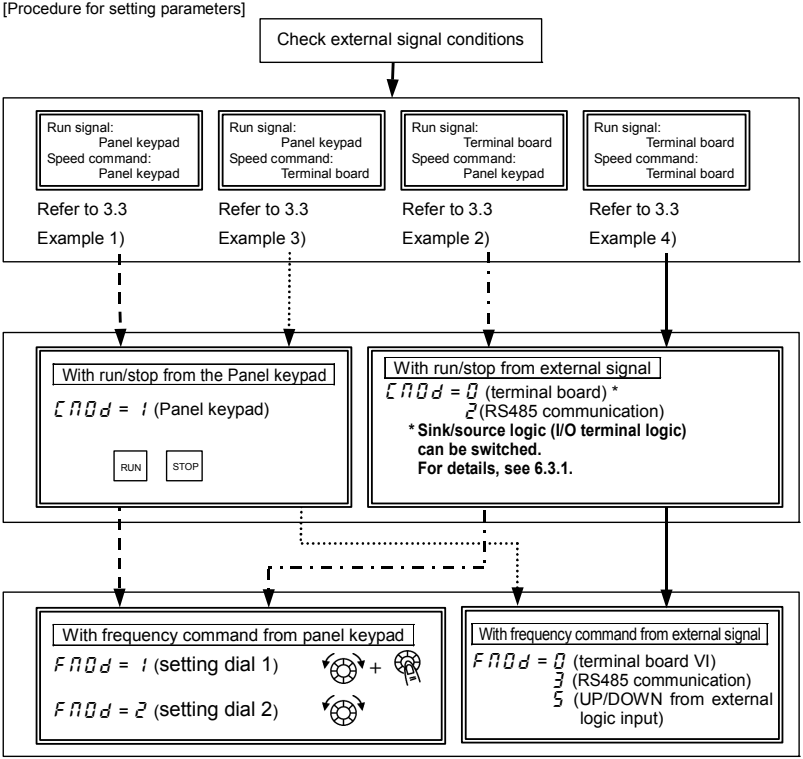
7. Operations with external signal

7.1 Operating external signals

You can control the inverter externally.
The parameter settings differ depending upon your method of operation. Determine your method of operation (the operational signal input method, speed command input method) before using the procedure below to set the parameters.

[Procedure for setting parameters]



* For settings based on communication, refer to the Communication Instruction Manual or section 6.22.

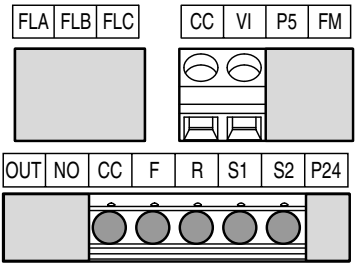
7.2 Applied operations by an I/O signal (operation from the terminal block)

Input terminal sink and source logic are set according to the selection on the setup menu. (See 3.1.)

7.2.1 Input terminal function

This function is used to send a signal to the input terminal from an external programmable controller to operate or configure the inverter.
The ability to select from a variety of functions allows for flexible system design.

[Control terminal board]



■ Settings for the contact input terminal function

Terminal symbol	Title	Function	Adjustment range	Standard defaults
F	F111	Input terminal selection 1A (F)	0 to 201 Note 1)	2 (F)
	F151	Input terminal selection 1B (F)		0 (No function)
	F155	Input terminal selection 1C (F)		0 (No function)
R	F112	Input terminal selection 2A (R)	0 to 201 Note 1)	4 (R)
	F152	Input terminal selection 2B (R)		0 (No function)
	F156	Input terminal selection 2C (R)		0 (No function)
S1	F113	Input terminal selection 3A (S1)	0 to 201 Note 1)	10 (SS1)
	F153	Input terminal selection 3B (S1)		0 (No function)
S2	F114	Input terminal selection 4A (S2)	0 to 201 Note 1)	12 (SS2)
	F154	Input terminal selection 4B (S2)		0 (No function)
VI	F109	Analog/logic input Selection (VI terminal)	0: Voltage signal input (0 - 10 V) 1: Current signal input (4 - 20 mA) 2: Logic input 3: Voltage signal input (0 - 5 V)	0
	F115	Input terminal selection 5	8 to 55 Note 3)	14 (SS3)

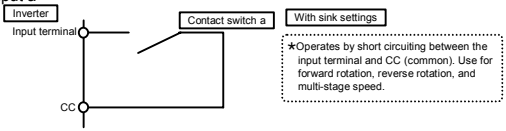
Note 1) Multiple functions assigned to a single terminal operate simultaneously.

Note 2) In case of setting always active function, assign the menu number to F108 and F110 (always active function selection).

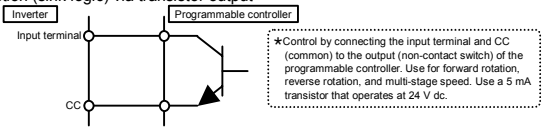
Note 3) When VI is used for the logic input (sink logic), always connect a resistor between VI and terminal P24. For details, see 2.3.2 (page B-9).

■ Connecting

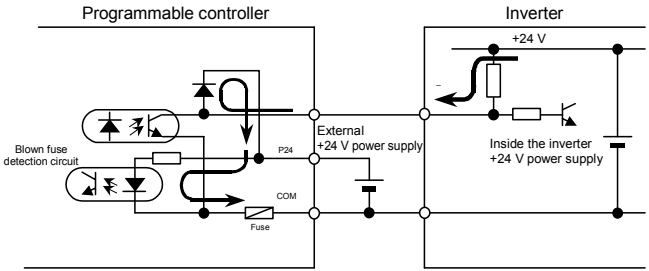
1) For contact input a



2) For connection (sink logic) via transistor output



∗ About programmable controllers and interfaces If controlling the inverter using an open collector output programmable controller, the following error signals are sent to the inverter. This is a result of differences in the height of control power supply potential when the inverter remains ON and the programmable controller is turned OFF. Always set the inverter lock to prevent the programmable controller from being turned OFF while the inverter is ON.



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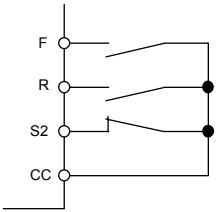
■ Usage example 1 ··· 3-wire operation (one-push operation)

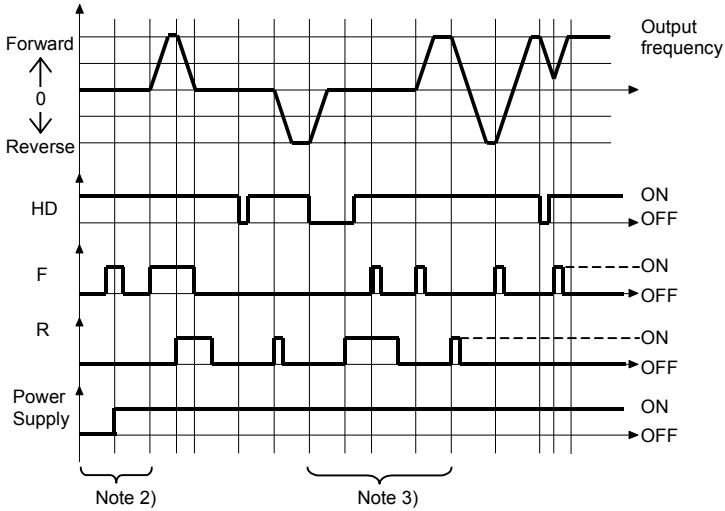
Use the 3-wire operation function to operate the inverter, maintaining operation without using the sequence circuit by inputting an external signal (reset contact signal).



Forward run (F) : Pressing forward run (F) rotates forward at the specified frequency command value.

Reverse run (R) : Pressing reverse run (R) rotates in reverse at the specified frequency command value.

HD (S2): Pressing HD (S2) decelerates and stops.



Note 1) Set F110 = 6 (ST: standby) and CNOd = 0 (terminal board) for 3 wire operation. Assign HD (operation hold) to any input terminal at input terminal selection. When assigning the S2 terminal as shown above, set F114 = 50 (HD: operation hold).

Note 2) If the terminals are ON before turning on the power, terminal input is ignored when the power is turned ON. (Prevents sudden movements.) After turning the power ON, turn terminal input ON again.

Note 3) When HD is OFF, F and R are ignored even when ON. R does not operate even if it's ON when HD is ON. Likewise in this state, F does not operate even if it's ON. Turn F and R OFF and then turn them ON.

Note 4) During 3 wire operation, sending the jog run mode command stops operation.
Note 5) Be aware that DC braking continues even if a startup signal is input during DC braking.
Note 6) Only F and R maintain HD (operation hold). When using F or R in combination with other functions, be aware that the other functions do not hold. For example, when F and SS1 are assigned, F holds, but SS1 does not.

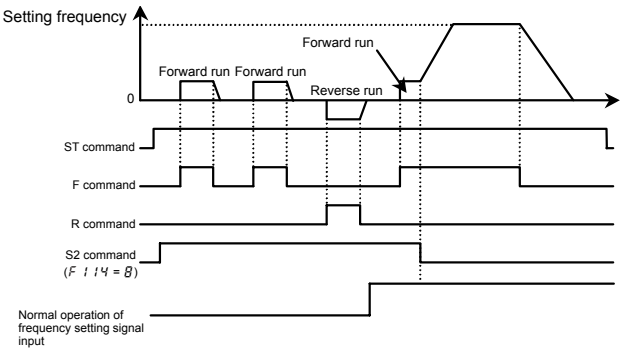
[Parameter settings]

Terminal symbol	Title	Function	Adjustment range	Setting example
S2	F114	Input terminal selection 4A (S2)	0 ~ 201	50 (HD operation hold)

■ Usage example 2 ··· Jog run

Jog run is used for inching the motor. When a jog run signal is input, a jog run frequency is immediately output, regardless of the acceleration time set.

Assign the jog run function to any input terminal. For example, when assigned to the S2 terminal, set F114 = 18. Jog run is done while the jog input terminal (S2 terminal) and either F or R are ON.



- The jog frequency is fixed at 5 Hz.
- The stop pattern is slowdown stop.
- The jog run setting terminal is valid when the operation frequency is less than the jog frequency. Jog run does not function when the operation frequency is higher than the jog frequency.
- Even if an operation command is input midway, jog operation is prioritized.
- The jog frequency is not limited by the upper limit frequency (parameter UL).

■ List of contact input terminal function settings

Parameter programmed value		Function	Parameter programmed value		Function
Positive logic	Negative logic		Positive logic	Negative logic	
0	1	No function	36	37	PID control prohibition
2	3	Forward run command	48	49	Forced local from communication
4	5	Reverse run command	50	51	Operation hold (hold of 3-wire operation)
6	7	Standby	52	53	PID integral/differential clear
8	9	Reset command	54	55	PID characteristics switching
10	11	Preset-speed command 1	88	89	Frequency UP from external logic input *1
12	13	Preset-speed command 2	90	91	Frequency DOWN from external logic input *1
14	15	Preset-speed command 3	92	93	Frequency UP/DOWN from external contacts *1
16	17	Preset-speed command 4	96	97	Coast stop
18	19	Jog run mode	106	107	Frequency setting mode terminal board VI
20	21	Emergency stop by external signal	108	109	Command mode terminal board
22	23	DC braking command	110	111	Parameter editing permission
24	25	2nd acceleration/deceleration	122	123	Forced deceleration command
28	29	2nd V/F control mode switching	200	201	Parameter editing prohibition
32	33	2nd stall prevention level			

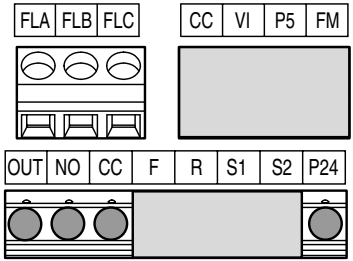
*1: Active when FMOd (frequency setting mode selection) = 5 (UP/DOWN from external logic input) is set. The frequency setup range is from 0.0 to UL (upper limit frequency). The acceleration/deceleration time relative to the set frequency is ACCIdEC while the acceleration/deceleration speed is not switched.

☆ For details about the input terminal function, see 11.6.

7.2.2 Output terminal function (sink logic)

This function is used to output a variety of signals to external devices from the inverter.
With the contact output terminal function, you can select from multiple output terminal functions. Set two types of functions for the OUT terminal and then you can output when either one or both of them is ON.

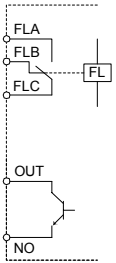
[Control terminal block]



■ Usage

FLA, B, C function: Set at parameter F 132.

OUT-NO function: Set at parameter F 130 and 137.



■ Assign one type of function to an output terminal

Terminal symbol	Title	Function	Adjustment range	Standard defaults
OUT-NO	F 130	Output terminal selection 1A	0 ~ 255	4 (Low-speed detection signal)
FL (A, B, C)	F 132	Output terminal selection 2		10 (fault FL)

Note) When assigning 1 type of function to the OUT-NO terminal, set only F 130.
Leave parameter F 137 as the standard setting (F 137 = 255).

■ Assign two types of functions to the output terminal (OUT-NO)

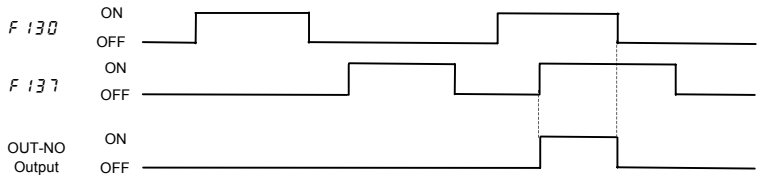
Terminal symbol	Title	Function	Adjustment range	Standard defaults
OUT-NO	F130	Output terminal selection 1A	0 ~ 255	4 (Low-speed detection signal)
	F137	Output terminal selection 1B		255 (normally ON)
	F139	Output terminal logic selection (OUT-NO)	0: F130 and F137 1: F130 or F137	O

Note 1) F130 and F137 are active only when F669 = 0: Logic output (default).
Function is inactive when F669 = 1: Pulse train output is set.

(1) Output signals when two types of functions are simultaneously turned ON.

Signals are output when parameter F139 is the default (F139 = 0), and the functions set at parameters F130 and F137 are simultaneously turned ON.

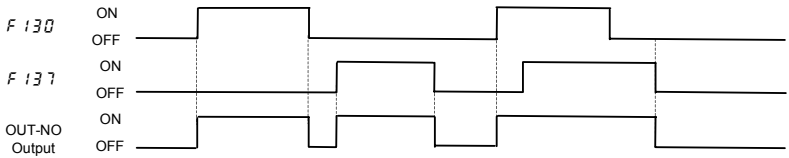
☆ Timing chart



(2) Output signals when either one of two types of functions are simultaneously turned ON.

Signals are output when parameter F139 = 1, and either of the functions set at parameters F130 and F137 are turned on.

☆ Timing chart



■ List of output terminal function settings

<Explanation of terminology>
• Alarm ..... Alarm output when a setting has been exceeded.
• Pre-alarm ..... Alarm output when the inverter may cause a trip during continued operation.

List of detection levels for output terminal selection

Parameter programmed value		Function	Parameter programmed value		Function
Positive logic	Negative logic		Positive logic	Negative logic	
0	1	Frequency lower limit	26	27	Small current detection
2	3	Frequency upper limit	28	29	Over-torque detection
4	5	Low-speed detection signal	40	41	Run/Stop
6	7	Output frequency attainment signal (acceleration/deceleration completed)	56	57	Cumulative operation time alarm
8	9	Set frequency attainment signal	60	61	Forward/reverse run
10	11	Fault signal (trip output)	78	79	RS485 communication error
14	15	Over-current pre-alarm	92	93	Assigned data output
16	17	Overload pre-alarm	128	129	Parts replacement alarm
20	21	Overheat pre-alarm	146	147	Fault signal (output also at a ready)
22	23	Overvoltage pre-alarm	254		Always OFF
24	25	Power circuit undervoltage detection	255		Always ON

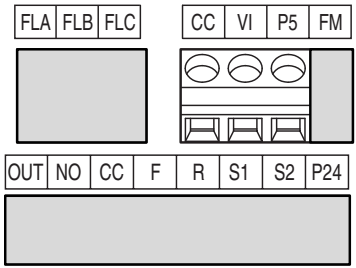
Note 1) ON with positive logic : Open collector output transistor or relay turned ON.
OFF : Open collector output transistor or relay turned OFF.
ON with negative logic : Open collector output transistor or relay turned OFF.
OFF : Open collector output transistor or relay turned ON.

☆ For details about the output terminal functions or levels, see 11.7.

7.3 Speed instruction (analog signal) settings from external devices

You can select from voltage input (0 to 10 V, 0 to 5 V), and current input (4 to 20 mA) for an analog input terminal (VI).
The maximum resolution is 1/1000.

[Control terminal block]



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■ Analog input terminal (VI) function settings

Title	Function	Adjustment range	Standard default setting
F109	Analog/logic input selection (VI terminal)	0: Voltage signal input (0 - 10 V) 1: Current signal input (4 - 20 mA) 2: Logic input 3: Voltage signal input (0 - 5 V)	0
F201	VI input point 1 setting	0 - 100%	0
F202	VI input point 1 frequency	0.0 - 400.0Hz	0.0
F203	VI input point 2 setting	0 - 100%	100
F204	VI input point 2 frequency	0.0 - 400.0Hz	*
F209	Analog input filter	4 - 1000 ms	64

* Depends upon the setup menu settings. Select either 50.0 or 60.0. (See 11.5.)

Note) When stable operation cannot be attained because of frequency setting circuit noise, increase F209.

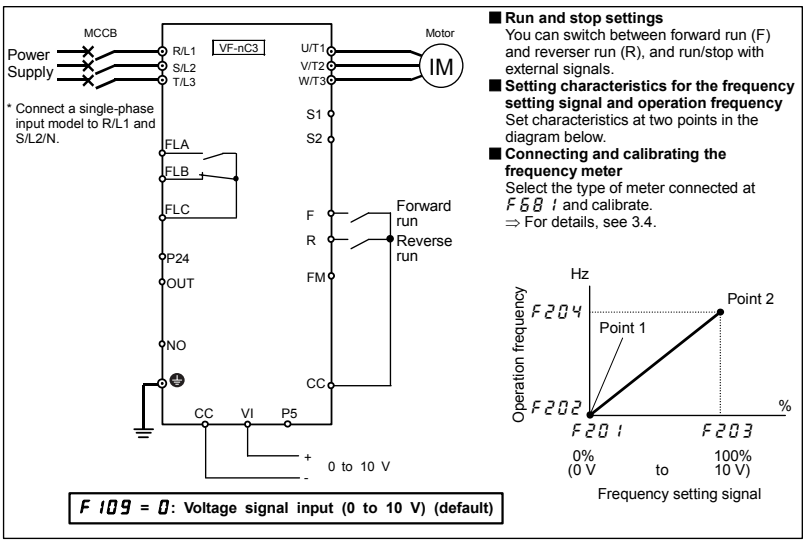
7.3.1 Settings depending on voltage (0 to 10 V) input

You can set the frequency settings by inputting an analog voltage signal of 0 to 10 V dc between the VI and CC terminals.

The following shows examples when the run command is input from the terminal.

Title	Function	Adjustment range	Standard defaults	Setting example
CMOd	Command mode selection	0 - 2	1 (panel keypad)	0 (terminal board)
FMOd	Frequency setting mode selection	0 - 5	2 (setting dial)	0 (terminal board VI)
F109	Analog/logic input selection (VI terminal)	0: Voltage signal input (0 - 10 V) 1: Current signal input (4 - 20 mA) 2: Logic input 3: Voltage signal input (0 - 5 V)	0	0 (Voltage signal (0 - 10 V))
F201	VI input point 1 setting	0 - 100%	0	0
F202	VI input point 1 frequency	0.0 - 400.0Hz	0.0	0.0
F203	VI input point 2 setting	0 - 100%	100	100
F204	VI input point 2 frequency	0.0 - 400.0Hz	*	60.0
F209	Analog input filter	4 - 1000 ms	64	64

* Depends upon the setup menu settings. Either 50.0 or 60.0 is selected.



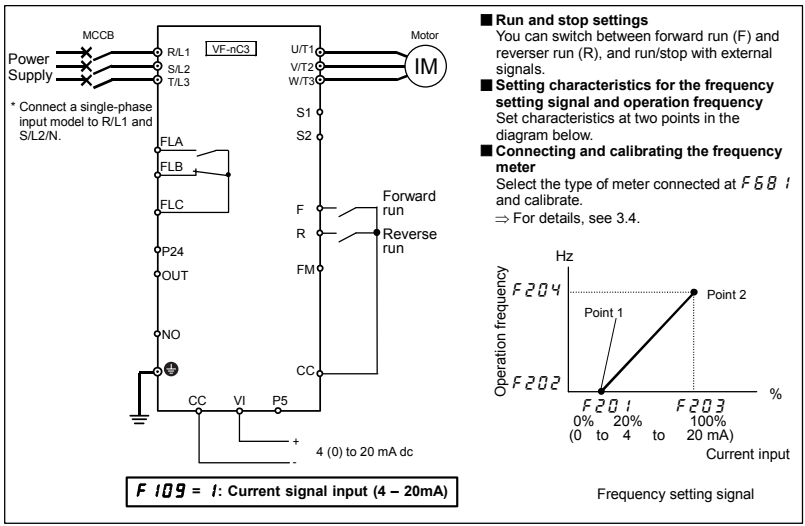
7.3.2 Settings depending on current (4 to 20 mA) input

You can set the frequency settings by inputting an analog current signal of 4 (0) to 20 mA dc between the VI and CC terminals.

The following shows examples when the run command is input from the terminal.

Title	Function	Adjustment range	Standard defaults	Setting example
CMOd	Command mode selection	0 - 2	1 (panel keypad)	0 (terminal board)
FMOd	Frequency setting mode selection	0 - 5	2 (setting dial)	0 (terminal board VI)
F109	Analog/logic input selection (VI terminal)	0: Voltage signal input (0 - 10 V) 1: Current signal input (4 - 20 mA) 2: Logic input 3: Voltage signal input (0 - 5 V)	0	1 (Current signal (4 - 20 mA))
F201	VI input point 1 setting	0 - 100%	0	20(0)
F202	VI input point 1 frequency	0.0 - 400.0Hz	0.0	0.0
F203	VI input point 2 setting	0 - 100%	100	100
F204	VI input point 2 frequency	0.0 - 400.0Hz	*	60.0
F209	Analog input filter	4 - 1000 ms	64	64

* Depends upon the setup menu settings. Either 50.0 or 60.0 is selected.



7.3.3 Settings depending on voltage (0 to 5 V) input <external potentiometer>

You can set the frequency by connecting the FRH kit (optional), or a potentiometer (1 to 10 kΩ – 1/4 W) to the VI terminal.

Connect the potentiometer between the P5, VI, and CC terminals. The standard voltage for the P5 terminal is 5 V dc. Instead of using the potentiometer, you can set the frequency settings by inputting an analog voltage signal of 0 to 5 V dc between the VI and CC terminals.

The following shows examples when the run command is input from the terminal.

Title	Function	Adjustment range	Standard defaults	Setting example
CMOd	Command mode selection	0 - 2	1 (panel keypad)	0 (terminal board)
FMOd	Frequency setting mode selection	0 - 5	2 (setting dial)	0 (terminal board VI)
F109	Analog/logic input selection (VI terminal)	0: Voltage signal input (0 - 10 V) 1: Current signal input (4 - 20 mA) 2: Logic input 3: Voltage signal input (0 - 5 V)	0	3 (Voltage signal (0 - 5 V))
F201	VI input point 1 setting	0 - 100%	0	0
F202	VI input point 1 frequency	0.0 - 400.0Hz	0.0	0.0
F203	VI input point 2 setting	0 - 100%	100	100
F204	VI input point 2 frequency	0.0 - 400.0Hz	*	60.0
F209	Analog input filter	4 - 1000 ms	64	64

*Depends upon the setup menu settings. Either 50.0 or 60.0 is selected.