format	Dec

Maximum output of the analog torque command:

In the torque mode, this indicates the setting of the torque while the maximum voltage (10V) is input for the analog torque command.

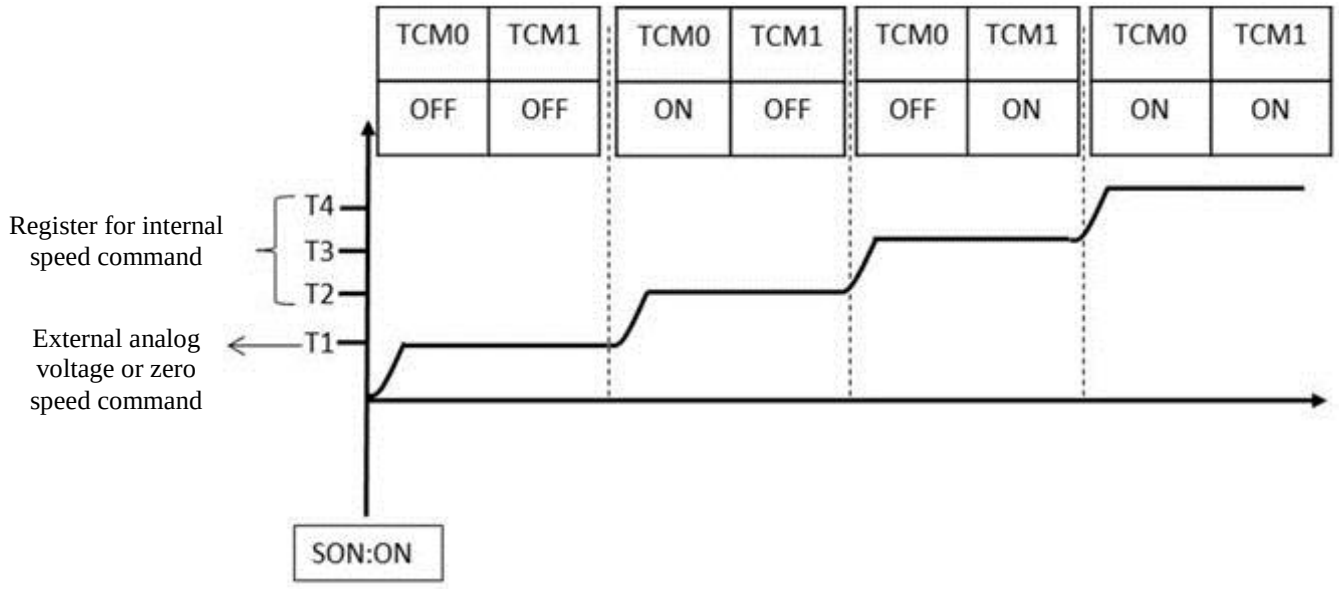
If the initial value is set to 100 and 10 V is input for external voltage, the torque control command is 100% rated torque. 5V implies that the torque control command is 50% rated torque.

Torque control command = Input voltage value x Setting value/10 (%)

In the speed and position modes, the parameter represents the command for analog torque limit.

Torque limit command = Input voltage value x Setting value/10 (%)

7.4.5. Timing diagram of torque mode



- OFF represents open circuit (Open) and ON represents close circuit (Close).
- For Tn Mode, Torque Command T1=0. For T Mode, Torque Command T1 is the analog voltage of external input.
- After Servo On, the command is selected based on the status of TCM0~TCM1.

7.4.6. Mixed mode

Besides the single operating mode, the drive also provides the mixed mode.

1) Speed/position mixed mode (P-S)
2) Speed/torque mixed mode (S-T)
3) Torque/position mixed mode (P-T)

Mode name	Mode code	Mode number	Description
Mixed mode	P-S	05	P and S can be switched via the DI signal S_P.
	P-T	06	P and T can be switched via the DI signal T_P.
	S-T	07	S and T can be switched via the DI signal S_T.

The mixed mode consisting of Sn and Tn is not available. To prevent the mixed mode from occupying DI input points, the signal for external analog voltage can be used as the command under the speed and torque modes. Therefore, the use of DI (SPD0 and SPD1 or TCM0 and TCM1) can be reduced.

The default DI/DO signal indicates the relationship between the DI/DO signal and pin right after the mode selection.

7.4.7. Position/speed mixed mode

P-S position command comes from the pulse input externally. The speed command can be the external analog voltage or internal parameter (PA-14 ~ PA-15) setting. The S-P signal controls the switching of the speed/position mode.

7.4.8. Position/torque mixed mode

P-T position command comes from the pulse input externally. The torque command can be the external analog voltage or internal parameter (PA-03 ~ PA-05) data. The T-P signal controls the switching of the torque/position mode.

7.4.9. Speed/torque mixed mode

The only mode available is S-T Mode. The speed command can come from the external analog voltage or internal parameter (PA-14～PA-16) data. The mode is selected through SPD0~SPD1. Similarly, the torque command can come from the external analog voltage or internal parameter (PA-03～PA-05) data. The mode is selected through TCM0~TCM1. The S-T signal controls the switching of the speed/torque mode.

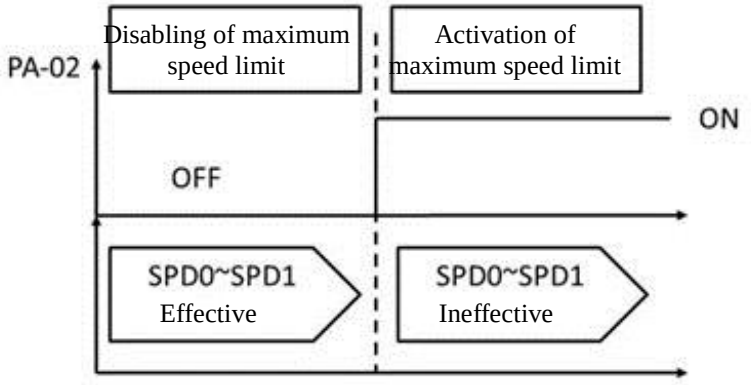
In the torque mode (S-T set to ON), the torque command is selected via TCM0 and TCM1. The torque command is selected via SPD0 and SPD1 after switchover to the speed mode (S-T set to OFF). The motor rotates by following the rotation speed in the command immediately. After S-T is turned on, the speed mode returns to the torque instantly. For the relationship between the DI signal in each mode and

the selected command, refer to the description in the chapter for each single mode.

7.5. Others

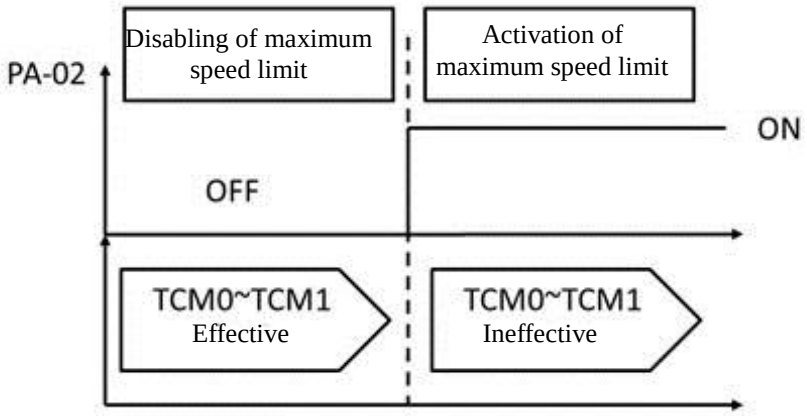
7.5.1. Use of the speed limit

In the position, speed, torque and other modes (if available), the maximum speed limit is restricted by the internal parameter PA-07. The speed limit and command can be passed down in the same way, which is through the external analog voltage or internal parameter (PA-14~PA-16). Refer to 7.3.1. The speed limit is only allowed in the torque mode and it is used to restrict the motor rotation speed. If the external analog voltage is adopted for the torque command, extra DI signals are available. These signals can be regarded as SPD0~SPD1 and utilized to select the speed limit command. If number of DI signals is insufficient, the speed limit command can also be input via the analog voltage. The speed limit is activated when PA-02 us set to 1. The following shows the diagram:



7.5.2. Use of the torque limit

The speed limit and command can be passed down in the same way, which is through the external analog voltage or internal parameter (PA-03~PA-05). Refer to 7.4.1. The speed limit is effective in the position or speed mode and it is used to restrict the motor torque output. If the external pulse is adopted for the position command or the external analog voltage is adopted for the speed mode, extra DI signals are available. These signals can be regarded as TCM0~TCM1 and utilized to select the torque limit command. If number of DI signals is insufficient, the torque limit command can also be input via the analog voltage. The speed limit is activated when PA-02 us set to 1. The following shows the diagram:



7.5.3. Analog monitoring

The drive provides two analog channels. The user observes the drive status needed through analog monitoring.

PD-22	VMON	Analog output monitoring	Communication address: 032CH 032DH

Initial value	01
Control mode	ALL
Unit	N/A
Configuration range	00 ~ 0x55
Data size	16bit
Data format	Hex

PD-28	VMR1	Ratio for MON1 analog monitoring output	Communication address: 0338H 0339H

Initial value	100
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

PD-29	VMR2	Ratio for MON2 analog monitoring output	Communication address: 033AH 033BH

Initial value	100
Control mode	ALL
Unit	%
Configuration range	0 ~ 100
Data size	16bit
Data format	Dec

PD-39	AOUT	Setting for the polarity of the pulse output for the detector	Communication address: 034AH 034BH

Initial value	
Control mode	
Unit	
Configuration range	
Data size	
Data format	

7.5.4. Use of the electromagnetic brake

PC-21	BTOD	Turn-on delay time for the electromagnetic brake	Communication address: 022AH 022BH

Initial value	0
Control mode	ALL
Unit	ms
Configuration range	0 ~ 1000
Data size	16bit
Data format	Dec

Parameter function: It sets the time delayed from the the time servo is activated to the time that the interlock signal of the electromagnetic brake (DO code 0x07, BREAK) is turned on.

PC-22	BTCD	Turn-off delay time for the electromagnetic brake	Communication address: 022CH 022DH

	Initial value	0
	Control mode	ALL
	Unit	ms
	Configuration range	-1000 ~ 1000
	Data size	16bit
	Data format	Dec

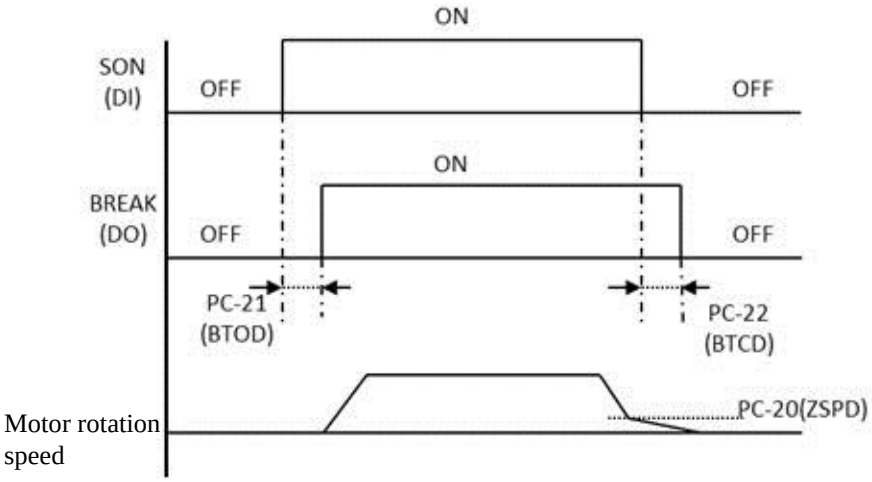
Parameter function: It sets the time delayed from the the time servo is ready and turned off to the time that the interlock signal of the electromagnetic brake (DO code 0x07, BREAK) is turned off. (Refer to 7.5.4 for the use of the electromagnetic brake.)

1) When the BTCD delay time is not over and the motor rotation speed is below the one for PC-20, the interlock signal of the electromagnetic brake (BREAK) is turned off.
2) When the BTCD delay time is over and the motor rotation speed is above the one for PC-20, the interlock signal of the electromagnetic brake (BREAK) is turned off.
3) If the Alarm or EMGS occurs causes the servo to be turned off, the negative value of BTCD will not become effective if a negative value is assigned to BTCD. This is equivalent to the situation that BVCD is set to zero.

7.5.5. Use of the electromagnetic brake

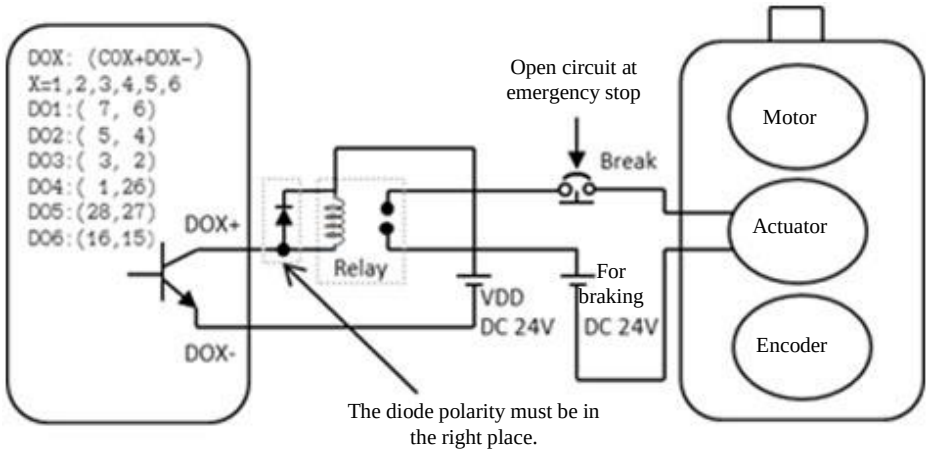
For the electromagnetic brake by the drive, (1) BREAK is set to OFF. In this case, the electromagnetic brake is inoperative and the motor is under the machinery lockout condition. (2) BREAK is set to ON. In that case, the electromagnetic brake is in operation and the motor rotates freely. The operation of electromagnetic brake can be divided into two types below. The user uses the parameter BTOD (PC-21) and BTCD (PC-22) to set relevant delay. Usually the electromagnetic brake is used for Z-axis direction to prevent high quantity of heat generated by high resistance created continuously by the servo motor. Such heat would cause the shortening of motor lifetime. For this device, the electromagnetic motor can only be activated after the servo is off to avoid malfunctions. In the situation that the electromagnetic brake is manipulated by the user, it can only be activated during braking. Therefore the braking force of the electromagnetic brake and the motor would be in the same direction. The drive operation becomes normal because it is less likely to require the intervention from the braking force of the electromagnetic brake. During acceleration or deceleration, the drive generates higher current to overcome the braking force of the electromagnetic brake. The alarm for overload protection could be triggered.

Time diagram of the control on electromagnetic brake:



Explanation regarding the timing for BREAK output:

1. After the servo is off, the motor rotation speed might be still over the one set in PC-20 after the time set the in PC-22 has elapsed. In this case, BREAK is OFF (electromagnetic brake lockout).
2. After the servo is off, the motor rotation speed might go below the one set in PC-20 even before the time set the in PC-22 has elapsed. In this case, BREAK is OFF (electromagnetic brake lockout).



Chapter 8 Communication Mechanism

8.1. RS-485/RS-232 Communication hardware interface

For communication, the servo drive supports two serial communication functions RS-485 and RS-232 to access and alter the parameter in the servo system. The communication functions RS-485 and RS-232 cannot be used simultaneously. The description is as follows:

Definition of the CN3 interface pin for servo motor:

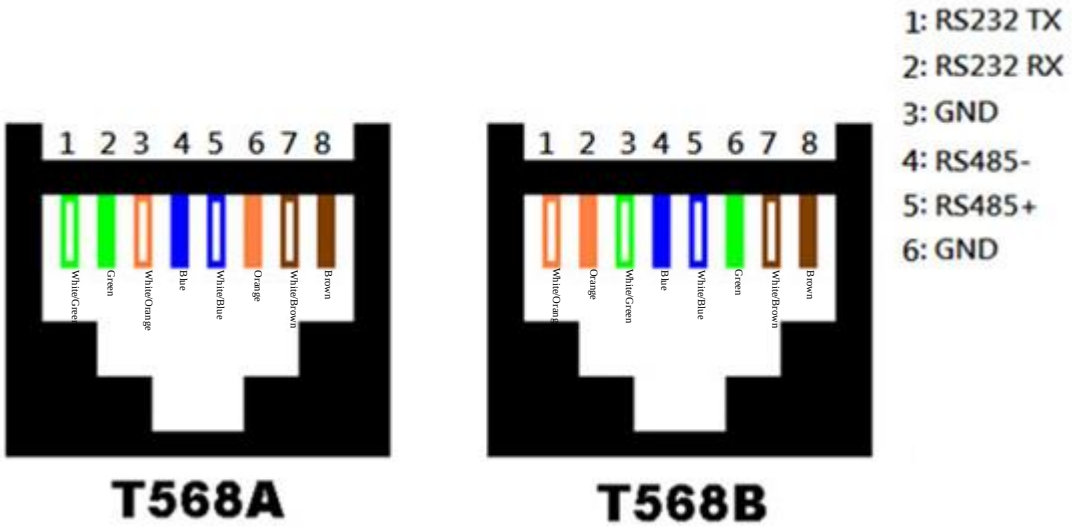


Fig. 8.1 Definition for the communication Interface CN3 of servo motor

For RS232 communication, use Pin 1 (TX), Pin 2 (RX) and Pin 3(GND) of Interface CN3. For RS485 communication, use Pin 4 (-) and Pin 5 (+) of CN3 Interface.

Note: The definition of RS232TX and RS232RX defined in Interface CN3 is the one for the signal at the servo drive end. If the servo motor is the slave for communication, dock TX of the master end for communication to RS232RX at the slave end. Dock RX at the master end to RS232TX at the slave end.

Description for the use of RS232:

1) 15 m is required for the environment with less noise. For the transmission speed above 38400bps, use the communication line with the length below 3 m to ensure the transmission accuracy.

2) For the definition of the wiring regarding RS232 connector, refer to Fig. 8.1 Definition for the communication Interface CN3 of servo motor.

Description for the use of **RS-485**:

1) It is suggested to use the line with the length below 15 m to ensure the transmission accuracy.

2) For the definition of the wiring regarding RS-485 connector, refer to Fig. 8.1 Definition for the communication Interface CN3 of servo motor.

3) When using RS-485, 32 drives can be connected simultaneously. For connecting more servo

drives or increase the communication distance, a repeater must be installed for expansion. Up to 254 servo drives can be connected to.

8.2. RS-485/RS-232 Communication parameter setting

PD-00 Setting of the branch number, PD-01 Communication transmission rate and PD-02 Protocol are the parameters must be set and confirmed before a servo drive is connected to the communication network. Rest of the settings are optional, including PD-03 Handling of the communication error, PD-04 Setting for the communication timeout, PD-06 Control switch for the source of the input contact (DI), PD-07 Time for the delay of the communication response and PD-08 Monitoring Mode. Refer to Chapter 7 in the manual for details.

The following is the setting for the communication group of Parameter PD:

Communication address for rate of ADR communication transmission: 0300H~0301H

PD-00	**ADR**	**Setting of the communication office number**	Communication address: **0300H** **0301H**

Initial value	0x7F
Control mode	ALL
Unit	N/A
Configuration range	0x01 ~ 0x7F (16-bit)
Data size	16 bit
Data format	Hex

When RS-232/RS-485 is used for communication, only one branch number may be set per servo drive.
If one branch number is set for multiple drives in the communication network, the communication would not work properly.
The station number implies the address of the drive in the communication network. It is also applicable to RS-232/485.

Communication address for rate of BRT communication transmission: 0302H~0303H

Operation interface: Index related to the panel/software communication: Sec. 8.2

PD-1	**BRT**	**Setting of communication transmission rate**	Communication address: **0302H** **0303H**

Initial value	0x0033
Control mode	ALL
Unit	bps
Configuration range	0x0000 ~ 0x0055 (16-bit)
Data size	16bit

	Data format	Hex

Parameter function: The communication transmission rate for RS-485 and RS-232 is set in A and B bits (16-bit).

	0	0	B	A
Communication method	-	-	RS-485	RS-232
Configuration range	0	0	0~5	0~5

The following shows the definition of the setting value for communication transmission rate for A and B:

0：4800

1：9600

2：19200

3：38400

4：57600

5：115200

Communication address for PTL protocol: 0304H~0305H

PD-02	**PTL**	**Protocol setting**	Communication address: **0304H** **0305H**

	Initial value	0x0006
	Control mode	ALL
	Unit	-
	Configuration range	0x0006 ~ 0x0008 (16-bit)
	Data size	16bit
	Data format	Hex

Parameter function: The protocol shared by RS-485 and RS-232 is set to the lowest bit A (4-bit, 16 bit).

	0	0	0	A	
Communication method	-	-	-	RS-485	RS-232
Configuration range	0	0	0	6~8	

The following is the definition for the setting value of protocol shared by RS-485 and RS-232:

6:8, N, 2(MODBUS, RTU)

7:8, E, 1(MODBUS, RTU)

8:8, O, 1(MODBUS, RUT)

8.3. MODBUS protocol

For the RTU (Remote Terminal Unit) mode, the user sets the required protocol in Parameter PD-02. As for functions supported by the drive, 03H Multiple Word Reading, 06H Single Word Writing and 10H Multiple Word Writing. Refer to the description below.

Data structure of communication

The following is the definition for the data frame in the RTU communication mode:

RTU mode:

Start	Standstill period over 10 ms
Slave address (communication address)	Slave address (communication address): 1-byte
Function code:	Function code: 1-byte
Data (n-1)	Data (n-1)
…….	Data content: n-word =2n-byte, n<=10
Data (0)	Data (0)
CRC error check:	CRC error check: 1-byte
End 1	Standstill period over 10 ms

The RTU (Remote Terminal Unit) communication mode begins from a static signal and ends with another static signal. The communication position, function code, data content, check for Cyclical Redundancy Check (CRC) error...etc. are between the beginning and end.

Example 1, Function Code 03H Multiple Word Reading:

For the example below, the master passes down the command to No. 127 (7FH) Slave for reading the data from two words in a row starting from the home address 0200H. The data content replied by the slave is Location 0200H = > Content 1122H and Location 0201H=> Content 3344H. Up to 10 entries allowed to be read at once.

RTU mode:

Request command: Response command:

Request command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	03H
Initial data location (2 bytes)	02H (high bit set) 00H (low bit set)

Number of data entries (Unit: word) (2 bytes)	00H (high bit set) 02H (low bit set)
CRC Check Low (1 Bytes)	CFH (low bit set)
CRC Check High (1 Bytes)	ADH (high bit set)

Response command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	03H
Number of data entries (Unit: byte) (1 byte)	04H
Initial data address Contents of 0200H (2 bytes)	11H (high bit set) 22H (low bit set)
Address of the second data Contents of 0201H (2 bytes)	33H (high bit set) 44H (low bit set)
CRC Check Low (1 Bytes)	D5H (low bit set)
CRC Check High (1 Bytes)	C1H (high bit set)

Note: A standstill period for 10 ms is required before and after transmission.

Example 2, Function Code 06H Single Word Writing:

For the following example, the master passes down the writing command to No. 127 (7FH) Slave for writing the data 1234H to the address 0200H. The slave replies the master after writing is complete.

RTU mode:

Request command: Response command:

Request command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	06H
Initial data location (2 bytes)	02H (high bit set) 00H (low bit set)
Data content (2 bytes)	12H (high bit set) 34H (low bit set)
CRC Check Low (1 Bytes)	8FH (low bit set)

CRC Check High (1 Bytes)	1BH (high bit set)

Response command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	06H
Initial data location (2 bytes)	02H (high bit set) 00H (low bit set)
Data content (2 bytes)	12H (high bit set) 34H (low bit set)
CRC Check Low (1 Bytes)	8FH (low bit set)
CRC Check High (1 Bytes)	1BH (high bit set)

Note: In the RTU mode, a standstill period for 10 ms is required before and after transmission.

Example 3, Function Code 10H, Multiple Word Writing:

For the example below, the master passes down the writing command to Slave No. 127 (7FH) for writing two words EF01H and 2345H to the home address 0012H. In other words, Location 0012H is written to EF01H and Location 0013H is written to 2345H. Up to 10 entries allowed to be read at once. The slave replies the master after writing is complete.

Request command: Response command:

Request command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	10H
Initial data location (2 bytes)	00H (high bit set) 12H (low bit set)
Number of data entries (Unit: word) (2 bytes)	00H (high bit set) 02H (low bit set)
Number of data entries (Unit: byte) (1 byte)	04H
First data written to Location 0012H	EF01H
Second data written to Location 0013H	2345H
CRC Check Low (1 Bytes)	50H (low bit set)

CRC Check High (1 Bytes)	84H (high bit set)

Response command:

Slave Address (1 Bytes)	7FH
Function (1 Bytes)	10H
Initial data location (2 bytes)	00H (high bit set) 12H (low bit set)
Number of data entries (Unit: word) (2 bytes)	00H (high bit set) 02H (low bit set)
CRC Check Low (1 Bytes)	EBH (low bit set)
CRC Check High (1 Bytes)	D3H (high bit set)

The following must be noted:

For PD-01, the new transmission rate must be used to transfer data for writing the next data after the new setting value of transmission speed is written when the communication speed is altered.

For PD-02, the new protocol value must be used to transfer data for writing the next data after the new setting value of protocol is written when the protocol is altered.

PD-31 relates to the control of forced output contact. With this parameter, the user tests the functioning of DO (Digit Output) more easily. The user writes in 1, 2, 4, 8 and 16 to test DO1, DO2, DO3, DO4 and DO5, respectively. After testing complete, 0 must be written to this parameter and the servo drive shall be notified for test completion.

Communication read parameter:

The parameter read by the servo drive via the communication method include:

PA-00~PA-21

PB-00~PB-41

PC-00~PC-25

PD-00~PD-55

Chapter 9 Warning Troubleshooting

9.1. Drive Alarm List

Alarm indication	Alarm name	Description for alarm activation	Indication DO	Switching of servo state
AL001	Overvoltage	It is activated when the voltage of main circuit is above the specified value.	ALM	Servo Off
AL002	Overcurrent	It is activated when the instantaneous current of the main circuit is above the current tolerance level of IGBT hardware.	ALM	Servo Off
AL003	Error with motor coupling	The drive does not match the corresponding motor.	ALM	Servo Off
AL004	Regeneration error	It is activated if any regeneration error occurs.	ALM	Servo Off
AL005	Overload	It is activated when the output of the drive is above the load curve.	ALM	Servo Off
AL006	Overspeed	It is activated when the motor speed is above the normal speed.	ALM	Servo Off
AL007	Abnormality in the pulse command	It is activated when the pulse command input frequency is above the specified value.	ALM	Servo Off
AL008	Excessive location error	It is activated when the value of location error is above the setting value.	ALM	Servo Off
AL009	Abnormality in the encoder	The communication error regarding the data of the encoder occurs.	ALM	Servo Off
AL010	Abnormality in the calibration		ALM	Servo Off
AL011	The IGBT is overheated.	The IGBT of drive is overheated.	ALM	Servo Off
AL012	Abnormality in the EEPROM	It is activated due to abnormality in the memory access.	ALM	Servo Off
AL013	Abnormality in the output signal of the detector		ALM	Servo Off
AL014	Serial communication error		ALM	Servo Off
AL015	Overheated environment	The ambient temperature is too high.	ALM	Servo Off
AL016	Internal error in the encoder		ALM	Servo Off
AL017	Error in the data reliability of the encoder	An abnormality occurs in the internal data of the encoder three times in a row.	ALM	Servo Off
AL018	Overheated motor	The motor is overheated.	WRN	Servo On
AL019	Error in the CRC communication	It is activated when an abnormality occurs in RS-232/485 communication.	ALM	Servo Off
AL020	Timeout of the serial communication	It is activated when a timeout occurs in RS-232/485 communication.	ALM	Servo Off
AL021	Error in the motor collision		ALM	Servo Off

Alarm indication	Alarm name	Description for alarm activation	Indication DO	Switching of servo state
AL022	Exceeding the upper limit for the motor temperature	The motor temperature exceeds the tolerance range.	ALM	Servo Off
AL023	Exceeding the upper limit for the encoder temperature	The encoder temperature exceeds the tolerance range.	ALM	Servo Off
AL024	Abnormality in the encoder output		ALM	Servo Off
AL025	Overheated encoder	The encoder is overheated.	ALM	Servo On
AL027	Retrogradation overload	The retrogradation of the drive exceeds the capacity of retrogradation resistance.	ALM	Servo Off
AL029	RST input voltage below level	The RST input voltage is too low.	ALM	Servo Off
AL050	Low voltage	The voltage of the main circuit is too low.	WRN	Servo Off
AL051	Emergency stop	It is activated when the emergency stop button is pressed.	WRN	Servo Off
AL052	Abnormality in the CCW-limit	It is activated when the CCW-limit switch is pressed.	WRN	Servo On
AL053	Abnormality in the CW-limit	It is activated when the CW-limit switch is pressed.	WRN	Servo On
AL054	Timeout of the serial communication		ALM	Servo Off
AL055	Phase failure for the power of the main circuit	The power of the main circuit is input in one way only.	WRN	Servo Off
AL056	Warning of the expected overload		WRN	Servo Off
AL057	Abnormality in the fan	It is activated when the fan operates abnormally.	ALM	Servo Off
AL058	Abnormality in the DSP	It is activated when the DSP operates abnormally.	WRN	Servo Off

9.2. Reason for and handling of the alarm

AL001 : Overvoltage

Reason for abnormality	Check for abnormality	Handling of abnormality
The input voltage of the main circuit exceeds the allowance.	Measure the input power by the voltmeter to see if it is consistent with the specified value.	Use the adequate power supply or cascade the voltage stabilizer.
Malfunction of the drive hardware	An alarm occurs despite that the input power is consistent with the specified value.	Return it to the dealer or factory for repair.
Abnormality in the regeneration system	The regeneration system fails or the regeneration voltage is too high.	Check the regeneration system or mechanism.

AL002 : Overcurrent

Reason for abnormality	Check for abnormality	Handling of abnormality
The output of the drive is open.	Check the connection of the motor and drive.	The open circuit issue is solved to prevent the exposure of conductor.
Abnormality in the motor wiring	Check the wiring order for the motor.	The wiring must be conducted again based on specifications.
Abnormality in the IGBT	Breakdown and abnormality in the IGBT module	Return it to the dealer or factory for repair.
Abnormality in the setting of the control parameter	The control or gain value is set too high.	The value is reset to the initial value. It will be set and calibrated again.
Abnormality in the control command	Check if the input command is in a state of high severity.	Modify the input command or turn on the filter function.

AL003 : Error with motor coupling

Reason for abnormality	Check for abnormality	Handling of abnormality
Encoder damage	An abnormality occurs in the encoder.	Replace the motor.
Loose encoder connector	The encoder wire is loose.	It is reattached.
Error with motor coupling	The motor does not match the drive.	Replace the motor.

AL004 : Regeneration error

Reason for abnormality	Check for abnormality	Handling of abnormality
Wrong selection of the regenerative resistor or no external regenerative resistor connected	Check the condition of the regenerative resistor.	Reset the parameter value. Send the resistor back to the factory if the abnormality is unsolved.
The parameter for resistor capacity not returned to zero when the regenerative resistor not in use	Check the parameter for the resistor capacity.	The parameter for resistor capacity must be returned to zero when the regenerative resistor is not in use.

AL005 : Overload

Reason for abnormality	Check for abnormality	Handling of abnormality
Continuous use while exceeding the rated load of the drive	Check if the motor operates in the condition that the rated load is above 100% for a long time through the monitoring state AVG-L.	Replace the old motor with the one with higher watts or reduce the load.
Inadequate setting of the system parameter	1. Check if the mechanical system sways. 2. The acceleration and deceleration constant is set too short.	Reset the value of switch parameter.
Wrong wiring of the motor and encoder	Check the UVW and encoder wiring.	Install the wire correctly.

AL006 : Overspeed

Reason for abnormality	Check for abnormality	Handling of abnormality
Excessive variation of speed command	Check if the speed command of the upper input is abnormal.	Modify the command or turn on the filter function.
Inadequate setting of the system parameter	Check if the condition for the overspeed warning (PD-53) is insufficient.	Set the parameter value correctly.

AL007 : Abnormality in the pulse command

Reason for abnormality	Check for abnormality	Handling of abnormality
Frequency in the pulse command above the rated input frequency	Check the pulse frequency sent by the upper controller.	Set the upper controller correctly.

AL008 : Excessive location error

Reason for abnormality	Check for abnormality	Handling of abnormality
The setting value of parameter for position control error set too low	Check the setting value of parameter for position control error (PD-54).	Increase the setting value of parameter for position control error (PD-54).
Control gain set too low	Check if the position and speed gains are appropriate.	Calibrate the control gain again.
Torque limit too low	Check the torque limit value.	Set the torque limit correctly.
Excessive external load	Check the state of external load.	Reduce the load or replace the old motor with the one with higher watts.

AL009 : Abnormality in the encoder

Reason for abnormality	Check for abnormality	Handling of abnormality
Loose encoder wire	Check if the encode wire is loose.	Reattach the encoder wire.
Wrong wiring of the encoder	Check if the encode wire is consistent with the specifications and definition.	Reattach the encoder wire.
Malfunction of encoder	An abnormality occurs in the motor.	Replace the motor.

AL010 : Abnormality in the calibration

Reason for abnormality	Check for abnormality	Handling of abnormality
Analog Input contact not returned to zero	Measure if the voltage level of the analog input contact is equivalent to the ground potential.	The analog input contact is grounded correctly.
Damage of the detecting element	Detection of power reset	If any abnormality still occurs, return the element to the factory for repair.

AL011 : IGBTOverheated module

Reason for abnormality	Check for abnormality	Handling of abnormality
Overheated drive	Check if the drive temperature is too high.	Lower the drive temperature.

AL012 : Abnormality in the EEPROM

Reason for abnormality	Check for abnormality	Handling of abnormality
Memory damage		Return it to the dealer or factory for repair.

AL015 : Ambient temperature too high

Reason for abnormality	Check for abnormality	Handling of abnormality
Ambient temperature of the drive too high	Check if the drive temperature is too high.	Lower the drive temperature.

AL017 : Error in the data reliability of the encoder

Reason for abnormality	Check for abnormality	Handling of abnormality
Abnormality in three data entries of the encoder data received by the drive in a row.	1. Check if the motor is grounded normally. 2. Check if the signal cable of the encoder is entangled with the line with the power or high current. If not, the interference source can be avoided. 3. Check if the mesh is used for the filament of the encoder.	1. Make sure that the ground end of the UVW connector is connected to the heat dissipation of the drive. 2. Check the wiring for the signal cable of the encoder to prevent it from entangling with other lines. 3. Use the filament with mesh. 4. If the situation is not improved, return the drive the factory for repair.

AL018 : Overheated motor

Reason for abnormality	Check for abnormality	Handling of abnormality
The motor temperature is over 75℃.	Check if the motor temperature is too high.	Reduce the motor temperature.

AL019 : Error in the CRC communication

Reason for abnormality	Check for abnormality	Handling of abnormality
Error in RS-232/485 communication	Check if the signal cable is interfered with.	Check the wiring for the signal cable to prevent it from entangling with other lines.

AL020 : Timeout of the serial communication

Reason for abnormality	Check for abnormality	Handling of abnormality
Inadequate setting of the timeout parameter	Check the setting of timeout parameter.	Set the parameter correctly.
Communication	Check if the wire is loose.	Connect the wire correctly.

interruption		

AL021 : Error in the motor collision

Reason for abnormality	Check for abnormality	Handling of abnormality
Inadequate setting of the timeout parameter	Check the setting of timeout parameter.	Set the parameter correctly.
Communication interruption	Check if the wire is loose.	Connect the wire correctly.

AL022 : Exceeding the upper limit for the motor temperature

Reason for abnormality	Check for abnormality	Handling of abnormality
The motor temperature is over 90℃.	Check if the motor temperature is too high.	Reduce the motor temperature.

AL023 : Exceeding the upper limit for the encoder temperature

Reason for abnormality	Check for abnormality	Handling of abnormality
Encoder temperature exceeding 85℃	Check if the encoder temperature is too high.	Lower the encoder temperature.

AL025 : Overheated encoder

Reason for abnormality	Check for abnormality	Handling of abnormality
Encoder temperature exceeding 65℃	Check if the encoder temperature is too high.	Lower the encoder temperature.

AL026 : Overcurrent output by the servo

Reason for abnormality	Check for abnormality	Handling of abnormality
Abnormality in the setting of the control parameter	The control or gain value is set too high.	The value is reset to the initial value. It will be set and calibrated again.
Abnormality in the control command	Check if the input command is in a state of high severity.	Modify the input command or turn on the filter function.

AL027 : Regeneration overload

Reason for abnormality	Check for abnormality	Handling of abnormality
Error in the parameter setting	Check the parameter for the resistor capacity and the resistor parameter.	Reset the parameter value.
The capacity of regenerative resistor is insufficient.	Check if the deceleration time is too short or if the capacity of the regenerative resistor is too low.	Increase the deceleration time or attach the regenerative resistor with higher watts.

AL050 : Low voltage

Reason for abnormality	Check for abnormality	Handling of abnormality
Input voltage of the main circuit below the allowance	Measure the input power by the voltmeter to see if it is consistent with the specified value.	Use the adequate power supply or cascade the voltage stabilizer.

AL051 : Emergency stop

Reason for abnormality	Check for abnormality	Handling of abnormality
Emergency stop switch pressed	Check the switch status.	Turn on the emergency stop switch.

AL052 : Abnormality in the CCW-limit

Reason for abnormality	Check for abnormality	Handling of abnormality
CCW-limit switch pressed	Check the switch status.	Turn on the CCW-limit switch.

AL053 : Abnormality in the CW-limit

Reason for abnormality	Check for abnormality	Handling of abnormality
CW-limit switch pressed	Check the switch status.	Turn on the CW-limit switch.

AL055 : Phase failure for the power of the main circuit

Reason for abnormality	Check for abnormality	Handling of abnormality
Phase failure for the power of the main circuit with only single phase input available	1. Check if the power connection is loose. 2. Check if the power input is normal.	Make sure that the three-way power supply is connected. Return the power supply to the factory for repair if there is still any abnormality.

AL056 : Warning of the expected overload

Reason for abnormality	Check for abnormality	Handling of abnormality
Warning of the expected overload	1. Check for the use during continuous overloading. 2.	1. Refer to AL005 for handling. 2.

AL057 : Abnormality in the fan

Reason for abnormality	Check for abnormality	Handling of abnormality
Abnormality in the fan	Check the condition of the fan.	Return it to the dealer or factory for repair.

AL058 : Abnormalityin the DSP

Reason for abnormality	Check for abnormality	Handling of abnormality
Abnormality in the DSP	Check whether the drive operates normally.	Return it to the dealer or factory for repair.

9.3. Alarm troubleshooting

Alarm indication	Alarm name	Action for recovery after alarm
AL001	Overvoltage	DI: ARST clear
AL002	Overcurrent	DI: ARST clear
AL003	Error with motor coupling	DI: ARST clear
AL004	Regeneration error	DI: ARST clear
AL005	Overload	DI: ARST clear
AL006	Overspeed	DI: ARST clear
AL007	Abnormality in the pulse command	DI: ARST clear
AL008	Excessive location error	DI: ARST clear
AL009	Abnormality in the encoder	DI: ARST clear
AL010	Abnormality in calibration	DI: ARST clear
AL011	Overheated IGBT	DI: ARST clear
AL012	Abnormality in EEPROM	DI: ARST clear
AL013	Abnormality in the output signal of the detector	DI: ARST clear
AL014	Serial communication error	DI: ARST clear
AL015	Overheated environment	It is cleared automatically after temperature recovery.
AL016	Internal error in the encoder	DI: ARST clear

Alarm indication	Alarm name	Action for recovery after alarm
AL017	Error in the data reliability of the encoder	DI: ARST clear
AL018	Overheated motor	It is cleared automatically after temperature recovery.
AL019	Error in the CRC communication	DI: ARST clear
AL020	Timeout of the serial communication	DI: ARST clear
AL021	Error in the motor collision	DI: ARST clear
AL022	Exceeding the upper limit for the motor temperature	It is cleared automatically after temperature recovery.
AL023	Exceeding the upper limit for the encoder temperature	It is cleared automatically after temperature recovery.
AL024	Abnormality in the encoder output	DI: ARST clear
AL025	Overheated encoder	It is cleared automatically after temperature recovery.
AL026	Overcurrent output by the servo	DI: ARST clear
AL027	Abnormality in the regeneration	DI: ARST clear
AL050	Low voltage	It is cleared automatically after the voltage returns to normal.
AL051	Emergency stop	DI: It is cleared automatically after EMG is clear.
AL052	Abnormality in the CCW-limit	DI: ARST clear
AL053	Abnormality in the CW-limit	DI: ARST clear
AL054	Timeout of the serial communication	DI: ARST clear
AL055	Phase failure for the power of the main circuit	DI: ARST clear
AL056	Warning of the expected overload	DI: ARST clear
AL057	Abnormality in the fan	DI: ARST clear
AL058	Abnormality in the DSP	Return it to the dealer or factory for repair.

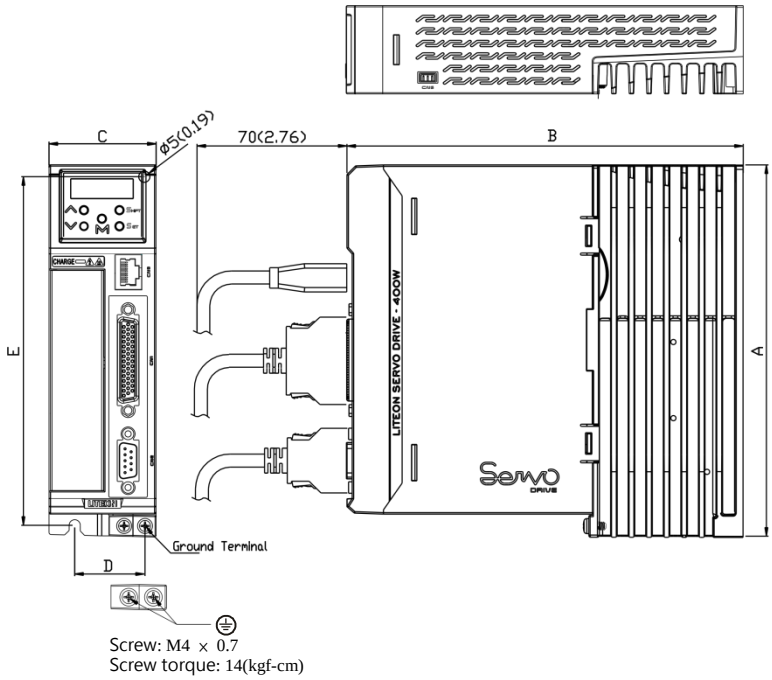
Chapter 10 Specifications

10.1. Standard specification for the servo drive

Model name of servo drive: ISA-7			100W	200W	400W	750W	1kW	1.5kW	2.0kW
			010	020	040	075	100	150	200
Output power	Rated voltage (Note 1)		Three phase 170VAC						
	Rated current [A] (Note 1)		0.9	1.7	2.8	5.8	6.0	10.0	11.0
Power supply input of the main circuit		Voltage/frequency	Three phase AC 200 ~ 230V/50, 60Hz Single phase AC 230V/50, 60Hz					Three phase 200VAC-230VAC, 50/60Hz	
		Rated current [A] (Note 1)	0.7	1.5	2.6	3.8	5.0	8.0	10.5
		Allowable voltage variation	Three phase: 170 ~ 255 VAC Single phase: 200 ~ 255 VAC					Three phase: 170 ~ 255 VAC	
		Allowable frequency variation	Maximum ±5%						
Power supply input of the control circuit		Voltage/frequency	Single phase 200VAC-240VAC, 50/60Hz						
		Rated current [A]	0.2						
		Allowable voltage variation	Single phase 170VAC-255VAC						
		Allowable frequency variation	Maximum ±5%						
		Power consumption [W]	30						
Power supply for interface			24VDC ±10% (required current capacity: 0.5A)						
Method for control of main circuit			Space-vector PWM control/current control method						
Built-in regenerative resistor Allowable regenerative power [W]			--	--	60	60	60	100	100
Dynamic brake			Built-in						
Communication function			RS232/RS485						
Output pulse of encoder			Compatible (A/B/Z-phase pulse)						
Analog monitoring			Two channels are available. Use the parameter to set the monitoring signal (range of output voltage: ±8V).						
External control method			Pulse and analog signals						
Position control mode		Pulse frequency of maximum output	500k/4Mpulses/s (if the differential receiver is used) and 200kpulse/s (if the open collector is used)						
		Command pulse mode	Pulse +symbol; A phase + B phase; CCW pulse + CW pulse						
		Command control method	External pulse control						
		Command smoothing method	Low-pass and P-curve smoothing filter						
		Position feedback pulse	Encoder resolution: 20 bits						
		Command pulse rate	A/B rate of electronic gear, A: 1-16777215, B: 1-16777215, 1/10 < A/B < 4000						
		Width setting for positioning completion	0-±65535 pulses (command pulse unit)						
		Excessive error	± 10 rotation						
		Torque limit	Via the parameter or external analog input (0- +10 VDC/maximum torque)						
		Feed-forward compensation	Parameter setting method						
Speed control mode		Speed control range	Analog speed command 1:2000, internal speed command 1:5000						
		Bandwidth	Maximum 550Hz						
		Command control method	Control of external analog command/control of internal register						
		Command smoothing method	Low-pass smoothing filter; S-curve smoothing filter						
		Input of analog speed command	0- ±10VDC/rated speed (may be changed via the parameter at 10V speed) (Input resistance: 10kΩ-12 kΩ)						
		Speed variation ratio	Maximum ±0.01% (load variation ratio: 0-100%), 0% (power variation ratio: ±10%) Maximum ±0.2% (ambient temperature: 25°C ±10°C); then the analog speed command is used						
		Torque limit	Via the parameter or external analog input (0- +10 VDC/maximum torque)						
Torque control		Command control	Control of external analog command						

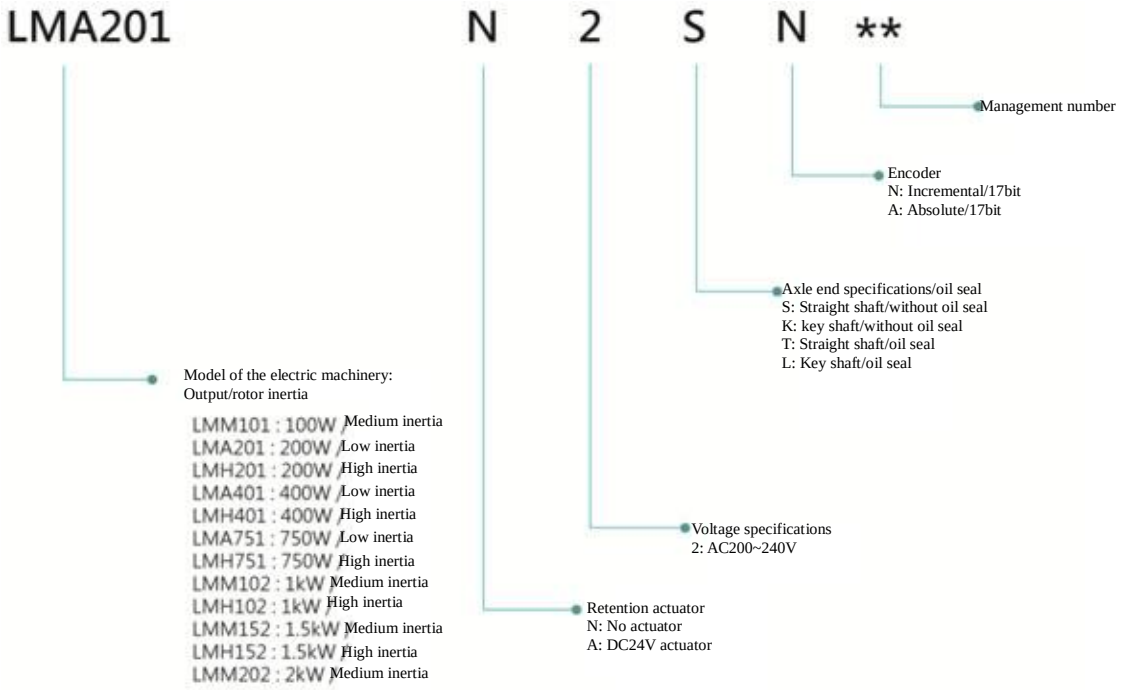
mode	method		
	Command smoothing method	Low-pass smoothing filter	
	Input of analog torque command	0- ±10VDC/maximum torque (input resistance: 10kΩ-12 kΩ)	
	Speed limit	Via the parameter or external analog input (0- +10VDC/rated speed)	
Digital I/O	Input	Servo start, error reset, gain switch, pulse clear, zero speed clamping, command input reverse control, torque limit, speed limit, motor stop, speed command selection, selection and switching of command for the speed/position mixed mode, selection and switching of command for the speed/torque mixed mode, selection and switching of command for the torque/position mixed mode, emergency stop, CW- /CCW-limit, CW- /CCW-limit torque limit, forward/reverse jog input, selection of ratio for the numerator of the electronic gear ratio and the pulse input inhibited.	
	Output	A/B/Z line driver input	
		Servo ready, servo start, zero speed detection, command speed arrival, command position arrival, torque limiting, servo alarm, electromagnetic brake, overload alert, servo warning, software limit (reverse direction), software limit (forward direction) and servo procedure complete.	
Protection function		Overcurrent protection, regenerative overvoltage protection, overload protection (electronic thermal relay), servo motor overheat protection, encoder error protection, regeneration error protection, low voltage protection, transient power failure protection, overspeed protection, excessive error protection, magnetic pole detection protection, as well as the malfunction protection of linear servo control malfunction.	
Safety authentication		IEC/EN 61800-5-1, UL508C (planned)	
Structure (IP level)		Natural cooling, open type (IP20)	Forced cooling, open type (IP20)
Close fitting		Allowed (Note 2)	
Environment	Ambient temperature	0-55°C (non-frozen), storage: -20°C-65°C (non-frozen) (If the ambient temperature is above 45°C, enforce the peripheral air cycling.)	
	Ambient humidity	Maximum 90% RH (non-condensing), storage: maximum 90% RH (non-condensing)	
	Installation location	It must be installed indoor without direct sunlight, corrosive gas, flammable gas, oil mist or dust.	
	Height	Height above sea level - below 1000 m	
	Vibration resistance	5.9m/s^2 at 10-55Hz (X, Y and Z directions)	

10.1.1. Outline dimension drawing (drive)



Power	A	B	C	D	E	Weight
200W~400W	173(6.81)	185(7.28)	50(1.97)	32.5(1.28)	162.5(6.40)	1.05(2.31)
750W~1kW	173(6.81)	195(7.68)	70(2.76)	52.5(2.07)	163(6.42)	1.64(3.61)

10.2. Standard specification for the servo motor



Item			Unit	Specifications	
Voltage			V	AC200V～240V	
Model of the electric machinery (M□□□□□□□□**)			—	M500□2□□ Medium inertia	M101□2□□ Medium inertia
Size of mounted flange			mm	□40	□40
Schematic weight		No actuator	kg	0.4	0.5
		With actuator		0.6	0.8
Basic specifications	Rated output		W	50	100
	Rated torque		N·m	0.16	0.32
	Maximum transient torque		N·m	0.56	1.12
	Rated current		Arms	0.6	0.9
	Maximum transient current		Arms	2.1	3.2
	Rated rotation speed		r /min	3000	
	Max. speed		r /min	6000	
	Torque constant		N・m/Arms	0.25	0.36
	Induced voltage constant for each phase		mV/(r/min)	8.8	12.5
	Rated power	No actuator	kW/s	5.6	13.6
		With actuator		4.7	12.3
	Machinery constant	No actuator	ms	2.60	1.69
		With actuator		3.06	1.87
	Electric constant		ms	0.64	0.76
	Rotor inertia	No actuator	$\times 10^{-4}$	0.045	0.074
		With actuator	$kg \cdot m^2$	0.053	0.082
	Encoder		17-bit serial communication (RS-422)		
Actuator specifications	Purpose		Actuator for reserve (not for actuation)		
	Power supply		—	Use the SELV power supply/and the power supply regarding the reinforced insulation for the dangerous voltage.	
	Rated voltage		V	DC24V±10 %	
	Rated current		A	0.25	
	Static friction torque		N·m	Above 0.16	Above 0.32
	Pull-in time		ms	Below 35	
	Release time		ms	Below 20	
	Release voltage		V	Above DC1V	
Condition of application environment	Rated time		Continuous		
	Temperature of application environment		0℃～40℃		
	Humidity of application environment		20～85% RH (non-condensing)		
	Temperature of storage environment		-20℃～65℃(non-condensing) Highest temperature: 80℃ and 72 hours		
	Humidity of storage environment		20～85% RH (non-condensing)		
	Use of the air in the storage environment		It must be installed indoor without direct sunlight, corrosive gas, flammable gas, oil mist, dust, combustible material or grinding compound.		
	Thermal resistance level		Class B		
	Insulation resistance		DC1000V, above 5MΩ		
	Insulation voltage resistance		AC1500V 1 minute		
	Altitude for operation		Altitude below 1000 m		
	Vibration level		V15 (JEC2121)		
	Endurance vibration		49m/s$_2$ (5G)		
	Endurance shock		98m/s$_2$ (10G)		
	Protective structure		IP65 (corresponding to IP67)		
Notes			・Grounding required, Class I item		
			・Overvoltage category II item		
			・Pollution degree 2 item		
			・The value indicated by the rated torque is the one regarding the mounted flange. This value is on the square L-flange. It is about twice of the value for the size of a flange mounted on the flange.		
			・The actuator cable is polarized. Connect the yellow lead wire (BRK+) to +24V and the blue lead wire (BRK-) to GND.		

Item			Unit	Specifications			
Voltage			V	AC200V～240V			
Model of the electric machinery (M□□□□□□□□**)			—	A201□2□□ Low inertia	H201□2□□ High inertia	A401□2□□ Low inertia	H401□2□□ High inertia
Size of mounted flange			mm	□60	□60	□60	□60
Schematic weight		No actuator	kg	0.9	1.0	1.3	1.5
		With actuator		1.4	1.5	1.8	2.0
Basic specifications	Rated output		W	200		400	
	Rated torque		N·m	0.64		1.27	
	Maximum transient torque		N·m	1.91		3.82	
	Rated current		Arms	1.7		2.7	
	Maximum transient current		Arms	5.1		8.1	
	Rated rotation speed		r/min	3000			
	Max. speed		r/min	5000			
	Torque constant		N・m/Arms	0.417		0.498	
	Induced voltage constant for each phase		mV/(r/min)	14.5		17.4	
	Rated power	No actuator	kW/s	23.9	9.3	58.7	23.5
		With actuator		19.5	8.6	51.9	22.4
	Machinery constant	No actuator	ms	1.12	2.87	0.67	1.66
		With actuator		1.37	3.12	0.75	1.75
	Electric constant		ms	1.99		2.47	
	Rotor inertia	No actuator	$\times 10^{-4}$ kg・m²	0.17	0.44	0.28	0.70
		With actuator		0.21	0.47	0.31	0.74
	Encoder			17-bit serial communication (RS-422)			
Actuator specifications	Purpose			Actuator for reserve (not for actuation)			
	Power supply		—	Use the SELV power supply/and the power supply regarding the reinforced insulation for the dangerous voltage.			
	Rated voltage		V	DC24V±10 %			
	Rated current		A	0.3			
	Static friction torque		N·m	Above 1.27			
	Pull-in time		ms	Below 50			
	Release time		ms	Below 15			
	Release voltage		V	Above DC1V			
Condition of application environment	Rated time			Continuous			
	Temperature of application environment			0℃～40℃			
	Humidity of application environment			20～85%RH (non-condensing)			
	Temperature of storage environment			-20℃～65℃(non-condensing) Highest temperature: 80℃ with 72 hours			
	Humidity of storage environment			20～85%RH (non-condensing)			
	Use of the air in the storage environment			It must be installed indoor without direct sunlight, corrosive gas, flammable gas, oil mist, dust, combustible material or grinding compound.			
	Thermal resistance level			Class B			
	Insulation resistance			DC1000V above 5MΩ			
	Insulation voltage resistance			AC1500V 1 minute			
	Altitude for operation			Altitude below 1000m			
	Vibration level			V15 (JEC2121)			
	Endurance vibration			49m/s² (5G)			
	Endurance shock			98m/s² (10G)			
	Protective structure			IP65 (corresponding to IP67)			
Notes				・Grounding required, Class I item			
				・Overvoltage category II item			
				・Pollution degree 2 item			
				・The value indicated by the rated torque is the one regarding the mounted flange. This value is on the square L-flange. It is about twice of the value for the size of a flange mounted on the flange.			
				・The actuator cable is polarized. Connect the yellow lead wire (BRK+) to +24V and the blue lead wire (BRK-) to GND.			

Item			Unit	Specifications	
Voltage			V	AC200V～240V	
Model of the electric machinery (M□□□□□□□□**)			—	A751□2□□ Low inertia	H751□2□□ High inertia
Size of mounted flange			mm	□80	□80
Schematic weight		No actuator	kg	2.5	2.7
		With actuator		3.3	3.5
Basic specifications	Rated output		W	750	
	Rated torque		N·m	2.39	
	Maximum transient torque		N·m	7.1	
	Rated current		Arms	4.3	
	Maximum transient current		Arms	12.9	
	Rated rotation speed		r/min	3000	
	Max. speed		r/min	4500	
	Torque constant		N・m/Arms	0.61	
	Induced voltage constant for each phase		mV/(r/min)	21.33	
	Rated power	No actuator	kW/s	64.1	35.9
		With actuator		52.8	32.1
	Machinery constant	No actuator	ms	0.53	0.94
		With actuator		0.64	1.06
	Electric constant		ms	4.3	4.3
	Rotor inertia	No actuator	$\times 10^{-4}$ kg・m²	0.89	1.62
		With actuator		1.08	1.81
	Encoder		17-bit serial communication (RS-422)		
Actuator specifications	Purpose		Actuator for reserve (Note: Not for actuation)		
	Power supply		—	Use the SELV power supply/and the power supply regarding the reinforced insulation for the dangerous voltage.	
	Rated voltage		V	DC24V±10 %	
	Rated current		A	0.4	
	Static friction torque		N·m	Above 2.39	
	Pull-in time		ms	70	
	Release time		ms	20	
	Release voltage		V	Above DC1V	
Condition of application environment	Rated time		Continuous		
	Temperature of application environment		0℃～40℃		
	Humidity of application environment		20～85%RH (non-condensing)		
	Temperature of storage environment		-20℃～65℃(non-condensing) Highest temperature: 80℃ with 72 hours		
	Humidity of storage environment		20～85%RH (non-condensing)		
	Use of the air in the storage environment		It must be installed indoor without direct sunlight, corrosive gas, flammable gas, oil mist, dust, combustible material or grinding compound.		
	Thermal resistance level		Class B		
	Insulation resistance		DC1000V above 5MΩ		
	Insulation voltage resistance		AC1500V 1 minute		
	Altitude for operation		Altitude below 1000m		
	Vibration level		V15 (JEC2121)		
	Endurance vibration		49m/s² (5G)		
	Endurance shock		98m/s² (10G)		
	Protective structure		IP65 (corresponding to IP67)		
Notes			・Grounding required, Class I item		
			・Overvoltage category II item		
			・Pollution degree 2 item		
			・The value indicated by the rated torque is the one regarding the mounted flange. This value is on the square L-flange. It is about twice of the value for the size of a flange mounted on the flange.		
			・The actuator cable is polarized. Connect the yellow lead wire (BRK+) to +24V and the blue lead wire (BRK-) to GND.		

Item			Unit	Specifications				
Voltage			V	AC200V～240V				
Model of the electric machinery (M□□□□□□□□**)			—	M101□2□□ Medium inertia	H102□2□□ High inertia	M152□2□□ Medium inertia	H152□2□□ High inertia	M202□2□□ Medium inertia
Size of mounted flange			mm	□130	□130	□130	□130	□130
Schematic weight		No actuator	kg	5.6	7.6	7.0	9.0	8.4
		With actuator		7.0	9.0	8.4	10.4	9.8
Basic specifications	Rated output		W	1000		1500		2000
	Rated torque		N·m	4.77		7.16		9.55
	Maximum transient torque		N·m	14.3		21.5		28.6
	Rated current		Arms	5.6		9.9		12.2
	Maximum transient current		Arms	16.8		30		36.6
	Rated rotation speed		r/min	2000		2000		2000
	Max. speed		r/min	3000		3000		3000
	Torque constant		N・m/Arms	0.88		0.81		0.85
	Induced voltage constant for each phase		mV/(r/min)	30.9		28.4		29.6
	Rated power	No actuator	kW/s	50.0	9.2	76.9	13.8	104.9
		With actuator		36.5	8.6	61.4	13.3	87.9
	Machinery constant	No actuator	ms	0.76	4.17	0.60	3.32	0.58
		With actuator		1.05	4.43	0.75	3.46	0.69
	Electric constant			10.1		12.2		8.2
	Rotor inertia	No actuator	$\times 10^{-4}$ kg・m²	4.56	24.9	6.67	37.12	8.70
		With actuator		6.24	26.4	8.35	38.65	10.38
	Encoder							
Actuator specifications	Purpose			Actuator for reserve (Note: Not for actuation)				
	Power supply		—	Use the SELV power supply/and the power supply regarding the reinforced insulation for the dangerous voltage.				
	Rated voltage		V	DC24V±10 %				
	Rated current		A	1.0				
	Static friction torque		N·m	Above 9.55				
	Pull-in time		ms	120				
	Release time		ms	30				
	Release voltage		V	Above DC1V				
Condition of application environment	Rated time			Continuous				
	Temperature of application environment			0℃～40℃				
	Humidity of application environment			20～85%RH (non-condensing)				
	Temperature of storage environment			-20℃～65℃(non-condensing) Highest temperature: 80℃ with 72 hours				
	Humidity of storage environment			20～85%RH (non-condensing)				
	Use of the air in the storage environment			It must be installed indoor without direct sunlight, corrosive gas, flammable gas, oil mist, dust, combustible material, or grinding compound.				
	Thermal resistance level			Class F				
	Insulation resistance			DC1000V above 5MΩ				
	Insulation voltage resistance			AC1500V within 1 minute				
	Altitude for operation			Altitude below 1000m				
	Vibration level			V15 (JEC2121)				
	Endurance vibration			49m/s² (5G)				
	Endurance shock			98m/s² (10G)				
	Protective structure			IP65 (corresponding to IP67)				
Notes				・Grounding required, Class I item				
				・Overvoltage category II item				
				・Pollution degree 2 item				
				・The value indicated by the rated torque is the one regarding the mounted flange. This value is on the square L-flange. It is about twice of the value for the size of a flange mounted on the flange.				
				・The actuator cable is polarized. Refer to Table 3-3-5 for connecting to +24V and GND.				

10.2.1. Size of the motor fixed screw

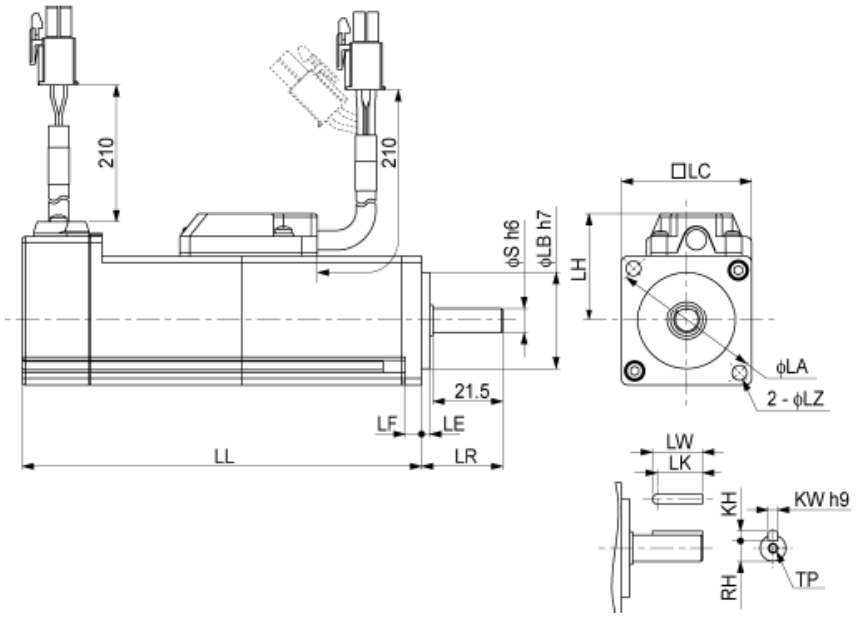
	The motor must be fixed with the screw in the recommended size.	If not, the motor lifetime may be shortened and the motor would no longer be fully functional.

Motor fixed screw		
Model of the servo motor	Fixing hole	Recommended screw
MM500, MM101	2-φ4.5	Above M4 X 12 mm
MA201, MH201	4-φ5.5	Above M5 X 12 mm
MA401, MH401	4-φ5.5	Above M5 X 12 mm
MA751, MH751	4-φ6.6	Above M6 X 14 mm
MM102, MH102	4-φ9	Above M8 X 18 mm
MM152, MH152	4-φ9	Above M8 X 18 mm
MM202	4-φ9	Above M8 X 18mm

	If the motor is integrated into the reducer, the leak might leak from the output shaft into the motor. In this case, it is required to order the motor with oil seal.	If not, the motor lifetime may be shortened and the motor would no longer be fully functional.

10.2.2. Outline dimension drawing (motor)

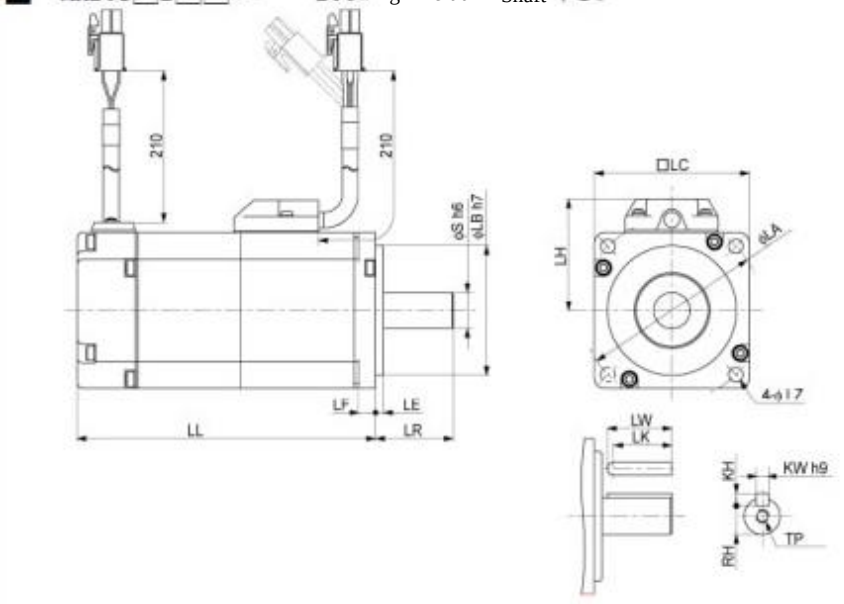
■ MM500□2□□** Medium inertia
■ MM101□2□□** Medium inertia



Voltage		AC200V～240V			
Motor model		50W		100W	
		Without oil seal	With oil seal	Without oil seal	With oil seal
		Medium inertia			
		MM500□2S□**	MM500□2T□**	MM101□2S□**	MM101□2T□**
		MM500□2K□**	MM500□2L□**	MM101□2K□**	MM101□2L□**
LC (Flange size)		□40			
LL	No actuator	66.4	72	82.4	88
	With actuator	106.8	112.4	122.8	128.4
LR		25			
S		8			
LA		46			
LB		30			
LE		2.5			
LF		5			
LH		33			
LZ		4.5			
Size of attached key	LW	15.5			
	LK	14			
	KW	3			
	KH	3			
	RH	6.2			
	TP	M3depth 6			

(Unit: mm)

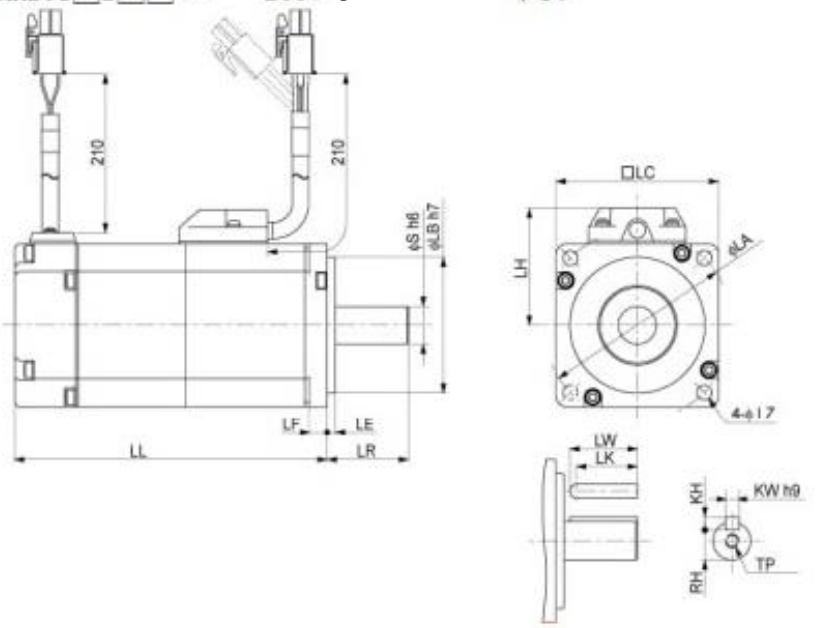
■ MA201□2△□** 200W Low inertia Shaft φ11
■ MH201□2△□** 200W High inertia Shaft φ11
■ MA201□2□□** 200W Low inertia Shaft φ14
■ MH201□2□□** 200W High inertia Shaft φ14



Voltage		AC200V~240V			
Motor model		200W			
		Low inertia	High inertia	Low inertia	High inertia
		MA201□2□□**	MH201□2□□**	MA201□2△□**	MH201□2△□**
Shaft diameter		14		11	
LC (Flange size)		□60			
LL	No actuator	79	98.5	79	98.5
	With actuator	115.5	135	115.5	135
LR		30			
S		14		11	
LA		70			
LB		50			
LE		3			
LF		6.5			
LH		43			
LZ		5.5			
Size of attached key	LW	25		20	
	LK	22.5		18	
	KW	5		4	
	KH	5		4	
	RH	11		8.5	
	TP	M5 depth 10		M4 depth 8	

(Unit: mm)

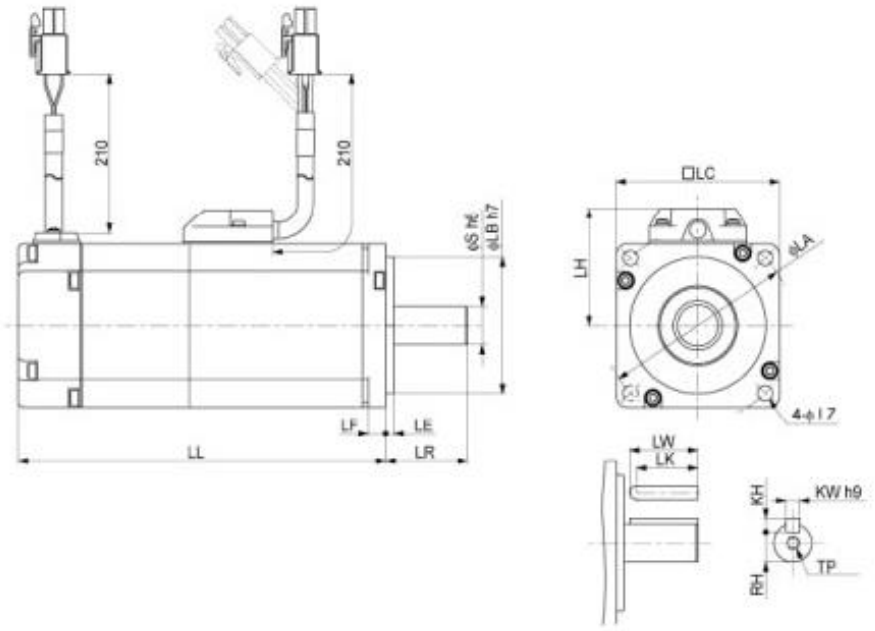
■ MA201□2△□** 200W Low inertia Shaft φ11
■ MH201□2△□** 200W High inertia Shaft φ11
■ MA201□2□□** 200W Low inertia Shaft φ14
■ MH201□2□□** 200W High inertia Shaft φ14



Voltage		AC200V～240V			
Motor model		200W			
		Low inertia	High inertia	Low inertia	High inertia
		MA201□2□□**	MH201□2□□**	MA201□2△□**	MH201□2△□**
Shaft diameter		14		11	
LC (Flange size)		□60			
LL	No actuator	79	98.5	79	98.5
	With actuator	115.5	135	115.5	135
LR		30			
S		14		11	
LA		70			
LB		50			
LE		3			
LF		6.5			
LH		43			
LZ		5.5			
Size of attached key	LW	25		20	
	LK	22.5		18	
	KW	5		4	
	KH	5		4	
	RH	11		8.5	
	TP	M5 depth 10		M4 depth 8	

(Unit: mm)

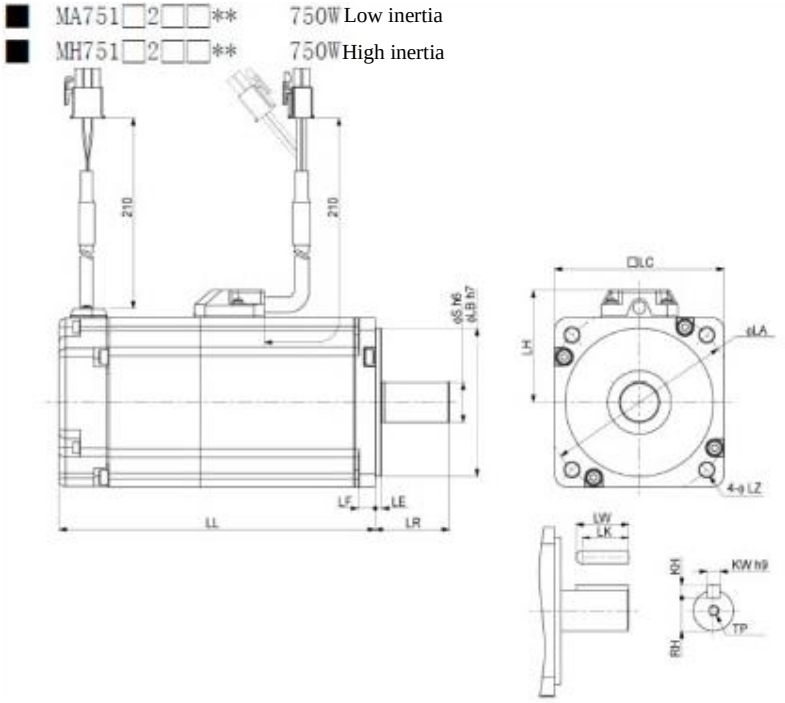
■ MA401□2□□** 400W Low inertia
■ MH401□2□□** 400W High inertia



Voltage		AC200V~240V	
Motor model		400W	
		Low inertia	High inertia
		MA401□2□□**	MH401□2□□**
LC (Flange size)		□60	
LL	No actuator	98.5	118
	With actuator	135	154.5
LR		30	
S		14	
LA		70	
LB		50	
LE		3	
LF		6.5	
LH		43	
LZ		5.5	
Size of attached key	LW	25	
	LK	22.5	
	KW	5	
	KH	5	
	RH	11	
	TP	M5 depth 10	

(Unit: mm)

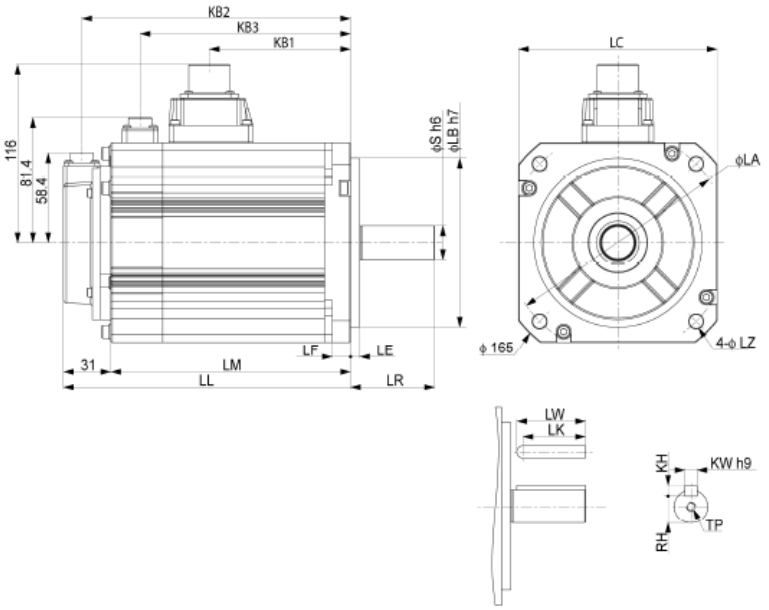
■ MA751□2□□** 750W Low inertia
■ MH751□2□□** 750W High inertia



Voltage		AC200V～240V	
Motor model		750W	
		Low inertia	High inertia
		MA751□2□□**	MH751□2□□**
LC (Flange size)		□80	
LL	No actuator	112.3	127.3
	With actuator	149.3	164.3
LR		35	
S		19	
LA		90	
LB		70	
LE		3	
LF		8	
LH		53	
LZ		6.6	
Size of attached key	LW	25	
	LK	22	
	KW	6	
	KH	6	
	RH	15.5	
	TP	M5 depth 10	

(Unit: mm)

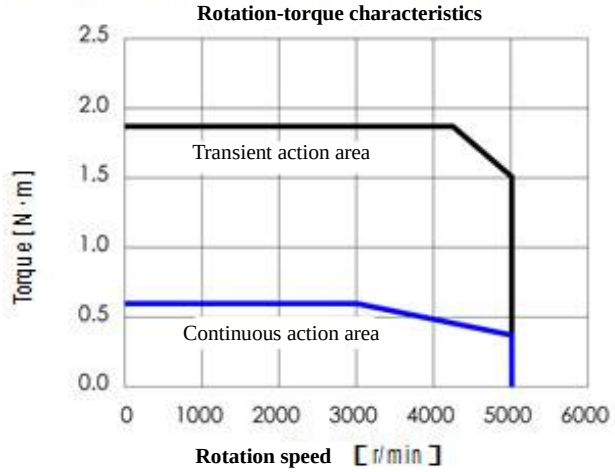
■ MM102□2□□** MH102□2□□** 1Kw Medium/high inertia
■ MM152□2□□** MH152□2□□** 1. 5kW Medium/high inertia
■ MM202□2□□** 2kW Medium inertia



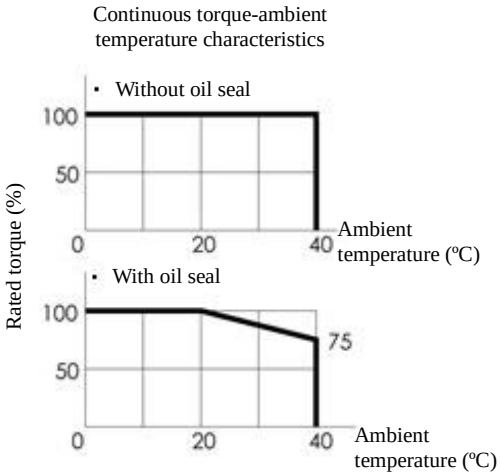
Voltage		AC200V~240V				
Motor model		1kW		1. 5kW		2Kw
		Medium inertia	High inertia	Medium inertia	High inertia	Medium inertia
		MM102 □2□□**	MH102 □2□□**	MM152 □2□□**	MH15 2□2□□**	MM202 □2□□**
LC (Flange size)		□130				
LL	No actuator	128	163	145. 5	180. 5	163
	With actuator	153	188	170. 5	205. 5	188
LM	No actuator	97	132	114. 5	149. 5	132
	With actuator	122	157	139. 5	174. 5	157
LR		55	70	55	70	55
S		22				
LA		145				
LB		110				
LE		6				
LF		12				
LZ		9				
KB1		57. 5	92. 5	75	110	92. 5
KB2		116	151	133. 5	168. 5	151
		141	176	158. 5	193. 5	176
KB3		-	-	-	-	-
		102. 8	137. 8	120. 3	155. 3	137. 8
Size of attached key	LW	45				
	LK	41				
	KW	8				
	KH	7				
	RH	18				
	TP	M6depth 20				

10.2.3. NT characteristic diagram

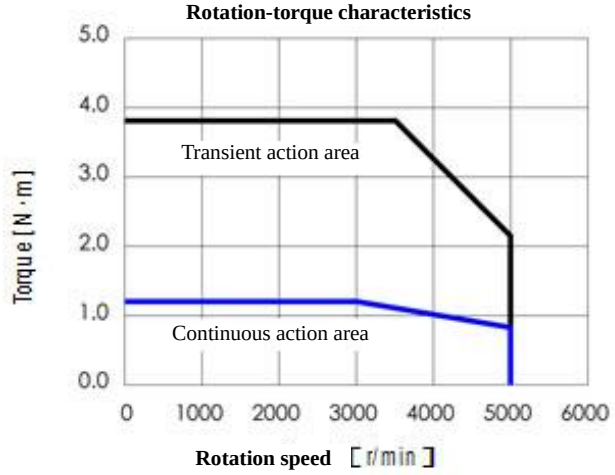
■ LMA201□2□□**、LMH201□2□□**



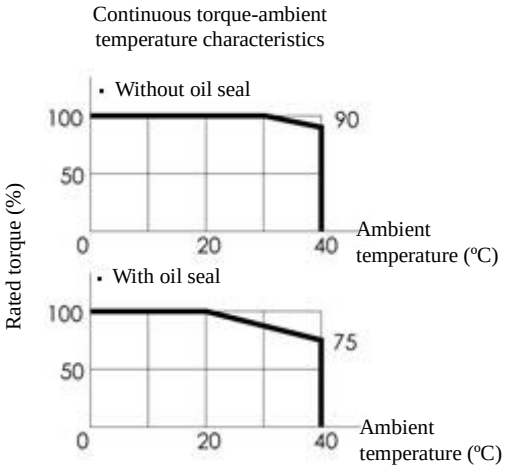
N-T characteristics (200W)



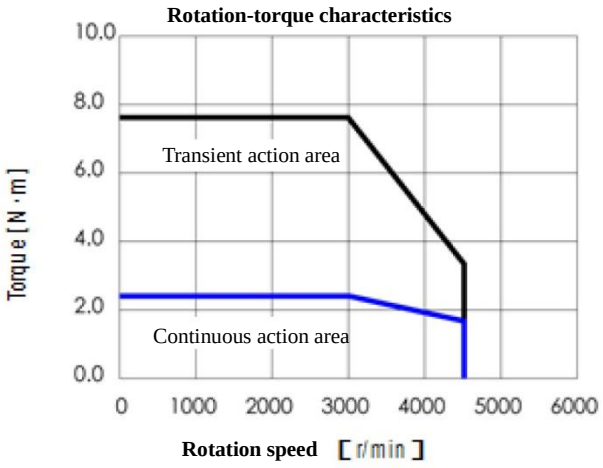
■ LMA401□2□□**、LMH401□2□□**



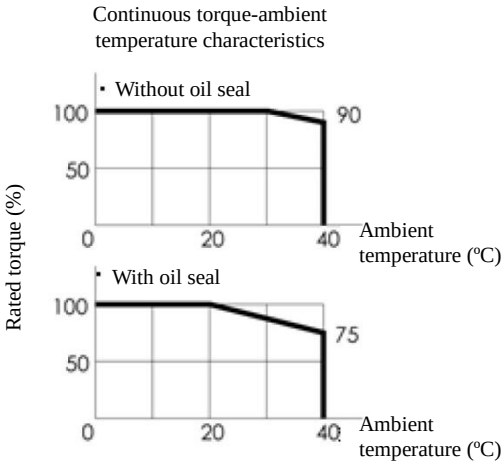
N-T characteristics (400W)



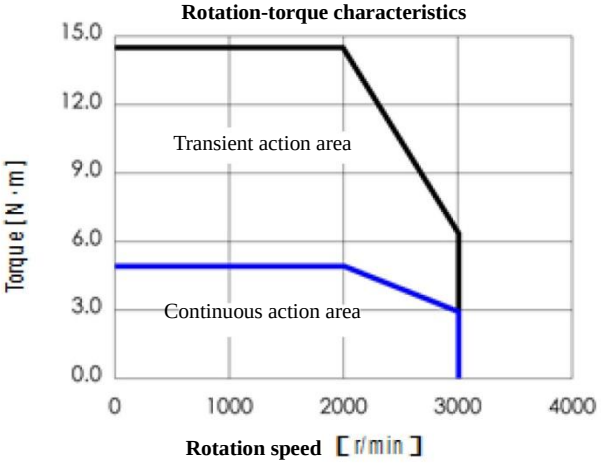
■ LMA751□2□□**LMH751□2□□**



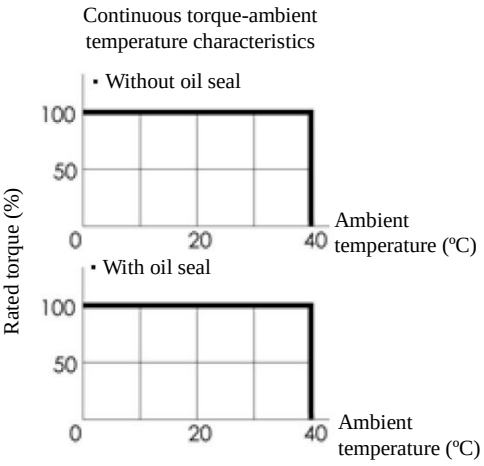
N-T characteristics (750W)



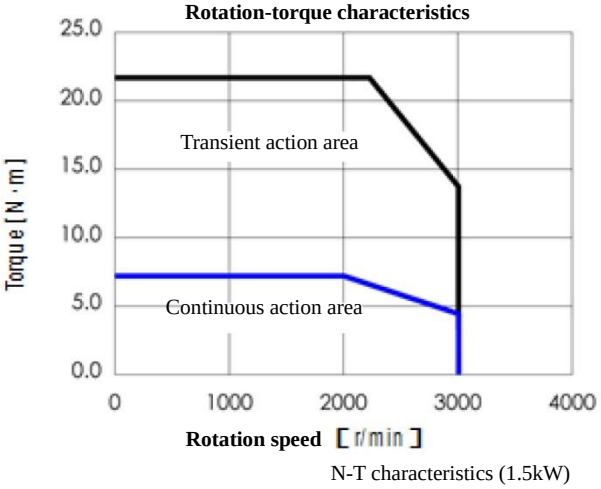
■ LMM102□2□□**LMH102□2□□**



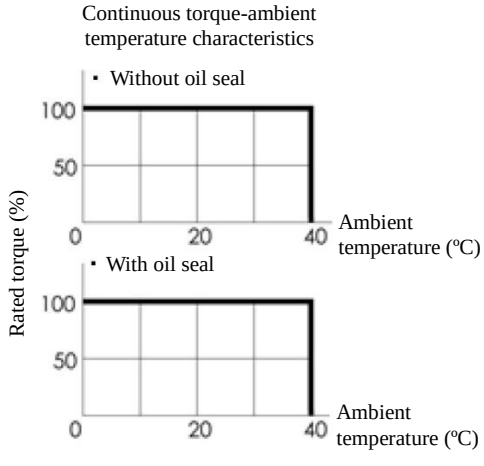
N-T characteristics (1kW)



■ LMM152□2□□**、LMH152□2□□**

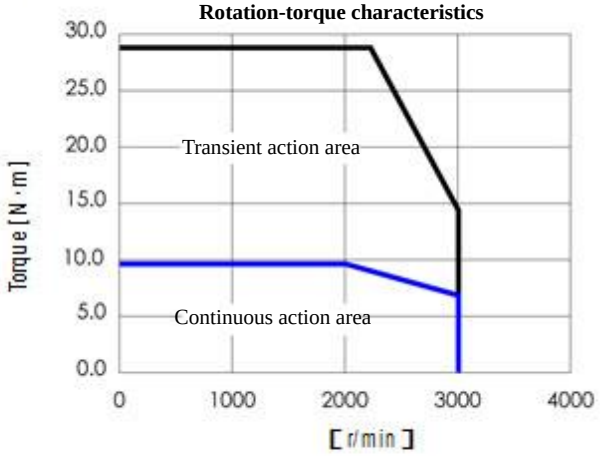


N-T characteristics (1.5kW)



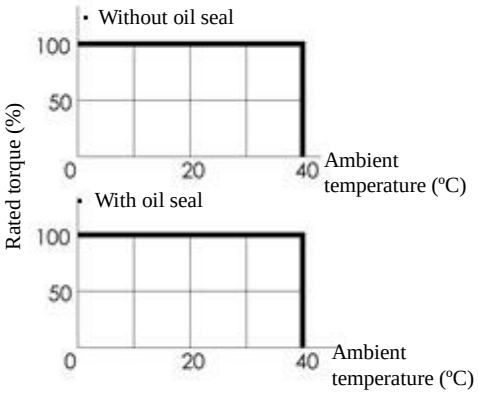
■ LMM202□2□□**

Rotation-torque characteristics



N-T characteristics (2kW)

Continuous torque-ambient temperature characteristics



Chapter 11 Absolute Servo System

11.1. Battery and cable for absolute servo

11.1.1. Battery specification

11.1.2. Battery case specification

11.1.3. Absolute encoder cable

11.1.4. Battery case cable

11.2. Installing

11.2.1. Battery case installing

11.2.2. Battery installing

11.2.3. Battery replacing

11.3. Initialization and operation

11.3.1. System and Initialization

For absolute servo, host controller can access absolute motor position by communication(rs232/485) or DI/DO. ISA-7 absolute system supports two types of position value, pulse and PUU(Pulse User Unit).

In the first time of operation, the servo emerges AL033, because coordinate system is not established, the warning will continue until initialization finished. If the battery exhausted or power interruption, the coordinate may lost, it may lead to AL033 too. In absolute system, maximum and minimum position is

limited. If the motor turns exceed the range -32768 ~ 32767, AL035 will be triggered. In PUU mode, if the position value exceed -2147483648 ~ 2147483647, AL038 will be triggered.

AL035 and AL038 function can closed by PD-57, when absolute system overflow(round number exceed -32768 ~ 32767 or PUU exceed -2147483648 ~ 2147483647), warning will not be triggered. This function is for the system using incremental command.

After coordinate initialization, AL033 will be clear automatically. ISA-7 supports two methods for initialization.

- Initialization by DI, refer to 11.3.4.
- Initialization by parameter, refer to 11.3.5.

After rebooting, host controller can access absolute position value by DI/DO(refer to 11.3.6) or communication(refer to 11.3.7). According to the setting of DP-57, the feedback signal can be choose in PUU value(refer to 11.3.7) or number of turns and pulse number(refer to 11.3.2).

11.3.2. Absolute pulse value

When motor rotating in clockwise, number of turns is defined negative; when in counter-clockwise, number of turns is defined positive. The maximum range of countable turn is -32768 ~ 32767, if number of turns exceed this range AL035 will be triggered and need to re-initialize the coordinate. If PD-57 is set to ignore overflow, the system will continue with overflow warning.

If the motor is rotating in counter-clockwise and number of turns is 32767, next round is -32768, and if continue rotating in counter-clockwise, round number will be -32768, -32767, -32766…

If number of turns is -32768 and the motor continue rotating in clockwise, the value will be 32767, 32766… So on and so forth.

Absolute pulse value = number of turns × 131072 + pulse in single round

(Pulse in single round is 0 ~ 131071)

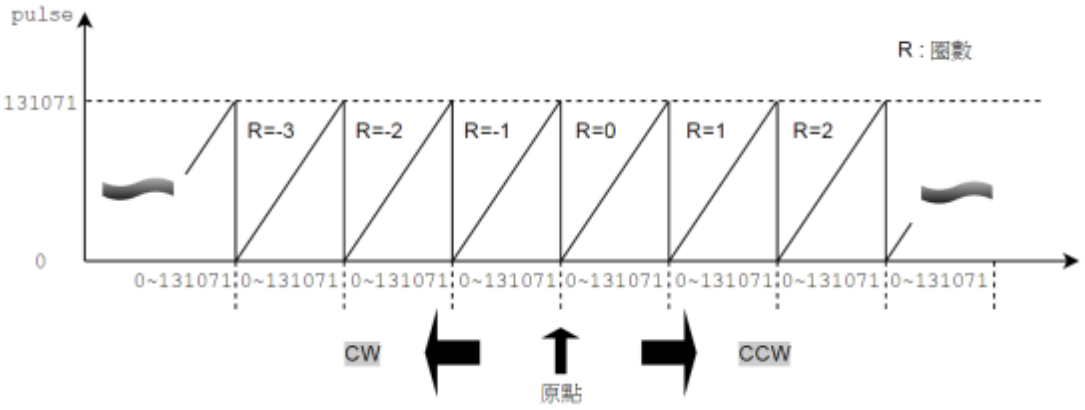
Absolute pulse value can be translate to PUU by following equation

If PA-00 define CCW rotation is positive direction

- PUU = Absolute pulse value $\times \frac{\text{Electronic Gear Ratio Numerator}}{\text{Electronic Gear Ratio Denominator}}$

If PA-00 define CCW rotation is positive direction

- PUU = (-1) × Absolute pulse value $\times \frac{\text{Electronic Gear Ratio Numerator}}{\text{Electronic Gear Ratio Denominator}}$



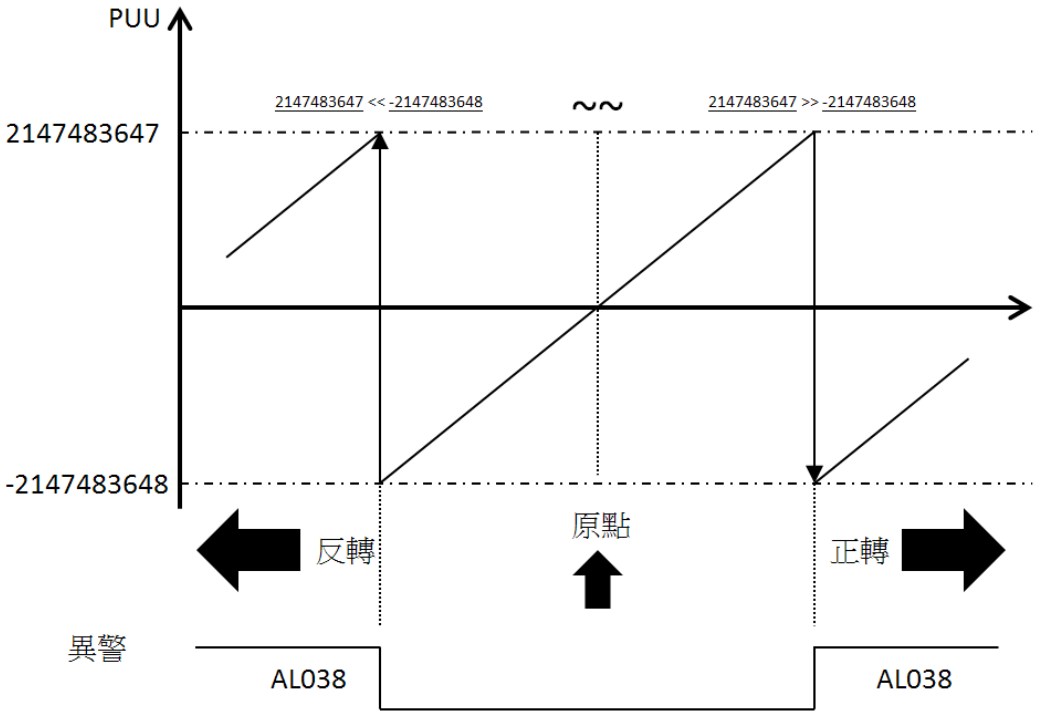
Pi

11.3.3. PUU value

PUU is signed 32 bits absolute position signal. When motor rotating in positive direction, value increases; When motor rotating in negative direction, value decreases. Positive direction is defined in PA-00, not depend on CW or CCW.

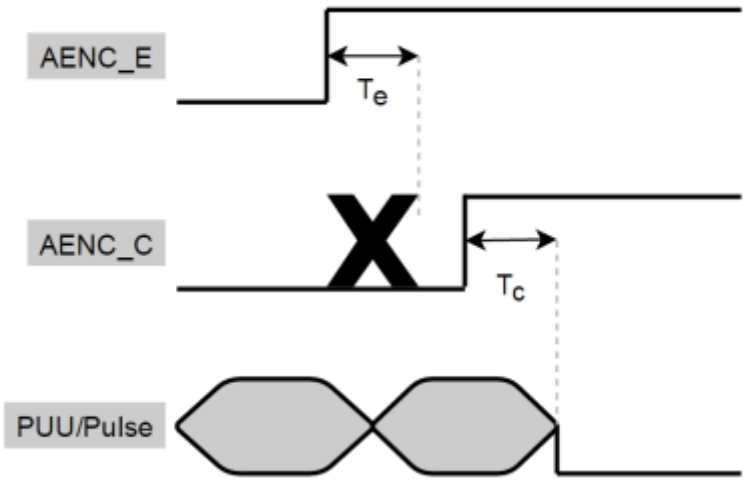
If the motor continues rotating in same direction, and number of turns exceed -32768~ +32767, AL035 will be triggered. If PUU value exceed -2147483648 ~ 2147438647, the position overflow warning AL038 will be triggered, and need to re-initialize to relieve warning. AL035 and AL038 warning can be disable by PD-57. When rotating in positive direction and over the maximum PUU value, the value change from 2147483647 to -2147483648. When rotating in negative direction and over the minimum PUU value, the value change from -2147483648 to 2147483647.

Follow is the example of overflow:
If electronic gear ratio is 10(e.g. PA-09 = 10, PA-10 = 1),



11.3.4. Coordinate initialization by DI/DO

When DI(AENC_E) signal ON, and DI(AENC_C) signal change from OFF to ON, coordinate system will be initialized. After initialization, absolute pulse value and PUU will be reset to zero. Please refer to picture 11.3



	Te(ms)	Tc(ms)
Min(ms)	PC-00+5	PC-00+20
Max(ms)	PC-00+200	N/A

Timing description:

1. When host controller switch AENC_E signal from OFF to ON, need to wait T_e for next step.
2. After T_e, host controller can reset coordinate, switch AENC_C from OFF to ON and hold T_c, absolute pulse number and PUU reset to zero.

11.3.5. Initialization by parameter

Coordinate can also be initialized by setting PD-58=111, setting by keypad or communication are both acceptable. When PD-58 being set as 111, the coordinate will be reset immediately, and other numbers are invalid.

11.3.6. Read absolute position by DI/DO

If PD-57 Bit 0=0, PUU can be accessed by DI/DO. The format is as follow:

Bit79 ~ Bit64	Bit63 ~ Bit32	Bit31 ~ Bit8	Bit7 ~ Bit0
Check Sum	Encoder PUU -2147483648 ~ 2147483647	Encoder number of turns 0	Encoder status

If PD-57 Bit 0=1, Absolute pulse number can be accessed by DI/DO. The format is as follow:

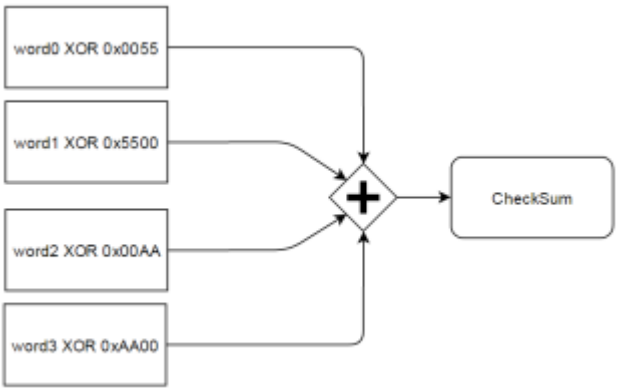
Bit79 ~ Bit64	Bit63 ~ Bit32	Bit31 ~ Bit8	Bit7 ~ Bit0
Check Sum	Pulse number in a round 0 ~ 131071(=131072-1)	Encoder number of turns -32768 ~ 32767	Encoder status

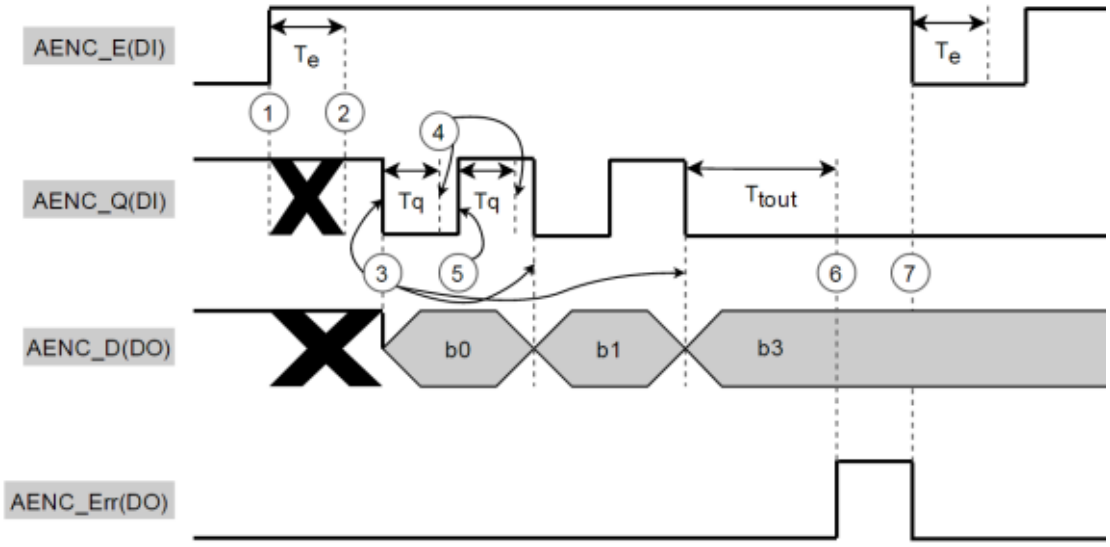
Check sum calculation is as follow:

Note1: word0=bit0~bit15, word1=bit16~bit31, word2=bit32~bit47, word0=bit48~bit63

Note2: Calculation is unsigned.

Note3: The overflow digital will be abandoned, only 16 bits reserved.





	Te(ms)	Tq(ms)	Tout(ms)
Min	PC-00+5	PC-00+2	PC-00+100

Timing description:

① When starting handshake, host controller enable AENC_E signal.

② After delay T_e, data handshake start.

③ When AENC_Q switch from ON to OFF, servo output AENC_D as absolute position data bit(n)(n is 0,1,2,3… 79).

④ After delay T_q, host controller can read data from AENC_D.

⑤ After reading AENC_D, host controller switch AENC_Q to ON again, and delay T_q for next bit data. Repeating step ③ to ⑤ until all the data(bit0 ~ bit79) transmitted.

⑥ If AENC_Q switched from ON to OFF, and hold for T_{OUT}, alarm AENC_ERR occurs and handshaking stopped.

If AENC_ERR occurred, host controller need to reset AENC_E to OFF to clear AENC_ERR, then set to ON to restart data transmission.

11.3.7. Read absolute position by communication

Absolute position can be accessed by following parameters:

PD-61 Absolute encoder position- pulses in a round or PUU.

PD-60 Absolute encoder position- numbers of turns.

By setting PD-57 bit1, the value can be set pulse or PUU.

11.4. Absolute encoder parameter setting

PD-56 (Re-on)	ENCType	Encoder type	Communication address： 0370H 0371H
	Initial value	0	
	Control mode	ALL	
	Unit	N/A	
	Configuration range	0 ~ 1	
	Data size	16bit	
	Data format	DEC	

0 ：Incremental system, absolute encoder can be used as incremental.

1 ：Absolute system, only for absolute encoder. If incremental encoder is connected, AL037 occurs.

PD-57	INFOS	Unit selection	Communication address： 0372H 0373H
	Initial value	0x00	
	Control mode	ALL	
	Unit	N/A	
	Configuration range	0x00 ~ x007	
	Data size	16bit	
	Data format	Hex	

Bit0：DI/DO unit setting 1 ：Pulse; 0 ： PUU 。

Bit1：Communication unit setting 1 ：Pulse; 0 ： PUU 。

Bit2：Overflow warning 1 ：Disable; 0 ：Enable AL038/AL035。

Bit3~Bit15：reserved (0)。

PD-58	ABSRST	Absolute position reset	Communication address： 0374H 0375H
	Initial value	0x00	
	Control mode	ALL	
	Unit	N/A	
	Configuration range	0x000 or 0x111	
	Data size	16bit	
	Data format	Hex	

Absolute coordinate can be reset by setting 111, this function is the same as resetting by DI (AENC_C).

PD-59 (R-only)	AENCSTS	Absolution system status	Communication address： 0376H 0377H
	Initial value	0x00	
	Control mode	ALL	
	Unit	N/A	
	Configuration range	0x00 ~ 0x1F	
	Data size	16bit	
	Data format	Hex	

Bit0 ： 1 Absolute position lost; 0 Normal

Bit1 ： 1 Low battery voltage; 0 Normal

Bit2 ： 1 Number of turns overflow; 0 Normal

Bit3 ： 1 PUU overflow; 0 Normal

Bit4 ： 1 Coordinate is not constructed; 0 Normal

Bit5~Bit15 ：Reserved (0)

PD-60 (R-only)	APREV	Absolute encoder position-numbers of turns	Communication address：0378H 0379H
	Initial value	0	
	Control mode	ALL	
	Unit	Revolution	
	Configuration range	-32768 ~ 32767	
	Data size	32bit	
	Data format	DEC	

If PD-57 Bit1= 1, the absolute coordinate is pulse value, the parameter represents the number of turns.

If PD-57 Bit1= 0, the absolute coordinate is PUU, the parameter is 0.

PD-61 (R-only)	APREV	Absolute encoder position-pulses in a round or PUU	Communication address： 037AH 037BH
	Initial value	0x00	
	Control mode	ALL	
	Unit	Pulse or PUU	
	Configuration range	0 ~ (131072-1) (Pulse) -2147483648 ~ 2147483647 (PUU)	
	Data size	32bit	
	Data format	DEC	

If PD-57 Bit1= 1, the absolute coordinate is pulse value, the parameter represents the pulse in a turn.

If PD-57 Bit1= 0, the absolute coordinate is PUU, the parameter is encoder absolute position PUU.

11.5. Digital input definition(absolute encoder function)

Name	DI code	Input function
AENC_E	0x10	Absolute encoder pin enable, refer to: 11.3.4 Initialization by DI/DO 11.3.6 Read absolute position by DI/DO
AENC_C	0x11	Absolute coordination reset, refer to: 11.3.4 Initialization by DI/DO
AENC_Q	0x12	Handshaking pin of data transmission, refer to: 11.3.6 Read absolute position by DI/DO

11.6. Digital output definition(absolute encoder function)

Name	DI code	Output function
AENC_D	0x0D	Absolute position output, refer to: 11.3.6 Read absolute position by DI/DO
AENC_ERR	0x0E	Absolute system warning, refer to: 11.3.6 Read absolute position by DI/DO

11.7. Absolute System Alarm List

Alarm indication	Alarm name	Description for alarm activation	Indication DO	Switching of servo state
AL030	Encoder over voltage or internal error	Battery over voltage (> 3.8V), or encoder internal error.	ALM	Servo Off
AL033	Position lost	1. Coordinate is not initialized. 2. Absolute encoder position lost, due to low battery or power interrupted.	WRN	Servo On

Alarm indication	Alarm name	Description for alarm activation	Indication DO	Switching of servo state
AL034	Encoder low voltage	Encoder battery low voltage, or wrong voltage range.	WRN	Servo On
AL035	Position overflow	Absolute position over range(-32768~+32767). Can be disable by PD-57 bit2. Need to re-initialization.	WRN	Servo On
AL036	Data I/O transmission error	Timing error, when read position by DI/DO.	WRN	Servo On
AL037	Wrong motor type	Absolute function is not supported by incremental motor.	ALM	Servo Off
AL038	PUU over flow	Position overflow PUU pulse over range -2147483648 ~ 2147483647 Need to re-initialization.	WRN	Servo On

11.7.1. Reason for and handling of the alarm

AL030 : Encoder over voltage or internal error

Reason for abnormality	Check for abnormality	Handling for abnormality
Battery over voltage	1. Check battery. (voltage> 3.8V)	Replacing the battery.
Encoder internal error	1. Check encoder type, absolute or incremental. 2. Check if the motor connected to ground. 3. Check if the encoder cable is too close to power cable. 4. Check if the mesh is used for the filament of the encoder.	1.If the situation is not improved, return the drive the factory for repair 2. Connect the power cable ground(green) with driver. 3. Separate the power and encoder cable. 4. Use the filament with mesh.

AL033 : Absolute position lose

Reason for abnormality	Check for abnormality	Handling for abnormality
Battery low voltage	Check if battery voltage lower than 1.2V.	Replace the battery and re-initialize system. Refer to 11.3.4~11.3.5.
Absolute system is not initialized.	1. Install battery. 2. Check battery and cable.	Replace the battery and re-initialize system. Refer to 11.3.4~11.3.5.

Battery power cable broke.	1. Check encoder cable. 2. Check battery and cable.	Re-connect battery power and re-initialize system. Refer to 11.3.4~11.3.5.

AL034 : Encoder voltage error

Reason for abnormality	Check for abnormality	Handling for abnormality
Battery low voltage	1. Check the voltage by panel, if voltage <3.1 V. 2. Measure the battery voltage, if voltage < 3.1 V.	Replace the battery as servo driver ON. After replacing, AL034 clear automatically.

AL035 : Number of turns overflow

Reason for abnormality	Check for abnormality	Handling for abnormality
Turns overflow	Check the turns within the range -8388608 ~ 8388607	1. Re-initialize system. Refer to 11.3.4~11.3.5. 2. This alarm can be closed by setting PD-57, bit2 as 1.

AL036 : Absolute data I/O transmission error

Reason for abnormality	Check for abnormality	Handling for abnormality
Reading overtime	Check if DO(AENC_D) On -> Off, and Off->On switching time valid with Tq or Tout.	1. Setting DI(AENC_E) to off, and re-start transmission. 2. Refer to 11.3.6.

AL037 : Wrong motor type

Reason for abnormality	Check for abnormality	Handling for abnormality
Incremental encoder is connected with absolute system.	1. Check the motor. 2. Check PD-56.	Replace the motor as absolute encoder, or set PD-56 to 0, switching to incremental system.

AL038 : Position counter overflow

Reason for abnormality	Check for abnormality	Handling for abnormality
Position counter overflow	Check if the position is over range.	This alarm can be closed by setting PD-57, bit3 as 1.

11.8. Display of status value

PD-21	LED display	Description	Unit
19	Battery voltage	Absolute encoder battery voltage.	Volt