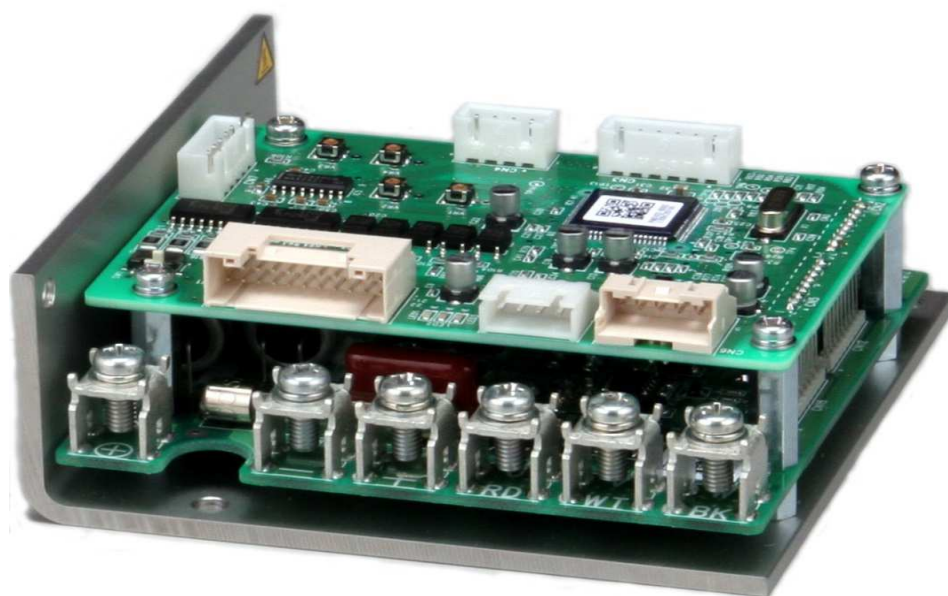**brother**
at your side

Low Voltage Brushless DC Gearmotor Driver

Instruction Manual
<Read this Manual before the use of the product.>

Brother International Corporation

Introduction
Thank you for purchasing the Brother Brushless DC series.

Safety precautions

● Be sure to read the contents described in this instruction manual carefully and to master how to use the product correctly before using it.

● Extents of hazard/damage expected to occur in the case of mishandling are basically classified and indicated into ranks of "Danger", "Warning" and "Caution" in this instruction manual. The definitions and indications are as follows:

⚠ Danger	Cases where mishandling possibly causes a dangerous situation to occur, which may lead to death or serious injury. The degree of danger is assumed to be extremely high.
⚠ Warning	Cases where mishandling possibly causes a dangerous situation to occur, which may lead to death or serious injury.
⚠ Caution	Cases where mishandling possibly causes a dangerous situation to occur, which may lead to a medium degree of injury or minor one.

Items described even in "Caution" may lead to a serious result depending on situations. Be sure to observe every instruction which deals with important contents.

⚠	: △ mark denotes "items about which care should be taken." (Left example shows electric shock hazard.)
🚫	: ○ mark denotes "items that must not be done." Indication inside the mark is specific details of prohibition. (Left example shows no disassembling.)
⏚	: ● mark denotes "items that must be done." Indication inside the mark is specific details of instructions. (Left example shows ground connection.)

⚠ Danger		
⚠	❗	If the product is used in a device such as a personnel transport device, make sure to install a protective device for safety purposes. Failure to implement safety measures may result in personal injury,death, and/or damage to the device.
⚠	❗	If the product is used in an elevator, install a safety device on the device side to prevent it from falling. Failure to implement safety measures may result in personal injury,death, and/or damage to the device due to the falling of the elevator.
⚠	🚫	Do not use the product in an explosive environment. Failure to follow this precaution may result in explosions, ignition of fire, fire, electric shocks, injuries, and/or damage to the device.
⚠	🚫	Do not change the wiring while the product is energized. Failure to follow this precaution may result in fire, electric shock, and/or damage to the device.
⚠	❗	Install a fuse and a circuit breaker on the power supply side to immediately stop the operations and cut off the power supply in case of a current overflow. Negligence may cause accidents leading to fire, electric shock, damage to the device, and/or other accidents.

⚠ Warning

⚠	🚫	Never use the product in a location where itmay be exposed to splashes of water, corrosive substances, flammable gas, and/or flammable objects. Failure to follow this precaution may result in fire or accidents.
⚠	❶	The operators in charge of transportation, installation, wiring, operation, handling, maintenance, and inspection should have enough knowledge and technical skill related to the product. Failure to follow this precaution may result in explosion, ignition of fire, fire, electric shock, injury, and/or damage to the device.
⚠	❶	Input voltage to this driver must be within the allowable range. Using the driver with voltage outside this range may cause failure/damage to the driver or accidents.
⚠	❶	Correctly connect the positive and negative sides of input voltage to this driver. Negligence may cause failure/damage to the driver or accidents.
⚠	❶	Regenerative energy is supplied to the power supply unit through this driver. When using a load that generates regenerative energy, the customer is required to take measures appropriate for the power supply unit. Negligence may cause malfunction of/damage to the driver or accidents.
⚠	❶	This driver is not equipped with the function to prevent inrush current when power is supplied. When power is supplied repeatedly at a frequency of once/hour or more or when inrush current becomes a problem for the instrument, the customer is requested to take appropriate treatment. Negligence may cause malfunction of/damage to the driver or accidents.
⚠	🚫	"If operation has stopped due to errors or activated safeguards, do not re-start the operation until the causes of error are identified and countermeasures are taken. Failure to follow this precaution may result in damage to the equipment, injury, fire, electric shock and/or burns."
⚠	🚫	The equipment might suddenly start operating after recovering from a power failure. Make sure not to go near the equipment. Failure to follow this precaution may result in injury.
⚠	🚫	Do not repair, disassemble or remodel the product. Failure to follow this precaution may result in injury, fire, electric shock and/or burns.

⚠ Caution

⚡	❶	When changing the setting of the built-in trimmer, use a slotted screwdriver made of resin. Negligence may cause electric shock or burns.
⚡	🚫	Never perform operations with wet hands. Negligence may cause electric shock.
⚠	❶	Use the specified combination of the motor and driver. Negligence may cause fire and damage to the equipment.
♨	🚫	Do not touch the motor or driver when the power is on or immediately after turning off the power, as their surfaces may be hot. Negligence may cause burns.
⚠	🚫	Immediately stop the product if any abnormality is noticed. Negligence may cause fire and injuries.
⚠	🚫	Do not keep any combustible material near the product. Negligence may cause fire.
⚠	❶	Operate the product under the conditions specified in this instruction manual. Negligence may cause damage to the equipment or injuries.
⚠	🚫	Do not keep any object that will block circulation of the air around the product. Negligence can cause abnormal overheating of the product. It may cause fire and burns.
⚠	🚫	Do not allow any foreign materials to enter the driver. Negligence may cause fire, electric shock, or malfunction of the driver.
⚠	🚫	Do not step on or place any heavy object on the product. Negligence may cause injuries.
⚠	🚫	Do not damage or strongly pull the cable. Negligence may cause injuries, fire or electric shock.
⚠	🚫	Keep the product away from any type of strong impact. Negligence may cause failure of the product or injuries.
⚠	🚫	Ensure that the wires to the power supply, motor, and driver are connected properly and securely. Negligence may cause malfunction of the equipment, resulting in injuries.
⚠	🚫	Do not touch the rotating part of the motor. Negligence may cause injuries.

Note
When disposing of the product, dispose of it as a general industrial waste. Please follow local laws and regulations if any applies and take care of the waste accordingly.

Notice
We shall assume no responsibility or liability for any troubles caused by use that violates the cautions above.
The contents of this Manual may be changed without notice.
We have made every possible effort to make the contents of this Manual precise and clear. If there is anything that is unclear or hard to understand, please feel free to contact us. Your comments will be appreciated.

Table of contents

Introduction
Safety precautions

Chapter 1: Part number and Model Configuration

■ Contents of part number

The model name is configured as follows.

Series		Motor Ver	Motor classification	Motor power	Voltage	Auxiliary code
A	—	BL	CD	010	L2	X
(1)		(2)	(3)	(4)	(5)	(6)
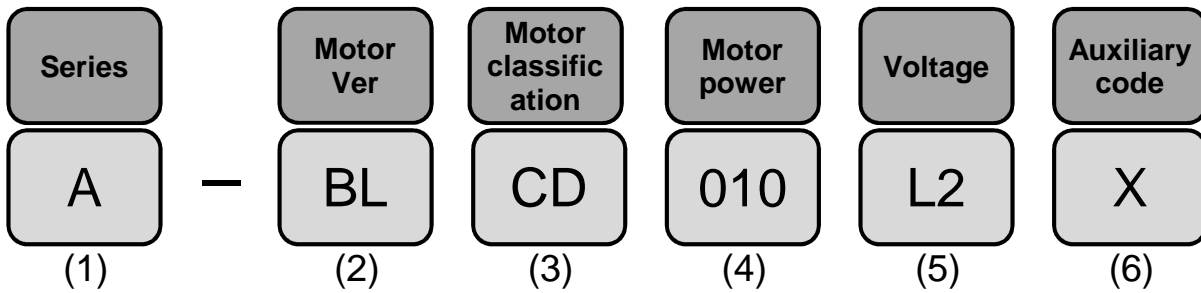
(1) Series	A	:	AR series		
(2) Motor version	BL	:	Motor version name		
(3) Motor classification	CD	:	Common to Motor and Brakemotor		
(4) Motor power	005	:	50 W		
	010	:	0.1 kW		
	020	:	0.2 kW		
	040	:	0.4 kW		
(5) Voltage	L1	:	12 V		
	L2	:	24 V		
	L4	:	48 V		
(6) Option	Empty	:	Standard specifications		
	X	:	Designates a special option		

■ Model configuration

Combinations of voltage and motor power are as follows.

		Voltage		
		12 V	24 V	48 V
Motor power	50 W	A-BLCD005L1	A-BLCD005L2	
	0.1 kW	A-BLCD010L1	A-BLCD010L2	A-BLCD010L4
	0.2 kW		A-BLCD020L2	A-BLCD020L4
	0.4 kW		A-BLCD040L2	A-BLCD040L4

Chapter 2: Driver Overview

■ A-BLCD005L1 / 005L2 / 010L1 / 010L2 / 010L4 / 020L2 / 020L4 / 040L4

Main circuit terminal block (M4)

Built-in switch (SW1)

Nameplate (attached to the side face)

Heat Sink

Mounting hole

Connector for control signal (CN1)

Built-in trimmer 3 (VR3)

Built-in trimmer 4 (VR4)

Built-in trimmer 2 (VR2)

Built-in trimmer 1 (VR1)

RD（U）

WT（V）

BK（W）

Status display LED lamps 1 ~ 3 (red/yellow/green)

Mounting hole

Connector for motor signal (CN6)

Connector for communication (CN8)

■ A-BLCD040L2

Mounting hole

Main circuit terminal block (M5)

RD（U）

WT（V）

BK（W）

Cooling fan

Mounting hole

Nameplate (attached to the side face)

■ Nameplate Detail

Model Name

Input specifications

Output specifications

Serial number

Safety Standards

```
MODEL  : A-BLCD040L4
INPUT  : DC48V  10.6A
OUTPUT : AC3PH 0-48V 0-150Hz  10.1A
S/N    : 01705240123          0001  01

CE   KC MSIP-REM-
        NCj-ABLCD040L4     10
brother CORP.      made in japan
```

Software version

Hardware version

■ Status display LED lamps

The status of the driver is shown with LED lamps. LED lamps turn on as below.

Code	Color	Specifications
LED1	Red	Lights up when an alarm is activated
LED2	Yellow	Lights up when operating in overloaded conditions (operation above motor rated current). Turns off when the overload condition is no longer present or when an alarm is activated.
LED3	Green	Stays lit while the controlled power is supplied. Lights up or blinks when an alarm is issued. The alarm type can be determined by the number of blinks.

■ LED lamp layout

CN1

LED 1 (red) Alarm

LED 2 (yellow) Warning for overload

LED 3 (green) Controlled power supply

CN8
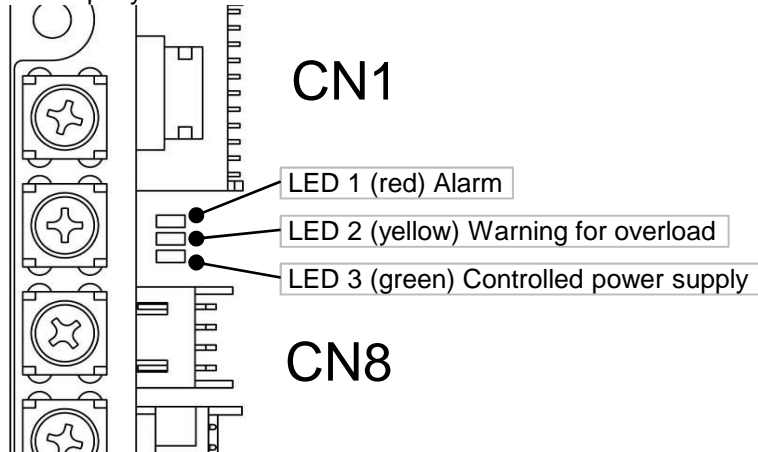
■ Built-in trimmer

There are four built-in trimmers on the driver. The following settings can be changed by adjusting the trimmers.

Code	Function name	Description	Initial setting
VR1	Built-in trimmer 1 (Speed Control)	Turning the trimmer clockwise increases the speed. *1 Speed Range: 0 ~ 3000 [r/min] The maximum speed value for this trimmer can be changed with Pn040. *2	Full Clockwise
VR2	Built-in trimmer 2 (Accelaration/ Deceleration Time)	Turning the trimmer clockwise increases the acceleration/deceleration time. Range: 0.00 ~ 5.00 [s] The standard speed for acceleration/deceleration time setting made by the trimmer can be changed with Pn025. The initial value of the standard speed is 2500 [r/min].	Full Counter-Clockwise
VR3	Built-in trimmer 3 (Torque Limit)	Turning the trimmer clockwise increases the torque limit value. Range: 0 ~ 200%	Full Clockwise
VR4	Built-in trimmer 4	Not used	-

*1. The function of the built-in trimmer 1 is not active upon shipment. Change the user constant (Pn000) to "4" per p.18 to activate built-in trimmer 1. The initial setting is set to external analog command.

*2. Speeds of up to 5000 [r/min] can be set by the trimmer, but the available motor speed is only up to 3000 [r/min].

■ Trimmer adjustment reference

Counter-clockwise   Clockwise
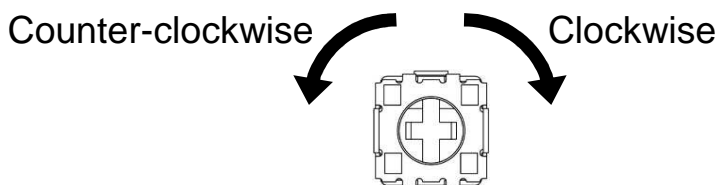
Chapter 3: External Dimensions (mm)

■ A-BLCD005L1 / 005L2 / 010L1 / 010L2 / 010L4 / 020L2 / 020L4 / 040L4

90　5

67.5

5.5

100

96

2-Φ4.5

Approximate Weight = 0.29 kg

5　82

5

33

2-Φ4.5

38

25

4

■ A-BLCD040L2

10　110　4-Φ4.5

5

102

64　92　112

130

149.5
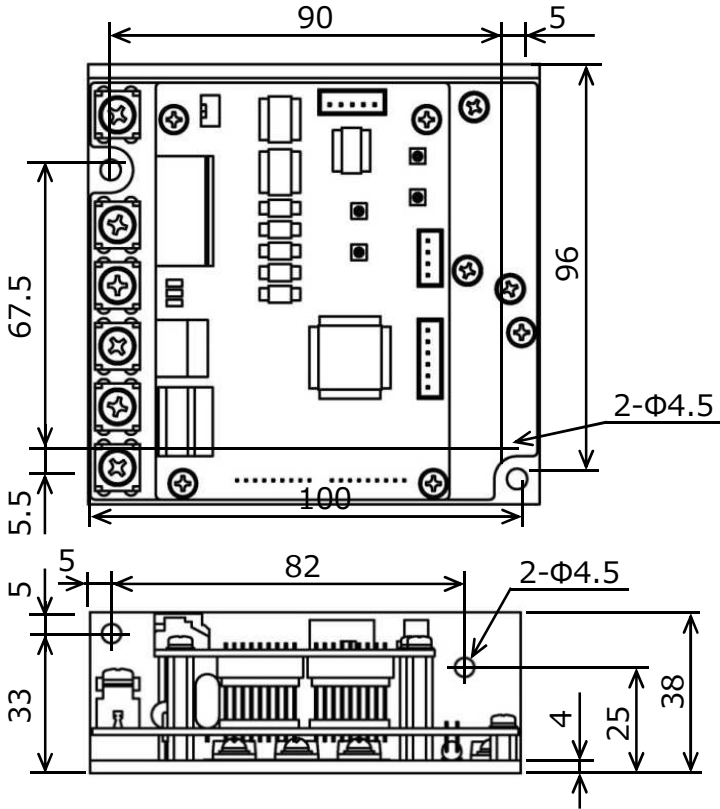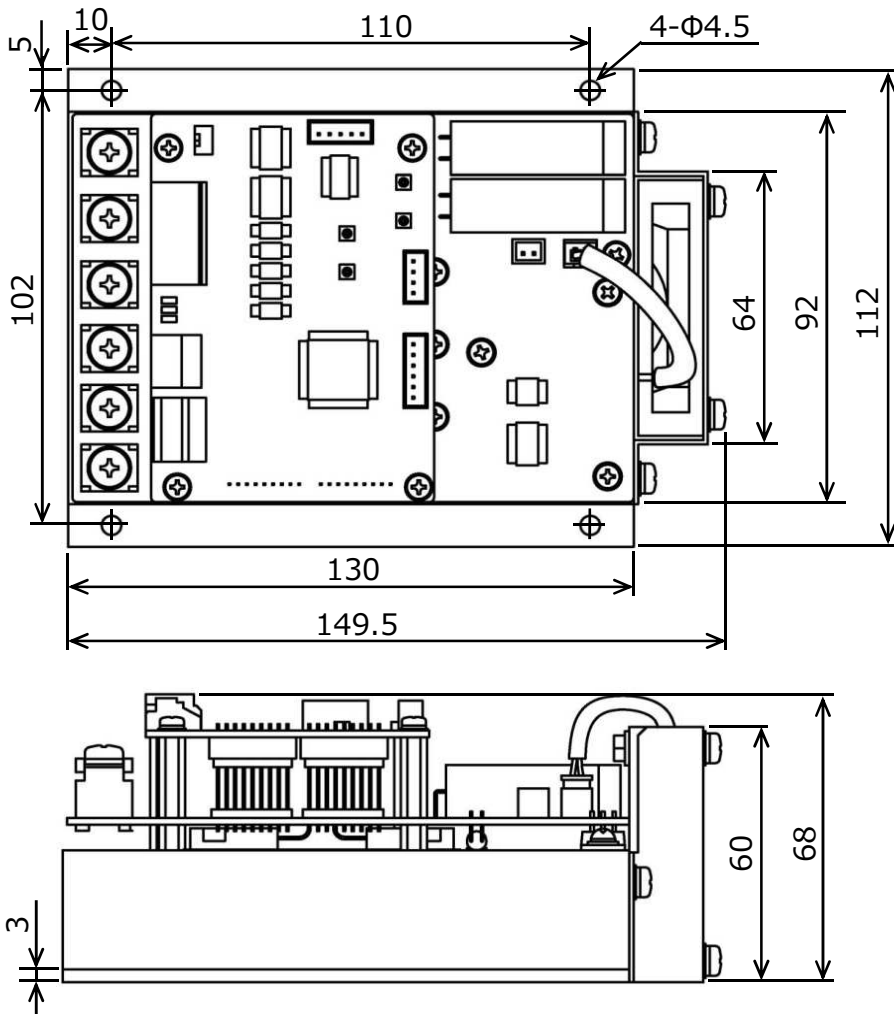
Approximate Weight = 0.73 kg

60　68

3

Chapter 4: Installation

◼ Installation environment

[Ambient temperature] -10 ~ +50ºC
[Ambient humidity]   95%RH or less (no condensation allowed)
[Altitude]   1,000 m or lower
[Atmosphere]   Well-ventilated place free from corrosive gas, explosive gas, vapor, and dust.
[Vibration]   2.0 G or less
[Installation location] Indoor

* When installing the driver, place it in a switchboard or the like to prevent foreign materials from entering.

There is no restriction on the mounting direction of the driver, but please provide a gap of 30mm or larger at the top and bottom of the driver.

◼ A-BLCD005L1 / 005L2 / 010L1 / 010L2
  010L4 / 020L2 / 020L4 / 040L4
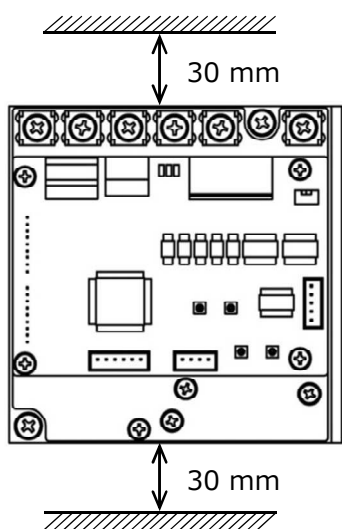
◼ A-BLCD040L2 (with cooling fan)
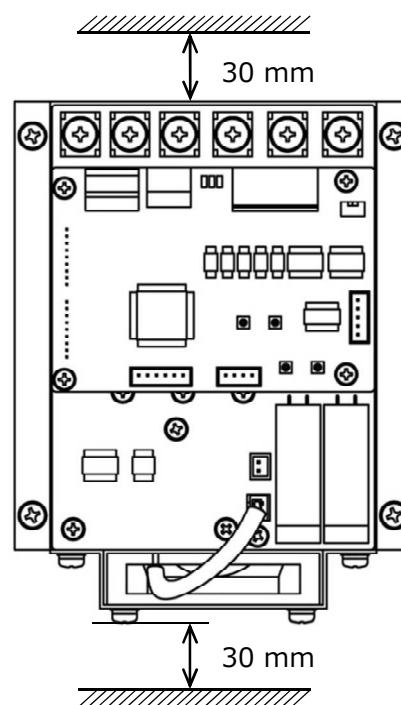
When installing multiple drivers in a row, provide a gap of 60 mm or larger between drivers.

10
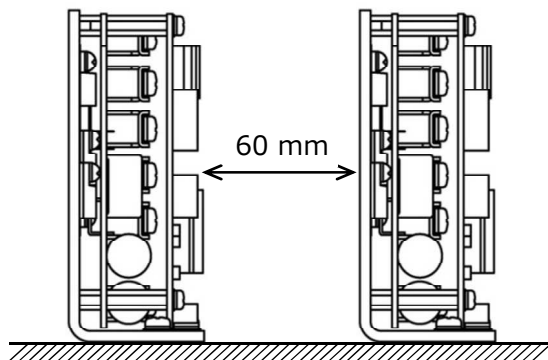
Chapter 5: Wiring Diagrams

■ Sink connection example (when using built-in power supply)
When using the built-in power supply, set the built-in switch lever of the driver (SW1) as shown on the right.

Built-in switch (SW1)
When using external power supply

When using built-in power supply

Terminal		Description
+	Main power supply (+)	
-	Main power supply (-)	
⊕	Controlled power supply (⊕)	

*1

Motor drive output U-phase — RD(U) Red
Motor drive output V-phase — WT(V) White
Motor drive output W-phase — BK(W) Black

M

Motor signal line
CN6

B

Ry

Surge protector

CN1

Pin	Terminal	Description
1	IN-COM	Input common
2	I1	Multi-function input 1 (CW driving command)
3	I2	Multi-function input 2 (CCW driving command)
4	I3	Multi-function input 3 (Speed command selection 1)
5	I4	Multi-function input 4 (Speed command selection 2)
6	I5	Multi-function input 5 (Acceleration/deceleration time selection)
7	I6	Multi-function input 6 (Torque limit value selection)
8	I7	Multi-function input 7 *2 (Alarm reset, emergency stop)
9	I8	Multi-function input 8 (Pulse frequency speed command)

CN8

Personal computer (RS-232C)

Pin	Terminal	Description
10	C1	Multi-function output 1 *2 (Error detection)
11	E1	
12	C2	Multi-function output 2 (During operation)
13	E2	
14	C3	Multi-function output 3 (Rotation pulse)
15	E3	
16	C4	Multi-function output 4 (Overload)
17	E4	

Ry

30 V or less

Pin	Terminal	Description
19	+5 V	External analog 5 V power supply
20	AIN	External analog input
21	AOUT	Analog output
22	TGND	Ground for external equipment *3

*1. This contact reduces standby electric power consumption of the driver.
*2. The polarity is reversed in the initial state for safety.
*3. Take the analog voltage reference from the main power supply terminal (-).

11

■ Sink connection example (when using external power supply)
When using the external power supply, set the built-in switch lever of the
driver (SW1) as shown on the right.

Built-in switch (SW1)
When using external
power supply

When using built-in
power supply

+ ⊗ Main power supply (+)

- ⊗ Main power supply (-)

Motor drive output | RD(U) Red
U-phase ⊗

Motor drive output | WT(V) White
V-phase ⊗

Motor drive output | BK(W) Black
W-phase ⊗

⊕ ⊗ Controlled power supply (⊕)

*1

12 V ~ 24 V

Motor signal line

CN6

M

B

Ry

Surge
protector

CN1

Pin	Terminal	Description
1	IN-COM	Input common
2	I1	Multi-function input 1 (CW driving command)
3	I2	Multi-function input 2 (CCW driving command)
4	I3	Multi-function input 3 (Speed command selection 1)
5	I4	Multi-function input 4 (Speed command selection 2)
6	I5	Multi-function input 5 (Acceleration/deceleration time selection)
7	I6	Multi-function input 6 (Torque limit value selection)
8	I7	Multi-function input 7 *2 (Alarm reset, emergency stop)
9	I8	Multi-function input 8 (Pulse frequency speed command)

CN8

Personal computer
(RS-232C)

Ry

Pin	Terminal	Description
10	C1	Multi-function output 1 *2 (Error detection)
11	E1	
12	C2	Multi-function output 2 (During operation)
13	E2	
14	C3	Multi-function output 3 (Rotation pulse)
15	E3	
16	C4	Multi-function output 4 (Overload)
17	E4	

30 V or less

Pin	Terminal	Description
19	+5 V	External analog 5 V power supply
20	AIN	External analog input
21	AOUT	Analog output
22	TGND	Ground for external equipment *3

*1. This contact reduces standby electric power consumption of the driver.
*2. The polarity is reversed in the initial state for safety.
*3. Take the analog voltage reference from the main power supply terminal (-).

■ Source connection example (when using external power supply)
When using the external power supply, set the built-in switch lever of the driver (SW1) as shown on the right.

Built-in switch (SW1)
When using external power supply

When using built-in power supply

+ ⊗ Main power supply (+)

- ⊗ Main power supply (-)

⊕ ⊗ Controlled power supply (⊕)

*1
12 V ~ 24 V

Motor drive output U-phase — RD(U) Red
Motor drive output V-phase — WT(V) White
Motor drive output W-phase — BK(W) Black

Motor signal line
CN6

M

B

Ry
Surge protector

CN8 → Personal computer (RS-232C)

CN1

1	IN-COM	Input common
2	I1	Multi-function input 1 (CW driving command)
3	I2	Multi-function input 2 (CCW driving command)
4	I3	Multi-function input 3 (Speed command selection 1)
5	I4	Multi-function input 4 (Speed command selection 2)
6	I5	Multi-function input 5 (Acceleration/deceleration time selection)
7	I6	Multi-function input 6 (Torque limit value selection)
8	I7	Multi-function input 7 *2 (Alarm reset, emergency stop)
9	I8	Multi-function input 8 (Pulse frequency speed command)

10	C1	Multi-function output 1 *2 (Error detection)
11	E1	
12	C2	Multi-function output 2 (During operation)
13	E2	
14	C3	Multi-function output 3 (Rotation pulse)
15	E3	
16	C4	Multi-function output 4 (Overload)
17	E4	

30 V or less

Ry

19	+5 V	External analog 5 V power supply
20	AIN	External analog input
21	AOUT	Analog output
22	TGND	Ground for external equipment *3

*1. This contact reduces standby electric power consumption of the driver.
*2. The polarity is reversed in the initial state for safety.
*3. Take the analog voltage reference from the main power supply terminal (-).

Chapter 6: External I/F Specifications

I/F is not isolated from the main power supply. Pay extreme attention when wiring.

■ Connector specifications

Code	Manufacturer	Type	Remarks
Terminal block (TM1 ~ 6)	-	-	Tightening torque: 0.8 ~ 1.2 N·m (M4) 1.6 ~ 2.0 N·m (M5)
CN1	J.S.T.MFG.CO.,LTD.	S22B-PUDSS-1	Applicable housing: PUDP-22V-S Applicable crimping terminal: SPUD-001T-P0.5
CN6	J.S.T.MFG.CO.,LTD.	S05B-XASK-1	Applicable housing: XAP-05V-1 Applicable crimping terminal: SXA-001T-P0.6
CN8	J.S.T.MFG.CO.,LTD.	S4B-XH-A	Applicable housing: XHP-4 Applicable crimping terminal: SXH-001T-P0.6N

■ Layout of terminal block

Terminal symbol	Function name	Description
⊕	Controlled power supply (+)	Plus side of the controlled power supply
-	Main power supply (-)	Minus side of the main power supply Common to the minus side of the controlled power supply
+	Main power supply (+)	Plus side of the main power supply
RD(U)	Motor drive output U-phase	Connected with motor *
WT(V)	Motor drive output V-phase	
BK(W)	Motor drive output W-phase	

* Pay attention to the wiring of the motor phases. If the wiring is incorrect, the motor will not operate.

■ I/O connector layout (CN1)

Terminal No.	Terminal name	Function name	Initial setting
1	IN_COM	Input common *1	
2	I1	Multi-function input 1	CW driving command
3	I2	Multi-function input 2	CCW driving command
4	I3	Multi-function input 3	Speed command selection 1
5	I4	Multi-function input 4	Speed command selection 2
6	I5	Multi-function input 5	Acceleration/deceleration time selection
7	I6	Multi-function input 6	Torque limit value selection 1
8	I7	Multi-function input 7	Alarm reset, emergency stop *2
9	I8	Multi-function input 8	Pulse frequency speed command
10	C1	Multi-function output 1	Error detection *2
11	E1		
12	C2	Multi-function output 2	During operation
13	E2		
14	C3	Multi-function output 3 (Correspond to high-speed pulse output) *3	Rotation pulse
15	E3		
16	C4	Multi-function feature output 4 (Correspond to high-speed pulse output) *3	Overload
17	E4		
18	-	Not used	
19	+5 V	External analog 5 V power supply *4	
20	AIN	External analog input	Speed command
21	AOUT	Analog output	Speed (output actual speed of motor)
22	TGND	Ground for external equipment *5	

*1. Short-circuited with the ground in the driver if the built-in switch lever is set to use the built-in power supply.
When the built-in power source is used, do not connect any other terminals here.

*2. The I/O polarity is reversed when initially set.

*3. Multi-function outputs 3 and 4 are compatible with high-speed pulse output. When selecting the output functions of rotation pulse, clockwise rotation pulse and counterclockwise rotation pulse, please assign the functions to multi-function outputs 3 and 4.

*4. This is the power supply output terminal. Do not connect an external power supply.

*5. Connect this terminal only when using an external setting unit. When an external setting unit is not used, do not connect any other terminals here.

Terminal #1 notch

1   21

2   22

CN1   PCB
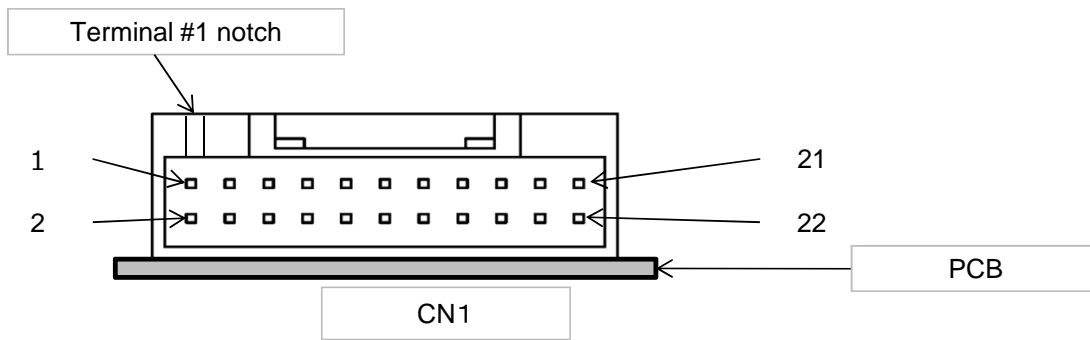
■ Layout of motor signal connector (CN6) *1

Terminal No.	Terminal name	Function name
1	+15 V	Power supply 15 V
2	HALL_U	Hall sensor input U-phase
3	HALL_V	Hall sensor input V-phase
4	HALL_W	Hall sensor input W-phase
5	GND	Ground *2

*1. The maximum extension length is 5 m.
*2. Do not connect the main power source (–) here.

■ Layout of communication connector (CN8)

Terminal No.	Terminal name	Function name
1	+5 V	Power supply 5 V
2	TxD	Data transmission
3	RxD	Data receipt
4	GND	Ground *

* Do not connect the main power source (–) here.

Chapter 7: I/O Terminal Wiring

7.1 Control input

■ When using built-in power supply (set SW1 to CN1 side)
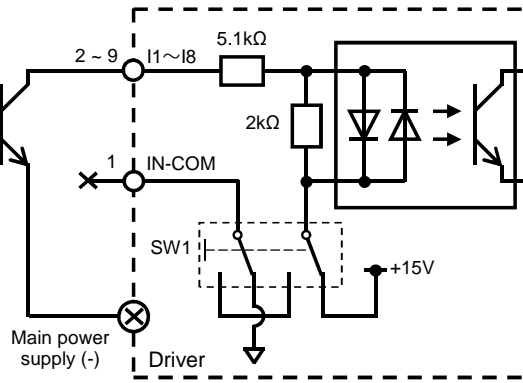
[Sink connection]   * Built-in switch setting
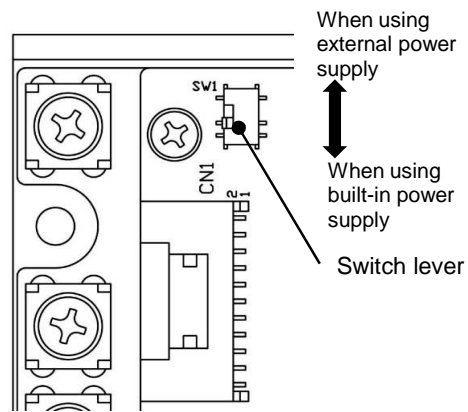
* As shown above, do not use CN1-1 (IN-COM).

■ When using external power supply (set SW1 to the side opposing to CN1 side)
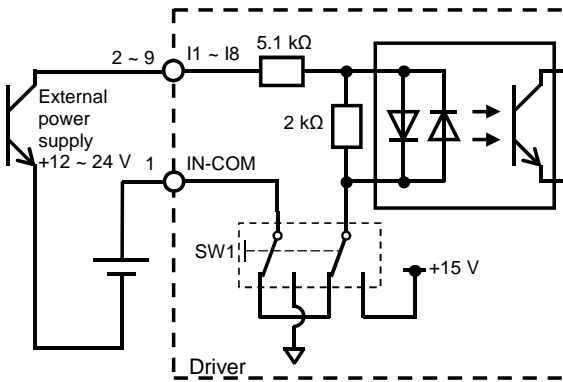
[Sink connection]   [Source connection]
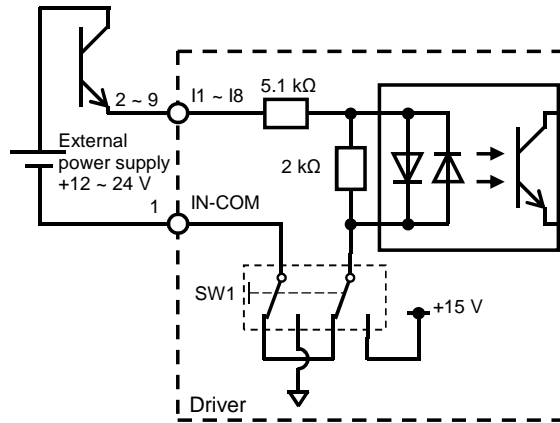
7.2 Control output

■ Maximum rated value of control output

Max voltage between C and E		30 V
Max current	C1/E1, C2/E2	100 mA
	C3/E3, C4/E4	50 mA
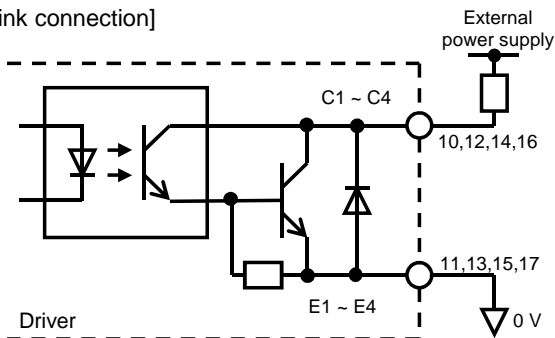
[Sink connection]   [Source connection]
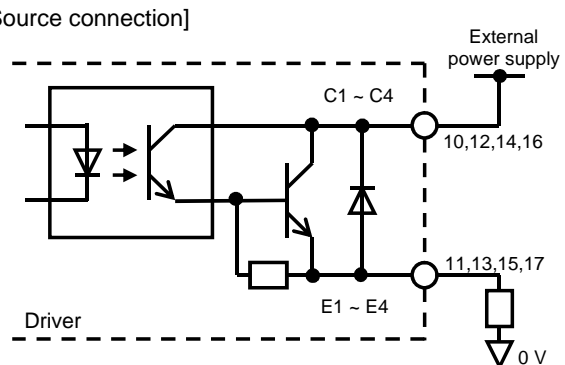
7.3 External analog input

By using the AIN Terminal (external analog input) to input a DC Votlage, a speed or torque limit value can be enabled.
* The DC voltage reference differs depending on the external speed setting unit and the DC voltage control. Connect wires according to the following wiring examples.

■ External speed setting unit wiring example

The external speed setting unit is available from us as an option.

When sourcing a unit from another vendor, select one with a range of 1k to 20kW.

Do not connect TGND to any terminal other than the No. 1 terminal of the external speed setting unit.

External speed setting unit
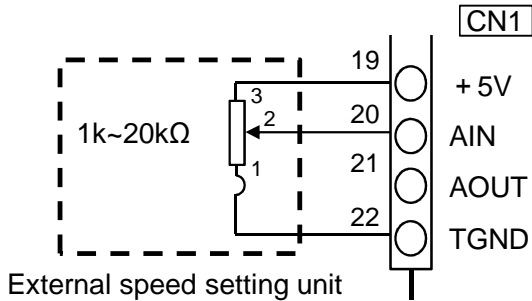
■ DC voltage control wiring example

When an analog output unit or the like is used, the one having insulated output is recommended.

Connect the – output terminal of the analog output unit directly to the main power source (–) of the driver.

Insulated analog output unit

To terminal (-) of the battery
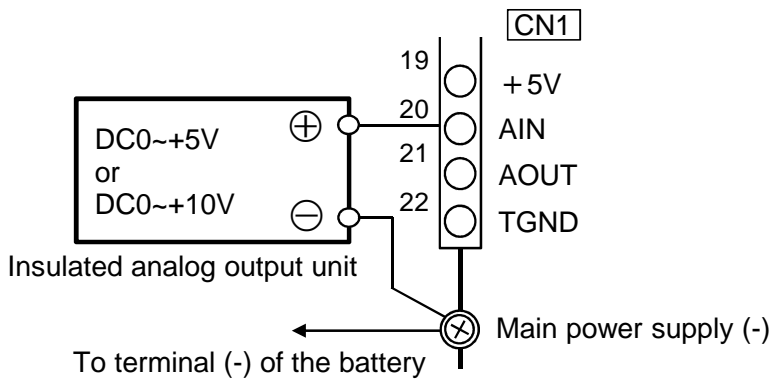
Chapter 8: User Constants

8.1 Setting of constants

The user constant can be changed using PC software "ACD-PSTool."

* "ACD-PSTool" can be downloaded from our website for free.

* The communication cable between PC (RS-232C) and the driver is an optional accessory (sold seperately).

■ The "ACD-PSTool" is compatible with the following operating systems.

Windows7®, Windows8®, Windows8.1® and Windows10®

8.2 Constant list

■ Attribute

Each constant has an attribute. Refer to the explanation below.

Attribute	Description
P	When the constant is changed, the setting becomes effective after power is supplied again. The previous setting is maintained until power is supplied again.
S	When the constant is changed, the setting becomes effective after the motor stops or power is supplied again. The previous setting is maintained while the motor is operating.
D	When the constant is changed, the new setting becomes effective immediately.

No.	Name	Description	Unit	Setting range	Initial value	Attribute
Pn000	Speed command source selection	Selects the speed command method. 1: External analog command 2: PWM speed command 3: Pulse frequency speed command 4: Built-in trimmer 1 5: Speed command 1 (Pn001)	-	1 ~ 5	1	S
Pn001	Speed command 1	Set the speed command 1.	r/min	100 ~ 3000	2500	D
Pn002	Speed command 2	Set the speed command 2.	r/min	100 ~ 3000	2500	D
Pn003	Speed command 3	Set the speed command 3.	r/min	100 ~ 3000	2500	D
Pn004	Speed command 4	Set the speed command 4.	r/min	100 ~ 3000	2500	D
Pn005	Speed command 5	Set the speed command 5.	r/min	100 ~ 3000	2500	D
Pn006	Speed command 6	Set the speed command 6.	r/min	100 ~ 3000	2500	D
Pn007	Speed command 7	Set the speed command 7.	r/min	100 ~ 3000	2500	D
Pn008	Speed command 8	Set the speed command 8.	r/min	100 ~ 3000	2500	D
Pn020	Acceleration/ deceleration time command source selection	Selects the command method for acceleration/deceleration time. 1: Built-in trimmer 2 2: Acceleration time 1, deceleration time 1	-	1 ~ 2	1	S
Pn021	Acceleration time 1	Sets the acceleration time 1 which is from 0 [r/min] to the acceleration/deceleration time standard speed (Pn025).	s	0.00 ~ 5.00	0.1	D
Pn022	Deceleration time 1	Sets the deceleration time 1 which is from the acceleration/deceleration time standard speed (Pn025) to 0 [r/min].	s	0.00 ~ 5.00	0.1	D
Pn023	Acceleration time 2	Sets the acceleration time 2 which is from 0 [r/min] to the acceleration/deceleration time standard speed (Pn025).	s	0.00 ~ 5.00	0.1	D
Pn024	Deceleration time 2	Sets the deceleration time 2 which is from the acceleration/deceleration time standard speed (Pn025) to 0 [r/min].	s	0.00 ~ 5.00	0.1	D
Pn025	Acceleration/deceleration time Standard speed	Sets the standard speed of acceleration/deceleration time. Acceleration time: Time required from 0 [r/min] to this constant Deceleration time: Time required from this constant to 0 [r/min]	r/min	1000 ~ 5000	2500	S

S: Changeable when motor is stopped or power is supplied again.　　　D: Always changeable

No.	Name	Description	Unit	Setting range	Initial value	Attribute
Pn030	Torque limit value command source selection	Selects the command method for torque limit value. 1: External analog command 2: Built-in trimmer 3 3: Torque limit value 1	-	1 ~ 3	2	S
Pn031	Torque limit value 1	Sets the torque limit value 1.	%	0 ~ 200	150	D
Pn032	Torque limit value 2	Sets the torque limit value 2.	%	0 ~ 200	150	D
Pn033	Torque limit value 3	Sets the torque limit value 3.	%	0 ~ 200	150	D
Pn034	Torque limit value 4	Sets the torque limit value 4.	%	0 ~ 200	150	D
Pn040	Built-in trimmer 1/PWM speed command standard speed	Sets the standard speed of the built-in trimmer and PWM speed command (Duty 100%).	r/min	100 ~ 5000	3000	S
Pn041	Frequency setting for pulse frequency speed command	Sets the frequency of the pulse frequency speed command at the standard speed (Pn042).	×10 Hz	1 ~ 9999	2500	S
Pn042	Standard speed for pulse frequency speed command	Sets the standard speed of the pulse frequency speed command.	r/min	1 ~ 5000	2500	S
Pn050	External analog Input level	Sets the voltage level of external analog input. 1 : 0 ~ 10 V 2 : 0 ~ 5 V	-	1 ~ 2	2	S
Pn051	Analog input gain	Sets the inclination of external analog command.	(r/min)/V or %/V	-9.99 ~ 9.99	0.6	S
Pn052	Analog input offset	Sets the offset of external analog command.	r/min or V	0 ~ 9999	0	S
Pn060	Analog output selection	Sets the function output from the analog output. 1: Speed (actual output speed of motor) 2: Load factor (output load factor of motor) 3: Commanded speed (output commanded speed of driver)	-	1 ~ 3	1	D
Pn061	Analog output gain	Sets the gain of the analog output.	V/(r/min) or V/%	-99.99 ~ 99.99	1.00	D
Pn062	Analog output offset	Sets the offset of the analog input.	V	0.00 ~ 5.00	0.00	D

S: Changeable when motor is stopped or power is supplied again.　　　D: Always changeable

No.	Name	Description	Unit	Setting range	Initial value	Attribute
Pn100	I1 input function selection	Select the function of input terminal 1.	-	1 ~ 12	1	P
Pn101	I2 input function selection	Select the function of input terminal 2.	-	1 ~ 12	2	P
Pn102	I3 input function selection	Select the function of input terminal 3.	-	1 ~ 12	3	P
Pn103	I4 input function selection	Select the function of input terminal 4.	-	1 ~ 12	4	P
Pn104	I5 input function selection	Select the function of input terminal 5.	-	1 ~ 12	6	P
Pn105	I6 input function selection	Select the function of input terminal 6.	-	1 ~ 12	7	P
Pn106	I7 input function selection	Select the function of input terminal 7.	-	1 ~ 12	9	P
Pn107	I8 input function selection	Select the function of input terminal 8.	-	1 ~ 14	14	P
Pn110	I1 input polarity selection	Select the polarity of input terminal 1.	-	0 ~ 1	0	P
Pn111	I2 input polarity selection	Select the polarity of input terminal 2.	-	0 ~ 1	0	P
Pn112	I3 input polarity selection	Select the polarity of input terminal 3.	-	0 ~ 1	0	P
Pn113	I4 input polarity selection	Select the polarity of input terminal 4.	-	0 ~ 1	0	P
Pn114	I5 input polarity selection	Select the polarity of input terminal 5.	-	0 ~ 1	0	P
Pn115	I6 input polarity selection	Select the polarity of input terminal 6.	-	0 ~ 1	0	P
Pn116	I7 input polarity selection	Select the polarity of input terminal 7.	-	0 ~ 1	1	P
Pn117	I8 input polarity selection	Select the polarity of input terminal 8.	-	0 ~ 1	0	P
Pn120	C1-E1 output function selection	Select the function of output terminal 1.	-	1 ~ 11	1	P
Pn121	C2-E2 output function selection	Select the function of output terminal 2.	-	1 ~ 11	2	P
Pn122	C3-E3 output function selection	Select the function of output terminal 3.	-	1 ~ 11	3	P
Pn123	C4-E4 output function selection	Select the function of output terminal 4.	-	1 ~ 11	8	P
Pn125	C1-E1 output polarity selection	Select the polarity of output terminal 1.	-	0 ~ 1	1	P
Pn126	C2-E2 output polarity selection	Select the polarity of output terminal 2.	-	0 ~ 1	0	P
Pn127	C3-E3 output polarity selection	Select the polarity of output terminal 3.	-	0 ~ 1	0	P
Pn128	C4-E4 output polarity selection	Select the polarity of output terminal 4.	-	0 ~ 1	0	P

P: Changeable when power is supplied again.

Input terminal function list

Setting	Function
1	CW driving command
2	CCW driving command
3	Speed command selection 1
4	Speed command selection 2
5	Speed command selection 3
6	Acceleration/deceleration time selection
7	Torque limit value selection 1
8	Torque limit value selection 2
9	Alarm reset, emergency stop
10	Brake control signal Forced ON command
11	Direct current lock
12	Load inertia switch
13	PWM speed command
14	Pulse frequency speed command

Output terminal function list

Setting	Function
1	Error detected
2	Operating
3	Rotation pulse
4	CW rotation pulse
5	CCW rotation pulse
6	Rotation direction
7	Rotating
8	Over Rated torque
9	Over Specified torque
10	Brake control signal
11	Voltage drop warning

* Brake cont rol signal is available from version 0004.
 Never use the driver with version 0003 or earlier.

No.	Name	Description	Unit	Setting range	Initial value	Attribute
Pn151	Current limit value upon direct current lock	Sets the current value (rated current ratio) when the direct current lock function is activated.	%	0 ~ 100	30	D
Pn160	Torque detection level	Sets the current value (rated current ratio) to turn ON the specified excessive torque output.	%	0 ~ 200	80	S
Pn161	Torque detection hysteresis width	Sets the hysteresis width (rated current ratio) of the torque to turn OFF at the specified excessive torque output.	%	0 ~ 50	10	S
Pn165	Rated torque detection hysteresis width	Sets the hysteresis width (rated current ratio) of the torque to turn OFF the at the rated excessive torque output.	%	0 ~ 50	10	S
Pn170	Mechanical brake release speed level	Sets the internal commanded speed that turns ON the brake control signal.	r/min	1 ~ 1000	20	S
Pn171	Mechanical brake operation speed level	Sets the internal commanded speed that turns OFF the brake control signal.	r/min	0 ~ 1000	20	S
Pn172	Mechanical brake release standby time	Sets the delay time after the internal commanded speed reaches the brake control signal ON speed until the signal is actually turned ON.	s	0.000 ~ 2.000	0.005	S
Pn173	Mechanical brake operation standby time	Sets the delay time after the internal commanded speed reaches the brake control signal OFF speed until the signal is actually turned OFF.	s	0.000 ~ 2.000	0.005	S
Pn175	Input voltage drop warning voltage	Sets the voltage that issues the input voltage drop warning alarm.	V	0.0 ~ 50.0	12 V product: 10.0 24 V product: 20.0 48 V product: 40.0	D
Pn180	Dynamic brake transition speed	Sets the transition speed to dynamic brake during deceleration stop.	r/min	30~5000	50W : 3000 100W : 3000 200W : 500 400W : 500	S

S: Changeable when motor is stopped or power is supplied again.   D: Always changeable

No.	Name	Description	Unit	Setting range	Initial value	Attribute
Pn200	Rigidity table	Sets the rigidity table. After the setting is completed, the following constants will be changed to the setting values in each table. - Speed control proportional gain (Pn201) - Speed control integral time (Pn202) - Torque filter time constant (Pn203)	-	1 ~ 5	3	S
Pn201	Speed control proportional gain	Set the proportional gain of the speed control.	-	0 ~ 200	100	D
Pn202	Speed control integral time	Sets the integral time of the speed control. The integral control will be invalid when "0" is set.	-	0 ~ 1000	80	D
Pn203	Torque filter time constant	Sets the time constant of the torque filter.	ms	0.0 ~ 10.0	2.0	D
Pn204	Inertia moment ratio 1	Sets the inertia moment ratio of the connected load. Set the percentage of the motor rotor inertia as the motor axis conversion inertia.	%	0 ~ 9999	0	D
Pn205	Inertia moment ratio 2	Sets the inertia moment ratio of the connected load. Set the percentage of the motor rotor inertia as the motor axis conversion inertia.	%	0 ~ 9999	0	D
Pn250	Overload selection	Selects the method to detect the load alarm. 1: Detection by overload application time 2: Detection by electronic thermal	-	1 ~ 2	2	S
Pn300	User constant initialization	When "5" is set, the user constant is initialized and this constant becomes "0."	-	0 ~ 5	0	P

P: Changeable when power is supplied again.   S: Changeable when motor is stopped or power is supplied again.
D: Always changeable

Rigidity table list

Setting	Speed control proportional gain	Speed control integral time	Torque filter time constant
1	60	120	3.0
2	80	100	2.5
3	100	80	2.0
4	120	60	1.5
5	140	40	1.0

8.3 Constants explained

■ Constants related to command settings

Pn000	Speed command source selection
Pn001 ~ Pn008	Speed command 1 ~ 8

Sets the speed command to the motor.

Select speed commands 1 ~ 8 by the multi-function input (speed command selection 1 ~ 3).
  * Refer to the explanation of Pn100 ~ 107 and Pn110 ~ 117 for detailed settings of the multi-function input.
You can perform the corresponding Speed commands 1 ~ 8 by turning ON/OFF input terminals 1~3 under the combinations listed below.

You can select the speed command method by setting setting speed command source selection(Pn000) when all speed command selections (1～3) are off.

Speed command selection			Speed command value
1	2	3	
OFF	OFF	OFF	Select the command method from below according to the setting of the speed command source selection (Pn000). 1: External analog command 2: PWM speed command 3: Pulse frequency speed command 4: Built-in trimmer 1 5: Speed command 1 (Pn001)
ON	OFF	OFF	Speed command 2 (Pn002)
OFF	ON	OFF	Speed command 3 (Pn003)
ON	ON	OFF	Speed command 4 (Pn004)
OFF	OFF	ON	Speed command 5 (Pn005)
ON	OFF	ON	Speed command 6 (Pn006)
OFF	ON	ON	Speed command 7 (Pn007)
ON	ON	ON	Speed command 8 (Pn008)

Pn000 sets the command source when all of speed command selection 1 ~ 3 are set to OFF.
  * When the command value reaches 3000 r/min, the motor is operated with 3000 r/min as the upper limit of the rotation speed.

Setting value	Speed command	Description
1	External analog command	Voltage to be input to the external analog terminal will be the speed command value. The voltage level and inclination/offset of command can be set by Pn050 ~ Pn052.
2	PWM speed command	Sets the speed command value by the duty ratio of PWM entered to the input terminal. Duty 100% will be built-in trimmer 1/PWM speed command standard speed (Pn040). The detection range of the PWM signal is 10 [Hz] ~ 100 [kHz]. Set "13" to I8 input function selection (Pn107) of user constants.
3	Pulse frequency speed command	Sets the speed command value by the pulse frequency to be entered to the input terminal. Sets the standard point by the frequency setting for pulse frequency speed command (Pn041) and standard speed for pulse frequency speed command (Pn042), and then the speed command value according to the proportional expression that passes the standard point. The detection range of pulse signals is 10 [Hz] ~ 100 [kHz]. Set "14" to I8 input function selection (Pn107) of user constants.
4	Built-in trimmer 1	Sets the speed command value by the trimmer (built-in trimmer 1) in the driver. Turning the trimmer clockwise increases the speed command value. The built-in trimmer 1/PWM speed command standard speed (Pn040) is commanded when turned clockwise to the end and the rotation speed 0 [r/min] is commanded when turned counterclockwise to the end.
5	Speed command 1 (Pn001)	Similar to the speed command 2 ~ 8, the value set by Pn001 will be the speed command value.

[Speed setting examples]
Examples of speed commands set by input terminals (speed command selection 1 ~ 3) are listed below.
Speed commands by external analog terminal voltage and digital speed commands set to user constants
can be used selectively by switching input terminals.

User constant setting

No.	Setting value
Pn000	1
Pn001	speed1
Pn002	speed2
Pn003	speed3
Pn004	speed4
Pn005	speed5
Pn006	speed6
Pn007	speed7
Pn008	speed8

Commanded speed [r/min]

speed8
speed7
speed4
speed2

External analog Terminal voltage

Speed command selection 1   OFF   ON   OFF

Speed command selection 2   OFF   ON

Speed command selection 3   OFF   ON

24
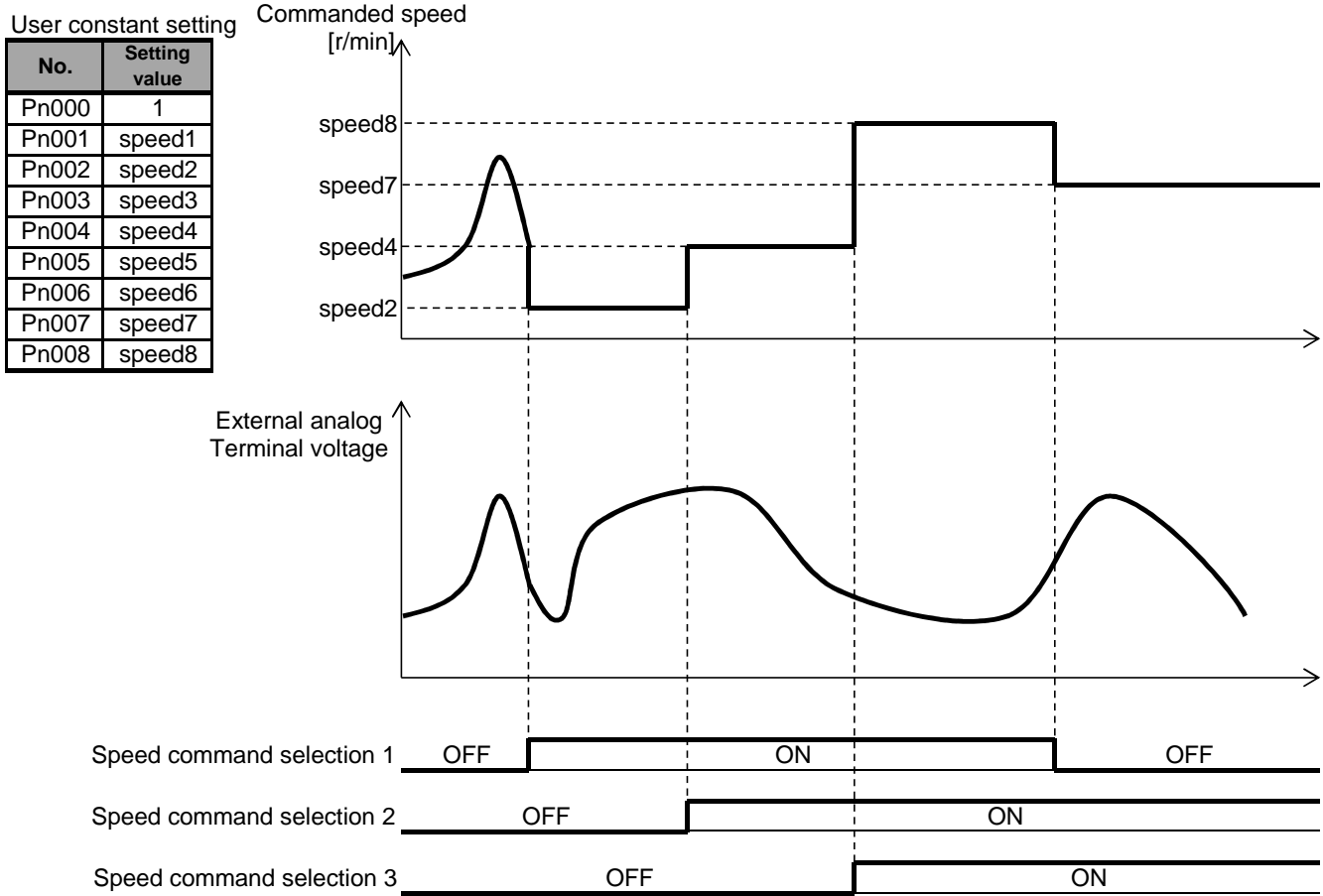
| Pn020 | Acceleration/deceleration time command source selection |
| Pn021 ~ Pn024 | Acceleration time 1 ~ 2, deceleration time 1 ~ 2 |

Set the acceleration/deceleration time when changing speeds commanded for the motor.
The motor can be accelerated or decelerated during any time within the setting range according to the constant and acceleration/deceleration time standard speed settings (Pn025).

You may set two values each for acceleration time and deceleration time, and values corresponding to the combinations listed below can be selected by turning ON/OFF input terminals to which the multi-function input (acceleration/deceleration time selection) is assigned.

   * Refer to the explanation of the speed command parameters Pn000 ~ Pn016 and torque limit value parameters Pn030 ~ Pn038.

When acceleration/deceleration time selection is set to OFF, you can select the command method for Acceleration/deceleration time by changing the settings for "acceleration/deceleration time selection 1" (Pn020).

Acceleration/ deceleration time selection	Acceleration/deceleration time	
OFF	Acceleration/deceleration time command source selection (Pn020)	1: Built-in trimmer 2*
		2: Acceleration time 1 (Pn021) Deceleration time 1 (Pn022)
ON	Acceleration time 2 (Pn023) Deceleration time 2 (Pn024)	

* The acceleration time will be common to the deceleration time when the built-in trimmer 2 is selected.

Pn020 sets the command source when the acceleration/deceleration time selection is set to OFF. The following is the correspondence table of the setting values and the command sources.

Setting value	Acceleration/ deceleration time	Description
1	Built-in trimmer 2	Sets the acceleration/deceleration time by the trimmer (built-in trimmer 2) in the driver. Turning the trimmer clockwise increases the acceleration/deceleration time and the time will be 5.00 [s] if turned clockwise all the way. The acceleration time will be common to the deceleration time if "built-in trimmer 2" is selected.
2	Acceleration time 1 (Pn021) Deceleration time 1 (Pn022)	Similar to "acceleration/deceleration time 2", the value set by Pn021 and Pn022 will be the acceleration/deceleration time.

Pn025	Acceleration/deceleration time standard speed

Sets the standard speed of acceleration/deceleration time.

[Acceleration time]
   For the acceleration time, this sets the time required to increase the motor operation speed from the stopped state to the acceleration/deceleration time standard speed (Pn025).
   When the speed command is lower than the standard speed, acceleration is conducted at the rate from the stop state of the motor to the standard speed.

[Deceleration time]
   The deceleration time, sets the time required to reduce the motor operation speed from the "acceleration/deceleration time standard speed (Pn025)" to a stop.
   If the motor is operated at a speed command lower than the standard speed, deceleration is conducted at the same rate as reducing the standard speed to a stop.
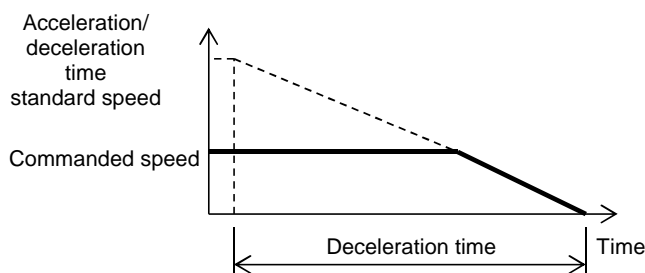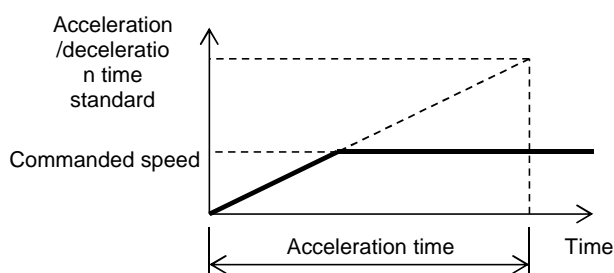
Pn030	Torque limit value command source selection
Pn031 ~ Pn034	Torque limit value 1 ~ 4

Sets the motor output torque limit value.

Select the torque limit value by the multi-function input (torque limit value selections 1 and 2).
Torque limit values corresponding to the following combinations can be commanded by changing the ON/OFF state of input terminals to which torque limit values 1 and 2 are assigned.

When both torque limit values 1 and 2 are set to OFF, change setting of the torque limit value 1 selection (Pn030) to select the command method for the torque limit value.

Torque limit value selection 1	Torque limit value selection 2	Torque command	
OFF	OFF	Torque limit value command source selection (Pn030)	1: External analog command 2: Built-in trimmer 3 3: Torque limit value 1 (Pn031)
ON	OFF	Torque limit value 2 (Pn032)	
OFF	ON	Torque limit value 3 (Pn033)	
ON	ON	Torque limit value 4 (Pn034)	

Pn030 sets the command source when both torque limit value selections 1 and 2 are set to OFF.
Following is the correspondence table of the setting values and the command sources.

Setting value	Speed command	Description
1	External analog command	The input voltage to the external analog terminal will be the torque limit value. The voltage level and inclination/offset of command can be set by Pn50 ~ Pn52. The speed/torque limit value cannot be set to the external analog command together.
2	Built-in trimmer 3	Sets the torque limit value using the trimmer (built-in trimmer 3) in the driver. Turning the trimmer clockwise increases the torque limit value and the value goes up to 200% of the motor rated current when turned clockwise all the way.
3	Torque limit value 1 (Pn031)	Similar to the torque limit value 2 ~ 4, the value set by Pn031 will be the torque limit value.

Pn040	Built-in trimmer 1/PWM speed command standard speed

Sets the standard speed of the built-in trimmer 1 and PWM speed command.
This will be the maximum speed for clockwise rotation for built-in trimmer 1, and the speed at Duty 100[%] for the PWM speed command.

* The speed of up to 5000 [r/min] can be set, but the available motor speed is only up to 3000 [r/min].

Pn041	Frequency setting for pulse frequency speed command
Pn042	Standard speed for pulse frequency speed command

[Frequency for pulse frequency speed command]

For the pulse frequency speed command, the frequency for pulse frequency speed command (Pn041) sets the pulse frequency at the commanded speed set by the standard speed for pulse frequency speed command (Pn042).

[Standard speed for pulse frequency speed command]

For the pulse frequency speed command, standard speed for pulse frequency speed command (Pn042) sets the speed command value when the pulse frequency set by the frequency for pulse frequency speed command (Pn041) is entered.

[Example]

Relation between input pulse frequency and commanded speed when setting Pn041 to 2500 (x10) and Pn042 to 2500
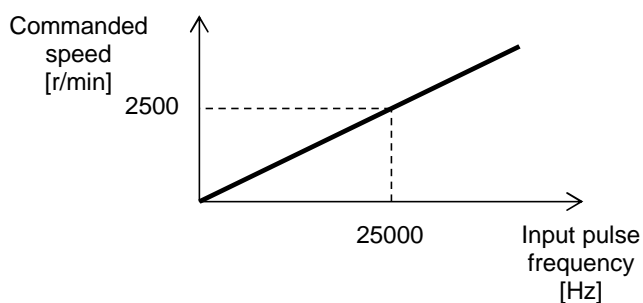
■ Constant related to external analog input

Pn050	External analog input level

Select the external analog input level.

1: 0 V ~ 10 V

2: 0 V ~ 5 V

* When voltage exceeding the selected level is input, the upper limit of the level is regarded as the input voltage.

Pn051	Analog input gain

Set the gain of external analog input.

Pn052	Analog input offset

Set the offset of external analog input.

[Calculation of speed command value by external analog input]

Speed command value [r/min] = Input voltage [V] x Analog input gain [(r/min)/V] x 10^3 + Analog input offset [r/min]

[Calculation of torque limit value by external analog input]

Torque limit value [%] = Input voltage [V] x Analog input gain [%/V] x 10^2 + Analog input offset [%]

[Setting example]

By adjusting settings Pn050 to Pn052, the speed command or torque limit values that correlate to input voltages can be set.

The following show initial values and a setting example in the case of setting the speed command value (Pn000 = 1):

No.	Name	Initial value	Setting example 1	Setting example 2
Pn050	External analog Input level	2	2	1
Pn051	Analog input gain	0.6	0.6	0.3
Pn052	Analog input offset	0	1500	0

speed command [r/min] vs DC voltage [V]

Setting example 1 — Initial value — Setting example 2
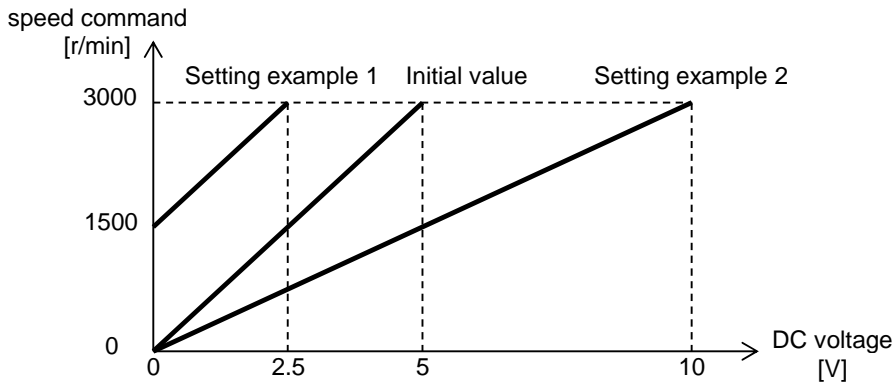
Caution
1. Even if a larger value is set, the command exceeding the maximum value cannot be entered. Excessive values will be recognized as the maximum values (speed command: 3000 [r/min], torque limit value: 200[%])

2. Make settings according to the status of the analog input device to be used.
3. Note that the motor may still run even if the analog input is OFF depending on the operating environment and setup.

4. The analog input gain (Pn051) and analog input offset (Pn052) use common values of speed command value and torque limit value.
5. You can only set either the speed command or the torque limit value via external analog input. (Not both)

■ Constant related to analog output

Pn060	Analog output selection

Sets the function output from the analog output terminal. Following is the correspondence table of the setting values and the functions.

Setting value	Function	Description
1	Speed	Output the actual speed of the motor.
2	Load factor	Output the load factor of the motor.
3	Commanded speed	Output the commanded speed in the driver. * Different from setting values.

Pn061	Analog output gain

Set the gain of analog output.

Pn062	Analog output offset

Set the offset of analog output.

[Calculation of analog output voltage]
In the case of speed and commanded speed

Output voltage [V] = Rotation speed [r/min] x Analog output gain [V/(r/min)] x 10^{-3} + Analog output offset [V]

In the case of load factor

Output voltage [V] = Load factor [%] x Analog output gain [V/%] x 10^{-2} + Analog output offset [V]

Caution
1. The voltage range available for output is 0 through 5 [V].
   When the command value is 5 [V] or larger, the output will be 5 [V]; when the command value is 0 [V] or lower, the output will be 0 [V].
   In such case, please adjust the analog output gain and analog output offset so that the output is within the above voltage range.

Pn100 ~ Pn107	I1 ~ I8 input function selection

Sets functions of input terminals I1 ~ I8.

Input functions can be assigned to corresponding input terminals I1 ~ I8 by setting I1 ~ I8 input function selection.
The PWM speed command and pulse frequency speed command can only be assigned to input terminal 8.
When the same function is assigned to multiple terminals, the function becomes valid as long as any of the assigned input terminals is set to ON.
All unassigned funtions are set to OFF.

Following is the correspondence between the setting values and the input functions.

Setting value	Function	Description
1	CW driving command	Turning input ON drives the motor clockwise (counterclockwise), and turning it OFF decelerates and stops the motor. When the clockwise driving command and counterclockwise driving command are turned ON at the same time, the motor stops.
2	CCW driving command	
3	Speed command selection 1	Select the speed command value according to combinations of ON/OFF state.
4	Speed command selection 2	* Refer to the explanation of Pn000 ~ Pn008 for the detailed correspondence table.
5	Speed command selection 3	
6	Acceleration/deceleration time selection	Select the acceleration/deceleration time according to the ON/OFF state. * Refer to the explanation of Pn020 ~ Pn025 for the detailed correspondence table.
7	Torque limit value selection 1	Select the torque limit value according to combinations of ON/OFF state. * Refer to the explanation of Pn030 ~ Pn038 for the detailed correspondence table.
8	Torque limit value selection 2	
9	Alarm reset, emergency stop	When the input is turned ON, the motor enters the emergency stop state (free-run state) regardless of operation conditions. Alarm will reset if all causes of the alarm are removed when the input state is changed from ON to OFF. However, if the driving command or direct current lock is still ON, the alarm will not reset. The brake control signal turns OFF at the emergency stop state. *** The above applies when the polarity selection is set to "0."** **The polarity selection is set to "1" (Pn116 = 1) for the input terminal I7 to which this constant is assigned by the initial setting, and the polarity is reversed.**
10	Brake control signal "Force ON" command	Turns on the brake control signal. Input becomes invalid at emergency stop or alarm state. * Refer to the explanation of Pn170 ~ Pn173 for details.
11	Direct current lock	Activates the direct current lock when input is turned ON. The direct current lock is inactive during operation. When this is activated, the driver command is turned OFF, and the motor enters the DC lock state once the motor has stopped. When the drive command is set to ON during the DC lock state, the DC lock is deactivated and the motor starts to run normally.
12	Load inertia switch	Select the inertia moment ratio according to the ON/OFF state. * Refer to the explanation of Pn204 ~ Pn205 for the detailed correspondence table.
13	PWM speed command	When the PWM speed command is selected (Pn000 = 2), input the PWM signal with this function assigned to input terminal I8. The range of input frequency is 10 [Hz] ~ 100 [kHz]. * Refer to the explanation of Pn040 for details.
14	Pulse frequency speed command	When the pulse frequency speed command is selected (Pn000 = 3), input the pulse signal with this function assigned to the input terminal I8. The range of input frequency is 10 [Hz] ~ 100 [kHz]. * Refer to the explanation of Pn041 ~ Pn042 for details.

* Setting values 13 and 14 can be set only to input terminal I8 applicable to high-speed input.

Pn110 ~ Pn117	I1 ~ I8 input polarity selection

Polarity of input terminals (I1 ~ I8) can be switched by setting the polarity selection.
Set the ON/OFF polarity of each input terminal according to the specifications of the host device.

Normally, commands such as the CW driving and CCW driving can be given by connecting input terminals (I1 ~ I8) with COM (when the built-in power supply is used). However, when this constant is set to 1, the polarity is reversed and commands such as CW driving and CCW driving can be given when not connected with COM.

■ Constant related to output terminals C1-E1 ~ C4-E4

Pn120 ~ Pn123	C1-E1 ~ C4-E4 output function selection

Sets functions of output terminals C1-E1 ~ C4-E4.

Following is the correspondence between the setting values and the functions.

Setting value	Function	Description
1	Error detection	Output is OFF while the driver is in the normal state and turns ON when the driver detects an alarm. The output turns ON when the program is initialized immediately after power is supplied. *** The above applies when the polarity selection is set to "0."** **The polarity selection is set to "1" (Pn125 = 1) for the output terminal C1-E1 by the initial setting, and the polarity is reversed.**
2	During operation	Output turns ON while the motor is energized (during torque output including special lock). * Dynamic braking is not included.
3	Rotation pulse	Output turns ON when the hall signal is switched. Output 18 pulses per 1 motor rotation. ON time is fixed to 160 [μs]. The output specifications of rotation pulse, CW rotation pulse, CCW rotation pulse and rotation direction are shown below. The output for rotation direction is OFF immediately after the power is supplied.
4	CW rotation	
5	CCW rotation pulse	
6	Rotation direction	
7	During rotation	Output turns ON when the motor rotates. It also turns ON when the motor is rotated by external forces.
8	Rated torque over	Output turns ON when the motor current value exceeds the rated current value of the motor. Output has hysteresis and electric current value to turn OFF can be set by the rated torque detection hysteresis width (Pn165). * Refer to the explanation of Pn165 for details.
9	Specified torque over	Output turns ON when the motor current value exceeds the torque detection level (Pn160). Output has hysteresis and the "ON" current value can be set by the torque detection level (Pn160) and the "OFF" current value can be set by the torque detection hysteresis width (Pn161). * Refer to the explanation of Pn160 ~ Pn161 for details.
10	Brake control signal	Outputs the timing signal to turn the external mechanical brake ON/OFF. The brake control signal turns OFF immediately when an alarm is issued. * Refer to the explanation of Pn170 ~ Pn173 for details.
11	Voltage drop warning	Turns ON the output when the input voltage lowers to the setting value or less. The value to turn ON the output can be set by the input voltage drop warning voltage (Pn175).

* Assign rotation pulse (3), CW rotation pulse (4) and CCW rotation pulse (5) to the C3-E3/C4-E4 multi-function output. Pulse is not output correctly from other multi-function output terminals.

* Brake control signal is available from version 0004.Never use the driver with version 0003 or earlier.

	CW rotation	CCW rotation

Rotation pulse

CW pulse

CCW pulse

Rotation direction ← Switched at the first pulse after changing the rotation direction.
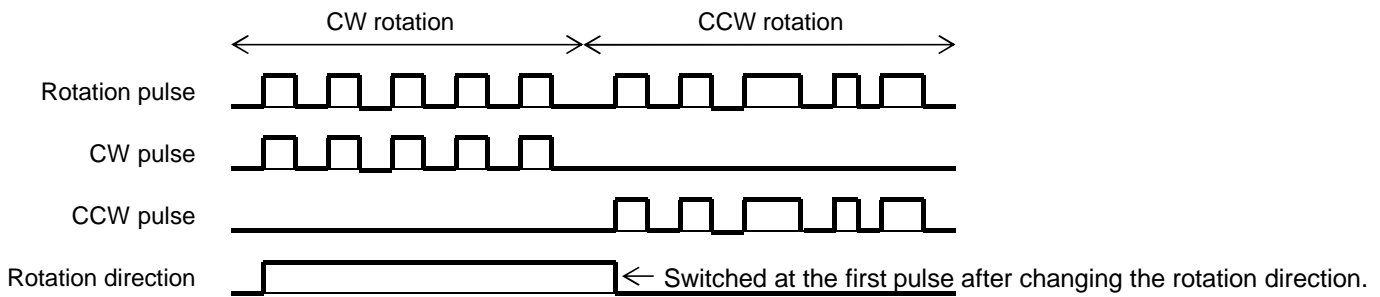
* About pulse waveform

The specifications of output pulse is as shown on the right.

Select the counter according to the specifications.

Fixed to 160 [µs]

ON   OFF

20 [µs] or less   20 [µs] or less
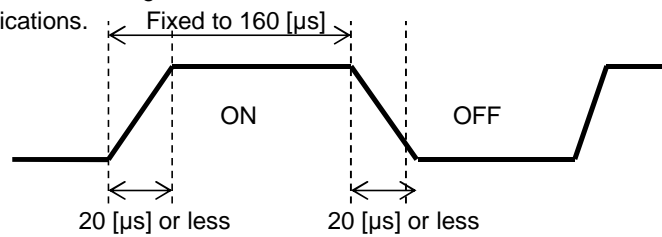
* The duty ratio changes according to frequencies.

Pn125 ~ Pn128   C1-E1 ~ C4-E4 output polarity selection

Polarity of output terminals (C1-E1 ~ C4-E4) can be switched by setting the polarity selection.
Set the ON/OFF polarity of each output terminal according to the specifications of the host device.

Normally, C1-E1 ~ C4-E4 is turned ON while the function is effective. However, when this constant is set
to 1, the polarity is reversed and C1-E1 ~ C4-E4 is turned OFF while the function is effective.

■ Constant related to direct current lock

Pn151   DC lock current limit value

The direct current lock is the function to supply direct current to the motor and lock it.
This constant is to set the current value (rated current ratio) that flows to the motor when the direct current lock function
is activated.

■ Constant related to torque detection of output function

Pn160	Torque detection level

Sets the current value to turn ON the specified torque over output. The detection level is set as the ratio [%] against the rated current.

Pn161	Torque detection hysteresis width

Sets the current value to turn OFF the specified torque over output. The value is set as the ratio [%] against the rated current.

The value obtained by subtracting the torque detection hysteresis width from the torque detection level is the current value to turn OFF the specified torque over output.

Pn165	Rated torque detection hysteresis width

Set the current value to turn OFF the rated torque over output. The value is set as the ratio [%] against the rated current.
The value obtained by subtracting the torque detection hysteresis width from the rated torque (100[%]) is the current value to turn OFF the rated torque over output.
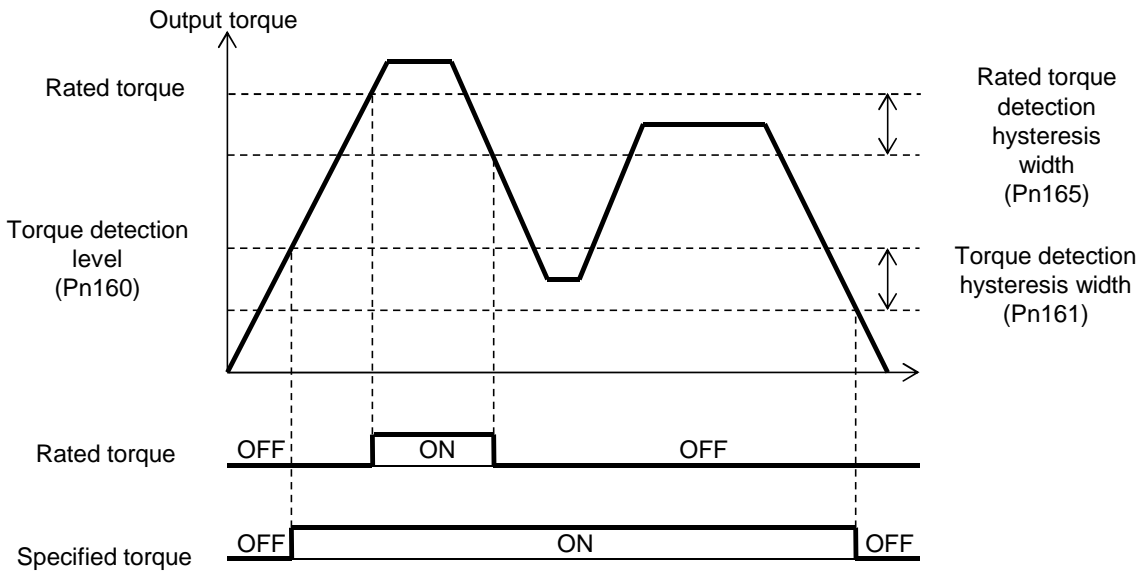
■ Constant related to brake control signal of output function(Brake control signal is available from version 0004.
  Never use the driver with version 0003 or earlier.)

Pn170	Mechanical brake release speed level

Sets the internal commanded speed that turns ON the brake control signal.
However, if the mechanical brake operation speed level (Pn171) is larger,
the brake control signal will not turn ON unless it exceeds the mechanical brake operation speed level.

Pn171	Mechanical brake operation speed level

Sets the internal commanded speed that turns OFF the brake control signal.

Pn172	Mechanical brake release standby time

Sets the operation standby time after the internal commanded speed reaches the mechanical brake
release speed level (Pn170) until the brake control signal is actually turned ON.

Pn173	Mechanical brake operation standby time

Sets the operation standby time after the internal commanded speed reaches the mechanical brake
operation speed level (Pn171) until the brake control signal is actually turned OFF.
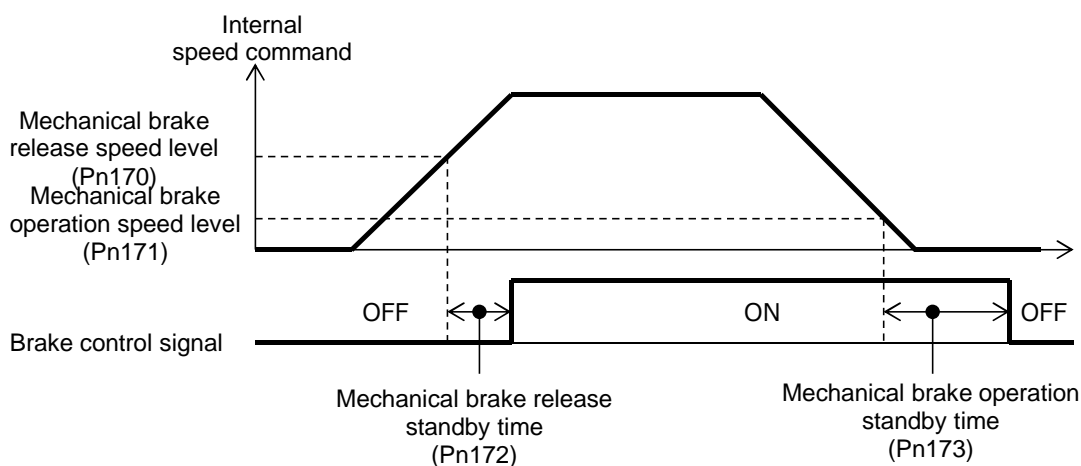
‖ Caution ‖
1. If the forced brake ON signal is entered from the outside, the mechanical brake release speed level (Pn170) and
   mechanical brake release standby time (Pn172) become invalid.
2. When an abnormality is detected or an alarm reset/emergency stop is input,
   the mechanical brake operation speed level (Pn171) and the mechanical brake operation standby time (Pn173)
   become invalid and the brake control signal turns OFF immediately.
3. When an abnormality is detected or when an alarm reset/emergency stop is input,
   the brake control signal forced ON command becomes invalid and the brake control signal turns OFF immediately.

■ Constant related to voltage drop warnings of output functions

Pn175	Input voltage drop warning voltage

Sets the voltage that turns ON the voltage drop warning of the output signal.

■ Constant related to dynamic brake

Pn180	Dynamic brake transition speed

Sets the speed at which the dynamic brake operates when the motor decelerates and stops.

When the following two conditions are satisfied at the time of deceleration stop, the dynamic brake will activate.
· The command speed inside the driver is 30 r / min or less.
· The actual speed of the motor is less than the dynamic brake transition speed (Pn180).

‖ Caution ‖
1. Depending on operating conditions, excess-current alarm may set off at deceleration stop.
   In such case, lower the set value of this constant.
2. If this constant is set low, undershoot may occur during the deceleration stop.
   How/when the undershoot occurs depends on the load conditions, and so this parameter must be adjusted by the user.

■ Constant related to gain adjustment

Pn200	Rigidity table

Select the control gain (speed control proportional gain [Pn201], speed control integral time [Pn202] and torque filter time constant [Pn203]) depending on the loaded machine rigidity connected to the motor. Set in accordance with the machine rigidity.

The setting values are as listed below.

Setting value	Speed control proportional gain	Speed control integral time	Torque filter time constant
1	60	120	3.0
2	80	100	2.5
3	100	80	2.0
4	120	60	1.5
5	140	40	1.0

Pn201	Speed control proportional gain

Sets the responsiveness of the speed control.

‖ Caution ‖
1. If gain is set to lower value, the responsiveness is reduced and may result in overshoots.
   If gain is set to extensively higher value, vibration will occur in the mechanical system.
2. This constant can be changed during operation, but the motor operation may become unstable if the setting value is changed largely during operation. Be sure to change the value gradually during operation.

Pn202	Speed control integral time

Sets the integral time constant of the speed control.

‖ Caution ‖
1. If the integral time is set long, responsiveness will be poor and overshoot will occur. In addition, if the integral time is set too short, vibration to the machinery system will occur.
2. This constant can be changed during operation, but the motor operation may become unstable if the setting value is changed largely during operation. Be sure to change the value gradually during operation.

Pn203	Torque filter time constant

Sets the filter time constant of the torque command value inside the driver control.
The smaller setting value enables control with good responsiveness. However, there are limitations depending on the machine condition.

Pn204 ~ Pn205	Inertia moment ratio 1 ~ 2

Sets the inertia moment ratio connected to the motor.
For the setting value, enter the load inertia moment ratio of motor input shaft conversion regarding the rotor inertia.

[Calculation of load inertia moment ratio]

$$\text{Inertia moment ratio [\%]} = \frac{\text{Load inertia moment of motor input shaft conversion}}{\text{Rotor inertia moment}} \times 100[\%]$$

■ Constant related to safeguards

Pn250	Overload selection

Selects the method to detect the overload alarm.

Following is the correspondence between the setting values and the functions.

Setting value	Function	Description
1	Time course	Issue an alarm when electric current exceeding the rated value (overload current) flows into the motor continuously for 10 seconds. Time is reset when the electric current of the motor lowers below the overload current.
2	Electronic thermal	Estimates the temperature of the motor according to actual electric current in the motor as shown below, and issue an alarm when the estimated value reaches the preset temperature.
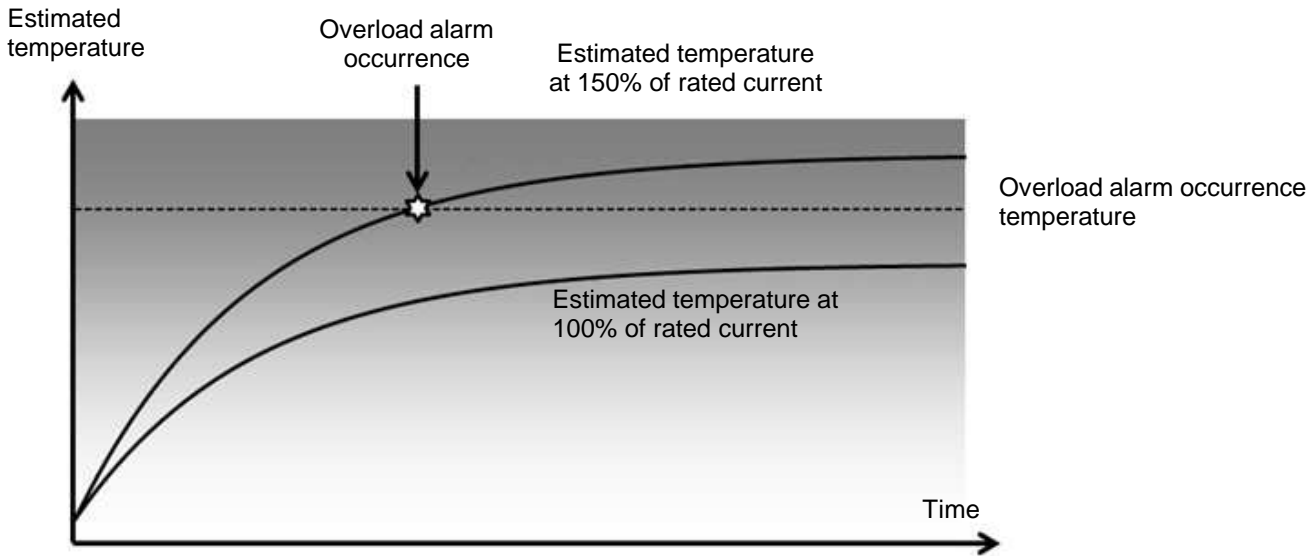
‖ Caution ‖

1. Under the electrical current monitoring method, you may not be able to detect overloads if you have fluctuating loads, or if the motor runs and stops in a short cycle (Intermittent operations). In such case, there will be risk of the motor burning out. Unless there are specific reasons that require this method of protection, it is strongly recommended to utilze the electro-thermal monitoring method.

2. Regardless of the method selected, if the alarms are reset repeatedly by turning the power off, the motor temperature may exceed the allowable value. Please reset alarms by the multi-function input (alarm reset/emergency stop).

■ Constant related to initialization function

Pn300	User constant initialization

Sets user constants to default values.
If 5 is entered as the setting value, all user constants will be reset to initial value.

‖ Caution ‖

1. When the user constant is reset to the initial value, this constant will also reset to the initial value (0).

Chapter 9: Safeguards

This driver outputs the error detection signal and displays the error state by LED lamps when any problem is detected.
(LED 1 (red) lit, LED 3 (green) lit or blinking)
When a problem occurs, the motor enters an emergency stop state (free-run state) regardless of operation conditions.
In such case, the brake control signal is turned OFF and the force ON command for the brake control signal is invalidated.

To resolve the error detection state, eliminate factors that caused the alarm and reset the alarm.

The PC software "ACD-PSTool" allows you to check the history of errors that occurred in the past.
Refer to the instruction manual of "ACD-PSTool" for details.

9.1 Driver error list and display method

The following lists the blinking condition of LED 3 (green) and possible causes of the alarm when an problem is detected.

LED 3 (green): No. of blinks	Alarm name	Occurrence conditions
0 (stays lit)	Overload	Occurs after operating under excessive load for a certain time. There are two detection methods: Detection by passing of certain period of time and detection by electronic thermal. * Refer to the explanation of the user constant (Pn250) for details.
1	Overvoltage	Occurs when the input voltage of the driver exceeds the maximum input voltage.
2	Voltage drop	Occurs when the input voltage of the driver drops to the minimum input voltage or lower while the motor is in operation (including special lock).
3	Driver overheat	Occurs when the temperature of the driver heat sink exceeds 85°C.
4	Overspeed	Occurs when the rotation speed of the motor (including when the motor is rotated) exceeds 1.2 times of the maximum rotation speed.
5	Overcurrent	Occurs when electric current of 500~600% or more of the rated current of the motor flows into the driver.
6	Sensor error	Occurs when the hall signal pattern is HHH or LLL.
10	System error	Occurs when there is any problem in the driver.

LED 3 (green): Lit
LED 3 (green): Unlit
0.25 s   0.25 s   1.25 s
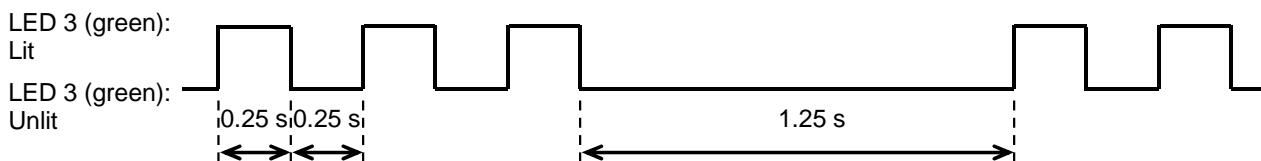
9.2 Causes and countermeasures when safeguards are activated

When the safeguard functions are activated, locate the cause and take necessary countermeasures according to the procedure below.

Alarm name	Example of causes	Countermeasures
Overload	Load (friction load, inertia load) is large.	Check the operation conditions.
	The brake is not released.	Check the brake power supply. Or, check the brake wiring.
Overvoltage	Power voltage is high.	Check the power voltage and use the power supply appropriate for the model.
	Operation in the regenerative state	The Driver does not have the capability to handle regeneration. In order to remedy this, return any regenerative energy directly to the power supply or change thange the operation conditions so that regeneration does not occur.
Voltage drop	Power voltage is low.	Check the power voltage and use the power supply appropriate for the model.
	Power supply capacity is small.	Change the power supply capacity to the appropriate size.
	Wiring length is long. Wires are thin.	Voltage drop occurs at wiring points. Shorten the wiring length, use thicker wires, and reduce resistance as much as possible.
Driver overheat	Ambient temperature is high.	Adjust the environment to allow the ambient temperature to become 50°C or lower.
Overspeed	Overshoot of motor occurs.	Check the gain. Or, check the operation conditions (rotation speed, acceleration time, torque limit, etc.).
	The motor is turned at a high speed from an external source.	Check the operation conditions so that the motor is not rotated from an external source.
Excessive current	Motor lines are short-circuited.	Check the wiring for the motor. It is also possible that the motor is broken. In such a case, replace the motor.
	Short-circuiting or ground fault occurs in driver.	Check the wiring for the driver. It is also possible that the driver is broken. In such a case, replace the driver.
	Occurance of Large instantaneous load.	Check the operation conditions to avoid shock loads.
	Dynamic brake activated during high speed operation. A sudden stop occurred due to emergency stop etc.	Lengthen the setting value of the deceleration time. Or, reduce the setting value of dynamic brake transition speed.
	The motor was turned from outside during dynamic brake operation.	Check the operation conditions so that the motor is not rotated from an external source.
Sensor error	Short-circuiting or open circuit of signal cables occurs.	Check the wiring of the signal cables. It is also possible that the motor is broken. In such a case, replace the motor.
System error	-	Contact us if the problem occurs even after the power is re-supplied.

* Contact us if the problem isn't resolved after implementing the countermeasures above.

9.3 Troubleshooting

If you experience problems such as motor rotation, please refer to the countermeasures listed below to inspect and resulve the cause of the problem.

Be sure that inspections are performed by qualified individuals as improper handling may increase the risk of injury.

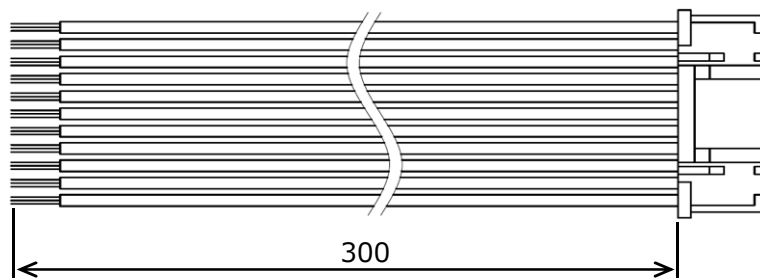| Symptoms	Cause	Things to check	Countermeasures
The motor does not rotate. LED (green): Unlit	Lack of power voltage for controls	-Power voltage for control -Wiring condition	Charge the battery. Check wiring.
	Noise	Peripheral equipment, noise source	Install clamp filter.
The motor does not rotate. LED (green): Lit	Failure of start command	CW and CCW are both selected. * The motor will not start if these are selected simultaneously.	Select either CW or CCW. Check wiring.
	Speed command is 0.	User constants - Speed command source selection (Pn000)	Make the setting according to the selected command. Check wiring.
	Torque is limited.	User constants - Torque limit value 1 selection (Pn030)	Make the setting according to the selected command. Check wiring.
	Alarm reset/emergency stop is inputted.	User constants - Multi-function selection - Polarity selection	Reset alarm and emergency stop. Check wiring.
	The motor line is not connected.	Connection of motor lines (U, V and W)	Check wiring for the motor.
	The brake is not released.	Brake voltage Brake control signal	Check wiring for the brake control signal. Check voltage of the brake power supply. Check wiring for the brake.
	Open circuit of signal cables occurs.	Wiring of the signal cables	Check the wiring of the signal cables.
The rotation speed of the motor is low.	Lack of main power voltage	Main power voltage	Charge the battery. Check wiring.
	Gain is small.	User constants in relation to speed gain - Pn200 ~ Pn205	Adjust gains.
	Torque is limited.	User constants - Torque limit value 1 selection (Pn030)	Change the setting according to the selected command. Check wiring.
The motor rotates and stops intermittently.	Wrong motor phase	The red, white and black lines of the motor are connected to the driver CN3 incorrectly.	Correct the wiring.

Chapter 10: Specifications

Item			Description			
Applicable motor power			50 W	100 W	200 W	400 W
Output current (Rated/max)		12 V	5.9 A/11.8 A	12.4 A/24.8 A	-	-
		24 V	2.7 A/5.4 A	5.8 A/11.6 A	9.8 A/19.6 A	20.1 A/40.2 A
		48 V	-	2.7 A/5.4 A	5.1 A/10.2 A	9.9 A/19.8 A
Main circuit/control circuit input voltage range			For 12 V: 10 ~ 15 VDC For 24 V: 20 ~ 30 VDC For 48 V: 40 ~ 60 VDC			
Rated rotation speed			2500 r/min			
Function	Control	Speed control range	100 ~ 3000 r/min			
		Speed command method	External analog command, PWM speed command, pulse frequency speed command, built-in trimmer 1, speed command 1 ~ 8			
		Acceleration/ deceleration time	Built-in trimmer 2, acceleration time 1 ~ 2, deceleration time 1 ~ 2			
		Torque limit	External analog command, built-in trimmer 3, torque limit value 1 ~ 4			
	Input	No. of input points	Sequence input: 8 Analog input: 1			
		Input function	CW rotation, CCW rotation, speed command selection, acceleration/deceleration time selection, torque limit value selection, alarm reset/emergency stop, brake control signal forcible ON command, special lock, load inertia switch, PWM speed command, pulse frequency speed command			
	Output	No. of output points	Sequence output: 4 Analog output: 1			
		Output function	Error detection, during operation, rotation pulse, CW rotation pulse, CCW rotation pulse, rotation direction, during rotation, rated torque over, specified torque over, brake control signal, voltage drop warning			
		Safeguards	Overload, overvoltage, voltage drop, driver overheat, overspeed overcurrent, sensor error, system error			
Environment		Ambient temperature	-10ºC ~ 50ºC			
		Ambient storage temperature	-25ºC ~ 70ºC			
		Ambient humidity	95%RH or less (no condensation)			
		Altitude	1,000 m or lower			
		Vibration	2G or less			
Conformance to international standard			CE (EMC directive), KC			
Protection structure			IP00			
RoHS directive			Conforming			
Motor-driver wiring distance			Maximum extended length: 5 m			

Chapter 11: Accessories

I/O cable (connected with CN1)

No.	Description	Color
1	IN-COM	
2	I1	
3	I2	
4	I3	
5	I4	Yellow
6	I5	
7	I6	
8	I7	
9	I8	
10	C1	
11	E1	
12	C2	
13	E2	Green
14	C3	
15	E3	
16	C4	
17	E4	
18	-	-
19	+5 V	
20	AIN	Orange
21	AOUT	
22	TGND	

300

Lead wire AWG26

3   7   11   15   19
1   5   9   13   17   21

2   6   10   14   22
4   8   12   16   20
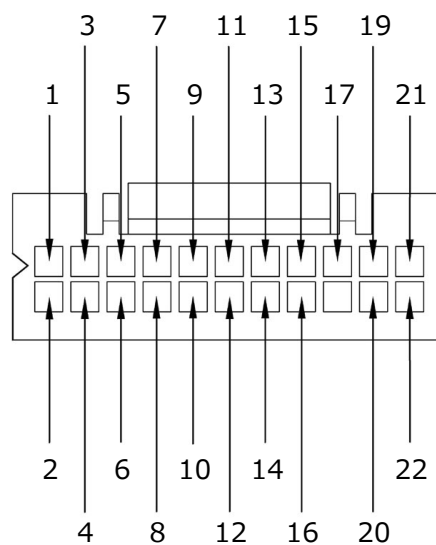
Code	Manufacturer	Type on board side	Type on I/O cable side
CN1	J.S.T.MFG.CO.,LTD.	S22B-PUDSS-1	Applicable housing: PUDP-22V-S
			Applicable crimping terminal: SPUD-001T-P0.5

Chapter 12: Conformity to Safety Standards (CE, KC)

■ Compliance with CE Marking (EMC Directive)

This driver is tested in accordance with European standards EN61800-3:2004+A1:2012, and complies with EMC Directive. The following conditions must be met to ensure continued compliance with EMC Directive.

- Insert the surge absorber to the input side.

The compatibility of the final machine to EMC varies depending on the other control systems used with the motor/driver, the configuration of electric parts, wiring, the arrangement state and degree of risk, etc. Therefore, it is necessary to confirm the compatibility by conducting EMC tests for the machine by the customer in the end use.

■ Compliance with KC Mark

This driver complies with the radio law in Korea.
When using this product in Korea, pay attention to the following.

Class A equipment (business-purpose broadcast and communication equipment)

This device is a business-purpose broadcast and communication equipment (class A) and is intended to be used in locations other than households. Sellers and users must be careful when selling/buying this product.

This product complies with the radio law in Korea under conditions in which the following countermeasures for EMC are taken. Make sure to correctly take countermeasures against EMC before use.

(1) Insert the surge absorber to the input side of the driver.
Use the recommended surge absorber listed in the table. Conformity of surge immunity is evaluated according to this combination.

(2) Shield the power cable and signal cable. When shielding, wiring distance must be as short as possible. Separate the power cable and signal cable as much as possible, and avoid parallel wiring and bundling. If unavoidable, you may cross the two cables.

(3) Radiation noise can be suppressed further more if the driver is installed in a sealed metallic control panel. In addition, securely ground the metal plate and the main unit of the control panel using the thickest and shortest possible cable, separated from the power line.

Recommended surge absorber

Manufacturer	Type
OTOWA ELECTRIC Co., LTD	LT-C12G801WS

Chapter 13: Standard Terms and Conditions of Sale

■General

These standard Terms and Conditions of Sale shall be incorporat ed into any contract between Purchaser and Brother International Corporation (hereafter Brother) and shall apply to all purchase orders issued by Purchaser. Unless specifically provided herein or in a separate written agreement duly executed by Brother, the quotation and this form constitute the entire agreement between Brother and Purchaser and no other terms or conditions oral or written shall be of any effect. All orders, whether placed pursuant to a quotation or not, are accepted only upon express condition that purchaser agrees to the Terms and Conditions as specified herein.

■Price and Delivery Terms

Price and delivery terms are F.O.B. Brothers n earest U.S. facility a nd do not include sales, use, excise, or any other taxes. Our responsibility ceases when delivery is made to the transportation company and any claims for loss or damage in transit must be handled by the Purchaser with the carrier.

■Packing

No charge is made for standard boxing for domestic shipments. Purchaser will be quoted and charged separately for export or special packing requirements.

■Payment Terms

To Purchasers with credit standing satisfactory to Brother, terms of payment are cash in full, net 30 days. If at any time Br other deems that by reason of financial condition of the Purchaser or otherwise, the continuance of production or shipments is not justified, Brother may revoke its extension of credit, enforce any security interest(s) created hereby on all goods furnished by Brother to the Purchaser and otherwise secure itself as to Purchasers performance of its obligation.

■Cancellation

Changes, suspension or cancellation of any order by Purchaser may be made only upon written approval of an authorized officer of Brother.

■Warranty

All Brother gearmotor product are warranted against defects in materials and workmanship for a period of 2 years from the date of manufacture. This constitutes Brother' s only warranty in connection with this sale, and is in lieu of all other warranties expressed or implied, written or oral. There are no implied warranties of m erchantability or fitness for a particular purpose that apply to this sale. If performance guarantees are requested, they should be requested in writing. Full consideration will be given to such requests when complete details of the proposed application are included.

■Limitation of Remedy

Brother will repair or replace, at brother' s option, F.O.B. Brother' s factory, freight prepaid, any Brother gearmotor proved defective in materials or workmanship if immediate written notice of claim i s made to Brother by Purchaser within 2 years from the date of manufacture. It is agreed that such repair or replacement is the exclusive remedy available from Brother. Under no circumstances shall Brother be liable to anyone for any special, incidental or consequential damages, whether the result of negligence or otherwise.

■Warranty Exclusions

The Warranty of Brother gearmotor products does not cover and Brother makes no warranty with respect to:

1. Failures not reported in writing to Brother within the warranty period of 2 years after the date of manufacture.
2. Failures or damages due to miss-application, abuse, improper installation or abnormal conditions of temperature, humidity, dirt or corrosive matter.
3. Failures due to operation, either intentional or otherwise, above rated capacities or in an otherwise improper manner.
4. Product which has in any way been tampered with or altered by anyone other than an authorized representative of Brother.
5. Expenses incurred by the Purchaser in an attempt to repair or rework an allegedly defective product.
6. Product damaged in shipment or otherwise without the fault of Brother.

■Returns

No product will be accepted for return unless authorized in writing with a returned merchandise authorization (RMA) number assigned. Any returned goods must be returned with transportation charges prepaid.

■Regulatory Laws and/or Standards

It is the Purchaser's obligation to install and operate all Brother gearmotor products in conformance with all applicable national or local laws and safety codes.

■Patents

Brother represents that its gearmotors are designed and manufactured such that they do not infringe on any United States Patent(s), and that Brother will, at its expense, defend any claim charging such infringement and will save Purchaser harmless from any adverse judgements resulting there from. Purchaser agrees to give Brother, prompt written notice of any claim of infringement and to turn over to Brother the complete control of any litigation involving such claims including the right to settle such claims. This indemnity does not apply to Products which are incorporated by the Purchaser into Products which are changed to infringe a Patent or to Product which is used by Purchaser in performance of a method or process which is charged to infringe a Patent.

■Law

These Standard terms and Conditions of Sale shall be interpreted in accordance with the Laws of the State of New Jersey.

■Severability

If any of the terms and Conditions shown here are determined to be invalid, illegal, or unenforceable the remainder of these Terms and Conditions shall remain in full force and effect.

Brother International Corporation
Gearmotor Division

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