NSK

MEGATORQUE MOTOR™ SYSTEM
(Driver Model EGA)

User's Manual

M-E099GA0C2-191

NSK Ltd.

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Revision History

2nd Edition

- All chapters
  - Added motors M-PB3030JN001 and M-PB3060JN001.
  - Added driver M-EGA-30A2301.
  - Added motor cable M-CAxxxA101.
  - Added converter cable M-CCxxxA101.
  - Added outline drawings.
  - Method of usage modified to set JRAT1 value.
  - Added supplementary items for usage.

- Chapter 2
  - Corrected values of circuit power for output signal of general output.
    Incorrect: 24-15 [VDC] → Correct: 24 [VDC]

- Chapter 3
  - Added content and location of serial number of drivers.
  - Deleted items about dummy inertia.
  - Added items about cables (for motors and converters).

- Chapter 4
  - Signal names and their function of CN1 modified to be factory default settings.
  - Added examples of wiring between CN1 and host unit.
  - Equivalent products added to model number of recommended ferrules.

- Chapter 5
  - Magnetic Pole Position Estimation status added to driver status display.
  - While Magnetic Pole Position Estimation Ready (CSETRDY) and Magnetic Pole Position Estimation Completion (CSETCMP) added to signals of Group A.

- Chapter 6
  - Flowchart of auto-tuning characteristic selection modified to set JRAT1 value.

- Chapter 7
  - Magnetic Pole Position Estimation status added to driver status display.

- Chapter 8
  - Added items about magnetic pole position estimation error (AL. 44).

- Chapter 9
  - Added motor outline drawings.
  - Added converter outline drawings.
  - Added outline drawing and pin allocation of motor cable.
  - Added outline drawing and pin allocation of converter cable.
  - Added pin allocation of PC communication cable.
  - Added supplementary items for usage.

The following signs are used to indicate safety precaution in this instruction manual.

Please fully observe the precautions as important contents included in the descriptions.

■ Safety precautions and the signs

Safety precautions		Signs	
Danger	Indicates an imminently hazardous situation which, if incorrectly operated, will result in death or serious injury.		Danger, injury
			Electrical shock
Warning	Indicates a potentially hazardous situation that, if incorrectly operated, may result in minor or moderate injury, or property damage only. Even those hazardous indicated with this sign may lead to a serious accident.		Warning
			Fire
			Burn injury
Prohibition	Indicates actions that must not be allowed.		Prohibition
			Disassembly prohibited
Mandatory	Indicates actions that must be carried out (mandatory actions).		Mandatory

■ Danger 

Do not use the system in explosive atmospheres.	
	Injuries and fire may occur.

Do not perform wiring, maintenance, and inspection with power distributed. Make sure to start performing any tasks surely 15 minutes or more after power shutdown.	
	Electrical shock may occur.

Make sure to ground the driver protective grounding terminal " ⏚ " to the machine or control cabinet.	
	Electrical shock may occur.

Never touch inside of driver.	
	Electrical shock may occur.

Only qualified personnel who have electrical knowledge should conduct maintenance and inspection.	
	Electrical shock, injuries, and fire may occur.

Do not damage, apply excessive stresses, put heavy things on, and tuck down cables.	
	Electrical shock may occur.

Perform wiring in accordance with wiring diagram and the instruction manual.	
	Electrical shock and fire may occur.

Never approach or touch terminals and connectors while power is being distributed.	
	Electrical shock may occur.

Never touch rotating part of motor during operation.	
	Injuries may occur.

Never remove terminals and connectors while power is being distributed.	
	Electrical shock may occur.

■ Warning

Unpack after checking upside and downside.	
	Injuries may occur.

Verify no discrepancies between the product you received and the product you ordered. Installing incorrect product can result in injuries and damages.	
	Injuries and failures may occur.

Make sure to read the instruction manual and observe the instructions before inspection, operation, maintenance, and inspection.	
	Electrical shock, injuries and fire may occur.

Do not use faulty, damaged, and burnt-out driver, motor and converter.	
	Injuries and fire may occur.

Please be aware that temperatures on driver, motor and peripheral equipment become high.	
	Fire may occur.

Do not use driver, motor and converter outside the scope of the specification.	
	Electrical shock, injuries and failures may occur.

Use the specified combination of motor and converter.	
	This can result in fire and failures.

For driver and motor, do not perform measurement of insulation resistance and dielectric strength voltage.	
	Failures may occur.

Correctly and properly perform wiring.	
	Injuries may occur.

Do not put heavy things on, or climb on the system.	
	Injuries may occur.

Make sure to observe the specified installation direction.	
	This can result in fire and failures.

Do not apply high impacts.	
	This can result in failures.

Never install the system in the area where it may be exposed to water, near corrosive/ flammable gaseous, or by combustible material.	
	This can result in fire and failures.

Do not apply static electrical charge and high voltage to motor resolver cable and converter connectors.	
	This can result in failures.

Perform wiring in accordance with electrical installation technical standards and internal wiring standards.	
	Burnout or fire may occur.

Do not block and let any foreign materials into inlet/outlet.	
	Fire may occur.

Maintain the specified distances for layout inside of driver control cabinet.	
	This can result in fire and failures.

It is very dangerous to carry the system, so carefully carry the system as not to fall and roll over.	
	Injuries may occur.

Install the system in incombustible material, such as metal.	
	Fire may occur.

No protective equipments are supplied with motor. Protect the system with overcurrent protective device, earth leakage circuit breaker, overtemperature thermostat, and emergency stop equipment.	
	Injuries and fire may occur.

Do not touch heat releasing fin and regenerative resistor of driver and motor while power being distributed or after a while power is turned off, as the temperatures on them become high.	
	Burn injuries may occur.

Stop operation immediately when any abnormality occurred.	
	Electrical shock, injuries, and fire may occur.

Never make excessive adjustment change as operation becomes unstable.	
	Injuries may occur.

Perform test operation by fixing motor with motor separated from mechanical systems, and then install the motor after performing the operation check.	
	Injuries may occur.

When alarm activated, eliminate the cause, secure the safety, reset the alarm, and then re-start operation.	
	Injuries may occur.

Confirm that input power voltage is within the specification.	
	This can result in failures.

Do not approach equipments after restoration from instantaneous interruption of service, as sudden re-start can occur. (Design the machine so as to ensure safety even sudden re-start occurs.)	
	Injuries may occur.

Do not externally and continuously rotate motor during servo-off with standard speciation driver with dynamic brake, as the dynamic brake will generate heat and this will cause dangers.	
	Fire and burn injuries may occur.

Carefully perform maintenance and inspection as temperature on driver frame becomes high.	
	Burn injuries may occur.

Please contact us to repair. Disassembly can cause inoperative.	
	This can result in failures.

It is very dangerous to carry the system, so carefully carry the system as not to fall and roll over.	
	Injuries may occur.

Do not hold cables and motor rotating part to carry the system.	
	Failures and injuries may occur.

Dispose any driver, motor and converter properly as general industrial wastes.


For repairing, if any, contact us. Any insulation failure in the motor and/or short-circuited or broken wires in any cables may occur depending on the motor operating environments or conditions. If you keep on using the system without repairing the faulty conditions, the motor becomes unable to demonstrate the original performance, the driver becomes damaged or other trouble may occur.	
	This can result in failures.

Use the specified combination of motor and converter.	
	This can result in failures.

Remember to make a note of parameters.	
	This can result in failures.

Never attempt to modify any cables.	
	This can result in failures.

Tightly lock the connectors and make sure that the screws are securely tightened without any loosening.	
	This can result in failures.

Make proper service parts available (drivers, motors, converters, cables, etc. for replacement).	
	This can result in failures.

For cleaning, do not use any thinner but use alcohol.	
	This can result in failures.

The motor produces regenerative electric power when reducing a large load moment of inertia. The regenerative electric power is normally charged in the capacitor in the driver. However, in case where higher regenerative electric power is continuously generated, it fails to be fully stored in the capacitor and the motor becomes shut down.	
	Change the operating conditions (speed, acceleration/deceleration, operating duty) otherwise make proper regenerative resistor available externally.

In the applications involving repeated operations through an angle of within 45 [°], be sure to perform the angular movement at an angle exceeding 90 [°] at least once a day.	
	This can result in failures.

Where rotation supporting parts (bearings, ball screws, etc.) are to be additionally installed outside the motor, be sure to complete the center alignment properly (within a runout of 0.01 [mm]). Remember that any excessive offset loads or excessive loads can cause abnormality in the bearings in the motor.	
	This can result in failures.

Ensure that the bending radius of motor cable lead wire (ϕ7) and resolver cable lead wire (ϕ7) becomes larger than R30 [mm] .	
	This can result in failures.

Never attempt to use any motor cable lead wire and resolver cable lead wire in any moving parts.	
	This can result in failures.

Ensure that the connections between lead wires and connectors are free from exposure to any stress (tension, vibration, etc.) to avoid possible broken wire and/or poor contact.	
	This can result in failures.

Ensure that the bending radius of motor cable (ϕ8) is larger than R43 [mm] and be sure to tightly secure the motor cable.	
	This can result in failures.

Install the power system (AC supply source, motor cable) and the signal system properly by separating them from each other. Never attempt to bundle the systems nor pass them through any same duct.	
	This can result in failures.

In any possible case where cables may be exposed to severe vibration, secure the cables next to the connectors to protect the connectors from exposure to stresses.	
	This can result in failures.

■ Prohibition

Never expose the motor, driver and converter to any water and oil. Do not store nor operate the system in the area where it may be exposed to rain and water drops, or toxic gasses or liquids exist.	
	This can result in failures.

Do not perform overhaul.	
	This can result in fire and electrical shock.

Do not remove nameplate.

Never cut any cables into segments for extension, shortening or splicing.	
	This can result in failures.

Never attempt to overhaul the motor body.	
	This can result in failures.

Do not remove the casings from driver and converter.	
	This can result in failures.

Do not impact the motor directly with a hammer or other tools. Direct impact on the sides of motor or the parts installed on the motor can cause degraded accuracy of internal detector.	
	This can result in failures.

The specifications of dynamic brake include limitations on allowable load and rotational speed. In the operation of position alignment, limit the operating actions to 360[°] within the allowable load of inertial moment.	
	This can result in failures.

■ Mandatory

Store the system within the specified temperature and humidity “-20°C to 65°C, 90%RH or less(no condensation)” away from direct sunlight. Driver and converter Temperature -20[°C] to 65[°C] Humidity 90[%RH] or less (No condensation) Motor Temperature 0[°C] to 40[°C] Humidity 20 to 80[%RH] (No condensation)
This can result in failures.

Place emergency stop circuit outside the product so that operation can be stopped and power supply can be shut down instantaneously. Place a safeguard circuit outside driver so as to shut off main circuit power supply when alarm activated.
Going out of control, injuries, burnout, fire, and secondary damages can occur.

Following the power-on sequence, remember to complete the estimation of magnetic pole position. In the estimation of magnetic pole position, the rotational part of motor moves through the maximum angle of ±18 [°].
Going out of control, injuries, burnout, fire, and secondary damages can occur.

Please operate within the specified range of temperature and humidity. Driver and converter Temperature: 0[°C] to 55[°C] Humidity: 90%RH or less (No condensation) Motor Temperature: 0[°C] to 40[°C] Humidity: 20 to 80[%RH] (No condensation)
This can result in burnout and failures.

Do not overload the products which may cause collapses.
Injuries may occur.

Allowable momentum load, allowable axial load, and allowable radial load vary depending on the size of individual motors. Make sure your operating conditions are suitable the allowable loads.
This can result in failures.

Any excessive offset loads or excessive loads can cause permanently deformed rotors and/or faulty bearings in the motor. Remember to prevent the motors from possible falling and exposure to any impact during the installation of motors, and also to protect the motors against possible impact due to external interference during the transportation.	
	This can result in failures.

Install every motor on the surface of flatness of 0.02 [mm] or less.	
	This can result in failures.

Use driver software with version A or later for motor M-PB3030JN001 and converter M-ECC-PB3030GA201.	
	Alarm will be output and cannot operate the motor.

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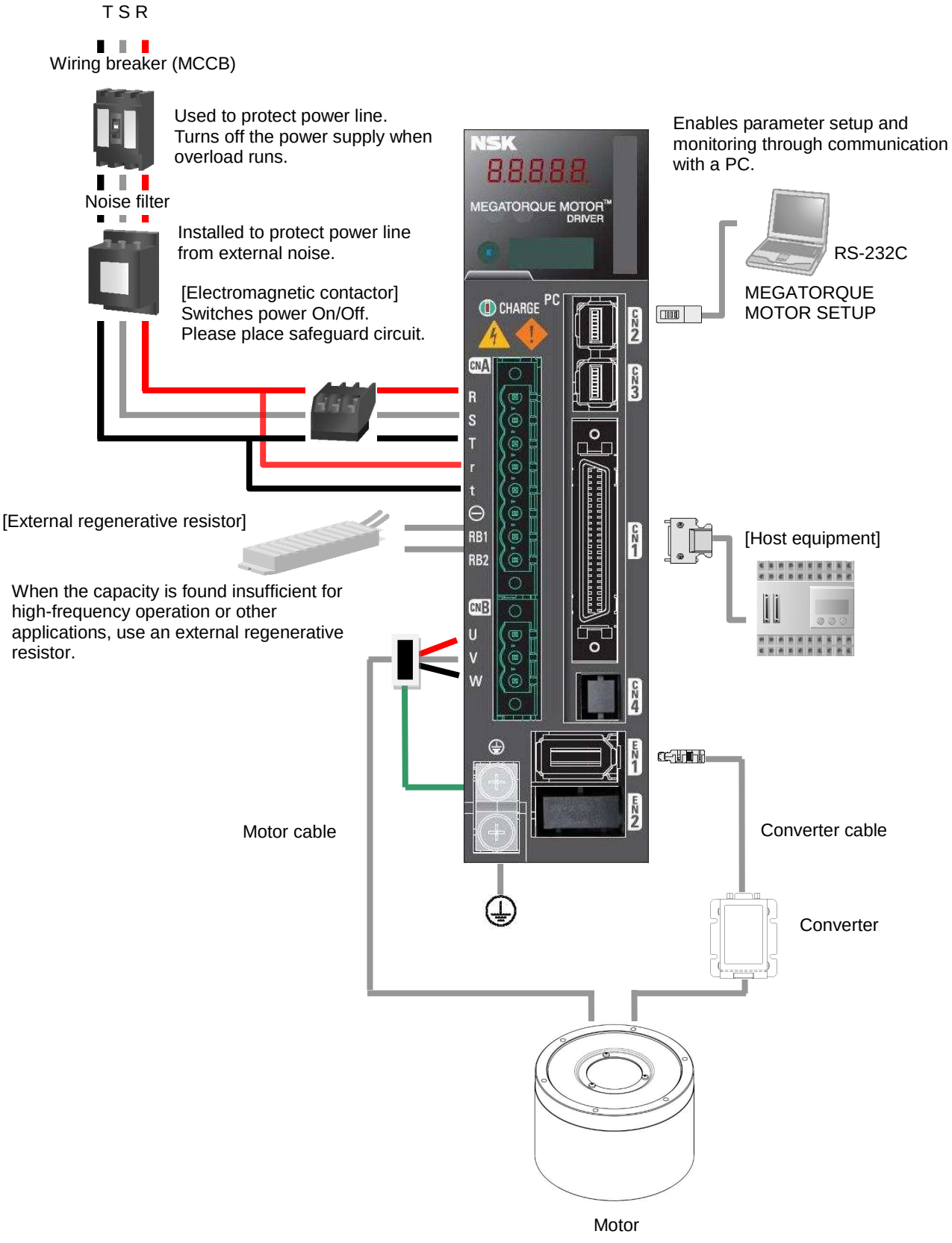
1. Preface

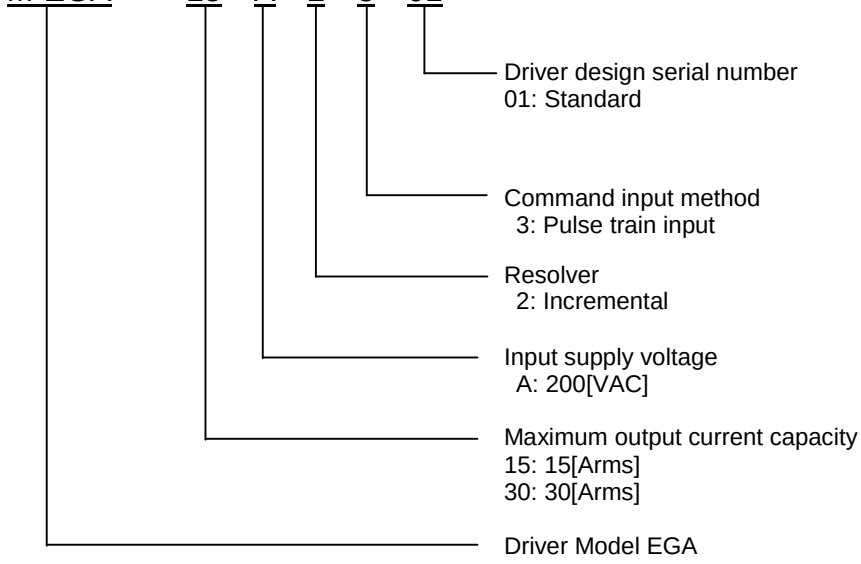
1.1 Illustration of system components



1.2 Coding for reference number of individual parts

1) Reference number of driver

M-EGA - 15 A 2 3 01

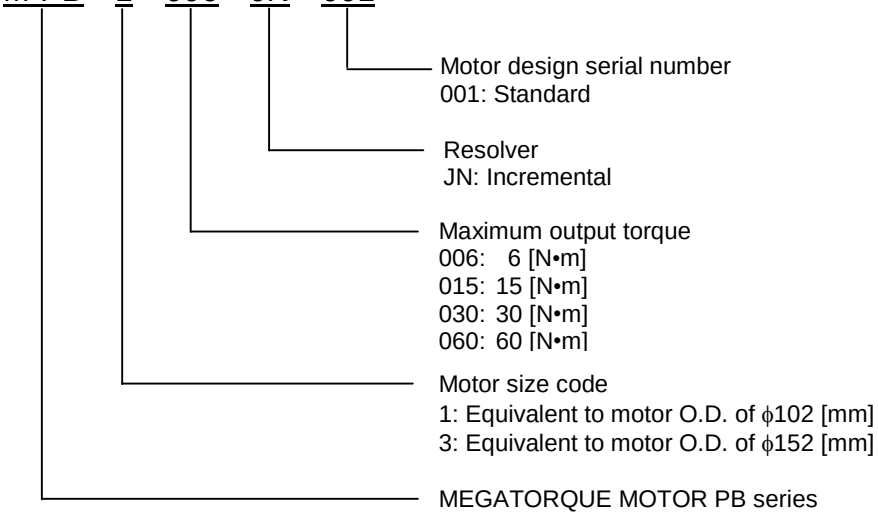


✔ At the time of shipment from the factory, the driver has been set in the “standard setting values.” Depending on the specifications of your system, the “system parameters” and “general parameters” must be changed.
Remember to select proper settings for your system, referring to the following sections.

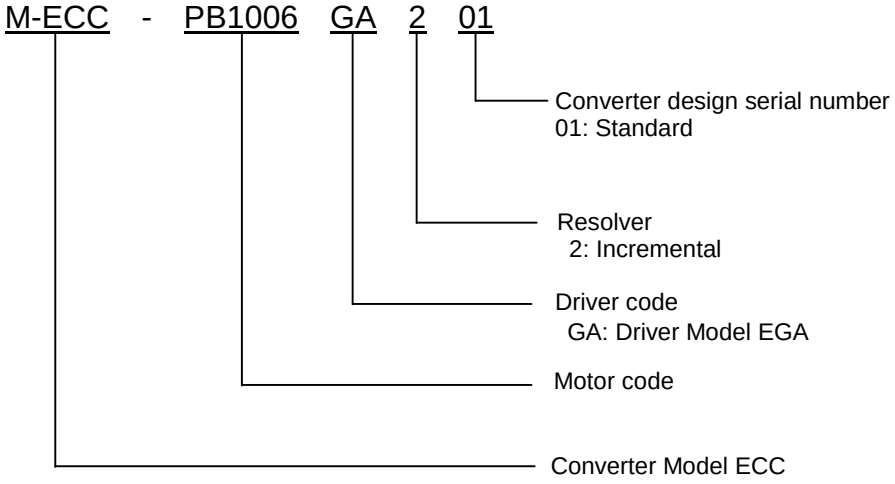
- ◆ “System parameters”
- ◆ “Factory default standard settings”
- ◆ “Setting of parameters”

2) Reference number of motor

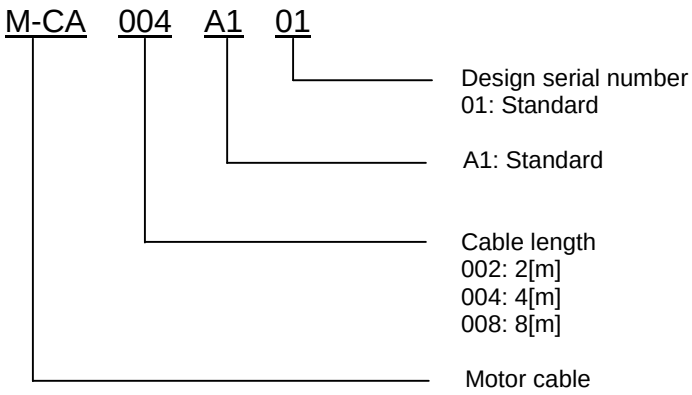
M-PB 1 006 JN 001



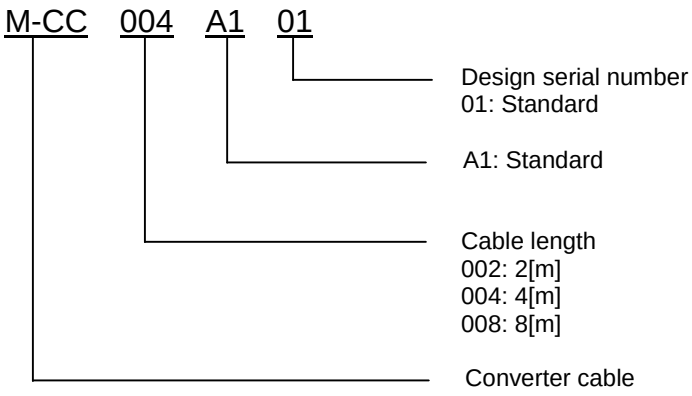
3) Reference number of converter



4) Reference number of motor

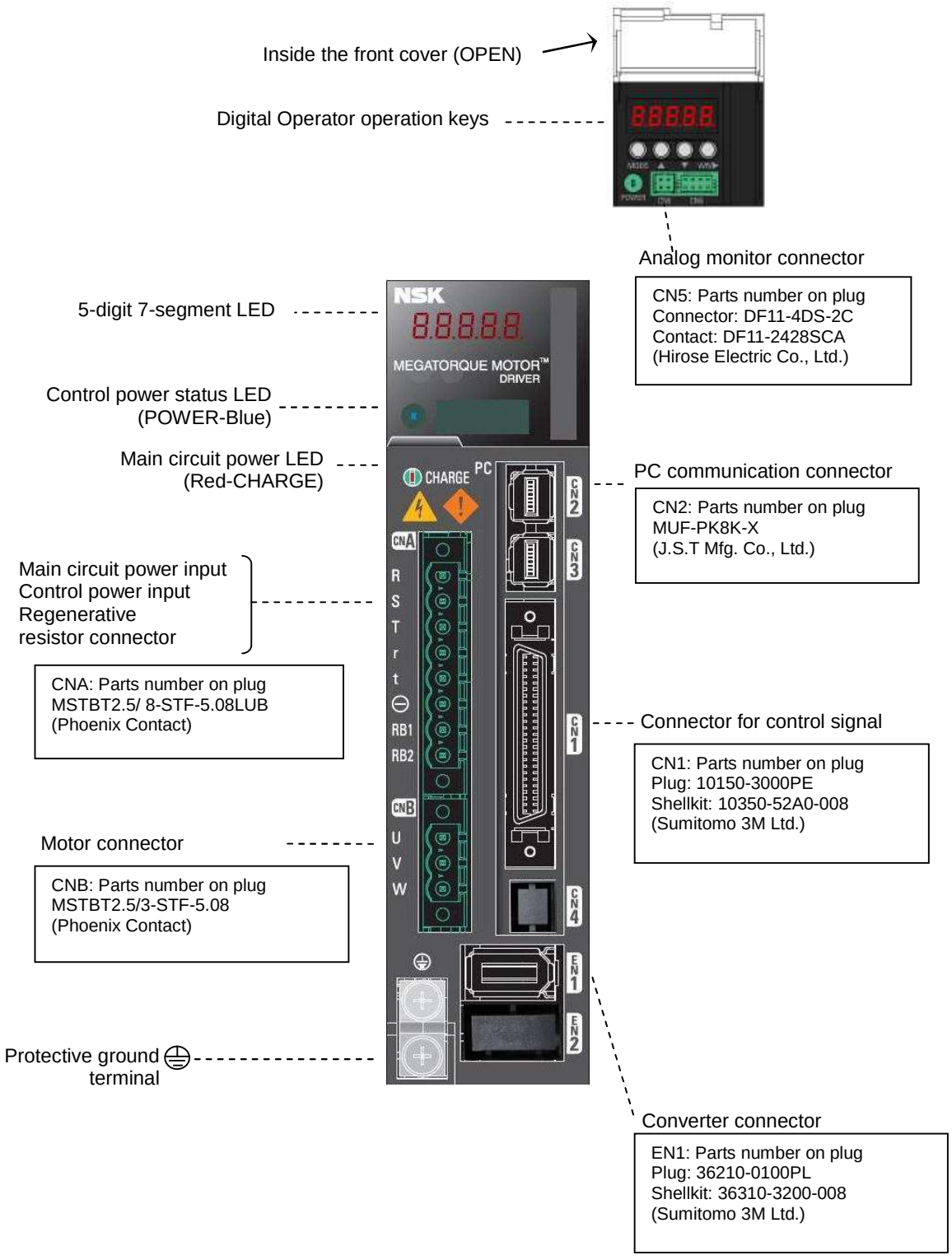


5) Reference number of converter cable

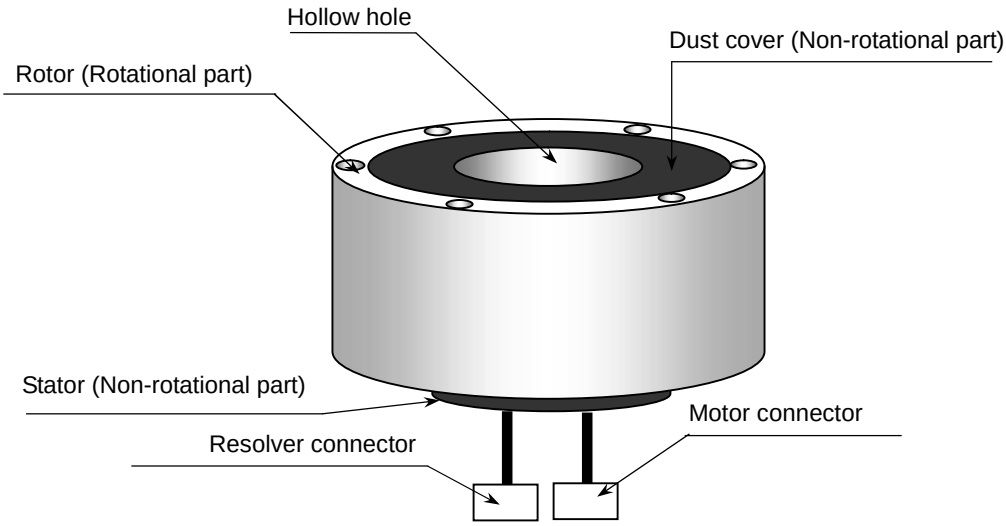


1.3 Part names

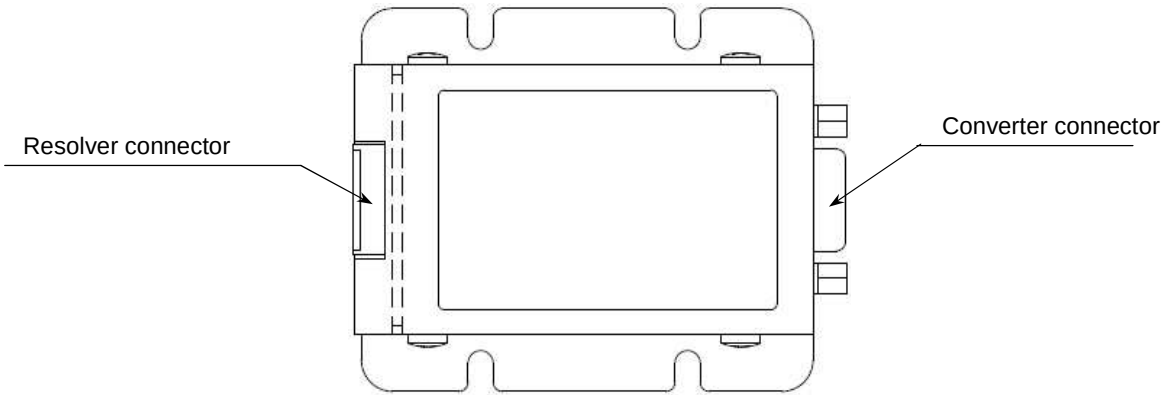
1) Driver



2) Motor



3) Converter



2

2. Specifications

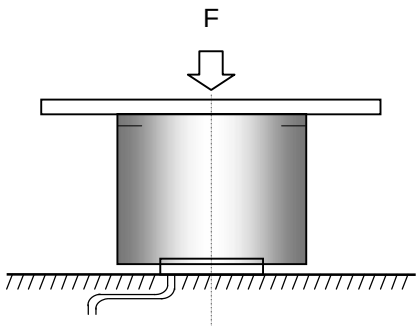
2.1 Motor

1) Motor specifications

Item [Unit] \ Designation		M-PB1006JN001	M-PB3015JN001	M-PB3030JN001	M-PB3060JN001
Motor outside diameter	[mm]	ϕ102	ϕ152		
Max. output torque	[N•m]	6	15	30	60
Rated output torque	[N•m]	2	5	10	20
Motor height	[mm]	75		92	126
Motor hollow hole	[mm]	ϕ35	ϕ56		
Max. speed	[s^{-1}]	10			8
Rated speed	[s^{-1}]	5			1
Resolution of position sensor	[counts/rev]	524 288			
Absolute positioning accuracy	[arc-sec]	112[*1]			
Positioning repeatability	[arc-sec]	±5			
Allowable axial load[*4]	[N]	1000[*2] / 120[*3]	2000[*2] / 200[*3]		
Allowable radial load[*5]	[N]	270	540		
Allowable moment load	[N•m]	9	20		
Rotor moment of inertia	[$kg•m^2$]	0.0026	0.014	0.016	0.021
Allowalble load moment of inertia	[$kg•m^2$]	0 to 0.26	0 to 1.1	0 to 1.4	0 to 3.1
Mass	[kg]	2.6	5.8	7.2	10.2
Environmental conditions		Ambient temperature: 0-40 [°C], Humidity: 20-80%RH, Indoor use only. Free from dust, condensation and corrosive gas. IP30 equivalent.			

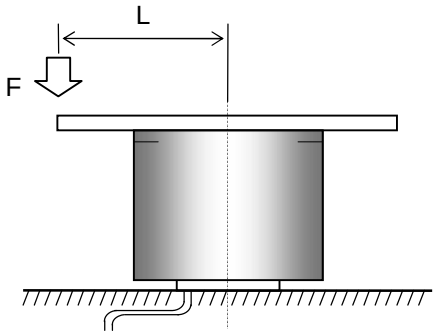
*1: Accuracy at an ambient temperature of 25±5 [°C]
*2: Load in the direction toward the lead wire from the loading side on the motor shaft
*3: Load in the direction toward the loading side from the lead wire on the motor shaft
*4: When the radial load is 0 [N].
*5: When the axial load is 0 [N].

2) Load on the motor



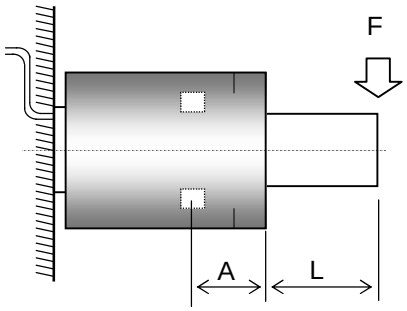
(1) Assuming the F refers to an external force:

- Axial load: Fa = F + weights of fixture, workpiece, etc.
- Moment load: M = 0



(2) Assuming the F refers to an external force:

- Axial load: Fa = F + weights of fixture, workpiece, etc.
- Moment load: M = F × L



(3) Assuming the F refers to an external force:

- Radial load: Fr = F + weights of fixture, workpiece, etc.
- Moment load: M = F × (L+A)

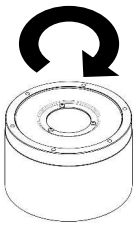
Distance between the bearing and the rotor end face

Motor model No.	Dimension A [mm]
PB1006	22.2
PB3015	22.9
PB3030	
PB3060	

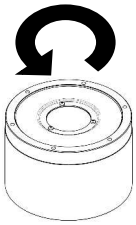
- ✔ **Limit the axial load Fa to the allowable axial load.**
- ✔ **Limit the radial load Fr to the allowable radial load.**
- ✔ **Limit the moment load M to the allowable moment load.**

3) Direction of rotation of motor

CW … Position signal output (PS data): Increase



CCW … Position signal output (PS data): Decrease



- ✔ **Direction of rotation of motor is defined as counterclockwise (CCW) or clockwise (CW) when viewed from the loading side.**
- ✔ **PS data can be confirmed by "Monitor ID16, 17 ABSPS."**

2.2 Driver

1) Specifications of driver

■General specifications

Item \ Designation		M-EGA-15A2301	M-EGA-30A2301
Control function		Position control	
Control system		IGBT：PWM control Sinusoidal drive	
Main Circuit Power	Three phase	200 to 230[VAC]+10，－15[%]，50/60[Hz]±3[Hz]	
	Single phase	200 to 230[VAC]+10，－15[%]，50/60[Hz]±3[Hz]	220 to 230[VAC]±10[%]，50/60[Hz]±3[Hz]
Control power	Single phase	200 to 230[VAC]+10，－15[%]，50/60[Hz]±3[Hz]	
Environment	Ambient temperature	0 to 55[℃]	
	Storage temperature	－20 to +65[℃]	
	Operation/Storage humidity	Below 90[%RH] (no condensation)	
	Elevation	1000[m] or below	
	Vibration	4.9[m/s^2]	
	Shock	19.6[m/s^2]	
External dimensions (H×W×D)		160×40×130 [mm]	160×50×130 [mm]
Weight		0.75 [kg]	0.9 [kg]

✔ **Power source voltage should be within the specified range**

■Built-in functions

Protection functions	Over current, Current detection error, Overload, Regeneration error, Driver overheating, External overheating, Over voltage, Main circuit power low voltage, Main circuit power supply open phase, Control power supply low voltage, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position, Position command pulse error, Built-in memory error, Parameter error	
Digital operator	Status display, Monitor display, Alarm display, Parameter setting, Test operation, Adjustment mode	
Dynamic brake circuit	Built-in	
Regeneration process circuit	Built-in	
Monitor	Speed monitor (VMON)	2.0[V]±10[%] (at 1000[min^{-1}])
	Torque (TCMON)	2.0[V]±10[%] (at 100[%])

2) Input command, position feedback signal output, general input, general output

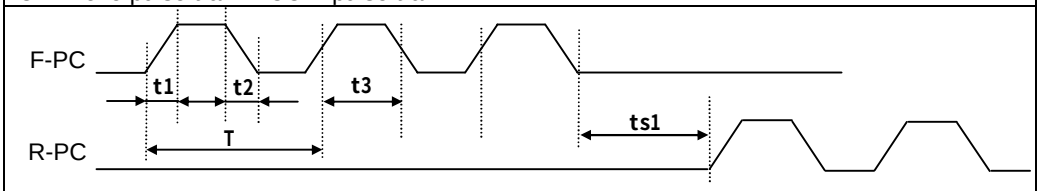
Input command

◆ Position command

Position command	Maximum input pulse frequency	5[Mpps] (CW+CCW pulse, Code + Pulse) 1.25[Mpps] (90°-phase difference two-phase pulse)
	Input pulse form	CW+CCW command pulse, Code + Pulse train command or 90[°]-phase difference two-phase pulse train command
	Electronic gear	N/D (N=1 to 2097152, D=1 to 2097152) however, 1/2097152 ≦ N/D ≦ 2097152

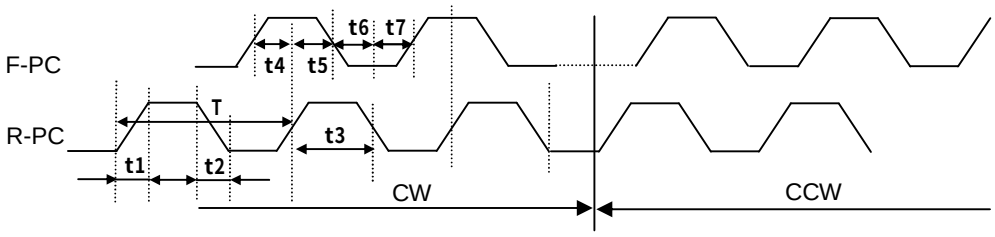
● Position command timing

CW move pulse train + CCW pulse train



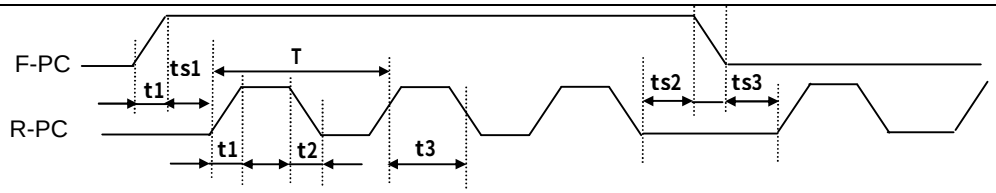
Stage up time (t1): ≦0.1[μs]	Stage down time (t2): ≦0.1[μs]
Duty[(t3/T)x100]: 50[%]	Change of pulse time: ts1>2[μs]

Pulse trains with 90[°]phase difference



Stage up time (t1): ≦0.1[μs]	Stage down time (t2): ≦0.1[μs]
Duty [(t3/T) x100]: 50[%]	
Minimum phase difference between pulse edges (t4, t5, t6, t7): >250[ns]	

Code + Pulse train



Stage up time (t1): ≦0.1[μs]	Stage down time (t2): ≦0.1[μs]
Duty [(t3/T) x100]: 50[%]	Change of pulse time: ts1, ts2, ts3>2[μs]

Position feedback signal output

Position feedback signal	N/32768(N=1 to 32767), 1/N(N=1 to 64) or 2/N(N=3 to 64)

General input

Sequence input	Interactive photo coupler (sink, source connection): ×6 input
	Line receiver: ×2 input
	Input power voltage range: 5[VDC]±5[%] / 12 to 24[VDC]±10[%], 100[mA] or over (24[VDC])
	Servo ON, Alarm reset, Torque limit, CW rotation prohibit, Command prohibit, CCW rotation prohibit, Command prohibit, Forced discharge, Emergency stop, Gain switching, Internal speed setting, Start of estimation of magnetic pole position, etc. Refer to [Group9 Condition settings for enabling function] for all the functions and input time function-enabled.

General output [NPN output]

Sequence output	Open collector output: ×8 output
	External power supply voltage (OUT-PWR): 5[VDC]±5[%] / 12[VDC] to 24[VDC]±10[%], 20[mA] or over
	Circuit power for output signal: 5[VDC]±5[%] / Maximum current value 10[mA] (per 1 output) Circuit power for output signal: 12 to 15[VDC]±10[%] / Maximum current value 30[mA](per 1 output) Circuit power for output signal: 24 [VDC]±10[%] / Maximum current value 50 [mA] (per 1 output)
	Servo ready, Power ON, Servo ON, Torque limiting, Low speed, Velocity attainment, Matching speed, Zero speed, Command acceptable, Status of gain switch, Velocity loop proportional control status, CW- OT, CCW-OT, Warning, Alarm code (3[bit]), Start of estimation of magnetic pole position, etc. Refer to [GroupA Settings for Generic Output Outputting Condition/Monitor Output selection/ Serial Communications]

2.3 Power supply

1) Main circuit power supply capacity, control power supply capacity

Driver Input voltage	Motor model	Rated output [W]	Rated main circuit power supply [kVA]	Control power supply [VA]
200[VAC]	PB1006	63	0.3	40
	PB3015	157	0.5	
	PB3030	314	1.0	
	PB3060	125	2.0	

✔ **Values are of rated speed, torque ratings.**

2) Incoming current, leakage current

Incoming current

Driver Input voltage	Control circuit (Max. value in 1[ms] after power-on sequence)	Main circuit (Max. value in 1.2[s] after power-on sequence)
200[VAC]	40[A](O-P)	22[A](O-P)

✔ **Using thermistor for incoming prevention circuit of control power supply. This is the maximum current value under normal temperature conditions when 230[VAC] is supplied.**
✔ **Incoming current value is the value when 230[VAC] is supplied.**
✔ **When the power is turned ON again immediately after disconnection, power supply disconnection is repeated for a short period of time, ambient temperature is high, or, the thermistor temperature rises, the incoming current exceeding the above table may pass.**

Leakage current

Leakage current
0.8[mA]

✔ **These values are applicable when a tough rubber sheath cable of 2[m] is used as a power line. In the case of a shorter or longer cable length, values of the above table should be selected as closely as possible.**

✔ **The machine should be grounded so that dangerous voltage does not occur at the main part of the machine, such as the operation panel, etc., during a period of emergency leakage current.**

✔ **The value of leaked current is the measured value using ordinary leak checkers (Filter 700[Hz]).**
When electric leakage current of high frequency flows through the floating capacity of the motor winding, power cable or driver, malfunctions may occur in the short circuit breaker and protective relay in the power supply electric circuit. Use the inverter as an electricity leakage breaker to provide countermeasures for incorrect operations.

2.4 Position feedback signal

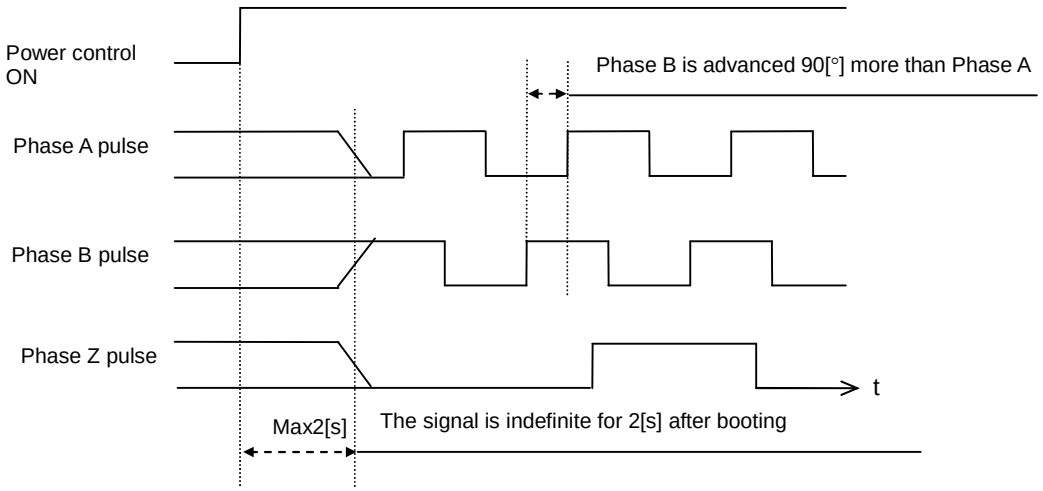
1) Position feedback signal output

Driver outputs “90[°]-phase difference two-phase pulse (phase A, phase B) and resolver pulse (phase Z).” Pulse output can change the division ratio by parameter.

Set the general parameter “Group C ID04 Encoder Output Pulse Division.”

- Output signal “A phase pulse output (A0/$\bar{A}\bar{0}$)” outputs from “CN1-3 pin, 4 pin.”
- Output signal “B phase pulse output (B0/$\bar{B}\bar{O}$)” outputs from “CN1-5 pin, 6 pin.”
- Output signal “Z phase output (Z0/$\bar{Z}\bar{O}$)” outputs from “CN1-7 pin, 8 pin.”

Output signal under CW rotation

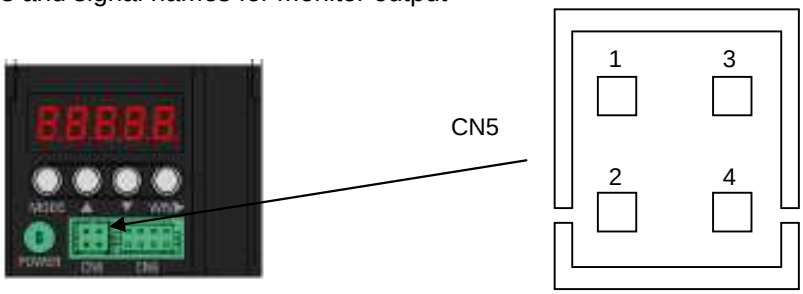


- ✔ **“Positions feedback signal output” delays about 224[μs].**
- ✔ **Phase Z output is 80 times in motor 1-rotation based on rise up or rise down edge of Phase A or Phase B with the width of one pulse of Phase A. (does not determine the position relation of Phase Z or Phases A&B.**
- ✔ **When other than 1/1 is set as division ratio, Phase A and Phase B are divided but Phase Z is output with original pulse width.**

2.5 Specifications for analog monitor

1) Monitor output

Pin numbers and signal names for monitor output



Connector model number on board: DF11-4DP-2DSA (01)

Housing model number on receiving equipment: DF11-4DS-2C

Connector model number on receiving equipment: DF11-2428SCA

	General input/output connector CN1	CN5
Analog monitor output 1 (MON1)	CN1-30	CN5-3
Analog monitor output 2 (MON2)	Disabled	CN5-4
Digital monitor output (DMON)	Disabled	CN5-2
GND	CN1-31	CN5-1

2) Monitor for velocity, torque, and position deviation

■Electrical specifications

□Output voltage range: ±8[VDC]

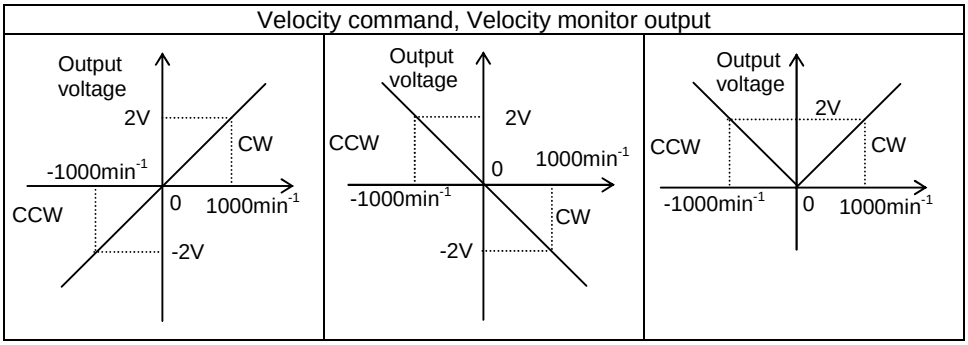
□Output resistance: 1[kΩ]

□Load: less than 2[mA]

□Monitor output is indefinite at the time of power ON/OFF and may output 12[VDC] + around 10[%].

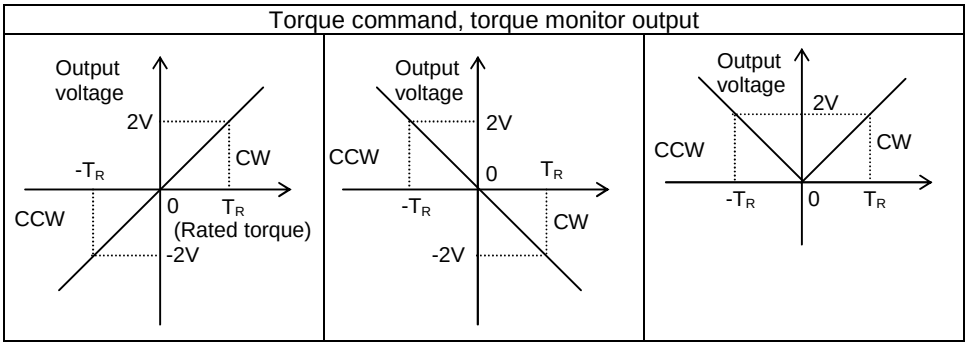
■Velocity command, velocity monitor

Velocity command, Velocity monitor output



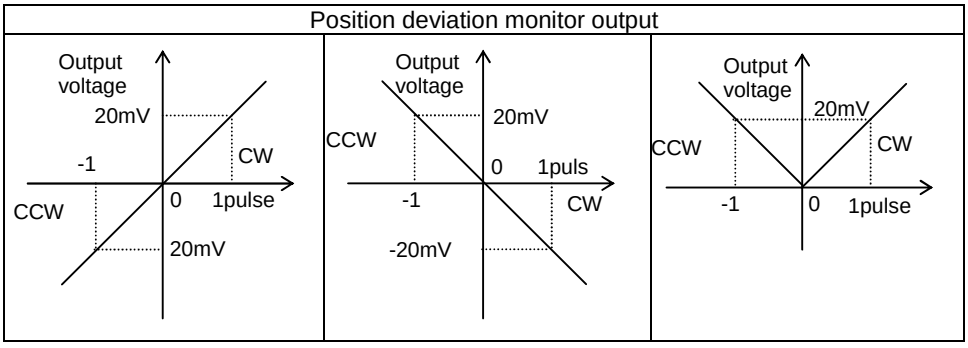
■Torque command, torque monitor

Torque command, torque monitor output



■Position deviation monitor

Position deviation monitor output



2.6 Specifications for dynamic brake

1) Allowable frequency, instantaneous tolerance, decreasing the rotation angle of the dynamic brake

■Allowable frequency of the dynamic brake (main circuit power ON/OFF)

Limit the positioning operation to a range within 360 [°] within the allowable load moment of inertia.

■Operation intervals

In basic terms, operation of the dynamic brake in six (6) minute intervals is acceptable. If the brake is to be operated more frequently, the motor speed must be reduced sufficiently.

Refer to the following expression to find a standard of operation:

$$\frac{6[\text{min}]}{(\text{Rated rotation speed/maximum rotation speed in use})^2}$$

■If/When load inertia moment (J_L) substantially exceeds allowable load inertia moment or if/when rotation through an angle exceeding 360 [°] is made, abnormal heat can generate due to dynamic brake resistance. Take precautions against (Overheat alarm of the dynamic break) or (failure of dynamic brake resistance). Please consult us if such a situation is evident.

■Instantaneous tolerance of dynamic brake

E_{RD} [J]
360

□The consumption of energy E_{RD} by dynamic brake resistance in one dynamic brake operation is as follows:

$$E_{RD} = \frac{1}{2} \times (J_M + J_L) \times (2\pi N)^2$$

J_M： Moment of inertia of motor rotor [kg • m^2]

J_L： Load inertia moment [kg・m^2]

N： Rotational speed [s^{-1}]

2.7 Regenerative control

■ Calculation of the rotational energy which MEGATORQUE MOTOR has in the process of deceleration

Calculate the rotational energy based on the following expression.

Rotational energy = $1/2 \times J \times \omega^2$ [J]

$= 1/2 \times J \times (2\pi N)^2$ [J]

$J = J_r + J_m$

J_r: Moment of inertial of rotor [kg•m^2]

J_m: Moment of inertia of load [kg•m^2]

N: Rotational speed [s^{-1}]

■ Available energy from storage in the internal capacitor

The regenerative energy internal capacitor can handle by charging is different depending upon the designation of driver.

Designation of driver	Energy absorbed in the capacitor[J]
M-EGA-15A2301	17
M-EGA-30A2301	24

■ Calculation of the energy which can be consumed in the external regenerative resistor

Energy consumed in the external regenerative resistor[J] = Rotational energy[J] – Energy absorbed in the capacitor[J]

When the result of the above calculation is found 0 or less, there is no need for additional installation of external regenerative resistor.

When the calculation result is found exceeding 0, determine the required capacity for the regenerative resistor based on the calculations described below.

■ Calculation of the required capacity for the external regenerative resistor

Capacity required for external regenerative resistor [W]

= Energy consumed in the external regenerative resistor [J]/(Operating cycle [s]×0.25)

0.25: Duty factor of regenerative resistor

When calculation result is found 80 or less: Use the external regenerative resistor (Optional model: M-FAE0004).

When calculation result is found 220 or less: Use the external regenerative resistor (Optional model: M-FAE0005).

When calculation result is found exceeding 220, consult us.

2.8 Converter

1) Specifications of converter

General specifications

Rated input voltage	4.75 to 5.4[VDC]	
Rated input current	150[mA] (max)	
Operating environment	Ambient temperature	0 to 55[°C]
	Storage temperature	-20 to +65[°C]
	Operation and storage humidity	90[%RH] or less (no condensation)
	Vibration	4.9[m/s^2]
Outside dimensions (H×W×D)	73×61×23.5[mm]	
Weight	0.135[kg]	

✔ **Remember to limit the supply voltage to the specifications.**

Performance

Resolution	524,288 [count/revolution]	
Communication	Protocol	EIA RS-485
	Type	Start-stop synchronization (NRZ)
	Baud rate	2.5 [Mbps]

3

3. Installation

3.1 Driver

1) Precautions

When installing, please be sure to protect the following precautions.

■ Various precautions

The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.
Do not stand, and put heavy items on the driver.
Operate the device within the specified environmental conditions.
Do not drop the device or subject it to excessive shock.
Make sure no screws or other conductive or flammable materials get inside the driver.
Do not obstruct the air intake and exhaust vents. The attachment direction should be observed strictly.
Please contact our office if the driver is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage.
Any damaged parts and parts with the mounting parts have been damaged shall be fixed by returning to our company immediately.

■ 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 driver 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 driver 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 driver 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.

■ 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 driver.

■ 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. A noise filter should be installed to protect the driver.

2) Unpacking

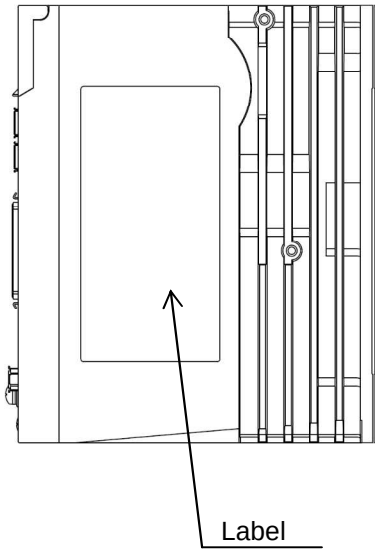
Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- ■ Verify that the driver reference number is the same as ordered.

  The reference number is located on the main label, following the word “MODEL”.

- ■ Verify that there is no problem in the appearance of driver.

Driver

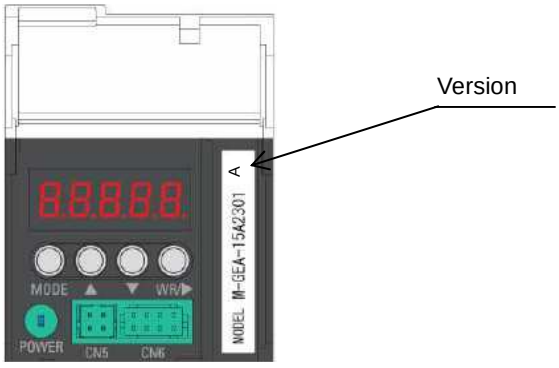


Example of driver label

Serial Number Month (two digits) + Year (two digits) + Day (two digits) + Serial number (four digits) + version

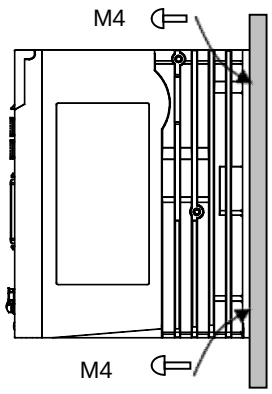
- ✔ When driver M-EGA-15A2301, motor M-PB3030JN001, and converter M-ECC-PB3030GA201 are used together, use driver with version A or later. When the combination is not appropriate, alarm will be output.
- ✔ Driver version is also displayed inside the cover of upper front.

Inside the cover of upper front

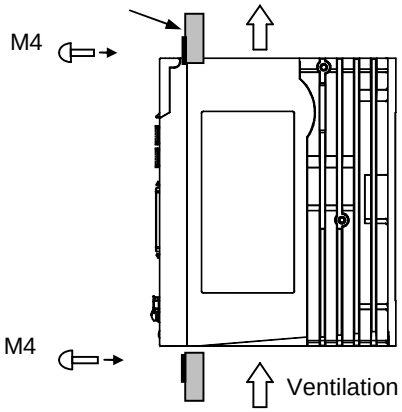


3) Mounting direction and location

In the case of rear-mounting



Front mounting In the case of front-mounting



✔ Refer to optional parts, Appendix, for metal fittings for front mounting.

4) Control arrangement within the machine

■ Leave at least 50 [mm] space above and below the driver to ensure unobstructed airflow from the inside of the driver and the radiator. If heat gets trapped around the driver, use a cooling fan to create airflow.

■ Make sure the temperature around the driver does not exceed 55[°C]. For longevity and reliability purposes it is recommended to keep the temperature below 40[°C].

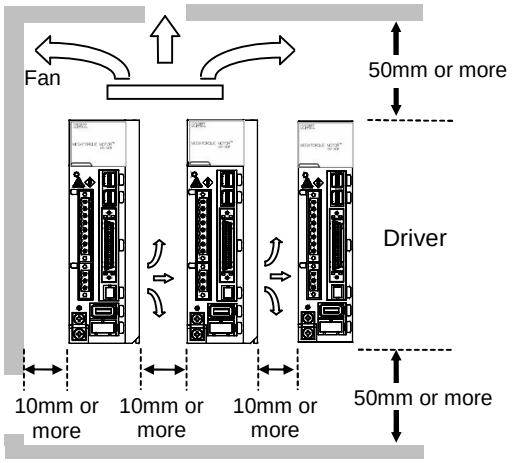
■ Leave at least 10 [mm] space on both sides of the driver to ensure unobstructed airflow from the heat sinks on the side and from the inside of the driver.

■ If the driver is installed on its side, make sure that the ambient temperature does not exceed 50[°C], and mount the back panel to a metal plate.

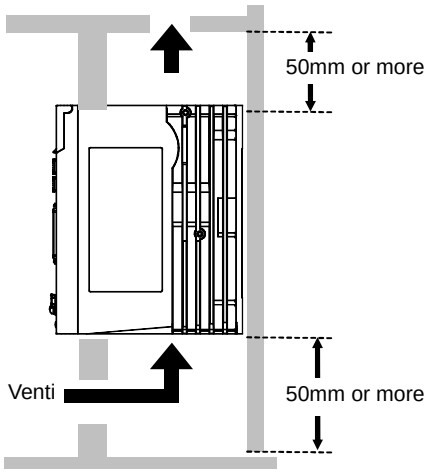
✔ Recommended metal plate thickness is 2[mm] or more

■ Since M-EGA-30A2301 is equipped with ventilation fan on its side, installation of driver as shown below is recommended.

Front view



Side view



3.2 Motor

1) Precautions

■ Various precautions

The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.
Do not stand, and put any very heavy loads.
Operate the device within the specified environmental conditions.
Do not drop the device or subject it to excessive shock.
The attachment direction should be observed strictly.
Any damaged parts and parts with the mounting parts have been damaged shall be fixed by returning to our company immediately.
Please contact us for long-term period storage (for 3 years or more).

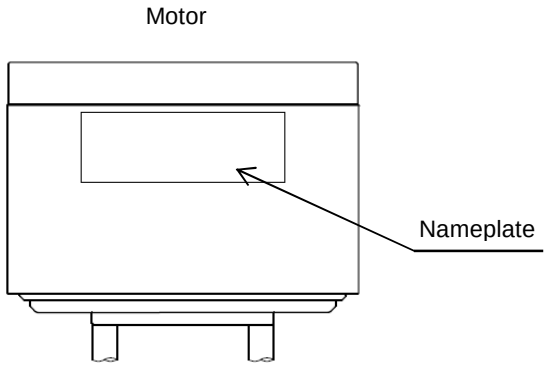
2) Unpacking

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

■ Verify that the reference number of the motor is the same as ordered.

The reference number is located on the nameplate, following the word “MODEL”.

■ Verify that there is no problem in the appearance of motor.



3) Installation

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

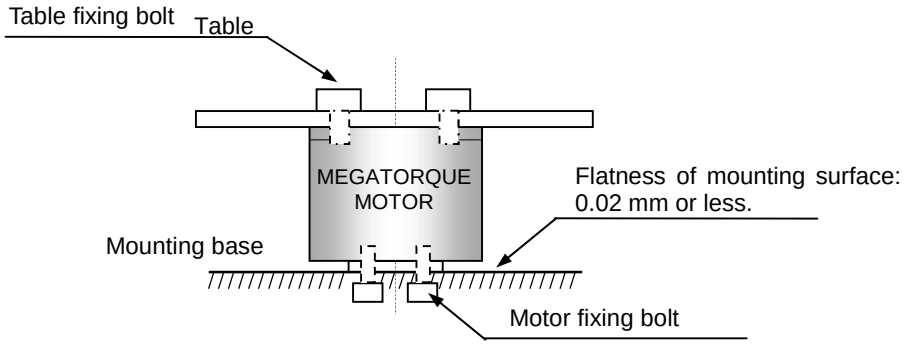
The motor is designed for indoor use. Make sure to Install it indoors.	
Ambient temperature: 0 to 40[°C] Storage temperature: 0 to 40[°C] Ambient humidity: 20 to 80[%]	Good ventilation, no corrosive or explosive gases present. No dust or dirt accumulation in the environment. Easy access for inspection and cleaning.

4) Motor mounting method

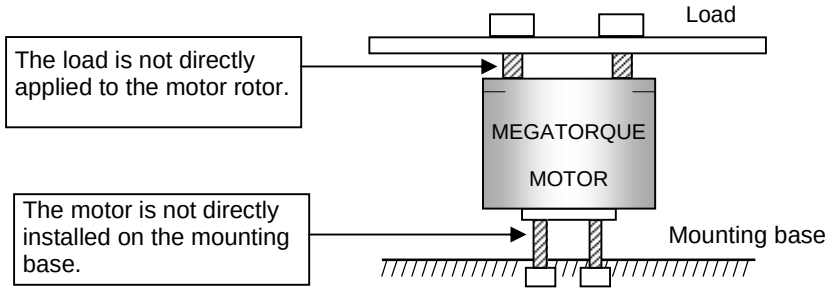
■ Location and environment for installation of motor

- ✔ Use the motor indoors free from any dust and corrosive gas.
- ✔ Operate the motor in the environment at an ambient temperature of 0 to 40 [°C].
- ✔ The motor is not dust-proof and waterproof design (IP30 equivalent). Use the motor in the environment free from any water or oil.
- ✔ If the mounting base is not rigid enough for installation of motor, mechanical resonance may occur. Remember to install and fix the motor securely onto the mounting base having high stiffness.
- ✔ Make sure that the motor mounting surface has a flatness of 0.02 [mm] or less.
- ✔ The motor may be installed in either orientation horizontal or vertical.
- ✔ For tightening torque and penetration depth of screws, follow the table below.

Motor model	Screw	Tightening torque [N•m]	Penetration depth [mm]
PB1006	M4	3.4 or less	4 to 5.5
PB3015	M6	13 or less	7 to 8.5
PB3030			
PB3060			



Since the installation condition shown below can cause mechanical resonant vibration or failure of estimation of magnetic pole due to low rigidity of the mounting base and the load, installation of motor to mounting base and load to motor have to be secure and rigid.



- ✔ Allow the load to be directly applied to the motor rotor.
- ✔ Install the motor directly onto the mounting base.

■ Coupling the load to the motor

✔ For installation of load, use the bolt hole in the rotor. Install the load securely with great care not to allow any looseness.

✔ For tightening torque and penetration depth of screws, follow the table below.

Motor model	Screw	Tightening torque [N•m]	Penetration depth [mm]
PB1006	M4	3.4 or less	5 to 6.5
PB3015	M6	13 or less	7 to 8.5
PB3030			
PB3060			

■ Checking the operating conditions

The MEGATORQUE MOTOR system involves significantly larger moment of inertia for load compared to the moment of inertial for rotor. Allowable load moment-of-inertia by motor size is shown in the table below.

Motor model	Rotor inertia moment [kg•m^2]	Allowable load moment-of-inertia [kg•m^2]
PB1006	0.0026	0 to 0.26
PB3015	0.014	0 to 1.1
PB3030	0.016	0 to 1.4
PB3060	0.021	0 to 3.1

✔ Remember to check for appropriate allowable moment load, allowable axial load and allowable radial load for your specific applications of the motor.

3.3 Converter

1) Precautions

Follow the precautions listed below when installing the converter.

■ General precautions

Remember that installation to or near any combustibles can cause a fire.
Never attempt to place any heavy materials on the converter or do not stand on the converter.
Use the converter within the range of specified environmental conditions.
Do not fall the converter nor expose it to any strong impact.
Protect the converter against possible entry of screws, metal fragments or other conductive substances and combustibles.
If the converter or any internal part is found damaged, immediately return it to us for proper repair.

■ Precautions for installation

In order to ensure extended service life and high reliance, use the converter at a temperature below 40[°C].

■ Where any heating element is located nearby

Even if temperature increase is expected due to thermal convection and/or radiation, keep the surroundings of converter below 55[°C].

■ Where corrosive gas is present

Extended use can cause contact failure in the connectors and contact elements. Never use the converter in any location exposed to corrosive gas.

■ Where explosive or combustible gas is present

Never use the converter in any location exposed to explosive or combustible gas.

■ Where any source of generating large noise is present

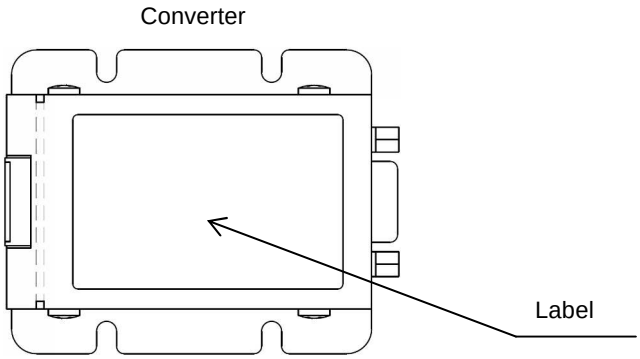
Malfunction may occur due to contaminated input signal/power supply circuit with induction noise. Where there is a possibility of noise contamination, make proper provisions such as consideration of power line wiring and prevention of noise generation.

2) Unpacking

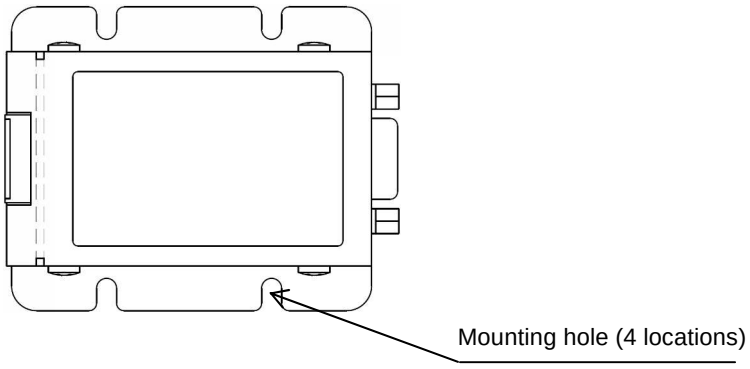
On receipt of the product, make checks listed below. Should any abnormality be discovered, immediately contact us.

■ Check the reference number of the converter for proper match with your ordered product. Locate the reference number next to “MODEL” on the label on the product.

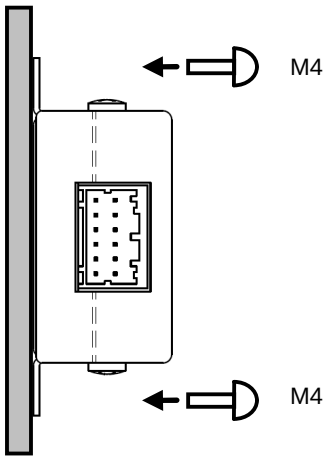
■ Check the external appearance of the converter for any defect.



3) Installation



Typical installation



3.4 Cable (motor and converter)

1) Precautions

Follow the precautions listed below when installing the cable.

■ General precautions

Remember that installation near any combustibles can cause a fire.
Never attempt to place any heavy materials on the converter or do not stand on the cable.
Use the cable within the range of specified environmental conditions.
Do not fall the cable nor expose it to any strong impact.
If the cable is found damaged, immediately return it to us for proper repair.
Do not cut cables for extension, reduction, or connection.
Do not give stress such as tension or vibration to connecting part of cable and connector.

■ Precautions for installation

In order to ensure extended service life and high reliance, use the cable at a temperature below 40[°C].
If cable is to be exposed to severe vibration, fix the cable near connector so that connector does not suffer from stress.

■ Where any heating element is located nearby

Even if temperature increase is expected due to thermal convection and/or radiation, keep the surroundings of cable below 40[°C].

■ Where corrosive gas is present

Extended use can cause contact failure in the connectors and contact elements. Never use the cable in any location exposed to corrosive gas.

■ Where explosive or combustible gas is present

Never use the cable in any location exposed to explosive or combustible gas.

■ Where any source of generating large noise is present

Where there is a possibility of noise contamination, make proper provisions such as consideration of power line wiring and prevention of noise generation.

4

4. Wiring

4.1 Wiring for main circuit power supply, control power, regenerative resistance, and protective grounding

1) Part name and function

Terminal name	Connector marking	Remarks	
Main circuit power supply	R・T or R・S・T	Single phase	200 to 230[VAC] +10[%], -15[%] 50/60[Hz]±3[%]
			220 to 230[VAC]±10[%], 50/60[Hz]±3[Hz]
		Three-phase 200 to 230[VAC] +10[%], -15[%] 50/60[Hz]±3[Hz]	
Control power supply	r・t	Single phase 200 to 230[VAC] +10[%], -15[%] 50/60[Hz]±3[Hz]	
Motor connector	CNB	Connected with motor cable connector	
Converter connector	EN1	Connected with converter cable connector	
Safeguard connector	⏚	Connected with grounding wire of power supply and of motor.	
Regeneration resistance connector	RB1・RB2	Connects any external regenerative resistor to RB1 / RB2 terminals.	
Maker maintenance	⊖	For maker maintenance. Do not connect anything.	

- ✔ For connection to CNB and EN1, be sure to use the dedicated cables. The cables cannot be cut off nor spliced due to the specifically designed lines.
- ✔ If main circuit power supply is used as single phase power source, specification of supply voltage is different depending upon motor and driver used.

2) Wire

Electric wires for use in driver main circuit power are shown below.

■ Wire type

Kinds of wires		Conductor allowable temperature [°C]
Code	Name	
PVC	Common vinyl electric wire	---
IV	600V electric wire	60
HIV	Special heat-resistant vinyl wire	75

- ✔ The information in this table is based on rated armature current running through three bundled lead wires at ambient temperature of 40[°C]. Use the electric wire beyond proof-pressure 600[V].
- ✔ When wires are bundled or put into a wire-duct, such as a hardening vinyl pipe or a metallic conduit, take the allowable current reduction ratio into account.
- ✔ At high ambient temperature,, service life of the wires becomes shorter due to heat-related deterioration. In this case, we recommend using heat-resistant vinyl wires.

3) Wire diameter-allowable current

AWG sides	Nominal cross-sectional area [mm^2]	Conductor resistance [Ω/km]	Allowable current over ambient temperature [A]		
			30[°C]	40[°C]	55[°C]
20	0.5	39.5	6.6	5.6	4.2
19	0.75	26.0	8.8	7.0	5.4
18	0.9	24.4	9.0	7.7	5.8
16	1.25	15.6	12.0	11.0	8.3
14	2.0	9.53	23.0	20.0	15.0

- ✔ This is reference value in the case of a special heat-resistant vinyl wire (HIV).
- ✔ The diameter of an electric wire and allowable current in the case of doing the bundle line of the three electric wires are shown.
- ✔ Use it below by the above-mentioned allowable current.

4) Recommended wire diameter

The recommendation electric wire diameter used for driver is shown below.

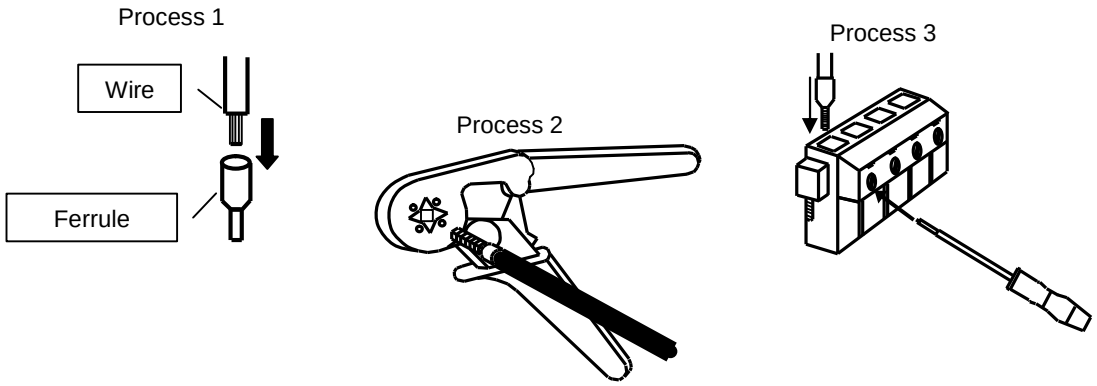
■ Input voltage 200[VAC]

Main circuit power supply (R・S・T)		Control power supply		Regeneration resistance		⏚	
mm^2	AWG No	mm^2		AWG No		mm^2	AWG No
1.25	16	1.25	16	1.25	16	2.0	14

- ✔ The information in this table is based on rated armature current flowing through three bundled lead wires at ambient temperature of 40[°C].
- ✔ When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.
- ✔ At high ambient temperature, service life of the wires becomes shorter due to heat-related deterioration. In this case, use special heat-resistant vinyl wire (HIV).

5) Crimping of wires

Insert the wire into ferrule, and use a special tool to crimp it in.
Insert the ferrule deep into the connector, and tighten it with a special minus screwdriver or something. The recommended torque is 0.5 to 0.6 [N・m].



■ Model number of recommended ferrules and crimping tools for various wire sizes

mm^2	AWG	Model number
0.75	19	AI0.75-8GY
1.0	18	AI1-8RD
1.5	16	AI1.5-8BK
2.5	14	AI2.5-8BU

- ✔ GY: Gray, RD: Red, BK: Black, BU: Blue
- ✔ Crimping tool model number: 0.25 to 6[mm^2] : CRIMPFOX UD 6-4, 0.75 to 10[mm^2]: CRIMPFOX UD 10-4GY
- ✔ Manufactured by Phoenix Contact.
- ✔ The procedures above are recommendations. Consider the use of equivalent products for both ferrule and crimping tool.

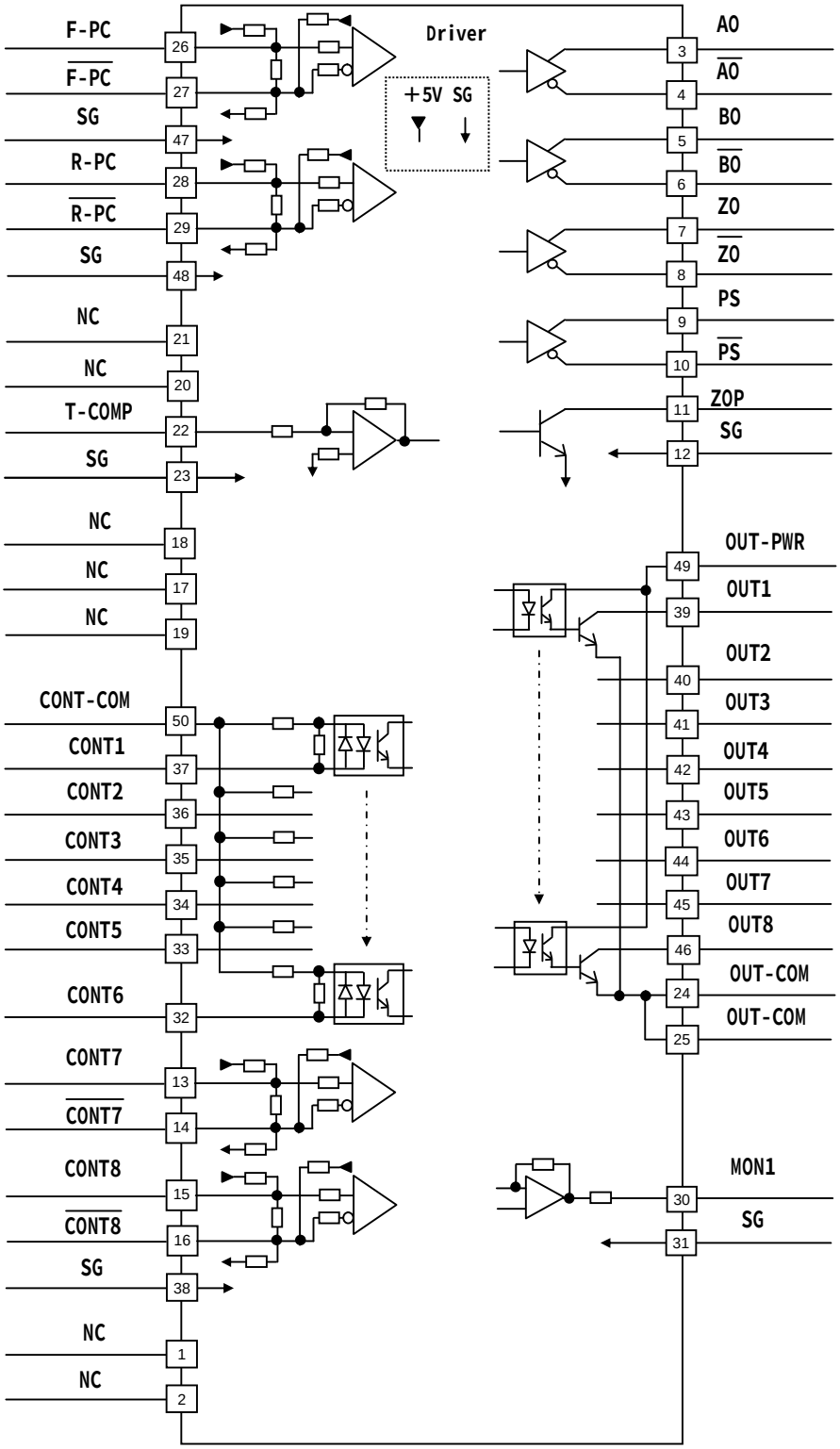
6) High voltage circuit terminal; tightening torque

Terminal marking	
CNA	⏚
0.5 to 0.6 [N・m]	1.18 [N・m] M4 (screw size)

4.2 Wiring with Host Unit

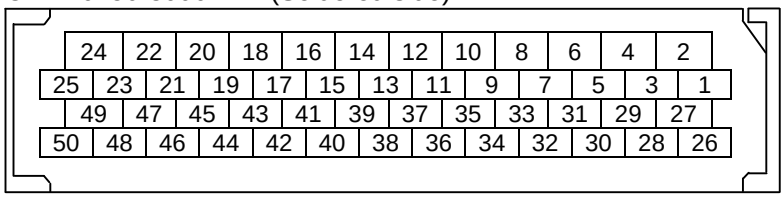
1) CN1 signal and pin number (wiring with host unit)

- CN1 terminal sequence



2) CN1 connector disposition

■ CN1 10150-3000PE (Soldered side)



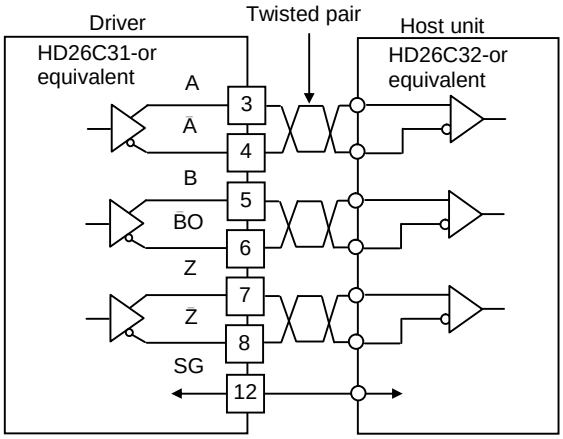
3) Signal name and its function

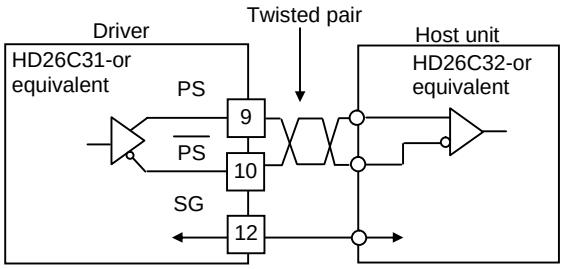
Terminal number	Signal name	Description
1	NC	NC
2	NC	NC
3	A0	A phase pulse output
4	/A0	/A phase pulse output
5	BO	B phase pulse output
6	/BO	/B phase pulse output
7	ZO	Z phase pulse output
8	/ZO	/Z phase pulse output
9	PS	Resolver signal output
10	/PS	/Resolver signal output
11	ZOP	Z phase pulse output
12	SG	Common for pins 3 to 11
17	NC	NC
18	NC	NC
19	NC	NC
20	NC	NC
21	NC	NC
22	T-COMP	Torque compensation input
23	SG	Common for pin 22
26	F-PC	Command pulse input
27	/F-PC	Command pulse input
28	R-PC	Command pulse input
29	/R-PC	Command pulse input
47	SG	Common for pins 26・27
48	SG	Common for pins 28・29

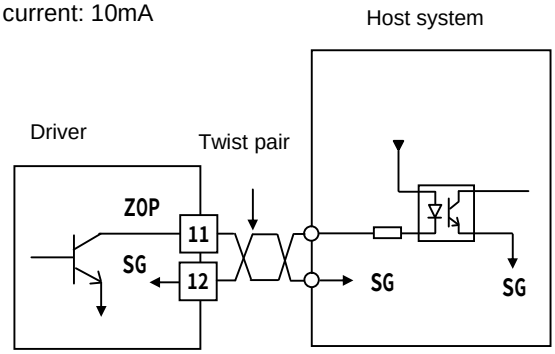
Terminal number	Signal name	Description
30	MON1	Analog monitor output
31	SG	Common for pin 30
13	CONT7	Position Command Pulse Function · shutdown at Zero Velocity Function (+)
14	/CONT7	Position Command Pulse Function · shutdown at Zero Velocity Function (-)
15	CONT8	Alarm Reset Function (+)
16	/CONT8	Alarm Reset Function (-)
38	SG	Common for pins 13 to 16
32	CONT6	CW over Travel Function
33	CONT5	CCW over Travel Function
34	CONT4	Deviation Clear Function
35	CONT3	Magnetic Pole Position Estimation Function
36	CONT2	Emergency Stop Function
37	CONT1	Servo-ON Function
50	CONT-COM	General input power supply
39	OUT1	In-Position Window
40	OUT2	Magnetic Pole Position Estimation Ready
41	OUT3	While Operation Setup Completion
42	OUT4	Magnetic Pole Position Estimation End
43	OUT5	Alarm Code Bit 5
44	OUT6	Alarm Code Bit 6
45	OUT7	Alarm Code Bit 7
46	OUT8	While Alarm Status
49	OUT-PWR	Power source for general output
24	OUT-COM	General output Common
25	OUT-COM	General output Common

• Terminal number 13 to 16 and 32 to 27 : factory default standard settings.
• Terminal number 39 to 46 : factory default standard settings.

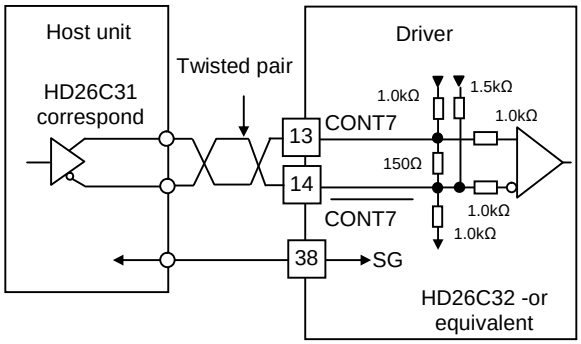
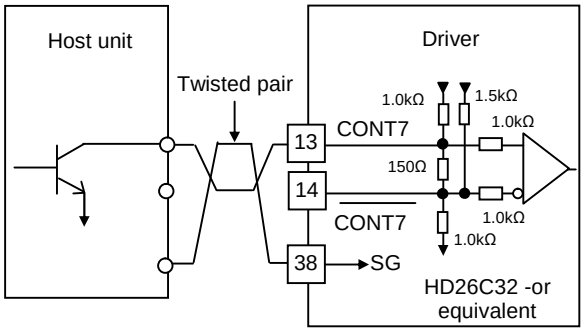
4) Terminal connection circuit

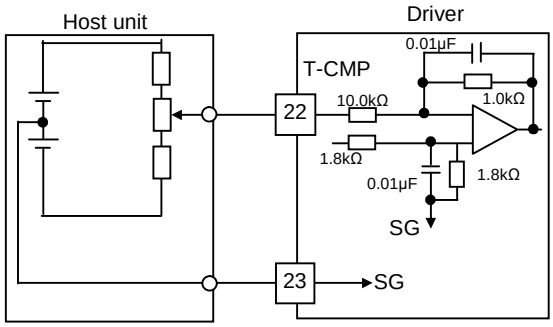
<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>NC</td><td>–</td><td rowspan="2">–</td></tr>
<tr><td>2</td><td>NC</td><td>–</td></tr>
<tr><td>3</td><td>A0</td><td>A phase pulse output</td><td rowspan="6">The signal of A phase of a resolver, B phase pulse, and a starting point Z phase pulse is outputted. Connect with a line receiver.
 

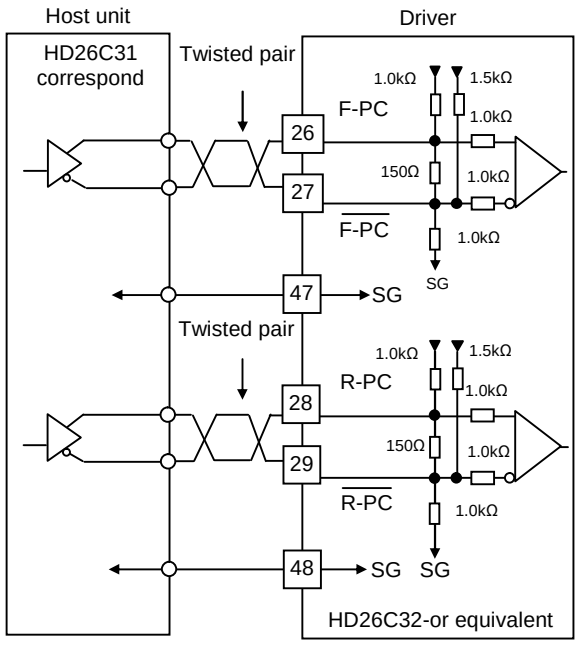
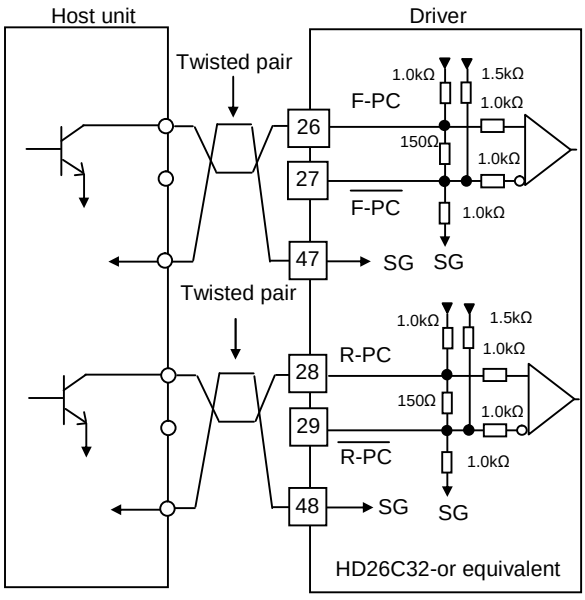
Make sure to connect SG.</td></tr>
<tr><td>4</td><td>$\overline{A0}$</td><td>/A phase pulse output</td></tr>
<tr><td>5</td><td>BO</td><td>B phase pulse output</td></tr>
<tr><td>6</td><td>$\overline{BO}$</td><td>/B phase pulse output</td></tr>
<tr><td>7</td><td>ZO</td><td>Z phase pulse output</td></tr>
<tr><td>8</td><td>$\overline{ZO}$</td><td>/Z phase pulse output</td></tr>
<tr><td>9</td><td>PS</td><td>Resolver signal output</td><td rowspan="2">Absolute position data output signal of a resolver.
 

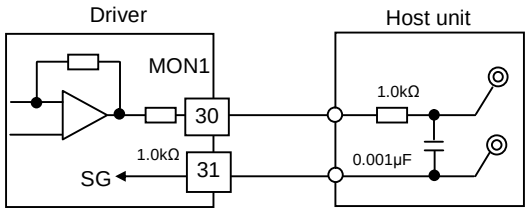
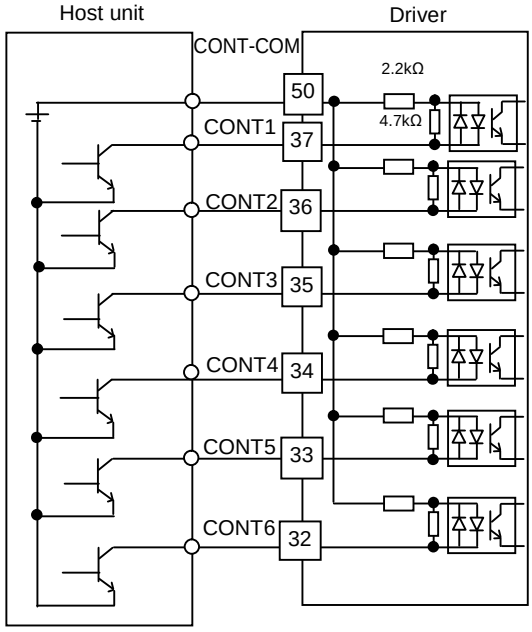
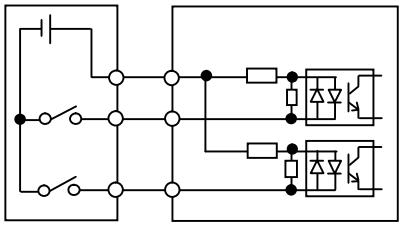
Make sure to connect SG.</td></tr>
<tr><td>10</td><td>$\overline{PS}$</td><td>/Resolver signal output</td></tr>
<tr><td>11</td><td>ZOP</td><td>Z phase pulse output</td><td>Resolver Z phase pulse is output at the open collector.
[NPN output]
Max. voltage: DC30V
Max. current: 10mA
 

Remember to connect SG.</td></tr>
</table>

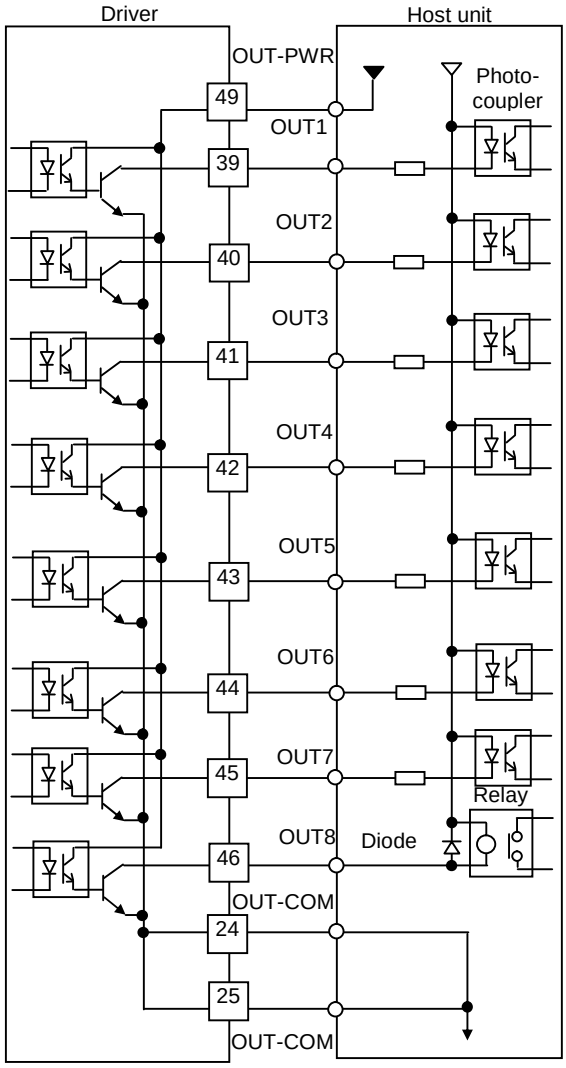
Terminal No.	Symbol	Name	Description
13	CONT7	General input	Receivable with a line receiver. General output signals can receive either a differential signal or an open collector signal. Differential output signal connection  Open collector signal output connection  Make sure to connect SG.
14	$\overline{\text{CONT7}}$	General input	
15	CONT8	General input	
16	$\overline{\text{CONT8}}$	General input	

Terminal No.	Symbol	Name	Description
18	NC	–	–
19	NC	–	–
20	NC	–	–
21	NC	–	–
22	T-COMP	Torque compensation input	

Terminal No.	Symbol	Name	Description
26	F-PC	Command pulse input	Command pulse input is a position command input. Velocity command input → Velocity control type. Three types of command input pulse. [CW pulse + CCW pulse] Maximum 5[Mpps] [Code + pulse train] Maximum 5[Mpps] [90°-phase difference two phase pulse train] Maximum 1.25[Mpps] Differential output signal connection  Be sure to connect SG. Open collector signal output connection 
27	$\overline{\text{F-PC}}$	Command pulse input	
28	R-PC	Command pulse input	
29	$\overline{\text{R-PC}}$	Command pulse input	

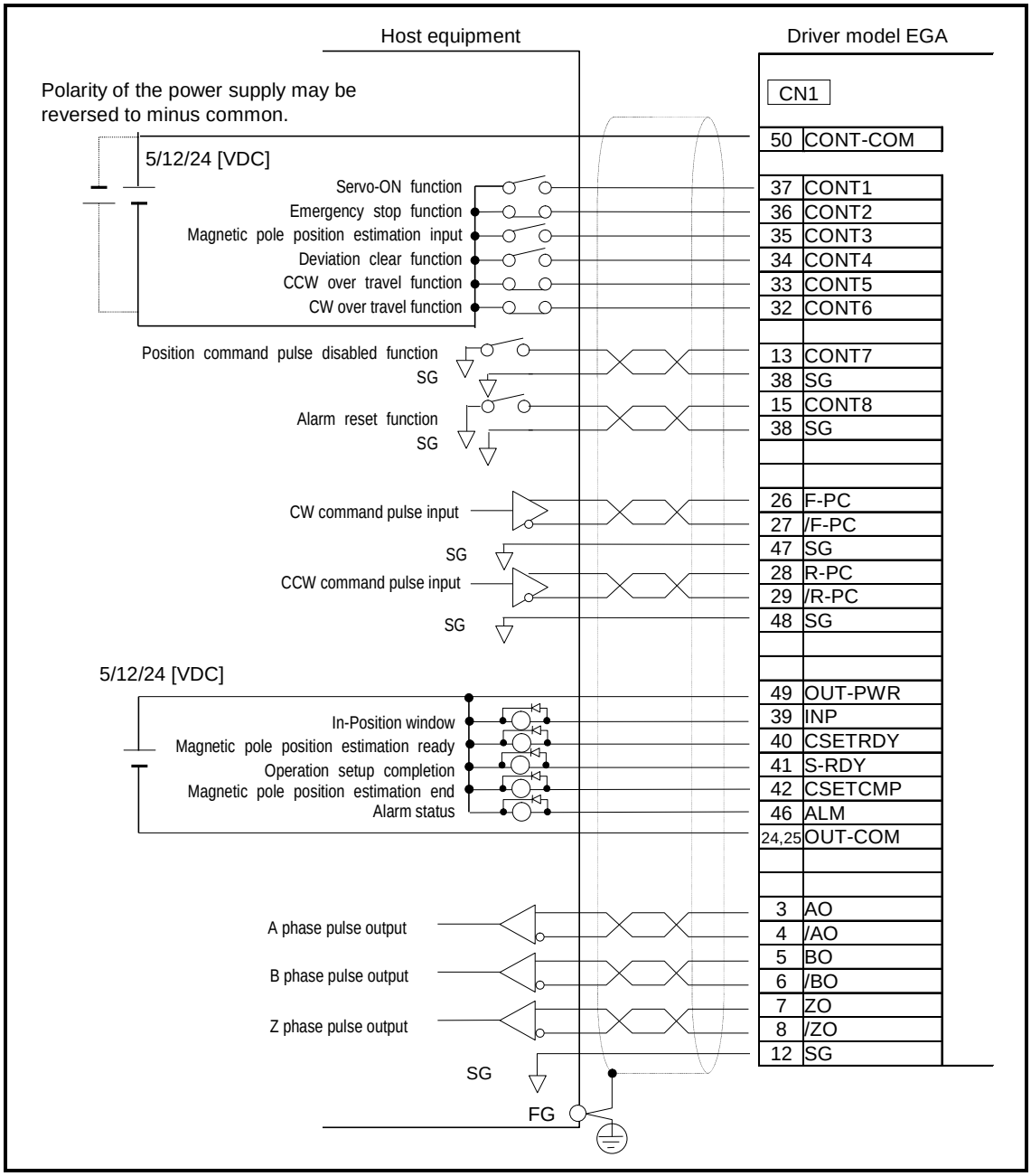
<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>30</td><td>MON1</td><td>Analog monitor output</td><td>Outputs the selection of analog monitor output 1.
Load shall be less than 2[mA].
Output resistance shall be 1[kΩ].
Output voltage range shall be ±8[V].
 
</td></tr>
<tr><td>32</td><td>CONT6</td><td>General input</td><td rowspan="7">General input circuit is connected with the transistor circuit of a relay or an open collector.
Power supply & voltage range:
5[VDC]±5[%] / 12[VDC] to 24[VDC]±10[%]
Minimum current: 100[mA]
[Sink circuit example]
 
</td></tr>
<tr><td>33</td><td>CONT5</td><td>General input</td></tr>
<tr><td>34</td><td>CONT4</td><td>General input</td></tr>
<tr><td>35</td><td>CONT3</td><td>General input</td></tr>
<tr><td>36</td><td>CONT2</td><td>General input</td></tr>
<tr><td>37</td><td>CONT1</td><td>General input</td></tr>
<tr><td colspan="3" rowspan="2"></td></tr>
<tr><td>Sink circuit type
  </td></tr>
</table>

Terminal No.	Symbol	Name	Description
39	OUT1	General output	General output circuit is connected with a photo-coupler or a relay circuit. [NPN output] OUT-PWR (outer power supply) specification Power supply & voltage range:5[VDC] ±5[%], 12 to 24[VDC] ±10[%] Minimum current: 20[mA] Specification of input circuit power Power supply voltage range: 5[VDC] ±5[%] Power supply voltage range: 12 to 15[VDC] ±10[%] Power supply voltage range: 24[VDC] ±10[%] Maximum current:5[VDC]‥‥‥‥‥10[mA] Maximum current:12 to 15[VDC]‥‥30[mA] Maximum current:24[VDC]‥‥‥‥‥50[mA]
40	OUT2	General output	
41	OUT3	General output	
42	OUT4	General output	
43	OUT5	General output	
44	OUT6	General output	
45	OUT7	General output	
46	OUT8	General output	
49	OUT-PWR	General output power supply	
24	OUT-COM	General output common	
25	OUT-COM	General output common	



✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to general (-purpose) output.
Please carefully install diode so as not to connect polarity of diode. Failure to do this causes driver malfunction.

5) Example of wiring with CN1



4.3 Peripheral equipments

1) Power supply capacity and peripherals list

Input voltage	Motor model No.	Main circuit power supply rating [kVA]	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
200[VAC]	PB1006	0.3	Model NF30 10A MITSUBISHI ELECTRIC	HF3030C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N10 MITSUBISHI ELECTRIC	LT-C32G801WS SOSHIN ELECTRIC Co., Ltd.
	PB3015	0.5				
	PB3030	1.0				
	PB3060	2.0				

✔ Please install surge absorber at the input part of driver when overvoltage such as lightning surge is applied to driver.

5

5. Operation

5.1 System parameters

1) Confirmation of specifications

Confirm the specifications the driver, using either of the MEGATORQUE MOTOR SETUP(set up software) or Digital Operator.

<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td rowspan="2">1</td><td>Confirmation of driver specifications</td></tr>
<tr><td>■ Confirm that the specifications of the product purchased are the same as that of the machine being used. Also, confirm the following three (3) items with statements or codes.

◆ Motor structure
◆ Main circuit power supply voltage
◆ Driver capacity code

■ Confirm the statement contents and codes with the MEGATORQUE MOTOR system support tools:
Setup software or Digital Operator.

◆ Confirm with setup software.
Turn on control power (r, t) to start up setup software.
Opening System parameters tab of Parameters setting (P) shows “System information” in the upper right of the display. Confirm in accordance with procedure 2 and later.

◆ Confirm with Digital Operator
Codes are shown at Information 1 (driver) and Information 2 (driver). Refer to [Status Display Mode (7-4)] for Digital Operator operation.</td></tr>
<tr><td rowspan="2">2</td><td>Motor structure</td></tr>
<tr><td>
<table>
<tr><th>Code</th><th>Motor structure</th></tr>
<tr><td>02</td><td>DDM</td></tr>
</table>
■ Confirm that DDM is displayed at Motor Structure in setup software.

■ Confirm that the Motor Structure code is shown at Information 1 (driver) of Digital Operator.

 
Motor Structure code</td></tr>
</table>

<table>
<tr><td>Procedure</td><td>Item and contents</td></tr>
<tr><td rowspan="2">3</td><td>Main circuit power supply voltage

<table>
<tr><td>Code</td><td>Main circuit power supply voltage display</td></tr>
<tr><td>00</td><td>200[V]</td></tr>
</table>

■ Using setup software, confirm that voltage value of main circuit power connected to connector CNA or terminal block RST is displayed.
■ Using Digital Operator, confirm that codes of voltage value of main circuit power connected to connector CNA or terminal block RST is displayed on “information 1 (driver information).”
 
</td></tr>
<tr><td>4</td><td>Output current capacity

<table>
<tr><td>Code</td><td>Output current capacity</td></tr>
<tr><td>0C</td><td>15[A]</td></tr>
<tr><td>0A</td><td>30[A]</td></tr>
</table>

■ Confirm setup software displays the driver capacity of the driver model that you use.
■ Confirm Digital Operator displays the code of the output current capacity you use at Information 2 (driver).
 
</td></tr>
</table>

2) System parameters list

System parameters list is shown below. Settings vary depending on the system used.

Please confirm 3), 4) and the following IDs for the proper settings.

ID	Contents
00	Control Cycle
01	Main Circuit Power Input Type
02	Regenerative Resistor Selection
05	Serial Encoder Resolution
0A	Position Control Selection

3) Confirmation and settings of system parameters

Use the setup software or digital operator, to set the specifications the driver. For operating instructions, see [Digital Operator (7)] for the Digital Operator.

System Parameters Setting (driver)

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>Control Cycle
■ Select the control cycle for Velocity control/ Torque control.
“High Frequency Sampling” enables increasing the frequency response of the velocity control system. Please set at “00: Standard_Sampling” for normal use.
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Standard_Sampling</td><td>Standard Sampling</td></tr><tr><td>01</td><td>High-freq_Sampling</td><td>High Frequency Sampling</td></tr></table>■ “High frequency sampling mode” is not available for the following conditions:
◆ System Parameters ID0A setting value of the “Position Control Selection”
<table><tr><th>Present setting value</th><th>Contents</th></tr><tr><td>01:Model1</td><td>Model Following Control</td></tr></table>or
<table><tr><th>Present setting value</th><th>Contents</th></tr><tr><td>02:Model2</td><td>Model Following Vibration Suppressor Control</td></tr></table></td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>01</td><td>
Main circuit power input type
■ Set input type of main circuit power connected to CNA on driver or R, S, and T on terminal block.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>AC_3-phase</td><td>3 phase AC power is supplied to the main circuit</td></tr>
<tr><td>01</td><td>AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
■ Set according to the specifications of the main circuit power that is used as Follows:
◆ Connect to 3 phase AC power 200V
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00: AC_3-phase</td><td>3 phase AC power is supplied to the main circuit</td></tr>
</table>
◆ Connect to single phase AC power 200V.
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
◆ Connect AC 100V to R, T of CNA
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
</td></tr>
<tr><td>02</td><td>
Regenerative resistor selection
■ Set installation specification of regenerative resistor connected to CNA on driver or RB1 and RB2 on terminal block, or the condition that regenerative resistance is not connected.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Not_connect</td><td>Regenerative resistor is not connected</td></tr>
<tr><td>01</td><td>Built-in_R</td><td>Use built-in regenerative resistor</td></tr>
<tr><td>02</td><td>External_R</td><td>Use external regenerative resistor</td></tr>
</table>
■ Set to meet the flowing specifications:
◆ Regenerative resistor is not connected
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00: Not_connect</td><td>Regenerative resistor is not connected</td></tr>
</table>
◆ Use built-in regenerative resistor of the driver
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: Built-in_R</td><td>Use built-in regenerative resistor</td></tr>
</table>
◆ Use external regenerative resistor
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>02: External_R</td><td>Use external regenerative resistor</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>ID</td><td>Contents</td></tr>
<tr><td>0A</td><td>Position control selection
■ Select the function Position Control Mode.
<table><tr><td colspan="2">Selection</td><td>Description</td></tr><tr><td>00</td><td>Standard</td><td>Standard</td></tr><tr><td>01</td><td>Model1</td><td>Model Following Control</td></tr><tr><td>02</td><td>Model2</td><td>Model Following Vibration Suppress Control</td></tr></table>■ Under the following parameter settings, ‘Model Flowing Control” and “Model Following Vibration Suppressor Control” are not valid.
◆ System parameter ID00 “Control Cycle” is set as follows:
<table><tr><td>Present setting value</td><td>Description</td></tr><tr><td>01: High-freq_Sampling</td><td>High Frequency Sampling</td></tr></table>◆ System parameter ID09 “Control Mode Selection” is not set as follows:
<table><tr><td>Present setting value</td><td>Description</td></tr><tr><td>02:Position</td><td>Position Control Mode</td></tr></table></td></tr>
</table>

4）Confirmation and settings of the system parameters (settings for encoder specification)

Factory use only. Do not change parameter setting value.

<table>
<tr><td>05</td><td>Serial encoder resolution
■ Set the divisions per single (1) shaft rotation
✔ When automatic motor parameter setting function (7-15) is executed, it is automatically updated.</td></tr>
</table>

5） Factory default setting values

The following chart shows the default factory parameter settings.

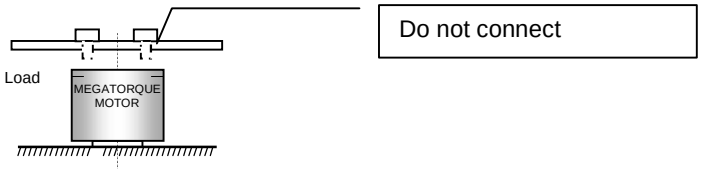
ID	Name	Setting value
00	Control Cycle	00:Standard_Sampling
01	Main Circuit Power Input Type	00:AC_3-Phase
02	Regenerative Resistor Selection	00：Not Connect
05	Serial Encoder Resolution	08:524288_FMT

✔ By performing parameter backup function, you can save “System Parameters”, “General parameters” and “Motor Parameters” inside of driver for restoration if needed.

5.2 Test operation

1) Confirmation of installation and wiring

Confirm the installation and the wiring of the driver and the motor.

Procedure	Item and contents
1	Installation ■ Install the driver and the motor by referring to [Installation (3)]. Do not connect any load to the motor. 
2	Wiring, connecting → Turning on the power supply ■ Wire the power supply, motor and upper device by referring to [Wiring (4)]. Do not connect CN1 to the driver. ■ Turn on the power supply. Confirm that there is no alarm code displayed at the upper center of the driver display. If there is one, follow the instructions in [Trouble shooting When Alarm Occurs (8-7). ■ Follow "Trouble shooting (8-1)" , if the 7 segment LED does not light "≡" when powered up.

2) Confirmation of movement

Perform JOG Operation by using the setup software or the digital operator.

Procedure	Item and contents
1	Estimation of magnetic pole position ■ Perform the estimation of magnetic pole position at no load without connecting any load to the motor. ■ The motor should start, allowing estimation of magnetic pole position. ◆ Operating using setup software: Select the Magnetic Pole Position Estimation option from the Test Operation menu.
2	JOG Operation ■ Perform JOG-operation. ■ Confirm that the motor rotates CW direction and CCW direction ◆ Operating using setup software: Select JOG Operation from the Test Operation menu. ◆ Confirming and setting with Digital Operator: For operating instructions, please see [Digital Operator (7)].

3) Confirmation of I/O signal

Settings for general I/O signals (CN1) are the defaults set at the time of shipment

Procedure 1 — Confirmation of I/O signal

■ Allocate functions you use to CONT1 to CONT8 by selecting parameters from general parameters Group 9.

		Default setting value at shipment	
Input signal	CN1 pin number	Signal selected form general parameter Group9	Setting value
CONT1	37	Servo-ON Function	02:_CONT1_ON
CONT2	36	Emergency Stop Function	04:_CONT2_OFF
CONT3	35	Estimation of Magnetic Pole Position	06:_CONT3_ON
CONT4	34	Deviation Clear Function	08:_CONT4_ON
CONT5	33	CCW over Travel Function	0B:_CONT5_OFF
CONT6	32	CW over Travel Function	0D:_CONT6_OFF
CONT7	13,14	Position Command Pulse Disabled Function / Shutdown at Zero Velocity Function	0E:_CONT7_ON
CONT8	15,16	Alarm Reset Function	10:_CONT8_ON

Procedure 2 — Confirmation of output signals

■ Select the output signal from general parameters GroupA and allocate OUT1 to OUT 8.

		Default setting value at shipment			Default setting value at shipment
Output signal	CN1 Pin number	Setting value	Output signal	CN1 Pin number	Setting value
OUT1	39	18:_INP_ON	OUT5	43	33:_ALM5_OFF
OUT2	40	68:_CSETRDY_ON	OUT6	44	35:_ALM6_OFF
OUT3	41	02:_S-RDY_ON	OUT7	45	37:_ALM7_OFF
OUT4	42	4E:_CSETCMP_ON	OUT8	46	39:_ALM_OFF

Procedure 3 — Confirmation of I/O signal

■ Confirm that the I/O signal functions fine at the monitor.
Refer to [Monitor Function (5-23)] for explanation.

- ◆ Confirming with setup software
  Confirm from the menu monitor.
- ◆ Confirming with Digital Operator
  For operating instructions, please see [Digital Operator (7)].

Procedure 4 — Input the Magnetic Pole Position Estimation signal

■ Please make sure that the estimation of magnetic pole position is set ready and then input the Magnetic Pole Position Estimation signal. The motor should be energized and it provides reciprocating action to perform the estimation of magnetic pole position.

Procedure 5 — Input servo ON signal

■ Input servo ON signal. Confirm that the motor is excited and the Digital Operator display on the driver front is drawing the character “8”.

Display shown below indicates over travel status.

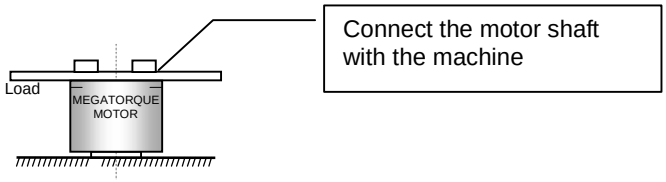
	Over-travel on CW rotation.
	Over-travel on CCW rotation.

■ Setting and changing the over-travel function can be done at the general parameters Group9 ID00, ID01.
■ Setting and changing the emergency stop function can be done at the general parameter Group9 ID42.

Procedure	Item and contents	
6	Command input ■ Input the command suitable for the control mode in use ■ Confirm that the motor rotates in the right direction. ■ If the command is input from the host unit but the motor does not rotate, confirm that the command is input at the monitor function of setup software. "Monitor_ID13:Position Command Pulse (FMON1)" displays input command pulse frequency. ■ If the driver does not receive the command from the host unit, the value displayed on the monitor becomes zero. Any of these cases could be the result of poor wiring: Confirm the wiring again. ■ Input command after receiving command reception enabling signal from driver. Refer to “Operation sequence” for the details.	
7	Power shut off	Turn off the servo-on signal. Then turn off the power supply.

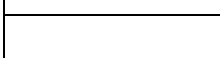
4) Confirmation of device operation

Connect the load to the motor and check the motor for proper operation.

Procedure	Item and contents
1	Connect the load. ■ Connect the load to the motor. 
2	Setting of load ■ Set "Gr.0_ID00: Tuning mode (TUNMODE)" to "01: AutoTun_JRAT-Fix". ■ Set inertia moment of the load device against the motor rotor inertia moment to "Gr.1_ID14: Load Inertia Moment Ratio 1 (JRAT1)". ◆ JRAT1 set value = (Load Inertia Moment) / (Rotor Inertia Moment) × 100 [%]
3	Estimation of magnetic pole position. ■ Close CONT3 (CN1-35 pin) to execute estimating magnetic pole position. ■ When rigidity of the device, such as mounting base, load, and installation, is low, estimation of magnetic pole position may not be properly implemented. Improve the rigidity of the device before implementation. ■ Do not allow unbalanced load or large friction to complete estimation of magnetic pole position properly. ■ In the estimation of magnetic pole position the rotational part of motor moves through the maximum angle of ±18 [°]. Ensure emergency stop and over travel limit for the motor operate properly.
4	Input Servo On signal ■ Input Servo-ON signal. Confirm if motor is excited and seven segments of driver front panel displays "8".
3	Operation ■ Input the command (low speed); check the rotation direction, rotational speed, emergency stop and over-travel (F-OT・R-OT) to make sure they are operating properly. ■ Be sure to stop in the event of any abnormal operation. ■ Input the command for the actual operation and start the machine. ■ If there is nothing wrong with operation and the characteristic, manual tuning is not necessary. Refer to [Adjustments (6)] for the Servo Tuning.

5.3 Driver status display

1) Default display

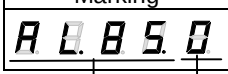
Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and driver ready (RDY) is on.	0
	Main circuit power supply established. Main power supply (R, S, T) is established, but operation preparation completion signal is off.	2
	Magnetic Pole Position Estimation Ready (blinking) Main power supply (R, S, T) is established and Magnetic Pole Position Estimation Ready is on.	9
	Magnetic Pole Position Estimation Rotates after displaying the character "O" (upper half).	9
	Operation setup completion signal established. (continuous) Magnetic pole position estimation is completed, and Operation setup completion signal is on.	4
	Servo is on. Rotates after displaying the character “8.”	8

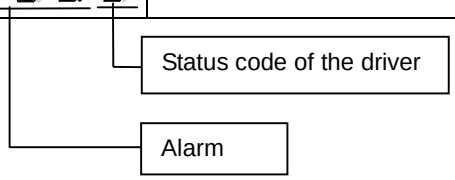
Marking	Description
	Over-travel status at CW rotation.
	Over-travel status at CCW rotation.

Marking	Description
	Regenerative overload warning status. If operation is kept on, alarm may go off.
	Overload Warning status. If operation is kept on, alarm may go off.

2) Alarm display

When an alarm occurs, the display shows the alarm code and the status code of the driver.

Marking	Description
	When an alarm occurs, take corrective actions as instructed in [Maintenance (8)].

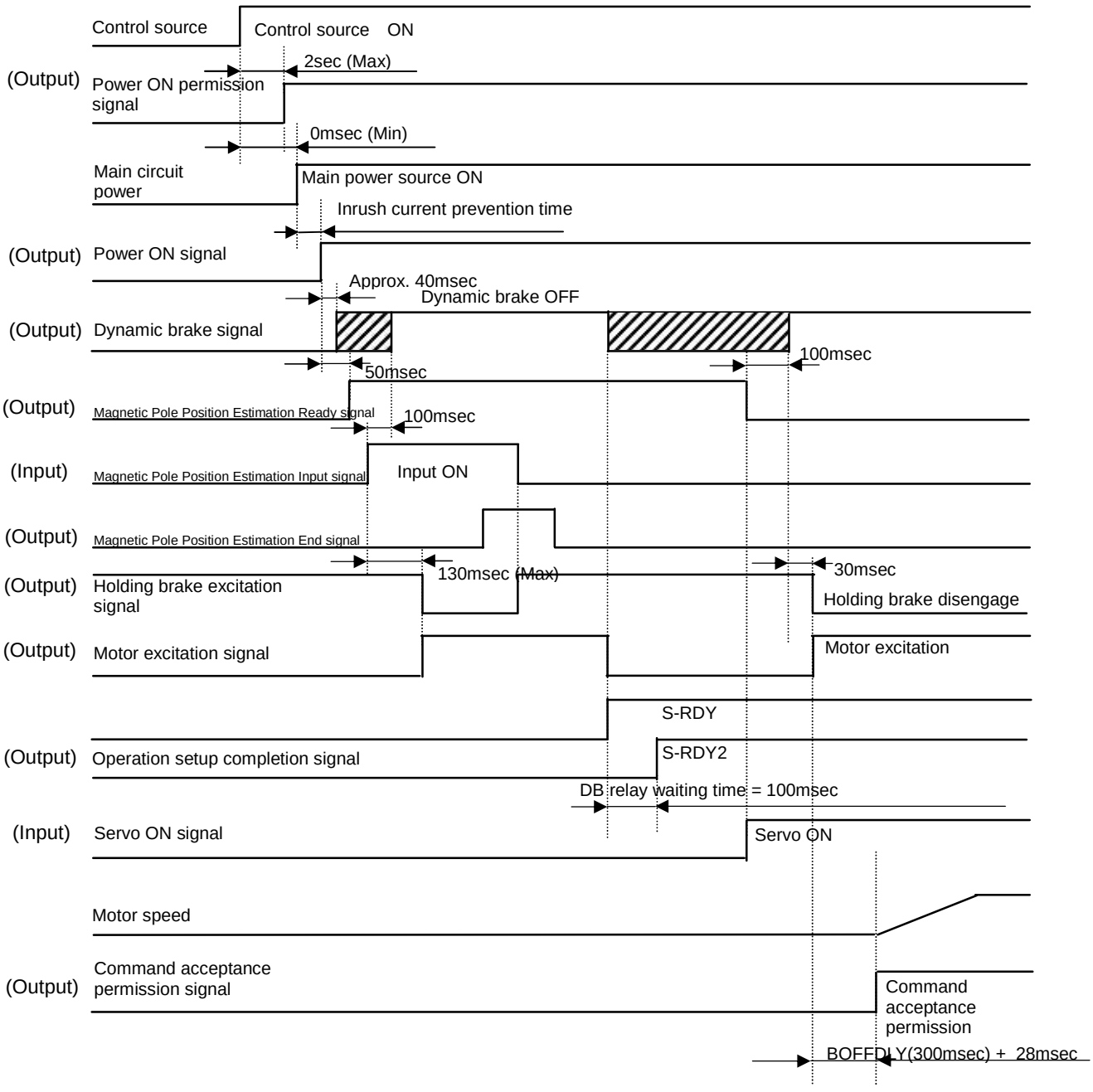


Code	Status	
0	Power ON status	(P-OFF)
2	Power OFF status	(P-ON)
4	Servo ready status	(S-RDY)
8	Servo ON status	(S-ON)
9	Magnetic Pole Position Estimation status	(CSETRDY)
A	Emergency stop status	(EMR)
F	Initial status	

5.4 Operation sequence

1) Operation sequence from power turn on to power shut off at the standard shipment setting

Power ON → Servo ON

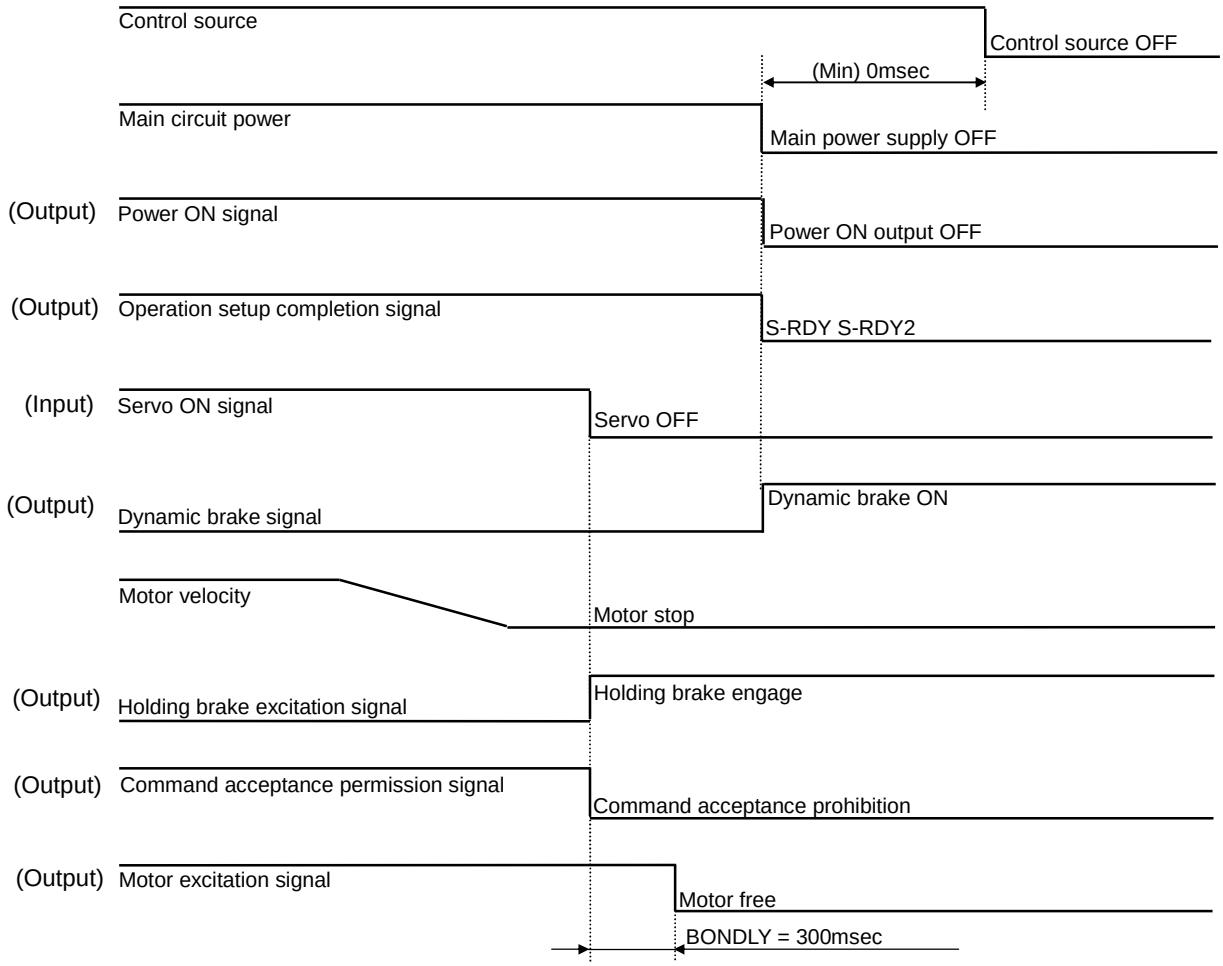


✔ The frequency of the power ON/OFF of the driver shall be 5 times/hour or less and 30 times/day or less. Please set 15 minutes or more to power ON/OFF interval.

✔ Inrush current suppression times of driver are as follows.

Inrush Current Suppression Time	900 [ms]

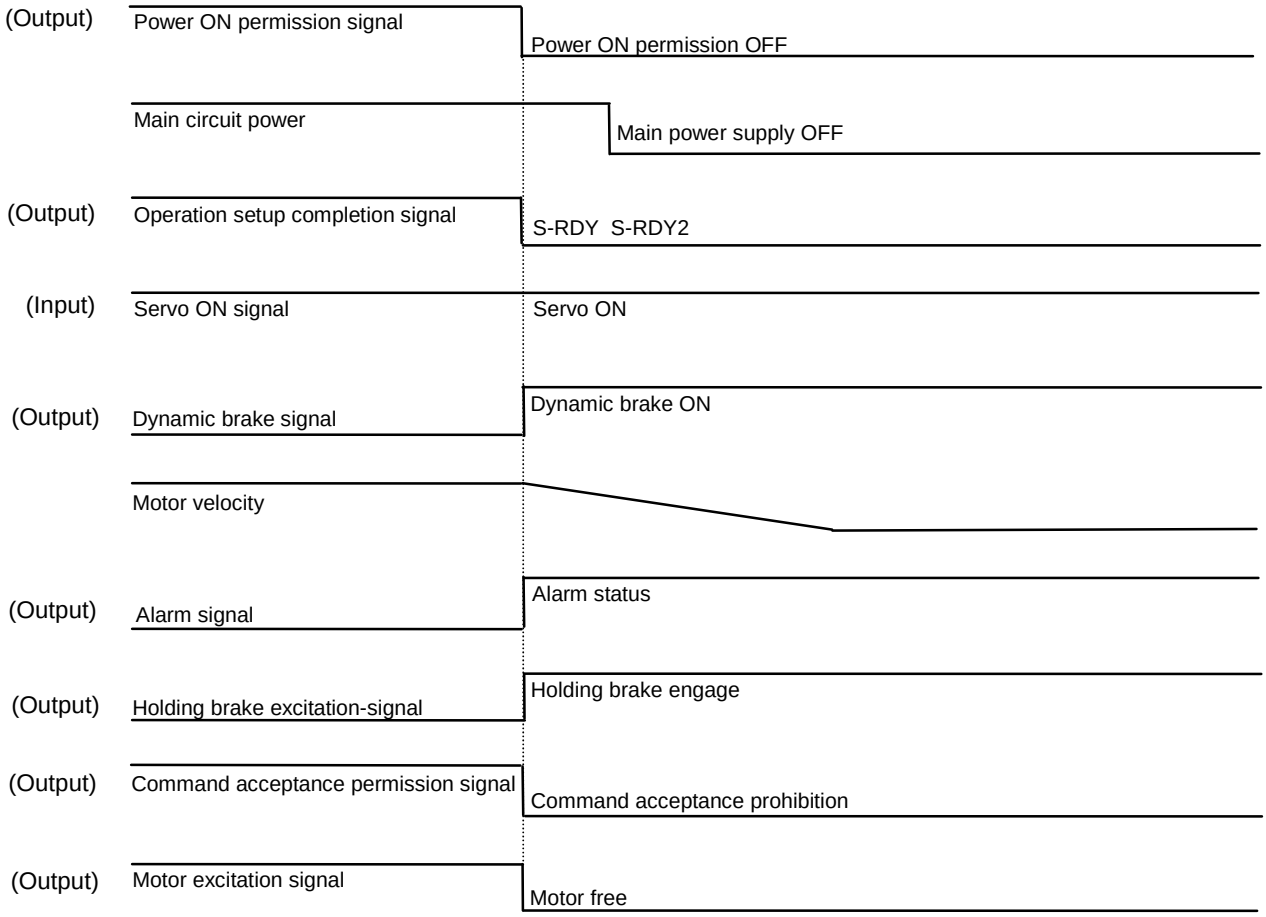
Servo OFF → Power OFF



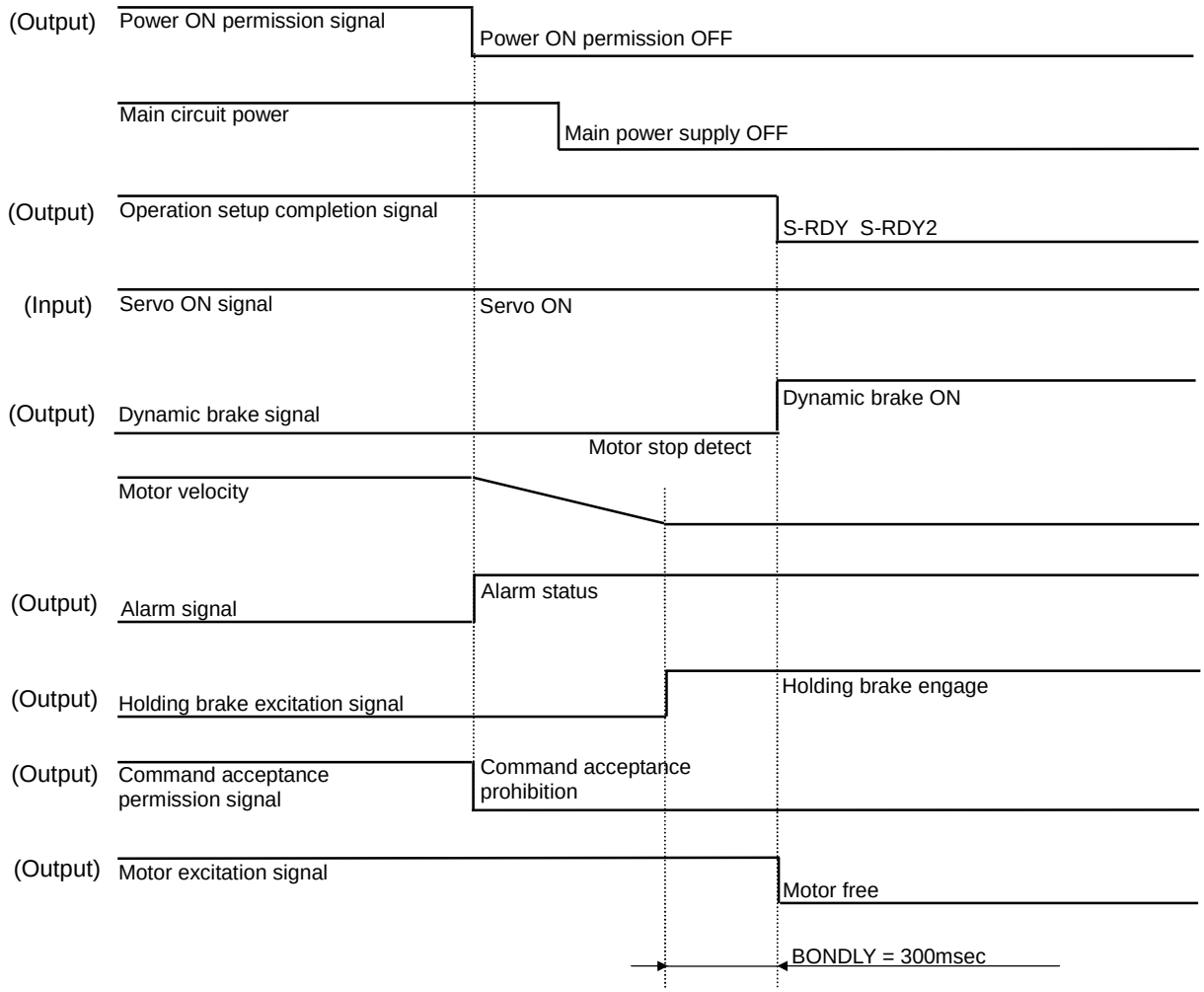
2) Stop sequence at alarm

When an alarm occurs, the motor is stopped by either dynamic brake or servo brake (zero-speed command). The alarm content dictates which brake to be used. Refer to [Warning and Alarm List (8-3)]

Stop by dynamic brake at alarm

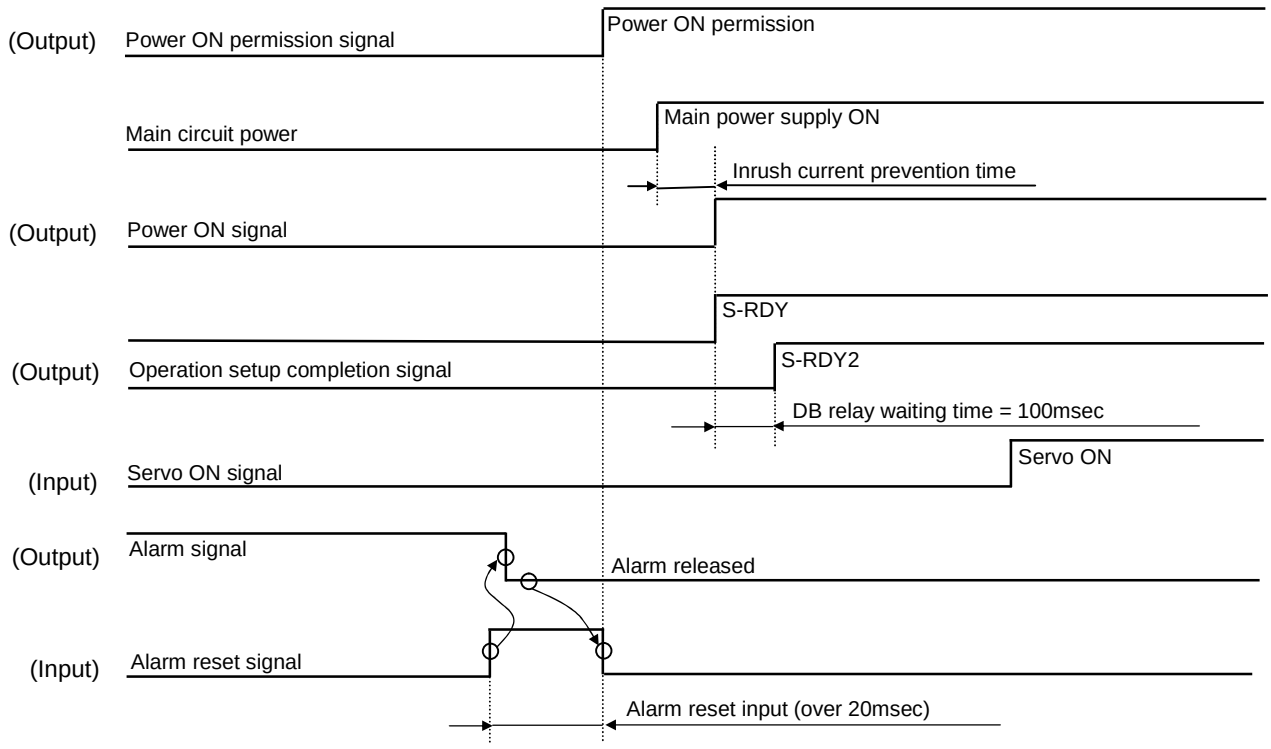


Stop by servo brake at alarm



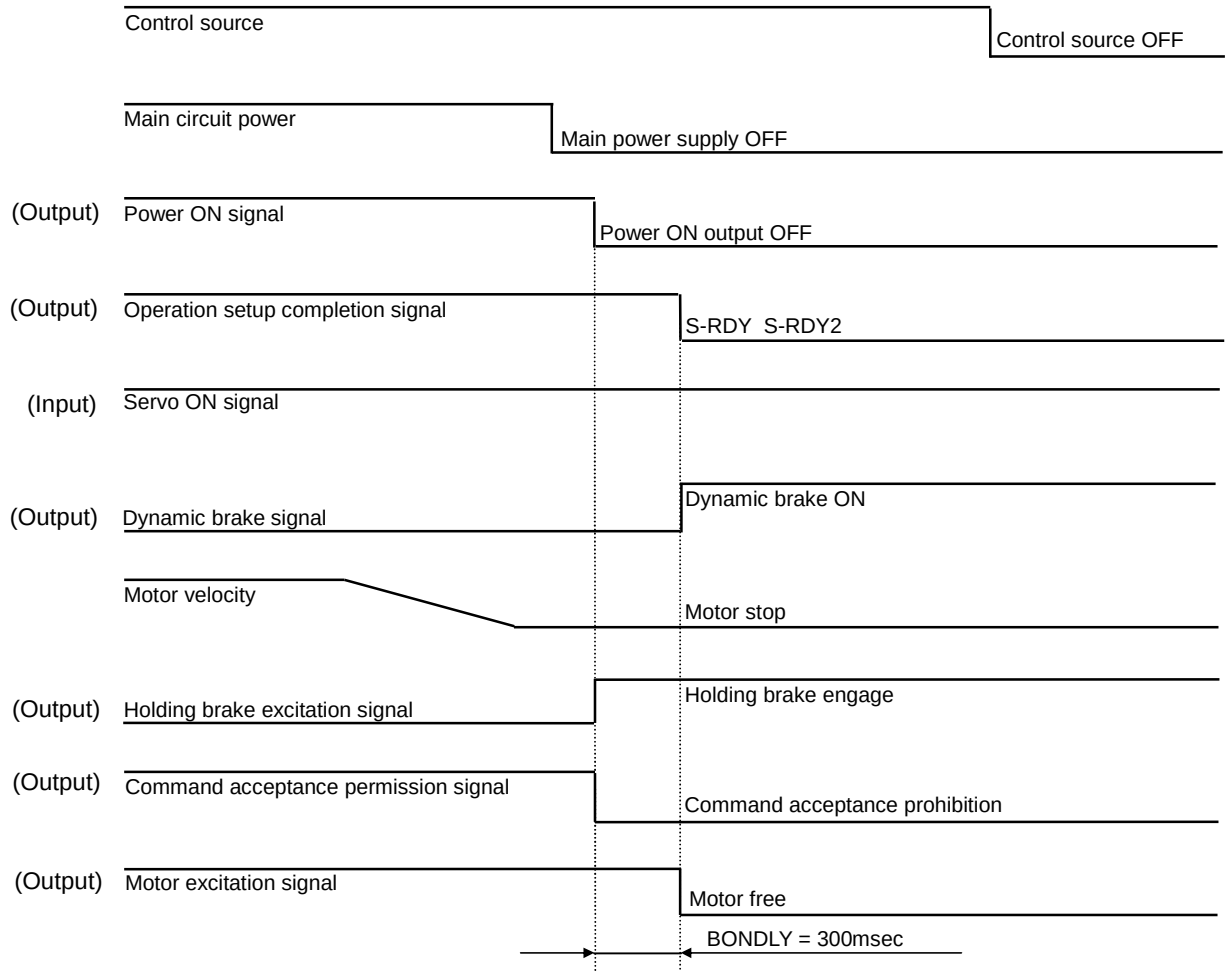
3) Sequence of alarm reset

Inputting alarm reset signal from general input signal can reset alarms.



- ✔ Some alarms cannot be reset unless the power is reset (control power is turned OFF and ON again). Refer to [Warning and Alarm List (8-3)].
- ✔ Clear the alarm reset signal after checking if the alarm signal is cleared.
- ✔ The alarm signal cannot be cleared when the alarm condition continues, therefore, set a timeout period of 20[ms] or more to clear “alarm reset signal”.
  Also, it is necessary to input the time of 20[ms] or more when the alarm reset signal is input without checking for the alarm signal output.

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



5.5 Monitor function

1) Monitor function

ID	Symbol	Name		Unit
00	STATUS	Driver status monitor		---
01	WARNING1	Warning status 1 monitor		---
02	WARNING2	Warning status 2 monitor		---
03	CONT8-1	General Purpose Input CONT8 to 1 monitor		---
04	OUT8-1	General Purpose Output OUT8 to 1 monitor		---
05	-	-		---
06	VMON	Velocity monitor		min^{-1}
07	VCMON	Velocity command monitor		min^{-1}
08	TMON	Torque monitor		%
09	TCMON	Torque command monitor		%
0A	PMON	Position deviation monitor		Pulse
0C	APMON	Present position monitor(encoder)	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
0D			Digital operator: Displays lower data	Pulse
0E	-	-	-	---
0F	-	-	-	---
10	CPMON	Command position monitor	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
11			Digital operator: Displays lower data	Pulse
12	-	-		-
13	FMON1	Position command pulse frequency monitor		k Pulse/s
14	CSU	U-phase electric angle monitor		deg
16	ABSPS	Resolver PS data monitor	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
17			Digital operator: Displays lower data	Pulse
1A	RegP	Regenerative resistor operation percentage monitor		%
1B	TRMS	Effective torque monitor		%
1C	ETRMS	Effective torque monitor (Estimated value)		%
1D	JRAT MON	Load Inertia Moment Ratio monitor		%
1E	KP MON	Position Loop Proportional Gain monitor		1/s
1F	TPI MON	Position Loop Integral Time Constant monitor		ms
20	KVP MON	Velocity Loop Proportional Gain monitor		Hz
21	TVI MON	Velocity Loop Integral Time Constant monitor		ms
22	TCFIL MON	Torque Command Filter monitor		Hz
23	MKP MON	Model Control Gain monitor		1/s
24	MTLMON -EST	Load Torque monitor (Estimate value)		%
25	OPE-TIM	Driver operation time		×2 hour
26	ACCMON	Acceleration monitor		rad/s^2
80	RESANG	Resolver sensor electric angle.		Pulse

2) Description of monitor

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>Driver status monitor [STATUS]
<table>
<tr><th>Code</th><th colspan="2">Status</th></tr>
<tr><td>0</td><td>Power OFF state</td><td>(P-OFF)</td></tr>
<tr><td>2</td><td>Power ON state</td><td>(P-ON)</td></tr>
<tr><td>4</td><td>Servo ready state</td><td>(S-RDY)</td></tr>
<tr><td>8</td><td>Servo ON state</td><td>(S-ON)</td></tr>
<tr><td>9</td><td>Magnetic Pole Position Estimation Ready state</td><td>(CSETRDY)</td></tr>
<tr><td>A</td><td>Emergency stop state</td><td>(EMR)</td></tr>
<tr><td>10</td><td>Alarm and power OFF state</td><td>(ALARM_P-OFF)</td></tr>
<tr><td>12</td><td>Alarm and power ON state</td><td>(ALARM_P-ON)</td></tr>
<tr><td>1A</td><td>Alarm and emergency stop state</td><td>(ALARM_EMR)</td></tr>
<tr><td>22</td><td>Gate off and power-on state</td><td>(GATE OFF_P-ON)</td></tr>
</table></td></tr>
<tr><td>01</td><td>Warning status 1 monitor [WARNING1]
■ Displays warning status. Displays warning status under“1”or “ON”
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>Regenerative load</td><td>Overload</td><td>---</td><td>Temperature inside driver</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>Excessive deviation</td><td>---</td><td>Velocity controlled</td><td>Torque controlled</td></tr>
</table></td></tr>
<tr><td>02</td><td>Warning status 2 monitor [WARNING2]
■ Displays warning status. Valid when“1”or“ON”.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>CCW direction Over-travel</td><td>CW direction Over-travel</td><td>---</td><td>Main circuit power being charged</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>Voltage sag</td><td>Low battery voltage</td><td>---</td><td>---</td></tr>
</table></td></tr>
<tr><td>03</td><td>General Purpose Input CONT8 to 1 monitor [CONT8-1]
■ Displays generic input terminal status. It will be in a photo coupler exciting state by 1 or ON.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>CONT4</td><td>CONT3</td><td>CONT2</td><td>CONT1</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>CONT8</td><td>CONT7</td><td>CONT6</td><td>CONT5</td></tr>
</table></td></tr>
<tr><td>04</td><td>General Purpose Output OUT8 to 1 monitor [OUT8-1]
■ Displays generic output terminal status. It will be in a photo coupler exciting state by 1 or ON.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>OUT8</td><td>OUT7</td><td>OUT6</td><td>OUT5</td></tr>
</table></td></tr>
<tr><td>05</td><td>■ Do not set.</td></tr>
</table>

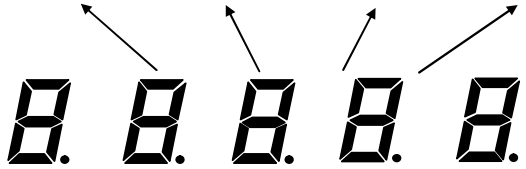
Refer to the following charts for the display format of ID01 to 05 as setup software and Digital Operator have different indicators:

■ Display of the setup software

Bit	7	6	5	4	3	2	1	0
0 or 1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

■ Display of the Digital operator

Bit	7	6	5	4	3	2	1	0
ON								
OFF								
-	LED4		LED3		LED2		LED1	



Digital operator at the front of the Driver

ID	Contents
06	Velocity monitor [VMON] ■ Displays the rotation speed of the motor. Display range: -9999 to 9999; Unit: min^{-1}
07	Velocity command monitor [VCMON] ■ Displays the velocity command value. Display range: -9999 to 9999; Unit: min-1
08	Torque monitor [TMON] ■ Displays the output torque. Display range: -499.9 to 499.9; Unit: %
09	Torque command monitor [TCMON] ■ Displays the torque command value. Display range: -499.9 to 499.9; Unit: %
0A	Position deviation monitor [PMON] ■ Displays the position deviation value. ◆ Setup software displays values in decimal notation. Display range: -2147483648 to 2147483647; Unit: Pulse ◆ Digital operator displays values in hexadecimal notation. ID: 0A; Data range: Bit31 to Bit0; Display range: H.FFFF to L.0000; Unit: Pulse

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>0C
0D</td><td>Actual position monitor) [APMON]
■ Displays the current position of the encoder(assuming that the position at the time the control power was turned ON is the original mode).
As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed.
◆ Setup software displays the data on ID0C.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays the data on ID0C, ID0D in hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>0C</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>×2^{32} Pulse</td></tr>
<tr><td>0D</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table></td></tr>
<tr><td>0E
0F</td><td>Reserved
■</td></tr>
<tr><td>10
11</td><td>Command position monitor[CPMON]
■ Displays the current position of the pulse command (assuming that the position at the time the control power was turned ON is the original mode). As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed.
◆ Setup software displays the data on ID10.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays the data on ID10, ID11 in hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>10</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>×2^{32} Pulse</td></tr>
<tr><td>11</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>12</td><td>Reserved
■</td></tr>
<tr><td>13</td><td>Position command pulse frequency monitor [FMON1]
■ Displays entered command pulse frequency.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-6000 to 6000</td><td>kPulse/s</td></tr>
</table></td></tr>
<tr><td>14</td><td>U-phase electric angle monitor [CSU]
■ Displays U-phase electric angle. Always displayed excluding encoder errors.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to 359</td><td>deg</td></tr>
</table></td></tr>
<tr><td>16
17</td><td>Serial encoder PS data monitor [ABSPS]
■ Displays position data of serial encoder.
◆ Setup software displays the data on D16.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to 1099511627775</td><td>Pulse</td></tr>
</table>
(Actual display range varies depending on the encoder specifications.)
◆ Digital operator displays the data on ID16, ID17 in hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>16</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>17</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table></td></tr>
<tr><td>1A</td><td>Regenerative resistor operation percentage monitor [RegP]
■ Displays run rate of regenerative resistance.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0.00 to 99.9</td><td>%</td></tr>
</table></td></tr>
<tr><td>1B</td><td>Effective torque monitor [TRMS]
■ Displays effective torque. Depending on the operation pattern, it may take some hours to become stable.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to 499</td><td>%</td></tr>
</table></td></tr>
<tr><td>1C</td><td>Effective torque monitor (Estimated value) [ETRMS]
■ Displays effective torque estimated value. Estimates from short time operation. This can be confirmed shortly if the same operation pattern is repeated.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to 499</td><td>%</td></tr>
</table></td></tr>
<tr><td>1D</td><td>Load inertia moment ratio monitor [JRAT MON]
■ Indicates present load inertia moment ratio.
You can check the value when using gain switching and auto-tuning function.</td></tr>
<tr><td>1E</td><td>Position loop proportional gain monitor [KP MON]
■ Indicates present position loop proportional gain.
You can check the value when using gain switching and auto-tuning function.</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>1F</td><td>Position Loop Integral Time Constant monitor [TPI MON]
■ Displays actual Position Loop Integral Time Constant value.
Value can be confirmed when changing the gain function.</td></tr>
<tr><td>20</td><td>Velocity Loop Proportional Gain monitor [KVP MON]
■ Displays actual Velocity Loop Proportional Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>21</td><td>Velocity Loop Integral Time Constant monitor [TVI MON]
■ Displays actual Velocity Loop Integral Time Constant.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>22</td><td>Torque Command Filter monitor [TCFIL MON]
■ Displays actual Torque Command Filter.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>23</td><td>Model Control Gain monitor [MKP MON]
■ Displays actual Model Control Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>24</td><td>Load Torque monitor (Estimate value) [MTLMON-EST]
■ Displays estimated value of load torque.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-499.9 to 499.9</td><td>%</td></tr></table></td></tr>
<tr><td>25</td><td>Driver operation time [OPE-TIM]
■ Is counted during period control power is being turned on. The time is displayed value x 2 hours.
<table><tr><th>Unit</th></tr><tr><td>×2 hour</td></tr></table></td></tr>
<tr><td>26</td><td>Acceleration monitor [ACCMON]
■ Indicates motor acceleration.
◆ Setup software displays values in decimal notation.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>rad/s^2</td></tr></table>◆ Digital operator displays values in hexadecimal notation.
<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>26</td><td>Bit31 to Bit0</td><td>H.FFFF L.FFFF to H.0000 L.0000</td><td>rad/s^2</td></tr></table></td></tr>
<tr><td>80</td><td>RESANG
■ Resolver sensor electric angle. [RESANG]
Reports Resolver sensor electric angle.
<table><tr><th>Data range</th><th>unit</th></tr><tr><td>0 to 65535</td><td>pulse</td></tr></table></td></tr>
</table>

5.6 Analog monitor and digital monitor

All signals and internal status of the driver can be monitored. Analog monitor output 1 is also output from “CN1-pin30”.

■ Selection of output signal

Select and change the output signal to be used from the parameters list below.

General parameters GroupA ID10	DMON: Digital Monitor Output Signal Selection
General parameters GroupA ID11	MON1: Analog Monitor Select Output 1
General parameters GroupA ID12	MON2: Analog Monitor Select Output 2

5.7 Setting parameters

1) Parameters list

Below is the parameters list. Groups in ID order are classified." System parameters", "General parameters" and "Motor parameters" are retained in the driver by keeping the parameter back-up function in effect for restoration of the parameter(s) as needed.

■ General parameters group list

Group	Classification of the parameters in this group
Group0	Auto-tuning settings
Group1	Basic control parameter settings
Group2	FF (feed forward) vibration suppressor control/ Notch filter/ Disturbance observer settings
Group3	Model following control settings
Group4	Gain switching control/ Vibration suppressor frequency switching settings
Group5	High setting control settings
Group8	Control system settings
Group9	Function enabling condition settings
GroupA	General output terminal output condition/ Monitor output selection/ Serial communication settings
GroupB	Sequence/alarm related settings
GroupC	Encoder related settings

✔ Parameters vary depending on the driver to be used.

■ General parameters Group0 "Auto-tuning settings"

ID	Symbol	Name	Standard value	Unit	Setting range
00	TUNMODE	Tuning Mode	00:AutoTun	-	00 to 02
01	ATCHA	Auto-Tuning Characteristic	00:Positioning1	-	00 to 06
02	ATRES	Auto-Tuning Response	5	-	1 to 30
03	ATSAVE	Auto-Tuning Automatic Parameter Saving	00:Auto_Saving	-	00 to 01
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	50.0	%	10.0 to 100.0
20	ASUPTC	Auto-FF Vibration Suppressor Frequency Tuning Torque Command	25.0	%	10.0 to 100.0
21	ASUPFC	Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value	5.0	%	0.0 to 50.0

■ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	PCSMT	Position Command Smoothing Constant	0.0	ms	0.0 to 500.0
01	PCFIL	Position Command Filter	0.0	ms	0.0 to 2000.0
02	KP1	Position Loop Proportional Gain 1	30	1/s	1 to 3000
03	TPI1	Position Loop Integral Time Constant 1	1000.0	ms	0.3 to 1000.0
04	TRCPGN	Higher Tracking Control Position Compensation Gain	0	%	0 to 100
05	FFGN	Feed Forward Gain	0	%	0 to 100
06	FFFIL	Feed Forward Filter	4000	Hz	1 to 4000
10	VCFIL	Velocity Command Filter	4000	Hz	1 to 4000
11	VDFIL	Velocity Feedback Filter	1500	Hz	1 to 4000
12	KVP1	Velocity Loop Proportional Gain 1	50	Hz	1 to 2000
13	TVI1	Velocity Loop Integral Time Constant 1	20.0	ms	0.3 to 1000.0
14	JRAT1	Load Inertia Moment Ratio 1	100	%	0 to 15000
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain	0	%	0 to 100
16	AFBK	Acceleration Feedback Gain	0.0	%	-100.0 to 100.0
17	AFBFIL	Acceleration Feedback Filter	500	Hz	1 to 4000
20	TCFIL1	Torque Command Filter 1	600	Hz	1 to 4000
21	TCFILOR	Torque Command Filter Order	2	Order	1 to 3

■ General parameters Group2 “FF (Feed forward) vibration suppressor control/ Notch filter/ Disturbance observer settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppressor Frequency 1	500	Hz	5 to 500
01	SUPLV	FF Vibration Suppressor Level Selection	00	-	00 to 03
10	VCNFIL	Velocity Command Notch Filter	1000	Hz	50 to 1000
20	TCNFILA	Torque Command Notch Filter A	4000	Hz	100 to 4000
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement	00	-	00 to 02
22	TCNFILB	Torque Command Notch Filter B	4000	Hz	100 to 4000
23	TCNFDB	TCNFILB, Depth Selection	00	-	00 to 03
24	TCNFILC	Torque Command Notch Filter C	4000	Hz	100 to 4000
25	TCNFDC	TCNFILC, Depth Selection	00	-	00 to 03
26	TCNFILD	Torque Command Notch Filter D	4000	Hz	100 to 4000
27	TCNFDD	TCNFILD, Depth Selection	00	-	00 to 03
30	OBCHA	Observer Characteristic	00:Low	-	00 to 02
31	OBG	Observer Compensation Gain	0	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	50	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	4000	Hz	100 to 4000

■ General parameters Group3 “ Model following control settings"

ID	Symbol	Name	Standard value	Unit	Setting range
00	KM1	Model Control Gain 1	30	1/s	1 to 3000
01	OSSFIL	Overshoot Suppressor Filter	1500	Hz	1 to 4000
02	ANRFRQ1	Model Control Antiresonance Frequency 1	80.0	Hz	10.0 to 80.0
03	RESFRQ1	Model Control Resonance Frequency 1	80.0	Hz	10.0 to 80.0

■ General parameters Group4 “Gain switching control/ Vibration suppressor frequency switching settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	KM2	Model Control Gain 2	30	1/s	1 to 3000
01	KP2	Position Loop Proportional Gain 2	30	1/s	1 to 3000
02	TPI2	Position Loop Integral Time Constant 2	1000.0	ms	0.3 to 1000.0
03	KVP2	Velocity Loop Proportional Gain 2	50	Hz	1 to 2000
04	TVI2	Velocity Loop Integral Time Constant 2	20.0	ms	0.3 to 1000.0
05	JRAT2	Load Inertia Moment Ratio 2	100	%	0 to 15000
06	TCFIL2	Torque Command Filter 2	600	Hz	1 to 4000
10	KM3	Model Control Gain 3	30	1/s	1 to 3000
11	KP3	Position Loop Proportional Gain 3	30	1/s	1 to 3000
12	TPI3	Position Loop Integral Time Constant 3	1000.0	ms	0.3 to 1000.0
13	KVP3	Velocity Loop Proportional Gain 3	50	Hz	1 to 2000
14	TVI3	Velocity Loop Integral Time Constant 3	20.0	ms	0.3 to 1000.0
15	JRAT3	Load Inertia Moment Ratio 3	100	%	0 to 15000
16	TCFIL3	Torque Command Filter 3	600	Hz	1 to 4000
20	KM4	Model Control Gain 4	30	1/s	1 to 3000
21	KP4	Position Loop Proportional Gain 4	30	1/s	1 to 3000
22	TPI4	Position Loop Integral Time Constant 4	1000.0	ms	0.3 to 1000.0
23	KVP4	Velocity Loop Proportional Gain 4	50	Hz	1 to 2000
24	TVI4	Velocity Loop Integral Time Constant 4	20.0	ms	0.3 to 1000.0
25	JRAT4	Load Inertia Moment Ratio 4	100	%	0 to 15000
26	TCFIL4	Torque Command Filter 4	600	Hz	1 to 4000
30	GCFIL	Gain Switching Filter	0	ms	0 to 100
40	SUPFRQ2	FF Vibration Suppressor Frequency 2	500	Hz	5 to 500
41	SUPFRQ3	FF Vibration Suppressor Frequency 3	500	Hz	5 to 500
42	SUPFRQ4	FF Vibration Suppressor Frequency 4	500	Hz	5 to 500
50	ANRFRQ2	Model Control Anti-resonance Frequency 2	80.0	Hz	10.0 to 80.0
51	RESFRQ2	Model Control Resonance Frequency 2	80.0	Hz	10.0 to 80.0
52	ANRFRQ3	Model Control Anti-resonance Frequency 3	80.0	Hz	10.0 to 80.0
53	RESFRQ3	Model Control Resonance Frequency 3	80.0	Hz	10.0 to 80.0
54	ANRFRQ4	Model Control Anti-resonance Frequency 4	80.0	Hz	10.0 to 80.0
55	RESFRQ4	Model Control Resonance Frequency 4	80.0	Hz	10.0 to 80.0

■ General parameters Group5 “High settling control settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	CVFIL	Command Velocity Low-pass Filter	1000	Hz	1 to 4000
01	CVTH	Command Velocity Threshold	20	min^{-1}	0 to 6553.5
02	ACCC0	Acceleration Compensation	0	×50 Pulse	-9999 to +9999
03	DECC0	Deceleration Compensation	0	×50 Pulse	-9999 to +9999

■ General parameters Group8 “Control system settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	CMDPOL	Position, Velocity, Torque Command Input Polarity	00:PC+_ VC+_TC+	-	00 to 07
10	PMOD	Position Command Pulse Selection	00:F-PC_ R-PC	-	00 to 02
11	PCPPOL	Position Command Pulse Count Polarity	00:Type1	-	00 to 03
12	PCPFIL	Position Command Pulse Digital Filter	00:834nsec	-	00 to 07
13	B-GER1	Electronic Gear 1 Numerator	1	-	1 to 2097152
14	A-GER1	Electronic Gear 1 Denominator	1	-	1 to 2097152
15	B-GER2	Electronic Gear 2 Numerator	1	-	1 to 2097152
16	A-GER2	Electronic Gear 2 Denominator	1	-	1 to 2097152
17	EDGEPOS	Positioning Methods	00:Pulse _Interval	-	00 to 01
18	PDEVMON	In-Position Signal/ Position Deviation Monitor	00:After _Filter	-	00 to 01
19	CLRSEL	Deviation Clear Selection	00:Type1	-	00 to 03
2B	TVCACC	Velocity Command Acceleration Time Constant	0	ms	0 to 16000
2C	TVCDEC	Velocity Command Deceleration Time Constant	0	ms	0 to 16000
2D	VCLM	Velocity Limit Command	65535	min^{-1}	1 to 6553.5
37	TCLM-F	Forward Direction Internal Torque Limit Value	100.0	%	10.0 to 500.0
38	TCLM-R	Reverse Direction Internal Torque Limit Value	100.0	%	10.0 to 500.0
39	SQTCLM	Sequence Operation Torque Limit Value	120.0	%	10.0 to 500.0
3B	TASEL	Torque Attainment select	00	-	00 to 01
3C	TA	Torque attainment	100.0	%	0.0 to 500.0
3D	TLMREST	The amount of torque limit value restoration when power restored.	10.0	%	0.0 to 500.0
3E	BDLY_TCMP	Torque Addition Command during Holding Brake Release Action Delay Time	0.0	%	-100.0 to 100.0
40	NEAR	Near Range	500	Pulse	1 to 2147483647
41	INP	In-Position Window	100	Pulse	1 to 2147483647
42	ZV	Speed Zero Range	50	min^{-1}	50 to 500
43	LOWV	Low Speed Range	50	min^{-1}	0 to 6553.5
44	VA	Speed Attainment Setting (High Speed Range)	1000	min^{-1}	0 to 6553.5
45	VCMPUS	Speed Matching Unit Selection	00_min^{-1}	-	00 to 01
46	VCMP	Speed Matching Range	50	min^{-1}	0 to 6553.5
47	VCMPR	Speed Matching Range Ratio	5.0	%	0.0 to 100.0

■ General parameters Group9 “Function enabling condition settings”

ID	Symbol	Name	Standard value	Setting range
00	F-OT	CWOver Travel Function	0D:CONT6_OFF	00 to 27
01	R-OT	CCWOver Travel Function	0B:CONT5_OFF	00 to 27
02	AL-RST	Alarm Reset Function	10:CONT8_ON	00 to 27
04	CLR	Deviation Clear Function	08:CONT4_ON	00 to 27
05	S-ON	Servo-ON Function	02:CONT1_ON	00 to 27
11	INH/Z-STP	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function	0E:CONT7_ON	00 to 27
12	GERS	Electronic Gear Switching Function	00:Always_Disable	00 to 27
13	GC1	Gain Switching Condition 1	00:Always_Disable	00 to 27
14	GC2	Gain Switching Condition 2	00:Always_Disable	00 to 27
15	SUPFSEL1	FF Vibration Suppressor Frequency Select Input 1	00:Always_Disable	00 to 27
16	SUPFSEL2	FF Vibration Suppressor Frequency Select Input 2	00:Always_Disable	00 to 27
17	PLPCON	Position Loop Proportional Control Switching Function	01:Always_Enable	00 to 27
18	MDLFSEL1	Model Vibration Suppressor Frequency Select Input 1	00:Always_Disable	00 to 27
19	MDLFSEL2	Model Vibration Suppressor Frequency Select Input 2	00:Always_Disable	00 to 27
1A	CSET	Magnetic Pole Position Estimation Function	06:CONT3_ON	00 to 27
20	SP1	Preset Velocity Command Select Input 1	00:Always_Disable	00 to 27
21	SP2	Preset Velocity Command Select Input 2	00:Always_Disable	00 to 27
22	SP3	Preset Velocity Command Select Input 3	00:Always_Disable	00 to 27
23	DIR	Preset Velocity Command Input Direction of Movement	00:Always_Disable	00 to 27
24	RUN	Preset Velocity Command Operation Start Signal Input	00:Always_Disable	00 to 27
25	RUN-F	Preset Velocity Command **CW**(direction) Move Start Signal Input	00:Always_Disable	00 to 27
26	RUN-R	Preset Velocity Command **CCW**(direction) Move Start Signal Input	00:Always_Disable	00 to 27
27	VLPCON	Velocity Loop Proportional Control Switching Function	00:Always_Disable	00 to 27
28	V-COMPS	Velocity Compensation Function	00:Always_Disable	00 to 27
30	T-COMPS1	Torque Compensation Function 1	00:Always_Disable	00 to 27
31	T-COMPS2	Torque Compensation Function 2	00:Always_Disable	00 to 27
32	TL	Torque Limit Function	00:Always_Disable	00 to 27
33	OBS	Disturbance Observer Function	00:Always_Disable	00 to 27
35	FBHYST	Minor vibration (oscillation) suppression function	00:Always_Disable	00 to 27
40	EXT-E	External Trip Input Function	00:Always_Disable	00 to 27
41	DISCHARG	Main Power Discharge Function	01:Always_Enable	00 to 27
42	EMR	Emergency Stop Function	00:CONT2_OFF	00 to 27

■ General parameters GroupA “General output terminal output condition/ Monitor output selection/ Serial communication settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	OUT1	General Purpose Output 1	18:INP_ON	-	00 to 5F
01	OUT2	General Purpose Output 2	68:CSETRDY_ON	-	00 to 5F
02	OUT3	General Purpose Output 3	02:S-RDY_ON	-	00 to 5F
03	OUT4	General Purpose Output 4	4E:CSETCMP_ON	-	00 to 5F
04	OUT5	General Purpose Output 5	33:ALM5_OFF	-	00 to 5F
05	OUT6	General Purpose Output 6	35:ALM6_OFF	-	00 to 5F
06	OUT7	General Purpose Output 7	37:ALM7_OFF	-	00 to 5F
07	OUT8	General Purpose Output 8	39:ALM_OFF	-	00 to 5F
10	DMON	Digital Monitor Output Signal Selection	00:Always_OFF	-	00 to 5F
11	MON1	Analog Monitor Select Output 1	05:VMON_20mV/min^{-1}	-	00 to1C
12	MON2	Analog Monitor Select Output 2	02:TCMON_2V/TR	-	00 to1C
13	MONPOL	Analog Monitor Output Polarity	00:MON1+_MON2+	-	00 to 08
20	COMAXIS	Serial Communication Axis Number	01:#1	-	01 to 0F
21	COMBAUD	Serial Communication Baud Rate	05:38400bps	-	03 to 06
22	RSPWAIT	Latency to start sending response message	0	ms	0 to 500
30	MONDISP	Monitor Display Selection	00:STATUS	-	00 to 26

■ General parameters GroupB “Sequence/Alarms related settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	JOGVC	JOG Velocity Command	50	min^{-1}	0 to 32767
01	EMPFREQ	Excitation Command Frequency setting	50	Hz	30～70
02	ACC	Acceleration threshold	5	rad/s^2	2～100
10	DBOPE	Dynamic Brake Operation	03:DB_DB	-	00 to 05
11	ACTOT	Over-Travel Action	00:CMDINH_SB_SON	-	00 to 06
12	ACTEMR	Emergency Stop Operation	00:DYNAMIC-BRAKE	-	00 to 01
13	BONDLY	Delay Time of Engaging Holding Brake (Holding Brake Holding Delay Time)	300	ms	0 to 1000
14	BOFFDLY	Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)	300	ms	0 to 1000
15	BONBGN	Brake Operation Beginning Time	10000	ms	0 to 65535
16	PFDDLY	Power Failure Detection Delay Time	32	ms	20 to 1000
17	INTTIM	Waiting Time for Completion of Initial Processing	00:Disabled	—	Verification required
19	POFFDLY	Power-off Detection Delay Time	0	ms	0～1000
20	OFWLV	Excessive Deviation Warning Level	2147483647	pulse	1 to 2147483647
21	OFLV	Deviation Counter Overflow Value	5000000	pulse	1 to 2147483647
22	OLWLV	Overload Warning Level	90	%	20 to 100
23	VFBALM	Velocity Feedback Alarm (ALM_C3) Detection	01:Enabled	-	00 to 01
24	VCALM	Velocity Control Alarm (ALM_C2) Detection	00:Disabled	-	00 to 01

■ General parameters GroupC “Encoder related settings”

ID	Symbol	Name	Default value	Unit	Setting range
04	ENRAT	Encoder Output Pulse Division	1/20	-	1/32768 to 1/1
05	PULOUTPOL	Encoder Output Pulse Divide Polarity	01:Type2	-	00 to 03
06	PULOUTRES	Encoder Output Pulse Divide Resolution Selection	00:163840P/R	-	00 to 01
07	PSOFORM	Encoder Signal Output (PS) Format	00:MOT_Binary	-	00 to 01
0A	CSETMD	Magnetic Pole Position Estimation mode	00:Normal	-	00 to 01

■ General parameters

ID	Symbol	Name	Remarks
00	COMAXIS	Serial Communication Axis Number	This is common with GroupA ID20
01	COMBAUD	Serial Communication Baud Rate	This is common with GroupA ID21
02	TUNMODE	Tuning Mode	This is common with Group0 ID00
03	ATRES	Auto-Tuning Response	This is common with Group0 ID02
04	PCSMT	Position Command Smoothing Constant	This is common with Group1 ID00
05	PCFIL	Position Command Filter	This is common with Group1 ID01
06	B-GER1	Electronic Gear 1 Numerator	This is common with Group8 ID13
07	A-GER1	Electronic Gear 1 Denominator	This is common with Group8 ID14
08	INP	In-Position Window	This is common with Group8 ID41
09	F-OT	CW Over Travel Function	This is common with Group9 ID00
0A	R-OT	CCW Over Travel Function	This is common with Group9 ID01
0B	AL-RST	Alarm Reset Function	This is common with Group9 ID02
0D	CLR	Deviation Clear Function	This is common with Group9 ID04
0E	S-ON	Servo-ON Function	This is common with Group9 ID05
0F	TL	Torque Limit Function	This is common with Group9 ID32
10	JOGVC	JOG Velocity Command	This is common with GroupB ID00
11	ENRAT	Encoder output frequency pulse dividing	This is common with GroupC ID04

✔ “General parameters” is operated from the Digital Operator.

5.8 Parameter functions

Each parameter function is explained below.

■ Group0 “Auto-tuning settings”

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="3">00</td><td rowspan="2">Tuning Mode
[TUNMODE]</td><td>Setting range</td><td>Unit</td><td>Selection</td></tr>
<tr><td>00 to 02</td><td>-</td><td>00:AutoTun</td></tr>
<tr><td colspan="4">■ Set the validity, invalidity of Auto-tuning, and Load inertia moment rate estimation.

<table>
<tr><td colspan="2">Selection</td><td>Contents</td></tr>
<tr><td>00</td><td>AutoTun</td><td>Automatic Tuning</td></tr>
<tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning (JRAT Manual Setting)</td></tr>
<tr><td>02</td><td>ManualTun</td><td>Manual Tuning</td></tr>
</table>
◆ Under the following operating conditions, Load inertia rate is not estimated properly: operation at low velocity, at low acceleration and at low acceleration/deceleration torque.
In these cases, please set “Automatic Tuning (JRAT Manual Setting)” and set proper value at JRAT 1.

◆ In addition, under the following machine operating conditions, Load inertia rate is not estimated properly: machine with large disturbance torque, with big backlash and with a machine in which movable parts vibrate. In these cases, set at “Automatic Tuning (JRAT Manual Setting)” and set proper value at JRAT1.

✔ When “model following vibration suppression control” is set to “ID0A Position Control Selection“ of system parameter, set “02 manual tuning.”</td></tr>
</table>

ID	Contents			
01	Auto-Tuning Characteristic [ATCHA]	Setting range	Unit	Standard value
		00 to 06	-	00:Positioning1

■ Sets the Auto-Tuning Characteristic best fits to the system.

Selection		Contents
00	Positioning1	Positioning Control 1 (General Purpose)
01	Positioning2	Positioning Control 2 (High Response)
02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)
03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)
05	Trajectory1	Trajectory Control 1
06	Trajectory2	Trajectory Control 2 (KP,FFGN Manual Setting)

◆ “Positioning Control 1”
- Used for general purpose positioning.
- Used for Velocity control mode or Torque control mode.
- Can be used for always affected by gravity and external forces.

◆ “Positioning Control 2”
- Used for Position control mode.
- If used for response positioning for shortened positioning time.
- Can be used for always affected by gravity and external forces.

◆ “Positioning Control 3”
- On the basis of “Positioning Control 2” to FFGN adjustment.

◆ “Positioning Control 4”
- Select this mode when the machine movement is in horizontal axis and receives no impacts from external force.
- Positioning time may be shortened compared to “Positioning Control 2.”
- Use this mode in “Position control mode.”
- Machines may receive any impacts.

◆ “Positioning Control 5”.
- On the basis of “Positioning Control 4” to FFGN adjustment.
- Do not used for always affected by gravity and external forces.
- The machine may receive impulse.

◆ “Trajectory Control 1”
- Used when following position command pulse and cutting behavior.
- Used for Position control mode.
- Can be used for always affected by gravity and external forces.
- Select this mode for single axis use. The response of each axis can be different.
- Used when cooperating with other axes, which used for “Trajectory Control 2”.
- The positioning characteristics will change when the “Position Loop Gain” is altered with fluctuation of the estimated inertia moment. Please adopt “Trajectory Control 2” or use manual tuning if you want to avoid this change.

◆ “Trajectory Control 2”
- This setting is used to tune the response of each axis positioning loop in cooperation with the other axes.
- Used for Position control mode.
- Can be used for always affected by gravity and external forces.

✔ When you use this mode for trajectory control, do not set “ID0A Position Control Selection” at Model following vibration suppressor control. In Model following vibration suppressor control, trajectory will be out of alignment.

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">02</td><td rowspan="2">Auto-Tuning Response
[ATRES]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 30</td><td>-</td><td>5</td></tr>
<tr><td colspan="4">■ Sets the Auto-Tuning Response.
◆ The larger the set value, the higher the response.
◆ Caution, if the response is set too high, the machine may oscillate.
◆ Make the setting suitable for rigidity of the device.</td></tr>
<tr><td rowspan="3">03</td><td rowspan="2">Auto-Tuning Automatic Parameter Saving
[ATSAVE]</td><td>Setting range</td><td>unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Auto_Saving</td></tr>
<tr><td colspan="4">■ Select if the automatic parameter saving function is valid to save the Load inertia moment ratio estimated by the Driver Auto-tuning function in the Group1 ID14 (JRAT1) Load Inertia Moment Ratio 1.
◆ This setting is valid when Group0 ID00 Tuning Mode is at 00 AutoTun Auto-tuning
◆ The first automatic save is done after one (1) hour from the power input. Then automatic save is done in every two (2) hours.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Auto_Saving</td><td>Automatically Saves in JRAT1</td></tr>
<tr><td>01</td><td>No_Saving</td><td>Automatic Saving is Invalid</td></tr>
</table></td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Auto-Notch Filter Tuning Torque Command
[ANFILTC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 100.0</td><td>%</td><td>50.0</td></tr>
<tr><td colspan="4">■ Sets the torque value to excite the mechanical system during operation under “Auto-Notch Filter Tuning.”
✔ Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.</td></tr>
<tr><td rowspan="3">20</td><td rowspan="2">Auto-FF Vibration Suppressor Frequency Tuning Torque Command [ASUPTC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 100.0</td><td>%</td><td>25.0</td></tr>
<tr><td colspan="4">■ Sets the torque value to excite the mechanical system during run time “Auto-FF Vibration Suppressor Frequency Tuning.”
✔ Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.</td></tr>
<tr><td rowspan="3">21</td><td rowspan="2">Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value [ASUPFC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 50.0</td><td>%</td><td>5.0</td></tr>
<tr><td colspan="4">■ Sets the friction torque compensation added to the motor torque to excite the mechanical system at the time of Auto-FF Vibration Suppressor Frequency Tuning.
◆ Set this value close to actual friction torque, and vibration suppressor frequency tuning will be more accurate.
✔ When the set value is low, there may be cases that the vibration frequency of the mechanical system cannot be detected, or the wrong value is detected. Raise the value until the detected value settles.</td></tr>
</table>

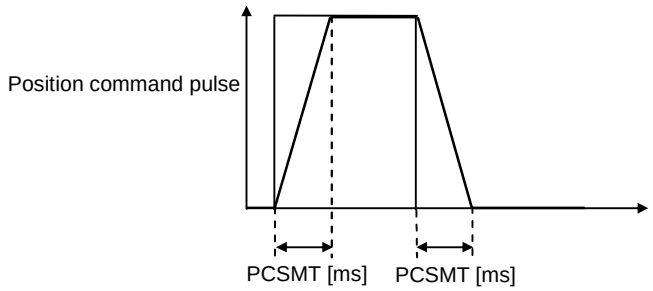
■ Group1 “Basic control parameter settings”

ID	Contents			
00	Position Command Smoothing Constant [PCSMT]	Setting range	Unit	Standard value
		0.0 to 500.0	ms	0.0

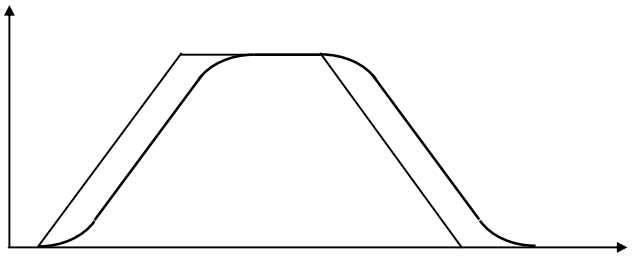
■ This moving low-pass filter smoothes the position command pulse.
Sets time constants.

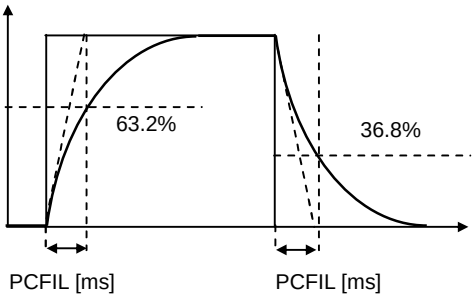
- ◆ Applies gradient to the step condition positioning pulse.
- ◆ Applies S curve to the lamp condition position command pulse.
- ◆ Smoothes the position command pulse when the electronic gear ratio is greater or the position command pulse is coarse. (This may decrease the operating noise from motor.)
- ◆ When the set value is “0.0[ms] to 0.2[ms]”, this filter is invalid.
- ◆ Set in increments of 0.5[ms]. (Under the set value “0.4[ms] and less”, there may be cases where the set value cannot be applied to the operation.)

- ● Position command pulse with step condition applied



- ● Position command pulse with lamp condition applied.



<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">01</td><td>Position Command Filter
[PCFIL]</td><td>Setting range
0.0 to 2000.0</td><td>Unit
ms</td><td>Standard value
0.0</td></tr>
<tr><td colspan="4">■ This low-pass filter suppresses any sudden change of the position control pulse.
Sets time constants.
◆ This parameter setting is valid when the value of Group1ID04 Higher Tracking Control Position Compensation Gain is set at 0[%].
◆ When Higher Tracking Control Position Compensation Gain is 0%, value is set at 0.0ms, the filter becomes invalid.
◆ This filter can suppress overshoot caused by the rise of the feed forward compensation gain.
 
</td></tr>
<tr><td rowspan="2">02</td><td>Position Loop Proportional Gain 1
[KP1]</td><td>Setting range
1 to 3000</td><td>Unit
1/s</td><td>Standard value
30</td></tr>
<tr><td colspan="4">■ Proportional gain for position controller.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Gain switching function is invalid, this setting value is applied.</td></tr>
<tr><td rowspan="2">03</td><td>Position Loop Integral Time Constant 1
[TPI1]</td><td>Setting range
0.3 to 1000.0</td><td>Unit
ms</td><td>Standard value
1000.0</td></tr>
<tr><td colspan="4">■ Integral time constant for position controller.
This setting is valid when the Position Loop Proportional Control Switching Function is invalid.
◆ Integral time is invalid (proportional control) at the setting value 1000.0ms.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Gain switching function is invalid, this setting value is applied.</td></tr>
<tr><td rowspan="2">04</td><td>Higher Tracking Control Position Compensation Gain
[TRCPGN]</td><td>Setting range
0 to 100</td><td>Unit
%</td><td>Standard value
0</td></tr>
<tr><td colspan="4">■ Adjusts the performance of command tracking of the position control system.
The larger value can raise command tracking performance.
◆ When a value other than 0[%] is set, Position Command Filter and Feed Forward Gain are automatically set in the driver.
◆ When Auto-tuning function is valid, this setting value not applied.</td></tr>
</table>

<table>
<tr><td>ID</td><td colspan="5">Contents</td></tr>
<tr><td rowspan="2">05</td><td>Feed Forward Gain
[FFGN]</td><td>Setting range
0 to 100</td><td>Unit
%</td><td>Standard value
0</td></tr>
<tr><td colspan="4">■ Sets feed forward compensation gain to position control system.
Model control system compensates for feed forward to Model following system when Position Control Selection is at Model following control.

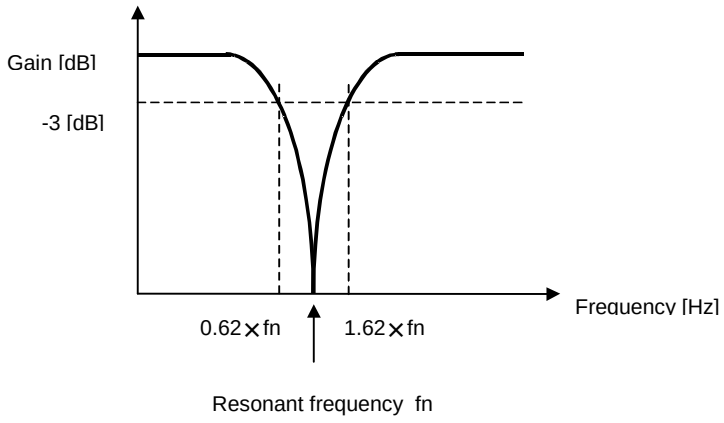
◆ Valid when Higher Tracking Control Position Compensation Gain is set at 0%.
◆ The setting value is not applied when using the Auto-Tuning Characteristics listed below.
<table><tr><td>Positioning1</td><td>Positioning Control 1 (General Purpose)</td></tr><tr><td>Positioning2</td><td>Positioning Control 2 (High Response)</td></tr><tr><td>Positioning4</td><td>Positioning Control 4 (High Response, Horizontal Axis Limited)</td></tr><tr><td>Trajectory1</td><td>Trajectory Control 1</td></tr></table></td></tr>
<tr><td rowspan="2">06</td><td>Feed Forward Filter
[FFFIL]</td><td>Setting range
1 to 4000</td><td>Unit
Hz</td><td>Standard value
4000</td></tr>
<tr><td colspan="4">■ First low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency.
◆ Depending on the setting of the system parameter ID0A Position Control Selection, the point the filter becomes invalid causes the value to vary.
<table><tr><td colspan="2">Position Control Selection</td><td></td></tr><tr><td>00</td><td>Standard</td><td>More than 2000Hz</td></tr><tr><td>01</td><td>Model 1 Model Following Control</td><td>More than 1000Hz</td></tr><tr><td>02</td><td>Model 2 Model Flowing Vibration Suppress Control</td><td>More than 1000Hz</td></tr></table></td></tr>
<tr><td rowspan="2">10</td><td>Velocity Command Filter
[VCFIL]</td><td>Setting range
1 to 4000</td><td>Unit
Hz</td><td>Standard value
4000</td></tr>
<tr><td colspan="4">■ First low-pass filter to suppress sudden change of velocity command.
Use External Velocity Command Filter when eliminating Analog velocity command noise. Sets the cutoff frequency.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
<table><tr><td colspan="2">Control Cycle</td><td>Setting value</td><td>Valid/Invalid</td></tr><tr><td rowspan="2">00</td><td>Standard_Sampling</td><td>1 to 1999[Hz]</td><td>Valid</td></tr><tr><td>Standard Sampling</td><td>2000 to 4000[Hz]</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td>High-freq_Sampling</td><td>1 to 3999[Hz]</td><td>Valid</td></tr><tr><td>High Frequency Sampling</td><td>4000[Hz]</td><td>Filter invalid</td></tr></table></td></tr>
</table>

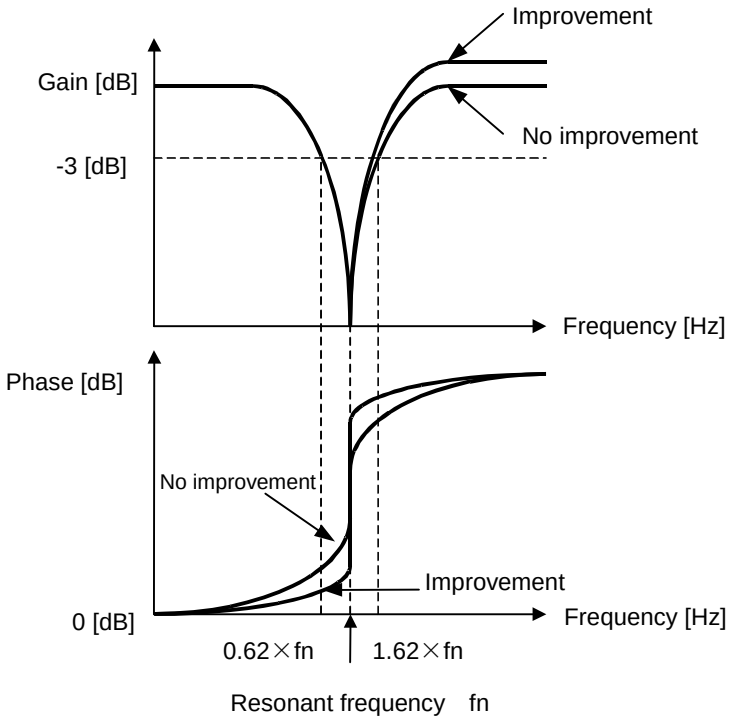
<table>
<tr><th>ID</th><th colspan="5">Contents</th></tr>
<tr><td rowspan="2">11</td><td>Velocity Feedback Filter
[VDFIL]</td><td>Setting range</td><td>Unit</td><td colspan="2">Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td colspan="2">1500</td></tr>
<tr><td colspan="6">■ First low-pass filter to eliminate ripples caused by encoder pulse included in the velocity control system feedback. Sets the cutoff frequency.
◆ When the encoder resolution is low, lowering the setting value and suppressor the ripples can suppress motor drive noise. In addition, when the encoder resolution is high, raising the setting value may improve the response of the velocity control system. For general use, set at the Standard value.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Valid/Invalid</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 to 1999[Hz]</td><td>Valid</td></tr>
<tr><td>2000 to 4000[Hz]</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>1 to 3999[Hz]</td><td>Valid</td></tr>
<tr><td>4000[Hz]</td><td>Filter invalid</td></tr>
</table></td></tr>
<tr><td rowspan="2">12</td><td>Velocity Loop Proportional Gain 1
[KVP1]</td><td>Setting range</td><td>Unit</td><td colspan="2">Standard value</td></tr>
<tr><td>1 to 2000</td><td>Hz</td><td colspan="2">50</td></tr>
<tr><td colspan="6">■ Proportional gain of velocity controller.
When Load Inertia Moment Ratio 1 is same as the actual load inertia moment, this setting value response is performed.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When the Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.</td></tr>
<tr><td rowspan="2">13</td><td>Velocity Loop Integral Time Constant 1
[TVI1]</td><td>Setting range</td><td>Unit</td><td colspan="2">Standard value</td></tr>
<tr><td>0.3 to 1000.0</td><td>ms</td><td colspan="2">20.0</td></tr>
<tr><td colspan="6">■ Integral time constant of velocity controller.
This setting value is valid when Velocity Loop Proportional Control Switching Function is invalid.
◆ Integral term is invalid (proportional control) with the setting value of 1000.0[ms].
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>14</td><td>
Load Inertia Moment Ratio 1 [JRAT1]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>0 to 15000</td><td>%</td><td>100</td></tr>
</table>
■ Sets inertia moment of the loading device to the motor inertia moment.
◆ Setting value=J_L/J_M×100[%]
● J_L: Load inertia moment
● J_M: Motor inertia moment
◆ Automatically saved by Auto-tuning result saving.
◆ If this value matches the actual mechanical system, setting value of KVP is the response frequency of the velocity control system.
◆ This parameter is saved with an estimated result when Auto-Tuning Automatic Parameter Saving function is valid. When Auto-tuning Function is valid, this value is not applied.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ Use between the range 100 to 3000[%] when driven with Model following vibration suppressor control.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.
</td></tr>
<tr><td>15</td><td>
Higher Tracking Control Velocity Compensation Gain [TRCVGN]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>0 to 100</td><td>%</td><td>0</td></tr>
</table>
■ Adjusts command tracking performance of velocity control system.
◆ The larger value can raise command tracking performance higher.
◆ When using Velocity Loop Proportional Control Switching Function, set 0%.
◆ When synchronizing with other axes, set 0%.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ The setting value is invalid with Model following control or Model following vibration suppressor control.
</td></tr>
<tr><td>16</td><td>
Acceleration Feedback Gain [AFBK]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>-100.0 to 100.0</td><td>%</td><td>0.0</td></tr>
</table>
■ Sets acceleration feedback compensation gain to make the velocity loop stable.
Multiply this gain with the detected acceleration to compensate torque command.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ If the value is too large, the motor may oscillate. Set within range ±15.0[%] for general use.
</td></tr>
<tr><td>17</td><td>
Acceleration Feedback Filter [AFBFIL]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>500</td></tr>
</table>
■ First low-pass filter to eliminate ripples caused by encoder pulse included in acceleration feedback compensation. Sets the cutoff frequency.
◆ Lower this setting value when the encoder resolution is low.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Valid/Invalid</th></tr>
<tr><td rowspan="2">00</td><td>Standard_Sampling</td><td>1 to 1999[Hz]</td><td>Valid</td></tr>
<tr><td>Standard Sampling</td><td>2000 to 4000[Hz]</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td>High-freq_Sampling</td><td>1 to 3999[Hz]</td><td>Valid</td></tr>
<tr><td>High Frequency Sampling</td><td>4000[Hz]</td><td>Filter invalid</td></tr>
</table>
</td></tr>
</table>

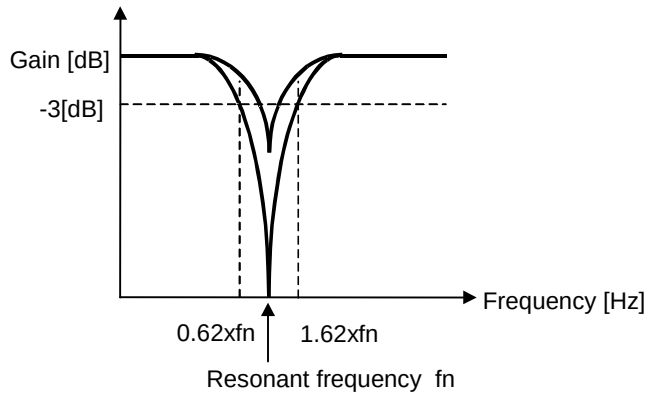
<table>
<tr><td>ID</td><td colspan="5">Contents</td></tr>
<tr><td rowspan="2">20</td><td>Torque Command Filter 1
[TCFIL1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>600</td></tr>
<tr><td colspan="5">■ Low-pass filter to eliminate high frequency component included in the torque command.
Sets cutoff frequency.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.
Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
(Torque command filter cannot be disabled)
<table>
<tr><td colspan="2">Control Cycle</td><td>Setting value</td><td>Cutoff frequency</td></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 to 2000[Hz]</td><td>Same as the setting value</td></tr>
<tr><td>2001 to 4000[Hz]</td><td>2000[Hz]</td></tr>
<tr><td>01</td><td>High-freq_Sampling
High Frequency Sampling</td><td>1 to 4000Hz</td><td>Same as the setting value</td></tr>
</table>
Use within 1 to 1000Hz with Model following control.
Use within 100 to 1000Hz with Model following vibration suppressor control.</td></tr>
<tr><td rowspan="2">21</td><td>Torque Command Filter Order
[TCFILOR]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 3</td><td>Order</td><td>2</td></tr>
<tr><td colspan="5">Sets order of the torque command filter.
The order is set within the setting range even if the cut off frequency of torque command filter is changed by Gain switching.</td></tr>
</table>

■ Group2 “FF (Feed Forward) vibration suppressor control/ Notch filter/ Disturbance observer settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">00</td><td>FF Vibration Suppressor Frequency 1 [SUPFRQ1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td colspan="4">■ Sets the frequency of the machine vibration to be suppressed by FF vibration suppressor function.
◆ Change this while the motor is OFF.
◆ Setting value can be input by 1Hz; inside the driver, the units listed below are used.
<table>
<tr><th>Setting range</th><th>Unit value inside driver</th></tr>
<tr><td>5 to 99[Hz]</td><td>Valid by 1[Hz]</td></tr>
<tr><td>100 to 499[Hz]</td><td>Valid by 5[Hz] and drop less than 5</td></tr>
<tr><td>500[Hz]</td><td>FF vibration suppressor control is invalid</td></tr>
</table>
This parameter is automatically saved by executing FF vibration suppressor frequency tuning.
FF vibration suppressor frequency can be switched 2-4.</td></tr>
<tr><td rowspan="2">01</td><td>FF Vibration Suppressor Level Selection [SUPLV]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>00 to 03</td><td>-</td><td>00</td></tr>
<tr><td colspan="4">■ Sets FF vibration suppressor control effect level.
◆ Change while motor is OFF.
◆ The smaller the value, the greater the effect will be.
◆ FF vibration suppressor frequency switching function does not affect this.</td></tr>
<tr><td rowspan="2">10</td><td>Velocity Command Notch Filter [VCNFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>50 to 1000</td><td>Hz</td><td>1000</td></tr>
<tr><td colspan="4">■ Notch filter to eliminate frequency element arbitrarily set from velocity command.
Sets the resonant frequency.
◆ When sympathetic vibration occurs in velocity control system, the gain is raised by setting the resonance frequency.
◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle.
Setting value can be input by 1[Hz]; inside the driver, the units listed below are applied.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Unit value inside driver</th></tr>
<tr><td rowspan="3">00</td><td rowspan="3">Standard_Sampling
Standard Sampling</td><td>50 to 99[Hz]</td><td>Valid by 1[Hz]</td></tr>
<tr><td>100 to 499[Hz]</td><td>Valid by 5[Hz] and drop less than 5</td></tr>
<tr><td>500 to 1000[Hz]</td><td>Filter invalid</td></tr>
<tr><td rowspan="3">01</td><td rowspan="3">High-freq_Sampling
High Frequency Sampling</td><td>50 to 199[Hz]</td><td>Valid by 1[Hz]</td></tr>
<tr><td>200 to 999[Hz]</td><td>Valid by 10[Hz] and drop less than 10</td></tr>
<tr><td>1000[Hz]</td><td>Filter invalid</td></tr>
</table>

</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>20</td><td>
<table>
<tr><td rowspan="2">Torque Command Notch Filter A [TCNFILA]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>100 to 4000</td><td>Hz</td><td>4000</td></tr>
</table>
■ Notch filter to eliminate sympathetic vibration element included in torque command.
Sets the resonant frequency.
◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle.
Setting value can be input by 1[Hz]; inside the driver, the units listed below are applied.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Unit value inside driver</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>100 to 1999[Hz]</td><td>Valid by 10Hz and drop less than 10</td></tr>
<tr><td>2000 to 4000[Hz]</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>100 to 3999[Hz]</td><td>Valid by 10Hz and drop less than 10</td></tr>
<tr><td>4000[Hz]</td><td>Filter invalid</td></tr>
</table>
This parameter is automatically saved by executing Notch filter tuning.
</td></tr>
<tr><td>21</td><td>
<table>
<tr><td rowspan="2">TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 02</td><td>-</td><td>00</td></tr>
</table>
■ Improves phase delay at lower frequency than resonant frequency of the Torque Command Notch Filter A.
◆ The larger the value is, the greater the improvement.
◆ Characteristic is same as the standard notch filter at the setting value 0.
◆ Caution, other than the setting value 0, higher frequencies than the middle frequency will be amplified.


</td></tr>
</table>

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="2">22</td><td rowspan="2">Torque Command Notch Filter B
[TCNFILB]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>100 to 4000</td><td>Hz</td><td>4000</td></tr>
<tr><td rowspan="2">24</td><td rowspan="2">Torque Command Notch Filter C
[TCNFILC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>100 to 4000</td><td>Hz</td><td>4000</td></tr>
<tr><td rowspan="2">26</td><td rowspan="2">Torque Command Notch Filter D
[TCNFILD]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>100 to 4000</td><td>Hz</td><td>4000</td></tr>
<tr><td></td><td colspan="4">■ Notch filter to eliminate sympathetic vibration element included in torque command.
Sets the resonant frequency.
◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle.
Setting value can be input by 1Hz unit; inside the driver, the units listed below are applied.
<table><tr><td colspan="2">Control Cycle</td><td>Setting value</td><td>Unit value inside driver</td></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>100 to 1999[Hz]</td><td>Valid by 10Hz and drop less than 10</td></tr><tr><td>2000 to 4000[Hz]</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>100 to 3999[Hz]</td><td>Valid by 10Hz and drop less than 10</td></tr><tr><td>4000[Hz]</td><td>Filter invalid</td></tr></table></td></tr>
<tr><td rowspan="2">23</td><td rowspan="2">TCNFILB, Depth Selection
[TCNFDB]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 03</td><td>-</td><td>00</td></tr>
<tr><td rowspan="2">25</td><td rowspan="2">TCNFILC, Depth Selection
[TCNFDC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 03</td><td>-</td><td>00</td></tr>
<tr><td rowspan="2">27</td><td rowspan="2">TCNFILD, Depth Selection
[TCNFDD]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 03</td><td>-</td><td>00</td></tr>
<tr><td></td><td colspan="4">■ Parameters to set the depth of each Torque Command Notch Filter (TCNFILB toD). The larger the value is, the shallower the depth.
 
</td></tr>
</table>

ID 30

Observer Characteristic [OBCHA]

Setting range	Unit	Standard value
00 to 02	-	00:Low

■ Select frequency characteristic of the disturbance observer

Selection		Contents
00	Low	For Low Frequency
01	Middle	For Middle Frequency
02	High	For High Frequency

◆ Select “00 Low, Low Frequency Disturbance Observer Suppressor” for Load torque monitor (estimate value).
◆ Select 02 High, High Frequency Disturbance Observer Suppressor, when the encoder resolution is over 1048576P/R.

ID 31

Observer Compensation Gain [OBG]

Setting range	Unit	Standard value
0 to 100	%	0

■ Compensation gain for Disturbance Observer.
The larger the value is, the higher the suppression performance. However, if the value is too large, oscillation may sometimes occur.

ID 32

Observer Output Low-pass Filter [OBLPF]

Setting range	Unit	Standard value
1 to 4000	Hz	50

■ First low-pass filter to eliminate high frequency elements included in the observer compensation. Sets the cutoff frequency.
◆ The larger the value is, the faster the response of disturbance observer suppression. However, it may cause a louder driving sound depending on the ripple components included in disturbance observer output.
◆ Filter is invalid at the setting value more than 2000[Hz].
◆ Filter is invalid when observer characteristic is set to [01 Middle, For Middle Frequency], or [02 High, For High Frequency].

ID 33

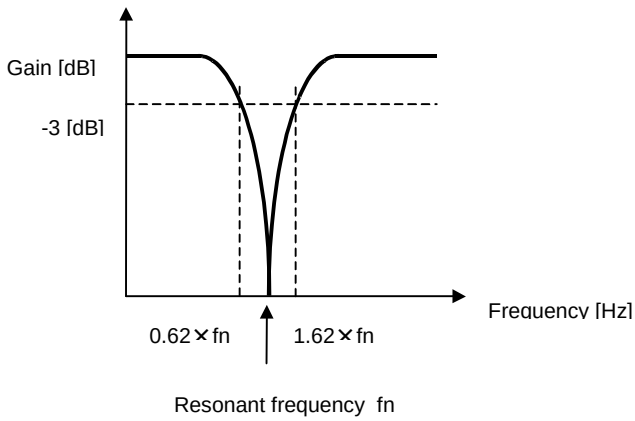
Observer Output Notch Filter [OBNFIL]

Setting range	Unit	Standard value
100 to 4000	Hz	4000

■ Notch filter to eliminate arbitrarily selected frequency from observer compensation.
Sets the resonant frequency.
When resonance appears in disturbance observer output, such as sympathetic vibration with the mechanical system, this notch filter sometimes suppresses the vibration.

◆ Setting value can be input by 1[Hz]; inside the driver, the units listed below are applied.

Setting value	Unit value inside the driver
100 to 1999[Hz]	Valid by 10[Hz] and drop less than 10
2000 to 4000[Hz]	Filter invalid



■ Group3 “Model following control settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td>Model Control Gain 1
[KM1]</td><td>Setting range
1 to 3000</td><td>Unit
1/s</td><td>Standard value
30</td></tr>
<tr><td colspan="4">■ Proportional gain for model position controller.
◆ Set within the range of 15 to 315 (1/s) when operating with Model following vibration suppressor control.
◆ Automatically saved by Auto-tuning result saving.
◆ When the Gain switching function is valid, select gain 1 and this setting value is applied.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">01</td><td>Overshoot Suppressor Filter
[OSSFIL]</td><td>Setting range
1 to 4000</td><td>Unit
Hz</td><td>Standard value
1500</td></tr>
<tr><td colspan="4">■ Filter to suppress overshoot with Model following control or Model following vibration suppressor control.
Sets cutoff frequency.
◆ Lower the setting value when overshoot on position deviation occurs.
◆ Filter is invalid at the setting value more than 2000Hz.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">02</td><td>Model Control Antiresonance Frequency 1
[ANRFRQ1]</td><td>Setting range
10.0 to 80.0</td><td>Unit
Hz</td><td>Standard value
80.0</td></tr>
<tr><td colspan="4">■ Sets antiresonance frequency to the mechanical device with Model following vibration suppressor control.
Sets actual antiresonance frequency value of the mechanical system by using System Analysis function of the setup software.
◆ Setting value is invalid with following control.
◆ If the sitting value is over the Model Control Resonance Frequency, vibration suppressor control is invalid.
◆ Change value while the motor is OFF.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">03</td><td>Model Control Resonance Frequency 1
[RESFRQ1]
Setting range</td><td>Setting range
10.0 to 80.0</td><td>Unit
Hz</td><td>Standard value
80.0</td></tr>
<tr><td colspan="4">■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control.
Sets actual resonance frequency value of the mechanical system by using System Analysis function of the setup software.
◆ Setting value is invalid with Model following control.
◆ Vibration suppressor control becomes invalid at the setting value 80.0[Hz].
◆ Change value while the motor is OFF.</td></tr>
<tr><td colspan="4"></td></tr>
</table>

✔ Turn the motor OFF when using gain switching function.
✔ Turn the motor OFF when using Model vibration suppressor frequency switching function.
✔ If alarm, ALC5 Model following vibration suppressor control abnormal, is issued during operation, lower the value of KM Model Control Gain, or Change the operation pattern so that acceleration and deceleration become moderate.
✔ Model following vibration suppressor control is invalid with JOG operation.

■ Group4 “Gain switching control/ vibration suppressor frequency switching settings”

ID	Contents			
00	Model Control Gain 2 [KM2]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
10	Model Control Gain 3 [KM3]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
20	Model Control Gain 4 [KM4]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
	■ Proportional gain for Model position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving.			
01	Position Loop Proportional Gain 2 [KP2]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
11	Position Loop Proportional Gain 3 [KP3]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
21	Position Loop Proportional Gain 4 [KP4]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
	■ Proportional gain for position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving.			
02	Position Loop Integral Time Constant 2 [TPI2]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
12	Position Loop Integral Time Constant 3 [TPI3]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
22	Position Loop Integral Time Constant 4 [TPI4]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
	■ Integral time constant for position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ Integral term is valid (Proportional control) at the setting value 1000.0ms. ◆ This setting in valid when the Position Loop Proportional Control Switching Function is invalid.			
03	Velocity Loop Proportional Gain 2 [KVP2]	Setting range	Unit	Standard value
		Setting range	Unit	Standard value
13	Velocity Loop Proportional Gain 3 [KVP3]	Setting range	Unit	Standard value
		1 to 2000	Hz	50
23	Velocity Loop Proportional Gain 4 [KVP4]	Setting range	Unit	Standard value
		1 to 2000	Hz	50
	■ Proportional gain for velocity controller. Select from Gain Switching Function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ When Load Inertia Moment Ratio (JRAT2, JRAT3, and JRAT4) are the same as actual load inertia moment, this setting value response is performed.			

ID	Contents			
04	Velocity Loop Integral Time Constant 2 [TVI2]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0
14	Velocity Loop Integral Time Constant 3 [TVI3]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0
24	Velocity Loop Integral Time Constant 4 [TVI4]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0
	■ Integral time constant for velocity controller. Select from gain switching function 1 and 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ This setting is valid when Velocity Loop Proportional Control Switching Function is invalid. ◆ Integral time is invalid (proportional control) with the setting value 1000.0ms.			
05	Load Inertia Moment Ratio 2 [JRAT2]	Setting range	Unit	Standard value
		0 to 15000	%	100
15	Load Inertia Moment Ratio 3 [JRAT3]	Setting range	Unit	Standard value
		0 to 15000	%	100
25	Load Inertia Moment Ratio 4 [JRAT4]	Setting range	Unit	Standard value
		0 to 15000	%	100
	■ Sets Inertia moment of load device to the motor inertia moment. Select from Gain switching function 1 or 2. ◆ If this value matches the actual mechanical system, the setting value corresponding to Velocity Loop Proportional Gain (KVP2, KVP3, and KVP4) is response frequency of the velocity control system. ◆ This parameter is not covered by Auto-Tuning Automatic Parameter Saving function. ◆ Setting value=$J_L/J_M \times 100$[%] ● J_L: Load inertia moment ● J_M: Motor inertia moment			
06	Torque Command Filter 2 [TCFIL2]	Setting range	Unit	Standard value
		1 to 4000	Hz	600
16	Torque Command Filter 3 [TCFIL3]	Setting range	Unit	Standard value
		1 to 4000	%	600
26	Torque Command Filter 4 [TCFIL4]	Setting range	Unit	Standard value
		1 to 4000	%	600

■ Low-pass filter to eliminate high frequency element included in torque command. Select from gain switching function 1 or 2. Sets cutoff frequency.

◆ This parameter is not covered by Auto-tuning result saving.

◆ Setting range varies depending on the setting of system parameter ID00 Control Cycle. (Torque command filter cannot be disabled.)

Control Cycle		Setting value	Cutoff frequency
00	Standard_Sampling Standard Sampling	1 to 2000[Hz]	Setting value
		2001 to 4000[Hz]	2000[Hz]
01	High-freq_Sampling High Frequency Sampling	1 to 4000[Hz]	Setting value

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="3">30</td><td rowspan="2">Gain Switching Filter
[GCFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 100</td><td>ms</td><td>0</td></tr>
<tr><td colspan="4">■ Low-pass filter to change gain moderately when switching.
Sets time constant.
◆ When the mechanical system is shocked by the change of gain resulted from gain switching, making a moderate gain change will modify the shock.
◆ The larger the value, the gentler the gain changes.</td></tr>
<tr><td rowspan="2">40</td><td rowspan="2">FF Vibration Suppressor Frequency 2
[SUPFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td rowspan="2">41</td><td rowspan="2">FF Vibration Suppressor Frequency 3
[SUPFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td rowspan="2">42</td><td rowspan="2">FF Vibration Suppressor Frequency 4
[SUPFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td></td><td colspan="4">■ Sets mechanical vibration frequency to be suppressed with this function. Select from FF vibration suppressor frequency selection 1 or 2.
◆ Change value while the motor is OFF.
◆ This parameter is not covered by Auto-tuning result saving.
◆ Setting value can be input by 1[Hz]; inside the driver, the units listed below are applied.
<table>
<tr><td>Setting range</td><td>Unit value inside the driver</td></tr>
<tr><td>5 to 99[Hz]</td><td>Valid by 1[Hz]</td></tr>
<tr><td>100 to 499[Hz]</td><td>Valid by 5[Hz] and drop less than 5</td></tr>
<tr><td>500[Hz]</td><td>FF vibration suppressor invalid</td></tr>
</table></td></tr>
<tr><td rowspan="2">50</td><td rowspan="2">Model Control Antiresonance Frequency 2
[ANRFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">52</td><td rowspan="2">Model Control Antiresonance Frequency 3
[ANRFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">54</td><td rowspan="2">Model Control Antiresonance Frequency 4
[ANRFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td></td><td colspan="4">■ Sets antiresonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2.
◆ Setting value is invalid with Model following control.
◆ Vibration suppressor is invalid when it is set over the value of Model Control Resonance Frequency.
◆ This is not overwritten by System Analysis function.
◆ Setting by using “system analysis” function cannot be performed.
◆ Change value while the motor is OFF.</td></tr>
<tr><td rowspan="2">51</td><td rowspan="2">Model Control Resonance Frequency 2
[RESFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">53</td><td rowspan="2">Model Control Resonance Frequency 3
[RESFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">55</td><td rowspan="2">Model Control Resonance Frequency 4
[RESFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td></td><td colspan="4">■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2.
◆ Setting value is invalid under Model following control.
◆ Vibration suppressor control becomes invalid at the setting value 80.0[Hz].
◆ This is not overwritten by System Analysis function.
◆ Setting by using “system analysis” function cannot be performed.
◆ Change value while the motor is OFF.</td></tr>
</table>

■ Group5 “High setting control settings”

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>
Command Velocity Low-pass Filter [CVFIL]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>1000</td></tr>
</table>
■ First low-pass filter to eliminate high frequency elements such as ripples included in the velocity (command velocity) calculated from position command pulse inside high setting control. Sets cutoff frequency.
◆ Lower the cutoff frequency when the encoder resolution is low.
◆ Filter is invalid at setting the value more then 2000[Hz].
</td></tr>
<tr><td>01</td><td>
Command Velocity Threshold [CVTH]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>0.0 to 6553.5</td><td>min^{-1}</td><td>2.0</td></tr>
</table>
■ Sets velocity threshold value to make high setting control compensation (Acceleration Compensation and Deceleration Compensation) valid.
◆ Acceleration Compensation or Deceleration Compensation is done when velocity (command velocity) calculated from the position command pulse reaches this value.
</td></tr>
<tr><td>02</td><td>
Acceleration Compensation [ACCCO]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>-9999 to +9999</td><td>×50 Pulse</td><td>0</td></tr>
</table>
■ Sets Acceleration Compensation value with high setting control.
◆ Sets in units of position deviation pulse
◆ Compensates to position deviation.
◆ The larger the setting value, the greater the compensation value.
◆ The larger the acceleration value calculated from position command pulse, compensation value increases.
◆ The larger the Load inertia moment, the greater the compensation value is.
◆ Position deviation decreases with high setting control.
◆ The setting value is invalid with Model following control or Model following vibration suppressor control.
</td></tr>
<tr><td>03</td><td>
Deceleration Compensation [DECCO]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>-9999 to +9999</td><td>×50 Pulse</td><td>0</td></tr>
</table>
■ Sets Deceleration Compensation value with high setting control.
◆ Set in units of position deviation pulse Compensation is performed for position deviation.
◆ The larger the set value, the more the amount of compensation.
◆ The larger the acceleration converted fro, position command, the more the amount of compensation.
◆ The larger load inertia moment, the more the amount of compensation.
◆ Position deviation decreases by high stabilization control.
◆ This setting value is not reflected in operation with “model following control” or “model following vibration suppression control.”
</td></tr>
</table>

■ Group8 “Control system settings”

ID	Contents			
00	Position, Velocity, Torque Command Input Polarity [CMDPOL]	Setting range	Unit	Standard value
		00 to 07	-	00:PC+_VC+_TC+

■ Select the combination of each command polarity for position command pulse input from the list below.

◆ Rotating direction of the motor can be reversed without changing the command wiring.

◆ Rotating direction with positive (+) polarity command supply according to the setting value is shown below.

Selection		Polarity	Position Command Pulse (PCMD)
00	PC+_VC+_TC+	+	CW
01	PC+_VC+_TC-	+	CW
02	PC+_VC-_TC+	+	CW
03	PC+_VC-_TC-	+	CW
04	PC-_VC+_TC+	+	CCW
05	PC-_VC+_TC-	+	CCW
06	PC-_VC-_TC+	+	CCW
07	PC-_VC-_TC-	+	CCW

◆ Command input polarity is at standard setting value “00:PC+_VC+_TC+”

CW rotation with (+) polarity command

CCW rotation with (-) polarity command

◆ Command input polarity change “07:PC-_VC-_TC-“

CCW rotation with (+) polarity command

CW rotation with (-) polarity command

ID 10

Position Command Pulse Selection [PMOD] Control power a reactivation after setting.	Setting range	Unit	Standard value
	00 to 02	-	00:F-PC_R-PC

■ Set the Position control command pulse type.

◆ Select from below to match with the upper device specifications.

Selection		Contents
00	F-PC_R-PC	Forward Rotation (Positive) Pulse+ Reverse Rotation (Negative) Pulse
01	PC-A_PC-B	Two-phase Pulse Train of 90[°]-Phase Difference
02	SIGN_PULS	Code + Pulse Train

◆ Connect position command pulse to CN1 pin listed below:

Forward rotation	Reverse rotation
Forward pulse (F-PC): CN1-26	Reverse pulse (R-PC): CN1-28
Forward pulse ($\overline{\text{F-PC}}$): CN1-27	Reverse pulse ($\overline{\text{R-PC}}$): CN1-29
Forward pulse SG: CN1-47	Reverse pulse SG: CN1-48

◆ Capable of these output types of the upper devise: Line driver output and Open collector output. Be sure to connect SG.

ID 11

Position Command Pulse Count Polarity [PCPPOL] Control power a reactivation after setting.	Setting range	Unit	Standard value
	00 to 03	-	00:Type1

■ Select the Position Command Pulse Count Polarity from the list below:

◆ Select according to host equipment.

Selection		Contents
00	Type1	F-PC: Not inverted. R-PC: Not inverted.
01	Type2	F-PC: Inverted. R-PC: Not inverted.
02	Type3	F-PC: Not inverted. R-PC: Inverted.
03	Type4	F-PC: Inverted. R-PC: Inverted.

ID 12

Position Command Pulse Digital Filter [PCPFIL]	Setting range	Unit	Standard value
	00 to 07	-	00:834nsec

■ Filter to eliminate noise elements included in the Position command pulse.

◆ Select from the following list:

Setting value		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 = 1.8µsec
04	3.6usec	Minimum Pulse Width = 3.6µsec
05	7.2usec	Minimum Pulse Width = 7.2µsec
06	125nsec	Minimum Pulse Width = 125nsec
07	83.4nsec	Minimum Pulse Width = 83.4nsec

■ When the Position command pulse width becomes less that the setting values of the Digital filter, the status becomes Alarm Code D2 (Position command pulse frequency error 1). Set Digital filter setting value smaller than that of Pulse width at maximum command frequency.

■ Refer to [Input command, Position signal output, General input, General output (2-8)] for the specification of the command pulse.

ID	Contents			
13	Electronic Gear 1 Numerator [B-GER1]	Setting range	Unit	Standard value
		1 to 2097152	-	1
14	Electronic Gear 1 Denominator [A-GER1]	Setting range	Unit	Standard value
		1 to 2097152	-	1
15	Electronic Gear 2 Numerator [B-GER2]	Setting range	Unit	Standard value
		1 to 2097152	-	1
16	Electronic Gear 2 Denominator [A-GER2]	Setting range	Unit	Standard value
		1 to 2097152	-	1

■ Sets the Electronic gear ratio to position command pulse.

- ◆ Two settings for Electronic gear ratio are available. Set gear 1 or gear 2 by switching.
- ◆ If the position command pulse is the same, by switching the Electronic gear, rotating velocity and distance are changed.

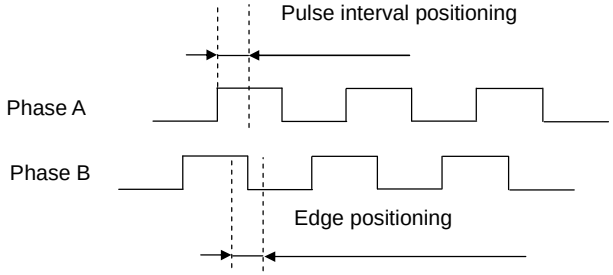
$$f1 \longrightarrow \boxed{\frac{B\ (1\ \text{to}\ 2097152)}{A(1\ \text{to}\ 2097152)} \qquad 1/2^{21} \leqq B/A \leqq 2^{21}} \longrightarrow f2\ (f2 = f1 \times B/A)$$

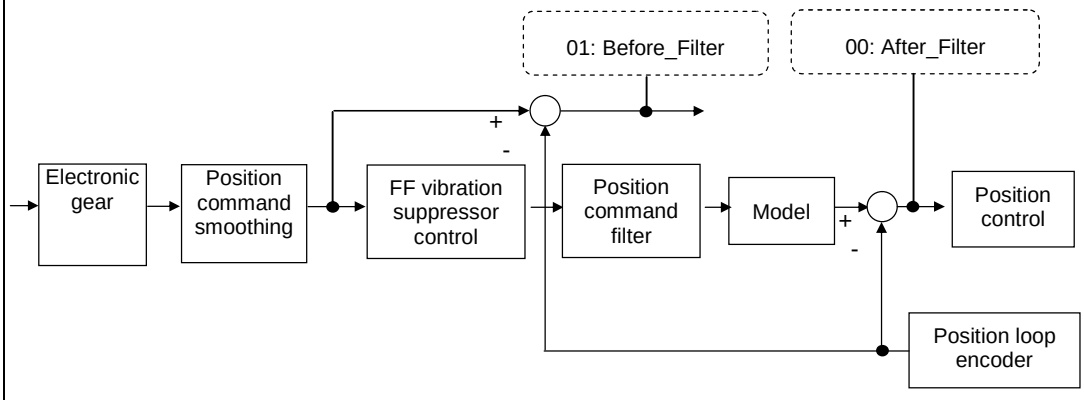
■ Example. To bypass the frequency constraint of Position command pulse.
In case you operate a servomotor with 524288 [P/R] resolution of serial encoder at 300 [min^{-1}] using a controller having maximum frequency of 600 [kpps] (600K pps), use the following formula to get the value of the numerator and the denominator of the electric gearing.

- ◆ Position command pulse frequency at the encoder resolution
  = 524288[P/R]×300[min^{-1}]/60 = 2621.44[kpps]

- ● Electronic gear ratio = $\frac{2621.44\ [kpps]}{600[kpps]} = \frac{8192}{1875}$

Thus, Electronic gear numerator = 8192, Electronic gear denominator = 1875.
(Setting value of numerator = 131072, denominator = 3000 are fine as they are within the setting range of Electronic gear.)
By setting this Electronic gear numerator, denominator, the motor rotation velocity is 300[min^{-1}] with the Position command pulse frequency 600[kpps].

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>17</td><td>
Positioning Methods [EDGEPOS]
Control power a reactivation after setting.
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Pulse_Interval</td></tr>
</table>
■ Select the Encoder pulse positioning.
◆ Positioning accuracy is improved by selecting Edge positioning when the encoder resolution is coarse. However, this may cause the driving sound of the mechanical system to increase as this edge is always the center of vibration.
◆ Select standard value for usual operation.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Pulse_Interval</td><td>Specify Pulse Interval</td></tr>
<tr><td>01</td><td>Pulse_Edge</td><td>Specify Pulse Edge</td></tr>
</table>


</td></tr>
<tr><td>18</td><td>
In-Position Signal/ Position Deviation Monitor [PDEVMON]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Standard value</th></tr>
<tr><td>00 to 01</td><td>-</td><td>00:After_Filter</td></tr>
</table>
■ Select in-position signal (INP) and Position deviation monitor output before and after passing through the Position Command Filter.
◆ For 00 After_Filter, use the Position deviation value of the Position controller.
◆ For 01 Before_Filter, use the Position deviation value based on Position command before FF vibration suppressor control.
◆ With system parameter ID0A Position Control Selection at 01 Model 1 Model Following Control, or 02 Model 2 Model Following Vibration Suppress Control, 01: Before_Filter always operates no matter the selection.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>After_Filter</td><td>Compare Position command value with Feedback value after passing through the filter.</td></tr>
<tr><td>01</td><td>Before_Filter</td><td>Compare Position command value with Feedback value before passing through the filter.</td></tr>
</table>


</td></tr>
</table>

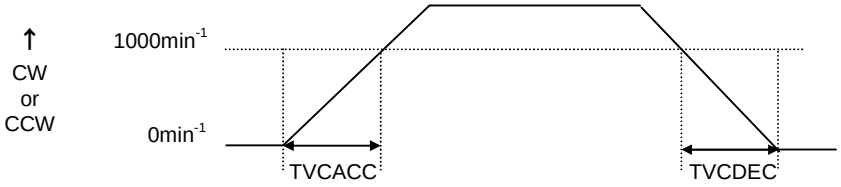
ID	Contents			
19	Deviation Clear Selection [CLRSEL]	Setting range	Unit	Standard value
		00 to 03	-	00:Type1

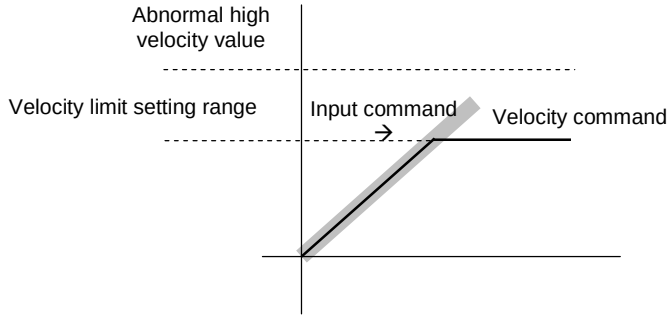
■ Sets ON/OFF of position deviation clear during servo OFF, and deviation clear signal treatment.
- ◆ Selects operation during servo OFF. Deviation clear/ Deviation NOT clear
- ◆ Selects deviation signal treatment. Level detection /Edge detection
- ◆ Select proper setting corresponding to above combination from the list below.

Selection		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	At the edge of OFF→ON of Deviation clear input, Deviation clear is executed.
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.)

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="2">2B</td><td rowspan="2">Velocity Command Acceleration Time Constant
[TVCACC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
<tr><td rowspan="2">2C</td><td rowspan="2">Velocity Command Deceleration Time Constant
[TVCDEC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
<tr><td></td><td colspan="4">■ These parameters control the acceleration and deceleration commands for the jog operation.
Acceleration: 0 min^{-1} -->CW, CCW rotation
Deceleration:CW, CCW rotation --> 0 [min^{-1}]
Sets acceleration, deceleration per 1000 [min^{-1}].

■ With Velocity command acceleration, deceleration time constant, and Step input velocity, the command can be accelerated or decelerated.

 
</td></tr>
<tr><td rowspan="2">2D</td><td rowspan="2">Velocity Limit Command
[VCLM]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.1 to 6553.5</td><td>min^{-1}</td><td>6553.5</td></tr>
<tr><td></td><td colspan="4">■ Set to restrict Velocity command.

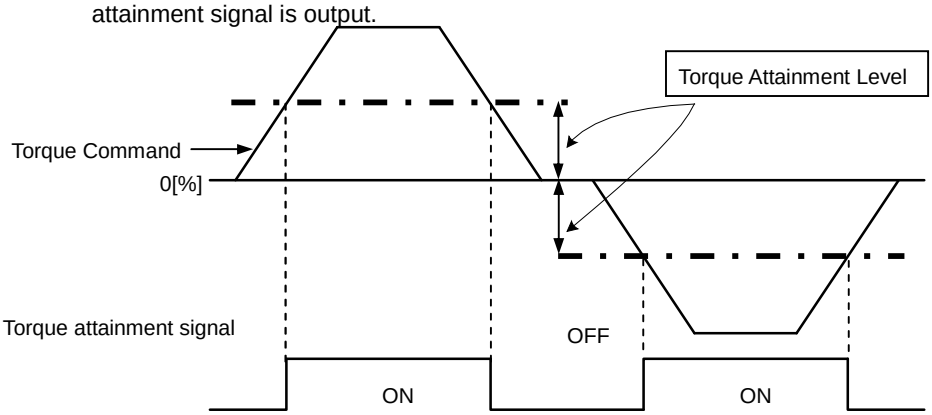
◆ Sets the maximum value of Velocity command.
◆ Restricts Velocity command at the setting range.
◆ At the setting value 5000 and over, Velocity command is restricted at maximum speed of the combined motor x 1.1.
Set this parameter to limit motor rotational velocity to the value lower than 1.1 times the maximum rotational velocity. Use the standard value for normal use.
 
</td></tr>
</table>

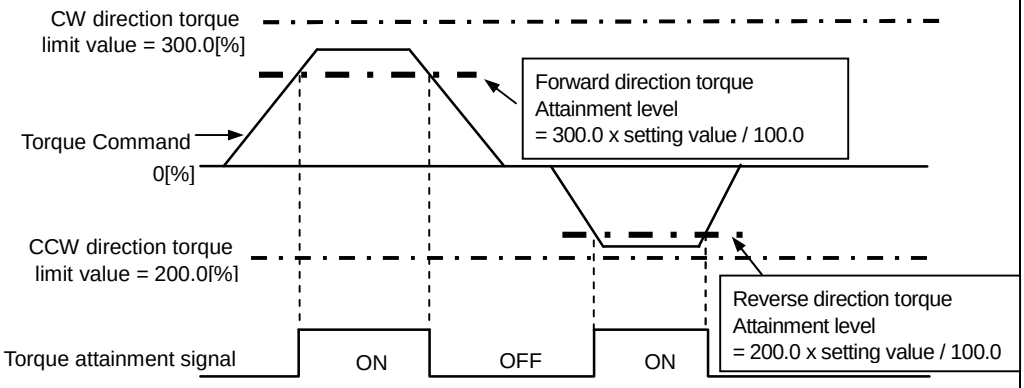
<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="2">37</td><td rowspan="2">CW Direction Internal Torque Limit Value
[TCLM-F]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 500.0</td><td>%</td><td>100.0</td></tr>
<tr><td rowspan="2">38</td><td rowspan="2">CCW Direction Internal Torque Limit Value
[TCLM-R]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 500.0</td><td>%</td><td>100.0</td></tr>
<tr><td></td><td colspan="4">■ Limits the Torque output at the setting value when Preset torque limit value is valid.
◆ Limits the torque by the ratio for the torque rating (100.0[%]= torque rating)
◆ When the Torque Limit Function (TL) is valid, the torque output is limited by the Preset torque limit setting value appropriate to the polarity of the Torque command.
◆ When the value is set exceeding the Maximum Instant Stall Torque (T_P) of the combining motor, it is limited by the Maximum Instant Stall Torque (T_P) of the combining motor.</td></tr>
<tr><td></td><td colspan="4">Torque limit function
The torque limit function includes the limiting of internal torque.

◆ To use preset torque limit

<table><tr><td colspan="2">Setting value</td><td></td></tr><tr><td>00</td><td>TCLM</td><td>Use preset torque limit value
CW side/TCLM-F
CCW side/TCLM-R</td></tr></table>
● Sets torque limit value.
<table><tr><td>Group</td><td>ID</td><td>Symbol</td><td>Contents</td></tr><tr><td>8</td><td>37</td><td>TCLM-F</td><td>CW Direction Internal Torque Limit Value</td></tr><tr><td>8</td><td>38</td><td>TCLM-R</td><td>CCW Direction Internal Torque Limit Value</td></tr></table>
● Sets torque limit function ON
<table><tr><td>Group</td><td>ID</td><td>Symbol</td><td>Contents</td></tr><tr><td>9</td><td>32</td><td>TL</td><td>Torque Limit Function</td></tr></table>
Selects to set the Torque function valid.
While the Torque limit function is valid, restricts torque.

✔ When setting, be cautious about acceleration/deceleration time. If the setting value is too low, Acceleration/Deceleration torque is not sufficient for normal operation.
✔ Set at: Preset torque limit value > Acceleration/Deceleration torque.
✔ With Preset torque limit, CW and CCW setting values can be set independently.</td></tr>
<tr><td rowspan="2">39</td><td rowspan="2">Sequence Operation Torque Limit Value
[SQTCLM]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 500.0</td><td>%</td><td>120.0</td></tr>
<tr><td colspan="4">■ Limits output torque at sequence operation.
◆ Sets the limiting torque by the ratio of rated output torque. (100.0[%]=rated torque)
◆ When the value is set exceeding the Maximum instant stall torque (T_P) of the combining motor, it is limited by the Maximum instant stall torque (T_P) of the combining motor.
◆ During the sequence operation, Torque limit corresponds to JOG Operation, Over-Travel Action, Holding brake stand-by time, and Servo brake action.</td></tr>
</table>

<table>
<tr><td>ID</td><td>Contents</td></tr>
<tr><td>3B</td><td>
Torque Attainment select [TASEL]
Setting range: 00 to 01 | Unit: - | Standard value: 00:TA/TR
■ To select a setting rate type of attaining torque
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>TA/TR</td><td>To set percentage of Rated torque
(Rated torque is 100[%])</td></tr>
<tr><td>01</td><td>TA/TCLM</td><td>To set percentage of Torque limit value</td></tr>
</table>
</td></tr>
<tr><td>3C</td><td>
Torque Attainment Setting [TA]
Setting range: 0.0 to 500.0 | Unit: % | Standard value: 100.0
■ To set the rate of Torque attainment
Target data of the ratio set in this parameter varies depending on torque attainment function selection [Group8-3B].
◆ [Torque Attainment select: 00]
● Set percentage of Rated torque (100.0[%]).
Therefore, once the commanded torque exceeds the setting value, Torque attainment signal is output.


◆ [Torque Attainment select: 01]
● Set percentage rate of torque limit value.
The level of attaining torque is calculated from the following formula.
Torque attainment level = Torque limit value x setting value / 100.0 [%]
Therefore, once the commanded torque exceeds the level of attaining torque that is calculated from the above formula, torque attainment signal is output.
Even if the setting value is set more than 100.0 [%], that is limited to 100.0[%].
If CW direction and CCW direction torque limit value are different, torque attainment level can be setup based on values of each of limited torque.


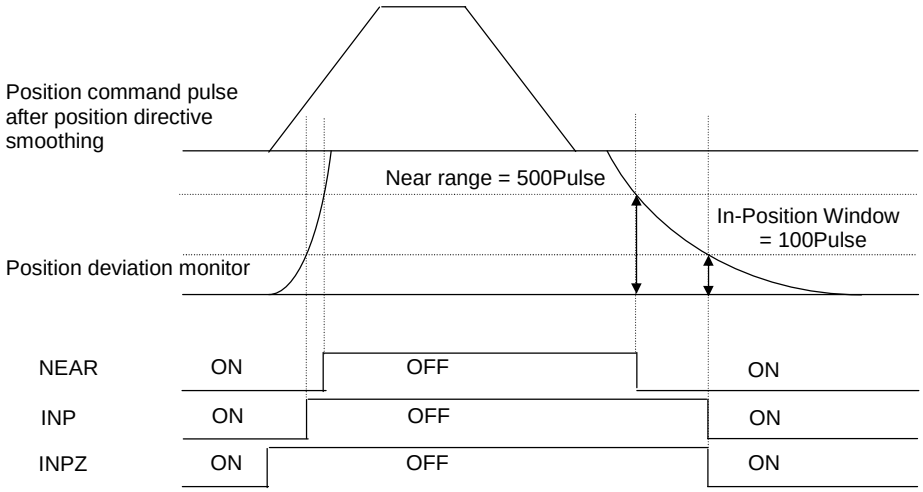
</td></tr>
</table>

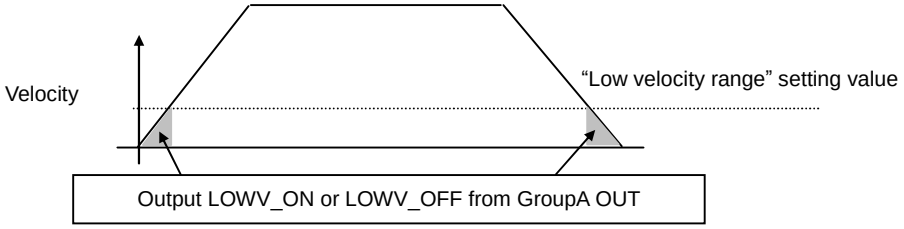
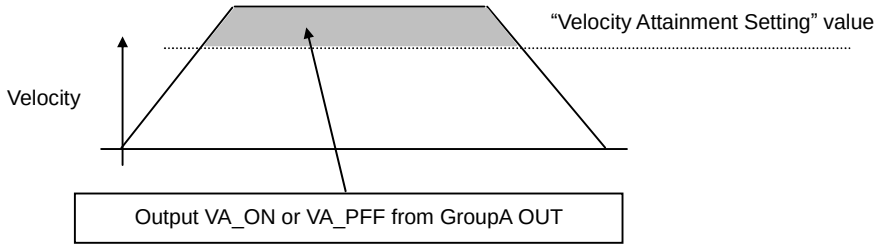
<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="2">3D</td><td rowspan="2">Amount t of torque limit value restoration when power restored
[TLMREST]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 500.0</td><td>%</td><td>10.0</td></tr>
<tr><td></td><td colspan="4">■ Sets the amount of restoration per 1ms when power restored from power supply drop, which can cancel torque limit value at power drop.
◆ Sets the ratio to rated torque. (100.0[%] = rated torque)
◆ When setting “0.0%,” operate as 10.0[%].</td></tr>
<tr><td rowspan="2">40</td><td rowspan="2">Near Range
[NEAR]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>500</td></tr>
<tr><td></td><td colspan="4">■ Sets the output range of near range (near in-position) signal.
◆ Outputs Near range signal when the Position deviation counter is set lower that this set value.
◆ Sets at the resolution of the encoder pulse at any Electronic gear. (Not the Position command pulse resolution.)

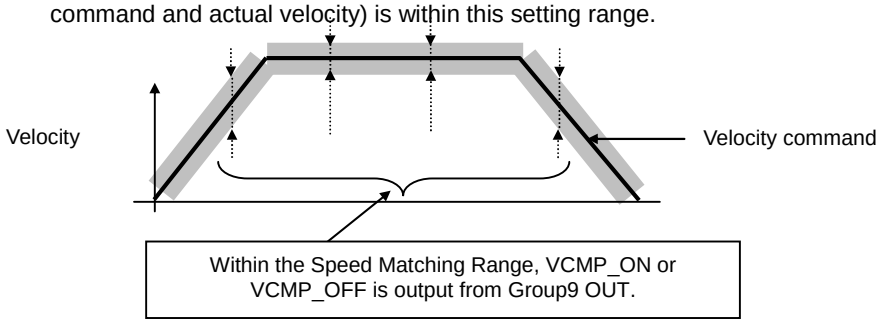
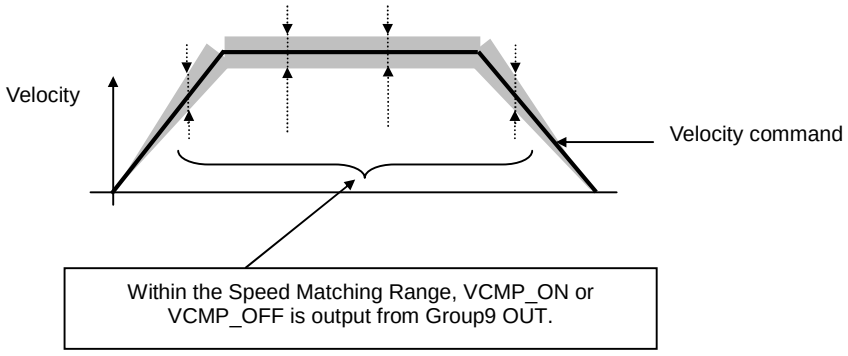
■ Generally, near range signal is used as auxiliary of In-position signal. For example, by setting this value larger than the range of In-position, it can receive the NEAR signal before the upper device receives the In-position signal (INP), thus when In-position the necessary action can smoothly be accomplished.

◆ Sets Near Range signal output
<table>
<tr><td>Group</td><td>ID</td><td>Symbol</td><td>Contents</td></tr>
<tr><td>A</td><td>0*</td><td>OUT*</td><td>Generic Purpose output*</td></tr>
</table>
<table>
<tr><td colspan="2">Selection</td><td>Contents</td></tr>
<tr><td>1A</td><td>NEAR_ON</td><td>Near Range Status, Output ON</td></tr>
<tr><td>1B</td><td>NEAR_OFF</td><td>Near Range Status, Output OFF</td></tr>
</table></td></tr>
<tr><td rowspan="2">41</td><td rowspan="2">In-Position Window
[INP]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>100</td></tr>
<tr><td></td><td colspan="4">■ Sets output range of In-Position signal.
◆ Outputs positioning completion signal when position deviation counter value is the setting value or less.
◆ Sets based on the resolution of encoder pulse, regardless of any electronic gears. (This is not position command pulse resolution.)

◆ Sets In-Position signal output
<table>
<tr><td>Group</td><td>ID</td><td>Symbol</td><td>Contents</td></tr>
<tr><td>A</td><td>0*</td><td>OUT*</td><td>Generic Purpose output*</td></tr>
</table>
<table>
<tr><td colspan="2">Selection</td><td>Contents</td></tr>
<tr><td>1A</td><td>INP_ON</td><td>In-Position Status,Output ON</td></tr>
<tr><td>1B</td><td>INP_OFF</td><td>In-Position Status,Output OFF</td></tr>
</table></td></tr>
</table>

ID	Contents
	 ◆ INPZ is a state signal turned on when the position directive pulse after position directive smoothing is 0 and a position deviation counter value is below setting of the completion range of positioning.

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">42</td><td>Speed Zero Range
[ZV]</td><td>Setting range
5.0 to 50.0</td><td>Unit
min^{-1}</td><td>Standard value
5.0</td></tr>
<tr><td colspan="4">■ Setting value for detecting Zero-speed status (motor stop).
◆ When the speed becomes lower than this value, Zero-speed status is out.</td></tr>
<tr><td rowspan="2">43</td><td>Low Speed Range
[LOWV]</td><td>Setting range
0.0 to 6553.5</td><td>Unit
min^{-1}</td><td>Standard value
5.0</td></tr>
<tr><td colspan="4">■ 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>Speed Attainment Setting (High Speed Range)
[VA]</td><td>Setting range
0.0 to 6553.5</td><td>Unit
min^{-1}</td><td>Standard value
100.0</td></tr>
<tr><td colspan="4">■ Parameters for setting speed attainment output range.
◆ When the speed exceeds this setting value, Speed attainment is output.
 
</td></tr>
</table>

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">45</td><td>Speed Matching Unit Selection
[VCMPUS]</td><td>Setting range
00 to 01</td><td>Unit
-</td><td>Standard value
00_</td></tr>
<tr><td colspan="4">■ Selects Speed Matching Unit setting method.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>min^{-1}</td><td>Sets by unit[min^{-1}]
Uses the setting value of ID46 [VCMP] Speed Matching Range</td></tr>
<tr><td>01</td><td>Percent</td><td>Sets the ratio to velocity command by [%] unit
Uses the setting value of ID47 [VCMPR] Speed Matching Range Ratio</td></tr>
</table></td></tr>
<tr><td rowspan="2">46</td><td>Speed Matching Range
[VCMP]</td><td>Setting range
0.0 to 6553.5</td><td>Unit
min^{-1}</td><td>Standard value
5.0</td></tr>
<tr><td colspan="4">■ Sets the range regarded as Speed matching by the unit [min^{-1}].
◆ Use this setting value when ID45 [VCMPUS] Speed Matching Unit Selection is ”00 min^{-1}.”
◆ Velocity matching is output when the Velocity deviation (difference between the velocity command and actual velocity) is within this setting range.
 
</td></tr>
<tr><td rowspan="2">47</td><td>Speed Matching Range Ratio
[VCMPR]</td><td>Setting range
0.0 to 100.0</td><td>Unit
%</td><td>Standard value
5.0</td></tr>
<tr><td colspan="4">■ Sets the range regarded as Speed matching ratio to Velocity command by the unit [%].
◆ This setting is used when ID45 ”[VCMPUS] Speed Matching Unit Selection” is “01 Percent”
◆ Speed matching is outputted when a velocity deviation (difference of commanded velocity and real one) is in this setting range.
◆ The value that multiplied the velocity command by setting is a Speed matching range. When this value is less than 1[min^{-1}], the Speed matching range is treated as 1[min^{-1}].
 
</td></tr>
</table>

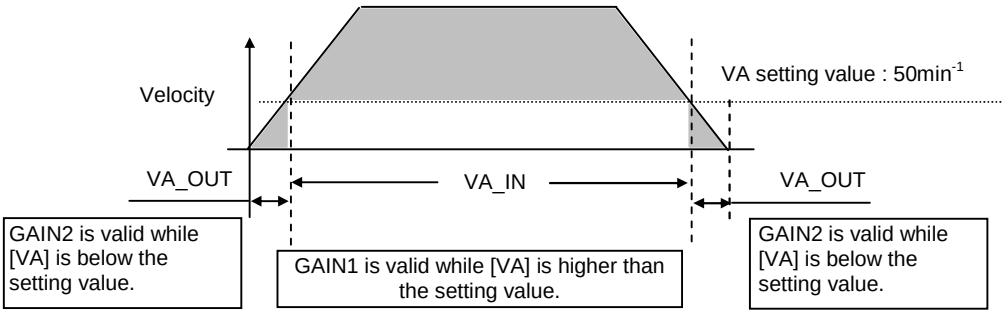
■ By combining with Group9, Condition Settings for Enabling Functions, the functions of Group9 are valid for ID42 to ID47.

Selection		Contents
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value)
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value)
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value)
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value)
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value)
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)

✔ Speed Matched Range is based on “Group8 ID45, ID47” setup.

◆ Example: The driver sets the GAIN1 and GAIN2 switching without using input signal from the host unit.

- Set 15: VA_OUT to Group9 ID13 Gain Switching Condition 1 GC1.
- Set 00: Always_Disable to Group9 ID14 Gain Switching Condition 2 GC2.
- Set 50min^{-1} (arbitrary value) to Group8 ID44 Speed Attainment (High Speed setting) VA.



■ Group9 “Functions enabling condition settings”

ID	Contents	Setting range	Standard value	Functions-enabled input time
00	CW Over Travel Function [F-OT]	00 to 27	OD:CONT6_OFF	20ms
01	CCW Over Travel Function [R-OT]	00 to 27	OB:CONT5_OFF	20ms
02	Alarm Reset Function [AL-RST]	00 to 27	10:CONT8_ON	20ms
04	Deviation Clear Function [CLR]	00 to 27	O8:CONT4_ON	1ms
05	Servo-ON Function [S-ON]	00 to 27	O2:CONT1_ON	20ms
11	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function [INH/Z-STP]	00 to 27	0E:CONT7_ON	20ms
12	Electronic Gear Switching Function [GERS]	00 to 27	00:Always_Disable	20ms
13	Gain Switching Condition 1 [GC1]	00 to 27	00:Always_Disable	1ms
14	Gain Switching Condition 2 [GC2]	00 to 27	00:Always_Disable	1ms
15	FF Vibration Suppressor Frequency Select Input 1 [SUPFSEL1]	00 to 27	00:Always_Disable	20ms
16	FF Vibration Suppressor Frequency Select Input 2 [SUPFSEL2]	00 to 27	00:Always_Disable	20ms
17	Position Loop Proportional Control Switching Function [PLPCON]	00 to 27	01:Always_Enable	20ms
18	Model Vibration Suppressor Frequency Select Input 1 [MDLFSEL1]	00 to 27	00:Always_Disable	20ms
19	Model Vibration Suppressor Frequency Select Input 2 [MDLFSEL2]	00 to 27	00:Always_Disable	20ms
1A	Magnetic Pole Position Estimation [CSET]	00 to 27	06:CONT3_ON	20ms
20	Preset Velocity Command Select Input 1 [SP1]	00 to 27	00:Always_Disable	20ms
21	Preset Velocity Command Select Input 2 [SP2]	00 to 27	00:Always_Disable	20ms
22	Preset Velocity Command Select Input 3 [SP3]	00 to 27	00:Always_Disable	20ms
23	Preset Velocity Command Input Direction of Movement [DIR]	00 to 27	00:Always_Disable	20ms
24	Preset Velocity Command Operation Start Signal Input [RUN]	00 to 27	00:Always_Disable	20ms
25	Preset Velocity Command CW (direction) Move Start Signal Input [RUN-F]	00 to 27	00:Always_Disable	20ms
26	Preset Velocity Command CCW (direction) Move Start Signal Input [RUN-F]	00 to 27	00:Always_Disable	20ms
27	Velocity Loop Proportional Control Switching Function [VLPCON]	00 to 27	00:Always_Disable	1ms
28	Velocity Compensation Function [V-COMPS]	00 to 27	00:Always_Disable	1ms
30	Torque Compensation Function 1 [T-COMPS1]	00 to 27	00:Always_Disable	1ms
31	Torque Compensation Function 2 [T-COMPS2]	00 to 27	00:Always_Disable	1ms
32	Torque Limit Function [TL]	00 to 27	00:Always_Disable	20ms
33	Disturbance Observer Function [OBS]	00 to 27	00:Always_Disable	20ms
35	Minor vibration (oscillation) suppression function	00 to 27	00:Always_Disable	20ms
40	External Trip Input Function [EXT-E]	00 to 27	00:Always_Disable	20ms
41	Main Power Discharge Function [DISCHARG]	00 to 27	01:Always_Enable	20ms
42	Emergency Stop Function [EMR]	00 to 27	05:CONT2_OFF	20ms

Group9 List of selection contents

■ Keeping the function always valid or invalid

Selection		Contents
00	Always_Disable	Function is always invalid
01	Always_Enable	Function is always valid

■ Using function with the generic input signals

Selection		Contents
02	CONT1_ON	Function is valid when generic input, CONT1, is ON
03	CONT1_OFF	Function is valid when generic input, CONT1, is OFF
04	CONT2_ON	Function is valid when generic input, CONT2, is ON
05	CONT2_OFF	Function is valid when generic input, CONT2, is OFF
06	CONT3_ON	Function is valid when generic input, CONT3, is ON
07	CONT3_OFF	Function is valid when generic input, CONT3, is OFF
08	CONT4_ON	Function is valid when generic input, CONT4, is ON
09	CONT4_OFF	Function is valid when generic input, CONT4, is OFF
0A	CONT5_ON	Function is valid when generic input, CONT5, is ON
0B	CONT5_OFF	Function is valid when generic input, CONT5, is OFF
0C	CONT6_ON	Function is valid when generic input, CONT6, is ON
0D	CONT6_OFF	Function is valid when generic input, CONT6, is OFF
0E	CONT7_ON	Function is valid when generic input, CONT7, is ON
0F	CONT7_OFF	Function is valid when generic input, CONT7, is OFF
10	CONT8_ON	Function is valid when generic input, CONT8, is ON
11	CONT8_OFF	Function is valid when generic input, CONT8, is OFF

■ Activating the functions conditioning the rotational speed of motor

Selection		Contents
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value)
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value)
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value)
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value)
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value)
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)

■ Activating the functions using the positioning signals

Selection		Contents
20	NEAR_IN	Function is valid while in Near status
21	NEAR_OUT	Function is valid while not in Near status
1A	INP_IN	Function is valid while in In-Position status (position deviation < INP)
1B	INP_OUT	Function is valid while not in In-Position status (position deviation < INP)
26	INPZ_IN	Function is valid while in Position command 0 and In-Position status (position deviation < INP)
27	INPZ_OUT	Function is valid while in Position command 0 and In-Position status (position deviation < INP)

■ Activating the functions using the torque / speed limit

Selection		Contents
1C	TLC_IN	Function is valid while in torque limit status
1D	TLC_OUT	Function is valid while not in torque limit status
1E	VLC_IN	Function is valid while in velocity limit status
1F	VLC_OUT	Function is valid while not in velocity limit status

■ Activating the functions conditioning the rotating direction of motor or zero-speed state

Selection		Contents
22	VMON_>_+LV	Function is valid while rotation direction is CW (VMON>+LOWV)
23	VMON_<=_+LV	Function is valid while rotation direction is not CW (VMON≦+LOWV)
24	VMON_<_-LV	Function is valid while rotation direction is CCW (VMON<-LOWV)
25	VMON_>=_-LV	Function is valid while rotation direction is not CCW (VMON≧-LOWV)

ID	Description
00 01	CW Over-Travel Function [F-OT] CCW Over-Travel Function [R-OT]

■ The over travel function uses limit switch to prevent damage to the unit. This function forcedly stops the unit when the movement range of the moving part is exceeded.

◆ Allocating over travel input signal to CONT1 to CONT8.

◆ To use travel function, select the operating conditions for “position command input, motor stop operation and servo-on signal” when over travel occurs.

Group	ID	Symbol	Description
B	11	ACTOT	Over travel operation

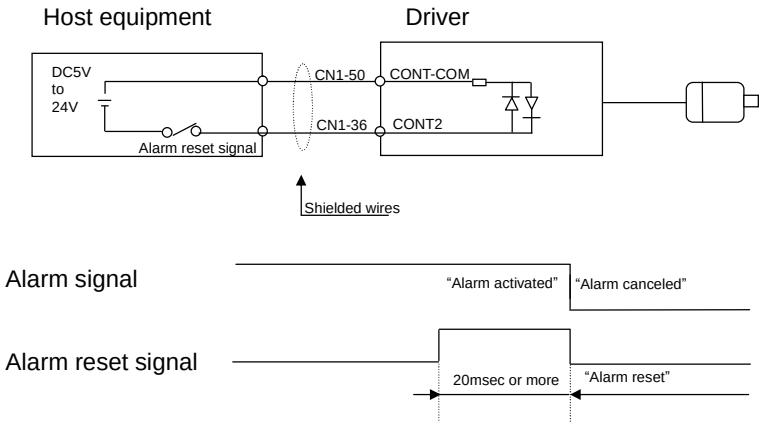
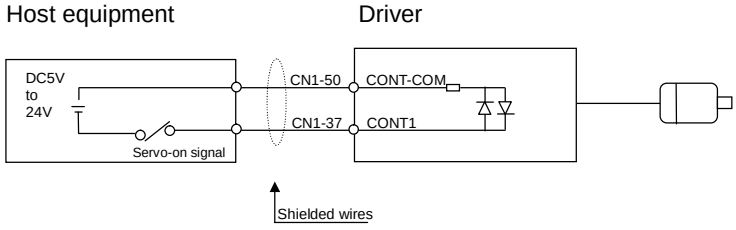
Selectable value		Contents
00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking when OT occurs. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
01	CMDINH_DB_SON	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
02	CMDINH_Free_SON	Command input is disabled, and motor is free-running when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
03	CMDINH_SB_SOFF	Command input is disabled, and motor is stopped by servo-braking when OT occurs. Servo is turned off after motor stops.
04	CMDINH_DB_SOFF	PC is inhibited and Dynamic-Braking is performed. After stops, S-OFF is operated Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned off after motor stops.
05	CMDINH_Free_SOFF	Command input is disabled, and motor is free-running when OT occurs. Servo is turned off after motor stops.
06	CMDACK_VCLM=0	Velocity limit command to the equipment on which OT occurs becomes zero when OT occurs.

◆ “ Stop motor by servo-braking ” when OT occurs

When selecting [00:_CMDINH_SB_SON] or [03:_CMDINH_SB_SOFF], torque value when servo-brake is working can be set by sequence operation torque limit value.

Group	ID	Symbol	Description
8	39	SQTCLM	Sequence operation torque limit value

✔ When setting the value over the maximum output torque (T_P) of motor combined, the torque is limited to the maximum output torque (T_P) of motor combined.

ID	Description
02	Alarm reset function [AL-RST] ■ This function enables inputting alarm reset signal from host equipment. Alarm is cleared by enabling alarm reset function (AL-RST). ◆ Allocating conditions to enable alarm reset function. When AL-RST signal enabled, this function clears alarms. ✔ Please note that you can not clear the alarms that cannot be cleared unless control power supply is turned off once by alarm reset signal. ◆ The wiring when enabling conditions allocation is set to CONT2 is as follows. Logic can be changed by selecting options of enabling conditions allocation. 
05	Servo-on function [S-ON] ■ This function is to input servo-on signal from host equipment. Enabling servo-on function (SON) can put motor into current-applied state. ◆ Allocating conditions to enable servo-on function. When SON signal is enabled, this inputs motor into current-applied state. ◆ The wiring is as follows when setting the allocation of enabling condition to CONT1. The logic can be changed by selection of enabling condition allocation. 

<table>
<tr><td>ID</td><td>Description</td></tr>
<tr><td>11</td><td>
Position command pulse inhibiting function・velocity-zero stop function [INH/Z-STP]
■ This may be used as a function to inhibit the position command pulse (INHIBIT function).

◆ Enabling the function during motor operation inhibits input command, and then motor stops with the state motor being excited.
✔ When operating in position control mode, input pulse is not counted inside of the driver even if position command pulse is input.

◆ Allocating conditions to enable position command pulse inhibiting function/ velocity-zero stop function. This functions when INH/Z-STP signal is enabled.
</td></tr>
<tr><td>13
14</td><td>
Gain switching condition 1 [GC1]
Gain switching condition 2 [GC2]
■ 4 types of gain can be used by switching them.

◆ Allocating conditions to enable gain switching condition. You can switch GAIN 1 to 4 by combination of GC1 and GC2 setting.

<table>
<tr><td>GC1: Gain switching condition 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>GC2: Gain switching condition 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Gain becoming valid</td><td>GAIN1</td><td>GAIN2</td><td>GAIN3</td><td>GAIN4</td></tr>
</table>
</td></tr>
<tr><td>15
16</td><td>
FF vibration suppression frequency selecting input 1 [SUPFSEL1]
FF vibration suppression frequency selecting input 2 [SUPFSEL2]
■ 4 types of FF vibration suppression frequency can be used by switching them.

◆ Allocating conditions to enable FF vibration suppression frequency selecting input. You can switch FF vibration suppression frequency 1 to 4 by combination of SUPFSEL1 and SUPFSEL2 setting.

<table>
<tr><td>SUPFSEL1: FF vibration suppression frequency selecting input 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>SUPFSEL2: FF vibration suppression frequency selecting input 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Vibration suppression becoming valid</td><td>FF vibration suppression frequency 1
Group 2 ID00</td><td>FF vibration suppression frequency 2
Group 4 ID40</td><td>FF vibration suppression frequency 3
Group 4 ID41</td><td>FF vibration suppression frequency 4
Group 4 ID42</td></tr>
</table>
</td></tr>
<tr><td>17</td><td>
Position loop proportional control switching function [PLPCON]
■ You can switch between position loop PI control and P control. Enabling position loop proportional control switching function (PLPCON) enable switching.

◆ Allocating conditions to enable position loop proportional control switching function. When PLPCON signal enabled, the control is switched to proportional control.
● PI control (proportional・integral control) …… Position loop proportional gain (KP)/ integral time constant (TPI)
● P control (proportional control) …… Position loop proportional gain (KP)

✔ In the standard setting, position loop integral time constant (TPI) is 1000.0ms, so integration function is disabled.
</td></tr>
</table>

<table>
<tr><td>ID</td><td>Description</td></tr>
<tr><td>18
19</td><td>Model vibration suppression frequency selecting input 1 [MDLFSEL1]
Model vibration suppression frequency selecting input 2 [MDLFSEL2]
■ 4 types of model vibration suppression frequency can be used by switching them.
◆ Allocating conditions to enable model control antiresonant frequency selecting input. You can switch model control antiresonant frequency 1 to 4/ model control antiresonant frequency 1 to 4 by combination of MDLFSEL1 with MDLFSEL2.
<table>
<tr><td>MDLFSEL1: Model vibration suppression frequency selecting input 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>MDLFSEL2: Model vibration suppression frequency selecting input 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Vibration suppression frequency becoming valid</td><td>Model control antiresonant frequency 1
Group 3 ID02
Model control resonant frequency 1
Group 3 ID03</td><td>Model control antiresonant frequency 2
Group 4 ID50
Model control resonant frequency 2
Group 4 ID51</td><td>Model control antiresonant frequency 3
Group 4 ID52
Model control resonant frequency 3
Group 4 ID53</td><td>Model control antiresonant frequency 4
Group 4 ID54
Model control resonant frequency 4
Group 4 ID55</td></tr>
</table></td></tr>
<tr><td>27</td><td>Velocity loop proportional control switching function [VLPCON]
■ You can switch between velocity loop PI control and P control
◆ Enabling velocity loop proportional control switching function (VLPCON)enables swathing.
◆ Allocating conditions to enable velocity loop proportional control switching function. When VLPCON signal is enabled, the control is switched to proportional control.
● PI control (proportional･integral control)･･Velocity loop proportional gain (KP)/ integral time constant (TPI)
● P control (proportional control)･･････ Velocity loop proportional gain (KP)
✔ Switching to proportional control decreases servo gain, and then servo system becomes stable.
✔ When setting velocity loop integral time constant (TVI) to 1000.0ms, the operation is in the state integration function is disabled (proportional control), so you do not need to use this function.</td></tr>
<tr><td>35</td><td>Minor vibration (oscillation) suppression function [FBHYST]
■ Minor vibration suppression function to suppress mechanical system-induced vibration due to ±1-pulse width modulation of encoder is enabled when motor stops.
◆ The conditions for enabling minor vibration suppression function are assigned. The minor vibration suppression function becomes enabled. If the FBHYST signal is valid.</td></tr>
<tr><td>40</td><td>External trip input function [EXT-E]
■ Contact input such as external thermal device can be taken in driver, and then output as an alarm (AL55).
◆ Allocating conditions to enable external trip function. When EXT-E signal is enabled, this becomes alarm (AL55).</td></tr>
<tr><td>41</td><td>Forced discharge function [DISCHARG]
■ This is to forcedly discharge the voltage charged in the capacitor for main circuit power supply inside of driver, when main circuit power supply is being turned off. Note that discharging cannot be performed when main circuit power supply is being turned on.
◆ Allocating conditions to enable forced discharge function. When DISCHARGE signal is enabled, capacitor is forcedly discharged.</td></tr>
<tr><td>42</td><td>Emergency stop function [EMR]
■ This can urgently stop motor by taking unit emergency signal into the driver.
◆ Allocating conditions to enable unit emergency signal. When EMR signal is enabled, motor urgently stops.</td></tr>
</table>

■ GroupA “General output terminal output condition/ Monitor output selection/ Serial communication settings”

ID	Contents	Setting range	Unit	Standard value
00	General Purpose Output 1 [OUT1]	00 to 5F	-	18:INP_ON
01	General Purpose Output 2 [OUT2]	00 to 5F	-	68:CSETRDY _ON
02	General Purpose Output 3 [OUT3]	00 to 5F	-	02:S-RDY_ON
03	General Purpose Output 4 [OUT4]	00 to 5F	-	4E:CSETCMP _ON
04	General Purpose Output 5 [OUT5]	00 to 5F	-	33:ALM5_OFF
05	General Purpose Output 6 [OUT6]	00 to 5F	-	35:ALM6_OFF
06	General Purpose Output 7 [OUT7]	00 to 5F	-	37:ALM7_OFF
07	General Purpose Output 8 [OUT8]	00 to 5F	-	39:ALM_OFF
10	Digital Monitor Output Signal Selection [DMON]	00 to 5F	-	00:Always_OFF

■ Select output signal for Output digital monitor
- ◆ The logic is reversed with the Digital monitor.
- ◆ Output voltage is approximately 5V when OFF, and 0V when ON.

■ Selection Contents list for General Purpose Output OUT1 to General Purpose Output OUT8 /Digital monitor output selection

◆ Fix Output on either selection.

01:Always_ON	00:Always_OFF

◆ When Generic input signal status it to be Output.

General Input, CONT1 is ON	3A:CONT1_ON	3B:CONT1_OFF
General Input, CONT2 is ON	3C:CONT2_ON	3D:CONT2_OFF
General Input, CONT3 is ON	3E:CONT3_ON	3F:CONT3_OFF
General Input, CONT4 is ON	40:CONT4_ON	41:CONT4_OFF
General Input, CONT5 is ON	42:CONT5_ON	43:CONT5_OFF
General Input, CONT6 is ON	44:CONT6_ON	45:CONT6_OFF
General Input, CONT7 is ON	46:CONT7_ON	47:CONT7_OFF
General Input, CONT8 is ON	48:CONT8_ON	49:CONT8_OFF

◆ When Driver Preset status is to be output.

While Servo Ready Complete	02:S-RDY_ON	03:S-RDY_OFF
	58:S-RDY2_ON	59:S-RDY2_OFF
While Power Supply ON	04:P-ON_ON	05:P-ON_OFF
While Power Supply ON Permission	06:A-RDY_ON	07:A-RDY_OFF
While Motor Excitation	08:S-ON_ON	09:S-ON_OFF
While Holding Brake Excitation Signal Output	0A:MBR-ON_ON	0B:MBR-ON_OFF
While Torque Limiting	0C:TLC_ON	0D:TLC_OFF
While Velocity Limiting	0E:VLC_ON	0F:VLC_OFF
While Low Speed Status	10:LOWV_ON	11:LOWV_OFF
While Speed Attainment Status	12:VA_ON	13:VA_OFF
While Speed Matching Status	14:VCMP_ON	15:VCMP_OFF
While Speed Zero Status	16:ZV_ON	17:ZV_OFF
While Command Acceptance Permission Status	1C:CMD-ACK_ON	1D:CMD-ACK_OFF
While Gain Switching Status	1E:GC-ACK_ON	1F:GC-ACK_OFF
While Velocity Loop Proportional Control Switching Status	20:PCON-ACK_ON	21:PCON-ACK_OFF
While Electronic Gear Switching Status	22:GERS-ACK_ON	23:GERS-ACK_OFF
While Control Mode Switching Status	24:MS-ACK_ON	25:MS-ACK_OFF
While CW Over-Travel Status	26:F-OT_ON	27:F-OT_OFF
While CCW Over-travel Status	28:R-OT_ON	29:R-OT_OFF
While Main Circuit Power Supply Charging	4A:CHARGE_ON	4B:CHARGE_OFF
While Dynamic Braking	4C:DB_OFF	4D:DB_ON
While Magnetic Pole Position Estimation Completion	4E:CSETCMP_ON	4F:CSETCMP_OFF
While Torque Attainment Status	5E:TA_ON	5F:TA_OFF
While Magnetic Pole Position Estimation Ready	68:CSETRDY_ON	69:CSETRDY_OFF

◆ When Positioning signal is to be output

While In-Position Status	18:INP_ON	19:INP_OFF
While Near Range Status	1A:NEAR_ON	1B:NEAR_OFF
While In-Position with Position Command 0 Status	5A:INPZ_ON	5B:INPZ_OFF

◆ When Warning signal is to be output

While Excessive Deviation Warning Status	2A:WNG-OFW_ON	2B:WNG-OFW_OFF
While Overload Warning Status	2C:WNG-OLW_ON	2D:WNG-OLW_OFF
While Regenerative Overload Warning Status	2E:WNG-ROLW_ON	2F:WNG-ROLW_OFF
While Battery Warning status	30:WNG-BAT_ON	31:WNG-BAT_OFF
While Under Voltage Sag Warning Status	5C:PEWNG_ON	5D:PEWNG_OFF

◆ When Alarm signals are to be output

Alarm Code Bit 5	32:ALM5_ON	33:ALM5_OFF
Alarm Code Bit 6	34:ALM6_ON	35:ALM6_OFF
Alarm Code Bit 7	36:ALM7_ON	37:ALM7_OFF
While Alarm Status	38:ALM_ON	39:ALM_OFF

ID	Contents	Setting range	Unit	Standard value
11	Analog Monitor Select Output 1 [MON1]	00 to 1C	-	05:VMON_2mV/min^{-1}
12	Analog Monitor Select Output 2 [MON2]	00 to 1C	-	02:TCMON_2V/TR

■ Select output signals to output to Analog monitor 1 and 2 from the list below:

01:TMON_2V/TR	Torque Monitor	2V/Rated torque
02:TCMON_2V/TR	Torque Command Monitor	2V/Rated torque
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_0.01mV/P	Position Deviation Counter Monitor	0.01mV/Pulse
0C:PMON_0.1mV/P	Position Deviation Counter Monitor	0.1mV/Pulse
0D:PMON_1mV/P	Position Deviation Counter Monitor	1mV/Pulse
0E:PMON_10mV/P	Position Deviation Counter Monitor	10mV/Pulse
0F:PMON_20mV/P	Position Deviation Counter Monitor	20mV/Pulse
10:PMON_50mV/P	Position Deviation Counter Monitor	50mV/Pulse
11:FMON1_2mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency	2mV/kPulse/s
12:FMON1_10mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	10mV/kPulse/s
13:FMON2_0.05mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	0.05mV/kPulse/s
14:FMON2_0.5mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	0.5mV/kPulse/s
15:FMON2_2mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	2mV/kPulse/s
16:FMON2_10mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	10mV/kPulse/s
17:TLMON_EST_2V/TR	Load Torque Monitor (Estimated Value)	2V/Rated torque
18:Sine-U	U Phase Electronic Angle Sin	8Vpeak
19:ACMON_0.01mV/rad/s^2	Acceleration monitor	0.01mV/rad/s^2
1A:ACMON_0.1mV/rad/s^2	Acceleration monitor	0.1mV/rad/s^2
1B:ACMON_1mV/rad/s^2	Acceleration monitor	1mV/rad/s^2
1C:ACMON_10mV/rad/s^2	Acceleration monitor	10mV/rad/s^2

- ◆ Position command pulse frequency monitor 1 monitors Position command pulse before the Electronic gear.
- ◆ Position command pulse frequency monitor 2 monitors Position command pulse after passing through the Electronic gear and Position command smoothing.
  - ✔ Position command pulse frequency monitor 1, 2 will be generated in pulse-state when the position command pulse is 10kHz or less.
    When converting it to position command frequency, use it after averaging.
- ◆ The following low-pass filters are placed into torque monitor, acceleration monitor, and load torque monitor:
  Torque monitor 250Hz
  Acceleration monitor 250Hz
  Load torque monitor 20Hz

ID	Contents			
13	Analog Monitor Output Polarity [MONPOL]	Setting range	Unit	Standard value
		00 to 08	-	00:MON1+_MON2+

■ Select Output polarity of Analog monitor output, MON1and MON2

◆ For both MON1 and MON2, set from any of the followings:
+ No Polarity Rotation,- Polarity Rotation, ABS Absolute Value Output

Selection	Contents
00:MON1+_MON2+	MON1: Output positive voltage at CW Rotation. Output positive/negative voltage. MON2: Output positive voltage at CW Rotation. Output positive/negative voltage.
01:MON1-_MON2+	MON1: Output negative voltage at CW Rotation. Output positive/negative voltage. MON2: Output positive voltage at CW Rotation. Output positive/negative voltage.
02:MON1+_MON2-	MON1: Output positive voltage at CW Rotation. Output positive/negative voltage. MON2: Output negative voltage at CW Rotation. Output positive/negative voltage.
03:MON1-_MON2-	MON1: Output negative voltage at CW Rotation. Output positive/negative voltage. MON2: Output negative voltage at CW Rotation. Output positive/negative voltage.
04:MON1ABS_MON2+	MON1: Output positive voltage at CW and CCW Rotation. MON2: Output negative voltage at CW Rotation. Output positive/negative voltage.
05:MON1ABS_MON2-	MON1: Output positive voltage at CW and CCW Rotation. MON2: Output negative voltage at CW Rotation. Output positive/negative voltage.
06:MON1+_MON2ABS	MON1: Output positive voltage at CW Rotation. Output positive/negative voltage. MON2: Output positive voltage at CW and CCW Rotation.
07:MON1-_MON2ABS	MON1: Output negative voltage at CW Rotation. Output positive/negative voltage. MON2: Output positive voltage at CW and CCW Rotation.
08:MON1ABS_MON2ABS	MON1: Output positive voltage at CW and CCWRotation. MON2: Output positive voltage at CW and CCW Rotation.

<table>
<tr><td>ID</td><td>Contents</td></tr>
<tr><td>20</td><td>
Serial Communication Axis Number [COMAXIS] Control power reactivation after setting
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>01 to 0F</td><td>-</td><td>01:#1</td></tr>
</table>
■ Select Axis number from below for Serial communication (RS-232C/RS-422A) with PC or upper controller:
◆ As this number identifies each driver, assign the different number so that the driver connected to PC or host controller do not have the same number.
<table>
<tr><td colspan="2">Selection</td><td colspan="2">Selection</td><td colspan="2">Selection</td><td colspan="2">Selection</td><td colspan="2">Selection</td></tr>
<tr><td>01</td><td>#1</td><td>04</td><td>#4</td><td>07</td><td>#7</td><td>0A</td><td>#A</td><td>0D</td><td>#D</td></tr>
<tr><td>02</td><td>#2</td><td>05</td><td>#5</td><td>08</td><td>#8</td><td>0B</td><td>#B</td><td>0E</td><td>#E</td></tr>
<tr><td>03</td><td>#3</td><td>06</td><td>#6</td><td>09</td><td>#9</td><td>0C</td><td>#C</td><td>0F</td><td>#F</td></tr>
</table>
</td></tr>
<tr><td>21</td><td>
Serial Communication Baud Rate [COMBAUD] Control power reactivation after setting
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>03 to 06</td><td>-</td><td>05:38400bps</td></tr>
</table>
■ Select Communication speed (Baud rate) with PC or upper controller from below:
<table>
<tr><td colspan="2">Selection</td></tr>
<tr><td>03</td><td>9600bps</td></tr>
<tr><td>04</td><td>19200bps</td></tr>
<tr><td>05</td><td>38400bps</td></tr>
<tr><td>06</td><td>57600bps</td></tr>
</table>
</td></tr>
<tr><td>22</td><td>
Latency to start sending response message
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 500</td><td>ms</td><td>0</td></tr>
</table>
■ When performing RS-422A-communication between controller and driver, a minimum latency to start sending response message can be set.
◆ Actual latency may vary to the extent of 0 to +3ms to this setting value.
✔ Make sure to set “0” to communicate with setup software.
</td></tr>
<tr><td>30</td><td>
Monitor Display Selection [MONDISP]
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 26</td><td>-</td><td>00:STATUS</td></tr>
</table>
■ Select status display on digital operator.
<table>
<tr><td colspan="2">Selection</td><td>Description</td></tr>
<tr><td>00</td><td>STATUS</td><td>Displays status of driver.
See “Driver Status Display (5-16)” for more details.</td></tr>
<tr><td>01
to
26</td><td>WARNING1
to
ACCMON</td><td>Select monitoring data to show on monitor function.
See “Monitor function (5-23)” for more details.</td></tr>
</table>
</td></tr>
</table>

■ GroupB “Sequence/Alarm related settings”

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="3">00</td><td rowspan="2">JOG Velocity Command
[JOGVC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 3276.7</td><td>min^{-1}</td><td>5.0</td></tr>
<tr><td colspan="4">■ Set velocity command value for JOG operation.
◆ This value is set as initial setting value for JOG Velocity Command for setup software.</td></tr>
<tr><td rowspan="3">01</td><td rowspan="2">Excitation Command Frequency setting
[EMPFREQ]</td><td>Allowable setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>30 to 70</td><td>Hz</td><td>50</td></tr>
<tr><td colspan="4">■ Set the excitation command frequency for the estimation of magnetic pole position.
◆ Change the setting in case where successful completion of the estimation of magnetic pole position fails due to the resonance point of the system.</td></tr>
<tr><td rowspan="3">02</td><td rowspan="2">Acceleration threshold
[ACC]</td><td>Allowable setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>2 to 100</td><td>rad/s^2</td><td>5</td></tr>
<tr><td colspan="4">■ Set the acceleration threshold for the estimation of magnetic pole position.
◆ Change the settings in case where successful completion of the magnetic pole position estimation fails due to the larger magnitude of applied load inertia of the system is low.</td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Dynamic Brake Operation
[DBOPE]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 05</td><td>-</td><td>03:DB_DB</td></tr>
<tr><td colspan="4">■ Select Dynamic Brake Operation when shifted from serve ON to servo OFF, and during servo OFF.

<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Free_Free</td><td>When Servo OFF, Free-Run Operation
After Motor Stop, Motor-Free Operation</td></tr>
<tr><td>01</td><td>Free_DB</td><td>When Servo OFF, Free-Run Operation
After Motor Stop, Dynamic Brake Operation</td></tr>
<tr><td>02</td><td>DB_Free</td><td>When Servo OFF, Dynamic Brake Operation
After Motor Stop, Motor-Free Operation</td></tr>
<tr><td>03</td><td>DB_DB</td><td>When Servo OFF, Dynamic Brake Operation
After Motor Stop, Dynamic Brake Operation</td></tr>
<tr><td>04</td><td>SB_Free</td><td>When Servo OFF, Servo Brake Operation
After Motor Stop, Motor-Free Operation</td></tr>
<tr><td>05</td><td>SB_DB</td><td>When Servo OFF, Servo Brake Operation
After Motor Stop, Dynamic Brake Operation</td></tr>
</table>

✔ When the main circuit power supply is shut-off, the motor stops as configured at “GroupB ID12: Emergency Stop Operation [ACTEMER]” and goes with dynamic brake operation after the stopping.
Nevertheless, if it detects “Main circuit voltage sag” or “Passing BONBGN” in the process of the emergency stopping, it stops with dynamic brake operation.</td></tr>
</table>

<table>
<tr><td>ID</td><td>Contents</td></tr>
<tr><td>11</td><td>
Over-Travel Action [ACTOT]
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 06</td><td>-</td><td>00:CMDINH_SB_SON</td></tr>
</table>
■ Select operations at over-travel action
<table>
<tr><td colspan="2">Selection</td><td>Contents</td></tr>
<tr><td>00</td><td>CMDINH_SB_SON</td><td>When in Over-travel action, Command input is invalid and servo brake stops motor.
After motor stops, servo is ON.
(command at OT side = velocity limit command =0)</td></tr>
<tr><td>01</td><td>CMDINH_DB_SON</td><td>When in Over-travel action, Command input is invalid and dynamic brake stops motor.
After motor stops, servo is ON.
(command at OT side = velocity limit command =0)</td></tr>
<tr><td>02</td><td>CMDINH_Free_SON</td><td>When in Over-travel action, Command input is invalid and Free run is operated.
After motor stops, servo is ON.
(command at OT side = velocity limit command =0)</td></tr>
<tr><td>03</td><td>CMDINH_SB_SOFF</td><td>When in Over-travel action, Command input is invalid and servo brake stops motor.
After motor stops, servo is OFF.</td></tr>
<tr><td>04</td><td>CMDINH_DB_SOFF</td><td>When in Over-travel action, Command input is invalid and dynamic brake stops motor.
After motor stops, servo is OFF.</td></tr>
<tr><td>05</td><td>CMDINH_Free_SOFF</td><td>When in Over-travel action, Command input is invalid and Free run is operated.
After motor stops, servo is OFF.</td></tr>
<tr><td>06</td><td>CMDACK_VCLM=0</td><td>When in Over-travel action, Command input to the Over -travel side is 0.</td></tr>
</table>
◆ Torque limit value to stop motor by servo brake is the setting value of sequence Torque limit.
</td></tr>
<tr><td>12</td><td>
Emergency Stop Operation [ACTEMR]
<table>
<tr><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>01:DYNAMIC-BRAKE</td></tr>
</table>
■ Sets operation at Emergency Stop
◆ From the following contents, select operation at the time of emergency stop (EMR, main power OFF). Besides, in usage by a vertical axis, please use it with setting 00: _SERVO-BRAKE).
<table>
<tr><td colspan="2">Selection</td><td>Contents</td></tr>
<tr><td>00</td><td>SERVO-BRAKE</td><td>At the time of EMR-input, main circuit power shutdown, alarm activated, or safe torque off operation, stop motor by operating servo brake, and then dynamic brake is activated after servo motor stopped.</td></tr>
<tr><td>01</td><td>DYNAMIC-BRAKE</td><td>At the time of EMR-input, main circuit power shutdown, alarm activated, or safe torque off operation, stop motor by operating dynamic brake, and the dynamic brake continues to be activated even after servo motor stopped.</td></tr>
</table>
◆ Alarm whose “stop operation” when alarm activated is DB, stops motor by dynamic brake regardless of this setting.
✔ Forced stop operation means “emergency stop function enabled,” “main circuit power shutoff,” ”alarm activated,” and “safe-torque-off operation.”
</td></tr>
</table>

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">13</td><td>Delay Time of Engaging Holding Brake
(Holding Brake Holding Delay time)
[BONDLY]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>0 to 1000</td><td>ms</td><td>300</td></tr>
<tr><td colspan="4">■ Sets holding-brake-activation delay time from when power distribution to holding brake stopped till when holding torque generated.
◆ While shifting from servo ON to servo OFF, during the setting time, Excitation command 0 is given to motor. (Even when servo is turned OFF, power is supplied to the motor until the setting time is over.)
◆ By this, until Holding brake functions, motor generates Holding torque.
◆ Setting unit is 4ms. When the setting value is 0ms, after servo OFF, command is invalid (command 0) for approximately 4ms.
◆ At the setting, Group8 ID10 [DBOPE] Dynamic Brake Operation, when servo brake is ON at servo OFF, (04 SB_Free or 05 SB_DB), it is valid.
(This function is invalid in Dynamic brake operation and Free-run operation.)</td></tr>
<tr><td rowspan="2">14</td><td>Delay Time of Releasing Holding Brake
(Holding Brake Releasing Delay time)
[BOFFDLY]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>0 to 1000</td><td>ms</td><td>300</td></tr>
<tr><td colspan="4">■ Sets holding-brake-release delay time from when power distribution to holding brake started till when holding torque disappeared.
◆ While shifting from servo OFF to servo ON, during the setting time, Excitation command 0 is given to motor. (Even when servo is turned ON, command is not accepted until the setting time is complete.)
◆ Therefore, until Holding brake is released, motor does not operate.
◆ Setting unit is 4ms. When the setting value is 0ms, after servo ON, command is invalid (command 0) for approximately 4ms.</td></tr>
<tr><td rowspan="2">15</td><td>Brake Operation Beginning Time
[BONBGN]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>0 to 65535</td><td>ms</td><td>10000</td></tr>
<tr><td colspan="4">■ Sets permissible time from servo OFF until motor stop.
◆ While shifting servo ON to servo OFF, even after the selected time passed and the motor does not stop. Motor is forced to stop with Holding brake and Dynamic brake.
◆ When the motor stops this setting does not function.
◆ When motor does not stop after servo OFF at gravity axis, set this parameter.
◆ When forced to stop by Holding brake, the Holding brake may possibly be broken. Be cautious about device specifications and sequence when using this function.</td></tr>
</table>

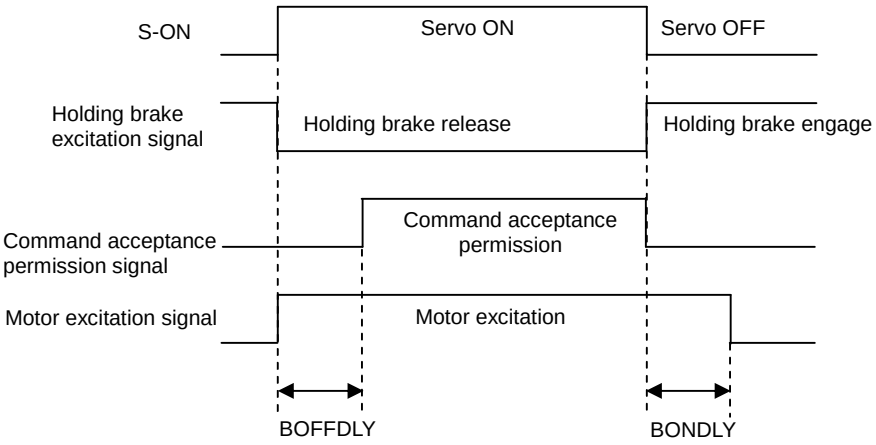
■ About Holding Brake

Motor with Holding brake function is usually used with
an axis that is always affected by gravity and external forces
in order to avoid movable parts falling off from its position
when main circuit power is OFF, or servo OFF.
The holding brake acts to bear the gravity and other external forces applied on the movable parts at rest. Do not use it to break any running machine to a stop.

◆ Setting for Holding brake excitation signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Output*

Selection		Contents
0A	MBR-ON_ON	While Holding brake excitation signal output, output ON.
0B	MBR-ON_OFF	While Holding brake excitation signal output, output OFF.



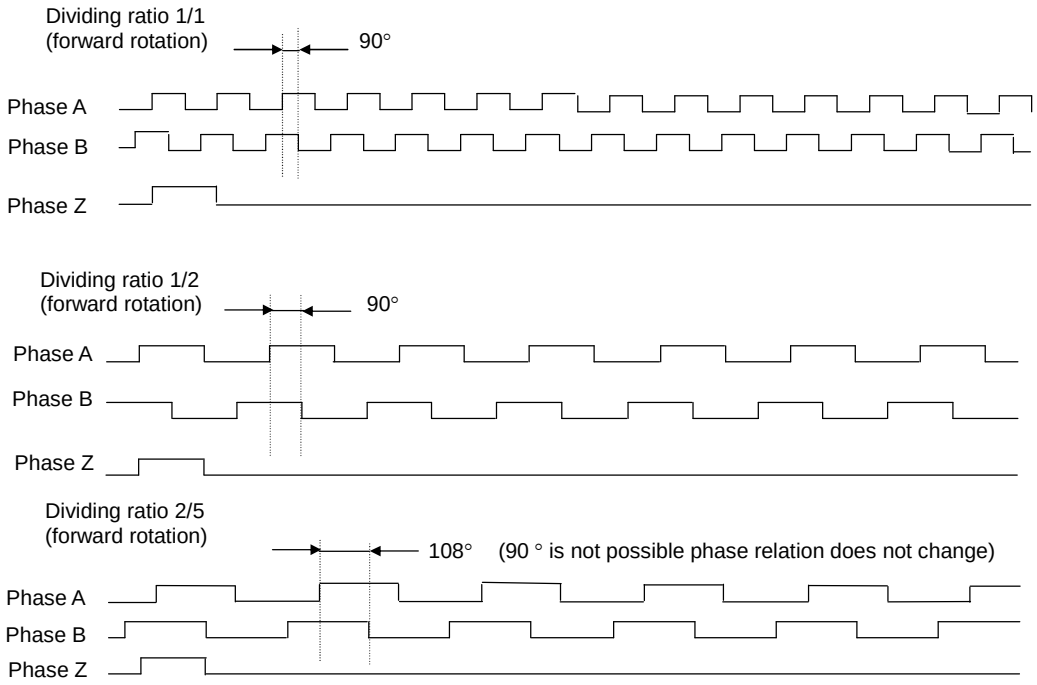
<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="2">16</td><td>Power Failure Detection Delay Time
[PFDDLY]
Control power reactivation after setting</td><td>Setting range
20 to 1000</td><td>Unit
ms</td><td>Standard value
32</td></tr>
<tr><td colspan="4">■ Sets the delay time from Control power OFF to Control power error detection.
The larger value makes the detection of Instantaneous stop slower.
(Control power holding time is about 100msec
Larger set value will only result in slower detections of errors. In case of power failure of Internal logic circuit, operation is 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 to +6ms.</td></tr>
<tr><td rowspan="2">20</td><td>Excessive Deviation Warning Level
[OFWLV]</td><td>Setting range
1 to 2147483647</td><td>Unit
Pulse</td><td>Standard value
2147483647</td></tr>
<tr><td colspan="4">■ Sets Warning output level before Excessive position deviation alarm is output.
◆ Sets at Encoder pulse resolution regardless of Electronic gear.</td></tr>
<tr><td rowspan="2">21</td><td>Deviation Counter Overflow Value
[OFLV]</td><td>Setting range
1 to 2147483647</td><td>Unit
Pulse</td><td>Standard value
5000000</td></tr>
<tr><td colspan="4">■ Sets Position deviation value regarded as Excessive position deviation alarm.
◆ Sets at Encoder pulse resolution regardless of Electronic gear.</td></tr>
<tr><td rowspan="2">22</td><td>Overload Warning Level
[OLWLV]
Control power reactivation after setting</td><td>Setting range
20 to 100</td><td>Unit
%</td><td>Standard value
90</td></tr>
<tr><td colspan="4">■ Sets Warning output level before Overload alarm output.
◆ The possible level to be set is from 20%-99%, assuming that the Overload Warning 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, Overload warning may be output when Control power is turned ON.</td></tr>
<tr><td rowspan="2">23</td><td>Velocity Feedback Alarm (ALM_C3) Detection
[VFBALM]</td><td>Setting range
00 to 01</td><td>Unit
-</td><td>Standard value
01:Enabled</td></tr>
<tr><td colspan="4">■ Selects Valid/Invalid Velocity feedback error detection.
<table><tr><td colspan="2">Selection</td><td>Contents</td></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table></td></tr>
<tr><td rowspan="2">24</td><td>Velocity Control Alarm (ALM_C2) Detection
[VCALM]</td><td>Setting range
00 to 01</td><td>Unit
-</td><td>Standard value
00:Disabled</td></tr>
<tr><td colspan="4">■ Selects Valid/Invalid Velocity control error detection.
<table><tr><td colspan="2">Selection</td><td>Contents</td></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table>◆ 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 invalid.</td></tr>
</table>

04

Encoder Output Pulse Division [ENRAT]	Setting range	Unit	Standard value
	1/1 to 1/64 2/3 to 2/64 1/32768 to 32767/32768	-	1/20

■ Sets ratio of Encoder output pulse division.

- ◆ When the numerator of the dividing ratio is 1, setting range of the denominator is 1 (not divide), 2-64,or 32768.
- ◆ When the numerator of the dividing ratio is 2, setting range of the denominator is 3-64,or 32768.
- ◆ When the denominator of the dividing ratio is 32768, setting range of the numerator is 1-32767.
- ◆ Z phase output is not divided
- ◆ After Control power ON, for 2s at maximum, the ratio is unstable.



05

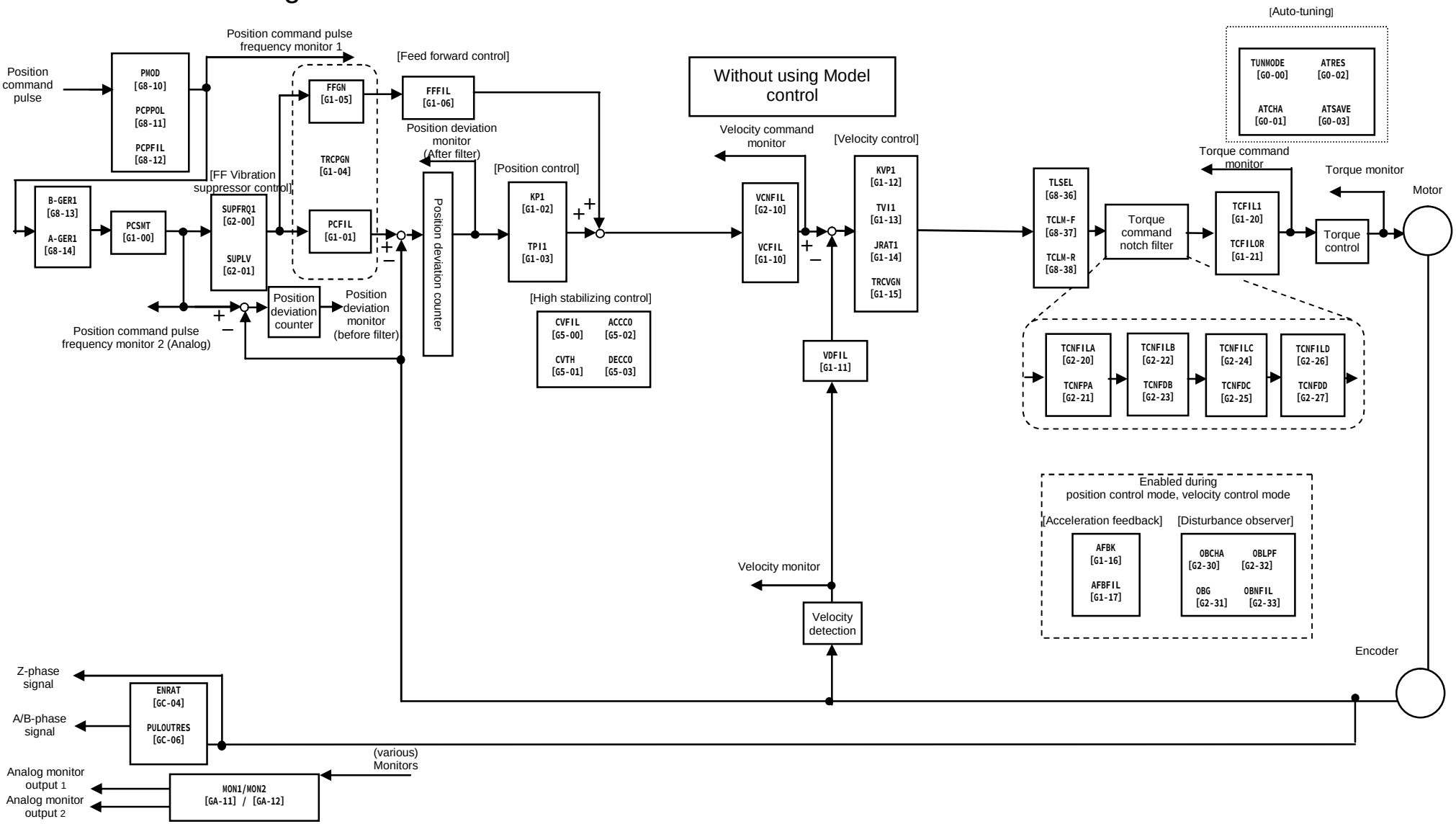
Encoder Output Pulse Divide Polarity [PULOUTPOL]	Setting range	Unit	Standard value
	00 to 03	-	01:Type2

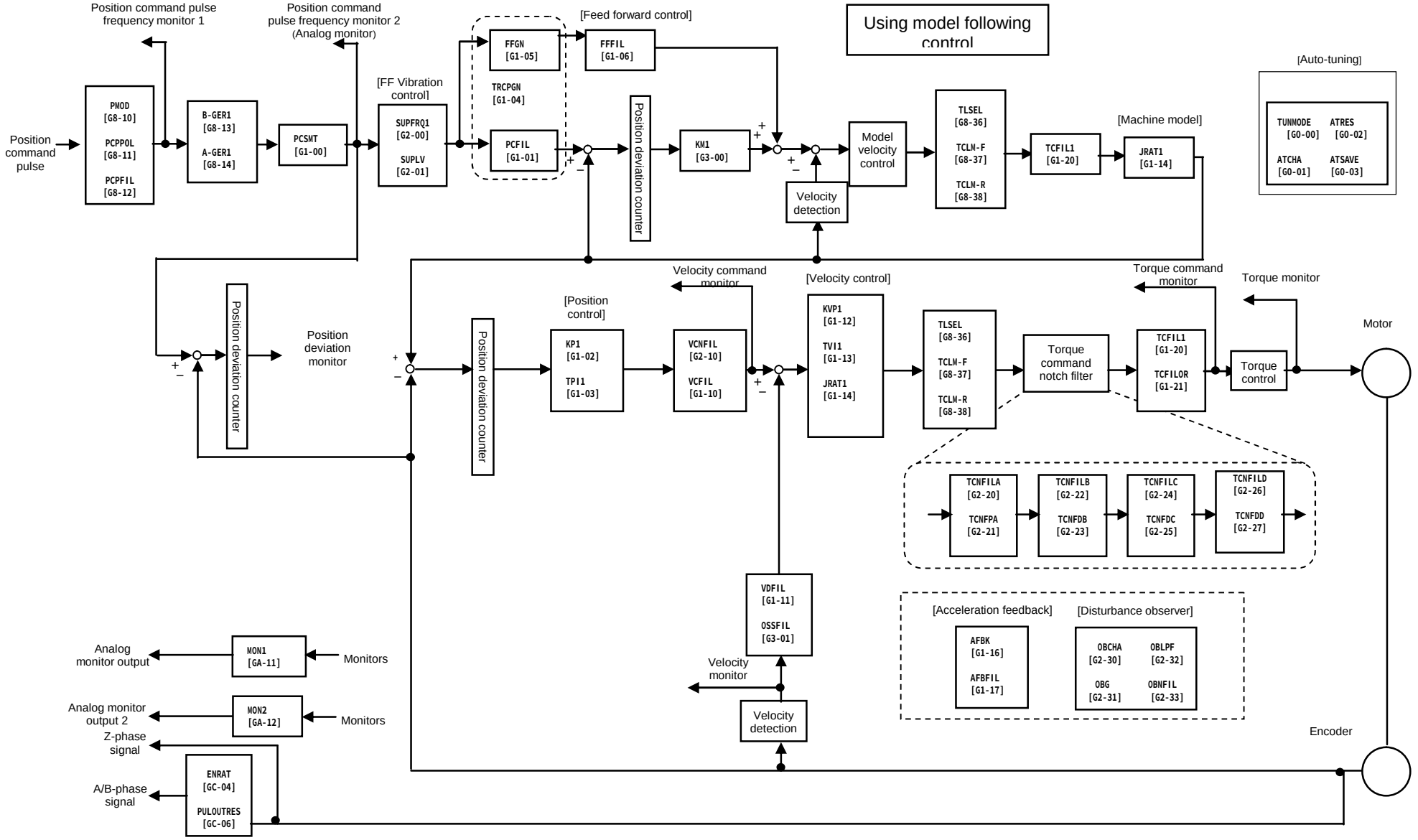
■ Sets division polarity of Encoder output pulse.

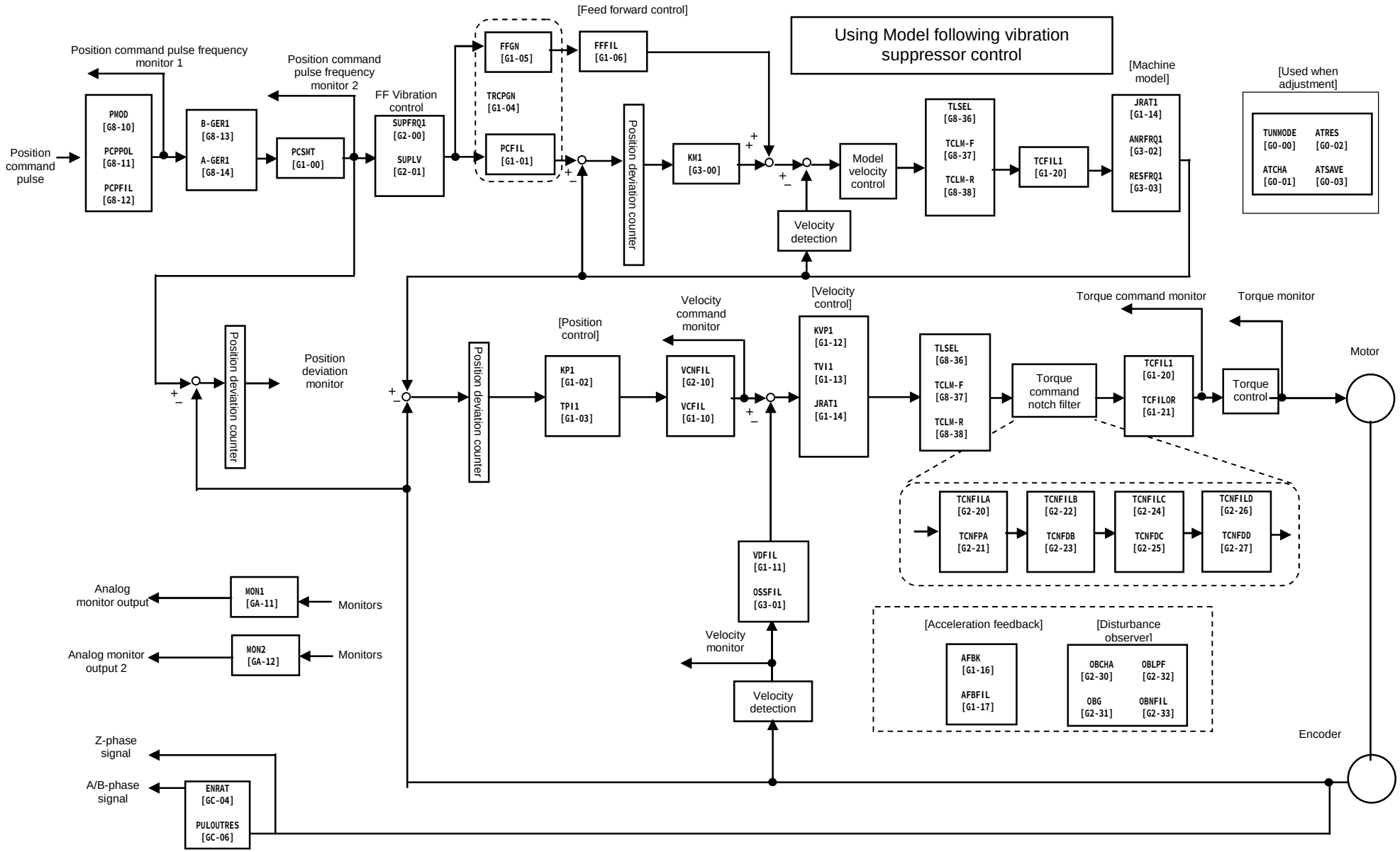
Selection		Contents
00	Type1	A Phase Signal/Not Reversed Z Phase Signal Logic/High Active
01	Type2	A Phase Signal/Reversed Z Phase Signal Logic/High Active
02	Type3	A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active
03	Type4	A Phase Signal/Reversed Z Phase Signal Logic/Low Active

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">06</td><td rowspan="2">Encoder Output Pulse Divide Resolution Selection [PULOUTRES]
Control power reactivation after setting</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:163840 P/R</td></tr>
<tr><td colspan="5">■ This parameter is settable only when using serial encoder.
◆ Sets resolution of Encoder output pulse divide.
◆ Set at 163840P/R when Output pulse frequency exceeds the specification of the upper controller.
◆ Outputs divided pulse by setting resolution to ID04 Encoder output divide.
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>163840P/R</td><td>163840 Pulse per 1 Motor Rotation</td></tr><tr><td>01</td><td>655360P/R</td><td>655360 Pulse per 1 Motor Rotation</td></tr></table></td></tr>
<tr><td rowspan="2">07</td><td rowspan="2">Resolver Signal Output(PS) Format [PSOFORM]
Control power reactivation after setting</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:MOT_Binary</td></tr>
<tr><td colspan="5">■ Sets signal format of Encoder signal output (PS).
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>MOT_Binary</td><td>Binary Code Output</td></tr><tr><td>01</td><td>MOT_ASCII</td><td>Decimal ASCII Code Output</td></tr></table></td></tr>
</table>

5.9 Control block diagram




Position command pulse frequency monitor 1
Position command pulse frequency monitor 2 (Analog monitor)
[Feed forward control]
Using model following control
[Auto-tuning]
Position command pulse
PMOD [G8-10]
PCPPOL [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
[FF Vibration control]
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Velocity detection
Model velocity control
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
[Machine model]
JRAT1 [G1-14]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Position deviation counter
Position deviation monitor
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
Velocity command monitor
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
Torque command monitor
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque monitor
Torque control
Motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
[Acceleration feedback]
AFBK [G1-16]
AFBFIL [G1-17]
[Disturbance observer]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Encoder
Analog monitor output
MON1 [GA-11]
Monitors
Analog monitor output 2
MON2 [GA-12]
Monitors
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]


[Feed forward control]
Using Model following vibration suppressor control
Position command pulse frequency monitor 1
Position command pulse frequency monitor 2
FF Vibration control
[Machine model]
[Used when adjustment]
Position command pulse
PMOD [G8-10]
PCPPOL [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Model velocity control
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
JRAT1 [G1-14]
ANRFRQ1 [G3-02]
RESFRQ1 [G3-03]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Velocity detection
Position deviation monitor
Position deviation counter
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
Velocity command monitor
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque command monitor
Torque monitor
Torque control
Motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
[Acceleration feedback]
[Disturbance observer]
AFBK [G1-16]
AFBFIL [G1-17]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Analog monitor output
MON1 [GA-11]
Monitors
Analog monitor output 2
MON2 [GA-12]
Monitors
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]
Encoder

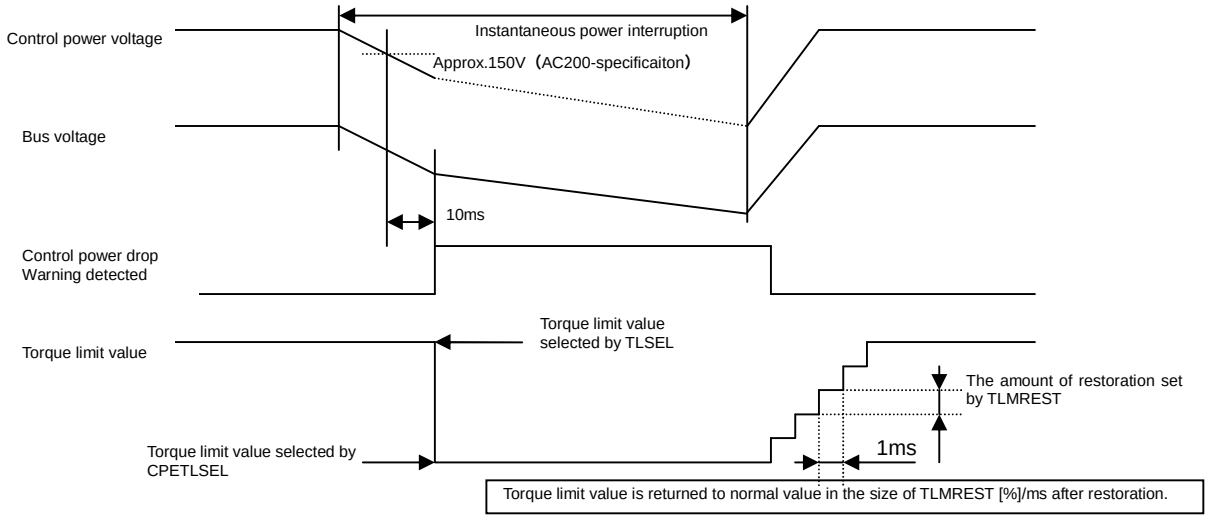
5.10 SEMI F47 supporting function

This function limits motor current when it detects voltage sag warning due to instantaneous power failure (when voltage dropped to 135~152VAC).
This function is provided to support acquiring “SEMI F47 Standard” that is requisite for semiconductor equipments.
Combined with Power Failure Detection Delay Time [GroupB ID16], it prevents motor stop with alarm when in instantaneous power failure and enables to continue operation.

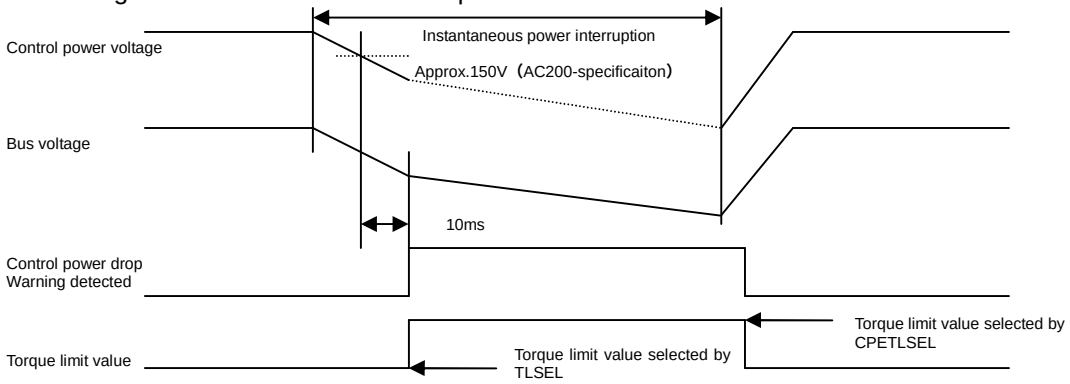
1) Parameter setting
General parameters Group8 “Control system”

ID	Symbol	Name	Standard setting value	Unit	Setting range
3D	TLMREST	The amounts of torque limit value restoration when power restored.	0.0	%	0.0 to 500.0

2) Operational sequence
This shows the operational sequence from detecting warning of low control power voltage to restoration of control power voltage.



3) Notes
Set torque limit value under voltage sag warning smaller than that of normal operation.
Even if the torque limit value of voltage sag is greater than that of normal operation, it limits the torque at the set value when in voltage sag. After power restoration, the limiting value goes back to that of normal operation.



✔ This function is supposed to limit motor torque when in power failure and does not support all the load or operating conditions. Check if it properly works on the actual machines before the actual use.

No Text on This Page.

6

6. Adjustments

6.1 Servo tuning functions and basic adjustment procedure

To operate the motor (and machine) using the driver, adjustments of the servo gain and its control system is necessary. Generally, the higher setting value of the servo gain increases the machine response. However, if the servo gain is too high, in a lower rigidity machine, vibration may result and the machine response will not increase. The servo gain and its control system need to be appropriately adjusted according to the operating motor and the mechanical system and this adjustment method is called Servo tuning.
Following is an explanation of the Servo tuning procedure:

1) Servo tuning functions

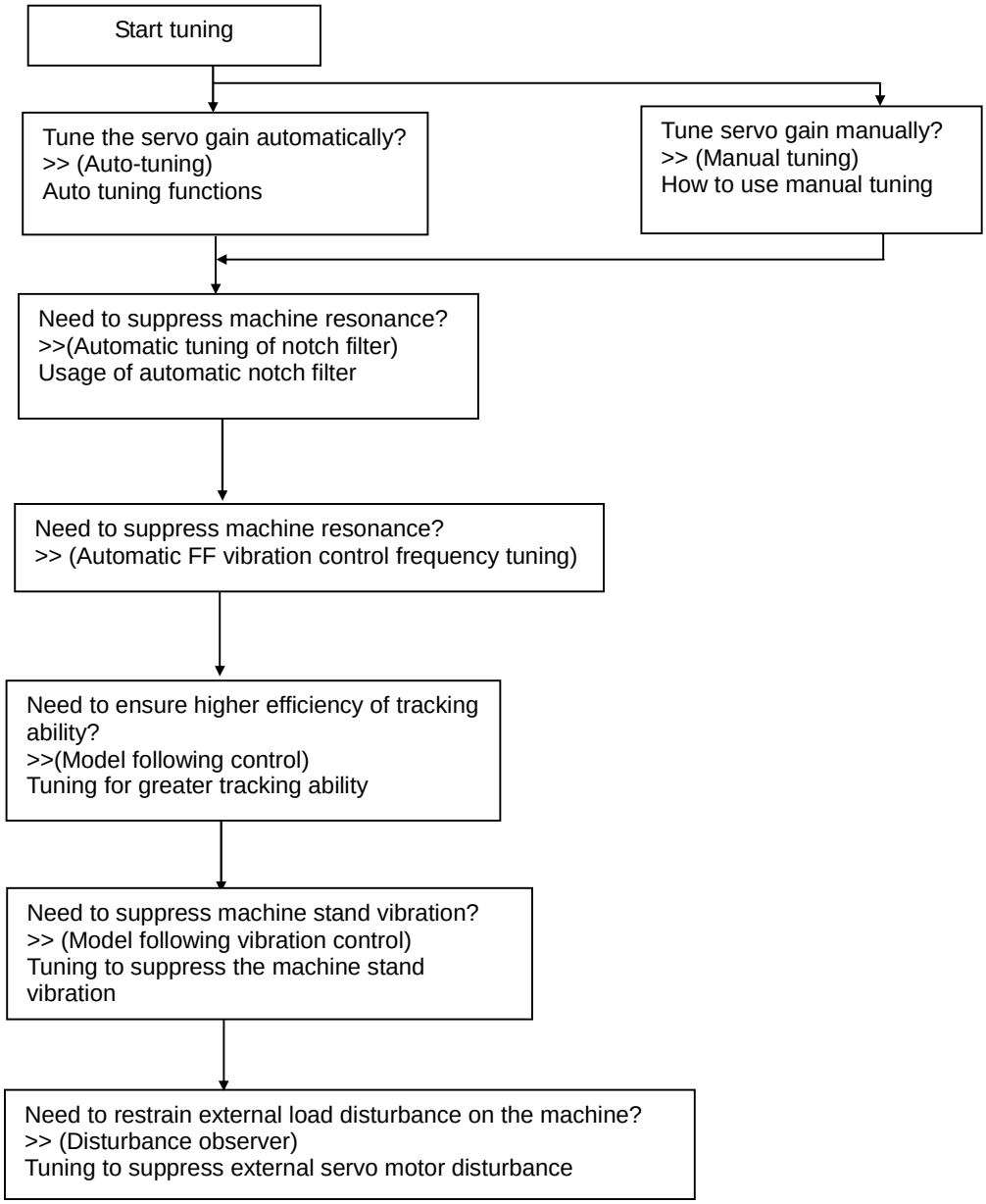
- Servo gain tuning procedure
  Servo gain tuning is performed as follows:
  - Automatic Tuning
    Driver estimates load inertia moment ratio during operation, and then automatically adjusts servo gain and filter frequency on a real-time basis.
  - Automatic Tuning [JRAT Manual Setting]
    The driver does not estimate the Load inertia moment ratio. Servo gain and filter frequency are adjusted automatically corresponding to the load inertia moment ratio and the responses that are already set. This method is used when the Load inertia moment ratio could not be estimated correctly with auto-tuning.
  - Manual Tuning
    Set all parameters, such as Load inertia moment ratio, servo gain, filter frequency, etc. manually. This method is used when characteristics during auto-tuning are insufficient.
- Vibration suppression of mechanical system
  - Automatic tuning of FF Vibration Suppression Frequency
    This is used to obtain the vibration frequency when FF vibration suppression control is initiated.
  - Automatic tuning of notch filter
    This method is used for suppressing high frequency resonance caused by coupling and/or rigidity of the mechanical system using a notch filter.

■ Model following control
Model following control is a control method that ensures a higher detection response by composing a model control system including the mechanical system in a driver to operate the actual motor in order to follow the model control system.

- ◆ Model following control
  Use Model control system to ensure higher detection response.
- ◆ Model following vibration suppression control
  Use the model control system to ensure a higher detection response by suppressing the machine stand vibration.

2) Tuning method selection procedure

The selection procedure is displayed in the following chart:



✔ Depending on the combination of these functions, use of more than two (2) methods jointly will invalidate the procedure.

6.2 Automatic tuning

1) Use the following parameters for automatic tuning

Explanation of Automatic tuning functions

■ Use the following parameters for Automatic tuning"
(For explanation of parameters, see following pages)

◆ Group0 ID00 [Tuning Mode]

00:_AutoTun	Automatic Tuning
01:_AutoTun_JRAT-Fix	Automatic Tuning [JRAT manual setting]
02:_ManualTun	Manual Tuning

◆ Group0 ID01 [Auto-Tuning Characteristic]

00:_Positioning1	Positioning Control 1(General Purpose)
01:_Positioning2	Positioning Control 2(High Response)
02:_Positioning3	Positioning Control 3(High Response，FFGN Manual Setting)
03:_Positioning4	Positioning Control 4(High Response, Horizontal Axis Limited)
04:_Positioning5	Positioning Control 5(High Response, Horizontal Axis Limited, FFGN Manual Setting)
05:_Trajectory1	Trajectory Control 1
06:_Trajectory2	Trajectory Control 2(KP, FFGN Manual Setting)

◆ Group0 ID02 [Auto-Tuning Response]

1 to 30	Automatic Tuning Response

◆ Group0 ID03 [Auto-Tuning Automatic Parameter Saving]

00:_Auto_Saving	Automatically Saves in JRAT1
01:_No_Saving	Automatic Saving is Invalid

■ Explanation for each parameter

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>
Tuning Mode [TUNMODE]

<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>00</td><td>AutoTun</td><td>Automatic Tuning</td></tr>
</table>
◆ Driver estimates Load inertia moment ratio of the machine or equipment during real time and automatically tunes the servo gain.
◆ Parameters for the driver to automatically tune vary depending on selected auto-tuning characteristics.
◆ Driver estimates the Load inertia moment ratio at the time of acceleration/deceleration. Therefore, for operations only with excessively long acceleration/deceleration time constants or with only low torque in low velocity, this mode cannot be used.
Also, for operations with high disturbance torque or with major mechanical clearance, this mode cannot be used.
[01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting]

<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning [JRAT manual setting]</td></tr>
</table>
◆ Based on the Load inertia moment ratio (JRAT1) [Group1 ID14], which has to be set, the driver automatically tunes to the best servo gain.
◆ Parameters for the driver to automatically tune will vary depending on the selected auto-tuning characteristics.

<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>02</td><td>ManualTun</td><td>Manual Tuning</td></tr>
</table>
◆ This mode is used in order to adjust the servo gain to the machine or equipment to ensure maximum response as well as when characteristics in auto-tuning are insufficient.
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>01</td><td>
Auto-Tuning Characteristic [ATCHA]
■ Auto-Tuning Characteristic to fit the mechanical requirements and movements are provided. Parameters that can be adjusted vary depending on each auto-tuning characteristic. Set the parameters based on the situation.

■ [Positioning control (Positioning)]
Positioning control is a control method used to reach the motor quickly to target a position from the present position by disregarding the trajectory between the positions. Select this mode when positioning point by point is necessary.

■ [Trajectory control (Trajectory)]
Trajectory control is a method used to move the motor to the target position from the present position while considering the trajectory between the positions. Select this mode when the Position command corresponding trajectory control is needed such as in processing work.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>00</td><td>Positioning 1</td><td>Positioning Control 1(General Purpose)</td></tr>
</table>
◆ Select for general positioning purposes.
◆ Parameters shown in table 2 cannot be adjusted manually.

<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>01</td><td>Positioning 2</td><td>Positioning Control 2(High Response)</td></tr>
</table>
◆ Select for high response positioning.
◆ Parameters shown in table 2 cannot be adjusted manually.

<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>02</td><td>Positioning 3</td><td>Positioning control 3(High Response, FFGN Manual Setting)</td></tr>
</table>
◆ Select this mode to adjust FFGN manually.
◆ The following parameter adjustment is made manually:
General parameters GROUP1 [Basic control parameter settings]
<table>
<tr><th>ID</th><th>Symbol</th><th>Name</th></tr>
<tr><td>05</td><td>FFGN</td><td>Feed Forward Gain</td></tr>
</table>
</td></tr>
</table>

01 — Auto-Tuning Characteristic [ATCHA]

Selection		Meaning
03	Positioning 4	Positioning control 4(High Response, Horizontal Axis Limited)

- ◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources.
- ◆ Positioning time may be shortened compared to “Positioning Control 2”.
- ◆ Parameters shown in table 2 cannot be adjusted manually.

Selection		Meaning
04	Positioning 5	Positioning control 5 (for high response, horizontal axis only, FFGN manual setting)

- ◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources or when you want to adjust FFGN manually.
- ◆ Positioning time may be shortened compared to “Positioning control 2”.
- ◆ The following parameter adjustment is done manually.
  General parameters GROUP1 [Basic Control Parameter Settings]

ID	Symbol	Name
05	FFGN	Feed Forward Gain

Selection		Meaning
05	Trajectory1	Trajectory Control 1

- ◆ Select this mode for single axis use. The response of each axis can be different.
- ◆ Parameters shown in table 2 cannot be adjusted manually.

Selection		Meaning
06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

- ◆ Select this mode when you need equal responses from multiple axes，respectively. Adjust KP, FFGN.
- ◆ The following parameter adjustment is done manually.
  General parameters GROUP1 [Basic control parameter settings]

ID	Symbol	Name
02	KP1	Position Loop Proportional Gain 1
05	FFGN	Feed Forward Gain

02 — Auto-Tuning Response [ATRES]

- ■ Select this mode when Auto-tuning and Auto-tuning [JRAT manual setting] are used.
- ■ As the setting value rises, the response increases.
  Set the value suitable for equipment rigidity.
- ■ This does not function for manual tuning.

03 — Auto-Tuning Automatic Parameter Saving [ATSAVE]

- ■ Load inertia moment ratio obtained from the result of auto-tuning is automatically saved in parameter JRAT1 every two (2) hours.
- ■ The value is effective when auto-tuning is used.
  This does not function for [JRAT manual setting].

2) Automatically adjusted parameters in auto-tuning

The following parameters are automatically adjusted at the time of auto-tuning. These parameters will not reflect on motor movements by changing or overriding those values. However, some of them can be adjusted manually depending on selected [Tuning Mode] and [Auto-Tuning Characteristic].

■ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Notes
02	KP1	Position Loop Proportional Gain 1	Note 1) 2)
05	FFGN	Feed Forward Gain	Note 2)
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

Note 1) Manual setting is available on Trajectory Control 2 (KP, FFGN Manual Setting).
Note 2) Manual setting is available on Positioning Control 3
(High Response, FFGN Manual Setting).
Manual setting is available on “Positioning Control 5”
(High Response, Horizontal Axis Limited, FFGN Manual Setting).
Note 3) Manual setting is available on auto-tuning [JRAT manual setting].

3) Adjustable parameters during auto-tuning

The following parameters are adjustable during auto-tuning:

■ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name
00	PCSMT	Position Command Smoothing Constant
01	PCFIL	Position Command Filter
06	FFFIL	Feed Forward Filter
10	VCFIL	Velocity Command Filter
11	VDFIL	Velocity Feedback Filter
21	TCFILOR	Torque Command Filter Order

■ General parameters Group2 [FF vibration suppression control/ Notch filter/ Disturbance observer settings]

ID	Symbol	Name
00	SUPFRQ1	FF Vibration Suppression Frequency 1
01	SUPLV	FF Vibration Suppression Level Selection
10	VCNFIL	Velocity Command Notch Filter
20	TCNFILA	Torque Command Notch Filter A
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement
22	TCNFILB	Torque Command Notch Filter B
23	TCNFDB	TCNFILB, Depth Selection
24	TCNFILC	Torque Command Notch Filter C
25	TCNFDC	TCNFILC, Depth Selection
26	TCNFILD	Torque Command Notch Filter D
27	TCNFDD	TCNFILD, Depth Selection
30	OBCHA	Observer Characteristic
31	OBG	Observer Compensation Gain
32	OBLPF	Observer Output Low-pass Filter
33	OBNFIL	Observer Output Notch Filter

■ General parameters Group4 [Gain switching control/Vibration suppression frequency switching settings]

ID	Symbol	Name
40	SUPFRQ2	FF Vibration Suppression Frequency 2
41	SUPFRQ3	FF Vibration Suppression Frequency 3
42	SUPFRQ4	FF Vibration Suppression Frequency 4

■ General parameters Group5 [High setting control setting]

ID	Symbol	Name
00	CVFIL	Command Velocity Low-pass Filter
01	CVTH	Command Velocity Threshold
02	ACCC0	Acceleration Compensation
03	DFCC0	Deceleration Compensation

4) Unstable functions during auto-tuning

The following functions CANNOT be used during auto-tuning:

■ General parameters Group9 [Function enabling condition settings]

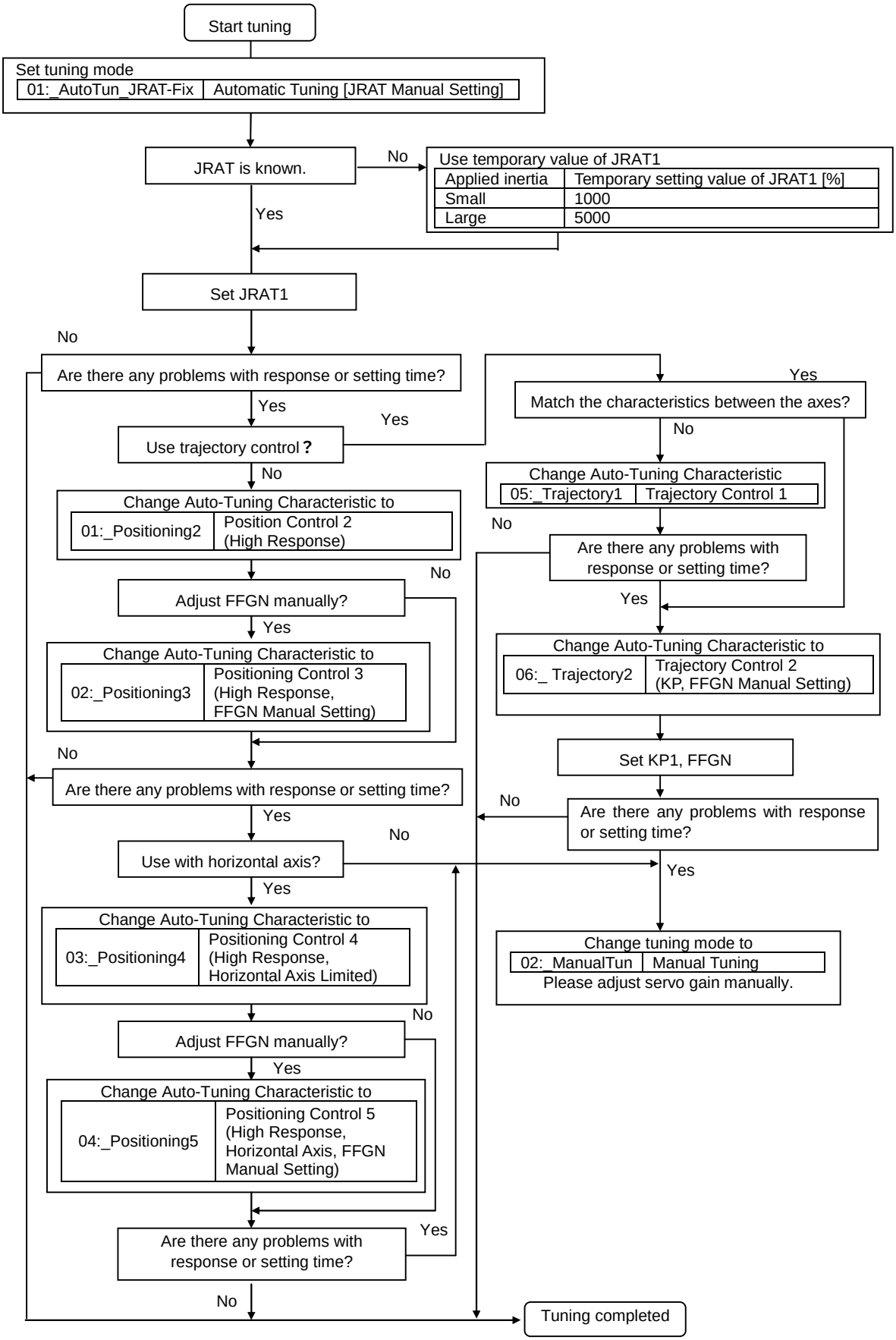
ID	Symbol	Name
13	GC1	Gain Switching Condition 1
14	GC2	Gain Switching Condition 2
17	PLPCON	Position Loop Proportional Control Switching Function
26	VLPCON	Velocity Loop Proportional Control Switching Function

■ General parameters Group1 [Basic control parameter setting]

ID	Symbol	Name
04	TRCPGN	Higher Tracking Control Position Compensation Gain
16	AFBK	Acceleration Feedback Gain

✔ [Disturbance observer] cannot be used together with auto-tuning at the same time. Render [Disturbance observer] function invalid when auto-tuning is used.

5) Auto-tuning characteristic selection flowchart



6) Adjustment method for auto-tuning

Auto tuning is a function where the driver automatically tunes to the best servo gain by setting JRAT value.

Procedure 1	■ Set “auto-tuning mode” to 01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting] to automatically adjust optimum servo gain based on manually set load inertia moment 1 ratio (JRAT1).
Procedure 2	■ After setting [Tuning Mode] select [Auto-Tuning Characteristic] for the machine or equipment.
Procedure 3	■ Next, boot the motor and adjust [Auto-Tuning Response] according to equipment rigidity. ◆ Set [Auto-Tuning Response] at a low value initially and allow the machine to work few times or more by commanding higher-rank equipment. ◆ When response is low and the positioning setting time is slow, after machine movement, try to improve the response and positioning times by increasing [Auto-tuning] gradually. ◆ If increasing the response has caused the machine to develop vibration, lower the value of the [Auto-Tuning Response] slightly. ✔ If the machine has not developed vibration, enable the Vibration suppression by setting the Notch filter and /or FF Vibration suppression frequency. Set the filter frequency to suppress mechanical vibration by using [Automatic tuning of notch filter] and/or [Automatic tuning of FF Vibration Suppression Frequency].

7) Monitoring servo gain adjustment parameters

Parameters automatically adjusted when using auto-tuning can be monitored with Digital Operator, setup software. Refer to [Digital operator (7)] for use of Digital Operator.

ID	Symbol	Name	Unit
1D	JRAT MON	Load Inertia Moment Ratio monitor	%
1E	KP MON	Position Loop Proportional Gain monitor	1/s
20	KVP MON	Velocity Loop Proportional Gain monitor	Hz
21	TVI MON	Velocity Loop Integral Time Constant monitor	ms
22	TCFIL MON	Torque Command Filter monitor	Hz
23	MKP MON	Model Control Gain monitor	1/s

8) Manual tuning method using auto-tuning results

Result of auto-tuning can be stored in block and used to perform auto-tuning.

Refer to [Digital Operator (7)] for use of Digital Operator.

For Software Setup, use Auto-tuning >> Auto-tuning result saving.

■ Saving parameters

◆ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Unit
02	KP1	Position Loop Proportional Gain 1	1/s
12	KVP1	Velocity Loop Proportional Gain 1	Hz
13	TVI1	Velocity Loop Integral Time Constant 1	ms
14	JRAT1	Load Inertia Moment Ratio 1	%
20	TCFIL1	Torque Command Filter 1	Hz

◆ General parameters Group3 [Model following control settings]

ID	Symbol	Name	Unit
00	KM1	Model Control Gain 1	1/s

6.3 Automatic tuning of notch filter

Automatic notch filter can suppress high frequency resonance resulting from coupling and rigidity from the device mechanism.
With short periods of operation of driver and motor, the mechanical resonance frequency can be found easily.

1) Operation method

- Operate from Auto-tuning mode in Software Setup or Digital Operator.
- The tuning results are saved automatically in [Group2 ID20: Torque Command Notch Filter A (TCNFILA)].

✔ Torque command notch filter function can be used together with Auto-tuning at the same time.

✔ Holding torque falls while auto notch filter is running. Do not use as a gravity axis.

- When resonance of the device does not stop even after using Automatic Tuning of notch filter, there may be two or more resonance points.
  In this case, inquire about the resonance frequency using the system analysis function and insert Notch filter B, C, D (Manual setting) to suppress each resonance. If resonance is still not suppressed, there is a possibility that auto-tuning response or gain control is too high. Lower the Auto-Tuning Response or control gain.

2) Setting parameters

- Torque command value for notch filter tuning
  Setting the Torque command value to the motor at the time of Automatic tuning of notch filter:
  - General parameters Group0 [Auto-tuning settings]

ID	Symbol	Name	Unit	Setting range
10	ANFILTC	Automatic tuning of notch filter Torque Command	%	10.0 to 100.0

✔ As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

- Automatically saving parameters with Automatic tuning of notch filter
  - General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
20	TCNFILA	Torque Command Notch Filter A	Hz	100 to 4000

✔ The above parameter is saved automatically with Automatic tuning of notch filter

6.4 Automatic tuning of FF vibration suppression frequency

Set FF vibration suppression frequency to suppress low frequency vibration at the tip or body of the machine. Automatic tuning of FF Vibration suppression frequency simply enables the frequency tune in minimal motion cycle time between the driver and the motor.

1) Operation method

- Operate from Auto-tuning mode in Software Setup or Digital Operator.
- The tuning result is automatically saved in Group2 ID00: FF Vibration suppression frequency "[SUPFREQ1]."
- FF vibration suppression frequency is obtained by executing auto-tuning of vibration suppression frequency or by calculating vibration frequency from the mechanical vibration period at the time of positioning.

✔ When vibration does not stop with FF vibration suppression frequency, there is a possibility that the gain for control system may be too high. In this case, lower the control system gain.

✔ When used together with Higher Tracking Control Velocity Compensation Gain, vibration- suppression effect may be improved.

✔ FF vibration suppression control function can be used with auto-tuning at the same time.

✔ Holding torque falls while Automatic tuning of FF Vibration Suppression Frequency is executing. Do not use as gravity axis.

2) Setting parameters

- Torque command value of Auto-FF vibration suppression frequency
  Sets torque command value to motor at the time of Automatic tuning of FF Vibration Suppression Frequency execution.
  - General parameters Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
20	ASUPTC	Automatic tuning of FF Vibration Suppression Frequency Torque Command	%	10.0 to 100.0

✔ As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

- Friction torque compensation amount during Automatic tuning of FF Vibration Suppression Frequency. Sets additional frictional torque compensation amount when Automatic tuning of FF Vibration Suppression Frequency is executed. By setting the value close to the actual friction torque, the accuracy of Automatic tuning of FF Vibration Suppression Frequency can be improved.
  - General parameters Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
21	ASUPFC	Automatic tuning of FF Vibration Suppression Frequency Friction Compensation Value	%	0.0 to 50.0

- Automatically saved parameter of Automatic tuning of FF Vibration Suppression Frequency.
  - General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppression Frequency 1	Hz	5 to 500

6.5 Using manual tuning

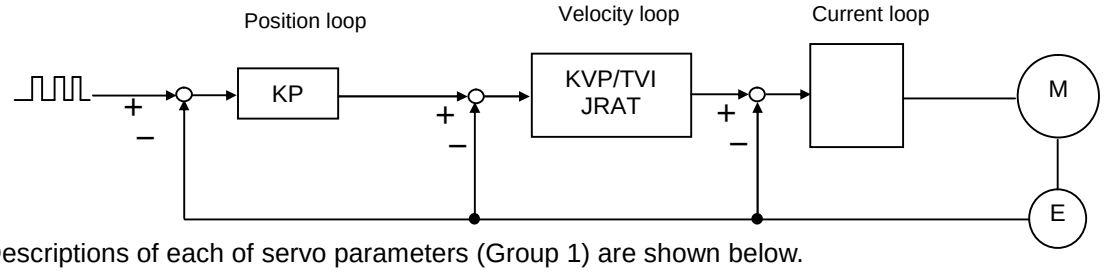
All gain is adjustable manually using manual tuning mode when characteristics in auto-tuning are insufficient. Sets tuning mode to “manual tuning.”

■ General parameters Group0 ID00 [Tuning Mode]

02:_ManualTun	Manual Tuning

1) Servo system configuration and servo adjustment parameters

The servo system consists of three (3) subsystems: Position loop, Velocity loop and Current loop. Higher response is required for internal loops. If this structure is compromised, it could result in instability, low response, vibration or oscillation.



Descriptions of each of servo parameters (Group 1) are shown below.

■ Position Command Smoothing Constant (PCSMT)
This moving low-pass filter smoothes the position command pulse. Sets time constants. The position command pulse will become smoother by setting this parameter when the electronic gear ratio is high or position command pulse is coarse.

■ Position Command Filter (PCFIL)
When the position command resolution is low, set this parameter to suppress the ripples contained in the position command. A larger value of this parameter will cause a greater ripple suppressing effect; however, delay will be increased.

✔ When Higher Tracking Control Position Compensation Gain is set to other than 0%, this parameter is automatically set.

■ Position Loop Proportional Gain (KP)
Sets the response of Position control.
Set this to: $KP_{[1/S]}=KVP_{[Hz]}/4\cdot 2\pi$

■ Higher Tracking Control Position Compensation Gain (TRCPGN)
When the tracking effect needs to be improved under high resolution of position command, increase this parameter after adjustment of Higher Tracking Control Velocity Compensation Gain.

■ Feed Forward Gain (FFGN)
The tracking effect of position command can be improved by increasing this gain. Under positioning control, set this to approximately 30-40% as the standard.

✔ When Higher 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 Loop Proportional Gain (KVP)
Sets responsiveness of velocity control. Set the value as high as possible in stable range that machine system does not vibrate and oscillate. If JRAT is properly set, the set value as KVP becomes velocity loop responsive range.

■ Velocity Loop Integral Time Constant (TVI)
Set this to: $TVI_{[ms]}=1000/(KVP_{[Hz]})$

■ Load inertia moment ratio (JRAT)
Set this value to the calculation shown below:

$$JRAT=\frac{\text{Motor axis converted load inertia moment } (J_L)}{\text{Motor inertia moment } (J_M)}\times 100\%$$

■ Higher Tracking Control Velocity Compensation Gain (TRCVGN)
Tracking effect can be improved by increasing compensation gain.
Adjust this to shorten the position setting time.

✔ Set the value of JRAT properly to use this function.

✔ Set 0% when you use [Velocity Loop Proportional Control Switching Function (Group9 ID27)] during operation.

■ Torque Command Filter 1 (TCFIL1)
When rigidity of the mechanical device is high, set this value high and the Velocit0 Loop Proportional Gain can also be set higher. When the rigidity of the mechanical device is low, set this value low and resonance in the high frequency zone as well as abnormal sound can be suppressed. For normal usage, set this below 1200Hz.

2) Basic manual tuning method for velocity control

- Set value of Velocity Loop Proportional Gain (KVP1) as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.
- Set value of Velocity Loop Integral Time Constant (TV1) by referring to "$TVI_{[ms]}$ =1000/ ($KVP_{[Hz]}$)" as a guide.

✔ When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

3) Basic manual tuning method for position control

- Set value of Velocity Loop Proportional Gain (KVP1) as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.
- Set value of Velocity Loop Integral Time Constant (TVI1) by referring to"$TVI_{[ms]}$ =1000/ ($KVP_{[Hz]}$)" as a guide.
- Set value of Position Loop Proportional Gain (KP1) by referring to "$KP_{[1/S]}$= $KVP_{[HZ]}$/4・2π" as a guide. When vibration occurs, lower the value.

✔ When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.6 Model following control

Model following control is a method used to obtain a higher response. Model control systems include mechanical devices in a driver and run a motor in order to track the Model control system.
Select [Position control form] in [Control mode]
Select [Model following control] in [Position control selection]

ID	Content
09	Control Mode Selection Select value: 02 Position — Content: Position control form
0A	Position Control Selection Select value: 01 Model1 — Content: Model following control

✔ Model following control cannot be used when in velocity control mode or torque control mode.
✔ Model following control can be used with auto-tuning at the same time.
✔ Model following control can be used with fully closed control at the same time.

1) Automatic tuning method for model following control

Model following control can be used with auto-tuning at the same time.
Follow the tuning procedure shown in [Adjustment method for auto-tuning].
Model Control Gain 1 is tuned in addition to tuning the parameter at Standard position control.

■ Automatically adjust parameters using Model following control auto-tuning.

◆ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Notes
02	KP1	Position Loop Proportional Gain 1	Note 1)
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 2)
20	TCFIL1	Torque Command Filter 1	

Note 1) Manual setting is available in Trajectory Control 2 [KP, FFGN manual setting]
Note 2) Manual setting is available in Automatic Tuning [JRAT Manual Setting]

◆ General parameters Group3 [Model following control settings]

ID	Symbol	Name	Notes
00	KM1	Model Control Gain 1	Note 3)

Note 3) KP1 setting value is set in Trajectory Control 2 [KP, FFGN Manual Setting]

✔ Parameters automatically adjusted by the driver vary according to selected Auto-Tuning Characteristic.

2) Manual tuning method for model following control

- Set value of Velocity Loop Proportional Gain (KVP1) as high a value as possible within the range that mechanical system stably works without any vibration or oscillation. If vibration occurs, lower the value.
- Set value of Velocity Loop Integral Time Constant (TVI1) by referring to "$TVI_{[ms]}$ =1000/ ($KVP_{[Hz]}$)" as a guide.
- Set value of Position Loop Proportional Gain (KP1) by referring to "$KP_{[1/S]}=KVP_{[Hz]}/4\cdot2\pi$" as a guide.
- Set value of model control gain [KM1] by referring to "KM KP" as a guide.
  When vibration occurs, lower the set value.
- When responsiveness is low, change the value of model control gain [KM1] to the value approximately 1.1 to 1.2 times the value.

✔ When the gain cannot rise because of mechanical vibration, etc., and the response time is insufficient, use Torque notch filter and/or FF Vibration suppression frequency to suppress resonance and attempt it again.

- Adjustable parameters in Model following control
  In addition to the parameters in Standard position control, the following parameters are also adjustable:
  - General parameters Group3 [Model following control settings]

ID	Symbol	Name
00	KM1	Model Control Gain 1
01	OSSFIL	Overshoot Suppression Filter

  - Model Control Gain 1 (KM1)
    Proportional gain fro Model following control position controller. Adjust this to: KM KP.
  - Overshoot Suppression Filter (OSSFIL)
    Set cutoff frequency of overshoot suppression filter in Model following control.
    If overshoot occurs, lower the setting value. When overshoot occurs on position deviation, lower the set value.

6.7 Tuning to suppress vibration

1) FF vibration suppression control

FF vibration suppression control can be used as a method of suppressing the vibration of the mechanical tip.

- ■ Adjust this gain by using the same basic tuning procedures from Position control.
- ■ When vibration rises on the machine tip during operation, use [Auto-FF vibration suppression frequency
  tuning] or calculate the vibration frequency from the vibration period and set the vibration frequency to
  [FF vibration suppression frequency (SUPFRQ1)].
  - ◆ General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppression Frequency 1	Hz	5 to 500

- ✔ If the machine tip vibration does not stop after taking the above steps, there is a possibility the gain for the control system could be too high. In this case, lower the Control system gain.
- ✔ Do not change the Setting value when the motor is running.

2) Model following vibration suppression control

When you use the motor to drive tables on a machine stand, the stand itself may vibrate as a reciprocal reactor of the motor.
When the machine stand vibrates, the vibration may cause a reaction with the Positioning stabilizing time of the table working on the stand.
Model following vibration suppression control suppresses this type of machine stand vibration and improves Position stabilization time and response.

- ■ When you use Model following vibration suppression control, select Position control at Control Mode Selection and Model following vibration suppression control at Position Control Selection at System parameters.
  You can run the motor under the condition that the machine stand vibration is suppressed using Model control system.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>09</td><td>Control Mode Selection
<table><tr><th colspan="2">Select value</th><th>Contents</th></tr><tr><td>02</td><td>Position</td><td>Position Control</td></tr></table></td></tr>
<tr><td>0A</td><td>Position Control Selection
<table><tr><th colspan="2">Select value</th><th>Contents</th></tr><tr><td>02</td><td>Model2</td><td>Model Following Vibration Suppress Control</td></tr></table></td></tr>
</table>

- ✔ Do not use Auto-tuning with Model following vibration suppression control.

■ Adjustable parameters in Model following vibration suppression control

◆ General parameters Group3 [Model following control settings]

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain **1**	1/s	15 to 315
01	OSSFIL	Overshoot Suppression Filter	Hz	1 to 4000
02	ANRFRQ1	Model Control Antiresonance Frequency 1	Hz	10.0 to 80.0
03	RESFRQ1	Model Control Resonance Frequency 1	Hz	10.0 to 80.0

◆ Model Control Gain 1 (KM1)
This is the proportional gain of the Model following controlling position controller and set response for Model control system.

◆ Overshoot Suppression Filter (OSSFIL)
This parameter is to set the cutoff frequency of the Overshoot suppression filter in Model following vibration suppression control.
When overshoot occurs on position deviation, lower the set value.

◆ Model Control Antiresonance Frequency 1 (ANRFRQ1)
This is to set the Anti-resonance frequency of the machine using Model following vibration suppression control.
When the value is set higher than Model Control Resonance Frequency, vibration suppression control will be invalid.

◆ Model Control Resonance Frequency 1 (RESFRQ1)
This is to set the Resonance frequency of the machine model using Model following vibration suppression control.
Vibration suppression control will be invalid at 80.0Hz.

✔ Do not change the setting value when the motor is running.

■ Parameter setting range for model following vibration suppression control
Setting ranges for the following parameters are restricted:

◆ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Unit	Setting Range
14	JRAT1	Load Inertia Moment Ratio 1	%	100 to 3000
20	TCFIL1	Torque Command Filter 1	Hz	100 to 1000

◆ General parameters Group3 [Model following control settings]

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15 to 315

3) Tuning methods

■ First, select “01: _Model_1 model following control” from “ID0A: position control selection” of system parameters, and then perform auto-tuning with “model following control” to adjust the machine to optimum servo gain. Refer to Auto-tuning method for model following control for instructions on tuning.

✔ When the best servo gain for the machine has been selected, ignore this step.

■ When servo gain tuning is completed, switch “tuning mode” to “manual tuning“ after performing tuning result saving function.

■ Set “02: _Model_2 model following suppression control” of “ID0A: position control selection” of system parameter, and then set mechanical anti-resonance frequency and resonance frequency. When anti-resonance frequency and resonance frequency are already known, set the values. If anti-resonance frequency and resonance frequency are not known, you can set by measuring anti-resonance frequency and resonance frequency by system analysis.

✔ When you measure the anti-resonance and resonance frequencies using System analysis, set the [Frequency range selection] in the low range. If you set the range in a high range, the ant-resonance and resonance frequencies in suppressible ranges created by the Model following vibration suppression control may not be measured.1 – 125Hz for [Frequency range selection] is recommended.

✔ When the mass of the drive motor is smaller than the machine stand mass, the anti-resonance and resonance frequencies may not be measured in system analysis. In this case, obtain the vibration frequency (Model anti-resonance frequency) by calculating the machine vibration period of the vibrating point at positioning and its reciprocal and set the model resonance frequency 1.05-1.2 times the anti-resonance frequency.

■ Set value of Velocity Loop Proportional Gain (KVP1) as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration occurs, lower the set value.

■ Set value of Velocity Loop Integral Time Constant (TVI1) by referring to $TVI_{[ms]}=1000/(KVP_{[Hz]})$ as a guide.

■ Set value of Position Loop Proportional Gain (KP1) by referring to $KP_{[1/S]}=KVP_{[Hz]}/4 \cdot 2\pi$ as a guide.

■ Set value of Model Control Gain (KM1) by referring to KM KP. If vibration increases, lower the value as a guide.

■ When responsiveness is low, change the value of model control gain [KM1] to the value approximately 1.1 to 1.2 times the value.

■ Depending on the mechanical system, there may be two or more frequency vibrations aside from anti-resonance and resonance frequencies that have already been set.
In this case, the vibration can be suppressed using FF vibration suppression controls together. Set the vibration frequency to: [Group02 ID00: FF vibration suppression frequency 1(SUPFRQ1)] by calculating the frequency from the vibration period.

■ In case you cannot increase the gain because of mechanical resonance, etc., and response is insufficient, use Torque command notch filter and FF vibration suppression frequency to suppress the resonance, and then try again.

6.8 Using disturbance observer function

The motor speed will fluctuate when an external force is applied to the operating machine, and it may affect the machine operation.
The Disturbance Observer is a function to suppress the influence of external load torque by estimating the load torque inside the driver and adding the load torque compensation to the torque command. To use the Disturbance Observer, set [Group9 ID33: disturbance observer function [OBS] to [Functions enabled]. Adjust the observer related parameters in [Group2 ID30-33] and suppression or reject the disturbance.

■ Parameters for using the Disturbance Observer

◆ Group9 [Functions enabling conditions settings]

ID	Symbol	Contents	Setting range
33	OBS	Disturbance Observer Function	00 to 27

◆ General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
30	OBCHA	Observer Characteristic	---	00 to 02
31	OBG	Observer Compensation Gain	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	Hz	100 to 4000

■ Explanation of the parameters using the Disturbance Observer.

◆ There are three types of disturbance observer characteristics.
Select a proper type depending on disturbance frequency to be suppressed

Frequency	Type
10 to 40[Hz]	00_Low : Low frequency disturbance suppression
40 to 80[Hz]	01_Middle : Mid-frequency disturbance suppression
80 to 200[Hz]	02_High : High frequency disturbance suppression

◆ Gradually increase Observer Compensation Gain. (Do not set the value at the beginning.)
The higher the Observer Compensation Gain becomes, the more disturbance suppressing characteristics will improve. However, if the gain is excessively high, oscillation may result. Use this within a range that will not cause oscillation.

✔ Disturbance Observer cannot be used with Auto-tuning at the same time.
✔ Observer low-pass filter can be used when the resolver resolution is high or the Load inertia moment ratio is low. Observer characteristics can be improved by setting the frequency high.
✔ Use the Observer notch filter to suppress vibration in case the resonance in high frequency zones has changed.
✔ Use [02_High for High frequency disturbance suppression] when resolver resolution is above 1048576 division.

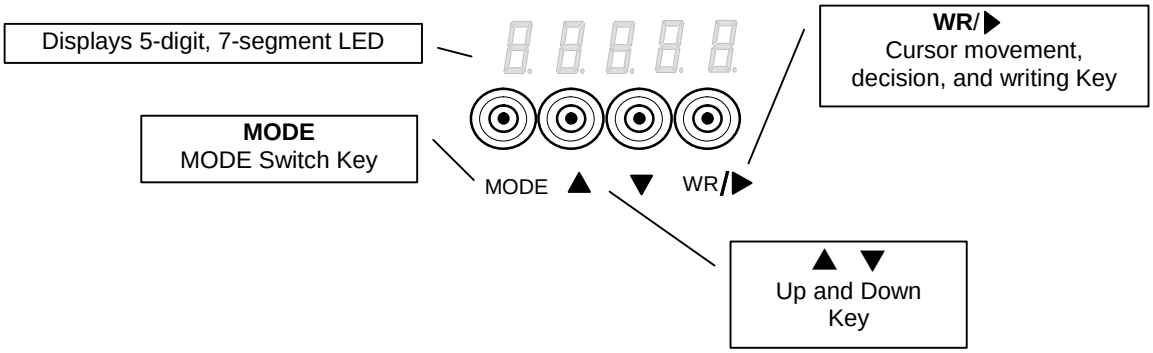
7

7. Digital Operator

7.1 Digital Operator names and functions

It is possible to change or set the parameters and to confirm the status display, monitor display, test operation and alarm history with the built-in digital operator.

■ Names



◆ Functions

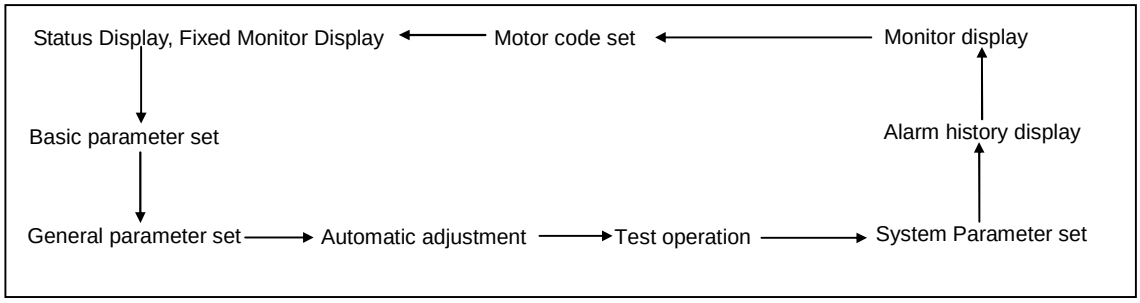
Displayed marks	Functions	Input time
WR	To input selections and write edited data.	More than 1second
MODE	Changes the Mode.	Less than 1 second
▶	Cursor Key. Changes the cursor position when editing.	Less than 1 second
▲ ▼	Up/Down key. Changes the numeric value.	Less than 1 second
7 segment LED	Displays monitor value or parameter setting value in five digits.	-

7.2 Modes

It is possible to display the status, to change or set the parameters, to automatically set the notch filter, to change motor, and to confirm test operation, alarm history and monitor display with the built-in digital operator.

1) Changing modes

Change in the mode presses the "MODE key." The mode switches in order of the following figure.



2) Mode contents

<table>
<tr><th>Mode</th><th>Contents</th></tr>
<tr><td>Status Display</td><td>■ Displays the establishment of control or main power supply, Servo ON, over-travel, warning and alarm status.</td></tr>
<tr><td>Basic parameter
  </td><td>■ Parameters necessary for test operations by JOG and auto-tuning. Can be set at general parameter mode.</td></tr>
<tr><td>General parameter
  </td><td>■ Settings can be made suitable for machines and equipment.
Parameters for adjusting servo gain can be changed.
Classified into 11 groups according to the functions.
<table>
<tr><th>Group</th><th>Description of Group</th></tr>
<tr><td>Group0</td><td>Settings of automatic tuning.</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 model following control.</td></tr>
<tr><td>Group4</td><td>Settings of gain switching control/damping frequency switching.</td></tr>
<tr><td>Group5</td><td>To set high setting control.</td></tr>
<tr><td>Group8</td><td>Settings of control system.</td></tr>
<tr><td>Group9</td><td>Settings of various functional effective conditions.</td></tr>
<tr><td>GroupA</td><td>Setting of general output terminal output condition / monitor output selection / serial communication</td></tr>
<tr><td>GroupB</td><td>Setting related to sequence / alarm.</td></tr>
<tr><td>GroupC</td><td>Settings related to encoder.</td></tr>
</table></td></tr>
<tr><td>Automatic adjustment
  </td><td>■ Enables Adjustment for Torque Command Notch Filter A and Vibration Suppression frequency 1.</td></tr>
<tr><td>Test operation
  </td><td>■ Enables JOG operation, Alarm Reset, Automatic Tuning Result writing and Alarm History Clear.</td></tr>
<tr><td>System parameter
  </td><td>■ Sets the parameters related to driver- encoder.</td></tr>
<tr><td>Alarm history
  </td><td>■ Displays the latest 7 alarm events.</td></tr>
<tr><td>Monitor
  </td><td>■ Displays the driver status such as Velocity, Velocity Command, Torque, Torque command, Position Deviation and Servo Adjustment Gain when using auto-tuning.</td></tr>
<tr><td>Motor code set
  </td><td>■ Sets the motor cord corresponding to motor, and changes the motor to be used.</td></tr>
</table>

7.3 Setting and display range

Digital operator displays data becomes the following form.

■ Data of 0 to +65535

Symbol	Digital operator display	Range of a digit display	
Plus	0	Position of 1 display	0 to 9
Plus	10	Position of 10 display	10 to 99
Plus	100	Position of 100 display	100 to 999
Plus	1000	Position of 1000 display	1000 to 9999
Plus	10000	Position of 10000 display	10000 to 99999

■ Data of -9999 to +9999

Symbol	Digital operator display	Range of a digit display	
Plus	0	Position of 1 display	0 to 9
Plus	10	Position of 10 display	10 to 99
Plus	100	Position of 100 display	100 to 999
Plus	9999	Position of 1000 display	1000 to 9999
Minus	-9999	Position of 1000 display	1000 to 9999

✔ Left end - expresses minus.

■ Data of 0 to +41999999999

Symbol	Digital operator display	Range of a digit display	
Plus	1000	Low position of 1 to 1000 display	0 to 9999
Plus	1000	Middle position of 10000 to 10000000 display	0 to 9999
Plus	419	High position of 100000000 to 10000000000 display	0 to 419

✔ Left end LED expresses low position, middle position, and high position. Press and hold MODE for 1 sec or more to switch.

■ Hexadecimal data

Data size	Digital operator display	Range of a digit display
1 byte	F0	00 to FF
2 byte	F000	0000 to FFFF
8 byte Low	L.F000	0000 to FFFF (Bit31 to Bit0) display
8 byte High	H.F000	0000 to FFFF (Bit63 to Bit32) display

■ Example display of decimal point data

First position of a decimal point	1000.0
Second position of a decimal point	100.00

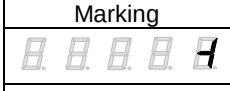
7.4 Status display mode

In this mode, the state of driver and the display of the alarm number when alarm occurring can be checked. In addition to these, reset of alarm, the software version check of driver, and setup of a password can be performed at the time of an alarm number display.

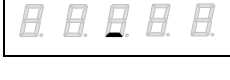
1) Driver status display

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and driver ready (RDY) is ON.	0
	Main circuit power supply established. Main power supply (R, S, and T) is established, but operation preparation completion signal is OFF.	2
	Magnetic Pole Position Estimation Ready (blinking) Main power supply (R, S, T) is established and Magnetic Pole Position Estimation Ready is on.	9
	Magnetic Pole Position Estimation Rotates after displaying the character "O" (upper half).	9
	Operation setup completion signal established. (continuous) Magnetic pole position estimation is completed, and Operation setup completion signal is on.	4
	Servo is ON. Rotates after displaying the character“8”.	8

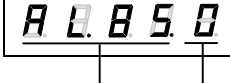
2) Over-travel status display

Marking	Description
	Over-travel status at CW rotation.
	Over-travel status at CCW rotation.

3) Status display of regenerative overload warning, and overload warning

Marking	Description
	Regenerative overload Warning status. If operation is kept on, alarm may be issued.
	Overload Warning status If operation is kept on, alarm may be issued.

4) Alarm code and driver status code when alarm occurs

Marking	Description
	Please take a measure according to the contents of "Maintenance" when alarm occurs.

5) Alarm reset when alarm activated

Alarm can be reset from the digital operator. However, the alarm that needs to perform power supply reset cannot be reset from the digital operator. About the alarm that performs power supply reset, can check by [Warning and Alarm List (8-3)]

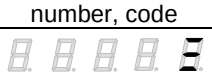
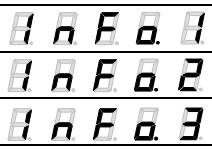
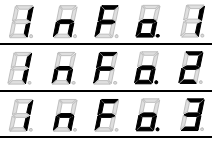
Step	Displayed Character, number, code	Input button	How to operate
1	AL.554		Make the state where the alarm number is displayed.
2		**MODE**	Push MODE for more than 1 second.
3	ALrSt		Display changes as the left.
4		**WR**	Push WR for more than 1 second.
5	.rUn.		Display changes as the left for 2 seconds.
6	3		When the cause of alarm is removed, the state of driver is displayed.

6) How to check the software version of driver

The software version of driver can be checked from the digital operator.

Step	Displayed Character, number, code	Input button	How to operate
1	3		Make the state of driver, or the state where alarm is displayed.
2		▼	Push the subtraction button for more than 1 second.
3	CPU.no		Display changes as the left.
4		**WR**	Push WR for more than 1 second.
5			The present software version is displayed.
6		**MODE**	Push MODE once.
7	CPU.no		Display changes as the left.
8		**MODE**	Push MODE once.
9	3		Returns to Process 1.

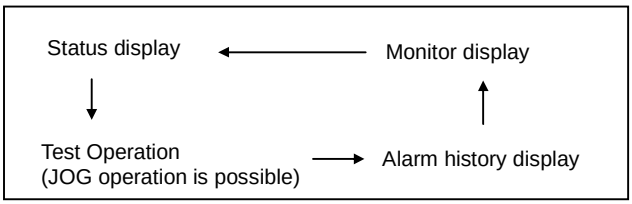
7) How to check Information 1, Information 2 (driver information), and Information 3 (Motor Code)

Step	Displayed character, number, code	Input button	How to operate
1			Make the state of driver, or the state where alarm is displayed.
2		▼	Push the subtraction button for more than 1 second.
3			Display changes as the left.
4		▲▼	Push addition and subtraction button.
5			Display changes as the left.
6		**WR**	Push WR for more than 1 second.
7			The selected information is displayed.
8		**MODE**	Push MODE once.
9			Returns to Process 5.
10		**MODE**	Push MODE once.
11			Returns to Process 1.

✔ The contents of display information 1, information 2, and information 3 are described to [Procedure to combine the motor (5-1)] and [System parameters (5-3)]

8) How to set pass ward

The function that can be used by setting up a password from digital operator can be restricted, and change of a parameter etc. can be forbidden. The function and the setting method can be used is the following.



Step	Displayed character, number, code	Input button	How to operate
1	E		Make the state of driver, or the state where alarm is displayed.
2		▲	Push addition button for more than 1 second.
3	-PAS-		Display switches as the left and the whole display blinks. When setup of the password has ended, display does not blink.
4	0000	**WR**	Push WR for more than 1 second.
5			Display changes as the left and right end LED blinks.
6	1234	▲▼ ▶	Display arbitrary numerical values with addition and subtraction and the cursor button. 0000 and FFFF cannot be set up.
7		**WR**	Push WR for more than 1 second.
8	1234		Display blinks 3 times, and setup will be completed if blink stops.
9		**MODE**	Push MODE once.
10			Returns to Process 1.
11	E		Password will become effective if power supply is turned on again.

9) How to cancel password

Step	Displayed character, number, code	Input button	How to operate
3	-PAS-		Display switches as the left and the whole display lights up. Password is not set up when the display is blinking.
4	0000	**WR**	Push WR for more than 1 second.
5			Display switches as the left and right end LED blinks.
6	1234	▲▼ ▶	Set up password is displayed with addition and subtraction and the cursor button.
7		**WR**	Push WR for more than 1 second.
8	1234		Display blinks 3 times, and cancel will be completed if blink stops.
9		**MODE**	Push MODE once. Then returns to Process 1.
10			After cancel does not need to turn on power supply again.

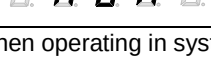
7.5 Editing parameters

The parameter inside driver can be changed into a setup put together with equipment and the machine of usage in fundamental parameter edit mode, general parameter edit mode, and system-parameter edit mode.

Here, the setting method is explained to an example for fundamental parameter edit mode.

1) Basic parameters, editing system parameters

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼ ▶	Display ID of the parameter changed with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5			The data set up is displayed.
6		▲▼ ▶	Display a value to set up with addition and subtraction and the cursor button.
7		**WR**	Push WR for more than 1 second.
8			Setup is completion when blink stops, after a display blinks 3 times. When the set-up value is outside a setting range, setting of Process 5 is displayed without a display blinking 3 times.
9		**MODE**	Push MODE.
10			Display switches as the left. When you set other parameters continuously, repeat from Process 3.
11		**MODE**	Push MODE.
12			Changes to the left display.

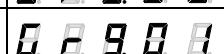
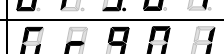
5		When reservation parameter cannot be set, the left is displayed in Process 5.

✔ When operating in system parameter editing mode, the displayed character in step 1 shall be “SY.”

2) Editing general parameters

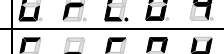
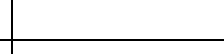
Editing method of general parameters other than Group C ID04 “Encoder Output Pulse Division”

For example, method to change Group9 ID01 “CCW Over Travel Function” from “0B” to ”00“ is as follows.

Step	Letters, numerical values, and codes indicated	Input button	Description of operating procedure
1		**MODE**	Hold down MODE until the figure left is displayed.
2			Display to be switched, and then rightmost LED flashes.
3		▲▼ ▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4		**WR**	Hold down WR for over a second.
5			“0b” is displayed.
6		▲▼ ▶	Set figure “00” by addition/ subtraction, cursor button.
7		**WR**	Hold down WR for over a second.
8		**MODE**	Press MODE.
9			Display to be switched to the display left.

Editing general parameter Group C ID04 “Encoder Output Pulse Division”

For example, method to change from 1/1 to 2/64 is as follows.

Step	Letters, numerical values, and codes indicated	Input button	Description of operating procedure
1		**MODE**	Hold down MODE until the figure left is displayed.
2			Display to be switched, and then rightmost LED flashes.
3		▲▼ ▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4		**WR**	Hold down WR for over a second.
5			“Gr nu” is displayed.
6		**MODE**	Hold down MODE for over a second to change the display to Gr dE. “nu” stands for numerator, “dE” stands for denominator. Hold down MODE for over a second to switch between “nu” and “dE.” Set “Gr dE (denominator)” first.
7		**WR**	Hold down WR for over a second.
8			Display to be switched, and then rightmost LED flashes. When setting dE first, holding down WR displays the denominator. The display left shows “1” as dE is set first. When you set nu first, holding down WR displays numerator.
9		▲▼ ▶	Set figure “64” (denominator) by addition/ subtraction, cursor button.
10		**WR**	Hold down WR for over a second.
11			When display flashes 3 times, and then the flashing stops, the setting of denominator is completed. If the set value is out of the setting range, the set value in the step 6 is displayed without flashing 3 times. When the numerator is “1,” “1 to 64” or “32768” is settable as the denominator.
12		**MODE**	Press MODE.

13	GrC.04		"GrC.04" is displayed.
14		**WR**	Hold down WR for over a second.
15	Gr nu	**MODE**	"Gr nu" is displayed.
16		**WR**	Hold down WR for over a second.
17	1		Display to be switched, and then rightmost LED flashes. The set data are displayed. The display left shows "1" as nu is set first.
18	2	▲▼ ▶	Display the figure "2 (numerator)" you want to set by addition/ subtraction, cursor button.
19		**WR**	Hold down WR for over a second.
20	2		When display flashes 3 times, and then the flashing stops, the setting is completed. If the set value is out of the setting range, the set value in the step 13 is displayed without flashing 3 times.
21		**MODE**	Press MODE.
22	GrC.04		Display to be switched to the display left.

✔ There are three setting ranges of pulse frequency dividing, "1/1 to 1/64," "2/3 to 2/64," and "1/32768 to 32767/32768."
If you set the figure out of the ranges, the figure is not displayed, the figure before the setting flashes.
When setting numerator, the figure of denominator is applicable to the figure presently established.
For example, to change from **1**/1 to 2/64, you need to set the denominator first, as the numerator is already fixed to "1," and "**2**/1" is out of the ranges.

✔ "nu" stands for numerator, "dE" stands for denominator.

7.6 How to tune automatic notch frequency

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5			Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7			The character of 8 is drawn and servo is on.
8		**WR**	Push WR for more than 1 second.
9			A display change as the left and it performs.
10			Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12			Servo is off and changes to the left display.
13		**MODE**	Push MODE.
14			Completes and changes to the left display.

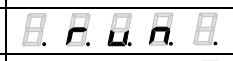
■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
	Changes to the left display.
MODE is pushed in Process 5.	
	Changes to the left display and return to Process 2.
MODE is pushed in Process 7.	
	Changes to the left display and return to Process 5.
MODE is pushed again.	
	Completes and changes to the left display.
MODE is pushed in Process 9.	
	Completes and changes to the left display.

Error is displayed when cannot end normally.

	Changes to the left display.
Will end, if MODE is pushed.	
	Changes to the left display.

7.7 How to tune automatic FF vibration suppression frequency

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5			Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7			The character of 8 is drawn and servo is on.
8		**WR**	Push WR for more than 1 second.
9			A display change as the left and it performs.
10			Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12			Servo is off and changes to the left display.
13		**MODE**	Push MODE.
14			Completes and changes to the left display.

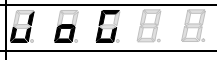
■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
	Changes to the left display.
MODE is pushed in Process 5.	
	Changes to the left display and return to Process 2.
MODE is pushed in Process 7.	
	Changes to the left display and return to Process 5.
MODE is pushed again.	
	Completes and changes to the left display.
MODE is pushed in Process 9.	
	Completes and changes to the left display.

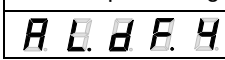
Error is displayed when cannot end normally.

	Changes to the left display.
MODE	Push MODE.
	Completes and changes to the left display.

7.8 Velocity-controlled JOG Operation

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5			Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7			The character of 8 is drawn and servo is on.
8		▲	If it continues pushing an addition button, a motor shaft will rotate in the CCW direction. Will stop when an addition button is detached.
9		▼	If it continues pushing an addition button, a motor shaft will rotate in the CW direction. Will stop when a subtraction button is detached.
10		**MODE**	Push MODE.
11			Servo is off and it changes to the left display.
12		**MODE**	Push MODE.
13			Completes and changes to the left display.

For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
	Changes to the left display and shifts to system parameter.
MODE is pushed in Process 5.	
	Changes to the left display and returns to step 2.
MODE is pushed in Process 7.	
	Changes to the left display and returns to step 5.
Mode is pushed again.	
	Completes and changes to the left display.

✔ The display shown below refers to Over Travel Status.

	Over-travel status at CW rotation.
	Over-travel status at CCW rotation.

■ For the Over Travel Function, settings may be edited by the general parameters Gr9.00 and Gr9.01.

For details, see “Functions enabling condition settings (5-78).”

7.9 Automatic tuning result writing

Step	Displayed character, number, code	Input button	How to operate
1	Ad	**MODE**	Push MODE until it displays the left.
2	Ad 00		Display changes and right end LED blinks.
3	Ad 02	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	tunSL		Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9	.run.		A display change as the left and it performs.
10	tunSL		Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12	Ad 02		Changes to the left display.
13		**MODE**	Push MODE.
14	SY		Changes to the left display.

7.10 Automatic setting of motor parameter

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5			Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9			A display change as the left and it performs.
10			Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12			Changes to the left display and it blinks.
13			Turn on the power supply again.

✔ When about 10 seconds pass in Process 10, it changes to the display of Process 12 compulsorily.

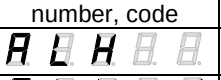
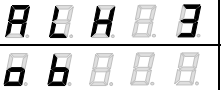
✔ Motor parameter auto-setting function cannot be used in the following cases:

・In alarm or servo-on state.

・Motor not applicable to auto-setting function is connected.

・Inappropriate combination of motor and driver (motor size, baud rate, etc.)

7.11 Alarm history display

Step	Displayed Character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		▲▼	Display the number of an alarm history to check with an addition-and-subtraction button. The history of 7 times past before can be displayed.
4		**WR**	Push WR for more than 1 second.
5			The alarm of 3 times ago is displayed.
6		**WR**	Push WR for more than 1 second.
7			The passed time of alarm generating is displayed. Low-position digit.
8		**MODE**	Press and hold MODE for more than 1 second.
9			The passed time of alarm generating is displayed. Middle-position digit.
10		**MODE**	Press and hold MODE for more than 1 second.
11			The passed time of alarm generating is displayed. High-position digit.
12		**MODE**	Push MODE.
13			Returns to Process 5.
14		**MODE**	Push MODE.
15			Returns to Process 3.
16			Changes to the left display.

7.12 How to clear alarm history

Step	Displayed character, number, code	Input button	How to operate
1	ALH 0 0	**MODE**	Push MODE until it displays the left.
2	ALH 0 1		Display changes and right end LED blinks.
3	ALH.CL	▲▼	Display the left with the addition-and-subtraction button.
4		**WR**	Push WR for more than 1 second.
5	0 rdY 0		Changes to the left display and it blinks.
7		**WR**	Push WR for more than 1 second.
8	0 r.u.n. 0		A display change as the left and it performs.
9	ALH 0 1		Changes to the display of the left after a normal end.
10		**MODE**	Push MODE.
11	ob 0 0 0		Changes to the left display.

7.13 Monitor display

Step	Displayed character, number, code	Input button	How to operate
1	ob 0 0 0	**MODE**	Push MODE until it displays the left.
2	ob 0 0		Display changes and right end LED blinks.
3	ob 0 8	▲▼ ▶	Display ID of the monitor with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	0 0 0 0.3		The data is displayed.
6		**MODE**	Push MODE.
7	ob 0 8		Changes to the left display. When you monitor other data continuously, repeat from Process 3.
8		**MODE**	Push MODE.
9	Co 0 0 0		Changes to the left display.

Note)	0 non 0	When it is a monitor that cannot be displayed, the left is displayed in Process 5.

7.14 Fixed monitor display

The display shows monitoring value in a second after powering up.

It shows monitoring value set at [Group A ID30: Monitor Display Selection [MONDISP]] in status display mode.

“Monitor” to be displayed is the same as parameter ID in monitor display mode, but in the setting value “00 STATUS driver status monitor”, the display will be different from the code display in the monitor mode and will show the driver status in the status display mode (- or ≡).

In the state of alarm occurring, requiring safety function input, requiring motor magnetic pole detection or detecting the poles, the monitor display prioritize these status over the fixed display.

In case of setting “Group A ID30: Monitor Display Selection [MONDISP]” from SETUP software with the digital operator in “Status mode”, either reboot the hardware or push “MODE” button on the digital operator to show “Status mode” again.

7.15 Motor code-setting of motor used

Step	Displayed character, number, code	Input button	How to operate
1		**MODE**	Push MODE until it displays the left.
2			Display changes and right end LED blinks.
3		**WR**	Push WR for more than 1 second.
4		▲▼ ▶	Display the motor cord of the motor used with addition and subtraction and the cursor button.
5		**WR**	Push WR for more than 1 second.
6			A display change as the left and it performs.
7			Changes to the display of the left after a normal end.
8			Turn on the power supply again.

Note)		The motor that cannot be combined or used displays the left in Process 5. In this display, please set up by "Setup Software."

- Applicable “Motor” varies depending on the “Software Version” for the “Driver.”

8

8. Maintenance

8.1 Trouble shooting

When troubles occurred without any alarm displayed, check and take corrective actions for them by referring to the description below. When alarm occurs, take corrective measures referring to “Trouble Shooting When Alarm Occurs “.

■ “≡“ does not blink in 7-segment LED even if main power is ON.

Investigation	Assumed causes and corrective actions
Check the voltage at the power input terminal.	■ If voltage is low, check the power supply. ■ Check that wires and screws are fastened properly.
Red “CHARGE“ LED goes out.	■ Internal power circuit of driver is defective, so replace the driver.
Over-travel status. Emergency Stop status.	■ Stop the input of Over-travel. ■ Stop the input of Emergency Stop. ■ Check of “Functions enabling condition settings “
7 segment LED is blinking displaying "≡".	■ Carry out Magnetic Pole Position Estimation function.
7 segment LED lights up continuously displaying "O (lower half)".	■ Magnetic Pole Position Estimation signal stays ON.

■ 7-segment LED displays a rotating character “8 “(Servo ON status), but motor does not rotate.

Investigation	Assumed causes and corrective actions
Check the command is inputted or not by a digital operator's monitor. Page07: Velocity command monitor (VCMON) Page09: Torque command monitor (TCMON) Page13: Position command pulse frequency monitor (FMON1)	■ If the value of a monitor is zero, input a command.
Check the servo motor is locked or not.	■ Check that the power line of a motor is connected.
Check if torque limit is input.	■ Since torque restrictions are inputted, a motor cannot output the torque beyond the load torque. ■ Check of “Functions enabling condition settings “
Enter deviation clear to check if process is continued.	■ Stop the input of deviation clear.

✔ When performing the work for correction processing, be sure to intercept power supply.

■ Rotations of motor are unstable and less than the specified velocity command.

Investigation	Assumed causes and corrective actions
Check if proportional control is entered.	■ Stop the input of proportional control. ■ Check of “Functions enabling condition settings “
Check if torque limit is input.	■ Quit inputting torque limit. ■ Check of “Functions enabling condition settings “

■ Motor rotates only once, and stops.

Investigation	Assumed causes and corrective actions
Check motor power line.	■ The motor power line is not connected.
Check a setup of a combination motor.	■ Change the settings and turn ON the power again.
Check a setup of encoder resolution. (System parameter)	

✔ When performing the work for correction processing, be sure to intercept power supply.

■ Motor hangs up.

Investigation	Assumed causes and corrective actions
Check the motor power line.	■ Phase order of motor power line is wrong.

✔ When performing the work for correction processing, be sure to intercept power supply.

■ Motor is vibrating.

Investigation	Assumed causes and corrective actions
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.

■ Occurs over shoot/ under shoot during starting / stopping.

Assumed causes and corrective actions
■ Adjust the auto tuning “response “. ■ Reduce the loop gain speed. ■ Increase the velocity integral time constant. ■ Simplify the acceleration and declaration command. ■ Set position command filter.

■ Abnormal sound occurs

Investigation	Assumed causes and corrective actions
Operate at a low speed and check whether abnormal sound has periodicity.	■ Confirm that the wiring for encoder line and motor power line are not installed in the same port. ■ Confirm that the power supply voltage is sufficient.
Check whether there is any problem in mechanical attachment.	■ Observe by operating motor without mechanical attachment. ■ Pay attention while coupling and confirm that there is no core shift or unbalance.

8.2 List of warning and alarm

Names and contents of warning/ alarm, and the stop operations when detected, and alarm-reset methods are listed below.

1) Warning List

	Warning Title	Warning Contents
Load system	Overload Warning	■ When the effective torque exceeds the Overload Warning Level
	Regenerated Overload Warning	■ In case of overload of regenerative resistance
	Driver Temperature Warning	■ Ambient temperature of the driver is out of range of the operation temperature
Power supply system	Main circuit is charging	■ Voltage of main circuit is above DC 105 V
	Voltage sag warning	■ Control power goes 152VAC or less
External input system	CW over travel	■ While entering CW over travel
	CCW over travel	■ While entering CCW over travel
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	■ In the state position deviation exceeds warning setting value.

2) Alarm List

Operation at detecting: “DB “ performs the slowdown stop of the motor in dynamic brake operation when the alarm generating.
Operation at detecting: “SB “ performs the slowdown stop of the motor with sequence current limiting value.
When dynamic brake is selected by Emergency Stop Operation selection, the motor is decelerating stopped for the dynamic brake operation regardless of the operation when detecting it. (However, it stops in free servo brake operation at the time of alarm 53H (DB resistor overheating) detection.

	Alarm code				Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output						
		Bit7	Bit6	Bit5				
Abnormality related to drive	21	0	0	1	Main Circuit Power Device Error (Over current)	■ Over current of drive module ■ Abnormality in drive power supply ■ Overheating of drive module	DB	V
	22				Current Detection Error 0	■ Abnormality of electric current detection value	DB	V
	23				Current Detection Error 1	■ Abnormality of Electric current detection circuit	DB	V
	24				Current Detection Error 2	■ Abnormality in communication with Electric current detection circuit	DB	V
Abnormality related to load	41	0	1	0	Overload 1	■ Excessive effective torque	SB	V
	42				Overload 2	■ Stall over load	DB	V
	43				Regenerative Overload	■ Regeneration load ratio exorbitance	DB	V
	44				Magnetic pole position estimation error	■ Error during the search of magnetic pole position		
	45				Average continuous over speed	■ Over speed in average rotational speed	SB	V
	51				Driver Temperature Error	■ Overheating detection of driver ambient temperature	SB	V
	52				RS Overheat	■ Detection of in-rush prevention resistance overheating	SB	V
	53				Dynamic Brake Resistance Overheat	■ Overheating detection of dynamic brake resistor	SB	V
	54				Internal Regenerative Resister Overheat	■ Overheating detection of Internal regeneration resistor	DB	V
	55				External Error	■ Overheating detection of External regeneration resistor	DB	V
	56				Main Circuit Power Device Overheat	■ Overheating detection of Drive module	DB	V
Abnormality in power supply	61	0	1	1	Over-voltage	■ DC Excess voltage of main circuit		
	62				Main Circuit Under-voltage Note1)	■ DC Main circuit low voltage	DB	V
	63				Main Power Supply Fail Phase Note1)	■ 1 phase of the 3 phase main circuit power supply disconnected	DB	V
	71				Control Power Supply Under-voltage Note2)	■ Control power supply low voltage	SB	V
	72				Control Circuit Under-voltage 1	■ Under voltage of ±12V	DB	V Note 3)
	73				Control Circuit Under-voltage 2	■ Under voltage of +5V	SB	V

	Alarm name				Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output						
		Bit7	Bit6	Bit5				
Abnormality related to converter wiring	84	1	0	0	Serial Encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	“ “
	85				Encoder Initial Process Error	■ Abnormality in initial process of serial converter	–	“ “
Abnormality in resolver main body	A0	1	0	1	Serial Encoder Internal Error 0	■ Converter failure	DB	“ “
	A2				Serial Encoder Internal Error 2	■ Accelerate error	DB	“ “
	A3				Serial Encoder Internal Error 3	■ Over-speed error	DB	“ “
	A4				Serial Encoder Internal Error 4	■ Access error of converter internal EEPROM	DB	“ “
	AA				Serial Encoder Internal Error 10	■ Position Data Error	DB	“ “
	AC				Serial Encoder Internal Error 12	■ Converter initialization error	DB	“ “
	AD				Serial Encoder Internal Error 13	■ Converter supply voltage abnormality	DB	“ “
	AE				Serial Encoder Internal Error 14	■ Resolver Abnormality	DB	“ “
	AF				Serial Encoder Internal Error 15	■ Resolver disconnection or short	DB	

	Alarm code				Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output						
		Bit7	Bit6	Bit5				
Control system abnormality	C1	1	1	0	Over-speed	■ Motor rotation speed is 120 % more than the highest speed limit	DB	V
	C2				Velocity Control Error	■ Torque command and acceleration direction are not matching.	DB	V
	C3				Velocity Feedback Error	■ Motor power disconnection Note 4)	DB	V
	C5				Model tracking vibration suppression control error	■ Machine cycle time is not match with model tracking vibration suppression control.	DB	V
	D1				Excessive Position Deviation	■ Position Deviation exceeds setup value.	DB	V
	D2				Faulty Position Command Pulse Frequency 1	■ Frequency of entered position command pulse is excessive	SB	V
	D3				Faulty Position Command Pulse Frequency 2	■ Position command frequency after electronic gear is high.	SB	V
	DF				Test Run Close Note 5)	■ Detection in 'Test mode end' status	DB	V
Control system/Memory system abnormality	E1	1	1	1	EEPROM Error	■ Abnormality of driver with built-in EEPROM	DB	" "
	E2				EEPROM Check Sum Error	■ Error in check sum of EEPROM (entire area)	–	" "
	E3				Memory Error 1	■ Access error in CPU built in RAM	–	" "
	E4				Memory Error 2	■ Checksum error of FLASH memory with built in CPU	–	" "
	E5				System Parameter Error 1	■ System parameter is outside a setting range.	–	" "
	E6				System Parameter Error 2	■ The combination of a system parameter is abnormal.	–	" "
	E7				Motor Parameter Error	■ Setup of a motor parameter is abnormal.	–	" "
	E8				Abnormalities in CPU circumference circuit	■ Access abnormality in CPU to ASIC	–	" "
	E9				System Code Error	■ Abnormalities of control circuit.	–	" "
	EE				Motor Parameter Automatic Setting Error 1	■ Motor parameter automatic setting function cannot be performed.	–	" "
	EF				Motor Parameter Automatic Setting Error 2	■ The result of motor parameter automatic setting is abnormal.	–	" "
	F1				Task Process Error	■ Error in interruption process of CPU	DB	" "
	F2				Initial Process Time-Out	■ Initial process does not end within initial process time	–	" "

Note 1) When the main power voltage increases or decreases gradually or is suspended, main circuit low voltage or main power failed phase may be detected.
Note 2) Control power supply under-voltage or servo ready OFF is detected during instantaneous break of 1.5 to 2 cycles. Detection of control power supply under-voltage and servo ready OFF can be delayed by setting larger value of PFDDLY (Group B ID16).
Note 3) When moment cutting of a control power source is long, it regards in power supply interception and re-input, and does not leave detected control power supply under-voltage to an alarm history. (If cutting exceeds 1 second at the moment, it will be certainly judged as power supply interception.)
Note 4) 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 5) Alarm that occurs in 'Test mode end' status is not recorded in the alarm history.

8.3 Trouble shooting when alarm activated

1) Alarm display

When an alarm occurs, the display shows the alarm code and the status code of the driver.

Display	Description
AL.85 *	Take appropriate action based on 2) Corrective action for alarm.

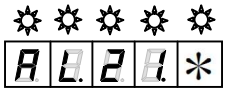
Status code of the driver

Alarm code

Code	Status	
0	Power ON status	(P-OFF)
2	Power OFF status	(P-ON)
4	Servo ready status	(S-RDY)
8	Servo ON status	(S-ON)
9	Magnetic Pole Position Estimation Ready	(CSETRDY)
A	Emergency stop status	(EMR)
F	Initial status	

2) Corrective action for alarm

■ Alarm code 21 (Main Circuit Power Device Error)



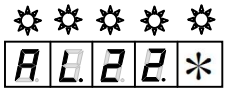
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at input of servo ON.	✔	✔	✔	
Issued while starting and stopping the motor.	✔	✔	✔	
Issued after extended operating time.	✔	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ U/V/W-phase of driver is short circuited due to the wiring in driver and motor. Also, U/V/W-phases are grounded in the earth.	■ Check the wiring conditions and restore if improper.
2	■ Short circuit or fault in U/V/W phases on motor side.	■ Replace the motor.
3	■ Defect in internal circuit of driver.	■ Replace the driver.
4	■ Overheating detection of the main circuit power device functioned.	■ Confirm that the temperature of the control panel (ambient temperature of the driver does not exceed 55°C. If in excess of 55°C, check the installation method of the driver, and confirm that the cooling temperature of the control panel is set to below 55°C

■ Alarm code 22 (Current Detection Error 0)

Status at the time of alarm	Cause	
	1	2
Issued when servo is turned ON.	✔	✔



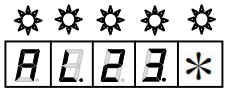
◆ Corrective actions

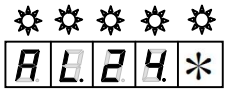
Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Driver and motor are not combined properly.	■ Confirm that the proper codes (per the specified Motor Codes) have been used for the motor; if not, replace the servo motor.

■ Alarm code 23 (Current Detection Error 1)

■ Alarm code 24 (Current Detection Error 2)

Status at the time of alarm	Cause	
	1	2
Issued during operation.	✔	✔

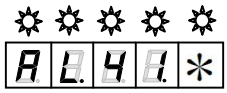




◆ Corrective actions

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

■ Alarm code 41 (Overload 1)

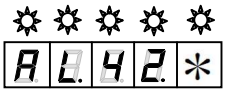


Status at the time of alarm	Cause						
	1	2	3	4	5	6	7
Issued at input of servo ON.	✔						
After command input, issued without rotating the motor.				✔	✔	✔	
After command input, brief motor rotation		✔	✔	✔		✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Effective torque exceeds the rated torque.	■ Monitor the load status using motor usage ratio monitor (TRMS), 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.
3	■ Defect in motor-driver combination.	■ Check if the motor in use matches with the recommended type, and replace if it is improper.
4	■ Holding brake of 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 motor.
5	■ Wiring of U/V/W –phase between driver and motor do not match.	■ Check the wiring conditions and restore if improper.
6	■ One or all connections of U/V/W -phase wiring of driver/ motor is disconnected.	■ Check the wiring conditions and restore if improper.
7	■ Machines collided.	■ Check the operating conditions and limit switch.

✔ During the alarm caused by conditions in #2 (above), if OFF→ON of power supply control is repeated, there is a risk of burning out the motor. Wait for longer than 30 min. for cooling purposes after power shut OFF, and resume operations.

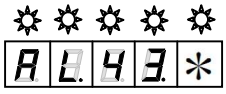


■ Alarm code 42 (Overload 2)

Status at the time of alarm	Cause						
	1	2	3	4	5	6	7
Issued at input of servo ON.	✔						
After command input, issued without rotating the motor.				✔	✔	✔	
After command input, brief motor rotation.		✔	✔	✔		✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Rotation is less than 50min-1 and torque command exceeds approx. 2 times of rated torque.	■ Check if torque command exceeds approx. 2 times of the rated torque-by-torque command monitor (TCMON). If any of the conditions (load condition when motor stops, operation condition at low velocity, and load condition) exceeds twice the rated torque, review operation or load condition. Or replace with larger sized motor.
3	■ Defect in motor-driver combination	■ Check the motor type setting and the motor in use are matching. If not, correct them.
4	■ Holding brake of motor does not release.	■ Check that wirings and voltage for holding brake are correct. If not, repair them. If they are appropriate, replace the motor.
5	■ Wiring of U/V/W –phase between driver and motor do not match.	■ Check the wiring conditions and restore if improper.
6	■ One or all connections of U/V/W -phase wiring of driver/ motor is disconnected.	■ Check the wiring conditions and restore if improper.
7	■ Machines collided.	■ Check the operating conditions and limit switch.



■ Alarm code 43 (Regenerative Overload)

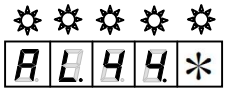
Status at the time of alarm	Cause							
	1	2	3	4	5	6	7	8
Issued when power supply control is turned ON.							✔	
Issued when power supply of main circuit is turned ON.		✔	✔	✔		✔	✔	✔
Issued during operation.	✔			✔	✔		✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Exceeded permitted value of regenerating power in built-in regenerative resistance specifications. ■ Excessive load inertia moment, or tact time is short.	■ Check the load and operating conditions. ■ Use an external regeneration resistor. ■ Set the load inertia moment within the specified range. ■ Increase the deceleration time. ■ Increase the tact time.
2	■ Regenerative resistance wiring conflicts with built-in regenerative resistance specifications.	■ Check wiring and replace if incorrect.
3	■ Regenerative resistance wiring conflicts with external regeneration resistor specifications.	■ Check wiring and replace if incorrect.
4	■ Regeneration resistor is disconnected.	■ For built-in regeneration resistor specifications, replace the driver. ■ For external regeneration resistor specifications, replace the regeneration resistor.
5	■ Resistance value of external regeneration resistor is excessive.	■ Replace the current resistance value with a value matching the specifications.
6	■ Input power supply voltage exceeds the specified range.	■ Check the input power supply voltage level.
7	■ Defect in internal circuit of driver.	■ Replace the driver.
8	■ When external regenerative resistance is selected for system parameter ID02 and external regenerative resistance is not installed.	■ Install the external regenerative resistance. ■ Set to “Do not connect regenerative resistance “.

✔ If the setting of system parameter ID02 Regenerative Resistor Selection is incorrect, regeneration overload is not detected properly, and the driver and surrounding circuit may be damaged or burnt.

■ Alarm code 44 (Magnetic pole position estimation error)



Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.		✔
Issued during operation.	✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Magnetic pole position detection frequency coincides with mechanical resonance point.	■ Change magnetic pole position detection frequency.
	■ Defect in control circuit of driver	■ Replace the driver.

✔ In case magnetic pole position estimation error takes place, please refer to the setting procedures of parameters for magnetic pole position estimation.

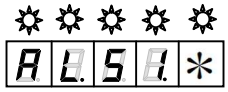
■ Alarm code 45 (Average continuous over speed)

Status at the time of alarm	Cause
	1
Occurred during operation.	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ The average speed exceeds the maximum speed of continuous rotation speed range.	■ Review the operating conditions. ■ Resize the motor.

■ Alarm code 51 (Driver Overheat)



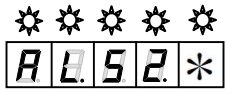
Status at the time of alarm	Cause			
	1	2	3	4
Issued when power supply control is turned ON.	✔		✔	
Issued during operation.	✔	✔	✔	
Issued after emergency stop.				✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Regenerating power exceeded.	■ Check the operating conditions. ■ Use external regeneration resistor.
3	■ Regenerating power is within the specified range but ambient temperature of driver is out of specified range.	■ Confirm that the cooling method maintains the temperature of control board between 0 to 55°C.
4	■ Regeneration energy during emergency stop exceeded.	■ Change the driver. ■ Check the loading condition.

✔ Abnormalities are detected in the internal temperature of the driver regardless of its ambient temperature. When a driver temperature warning is issued, please be sure to check the cooling method of the control panel.

■ Alarm Code 52 (In-rush prevention resistance Overheat)

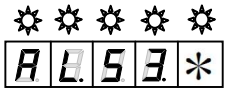


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		
Issued when main circuit power supply is turned ON.		✔	
Issued during operation.			✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Power turning ON is repeated too frequently.	■ Turn ON/OFF the power less frequently.
3	■ Ambient temperature is high.	■ Check if the temperature inside the control board (driver ambient temperature) exceeds 55°C. If it does, review the driver installing method and cooling method of control board to make it below 55°C.

■ Alarm Code 53 (Dynamic Brake Resistor Overheat)

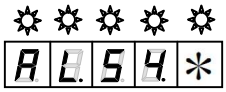


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	
Issued during operation.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Dynamic Brake operation frequency exceeded.	■ Use the dynamic brake so as not to exceed the permissive frequency.

■ Alarm Code 54 (Built-in Regenerative Resistance Overheat)



Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		✔
Issued during operation.	✔	✔	✔

◆ Corrective actions

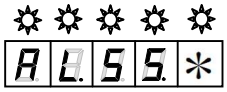
Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Regenerating power excessive.	■ Check the built-in regenerative resistance absorption power ■ Check the operating conditions, so that regenerating power is within permitted absorption power. ■ Use an external regeneration resistor.
3	■ Improper wiring of built-in regeneration resistor.	■ Confirm improper condition and repair if necessary.

✔ When using a regeneration resistance built in the driver, make sure to set “built-in regeneration resistance” at system parameter ID02 [Regenerative Resistor Selection]. This setting makes the judgment between enabled/disabled of the overheating protection detection treatment of the built-in regeneration resistance. When “No connected regenerative resistance or external regenerative resistance“is selected, overheating of built-in regenerative resistance is not detected. Therefore, there is a danger that built-in regenerative resistance will burn out or be damaged.

■ Alarm Code 55 (External Error)

When host device or thermal output signal of external regenerative resistor are not connected

Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔



◆ 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 ID40.
2	■ Defect in internal circuit of driver.	■ Replace the driver.

■ When thermal signal of the external regenerative resistor is connected

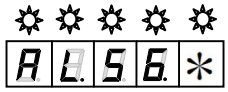
Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		✔
Issued after operation for some time.		✔	✔

◆ 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 internal circuit of driver.	■ Replace the driver.

✔ When output terminal of upper level device is connected, eliminate the alarm trigger of the host level device.

■ Alarm Code 56 (Main Circuit Power Device Overheat)

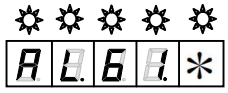


Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at servo input.	✔	✔	✔	
Issued while starting and stopping the motor.	✔	✔	✔	
Issued after operation for some time.	✔	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ U/V/W-phase of driver is short circuited due to the wiring in driver and motor. Also, U/V/W-phases are grounded in the earth.	■ Check wiring and replace if necessary.
2	■ Short circuit or fault in U/V/W phases on motor side.	■ Replace the motor.
3	■ Defect in internal circuit of driver.	■ Replace the driver.
4	■ Ambient temperature is high.	■ Confirm that the temperature of the control board (ambient temperature of the driver) does not exceed 55°C. If in excess of 55°C, check the installation method of the driver, and confirm that the cooling temperature of the control board is set to below 55°C.

■ Alarm Code 61 (Over-Voltage)



Status at the time of alarm	Cause			
	1	2	3	4
Issued when power supply control is turned ON.	✔			
Issued when power supply of main circuit is turned ON.	✔	✔		
Issued while starting and stopping the motor.		✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ The power supply voltage of main circuit is out of the specification.	■ Reduce the power supply voltage to within the specified range.
3	■ Excessive load inertia moment.	■ Reduce the load inertia moment to within the specified range.
4	■ Incorrect wiring for regeneration resistance. ■ Built-in regeneration circuit is not functioning.	■ Wire the regeneration resistance correctly. ■ While using the external regenerative resistance, check the wiring and resistance value. ■ Replace the driver if any abnormality occurs.

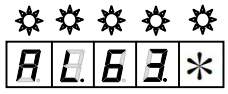
■ Alarm Code 62 (Main Circuit Under-voltage)

Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.				✔	✔
Issued after power supply of main circuit is turned ON.	✔	✔	✔		
Issued during operation.		✔	✔		

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Input power supply voltage is below the specified range.	■ Check the power supply and set it within the specified range.
2	■ Rectifier of main circuit is broken.	■ Replace the driver.
3	■ Input power supply voltage is reduced and/or blinking.	■ Check the power supply and confirm that there is no blinking or low voltage.
4	■ Low voltage outside of the specified range is supplied to the main circuit (R/S/T).	■ Check the main circuit voltage. Confirm that there is no external power supply to R/S/T when the main circuit is OFF.
5	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code 63 (Main Power Supply Fail Phase)

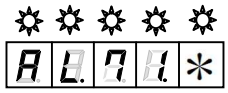


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.		✔	
Issued when power supply of main circuit is turned ON.	✔		✔
Issued during operation.	✔		
Alarm issued during single-phase power input selection.			✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ One out of 3 phases (R/S/T) is not inserted.	■ Check the wiring and repair if necessary.
2	■ Defect in internal circuit of driver.	■ Replace the driver.
3	■ driver is not specified for single phase.	■ Check the model number and delivery specifications of the driver and replace it with a driver for single-phase power supply. ■ Change ID01 of system parameter to “Single phase AC power is supplied to the main circuit “.

■ Alarm Code 71 (Control Power Supply Under-voltage)

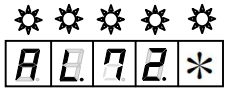


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔	✔	
Issued during operation.	✔		✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Input power supply voltage is below the specified range.	■ Confirm that the power supply is set within the specified range.
3	■ Input power supply voltage is fluctuating or blinking.	■ Confirm that the power supply is not going to neither blink nor reduce the power.

■ Alarm Code 72 (Control Circuit Under-voltage 1)

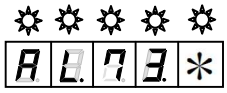


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector; if alarm is not issued, check the external circuit. ■ Restart the power supply after replacing the converter; if alarm is not issued, there is defect in internal circuit of converter.

■ Alarm Code 73 (Control Circuit Under-voltage 2)

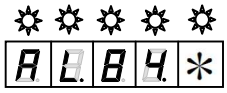


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector; if alarm is not issued, check the external circuit.

■ Alarm Code 84 (Serial Encoder Communication Error)

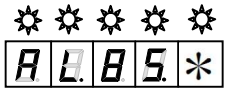


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔	✔	✔
Issued during operation.		✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of converter.	■ Replace the converter.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the driver. ■ Add ferrite core or similar countermeasures against noise.
3	■ Converter encoder wiring has abnormalities.	■ Check wiring and replace if necessary.

■ Alarm Code 85 (Encoder Initial Process Error)

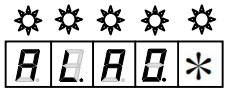


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ For converter wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection.	■ Check wiring and replace if necessary.
2	■ Driver internal circuit failure	■ Replace the driver.
3	■ Defect in internal circuit of converter.	■ Replace the converter.

■ Alarm Code A0 (Serial Encoder Internal Error 0)



Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔
Issued during operation.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of converter.	■ Turn ON the power supplies again; if not restored, replace the converter.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the driver. ■ Add ferrite core or similar countermeasures against noise.

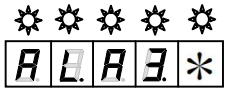
■ Alarm Code A2 (Serial Encoder Internal Error 2)

Status at the time of alarm	Cause		
	1	2	3
Issued while stopping the motor.	✔	✔	
Issued while rotating the motor.	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of converter.	■ Turn ON the power supplies again; if not restored, replace the converter.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the driver. ■ Add ferrite core or similar countermeasures against noise.
3	■ The acceleration of motor rotation exceeds the permitted acceleration.	■ Check the operation condition, and extend the acceleration and declaration time.

■ Alarm Code A3 (Serial Encoder Internal Error 3)



Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		✔
Issued while stopping the motor.	✔	✔	
Issued while rotating the motor.	✔	✔	✔

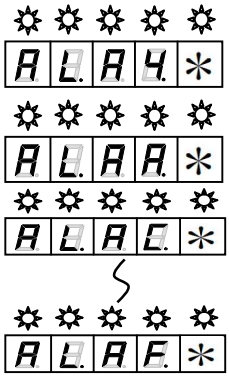
◆ Corrective actions

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

■ Alarm Code A4 (Serial Encoder Internal Error 4)

■ Alarm Code AA (Serial Encoder Internal Error 10)

■ Alarm Code AC to AF (Serial Encoder Internal Error 12 to 15)

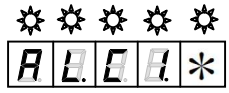


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	
Issued during operation.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of converter.	■ Turn ON the power supplies again; if not restored, replace the converter.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the driver. ■ Add ferrite core or similar countermeasures against noise.

■ Alarm Code C1 (Over-speed)

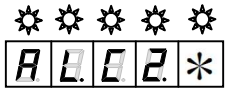


Status at the time of alarm	Cause			
	1	2	3	4
Issued when command is entered after Servo ON.	✔	✔		
Issued when the motor is started.			✔	✔
Issued other than operating and starting the motor.		✔	✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.
2	■ Defect in internal circuit of converter.	■ Replace the converter
3	■ Excessive overshoot while starting.	■ Adjust the servo parameters. ■ Simplify the acceleration and declaration command pattern. ■ Reduce the load inertia moment.
4	■ Wiring of U/V/W -phase between driver and motor do not match.	■ Check the wiring and repair any irregularities.

■ Alarm Code C2 (Velocity Control Error)



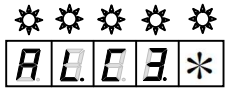
Status at the time of alarm	Cause		
	1	2	3
Issued while due to input of Servo ON.	✔	✔	
Issued if command is entered.	✔	✔	
Issued while starting and stopping the motor.			✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Wiring of U/V/W -phase between driver and motor do not match.	■ Check the wiring and repair any irregularities.
3	■ The motor is vibrating (oscillating).	■ Adjust the servo parameters so that 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. ■ Simplify the acceleration and declaration command pattern. ■ Mask the alarm.

✔ For the velocity control error alarm, an alarm may occur while starting and stopping when load inertia moment 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 C3 (Velocity Feedback Error)

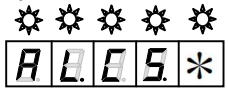


Status at the time of alarm	Cause		
	1	2	3
Issued when command is entered.	✔	✔	✔
Generated at the time of control input.		✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Motor is not rotating.	■ Confirm that the power line is properly connected. ■ Replace the motor.
2	■ Defect in internal circuit of driver.	■ Replace the driver.
3	■ The motor is vibrating (oscillating).	■ Adjust the servo parameter so that motor will not vibrate (oscillate).

■ Alarm Code C5 (Model Tracking Vibration Suppression, Control Error)

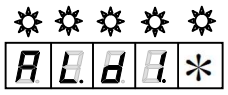


Status at the time of alarm	Cause		
	1	2	3
Issued after entering position command pulse.	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Setup of model control gain is high.	■ Lower model control gain.
2	■ The acceleration-and-deceleration time of a position command is short.	■ Simplify the acceleration and declaration command pattern.
3	■ Torque limiting value is low.	■ Enlarge a torque limiting value or repeal torque restrictions.

✔ Other alarms are generated, and this alarm may be generated if a servo brake performs alarm reset during a slowdown.



■ Alarm Code D1 (Following Error / Excessive Position Deviation)

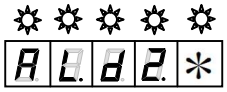
Status at the time of alarm	Cause											
	1	2	3	4	5	6	7	8	9	10	11	12
Issued when control power supply is turned ON.										✔		
Issued when servo ON is stopped.						✔					✔	
Issued immediately after entering the command.	✔	✔	✔	✔	✔		✔	✔	✔		✔	
Issued during starting or stopping at high speed.	✔	✔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

◆ 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 load inertia moment or low motor capacity.	■ Correct the load condition or increase the motor capacity.
3	■ Holding brake is not released.	■ Check wiring and replace if necessary. If specified voltage is applied, replace the 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 driver and motor has disconnected.	■ Check wiring and replace if necessary.
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 torque limit command is entered by the controller, and the torque limit setting is too much reduced. ■ Setting of a Velocity Limit Command is too little.	■ Increase the torque limit value or disable the torque limit. ■ Enlarge setting of a Velocity Limit Command.
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 much reduced.	■ Set a greater value for excessive deviation.
10	■ Defect in internal circuit of driver.	■ Replace the driver.
11	■ Defect in internal circuit of converter.	■ Replace the converter.
12	■ Power supply voltage is low.	■ Check the power supply voltage.

■ Alarm Code D2 (Faulty Position Command Pulse Frequency 1)

Status at the time of alarm	Cause
	1
Issued after entering position command pulse.	✔

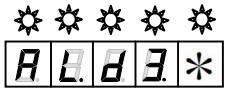


◆ Corrective actions

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.

■ Alarm Code D3 (Faulty Position Command Pulse Frequency 2)

Status at the time of alarm	Cause	
	1	2
Issued after entering position command pulse.	✔	✔

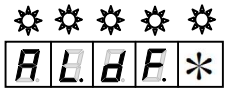


◆ Corrective actions

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 DF (Test Run Close)

Status at the time of alarm	Cause
	1
Occurred after execution of test mode.	✔

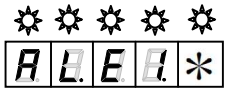


◆ Corrective actions

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 E1 (EEPROM Error)

Status at the time of alarm	Cause
	1
Issued during display key operation or set up software operation.	✔

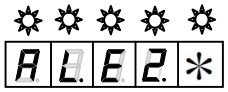


◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code E2 (EEPROM Check Sum Error)

Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔



◆ Corrective actions

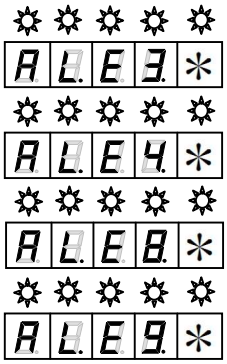
Cause		Investigation and corrective actions
1	■ Correct value not read by CPU by EEPROM built-in driver.	■ Replace the driver.
2	■ Failed to write into the EEPROM during last power supply cutoff.	■ Replace the driver.

■ Alarm Code E3 (Memory Error 1)

■ Alarm Code E4 (Memory Error 1)

■ Alarm Code E8 (CPU Surrounding Circuit Error)

■ Alarm Code E9 (System Code Error)

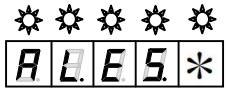


Status at the time of alarm	Cause
	1
Issued when control power supply is turned ON.	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code E5 (System Parameter Error 1)

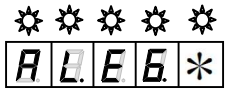


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ 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 driver. Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code E6 (System Parameter Error 2)

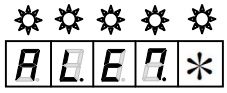


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ 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 reference number of the driver. ■ Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code E7 (Motor Parameter Error)

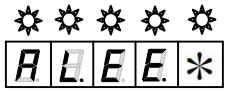


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Correct value not read by CPU by EEPROM built-in driver.	■ If control power supply is re-switched on and alarm recurs after re-setting a motor parameter, replace the driver.
2	■ Failed to write into the EEPROM when changing motor parameter.	■ If power supply is re-switched on and alarm recurs after re-setting a motor parameter, replace the driver.

■ Alarm Code EE (Motor Parameter Automatic Setting Error 1)

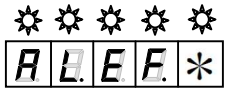


Status at the time of alarm	Cause
	1
Issued after motor parameter automatic setting functional execution.	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of converter.	■ Replace the converter.

■ Alarm Code EF (Motor Parameter Automatic Setting Error 2)

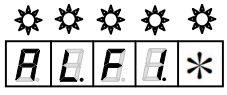


Status at the time of alarm	Cause	
	1	2
Issued after motor parameter automatic setting functional execution.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Motor, driver, and converter are not combined properly.	■ Check the model numbers of driver, motor, and converter, and correct the combination. ■ Check if the combination of versions of the driver is correct.
2	■ Defect in internal circuit of converter.	■ Replace the converter.

■ Alarm Code F1 (Task Process Error)



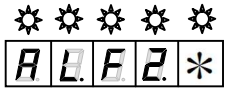
Status at the time of alarm	Cause
	1
Issued during operation.	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of driver.	■ Replace the driver.

■ Alarm Code F2 (Initial Process Time-Out)

Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔



◆ Corrective actions

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

8.4 Inspection

For maintenance purposes, a daily inspection is typically sufficient.

Upon inspection, refer to the following description.

Inspection location	Testing conditions			Inspection Items	Inspection Methods	Solution if abnormal
	Time	During operation	While stopping			
Motor	Daily	✔		Vibration	Check for excessive vibration.	Contact dealer/sales office.
	Daily	✔		Sound	Check if there is no abnormal sound as compared to normal sound.	
	Periodic		✔	Cleanliness	Check for dirt and dust.	Clean with cloth or air. Note 1)
	Yearly		✔	Measure value of insulation resistance	Contact dealer or sales office.	
Driver	Periodic		✔	Cleaning	Check for dust accumulated in the accessories.	Clean with air. Note 1)
	Yearly		✔	Loose screws	Check for loose connections.	Fasten the screws properly.
Temperature	Periodic	✔		Measure temperature	Ambient temperature Motor frame temperature	Set the ambient temperature within the specified range. Check the load condition.

Note 1) While cleaning with air, confirm that there is no oil content and/or moisture in the air.

9

9 Appendix

9.1 Standards conformity

For NSK Ltd. products, compatibility examinations of overseas standards are conducted by certificate authorities, and attestation markings are performed based on the published certificate of attestation.

1) Standards conformity

■ Drivers

Reference Number.	Applicable laws and Regulations	Standard code	Certificate authorities
M-EGA-xxxxxxx	UL/c-UL standard	UL508C	UL (Underwriters Laboratories inc.)
	Low Voltage Directive: LVD	EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	EMC Directive: EMC (Electromagnetic Compatibility)	EN61000-6-2 EN61800-3	TÜV (TÜV SÜD Japan, Ltd.)
	KC standard: (Korea Certification)	KN22 (EMI) KN24 (EMS)	National Radio Research Agency Korea Communications Commission Republic of Korea

■ Converters

Reference Number	Applicable laws and Regulations	Standard code	Certificate authorities
M-ECC-xxxxxxxxxxx	Low Voltage Directive: LVD	EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	EMC Directive: EMC (Electromagnetic Compatibility)	EN55011 G1 Class A EN61000-6-2 EN61800-3	TÜV (TÜV SÜD Japan, Ltd.)
	KC standard: (Korea Certification)	KN11 (EMI) KN61000-6-2 (EMS)	National Radio Research Agency Korea Communications Commission Republic of Korea

✔ Motors have not been tested and verified for conformity with any international standards.

2) Over-voltage category, protection grade, pollution level

- The "over-voltage category" of driver is "III" (EN61800-5-1). For the interface, use a DC power supply with reinforced and insulated input and outputs.
- Make sure to install the driver in your control panel in an environment where the pollution level specified in EN61800-5-1 and IEC664 is no less than 2 (polution level 1, 2). The protection grade of driver is IP1X. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc.

3) Connection and installation

Be careful of connection and installation as follows.

- ✔ Always ground the protective earth terminals of the driver to the power supply earth.
- ✔ When connecting grounding wire to the protective earth terminal, always connect one wire in one terminal; never connect jointly with multiple wires or terminals.
- ✔ When connecting the leakage stopper, make sure to connect the protective earth terminal to the power supply earth.
- ✔ Connect earthing wire by using a crimping terminal with insulated tube, so that the connected wire will not touch the neighboring terminals.
- ✔ For wire relays, use a fixed terminal block to connect wires; never connect wires directly.
- ✔ Connect an EMC filter to the input power supply of the unit.
- ✔ Use an EN/ IEC-standard compatible no-fuse Circuit breaker and electromagnetic contactor.

4) UL file number

The UL file number of driver and motor is as follows. You can check them on the website of UL.
http://www.ul.com/database/

- The UL file number of driver: E216221

9.2 Compliance with EN Directives

NSK Ltd. implements the conformity verification test of "Low Voltage Directive" and "an EMC command" in a certificate authority so that a user's CE Marking acquisition can be performed easily, and CE Marking is done based on the published certificate of attestation.

1) Conformity verification test

The following conformity verification tests are implemented.

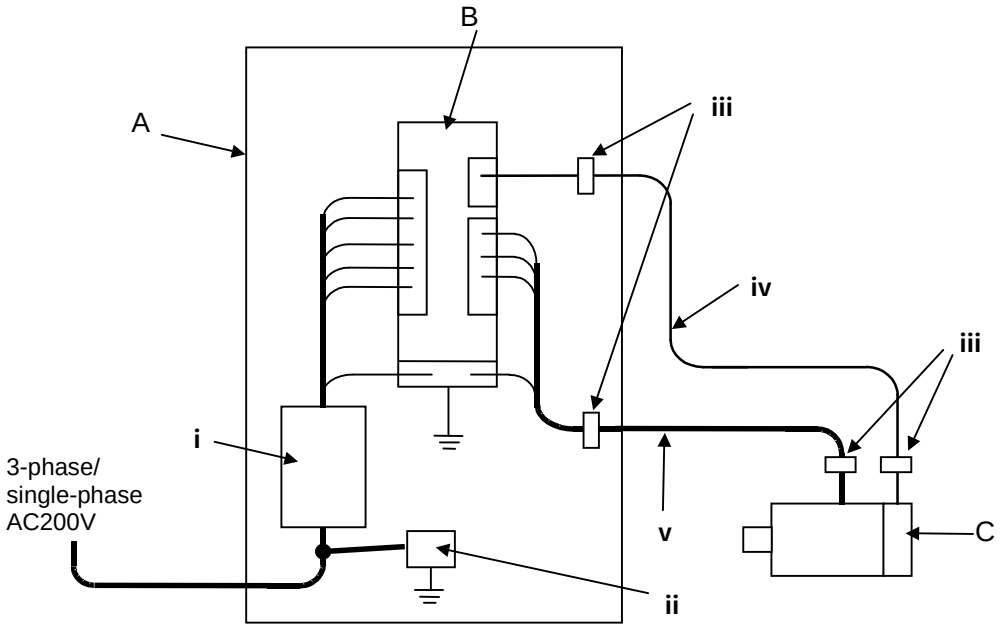
Directive classification	Classification	Test	Test standard
Low voltage Directive	-	-	EN61800-5-1: 2007
EMC Directive	Immunity	Electrostatic discharge immunity	EN61000-4-2: A2/2001
		Radiated electromagnetic field immunity	EN61000-4-3: A1/2002
		Electrical first transient/ burst immunity	EN61000-4-4: 2004
		Conducted disturbance immunity	EN61000-4-6: A1/2001
		Surge immunity	EN61000-4-5: A1/2001
		Voltage Dips & Interruptions immunity	EN61000-4-11 : 2004
		Adjustable speed electrical power drive system	EN61800-3/ 2004

Converters have been tested and verified for proper conformity with the standards listed below.

Directive classification	Classification	Test	Test standard
Low voltage Directive	-		EN61800-5-1: 2007
EMC Directive	Emission	Conducted emission	EN55011: A2/ 2007
		Radiated emission	EN55011: A2/ 2007
	Immunity	Electrostatic discharge immunity	EN61000-4-2: A2/2001
		Radiated electromagnetic field immunity	EN61000-4-3: A1/2002
		Electrical first transient/ burst immunity	EN61000-4-4: 2004
		Conducted disturbance immunity	EN61000-4-6: A1/2001

2) Requirements for driver installation to achieve the EMC certification

For the installation requirements, in our company the verification test is implemented by the following installations and measures methods, as machines and configurations differ depending on customers' needs. This servo amplifier has been authorized to display CE marking based on the recognition certificate issued by a certifying authority. Customers are instructed to perform the final conformity tests for all instruments and devices in use.

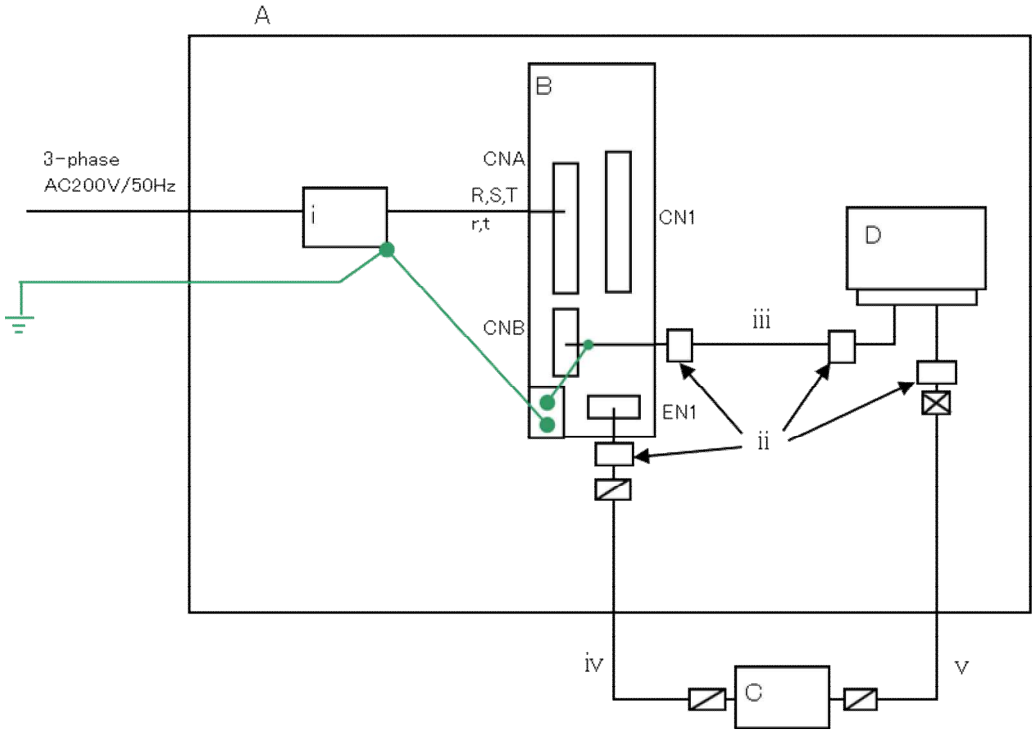


No	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
i	Noise filter (Recommended prevention components)	HF3030C-UQA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/ rated armature current: Line-Line 480V AC/ 30A
ii	Surge-absorber (Recommended prevention components)	LT-C32G801WS: SOSHIN ELECTRIC Co. Ltd.
iii	Clamp grounding	-
iv	Encoder cable	Shielded cable
v	Servo motor power cable	Shielded cable

- ✔ Use metallic materials for the door and main body of control panel.
- ✔ Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
- ✔ Ground noise filter frame to control panel.
- ✔ Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
- ✔ Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
- ✔ Wire servo amplifier at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.

3) Requirements for converter installation to achieve the EMC certification

Requirements for converter installation vary depending on the machines and system configurations adopted at individual customers. Then NSK Ltd.has been performing the EMC compliance testing based on the following installation and safeguarding methods. Consequently, in accordance with the certificates issued from an accredited certifying body based on the results of the EMC testing, NSK Ltd. has been attaching the CE Marking to individual converters. In order to make your machines and systems compliant with the CE Marking, you must conduct the final EMC testing on your own initiative.



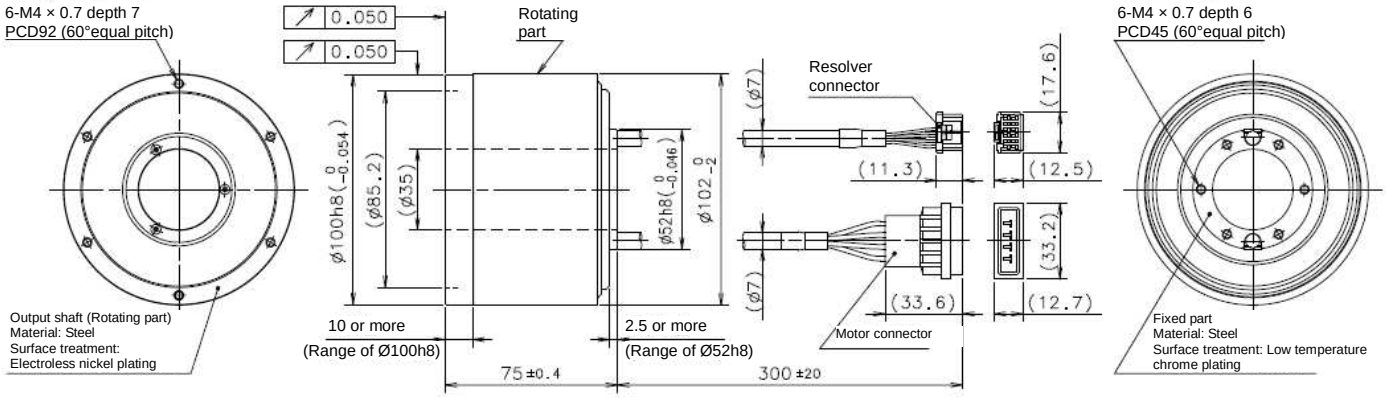
No	Name	Remarks
A	Shield box	-
B	Driver	-
C	Converter	-
D	Motor	-
i	Noise filter (Recommended replacement parts)	HF3030C-UQA：SOSHIN ELECTRIC Co., Ltd. Rated voltage / Rated current：Line-Line 480V AC / 30A
ii	Clamp installation	-
iii	Motor cable	Shielded cable
iv	Converter cable	Shielded cable
v	Resolver cable	Shielded cable

- ✔ Ground the noise filter frame to the control panel.
- ✔ For converter cable and motor cable, use the shielded cables. Ground the shields to the control panel and system frame with proper clamps.
- ✔ For grounding of shielded cables with clamps, use the conductive metal P-clip or U-clip and secure them directly with metallic screws. Never adopt soldering of electric wires to the shielded cables for the grounding.
- ✔ Limit the wiring distance between the secondary side of noise filter and the driver to a required minimum and remember to run the primary and secondary wirings of noise filter separately from each other.

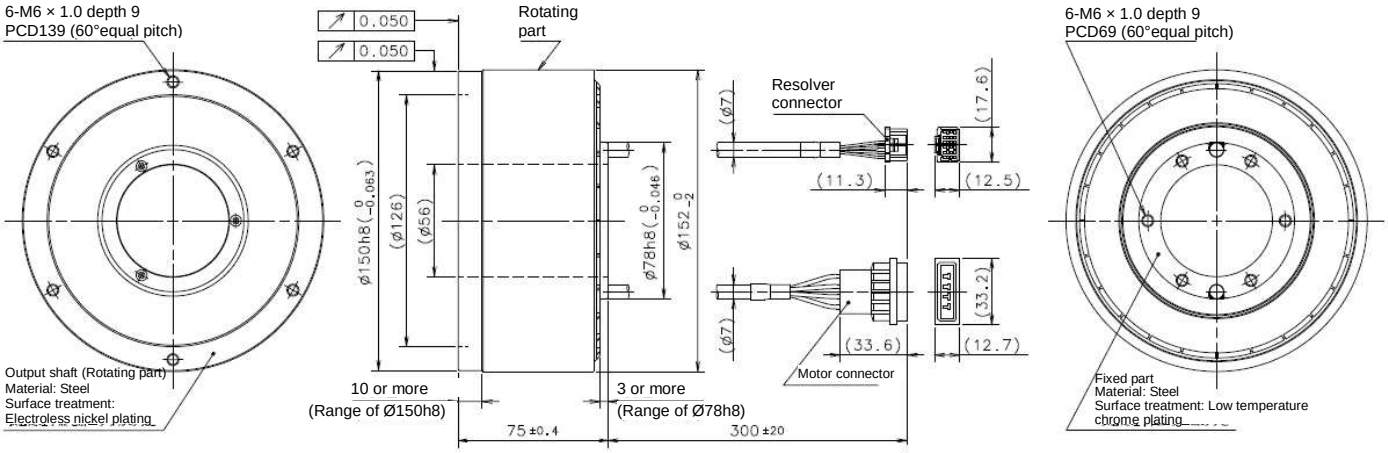
9.3 Outline drawing

1) Motor

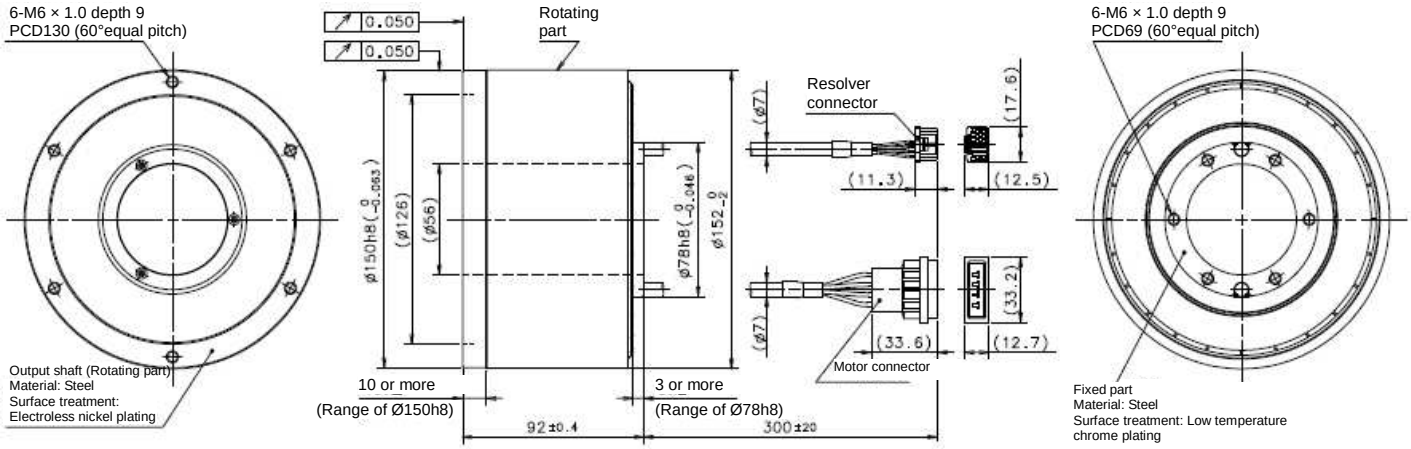
M-PB1006JN001



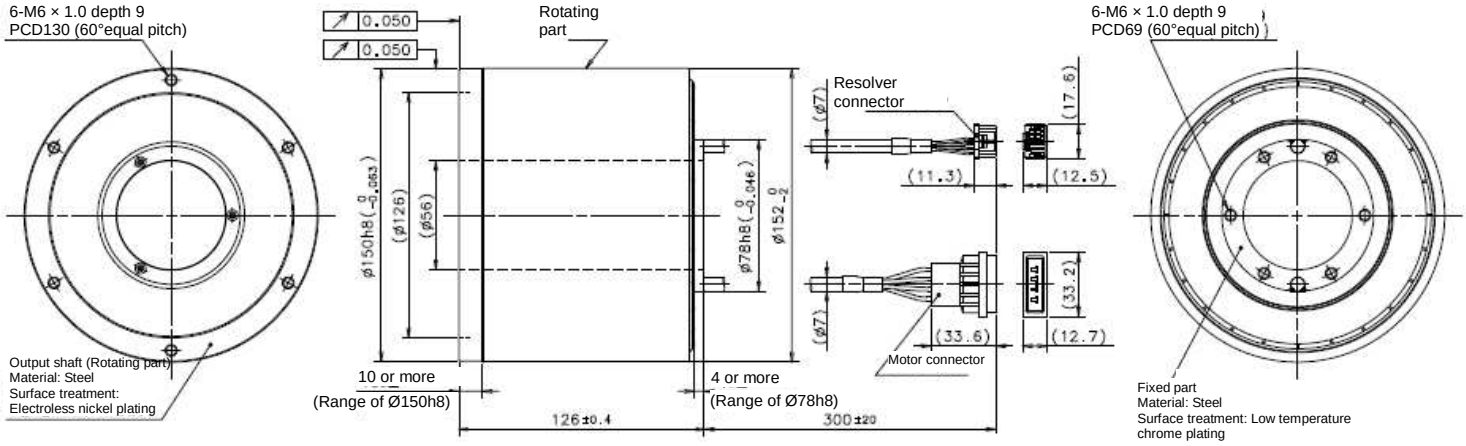
M-PB3015JN001



M-PB3030JN001

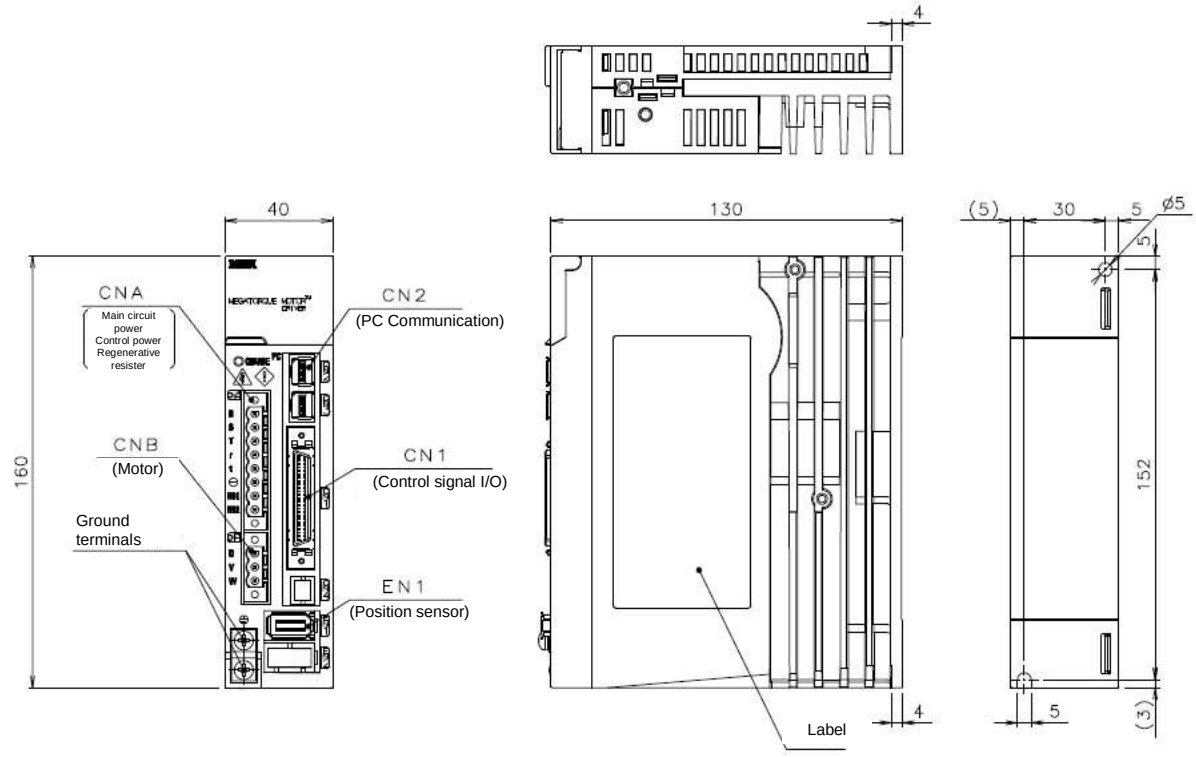


M-PB3060JN001

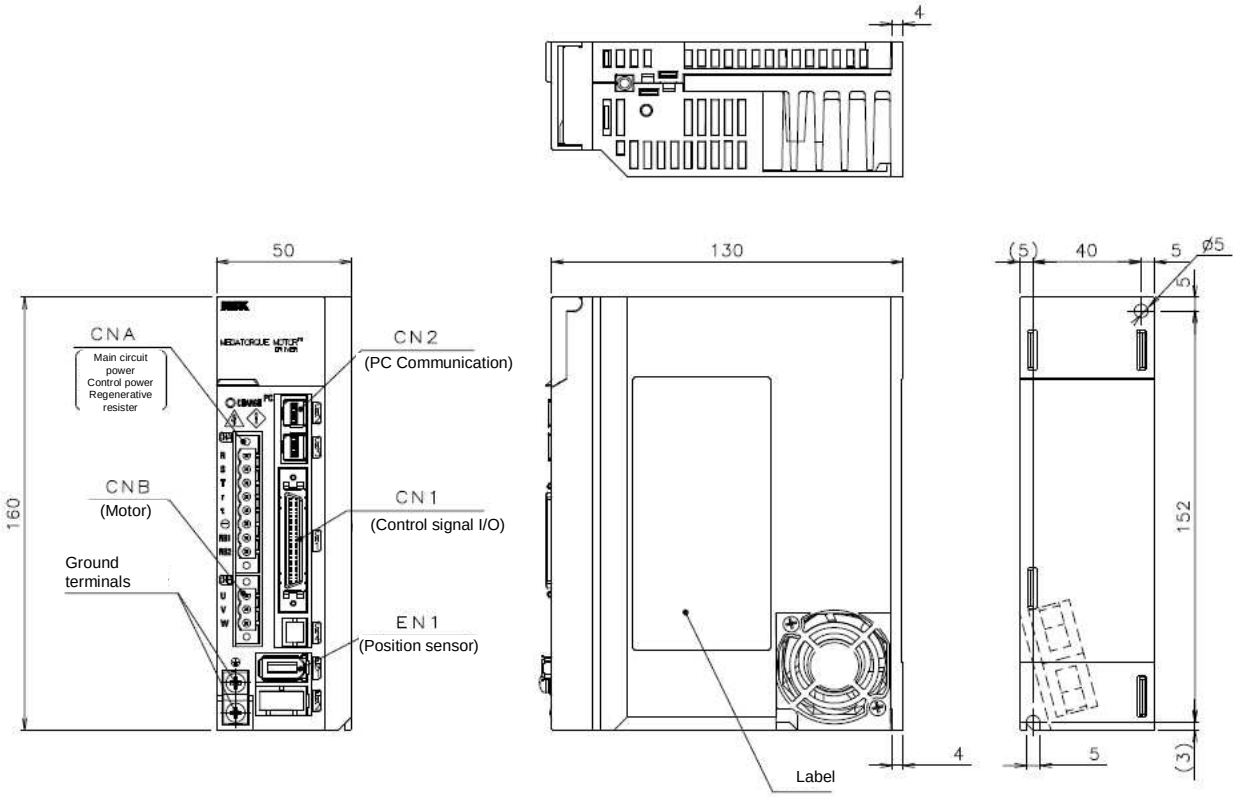


2) Driver

M-EGA-15A2301

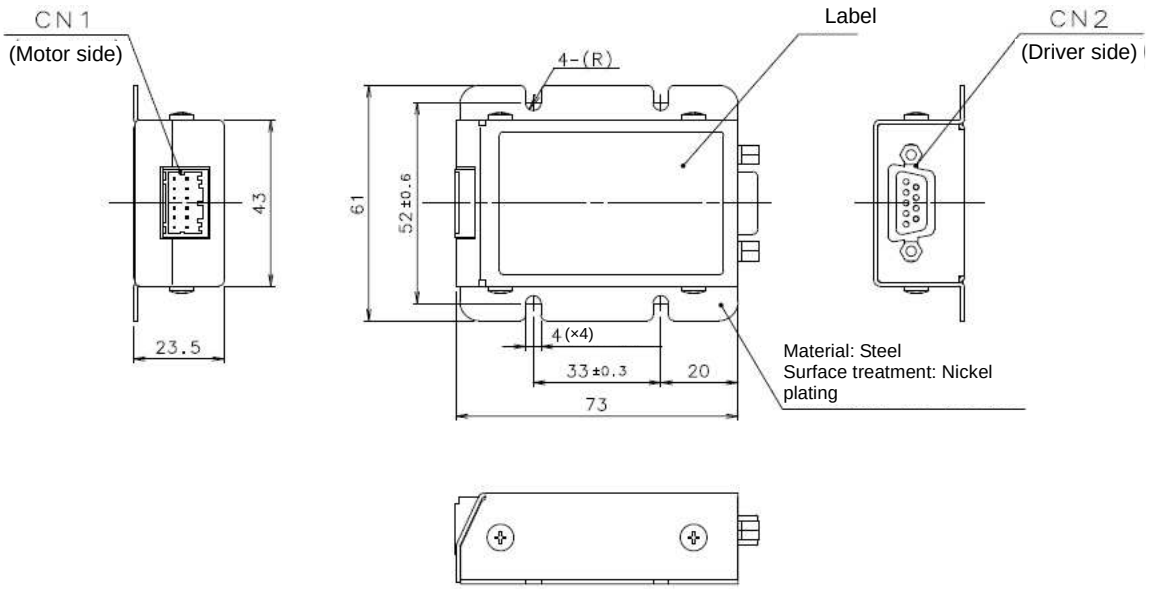


M-EGA-30A2301

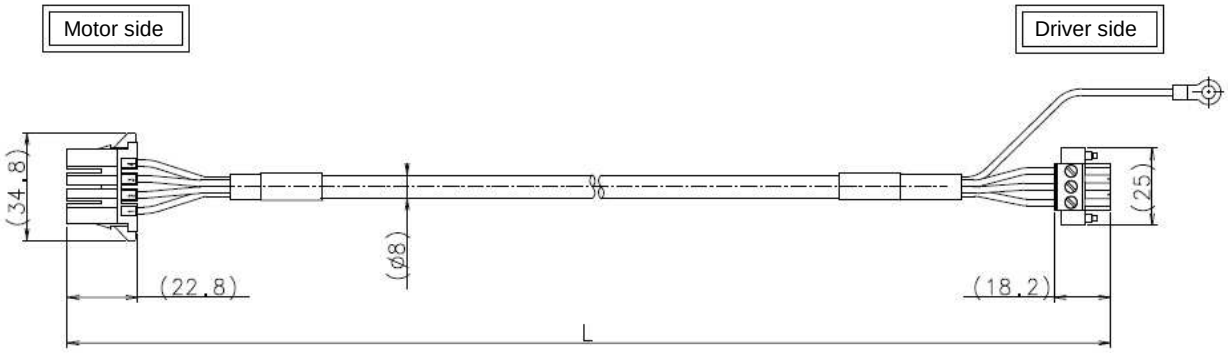


3) Converter

M-ECC-PBxxxxGA201



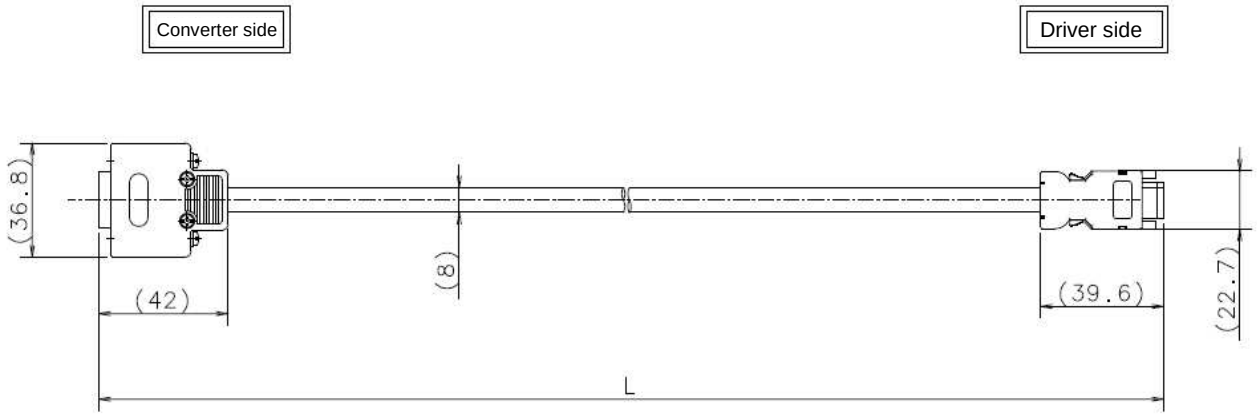
4) Motor cable



Dimension L
2000
4000
8000

Wiring table		
Connector motor side Pin number	Signal	Connector driver side Pin number
1	U	1
2	V	2
3	W	3
4	PE	Round solderless terminal

5) Converter Cable



Wiring table		
Converter side Pin number	Signal	Driver side Pin number
1	+5VDC	1
2	+5VRTN	2
3	COM–	8
4	COM+	7
5	Do not connect	3
6		4
7		5
8		6
Shell	FG	Shell

Dimension L
2000
4000
8000

9.4 Optional parts

The following optional parts are available.

1) Connectors

■ Connectors available as discrete components

Connector No.	Description	Reference No.	Maker Model No.	Name of Maker
CN1	For control signal	M-FAE0002	10150-3000PE and 10350-52A0-008	Sumitomo 3M Limited
CNA	For connection to input power and regenerative resistor	M-FAE0001	MSTBT2.5/8-STF-5.08LUB	Phoenix Contact K.K.

■ Connectors available as closed stock

Connector No.	Description	Reference No.
CN1,CNA	For control signal & for connection to input power and regenerative resistor	M-FAE0007

2) Mounting bracket

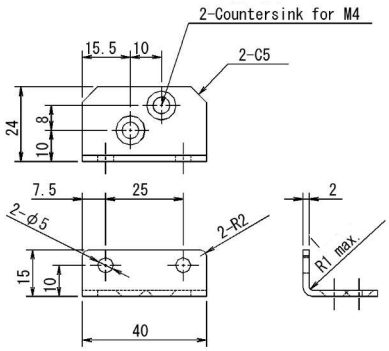
Mounting position	Description	Reference No.
Front face	Mounting bracket: One each for upper and bottom Tightening screws: 4 pcs	M-FAE0003

The optionally available mounting brackets are finished with trivalent chromate plating.

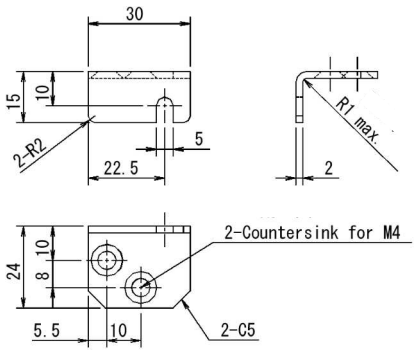
(Surface color: Bluish silver/Different from the body color.)

■ Mounting bracket outline drawing

Upper



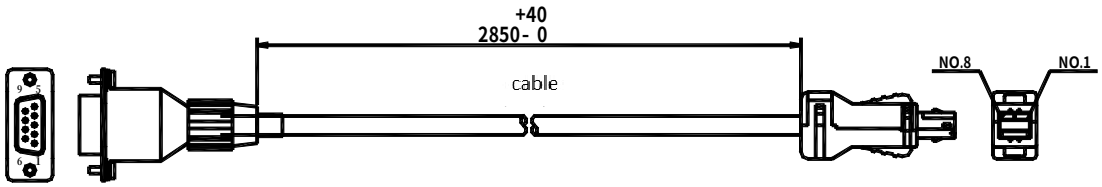
Bottom

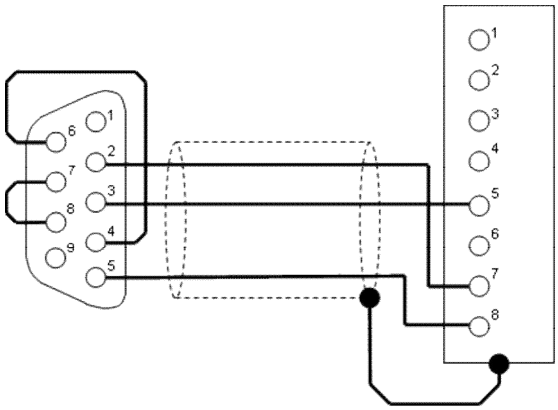


3) Setup software and serial communication

Name	Description	Reference No.
PC communication cable	Between PC (RS-232C port) ⇔ Driver (CN2)	M-FAE0006

■ PC communication cable outline drawing





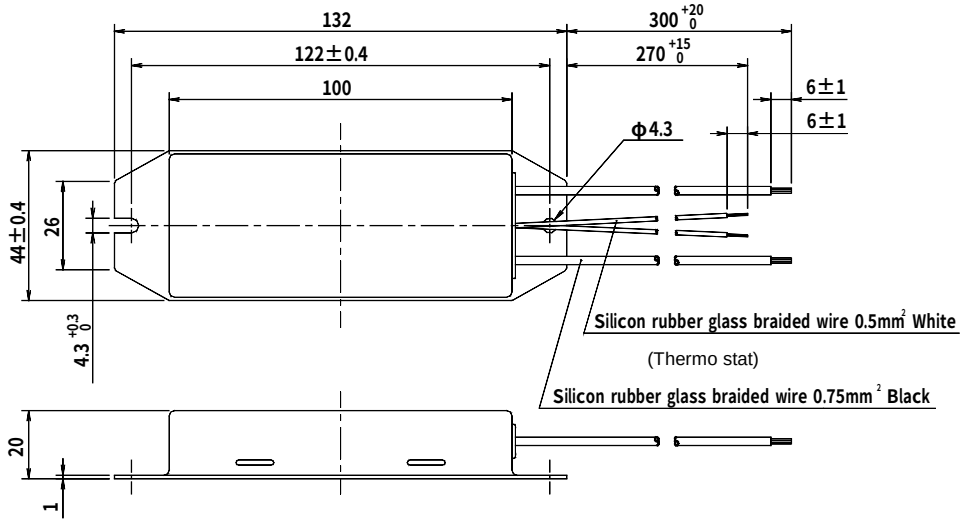
Host PC side (COM)	
JEZ-9S-3(LF) (J.S.T. Mfg. Co., Ltd.)	
Pin number	Signal
1	DCD
2	RD
3	TD
4	DTR
5	SG
6	DSR
7	RS
8	CS
9	RI

Driver side (CN2)	
MUF-PK8K-X (J.S.T. Mfg. Co., Ltd.)	
Pin number	Signal
1	NC
2	NC
3	NC
4	NC
5	RXD
6	NC
7	TXD
8	SG
Case	Shield

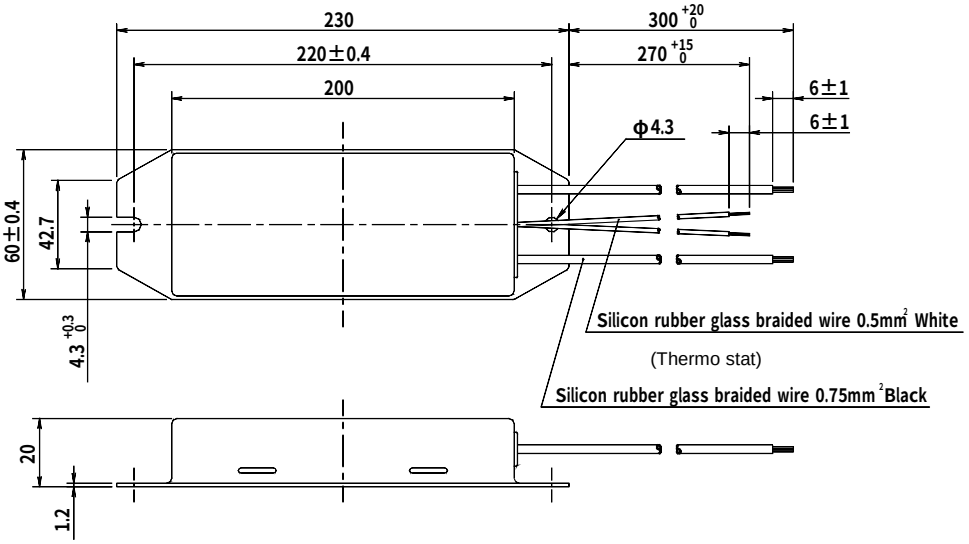
- ✔ When connect to a PC, connect the cable to CN2 of the driver.
- ✔ Use shielded cable.
- ✔ Connect shield line of the cable to the case of connector of driver side.
  Do not connect to the case of connector of host PC side (D-Sub 9-pin).
- ✔ Do not connect terminals of which connection is not specified in the wiring diagram.

9.5 Regenerative resistor

■ M-FAE0004 (80W, 50Ω)



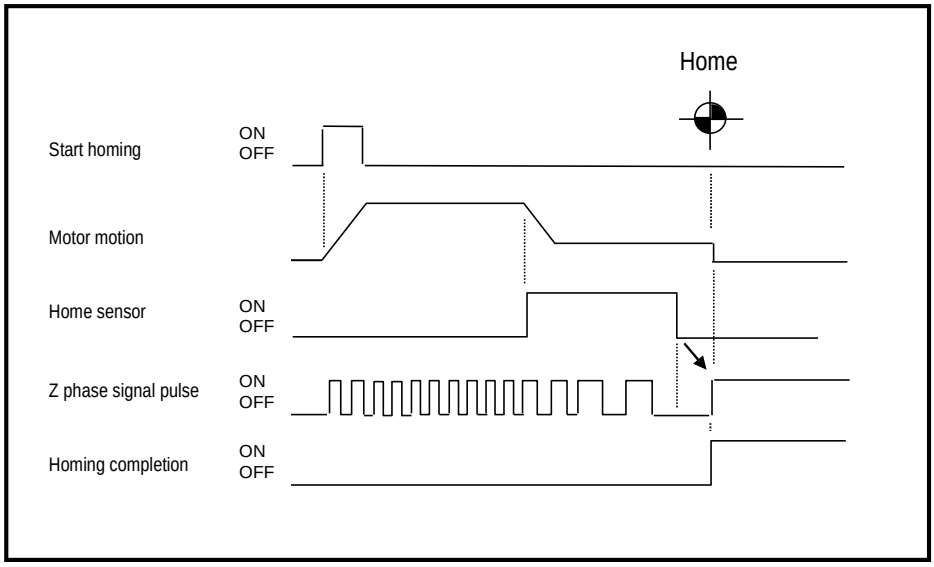
■ M-FAE0005 (220W, 100Ω)



9.6 Supplementary items for usage

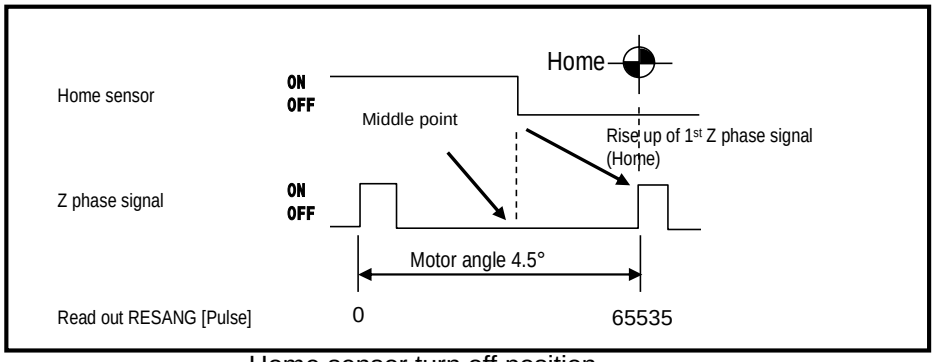
1) Homing

Motor does not incorporate home sensor. Homing must be operated by host equipment using external home sensor referring homing sequence and home sensor setting position described in below.



Example of Homing sequence

To secure home position by detecting rise up of Z phase signal properly, turn off point of home sensor must be adjusted at the middle point between Z phase signal described in below. Adjust home sensor turn off position around 32767 [pulse] by monitoring motor position using “Monitor_ID80:Resolver sensor electric angle(RESANG)”.



Home sensor turn off position

2) Setting procedures for parameters of magnetic pole position estimation

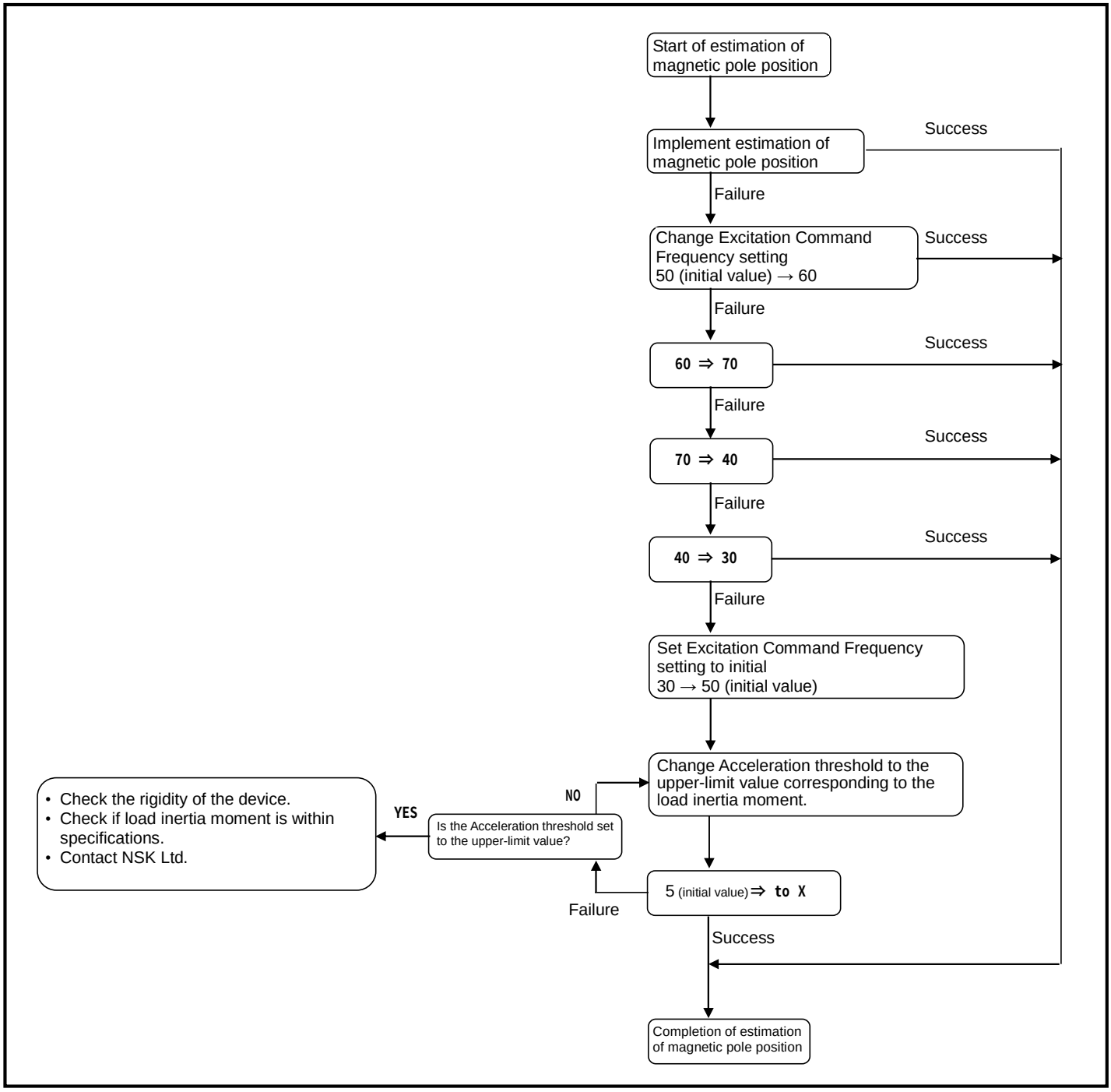
Magnetic pole position estimation is necessary every time at start-up of driver model EGA.
For the following cases, set the parameters of "Gr.B_ID01: Excitation Command Frequency setting (EMPFREQ)" and "Gr.B_ID02: Acceleration threshold (ACC)", which are relating to the estimation of magnetic pole position, suitable for each device.

◆ Check items when estimation of magnetic pole position does not complete correctly

- Unbalanced load or external force is applied to the motor.
- Rigidity of device (mounting base, load, installation) is low.
- Load inertia moment exceeds the specification of allowable load inertia moment.
- "Gr.B_ID01: Excitation Command Frequency setting (EMPFREQ)" is close to the resonance point of the device.
- Combination of motor and converter is not appropriate.

◆ Procedures for setting the parameters when alarm of Estimation of magnetic pole position error occurs

(1) Change "Gr.B_ID01: Excitation Command Frequency setting (EMPFREQ)", and implement estimation of magnetic pole position.
(2) Change "Gr.B_ID02: Acceleration threshold (ACC)", and implement estimation of magnetic pole position.



Setting procedures for parameters of estimation of magnetic pole position

Upper-limit value of acceleration threshold of each motor are described below.

PB1006

Load inertia moment [kg • m^2]	Load inertia moment ratio [%]	Upper-limit value of acceleration threshold [rad/s^2]
0.026	1000	100
0.052	2000	58
0.078	3000	38
0.104	4000	29
0.130	5000	23
0.156	6000	19
0.182	7000	16
0.208	8000	14
0.234	9000	13
0.260	10000	12

PB3015

Load inertia moment [kg • m^2]	Load inertia moment ratio [%]	Upper-limit value of acceleration threshold [rad/s^2]
0.14	1000	21
0.28	2000	11
0.42	3000	7
0.56	4000	5
0.70	5000	5
0.84	6000	5
0.98	7000	5

PB3030

Load inertia moment [kg • m^2]	Load inertia moment ratio [%]	Upper-limit value of acceleration threshold [rad/s^2]
0.16	1000	91
0.32	2000	50
0.48	3000	30
0.64	4000	16
0.80	5000	11
0.96	6000	11
1.12	7000	8
1.28	8000	8

PB3060

Load inertia moment [kg • m^2]	Load inertia moment ratio [%]	Upper-limit value of acceleration threshold [rad/s^2]
0.21	1000	100
0.42	2000	80
0.63	3000	54
0.84	4000	41
1.05	5000	24
1.26	6000	19
1.47	7000	16
1.68	8000	13
1.89	9000	10
2.10	10000	10
2.31	11000	9
2.52	12000	7
2.73	13000	7
2.94	14000	7

MEGATORQUE MOTOR SYSTEM

(Driver Model EGA)

User's Manual

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NSK Ltd.

MOTION & CONTROL™

NSK

Worldwide Sales Offices

P: Phone ☆: Head Office

NSK LTD. HEADQUARTERS, TOKYO JAPAN
INDUSTRIAL MACHINERY BUSINESS DIVISION-HEADQUARTERS P: +81-3-3779-7227
AUTOMOTIVE BUSINESS DIVISION-HEADQUARTERS P: +81-3-3779-7189

Africa

South Africa:
NSK SOUTH AFRICA (PTY) LTD.
JOHANNESBURG P: +27-11-458-3600

Aisia and Oceania

Australia:
NSK AUSTRALIA PTY. LTD.
MELBOURNE ☆ P: +61-3-9765-4400
SYDNEY P: +61-2-8843-8100
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New Zealand:
NSK NEW ZEALAND LTD.
AUCKLAND P: +64-9-276-4992
China:
NSK HONG KONG LTD.
HONG KONG ☆ P: +852-2739-9933
SHENZHEN P: +86-755-25904886
NSK (SHANGHAI) TRADING CO., LTD.
JIANGSU P: +86-512-5796-3000
NSK (CHINA) INVESTMENT CO., LTD.
JIANGSU ☆ P: +86-512-5796-3000
BEIJING P: +86-10-6590-8161
TIAN JIN P: +86-22-8319-5030
CHANGCHUN P: +86-431-8898-8682
SHENYANG P: +86-24-2334-2868
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QINGDAO P: +86-532-5568-3877
GUANGZHOU P: +86-20-3817-7800
CHANGSHA P: +86-731-8571-3100
LUOYANG P: +86-379-6069-6188
XI'AN P: +86-29-8765-1896
CHONGQING P: +86-23-6806-5310
CHENGDU P: +86-28-8528-3680
NSK CHINA SALES CO., LTD.
JIANGSU P: +86-512-5796-3000
India:
NSK INDIA SALES CO.PVT.LTD.
CHENNAI ☆ P: +91-44-2847-9600
GURGAON P: +91-124-4104-530
MUMBAI P: +91-22-2838-7787
Indonesia:
PT. NSK INDONESIA
JAKARTA P: +62-21-252-3458
Korea:
NSK KOREA CO., LTD.
SEOUL P: +82-2-3287-0300
Malaysia:
NSK BEARINGS (MALAYSIA) SDN.BHD.
SHAH ALAM ☆ P: +60-3-7803-8859
PRAI P: +60-4-3902275
JOHOR BAHRU P: +60-7-3546290
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Philippines:
NSK REPRESENTATIVE OFFICE
MANILA P: +63-2-893-9543
Singapore:
NSK INTERNATIONAL (SINGAPORE) PTE LTD.
SINGAPORE P: +65-6496-8000
NSK SINGAPORE (PRIVATE) LTD.
SINGAPORE P: +65-6496-8000
Taiwan:
TAIWAN NSK PRECISION CO., LTD.
TAIPEI ☆ P: +886-2-2509-3305
TAICHUNG P: +886-4-2708-3393
TAINAN P: +886-6-505-5861
TAIWAN NSK TECHNOLOGY CO., LTD.
TAIPEI ☆ P: +886-2-2509-3305
TAICHUNG P: +886-4-2358-2945
TAINAN P: +886-6-505-5861
Thailand:
NSK BEARINGS (THAILAND) CO., LTD.
BANGKOK P: +66-2320-2555
Vietnam:
NSK VIETNAM CO., LTD.
HANOI P: +84-4-3955-0159
NSK REPRESENTATIVE OFFICE
HO CHI MINH CITY P: +84-8-3822-7907

Europe

United Kingdom:
NSK EUROPE LTD. (EUROPEAN HEADQUARTERS)
MAIDENHEAD P: +44-1628-509-800
NSK UK LTD.
NEWARK P: +44-1636-605-123
France:
NSK FRANCE S.A.S.
PARIS P: +33-1-30-57-39-39
Germany:
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NSK RULMANLARI ORTA DOGU TIC. LTD. STI.
ISTANBUL P: +90-216-477-7111
UAE:
NSK BEARINGS GULF TRADING CO.
DUBAI P: +971-4-804-8200

North and South America

United Sates of America:
NSK AMERICAS, INC. (AMERICAN HEADQUARTERS)
ANN ARBOR P: +1-734-913-7500
NSK CORPORATION
ANN ARBOR P: +1-734-913-7500
NSK PRECISION AMERICA, INC.
FRANKLIN ☆ P: +1-317-738-5000
SAN JOSE P: +1-408-944-9400
NSK LATIN AMERICA, INC.
MIAMI P: +1-305-477-0605
Canada:
NSK CANADA INC.
TORONTO ☆ P: +1-905-890-0740
MONTREAL P: +1-514-633-1220
VANCOUVER P: +1-877-994-6675
Argentina:
NSK ARGENTINA SRL
BUENOS AIRES P: +54-11-4704-5100
Brazil:
NSK BRASIL LTDA.
SAO PAULO ☆ P: +55-11-3269-4786
BELO HORIZONTE P: +55-31-3274-2591
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LIMA P: +51-1-652-3372
Mexico:
NSK RODAMIENTOS MEXICANA, S.A. DE C.V.
MEXICO CITY ☆ P: +52-55-3682-2900
MONTERREY P: +52-81-8000-7300

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