Melec

2-phase/5-phase Stepping Motor Driver

QDB-MS450EL

Instructions Manual

(For designers' use)

USER'S MANUAL

Please ensure to read and understand this Instructions Manual before using the product.
Please keep this Instructions Manual at hand so that it is always available for reference.

CE

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Introduction

This Instructions Manual describes the safe and proper method of handing
"2-phase/5-phase Stepping Motor Driver QDB-MS450EL" with emphasis on the specifications,
assuming that our readers are engaged in designing of control devices
incorporating stepping motors.
Please ensure to read and understand this Instructions Manual
before using the product.
Please keep this Instructions Manual at hand
so that it is always available for reference.

Descriptions in this manual on safety matters:

This product must be operated and used properly.

Otherwise, or when it is operated and used erroneously, unforeseen accidents may occur, causing physical injuries or property damages.

Majority of these accidents can be avoided if you are well informed of hazardous circumstances in advance.

Consequently, this instructions manual describes all the hazardous and dangerous circumstances and situations which can be foreseen and anticipated as well as necessary precautions.

All the above descriptions are being titled by the following symbol-marks and signal-words, namely:

⚠ WARNING	Represents warnings ignorance of which can cause accidents involving fatal or serious physical injuries.
⚠ CAUTION	Represents cautions ignorance of which can cause accidents involving minor physical injuries or property damages.

Introduction

Descriptions in this manual on safety matters:

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PAGE

8. Maintenance and Check-up

9. Storing and Disposal

10. Specifications

The main parts which revised by this manual

1. Safety

1－1. Safety Precautions

⚠ WARNING

(1) This product is not designed or manufactured for application for equipment requiring high level of reliability such as equipment related to nuclear energy, aeronautics-related equipment, automobiles, ships, medical appliances directly handling the human body and equipment that might seriously affect properties.

(2) Do not use or keep the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, fine particles, soot, steam, or exposed to radiation or direct sunshine. Doing so may cause injury or fire.

(3) For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.
Failure to do so may cause electric shock.

(4) This product is designed for use within machinery, so it should be installed within an enclosure.
Failure to do so may cause injury.

(5) Do not transport, move, install the product, perform connections or inspections when the power is on.
Doing so may cause electric shock, injury or fire.

(6) Only qualified personnel are allowed to transport, move, install the product, perform connections or inspections.
Failure to do so may cause injury or fire.

⚠ CAUTION

(7) Do not touch the driver during operation or immediately after stopping.
Doing so may cause burn on the skin due to overheating of the driver.

(8) Ensure to use this product according to the method specified in the Instructions Manual and within the specifications.

(9) Depending on the operational conditions, the stepping motor may step out when it is on holding-state or driving-state.
In particular, the load in transport may fall if the motor steps out on the vertical drive (such as the Z-axis).
Start operation after test run for deliberate confirmation of operation.

(10) Provide fail-safe measures so that the entire system may operate in a safe mode even in cases of the external power supply failure, disconnection of the signal line, or any failure on the driver.

1－2. Safety Information for Handling

●Overall:

> ⚠ CAUTION
>
> Do not touch the driver during operation or immediately after stopping.
> it may cause burn on the skin due to overheating of the driver.

●When setting up the MOTOR SELECT switch/ the STEP ANGLE SELECT switch:

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

●When setting up the HOLD CURRENT SELECT switch:

> ⚠ CAUTION
>
> A high setting value may cause burn on the skin due to overheating of the motor.
> Do not select a high value beyond the required.

●When setting up the DRIVE CURRENT SELECT switch:

> ⚠ CAUTION
>
> Erroneous setting may cause motor deterioration or damage and burn on the skin due to overheating of the motor.
> Ensure correct setting.

●When setting up the PULSE INPUT TYPE SELECT switch:

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

●When setting up the EXTEND FUNCTION SELECT switch:

⚠ CAUTION

Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
Ensure correct setting.

●When installing:

⚠ WARNING

Overheating may cause fire.
Mount it on a noncombustible member.
Keep it away from combustibles.

●When connecting the DC Input/ Motor Output Connectors (J2, J3):

⚠ CAUTION

Erroneous connection may cause breakage of the motor or the driver.
Correctly connect the DC Input/Motor output connector.

●When inputting power:

⚠ CAUTION

Breakage of the machine or injury is apprehended due to unexpected behavior of the motor. Maintain the state where emergency stop is enabled at any time.

●When inputting the motor excitation stop (M.F) signal:

⚠ WARNING

Deterioration of the holding power with the motor may cause breakage of the machine or injury.
Check safety before inputting.

●When alarm (ALM) LED comes on:

⚠ WARNING

Overheating may cause fire.
Stop operation when this LED comes on.

●When the alarm (ALM) LED flashes:

⚠ CAUTION

Breakage of the machine or injury is apprehended due to unexpected behavior of the motor.
Stop operation when this LED flashes.

●When performing maintenance and checking:

⚠ WARNING

Injury or fire is apprehended due to unexpected behavior.
Do not replace fuse.
Do not disassemble, repair or modify.

2. Overview

2－1. Characteristics

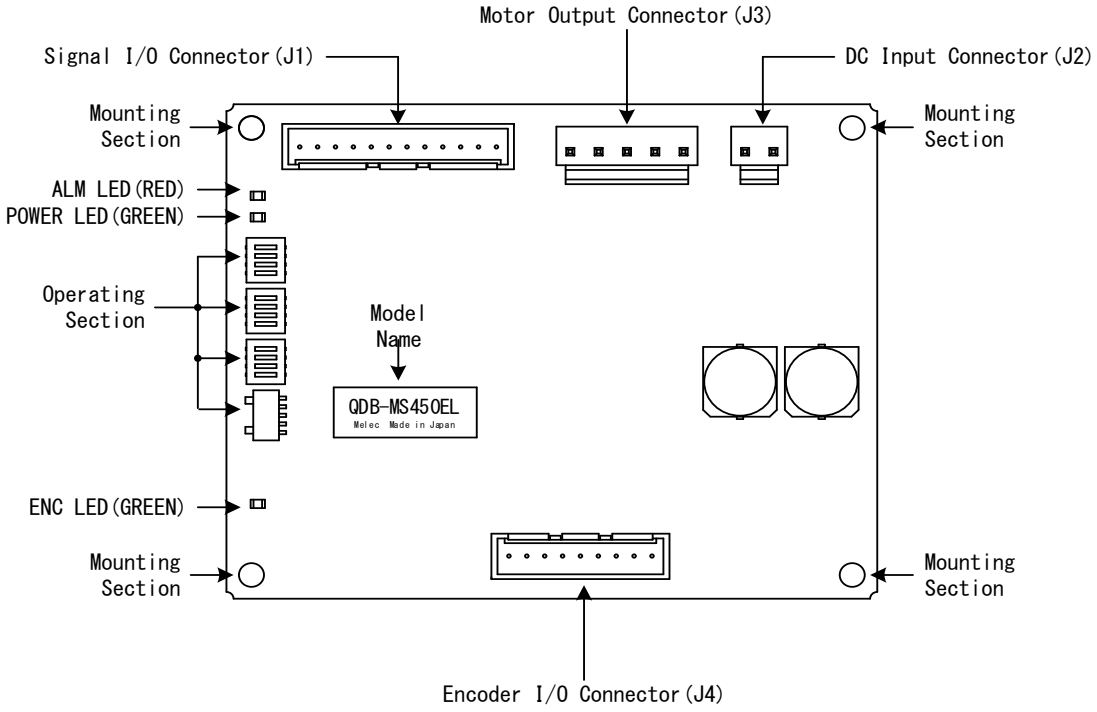
QDB-MS450EL is a step-out detection function driver for 2-phase/5-phase stepping motors with DC +24V input.
Driving method is the bipolar constant current type.
It can drive the 5-phase stepping motor of new pentagon connection ranging from 1.40A/phase to 4.50A/phase, and the 2-phase stepping motor of bipolar winding ranging from 1.40A/phase to 4.50A/phase.
Step angles can be selected from sixteen step angles ranging from 1 division to 500 division of the basic angle.
HOLD CURRENT and DRIVE CURRENT can be set up.

2－2. Product Configuration

●QDB-MS450EL　　One unit

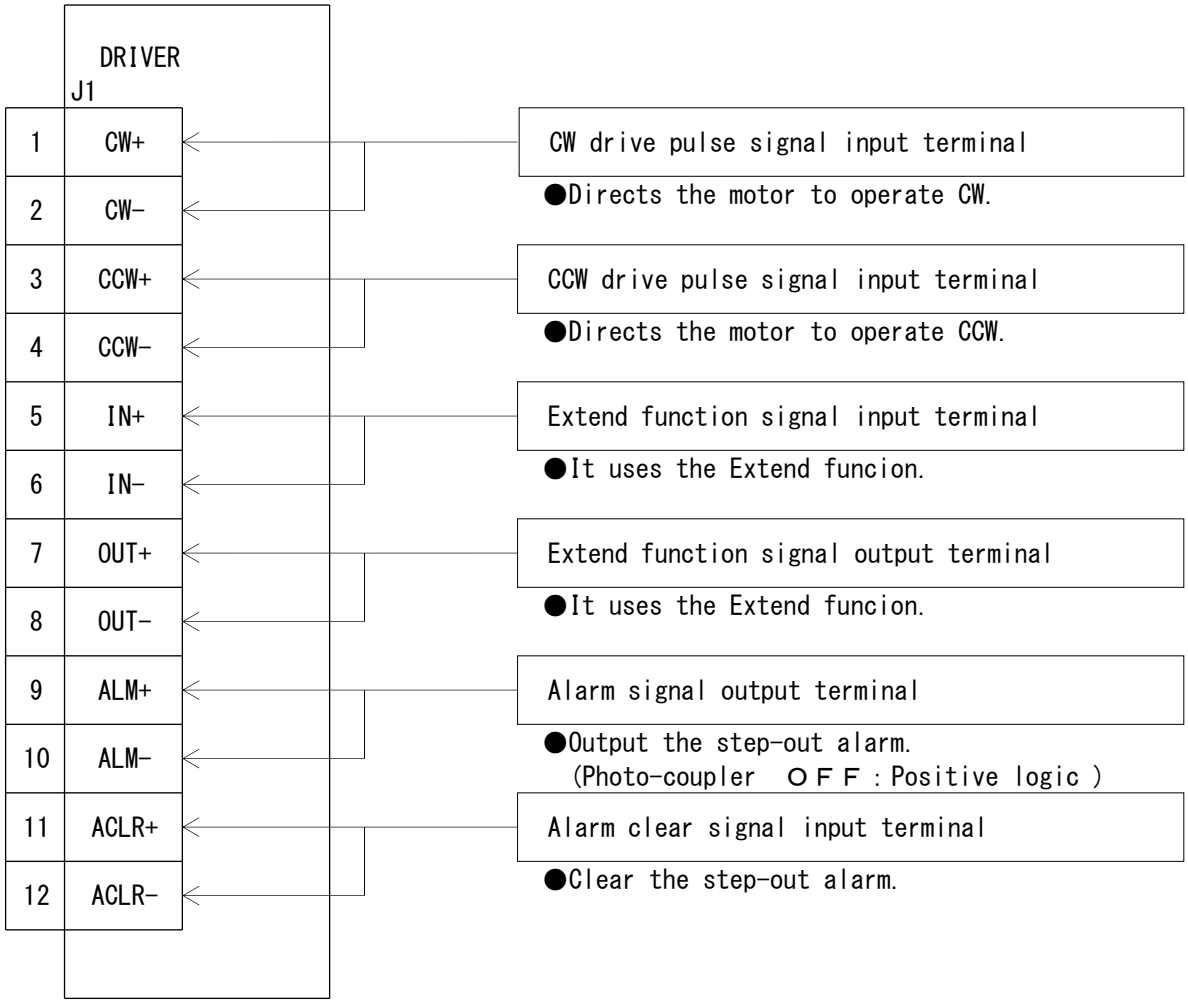
J1, J2, J3, J4 of the housing and the contact is not in accessories.

2－3. Appearance

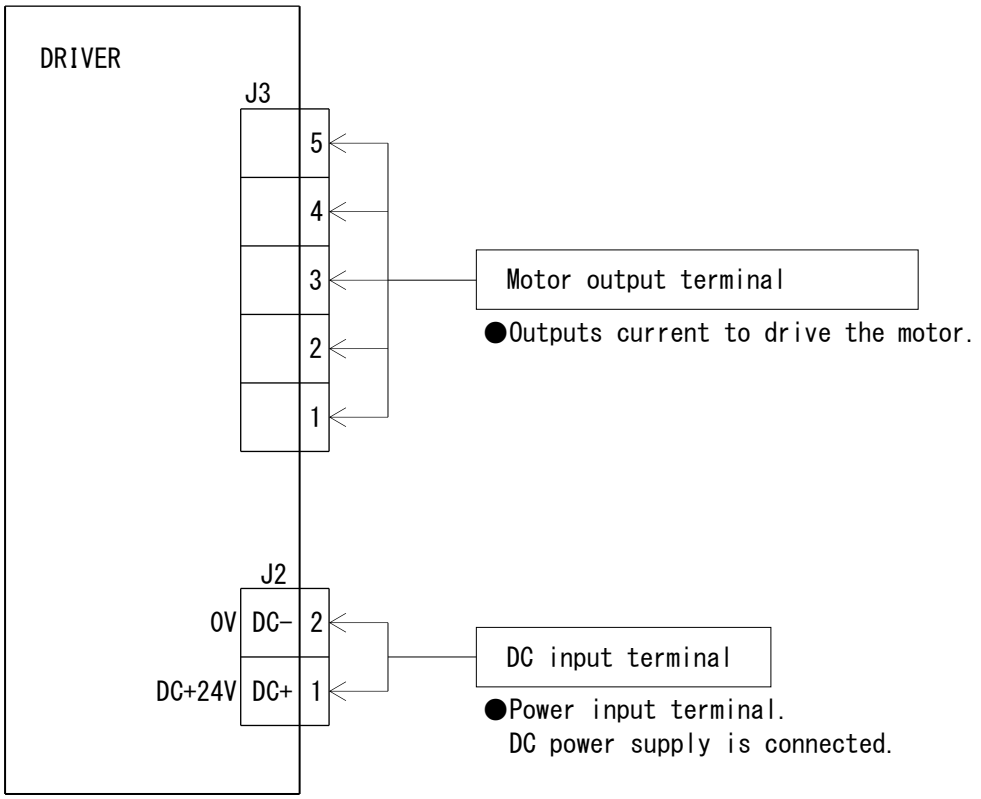


3. Name and Function of Each Section

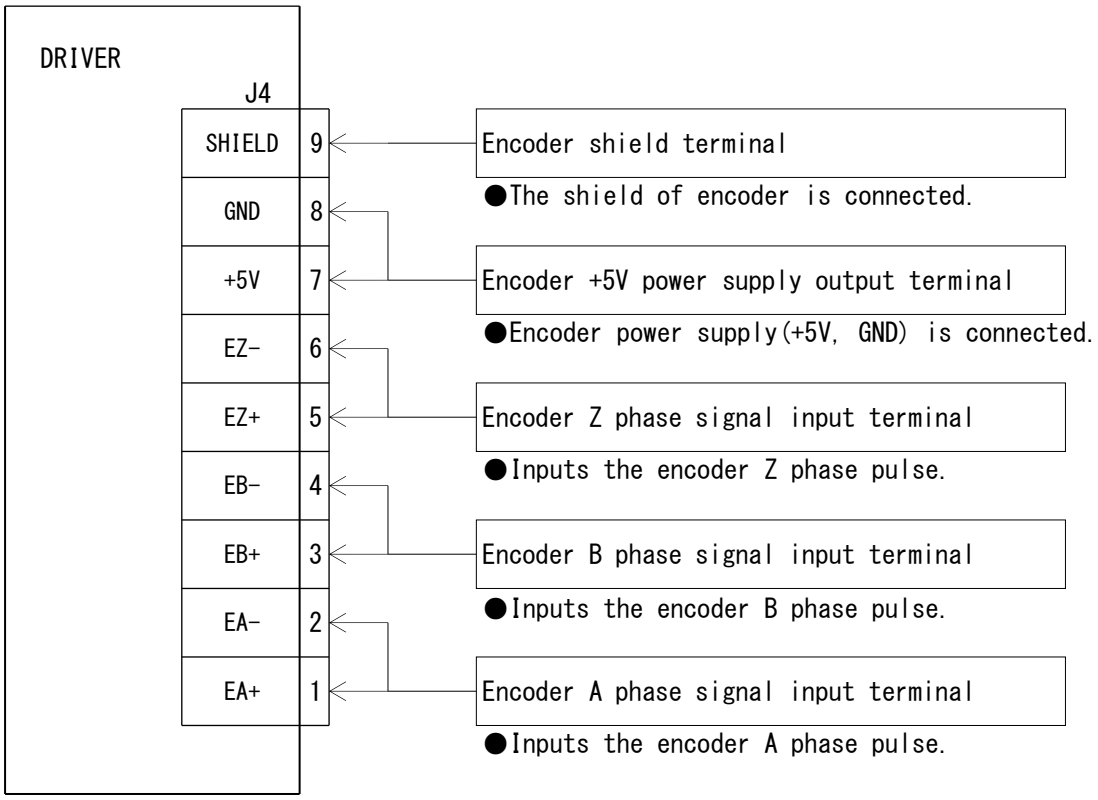
3－1. Signal I/O Connector (J1)



３－２. DC Input / Motor Output Connector（Ｊ２, Ｊ３）



３－３. Encoder I/O Connecter （Ｊ４）



３－４. POWER LED

(1) POWER LED(GREEN) comes on upon inputting power.

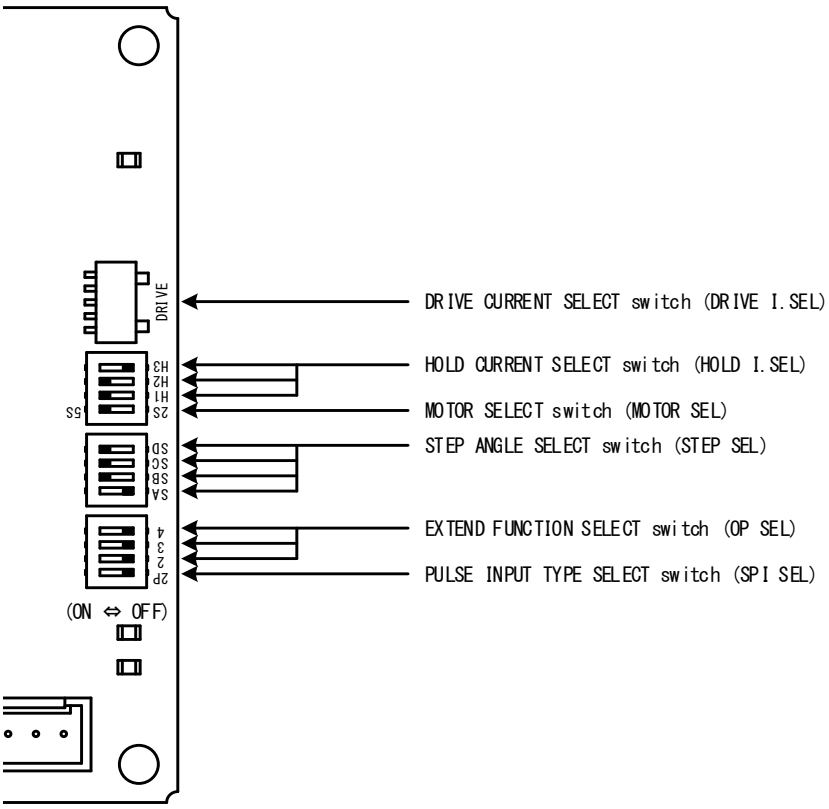
３－５. ENC LED

(1) ENC LED (GREEN) comes on upon outputting of +5V power for encoder.

３－６. ALM LED

(1) When an alarm occurs, ALM LED(RED) comes on or flashes.

3－7. Operating Section



Name of Operating Section	Function	Factory Setting
DRIVE CURRENT SELECT switch	Select DRIVE CURRENT.	〔No.3〕
4: HOLD CURRENT SELECT switch	Select HOLD CURRENT.	H3 : 〔OFF〕
3: HOLD CURRENT SELECT switch		H2 : 〔ON〕
2: HOLD CURRENT SELECT switch		H1 : 〔ON〕
1: MOTOR SELECT switch	Select 2-phase MOTOR or 5-phase MOTOR.	2S/5S : 〔ON〕
4: STEP ANGLE SELECT switch	Select STEP ANGLE.	SD : 〔ON〕
3: STEP ANGLE SELECT switch		SC : 〔ON〕
2: STEP ANGLE SELECT switch		SB : 〔ON〕
1: STEP ANGLE SELECT switch		SA : 〔OFF〕
4: EXTEND FUNCTION SELECT switch	Select EXTEND FUNCTION.	4 : 〔OFF〕
3: EXTEND FUNCTION SELECT switch		3 : 〔OFF〕
2: EXTEND FUNCTION SELECT switch		2 : 〔OFF〕
1: PULSE INPUT TYPE SELECT switch	Select pusle input type.	2P : 〔OFF〕

4. Setting

4－1. Setting MOTOR SELECT switch

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

The motor is set up with the MOTOR SEL switch.
MOTOR SEL can be selected 2-phase motor or 5-phase motor.
Set this switch with power OFF.

(1) Turn power [OFF].

(2) Set the MOTOR SEL switch.

MOTOR SEL	Motor	
ON	5-phase stepping motor of new pentagon connection (5S)	(Factory Setting)
OFF	2-phase stepping motor of bipolar winding (2S)	

4－2. Setting STEP ANGLE SELECT switch

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

The step angle is set up with the STEP SEL switch.
The step angle can be selected from sixteen different types of step angles.
Set this switch with power OFF.

(1) Turn power [OFF].

(2) Set the step angle required by STEP SEL switch.

●Relationship between the MOTOR SEL switch, the STEP SEL switch and the step angle.

MOTOR SEL [ON : 5-phase motor (5S)]					
STEP SEL				1/ Divisions	step angle(°)
SD	SC	SB	SA		0.72° motor
ON	ON	ON	ON	1/1	0.72
ON	ON	ON	OFF	1/2	0.36 (Factory Setting)
ON	ON	OFF	ON	1/4	0.18
ON	ON	OFF	OFF	1/10	0.072
ON	OFF	ON	ON	1/20	0.036
ON	OFF	ON	OFF	1/40	0.018
ON	OFF	OFF	ON	1/100	0.0072
ON	OFF	OFF	OFF	1/200	0.0036
OFF	ON	ON	ON	—	—
OFF	ON	ON	OFF	—	—
OFF	ON	OFF	ON	—	—
OFF	ON	OFF	OFF	—	—
OFF	OFF	ON	ON	—	—
OFF	OFF	ON	OFF	—	—
OFF	OFF	OFF	ON	—	—
OFF	OFF	OFF	OFF	—	—

MOTOR SEL [OFF : 2-phase motor (2S)]					
STEP SEL				1/ Divisions	step angle(°)
SD	SC	SB	SA		1.8° motor
ON	ON	ON	ON	1/2.5	0.72
ON	ON	ON	OFF	1/5	0.36
ON	ON	OFF	ON	1/10	0.18
ON	ON	OFF	OFF	1/25	0.072
ON	OFF	ON	ON	1/50	0.036
ON	OFF	ON	OFF	1/100	0.018
ON	OFF	OFF	ON	1/250	0.0072
ON	OFF	OFF	OFF	1/500	0.0036
OFF	ON	ON	ON	1/1	1.8
OFF	ON	ON	OFF	1/2	0.9
OFF	ON	OFF	ON	1/4	0.45
OFF	ON	OFF	OFF	1/8	0.225
OFF	OFF	ON	ON	1/16	0.1125
OFF	OFF	ON	OFF	1/32	0.05625
OFF	OFF	OFF	ON	1/64	0.028125
OFF	OFF	OFF	OFF	1/128	0.0140625

4－3. Setting HOLD CURRENT SELECT switch

> ⚠ CAUTION
>
> A high setting value may cause burn on the skin due to overheating of the motor.
> Do not select a high value beyond the required.

The HOLD CURRENT is set up with the HOLD I.SEL switch.
The ratio of HOLD CURRENT to DRIVE CURRENT can be selected.

(1) Set the HOLD I.SEL switch to the ratio of HOLD CURRENT to DRIVE CURRENT required.

●Ratio of HOLD CURRENT

$$\text{Ratio of HOLD CURRENT (\%)} = \frac{\text{HOLD CURRENT}}{\text{DRIVE CURRENT}} \times 100$$

HOLD I.SEL switch			Ratio of HOLD CURRENT (%)	
H3	H2	H1		
OFF	OFF	OFF	10	
OFF	OFF	ON	20	
OFF	ON	OFF	30	
OFF	ON	ON	40	(Factory Setting)
ON	OFF	OFF	50	
ON	OFF	ON	60	
ON	ON	OFF	70	
ON	ON	ON	100	

●HOLD CURRENT changes relative to DRIVE CURRENT setting.
The ratio of HOLD CURRENT [100%] represents the same as the setting for DRIVE CURRENT.

●The greater the ratio of HOLD CURRENT grows, the more heat the motor generates when is on holding-state.

4－4. Setting DRIVE CURRENT SELECT switch

> ⚠ CAUTION
>
> Erroneous setting may cause motor deterioration or damage and burn on the skin due to overheating of the motor. Ensure correct setting.

The DRIVE CURRENT is set up with the DRIVE I.SEL switch.

(1) Set the DRIVE I.SEL switch.

●Relationship between the DRIVE I.SEL switch No. and DRIVE CURRENT.

DRIVE I.SEL No.	A/phase	
0	0.75	
1	1.00	
2	1.20	
3	1.40	(Factory setting)
4	1.50	
5	1.80	
6	2.00	
7	2.30	
8	2.40	
9	2.80	
A	3.00	
B	3.40	
C	3.80	
D	4.00	
E	4.20	
F	4.50	

4－5. Setting PULSE INPUT TYPE SELECT switch

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

The pulse input method is set up with the SPI SEL switch.
Set this switch with power OFF.

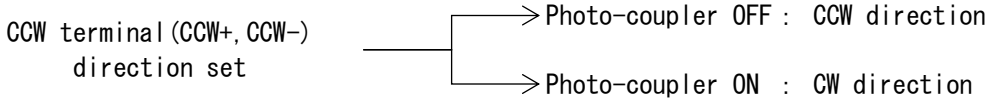
(1) Turn power [OFF].

(2) Set the SPI SEL switch.

SPI SEL	Input type
ON	1 PULSE (1P)
OFF	2 PULSE (2P)

(Factory setting)

- When the motor is operated with two pulse signal inputs of CW and CCW, set the SPI SEL switch to [OFF(2P)].
- When the motor is operated with the pulse signal and direction signal input, set the SPI SEL switch to [ON(1P)].
- In the case that 1-pulse input method is selected, the CCW terminal becomes direction signal input designating the direction of the motor rotation. Drive pulse set to the CW terminal(CW+,CW-).



- The input timing is same with 2-pulse input method and 1-pulse input method. As for input timing, refer to "10-2. (2)Drive pulse input (CW, CCW)"

4－6. Setting EXTEND FUNCTION SELECT switch

> ⚠ CAUTION
>
> Erroneous setting may cause breakage of the machine or injury due to unexpected rotation of the motor.
> Ensure correct setting.

Set this switch with power OFF.

(1) Turn power [OFF].

(2) Set the function required by the OP SEL switch.

OP SEL switch			Function	
4	3	2		
OFF	OFF	OFF	Motor excitation stop input(M.F), Phase signal output(P.O)	(Factory Setting)
OFF	OFF	ON	Motor excitation stop input(M.F), Phase signal output(P.O), Step-out detection function is disabled	
OFF	ON	OFF	－	
OFF	ON	ON	－	
ON	OFF	OFF	Sub adjustment (Not available)	
ON	OFF	ON	－	
ON	ON	OFF	－	
ON	ON	ON	－	

5. Installation

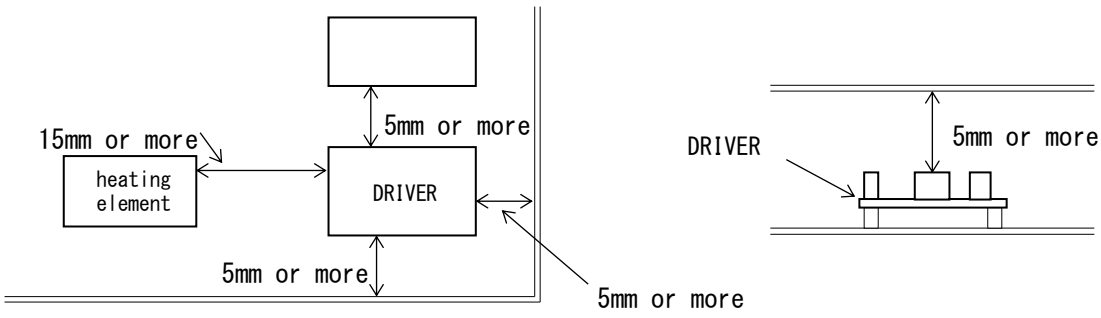
5－1. Conditions for Installation

> ⚠ WARNING
> Overheating may cause fire.
> Mount it on a noncombustible member.
> Keep it away from combustibles.

(1) Designed for incorporating into equipment used indoors, this product requires to be installed in the following environment:

- ●Indoors (where it is not exposed to direct sun).
- ●Where ambient temperature and humidity are controlled within the range set out in the specifications.
- ●Where there is no explosive, corrosive or inflammable gas.
- ●Where it can be protected from dust, salt or iron powder.
- ●Where the product is not exposed to direct vibration or shock.
- ●Where it is not exposed to splashes of water, oil or chemicals.

(2) Install the driver at least 5mm away from other equipment.
However, please be installed to a distance of at least 15mm from the heating element.



- ●Please contact us if you are not installed to a distance of at least 15mm from the heating element.

(3) Take measures against accumulation of heat such as allowing generous space around the driver or installing a fan so that heat release is taken care of.

(4) In the case that the alarm(ALM) LED comes on, perform compulsion air cooling and use the driver on the condition that the alarm(ALM) LED goes out.

(5) Do not allow standing or placing anything heavy on the product.

５－２. Mounting Method

The holes for the fixing section on the product are used.

The following items are required:

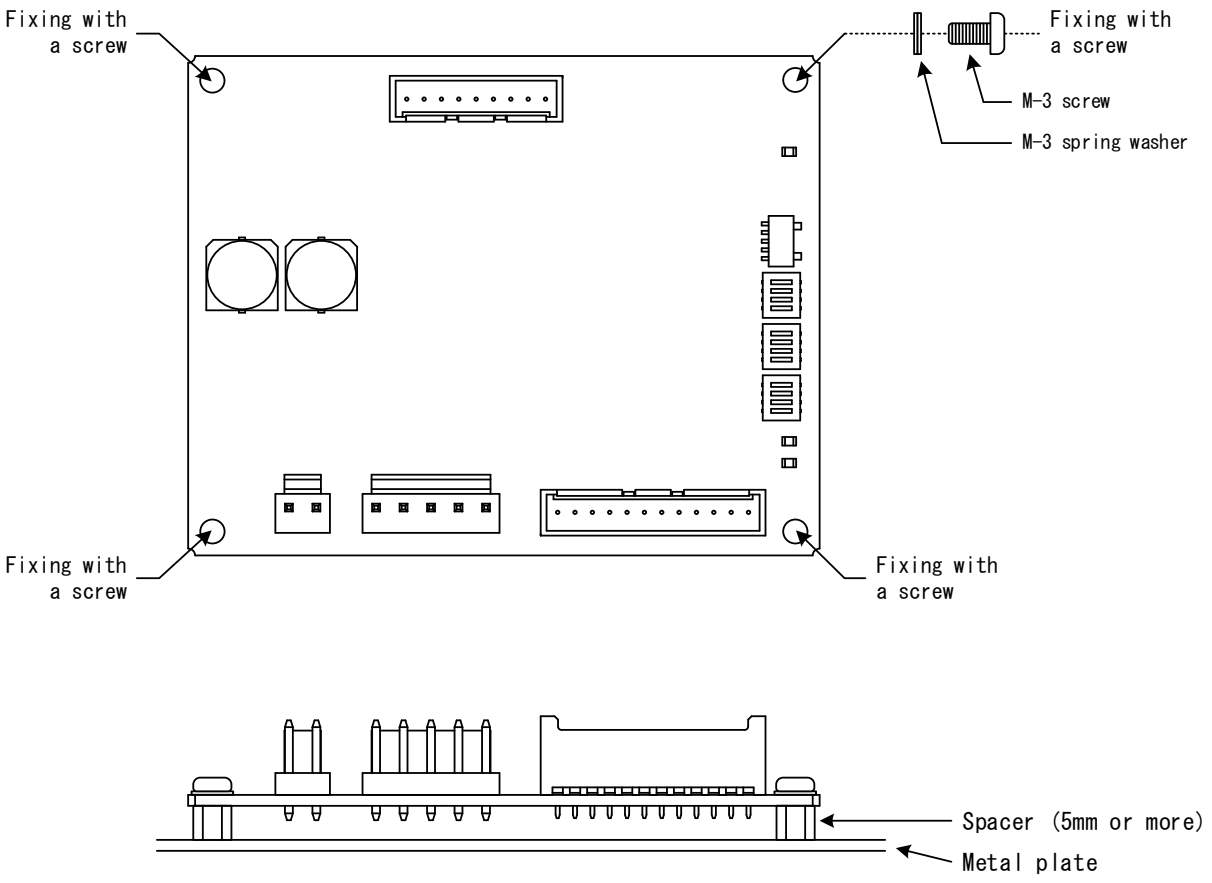
- M-3 screw: ---------- 4 *1
- M-3 spring washer: ---------- 4 *1
- Spacer ---------- 4 *1 *2

*1 Use the screw, the spring washer and the spacer are ϕ6.5mm or less.
*2 Use the spacer 5mm or more in length.

(1) Fix the product at the each holes of the Mounting section on the product.

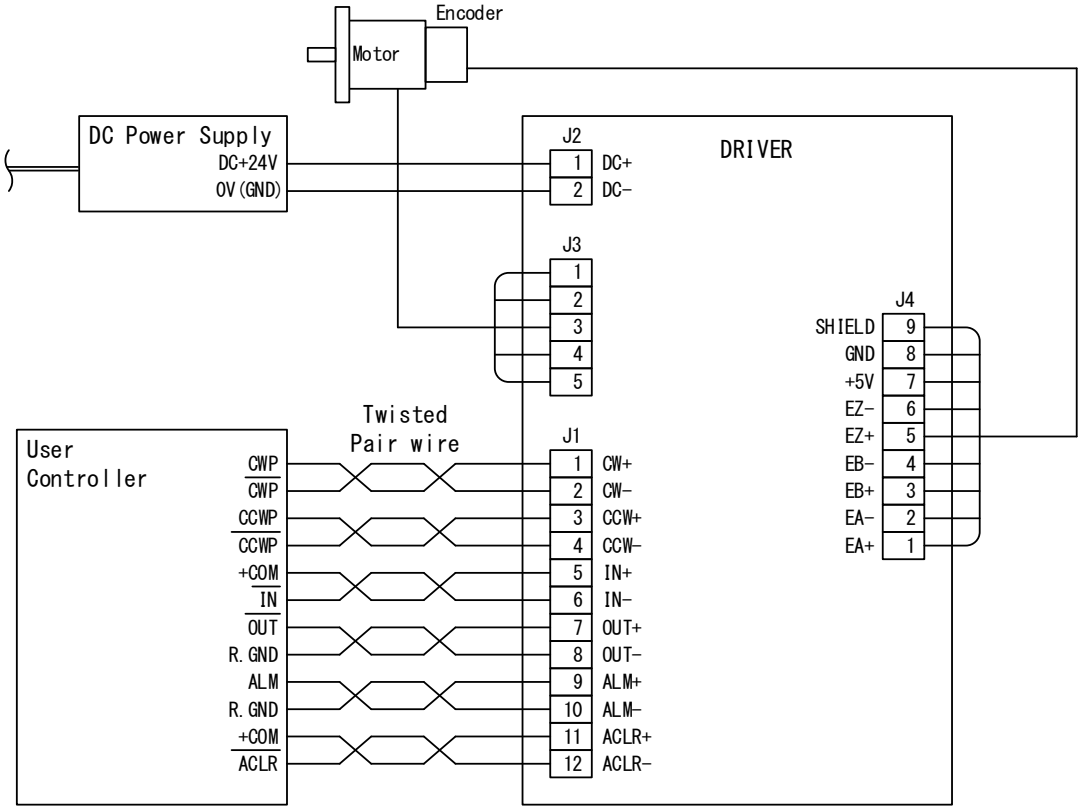
●The screw tightening torque value of 0.5N･m is recommended.

●Mounting example



6. Connection

6－1. Overview of Connection Configuration



●Connect only one motor to one DRIVER.

●Use twisted pair wire for the CW/CCW input signal line.

●Provide shielding for the signal line where considerable noise is generated.

●Use the wire material of the characteristic that is difficult to burn.

●For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.

●Connect the motor with power off.

6－2. Connecting Signal I/O Connector (J1)

The following items are required:

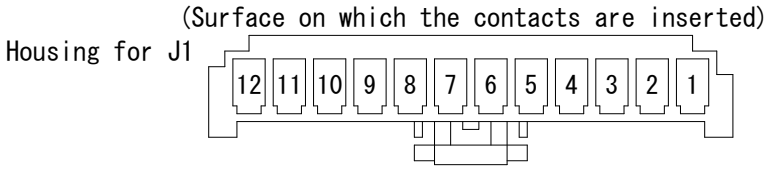
●Housing for J1 (51103-1200 or 51163-1200:Molex)	One unit
●Contact for J1 (50351-8100:Molex)	12 contacts
●Manually operated crimping tool for AWG28-22(57295-5000:Molex)	One unit

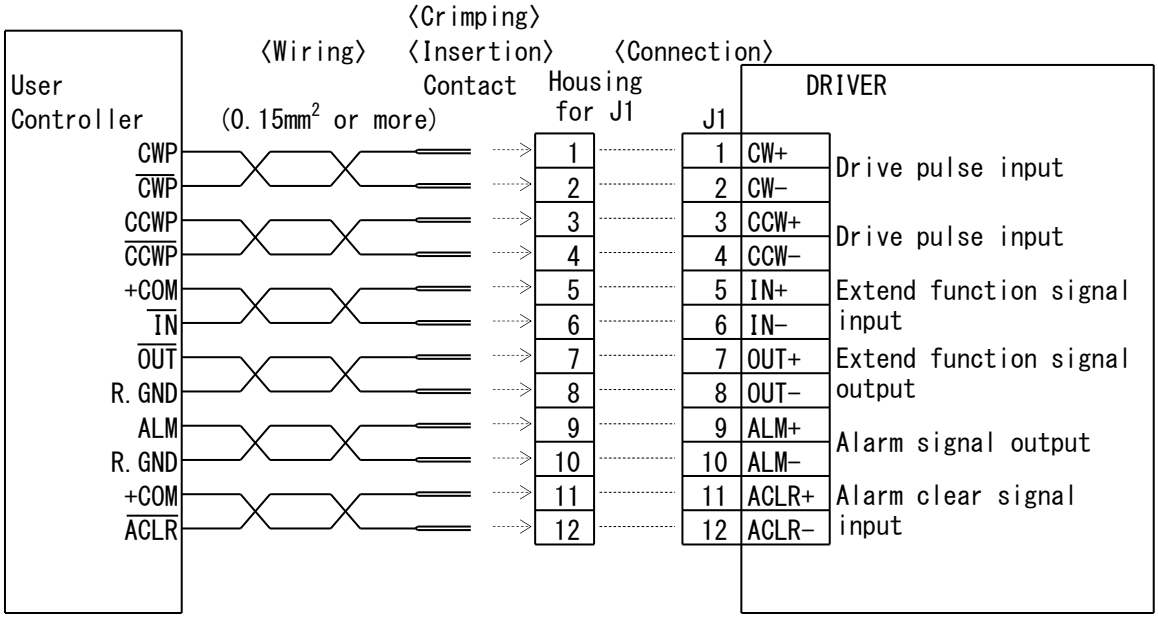
(1) Crimp the contact to the cable used for wiring.

(2) Insert the contact into the housing.
Make sure that the housing No. and the connector No. on the product are matched before inserting the contacts.

(3) Connect the housings to the connectors on the product.

●The contacts for J1 are 12 pieces.
●When inserting, keep pushing J1 housing into the connectors until it is locked. Also, check if the contacts are not displaced from the housing.
●In wiring, isolate the J1 signal lines from equipment that may be a source of noise, the power line and the motor line.





６－３. Connecting DC Input/Motor Output Connector（Ｊ２, Ｊ３）

> ⚠ CAUTION
>
> Erroneous connection may cause breakage of the motor or the driver. Correctly connect the DC Input/Motor output connector.

The following items are required:

●Housing for J2 (VHR-2N: J.S.T)	One unit
●Housing for J3 (VHR-5N: J.S.T)	One unit
●Contact for J2,J3 (BVH-21T-P1.1: J.S.T)	7 contacts
●Manually operated crimping tool for AWG22-18(YC-160R: J.S.T)	One unit

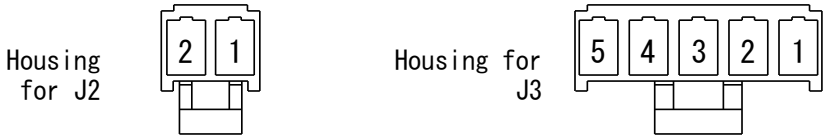
(1) Crimp the contact to the cable used for wiring.

(2) Insert the contact into the housing.
Make sure that the housing No. and the connector No. on the product are matched before inserting the contacts.

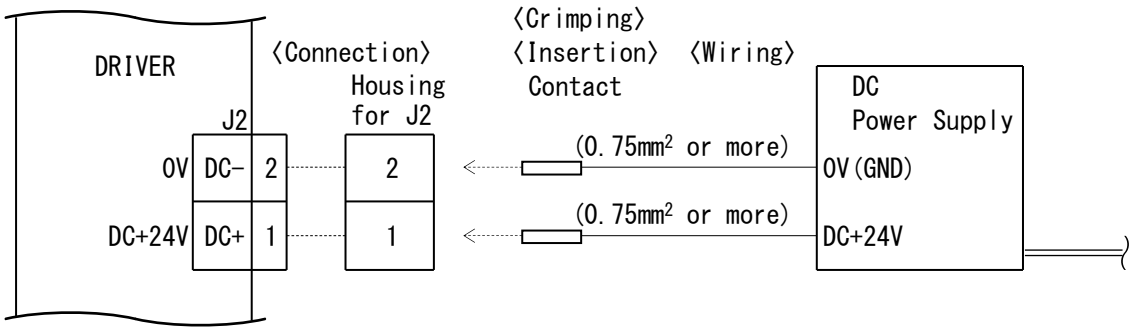
(3) Connect the housings to the connectors on the product.

- ●The contacts for J2(for DC input) are 2 pieces, and for J3(motor output) are 5 pieces.
- ●When inserting, keep pushing J2,J3 housings into the connectors until it is locked. Also, check if the contacts are not displaced from the housing.

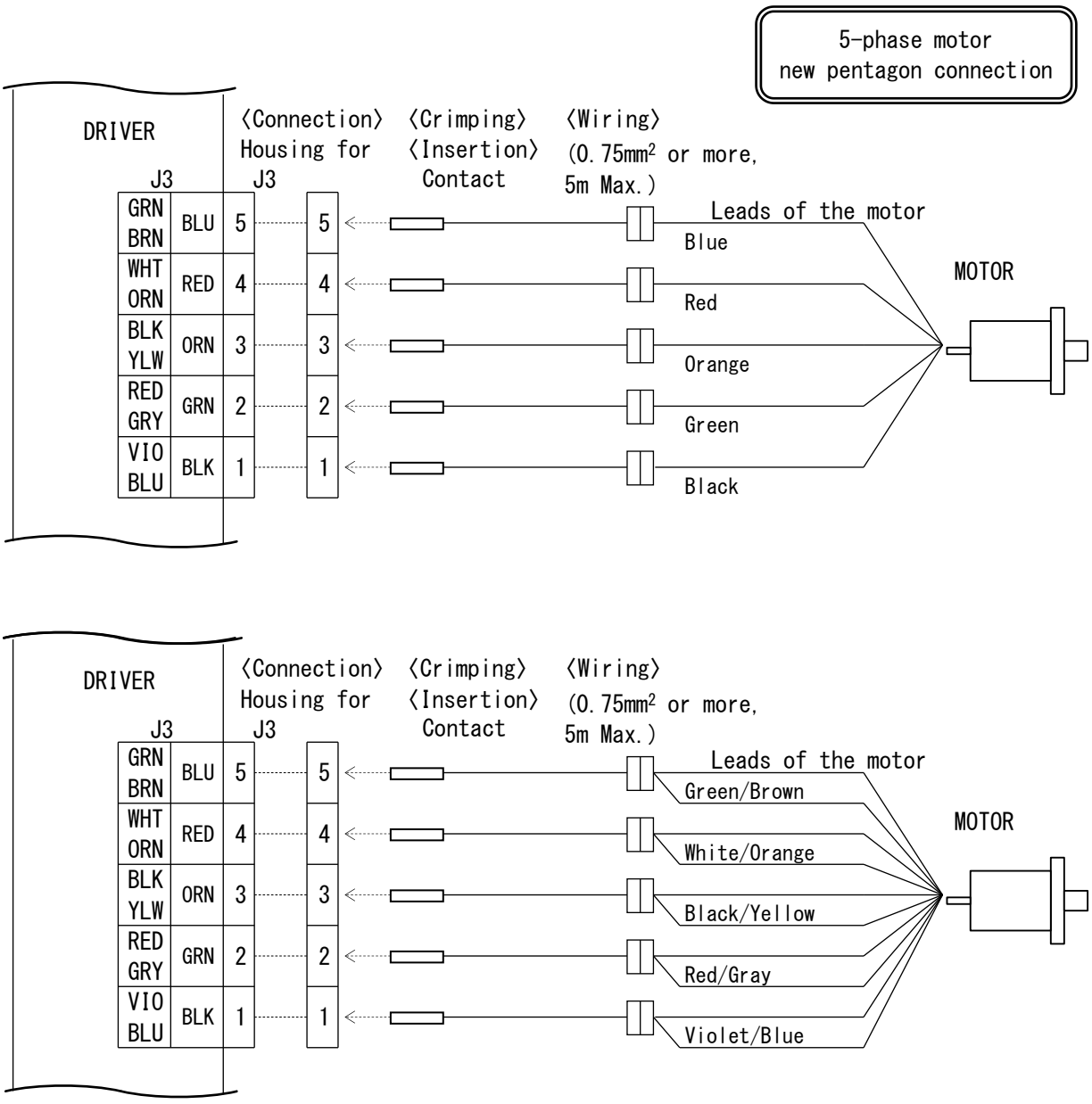
(Surface on which the contacts are inserted)



〔DC input Connector〕



〔Motor output Connector〕

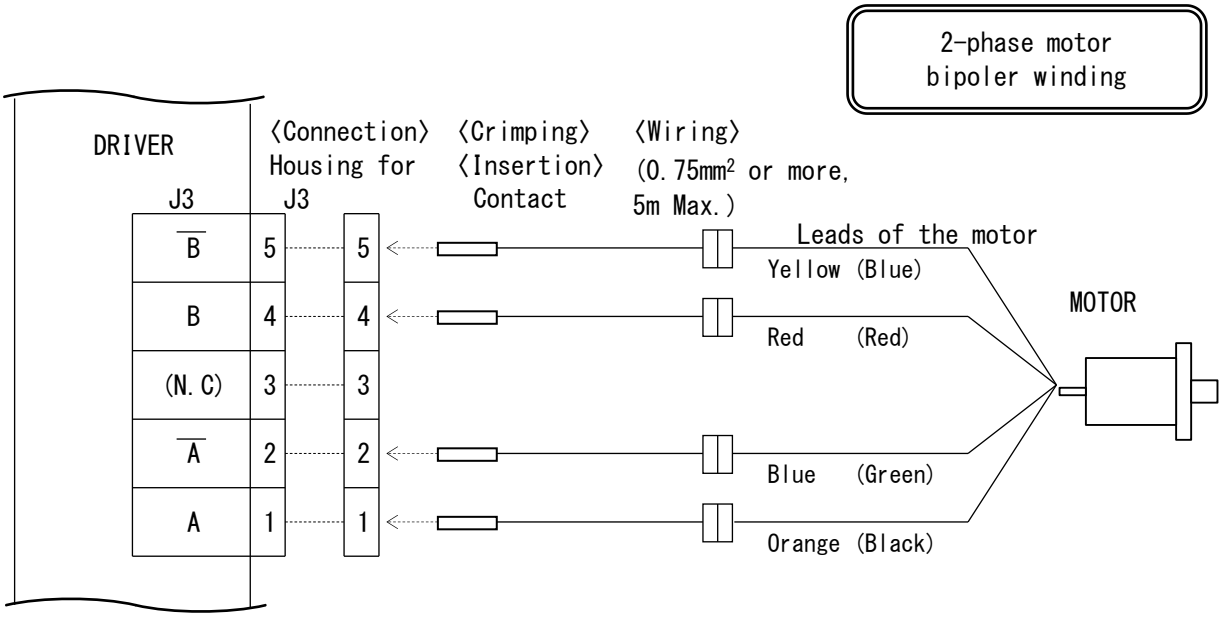


●The color indications for the motor crimping J3 represent color of the leads of the motor.

●Use a cable of 5m or less for the motor cable.

●Connect the motor with power off.

〔Motor output Connector〕



●The color indications for leads of the motor indicate the motor of the SANYO DENKI CO., LTD..
The color indications for leads of the motor in parentheses( ) indicate the motor of the ORIENTAL MOTOR Co., Ltd..

●Use a cable of 5m or less for the motor cable.

●Do not wiring anything to the pin number 3 of the connector.

●Connect the motor with power off.

6－4. Connecting Encoder I/O Connector (J4)

The following items are required:

●Housing for J4 (51103-0900 or 51163-0900:Molex)	One unit
●Contact for J4 (50351-8100:Molex)	9 contacts
●Manually operated crimping tool for AWG28-22(57295-5000:Molex)	One unit

(1) Crimp the contact to the cable used for wiring.

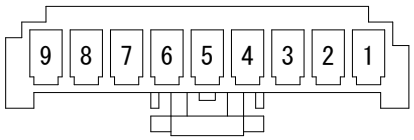
(2) Insert the contact into the housing.
Make sure that the housing No. and the connector No. on the product are matched before inserting the contacts.

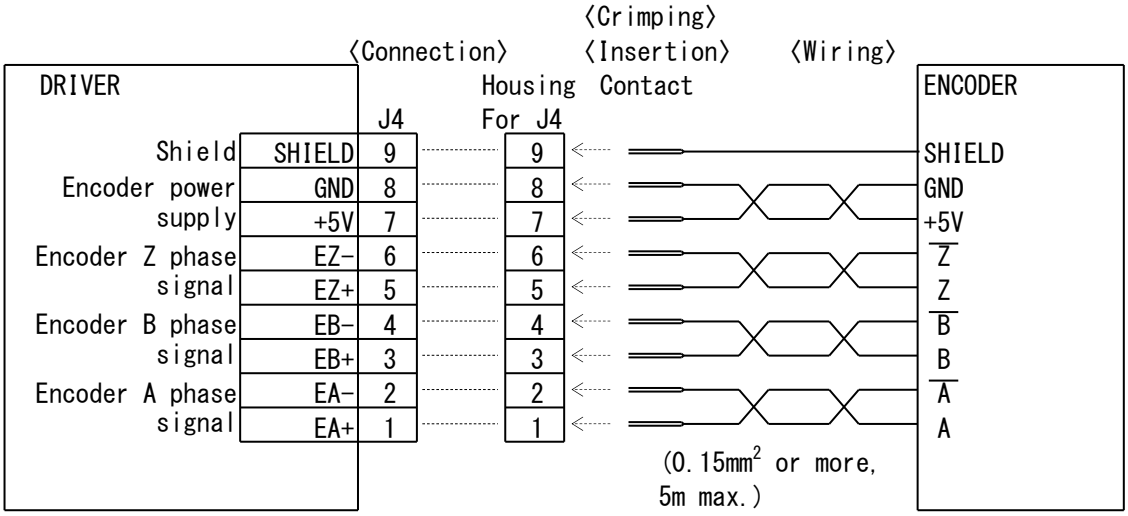
(3) Connect the housings to the connectors on the product.

●The contacts for J4 are 9 pieces.
●When inserting, keep pushing J4 housing into the connectors until it is locked. Also, check if the contacts are not displaced from the housing.
●In wiring, isolate the J4 signal lines from equipment that may be a source of noise, the power line and the motor line.

(Surface on which the contacts are inserted)

Housing for J4



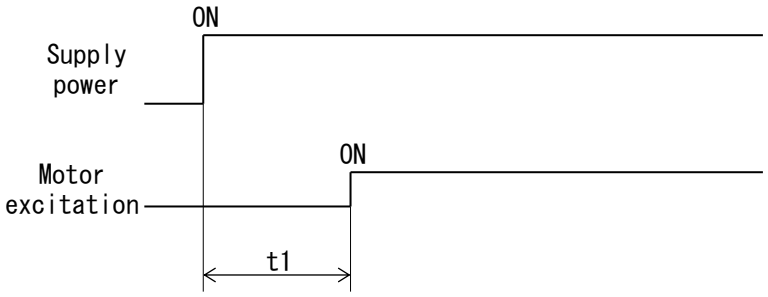


６－５. Inputting Power

> ⚠ CAUTION
>
> Breakage of the machine or injury is apprehended due to unexpected behavior of the motor. Maintain the state where emergency stop is enabled at any time.

(1) Input the DC power supply (DC+24V) in the cable that connected to No.1 and No.2 terminals of J2.

① Timing chart



t1≦1s (t1：Time required for the motor to be enabled.)

●Connect the motor with power off.

7. Confirmation of Setting and Connection

7－1. Check Points

This product requires different switch setting and motor wiring depending on the motor used.
Check if the switch setting and the motor wiring are correctly performed.

Check Points		Check	Remarks
Setting of DRIVE CURRENT SELECT switch	DRIVE I.SEL		
Setting of HOLD CURRENT SELECT switch	HOLD I.SEL		
Setting of MOTOR SELECT switch	MOTOR SEL		
Setting of STEP ANGLE SELECT switch	STEP SEL		
Setting of PULSE INPUT TYPE SELECT switch	SPI SEL		
Setting of EXTEND FUNCTION SELECT switch	OP SEL		
Connection of J1	Signal		
Connection of J2	DC+, DC-		
Connection of J3	MOTOR		
Connection of J4	ENCODER		

8. Maintenance and Check-up

8－1. Maintenance and Check-up

> ⚠ WARNING
>
> Injury or fire is apprehended due to unexpected behavior.
> Do not replace fuse.
> Do not disassemble, repair or modify.

(1) As for maintenance inspections the engineer of the specialty shall do it.

(2) We recommend that the following check-ups should be performed periodically:

- ●Checking for any loosened contact on the connectors.
- ●Checking for any flaw and crack on the cabling.

(3) In case of failure, return the driver to us and have it repaired.

8－2. Troubleshooting

Trouble	Check Item	Assumed Cause
1. POWER LED does not come on.	・Connection of power supply. ・Value of power voltage.	・Wiring error with power supply. ・Power voltage failure. ・Driver failure.
2. The motor is not excited. (It can be easily rotated by hand.)	・Setting of the MOTOR SELECT switch. ・Connection of the motor to the driver. ・ON/OFF status of the M.F signal.	・Wrong setting for the motor selection. ・Wiring error or disconnection with the motor and the driver. ・The motor connected to the driver with power on. ・The M.F signal is input. ・Driver failure.

Trouble	Check Item	Assumed Cause
3. The motor does not rotate. The motor behaves abnormally. The motor steps out.	・The same check items as those under item 2 above. ・Setting of the PULSE INPUT TYPE SELECT switch. ・Connection of the pulse signal. ・Voltage and wave form of the pulse signal. ・Setting of the DRIVE CURRENT SELECT switch. ・Setting of the STEP ANGLE SELECT switch. ・Connection of the encoder signal.	・Wrong setting for the pulse input type. ・Wiring error with the pulse signal line. ・Pulse signal of wrong specifications. ・Wrong setting for DRIVE CURRENT selection. ・Wrong setting for the step angle. ・Wiring error with the encoder signal line. ・Driver failure. ・Motor failure.
4. The motor steps out during acceleration.	・Starting pulse speed. ・Acceleration time.	・Starting pulse signal speed is too high. ・Acceleration time is too short.
5. The motor generates excessive heat.	・Setting of the DRIVE CURRENT SELECT switch. ・Setting of the HOLD CURRENT SELECT switch.	・DRIVE CURRENT is higher than the setting for the applicable motor. ・The setting for HOLD CURRENT is too high.
6. The alarm(ALM) LED flashes twice.	・Connection of the encoder signal.	・Wiring error with the encoder signal line. ・Driver failure. ・Encoder failure.

(1) Short-circuiting of the motor output connector may cause the driver to fail.

●The motor output connector and the power line.
●The motor output connector and the motor output connector.

(2) When a large inertial load (motor rotor inertia x 5 or more)is operated at high speed (rotational speed 20s^{-1} or more), regenerative energy will generate and increase the power supply voltage, which can damage the driver. Review the operating condition and make sure regenerative voltage will not generate.

When the failure phenomenon cannot be remedied, contact our office.

９．Storing and Disposal

９－１．Storing

(1) Keep the product in the following environment:

- ●Indoors (where it is not exposed to direct sun).
- ●Where ambient temperature and humidity are controlled within the range set out in the specifications.
- ●Where there is no explosive, corrosive or inflammable gas.
- ●Where it can be protected from dust, salt or iron powder.
- ●Where the product is not exposed to direct vibration or shock.
- ●Where it is not exposed to splashes of water, oil or chemicals.

(2) Do not allow standing or placing anything heavy on the product.

９－２．Disposal

(1) Dispose of the product as industrial waste.

１０. Specifications

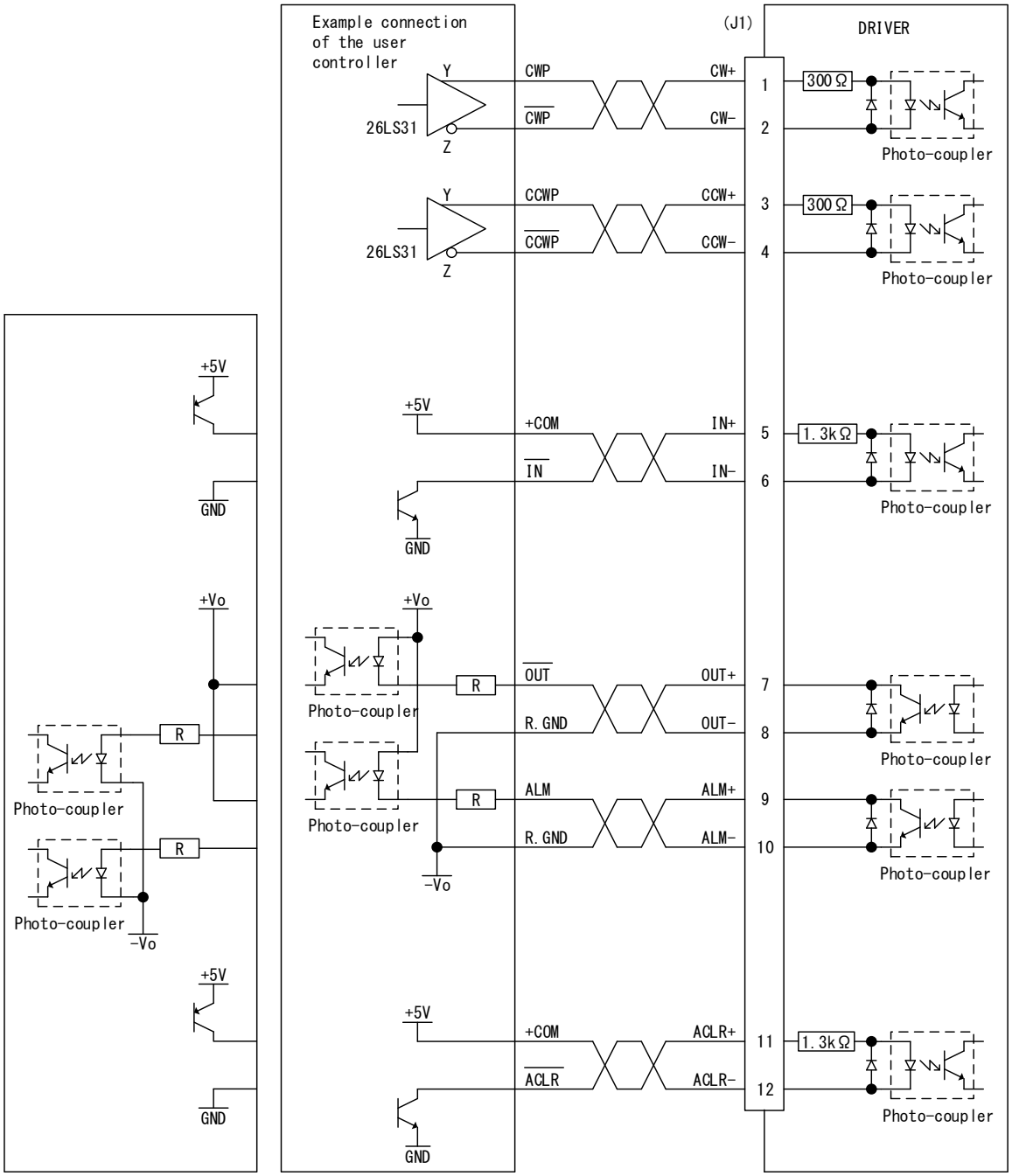
１０－１. General Specifications

Supply Power	DC+24V *1 (Ripple voltage P-P 2.0V or less) ●Rated input current : 〔DRIVE I.SEL ⇒ No.F set up〕 at DRIVE DC+24V: 4.9A *2 ●Rated input current : 〔HOLD I.SEL ⇒ Approx. 40% set up〕 at HOLD DC+24V: 0.9A	
Driving method	Bipolar constant current type	
Motor output current	●DRIVE CURRENT 0.75A/phase～4.50A/phase ●HOLD CURRENT Approx. 40% of DRIVE CURRENT (factory-set)	
Encoder +5V output	+5V: MAX200mA *3	
Input Signal	●Drive pulse input (CW,CCW) ..... Photo-coupler input ●Extend function signal input (IN) ..... Photo-coupler input ●Alarm clear signal input (ACLR) ..... Photo-coupler input ●Encoder signal input (EA,EB,EZ) ..... Photo-coupler input	
Output signal	●Extend function signal output (OUT) ..... O/C output ●Alarm signal output (ALM) ..... O/C output	
Functions of Operating Sections	●MOTOR selection (MOTOR SEL) ●STEP ANGLE selection (STEP SEL) ●HOLD CURRENT selection (HOLD I.SEL) ●DRIVE CURRENT selection (DRIVE I.SEL) ●PULSE INPUT TYPE selection (SPI SEL) ●EXTEND FUNCTION selection (OP SEL)	
Alarm	●Overheat alarm, Step-out detection, Encoder +5V output overcurrent detection (ALM LED)	
Operating Ambient Temperature	0℃ ～ +50℃ (No freezing allowed.)	
Operating Ambient Humidity	80%RH or less (No condensation allowed.)	
Storing Temperature	-10℃ ～ +60℃ (No freezing allowed.)	
Storing Humidity	80%RH or less (No condensation allowed.)	
Altitude	Up to 1000m above sea level	
Atmosphere	Indoor (Exposure to direct sun is not allowed.) Without any explosive, corrosive or inflammable gas, oil mist, or dust.	
Withstanding Vibration	No abnormality should be found after a vibration test at 10～55Hz, 0.15mm P-P	
Insulation resistance (nomal temperature and humidity)	DC connector - signal connector	DC500V 100MΩ or more
Exterior Dimensions	$^{W}91 \times {}^{H}73 \times {}^{D}16$ (mm)	
Weight	0.05 kg	

*1 Input voltage range is DC+24V±10%.
*2 Use a power supply that provides sufficient input current.
*3 Output voltage range is +5V±5%.

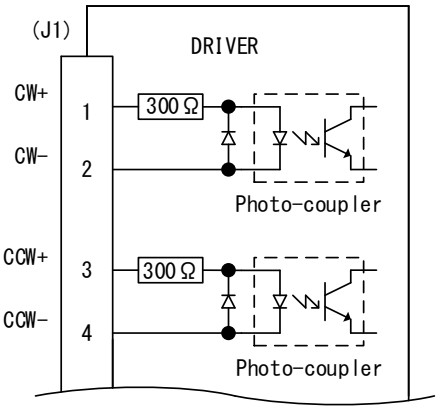
１０－２. I/O Signal

(1) Example Circuit Connection (J1)

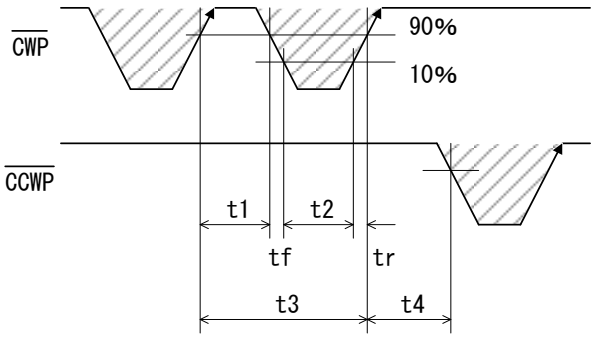


(2) Drive pulse input (CW,CCW)

① Operating current range : 5mA～14mA
The photo-coupler turns on with inter-terminal voltage of 3.1V～5.5V.
(Photo-coupler diode $V_F \fallingdotseq$ 1.5V)

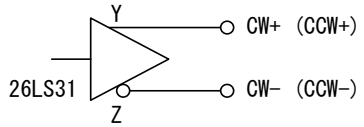


② Timing chart



t1≧0.5μs, t2≧0.5μs, tf,tr≦1μs
t3≧1μs, t4>1μs

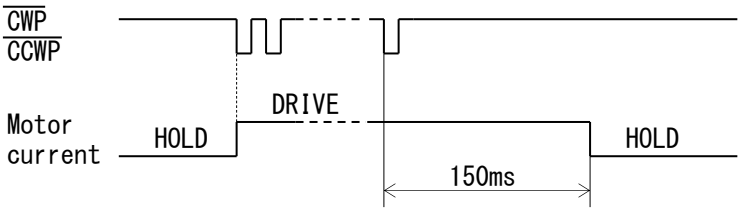
[To the line driver 26LS31]



Maximum response frequency : 1MHz
(at 50% duty)

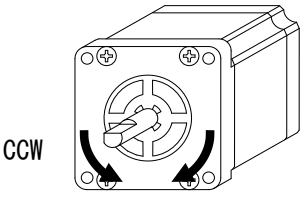
● The shaded area (▨) indicates light emission from the photo-coupler, and the motor is driven at the rising edge (↗).
"t4" greatly varies according to the inertial moment including that of the motor.

③ Automatic switching for DRIVE/HOLD



● Inputting drive pulse causes the current output to the motor to change from HOLD CURRENT to DRIVE CURRENT, which returns to HOLD CURRENT in about 150ms. DRIVE CURRENT continues if pulse is input on driving-state.

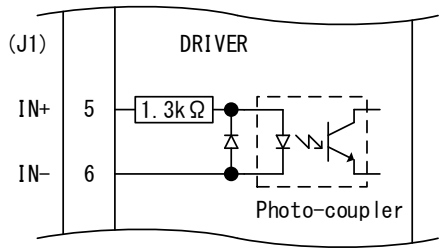
④ Direction of rotation



CW(Clockwise)

(3) Extend function signal input (IN)

① Operating current range : 2.6mA～19.5mA
The photo-coupler turns on with inter-terminal voltage of 4.5V～26.4V.
(Photo-coupler diode $V_F \fallingdotseq$ 1.1V)



⚠ CAUTION

Deterioration of the holding power with the motor may cause breakage of the machine or injury.
Check safety before inputting.

② Motor excitation stop input (M.F)

● In the case that OP SEL set as below,
The extend function signal input can use as the motor excitation stop input.

Set this switch with power OFF.

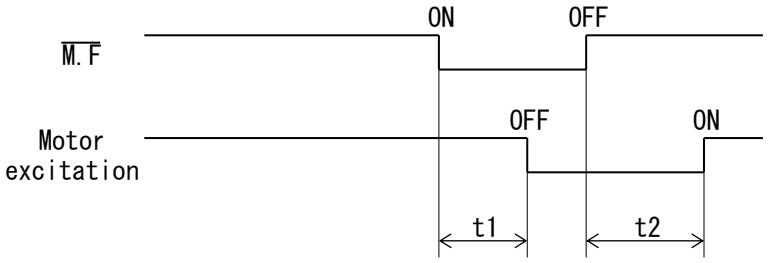
OP SEL switch			Function	
4	3	2		
OFF	OFF	OFF	Motor excitation stop input(M.F), Phase signal output(P.O)	(Factory Setting)
OFF	OFF	ON	Motor excitation stop input(M.F), Phase signal output(P.O), Step-out detection function is disabled	

● Motor output current is shut off with the photo-coupler ON.
At this time, motor torque changes to detent torque.

● Step-out is not detected when the photo-coupler is ON.

● When this signal is input, motor torque may be lost, resulting in failure to retain the load transported.
In particular, this risk is high with the vertical drive (such as the Z-axis).

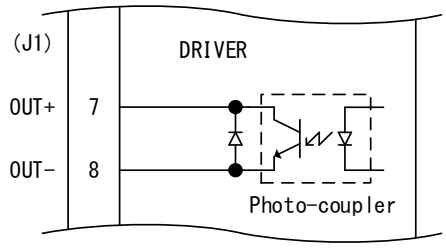
③ Timing chart



t1≦5ms (t1 : Time required for the motor output current to be shut off.)
t2≦100ms (t2 : Time required for the motor to be enabled.)

(4) Extend function signal output (OUT)

① Output current a. $I_C \leqq 6mA$, $V_{CE} < 2V$
b. $I_C \leqq 2mA$, $V_{CE(sat)} < 0.6V$
$V_{CEO} \leqq 30V$



② Phase signal output (P.O)

● In the case that OP SEL set as below,
The extend function signal output can use as the phase signal output.

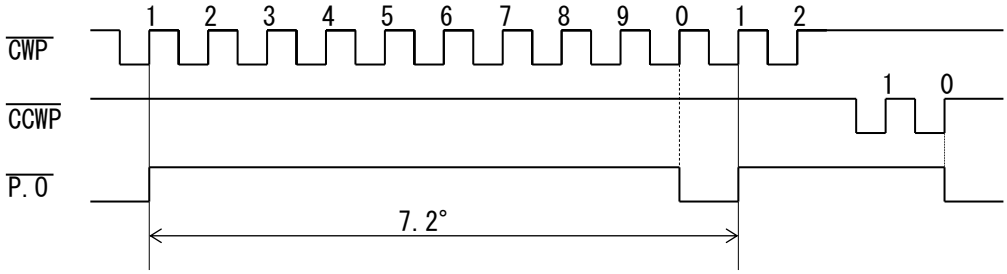
Set this switch with power OFF.

OP SEL switch			Function	
4	3	2		
OFF	OFF	OFF	Motor excitation stop input(M.F), Phase signal output(P.O)	(Factory Setting)
OFF	OFF	ON	Motor excitation stop input(M.F), Phase signal output(P.O), Step-out detection function is disabled	

● In case of the excitation home position, the signal is output (photo-coupler ON).

③ Timing chart

● P.O output timing (for 5S MOTOR, 1/1 STEP)



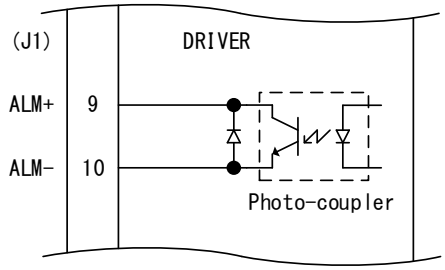
(For a motor with the basic angle of 0.72°)

● P.O output time

5S	2S			2S		
1/1	1/2.5	→	STEP: once in 10 pulses	1/1	→	STEP: once in 4 pulses
1/2	1/5	→	STEP: once in 20 pulses	1/2	→	STEP: once in 8 pulses
1/4	1/10	→	STEP: once in 40 pulses	1/4	→	STEP: once in 16 pulses
1/10	1/25	→	STEP: once in 100 pulses	1/8	→	STEP: once in 32 pulses
1/20	1/50	→	STEP: once in 200 pulses	1/16	→	STEP: once in 64 pulses
1/40	1/100	→	STEP: once in 400 pulses	1/32	→	STEP: once in 128 pulses
1/100	1/250	→	STEP: once in 1000 pulses	1/64	→	STEP: once in 256 pulses
1/200	1/500	→	STEP: once in 2000 pulses	1/128	→	STEP: once in 512 pulses

(5) Alarm signal output (ALM)

① Output current a. Ic≦6mA, V_{CE}＜2V
b. Ic≦2mA, $V_{CE(sat)}$＜0.6V
V_{CEO}≦30V

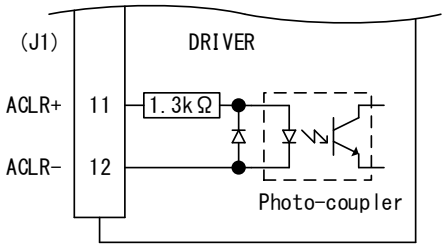


● When step-out is detected, photo-coupler output of the alarm signal is OFF and the ALM LED flashes once.

● During the alarm signal output is, it makes the motor in HOLD state. Drive pulse will not be accepted.

(6) Alarm clear signal input (ACLR)

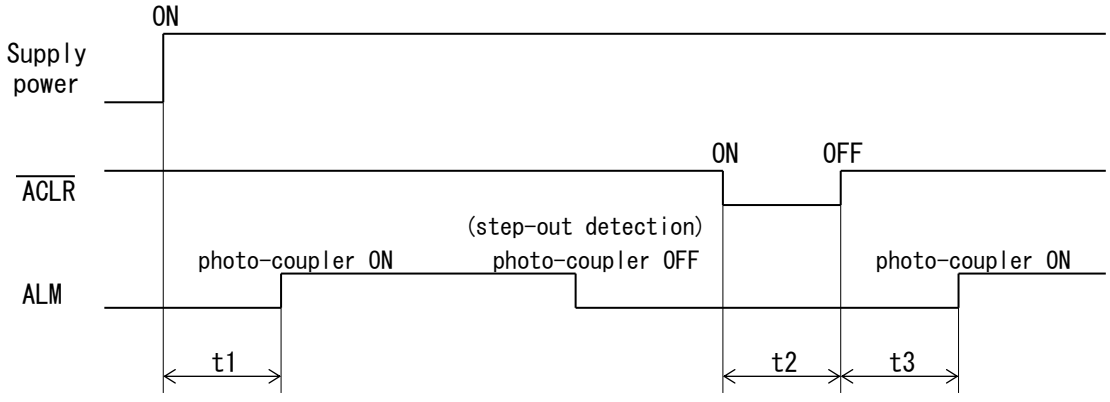
① Operating current range : 2.6mA～19.5mA
The photo-coupler turns on with inter-terminal voltage of 4.5 V～26.4 V.
(Photo-coupler diode V_F≒ 1.1 V)



● When the alarm clear signal is input, the internal process for the step-out detection is returned to the initial state.
At this time the motor output current is not blocked.

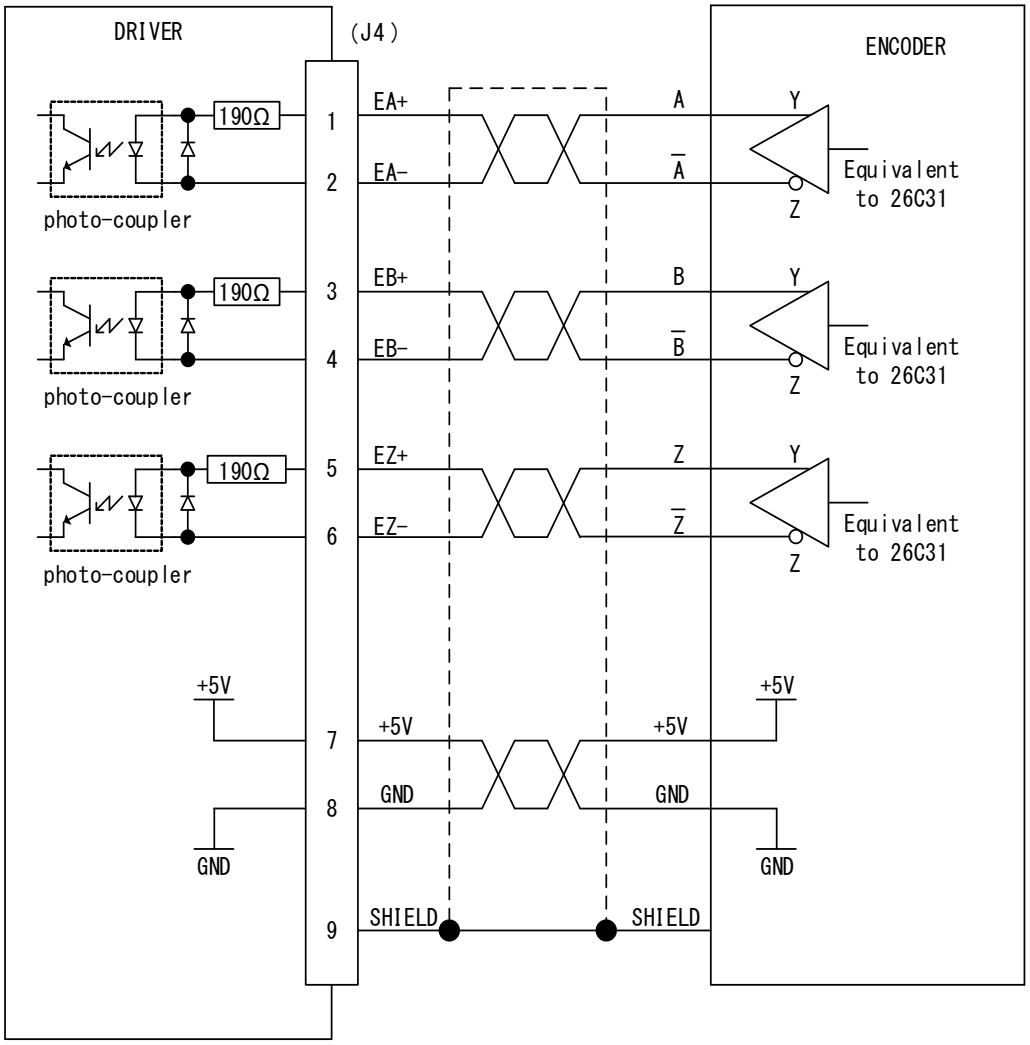
● When you release the input of the alarm clear signal, the alarm signal output is released(photo-coupler ON), and the ALM LED turns off.

② Timing chart



t1≦200ms
t2≧5ms
t3≦100ms

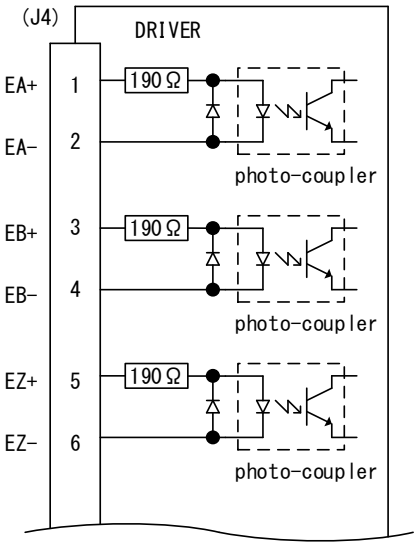
(7) Example Circuit Connection (J4)



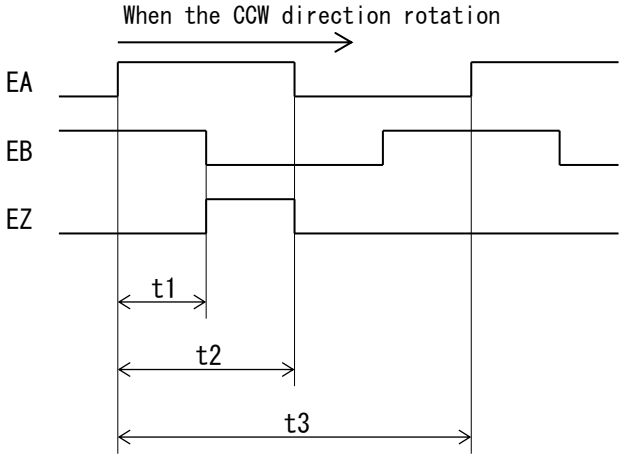
● +5V and GND are not insulated from the internal power supply of the DRIVER.

(8) Encoder input (EA, EB, EZ)

① Operating current range : 9mA～27mA
The photo-coupler turns on with inter-terminal voltage of 3.1V～5.5V.
(Photo-coupler diode V_F≒ 1.55V)
The photo-Coupler turns off with inter-terminal voltage ≦ 1V.

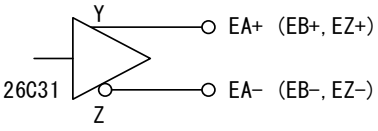


② Timing chart



t1≧1.25μs, t2≧2.5μs, t3≧5μs
Maximum response frequency : 200kHz

[To the line driver 26C31]

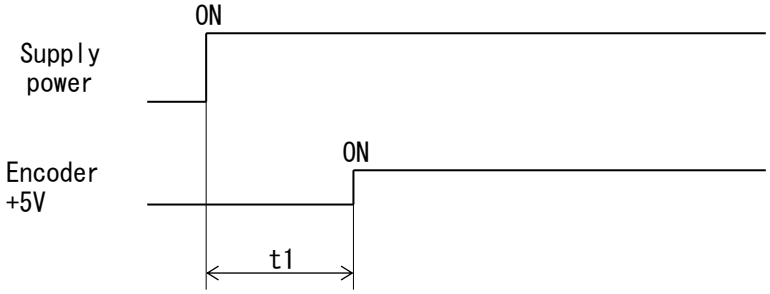


● The encoder Z phase signal input is not used for internal process of step-out detection.

(9) Encoder +5V output

① Output voltage and output current +5V±5%, MAX200mA

② Timing chart



t1≦100ms

１０－３. Alarm (ALM) LED

⚠ WARNING

Overheating may cause fire.
Stop operation when this LED comes on.

⚠ CAUTION

Breakage of the machine or injury is apprehended due to unexpected behavior of the motor.
Stop operation when this LED flashes.

(1) Overheat alarm

- In case of internal temperature of the driver reaches approx. 70℃ or more, ALM LED comes on. At this time the motor output current is not blocked.
- When this LED comes on, stop operation and check if there is any abnormality occurring with the motor and the driver.
- Provide mechanical cooling, for example, if this LED comes on while no abnormality is detected.
- Continuous operation is possible unless this LED comes on.

(2) Step-out detection

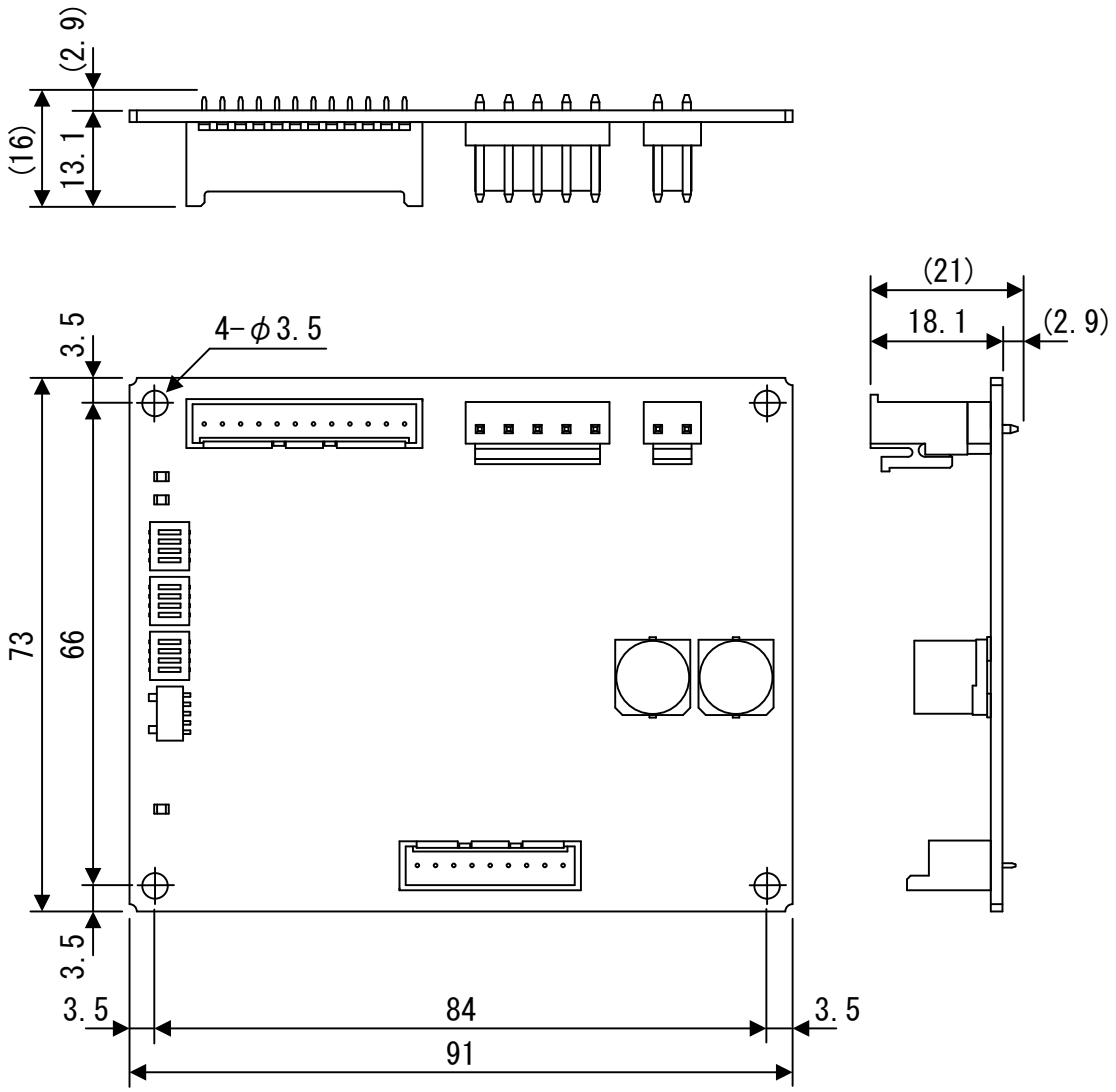
- When step-out is detected, the ALM LED flashes once.

(3) Encoder +5V output overcurrent detection

- When overcurrent of the encoder +5V output is detected, the ALM LED flashes twice. Drive pulse will not be accepted.
  When this LED flashes, stop operation and check if there is any abnormality occurring with the encoder and the driver.
- Please refer to "8-2. Troubleshooting" for the cause.

１０－４. Dimensions

(Unit：mm)



１０－５. Applicable Encoders

(1) Encoder Specifications

MOTOR SEL switch		ON：5-phase motor (5S)	OFF：2-phase motor (2S)
Encoder Specifications	Supply power	DC+5V, MAX200mA	
	Basic number of divisions	500P/R	200P/R
	Maximum response frequency	MAX200kHz	
	Output method	To the line driver output	
	Output signal	A phase, B phase, Z phase	

１０－６. Applicable Motors

(1) It can drive the 5-phase stepping motor of new pentagon connection ranging from 1.40A/phase to 4.50A/phase, and the 2-phase stepping motor of bipolar winding ranging from 1.40A/phase to 4.50A/phase.

① Examples of applicable motors

●5-phase stepping motor of new pentagon connection

SANYO DENKI Co., LTD.		Basic Angle (°)	Current (A/phase)	Setting DRIVE I.SEL switch	Setting MOTOR SEL switch	Torque Data Fig. No.
□60mm	103F7851-82XE42	0.72	1.4	3	ON	—
	103F7852-82XE42	0.72	1.4	3	ON	Fig.1

ORIENTAL MOTOR Co., Ltd.		Basic Angle (°)	Current (A/phase)	Setting DRIVE I.SEL switch	Setting MOTOR SEL switch	Torque Data Fig. No.
□42mm	PKP543N18A2-R2GL	0.72	1.8	5	ON	—
	PKP546N18A2-R2GL	0.72	1.8	5	ON	Fig.2
□60mm	PKP566FN24A2-R2GL	0.72	2.4	8	ON	—
	PKP569FN24A2-R2GL	0.72	2.4	8	ON	Fig.3
	PKP569FN38A2-R2GL	0.72	3.8	C	ON	Fig.4
Factory Setting				3	ON	—

●Please contact us if you want to use the motor other than the above to our office.

●2-phase stepping motor of bipolar winding

ORIENTAL MOTOR Co., Ltd.		Basic Angle (°)	Current (A/phase)	Setting DRIVE I.SEL switch	Setting MOTOR SEL switch	Torque Data Fig.No.
□42mm	PKP243D15A2-R2EL	1.8	1.5	4	OFF	Fig.5
	PKP243D23A2-R2EL	1.8	2.3	7	OFF	—
□56.4mm	PKP266D14A2-R2EL	1.8	1.4	3	OFF	Fig.6
	PKP266D28A2-R2EL	1.8	2.8	9	OFF	Fig.7
Factory Setting				3	ON	—

●Please contact us if you want to use the motor other than the above to our office.

１０－７. Torque Characteristics

(1) Representations in the torque characteristics table are made in terms of the motor rotation (s^{-1}, r/min) vs. torque (N・m).
Motor rotation (s^{-1}) and drive pulse frequency (Hz) are converted as follows:

$$\text{Motor rotation}(s^{-1}) \times \frac{360°}{\text{Step angle}} = \text{Drive pulse input frequency}(Hz)$$

Motor rotation (s^{-1}) and motor rotation (r/min) are converted as follows:

$$\text{Motor rotation}(s^{-1}) \times 60 = \text{Motor rotation}(r/min)$$

●Use the motor rotation at $100s^{-1}$ (6000r/min) or less.

(2) The Maximum Starting Pulse Rate is represented as "fs" by the value at zero inertial load.

(3) Upon operation, provide adequate allowance for torque.

(4) The stepping motor may attain high temperature, depending on the operational conditions.
Use the stepping motor according to the Instructions Manual produced by motormakers.

Fig.1

QDB-MS450EL
103F7852-82XE42
1.4A/PHASE

MOTOR SEL = ON
DRIVE I.SEL = No.3
DC24V

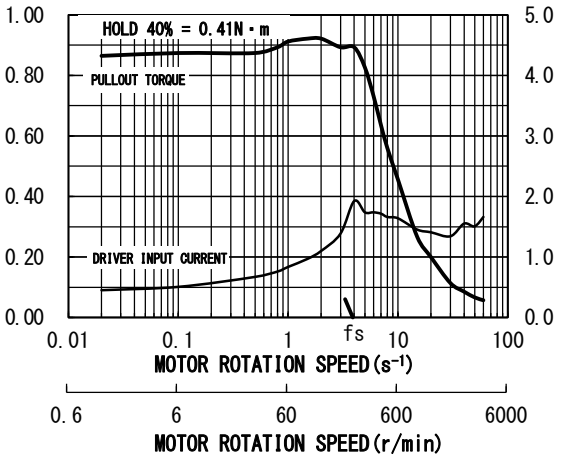


Fig.2

QDB-MS450EL
PKP546N18A2-R2GL
1.8A/PHASE

MOTOR SEL = ON
DRIVE I.SEL = No.5
DC24V

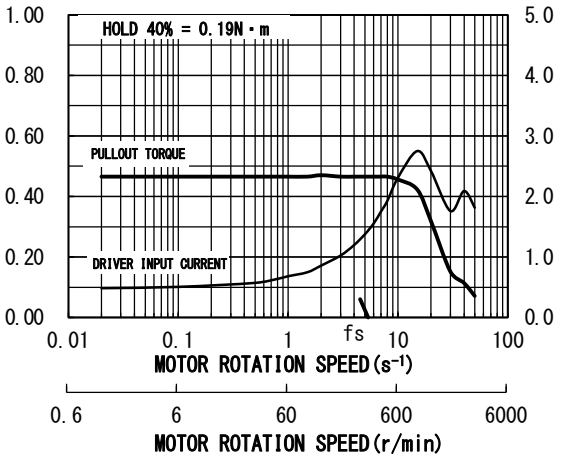


Fig.3

QDB-MS450EL
PKP569FN24A2-R2GL
2.4A/PHASE

MOTOR SEL = ON
DRIVE I.SEL = No.8
DC24V

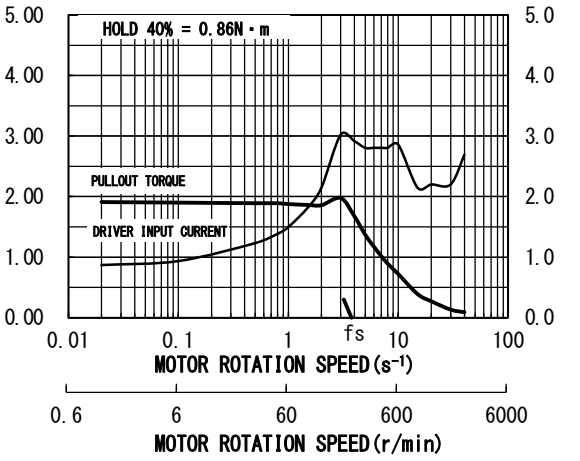


Fig.4

QDB-MS450EL
PKP569FN38A2-R2GL
3.8A/PHASE

MOTOR SEL = ON
DRIVE I.SEL = No.C
DC24V

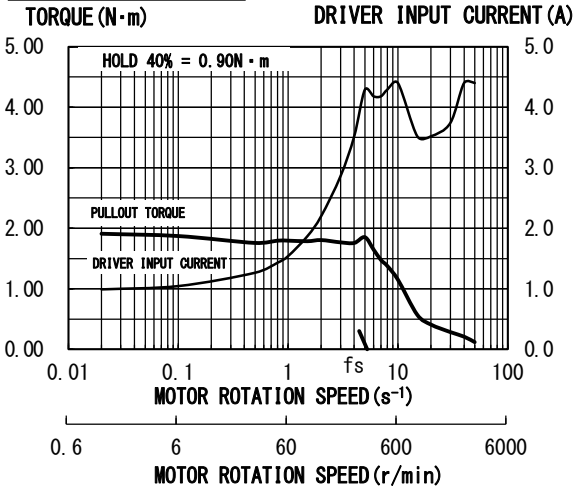


Fig.5

QDB-MS450EL
PKP243D15A2-R2EL
1.5A/PHASE

MOTOR SEL = OFF
DRIVE I.SEL = No.4
DC24V

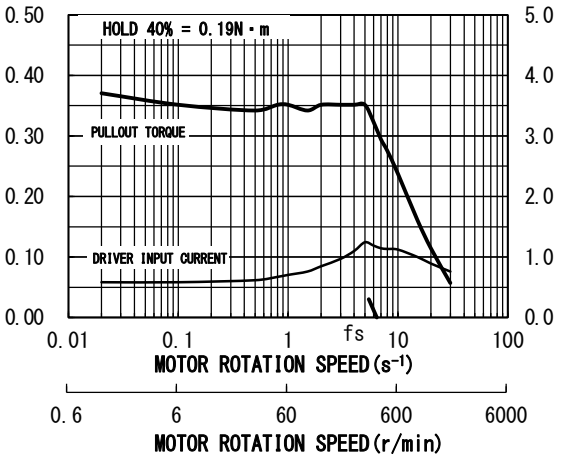


Fig.6

QDB-MS450EL
PKP266D14A2-R2EL
1.4A/PHASE

MOTOR SEL = OFF
DRIVE I.SEL = No.3
DC24V

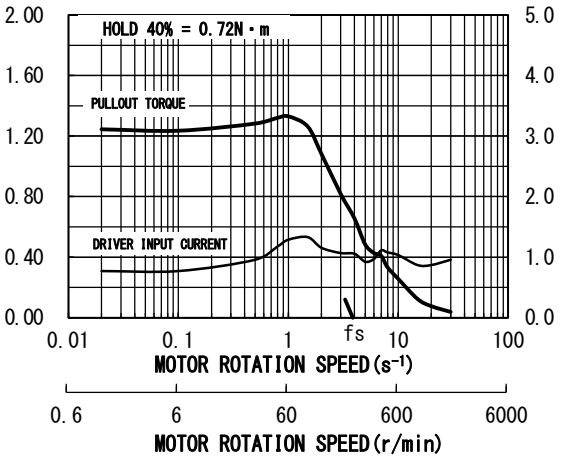
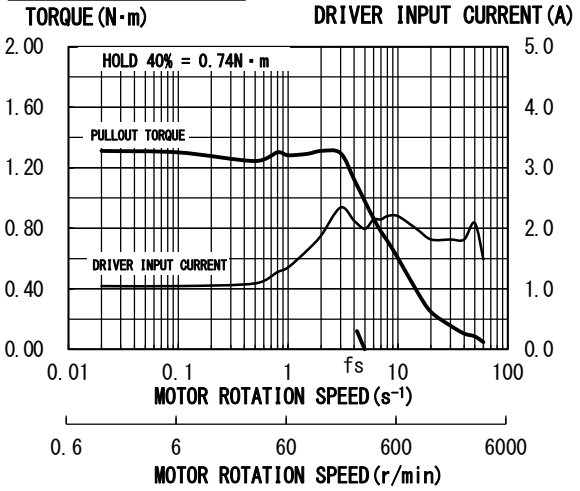


Fig.7

QDB-MS450EL
PKP266D28A2-R2EL
2.8A/PHASE

MOTOR SEL = OFF
DRIVE I.SEL = No.9
DC24V



１０－８. Conforming to Europe standards

(1) Low voltage directive

This product is not subject to the EC's Low Voltage Directive by the following.

・This product should be installed within an enclosure.

・For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.

(2) EMC directive

This product declares the CE marking based on the EMC Directive by oneself.

● Applicable Standards

EN61000-6-4

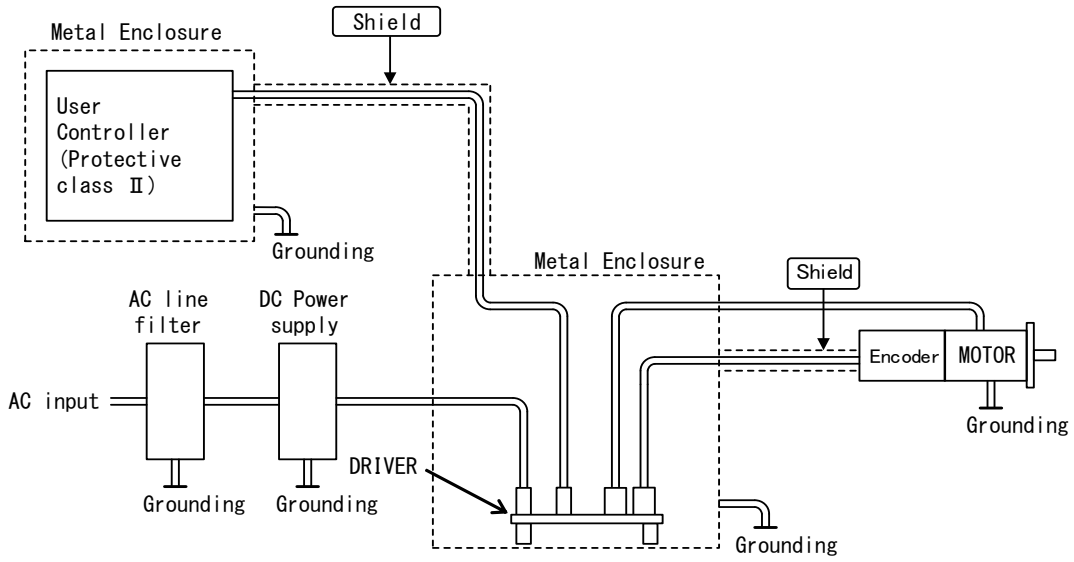
EN61000-6-2

● This product conducted EMC measurement with the system configuration for EMC.

・EMC characteristic may vary depending on the configuration of the equipment that contains the driver or stepping motor. Be sure to conduct EMC measurement with the product assembled in your equipment.

Configuration

The metallic enclosure and shielded wires work to shield noise.



(3) RoHS directive

This product dose not contain the substrances exceeding the restriction values.

The main parts which revised by this manual

Parts	Content

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Sales and Service

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