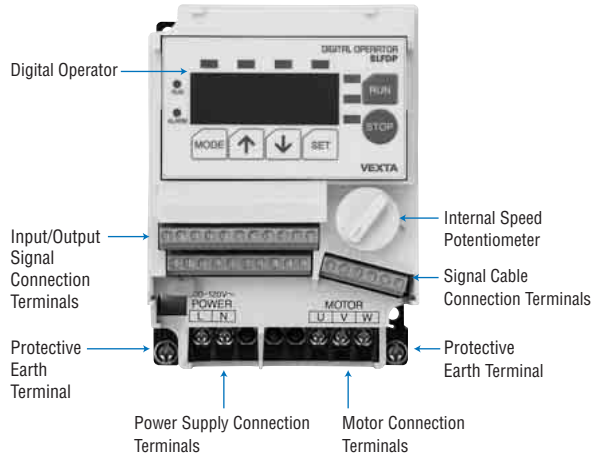
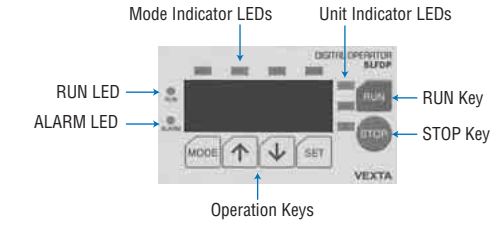
Connection and Operation

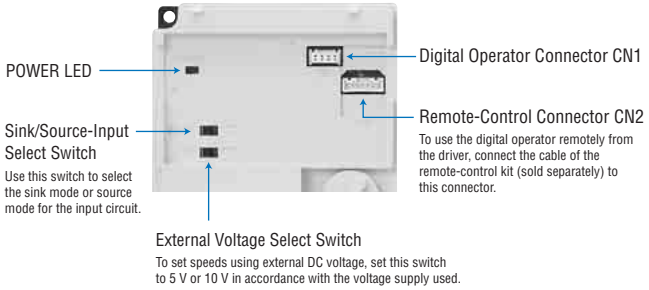
Names and Functions of Driver Parts



◇Digital Operator



When the digital operator is detached



Input/Output Signals

Terminal Name	Signal	Signal Name	Function
TH	Input	N. C.	Do not connect any signals to this terminal.
TH		N. C.	Do not connect any signals to this terminal.
M0		M0 Input	These signals are used to select operation data in multi-speed operation. One of up to eight preset speed data can be selected using the M0, M1 and M2 inputs.
M1		M1 Input	
M2		M2 Input	
VH		VH Input	These signals are used to set speeds via an external speed potentiometer or external DC voltage.
VM		VM Input	
VL		VL Input	
C3		IN-COM1	Input signal common (0 V)
X0*1		EXT-ERROR Input	External error input (Normally closed)
C0		IN-COM0	Input signal common
C1		IN-COM0	Input signal common
X1*2		2-Wire Mode: CW Input	Clockwise rotation/stop switch input signal
		3-Wire Mode: START/STOP Input	Start/stop input signal
X2*2		2-Wire Mode: CCW Input	Counterclockwise rotation/stop switch input signal
		3-Wire Mode: RUN/BRAKE Input	Run/instantaneous stop input signal
X3*2		2-Wire Mode: STOP-MODE Input	This signal is input to select the motor stop action.
		3-Wire Mode: CW/CCW Input	Clockwise/counterclockwise direction input signal
X4		N. C.	Do not connect any signals to this terminal.
X5		ALARM-RESET Input	This signal is used to reset alarms.
Y1	Output	ALARM-OUT1 Output	This signal is output upon generation of an alarm. (Normally closed)
Y2		ALARM-OUT2 Output	This signal is output upon actuation of the overload protective function or overload warning function. (Normally closed)
Y0		SPEED-OUT Output	30 pulses are output per each rotation of the motor output shaft.
C2		OUT-COM	Output signal common

*1 Do not remove the short circuit bar if the EXT-ERROR input is not used.
*2 The functions of the external-input signal terminals X1, X2 and X3 can be changed between the 2-wire input mode and 3-wire input mode. The functions under the 2-wire input mode are initially assigned to the terminals.

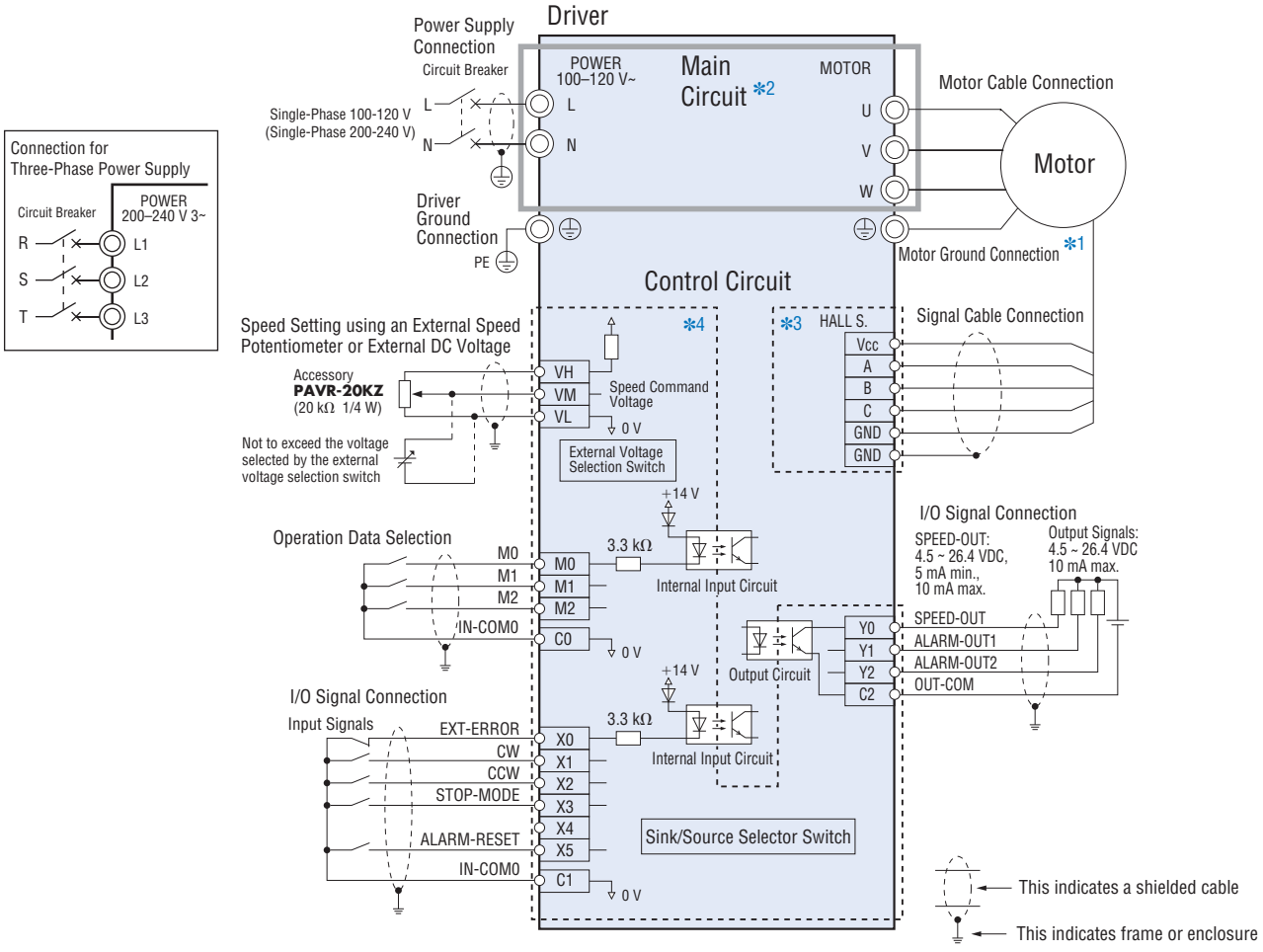
Digital Operator Indicator

Display		Function	Description
RUN		Running	A green LED stays lit while the motor is running.
ALARM		Alarm	A red LED turns on when an alarm occurs.
Mode	MNTR	Monitor mode	The motor can be operated in this mode. The motor speed and load condition are displayed during motor operation.
	F/R	Direction setting mode	If the digital operator is used to operate the motor, set the motor direction in this mode. For: Clockwise direction, rEv: Counterclockwise direction
	LO/RE	Digital operator/external-input signal mode	In this mode, set whether to use the digital operator or external I/O signals to input the motor operation/stop signals. Lo: Digital operator, rE: External-input signals
	PRGM	Data setting mode	In this mode, set the data needed to operate the motor. Operation data (eight speeds and acceleration/deceleration times), Gear ratio setting/conveyor speed setting Input mode, Overload warning function
Display Unit	r/min	Motor speed	The speed of the motor or gearhead output shaft is displayed.
	m/min	Conveyor speed	An equivalent moving speed of the work on a conveyor or other transfer system is displayed.
	%	Load factor*	The actual load is displayed as a percentage of the rated torque being 100%.

*A maximum error of approximately 20% may generate when the motor is operated at the rated speed under the rated load.

●Connection Diagram

The figure below is a connection diagram for a configuration based on a single-phase 100-120 V supply voltage, with the sink/source selector switch set to the sink side.



✻1 The grounding method will vary depending on the length of the connection cable.
When the connection cable is 7 m (23.0 ft.) or shorter: Connect the protective earth terminal on the connection cable to the protective earth terminal on the driver.
When the connection cable is 10 m (32.8 ft.) or longer: Connect the protective earth terminal of the motor directly to the grounding point.

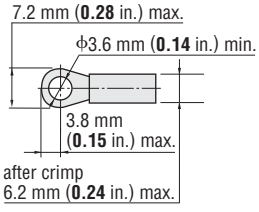
✻2 The main circuit is insulated to prevent electrical shock resulting from accidental contact by a hand, etc.

✻3 The signal cable connection terminals and the signal cable including the shielded cable comprise an ELV circuit, which is insulated from dangerous voltages only by means of basic insulation. Therefore, connect the shielded cable to the GND point specified in the connection diagram, instead of connecting it to a protective earth terminal.

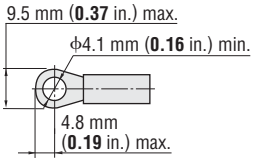
✻4 The I/O signal connection terminals comprise a SELV circuit, which is insulated from dangerous voltages by means of double insulation or reinforced insulation.

◇Applicable Crimp Terminals

· Power Supply Connection Terminals (M3.5):
Round Terminal with Insulation

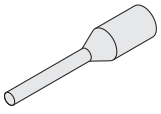


· Protective Earth Terminals (M4):
Round Terminal with Insulation



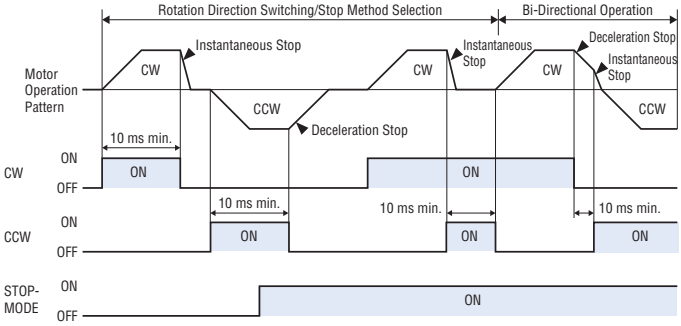
· I/O Terminals

Use the terminals specified below for connection using crimp terminals. Please note that the applicable crimp terminal will vary depending on the size of the wire. The following terminals can be used with wires of AWG26 to 22.
[Manufacturer: Phoenix Contact]
AI 0.25-6 Applicable wire size
: AWG26 to 24 (0.14 to 0.2 mm²)
AI 0.34-6 Applicable wire size
: AWG22 (0.3 mm²)



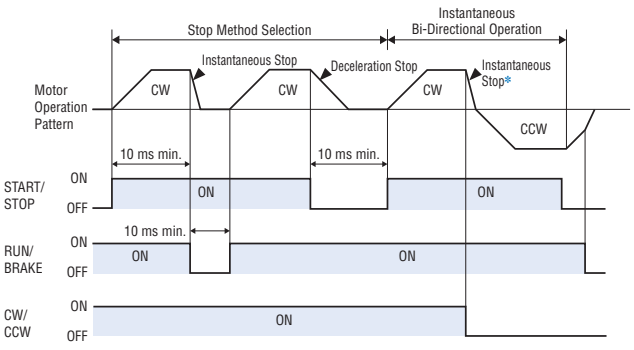
●Timing Chart

◇2-Wire Mode



- The CW input signal, CCW input signal and STOP-MODE signal can be used to control all motor operations, such as run, stop, direction switching, deceleration stop and instantaneous stop.
- Switching the CW signal ON will cause the motor to turn clockwise as viewed from the motor shaft, while switching the CCW signal ON will cause the motor to turn counterclockwise. Switching each signal OFF will stop the motor. If both the CW signal and CCW signal are turned ON at the same time, the motor will stop instantaneously. The motor will start at the rise time corresponding to the acceleration time (ACC) set on the digital operator.
- Switching the STOP-MODE signal ON will cause the motor to decelerate at the deceleration time (DEC) set on the digital operator until it eventually stops. Switching the STOP-MODE signal OFF will cause the motor to stop instantaneously.

◇3-Wire Mode



- The START/STOP signal, RUN/BRAKE signal and CW/CCW signal can be used to control all motor operations, such as run/stop, instantaneous stop and direction switching.
- Switching both the START/STOP signal and RUN/BRAKE signal ON at the same time will start the motor. At this time, switching the CW/CCW signal ON will cause the motor to turn clockwise as viewed from the motor shaft, while switching the signal OFF will cause the motor to turn counterclockwise. The motor will start at the rise time corresponding to the acceleration time (ACC) set on the digital operator.
- Switching the RUN/BRAKE signal OFF while the START/STOP signal is ON will cause the motor to stop instantaneously. Switching the START/STOP signal OFF while the RUN/BRAKE signal is ON will cause the motor to decelerate at the deceleration time (DEC) set on the digital operator until it eventually stops.

✻Changing the direction while the motor is running will cause the motor to stop instantaneously and then change its direction.

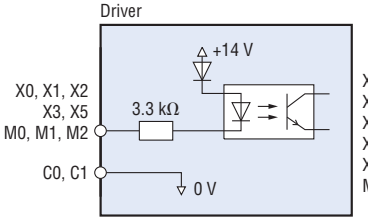
●Input/Output Signal Circuits

The initial setting is the sink logic. Select the sink logic or source logic according to the controller you will be using.

◇Input Circuit

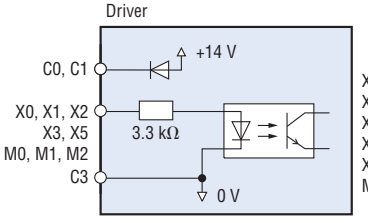
Common to the CW (START/STOP), CCW (RUN/BRAKE), STOP-MODE (CW/CCW), EXT-ERROR, ALARM-RESET and operation-data selection inputs.

• Sink Logic



X0: EXT-ERROR Input
X1: CW Input
X2: CCW Input
X3: STOP-MODE Input
X5: ALARM-RESET Input
M0, M1, M2: Operation data selection inputs

• Source Logic

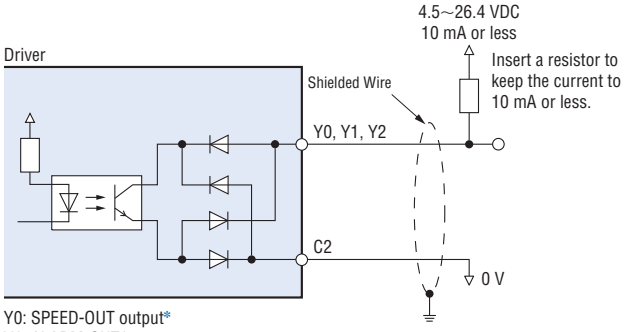


X0: EXT-ERROR Input
X1: CW Input
X2: CCW Input
X3: STOP-MODE Input
X5: ALARM-RESET Input
M0, M1, M2: Operation data selection inputs

◇Output Circuit

Common to the SPEED-OUT, ALARM-OUT1 and ALARM-OUT2 outputs.

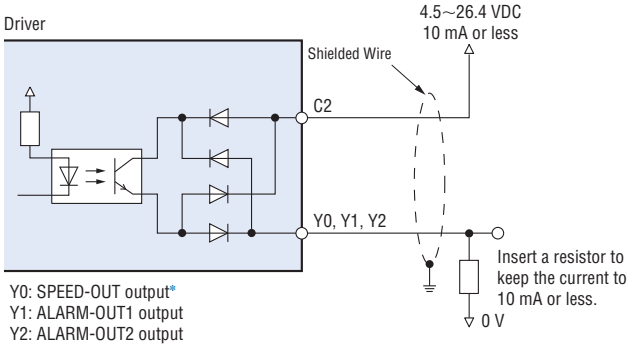
• Sink Logic



Y0: SPEED-OUT output*
Y1: ALARM-OUT1 output
Y2: ALARM-OUT2 output

*Supply a current of 5 mA or more to the SPEED-OUT output.

• Source Logic



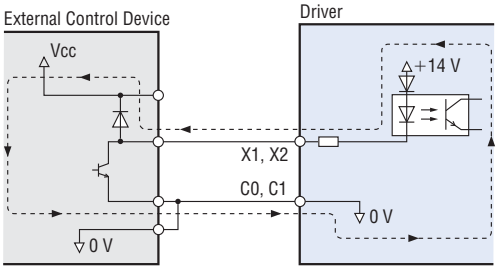
Y0: SPEED-OUT output*
Y1: ALARM-OUT1 output
Y2: ALARM-OUT2 output

*Supply a current of 5 mA or more to the SPEED-OUT output.

◇When an External Control Device with a Built-In Clamp Diode is Used

When you want to use an external control device with a built-in clamp diode, if the external control device power is turned off with the driver power turned on, current will be applied and the motor may run. When the power is turned on or off simultaneously, the motor may run temporarily due to differences in power capacity. The external control device power must be turned on first, and driver power must be turned off first.

• Example of Sink Logic



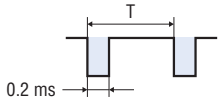
◇SPEED-OUT Output

Pulse signals of 30 pulses (pulse width: 0.2 ms) are output per each rotation of the motor output shaft in synchronization with the motor operation.

By measuring the frequency of SPEED-OUT outputs, the motor speed can be calculated.

$$\text{SPEED-OUT output frequency (Hz)} = \frac{1}{T}$$

$$\text{Motor shaft speed (r/min)} = \frac{\text{SPEED-OUT output frequency}}{30} \times 60$$



◇ALARM-OUT1 Output

When any of the driver's protective functions is activated, the ALARM-OUT1 output will turn OFF and the digital operator will display an alarm code. The motor will coast to a stop.

◇ALARM-OUT2 Output

The ALARM-OUT2 output will turn OFF when the driver's overload protective function or overload warning function is activated. Actuation of any other protective function will not turn this output OFF.

The overload warning function is activated based on a preset load factor relative to the rated torque. The ALARM-OUT2 output will turn OFF once the set load factor is exceeded.

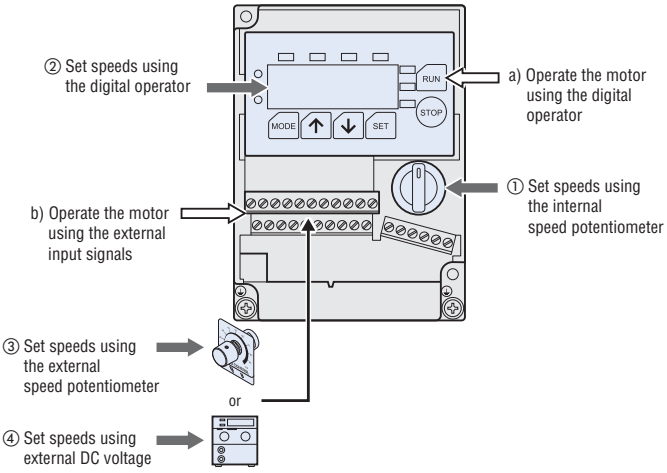
(A desired load factor can be set at 10% intervals between 50 and 100%.)

Type of Protective Function	ALARM-OUT1 Output	ALARM-OUT2 Output
Normal Operation	ON	ON
Overload Protective Function	OFF	OFF
Other Protective Functions	OFF	ON
Overload Warning Function*	ON	OFF

*A maximum error of approximately 20% may generate when the motor is operated at the rated speed under the rated load.

Features B-60 / System Configuration B-62 / Product Line B-64 / Specifications B-66

●Operating Methods



One of the following two operating methods (a and b) can be set by switching between the digital operator mode and external input signal mode.

a) Operate the motor using the RUN and STOP keys on the digital operator

b) Operate the motor using external input signals

●Speed Setting Methods

One of the following four methods (① to ④) can be used to set speeds:

① Set speeds using the internal speed potentiometer

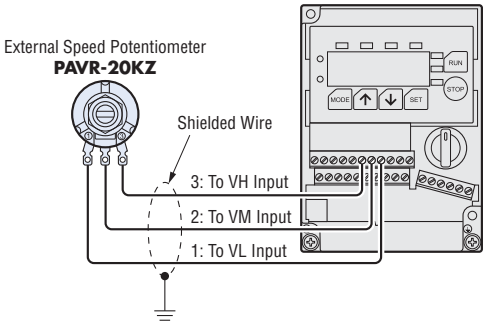
Set speeds using the potentiometer provided on the driver's front panel.

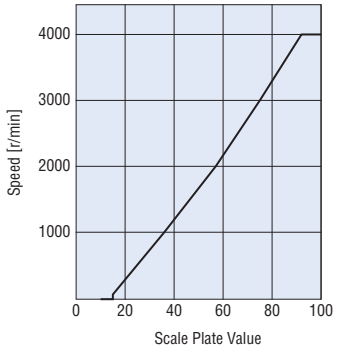
② Set speeds using the digital operator

The digital operator can be used to set speeds in units of 1 r/min. Up to eight speed data can be set.

③ Set speeds using an external speed potentiometer (sold separately)

To set speeds at a location away from the driver, connect an accessory external speed potentiometer as shown below.





External Speed Potentiometer Scale – Speed Characteristics
(Representative values)

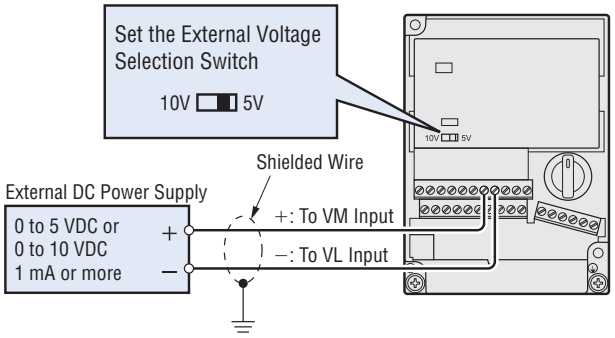
Note:

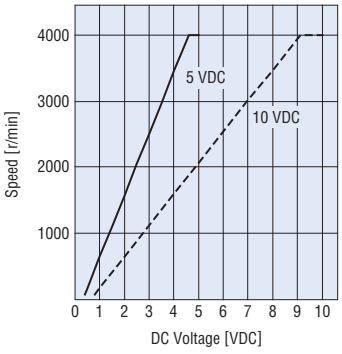
●The speed in the graph represents the speed of a motor alone. The gearhead output shaft speed of the combination type is calculated by dividing the graph speed by the gear ratio.

④ Set speeds using external DC voltage

Set the external voltage select switch on the driver in accordance with the external DC voltage to be supplied. Detach the digital operator and set the switch to either 5 V or 10 V.

Thereafter, connect an external DC power supply as shown below. Connect the positive and negative terminals of the power supply correctly.





External DC Voltage – Speed Characteristics
(Representative values)

Note:

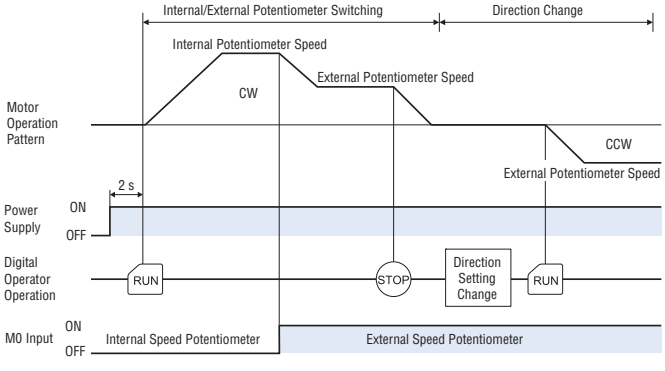
●The speed in the graph represents the speed of a motor alone. The gearhead output shaft speed of the combination type is calculated by dividing the graph speed by the gear ratio.

●Multi-Speed Operation

◇Two-Speed Operation

The speed set by the internal speed potentiometer and another set by an external speed potentiometer can be combined for two-speed operation by switching the operation data selection input M0.

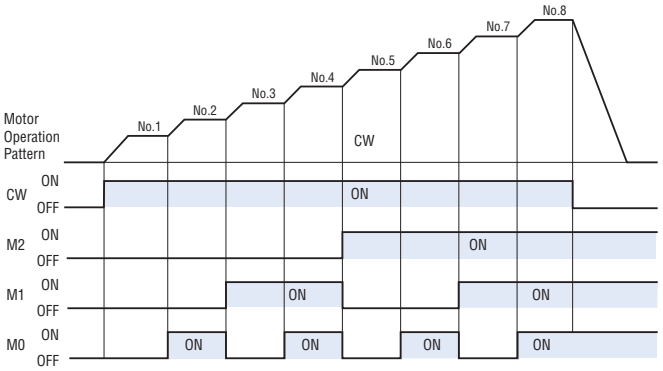
M0 Input	M1 Input	M2 Input	Speed Setting Method
OFF	OFF	OFF	Internal speed potentiometer
ON	OFF	OFF	External speed potentiometer



◇Eight-Speed Operation

A multi-speed operation using up to eight speeds can be performed by setting desired speeds in operation data No. 1 to 8 and then switching the speed using operation-data selection input M0, M1 or M2.

Operation Data	M0 Input	M1 Input	M2 Input	Speed Setting Method
No. 1	OFF	OFF	OFF	Internal speed potentiometer/Digital operator
No. 2	ON	OFF	OFF	External speed potentiometer/Digital operator
No. 3	OFF	ON	OFF	Digital operator
No. 4	ON	ON	OFF	Digital operator
No. 5	OFF	OFF	ON	Digital operator
No. 6	ON	OFF	ON	Digital operator
No. 7	OFF	ON	ON	Digital operator
No. 8	ON	ON	ON	Digital operator



●Multi-Motor Control

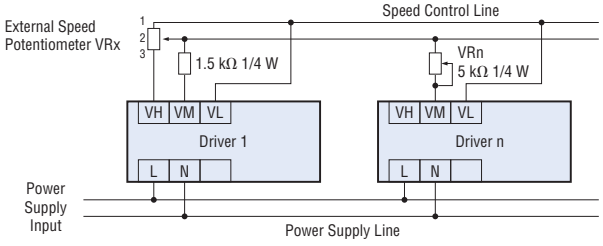
Two or more motors can be operated at the same speed by using a single external speed potentiometer or external DC voltage.
The diagram below applies to a single-phase power supply specification. For a three-phase power supply specification, change the power supply line to a three-phase type. Also note that the diagram does not show the motor or operation control part.

◇Using an External Speed Potentiometer

As shown in the diagram, use a common power supply line and a common speed control line for each driver and set speeds by using the external speed potentiometer VRx.
The resistance of the external speed potentiometer is determined using the formula below:

Resistance when the number of drivers is n:
VRx = 20/n (kΩ), n/4 (W)
Example: When two drivers are connected
VRx = 20/2 = 10 (kΩ), 2/4 = 1/2 (W)
Accordingly, the resistance is calculated as 10 kΩ, 1/2 W.

To adjust the speed difference between motors, connect a 1.5 kΩ, 1/4 W resistor to the VM terminal on the first driver, and connect a 5 kΩ, 1/4 W variable resistor (VRn) to the VM terminal on each of the remaining drivers.
Up to five drivers can be operated in parallel using an external speed potentiometer.

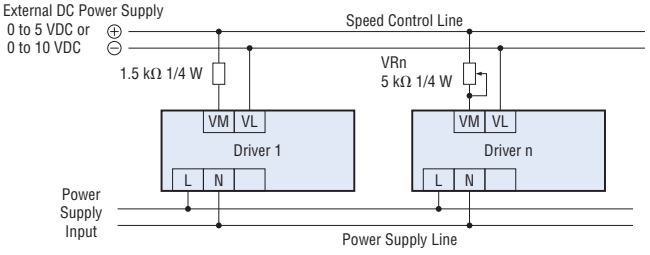


◇Using External DC Voltage

As shown in the diagram, use a common power supply line and a common speed control line for each driver and connect all drivers to a 5 or 10 VDC power supply.
The power-supply capacity of the external DC power supply is determined using the formula below:

Power-supply capacity when the number of drivers is n:
I = 1 × n (mA)
Example: When two drivers are connected
I = 1 × 2 = 2 (mA)
Accordingly, the power-supply capacity is calculated as 2 mA or more.

To adjust the speed difference between motors, connect a 1.5 kΩ, 1/4 W resistor to the VM terminal on the first driver, and connect a 5 kΩ, 1/4 W variable resistor (VRn) to the VM terminal on each of the remaining drivers.



◇Using the Digital Operator

When multiple drivers are connected where the same data are set digitally in each driver, the operations of multiple motors can be controlled via an external input signal using the wiring circuit shown below.