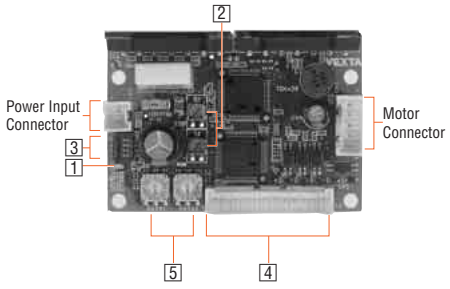
Connection and Operation

Names and Functions of Driver Parts



1 Power Input Display

Color	Function	When Activated
Green	Power supply indication	Lights when power is on.

2 Current Adjustment Potentiometers

Indication	Potentiometer Name	Function
RUN	Motor run current potentiometer	For adjusting the motor running current.
STOP	Motor stop current potentiometer	For adjusting the motor current at standstill.

3 Function Select Switches

Indication	Switch Name	Function
1P/2P	Pulse input mode switch	Switches between 1-pulse input and 2-pulse input.
OFF/SD	Smooth drive function switch	Enables or disables the smooth drive function.
R2/R1	Resolution select switch	Switches the basic step angle between R1 and R2.

4 Input/Output Signals

Indication	Input/ Output	Pin No.	Signal Name	Function
CN2	Input	1	Pulse signal (CW pulse signal)	Operation command pulse signal (The motor will rotate in the CW direction when in 2-pulse input mode.)
		2		
		3	Rotation direction signal (CCW pulse signal)	Rotation direction signal Photocoupler ON: CW, Photocoupler OFF: CCW (The motor will rotate in the CCW direction when in 2-pulse input mode.)
		4		
		5	All windings off signal	Cuts the output current to the motor and allows the motor shafts can be rotated manually.
		6		
		7	Step angle select signal	Switches to step angle set in DATA1 and DATA2.
		8		
		9	Automatic current cutback release signal	This signal is used to disable the automatic current cutback function.
		10		
	Output	11	Excitation timing signal	Outputs signals when the excitation sequence is at STEP "0."
		12		

Description of input/output signals ➜ Page C-160

5 Step Angle Setting Switches

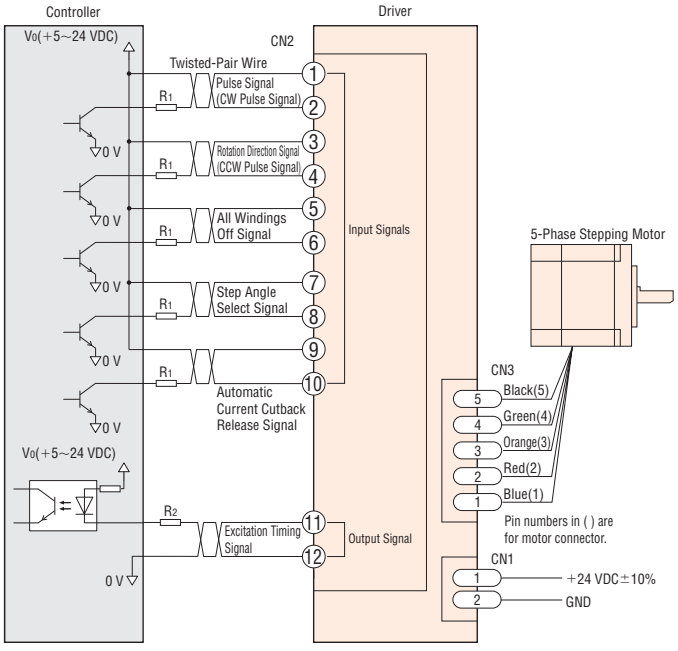
Indication	Switch Name	Function
DATA1 DATA2	Step angle setting switch	Each switch can be set to the desired resolution from the 16 resolution levels.

R1				R2			
DATA1 DATA2	Microsteps/ Step 1	Resolution 1	Step Angle 1	DATA1 DATA2	Microsteps/ Step 2	Resolution 2	Step Angle 2
0	1	500	0.72°	0	×2.5	200	1.8°
1	2	1000	0.36°	1	×1.25	400	0.9°
2	2.5	1250	0.288°	2	1.6	800	0.45°
3	4	2000	0.18°	3	2	1000	0.36°
4	5	2500	0.144°	4	3.2	1600	0.225°
5	8	4000	0.09°	5	4	2000	0.18°
6	10	5000	0.072°	6	6.4	3200	0.1125°
7	20	10000	0.036°	7	10	5000	0.072°
8	25	12500	0.0288°	8	12.8	6400	0.05625°
9	40	20000	0.018°	9	20	10000	0.036°
A	50	25000	0.0144°	A	25.6	12800	0.028125°
B	80	40000	0.009°	B	40	20000	0.018°
C	100	50000	0.0072°	C	50	25000	0.0144°
D	125	62500	0.00576°	D	51.2	25600	0.0140625°
E	200	100000	0.0036°	E	100	50000	0.0072°
F	250	125000	0.00288°	F	102.4	51200	0.00703125°

Notes:

- The step angle is calculated by dividing the basic step angle by the number of microstep. The above figures are based on a basic step angle of 0.72°.
- With the high-resolution type, the basic step angle and resolution are 0.36° and 1000 (microsteps/step 1), respectively.
- If you are using a geared type, the step angle divided by the gear ratio becomes the actual step angle.
- The number of microstep that can be switched by the "Step Angle Select" signal are limited to those selected in step angles 1 and 2.
- Do not change the "Step Angle Select" signal input or step angle setting switch while the motor is operating. It may cause the motor to misstep and stop.

Connection Diagram



Description of Input/Output Signals

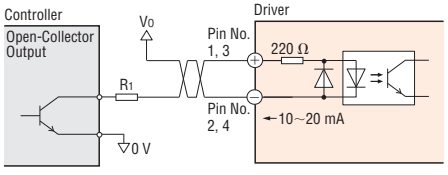
Indication of Input/Output Signal "ON""OFF"

Input (output) "ON" indicates that the current is sent into the photocoupler (transistor) inside the driver. Input (output) "OFF" indicates that the current is not sent into the photocoupler (transistor) inside the driver. The input/output remains "OFF" if nothing is connected.

Photocoupler: OFF | ON

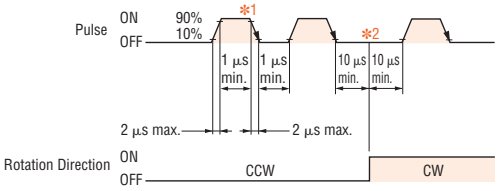
Pulse (CW) and Rotation Direction (CCW) Input Signal

◇Input Circuit and Sample Connection

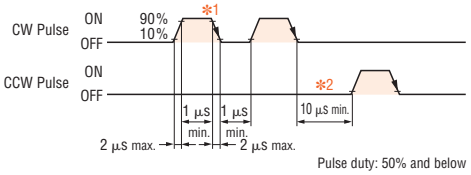


◇Pulse Waveform Characteristics

• 1-Pulse Input Mode



• 2-Pulse Input Mode



Pulse duty: 50% and below

*1 The shaded area indicates when the photocoupler diode is ON. The motor moves when the photocoupler state changes from ON to OFF.

*2 The minimum interval time when changing rotation direction is 20 µs (10 µs in 2-pulse input mode). This value varies greatly depending on the motor type and load inertia.

◇Input Signal Connection

Signals can be connected directly when 5 VDC is supplied. If the signals are used at a voltage exceeding 5 VDC, be sure to provide an external resistor to prevent the current exceeding 20 mA from flowing. Internal components will be damaged if a voltage exceeding 5 VDC is supplied directly without using an external resistor.

Example: If the voltage is 24 VDC, connect a resistor (R_1) of 1.5 to 2.2 kΩ and 0.5 W or more.

◇Output Signal Connection

Use output signals at 24 VDC or less and 10 mA or less.

If these specifications are exceeded, the internal components may be damaged.

Check the specification of the connected equipment.

When the current is above 10 mA, connect an external resistor R_2.

◇Power Supply

Use a power supply that can supply sufficient input current. When power supply capacity is insufficient, a decrease in motor output can cause the following malfunctions:

- Motor does not operate properly at high-speed
- Slow motor startup and stopping

◇Notes on Wiring

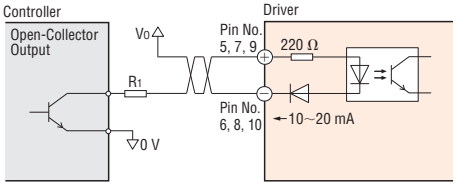
- Use twisted-pair wires of AWG24~22 and keep wiring as short as possible [within 2 m (6.6 ft.)].
- Note that as the length of the pulse signal line increases, the maximum transmission frequency decreases. Technical reference ➜ Page F-54
- Use wires of AWG22 or thicker for the power supply lines. When assembling the connector, use the hand-operated crimp tool or the crimped driver lead wire set (sold separately). The crimp tool is not provided with the package. It must be purchased separately.
- Provide a minimum distance of 2 cm (0.79 in.) between the signal lines and power lines (AC lines, motor lines and other large-current circuits).
  Do not run the signal lines in the same duct as power lines or bundle them with power lines.
- If noise generated by the motor lead wires causes a problem, insert ferrite cores in the motor lead wire.
- Incorrect connection of DC power input will lead to driver damage. Make sure that the polarity is correct before turning power on.

◇Pulse Signal Characteristics

- Keep the pulse signal at the "photocoupler OFF" state when no pulses are being input.
- In 1-pulse input mode, leave the pulse signal at rest ("photocoupler OFF") when changing rotation directions.
- In 2-pulse input mode, do not input a CW pulse and CCW pulse simultaneously.

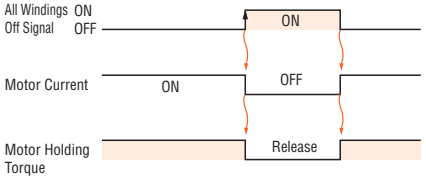
All Windings Off (A.W.OFF) Input Signal
Step Angle Select (C/S) Input Signal
Automatic Current Cutback Release (C.D.INH) Input Signal

◇Input Circuit and Sample Connection



◇All Windings Off (A.W.OFF) Input Signal

- Inputting this signal puts the motor in a non-excitation (free) state.
- This signal is used to move the motor shaft with external force or manual home position is desired. The photocoupler must be "OFF" when the motor is operating.



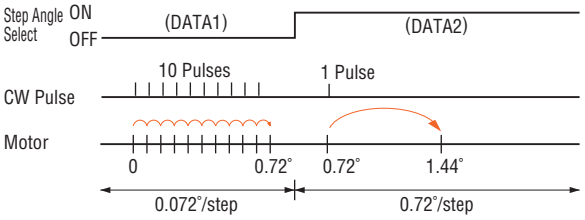
The shaded area indicates that the motor provides holding torque in proportion to standstill current set by STOP switch.

- Switching the "All Windings Off" signal from "photocoupler ON" to "photocoupler OFF" does not alter the excitation sequence. When the motor shaft is manually adjusted with the "All Windings Off" signal input, the shaft will shift up to ±3.6° (Geared type: ±3.6°/gear ratio) from the position set after the "All Windings Off" signal is released.

◇Step Angle Select (C/S) Input Signal

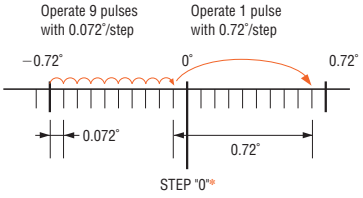
- You may select two step angles (resolutions) from 16 available step angles (resolutions) with the step angle setting switches DATA1 and DATA2.
- When the signal is at "photocoupler OFF," a step angle set by DATA1 is selected; at "photocoupler ON," DATA2 is selected.

Example: Changing the step angle from 0.072˚ to 0.72˚.



- Be sure to change step angle select inputs only when the pulse signals are at rest. Switching while moving may cause a positional error of the motor.
- When the step angle is changed by the "Step Angle Select" signal, the "Excitation Timing" signal output may become impossible for some combinations of step angles. When the "Excitation Timing" signal is used, adjust the number of pulses so that the motor can operate with angles that are multiples of 7.2˚.

Example:
After moving 9 pulses with 0.072˚/step setting, change the step angle to 0.72˚/step and move 1 pulse. In this case, "Excitation Timing" signal will not be output because the step "0" position is skipped.



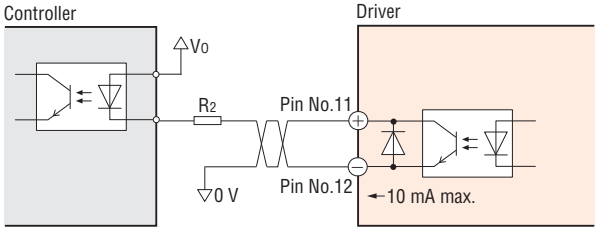
*"Excitation Timing" signal is only output at step "0" position.

◇Automatic Current Cutback Release (C.D.INH) Input Signal

- When this signal is in the "photocoupler ON" state, the automatic current cutback function is disabled. When this signal is in the "photocoupler OFF" state, the automatic current cutback function will be activated after the motor stops (after approximately 100 msec).
- The photocoupler must be "OFF" except when the running current is adjusted.

Excitation Timing (TIMING) Output Signal

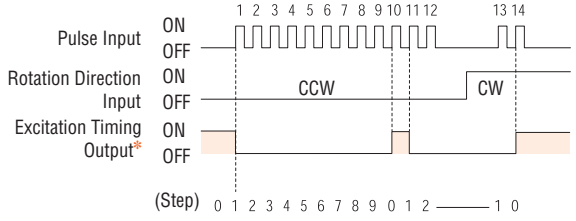
◇Output Circuit and Sample Connection



- The "Excitation Timing" signal is output to indicate when the motor excitation is in the initial stage (step "0" at power up).
- The "Excitation Timing" signal is output simultaneously with a pulse input each time the excitation sequence returns to step "0." The excitation sequence will complete one cycle for every 7.2˚ rotation of the motor output shaft.
  Microsteps/step 1: Signal is output once every 10 pulses.
  Microsteps/step 10: Signal is output once every 100 pulses.

Timing chart at 0.72˚/step (Microsteps/step 1)

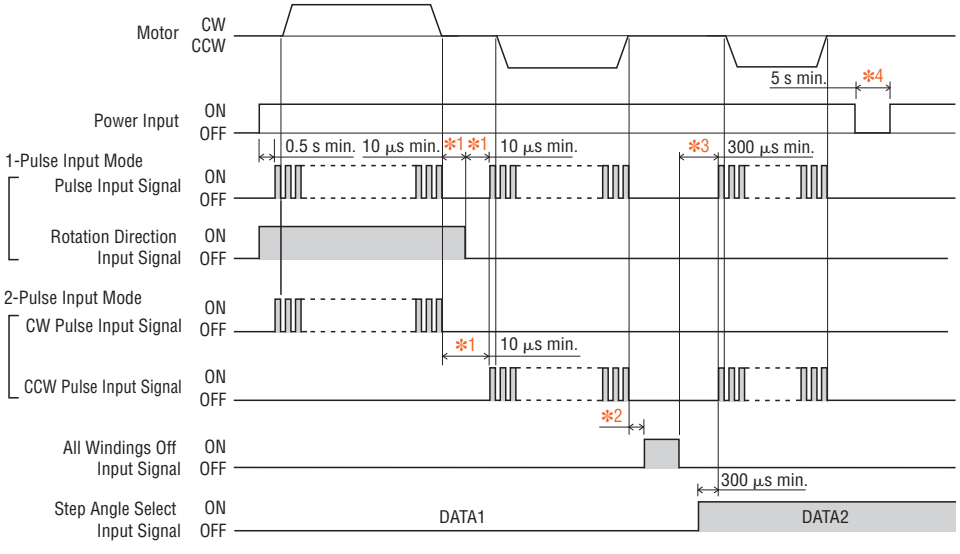
*When connected as shown in the sample connection, the signal will be "photocoupler ON" at step "0."



Note:

- When power is turned ON, the excitation sequence is reset to step "0" and the "Excitation Timing" signal is output.

●Timing Chart



The ▭ section indicates that the photocoupler diode is emitting light.

*1 The minimum switching time to change direction (1-pulse input mode), and switching time to change CW, CCW pulse (2-pulse input mode) 10 μs is shown as a response time of circuit. The motor may need more time than that.
*2 Depends on load inertia, load torque and starting frequency.
*3 Never input a pulse signal immediately after switching the "All Windings Off" signal to the "photocoupler OFF" state. The motor may not start.
*4 Wait at least 5 seconds before turning on the power again.

Adjusting the Current

●Adjusting the Motor Current

Use the "RUN" potentiometer to decrease the current and suppress the temperature rise in the motor/driver, or when there is sufficient motor torque and you want to suppress vibration by lowering the current.
Use the "STOP" potentiometer to readjust the current at motor standstill in relation to the holding-brake force of the motor.

Factory settings

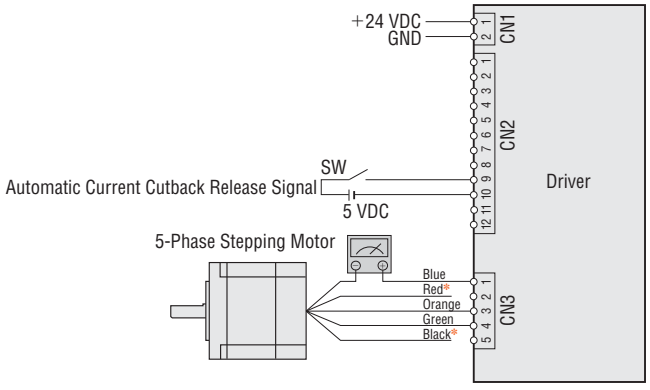
Running current: Rated current

Current at motor standstill: 50% of rated current

Follow the procedure below to adjust the motor current.

◇Connecting an Ammeter

Connect a DC ammeter as illustrated below.
Connect a DC ammeter in series to the blue motor lead wire and motor connector pin No. 1. Set all driver input signals to the "photocoupler OFF" state.
Disconnect the red motor lead wire from connector pin No. 2, and black motor lead wire from connector pin No. 5.



Note:

- Do not input pulse signals.

*Electric shock may result if the red and black motor lead wires contact each other. Insulate these motor lead wires to prevent electric shock.

◇Adjusting the Motor Running Current

To adjust the motor running current, follow the procedure below:

1. Set the automatic current cutback release signal to the "photocoupler ON" state. Keep other signals in the "photocoupler OFF" state.
2. Turn on the power to the driver.
3. Use the "RUN" potentiometer to adjust the motor running current.
4. When the power is turned on, the value measured by the ammeter represents the total current in two phases through the blue motor lead wire. The current for one phase is equivalent to one-half the ammeter value. (Example: To set the current to 1.0 A/phase, adjust the current level until the ammeter reads 2.0 A.)
5. When the running current has been adjusted, set the automatic current cutback release signal to the "photocoupler OFF" state.

Notes:

- Be sure to use the motor at the rated current or below.
- Adjusting the running current will also change the current at standstill.

◇Adjusting the Current at Motor Standstill

To adjust the current at motor standstill, follow the procedure below:

1. Set the automatic current cutback release signal to the "photocoupler OFF" state. Keep other signals in the "photocoupler OFF" state.
2. Turn on the power to the driver.
3. Use the "STOP" potentiometer to adjust the motor current at standstill.
4. When the power is turned on, the value measured by the ammeter represents the total current in two phases through the blue motor lead wire. The current for one phase is equivalent to one-half the ammeter value. (Example: To set the current to 0.5 A/phase, adjust the current level until the ammeter reads 1.0 A.)

$$\text{Holding Torque [N·m (oz-in)]} = \frac{\text{Maximum Holding Torque [N·m (oz-in)]} \times \text{Current at Standstill [A]}}{\text{Motor Rated Current [A]}}$$

Notes:

- Always set the running current first, turn off the driver power and turn it back on, and then set the current at standstill. Setting the running current after current at standstill may change the current setting at standstill.
- Setting the current at motor standstill too low may affect the starting of the motor or the position-holding action.