Connection and Operation

Names and Functions of Speed Controller Parts

- **ALARM LED (Red)**
  - Blinks when the alarm is invoked. The alarm output signal turns OFF (H level).

- **POWER LED (Green)**
  - Lights while the AC power is supplied to the speed controller.

- **Internal Speed Potentiometer (VR1)**
  - Sets the motor’s speed.

- **Acceleration Time Potentiometer (VR2)**
  - Sets the acceleration time at starting of motor.

- **Deceleration Time Potentiometer (VR3)**
  - Sets the deceleration time at stopping of motor.

- **Speed Command Voltage Switch (SW1-1)**
  - To set speeds using external DC voltage, set this switch to either 5 V or 10 V.

- **Control Circuit Terminals (CN1)**
  - Connects the DC power supply for control (24 VDC) and the I/O signals.

- **Main Circuit Terminals (TB1)**
  - Connects to the AC power supply, motor, tachogenerator, and capacitor.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Terminal Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tachogenerator connection terminal</td>
<td>Connects 24 VDC for the control circuit.</td>
</tr>
<tr>
<td>2</td>
<td>Motor connection terminal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Common COM (GND)</td>
<td>I/O signal common</td>
</tr>
<tr>
<td>4</td>
<td>Input FWD</td>
<td>The motor rotates in clockwise direction.</td>
</tr>
<tr>
<td>5</td>
<td>Input REV</td>
<td>The motor rotates in counterclockwise direction.</td>
</tr>
<tr>
<td>6</td>
<td>Input INT/EXT</td>
<td>Switches to internal or external speed potentiometer.</td>
</tr>
<tr>
<td>7</td>
<td>ALARM-RESET</td>
<td>Resets alarms</td>
</tr>
<tr>
<td>8</td>
<td>Input VH</td>
<td>Connect when setting the speed externally.</td>
</tr>
<tr>
<td>9</td>
<td>Input VL</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Output SPEED-OUT</td>
<td>12 pulses are output for each rotation of the motor output shaft.</td>
</tr>
<tr>
<td>11</td>
<td>Output ALARM-OUT</td>
<td>This signal is output when an alarm is generated (normally closed).</td>
</tr>
</tbody>
</table>
Connection Diagram

The figure shows an example in which a V Series motor is connected and operated with contact switches such as relays and switches. When operating the motor, be sure to connect the DC power supply for control.

For motors of 60 W (1/12 HP) or higher output, connect the lead wires for the fan (2 orange leads) to the AC power supply terminals (8 and 9 of TB1).

FUSE RATINGS

For overcurrent protection, make sure to insert a fuse in the power supply line.

<table>
<thead>
<tr>
<th>Fuse Ratings</th>
<th>216 Series (Littlefuse, Inc.) 10 A or equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Phase 100/110/115 VAC</td>
<td>216 Series (Littlefuse, Inc.) 6.3 A or equivalent</td>
</tr>
<tr>
<td>Single-Phase 200/220/230 VAC</td>
<td></td>
</tr>
</tbody>
</table>

Timing Chart during Operation

The timing chart below shows an example of a 2-speed control operation, where the internal speed potentiometer is set to 1200 r/min, and the external speed potentiometer is set to 100 r/min.

Note: The duration of each signal in the ON state must be 10 ms or longer.
When switching between FWD and REV inputs, hold for 10 ms min. between switching.
**Speed Setting Methods**

The following 3 methods can be used for setting the speed. The setting speed range is 90~1400 r/min at 50 Hz, or 90~1600 r/min at 60 Hz.

**Internal Speed Potentiometer**

When the dial on the internal speed potentiometer (VR1) is turned in the clockwise direction, the speed will be faster.

Factory setting: 0 r/min

![Internal Speed Potentiometer (VR1)](image)

**External Speed Potentiometer (Sold Separately)**

By connecting the separately-sold external speed potentiometer (PAVR-20KZ) to CN1 and turning ON the INT/EXT input, the external speed potentiometer becomes effective. When the dial on the external speed potentiometer is turned in the clockwise direction, the speed will be faster.

![External Speed Potentiometer](image)

**External DC Voltage**

Set the external DC voltage at 5 VDC or 10 VDC. Use the speed command voltage switch (SW1-1) to match it to the voltage you are using. To set it with the external DC voltage, turn ON the INT/EXT input.

**Note**

Make sure that the voltage is set to the selected voltage (5 VDC or 10 VDC), and ensure the correct polarity when connecting.

![External DC Power Supply](image)

**Acceleration/Deceleration**

You can adjust the acceleration/deceleration time when the motor starts, stops, and changes speed, so that no shock is applied to the load. This is set via the acceleration time potentiometer and the deceleration time potentiometer. The setting range is approximately 0.3~15 seconds (at 1000 r/min, with no inertial load). However, if the load inertia is large, the deceleration time cannot be set shorter than the time the motor would take to coast to a stop.

**Acceleration (ACCEL)**

The acceleration function is activated at starting or when the speed is switched to the higher setting in a two-level speed control. The setting time is increased by turning the switch clockwise. Factory setting: Min.

![Acceleration Time Potentiometer (VR2)](image)

**Deceleration (DECEL)**

The deceleration function is activated when coasting to a stop, or when the speed is switched to the lower setting in a two-level speed control. The setting time is increased by turning the switch clockwise. Factory setting: Min.

![Deceleration Time Potentiometer (VR3)](image)
**Parallel-Motor Operation**

2 or more motors can be operated at the same speed by using an external speed potentiometer or an external DC power supply.

**Using an External Speed Potentiometer**

Up to 20 speed controllers can be operated in parallel-motor operation using an external speed potentiometer.

- Connect the I/O signals for each speed controller.
- If the motors are at different speeds, adjust by doing the following.
  
  **Speed controller 1:**
  
  Connect a 1.5 kΩ, 1/4 W resistor to the VM terminal.
  
  **Speed controllers 2 and thereafter:**
  
  Connect a 5 kΩ, 1/4 W variable resistor VRn.

**How to Calculate the Resistance (VRx) When Connecting n Speed Controllers**

Resistance (VRx) = 20/n (kΩ), n/4 (W)

Example: When connecting 2 speed controllers

Resistance (VRx) = 20/2 (kΩ), 2/4 (W), i.e. resistance of 10 kΩ, 1/2 W.

**Repetition Cycle of Running and Instantaneous Stops**

When running and instantaneous stopping of the motor is repeated in short cycles, the motor temperature rise will increase and the continuous operating time will be limited. Use the repetition cycle given in the table below for running and instantaneous stopping. The motor's heat generation may become higher depending on the driving conditions. Be sure to keep the temperature of the motor case under 90°C (194°F).

<table>
<thead>
<tr>
<th>Motor Output Power</th>
<th>Repetition Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 W (1/125 HP)</td>
<td>2 seconds min. (Running time 1 second, stopping time 1 second)</td>
</tr>
<tr>
<td>20 W (1/60 HP)</td>
<td>4 seconds min. (Running time 2 second, stopping time 2 second)</td>
</tr>
<tr>
<td>40 W (1/28 HP)</td>
<td>8 seconds min.</td>
</tr>
</tbody>
</table>

**Using an External DC Voltage**

- Connect the I/O signals for each speed controller.
- If the motors are at different speeds, adjust by doing the following.
  
  **Speed controller 1:**
  
  Connect a 1.5 kΩ, 1/4 W resistor to the VM terminal.
  
  **Speed controllers 2 and thereafter:**
  
  Connect a 5 kΩ, 1/4 W variable resistor VRn.

**Dimensions**

Unit = mm (in.)

- Mounting screws are included with the combination type.

**6 W (1/125 HP)**

**Motor/Gearhead (Combination type)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSI206A2-□U</td>
<td>VSI206A2-GV</td>
<td>GV2G</td>
<td>5–25</td>
<td>34 (1.34)</td>
<td>A500A</td>
</tr>
<tr>
<td>VSI206C2-□E</td>
<td>VSI206C2-GV</td>
<td></td>
<td>30–120</td>
<td>38 (1.50)</td>
<td>A500B</td>
</tr>
<tr>
<td>VSR206A2-□U</td>
<td>VSR206A2-GV</td>
<td></td>
<td>150–360</td>
<td>43 (1.69)</td>
<td>A500C</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSR206C2-□E</td>
<td>VSR206C2-GV</td>
<td></td>
<td>150–360</td>
<td>43 (1.69)</td>
<td>A500C</td>
</tr>
</tbody>
</table>

Mass: 1.3 kg (2.9 lb.) (Including gearhead)

**Key and Key Slot**

(The key is included with the gearhead)

- For U Model
  
  Key length: 10 mm (0.39 in.)
  
  Key width: 7 mm (0.28 in.)

- For E Model
  
  Key length: 10 mm (0.39 in.)
  
  Key width: 4 mm (0.16 in.)

- Protective Earth Terminal M4
  
  Terminal screw size: M4
  
  Terminal screw pitch: 5 (0.20) max.

- Motor Leads 300 mm (12 in.) Length
  
  UL Style 3271, AWG20

- Generator Leads 300 mm (12 in.) Length
  
  UL Style 3266, AWG24
**15 W (1/50 HP)**

**Motor/Gearhead (Combination type)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS135A2-U</td>
<td>VS135A2-GV</td>
<td>GV3G</td>
<td>5−25</td>
<td>38</td>
<td>A501A</td>
</tr>
<tr>
<td>VS135C2-E</td>
<td>VS135C2-GV</td>
<td></td>
<td>30−120</td>
<td>43</td>
<td>A591B</td>
</tr>
<tr>
<td>VS15A2-U</td>
<td>VS15A2-GV</td>
<td></td>
<td>150−360</td>
<td>48</td>
<td>A591C</td>
</tr>
</tbody>
</table>

Mass: 1.8 kg (4.0 lb.) (including gearhead)

**25 W (1/30 HP)**

**Motor/Gearhead (Combination type)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS425A2-U</td>
<td>VS425A2-GV</td>
<td>GV4G</td>
<td>5−25</td>
<td>41</td>
<td>A502A</td>
</tr>
<tr>
<td>VS425C2-E</td>
<td>VS425C2-GV</td>
<td></td>
<td>30−120</td>
<td>46</td>
<td>A502B</td>
</tr>
<tr>
<td>VS45A2-U</td>
<td>VS45A2-GV</td>
<td></td>
<td>150−360</td>
<td>51</td>
<td>A502C</td>
</tr>
</tbody>
</table>

Mass: 2.55 kg (5.6 lb.) (including gearhead)

"Enter the gear ratio in the box ( ) within the model name."
● 40 W (1/19 HP)

Motor/Gearhead (Combination type)

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSI540A2-U</td>
<td>VSI540A2-GVH</td>
<td></td>
<td>5–18</td>
<td>45 (1.77)</td>
<td>A503A</td>
</tr>
<tr>
<td>VSI540C2-E</td>
<td>VSI540C2-GVH</td>
<td></td>
<td>25–100</td>
<td>58 (2.28)</td>
<td>A503B</td>
</tr>
<tr>
<td>VSR540A2-U</td>
<td>VSR540A2-GVH</td>
<td></td>
<td>120–300</td>
<td>64 (2.52)</td>
<td>A503C</td>
</tr>
<tr>
<td>VSR540C2-E</td>
<td>VSR540C2-GVH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key and Key Slot
(The key is included with the gearhead)

Mass: 4.1 kg (9.0 lb.) (including gearhead)

Enter the gear ratio in the box (□) within the model name.

● 60 W (1/12 HP)

Motor/Gearhead (Combination type)

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSI560A-U</td>
<td>VSI560A-GVH</td>
<td></td>
<td>5–18</td>
<td>45 (1.77)</td>
<td>A395A</td>
</tr>
<tr>
<td>VSI560C-E</td>
<td>VSI560C-GVH</td>
<td></td>
<td>25–100</td>
<td>58 (2.28)</td>
<td>A395B</td>
</tr>
<tr>
<td>VSR560A-U</td>
<td>VSR560A-GVH</td>
<td></td>
<td>120–300</td>
<td>64 (2.52)</td>
<td>A395C</td>
</tr>
<tr>
<td>VSR560C-E</td>
<td>VSR560C-GVH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key and Key Slot
(The key is included with the gearhead)

Mass: 4.3 kg (9.5 lb.) (including gearhead)

Enter the gear ratio in the box (□) within the model name.
### Motor/Gearhead (Combination type)

<table>
<thead>
<tr>
<th>Model</th>
<th>Motor Model</th>
<th>Gearhead Model</th>
<th>Gear Ratio</th>
<th>L</th>
<th>DXF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSI590A-□-U</td>
<td>VSI590A-GVR</td>
<td>GVR5G</td>
<td>5 – 15</td>
<td>45 (1.77)</td>
<td>A396A</td>
</tr>
<tr>
<td>VSI590C-□-E</td>
<td>VSI590C-GVR</td>
<td></td>
<td>18 – 36</td>
<td>58 (2.28)</td>
<td>A396B</td>
</tr>
<tr>
<td>VSR590A-□-U</td>
<td>VSR590A-GVR</td>
<td></td>
<td>50 – 180</td>
<td>70 (2.76)</td>
<td>A396C</td>
</tr>
</tbody>
</table>

Mass: 4.8 kg (10.6 lb.) (including gearhead)

### Capacitor Dimensions

#### Dimension No. 1

- A
- B (0.10)
- C (0.18)

#### Dimension No. 2

- A
- B (0.15)
- C (0.30)

### Induction Motors

#### Capacitor (Included)
- A capacitor cap is included with a capacitor.

#### Reversible Motors
- A capacitor cap is included with a capacitor.

### Key and Key Slot
- (The key is included with the gearhead)

### Capacitor Dimensions

- Model: VSI206A2-□-U
  - Capacitor Model: CH25FAUL2
  - Dimension: 31 (1.22) x 17 (0.67) x 27 (1.06) x 21 (0.82)

- Model: VSI206C2-□-E
  - Capacitor Model: CH06FAUL
  - Dimension: 31 (1.22) x 17 (0.67) x 27 (1.06) x 21 (0.82)

- Model: VSI315A2-□-U
  - Capacitor Model: CH45FAUL2
  - Dimension: 37 (1.46) x 27 (1.06) x 26 (0.92)

- Model: VSI425C2-□-E
  - Capacitor Model: CH15FAUL
  - Dimension: 37 (1.46) x 27 (1.06) x 26 (0.92)

- Model: VSI425A2-□-U
  - Capacitor Model: CH50FAUL2
  - Dimension: 38 (1.50) x 29 (1.14) x 35 (1.38) x 60 (2.1)

- Model: VSI450C2-□-E
  - Capacitor Model: CH25FAUL2
  - Dimension: 48 (1.89) x 21 (0.83) x 31 (1.22) x 43 (1.52)

- Model: VSI540A2-□-U
  - Capacitor Model: CH90FAUL2
  - Dimension: 48 (1.89) x 22.5 (0.89) x 31.5 (1.24) x 45 (1.59)

- Model: VSI540C2-□-E
  - Capacitor Model: CH23FAUL2
  - Dimension: 48 (1.89) x 21 (0.83) x 31 (1.22) x 43 (1.52)

- Model: VSI560A-□-U
  - Capacitor Model: CH180FAUL2
  - Dimension: 58 (2.28) x 23.5 (0.93) x 37 (1.46) x 70 (2.75)

- Model: VSI560C-□-C
  - Capacitor Model: CH408FAUL
  - Dimension: 58 (2.28) x 23.5 (0.93) x 37 (1.46) x 73 (2.6)

- Model: VSI590A-□-U
  - Capacitor Model: CH200FAUL2
  - Dimension: 58 (2.28) x 29 (1.14) x 41 (1.61) x 95 (3.6)

- Model: VSI590C-□-E
  - Capacitor Model: CH608FAUL
  - Dimension: 58 (2.28) x 29 (1.14) x 41 (1.61) x 92 (3.2)

### Enter the gear ratio in the box □ within the model name.