NEW-CONCEPT TOP-CLASS INVERTERS
FEATURING COMPACT DESIGN & LIGHT WEIGHT

SAMCO-e

Actual Size

SANKEN ELECTRIC CO., LTD.

http://www.sanken-ele.co.jp/en/index.html

Birth of the new SAMCO-e Series of inverters that offer outstanding operability and multiple functions in a compact body

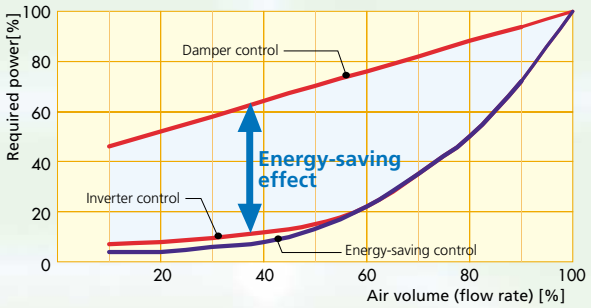
Sanken Electric is proud to introduce the SAMCO-e Series of top-class compact, lightweight, and space-saving general-purpose inverters.
This series is based on a new design concept that realizes both low cost and high performance, enabling its use in light-load variable systems, which are highly restricted in terms of cost and space, and simple systems for which easy operation is required.
While providing as standard all the functions of well-reputed general-purpose inverters, such as an automatic energy-saving function, V/f separation function, and communication function, they also answer diverse system needs by featuring a large array of easy-to-use functions, including the use of a frequency setting dial that allows smooth operation using a single dial.

Ideal for fan/pump applications

◆Automatic energy-saving function

Realizes power-saving control for input power supply.

• **Energy saving graph**



◆PID control function

Operation controlling the temperature, pressure, flow rate, etc., is possible.

◆Second-order deceleration torque control

Control for second-order deceleration load for applications such as fans and pumps is possible.

Compact

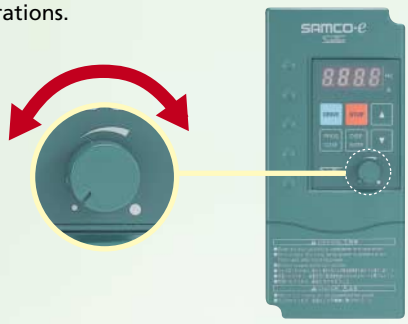
◆40% reduction compared to conventional inverters (surface comparison)

Achievement of compact form and space saving compared to conventional inverters.

Simple operation and simple wiring

◆Frequency setting dial

The motor's speed of rotation can be adjusted by simply turning the dial, eliminating the need for complicated operations.

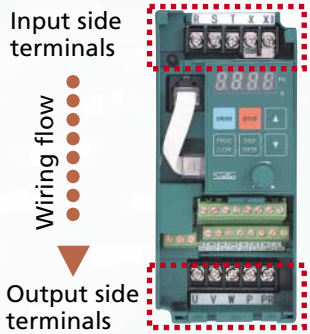


◆Main circuit terminals arranged in upper and lower rows

This configuration allows easy wiring design and efficient operation.

◆Use of screw-type terminals for main circuit and control circuit terminals

Suitable for vibration and high-reliability applications



Rich Array of Functions

◆ **V/f separation function**
This function allows independent setting of the inverter's output frequency and output voltage.

◆ **Communication function (RS485 interface provided as standard)**
Provision of a communication function as standard allows external communication.

◆ **I/O open-phase function**
An inverter I/O protection function is provided.

◆ **400 Hz maximum output frequency**
Enables support of special motors and high-speed motors.

◆ **Multifunction input terminals**
The function can be selected according to the application.

◆ **External 2-channel analog setting**
Two types of analog settings, 0 V to 10 V and 4 mA to 20 mA, are possible.

◆ **Built-in braking transistor**
The braking performance can be improved by simply connecting brake resistors (option).

◆ **DC reactor connection terminals provided as standard**
The power factor can be improved and harmonics can be suppressed by simply connecting a DC reactor (option).

Maintenance

◆ **Changed data display**
The set function code and factory default settings can be compared and only the changed code displayed.

◆ **Copy function (option)**
Function code data can be transferred to multiple inverters using an operation panel (option).

◆ **Long-life electrolytic capacitor**
Long-life capacitors are used for the main circuit's and control circuit's capacitors.

◆ **Easy cooling fan replacement**
The cooling fan can be easily replaced with a simple one-touch operation.

◆ **Usable in adverse environments such as high-humidity and dusty environments**
Can be used in adverse environments because it uses a moisture-proofed board.

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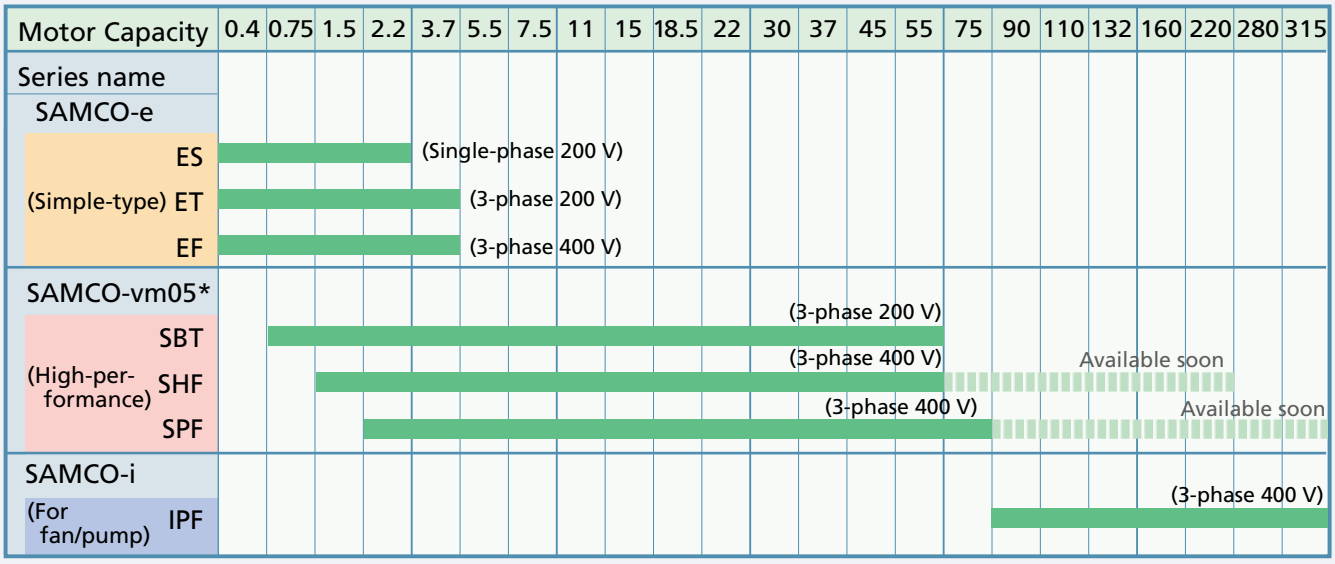
1.Lineup

- **SAMCO-e lineup**

		ES Series	ET Series	EF Series
Power supply type		Single-phase 200 V	3-phase 200 V	3-phase 400 V
Motor capacity	0.4kW	ES-0.4K	ET-0.4K	EF-0.4K
	0.75kW	ES-0.75K	ET-0.75K	EF-0.75K
	1.5kW	ES-1.5K	ET-1.5K	EF-1.5K
	2.2kW	ES-2.2K	ET-2.2K	EF-2.2K
	3.7kW(4.0kW)	————	ET-3.7K	EF-4.0K

2. SAMCO Series Lineup



*** SAMCO-vm05 Lineup**

- SBT model (dual rating series)

  H characteristic (150% overload capacity) and P characteristic (120% overload capacity)

- SHF model

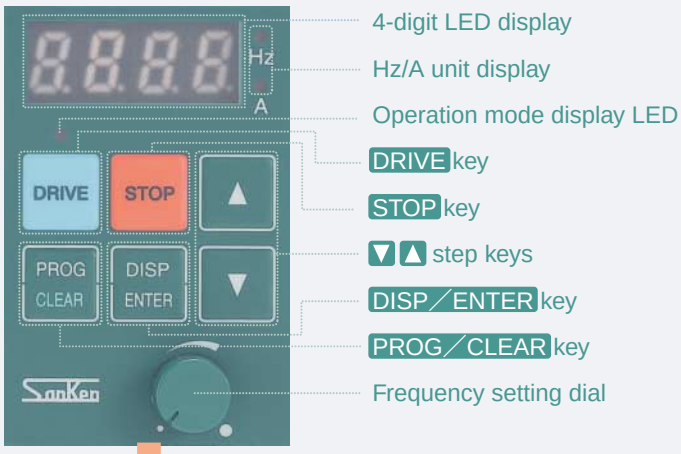
  For general industry (H characteristic/150% overload capacity)

- SPF model

  For fan/pump (P characteristic/120% overload capacity)

3. Panel and Operation Method

- All SAMCO-e operations can be performed on the operation panel.
- Operation, rotation settings, and stopping can all be easily performed using the switch keys and the setting dial.
- Four-digit high-luminescence LED display for easy viewing and verification
- A large number of useful functions can easily be set.
- Rich alarm and error display

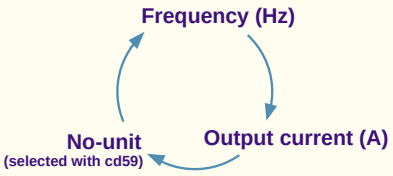


Operating the inverter

Switch on the power.

is displayed.

1. Press the DRIVE key.The inverter starts operating and the operation mode LED lights.
2. To switch the display, press the DISP ENTER key.



3. The speed can be adjusted by turning the frequency setting dial left or right. (Set Cd002 = 0 (factory default data).)

4. The speed can be adjusted by pressing the ▲ and ▼ keys. (Set Cd = 002.)
5. Press the STOP key to stop the inverter's operation.

Setting functions

Switch on the power.

is displayed.

1. Press the PROG CLEAR key.

is displayed, and function codes are displayed in this status.

2. Shift the input digit by pressing the DISP ENTER key and input the function code number with the ▲ and ▼ step keys.
   Press the DISP ENTER key to confirm your choice.
   The set value is then displayed.
3. Press the DISP ENTER key and input the desired setting value.
   Then press the DISP ENTER key again to confirm your choice.
4. Press the PROG CLEAR key to return to the status display.
5. Copy function (option)
   The function code can be copied to other units by using the operation panel (with Cd084).

Changed data display function

1. Press the PROG CLEAR key.
   Input Cd140 = 1 and then press the DISP ENTER key to confirm your choice.
2.
   is displayed.
   The function codes that differ from the factory default data are searched in the function codes and displayed.
3. Restore or correct the changed functions and data.
   Then press the DISP ENTER key to confirm your choices.

3. Standard Specifications

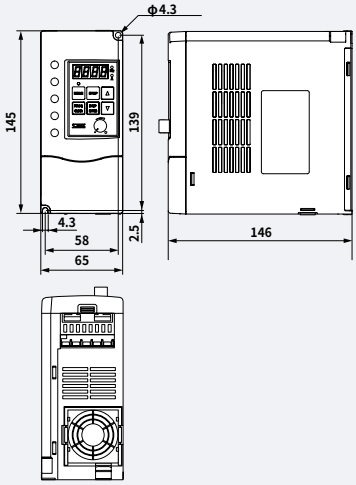
Power Supply Type			Single-Phase 200 V System				Three-Phase 200 V System					Three-Phase 400 V System				
Model Name			ES-0.4K	ES-0.75K	ES-1.5K	ES-2.2K	ET-0.4K	ET-0.75K	ET-1.5K	ET-2.2K	ET-3.7K	EF-0.4K	EF-0.75K	EF-1.5K	EF-2.2K	EF-4.0K
Output	Applicable motor capacity [kW]		0.4	0.75	1.5	2.2	0.4	0.75	1.5	2.2	3.7	0.4	0.75	1.5	2.2	4
	Rated capacity [kVA]*1		0.99	1.6	2.82	3.81	0.99	1.6	2.82	3.81	6.28	1.04	1.73	2.77	3.81	6.03
	Rated current [A]*2		2.6	4.3	7.4	10	2.6	4.3	7.4	10	16.5	1.5	2.5	4	5.5	8.7
	Overload current [A]		150%, 1 minute													
	Rated output voltage		200V 50/60Hz 220V/60Hz									380V/50Hz,400V/50Hz, 460V/60Hz				
Input	Rated voltage and frequency		Single-phase 200 V to 240 V, 50/60 Hz				Three-phase 200 V to 230 V 50/60 Hz					Three-phase 380 V to 460 V 50/60 Hz				
	Allowable fluctuation		Voltage: ±10%, frequency: ±5%, voltage imbalance: 3% max.													
	Source impedance		1% or more (Use the optional reactor if less than 1%)													
Protective structure			Shutdown method (IP20)													
Cooling method			Forced air cooling													
Weight [kg]			1.0	1.3	1.8		1.0	1.3	1.8			1.0	1.3	1.8		
Control functions	Control method		V/f control													
	High-frequency carrier		Sine wave PWM (carrier frequency: 1 to 14 kHz)*3													
	Output frequency range		0.1 to 400 Hz (starting frequency: 0.1 to 20 Hz, variable)													
	Frequency setting resolution	Digital setting	0.1 Hz (0.1 to 400 Hz)													
		Analog setting	10 bits for 0 to 10 V, 4 to 20 mA, 9 bits for 0 to 5 V for maximum output frequency													
	Frequency accuracy	Digital setting	±0.01% of output frequency (at -10 to 40°C)													
		Analog setting	±0.2% of maximum output frequency (at 25°C ±10°C)*4													
	DC braking		Starting frequency (0.2 to 20 Hz), operation time (0.1 to 10 s), braking force (1 to 10 steps)													
	Additional functions		Multi-speed operation, frequency jump, auto alarm recovery, PID control operation, energy-saving operation													
Operational functions	Start/stop setting		Operation panel, serial communication (RS485), control circuit terminals													
	Frequency command setting	Digital setting	Operation panel, serial communication (RS484)													
		Analog setting	2 external channels: 0 to 5 V, 0 to 10 V, 4 to 20 mA, external variable resistor (5 kΩ, 0.3 W or higher)/operation panel dial													
	Input signals		Frequency command, forward run command, reverse run command, acceleration/deceleration time setting, free-run stop/alarm reset, emergency stop,jogging selection, operation signal hold [Digital input: 6 channels (arbitrary allocation available] [Analog input: 1 channel for voltage, 1 channel for current]													
	Output signals	Contact output	Alarm batch contact output (1C contact, 250 VAC, 0.3 A)													
		Monitor signals	Operating, frequency matching, overload alarm, undervoltage, frequency approach [Open-collector output: 1 channel (arbitrary allocation available), Analog output: 1 channel]													
	LED display		Frequency, output current, operating, no-unit alarm, load factor, output voltage, line speed													
Protection functions			Current limiting, overcurrent shutoff, motor overload, external temperature, undervoltage, overvoltage, momentary power failure, fin overheat, open phase													
Warning functions			Overvoltage prevention, current limiting during acceleration/deceleration, brake resistor overheat, overload, overheating of radiator fins													
Ambient temperature			-10 to +50°C (However, reduce carrier frequency at +40°C and higher)*5													
Storage temperature			-20 to +65°C*6													
Ambient humidity			90% or less (with no condensation)													
Operating environment			Indoors at 1,000 m or lower altitude (No direct sunlight, corrosive or inflammable gases, oil mist, or dust)													

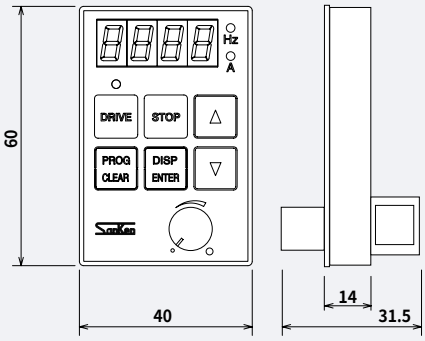
*1: Rated capacity at an output voltage of 220 V for 200 V system, and at an output voltage of 400 V for the 400 V system
*2: Rated current should be reduced according to output voltage when input voltage is 400 VAC or higher.
*3: The maximum carrier frequency varies depending on the rated characteristics and the operating status.
*4: The maximum output frequency is at 5 V, 10 V, and 20 mA.
*5: Use the inverter with the carrier frequency set to Cd051 = 90 or lower.
*6: This temperature is for short periods, such as during transportation.

4. External Dimensions

The SAMCO-e Series uses three types of compact cases according to the voltage setting and the capacity. Each type and its dimensions are shown below.

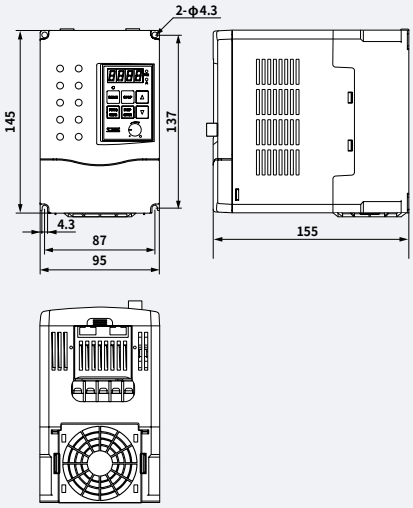
<Operation panel>





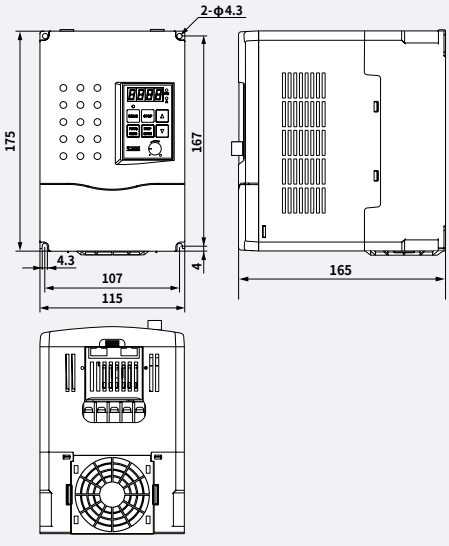
Type I

ES-0.4K
ET-0.4K/0.75K
EF-0.4K/0.75K



Type II

ES-0.75K
ET-1.5K
EF-1.5K/2.2K



Type III

ES-1.5K/2.2K
ET-2.2K/3.7K
EF-4.0K

5. Connection Diagram and Terminal Connection Diagram

The input side terminals are placed at the top and the output side terminals are placed at the bottom, greatly improving power distribution design, operability, and reliability. The control circuit terminals are placed in the middle. Press-down fastening type terminals are used for both reliability and durability.

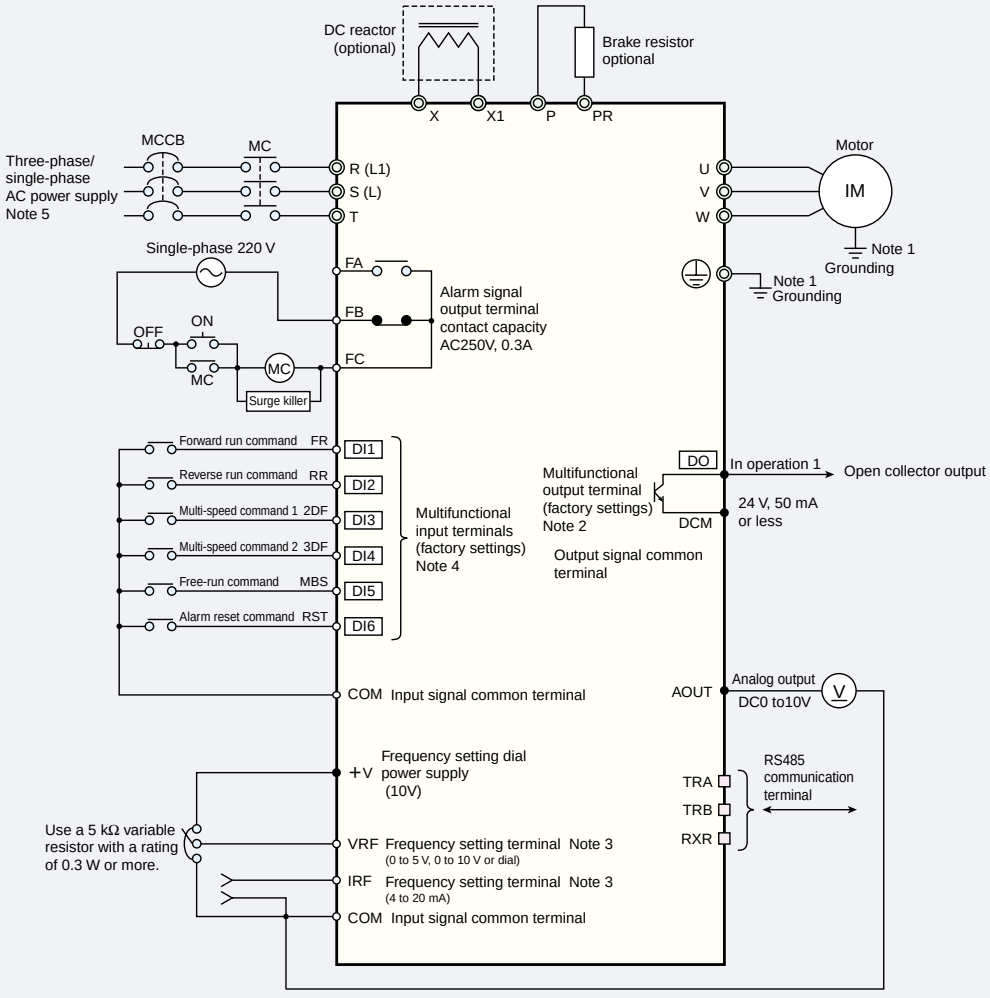
Input side terminal board
(Input power supply, DC reactor optional)

Operation panel-Main unit connection cable

Control circuit terminal board
(Signal output, multifunctional terminals, etc.)

Output side terminal board
(AC output, brake resistor optional)

• Standard connection diagram



Note 1: Be sure to ground the inverter and motor.
Note 2: The output terminals are multifunctional terminals that can be assigned individually with function code Cd638.
Note 3: Switch the function with function code Cd002. The terminal can be used as an input terminal for various feedback signals.
Note 4: The input terminals are multifunctional terminals that can be assigned individually with function codes Cd630 to Cd635.
Note 5: ES Series: Single-phase input; ET, EF Series: Three-phase input

◎ Main circuit terminal
○ Control circuit input terminal
● Control circuit output terminal
□ Communication circuit terminal

• Wiring equipment and recommended cables

Single-Phase 200 V System

Model	MCCB (Breaker) [A]	MC(Magnetic Contact) Rated current [A]	MC(Magnetic Contact) Rated applied current[A]	Main Circuit Recommended wire size [mm²] Input wire	Main Circuit Recommended wire size [mm²] X/X1 wire	Main Circuit Recommended wire size [mm²] Output wire	Main Circuit Screw diameter	Main Circuit Applied wire [mm²]	Control Circuit Maximum wire size[mm²]	Control Circuit Wire stripping length[mm]
ES-0.4K	15	11	20	2	2	2	M3	2.5	0.3 to 2.5	6 to 7
ES-0.75K	20	11	20	2	2	2	M4	5.5		
ES-1.5K	30	18	25	3.5	2	2				
ES-2.2K	40	18	32	5.5	3.5	2				

Three-Phase 200 V System

Model	MCCB (Breaker) [A]	MC(Magnetic Contact) Rated current [A]	MC(Magnetic Contact) Rated applied current[A]	Main Circuit Recommended wire size [mm²] Input wire	Main Circuit Recommended wire size [mm²] X/X1 wire	Main Circuit Recommended wire size [mm²] Output wire	Main Circuit Screw diameter	Main Circuit Applied wire [mm²]	Control Circuit Maximum wire size[mm²]	Control Circuit Wire stripping length[mm]
ET-0.4K	5	11	20	2	2	2	M3	2.5	0.3 to 2.5	6 to 7
ET-0.75K	10	11	20	2	2	2				
ET-1.5K	15	11	20	2	2	2	M4	5.5		
ET-2.2K	20	18	25	2	2	2				
ET-3.7K	30	18	25	3.5	3.5	2				

Three-Phase 400 V System

Model	MCCB (Breaker) [A]	MC(Magnetic Contact) Rated current [A]	MC(Magnetic Contact) Rated applied current[A]	Main Circuit Recommended wire size [mm²] Input wire	Main Circuit Recommended wire size [mm²] X/X1 wire	Main Circuit Recommended wire size [mm²] Output wire	Main Circuit Screw diameter	Main Circuit Applied wire [mm²]	Control Circuit Maximum wire size[mm²]	Control Circuit Wire stripping length[mm]
EF-0.4K	5	7	20	2	2	2	M3	2.5	0.3 to 2.5	6 to 7
EF-0.75K	5	7	20	2	2	2				
EF-1.5K	10	7	20	2	2	2	M4	5.5		
EF-2.2K	15	7	20	2	2	2				
EF-4.0K	20	7	20	2	2	2				

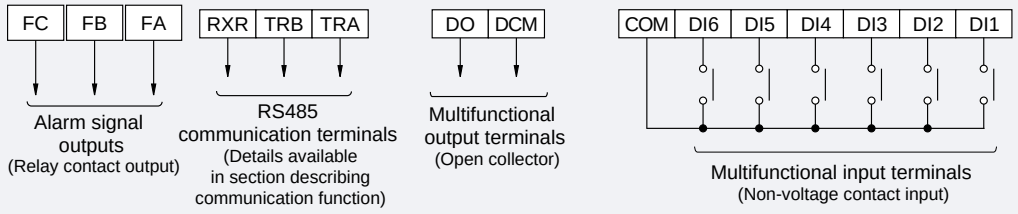
Caution 1: The values for wires in the main circuit are for 600 V IV PVC-insulated wires (60°C) when the inverter's ambient temperature is 40°C.
Caution 2: The maximum wire size indicates the maximum size of wire that can be used according to the terminal board.

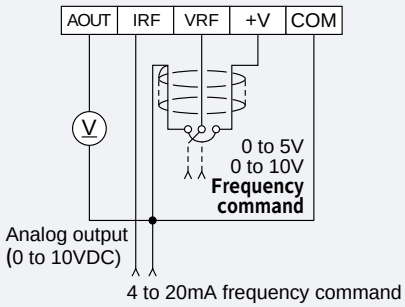
• Description of main circuit terminals

Symbol	Name	Description
R, S, T	Input power supply terminals	These terminals are used to connect the three-phase commercial power supply.
U, V, W	Inverter output terminals	These terminals are used to connect the three-phase induction motor.
X, X1	DC reactor connection terminals	These terminals are used to connect a DC reactor.*1
P, PR	Brake resistor connection terminals	These terminals are used to connect a brake resistor between P and PR.
P, X	DC link voltage connection terminals	P is a DC positive terminal, and X is a DC negative terminal.

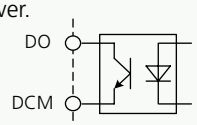
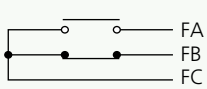
*1: When connecting a DC reactor, remove the shorting bar between X and X1.

• Description of control circuit terminals





6. Control Circuit Terminal Functions

Symbol		Terminal	Description
	DCM	Output signal common terminal	• Common terminal for output signals
Input terminals	DI1 DI2 DI3 DI4 DI5 DI6	Multifunctional input terminals Function selection with Cd630 to Cd635	• Signal input switched on by shorting with COM • Signal input switched off by disconnecting from COM
	COM	Input signal common terminal	• Common terminal for input signals
	+V	Frequency setting dial connection terminal	• Use a 5KW variable resistor with a rating of 0.3 W or more. • Power cannot be supplied to external from this terminal. Connect only a variable resistor.
	VRF	Analog voltage input terminal	• Input 0 to 10 VDC. When the input terminal function is set to "frequency setting", the command frequency is proportional to the input analog signal voltage and the set gain frequency (Cd055) is applied when the input signal is 10 V. (When function code Cd002 is set to data related to VRF) • The input impedance is approximately 31 kW. • The input voltage range can be changed from 0 to 5 V using the corresponding function code.
	IRF	Analog current input terminal	• When frequency setting is selected, input 4 to 20 mADC when IRF = current input is selected using Cd002. When the input terminal function is set to "frequency setting", the command frequency is proportional to the input signal voltage and the set gain frequency (Cd063) is applied when the input signal is 20 mA. When IRF is selected, the input impedance is approximately 500 W.
Output terminals	AOUT	Built-in analog output terminal	• On the ground side, use the COM input signal common terminal. • One monitor item is selected from Cd126 (AOUT), and indicated by an analog output. • The output signal voltage is from 0 to 10 VDC and the maximum allowable current is 15 mA. (However, adjust the output coefficient because the output voltage decreases as the output current increases.) • The output signal can be varied from 0 to 20 times using the Cd127 (AOUT) function code.
	DO	Multifunctional output terminal (Function selection with Cd638)	• The open collector output is 48 VDC and 50 mA or lower. • The signal turns on according to the selected function. • The common terminal is common to the DCM output signal common terminal. 
	FA FB FC	Alarm signal output terminals 	• These are contact output terminals indicating that the protection function has stopped the inverter. Normal: FA-FC open, FB-FC closed Abnormal: FA-FC closed, FB-FC open Contact capacity: 250 VAC, 0.3 A
Communication terminals	TRA TRB	RS485 serial communication terminals * Refer to the explanation of the serial communication function.	• Send/receive terminal
	RXR		• Terminating resistor shorting terminal

• Multifunctional input signal list

Data No.	Symbol	Function
0	-	Unused
1	FR	Forward run command
2	RR	Reverse run command
3	2DF	Multi-speed command 1
4	3DF	Multi-speed command 2
5	MBS	Free-run command
6	ES	External anomaly stop command
7	RST	Alarm reset command
8	AD2	2nd acceleration/deceleration command
9	Reserved	
10	JOG	Jogging operation command
11	Multiplexed terminal	FR+JOG
12	Multiplexed terminal	RR+JOG
13	Multiplexed terminal	FR+AD2
14	Multiplexed terminal	RR+AD2
15,16	Reserved	
17	Multiplexed terminal	FR+2DF
18	Multiplexed terminal	RR+2DF
19	Multiplexed terminal	FR+3DF
20	Multiplexed terminal	RR+3DF
21	Multiplexed terminal	FR+2DF+3DF
22	Multiplexed terminal	RR+2DF+3DF
23	Multiplexed terminal	FR+AD2+2DF
24	Multiplexed terminal	RR+AD2+2DF
25	Multiplexed terminal	FR+AD2+3DF
26	Multiplexed terminal	RR+AD2+3DF
27	Multiplexed terminal	FR+AD2+2DF+3DF
28	Multiplexed terminal	RR+AD2+2DF+3DF
29 to 35	Reserved	
36	IF	IRF terminal signal priority command *1
37	5DF	Multi-speed (5th-8th speed) selection command
38	HD	Operation signal hold command
39 to 45	Reserved	
46	PID	PID control switching signal (only valid during stop) *2
47 to 64	Reserved	
65	Multiplexed terminal	2DF+AD2
66	Reserved	
67	Multiplexed terminal	3DF+AD2
68 to 99	Reserved	

The 4 to 20 mA analog frequency command input to the IRF input terminal is used as the 1st speed frequency setting value while the IF terminal is ON, regardless of the content of 1st speed frequency selection code Cd002. For closed loop control using a sensor, such as flow rate control for pumps, it is possible to easily switch between manual setting from the operation panel during system adjustment and automatic operation using 4 to 20 mA from the external analog input terminal during normal operation.

In the Cd071 = 3 PID control mode, if this input terminal is switched on while the inverter is stopped, feedback control is disabled and normal V/f control is performed.

• Multifunctional output signal list

Data No.	Symbol	Function
0	-	Unused
1	Operating 1	ON during gate on
2	Undervoltage	
3	Reserved	
4	Operating 2	DC braking is off
5	Frequency matching	1st speed frequency only
6	Frequency matching	1st to 8th frequency
7	Frequency approach	
8	Reserved	
9	Electrothermal level alarm signal	Output when exeeding 80%
10	Radiator overheat alarm signal	
11, 12	Reserved	
13	DC braking signal	
14	Lower frequency limit matching signal	
15	Upper frequency limit matching signal	
16, 17	Reserved	
18	FR signal	Multifunctional input terminal status output
19	RR signal	Multifunctional input terminal status output
20	2DF signal	Multifunctional input terminal status output
21	3DF signal	Multifunctional input terminal status output
22	AD2 signal	Multifunctional input terminal status output
23	Reserved	
24	JOG signal	Multifunctional input terminal status output
25	MBS signal	Multifunctional input terminal status output
26	ES signal	Multifunctional input terminal status output
27	RST signal	Multifunctional input terminal status output
28～99	Reserved	

• Multifunctional input terminals

Function Code No.	Input Terminal Name	Data Range	Initial Value (Symbol)
Cd630	DI1	0 to 99	1 (FR)
Cd631	DI2	0 to 99	2 (RR)
Cd632	DI3	0 to 99	3 (2DF)
Cd633	DI4	0 to 99	4 (3DF)
Cd634	DI5	0 to 99	5 (MBS)
Cd635	DI6	0 to 99	7 (RST)

• Multifunctional output code list

Function Code No.	Input Terminal Name	Data Range	Initial Value (Symbol)
Cd638	DO	0 to 99	1(In operation 1)

7. Function Settings

1. Setting procedure (function code display mode)

Function settings are performed in the function code display mode.

Switching between the status display mode and function code display mode is done with the PROG/CLEAR key.

Status display mode ⟷ PROG CLEAR ⟷ Function code display mode

Operation	Display	Explanation
	50.0 or 50.0	Status display mode
PROG CLEAR	C000	Function code display mode Displays 000 and flashes the 100's digit as the input digit.
DISP ENTER ▲ ▼	C008	Move the input digit with the DISP/ENTER key and input the function code number with the ▲ and ▼ keys.
DISP ENTER	0002	The data corresponding to the input function code number is read out and the numerical data input wait status is entered. The leftmost digit flashes as the input digit.
DISP ENTER ▲ ▼	0150	Input the value to be set. Each time the DISP/ENTER key is pressed, the flashing digit moves one place to the right. When the rightmost digit flashes, pressing the DISP/ENTER key applies the setting. Each time the ▲ key is pressed, the number of the flashing digit changes in the sequence of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. Each time the ▼ key is pressed, the number of the flashing digit changes in the sequence of 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, 9.
DISP ENTER	C008	The input values are recorded as new settings, and the function code display mode is returned to. (As a number of function codes prevent data rewriting due to malfunction, the user may be prompted to input a value again for rechecking purposes. -> Refer to the following page.)
PROG CLEAR	50.0 or 500.	The status display mode is returned to.

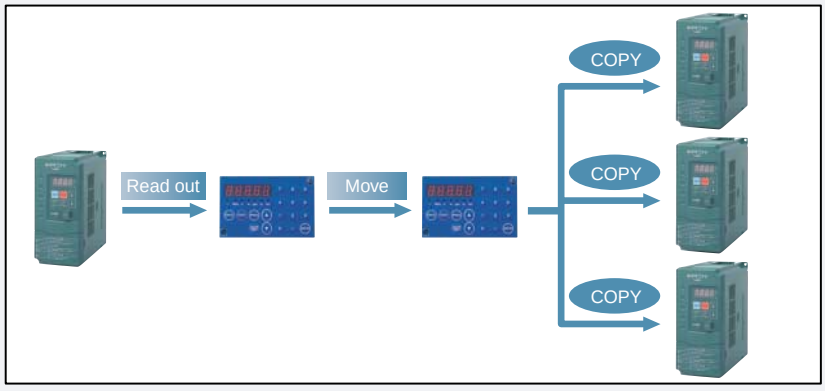
- To perform a numerical input again, press the PROG/CLEAR key to return to the display prior to input, and perform the input again.
- To stop function code data input, press the PROG/CLEAR key to return to the function code display mode.
  (When stopping function code data input after changing a value, if the PROG/CLEAR key is pressed twice without pressing the PROG/CLEAR key, the code display mode is returned to.)
- Copy function (Cd084)...Option (using operation panel)
  This function is used to transfer the function code data on the main unit's side to the operation panel side, and transfer the function code data to a different main unit's side. This function is enabled when similar function code data is set to multiple inverters. Since it is possible to transfer the same function code data to different inverters by just setting one inverter, it is easy to set the same function code.

<Description of simple function code>

Cd084 = 1: Transfers the current function code data to operation panel.

2: Transfers the recorded contents of the operation panel to the main unit.

For a detailed description of functions and operation methods, refer to the Cd084 function descriptions.



2. Function code list

Shaded parts indicate items whose values cannot be changed during operation.
* Typical constants suitable for all models are input.

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
000	Monitor displayselection	1: Frequency (Hz) 2: Output current (A) 7: No-unit display	1	1	
001	Operation command selection	1: Operation panel 2: External terminal 3: Communication	1	1	
002	1st speed frequency setting selection	0: Operation panel dial 1: Operation panel 2: External analog VRF (0 to 5 V) 3: External analog VRF (0 to 10 V or dial) 6. External analog IRF (4 to 20 mA) 10: External analog VRF + IRF 11: External analog VRF - IRF 12: Reserved 13: Reserved 14. Communication	1	0	
003	V/f pattern	1: Straight-line pattern 2: Second-order deceleration pattern	1	1	
004	Torque boost	0 to 20% (highest voltage ratio)	0.1%	*	
005	Prescribed voltage	200 V system 0: No AVR 30 to 240 V 400 V system 0: No AVR 30 to 460 V	1V	*	
006	Prescribed frequency	0.1 to 400Hz	0.1Hz	*	
007	Upper limit frequency	30 to 400Hz	0.1Hz	60	
008	Lower limit frequency	0.1 to 200Hz	0.1Hz	0.1	
009	Trigger method	1: Trigger frequency 3: From trigger frequency after DC braking	1	1	
010	Trigger frequency	0.1 to 20Hz	0.1Hz	1	
011	Operation start frequency	0 to 20Hz	0.1Hz	0	
012	Trigger delay time	0 to 5 s	0.1s	0	
013	Braking method	1: Deceleration stop 2: Deceleration stop + DC braking 3: Free-run stop	1	1	
014	DC braking start frequency	0.2 to 20Hz	0.1Hz	0.5	
015	DC braking time	0.1 to 10 s	0.1s	2	
016	DC braking force	1 to 10	1	5	
018	Acceleration/deceleration reference frequency	10 to 120Hz	0.1Hz	*	
019	1st acceleration time	0 to 999.9 s	0.1s	5	

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
020	2nd acceleration time	0 to 999.9s	0.1s	10	
023	1st deceleration time	0 to 999.9s	0.1s	5	
024	2nd deceleration time	0 to 999.9s	0.1s	10	
027	JOG acceleration/deceleration time	0 to 20s	0.1s	0.1	
028	JOG frequency	0.1 to 60Hz	0.1Hz	5	
029	1st speed frequency	0 to 400Hz	0.1Hz	0	
030	2nd speed frequency	0 to 400Hz	0.1Hz	10	
031	3rd speed frequency	0 to 400Hz	0.1Hz	20	
032	4th speed frequency	0 to 400Hz	0.1Hz	30	
033	5th speed frequency	0 to 400Hz	0.1Hz	40	
034	6th speed frequency	0 to 400Hz	0.1Hz	50	
035	7th speed frequency	0 to 400Hz	0.1Hz	60	
036	8th speed frequency	0 to 400Hz	0.1Hz	0	
037	Jump frequency lower limit	0 to 400Hz	0.1Hz	0	
038	Jump frequency upper limit	0 to 400Hz	0.1Hz	0	
043	Output current limiting function	0:No function 50 to 200%	1%	150	
044	Electrothermal setting	0:No function 20 to 105%	1%	100	
045	Normal state medium output current limiting function	0:None 1: Provided (currently selected acceleration/deceleration time) 2: Provided (acceleration/deceleration = Cd019, Cd023: 1st acceleration/deceleration time) 3: Provided (acceleration/deceleration = Cd020, Cd024: 2nd acceleration/deceleration time)	1	0	
047	Alarm automatic recovery	0: No automatic recovery function 1: Automatic recovery function provided	1	0	
049	Brake resistor usage rate	0: No brake resistor 2 to 25%ED	1%ED	*	
050	Motor rotation direction Note: Rotation direction command on operation panel is determined with Cd130.	1: Both forward and reverse run possible 2: Only forward run possible 3: Only reverse run possible	1	1	
051	Carrier frequency	0 to 130	1	*	
052	Motor type	1: General-purpose motor 2: Inverter dedicated motor	1	1	
054	Bias frequency (VRF)	-99.9 to 400Hz (frequency at 0 V)	0.1Hz	0	
055	Gain frequency (VRF)	-99.9 to 400Hz (frequency at 5 V or 10 V)	0.1Hz	60	

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
056	Attained frequency	0 to 400Hz	0.1Hz	10	
057	Frequency matching width	0 to 10Hz	0.1Hz	0	
058	No-unit display amplification	0 to 99.99 (amplification in relation to output frequency)	x0.01	1	
059	Status monitor display selection	1: No-unit (CD058 amplification) 2: PID feedback frequency [Hz] 3: Load factor [%] 4: Output voltage [V] 5: Reserved 6: Fin temperature [°C] 7 to 13: Reserved	1	1	
062	Bias frequency (IRF)	-99.9 to 400 Hz (frequency at 4 mA)	0.1Hz	0	
063	Gain frequency (IRF)	-99.9 to 400 MHz (frequency at 20 mA)	0.1Hz	60	
066	V/f separation function selection	1: V/f proportional type 2: Complete separation type	1	1	
070	ES input terminal function	1: NO external thermal signal 2: NC external thermal signal	1	1	
071	Motor control mode selection	1: V/f control mode 3: Built-in PID control mode 7: Automatic energy-saving mode 11: V/f separation control	1	1	
072 to 082	Reserved				
083	External analog input filter time constant	1 to 500 (setting value 1 = 10 ms)	10ms	10	
084	Copy function (option)	1: Transfer current code data to operation panel 2: Transfer recorded contents of operation panel to main unit	1	0	
087	"OV", "LV" alarm switching function while stopped (supported by software version 1.01 or later)	0: "OV" enabled and "LV" disabled when stopped 1: "OV" disabled and "LV" enabled when stopped 2: "OV" disabled and "LV" disabled when stopped 3: "OV" enabled and "LV" enabled when stopped	1	0	
096	Operation function lock	0: Code data change possible (no lock function) 2: Code data change not possible (except Cd096 and Cd028 to 036)	1	0	

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
098	Alarm contents readout	0 1: Readout start 9: Delete records	1	0	
099	Data initialization	0 1: Factory setting data initialization	1	0	
120	Analog input switching (Used both as PID and energy-saving function)	0: No analog input 1: External analog VRF (0 to 5 V) 2: External analog VRF (0 to 10 V or variable resistor) 5: External analog IRF (4 to 20 mA)	0	1	
122	PID control proportional gain	0 to 99.99	0.01	0.1	
123	PID control integral gain	0 to 99.99	0.01	0.1	
124	PID control differential gain	0 to 99.99	0.01	0.1	
125	Feedback input filter time constant	1 to 500 (setting value 1 = 10 ms) 0: No function	10ms	10	
126	Built-in analog output function	1: Setting frequency 2: Output frequency 3: Output current 4: Reserved 5: Radiator temperature 6: Load factor (Electrothermal level accumulated value) 7. Analog input conversion value output (VRF control circuit terminal input) 8. Analog input conversion value output (IRF control circuit terminal input) 9: Output voltage 10: Load factor (Percentage in relation to rated current) 12: Reserved	1	0	
127	Built-in analog output coefficient	0 to 20 times	x0.01	1	
130	Motor rotation direction (operation panel)	1: Forward run 2: Reverse run	1	1	
136	Bias frequency (operation panel dial)	-99.9 to 400Hz	0.1Hz	0	
137	Gain frequency (operation panel dial)	-99.9 to 400Hz	0.1Hz	60	

Shaded parts indicate items whose values cannot be changed during operation.
* Typical constants suitable for all models are input.

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
140	Changed code display function	0 1: Display differences with factory setting data	1	0	
142	Telegram check-sum	0: No 1: Yes	1	1	
144	Pull-up/down function selection	0: No 1: Yes	1	0	
146	Communication function	0: No function 1: Serial communication function provided	1	0	
147	Inverter numbers	1 to 32	1	1	
148	Communication speed	1:1200bps 2:2400bps 3:4800bps 4:9600bps 5:19200bps	1	3	
149	Parity bit	0: None 1: Odd 2: Even	1	1	
150	Stop bit	1: 1 bit 2: 2 bits	1	1	
151	End bit	0:CR,LF 1:CR	1	0	
152	Special command INV reply selection	0: Reply provided 1: No reply (error reply provided) 2 No reply (error reply not provided)	1	0	
630	Input terminal DI1 selection	0: Unused 1:FR 2:RR 3:2DF 4:3DF 5:MBS 6:ES 7:RST 8:AD2 9: Reserved 10:JOG	1	1	
631	Input terminal DI2 selection	11:FR+JOG 12:RR+JOG 13:FR+AD2 14:RR+AD2 15,16:Reserved 17:FR+2DF 18:RR+2DF 19:FR+3DF 20:RR+3DF 21:FR+2DF+3DF		2	
632	Input terminal DI3 selection	22:RR+2DF+3DF 23:FR+AD2+2DF 24:RR+AD2+2DF 25:FR+AD2+3DF		3	
633	Input terminal DI4 selection	26:RR+AD2+3DF 27:FR+AD2+2DF+3DF 28:RR+AD2+2DF+3DF		4	
634	Input terminal DI5 selection	29 to 35:Reserved 36:IF 37:5DF 38:HD 39 to 45: Reserved		5	
635	Input terminal DI6 selection	47 to 64: Reserved 65:2DF+AD2 66: Reserved 67:3DF+AD2 68~99: Reserved		7	

Code No. Cd	Function Name	Data Contents	Minimum Setting Unit	Factory Setting	Customer Setting Value
636	Reserved				
637	Reserved				
638	Output terminal DO selection	0: Unused 1: In operation 1 2: Undervoltage 3: Reserved 4: In operation 2 5: Frequency match (1st speed frequency) 6: Frequency match (1st to 8th speed frequency) 7: Frequency approached 8: Reserved 9: Electrothermal level alarm signal (Electrothermal 80%) 10: Radiator overheat alarm signal 11, 12: Reserved 13: DC braking in progress signal 14: Lower limit frequency match signal 15: Upper limit frequency match signal 16: 17: Reserved 18: FR signal 19: RR signal 20: 2DF signal 21: 3DF signal 22: AD2 signal 23: Reserved 24: JOG signal 25: MSB signal 26: ES signal 27: RST signal 28 to 99: Reserved	1	1	
641	Open phase detection function selection	0: Input open phase detection disabled, Output open phase detection disabled 1: Input open phase detection enabled, Output open phase detection disabled 2: Input open phase detection disabled, Output open phase detection enabled 3: Input open phase detection enabled, Output open phase detection enabled	1	1	
642	Overvoltage stall prevention function selection	0: No overvoltage stall prevention function 1: Overvoltage stall prevention function provided	1	0	
643	Feedback signal disconnection detection time	0 to 99 s 99: No function	0.01s	5	

8. Protection and Alarm Functions

When the protection operation of the main unit and machine starts, an alarm is displayed on the LED panel and tripping is stopped. After checking the protection operation contents for restarting, it is necessary to remove all causes of anomaly from the main unit, machine, and motor.

For the LED display contents, inspection items, and handling, refer to Alarm List.

- **Protection operation list**

Name	Description	Display
Overcurrent limiting (Anti-breakdown)	When a current that exceeds the current set with Cd043 flows, the frequency curves are adjusted to limit the increase in current. **Acceleration**: After the output current reaches the set value during acceleration, the frequency increases at a slower rate for a while to accelerate the motor within the current limit, preventing breakdown from occurring. **Constant power operation**: When the output current reaches the set value due to an overload during constant power operation, the frequency is reduced to keep the output current below the setting. When the overload is removed, the frequency returns to its previous setting.When the energy regenerated during deceleration of the motor exceeds the dissipation capacity of the brake resistor, raising the inverter- DC link voltage, the drive frequency stops decreasing and actually increases as necessary to prevent an overvoltage trip.	SC SCn
Overvoltage prevention	After the regenerated energy decreases, deceleration is continued at a slower rate.	Su
Overcurrent shutdown	When a current exceeding the allowable current range of the inverter is input, the protection circuit activates and stops the inverter.	oCA oCn oCd
Overvoltage shutdown	When the inverter-DC link voltage exceeds the specified voltage due to excessive regenerated energy, a protection circuit is activated to stop the inverter.	ouA oun oud
Protection against undervoltage (momentary power failure)	When the DC link voltage falls below the specified value due to an abnormal power supply voltage, the inverter stops operating.	LuA Lun Lud
Overload shutdown (motor electrothermal shutdown)	Overloading and overheating of the motor during low-speed operation are detected by the electrothermal protector to stop the inverter. Different values can be specified to trip the electrothermal protector depending on the type, rated current, etc., of the motor.	oLA oLn oLd
Overload shutdown (inverter thermal shutdown)	The inverter stops operating when a current greater than the current rating of the inverter flows for one second or longer.	oCPA oCPn oCPd
Fin overheat protection	Warning (tH) is issued at a temperature 10°C below the abnormal radiator fin temperature (oH) when the ambient temperature rises sharply of the cooling fan stops. If it continues to rise further and exceeds the abnormal radiator fin temperature (oH), the protection function stops the motor drive. (The abnormal radiator fin temperature (oH) differs depending upon the output frequency and output current.) This function also stops the drive when the main switching device (power module) is overheating. This function is released when the temperature decreases to more than 10°C below the abnormal radiator fin temperature (oH).	tH oH oCH
Brake resistor overheating	As the regenerative energy of the motor increases, and the allowable brake resistor value (%ED) is exceeded, the brake resistor becomes temporarily unusable due to overheating protection. By letting the brake resistor cool down, it becomes usable again.	dboH
protection Overload prevention alarm	The inverter stops operating if the motor is unable to accelerate or decelerate because the motor load is excessive or the setting of Cd043 (output current limiting function) is too low.	ACEr dCEr CnEr
External thermal protection	An external thermal protector can be attached to a motor. By inputting this signal to the ES control signal terminal, the inverter can be set to stop when the thermal protector is activated.	ES
CPU abnormality	If excessive external electrical noise or other disturbances lead to a malfunction of the CPU, connection failure of an option board, or internal memory abnormality, the inverter stops operating.	AL 1 ~ AL 10

•Alarm list

The inspection items and handling contents are displayed as the alarm contents displayed by the LED on the operation panel.

Refer to the following list to determine the cause of the anomaly, and during inspection, handling, and recovery.

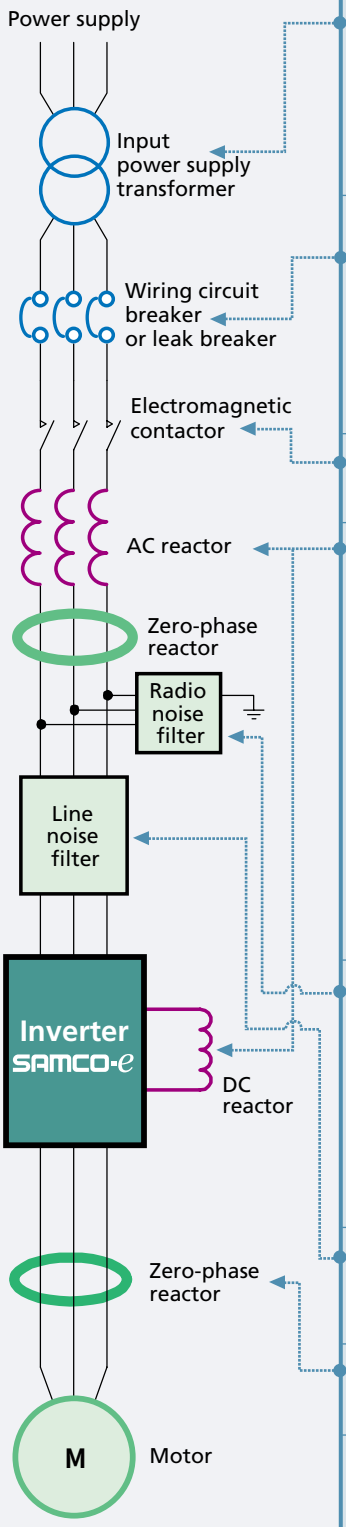
Alarm Display	Alarm Description	Inspection Contents	Handling
AL 1 *2	Memory anomaly	After switching off the power and extinguishing the CHARGE lamp, switch the power back on and check the alarm.	Failure or destruction is likely to have occurred, and repair is required. Contact the location of purchase.
AL 2 *1	System anomaly	Is external noise large?	Attach absorber and noise filter.
AL 3 *1	System anomaly	Are the signal lines and power lines too close?	Place signal lines further apart from power lines.
AL 4 *2	System anomaly	Did sudden capacitor discharge occur? After switching off the power and extinguishing the CHARGE lamp, switch the power back on and check the alarm.	Recheck the changed code data. If the alarm does not clear even after reapplying power several times, initialize the function code with Cd099 = 1, and then reapply power. However, in this case, all the function data return to the factory setting data.
AL 5 *2	System anomaly	Is external noise large?	Attach absorber and noise filter.
AL 9 *2	System anomaly	Are the signal lines and power lines too close?	Place signal lines further apart from power lines.
AL 10	System anomaly	After switching off the power and extinguishing the CHARGE lamp, switch the power back on and check the alarm.	Failure or destruction is likely to have occurred, and repair is required. Contact the location of purchase.
ACEr	Overload during acceleration prevention alarm	Current limit value: Is Cd043 too small?	Increase the setting value. Increase the acceleration/deceleration time.
CnEr	Overload during regular operation prevention alarm		
dCEr	Overload during deceleration prevention alarm		
ES	External temperature	Has the motor overheated?	Reduce the load.
oH	Radiator temperature anomaly	Is the fan stopped? Is the ambient temperature high?	Check the fan operation. Increase the amount of ventilation.
LuA	Undervoltage during acceleration	Are the power supply voltage conditions adequate?	Improve or adjust the power supply conditions.
Lun	Undervoltage during regular operation	Is there a drop in voltage?	
Lud *3	Undervoltage during deceleration	Is input open phase?	
oCH *3	Main switching element	Is the fan stopped? Is the ambient temperature high?	Check the fan operation. Increase the amount of ventilation.
oCA *3	Overcurrent during acceleration	Does acceleration/deceleration occur suddenly?	Increase the acceleration/deceleration time.
oCn	Overcurrent during regular operation	Is there an output short or grounding?	Eliminate the short circuit or grounding. If the same alarm is displayed repeatedly, contact the location of purchase.
oCd	Overcurrent during deceleration	Is the main switching element abnormal?	
oCPA	Short-time overcurrent during acceleration	Sudden acceleration? Current limit value: Is Cd043 too large?	Sudden acceleration? Current limit value: Is Cd043 too large?
oCPn	Short-time overcurrent during regular operation	Sudden change (increase) in load? Current limit value: Is Cd043 too large?	Sudden change (increase) in load? Current limit value: Is Cd043 too large?
oCPd	Short-time overcurrent during deceleration	Sudden deceleration due to large GD2? Current limit value: Is Cd043 too large?	Sudden deceleration due to large GD2? Current limit value: Is Cd043 too large?
oLA	Overload during acceleration	Is motor used with overload?	Is motor used with overload?
oLn	Overload during regular operation	Is electrothermal setting correct?	Is electrothermal setting correct?
oLd	Overload during deceleration	Is load GD2 too large?	Is load GD2 too large?
ouA	Overvoltage during acceleration	Does start occur during free run?	Start after motor stops.
oun	Overvoltage during regular operation	Is motor activated from other source?	Change to system that does not activate motor. Set a large-capacity brake resistor.
oud	Overvoltage during deceleration	Does rapid deceleration occur?	Increase deceleration time. (Set deceleration time according to load GD2.)
ouP	Brake resistor protection overvoltage	Is braking frequency excessive?	Reduce braking frequency. Increase brake resistor capacity.
oPEn	Output open-phase (No detection in case of ultra-low frequency of just a few Hz)	Is inverter's output cable open-phase?	Securely connect the output cable.
GAL 1	Detection of feedback signal disconnection during PID control operation with Cd071 = 3	Is feedback signal cable disconnected? Is feedback signal normal? Cd055 or Cd063: Is gain frequency normal?	Securely connect feedback signal cable. Cd055 or Cd063: Correctly check gain frequency.

***1: Perform settings again so that all the function data are returned to the factory setting data and use these settings.**
***2: If the same alarm is displayed again even after repeated power reapplications, contact the location of purchase.**
***3: The main switch element is provided with a short-circuit protection function, but in the case of repeated short-circuits that occur with high frequency, device damage may occur due to element deterioration, so resume operation after completely eliminating the causes of stoppage and checking safety.**

Note: If for some reason or another the operation panel display goes out, switch off the inverter's power, check each wire, and after extinguishing the charge lamp, reapply power (when power supply was short-circuited by mistake, etc.).

9. Options and Peripheral Devices

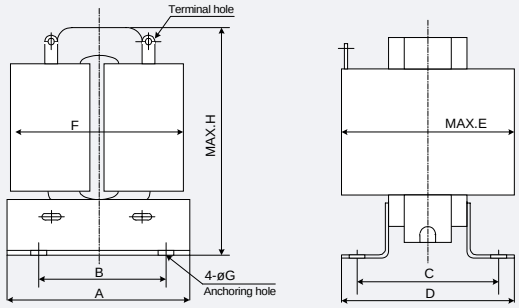
Use the inverter by installing options and peripheral devices according to the usage status, purpose, and environment.



Name	Usage Purpose and Other Details
Input power supply transformer	If the following items are matched, install an insulation transformer. • When the power supply voltage of the power-receiving system and inverter rated input voltage must match. • When large equipment or equipment causing voltage surges is connected to the power-receiving system • When it is necessary to lower the influence of harmonic current on other equipment connected to the same power-receiving system when using a large capacity inverter or multiple inverters
Wiring circuit breaker (MCCB) or leak circuit breaker (ELB)	• Use for power supply system protection, transformer and wiring overcurrent protection. • When selecting the machine type, ratings, cutoff current, etc., refer to the Wiring Equipment and Recommended Cables attachment. • When selecting the leak circuit breaker (ELB), refer to the Leak Current of Various Equipment attachment. • The leak current increases when noise filters are installed. Also, when multiple inverters are connected to the same leak circuit breaker (ELB), caution is required (for example, the values to be set should be multiples corresponding to the number of inverters.)
Electromagnetic contactor (MC)	• An open/close surge absorber must be attached to the electromagnetic contactor (MC).
Input (AC) reactor and DC reactor	If the following items are matched, install an input (AC) reactor and a DC reactor. • When the input power factor on the inverter's power supply side needs to be improved • When the power supply's phase voltage imbalance affects the inverter • When the power supply capacity of the power-receiving system is 500 kVA or higher, or is 10 or more times the inverter's input capacity • When large equipment or equipment causing voltage surges is connected to the same power-receiving system • When it is necessary to reduce the influence of harmonic current on other equipment connected to the same power-receiving system when using a large capacity inverter or multiple inverters Inverters of 200 V 3.7 kW or lower are subject to the Home Appliance and General-Purpose Product Harmonic Suppression Measures Guidelines and must meet this standard. Refer also to Inverter Introduction/Usage Cautions.
Radio noise filter	Reduces the conduction, radiation, and inductance noise generated by the inverter. • Reduces the interference on audio equipment or receiving equipment used in the vicinity of the inverter. • Reduces the influence of noise on equipment used to control the inverter and PLC. • Is effective over the frequency band ranging from the AM radio band to approximately 10 MHz. Part No. 200 V class: 3XYEB-105/104 400 V class: 3XYEB-105/104 (Recommended: Products by Okaya Denki Sangyo Co., Ltd.)
High-attenuation LC noise filter supporting EMC command	Part No. 3SUP-HE[ ][ ]-ER-6 [ ][ ]: Set rated current from the inverter capacity. (Recommended: Products by Okaya Denki Sangyo Co., Ltd.)
Zero-phase reactor (Ferrite core type)	Product No. RC5078 RC5096 (Recommended: Products by Soshin Electric Co., Ltd.)
Brake resistors	Use these to shorten the deceleration time for loads with large inertia (GD2) when frequently performing sudden motor deceleration or stops. Refer to External Brake Resistor Selection Examples.

• DC reactor

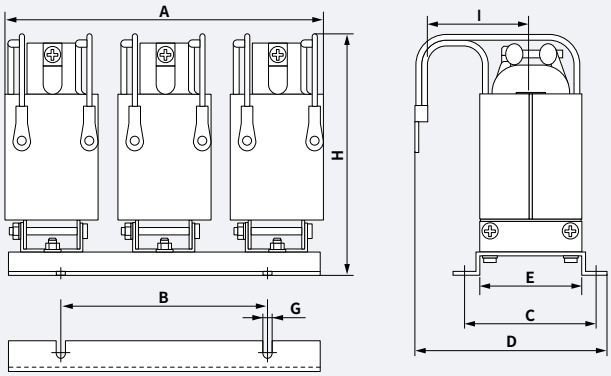
<Figure 1>



Series	Applicable Motor Capacity[kW]	Inverter Type	Reactor Type	Dimensions[mm]							Weight [kg]
				A	B	C	D	G	H	Figure No.	
Single-phase 200 V ES Series	0.4	ES-0.4k	SS-DCL-0.75K	110	95	75	65	6	170	M4	3.6
	0.75	ES-0.75k	SS-DCL-0.75K	110	95	75	65	6	170	M4	3.6
	1.5	ES-1.5k	SS-DCL-2.2K	110	95	95	110	6	180	M4	5.6
	2.2	ES-2.2k	SS-DCL-2.2K	110	95	95	110	6	180	M4	5.6
Three-phase 200 V ET Series	0.4	ET-0.4k	ST-DCL-0.4K	60	40	50	60	4	150	M4	2.1
	0.75	ET-0.75k	ST-DCL-1.5K	75	50	56	60	5	150	M4	2.1
	1.5	ET-1.5k	ST-DCL-1.5K	75	50	56	60	5	150	M4	2.1
	2.2	ET-2.2k	ST-DCL-3.7K	110	95	65	75	6	170	M4	4
	3.7	ET-3.7k	ST-DCL-3.7K	110	95	65	75	6	170	M4	4
Three-phase 400 V EF Series	0.4	EF-0.4k	SF-DCL-0.75K	75	50	66	56	5	150	M3	2.7
	0.75	EF-0.75k	SF-DCL-0.75K	75	50	66	56	5	150	M3	2.7
	1.5	EF-1.5k	SF-DCL-2.2K	75	50	62	72	5	150	M4	3.5
	2.2	EF-2.2k	SF-DCL-2.2K	75	50	62	72	5	150	M4	3.5
	4.0	EF-4.0k	SF-DCL-4.0K	75	50	62	72	5	160	M4	3.5

Note:The shape of the reactor may change according to the circumstances, please contact SANKEN for more details.
Note:The reactor will become hot during the operation, please install the reactor in an airy place and keep a distance of at least 30 cm away from nearby equipment.
The reactor will become very hot during operation - do not touch.

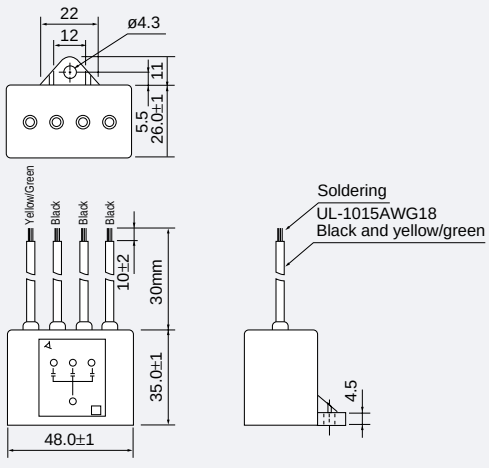
• AC reactor



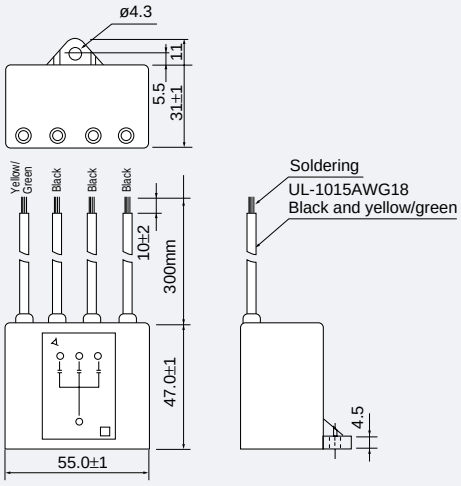
Series	Applicable Motor Capacity[kW]	Inverter Type	Reactor Type	Dimensions[mm]										Figure No.	Weight [kg]
				A	B	C	D	E	F	G	H	I	Terminal Hole Diameter		
Single-phase 200 V ES Series	0.4	ES-0.4K	SS-ACL-0.4k	200	140	90	120	81	205	6	135	72	M3	1	1.4
	0.75	ES-0.75K	SS-ACL-0.75k	200	140	90	120	81	205	6	135	72	M4	1	1.4
	1.5	ES-1.5K	SS-ACL-1.5k	200	140	90	120	81	205	6	135	72	M4	1	1.5
	2.2	ES-2.2K	SS-ACL-2.2k	200	140	90	120	81	205	6	135	72	M4	1	2
Three-phase 200 V ET Series	0.4	ET-0.4K	ST-ACL-0.4k	170	100	65	80	59	175	5	100	48	M3	1	2
	0.75	ET-0.75K	ST-ACL-0.75K	170	100	65	80	59	175	5	100	48	M3	1	2.5
	1.5	ET-1.5K	ST-ACL-1.5K	170	100	65	80	59	175	5	110	48	M4	1	2.8
	2.2	ET-2.2K	ST-ACL-2.2K	170	110	70	90	63	175	5	120	54	M4	1	3.7
	3.7	ET-3.7K	ST-ACL-3.7K	200	140	90	120	81	205	6	135	72	M4	1	4.5
Three-phase 400 V EF Series	0.4	EF-0.4K	SF-ACL-0.4k	155	100	65	80	59	160	5	100	48	M3	1	2
	0.75	EF-0.75K	SF-ACL-0.75k	160	100	65	90	59	165	5	100	54	M3	1	2.6
	1.5	EF-1.5K	SF-ACL-1.5K	170	110	70	90	63	175	5	120	54	M4	1	3.7
	2.2	EF-2.2K	SF-ACL-2.2K	170	110	90	120	81	175	6	135	72	M4	1	4.7
	4.0	EF-4.0K	SF-ACL-4.0K	170	110	90	120	81	175	6		72	M4	1	5.5

• Noise suppression capacitor (Recommended: Products by Okaya Denki Sangyo Co., Ltd.)

200 V class: 3XYEB-105/104



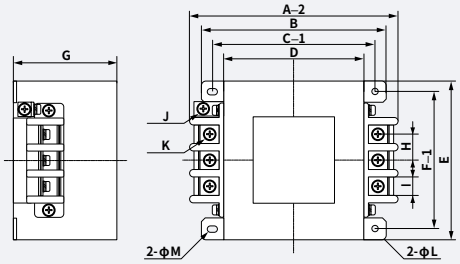
400 V class: 3XYHB-105/104



• High-attenuation LC filter supporting EMC command (Recommended: Products by Okaya Denki Sangyo Co., Ltd.)

200VSystem	400VSystem	Part No.
———	0.4K	3SUP-HE5-ER6
———	0.75K	3SUP-HE5-ER6
0.4K	1.5K	3SUP-HE10-ER6
0.75k	2.2k	3SUP-HE10-ER6
1.5k	4.0k	3SUP-HE20-ER6
2.2k	———	3SUP-HE20-ER6
3.7k	———	3SUP-HE30-ER6

External Dimension Diagrams 3SUP-HE -ER-6(5 to 200)

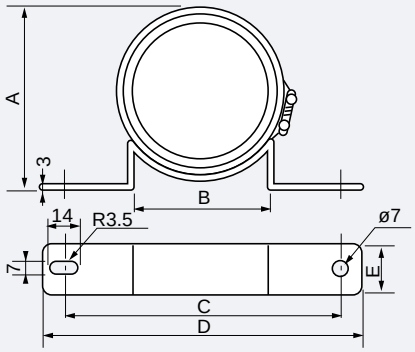


Dimension Diagrams

Part No.	A	B	C	D	E	F	G	H	I	J	K	L	M
3SUP-HE5-ER-6	141	125	110	95	110	95	70	18	13	M4	M4	4.5	4.5X7
3SUP-HE10-ER-6	141	125	110	95	110	95	70	18	13	M4	M4	4.5	4.5X7
3SUP-HE20-ER-6	176	160	145	130	120	100	70	18	13	M4	M4	4.5	4.5X7
3SUP-HE30-ER-6	176	160	145	130	120	100	70	18	13	M4	M4	4.5	4.5X7

Zero-phase reactor (Recommended: Products by Soshin Electric Co., Ltd.)

	RC5078	RC5096
A	85	103
B	64	84
C	130	140
D	150	160
E	23(24)	25(26)



• External brake resistor selection example

All the SAMCO-e inverters are provided as standard with a circuit that allows control by externally connected brake resistors.

If sudden motor deceleration or stopping is frequently performed, connect an external brake resistor based on the selection examples in the following table, in order to reduce the deceleration time for loads with large inertia (GD2).

	Model		External Brake Resistor	
			Resistance	Capacity*
200 V system	ET-0.4K	ES-0.4K	220Ω or Higher	100W
	ET-0.75K	ES-0.75K	120Ωor Higher	150W
	ET-1.5K	ES-1.5K	60Ω or Higher	300W
	ET-2.2K	ES-2.2K	60Ω or Higher	300W
	ET-3.7K	————	40Ω or Higher	400W
400 V system	EF-0.4K	————	1000Ω or Higher	80W
	EF-0.75K	————	700Ω or Higher	100W
	EF-1.5K	————	320Ω or Higher	200W
	EF-2.2K	————	160Ω or Higher	400W
	EF-4.0K	————	120Ω or Higher	600W

* These selection examples are based on a maximum brake resistance usage rate of 10% ED. In the case of these examples, set 10% ED or lower for the brake protection Cd049 (brake resistance usage rate).
If Cd049 (brake resistance usage rate) is set to 10% ED or higher, increase the brake resistance capacity proportionally.
Example: If 20% ED is set, select a capacity that is twice that for 10% ED.

10. Inverter Introduction/Usage Cautions

• Peripheral devices

Leak Current

When the wiring between the inverter and motor is long, harmonic leak current caused by the wiring's stray capacitance increases. If the wiring length cannot be made shorter, set Cd051 (carrier frequency) using the following table as reference.

InverterMotor↔Wiring Distance	50m	100m	200m
Carrier frequency (set with Cd051)	Cd051=130 or lower	Cd051=090 or lower	Cd051=040 or lower

Be sure to ground the inverter's grounding terminal.

Voltage	Grounding Resistance
200V System	100Ω or lower
400V System	10Ω or lower

Note that the leak current varies according to the type of grounding, the wiring status, the other machinery sharing the same power supply system, and so on.
Leak current values when grounding is performed are listed in the following table for reference.

Voltage	Inverter	With Filter
200V System	0.33mA	10.1mA
400V System	0.6mA	20.3mA

The values in the "With Filter" column are for when a radio noise filter (3XYEB-105/104 (200 V), 3XYHB-105/104 (400 V)) is connected. (Measurement conditions: Rated input voltage, rated motor capacity, maximum carrier frequency, output electric wiring length of 8 m)
As the leak circuit breaker (ELB), use a breaker with a built-in harmonic suppression feature. If connecting multiple inverters to the same leak circuit breaker, add up the corresponding values in the above table and set a large sense current.

Radio wave/harmonic interference

In principle, inverters generate conduction, radiation, and inductance noise due to switching control.

- Audio equipment and reception equipment used in the vicinity of inverters may be subject to radio wave interference.
- Inverter-generated noise may affect devices that control inverters, PLCs, etc.
- Harmonic current may affect equipment connected to the same power supply system.

In such cases, it is necessary to connect an AC reactor, DC reactor and/or noise filter, implement shielding inside the metal pipes used for wiring, and/or replace control lines with shielded cable.

Use of capacitors to improve power factor

Do not connect capacitors for improving the power factor on the inverter's input and output sides. This would cause the harmonic component of the inverter to flow to the capacitor, make the inverter cause overcurrent tripping and have a negative influence on the capacitor.
To improve the power factor, use the optional AC or DC reactor.

Input (AC) reactor and DC reactor

- When the input power factor on the inverter's power supply side needs to be improved
- When the power supply's phase voltage imbalance affects the inverter
- When the power supply capacity of the power-receiving system is 500 kVA or higher, or is 10 or more times the inverter input capacity
- When large equipment or equipment causing voltage surges is connected to the same power-receiving system
- When it is necessary to reduce the influence of harmonic current on other equipment connected to the same power-receiving system, when using a large-capacity inverter or multiple inverters

• Motor and inverter selection

Standard specification induction motor

Select the motor referring to the applied motor capacity listed in the standard specifications.
When driving multiple motors in series with one inverter, select the motors and the inverter so that the total of the motor rated current × 1.1 is equal to or less than the inverter's rated output current.
If a large trigger torque is required, select an inverter with a suitable capacity.

Geared motor

The motor intake current varies according to the gear ratio, gear shape, deceleration rate, deceleration method, and the manufacturer.
Select an inverter model that has a sufficient output current rating compared with the output current rated for the motor, referring to the inverter rated output current listed in the standard specifications.
Lubrication-related problems may arise during low-speed operation due to the lubrication method and the manufacturer. Check the continuous use range with the manufacturer.

Brake motor

Select an inverter model that has a sufficient output current rating compared with the output current rated for the motor, referring to the inverter rated output current listed in the standard specifications. Use a motor that has an independent brake power supply, and connect the brake power supply to the inverter's input power supply side.
During brake operation (motor stop), stop the inverter output using the free-run stop function
.

Submersible motor/multi-pole motor

The motor intake current differs according to the specifications, shape, and number of poles.
Select an inverter model that has a sufficient output current rating compared with the output current rated for the motor, referring to the inverter rated output current listed in the standard specifications.

Explosion-proof motor

It is necessary to use an inverter and motor combination that has certified explosion-proof characteristics.

Synchronous motor

It is necessary to use a dedicated inverter that best suits the motor specifications. Consult Sanken Electric when selecting the inverter.

Single-phase motor

Since single-phase motors include a startup capacitor and centrifugal force switching, they cannot be used with inverters.

Insulating voltage

When driving a 400 V motor with an inverter, a high surge voltage caused by the cable length, wiring method, motor constants, etc., may be generated and cause degradation of the motor's insulation. Therefore be sure to implement protective measures such as using a motor with reinforced insulation, installing a surge voltage suppression filter, and so on.

Allowable torque

During inverter driving, the temperature rises higher compared with commercial power supply driving because of the inverter output waveform. Moreover, in the low-speed range, the cooling effect declines and the allowable output torque also declines. If continuous allowable torque is required in the low-speed range, use an inverter-dedicated motor of a motor manufacturer.

Vibration

During inverter driving, vibrations when driving a light load are greater than in the case of commercial power supply driving. Resonance may occur due to natural vibration, including that of the mechanical system. As countermeasures, it is effective to strengthen the machine's foundation, use rubber pads, use the frequency jump function, etc.

Noise

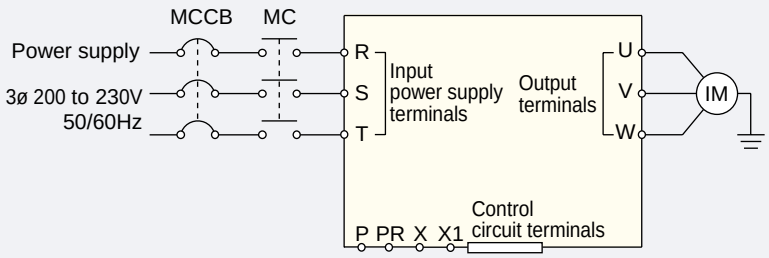
During inverter driving, more noise is generated than during commercial power supply driving, due to the inverter's output waveform. To attenuate such noise, it is effective to change the carrier frequency while comparing the noise level by ear.

11. Inverter Q&A

Q1 **I want to use the inverter right away.**

A The SAMCO-e inverters feature an input terminal board on the top and an output terminal board on the bottom. Wiring is done by simply connecting the power supply wiring to the top terminal board and the wiring to the motor to the bottom terminal board. When this is done, motor driving is simply achieved by pressing the DRIVE key on the operation panel and turning the frequency setting dial to set the desired frequency.

• Basic inverter wiring diagram



Q2 **Using the inverter generates noise that causes other devices to malfunction.**

A Due to the control operation principle, the inverter generates noise that affects other devices. This noise can be divided into conduction, radiation, and inductance noise, and countermeasures must be implemented according to the type of influence exerted.
In order to reduce the influence of such noise, it is necessary to connect an AC reactor, DC reactor, or noise filter, provide shielding inside the metal pipes used for wiring, and/or replace control lines with shielded cable. For details, contact Sanken Electric.

Conduction noise: This is noise generated inside the inverter that travels through conductors such as wiring and influences peripheral devices.

Inductance noise: This is noise induced by electromagnetic induction and electrostatic induction when the wiring of peripheral devices and signal wires are placed near the wiring on the input side and the output side of an inverter in which noise current flows.

Radiation noise: This type of noise occurs when the noise generated inside the inverter is radiated into the atmosphere by the wiring on the input side and output side, which acts as an antenna, affecting peripheral devices.

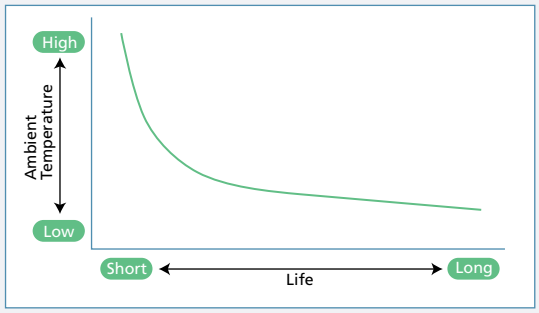
Q3 **What is the life of an inverter?**

A

Product Name	Conditions	Design Life
Cooling fan	Generally, replacement is recommended every 10,000 to 35,000 hours (normally 2 to 4 years in the case of a continuously driving device)	
Main smoothing electrolytic capacitor	• Average annual ambient temperature of inverter: 35°C • Operating load factor: 80%, utilization rate: 12 hours/day, 365 days/year • No top cover set on inverter	Under the temperature condition described on the left, the life estimated by Sanken Electric is approximately 10 years.
Smoothing electrolytic capacitor on board		

Maintenance inspections	[Recommended periodic inspection] While the above-listed life figures estimated by Sanken Electric generally apply, we recommend periodic inspection of inverters, checking the indicated inspection items.

Moreover, a trend related to the ambient temperature exists for the aluminum electrolytic capacitors used inside the inverter (Arrhenius Law*), which determines the life of inverters, which are easily influenced by the ambient temperature. If an inverter is used in a high-temperature environment, it is necessary to replace the aluminum electrolytic capacitors inside that inverter within the standard replacement period in order to ensure long use of the inverter.

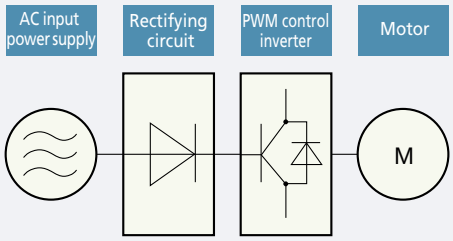


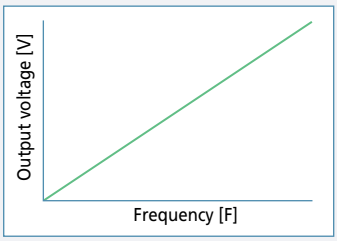
* Arrhenius Law (doubling for every 10°C)
When the ambient temperature increases by 10°C, the life decreases by half, and when the ambient temperature declines by 10°C, the life doubles.

Q4 Could you describe the inverter's operation?

A

The inverter converts the input AC power supply into DC power supply via a rectifying circuit. Since a motor's speed of rotation cannot be controlled with DC current, the DC current is converted to AC by a pulse width modulation (PWM) control inverter. This AC current is a pulse called a square wave, and control is performed to obtain the optimum pulse count (which depends on the carrier frequency) and pulse width for output. The relationship between the voltage and frequency at this time is expressed by a V/F pattern.
The relationship between the motor's rotation speed and the inverter's output frequency can be expressed with the following equation.





$$N[prm] = \frac{120 \times F[Hz](1-S)}{[\text{Number of motor poles}]}$$

S:Slip

Q5 What should I do for inverter maintenance and in case of failure?

A

Have the inverter serviced at one of the sales offices on the back cover. These sales offices will assist you with technical support and questions regarding product introduction, support, inspections, and maintenance for products in use, and support in case of product failure.
To request service support, use the After Sales Service Sheet on page 27. Your contract with the machine manufacturer and purchasing location will take precedence, but in order to gain more detailed knowledge of the state of your inverters and take quicker action, please send in the filled out sheet or contact us with the details based on the items listed on this sheet.

Q6 I would like to make greater use of inverters.

A We offer optimum solutions, including specialized inverters through customized functions that are available by upgrading to the vm05 series. We welcome inquiries about your problems and requirements.

SAMCO-vm05 Customized inverter Device

- **Control devices customized for specific applications**
  We offer dedicated inverters through software that is optimized for the customer's desires, specifications, and usage purposes.
- **Control algorithms supporting various applications and machines**
  Sanken Electric inverters come with a rich array of control parameters and setting values as standard. They support various systems as standard.
- **Pursuit of ease of use and security through communication function, data lock function, etc.**
  Our inverters feature a communication function (option) that supports data busses, and strong security features, such as data lock and password functions.

• After Sales Service Sheet

Please use this sheet for inquiries or repair requests to Sanken Electric or purchase locations for quick support.

Company Name		Date (MM/DD/YY)	

Item		Response/Question	Remarks
Used equipment	Equipment manufacturer or purchase location name and country	Name: Country:	
	Equipment name	Name:	
	Equipment purpose/application		
	Inverter operation purpose	Inverter used for:	
	Number of years in use	_____ years	
	Usage environment	Ambient temperature: Approximately ____ °C Atmosphere:	
	Maintenance contract existence	Yes / No	
Condition of inverter	Inverter condition/symptoms	Observed symptoms:	
	Operation panel display	Display:	
	Model:		
Desired support	Substitution	Yes / No	
	Saving of function code settings	Saved / Not saved	
	Replacement	Yes / No	
	Product return request		
Customer contact	Customer name	Name:	
	Section		
	Person to contact		
	Phone No.		
	E-Mail	@	

• Symbol/Conversion Chart

Quantities		SI Unit Symbols		Remarks
Length		m	Meter	
Weight		kg	Kilogramme	
Time	t	s	Second	
Frequency	f	Hz	Hertz	
Force		N [kg·m/s2]	Newton	kgf=9.8N
Torque	τ	T [N·m]	Newton·meter	kgf·m=9.8N·m
Pressure (stress)		Pa [N/m2]	Pascal	kgf/mm2=9.8Mpa
Energy	E	J [N·m]	Joule	kgf·m=9.8J KWh=3.6MJ
Power	P	W [J/s]	Watt	kgf·m/s=9.8J/s
Rotational speed	N	N [r/min]		r/min=2π/60 rad/s
Flywheel effect Moment of inertia		J [kg·m2]	———————	GD2=4J
Electric current	I	A	Ampere	
Electric potential difference (voltage)	E	V	Volt	
Electric charge	C	C [A·s]	coulomb	
Electric resistance	R	Ω[V/A]	Ohm	
Conductance	S	S [A/V]	siemens	
Capacitance		F [C/V]	Farad	
Magnetic flux		Wb [V·s]	Weber	
Magnetic flux		T [Wb/m2]	Tesla	
density	L	H [Wb/A]	Henry	
Inductance		K	Kelvin	
Temperature		rad	Radian	

Formulae
1) T [N·m]=2π/60 x P [W] / N [r/min]
2) P [W]=2π/60 x T [N·m] x N [r/min]

Safety Cautions

Please observe the following cautions when using SAMCO-e Series inverters.

- Prior to use, carefully read the INSTRUCTION MANUAL to ensure correct use.
- Please observe the usage conditions and environmental conditions described in this catalog.
- Use these products for variable speed applications that employ general-purpose industrial three-phase AC-driven motors.
  *If considering use of these products for other applications, consult a Sanken Electric sales representative beforehand.
- If considering use of these products for the following equipment and applications, for which there is the risk that failure or malfunction of these products may directly endanger human life or cause injury, consult beforehand a Sanken Electric sales representative.
  a. Passenger transportation vehicles b. Medical equipment c. Nuclear reactor and powered control systems
  d. Aerospace applications e. Transportation equipment f. Safety equipment g. Special applications
- When using these products for equipment where failure of these products may cause loss of life or equipment where failure of these products is likely to cause major losses, implement safety measures in the equipment.
- These products required electrical work. Have such work performed by a specialist.

● http://www.sanken-ele.co.jp

SANKEN ELECTRIC CO., LTD.

ISO9001/14001 certified
Sanken Electric products are brought to you only through our stringent quality control and environment control based on the ISO9001 and ISO14001 authentication standards.

■Business product line-up: Switching power supplies,uninterruptible power supplies,motor control inverters, DC power units,high-intensity obstacle lights system,various types of power supply equipment,hybrid ICs,monolithic ICs,Hall ICs,transistors,MOS-FETs,thyristors, rectification diodes,Schottky barrier diodes,light-emitting diodes,and cold-cathode dischage tubes

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•New publication, effective Mar., 2006.
•Specifications are subject to change without notice.
•For typographical reasons, the color tones of the products featured in this brochure may vary from those of the actual products.

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