M0007846F

SANMOTION

CLOSED LOOP STEPPING SYSTEM

Model No.PB

TYPE M

PB3D003M20*

DC24V/48V

Instruction Manual

SANYO DENKI

Details of revision history

The 6th edition (F)

- p. ii
  - Changed the notation of the rank of safety precautions.

- p. vii
  - Changed 1. Safety precautions (common) and 2. Model number specifications (common) to 1. Priority to Use (common).

- p. i to p.7.2
  - Unification of words

Amplifier->driver	sensor -> encoder	ENC->ENZ
C->Z	channel->phase	SON monitor->SON MON
data->parameter	ROM->Non volatile memory	1PLS->Pulse
SDN->external sensor	don't care->reserve	scan-> continuous rotation
Delay timer-> wait timer	coupler->photo coupler	motor type ->motor model
Amplifier alarm status->Alarm status		Point data write->point store
Program data write->Program store		Initial value(HEX)-> Initial value

reset operation-> initialization operation
Position command resolution->resolution
Depends on the resolution setting-> Pulse (Resolution is set with a soft switch)

- p. 2-5
  - Added comments to 2.3.2 External Installation Wiring Diagram.

- p. 2-6,6-5
  - Changed maker name from AMP to Tyco.

- p. 3-10,3-11,4-19
  - Added encoder output timing.

- p. 3-20
  - Corrected the error
    executing zero-return type 1 to 3-> executing zero-return type 1 to 4

- p. 3-26,3-27
  - Added type number to the description of homing.

- p. 3-42,4-76
  - Removed the description of the communication converter DIP switch.

- p. 4-2
  - Changed the title of 4.2.1. Input / Output Signal on Normal Mode

- p. 4-5
  - Corrected the error.
    Zero-return Type=1-> Zero-return Type=2

- p. 4-11
  - Moved MODE MON description after Bit Out.

Details of revision history

- p. 4-41
  - Corrected the error.
    Correction Coefficient setting unit 1Pulse/LSB->min^{-1}

- p. 2-
  - Corrected the error.
    Soft limit setting unit 360 / Setting resolution(P/R)->Pulse

- p. 4-44 to 4-46
    Clarified the explanation of setting range.

- p. 4-50
  - Corrected the error.
    Rotational direction／Zero-return Type setting unit rotation->-
    Velocity setting unit $1min^{-1}$/ms->min^{-1}

- p. 4-53
  - Corrected the error.
    the holding brake will be engaged-> the holding brake will be opened

- p. 4-67
  - Corrected the error.
    Loop counter RD reply data 2byte->10byte

- p. 4-81
  - Corrected the error.
    one packet in hexadecimal notation-> one packet

- p. 5-2
  - Corrected the error.
    khz->kHz

- p. 5-3,5-6
  - Corrected the error.
    BM284->PBM284 BM423->PBM423 BM604->PBM604

- p. 5-7
  - Corrected the error.
    PBM282->PBM284

- p. 6-2
  - Corrected the error.
    I/O cable (without shield) will be included-> I/O cable (with shield) will be included

- p. 6-6
  - Supported OS changed to Windows Vistta,7..

Details of revision history

- p. 6-6
  - Changed the model number of the communication unit to PBFM-U6.
  - Changed description for PBFM-U6.

- p. 7-1
  - Changed TUV to TUV SUD.

Preface

★Shipping the product

This product in this instruction manual corresponds with the shipping regulations given in the Export Trade Control Ordinance (Table 1, item 16). When these products are exported by customers, it is recommended to fulfill the requirements of export procedure with the relevant authorities, as well as “Information Requirements” and “Objective Requirements” according to the Catch-all regurations.

★Feature outline

This manual outlines the functions, wiring, installation, operations, maintenance, specifications, etc. of the Closed Loop Stepping System Model No.PB.

“Model No. PB Series” was born as a new, intelligent, and easy to handle closed loop stepping system which the technology of design and production in précised compact motor with high performance is in harmony with up-to-date control technology.

This is a system which controls according to the command of upper controller.

- Especially in minor stroke and high-hitrate operation, this has higher response of acceleration/deceleration than the servo system in the same size.
- The moving command unit may be selected from 500, 1000, 2000, 4000, 5000 and 10000.
- Since this has its unique stopping holding torque, slight vibration is not caused as usual servos has.
- Has interface selecting function of pulse train (Type P) and RS-485+P10 (Type R).
- When selecting Type R, operation command stored beforehand or program can be started by PIO (parallel I/O). As this can be controlled by general PIO, hardware cost can be cut down.
- Push operation, teaching, modulo function, and various returning-to-origin are equipped. Addition command is also enabled.

★Precautions related to this Instruction Manual

- In order to fully understand the functions of Closed Loop Stepping System Model No.PB, please read this instruction manual thoroughly before use.
- Please contact the dealre or sales representative if there are defects such as nonconsecutive pages, missing pages or if the manual is lost or damaged.
- Carefully and completely follow the safety instructions outlined in this manual. Please note that safety is not guaranteed for usage methods other than those specified in this manual or usage methods intended for the original product.
- The contents of this manual may be modified without prior notice, as revisions or additions are made in the usage method of this product. Modifications are performed per the revisions of this manual.
- Permission is granted to reproduce or omit part of the attached figures (as abstracts) for use.
- Although the manufacturer has taken all possible measures to ensure the veracity of the contents of this manual, if you should notice any error or ommission, please notify the dealer or sales office of the finding.

★Related instructions manual

Refer to M0007856 for the specification of the PC interface software.

Safety Precautions (common)

■ Introduction

The PB system is designed for use in general manufacturing equipment.

Please observe the following instructions:

・Read this User Manual carefully before any installation or assembly, to ensure proper use.

・Do not perform any retrofitting or modification of the product.

・Consult with a sales representative or a qualified technician regarding installation and maintenance.

・Special considerations, such as redundant services or an emergency generator are required when operating, maintaining and/or controlling devices in the following applications. Contact our office if:

① The device is used in medical instruments used for life support.

② The device is used in trains or elevators, the failure of which could cause bodily injury.

③ The device is used in computer systems of social or public importance.

④ The device is used in any equipment related to human safety or public infrastructure.

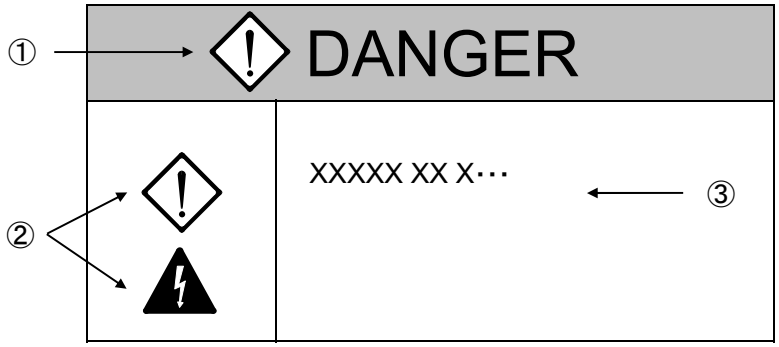
・ Please contact our office if the device is to be used in an environment where vibration is present, such as in-vehicle or transport applications.

Before installing, operating, performing maintenance or inspecting this device, read this entire manual carefully to ensure proper use. Use this device only after learning about the device, its safety information and the precautions related to its use.

After reading this User Manual, keep it in a place where it is always visible to the user.

Safety Precautions (common)

■ Explanation about Indications
This chapter explains the following precautions. Be sure of conventions of indications.



① : Safety precaution item ranking
② : Display
③ : Details of each visual cue

■ There are four precaution levels.

Danger	Denotes immediate hazards which WILL probably cause severe bodily injury or death as a result of incorrect operation.
Caution	Denotes hazards which COULD cause bodily injury and product or property damage as a result of incorrect operation. *Even those hazards denoted by this symbol could lead to a serious accident.
Prohibited	Indicates actions that must be carried out (mandatory actions).
Mandatory	Indicates actions that must not be allowed to occur prohibited actions.

■ There are eight graphic symbols.

Type	Sample symbols
Danger symbols	Danger / Injury, Electric shock
Caution symbols	Caution, Fire, Burn
Prohibition symbols	Prohibited, Disassembly prohibited
Mandatory symbol	Mandatory

Safety Precautions (common)

⚠ Danger

『 General 』

1. Do not use the system in an explosive atmosphere.
   Doing otherwise may result in injury or fire.

2. Do not touch the working driver under any circumstances.
   Touching inside the driver may result in electric shock.

3. Do not conduct work while power is being supplied. Be sure to wait at least one minute after turning off the power supply before doing an electrical wiring or inspection work.
   Touching inside the driver may result in electric shock.

4. Only properly rained staff should take charge of transportation, installation, piping, wiring, operation, manipulation, maintenance, and inspection work. Doing otherwise may result in electric shock, injury, or fire.

『 Wiring 』

5. To avoid getting an electric shock, be sure to ground the heat dissipation fin and motor frame.

6. Avoid damaging cables, applying excessive stress to them, putting heavy objects on them, or nipping them.
   Doing otherwise may result in electric shock.

7. Make connections with the power cable according to the Operation's Manual.
   Failure to do so may result in electric shock or fire.

『 Operation 』

8. Before starting the motor, take necessary safety measures such as covering the rotary parts. Never touch a rotating part of the motor.
   Doing so may result in injury.

9. Never approach or touch terminals when the power is on.
   Removing the terminal base cover may result in electric shock or damage.

10. Do not unplug the connector when the power is on. Doing so may result in electric shock or damage.

Safety Precautions (common)

⚠ Caution

『 General 』

1. Before starting installation, operation, maintenance, or inspection, be sure to read the Operator's Manual carefully and observe the instructions in it. Failure to observe the instructions may result in electric shock, injury, or fire.

2. Do not use the system out of the specifications of the driver. Doing so may result in electric shock, injury, or damage.

3. Do not use a damaged driver. Doing so may result in injury or fire.

4. Use an driver and a motor in the specified combination. Doing so may result in a fire or failure.

5. Note that the driver/motor and peripheral units will become hot enough to cause a burn.

『 Unpacking 』

6. Open the box only after checking its top and bottom to avoid injury.

7. Check if the product is the ordered one. Installing an incorrect wrong product may result in injury or damage.

8. To avoid damage, do not measure the insulation resistance or the pressure resistance. Please contact us if testing is necessary.

9. Wiring should follow electric equipment technical standards and indoor wiring regulations. An electrical short or fire could otherwise result.

10. Wiring connections must be secure to avoid motor interruption or injury.

11. Avoid applying static electricity to the encoder terminals on the motor. Doing so may result in functional failures.

『 Installation 』

12. Do not stand on the device or place heavy objects on top of it. Doing so may result in injury.

13. Do not obstruct the air intake and exhaust vents, and keep them free of debris and foreign matter. Fire could otherwise result.

14. Make sure the mounting orientation is correct. Damage could otherwise result.

15. Consult the User Manual regarding the required distance between the driver, the control panel interior, and other devices. Damage to the device could otherwise result.

16. Never apply a strong shock to the system. Doing so may result in damage.

17. Secure the device against dropping or turning over during installation.

18. Never expose the device to water, corrosive or flammable gases, or any flammable materials. Doing so may result in fire or failure.

19. Install the device on a metal or other non-flammable structure. Otherwise, fire accident may occur.

Safety Precautions (common)

⚠ Caution

『 Operation 』

20. The motor is not equipped with protection means. Install an earth leakage breaker, an excessive temperature rise prevention means and an emergency stop unit as necessary protection measures.
    Failure to do so may result in an injury or a fire accident.
21. Do not touch the radiation fin of the driver or the motor while the power is on or for a while after the power has been turned off, as these parts generate excessive heat. Burn could otherwise result.
22. In the event of any abnormality, stop operating the system immediately.
    Failure to do so may result in electric shock, injury, or fire.
23. Never make an extreme adjustment change that will cause the system operation to become unstable. Doing so may result in injury.
24. At trial operation, fix the motor and check the operation separate from the mechanical system, then install the system on the machine. Failure to do so may result in an injury.
25. The holding brake is not a stop unit to secure the safety of the machine. Install a stop unit to secure the safety on the machine side.
    Failure to do so may result in an injury.
26. When an alarm occurs, remove the cause of the alarm and secure safety. After that, reset the alarm, then result the system operation. Failure to follow this procedure may result in an injury.
27. After a recovery from an instantaneous power interruption, the operation may be restarted suddenly. Do not approach the machine. (Design the machine so that safety for personnel may be secured even if the system operation is restarted.)
    Approaching the machine when it restarts may result in an injury.
28. Make sure the supply voltage is within the specified range. If the supply voltage is out of specification, functional failures may occur.

『 Maintenance 』

29. The driver frame becomes very hot. Take care to avoid burns when doing maintenance and inspection.
30. It is recommended to replace the electrolytic capacitors in the driver after 5 years, if used at an average temperature of 40°C year around.
31. When repair is required, please contact us.
    Disassembly of the system by the user may render it inoperable.

『 Transportation 』

32. Make sure the device does not fall or overturn during transportation.
33. Do not hold the unit by the cables or the motor shaft.
    Doing so may result in injury or equipment failure.

『 Scrapping 』

34. When discarding the driver and the motor, dispose of it as a general industrial waste.

Safety Precautions (common)

Prohibited

『 Storage 』

1. Do not store the device where it could be exposed to rain, water, toxic gases or other liquids. Damage to the device could otherwise result.

『 Operation 』

2. The built-in brake is intended to secure the motor; do not use it for regular control. Damage to the brake could otherwise result.

『 Maintenance 』

3. Do not disassembly or repair the system. Doing so may result in fire or electric shock.

『 General 』

4. Do not remove the nameplate cover attached to the device.

Mandatory

『 Storage 』

1. Store the system in a place which is not exposed to direct sunlight and in the determined temperature/humidity range (–20°C to +65°C, 90% RH or less without condensation).

2. When the system is to be stored for a long time (more than 3 years as a reference period), consult us.
   The capacity of the electrolytic capacitors decreases during long-term storage, and could cause damage to the device.

『 Operation 』

3. Install an external emergency stop circuit that can stop the device and cut off the power instantaneously. Install an external protective circuit to the driver to cut off the power from the main circuit in the case of an alarm. Motor interruption, injury, burnout, fire and secondary damage could otherwise result.

4. Operate within the specified temperature and humidity range {Driver: Temperature 0°C to 55°C, Humidity below 90% RH (non-condensing); Motor: Temperature 0°C to 40°C, Humidity below 90% RH (non-condensing)}

『 Transportation 』

5. Follow the directions written on the outside box. Excess stacking could result in collapse.

Contents

Contents

1

Prior to Use (Common)

1. Prior to Use (Common)

1.1 Verifying Package Contents

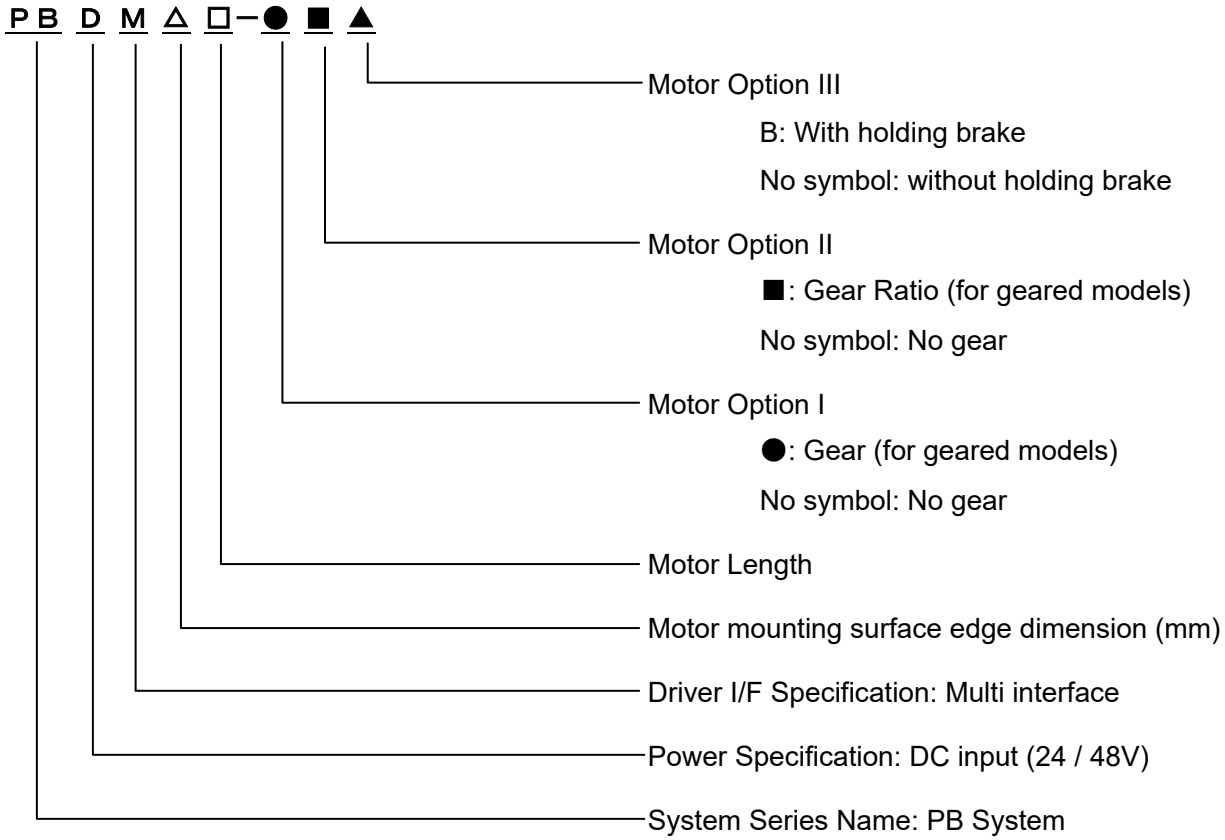
Verify the following items when the product arrives. If any discrepancies are noticed, contact our office.

- Verify that the model number is the same as ordered (model number is located on the main name plate).
- Verify that there are no defects, such as damage to the exterior of the device.

1.2 Model number Specifications

1.2.1 Set Number Specification

The PB system has a set number based on the combination of driver and motor.



1.2.2 Set Product Packing List

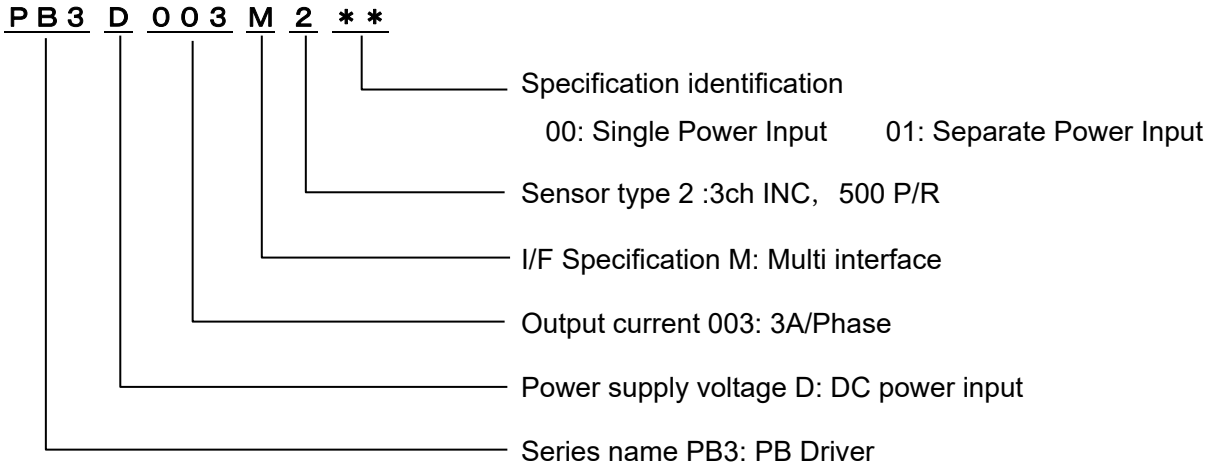
Product	Quality	Model Number	Drawing Reference (page number)
Driver (Note)	1	PB3D003M200-S*	5-9
Motor	1	PBM△△□F**20	5-10
Power cable	1	PBC6P0010A (1m)	6-3
I/O cable (with shield)	1	PBC5S0010C (1m)	6-3

Note1) Set product driver has the combination motor model number set in advance. To change the combination motor, transmitting is necessary to reset the new motor model number. As the need to reset will arise, please purchase the communication unit (refer to chapter 6: Options). For the set up method details, please refer to PC I/F Specifications M0007856 and Trial Operation (Sections 3.7 and 4.7)

Note2) It is impossible to connect holding brake to driver when using it power-supply-voltage 48V in single power supply .When using motor power supply voltage by 48V and using a holding brake, choose driver of the separate power supply type, and supply 24V to a control power supply (= holding brake power supply).

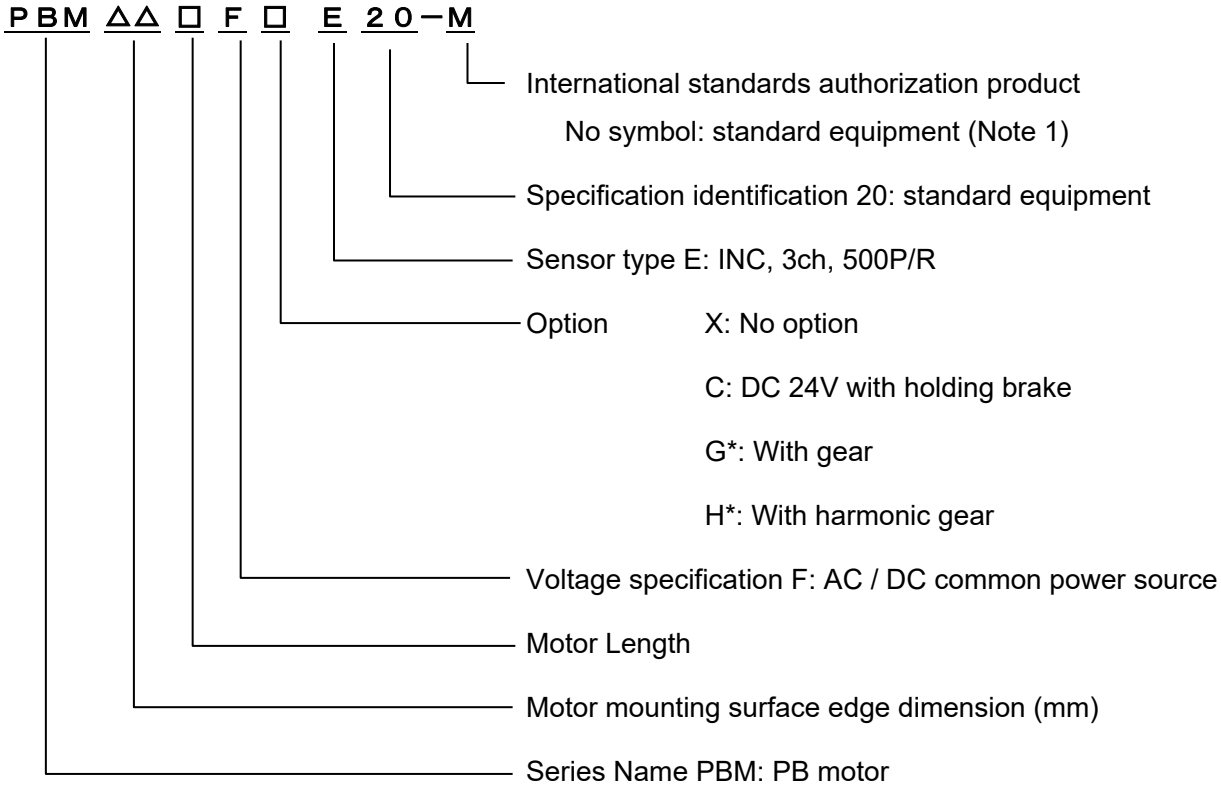
1. Prior to Use (Common)

1.2.3 Driver Number



＊The model number of an driver purchased as set product ends with the suffix －＊＊＊.

1.2.4 Motor Number Specifications



Note 1) International standards authorized products do not include 28mm Sq. motors.

1. Prior to Use (Common)

1.3 Motor Model Combination

1.3.1 Set model number combination table

SET model number (without motor option)	PBDM282	PBDM284	PBDM423
Motor mounting square size	28mm Sq.	28mm Sq.	42mm Sq.
Driver model number	PB3D003M200	PB3D003M200-S1	PB3D003M200-S2
Motor model number	PBM282FXE20	PBM282FXE20	PBM423FXE20

SET model number (without motor option)	PBDM603	PBDM604
Motor mounting square size	60mm Sq.	60mm Sq.
Driver model number	PB3D003M200-S3	PB3D003M200-S4
Motor model number	PBM603FXE20	PBM604FXE20

1.3.2 Motor option compatibility table

Items	Option compatibility ○：Optional setting ×： No optional setting				
Motor model number	PBM282F□E20	PBM284F□E20	PBM423F□E20	PBM603F□E20	PBM604F□E20
Gear box	○(GA～GL)	×	○(GA～GJ)	○(GA～GJ)	×
Harmonic gear	○(HL,HM)	×	○(HJ,HL,HM)	○(HL,HM)	×
Holding brake	○(C)	○(C)	○(C)	○(C)	○(C)

Note. Please refer to Section 5.3 for motor option details.

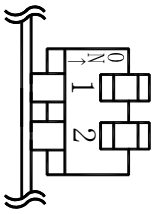
1. Prior to Use (Common)

1.4 Switch settings

1.4.1 Dip-switches (DSW)

The amp interface specification is selected by setting the dip-switch 1 on the top surface.

The setting of dip-switch 1 is confirmed when the power is turned on and alteration during operation will have no effect.



DSW No.	Initial setting	Function	ON	OFF
1	ON	Interface type	Type R (RS-485)	Type P (Pulse)
2	ON	Communication termination resistance setting	With termination	Without termination

Note. Select Type R for termination resistance and when daisy-chaining multiple nodes. Set only the last node to ON and set the rest of the nodes to OFF. (When selecting Type P, please set to ON.)

1.4.2 Rotary switch (RSW)

DSW1 Setting condition	Rotary switch function
When set to ON (Type R)	Node address setting (setting range: 0 to 15) ・Sets the node address when connecting multiple AMP.
When set to OFF (Type P)	Selects velocity loop Gain (setting range: 0 to 15)

It is set to 0 initially.

No Text on This Page.

2

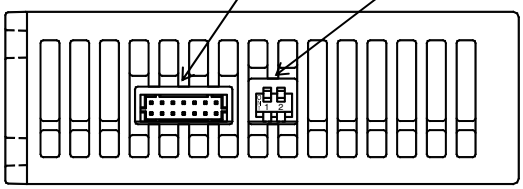
Installation, Wiring (Common)

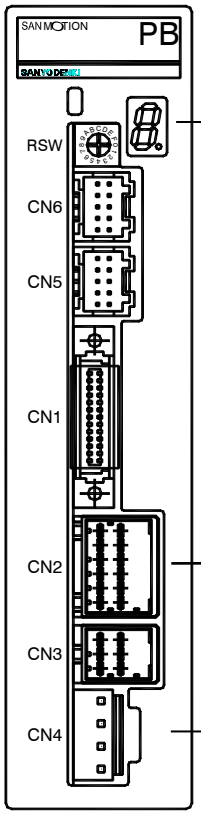
2. Installation, Wiring (Common)

2.1 Part Names and Functions

CN7: Adjustment connector reserved for use by manufacturer (Not intended for customer use).

DSW: For Interface selection and setting termination resistance. Please refer to Section 1.4.1 for settings.





Rotary switch
【Type R】Address setting
【Type P】 Gain setting

Driver condition display
7Seg LED（P4-9）

CN5,6: Communication connector
* CN5 and 6 are equivalent circuits

CN1: Control I / O signal connector

CN2: Encoder connector

CN3: Motor connector

CN4: Power connector

Driver front panel

2. Installation, Wiring (Common)

2.2 Installation

2.2.1 Driver Installation Precautions

- The driver must be installed in an enclosure. Carefully consider the size of the case, the cooling method, and the location so that the ambient temperature around the driver does not exceed 55°C.For longevity and high reliability, it is recommended to keep the temperature around the driver below 40°C.
- If there is a vibration source nearby, use a shock absorber between the driver and the installation base to prevent the vibration from directly affecting the driver.
- Long-term use in the presence of corrosive gas may cause contact failure on the connectors and on connecting parts. Never use the device where it may be subjected to corrosive gas.
- Do not use the device where explosive or combustible gas is present, it can cause fire or an explosion.
- Do not use the device where dust or oil mist is present. If dust or oil mist attaches to and accumulates on the device, it can cause insulation deterioration or leakage between the conductive parts, and damage the driver.
- A large noise source may cause inductive noise to enter the input signals or the power circuit, and can cause a malfunction. If there is a possibility of noise, insert a noise filter, inspect the line wiring and take appropriate noise prevention measures.

2.2.2 Driver Installation Method

1) Installation dimensions

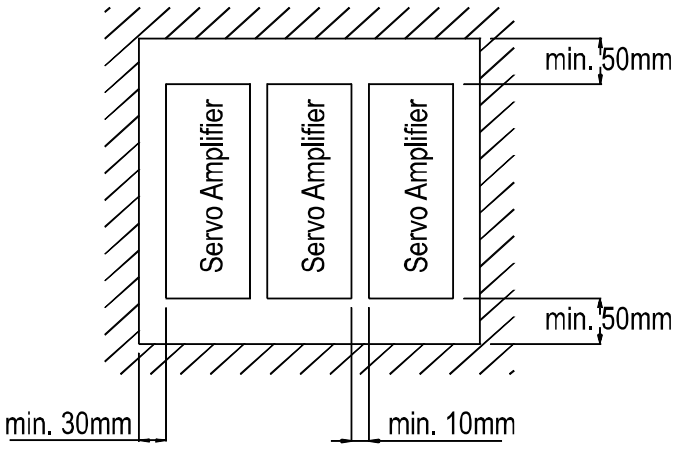
   The driver must be installed using four M4 screws on its rear panel. Refer to the driver outline drawing (Section 5.5.1) for the installation dimensions.

2) Installation direction

   The driver uses natural convection cooling. The installation direction must be vertical. Do not install the unit upside down.

3) Installing multiple drivers in a row

   Leave at least 50mm of space above and below the drivers to ensure unobstructed airflow from the radiator. If heat gets trapped above the driver, use a fan to create airflow. Leave at least 10mm of space between the drivers.

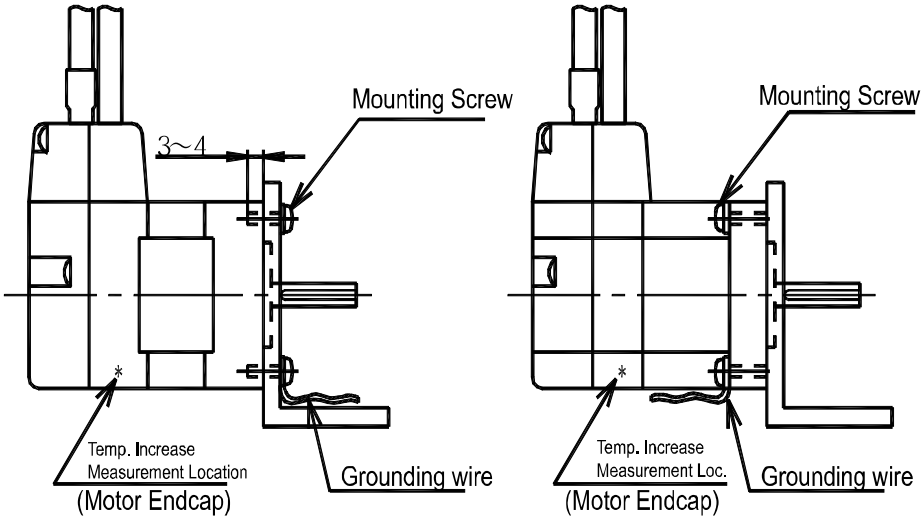


2. Installation, Wiring (Common)

2.2.3 Motor Installation Precautions

- If the motor is enclosed in an enclosure, consider its size, the use of a heat sink and ensure the temperature inside the case is between 0 and 40°C.
- Consider a radiation method to ensure that the surface temperature of the motor (end cap surface temperature) does not exceed 85°C.
- When installing a pulley or a gear to the motor, avoid methods such as press fitting that applies force in the thrust direction. Ensure accurate shaft centering when integrating the rotating shaft of the motor with the target machinery. Incorrect centering can damage the shaft and the bearings.
- Avoid installation in places where the unit may be subjected to water, cutting fluid, rain or conductive particles such as dust and iron fillings.
- Never install the unit where it could be subjected to corrosive (acid, alkali, etc.), flammable, explosive liquids or fumes.
- Avoid using the motor on moving parts. Since the wires and cables used for this device are electric connection wires, disconnection could occur. Contact the manufacturer for assistance for use on moving parts.
- If a belt-drive is used, verify that the gear reduction value of the belt tension does not exceed the thrust load tolerance. Refer to 5.2.1.)

2.2.4 Motor Installation Method



PBM28*,PBM423 PBM60*, PBM565

Use the tap hole or mounting hole on the installation surface and the mounting rabbet for installation. Refer to the outline drawing (Section 5.5.2) for the tap hole pitch measurements and the mounting rabbet diameter.

Mounting Square Size	Motor Model	Screws to Use	Recommended Tightening Torque
28mm Sq.	PBM28*	M2.6 x2	0.4N·m
42mm Sq.	PBM423	M3 x4	0.6N·m
60mm Sq.	PBM60*	M4 x4	1.4N·m
56mm Sq.	PBM60*	M4 x4	1.4N·m

2. Installation, Wiring (Common)

2.3 Wiring Specifications

2.3.1 Wiring Precautions

1) Grounding

- Driver grounding : Ground the driver using the CN4-4 pin(earth). Use single point grounding with at least AWG18（0.75 mm^2）wire.
- Motor frame grounding: If the motor is grounded through the frame, then Cf x dv/dt current flows from the PMW power part of the servo driver through the motor floating capacitance (Cf). To prevent the effects of this current, use single point grounding for the motor frame and the servo driver ground. Use at least AWG18 (0.75mm^2) wire for grounding the motor.
- Grounding the wiring: If the motor is wired to a metal conduit or metal box, the metal must be grounded. Use single-point grounding.

2) Noise protection

Follow the instructions below to prevent malfunctions due to noise.

- The noise filter, driver and the host controller should be placed at a minimum distance.
- Apply a surge absorber circuit to coils such as relays, electromagnetic contacts, induction motors and brake solenoids, etc.
- Do not enclose the power lines, the motor lines, and the signal lines in the same wire conduit; they are not intended to be bundled together.
- If there are large noise sources such as electric welding machines or electric discharge machines nearby, apply a noise filter for the power line and the input circuit.
- Do not bundle the primary and secondary wiring of the noise filter together.

3) Wiring

Perform wiring only when power is cut off. Carefully verify that the wiring is correct, as faulty wiring can cause damage to the device.

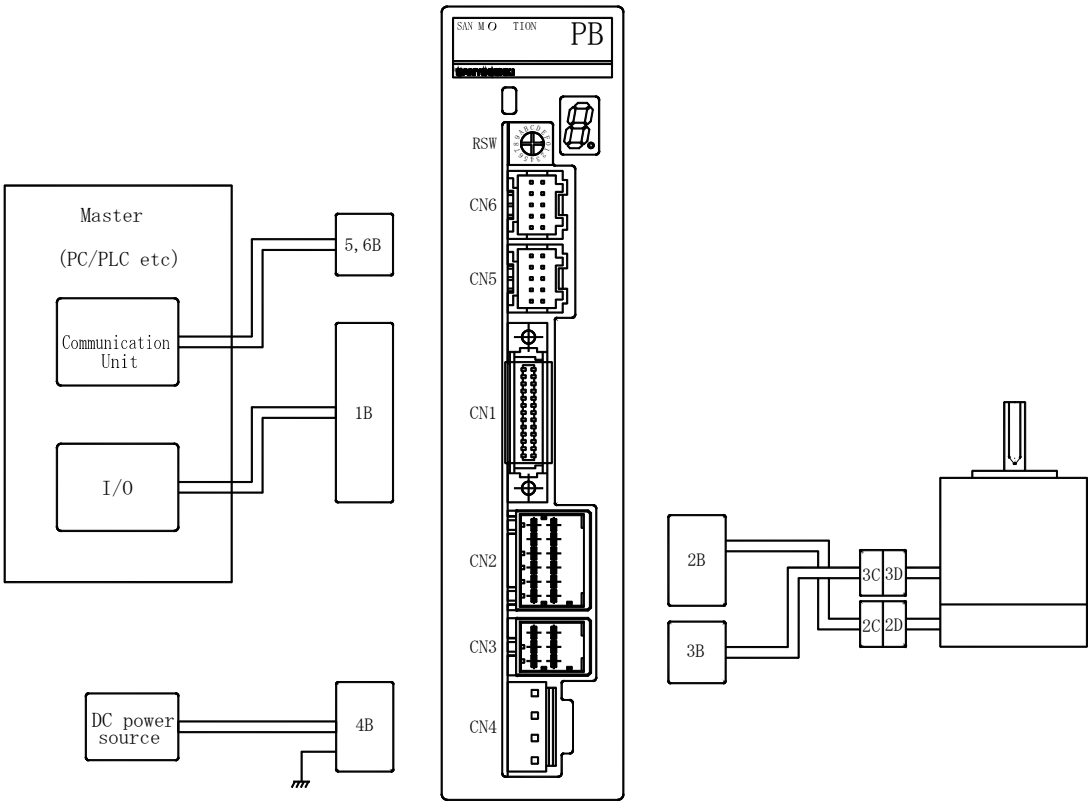
4) Cables for wiring

Use the specified sizes and lengths for all cables.

5) Emergency stop circuit

Be sure to install an external emergency stop circuit that can stop the device and cut off the power instantaneously.

2.3.2 External Installation Wiring Diagram



* The symbols shown in the figure indicate the connector types shown in the connector model/symbol on the next page.
* When inserting a contact such as a relay on the secondary side of the power supply, be sure to insert a surge absorbing element.
* Optional accessories for cables and connector sets are available. See Chapter 6 for details.

2. Installation, Wiring (Common)

2.3.3 Connector Model Numbers and Appropriate Electrical Wires

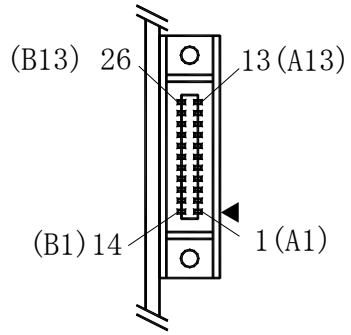
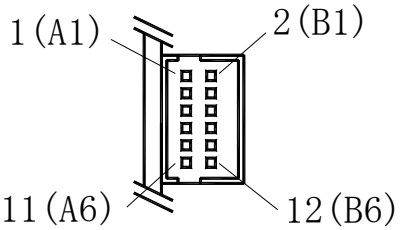
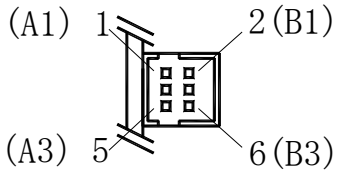
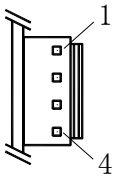
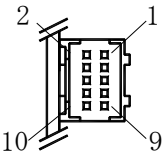
Symbols in the table indicate the symbols shown in Section 3.3.2 External installation wiring diagram.

Application	Symbol	Name	Model	Appropriate Electric Wire	Maximum Extension Length	Manufacturer
I/O	CN1	Plug	8830E-026-170LD	AWG28 (7/0.127)	2m	KEL
	1B	Receptacle	8822E-026-171D			
Encoder	CN2	Tab header	1376020-1	AWG24, 26 Twisted pair wire with external shield	20m	Tyco
	2B	Receptacle housing	1-1318118-6			
	2D	Receptacle contact	1318108-1 (bulk) 1318106-1 (chain)			
	2C	Tab housing	1-1318115-6			
		Tab contact	1318112-1 (bulk) 1318110-1 (chain)			
Motor power	CN3	Tab header	1376136-1	AWG18～22 Discrete wire	20m	Tyco
	3B	Receptacle housing	1-1318119-3			
	3D	Receptacle contact	1318107-1 (bulk) 1318105-1 (chain)			
	3C	Tab housing	1-1318115-3			
		Tab contact	1318111-1 (bulk) 1318109-1 (chain)			
Electric power	CN4	Tab header	B4PS-VH	AWG16～18 Discrete wire	2m	JST
	4B	Receptacle housing	VHR-4N			
		Receptacle contact	SVH-21T-P1.1			
Communication	CN5,6	Post with base	S10B-PADSS-1GW	AWG28～24 Twisted pair wire with external shield	100m	JST
	5,6B	Housing	PADP-10V-1-S			
		Contact	SPH-002T-P0.5L			

Note. Optional cables and connector sets are available. Refer to Options (Section 6) for more information.

2. Installation, Wiring (Common)

2.3.4 Connector pin assignment (driver side)

CN No.	Pin No／Signal name						Pin layout (Driver front panel view)
CN1	No	Type R	Type P	No	Type R	Type P	
I/O signal	1	-	CCW Pulse+	14	-COM	-COM	
	2	-	CCW Pulse-	15	ALM	ALM	
	3	-	CW Pulse+	16	OUT1	HEND	
	4	-	CW Pulse-	17	OUT2	SON MON	
	5	IN1	Positive direction limit	18	OUT3	STOP MON	
	6	IN2	Negative direction limit	19	OUT4	Reserve	
	7	IN3	IN1	20	OUT5	Reserve	
	8	IN4	IN2	21	OUT6	In-Position	
	9	IN5	IN3	22	OUT7	ENZ/ phase origin	
	10	IN6	IN4	23	OUT8	ENA	
	11	IN7	IN5	24	OUT9	ENB	
	12	IN8	STOP	25	+COM	+COM	
	13	ALMCLR	ALMCLR	26	-COM	-COM	
CN2	1	A		7	VCC (+5V)		
Encoder	2	$\overline{A}$		8	GND		
	3	B		9	-		
	4	$\overline{B}$		10	-		
	5	Z		11	FG		
	6	$\overline{Z}$		12	N.C		
CN3	1	A					
Motor	2	$\overline{A}$					
power	3	B					
	4	$\overline{B}$					
	5	BRK+（for motors with holding brake）					
	6	BRK-（for motors with holding brake）					
CN4	1	DC24 / 48V					
Electric	2	GND					
power	3	(DC24V: In Case of PB3D003M201)					
	4	FG					
CN5, 6	1	A		6	-		
Communicati	2	B		7	MODE (Type R limited)		
on	3	-		8	Brake (Type R limited)		
	4	-		9	GND		
	5	GND		10	FG		

* The information contained within brackets under Pin No indicates connector maker pin no labeling.

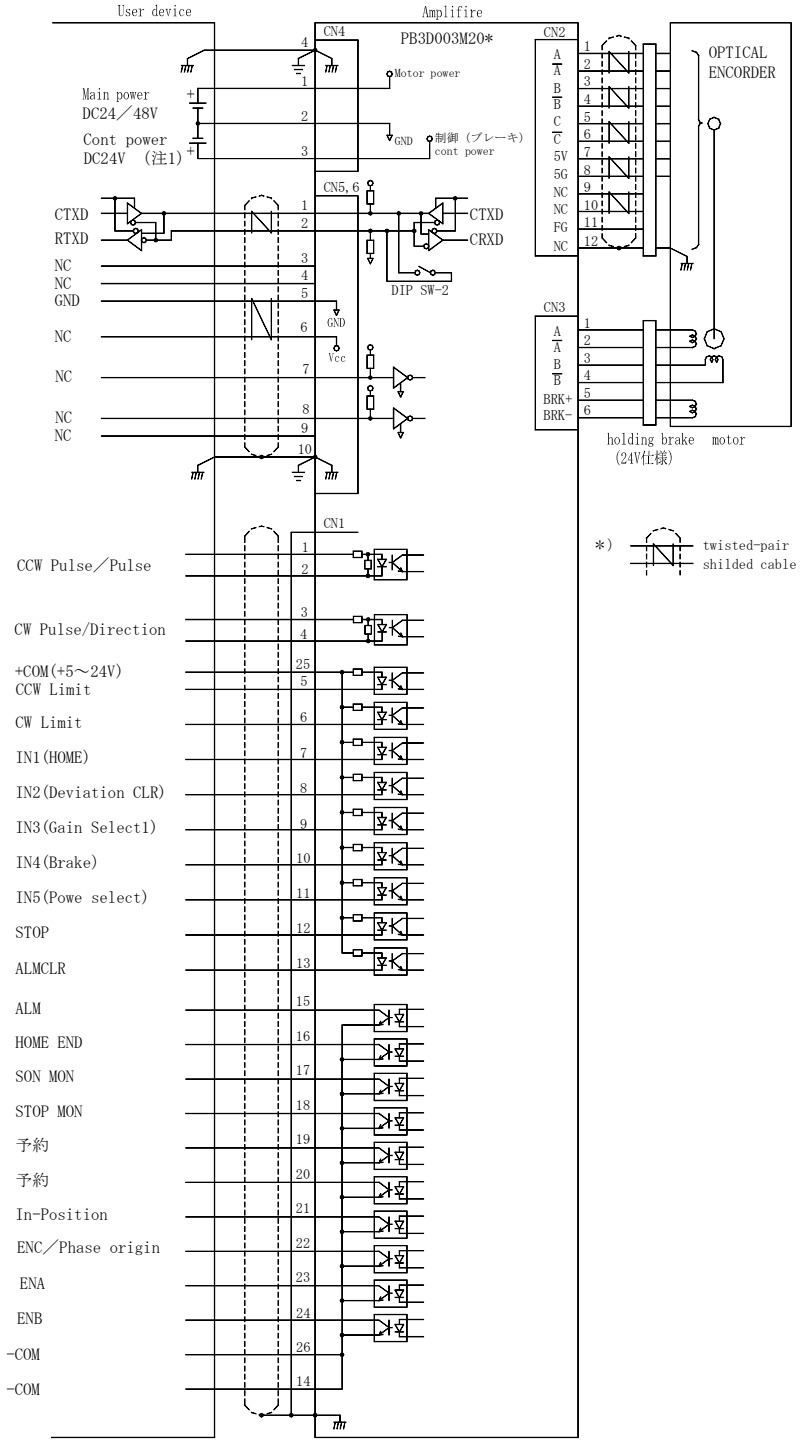
* It is impossible to connect holding brake to driver when using it power-supply-voltage 48V in single power supply. When using motor power supply voltage by 48V and using a holding brake, choose driver of the separate power supply type, and supply 24V to a control power supply (= holding brake power supply).

3

Type P (Pulse Train Input)

3. Type P (Pulse Train Input)

3.1 External Wiring Diagram (Dip-switch 1=OFF)



* IN1 to IN5 are functions selected by Command 16h. Information contained within brackets indicates initial setting conditions.

* Hard Limit, STOP input, Call out and ALM output signal logic are selected by Command 16h.

* Encoder signal outputs ENA, ENB and ENZ/phase origin are not emitted if +COM (5to 24V) is not provided.

Note1) It is impossible to connect holding brake to driver when using it power-supply-voltage 48V in single power supply. When using motor power supply voltage by 48V and using a holding brake, choose driver of the separate power supply type, and supply 24V to a control power supply (= holding brake power supply).

3. Type P (Pulse Train Input)

3.2 Input / Output Signal Functions

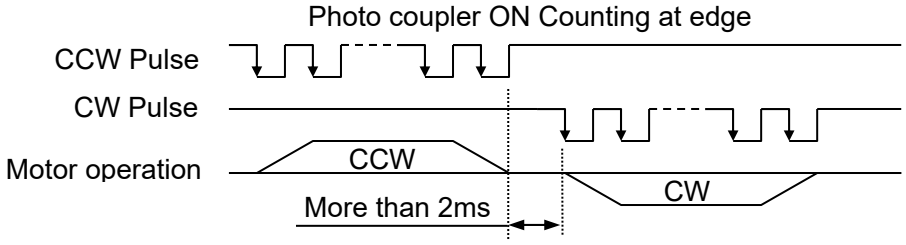
3.2.1 CN1 Input signal functions

1) Input with Fixed Functions

Pin No.	Name	Logic selection	Function outline
1,2	CCW Pulse / Pulse	Fixed	Pulse input method is selected by setting Command 11h-DAT2. DAT2=0 (2 input method): CCW direction input. DAT2=1 (1 input method): Pulse input.
3,4	CW Pulse / Direction	Fixed	Pulse input method is selected by setting Command 11h-DAT2. DAT2=0 (2 input method): CW direction input. DAT2=1 (1 input method): Direction switch signal. The following are the rotational directions when 1 input method is selected. * Photo coupler ON: CW direction * Photo coupler OFF: CCW direction

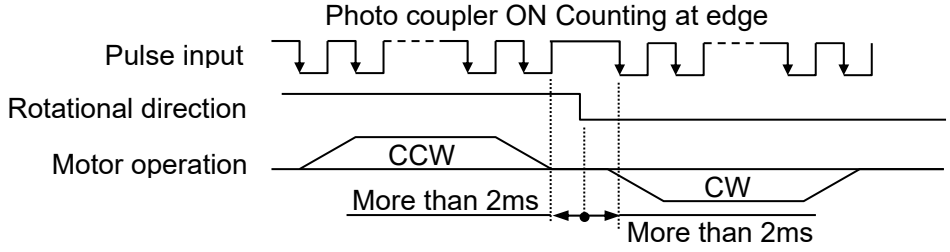
* Rotational directions are when looking from the output shaft side of the motor.

<2 input method>



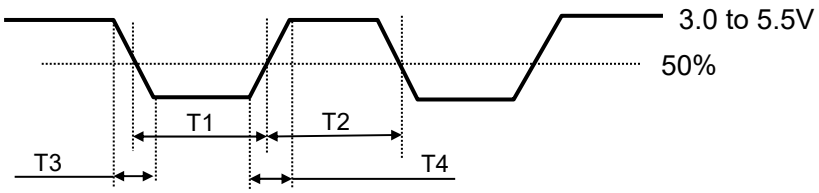
* Do not input CW/CCW Pulse simultaneously.
* Photo coupler must be OFF when Pulse input has stopped.

<1 input method>



* Rotational direction must be switched when Pulse input is OFF.
* Photo coupler must be OFF when Pulse input has stopped.

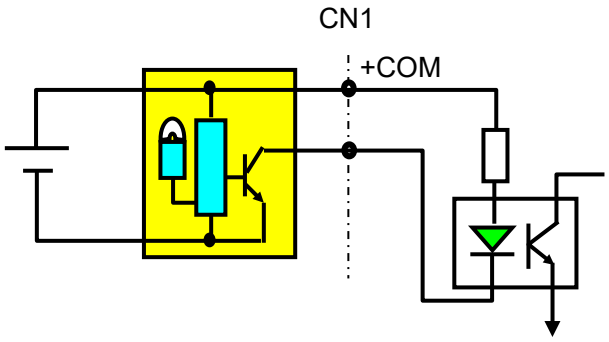
<Pulse waveform> Maximum input frequency: 250kPPS



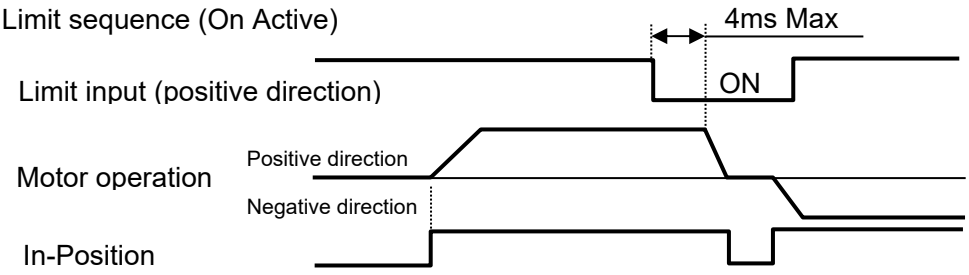
Below T3, T4:1μs T1=T2 (50%Duty)

* When the resolution is high, operation at maximum rotation speed is not possible due to limits of maximum response frequency.

3. Type P (Pulse Train Input)

Pin No	Name	Logic selection	Function outline
5,6	Hard Limit	Selectable (CMD16h) Initial value: ON=Limit	Functions as Hard Limit input or as SND signal (external zero-signal) when zero-returning. (Hard Limit function) Decelerates and stops when Limit is detected. During Limit, shift commands for the Limit direction are disabled. Shift commands for the opposite limit direction are accepted. During Limit, command pulse for Limit direction is disregarded. * Gains soft Limit function by Command 32h and 33h. * Limit function does not operate during zero-return. Limit input is enabled after completion of zero-return. (Zero-return SDN signal function) Functions as SDN signal when the zero-return Type, set by Command 45h, is 1 or 2. * In the case of rotational operation or for use only as SDN signal function, set command 11h-DAT3-Bit7=1 and mask the Limit function. * For SDN signal function details, please refer to the zero-return timing chart. <External sensor is useable only for NPN Type> 

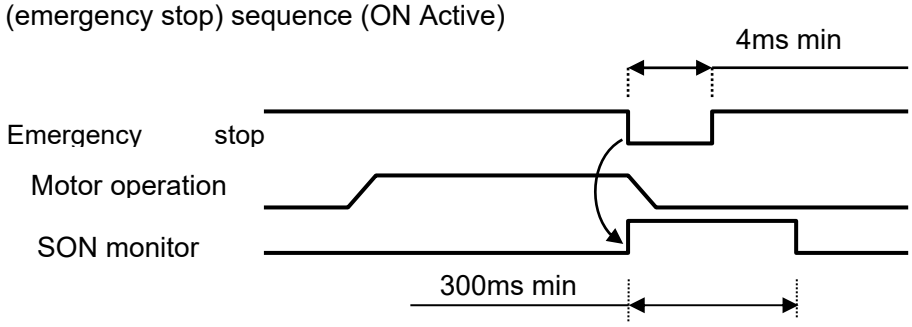
・Hard Limit sequence (On Active)



3. Type P (Pulse Train Input)

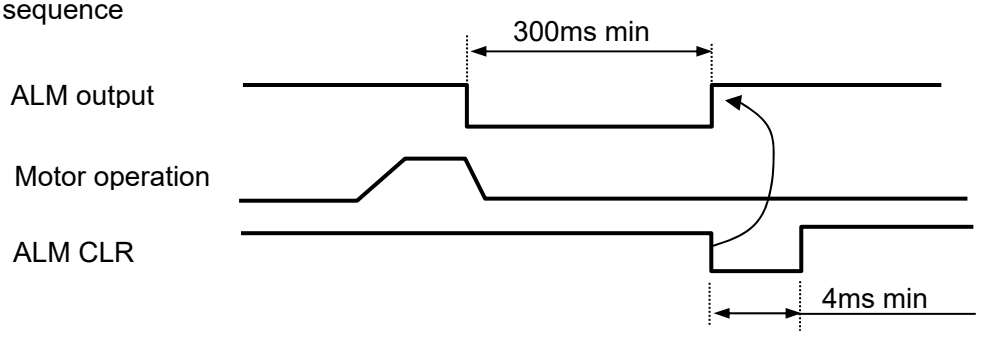
Pin No	Name	Logic selection	Function outline
12	STOP	Selectable (CMD16h) Initial value: ON=STOP	This is the emergency stop input signal. If input during drive, rapid deceleration to stop in servo OFF state will result. After stoppage, follow the command 20h setting value for the motor torque. Cancellation will enter SON state only after the STOP input is OFF, the motor has stopped and 300ms have elapsed.

・STOP (emergency stop) sequence (ON Active)



Pin No	Name	Logic selection	Function outline
13	ALM CLR	Fixed On edge cancel	Alarm clear signal when ALM is activating. Power must be reset to clear non-cancelable alarms. * The ALM is cleared after the motor has completely stopped and 300ms have elapsed. * Please refer to Section 3.4 for ALM details.

・Alarm sequence



3. Type P (Pulse Train Input)

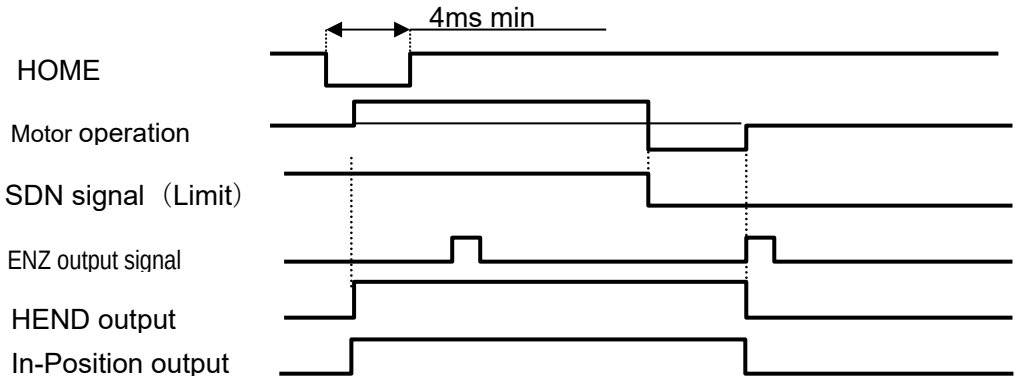
2) Selection Function

The following functions can only be used after function allocation using command 16h.

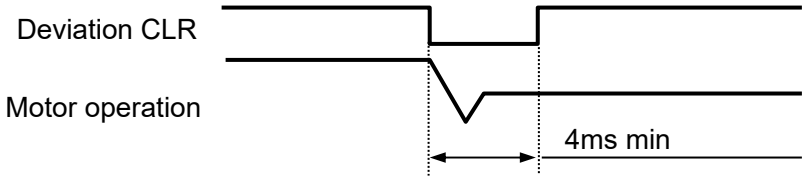
There are 5 assigned input ports: CN1-7 to 11Pin.

Name	Logic selection	Function outline
HOME	Fixed On edge start	Execute the zero-return operation commands preset by command 56h. HEND signal is emitted when zero-return is successfully completed. * In-Position signal is emitted when zero-return is completed. * During zero-return operation, command pulse is invalid.

Zero-return example: Type=1 (SDN signal + Z phase)



Name	Logic selection	Function outline
Deviation CLR	Fixed ON= Deviation CLR	Execute deviation clear (internal collected pulse clear) with coupler On. The target position will be the actual time and point of input. Deceleration rate will be at maximum. * During deviation clear input, command pulse is invalid. * If input during drive, will return the distance of decelerated movement.

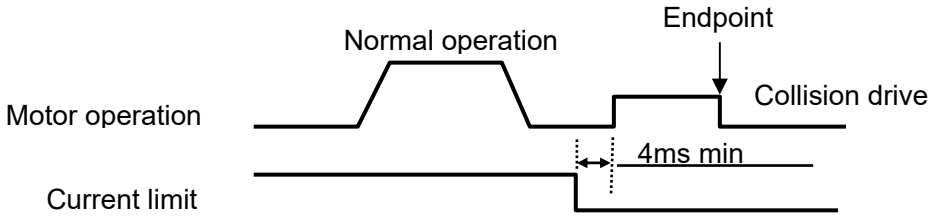


Name	Logic selection	Function outline
Gain selection 1,2	Fixed ON=1 OFF=0	Employ this when changing the gain setting using operations profile. Set the maximum 4 pattern gain, pre-set by command 2Fh, with 2 Bit binaries. * Do not change during operation, otherwise operation will become unstable.

3. Type P (Pulse Train Input)

Name	Logic selection	Function outline
Current limit	Fixed ON=Maximum current during motion 2 OFF=Maximum current during motion 1	Use this to switch the current limit during operation and to carry out current limit (torque limit) for collision drive etc. Set the current limit to the value pre-set by command 20h. * Note that motion torque changes with current limit. * Overload error is not detected when maximum current is selected during motion 2.

Current limit usage example



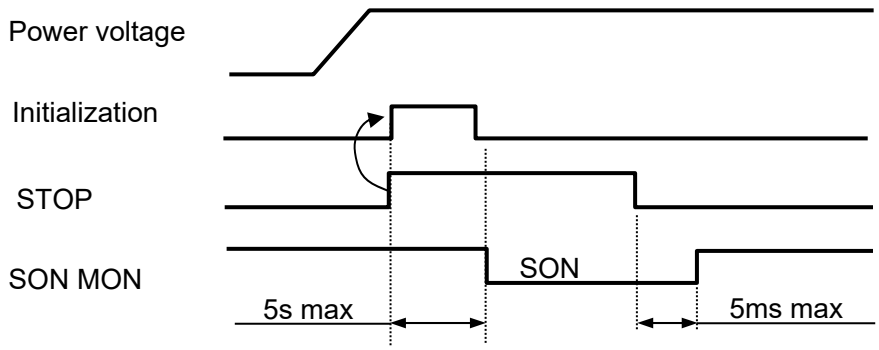
Name	Logic selection	Function outline
Brake	Fixed ON=Release	Release the holding brake forcibly when servo is OFF. Has no effect when servo is ON. * To avoid danger caused by falling loads etc, ensure safety before releasing brake. * Please refer to chapter 5.3 for holding brake particulars.

3.2.2 CN1 Output Signal Function

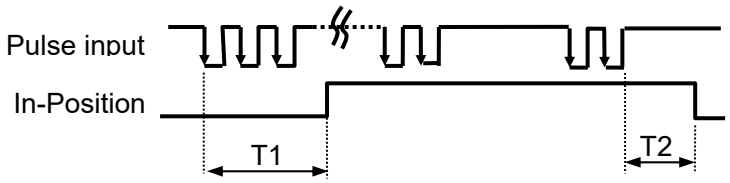
Note) When the power is turned on, the status of each output Port is uncertain until the CPU is in motion. Observe output Ports for more than 5 seconds after the power supply voltage has settled.

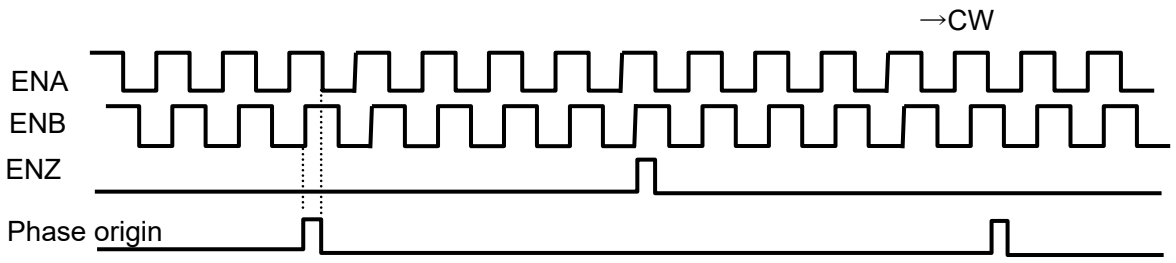
Name	Logic selection	Function outline
ALM	Selectable (CMD16h) Initial value ON=ALM	Issued when alarm is activated * Detects low voltage error when power failure occurs with the servo ON. Switch off the power with the servo OFF if the alarm becomes a problem.
HEND	Fixed ON=Completed	Zero-return completion output signal. It is OFF after the power is switched on and turns ON when zero-return has successfully completed. It switches OFF when the next zero-return commences and switches on again when zero-return has successfully completed.
SON MON	Fixed ON=SON OFF=SOFF	Monitors the condition of the servo. Will not receive move command when in the servo OFF state. * It switches to servo ON state automatically after the power supply voltage of the PB system has settled and initialization has successfully completed. If STOP status is Active, initialization will not be executed.
STOP MON	Fixed	Monitors input status of the STOP signal.

・Power supply sequence



3. Type P (Pulse Train Input)

Name	Logic selection	Function outline
In-Position	Fixed ON=In-Position	 <T1: Out Position condition> The time taken for the position deviation to outstrip the In-Position width set value after recognition of the command pulse. <T2: In-Position condition> The condition when the command pulse is failed to be recognized for longer than 2ms; and when position deviation is less than the In-Position width set value. * The In-Position signal will not be emitted when the command pulse is less than the In-Position width set value or because of hardware response delay time. * It is in the Out-Position when servo is in the OFF state.
ENA/B	Fixed	Encoder signal output (A/B-phase). * ENA and ENB will not be emitted when +COM (pin no 25) is not provided.
Z-phase phase origin	Fixed	Emits encoder Z-phase signal (1P/R) or phase origin (50P/R) signal. * Will not be emitted at velocities over 200min^{-1}. * Z-phase output or phase origin output is selected by setting command 16h. * ENZ will not be emitted when +COM (pin no 25) is not provided.

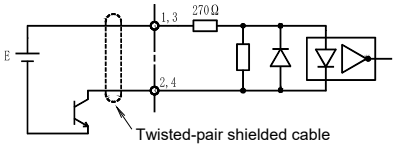
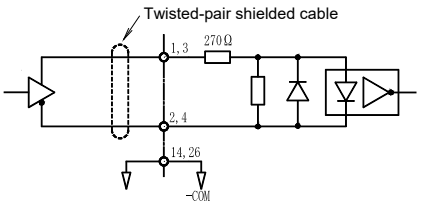
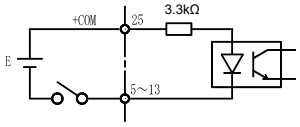
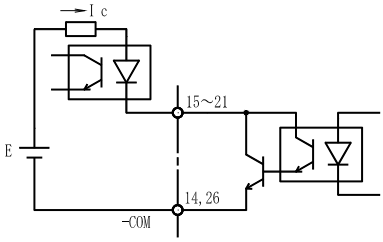
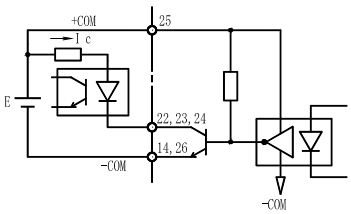


* Encoder signal output is emitted when ENA/ENB is 500P/R, ENZ is 1P/R and phase origin signal is 50P/R. ENZ and phase origin signals will not be emitted at velocities over 200min^{-1}.

3. Type P (Pulse Train Input)

3.2.3 Input / Output Circuit

DC characteristics

Circuit Type	Circuit formation (connection example)	Standard value
Pulse input	1) Connection with open collector output  2) Connection with line driver 	E=DC3.5V to 5.5V * When voltage is greater than 5V, insert resistance in series to satisfy; (input voltage -1V) / (270 + R) ≒ 10mA
Generic input		E=DC5 to 24V±10%
Generic output		E=DC5 to 24V±10% Ic=30mA max
Encoder output		E=DC5 to 24V±10% Ic=2 to 12mA max at 5V Ic=8 to 30mA max at 24 * Output will not occur when power is not supplied to +COM (pin 25). * ENZ / phase origin signal outputs will not be emitted at velocities over 200min^{-1}.

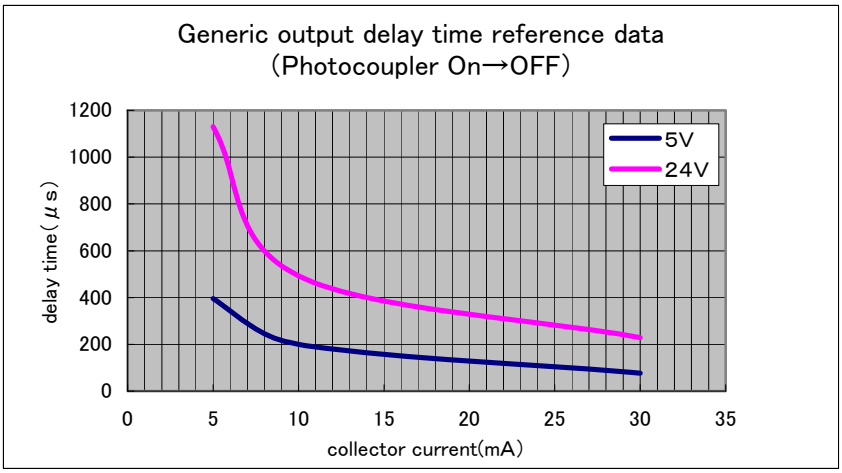
3. Type P (Pulse Train Input)

AC characteristics

The response time of each input / output signal depends on applied voltage and output current conditions. Also, as input / output interface uses a photo coupler, delay time changes due to dispersion of parts and secular changes. Expecting there to be delay time in the higher controller side, secure the margin when deciding the control timing. About 1ms delay time occurs for each input / output signal because of sampling cycles (500μs).

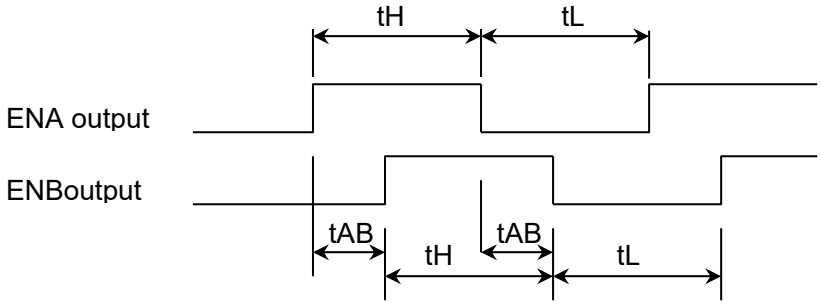
Hardware response time reference values

Signal name	Measurement conditions	ON→OFF delay time	OFF→ON delay time	Note
Pulse input	5V	Response frequency: 250kHz		-
Generic input	5V input 24V input	250μs NOM 250μs NOM	30μs NOM 10μs NOM	-
Generic output	5V input 10mA 24V input 10mA	250μs NOM 500μs NOM	20μs NOM 20μs NOM	Refer to the following chart
Encoder output	5V input 10mA 24V input 10mA	1μs NOM 2μs NOM	1μs NOM 0.5μs NOM	-



Encoder output timing

ENA/ENB has a delay due to the characteristics of the driver output circuit. Since the delay time differs depending on whether it is ON or OFF, the output pulse width and phase difference of the driver output signal will be smaller than the original encoder signal.



Input voltage	5V	24V
Minimum output pulse width tH,tL	6μs	6μs
Minimum phase difference of ENA and ENB tAB	1μs	1μs

3. Type P (Pulse Train Input)

3.3 Commands

3.3.1 Command Lists

1) System Commands

Command	Command name	Function
1	Initialization	Initializes the CPU to the state of power on.
2	Parameter Clear	Clears the parameters and resets them to their factory settings.
3	Parameter Save	Saves the edited parameters to non-volatile memory.
4	Parameter Load	Loads the data from non-volatile memory to RAM.
6	Alarm history Clear	Clears the alarm history.

2) Setting Commands

Command	Command name	Function
17(11h)	Software switch	Sets the motor model, resolution and pulse input method etc.
19(13h)	Initialization movement direction	Sets the initialization movement direction.
20(14h)	Alarm detection condition	Enables or disables the overload stop, position deviation error detection threshold, alarm detection functions and soft Limit functions.
22(16h)	I/O port function	Sets the signal logic and function of I/O port.
31(1Fh)	User memory	Provides memory data area for the user.
35(23h)	Zero-return maximum travel distance	Sets the maximum travel distance during zero-return.

3) Adjustment Commands

Command	Command name	Function
32(20h)	Power Limit	Sets the current limit value at each driver state. It is used for Torque limit or Power Down.
33(21h)	S-shape filter	Sets the time constants of S-shape filter on pulse train command.
47(2Fh)	Gain table	Able to set 4 patterns of position and velocity loop gain. It is used when changing gain by motion.
34(22h)	LPF	Sets the low-pass filter of velocity feedback.
225(E1h)	P/PI control switch	Sets switching velocity of P/PI control.
226(E2h)	Control switch condition	Sets the control method switch frequency.

4) User Setting Commands

Command	Command name	Function
48(30h)	In-Position width	Sets In-Position width.
50(32h)	Positive direction soft limit	Sets positive direction soft limit value.
51(33h)	Negative direction soft limit	Sets negative direction soft limit value.

5) Operation Command

Command	Command name	Function
69(45h)	Zero-return Profile	Sets zero-return Profile.

6) State Control Commands

Command	Command name	Function
53(35h)	Brake control	Specifies holding brake engage / release when the servo is OFF.
74(4Ah)	Alarm clear	Specifies the clear of cancelable alarms.
76(4Ch)	STOP command	Commands a STOP. Moves to servo OFF state.
77(4Dh)	STOP clear	Clears the STOP status. Moves to servo ON state.

7) Read Commands

Command	Command name	Function
128(80h)	Parameter	Reads the set value of a desired command.
131(83h)	Driver status	Reads the driver status and the I/O port status.
132(84h)	Absolute position counter	Reads the absolute position counter.
133(85h)	Velocity monitor	Reads the actual velocity.
134(86h)	Alarm history	Reads the alarm history.
135(87h)	Communication error history	Reads the communication error history.
137(89h)	Software revision	Reads the software revision.
139(8Bh)	Power voltage monitor	Reads the power voltage and internal voltage of driver.
144(90h)	Driver type	When selecting R Type: 4-0 When selecting P Type: 5-0
146(92h)	Switch monitor	Monitors the rotary switch setting status.
148(94h)	Pulse train command counter	Reads the pulse train command counter.

3. Type P (Pulse Train Input)

Memory Access

The following diagram shows the conditions for accessing the Non-volatile memory (EEPROM).

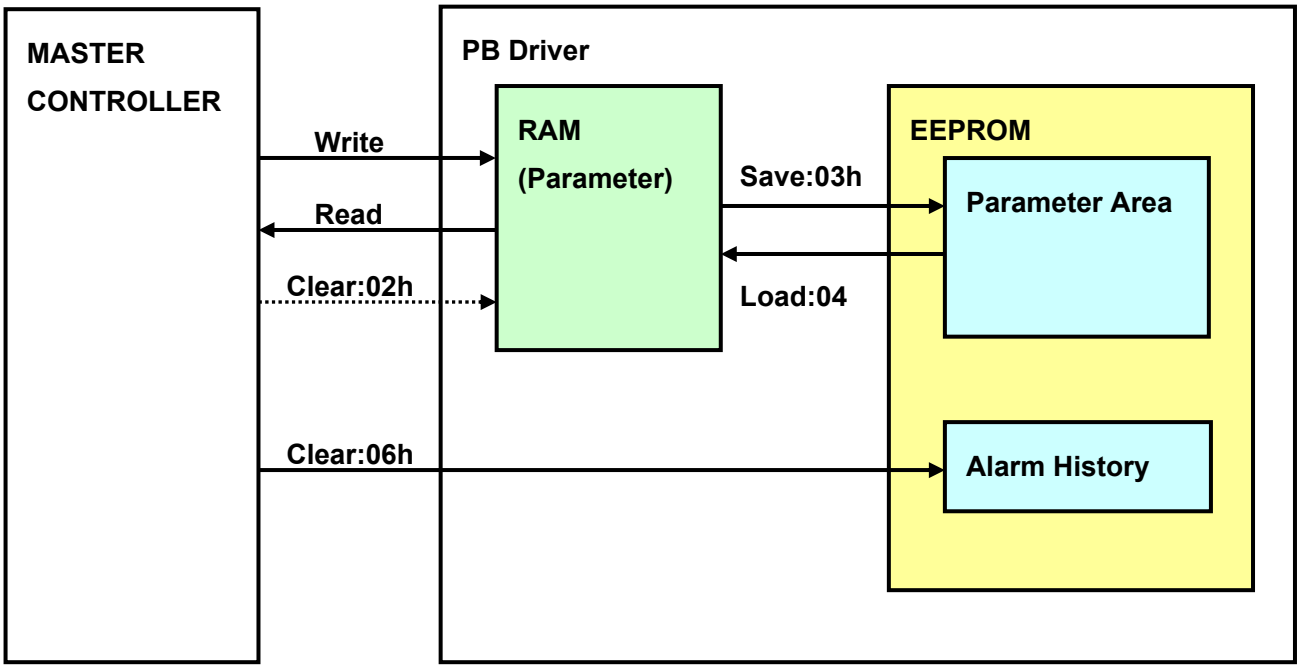


Figure 1 Memory Access

Memory Access Time

After the driver receives the commands listed below, a period of time is needed for processing the EEPROM access. After issuing these commands, do not interrupt the power or issue commands during the specified processing time, since an EEPROM error or data loss can result.

Command code	Maximum processing time
01h: Initialization	6s
03h: Parameter Save	20ms
04h: Parameter Load	20ms
06h: Alarm history Clear	20ms

* Do not issue commands during EEPROM access, as this will result in a command error.
* Data writing to the EEPROM should be performed only after the motor has stopped.

3.3.2 Commands

1) System commands

Command Code: 01h Data Length: 0 byte

Initialization
Initializes the driver status to the power-up status. For parameter, the value of Non-volatile memory is loaded to RAM.

Command Code: 02h Data Length: 0 byte

Parameter Clear
Resets RAM parameters to their factory settings.

Command Code: 03h Data Length: 0 byte

Parameter Save
Saves RAM parameters to the Non-volatile memory. * If a reset is performed without saving the parameters, the RAM values will be lost.

Command Code: 04h Data Length: 0 byte

Parameter Load
Loads the parameters saved to Non-volatile memory to RAM. * The same operation is performed at power-up and when using the initialization command. * RAM data is used when controlling.

Command Code: 06h Data Length: 0 byte

Alarm History Clear
Clears the alarm history.

3. Type P (Pulse Train Input)

2) Setting Commands

Command Code: 17 (11h) Data Length: 4 bytes

Software Switch				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Motor type	Cf. list shown below	0	-
Data2	Pulse input method	0, 1	0 (2 input)	0=2 input method, 1=1 input method
Data3	Resolution, Limit allowed	Cf. list shown below	0	-
Data4	No function allocation			-

Sets the motor type, the resolution and the pulse input method.

Data No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Data1	*	*	*	*	*	Motor model number: ①		
Data2	Pulse input method selection							
Data3	Limit	*	*	*	*	Resolution: ②		
Data4	No function allocation							

Data1 Motor type: ①

Bit2	Bit1	Bit0	Motor model
0	0	0	PBM282
0	0	1	PBM284
0	1	0	PBM423
0	1	1	PBM603
1	0	0	PBM604
1	0	1	Reserved
1	1	0	Reserved
1	1	1	Reserved

Data3 Resolution: ②

Bit2	Bit1	Bit0	Position command resolution(P/R)
0	0	0	500
0	0	1	1000
0	1	0	2000
0	1	1	4000
1	0	0	5000
1	0	1	10000
1	1	0	Setting prohibited
1	1	1	Setting prohibited

Data3-Bit7

For CN1- Hard Limit input, select SDN + Limit or only SDN.

0=Hard Limit function and SDN function (Functions as SDN input during zero-return motion and as Limit input during the normal operation).

1=SDN function (Hard Limit function input becomes invalid).

3. Type P (Pulse Train Input)

Command Code: 19 (13h) Data Length: 1 byte

Initial Movement Direction

Data No	Function	Setting range	Initial value	Setting unit
Data1	Initial movement direction	0, 1	0 (CW)	0=CW, 1=CCW

Defines the initialization movement direction.

As the PB system initializes the encoder counter when the power is turned on, operate the motor within the prescribed range.

* If it is not in STOP or Alarm status after the power is turned on, initialization movement is executed automatically and it will change to servo ON status after normal completion.
* Initialization movement error will occur if the load condition reaches mechanical limit or a power line connection error occurs.

Command Code: 20 (14h) Data Length: 4 bytes

Alarm Detection Condition

Data No	Function	Setting range	Initial value	Setting unit
Data1	Overload stop time	1-Ch	8	s
Data2-3	Position deviation excess detection threshold value	14-FFFFh	1770h	1PLS（standard 2000P/R）
Data4	Enables or disables the detection	-	01h	0=Detection allowed 1=Detection prohibited

Sets the alarm detection conditions and enables or disables the alarm detection function.

Data No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Data1	Overload stop time							
Data2	Position deviation excess value (lower Byte)							
Data3	Position deviation excess value (higher Byte)							
Data4	*	*	*	SL-	SL+	*	*	Wrap

Data1

Sets the ALM detection time for when the motor can not operate because of overload or load reaching mechanical end.

Data2,3

Position deviation error is detected when excessive acceleration or deceleration affects the motor torque. For these cases, decrease the acceleration or deceleration rates or change the position deviation excess value.

Data4

Enables or disables the desired alarm and Soft Limit function.

WRAP: Enables or disables ALM detection for Wrap Around (coordinate sign reversal).

Select “1” (detection prohibited) to enable continuous operation in the same direction.

SL+: Enables or disables the Positive Soft Limit function set by Command 32h.

SL-: Enables or disables the Negative Soft Limit function set by Command 33h.

3. Type P (Pulse Train Input)

Command Code: 22 (16h) Data Length: 10bytes

I / O Port Function				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Input logic select	-	0	0=A conn. (On Active), 1=B conn.
Data2	Output logic select	-	0	0=A conn. (On Active), 1=B conn.
Data3	Z-phase output select	0-1	0 (Z -phase output)	Selects the output function of CN1, 22Pin 0=Z-phase output, 1=phase origin output
Data4	IN1 function select	0-5	0 (Home)	Refer to the list shown below
Data5	IN2 function select	0-5	1 (DEV CLR)	Refer to the list shown below
Data6	IN3 function select	0-5	2 (Gain1)	Refer to the list shown below
Data7	IN4 function select	0-5	4 (Brake)	Refer to the list shown below
Data8	IN5 function select	0-5	5 (POW SEL)	Refer to the list shown below
Data9/10	No function allocation			

Sets the input / output signal logic of CN1, and selects the function of the Z-phase output function and input / output function.

Data No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Data1	*	*	*	*	*	STOP	HL-	HL+
Data2	*	*	*	ENZ/ phase origin	*	*	ALM	*

Data1

Sets the input port logic.

HL+: Sets the Positive Hard Limit logic.

HL-: Sets the Negative Hard Limit logic.

STOP: Sets the STOP input logic.

Data2

Sets the output port logic.

ALM: Sets the Alarm output logic.

ENZ/phase original output: Sets the logic for the Z-phase or phase original output.

The ENZ/ phase original signal will not be output if the initialization operation is incomplete.

The ENZ/ phase original signal is undefined if the encoder is disconnected or drive speed is 200 min^{-1} or higher.

Data4-8

Sets the function of input port (IN1-5).

Setting value	Name	Function	Function outline
0	Home	Zero-return start	Starts the zero-return operation set by Command 45h.
1	DEV CLR	Deviation clear	Commands the deviation clear. The command is rejected when it is ON.
2	Gain1	Gain select 1	Selects the gain table set by Command 2Fh.
3	Gain2	Gain select 2	Selects the gain table set by Command 2Fh.
4	Brake	Brake control	Forcibly releases the holding brake.
5	POW SEL	Maximum current select	Selects the maximum current during operation set by Command 20h.

3. Type P (Pulse Train Input)

Command Code: 31 (1Fh) Data Length: 8 bytes

User Memory				
Data No	Function	Setting range	Initial value	Setting unit
Data1-8	User memory	-	0	-
Provides 8 bytes of memory area for the user which can be used as the user management data area.				

Command Code:35 (23h) Data Length: 4 bytes

Zero-Return Maximum Travel Distance				
Data No	Function	Setting range	Initial value	Setting unit
Data1-4	Zero-return maximum travel distance	See below	Maximum	Pulse (Resolution is set with a soft switch)

Sets the maximum travel distance from the point where the zero-return was started. It is enabled when executing zero-return type 1 to 4.

If there is no normal completion within the maximum travel distance, it will generate a zero-return error.

Resolution settings

Setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Maximum	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF

3) Commands for Adjustment

Command Code: 32 (20h) Data Length: 4 bytes

Power Limit (Power Down)				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Current during servo ON status	0-7Fh	7Fh	Set current (A)=(Setting value/255)×Rated current
Data2	Maximum current during operation 1	0-FFh	FFh	Set current (A)=(Setting value/255)×Rated Current
Data3	Current during servo OFF status	0-7Fh	7Fh	Set current (A)=(Setting value/255)×Rated current
Data4	Maximum current during operation 2	0-FFh	7Fh	Set current (A)=(Setting value/255)×Rated current

Sets the Power Limit value (motor excitation current limit) for each status of driver.

For maximum current during operation, 1 (Data 2) is normally used.

When switching to maximum current during operation 2 (Data 4), set maximum current to input port function by Command 16h.

Maximum current select	Maximum current during operation
OFF	Maximum current during operation 1
ON	Maximum current during operation 2

* Overload error will not be detected when maximum current during operation 2 is selected.

Command Code: 33 (21h) Data Length: 2 bytes

S-Shape Filter Time Constant				
Data No	Function	Setting range	Initial value	Setting unit
Data1	No function allocation			
Data2	S-shape filter	0-Fh	0	-

Sets the S-shape filter.

* Smoother operation is enabled by setting higher S-shape filter time constant.
Instead, greater delay towards command will result.

* Do not change the S-shape filter time constant during pulse input. Position shift will occur.

Command Code: 34 (22h) Data Length: 1 byte

LPF				
Data No	Function	Setting range	Initial value	Setting unit
Data1	LPF	0-3	0	-

Sets the low-pass filter of velocity feedback.

3. Type P (Pulse Train Input)

Command Code: 47 (2Fh) Data Length: 13 bytes

Gain Table					
Data No	Function		Setting range	Initial value	Setting unit
Data1	0	Proportion Gain	0-FFh	2	-
Data2		Integral Gain	0-FFh	1	-
Data3		Kp	0-Fh	4	$1/2^n$
Data4	1	Proportion Gain	0-FFh	2	-
Data5		Integral Gain	0-FFh	1	-
Data6		Kp	0-Fh	4	$1/2^n$
Data7	2	Proportion Gain	0-FFh	2	-
Data8		Integral Gain	0-FFh	1	-
Data9		Kp	0-Fh	4	$1/2^n$
Data10	3	Proportion Gain	0-FFh	2	-
Data11		Integral Gain	0-FFh	1	-
Data12		Kp	0-Fh	4	$1/2^n$
Data13	Gain select		0-1	0 (RSW)	0=RSW, 1=Gain table

Using the Gain table, set Gain select (Data13）=1（Gain table）and set Gain select 1 and 2 for input port function by Command 16h.

Between Gain select 1 and 2, the Gain select which was not set for input port will be recognized as OFF.

Gain select 2	Gain select 1	Table No.
OFF	OFF	0
OFF	ON	1
ON	OFF	2
ON	ON	3

Command Code: 225 (E1h) Data Length: 2 bytes

P / PI Control Switch				
Data No	Function	Setting range	Initial value	Setting unit
Data1-2	P/PI switching velocity	A-1194h	1194h	min^{-1}

Sets the switching velocity threshold of P/PI control.

It will be PI control when the actual velocity is less than the set velocity. When actual velocity is more than the set velocity, it will be P control.

It is effective for reducing the positioning time caused by collected deviations and for improvement of velocity change during operation at fixed speed.

3. Type P (Pulse Train Input)

Command Code: 226 (E2h) Data Length: 2 bytes

Control Switch Condition				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Control switching frequency	0-FFh	2	2000PPS/LSB
Data2	Current time constant	0-FFh	2	3A/255/0.5ms

Control switching frequency is used to reduce the vibration caused at the time of slow motion operation.

Set the frequency after referring to the recommended methods shown below.

Normally, do not change the current time constant.

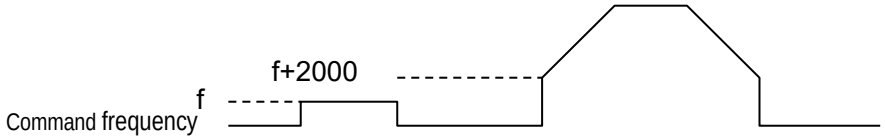
* Velocity differentiates depending on setting resolution.
* The torque generated below the set frequency will depend on Power Limit during stoppage.
* If the control switch is employed, please set it to 0.

(Recommended methods for use)

Control switch frequency (Setting value×2000PPS)=f

During slow motion operation: Command frequency<f(PPS)

During normal operation: Start frequency>f+2000(PPS)



4) User Setting Commands

Command Code: 48 (30h) Data Length: 4 bytes

In-Position Width				
Data No	Function	Setting range	Initial value	Setting unit
Data1-4	In-Position width	1-CCCCCCCh	Ah	1PLS(Standard 2000P/R)
Sets the in-position width. In-position signal is sent when there is no pulse command (2ms) and when the remaining pulse is within the range of ± in-position width. When a zero-return operation is performed, in-position is output at the time of zero-return completion.				

Command Code: 50 (32h) / 51 (33h) Data Length: 4 bytes

Positive Soft Limit / Negative Soft Limit				
Data No	Function	Setting range	Initial value	Setting unit
Data1-4	Limit value	See below	Maximum	Pulse (Resolution is set with a soft switch)

Command 32h: Positive soft limit value setting

Command 33h: Negative soft limit value setting

Sets the software limit as an absolute position.

The limit is valid if the soft limit function was enabled by command code 14h.

Setting range (with sign)

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

Detection conditions

* If the absolute position counter exceeds the limit, a deceleration stop is performed. During the limit state, a pulse command in the limit direction will be invalid.
* When performing a zero-return operation
  Limit is not monitored if the zero-return is incomplete or the zero-return is still in progress.

5) Operation Command

Command Code: 69 (45h) Data Length: 8 bytes

Zero-Return Profile				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Zero-return type	See below	10h	
Data2	Velocity	0-C8h	4Bh	min^{-1}
Data3	Low velocity	0-C8h	4Bh	min^{-1}
Data4-7	Grid shift	See below	0	Pulse (Resolution is set with a soft switch)
Data8	Current limit	0-FFh	0	Setting value /255× Rated current

Sets the profile of zero-return. The acceleration / deceleration rate is 2 fixed values.

Data1

Data No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Data1	*	*	*	Dir: ②	Zero-return type: ①			

① Zero-return type

Bit3	Bit2	Bit1	Bit0	Zero-return type
0	0	0	0	Z-phase detection
0	0	0	1	External sensor detection
0	0	1	0	External sensor + Z-phase detection
0	0	1	1	Push detection
0	1	0	0	Push ＋C-phase detection
Others				Setting prohibited

② Dir

Sets the rotational direction of zero-return.

Bit4	Rotational direction
0	Positive (CCW)
1	Negative (CW)

Data4-7

Grid shift volume setting range (with sign)

Resolution (P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit coordinates	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit coordinates	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* The grid shift setting values have signs. If the push is detected, set the grid shift in the opposite direction of the command direction.

3. Type P (Pulse Train Input)

Each setting is enabled or disabled based on the type of zero-return.

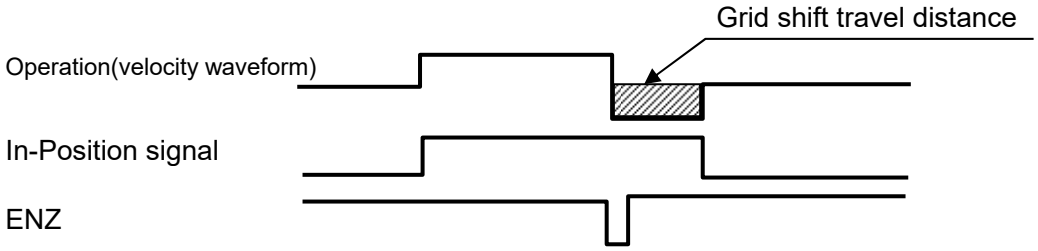
Zero-return type	Velocity	Low-velocity	Grid shift	Current limit
Z-phase detection	Disabled	Enabled	Enabled	Disabled
External sensor detection	Enabled	Enabled	Enabled	Disabled
External sensor + Z-phase detection	Enabled	Enabled	Enabled	Disabled
Push detection	Enabled	Enabled	Enabled	Enabled
Push + Z-phase detection	Enabled	Enabled	Enabled	Enabled

<Zero-return operation overview>

* The zero-return in-position signal is output after the zero-return operation is complete.

1) Z-phase detection: Type 0

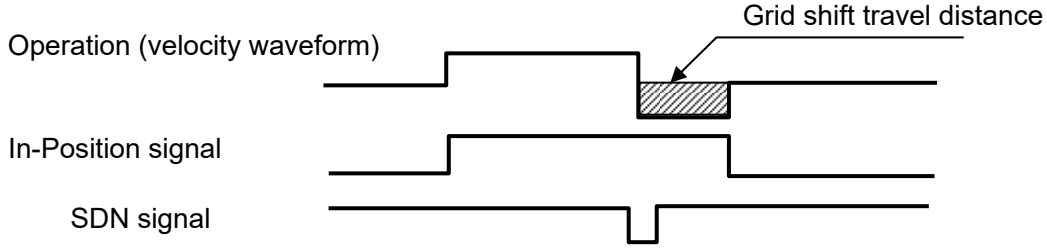
Zero-return is based on detecting the Z-phase (1PLS/rotation) of the motor-sensor.



* If high velocity is used, an overshoot can occur after detecting the Z-phase, causing a return operation to be performed.

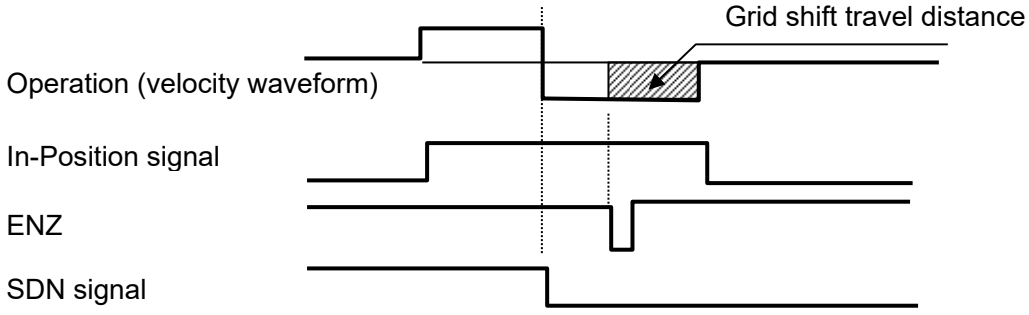
2) External sensor detection: Type 1

Zero-return is performed by detecting the edge of the external sensor signal.



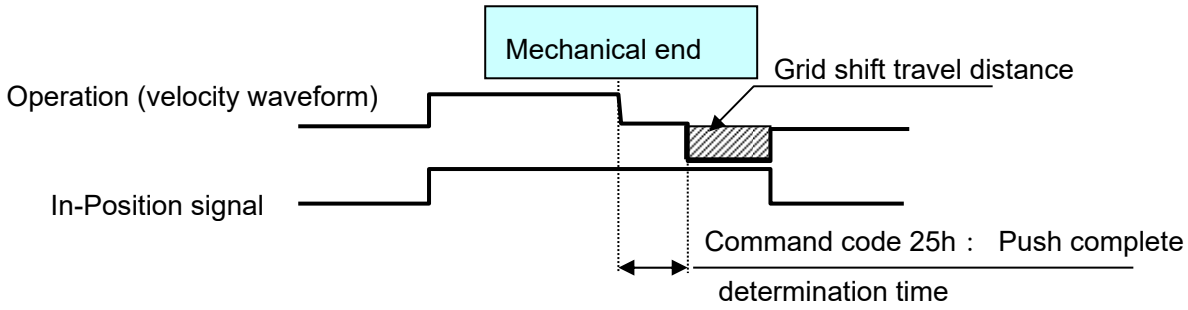
3) External sensor + Z-phase detection: Type 2

After detecting the edge of the external sensor signal, movement starts in the opposite direction and zero-return is performed based on Z-phase signal detection.



4) Push detection: Type 3

Zero-return is based on detecting a stop due to pushing against the mechanical end.

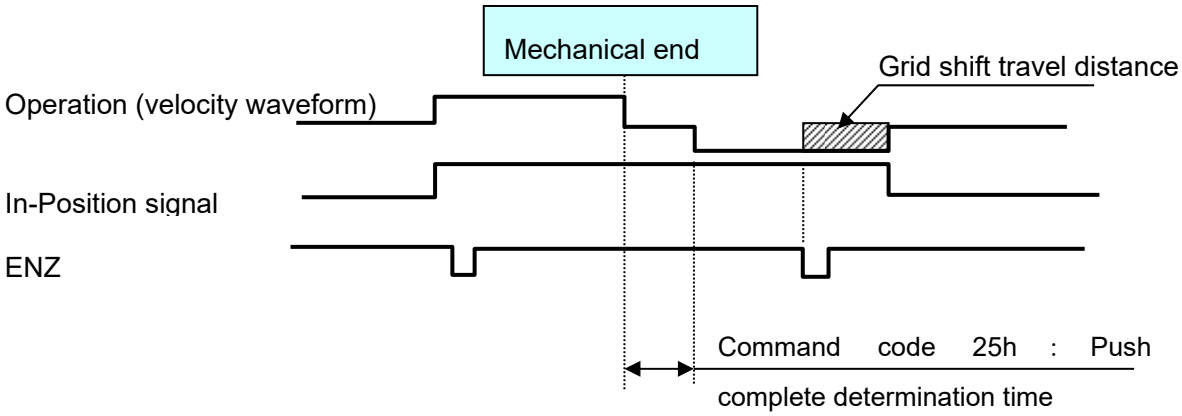


* The sign of the grid shift volume must be set to the opposite direction of the push direction.

* Confirm that the push current limit setting is a value with which the motor can operate. If the value is low, it may be prematurely determined as stop before being pushed against the mechanical end.

5) Push + Z-phase detection: Type 4

After detecting a stop due to pushing against the mechanical end, movement starts in the opposite direction and zero-return is performed based on Z-phase signal detection.



6) State Control Commands

Command Code: 53 (35h) Data Length: 1 byte

Brake Control				
Data No	Function	Setting range	Initial value	Setting unit
Data1	Brake control	0, 1	1	1=Engage, 0=Release

* Directly controls the holding brake status during servo OFF (including Alarm and STOP status).

* This parameter is not saved in the non-volatile memory. (Normally 1 after powering up.)
When switching to servo ON, the status is automatically set to 1. Unless 0 was preset, the holding brake will be engaged when a STOP or ALM occurs.

Command Code: 74 (4Ah) Data Length: 0 byte

Alarm Clear

This command clears the alarm.

* Non-recoverable alarms are not cancelable; they can be cleared only by restarting the power, or using the initialization command.

* The command operates using an OR condition with the alarm clear signal of input port.

Command Code: 76 (4Ch) Data Length: 0 byte

STOP Command

This command initiates an emergency stop. If the motor is in motion, it stops with the maximum possible deceleration rate, and the driver status changes to servo OFF.

* This command operates using the STOP signal at an input port and OR condition.

Command Code: 77 (4Dh) Data Length: 0 byte

STOP Clear

Cancels the STOP (command 4Ch) initiated by a STOP command. At the time of the STOP clear, the driver status automatically changes to servo ON.

* This command does not clear the STOP signal at an input port.

7) Read Commands

Command Code: 128 (80h) Data Length: 1 byte

Parameter Read

Data No	Function	Setting range	Initial value	Setting unit
Data1	RD target command code	Command with initial value	-	-

This command reads the setting value of a direct command or a system command.

* The returned data represents the setting data in RAM.

Returned data

Data length: Differentiates depending on the command to read

Data No	Description
Data1	RD target command code
Data2 to n	Data

3. Type P (Pulse Train Input)

Command Code: 131 (83h) Data Length: 0 byte

Driver Status

This command reads the driver status and I/O port status.

Returned data

Data length：6Byte

Data1: Driver status 1

bit	Description	Data		Explanation
		0	1	
0	Main power status	ON	OFF	The status of the main power
1	In-position status	Within range	Out of range	The status of the in-position
2	Alarm status	Normal	Alarm	The alarm status
3	Initialization operation	Complete	Incomplete	Completion status of the initialization process
4	Servo ON／OFF status	ON	OFF	Servo ON/OFF status
5	STOP control status	Normal	STOP	STOP status
6	Zero-return completion	Incomplete	Complete	Zero-return completion status
7	*	-	-	Always 0 returned

Data2: Driver status 2

bit	Description	Data		Explanation
		0	1	
0	Positive direction soft limit	Normal	Limit	Positive direction soft limit status
1	Negative direction soft limit	Normal	Limit	Negative direction soft limit status
2	Brake	Release	Hold	Holding brake control status
3	*	-	-	
4	Positive direction hard limit	Normal	Limit	Positive direction hard limit status
5	Negative direction hard limit	Normal	Limit	Negative direction hard limit status
6	*	-	-	Always 0 returned
7	*	-	-	Always 0 returned

Data3-6: I/O port status 1: photocoupler ON 0: photocoupler OFF

bit	Data3(Input port)	Data4(Input port)	Data5(Output port)	Data6(Output port)
0	CN1- Pin 1/2	CN1- Pin 11	CN1- Pin 15	*
1	CN1- Pin 3/4	CN1- Pin 12	CN1- Pin 16	*
2	CN1- Pin 5	CN1- Pin 13	CN1- Pin 17	*
3	CN1- Pin 6	*	CN1- Pin 18	*
4	CN1- Pin 7	*	CN1- Pin 19	*
5	CN1- Pin 8	*	CN1- Pin 20	*
6	CN1- Pin 9	*	CN1- Pin 21	*
7	CN1- Pin 10	*	CN1- Pin 22	*

* The I/O port status monitors the photocoupler ON/OFF status regardless of the port function.

3. Type P (Pulse Train Input)

Command Code: 132 (84h) Data Length: 0 byte

Absolute Position Counter

This command reads the absolute position counter (with sign) inside the driver.

Returned data depends on the resolution set by Command 11h.

Returned data

Data length: 4 bytes

Data No	Description
Data1	Absolute position counter (the lowest byte)
Data2	Absolute position counter (lower byte)
Data3	Absolute position counter (higher byte)
Data4	Absolute position counter (the highest byte)

Command Code: 133 (85h) Data Length: 0 byte

Velocity Monitor

This command monitors the actual velocity (absolute value).

Returned data

Data length: 2 bytes

Unit: min^{-1}

Data No	Description
Data1	Actual velocity (higher byte)
Data2	Actual velocity (lower byte)

3. Type P (Pulse Train Input)

Command Code: 134 (86h) Data Length: 0 byte

Alarm History

This command reads the current and past alarm history.

Returned data

Data length 8 byte

Data No	Description
Data1	Current alarm state
Data2-8	Alarm history (in order of most recent to the oldest)

Abbreviation	Code (Hex)	Description
No alarm	0	Normal status
DE	1	Encoder disconnected
OV	2	Input power voltage is above the specification range
MPE	3	Input power voltage is below the specification range
RSTE	4	Initialization error (overload) / Power line disconnected
OVF	5	Position deviation abnormal
OL	6	Overload stop
OS	7	Overspeed
RGOL	8	Regeneration voltage is over the specified value
ORG	9	Zero-return error
Wrap around	B	Absolute position counter sign reversal
LAE	D	Lead angle error
OC	E	Overcurrent
EEPER	F	Non-volatile memory error

* Low voltage error when the power is OFF will not be stored in Alarm history.

3. Type P (Pulse Train Input)

Command Code: 135 (87h) Data Length: 0 byte

Communication Error History

This command reads the history of past communication errors.

Returned data

Data length: 8 bytes

Data No	Description
Data1-8	Communication error history (in the order of most recent to oldest)

Code (Hex)	Description
1	Checksum error
2	Timeout
8	Parity error
10	Framing error
20	Overrun error

Command Code: 137(89h) Data Length: 0 byte

Soft Revision

This command reads the software revision.

Returned data

Data length: 2 bytes

Data No	Description
Data1	Software revision (Major)
Data2	Software revision (Minor)

Command Code: 139 (8Bh) Data Length: 0 byte

Power Voltage Monitor

This command monitors the power voltage and the regeneration voltage inside the driver.

Returned data

Data length: 2 bytes

Unit: 703/V

Data No	Description
Data1	Regeneration voltage (lower byte)
Data2	Regeneration voltage (higher byte)
Data3	Power voltage (lower byte)
Data4	Power voltage (higher byte)

3. Type P (Pulse Train Input)

Command Code: 144 (90h) Data Length: 0 byte

Driver Type

This command reads the driver type.

Returned data

Data length: 2 bytes

Data No	Description
Data1	Type
Data2	Spare

Driver model number：PB3D003M200

Type	Description
4	RS-485 + PIO Type
5	Pulse train type

Command Code: 146 (92h) Data Length: 0 byte

Switch Monitor

This command monitors the setting value of the rotary switch.

Returned data

Data length: 1 byte

Data No	Description
Data1	Rotary switch (Gain setting value)

Command Code: 148 (94h) Data Length: 0 byte

Pulse Train Command Counter

This command reads the pulse train command counter (with sign).

Counts in a positive direction with CCW direction command; and in a negative direction with CW direction command.

This is a function to ensure that there is no false count on the command caused by noise factors etc.

Returned data

Data length: 4 bytes

Unit: Pulse

Data No	Description
Data1	Pulse train command counter (the lowest byte)
Data2	Pulse train command counter (lower byte)
Data3	Pulse train command counter (higher byte)
Data4	Pulse train command counter (the highest byte)

3.4 Protection Function

Alarm status is activated when an error in the system occurs.

In the alarm status, the motor is in the fixed excitation state with the excitation current preset by Command 20h-DAT3. During motor operation, it enters the fixed excitation state after the motor is stopped at maximum torque.

* When the Power Limit during servo OFF status is set to 0, it enters the unexcited state.

3.4.1 Alarm Description Confirmation

Alarm description can be confirmed with 7 segment LED display or Communication (Command 87h: Alarm history RD).

Alarm abbreviation	Display	Alarm description	Recoverability
DE	1	Encoder disconnected	Unrecoverable
OV	2	Input power voltage is above the specification range	Recoverable
MPE	3	Input power voltage is below the specification range	Recoverable
RSTE	4	Initialization error / Power line disconnected	Unrecoverable
OVF	5	Position deviation error	Recoverable
OL	6	Overload stop	Recoverable
OS	7	Over-speed	Recoverable
RGOL	8	Regeneration voltage is over the specified value	Recoverable
ORG	9	Zero-return error	Recoverable
Wrap around	B	Absolute position counter sign reversal	Recoverable
LAE	D	Lead angle error	Unrecoverable
OC	E	Over-current	Unrecoverable
EEPER	F	Non-volatile memory error	Unrecoverable

* To cancel unrecoverable alarms, it is necessary to turn off the power, and then restart.

3.4.2 Alarm Causes

Abbreviation	Display	Alarm cause
DE	1	Indicates the disconnection of the encoder input signal A, B and Z –phase. Observed at all times.
OV	2	Indicates that the input power voltage is above the specification range. At power-up, the input voltage specification automatically recognizes 24V or 48V. Alarm will be triggered according to the following excess voltage detection values dependent on input voltage specification. 24V input: approx. above 36V 48V input: approx. above 55V
MPE	3	Indicates that the input power voltage is below the specification range. The detection voltage is shown below. 24V input: approx. below 15V 48V input: approx. below 30V * Not detected during servo OFF. * Termination of power with servo ON may trigger alarm output. * ALM history will be saved only if the power voltage returns to normal after low-voltage detection.
RSTE	4	When the power of the PB system is turned on, Initialization action detects the initial phase of the encoder, initializes the internal counter, and switches to servo ON status. If the encoder initial phase cannot be detected because of overload and power line disconnection etc, it results in an Alarm condition. * If there is an ALM, STOP or Interlock (Type R) status after the power is turned ON, Initialization will not be executed. * Refer to Chapter 5.2 for more information about load tolerance. * Refer to Section 3.6 for Initialization details.
OVF	5	When the position deviation (Differences between the actual position and the command position set by pulse input) exceeds the Command 14h setting value, an Alarm condition will result. Confirm that it is not used under unreasonable acceleration / deceleration or overload conditions.
OL	6	Indicates that before reaching the target position, the load was inoperative for a certain time. The detection time for inoperative status can be set using command 14h. Check the cause such as the load reached the mechanical limit. * Not detected when Maximum current during operation 2 is selected.
OS	7	Indicates a velocity error. If the actual velocity exceeds approx. 5200min^{-1}, it results in an Alarm condition. Confirm that it is not used under unreasonable acceleration / deceleration or overload conditions.

3. Type P (Pulse Train Input)

Abbreviation	Display	Alarm cause
RGOL	8	The PB driver regulates the regeneration voltage by software control and detects regeneration error when the stipulated value is exceeded. Regeneration to the power source is prevented within the driver. * Contact Sanyo Denki for assistance if regeneration control is not sufficient. * When excessive regeneration voltage occurs, the hardware might be damaged. When used with abrupt deceleration or under excessive load, gradually accelerate and decelerate starting from low-velocity operation to check the drive. * Confirm the rated load limit for each motor before operation. Refer to Chapter 5.2 for more information about load limit.
ORG	9	Indicates a zero-return error. For Z-phase detection zero-return Indicates that the Z-phase could not be detected within one rotation of the motor shaft For external sensor detection, Push zero-return Indicates that the drive was incomplete within the travel distance range set by command 23h.
Wrap Around	B	Indicates the overflow of absolute position counter. Command 14h-DAT4-Bit1 can be used to enable or disable detection of this condition. Not detected on the initial value.
LAE	D	Indicates a count error of the encoder counter. Detected only during the motor operation. Confirm that there is no encoder error caused by shock to the motor or excessive noise.
OC	E	Indicates excess current in the motor. It does not function as protection for short circuit or earth-fault on the power line. * Contact Sanyo Denki for assistance if problem occurs.
EEPER	F	Indicates a non-volatile memory data error. • After detecting the memory error, the parameters are reset to the initial factory settings. * Contact Sanyo Denki for assistance if problem occurs.

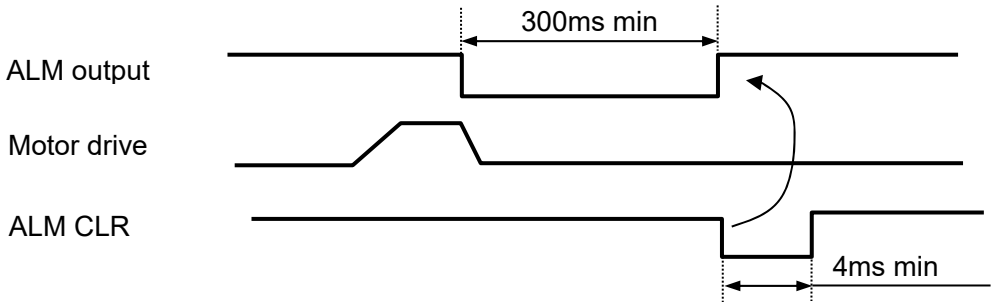
3.4.3 Alarm Recovery Process

There are recoverable alarms and unrecoverable alarms (Refer to Section 3.4.1) depending on the alarm cause.

When the alarm occurs, remove the alarm cause to cancel.

<For recoverable alarm>

Will be cancelled by ALMCLR signal.



<For unrecoverable alarm>

It is necessary to reconnect the power.

Remove the alarm cause and reconnect the power.

3. Type P (Pulse Train Input)

3.5 Adjustments

For maximum performance for a motor, it is necessary to adjust the gain.

The responsiveness of the motor is changed according to the gain setting value. The gain is regulated by adjustment of the rotary switch or PC interface. Use the waveform monitor of the PC interface etc to adjust the velocity waveform and In-Position signal.

3.5.1 Adjustment Parameters

・Rotary switch

Select the normalized proportional gain and integral gain of the velocity loop from 16 levels shown below.

SW setting value	Proportional Gain	Integral Gain	SW setting value	Proportional Gain	Integral Gain
0	4	1	8	20	20
1	6	10	9	22	1
2	8	20	A	24	10
3	10	1	B	26	20
4	12	10	C	28	1
5	14	20	D	30	10
6	16	1	E	32	20
7	18	10	F	34	1

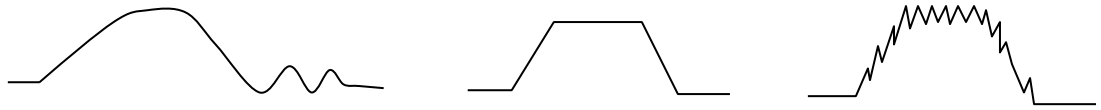
・Commands for adjustment (For adjustment parameter details, refer to Section 3.3.2 – Commands for Adjustment)

Command	Command name	Function
33(21h)	S-Shape Filter	Sets the time constants of S-shape filter on pulse train command. Effective for reducing shock and vibration during load operation stoppage. However, increasing the value setting will lead to reduced synchronicity with command.
47(2Fh)	Gain Table	Sets maximum 4 patterns of gain table. Used when switching the gain by motion in the Input Port rather than single adjustment of the gain by rotary switch.
34(22h)	LPF	Sets the low-pass filter of velocity feedback.
225(E1h)	P/PI Control Switch	Sets switching velocity of P/PI control. Switches to PI control when actual velocity is less than the set velocity and P control when greater than the set velocity. Effective for reducing the positioning time caused by accumulated deviations and for improving velocity change during fixed speed operation.
226(E2h)	Control Switch Condition	The PB system utilizes Close control (PI control) during operation and Open control during stoppage. As switching this control method may cause vibration during acceleration or slow motion operation, set the control switch frequency with this command to determine the operation profile.

3.5.2 Adjustment Methods

a) Proportional gain of velocity loop

Increase the proportional gain of velocity loop gradually as long as there is no oscillation in the motor or the load. As the gain increases, the velocity waveform changes as shown below. By increasing the proportional gain as much as possible without oscillation, high response can be achieved.



Low proportional gain → High proportional gain

* Increasing the proportional gain may increase the noise of the motor.

b) Integral gain of velocity loop

As this is the delay factor for the servo system, a low setting will adversely affect responsiveness. A high setting may render the servo system unstable. Select an appropriate value after checking the vibration and oscillation status of the machine system.

If the response before positioning is slow due to gravity load and single load, adjust by increasing the integral gain of velocity loop.

c) Proportional gain of position loop

Increasing the proportional gain of position loop will quicken response and shorten positioning time. However, oscillation may occur if the rigidity of the machine system is low. Adjust in the range that is free of load oscillation.

d) Adjustment by operation profile

If overshooting during acceleration or undershooting during stoppage is not solved by gain adjustment, this may be due to torque shortage. Check motor size, load conditions or operation profile (moderate acceleration / deceleration rate).

e) Control switch frequency setting

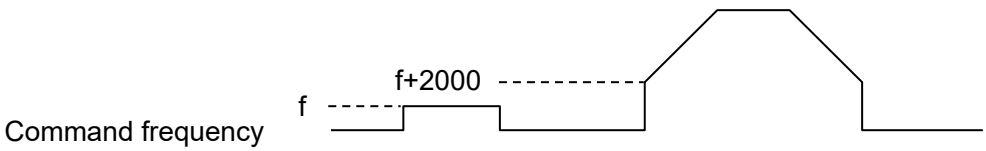
Sets the switching frequency of Open / Close control by Command E2h.

Especially during slow motion operation, setting the switching frequency above the operation frequency and operating with Open control may reduce oscillation.

Control switch frequency (setting value × 2000PPS) = f

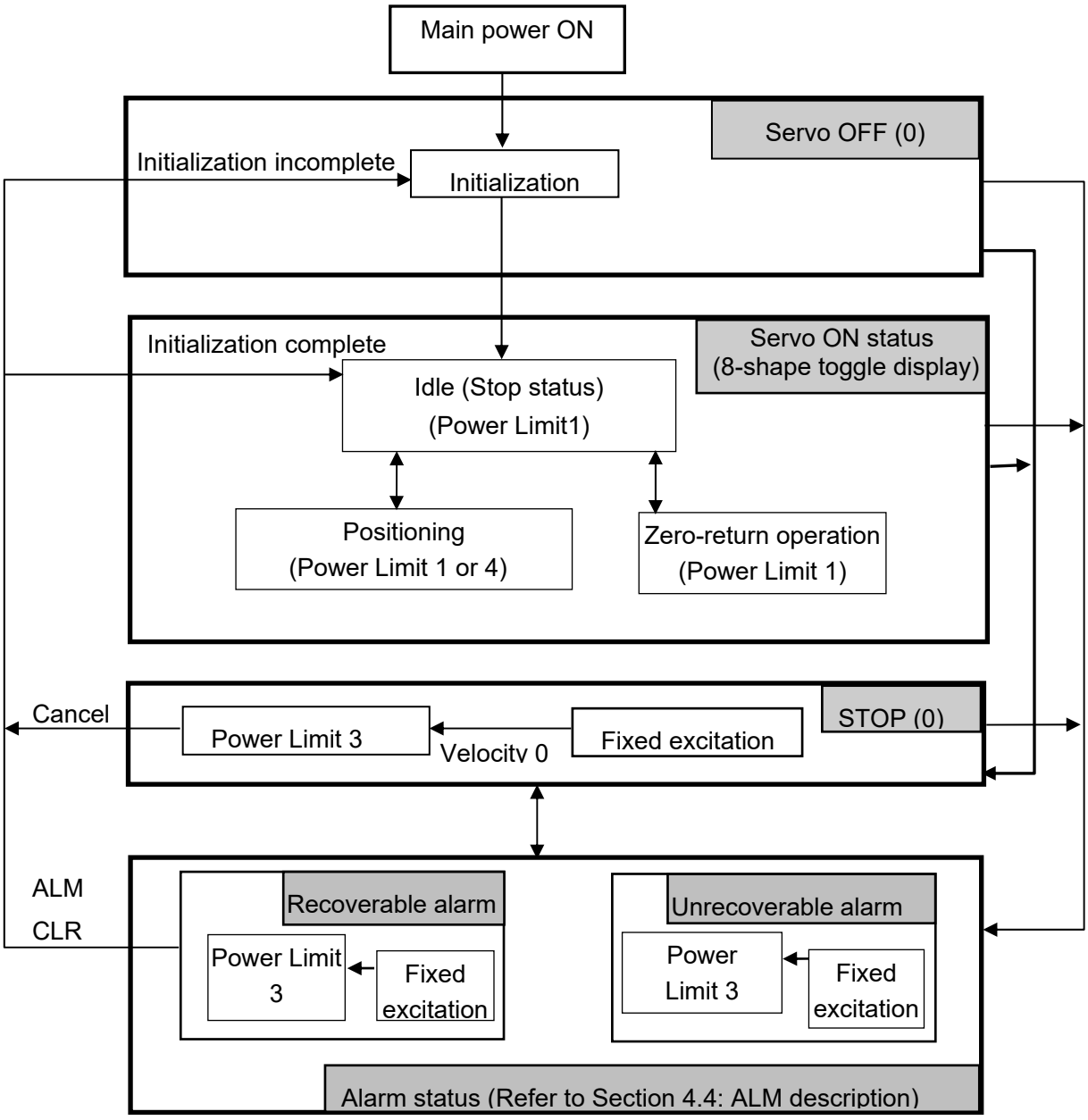
During slow move operation: Command frequency < f (PPS)

Normal operation: Use at Start frequency > f + 2000 (PPS)



3.6 Driver Status Change Diagram · Display

Shows the driver status change diagram. Display status of 7SEG LED is shown in ( ).



(1) The initialization operation is automatically initiated when the driver detects that the power of the main circuit is within the specified voltage range. After initialization is complete, the status automatically changes to “Servo ON". If the initialization operation is completed once, the initialization will not be performed. Use the STOP signal to maintain "Servo OFF” status. Initialization will energize the initial excitation phase at maximum rate, and move at a maximum of ±1.8 degrees. If error occurs during operation due to reaching the mechanical limit, it will move 7.2 degrees in the opposite direction and then resume moving within the range of ± 1.8 degrees.

(2) If a STOP or alarm occurs, the motor decelerates with fixed excitation until the motor is stopped. After the motor stops, the excitation current selected for Power Limit 3 is applied.

3. Type P (Pulse Train Input)

3.7 Trial Operation

1) Switch Setting

・ Confirm that the Dip-switch 1 located on the top side of the driver body is turned OFF.

2) Parameter Setting

①Wiring

Connect the driver power, communication unit and PC to the driver.

* Please do not connect a Motor at this time.

②Turn the power on (1(encoder disconnection) is detected for 7SEG LED) and start-up the PC interface.

Select On Line

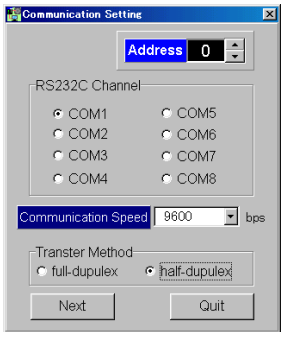
Click “NEXT”

COM Port setting

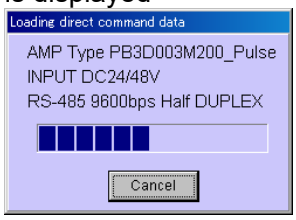
Select ADRESS=0

9600bps Half Duplex

Click “NEXT”



Parameter RD task bar is displayed

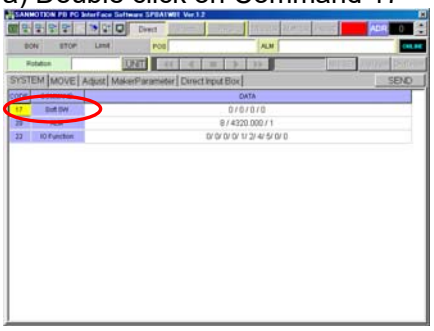


3. Type P (Pulse Train Input)

③Command setting (Shown below is a setting example of Command 17).

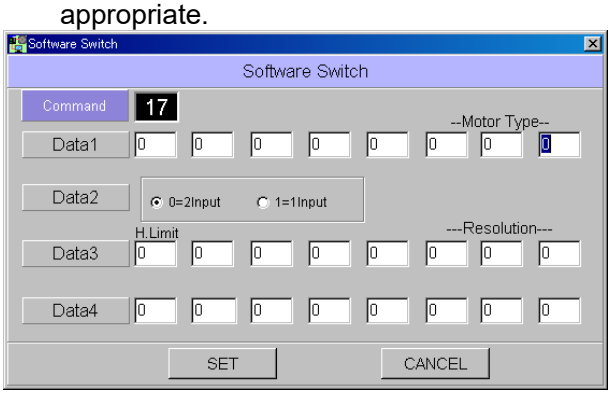
Set the commands such as a soft switch, input and output function if necessary.

a) Double click on Command 17



b) Set the motor TYPE, pulse input method and resolution and then click on the SET button.

* Must be set as damage may occur to both motor and driver when the motor Type is not appropriate.

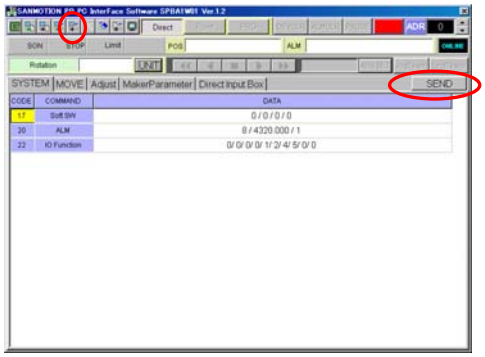


c) Transfer data to driver by pressing the SEND button.

Press PC→Amp ROM on the MENU button and Save the sent parameter to the non-volatile memory.

* Press Save as the transferred parameter will not be saved until this is done.

* When it is saved on the Driver, it needs to be saved only once after setting parameters as all commands will be forwarded and saved at once.



If necessary, follow the same procedure as ② to set parameters other than Command 17 (11h).

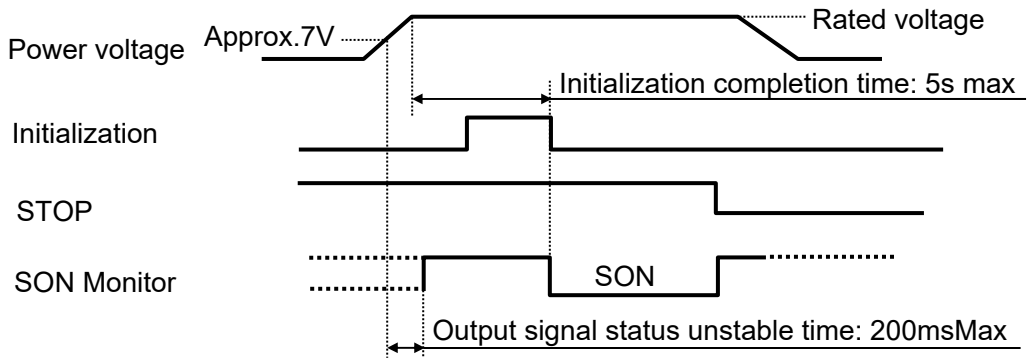
3) Operation

i) After the parameter setting is completed, turn the power off and connect wiring for the motor power, encoder and I/O.

* Refer to Chapter 2 to ensure the correct wiring.
* Perform safety check and attach the motor to the fixed plate etc. For safety, set up the emergency stop circuit before operating.

ii) Turn the power on again after confirming that the STOP input signal is cancelled. If the 7SEG LED writes an 8-shape, it is normal.

Power start sequence（When the STOP input signal is cancelled）



* The output signal status is unstable for a maximum of 200ms after the power voltage reaches approximately 7V.
* Turn the power off after setting to STOP status, as low power voltage error may be detected when power is turned off with the servo ON.

iii) Input the pulse and confirm that the motor operates.

iv) After operation is confirmed, connect the load to the motor. Refer to Section 3.5 and set the Gain and operation profile.

* If it does not operate normally, confirm that the wiring and power voltage is correct.
* In case of Alarm, refer to Section 3.4 to remove the alarm cause.
* For details of waveform monitor method, refer to M0007856.

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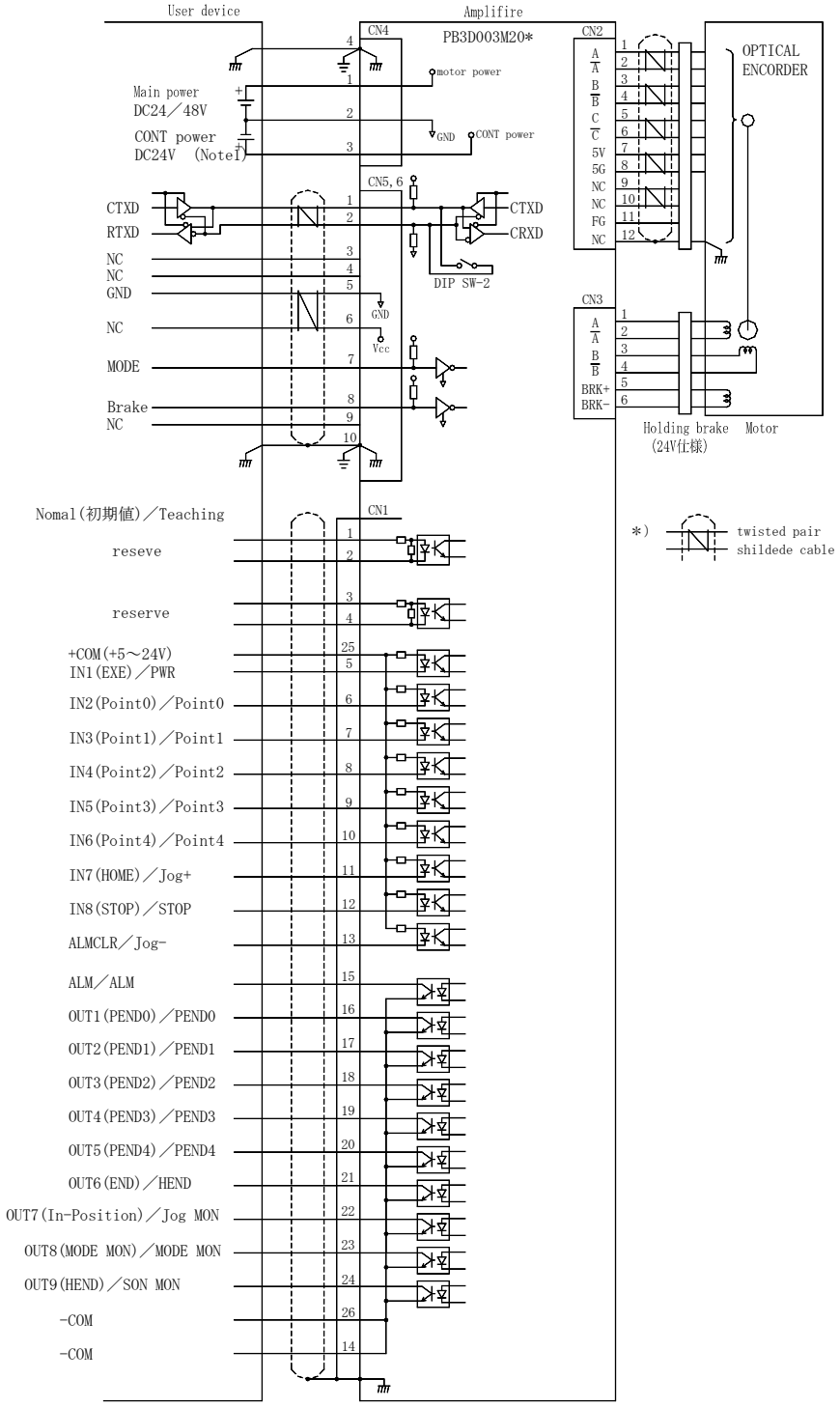
4

Type R (RS-485 + PIO)

4. Type R (RS-485 + PIO)

4.1 External Wiring Diagram (Dip-switch 1=ON)



* Names of CN1 input signals are displayed in normal mode (initial value) and teaching mode.

* CN1 input and output signal function is selected by Command 16h.

* Please note that OUT 7 to 9 of CN1 are not emitted if COM (5 to 24V) is not provided.

Note1) It is impossible to connect holding brake to driver when using it power-supply-voltage 48V in single power supply. When using motor power supply voltage by 48V and using a holding brake, choose driver of the separate power supply type, and supply 24V to a control power supply (= holding brake power supply).

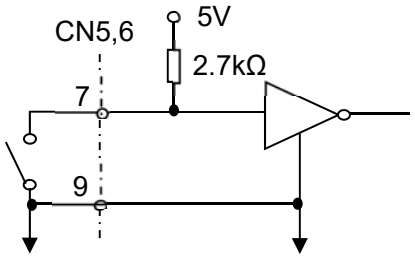
4. Type R (RS-485 + PIO)

4.2 Input / Output Signal Functions

For Type R, selection of normal mode or teaching mode is dependent on the input status of CN 5 and 6 - Pin 7. Each mode has different CN1 input / output signal functions.CN1 input / output signal functions in normal mode are preset by Command 16h and are fixed in teaching mode.

Normal mode: CN 5 and 6-Pin7=OFF Mode for normal position settings.

Teaching mode: CN 5 and 6-Pin7=ON Mode for current position teaching when positioning by Jog operation or for offline teaching.

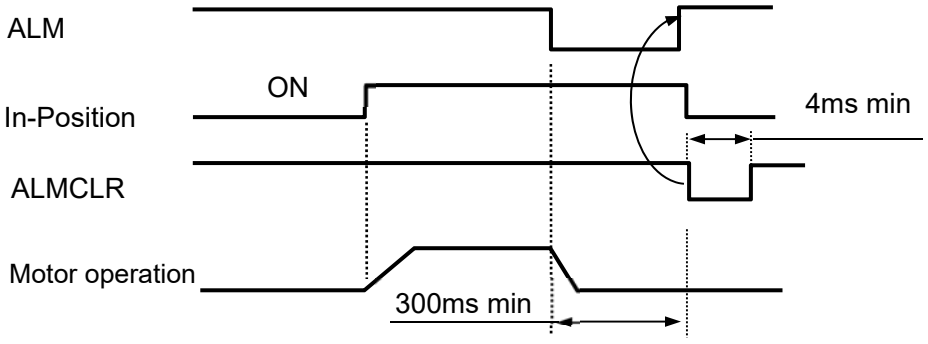


* Teaching with PC interface software is also possible. When using PC interface software, teaching will be performed in normal mode status without CN pin 5 and 6-7 control. Refer to M0007856 for more details.

4.2.1 Input / Output Signal on Normal Mode

1) Input with Fixed Functions

Pin No	Name	Logic selection	Function outline
15	ALM CLR	Fixed Clear when ON edge is recognized	Alarm clear signal when ALM is activating. Power must be reset to clear non-cancelable alarms. * Alarm can be canceled after 300ms have elapsed and the motor has stopped completely.



Note) Timing chart is displayed according to the following definition.
The logic selectable input / output signal is shown as the initial value.

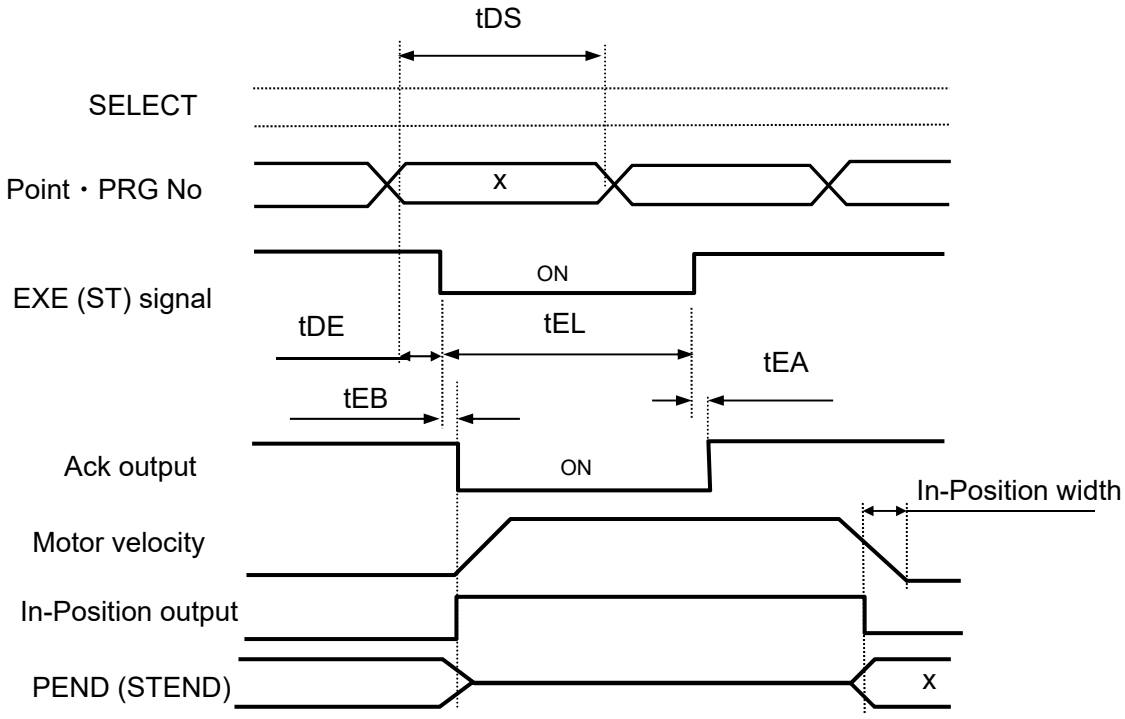
2) Input Functions by Function Selections

Input signal functions are preset by Command 16h. Refer to Command 16h for more details in function selection.

Name	Logic selection	Function outline
Point0 to 6	Fixed ON=1 OFF=0	Point numbers and program numbers are set by the Point0 to Point6 7bit binary codes. Point and program numbers set by EXE signal will be activated. * Point input status that lies outside the PRG number setting range will be ignored when program is in execution. * If a Point No is not allocated an input function, it is recognized as 0. * When allocating the function to Point rather than operation, PEND signal will not be emitted.
SELECT	Selectable Initial value: ON=PRG	Selects an execution object from either Point or Program during EXE execution. * When SELECT signal is not used, an execution object can be selected by Command 1Ch. * The setting of this signal is ignored during activation by ST signal.
EXE	Fixed On edge start	Execution signal for command selected by Point0 to 6 and SELECT signal. Ack signal responds during normal reception and PEND signal responds when the operation is successfully completed. * Execution of desired movement command when zero-return is incomplete can be preset to enable / disable by Command 1Eh setting values. SCAN operation may be executed with any setting status by Command 1Eh. * Ack signal will not respond if the command selected by Point and program is not able to be executed. * Enables / disables the additional movement command by setting Command 8. * PEND signal out will respond only to movement command. * EXE function (Point execution) and ST n signal should not conflict. (In case of conflict, EXE execution will take precedence.)
ST0 to 3	Fixed On edge start	Executes a command (Point 0 to 3) which corresponds to an input signal. Ack signal responds when received successfully and STEND signal responds when the operation is completed. * When multiple ST is conflicting, the lower number will take precedence). However, activation after more than 1ms will be received or rejected depending on the setting status of Command 8: enable / disable additional movement command.

4. Type R (RS-485 + PIO)

Point·PRG Execution (ST execution)



Command Ch (When EXE Filter=0)

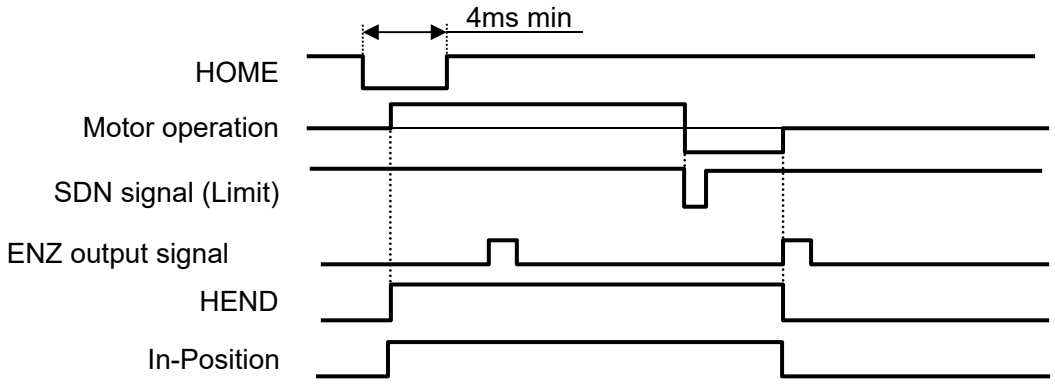
Point data hold time: tDS	4ms min
EXE signal hold time: tEL	2ms min
EXE signal set up time: tDE	2ms min
Ack signal response delay time: tEA	2ms max
Ack signal response delay time: tEB	4ms max

* EXE signal has software filter function by Command Ch. Setting the higher Filter is effective to avoid malfunctions when the relay contact point or noise environment is poor.

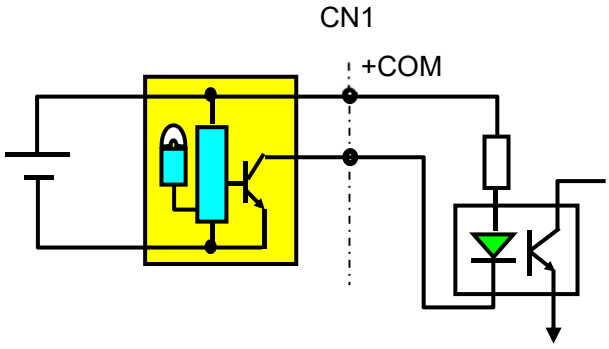
4. Type R (RS-485 + PIO)

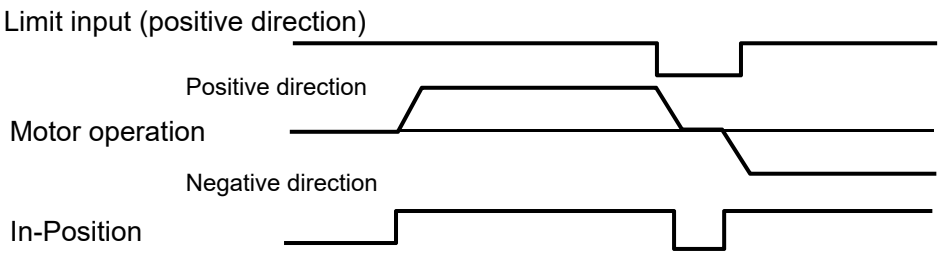
Name	Logic selection	Function outline
HOME	Fixed On edge start	Execute the zero-return operation commands preset by command 56h (Point No = 80h). HEND signal is emitted when zero-return is successfully completed. * When zero-return is incomplete, enable / disable setting of operation command is selected by Command 1Eh. * In-Position signal is emitted when zero-return is completed. * When zero-return operation is incomplete, soft limit function is invalid. * If zero-return is using SDN signal, the limit function must be allocated an input port function.

Zero-return Type=2 (external sensor + Z-phase) example



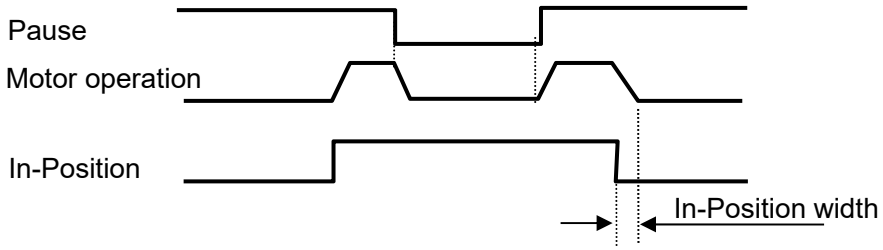
4. Type R (RS-485 + PIO)

Name	Logic selection	Function outline
Hard Limit	Selectable Initial value: ON=Limit	Functions as Hard Limit input or as SDN signal (external sensor) when zero-returning. <Hard Limit function> Decelerates and stops when Limit is detected. During Limit, shift commands for the Limit direction are disabled. Shift commands for the opposite limit direction are accepted. * Gains soft Limit function by Command 32h and 33h. Refer to Section 4.3 for more details. * Limit signal is ignored during zero-return operation if SDN is not used. Limit input is enabled after completion of zero-return. <Zero-return SDN signal function> Functions as SDN signal (external origin signal) when the zero-return Type, set by Command 45h, is 1 or 2. * In the case of rotational operation or for use only as SDN signal function, set command 11h-DAT3-Bit7=1 and mask the Limit function. * For SDN signal function details, please refer to the zero-return timing chart. <External sensor is useable only for NPN Type> 

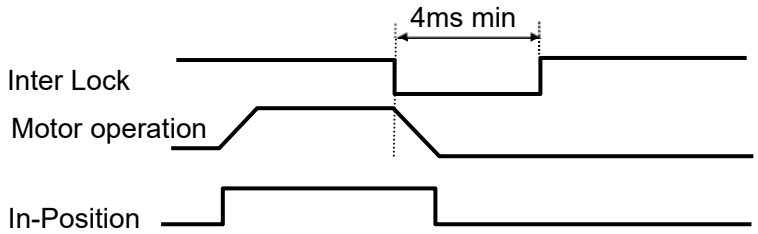


4. Type R (RS-485 + PIO)

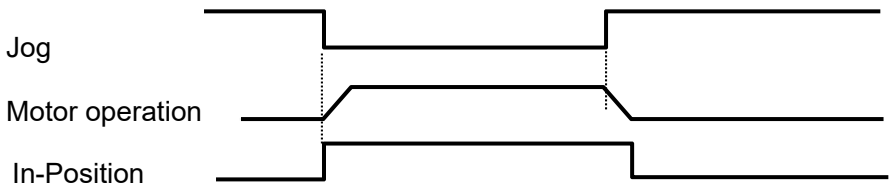
Name	Logic selection	Function outline
PAUSE	Fixed ON=Pause	Pause input. When input during operation, it decelerates and stops at the preset rate. When released, it resumes motion towards the target position. * Able to effect operation command when program is in execution.



Name	Logic selection	Function outline
Inter Lock	Fixed ON=linter lock	Decelerates and stops at the preset velocity while maintaining servo ON status. Stop position becomes the target position. Movement command cannot be received during inter lock. Inter lock status is cancelled when the Inter lock signal is OFF and the motor has stopped. * Able to effect operation command when program is in execution.

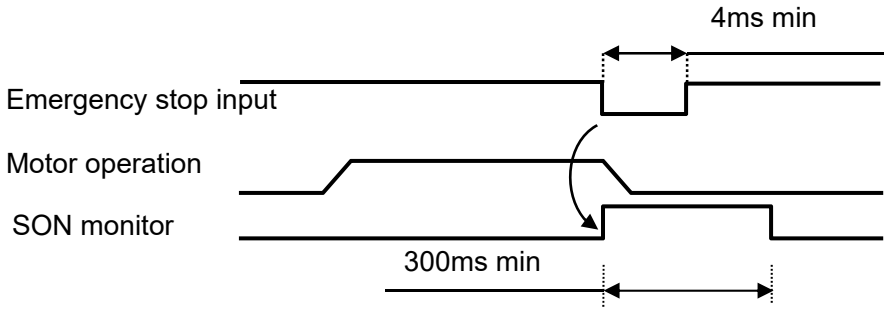


Name	Logic selection	Function outline
Jog	Fixed ON=Start OFF=Stop	Activates continuous rotation motion preset by Command Ah. Continuous rotation is stopped by selecting OFF. The stop position becomes the target position.



4. Type R (RS-485 + PIO)

Name	Logic selection	Function outline
STOP	Selectable Initial value: ON=STOP	This is the emergency stop input signal. It becomes servo OFF status when the STOP signal is recognized, and if input during drive, rapid deceleration stop will result. After stoppage, follow the command 20h setting value for the motor torque. Cancellation will enter servo ON state after the STOP signal input is OFF, the motor has stopped and 300ms have elapsed.



Name	Logic selection	Function outline
Generic input	N/A	Functions as generic input. Use for the input monitor (Command 63h) during program execution.

3) Output with Fixed Functions

Name	Logic selection	Function outline
ALM	Selectable Initial value ON=ALM	Issued when alarm is activated. * Detects low voltage error when power failure occurs with the servo ON. Switch off the power with the servo OFF.

4) Output Function by Function Selection

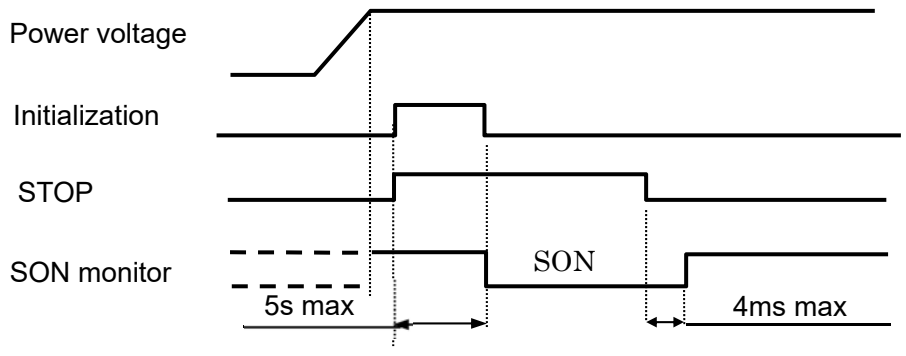
Output signal function is preset by Command 16h. Refer to Command 16 for more details.

Note) When the power is turned on, the status of each output Port is uncertain until the CPU is in motion. Observe output Ports for more than 5 seconds after the power supply voltage has settled.

Name	Logic selection	Function outline
Ack	Fixed ON=successful response	Response signal for execution of HOME, EXE and ST0 to 3(input port). Output is hand shaken with activation signal. Does not respond if command cannot be executed due to driver status.
PEND0 to 6	Fixed On=1 OFF=0	Emits the completed Position number in binary code during Point positioning. Also responds to Point selecting movement during PRG. ＜Output criteria＞ **Conditions for all OFF** ・Servo OFF status ・When operation command is successfully received by EXE, ST and communication. **SET conditions** ・On successful completion of positioning using Point activation by EXE, ST and communication. (within In-Position range) ・On completion of push during push. ・On successful completion of zero-return during zero-return. ・When Jog stops during Jog. * Once the output status is confirmed, it will not change.
END	Fixed 0n= Successful completion	Emitted during Point positioning by I/O when Ack output=OFF and within In-Position range. Also responds during activation by ST0 to 3. * No response to execution except activation command and operation command by communication. * This function is effective for when In-Position does not respond and for short movement command. * Does not turn On during Pause and Inter Lock. * Output criteria are the same as for PEND signal. * Output status will not change after the first positioning is completed.

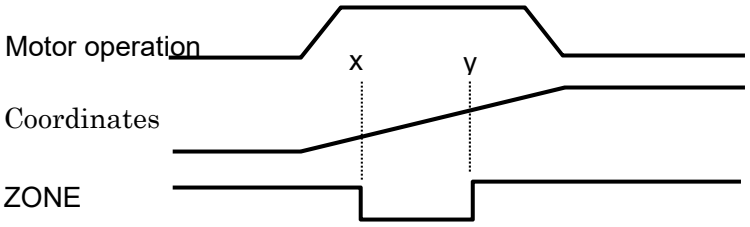
4. Type R (RS-485 + PIO)

Name	Logic selection	Function outline
STEND	Fixed OFF=0 ON=1	Completion output signal for 4-point positioning by STO to 3. ＜Output criteria＞ * Does not change after being set On. * Output criteria are the same as for PEND signal.
HEND	Fixed On=completed	Zero-return completion output signal. It is OFF after the power is switched on and turns ON when zero-return has successfully completed. It switches OFF when the next zero-return commences and switches on again when zero-return has successfully completed. * When zero-return is incomplete, operation command can be set to enable/disable by Command 1Eh. Activation of zero-return responds to HOME, Command 45h and Point start.
P.Busy	Fixed On=PRG in execution	Emitted during program execution. Does not receive commands other than program stop, initialization and STOP during program execution. * PRG execution will terminate there are commands which can not be executed.
SON MON	Fixed On=SON OFF=SOFF	Monitors the condition of the servo. Will not receive move command when in the servo OFF state. * It switches to servo ON state automatically after the power supply voltage of the PB system has settled and initialization has successfully completed. If Inter Lock or STOP status is Active, initialization will not be executed.



4. Type R (RS-485 + PIO)

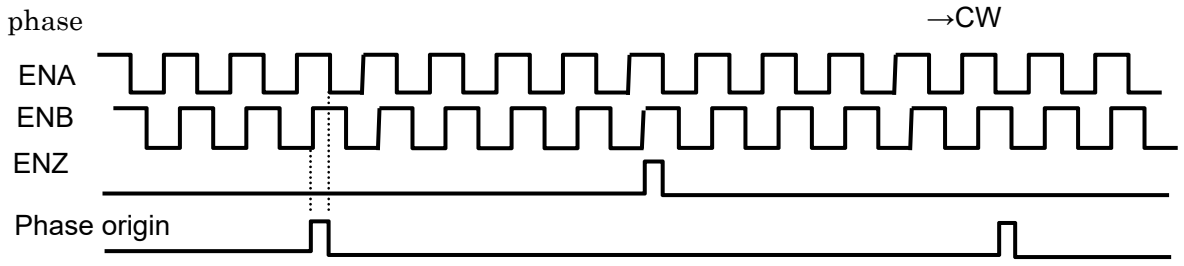
Name	Logic selection	Function outline
ZONE	Selectable Initial value： On Active	Zone output signal preset by Command 2Ah. Will be emitted 1 to 1 according to Zone setting range. * Not emitted if zero-return is incomplete. * Will also be emitted when in servo OFF status and the modulo function is in effect * It is also possible for output to straddle the 0 position.



Name	Logic selection	Function outline
In-Position	Fixed On=In-Posi	Becomes On when within the in-Position width range for which a target position has been set. Becomes On when push is completed during push operation and when stop position is reached during Jog operation. * It is always OFF during servo OFF status. * The In-Position signal may not be recognized if the move command is short or because of the hardware response delay time.
Input monitor	Fixed Same as input status	Monitor output for the input status of IN1-In8 and ALMCLR. Not affected by input function and output is the same as for input status. (if Input = On, output = On).
Bit Out	Fixed	Controls the output status by Bit Out command（Command 4Bh）.
MODE MON	Fixed OFF=Normal mode ON= Teach mode	Monitor of normal mode / teaching mode. When using teaching mode, status can be monitored by allocating function.

4. Type R (RS-485 + PIO)

Name	Logic selection	Function outline
ENA ENB	Fixed	Encoder output (A / B phase）. * When allocating this function, both OUT 8 and 9 must be set to 26h. If not set, command error will result. * Encoder signal outputs A and B will not be emitted when +COM（pin no 25）is not provided.
ENZ	Fixed	Emits encoder Z-phase signal (1P/R). * Z-phase signal output will not be emitted at velocities over 200min^{-1}. * Can not be allocated except to Out7. * It will not be emitted when +COM（pin no 25）is not provided.
Phase origin	Fixed	Emits phase origin signal of the encoder(50P/R). * Phase origin signal output will not be emitted at velocities over 200min^{-1}. * Can not be allocated except to Out7. * It will not be emitted when +COM（pin no 25）is not provided.



* Encoder signal output is emitted when ENA/ENB is 500P/R, ENZ is 1P/R and phase origin signal is 50P/R.
* ENZ and phase origin signals will not be emitted at velocities over 200min^{-1}.

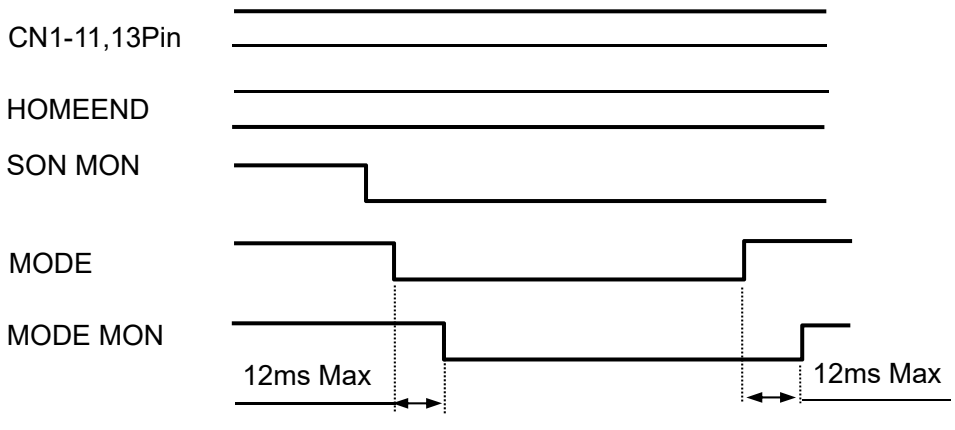
4.2.2 Teaching Mode Input / Output Signal

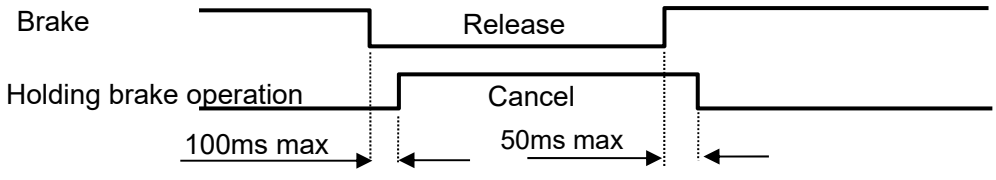
A mode used for instructing the current position to a desired point.

During the teaching mode, input / output signal function of CN1 is fixed and not dependent on input / output signal function.

1）CN5, 6 Input Signal

Pin No	Name	Logic selection	Function outline
7	MODE	Fixed On= Teaching mode OFF=Normal mode	A mode switch signal which controls the shift to teaching mode. It switches to teaching mode when the driver status is zero-return completed, servo ON stop, ±Jog input is OFF and the MODE signal has lasted more than 10ms. Teaching status is canceled when the motor stops and MODE = OFF. * If the alarm is activated during teaching mode, it automatically changes to normal mode.
8	Brake	Fixed On=Release OFF=Hold	Functions as control input of holding brake release / hold, only during STOP input in teaching mode. It will not function in any other status. Use this during Offline teaching (manually). * The load may drop by its own weight when the holding brake is released. Ensure safety checks before releasing the brake. * The excitation current during STOP will be non-excitation regardless of the value setting of Command 20h.





4. Type R (RS-485 + PIO)

2）CN1 Input Signal Functions (Teaching Mode)

Name	Logic selection	Function outline
PWR	Fixed On=Write	Writes the current position to the specified Point Number. Writing is completed by having PWR On for longer than 25ms. When overwriting, only the current position is renewed and when writing for the first time, the velocity, acceleration velocity and In-Position width defined by Command 9 take effect. * If the former command is not the absolute position move command, it automatically becomes the absolute power move command by Command 44h.
Point0 to 6	Fixed On=1 OFF=0	Sets the Point Number in teaching mode by binary code. When using in 4-point motion, set Point 0 to 3 by binary code.
±Jog	Fixed On=Jog operation OFF = stop	Pin number CN1-11 and 13 each become positive direction Jog and negative direction Jog terminals. Operates with conditions preset by Command Ah. If positive and negative direction is On simultaneously, motor will stop. * It will not function when the STOP signal is On.
STOP	Fixed On= Offline teaching OFF=Online teaching	Sets the teaching condition. 【Online teaching】 Executes positioning by sending Jog. 【Offline teaching】 Driver will be in servo OFF status and the motor will be in the non-excited state, regardless of the Power Limit setting. Manual teaching is necessary. Brake input takes effect and the holding brake will become able to be released. Brake input will be invalid in modes other than Offline teaching mode.

4. Type R (RS-485 + PIO)

3）CN1 Output Signal （Teaching Mode）

Name	Logic selection	Function outline
ALM	Selectable Initial value On=ALM	Issued when alarm is activated. * Detects low voltage error when power failure occurs with the servo ON. Switch off the power with the servo OFF if the alarm becomes a problem. * By alarm activation, change to normal mode will be automatic.
Point MON	Fixed On=1　OFF=0	Monitor output of Point input. Outputs the same status as Point input.
Jog MON	Fixed On=In operation	On during Jog operation. OFF when stopped.
WEND	Fixed On= writing	Turns on 20ms after the PWR signal starts writing. When writing is completed and the PWR signal turns OFF, the WEND signal will be OFF.
MODE MON	Fixed On= Teaching Mode	Signal to monitor the current mode of input.
SON MON	Fixed On=SON	Monitors the condition of servo. It is in servo OFF status (manual teaching) when the STOP input is On.

4）Teaching operation in PIO.

a) Jog teaching operation procedure

① Complete zero-return in normal mode.

② Pin number CN1-11,13 (JOG input when in teaching mode）OFF.

③ MODE Input=On in SON stop status, change to teaching mode. (more than12ms）

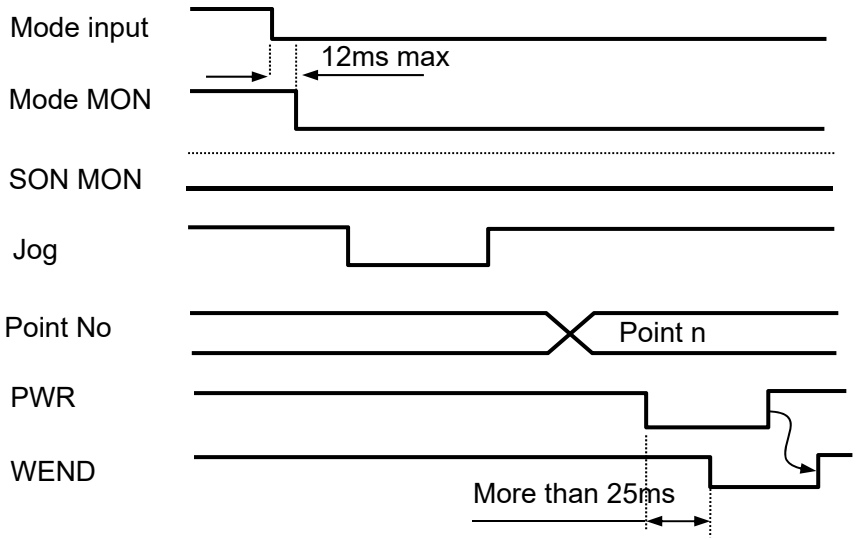
④ Set the desired position by Jog operation.

⑤ Select the Point No and write with PWR signal.（On more than 25ms）

⑥ Confirm the completion of writing with WEND signal monitor.

* When overwriting the point data, it renews only the current position. If written for the first time, the velocity, acceleration velocity and In-Position width defined by Command 9 take effect. If the former command is not the absolute position command, Command 44h will be automatically allocated.

* Select Point No=0 to 3 when instructing to 4-point positioning.



b) Jog teaching operation procedure

① Complete zero-return in normal mode.

② Pin number CN1-11,13 (JOG input when teaching mode) OFF

③ MODE Input=On in SON stop status, change to teaching mode. (more than12ms

④ STOP input On

⑤ Release holding brake if fixed.

⑥ Set the position of Work manually.

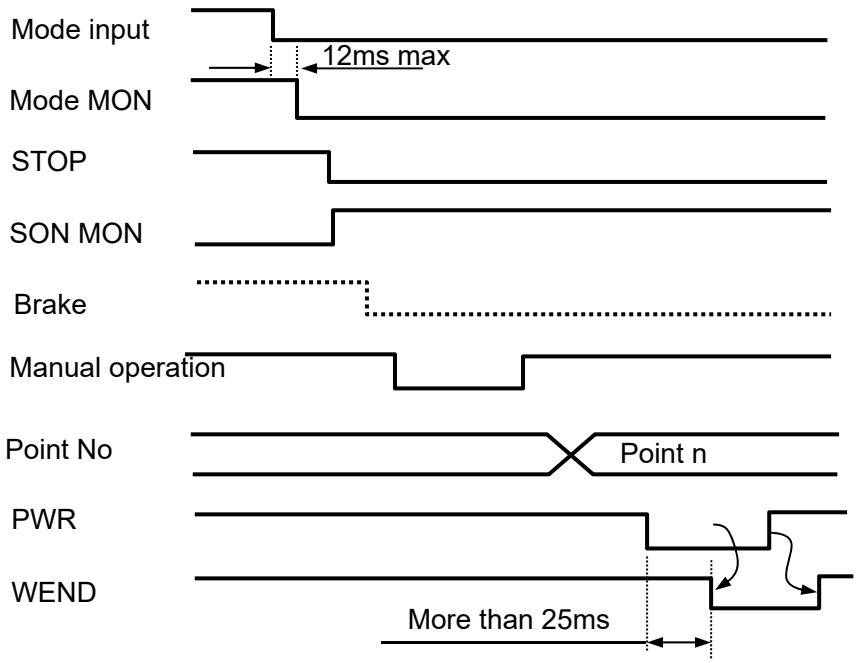
⑦ Select the Point No and write with PWR signal (On more than 25ms)

⑧ Confirm the completion of writing with WEND signal monitor.

* When overwriting the point data, it renews only the current position. If written for the first time, the velocity, acceleration velocity and In-Position width defined by Command 9 take effect. If the former command is not the absolute position command, Command 44h will be automatically allocated.

* Select Point No=0 to 3 if instructing to 4-point positioning.

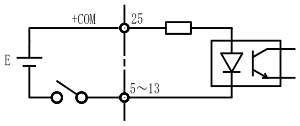
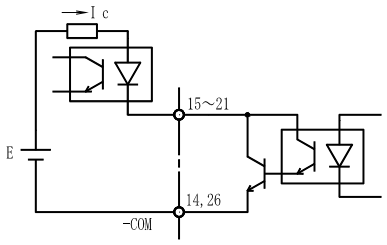
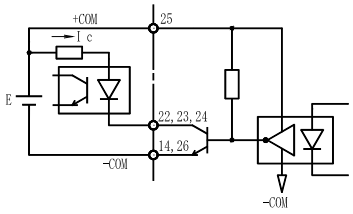
* Ensure safety checks before releasing the holding brake.



4. Type R (RS-485 + PIO)

4.2.3 Input / Output Signal Circuit

DC Characteristics

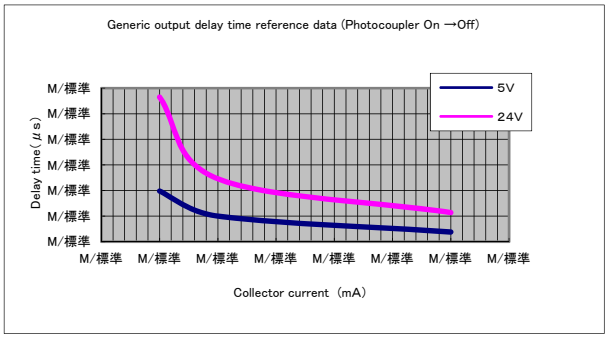
Circuit Type	Circuit formation (connection example)	Standard value
Generic input		E=DC5 to 24V±10%
Generic output OUT1 to OUT6		E=DC5 to 24V±10% Ic=30mA max
Generic output OUT7 to OUT9		E=DC5 to 24V±10% Ic=2 to 12mA max at 5V Ic=8 to 30mA max at 24 * Please note that output will not occur when power is not supplied to +COM（pin 25）. * ENZ / phase origin signal outputs will not be emitted at velocities over 200min-1.

AC Characteristics

The response time of each input / output signal depends on applied voltage and output current conditions. In anticipation of delay time in the higher controller side, refer to the chart below to decide the control timing. Also, as input / output interface uses a photo coupler, delay time changes due to dispersion of parts and secular changes. Secure the margin when deciding the control timing. About 1ms delay time occurs for each input / output signal because of sampling cycles (500μs) of the driver.

Hardware response time reference values

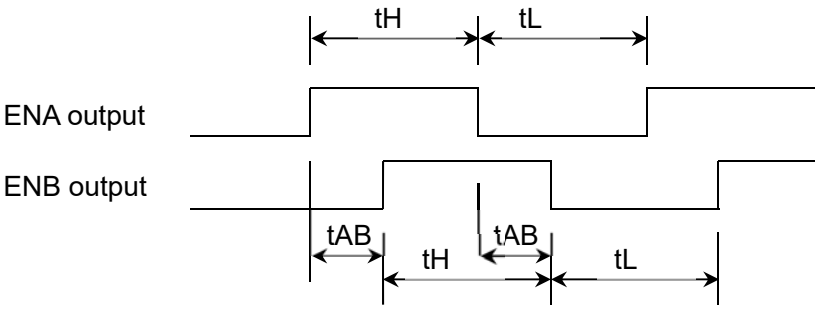
Hardware No	Measurement conditions	ON→OFF delay time	OFF→ON delay time	Note
Generic input	5v input 24v input	250μs NOM 250μs NOM	30μs NOM 10μs NOM	—
Generic output OUT1 to OUT6	5V input 10mA 24V input 10mA	250μs NOM 500μs NOM	20μs NOM 20μs NOM	Refer to the following chart
Generic output OUT7 to OUT9	5V input 10mA 24V input 10mA	1μs NOM 2μs NOM	1μs NOM 0.5μs NOM	—



4. Type R (RS-485 + PIO)

Encoder output timing

ENA/ENB has a delay due to the characteristics of the driver output circuit. Since the delay time differs depending on whether it is ON or OFF, the output pulse width and phase difference of the driver output signal will be smaller than the original encoder signal.



Input voltage	5V	24V
Minimum output pulse width tH,tL	6μs	6μs
Minimum phase difference of ENA and ENB tAB	1μs	1μs

4. Type R (RS-485 + PIO)

4.3 Commands

4.3.1 Command Lists

1）System Commands

Command	Command Name	Function	Point/PRG Indication
1	Initialization	Initializes the CPU to the state of power on.	No
2	Parameter CLR	Clears the parameters and resets them to their factory settings *Communication condition（Command 7）is not cleared.	No
3	Parameter Save	Saves the edited parameters to non-volatile memory.	No
4	Parameter Load	Loads the data from non-volatile memory to RAM.	No
5	Point CLR	Clears only the Point and PRG data.	No
6	ALM history CLR	Clears the alarm history.	No

2） Initial Setting Commands

Command	Command Name	Function	Point/PRG Indication
7	Communication Condition	Sets the communication velocity.	No
8	Additional Command	Enables or disables the additional movement command during optional drive.	No
12(Ch)	EXE Filter	Sets the software Filter of EXE signal.	No
14(Eh)	I/O Disable Command	Enables or disables activation by I/O.	No
16(10h)	Response Time	Sets the response time of communication.	No
17(11h)	Software Switch	Sets the motor model and resolution.	No
18(12h)	Positive Direction Definition	Sets the positive direction.	No
19(13h)	Initialization Movement Direction	Sets the initialization movement direction.	No
20(14h)	ALM Detection Condition	Enables or disables the overload stop, servo error detection threshold and ALM detection function.	No
22(16h)	I/O Port Function	Sets the logic and function of the I/O signal.	No
27(1Bh)	Number of Programs	Sets the number of programs.	No
28(1Ch)	Execution Target Selection	Selects the EXE signal execution target to point or program when not using the SELECT signal function.	No
30(1Eh)	Move Enable	Selects the enable or disables of movement before zero-return.	No
31(1Fh)	User Memory	Provides the memory data area for user.	No
35(23h)	Zero-Return Maximum Travel Distance	Sets the maximum travel distance during zero-return.	No

3) Push Condition/Teaching Function

Command	Command Name	Function	Point/PRG Indication
24(18h)	Push Deviation	Sets the threshold for detecting a deviation error due to push back during push operations.	No
37(25h)	Push Determination Time	Sets the determination time for push completion.	YES
38(26h)	Push Velocity	Sets the push velocity of a push operation	YES
9	Teach Initial Value	Sets the initial value of velocity, acceleration /deceleration rate, In-Position and push current when in teaching mode. * Define initial value of the movement command when data is not stored in teaching Point or when a command other than movement command is memorized.	No
10(0Ah)	Operation Condition when Teaching	Sets the Jog operation velocity and acceleration / deceleration rate when in teaching mode.	No

4) Adjustment Parameter

Command	Command Name	Function	Point/PRG Indication
32 (20h)	Power Limit	Sets the current limit value at optional state. Used for Torque limit or Power Down, etc.	Yes
33(21h)	Gain 1	Sets the normalized servo parameter.	Yes
47(2Fh)	Gain 2	Sets the detailed Gain.	Yes
34(22h)	LPF	Sets the low-pass filter of velocity loop.	Yes
36(24h)	Correction Coefficient	This is an adjustment parameter for soft landing.	Yes
225(E1h)	P/PI Switch	Sets the switching condition of proportional / Integral control.	No

5) User Setting Commands

Command	Command Name	Function	Point/PRG Indication
42(2Ah)	ZONE	Sets the coordinates range for Zone output.	Yes
48(30h)	In-Position Width	Sets the In-Position width.	Yes
50(32h)	Positive Direction Soft Limit	Sets the soft limit for the positive direction.	Yes
51(33h)	Negative Direction Soft Limit	Sets the soft limit for the negative direction.	Yes
43(2Bh)	Modulo Enabled / Disabled	Enables or disables the modulo function (coordinate range adjustment function). This function is effective for indexing applications.	Yes
44(2Ch)	Modulo Value	Sets the modulo pulse number per rotation.	Yes
45(2Dh)	Modulo Rotational Direction	Sets the rotational direction for the modulo function.	Yes

6） Operation Commands

Command	Command Name	Function	Point/PRG Indication
62(3Eh)	Slow Move command	Specifies a slow movement command using the Open control.	YES
64(40h)	SCAN Operation	Initiates continuous rotation.	YES
65(41h)	SCAN Stop	Specifies the stop of a continuous rotation.	YES
66(42h)	Incremental Move Command	Specifies the velocity, acceleration / deceleration rate, or an incremental move with push condition.	YES
68(44h)	Absolute Move Command	Specifies the velocity, acceleration / deceleration rate, or an absolute move with push condition.	YES
69(45h)	Zero-Return	Initiates zero-return.	YES
54(36h)	Velocity	Specifies the movement of Command 56 and 58, or modifies the velocity during operation.	YES
55(37h)	Acceleration / Deceleration Rate	Commands the movement of Command 56 and 58, or modifies the acceleration / deceleration rate during operation.	YES
56(38h)	Incremental Move	Initiates an incremental position move. The command data specifies only the travel distance.	YES
58(3Ah)	Absolute Move	Initiates an absolute position move. The command data specifies only the absolute move coordinates.	YES

7） State Control Command

Command	Command Name	Function	Point/PRG Indication
52(34h)	Counter Preset	Presets the absolute position counter inside the driver.	YES
53(35h)	Brake Enable	Specifies holding brake engage/release when the servo is OFF.	No
71(47h)	Deviation Clear	Initiates deviation clear. The position at the time of receiving this command will become the target position.	YES
72(48h)	Pause	Initiates the Pause (temporary stop). The target position is maintained and when the signal is cancelled, the movement to the target continues.	YES
73(49h)	Pause Clear	Cancels the Pause signal. Starts movement to the target position.	YES
74(4Ah)	Alarm Clear	Specifies the clearing of cancelable alarms.	YES
75(4Bh)	Bit Out	Controls the output function when the generic output is used for output port functions.	YES
76(4Ch)	STOP Command	Commands a STOP. Moves to servo OFF state.	No
77(4Dh)	STOP Clear	Clears the STOP status. Moves to servo ON state.	No
78(4Eh)	Interlock	Keeps the servo ON status, and stops.	YES
79(4Fh)	Interlock Clear	Clears the interlock status.	YES

8) Store・Activating Command

Command	Command Name	Function
80(50h)	Communication Activation	Activates the pre-stored Point, 4-point positioning, zero-return or program.
81(51h)	STEP Operation	Commands the STEP operation of the program.
82(52h)	Program Stop	Stops the program.
86(56h)	Point Store	This command stores the Point, 4-point positioning, zero-return (for HOME), and Jog data.
87(57h)	PRG Store	This command stores the program data.
88(58h)	Teaching	Writes the current position to specified Point.

9) Program Exclusive Commands

Command	Command name	Function
96(60h)	Program END	Ends the program.
97(61h)	Timer Wait	Sets the delay timer.
98(62h)	In-Position JMP	Jump command based on In-Position status.
99(63h)	In-Port JMP	Jump command based on input Port status.
100(64h)	ZONE JMP	Jump command based on ZONE status.
101(65h)	Position JMP	Jump command based on absolute position condition.
102(66h)	Unconditional JMP	Unconditional jump command.
103(67h)	Motor stop JMP	Jump command based on motor stop status.
106(6Ah)	FOR	Sets the loop counter. Multiple structures are possible.
107(6Bh)	NEXT	Returns to the loop counter.
108(6Ch)	Gosub	Calls a subroutine.
109(6Dh)	Return	Returns from the subroutine.
110(6Eh)	Point	Calls Point data within PRG.

10) Read Commands

Command	Command Name	Function
128(80h)	Parameter RD	Reads a direct command.
129(81h)	Point data RD	Reads the Point data.
130(82h)	Program data RD	Reads the program data.
131(83h)	Driver status RD	Monitors the driver status and the input / output status.
132(84h)	Absolute position RD	Monitors the absolute position counter.
133(85h)	Velocity monitor	Monitors the actual velocity.
134(86h)	ALM monitor	Reads the alarm history.
135(87h)	Communication error history RD	Reads the communication error history.
137(89h)	Software REV	Reads the driver software revision.
138(8Ah)	Program stop line	Read the line number where the program stopped.
140(8Ch)	Loop counter	Reads the current value of the loop counter associated with the For / NEXT command in the program.
143(8Fh)	Operation complete cause	Reads the motor stop cause.
141(8Dh)	Point No	Reads the last executed Point number.

4. Type R (RS-485 + PIO)

The following diagram shows the conditions for accessing the Non-volatile memory (EEPROM).

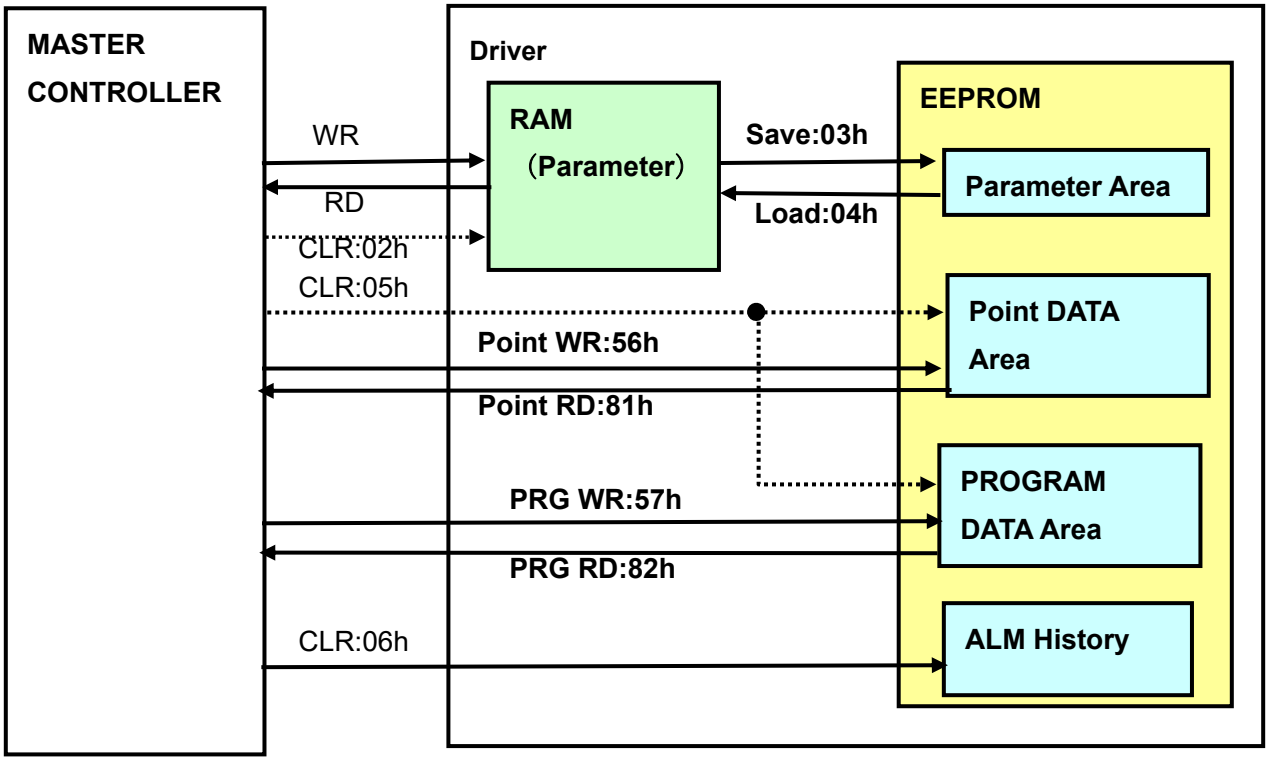


Figure 1　Memory Access

Memory access time

After the driver receives the commands listed below, a period of time is needed for processing the EEPROM access.　After issuing these commands, do not interrupt the power or issue commands during the specified processing time, since an Non-volatile memory error or data loss can result.

Command code	Maximum processing time
01h：Initialization	6s
03h：Parameter Save	20ms
04h：Parameter Load	20ms
05h：Point CLR	6s
06h：ALM CLR	20ms
56h：Point Store	20ms
57h：PRG Store	20ms

① Do not issue commands during EEPROM access, as this will result in a command error. Data writing to the EEPROM should be performed after the motor has stopped.

4.3.2 Commands

1）System Commands

Command Code : 1 Data Length : 0 byte

Initialization
Initializes the driver status to power-up status. ROM parameters are loaded to RAM.

Command Code : 2 Data Length : 0 byte

Parameter CLR
Resets RAM parameters to their factory settings. Point, program data and communication conditions (07h) will not be cleared. * When resetting the ROM parameters, use the Parameter Save (03h) after this command.

Command Code : 3 Data Length : 0 byte

Parameter Save
Saves RAM parameters to the ROM. * If a reset is performed without saving the parameters, the RAM values will be lost.

Command Code : 4 Data Length : 0 byte

Parameter Load
Loads the ROM parameters to RAM. * The same operation is performed at power-up and when using the initialization command.

Command Code : 5 Data Length : 0 byte

Point・PRG CLR
Clears all point and program data.

Command Code : 6 Data Length : 0 byte

ALM History CLR
Clears the alarm history.

2）Initial Setting Command

Ensure settings are appropriate for conditions for use prior to installation.

Command Code : 7 Data Length : 2 bytes

Communication Condition				
DAT No	Function	Setting range	Initial range	Setting value
DAT1	Communication velocity	0 to 3	0（9600bps）	0=9600 1=38400 2=115200 3=128000bps

Sets the communication speed. After being changed, it will take effect from the next command issue.

* Will not be cleared by Parameter clear.

* Communication speed settings are displayed as shown below in LED for approximately 2s after the power is turned on.


9600bps


38400bps


115200bps


128000bps

Command Code : 8 Data Length : 1 byte

Additional Command Enable / Disable				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Additional command enable / disable	0 to 1	0（Enable）	0=Enabled 1=Disabled

Enables / disables the additional movement command during the operation.

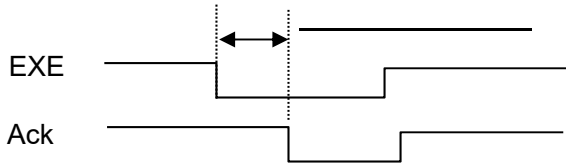
The additional command enable/disable depends on the operation status. Refer to status change diagram.

Command Code : 12(Ch) Data Length : 1 byte

EXE Filter				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	EXE Filter	0 to 255	0	500μs /LSB

Sets the software filter of EXE signal.

* It is effective when EXE signal suffers noise disturbance or when chattering occurs during the relay contact point is being used. However, the operation will be delayed by the setup time of the Filter.



4. Type R (RS-485 + PIO)

Command Code : 14(Eh) Data Length : 1 byte

I/O Disable Command				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	IO Activation enable / disable	0 to 1	0 (Enable)	0=Enable 1=Disable
Enables / disables EXE, ST, Jog and HOME input Port functions. When set to disable, activation using Point (including ST), program and HOME input Port is disabled. Activation by communication is allowed. * The setting value of this command will not be stored in EEPROM.				

Command Code : 16 (10h) Data Length : 1 byte

Response Time				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Response time	0 to 7	7	T1=500μsec×2^n T2=2×T1 T3=2×T2
Sets the driver status response time. The setting will be valid beginning with the response to this command. * If 0 is specified, the response will be the status immediately after receiving the command. Certain cases exist when the driver status is not reflected in the response data. * Refer to Section 4.8 for communication specifications.				

4. Type R (RS-485 + PIO)

Command Code：17（11h） Data Length：4 bytes

Software Switch				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Motor model / resolution	-	10h	-
DAT2	Reserve	-	-	-
DAT3	Limit prohibited	0,80h	0	0：Limit allowed 1：Limit prohibited
DAT4	Reserve	-	-	-

DAT1：Sets the motor model and the resolution.

DATA NO	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
DAT1	*	*	Resolution：②			Motor model number：①		

Motor model / resolution

②			resolution (P/R)	①			Motor model	Current specifications (A)
Bit5	Bit4	Bit3		Bit2	Bit1	Bit0		
0	0	0	500	0	0	0	PBM282	1
0	0	1	1000	0	0	1	PBM284	1
0	1	0	2000	0	1	0	PBM423	2.8
0	1	1	4000	0	1	1	PBM603	2.8
1	0	0	5000	1	0	0	PBM604	2.8
1	0	1	10000	1	0	1	Reserve	-
1	1	0	Setting prohibited	1	1	0	Reserve	-
1	1	1	Setting prohibited	1	1	1	Reserve	-

DAT3-Bit7

For CN1- Hard Limit input, select SDN + Limit or only SDN.

0=Hard Limit function or SDN function（Function as SDN input during zero-return motion and as Limit input during the normal operation.）

1=Conjunction（Hard Limit function input becomes invalid.）

Command Code：18（12h） Data Length：1 byte

Positive Direction Definition				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Rotational direction definition	0 to 1	1	0（Pos. direction=CW） 1（Pos. direction=CCW）

Defines the positive direction. (when viewed from the surface where the motor was installed.)

The sign of an incremental move command is “+" for positive direction, and “-“ for negative direction.

* Limit direction also follows this definition.

* Do not change the setting during operation.

4. Type R (RS-485 + PIO)

Command Code ： 19 (13h) Data Length：1 byte

Initial Movement Direction				
DAT No	Function	Setting rage	Initial value	Setting range
DAT1	Initial movement direction	0 to 1	0	0 (CW) 1 (CCW)

Defines the initialization method.

* As the PB system initializes the sensor counter when the power is turned on, operate the motor within slight angles.
* If it is not in STOP, interlock or Alarm status after the power is turned on, initialization movement is executed automatically and it will change to servo ON status after normal completion. The maximum Initial movement time is approximately 5s.
* Initialization movement error will occur if the load condition reaches mechanical limit or a power line connection error occurs.

Command Code：20 (14h) Data Length：4 bytes

ALM Detection Condition				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Overload stop time	1 to Ch	8	1s／LSB
DAT2、3	Servo error detection threshold value	14 to FFFFh	1770h	1PULSE（equivalent of 2000P/R）
DAT4	Enables or disables the ALM detection	-	01h	0=Detection allowed(enabled) 1=Detection prohibited (disabled)

Sets the alarm detection conditions and enables or disables the alarm detection function.

DAT1：Sets the overload detection time when stopped before reaching the target position.

DAT2 and DAT3：Sets the servo error detection condition.（Detected if DAT4, Bit2=0）

DAT4：Enables or disables the optional Alarm and Limit functions.

DATA NO	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
DAT1	*				Overload stop time			
DAT2	Deviation excess value（lower Byte）							
DAT3	Deviation excess value（higher Byte）							
DAT4	*	*	*	SL-	SL+	SE	Push	Wrap

* Overload stop ALM is not detected during push operation.

DAT4

WRAP: Enables or disables ALM detection for Wrap Around (coordinate sign reversal).
Select “1” (detection prohibited) to enable continuous operation in the same direction.

Push：Enables or disables alarm detection for an unloaded push (when the target position set by the movement distance is reached during the push operation).

SE: Enables or disables the detection of a servo error in the case of excessive deviation. If enabled, the detection conditions set in DAT2, 3 are used.

SL+: Enables or disables the Positive Soft Limit function set by command 32h.

SL-: Enables or disables the Negative Soft Limit function set by command 33h.

4. Type R (RS-485 + PIO)

Command Code : 22 (16h) Data Length : 19 (d) bytes

Input and Output Port Function				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Input logic selection	-	0	Other than SELECT : 0=On Active SELECT : 0=Point 1=PRG
DAT2	Output logic selection	-	0	ZONE, ALM: 0 =A conn. (On Active) 1=B conn. Z-phase/phase origin: 0=OFF Active 1=ON Active
DAT3 to 10	Input Port function	0 to 15h	8,0,1,2,3,4,D,15	-
DAT11 to 19	Output Port function	0 to 29h	0,1,2,3,4,D,28,29,E	-

Sets the input / output signal logic of CN1, and selects the function of the generic input / output signals.

DATA NO	Function	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
DAT1	Input logic	*	*	SEL	*	*	STOP	HL-	HL+
DAT2	Output logic	*	*	*	ENZ/phase origin	*	ZONE	ALM	*
DAT3 to 10	Input function	Allocates functions to each CN1 input Port : IN1 to IN8. Functions are to be selected from Chart 1.							
DAT11 to 19	Output function	Allocates functions to each CN1 output Port : Out1 to Out9. Functions are to be selected from Chart 2.							

* Points can be selected up to maximum of 128, but PEND output can be selected only up to 64 Points.
* When either of Out8 or 9 is selected for the encoder signal output, both Out 8 and 9 will be encoder output. The selected function remain valid for other cases.
* The Z-phase/phase origin signal is not output if the initialization operation is incomplete.
* The Z-phase/phase origin signal is undefined if the encoder is broken or the drive speed is 200min^{-1} or higher.

4. Type R (RS-485 + PIO)

Chart 1 Input Function Selection Lists

Type(decimal)	Name	Logic selection	Function outline	Logic
0	Point0	Not selectable	Selects the Point numbers from Point0 to Point6 in 7bit binary code and the program number. Point and program number set with EXE signal will be activated.	On=1, OFF=0
1	Point1	Not selectable		
2	Point2	Not selectable		
3	Point3	Not selectable		
4	Point4	Not selectable		
5	Point5	Not selectable		
6	Point6	Not selectable		
7	SELECT	Selectable	Selects an execution target from either Point or Program. When SELECT signal is not used, an execution target can be selected by Command 1Ch.	-
8	EXE	Not selectable	Activates the signal selected by Point0 to 6 and SELECT signal.	On edge start
9	ST0	Not selectable	Activation signal for 4-point positioning. One command will be allocated to each input.	On edge start
A(10)	ST1			
B(11)	ST2			
C(12)	ST3			
D(13)	HOME	Not selectable	Activation signal for zero-return preset by command 56h.	On edge start
E(14)	Pos. direction Hard Limit	Selectable	Positive direction Hard Limit sensor input. Functions as SDN signal when zero-returning.	-
F(15)	Neg. direction Hard Limit	Selectable	Negative direction Hard Limit sensor input. Functions as SDN signal when zero-returning.	-
10(16)	Pause	Not selectable	Signal for temporary stoppage of operation.	On Active
11(17)	Inter Lock	Not selectable	Interlock（Deceleration stop in SON status）signal.	On Active
12(18)	Pos. direction Jog	Not selectable	Rotates continuously at the velocity and acceleration / deceleration rate preset by Command Ah. Stops when turned OFF.	On Active
13(19)	Neg. direction Jog	Not selectable		
14(20)	Generic input	Not selectable	Functions as input monitor.	OFF=0 On=1
15(21)	STOP	Selectable	Emergency stop input.	-

* Refer to Section 4.2 for function details.

Chart 2 Output Function Selection Lists

Type(d)	Name	Function outline
0	PEND0	Binary outputs the positioning completed Point No. selected by Point0 to 6. All will be OFF during the servo OFF state and during operation.
1	PEND1	
2	PEND2	
3	PEND3	
4	PEND4	
5	PEND5	
6	PEND6	
7	Ack	Receival complete signal for EXE and ST signal.
8	Busy	Will be emitted during PRG execution.
9	STEND0	Indicates that the 4-point positioning using ST signal is successfully completed.
A（10）	STEND1	
B（11）	STEND2	
C（12）	STEND3	
D（13）	END	It will be emitted during the Point positioning by I / O（including point move during PRG）if EXE=OFF and the operation is successfully completed. Responds also when activating by ST.
E（14）	HEND	Zero-return completion signal.
F（15）	SON MON	Outputs the driver status.
10 to 13 (16 to 19）	ZONE1	The Zone signal output set in command 31h. Will also be emitted when the modulo function is in effect. Output is 1 to 1 for the zone setting range.
	ZONE2	
	ZONE3	
	ZONE4	
14(20)	MSTOP	Indicates operation completion of move commands.
15 to 1D (21 to 29)	Input monitor	Monitors the input status of IN1 to IN8 and ALMCLR. Is not affected by input functions and echoes back the input status.
1E to 26 (30 to 38）	Bit Out	Controls the output status by Bit Out command (Command 4Bh) corresponding to OUT1 to OUT8.
27（39）	EN	Indicates Out8 and 9 functions as encoder A/B-phase output. When allocating this function, set 26h for both Out 8 and 9. If not set, command error will result.
28（40）	In-Posi	In-Position output.
29（41）	MODE MON	MODE input monitor.
2A（42）	C-phase	Outputs the encoder c-phase signal (1P/R). Can be set only for Out7.
2B（43）	Phase origin	Outputs the phase origin (50P/R) signal for motor. Can be set only for Out7.

* Refer to Section 4.2 for function details.

4. Type R (RS-485 + PIO)

Command Code : 27 (1Bh) Data Length : 1 (d) byte

Program Number Selection				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Program number	0 to 2	0	0=1PRG×1024 Line 1=128PRG×8 Line 2=32PRG×32 Line
Selects the number of programs.				

Command Code : 28 (1Ch) Data Length : 1 (d) byte

Execution Target Selection				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Execution target selection	0 to 1	0	0=Point 1=PRG
Sets the execution target of the EXE signal when not using the SELECT signal.				

Command Code : 30 (1Eh) Data Length : 1 (d) byte

Move Enable				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Movement permission	0 to 1	0	0=Enable 1=Disable
Enable or disable the movement before zero-return completion. When set the disable, a movement order before origin return movement becomes command error. * SCAN movement can be executed regardless of this setting.				

Command Code : 31 (1Fh) Data Length : 8 bytes

User Memory				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 8	User memory	-	ALL 0	-
Provides 8 bytes of memory for the user, which can be used as the user management data area.				

Command Code : 35 (23h) Data Length : 4 bytes

Zero-return Maximum Travel Distance				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 4	Zero-return maximum travel distance	-	Maximum value/2	Pulse (Resolution is set with a soft switch)

Sets the maximum travel distance from the point where the zero-return was started. It is enabled when executing zero-return Type=1 to 4

If there is no normal completion within the maximum travel distance, it will generate a zero-return error.

Resolution(P/R)	500	1000	2000	4000	5000	10000
Maximum value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF

3） Push Condition / Teaching Function

Command Code：24（18h） Data Length：2 bytes

Push Deviation				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Push deviation	1 to FFFFh	FFFFh	1Pulse（standard 2000P/R）
Sets the threshold for detecting a deviation error due to pushback during push operation. Enabling or disabling the alarm detection is configured by Command 14h DAT 4, Bit 1.				

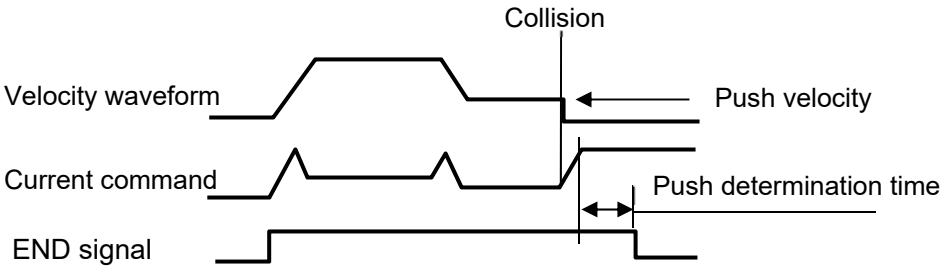
Command Code：37（25h） Data Length：1 byte

Push Determination Time				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Push determination time	1 to FFh	Fh	10ms／LSB
Sets the time for completion determination for push zero-return operation and push operation. The determination time counter starts when the current limit for push set for the respective operation is reached.				

Command Code：38（26h） Data Length：2 bytes

Push Velocity				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Push velocity	0 to 1194h（0 to 4500 min^{-1}）	28h（40 min^{-1}）	1min^{-1}／LSB
Sets the push velocity for push zero-return operation and push operation.				

Push determination overview



4. Type R (RS-485 + PIO)

Command Code : 9 (9h) Data Length : 9 bytes

Teaching Condition				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Velocity	0 to 1194h (0 to 4500 min^{-1})	64h (100 min^{-1})	1 min^{-1}
DAT3	Teaching acceleration rate	0 to FFh	2	1min^{-1}／ms／LSB
DAT4	Teaching deceleration rate	0 to FFh	2	1min^{-1}／ms／LSB
DAT5	Current limit	0 to FFh	0	0=No push 1 to FF : Push current limit
DAT6 to 9	Positioning width	0 to CCCCCCCh	4	1Pulse(2000P/R fixed)
Defines the teaching data initial value when in Teaching Mode. This setting value is applied when overwriting if data has not been set in specified Point or if a command other than the absolute position move command has been stored. The original data will be valid if data has already been set.				

Command Code : 10 (Ah) Data Length : 4

Jog Operation Condition (During Jog operation in Teaching Mode / Input Port)				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Velocity	0 to 1194h (0 to 4500 min^{-1})	64h (100 min^{-1})	1 min^{-1}
DAT3	Teaching acceleration rate	0 to FFh	2	1min^{-1}／ms／LSB
DAT4	Teaching deceleration rate	0 to FFh	2	1min^{-1}／ms／LSB
Sets the Jog operation velocity and acceleration / deceleration rate when in Teaching Mode and in input functions 18 and 19.				

Command Code : 88 (58h) Data Length : 0

Teaching				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Teaching Point	0 to 7Fh	-	-
Writes the current position to specified Point. Valid only when in Teaching Mode. If there is no teaching data in the specified Point, the parameter defined by Command 9 will be set.				

4） Adjustment Parameters

Command Code : 32 (20h) Data Length : 4 bytes

Power Limit（Power Down）				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Stop status during SON	0 to 7Fh	7Fh	Set current (A)=（Setting value(d)/255）× Rated current
DAT2	During operation	0 to FFh	FFh	Set current (A)=（Setting value(d)/255）× Rated current
DAT3	SOFF status	0 to 7Fh	7Fh	Set Current (A)=（Setting value(d)/255）× Rated current
DAT4	Reserve	-	-	-

Sets the Power Limit value (motor excitation current limit) for each status of driver.

DAT NO	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
DAT1	P.Limit1：Positioning completion (Idle) Current during servo ON status.							
DAT2	P.Limit2：Current upper limit value during operation.							
DAT3	P.Limit3：Current limit for ALM / STOP status.							
DAT4	Reserve							

* When STOP input in Teaching Mode, it will be non-excited state, regardless of DAT3 setting value.

Command Code : 33 (21h) Data Length : 1 byte

Gain 1				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Gain	0 to Fh	0	-

Sets the normalized servo parameter.

Refer to Section 4.5 for details about the adjustment method.

Gain

Setting value	Proportion Gain	Integral Gain	Setting value	Proportion Gain	Integral Gain
0	4	1	8	20	20
1	6	10	9	22	1
2	8	20	A	24	10
3	10	1	B	26	20
4	12	10	C	28	1
5	14	20	D	30	10
6	16	1	E	32	20
7	18	10	F	34	1

4. Type R (RS-485 + PIO)

Command Code : 47 (2Fh) Data Length : 3 bytes

Gain Parameter 2				
DAT No	Contents	Setting range	Setting unit	Initial value
DAT1	Velocity Loop Proportion Gain	0 to FFh	-	4
DAT2	Velocity Loop Integral Gain	0 to FFh	-	4
DAT3	Gain select	0、1	0 : CMD 21h Enable 1 : CMD 2Fh Enable	0
Use this command to set the detailed Gain for Command 21h. The setting value becomes valid when DAT3=1. * Do not set both proportion and integral Gain to 0. * Refer to Section 4.5 for details about the adjustment method.				

Command Code : 34 (22h) Data Length : 1 byte

LPF				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	LPF	0 to 3	0	
Sets the low-pass filter of velocity feedback.				

Command Code : 36 (24h) Data Length : 2 bytes

Correction Coefficient				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Correction Coefficient Enable / Disable	0 to 1	0	0=disable 1=enable
DAT2	Correction Coefficient	0 to FF	0	min^{-1}

Corrects the deceleration start position calculated inside the driver. A large setting value will result in a gentle deceleration slope near the target position. This function is effective for soft landing, etc.

Smaller ← Correction coefficient →Larger

* Note that increasing the correlation coefficient will result in increased In-position time.

5) User Setting Command

Command Code : 42 (2Ah) Data Length : 9 bytes

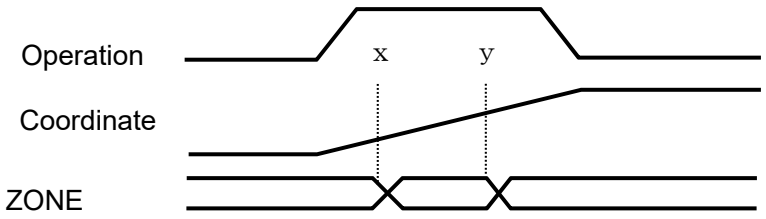
ZONE				
DAT No	Contents	Setting range	Setting unit	Initial value
DAT1	ZONE No	0 to 3	-	0
DAT2 to 5	Zone start coordinates	See below	Pulse (Resolution is set with a soft switch)	0
DAT6 to 9	Zone end coordinates	See below	Pulse (Resolution is set with a soft switch)	0

Sets the coordinate range of the 4 Zone output. It is also effective for the coordinates set by Modulo function.

Setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit coordinates	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit coordinates	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* The sent data should be signed, starting with the low value (negative direction) followed by the high value (positive direction).
* The zone signal is output within the set coordinate range.
* For parameter reading by Command 80h, Zone No. should be specified. Zone No. will not be added to return data.
* Straddling of 0 coordinate when modulo is in effect may also be set.



4. Type R (RS-485 + PIO)

Command Code : 43 (2Bh) Data Length : 1 byte

Modulo Function Enable / Disable				
DAT No	Contents	Setting range	Setting value	Initial value
DAT1	Modulo function enable / disable	0, 1	0: disabled 1: enabled	0
Enables or disables the modulo function. When enabled, absolute move commands perform modulo operation. * When the modulo is enabled, the target position should be set in the following range: 0 ≦ Target position ≦ Modulo value -1 * ZONE set coordinates will also be enabled along modulo coordinates.				

Command Code : 44 (2Ch) Data Length : 4 bytes

Modulo Value				
DAT No	Content	Setting range	Setting unit	Initial value
DAT1 to 4	Modulo Value	See below	Pulse (Resolution is set with a soft switch)	Equivalent of 1 rotation

Sets the modulo pulse number per rotation.

* Coordinate setting is not possible for the negative direction.

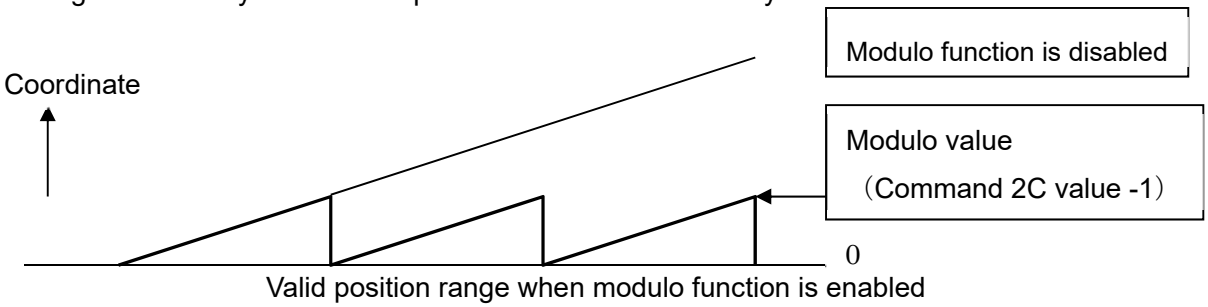
Resolution(P/R)	500	1000	2000	4000	5000	10000
Setting unit (Deg)	0.72	0.36	0.18	0.09	0.072	0.036
Upper limit coordinate(Hex)	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF

Command Code : 45 (2Dh) Data Length : 1 byte

Modulo Direction				
DAT No	Content	Setting range	Setting unit	Initial Value
DAT1	Modulo Direction	0 to 2	0=Positive direction 1=Negative direction 2=Shortcut	2
Sets the direction of the modulo operation.				

This function presets the driver internal coordinates to the range specified by Command 2Ch.

Enabled after zero-return is completed. The operation is performed in the direction selected by Command2Dh. This function is effective for applications where shortcut-control of rotating loads or switching from velocity control to in-position control is necessarily.



Valid position range when modulo function is enabled

* When using incremental move commands or continuous rotation operation, the coordinates (absolute position monitor) follow the modulo settings.

4. Type R (RS-485 + PIO)

Command Code : 48 (30h) Data Length : 4 bytes

In-Position width				
DAT No	Function	Setting range	Setting unit	Initial value
DAT1 to 4	In-Position width	0 to CCCCCCCh	Pulse (Standard 2000P/R)	Ah

Sets the in-position width during move commands by Command 38, 3Ah. In-position status results from reaching the range defined by the target position ± the setting value.

* When a zero-return operation is performed, in-position is output at the time of zero-return completion.
* When move commands with push are used, in-position will be output in reference to the push target position. (Use the motor stop signal function to determine push completion.)

Command Code : 50 (32h) /51 (33h) Data Length : 4 bytes

＋Soft Limit／－Soft Limit				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 4	Limit value	See below	Maximum	Pulse (Resolution is set with a soft switch)

Command 32h : Positive direction Soft Limit value setting

Command 33h : Negative direction Soft Limit value setting

Sets the Soft limit as an absolute position.

It is valid if the Soft limit function was enabled by Command 14h.

Setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. direction upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. direction upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

(Detection conditions)

- When a move command is received

  If the target position exceeds the limit when a move command is received, a command error is generated.

- During continuous rotation operation

  If the actual position exceeds the limit, a deceleration stop is performed. During the limit state, a move command in the limit direction will generate a command error. A move command opposite to the limit direction will be executed normally.

- When performing a zero-return operation

  Limit is not monitored if the zero-return is incomplete or the zero-return is still in progress.

6）Move Commands

Command Code：54（36h） Data Length：2 bytes

Velocity				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Velocity	0 to 1194h（0 to 4500 min^{-1}）	28h（40 min^{-1}）	1 min^{-1}
This command is used to specify the operation velocity initiated by Command 38h, 3Ah, and to modify the velocity of an operation.				

Command Code：55（37h） Data Length：2 bytes

Acceleration / Deceleration Rate				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Acceleration	0 to FFh	1	1min^{-1}／ms
DAT2	Deceleration	0 to FFh	1	1min^{-1}／ms
This command is used to specify the acceleration or deceleration rate for Command 38h, 3Ah and zero-return, and to modify the acceleration or deceleration rate during an operation.				

Command Code：56（38h） Data Length：4 bytes

Incremental Move (without options)			
DAT No	Function	Setting range	Setting unit
DAT1 to 4	Incremental move travel distance	See below	Pulse (Resolution is set with a soft switch)

Initiates an incremental move. The rotation direction is determined by the sign of the move command. (+ = positive direction, －= negative direction） The velocity, acceleration or deceleration rate are set by Commands 36h and 37h.

Incremental travel distance setting range （depends on the resolution as shown below）

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* If used during operation, it will be treated as an additional move command. The travel distance will be added to the original target position before the additional move command.

Command Code：58（3Ah） Data Length：4 bytes

Absolute Move Command (without option)			
DAT No	Function	Setting range	Setting unit
DAT1 to 4	Absolute position	See below	Pulse (Resolution is set with a soft switch)

Initiates an absolute position move. The rotation direction is determined by the current position and the command position at the time of the command

Command position＞Current position：Positive direction Command position＜Current position：Negative direction

The velocity, acceleration and deceleration rate are set by Command 36, 37h.

Absolute travel distance setting range (Depends on the resolution as shown below)

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

4. Type R (RS-485 + PIO)

Command Code : 62 (3Eh) Data Length : 6 bytes

Slow Move Command			
DAT No	Function	Setting range	Setting unit
DAT1	Velocity	1 to 64h	1min^{-1}
DAT2	Current limit	0 to FF h	(Setting value(d)/255) × Rated current
DAT3 to 6	Incremental move travel distance	See below	Pulse (Resolution is set with a soft switch)

Initiates slow movement by open control. Use this command if a velocity change during a slow operation causes problems.

Incremental travel distance setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* If a slow move command is entered as an additional command during operation, the slow move will start after the current operation is completed. The in-position signal will be output when the slow move operation completed.
* If there is a position drift during slow move operation, the control will switch to close-control mode.

Command Code : 64 (40h) Data Length : 6(d) bytes

Continuous Rotation Command				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Rotational direction	0 to 1	-	0 : Positive direction 1 : Negative direction
DAT2 to 3	Velocity	0 to 1194h (0 to 4500 min^{-1})	-	1 min^{-1}
DAT4	Acceleration rate	1 to FFh	-	1min^{-1}/ms
DAT5	Deceleration rate	1 to FFh	-	1min^{-1}/ms
DAT6	Push current	0 to FFh	-	0=no push 0≠setting value(d)/255×Rated current

Initiates continuous rotation.

* If the push current limit is other than 0, overload will not be detected during continuous rotation operation.
* Push completion can be detected by the PEND, STEND output or the END signal. The in-position signal will stay the same as it was during operation.
* There is no error detection performed during continuous rotation push operation.

Note) If this function is used for continuous rotation or in a single direction only, use command code 14h, DAT4, Bit0=0 to enable Wrap Around.

Command Code : 65 (41h) Data Length : 0 byte

Continuous Rotation Stop
Specifies the stop of a continuous rotation. While receiving the command, the motor will decelerate to a stop using the deceleration rate set for the continuous rotation operation. The stop position becomes the target position.

Command Code : 66 (42h) Data Length : 13(d) bytes

Incremental Move Command (with velocity, acc / dec. rate, push specifications)				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Velocity	0 to 1194h (0 to 4500 min^{-1})	-	1 min^{-1}
DAT3	Acceleration rate	1 to FFh	-	1min^{-1}／ms
DAT4	Deceleration rate	1 to FFh	-	1min^{-1}／ms
DAT5 to 8	travel distance	See below	-	Pulse (Resolution is set with a soft switch)
DAT9	Push current	0 to FFh	-	0=no push 0≠setting value(d)/255×Rated current
DAT10 to 13	Positioning width	0 to 7FFFFFF	-	PULSE (2000P/R Fixed) When DAT9=0 : In-Position width When DAT9≠0 : Travel distance with push

Specifies the incremental move. The rotation direction is determined by the sign of the move command.
(+ = positive direction, － = Negative direction)
Incremental travel distance setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* If the incremental travel distance is 0, do not set the push travel distance to value other than 0.

Command Code : 68 (44h) Data Length : 13(d) byte

Absolute Move Command (with velocity, acc/dec. rate, push specifications)				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Velocity	0 to 1194h (0 to 4500 min^{-1})	-	1 min^{-1}
DAT3	Acceleration rate	1 to FFh	-	1min^{-1}／ms
DAT4	Deceleration rate	1 to FFh	-	1min^{-1}／ms
DAT5 to 8	Absolute position	See below	-	Pulse (Resolution is set with a soft switch)
DAT9	Push current	0 to FFh	-	0= no push 0≠setting value(d)/255×Rated current
DAT10 to 13	Positioning width	0 to 7FFFFFF	-	PULSE (2000P/R Fixed) When DAT9=0 : In-Position width When DAT9≠0 : Travel distance with push

Specifies the absolute move. The rotation direction is determined by the current position and the specified position at the time of the command. Command position>Current position: Positive direction
Command position<Current position: Negative direction
Absolute travel distance setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* If the absolute move travel distance is 0, do not set the push travel distance to a value other than 0.

4. Type R (RS-485 + PIO)

Command Code : 69 (45h) Data Length : 10(d) bytes

Zero - Return Command			
DAT No	Contents	Setting range	Setting unit
DAT1	Rotational direction／Zero-return Type	Rotational direction : 0 to 1 Zero-return Type : 0 to 4	-
DAT2	Zero-return velocity	1 to C8h	min^{-1}
DAT3	Zero-return low velocity	1 to C8h	min^{-1}
DAT4 to 5	Grid shift	8001 to 7FFF (with sign)	Pulse (Resolution is set with a soft switch)
DAT6	Push current limit (Setting value is valid for Type3,4)	0 to FFh	Setting value(d)/255×Rated current
DAT7 to 10	Counter preset value	See below	Pulse (Resolution is set with a soft switch)

Initiates zero-return. The acceleration / deceleration rate is set by Command 37h.

DATA NO	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
DAT1	*	*	*	Rotational direction	*	Zero-return type		

Zero-return type

Bit2	Bit1	Bit0	Zero-return type
0	0	0	Z-phase detection
0	0	1	SDN detection
0	1	0	SDN＋Z-phase
0	1	1	Push zero detection
1	0	0	Push＋Z-phase detection
Others			Setting prohibited

Counter preset value setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* The grid shift setting values have signs. For push zero-return type, set the grid shift in the opposite direction of the command direction.

* If zero-return Type 1, 2 is used, H.Limit function (Command 16h) needs to be set at the input port.

4. Type R (RS-485 + PIO)

Each setting is enabled or disabled based on the type of zero-return.

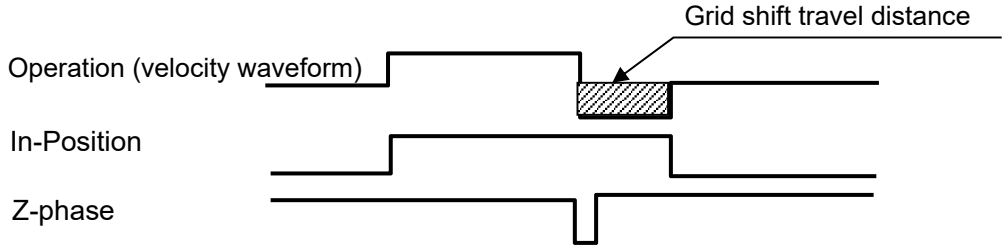
Zero-return type	Velocity	Low - velocity	Grid shift	Current limit	Preset value
Z-phase detection	Disabled	Enabled	Enabled	Disabled	Enabled
SDN detection	Enabled	Enabled	Enabled	Disabled	Enabled
SDN＋Z-phase	Enabled	Enabled	Enabled	Disabled	Enabled
Push zero detection	Enabled	Enabled	Enabled	Enabled	Enabled
Push＋Z-phase detection	Enabled	Enabled	Enabled	Enabled	Enabled

＜Zero-return operation overview＞

*The zero-return in-position signal is output after the zero-return operation is complete.

1）**Z-phase detection mode：Type0**

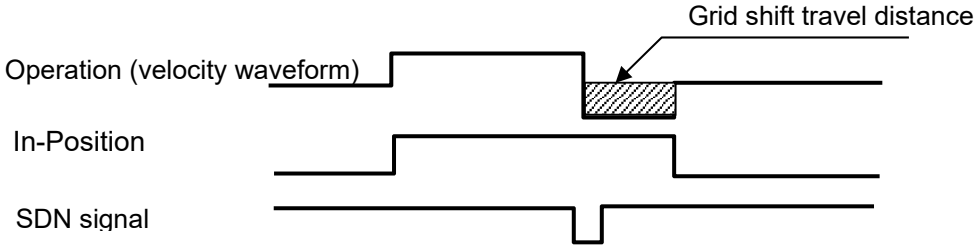
Zero-return is based on detecting the Z-phase (1 Pulse / rotation) of the encoder.



＊ If high velocity is used, an overshoot can occur after detecting the Z-phase, causing a return operation to be performed.

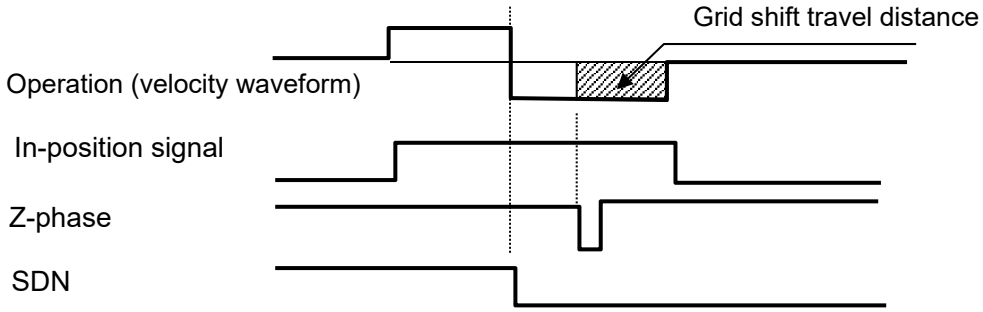
2）SDN detection：Type 1

Zero-return is performed by detecting the edge of the SDN signal.



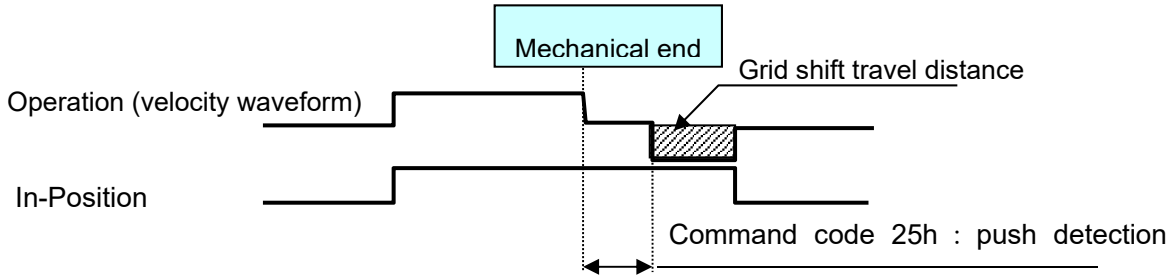
3）SDN－Z-phase detection mode：Type 2

After detecting the edge of the SDN signal, movement starts in the opposite direction and zero-return is performed based on Z-phase signal detection.



4）Push zero detection：Type 3

Zero-return is based on detecting a stop due to pushing against the mechanical end.

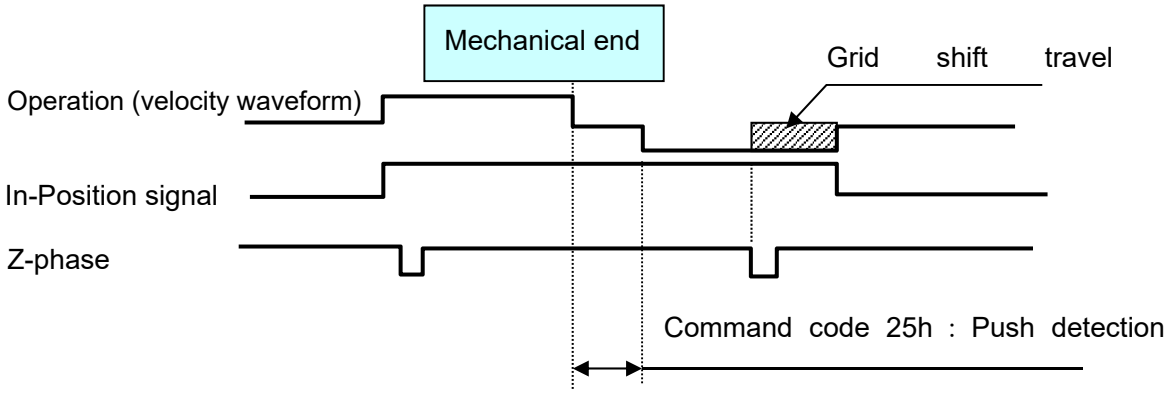


* **The sign of the grid shift volume must be set to the opposite direction of the push direction.**

* **Confirm that the push current limit setting is a value with which the motor can operate. If the value is low, it may be prematurely determined as a stop before being pushed against the mechanical end.**

5）Push + Z-phase detection：Type 4

After detecting a stop due to pushing against the mechanical end, movement starts in the opposite direction and zero-return is performed based on Z-phase signal detection.



7） State Control Commands

Command Code : 52 (34h) Data Length : 4 bytes

ABS Counter Preset				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 4	Preset value	See below	-	Pulse (Resolution is set with a soft switch)

Presets the absolute position counter inside the driver.

Counter preset value setting range

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

* Do not command during operation.

Command Code : 53 (35h) Data Length : 1 byte

Brake Enable				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Brake cancel	0/1	-	1=Engage 0=Release

Directly controls the holding brake status during servo OFF（Alarm and STOP status）.

* This status is not saved in the non-volatile memory.（Normally 1 after powering up）
  When switching to servo ON, the status is automatically set to 1, and unless 0 was preset, the holding brake will be opened when a STOP or ALM occurs.

Command Code : 71 (47h) Data Length : 0 byte

Deviation Clear

This command initiates deviation clear. The position at the time of receiving this command becomes the target position.

* Note that if the command is sent during rotation, it returns to the original position using the excess deceleration distance.

Command Code : 72 (48h) Data Length : 0 byte

Pause

This command initiates a Pause (temporary stop). The target position is held, and a deceleration stop is performed based on the current deceleration rate settings. When Pause is cancelled, the move to the target position resumes.

* If the Pause function is allocated to an input port, it will operate with an OR condition with this command.
* The Pause input function is allocated by command 16h.

Command Code : 73 (49h) Data Length : 0 byte

Pause Clear

This command cancels the Pause, and at the same time, moving to the target position resumes.

* If the Pause function is active at the input port, it will not be cancelled.

Command Code : 74 (4Ah) Data Length : 0 byte

Alarm Clear
This command clears the alarm. * Non-recoverable alarms are not cancelable; they can be cleared only by restarting the power, or using the initialization command. * The command operates using an OR condition with the alarm clear signal of input port.

Command Code : 75 (4Bh) Data Length : 2 bytes

Bit Out

DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Bit Out	0 to 3Fh	-	0=photocoupler OFF 1=photocoupler ON

Selects the output status of the generic output port.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
OUT8	OUT7	OUT6	Out5	Out4	Out3	Out2	Out1
*	*	*	*	*	*	*	Out9

* This command is valid only at Bid Out ports set for output port functions using command 16h. For output port other than Bif Out, this function will be ignored.

Command Code : 76 (4Ch) Data Length : 0 byte

STOP Command

This command initiates an emergency stop. If the motor is in motion, it stops with the maximum possible deceleration rate, and the driver status changes to servo OFF.
* The command operates using an OR condition with the STOP input port.
* If used during program execution, the program execution will stop.

Command Code : 77 (4Dh) Data Length : 0 byte

STOP Clear

Cancels the STOP initiated by a STOP command. At the time of the STOP clear, the driver status automatically changes to servo ON. This command does not clear the STOP signal at an input port.

Command Code : 78 (4Eh) Data Length : 0 byte

Interlock

A deceleration stop is performed using the deceleration rate set at the time of receiving the command. The stop position becomes the target position. The system keeps the SON status. Move commands during interlock will generate a command error.
* If the interlock is engaged when the power is turned on, initialization will not be executed.

Command Code : 79 (4Fh) Data Length : 0 byte

Interlock Clear

Clears the Interlock.

* This command does not clear the interlock of an input port.

8）POINT, Program Store

Command Code : 80 (50h) Data Length : 2 bytes

START Command				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Start target	0 to 2	-	0=Point 1=PRG 2=4-point mode
DAT2	Start target Number	Point : 0 to 80 PRG : 0 to 3 4-point : 0 to 3	-	-

This command starts the point or point program by remote.

* Point No80h is a start command exclusively for HOME.
* The data of 4-point start(ST) is allocated to the same memory as Point 0 to 3.

Command Code : 81 (51h) Data Length : 3 bytes

STEP Operation				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	PRG Number	Depends on the PRG number	-	-
DAT2 to 3	PRG line	Depends on the PRG number	-	-

This command specifies the STEP operation (line by line execution) of the program.

Response :

As a response to the STEP operation command, the next executable line (2 bytes) is returned. The response format is the following:

Packet length	Address	Response status	Line number	Check Sum

* Do not command the STEP operation in the middle of a Gosub / Return command.
* If the next executable line is unknown, the response will be FFh.
* When a Timer Wait is executed in STEP mode, the setting time of the Timer will be disabled.

Command Code : 82 (52h) Data Length : 0 bytes

Program STOP
This command aborts the program operation. The driver maintains the servo ON status.
* Program lines that have already started execution will not be aborted. To abort the movement itself, use the STOP command.
* The Program stop command can only be used during program execution; otherwise, a command error will be generated.
* Refer to command code 8Ah to read the stopped program line.

4. Type R (RS-485 + PIO)

Command Code：86（56h） Data Length：Depends on the command

Point Store				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Point No	0 to 80h	-	-
DAT2	Command code	Refer to command list	-	-
DAT3 and above	Data	Depends on the command	-	-
Stores a direct command to the specified point number. The data length depends on the direct command being stored. * Point No=80h only receives Zero-return command (Command 45h) and stores zero-return by input Port HOME signal. * Command by 4-point operation type is allocated to Point0 to 3. 4-point operation and optional Point start may not co-exist.				

Command Code：87（57h） Data Length：Depends on the command

Program Store				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	PRG Number	0 to 3	-	-
DAT2、3	PRG line	Depends on the number of PRG	-	-
DAT4	Command code	Refer to command list	-	-
DAT5 and above	Data	Depends on the command	-	-
Stores a direct command line by line to the specified program number. The data length depends on the direct command being stored.				

9） Program Commands

Definition and use of jump conditions

The following section describes the conditions of jump commands.

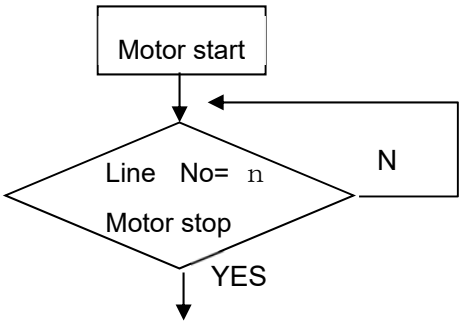
Condition = 0: If the condition does not match, jump to the specified line; if it matches, execute the next line.

Condition = 1: If the condition matches, jump to the specified line; if it does not match, execute the next line.

Command 67h (Motor stop jump example)

A) Example using a jump condition to wait for move completion

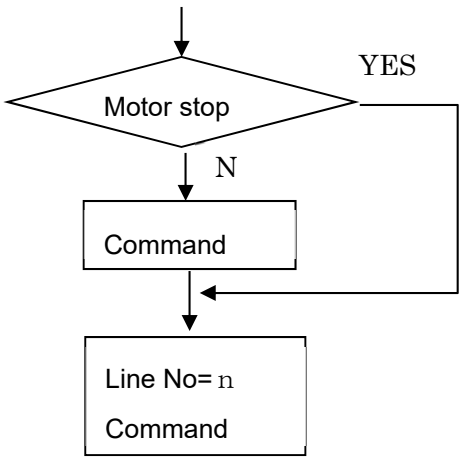
Data included: Jump condition = 0, Jump target line =same line (Line No=n)

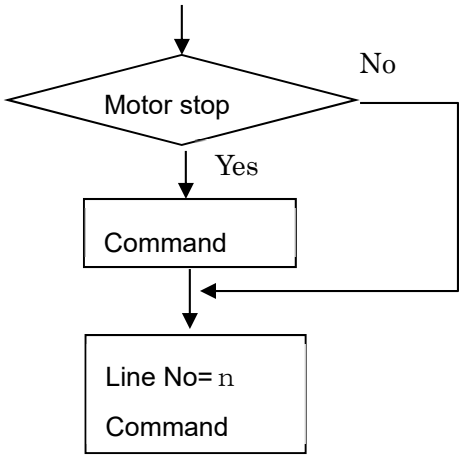


B) Example using a jump condition for a simple jump

Data included:

Jump condition = 1, Jump target line=n Jump condition = 0, Jump target line=n





4. Type R (RS-485 + PIO)

Command Code : 96 (60h) Data Length : 0 byte

Program END
This command ends the program. Program execution stops when the END command is encountered. * Empty command lines are recognized as NOP and the program execution continues. It is necessary to always include the END command in the program. * It is possible to have subroutines after the END command.

Command Code : 97 (61h) Data Length : 2 bytes

Timer Wait				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Timer Wait	0 to FFFFh	-	1ms
This command sets the wait timer value. * This command is ignored during STEP operations.				

Command Code : 98 (62h) Data Length : 3 bytes

In-Position JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Jump Condition	0 to 1	-	0 : Jumps to the specified line when out-position 1 : Jumps to the specified line when in-position.
DAT2 to 3	JMP target line number	Depends on PRG number	-	-
Sets the jump target according to the In-Position condition set by former movement command.				

Command Code : 99 (63h) Data Length : 4 bytes

In-Port JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Jump condition	0 to 1	-	0 : Jumps to the specified line when condition does not match 1 : Jumps to the specified line when condition matches
DAT2	Input Port status	0 to FFh	-	0=photo coupler OFF 1=photo coupler On
DAT3 to 4	JMP target line number	Depends on PRG number	-	-

This command sets the jump target according to the status of the generic input.

DAT2 input port allocation

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1

* Only the port selected as generic input port by Command 16h can be the target.

Command Code : 64h Data Length : 4 bytes

Zone JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Jump condition	0 to 1	-	0 : Jumps to the specified line when out of the Zone range 1 : Jumps to the specified line when in the Zone range
DAT2	Target Zone No	0 to 3	-	-
DAT3 to 4	JMP target line Number	Depends on PRG number	-	-
This command sets the jump target according to the Zone output condition.				

Command Code : 101 (65h) Data Length : 7 bytes

Actual Position JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Jump condition	0 to 1	-	0 : Jumps to the specified line when the condition does not match 1 : Jumps to the specified line when the condition matches
DAT2 to 5	Position coordinates	See below		Pulse (Resolution is set with a soft switch)
DAT6 to 7	JMP target line Number	Depends on PRG number	-	-

This command sets the jump target according to the current position condition (absolute position).

Absolute travel distance setting range (Setting range depends on the resolution, as follows)

Resolution(P/R)	500	1000	2000	4000	5000	10000
Pos. upper limit value	3333333	6666666	CCCCCCC	19999999	1FFFFFFF	3FFFFFFF
Neg. upper limit value	FCCCCCCD	F999999A	F3333334	E6666667	E0000001	C0000001

Command Code : 102 (66h) Data Length : 2 bytes

Unconditional JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	JMP target line number	Depends on PRG number	-	-
This command sets the Jump target unconditionally.				

Command Code : 103 (67h) Data Length : 3 bytes

Motor Stop JMP				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Jump condition	0 to 1	-	0 : Jumps to the specified line during operation 1 : Jumps to the specified line when the motor is stopped
DAT2 to 3	JMP target line No.	Depends on RPG No.	-	-
This command specifies the jump target according to the motor stop status.				

Command Code : 106 (6Ah) Data Length : 2 bytes

FOR (loop counter)				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Variable	0 to Ah	-	-
DAT2	Loop counter	1 to FFh	-	times
This command repeats the program enclosed by a For and a Next (Command 68h), using the same variable, as many times as specified by the loop counter and is used together with the Next command. * The loop counter increments by 1. The number of loop repetition is specified by the loop counter. * Nested loops are allowed within the specified variable range.				

Command Code : 107 (6Bh) Data Length : 1 byte

NEXT (loop counter)				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	Variable	0 to Ah	-	-
This command repeats the program enclosed by a For (Command 6Ah) and a Next, using the same variable, as many times as specified by the loop counter, and is used together with the For command.				

Command Code : 108 (6Ch) Data Length : 2 bytes

GOSUB				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Line number	Depends on PRG number	-	-
This command initiates a subroutine call. The target of the subroutine call is specified by the line number, and is used together with Return (Command 6Dh). * Nested Gosub / Return commands are allowed up to 16 levels				

Command Code : 109 (6Dh) Data Length : 0 byte

Return
This command returns execution from the subroutine to main program, and is used together with the Gosub command. * Nested Gosub／Return commands are allowed up to 16 levels.

Command Code : 110 (6Eh) Data Length : 2 bytes

Point Link				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1 to 2	Point No	0 to 7Fh	-	-
Defines the reference for a command set to point during program execution. If an undefined Point is referred to, PRG execution will stop.				

10） RD Command

Command Code : 128 (80h) Data Length : 1 byte

Parameter RD				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	RD target command code	(Command with initial value)	-	-
This command reads the setting data of a command with initial value. * The returned data represents the setting data stored in RAM.				
Returned data	Command code + data content			

Command Code : 129 (81h) Data Length : 1 byte

Point RD				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	RD target point Number	0 to 80h	-	-
This command reads the data content of the specified point number.				
Returned data	Command code + data content			

Command Code : 130 (82h) Data Length : 3 bytes

Program RD				
DAT No	Function	Setting range	Initial value	Setting unit
DAT1	RD target PRG number	Depend on PRG number	-	-
DAT2 to 3	RD target line number	Depend on PRG number	-	-
This command reads a single line of the specified program.				
Returned data	Command code + data content			

4. Type R (RS-485 + PIO)

Command Code : 131 (83h) Data Length : 0 byte

Driver Status RD

DAT1 : Driver status 1

Bit	Description	Data		Explanation
		0	1	
0	Main power status	ON	OFF	The status of the main power
1	In-position status	Within range	Out of range	The status of the in-position signal
2	Alarm status	Normal	Alarm	The alarm status of the driver
3	Initialization operation	Complete	Incomplete	Completion status of the initialization process
4	Servo ON / OFF status	ON	OFF	Servo ON / OFF status
5	STOP control status	Normal status	STOP status	STOP control status
6	Zero-return completion	Incomplete	Complete	Zero-return completion status
7	Pause control status	Non-PAUSE	PAUSE	Pause control status

DAT2 : Driver status 2

Bit	Description	Data		Explanation
		0	1	
0	Positive direction soft limit	No Limit	Limit	Positive direction soft limit status
1	Negative direction soft limit	No Limit	Limit	Negative direction soft limit status
2	Brake	Open	Excite	Holding brake control status
3	Interlock control status	No interlock	Interlock	Interlock control status
4	Positive direction hard limit	No Limit	Limit	Positive direction hard limit status
5	Negative direction hard limit	No Limit	Limit	Negative direction hard limit status
6	*	-	-	Always 0 returned
7	MODE	Normal	Teaching	Teaching mode

* These status conditions are returned only if the function is enabled by the port settings. If the function is disabled, it will return 0.

* The I / O port status monitors the photocoupler ON / OFF status regardless of the driver status.

DAT3 to DAT5 : I/O status 1 ; photocoupler ON 0 ; photocoupler OFF

bit	DAT3(input port)	DAT4 (input port)	DAT5 (output port)	DAT6 (output port)
0	Pin No. CN1-5	Pin N0. CN1-13	Pin No. CN1-15	Pin No. CN1-23
1	Pin No. CN1-6	Pin No. CN5(6)-7	Pin No. CN1-16	Pin No. CN1-24
2	Pin No. CN1-7	Pin No. CN5(6)-8	Pin No. CN1-17	*
3	Pin No. CN1-8	*	Pin No. CN1-18	*
4	Pin No. CN1-9	*	Pin No. CN1-19	*
5	Pin No. CN1-10	Pin No. CN1-1/2	Pin No. CN1-20	*
6	Pin No. CN1-11	Pin No. CN1-3/4	Pin No. CN1-21	*
7	Pin No. CN1-12	Pin No. CN2-10	Pin No. CN1-22	*

* The I / O port status monitors the photocoupler ON / OFF status regardless of the driver status.

Command Code : 132 (84h) Data Length : 0 byte

Absolute Position RD	
This command reads the absolute position counter inside the driver and returns a 4 byte signed data.	
Returned data	Signed 4 bytes (based on the resolution setting, returned in order, starting with the lower bytes)

Command Code : 133 (85h) Data Length : 0 byte

Velocity monitor	
This command monitors the actual velocity.	
Returned data	The returned data is 2 bytes in an absolute value (unit 1min^{-1}, returned in ascending order).

Command Code : 134 (86h) Data Length : 0 byte

ALM Monitor	
This command reads the alarm history.	
Returned data	The returned data is 8 bytes. DAT1 : Current alarm status / DAT2 to 8 : Alarm history (in the order of most recent to oldest) * A low voltage(MPE) alarm is saved only if the power is recovered after detecting the low voltage.

Abbreviation	Code(Hex)	ALM description
No alarm	00	Normal status
DE	01	Encoder disconnected
OV	02	Input power voltage is above the specification range
MPE	03	Input power voltage is below the specification range
RSTE	04	Initialization error (overload) / power line disconnected
OVF	05	Servo error
OL	06	Overload stop
OS	07	Overspeed
RGOL	08	Regeneration voltage is over the specified value
ORG	09	Zero-return error
CNT OVF	0A	Deviation counter over flow
Wrap around	0B	Absolute position counter sign reversal
HSTOP	0C	Push error (wide swing)
LAE	0D	Lead angle error
OC	0E	Overcurrent
EEPER	0F	Non-volatile memory error

4. Type R (RS-485 + PIO)

Command Code : 135 (87h) Data Length : 0 byte

Communication Error	
This command returns the history of all past communication errors. The data is cleared at power OFF.	
Returned data	The returned data is 8 bytes (returned in the order of most recent to oldest)

Communication error codes

Name	Code (Hex)
Checksum error	01
Timeout	02
Parity error	08
Framing error	10
Overrun error	20

Command Code : 137 (89h) Data Length : 0 byte

Software Rev								
This command reads the software revision.								
Returned data	The returned data is 2 bytes.							
	DAT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	DAT1	*							
	DAT2	Software Rev							

Command Code : 138 (8Ah) Data Length : 0 byte

Program Stop Line
This command reads the line where the program stopped if a STOP, program stop, or ALM aborts the running program.

Command Code : 140 (8Ch) Data Length : 0 byte

Loop Counter RD								
This command is exclusively used in programs: it returns the current value of the For / Next loop counter. The returned data contains the values of all variables from 0 through A, in that order.								
Returned data	The returned data is 10 bytes.							
	DAT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	DAT1 to 10	Loop counter (variable 0 to Ah)							

4. Type R (RS-485 + PIO)

Command Code : 143 (8Fh) Data Length : 0 byte

Operation Complete Cause

This command reads the cause of a motor stop. This function can be used to analyze the cause of an unexpected motor stop.

Returned data

The returned data is 1 byte.

Data	Stop cause
0	Normal completion
1	Stop due to positive direction limit
2	Stop due to negative direction limit
3	Stop due to deviation clear
4	Stop due to STOP
5	Stop due to alarm
6	Stop due to Pause
7	Stop due to Interlock
FF	In motion

* This function cannot be used for zero-return operation.
* The read data is kept only for the move command immediately before the stop. After checking the stop cause, the move command must be updated.

Command Code : 144 (90h) Data Length : 0 byte

Driver Type

This command reads the type of driver.

Returned data

The returned data is 2 bytes.

Interface Type	DAT1	DAT2
R Type	4	0

Command Code : 141 (8Dh) Data Length : 0 byte

Execution Point No

This command reads the last Point No executed.

The returned data (Point No) is confirmed at the point of execution.

* Will not be refreshed if Point execution is not received.

4.4 Protection Function

Alarm status is activated when an error in the system occurs.

In the alarm status, the motor is in the fixed excitation state with the excitation current preset by Command 20h-DAT3. During motor operation, it enters the fixed excitation state after the motor is stopped at maximum torque.

* When the Power Limit during servo OFF status is set to 0, it enters the unexcited state.

4.4.1 Alarm Description Confirmation

Alarm description can be confirmed with 7 segment LED display or Communication (Command 87h: Alarm history RD).

Alarm abbreviation	Display	Alarm description	Recoverability
DE	1	Encoder disconnected	Unrecoverable
OV	2	Input power voltage is above the specification range	Recoverable
MPE	3	Input power voltage is below the specification range	Recoverable
RSTE	4	Initialization error / Power line disconnected	Unrecoverable
OVF	5	Servo error	Recoverable
OL	6	Overload stop	Recoverable
OS	7	Over-speed	Recoverable
RGOL	8	Regeneration voltage is over the specified value	Recoverable
ORG	9	Zero-return error	Recoverable
CNT OVF	A	Position command counter overflow	Recoverable
Wrap around	B	Absolute position counter sign reversal	Recoverable
HSTOP	C	Push error (wide swing)	Recoverable
LAE	D	Lead angle error	Unrecoverable
OC	E	Over-current	Unrecoverable
EEPER	F	Non-volatile memory error	Unrecoverable

* To cancel unrecoverable alarms, it is necessary to turn off the power, and then restart.

4.4.2 Alarm Causes

Abbreviation	Display	Alarm cause
DE	1	Indicates the disconnection of the encoder input signal A, B and Z-phase. Observed at all times.
OV	2	Indicates that the input power voltage is above the specification range. At power-up, the input voltage specification automatically recognizes 24V or 48V. Alarm will be triggered according to the following excess voltage detection values dependent on input voltage specification. 24V input : approx. above 36V 48V input : approx. above 55V
MPE	3	Indicates that the input power voltage is below the specification range. The detection voltage is shown below. 24V input : approx. below 18V 48V input : approx. below 30V * Not detected during servo OFF. * Termination of power with servo ON may trigger alarm output. ALM history will be saved only if the power voltage returns to normal after low-voltage detection.
RSTE	4	When the power of the PB system is turned on, Initialization action detects the initial phase of the encoder, initializes the internal counter, and switches to servo ON status. If the encoder initial phase cannot be detected because of overload and power line disconnection etc, it results in an Alarm condition. * If there is an ALM, STOP or Interlock (Type R) status after the power is turned ON, Initialization will not be executed. * Refer to Chapter 5 for more information about load tolerance.
OVF	5	When actual movement is opposite to commanded direction due to excessive rotational vibration of motor or forced operation by external force, and when the position deviation threshold value exceeds the Command 14h setting value, alarm detection will result. Confirm that it is not used under unreasonable acceleration / deceleration or overload conditions.
OL	6	Indicates that before reaching the target position, the load was inoperative for a certain time. The detection time for inoperative status can be set using command 14h. Check unintentional causes such as the load reaching the mechanical limit. * Not detected when Maximum current during operation 2 is selected.
OS	7	Indicates a velocity error. If the actual velocity exceeds approx. 5200min^{-1}, it results in Alarm condition. Confirm that it is not used under unreasonable acceleration / deceleration or overload conditions.

4. Type R (RS-485 + PIO)

Abbreviation	Display	Alarm cause
RGOL	8	The PB driver regulates the regeneration voltage by software control and detects regeneration error when the stipulated value is exceeded. Regeneration to the power source is prevented within the driver. * Contact Sanyo Denki for assistance if regeneration control is not sufficient. * When excessive regeneration voltage occurs, the hardware might be damaged. When used with abrupt deceleration or under excessive load, gradually accelerate and decelerate starting from low-velocity operation to check the drive. * Confirm the rated load limit for each motor before operation. Refer to Chapter 5 for more information about load limit.
ORG	9	Indicates a zero-return error. For Z-phase detection zero-return Indicates that the Z-phase could not be detected within one rotation of the motor shaft For SDN detection, Push zero-return Indicates that the drive was incomplete within the travel distance range set by command 23h.
Counter Overflow	A	Remain Pulse Counter Overflow
Absolute position sign reversal	B	Indicates the sign reversal of the absolute position counter inside the driver. Command 14h can be used to enable or disable detection of this condition. ・Detection is enabled during a drive using single rotational direction only.
Push Error	C	When hard stop occurred, at the time of imposition movement, it is detected. ALM is detected in the case of CMD14h-DAT4-Bit1 =0. ・ Setting value of an imposition push current limit is unreasonable ・ Push travel distance is excessive
LAE	D	Indicates a count error of the encoder counter. Detected only during the motor operation. Confirm that there is no sensor error caused by shock to the motor or excessive noise.
OC	E	Indicates excess current in the motor. It does not function as protection for short circuit or earth-fault on the power line. * Contact Sanyo Denki for assistance if problem occurs.
EEPER	F	Indicates a non-volatile memory data error. * After detecting the memory error, the parameters are reset to the initial factory settings. * Contact Sanyo Denki for assistance if problem occurs.

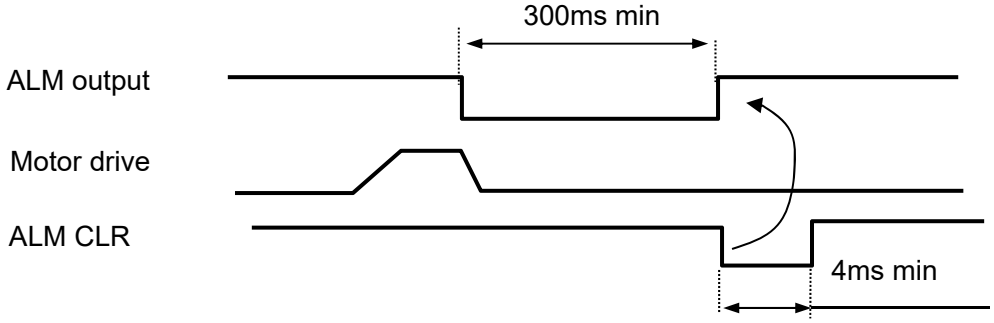
4.4.3 Alarm Recovery Process

There are cancelable alarms and noncancelable alarms (Refer to Section 4.4.1) depending on the alarm cause.

When the alarm occurs, remove the alarm cause to cancel.

＜For cancelable alarm＞

Will be cancelled by ALMCLR signal.



＜For noncancelable alarm＞

It is necessary to reconnect the power.

Remove the alarm cause and reconnect the power.

4.5 Adjustments

For maximum performance for a motor, it is necessary to adjust the gain.

The responsiveness of the motor is changed according to the gain setting value. The gain is regulated by PC interface. Use the waveform monitor of the PC interface etc to adjust the velocity waveform and In-Position signal.

4.5.1 Adjustment Parameters

・Command 21h: Select the normalized proportional gain and integral gain of the velocity loop from 16 levels shown below.

Setting value	Proportional Gain	Integral Gain	Setting value	Proportional Gain	Integral Gain
0	4	1	8	20	20
1	6	10	9	22	1
2	8	20	A	24	10
3	10	1	B	26	20
4	12	10	C	28	1
5	14	20	D	30	10
6	16	1	E	32	20
7	18	10	F	34	1

・Commands for adjustment（For adjustment parameter details, refer to Section 4.3.2 – Commands for Adjustment）

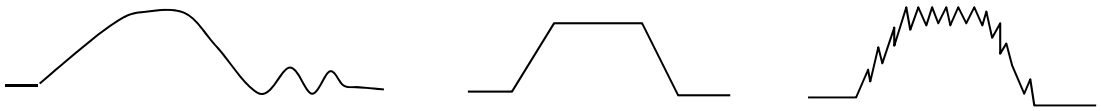
Command	Command name	Function
47(2Fh)	Gain 2	Sets the detailed proportional / integral gains of velocity loop for Command 21h. While Command 21h contains the coefficient tabled to actual velocity, the setting value of this gain is always valid regardless of the velocity. Normally, use the setting by Command 21h.
34(22h)	LPF	Sets the low-pass filter of velocity feedback.
36(24h)	Correction coefficient	Corrects the deceleration start position calculated inside the driver. A large setting value will result in a gentle deceleration slope near the target position. This function is effective for soft landing, etc.
225(E1h)	P／PI Control switch	Sets switching velocity of P／PI control. Switches to PI control when actual velocity is less than the set velocity and P control when greater than the set velocity. Effective for reducing the positioning time caused by accumulated deviations and for improving velocity change during fixed speed operation.

* There is no position loop gain for Type R as it generates the operation profile automatically.

4.5.2 Adjustment Method

a) Proportional gain of velocity loop

- Increase the proportional gain of velocity loop gradually as long as there is no oscillation in the motor or the load. As the gain increases, the velocity waveform changes as shown below. By increasing the proportional gain as much as possible without oscillation, high response can be achieved.



Low proportional gain ⟶ High proportional gain

＊ Increasing the proportional gain may increase the noise of the motor.

b) Integral gain of velocity loop

As this is the delay factor for the servo system, a low setting will adversely affect responsiveness. A High setting may render the servo system unstable. Select an appropriate value after checking the vibration and oscillation status of the machine system.

If the response before positioning is slow due to gravity load and single load, adjust by increasing the integral gain of velocity loop.

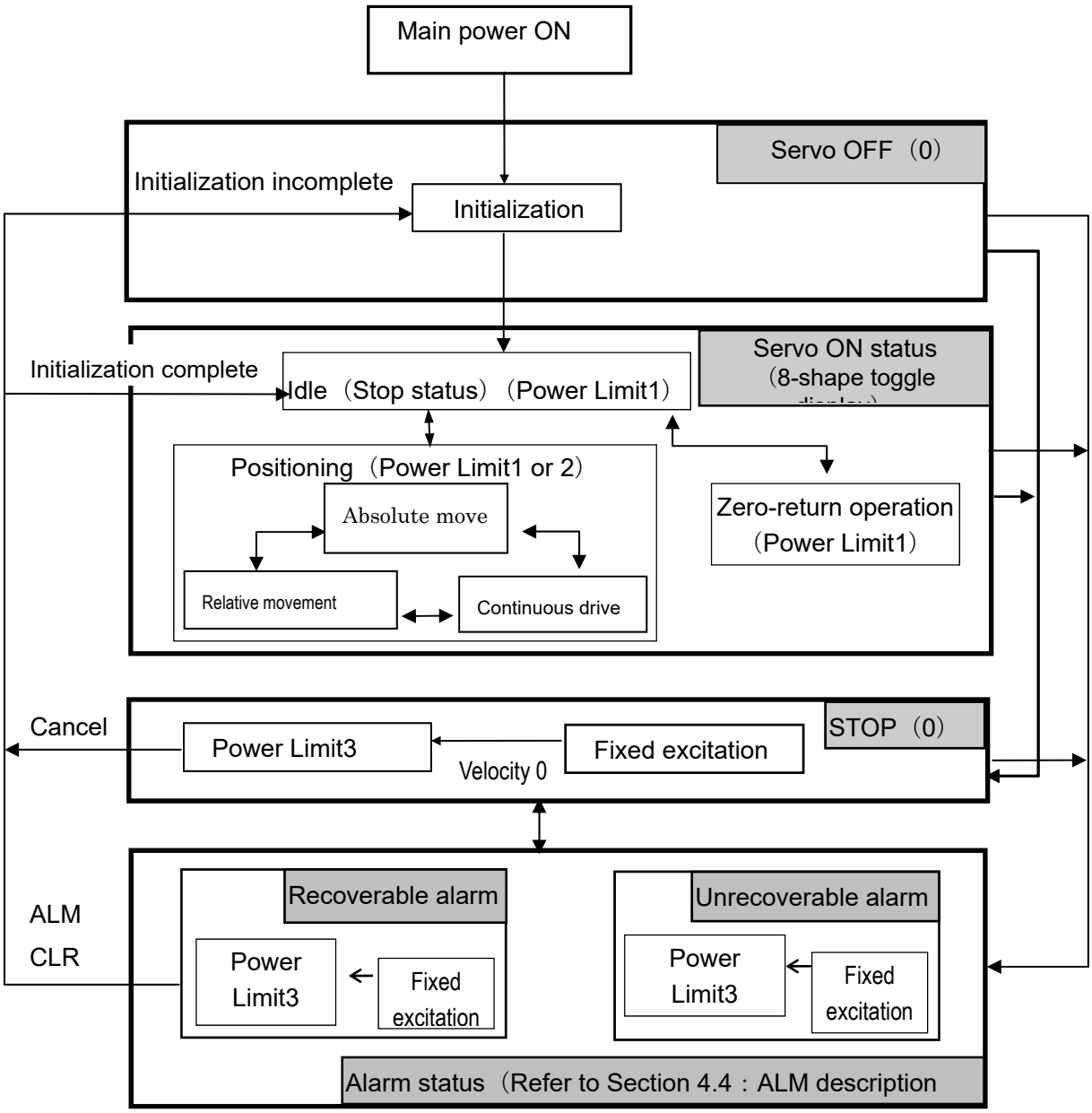
c) Adjustment by acceleration / deceleration rate

If overshooting during acceleration or undershooting during stoppage is not solved by gain adjustment, this may be due to torque shortage. Check motor size, load conditions or operation profile (moderate acceleration / deceleration rate).

4. Type R (RS-485 + PIO)

4.6 Driver Status Change Diagram ・ Display

Shows the driver status change diagram. Display status of 7SEG LED is shown in ( ).



(1) The initialization operation is automatically initiated when the driver detects that the power of the main circuit is within the specified voltage range. After initialization is complete, the status automatically changes to “Servo ON". If the initialization operation is completed once, the initialization will not be performed. Use the STOP signal to maintain "Servo OFF” status. Initialization will energize the initial excitation phase at maximum rate, and move at a maximum of ±1.8 degrees. If error occurs during operation due to reaching the mechanical limit, it will move 7.2 degrees in the opposite direction and then resume moving within the range of ± 1.8 degrees.

(2) If a STOP or alarm occurs, the motor decelerates with fixed excitation until the motor is stopped. After the motor stops, the excitation current selected for Power Limit 3 is applied.

4. Type R (RS-485 + PIO)

4.7 Trial operation (operation by PC interface)

1) Switch setting

Confirm that the Dip-switch 1 located on the top of the driver body is turned ON.

Set the communication speed and node address of the driver body by referring to Chapter 1.4.

2) Parameter setting

① Initial setting

When changing parameters, including combination motor, command resolution, input / output function, the PC interface needs to be connected.

* Combination motor : Motor type is preset if the set product is purchased, otherwise it is necessary to set the appropriate motor type with combination motor.

② Communication preparation

Connect the driver power, communication unit and PC to the driver.

③ Turn the power on (1 (encoder disconnection) is detected for 7SEG LED), start communication and set the parameters.

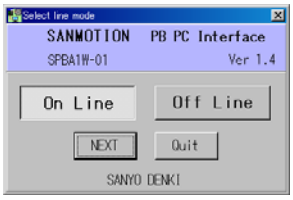
* Refer to M0007856 for more details of operation method for PC interface.

Shown below is the Start-up and Setting outline of the PC interface.

i) Start-up

Select On Line

Click “NEXT”



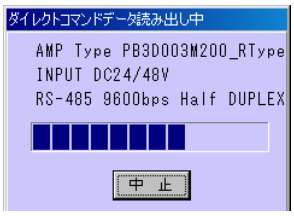
COM Port setting

Select ADRESS=RoSW

Select 9600bps Half Duplex

Click “NEXT”

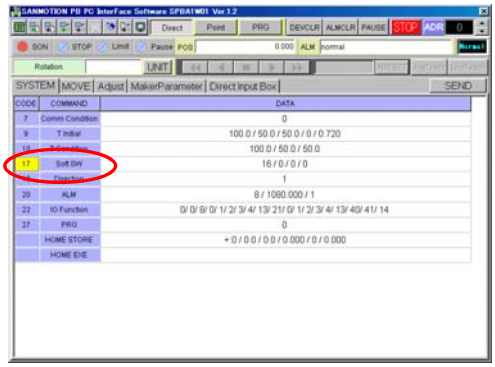
Parameter RD task bar is displayed



ii） Setting example

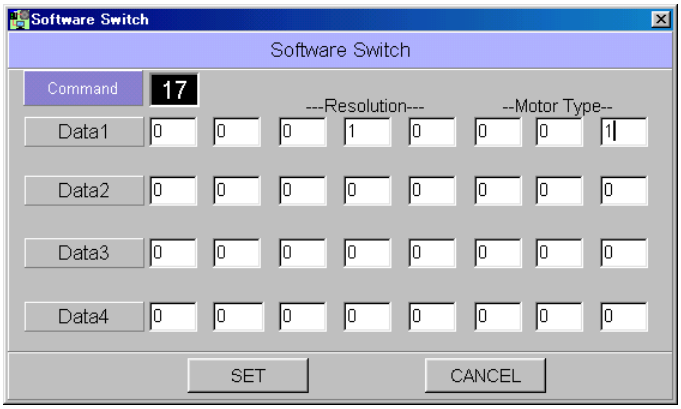
Shown below is a setting example of Command 17.

a） Double click on Command 17.



b） Set the motor model: ① and resolution: ② and then click on the SET button to return to Main screen. (Refer to Command 11h) （example）PBM423、2000P/R setting

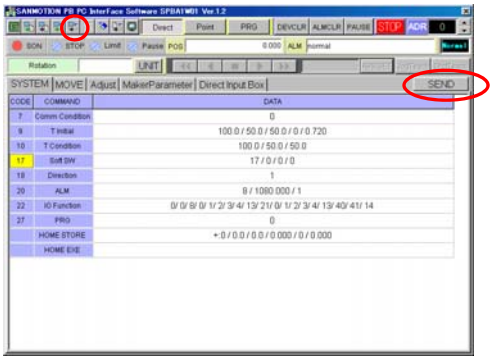
* Must be set as damage may occur to motor when the motor model is not appropriate.



c） Transfer parameter to driver by pressing the SEND button.

Press PC→Amp ROM on the MENU button and Save the sent parameter to the non-volatile memory.

* **Press Save as the transmitted parameter will not be saved until this is done.**



If necessary, follow the same procedure as ② to set parameters other than Command17 (11h).

To assign the I/O function, refer to Chapter 4.3.2, edit the I/O function setting file in advance, and then set command 22.

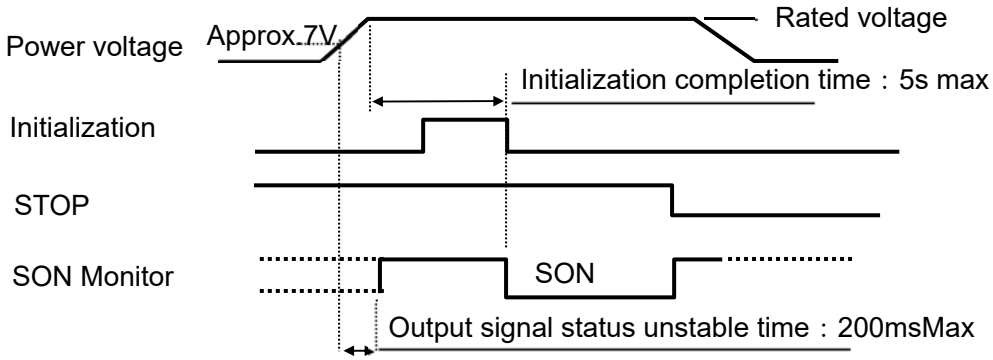
3) Operation

i) After the parameter setting is completed, turn the power off and connect wiring for the motor power and encoder.

* Refer to Chapter 2 to ensure the correct wiring.
* Perform safety check and attach the motor to the fixed plate etc. For safety, set up the emergency stop circuit before operating.

ii) If the 7SEG LED writes an 8-shape after turning the power on, it is normal.

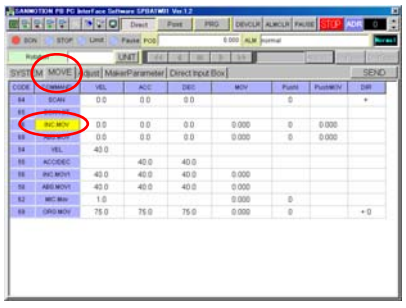
Power start sequence (When the STOP input signal is cancelled)



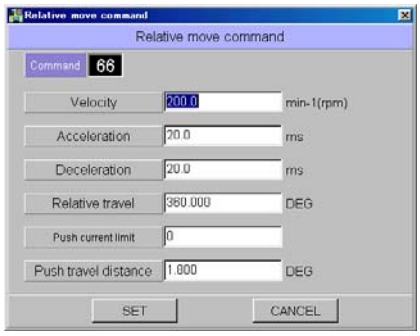
* The output signal status is unstable for a maximum of 200ms after the power voltage reaches approximately 7V.
* Turn the power off after setting to STOP status, as low power voltage error may be detected when power is turned off with the servo ON.

iii) This is a trial operation of the motor by communication. Shown below is an example of motor operation by relative move command (Command 42h). Refer to PC interface specification: M0007856 for PRG and Point operation by I/O.

① Select Move from the Menu select tab.



② Double click Command 66 to display the move pattern setting window.



Set the desired data for each section. Press SET to return to the Main window.

③ The parameter selected by the SEND button on the main window will be sent and the motor will operate.

ⅳ) After confirmation of the above operation, connect the load to the motor. Refer to Section 4.5 and set the Gain and operation profile.

* If it does not operate normally, confirm that the wiring and power voltage is correct.
* In case of Alarm, refer to Section 4.4 to remove the alarm cause.
* For details of waveform monitor method, refer to M0007856.

4. Type R (RS-485 + PIO)

4.8 Communication Specifications

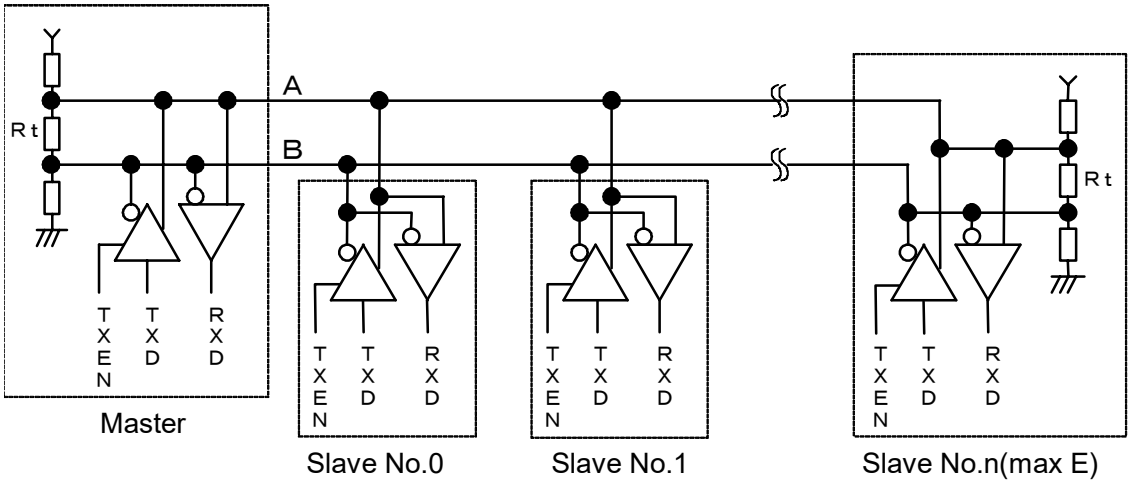
4.8.1 Communication Format

Item	Specifications
Transmission rate	9600、38400、115200、128000bps（Select by Command 7）
Synchronization method	Start-stop synchronization
Data bits	8 bit
Parity bit	Even number
Stop bit	1 bit
Number of slaves	1 to 16 units (select with rotary switch)
Data length	Maximum of 255 bytes
Data	Hexadecimal
Data transmission	LSB First
Transmission method	Two-wire half duplex polling method

4.8.2 Hardware

Item	Specifications
Line driver / Receiver IC	Half duplex：SN751176(TI) equivalent
Cable	Twisted pair shielded cable
Termination resistor	Both ends of the signal line have a termination resistor connected(Rt：150Ω). Driver termination can be set using dip-switch 2.
Extension length	Maximum 100m
Insulation	None
Connector (driver side)	S10B-PADSS-1GW（JST）

4.8.3 Daisy Chain



4.8.4 Data Format

1) Command Issue (Master →Slave)

Packet Length	Address	Command Code	Data	Checksum
1byte	1byte	1byte	n byte	1byte

① Packet Length

Shows the number of bytes in one packet. Indicates the total number of transmitted bytes from the packet length to the checksum.

Packet length = Number of databytes(N)+4

② Address

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
*				Address			

A maximum of 16 drivers can be connected. This value specifies the address set by the rotary Switch.

Address=FFh simultaneously specifies all the drivers connected to the communication line.

In this case only the driver at address 0 will respond.

③ Command Code

Specifies the command code defined in Chapter 4.3.

④ Data

The number of data bytes depends on the command. Sets the defined data for each command. Data longer than 2 bytes is sent in lower-higher order.

⑤ Checksum

The checksum is calculated by adding all bytes except the checksum, and taking the lowest byte.

2） Status Response（Slave →Master）

Packet Length	Address	Transmission Status	Response Data	Checksum
1byte	1byte	1byte	n byte	1byte

① Packet Length

Shows the number of bytes in one packet.

Packet length =Number of returned databytes(N)＋4

② Address

Returns the address of the status response-originating slave device in hexadecimal notation.

③ Communication Status

The communication status byte contains information about the communication status of the last command sent, the device status, etc. for the slave.

bit	Description	Data	
		0	1
0	Operation complete	Incomplete	Complete
1	In-Position status	Out of range	Within range
2	Alarm status	Normal	Alarm
3	Servo ON status	SOFF	SON
4	Limit（both soft and hard）	Out of Limit	Within Limit
5	Command error	Normal	Error
6	STOP control status	Normal	STOP status
7	No function assigned	—	—

* Command error is generated when the following conditions are met:

- If a non-preset command is received.
- If a command that is not receivable due to the status of the driver is received.

④ Response Data

The number of bytes in the response data depends on the command sent and the data.

Responses to commands other than RD commands do not have data attached.

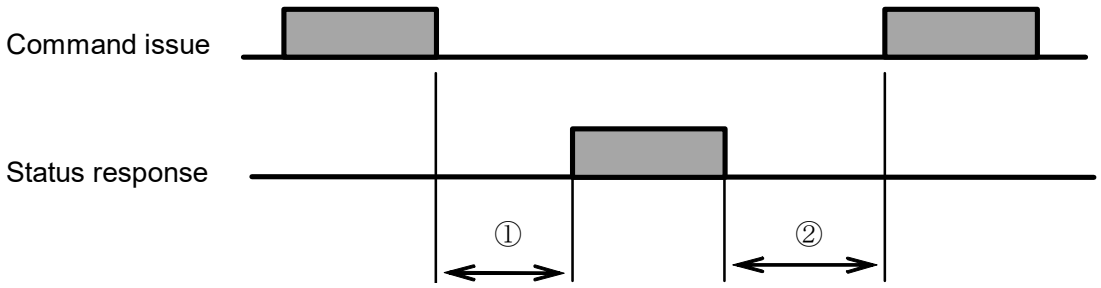
Data longer than 2 bytes is sent in lower-higher order.

⑤ Checksum

The checksum is calculated by adding all bytes except the checksum, and taking the lowest byte.

4.8.5 Communication Method, Timing Chart

1）Communication Method (Normal Operation)



① Time until the slave sends the status response after receiving the command: Minimum［T1］/ Maximum［T2］

② Time until the master is able to issue commands after receiving the status: Minimum of 1ms

1） The master sends all commands with an address attached to the header (Packet length).

2） Slave devices can only transmit immediately after receiving a command with their own address.

3） Slave devices send the status response with their address attached to the header.

4） After receiving the command, the slave device must start responding after [T1] but before [T2] is over.

5） After the master receives the response from the slave, it can issue the next command after [T1] has passed.

6） If there is no response from the slave after [T3], it will be considered a time-out error, and the master can issue the next command. (It is possible to re-issue the command.)

7） If the slave doesn’t complete receiving the data until [T3] is over, it discards the data received, and interprets the next data as a header (packet length).

8） If there is a communication error, the master stops issuing commands after [T3] and clears the receive buffer of the slave device.

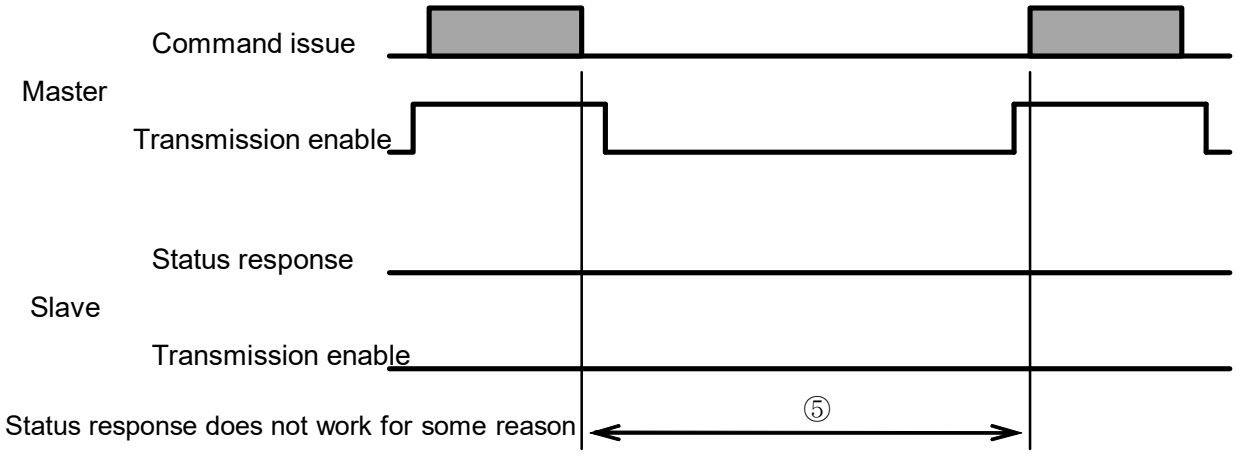
9） If there is a communication error, the slave discards the data received, and does not send a response. A communication error is shown by opening the line longer than [T3].

10） If the slave receives a command that is not a pre-set command, it returns the command error status.

Note 1: During control power connection / cutoff, when the CPU is not working due to unstable control power, the driver may output some arbitrary data, which should be ignored by the user.

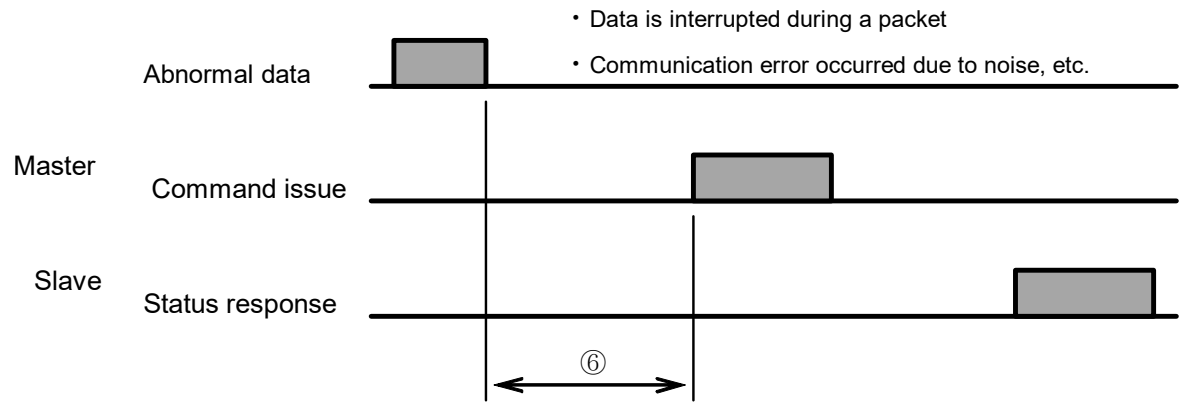
2） Communication Method (Abnormal Operation)

・If the slave device did not send a status response (but a return response is sent)



i) Time until the master can issue the next command if there is no status response after issuing the command: ⑤ Minimum [T3]

・If abnormal data is generated



i ） In the case of abnormal data (1 packet is not recognizable), the master stops issuing of commands for at least ⑥ [T3].

ii） If there is no communication for at least [T3], the slave discards the previously received unrecognizable data. If the communication continues after [T3], the first data is interpreted as the header (packet length). If the packet is recognizable, it will be processed normally.

4.8.6 Standard Response Time Values

［T1］=500μsec×2^{n}（n=0 to 7）setting is possible（command code 10h）.

Based on the T1 setting, [T2] = [T1] x2, [T3] = [T1] x 4 will be set.

Standard values for [T1] to [T3] are shown in the table below.

Standard response time values Unit (ms)

Response Time Setting Value **n**	T1	T2	T3	Response Time Setting Value **n**	T1	T2	T3
0	0.5	1	2	4	8	16	32
1	1	2	4	5	16	32	64
2	2	4	8	6	32	64	128
3	4	8	16	7	64	128	256

4.8.7 Communication Example

The following example explains the communication process in detail.

*For the purposes of this example, the driver's address is set to 0.

Parameter WR

Transmission example）Setting the Gain parameter 1=5（Command 21h：Type R）

Packet Length	Address	Command code	Data	Check sum
5	0	21h	5	2Bh

Parameter RD

Example）Reading the servo parameter(Command 21h: Type R) using Parameter RD (Command 80h).

Transmitted data）

Packet Length	Address	Command code	Data	Check sum
5	0	80h	21h	A6h

Returned data）

Packet Length	Address	Response status	Data 1	Data 2	Check sum
6	0	*	21h	5	*

Point Data Save

Transmitted data format:

Packet Length	Address	Command code **(56h)**	Point No	Direct command code	Data	Check sum

Example）Storing an incremental move command（Command 38h）=4000（FA0h）to Point No=2.

Packet Length	Address	Command code	Point No	Command	Data	Data	Data	Data	Check sum
A	0	56h	2	38h	A0h	Fh	0	0	49h

Point data RD

Transmitted data format:

Packet Length	Address	Command code (81h)	Point No	Check sum

Returned data format

Packet Length	Address	Response Status	Store Command	Data	Check sum

*There is no point number attached to the return data.

Example）Reading the Point data stored at ③.

Transmitted data format:

Packet Length	Address	Command	Point No	Check sum
5	0	81h	2	88h

Returned data format

Packet Length	Address	Response Status	Store Command	Data	Data	Data	Data	Check sum
9	0	*	38h	A0h	Fh	0	0	*

4. Type R (RS-485 + PIO)

Program Data Save

Transmitted data format

Packet Length	Address	**57h**	Program No.	Line Number (2 bytes)	Command Code	Data	Check sum

Example）This program is PRG number 0, which performs a zero-return and a 100ms Timer Wait, and then executes an incremental move.

Line	Command	Code
0	Zero-return（Negative direction push origin, velocity=75min^{-1}, gird shift=200, counter=0）	45h
1	Zero-return complete wait（This line waits to complete while operating）	67h
2	Timer Wait（200ms）	61h
3	Absolute travel distance（velocity : 1000 min^{-1}, accel. / decel. rate : 100 min^{-1}/ms, absolute position=4000）	44h
4	PRG exit	60h

Packet	ADR	Command	PRG No	Line (lower)	Line (higher)	Command	Data (n byte)	Sum
12h	0	57h	0	0	0	45h	13h,4B,4B,C8,0,0,0,0,0,0	1Fh
Bh	0	57h	0	1	0	67h	0,1,0	CBh
Ah	0	57h	0	2	0	61h	C8h,0	8Ch
13h	0	57h	0	3	0	44h	E8h,3,64h,64h,A0h,0Fh,0,0, 0,0,0,0,A	13h
8	0	57h	0	4	0	60h	—	C3h

Program data RD

Transmitted data format:

Packet Length	Address	**82h**	Program No.	Line Number (2 bytes)	Check sum

Returned data format:

Packet Length	Address	Response Status	Command Code	Data（n byte）	Check sum

* There is no program number or line number attached to the return data.

5

Specifications (Common)

5 Specifications (Common)

5.1 Driver Basic Specifications

Driver model			PB3D003M20*	
Interface			RS-485+PIO (SW1=ON) Type R	Pulse train (SW1=OFF) Type P
Control Mode			PWM control SIN drive method	
Power	Single Power		DC24 / 48V ±10% *For 28mm sq. motor, only 24V	
	Separate Power		Main power Supply: DC24 / 48V±10% Control power Supply: DC24V±10% 0.2A (Without holding brake) note1)	
Environment	Ambient temp.	Operation	0 to 55°C	
		Storage	-20 to 65°C	
	Operating and Storage Humidity		Maximum 90%RH (Non-condensing)	
	Vibration Resistance		0.5G (Tested with frequency range 10 to 55 Hz X,Y,Z each direction 2H)	
Structure			Tray structure Rear mounting type	
Weight			Approximately 0.35 kg	
Dimensions			W32×H160×D95	
Functions	Rotation Speed		0 to 4500 min^{-1}	
	Resolution (P/R)		500,1000,2000,4000,5000,10000	
	Regeneration Process		Internal (external regeneration available)	
	Protective Functions		Power Voltage Error, Regeneration Voltage Error, Over-speed, Encoder Disconnection, CPU Error, Overload Stop, Servo Error, Zero-return Error, Non-volatile Memory Error, Initialization Error, Over-current, Sensor Phase Error	
			Position Deviation Counter Overflow Push Error	-
	Display		7SEG LED Display	
	Operation Functions		Normal Drive (incremental move, absolute move) Zero-return, Modulo Operation Push Operation, Teaching Function Point Function：128Point Program Function: 1PRG×1024Line 32PRG×32Line 128PRG×8Line	Normal Drive Zero-return Current Control Operation S-shape Drive
	Dip-switch		DSW1: Interface Type selection DSW2: Terminating resistor setting	
	Rotary Switch		Node address setting	Gain setting

Note1) It is impossible to connect holding brake to amplifier when using it power-supply-voltage 48V in single power supply. When using motor power supply voltage by 48V and using a holding brake, choose amplifier of the separate power supply type, and supply 24V to a control power supply (= holding brake power supply).

5 Specifications (Common)

Driver Model		PB3D003M200	
Interface		RS-485+PIO (SW1=ON) Type R	Pulse Train (SW1=OFF) Type P
Input / Output Signal	Input Signal	(Normal Mode) STOP, EXE, POINT, HOME, JOG SELECT, Pause, Interlock, Generic Input, MODE SELECT, Hard Limit, ALM CLR (Teaching Mode) STOP, JOG, Point, PWR	Pulse, STOP, ALMCLR, Gain Selection, Deviation CLR, HOME
	Output Signal	(Normal Mode) Ack, PEND, END, Busy, Zone, Mode MON, STOP MON, In-Position, Zero-return Complete, Generic Output, Encoder Output, SON MON, ALM, HEND, Input Monitor (Teaching Mode) PEND, HEND, In-Position, Mode MON SON MON	ALM, STOP MON In-Position, Zero-return Complete Encoder Output, SON MON STOP MON
	Serial Communication	RS-485 Standard, Start-stop Synchronization Half Duplex Transmission Rate：9600、38400、115200、128000bps Maximum Connections：16 devices	RS-485 Standard, Start-stop Synchronization Half Duplex Transmission Rate：9600
	Pulse Input Response Frequency	-	250kHz

5 Specifications (Common)

5.2 Motor Standard Specifications (No Gear, no holding brake)

5.2.1 Motor Standard Features

Motor Model	Unit	PBM282FXE20	PBM284FXE20	PBM423FXE20	PBM603FXE20	PBM604FXE20
Maximum Stored Torque	N·m	0.055	0.12	0.39	1.3	1.9
Rotor Inertia	$\times 10^{-4}$kg·m^2	0.008	0.016	0.056	0.4	0.84
Thrust Load Tolerance	N	9.8	9.8	9.8	14.7	14.7
Radial Load Tolerance *	N	33	33	49	167	167
Motor Weight	kg	0.16	0.25	0.35	0.85	1.42

5.2.2 Load Tolerances

Motor Model	Unit	PBM282FXE20	PBM284FXE20	PBM423FXE20	PBM603FXE20	PBM604FXE20
Maximum Inertia Tolerance	$\times 10^{-4}$kg·m^2	0.08	0.16	0.56	4	8.4
Maximum Friction Torque	N·m	0.013	0.036	0.15	0.52	0.76
Maximum Side Load Tolerance	N·m	0.009	0.024	0.15	0.52	0.76

5.2.3 Motor Common Specifications

Motor Model			-	PBM282, PBM284	PBM423, PBM603, PBM604
Encoder Specifications	Basic Divisions		P/R	500×4 multiplier	
	Number of Channels		-	3	
	Maximum Response Frequency		kHz	37.5	
	Output Method		-	Line driver	
Common Specifications	Environment	Ambient Temperature	°C	-10 to +40°C (0°C to 40°C with Harmonic gear)	
		Ambient Humidity	%RH	20 to 90 (Non-condensing)	
	Vibration Resistance		G	15（Tested with frequency range 10～70 Hz Oscillation 1.52mm 70～2000 Acceleration 15G） Tested with sweep time15 minutes / number of cycle sweeps X,Y,Z 12 times each	
	Shock Tolerance		G	30 (Shock wave: half sine wave, shock time: 11ms X,Y,Z directions 3 times each)	
	Withstand Voltage		V	AC500V 50/60Hz 1min	AC1500V 50/60Hz 1min
	Insulation Resistance		MΩ	DC500V more than 100MΩ	
	Insulation Class		-	Class B (130°C)	
	Protection Class		-	IP40 Fully enclosed, self-cooling type	
	Allowable Motor Surface Temperature		°C	Max 85°C (Consider a radiation cooling method to ensure the temperature is below the specified limit)	

5 Specifications (Common)

5.3 Motor Option Specifications

5.3.1 Spur Gear

1) PBM282

Motor Model	Unit	PBM282FGAE20	PBM282FGBE20	PBM282FGEE20	PBM282FGGE20	PBM282FGJE20	PBM282FGLE20
Reduction Gear Ratio	-	1:3.6	1:7.2	1:10	1:20	1:30	1:50
Torque Tolerance	N·m	0.1	0.15	0.2	0.35	0.5	0.5
Rotation Tolerance	min^{-1}	800	400	300	150	100	60
Backlash	degree	2	2	2	1.5	1.5	1.5
Rotational Direction	Compared to the CMD	Forward	Forward	Reverse	Forward	Forward	Forward
Rotor Inertia	$\times10^{-4}kg\cdot m^2$	0.017					
Thrust Load Tolerance	N	10					
Radial Load Tolerance*	N	15					
Motor Weight	kg	0.22					

5.3.2 Low-backlash gear

1) PBM423

Motor Model	Unit	PBM423FGAE20	PBM423FGBE20	PBM423FGEE20	PBM423FGGE20	PBM423FGJE20
Reduction Gear Ratio	—	1:3.6	1:7.2	1:10	1:20	1:30
Torque Tolerance	N·m	0.343	0.7	0.98	1.47	1.47
Rotation Tolerance	min^{-1}	500	250	180	90	60
Backlash	degree	0.6	0.4	0.35	0.25	0.25
Rotational Direction	Compared to the CMD	Forward	Forward	Forward	Reverse	Reverse
Rotor Inertia	$\times10^{-4}kg\cdot m^2$	0.056				
Thrust Load Tolerance	N	15				
Radial Load Tolerance*	N	20				
Motor Weight	kg	0.48				

2) PBM603

Motor Model	Unit	PBM603FGAE20	PBM603FGBE20	PBM603FGEE20	PBM603FGGE20	PBM603FGJE20
Reduction Gear Ratio	—	1:3.6	1:7.2	1:10	1:20	1:30
Torque Tolerance	N·m	1.25	2.5	3	3.5	4
Rotation Tolerance	min^{-1}	500	250	180	90	60
Backlash	degree	0.55	0.25	0.25	0.17	0.17
Rotational Direction	Compared to the CMD	Forward	Forward	Reverse	Reverse	Reverse
Rotor Inertia	$\times10^{-4}kg\cdot m^2$	0.4				
Thrust Load Tolerance	N	30				
Radial Load Tolerance*	N	100				
Motor Weight	kg	1.22				

* There is no gear option for the PBM284 and PBM604.

* The load point is at 1/3 length from the output shaft.

5 Specifications (Common)

5.3.3 Harmonic Gear

Motor Model	Unit	PBM282FHLE20	PBM282FHME20	PBM423FHJE20	PBM423FHLE20	PBM423FHME20
Reduction Gear Ratio	-	1:50	1:100	1:30	1:50	1:100
Torque Tolerance	N·m	1.5	2	2.2	3.5	5
Instantaneous Torque Tolerance	N·m	2.7	3.6	4.5	8.3	11
Rotation Tolerance	min^{-1}	70	35	116	70	35
Lost Motion	min	0.4～3 (±0.06N·m)	0.4～3 (±0.08N·m)	—	—	—
Hysteresis Loss	min	—	—	3.6	2.4	2.4
Rotational Direction	Compared to the CMD	Reverse	Reverse	Reverse	Reverse	Reverse
Rotor Inertia	$\times10^{-4}kg\cdot m^2$	0.012		0.068		
Thrust Load Tolerance	N	9.8		1150		
Radial Load Tolerance*	N	33		209		
Motor Weight	kg	0.27		0.54		

Motor Model	Unit	PBM603FHLE20	PBM603FHME20
Reduction Gear Ratio	-	1:50	1:100
Torque Tolerance	N·m	5.5	8
Instantaneous Torque Tolerance	N·m	14	20
Rotational Tolerance	min^{-1}	70	35
Lost Motion	min	0.4～3 (±0.28N·m)	0.4～3 (±0.4N·m)
Hysteresis Loss	min	—	—
Rotational Direction	Compared to the CMD	Reverse	Reverse
Rotor Inertia	$\times10^{-4}kg\cdot m^2$	0.435	
Thrust Load Tolerance	N	400	
Radial Load Tolerance*	N	360	
Motor Weight	kg	1.45	

* There is no harmonic gear option for the PBM284 and PBM604.

* The load point is at 1/3 length from the output shaft.

5 Specifications (Common)

5.3.4 Holding brake

Motor Model	Unit	PBM282FCE20	PBM284FCE20	PBM423FCE20	PBM603FCE20	PBM604FCE20
Operation Method	–	Non-excitation type				
Excitation Current	A	0.15	0.15	0.08	0.25	0.25
Power Consumption	W	3.6	3.6	2	6	6
Friction Torque	N·m	0.049	0.049	0.22	0.78	0.78
Motor Weight	kg	0.28	0.35	0.5	1.19	1.76
Release Delay Time	ms	Max. 100				
Control Delay time	ms	Max. 50				

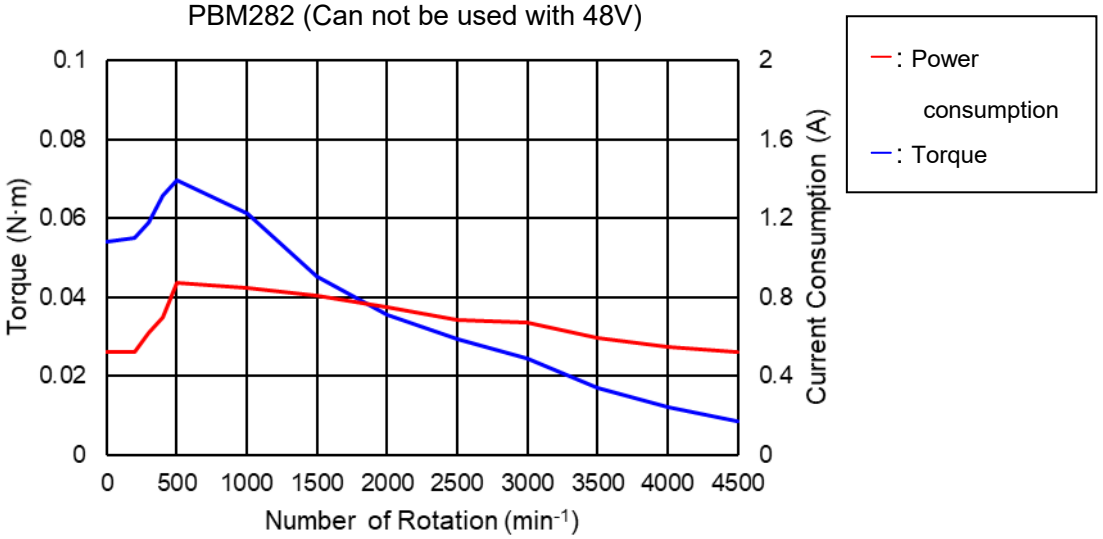
* There is no holding brake option for the PBM565.

* The holding brake control function is built into the driver.

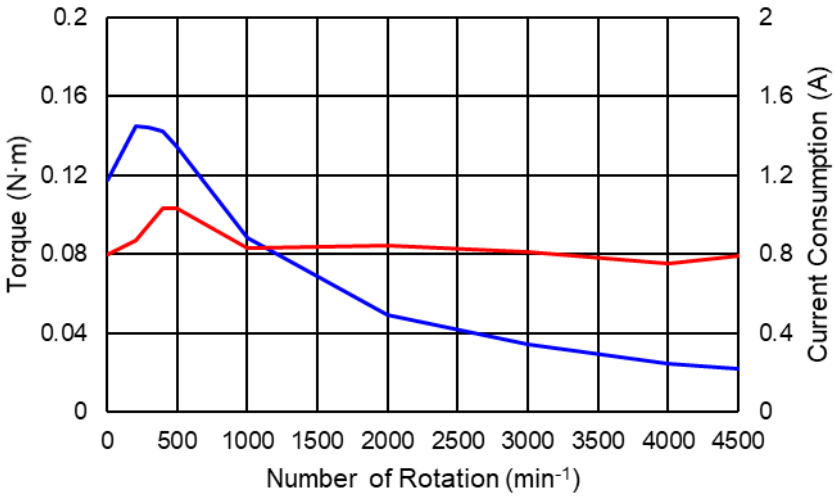
5 Specifications (Common)

5.4 Velocity-Torque, Power Consumption (during drive) Characteristics

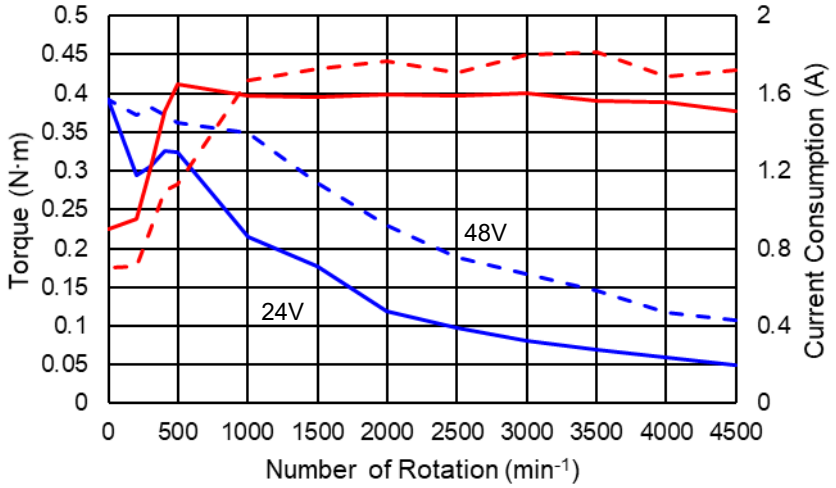
PBM282 (Can not be used with 48V)



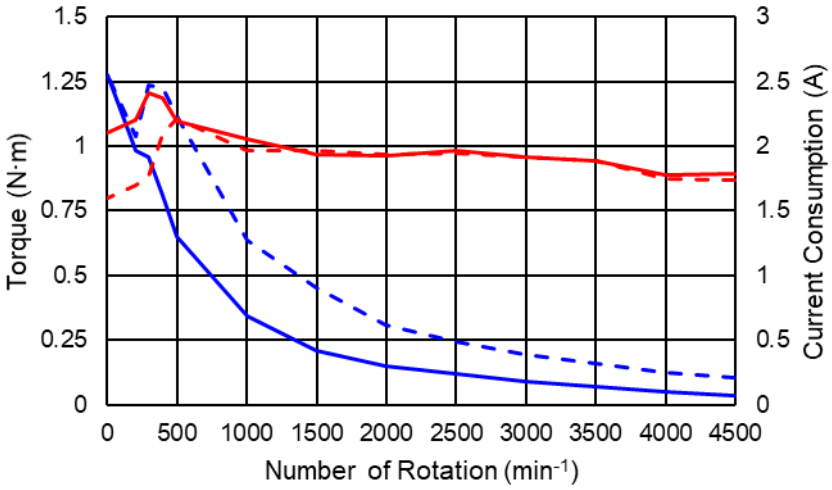
PBM284 (Can not be used with 48V)



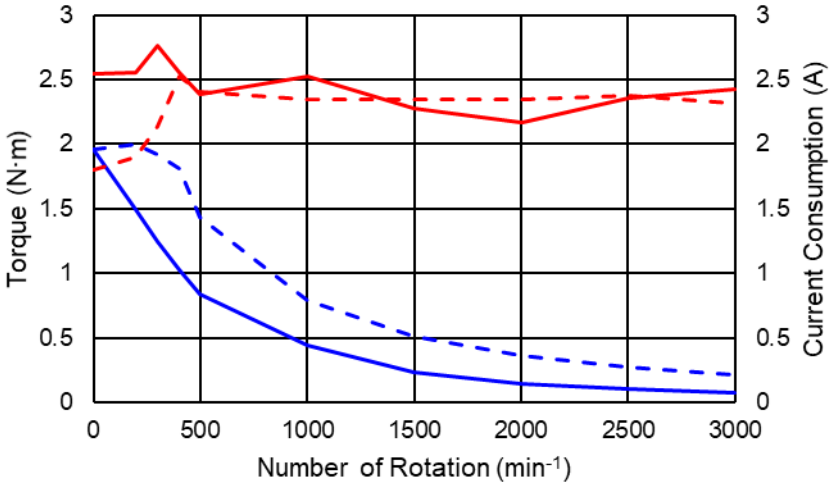
PBM423



PBM603



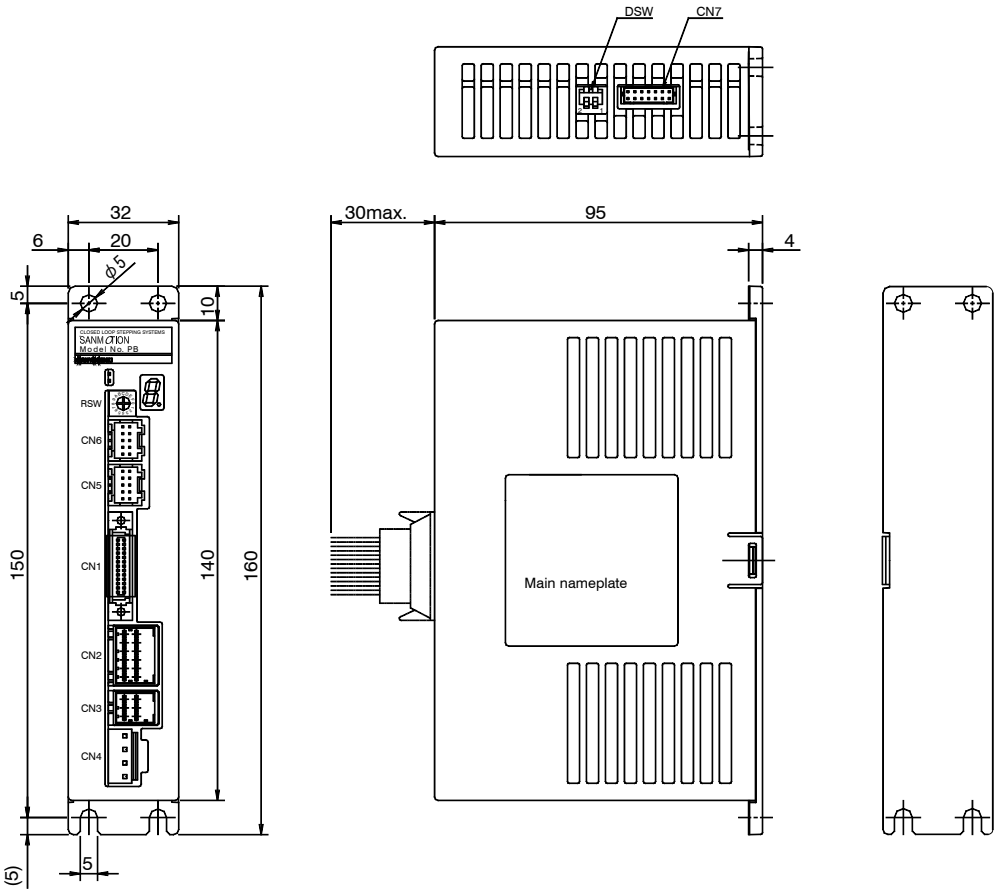
PBM604



5 Specifications (Common)

5.5 Outline Drawings

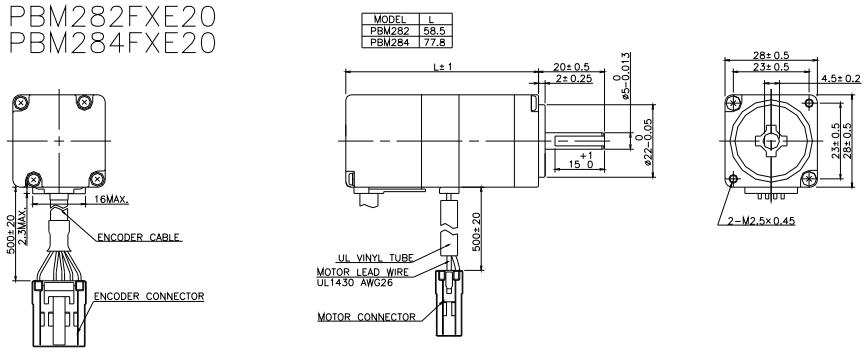
5.5.1 Driver Drawing



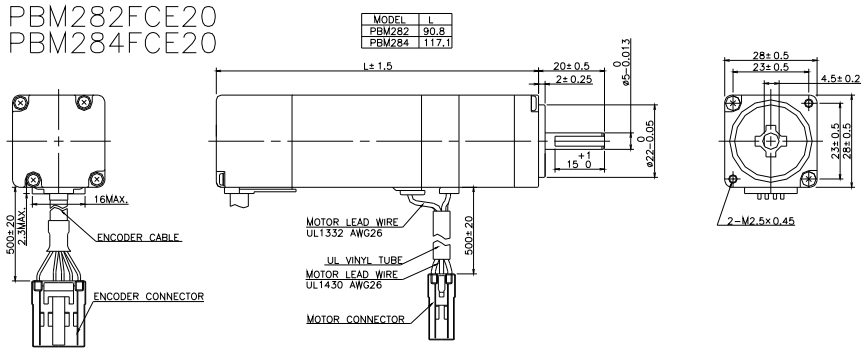
5 Specifications (Common)

5.5.2 Motor Drawings

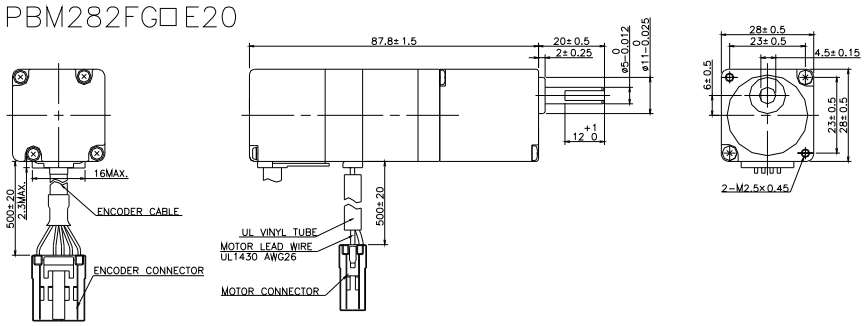
PBM282FXE20
PBM284FXE20



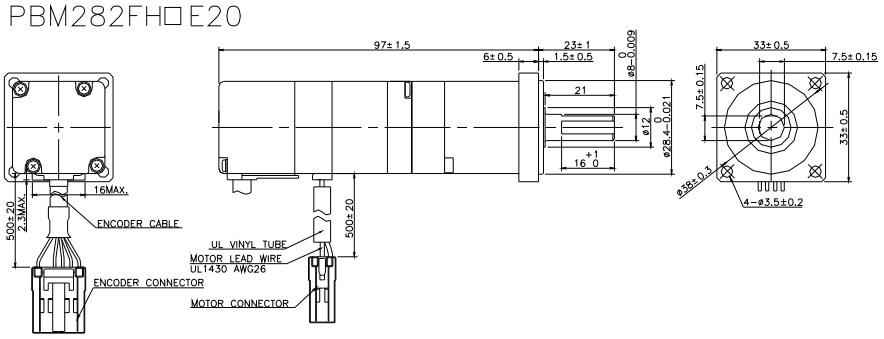
PBM282FCE20
PBM284FCE20



PBM282FG□E20

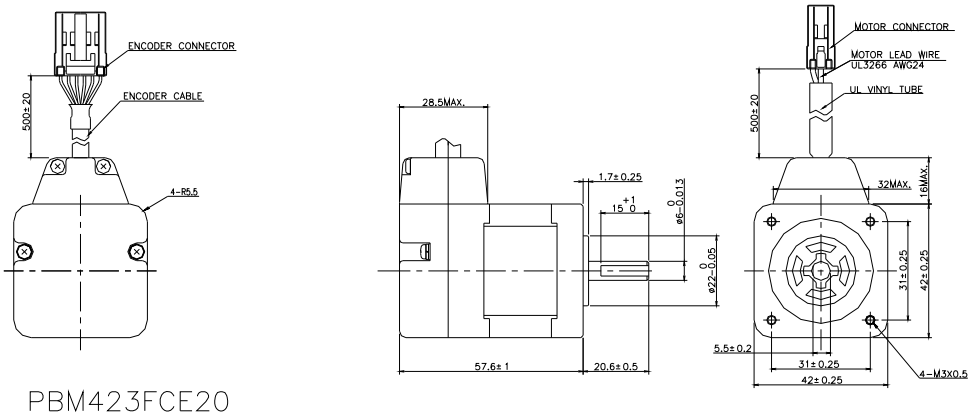


PBM282FH□E20

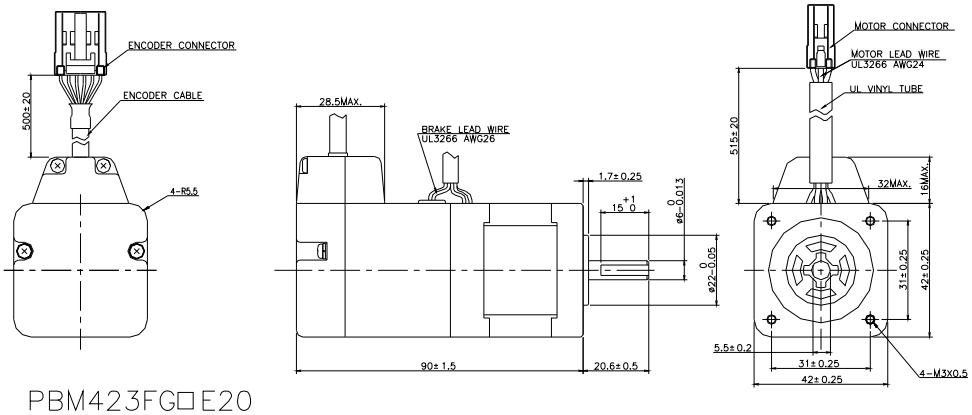


5 Specifications (Common)

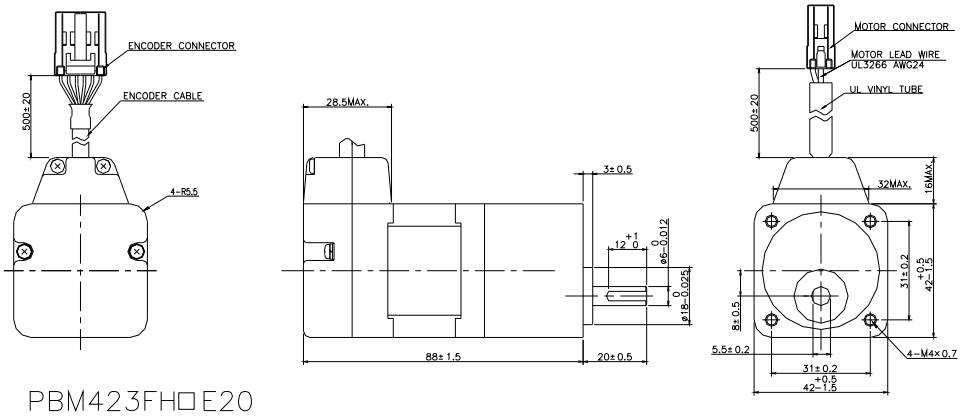
PBM423FXE20



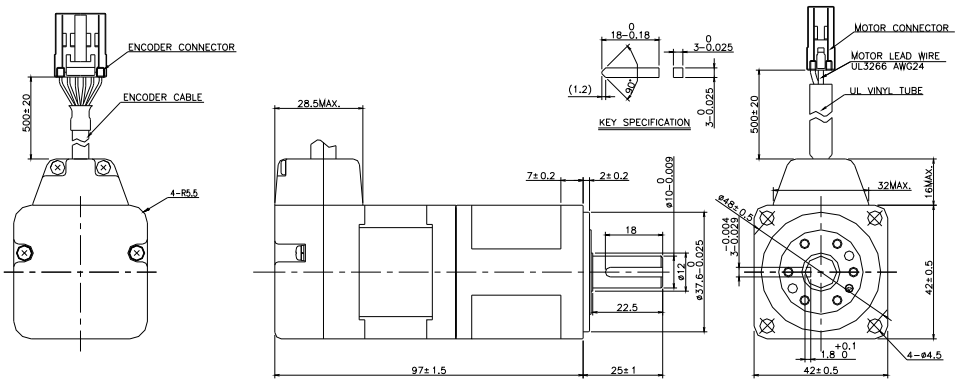
PBM423FCE20



PBM423FG□E20



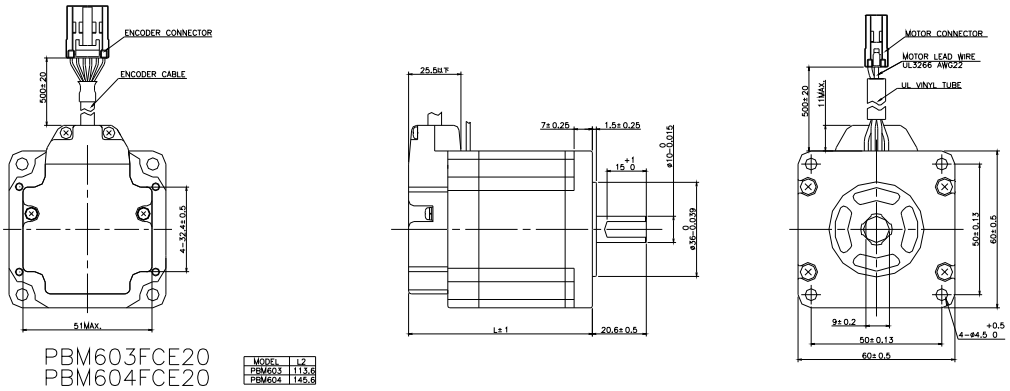
PBM423FH□E20



5 Specifications (Common)

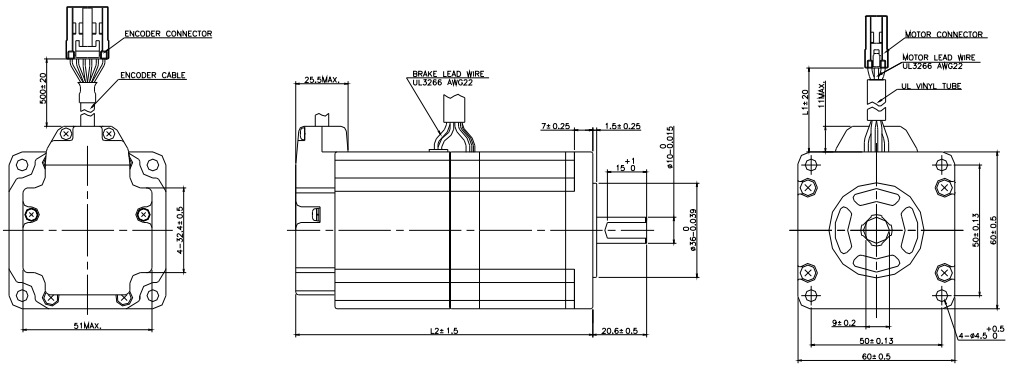
PBM603FXE20
PBM604FXE20

MODEL	L
PBM603	70.3
PBM604	102.3

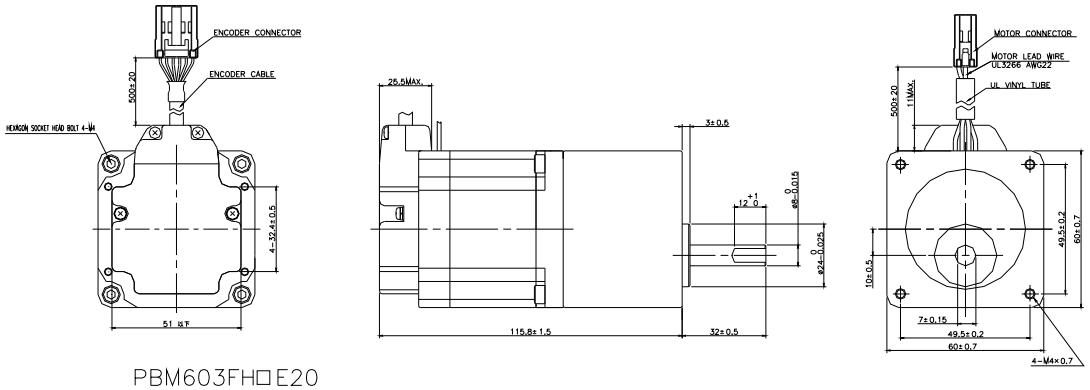


PBM603FCE20
PBM604FCE20

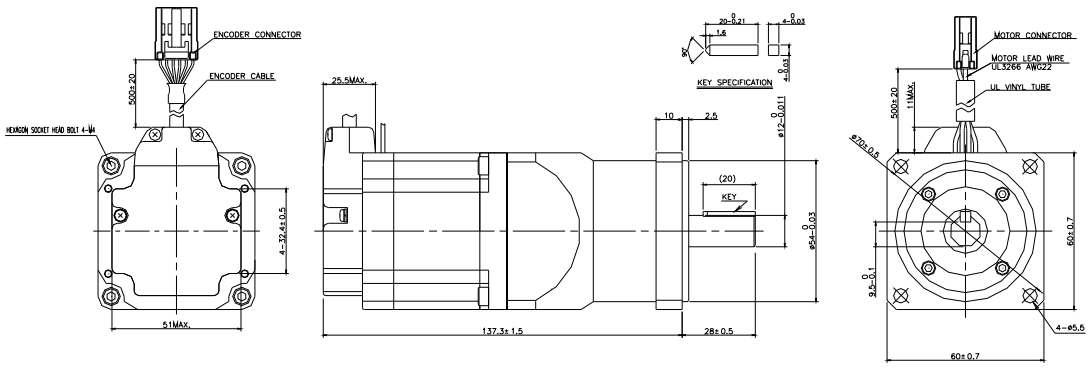
MODEL	L2
PBM603	113.6
PBM604	145.6



PBM603FG□E20

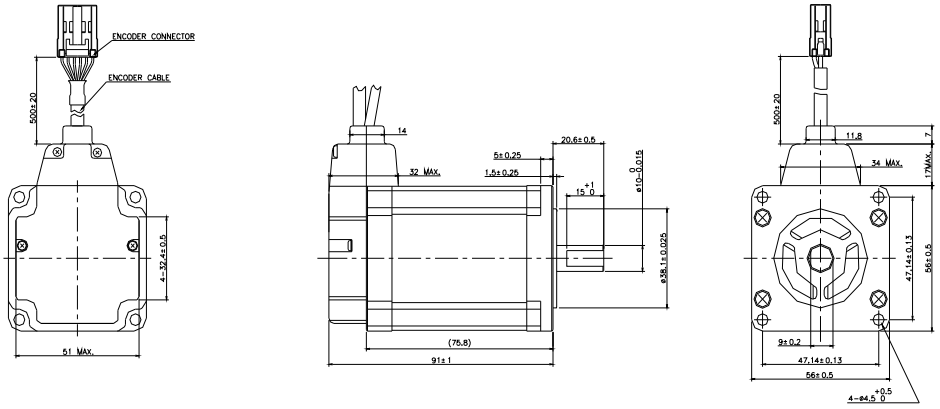


PBM603FH□E20



5 Specifications (Common)

PBM565FXE20

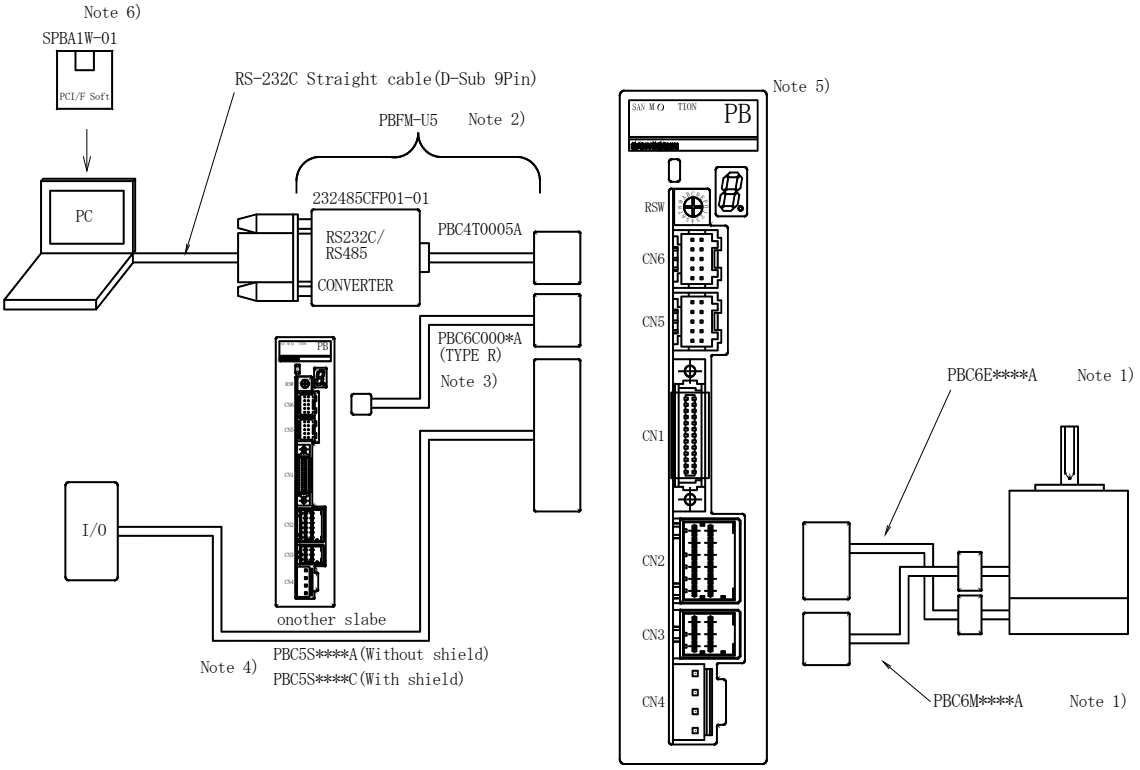


6

Option (Common)

6 Option (Common)

6.1 Optional Configurations



Note 1 Motor and encoder extension cables are necessary when extending beyond 50 cm.

Note 2 The communication unit is necessary when setting a parameter etc.
If you wish to purchase the driver with Parameter, Point Data and Program Data etc written at the start of mass production, please contact Sanyo Denki.

Note 3 Necessary when daisy-chaining the multiple AMP for Type R.

Note 4 When using the I/O cable in pulse train, use shield type.

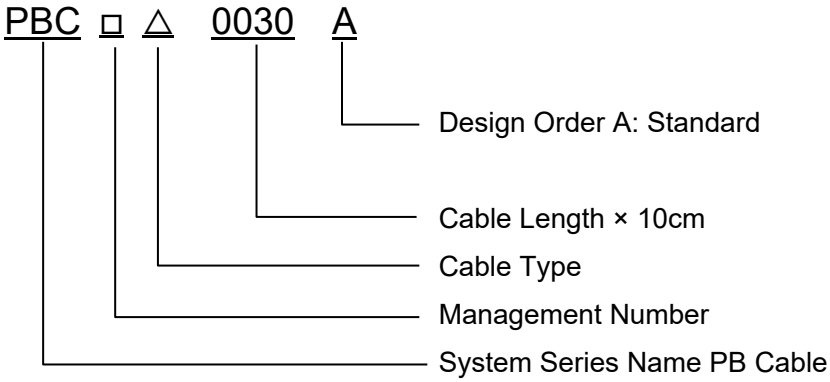
Note 5 If a set is ordered, I/O cable (1m with shield) and power cable (1m) will be included.

Note 6 For PC interface software, please download from Sanyo Denki's homepage.

6 Option (Common)

6.2 Optional Cables

6.2.1 Optional Cable Model Number Specifications



6.2.2 Optional Cable Model Numbers

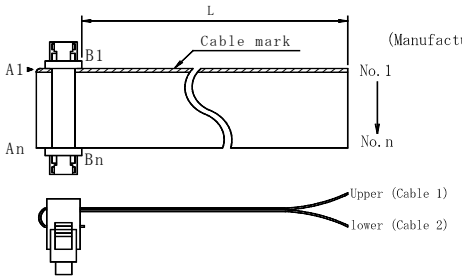
Cable Type	Cable Standard Model Number	Standard Length	Maximum Length
Power cable	PBC6P0010A	1m	3m
Motor power cable	PBC6M0030A	3m	20m
Sensor cable	PBC6E0030A	3m	20m
I/O cable (without shield)	PBC5S0010A	1m	3m
I/O cable (With shield)	PBC5S0010C	1m	3m
Communication cable (to driver) *Only for Type R	PBC6C0003A	0.3m	100m

* The optional cables are necessary to extend the motor power cable and the sensor cable beyond 50cm.
* If a set is ordered, the power cable and I/O cable (with shield) will be included.
* I/O cable is available with or without shield. Use a cable with shield if the noise environment is bad for pulse train and Type R.

6 Option (Common)

6.2.3 Cable Diagrams

PIO cable without shield



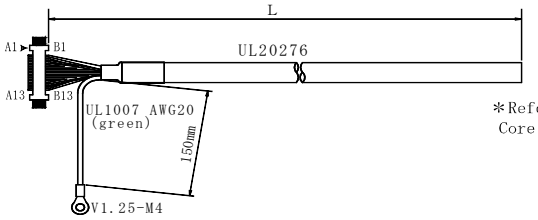
Cable model number
PBC5S****A

(Manufacturer model number: 8822E-026-171D-***S-A0)

Cable connection

Cable 1	Cable 2
A1 — No. 1	B1 — No. 11
A2 — No. 2	B2 — No. 12
A13 — No. 13	B13 — No. 26

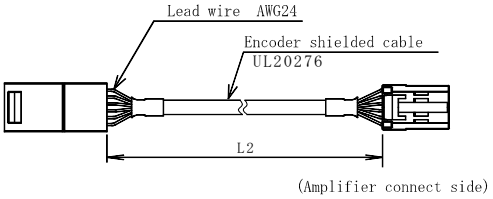
PIO cable with shield



Cable model number
PBC5S****C

*Refer to Section 7.2.4 for Core Wire Identification Chart

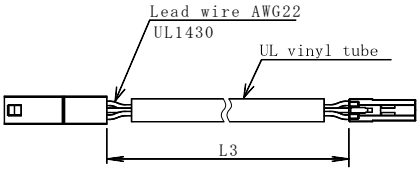
Encoder extension cable



Cable model number
PBC6E****A

Pin No.	Lead wire color	Signal name
1	Blue	A
2	Brown	$\overline{A}$
3	Green	B
4	Purple	$\overline{B}$
5	White	C
6	Yellow	$\overline{C}$
7	Red	5V
8	Black	GND
9	—	NC
10	—	—
11	Black	Shield
12	—	NC

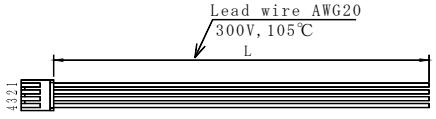
Motor extension cable



Cable model number
PBC6M****A

Pin No.	Lead wire color	Signal name
1	Blue	A
2	Orange	$\overline{A}$
3	Red	B
4	Yellow	$\overline{B}$
5	White	BRK+
6	Black	BRK-

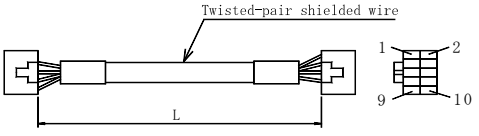
Power cable



Cable model number
PBC6P****A

Pin No.	Lead wire color	Signal name
1	Red	Pow
2	Blue	GND
3	Yellow	NC
4	Green	FG

Communication cable (between amplifiers) TYPE R Limitation



Cable model number
PBC6C****A

Pin No.	Lead wire color	Signal name
1	Yellow	A
2	White	B
3	Brown	—
4	Blue	—
5	Black	GND
6	—	Vcc
7	Purple	Mode
8	Green	Brake
9	—	GND
10	Black	FG

6.2.4 I/O Cable (with shields) Core Wire Identifications

Terminal Number	Signal Name (pulse train)	Signal Name (Type R)	Lead wire color	Printed mark color
1 (A1)	CCW Pulse+	Reserve	Orange	Red —
2 (A2)	CCW Pulse-	Reserve		Black —
3 (A3)	CW Pulse+ (DIR+)	Reserve	Gray	Red —
4 (A4)	CW Pulse- (DIR-)	Reserve		Black —
5 (A5)	Positive Direction Limit	IN1/PWR	White	Red —
6 (A6)	Negative Direction Limit	IN2/Point0		Black —
7 (A7)	Generic Input 1	IN3/Point1	Yellow	Red —
8 (A8)	Generic Input 2	IN4/Point2		Black —
9 (A9)	Generic Input 3	IN5/Point3	Pink	Red —
10 (A10)	Generic Input 4	IN6/Point4		Black —
11 (A11)	Generic Input 5	IN7/Jog+	Orange	Red — —
12 (A12)	STOP	IN8/STOP		Black — —
13 (A13)	ALMCLR	ALMCLR/Jog-	Gray	Red — —
14 (B1)	-COM	-COM		Black — —
15 (B2)	ALM	ALM	White	Red — —
16 (B3)	HEND	OUT1/PEND0		Black — —
17 (B4)	SON MON	OUT2/PEND1	Yellow	Red — —
18 (B5)	STOP MON	OUT3/PEND2		Black — —
19 (B6)	Reserve	OUT4/PEND3	Pink	Red — —
20 (B7)	Reserve	OUT5/PEND4		Black — —
21 (B8)	In-Position	OUT6/HEND	Orange	Red — — —
22 (B9)	ENC/phase origin	OUT7/In-Position		Black — — —
23B (10)	ENA	OUT8/MODE MON	Gray	Red — — —
24B (11)	ENB	OUT9/SON MON		Black — — —
25B (12)	+COM (5 to 24V)	+COM (5 to 24V)	White	Red — — —
26B (13)	-COM	-COM		Black — — —

6 Option (Common)

6.3 Optional Connectors

Model No.	Connector Type	Packaging Type	Model Number	Qty.	Mfr.
PBC6P0000A	Power connector	Housing	VHR-4N	1	JST
		Contact	SVH-41T-P1.1	4	
PBC5S0000A	I/O connector	Receptacle	8822E-026-171D	1	KEL
PBC6M0000A	Motor Power connector	Receptacle housing	1-1318119-3	1	Tyco
		Receptacle contact	1318107-1	6	
		Tab housing	1-1318115-3	1	
		Tab contact	1318111-1	6	
PBC6E0000A	Encoder connector	Receptacle housing	1-1318118-6	1	Tyco
		Receptacle contact	1318108-1	12	
		Tab housing	1-1318115-6	1	
		Tab contact	1318112-1	12	
PBC6C0000A	Communication connector	Housing	PADP-10V-1-S	1	JST
		Contact	SPH-002T-P0.5L	10	

* Refer to Section 2.3.3 regarding the appropriate electric wire.

* Refer to Section 2.3.4 regarding the connector pin assignment.

* For harness assembly, special crimping and pressure welding tools are necessary. Refer to the manufacturer's specifications regarding each connector.

6 Option (Common)

6.4 Optional Communication Equipment

6.4.1 PC interface

Type	Model Number	Memo
PC software for Windows™	SPBA1W-01	Supports Windows™ Vista,7 Both Japanese and English versions Specifications：M0007856
USB／RS-485 converter unit	PBFM-U6	Unit configuration ・ Communication unit：Uport1130 (MOXA) Package contents ・ USB/Serial adapter ・ Terminal block conversion adapter ・ Cable：PBC6T0005A（0.5m）

Converter terminal block connector pin array

TB pin No.	Signal name	PBC6T0005A wire color
1	—	—
2	—	—
3	DATA+ (A)	Yellow
4	DATA- (B)	White
5	GND	Black

Note. For details on how to install and use the Uport1130 driver, refer to the installation manual included with the product or the MOXA website(https://japan.moxa.com/).

Note. Please download the latest version of the Uport1130 device driver from the MOXA website.

Note. Please note that we are not responsible for any problems caused by Uport1130.

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7

Standard (Common)

7 Standard (Common)

7.1 International Standards

The PB driver conforms to the international standards below.

Mark	International standards	Standard number	Certification Organization / Certificate No.
c UL us	UL standard	UL508C	UL (Underwriters Laboratories inc.) File No.: E179775
	CSA standard	UL508C	
TÜV	EN standard	SAFETY：EN61010 EMC：EN55011 IEC61000	TÜV (TÜV SÜD Japan, Ltd.)

The PB motor has the following products with international standards.

Mark	International standards	Standard number	Certification Organization / Certificate No.
UL	UL standard	UL1004	UL (Underwriters Laboratories inc.) File No.: E179832
TÜV	EN standard	EN60034-1 EN60034-5	TÜV (TÜV SÜD Japan, Ltd.) B05 05 30982 046

* The products conforming to international standards differ from the standard product. Please refer to Chapter 1 “Model Number Nomenclature”.

* There is no product conforming to international standards for 28mm Sq. motors.

7.2 Conditions of Use

* Installment environment: Install in a control panel that has a structure (IP54) to avoid exposure to water, oil, carbon, dust, etc.

* For power supply, use reinforced and insulated products of IEC or EN standard.
Grounding: Driver case must be grounded. When connecting ground wire, always connect one wire to one terminal.

7 Standard (Common)

7.3 EMC Directive

7.3.1 Tests

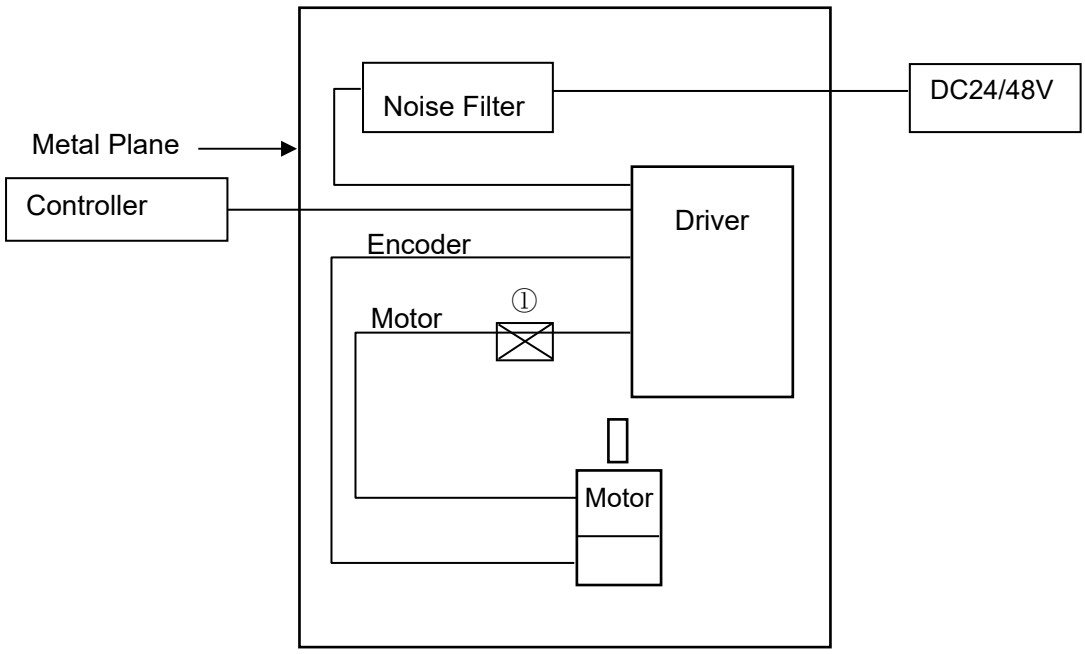
For the PB system, the following conformity tests for standards are performed.

Directive classification	Classification	Test	Test standard
EMC Directive (driver/motor)	Emission	Conducted emission	EN55011:1998/A2:2002
		Radiated emission	EN55011:1998/A2:2002
	Immunity test	Electrostatic discharge immunity	IEC61000-4-2/2001
		Radiated electromagnetic field immunity	IEC61000-4-3/2002
		Electrical first transient/ burst immunity	IEC61000-4-4/1995, A1/2000, A2/2001
		Conducted disturbance immunity	IEC61000-4-6/2001

7.3.2 Installation Condition

For the EMC Directives, tests are performed by general installation and countermeasure methods, in our company as machines and configurations differ depending on customer’s needs.
Accordingly, customers are instructed to perform the final conformity tests for all instruments and devices in use.

Shown below are the Installation conditions when testing conformity.



Noise suppression components:
Noise Filter: SUP-EK10-ER-6 (OKAYA)
Ferrite Core: ① SFC-10 (KITAGAWA) 1turn

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Release	
Revision A	Jan. 2007
Revision B	Jun. 2007
Revision C	Oct. 2007
Revision D	Apr. 2008
Revision E	Jun.2018
Revision F	Oct.2020

■Precautions For Adoption

Failure to follow the precautions on the right may cause moderate injury and property damage, or in some circumstances, could lead to a serious accident.
Always follow all listed precautions.

⚠ Cautions

- Read the accompanying Instruction Manual carefully prior to using the product.
- If applying to medical devices and other equipment affecting people's lives please contact us beforehand and take appropriate safety measures.
- If applying to equipment that can have significant effects on society and the general public, please contact us beforehand.
- Do not use this product in an environment where vibration is present, such as in a moving vehicle or shipping vessel.
- Do not perform any retrofitting, re-engineering, or modification to this equipment.
- The Products presented in this Instruction Manual are meant to be used for general industrial applications. If using for special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc., please contact us beforehand.

* For any question or inquiry regarding the above, contact our Sales Department.

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Translated version of the original instructions