

# MITSUBISHI

VARIABLE FREQUENCY DRIVES

## E500 SERIES



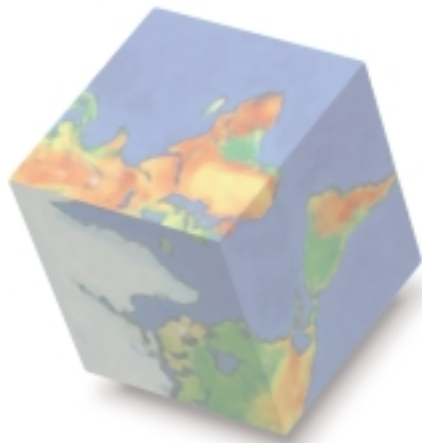
EXPANSIVE FUNCTIONALITY IN  
A COMPACT PACKAGE

# POWERFUL

Get a high torque (150%) at speeds as low as 1Hz  
A regenerative braking resistor can be connected (0.4K or more)

The high response current limit function helps provide safety  
Now with an even higher output current rating

## Mitsubishi's New E500 Series Offers Three Great Values.



# SIMPLE

### Easy to operate.

The control panel now has a frequency setting knob as standard equipment.

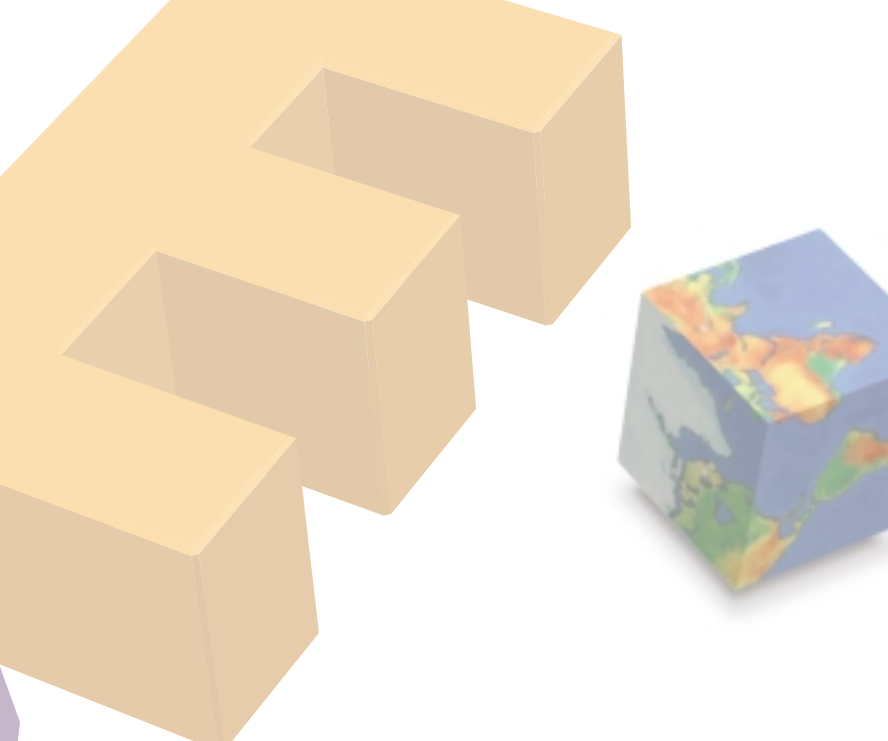
### Easy to maintain.

Easy access make the cooling fan easy to replace.

### Wiring is simple.

Screwed terminal plates are used for the main circuit and for the control circuit (leads plug in).





# SMALL

## Most compact inverter in its class.

Only 85% the volume of a Mitsubishi FREQROL-U100 (for FR-E520-0.2K).

## Height is now standardized.

All models from 0.1 to 3.7kW are the same 128mm in height making panel layout easier. (Except FR-E540)



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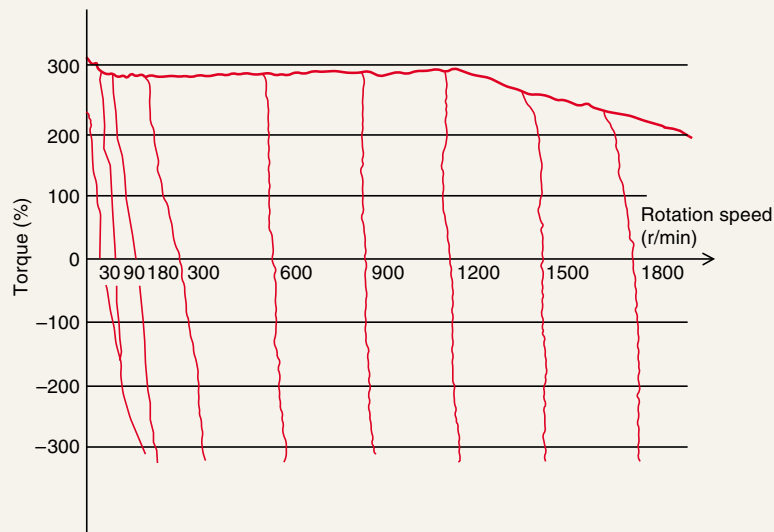
# Features

## Advanced Mitsubishi Technology Creates a Winner Highly Cost-Effective and Very Powerful

### ■ High Torque (150%) at Speeds as Low as 1Hz.

Mitsubishi has achieved a 1Hz 150% torque by combining slip compensation with its original general-purpose flux vector control. Operation can be controlled by general-purpose flux vector control even when motor characteristics vary simply by using the off-line auto-tuning function.

Sample speed-torque characteristics when general-purpose flux vector control and slip compensation are selected (with an SF-JR 4P 0.75kW motor)



### ■ A Brake Resistor can be Connected (0.4K and above).

### ■ High Response Current Limit.

Thanks to the high-response current limit function, there are fewer trips caused by overcurrent. It even handles instant peak currents when starting during reverse coasting.

### ■ Now with a Higher Output Current Rating.

More powerful thanks to the highest output current rating in its class.

## Very Simple

### ■ Easy to Operate

- We added a frequency setting knob (run by a varistor) to the control panel as standard. Variable speed operation is available soon after power is turned on. The control panel is removable, so you can install it on a main control panel with optional equipment and “off-the-shelf” cables. The knob itself is removable. You can also operate it remotely using parameter settings and externally input frequency setting signals.

### ■ The Parameter Unit

- The FR-PU04 is another option available. It takes direct input from a key pad. It uses a long-life backlit LCD and allows you to copy parameters. Eight languages are available (Japanese, English, German, French, Spanish, Italian, Swedish, and Finnish). Connect it with the separately sold cable.



FR-PU04 parameter unit (option)

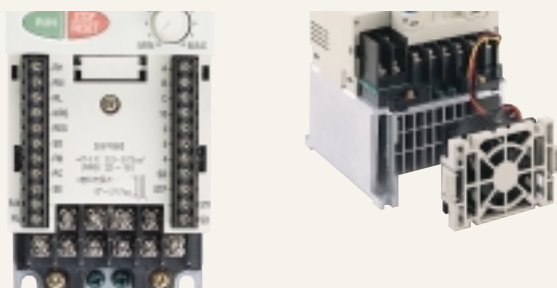
- We've made parameter user group functions as standard. You can select just the parameters you need for writing and reading to simplify parameter management.
- You can use the setup software for parameter settings. We've provided optional software that lets you use a personal computer to assist you in everything from starting up the inverter to maintenance.

### ■ Easy to Maintain

- Easy access makes changing the cooling fan very simple. Operating life can also be increased by turning ON-OFF control on.

### ■ Easy to Wire

- A screwed terminal plate is used for the main circuit.
- A screwed terminal plate is also used for the all new control circuit (with plug in leads). The wide lead holes allow two leads to be plugged in simultaneously.



## Very Compact

### ■ Most Compact Inverter in its Class

Only 85% the volume of a Mitsubishi FREQROL-U100 (for FR-E520-0.2K).

### ■ Height is Now Standardized

All models from 0.1 to 3.7kW are the same 128mm in height. This makes panel layout easier. (Except FR-E540)



Actual Size



# Features

## Highly Cost-Effective Inverters Environmentally Friendly

### Newly Developed Soft-PWM Control

Mitsubishi's Soft-PWM switching system keeps noise to a minimum (as low as a Mitsubishi FR-Z Series inverter).

Note: The default setting is Soft-PWM control.

Sample Motor Noise Data (With an SF-JR 4P 3.7kW Motor and a 2kHz Carrier Frequency).

### Low Noise Operation Available

A higher carrier frequency can be used to reduce operating noise.

### Can Handle Power Supply Harmonic Restrictions

A compact, lightweight DC reactor (FR-BEL) can be connected to all capacities.

### EMC Filter

Use the optional EMC filter to help to comply with EMC standards.

## Full Product Line-Up

### Globally Compatible with Worldwide Standards

- Compatible with UL, CSA, and EN standards (eligible for CE mark). (Models available soon.)
- Select either IP20 or IP40 construction.

### Compatibility with 240V and 480V Power Supply Now Standard

### Full Line-Up of Capacities Available

The FR-E500 is the first line-up in its class to include 5.5kW and 7.5kW capacities, which extends the range to 0.1–7.5kW.

### Compatible with Single-Phase Power Supplies

Compatible with single phase 100V and 200V as well as three-phase 200V and 400V power supplies. (Output is three-phase 200V.)

### Compatibility with Data Communications Also Standard

- We've added RS-485 communications functionality as standard, so you can control operations via data communications once the control panel is removed.

Note: An "off-the-shelf" converter is needed for RS-232C communication.

Model: Converter FA-T-RS40 Series

Mitsubishi Electric Engineering

Industrial Systems Division

Model:

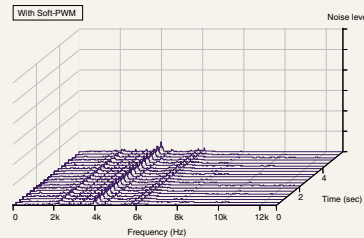
Cable with built-in interface DAFX-CAB Series

Connector conversion cable DINV-485CAB

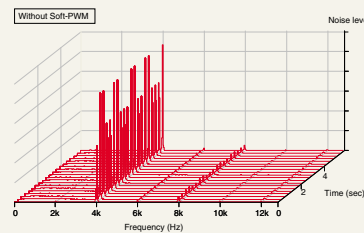
- The inverter can be run using PLC X and Y instructions via CC-Link (compatible models to be released soon), making programming easy.



Motor noise data example (SF-JR 4P 3.7kW motor, carrier frequency 2kHz)



Since the frequency components are dispersed, the motor generates little metallic noise and does not sound unpleasant.

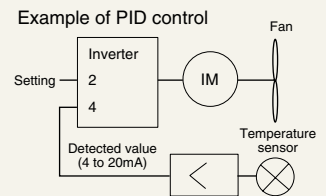


Since the frequency components are concentrated, the motor generates a grating metallic noise.

## Full of Convenient Functions

### New Models Provide Compatibility with Many New Applications

- Stop selection: Select either decelerating stop or coasting stop, depending on machine specification
- PID control: Facilitates flow control using pumps.



### Ample Protection Functions for Safer Operation

- Instantaneous power failure stop restart function: Can start while coasting.
- Built-in electronic overcurrent protection
- Alarm retry selection

### Compatible with Numerous I/Os

- Multi-speed operation (15 speeds)
- 4 to 20mA input
- Multi-input terminals: Select four inputs from 11 possible input types
- Multi-output terminals: Select three outputs from 12 possible output types
- 24V external power supply output (permissible values: 24V DC 0.1A)

### Operating Functions

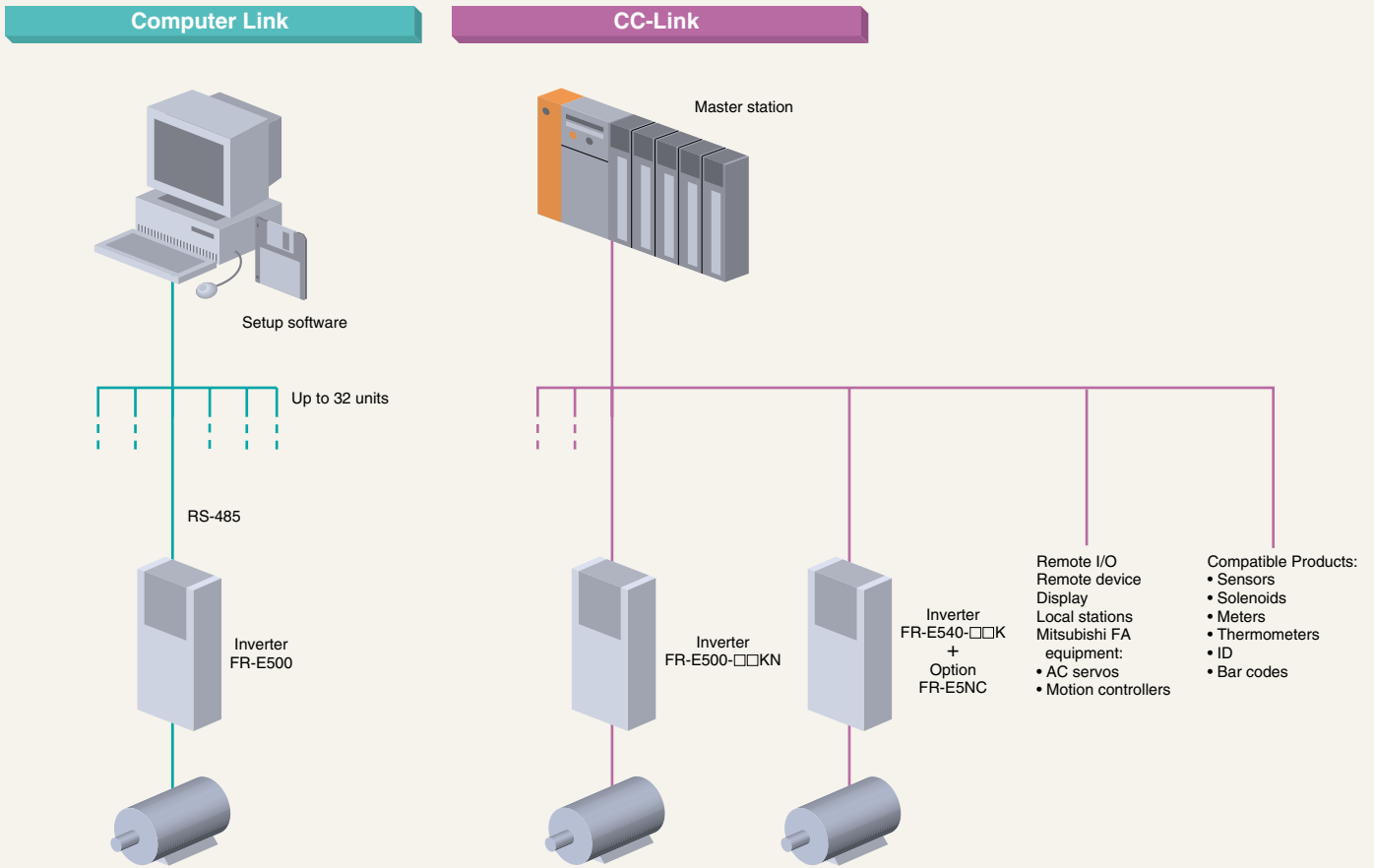
- JOG operation
- Frequency jumps (three points): Avoid the machine's resonant frequency

### Other Convenient Functions

- Fast acceleration/deceleration mode
- Full monitoring: Monitors actual operating time and more
- Second functions: Switch between two sets of motor characteristics
- Zero current detection

# Networks

Compatible with RS-485 and CC-Link.



## Inverter Setup Software (Note)

### Inverter Setup Software

**FR-SW0-SETUP-WJ** (Windows\* 3.1 or 95) (Japanese)

**FR-SW0-SETUP-WE** (Windows\* 3.1 or 95) (English)

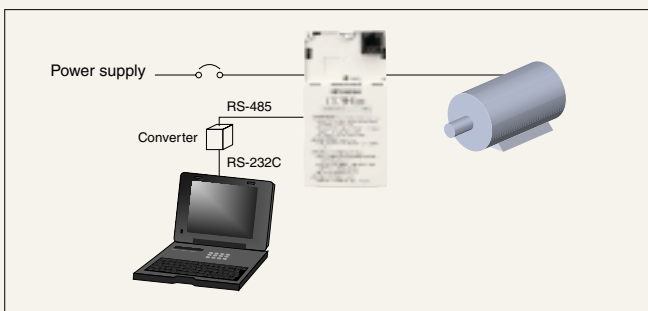
Inverter setup software provides an amenable inverter operating environment. Use it as a support tool for everything from inverter startup to maintenance. It allows you to efficiently set parameters and motor operation in Windows\*.

\*"Windows" is a registered trademark of Microsoft Corporation.

Note: Some models will soon be compatible.

### Functions

- Set and edit parameters
- Monitor
- Test operation
- Diagnosis
- System settings
- Files
- Windows
- Help



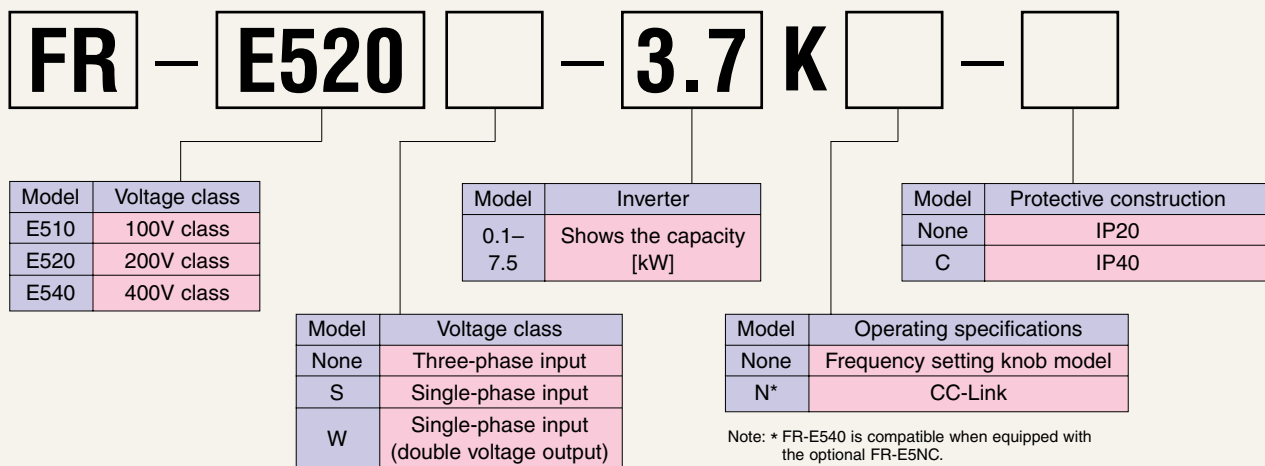
Sample screen showing simple parameter setting

Sample screen showing monitoring and meter displays

Sample screen showing test operation

# Model Configurations

## Model



## Three-Phase 200V Power Supply

Inverter capacity (kW)	Model	IP20		IP40
		Frequency setting knob model	CC-Link	Frequency setting knob model
0.1		FR-E520-0.1K	FR-E520-0.1KN	FR-E520-0.1K-C
0.2		FR-E520-0.2K	FR-E520-0.2KN	FR-E520-0.2K-C
0.4		FR-E520-0.4K	FR-E520-0.4KN	FR-E520-0.4K-C
0.75		FR-E520-0.75K	FR-E520-0.75KN	FR-E520-0.75K-C
1.5		FR-E520-1.5K	FR-E520-1.5KN	FR-E520-1.5K-C
2.2		FR-E520-2.2K	FR-E520-2.2KN	FR-E520-2.2K-C
3.7		FR-E520-3.7K	FR-E520-3.7KN	FR-E520-3.7K-C
5.5		FR-E520-5.5K	FR-E520-5.5KN	FR-E520-5.5K-C
7.5		FR-E520-7.5K	FR-E520-7.5KN	FR-E520-7.5K-C

## Three-Phase 400V Power Supply

Inverter capacity (kW)	Model	IP20	IP40
		Frequency setting knob model	
0.4		FR-E540-0.4K	FR-E540-0.4K-C
0.75		FR-E540-0.75K	FR-E540-0.75K-C
1.5		FR-E540-1.5K	FR-E540-1.5K-C
2.2		FR-E540-2.2K	FR-E540-2.2K-C
3.7		FR-E540-3.7K	FR-E540-3.7K-C
5.5		FR-E540-5.5K	FR-E540-5.5K-C
7.5		FR-E540-7.5K	FR-E540-7.5K-C

## Single-Phase 200V Power Supply

Inverter capacity (kW)	Model	IP20
		Frequency setting knob model
0.1		FR-E520S-0.1K
0.2		FR-E520S-0.2K
0.4		FR-E520S-0.4K
0.75		FR-E520S-0.75K

## Single-Phase 100V Power Supply

Inverter capacity (kW)	Model	IP20
		Frequency setting knob model
0.1		FR-E510W-0.1K
0.2		FR-E510W-0.2K
0.4		FR-E510W-0.4K
0.75		FR-E510W-0.75K



# Standard Specifications

## Ratings

### ■ Three-Phase 200V Power Supply

Model FR-E520-□□(N)		0.1K	0.2K	0.4K	0.75K	1.5K	2.2K	3.7K	5.5K	7.5K
Applied motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Power rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0	3.2	4.4	7.0	9.5	13.1
	Rated current (A) (Note 6)	0.8 (0.8)	1.5 (1.4)	3 (2.5)	5 (4.1)	8 (7)	11 (10)	17.5 (16.5)	24 (23)	33 (31)
	Overload current rating (Note 3)	150% for 60 seconds, 200% for 0.5 seconds (reverse limited characteristics)								
	Voltage (Note 4)	3-phase 200–240V, 50/60Hz								
Power supply	Power supply rated input: AC (DC) voltage and frequency	3-phase 200–240V, 50/60Hz (280V DC (Note 7))								
	Permissible AC (DC) voltage fluctuation	170–264V, 50/60Hz (252–310V DC (Note 7))								
	Permissible frequency fluctuation	±5%								
	Supply capacity (kVA) (Note 5)	0.4	0.8	1.5	2.5	4.5	5.5	9	12	17
Protective construction (JEM1030)		IP20								
Cooling system		Self-cooled				Forced air				
Approximate weight kg (lb)		0.6 (1.3)	0.6 (1.3)	0.8 (1.8)	1.0 (2.2)	1.7 (3.7)	1.7 (3.7)	2.2 (4.9)	4.4 (9.7)	4.9 (10.8)

### ■ Three-Phase 400V Power Supply

Model FR-E540-□□		0.4K	0.75K	1.5K	2.2K	3.7K	5.5K	7.5K
Applied motor capacity (kW) (Note 1)		0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Power rated capacity (kVA) (Note 2)	1.2	2.0	3.0	4.6	7.2	9.1	13.0
	Rated current (A) (Note 6)	1.6 (1.4)	2.6 (2.2)	4.0 (3.8)	6.0 (5.4)	9.5 (8.7)	12	17
	Overload current rating (Note 3)	150% for 60 seconds, 200% for 0.5 seconds (reverse limited characteristics)						
	Voltage (Note 4)	3-phase 380–480V, 50/60Hz						
Power supply	Power supply rated input: AC (DC) voltage and frequency	3-phase 380–480V, 50/60Hz						
	Permissible AC (DC) voltage fluctuation	325–528V, 50/60Hz						
	Permissible frequency fluctuation	±5%						
	Supply capacity (kVA) (Note 5)	1.5	2.5	4.5	5.5	9.5	12	17
Protective construction (JEM1030)		IP20						
Cooling system		Self-cooled	Forced air					
Approximate weight kg (lb)		1.9 (4.2)	1.9 (4.2)	2.0 (4.4)	2.1 (4.6)	2.1 (4.6)	3.8 (8.4)	3.8 (8.4)

### ■ Single-Phase 200V Power Supply

Model FR-E520S-□□		0.1K	0.2K	0.4K	0.75K
Applied motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75
Output	Power rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0
	Rated current (A) (Note 6)	0.8 (0.8)	1.5 (1.4)	3 (2.5)	5 (4.1)
	Overload current rating (Note 3)	150% for 60 seconds, 200% for 0.5 seconds			
	Voltage (Note 4)	3-phase 200–240V, 50/60Hz			
Power supply	Power supply rated input: AC (DC) voltage and frequency	Single-phase 200–240V, 50/60Hz			
	Permissible AC voltage fluctuation	180–264V, 50/60Hz			
	Permissible frequency fluctuation	Less than ±5%			
	Supply capacity (kVA) (Note 5)	0.5	0.9	1.5	2.5
Protective construction (JEM1030)		IP20			
Cooling system		Self-cooled		Forced air	
Approximate weight kg (lb)		0.6 (1.3)	0.6 (1.3)	1.0 (2.2)	1.7 (3.7)

### ■ Single-Phase 100V Power Supply

Model FR-E510W-□□		0.1K	0.2K	0.4K	0.75K
Applied motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75
Output	Power rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2
	Rated current (A) (Note 6)	0.8	1.5	3	5
	Overload current rating (Note 3)	150% for 60 seconds, 200% for 0.5 seconds			
	Voltage (Note 4)	3-phase 200–230V, 50/60Hz			
Power supply	Power supply rated input: AC (DC) voltage and frequency	Single-phase 100–115V, 50/60Hz			
	Permissible AC voltage fluctuation	90–132V, 50/60Hz			
	Permissible frequency fluctuation	Less than ±5%			
	Supply capacity (kVA) (Note 5)	0.5	0.9	1.5	2.5
Protective construction (JEM1030)		IP20			
Cooling system		Self-cooled			
Approximate weight kg (lb)		0.6 (1.3)	0.6 (1.3)	1.0 (2.2)	1.7 (3.7)

#### Notes:

- The applied motor shown is the maximum application capacity when a standard four-pole Mitsubishi motors is used.
- The rated output capacity is for a 230V output voltage.
- After operation in the overload region, care should be taken to make sure that standard operating conditions are once again met.
- The maximum output voltage should not exceed the power supply voltage. Any voltage less than that can be set as the maximum output voltage. The exception is the FR-E510W series.
- The power supply capacity will vary with the value of the power supply impedance (including the input reactor and power lines).
- The rated output current shown in parentheses is for low-noise operation with Pr. 72

- (PWM frequency selection) set to 2kHz or more when the ambient temperature is 40°C (30°C for IP40 construction) or higher.
- When using a DC power supply:
  - Use DC 280V ±10% as a guide for the supply voltage fluctuation range and try to keep voltage at 300V DC or less.
  - There is a larger surge current when the power is turned on compared with an AC power supply. Keep the number of "on-offs" to a minimum.
  - Ensure a voltage of DC 300V to keep torque characteristics the same as with an AC power supply.
- Please refer to the sequencer side specifications below for information on the communications specifications for CC-Link communication.

# Standard Specifications

## Common Specifications

Operation specifications	Control method selection		Soft-PWM control or high carrier frequency PWM control; select V/F control or general-purpose flux vector control.	
	Output frequency range		0.2 to 400Hz (variable starting frequency 0 to 60Hz)	
	Frequency control resolution	Analog input (Note 4)	Between terminals 2 and 5 1/500 of the maximum set frequency (for the 5V DC input), 1/1000 of maximum set frequency (for the 10V DC input at 4 to 20mA DC), or 1/256 of maximum set frequency (using control panel knob).	
		Digital input (Note 4)	When set digitally on control panel 0.01Hz (less than 100Hz) or 0.1Hz (100Hz and up).	
	Frequency precision	Analog input (Note 4)	±0.5% of maximum output frequency 25°C (53°F) ±10°C (±21.2°F).	
		Digital input	Within 0.01% of set output frequency.	
	Voltage/frequency characteristics		Any base frequency setting possible between 0 and 400Hz; constant torque or variable torque pattern selection possible.	
	Starting torque		Minimum 150% at 1Hz or minimum 200% at 3Hz: General purpose flux vector control when set for slip compensation.	
	Torque boost		Manual torque boost can be set between 0–30%	
	Acceleration time setting		0.01 to 3,600 seconds	
	Deceleration time setting		0.01 to 3,600 seconds	
	Acceleration/deceleration pattern		Linear, S-curve A, or S-curve B modes.	
	Braking torque	Regenerative (Note 1)	0.1 and 0.2K: 150% minimum; 0.4 and 0.75K: 100% minimum; 1.5K: 50% minimum; 2.2K, 3.7K, 5.5K and 7.5K: 20% minimum.	
		DC braking	Variable operation frequency (0 to 120Hz), operation time (0 to 10 seconds), operation voltage (0 to 30%).	
	Current stall prevention operation level		Operation current level setting possible (0 to 200% variable), enable/disable selection.	
	Voltage stall prevention operation level		Operation level is fixed, enable/disable selection.	
	High-response current restriction level		Operation level is fixed, enable/disable selection.	
	Input signals	Frequency setting signal (Note 5)	Analog input (Note 4)	0 to 5V DC, 0 to 10V DC, 4 to 20mA DC, built-in analog knob.
			Digital input	Input from control panel. (CC-Link Series: Input using CC-Link communications or parameter unit.)
		Starting signal (Note 5)		Individual selection of forward or reverse run; starting signal self-hold input (3-wire input) selective.
Alarm reset (Note 6)		Used to reset alarm output provided when protective function is activated.		
Multi-speed selection (Note 6)		Up to 15 set speeds (each speed can be set between 0 and 400Hz; speed can be changed via control panel or during operation).		
2nd function selection (Note 6)		Selects 2nd function (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).		
Output stop (Note 6)		Instant shut-off of inverter output (frequency and voltage).		
Current input selection (Note 4)		Select input of frequency setting signal 4 to 20mA DC (terminal No.4).		
Select self-hold at start (Note 4)		Select self-hold of start signal.		
External thermal input (Note 6)		Thermal contact input for when stopping inverter with an externally mounted thermal relay.		
Switching between operation modes (Note 4)		PU and external operation Enables external switching between PU operation and external operation.		
Switch between V/F and general-purpose flux vector control (Note 6)		Enables external switching between V/F control and general-purpose flux vector control.		
Operation functions		Maximum and minimum frequency settings, frequency jump operation, external thermal input selection, instantaneous power failure restart operation, forward run/reverse run prevention, slip compensation, operation mode selection, off-line auto tuning function, PID control (Note 4), and computer link operation (RS-485), CC-Link operation (Note 8).		
Output signals	Operation status	Two types of open collector output can be selected from: inverter running, frequency reached, frequency detection, overload warning, zero current detection, output current detection, maximum PID (Note 4), minimum PID (Note 4), PID forward run, PID reverse run (Note 4), operation ready, minor failure, and error. One type can be selected for the contact output (AC 230V 0.3A, DC 30V 0.3A).		
	For meter (Note 4)	One type can be selected from: output frequency, motor current, or output voltage. Pulse train output (1440 pulse/second full scale).		
Display	Displayed on control panel	Operation status	Output voltage, output current, set frequency, and running.	
		Error details	Details of errors are displayed when the protective function activates. Details of up to four errors are saved.	
Displayed on LED		Power on (POWER), Error (ALARM) (CC-Link Series: Power (POWER), Error (ALARM), Operational state (L.RUN, SD, RD, L.ERR))		
Protective and warning functions		Overcurrent shut-off (during acceleration, deceleration, and constant speed), regenerative overvoltage shut-off, undervoltage (Note 3), instantaneous power failure (Note 3), overload shut-off (electronic thermal relay), output short, stall prevention, brake resistor overheating, fan overheating, fan breakdown (Note 5), parameter error, PU disconnected, ground fault protection.		
Environment	Ambient temperature		-10°C (-21.2°F) to +50°C (+106°F) (no freezing; -10 to +40°C for IP40 model).	
	Ambient humidity		90% RH or less (no condensation)	
	Storage temperature (Note 2)		-20°C (+42.4°F) to +65°C (+137.8°F)	
	Atmosphere		Indoors (no corrosive gases, flammable gases, oil mist or dust)	
	Altitude and vibration		Maximum 1000m (3280.8 ft) above sea level, maximum 5.9 m/s <sup>2</sup> (0.6G) (Conform to JIS C 0911.)	

Select using Pr.180 to Pr.183.

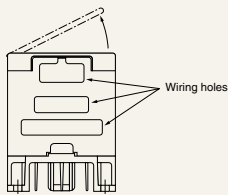
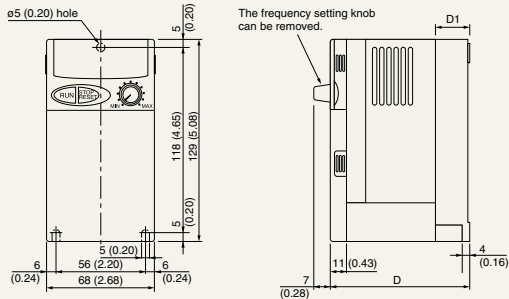
- Notes:
- The indicated control torque size is the short-term average torque (which changes with motor loss) when decelerated at maximum rate from 60Hz when the motor is operated alone. It is not continuous regenerative torque. Deceleration from frequencies in excess of the base frequency will have lower average deceleration torque values. The inverters have no built-in brake resistors, so when the regenerative energy is high, use the optional brake resistor. A BU model brake unit may also be used (except with 0.1K and 0.2K models). The control torque when a brake resistor is used is shown on page 41; the same for when a brake unit is used is shown on page 36.
  - Temperature to which units can be exposed for a short time, such as during transportation.
  - When an insufficient voltage or instantaneous power failure occurs, error display and output do not work, but the inverter is protected. Depending on the operating status (e.g., the size of the load), Overcurrent protection, regenerative overvoltage protection etc. may engage upon restoration of power.
  - This function is not available for the CC-Link Series.
  - For the CC-Link series, can be set by means of CC-Link communications or the optional parameter unit.
  - For the CC-Link series, can be set by means of CC-Link communications or one of the input terminals.
  - For the CC-Link series, display is possible when the optional parameter unit is in use.
  - This form is not available with the frequency setting volume type.

# External Dimension Diagrams and Terminal Layouts

## Three-Phase, 200V Power Supply (Frequency Setting Volume Type)

Unit: mm (inch)

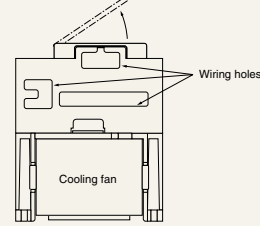
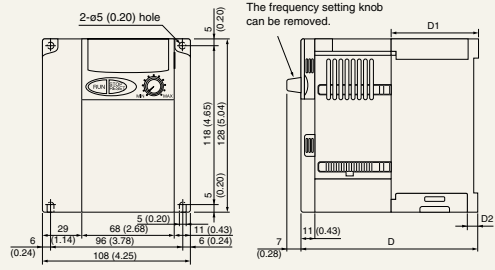
### FR-E520-0.1K-0.75K



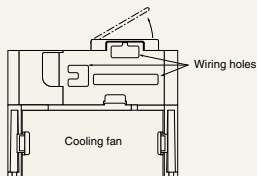
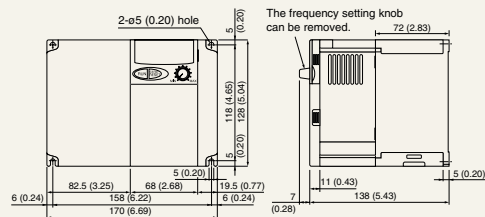
Capacity	D	D1
0.1K	76 (2.99)	10 (0.39)
0.2K	76 (2.99)	10 (0.39)
0.4K	108 (4.25)	42 (1.65)
0.75K	128 (5.04)	62 (2.44)

Note: The 0.75K unit has a cooling fan.

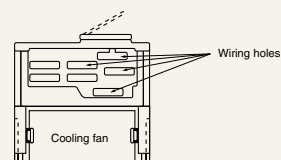
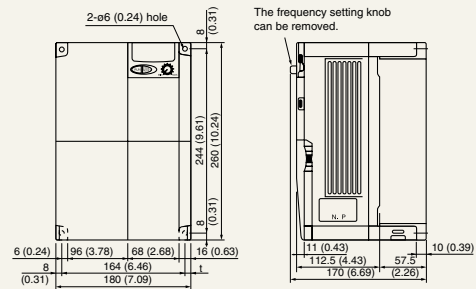
### FR-E520-1.5K, 2.2K



### FR-E520-3.7K



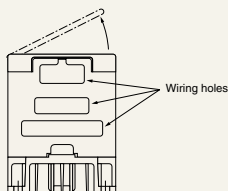
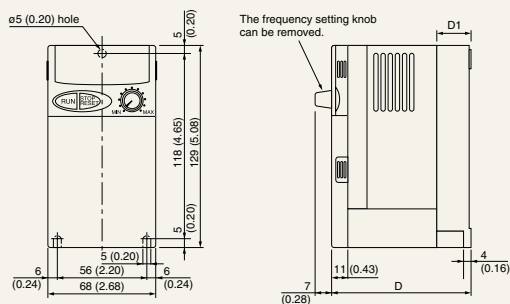
### FR-E520-5.5K, 7.5K



## Single-Phase, 100V/200V Power Supply

Unit: mm (inch)

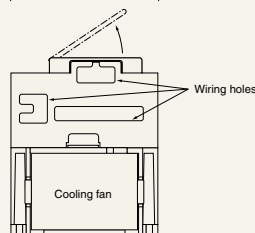
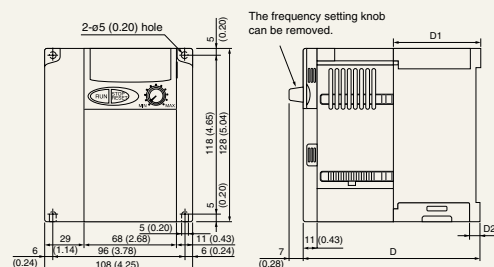
### FR-E520S-0.1K-0.4K, FR-E510W-0.1K-0.4K



Single-Phase, 200V		
Capacity	D	D1
0.1K	76 (2.99)	10 (0.39)
0.2K	76 (2.99)	10 (0.39)
0.4K	138 (5.43)	42 (1.65)

Single-Phase, 100V		
Capacity	D	D1
0.1K	76 (2.99)	10 (0.39)
0.2K	106 (4.17)	10 (0.39)
0.4K	138 (5.43)	42 (1.65)

### FR-E520S-0.75K, FR-E510W-0.75K



Single-Phase, 200V			
Capacity	D	D1	D2
0.75K	131 (5.16)	65 (2.56)	8 (0.31)

Single-Phase, 100V			
Capacity	D	D1	D2
0.75K	155 (6.10)	59 (2.32)	5 (0.20)

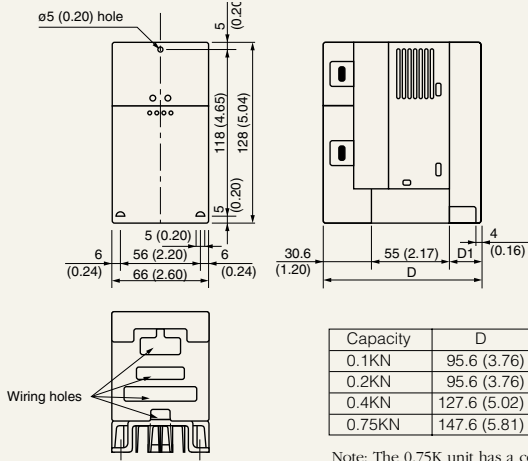
Note: Single-phase 100V specifications units do not have cooling fans.

# External Dimension Diagrams and Terminal Layouts

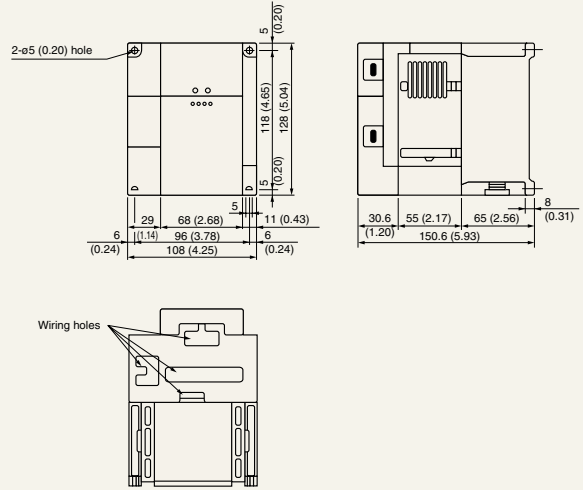
## Three-Phase, 200V Power Supply (CC-Link)

Unit: mm (inch)

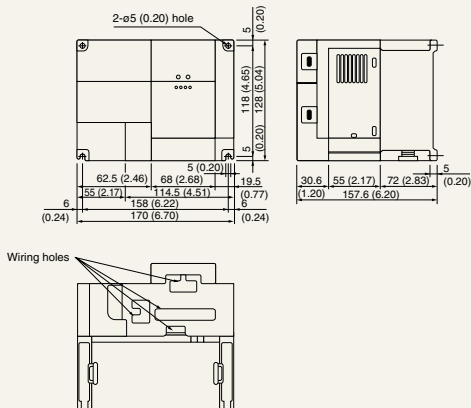
### ● FR-E520-0.1KN, 0.2KN, 0.4KN, 0.75KN



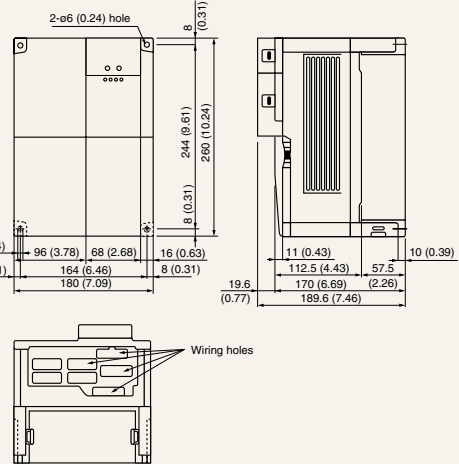
### ● FR-E520-1.5KN, 2.2KN



### ● FR-E520-3.7KN



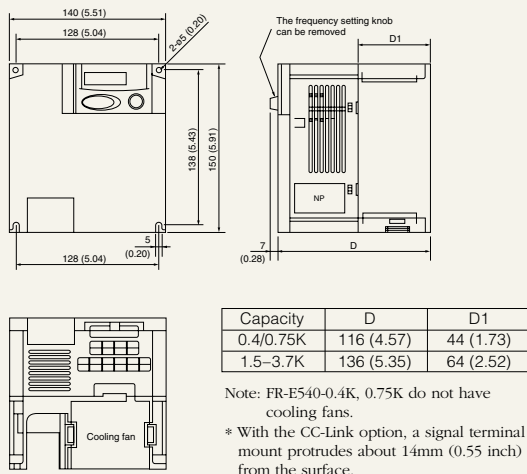
### ● FR-E520-5.5KN, 7.5KN



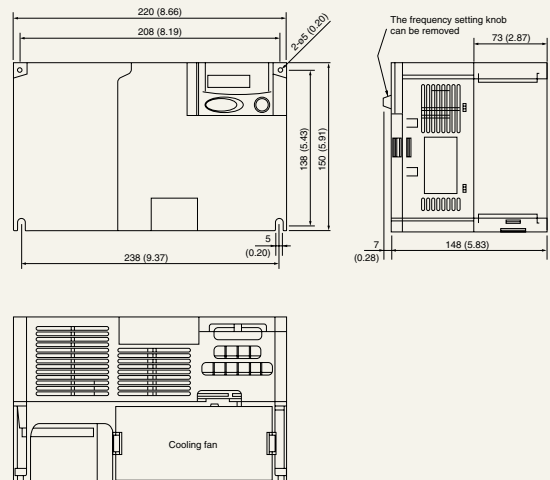
## Three-Phase, 400V Power Supply

Unit: mm (inch)

### ● FR-E540-0.4K, 0.75K, 1.5K-3.7K

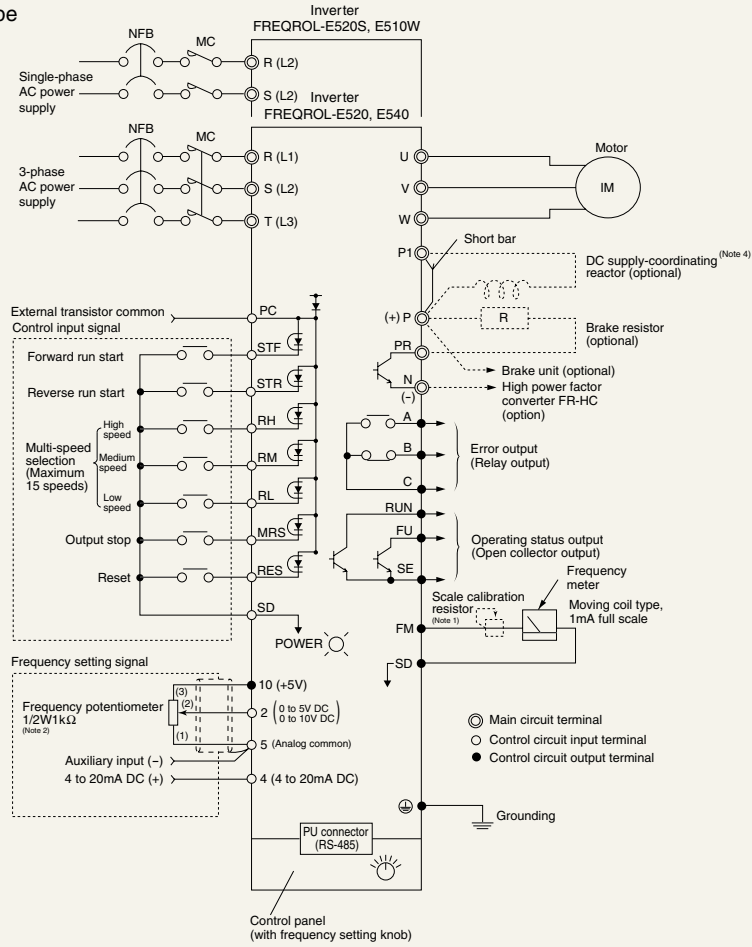


### ● FR-E540-5.5K, 7.5K

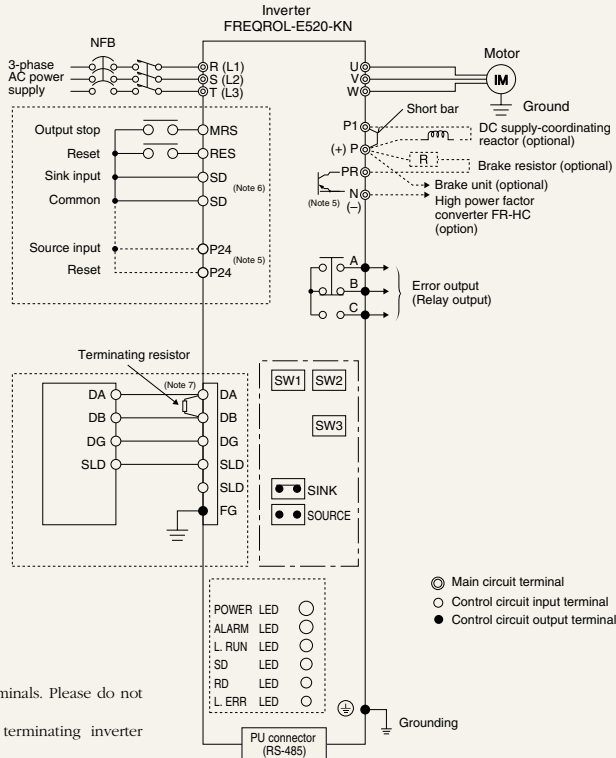


# Terminal Connection Diagram

## ● Frequency Setting Volume Type



## ● CC-Link



# Description of Terminal Specifications

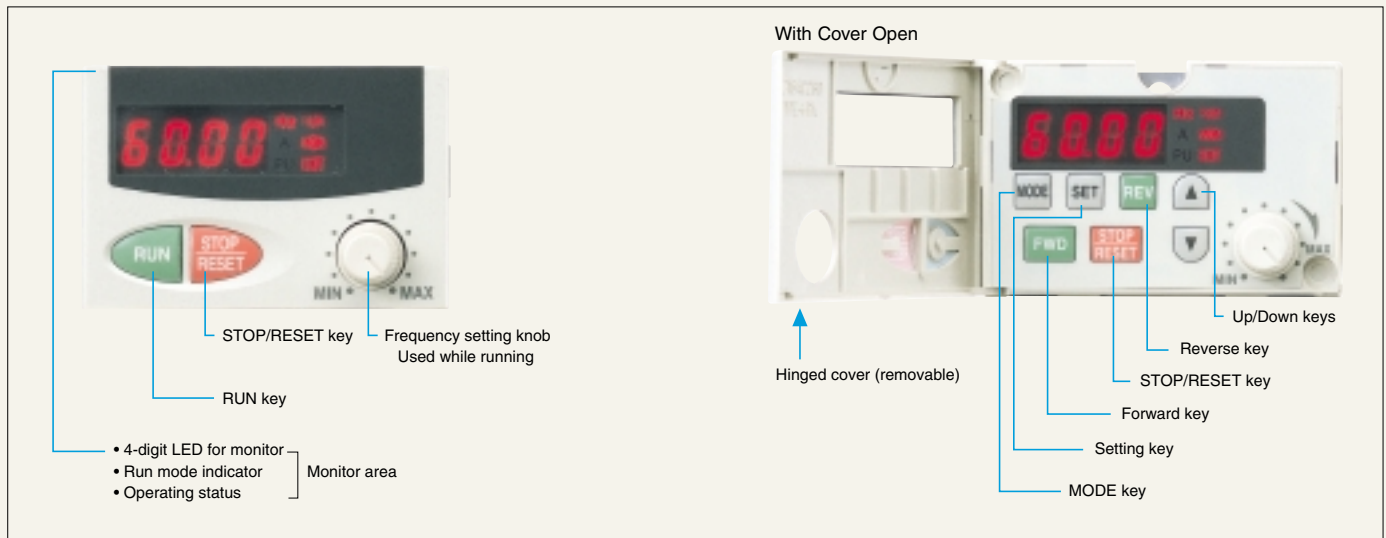
Terminal symbol		Terminal name	Explanation		Model type	
					Frequency setting volume type	CC-Link
Main circuit	R, S, T (L1, L2, L3) <sup>(Note 2)</sup>	Main circuit R, S, T (L1, L2, L3) AC power supply input	Connected to the commercial power supply. When using a DC power input for units with 3-phase power input specifications, please connect it across terminals R (L1) and S (L2). When using a high power factor converter (FR-HC), do not connect anything.		○	○
	U, V, W	Inverter output	Connects the 3-phase squirrel cage motor.		○	○
	P, PR (+, PR)	Brake resistor connection	This terminal is used to connect the optional dedicated brake resistor (cannot be connected to the 0.1K and 0.2K models).		○	○
	P, N (+, -)	Brake unit connection	Connect the optional brake unit and high power factor converter to these terminals.		○	○
	P, P1 (+, P1)	Power factor improvement	DC reactor connection Remove the short bar between terminals P (+) and P1 and connect the optional power factor improvement DC reactor (FR-BEL).		○	○
	⊕	Ground (Earth)	This is for grounding the inverter chassis. Always ground the inverter.		○	○
Control circuit (input signals)	STF	Forward run start	Serves as the forward run command when terminals STF-SD are ON.	If terminals STF and STR-SD are ON simultaneously, they serve as the stop command.	○	—
	STR	Reverse run start	Serves as the reverse run command when terminals STR-SD are ON.		○	—
	RH, RM, RL	Multi-speed selection	The multi-speed type can be selected with a combination of shorts between the terminals RH, RM and RL-SD.	The terminal function changes according to the input terminal function selection (Pr.180 to Pr.183). (See page 26.)	○	—
	MRS	Output stop	Inverter output stops when terminals MRS-SD are shorted (for 20ms or more). This is used to cut off the inverter output when stopping the motor with a magnetic brake.		○	○
	RES	Reset	This is used to cancel the hold state when the protection circuit activates. Turn ON terminals RES-SD for 0.1 second or more, and then turn them OFF.		○	○
	SD	Contact input common	This is the common terminal for the contact input terminal and the display meter <sup>(Note 4)</sup> .		○	○
	PC	External transistor common	When connecting a transistor output (open collector output) such as a programmable logic controller (PLC), malfunctions caused by supplied current can be prevented by connecting the external power common for the transistor output to this terminal. It is possible to use 24V DC 0.1A as the power supply.		○	—
	10	Frequency setting power supply	5V DC. Tolerable load current 10mA.		○	—
	2	Frequency setting (voltage)	When 0 to 5V DC (or 0 to 10V) is input, the maximum output frequency is reached at 5V (10V). The input and output are proportional. 5V DC and 10V DC are changed using Pr.73 (See page 23). Input resistance is 10kΩ; tolerable input voltage is 20V.		○	—
	5	Frequency setting input common	This is the common terminal for the frequency setting signal <sup>(Note 4)</sup> . Do not ground this common.		○	—
	4	Frequency setting (current signal)	Input 4 to 20mA DC. The maximum output frequency is reached at 20mA. At shipment, the inverter is adjusted so that 4mA gives 0Hz and 20mA gives 60Hz. The maximum tolerable current is 30mA; the input resistance is approximately 250Ω.		○	—
P24	Contact input common (source)	Common terminal for contact inputs when using source input. When using source input, turn signals ON by shorting to this terminal or OFF by leaving it open.		—	○	
Control circuit (output signals)	A, B, C	Alarm output	This is a contact output that indicates that the inverter's protection circuit has functioned and the output has stopped. 200V AC 0.3A or 30V DC 0.3A. When an alarm occurs, there is non-continuity between B-C (continuity between A-C); in normal operations, there is continuity between B-C (non-continuity between A-C).	The terminal function changes according to the selection for output terminal function (Pr.190 to Pr.192) (See page 26.)	○	○
	RUN	Inverter running	L level is output when the inverter output frequency is higher than the starting frequency (the default of 0.5Hz is changeable); H level is output when stopped or during DC braking <sup>(Note 1)</sup> . Tolerable load: 24V DC 0.1A.		○	—
	FU	Frequency detection	L level is output when the output frequency is higher than the set detection frequency; H level is output when it is lower <sup>(Note 1)</sup> . Tolerable load: 24V DC 0.1A.		○	—
	SE	Open collector output common	This is the common terminal for the terminals RUN and FU <sup>(Note 4)</sup> .		○	—
	FM	For display meter	When shipped, the inverter is set so that when terminals FM-SD are opened, 60Hz gives about 5V and output frequency is proportional. The output voltage is a pulse waveform, so a digital display meter can be connected. Pulse specification: 1440 pulse/sec. at 60Hz.		○	—
Communi- cations	—	PU connector	RS-485 communications can be carried out using the PU connector. • Complied standard: EIA Standard RS-485. • Transmission format: multidrop link method. • Communication rate: maximum 19200 baud. • Total length: 500 m (1640.4 ft).		○	○
CC-Link communi- cations	DA DB DG SLD FG	CC-Link communication signal	CC-Link communication signal Connects the master station and other local stations when using CC-Link communications.		—	○

- Notes: 1. The L level is when the open connector output transistor turns ON (continuity state). The H level is when it is OFF (non-continuity state).  
2. In the case of units with single-phase power input specifications, the only AC power input terminals are R and S.  
3. ○ : Applicable. — : Not applicable.  
4. For the E540 models, terminals SD, 5 and SE are isolated. For other models, e.g. E510 terminal SE is isolated from terminals SD and 5.



# Operation

## Control Panel (Frequency Setting Volume Type)

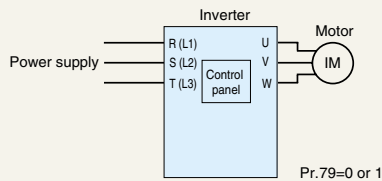


## Operation

### 1. Using the Control Panel Knob

Use the RUN key to start and the STOP/RESET key to stop. Set the operating frequency with the frequency setting knob.

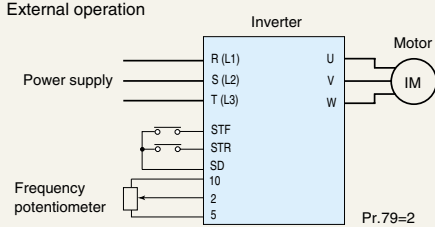
(Example of connection and setting)



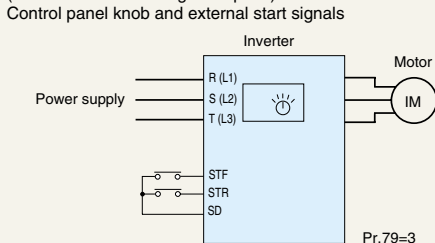
### 2. External Operation or Control Panel/External Operation

Use Pr.79 to set the unit for external operation by means of start signals and frequency instructions to the control terminals or for operation via the control panel or optional parameter unit (FR-PU04) with external operation signals.

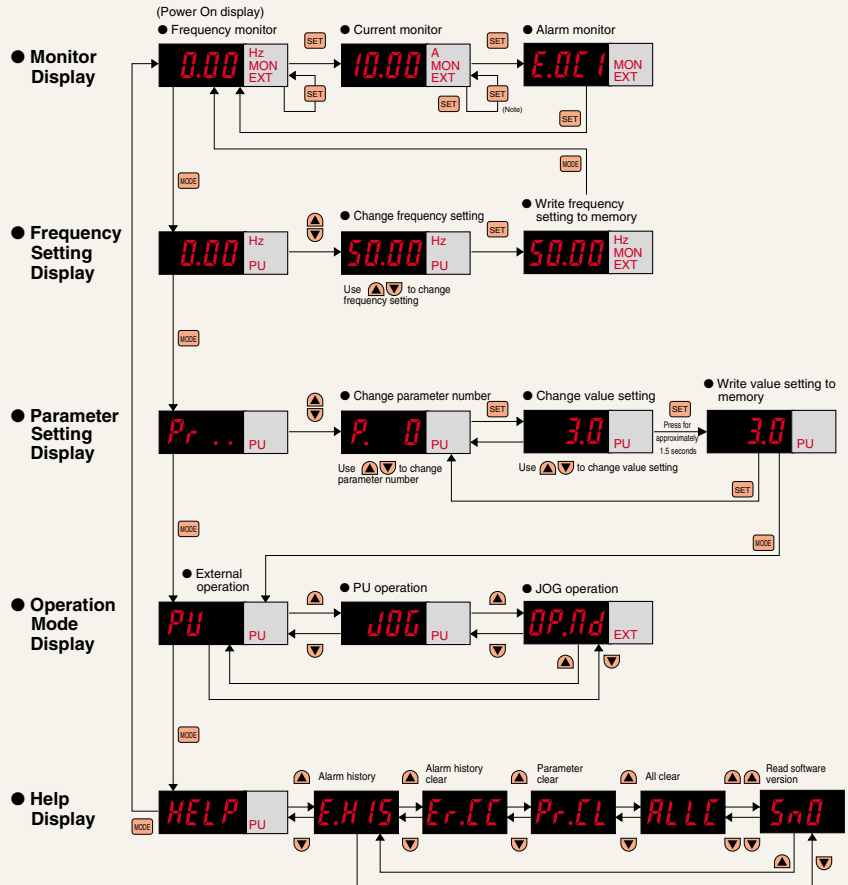
(Connection and setting example 1)



(Connection and setting example 2)



## Key Operations



Note: If **SET** is pressed continuously for approximately 1.5 seconds, the current display switches to the initial power ON display.

# List of Parameters

Function	Pr. No.	Name	Setting range	Minimum setting	Default setting	Series name	
						Frequency setting volume type	CC-Link
Basic functions	0	Torque boost (Note 1)	0 to 30%	0.1%	6% / 4% (Note 9)	○	○
	1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	○	○
	2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	○	○
	3	Base frequency (Note 1)	0 to 400Hz	0.01Hz	60Hz	○	○
	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	○	○
	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	○	○
	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	○	○
	7	Acceleration time	0 to 3600 s / 0 to 360 s	0.1 s / 0.01 s	5 s	○	○
	8	Deceleration time	0 to 3600 s / 0 to 360 s	0.1 s / 0.01 s	5 s	○	○
Standard operation functions	9	Electronic thermal O/L relay	0 to 500A	0.1A	Rated output current	○	○
	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	○	○
	11	DC injection brake operation time	0 to 10 s	0.1 s	0.5 s	○	○
	12	DC injection brake voltage	0 to 30%	0.1%	6 %	○	○
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	○	○
	14	Load pattern selection (Note 1)	0 to 3	1	0	○	○
	15	JOG frequency	0 to 400Hz	0.01Hz	5Hz	○	–
	16	JOG acceleration/deceleration time	0 to 3600 s / 0 to 360 s	0.1 s / 0.01 s	0.5 s	○	–
	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120Hz	○	○
	19	Base frequency voltage (Note 1)	0 to 1000V, 8888, 9999	0.1V	9999	○	○
	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	○	○
	21	Acceleration/deceleration time increments	0, 1	1	0	○	○
	22	Stall prevention operation level	0 to 200%	0.1%	150%	○	○
	23	Stall prevention operation at double speed (Note 3)	0 to 200%, 9999	0.1%	9999	○	○
	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	○	○
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	○	○
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	○	○
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	○	○
	29	Acceleration/deceleration pattern selection	0, 1, 2	1	0	○	○
	30	Regenerative function selection	0, 1	1	0	○	○
	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	○	○
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	○	○
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	○	○
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	○	○
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	○	○
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	○	○
	37	Speed display	0, 0.01 to 9998	0.001 r/min	0	○	○
	38	Frequency at 5V (10V) input	1 to 400Hz	0.01Hz	60Hz (Note 4)	○	–
	39	Frequency at 20mA input	1 to 400Hz	0.01Hz	60Hz (Note 4)	○	–
	Output terminal functions	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	○
42		Output frequency detection	0 to 400Hz	0.01Hz	6Hz	○	○
43		Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	○	○
2nd functions	44	2nd acceleration/deceleration time	0 to 3600 s / 0 to 360 s	0.1 s / 0.01 s	5 s / 10 s (Note 7)	○	○
	45	2nd deceleration time	0 to 3600 s / 0 to 360 s, 9999	0.1 s / 0.01 s	9999	○	○
	46	2nd torque boost	0 to 30%, 9999	0.1%	9999	○	○
	47	2nd V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	○	○
	48	2nd electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	○	○
Display functions	52	Control Panel/PU main display data	0, 23, 100	1	0	○	○
	54	FM terminal function selection	0, 1, 2	1	0	○	–
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60	○	–
	56	Current monitoring reference	0 to 500A	0.01A	Rated output current	○	–
Restart	57	Restart coasting time	0 to 5 s, 9999	0.1 s	9999	○	○
	58	Restart cushion time	0 to 60 s	0.1 s	1.0 s	○	○
Supplementary functions	59	Remote setting function selection	0, 1, 2	1	0	○	–
Operation selection functions	60	Shortest acceleration/deceleration time	0, 1, 2, 11, 12	1	0	○	○
	65	Retry selection	0, 1, 2, 3	1	0	○	○
	66	Stall prevention operation level reduction starting frequency (Note 3)	0 to 400Hz	0.01Hz	60Hz	○	○
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	○	○
	68	Retry waiting time	0.1 to 360 s	0.1 s	1 s	○	○
	69	Retry count display erasure	0	1	0	○	○
	70	Special regenerative brake duty	0 to 30%	0.1%	0%	○	○
	71	Applied motor (Note 3)	0, 1, 5, 6, 15, 16, 23, 101 to 123	1	0	○	○
	72	PWM frequency selection	0 to 15	1	1	○	○
	73	0 to 5V, 0 to 10V selection	0, 1	1	0	○	–
	74	Filter time constant	0 to 8	1	1	○	–
	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	○	○
	77	Parameter write disable selection	0, 1, 2	1	0	○	○
78	Reverse rotation prevention selection	0, 1, 2	1	0	○	○	
79	Operation mode selection (Note 3)	0 to 4, 6 to 8	1	0	○	○	
General-purpose flux vector control	80	Motor capacity	0.1 to 3.7kW, 9999	0.01kW	9999	○	○
	82	Motor excitation current	0 to 500A, 9999	0.01A	9999	○	○
	83	Rated motor voltage	0 to 1000V	0.1V	200V / 400V	○	○
	84	Rated motor frequency	0 to 400Hz	0.01Hz	60Hz	○	○
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	○	○
	96	Auto-tuning setting/status (Note 3)	0, 1	1	0	○	○

# List of Parameters

Function	Pr. No.	Name	Setting range	Minimum setting	Default setting		Series name	
							Frequency setting volume type	CC-Link
Communications functions	117	Station number	0 to 31	1	0		○	○
	118	Communication speed	48, 96, 192	1	48		○	○
	119	Stop bit length/data length	0, 1 (data length 8), 10, 11 (data length 7)	1	1		○	○
	120	Parity check presence/absence	0, 1, 2	1	2		○	○
	121	Number of communication retries	0 to 10, 9999	1	1		○	○
	122	Communication check time interval	0 to 999.8 s, 9999	0.1 s	0		○	○
	123	Waiting time setting	0 to 15, 9999	2	9999		○	○
PID control	124	CR/LF presence/absence selection	0, 1, 2	1	1		○	○
	128	PID action selection	0, 1, 9999	1	0		○	–
	129	PID proportional band	0.1 to 1000%, 9999	0.1 s	100%		○	–
	130	PID integral time	0.1 to 3600 s, 9999	0.1 s	1 s		○	–
	131	Upper limit	0 to 100%, 9999	1%	9999		○	–
	132	Lower limit	0 to 100%, 9999	1%	9999		○	–
	133	PID action set point for PU operation	0 to 100%	1%	0%		○	–
134	PID differential time	0.01 to 10.00 s, 9999	0.01 s	9999		○	–	
Indication	145	Display language (When using FR-PU04)	0 to 7	1	23		○	○
Supplementary function	146	Select frequency setting instruction	0, 1, 9999	1	0		○	–
Current detection	150	Output current detection level	0 to 200%, 9999	0.1%	150%		○	○
	151	Output current detection period	0 to 10 s	0.1 s	0		○	○
	152	Zero current detection level	0 to 200.0%	0.1%	5.0%		○	○
	153	Zero current detection period	0.05 to 1 s	0.01 s	0.5 s		○	○
Auxiliary function	156	Stall prevention operation selection	0 to 31, 100	1	0		○	○
Supplementary function	160	User group read selection	0, 1, 10, 11	1	0		○	○
Manufacturers parameter	168	Parameter set by manufacturer. Do not set.	–	–	–		○	○
	169		–	–	–		○	○
Initial monitor	171	Actual operation hour meter clear	0	–	0		○	○
User functions	173	User group 1 registration	0 to 999	1	0		○	○
	174	User group 1 deletion	0 to 999, 9999	1	0		○	○
	175	User group 2 registration	0 to 999	1	0		○	○
	176	User group 2 deletion	0 to 999, 9999	1	0		○	○
Terminal function selection	180	RL terminal function selection (RY4)	0 to 8, 16, 18	1	0		○	○
	181	RM terminal function selection (RY3)	0 to 8, 16, 18	1	1		○	○
	182	RH terminal function selection (RY2)	0 to 8, 16, 18	1	2		○	○
	183	MRS terminal (RY1) function selection	0 to 8, 16, 18	1	6		○	○
	190	RUN terminal function selection (RX2)	0 to 99	1	0		○	○
	191	FU terminal function selection (RX6)	0 to 99	1	4		○	○
Multi-speed operations	192	A, B, C terminal (RY7) function selection	0 to 99	1	99		○	○
	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999		○	○
Auxiliary functions	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999		○	○
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999		○	○
Standard operation function	240	Soft-PWM setting	0, 1	1	1		○	○
	244	Cooling fan operation selection	0, 1	1	0		○	○
	245	Rated motor slip	0 to 50%, 9999	0.01%	9999		○	○
Auxiliary function	246	Slip compensation response time	0.01 to 10 s	0.01 s	0.05 s		○	○
	247	Constant-output region slip compensation selection	0, 9999	–	9999		○	○
Stop selection functions	249	Ground fault detection at start-up (Y/N) <sup>(Note 8)</sup>	0, 1	1	0		○	○
Calibration functions	250	Stop selection	0 to 100 s, 1000 to 1100 s, 8888, 9999	1	9999		○	○
	900	FM terminal calibration	–	–	–		○	–
	902	Frequency setting voltage bias	0 to 10V   0 to 60Hz	0.01Hz	0V	0Hz	○	–
	903	Frequency setting voltage gain	0 to 10V   1 to 400Hz	0.01Hz	5V	60Hz	○	–
	904	Frequency setting current bias	0 to 20mA   0 to 60Hz	0.01Hz	4mA	0Hz	○	–
	905	Frequency setting current gain	0 to 20mA   1 to 400Hz	0.01Hz	20mA	60Hz	○	–
	922	Built-in knob bias	0 to 5V   0 to 60Hz	0.01Hz	0V	0Hz	○	–
Function selection	923	Built-in knob gain	0 to 5V   0 to 400Hz	0.01Hz	5V	60Hz	○	–
	990	Buzzer sound control (When using FR-PU04)	0, 1	1	1		○	○
	991	LCD contrast (When using FR-PU04)	0 to 63	1	53		○	○

- Notes:
- This indicates a parameter whose setting is ignored when general-purpose flux vector control mode is selected.
  - The set values for the parameters in the shaded areas can be altered during operations even if Pr.77 (Parameter write disable) is set to 0 (default setting).
  - Even if Pr.77 (Parameter write disable) is set to 2, the set value cannot be changed during operations.
  - Since they are calibrated before shipment, settings will vary slightly from inverter to inverter. Some are set to a frequency is slightly higher than 60Hz.
  - Some of the names of CC-Link Series functions differ from those of frequency setting volume type functions.
  - : Applicable. – : Not applicable.
  - The setting depends on the inverter capacity: (0.1K to 3.7K) / (5.5K to 7.5K)
  - The ground fault detection setting parameter is not applicable to the FR-E540 series.  
The FR-E540 series is automatically set to detect ground faults.
  - The setting for the FR-E540-5.5K/7.5K is 4%.

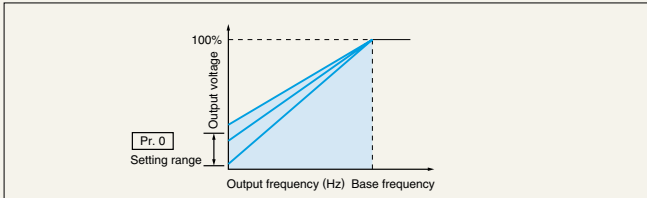
# Description of Parameters

## Pr. 0–Pr. 6

Note: "Parameter" is sometimes abbreviated "Pr."

### Pr. 0 Setting Torque Boost

- The motor torque can be adjusted at low frequencies to match the load.

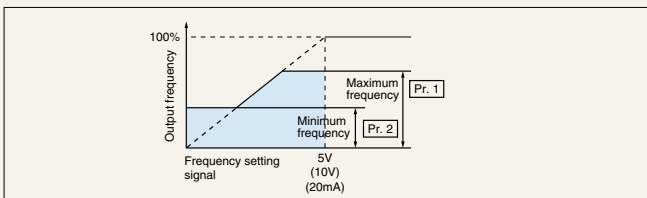


- Notes:
- When general-purpose flux vector control mode is selected using Pr.80, this setting is ignored.
  - When using a motor that is dedicated for inverters (a constant torque motor), change the settings as follows.  
0.1–0.75K: 6%; 1.5–3.7K: 2%  
If Pr.71 is changed to the settings for using constant torque motors, but the default settings are not changed, the Pr.0 setting will switch to the above values.
  - Default setting  
FR-E540.....4% Others.....6%

### Pr. 1 Pr. 2 Setting Maximum and Minimum Frequencies

Pr. 1 Maximum frequency Pr. 2 Minimum frequency

- The output frequency can be clamped by maximum and minimum frequencies.



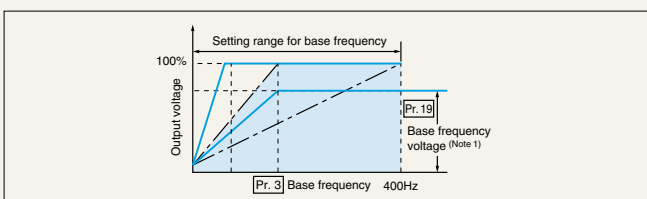
Note: Set Pr.18 if you need an maximum frequency of 120Hz or higher.

### Pr. 3 Pr. 19 Setting the Base Frequency

Pr. 3 Base frequency

Pr. 19 Base frequency voltage

- Any base frequency (the reference frequency at the motor's rated torque) can be set in the range of 0–400Hz to match the motor rating.
- Motors rated at below the inverter's power supply voltage are best used by setting Pr.19 (base frequency voltage). This is convenient when using, for example, a 200V rated motor with a 230V power supply.



Note: When Pr.19 is set to 8888, the maximum output voltage is 95% of the power supply voltage. When Pr.19 is set to 9999 (the default setting), the maximum output voltage is the same as the power supply voltage.

### Pr. 4–6 Pr. 24–27 Pr. 232–239

#### Setting Multi-Speeds

Pr. 4 Three-speed setting (high speed)

Pr. 5 Three-speed setting (middle speed)

Pr. 6 Three-speed setting (low speed)

Pr. 24 Multi-speed setting (speed 4)

Pr. 25 Multi-speed setting (speed 5)

Pr. 26 Multi-speed setting (speed 6)

Pr. 27 Multi-speed setting (speed 7)

Pr. 232 Multi-speed setting (speed 8)

Pr. 233 Multi-speed setting (speed 9)

Pr. 234 Multi-speed setting (speed 10)

Pr. 235 Multi-speed setting (speed 11)

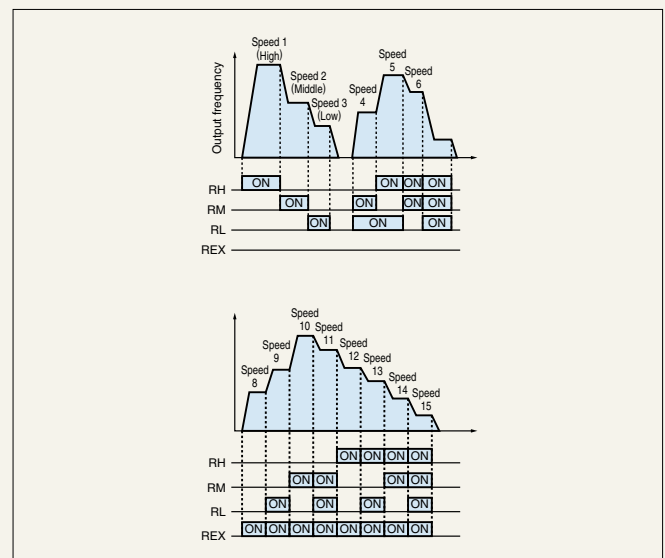
Pr. 236 Multi-speed setting (speed 12)

Pr. 237 Multi-speed setting (speed 13)

Pr. 238 Multi-speed setting (speed 14)

Pr. 239 Multi-speed setting (speed 15)

- Speeds can be selected by simply switching the external contact signals (RH, RM, RL, and REX signals).
- All speeds (frequencies) can be set in the range 0-400Hz while the inverter is running. Change the settings by using the  $\nabla$ / $\blacktriangle$  keys while a multi-speed parameter is displayed. (Press the write key to record the frequency setting in memory once you have released the  $\nabla$ / $\blacktriangle$  keys.)
- Up to 17 speeds can be set by combining the maximum frequency (Pr. 1) and minimum frequency (Pr. 2).



- Notes:
- When Pr. 24–Pr. 27 and Pr. 232–Pr. 239 are set to 9999 (default setting), 4–7 and 8–15 cannot be selected (or run).
  - Multi-speed settings have priority over analog input commands (between terminals 2 and 5 or 4 and 5).
  - Multi-speed settings can be done during PU operation or external operation.
  - For three-speed settings (when Pr. 24–Pr. 27 and Pr. 232–Pr. 239 are not set), selection of two or more speeds simultaneously will set the speed to the speed set at the low speed signal terminal.
  - Terminals used for REX signal input are assigned by Pr.180–Pr.183 (input terminal function selection).

## Pr. 7–Pr. 14

### Pr. 7 Pr. 8 Setting Acceleration/Deceleration Time

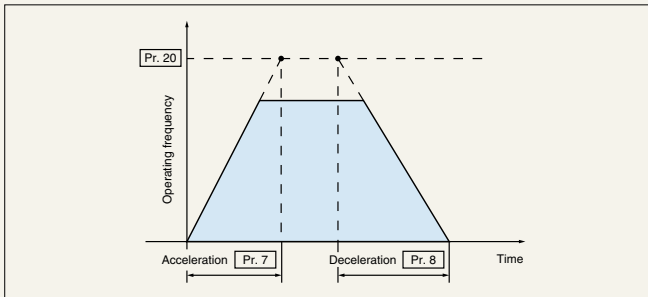
**Pr. 7** Acceleration time frequency

**Pr. 8** Deceleration time

**Pr. 20** Acceleration/deceleration reference

**Pr. 21** Acceleration/deceleration time increments

- Pr.7 (acceleration time) is the time required from reach the reference frequency of Pr.20 from 0Hz; Pr.8 (deceleration time) is the time required to reach 0Hz from the setting of Pr.20.
- Pr.21 (acceleration/deceleration time increments) allows you to set the setting range and the minimum setting increment. A setting of 0 provides a range 0–3600sec. (minimum increment of 0.1sec.); a setting of 1 provides a range of 0–360sec. (minimum increment 0.01 sec.).



Notes: 1. For S-curve acceleration/deceleration pattern A (see Pr.29), the time is that required to reach the base frequency (Pr.3).  
2. The frequency output to the frequency setting signal (analog) is set by Pr.38 or Pr.39.

### Pr. 9 Electronic Thermal O/L Relay

- The setting for motor overheating protection can be set as the current value (A). Normally, the rated motor current for 50Hz is set. This provides the optimum protection characteristics for low speed operations, including when motor cooling power drops during low-speed operation.
- When 0A is set, the motor protection function does not engage. (The inverter's output transistor protection function does.)
- When using a Mitsubishi fixed torque motor, set Pr.71 (applied motor) to 1, 13, 15, or 16, select the 100% continuous torque characteristics at low speed, and set the motor's rated current in Pr.9 (electronic thermal O/L relay).
- The factory default setting is the inverter's rated output current, except for 0.1–0.75K inverters, for which it is 85% of the inverter's rated current.
- When several motors are operated simultaneously, install an external thermal relay on each motor.

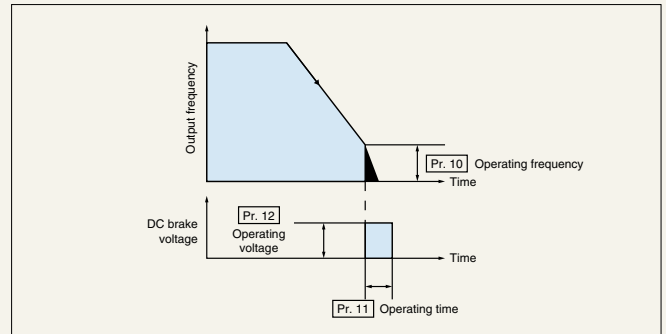
### Pr. 10 Pr. 11 Pr. 12 DC Injection Brake Adjustment

**Pr. 10** DC injection brake operation frequency

**Pr. 11** DC injection brake operation time

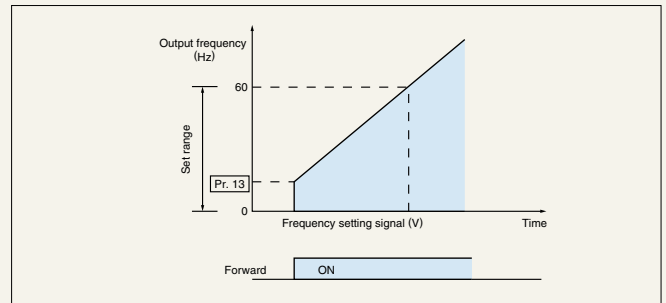
**Pr. 12** DC injection brake voltage

- The stopping precision for positioning or similar operations can be adjusted to the load by setting the time for which the DC brake torque (voltage) is activated during stopping and the frequency at which the operation is started.



### Pr. 13 Setting the Starting Frequency

- The frequency at startup can be set in the range 0–60Hz.

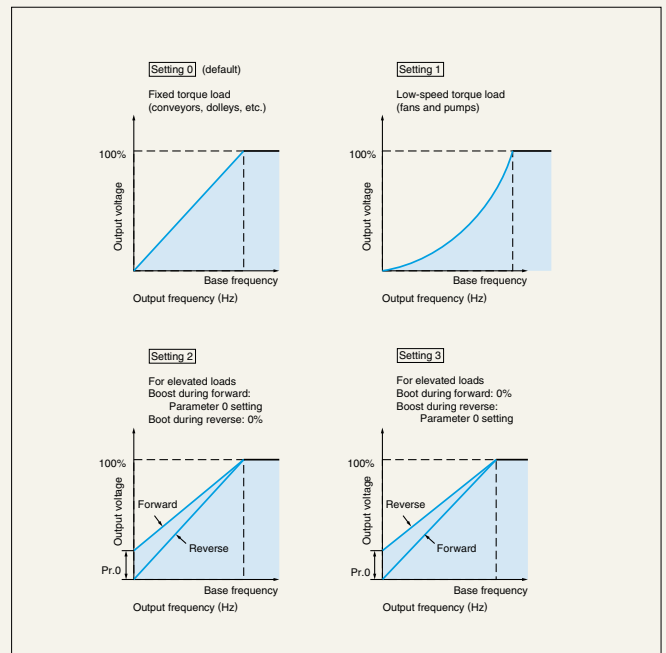


### Pr. 14 Load Pattern Selection

- This allows you to select the optimum output characteristics (V/F characteristics) for your application and load characteristics.

Pr.14 setting	Output characteristics	
0	Fixed torque load	
1	Low-speed torque load	
2	For fixed torque elevation	0% boost during reverse
3		0% boost during forward

Note: When general-purpose flux vector control mode is selected with Pr.80, this parameter setting is ignored.



# Description of Parameters

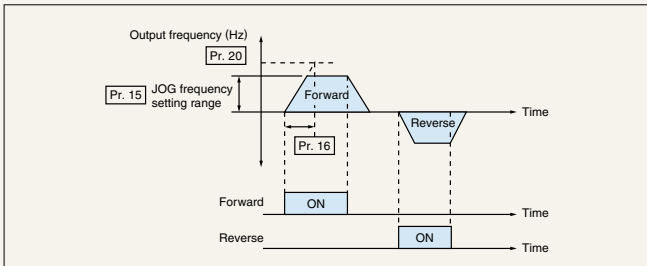
## Pr.15–Pr.30

### Pr.15 Pr.16 JOG Operation Settings

**Pr.15** JOG frequency

**Pr.16** JOG acceleration/deceleration time

- JOG operation can be run from the control panel.  
(See manual for details.)
- JOG operation is not available during external operation.



### Pr.18 Setting the High-Speed Maximum Frequency

- Set this when operating beyond 120Hz.
- Set this parameter to have Pr.1 (maximum frequency) automatically changed to this value.

**Pr.19** See the description of **Pr.3**

**Pr.20** **Pr.21** See the description of **Pr.7**

### Pr.22 Pr.23 Pr.66

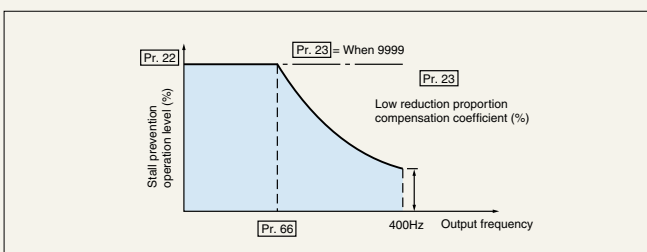
#### Setting the Stall Prevention Operation Level

**Pr.22** Stall prevention operation level

**Pr.23** Stall prevention operation at double speed

**Pr.66** Stall prevention operation level reduction starting frequency

- Use Pr.22 to set the stall prevention operation level. It is usually set to 150% (default).
- When operated faster than 60Hz, the motor current does not increase, so acceleration is not always available. To improve the motor operating characteristics, the stall prevention operation level can be decreased in the high frequency zone. Normally, Pr.66 is set to 60Hz and Pr.23 to 100%.
- When Pr.23 is set to 9999 (default), the stall prevention operation level is the value set in Pr.22 and is constant to 400Hz.



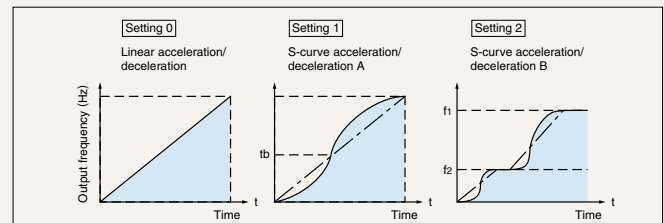
### Pr.24 Pr.25 Pr.26 Pr.27

See the description of **Pr.4**

### Pr.29 Acceleration/Deceleration Pattern Selection

You can select the best pattern for your application.

- **Setting 0 (linear acceleration/deceleration):** The most common acceleration/deceleration pattern. Normally, you should use this setting.
- **Setting 1 (S-curve acceleration/deceleration A):** Use this pattern when you need acceleration/deceleration in a short time frame in high-speed zones of 60Hz and above. In this acceleration/deceleration pattern, fb (the base frequency) is the inflection point. You can set the acceleration/deceleration time to match the reduction in motor torque in fixed output operation zones of 60Hz and above. It is suited for applications such as main axes of machine tools.
- **Setting 2 (S-curve acceleration/deceleration B):** Because it always accelerates/decelerates in an S-curve between f2 (current frequency) and f1 (target frequency), the shock of acceleration/deceleration is softened, which prevents load wobble.



### Pr.30 Pr.70 Selecting Regenerative Brake Duty

**Pr.30** Regenerative function selection

**Pr.70** Special regenerative brake duty

- Set this when you need a higher regenerative brake duty, for instance, when operation involves frequent starts and stops. Since the capacity of the brake resistor will have to be increased, use the optional high-frequency brake resistor.
- Setting Method: After “Select Change Duty” is set to 1 in Pr.30, use Pr.70 to set the duty.

Model	Default setting for regenerative brake duty (when Pr.30=0)	Default setting for Pr.70 (when Pr.30=0)
FR-E520-0.4K-3.7K/ 55K/72.5K	3%/2% fixed	0% (Note 1)

Notes: 1. Pr.70 is only displayed when Pr.30=1.

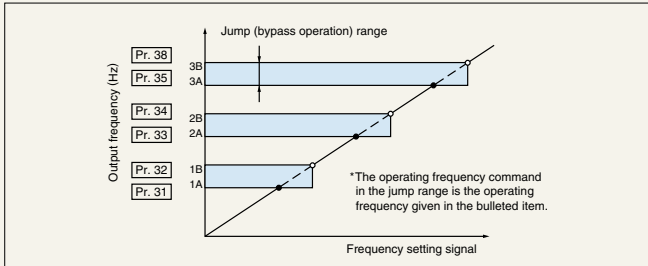
2. The brake duty is shown as the % ED of built-in brake transistor operation.



## Pr. 31–Pr. 43

### Pr. 31–36 Frequency Jumps

- To bypass the resonant frequency of a piece of machinery, jump over that frequency. You can set three jump points. The jump frequency can be the frequency either above or below the jump point.
- The setting for 1A, 2A, or 3A becomes the jump point; operation is at this frequency.



- Notes:
1. No jumps are made when set to 9999 (the default).
  2. During acceleration or deceleration, the operating frequency in the set range is passed over.

### Pr. 37 Setting the Speed Display Increment

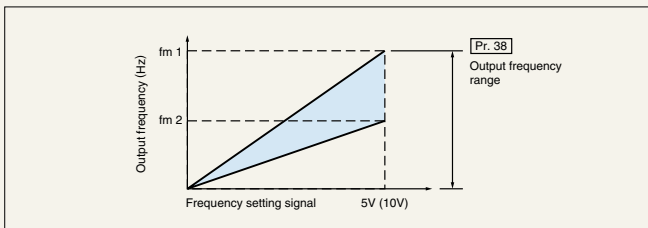
- The actual operating speed of machinery such as conveyors can be displayed. You can set the control panel monitor to show operating speed in the same units as the speed specifications of the machinery you are using.
- Set the machine speed when operated at 60Hz.

Pr.37 setting	Display
0	● The output frequency is displayed (default setting).
0.01–9998	<ul style="list-style-type: none"> <li>● Set the machine speed when operated at 60Hz. For example, if set for 950 (m/min.), 950 (without units) is displayed when 60Hz is output.</li> <li>● The units of the operating speed are also converted in the display.</li> </ul>

- Notes:
1. The set unit is only used with this parameter for the PU monitor display and setting operating speed. Other parameters for speeds (such as Pr.1) should be set as frequencies.
  2. The speed display is converted from output frequency; it does not match the actual RPM.
  3. Due to the setting resolution, frequencies set directly through the control panel may differ from operating speed.

### Pr. 38 Frequency at 5V (10V) Input

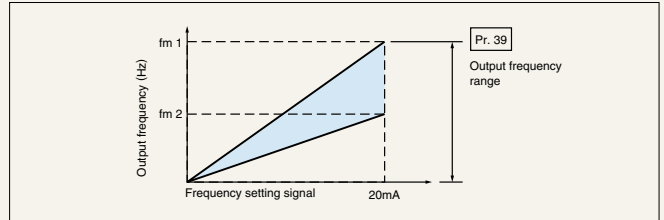
- You can set the frequency when the frequency setting signal input externally is 5V DC (or 10V DC).



- Note: There is no need to input a 5V DC (or 10V DC) voltage between terminals 2 and 5.

### Pr. 39 Frequency at 20mA Input

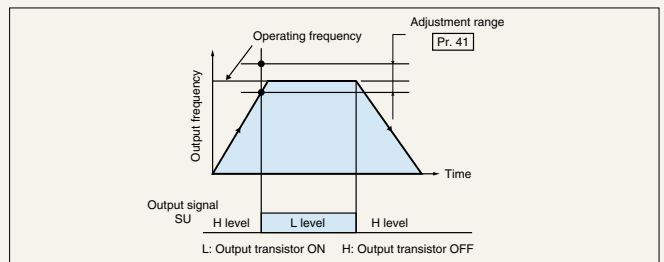
- The frequency setting signal from outside the inverter can set the frequency used for 20mA.



- Note: There is no need to input a 20mA current between terminals 4 and 5.

### Pr. 41 Up-to-Frequency Sensitivity

- The output signal operating width when the output frequency reaches operating frequency can be adjusted within the range 0 to  $\pm 100\%$ .

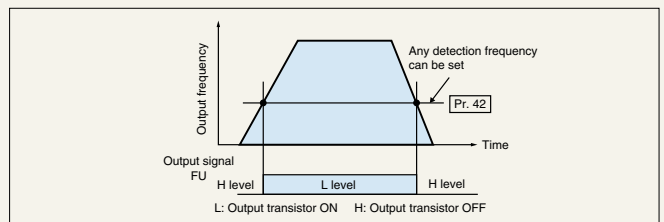


### Pr. 42 Pr. 43 Output Frequency Detection

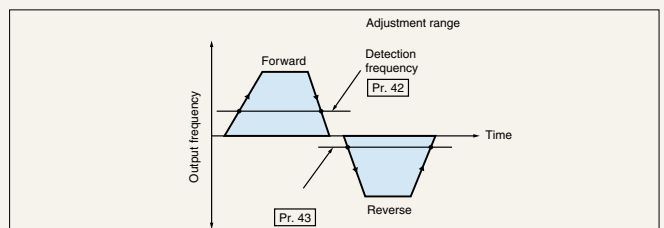
**Pr. 42** Output frequency detection

**Pr. 43** Output frequency detection for reverse rotation

- When the output frequency rises above an arbitrary detection frequency (set with output frequency detection Pr.42), the level becomes L; below that frequency, it remains H. This can be used for engaging electromagnetic brakes, for release signals, and so on.



- Use Pr.43 to engage frequency detection only when operating in reverse. (The value set in Pr.42 only works for forward operation.) This can be effective when timing use of electromagnetic brakes based on forward (up) and reverse (down), as in elevators. The default setting is 9999, which means that the value set in Pr.42 is used for both forward and reverse.



# Description of Parameters

## Pr. 44–Pr. 65

### Pr. 44–48 Setting the 2nd Control Functions

**Pr. 44** 2nd acceleration/deceleration time

**Pr. 45** 2nd deceleration time    **Pr. 47** 2nd base frequency

**Pr. 46** 2nd torque boost    **Pr. 48** 2nd electronic thermal O/L relay

- You can change settings such as the acceleration/deceleration time and boost all at once using external contact signals (between terminals RT and SD).
- This is useful when switching between two motors with different parameter settings, such as elevation and lateral movement.

Set Function	Parameter number	Signal between terminals RT and SD	
		OFF	ON
Acceleration time	Pr.7	●	
	Pr.44		●
Deceleration time	Pr.8	●	
	Pr.45		●
Torque boost	Pr.0	●	
	Pr.46		●
Base frequency	Pr.3	●	
	Pr.47		●
Electronic thermal O/L relay	Pr.9	●	
	Pr.48		●

- Notes: 1. If Pr. 45 is set to 9999 (the default), the value set in Pr.44 is used for the second acceleration and deceleration times.  
 2. When general-purpose flux vector control mode is selected using Pr.80, the settings of Pr.0, Pr.3, Pr.46, and Pr.47 are ignored.  
 3. As with Pr.7 and Pr.8, the second acceleration/deceleration times of Pr.44 and Pr.45 are the times until the setting of Pr.20 (base frequency for acceleration/deceleration).  
 4. Default setting of Pr.44  
 0.1K to 3.7K: 5 seconds  
 5.5K to 7.5K: 10 seconds

### Pr. 52 Control Panel/PU Main Display Data

- You can choose from among five signals by setting the numbers shown in the table below.

Pr.52 setting	Signal type	Display units
0, 100	Output frequency	Hz
	Output current	A
	Output voltage	V
	Alarm display	–
23	Actual running time	hr

- Notes: 1. When set to 0, you can select the item monitored, in order, from output frequency through to alarm display using the setting key. (This is the factory default.)  
 2. The actual running time is counted from 0 to 99990 hours and then cleared, whereupon counting resumes from 0.  
 3. The actual running time is counted in terms of time the inverter operates. Time is not counted when the inverter is stopped.

- When Pr. 52 is set to 100, the output frequency value monitored will differ when it is stopped and when it is running. (While stopped, the Hz LED blinks; while running, it stays lit.)

	Pr.52		
	0	100	
	Running/stopped	Stopped	Running
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Error display	Error display		

- Notes: 1. During an alarm, the frequency when the alarm occurred is displayed.  
 2. While output is stopped (MRS), everything is handled the same as when the inverter is stopped. When off-line auto-tuning is engaged, monitoring of the tuning status takes priority.

### Pr. 54 FM Terminal Function Selection

- Use the FM output terminal by connecting a meter that displays the operating status. You can select whether to display output frequency or the motor current (output current).

Pr.54 setting	Signal type
0	Output frequency (default setting)
1	Motor current (output current)
2	Output voltage

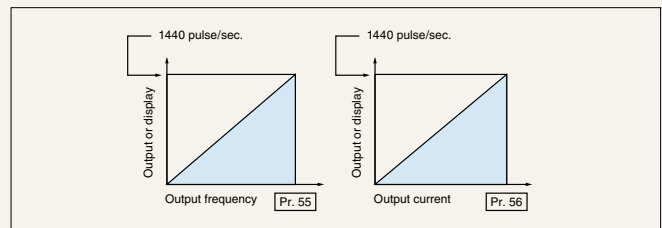
- Note: The output frequency gain can be adjusted using Pr.55 (frequency monitor reference); the motor current gain can be adjusted using Pr.56 (current monitor reference).

### Pr. 55 Pr. 56 Setting the Monitor Reference

**Pr. 55** Frequency monitoring reference

**Pr. 56** Current monitoring reference

- Pr. 55 is set with an output frequency that gives a pulse train output between terminals FM and SD when Pr.54 is set to 0 (output frequency) of 1440 pulse/sec.
- Pr. 56 is set with a motor current value that gives a pulse train output between terminals FM and SD when Pr.54 is set to 1 (motor current) of 1440 pulse/sec.



- Note: The maximum pulse train output of the FM terminal is 2400 pulse/sec.

### Pr. 57 Pr. 58 Restarting After an Instantaneous Power Failure

**Pr. 57** Restart coasting time    **Pr. 58** Restart cushion time

- You can have the inverter start operating when the power comes back on after an instantaneous power failure without stopping the motor (the motor coasts).

- Notes: 1. The operation of restarting after an instantaneous power failure uses a system in which the motor starts by reducing voltage that gradually cushions the output voltage at the set frequency regardless of the motor's coasting speed. This system does not detect the motor's coasting speed (the speed searching method).  
 2. When the instantaneous power failure stop period is long, restarting may not always be smooth. See manual for details.

## ● Pr.57 (Coasting Time)

Pr.57 setting	Restarting possible
9999 (default)	No
0 or 0.1–5 (Note)	Yes

The coasting time is the time spent waiting for control to start, which is used for restarting after recovery.

Note: When Pr.57 is set to 0, the standard coasting time described below is set. You can generally operate at this setting, but you can also adjust the time in the range of 0.1–5 seconds to better suit the inertial moment (GD<sup>2</sup>) of the load and the size of the torque.

0.1–1.5K: 0.5 seconds

2.2–7.5K: 1.0 second

## ● Pr.58 (Output Voltage Cushion Time)

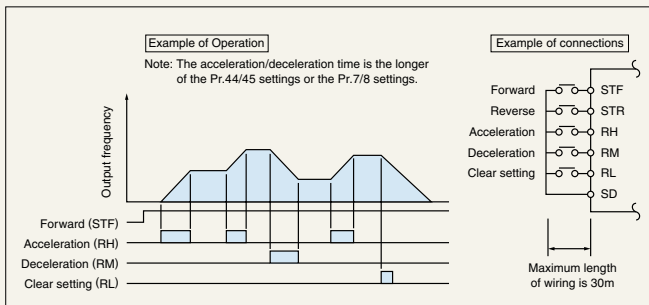
You can run the inverter using the default setting of 1 second for this parameter, but you can also adjust the output voltage cushion time for restarting between 0 and 60 seconds to better suit the load specifications (the inertial moment and the size of the torque).

## Pr.59 Remote Setting Function Selection

- By setting Pr.59 to 1 or 2, you can change the RH, RM, and RL terminal functions to the acceleration, deceleration, clear setting, and same input functions of the remote setting box FR-FK.

Pr.59 setting	Operation	
	Remotely set function	Frequency setting memory function (Note 1)
0	×	–
1	●	●
2	●	×

Note: When the RH-SD terminals or RM-SD terminals stay open for at least one minute or when the start signal changes to OFF, the operating frequency setting is placed in memory. If the power is turned off thereafter, operation resumes from this setting when power goes back on.



## Pr.60 Shortest Acceleration/Deceleration Mode Selection

### Pr.60 Shortest acceleration/deceleration mode

- When this parameter is selected, the inverter can be operated even when the acceleration/deceleration times are not set under the same type of conditions as though appropriate values were set for each parameter. This is a convenient operating mode when you just need the settings to be approximately right. (Note 1) That the appropriate parameters are selected automatically.

Pr.60 setting	Function set	Description of operation	Parameter automatically set
0 (default)	Normal operating mode	–	–
1, 2, 11, 12	Shortest acceleration/deceleration mode	Set to accelerate/decelerate the motor in the shortest time. The inverter makes acceleration/deceleration in the shortest time using its full capabilities. During deceleration, an insufficient brake capability may cause the regenerative overvoltage alarm (E.OV3). "1": Stall prevention operation level 150% "2": Stall prevention operation level 180% "11": Stall prevention operation level 150% when brake resistor or brake unit is used "12": Stall prevention operation level 180% when brake resistor or brake unit is used	(Note 2) Pr.7 (shortest), Pr.8 (shortest)

Notes: 1. Set individual parameters when you need control suited to the application as well.

2. Accelerates in the shortest time regardless of the Pr.7 and 8 settings.

## Pr.65 Pr.67 Pr.68 Pr.69

### Retry Selection

**Pr.65** Retry selection

**Pr.67** Number of retries at alarm occurrence

**Pr.68** Retry waiting time

**Pr.69** Retry count display erasure

- Retry is a function in which the inverter automatically resets the alarm when an inverter alarm occurs and then restarts and continues operation.
- Use Pr.65 to select the alarms for which a retry is done.

Pr.65 setting	Retry type
0	Retry for all alarms except fin overheating (FIN), PU disconnected (PUE), and CPU error (CPU).
1	Retry when an overcurrent cut-off (OCT) occurs.
2	Retry when a regenerative overvoltage cut-off (OVT) occurs.
3	Retry when a regenerative overvoltage cut-off (OVT) or overcurrent cut-off (OCT) occurs.

- You can also set the number of retries when an alarm occurs with Pr.67.

Pr.67 setting	Number of retries	Alarm error signal output
0 (default)	No retries	–
1–10	1–10	Not output
01–110	1–10	Output

- You can set the length of time to wait after an inverter alarm before restarting (0.1–360 sec.) using Pr.68.
- You can find out how many retries were needed to successfully restart by reading Pr.69. When set to 0, the count is erased.

Notes: 1. When using this function, be sure to take precautions so that the operator or machinery is not injured when the inverter automatically starts running after the retry wait time set with Pr.68.

2. A reset when restarting using the retry function does not clear accumulated data, such as for the electronic thermal O/L relay and regenerative brake duty (which is not the case for a power supply reset).

# Description of Parameters

## Pr. 66–Pr. 77

**Pr. 66** See the description of **Pr. 22**

**Pr. 70** See the description of **Pr. 30**

### **Pr. 71** Selecting Applied Motor

- When using a Mitsubishi constant torque motor, set Pr. 71 to 1 for both V/F control and general-purpose flux vector control. The electronic thermal is set to the constant torque motor thermal characteristics.

Pr. 71 setting	Electronic thermal characteristics		Motor	
			Standard	Constant torque
0, 100	Thermal characteristics to match general-purpose motors (default)		●	
1, 101	Thermal characteristics for Mitsubishi constant torque motor			●
2, 102	Standard motor	Select "off-line auto-tuning setting"	●	
13, 113	Constant torque motor			●
23, 123	Mitsubishi standard motor SF-JR4P (1.5 kW max.)		●	
5, 105	Standard motor		●	
15, 115	Fixed torque motor	Star wiring		●
6, 106	Standard motor	Delta wiring	●	
16, 116	Constant torque motor			●

Set 3, 13, 23, 103, 113, or 123 for off-line auto-tuning. When a number in the range 100–123 is set, the electronic thermal switches to fixed torque thermal characteristics when the RT signal goes ON.

### **Pr. 72** **Pr. 240** Changing Motor Noise

**Pr. 72** Select PWM frequency **Pr. 240** Set Soft-PWM

- When the PWM carrier frequency is lowered, motor noise increases, but the noise generated from the inverter and the leakage current decrease.
- Pr. 72 can be set between 0 and 15; however, for 0, the value is 0.7kHz, for 15 the value is 14.5kHz, and all other settings are the set value in kHz.
- You can use Pr. 240 to set whether to have Soft-PWM control, which changes the motor noise quality.

Pr. 240 setting	Description
0	Soft-PWM control disabled
1	Soft-PWM control enabled

Note: This is only valid when Pr. 72 (Set PWM frequency) is 0–5.

### **Pr. 73** Selecting the Frequency Command Voltage Range

- You can switch the input (terminal 2) specifications for the frequency setting voltage signal. Be sure to set this when inputting 0 to 10V DC.

Pr. 73 setting	Terminal 2 input voltage
0	DC 0–5V input (default)
1	DC 0–10V input

- Notes:
- To change the maximum output frequency when inputting the maximum frequency command voltage (current), set the frequency setting voltage (current) gain with Pr. 903 (or Pr. 905). Since the acceleration/deceleration time is the slope to the acceleration/deceleration reference frequency, it is not affected by changing the Pr. 73 setting.
  - When operating the inverter while connected to a frequency meter, be sure to set this value to 0.

### **Pr. 74** Input Filter Time Constant

- You can set the built-in input filter constant of the frequency setting signal for the external voltage or current. This aids in removing noise from the frequency setting circuit.
- When noise prevents stable operation, increase the filter time constant. Increasing the setting will lower responsiveness.

### **Pr. 75** Reset Selection/Disconnected PU Detection/PU Stop Selection

- This function sounds an alarm and stops the inverter with an inverter error when the inverter detects that a PU (control panel and parameter unit) connector has become disconnected from the inverter. You can select either a reset terminal function or a function that decelerates to a stop when PU stop key is hit.

Pr. 75 setting	Reset signal	PU disconnected	PU stop selection
0	Input always accepted	Keeps operating even when PU disconnected	Decelerates to a stop only when PU stop key is entered in PU operating mode
1	Input accepted only when protective function engaged		
2	Input always accepted	Inverter output cuts off when PU disconnected	
3	Input accepted only when protective function engaged		
14 (default)	Input always accepted	Keeps operating even when PU disconnected	Stops when PU stop key is entered in all operating modes (PU, external, communications, etc.).
15	Input accepted only when protective function engaged		
16	Input always accepted	Inverter output cuts off when PU disconnected	
17	Input accepted only when protective function engaged		

- Notes:
- When the RES signal goes ON during operation, the inverter cuts off the output while the signal remains ON; the electronic overcurrent protection and regenerative brake duty are reset, and the motor coasts to a stop.
  - When something other than a PU is connected (such as when doing RS-485 serial communications with a computer), no PU disconnections are detected.
  - Input from the PU reset key is only accepted when protective functions are engaged, regardless of the Pr. 75 settings.

### **Pr. 77** Parameter Write Disable Selection

- This parameter disables writing in control panel and parameter unit functions.

Pr. 77 setting	Write disable function
0	Parameter write enabled. (Only while stopped in PU mode. Default.)*1
1	Parameter write disabled.*2
2	Parameter write also enabled during operation.*3

- Notes:
- Monitor-related Pr. 54–56 can be set at any time.
  - Pr. 77 and 79 (operating mode selection) are write-enabled.
  - Some parameters are write-disabled during operation. See the parameter list.

## Pr. 78–Pr. 96

### Pr. 78 Reverse Rotation Prevention Selection

- Set this parameter to prevent problems caused by reverse rotation caused by mistaken start signal input.

Pr. 78 setting	Rotation direction
0	Forward or reverse both allowed. (Default.)
1	Reverse disabled.
2	Forward disabled.

Note: These settings are valid for both PU and external operation.

### Pr. 79 Operation Mode Selection

- The inverters have two operating modes: operation by external signal and operation by PU (control panel and parameter unit). You can set this parameter to use either or both. The setting for this parameter can be changed even when in external mode.

Operation by control panel and parameter unit is called "PU operation" in this table.

Setting	Description		
0 (default)	You can change between PU operation mode and external operation mode using the keys of the control panel and parameter unit. See the columns for values 1 and 2 for the descriptions of the modes.		
	Operating mode	Operating frequency	Start signal
1	PU operating mode	Set by control panel knob or digitally by control panel or parameter unit key	Control panel start (FWD and REV) keys or parameter unit FORWARD and REVERSE keys
2	External mode	External signal input (between terminals 2 (or 4) and 5, multi-speed selection)	External signal input (STF and STR terminals)
3	External and PU operating mode	Set by control panel knob or digitally by control panel or parameter unit key, multi-speed selection	External signal input (STF and STR terminals)
4	External and PU operating mode	External signal input (between terminals 2 (or 4) and 5, multi-speed selection)	Control panel start (FWD and REV) keys or parameter unit FORWARD and REVERSE keys
6	Switchover mode		
7	PU operation interlock		
8	Switch operating mode external signal (can't switch during operation) • PU operation is selected when X16 signal is OFF • External operation is selected when X16 signal is ON		

Note: Use Pr. 180-183 (input terminal function selection) to assign the terminal that the X16 signal will use.

#### ● Pr. 79 = 6: Switchover Mode

When set to switchover mode, you can change between PU and external operation at any time.

	Switchover mode	Switch
1	External operation to PU operation	External mode data is brought into PU mode
2	PU operation to external operation	When mode switches, the external knob value and starting signal are used.

Note: In switchover mode, frequency cannot be set with the control panel knob (which is disabled).

#### ● Pr. 79 = 7: PU Operation Interlock Function

When set to PU operation interlock, PU operation can be interlocked as shown below by turning the MRS signal ON or OFF.

MRS signal	External operation mode	PU operation mode
ON	Output stops	PU operation enabled, parameter setting enabled.
OFF	External operation enabled.	Both PU operation and parameter setting disabled. Forcibly switched to external operation mode.

### Pr. 80 General-Purpose Flux Vector Control

#### Pr. 80 Motor capacity

- General-purpose flux vector control can be advantageous when you need a large starting torque or sufficient low-speed torque. Set the motor capacity. When using a constant torque motor, set Pr. 71 (applied motor selection) to 1 or 13–16 (constant torque motor).

Notes: General-purpose flux vector control can be used with the following restrictions.

1. The motor is a standard, general-purpose squirrel-cage motor whose capacity (0.1kW or higher) is equal to or less than the inverter capacity. In the fixed torque motor (SF-JRCA) 200V class 4P, it can be used with 0.4–3.7kW motors.
2. The motor has 2, 4, or 6 poles. (Fixed torque motors must have four poles.) There is no need to set the number of poles.
3. The motor must be used alone (one inverter per motor).
4. The maximum wiring length between motor and inverter cannot exceed 30m. Beyond 30m, use off-line auto-tuning. Usage under other conditions may not provide the best performance.,

Note: This control system is not the same as the Mitsubishi advanced flux vector control used in the FR-A500 Series inverters.

### Pr. 82 Pr. 83 Pr. 90, 96

## Off-Line Auto-Tuning and Manual Setting of Motor Constant

#### Pr. 82 Motor excitation current

#### Pr. 83 Rated motor voltage

#### Pr. 90 Motor constant (R1)

#### Pr. 96 Auto-tuning setting/status

- You can automatically measure the motor constant to be used with general-purpose flux vector control with the auto-tuning (off-line) function.
- After you select general-purpose flux vector control, set the following parameters.

Pr. number	Name	Setting range
71	Applied motor	3, 13, or 23
83	Rated motor voltage	0–1000V
84	Rated motor frequency	0–400Hz
96	Off-line auto-tuning setting/status	0 No off-line auto-tuning
		1 Off-line auto-tuning without running the motor

- Notes:
1. Motor shall be connected. When tuning starts, however, the motor should be stopped.
  2. You can do off-line auto-tuning even with a load (friction, constant load, etc.) on the motor.
  3. You cannot tune special motors such as high-slip motors and high-speed motors.

- You can monitor the results of tuning with Pr. 90.

- You can set the motor excitation current and motor constant with Pr. 82 and Pr. 90. (See manual for details.)

# Description of Parameters

## Pr. 117–Pr. 151

### Pr. 117–124 RS-485 Communications Operation

- Pr. 117** Station number
- Pr. 118** Communication speed
- Pr. 119** Stop bit length/data length
- Pr. 120** Parity check presence/absence
- Pr. 121** Number of communication retries
- Pr. 122** Communication check time interval
- Pr. 123** Waiting time setting
- Pr. 124** CR/LF presence/absence selection

- RS-485 communications can be performed from the inverter's PU connector.

For RS-485 communication, set the following parameters. (See manual for details.)

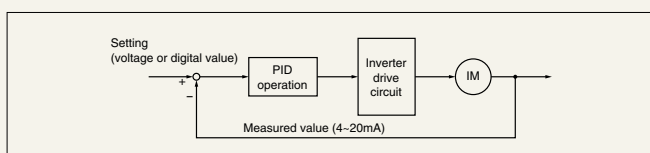
Pr. number	Name	Setting	Description
117	Local station	0-31	Set inverter station number
118	Communication speed	48	4800 baud
		96	9600 baud
		192	19200 baud
119	Stop bit length/data length	0	1 stop bit, 8 data bits
		1	2 stop bit, 8 data bits
		10	1 stop bit, 7 data bits
		11	2 stop bit, 7 data bits
120	No. of parity checks	0	No parity check
		1	Odd parity
		2	Even parity
121	Number of communication retries	0–10	Set permitted No. of retries for communications errors
		9999	Do not check for communications errors
122	Communication check time interval	0	Communication disabled
		0.1–999.8	Set communication time interval (in seconds)
		9999	Halt communication check
123	Waiting time setting	0–150	Set send wait time (in ms)
		9999	Set send wait time in communication
124	CR/LF presence/absence selection	0	No CR or LF
		1	Only CR
		2	Both CR and LF

Note: These parameter settings are disabled during PU operation.

### Pr. 128–134 PID Control

- Pr. 128** PID action selection      **Pr. 132** Lower limit
- Pr. 129** PID proportional band    **Pr. 133** PID action set point for PU operation
- Pr. 130** PID integral time
- Pr. 131** Upper limit                    **Pr. 134** PID differential time

- Use these for process controls of flow, airflow, pressure, etc. Quantities provided externally as voltage or digital values are used as the settings; PID control is performed with 4–20mA current input signals as the feedback quantities.



### Pr. 145 Switch Parameter Unit Language

- You can switch the language that the parameter unit uses. This setting is enabled when the optional FR-PU04 unit is used.

Pr.145 setting	Language
0	Japanese (default)
1	English
2	German
3	French
4	Spanish
5	Italian
6	Swedish
7	Finnish

### Pr. 146 Select Frequency Setting Instruction

- Select whether to set the frequency using the control panel knob or digitally using the  $\blacktriangledown$ / $\blacktriangle$  keys.

Pr.146 setting	Select frequency setting
0	Built-in frequency setting control volume
1	Digital frequency setting using the $\blacktriangledown$ / $\blacktriangle$ keys
9999	Frequency setting using the built-in frequency setting control volume is available when the frequency setting has been set at (OH2) using the $\blacktriangledown$ / $\blacktriangle$ keys

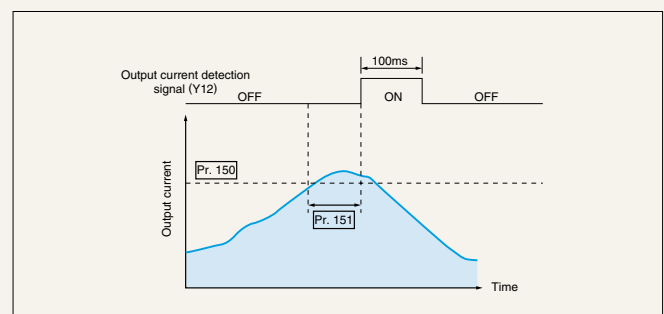
\*CC-Link type does not have this function.

### Pr. 150 Pr. 151 Current Detection

**Pr. 150** Output current detection level

**Pr. 151** Output current detection period

- When the output current exceeds the level set in Pr.150 (output current detection level) and the time set in Pr.151 (output current detection time) elapses, the output terminal goes ON. Once the output signal goes ON, it stays ON for at least 100ms (approximately).



Note: Use parameters 190–192 (output terminal function selection) to assign the terminal that the output current detection signal (Y12) will use for output.



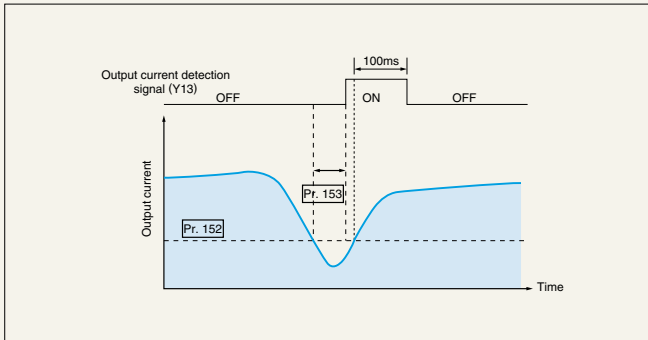
## Pr. 152–Pr. 192

### Pr. 152 Pr. 153 Zero Current Detection Signals

**Pr. 152** Zero current detection level

**Pr. 153** Zero current detection period

- When the output current falls below the level set in Pr.152 (zero current detection level) and the time set in Pr.153 (zero current detection time) elapses, the output terminal goes ON. The output signals stays ON for about 100ms even after conditions change.



Note: Use Pr.190–192 (output terminal function selection) to assign the terminal that the zero current detection signal (Y13) will use for output.

### Pr. 156 Stall Prevention Operation Selection

- This selects how the stall prevention and high-response current limit function work.

Pr. 156 setting	Stall prevention and high-response current limit function operation
0	Operates (default)
100	Does not work during regenerative operation.

Note: There are other settings than the above. See manual for details.

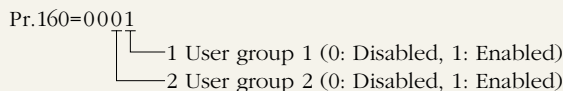
### Pr. 160 Pr. 173–176 User Group Selection

**Pr. 160** User group read selection    **Pr. 175** User group 2 registration

**Pr. 173** User group 1 registration    **Pr. 176** User group 2 deletion

**Pr. 174** User group 1 deletion

- Up to 32 of the parameters can be registered in two user groups. The registered parameters can be read and written. When a user group is selected with Pr.160 (user group selection), unregistered parameters cannot be read.



- Registering Parameters in a User Group:  
Write the parameter number to be registered in Pr.173 (user group 1 registration) or Pr.175 (user group 2 registration).
- Deleting Parameters from a User Group:  
Write the parameter number to be deleted in Pr.174 (user group 1 deletion) or Pr.176 (user group 2 deletion).

### Pr. 171 Actual Operation Hour Meter Clear

- Write 0 to clear the actual operation time monitor (Pr.52=23).

### Pr. 180–183 Input Terminal Function Selection

**Pr. 180** RL terminal function selection

**Pr. 181** RM terminal function selection

**Pr. 182** RH terminal function selection

**Pr. 183** MRS terminal function selection

- Functions can be freely assigned to input terminals by setting 0–18 for Pr.180–Pr.183.

Pr. number	Name	Terminal
180	RL terminal function selection	RL
181	RM terminal function selection	RM
182	RH terminal function selection	RH
183	MRS terminal function selection	MRS

Setting	Terminal	Terminal function			
0	RL	Pr. 59=0	Low speed	Pr. 59=1	Remote setting (clear settings)
1	RM		Middle speed		Remote setting (deceleration)
2	RH		High speed		Remote setting (acceleration)
3	RT	Second function selection			
4	AU	Current input selection			
5	STOP	Start self-hold selection			
6	MRS	Stop output			
7	OH	External thermal input			
8	REX	15 speed setting (combination of 3 speeds, RL, RM, and RH)			
16	X16	Switch between PU operation to external operation			
18	X18	Switch between V/F to general-purpose flux vector control			

Note: The functions of the STF, STR, and RES terminals cannot be changed.

### Pr. 190–192 Output Terminal Function Selection

**Pr. 190** RUN terminal function selection

**Pr. 191** FU terminal function selection

**Pr. 192** A, B, C terminal function selection

- Set Pr.190–Pr.192 to 0–99 or 9999 to freely assign functions to the output terminals (including relays)

Pr. number	Name	Terminal
190	RUN terminal function selection	RUN
191	FU terminal function selection	FU
192	A, B, C terminal function selection	A, B, C

Setting	Terminal	Terminal function
0	RUN	Inverter running
1	SU	Reach frequency
3	OL	Overload warning
4	FU	Frequency detection
11	RY	Inverter ready to run
12	Y12	Output current detection
13	Y13	Zero current detection
14	FDN	PID minimum
15	FUP	PID maximum
16	RL	PID forward reverse output
98	LF	Minor breakdown output
99	ABC	Error output

# Description of Parameters

## Pr. 232–Pr. 991

**Pr. 232–239** See the description of **Pr. 4**

### Pr. 244 Fan ON-OFF Control

- Controls the cooling fan.

Pr. 244 setting	Fan operation
0	No ON-OFF control (Factory setting)
1	ON-OFF control (Always ON during inverter operation; while the inverter is stopped, goes ON-OFF according to temperature control.)

### Pr. 245–247 Slip Compensation

**Pr. 245** Rated motor slip

**Pr. 246** Slip compensation response time

**Pr. 247** Constant-output region slip compensation selection

- The motor slip can be estimated from the inverter output current and the motor rotation held constant.

Pr. number	Name	Description	Default
245	Rated motor slip	Sets the rated slip of the motor	9999
246	Slip compensation response time	Sets the response time for slip compensation. <small>(Note 1)</small>	500ms

$$\text{Rated slip} = \frac{\text{Base frequency synchronization speed} - \text{rated RPM}}{\text{Base frequency synchronization speed}} \times 100\%$$

Pr. 247 selects whether or not to activate slip compensation in the rated output zone (the frequency zone above the frequency set in Pr. 3).

Pr. 247 setting	Function
0	No slip compensation in constant output zone.
9999	Slip compensation in constant output zone.

- Notes:
- Decreasing this value increases the response time but also makes regenerative overvoltage errors (OVT) more frequent, for example, when there is greater load inertia.
  - There is no slip compensation when Pr. 245 is set to 9999.

### Pr. 249 Check for Ground Faults at Startup

- You can choose whether to check for ground faults at startup. Ground faults can only be implemented immediately after the start signal is input to the inverter.

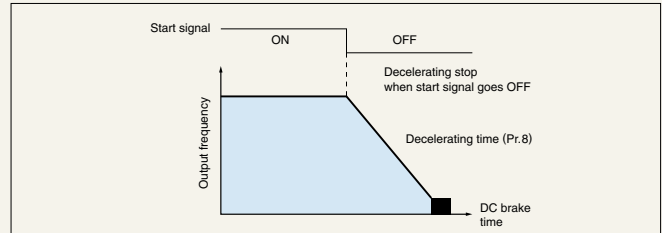
Pr. 249 setting	Description
0	Don't detect ground faults (default)
1	Detect ground faults. Output is delayed about 20ms at every startup when ground faults are checked.

- Notes:
- When parameter 249 is 1 and a ground fault is detected, error indicator "E.GF" is displayed and output cuts off.
  - The protective function does not engage for ground faults that occur while the inverter is running.
  - If the motor capacity is less than 100W, ground fault protection may not be available.
  - This parameter is not applicable to the FR-E540 series.

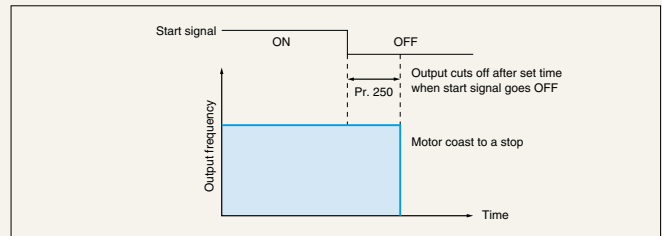
### Pr. 250 Stop Selection

- This parameter selects the stopping method used when the start signal goes OFF (decelerating stop or coasting stop).

When Pr. 250 is 9999 (decelerating stop when start signal goes OFF):



When Pr. 250 is 0–100 (coasting stop when start signal goes OFF):



When Pr. 250 is 8888, the terminal STF and STR functions switch as follows. (STF: Start signal, STR: Rotation direction signal)

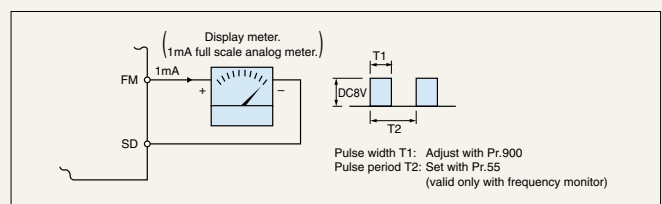
STF	STR	Inverter Operating Status
OFF	OFF	Stop
OFF	ON	Stop
ON	OFF	Forward
ON	ON	Reverse

When Pr. 250 is 1000–1100 seconds, the STF and STR terminal functions are the same as when Pr. 250 is 8888. It will stop while the start signal is OFF by cutting off output (coasting to a stop) after (Pr. 250 setting)–1000 seconds.

- Notes:
- When Pr. 250 is something other than 9999, the RUN signal goes OFF when the start signal goes OFF.
  - When the restart signal goes ON while the motor is coasting, the motor starts from 0Hz.
  - When Pr. 250 is 0, the cut-off of output is the within the shortest time.

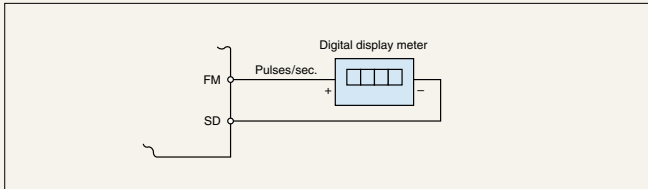
### Pr. 900 FM Terminal Output Calibration

- You can use the control panel to calibrate meters connected to the FM terminal. This calibration function is shared by all monitor functions selected with Pr. 54.
- The FM terminal output is pulse output like that shown in the diagram below. You can set Pr. 900 so you can use the control panel for scale calibration of meters connected to the inverter without having to install a scale calibrating resistor. (See the manual for more information about calibration.)



● **Monitoring Using Digital Display Meter**

You can display data digitally using a digital counter by employing the pulse train output of the FM terminal. Output is 1440 pulse/sec. at the full scale value described in the section on Pr.54. When operating frequency is selected for monitoring, you can set the FM output frequency for this terminal using Pr.55.



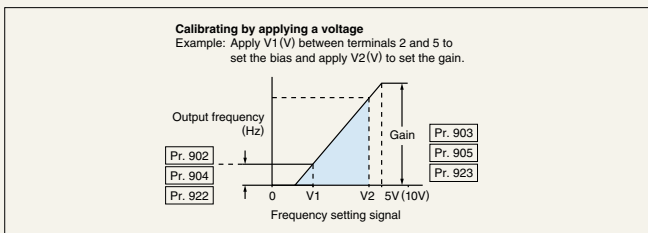
Note: Set before shipment so that 1mA provides full scale and a FM output frequency of 1440Hz at 60Hz.

**Pr.902–905** **Pr.922–923**

## Frequency Setting Signal Gain and Bias Adjustment

- Pr.902** Frequency setting voltage bias
- Pr.903** Frequency setting voltage gain
- Pr.904** Frequency setting current bias
- Pr.905** Frequency setting current gain
- Pr.922** Built-in knob bias
- Pr.923** Built-in knob gain

- You can set any size (slope) of output frequency for the frequency setting signal (0 to 5V, 0 to 10V, or 4–20mA DC) and control panel knob setting.
- Input between inverter terminals 2 and 5 (0 to 5V, 0 to 10V DC) or terminals 4 and 5 (4–20mA DC) or calibrate by turning the control panel knob to any position.
- Set Pr.902–Pr.905 to some setting other than the digital frequency setting 0.00. Set Pr.922 and Pr.923 to the digital frequency setting 0.00 in PU operating mode and calibrate when operation by the knob is selected.



- Notes: 1. When Pr.903 and Pr.905 are set, the 5V input frequency (Pr.38) and 20mA input frequency (Pr.39) are automatically overwritten.  
 2. An error will result if the differences between Pr.902 and Pr.903, Pr.904 and Pr.905, or Pr.922 and Pr.923 exceed 5% of the maximum input.

- To calibrate without inputting a voltage or current, set a frequency in Pr.38 (5V (10V) input frequency) or Pr.39 (20mA input frequency). When Pr.38 is set, the values of Pr.902 and Pr.903 are no longer valid; when Pr.39 is set, the values of Pr.904 and Pr.905 are no longer valid.

**Pr.990** **Buzzer Sound Control**

- You can turn the buzzer sound used when parameter unit FR-PU04 keys are pressed either on or off.

Pr.990 setting	Description
0	No buzzer
1	Buzzer (default)

**Pr.991** **LCD Contrast**

- You can adjust the contrast of the LCD on the optional FR-PU04 parameter unit.

Pr.991 setting	Description
0 to 63	Bright
	53 (default)
	Dark

Note: The LCD contrast setting will not be recorded unless you press the [WRITE] key.

# Protective Functions

The following protective functions are provided for the protection of the inverter itself (except for the motor's electronic thermal relay), but they may also function when the inverter breaks down.

Function name		Description	Display	Type <sup>(Note 5)</sup>		
				Major fault	Minor fault	
Over-current shut-off		When the inverter output current exceeds the rated current by more than approximately 200% during acceleration/deceleration or at constant speed, the protective circuit activates, halting inverter output.	Accelerating	<i>E.OC1</i> (OC1)	●	
			Constant speed	<i>E.OC2</i> (OC2)		
			Decelerating	<i>E.OC3</i> (OC3)		
Regenerative overvoltage shut-off		If the DC voltage in the inverter's internal main circuit exceeds the rated value as a result of regenerative energy generated through motor braking during acceleration/deceleration or at constant speed, the protective circuit activates, halting inverter output. There are also cases where it is activated by surge voltage generated in the power supply system.	Accelerating	<i>E.OV1</i> (OV1)	●	
			Constant speed	<i>E.OV2</i> (OV2)		
			Decelerating	<i>E.OV3</i> (OV3)		
Overload shut-off (electronic thermal relay) <sup>(Note 1)</sup>	Motor	The electronic overcurrent protection inside the inverter detects motor overheating resulting from overloading or a decline in cooling capacity at constant speed, activating the protective circuit and halting inverter output. The electronic thermal relay cannot protect multipolar and other special motors, or several motors working together, so a thermal relay should be installed on the inverter's output side.		<i>E.FHM</i> (THM)	●	
	Inverter	In the case where a current flows that is at least 150% of the rated output current but does not exceed the overcurrent shut-off (OC) level (200% max.), the electronic thermal relay activates according to reverse time characteristics to protect the main circuit transistors, and halts inverter output. (150% of overload capacity, 60 seconds.)		<i>E.FHF</i> (THT)	●	
Fin overheat		If the cooling fin overheats, the fin overheat sensor activates and halts inverter output.		<i>E.FIn</i> (FIN)	●	
Fan breakdown		When the inverter has a built-in cooling fan, FN will be displayed on the control panel when the cooling fan breaks down or an operation different from the setting of Pr.244 (cooling fan operation selection) is performed. Inverter output does not stop.		<i>Fn</i> (FN)		●
Output ground fault overcurrent protection		When a ground fault occurs at the inverter output (the load side) when the inverter is started up and the ground fault overcurrent flows, inverter output stops. Use Pr.249, "Ground fault detection at Startup (Y/N)" to set whether to engage the protection function. <sup>(Note 8)</sup>		<i>E.GF</i> (GF)	●	
External thermal relay operation <sup>(Note 2)</sup>		When an externally installed motor overheating protective thermal relay or temperature relay within the motor, etc., activates (relay contact open), the inverter can be stopped if the contact is input to the inverter. Even if the relay contact resets automatically, the inverter will not restart unless it is reset also.		<i>E.OHT</i> (OHT)	●	
Brake transistor error detected <sup>(Note 3)</sup>		When the optional brake resistor is connected and a brake transistor error occurs (for example, when the energy regenerated from the motor becomes very large), this is judged a brake transistor error and inverter output stops.		<i>E.bE</i> (BE)	●	
Parameter error		Generated when an error occurs in a stored parameter (e.g. E <sup>2</sup> ROM breakdown).		<i>E.PE</i> (PE)	●	
PU disconnected		Inverter output halts when communication between the main unit and the PU is interrupted by disconnection of the PU, etc., when Pr. 75 is set to 2, 3, 16, 17.		<i>E.PUE</i> (PUE)	●	
Number of retries exceeded		When operations cannot be restarted normally within the set number of retries, inverter output is halted.		<i>E.rEF</i> (RET)	●	
Output phase loss detection		Detects when the inverter loses an output phase (U, V or W).		<i>E.LF</i> (LF)	●	
CPU error		If the built-in CPU does not complete operations within the prescribed time, it self-diagnoses a fault and halts inverter output.		<i>E.CPU</i> (CPU)	●	
Current limit/ Stall prevention	During acceleration	When a current of 150% <sup>(Note 4)</sup> or more of the inverter's rated current flows in the motor, the rise in frequency is stopped until the load current declines, preventing the inverter from executing an over-current shut-off. The frequency is increased again once the current falls below 150% of the rated value.		<i>OL</i> and monitor displayed alternately.	●	
	At constant speed	When a current of 150% <sup>(Note 4)</sup> or more of the inverter's rated current flows in the motor, the frequency is lowered until the load current declines, preventing the inverter from executing an over-current shut-off. The frequency is restored to the set level once the current falls below 150% of the rated value.		<i>OL</i> and monitor displayed alternately. (OLT)		
	During deceleration	If the motor's regenerative energy is excessive and surpasses its braking capacity, the decline in frequency is halted, preventing the inverter from executing an over-current shut-off. Once the regenerative energy has declined, deceleration continues. When a current of 150% <sup>(Note 4)</sup> or more of the inverter's rated current flows in the motor, the decline in frequency is halted until the load current declines, preventing the inverter from executing an over-current shut-off. The frequency is lowered once again once the current falls below 150% of the rated value.		<i>OL</i> and monitor displayed alternately.		
Optional equipment error <sup>(Note 7)</sup>		Checks for breaks in the CC-Link connection cable. This protection function also engages when reset with the master unit in NET mode (Pr. 79 = 2). (Inverters are set to NET mode when shipped.)		<i>E.OPT</i> (OPT)	●	

- Notes:
- When the inverter is reset, the internal heat counting data in the electronic thermal O/L relay (overcurrent protection) is initialized.
  - External thermal relay operations are only performed when Pr. 180–Pr. 183 (input terminal function selection) is set to OH.
  - This only functions when the optional brake resistor is connected.
  - Any stall prevention operation current can be set. Set to 150% when shipped.
  - Major Breakdowns: Inverter output is cut off by the protection function and an error signal is output.  
Minor Breakdowns: The protection function does not cut off output. A minor breakdown signal can be output if the parameter is set to do so.
  - In the case of the CC-Link Series, the ALARM lamp lights up when the protection function activates. If parameter unit FR-PU04 is in use, its displays switches automatically to indicate an error.
  - CC-Link Series only.
  - Pr.249 is not applicable to the FR-E540 series.  
The FR-E540 series is automatically set to detect ground faults.

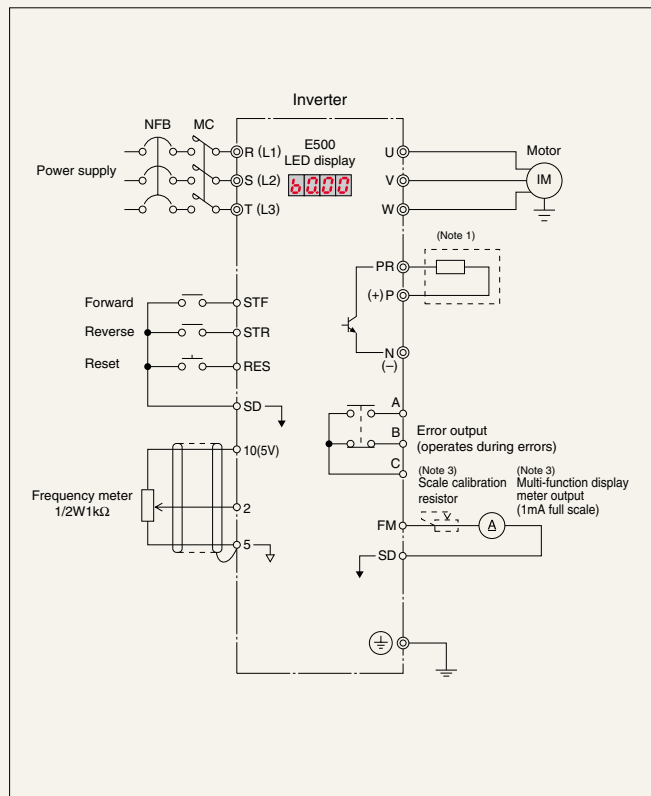
- Alarm output signal held.....When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm display.....When the protective function is activated, the control panel display automatically switches to the above indication.
- Resetting method.....When the protective function is activated, the inverter output is kept at a stop. Therefore, unless reset, the inverter cannot restart. Switch power off once, then on again; or short reset terminal RES-SD for more than 0.1 second, then open. If RES-SD are kept shorted, "Err." appears (flickers) to indicate that the inverter is being reset.

# Connection Examples

## Basic Wiring Diagram (Operation by External Signal)

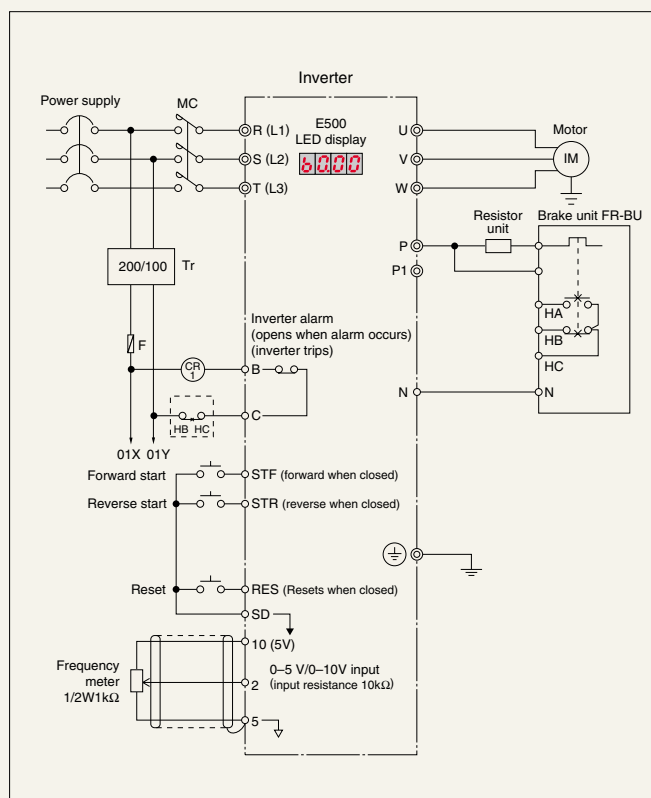
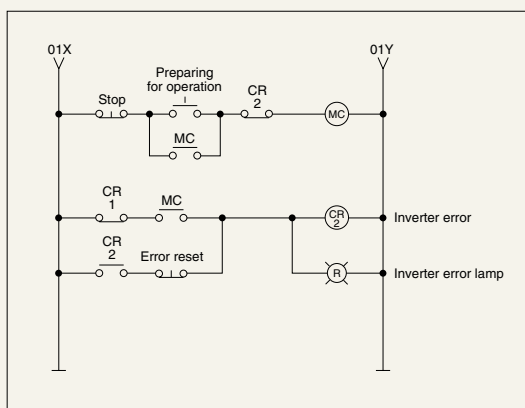
- This is the basic inverter wiring diagram when operating by using forward and reverse switches, an external potentiometer etc.
- For safety, install a magnetic contactor on the input side.

- Notes:
1. To install the model MRS optional external brake resistor to increase braking power, connect it between terminals PR and P(+).
  2. Set Pr. 54 to be able to select an output current display rather than frequency.
  3. Since Pr.900 can be used to calibrate the scale of the display meter, there is no need for a scale calibration resistor except when remote calibration is required.



## Basic Wiring Diagram (Main Circuit Input Cut-Off by Alarm)

- This is the circuit when cutting off the main inverter circuit input with a magnetic contactor when an inverter alarm stop occurs.
- The terminal FM-SD output can be either a frequency or a motor current signal. (See the description of Pr. 54 on page 21 for details.)
- For reset input, you can also select a function (error reset) that accepts signals only when the inverter alarm stops. (See the description of Pr. 75 on page 23 for details.)



# Connection Examples

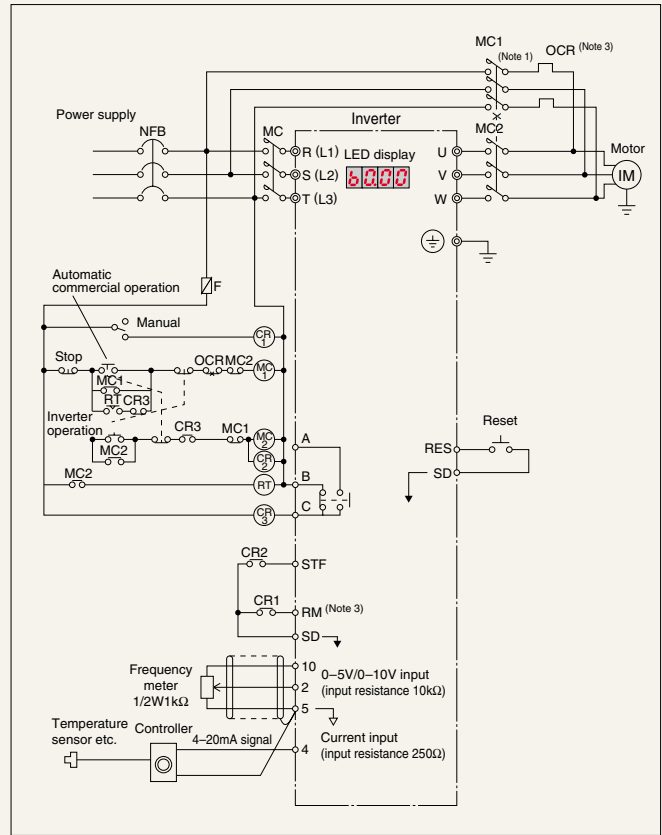
## Automatic Operation Using DC 4–20mA

### Current Signals (Building Air-Conditioners)

- This is a sample circuit for automatic operation when used in combination with controllers such as temperature control for building air-conditioners.
- You can switch from inverter operation to commercial power supply operation and vice versa. To switch from commercial power supply operation to inverter operation, first stop the motor.
- Operation automatically switches to commercial power supply operation when an alarm stop occurs in the inverter.
- Assign the AU signal to the RM terminal to be able to switch between a 4 to 20mA signal from the controller and a manual signal (voltage) from the speed setter.
- Set Pr.75 to change the reset input signal to an error reset that is only accepted when an inverter alarm stop occurs.
- For safety, install a magnetic contactor on the input side.

**Related parameters: Pr. 75 (Reset selection) and Pr. 180–Pr. 183 (Input terminal function selection).**

- Notes:
1. Use mechanically interlocked magnetic contactors for MC1 and MC2.
  2. Connect OCR to the commercial circuit side. If connected to the inverter, it may be engaged unexpectedly by leakage current during low noise operation. We recommend the electronic thermal O/L relay function (Pr.9) for motor protection when the inverter is operating.
  3. This terminal is used when Pr.181=4.



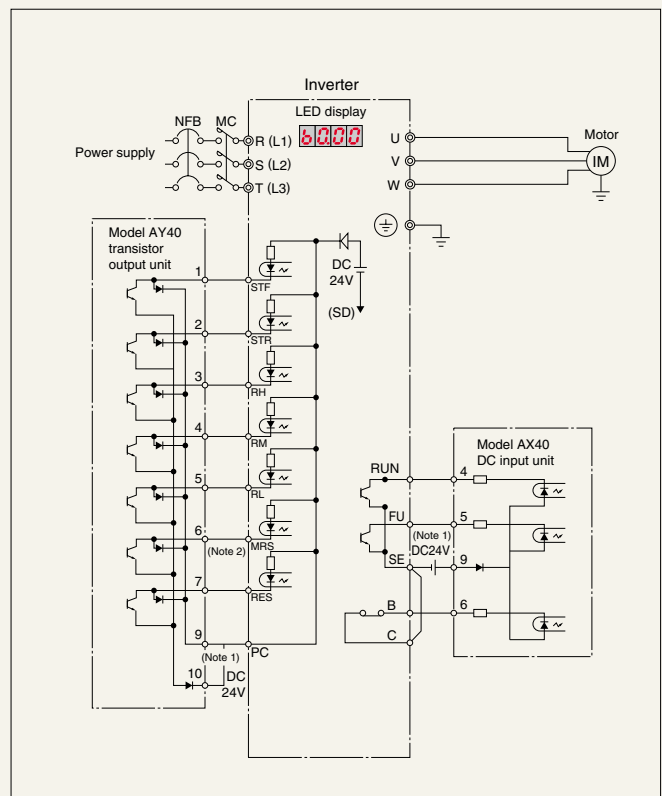
## Multi-Speed Operation

### (With Mitsubishi Programmable Controllers)

- This is a sample circuit for multi-speed operation with a Mitsubishi programmable controller (with an AY40 transistor output unit).
- AY40 common pin 9 for preventing wrap-arounds must be connected to inverter terminal PC.
- You can select a variety of functions for the inverter's transistor output signals (RUN, SU, etc.) using Pr.190 and Pr.191 (output terminal function selection). These inverter output signals, however, must be received at an AX40 DC input unit.
- Up to 15 speeds can be set with the multi-speed setter, but an additional two speeds can be obtained by shorting terminals 10 and 2 for an upper limit frequency setting (Pr.1) and terminals 2 and 5 for a lower limit frequency setting (Pr.2).
- For safety, install a magnetic contactor on the input side.

- Notes:
1. Units AY40 and AX40 require a DC 24V power supply.
  2. This terminal is used when Pr.183=8.

**Related parameters: Pr. 4–Pr. 6, Pr. 24–Pr. 27, and Pr. 232–Pr. 239 (Multi-speed setting), and Pr. 1, Pr. 2 (Maximum and minimum frequency settings), and Pr. 183 (MRS terminal function selection).**



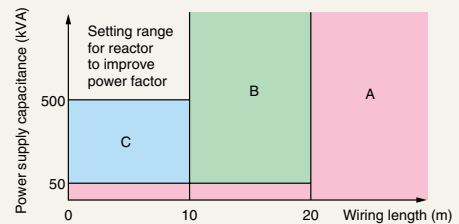


# Peripherals

## Selecting Peripherals

Voltage	Motor output (kW)	Applicable inverters	No-fuse breaker (NFB) or leakage breaker (NV)	Magnetic contactors (MC)			Lead (mm <sup>2</sup> )		AC supply-coordinating reactor	DC supply-coordinating reactor
							R, S, T (L1, L2, L3)	U, V, W		
3-phase 200V	0.1	FR-E520-0.1K(N)	Models NF30 and NV30 5A	S-N11	S-N18	S-N20	2	2	FR-BAL-0.4K (Note 5)	FR-BEL-0.4K (Note 5)
	0.2	FR-E520-0.2K(N)	Models NF30 and NV30 5A	S-N18	S-N20	S-N20	2	2	FR-BAL-0.4K (Note 5)	FR-BEL-0.4K (Note 5)
	0.4	FR-E520-0.4K(N)	Models NF30 and NV30 5A	S-N18	S-N21	S-N21	2	2	FR-BAL-0.4K	FR-BEL-0.4K
	0.75	FR-E520-0.75K(N)	Models NF30 and NV30 10A	S-N18	S-N21	S-N21	2	2	FR-BAL-0.75K	FR-BEL-0.75K
	1.5	FR-E520-1.5K(N)	Models NF30 and NV30 15A	S-N21	S-N25	S-K50	2	2	FR-BAL-1.5K	FR-BEL-1.5K
	2.2	FR-E520-2.2K(N)	Models NF30 and NV30 20A	S-N11, S-N12			2	2	FR-BAL-2.2K	FR-BEL-2.2K
	3.7	FR-E520-3.7K(N)	Models NF30 and NV30 30A	S-N20			3.5	3.5	FR-BAL-3.7K	FR-BEL-3.7K
	5.5	FR-E520-5.5K(N)	Models NF50 and NV50 50A	S-N25			5.5	5.5	FR-BAL-5.5K	FR-BEL-5.5K
3-phase 400V	0.4	FR-E540-0.4K	Models NF30 and NV30 5A	S-N10			2	2	FR-BAL-H0.4K	FR-BEL-H0.4K
	0.75	FR-E540-0.75K	Models NF30 and NV30 5A	S-N10			2	2	FR-BAL-H0.75K	FR-BEL-H0.75K
	1.5	FR-E540-1.5K	Models NF30 and NV30 10A	S-N10			2	2	FR-BAL-H1.5K	FR-BEL-H1.5K
	2.2	FR-E540-2.2K	Models NF30 and NV30 15A	S-N20			2	2	FR-BAL-H2.2K	FR-BEL-H2.2K
	3.7	FR-E540-3.7K	Models NF30 and NV30 20A	S-N20			2	2	FR-BAL-H3.7K	FR-BEL-H3.7K
	5.5	FR-E540-5.5K	Models NF30 and NV30 30A	S-N20			3.5	2	FR-BAL-H5.5K	FR-BEL-H5.5K
Single-phase 200V	0.1	FR-E520S-0.1K	Models NF30 and NV30 5A	S-N18	S-N20	S-N20	2	2	FR-BAL-0.4K (Note 5)	FR-BEL-0.4K (Note 5)
	0.2	FR-E520S-0.2K	Models NF30 and NV30 10A	S-N18	S-N21	S-N21	2	2	FR-BAL-0.4K (Note 5)	FR-BEL-0.4K (Note 5)
	0.4	FR-E520S-0.4K	Models NF30 and NV30 10A	S-N21	S-N25	S-K50	2	2	FR-BAL-0.4K (Note 5)	FR-BEL-0.4K (Note 5)
	0.75	FR-E520S-0.75K	Models NF30 and NV30 15A	S-N21	S-N25	S-K50	2	2	FR-BAL-0.75K (Note 5)	FR-BEL-0.75K (Note 5)
Single-phase 100V	0.1	FR-E510W-0.1K	Models NF30 and NV30 10A	S-N18	S-N21	S-N21	2	2	FR-BAL-0.4K (Note 5)	—
	0.2	FR-E510W-0.2K	Models NF30 and NV30 15A	S-N21	S-N25	S-N25	2	2	FR-BAL-0.4K (Note 5)	—
	0.4	FR-E510W-0.4K	Models NF30 and NV30 20A	S-N21	S-N25	S-K50	2	2	FR-BAL-0.4K (Note 5)	—
	0.75	FR-E510W-0.75K	Models NF30 and NV30 30A	S-N21	S-N25	S-K50	2	2	FR-BAL-0.75K (Note 5)	—

- Notes: 1. Select the appropriate NFB model for your power supply capacitance.  
 2. The lead size shown is for a wiring length of 20m.  
 3. Selection of the magnetic contactor at the inverter input side will differ in the areas A, B, and C (as shown in the right diagram) because of the power supply capacitance and wiring length. For 0.4K to 1.5K, select an S-N10 when using a reactor for improving the power factor (FR-BEL or FR-BAL).  
 4. When the inverter capacity exceeds the motor capacity, select the breaker and magnetic contactor appropriate for the inverter model and select the lead and reactor for improving the power factor appropriate for the motor model.  
 5. There are occasions where goes slightly under 0.9.



Note: This is for when the recommended lead size is used.

## Selecting the Rated Sensitivity Current of the Leakage Breaker

If you are using a leakage breaker in the inverter circuit, use the following criteria to select a rated sensitivity current, regardless of the carrier frequency.

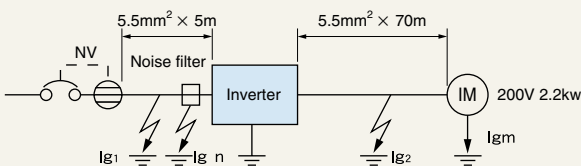
- For the Progressive Super NV Series (models SP and CP):  
 Rated sensitivity current  $I_{\Delta n} \geq 10 \times (I_{g2} + I_{gn} + I_{g2} + I_{gm})$
- For the conventional NV series (models CA, CS, and SS):  
 Rated sensitivity current  $I_{\Delta n} \geq 10 \{ I_{g1} + I_{gn} + 3 \times (I_{g2} + I_{gm}) \}$

$I_{g1}$ ,  $I_{g2}$ : Leakage current when operating with a cable run off a commercial power supply.

$I_{gn}^*$ : Leakage current of noise filter on inverter input side.

$I_{gm}$ : Leakage current when operating a motor off a with commercial power supply.

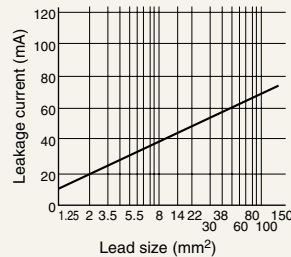
Example



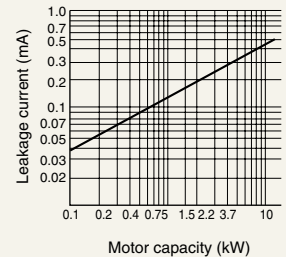
- Notes: 1. Install the NV on the primary side of the inverter the (power supply side).  
 2. Ground detection on the inverter's secondary side is possible if the operating frequency is 120Hz or less.  
 3. If you are using the W connection neutral point grounding method, the sensitivity current of the grounding at the inverter's secondary side will slow down, so use a special class 3 ground (10Ω or less) for the protection ground of the equipment under load.

\* Consult the filter manufacturer for the leakage current value of the noise filter installed at the inverter input side. (See pages 37 for the Mitsubishi inverter filters.)

- Example of leakage currents per 1kW in cable path during commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



- Example of leakage currents for operating a 3-phase induction motor off a commercial power supply (200V 60Hz)



- Examples of Selections (Based on Figure Above)

	Progressive Super NV Series	Conventional NV
Leakage current ( $I_{g1}$ )	$33 \times \frac{70m}{1000m} = 0.17$	
Leakage current ( $I_{gn}$ )	0 (without noise filter)	
Leakage current ( $I_{g2}$ )	$33 \times \frac{70m}{1000m} = 2.31$	
Motor leakage current ( $I_{gm}$ )		0.18
Total leakage current	2.66	7.64
Rated sensitivity current ( $\geq I_{g} \times 10$ )	30	100

## Low-Voltage Standards

- (1) General-purpose inverters can be used for low-voltage standards.
- (2) Caution: When using DIN VDE0160, some specifications and cautions differ from the standard, as described in the table below.

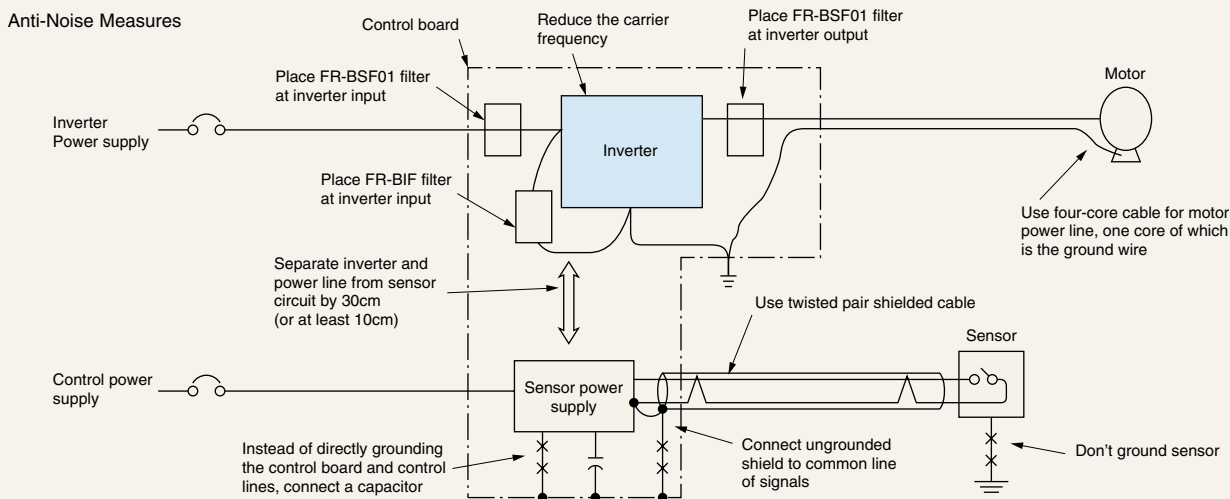
Specification	Changes and cautions	Comments
Error output	Contactors (30V DC, 0.3A)	-
Ground	Securely ground equipment and use single wires for ground terminals.	-
Magnetic contactor, no-fuse breaker	Use products that conform to EN or IEC standards.	The magnetic contactors and no-fuse breakers on the peripherals list conform to IEC standards.
Input insulation transformer surge absorber	Use products that conform to EN or IEC standards for the inverter inputs.	Standard IEC664
Line type and lead size	The inverter connection lead should conform to EN60204.	Standard EN60204, appendix C

## Noise

When making operation quieter by raising the carrier frequency, electromagnetic noise tends to increase, so measures should be taken to reduce it along the lines outlined below. Note that in some installations, noise can be a factor even without the low noise settings (i.e., at default settings).

- Noise levels can be reduced by decreasing the Pr.72 setting for the carrier frequency.
- An FR-BIF radio noise filter can be effective against AM radio broadcast noise.

- The FR-BSF01 line noise filter can be effective against malfunctioning of sensors.
- Inductive noise in the inverter's cable runs can be reduced by separating them 30cm (or at least 10cm) and using twisted pair shielded cable. The shielded cable should not be grounded; instead, connect them to one point on the common side of the signals.



## Leakage Current

There are electrostatic capacitances between the inverter's input/output wiring and other wires and the earth and in the motor. Leakage current flows through these. Since their values are affected by the static capacitances and carrier frequencies, leakage current

increases when operation is made quieter by increasing the inverter's carrier frequency. This can be improved by the following measures. Also, when selecting a leakage breaker, follow the advice on page 32, regardless of the carrier frequency.

Type	Effect and Response	Leakage current paths
Leakage current to earth	<ul style="list-style-type: none"> <li>● The leakage current between the inverter input and output lines and the earth flows not just to the inverter system but also to other systems through the ground wires.</li> <li>● Leakage breakers and relays may trip unnecessarily.</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>● Lower the inverter's carrier frequency (Pr.72). Motor noise will increase, but the noise can be made more pleasant by selecting Soft-PWM control (Pr.240).</li> <li>● Use of anti-harmonic and anti-surge components (such as Mitsubishi's New Super NV Series) in the leakage breakers of the inverter system and other systems can allow use of the low noise configuration (with the raised carrier frequency).</li> </ul>	
Leakage current between wires	<ul style="list-style-type: none"> <li>● Leakage current flows through the electrostatic capacitance between inverter output lines.</li> <li>● Externally connected thermal relays can be tripped unnecessarily by harmonics of leakage currents.</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>● Use the built-in electronic thermal protection in the inverter.</li> <li>● Lower the inverter's carrier frequency (Pr.72). Motor noise will increase, but the noise can be made more pleasant by selecting Soft-PWM control (Pr.240).</li> </ul>	

# Optional Equipment

## List of Options

Name	Model	Application, specifications etc.	Applicable inverters
CC-Link	FR-E5NC	Allows changes in inverter operations, monitoring and parameters to be executed from PLC.	FR-E540 series only.
Parameter unit (8 languages)	FR-PU04	Interactive parameter unit with LCD	Common to all models
Parameter unit connector cable	FR-CB2□□ (Note 5)	Cable for connecting inverter and parameter unit	
Control panel rear cover and adapter set	FR-E5P	Set of rear cover for control panel and connector cable relay adapter	For 2.2K to 7.5K
Mounting attachment for EMC filter	FR-E5T□□ (Note 5)	Mounting attachment for noise filter for EMC standards	
Brake resistor	MRS and MYS models	Increases regenerative braking power (permissible duty 3% ED)	For each individual capacity
High frequency brake resistor	FR-ABR-(H)□□ (Note 3, 6)	Increases regenerative braking power (permissible duty 10% ED)	
BU brake units	BU-(H)□□ (Note 3, 6)	Greatly increase regenerative braking power	
Discharging resistor	GZG, GRZG	Discharging resistors for BU brake units	
High power factor converter	FR-HC-(H)□□ (Note 3, 6)	Suppresses harmonics	
AC supply-coordinating reactor	FR-BAL-(H)□□ (Note 3, 6)	Improves power factor of power supply (power factor about 90%) Connect to input side	
DC supply-coordinating reactor	FR-BEL-(H)□□ (Note 3, 4, 6)	Improves power factor of power supply (power factor about 95%)	Common to all types
Noise filter for EMC standards	SF□□ FR-E5NF-H□□ (Note 5)	Noise filter compatible with EMC standards (EN50081-2)	
Radio noise filter	FR-BIF-(H)□□ (Note 3, 6)	Reduces radio noise. Connect to input side	
Line noise filter	FR-BSF01 FR-BLF	For suppressing line noise (for small capacities of 3.7kW or less) For suppressing line noise	
Surge voltage suppression filter	FR-ASF-(H)□□	Filter for suppressing micro-surge voltage at inverter's output side	For inverter capacities 0.4 to 7.5K
Inverter setup software	FR-SW0-SETUP-WJ (Jap.) FR-SW0-SETUP-WE (Eng.)	Provides support from inverter start-up to maintenance	Common to all types

- Notes: 1. Rated power consumption for the FR series control and settings box power supply specifications are AC 200V 50Hz, 200/220V 60Hz, and AC 115V 60Hz.  
 2. When a radio noise filter is connected, the inverter may trip if the power is turned OFF during motor operation. In such cases, connect the radio noise filter to the primary side of the electromagnetic contactor.  
 3. Units in the 400V class designed by an "H" in the model name.  
 4. Single-phase 100V input specifications units cannot use.  
 5. □□ shows values.  
 6. □□ shows capacity.

Name (model)	Specifications and construction
Parameter unit FR-PU04	<p>● Connect with parameter unit connection cable</p> <p>Unit: mm (inch)</p> <p>● Panel cut-out dimensions</p>
Adapter set FR-E5P for rear cover of control panel	<p>● Use this to separate the control panel and parameter unit from the inverter and mount them in other housings.</p> <p>Unit: mm (inch)</p> <p>Size of panel cut-out</p> <p>Front</p> <p>Note: The mounting hole in the control panel is sealed, so push it open with mounting screws when installing it in a panel. The heads of the mounting screws should be no larger than 5.5 mm (outer diameter) x 2 mm (height). Do not use washers.</p>

# Optional Equipment

**Name (model)** Specifications and construction

Unit: mm (inch)

Mounting fixture  
FR-E5T□□ for EMC filter

Note:  
Don't use screws that are so long they will hit the EMC filter.

Attachment model	Inverters	W	W1	W2	H	H1	H2	D	C
FR-E5T01	FR-E520-2.2K, 3.7K	199 (7.83)	188 (7.40)	5 (0.20)	149 (5.87)	138 (5.43)	118 (4.65)	12 (0.47)	4 (0.16)
FR-E5T02	FR-E520-5.5K, 7.5K	222 (8.74)	195 (7.68)	6 (0.24)	300 (11.81)	285 (11.22)	244 (9.61)	12 (0.47)	5 (0.20)

**Name (model)** Specifications and construction

Unit: mm (inch)

High-frequency brake resistor  
FR-ABR-(H)□□

Model	Permissible brake duty	External dimensions						Resistance (Ω)	Approximate weight (kg/lb)	Continuous permissible power (W)	
		A	B	C	D	E	F				
200V class	FR-ABR-0.4K	10%	140 (5.51)	125 (4.92)	100 (3.94)	40 (1.57)	20 (0.79)	2.5 (0.10)	200	0.2 (0.4)	60
	FR-ABR-0.75K	10%	215 (8.46)	200 (7.87)	175 (6.89)	40 (1.57)	20 (0.79)	2.5 (0.10)	100	0.4 (0.9)	80
	FR-ABR-2.2K	10%	240 (9.45)	225 (8.86)	200 (7.87)	50 (1.97)	25 (0.98)	2.5 (0.10)	60	0.5 (1.1)	120
	FR-ABR-3.7K	10%	215 (8.46)	200 (7.87)	175 (6.89)	60 (2.36)	30 (1.18)	2.5 (0.10)	40	0.8 (1.8)	155
	FR-ABR-5.5K	10%	335 (13.19)	320 (12.60)	295 (11.61)	60 (2.36)	30 (1.18)	2.5 (0.10)	25	1.3 (2.9)	185
FR-ABR-7.5K	10%	400 (15.75)	385 (15.16)	360 (14.17)	80 (3.15)	40 (1.57)	2.5 (0.10)	20	2.2 (4.9)	340	
400V class	FR-ABR-H0.4K	10%	115 (4.53)	100 (3.94)	75 (2.95)	40 (1.57)	20 (0.79)	2.5 (0.10)	1200	0.2 (0.4)	45
	FR-ABR-H0.75K	10%	140 (5.51)	125 (4.92)	100 (3.94)	40 (1.57)	20 (0.79)	2.5 (0.10)	700	0.2 (0.4)	75
	FR-ABR-H0.15K	10%	215 (8.46)	200 (7.87)	175 (6.89)	40 (1.57)	20 (0.79)	2.5 (0.10)	350	0.4 (0.9)	115
	FR-ABR-H2.2K	10%	240 (9.45)	225 (8.86)	200 (7.87)	50 (1.97)	25 (0.98)	2.5 (0.10)	250	0.5 (1.1)	120
	FR-ABR-H3.7K	10%	215 (8.46)	200 (7.87)	175 (6.89)	60 (2.36)	30 (1.18)	2.5 (0.10)	150	0.8 (1.8)	155
	FR-ABR-H5.5K	10%	335 (13.19)	320 (12.60)	295 (11.61)	60 (2.36)	30 (1.18)	2.5 (0.10)	110	1.3 (2.9)	185
	FR-ABR-H7.5K	10%	400 (15.75)	385 (15.16)	360 (14.17)	80 (3.15)	40 (1.57)	2.5 (0.10)	75	2.2 (4.9)	340

Notes:  
1. Settings for regenerative brake duties should be less than the permissible brake duties shown above.  
2. Design the mountings and heat radiation with the knowledge that brake resistor temperatures can exceed 300°C in high-frequency operations.  
3. See page 41 for information about selection.

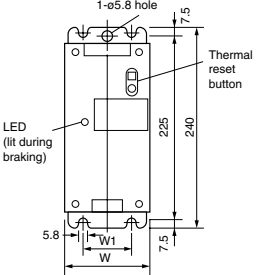
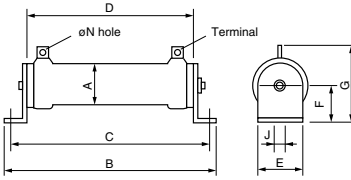
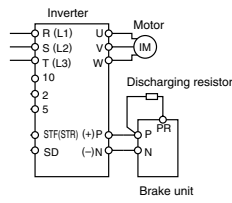
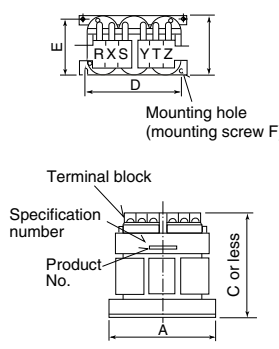
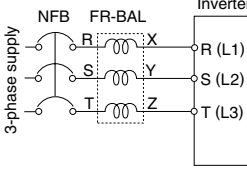
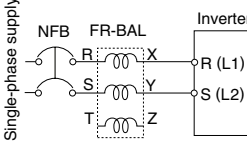
**Name (model)** Specifications and construction

Unit: mm (inch)

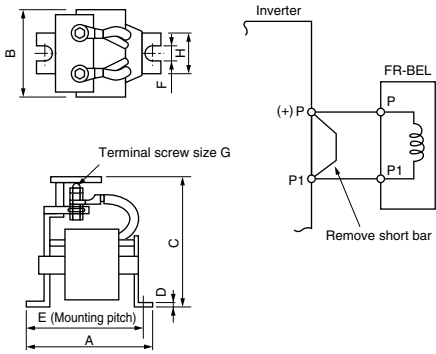
MRS and MYS brake resistors

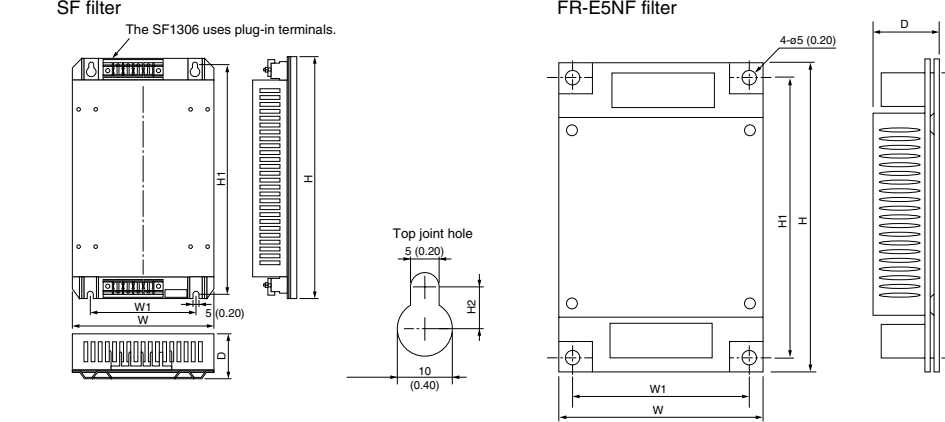
Break resistor	Permissible brake duty	Resistance (Ω)	Permissible power (W)	Applicable motor capacity (kW)	
				200V class	400V class
MRS models	MRS120W200	200	15	0.4	
	MRS120W100	100	30	0.75	
	MRS120W60	60	55	1.5, 2.2	
	MRS120W40	40	80	2.2, 3.7	
MYS model	MYS220W50*	50 / 2	2 × 80	3.7	

Notes:  
1. Design the mountings and heat radiation with the knowledge that brake resistor temperatures can exceed 200°C in high-frequency operations.  
2. See page 41 for information about selection.  
\* Two in parallel

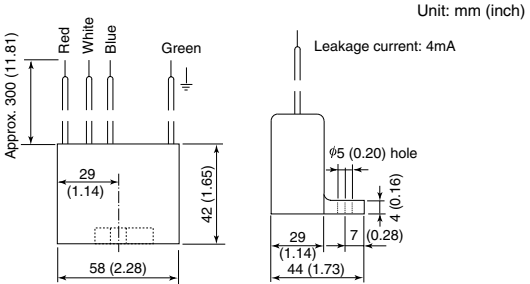
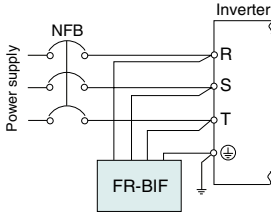
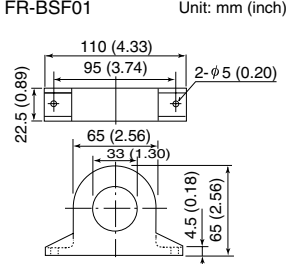
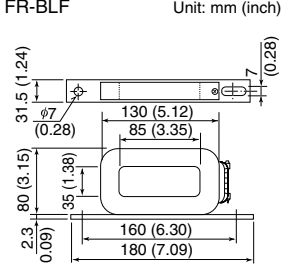
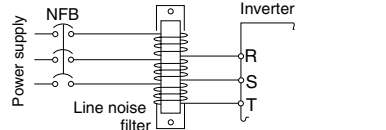
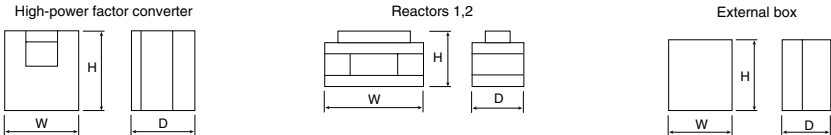
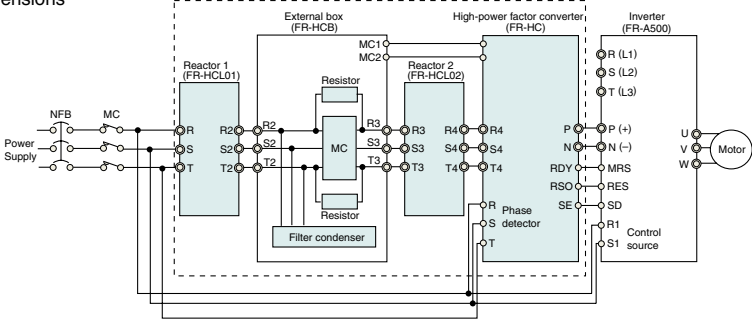
Name (model)	Specifications and construction																																																																																																																																																																								
<p>Brake units BU-(H)□□, discharging resistors GZG and GRZG</p>	<p style="text-align: right;">Unit: mm (inch)</p> <ul style="list-style-type: none"> <li>● Brake units are optional equipment that increases regenerative braking power. Use them in combination with discharging resistors.</li> <li>● Select the brake units that match your braking torque requirements.</li> </ul> <p>● <b>Selecting a Brake Unit</b></p> <table border="1" data-bbox="419 454 922 589"> <thead> <tr> <th rowspan="2">Voltage</th> <th rowspan="2">Braking torque</th> <th rowspan="2">Motor (kW)</th> <th colspan="2">0.4 0.75</th> <th colspan="2">1.5</th> <th colspan="2">2.2</th> <th colspan="2">3.7</th> <th colspan="2">5.5</th> <th colspan="2">7.5</th> </tr> <tr> <th>BU-1500</th> <th>BU-3700</th> <th>BU-7.5K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> <th>BU-15K</th> </tr> </thead> <tbody> <tr> <td rowspan="2">200V</td> <td>50% 30 sec.</td> <td></td> <td colspan="2">BU-1500</td> <td colspan="2">BU-3700</td> <td colspan="2">BU-7.5K</td> <td colspan="2">BU-15K</td> <td colspan="2"></td> <td colspan="2"></td> </tr> <tr> <td>100% 30 sec.</td> <td></td> <td>BU-1500</td> <td>BU-3700</td> <td>BU-7.5K</td> <td>BU-15K</td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2"></td> </tr> <tr> <td rowspan="2">400V</td> <td>50% 30 sec.</td> <td></td> <td colspan="2">*</td> <td colspan="2">BU-H7.5K</td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2"></td> </tr> <tr> <td>100% 30 sec.</td> <td></td> <td colspan="2">*</td> <td colspan="2">BU-H7.5K</td> <td colspan="2">BU-H15K</td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2"></td> </tr> </tbody> </table> <p>* 400V class inverters (not exceeding 1.5K) cannot be combined with the brake unit. Use an inverter of 2.2K or above to combine with the brake unit.</p> <p>● <b>Brake Unit/Discharging resistor Combinations</b></p> <table border="1" data-bbox="949 454 1485 622"> <thead> <tr> <th>Brake unit</th> <th>Resistor</th> <th>Lead used (P, N (+, -))</th> </tr> </thead> <tbody> <tr> <td>BU-1500</td> <td>GZG300W-50Ω</td> <td>2mm<sup>2</sup></td> </tr> <tr> <td>BU-3700</td> <td>GRZG200-10Ω (Three in series)</td> <td>2mm<sup>2</sup></td> </tr> <tr> <td>BU-7.5K</td> <td>GRZG300-5Ω (Four in series)</td> <td>3.5mm<sup>2</sup></td> </tr> <tr> <td>BU-15K</td> <td>GRZG400-2Ω (Six in series)</td> <td>3.5mm<sup>2</sup></td> </tr> <tr> <td>BU-H7.5K</td> <td>GRZG200-10Ω (Six in series)</td> <td>2mm<sup>2</sup></td> </tr> <tr> <td>BU-H15K</td> <td>GRZG300-5Ω (Eight in series)</td> <td>3.5mm<sup>2</sup></td> </tr> </tbody> </table> <p>● <b>Brake units</b></p>  <p>● <b>Discharging resistor</b></p>  <p>● <b>External Wiring Diagram</b></p>  <table border="1" data-bbox="419 1003 805 1097"> <thead> <tr> <th>Model</th> <th>W</th> <th>D</th> <th>W1</th> </tr> </thead> <tbody> <tr> <td>BU-1500, 3700, 7.5K, 15K</td> <td>100 (3.94)</td> <td>128 (5.04)</td> <td>60 (2.36)</td> </tr> <tr> <td>BU-H7.5K, H15K</td> <td>160 (6.30)</td> <td>145 (5.71)</td> <td>90 (3.54)</td> </tr> </tbody> </table> <table border="1" data-bbox="837 981 1485 1164"> <thead> <tr> <th>Model</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>J</th> <th>N</th> </tr> </thead> <tbody> <tr> <td>GZG300W</td> <td>42 (1.65)</td> <td>335 (13.19)</td> <td>309 (12.17)</td> <td>274 (10.79)</td> <td>40 (1.57)</td> <td>40 (1.57)</td> <td>78 (3.07)</td> <td>9.5 (0.37)</td> <td>5.5 (0.22)</td> </tr> <tr> <td>GRZG200</td> <td>33 (1.30)</td> <td>306 (12.05)</td> <td>287 (11.30)</td> <td>266 (10.47)</td> <td>26 (1.03)</td> <td>22 (0.87)</td> <td>53 (2.09)</td> <td>6 (0.24)</td> <td>5.5 (0.22)</td> </tr> <tr> <td>GRZG300</td> <td>47 (1.85)</td> <td>334 (13.15)</td> <td>308 (12.13)</td> <td>274 (10.79)</td> <td>40 (1.57)</td> <td>40 (1.57)</td> <td>79 (3.11)</td> <td>9.5 (0.37)</td> <td>5.5 (0.22)</td> </tr> <tr> <td>GRZG400</td> <td>47 (1.85)</td> <td>411 (16.18)</td> <td>385 (15.16)</td> <td>350 (13.78)</td> <td>40 (1.57)</td> <td>40 (1.57)</td> <td>79 (3.11)</td> <td>9.5 (0.37)</td> <td>5.5 (0.22)</td> </tr> </tbody> </table> <p>● <b>Handling Cautions</b></p> <ol style="list-style-type: none"> <li>The thermal relay in the brake unit will trip if the rated torque is continuously exceeded. After a trip, reset the inverter and increase its deceleration time setting.</li> <li>The maximum temperature rise for the discharging resistor is 100°C. Use heat resistant lead and wire to avoid contact with resistors.</li> </ol> <p>Notes:</p> <ol style="list-style-type: none"> <li>Connect so the terminal symbols are the same for both inverter and brake. Wrong connections can damage the reactor.</li> <li>Keep the wiring between inverter and brake unit and between discharging resistor and brake unit as short as possible. Use twisted leads for lengths greater than 2 m. (Even twisted leads should not exceed 5 m.)</li> </ol>	Voltage	Braking torque	Motor (kW)	0.4 0.75		1.5		2.2		3.7		5.5		7.5		BU-1500	BU-3700	BU-7.5K	BU-15K	BU-15K	BU-15K	BU-15K	BU-15K	BU-15K	BU-15K	BU-15K	BU-15K	200V	50% 30 sec.		BU-1500		BU-3700		BU-7.5K		BU-15K						100% 30 sec.		BU-1500	BU-3700	BU-7.5K	BU-15K									400V	50% 30 sec.		*		BU-H7.5K										100% 30 sec.		*		BU-H7.5K		BU-H15K								Brake unit	Resistor	Lead used (P, N (+, -))	BU-1500	GZG300W-50Ω	2mm <sup>2</sup>	BU-3700	GRZG200-10Ω (Three in series)	2mm <sup>2</sup>	BU-7.5K	GRZG300-5Ω (Four in series)	3.5mm <sup>2</sup>	BU-15K	GRZG400-2Ω (Six in series)	3.5mm <sup>2</sup>	BU-H7.5K	GRZG200-10Ω (Six in series)	2mm <sup>2</sup>	BU-H15K	GRZG300-5Ω (Eight in series)	3.5mm <sup>2</sup>	Model	W	D	W1	BU-1500, 3700, 7.5K, 15K	100 (3.94)	128 (5.04)	60 (2.36)	BU-H7.5K, H15K	160 (6.30)	145 (5.71)	90 (3.54)	Model	A	B	C	D	E	F	G	J	N	GZG300W	42 (1.65)	335 (13.19)	309 (12.17)	274 (10.79)	40 (1.57)	40 (1.57)	78 (3.07)	9.5 (0.37)	5.5 (0.22)	GRZG200	33 (1.30)	306 (12.05)	287 (11.30)	266 (10.47)	26 (1.03)	22 (0.87)	53 (2.09)	6 (0.24)	5.5 (0.22)	GRZG300	47 (1.85)	334 (13.15)	308 (12.13)	274 (10.79)	40 (1.57)	40 (1.57)	79 (3.11)	9.5 (0.37)	5.5 (0.22)	GRZG400	47 (1.85)	411 (16.18)	385 (15.16)	350 (13.78)	40 (1.57)	40 (1.57)	79 (3.11)	9.5 (0.37)	5.5 (0.22)
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BU-7.5K	GRZG300-5Ω (Four in series)	3.5mm <sup>2</sup>																																																																																																																																																																							
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GRZG300	47 (1.85)	334 (13.15)	308 (12.13)	274 (10.79)	40 (1.57)	40 (1.57)	79 (3.11)	9.5 (0.37)	5.5 (0.22)																																																																																																																																																																
GRZG400	47 (1.85)	411 (16.18)	385 (15.16)	350 (13.78)	40 (1.57)	40 (1.57)	79 (3.11)	9.5 (0.37)	5.5 (0.22)																																																																																																																																																																
<p>AC supply-coordinating reactor FR-BAL-(H)□□</p>	<p style="text-align: right;">Unit: mm (inch)</p>  <p>3-phase supply</p>  <p>Single-phase supply</p>  <p>Notes:</p> <ol style="list-style-type: none"> <li>The input power factor is improved to about 90%.</li> <li>Select the reactor for the capacity of motor to be used from the selecting peripherals table. (When the inverter capacity is greater, match the motor capacity.)</li> <li>For motors less than 0.4kW, select for 0.4kW. The power factor will be somewhat less than 90%.</li> </ol> <table border="1" data-bbox="419 1713 1485 2072"> <thead> <tr> <th rowspan="2">Capacity</th> <th colspan="6">FR-BAL</th> <th rowspan="2">Weight kg (lb)</th> <th colspan="6">FR-BAL-H</th> <th rowspan="2">Weight kg (lb)</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>0.4kW</td> <td>135 (5.31)</td> <td>64 (2.52)</td> <td>120 (4.72)</td> <td>120 (4.72)</td> <td>45 (1.77)</td> <td>M4 (0.028)</td> <td>2 (4.4)</td> <td>135 (5.31)</td> <td>64 (2.52)</td> <td>120 (4.72)</td> <td>120 (4.72)</td> <td>45 (1.77)</td> <td>M4 (0.028)</td> <td>2.1 (4.6)</td> </tr> <tr> <td>0.75kW</td> <td>135 (5.31)</td> <td>74 (2.91)</td> <td>120 (4.72)</td> <td>120 (4.72)</td> <td>57 (2.24)</td> <td>M4 (0.028)</td> <td>3 (6.6)</td> <td>160 (6.30)</td> <td>76 (2.99)</td> <td>145 (5.71)</td> <td>145 (5.71)</td> <td>55 (2.17)</td> <td>M4 (0.028)</td> <td>3.7 (8.2)</td> </tr> <tr> <td>1.5kW</td> <td>160 (6.30)</td> <td>76 (2.99)</td> <td>145 (5.71)</td> <td>145 (5.71)</td> <td>55 (2.17)</td> <td>M4 (0.028)</td> <td>4 (8.8)</td> <td>160 (6.30)</td> <td>92 (3.62)</td> <td>145 (5.71)</td> <td>145 (5.71)</td> <td>70 (2.76)</td> <td>M4 (0.028)</td> <td>5.3 (11.7)</td> </tr> <tr> <td>2.2kW</td> <td>160 (6.30)</td> <td>96 (3.78)</td> <td>145 (5.71)</td> <td>145 (5.71)</td> <td>75 (2.95)</td> <td>M4 (0.028)</td> <td>6 (13.2)</td> <td>160 (6.30)</td> <td>96 (3.78)</td> <td>145 (5.71)</td> <td>145 (5.71)</td> <td>75 (2.95)</td> <td>M4 (0.028)</td> <td>5.9 (13.0)</td> </tr> <tr> <td>3.7kW</td> <td>220 (8.66)</td> <td>95 (3.74)</td> <td>200 (7.87)</td> <td>200 (7.87)</td> <td>70 (2.76)</td> <td>M5 (0.035)</td> <td>8.5 (18.7)</td> <td>220 (8.66)</td> <td>95 (3.74)</td> <td>195 (7.68)</td> <td>200 (7.87)</td> <td>70 (2.76)</td> <td>M5 (0.035)</td> <td>8.5 (18.7)</td> </tr> <tr> <td>5.5kW</td> <td>220 (8.66)</td> <td>101 (3.98)</td> <td>200 (7.87)</td> <td>200 (7.87)</td> <td>75 (2.95)</td> <td>M5 (0.035)</td> <td>9.5 (20.9)</td> <td>220 (8.66)</td> <td>101 (3.98)</td> <td>200 (7.87)</td> <td>200 (7.87)</td> <td>75 (2.95)</td> <td>M5 (0.035)</td> <td>9.5 (20.9)</td> </tr> <tr> <td>7.5kW</td> <td>220 (8.66)</td> <td>125 (4.92)</td> <td>205 (8.07)</td> <td>205 (8.07)</td> <td>100 (3.94)</td> <td>M5 (0.035)</td> <td>14.5 (32.0)</td> <td>220 (8.66)</td> <td>125 (4.92)</td> <td>200 (7.87)</td> <td>200 (7.87)</td> <td>100 (3.94)</td> <td>M5 (0.035)</td> <td>14 (30.9)</td> </tr> </tbody> </table>	Capacity	FR-BAL						Weight kg (lb)	FR-BAL-H						Weight kg (lb)	A	B	C	D	E	F	A	B	C	D	E	F	0.4kW	135 (5.31)	64 (2.52)	120 (4.72)	120 (4.72)	45 (1.77)	M4 (0.028)	2 (4.4)	135 (5.31)	64 (2.52)	120 (4.72)	120 (4.72)	45 (1.77)	M4 (0.028)	2.1 (4.6)	0.75kW	135 (5.31)	74 (2.91)	120 (4.72)	120 (4.72)	57 (2.24)	M4 (0.028)	3 (6.6)	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4 (0.028)	3.7 (8.2)	1.5kW	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4 (0.028)	4 (8.8)	160 (6.30)	92 (3.62)	145 (5.71)	145 (5.71)	70 (2.76)	M4 (0.028)	5.3 (11.7)	2.2kW	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4 (0.028)	6 (13.2)	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4 (0.028)	5.9 (13.0)	3.7kW	220 (8.66)	95 (3.74)	200 (7.87)	200 (7.87)	70 (2.76)	M5 (0.035)	8.5 (18.7)	220 (8.66)	95 (3.74)	195 (7.68)	200 (7.87)	70 (2.76)	M5 (0.035)	8.5 (18.7)	5.5kW	220 (8.66)	101 (3.98)	200 (7.87)	200 (7.87)	75 (2.95)	M5 (0.035)	9.5 (20.9)	220 (8.66)	101 (3.98)	200 (7.87)	200 (7.87)	75 (2.95)	M5 (0.035)	9.5 (20.9)	7.5kW	220 (8.66)	125 (4.92)	205 (8.07)	205 (8.07)	100 (3.94)	M5 (0.035)	14.5 (32.0)	220 (8.66)	125 (4.92)	200 (7.87)	200 (7.87)	100 (3.94)	M5 (0.035)	14 (30.9)																																				
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0.4kW	135 (5.31)	64 (2.52)	120 (4.72)	120 (4.72)	45 (1.77)	M4 (0.028)	2 (4.4)	135 (5.31)	64 (2.52)	120 (4.72)	120 (4.72)	45 (1.77)	M4 (0.028)	2.1 (4.6)																																																																																																																																																											
0.75kW	135 (5.31)	74 (2.91)	120 (4.72)	120 (4.72)	57 (2.24)	M4 (0.028)	3 (6.6)	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4 (0.028)	3.7 (8.2)																																																																																																																																																											
1.5kW	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4 (0.028)	4 (8.8)	160 (6.30)	92 (3.62)	145 (5.71)	145 (5.71)	70 (2.76)	M4 (0.028)	5.3 (11.7)																																																																																																																																																											
2.2kW	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4 (0.028)	6 (13.2)	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4 (0.028)	5.9 (13.0)																																																																																																																																																											
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# Optional Equipment

Name (model)	Specifications and construction																																																																																																																																																								
DC supply-coordinating reactor FR-BEL-(H) □ □	<div style="text-align: right;">Unit: mm (inch)</div>  <p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>The input power factor is improved to about 95%.</li> <li>Be sure to remove the short bar between inverter terminals P(+) and P1. (Power factor will not improve if it is not removed.)</li> <li>Keep wiring to the inverter within 5 m.</li> <li>The lead used should be as large or larger than the power supply lead (R, S, T (L1, L2, L3)). (See page 32.)</li> <li>Select the reactor for the capacity of motor to be used from the selecting peripherals table. (When the inverter capacity is greater, match the motor capacity.)</li> <li>For motors less than 0.4kW, select for 0.4kW. The power factor will be somewhat less than 95%.</li> </ol> <table border="1" data-bbox="901 398 1453 965"> <thead> <tr> <th>Model</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> <th>Weight kg (lb)</th> </tr> </thead> <tbody> <tr> <td rowspan="7">200V</td> <td>0.4K</td> <td>110 (4.33)</td> <td>50 (1.97)</td> <td>94 (3.70)</td> <td>1.6 (0.06)</td> <td>95 (3.74)</td> <td>6 (0.24)</td> <td>M3.5 (0.024)</td> <td>25 (0.98)</td> <td>0.5 (1.1)</td> </tr> <tr> <td>0.75K</td> <td>120 (4.72)</td> <td>53 (2.09)</td> <td>102 (4.02)</td> <td>1.6 (0.06)</td> <td>105 (4.13)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>25 (0.98)</td> <td>0.7 (1.5)</td> </tr> <tr> <td>1.5K</td> <td>130 (5.12)</td> <td>65 (2.56)</td> <td>110 (4.33)</td> <td>1.6 (0.06)</td> <td>115 (4.53)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>30 (1.18)</td> <td>1.1 (2.4)</td> </tr> <tr> <td>2.2K</td> <td>130 (5.12)</td> <td>65 (2.56)</td> <td>110 (4.33)</td> <td>1.6 (0.06)</td> <td>115 (4.53)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>30 (1.18)</td> <td>1.2 (2.6)</td> </tr> <tr> <td>3.7K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>102 (4.02)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>40 (1.57)</td> <td>1.7 (3.7)</td> </tr> <tr> <td>5.5K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>126 (4.96)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M5 (0.035)</td> <td>40 (1.57)</td> <td>2.2 (4.9)</td> </tr> <tr> <td>7.5K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>126 (4.96)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M5 (0.035)</td> <td>40 (1.57)</td> <td>2.2 (4.9)</td> </tr> <tr> <td rowspan="7">400V</td> <td>H0.4K</td> <td>110 (4.33)</td> <td>54 (2.13)</td> <td>80 (3.15)</td> <td>1.6 (0.06)</td> <td>95 (3.74)</td> <td>6 (0.24)</td> <td>M3.5 (0.024)</td> <td>28 (1.10)</td> <td>0.5 (1.1)</td> </tr> <tr> <td>H0.75K</td> <td>110 (4.33)</td> <td>54 (2.13)</td> <td>85 (3.35)</td> <td>1.6 (0.06)</td> <td>105 (4.13)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>28 (1.10)</td> <td>0.7 (1.5)</td> </tr> <tr> <td>H1.5K</td> <td>130 (5.12)</td> <td>63 (2.48)</td> <td>89 (3.50)</td> <td>1.6 (0.06)</td> <td>115 (4.53)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>32 (1.26)</td> <td>0.9 (2.0)</td> </tr> <tr> <td>H2.2K</td> <td>130 (5.12)</td> <td>63 (2.48)</td> <td>101 (3.98)</td> <td>1.6 (0.06)</td> <td>115 (4.53)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>32 (1.26)</td> <td>1.1 (2.4)</td> </tr> <tr> <td>H3.7K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>102 (4.02)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M4 (0.028)</td> <td>40 (1.57)</td> <td>1.7 (3.7)</td> </tr> <tr> <td>H5.5K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>124 (4.88)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M5 (0.035)</td> <td>40 (1.57)</td> <td>2.2 (4.9)</td> </tr> <tr> <td>H7.5K</td> <td>150 (5.91)</td> <td>75 (2.95)</td> <td>124 (4.88)</td> <td>2 (0.08)</td> <td>135 (5.31)</td> <td>6 (0.24)</td> <td>M5 (0.035)</td> <td>40 (1.57)</td> <td>2.3 (5.1)</td> </tr> </tbody> </table>	Model	A	B	C	D	E	F	G	H	Weight kg (lb)	200V	0.4K	110 (4.33)	50 (1.97)	94 (3.70)	1.6 (0.06)	95 (3.74)	6 (0.24)	M3.5 (0.024)	25 (0.98)	0.5 (1.1)	0.75K	120 (4.72)	53 (2.09)	102 (4.02)	1.6 (0.06)	105 (4.13)	6 (0.24)	M4 (0.028)	25 (0.98)	0.7 (1.5)	1.5K	130 (5.12)	65 (2.56)	110 (4.33)	1.6 (0.06)	115 (4.53)	6 (0.24)	M4 (0.028)	30 (1.18)	1.1 (2.4)	2.2K	130 (5.12)	65 (2.56)	110 (4.33)	1.6 (0.06)	115 (4.53)	6 (0.24)	M4 (0.028)	30 (1.18)	1.2 (2.6)	3.7K	150 (5.91)	75 (2.95)	102 (4.02)	2 (0.08)	135 (5.31)	6 (0.24)	M4 (0.028)	40 (1.57)	1.7 (3.7)	5.5K	150 (5.91)	75 (2.95)	126 (4.96)	2 (0.08)	135 (5.31)	6 (0.24)	M5 (0.035)	40 (1.57)	2.2 (4.9)	7.5K	150 (5.91)	75 (2.95)	126 (4.96)	2 (0.08)	135 (5.31)	6 (0.24)	M5 (0.035)	40 (1.57)	2.2 (4.9)	400V	H0.4K	110 (4.33)	54 (2.13)	80 (3.15)	1.6 (0.06)	95 (3.74)	6 (0.24)	M3.5 (0.024)	28 (1.10)	0.5 (1.1)	H0.75K	110 (4.33)	54 (2.13)	85 (3.35)	1.6 (0.06)	105 (4.13)	6 (0.24)	M4 (0.028)	28 (1.10)	0.7 (1.5)	H1.5K	130 (5.12)	63 (2.48)	89 (3.50)	1.6 (0.06)	115 (4.53)	6 (0.24)	M4 (0.028)	32 (1.26)	0.9 (2.0)	H2.2K	130 (5.12)	63 (2.48)	101 (3.98)	1.6 (0.06)	115 (4.53)	6 (0.24)	M4 (0.028)	32 (1.26)	1.1 (2.4)	H3.7K	150 (5.91)	75 (2.95)	102 (4.02)	2 (0.08)	135 (5.31)	6 (0.24)	M4 (0.028)	40 (1.57)	1.7 (3.7)	H5.5K	150 (5.91)	75 (2.95)	124 (4.88)	2 (0.08)	135 (5.31)	6 (0.24)	M5 (0.035)	40 (1.57)	2.2 (4.9)	H7.5K	150 (5.91)	75 (2.95)	124 (4.88)	2 (0.08)	135 (5.31)	6 (0.24)	M5 (0.035)	40 (1.57)	2.3 (5.1)
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	H0.75K	110 (4.33)	54 (2.13)	85 (3.35)	1.6 (0.06)	105 (4.13)	6 (0.24)	M4 (0.028)	28 (1.10)	0.7 (1.5)																																																																																																																																															
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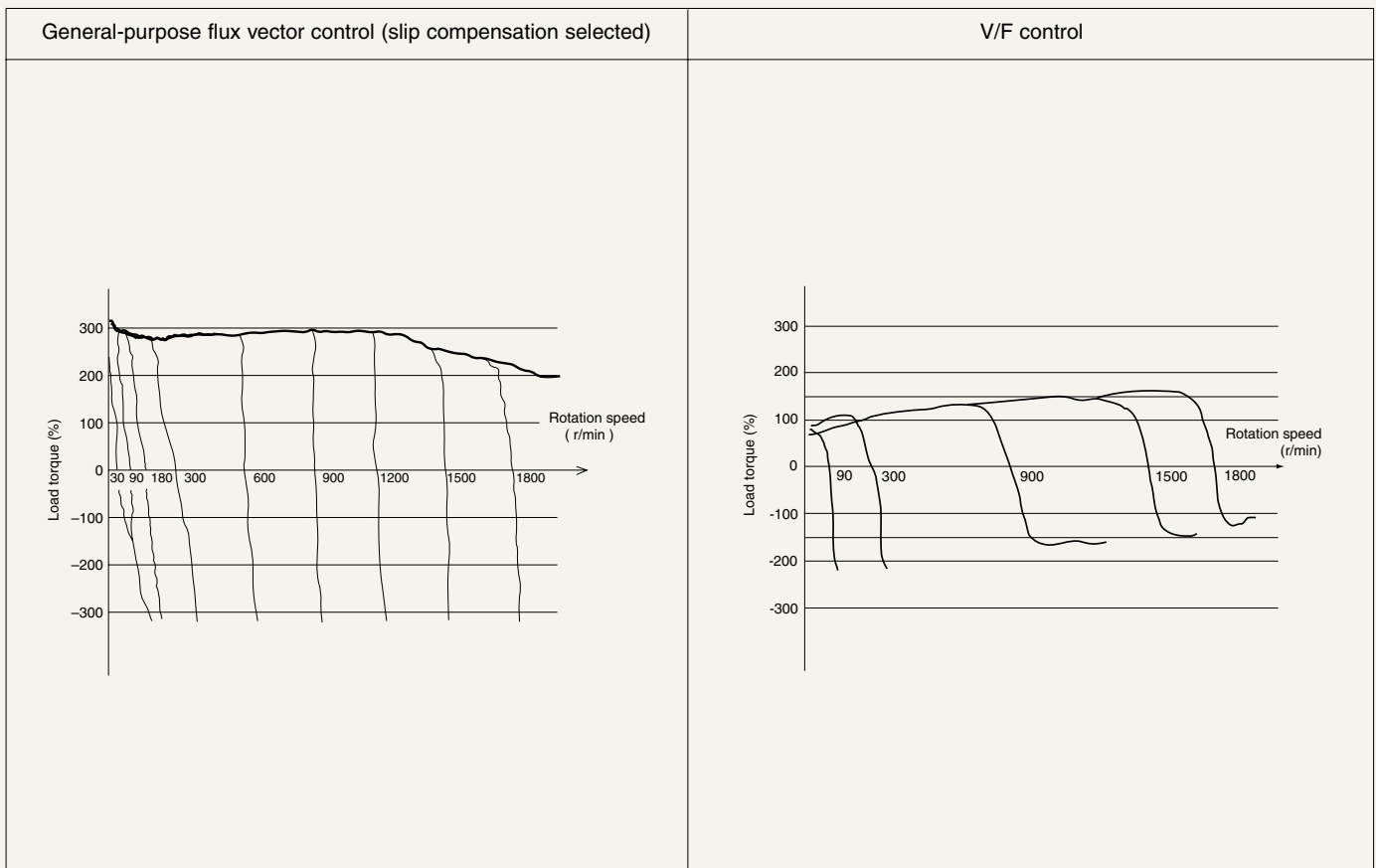
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EMC standard noise filter SF □ □ (200V class) FR-E5NF-H □ □ (400V class)	<div style="text-align: right;">Unit: mm (inch)</div> <ul style="list-style-type: none"> <li>This noise filter conforms to Europe's EMC standards.</li> <li>External dimensions diagram</li> </ul>  <ul style="list-style-type: none"> <li>Connection diagram</li> </ul> <p><b>Note:</b> You will need an EMC filter mounting attachment (FR-E5T/FR-E5T-02) to mount an inverter on the SF1309/SF1260. Remember that the attachment will add additional depth.</p> <p>*The SH1260 has ø7 mounting holes.</p> <table border="1" data-bbox="384 1832 1453 2078"> <thead> <tr> <th rowspan="2">Noise filter model</th> <th rowspan="2">Applicable inverter</th> <th colspan="6">External dimensions of filter</th> <th rowspan="2">Approximate weight kg (lb)</th> <th rowspan="2">Leakage current reference value (mA)</th> <th rowspan="2">Loss (W)</th> </tr> <tr> <th>W</th> <th>H</th> <th>D</th> <th>W1</th> <th>H1</th> <th>H2</th> </tr> </thead> <tbody> <tr> <td>SF1306</td> <td>FR-E520-0.1K - 1.5K</td> <td>110 (4.33)</td> <td>200 (7.87)</td> <td>36 (1.42)</td> <td>96 (3.78)</td> <td>190 (7.48)</td> <td>8 (0.31)</td> <td>0.7 (1.5)</td> <td>10</td> <td>7.3</td> </tr> <tr> <td>SF1309</td> <td>FR-E520-2.2K, 3.7K</td> <td>200 (7.87)</td> <td>281.3 (11.07)</td> <td>57 (2.24)</td> <td>164 (6.46)</td> <td>268.4 (10.57)</td> <td>9 (0.35)</td> <td>2.1 (4.6)</td> <td>15</td> <td>15</td> </tr> <tr> <td>SF1260</td> <td>FR-E520-5.5K, 7.5K</td> <td>222 (8.74)</td> <td>468 (18.43)</td> <td>80 (3.15)</td> <td>190 (7.48)</td> <td>449 (17.68)</td> <td>7* (0.28)</td> <td>5 (11.0)</td> <td>440</td> <td>118</td> </tr> <tr> <td>SF1320</td> <td>FR-E520-0.1K - 0.4K</td> <td>70 (2.76)</td> <td>168 (6.61)</td> <td>30.5 (1.20)</td> <td>56 (2.20)</td> <td>158 (6.22)</td> <td>8 (0.31)</td> <td>0.4 (0.9)</td> <td>10</td> <td>2.7</td> </tr> <tr> <td>SF1321</td> <td>FR-E520-0.75K</td> <td>110 (4.33)</td> <td>168 (6.61)</td> <td>36.5 (1.44)</td> <td>96 (3.78)</td> <td>158 (6.22)</td> <td>8 (0.31)</td> <td>0.6 (1.3)</td> <td>10</td> <td>3.8</td> </tr> <tr> <td>FR-E5NF-H0.75K</td> <td>FR-E540-0.4K - 0.75K</td> <td>140 (5.51)</td> <td>210 (8.27)</td> <td>46 (1.81)</td> <td>128 (5.04)</td> <td>198 (7.80)</td> <td>—</td> <td>1.1 (2.2)</td> <td>22.6</td> <td>5.5</td> </tr> <tr> <td>FR-E5NF-H3.7K</td> <td>FR-E540-1.5K - 3.7K</td> <td>140 (5.51)</td> <td>210 (8.27)</td> <td>46 (1.81)</td> <td>128 (5.04)</td> <td>198 (7.80)</td> <td>—</td> <td>1.3 (2.6)</td> <td>44.5</td> <td>8</td> </tr> <tr> <td>FR-E5NF-H7.5K</td> <td>FR-E540-5.5K - 7.5K</td> <td>220 (8.66)</td> <td>210 (8.27)</td> <td>50 (1.97)</td> <td>208 (8.19)</td> <td>198 (7.80)</td> <td>—</td> <td>2.0 (4.1)</td> <td>68.4</td> <td>15</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>Countermeasures Against Leakage Current Leakage current can cause peripheral malfunctions and shocks, so take the following countermeasures.                     <ol style="list-style-type: none"> <li>Ground the noise filter before connecting it to the power supply. At this point, check that the connection to the earth through the ground of the board is secure.</li> <li>Include the noise filter's leakage current in your calculations when selecting a leakage breaker and leakage relay. Also, since large noise filters have large leakage currents, you may not always be able to use leakage breakers. Either use a leakage relay with a high sensitivity current or securely ground as described in item 1 if you cannot use a leakage breaker or leakage relay.</li> </ol> </li> </ul>	Noise filter model	Applicable inverter	External dimensions of filter						Approximate weight kg (lb)	Leakage current reference value (mA)	Loss (W)	W	H	D	W1	H1	H2	SF1306	FR-E520-0.1K - 1.5K	110 (4.33)	200 (7.87)	36 (1.42)	96 (3.78)	190 (7.48)	8 (0.31)	0.7 (1.5)	10	7.3	SF1309	FR-E520-2.2K, 3.7K	200 (7.87)	281.3 (11.07)	57 (2.24)	164 (6.46)	268.4 (10.57)	9 (0.35)	2.1 (4.6)	15	15	SF1260	FR-E520-5.5K, 7.5K	222 (8.74)	468 (18.43)	80 (3.15)	190 (7.48)	449 (17.68)	7* (0.28)	5 (11.0)	440	118	SF1320	FR-E520-0.1K - 0.4K	70 (2.76)	168 (6.61)	30.5 (1.20)	56 (2.20)	158 (6.22)	8 (0.31)	0.4 (0.9)	10	2.7	SF1321	FR-E520-0.75K	110 (4.33)	168 (6.61)	36.5 (1.44)	96 (3.78)	158 (6.22)	8 (0.31)	0.6 (1.3)	10	3.8	FR-E5NF-H0.75K	FR-E540-0.4K - 0.75K	140 (5.51)	210 (8.27)	46 (1.81)	128 (5.04)	198 (7.80)	—	1.1 (2.2)	22.6	5.5	FR-E5NF-H3.7K	FR-E540-1.5K - 3.7K	140 (5.51)	210 (8.27)	46 (1.81)	128 (5.04)	198 (7.80)	—	1.3 (2.6)	44.5	8	FR-E5NF-H7.5K	FR-E540-5.5K - 7.5K	220 (8.66)	210 (8.27)	50 (1.97)	208 (8.19)	198 (7.80)	—	2.0 (4.1)	68.4	15
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Radio noise filter FR-BIF (200V class) FR-BIF-H (400V class)	Unit: mm (inch)  Leakage current: 4mA																																																																																			
Line noise filter FR-BSF01 (for small capacities) FR-BLF	FR-BSF01 Unit: mm (inch) 	FR-BLF Unit: mm (inch) 	 <p>Notes:</p> <ol style="list-style-type: none"> <li>Each phase should be wound at least 3 times (4T, 4 turns) in the same direction. (The greater the number of turns, the more efficient.)</li> <li>When the thickness of the wire prevents winding, use at least 4 in series and ensure that the current passes through each phase in the same direction.</li> <li>Can be used on the output side in the same way as the input side. On the output side, the number of turns should be less than 3 (4T, 4 turns).</li> <li>Please use FR-BSF01 for inverters with small capacities of 3.7kW or less. Thick wires (38mm<sup>2</sup> or more) cannot be used. In such cases, use FR-BLF.</li> </ol>																																																																																	
High power factor converter FR-HC- (H) □ □	<p style="text-align: right;">Unit: mm (inch)</p> <ul style="list-style-type: none"> <li>Greatly suppresses power supply harmonics and provides a equivalent capacity conversion coefficient of K5 = 0 as described in "Harmonic Suppression Guidelines for Specific Consumers."</li> <li>Turns input current waveform into a sine wave.</li> <li>Reduces the input capacitance by increasing the input power factor.</li> <li>Has a power supply regenerative function as standard.</li> <li>Can be operated under the common converter system with multiple inverters connected. A single-phase power supply input inverter cannot be connected.</li> </ul> <p>● Specifications</p> <table border="1" data-bbox="863 1016 1485 1285"> <thead> <tr> <th rowspan="2">Model FR-HC-□□</th> <th>200V</th> <th>400V</th> </tr> </thead> <tbody> <tr> <td></td> <td>7.5K</td> <td>H7.5K</td> </tr> <tr> <td>Applicable inverter capacity (Note 1)</td> <td>0.1K – 7.5K (Note 2)</td> <td>0.4K – 7.5K</td> </tr> <tr> <td>Rated input voltage and frequency</td> <td>3-phase 200V – 220V 50Hz 200V – 230V 60Hz</td> <td>3-phase 380V – 460V 50/60Hz</td> </tr> <tr> <td>Rated input current (A)</td> <td>33</td> <td>17</td> </tr> <tr> <td>Rated output voltage (V) (Note 3)</td> <td>DC 293V – 335V</td> <td>DC 558V – 670V</td> </tr> <tr> <td rowspan="2">Unit weight (kg (lb))</td> <td>Unit</td> <td></td> </tr> <tr> <td>Total weight of accessories (reactors 1, 2 and external box)</td> <td>8 (17.6)</td> <td>9 (19.8)</td> </tr> <tr> <td></td> <td>20.3 (44.8)</td> <td>23 (50.7)</td> </tr> </tbody> </table> <p>Notes:</p> <ol style="list-style-type: none"> <li>The applicable capacity is the total capacity of the applicable inverters for the high power factor converter.</li> <li>One 3.7K must be connected.</li> <li>The output voltage will vary with the input voltage value.</li> </ol> <p>● External dimensions</p> <table border="1" data-bbox="416 1384 1485 1503"> <thead> <tr> <th rowspan="2">Voltage</th> <th rowspan="2">Capacity</th> <th colspan="3">High power factor converter FR-HC</th> <th colspan="3">Reactor 1 FR-HCL01</th> <th colspan="3">Reactor 2 FR-HCL02</th> <th colspan="3">External box FR-HCB</th> </tr> <tr> <th>W</th> <th>H</th> <th>D</th> <th>W</th> <th>H</th> <th>D</th> <th>W</th> <th>H</th> <th>D</th> <th>W</th> <th>H</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>200V</td> <td>7.5K</td> <td>220 (8.66)</td> <td>330 (12.99)</td> <td>190 (7.48)</td> <td>160 (6.30)</td> <td>155 (6.10)</td> <td>100 (3.94)</td> <td>240 (9.45)</td> <td>230 (9.06)</td> <td>160 (6.30)</td> <td>190 (7.48)</td> <td>320 (12.60)</td> <td>165 (6.50)</td> </tr> <tr> <td>400V</td> <td>7.5K</td> <td>220 (8.66)</td> <td>300 (11.81)</td> <td>190 (7.48)</td> <td>160 (6.30)</td> <td>150 (5.91)</td> <td>100 (3.94)</td> <td>240 (9.45)</td> <td>220 (8.66)</td> <td>160 (6.30)</td> <td>190 (7.48)</td> <td>320 (12.60)</td> <td>165 (6.50)</td> </tr> </tbody> </table> 			Model FR-HC-□□	200V	400V		7.5K	H7.5K	Applicable inverter capacity (Note 1)	0.1K – 7.5K (Note 2)	0.4K – 7.5K	Rated input voltage and frequency	3-phase 200V – 220V 50Hz 200V – 230V 60Hz	3-phase 380V – 460V 50/60Hz	Rated input current (A)	33	17	Rated output voltage (V) (Note 3)	DC 293V – 335V	DC 558V – 670V	Unit weight (kg (lb))	Unit		Total weight of accessories (reactors 1, 2 and external box)	8 (17.6)	9 (19.8)		20.3 (44.8)	23 (50.7)	Voltage	Capacity	High power factor converter FR-HC			Reactor 1 FR-HCL01			Reactor 2 FR-HCL02			External box FR-HCB			W	H	D	W	H	D	W	H	D	W	H	D	200V	7.5K	220 (8.66)	330 (12.99)	190 (7.48)	160 (6.30)	155 (6.10)	100 (3.94)	240 (9.45)	230 (9.06)	160 (6.30)	190 (7.48)	320 (12.60)	165 (6.50)	400V	7.5K	220 (8.66)	300 (11.81)	190 (7.48)	160 (6.30)	150 (5.91)	100 (3.94)	240 (9.45)	220 (8.66)	160 (6.30)	190 (7.48)	320 (12.60)	165 (6.50)
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<p>● External dimensions</p>  <p>Notes:</p> <ol style="list-style-type: none"> <li>Always open the inverter's R, S, and T power supply input terminals. Wrong connections can damage the inverter. Both the high power factor converter and the inverter can be damaged if the P and N terminals polarities are wrong.</li> <li>Wire so that the R4, S4, and T4 terminals and the R, S, and T terminals match the power supply phases.</li> <li>Check the connection order for reactors 1 and 2. Reactors produce heat if connected incorrectly.</li> </ol>																																																																																				

# Characteristic Data

## Rotational Speed/Load Torque Characteristics

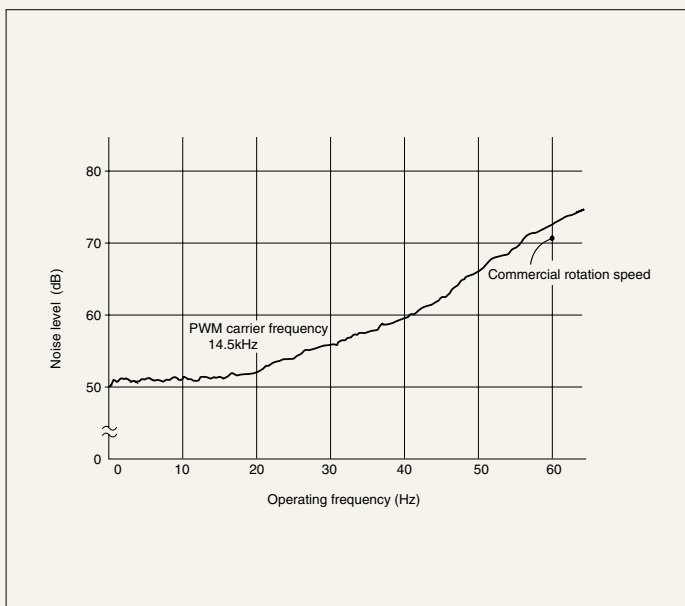


Note: The data shown is for an inverter combined with a Mitsubishi 0.75kW 4P motor.

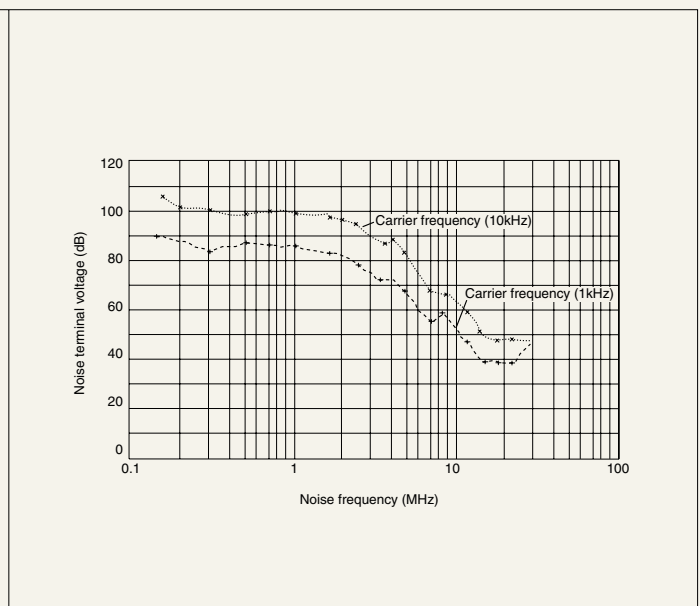
These figures compare rotational speed/load torque characteristics and rotational speed/motor current for general-purpose flux vector control and V/F control.

For general-purpose flux vector control, it is clear that 200% or better of torque is output at 6Hz operation.

## Example of Motor Noise (A Characteristics with no Load)



## Example of Noise Terminal Voltage (Average Values)



# Motor Applications

## Application of Special Motors

### ■ Motors with Brakes

Use a motor with a brake that has an independent power supply for the brake, connect the brake supply to the primary supply of the inverter, use the output stop terminal (MRS) for braking (stopping the motor), and turn the inverter output off. Depending on the type of brake, there may be a clattering noise in the brake lining at low speeds. This is not a malfunction.

### ■ Motors with a Variable Numbers of Poles

When the number of motor poles is convertible, the rated current will differ from a standard motor, so check the motor's maximum current when selecting an inverter. Be sure to stop the motor before switching the number of poles. Switching on the fly will engage the regenerative overvoltage protection circuit, trigger the inverter alarm, and send the motor into a coasting stop.

### ■ Geared Motors

The ranges for continuous operation vary with both the lubrication system used and the manufacturer. Oil lubricated motors are particularly prone to burning of gears when operated exclusively at low speeds. Consult the manufacturer before operating motors at speeds in excess of 60Hz.

### ■ Synchronous Motors

Applications that involve load fluctuations and high impacts can easily put a motor out of synchronization, so these are not suitable applications. They have higher starting currents and rated currents than standard motors and do not maintain stable speeds at low speeds, please take these factors into consideration.

### ■ Single-Phase Motors

Single-phase motors are not suited to variable speed operation with inverters. The harmonic current that flows to the capacitor in capacitor-started motors can damage the capacitor. Motors that are phase-split started or repulsion started not only do not provide output torque at low speeds, their internal centrifugal force switches also do not engage, so their starting coils sometimes burn. If inverter operation is desired please use three-phase motors.

## Operating Cautions

### ■ Operation

- To avoid damage to the inverter when a magnetic contactor (MC) is installed on the primary side, please do not subject the MC to repeated start/stop operations.
- When a malfunction occurs in the inverter, the protection function engages to halt inverter output but does not suddenly stop the motor itself. For this reason, please install the mechanical stopping and holding mechanism necessary for emergency stops.
- When the inverter's power supply is cut off, it takes time for the capacitors to discharge. When carrying out inspections, wait at least ten minutes after the power cuts off, then use a meter to confirm that the voltage has decreased.

### ■ Wiring

- The inverter will be damaged if electric power is applied to the inverter's output terminals U, V, and W. Before switching on the power, please check the wiring and sequence very carefully.
- Terminals P(+), PR, P1, and N(-) are designed for use in connecting dedicated optional equipment. Do not connect other equipment to these terminals. Also, do not short frequency setting power supply terminal 10 to common terminal 5.

### ■ Installation

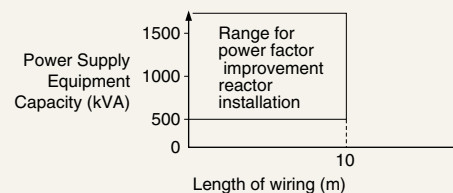
- Please install the unit in a clean location, avoiding adverse environments such as oil mist, lint, dust etc. or use it within a sealed enclosure which keeps out floating particles. The enclosure's cooling system and dimensions should allow the inverter's ambient temperature to remain within the permissible values (see page 9 for specifications).
- Since certain parts of the inverter can get extremely hot, do not attach it to combustible material.
- The unit should be installed vertically.

### ■ Settings

- Control panel settings make it possible to set the inverter for high speed operations up to 400Hz, so a mistake when setting can be very dangerous. Use the maximum frequency setting function to set an upper limit. (The default setting is a maximum frequency of 60 Hz during external input signal operations. PU operation is set for 120Hz.)
- Please do not set the regenerative brake duty function (Pr.70) except when the optional brake resistor is being used. Since this function is used to protect against brake resistor overheating, do not set it beyond the brake resistor's permissible duty.
- Setting the DC braking voltage and operation time at a higher value than the default setting can cause motor overheating (electronic thermal trip).

### ■ Power Requirements

- If the unit is installed close to a large-capacity power supply transformer, or where switching of a phase advance capacitor occurs, an excessive peak current may flow in the power input circuit, damaging the inverter. In such cases, be sure to install an optional FR-BEL or FR-BAL power supply coordinating reactor.
- If a surge voltage occurs in the power system, the surge energy



may flow into the inverter, causing the inverter to display E.OV1, E.OV2, or E.OV3 and execute an alarm stop. In such cases, be sure to install an optional FR-BEL or FR-BAL power supply coordinating reactor.

# Cautions

## For Maximum Safety

- In order to use the equipment properly and safely, be sure to read the manual before use.
- Mitsubishi general-purpose inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this equipment for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to forestall serious accidents when it is used in facilities where a breakdown in the product is likely to cause a serious accident.
- Please do not use for loads other than 3-phase induction motors.

## Selection Cautions

### Selecting Inverter Capacity

- When running special motors or several motors in parallel off a single inverter, select an inverter capacity so that the total motor rated current (at 50Hz) is lower than the inverter's rated output current.
- To make the motor quieter, set the PWM carrier frequency (Pr.72) to 2kHz or higher and lower the output current as described in the rating table on page 8 if you are using it in an ambient environment of 40°C or more. (Also change the setting for electronic thermal O/L relay, Pr.9.) If the temperature is lower than 40°C, however, there is no need to lower the output current. Note that when the PWM carrier frequency is raised, the motor gets quieter but the inverter produces more noise and leakage current. Select Soft-PWM control with (Pr.240) to hold down the increase in noise and make it less irritating.

### Selecting a Brake Resistor

- Use the following table to select a brake resistor based on its braking torque and permissible duty (%ED).

Capacity	Permissible duty 3%ED		Permissible duty 10%ED	
	100% torque	150% torque	100% torque	150% torque
0.1K	—	—	—	—
0.2K	—	—	—	—
0.4K	→	MRS120W200	→	FR-ABR-0.4K
0.75K	→	MRS120W100	→	FR-ABR-0.75K
1.5K	→	MRS120W60	→	FR-ABR-2.2K
2.2K	MRS120W60	MRS120W40	FR-ABR-2.2K	FR-ABR-3.7K
3.7K	MRS120W40	MYS220W50 (two in parallel)	FR-ABR-3.7K	FR-ABR-5.5K
5.5K	—	—	FR-ABR-5.5K	—
7.5K	—	—	FR-ABR-7.5K	—

### Motor Starting Torque

- The starting and accelerating characteristics of motors driven by inverters are constrained by the overload current rating of the inverters used. Torque characteristic values are smaller than when general commercial power supplies are used. When a larger starting torque is necessary, select general-purpose flux vector control (set motor capacity using Pr.80) or adjust the torque boost value. When even these measures are inadequate, choose an inverter with a capacity one rank higher or increase the capacity of both the motor and the inverter.

### Acceleration and Deceleration Times

- The motor's acceleration/deceleration time is determined by the torque and load torque generated by the motor and by the moment of inertia ( $GD^2$ ) of the load.
- Should the current limit function or stall prevention function engage during acceleration/deceleration, the time sometimes increases, so make the acceleration/deceleration time greater.
- To shorten the acceleration/deceleration time, make the torque boost value larger, select general-purpose flux vector control or increase inverter and motor capacity. (Too large a torque boost value will activate the stall prevention function, actually lengthening the acceleration time.) To shorten the deceleration time, add the optional MRS or FR-ABR brake resistor (for 0.4K or higher).

## For Selecting Peripherals

### Selecting and Installing No-Fuse Breakers

- Please install a no-fuse breaker (NFB) on the incoming side to protect the wiring on the inverter's primary side. The selection of the NFB depends on the power factor on the inverter's power supply side (changes in supply voltage, output frequency, or load) (See page 32). In particular, since the operating characteristics of fully electromagnetic NFBs are altered by harmonic currents, it is necessary to select larger capacities. (Refer to the documentation for the appropriate breakers for more information.) Use Mitsubishi's anti-harmonic and anti-surge Progressive Super Series as leakage breakers. (See page 32.)
- If you are installing no-fuse breakers on the secondary side of the inverter, ripple currents will generate heat at the contacts, so select a higher capacity.

### Handling of Primary Magnetic Contactors

- When operating through the external terminals (using terminals STF or STR), install a magnetic contactor (MC) on the primary side to prevent accidents caused by restarts when the power comes on after it has been off and ensure safety in maintenance work. Do not use the MC to engage in frequent starts and stops. (The life of the inverter input circuit is about 100,000 on-offs.)
- When operating the parameter unit, you cannot start operation with an MC since the device does not restart automatically after power is restored. It is generally not a good idea to stop with the primary MC. The inverter's special regenerative brake will not work, so the result will be a coasting stop.

### Handling of Secondary Magnetic Contactors

- You should generally not install a magnetic contactor between the inverter and the motor and turn the inverter on and off during operation. If the inverter is turned on during operation, a large in-rush current flows into the inverter, and the inverter may stop running due to the overcurrent. If an MC is used to switch to the commercial power supply, the MC must be switched from ON to OFF (inverter circuit) or from OFF to ON (commercial power circuit) only after the inverter and the motor have stopped.

## ■ Installing Thermal Relays

- The inverter is provided with a protection function that employs an electronic thermal relay to protect the motor from overheating. When several motors or multi-polar motors are operated using a single inverter, however, install a heat-activated thermal relay (OCR) between the inverter and the motor(s). In such cases, set the inverter's electronic thermal relay to 0 A and the OCR setting to 1.0 times the current value on the motor's rating plate for 50Hz or 1.1 times the value for 60Hz, taking inter-wire leakage current into account (see page 32 and 33).

## ■ Eliminating the Capacitor for Enhancing the Power Factor (Phase-Advance Capacitor)

- The power factor-enhancing capacitor and surge breaker on the inverter output side may be overheated and damaged by the harmonic component of inverter output. In addition, an overcurrent may flow in the inverter and set off the inverter's overcurrent protection device. Therefore, do not install any capacitor or surge breaker in the inverters output side. Use a power-factor-enhancing AC reactor (see pages 36 and 37).

## ■ Secondary Instrumentation

- When wiring between inverter and motor is long, the effects of leakage current between lines can generate heat in instruments and current transformers. Select equipment that has a sufficient margin in its current rating.

## ■ Radio Interference

- The input and output of the main inverter circuit contain higher harmonic components that may interfere with communication equipment (such as AM radios) and sensors that are being used close to the inverter. You can reduce interference by attaching a radio noise filter FR-BIF (for input side only), a line noise filter FR-BSF01, or an SF type noise filter.

## ■ Power Supply Harmonics

Harmonics are defined as integer multiples of the base frequency. Normally, harmonics refers to frequencies up to the 40<sup>th</sup> or 50<sup>th</sup> order of magnitude or greater (up to several kHz). Anything larger is considered noise. Noise and harmonics are described in the table below.

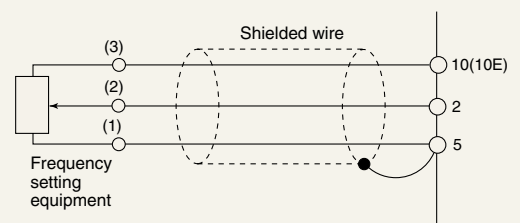
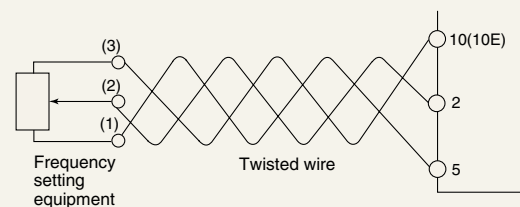
Item	Noise	Harmonics
Frequency band	Harmonics (10kHz and up)	40th–50th orders (up to several kHz)
Main source	Inverter	Converter
Transmission route	Cable runs, air, induction	Cable runs
Effects	Distance, wiring routes	Line impedance
Quantity produced	Voltage fluctuation rate, switching frequency	Current capacitance
Physical effect	Malfunctioning sensors, radio noise etc.	Heat produced by phase-advance capacitor, generators etc.
Primary countermeasures	Change wiring routes, install noise filters	Install a reactor

## ■ Wiring Thickness and Length

- When the wiring distance between the inverter and the motor is long, the voltage across the main circuit cable drops, especially for low frequency output. This causes the motor torque to drop. Use thicker wires between the inverter and the motor so that the voltage drop is 2% or less. (If wiring is longer than 20m, select equipment as described on page 32.)
- When wiring is particularly long, the high-response current limiting function may be engaged by the effects of charge current caused by floating capacitance in the wiring, so keep the maximum wiring length within the bounds suggested by the table below. If you exceed these lengths, change the high-response current limiting function parameters as described in the manual.

Inverter capacitance		0.1K	0.2K	0.4K	0.75K	1.5K–7.5K
Maximum wiring length	Regular operation	200m	200m	300m	500m	500m
	Quiet operation	30m	100m	200m	300m	500m

- When operating with general-purpose flux vector control, keep the wiring length between inverter and motor to 30 m or less. (If you need more than 30 m of distance, use off-line auto-tuning.)
- To connect the inverter to a parameter unit that is separated from the inverter, use the special connecting cable, connector adapter, and rear cover (optional). For remote operation using analog signals, make sure the control line between the operation box or operation signal and the inverter is no more than 30 m. Locate wires away from strong electrical circuits (such as the main circuit and the relay sequence circuit) to prevent induction from other equipment.
- When setting frequency not with the parameter unit but with an external potentiometer, use shielded or twisted wire, as shown below, and connect shielded wire to Terminal 5, not to the ground.



## ■ Grounding

The high-speed switching used in these inverters produces more leakage current than conventional inverters do. Always ground the inverter and the motor. Furthermore, when grounding the inverter, it is essential to use the inverter's grounding terminal.



### **Safety Warning**

To ensure proper use of the products listed in this catalog,  
please be sure to read the instruction manual prior to use.

 **mitsubishi electric corporation**  
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