Connection and Operation

Names and Functions of Speed Controller Parts

Control Panel
- Indicator: Displays speed, parameters, alarms, etc.
- Operation Key: Switches operating mode, sets operating data and changes parameters.

POWER LED (Green)
- Lights when the AC power supply is provided to the speed controller.

ALARM LED (Red)
- Lights when an alarm is activated.

Motor Connector (CN3)
- Connects to the motor connector.

Electromagnetic Brake Connector (CN2)
- Connects to the electromagnetic brake connector.

Main Circuit Connector (CN1)
- Connects to the AC power supply, capacitor and FG.

Control Circuit Connector (CN4)
- Connects the DC power supply for control and I/O signals.

Sink Logic/Source Logic Switch
- Switches between the sink logic and source logic for the input signal.

Main Circuit Connector (CN1)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Contents</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Capacitor</td>
<td>Connects the capacitor.</td>
</tr>
<tr>
<td>2</td>
<td>N.C.</td>
<td>No connection.</td>
</tr>
<tr>
<td>3</td>
<td>AC Power Supply</td>
<td>Connects to the live side.</td>
</tr>
<tr>
<td>4</td>
<td>FG</td>
<td>Connects to the ground wire.</td>
</tr>
</tbody>
</table>

Control Circuit Connector (CN4)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name</th>
<th>Function¹</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 V</td>
<td>DC Power Supply for Control</td>
<td>Connects the 24 VDC power supply for control circuit.</td>
</tr>
<tr>
<td>2</td>
<td>0 V (GND)</td>
<td>[FWD]</td>
<td>The motor rotates in the forward direction when &quot;ON&quot;.²</td>
</tr>
<tr>
<td>3</td>
<td>IN0</td>
<td>[REV]</td>
<td>The motor rotates in the reverse direction when &quot;ON&quot;.³</td>
</tr>
<tr>
<td>4</td>
<td>IN1</td>
<td>[M0]</td>
<td>Selects the operating data.</td>
</tr>
<tr>
<td>5</td>
<td>IN2</td>
<td>[M1]</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>IN3</td>
<td>[ALARM-RESET]</td>
<td>Alarms are canceled.</td>
</tr>
<tr>
<td>7</td>
<td>IN4</td>
<td>[FREE]</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>INS</td>
<td>[SPEED-OUT]</td>
<td>12 pulses are output when the motor output shaft makes one rotation.</td>
</tr>
<tr>
<td>9</td>
<td>VH</td>
<td>External Speed Setting Input</td>
<td>It is connected when speed is set externally using external speed potentiometer or external DC voltage.</td>
</tr>
<tr>
<td>10</td>
<td>VM</td>
<td>–</td>
<td>No connection.</td>
</tr>
<tr>
<td>11</td>
<td>VL</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>N.C.</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>OUT0+</td>
<td>[SPEED-OUT]</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>OUT0−</td>
<td>[ALARM-RESET]</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>OUT1+</td>
<td>[ALARM-OUT]</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>OUT1−</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

¹ Text inside the [ ] represents the factory default function assignment. The following signals can be assigned as necessary to 6 input signal terminals (IN0−IN5) and 2 output signal terminals (OUT0, OUT1).
² 6 of the 7 input signals (FWD, REV, M0, M1, ALARM-RESET, FREE, EXT-ERROR) 2 of the 4 output signals (SPEED-OUT, ALARM-OUT, TH-OUT, WNG) are necessary.
³ Rotation direction varies according to the gearhead's gear ratio and the parameter settings.

Brushless Motors

- AC Input BMU
- AC Input BLE
- AC Input BLF
- DC Input BLH

Accessories

Installation
Connection Diagram
The figure shows a connection example for the electromagnetic brake type. Always connect the DC power supply for control when operating the motor in addition to the AC power supply.

Example of I/O Signal (CN4) Connection
The figure shows a connection example when operating with a contact switch, such as switches and relays with sink logic setting.

Rating of Fuse
For overcurrent protection, be sure to insert a fuse into the power supply line.

Timing Chart
Operating data No.0 has been set to 1200 r/min and operating data No.1 has been set to 300 r/min.

Note
● The duration of ON for each signal must be 10 ms or more.
I/O Signal Circuits
Sink logic or source logic can be selected according to the external control device the customer is using.

Connection to Programmable Controller
• Sink Logic

Source Logic

Output Circuit
OUT0, OUT1

Note
Maintain the current value of OUT0 and OUT1 at 40 mA or less. If this current value is exceeded, connect the limiting resistor R0.

When an External Control Device with a Built-in Clamp Diode is Used
If an external control device with a built-in clamp diode is connected and the external control device is turned off when the speed controller power is on, current may flow in and rotate the motor. Also, depending on the external control device used with the speed controller, the motor may rotate even when the power supply is set to ON and OFF simultaneously. Use the following procedure to turn the power ON or OFF.

When turning the power off:
Speed controller ➜ External control device

When turning the power on:
External control device ➜ Speed controller

Speed Output (SPEED-OUT)
Pulse signals of 12 pulses are output at every rotation of the motor output shaft in synchronization with the motor operation. If the speed output frequency is measured, the motor speed can be calculated.

Motor Shaft Speed [r/min] = \( \frac{\text{Speed Output Frequency [Hz]}}{12} \times 60 \)

Speed Output Frequency [Hz] = \( \frac{1}{T [s]} \)

Speed Output Waveform
Speed Setting Method

The following 3 methods for setting speed can be used.

1. Setting by control panel (factory setting)

2. External speed potentiometer

3. External DC voltage

Setting by Control Panel

Up to 4 operating data can be set. By switching the M0 and M1 inputs between ON and OFF, the pattern can be selected and the motor will operate.

<table>
<thead>
<tr>
<th>Operating Data No.</th>
<th>M1</th>
<th>M0</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OFF</td>
<td>OFF</td>
<td>Setting by control panel/remote setting</td>
</tr>
<tr>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>Setting by control panel</td>
</tr>
<tr>
<td>2</td>
<td>ON</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ON</td>
<td>ON</td>
<td></td>
</tr>
</tbody>
</table>

Note:
When the "External speed command input" parameter is set to "ON (enabled)" (Initial value: OFF), the speed can be set using the external speed potentiometer and external DC voltage.

Setting by External Speed Potentiometer (Included)

Connect the external speed potentiometer to CN4.

"External speed command voltage selection" parameter setting:
- "0-5" (Initial value)

External Speed Potentiometer

Parallel-Motor Control

Multiple motors can be operated at the same speed using 1 external speed potentiometer or external DC voltage.

Using an External Speed Potentiometer

Parallel-motor operation using the external speed potentiometer (VRx) should be performed with a maximum of 20 speed controllers.

Setting by External DC Voltage

Connect the external DC power supply (0-5 VDC or 0-10 VDC) to CN4.

"External speed command voltage selection" parameter setting:
- 0-5 VDC "0-5" (Initial value)
- 0-10 VDC "0-10"

Example: When connecting 2 speed controllers
Current capacity (I) = 1 x 2 = 2 (mA)

Note:
Ensure that the external DC voltage is 10 VDC or less. When connecting the external DC voltage, ensure that the polarity is correct. Otherwise, it may damage the speed controller.
Repetitive Operation Cycle
When the motor is operated repeatedly in short cycles, use the cycles below as a reference, and ensure that the motor’s external temperature is at 90˚C (194˚F) or less.

- **Instantaneous Stop**
  - 6—40 W (1/125—1/19 HP)
    - When operation and instantaneous stops are repeated 2 seconds min., operating duty 50% max. (Example: 1 second operating, 1 second stopped)
  - 60 W, 90 W (1/12 HP, 1/8 HP)
    - When operation and instantaneous stops are repeated 4 seconds min., operating duty 50% max. (Example: 2 seconds operating, 2 seconds stopped)

- **Instantaneous Bi-Directional Operation**
  - 6—40 W (1/125—1/19 HP)
    - When rotation direction is repeatedly switched during operation
      - Switch once every 2 seconds min.
  - 60 W, 90 W (1/12 HP, 1/8 HP)
    - When rotation direction is repeatedly switched during operation
      - Switch once every 4 seconds min.

**On the electromagnetic brake type, continuous operation conditions occur when the “deceleration control” parameter is set to ON. Check the electromagnetic brake type “Common Specifications – Permissible Continuous Operation Time While Deceleration Control is ON” (➔ Page D-159)**

Brake Current
When performing an instantaneous stop, bi-directional operation or vertical operation*, the large brake current flows for approximately 0.4 seconds on a half-wave rectified AC power supply line. When performing these kinds of operations, select the equipment breaker and AC power supply capacitance by referring to the table’s braking current (peak value).

<table>
<thead>
<tr>
<th>Motor Output Power</th>
<th>Braking Current (Peak value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single-Phase 110/115 VAC</td>
</tr>
<tr>
<td>6 W (1/125 HP)</td>
<td>2 A</td>
</tr>
<tr>
<td>15 W (1/50 HP)</td>
<td>4 A</td>
</tr>
<tr>
<td>25 W (1/30 HP)</td>
<td>8 A</td>
</tr>
<tr>
<td>40 W (1/19 HP)</td>
<td>12 A</td>
</tr>
<tr>
<td>60 W (1/12 HP)</td>
<td>21 A</td>
</tr>
<tr>
<td>90 W (1/8 HP)</td>
<td>29 A</td>
</tr>
</tbody>
</table>

*Only for electromagnetic brake type.