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Controller for Brushless Motor

DS-34EC1 Series Instruction Manual



- DS-34EC1-IS221
 - DS-34EC1-IS311
- Controller

Notice to users

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MABUCHI MOTOR CO., LTD.

○ Features

Please refer to 「1. Functions and characteristics」 for details.

Notes

This instruction manual describes the functions and characteristics of the controller unit. You should also refer to the respective instruction manual for detailed characteristics and specifications of the motor you intend to use it with.

- 24V and 36V battery powered drive
 - Allowable voltage range: 17 to 45V DC constant
- Rated output current: 9Arms
- Maximum output current
 - DS-34EC1-IS221 : 50A
 - DS-34EC1-IS311 : 29A
- Sinusoidal drive
- Speed control function
- Maximum regenerative current: -10A
- Function to protect the controller system
 - Power supply undervoltage/overvoltage protection
 - Overheat protection
 - Overcurrent protection
 - Sensor wire disconnection detection
 - Motor lock detection
- CAN communication function (CAN2.0B compliant)
- Water Resistance: IPx4 equivalent
- Mass: 220g

○ Applicable products

Mobility/AGV devices, etc.

○ Product overview

This product is a controller that drives the Mabuchi Motor brushless motor IS-74, IS-94 and MS-94 series. The compatible brushless motor model varies depending on the controller model.

Controller model name	Brushless motor model name
DS-34EC1-IS221	IS-94BZC, MS-94BZA, MS-94BZB, MS-94BZC MS-94BZD, MS-94BZE, MS-94BZF
DS-34EC1-IS311	IS-74BZA

It presumes use with mobility or AGV devices equipped with 24V or 36V batteries, with speed control and direction of rotation switching possible through CAN communication.

FOR YOUR SAFTY

Read the safety warnings for proper use of this product.

Mabuchi Motor Co., Ltd. has no liability to indemnify damages, including any malfunction of the motor resulting from failure to follow this operation manual. Thank you for your understanding.

Safety Precautions

Warning

- This controller is a device used to drive a specific motor.
Check that the motor type and model are compatible before use.
If the wrong motor is used in conjunction with the controller, not only is performance not guaranteed, but there is a risk of accidents and fire.
- Use a power supply that meets the specifications of the product in which this controller is used.
Misuse can lead to damage by burnout, electric shock, or fires.
- Use a wire size that conforms to the specifications. Misuse can lead to damage by burnout, electric shock, or fires.
- This controller is not equipped with a reverse connection protection circuit. If necessary, select the appropriate protection circuit for your needs.
Failure to protect the circuit can lead to fires or malfunction.
- Do not insert lead wires or motor terminals into household electrical outlets. This carries the risk of causing electric shock, injury, or damage to the device.
- Do not install near corrosive or inflammable gases, or inflammable materials. Failure to protect the circuit can lead to fires or malfunction.
- Do not touch conductive parts such as powered terminals when the power is on. This carries the risk of causing electric shock or burns.
- Note that the temperature of the device may remain hot while turned on, and some time after power is cut. This carries the risk of causing burns.
- Do not enter the range of motion of the machine while it is in operation. In addition, do not touch the moving parts of the motor or machine. This carries the risk of causing injury.
- Should the controller be damaged, deformed, corroded, or otherwise broken, refrain from using it. This carries the risk of causing fires or damaging the product.
- When an abnormality or failure occurs, immediately send a system stop command to the controller and cut off the power supply to the controller. Failure to do so may result in fire, electric shock, or injury.
- Do not disassemble, repair, or modify the controller. This carries the risk of causing fires or damaging the product.

Usage and handling

- The controller is intended as a general purpose product. It cannot be used with medical, military, aerospace, automotive, or other specialty equipment.
- Although the controller is protected by a case, carefully consider its handling and installation location to avoid excessive electrical and mechanical stress.
- Leads, switches, relays, etc., should be used with sufficient consideration of electrical capacity and heat resistance.
If they do not meet the applicable standards, it can lead to malfunctions such as burnout.
- Matching checks and lifetime checks for set implementation should be performed by the user, and quality assurance carried out.

Example Checklist for Set Installation:

Laws and standards applicable to the mounting product. Service life, electrical characteristics, mechanical characteristics, mechanical/electrical noise, storage environment, atmosphere gases, etc.

- Depending on the internal resistance and capacity of the motor drive power supply (including circuit), start-up and rotational stability may be affected.
In addition, please perform tests under actual use conditions, not only at room temperature, but also under low or high temperature.
- Do not use the controller outside the range of the specifications.
- Do not mix inflammable foreign matter such as oil, or conductive foreign matter such as metal pieces, into the controller.
- Design a configuration for the controller that takes into account the maximum input current.
- When handling the controller, pay attention to sharp parts such as corners to prevent yourself from getting injured.
- Install the controller within a housing.
- Do not place heavy objects on the controller. This can lead to malfunction.
- When attaching the controller into place, do not apply force to deform the controller body.
When tightening screws, ensure that all sides are equally tightened.
Failure to do so can adversely affect the product's characteristics.
- If the wiring of the main power supply or motor power line is too long or thin, motor torque will decrease due to the impedance of the wiring. When selecting a motor, ensure sufficient margins for acceleration and deceleration torque, and check the final product condition.
- Do not install an advancing phase capacitor or noise filter between the controller and the motor.
This carries the risk of causing overheating or burnout.
- Be sure to set up safety devices such as emergency stop brakes such that machines and equipment do not fall into a dangerous state even if the controller fails.

- Set up an additional mechanism for emergency stop (power off and emergency stop brakes, etc.).
Note that even if a drive stop is triggered, the output may not stop due to the setting state or external forces.
- Before installing on a machine and starting operations, set the parameters according to the machine being used.
- Do not configure extreme parameter settings. This can cause operations to become unstable, damage the machine, or cause injuries.
- Design the system so that safety can be ensured even in the event of a problem such as a broken signal line.
- Do not turn the controller power on and off frequently.
- When an error is detected, the motor stops free running. Because the moment of inertia of the load and the speed of rotation of the motor changes the coasting distance, consider the appropriate safety devices to use on the machine.
- Ensure that the cable connector is fully plugged in until it is secured by the locking mechanism.
If excessive force is applied to the cable connector in a semi-plugged in state (not secured by the locking mechanism), the connectors on the controller may be damaged.
When unplugging, release the locking mechanism and be careful not to exert excessive force on the plug side.
- Do not damage the cable connector, pull it strongly, apply excessive force, put heavy objects on it, or pinch it.
- Wiring and testing/maintenance must be performed by a professional technician who has expert knowledge of the target electrical equipment.
- When performing wiring work or inspections, check the voltage with a tester or other device after more than 5 minutes have elapsed since the power is cut off.
Voltage may remain in the controller, which can cause electric shocks.
- Ensure that the polarity of the power supply (+ –) and the wiring of the signal lines are correctly installed. Misuse can lead to damage or breakage.
- To prevent damage caused by static electricity, before touching the product, touch a nearby metal surface to discharge static electricity from your body.
When working, take measures to prevent electrification.
- If necessary, purchase connection cables separately.
- Turn on the power connected to the controller only after all wiring is complete.
- When operating the controller after long-term storage, perform checks and commissioning tests.
- The controller is a precision instrument. Do not drop or subject the product to strong shocks.
- Never remove connectors while the motor is in operation. Also, ensure that the power supply is turned off when inserting into a device.
Failure to do so can cause breakage of the controller.

- When an error is detected, rectify the cause of the error and ensure safety.
After that, release the error state, turn on the power again, and restore operations.
- When disposing of this product, do so according to laws and regulations, and applicable directives from local governments.

Operating and Storage Environment

- When storing the controller, avoid direct sunlight, high temperatures, humid places, and corrosive gases.
The recommended operating environment is +10 to +30°C and relative humidity of 30 to 85% (no condensation). Exercise due care with long-term storage, as pin contacts may deteriorate.
- Agents used for fumigation and disinfection can contaminate the metal parts of the controller and electronic components.
When fumigating packaging materials (pallets, etc.) containing the controller or a product that incorporates the controller, ensure that the controller is not exposed to fumigation materials and gases.
- The ambient temperature when using the controller has an impact on performance and longevity.
Use the product within the operating temperature and humidity range stated in the specifications.

1. Functions and characteristics

1-1. Standard use conditions

The standard use conditions are conditions or states indicating allowable use, but not a guarantee of characteristics or performance.

1	Applicable motors (Controller model name:)	- DS-34EC1-IS221: IS-94BZC and MS-94BZA/BZB/BZC/BZD/BZE/BZF - DS-34EC1-IS311: IS-74BZA (*1)
2	Drive method	Sinusoidal drive/PWM drive system (carrier frequency 20kHz)
3	Control method	Speed control system (Control by CAN communication)
4	Speed and position detection method	Hall effect sensor
5	Power supply voltage (Controller model name:)	- DS-34EC1-IS221: 24V/36V - DS-34EC1-IS311: 24V DC constant (*1)
6	Maximum regenerative current	-10A (max.) Connect a power source that does not cause any abnormality due to the regenerative current.
7	Maximum input current	25A (max.)
8	Direction of rotation	CW & CCW as seen from the output shaft side
9	Speed setting range (Controller model name:)	- DS-34EC1-IS221: 60 r/min to 3,000 r/min - DS-34EC1-IS311: 100 r/min to 4,000 r/min (*1)

10	Operating temperature range	-10°C to +50°C
11	Operating humidity range	30%RH to 95%RH (without condensation)
12	Connector lead terminal temperature	105°C (max.)

*1: - The appropriate controller name varies depending on the type of brushless motor connected.

Please make sure to use a controller that is compatible with each motor.

- The values of power supply voltage, speed, or speed range specified in this instruction manual are described with reference to characteristics when used in combination with IS-74BZA and IS-94BZC.
- As the characteristics and specifications of MS-94BZA/BZB/BZC/BZD/BZE/BZF need to consider the gear reduction ratio, please refer to the separate MS-94BZA/BZB/BZC/BZD/BZE/BZF instruction manual, check the characteristics and specifications before use.

1—2. Electrical characteristics (initial state)

1	Power supply voltage range	17V to 45V
2	Power supply current (Standby mode) CN_D Pin 1–Pin 2 = open	0.5mA (max.) Power supply voltage: 36V
3	Power supply current (Stop mode) CN_D Pin 1–Pin 2 = short	20mA (max.) Power supply voltage: 36V when motor sensor is not connected.
4	Rated input current	10.5A (24V) 8.5A (36V)
5	Output current limit 1 (Controller model name:) (*1)	- DS-34EC1-IS221: 37A (Maximum setting value) - DS-34EC1-IS311: 29A (Maximum setting value)
6	Output current limit 2 (Controller model name:) (*1, *2)	- DS-34EC1-IS221: 50A (Maximum setting value)
7	Insulation resistance *Applicable to power supply part only	10MΩ (min.) (DC500V) Between power input and housing.
8	Withstand voltage *Applicable to power supply part only	AC500V(50-60Hz), 1 minute Between power input and housing.

*1: - The output current limit value is the current that can be instantaneously flown out of the controller when starting the motor, etc.

This current cannot be used continuously at all times.

- The output current limit values 1 and 2 are set based on the following “3. CAN communication 3-2. Communication details: Motor drive command: Current limit”.
- Read the instruction manual of the motor (IS-94BZC, MS-94BZA/BZB/BZC/BZD/BZE/BZF) before use, and use it with the torque less than the instantaneous maximum torque.
- If the motor output shaft is locked, or a load exceeding the instantaneous maximum torque is applied to the motor, the motor winding and cable connectors may heat up and burn out depending on the current value, operating time, and operating environment.
Check the temperature of the motor and connector under the operating conditions of the product in which the motor is mounted.

- For details on how to check the temperature of the motor, refer to "3.CAN Communication > 3-2. Communication details > Drive status notification 2 > Motor temperature."
- For details on how to check the temperature of the connector terminals, refer to "5-5. Notes on cable connector terminals".
- To keep the motor and connector temperature at the specified value (motor 100°C max, connector 105°C max), limit the drive current value by changing the current limit value or forcibly cool down the motor and connectors.

*2: For protection of the main circuit, there is a limit on the time and speed that can be used.

In the case of setting 50A in "3. CAN communication: 3-2. Communication details: Motor drive command: Current limit ", the current limit will be 50Apeak for up to 2 sec when the motor speed is 1,000r/min or less.

In order to drive again at 50 Apeak, the following cooling time is required. (DS-34EC1-IS221)

- In the case of motor stop, cooling time of 30sec is required.
- In the case of continuous operation, the cooling time is longer.

1-3. ON OFF signal, CAN communication circuit

① ON_OFF signal input circuit

CN_D Pin 1: ON_OFF signal input pin

System active: Pin 1 – Pin 2 = short or low level

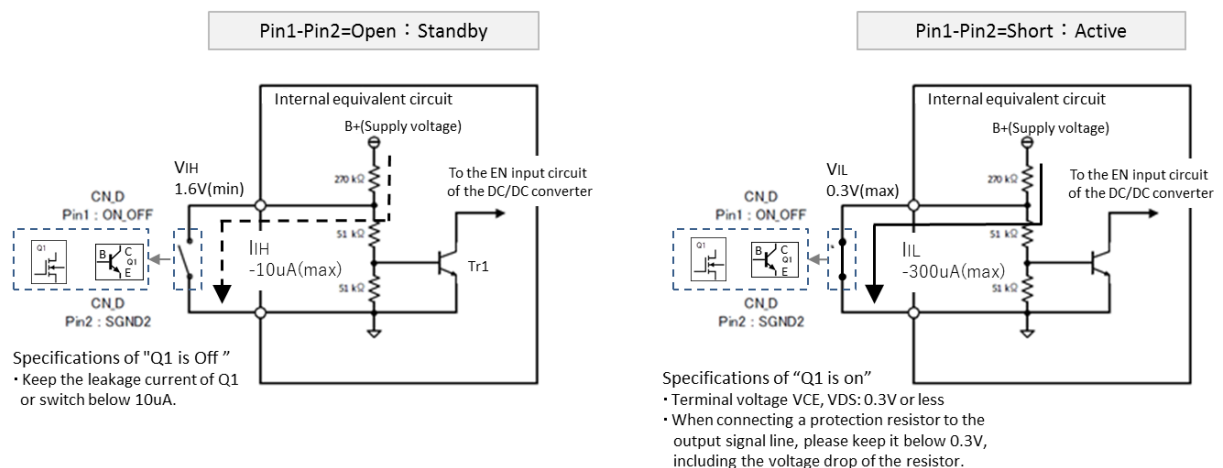
System standby: Pin 1 – Pin 2 = open or high level

Type	Item: Symbol	Condition	min	typ	max	Unit
System active	ON_OFF pin threshold voltage: V_{IL}	Supply voltage = 17-45V	-0.3		0.3	V
	ON_OFF pin input current: I_{IL}	Supply voltage = 17-45V			-300	uA
System standby	ON_OFF pin threshold voltage: V_{IH}	Supply voltage = 17-45V	1.6			V
	ON_OFF pin input current: I_{IH}	Supply voltage = 17-45V			-10	uA

Only open collector (NPN type), open drain (N-channel), and mechanical contact switches can be connected to the ON_OFF pins.

- When an abnormality or failure occurs in the controller, immediately open the ON_OFF terminal to stop the system (system standby state) and cut off the power supply to the controller.

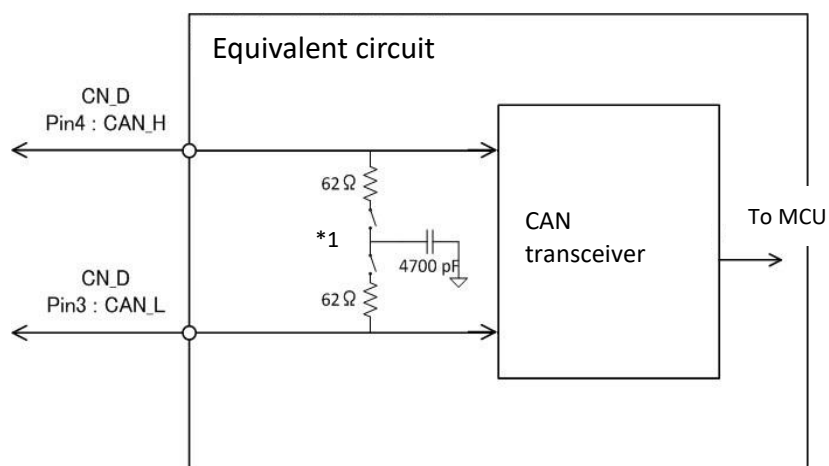
ON_OFF signal internal equivalent circuit



② CAN communication circuit

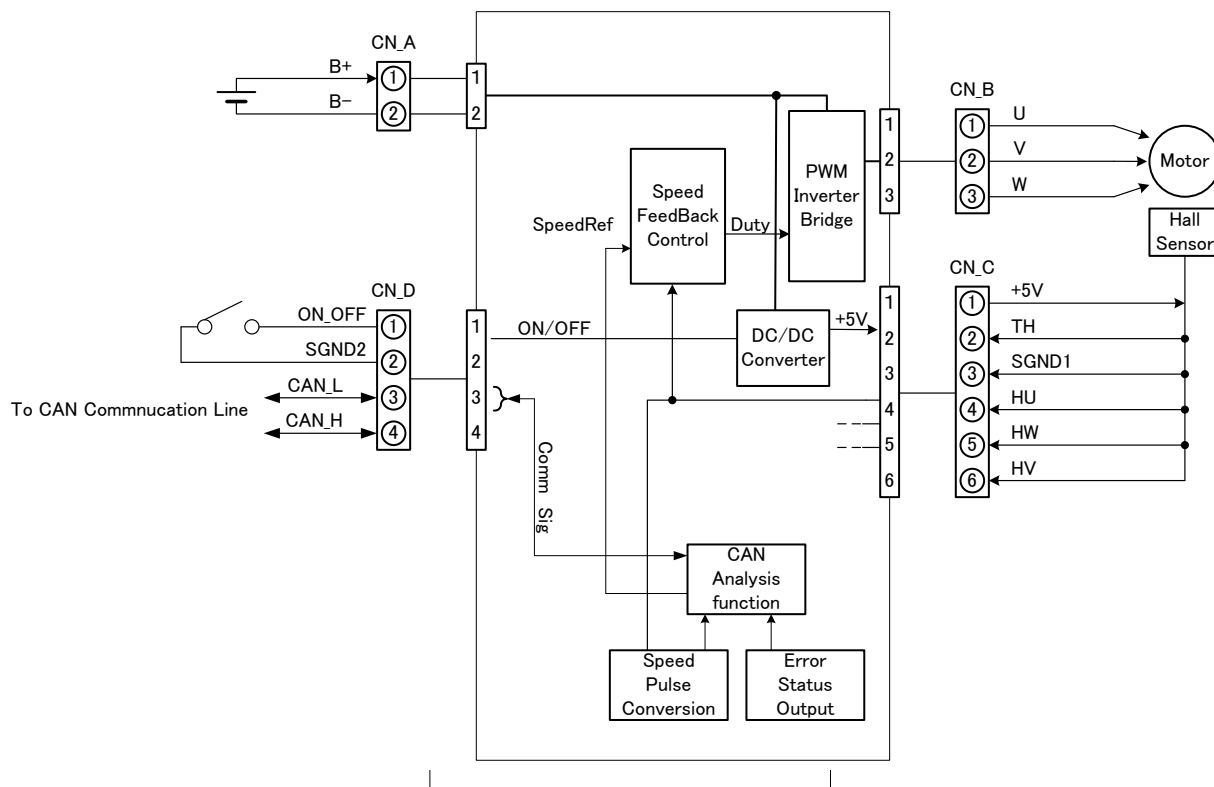
1	Communication method	CAN communication (High Speed Can supported) CAN2.0B compliant
2	Signal connection terminal	CN_D Pin 4: CAN High level signal CN_D Pin 3: CAN Low level signal
3	Data transfer rate	500kbps
4	Line termination resistance	124Ω/open (Selectable)

CAN communication internal equivalent circuit



*1: Selectable with CAN parameters

2. Functional block diagram



The following abbreviations of signal names shown in “4. Connector” are shown in a functional block diagram.

Connector name	No.	Signal name	Abbreviation
CN_A	1	BATTERY POSITIVE	B+
	2	BATTERY NEGATIVE	B-
CN_B	1	U PHASE OF MOTOR	U
	2	V PHASE OF MOTOR	V
	3	W PHASE OF MOTOR	W
CN_C	1	+5V POSITIVE ELECTRODE	+5V
	2	THERMISTOR	TH
	3	SGND1	SGND1
	4	U SIGNAL BY ELECTROMAGNETIC WAVE	HU
	5	W SIGNAL BY ELECTROMAGNETIC WAVE	HW
	6	V SIGNAL BY ELECTROMAGNETIC WAVE	HV
CN_D	1	ON_OFF	ON_OFF
	2	SGND2	SGND2
	3	CAN_L	CAN_L
	4	CAN_H	CAN_H

3. CAN communication

3-1. CAN ID configuration rules

The ID for CAN communication is configured to consist of a function code for the top 4 bits and a node device ID for the lower 7 bits.

The function code (FCD) is a number used to identify a particular function.

The node device ID (NID) is a number used to identify an individual unit when multiple units are used.

CAN ID configuration												
Function code				Node device ID								
MSB	11	10	9	8	7	6	5	4	3	2	1	LSB

The assignment of FCD is as follows.

Function code (FCD) contents	
Code	Contents
0x03	Motor drive command
0x05	Drive state notification 1
0x06	Error state notification
0x07	Drive state notification 2
0x09	Controller settings
0x0A	Flag settings
0x0B/0x0C	Parameter settings

An example of device ID setting when using two motors is shown below.

Node device ID contents (configuration examples)	
ID	Designated device
0x01 (default)	Circuit for motor L
0x02	Circuit for motor R

E.g., When driving instructions are performed on a motor R circuit, the CAN ID is
 $FCD (0x03) * 0x80 + NID (0x02) = 0x182$.

*Node device ID can be set as WID (0x10) of parameter writing (0x0B).
 For details, please refer to "3-3.WID/PID".

3.2. Communication details

CAN communication settings/readout function (*4, *5)										
Function	Direc- tion (*1)	FCD [CAN ID] (*2)	Data contents							
			1Byte	2Byte	3Byte	4Byte	5Byte	6Byte	7Byte	8Byte
Motor drive command	R	0x03 [0x181,0x182]	Operat- ing state set- ting	Motor speed (Rotation) setting		Acceleration setting		Current limit		
Reserved (*3)	-	0x04 [0x201,0x202]	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Driving state notification 1	S	0x05 [0x281,0x282]	Motor speed (Rotation)		Current value		Torque		Board tempera- ture 1	Com- mand mode read
Error state notification	S	0x06 [0x301,0x302]	Error code		Warning code					
Driving state notification 2	S	0x07 [0x381,0x382]	Moving distance (Traveled distance)				DC voltage		Motor tempera- ture	Circuit board tempera- ture 2
Reserved (*3)	-	0x08 [0x401,0x402]	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Controller set- tings	R	0x09 [0x481,0x482]	Com- mand mode	Commu- nication request	Request informa- tion Interval	Reserved	Reserved	Reserved		
Flag settings	R	0x0A [0x501,0x502]	Reset settings	Reserved						
Parameter write/read request	R	0x0B [0x581,0x582]	Data length	Write/rea d identifica- tion number	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
Parameter write/read results returned	S	0x0C [0x601,0x602]	Data length	Validity evalua- tion	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5

*1: For the direction, S indicates the direction of notification from the controller to the outside, and R indicates the direction of receiving instructions from the outside.

*2: [CAN ID] is given as an example when the node device is set to 0x01,0x02.

*3: FCD = 0x04,0x08 is intended for securing CAN IDs towards future expansibility.

*4: CAN ID=0x7E0,0x7E1 is used to reprogram via CAN, so ensure that you secure this CAN ID.

*5: Data over 2 bytes is expressed in MSB first. Be sent in order of upper byte / lower byte in CAN communication.

Function: Motor drive command [FCD=0x03]	Setting contents	Default value
Operational state setting	[1bit] 0: motor stop, 1: motor drive [2bit] 0: CCW drive, 1: CW drive [3 to 7bit] - : Invalid setting [8bit] 0: Short brake, 1: Motor free (*1)	0 0 0 1
Motor speed setting (Controller model name:)	Rotation speed command: (*2) - DS-34EC1-IS221: 60-3,000 [r/min] - DS-34EC1-IS311: 100-4,000 [r/min]	- DS-34EC1-IS221: 60 - DS-34EC1-IS311: 100
Acceleration setting	Acceleration command: 100-11,164 [r/min/s] (*2)	100
Current limit	Set the current limit value [Apeak] × 10 Setting range: - DS-34EC1-IS221: 5-500 [0.1Apeak] - DS-34EC1-IS311: 5-290 [0.1Apeak]	- DS-34EC1-IS221: 500 - DS-34EC1-IS311: 290

*1: When the 8th bit of the drive status setting is set, the motor rotation becomes free and the drive command of the 1st bit is ignored.

*2: If set to more than the configuration range, it will be set to the upper limit.
If set to less than or equal to the set range, it is set to the lower limit.

Function: Driving state notification 1 [FCD=0x05]	Reading contents	Data range
Motor speed (*3)	Notification of motor rotation speed [r/min] Notifies of + value: CCW direction, - value: CW direction	-5000~+5000
Current value (*3)	Notification of motor supply phase current [Arms] × 100 + Value: Motor supply current - Value: Motor regenerative current	-32768~+32767
Torque (*3)	Notification of motor output torque [Nm] × 100 + Value: Torque in the specified direction - Value: Torque in reverse direction of specified rotation	-32768~+32767
Circuit board temperature 1 (*3)	Notifies of board (motor output circuit) temperature [°C]	0~255
Command mode read	0: Driving in PWM command mode 1: Driving in CAN communication command mode	0~1

*3: When an IC error occurs (anomaly detection of internal IC), an abnormal value is notified. Do not use this notification value if an IC error has been notified.

Function: Notifies of error state [FCD=0x06]	Reading contents	Data range
Error code	Sends the error states 0: No error Other than 0: Error (Please refer to "3-5. Errors" for details)	—
Warning code	Sends the warning states 0: No warning Other than 0: warning (Please refer to "3-4. Warnings" for details)	—

Function: Driving state notification 2 [FCD=0x07]	Reading contents	Data range
Moving distance (Traveled distance)	Motor moving distance [rotation/42] For every 1/42 rotation, counted as + when moving in CCW direction and - when moving in CW direction (*1)	-2147483648~ +2147483647
DC voltage	Notifies of input DC voltage [V] × 10	0~700
Motor temperature	Notifies of motor temperature [°C]	0~255
Circuit board temperature 2	Notifies of the temperature [°C] of the circuit board (power input circuit)	0~255

*1: If in overflow, treated as - maximum value; if in underflow, becomes + max value, and continues counting.

Function: Controller settings [FCD=0x09]	Setting contents	Default value
Command mode	1: CAN communication command mode	1 (*2, *3)
Communication request	Communication request command 0: No request, 1: Drive states send request	1 (*3, *4)
Request information interval	Driving state transmission interval setting: (set value + 1) × 10 [msec]	0

*2: In CAN communication command mode, supply the motor drive instruction [FCD=0x03] at an interval of 0.5sec or shorter.

If there is no drive command for more than 0.5sec, the CAN communication line is deemed to have disconnected, and the process halts with an error.

*3: The value at power-on can be set with WID [= 0x11] of parameter write [= 0x0B].

If WID [=0x11] is set to 0, treated as [Command mode: 0; communication request: 0].

If set to 1, treated as [Command mode: 1; Communication request: 1].

*4: For details, please refer to "3-6. CAN communication flow".

Function: Flag setting [FCD=0x0A]	Setting contents	Default value
Reset setting	[1bit] - : Invalid setting [2bit] 0: Invalid; 1: Moving(Travel) distance reset [3 to 8bit] - : Invalid setting	0 0 (*5) 0

*5: If sending 1, the count will be reset immediately after receiving the value.

Function: Parameter write/read request [FCD=0x0B]	Setting contents	Default value
Data length	Valid data length for data 1 to 5 (0 to 5 Byte)	—
Read/write number	Write/read identification number (0x3B: Write; 0x21: Read)	—
WID/PID	Write/read identification data number (*1)	—
Data 1-5	Written data contents	—

Function: Returns results of parameter write/read [FCD=0x0C]	Reading contents	Default value
Data length	Valid data length for data 1 to 5 (0 to 5 Byte)	—
Validity evaluation	Read/write result determination (0x7B: write successful; 0x61: read successful; 0x7F: abnormal response)	—
WID/PID	Write/read identification data number (*1)	—
Data 1-5	Read data contents	—

*1 : For details, refer to "3-3. WID/PID".

3-3. WID/PID

WID/PID indicates a number that identifies what is used during parameter write/read requests or responses. WID refers to write ID, and PID refers to read ID.

WID PID	Data length	Data name	Data place- ment	Details	Default value	Setting range
0x00 (Read Only)	3	Main version	1	Indicates the software version	-	-
		Minor version	2			-
		Sub version	3			-
0x01	4	PI control: proportional gain	1-2	Set proportional gain for PI control	2800	0~65535
		PI Control: integral time	3-4	Set the integral time for PI control	800	10~65535
0x02	2	Disturbance observer Input response time	1	Basic response change 0: High response 1: Medium response 2: Low response	1	0~2
		Disturbance observer Disturbance response	2	1: Low response ⇔ 255: High re- sponse	15	1~255
0x03	1	Speed control method selection	1	0: Disturbance observer method 1: PI control method	0	0~1
0x04	5	Overheating warning operation settings	1	0: Warning notification only 1: Stop processing	0	0~1
		Over speed warning operation settings	2	0: Warning notification only 1: Stop processing	0	0~1
		Low voltage warning operation settings	3	0: Warning notification only 1: Stop processing	0	0~1
		High voltage warning operation settings	4	0: Warning notification only 1: Stop processing	0	0~1
		Stall warning operation settings	5	0: Warning notification only 1: Stop processing	0	0~1
0x05	2	Warning stop acceleration settings	1~2	Configured as [r/min/s]	1000	100~11164

WID PID	Data length	Data name	Data Place- ment	Details	Default value	Setting range
0x10	1	Node device ID settings	1	Set the node device ID to identify the controller	1	1~127
0x12	1	Terminating resistor selection	1	0: Do not connect the terminating resistor 1: Connect the terminating resistor	1	0~1

- ① When "Parameter writing / reading request 【FCD=0x0B】 " is commanded to the controller from the outside, it returns with "Parameter writing / reading result reply 【FCD=0x0C】 ".
- ② The write or read request is determined by the second byte (Write/Read Identification Number) of "Parameter Write/Read Request".
When writing, supply the corresponding "Data length" for the 1st byte as given for the WID/PID in the table above.
(E.g., if specifying 0x01, enter 4); When reading, it is not necessary to specify "Data length".
- ③ Parameter write/read is accepted only under normal stop/error conditions. Note that when in the driving state, writes will be kept pending.
However, in the case of WID=0x02 (disturbance observer response), changes can be made while driving state.
The settings for WID=0x10,0x11 will be effective when rebooting.
- ④ The settings that have been successfully returned by the write request are saved in the flash memory and do not need to be set from the next time.
- ⑤ If a parameter write request succeeds, the process returns a validation response of 0x7B.
E.g., WID/PID=0x02 disturbance observer input response, NID = 0x01

- Write request (input response time = 1: medium response; disturbance response: set to 100)

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Write	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x581	0x08	0x02	0x3B	0x02	0x01	0x64	0x00	0x00	0x00

- Returned upon successful acceptance of writing request

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Validity evalua- tion	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x601	0x08	0x00	0x7B	0x02	0x00	0x00	0x00	0x00	0x00

- ⑥ When reading parameters, if a successful response is received, the data corresponding to a success/fail determination (0x61) is returned.

E.g., WID/PID = 0x05, warning stop acceleration setting, NID = 0x01
(Premise: memorize warning acceleration stop 1000 in the controller.)

- Read request

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Read	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x581	0x08	0x00	0x21	0x05	0x00	0x00	0x00	0x00	0x00

- Read request response

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Validity evaluation	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x601	0x08	0x02	0x61	0x05	0x03	0xE8	0x00	0x00	0x00

- ⑦ When parameter reading / writing is not accepted due to an abnormal value, returns 0x7F as the evaluation response.

E.g., if parameter write WID/PID= 0x25, unsupported value

- Read request

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Read	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x581	0x08	0x00	0x21	0x25	0x00	0x00	0x00	0x00	0x00

- Abnormal data reception response

CAN ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
		Data length	Validity evaluation	WID/PID	Data 1	Data 2	Data 3	Data 4	Data 5
0x601	0x08	0x00	0x7F	0x05	0x00	0x00	0x00	0x00	0x00

3-4 Warning

Warning code	Warning contents	Warning detection condition	Warning cancellation condition
0x0001	Overheating warning	Circuit board temperature 1, 2: 90°C or higher	Circuit board temperature: 75°C or lower
0x0002	Over speed warning	- DS-34EC1-IS221 Speed: 4,000r/min or higher - DS-34EC1-IS311 Speed: 5,000r/min or higher	- DS-34EC1-IS221 Speed: 3,800r/min or lower - DS-34EC1-IS311 Speed: 4,800r/min or lower
0x0004	Low voltage warning	Power supply voltage: 16.5V or lower	Power supply voltage: 17.0V or higher
0x0008	High voltage warning	Power supply voltage: 47.5V or higher	Power supply voltage: 47.0V or lower
0x0010	Stall warning	- DS-34EC1-IS221 Speed: 50r/min or lower Current: 30.0A or higher More than 15sec continuously - DS-34EC1-IS311 Speed: 50r/min or lower More than 15sec continuously	Speed: 50r/min or higher or [Operating state setting=0]
0x0080	Motor over-heating warning	Motor temperature: 90°C or higher	Motor temperature: 75°C or lower

*Warnings can be selected as [0: Warning notification only] or [1: Warning notification and motor stop] by configuring WID/PID=0x04.

When configuring a halt, "Speed of 50r/min or lower is detected and [Operation state setting=0]" is added to the return condition.

When configuring a halt, the motor will halt at the acceleration set per [WID=0x05], and halt with the short brake engaged.

However, if [Operating state setting=0x80: Motor-free setting] is enabled, it is set to motor free.

3-5. Errors (*1)

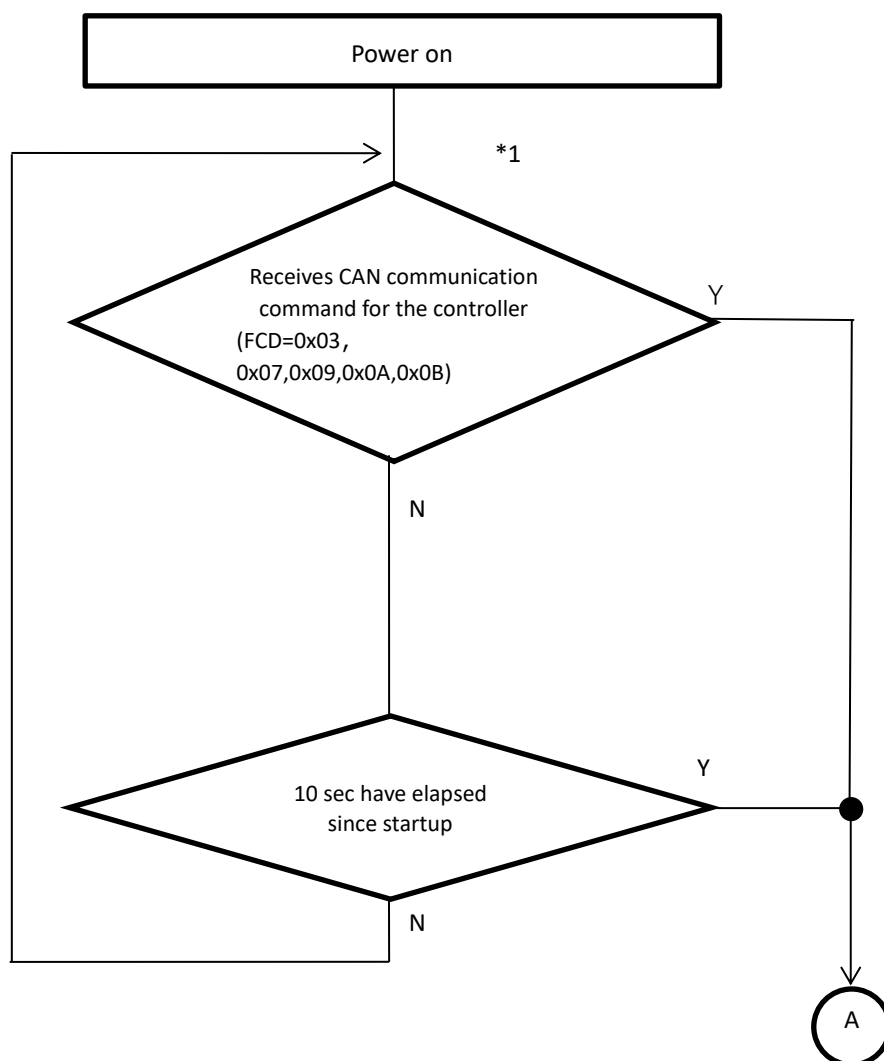
Error Code	Error contents	Error detection conditions	Error cancellation condition *3
0x0001	Overheating error	Circuit board temperature 1, 2 : 100°C or higher	All temperatures 75°C or lower, and [Operating state setting=0]
0x0002	Over speed error	- DS-34EC1-IS221 Speed: 4,500r/min or higher - DS-34EC1-IS311 Speed: 5,500r/min or higher	Speed: 150r/min or lower, and [Operating state setting=0]
0x0004	Low voltage error	Power supply voltage: 14V or lower	Power supply voltage: 16.5V or higher, and [Operating state setting=0]
0x0008	High voltage error	Supply voltage: 50V or higher	Supply voltage: 48V or lower, and [Operating state setting=0]
0x0010	Stall error	- DS-34EC1-IS221 Speed: 50r/min or lower Current: 30.0A or higher More than 16sec continuously - DS-34EC1-IS311 Speed: 50r/min or lower More than 16sec continuously	5sec elapsed after setting [Operation status setting = 0].
0x0020	Sensor error	Detected disconnection of Hall sensor signal	The sensor state is normal, and [Operating state setting=0]
0x0040	CAN communication error	When driving with CAN communication and no motor instruction is received for 0.5sec or longer, or if CAN communication fails to complete (such as ACK not received).	Receive motor drive command
0x0080	Motor overheating Error	Motor temperature: 100°C or higher	Motor temperature: 75°C or lower, and [Operating state setting=0]
0x2000	System Error	If receiving 50 times or more [FCD=0x0B: parameter write command] within 1sec, or if unable to write	Re-power on or restart with ON_OFF switch
0x4000	Overcurrent error	Output current: 51A or higher	Re-power on or restart with ON_OFF switch
0x8000	IC error (*2)	Anomaly detection of internal IC	Re-power on or restart with ON_OFF switch

*1: When an error is detected, the motor rotation control is set to free.

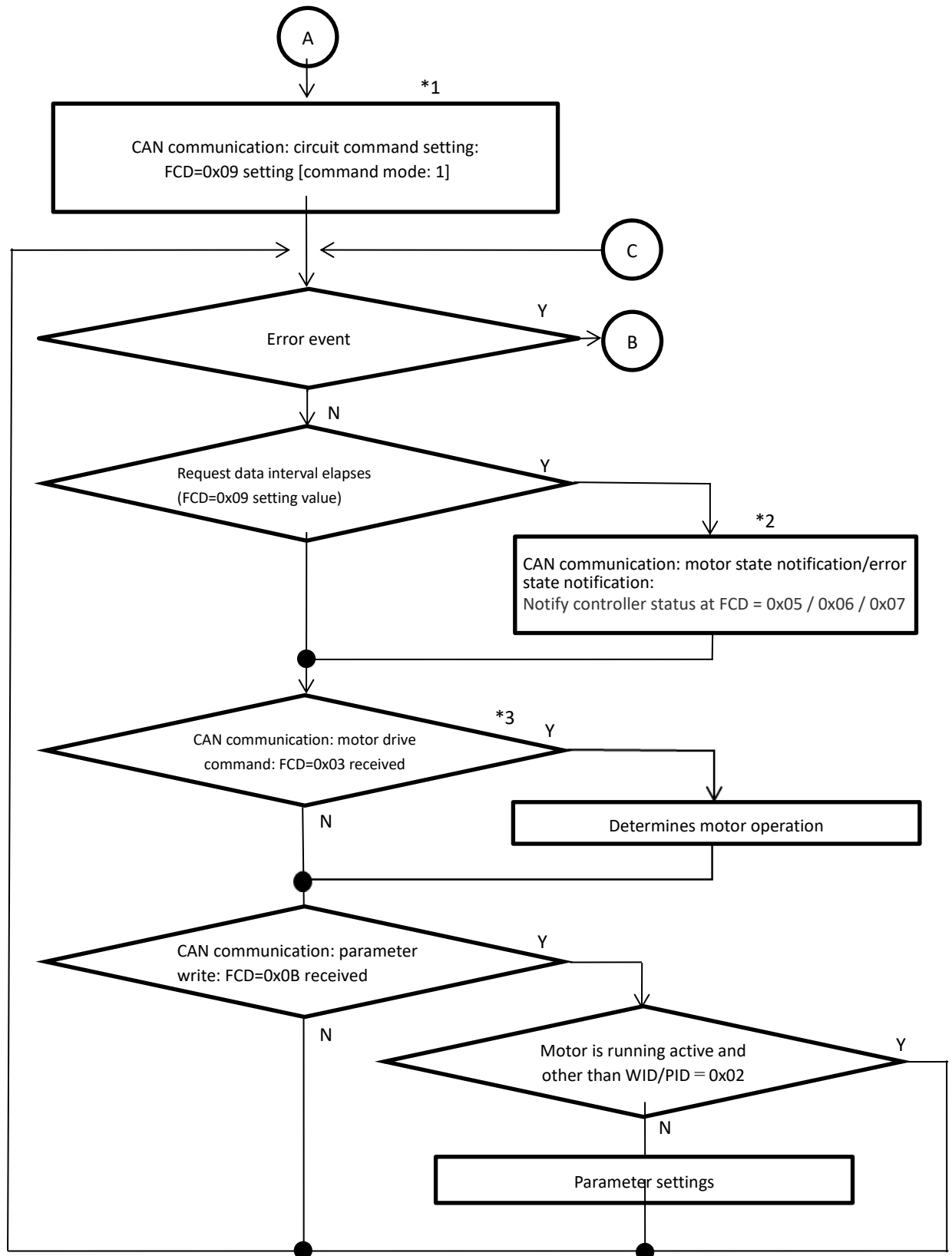
*2: When an IC error is detected, current value notification and board temperature 1 notification are abnormal values. In addition, depending on the cause of the IC error, other errors may be false positives/notifications.

*3: The motor speed must be 150 r/min or lower, and 5 sec must have elapsed since the error occurred.

3-6. CAN communication flow



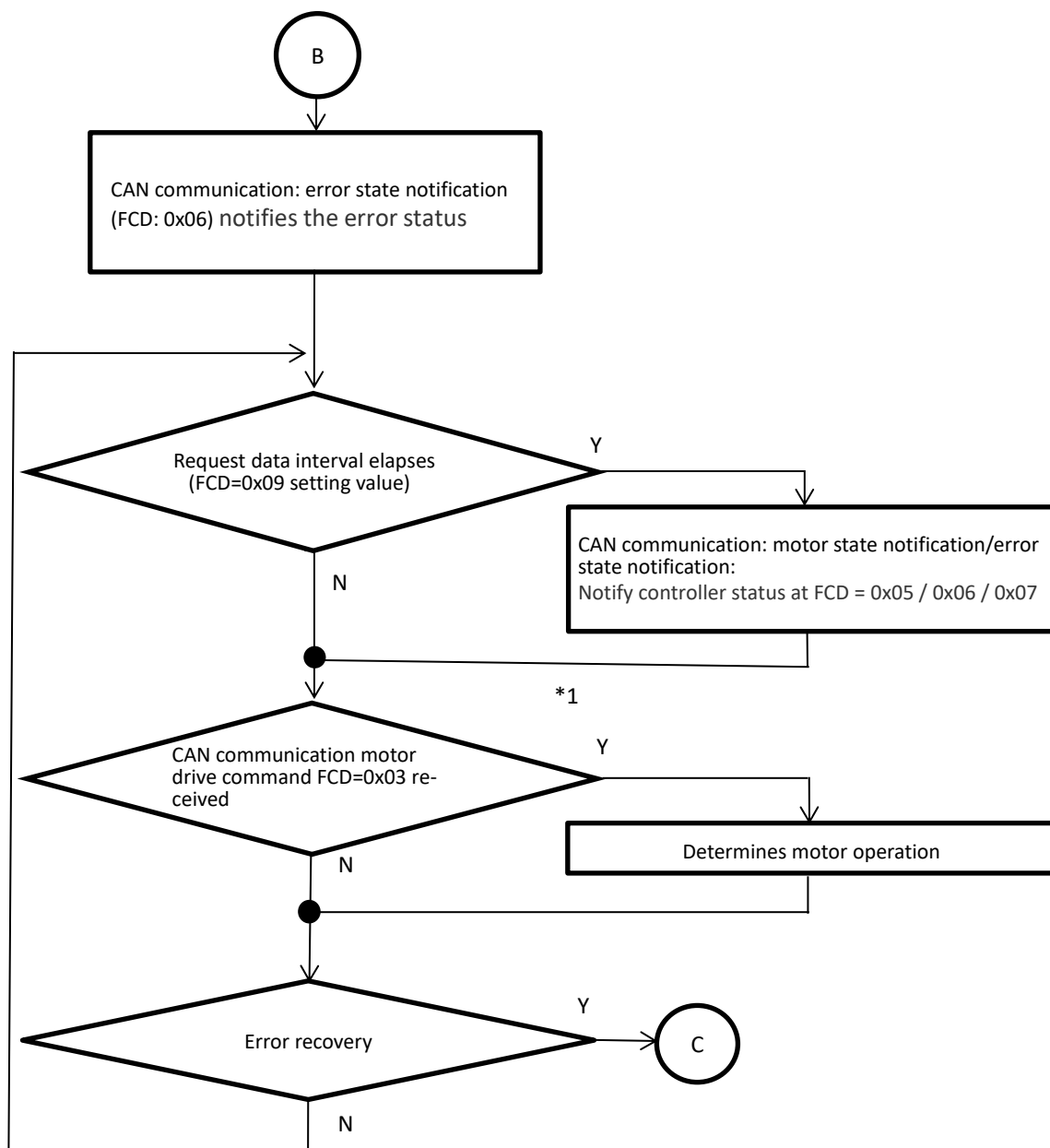
*1: After turning on the power and starting the system, wait at least 0.3 sec before starting communication.



*1: If the boot interface was configured to CAN via "Parameter write request [FCD=0 x 0B], WID=0x11", this setting is not needed.

*2: 0x05/0x06/0x07 are communicated in sequence

*3: Send a command with a period of 0.001 to 0.5 sec. (an interval of 0.5sec or more will cause a CAN communication error)



*1: Send a command with a period of 0.001 to 0.5 sec. (an interval of 0.5sec or more will cause a CAN communication error)

4. Connectors

Connector and signal name and function

CN_A	Connector type: Conforms to Minebea Connect CL07D02M		
Appearance 	Terminal number	Signal name	Function
	1	BATTERY POSITIVE	Controller power supply
	2	BATTERY NEGATIVE	

CN_B	Connector type: Conforms to Minebea Connect CL07D03M		
Appearance 	Terminal number	Signal name	Function
	1	U PHASE OF MOTOR	Motor power supply
	2	V PHASE OF MOTOR	
	3	W PHASE OF MOTOR	

CN_C	Connector type: Conforms to Minebea Connect CA01A5-06B0		
Appearance 	Terminal number	Signal name	Function
	1	+5V POSITIVE ELECTRODE	+5V power supply for Hall sensor
	2	THERMISTOR	Motor thermistor signal
	3	SGND1	Signal ground
	4	U SIGNAL BY ELECTROMAGNETIC WAVE	Hall sensor signal (digital signal)
	5	W SIGNAL BY ELECTROMAGNETIC WAVE	
	6	V SIGNAL BY ELECTROMAGNETIC WAVE	

CN_D	Connector type: Conforms to Minebea Connect CA01A5-04B0		
Appearance 	Terminal number	Signal name	Function
	1	ON_OFF	Connect to ON/OFF switch
	2	SGND2	Signal ground
	3	CAN_L	CAN_L signal
	4	CAN_H	CAN_H signal

5. Precautions

5-1. Speed setting method

- ① Speed setting method by CAN communication command.

The motor will be driven by setting 1 in the first bit of the operation status setting (= First byte) in the “motor drive commands” by CAN communication. At the same time, by setting the motor operating speed and acceleration, it operates with the set values as targets.

However, if it is set above the setting range, it will be set to the upper limit.

If it is set below the setting range, it will be set to the lower limit.

In addition, the current limit value is set with the same command. The maximum output torque is limited by the limited current value. In the current limit state, the set speed is not reached.

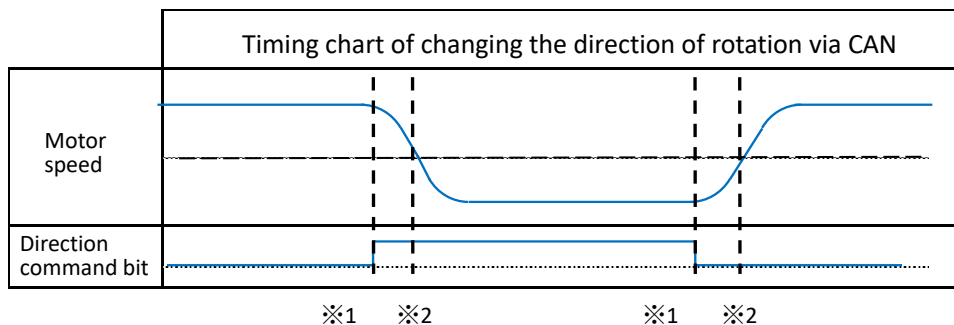
The current limit value is also set to the upper limit value when set above the set range, and set to the Lower limit value when set below the set range.

5-2. Direction of rotation switching

- ① Direction of rotation switching by CAN communication directive.

The orientation is toggled by flipping, of the motor drive directives available through CAN communication, the 2nd bit (referred to as direction command bit below) of the operation state (1st byte).

When the direction command bit is changed, the motor performs a stop process (brake operation) and drives in the direction opposite to the previous direction.



※1: Motor stop processing because the drive command bit is switched

※2: Since the internal command speed has become 0, reverse drive

5-3. Notes on battery connections

① Reverse-battery connection

The controller circuit does not provide protection against reverse battery connection.
Select protection elements such as clamping diodes and fuses and take appropriate measures.

② Residual voltage when battery is shut off

The current consumption between B+ and B- terminals during standby is kept low at 0.5mA or less (when 36V).

If the charge stored in the capacitor of the controller circuit must be discharged when the battery is shut off, add an external discharge resistor.

③ Input protection when connected to battery

Add surge suppression circuitry if there is a possibility of a surge voltage of 50V or more when connected to the battery.

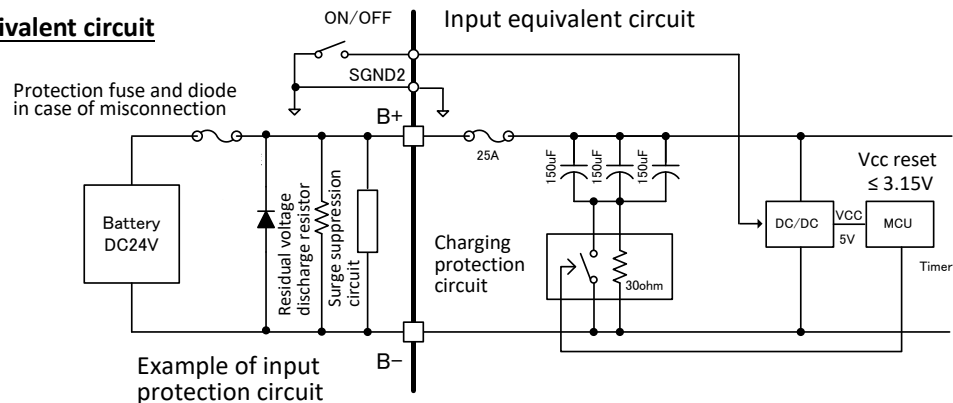
In order to prevent damage to the fuse (rated 25A) in the circuit board, a circuit that limits the capacitor charge current upon voltage input is connected.

The electrolytic capacitor is connected in series to a 30Ω resistor until the 5V DC/DC converter starts up and the internal system launches (after 120 msec).

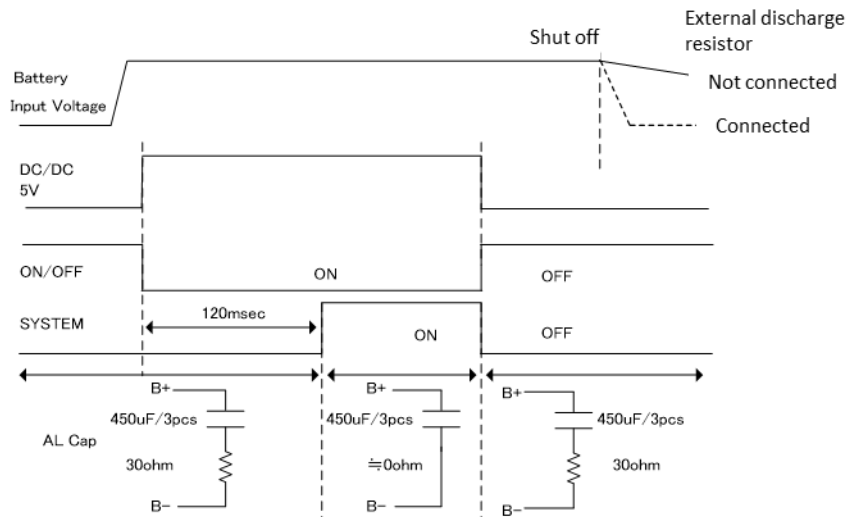
When the internal system boots, the 30Ω resistor is shorted.

Therefore, please note that until the system in the circuit starts, the input capacitance is small and the surge voltage cannot be sufficiently absorbed.

Input equivalent circuit



Changes in connection of electrolytic capacitors



5-4. Start and stop methods

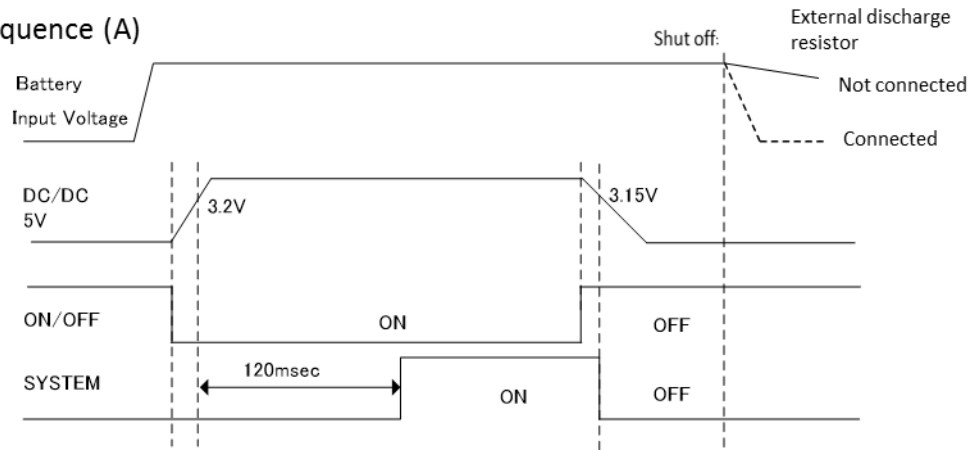
① How to start and stop using the ON/OFF port after battery connection

After connecting the battery, provided the battery voltage is 12V or more, setting the ON/OFF port to ON can be used to start DC/DC converter.

The system starts when the DC / DC output is 3.2V or higher, and normal operation is possible after 120msec. When the ON / OFF port is set to OFF, DC / DC stops.

The system stops when the DC / DC output drops 3.15V or lower.

Sequence (A)



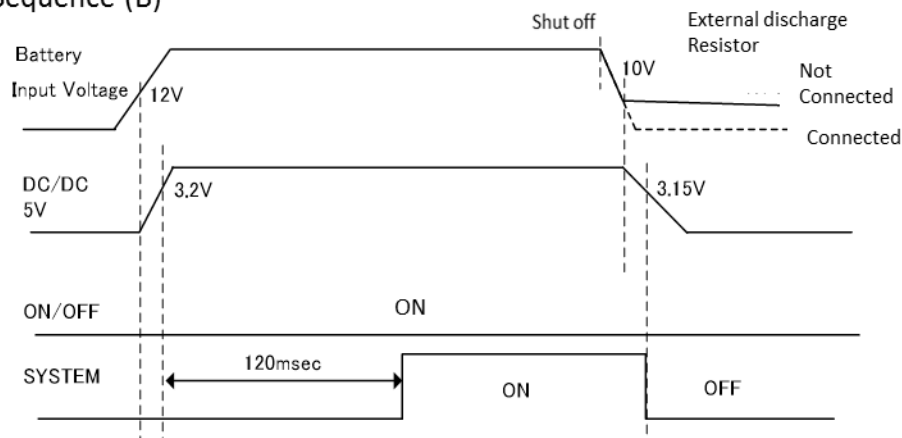
• When an abnormality or failure occurs in the controller, immediately open the ON_OFF terminal to stop the system (system standby state) and cut off the power supply to the controller.

② How to start and stop using the ON/OFF port set to ON (CN_D PIN 1-PIN 2 = short)

DC/DC converter starts at a battery voltage of 12V or higher and stops when it is 10V or lower. The battery connection activates DC/DC.

The system starts when the DC / DC output is 3.2V or higher, and normal operation is possible after 120msec. When the battery is shut off, DC / DC stops when the battery voltage drops 10V or lower. The system stops when the DC / DC output drops 3.15V or lower.

Sequence (B)



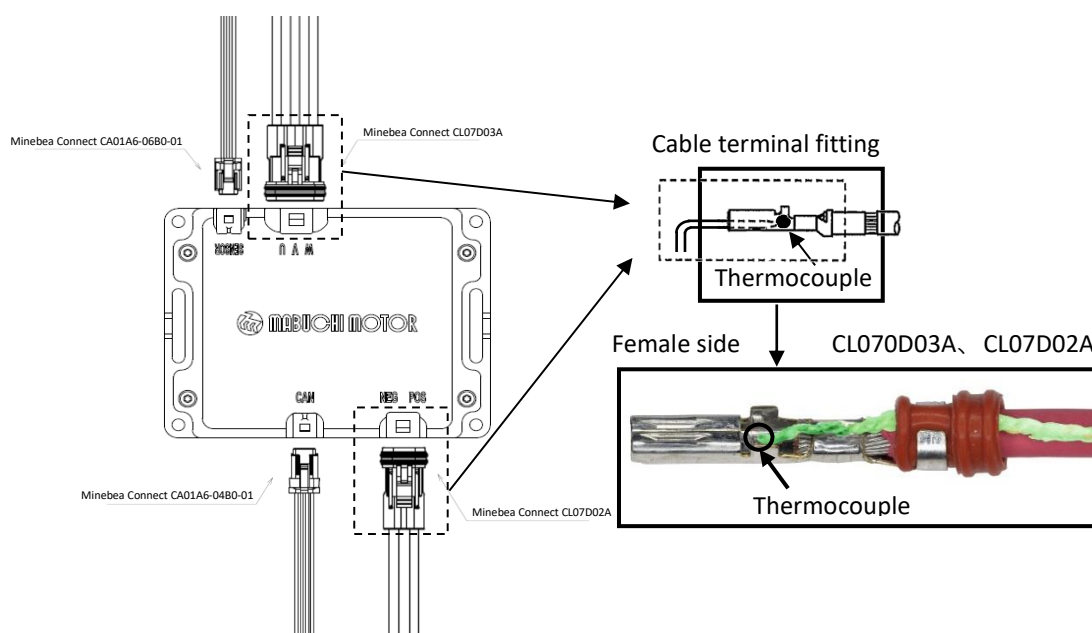
• When an abnormality or failure occurs in the controller, immediately open the ON_OFF terminal to stop the system (system standby state) and cut off the power supply to the controller.

5-5. Notes on cable connector terminals

Note that the cable terminals of the connectors CN_A (controller power supply) and CN_B (motor power supply) generate heat when the motor is driven.

Please use it so that the specified temperature of the lead terminal is 105°C or less when the actual machine is installed and the environmental temperature is maximum.

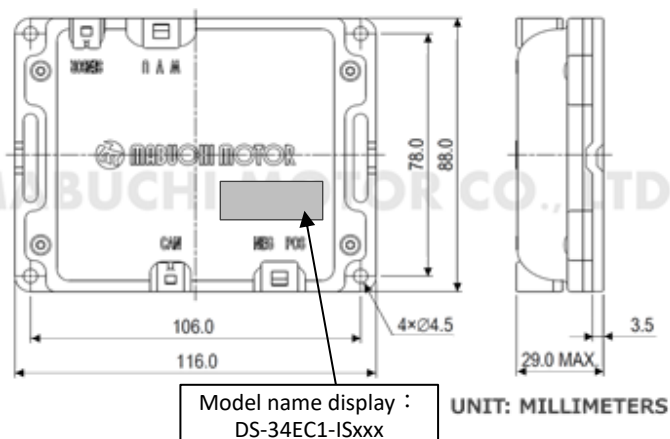
Referring to the figure below, attach a thermocouple to the connector lead terminal on the female side, install it in the connector, and measure the temperature to confirm.



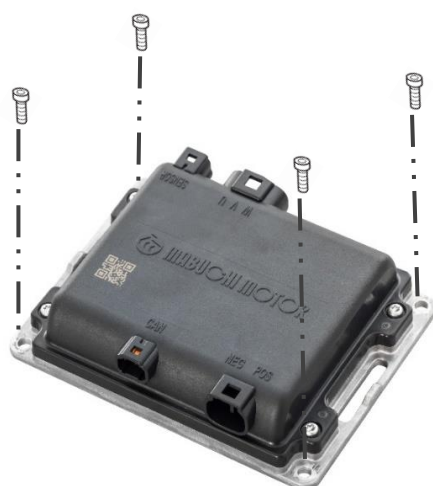
If the measured temperature of the connector cable terminals exceeds the specified value of 105 °C, adjust the temperature rise by the following method

- Reduce the current limit value; motor drive command [FCD=0x03] setting range 0.5 to 50A
- Restrict the time on motor high output
- Reduced the temperature rise by forced air cooling, etc.

6. Drawing, mounting method



- Mounting method

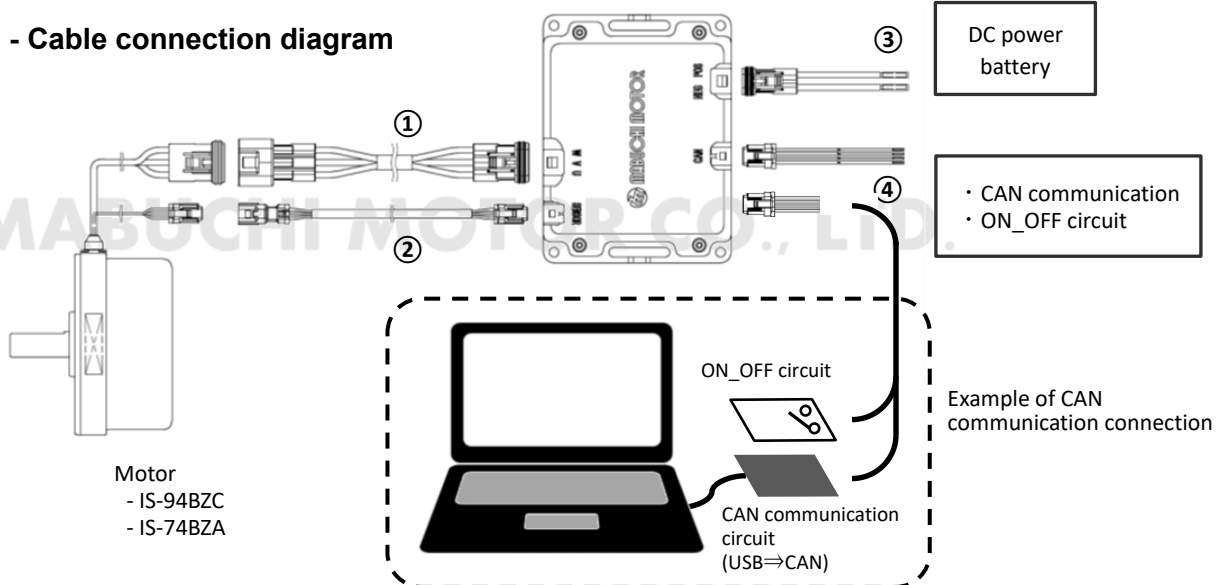


4 x M4 screws
(sold separately)

*Use 4x M4 screws to affix the controller to a flat metal surface such that there is sufficient heat dissipation

7. Optional items (cables sold separately)

- Cable connection diagram

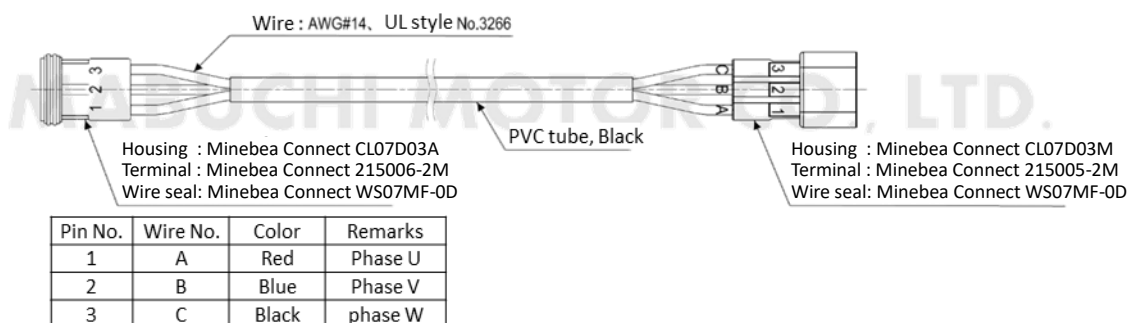


- * • The motor unit and controller do not come with included connection cables or extension cables. Select a separately sold cable to meet your use case.
- DC power, battery, CAN communication circuit, and ON_OFF circuit are not included. Purchase these separately.
- The controller model required for each brushless motor varies depending on the motor model being connected. Please make sure to use the appropriate controller for each motor.

① Motor power line extension cable

Part number: 67-Q22AA

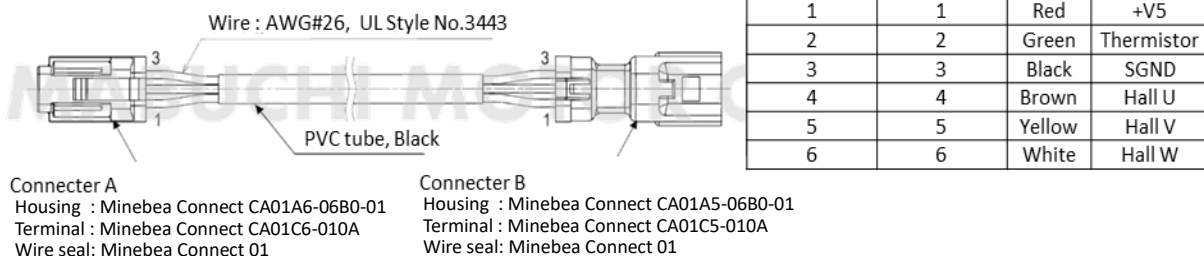
Cable length: 1m



② Motor sensor line extension cable

Part number: 67-Q23AA

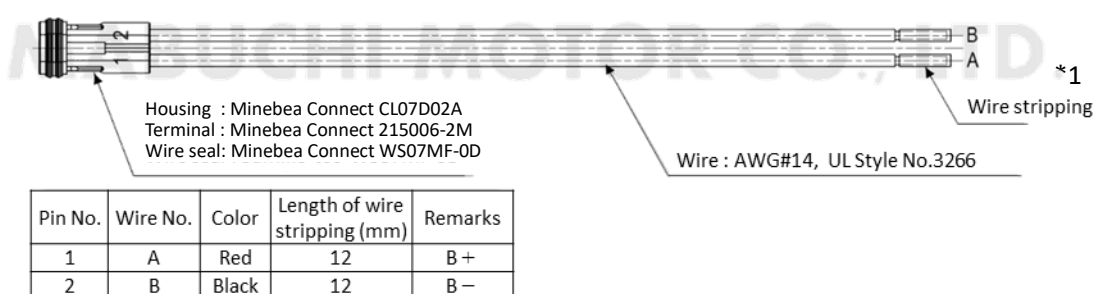
Cable length: 1m



③ Controller power cable

Part number: 41-L11XA

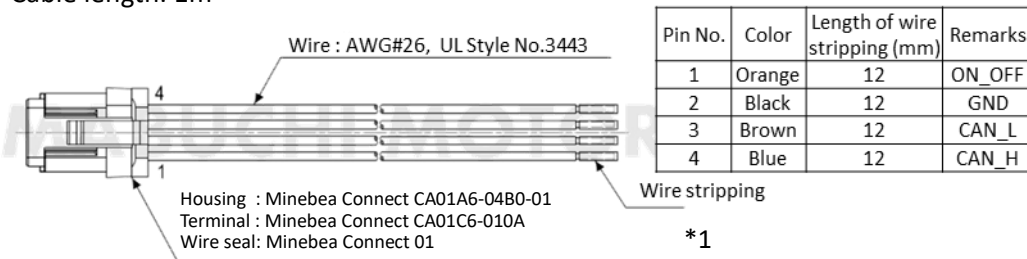
Cable length: 1m



④ Controller signal cable

Part number: 41-L12XA

Cable length: 1m



* 1 : The stripped side of the controller power cable and the controller signal cable is not waterproof.

When connecting to terminals, place the connection point in a place where it will not be splashed with water.

8. Product warranty, inquiries

- Please contact the retailer where you purchased this product.