M0007307C

SANMOTION

DC SERVO SYSTEMS

T

TYPE S

Analog / Pulse Input Type

For Rotary Motor

Instruction Manual

SANYO DENKI

PREFACE

Since this product does not correspond to the strategic materials specified in the “Foreign Exchange and Foreign Trade Law”, it is unnecessary to apply to the Ministry of International Trade and Industry to export the product. However, since customs may require explanations for non-correspondence, we will send you documents for it on request.
When this product is combined with other machines, be sure to follow their corresponding/non-corresponding judgments.

This instruction manual explains functions, wiring, installation, driving, maintenance, and specifications etc. for the DC servo amplifier "T" series/type S.

The functions and efficiency of the DC servo amplifier "T" series/type S and AC servo amplifier "R" series/type S are unchanged and are compatible with the DC motor. Compared with the previous DC servo amplifier "DA" series, this has more functions, higher efficiency, and a higher cost performance and is compatible with a wider range of applications than previously.

★Notes regarding the instruction manual

- Please read this entire instruction manual before use to get the best from the functions of the DC servo amplifier "T" series/type S and use it correctly.
- After reading the instruction manual, keep it in a handy place where it can be referred to easily if needed.
- Contact the nearest office or headquarters as described on the back of this paper if this manual is incomplete, it is lost, it has stains, it has incorrect numbering, it has missing pages, etc.
- Make sure you follow all instructions regarding safety in this manual. Note that we cannot guarantee safety if this product is not used correctly or if this product is not used in the way described in this manual.
- The contents of this manual are subject to change without notice due to future product upgrades and additions. Regarding changes, this manual will be revised accordingly.
- There are times when parts of the figure may be omitted or may be an abstraction.
- Whilst we strive for perfection in the contents of this manual, please contact our nearest office or headquarters as described on the back of this paper if you notice anything unusual, any mistakes, or any omissions etc.

[Safety Precautions]

This chapter is a summary of the safety precautions regarding the use of the TS1-series type-S amplifier.
Please read this entire manual carefully prior to installing, operating, performing maintenance or inspecting this device to ensure proper use.
Use this device only after learning about its operation, safety information, and the precautions related to its use. After reading the User Manual, keep it in a location where it is always available to the user for easy reference.

The TS1-series servo amplifiers and servo motors were designed for use with general industrial equipment. The following instructions should be followed:

- Read the User Manual carefully before any installation or assembly work to ensure proper use.
- Do not perform any retrofitting or modification of the product.
- Consult with your sale representatives or a trained professional technician regarding the installation and maintenance of these devices.
- Special consideration, such as redundant services or an emergency generator, is required when operating, maintaining and controlling devices in certain applications related to human safety or public functions. Contact your distributor or sales office if you intend to use these devices in applications such as;
  - ※ In medical instruments or systems used for life support;
  - ※ With control systems for trains or elevators, the failure of which could cause bodily injury;
  - ※ In computer systems of social or public importance;
  - ※ In other equipment or systems related to human safety or public infrastructure.

- Additionally, please contact your distributor or sales office if the device is to be used in an environment where vibration is present, such as in-vehicle or transport applications.

Safety Precautions [Make sure to follow.]

This documentation uses the following annotation. Make sure to strictly follow these safety precautions.

■ Safety Precautions and symbols

Safety Precautions		Symbols	
Danger	Denotes immediate hazards that will probably cause severe bodily injury or death as a result of incorrect operation.		Danger /Injury
			Electric shock
Caution	Denotes hazards that 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.		Caution
			Fire
			Burn
Prohibited	Indicates actions that must not be allowed to occur prohibited actions.		Prohibited
			Disassembly prohibited
Mandatory	Indicates actions that must be carried out (mandatory actions).		Mandatory

Danger

Do not use this device in explosive environment. Injury or fire could otherwise result.	Do not touch the inside of the Amplifier and Power Unit. Electric shock could otherwise result.
Do not perform any wiring, maintenance or inspection while the POWER is ON. After switching the power off, wait at least 5 minutes before performing these tasks. Electric shock could otherwise result.	Only technically qualified personnel should transport, install, wire, operate, or perform maintenance and inspection on this device. Electric shock, injury or fire could otherwise result.
The protective ground terminal (⏚) should always be grounded to the control box or equipment. The ground terminal of the motor should always be connected to the protective ground terminal (⏚) of the Amplifier. Electric shock could otherwise result.	Do not damage the cable, do not apply unreasonable stress to it, do not place heavy items on it, and do not insert it in between objects. Electric shock could otherwise result.

Safety Precautions [Make sure to follow.]

Wiring should be done based on the wiring diagram or the user manual.  Electric shock or fire could otherwise result.	Do not touch the rotating part of the motor during operation.  Bodily injury could otherwise result.
Do not touch or get close to the terminal and the connector while the device is powered up.  Electric shock could otherwise result.	Do not unplug the terminal and the connector while the device is powered up.  Electric shock could otherwise result.

Caution

Please read the User Manual carefully before installation, operation, maintenance or inspection, and perform these tasks according to the instructions.  Electric shock, injury or fire could otherwise result.	Do not use the Amplifier, the Power Unit or the motor outside their specifications.  Electric shock, injury or damage to the device could otherwise result.
Do not use a defective, damaged or burnt amplifier, or Power Unit or motor.  Injury or fire could otherwise result.	Use the Amplifier and motor together in the specified combination.  Fire or damage to the device could otherwise result.
Be careful of the high temperatures generated by the Amplifier/motor and the peripherals.  Burn could otherwise result.	Open the box only after checking its top and bottom location.  Bodily injury could otherwise result.

Safety Precautions [Make sure to follow.]

⚠ Caution

Verify that the products correspond to the order sheet/packing list. If the wrong product is installed, injury or damage could result.  Injury or damage could result.	Please do not apply static electricity, the high voltage, etc. to the cable for encoders of motor.  Damage to the device could otherwise result.
Do not measure the insulation resistance and the pressure resistance.  Damage to the device could otherwise result.	Wiring should follow electric equipment technical standards and indoor wiring regulations.  An electrical short or fire could otherwise result.
Wiring connections must be secure.  Motor interruption or bodily injury could otherwise result.	
Do not place heavy objects on the device or stand on top of it.  Bodily injury could otherwise result..	Do not obstruct the air intake and exhaust vents, and keep them free of debris and foreign matter.  Fire could otherwise result.
Make sure the mounting orientation is correct.  Fire or damage to the device could otherwise result.	Consult the User Manual regarding the required distance between the Amplifier, and sequence of the control panel interior in the Power Unit.  Fire or damage to the device could otherwise result.
Do not subject the device to excessive shock or vibration.  Damage to the device could otherwise result.	Secure the device against falling, overturning, or shifting inadvertently during installation.  Use the hardware supplied with the motor (if applicable).
Do not expose the device to water, corrosive or flammable gases, or any flammable material.  Fire or damage to the device could otherwise result.	Install the device on a metal or other non-flammable support.  Fire could otherwise result.

Safety Precautions [Make sure to follow.]

Caution

There is no safeguard on the motor. Use an over-voltage safeguard, short-circuit breaker, overheating safeguard, and emergency stop to ensure safe operation. Injury or fire could otherwise result.	Do not touch the radiation fin of the Amplifier, the regenerative resistor, or the motor while the device is powered up, or immediately after switching the power off, as these parts generate excessive heat. Burn could otherwise result.
In the case of any irregular operation, stop the device immediately. Electric shock, injury or fire could otherwise result.	Do not perform extensive adjustments to the device as they may result in unstable operation. Bodily injury could otherwise result.
Trial runs should be performed with the motor in a fixed position, separated from the mechanism. After verifying successful operation, install the motor on the mechanism. Bodily injury could otherwise result.	The Holding brake is not to be used as a safety stop for the mechanism. Install a safety stop device on the mechanism. Bodily injury could otherwise result.
In the case of an alarm, first remove the cause of the alarm, and then verify safety. Next, reset the alarm and restart the device. Bodily injury could otherwise result.	Verify that input power supply voltage is in a specification range. Damage to the device could otherwise result
Avoid getting close to the device, as a momentary power outage could cause it to suddenly restart (although it is designed to be safe even in the case of a sudden restart). Bodily injury could otherwise result.	It is recommended to replace the electrolytic capacitors in the Amplifier and the Power Unit after 5 years, if used at an average temperature of 40°C year round. Damage to the device could otherwise result.
Be careful during maintenance and inspection, as the body of the Amplifier becomes hot. Burn could otherwise result.	

Safety Precautions [Make sure to follow.]

Caution

Please contact your distributor or sales office if repairs are necessary. Disassembly could render the device inoperative. Damage to the device could otherwise result.	Make sure the device does not fall, overturn, or move inadvertently during transportation. Bodily injury could otherwise result.
Do not hold the device by the cables or the shaft while handling it. Damage to the device or bodily injury could otherwise result.	If the Amplifier, Power Unit or the motor is no longer in use, it should be discarded as industrial waste.

Prohibited

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.	The built-in brake is intended to secure the motor; do not use it for regular control. Damage to the brake could otherwise result. Damage to the device could otherwise result.
Do not overhaul the device. Fire or electric shock could otherwise result.	Do not remove the nameplate cover attached to the device.

Safety Precautions [Make sure to follow.]

Mandatory

Store the device where it is not exposed to direct sunlight, and within the specified temperature and humidity ranges {−20°C to+ 65°C, below 90% RH (non-condensing)}.	Please contact our office if the Amplifier and the Power Unit is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage, and could cause damage to the device. Damage to the device could otherwise result.
Install an external emergency stop circuit and enable it to stop the device and cut off the power supply immediately. Install an external protective circuit to the Amplifier to cut off the power from the main circuit in the case of an alarm. Motor interruption, bodily injury, burnout, fire and secondary damages could otherwise result.	Operate within the specified temperature and humidity range. Amplifier and Power Unit: 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) Burnout or damage to the device could otherwise result.
Follow the directions written on the outside box. Excess stacking could result in collapse. Bodily injury could otherwise result.	The motor angling bolts are used for transporting the motor itself. Do not use them for transporting the machinery. Damage to the device or bodily injury could otherwise result.

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Chapters 1

[Prior to Use]

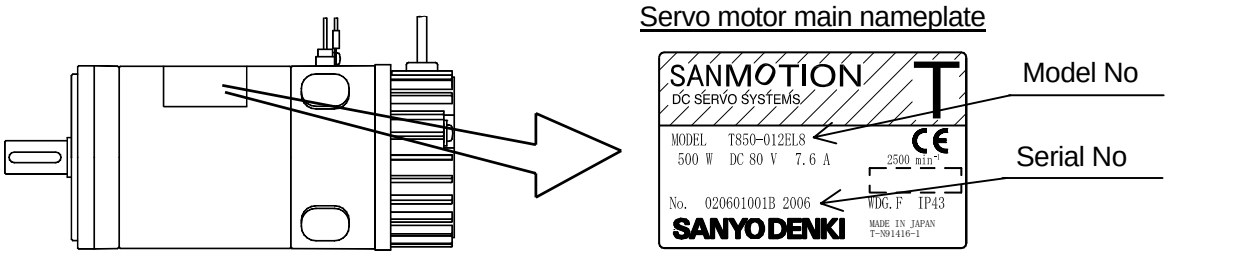
1. Prior to Use [Product verification]

■ Product verification

Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- Verify that the model number of the Servo Motor, Servo Amplifier or Power Unit is the same as ordered. (The model number is located on the main nameplate, following the word “MODEL”.)
- Verify that there are no abnormalities, such as damages to the exterior of the device, or missing accessories.
- Verify that there are no loose screws on the Servo Motor, Servo Amplifier or Power Unit.

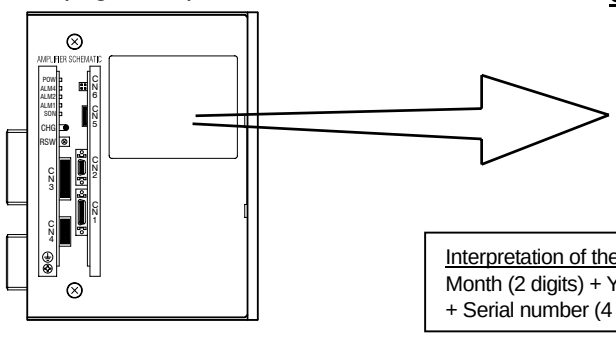
(Name Plate of Servo Motor)



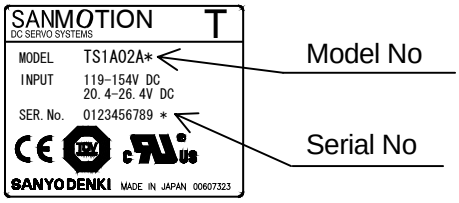
Interpretation of the serial number
Month (2 digits) + Year (2 digits) + Day (2 digits) + Series number (3 digits) + Revision ("A" is abbreviated) + (blank) + Year (4 digits)

(Name Plate of Servo Amplifier)

(Right side)



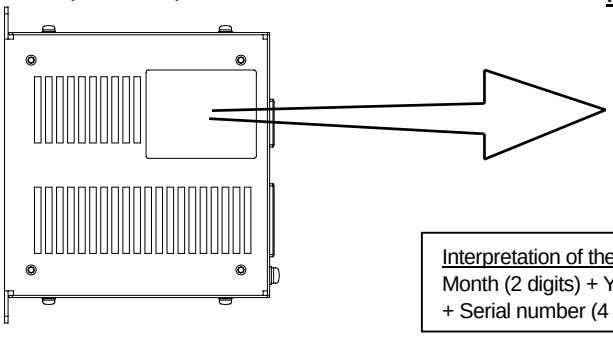
Servo amp main nameplate



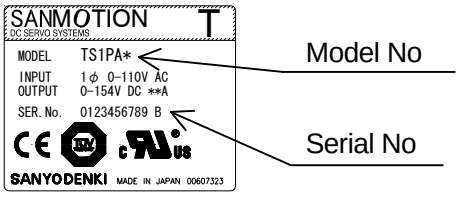
Interpretation of the serial number
Month (2 digits) + Year (2 digits) + Day (2 digits)
+ Serial number (4 digits) + (blank) +Revision ("A" is abbreviated)

(Name Plate of Power Unit)

(Left side)



Power Unit main nameplate



Interpretation of the serial number
Month (2 digits) + Year (2 digits) + Day (2 digits)
+ Serial number (4 digits) + (blank) +Revision ("A" is abbreviated)

1. Prior to Use [Servo motor model number]

■ Servo motor model number

T-series

Flange size
4･･･φ41
5･･･φ51
7･･･φ76
8･･･φ87.5

Encoder (Line driver)
EL8･･･1000P/R
EL0･･･2000P/R
E59･･･2500P/R

Voltage specification
1･･･24V
2･･･75V

Rated power	
02･･･23W	20･･･200W
04･･･40W	30･･･300W
06･･･60W	40･･･400W
11･･･110W	50･･･500W

Specification identification
01･･･Standard specification
Except 01･･･Option

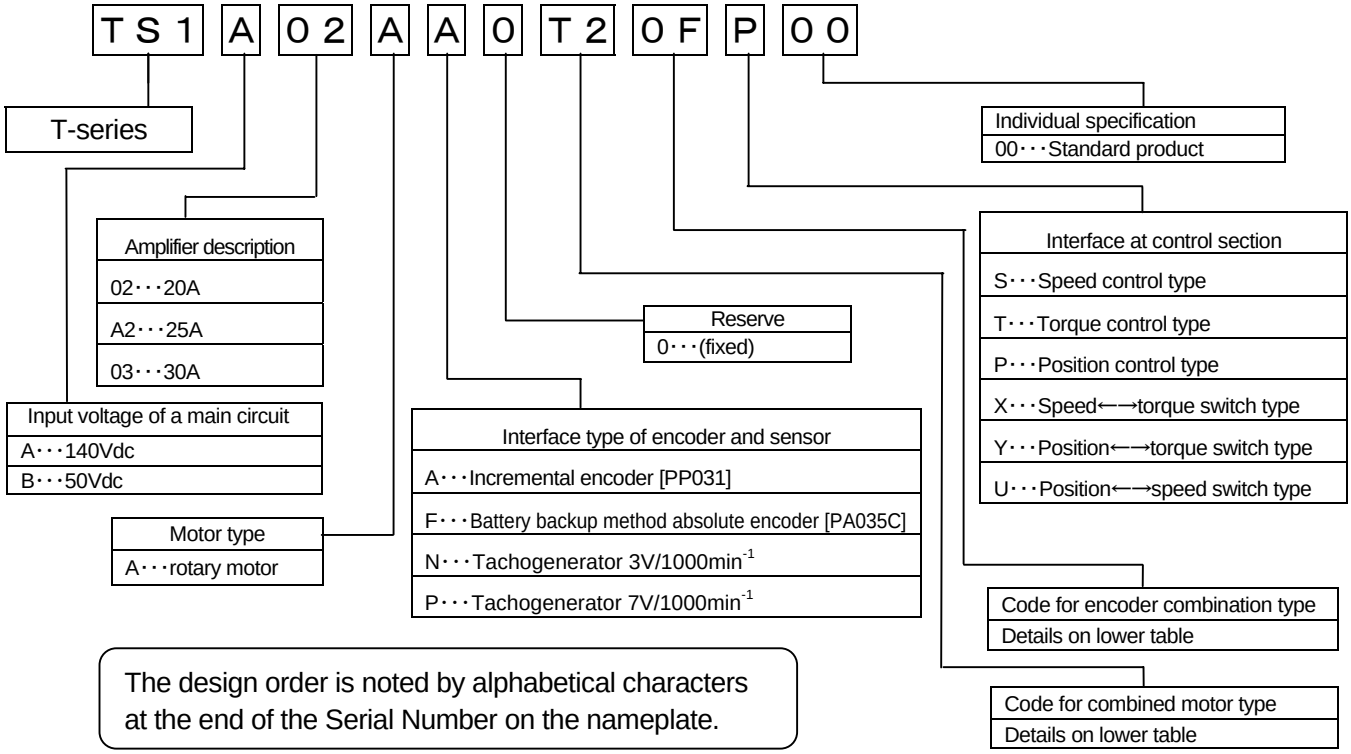
Tachogenerator
T･･･with a tachogenerator
Blank･･･without a tachogenerator

Holding brake
B･･･With a holding brake(Only as for the flange size of 4, 7 and 8)
Blank･･･Without a holding brake

The design order is noted by alphabetical characters at the end of the Series Number on the nameplate.

1. Prior to Use [Servo Amplifier model number]

■ Servo amplifier model number（Full number）



The design order is noted by alphabetical characters at the end of the Serial Number on the nameplate.

● Code for combined motor type

140Vdc input model		
Combined servo amplifier	Servo motor model number	Motor code
TS1A02A	T404-012	T2
	T406-012	T3
	T506-012	T4
TS1AA2A	T511-012	T5
	T720-012	T6
	T730-012	T7
TS1A03A	T840-012	T8
	T850-012	T9

50Vdc input model		
Combined servo amplifier	Servo motor model number	Motor code
TS1B02A	T402-011	T1

● Code for combined encoder type

Incremental encoder [PP031]			
Code	Measurement	Resolution [P/R]	Hard ID.
0F	Optical	1000	A
01	Optical	2000	A
04	Optical	2500	A

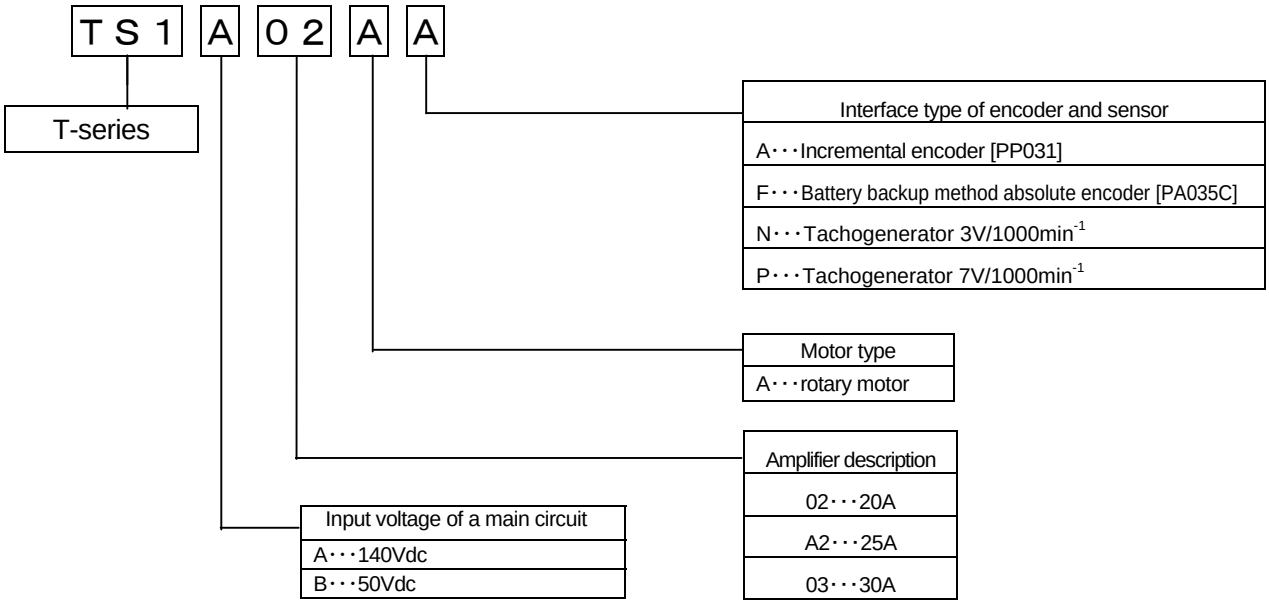
Battery backup method absolute encoder [PA035C]						
Code	Measurement	Transmission format	Resolution [P/R]	Multiple rotations	Hard ID.	Remarks
A3	Optical	Half duplex start-stop synchronization 2.5M	17bit	16bit	F	
A4	Optical	Half duplex start-stop synchronization 4.0M	17bit	16bit	F	Applicable to options

(In the case of a tachogenerator)

Tachogenerator		
Code	Tachogenerator type	Hard ID.
G1	3V/1000min-1	N
G2	7V/1000min-1	P

1. Prior to Use [Servo Amplifier model number]

■ Servo amplifier model number（Abbreviated number）



The design order is noted by alphabetical characters at the end of the Serial Number on the nameplate.

■ Setting contents of Abbreviated number (initial value)

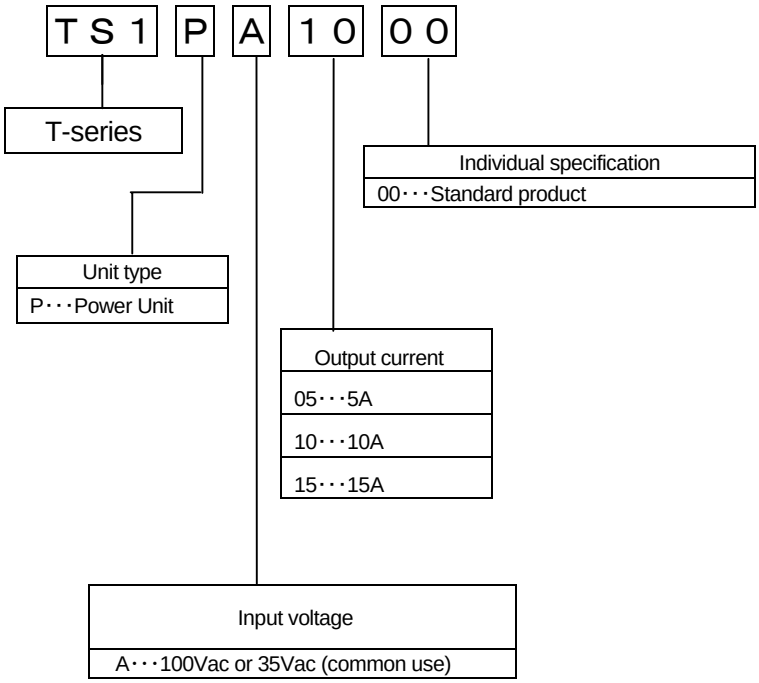
ページ	Name	Set-up value			
		TS1B02A*	TS1A02A*	TS1AA2A*	TS1A03A*
—	Amplifier capacity	20_Ampere		25_Ampere	30_Ampere
—	Motor structure	Rotary_Motor			
—	Control power input voltage	24V			
—	Control power input class	DC			
—	Main circuit power input class	50V	140V		
00	Main circuit power input class	01:_DC_Input			
01	Motor encoder type	If * is A, 00:_Incremental_ENC If * is F, 01:_Absolute_ENC If *is N, 04:_TG_3V If *is P, 05:_TG_7V			
02	Incremental encoder function selection	00:_Standard			
03	Incremental encoder resolution	1000			
04	Absolute encoder function selection	04:_PA035C-2.5MH_Manu（If * is F）			
05	Absolute encoder resolution	06:_131072_FMT（If * is F）			
06	Combination motor model number	T402-011	T404-012	T511-012	T840-012
08	Control mode	01:_Velocity			
09	Position loop control・Position loop encoder selection	00:_Motor_Encoder			
0A	External encoder resolution	-			
0B	Regenerative resistance selection	-			

✍ The above table is a System Parameter setting screen of “R-SETUP” - Setup Software.

✍ Please refer to "Chapter 5 Parameter" and "Chapter 6 Driving" for the change in each parameter.

1. Prior to Use [Power Unit model number / Part names]

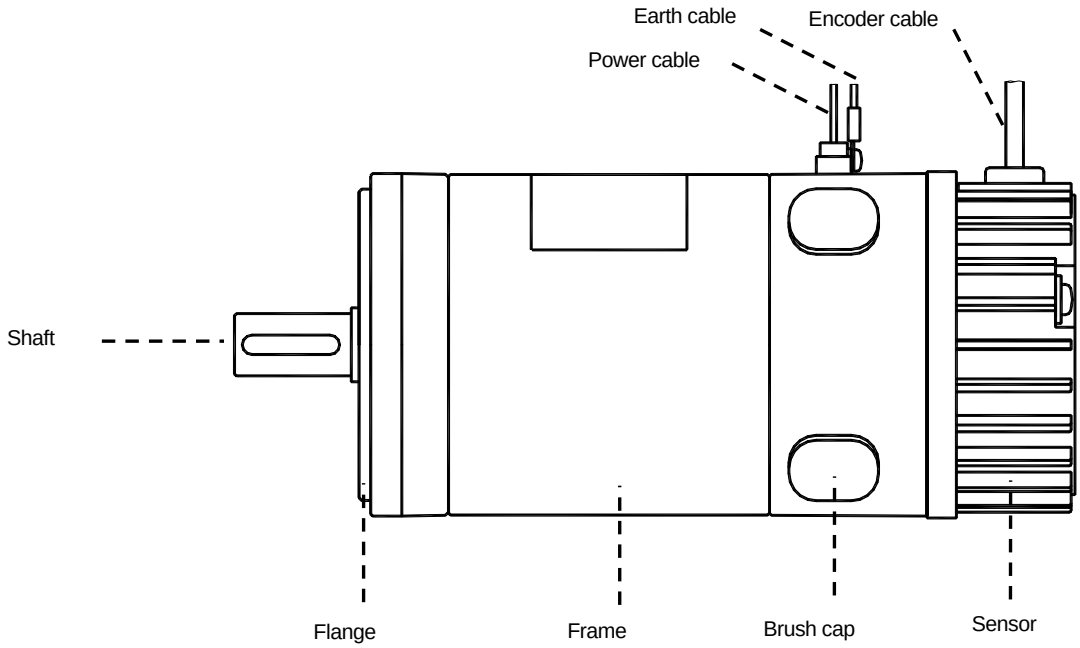
■ Power Unit model number



The design order is noted by alphabetical characters at the end of the Serial Number on the nameplate.

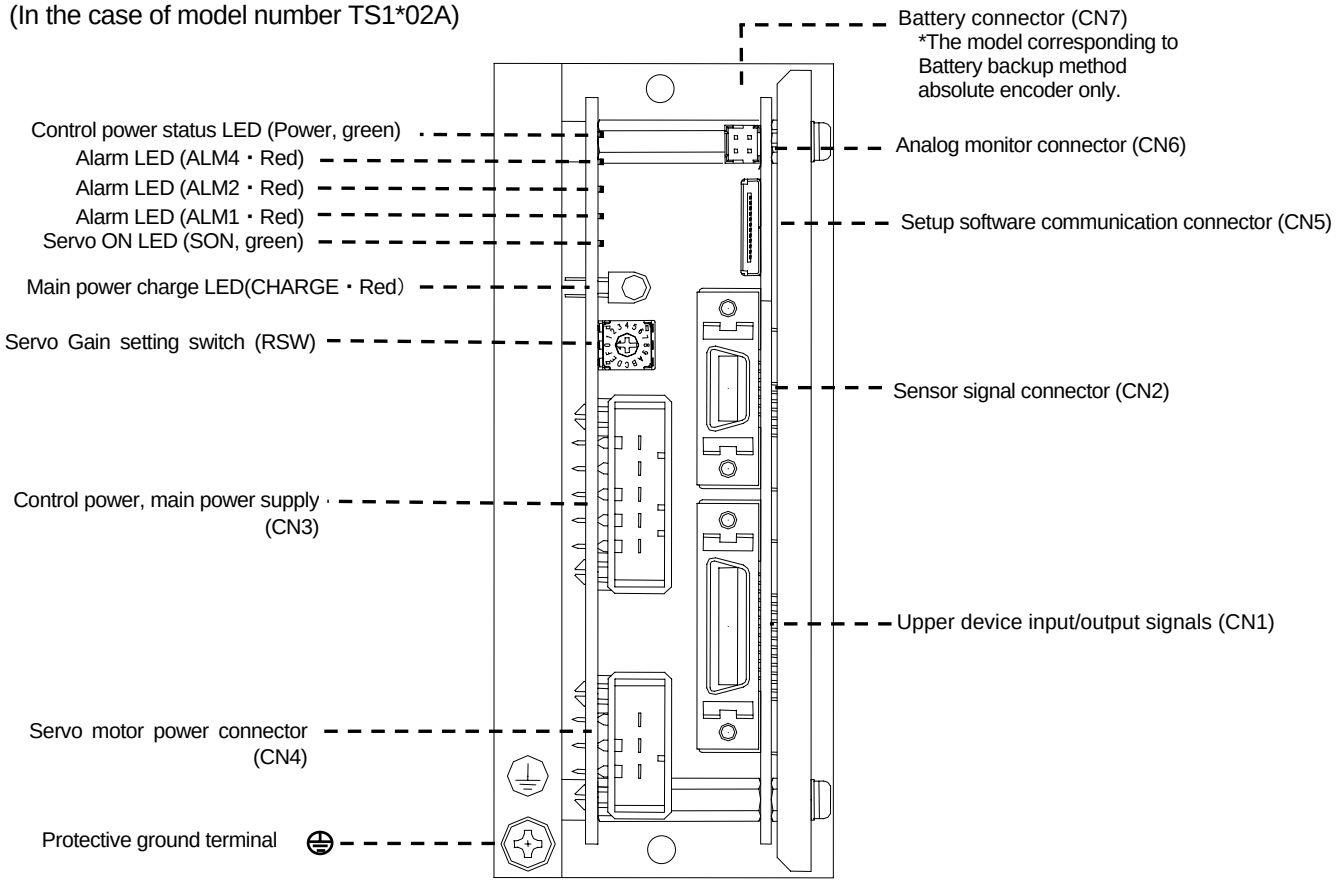
■ Part names

● Servo motor

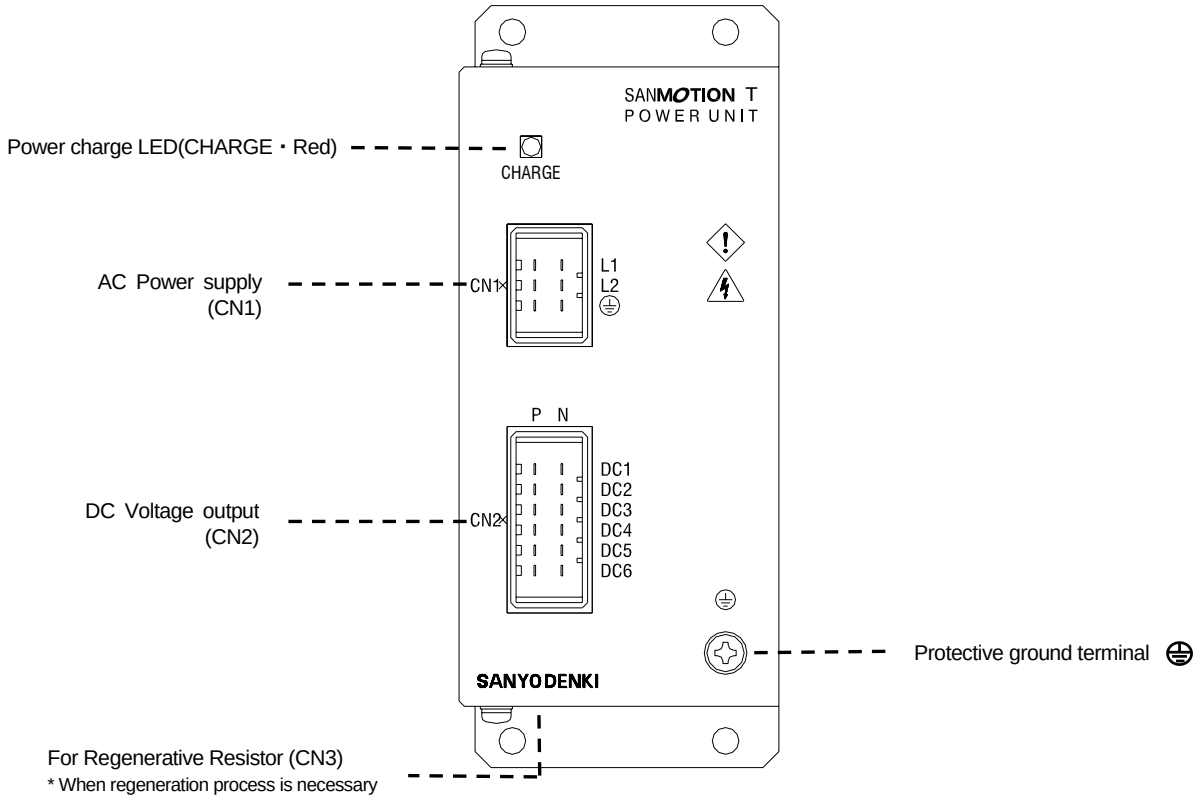


● Servo amplifier

(In the case of model number TS1*02A)



● Power Unit



Chapters 2

[Installation]

2. Installation [Servo Amplifier / Power Unit]

■ Please note the following points regarding the servo amplifier or the power unit installation location and mounting method.

Various precautions

Installation on or near flammable materials can cause fire.	Do not stand or put heavy items on the servo amplifier or the power unit.
Operate the device within the specified environmental conditions.	Do not drop the device or subject it to excessive shock.
Do not install or operate a damaged device, or one with damaged parts; return it for repair at once.	Make sure no screws or other conductive or flammable materials get inside the servo amplifier.
Contact your distributor or sales office if the servo amplifier or the power unit was stored out of use for an extended period of time (3years or more). The capacity of an electrolytic condenser decreases by long-term storage.	

If enclosed in a cabinet

The temperature inside the cabinet can exceed the external temperature depending on the power consumption of the device and the size of the cabinet. Consider the cabinet size, cooling, and placement, and make sure the temperature around the servo amplifier or the power unit does not exceed 55°C. For longevity and reliability purposes it is recommended to keep the temperature below 40°C.

If there is a vibration source nearby

Protect the servo amplifier or the power unit from vibration by installing it on a base with a shock absorber.

If there is a heat generator nearby

If the ambient temperature may increase due to convection or radiation, make sure the temperature near the servo amplifier or the power unit does not exceed 55°C.

If corrosive gas is present

Long-term use may cause contact failure on the connectors and connecting parts.
Never use the device where it may be exposed to corrosive gas.

2. Installation [Servo Amplifier / Power Unit]

If explosive or combustible gas is present

Never use the device where explosive or combustible gas is present. The device's relays and contacts, regenerative resistors and other parts can arc (spark) and can cause fire or explosion.

If dust or oil mist is present

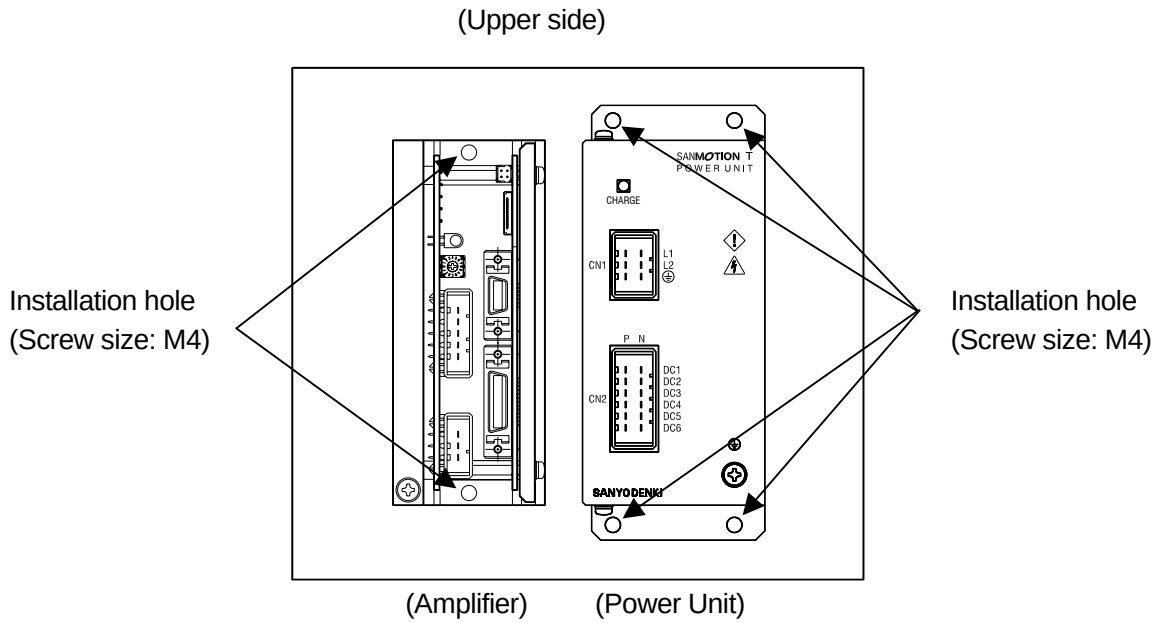
The device cannot be used where dust or oil mist is present. If dust or oil mist accumulates on the device, it can cause insulation deterioration or leakage between the conductive parts, and damage the servo amplifier.

If a large noise source is present

If inductive noise enters the input signals or the power circuit, it can cause a malfunction. If there is a possibility of noise, inspect the line wiring and take appropriate noise prevention measures etc. A noise filter should be installed to protect the power unit.

2. Installation [Servo Amplifier / Power Unit]

■ Mounting direction and location



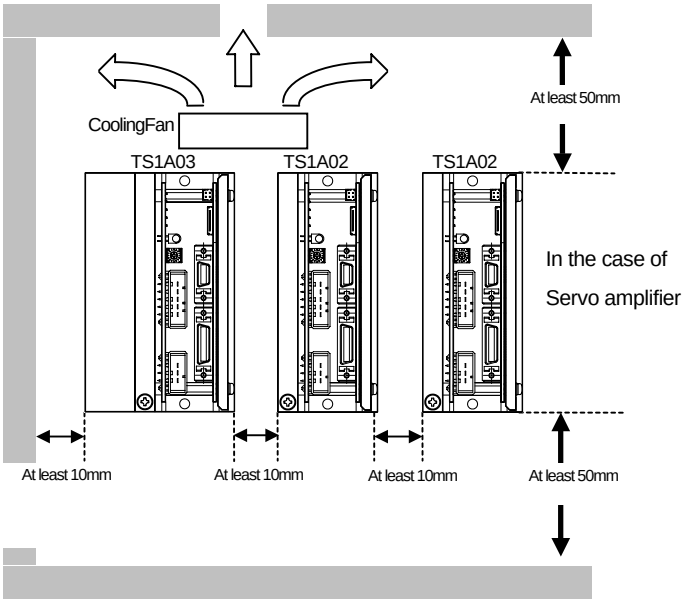
■ Arrangement within the control panel

- Leave at least 50 mm space above and below the servo amplifier (or the power unit) to ensure unobstructed airflow from the inside of the servo amplifier (or the power unit) and the radiator. If heat gets trapped around the servo amplifier or the power unit, use a cooling fan or equivalent to create airflow.

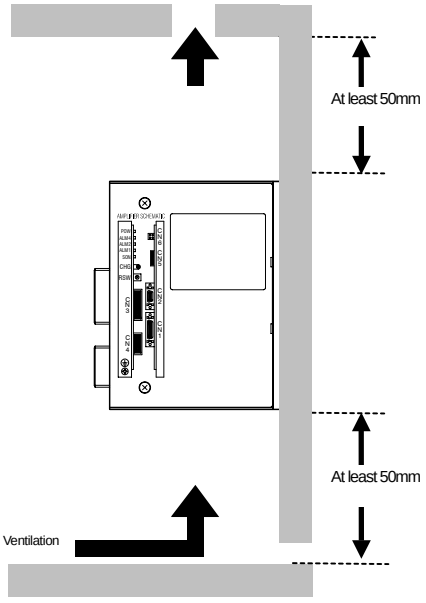
- The ambient temperature of servo amplifier should always become 55℃ or less.
  In addition, in order to secure a long-life and high reliability, we recommend you to use temperature below 40℃.

- Leave at least 10 mm space on both sides of the servo amplifier or power unit to ensure unobstructed airflow from the heat-sinks on the side and from the inside of the servo amplifier or the power unit.

Front view



Side view



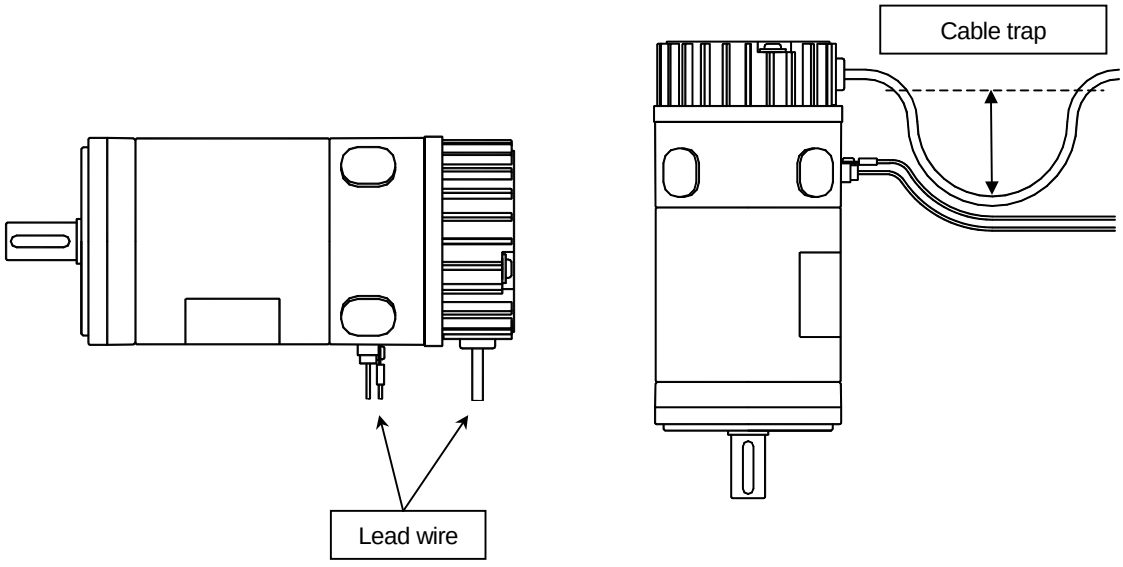
2. Installation [Servo motor]

■ Please note the following regarding the installation location and mounting method for the servo motor.

The servo motor is designed for indoor use. Make sure to Install it indoors.	
Do not use the device in locations where the oil seal lip is continuously exposed to oil, or where the device is exposed to large quantities of water, oil drops, or cutting fluid. The motor is designed to withstand only small amounts of moisture spray.	
Ambient temperature: 0 to 40°C Storage temperature: -20 to 65°C Ambient humidity: 20 to 90%	Good ventilation, no corrosive or explosive gases present. No dust or dirt accumulation in the environment. Easy access for inspection and cleaning.

■ Mounting method

- Mounting in several orientations - horizontal, or with the shaft on top or bottom- is acceptable.
- If the output shaft is used in reduction devices that use grease, oil, or other lubricants, or in mechanisms exposed to liquids, the motor should be installed in a perfectly horizontal or downward position.
- The motor connector and cable outlet should be installed facing downwards, as nearly vertical as possible.
- In vertical installation, create a cable trap to prevent oily water from getting into the motor.

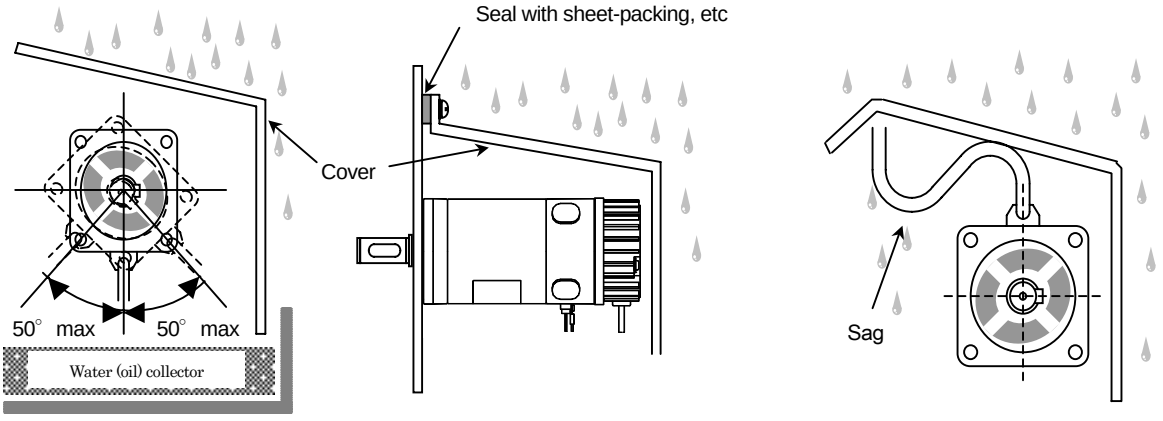


■ Waterproofing and dust proofing

- The protection inside the motor conforms to IEC standards (IEC34-5). However, such protection is suitable only for short-term use. For regular use, additional sealing measures are required.
- Install a protective cover to prevent corrosion of the coating and the sealing material, which can be caused by certain types of coolants (especially water soluble types).

■ Protective cover installation

- Install a protective cover (as described below) for motors continuously subjected to liquids.
- Turn the connectors (lead outlets) downwards within the angle range shown in the picture below.
- Install the cover on the side where the water or oil would drip.
- Install the cover at an angle (for runoff), to prevent water or oil from collecting.
- Make sure that the cable does not get soaked in water or oil.
- Create a sag in the cable outside the cover, to make sure water or oil does not penetrate to the motor.
- If it is not possible to install the connectors (lead outlets) facing downwards, create a sag in the cable to prevent water or oil from entering the motor.

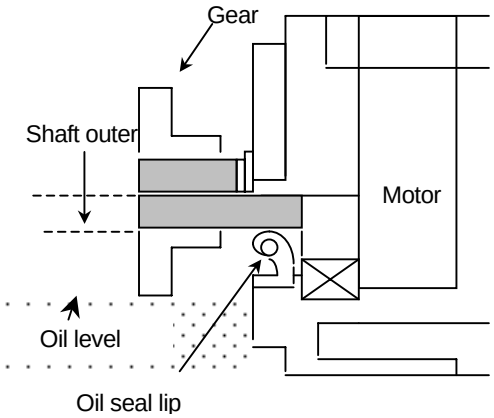


■ Gear installation

● The oil level of the gear box should be below the oil seal lip, for a slight spraying effect on the lip.

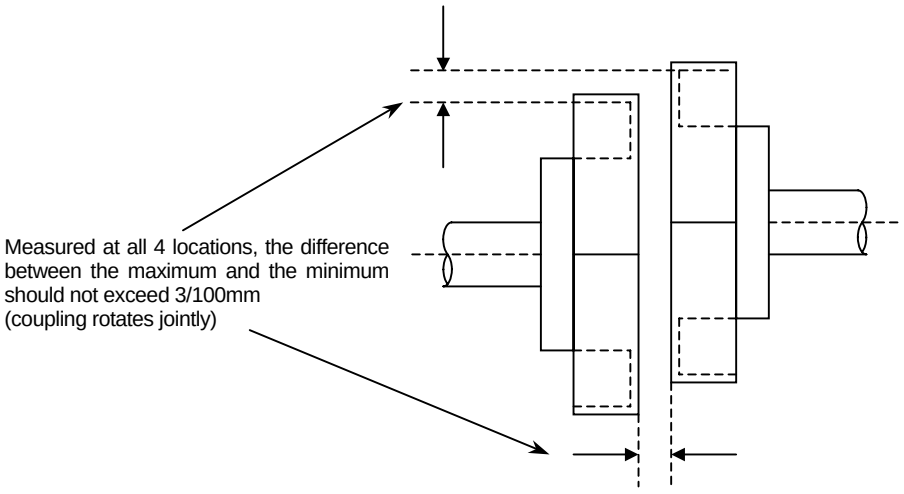
● Create a hole to prevent pressure build-up inside the gear box, as pressure can cause water or oil to penetrate the oil seal and enter inside the motor.

● If the motor is used with the shaft facing upwards, an oil seal should be used on the opposite side of the mechanism as well. In addition, install a drain to expel the water or oil that may penetrate through this oil seal.

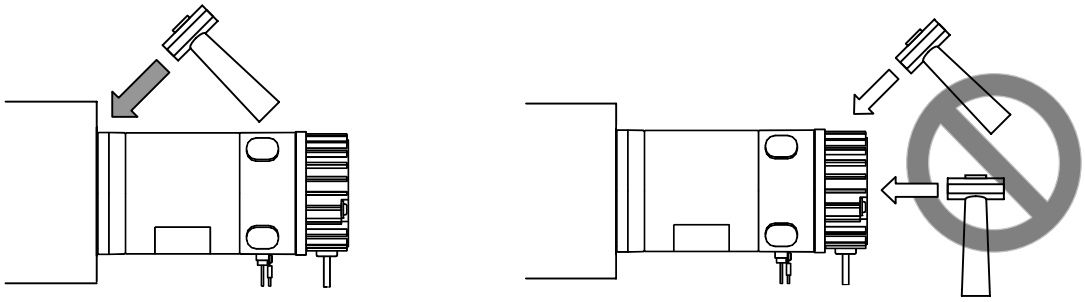


■ Integration with the target machinery

● Refer to the drawing below for correct centering of the motor shaft and the target machinery. Please note when using a rigid coupling that even a slight mistake in centering can damage or break the output shaft.

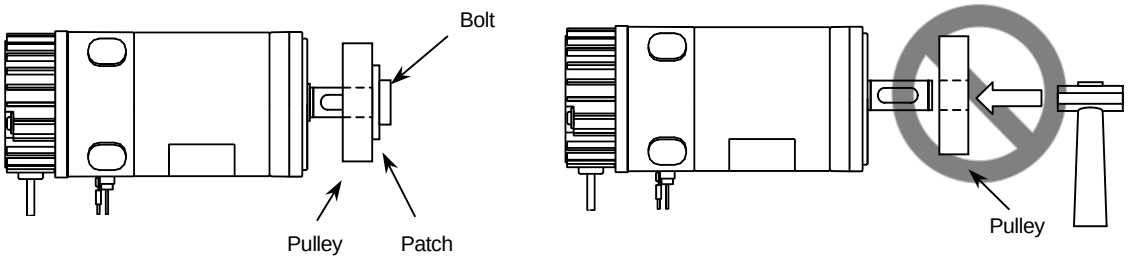


● Do not subject the motor shaft to shock, as the precision encoder is directly connected to it. If it is absolutely necessary to hit the motor for position adjustment or other reasons, use a rubber or plastic hammer and hit the front flange area.



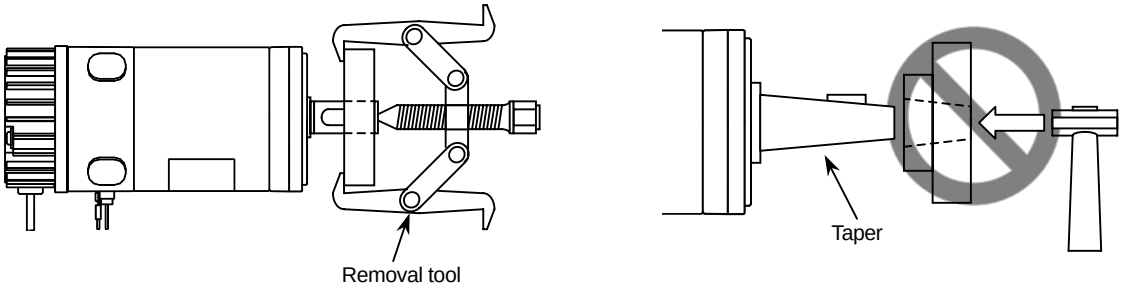
● If mounting to a machine, create enough mounting holes for smooth coupling of the motor flange rabbet.
The mounting surface should be flat, otherwise damage or fractures to the shaft or the load may occur.

● Use the screw at the end of the shaft for installing parts such as the gear, pulley, or coupling, to avoid shock.



● Tapered motor shafts transmit the torque via the tapered surface. Make sure the key fits without rattling. The tapered surface contact should be no less than 70%.

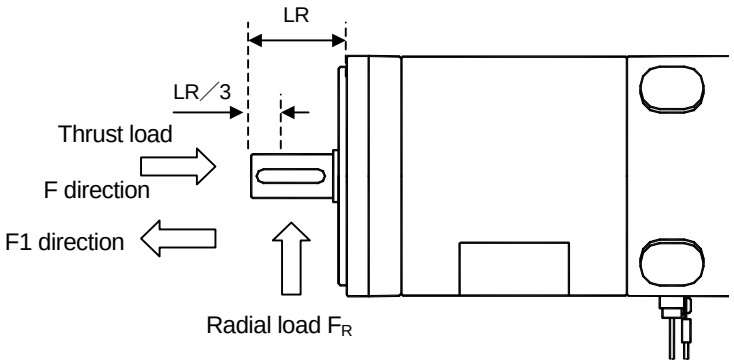
● Use a special tool for removing the gear, pulley, etc.



■ Allowable bearing load

● The table below shows the allowable bearing load of the servo motors. Do not apply excessive thrust load or radial load. In case of belt driving, make sure that the shaft converted value of belt tension does not exceed the allowable values shown below. The thrust load and radial load tolerance values assume individual application to the shaft.

The radial load tolerance value is the maximum load that can be applied at the point measured 1/3 of the distance from the tip of the output shaft.



Model	Assembly			Operation		
	Radial load (N)s	Thrust load (N)		Radial load (N)	Thrust load (N)	
	F_R	F direction	F1 direction	F_R	F direction	F1 direction
T4 series	100	100	100	80	20	20
T5 series	150	200	150	100	30	30
T7 series	250	500	200	200	50	50
T8 series	250	500	200	200	50	50

■ Cable installation considerations

● Make sure that no stress is applied to the cable and that it is undamaged.

● If the servo motor is installed in a moving location, make sure that no excessive stress is applied to the cable, by allowing a large bending radius.

● Avoid pulling the cable over sharp objects such as cutting scrap that can damage its exterior. Make sure the cable is not touching any machinery, and that it is out of the path of people and machines.

● Prevent bending or additional weight stress on the cable connection by clamping the cable to the machinery.
In applications where the motor or the cable is moving using a cable bear, the bending radius should be based on the required cable-life and the type of cable used.

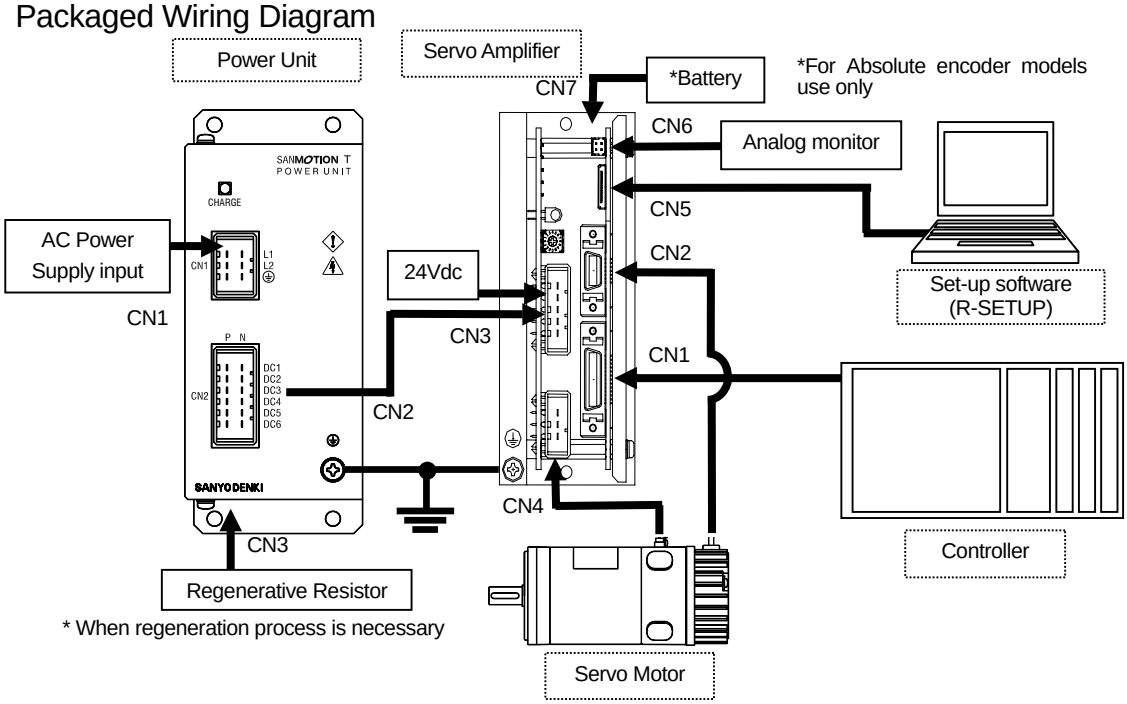
● Install the cables of moving parts in a manner that permits easy regular replacement.
Consult with your distributor or sales office for recommendations, if you use cables for moving parts.

Chapters 3

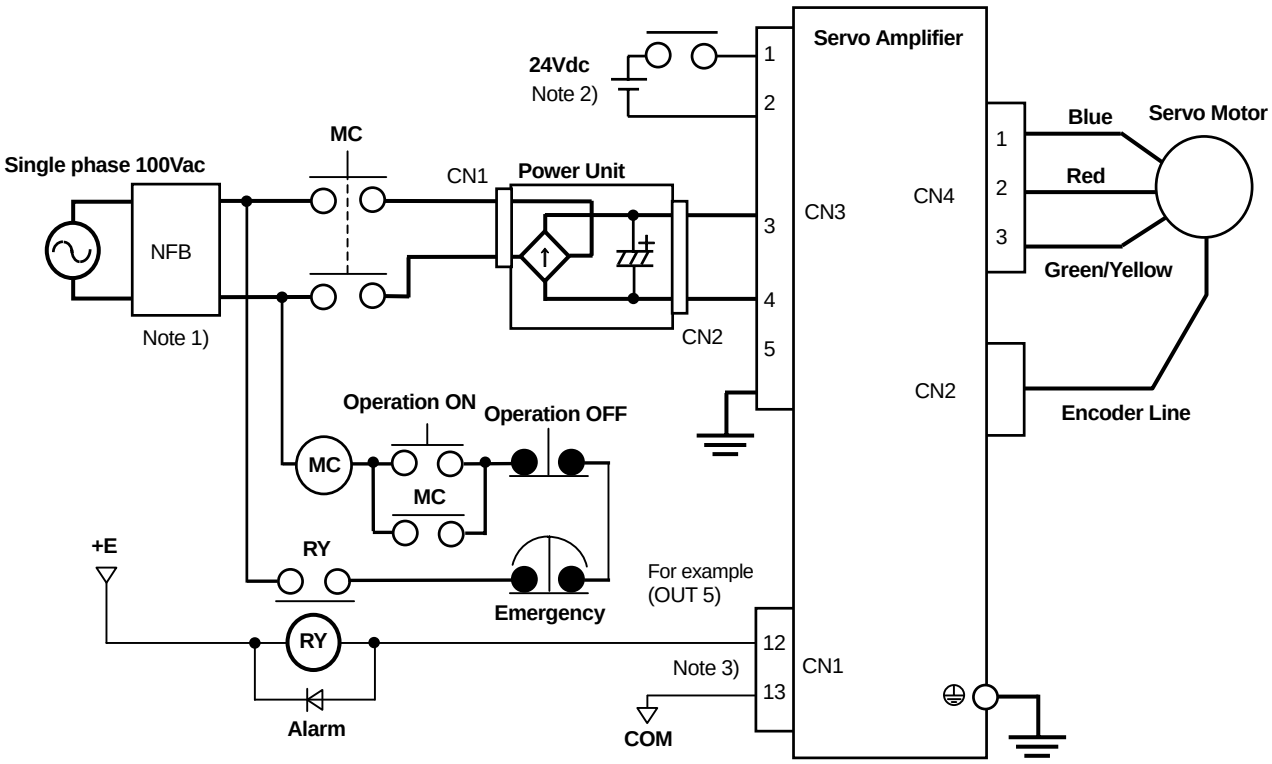
[Wiring]

3. Wiring [Packaged Wiring Diagram / Wiring example of a safety circuit]

■ Packaged Wiring Diagram



■ Wiring example of a safety circuit



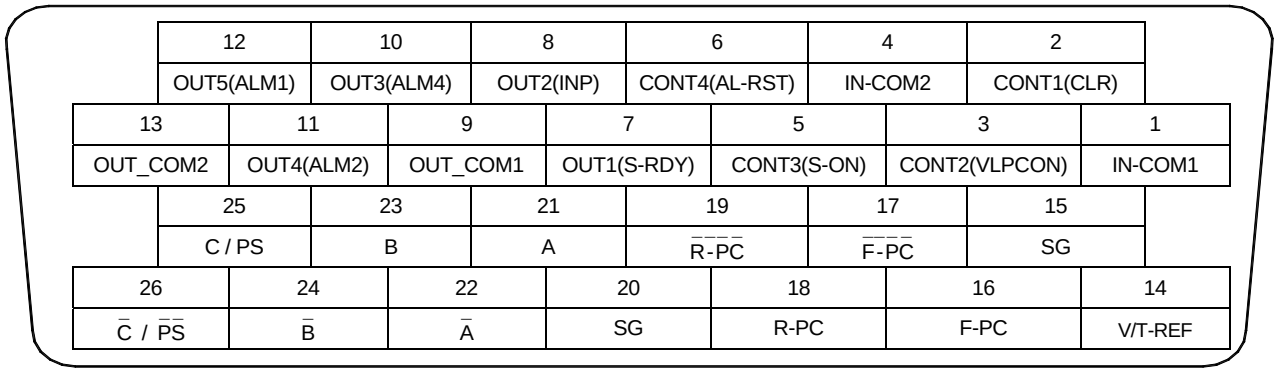
Note 1) It is recommended that an UL-approved earth leakage breaker be used that complies with IEC or EN standard.

Note 2) A power supply for control power please use a power supply that insulated double or reinforced from a primary power supply of 100V or 200V.

Note 3) Use output 1 of OUT1 - OUT5 of CN1, and set either During ALM status-output OFF at the selection setting of "parameter group A". In the case of this wiring diagram, the status-output OFF in ALM is set up.

■ Wiring of CN1(Input and output signal with the Controller)

● CN1 connector Terminal layout



(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN1 connector terminal name

Terminal number	Code	Signal name
1	CONT-COM1	Common for pins 2,3
2	CONT1	Generic input (CLR)
3	CONT2	Generic input (VLPCON/ECLR) *2
4	CONT-COM2	Common for pins 5,6
5	CONT3	Generic input (S-ON)
6	CONT4	Generic input (AL-RST)
7	OUT1	Generic output (S-RDY)
8	OUT2	Generic output (INP/LOWV) *3
9	OUT-COM1	Common for pins 7,8
10	OUT3	Generic output (ALM4)
11	OUT4	Generic output (ALM2)
12	OUT5	Generic output (ALM1)
13	OUT-COM2	Common for pins 10-12

Terminal number	Code	Signal name
14	V-REF	Speed command input
	T-REF	Torque command input
15	SG	Common for pins 14-26
16	F-PC	Command pulse input(+)
17	$\overline{\text{F-PC}}$	Command pulse input(-)
18	R-PC	Command pulse input(+)
19	$\overline{\text{R-PC}}$	Command pulse input(-)
20	SG	Common for pins 14-26
21	A	A phase position signal output
22	$\overline{\text{A}}$	$\overline{\text{A}}$ phase position signal output
23	B	B phase position signal output
24	$\overline{\text{B}}$	$\overline{\text{B}}$ phase position signal output

●The model corresponding to Incremental encoder
In the case of the part number: TS1***AA

Terminal number	Code	Signal name
25	C	C phase position signal output
26	$\overline{\text{C}}$	$\overline{\text{C}}$ phase position signal output

●For Absolute encoder models that numbered:
TS1***AF

Terminal number	Code	Signal name
25	PS	Position date output
26	$\overline{\text{PS}}$	Position date output

*1) The mane in a parenthesis of general input and output signal is a standard value.

*2) CONT2 signals are different by an encoder kind.

In the case of the Incremental encoder：VLPCON（Velocity Loop Proportional Control, Switching Function）

In the case of the Absolute encoder：ECLR（Absolute Encoder Clear Function）

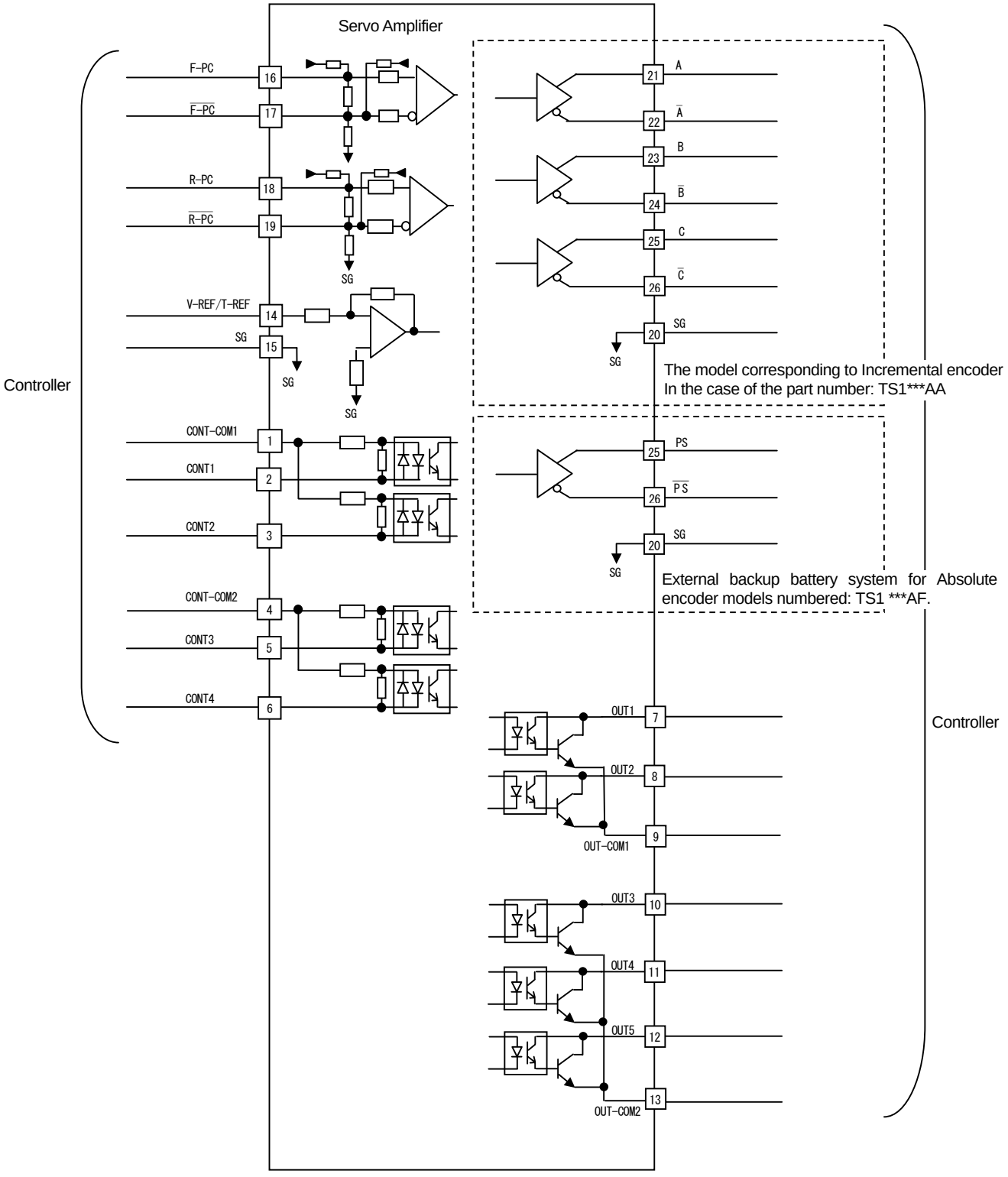
*3) OUT2 signals are different by a control mode.

In the case of the Position command input type：INP（In-Position status output）

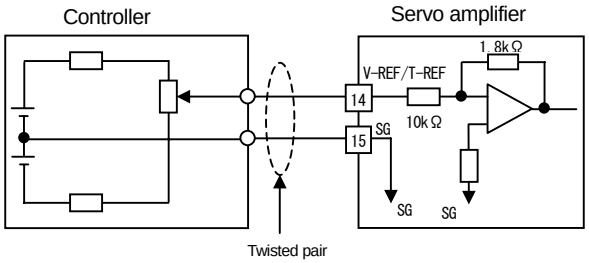
In the case of the Speed command input type：LOWV（low speed status output）

✍ General input and output signal are the General Parameters of “5.Parameter”. It has indicated to Group 9/Group A.

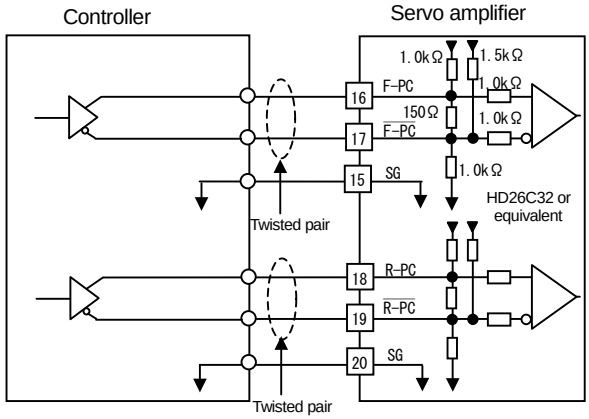
● CN1 Connector wiring diagram

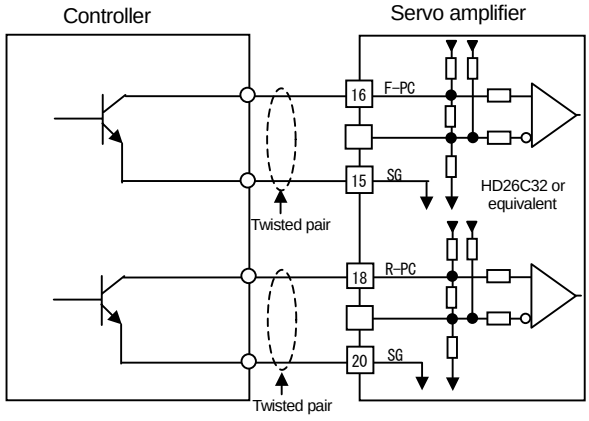


● Connection example with analog input circuit

Speed command input/Torque command input	
・Analog command input is either speed command input or torque command input. ・Speed command input → Speed control type. ・Torque command input → Torque control type. ・Input impedance is 10kΩ.	

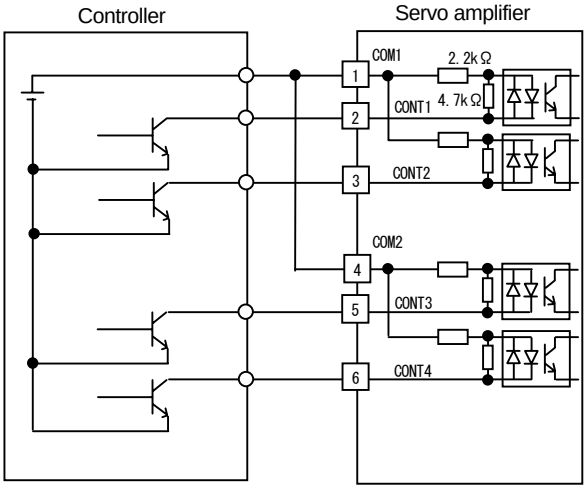
● Position command input circuit [Input circuit : Line receiver]

Command pulse input - Upper device line driver output	
・Connected with line driver ・Applicable line driver : HD26C31 or equivalent manufactured by HITACH. ・Position command input is command pulse input. ・Command pulse input → Position control type. ・Three types of command input pulse. [Positive pulse + Reverse pulse] Maximum 5M pulse/second [Code + pulse train] Maximum 5M pulse/second [90deg phase difference two phase pulse train] Maximum 2.5M pulse/second ・Make sure to connect SG. If not, malfunction due to noise or damage may be caused.	

Command pulse input – Upper device open collector output	
・Connected with open collector transistor circuit. ・Position command input is command pulse input. ・Command pulse input → Position control type. ・Three types of command input pulse. [Forward pulse + Reverse pulse] [Symbol + pulse train] [90deg phase difference two phase pulse train] ・Maximum pulse frequency : 150kHz	

● Generic input circuit CONT1 – CONT4 [Input circuit : Bi-directional photo coupler]

・Connected with transistor circuit of relay or open collector.
・Voltage range of power source : DC5V - 24V
・Minimum current : 100mA



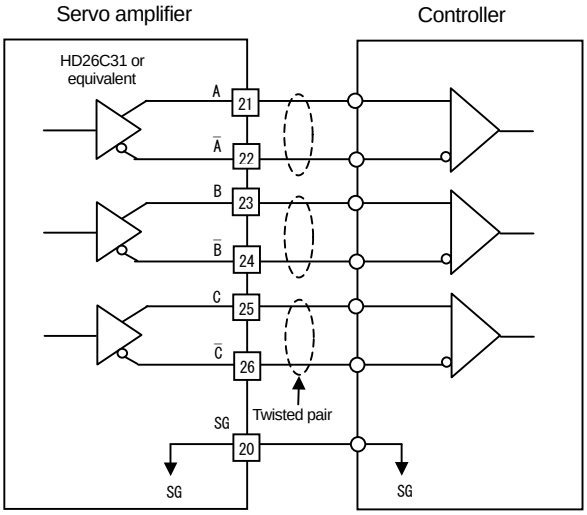
● Incremental pulse signal output circuit [output circuit : line driver]
(Model number : TS1***AA)

・Connected with line receiver.
・Applicable line receiver : HD26C32 or equivalent manufactured by HITACHI.

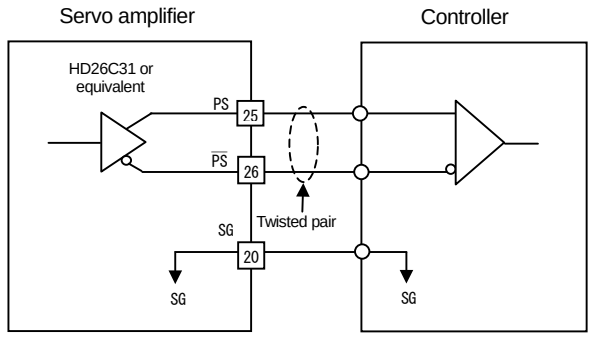
・Make sure to connect SG. If not, malfunction due to noise or damage may be caused.

・Outputs the signal of incremental encoder A phase /B phase pulse, and origin C phase pulse.

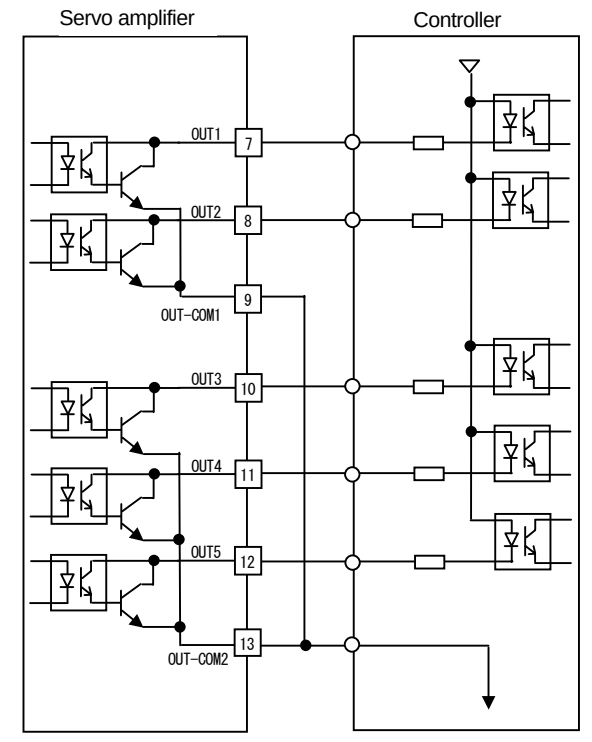
・Outputs the signal of dummy incremental, A phase /B phase pulse of absolute encoder and absolute sensor; and origin C phase pulse.



● Absolute position data output circuit [output circuit : line driver]
(Model number : TS1***AF)

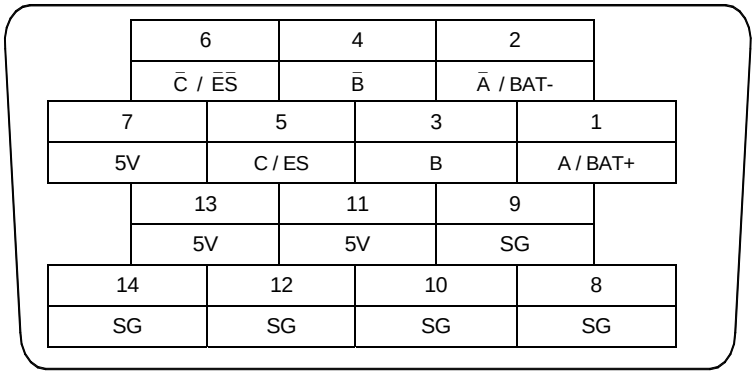
・connected with line receiver. ・Applicable line receiver : HD26C32 or equivalent manufactured by HITACHI. ・Make sure to connect SG. If not, malfunction due to noise or damage may be caused. ・Outputs the signals of absolute position data of absolute encoder and absolute sensor.	

● Generic output circuit OUT1 – OUT5 [output circuit : Bi-directional photo coupler]

・Connected with photo coupler or relay circuit. ・OUT-PWR (outer power source) specification Power source voltage range : DC5V ±5% Power source voltage range : DC12V～15V ± 10% Power source voltage range : DC24V ±10% Maximum current : DC5V‥‥‥‥‥10mA Maximum current : DC12V～15V‥‥30mA Maximum current : DC24V‥‥‥‥‥50mA	

■ Wiring of CN2(encoder signal)

● CN2 connector Terminal layout



(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN2 connector terminal name

For Incremental encoder [PP031] models (Model number : TS1***AA)		
Terminal number	Code	Signal name
1	A	A phase position signal output
2	$\overline{A}$	
3	B	B phase position signal output
4	$\overline{B}$	
5	C	C phase position signal output
6	$\overline{C}$	
7	5V	5V power source
8	SG	5V power source common
9	SG	5V power source common
10	SG	5V power source common
11	5V	5V power source
12	SG	5V power source common
13	5V	5V power source
14	SG	5V power source common

For external backup battery system of absolute encoder [PA035C] models (Model number : TS1***AF)		
Terminal number	Code	Signal name
1	BAT+	Battery
2	BAT-	
3	-	–
4		
5	ES	Position date input
6	$\overline{ES}$	
7	5V	5V power source
8	SG	5V power source common
9	SG	5V power source common
10	SG	5V power source common
11	5V	5V power source
12	SG	5V power source common
13	5V	5V power source
14	SG	5V power source common

● For details on shield cable installation, see page 3-13.

● In the encoder power connection, the number of pins of CN2 are determined depending on length of the cable from the Amplifier to the Encoder. See the table below.

	Pin No. for encoder power supply (CN2)	
Length of cable from the Amplifier	+DC 5V wiring	GND (0V) wiring
5m or less	13-pin connection (7 and 11 pins need not be connected)	14-pin connection (8 and 12 pins need not be connected)
10m or less	11- and 13-pin connection (7 pin need not be connected)	12- and 14- pin connection (8 pin need not be connected)
20m or less	7-, 11-, and 13-pin connection	8-, 12-, and 14-pin connection

● Use a shielded twisted pair cable

● CN2 Plug: 10114-3000PE

● CN2 shell: 10314-52A0-008

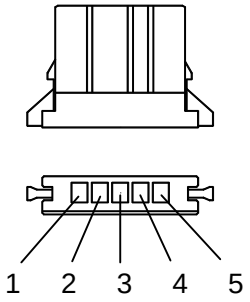
For Tachogenerator models (Model No.: TS1 *** AN, TS1 *** AP)			
Pin No.	Code	Signal name	Lead color of servo motors
3	TG+	Tachogenerator signal	Red
4	TG-		Blue

● For the Tachogenerator, use Pin numbers of No.3 and 4 only

3. Wiring [Servo Amplifier / Wiring of CN3 and CN4]

■ Wiring of CN3(DC Power supply input)

● CN3 connector Terminal layout



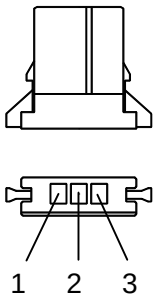
(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN3 connector terminal name

Terminal No.	Code	Signal name
1	24V(+)	Control power source 24Vdc (+)
2	24V(-)	Control power source 24Vdc (-)
3	P	Main power source 140Vdc / 50Vdc (P)
4	N	Main power source 140Vdc / 50Vdc (N)
5	PE	Protective Earth

■ Wiring of CN4(Power line of a Servo Motor)

● CN4 connector Terminal layout



(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN4 connector terminal name

Terminal No.	Code	Signal name	Lead color of Servo motors
1	MA	Servo motor power line	Blue
2	MB	Servo motor power line	Red
3	FG	Frame Ground	Green/ Yellow

3. Wiring [Servo Amplifier / Wiring of CN5 CN6 and CN7]

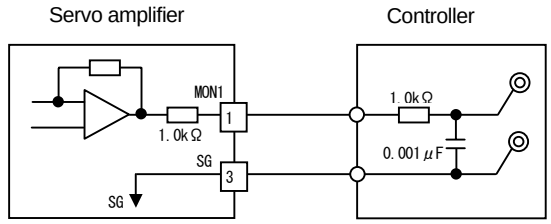
■ Wiring of CN5(Communication with a PC)

The details please refer to "4 chapters - Setup Software".

■ Wiring of CN6 (Analog monitor output)

Terminal number	Code	Signal Name
1A	MON1	Analog monitor output 1
1B	MON2	Analog monitor output 2
2A	SG	Common for pins 1A, 1B

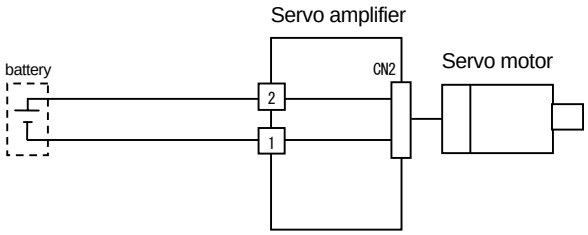
● Analog monitor output circuit

・Outputs the selection of analog monitor output1,2. ・Lode shall be than 2mA. ・Output resistance shall be 1kΩ. ・Range of output voltage: ±8V	

■ Wiring of CN7(Battery input)

(Model number: TS1***AF only)

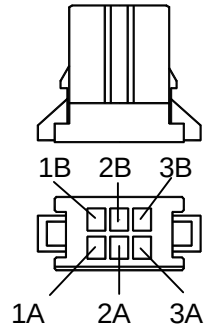
● Battery input circuit

External backup battery connection for Absolute encoder models numbered: TS1 ***AF.	

3. Wiring [Power Unit / Wiring of CN1 CN2 and CN3]

■ Wiring of CN1(AC Power supply input)

● CN1 connector Terminal layout



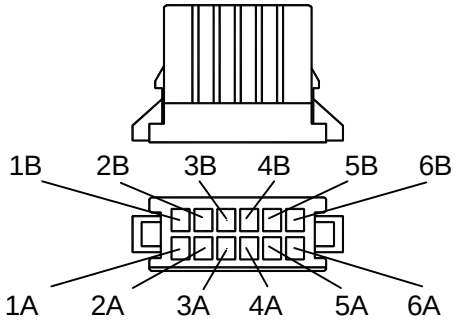
(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN1 connector terminal name

Terminal No.	Code	Signal name
1A	L1	AC Power Supply input -1
1B		
2A	L2	AC Power Supply input -2
2B		
3A	PE	Protective Earth
3B		

■ Wiring of CN2(DC Voltage output)

● CN2 connector Terminal layout



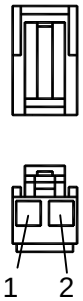
(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN2 connector terminal name

Terminal No.	Code	Signal name
1A	DC1-P	+DC Voltage output (axis 1)
1B	DC1-N	-DC Voltage output (axis 1)
2A	DC2-P	+DC Voltage output (axis 2)
2B	DC2-N	-DC Voltage output (axis 2)
3A	DC3-P	+DC Voltage output (axis 3)
3B	DC3-N	-DC Voltage output (axis 3)
4A	DC4-P	+DC Voltage output (axis 4)
4B	DC4-N	-DC Voltage output (axis 4)
5A	DC5-P	+DC Voltage output (axis 5)
5B	DC5-N	-DC Voltage output (axis 5)
6A	DC6-P	+DC Voltage output (axis 6)
6B	DC6-N	-DC Voltage output (axis 6)

■ Wiring of CN3 (Regenerative Resistor)

● CN3 connector Terminal layout



(Please watch a pin arrangement of an upper number than the wiring side of a combination connector.)

● CN3 connector terminal name

Terminal No.	Code	Signal name
1	R1	Regenerative Resistor -1
2	R2	Regenerative Resistor -2

■ Applicable Wire Diameter

Applicable Wire Diameter of Servo Amplifier

Model / Connector	TS1*02*	TS1AA2*	TS1A03*
CN1	Twist pair lump shielded wire for 0.2mm^2 or more		
CN2	Twist pair lump shielded wire for 0.2mm^2 or more (In the case of a tachogenerator: AWG20 or equivalent)		
CN3 (24V)	AWG20 or equivalent (Sheath OD 2.8mm or less)		
CN3 (P, N)	AWG18 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)
CN4	AWG18 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)

- When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.
- If ambient temperature is high, service life of the wires becomes shorter due to heat-related deterioration. In this case, use heat-resistant vinyl wires.
- Heat resistance insulated vinyl covered wire (HIV) is recommended to use.
- Depending on the servo motor capacity, thinner electric wires than indicated in the table can be used for the main circuit power input connector and the motor connector. (Choose appropriate size of wires in accordance with the power capacity.)

Applicable Wire Diameter of Power Unit

Model / Connector	TS1PA05*	TS1PA10*	TS1PA15*
CN1 (For one pin)	AWG18 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)	AWG16 or equivalent (Sheath OD 2.8mm or less)
CN2	(Depends on Servo Amplifier combination)		
CN3	AWG18 or equivalent (Sheath OD 2.8mm or less)		

- Please make the wiring length between the Power Unit and the Servo Amplifier within 0.3m.
- When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.
- If ambient temperature is high, service life of the wires becomes shorter due to heat-related deterioration. In this case, use heat-resistant vinyl wires.
- Heat resistance insulated vinyl covered wire (HIV) is recommended to use.

■ Connector

Combination connector of Servo Amplifier

Connector	SANYO DENKI Model No.	Name	Manufacturer' model No.	Manufacturer	Remarks
CN1	AL-00608709	Plug	10126-3000PE or 54306-2619	Sumitomo 3M Ltd. or Molex Japan Co Ltd.	The recommendation bolting torque of CN1 and CN2 shell kit jack screw is 0.196 ± 0.049N-m.
		Shell kit	10326-52A0-008 or 54331-0261		
CN2	AL-00608710	Plug	10114-3000PE or 54306-1419		
		Shell kit	10314-52A0-008 or 54331-0141		
CN3	AL-00608711	Shell	1-178288-5 or DK-3100S-05R	Tyco Electronics AMP Ltd. or DDK Ltd.	〈Crimping tool〉 91558-1 or 357J-22112 〈Extraction tool〉 234168-1 or 357J-23040 Manufacturer is the same as the table on the left
		Contact	1-175218-2 or DK-3RECLLP1-100		
CN4	AL-00608712	Shell	1-178288-3 or DK-3100S-03R		
		Contact	1-175218-2 or DK-3RECLLP1-100		
CN5	AL-00490833-01	Communication cable for Set-up software - " R/T-Setup "		Sanyo Denki Co Ltd.	Refer to "Materials - Option".
CN6	AL-00496726-01	Monitor cable		Sanyo Denki Co Ltd	Refer to "Materials - Option".
CN7	AL-00494635-01	Lithium battery		Sanyo Denki Co Ltd	Refer to "Materials - Option".
Connector Set	AL-00608713	Model number set of CN1, CN2, CN3 and CN4			

● Connectors are not included in the Servo Amplifier. Available separately.

Combination connector of Power Unit

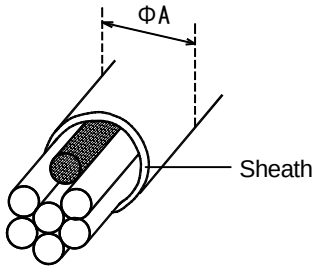
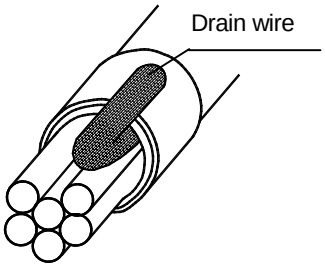
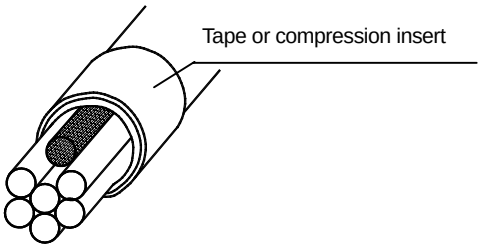
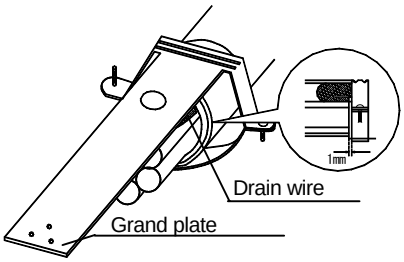
Connector	SANYO DENKI Model No.	Name	Manufacturer' model No.	Manufacturer	Remarks
CN1	AL-00632983	Shell	178289-3 or DK-3100D-06R	Tyco Electronics AMP Ltd. or DDK Ltd.	〈Crimping tool〉 91558-1 or 357J-22112 〈Extraction tool〉 234168-1 or 357J-23040 Manufacturer is the same as the table on the left
		Contact	1-175218-2 or DK-3RECLLP1-100		
CN2	AL-00632984	Shell	178289-6 or DK-3100D-12R		
		Contact	1-175218-2 or DK-3RECLLP1-100		
CN3	AL-00632985	Shell	VHR-2N	J.S.T Mfg Co Ltd	〈Crimping tool〉 YC-160R 〈Extraction tool〉 EJ-NV
		Contact	SVH-21T-P1.1		
Connector Set	AL-00632986	Model number set of CN1, CN2 and CN3			

● Connector Set (AL-00632986) is attached to the Power Unit.

■ Shield wire of cable installation procedure for CN1/CN2

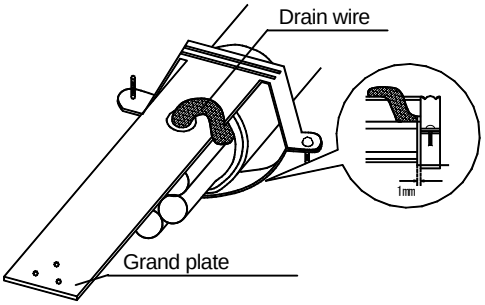
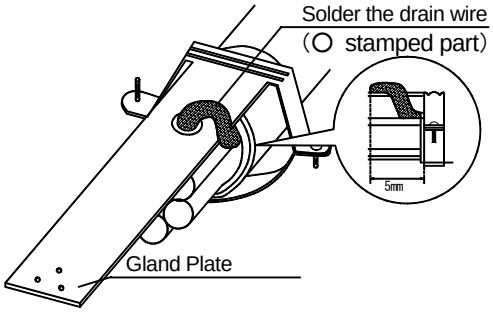
Shield wire of cable installation procedures for CN1/CN2 is shown in the below Figures.
There are two ways to process shields; clamping and soldering.

● Clamping

1	 Remove the cable sheath.	3	 Bend back the drain wire
2	 Attach tape or compression insert. When attached, tape or compression insert must completely be on the sheath of the cable.	4	 Tighten the cable clamp over the drain wire. Attach approximately 1mm away from the tape or the compression insert.

∗ Compression insert should only be attached before soldering the cable to the connector

● Soldering (Conditions 1 and 2 are the same as for clamping.)

3	 Turn the cable and bring the drain wire close to the grand plate.	4	

● **Applicable Φ A measurements for CN1, CN2.**

Applicable ϕ A measurements are shown below. Compression insert is not required if the ϕ A measurements are within these.

Connector No.	Applicable ϕ A measurement	Connector model number	Manufacturer
CN1	11.0～12.0mm	10126-3000PE 10326-52A0-008	Sumitomo 3M Ltd.
CN2	7.0～8.0mm	10114-3000PE 10314-52A0-008	Sumitomo 3M Ltd.

Chapters 4

[Setup Software]

4. Setup Software [Outline]

■ Outline

● About “R-SETUP” - Setup Software

T series Servo Amplifier performs various setting or monitor functions using “R-SETUP” - Setup Software.
In this chapter, I explain a basic function of R-SETUP.

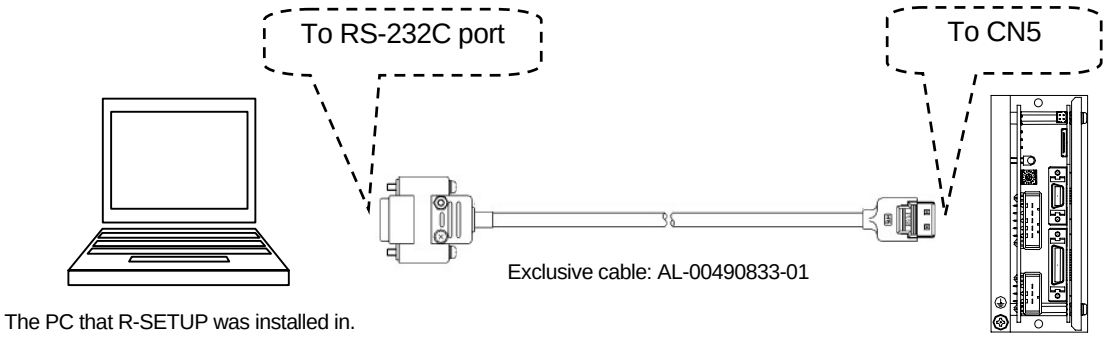
✍ Please refer to "R-SETUP - Setup Software instruction manual M0006935" about an operation method of each function.

✍ The version of " R-SETUP - Setup Software " must use since “ Version 1.0.5 - #.##.# “. The version can be confirmed from “HELP" of the main screens. (Refer to the following Screen of “R-SETUP”)

✍ Transmission rate with T series Servo Amplifier is 38400bps fixation. Transmission rate of “R-SETUP” cannot communicate with Servo Amplifier in the case of 38400bps.

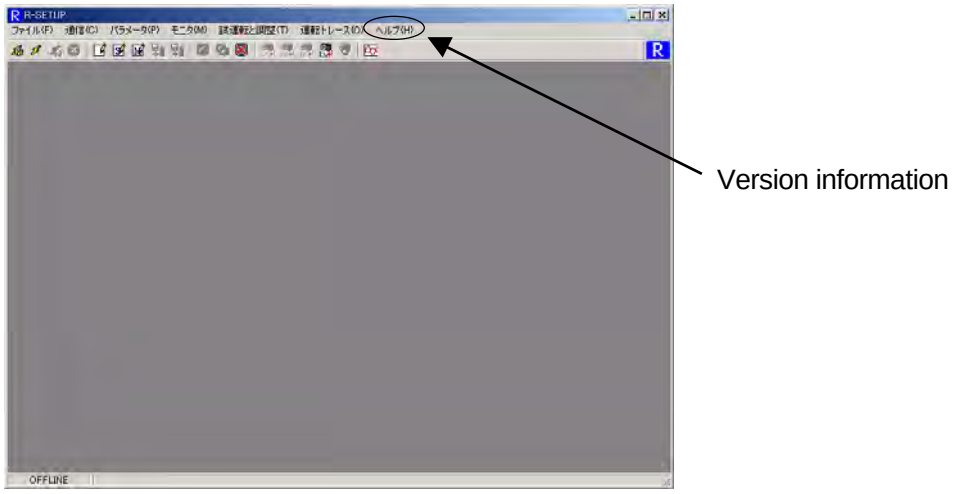
✍ In the T series Servo Amplifier , a Remote Operator (model number : PR -001) for DA series Servo Amplifier cannot use it.

● Connection of Servo Amplifier and “R-SETUP” - Setup Software



● Screen of “R-SETUP”

The following main screens are displayed when start “R-SETUP”. Each function can use by choosing it among menu bar of a main screen.



■ List of functions

<table>
<tr><th>Functions</th><th>Outline</th></tr>
<tr><td>General Parameter setting</td><td>The following parameters can be set and changed at each page of general parameter mode. Settings can be made suitable for machines and equipment. Parameters for adjusting servo gain can be changed. Classified into 11 groups according to their functions.

<table>
<tr><th>Group</th><th>Description of Group</th></tr>
<tr><td>Group0</td><td>Tuning mode setting</td></tr>
<tr><td>Group1</td><td>Settings of basic control parameters</td></tr>
<tr><td>Group2</td><td>Settings of damping control/notch filter/disturbance observer</td></tr>
<tr><td>Group3</td><td>Settings of gain switching control/damping frequency switching</td></tr>
<tr><td>Group4</td><td>To set high setting control</td></tr>
<tr><td>Group5</td><td>Parameter setting of a gain setting switch</td></tr>
<tr><td>Group8</td><td>Settings related to system control</td></tr>
<tr><td>Group9</td><td>Settings related to general purpose input signals/function condition setting</td></tr>
<tr><td>GroupA</td><td>Settings related to general purpose output signals/monitor output signals/Setup software</td></tr>
<tr><td>GroupB</td><td>Settings related to system sequence/warning and alarms</td></tr>
<tr><td>GroupC</td><td>Settings related to servo motor encoder</td></tr>
</table>

✍ Refer to “Chapter5, Parameter” for details of parameters.</td></tr>
<tr><td>System Parameter setting</td><td>Sets the parameters related to servo amplifier - servo motor combination and specifications.</td></tr>
<tr><td>Motor Parameter setting</td><td>Sets the servomotor's model number to servo amplifier - combination servomotor and servo amplifier.</td></tr>
<tr><td>Transmit Parameter</td><td>[Amplifier -> File]
“Transmit Parameter [Amplifier -> File]” read all parameters and alarm history of servo amplifier and save them in amplifier file together.
[File -> Amplifier]
“Transmit Parameter [File -> Amplifier]” directly writes the parameters saved in amplifier file to servo amplifier together.</td></tr>
<tr><td>Monitor Display</td><td>Displays the servo amplifier status.
✍ Refer to “Chapter7, Adjustment・Functions” for details of Monitor Display.</td></tr>
<tr><td>Alarm history and Software version</td><td>Displays the latest 7 alarm events, and the servo amplifier CPU software version.</td></tr>
</table>

Functions	Outline
Jogging Operation	Jogging Operation and Pulse feed Jogging Operation can test the servo amplifier and servomotor easily.
Automatic Notch Filter Tuning	Automatic notch filter tuning can readily find the resonance frequency by running servo amplifier and servomotor for a short period. In case resonance frequency exists, set the frequency at command notch filter A (TCNFILA).
Automatic Vibration Suppressor Frequency Tuning	Automatic Vibration Suppressor Frequency Tuning can easily set the vibration suppressor control parameter by running servo amplifier and servomotor for a short period. After the tuning is executed, the result is automatically set to Vibration Suppressor Frequency 1 (SUPFRQ1).
System Analysis	In the System Analysis, system can be easily analyzed by operating servo amplifier and servomotor for the duration from hundreds ms to tens seconds.
Automatic Offset Adjustment of V-REF/T-REF Terminal	This is the function for offset adjustment of analog velocity command input terminal (V-REF/T-REF).
Save Result of Automatic Tuning	This is the function for saving control gain that automatic tuning function outputs.
Alarm Reset	This is the function for resetting alarm state of servo amplifier. This function is equivalent to Alarm Reset (AL-RST) with general purpose input terminal.
Absolute Encoder Clear	This is a function for absolute encoder clear. This is equivalent to absolute clear (ECLR) function.
Trace Operation	This is a function to confirm various signals of servo amplifier or a movement state of a servomotor. ✍ Refer to “Chapter7, Adjustment・Functions” for details of Trace Operation.

✍ "Fixation Excitation operation" and "Automatic Offset Adjustment of T-COMP Terminal" are non-correspondence.

Chapters 5

[Parameters]

5. Parameter [Parameter List]

■ Parameter List

● General Parameter Group 0 [Auto-tuning setting]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	TUNMODE	Tuning mode	02:_ManualTun	-	00～02	5-6
01	ATCHA	Automatic Tuning Characteristic	00:_Positioning1	-	00～04	5-6
02	ATRES	Automatic Tuning Response	5	-	1～30	5-6
03	ATSAVE	Automatic Tuning, Automatic Parameter Saving	00:_Auto_Saving	-	00～01	5-6
10	ANFILTC	Automatic Notch Filter Tuning, Torque Command	50	%	10～100	5-6
20	ASUPTC	Automatic Vibration Suppressor Frequency Tuning, Torque Command Value	25	%	10～100	5-6
21	ASUPFC	When Automatic Vibration Suppressor Frequency Tuning, Friction Torque Compensation Value	5	%	0～50	5-6

● General Parameter Group 1 [Basic controlling parameter setting]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
01	PCFIL	Position command filter	0.0	ms	0.0～2000.0	5-6
02	KP1	Position Loop Proportional Gain 1	30	1/s	1～3000	5-6
03	TPI1	Position Loop Integral Time Constant 1	1000.0	ms	0.5～1000.0	5-6
04	TRCPGN	Higher Tracking Control, Position Compensation Gain	0	%	0～100	5-7
05	FFGN	Feed Forward Gain	0	%	0～100	5-7
08	FFFIL	Feed Forward Filter	2000	Hz	1～2000	5-7
10	VCFIL	Velocity Command Filter	2000	Hz	1～2000	5-7
12	VDFIL	Velocity Feedback Filter	1500	Hz	1～2000	5-7
13	KVP1	Velocity Loop Proportional Gain 1	70	Hz	1～2000	5-7
14	TVI1	Velocity Loop Integral Time Constant 1	20.0	ms	0.5～1000.0	5-7
15	JRAT1	Load Inertia Moment Ratio (Load Mass Ratio) 1	0	%	0～15000	5-7
16	TRCVGN	Higher Tracking Control, Velocity Compensation Gain	0	%	0～100	5-7
17	AFBK	Acceleration Feedback Gain	0.0	%	-100.0～100.0	5-7
18	AFBFIL	Acceleration Feedback Filter	500	Hz	1～2000	5-7
20	TCFIL1	Torque Command Filter 1	500	Hz	1～2000	5-7
21	TCFILOR	Torque Command Filter Order	1	Order	1～3	5-7

● General Parameter Group 2 [Vibration suppressing control / Notch filter / Disturbance observer setting]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	SUPFRQ1	Vibration Suppressor Frequency 1	500	Hz	5～500	5-8
01	SUPLV	Vibration Suppressor Level Selection	00	-	00～03	5-8
10	VCNFIL	Velocity Command,Notch Filter	500	Hz	50～500	5-8
20	TCNFILA	Torque Command,Notch Filter A	2000	Hz	100～2000	5-8
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement	00	-	00～02	5-8
22	TCNFILB	Torque Command,Notch Filter B(TCNFILB)	2000	Hz	100～2000	5-8
23	TCNFDB	TCNFILB, Depth Selection	00	-	00～03	5-8
24	TCNFILC	Torque Command, Notch Filter C(TCNFILC)	2000	Hz	100～2000	5-8
25	TCNFDC	TCNFILC, Depth Selection	00	-	00～03	5-8
26	TCNFILD	Torque Command,Notch Filter D (TCNFILD)	2000	Hz	100～2000	5-8
27	TCNFDD	TCNFILD, Depth Selection	00	-	00～03	5-9
30	OBCHA	Observer characteristic	00:_Low	-	00～01	5-9
31	OBG	Observer Compensation Gain	0	%	0～100	5-9
32	OBLPF	Observer Output, Low Pass Filter	50	Hz	1～2000	5-9
33	OBNFIL	Observer Output, Notch Filter	2000	Hz	100～2000	5-9

● General Parameter Group 3 [Setting for gain switching control / Vibration suppressing frequency switching]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	KP2	Position Loop Proportional Gain 2	30	1/s	1～3000	5-9
01	TPI2	Position Loop Integral Time Constant 2	1000.0	ms	0.5～1000.0	5-9
02	KVP2	Velocity Loop Proportional Gain 2	50	Hz	1～2000	5-9
03	TVI2	Velocity Loop Integral Time Constant 2	20.0	ms	0.5～1000.0	5-9
04	JRAT2	Load Inertia Moment Ratio (Load Mass Ratio) 2	100	%	0～15000	5-9
05	TCFIL2	Torque Command Filter 2	600	Hz	1～2000	5-9
10	KP3	Position Loop Proportional Gain 3	30	1/s	1～3000	5-10
11	TPI3	Position Loop Integral Time Constant 3	1000.0	ms	0.5～1000.0	5-10
12	KVP3	Velocity Loop Proportional Gain 3	50	Hz	1～2000	5-10
13	TVI3	Velocity Loop Integral Time Constant 3	20.0	ms	0.5～1000.0	5-10
14	JRAT3	Load Inertia Moment Ratio (Load Mass Ratio) 3	100	%	0～15000	5-10
15	TCFIL3	Torque Command Filter 3	600	Hz	1～2000	5-10
20	KP4	Position Loop Proportional Gain 4	30	1/s	1～3000	5-10
21	TPI4	Position Loop Integral Time Constant 4	1000.0	ms	0.5～1000.0	5-10
22	KVP4	Velocity Loop Proportional Gain 4	50	Hz	1～2000	5-10
23	TVI4	Velocity Loop Integral Time Constant 4	20.0	ms	0.5～1000.0	5-10
24	JRAT4	Load Inertia Moment Ratio (Load Mass Ratio) 4	100	%	0～15000	5-10
25	TCFIL4	Torque Command Filter 4	600	Hz	1～2000	5-10
30	GCFIL	Low Pass Filter of Gain Switching	0	ms	0～100	5-10
40	SUPFRQ2	Vibration Suppressor Frequency 2	500	Hz	5～500	5-11
41	SUPFRQ3	Vibration Suppressor Frequency 3	500	Hz	5～500	5-11
42	SUPFRQ4	Vibration Suppressor Frequency 4	500	Hz	5～500	5-11

● General Parameter Group 4 [To set high setting control]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	CVFIL	Command Velocity, Low Pass Filter	1000	Hz	1～2000	5-11
01	CVTH	Command Velocity Threshold	20	min^{-1}	0～65535	5-11
02	ACCC0	Acceleration Compensation Value	0	×50 Pulse	-9999～+9999	5-11
03	DECC0	Deceleration Compensation Value	0	×50 Pulse	-9999～+9999	5-11

● General Parameter Group 5 [Gain setting switch compatible gain setting]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
		(RSW Gain Group 0)				5-12
00	RSW0-KP	RSW0— Position Loop Proportional Gain	10	1/s	1～3000	5-12
01	RSW0-KVP	RSW0-Velocity Loop Proportional Gain	20	Hz	1～2000	5-12
02	RSW0-TVI	RSW0-Velocity Loop Integral Time Constant	50	ms	0.5～1000.0	5-12
10～12	RSW1-*	(RSW Gain Group 1)	10,20,20	↑	↑	5-12
20～22	RSW2-*	(RSW Gain Group 2)	20,35,50	↑	↑	5-12
30～32	RSW3-*	(RSW Gain Group 3)	20,35,20	↑	↑	5-12
40～42	RSW4-*	(RSW Gain Group 4)	30,50,50	↑	↑	5-12
50～52	RSW5-*	(RSW Gain Group 5)	30,50,20	↑	↑	5-12
60～62	RSW6-*	(RSW Gain Group 6)	30,70,50	↑	↑	5-12
70～72	RSW7-*	(RSW Gain Group 7)	30,70,20	↑	↑	5-12
80～82	RSW8-*	(RSW Gain Group 8)	45,100,50	↑	↑	5-12
90～92	RSW9-*	(RSW Gain Group 9)	45,100,20	↑	↑	5-12
A0～A2	RSWA-*	(RSW Gain Group A)	45,140,50	↑	↑	5-12
B0～B2	RSWB-*	(RSW Gain Group B)	45,140,20	↑	↑	5-12
C0～C2	RSWC-*	(RSW Gain Group C)	60,200,50	↑	↑	5-12
D0～D2	RSWD-*	(RSW Gain Group D)	60,200,20	↑	↑	5-12
E0～E2	RSWE-*	(RSW Gain Group E)	60,280,50	↑	↑	5-12
F0～F2	RSWF-*	(RSW Gain Group F)	60,280,20	↑	↑	5-12

● General Parameter Group 8［Control system setting］

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	CMDPOL	Positioning, Velocity, and Torque Command Input Polarity	00:_PC+_VC+_TC+	-	00～07	5-13
01	VC/TC-DB	Analog Input Dead Band	00:_Disabled	-	00～01	5-13
02	VCZDAT	Analog Input Dead Band window	0.0	mV	0.0～6553.5	5-13
11	PCPTYP	Positioning Command Pulse Selection	00:_F-PC_R-PC	-	00～02	5-13
12	PCPPOL	Position Command Pulse, Count Polarity	00:_Type1	-	00～03	5-13
13	PCPFIL	Position Command Pulse, Digital Filter	00:_834nsec	-	00～07	5-14
14	PCPMUL	Position Command, Pulse Multiplier	1	-	1～63	5-14
15	GER1	Electric Gear 1	4/1	-	1/32767～32767/1	5-14
16	GER2	Electric Gear 2	4/1	-	1/32767～32767/1	5-14
17	EDGEPOS	Positioning method	00:_Pulse_Interval	-	00～01	5-14
18	PDEVMON	In position / Position Deviation Monitor	00:_After_Filter	-	00～01	5-14
19	CLR	Deviation Clear Selection	00:_Type1	-	00～03	5-14
20	VC1	Internal Velocity Command 1	100	min^{-1}	0～32767	5-15
21	VC2	Internal Velocity Command 2	200	min^{-1}	0～32767	5-15
22	VC3	Internal Velocity Command 3	300	min^{-1}	0～32767	5-15
24	VCOMP	Internal Velocity Compensation Command	0	min^{-1}	-9999～+9999	5-15
25	VCGN	Analog Velocity (Compensation) Command Scaling	333	min^{-1}/V	0～4000	5-15
26	TVCACC	Velocity Command, Acceleration Time Constant	0	ms	0～16000	5-15
27	TVCDEC	Velocity Command, Deceleration Time Constant	0	ms	0～16000	5-15
28	VCLM	Velocity Limit Command	65535	min^{-1}	1～65535	5-15
31	TCOMP1	Internal Torque Compensation Command 1	0	%	-500～500	5-16
32	TCOMP2	Internal Torque Compensation Command 2	0	%	-500～500	5-16
33	TCGN	Analog Torque Command Scaling	33	%/V	0～500	5-16
36	TCLM	Internal Torque Limit Value	100	%	10～500	5-16
37	SQTCLM	Torque Limit Value at Sequence Operation	120	%	10～500	5-16
40	NEAR	Near Range	100	Pulse	1～65535	5-17
41	INP	In-Position Complete Range	32	Pulse	1～65535	5-17
42	ZV	Speed Zero Range	50	min^{-1}	50～500	5-17
43	LOWV	Low Speed Setting	50	min^{-1}	0～65535	5-17
44	VCOMP	Speed Matching Width	50	min^{-1}	0～65535	5-17
45	VA	Attain Velocity Setting (High Speed Setting)	1000	min^{-1}	0～65535	5-17

When setting values of parameters page 11, 12 and 17 were done, restore the power supply of control system again to be valid.

● General Parameter Group 9［Function enabling condition setting］

Page	Symbol	Name	Standard Setting Value	Setting Range	Reference page
00	F-OT	Positive Rotation (Positive Direction) Over-Travel Function	00:_Always_ Disable	00～27	5-18,19
01	R-OT	Negative Rotation (Negative Direction) Over-Travel Function	00:_Always_ Disable	00～27	5-18,19
02	AL-RST	Alarm Reset Function	08:_CONT4_ON	00～27	5-18,19
03	ECLR	Absolute Encoder Clear Function	00:_Always_ Disable	00～27	5-18,19
04	CLR	Deviation Clear Function	02:_CONT1_ON	00～27	5-18,19
05	S-ON	SERVO-ON Function	06:_CONT3_ON	00～27	5-18,19
10	MS	Control Mode Switching Function	00:_Always_ Disable	00～27	5-18,19
11	INH/Z-STP	Position Command Pulse Inhibit Function and Zero Velocity Command Clamp Function	00:_Always_ Disable	00～27	5-18,19
12	GERS	Electric Gear Switching Function	00:_Always_ Disable	00～27	5-18,19
13	GC1	Gain Switching Condition 1	00:_Always_ Disable	00～27	5-18,19
14	GC2	Gain Switching Condition 2	00:_Always_ Disable	00～27	5-18,19
15	SUPFSEL1	Vibration Suppressor Frequency, Select Input 1	00:_Always_ Disable	00～27	5-18,19
16	SUPFSEL2	Vibration Suppressor Frequency, Select Input 2	00:_Always_ Disable	00～27	5-18,19
17	PLPCON	Position Loop Proportional Control, Switching Function	01:_Always_ Enable	00～27	5-18,19
18	RSWGC	RSW Gain Switching Function	01:_Always_ Enable	00～27	5-18,19
20	SP1	Internal Velocity Setting Selection Input 1	00:_Always_ Disable	00～27	5-18,19
21	SP2	Internal Velocity Setting Selection Input 2	00:_Always_ Disable	00～27	5-18,19
22	DIR	Internal Velocity Driving Direction Selection Input	00:_Always_ Disable	00～27	5-18,19
23	RUN	Internal Velocity Driving Start Signal Input	00:_Always_ Disable	00～27	5-18,19
24	RUN-F	Internal Velocity Stop Rotation (Stop Direction) Start Signal Input	00:_Always_ Disable	00～27	5-18,19
25	RUN-R	Internal Velocity 9Negative Direction) Start Signal Input	00:_Always_ Disable	00～27	5-18,19
26	VLPCON	Velocity Loop Proportional Control, Switching Function	04:_CONT2_ON	00～27	5-18,19
27	VCOMPS	Velocity Compensation Function	00:_Always_ Disable	00～27	5-18,19
30	TCOMPS1	Torque Compensation Function 1	00:_Always_ Disable	00～27	5-18,19
31	TCOMPS2	Torque Compensation Function 2	00:_Always_ Disable	00～27	5-18,19
32	TL	Torque Limit Function	00:_Always_ Disable	00～27	5-18,19
33	OBS	Disturbance Observer Function	00: Always_ Disable	00～27	5-18,19
40	EXT-E	External Trip Input Function	00:_Always_ Disable	00～27	5-18,19
42	EMR	Emergency Stop Function	00:_Always_ Disable	00～27	5-18,19

● General Parameter Group A［Setting for output condition of general output terminal / Monitor output selection / Setup software］

Page	Symbol	Name	Standard Setting Value	Setting Range	Reference page
00	OUT1	General Purpose Output 1	02:_S-RDY_ON	00～5B	5-20,21
01	OUT2	General Purpose Output 2	18:_INP_ON	00～5B	5-20,21
02	OUT3	General Purpose Output 3	36:_ALM4[ALMB7]_ON	00～5B	5-20,21
03	OUT4	General Purpose Output 4	34:_ALM2[ALMB6]_ON	00～5B	5-20,21
04	OUT5	General Purpose Output 5	32:_ALM1[ALMB5]_ON	00～5B	5-20,21
11	MON1	Analog Monitor 1, Output Signal Selection	04:VMON_1mV/ min^{-1}	00～12	5-20
12	MON2	Analog Monitor 2, Output Signal Selection	02:TCMON_1V/TR	00～12	5-20
13	MONPOL	Analog monitor output polarity	00:_MON1+_MON2+	00～08	5-22
20	COMAXIS	Setup Software, Communication Axis Number	01:_#1	01～0F	5-22

When setting value of parameter page 20 is done, restore the power supply of control system again to be valid.

● General Parameter Group B [Setting related to sequence/alarms]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	JOGVC	JOG Velocity Command	50	min^{-1}	0～32767	5-23
10	DBOPE	Brake Operation	00:_Free	-	00～04	5-23
11	ACTOT	Over-Travel Operation	00:_CMDIN H_SB_SON	-	00～06	5-23
12	ACTEMR	Emergency Stop Operation	01:_Free	-	00～01	5-23
13	BONDLY	Retention Brake Operation Delay Time (Retention brake retention delay time)	300	ms	0～1000	5-24
14	BOFFDLY	Retention Brake Operation Release Delay Time (Retention brake release delay time)	300	ms	0～1000	5-24
15	BONBGN	Brake Operation Start Time	0	ms	0～65535	5-24
16	PFDDLY	Power Failure Detection Delay Time	32	ms	20～1000	5-24
20	OFWLV	Excessive Deviation Warning Level	65535	X1024 pulse	1～65535	5-24
21	OFLV	Deviation Counter Overflow Value	32	X1024 pulse	1～65535	5-24
22	OLWLV	Overload Warning Level	90	%	20～100	5-25
23	VFBALM	Speed Feedback Error (ALM_C3) Detection	01:_Enabled	-	00～01	5-25
24	VCALM	Speed Control Error (ALM_C2) Detection	00:_Disabled	-	00～01	5-25

When setting values of parameters page16 and 22 were done, restore the power supply of control system again to be valid.

● General Parameter Group C [Encoder related setting]

Page	Symbol	Name	Standard Setting Value	Unit	Setting Range	Reference page
00	ABS/INCSYS	Position Detection System Selection	00:_Absolute	-	00～01	5-26
01	ENFIL	Motor Incremental Encoder, Digital Filter	01:_220nsec	-	00～07	5-26
05	ENRAT	Encoder Pulse Divided Output, Divide Ratio	1/1	-	1/8192～1/1	5-27
06	PULOUTPOL	Encoder Pulse Divided Output, Polarity	00:_Type1	-	00～03	5-27
07	PS0FORM	Encoder Signal Output (PS), Format	00:_Binary	-	00～02	5-27
08	ECLRFUNC	Absolute Encoder Clear Function Selection	00:_Status_MultiTurn	-	00～01	5-27
10	TG_SCALING	Tachogenerator Velocity Scale Range Setting	0	-	-13107～13107	5-27
11	TG_OFFSET	Tachogenerator Velocity Offset Setting	0	-	-182～182	5-27
12	TG_POL	Tachogenerator Output Voltage Polarity Setting	00	-	00～01	5-27

When setting values of parameters page 00 and 07 were done, restore the power supply of control system again to be valid.

⚠ For users of the absolute encoder with backup battery system who utilize incremental system, be sure to set the parameter value of the servo amplifier as indicated in the below table.

Group	Page	Symbol	Name	Setting value	Description
C	00	ABS/INCSYS	Position detection system call	00:_Incremental	Incremental system
C	08	ECLRFUNC	Absolute Encoder Clear Function call	01:_Status	Encoder status (Error・Warning only)Clear

When setting values of parameters page 00, and 08 were done, restore the power supply of control system again to be valid

● System parameter

Page	Name	Setting Range	Reference page
00	Main Circuit Power Supply Input Type	1way (DC Power Supply)	5-28
01	Motor Encoder Type	4 ways (Depending on the hardware type)	5-28
02	Incremental Encoder Function Selection	1way (Incremental Encoder)	5-28
03	Incremental Encoder Resolution	500P/R ～ 65535P/R	5-28
04	Absolute Encoder Function Selection	2 way	5-28
05	Absolute Encoder Resolution	11 ways	5-28
06	Combination Motor Model Number	-	5-29
08	Control Mode	6 ways	5-29
09	Position Loop Control and Position Loop Encoder Selection	1way(Motor Encoder)	5-29
0A	External Encoder Resolution	-	5-29
0B	Regenerative Resistor Selection	-	5-29

5. Parameter [Parameter Specifications 【Group 0】【Group 1】]

■ General parameter Group 0 [Auto-tuning settings]

Page 00 — Tuning mode [TUNMODE]

Setting range	Unit	Standard value
00～02	-	02:_ManualTun

Selection value	Contents
00:_AutoTun	Automatic Tuning
01:_AutoTun_JRAT-Fix	Automatic Tuning (JRAT Manual Setting)
02:_ManualTun	Manual Tuning

Page 01 — Automatic Tuning Characteristic [ATCHA]

Setting range	Unit	Standard value
00～04	-	00:_Positioning1

Selection value	Contents
00:_Positioning1	Positioning Control 1 (Generic)
01:_Positioning2	Positioning Control 2 (For High Response)
02:_Positioning3	Positioning Control 3 (For High Response, Horizontal Axis Limit)
03:_Trajectory1	Trajectory Control
04:_Trajectory2	Trajectory Control (KP Manual Setting)

Page 02 — Automatic Tuning Response [ATRES]

Setting range	Unit	Standard value
1～30	-	5

Sets the auto-tuning response. The larger the set value, the higher the response. Make the setting suitable for rigidity of the device.

Page 03 — Automatic Tuning, Automatic Parameter Saving [ATSAVE]

Setting range	Unit	Standard value
00～01	-	00:_Auto_Saving

The parameter (JRAT) obtained from auto-tuning result is automatically saved.

Selection value	Contents
00:_Auto_Saving	Saves Parameter Automatically in JRAT1.
01:_No_Saving	Automatic Saving is Invalidity

Page 10 — Automatic Notch Filter Tuning, Torque Command [ANFILTC]

Setting range	Unit	Standard value
10～100	%	50

Sets the torque command value applied to the motor at the time of auto-notch filter tuning.
Larger value makes the tuning more accurate; however, note that it also makes the move of the machine larger.

Page 20 — Automatic Vibration Suppressor Frequency Tuning, Torque Command [ASUPTC]

Setting range	Unit	Standard value
10～100	%	25

Sets the torque command value applied to the motor at the time of auto-vibration suppressing frequency tuning.
Larger value makes the tuning more accurate; however, note that it also makes the move of the machine larger.

Page 21 — Automatic Vibration Suppressor Frequency Tuning, Friction Torque Compensation Value [ASUPFC]

Setting range	Unit	Standard value
0～50	%	5

Sets the friction torque compensation added to the motor torque at the time of auto-vibration suppressing frequency tuning. Set this value close to actual friction torque, and vibration suppressing frequency tuning will be more accurate.

■ General parameter Group 1 [Basic control parameter setting]

Page 01 — Position command filter [PCFIL]

Setting range	Unit	Standard value
0.0～2000.0	ms	0.0

Parameter to put primary low pass filter to the position command. Time constant of the filter is set. Filter is disabled with the set value of 0.0ms.

Page 02 — Position Loop Proportional Gain 1 [KP1]

Setting range	Unit	Standard value
1～3000	1/s	30

Proportional gain for position controller.
When auto-tuning result saving is executed, the tuning result is automatically saved in this parameter.

Page 03 — Position Loop Integral Time Constant 1 [TPI1]

Setting range	Unit	Standard value
0.5～1000.0	ms	1000.0

Integral time constant for position controller. When position loop proportional control switching function is disabled, this setting becomes enabled.
Integral term is disabled (proportional control) with the set value of 1000.0ms.

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td rowspan="2">04</td><td colspan="2">Higher Tracking Control, Position Compensation Gain [TRCPGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～100</td><td>%</td><td>0</td></tr></table></td><td>Parameter to enhance following-up performance. The larger value can make the following-up performance higher. When the value other than 0% is set, position command filter and feed forward gain are automatically set.</td></tr>
<tr><td rowspan="2">05</td><td colspan="2">Feed Forward Gain [FFGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～100</td><td>%</td><td>0</td></tr></table></td><td>Feed forward compensation gain at the time of position control.</td></tr>
<tr><td rowspan="2">08</td><td colspan="2">Feed Forward Filter [FFFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to put primary low pass filter to feed forward command. Sets the cut-off frequency.
Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">10</td><td colspan="2">Velocity Command Filter [VCFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to put primary low pass filter to velocity command. Sets the cut-off frequency.
Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">12</td><td colspan="2">Velocity Feedback Filter [VDFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>1500</td></tr></table></td><td>Parameter to put primary low pass filter to velocity feedback. Sets the cut-off frequency. Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">13</td><td colspan="2">Velocity Loop Proportional Gain 1 [KVP1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>70</td></tr></table></td><td>Proportional gain of velocity controller.
When auto-tuning result saving is executed, the tuning result is automatically saved in this parameter.</td></tr>
<tr><td rowspan="2">14</td><td colspan="2">Velocity Loop Integral Time Constant 1 [TVI1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>20.0</td></tr></table></td><td>Integral time constant of velocity controller. When velocity loop proportional control switching function is disabled, this set value is enabled.
Integral term (proportional control) is disabled with the set value of 1000.0ms.
When auto-tuning result saving is executed, the tuning result is automatically saved in this parameter.</td></tr>
<tr><td rowspan="2">15</td><td colspan="2">Load Inertia Moment Ratio (Load Mass Ratio) 1 [JRAT1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～15000</td><td>%</td><td>0</td></tr></table></td><td>Sets inertia moment of the loading device to the motor inertia moment. Set value＝JL/JM×100%
JL：Load inertia moment
JM：Motor inertia moment
When auto-tuning result saving is executed, the tuning result is automatically saved in this parameter.</td></tr>
<tr><td rowspan="2">16</td><td colspan="2">Higher Tracking Control, Velocity Compensation Gain [TRCVGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～100</td><td>%</td><td>0</td></tr></table></td><td>Parameter to enhance following-up performance. The larger value can make the following-up performance higher. When velocity loop proportional control switching function is used, set this to 0%.</td></tr>
<tr><td rowspan="2">17</td><td colspan="2">Acceleration Feedback Gain [AFBK]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>-100.0～100.0</td><td>%</td><td>0.0</td></tr></table></td><td>Compensation function to make the velocity loop stable. Multiply this gain with the detected acceleration to compensate torque command. Setting unit is 0.1%.</td></tr>
<tr><td rowspan="2">18</td><td colspan="2">Acceleration Feedback Filter [AFBFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>500</td></tr></table></td><td>Parameter to put primary low pass filter to acceleration feedback compensation. Sets the cut-off frequency. Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">20</td><td colspan="2">Torque Command Filter 1 [TCFIL1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>500</td></tr></table></td><td>Parameter to put low pass filter to torque command. Sets the cut-off frequency.
When auto-tuning result saving is executed, the tuning result is automatically saved in this parameter.</td></tr>
<tr><td rowspan="2">21</td><td colspan="2">Torque Command Filter Order [TCFILOR]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～3</td><td>Order</td><td>1</td></tr></table></td><td>Parameter to set ordinal number of torque command filter.</td></tr>
</table>

5. Parameter [Parameter Specifications 【Group 2】]

■ General parameter Group 2 [Settings for vibration suppressing control, notch filter, and disturbance observer]

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">00</td><td colspan="2">Vibration Suppressor Frequency 1 [SUPFRQ1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>5～500</td><td>Hz</td><td>500</td></tr></table></td><td>Parameter to set the frequency of restricting vibration.
Inside the servo amplifier, vibration suppressing frequency from 5～99Hz is treated by 1HzUnit, and that from 100～500Hz is by 10HzUnit. Even when set by lower unit than these, operations do not change.
Vibration suppressing control is disabled with the set value of 500Hz.
When auto-frequency tuning is executed, the tuning result is automatically saved in this parameter.
Change this while the motor stops.</td></tr>
<tr><td rowspan="2">01</td><td colspan="2">Vibration Suppressor Level Selection [SUPLV]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～03</td><td>-</td><td>00</td></tr></table></td><td>Parameter to set the size of vibration suppressing control effect. The smaller the value is, the greater the effect will be.
Change this while the motor stops.</td></tr>
<tr><td rowspan="2">10</td><td colspan="2">Velocity Command,Notch Filter [VCNFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>50～500</td><td>Hz</td><td>500</td></tr></table></td><td>Parameter to set notch filter to velocity command. Sets the center frequency.
Inside the servo amplifier, the center frequency from 50～99Hz is treated by 1HzUnit and that from 100～500Hz is by 10HzUnit. Even when set by lower unit than these, operations do not change.
Filter is disabled with the set value of 500Hz.</td></tr>
<tr><td rowspan="2">20</td><td colspan="2">Torque Command,Notch Filter A [TCNFILA]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>100～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to set notch filter to torque command. Sets the center frequency.
Inside the servo amplifier, the center frequency is treated by 10HzUnit. Even when set by lower unit than 1HzUnit, operations do not change.
Filter is disabled with the set value of 2000Hz.
When auto-notch filter tuning is executed, the tuning result is automatically saved in this parameter.</td></tr>
<tr><td rowspan="2">21</td><td colspan="2">TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～02</td><td>-</td><td>00</td></tr></table></td><td>Parameter to improve phase delay at lower frequency than center frequency of torque command notch filter A. The larger the value is, the greater the effect is.
Same characteristics as the standard notch filter with the set value of 0.</td></tr>
<tr><td rowspan="2">22</td><td colspan="2">Torque Command,Notch Filter B [TCNFILB]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>100～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to set notch filter to torque command. Sets the center frequency.
Inside the servo amplifier, the center frequency is treated by 10HzUnit. Even when set by 1HzUnit, operations do not change.
Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">23</td><td colspan="2">TCNFILB, Depth Selection [TCNFDB]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～03</td><td>-</td><td>00</td></tr></table></td><td>Parameter to set the depth of torque command notch filter B. The larger the value is, the shallower.</td></tr>
<tr><td rowspan="2">24</td><td colspan="2">Torque Command, Notch Filter C [TCNFILC]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>100～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to set notch filter to torque command. Sets the center frequency.
Inside the servo amplifier, the center frequency is treated by 10HzUnit. Even when set by 1HzUnit, operations do not change.
Filter is disabled with the set value of 2000Hz.</td></tr>
<tr><td rowspan="2">25</td><td colspan="2">TCNFILC, Depth Selection [TCNFDC]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～03</td><td>-</td><td>00</td></tr></table></td><td>Parameter to set the depth of torque command notch filter C. The larger the value is, the shallower.</td></tr>
<tr><td rowspan="2">26</td><td colspan="2">Torque Command,Notch Filter D [TCNFILD]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>100～2000</td><td>Hz</td><td>2000</td></tr></table></td><td>Parameter to set notch filter to torque command. Sets the center frequency.
Inside the servo amplifier, the center frequency is treated by 10HzUnit. Even when set by 1HzUnit, operations do not change.
Filter is disabled with the set value of 2000Hz.</td></tr>
</table>

5. Parameter [Parameter Specifications【Group2】【Group3】]

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td>27</td><td>TCNFILD, Depth Selection [TCNFDD]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～03</td><td>-</td><td>00</td></tr></table>
Parameter to set the depth of torque command notch filter D. The greater the value is, the shallower the depth will be.</td></tr>
<tr><td>30</td><td>Observer characteristic [OBCHA]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>00～01</td><td>-</td><td>00:_Low</td></tr></table>
Selects the observer characteristics.
<table><tr><th>Selection</th><th>Contents</th></tr><tr><td>00:_Low</td><td>For Low Frequency Noise Suppression</td></tr><tr><td>01:_Middle</td><td>For Medium Frequency Noise Suppression</td></tr></table></td></tr>
<tr><td>31</td><td>Observer Compensation Gain [OBG]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～100</td><td>%</td><td>0</td></tr></table>
Observer compensation gain. The larger the value is, the higher the suppression characteristics will be. However, if this is too large, oscillation may sometimes occur.</td></tr>
<tr><td>32</td><td>Observer Output, Low Pass Filter [OBLPF]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>50</td></tr></table>
Sets the cut off frequency of observer output low pass filter. Filter is disabled with the set value of 2000Hz.
When the observer characteristics are “01: Middle (For Middle Cycle)”, the function is disabled.</td></tr>
<tr><td>33</td><td>Observer Output, Notch Filter [OBNFIL]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>100～2000</td><td>Hz</td><td>2000</td></tr></table>
Sets the center frequency of observer output notch filter. Inside the servo amplifier, the center frequency is treated by 10HzUnit. Even when set by 1HzUnit, operations do not change.
Filter is disabled with the set value of 2000Hz.</td></tr>
</table>

■ General parameter Group 3 [Settings for gain switching control and vibration suppression frequency switching]

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td>00</td><td>Position Loop Proportional Gain 2 [KP2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～3000</td><td>1/s</td><td>30</td></tr></table>
Proportional gain for position controller.</td></tr>
<tr><td>01</td><td>Position Loop Integral Time Constant 2 [TPI2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>1000.0</td></tr></table>
Integral time constant for position controller.
Integral term is disabled (proportional control) with the set value of 1000.0ms.
✍ Cannot be used when the position loop proportional control switching function is enabled.</td></tr>
<tr><td>02</td><td>Velocity Loop Proportional Gain 2 [KVP2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>50</td></tr></table>
Proportional gain for velocity controller.
When load inertia is the one set by load inertia moment ratio (load mass ratio) 2, the response is this set value.</td></tr>
<tr><td>03</td><td>Velocity Loop Integral Time Constant 2 [TVI2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>20.0</td></tr></table>
Integral time constant for velocity controller.
Enabled when velocity loop proportional control switching function is disabled.
Integral term is disabled (proportional control) with the set value of 1000.0ms.</td></tr>
<tr><td>04</td><td>Load Inertia Moment Ratio (Load Mass Ratio) 2 [JRAT2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～15000</td><td>%</td><td>100</td></tr></table>
Sets the inertia moment of load device to the motor inertia moment. Set value＝JL/JM×100%
JL：Load inertia moment
JM：Motor inertia moment</td></tr>
<tr><td>05</td><td>Torque Command Filter 2 [TCFIL2]
<table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>600</td></tr></table>
Parameter to set low pass filter to torque command. Sets the cut off frequency.</td></tr>
</table>

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">10</td><td colspan="2">Position Loop Proportional Gain 3 [KP3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～3000</td><td>1/s</td><td>30</td></tr></table></td><td>Proportional gain for position controller.</td></tr>
<tr><td rowspan="2">11</td><td colspan="2">Position Loop Integral Time Constant 3 [TPI3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>1000.0</td></tr></table></td><td>Integral time constant for position controller.
Integral term is disabled (proportional control) with the set value of 1000.0ms.
✍ Cannot be used when position loop proportional control switching function is enabled.</td></tr>
<tr><td rowspan="2">12</td><td colspan="2">Velocity Loop Proportional Gain 3 [KVP3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>50</td></tr></table></td><td>Proportional gain for velocity controller.
When load inertia is the one set by load inertia moment ratio (load mass ratio) 2, the response is this set value.</td></tr>
<tr><td rowspan="2">13</td><td colspan="2">Velocity Loop Integral Time Constant 3 [TVI3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>20.0</td></tr></table></td><td>Integral time constant for velocity controller. This setting is enabled when velocity loop proportional control switching function is disabled.
Integral term is disabled (proportional control) with the set value of 1000.0ms.</td></tr>
<tr><td rowspan="2">14</td><td colspan="2">Load Inertia Moment Ratio (Load Mass Ratio) 3 [JRAT3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～15000</td><td>%</td><td>100</td></tr></table></td><td>Sets the inertia moment of load device to the motor inertia moment. Set value＝JL/JM×100%
JL：Load inertia moment
JM：Motor inertia moment</td></tr>
<tr><td rowspan="2">15</td><td colspan="2">Torque Command Filter 3 [TCFIL3]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>%</td><td>600</td></tr></table></td><td>Parameter to set low pass filter to torque command. Sets the cut off frequency.</td></tr>
<tr><td rowspan="2">20</td><td colspan="2">Position Loop Proportional Gain 4 [KP4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～3000</td><td>1/s</td><td>30</td></tr></table></td><td>Proportional gain for position controller.</td></tr>
<tr><td rowspan="2">21</td><td colspan="2">Position Loop Integral Time Constant 4 [TPI4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>1000.0</td></tr></table></td><td>Integral time constant for position controller. Integral term is disabled (proportional control) with the set value of 1000.0ms.
✍ Cannot be used when position loop proportional control switching function is enabled.</td></tr>
<tr><td rowspan="2">22</td><td colspan="2">Velocity Loop Proportional Gain 4 [KVP4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>Hz</td><td>50</td></tr></table></td><td>Proportional gain for velocity controller.
When load inertia is the one set by load inertia moment ratio (load mass ratio) 2, the response is this set value.</td></tr>
<tr><td rowspan="2">23</td><td colspan="2">Velocity Loop Integral Time Constant 4 [TVI4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0.5～1000.0</td><td>ms</td><td>20.0</td></tr></table></td><td>Integral time constant for velocity controller. This setting is enabled when velocity loop proportional control switching function is disabled.
Integral term is disabled (proportional control) with the set value of 1000.0ms.</td></tr>
<tr><td rowspan="2">24</td><td colspan="2">Load Inertia Moment Ratio (Load Mass Ratio) 4 [JRAT4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～15000</td><td>%</td><td>100</td></tr></table></td><td>Sets the inertia moment of load device to the motor inertia moment. Set value＝JL/JM×100%
JL：Load inertia moment
JM：Motor inertia moment</td></tr>
<tr><td rowspan="2">25</td><td colspan="2">Torque Command Filter 4 [TCFIL4]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～2000</td><td>%</td><td>600</td></tr></table></td><td>Parameter to set low pass filter to torque command. Sets the cut off frequency.</td></tr>
<tr><td rowspan="2">30</td><td colspan="2">Low Pass Filter of Gain Switching [GCFIL]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～100</td><td>ms</td><td>0</td></tr></table></td><td>Parameter to set time constant for gain switching.
The larger the value is, the gentler the switching is.</td></tr>
</table>

5. Parameter [Parameter Specifications 【Group 3】【Group 4】]

Page	Contents	
40	Vibration Suppressor Frequency 2 [SUPFRQ2]	
	Setting range: 5～500 / Unit: Hz / Standard value: 500	Parameter to set the frequency of vibration suppressing vibration. In the servo amplifier, the vibration suppressing frequency from 5 to 99Hz is treated by 1Hz unit, and from 100 to 500Hz is by 10Hz unit. Operations do not change if set by lower unit than these. Vibration suppressing control is disabled when the set value is 500Hz. ✍ Change this while the motor stops.
41	Vibration Suppressor Frequency 3 [SUPFRQ3]	
	Setting range: 5～500 / Unit: Hz / Standard value: 500	Parameter to set the frequency of vibration suppressing vibration. In the servo amplifier, the vibration suppressing frequency from 5 to 99Hz is treated by 1H unit, and from 100 to 500Hz is by 10Hz unit. Operations do not change if set by lower unit than these. Vibration suppressing control is disabled when the set value is 500Hz. ✍ Change this while the motor stops.
42	Vibration Suppressor Frequency 4 [SUPFRQ4]	
	Setting range: 5～500 / Unit: Hz / Standard value: 500	Parameter to set the frequency of vibration suppressing vibration. In the servo amplifier, the vibration suppressing frequency from 5 to 99Hz is treated by 1H unit, and from 100 to 500Hz is by 10Hz unit. Operations do not change if set by lower unit than these. Vibration suppressing control is disabled when the set value is 500Hz. ✍ Change this while the motor stops.

■ General parameter Group 4［High setting control settings］

Page	Contents	
00	Command Velocity Calculation, Low Pass Filter [CVFIL]	
	Setting range: 1～2000 / Unit: Hz / Standard value: 1000	Sets the cut off frequency of low pass filter, when command velocity is calculated. When the position command resolution is low, lower the cut off frequency. Filter is disabled when the set value is 2000Hz.
01	Command Velocity Threshold [CVTH]	
	Setting range: 0～65535 / Unit: min^{-1} / Standard value: 20	When the command velocity calculated from position command is larger than this threshold, acceleration or deceleration compensation is added to the positional deviation.
02	Acceleration Compensation [ACCCO]	
	Setting range: -9999～+9999 / Unit: ×50 Pulse / Standard value: 0	Compensation at acceleration.
03	Deceleration Compensation [DECCO]	
	Setting range: -9999～+9999 / Unit: ×50 Pulse / Standard value: 0	Compensation at deceleration.

■ General Parameter Group 5 [Setting a parameter compatible with the gain setting switch]

<table>
<tr><td>Page</td><td>Contents</td></tr>
<tr><td rowspan="2">00</td><td>RSW0- Position Loop Proportional Gain [RSW0-KP]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Units</th><th>Standard setting value</th></tr>
<tr><td>1～3000</td><td>1/s</td><td>10</td></tr>
</table>
When the value of the gain setting switch is 0, it is the corresponding proportional gain of position controller.
</td></tr>
<tr><td rowspan="2">01</td><td>RSW0- Velocity Loop Proportional Gain [RSW0-KVP]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Units</th><th>Standard setting value</th></tr>
<tr><td>1～2000</td><td>Hz</td><td>20</td></tr>
</table>
When the value of the gain setting switch is 0, it is the corresponding proportional gain of velocity controller.
</td></tr>
<tr><td rowspan="2">02</td><td>RSW0- Velocity Loop Integral Time Constant [RSW0-TVI]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Units</th><th>Standard setting value</th></tr>
<tr><td>0.5～1000.0</td><td>ms</td><td>50</td></tr>
</table>
When the value of the gain setting switch is 0, it is the corresponding integral time constant of velocity controller.
When the velocity loop proportional control change function is invalid, this setting becomes effective.
The integral clause becomes invalid when set control is 1000.0ms (proportional control).
</td></tr>
<tr><td></td><td>✍ As well as the above, the parameter corresponding to value (0～F) of the gain setting switch is allocated on page (00～F2).
<table>
<tr><th rowspan="2">Value of Gain Setting Switch</th><th rowspan="2">Page</th><th colspan="3">Standard Value</th></tr>
<tr><th>Position Loop Proportional Gain (1/s)</th><th>Velocity Loop Proportional Gain (Hz)</th><th>Velocity Loop Integral Time Constant (ms)</th></tr>
<tr><td>0</td><td>00～02</td><td>10</td><td>20</td><td>50</td></tr>
<tr><td>1</td><td>10～12</td><td>10</td><td>20</td><td>20</td></tr>
<tr><td>2</td><td>20～22</td><td>20</td><td>35</td><td>50</td></tr>
<tr><td>3</td><td>30～32</td><td>20</td><td>35</td><td>20</td></tr>
<tr><td>4</td><td>40～42</td><td>30</td><td>50</td><td>50</td></tr>
<tr><td>5</td><td>50～52</td><td>30</td><td>50</td><td>20</td></tr>
<tr><td>6</td><td>60～62</td><td>30</td><td>70</td><td>50</td></tr>
<tr><td>7</td><td>70～72</td><td>30</td><td>70</td><td>20</td></tr>
<tr><td>8</td><td>80～82</td><td>45</td><td>100</td><td>50</td></tr>
<tr><td>9</td><td>90～92</td><td>45</td><td>100</td><td>20</td></tr>
<tr><td>A</td><td>A0～A2</td><td>45</td><td>140</td><td>50</td></tr>
<tr><td>B</td><td>B0～B2</td><td>45</td><td>140</td><td>20</td></tr>
<tr><td>C</td><td>C0～C2</td><td>60</td><td>200</td><td>50</td></tr>
<tr><td>D</td><td>D0～D2</td><td>60</td><td>200</td><td>20</td></tr>
<tr><td>E</td><td>E0～E2</td><td>60</td><td>280</td><td>50</td></tr>
<tr><td>F</td><td>F0～F2</td><td>60</td><td>280</td><td>20</td></tr>
</table>
</td></tr>
</table>

■ General parameter Group 8 [Settings for control system]

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td>00</td><td>
Position, Velocity, and Torque Command Input Polarity [CMDPOL]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～07</td><td>-</td><td>00:_PC+_VC+_TC+</td></tr>
</table>
Select the command polarity from the contents blow.
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Forward</td><td rowspan="3">00:
_PC+_VC+_TC+</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Forward</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Forward</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Reverse</td><td rowspan="3">04:
_PC-_VC+_TC+</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Forward</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Forward</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Forward</td><td rowspan="3">01:
_PC+_VC+_TC-</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Forward</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Reverse</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Reverse</td><td rowspan="3">05:
_PC-_VC+_TC-</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Forward</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Reverse</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Forward</td><td rowspan="3">02:
_PC+_VC-_TC+</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Reverse</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Forward</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Reverse</td><td rowspan="3">06:
_PC-_VC-_TC+</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Reverse</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Forward</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Forward</td><td rowspan="3">03:
_PC+_VC-_TC-</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Reverse</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Reverse</td></tr>
</table>
<table>
<tr><th>Input command</th><th>Command polarity</th><th>Rotation direction</th><th>Selection value</th></tr>
<tr><td>position command</td><td>＋</td><td>Reverse</td><td rowspan="3">07:
_PC-_VC-_TC-</td></tr>
<tr><td>Velocity command</td><td>＋</td><td>Reverse</td></tr>
<tr><td>Torque command</td><td>＋</td><td>Reverse</td></tr>
</table>
</td></tr>
<tr><td>01</td><td>
Analog Input Dead Band [VC/TC-DB]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>00:_Disabled</td></tr>
</table>
Select enabled/disabled of analog input dead zone.
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Disabled</td><td>Disabled</td></tr>
<tr><td>01:_Enabled</td><td>Enabled</td></tr>
</table>
</td></tr>
<tr><td>02</td><td>
Analog Input Dead Band range [VCZDAT]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>0.0～6553.5</td><td>mV</td><td>0.0</td></tr>
</table>
Sets the dead-band range of analog input command.
This range of analog input voltage (absolute value) is regarded as 0 [V].
Settable range is 0.0～6553.5[mV]. (Can be changed in 0.1 [mV] unit)
Valid for Velocity/Torque commands.
Select “Enabled” value in page 01 Group 08 of “Analog input dead-band [VC/TC-DB]” to enable this setting value.
</td></tr>
<tr><td>11</td><td>
Position Command Pulse Selection [PCPTYP]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～02</td><td>-</td><td>00:_F-PC_R-PC</td></tr>
</table>
Select the position command pulse type from the contents below.
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_F-PC_R-PC</td><td>Positive Move Pulse + Negative Move Pulse</td></tr>
<tr><td>01:_2PhasePulse</td><td>Two-Phase Pulse Train of 90 Degrees Phase Difference</td></tr>
<tr><td>02:_CODE_PC</td><td>Code + Pulse Train</td></tr>
</table>
✍ The setting value is enabled after control power is turned ON again.
</td></tr>
<tr><td>12</td><td>
Position Command Pulse, Count Polarity [PCPPOL]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～03</td><td>-</td><td>00:_Type1</td></tr>
</table>
Select the position command pulse count polarity from the contents below.
<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>00:_Type1</td><td>F-PC/ Count at the Rising Edge : R-PC/ Count at the Rising Edge</td></tr>
<tr><td>01:_Type2</td><td>F-PC/ Count at the Falling Edge : R-PC/ Count at the Rising Edge</td></tr>
<tr><td>02:_Type3</td><td>F-PC/ Count at the Rising Edge : R-PC/ Count at the Falling Edge</td></tr>
<tr><td>03:_Type4</td><td>F-PC/ Count at the Falling Edge : R-PC/ Count at the Falling Edge</td></tr>
</table>
✍ The setting value is enabled after control power is turned ON again.
</td></tr>
</table>

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Position Command Pulse, Digital Filter [PCPFIL]

Setting range	Unit	Standard setting value
00～07	-	00:_834nsec

Select the setting of position command pulse digital filter from the contents below.
As timing for command direction, observe the specifications of position command. When the pulse command form is “Two-Phase Pulse Train of 90 Degrees Phase Difference”, observe the specification s of position command.

Selection	Contents
00:_834nsec	Minimum Pulse Width = 834nsec
01:_250nsec	Minimum Pulse Width = 250nsec
02:_500nsec	Minimum Pulse Width = 500nsec
03:_1.8usec	Minimum Pulse Width = 1.8 μ sec
04:_3.6usec	Minimum Pulse Width = 3.6 μ sec
05:_7.2usec	Minimum Pulse Width = 7.2 μ sec
06:_125nsec	Minimum Pulse Width = 125nsec
07:_83.4nsec	Minimum Pulse Width = 83.4nsec

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Position Command, Pulse Multiplier [PCPMUL]

Setting range	Unit	Standard setting value
1～63	-	1

Parameter to multiply the command pulse by x1～x63. Values from 1 to 63 are set, which are always enabled.

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Electric Gear 1 [GER1]

Setting range	Unit	Standard setting value
1/32767～32767/1	-	4/1

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Electric Gear 2 [GER2]

Setting range	Unit	Standard setting value
1/32767～32767/1	-	4/1

Setting of electronic gear to position command pulse.

$$f1 \rightarrow \frac{N(1 \sim 32767)}{D(1 \sim 32767)} \rightarrow f2 \quad (f2 = f1 \times N/D)$$

$$1/32767 \leqq N/D \leqq 32767$$

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Positioning method [EDGEPOS]

Setting range	Unit	Standard setting value
00～01	-	00:_Pulse _Interval

Select the encoder pulse positioning from the contents below.

Selection value	Contents
00:_Pulse_Interval	Specify Pulse Interval Positioning
01:_Pulse_Edge	Specify In-Position Edge

✍ The set value is enabled after control power is turned ON again.

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Specify In-Position Signal/In-Position Deviation Monitor [PDEVMON]

Setting range	Unit	Standard setting value
00～01	-	00:_After_Filter

Select the positioning complete signal (INP) and position deviation monitor from the contents below.

Selection value	Contents
00:_After_Filter	After passing the filter compare the “Position Command Value” with the “Feedback Value”.
01:_Before_Filter	Before passing the filter compare the “Position Command Value” with the “Feedback Value”.

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Deviation Clear Selection [CLR]

Setting range	Unit	Standard setting value
00～03	-	00:_Type1

Select the position deviation clearing method from the contents below.

Selection value	Contents	
00:_Type1	When SERVO-OFF/ Clear Deviation : Deviation Clear Input/ Level Detection	During servo OFF, deviation clear is always executed. While deviation clear input is ON, deviation clear is always executed.
01:_Type2	When SERVO-OFF/ Clear Deviation : Deviation Clear Input/ Edge Detection	During servo OFF, deviation clear is always executed. When deviation clear input is switched from OFF → ON deviation is cleared to the edge.
02:_Type3	When SERVO-OFF/ Not Clear Deviation : Deviation Clear Input/ Level Detection	During servo OFF, deviation clear is not executed. (After servo ON, the motor may operate suddenly.)
03:_Type4	When SERVO-OFF/ Not Clear Deviation : Deviation Clear Input/ Edge Detection	During servo OFF, deviation clear is not executed. (After servo ON, the motor may operate suddenly.)

5. Parameter [Parameter Specifications【Group8】]

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">20</td><td colspan="2">Preset Velocity Command 1 [VC1] Refer to “Chapter 7. Adjustment ・ Functions Internal velocity command”.</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～32767</td><td>min^{-1}</td><td>100</td></tr></table></td><td>Parameter for setting velocity command of internal velocity operation.
When “Internal velocity setting selection input 1 (SP1)” is valid, and “Internal velocity setting selection input 2 (SP2)” of general parameter Group 9 is invalid, this parameter is enabled.</td></tr>
<tr><td rowspan="2">21</td><td colspan="2">Preset Velocity Command 2 [VC2] Refer to “Chapter 7, Adjustment ・ Functions Internal velocity command “.</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～32767</td><td>min^{-1}</td><td>200</td></tr></table></td><td>Parameter for setting velocity command of internal velocity operation.
When “Internal velocity setting selection input 1 (SP1)” is invalid, and “Internal velocity setting selection input 2 (SP2)” of general parameter Group 9 is valid, this parameter is enabled.</td></tr>
<tr><td rowspan="2">22</td><td colspan="2">Preset Velocity Command 3 [VC3] Refer to “Chapter 7, Adjustment ・ Functions Internal velocity command”.</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～32767</td><td>min^{-1}</td><td>300</td></tr></table></td><td>Parameter for setting velocity command of internal velocity operation.
When “Internal velocity setting selection input 1 (SP1)” is valid and “Internal velocity setting selection input 2 (SP2)” of general parameter Group 9 is valid, this parameter is enabled.</td></tr>
<tr><td rowspan="2">24</td><td colspan="2">Preset Velocity Compensation Command [VCOMP]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>-9999～+9999</td><td>min^{-1}</td><td>0</td></tr></table></td><td>Parameter for using velocity addition command in a fixed value when “Velocity addition function (VCOMPS)” of general parameter Group 9 is used.</td></tr>
<tr><td rowspan="2">25</td><td colspan="2">Analog Velocity (Compensation) Command Scaling [VCGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～4000</td><td>min^{-1}/V</td><td>333</td></tr></table></td><td>Parameter for setting analog velocity (addition) command scaling.</td></tr>
<tr><td rowspan="2">26</td><td colspan="2">Velocity Command, Acceleration Time Constant [TVCACC]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～16000</td><td>ms</td><td>0</td></tr></table></td><td>Parameter for restricting acceleration of command, to analog velocity command input, analog velocity addition input, internal velocity command and Jog operation.
Acceleration : 0 min^{-1} → forward ・reverse rotation
Sets the acceleration time for 1000 min^{-1}.</td></tr>
<tr><td rowspan="2">27</td><td colspan="2">Velocity Command, Deceleration Time Constant [TVCDEC]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>0～16000</td><td>ms</td><td>0</td></tr></table></td><td>Parameter for restricting deceleration of command, to analog velocity command input, analog velocity addition input, internal velocity command and Jog operation.
Deceleration : forward ・reverse rotation → 0 min^{-1}
Sets the deceleration time for 1000 min^{-1}.</td></tr>
<tr><td rowspan="2">28</td><td colspan="2">Velocity Limit Command [VCLM]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr><tr><td>1～65535</td><td>min^{-1}</td><td>65535</td></tr></table></td><td>Parameter for restricting the velocity command.
Sets the maximum value of velocity command. Velocity command is restricted by this value at operations of position control and velocity control.
When the set value is larger than 50000, velocity command is restricted at maximum rotation velocity × 1.1.
Set this parameter when it is to be restricted at lower than motor rotation velocity × 1.1.
（Use the standard value usually.）</td></tr>
</table>

5. Parameter [Parameter Specifications【Group8】]

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">31</td><td colspan="2">Internal Torque Compensation Command 1 [TCOMP1]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>-500～+500</td><td>%</td><td>0</td></tr></table></td><td>Parameter for using torque addition command in a fixed value, when “Torque addition function 1 (TCOMPS1) “ of general parameter Group 9 is used.</td></tr>
<tr><td rowspan="2">32</td><td colspan="2">Internal Torque Compensation Command 2 [TCOMP2]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>-500～+500</td><td>%</td><td>0</td></tr></table></td><td>Parameter for using torque addition command in a fixed value, when “Torque addition function 2 (TCOMPS2)” of general parameter Group 9 is used.</td></tr>
<tr><td rowspan="2">33</td><td colspan="2">Analog Torque Command Scaling [TCGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>0～500</td><td>%/V</td><td>33</td></tr></table></td><td>Parameter for setting analog torque command scaling.</td></tr>
<tr><td rowspan="2">36</td><td colspan="2">Internal Torque Limit Value [TCLM]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>10～500</td><td>%</td><td>100</td></tr></table></td><td>Parameter for limiting output torque. Torque limit value is set in ratio to the rated output torque.(100%= rated torque) Output torque is limited at the internal “Torque limit set value (TL)” of general parameter Group 9 when the torque limit input signal is functioning.
Output torque is restricted by TP if a value exceeding the peak output torque TP is selected.</td></tr>
<tr><td rowspan="2">37</td><td colspan="2">Sequence Operation Torque Limit Value [SQTCLM]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>10～500</td><td>%</td><td>120</td></tr></table></td><td>Parameter for setting sequence operation torque limit value (JOG operation, holding brake operation waiting, and OT status, etc.) Torque limit value is determined by comparing it with the rated output torque. (100%=rated torque)
During sequence operation, output torque is restricted by this set value.
Output torque is restricted by TP if a value exceeding the peak output torque TP is selected.</td></tr>
</table>

5. Parameter [Parameter Specifications【Group8】]

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">40</td><td colspan="2">Near Range [NEAR]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>1～65535</td><td>Pulse</td><td>100</td></tr>
</table>
</td><td>Parameter for setting the output range of near range signal (near in-position complete).
Near range signal is output when the deviation counter is lower than this set value.
Encoder pulse is standard irrespective of electronic gear and command multiplication functions.</td></tr>
<tr><td rowspan="2">41</td><td colspan="2">In-Position Complete Range [INP]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>1～65535</td><td>Pulse</td><td>32</td></tr>
</table>
</td><td>Parameter for setting output range of positioning complete signal.
Positioning complete signal is output when the deviation counter is lower than this set value.
Encoder pulse is standard irrespective of the electronic gear function or command multiplication function.
Incremental encoder
→ Encoder pulse multiplied by 4 is standard.
Absolute encoder
（except for the ones with incremental signal）
→absolute value is standard.</td></tr>
<tr><td rowspan="2">42</td><td colspan="2">Zero Speed Range [ZV]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>50～500</td><td>min^{-1}</td><td>50</td></tr>
</table>
</td><td>Set value for detecting zero-speed status (motor stop).
When the motor speed becomes lower than this value, zero-speed status is detected.</td></tr>
<tr><td rowspan="2">43</td><td colspan="2">Low Speed Setting [LOWV]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>0～65535</td><td>min^{-1}</td><td>50</td></tr>
</table>
</td><td>Parameter for setting low-speed output range.
When the speed is lower than this value, low-speed range is output.</td></tr>
<tr><td rowspan="2">44</td><td colspan="2">Speed Matching Range [VCMP]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>0～65535</td><td>min^{-1}</td><td>50</td></tr>
</table>
</td><td>Parameter for setting the range of velocity matching output. Velocity matching is output when the speed deviation (difference between speed command and actual speed) is within the setting range.</td></tr>
<tr><td rowspan="2">45</td><td colspan="2">Attain Velocity Setting (High Speed Setting) [VA]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>0～65535</td><td>min^{-1}</td><td>1000</td></tr>
</table>
</td><td>Parameter for setting the value for speed attainment output. When the speed exceeds this set value, velocity attainment is output.
If the motor speed exceeds the selected value during torque control operations, and when the control switching function is enabled, the torque command is always set to 0. Fixed speed cannot be controlled. Avoid continuous usage in this manner.</td></tr>
</table>

5. Parameter [Parameter Specifications【Group9】]

■ General parameter Group 9［Settings for enabling functions］
Input signals and conditions to enable the functions of each page are set.

Selection contents to be set are on the next page.

Page	Contents
00	Positive Over-Travel Function [F-OT] Setting range: 00～27 / Standard setting value: 00:_Always_ Disable
01	Negative Over-Travel Function [R-OT] Setting range: 00～27 / Standard setting value: 00:_Always_ Disable
02	Alarm Reset Function [AL-RST] Setting range: 00～27 / Standard setting value: 08:_CONT4_ON
03	Absolute Encoder Clear Function [ECLR] (For models corresponding the incremental encoder, the Tachogenerator) Setting range: 00～27 / Standard setting value: 00:_Always_ Disable （For models corresponding to the absolute encoder） Setting range: 00～27 / Standard setting value: O4:_CONT2_ON
04	Deviation Clear Function [CLR] Setting range: 00～27 / Standard setting value: O2:_CONT1_ON
05	SERVO-ON Function [S-ON] Setting range: 00～27 / Standard setting value: O6:_CONT3_ON
10	Control Mode Switching Function [MS] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
11	Position Command Pulse Inhibit Function and Velocity Zero Clamp Function [INH/Z-STP] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
12	Electric Gear Switching Function [GERS] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
13	Gain Switching Condition 1 [GC1] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
14	Gain Switching Condition 2 [GC2] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
15	Vibration Suppressor Frequency, Select Input 1 [SUPFSEL1] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
16	Vibration Suppressor Frequency, Select Input 2 [SUPFSEL2] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
17	Position Loop Proportional Control, Switching Function [PLPCON] Setting range: 00～27 / Standard setting value: 01:_Always_Enable
18	RSW Gain Switching Function [RSWGC] Setting range: 00～27 / Standard setting value: 01:_Always_Enable

Page	Contents
20	Internal Velocity Setting Select Input 1 [SP1] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
21	Internal Velocity Setting Select Input 2 [SP2] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
22	Internal Velocity Driving Direction Select Input [DIR] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
23	Internal Velocity Driving Start Signal Input [RUN] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
24	Internal Velocity Positive Rotation (Positive Direction) Start Signal Input [RUN-F] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
25	Internal Velocity Negative Rotation (Negative Direction) Start Signal Input [RUN-R] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
26	Velocity Loop Proportional Control, Switching Function [VLPCON] （For models corresponding the incremental encoder, the Tachogenerator） Setting range: 00～27 / Standard setting value: O4:_CONT2_ON （For models corresponding to the absolute encoder） Setting range: 00～27 / Standard setting value: 00:_Always_ Disable
27	Velocity Compensation Function [VCOMPS] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
30	Torque Compensation Function 1 [TCOMPS1] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
31	Torque Compensation Function 2 [TCOMPS2] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
32	Torque Limit Function [TL] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
33	Disturbance Observer [OBS] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
40	External Trip Input Function [EXT-E] Setting range: 00～27 / Standard setting value: 00:_Always_Disable
42	Emergency Stop Function [EMR] Setting range: 00～27 / Standard setting value: 00:_Always_Disable

5. Parameter [Parameter Specifications【Group9】]

● General parameter Group 9 List of selection contents

When functions are to be always enabled or disabled.

Selection value	Contents
00:_Always_ Disable	Always disable the function.
01:_Always_ Enable	Always enable the function.

When functions are to be used with the generic input signals.

Selection value	Contents
02:_CONT1_ON	Enable the function when general purpose input CONT1 is ON.
03:_CONT1_OFF	Enable the function when general purpose input CONT1 is OFF.
04:_CONT2_ON	Enable the function when general purpose input CONT2 is ON.
05:_CONT2_OFF	Enable the function when general purpose input CONT2 is OFF.
06:_CONT3_ON	Enable the function when general purpose input CONT3 is ON.
07:_CONT3_OFF	Enable the function when general purpose input CONT3 is OFF.
08:_CONT4_ON	Enable the function when general purpose input CONT4 is ON.
09:_CONT4_OFF	Enable the function when general purpose input CONT4 is OFF.

When functions are to be set with the conditions of servo motor rotation speed.

Selection value	Contents
12:_LOWV_IN	Enable the function during low speed status (speed is less than LOWV).
13:_LOWV_OUT	Enable the function while low speed status is not kept (speed is less than LOWV).
14:_VA_IN	Enable the function during attain velocity status (speed is more than VA).
15:_VA_OUT	Enable the function while attain velocity status is not kept (speed is more than VA).
16:_VCMP_IN	Enable the function during speed matching status (velocity deviation < VCMP).
17:_VCMP_OUT	Enable the function while speed matching status is not kept (velocity deviation < VCMP).
18:_ZV_IN	Enable the function during zero speed status (speed is less than ZV).
19:_ZV_OUT	Enable the function while zero speed status is not kept (speed is less than ZV).

When functions are to be set with the conditions of positioning signals.

Selection value	Contents
20:_NEAR_IN	Enable the function during NEAR status (position deviation < NEAR).
21:_NEAR_OUT	Enable the function while NEAR status is not kept.
1A:_INP_IN	Enable the function during In-Position status (position deviation < INP).
1B:_INP_OUT	Enable the function while In-Position status is not kept.
26:_INPZ_IN	Enable the function during PCMD=0 and In-position Status.
27:_INPZ_OUT	Enable the function during PCMD=0 or In-position Status is not kept

When functions are to be set with the conditions of torque / speed limit

Selection value	Contents
1C:_TLC_IN	Enable the function during torque limiting operation status.
1D:_TLC_OUT	Enable the function while torque limiting operation status is not performed.
1E:_VLC_IN	Enable the function during velocity limiting operation status.
1F:_VLC_OUT	Enable the function while velocity limiting operation status is not performed.

When functions are to be set with the servo motor rotation direction and stop status.

Selection value	Contents
22:_VMON_>_+LV	Enable the function when Rotation Direction is Positive (VMON > LOWV).
23:_VMON_<=_+LV	Enable the function when Rotation Direction is not Positive (VMON <= LOWV).
24:_VMON_<_-LV	Enable the function when Rotation Direction is Negative (VMON < LOWV).
25:_VMON_>=_-LV	Enable the function when Rotation Direction is not Negative (VMON >= LOWV).

5. Parameter [Parameter Specifications【GroupA】]

■ General parameter Group A [Settings for generic output terminal outputting condition, monitor output selection, and setup software]

<table>
<tr><th>Page</th><th colspan="2">Name and Contents</th></tr>
<tr><td>00</td><td>General Purpose Output 1 [OUT1]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>02:_S-RDY_ON</td></tr></table></td><td rowspan="5">Output signals for Generic output OUT1～Generic output OUT5 are selected.
✍ Selection values to be set are on the next page.</td></tr>
<tr><td>01</td><td>General Purpose Output 2 [OUT2]
（For the positional control type）<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>18:_INP_ON</td></tr></table>（For the velocity control type and the torque control type）<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>10:_LOWV_ON</td></tr></table></td></tr>
<tr><td>02</td><td>General Purpose Output 3 [OUT3]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>36:_ALM4[ALMB7]_ON</td></tr></table></td></tr>
<tr><td>03</td><td>General Purpose Output 4 [OUT4]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>34:_ALM2[ALMB6]_ON</td></tr></table></td></tr>
<tr><td>04</td><td>General Purpose Output 5 [OUT5]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～5B</td><td>32:_ALM1[ALMB5]_ON</td></tr></table></td></tr>
<tr><td>11</td><td>Analog Monitor Output 1 Selection [MON1]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～12</td><td>04:_VMON_1mV/min^{-1}</td></tr></table></td><td rowspan="2">Output signals for analog monitor output 1, 2 are selected from the followings.</td></tr>
<tr><td>12</td><td>Analog Monitor Output 2 Selection [MON2]
<table><tr><th>Setting range</th><th>Standard setting value</th></tr><tr><td>00～12</td><td>02:_TCMON_1V/TR</td></tr></table></td></tr>
<tr><td></td><td colspan="2"><table>
<tr><td>00</td><td>Reserved</td></tr>
<tr><td>01:_TMON_1V/TR</td><td>Torque (thrust) monitor 1V/ rated torque (thrust)</td></tr>
<tr><td>02:_TCMON_1V/TR</td><td>Torque (thrust) command monitor 1V/ rated torque (thrust)</td></tr>
<tr><td>03:_VMON_0.2mV/ min^{-1}</td><td>Velocity monitor 0.2mV/ min^{-1}</td></tr>
<tr><td>04:_VMON_1mV/ min^{-1}</td><td>Velocity monitor 1mV/ min^{-1}</td></tr>
<tr><td>05:_VMON_2mV/ min^{-1}</td><td>Velocity monitor 2mV/ min^{-1}</td></tr>
<tr><td>06:_VMON_3mV/ min^{-1}</td><td>Velocity monitor 3mV/ min^{-1}</td></tr>
<tr><td>07:_VCMON_0.2mV/ min^{-1}</td><td>Velocity command monitor 0.2mV/ min^{-1}</td></tr>
<tr><td>08:_VCMON_1mV/ min^{-1}</td><td>Velocity command monitor 1mV/ min^{-1}</td></tr>
<tr><td>09:_VCMON_2mV/ min^{-1}</td><td>Velocity command monitor 2mV/ min^{-1}</td></tr>
<tr><td>0A:_VCMON_3mV/ min^{-1}</td><td>Velocity command monitor 3mV/ min^{-1}</td></tr>
<tr><td>0B:_PMON_0.1mV/P</td><td>Position deviation counter monitor 0.1mV/ Pulse</td></tr>
<tr><td>0C:_PMON_1mV/P</td><td>Position deviation counter monitor 1mV/ Pulse</td></tr>
<tr><td>0D:_PMON_10mV/P</td><td>Position deviation counter monitor 10mV/ Pulse</td></tr>
<tr><td>0E:_PMON_20mV/P</td><td>Position deviation counter monitor 20mV/ Pulse</td></tr>
<tr><td>0F:_PMON_50mV/P</td><td>Position deviation counter monitor 50mV/Pulse</td></tr>
<tr><td>10:_FMON_2mV/kP/s</td><td>Position command pulse monitor
(position command pulse input frequency)2mV/kPulse/s</td></tr>
<tr><td>11:_FMON_10mV/kP/s</td><td>Position command pulse monitor
(position command pulse input frequency)10mV/kPulse/s</td></tr>
<tr><td>12:_TLMON_EST_1V/TR</td><td>Load torque (thrust) monitor (estimated value) 1V/ rated torque (thrust)</td></tr>
</table></td></tr>
</table>

● List of setting selection contents for general purpose output OUT1 to general purpose output OUT5

When functions are to be always enabled or disabled.

Selection value	Contents
00:_Always_OFF	The output is always OFF.
01:_Always_ON	The output is always ON.

When Generic input signal status is to be output.

Selection value	Contents
3A:_CONT1_ON	The output is ON while general purpose input CONT 1 is ON.
3B:_CONT1_OFF	The output is OFF while general purpose input CONT 1 is ON.
3C:_CONT2_ON	The output is ON while general purpose input CONT 2 is ON.
3D:_CONT2_OFF	The output is OFF while general purpose input CONT 2 is ON.
3E:_CONT3_ON	The output is ON while general purpose input CONT 3 is ON.
3F:_CONT3_OFF	The output is OFF while general purpose input CONT 3 is ON.
40:_CONT4_ON	The output is ON while general purpose input CONT 4 is ON.
41:_CONT4_OFF	The output is OFF while general purpose input CONT 4 is ON.

When servo amplifier internal status is to be output.

Selection value	Contents
02:_S-RDY_ON	The output is ON when Driving Ready complete.
03:_S-RDY_OFF	The output is OFF when Driving Ready complete.
58:_S-RDY2_ON	The output is ON when Driving Ready complete.
59:_S-RDY2_OFF	The output is OFF when Driving Ready complete.
04:_P-ON_ON	The output is ON during power ON.
05:_P-ON_OFF	The output is OFF during power ON.
06:_A-RDY_ON	The output is ON during power ON permission.
07:_A-RDY_OFF	The output is OFF during power ON permission.
08:_S-ON_ON	The output is ON during motor excitation.
09:_S-ON_OFF	The output is OFF during motor excitation.
0A:_MBR-ON_ON	The output is ON while retention brake excitation signal outputs.
0B:_MBR-ON_OFF	The output is OFF while retention brake excitation signal outputs.
0C:_TLC_ON	The output is ON during torque limiting operation.
0D:_TLC_OFF	The output is OFF during torque limiting operation.
0E:_VLC_ON	The output is ON during velocity limiting operation.
0F:_VLC_OFF	The output is OFF during velocity limiting operation.
10:_LOWV_ON	The output is ON during low speed status.
11:_LOWV_OFF	The output is OFF during low speed status.
12:_VA_ON	The output is ON during high speed status.
13:_VA_OFF	The output is OFF during high speed status.
14:_VCMP_ON	The output is ON during speed matching status.
15:_VCMP_OFF	The output is OFF during speed matching status.

Selection value	Contents
16:_ZV_ON	The output is ON during zero speed status.
17:_ZV_OFF	The output is OFF during zero speed status.
1C:_CMD-ACK_ON	The output is ON while command can be accepted status.
1D:_CMD-ACK_OFF	The output is OFF while command can be accepted status.
1E:_GC-ACK_ON	The output is ON during gain switching status.
1F:_GC-ACK_OFF	The output is OFF during gain switching status.
20:_PCON-ACK_ON	The output is ON during velocity loop proportional control switching status.
21:_PCON-ACK_OFF	The output is OFF during velocity loop proportional control switching status.
22:_GERS-ACK_ON	The output is ON during electric gear switching status.
23:_GERS-ACK_OFF	The output is OFF during electric gear switching status.
24:_MS-ACK_ON	The output is ON during control mode switching status.
25:_MS-ACK_OFF	The output is OFF during control mode switching status.
26:_F-OT_ON	The output is ON during positive over-travel status.
27:_F-OT_OFF	The output is OFF during positive over-travel status.
28:_R-OT_ON	The output is ON during negative over-travel status.
29:_R-OT_OFF	The output is OFF during negative over-travel status.

When positioning signal is to be output.

Selection value	Contents
18:_INP_ON	The output is ON during In-Position complete status.
19:_INP_OFF	The output is OFF during In-Position complete status.
1A:_NEAR_ON	The output is ON during near range status.
1B:_NEAR_OFF	The output is OFF during near range status.
5A:_INPZ_ON	The output is ON during PCMD=0 and In-position complete status.
5B:_INPZ_OFF	The output is OFF during PCMD=0 and In-position complete status.

When warning signal is to be output.

Selection value	Contents
2A:_WNG-OFW_ON	The output is ON during excessive deviation warning status.
2B:_WNG-OFW_OFF	The output is OFF during excessive deviation warning status.
2C:_WNG-OLW_ON	The output is ON during over-load warning status.
2D:_WNG-OLW_OFF	The output is OFF during over-load warning status.
30:_WNG-BAT_ON	The output is ON during battery warning status.
31:_WNG-BAT_OFF	The output is OFF during battery warning status.

When alarm signals are to be output.

Selection value	Contents
32:_ALM1[ALMB5]_ON	Output alarm code 1 (Positive logic).
33:_ALM1[ALMB5]_OFF	Output alarm code 1 (Negative logic).
34:_ALM2[ALMB6]_ON	Output alarm code 2 (Positive logic).
35:_ALM2[ALMB6]_OFF	Output alarm code 2 (Negative logic).
36:_ALM4[ALMB7]_ON	Output alarm code 4 (Positive logic).
37:_ALM4[ALMB7]_OFF	Output alarm code 4 (Negative logic).
38:_ALM_ON	The output is ON during alarm status.
39:_ALM_OFF	The output is OFF during alarm status.

When alarm signals are to be made compatible with DA.

Selection value	Contents
50:_DAALM1_ON	Output DA compatible alarm code 1. (Positive logic).
51:_DAALM1_OFF	Output DA compatible alarm code 1. (Negative logic).
52:_DAALM2_ON	Output DA compatible alarm code 2. (Positive logic).
53:_DAALM2_OFF	Output DA compatible alarm code 1. (Negative logic).
54:_DAALM4_ON	Output DA compatible alarm code 4. (Positive logic).
55:_DAALM4_OFF	Output DA compatible alarm code 4. (Negative logic).

*Compatibility with DA series amplifier please set follows.

54:_DAALM4_ON : General Purpose Output 3 [OUT3]
52:_DAALM2_ON : General Purpose Output 4 [OUT4]
50:_DAALM1_ON : General Purpose Output 5 [OUT5]

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Analog monitor output polarity [MONPOL]

Setting range	Standard setting value
00～08	00:_MON1+_MON2+

The output polarity of analog monitor output MON1 and MON2 is selected from the contents below.

Selection value	Contents
00:_MON1+_MON2+	MON1 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage.
01:_MON1-_MON2+	MON1 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage.
02:_MON1+_MON2-	MON1 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage.
03:_MON1-_MON2-	MON1 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage.
04:_MON1ABS_MON2+	MON1 : Output the positive voltage at both forward rotation (positive direction) and reverse rotation (reverse direction). MON2 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage.
05:_MON1ABS_MON2-	MON1 : Output the positive voltage at both forward rotation (positive direction) and reverse rotation (reverse direction). MON2 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage.
06:_MON1+_MON2ABS	MON1 : Output the positive voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the positive voltage at both forward rotation (positive direction) and reverse rotation (reverse direction).
07:_MON1-_MON2ABS	MON1 : Output the negative voltage at forward rotation (positive direction). Output the positive/negative voltage. MON2 : Output the positive voltage at both forward rotation (positive direction) and reverser rotation (reverse direction).
08:_MON1ABS_MON2ABS	MON1 : Output the positive voltage at both forward rotation (positive direction) and reverse rotation (reverse direction). MON2 : Output the positive voltage at both forward rotation (positive direction) and reverse rotation(reverse direction).

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Setup Software, Communication Axis Number [COMAXIS]

Setting range	Standard setting value
01～0F	01:_#1

The axis number for communication with PC is selected from the contents below.

✍ The selected value is enabled after turning ON the control power again.

Selection value	Selection value
01:_#1	09:_#9
02:_#2	0A:_#A
03:_#3	0B:_#B
04:_#4	0C:_#C
05:_#5	0D:_#D
06:_#6	0E:_#E
07:_#7	0F:_#F
08:_#8	

■ General parameter Group B [Settings related to sequence and alarm]

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td>00</td><td>JOG Velocity Command [JOGVC]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>0～32767</td><td>min^{-1}</td><td>50</td></tr>
</table>
Velocity command value for test run and adjustment JOG operation is set.</td></tr>
<tr><td>10</td><td>Brake Operation [DBOPE]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～05</td><td>-</td><td>00:_Free</td></tr>
</table>
Brake operation when shifted from servo ON → servo OFF, and during servo OFF is selected from the contents below.
✍ When the main circuit power is shut OFF, an emergency stop operates irrespective of this setting.
<table>
<tr><th colspan="2">Selection</th></tr>
<tr><td>00:_Free</td><td>When Servo-OFF, Free-Run is operated（After motor stop, Motor-Free is operated）</td></tr>
<tr><td>04:_SERVO-BRAKE</td><td>When Servo-OFF, Free-Run is operated（After motor stop, Motor-Free is operated）</td></tr>
</table></td></tr>
<tr><td>11</td><td>Over-Travel Operation Selection [ACTOT]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>00～06</td><td>-</td><td>00:_CMDINH_SB_SON</td></tr>
</table>
Operations at over travel are selected from the contents below.
<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>00:_CMDINH_SB_SON</td><td>The command input becomes invalid when OT is generated, and the motor is stopped by the servo brake operation. After it stops Serbo ON is operated.
(Command generated on the OT side is invalid = velocity limitation command =0.)</td></tr>
<tr><td>02:_CMDINH_Free_SON</td><td>The command input becomes invalid when OT is generated, and a free run is operated. After it stops Serbo ON is operated.
(Command generated on the OT side is invalid = velocity limitation command =0.)</td></tr>
<tr><td>03:_CMDINH_SB_SOFF</td><td>The command input becomes invalid when OT is generated, and the motor is stopped by the servo brake operation. After it stops Serbo OFF is operated.</td></tr>
<tr><td>05:_CMDINH_Free_SOFF</td><td>The command input becomes invalid when OT is generated, and a free run is operated. After it stops Serbo OFF is operated.</td></tr>
<tr><td>06:_CMDACK_VCLM=0</td><td>The velocity limitation command input from the OT side becomes zero when an OT is generated.</td></tr>
</table></td></tr>
<tr><td>12</td><td>Emergency Stop Operation [ACTEMR]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>01:_Free</td></tr>
</table>
Emergency stop (EMR) with Main power off operation can be selected from the values shown as below. However when installation is on vertical axis, to select standard setting (00_SERVO-BRAKE) is recommended
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_SERVO-BRAKE</td><td>When EMR is input, motor is stopped by servo brake operations.</td></tr>
<tr><td>01:_Free</td><td>When EMR is input, Free-Run is operated.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">13</td><td colspan="2">Delay Time of Engaging Retention Brake Operation (Retention brake retention delay time) [BONDLY]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>0～1000</td><td>ms</td><td>300</td></tr></table></td><td>Retention brake operation delay time when shifted from servo ON to servo OFF is set.
When shifted from servo ON to servo OFF, motor excitation is kept during this time.</td></tr>
<tr><td rowspan="2">14</td><td colspan="2">Delay Time of Releasing Holding Brake (holding brake release delay time) [BOFFDLY]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>0～1000</td><td>ms</td><td>300</td></tr></table></td><td>Holding brake operation release delay time when shifted from servo OFF to servo ON is set.
When shifted from servo OFF to servo ON, motor is excited during this time.</td></tr>
<tr><td rowspan="2">15</td><td colspan="2">Brake Operation Start Time [BONBGN]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>0～65535</td><td>ms</td><td>0</td></tr></table></td><td>Parameter for setting motor free operation time and servo brake operation time.
When shifted from servo ON to Servo OFF, the retention brake starts to operate after this set time.
When motor does not stop even after servo OFF at gravity axis or else, the motor is stopped by the retention brake.
In the system where motor speed becomes lower than Speed Zero Range (ZV) within the set time, this setting does not function.
If set to 0msec, brake operation start time is disabled (＝infinite).</td></tr>
<tr><td rowspan="2">16</td><td colspan="2">Power Failure Detection Delay Time [PFDDLY]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>20～1000</td><td>ms</td><td>32</td></tr></table></td><td>The delay time from control power OFF to control power error detection is set. The larger value makes the detection of instantaneous stop slower.
(Larger set value will only result in slower detection of error. In case of power failure of internal logic circuit, operation is the same as when control power is turned ON again. In case of energy shortage of main circuit power, other errors, such as main circuit power loss, may be detected.)
In this setting, actual detection delay time varies by 12ms and +6ms.
✍ The selected value is enabled after control power is turned ON again.</td></tr>
<tr><td rowspan="2">20</td><td colspan="2">Excessive Deviation Warning Level [OFWLV]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>1～65535</td><td>×1024 Pulse</td><td>65535</td></tr></table></td><td>Parameter to output warning before excessive position deviation alarm (following error) is output.</td></tr>
<tr><td rowspan="2">21</td><td colspan="2">Deviation Counter Overflow [OFLV]</td></tr>
<tr><td><table><tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr><tr><td>1～65535</td><td>×1024 Pulse</td><td>32</td></tr></table></td><td>Parameter for setting the value to output position excessive deviation alarm (following error). Encoder pulse is the standard irrespective of electronic gear and command multiplication function.</td></tr>
</table>

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">22</td><td colspan="2">Overload Warning Level [OLWLV]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>20～100</td><td>%</td><td>90</td></tr>
</table>
</td><td>Parameter for outputting warnings before overload alarm is output. The possible level to be set is ranged from 20%～99%, assuming that the overload alarm level is 100%.
When set to 100%, overload warning and overload alarm are output at one time.
Overload detection is assumed and set as 75% of a rated load when control power is turned ON (hot start).
Therefore, if this is set to below 75%, overload warning may be output when control power is turned ON.
✍ The set value is enabled after control power is turned ON again.</td></tr>
<tr><td rowspan="2">23</td><td colspan="2">Speed Feedback Error (ALM_C3) Detection [VFBALM]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>01:_Enabled</td></tr>
</table>
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Disabled</td><td>Disabled</td></tr>
<tr><td>01:_Enabled</td><td>Enabled</td></tr>
</table>
</td><td>Select either one from enabled or disabled of velocity feedback error alarm detection.</td></tr>
<tr><td rowspan="2">24</td><td colspan="2">Speed Control Error (ALM_C2) Detection [VCALM]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>00:_Disabled</td></tr>
</table>
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Disabled</td><td>Disabled</td></tr>
<tr><td>01:_Enabled</td><td>Enabled</td></tr>
</table>
</td><td>Select either one from enabled or disabled of velocity control error alarm detection.
In such an operation pattern as causing a motor overshoot to the command, velocity control error may be detected by mistake. For this, set this parameter to “disabled”.</td></tr>
</table>

5. Parameter [Parameter Specifications【GroupC】]

■ General parameter Group C [Settings related to encoder]

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td rowspan="3">00</td><td colspan="2">Position detection system selection [ABS/INCSYS]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>00:_Absolute</td></tr>
</table>
</td><td>Position detection system is selected from the contents below.</td></tr>
<tr><td>
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Absolute</td><td>Absolute System</td></tr>
<tr><td>01:_Incremental</td><td>Incremental System</td></tr>
</table>
</td><td>Selecting “incremental system” enables the use similar to incremental encoder without installing backup battery in absolute encoder.</td></tr>
<tr><td rowspan="3">01</td><td colspan="2">Motor Incremental Encoder, Digital Filter [ENFIL]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～07</td><td>-</td><td>01_220nsec</td></tr>
</table>
</td><td>Settings for motor incremental encoder digital filter are selected from the contents below.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_110nsec</td><td>Minimum Pulse Width = 110nsec
(Minimum Pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>01:_220nsec</td><td>Minimum Pulse Width = 220nsec</td></tr>
<tr><td>02:_440nsec</td><td>Minimum Pulse Width = 440nsec</td></tr>
<tr><td>03:_880nsec</td><td>Minimum Pulse Width = 880nsec</td></tr>
<tr><td>04:_75nsec</td><td>Minimum Pulse Width = 75nsec
(Minimum Pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>05:_150nsec</td><td>Minimum Pulse Width = 150nsec</td></tr>
<tr><td>06:_300nsec</td><td>Minimum Pulse Width = 300nsec</td></tr>
<tr><td>07:_600nsec</td><td>Minimum Pulse Width = 600nsec</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">05</td><td colspan="2">Encoder Pulse Divide Output, Divide Ratio [ENRAT]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>1/1～1/64
2/3～2/64
1/8192～8191/8192</td><td>-</td><td>1/1</td></tr>
</table>
</td><td>Parameter for setting division ratio of encoder pulse dividing output. Division ratio is set.
(Signal polarity can be set at amplifier function selection.)</td></tr>
<tr><td rowspan="3">06</td><td colspan="2">Encoder Pulse Divided Output, Polarity [PULOUTPOL]</td></tr>
<tr><td>
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～03</td><td>-</td><td>00:_Type1</td></tr>
</table>
</td><td>Encoder pulse dividing output polarity is selected from the followings.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Type1</td><td>A-Phase Signal / Not Reversed : Z-Phase Signal Logic / High Active</td></tr>
<tr><td>01:_Type2</td><td>A-Phase Signal / Reversed : Z-Phase Signal Logic / High Active</td></tr>
<tr><td>02:_Type3</td><td>A-Phase Signal / Not Reversed : Z-Phase Signal Logic / Low Active</td></tr>
<tr><td>03:_Type4</td><td>A-Phase Signal / Reversed : Z-Phase Signal Logic / Low Active</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Page</th><th>Contents</th></tr>
<tr><td>07</td><td>
Encoder Signal Output (PS), Format [PSOFORM]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～02</td><td>-</td><td>00:_Binary</td></tr>
</table>
Signal format of encoder signal output(P S) is selected from the followings.
✍ The set value is enabled after control power is turned ON again.
<table>
<tr><th>Selection value</th><th>Contents</th></tr>
<tr><td>00:_Binary</td><td>Binary Code Output</td></tr>
<tr><td>01:_Decimal</td><td>Decimal ASCII Code Output</td></tr>
<tr><td>02:_Encoder_Signal</td><td>Encoder signals, Direct Output</td></tr>
</table>
</td></tr>
<tr><td>08</td><td>
Absolute Encoder Clear Function Selection [ECLRFUNC]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>00～01</td><td>-</td><td>00:_Status_MultiTurn</td></tr>
</table>
Used for clearing some absolute encoder warnings that are not automatically restored.
✍ Valid when the absolute encoder with backup battery system is used.
<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>00:_Status_MultiTurn</td><td>Clear Encoder Status (Alarm and Warning) and Multi Turn Data</td></tr>
<tr><td>01:_Status</td><td>Clear Only Encoder Status</td></tr>
</table>
</td></tr>
<tr><td>10</td><td>
Tachogenerator Velocity Scale Range Setting [TG_SCALING]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>-13107～13107</td><td>—</td><td>0</td></tr>
</table>
Sets the scale range of velocity of the tachogenerator when velocity is detected.

Scale = (User-settable value/ 65535) + 1
<Calculation example>
At 13107,
(13107 / 65535) + 1 ≒ 1.2
At Zero,
(0 / 65535) +1 ≒ 1
At –13107,
(-13107 / 65535) +1 ≒ 0.8
are results.
✍ Valid when the tachogenerator is used.
</td></tr>
<tr><td>11</td><td>
Tachogenerator velocity offset setting [TG_OFFSET]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard setting value</th></tr>
<tr><td>-182～182</td><td>—</td><td>0</td></tr>
</table>
Sets Velocity Offset value of the tachogenerator when velocity is detected.

<Calculation example>
① Specified 3V/1000min^{-1}
Offset value (min^{-1}) ≒ 0.141 × Set value

② Specified 7V/1000min^{-1}
Offset value (min^{-1}) ≒ 0.134 × Set value

✍ Valid when the tachogenerator is used.
</td></tr>
<tr><td>12</td><td>
Tachogenerator Output Voltage Polarity Setting [TG_POL]
<table>
<tr><th>Setting Range</th><th>Unit</th><th>Standard setting</th></tr>
<tr><td>00～01</td><td>—</td><td>00</td></tr>
</table>
Sets the Output voltage polarity of the tachogenerator
Set the polarity for counterclockwise operation.
✍ Valid when the tachogenerator is used.
<table>
<tr><th>Setting Range</th><th>Description</th></tr>
<tr><td>00h</td><td>Counterclockwise operation
+ Output</td></tr>
<tr><td>01h</td><td>Counterclockwise operation
- Output</td></tr>
</table>
</td></tr>
</table>

5. Parameter [Parameter Specifications【System Parameter】]

■ System parameter

<table>
<tr><th>Page</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="2">00</td><td>Main Circuit Power Supply Input Type</td><td>Selects the input type supplied to the main circuit power supply.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting value</th><th>Contents</th></tr>
<tr><td>01 : _DC_Input</td><td>DC power is supplied to the main circuit</td></tr>
</table>
Note) In the T-series, it becomes only DC power supply.
</td></tr>
<tr><td rowspan="2">01</td><td>Motor Encoder Type</td><td>Motor encoder type in use is selected.
Setting range varies depending on the hardware type.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting value</th><th>Contents</th></tr>
<tr><td>00 : _Inclemental_ENC</td><td>Incremental Encoder</td></tr>
<tr><td>01 : _Absolute_ENC</td><td>Absolute Encoder</td></tr>
</table>
Note) In the T-series, it becomes either depending on the type of hardware.
</td></tr>
<tr><td rowspan="2">02</td><td>Incremental Encoder Function Selection</td><td>Incremental encoder type is selected when an incremental encoder is used for the motor encoder.
Setting range varies depending on the hardware type.
✍ It can only be set when the motor encoder type is an incremental encoder.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting value</th><th>Contents</th></tr>
<tr><td>00 : _Standard</td><td>Incremental Encoder Encremental Encoder (standard (4 pairs))</td></tr>
</table>
Note) In the T-series, only an incremental encoder can be used.
</td></tr>
<tr><td rowspan="2">03</td><td>Incremental Encoder Resolution</td><td>Pulse number per motor shaft rotation is set when an incremental encoder is used for the motor encoder.
✍ It can only be set when the motor encoder type is an incremental encoder.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>500～65535</td><td>P/R</td><td>-</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">04</td><td>Absolute Encoder Function Selection</td><td>Absolute encoder type is selected when an absolute encoder is used for the motor encoder.
✍ It can only be set when the motor encoder type is an absolute encoder.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>04 : _PA035C-2.5MH_Manu</td><td>PA035, Asynchronous, 2.5Mbps, Half Duplex (Manual Setting)</td></tr>
<tr><td>05 : _PA035C-4MH_Manu</td><td>PA035, Asynchronous, 4Mbps, Half Duplex (Manual Setting)</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">05</td><td>Absolute Encoder Resolution</td><td>Divisions per motor shaft rotation are set when absolute encoder is used for the motor encoder.
✍ It can only be set when the motor encoder type is an absolute encoder.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>00 : _2048_FMT</td><td>2048 divisions</td></tr>
<tr><td>01 : _4096_FMT</td><td>4096 divisions</td></tr>
<tr><td>02 : _8192_FMT</td><td>8192 divisions</td></tr>
<tr><td>03 : _16384_FMT</td><td>16384 divisions</td></tr>
<tr><td>04 : _32768_FMT</td><td>32768 divisions</td></tr>
<tr><td>05 : _65536_FMT</td><td>65536 divisions</td></tr>
<tr><td>06 : _131072_FMT</td><td>131072 divisions</td></tr>
<tr><td>07 : _262144_FMT</td><td>262144 divisions</td></tr>
<tr><td>08 : _524288_FMT</td><td>524288 divisions</td></tr>
<tr><td>09 : _1048576_FMT</td><td>1048576 divisions</td></tr>
<tr><td>0A : _2097152_FMT</td><td>2097152 divisions</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Page</td><td colspan="2">Contents</td></tr>
<tr><td>06</td><td>Combined motor model number</td><td>In “The set up software”, model numbers of combined motor and their codes are shown.
When combined motor is to be changed, change the motor parameter setting of “The set up software”.
✍ The motor combination cannot be changed from the system parameter setting screen.</td></tr>
<tr><td rowspan="2">08</td><td>Control Mode</td><td>Selects control mode.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>00 : _Torque</td><td>Torque Control Mode</td></tr>
<tr><td>01 : _Velocity</td><td>Velocity Control Mode</td></tr>
<tr><td>02 : _Position</td><td>Position Control Mode</td></tr>
</table>
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>03 : _Velo－Torq</td><td>Velocity Control - Torque (Thrust) Control Switch Mode</td></tr>
<tr><td>04 : _Posi－Torq</td><td>Positioning Control - Torque (Thrust) Control Switch Mode</td></tr>
<tr><td>05 : _Posi－Velo</td><td>Positioning Control - Velocity Control Switch Mode</td></tr>
</table>
✍ When the switching type between [03 : _Velo－Torq], [04 : _Posi－Torq] and [05 : _Posi－Velo] is used, there is a possibility that “auto-notch frequency tuning”, “auto-vibration suppressing frequency tuning” and “JOG operation” cannot be used.
To use these, switch the control mode to the base side (Velo(velocity control) in case of [03 : _Velo－Torq]).
</td></tr>
<tr><td rowspan="2">09</td><td>Position Loop Controller and Encoder Selection</td><td>Position loop encoder is selected used for position loop control method and position loop control.
Setting range varies depending on the hardware type.</td></tr>
<tr><td colspan="2">
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>00 : _Motor_encoder</td><td>Semi-Closed Controller/Motor Encoder</td></tr>
</table>
Note) In the T-series, it becomes a Semi-Closed controller only.
</td></tr>
<tr><td rowspan="2">0A</td><td>External Encoder Resolution</td><td>Sets the resolution of the external encoder under full closed control.
Sets the number of converted pulses for each rotation of the motor shaft.</td></tr>
<tr><td colspan="2">Note) In the T-series, an external encoder cannot be connected.</td></tr>
<tr><td rowspan="2">0B</td><td>Regenerative Resistor Selection</td><td>Selects the type of regenerative resistance to be connected.</td></tr>
<tr><td colspan="2">Note) In the T-series, a regenerative resistor cannot be connected.</td></tr>
</table>

✍ When setting values of parameters were done, restore the power supply of control system again to be valid

5. Parameter [DA Series Parameter Compatibility]

■ Compatible Parameter Table for the DA-series and TS1-series

DA Series Parameter		TS1 Series Parameter		
Abbreviation	Name	Name	Group	Page
Kp	Position Loop Gain	Position Loop Proportional Gain 1	Group 1	02
Kff	Feed Forward Gain	Feed Forward Gain	Group 1	05
Kvp	Velocity Loop Proportional Gain	Velocity Loop Proportional Gain 1	Group 1	13
Tvi	Velocity Loop Integral Time Constant	Velocity Loop Integral Time Constant 1	Group 1	14
INP	In-Position Complete Signal Width	In-Position Complete Range	Group 8	41
OVF	Excessive Deviation Error	Deviation Counter Overflow Value	Group B	21
EGER	Electric Gear Ratio	Electric Gear 1	Group 8	15
ENCR	Output Pulse Division Ratio	Encoder Pulse Division Output, Divide Ratio	Group C	05
LTG	Low Speed	Low Speed Setting	Group 8	43
PMOD:	(Position Command Pulse Form) Digital Filter Edge Specification Rotation Direction Specification Command Pulse Form	Position Command Pulse, Digital Filter Position Command Pulse, Count Polarity Position, Velocity, and Torque Command Input Polarity Position Command Pulse Selection	Group 8	13 12 00 11
SSW1:0	Internal Forced SON/External SON Signal Switching	Servo-ON Function	Group 9	05
SSW1:1	P Control Valid/Invalid Switching	Velocity Loop Proportional Control, Switching Function	Group 9	26
SSW1:1	ZCMD Valid/Invalid Switching	Position Command Pulse Inhibit Function and Velocity Command Zero Clamp Function	Group 9	11
SSW1:1	INH Valid/Invalid Switching	Position Command Pulse Inhibit Function and Zero Velocity Command Clamp Function	Group 9	11
SSW1:7	RSW Valid/Invalid Switching	RSW Gain Switching Function	Group 9	18
SSW2:0	Velocity Command Polarity	Position, Velocity, and Torque Command Input Polarity	Group 8	00
SSW2:1	Alarm Code Output Form	General Purpose Output 3 to 5	Group A	02～04
SSW2:2	Alarm Output Logic			
SSW2:3	Deviation Clear Method when Motor Excitation OFF	Deviation Clear Selection	Group 8	19
SSW2:4	CN1-3 Pin Function Selection (PCON/INH/ZCMD)	(Group 9 Corresponding Function Terminal Settings)	Group 9	00～42
SSW2:6	Test Mode Execution	-	-	-
SSW2:7	Rewriting System Parameters	-	-	-
VLPF	Velocity Command LPF	Velocity Command Filter	Group 1	10
ILPF	Current Command LPFF	Torque Command Filter 1 Torque Command Filter Order	Group 1	20 21
Tacc	Velocity Command Acceleration and Deceleration Time	Velocity Command, Acceleration Time Constant Velocity Command, Deceleration Time Constant	Group 8	26 27
Tpcm	Position Command Acceleration and Deceleration Time Constant	Position Command Filter	Group 1	01
Tacc	Torque Command Acceleration and Deceleration Time	-	-	-
Scal	Velocity Scale	Analog Velocity (Compensation) Command Scaling	Group 8	25
Scal	Torque Scale	Analog Torque Command Scaling	Group 8	33
TYPE	Control Mode	Control Mode	System	08
ENKD	Encoder Type	Motor Encoder Type	System	01
ENPL	Encoder Pulse Number	Incremental Encoder Resolution	System	03
MOT.	Motor Type	Combination Motor Model Number	System	06
Vzero	Zero Velocity Adjustment	("Analog Velocity Command/Torque Command Auto Offset Adjustment" Function is used)	-	-
Vzero	Torque Zero Adjustment		-	-
-	Gain Parameter for RSW	Gain Parameter for RSW	Group 5	-

✍ All of the parameters shown above can be confirmed and operated when the display level of "R-SETUP" is set to "Basic Level". Also, the initial value when shipping is equal to the DA-series.

Chapters 6

[Driving]

6. Driving [Procedure Before Driving]

Procedure Before Driving

This shows the entire procedure before driving. For detailed procedures, refer to pages 6-2.

● Confirm installation and wiring of the servo amplifier and servo motor.

[Confirmation of installation and wiring]

Procedure	Item
1	Installation
2	Wiring and connection
3	Power supply turning on

● Confirmation of the servo amplifier, servo motor, and encoder combinations and specifications

[Confirmation and change of specifications]

Procedure	Item
4	Confirmation of servo amplifier specification
5	Confirmation of servo motor encoder specification
6	Confirmation of combined servo motor
7	Power supply re-turning on
8	Reconfirmation

● Confirming operation of the servo amplifier and servo motor by JOG driving. [JOG driving]

Procedure	Item
9	JOG driving

● Connecting the upper device with CN1, and set the parameter of the I/O signal.

[I/O signal confirmation]

Procedure	Item
10	Setting of general purpose I/O signal
11	Confirmation of input signal
12	The servo on signal is input.
13	Command input
14	Power supply is turned off

● Connecting the servo motor shaft with the machine and confirming the operation.

[Confirmation of machine's operation function]

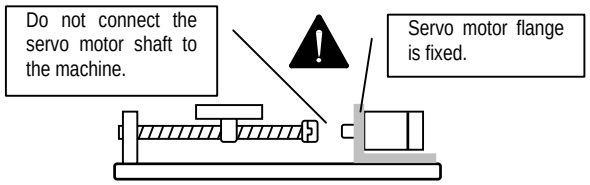
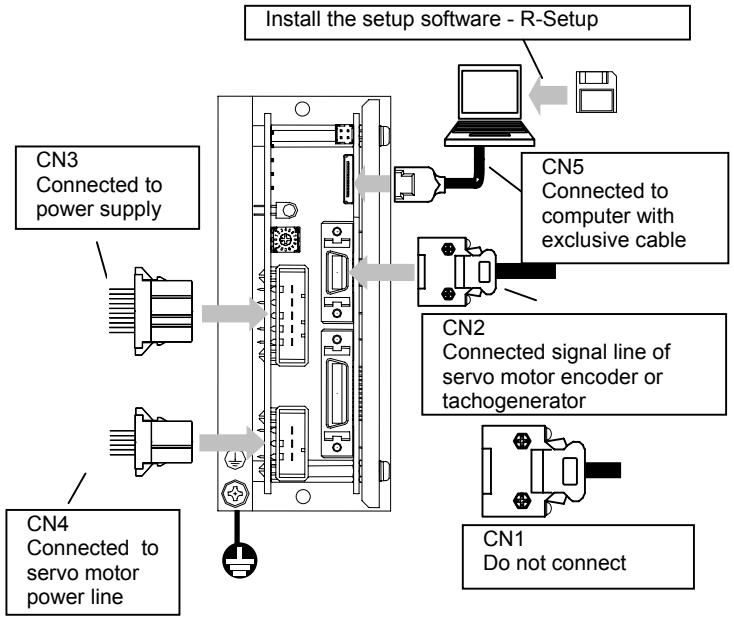
Procedure	Item
15	Command input（low-speed）

● Inputting the driving pattern command in use and starting machine driving. [Driving]

Procedure	Item
16	Operation

6. Driving [Confirmation and change of specifications]

■ [Procedure 1 - Procedure 3] Confirmation of installation and wiring

Procedure	Item	Contents
1	Installation Install the servo amplifier and servo motor referring to [Chapter 2, Installation]. Do not connect the servo motor to the machine to keep the no load status.	
2	Wiring / Connecting Wire the power supply, servo motor and upper device referring to [Chapter 3, Wiring]. Confirm the correct wiring. If the servo motor does not rotate or is in a state of runaway / overload in test run, faulty wiring may be the cause. Do not connect CN1 to servo amplifier after wiring.	
3	Turning on the power supply Turn on the power supply. Confirm that the warning display LED for the servo amplifier is off. If the warning LED is lit, follow the corrective procedures in [Chapter 8, Maintenance].	

6. Driving [Confirmation and change of specifications]

■ [Procedure 4 - Procedure 8] Confirmation and change of specifications

<table>
<tr><th>Procedure</th><th>Item and Contents</th></tr>
<tr><td>4</td><td>
<u>Confirming servo amplifier specifications</u> System parameter settings
Use the servo system supporting tool [Setup Software R-Setup] to confirm and set the specifications of the servo amplifier.
For how to use the [Setup Software R-Setup], refer to the [R-SETUP Instruction Manual].
<table>
<tr><th>Item</th><th></th></tr>
<tr><td>Amplifier Capacity
Displays the capacity of the servo amplifier.</td><td rowspan="6">Setting cannot be changed.

Confirm that the contents being displayed conform to the machine specifications.</td></tr>
<tr><td>Motor Structure
Displays the structure of the motor that can be combined.</td></tr>
<tr><td>Control Power Supply Input Voltage
Displays the power supply voltage to be supplied to the control power supply.</td></tr>
<tr><td>Control Power Supply Input Type
Displays the power supply input type supplied to the control power supply.</td></tr>
<tr><td>Main Circuit Power Supply Input Voltage
Displays the power supply voltage to be supplied to the main circuit power supply.</td></tr>
<tr><td>Main Circuit Power Supply Input Type
Displays the power supply input type supplied to the main circuit power supply.</td></tr>
<tr><td>Control Mode
Selects the control mode. Change the control mode suitable for upper device.</td><td>
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>00 : _Torque</td><td>Torque Control Mode</td></tr>
<tr><td>01 : _Velocity</td><td>Velocity Control Mode</td></tr>
<tr><td>02 : _Position</td><td>Position Control Mode</td></tr>
<tr><td>03 : _Velo－Torq</td><td>Velocity Control - Torque Control Switch Mode</td></tr>
<tr><td>04 : _Posi－Torq</td><td>Position Control - Torque Control Switch Mode</td></tr>
<tr><td>05 : _Posi－Velo</td><td>Position Control - Velocity Control Switch Mode</td></tr>
</table>
</td></tr>
<tr><td>Full Loss Control Encoder Selection</td><td>Full loss control does not correspond to this machine.</td></tr>
<tr><td>Regenerative Resistor Selection</td><td>You cannot use a regenerative resistor with this machine.</td></tr>
</table>
</td></tr>
</table>

Procedure: 5

Confirming servo motor encoder specifications — System parameter setting

Use the servo system supporting tool [Setup Software R-Setup] to confirm and set the specifications of the servo motor encoder.

For how to use the [Setup Software R-Setup], refer to [R-SETUP Instruction Manual].

Motor Encoder Type

Displays the servo motor encoder type.

Setting cannot be changed.

Confirm that the contents being displayed conform to the machine specifications.

Incremental Encoder, Function Selection

Displays detailed functions of the incremental encoder.

This is only valid when the motor encoder type is “Incremental Encoder”.

Incremental Encoder Resolution

Sets the incremental encoder resolution.

Sets the pulse number of motor shaft one rotation.
500P/R ～ 65535P/R Setting unit＝Pulse/Rev.

Absolute Encoder Function Selection

Selects detailed function of absolute encoder.

Set when the motor encoder type is “absolute encoder”.

setting	Contents
04 : PA035C-2.5MH_Manu	PA035, Asynchronous, 2.5Mbps, Half Duplex Communication (Manual Setting)
05 : PA035C-4MH_Manu	PA035, Asynchronous, 4.0Mbps, Half Duplex Communication (Manual Setting)

Absolute Encoder Resolution

Sets the absolute encoder resolution.
Sets the pulse number of one motor shaft rotation.

Set when the motor encoder type is “absolute encoder”

Setting	Contents	Setting	Contents
00:_2048 division	2048 division	06:_131972 division	131072 division
01:_4096 division	4096 division	07:_262144 division	262144 division
02:_8192 division	8192 division	08:_524288 division	524288 division
03:_16384 division	16384 division	09:_1048576 division	1048576 division
04:_32768 division	32768 division	0A:_2097152 division	2097152 division
05:_65536 division	65536 division		

External Encoder Resolution

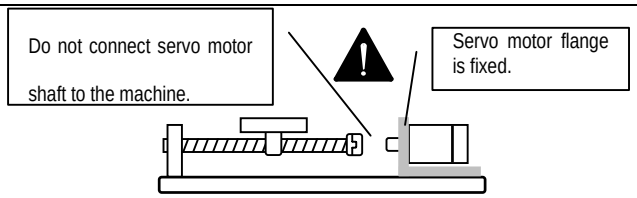
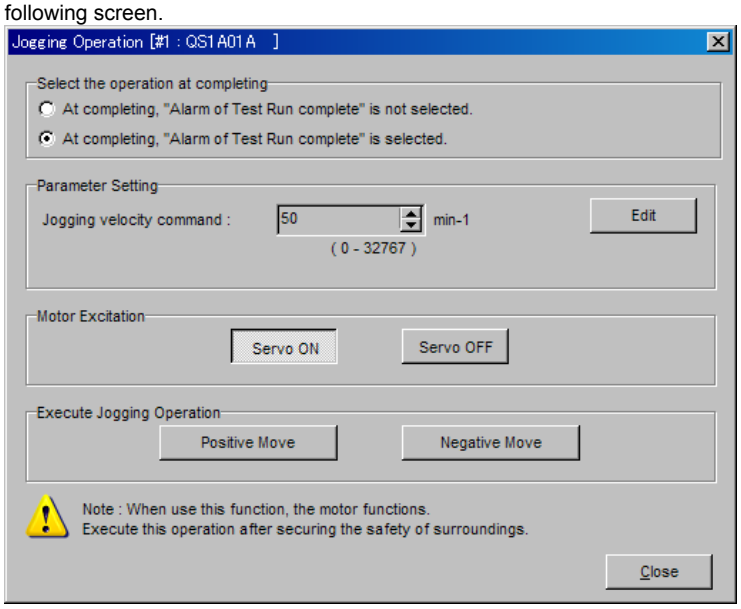
You cannot use an external encoder with this machine.

Procedure	Item and Contents	
6	Confirming the combined servo motor — System parameter setting Use the servo system supporting tool [Setup Software R-Setup] to confirm and set the model number of combined servo motor. For how to use the [Setup Software R-Setup], refer to the [R-SETUP Instruction Manual].	
	Item	
	Model number of combined motor Shows the combined motor model number.	EX: T404-012(0000-0064) ↑ Model number of combined motor is displayed Combined motor can be changed at Motor parameter setting.

Procedure	Item and Contents
7	Turning ON the power supply again — Power turn OFF→turn ON again Turn OFF the power supply to the servo amplifier and turn it ON again. Turning OFF the power supply rewrites the parameter. Without turning OFF the power, the parameter cannot be changed. Make sure you turn OFF → turn ON again.

Procedure	Item and Contents
8	Reconfirming the specifications — Reconfirmation Reconfirm the specifications of the changed servo amplifier and servo motor encoder, and the servo motor combinations. Many of the troubles at test run, such as servo motor not rotating, are caused by mistakes in parameter setting.

■ [Procedure 9] JOG Driving

<table>
<tr><th>Procedure</th><th colspan="2">Item</th><th>Contents</th></tr>
<tr><td rowspan="5">9</td><td colspan="2"><u>JOG driving</u>
Do not connect the servo motor shaft to the machine to keep the status of no load for JOG driving. Confirm that the servo motor rotates forward and backward.</td><td> 
</td></tr>
<tr><td colspan="3">Operating R-Setup</td></tr>
<tr><td colspan="2">R-SETUP is used and velocity JOG driving is performed.</td><td>For details, refer to the [R-SETUP setup software Instruction Manual] - "3.14 Velocity JOG Driving".</td></tr>
<tr><td>Forward direction (CCW)</td><td>Backward direction (CW)</td><td></td></tr>
<tr><td> 
Forward direction motor rotation</td><td> 
Backward direction motor rotation</td><td>Confirm that the motor rotates in a forward or backward direction on the following screen.
 
</td></tr>
</table>

✍ The speed at JOG driving can be changed at general parameter group B page 00.

■[Procedure 10 - Procedure 14] I/O signal confirmation

<table>
<tr><th>Procedure</th><th>Item</th><th>Contents</th></tr>
<tr><td rowspan="2">10</td><td>I/O signal setting</td><td>Settings for general purpose I/O signals (CN1) are standard setting values set at the time of shipment.
Necessary I/O signals are set at the servo amplifier.</td></tr>
<tr><td>General purpose input signal Standard setting values at the time of shipment</td><td>
<table>
<tr><th>Input signal</th><th>Name</th><th>Set value</th></tr>
<tr><td>CONT1</td><td>Deviation clear function</td><td>02:_CONT1_ON</td></tr>
<tr><td>CONT2</td><td>(For the models with an incremental encoder or a tachogenerator)
Velocity loop proportional control switching function
(For the models with an absolute encoder)
Absolute encoder clear function</td><td>04:_CONT2_ON</td></tr>
<tr><td>CONT3</td><td>Servo ON function</td><td>06:_CONT3_ON</td></tr>
<tr><td>CONT4</td><td>Warning display reset function</td><td>08:_CONT4_ON</td></tr>
</table>
✍ General purpose input signals (CONT1 TO CONT4) are allocated to functions necessary to the device, referring to [Chapter 5, Parameter][Parameter setting value Group9].
</td></tr>
<tr><td>General purpose output signal Standard setting values at the time of shipment</td><td>General parameter Group A
<table>
<tr><th>Page</th><th>Name</th><th>Standard setting values</th></tr>
<tr><td>00</td><td>General purpose output 1 （OUT1）</td><td>02:_S-RDY_ON</td></tr>
<tr><td>01</td><td>General purpose output 2 （OUT2）</td><td>(For positional control type)
18:_INP_ON
(For velocity control type and torque control type)
10:_LOWV_ON</td></tr>
<tr><td>02</td><td>General purpose output 3 （OUT3）</td><td>33:_ALM4[ALMB7]_ON</td></tr>
<tr><td>03</td><td>General purpose output 4 （OUT4）</td><td>35:_ALM2[ALMB6]_ON</td></tr>
<tr><td>04</td><td>General purpose output 5 （OUT5）</td><td>37:_ALM1[ALMB5]_ON</td></tr>
</table>
✍ General purpose output signals (OUT1 TO OUT5) are allocated to functions necessary to the device, referring to [Chapter 5, Parameter][Parameter setting value Group A].
</td></tr>
</table>

Procedure	Item	Contents
11	Confirmation of input signals	Input signal status is confirmed by the servo amplifier's internal monitoring function. Confirm that there are protective functions such as emergency stop, over travel, and warning display reset etc. ✍ Confirm that every I/O signal is properly functioning using general purpose input (CONT4 TO CONT1) monitor and general purpose output (OUT5 TO OUT1) monitor, referring to [R-SETUP-Setup Software] - "Monitor Display".

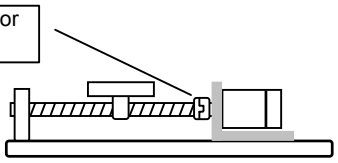
Procedure	Item	Contents
12	Servo ON signal is input.	Servo ON signal is input and the servo motor is excited. Confirm that LED (SON) is lit on the front of the servo amplifier.

6. Driving [Confirmation of machine's operation function / Driving]

Procedure	Item	Contents
13	Command input	Input the command conforming to the control mode in use. Confirm that the rotation direction and command input are correct. Confirm the command input in [R-SETUP-Setup Software] - "Monitor Display". ● When using with velocity controlled type and torque controlled type Page OD Analog velocity command ／Analog torque command input voltage — Displays the command voltage being input. ● When using with position controlled type Page OE Positioning command pulse monitor (Positioning command pulse input frequency) — Displays the command pulse frequency being input. Many of the cases when monitor values do not change with command input are caused by faulty wiring. Confirm the wiring again, referring to [Chapter3, Wiring].

Procedure	Item	Contents
14	Turning off power supply	Turns OFF the servo ON signal, then turns OFF the power supply.

■ [Procedure 15] Confirmation of machine's operation function

Procedure	Item	Contents
15	Command input (low speed)	Connect the servo motor shaft with the machine  Input the command (low speed) suitable for the control mode in use. Confirm that the movement direction and movement distance, etc. operate normally.

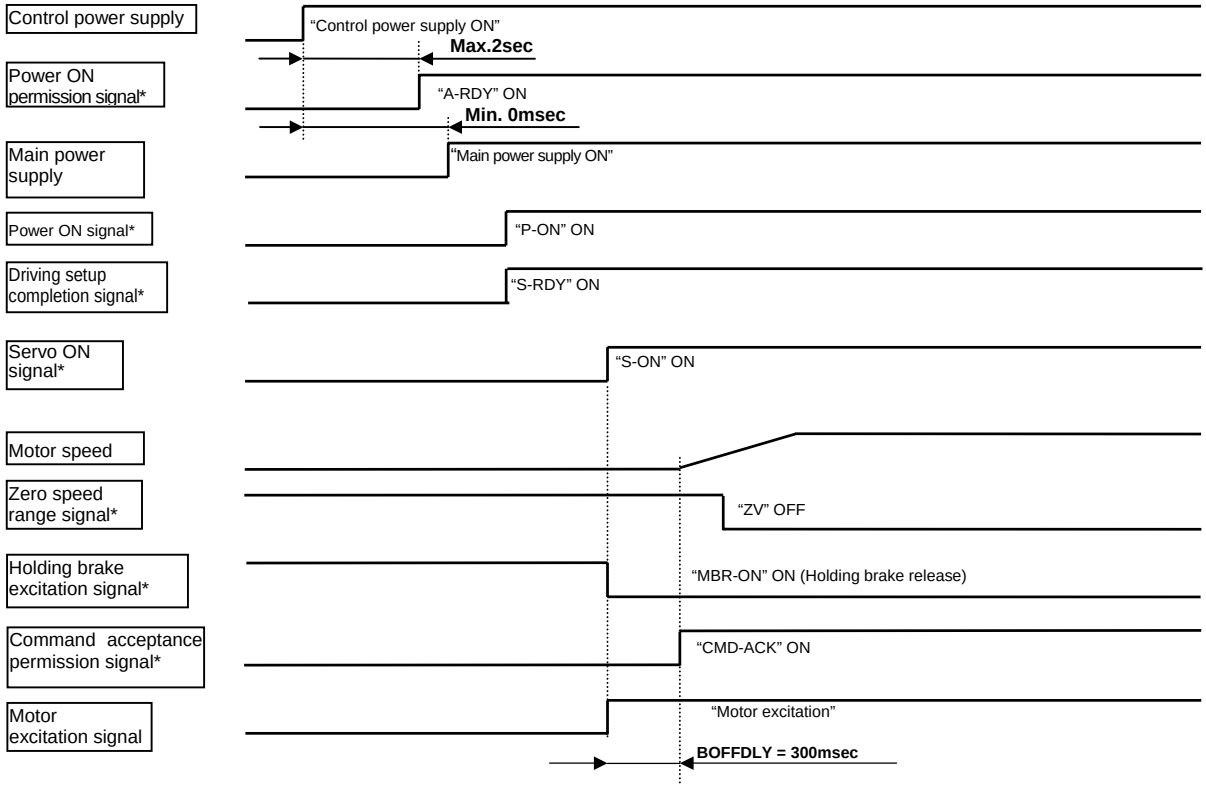
■ [Procedure 16] Driving

Procedure	Item	Contents
16	Operation	At the time of shipment, it is shipped in gain setting mode by the rotary switch. Execute gain adjustment according to the situation.

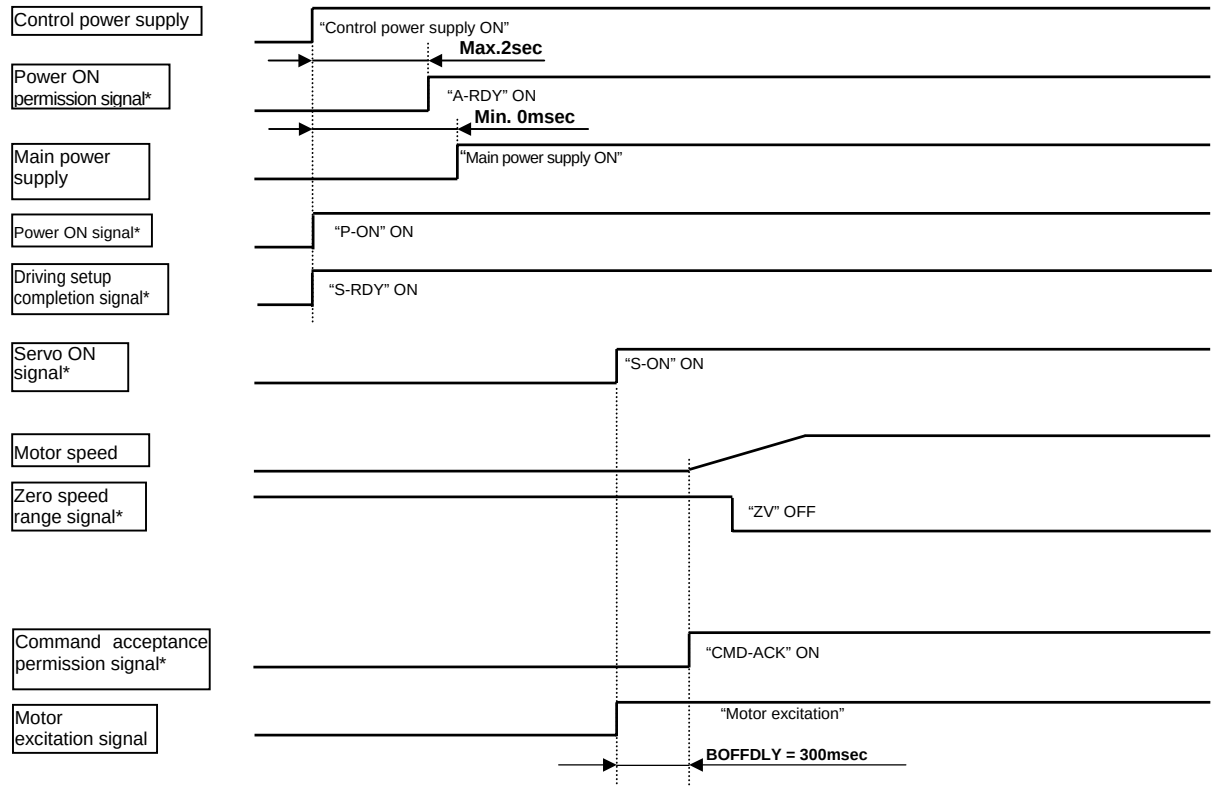
■ Driving sequence from power supply ON to power supply OFF at the standard setting when shipped

● [Power supply ON → Servo ON]

In the case of the model number: TS1A*(140Vdc input type)



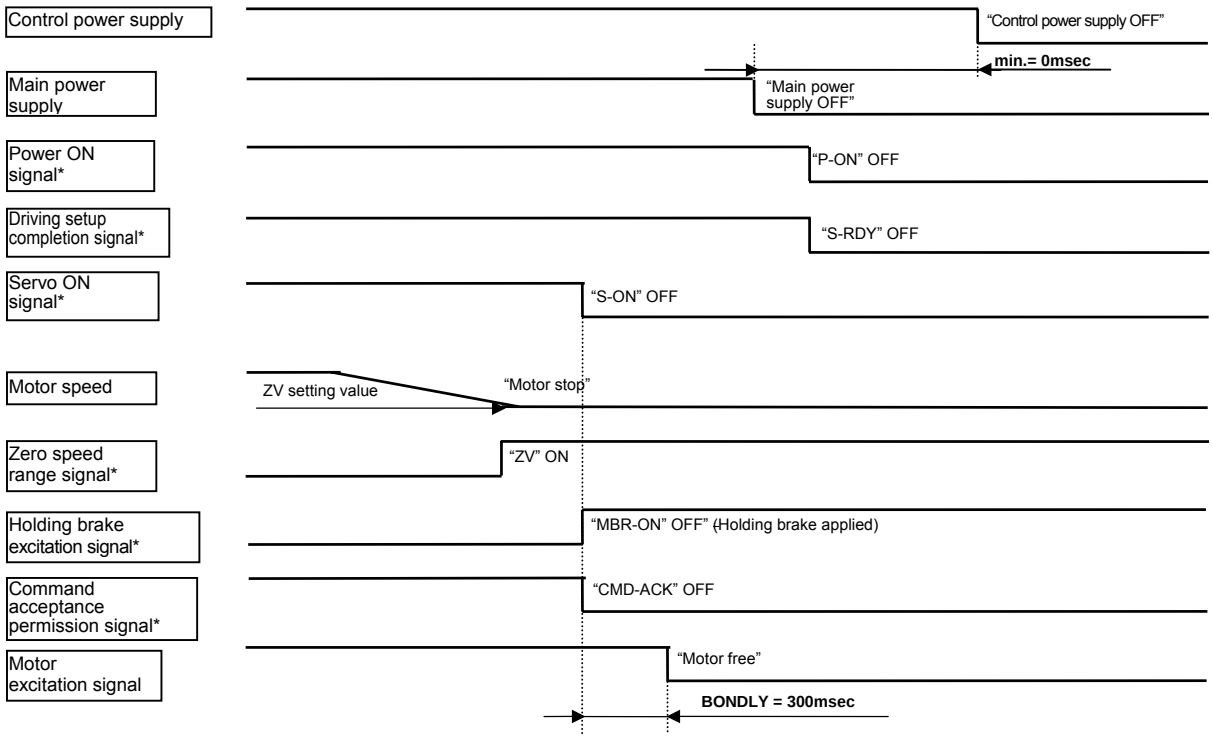
In the case of the model number: TS1B*(50Vdc input type)



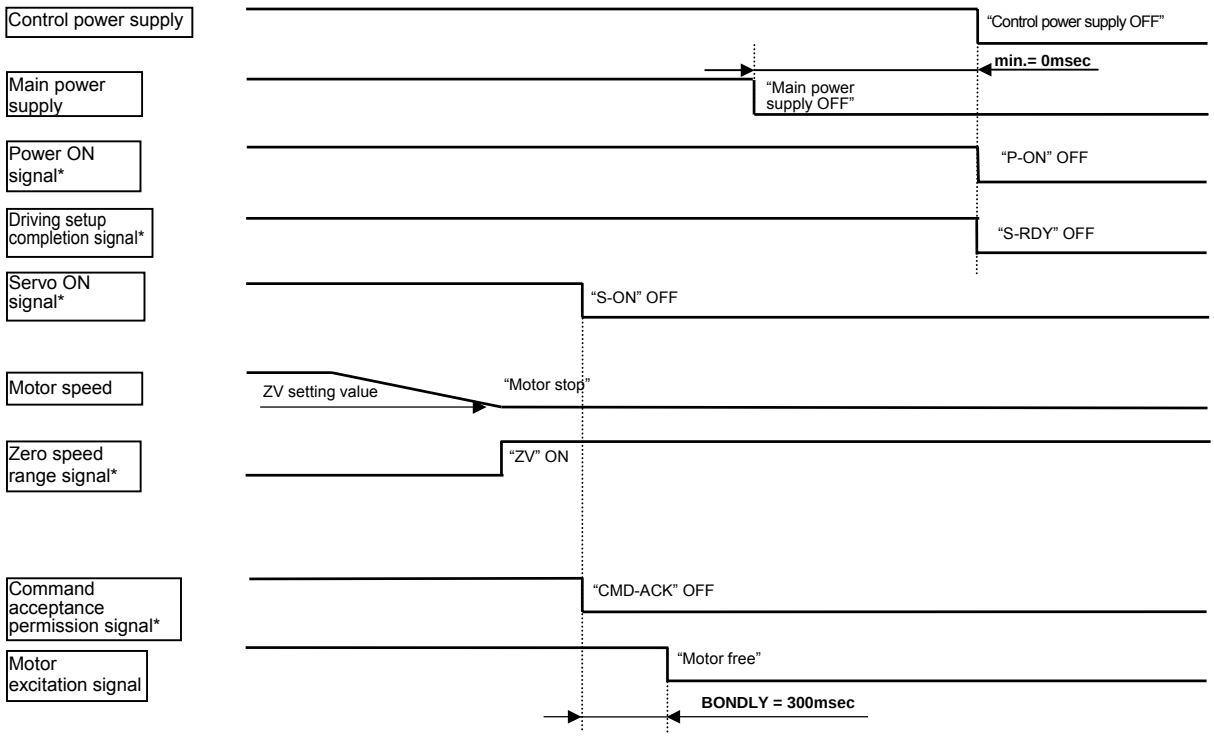
✍ The signal of sign (*) can be allocated to general-purpose output OUT1 to OUT5.

● [Servo OFF → Power supply OFF]

In the case of the model number: TS1A*(140Vdc input type)



In the case of the model number: TS1B*(50Vdc input type)



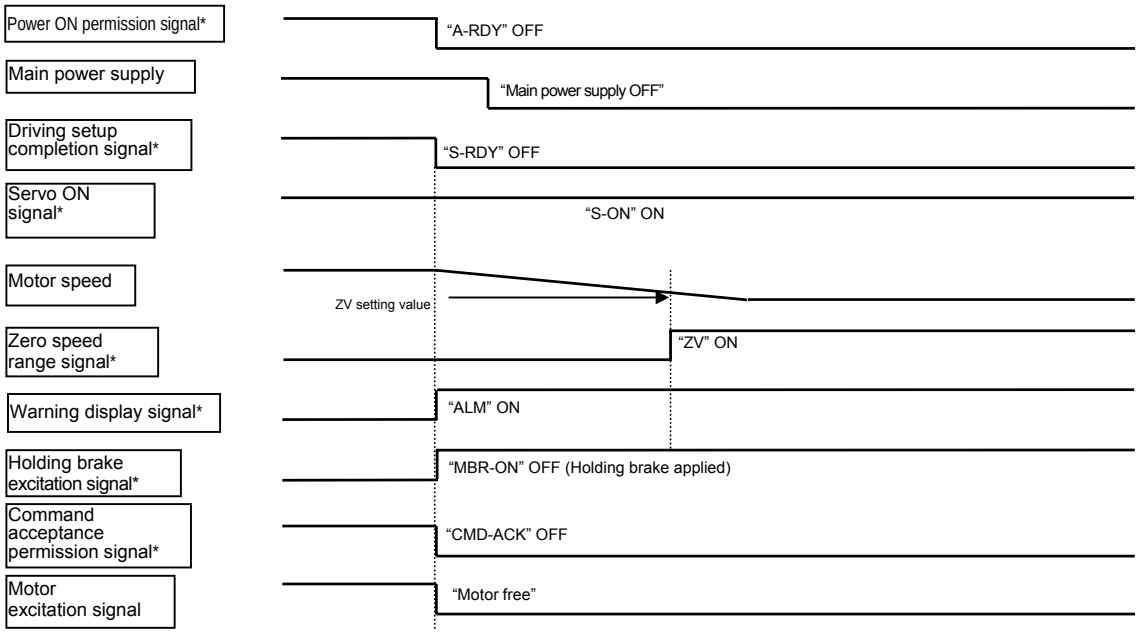
✍ The signal of sign (*) can be allocated to general-purpose output OUT1 to OUT5.

■ Operation sequence

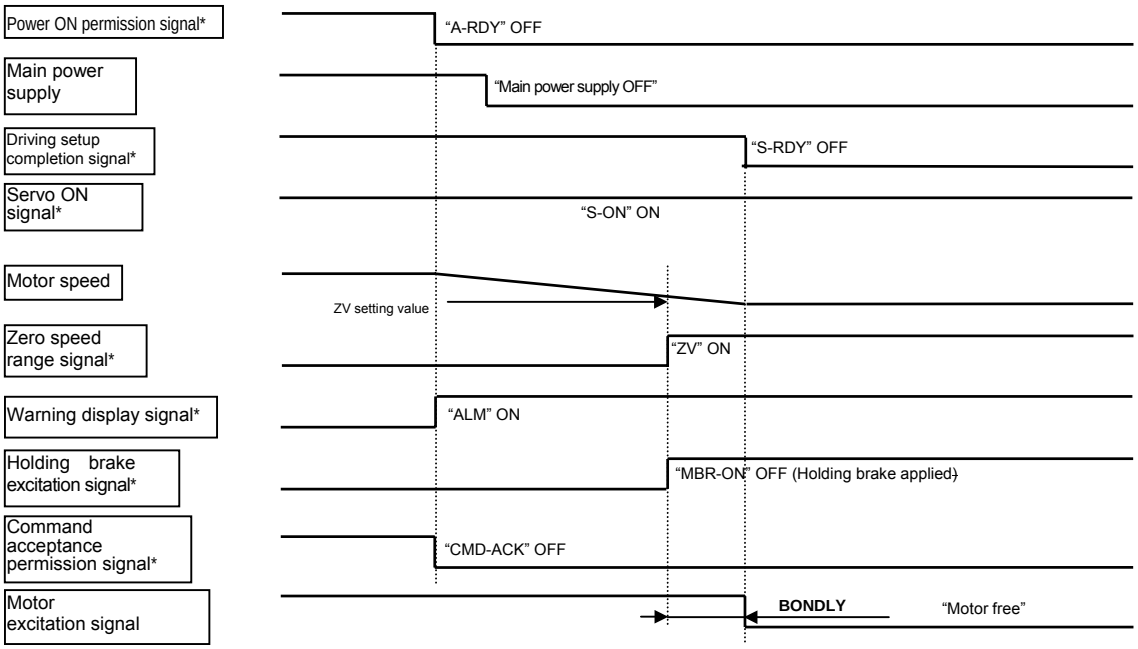
● Warning display sequence

When a warning display is generated, the servo motor is stopped by the motor free or the servo brake. Whether it stops by the servo brake differs depending on the warning display generated, refer to [Chapter 8. Maintenance - Alarm List].

● Motor free operation when warning display is generated



● Servo brake stop when warning display is generated



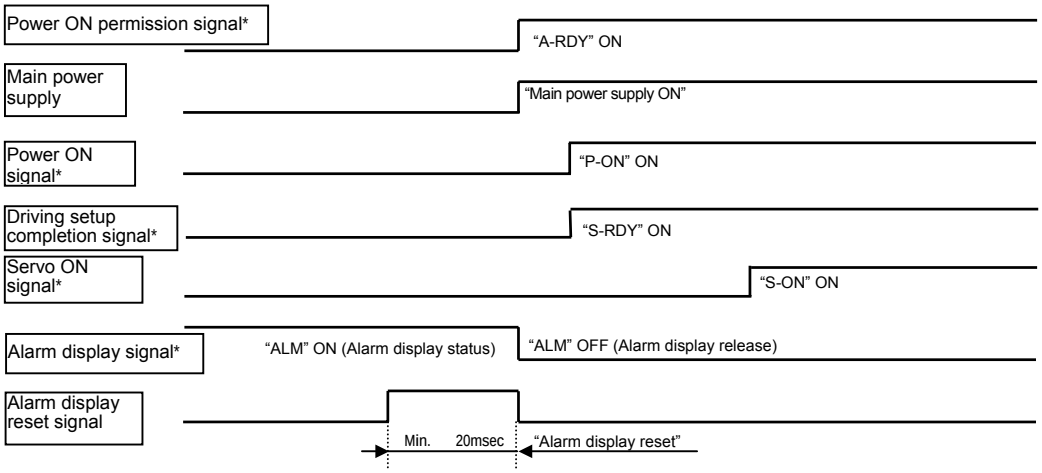
✍ The signal of sign (*) can be allocated to general-purpose output OUT1 to OUT5.

⚠ Install a protective circuit referring to [Chapter 3, Wiring - Wiring example of safety circuit]. The above sequence is for when a protective circuit is installed.

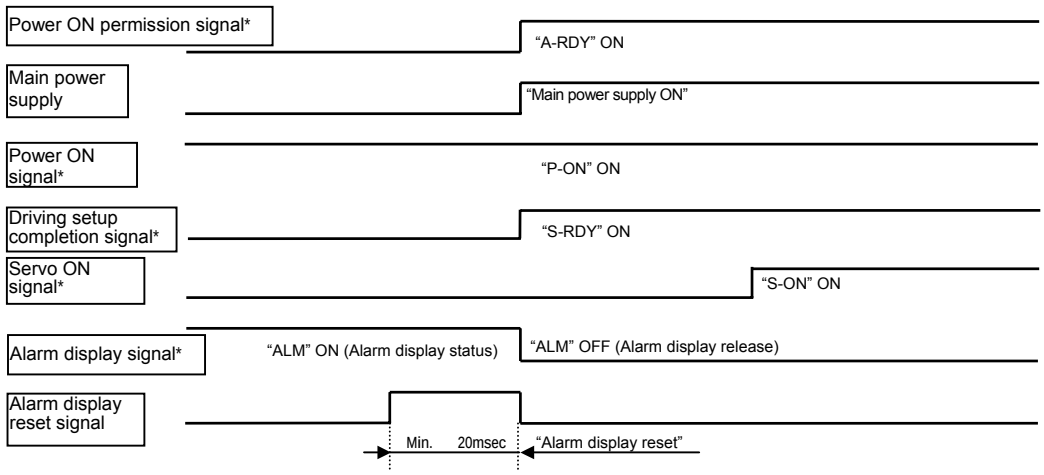
- Warning display reset sequence

  Warning displays can be reset by inputting the warning display reset signal from general purpose input signal.

In the case of the model number: TS1A*(140Vdc input type)



In the case of the model number: TS1B*(50Vdc input type)

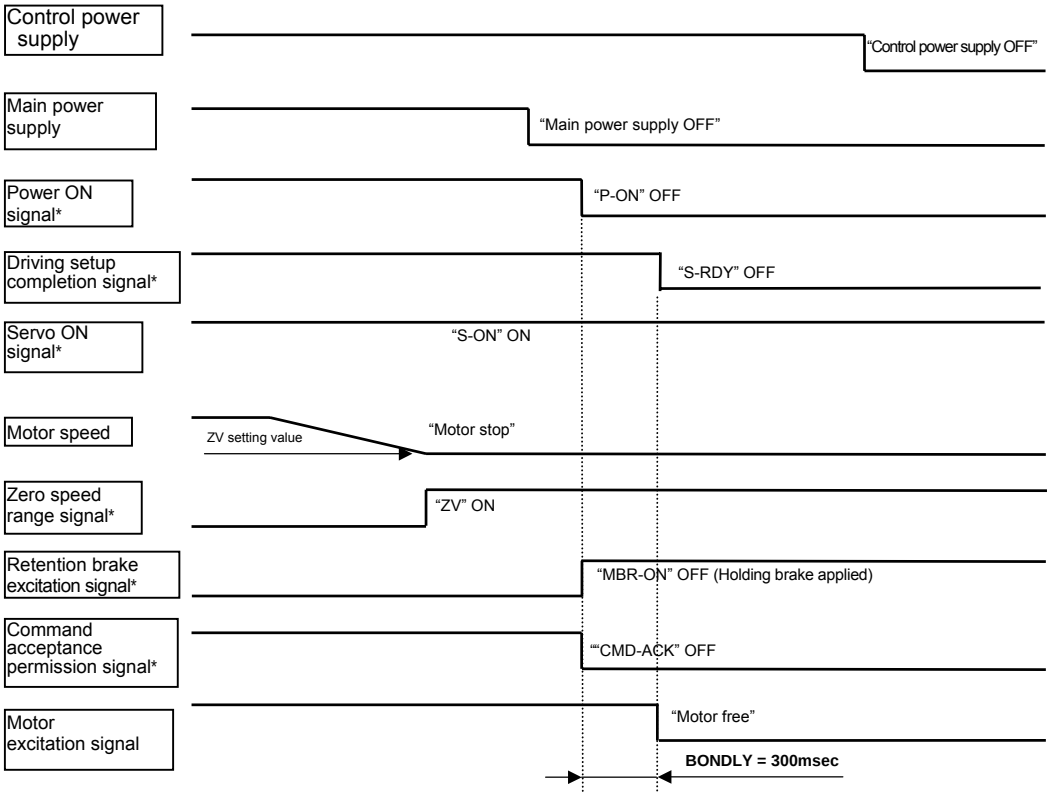


✍ The signal of sign (*) can be allocated to general-purpose output OUT1 to OUT5.

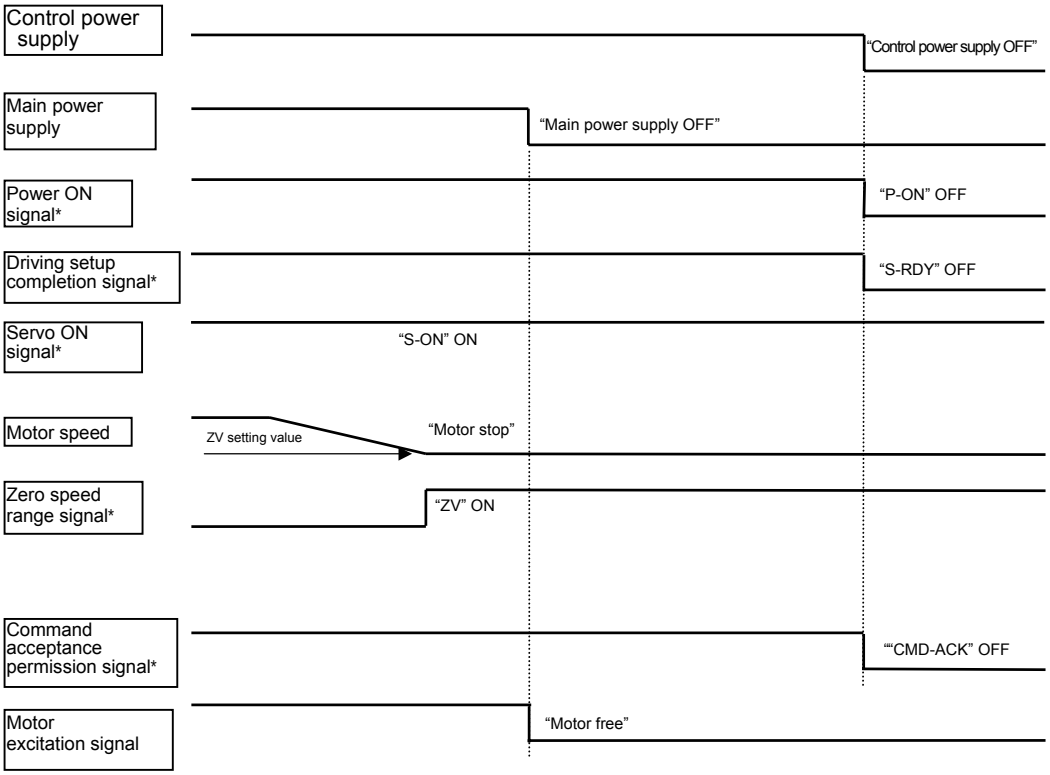
✍ Some warning displays cannot be reset unless the power is reset (control power is turned OFF and ON again) or encoder is cleared. Refer to [Chapter 8, Maintenance – Alarm list].

- Sequence when power is turned OFF during operation (During servo ON)

  In the case of the model number: TS1A*(140Vdc input type)



In the case of the model number: TS1B*(50Vdc input type)



✍ The signal of sign (*) can be allocated to general-purpose output OUT1 to OUT5.

Chapters 7

[Adjustment / Functions]

■ Servo gain tuning

■ Basic function of tuning

T series Servo Amplifier is equipped with automatic tuning function same as R series Servo Amplifier, and the best gain is in real time adjusted.

However, when shipping it, it is set to the gain adjustment mode with the Gain Setting Switch (RSW) to keep compatibility with conventional DA series servo amplifier.

Please refer to "Structure of tuning" since 7-2 pages when adjust the gain by Automatic Tuning and Manual Tuning.

● Method to set a gain with a Gain Setting Switch (RSW) (default setting)

This function can choose "Position Loop Proportional Gain(KP)" "Velocity Loop Proportional Gain(KVP) " "Velocity Loop Integral Time Constant(TVI)" set in Servo Amplifier with a Gain Setting Switch (RSW). Therefore, easily set a gain and can shorten tuning time.

(Setting method)

1. Please set Tuning mode [TUNMODE] setting in "02:ManualTun".

Group	Page	Contents	Value	Reference page
0	00	Tuning mode [TUNMODE]	02:ManualTun	5-6

2. Please set RSW Gain Switching Function [RSWGC] setting in "01:Always_Enable".

Group	Page	Contents	Value	Reference page
9	18	RSW Gain Switching Function [RSWGC]	01:Always_Enable	5-18

3. Please set a Gain Setting Switch (RSW) in the front of Servo Amplifier in “0 to F (default setting: 7)”. Gain set value please refer to page 5-12.

* This function cannot use with Automatic Tuning.

■ Structure of tuning ≪General parameter Group 0≫

At “parameter Group 0 ”, tuning structure of the T series servo amplifier is as follows.

≪General parameter Group 0 ≫

Page	Name
00	Tuning Mode
01	Automatic Tuning Characteristic
02	Automatic Tuning Response
03	Automatic Tuning, Automatic Parameter Saving

00:_AutoTun	Automatic Tuning
01:_AutoTun_JRAT-Fix	Automatic Tuning (JRAT Fixed)
02:_ManualTun	Manual Tuning

00:_Positioning1	Positioning Control 1
01:_Positioning2	Positioning Control 2
02:_Positioning3	Positioning Control 3
03:_Trajectory1	Trajectory Control 1
04:_Trajectory2	Trajectory Control 2 (KP Fixed)

1-30	Automatic Tuning Response

00:_Auto_Saving	Saves Parameter Automatically in JRAT1.
01:_No_Saving	Automatic Saving is Invalidity

● Tuning Mode [page 00]

00:_AutoTun auto- tuning

The servo amplifier estimates the load inertia moment ratio of the machine and equipment at real time and automatically tunes the servo gain so that it will become the best one. The parameters for the servo amplifier to automatically tune vary depending on the selected auto-tuning characteristics.

*The servo amplifier estimates the load inertia moment ratio at the time of acceleration/deceleration. Therefore, for operations with only excessively low acceleration/deceleration time constant or with only low torque with low velocity, this mode cannot be used. Also, operations with large disturbance torque or with large mechanical clearance, this mode cannot be used, either.

01:_AutoTun_JRAT-Fix Usage at Auto-tuning [JRAT manual setting].

01:_AutoTun_JRAT-Fix Automatic Tuning (JRAT Fixed)

Based on the load inertia moment ratio（JRAT1）which was set, the servo amplifier automatically tunes and makes the servo gain the best one. The parameters for the servo amplifier to automatically tune vary depending on the selected auto-tuning characteristics.

02:_ManualTun Manual Tuning

This is used in order for adjusting the servo gain to the machine and equipment to ensure the maximum response, and when characteristics in auto-tuning are insufficient.

● Automatic Tuning Characteristic [page 01]

Characteristics adjusted to machines and equipment is selected when Automatic Tuning and Automatic Tuning (JRAT Fixed) are used.

When Manual Tuning is used, this does not function.

● Automatic Tuning Response [page 02]

Set this when Automatic Tuning and Automatic Tuning (JRAT Fixed) are used. The larger set value makes the response higher. Set this suitable for the equipment rigidity.

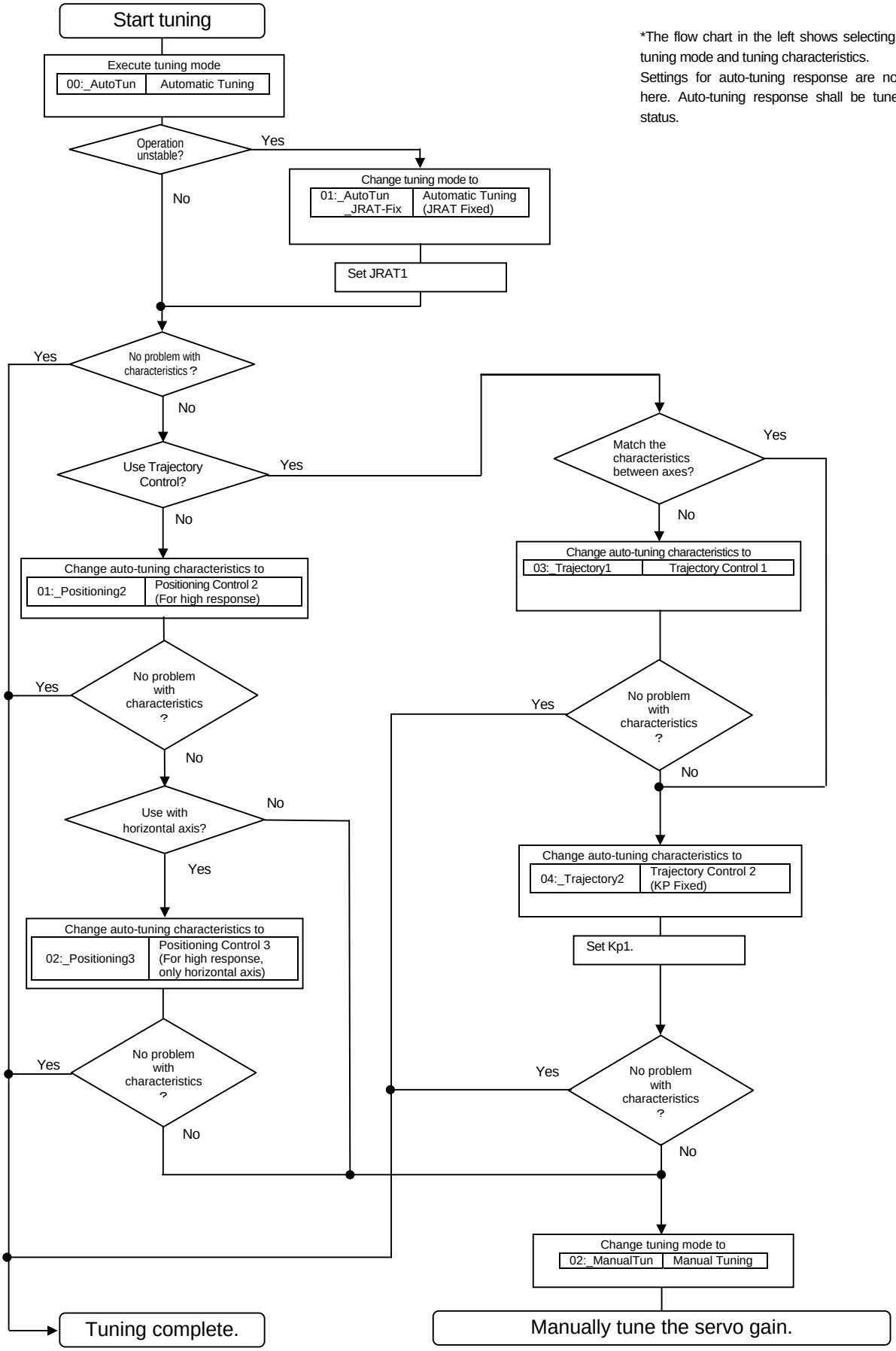
When Manual Tuning is used, this does not function.

● Automatic Tuning, Automatic Parameter Saving ［load inertia moment ratio］ [page 03]

The “load inertia moment ratio” obtained from auto-tuning is automatically saved in parameter JRAT 1 at every 2 hours. The set value is enabled when Automatic Tuning is used.

When Automatic Tuning (JRAT Fixed) and Manual Tuning are used, this does not function.

■ Tuning method selecting procedure



*The flow chart in the left shows selecting method of tuning mode and tuning characteristics.
Settings for auto-tuning response are not indicated here. Auto-tuning response shall be tuned at each status.

■ Monitoring servo gain adjustment parameter

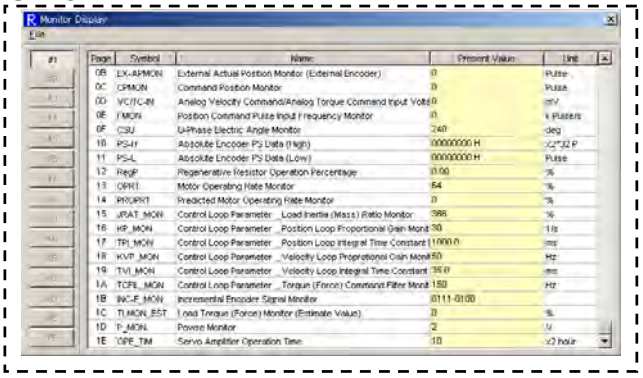
The following parameters can be monitored when auto-tuning is used.

● Digital operator

Monitor mode	Name
Page 15	Load Inertia Ratio Monitor
Page 16	Position Loop Proportional Gain Monitor
Page 18	Velocity Loop Proprotional Gain Monitor
Page 19	Velocity Loop Integral Time Constant Monitor
Page 1A	Torque Command Filter Monitor

For how to operate these,
refer to “Chapter 4, Digital operator”.

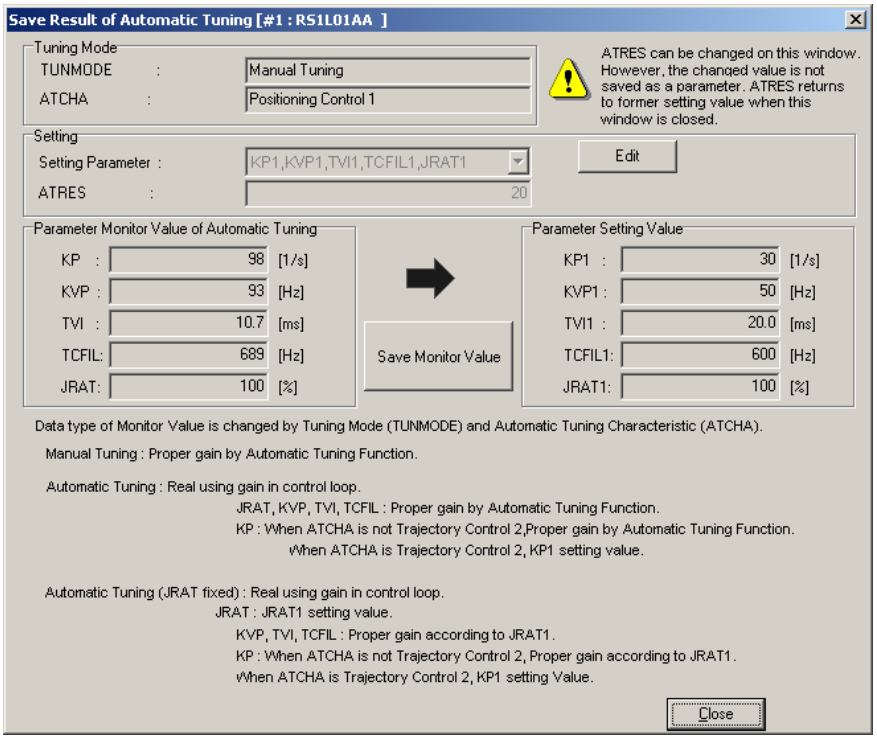
● R-SETUP



For how to operate these, refer to “R-SETUP Instruction Manual”.

■ Using auto-tuning result at manual tuning.

At manual tuning, auto-tuning result is saved as a batch or by selection using R-SETUP, and can be used as controlling parameter.

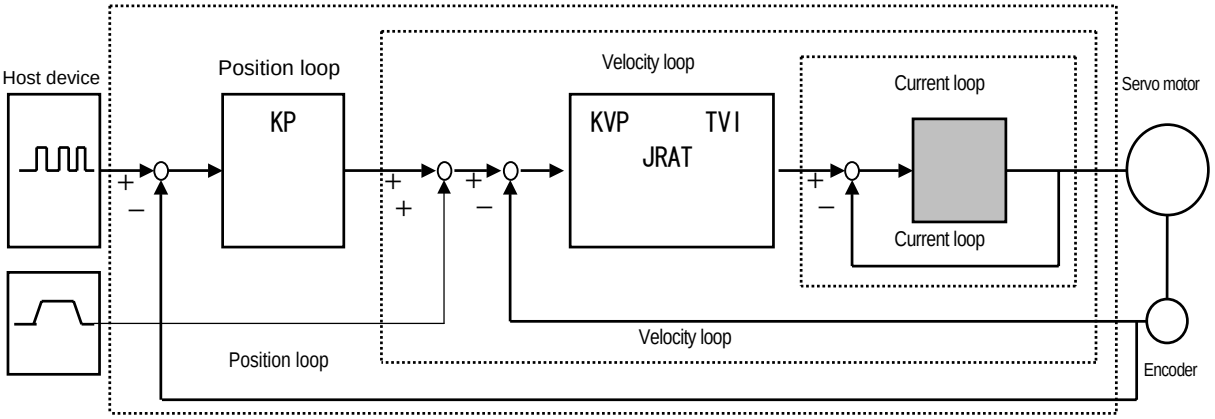


For how to operate these, refer to “ R-SETUP Instruction Manual”.

Note) In the setting of TUNMODE=02:_ManualTun, parameter setting value is used in the control loop. When auto-tuning result saving is executed, the gain parameter being used will change (except during gain switch over). Therefore, the motor operation may change suddenly. Execute auto-tuning result saving while servo OFF or motor stoppage.

■ Servo system structure

Servo system consists of 3 subsystems; the position loop, the velocity loop and the current loop. High response is required for the internal loops. If this structure is compromised, it could result in instability, low response, vibration or oscillation.



The response of the current loop is ensured internally in the servo amplifier, there is no need for the user to make additional adjustments.

■ Servo adjustment parameters

Position Command Filter [PCFIL]

When the position command resolution is low, set this parameter to suppress the ripples contained in the position command. The larger value of this will make the ripple suppressing effect greater, however, delay will be greater.

*When high tracking control position compensation gain is set to other than 0%, this parameter is automatically set.

Position Loop Proportional Gain [KP]

Set this equivalent to $KP_{[1/S]}=KVP_{[Hz]}/4 \cdot 2\pi$.

Higher Tracking Control, Position Compensation Gain [TRCPGN]

When tracking effect needs to be improved under high resolution of position command, increase this parameter after adjustment of high tracking control velocity compensation gain.

Feed Forward Gain [FFGN]

Tracking effect of position command can be improved by increasing this gain.

Under positioning control, set this to approximately 30 to 40%.

*When high tracking control position compensation gain is set to other than 0%, this parameter is automatically set.

Feed Forward Filter [FFFIL]

When position command resolution is low, set this parameter to suppress ripples.

Velocity Command Filter [VCFIL]

Under velocity control, when there is a big noise component contained in velocity command, set this parameter to suppress the noise.

Velocity Loop Proportional Gain [KVP]

Set this as high as possible within such a stable operation range as not to cause vibration or oscillation of the machine. If JRAT is accurately set, the set value of KVP becomes the velocity loop response zone.

Velocity Loop Integral Time Constant [TVI]

Set this equivalent to $TVI_{[ms]}=1000/(KVP_{[Hz]})$.

Load Inertia Ratio [JRAT]

Set the value calculated as shown below.

$$JRAT=\frac{\text{Motor axis converted load inertia moment 【JL】}}{\text{Motor inertia moment 【JM】}}\times 100\%$$

Higher Tracking Control, Velocity Compensation Gain [TRCVGN]

Tracking effect can be improved by increasing compensation gain.
Adjust this so as to shorten the positioning setting time.
※Set the value of JRAT properly to use this function.

Torque Command Filter 1 [TCFIL]

When rigidity of the mechanical device is high, set this value high and the velocity loop proportional gain can be set to high. When rigidity of the mechanical device is low, set this value low and resonance in high frequency zone and abnormal sound can be suppressed. For normal usage, set this below 1200Hz.

■ Adjustment method of vibration suppressing control

Set vibration suppressing frequency to suppress the low frequency vibration at the tip or the body of the machine. Vibration suppressing frequency is obtained by executing auto-tuning of vibration suppressing frequency or by calculating vibration frequency of vibrating point at positioning and its reciprocal. When vibration does not stop with the vibration suppressing control, there is a possibility that the gain for control system may be too high. In this case, lower the control system gain. Also, when used together with high tracking control velocity compensation gain, vibration suppressing effect may be greater.

*Vibration suppressing control function can be used together with auto-tuning.

■ Adjustment method of notch filter

Set the torque command notch filter to suppress high frequency resonance resulted from coupling and rigidity of the device mechanism. Notch filter center frequency can be obtained by executing auto-notch filter tuning or by system analysis.

*Torque command notch filter function can be used together with auto-tuning.

*When resonance of the device mechanism does not stop even after this parameter is set, there may be two or more resonance points. In this case, insert notch filters B, C and D to suppress each of them. If not yet suppressed, there is a possibility that auto-tuning response or control gain is too high. If so, lower the auto-tuning response or control gain.

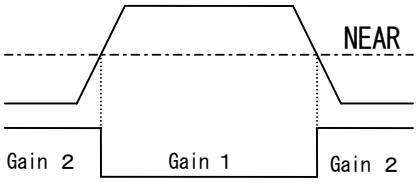
■ Adjustment method of disturbance observer

Set the disturbance observer to suppress the disturbance applied to the motor.
At first, use the low frequency observer characteristics. If not suppressed by that, use that for medium frequency. Gradually increase the observer compensation gain.
The higher the observer compensation gain becomes, the more the disturbance suppressing characteristics will be improved.
However, if it is excessively high, oscillation may result. Use this within the range not causing oscillation.
*Disturbance observer cannot be used with auto-tuning.

■ Adjustment method of gain switch over

When tracking effect is insufficient even if basic parameters of high tracking control position compensation gain and high tracking control velocity compensation gain are set, set the gain switch over so that tracking effect can be improved.

(Example)Gain is increased near positioning compete.



The value of gain 2 shall be set to 1.2 times the value of gain 1.

*Gain switch over function cannot be used with auto-tuning.

■ Adjustment method of high setting control

When tracking effect is insufficient even after gain switch over, set the high setting control parameter and in-position setting characteristics can be improved. When position command resolution is low, set the value of command velocity calculation low pass filter low. Set the acceleration compensation so that the position deviation near acceleration conclusion becomes small. Set the deceleration compensation so that the position deviation near deceleration conclusion (positioning complete) becomes small.

*This function cannot be used together with auto-tuning.

■ Functions of Group 8

[Group 8] 00

Command Input Polarity [CMDPOL] Velocity control mode Position control mode Torque control mode

The rotation direction of the servo motor can be reversed without modifying the input command wiring or the servo motor wiring.

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Forward	00: _PC+_VC+_TC+
Velocity command	+	Forward	
Torque command	+	Forward	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Reverse	04: _PC-_VC+_TC+
Velocity command	+	Forward	
Torque command	+	Forward	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Forward	01: _PC+_VC+_TC-
Velocity command	+	Forward	
Torque command	+	Reverse	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Reverse	05: _PC-_VC+_TC-
Velocity command	+	Forward	
Torque command	+	Reverse	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Forward	02: _PC+_VC-_TC+
Velocity command	+	Reverse	
Torque command	+	Forward	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Reverse	06: _PC-_VC-_TC+
Velocity command	+	Reverse	
Torque command	+	Forward	

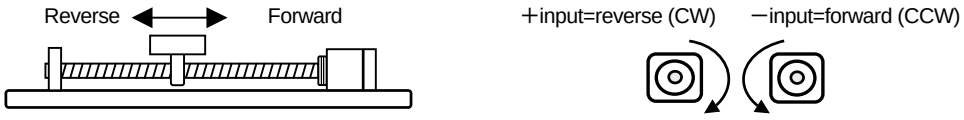
Input command	Command polarity	Rotation direction	Selected value
Position command	+	Forward	03: _PC+_VC-_TC-
Velocity command	+	Reverse	
Torque command	+	Reverse	

Input command	Command polarity	Rotation direction	Selected value
Position command	+	Reverse	07: _PC-_VC-_TC-
Velocity command	+	Reverse	
Torque command	+	Reverse	

∗Using the initial factory settings, the servo motor rotates in the forward (CCW) direction with a positive (+) input, and in the reverse (CW) direction with a negative (-) input.

Standard command input polarity setting

Modified command input polarity setting



[Group 8] 11

Position Command Pulse, Form Selection [PCPTYP]

Position control mode

3 types of location command pulse can be selected; make this selection per the specifications of the host unit.

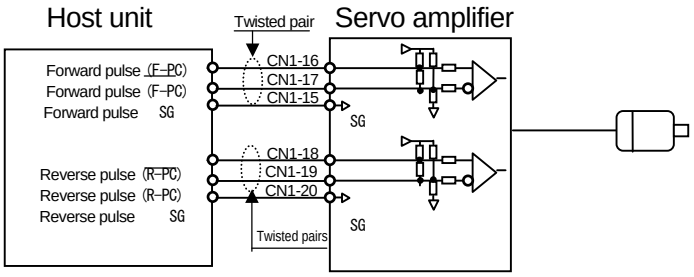
Selected value	Contents
00:_F-PC_R-PC	Positive Move Pulse + Negative Move Pulse
01:_2PhasePulse	Two-Phase Pulse Train of 90 Degrees Phase Difference
02:_CODE_PC	Code + Pulse Train

The location command pulse input command is the input command used for location control. Connect to CN1 location command pulse input.

Forward	Reverse
Positive Move Pulse (F-PC) : CN1-16	Negative Move Pulse (R-PC) : CN1-18
Positive Move Pulse ($\overline{\text{F-PC}}$) : CN1-17	Negative Move Pulse ($\overline{\text{R-PC}}$) : CN1-19
Positive Move Pulse SG : CN1-15	Negative Move Pulse SG : CN1-20

There are 2 output types for the host unit, the “Line driver output” and the “Open collector output”.

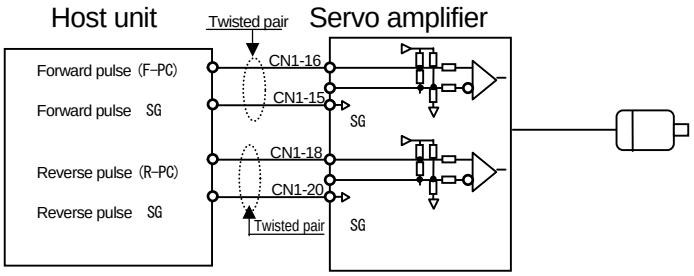
Using line driver output



* Always connect SG.

* Line Receiver : HD26C32 or equivalent

Using open collector output



* Always connect SG.
* Line Receiver : HD26C32 or equivalent

[Group 8] 12

Position Command Pulse, Count Polarity [PCPPOL]

Position control mode

Position command pulse count polarity can be selected form the following 4 types.
Select the one suitable for the host unit.

Selected value	Contents
00:_Type1	F-PC/ Count at the Rising Edge: R-PC/ Count at the Rising Edge
01:_Type2	F-PC/ Count at the Falling Edge: R-PC/ Count at the Rising Edge
02:_Type3	F-PC/ Count at the Rising Edge: R-PC/ Count at the Falling Edge
03:_Type4	F-PC/ Count at the Falling Edge: R-PC/ Count at the Falling Edge

[Group 8] 13

Position Command Pulse, Digital Filter [PCPFIL]

Position control mode

When the time for minimum pulse width at position command input maximum frequency is less than the digital filter set value, alarm “AL D2” will be issued. Set the smaller value for digital filter than the time of minimum pulse width at the time of position command input maximum frequency. Select the position command pulse digital filter setting from the followings according to the command pulse type of the unit in use.

Forward pulse string + Reverse pulse string

Selected value	Minimum pulse width [t]	Position command input maximum frequency[f]
00	t > 834 nsec	f < 599 Kpps
01	t > 250 nsec	f < 2.0 Mpps
02	t > 500 nsec	f < 1.0 Mpps
03	t > 1.8 μsec	f < 277 Kpps
04	t > 3.6 μsec	f < 138 Kpps
05	t > 7.2 μsec	f < 69 Kpps
06	t > 125 nsec	f < 4 Mpps
07	t > 83.4 nsec	f < 5.9 Mpps

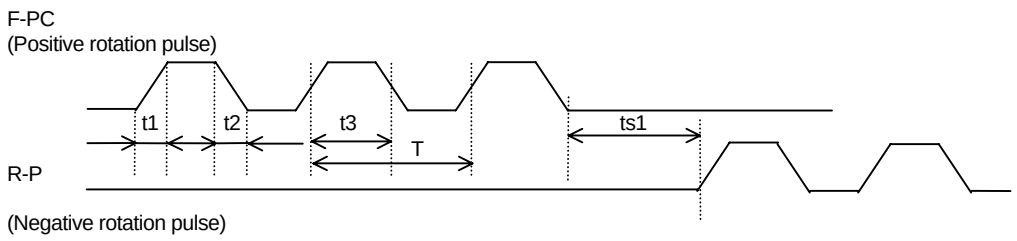
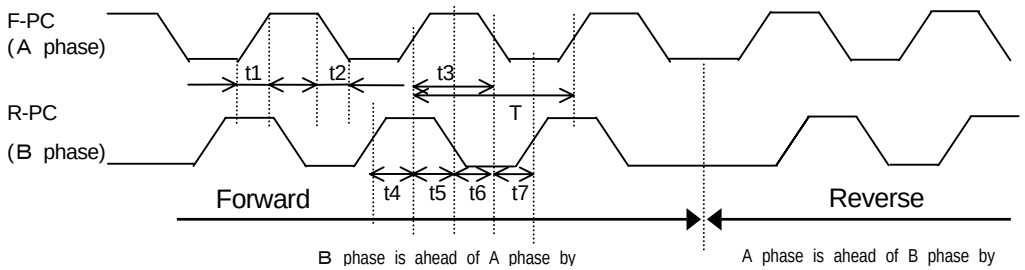
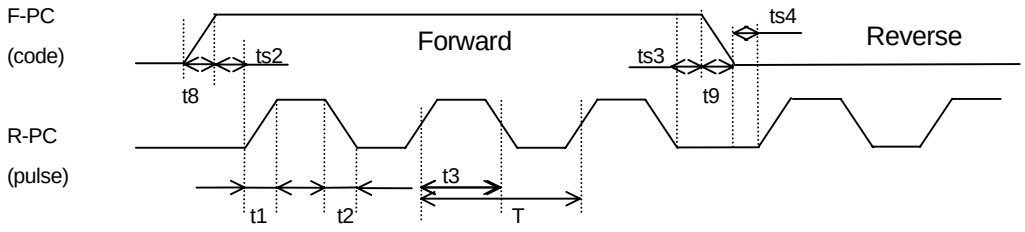
90° phase difference 2 phase pulse

Selected value	A phase・B phase Minimum edge interval [t]	Position command input maximum frequency[f]
00	t > 834 nsec	f < 599 Kpps
01	t > 250 nsec	f < 2.0 Mpps
02	t > 500 nsec	f < 1.0 Mpps
03	t > 1.8 μsec	f < 277 Kpps
04	t > 3.6 μsec	f < 138 Kpps
05	t > 7.2 μsec	f < 69 Kpps
06	t > 164 nsec	f < 1.5 Mpps
07	t > 164 nsec	f < 1.5 Mpps

Code + pulse string

Selected value	Minimum pulse width [t]	Position command input maximum frequency[f]
00	t > 834 nsec	f < 599 Kpps
01	t > 250 nsec	f < 2.0 Mpps
02	t > 500 nsec	f < 1.0 Mpps
03	t > 1.8 μsec	f < 277 Kpps
04	t > 3.6 μsec	f < 138 Kpps
05	t > 7.2 μsec	f < 69 Kpps
06	t > 125 nsec	f < 4 Mpps
07	t > 83.4 nsec	f < 5.9 Mpps

7. Adjustment / Functions [Functions of Group 8]

Command pulse	Command pulse timing
Positive Move Pulse + Negative Move Pulse	
Two-Phase Pulse Train of 90 Degrees Phase Difference	
Code + Pulse Train	

	Positive Move Pulse + Negative Move Pulse	Two-Phase Pulse Train of 90 Degrees Phase Difference	Code + Pulse Train
t1・t8	≦0.1 μs	≦0.1 μs	≦0.1 μs
t2・t9	≦0.1 μs	≦0.1 μs	≦0.1 μs
ts1・ts2 ts3・ts4	＞T	＞T	＞T
t4・t5・t6・t7	——	＞250ns	——
(t3/T)x100	50%	50%	50%

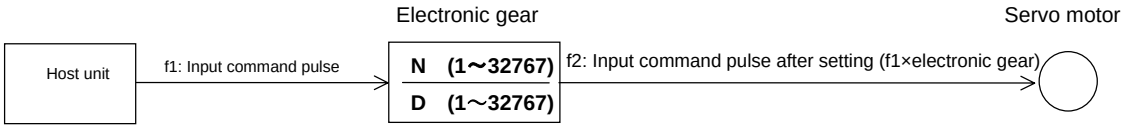
[Group 8]15,16

Electric Gear Ratio * [GER*]

Position control mode

This function allows a distance setting on the servo motor in reference to the location command pulse from the unit.

Setting range	Unit	Standard set value
1/32767～32767/1	—	1/1



Electronic gear setting range: $\frac{1}{32767} \leqq \frac{N}{D} \leqq \frac{32767}{1}$

Refer to “Materials; Electronic Gear”.

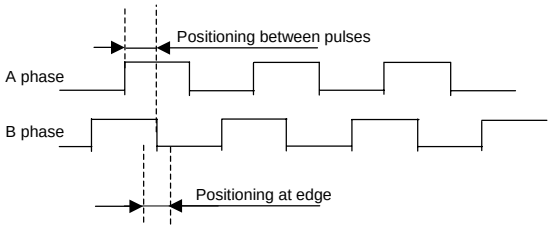
[Group 8] 17

Positioning Method [EDGEPOS]

Position control mode

The location of positioning stop is selected; between encoder pulses or at edge.

Selected value	Contents
00:_Pulse_Interval	Specify Pulse Interval
01:_Pulse_Edge	Specify Pulse Edge



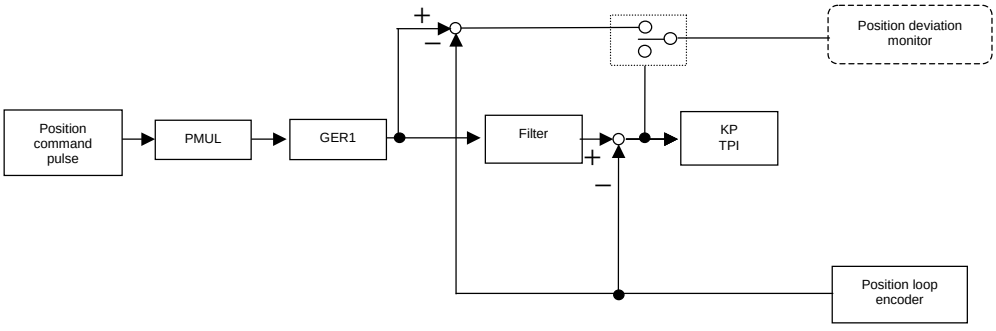
[Group 8] 18

In position / Position Deviation Monitor [PDEVMON]

Position control mode

Positioning complete signal when the position control mode is used, and position command used for outputting position deviation monitor can be selected from before or after the position command filter passes.

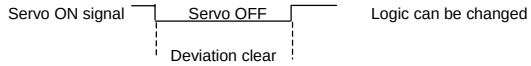
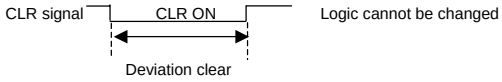
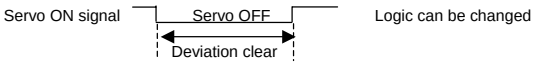
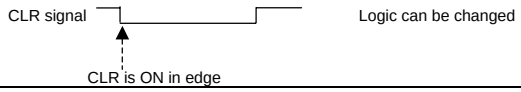
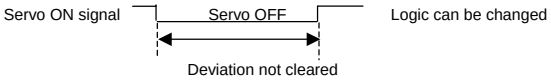
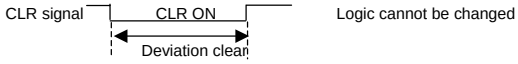
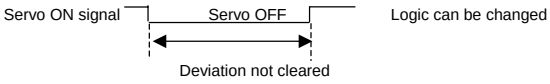
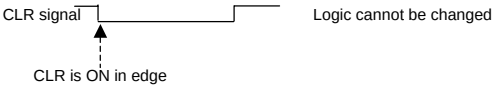
Selected value	Contents
00:_After_Filter	Compare "Position Command Value After Filter Passes by" with "Feedback Value"
01:_Before_Filter	Compare "Position Command Value Before Filter Passes by" with "Feedback Value"



[Group 8] 19

Deviation Clear Selection [CLR] Position control mode

This function is used for changing the location deviation counter in the servo amplifier from the host unit to zero.

Selection		Description
0H	When SERVO-OFF/ Clear Deviation : Deviation Clear Input/ Level Detection	・Deviation is always cleared when servo is off.  ・Deviation is always cleared when deviation clear input is ON. 
1H	When SERVO-OFF/ Clear Deviation : Deviation Clear Input/ Edge Detection	・Deviation is always cleared when servo is off.  ・Deviation is cleared in the edge when deviation clear input becomes OFF/ON. 
2H	When SERVO-OFF/ Not Clear Deviation : Deviation Clear Input/ Level Detection	・Deviation is not cleared when servo is OFF. ・The motor may start suddenly after servo is turned ON with location deviation detected.  ・Deviation is cleared in the edge when deviation clear input becomes OFF/ON. 
3H	When SERVO-OFF/ Not Clear Deviation : Deviation Clear Input/ Edge Detection	・Deviation is not cleared when servo is OFF. ・The motor may start suddenly after servo is turned ON with location deviation detected.  ・Deviation is cleared in the edge when deviation clear input becomes OFF/ON. 

Select the conditions for enabling deviation clear.

Parameter Group9 page04	CLR : Deviation Clear Function

[Group 8] 20 to 22

Preset Velocity Command1 to 3 [VC*] Velocity control mode

The servo motor can be controlled using Preset Velocity Command. Preset Velocity Command settings have 3 ways. Preset Velocity Command and rotation direction can be selected via conditions of generic input CONT1 to CONT8.

1. Set the Preset Velocity Command value.

Parameter Group8Page20	VC1: Preset Velocity Command 1	0 to 32767min^{-1}
Parameter Group8Page21	VC2: Preset Velocity Command 2	0 to 32767min^{-1}
Parameter Group8Page22	VC3: Preset Velocity Command 3	0 to 32767min^{-1}

2. Select the conditions for enabling the Preset Velocity Command. The Preset Velocity Command requires the selection of valid conditions.

Parameter Group9Page20	SP1: Preset Velocity Command, Select Input 1
Parameter Group9Page21	SP2: Preset Velocity Command, Select Input 2

SP1 : Preset Velocity Command, Select Input 1 SP2 : Preset Velocity Command, Select Input 2	Valid Invalid	→	VC1: internal velocity command 1
SP1 : Preset Velocity Command, Select Input 1 SP2 : Preset Velocity Command, Select Input 2	Invalid Valid	→	VC2: internal velocity command 2
SP1 : Preset Velocity Command, Select Input 1 SP2 : Preset Velocity Command, Select Input 2	Valid Valid	→	VC3: internal velocity command 3
SP1 : Preset Velocity Command, Select Input 1 SP2 : Preset Velocity Command, Select Input 2	Invalid Invalid	→	Analog velocity command

3. Begin operation with the Preset Velocity Command and select the conditions for rotation direction.

Parameter Group9Page22	DIR: Preset Velocity Command, Direction of Move
Parameter Group9Page23	RUN: Preset Velocity Command, Operation Start Signal Input
Parameter Group9Page24	RUN-F: Preset Velocity Command, Positive Move Signal Input
Parameter Group9Page25	RUN-R: Preset Velocity Command, Negative Move Signal Input

4 If the above conditions are valid, run the servo motor with the selection combinations listed below.

RUN: Preset Velocity Command, Operation Start Signal Input	Valid	Servo motor moves forward
DIR: Preset Velocity Command, Direction of Move	Invalid	
RUN: Preset Velocity Command, Operation Start Signal Input	Valid	Servo motor in reverse
DIR: Preset Velocity Command, Direction of Move	Valid	

RUN-F: Preset Velocity Command, Positive Move Signal Input	Valid	Servo motor moves forward
RUN-R: Preset Velocity Command, Negative Move Signal Input	Valid	Servo motor in reverse

[Group 8] 24

Preset Velocity Compensation Command [VCOMP] Position control mode

The velocity compensation addition function is the fast-forward function in the velocity control system. Preset Velocity Compensation Function becomes effective by setting Preset Velocity Compensation Command value and availability of Velocity Compensation Function.

1. Set the Preset Velocity Compensation Command value.

Parameter Group8 Page24	VCOMP : Preset Velocity Compensation Command	-9999 to +9999 min^{-1}

2. Select the condition for enabling the Velocity Compensation Function and then input the setting.

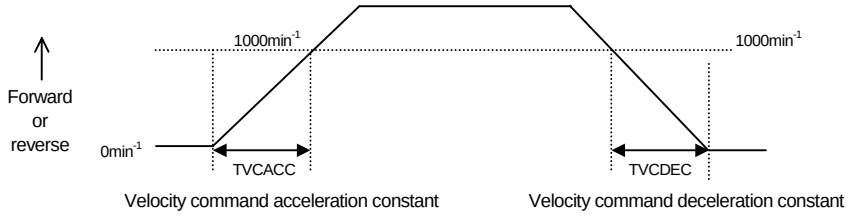
Parameter Group9 Page27	VCOMPS : Velocity Compensation Function, Select Input

[Group 8] 26 to 27

Velocity Command, Acceleration Time Constant. [TVCACC]
Velocity Command, Deceleration Time Constant. [TVCDEC] Velocity control mode

The step input velocity command can be changed to a constant acceleration/deceleration velocity command using the Velocity Command, Acceleration/Deceleration Time Constant.
Acceleration/deceleration time per ±1000min^{-1} is set.

Parameter Group8Page26	TVCACC : Velocity Command, Acceleration Time Constant.	0～16000 ms
Parameter Group8Page27	TVCDEC : Velocity Command, Acceleration Time Constant.	0～16000 ms



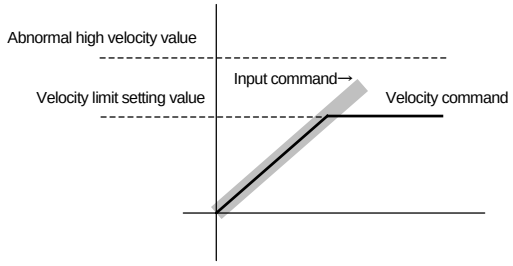
26 and 27 are commonly applicable to the following commands: Analog Velocity Command, Internal Velocity Command, and JOG Velocity Command.

[Group 8] 28

Velocity Limit [VCLM] Velocity control mode Position control mode

A host limit value can be locked in with the velocity limit command.
This value cannot be set to exceed the velocity capabilities of the adjoining motor.

Parameter Group8Page28	VCLM : Velocity Limit	1～65535 min^{-1}



7. Adjustment / Functions [Functions of Group 8]

[Group 8] 31 to 32

Preset Torque Compensation Command 1 [TCOMP1] Preset Torque Compensation Command 2 [TCOMP2]
Torque Compensation Function, Select Input 1 [TCOMPS1] Torque Compensation Function, Select Input 2 [TCOMPS2]

Velocity control mode Position control mode

The torque addition function is the fast-forward function of the torque control system. Torque Compensation Function becomes effective by setting internal torque addition command value and availability of Torque Compensation Function.

1. Sets the internal torque addition command value.

Parameter Group8 Page31	TCOMP : Preset Torque Compensation Command 1	-500 to +500 %
Parameter Group8 Page32	TCOMP : Preset Torque Compensation Command 2	-500 to +500 %

2. Select the condition for enabling the torque addition function and then input the setting.

Parameter Group9 Page30	TCOMPS1 : Torque Compensation Function, Select Input 1
Parameter Group9 Page31	TCOMPS2 : Torque Compensation Function, Select Input 2

[Group 8] 36

Torque Limit, Input Selection [TLSEL] Internal Torque Limit [TCLM]

Velocity control mode Position control mode Torque control mode

The internal torque limit (constant) can be used to limit the maximum torque and protect the unit mechanism. Torque limit function becomes effective by setting Internal torque limit value and availability of Torque limit function.

1. Internal torque limit value setting

Parameter Group8 Page36	TCLM : Internal Torque Limit	10～500%

2. Torque limit function enable

Parameter Group9 Page32	TL: Torque limit function

Conditions for enabling torque limit permission function are selected. When conditions are valid, torque limit is permitted and operation starts.

* If the value is set higher than the maximum output torque (T_P) of the servo motor, it will be limited by (T_P).
* Set this value after considering the acceleration time. Too low of a setting can result in insufficient acceleration torque and poor control.
* The internal torque limit should be set higher than the acceleration torque.
* The internal torque limit is identical for forward and reverse rotation. Separate torque limits cannot be set.

[Group 8] 37

Torque Limit at Sequence Operation [SQTCLM]

Velocity control mode Position control mode Torque control mode

During the sequence operation the output torque is limited. Limiting the output torque protects the unit mechanism.

The torque limits during sequence operation support the following sequence operations:

- JOG operation
- Over travel operation
- Securing brake standby time
- Servo brake operation

Sequence operation torque limit value setting

Parameter Group 8 Page37	SQTCLM：Torque Limit at Sequence Operation	10～500%

If this value is set higher than the maximum output torque (TP) of the servo motor, it will be limited by (TP).

[Group 8] 40

In-Position Near Range [NEAR] Position control mode

Outputs signal indicating proximity to position completion.

This is used together with positioning complete signal (INP) and near range of positioning complete is output.

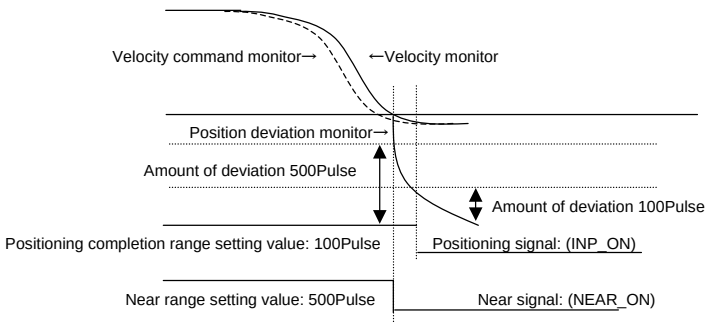
Parameter Group8Page40	NEAR：In-Position Near Range	1～65535 Pulse

Parameter GroupAPage0＊	OUT*：General Purpose Output＊

Selection		Description
1A	NEAR_ON	The output is ON during In-Position Near status (position deviation < NEAR).
1B	NEAR_OFF	The output is OFF during In-Position Near status (position deviation < NEAR).

Determine the logical status of the NEAR signal output, and to which output terminal to assign the positioning completion signal output. The assignment of the output terminal is the same location as the positioning completion signals (above).

If set to a value greater than the positioning completion range settings, the host unit receives the NEAR signal before receiving the positioning completion signal (INP), and transition to the positioning completion operations is enabled.



[Group 8] 41

In-Position Window [INP] Position control mode

The positioning completion signal is output from the selected output terminal when servo motor movement is completed (reaches the set deviation counter value) during location control mode.

Setting the positioning completion range

Parameter Group8Page41	INP : In-Position Window	1～65535 Pulse

Set the deviation counter value with positioning completion signals. The encoder pulse is standard, irrespective of the command pulse multiplication and electronic gear settings.

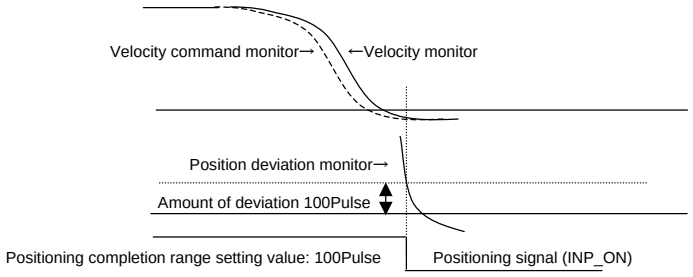
Incremental encoder: 4 times (4x) encoder pulses are standard.
Absolute encoder: absolute value is standard.

Setting the positioning completion signal

Parameter GroupA Page0 ∗	OUT* : General Purpose Output ∗

Selection		Description
18	INP_ON	The output is ON during In-Position status (position deviation < INP).
19	INP_OFF	The output is OFF during In-Position status (position deviation < INP).

Determine the logical status of the positioning completion signal output, and to which output terminal to assign the positioning completion signal output.



[Group 8] 43 to 45

Low Speed Range [LOWV] Speed Matching Width [VCMP] High Speed Range [VA]

Position control mode Velocity control mode Torque control mode

This parameter affects settings for the speed output range. The signal can be output from general output (OUT1～OUT8) and used as a valid condition for all functions. However, the speed coincidence range is invalid in torque control mode.

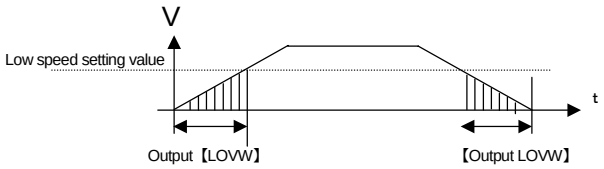
To direct signals to the host unit, make assignments to the signals in parameter Group 9. Use the general output terminal (OUT1～OUT8) of the connected CN1.

Parameter GroupA Page0＊	OUT*：General Purpose Output＊

Selection		Description
10	LOWV_ON	The output is ON during low speed status (speed is less than LOWV).
11	LOWV_OFF	The output is OFF during low speed status (speed is less than LOWV).
12	VA_ON	The output is ON during high speed status (speed is more than VA).
13	VA_OFF	The output is OFF during high speed status (speed is more than VA).
14	VCMP_ON	The output is ON during speed matching status (speed deviation < VCMP).
15	VCMP_OFF	The output is OFF during speed matching status (speed deviation < VCMP).

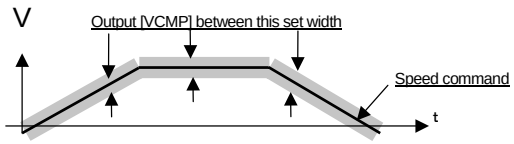
Low speed range: Low speed signal is sent if speed goes below the set value.

Parameter Group8 Page43	LOWV：Low speed range	0～65535min^{-1}



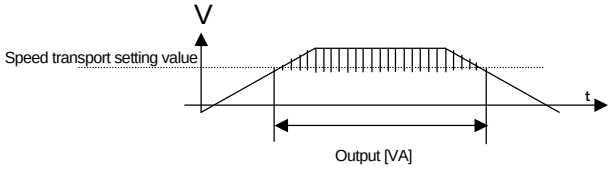
Speed Matching Width: Speed coincidence range signal is given if speed deviation reaches the set range.

Parameter Group8 Page44	VCMP：Speed Matching Width	0～65535min^{-1}



Speed transport settings: Speed transport signal is given if speed exceeds the set value.

Parameter Group1 Page08	VA：High Speed Range	0～65535min^{-1}

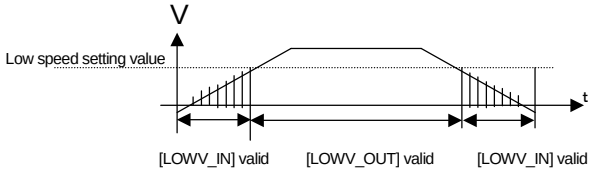


7. Adjustment / Functions [Functions of Group 8]

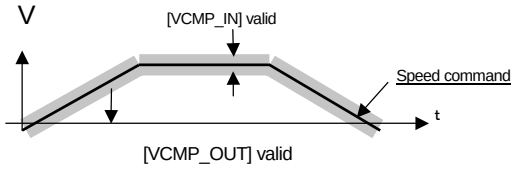
Various functions can be made valid without output signals taken into the host unit when this is used together with Group9 function enabling conditions (input signals).

Selection		Description
12	LOWV_IN	Enable the function during low speed status (speed is less than LOWV).
13	LOWV_OUT	Enable the function while low speed status is not kept.
14	VA_IN	Enable the function during high speed status (speed is more than VA).
15	VA_OUT	Enable the function while high speed status is not kept.
16	VCMP_IN	Enable the function during speed matching status (speed deviation < VCMP).
17	VCMP_OUT	Enable the function while speed matching status is not kept.

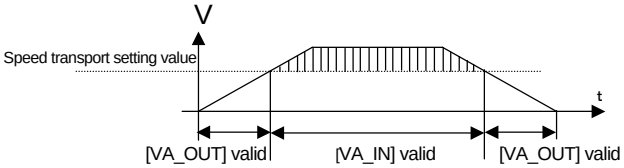
Low speed status [LOWV_IN]: Function is enabled during low speed status (speed below LOWV set value).
Low speed status [LOWV_OUT]: Function is enabled outside of low speed status (speed below LOWV set value).



Speed coincidence status [VCMP_IN]: Function is enabled during speed coincidence status
(speed deviation below VCMP set value).
Speed coincidence status [VCMP_OUT]: Function is enabled outside of speed coincidence status
(speed deviation below VCMP set value).



Speed transport status [VA_IN]: Function is enabled during speed transport status (speed above VA set value).
Speed transport status [VA_OUT]: Function is enabled outside of speed transport status (speed above VA set value).



■ Functions of Group 9

[Group 9] 00 to 01

Positive Over-Travel Function [F-OT]

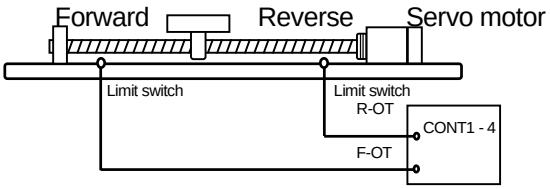
Position control mode Velocity control mode Torque control mode

Negative Over-Travel Function [R-OT]

The over travel function uses a limit switch to prevent failure or damage to the unit. It stops the unit when the movement range of the moving part is exceeded.

1. Allocate the over travel input signal to CONT1 – CONT4.

Parameter Group9 Page00	F-OT : Positive Over-Travel Function
Parameter Group9 Page01	R-OT : Negative Over-Travel Function



2. If the over travel function is used, select the operating conditions of "Position command input, Servo motor stop operation and Servo ON signal" in the case of over travel.

Parameter GroupB Page11	ACTOT : Over-Travel Action Selection

Selected value	Contents
00:_CMDINH_SB_SON	・PC is inhibited and Servo-Braking is performed. After stops, S-ON is operated. (At OT, command disabled = velocity limit command = 0)
02:_CMDINH_Free_SON	・PC is inhibited and Free-Run is performed. After stops, Servo-ON is operated. (At OT, command disabled = velocity limit command = 0)
03:_CMDINH_SB_SOFF	・PC is inhibited and Servo-Braking is performed. After stops, S-OFF is operated.
05:_CMDINH_Free_SOFF	・PC is inhibited and Free-Run is performed. After stops, Servo-OFF is operated.
06:_CMDACK_VCLM=0	・Position Command is accepted and Velocity Limit is zero.

If "the motor is stopped by servo brake operation" [00:_CMDINH_SB_SON][03:_CMDINH_SB_SOFF] is selected when over travel occurs, torque at the time of servo brake operation can be set at the sequence torque operation limit value.

Parameter Group8 Page37	SQTCLM: Torque Limit at Sequence Operation	10～500%

If the value is set higher than the maximum output torque (TP) of the servo motor, it will be limited by (TP).

[Group 9] 02

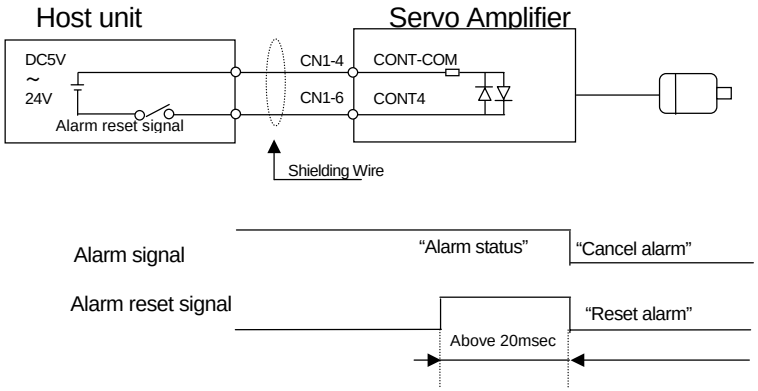
Alarm Reset Function [AL-RST] Position control mode Velocity control mode Torque control mode

This function enables the sending of an alarm reset signal from the host unit. An alarm is cleared by enabling alarm reset function (AL-RST).

The conditions for enabling alarm reset function are assigned. The alarm is cleared if the AL-RST signal is valid.

Parameter Group9 Page02	AL-RST : Alarm Reset Function

The following circuit is created when valid conditions are assigned to CONT4. The logic can also be modified by the allocation of valid conditions.



∗Note that any alarm not cleared by simply turning OFF the control power supply cannot be cleared with the alarm reset signal.

[Group 9] 05

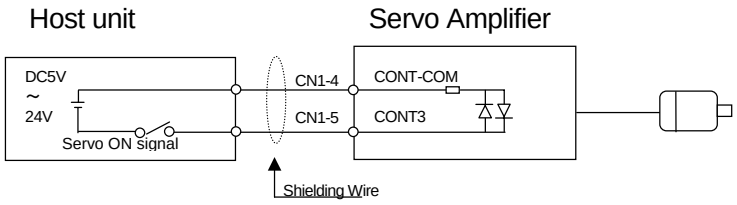
SERVO-ON Function [S-ON] Position control mode Velocity control mode Torque control mode

This function enables the sending of a servo ON signal from the host unit. The servo motor can be set to "ready" status by enabling the servo ON function (SON).

The conditions for enabling the Servo ON function are assigned. The servo motor is set to "ready" status when the SON signal is enabled.

Parameter Group9 Page05	S-ON : SERVO-ON Function

The following circuit is created when valid conditions are assigned to CONT3.The logic can also be modified by the allocation of valid conditions.



[Group 9] 10

Control Mode Switching Function [MS] Position control mode Velocity control mode Torque control mode

2 types of control mode can be switched and used. The control mode to be combined is selected by system parameter and can be switched with control mode switch over function.

Control mode is selected from system parameter Page 08.

Page	Name	Setting range
08	Control Mode	6 ways

Setting	Contents
03：_Velo－Torq	Velocity Control Mode — torque control switching type
04：_Posi－Torq	Position Control Mode — torque control switching type
05：_Posi－Velo	Position control — velocity control switching type

After setting has been changed →The value becomes valid when control power is turned ON again.

Conditions enabling control mode switch over function are allocated. When MS signal is valid, control mode is switched.

Parameter Group9 Page10	MS：Control Mode Switching Function

✍ When control mode switch over type is in use, there is a possibility that “auto-notch frequency tuning”, “auto-vibration suppressing frequency tuning”, and “JOG operation” cannot be used. Switch the control mode to the base side (disable MS) prior to using “auto-notch frequency tuning”, “auto-vibration suppressing frequency tuning”, and “JOG operation”.

[Group 9] 11

Position Command Pulse Inhibit Function and Velocity Command Zero Clamp Function [INH/Z-STP]

Velocity control mode Position control mode

This can be used as position command pulse inhibit function (INHIBIT function) in the position control type, and as zero velocity stop function in the velocity control type.
When the function is enabled while servo motor is operating, input command is inhibited and the servo motor stops at servo motor excitation status. In the position control type, even if position command pulse is input, the input pulse is not counted in the servo amplifier.

Conditions enabling position command pulse inhibit function, zero velocity stop function are allocated. When signals of INH/Z-STP are valid, this will function.

Parameter Group9 Page11	INH/Z-STP：Position Command Pulse Inhibit Function / Velocity Command Zero-speed Clamp Function

[Group 9] 13, 14

Gain Switching Function, Select Input 1 [GC1] Gain Switching Function, Select Input 2 [GC2]

Position control mode Velocity control mode Torque control mode

4 types of gains can be switched and used.

Conditions enabling gain switch over are allocated. When the signal of GC1 and GC2 combination is valid, the set value of corresponding GAIN becomes enabled.

Parameter Group9 Page13	GC1：Gain Switching Function, Select Input 1
Parameter Group9 Page14	GC2：Gain Switching Function, Select Input 2

GC1：Gain Switching Function, Select Input 1	Disabled	Enabled	Disabled	Enabled
GC2：Gain Switching Function, Select Input 2	Disabled	Disabled	Enabled	Enabled
	↓	↓	↓	↓
Gain to be enabled	GAIN 1	GAIN 2	GAIN 3	GAIN4

[Group 9] 15, 16

Position control mode Velocity control mode Torque control mode

Vibration Suppressor Frequency, Select Input 1 [SUPFSEL1]

Vibration Suppressor Frequency, Select Input 2 [SUPFSEL2]

4 types of vibration suppressing frequency can be switched and used.

Conditions for enabling vibration suppressing frequency selection input are allocated. When the signal of SUPFSEL1 and SUPFSEL2 combination is valid, the set value of corresponding vibration frequency becomes enabled.

Parameter Group9 Page15	SUPFSEL1：Vibration Suppressor Frequency, Select Input 1
Parameter Group9 Page16	SUPFSEL2：Vibration Suppressor Frequency, Select Input 2

SUPFSEL1：Vibration Suppressor Frequency, Select Input 1	Disabled	Enabled	Disabled	Enabled
SUPFSEL2：Vibration Suppressor Frequency, Select Input 2	Disabled	Disabled	Enabled	Enabled
	↓	↓	↓	↓
Vibration suppressing frequency to be enabled	Vibration Suppressor Frequency 1 Group2 Page 00	Vibration Suppressor Frequency 2 Group 3 Page 40	Vibration Suppressor Frequency 3 Group 3 Page 41	Vibration Suppressor Frequency 4 Group 3 Page 42

[Group 9] 17

Position Loop Proportional Control, Switching Function [PLPCON]

Position control mode

Switching between position loop PI control ←→ P control is possible. Switching is possible when position loop proportional control switching function (PPCON)is enabled.

The conditions for enabling position loop proportional control switching function are allocated. Switches to proportional control when the signal of PPCON is valid.

Parameter Group9 Page17	PLPCON：Position Loop Proportional Control, Switching Function

PI control (proportional / integral control) ・・・・Position loop proportional gain(KP) / Integral time constant(TPI)
P control (Proportional control) ・・・・Position loop proportional gain(KP)

＊ Position loop integral time constant (TPI)is 1000.0ms at standard setting, therefore, integral function is invalid.

[Group 9] 18

RSW Gain Switching Function [RSWGC]

Position control mode Velocity control mode Torque control mode

Function to set a gain for facility by Servo Gain setting switch (RSW).

The conditions for enabling the RSW gain switching function are assigned.

Parameter Group9 Page18	RSWGC: RSW Gain Switching Function

[Group 9] 26

Velocity Loop Proportional Control, Switching Function [VLPCON]

Velocity control mode Position control mode

Switching between Velocity loop PI control ←→ P control is possible. Switching is possible when Velocity loop proportional control switching function (PCON)is enabled.

The conditions for enabling the velocity loop comparison control switching function are assigned. Change the comparison control when the PCON signal is valid.

Parameter Group9 Page26	VLPCON：Velocity Loop Proportional Control, Switching Function

PI control (comparison / integral control): Velocity loop comparison gain (KVP) / Velocity loop reset time constant (TVI)
P control (Comparison control): Velocity loop comparison gain (KVP)

＊ When set to comparison control, servo gain is reduced and the servo system is made stable.
＊ When the velocity loop reset time constant (TVI) is set to 1000.0ms, it is not necessary to use this function, since the reset time constant in use is invalid (Comparison control)

[Group 9] 40

External Error Input [EXT-E] Position control mode Velocity control mode Torque control mode

This function can output a contact input (such as external thermal) as an alarm (AL55H) in the servo amplifier.

The conditions for enabling the external trip function are assigned. An alarm (AL55H) is given if the EXT-E signal is valid.

Parameter Group9 Page40	EXT-E : External Error Input

[Group 9] 42

Emergency Stop Function [EMR] Position control mode Velocity control mode Torque control mode

This function enables an emergency stop of the servo motor after receiving an emergency stop signal in the servo amplifier.

The conditions for enabling the unit emergency stop signal are assigned. The unit emergency stop function is executed when the EMR signal is valid.

Parameter Group9 Page42	EMR : Emergency Stop Function

■ Functions of Group B

[Group B] 10

Dynamic Brake Action Selection [DBOPE] Position control mode Velocity control mode Torque control mode

Conditions for stop at servo OFF can be selected from Servo brake / Free run.

Parameter GroupB Page10	DBOPE: Dynamic Brake Action Selection

Selected value	
00:_Free_Free	When Servo-OFF, Free-Run is operated. After stops, Motor-Free is operated.
04:_SB__Free	When Servo-OFF, Servo-Braking is performed. After stops, Motor-Free is operated.

[Group B] 12

Forced stop operation [ACTEMR] Position control mode Velocity control mode Torque control mode

When forced stop is executed by power shut off while servo motor is operating (servo motor is not stopped), conditions for servo motor stop can be selected from servo brake / Free run.

Parameter GroupB Page12	ACTEMR：Emergency Stop Operation

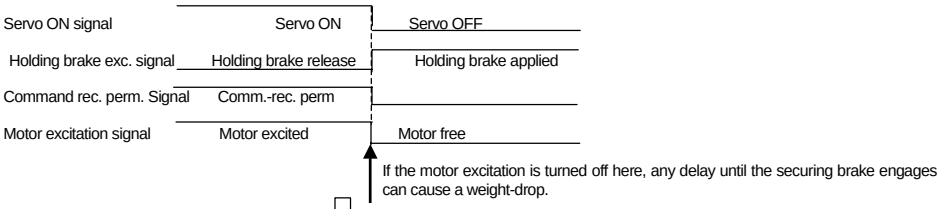
Selected value	Contents
00:_SERVO-BRAKE	When EMR is input, motor is stopped by servo brake operation.
01:_Free	When EMR is input, motor is stopped by free run.

[Group B] 13

Position control mode Velocity control mode Torque control mode

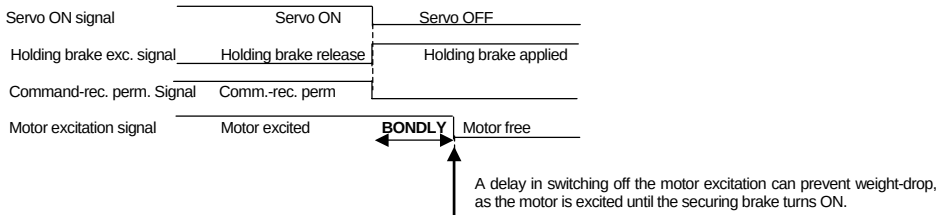
Delay Time of Engaging Holding Brake [BONDLY]

This function is enabled during servo brake operation at servo OFF. It is disabled for dynamic brake and free-run.



Set the delay time for the holding brake operation

Parameter GroupB Page13	BONDLY：Delay Time of Engaging Holding Brake	0～1000ms



・The setting increment is 4 msec. If the setting is 0 msec, the command is disabled (forced zero) for 4 msec after SON.

・The securing brake excitation signal can be output through the generic outputs (OUT1～OUT5).

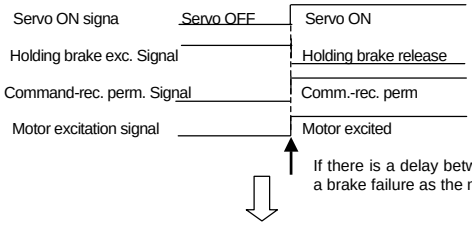
Parameter GroupA Page0＊	OUT*：General Purpose Output*

0A:_MBR-ON_ON	The output is ON while holding brake excitation signal outputs.
0B:_MBR-ON_OFF	The output is OFF while holding brake excitation signal outputs.

[Group B] 14

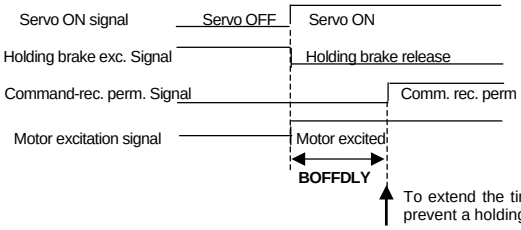
Position control mode Velocity control mode Torque control mode

Delay Time of Releasing Holding Brake [BOFFDLY]



・Set the delay time for the holding brake release

Parameter GroupB Page14	BOFFDLY : Delay Time of Releasing Holding Brake	0～1000ms



・The setting increment is 4 msec. If the setting is 0 msec, the command is disabled (forced zero) for 4 msec after SON.

・The securing brake excitation signal can be output through the generic outputs (OUT1～OUT8).

Parameter Group9 Page0 *	OUT* : General Purpose Output *

0A:_MBR-ON_ON	The output is ON while holding brake excitation signal outputs.
0B:_MBR-ON_OFF	The output is OFF while holding brake excitation signal outputs.

[Group B] 15

Brake Operation Beginning Time [BONBGN] Position control mode Velocity control mode Torque control mode

If the motor does not stop within the time frame set for the brake operation start (BONBGN)when the servo is turned OFF, the securing brake and the dynamic brake force the motor to stop. The function can be disabled by setting the value to “0”ms. The setting increment is 4msec; therefore, set the value to 4 msec or higher.

Parameter GroupB Page15	BONBGN : Brake Operation Beginning Time	0～65535ms

* The term “motor does not stop” (above) means that the motor velocity does not fall below the zero velocity (ZV) range.
* The stop sequence is different depending on the condition settings of the emergency stop operation.
* When the brake operation start time（BONBGN）passes, the servo motor will be forced to stop by both the dynamic brake and the securing brake, which can cause damage to the securing brake. Therefore, use this function only after considering the specifications and the sequence of the unit.

[Group B] 16

Power Failure Detection Delay Time [PFDDLY]Position control mode Velocity control mode Torque control mode

This function can set a delay period, after power off of the control power supply, for detecting problems in the control power supply. Detection of unexpected power failure is diminished when this value is increased. However, even if this value is increased and problem detection is delayed, when the power supply to the internal logic circuit is exhausted, routine operations at the time of control power supply cut off / restart will continue.

Parameter GroupB Page16	PFDDLY：Power Failure Detection Delay Time	20～1000 ms

＊The actual anomaly detection delay time compared to the selected value can vary between -12ms and +6ms.

[Group B] 20

Following Error Warning Level [OFWLV]

Position control mode Velocity control mode Torque control mode

This function gives a warning before reaching excessive deviation alarm status.

Set the deviation excessive warning value.

Parameter GroupB Page20	OFWLV：Following Error Warning Level	1～65535 × 1024 pulse

For sending the signals to the host unit, assign the signals in parameter Group A. Output from general output number (OUT1～OUT5) of the connected CN1.

Parameter GroupA Page0＊	OUT*：General Purpose Output＊

2A:_WNG-OFW_ON	The output is ON during following warning status (position deviation > OFWLV).
2B:_WNG-OFW_OFF	The output is OFF during following warning status (position deviation > OFWLV).

[Group B] 21

Following Error Limit [OFLV] Position control mode Velocity control mode Torque control mode

Parameter to set the value for outputting excessive position deviation alarm. Encoder pulse is the standard irrespective of electronic gear or command multiplication functions.

Deviation counter overflow value is set.

Parameter GroupB Page21	OFLV：Following Error Limit	1～65535 × 1024 pulse

[Group B] 22

Overload Warning Level [OLWLV] Position control mode Velocity control mode Torque control mode

This function will send a warning before reaching overload alarm status. Set the ratio corresponding to the overload alarm value to 100%. When set to 100%, the overload warning and overload alarm are given simultaneously.

Set the overload warning level.

Parameter GroupB Page22	OLWLV：Overload Warning Level	20～100 %

For sending the signals to the host unit, assign the signals in parameter Group 9. Output from general output terminal (OUT1～OUT5) of the connected CN1.

Parameter GroupA Page0＊	OUT*：General Purpose Output＊

2C:_WNG-OLW_ON	The output is ON during over-load warning status.
2D:_WNG-OLW_OFF	The output is OFF during over-load warning status.

■ Functions of Group C

[Group C] 01

Position control mode Velocity control mode Torque control mode

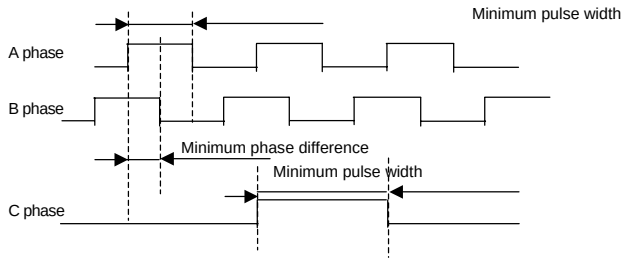
Motor Incremental Encoder, Digital Filter [ENFIL]

You can set the digital filer value of the incremental pulse for the selected incremental encoder. When noise is superimposed on the incremental encoder, the pulse below the set value is removed as noise. Set this value by considering the frequency of pulses from the selected encoder and the maximum number of rotations of the servo motor. If the input value is greater than the encoder frequency during the peak rotation of the servo motor, the encoder pulse is removed and the servo motor will stop.

Selection for motor incremental encoder digital filter

Parameter GroupC Page01	ENFIL : Motor Incremental Encoder, Digital Filter

Selected value	Contents
00:_110nsec	Minimum Pulse Width=110nsec (Minimum Pulse Phase Difference = 37.5nsec)
01:_220nsec	Minimum Pulse Width=220nsec
02:_440nsec	Minimum Pulse Width=440nsec
03:_880nsec	Minimum Pulse Width=880nsec
04:_75nsec	Minimum Pulse Width=75nsec (Minimum Pulse Phase Difference = 37.5nsec)
05:_150nsec	Minimum Pulse Width=150nsec
06:_300nsec	Minimum Pulse Width=300nsec
07:_600nsec	Minimum Pulse Width=600nsec



[Group C] 05

Encoder Output Pulse, Divide Ratio [ENRAT]

Position control mode Velocity control mode Torque control mode

The encoder signals (Phase A/ Phase B) used in the host unit can be output according to a ratio formula. When using in the host unit's position loop control, input the result (obtained after dividing the number of encoder pulses) as an integer. However, when using this function to monitor the host unit, input a ratio that is as close to the setup value as possible.

The output of Z phase is not divided. Output can be sin O/C（CN1-11）.

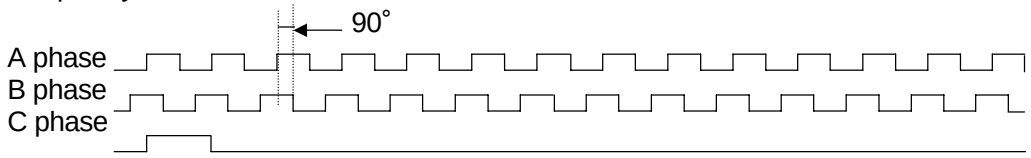
Division ratio for the encoder pulse divider output is set.

Parameter GroupC Page05	ENRAT：Encoder Output Pulse, Divide Ratio	1/1～1/8192

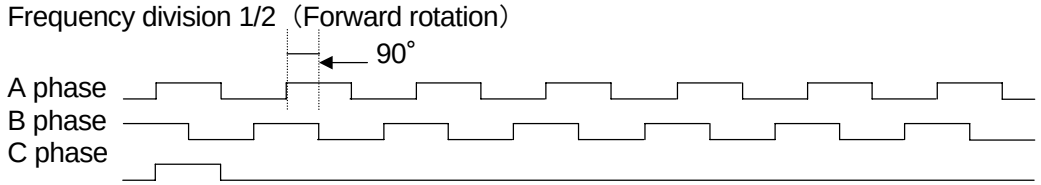
The following settings are possible.

When numerator is "1" : 1/1～1/64、1/8192 can be set.
When numerator is "2" : 2/3～2/64、2/8192 can be set.
When denominator is "8192" : 1/8192 ～ 8191/8192 can be set.

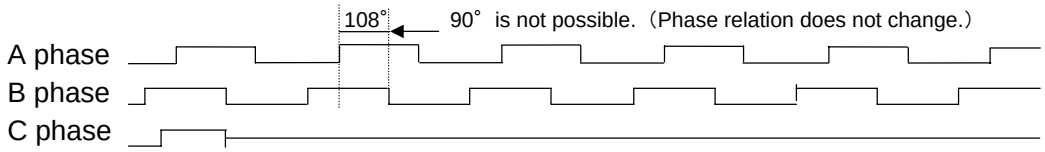
Frequency division 1/1（Forward rotation）



Frequency division 1/2（Forward rotation）



Frequency division 2/5（Forward rotation）



＊ Destabilizes for 0.2 sec after control power is supplied.

[Group C] 06

Encoder Pulse Divided output, Polarity [PULOUTPOL]

Position control mode Velocity control mode Torque control mode

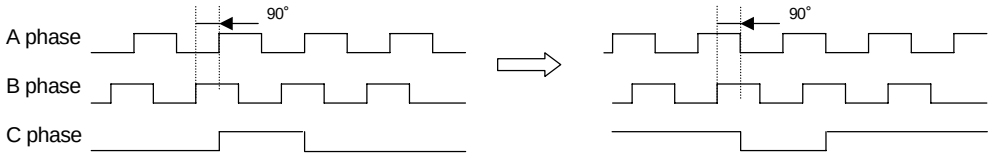
The polarity of the encoder pulse frequency output can be selected.

Parameter GroupC Page06	PULOUTPOL : Encoder Pulse Divided output, Polarity

Selected value	Contents
00:_Type1	A-Phase Signal / Not Reversed : C-Phase Signal Logic / High Active
01:_Type2	A-Phase Signal / Reversed : C-Phase Signal Logic / High Active
02:_Type3	A-Phase Signal / Not Reversed : C-Phase Signal Logic / Low Active
03:_Type4	A-Phase Signal / Reversed : C-Phase Signal Logic / Low Active

Setting 00H (Frequency division ratio 1/1: with forward rotation)
Using the incremental encoder

Setting 03H(Frequency division ratio 1/1: with forward rotation)
Using the incremental encoder



[Group C] 08

Absolute Encoder Clear Function Selection [ECLRFUNC]

Position control mode Velocity control mode Torque control mode

Select the conditions for enabling absolute encoder clear.

Parameter Group9 Page03	ECLR : Absolute Encoder Clear Function

When using the absolute encoder with back-up battery system, you can select the contents to be cleared.

Clear “Warning + multiple rotation data”

Clear only “Warning”

Parameter GroupC Page08	ECLRFUNC : Absolute Encoder Clear Function Selection

Selected value	Contents
00:_Status_MultiTurn	Clear Encoder Status (Alarm and Warning) and Multi Turn Data
01:_Status	Clear Only Encoder Status

* These conditions are applicable only to the absolute encoder.
* Do not input this while the servo motor is rotating. Confirm that the servo motor stops before inputting this.

[Group C] 10

Tachogenerator Velocity Scale Range Setting [TG_SCALING]

Speed control mode Torque control mode

Set the scale range of velocity of the tachogenerator when velocity is detected.

Parameter Group C Page 10	TG_SCALING : TG Velocity scaling

Factory default setting value of velocity command voltage (V_{CMD}) = Motor speed (N) per 3V = 1,000 (min^{-1})
When motor combination varies the value, adjust TG velocity scale (TG_SCALING) range as the following ways.
Ex.

- V_{CMD} = Motor speed (N) per 3 V = 1000 min^{-1} < or more : Increase TG SCALING Value.
- V_{CMD} = Motor speed (N) per 3V = 1000 min^{-1} > or less : Decrease TG SCALING Value.

* These conditions apply only to a Tachogenerator.

[Group C] 11

Tachogenerator Velocity Offset Setting [TG_OFFSET]

Speed control mode Torque control mode

Sets Velocity Offset value of the tachogenerator when velocity is detected.

Parameter Group C Page 11	TG_OFFSET : T G Velocity Offset

If the servo motor shaft still rotates even if the Analog Velocity command (v_{CMD}) = 0V, adjust TG velocity offset (TG_OFFSET) as the following procedure to stop the motor shaft regardless preset value of factory default setting,

<Adjustment of TG velocity offset>

1.: Set "Servo Off" (SOFF)

2.: Set up "R/T_SET_UP" to execute a necessary adjustment as the below

Select [Test run and Adjustment (T)] in the menu bar.

↓

Select and execute [Analog Offset Adjustment of (T-COMP)].

* These conditions apply only to a Tachogenerator.

[Group C] 12

Tachogenerator Output Voltage Polarity Setting [TG_POL]

Speed Control Mode Torque Control Mode

Sets the Output voltage polarity of the tachogenerator.

Parameter Group C Page 12	TG_POL : Tachogenerator Output Voltage Polarity Setting

Set the polarity for counterclockwise operation.

Setting Range	Description
00h	Counterclockwise operation, + Output、
01h	Counterclockwise operation, - Output

* These conditions apply only to a Tachogenerator.

■ Description of Monitor

All signals and internal status of the servo amplifier can be monitored. There are 2 kinds of monitors.

1. Analog monitor { Monitor box and dedicated monitor cable are needed. Refer to "Materials; Option, Monitor box". Refer to "Chapter 1, Prior to Use, Servo Amplifier Part Names 1-5" for locations for connectors to be connected.
2. Monitor in display (Setup software-R-SETUP)

● **Analog monitor** (2 channels)

[Group A]11 to 13

Analog Monitor 1, Output Signal Selection [MON1]
Analog Monitor 2, Output Signal Selection [MON2]
Analog Monitor, Output Polarity [MONPOL]

Position control mode Velocity control mode Torque control mode

Analog monitor for use is selected.

Parameter GroupA Page11	MON1 : Analog Monitor 1, Output Signal Selection
Parameter GroupA Page12	MON2 : Analog Monitor 2, Output Signal Selection

Selected value	Contents
00	Reserved
01:_TMON_1V/TR	Torque Monitor 1V/ rated torque (thrust)
02:_TCMON_1V/TR	Torque Command Monitor 1V/ rated torque (thrust)
03:_VMON_0.2mV/ min^{-1}	Velocity Monitor 0.2mV/ min^{-1}
04:_VMON_1mV/ min^{-1}	Velocity Monitor 1mV/ min^{-1}
05:_VMON_2mV/ min^{-1}	Velocity Monitor 2mV/ min^{-1}
06:_VMON_3mV/ min^{-1}	Velocity Monitor 3mV/ min^{-1}
07:_VCMON_0.2mV/ min^{-1}	Velocity Command Monitor 0.2mV/ min^{-1}
08:_VCMON_1mV/ min^{-1}	Velocity Command Monitor 1mV/ min^{-1}
09:_VCMON_2mV/ min^{-1}	Velocity Command Monitor 2mV/ min^{-1}
0A:_VCMON_3mV/ min^{-1}	Velocity Command Monitor 3mV/ min^{-1}
0B:_PMON_0.1mV/P	Position Deviation Monitor 0.1mV/ Pulse
0C:_PMON_1mV/P	Position Deviation Monitor 1mV/ Pulse
0D:_PMON_10mV/P	Position Deviation Monitor 10mV/ Pulse
0E:_PMON_20mV/P	Position Deviation Monitor 20mV/ Pulse
0F:_PMON_50mV/P	Position Deviation Monitor 50mV/Pulse
10:_FMON_2mV/kP/s	Position Command Pulse Input Frequency Monitor 2mV/kPulse/s
11:_FMON_10mV/kP/s	Position Command Pulse Input Frequency Monitor 10mV/kPulse/s
12:_TLMON_EST_2V/TR	Load Torque Monitor (Estimated Value) 2V/ rated torque (thrust)

Select this when polarity is to be changed.

Parameter GroupA Page12	MONPOL: Analog Monitor, Output Polarity

Selected value	Contents
00:_MON1+_MON2+	MON1 : Positive voltage output in forward rotation; output pos and neg voltage. MON2 : Positive voltage output in forward rotation; output pos and neg voltage.
01:_MON1-_MON2+	MON1 : Negative voltage output in forward rotation; output pos and neg voltage. MON2 : Positive voltage output in forward rotation; output pos and neg voltage.
02:_MON1+_MON2-	MON1 : Positive voltage output in forward rotation; output pos and neg voltage. MON2 : Negative voltage output in forward rotation; output pos and neg voltage.
03:_MON1-_MON2-	MON1 : Negative voltage output in forward rotation; output pos and neg voltage. MON2 : Negative voltage output in forward rotation; output pos and neg voltage.
04:_MON1ABS_MON2+	MON1 : Positive voltage output together in forward and reverse rotation MON2 : Positive voltage output in forward rotation; output pos and neg voltage.
05:_MON1ABS_MON2-	MON1 : Positive voltage output together in forward and reverse rotation MON2 : Negative voltage output in forward rotation; output pos and neg voltage.
06:_MON1+_MON2ABS	MON1 : Positive voltage output in forward rotation; output pos and neg voltage. MON2 : Positive voltage output together in forward and reverse rotation
07:_MON1-_MON2ABS	MON1 : Negative voltage output in forward rotation; output pos and neg voltage. MON2 : Positive voltage output together in forward and reverse rotation
08:_MON1ABS_MON2ABS	MON1 : Positive voltage output together in forward and reverse rotation MON2 : Positive voltage output together in forward and reverse rotation

● List of monitors in display

[monitor] 00 to 1E

Page	Name	Contents	Unit
00	Servo Amplifier Status	Displays the statuses of main circuit power being supplied, operation ready and servo ON.	---
01	Warning status 1	Displays warning status.	---
02	Warning status 2	Displays warning status.	---
03	General Purpose Input CONT4 to CONT1 Monitor	Displays generic input terminal status.	---
04	General Purpose Output OUT5 to OUT1 Monitor	Displays generic output terminal status.	---
05	Velocity Monitor	Displays motor rotation velocity.	min^{-1}
06	Velocity Command Monitor	Displays velocity command value.	min^{-1}
07	Torque Monitor	Displays motor output torque.	%
08	Torque Command Monitor	Displays torque command value.	%
09	Position Deviation Monitor	Displays position deviation values.	Pulse
0A	Actual Position Monitor	Displays current position compared with original position when the control power is turned ON. This is a free run counter. Therefore, when current position exceeds the displayed range, the display is maximum value of reversed polarity.	Pulse
0C	Command Position Monitor		
0D	Analog Velocity Command/Analog Torque Command Input Voltage	Displays command voltage being input.	mV
0E	Position Command Pulse Input Frequency Monitor	Displays command pulse frequency being input.	k Pulse/s
10	Absolute Encoder PS Data (High)	Displays absolute encoder position data PS.	x2^32 P
11	Absolute Encoder PS Data (Low)	Displays absolute encoder position data PS.	Pulse
13	Motor Operating Rate Monitor	Displays exact values, however, it may take several hours for the value to become stable depending on the operation pattern.	%
14	Predicted Motor Operating Rate Monitor	Displays estimated value of servo motor usage ratio, which is estimated from a short period of operation. In an application where the same operation pattern repeats in a short period of time, the usage ratio can be confirmed fast.	%
15	Load Inertia (Mass) Ratio Monitor	Values can be confirmed when gain switch over and auto-tuning functions are used.	%
16	Position Loop Proportional Gain Monitor		1/S
17	Position Loop Integral Time Constant Monitor	Values can be confirmed when gain switch over function is used.	ms
18	Velocity Loop Proportional Gain Monitor	Values can be confirmed when gain switch over and auto-tuning function are used.	Hz
19	Velocity Loop Integral Time Constant Monitor		ms
1A	Torque Command Filter Monitor		Hz
1B	Incremental Encoder Signal Monitor	Incremental signal of CN2 is displayed.	-----
1C	Load Torque Monitor (Estimate Value)	Load torque is displayed.	%
1E	Servo Amplifier Operation Time	Counted while control power supply is ON. The time is displayed value × 2 hours.	× 2 hour

*Monitor item of bit code indication please refer to a list shown below.

● Monitor item of bit code indication

		Bit code indication							
Page	Name	7	6	5	4	3	2	1	0
01	Warning status 1	Following Warning	---	During Velocity Limiting	During Torque Limiting		Overload Warning	—	—
02	Warning status 2	---	Absolute encoder battery warning	—	—	Negative Over-Travel	Positive Over-Travel	—	—
03	General Purpose Input CONT4 to CONT1 Monitor	—	—	—	—	CONT4	CONT3	CONT2	CONT1
04	General Purpose Output OUT5 to OUT1 Monitor	—	—	—	OUT5	OUT4	OUT3	OUT2	OUT1
1B	Incremental Encoder Signal Monitor	—	—	—	—	—	Servo motor Encoder Phase C	Servo motor Encoder Phase B	Servo motor Encoder Phase A

7. Adjustment / Functions [Description of Trace Operation]

■ Description of Trace Operation

Display various signals and inside states of Servo Amplifier by an analog signal (four points at the maximum) and a digital signal (four points at the maximum) and can save it. Optional signal name please refer to follows.

● Analog signal select contents

Signal name	Data type (Data length)	Data range	Unit
VMON: Velocity Monitor	2Byte	-32768 ～ 32767	min-1
VCMON: Velocity command Monitor	2Byte	-32768 ～ 32767	min-1
TMON: Torque Monitor	2Byte	-32768 ～ 32767	%
TCMON: Torque command Monitor	2Byte	-32768 ～ 32767	%
PMON: Position Deviation Monitor	4Byte	-2147483648 ～ 2147483647	Pulse
APMON: Actual Position Monitor (Motor Encoder)	4Byte	-2147483648 ～ 2147483647	Pulse
CPMON: Command Position Monitor	4Byte	-2147483648 ～ 2147483647	Pulse
FMON: Position Command Pulse Monitor (Position Command Pulse Input Frequency)	2Byte	-32768 ～ 32767	Pulse
PS-H: Absolute Encoder PS (High)	4Byte	0 ～ 4294967295	x2^32 P
PS-L: Absolute Encoder PS (Low)	4Byte	0 ～ 4294967295	Pulse
OPRT: Motor Operating Rate Monitor	2Byte	0 ～ 65535	%
JRAT_MON: Control Loop Parameter_Load Inertia Moment Ratio Monitor	2Byte	0 ～ 65535	%
TLMON_EST: Load Torque (Estimated Value)	2Byte	-32768 ～ 32767	%
PMON_S: Position Deviation Monitor (2Byte)	2Byte	-32768 ～ 32767	Pulse

● Digital signal select contents

Signal name	Explanation of signal
CONT1: General Purpose Input 1	Indicates input signal state of general purpose input (CONT1-4) terminal. “High”: Input photo coupler ON “Low”: Input photo coupler OFF
CONT2: General Purpose Input 2	
CONT3: General Purpose Input 3	
CONT4: General Purpose Input 4	
OUT1: General Purpose Output 1	Indicates the state of general purpose output (OUT1-5) terminal. (note 1) “High”: Output transistor OFF “Low”: Output transistor ON
OUT2: General Purpose Output 2	
OUT3: General Purpose Output 3	
OUT4: General Purpose Output 4	
OUT5: General Purpose Output 5	
INP: In-Positioning	“High” during positioning complete state.
NEAR: In-Position Near	“High” during near range state.
VCMP: Speed Matching	“High” during velocity conformity state.
TLC: Torque Limiting Operation	“High” during torque limit operation.
VLC: Velocity Limiting Operation	“High” during velocity limit operation.
S-ON: Motor Excitation	“High” during motor excitation.
S-RDY: Servo Ready Complete	“High” during operation ready complete.
CMD-ACK: Command Can be Accepted	“High” during command receive permit state.
PCON-ACK: During Velocity Loop Proportional Control	“High” during velocity loop proportional control switching state.
EGR-ACK: During Electric Gear Switching	“High” during electric gear switching state.
WNG-OFW: Following Warning	“High” during excessive deviation warning.
WNG-OLW: Over Load Warning	“High” during over load warning.
ALM：Alarm State	“High” during alarm state.

Note 1: Logic is reverse to the monitor display (monitor display page 04 of R-Setup)

State of output transistor	SET-UP	
	Trace Operation digital data OUT*: General Purpose Output*	Monitor Display page 04 (OUT5-1) OUT*: General Purpose Output*
Output transistor OFF	“High”	“0”
Output transistor ON	“Low”	“1”

Chapters 8

[Maintenance]

8. Maintenance [Corrective Actions for Problems During Operation]

■ Corrective Actions for Problems During Operation

●When troubles occur without any alarm displayed, check and take corrective actions for them referring to the description below. When alarm rings, take corrective measures referring to “Trouble Shooting When Alarm Rings”.

⚠ ENSURE THAT ALL POWER IS DISCONNECTED IN THE SERVO AMPLIFIER BEFORE CONDUCTING ANY CORRECTIVE ACTIONS.

No.	Problems	Investigation	Assumed causes and corrective actions
1	Red "CHARGE" LED does not turn on even if main power supply is ON.	Check the voltage at the power input terminal.	・ If voltage is low, check the power supply. ・ Improve wiring and clamping of screws. ・ Internal power circuit of servo amplifier is defective. → Replace the servo amplifier.
2	“SON” LED turns on (Servo ON status), but motor does not rotate.	Check if command is entered.	・ Reenter the previous command.
		Check if the Servo motor shaft is not servo-locked (is free)	・ Check the connection between the power line and the motor.
		Check if torque limit is input.	・ Because torque limit has been input, motor cannot rotate more than load torque.
		Enter deviation clear to check if process is continued.	・ Stop the input of deviation clear.
3	Rotation ripples (speed fluctuations) are large at lower speed than command velocity.	Check if proportional control is entered.	・ Stop the input of proportional control.
		Check if torque limit is input.	・ Stop the input of torque limit.
4	Servo motor rotates only once, and stops.	Check if the encoder resolution settings are correct.	・ The motor power line is not connected.
			・ Change the settings and turn ON the power again.

8. Maintenance [Corrective Actions for Problems During Operation]

No	Problems	Investigation	Assumed causes and corrective actions
5	The servo motor runs recklessly.	Check the motor power line.	・ Phase order of motor power line does not match.
		Check the wiring of encoder cable.	・ Wiring of A phase and B phase of the encoder is incorrect.
6	Motor is vibrating with frequency above 200 Hz.	–	・Reduce the loop gain speed. ・ Set the torque command low-pass filter and torque command notch filter.
7	Excessive over shoot/ under shoot occurs during starting / stopping.	–	・Adjust the servo tuning “response”. ・Reduce the loop gain speed. ・ Increase the integral time constant. ・ Simplify the acceleration and declaration command. Use position command low-pass filter.
8	Abnormal sound occurs	Check that there is no defect in mechanical installation.	・ Observe by operating one motor. ・ Pay attention while coupling and confirm that there is no unbalance.
		Check whether abnormal sound is random or periodic while operating at low speed.	・ Confirm that the twisted pair and shield processing of encoder signal line are correct. ・ Confirm that the wiring for encoder line and power line are installed in the same port. ・ Confirm that the power supply voltage is sufficient.

■ Alarm List

	Alarm code Note 3)							Alarm title	Alarm contents	Detection Motor Operations	Alarm Clear Note 2)
	Display	3 bits output			DA compatible code						
		Bit7	Bit6	Bit5	ALM4	ALM2	ALM1				
Abnormality related to drive	21H	0	0	1	0	0	1	Power Module Error (Over current)	• Over current of drive module • Abnormality in drive power source • Overheating of drive module	Motor Free	V
	22H							Current Detection Error 0	• Abnormality of electric current detection value	Motor Free	V
	23H							Current Detection Error 1	• Abnormality of Electric current detection circuit	Motor Free	V
	24H							Current Detection Error 2	• Abnormality in communication with Electric current detection circuit	Motor Free	V
Abnormality related to load	41H	0	1	0	0	1	0	Overload 1	• Excessive effective torque	Servo Brake	V
	55H				-	-	-	External Error	• Overheating detection of External regeneration resistor	Motor Free	V
Abnormality in power source	61H	0	1	1	1	0	1	Over voltage	• DC Excess voltage of main circuit	Motor Free	V
	71H							Control Power Supply Under voltage Note 1)	• Control power supply low voltage	Motor Free	V
Abnormality related to encoder wiring	81H	1	0	0	1	0	0	Encoder Pulse Error 1 (A-phase, B-phase, Z-phase)	• Incremental encoder (A, B, Z) signal line break • Power supply break	Motor Free	" "
	82H							Absolute Encoder Signal Disconnect	• Absolute Encoder (PS) signal line break	Motor Free	V
	84H							Communication Error Between Encoder and Amplifier	• Encoder serial signal time out	Motor Free	V
	85H							Encoder Initial Process Error	• Failed to read CS data of incremental encoder • Abnormality in initial process of absolute encoder • Cable break	Motor Free	" "
	91H							Encoder Command Error	• Mismatch of transmission command and reception command	Motor Free	V
	92H							Encoder FORM Error	• Start, Stop bit Abnormality • Insufficient data length	Motor Free	V
	93H							Encoder SYNC Error	• Data cannot be received during the prescribed time after the command is sent.	Motor Free	V
	94H							Encoder CRC Error	• CRC generated from the received data and sent CRC does not match	Motor Free	V

Note 1:When the control panel voltage drops below +5V due to suspension of control power, the alarm cannot be cleared without turning OFF the control power, even if having been restored with only a little drop from +5V resulting in detection of control power supply error. Turn OFF the control power to reset the alarm.

Note 2: "V" symbolizes "Can be reset". "Blank" symbolize "Can not be reset"

Note 3: Alarm code of 3 bits to display to alarm indication LED is not compatible with DA series servo amplifier. Setting of an alarm code compatible with DA please refer to "5-21" pages. In addition, an alarm code of the DA series is different from the T series in the following points partly.

Alarm code	Alarm code of T series			Alarm code of DA series		
	Bit7	Bit6	Bit5	ALM4	ALM2	ALM1
Abnormality in power source (Display: 6* or 7*)	0	1	1	1	0	1
Abnormality related to encoder wiring (Display: 8* or 9*)	1	0	0	1	0	0
Abnormality in encoder main body (Display: A* or B*)	1	0	1	1	0	0
Control system abnormality (Display: C*)	1	1	0	0	1	1

	Alarm code Note 4)						Alarm name	Alarm contents	Detection Motor Operations	Alarm clear
	Display	3 bits output			DA compatible code					
		Bit7	Bit6	Bit5	ALM4	ALM2	ALM1				
Abnormality in encoder main body	A2H	1	0	1	1	0	0	Absolute Encoder Battery Error	・Battery low voltage	Motor Free	Note 3)
	A3H							Encoder Overheat	・Motor built-in Encoder Overheating	Motor Free	Note 3)
	A9H							Failure of Encoder	・Encoder failure	Motor Free	Note 3)
	B2H							Encoder Error 2	・Position data incorrect	Motor Free	Note 3)
	B3H							Absolute Encoder Multi-Turn Counter Error	・Detection of incorrect multiple rotations coefficient	Motor Free	Note 3)
	B4H							Absolute Encoder Single-Turn Counter Error	・Detection of incorrect 1 rotation coefficient	Motor Free	Note 3)
	B5H							Over-allowable Speed of Absolute Encoder at Turning ON	・Exceeds the permitted speed of motor rotation speed when the power is turned ON	Motor Free	Note 3)
	B6H							Encoder Memory Error	・Access error of Encoder internal EEPROM	Motor Free	Note 3)
Control system abnormality	C1H	1	1	0	0	1	1	Over speed	・Motor rotation speed is 120 % more than the highest speed limit	Motor Free	V
	C2H							Speed Control Error	・Torque command and acceleration direction are not matching.	Motor Free	V
	C3H							Speed Feedback Error	・Motor power disconnection (Note 2) ・Tachogenerator line brake	Motor Free	V
	D1H				1	1	0	Following Error (Excessive Position Deviation)	・Position error exceeds setup value	Motor Free	V
	D2H							Faulty Position Command Pulse Frequency 1	・Frequency of entered position command pulse is excessive	Servo Brake	V
	D3H							Faulty Position Command Pulse Frequency 2	・Position command frequency after electronic gear is high.	Servo Brake	V
	DFH							Test Run Close Note 1)	・Detection in 'Test mode end' status	Motor Free	V
Control system/Memory system abnormality	E1H	1	1	1	1	1	1	EEPROM Error	・Abnormality of amplifier with built-in EEPROM	Motor Free	" "
	E2H							EEPROM Check Sum Error	・Error in check sum of EEPROM (entire area)	Motor Free	" "
	E3H							Internal RAM Error	・Access error in CPU built in RAM	Motor Free	" "
	E4H							Process Error between CPU and ASIC	・Access abnormality in CPU ~ ASIC	Motor Free	" "
	E5H							Parameter Error 1	・Detection when non-corresponding or undefined amplifier, motor, encoder code are specified.	Motor Free	" "
	E6H							Parameter Error 2	・Error in combining motor, encoder, and/or amplifier code set from system parameter	Motor Free	" "
	F1H							Task Process Error	・Error in interruption process of CPU	Motor Free	" "
	F2H							Initial Process Time-Out	・Detection when initial process does not end within initial process time	Motor Free	" "

Note 1: Alarm that rings in 'Test mode end' status is not recorded in the alarm history.

Note 2: When there is a rapid motor slow down simultaneous with servo ON, there is a possibility that a break in the motor's power line cannot be detected.

Note 3: Due to abnormality in encoder main body, encoder clear may sometimes be needed.

Note 4: Alarm code of 3 bits to display to alarm indication LED is not compatible with DA series servo amplifier. Setting of an alarm code compatible with DA please refer to "5-21" pages. In addition, an alarm code of the DA series is different from the T series as shown in the table of "Alarm code" on "8-3" page.

■ Warning List

	Warning Title	Warning Contents
Load system	Overload Warning	・When the effective torque exceeds the set torque
External input system	Forward over travel	・While entering forward over travel
	Reverse over travel	・While entering reverse over travel
Encoder system	Absolute encoder battery warning	・Battery voltage is below 3.0 V
Control system	Restricting torque command	・While restricting the torque command by torque restriction value
	Restricting speed command	・While restricting the speed command by speed value.
	Excessive position deviation	・When position deviation warning setup value is outside the proscribed limits

8. Maintenance [Trouble Shooting When Alarm Occurs]

■ Trouble shooting when Alarm Occurs

Alarm code 21H (Power Module Error / Over current)

Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	(V)		V
Issued at servo input.	V	V	V
Issued while starting and stopping the motor.	(V)	(V)	(V)
Issued after extended operating time.	(V)	(V)	(V)

Corrective actions

Cause		Investigation and corrective actions
1	·MA/MB-phase of amplifier is short circuited due to the wiring in amplifier and motor. Also, U/V/W-phases are grounded in the earth.	·Check the wiring between the amplifier and motor, and confirm that there is no error. If some error is detected, modify or change the wiring.
2	·Short circuit or fault in MA/MB-phases on servo motor side.	·Replace the servo motor.
3	·Defect in control print panel ·Defect in power device	·Replace the servo amplifier.

Alarm code 22H (Current Detection Error 0)

Status during alarm	Cause	
	1	2
Issued when the control power is turned ON.	V	(V)
Issued after the power is turned ON.	(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	·Defect in control print panel · Defect in power device	· Replace the servo amp.
2	· Servo amplifier and motor are not combined properly	· Confirm that the proper codes (per the specified Motor Codes) have been used for the servo motor; if not, replace the servo motor.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code 23H (Current Detection Error 1)
Alarm code 24H (Current Detection Error 2)

Status during alarm	Cause	
	1	2
Issued when the control power is turned ON.	V	
Issued during operation.	(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	· Defect in internal circuit of servo amplifier.	· Replace the servo amplifier.
2	· Malfunction due to noise	· Confirm proper grounding of the amplifier. · Add ferrite core or similar countermeasures against noise.

Alarm code 41H (Overload 1)

Status during alarm	Cause								
	1	2	3	4	5	6	7	8	9
Issued when power supply control is turned ON.	V								
Issued at input of servo ON.	V	V							V
After command input, issued without rotating the motor.		V			V	V	V		V
After command input, brief motor rotation			V	V	V		(V)	V	

Corrective actions

Cause		Investigation and corrective actions
1	·Defect in servo amplifier control panel or power element peripheral	·Replace the servo amplifier.
2	·Defect in encoder circuit of servomotor	·Replace the servo motor.
3	·Effective torque exceeds the rated torque.	・Monitor the load status using motor usage ratio monitor (OPRT), and check if effective torque exceeds the rated value. ▪ Or, calculate the motor effective torque from load conditions and operation conditions. → If the effective torque is excessive, check the operating or loading, or replace the capacity of the large motor.
4	·Defect in motor-amplifier combination	·Check if the motor in use matches with the recommended type, and replace if it is improper.
5	·Holding brake of servo motor does not release.	·Check that the wiring and voltage of the holding brake are acceptable; if not, repair. → If the above are OK, replace the servomotor.
6	·Wiring of U/V/W –phase between servo amplifier and motor do not match.	・Check the wiring conditions and restore if improper.
7	·One or all connections of U/V/W -phase wiring of servo amplifier / motor is disconnected	・Check the wiring conditions and restore if improper.
8	·Machines collided.	·Check the operating conditions and limit switch.
9	·Encoder pulse number setting does not match with the motor.	·Match the encoder pulse number with the motor.

During the alarm caused by conditions in #3 (above), if OFF→ON of power supply control is repeated, there is a risk of burning out the servo motor.
Wait for longer than 30 min. for cooling purposes after power shut OFF, and resume operations.

Refer to “Material-19” for details of Over Load Characteristics.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code 55H (External Error)

●When external regenerative resistor and output terminal of upper device are not connected

Status during alarm	Cause	
	1	2
Issued when power supply control is turned ON.	V	(V)

Corrective actions

Cause		Investigation and corrective actions
1	• Validity condition for external trip function is set to 'Valid'.	When not used, set 00 : _Always_Disable at Group9 40.
2	• Defect in control panel of servo amplifier.	• Replace the servo amplifier.

●When external regenerative resistor is not connected

Status during alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	V		(V)
Issued after operation.		V	(V)

Corrective actions

Cause		Investigation and corrective actions
1	• Improper wiring of external regenerative resistance.	• Check wiring and replace if necessary.
2	• External regeneration resistor is operating.	• Check the operating conditions. • Increase the capacity of the external regeneration resistor.
3	• Defect in control panel of servo amplifier.	• Replace the servo amplifier.

● When output terminal of upper level device is connected:
Eliminate the alarm trigger of the upper level device.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code 61H (Over voltage)

Status during alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	V		
Issued when power supply of main circuit is turned ON.	V	V	
Issued at the time of motor start/stop.		(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in control panel of servo amplifier.	• Replace the servo amplifier.
2	• The power supply voltage of main circuit exceeds the rated value.	• Reduce the power supply voltage to within the specified range.
3	• Excessive load inertia.	• Reduce the load inertia to within the specified range.

Alarm code 71H (Control Power Supply Under voltage)

Status during alarm	Cause		
	1	2	3
Issued at the time of power on.	(V)	V	
Issued during operation.	(V)		V

Corrective actions

Cause		Investigation and corrective actions
1	•Defect in internal circuit of the servo amplifier.	•Replace the servo amplifier.
2	•Power supply voltage is within the specified range.	•Confirm that the power supply is set within the specified range.
3	•Input voltage is fluctuating or stopped.	•Confirm that the power supply is neither stopped nor reduced.

Alarm code 81H (Encoder Pulse Error 1 /A-phase, B-phase, Z-phase)
Alarm code 82H (Absolute Encoder Signal Disconnect)
Alarm code 84H (Communication Error Between Encoder and Amplifier)

Status during alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.	V	V	V	V	V
Issued after servo is turned ON.				V	V
Issued during operation.	(V)			V	V

Corrective actions

Cause		Investigation and corrective actions
1	For encoder wiring: ·Improper wiring ·Connector is removed ·Loose connection ·Encoder cable is too long ·Encoder cable is too thin	· Check wiring and repair any abnormality. · Confirm that the encoder power supply voltage of the motor is above 4.75 V; increase it if below 4.75 V.
2	· Wrong amplifier encoder type is selected.	·Select the correct encoder type.
3	·Motor encoder that does not match with amplifier encoder type is attached.	·Replace with servo motor equipped with proper encoder.
4	·Defect in servo amplifier control circuit	·Replace the servo amplifier.
5	·Defect in servo motor encoder	· Replace the servo motor.

Alarm code 85H (Encoder Initial Process Error)

Status during alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.	V	V	V	V	(V)

Corrective actions

Cause		Investigation and corrective actions
1	For encoder wiring: ·Improper wiring ·Connector is removed ·Loose connection ·Encoder cable is too long ·Encoder cable is too thin	· Check wiring and repair any abnormality. · Confirm that the encoder power supply voltage of the motor is above 4.75 V; increase it if below 4.75 V.
2	· Wrong amplifier encoder type is selected, or wrong setting of Group C of parameter page 00	·Select the correct encoder type.
3	· Defect in servo amplifier control circuit	·Replace the servo amplifier.
4	·Defect in servo motor encoder	·Replace the servo motor.
5	·Initial position data could not be set, as the number of rotations of the motor is more than 300 min^{-1} during power supply.	·Restore power under the condition of the motor is suspended. (Apply only to the time PA 035C sensor is in operation.)

Note) V means the cause number with high possibility.

(V) means the cause number with middle possibility.

Alarm code 91H (Encoder Command Error)
Alarm code 92H (Encoder FORM Error)
Alarm code 93H (Encoder SYNC Error)
Alarm code 94H (Encoder CRC Error)

When abnormalities are detected in the internal part of the absolute position detector for the start-stop synchronization system.

Status during alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	(V)	V	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in encoder	• Replace the servo motor.
2	• Malfunction due to noise	• Confirm proper grounding of the amplifier. • Check the shielding of the encoder cable. • Add ferrite core or similar countermeasures against noise.
3	• Abnormality in encoder wiring.	• Check wiring between the encoder and amplifier.

Alarm code A2H (Absolute Encoder Battery Error)

Status during alarm	Cause	
	1	2
Issued when control power is turned ON.	V	V
Issued during operation.		V

Corrective actions

Cause		Investigation and corrective actions
1	• Loose connection of battery cable.	• Confirm the battery connection in the front ON/OFF switch of the amplifier.
2	• Low battery voltage	• Check the battery voltage.

"Encoder clearing and alarm resetting methods" vary depending on the encoder in use.
Refer to page 24 "Materials; Encoder clear / Alarm reset method".

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code A3H (Encoder Overheat)

When abnormalities are detected in the internal part of the absolute position detector for the start-stop synchronization system.

Status during alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	(V)	V	
Issued while stopping the motor.	(V)	V	
Issued during motor operations.		V	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in internal circuit of encoder	• Turn ON the power supplies again; if not restored, replace the motor.
2	• Motor is not generating heat, but encoder ambient temperature is high.	• Confirm that the cooling method keeps the encoder ambient temperature below 80^0C.
3	• Motor is overheated.	• Confirm the cooling procedure of the servo motor.

✍ "Encoder clearing and alarm resetting methods" vary depending on the encoder in use.
Refer to page 24 "Materials; Encoder clear / Alarm reset method".

Alarm code A9H (Failure of Encoder)

When abnormalities are detected in the internal part of the absolute position detector for the start-stop synchronization system.

Status during alarm	Cause	
	1	2
Issued when power supply is turned ON.	V	V
Issued during motor operations.	(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in internal circuit of encoder	• Turn ON the power supplies again; if not restored, replace the motor.
2	• Malfunction due to noise	• Confirm proper grounding of the amplifier. • Check the shielding of the encoder cable. • Add ferrite core or similar countermeasures against noise.

✍ "Encoder clearing and alarm resetting methods" vary depending on the encoder in use.
Refer to page 24 "Materials; Encoder clear / Alarm reset method".

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code B3H (Absolute Encoder Multi-Turn Counter Error)
Alarm code B4H (Absolute Encoder Single-Turn Counter Error)
Alarm code B6H (Encoder Memory Error)

When abnormalities are detected in the internal part of the absolute position detector for the start-stop synchronization system.

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	V	
Issued while operation.	(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in internal circuit of encoder	• Turn ON the power supplies again; if not restored, replace the motor.
2	• Malfunction due to noise	• Confirm proper grounding of the amplifier. • Check the shielding of the encoder cable. • Add ferrite core or similar countermeasures against noise.

✍ "Encoder clearing and alarm resetting methods" vary depending on the encoder in use.
Refer to page 24 "Materials; Encoder clear / Alarm reset method".

Alarm code B5H (Over-allowable Speed of Absolute Encoder at Turning ON)

When abnormalities are detected in the internal part of the absolute position detector for the start-stop synchronization system.

Status during alarm	Cause		
	1	2	3
Issued when power supply is turned ON.	V		(V)
Issued while stopping the motor.	V	V	
Issued while rotating the motor.	(V)	V	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in internal circuit of encoder	• Turn ON the power supplies again; if not restored, replace the motor.
2	• Malfunction due to noise	• Confirm proper grounding of the amplifier. • Check the shielding of the encoder cable. • Add ferrite core or similar countermeasures against noise.
3	• Number of motor rotations exceeds the permitted speed.	• Check the operation pattern and reduce the maximum number of rotations.

✍ "Encoder clearing and alarm resetting methods" vary depending on the encoder in use.
Refer to page 24 "Materials; Encoder clear / Alarm reset method".

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code C1H (Overspend)

Status during alarm	Cause			
	1	2	3	4
Issued when control power supply is turned ON.	V	(V)		
Issued if command is entered after Servo ON	(V)	V		
Issued when the motor is started.			V	V
Issued other than operating and starting the motor		V	V	
An alarm occurred after servo on				V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in control panel of servo amplifier.	• Replace the servo amplifier.
2	• Defect in the encoder of servo motor	• Replace the servo motor.
3	• Excessive overshoot while starting.	• Monitor speed with the analog monitor. →Adjust the servo parameters if overshoot is excessive. → Simplify the acceleration and declaration command pattern. → Reduce the load inertia.
4	• Wiring of U/V/W -phase between servo amplifier and motor do not match.	• Check the wiring and repair any irregularities.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code C2H (Speed Control Error)

Status during alarm	Cause				
	1	2	3	4	5
Issued when control power supply is turned ON.					V
Issued while due to input of Servo ON	V		V		
Issued if command is entered.	V	V	V		
Issued while starting and stopping the motor.				V	

Corrective actions

Cause		Investigation and corrective actions
1	• Wiring of MA/MB -phase between servo amplifier and motor do not match.	• Check the wiring and repair any irregularities.
2	• The wiring of A, B phase of INC-E and ABS-EI encoder connection is incorrect.	• Check the wiring and repair any irregularities.
3	• The motor is vibrating (oscillating).	• Adjust the servo parameters so that servo motor will not vibrate (oscillate).
4	• Excessive overshoot and undershoot.	• Monitor speed with the analog monitor. • Adjust the servo parameters to reduce overshoot and undershoot. • Increase acceleration and declaration command time. Mask the alarm.
5	• Abnormality in servo amplifier control circuit	• Replace the servo amplifier.

For the speed control error alarm, an alarm may occur while starting and stopping when load inertia is excessive. For this reason, in the gravitational axis applications, "Do not detect" is selected as the standard setting.
If its detection is needed, consult our representatives.

Alarm code C3H (Speed Feedback Error)

Status during alarm	Cause			
	1	2	3	4
Issued when command is entered.	V	(V)	V	
An alarm occurred after servo on				V

Corrective actions

Cause		Investigation and corrective actions
1	• Motor is not rotating.	• Confirm that the power line is properly connected. • Replace the servo motor.
2	• Defect in internal circuit of servo amplifier.	• Replace the servo amplifier.
3	• The motor is vibrating (oscillating).	• Adjust the servo parameter so that servo motor will not vibrate (oscillate).
4	• Disconnection between the Servo amplifier and the motor.	• Check the connection and correct the wiring.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

8. Maintenance [Trouble Shooting When Alarm Occurs]

Alarm code D1H (Following Error / Excessive Position Deviation)

Status during alarm	Cause											
	1	2	3	4	5	6	7	8	9	10	11	12
Issued when control power supply is turned ON.										V		
Issued when servo ON is stopped.						V					V	
Issued immediately after entering the command.	V	(V)	V	V	V		V	(V)	V		(V)	
Issued during starting or stopping at high speed.	V	V					V	V	V		(V)	V
Issued during the operations by lengthy command.		V					V	(V)			(V)	

Corrective actions

Cause		Investigation and corrective actions
1	• Position command frequency is high or acceleration and declaration time is short.	• Correct the position command of the controller
2	• Excessive initial load or low motor capacity.	• Correct the load condition or increase the motor capacity
3	• Holding brake is not released.	• Check the wiring and repair any abnormalities. If specified voltage is applied, replace the servo motor.
4	• Motor is mechanically locked or machine is colliding.	• Check the machinery system.
5	• One or all phases of U/V/W -phase of the servo amplifier and motor has disconnected.	• Check and repair the wiring connections.
6	• Motor is being rotated by an external force (Gravity, etc.) during stopping (positioning completion).	• Check the load, and/or increase the motor capacity.
7	• Valid current limit command is entered by the controller, and the current limit setting is reduced. • Number of encoder pulses does not match with the motor.	• Increase the current limit value or disable the current limit. • Match the number of motor encoder pulses.
8	• Settings of servo parameters (Position loop gain, etc.) are not appropriate.	• Check the servo parameter settings (Raise the position loop gain, etc.)
9	• Excessive deviation setting value is reduced.	• Set a greater value for excessive deviation.
10	• Defect in control panel of servo amplifier.	• Replace the servo amplifier.
11	• Servo motor encoder is defective.	• Replace the servo motor.
12	• Power supply voltage is low.	• Check the power supply voltage.

Alarm code D2H (Faulty Position Command Pulse Frequency 1)

Status during alarm	Cause
	1
Issued after entering position command pulse.	V

Corrective actions

Cause		Investigation and corrective actions
1	• Command for the digital filter setting of the command pulse input is entered	• Decrease the frequency of the command pulse. • Increase the frequency of the digital filter.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code D3H (Faulty Position Command Pulse Frequency 2)

Status during alarm	Cause	
	1	2
Issued after entering position command pulse.	V	V

Corrective actions

Cause		Investigation and corrective actions
1	• Frequency of command pulse input is excessive.	• Reduce the frequency of command pulse input.
2	• Setting value of electronic gear is excessive.	• Decrease the electronic gear setting value.

Alarm code DFH (Test Run Close)

Status during alarm	Cause
	1
Occurred after execution of test mode.	V

Corrective actions

Cause		Investigation and corrective actions
1	• Normal operation.	• Clear the alarm and restore operation. (After completion of test mode, to confirm any deviation in the controller).

Alarm code E1H (EEPROM Error)

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	V	(V)
Issued during display key operation or when the setup software is operated		V

Corrective actions

Cause		Investigation and corrective actions
1	• Correct value not read by CPU by nonvolatile memory of built-in servo amplifier.	• Replace the servo amplifier.
2	• Defect in the servo amplifier control panel	• Replace the servo amplifier.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code E2H (EEPROM Check Sum Error)

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	(V)	V

Corrective actions

Cause		Investigation and corrective actions
1	• Correct value not read by CPU by nonvolatile memory of built-in servo amplifier	• Replace the servo amplifier.
2	• Failed to write into the nonvolatile memory during last power supply cutoff.	• Change the optional parameters, turn ON the power supply again, and confirm that alarm has cleared. → If alarm is not cleared, replace the servo amplifier.

Alarm code E3H (Internal RAM Error)
Alarm code E4H (Process Error between CPU and ASIC)

Status during alarm	Cause
	1
Issued when control power supply is turned ON.	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in the servo amplifier control panel	• Replace the servo amplifier.

Alarm code E5H (Parameter Error 1)

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	V	V
Issued after changing any of system parameters.	V	

Corrective actions

Cause		Investigation and corrective actions
1	• Selected value is outside the specified range for a system parameter.	• Confirm the model number of the servo amplifier. • Confirm selected values of system parameters and modify if necessary. →Turn ON the power again and confirm that alarm is cleared.
2	• Defect in servo amplifier	• Replace the servo amplifier.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

Alarm code E6H (Parameter Error 2)

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	V	V
Issued after changing any of system parameters.	V	

Corrective actions

Cause		Investigation and corrective actions
1	• Selected values of system parameters and actual hardware do not match • Improper assembly of system parameter settings.	• Confirm the model number of servo amplifier. • Confirm selected values of system parameters and correct if necessary. →Turn ON the power again and confirm that alarm is cleared.
2	• Defect in servo amplifier	• Replace the servo amplifier.

Alarm code F1H (Task Process Error)

Status during alarm	Cause
	1
Issued while operating.	V

Corrective actions

Cause		Investigation and corrective actions
1	• Abnormality in control circuit of servo amplifier	• Replace the servo amplifier

Alarm code F2H (Initial Process Time-Out)

Status during alarm	Cause	
	1	2
Issued when control power supply is turned ON.	V	V

Corrective actions

Cause		Investigation and corrective actions
1	• Defect in internal circuit of servo amplifier	• Replace the servo amplifier.
2	• Malfunction due to noise	• Confirm proper grounding of the amplifier. • Add ferrite core or similar countermeasures against noise.

Note) V means the cause number with high possibility.
(V) means the cause number with middle possibility.

8. Maintenance [Corrective Actions for Problems During Operation]

[DC Motor Brush Maintenance]

■ Corrective Actions for Problems During Operation

● Because the servo amplifier and the servo motor (The brush is excluded) do not use wearing parts, maintenance is enough by an easy check in daily life.
Upon inspection, refer to the following description.

Inspection location	Testing conditions			Inspection Items	Inspection Methods	Solution if abnormal
	Time	During operation	While stopping			
Servo motor	Daily	V		Vibration	Check for excessive vibration.	Contact dealer/sales office.
	Daily	V		Sound	Check if there is no abnormal sound as compared to normal sound.	
	Periodic		V	Cleanliness	Check for dirt and dust.	Clean with cloth or air. → ⚠ 1
	Yearly		V	Measure value of insulation resistance	Contact the dealer or sales office.	
	5000 hours → ⚠ 2		V	Replacement of oil seal		
	Three months		V	Check of brush abrasion	Check for length of a brush	Exchange of a brush
Servo amplifier	Periodic		V	Cleaning	Check for dust accumulated in the accessories.	Clean with air. → ⚠ 1
	Yearly		V	Loose screws	Check for loose connections	Fasten the screws properly.
absolute encoder back up battery	Regularly → ⚠ 3		V	Battery voltage	Confirm that battery voltage is more than DC3.6V.	Replace the battery.
Temperature	On demand	V		Measure temperature	Ambient temperature Motor frame temperature	Set the ambient temperature within the limit. Check the load condition pattern.

⚠
1. While cleaning with air, confirm that there is no oil content and/or moisture in the air.
2. This inspection and replacement period is when water- or oil-proof functions are required.
3. The life expectancy of the battery is approximately 2 years, when its power is OFF throughout the year. For replacement, a lithium battery (ER3V: 3.6V, 1000mAh) manufactured by Toshiba Consumer Marketing Corp. is recommended.

■ DC Motor Brush Maintenance

Before inspecting or replacing brushes, the device must be disconnected from the mains voltage or power supply unit.

● Check the grade of brushes

Brushes should be inspected and cleaned periodically for once every three months to maintain.
Minimum operating length of brushes are shown as the below table. If brushes wear away and became less than minimum operating length, replace them with new brushes.
Also, if excessive chipping is found on brushes, replace them with new ones, regardless of its length.

Table ; Wear limit of the brushes

Model		Length of new brushes axbxL (mm)	Minimum operating length (mm)	Q'TY
Motor	T4 type	3.8X8X6	3	4
	T5 type	3.8X8X6	3	
	T7 type	4.3X10X10	5	4
	T8 type	4.3X10X10	5	
Tachogenerator	T4 type	3X5X5	2.5	2
	T5 type	3.5X4.5X6.5	3	
	T7 and T8 types	3.5X4.5X10	4.5	

✍ Brushes should be inspected individually and be sure to place back them along the limited operating line and material code that to the exactly as the same location and direction as you removed.

8. Maintenance [DC Motor Brush Maintenance]

● Periodic cleaning and motor bushes replacement Procedure

1) Disconnect the motor from the power sources. Remove the end-cap and the brush holder caps. (The end cap is usually sealed tighten by waterproof adhesive.) Note the brush rump position and spring location prior to removing the brushes.

2) Lift all of the brushes with springs from brush holder pockets to supply sufficient airflow to clean up dusts in there completely.

3) Vacuum dusts of brushes by using a vacuum cleaner. (See the example figure as below)
When a cleaner that is blowing type is used, feed compressed air (Pressure 9.8 x 10^4 Pa or less) into brush holder pockets and blow out dusts.
However, a vacuum type of cleaner is more recommended since a blowing type disperses dusts of brushes.

4) Clean up dusts completely as the remaining of dusts of brushes may cause lower insulation or defect. If still insulation resistance lowers, contact our sales office for further information to overhaul.

5) Replace with new brushes and reinstall the caps. Seal the end cap with waterproof adhesive (Three bond 1104)

6) Carry out a test run before starting full load operation, in order to fit the surface of new brushes in the commutator. Otherwise the motor would make a loud sliding noise, or waveform of TG output could be displayed abnormally.

Run the motor in clockwise direction and counter clockwise direction repeatedly by no-load operation to fit the face of new brushes to the contour of the commutator, and also check that the operating is executed without problem at the same time of this running-in period, which has to take 60 minutes or more. (Set revolution RPM from1, 000 to 3,000 min $^{-1}$)

1) Check if the new brushes are free of oil or water before mounting them on. Never handle the brushes with hand soiled with oil or put in the place where the brushes may be contaminated with oil.

2) Remove water and oil from the compressed air at all.

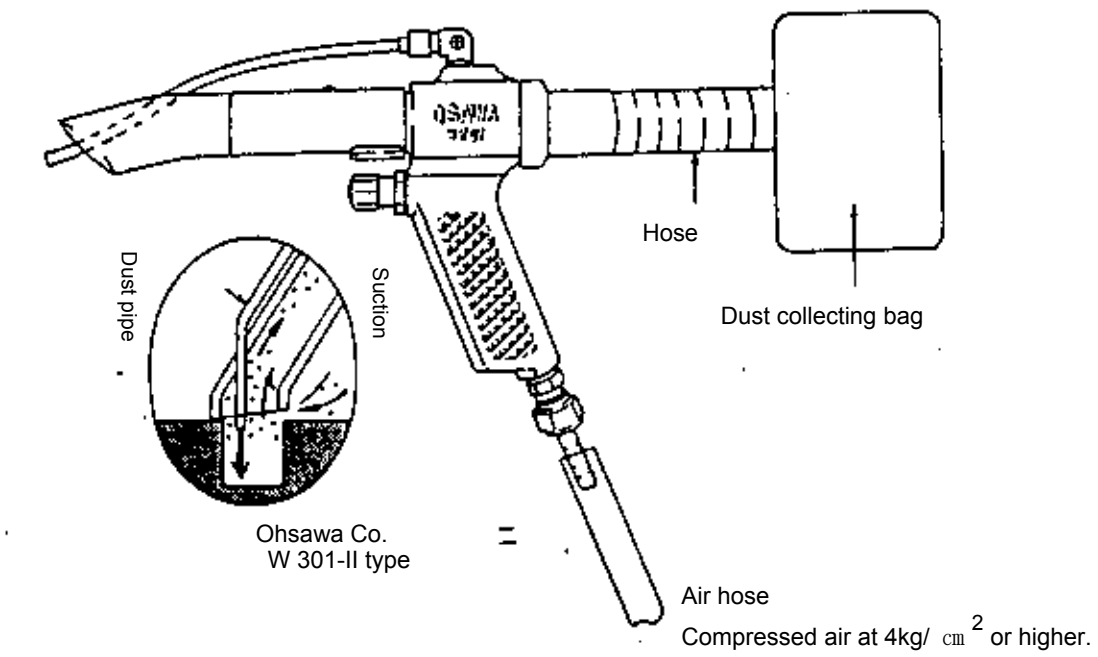


Fig.12 Example of a dust collector. (an inhale type)

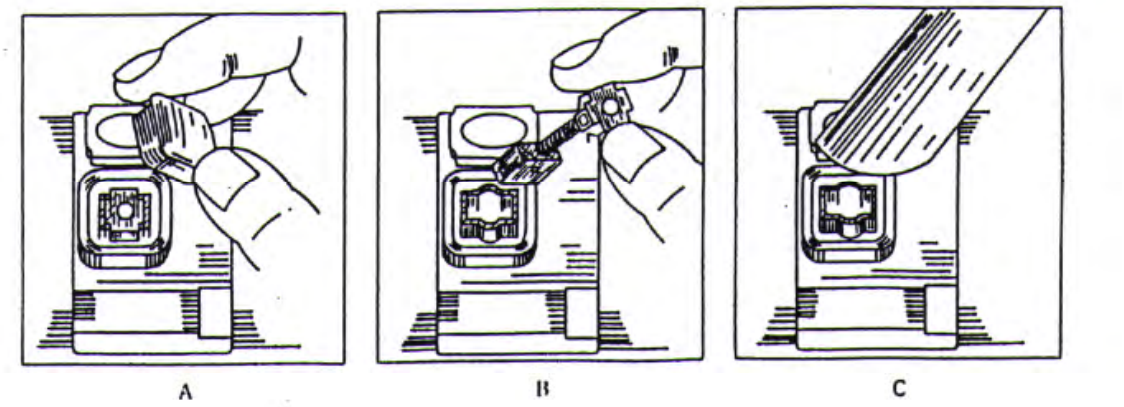
8. Maintenance [DC Motor Brush Maintenance]

●Periodic cleaning of Tachogenerator brushes and replacement procedure.

1) See Chapter 1-5 on the position of the cap of Tachogenerator brushes.

Lift brushes and vacuum dusts in the brush holding pocket as the figure below shown.

For the details on how to clean and replacement brushes, refer to "●Periodic cleaning and motor bushes replacement Procedure"



Remove the cap Lift the brush Vacuum dusts

● Note

If you find any failure of this DC motor in runs, contact our sales office or service office, or return it to us before disassembling. (If it is assembled, it could be impeditive of investigation of the causes)

■ Parts Overhaul

Parts indicated in the following may deteriorate over time. Perform periodic inspection for preventive maintenance.

No.	Part name	Number of average replacement years	Corrective measures / usage conditions
1	Electrolysis capacitor	5 Years	Replacement with new part is necessary. (Usage condition: Average temp. 40℃ year-round, Annual usage period is 4800 hours)
	Fuse	10 Years	Replacement with new part is necessary.
3	Lithium battery for absolute encoder [ER3V]	3 Years	Replacement with new part is necessary.

Lithium battery

・The standard replacement period recommended by our company is the life expectancy of lithium battery based on normal usage conditions. However, if there is high frequency of turning the power ON/OFF, or the motor is not used for a long period, then the life of lithium battery is reduced. If the battery power is less than 3.6 V during inspection, replace it with new one.

● How to replace absolute encoder back-up battery

① Turn ON the servo amplifier control power supply.

② Prepare the replacement lithium battery. [SANYO model number：AL-00494635-01]

③ Remove the battery connector.

④ Take out the used lithium battery and put in the new replacement one (prepared at ②).

⑤ Attach the connector in the right direction.

✍ If the battery is replaced while the control power is OFF, multiple rotation counter (position data) of the absolute encoder may be instable. When the amplifier control power is turned ON in this status, an alarm (battery error) may be issued. For this, execute encoder clear and alarm reset to release the alarm status. Also, absolute encoder position data may be instable. Check and adjust the relations between position data and machine coordinate system.

✍ At SANYO DENKI, the overhauled servo amplifier is shipped with the same parameters as the ones before overhauling. Be sure to confirm the parameters before use.

Chapters 9

[Specifications]

9. Specifications [Servo amplifier]

■ Servo amplifier

Basic specifications	Model number			TS1*02*, TS1AA2*	TS1A03*
	Control function			Speed control, torque control, or position control (Parameter change)	
	Control system			PWM control Sinusoidal drive	
	*1Input power		Main power	140Vdc +10, -15% 50Vdc +10, -15% *2	
			Control power	24Vdc +10, -15%	
	Environment	Ambient temperature*3		0～55℃	
		Storage temperature		-20～+65℃	
		Operating / storage humidity		Below 90%RH (no condensation)	
		Elevation		Below 1000 m	
		Vibration		0.5G Frequency range 10～55HZ Test for 2H in each direction X.Y.Z	
		Shock		2G	
	Structure			Tray type power supply on the outside	
	Mass			0.45 kg	0.65 kg
Performance	In case of speed control specification	Speed control range*4		1:3000	
		Frequency characteristics		50Hz(JL=JM)	
Built-in functions	Protection functions			Over current, Current detection error, Overload, External overheating, Over voltage, Control power supply error, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position error, Position command pulse error, CPU error, Built-in memory error, Battery error, Parameter error	
	LED display			Status display, Alarm display	
	Applied load inertia			Within the applied load inertia of combined servo motor	
	Monitor output	Speed monitor (VMON)		1.0Ⅴ±10% (at 1000min^{-1})	
		Torque monitor (TMON)		1.0Ⅴ±10% (at 100% torque)	
Input / Output signal	For speed/torque control specification	Speed command	Command voltage	DC±3.0V (at 1000min^{-1} command, Forward motor rotation with positive command, maximum input voltage ±10V)	
			Input impedance	Approx. 10k Ω	
		Torque command	Command voltage	DC±3.0V (at 100% torque, Forward motor rotation with positive command)	
			Input impedance	Approx. 10k Ω	
		Current input limit		DC±2.0V ±15% (at rated armature current)	
		Sequence input signal		Servo on, Alarm reset, Torque limit, Encoder clear, Forward rotation inhibition, Reverse rotation inhibition, Command inhibition, External trip, Emergency stop, Change of control mode, Proportional control, Gain switch, Internal speed setting	
		Sequence output signal		Servo ready, Power ON, Servo ON, Holding brake timing, Within torque limit, Within speed limit, Low speed, velocity attainment, Matching speed, Zero speed, Command acceptable, Status of gain switch, Speed loop proportional control status, Control mode switchover status, Forward OT, Reverse OT, Warning, Alarm code (3Bit)	
		Position output signal (Pulse division)		N/8192 (N=1～8191), 1/N (N=1～64) or 2/N (N=3~64)	
	For position control specification	Position command	Maximum input pulse frequency	5M pulse/second (Reverse rotation Forward rotation pulse, symbol + Pulse), 1.25M pulse/second (90° phase difference Two phase pulse)	
			Input pulse type	Forward rotaion+Reverse rotation command pulse or symbol+Pulse string command or 90°phase difference Two phase sequence command	
			Electronic gear	N/D (N=1～32767, D=1～32767) however, 1/32767 ≦N/D≦ 32767	
		Sequence input signal		Servo ON, Warning reset, Torque limit, Clear encoder, Forward rotation inhibition, Reverse rotation inhibition, Command inhibition, External trip, Emergency stop, Deviation Clear, Change of control mode, Proportional control, Gain switch, Change of electronic gear, Position loop proportional control	
		Sequence output signal		Servo ready, Power ON, Servo ON, Holding brake timing, Within torque limit, Within speed limit, Low speed, velocity attainment, Matching speed, Zero speed, Position fixed, Near range, Command acceptable, Status of gain switch, Speed loop proportional control status, Changed status of electronic gear, Changed control mode status, Forward OT, Reverse OT, Warning, Alarm code (3 bit)	
		Position output signal (Pulse division)		N/8192 (N=1～8191), 1/N (N=1～64) or 2/N (N=3～64)	

*1 Source Voltage should be within the specified range.
Control power: 20.4Vdc – 26.4Vdc
Main power: 119Vdc – 154Vdc(140Vdc input type)
42.5Vdc – 55Vdc(50Vdc input type)
*2 "50Vdc power supply input type" supports only TS1B02.
*3 When stored in the box, be sure that internal temperature does not exceed this range.
*4 Minimum rotational speed is determined as equivalent to the amplifier not stopping for a load with maximum continuous torque.

● Power Supply Capacity

Amplifier model name	Motor model name	Power supply capacity per unit	
		Control Power Supply	Main Power Supply
TS1A02	T404-012	12VA	0.2kVA
	T406-012		0.3kVA
	T506-012		0.3kVA
TS1AA2	T511-012		0.4kVA
	T720-012		0.6kVA
	T730-012		0.9kVA
TS1A03	T840-012		1.0kVA
	T850-012		1.3kVA
TS1B02	T402-011		0.2kVA

・When operating two or more motors at the same time, add the power supply capacity per unit of each motor.
・When the motor is accelerated, the system may require the momentary power of two to four times the ordinary power.

● Inrush current

Input voltage	Amplifier model name	Control power (Maximum value between 0.1ms after input)	Main power
140Vdc	TS1A02、TS1AA2	75A(0-P)	0A
	TS1A03		
50Vdc	TS1B02	75A(0-P)	0A

● Leakage Current

The T Series drive the motor under the PWM control of FET, and a high frequency leakage current may flow through the ground floating capacity of the motor winding, power cable or the amplifier.
This leakage current may malfunction the leakage circuit breaker of the leakage protective relay set to the power supply side power line.
So, use a leakage circuit breaker that is designed so as not to cause malfunction but to match with the inverter.

Motor model number	Leakage current per motor
TS1A02、TS1AA2	1 mA or less
TS1A03	1 mA or less
TS1B02	1 mA or less

・When using 2 or more motors, the electric current leakage each motor is compounded.
・The above values are based on using the recommended tough**, rubber-sheathed 2mm cable** as a power line.
・The system must be grounded (Type D, 3rd type) so that a dangerous voltage condition (on the main part of the machine, i.e. operation panel, etc.) does not occur during an emergency leakage.
・The value of leaked current is measured by an ordinary leak checker (700Hz Filter).

● Calorific value

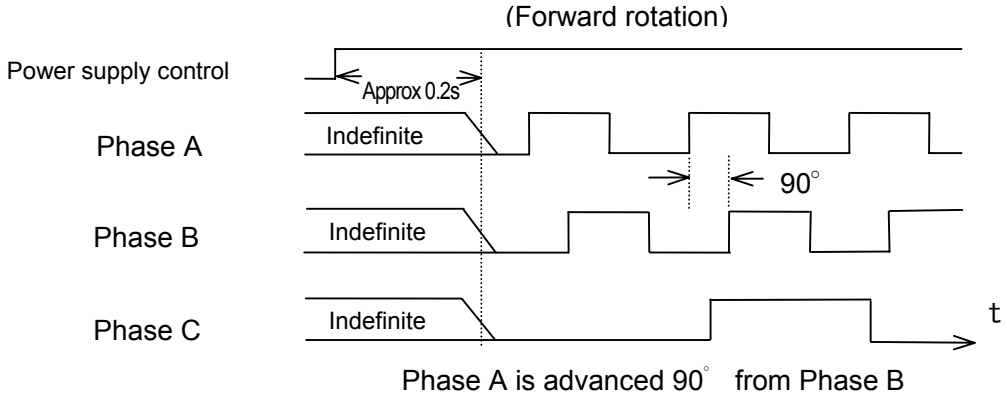
Input voltage	Amplifier capacity	Motor model number	Total calorific value of Servo amplifier	Input voltage	Amplifier capacity	Motor model number	Total calorific value of Servo amplifier
DC140V	TS1A02	T404-012	8 W	DC50V	TS1B02	T402-011	11 W
		T406-012	9 W				
		T506-012	9 W				
	TS1AA2	T511-012	12 W				
		T720-012	17 W				
		T730-012	23 W				
	TS1A03	T840-012	26 W				
		T850-012	33 W				

・Be sure to carefully follow the installation method outlined in “Section 2, Installation”.

9. Specifications [Pulse output]

■ Pulse output

Outputs 90° phase difference two phase pulse (Phase A, Phase B) and Original pulse (Phase C) from CN 1-21～26



Phase A is advanced 90° from Phase B

✍ After turning ON the system, the power supply is not fixed for about 0.2 sec.

✍ For absolute encoders, the pulse (incremental) output will be delayed for approximately 250 μs.One pulse is output for every change (once per rotation) of multiple rotations for Phase C. (Does not determine the position relation of Phase C and Phase A & B. A single pulse width is output based on the leading or trailing edge of Phase A or Phase B)

✍ When the division ratio is set other than 1/1, Phase A and Phase B are divided, but Phase C is output by the original pulse width. In this case, no position relation of Phase C and Phase A & Phase B is determined.

■ Serial output (Battery backup system absolute encoder)

Encoder signal output(PS) format can be selected from 3 transmission methods.
Select from selection values of [Group C 07 encoder signal output(PS) format].
The specifications are shown below.

Selection values 00:_Binary	Binary code output
Transmission method	Asynchronous
Baud rate	9600bps
Transfer frame	8 frames (11 bit/ frame)
Transfer format	Refer to page 9-6
Transmission error check	(1 bit)even number parity
Transfer time	9.2ms(Typ.)
Transfer period	Approx.11ms Refer to page9-10
Increase method	Increase during forward rotation

Selection value 01:_Decimal	ASC Ⅱ in decimal code output
Transmission method	Asynchronous
Baud rate	9600bps
Transfer frame	16 frame (10 bit/ frame)
Transfer format	Refer to page 9-7
Transmission error check	(1 bit)even number parity
Transfer time	16.7ms(Typ.)
Transfer period	Approx.40ms Refer to page 9-10
Increase method	Increase during forward rotation

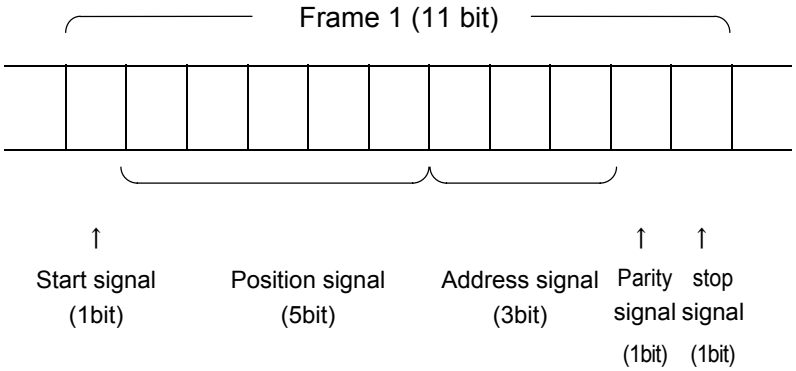
Selection value 02:_Encoder_Signal	Encoder signal direct output
Transmission method	Asynchronous
Baud rate	2.5Mbps、4.0Mbps
Transfer frame	3 or4 frame(18 bit/ frame)
Transfer format	Refer to page 9-8
Transmission error check	(8 bit)CRC error check
Transfer time	21.6μs or 28.8μs (Typ.) 2.5Mbps 13.5μs or18.0μs (Typ.) 4.0Mbps
Transfer period	125μs Refer to page 9-10
Increase method	Increase during forward rotation

✍ Forward rotation means counterclockwise rotation, as seen from the motor shaft.
If the absolute value is increased to the maximum, the minimum value becomes 0.

● Transfer format

Selection value 00:_Binary Binary code output

1 Structure of Frame 1



Structure of each frame

	Start signal	Position signal					Address signal			Parity signal	Stop signal
・1st frame	0	D0 (LSB)	D1	D2	D3	D4	0	0	0	0／1	1
・2nd frame	0	D5	D6	D7	D8	D9	1	0	0	0／1	1
・3rd frame	0	D10	D11	D12	D13	D14	0	1	0	0／1	1
・4th frame	0	D15	D16	D17	D18	D19	1	1	0	0／1	1
・5th frame	0	D20	D21	D22	D23	D24	0	0	1	0／1	1
・6thframe	0	D25	D26	D27	D28	D29	1	0	1	0／1	1
・7th frame	0	D30	0/D31	0/D32	0	0	0	1	1	0／1	1
・8th frame	0	0 (MSB)	0	0 (MSB)	0	0	1	1	1	0／1	1

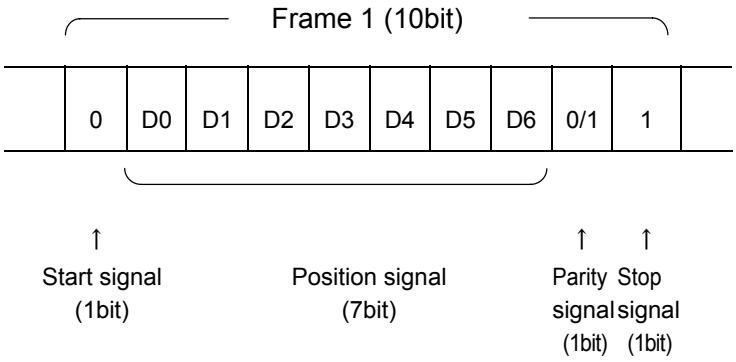
For PA035C

D0 ～D16 ・・・Absolute value of 1 rotation

D17～D32 ・・・Absolute value of multiple rotations

Selection value 01:_Decimal ASCII in decimal code output

Structure of Frame 1



Structure of each frame

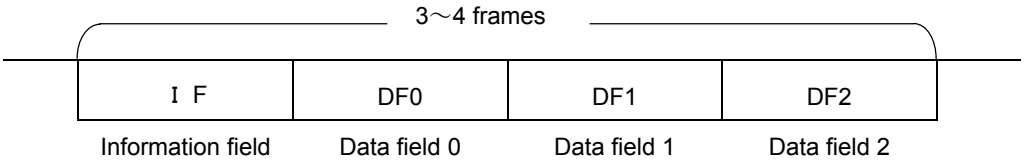
Frame number	Transmission character	Data contents
1	“P” (ASCII code 50H)	Indicates that transmission data is position data
2	“+”(ASCII code 2BH)	Symbol of multiple rotations data
3	“0”(ASCII code 30H)	Multiple rotations data (5 digits)
4	Highest rank	
5	0000～8191	
6		
7	Lowest rank	
8	“,”(ASCII code 2CH)	End characters
9	“0”(ASCII code 30H)	Absolute value data in 1 rotation (7digits)
10	Highest rank	
11		
12	000000～131071	
13		
14		
15	Lowest rank	
16	“CR”(ASCII code 0DH)	Carriage return

For PA035C 1 rotation data : 000000～131071

Multiple rotation data : 00000～65535

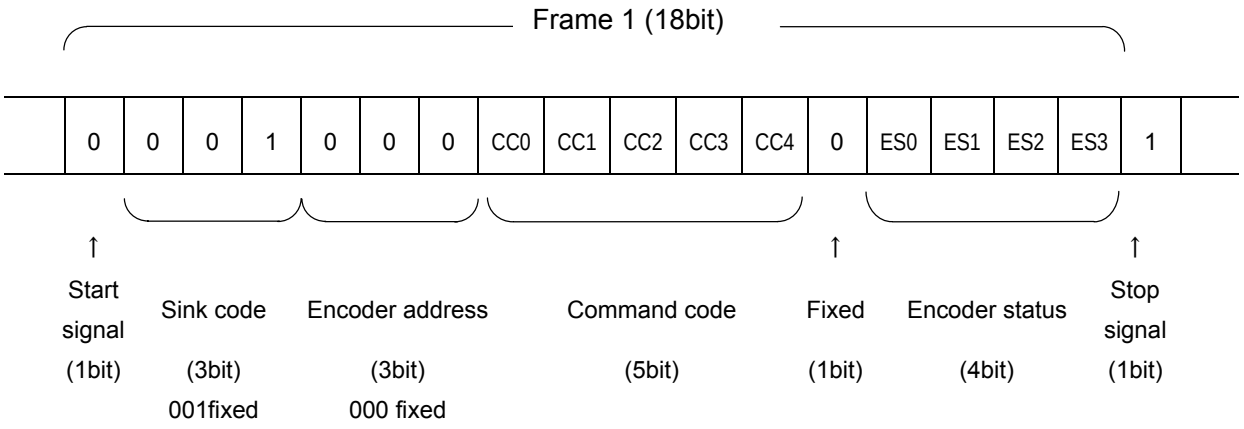
Selection value 02:_Encoder_Signal Encoder signal direct output

Structure of Frame 1



Frame structure

Information field (IF)



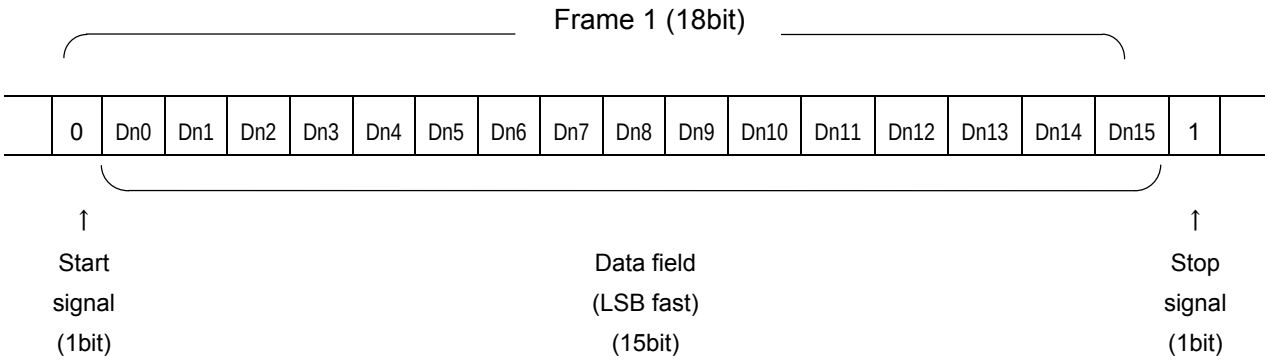
Command code CC [4:0]

CC[4:0]	Command contents
00000	Absolute full data request
00011	Encoder status request
01000	Status clear request
01010	Status+data clear request with multiple rotations

Encoder status ES [3:0]

ES[3:0]	Status contents	
ES0	PA035C	Accessing encoder, accessing memory in the encoder
ES1	PA035C	Battery warning
ES2	PA035C	Encoder overheat, abnormal memory, overspeed
ES3	PA035C	Battery alarm, single / multiple rotations counter error

Data field (DF0~DF2)



Compatibility table of command and data

Command CC[4:0]	Data			Frame length
	DF0 D0[0:15]	DF1 D1[0:15]	DF2 D2[0:15]	
00000	D0[0:15]=ABS[0:15]	D1[0:15]=ABS[16:31]	D2[0:7]=ABS[32:39] D2[8:15]=CRC[0:7]	4 frames
00011 01000 01010	D0[0:15]=ALM[0:15]	D1[0:7]=”00000000” D2[8:15]=CRC[0:7]	—	3 frames

CRC [0:7] CRC generator polynomial $P(X) = X^8+X^4+X^3+X^2+1$

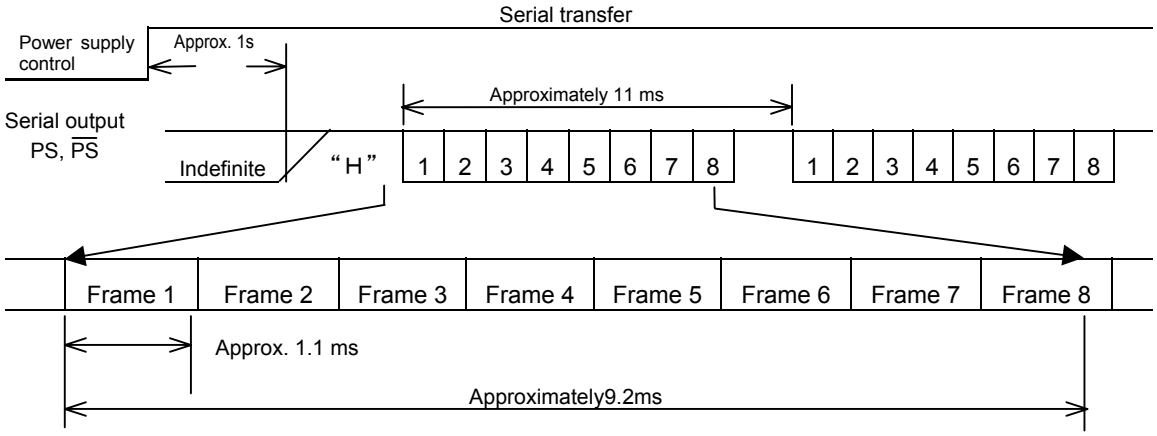
Applicable range is other than start bit and stop bit of each frame

ALM [0:15] Alarm contents differ per the encoder type.

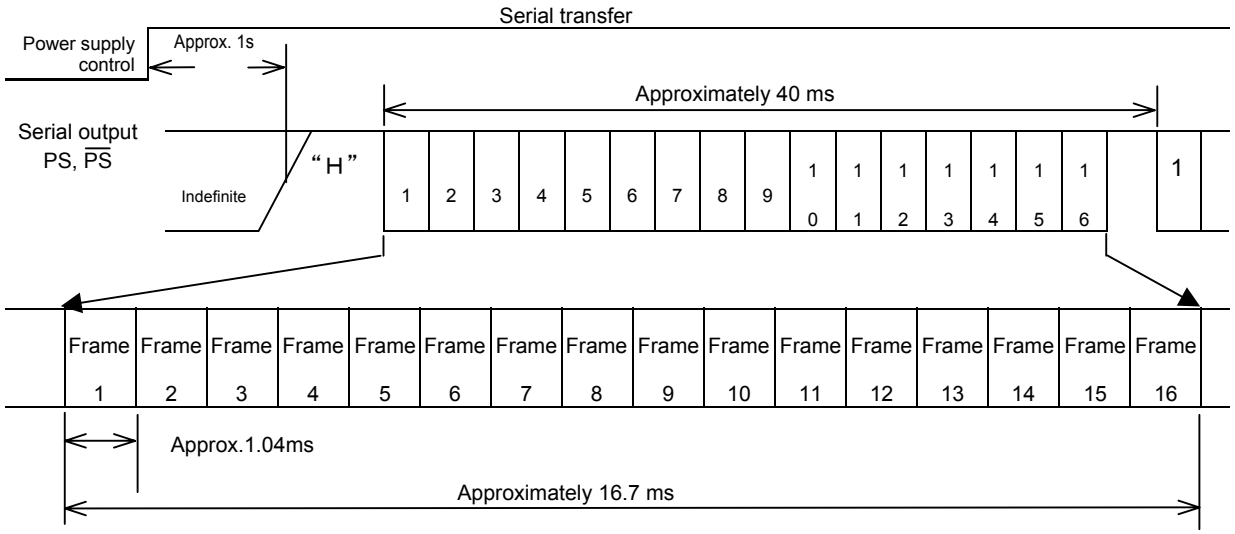
Check encoder specifications for details.

● Transfer period

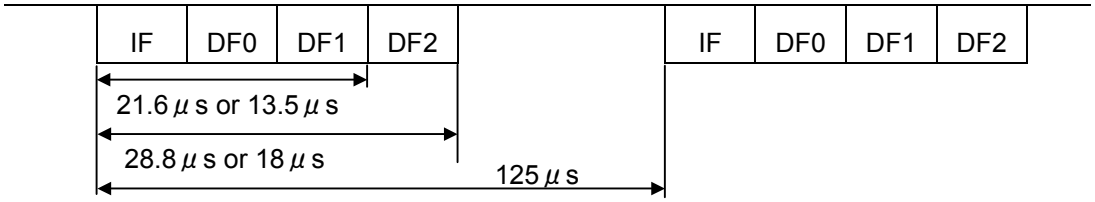
Selection value 00:_Binary Binary code output



Selection value 01:_Decimal 10 ASCII in decimal in decimal code output



Selection value 02:_Encoder_Signal Encoder signal direct output



✍ Power supply control is not fixed for 1s after booting.
Communication may not necessarily start from the first frame after 1s.

■ Serial output［Incremental encoder］

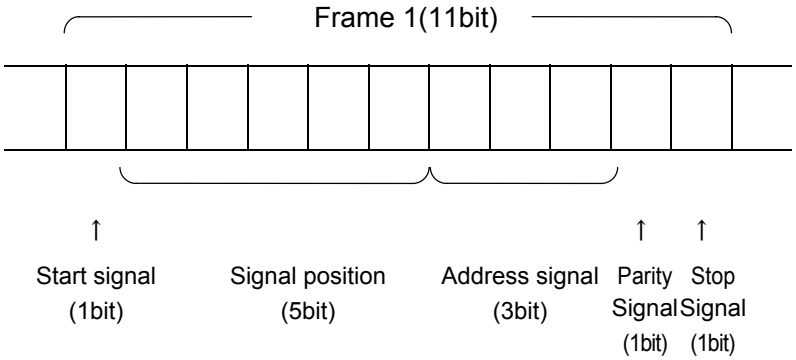
When using the incremental encoder, the actual position monitor value is output, irrespective of the selected value in Group C 07 encoder signal output (PS) format.

When using incremental encoder	
Selection value : invalid	―――
Transmission method	Asynchronous
Baud rate	9600bps
Number of transferred frames	8 frames（11 bit／frame）
Transfer format	Chart below
Transmission error check	(1bit) Even number parity
Transfer time	9.2ms(Type.)
Transfer period	Apprx.11ms Refer to page 9-12
Increasing direction	Increasing at normal rotation

✍ Normal rotation means anticlockwise one as seen from motor shaft axis.
Absolute value will be minimum value (0) if it increases to maximum.

●Transfer format

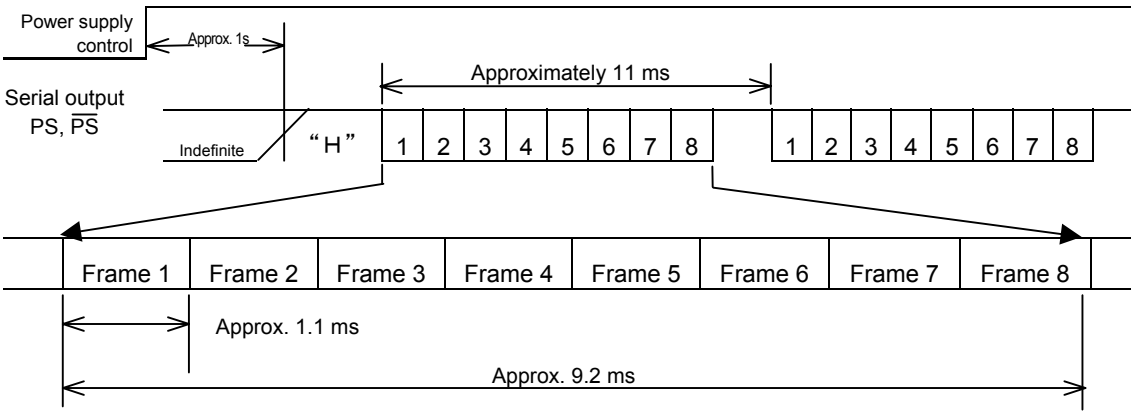
Structure of Frame 1



Structure of each frame

	Start Signal	Signal position					Address Signal			Parity Signal	Stop Signal
・Frame 1	0	D0 (LSB)	D1	D2	D3	D4	0	0	0	0／1	1
・Frame 2	0	D5	D6	D7	D8	D9	1	0	0	0／1	1
・Frame 3	0	D10	D11	D12	D13	D14	0	1	0	0／1	1
・Frame 4	0	D15	D16	D17	D18	D19	1	1	0	0／1	1
・Frame 5	0	D20	D21	D22	D23	D24	0	0	1	0／1	1
・Frame 6	0	D25	D26	D27	D28	D29	1	0	1	0／1	1
・Frame 7	0	D30	D31	0	0	0	0	1	1	0／1	1
・Frame 8	0	0 (MSB)	0	0	0	0	1	1	1	0／1	1

● Transfer period



9. Specifications [Power Unit]

■ Power Unit

Basic specifications	Model number		TS1PA05*	TS1PA10*	TS1PA15*
	Rectification system		Full-wave rectification		
	AC power supply input	Voltage	Single Phase 100Vac +10, -15%, 50/60Hz±3Hz Single Phase 35Vac +10, -15%, 50/60Hz±3Hz *1		
		Current (In rating electricity)	9Arms	17Arms	26Arms
	DC rating output	Voltage	140Vdc +10, -15% (In input voltage 100Vac) 35Vdc +10, -15% (In input voltage 35Vac)		
		Current	5A	10A	15A
		Electricity (In input voltage 100Vac)	300W	600W	900W
	Environment	Ambient temperature*2	0～55℃		
		Storage temperature	-20～+65℃		
		Operating / storage humidity	Below 90%RH (no condensation)		
		Elevation	Below 1000m		
		Vibration	0.5G Frequency range 10～55HZ Test for 2H in each direction X.Y.Z		
		Shock	2G		
	Structure		Tray type		
	Mass		0.70 kg	0.75 kg	0.80 kg
Built-in functions	Regeneration Process function	Regenerative electricity	55W max		
		Regenerative resistor value (Resistor is optional)	More than 20Ω		
	LED display		Charge state indication(CHARGE LED)		

*1 Source Voltage should be within the specified range.

Input voltage: 85Vac – 110Vac (In the case of the Amplifier model name: TS1A**A*)

30Vac – 38Vac (In the case of the Amplifier model name: TS1B02A*)

*2 When stored in the box, be sure that internal temperature does not exceed this range.

*3 About the choice of a Power Unit

Please choose the choice of a Power Unit so that a grand total of a rating armature current (I_R) of a combination Servo Motor is not beyond rating output current value of a Power Unit. Refer to “Material-17” for details of Standard Combination Specification.

The choice example) A grand total of I_R becomes 9.8A in the case of the following combination Servo Motor. In this case please use a Power Unit of “TS1PA10*” that a rating output current value is 10A.

Motor of #1 axis - T506 (I_R=1.2A)
Motor of #2 axis - T720 (I_R=3.4A)
Motor of #3 axis - T730 (I_R=5.2A) grand total of I_R =9.8A

● Calorific value

Power Unit model name	Total calorific value (In rating electricity)
TS1PA05*	20W
TS1PA10*	20W
TS1PA15*	20W

・If using external regeneration resistance, modify the added of calorific value of external regeneration resistance based on the place where it is installed.
・Be sure to carefully follow the installation method outlined in “Section 2, Installation”.

● Leakage Current

Power Unit model name	Leakage current
TS1PA05*	0.1 mA or less
TS1PA10*	0.1 mA or less
TS1PA15*	0.1 mA or less

・The system must be grounded (Type D, 3rd type) so that a dangerous voltage condition (on the main part of the machine, i.e. operation panel, etc.) does not occur during an emergency leakage.
・The value of leaked current is measured by an ordinary leak checker (700Hz Filter).

● Inrush current

Input voltage	Control power (Maximum value between 1ms after input)
In AC100V	240A(0-P)
In AC35V	85A(0-P)

9. Specifications [Servo motor / Rotation Direction Specifications]

■ Servo motor general specifications

Time Rating	Continuous
Insulation Classification	Class F
Dielectric Strength Voltage	75 V Series 1500 VAC for 1 minute 24 V Series 600 VAC for 1 minute
Insulation Resistance	DC 500 V, More than 10M Ω Fully closed, Auto cooling
Protective system	Totally enclosed (IP43)
Excitation Method	Permanent-magnet type
Ambient Temperature	0 ～ + 40℃
Ambient Humidity	20 ～ 90% (without condensation)
Vibration Classification	V 15
Oil seal	Option
Coating Color	Black

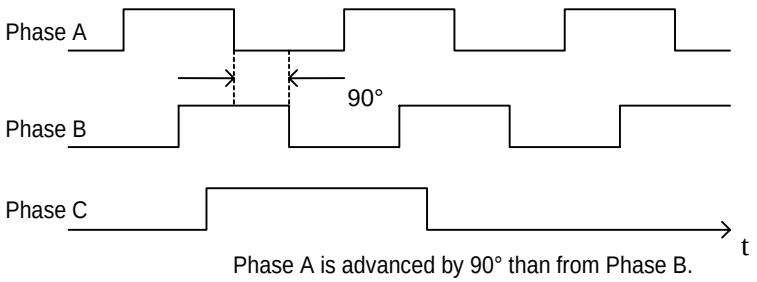
■ Rotation Direction Specifications

● When a command to increase the position command is entered, the servo motor rotates in a counterclockwise direction from the load side

● Encoder Signal Phases

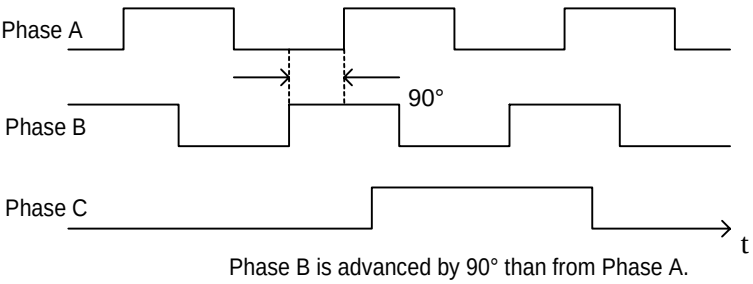
Incremental encoder

＜Normal rotation＞



Phase A is advanced by 90° than from Phase B.

＜Reverse rotation＞



Phase B is advanced by 90° than from Phase A.

When the C-Phase is high, both A- and B- Phases cross the low level, once every revolution.

Absolute encoder

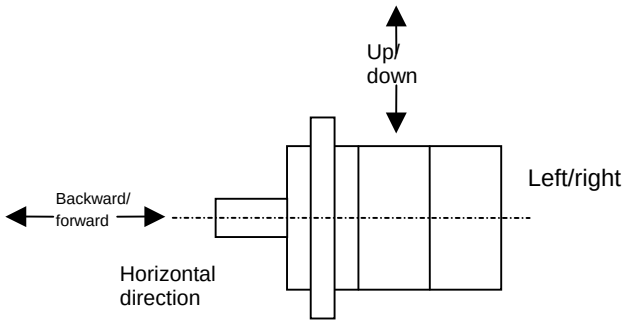
Normal (forward) rotation: Position data incremental output

Reverse rotation: Position data decreased output

■ Mechanical specifications

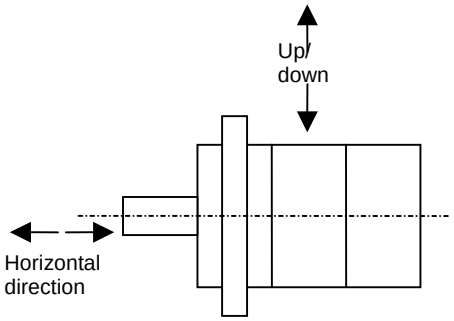
● Vibration Resistance

Install the servo motor in a horizontal direction (as shown in the following figure), so that when vibration is applied in any 3 directions (up/down, back/forward, left/right) it can withstand the vibration acceleration up to 24.5m/s^2.



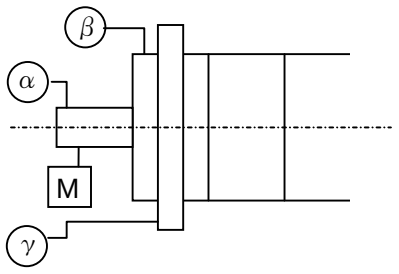
● Shock Resistance

Install the shaft of the servo motor in a horizontal direction (as shown in the following figure). It should withstand shock acceleration up to 98 m/s^2 (when shocks are applied in an Up/down direction) for 2 rotations. However, since a precision detector is fixed to the counter-load side of the motor, any shock applied to the shaft may cause damage or failure the detector; therefore, do not the shaft to drop impact or shock loads under any circumstances.



● Working accuracy

The following table shows the accuracy of the servo motor output shaft and precision (Total Indicator Reading) of the parts surrounding the shaft.

Items	* 1 T.I.R.	Reference Figure
Vibrations of output shaft terminal α	0.02mm	
Eccentricity of the external diameter of the flange on output shaft M (β)	0.03mm（T4 and T5 Series）	
	0.05mm（T7 and T8 Series）	
Perpendicularity of the flange face to output shaft M (γ)	0.04mm（T4 and T5 Series）	
	0.05mm（T7 and T8 Series）	

*1 T.I.R (Total Indicator Reading)

9. Specifications [Mechanical specifications]

● Oil seal

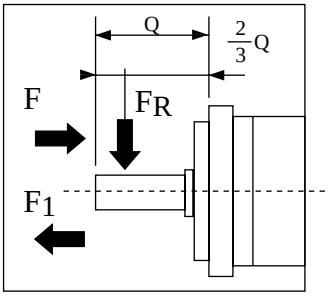
These oil seals are of optional specification and can be set on T5, T7 and T8 Series.
The table below shows our standard oil seals that are readily available: (JIS S type)

Motor model number	Oil Seal Model No. (SC Type)		
	Inner diameter	Outer diameter	Width
T5 Series	ϕ8mm	ϕ22mm	7mm
T7 Series	ϕ16mm	ϕ30mm	7mm
T8 Series	ϕ19mm	ϕ35mm	8mm

● Permissible load

Limit the radial load and thrust load being applied to the output shaft of the servo motor to a level below the values indicated in Table below.
Pay attention not to apply excessive load by installation of reduction gears, couplings and belts.

Motor model number	When installation is made			During operation	
	Radial load	Thrust load		Radial load F_R	Thrust load
	F_R	F-direction	F1-direction		
T4 Series	100 N	100 N	100 N	80 N	20 N
T5 Series	150 N	200 N	150 N	100 N	30 N
T7 Series	250 N	500 N	200 N	200 N	50 N
T8 Series	500 N	500 N	200 N	345 N	70 N



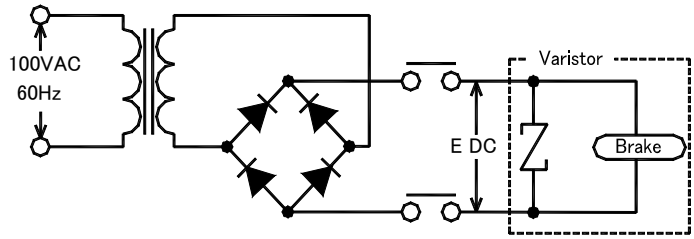
・The permissible loads during operation were determined corresponding to the revolution rate of the motor and the load being applied to the output shaft of the motor and in consideration the service life of the bearing and shaft strength.

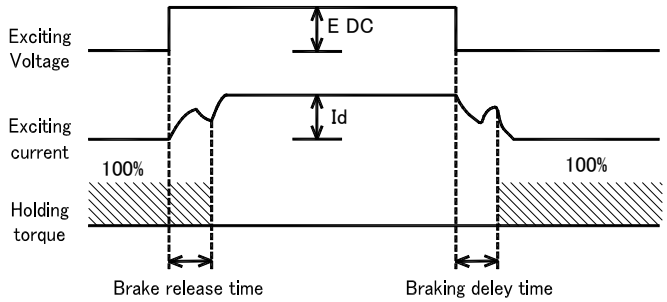
■ Holding brake specifications

An optional holding brake is available for each motor. Since this brake is used for holding, it cannot be used for braking, except for an emergency. Turn brake excitation ON or OFF by using the holding brake timing signal output. When using this signal, set the command for brake release time to 0min^{-1} for the servo amplifier.
To externally control the holding brake, a response time (as shown in the following table) is required. When using a motor with a brake, determine a time sequence that takes this delay time into account.

Motor model number	Static friction torque N.m	Release time msec	Braking delay time msec
T5 Series	0.29	30	35
T7 Series	1.47	40	85
T8 Series	1.96	45	90

Brake operating time is measured in the following circuit.





The brake release time and braking delay time refer to those mentioned in the above tables.

Materials

[Selection Details]

[UL/C-UL standard and EN standard]

[Dimension]

[Servo motor characteristics]

[Option]

[Encoder clear]

[Electronic gear]

■ Time of Acceleration and Deceleration

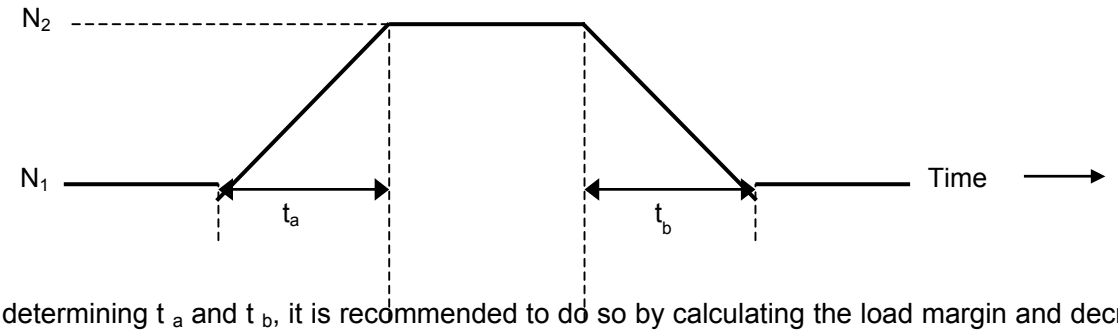
● The motor's acceleration time (t_a) and deceleration time (t_b) when under a constant load is calculated by following method.

Acceleration time: $t_a = (J_M+J_L) \cdot (2\pi / 60) \cdot \{ (N_2 - N_1) / (T_P - T_L) \}$ [S]

Deceleration time: $t_b = (J_M+J_L) \cdot (2\pi / 60) \cdot \{ (N_2 - N_1) /(T_P + T_L) \}$ [S]

✍ These expressions are for the rated speed values, but exclude the viscous torque and friction torque of the motor.

t_a : Acceleration time(S)
t_b : Deceleration time(S)
J_M : Motor inertia($kg \cdot m^2$)
J_L : Load inertia($kg \cdot m^2$)
N_1, N_2 : Rotational speed of motor(min^{-1})
T_P : Instantaneous maximum stall torque($N \cdot m$)
T_L : Load torque($N \cdot m$)



✍ When determining t_a and t_b, it is recommended to do so by calculating the load margin and decreasing the instantaneous maximum instant stall torque value (TP) to 80%.

■ Permitted repetitions

● There are separate limitations on repetitive operations for both the servo motor and servo amplifier, and the conditions of both must be fulfilled simultaneously.

Permitted repetitions for the servo amplifier

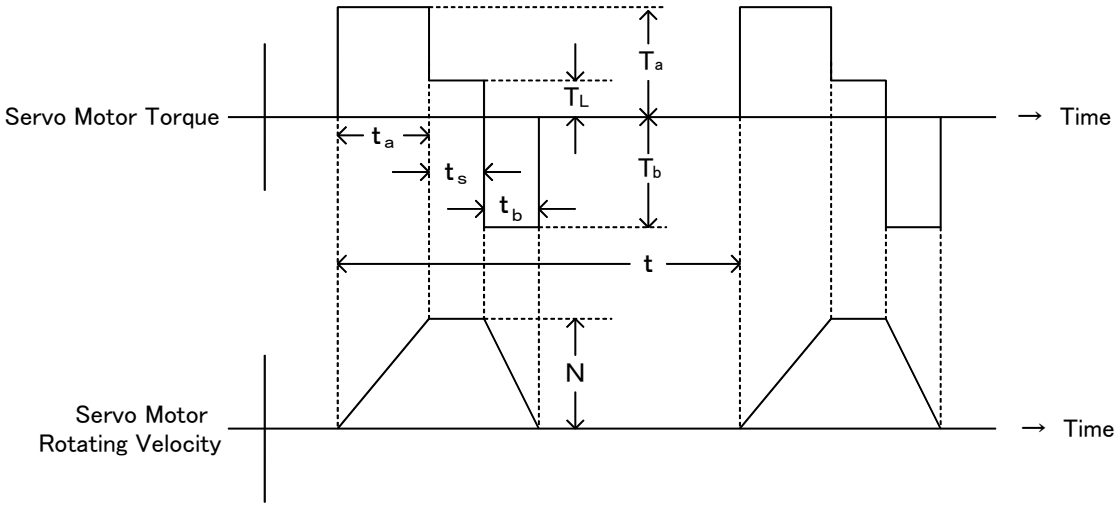
When START / STOP sequences are repeated frequently, confirm in advance that they are within the allowed range. Allowed repetitions differ depending on the type, capacity, load inertia, adjustable-speed current value and motor rotation speed of the motor in use. If the load inertia = motor inertia × m times, and when the permitted START / STOP repetitions (up until the maximum rotation speed) exceed $\frac{20}{m+1}$ times/min, contact your dealer or sales office for assistance, as precise calculation of effective torque and regenerating power is critical.

Permitted repetitions for the motor

Permitted START / STOP repetitions differ according to the motor's usage conditions, such as the load condition and time of operation.

■ When continuous-speed status and motor stop status is repeated

- In operating conditions such as shown below, the motor should be used at a frequency in witch its effective torque is less than the rated torque.



If the operating cycle is considered as 't', the usable range can be determined as follows:

$$t \geqq \frac{Ta^2\,ta + T_L{}^2\,ts + Tb^2\,tb}{T_R{}^2} \quad [s]$$

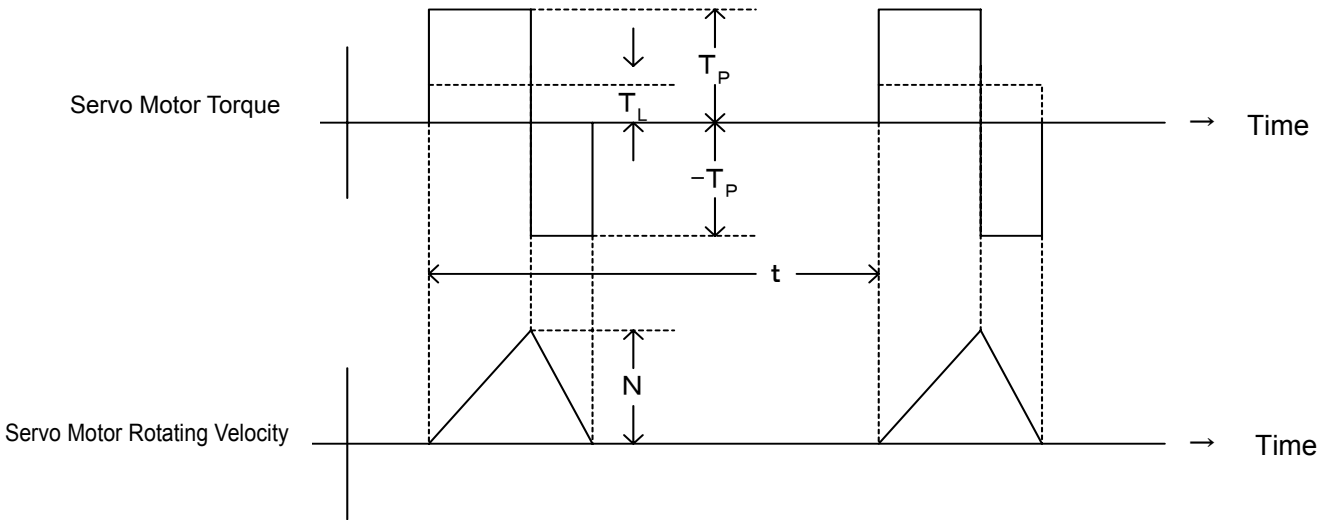
Ta: Acceleration Torque
Tb: Deceleration Torque
T_L : Load Torque
Trms : Effective Torque
T_R: Rated Torque

When cycle time (t) is predetermined, Ta, Tb, t_a, t_b appropriate in the above formula are required.

✍ When actually determining the system drive mode, it is recommended to calculate the load margin and suppress it to Trms ≦ $0.7T_R$

■ When the motor repeats acceleration, deceleration, and stop status

- For the operating status shown below, the value of permitted repetitions n (times/min) is displayed by following equation.

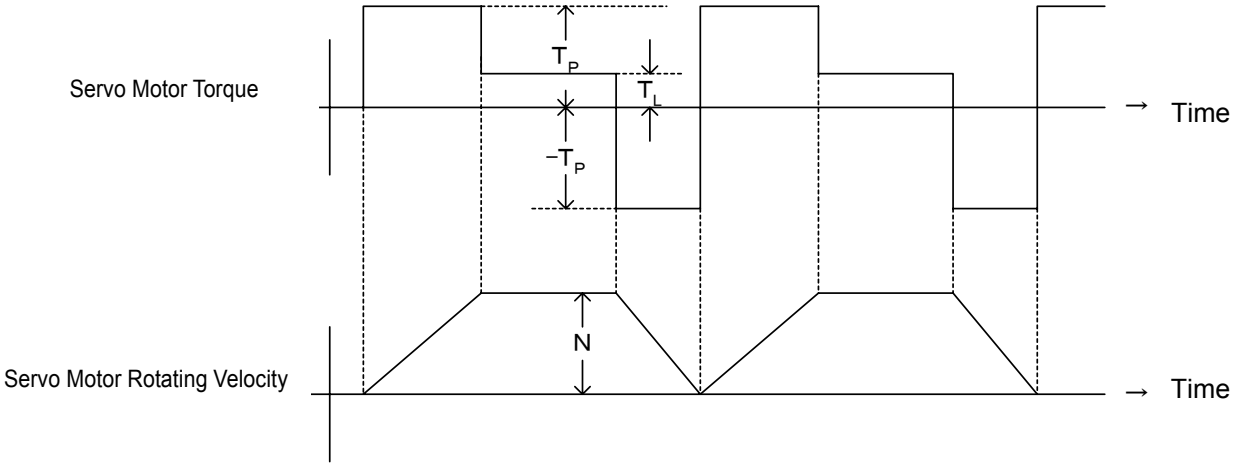


$$n = 2.86 \times 10^2 \times \frac{1}{N(J_M + J_L)} \times \frac{T_P{}^2 - T_L{}^2}{T_P{}^3} \times T_R{}^2 \quad [\text{times/min}]$$

T_R : Rated torque

■When the motor repeats acceleration, constant speed operation, and deceleration status

● For the operating status shown below, the value of permitted repetitions 'n' (times/min) is displayed by following equation.



$$n = 2.86 \times 10^2 \times \frac{1}{N(J_M + J_L)} \times \frac{T_R^2 - T_L^2}{T_P} \quad \text{[times/min]}$$

■ Loading Precautions

● Negative load

The servo amplifier cannot perform continuous operations by negative load from the servo motor for more than several seconds.

When using the amplifier with a negative load, contact your dealer or sales representative.

- Downward motor drive (when there is no counter weight.)
- When usinglike a generator, such as the wind-out spindle of a winder.

● Load Inertia (J_L)

When the servo amplifier is used with a load inertia exceeding the allowable load intertia calculated in terms of the motor shaft, a main circuit power overvoltage detection or regenerative error function may be issued at the time of deceleration.

The following measures must be taken in this case. For more details, please consult with your dealer or sales representative.

- Reduce the torque limit
- Extend the acceleration and deceleration time (Slow down)
- Reduce the maximum motor speed
- Install an external regenerative resistor

■ Regeneration Process

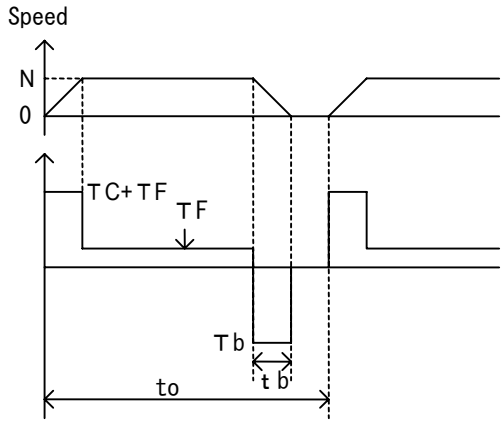
●When Overvoltage alarm (ALM_61) occurs during movement, it needs Regeneration processing in External Regenerative Resistor. Please calculate Regenerative power [PM] from a movement condition first, connect a chosen External Regenerative Resistors (an option) to a Power Unit. The regeneration capacity depends on the permitted power [PRO] of the regenerative resistor.

■ Regeneration Power [PM] by Operations along Horizontal Axis

● Regeneration energy is calculated.

$$EM = EHb = \frac{1}{2} \times N \times KE \times \frac{Tb}{KT} \times tb - \left(\frac{Tb}{KT}\right)^2 \times R \times tb$$

EM	:	Regeneration energy during operations along horizontal axis	……[J]
EHb	:	Regeneration energy during deceleration	……[J]
KE	:	Induced voltage constant	……[Vrms/min^{-1}] (Motor constant)
KT	:	Torque constant	……[N･m/Arms] (Motor constant)
N	:	Motor rotation speed	……[min^{-1}]
R	:	Armature resistance	……[Ω] (Motor constant)
tb	:	Deceleration time	……[s]
Tb	:	Torque during deceleration	……[N･m] (Tb= Tc - TF)
Tc	:	Adjustable speed torque	……[N･m]
TF	:	Friction torque	……[N･m]



● Effective regeneration power is calculated.

$$PM = \frac{EM}{to}$$

PM	:	Effective regeneration power [W]
EM	:	Regeneration energy during deceleration [J]
to	:	Cycle time [s]

■ Regeneration Power [PM] by Operations along Vertical Axis (With a Gravitational Load)

● Regenerative energy is calculated.

$$EM = EVUb + EVD + EVDb$$

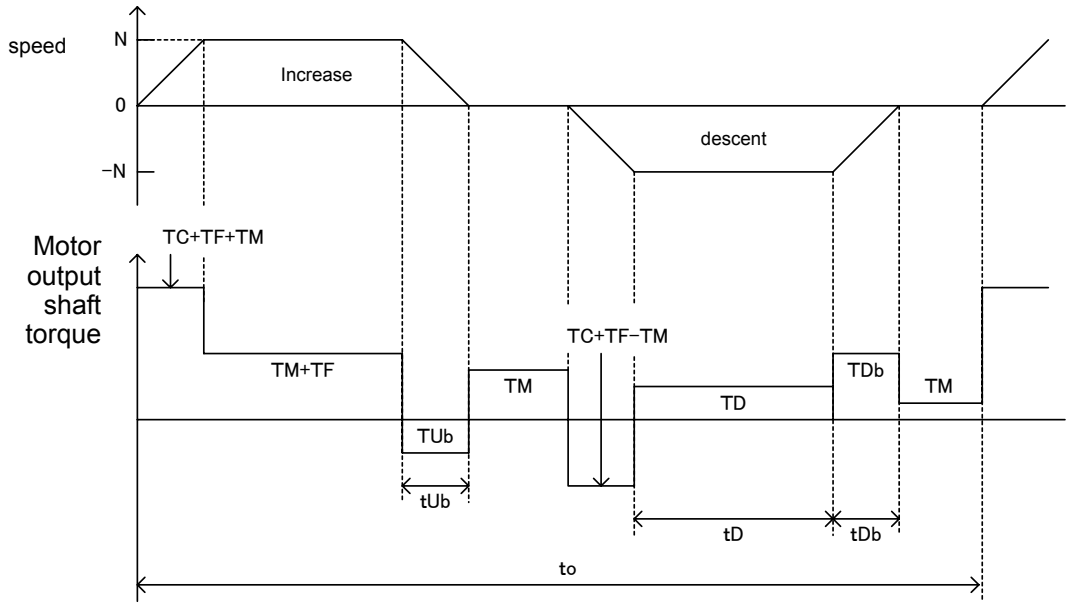
$$= \frac{1}{2} \times N \times KE \times \frac{TUb}{KT} \times tUb - \left(\frac{TUb}{KT}\right)^2 \times R \times tUb$$

$$+ N \times KE \times \frac{TD}{KT} \times tD - \left(\frac{TD}{KT}\right)^2 \times R \times tD$$

$$+ \frac{1}{2} \times N \times KE \times \frac{TDb}{KT} \times tDb - \left(\frac{TDb}{KT}\right)^2 \times R \times tDb$$

EM	:	Regeneration energy during operations along vertical axis	……[J]
EVUb	:	Regeneration energy during increased deceleration	……[J]
EVD	:	Regeneration energy during descending run	……[J]
EVDb	:	Regeneration energy during decreased deceleration	……[J]
TUb	:	Torque during increased deceleration	……[N·m]
tUb	:	Increased deceleration time	……[s]
TD	:	Torque during descending run	……[N·m] (TD=TM – TF)
tD	:	Descending run time	……[s]
TDb	:	Torque during decreased deceleration	……[N·m] (TDb=TC – TF+TM)
tDb	:	Decreased deceleration time	……[s]
TM	:	Gravitational load torque	……[N·m]

✍ When the calculation result of either of **EVUb**, **EVD**, or **EVDb** is negative, calculate **EM** by considering the value of those variabkes as 0.



● Effective regeneration power is calculated.

$$PM = \frac{EM}{to}$$

PM : Effective regeneration power [W]
EM : Regeneration energy during increased deceleration/ descending / decreased deceleration [J]
to : Cycle time [s]

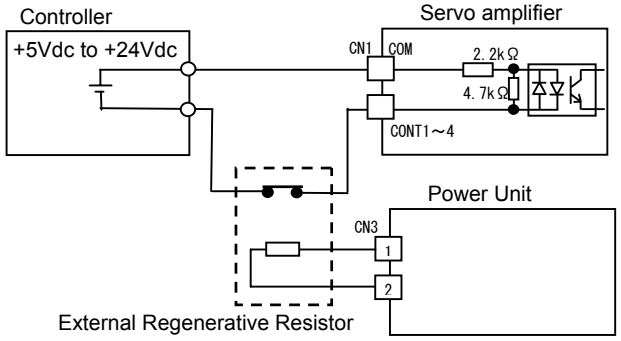
■ Selection of Optional External Regenerative Resistor

● You can select the combination of external regenerative resistors based on effective regenerative power [PM] sought by the regeneration calculation.

Regenerative power [PM]	Resistor Model Number	Resistance Value	Thermostat Temperature detected (Detection temperature range)	Permitted power [PRO]	Outline Drawing
Up to 10W	REGIST-080W50B	50Ω	135℃±7℃ (b contact) (Normally closed contact)	10W	Refer to 'Materials -7'
Up to 30W	REGIST-120W50B	50Ω		30W	
Below 55W	REGIST-220W50B	50Ω		55W	
	REGIST-220W20B	20Ω			
55W and over	Contact us				

✍ When regeneration power [PM] exceeds the permitted power [PRO] of the external regeneration resistor, reconsider the acceleration constant, load inertia, etc.

■ Connection of Regenerative Resistance



✍ Please connect resistance wire of the External Regenerative Resistor to CN3 of the Power Unit.

✍ Thermostat of the Regenerative Resistance please allocate the connected general-purpose input(any of [CONT1 – CONT4]) to [Group9 40 External Trip Input Function of General Parameter].

Parameter Set-up Example：When connecting the thermostat to CONT4

The external trip function will be valid when [0DH: CON4_OFF]
CONT4 is turned off in [Grop4 40 External Trip Input Function

Alarm (ALM-55) will be output from the servo amplifier when the thermostat of a generative resistor trips (the contact point comes off) because of heating.

✍ Please make sure to install the external regenerative resistor with twisted wires and use as a short wire that is up to 5 meters long as possible.

✍ Use nonflammable electric wire or perform non-combustible processing (silicon tube, etc.) for connecting cable and wired, and install wiring so as to not come in contact with the built-in unit .

✍ The built-in regenerative resistance may generate heat even if the overheat alarm does not occur. Do not touch the servo amplifier for 30 minutes after power is disconnected in the case of a power failure, as there is a risk of burn.

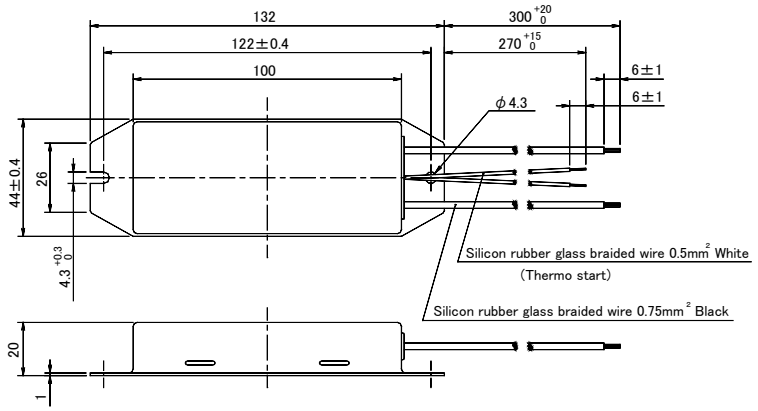
✍ Install the external regeneration resistor on the amplifier, and measure the temperature of the external regeneration resistor by the operating condition that the regeneration electric power PM becomes the maximum. Then do sufficient mounting check of alarm not being generated. In addition, it takes 1 to 2 hours until the temperature of the external regeneration resistor is saturated.

✍ Do not install the external regeneration resistor in a corrosive gas environment, nor be exposed amount of dust, because the gas may cause insulation deterioration, corrosion.

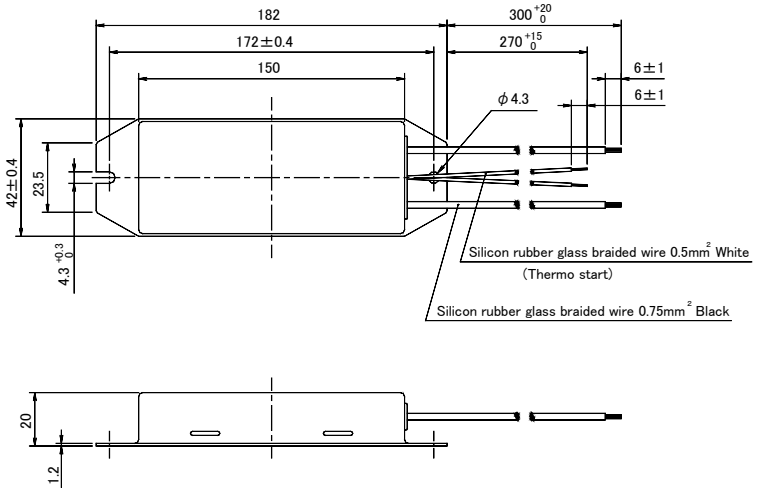
✍ Keep sufficient distance to other devices to circumvent the effect of their radiated heat to the external regeneration resistor.

■ External Dimension of Regenerative Resistor

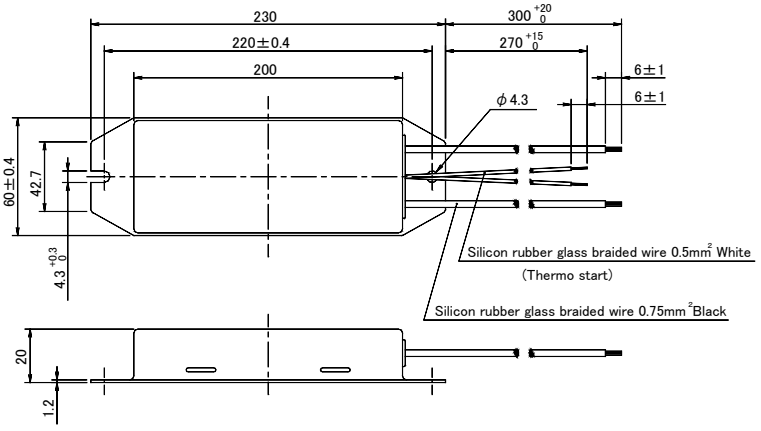
Unit : mm



Model number	Thermostat Detection temperature (*Contact specification*)
REGIST-080W50B	135℃±7℃ (Normal close contact)



Model number	Thermostat Detection temperature (*Contact specification*)
REGIST-120W50B	135℃±7℃ (Normal close contact)



Model number	Thermostat Detection temperature (*Contact specification*)
REGIST-220W50B	135℃±7℃ (Normal close contact)
REGIST-220W20B	135℃±7℃ Normal close contact

Materials [UL/c-UL standard and EN standard]

■ Outline of UL/C-UL standard and EN standard conformity

● TS1 series servo amplifier and power unit conforms to the UL/C-UL standard and EN standard below.

Mark	Standards	Standard number	Certification Organization
	UL/c-UL standard	UL508C (File No.E179775)	UL （Underwriters Laboratories inc.）
	EN standard	EN50178 EN61000-6-2	TÜV （TÜV Product Service Japan, Ltd.）

✍ Servo amplifiers that Model No.:TS1***AN or TS1***AP
(Tachogenerator as velocity detector applied models) are not complied with UL, EN standards

● T series servo motor conforms to the UL standard and EN standard below.

Display	Standards	Standard number	Certification Organization
	UL standard	UL1004 UL1446 (File No.E179832)	UL （Underwriters Laboratories inc.）
	EN standards	EN60034-1 EN60034-5 EN61010-1	-

✍ For products conforming to UL standards, some specifications may differ from the standard product due to prerequisites necessary for obtaining approval. Contact the manufacturer for more details.

✍ The above information can be verified at the UL web site http://www.ul.com/database/

✍ If you need certification or a declaration of UL standard compliant products for the above T series servo motors, please contact our sales office.

● Precautions for conformity standards

① Make sure to use servo amplifier and servo motor in a proper combination. Check “Section 1: Prior to use --- Servo amplifier type number.

② Make sure to install the servo amplifier or the power unit in your control panel in an environment where the pollution degree specified in EN50178 and IEC664 to pollution degree 2 or less.(polution degree 1 or 2). The control panel installation configuration (under “IP54”) must exclude exposure to water, oil, carbon, dust, etc.

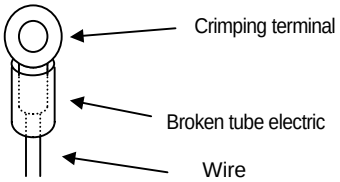
③ A International protection class of Servo amplifier or Power unit is “IP0X”. Please be never involved in the main body of Servo amplifier in a power supply input state (CHARGE LED of the front is turning on) that is the structure that is not protected for an object.

④ Please use a supply power supply to a product for EN50178 in the prescribed following condition.
Control power supply and for Input/Output signal (24Vdc): overvoltage category I
Main power supply of Servo Amplifier(140Vdc) : overvoltage category II
Power supply input of Power Unit(100Vac) : overvoltage category III

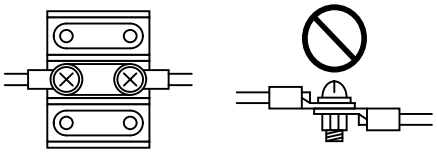
⑤ Always ground the protective earth terminals of the servo amplifier or the power unit to the power supply earth. (⏚)

⑥ When connecting the leakage stopper, make sure to connect the protective earth terminal to the power supply earth. (⏚)

⑦ Connect earthing wire by using a crimping terminal with insulated tube, so that the connected wire will not touch the neighboring terminals.



⑧ For wire relays, use a fixed terminal block to connect wires; never connect wires directly.



⑨ Connect an EMC filter to the input power supply of the unit.

⑩ Use an EN/ IEC-standard compatible no-fuse circuit breaker and electromagnetic contactor.

■ Compliance with EC Directives

● Precautions for EMC Directives

Use the following guidelines below for the TS1 servo system in order to conform the customer's equipment and devices to the EMC Directives.

① A metallic material must be used for the door and main body of control panel.

② The joints of the top and side panels must be masked and welded.

③ Parts joined with screws must be welded to prevent noise from leaking out from joints.

④ When joining parts with screws or spot welding, the welding space must be within 10cm.

⑤ Use an EMI gasket so that there is zero clearance between the door and control panel.

⑥ Install EMI gasket uniformly to the contact points between door and main body of control panel.

⑦ Perform conductivity processing on the EMI gasket, door and main body of control panel to confirm their conductivty.

⑧ Ground the noise filter frame to the control panel.

⑨ Ground the servo amplifier chassis provided by the customer.

⑩ Use shield cables for the motor encoder line cable.

⑪ Ground the shield of motor encoder line cable to the control panel with the clamp.

⑫ Use a conducting metal P clip or U clip to ground and clamp the shield wire, and fix it directly with metal screws. Do not ground by soldering electric wire to the shield wire.

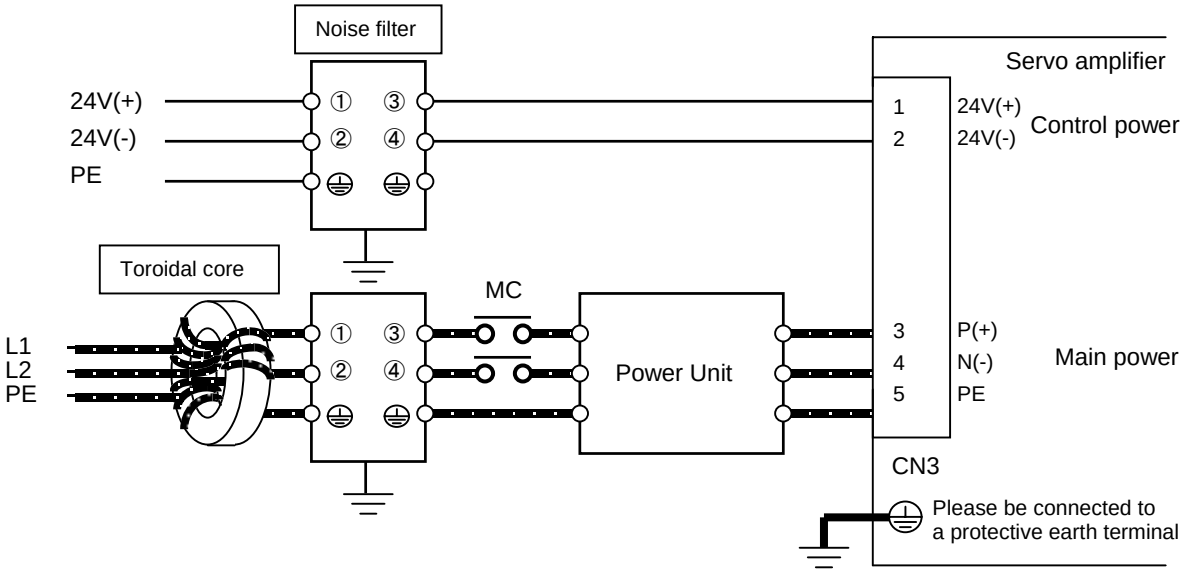
Grounding by U clip or P clip

Grounding by soldering

Materials [UL/c-UL standard and EN standard]

■ Installation of servo amplifier, noise filter and toroidal core.

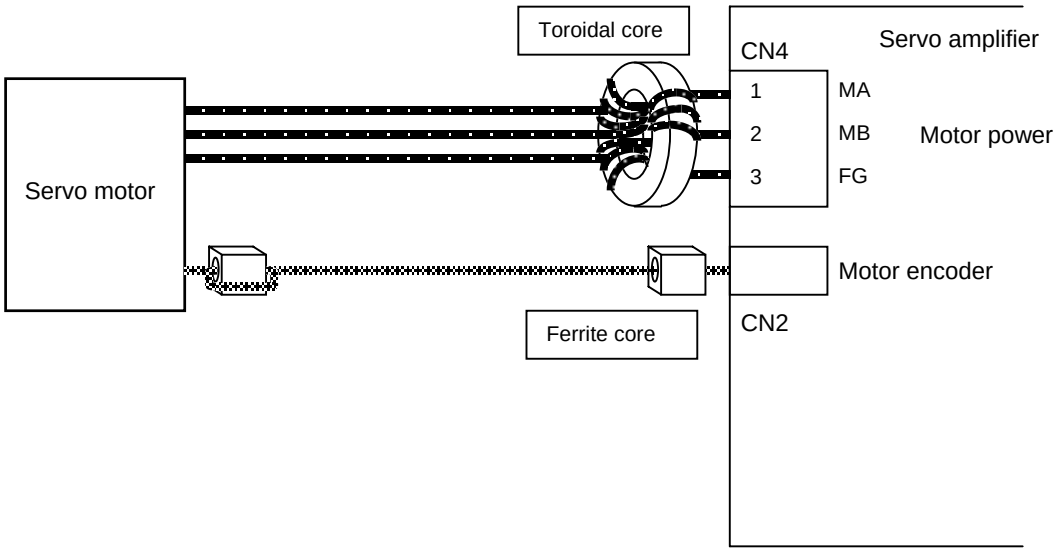
● Power supply side



⑬ Please put a noise filter(note 1) in a power supply line. In addition, Always ground the frame of the noise filter and Install wiring by separating the primary and secondary wiring of the noise filter as much as possible.

⑭ Please wrap the Toroidal core(note 2) three times around the primary side of the noise filter in the main power side.

● Servo motor side



⑮ Please wrap the Toroidal core (note 3) two times around the amplifier side of the motor power line.

⑯ Please add a Ferrite core (note 4) to around the servo amplifier side of the motor encoder line.

⑰ Please wrap the Ferrite core (note 4) two times around the servo motor side of the motor encoder line.

Materials [UL/c-UL standard and EN standard]

■ Recommended prevention components

● (note 1) Noise filter

Model Number	Specifications	Manufacturer
SUP-EK10-ER6	Rated voltage : Line-Neutral 250 V Rated current : 10 A	Okaya Electric Industries Co. Ltd.

● (note 2) Toroidal core

Model Number	External diameter	Internal diameter	Manufacturer
251-211	65 mm	36 mm	SCHAFFNER

● (note 3) Toroidal core

Model Number	External diameter	Internal diameter	Manufacturer
T60x26x36	60 mm	36 mm	TDK

● (note 4) Ferrite core

Model Number	Internal diameter	Manufacturer
SFC-10	9.5 - 10.5 mm	KITAGAWA

Okaya Electric Industries Co. Ltd.: http://www.okayaelec.co.jp/

SCHAFFNER : http://www.schaffner.com/

TDK : http://www.tdk.co.jp/

KITAGAWA : http://www.kitagawa-ind.com/

■ Implementation of check test

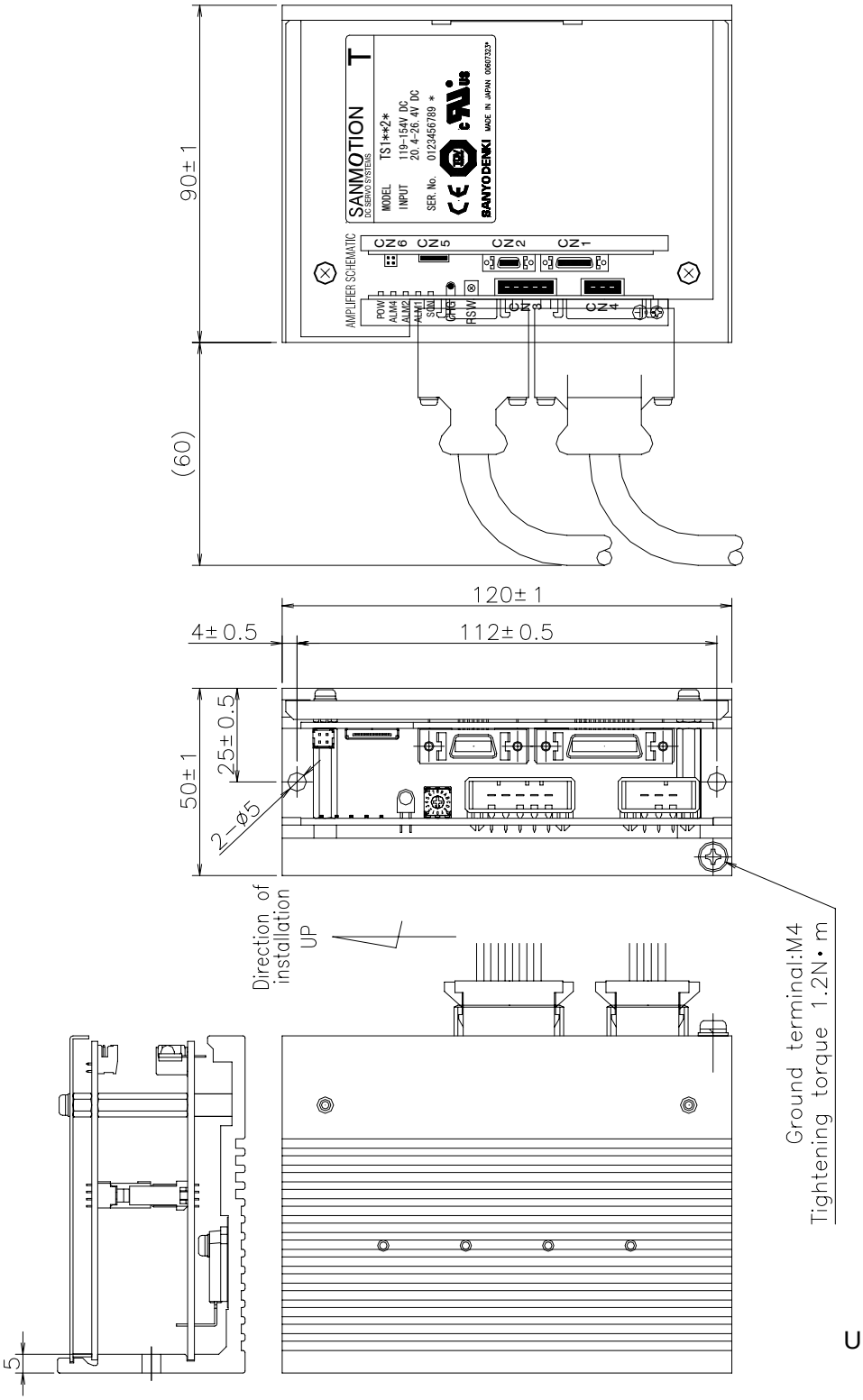
EMC testing of equipment and devices which the TS1 servo system is built–in should meet the emission and immunity (electromagnetic compatibility) standards for the usage environment / and operating conditions.

It is necessary to follow the instructions mentioned above and conduct a final conformity check test after review.

Materials [Dimension]

■ Servo Amplifier

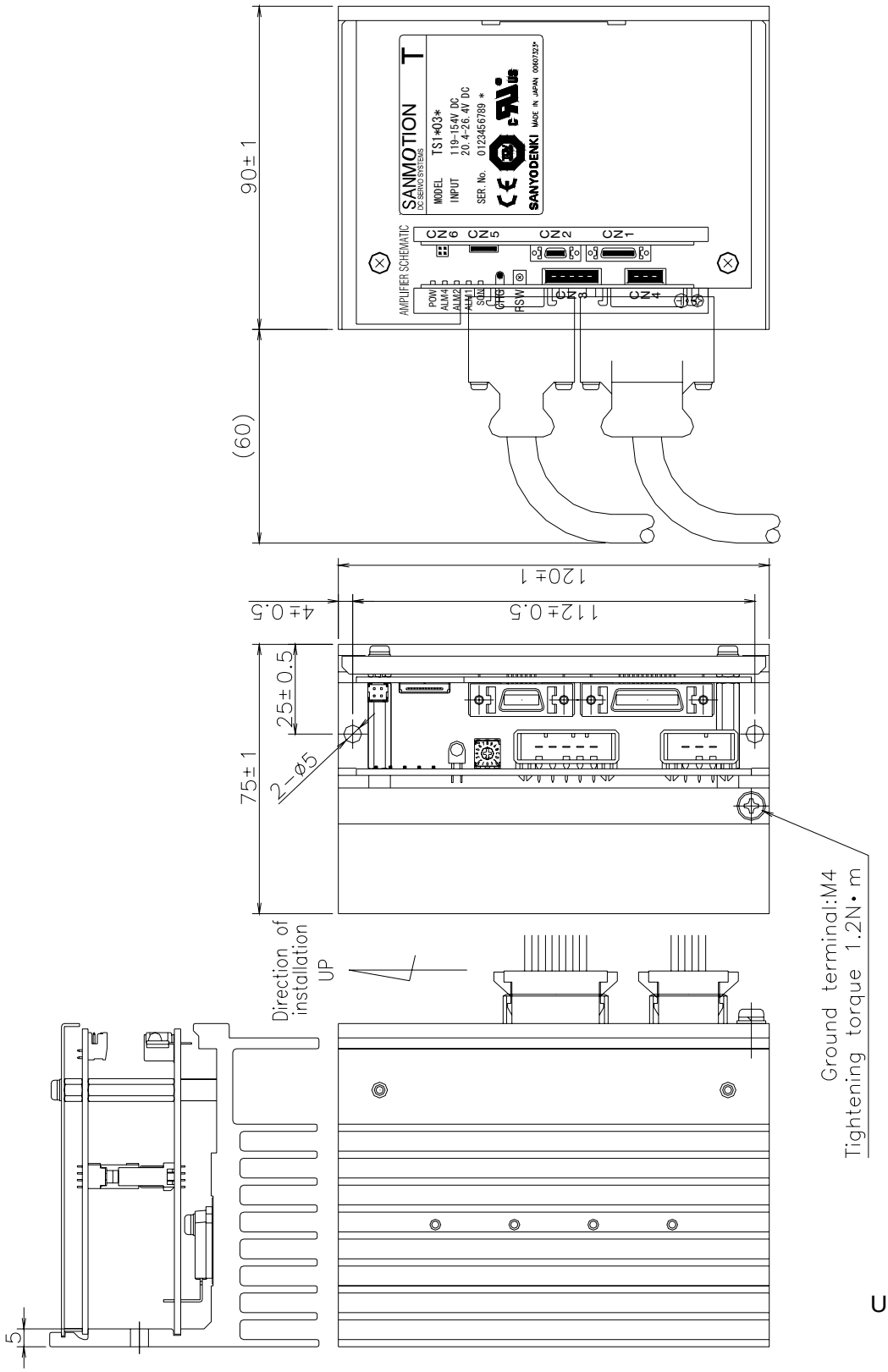
● Model Number: TS1*02*, TS1AA2*



UNIT[mm]

Materials [Dimension]

- Model Number: TS1A03*

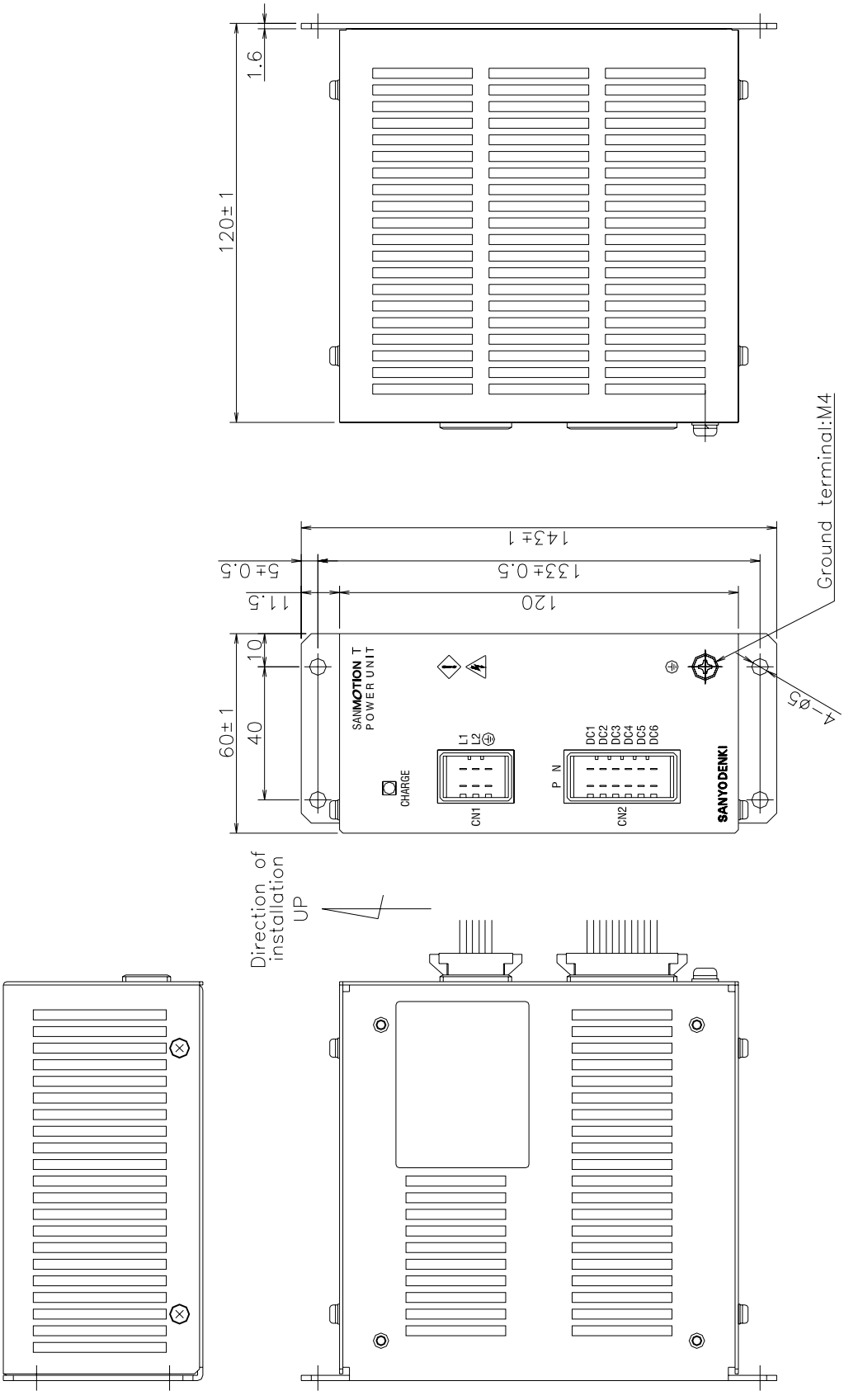


UNIT[mm]

Materials [Dimension]

■ Power Unit

● Model Number: TS1PA*

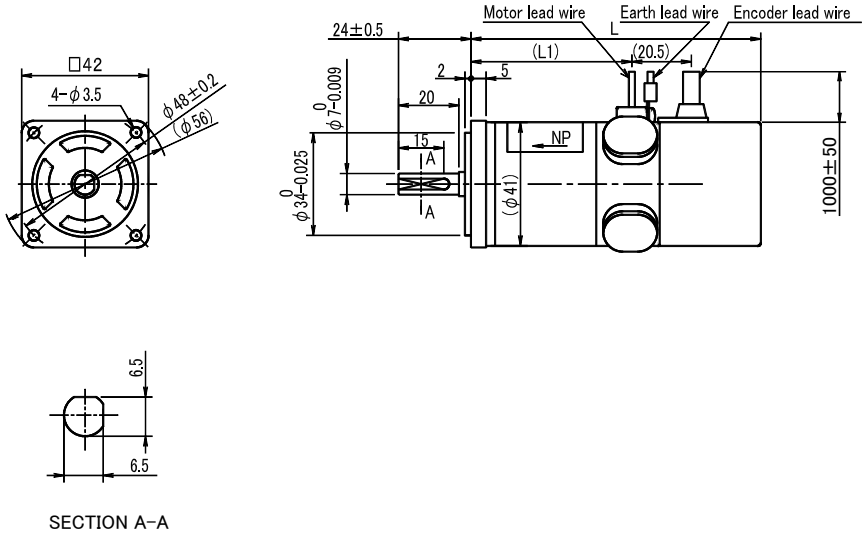


UNIT[mm]

■ Servo Motor

● Model Number: T4*

T402-011EXX, T404-012EXX, T406-012EXX

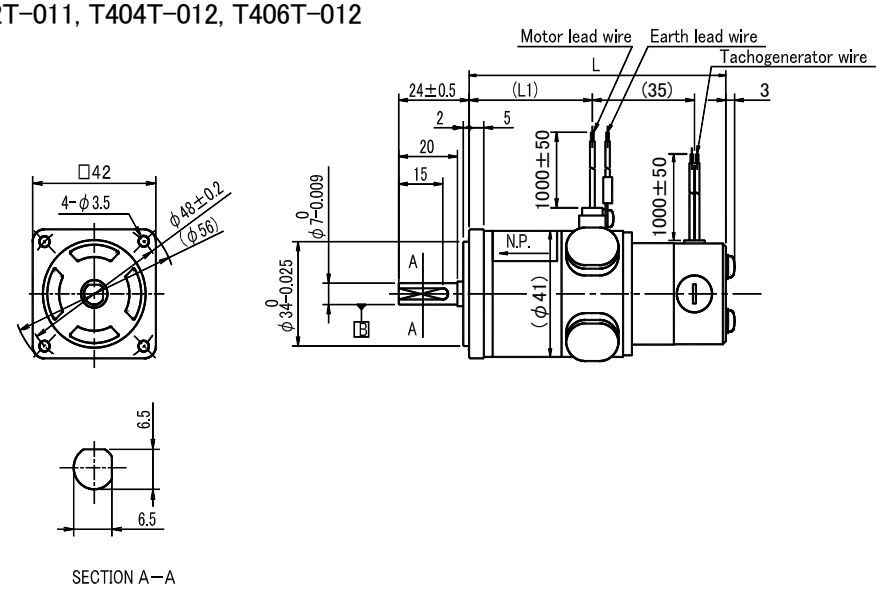


Model number	L	(L1)
T402-011EXX	83	39.5
T404-012EXX	96	52.5
T406-012EXX	109	65.5

UNIT[mm]

● Model Number: T4**T

T402T-011, T404T-012, T406T-012

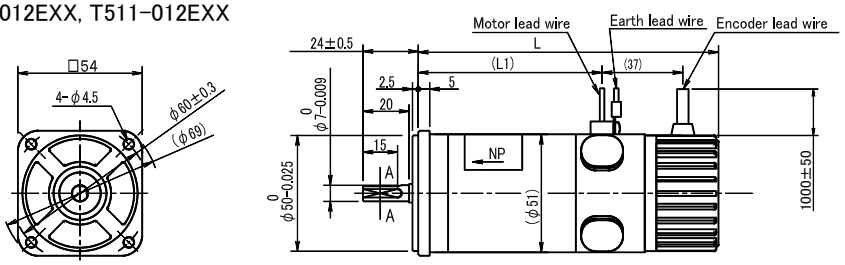


Model number	L	(L1)
T402T-011	87.5	42
T404T-012	98	52
T406T-012	111	65

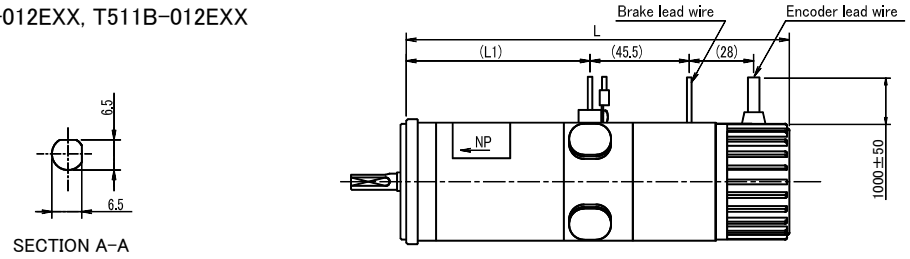
UNIT[mm]

● Model Number: T5*

T506-012EXX, T511-012EXX



T506B-012EXX, T511B-012EXX

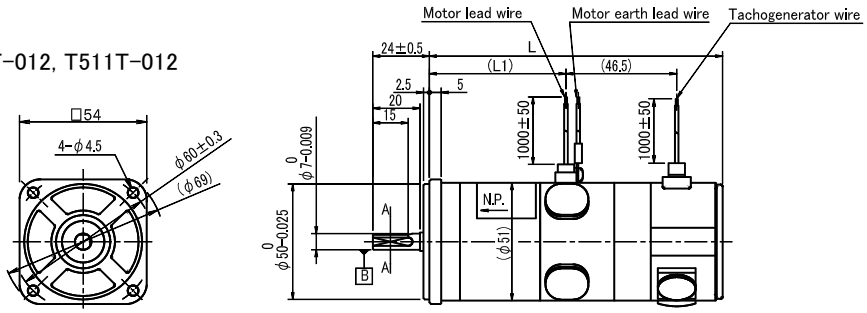


Model number	L	(L1)
T506-012EXX	110.5	58
T506B-012EXX	147	
T511-012EXX	130.5	78
T511B-012EXX	167	

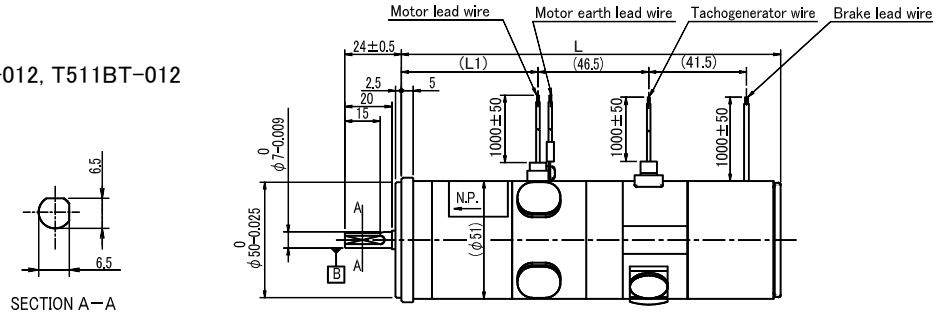
UNIT[mm]

● Model Number: T5**T

T506T-012, T511T-012



T506BT-012, T511BT-012

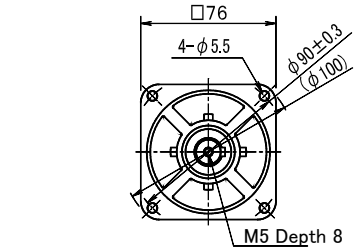


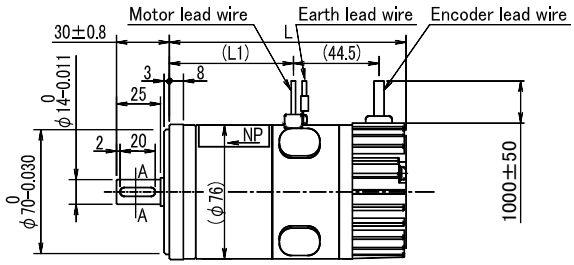
Model number	L	(L1)
T506T-012	124.5	58
T506BT-012	161	
T511T-012	144.5	78
T511BT-012	181	

UNIT[mm]

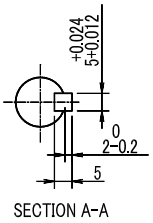
- Model Number: T7*

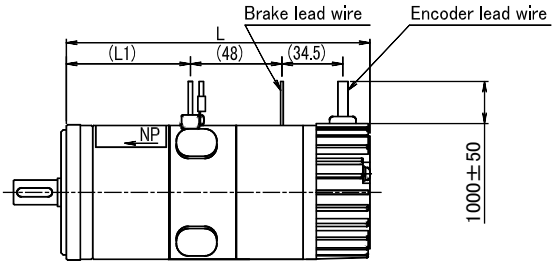
T720-012EXX, T730-012EXX





T720B-012EXX, T730B-012EXX



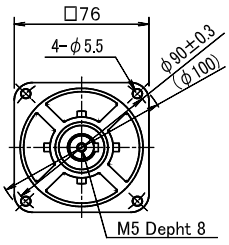


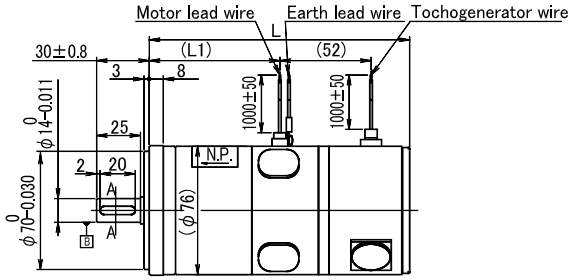
Model number	L	(L1)
T720-012EXX	134.5	74.5
T720B-012EXX	172.5	
T730-012EXX	158.5	98.5
T730B-012EXX	196.5	

UNIT[mm]

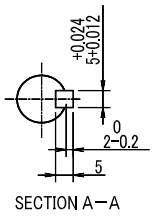
- Model Number: T7**T

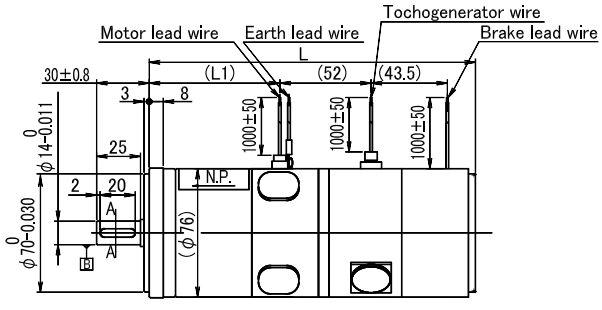
T720T-012, T730T-012





T720BT-012, T730BT-012



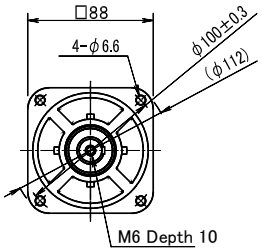


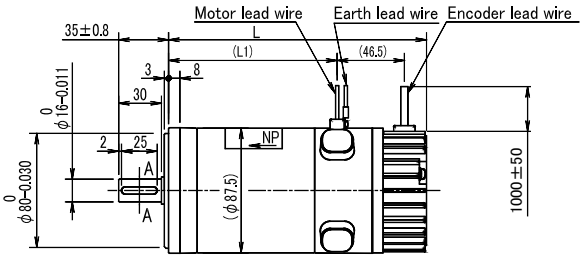
Model number	L	(L1)
T720T-012	148.5	74.5
T720BT-012	186.5	
T730T-012	172.5	98.5
T730BT-012	210.5	

UNIT[mm]

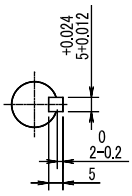
- Model Number: T8*

T840-012EXX, T850-012EXX

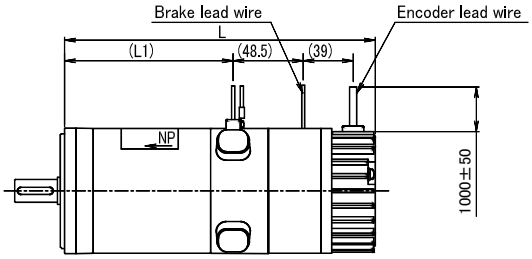




T840B-012EXX, T850B-012EXX



SECTION A-A

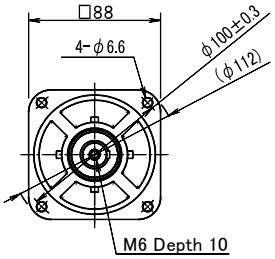


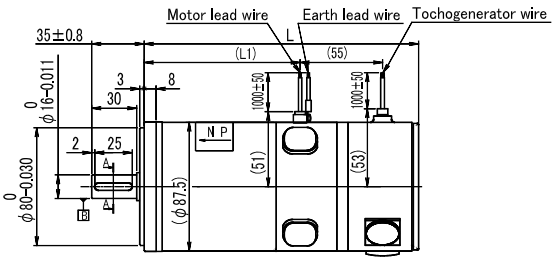
Model number	L	(L1)
T840-012EXX	166	104
T840B-012EXX	207	
T850-012EXX	181	119
T850B-012EXX	222	

UNIT[mm]

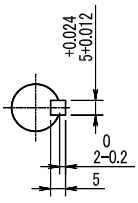
- Model Number: T8**T

T840T-012, T850T-012

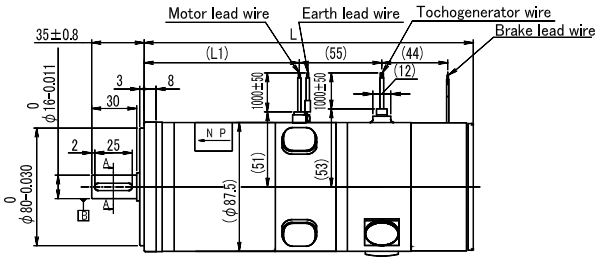




T840BT-012, T850BT-012



SECTION A-A



Model number	L	(L1)
T840T-012	183	104
T840BT-012	219.5	
T850T-012	197.5	119
T850BT-012	234.5	

UNIT[mm]

■ Standard Combination Specification

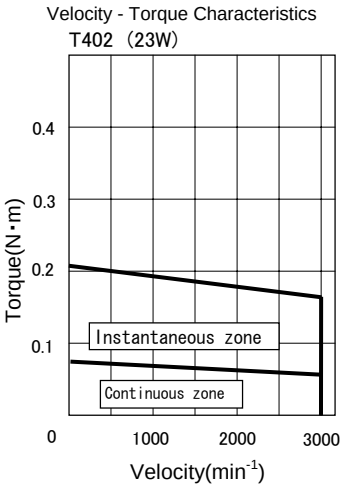
Servo Motor model (standard model)			T402-011EL8	T404-012EL8	T406-012EL8	T506-012EL8
Servo Amplifier model			TS1B02	TS1A02		
*Rated output	P_R	W	23	40	60	60
*Rated speed	N_R	min^{-1}	3000			
*Maximum speed	N_{max}	min^{-1}	3000			
*Rated torque	T_R	N·m	0.061	0.080	0.137	0.156
*Continuous stall torque	T_S	N·m	0.070	0.120	0.175	0.192
*Peak torque	T_P	N·m	0.206	0.319	0.441	0.441
*Rated armature voltage	E_R	V	20	72	70	75
*Rated current	I_R	A	1.9	1.0	1.4	1.2
*Continuous stall current	I_S	A	1.9	0.9	1.4	1.3
*Peak current	I_P	A	4.9	2.1	2.9	2.8
Torque constant	K_T	N·m/A	0.047	0.174	0.177	0.183
Induced voltage constant	K_E	V/min^{-1}	4.9×10^{-3}	18.2×10^{-3}	18.5×10^{-3}	19.1×10^{-3}
Armature resistance	Ra	Ω	3.2	18.6	11.8	12.1
*Rated power rate	Q_R	kW／s	1.2	2.1	3.2	1.7
Electrical time constant	te	ms	0.35	0.35	0.37	0.47
Mechanical time constant	tm	ms	7.1	4.8	4.1	7.4
Applicable load inertia	J_L	$kg\cdot m^2(GD^2/4)$	0.16×10^{-4}	0.27×10^{-4}	0.34×10^{-4}	0.68×10^{-4}
Standard encoder for detector	-	P/R	1000 (Line driver)			
Rotor inertia	J_M	$kg\cdot m^2(GD^2/4)$	0.055×10^{-4}	0.092×10^{-4}	0.116×10^{-4}	0.228×10^{-4}
Motor weight	-	kg	0.55	0.65	0.75	0.9
*Brake holding torque	T_B	N·m	-			0.29
Brake exciting voltage	V_B	V	-			90
Brake exciting current	I_B	A	-			0.06
Brake inertia	J_B	$kg\cdot m^2(GD^2/4)$	-			0.01×10^{-4}
Brake weight	-	kg	-			0.26
Motor operation temperature and humidity	–	–	Temperature: 0～40℃ Humidity: Maximum 90% (no condensation)			

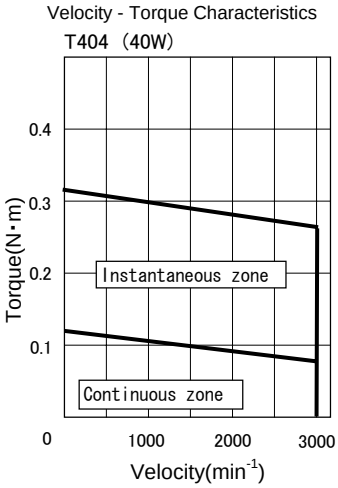
Note 1) The mark * denotes values at the maximum temperature rises in the combination with the standard amplifier.
Note 2) The item without a mark is a typical value when the winding temperature is at 25℃.

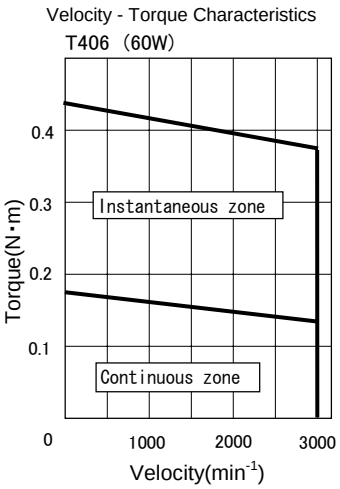
Servo Motor model (standard model)			T511-012EL8	T720-012EL8	T730-012EL8	T840-012EL8	T850-012EL8
Servo Amplifier model			TS1AA2			TS1A03	
*Rated output	P_R	W	110	200	300	400	500
*Rated speed	N_R	min^{-1}	3000		2500		
*Maximum speed	N_{max}	min^{-1}	3000		2500		
*Rated torque	T_R	N·m	0.270	0.605	1.00	1.66	1.76
*Continuous stall torque	T_S	N·m	0.358	0.658	1.05	1.70	1.90
*Peak torque	T_P	N·m	0.784	1.47	2.45	3.72	4.21
*Rated armature voltage	E_R	V	75	80	75	85	80
*Rated current	I_R	A	2.0	3.4	5.2	5.8	7.6
*Continuous stall current	I_S	A	2.2	3.7	5.5	6.0	7.6
*Peak current	I_P	A	4.5	7.7	10.9	13.7	17.6
Torque constant	K_T	N·m/A	0.21	0.23	0.273	0.31	0.287
Induced voltage constant	K_E	V/min^{-1}	21.8×10^{-3}	24.2×10^{-3}	28.6×10^{-3}	32.9×10^{-3}	30×10^{-3}
Armature resistance	Ra	Ω	5.1	2.8	1.1	0.95	0.56
*Rated power rate	Q_R	kW／s	3.2	2.7	5.1	5.0	6.4
Electrical time constant	te	ms	0.63	1.1	1.5	2.0	1.9
Mechanical time constant	tm	ms	4.3	7.8	4.0	5.2	4.1
Applicable load inertia	J_L	$kg\cdot m^2(GD^2/4)$	1.13×10^{-4}	4.43×10^{-4}	8.12×10^{-4}	15×10^{-4}	18×10^{-4}
Standard encoder for detector	-	P/R	1000 (Line driver)				
Rotor inertia	J_M	$kg\cdot m^2(GD^2/4)$	0.378×10^{-4}	1.478×10^{-4}	2.708×10^{-4}	5.008×10^{-4}	6.008×10^{-4}
Motor weight	-	kg	1.2	2.05	2.75	3.65	4.25
*Brake holding torque	T_B	N·m	0.29	1.47		1.96	
Brake exciting voltage	V_B	V	90	90		90	
Brake exciting current	I_B	A	0.06	0.11		0.11	
Brake inertia	J_B	$kg\cdot m^2(GD^2/4)$	0.01×10^{-4}	0.09×10^{-4}		0.2×10^{-4}	
Brake weight	-	kg	0.26	0.59		0.79	
Motor operation temperature and humidity	–	–	Temperature: 0～40℃ Humidity: Maximum 90% (no condensation)				

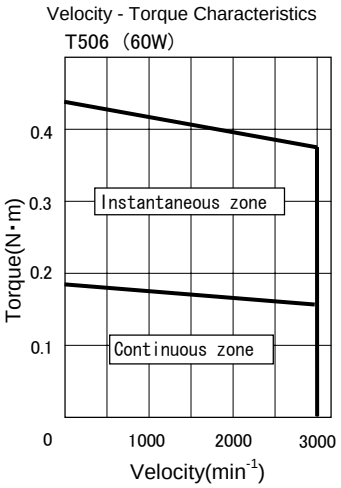
Note 1) The mark * denotes values at the maximum temperature rises in the combination with the standard amplifier.
Note 2) The item without a mark is a typical value when the winding temperature is at 25℃.

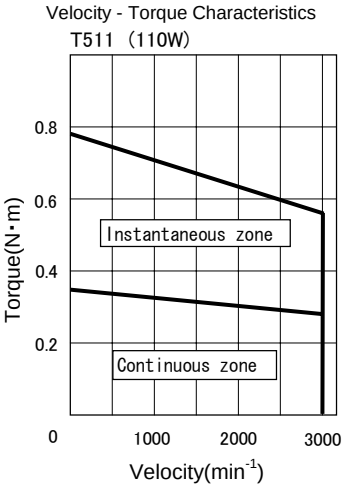
■ Velocity - Torque Characteristics

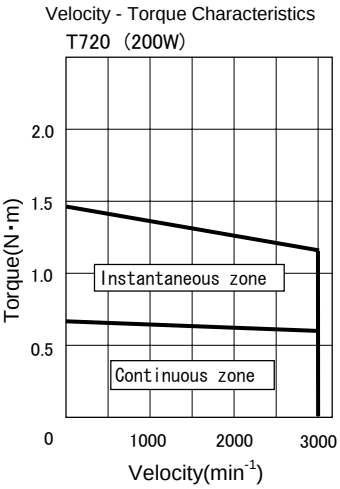


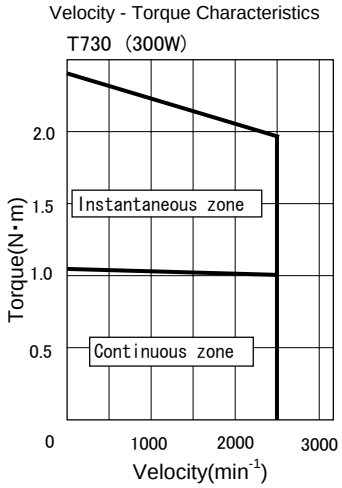


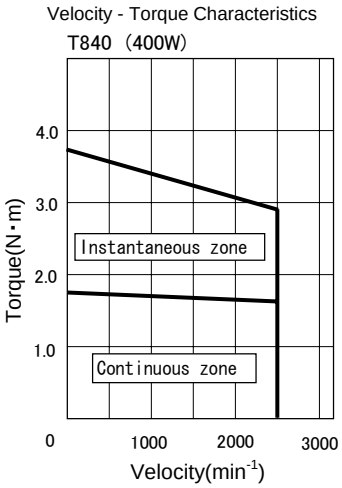


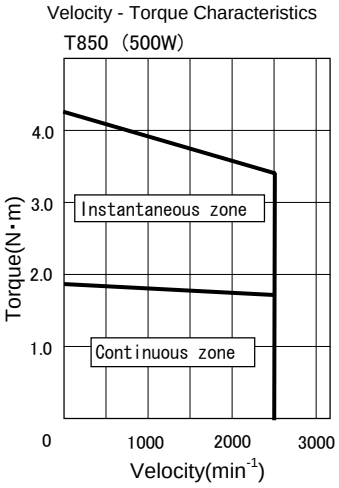






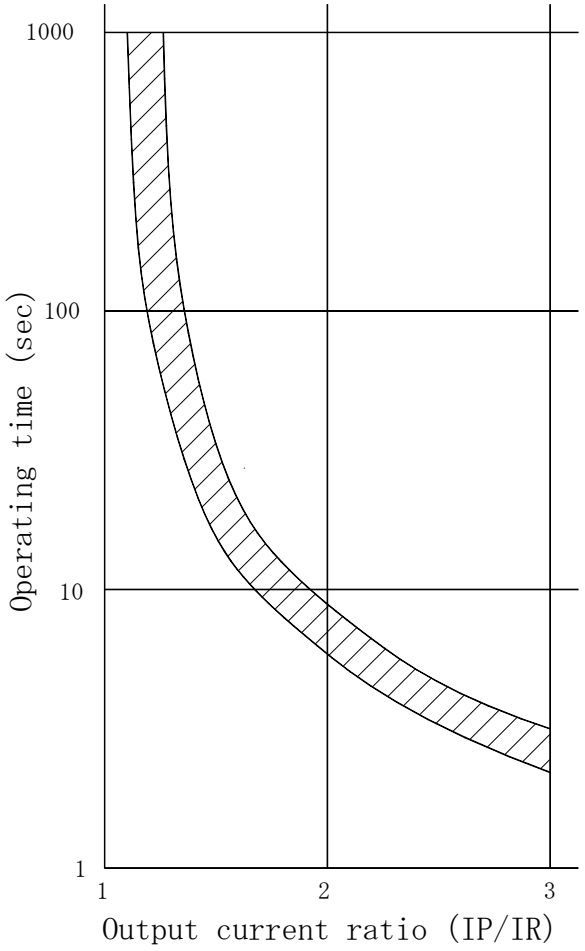




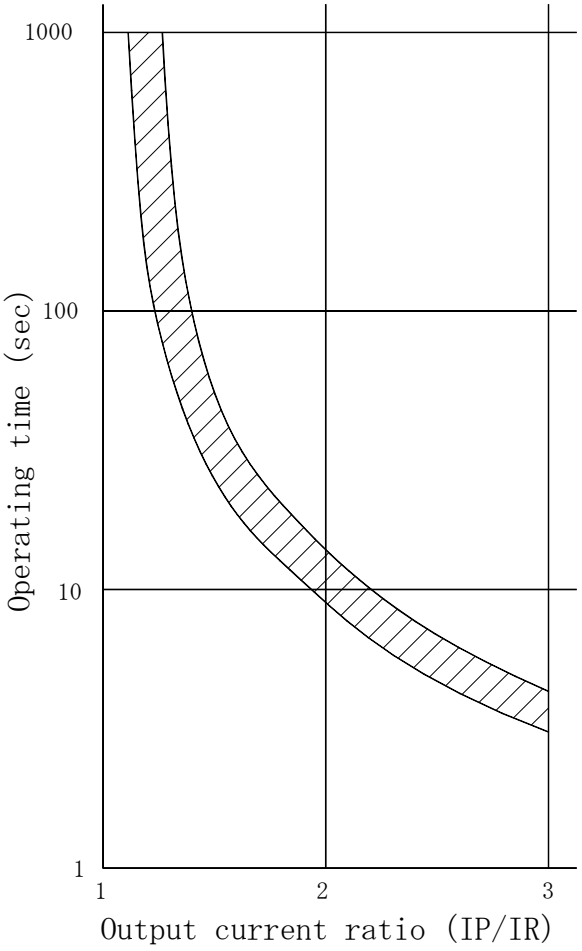


■ Over Load Characteristics

The servo amplifier has a built-in overload protection circuit to protect it from overload. So, the allowable flowing time of armature current is limited with the circuit protection circuit. It becomes "Alarm code 41H(overload 1)" in the shaded portion area in the table below and the servo motor is stopped.



Overload characteristics
of the T506 and down.



Overload characteristics
of the T511 and up.

Materials [Option]

■ Input-output connector

Connector table of Servo Amplifier

Application	Model number	Contents	Remarks
Single connector	AL-00608709	CN1 Plug and Shell kit	Refer to “Chapter3, Wiring” for Manufacturer name and Manufacturer’ model No.
	AL-00608710	CN2 Plug and Shell kit	
	AL-00608711	CN3 Shell and contact kit	
	AL-00608712	CN4 Shell and contact kit	
Connector set	AL-00608713	CN1,CN2 plug and housing CN3,CN4 Shell and contact	

Connector table of Power Unit

Application	Model number	Contents	Remarks
Single connector	AL-00632983	CN1 Shell and contact kit	Refer to “Chapter3, Wiring” for Manufacturer name and Manufacturer’ model No.
	AL-00632984	CN2 Shell and contact kit	
	AL-00632985	CN3 Shell and contact kit	
Connector set	AL-00632986	CN1,CN2,CN3 Shell and contact	

PC Interface Cable

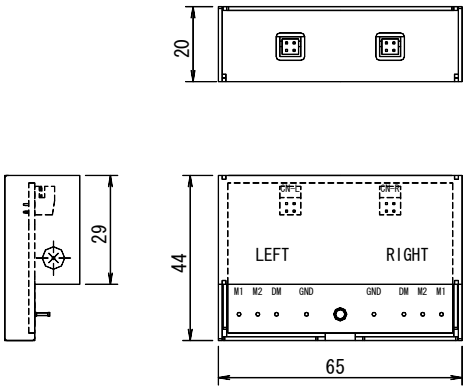
Model number	Remarks
AL-00490833-01	Dedicated cable

■ Monitor box

● Monitor box and dedicated cable

Model number	Remarks
Q-MON-1	Monitor box ＋Dedicated cables (2 cables)

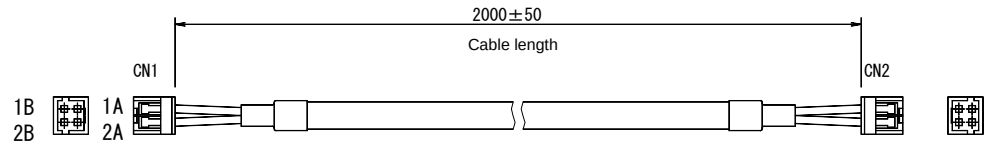
Two dedicated cables blow come with this monitor box.



Materials [Option]

● Dedicated cables

Model number	Remarks
AL-00496726-01	Dedicated cables (2 cables)



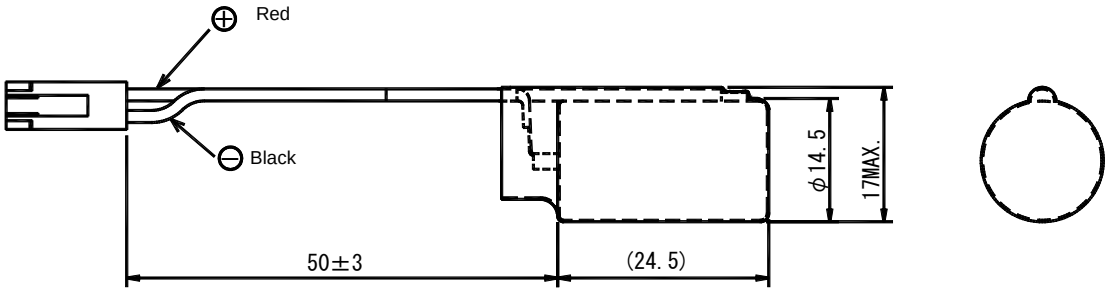
Terminal name	Function
1A	Analog monitor 1
1B	Analog monitor 2
2A	GND
2B	Digital monitor

	Manufacturer mdel number	Manufacturer
Connector	LY10-DC4	Japan Aviation Electronics Industry, Ltd.
Contact	LY10-C1-1-10000	Japan Aviation Electronics Industry, Ltd.

■ Lithium battery

Model number	Remarks
AL-00494635-01	ER3VLY

Mass：0.02kg



	Manufacturer mdel number	Manufacturer
Connector	IL-2S-S3L-(N)	Japan Aviation Electronics Industry, Ltd.
Contact	IL-C2-1-10000	Japan Aviation Electronics Industry, Ltd.
Battery	ER3VLY	Toshiba Consumer Marketing Corporation

■ Encoder clear / Alarm reset method

'Encoder clear / alarm reset method' vary according to the encoder you use. Any alarms will not be reset under the procedure of the list below unless any alarm factors are removed by correction.

● Asynchronous encoder

Alarm code	Name		Encoder clear and alarm reset method
A2	Battery abnormal	→	After' Encoder clear input' ⇒ 'Alarm reset input'
A3	Encoder overheat	→	'Alarm reset input'
A9	Encoder failure	→	Power restoration
B3	Numerous rotation abnormal	→	Power restoration
B4	One rotation abnormal	→	Power restoration
B5	Over speed／ Numerous rotation abnormal	→	After' Encoder clear input' ⇒ 'Power restoration' or 'Alarm reset input'
B6	Memory abnormal	→	After' Encoder clear input' ⇒ 'Power restoration' or 'Alarm reset input'

■ How to use electronic gear

This has a function that can set up the servo motor travel distance equivalent to position command pulse in accordance with the device.

For example : Set-up method when wiring-saving incremental encoder 1000 [P/R] is used.

① Encoder pulse number equivalent of one rotation of servo motor is 1000 [P/R] × 4 [times] ＝4000 P/R]

② Feed of command input pulse necessary to revolve once or move one revolution is 4000 [P/R] then.

③ Frequency of command input pulse necessary to operate the servo motor at 3000min^{-1} under this condition can be sought by the equation below.

$$F = \frac{N}{60} \times \text{Encoder pulse [P/R]} \times 4 \text{ [times]}$$

f = Frequency of input pulse
N = Revolution number to operate servo motor

Frequency of the command input pulse necessary to operate the servo motor at 3000min^{-1} under the above condition is 200kHz.

④ If operation is possible under this condition, set-up value of electronic gear will be 1/1.

⑤

- Set-up value of electronic : 1/1
- Command input pulse feed per servo motor rotation : 4000 [P/R]
- Frequency of command input pulse necessary to operate the servo motor at 3000min^{-1} : 200kHz

If it cannot be used under the above condition

For example

You want to make command input pulse feed per servo motor revolution 500 [P/R]

① Encoder pulse number equivalent of servo motor revolution is 1000 [P/R] × 4 [times]＝4000 [P/R].

② Command input pulse feed necessary to revolve servo motor once or move one revolution at this time is 4000 [P/R].

However, command input pulse feed must be 500[P/R].

$$\frac{4000}{500} = \frac{8}{1} \text{ times are necessary.}$$

If set-up value of electronic gear is made to be 8 / 1, command input pulse feed will be 500 [P/R]×8 / 1 ⇒ 4000 [P/R]

- Set-up value of electronic gear : 8 / 1
- Command input pulse feed per servo motor rotation : 500 [P/R]
- Frequency of command input pulse necessary to operate the servo motor at 3000min^{-1} 200kHz/(8/1) : 25kHz

Release
Revision A Oct.2006
Revision C Oct.2009

Precautions For Adoption

⚠ Cautions

The possibility of moderate or minor injury
and the occurrence of physical damage are assumed
when the precautions at right column are not observed.
Depending on the situation,
this may cause serious consequences.
Be sure to follow all listed precautions.

⚠ Cautions

- Be sure to read the instruction manual before using this product.
- Take sufficient safety measures and contact us before applying this product to medical equipment that may involve human lives.
- Contact us before adapting this product for use with equipment that could cause serious social or public effects.
- The use of this product in high motion environments where vibration is present, such as in vehicles or shipping vessels, is prohibited.
- Do not convert or modify any equipment components.

* Please contact our Business Division for questions and consultations regarding the above.

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