Fuji Electric

Innovating Energy Technology

High Performance Inverter

FRENIC-Ace New

FRENIC Ace

FUJI INVERTERS

The FRENIC-Ace is the inverter that produces excellent cost-performance; maintains high performance through optimal design. In this way, it can be applied to various machines and devices.

24A1-E-0042

The next generation inverter has arrived

Introducing our New Standard Inverter!

Enjoy a full range of applications

The standard inverter for the next generation, the FRENIC-Ace, can be used in almost any type of application—from fans and pumps to specialized machinery.

3-phase 400V series								
Nominal applied motor [kW]	ND rating		HD rating		HND rating		HHD rating	
	Model	Rated output current	Model	Rated output current	Model	Rated output current	Model	Rated output current
18.5							FRN0059E2S-4□	39A
22			FRN0059E2S-4□	45A	FRN0059E2S-4□	45A	FRN0072E2S-4□	45A
30	FRN0059E2S-4□	59A	FRN0072E2S-4□	60A	FRN0072E2S-4□	60A	FRN0085E2S-4□	60A
37	FRN0072E2S-4□	72A	FRN0085E2S-4□	75A	FRN0085E2S-4□	75A	FRN0105E2S-4□	75A
45	FRN0085E2S-4□	85A	FRN0105E2S-4□	91A	FRN0105E2S-4□	91A	FRN0139E2S-4□	91A
55	FRN0105E2S-4□	105A	FRN0139E2S-4□	112A	FRN0139E2S-4□	112A	FRN0168E2S-4□	112A
75	FRN0139E2S-4□	139A	FRN0168E2S-4□	150A	FRN0168E2S-4□	150A	FRN0203E2S-4□	150A
90	FRN0168E2S-4□	168A	FRN0203E2S-4□	176A	FRN0203E2S-4□	176A		
110	FRN0203E2S-4□	203A						
Rating condition	Overload current rating 120% -1min	Max. ambient temp. 40℃	Overload current rating 150% -1min	Max. ambient temp. 40℃	Overload current rating 120% -1min	Max. ambient temp. 50℃	Overload current rating 150% -1min, 200% -0.5sec	Max. ambient temp. 50℃
Application: Fans, pumps	●				●			
Application: Wire drawing	●				●			
Application: Vertical conveyance			●				●	
Application: Winding machines							●	
Application: Printing machines							●	

Note: The 3-phase 400V 0.1 - 15 kW, 132 kW - 220 kW, 3-phase 200V series, and single-phase 200V will be coming soon.

Type

How to read the model number

FRN ① E 2 S - 4 ②

Series name

FRN	FRENIC Series

①Standard motor (kW)

Code	ND	HD	HND	HHD
0059	30	22	22	18.5
0072	37	30	30	22
0085	45	37	37	30
0105	55	45	45	37
0139	75	55	55	45
0168	90	75	75	55
0203	110	90	90	75

②Destination, specialty items

C	China
A	Asia
E	Europe

External diagram

Fig. A

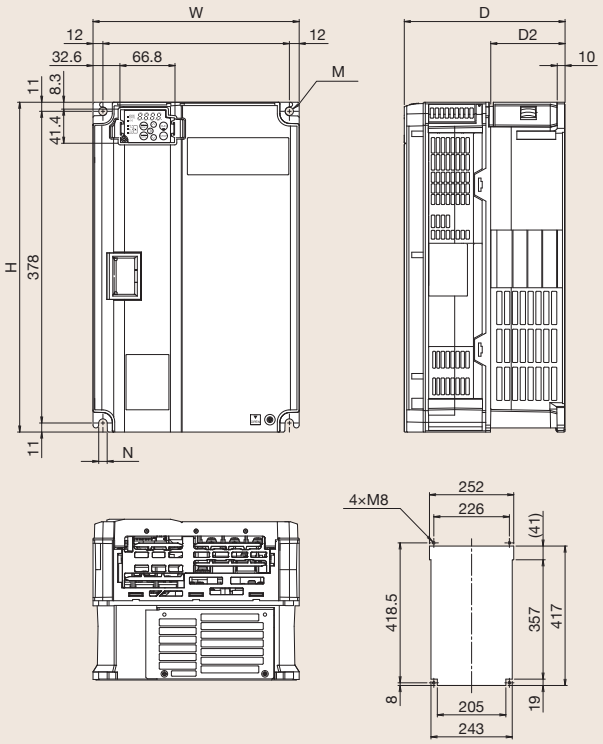
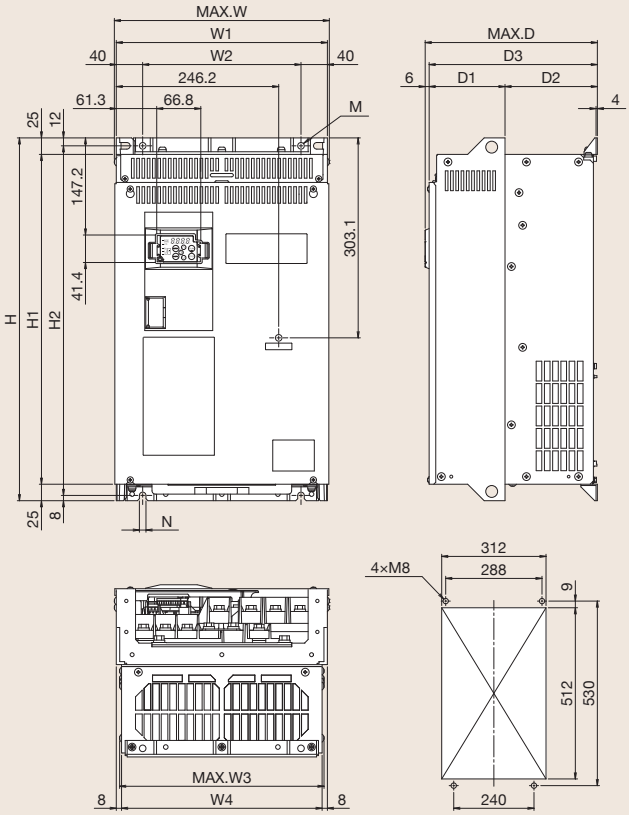


Fig. B



Series	Inverter type	Fig	Dimensions (mm)												
			W	W1	W2	W3	W4	H	H1	H2	D	D1	D2	D3	M	N
Three-phase 400V	FRN0059E2S-4□	A	250	–	–	–	–	400	–	–	195	105	90	–	2× ϕ10	10
	FRN0072E2S-4□															
	FRN0085E2S-4□	B	326.2	320	240	310.2	304	550	530	500	261	115	140	255		
	FRN0105E2S-4□															
	FRN0139E2S-4□		361.2	355	275	345.2	339	615	595	565	276		155	270		
	FRN0168E2S-4□							675	655	625						
	FRN0203E2S-4□							740	720	690						

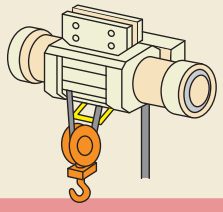
Customizable logic

Customizable logic function is available as a standard feature. FRENIC-Ace has built-in customizable logic functions with a maximum of 100 steps* including both digital and analog operation functions, giving customers the ability to customize their inverters—from simple logic functions to full-scale programming. Fuji also has plans to offer programming templates for wire drawing machines, hoists, spinning machines, and other applications so that the FRENIC-Ace can be used as a dedicated purpose inverter.

Example: Hoist crane application

Programming the FRENIC-Ace main unit with the required logic for controlling a hoist

- (1) Set speed program
- (2) Reset the alarm by using the push-button switch
- (3) Mechanical limit switch function
- (4) Detect load
- (5) Automatic speed drive when no load is detected
- (6) Overload stop function

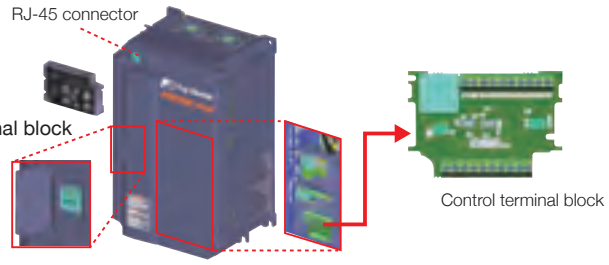
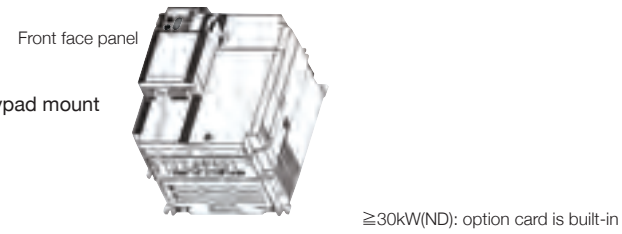


Dedicated/specialized functions for hoist application implemented by using customizable logic

* 200 steps planned for upcoming version upgrade

Superior flexibility (coming soon)

FRENIC-Ace has readily available interface cards and various types of fieldbus / network to maximize its flexibility.

Option	Installation type
PG interface (5V) card PG interface (12/15V) card	
DeviceNet communication card CC-Link communication card PROFIBUS-DP communication card EtherNet/IP communication card ProfiNet-RT communication card CANopen communication card Digital input/output interface card Analog input/output interface card	 ≧30kW(ND): option card is built-in

Wide variety of functions as a standard feature

- Sensorless dynamic torque vector control
- Motor vector control with PG (coming soon / with optional card)
- Synchronous motor with sensorless vector control (coming soon)
- 2-channel on-board RS485 communications port
- Standard CANopen compatibility
- Removable keypad device
- Removable control terminal block board

Multi-function keypad (option)

FRENIC-Ace has two different multi-function keypads available

- Multi-function keypad with LCD display: Enhanced HMI functionality (coming soon)
- USB keypad: Connect to a computer for more efficient operation (set-up, troubleshooting, maintenance, etc)

Multi-function keypad with LCD screen

Functional Safety

FRENIC-Ace is equipped with STO functional safety function as a standard. Therefore output circuit magnetic contactors are not required for safe stop implementation. Enhanced standard features position FRENIC-Ace ahead of its class (Safety input: 2CH, output: 1CH).

■Complies with (coming soon)

EN ISO 13849-1: 2008, Cat.3 / PL=e
IEC/EN 60204-1: 2005/2006 Stop category 0
IEC/EN 61508-1 to -7: 2010 SIL3
IEC/EN 61800-5-2: 2007 SIL3 (Safety feature: STO)
IEC/EN 62061: 2005 SIL3

10 years lifetime design

FRENIC-Ace components have a design life of ten years.
A longer maintenance cycle also helps to reduce running costs.

Design life	Main circuit capacitor		10 years*
	Electrolytic capacitors on PCB		10 years*
	Cooling fan		10 years*
	Life conditions	Ambient temperature	+40°C (104°F)
		Load rate	100% (HHD specifications) 80% (HND/HD/ND specifications)

* ND specifications have a rated current of two sizes higher than HHD specifications, so the life is 7 years.

Standards

■RoHS Directive

Standard compliance with European regulations that limit the use of specific hazardous substances (RoHS)

<Six hazardous substances> Lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyl (PBB), polybrominated biphenyl ether (PBDE)

<About RoHS> Directive 2002/95/EC, issued by the European Parliament and European Council, limits the use of specific hazardous substances in electrical and electronic devices.

Global compliance

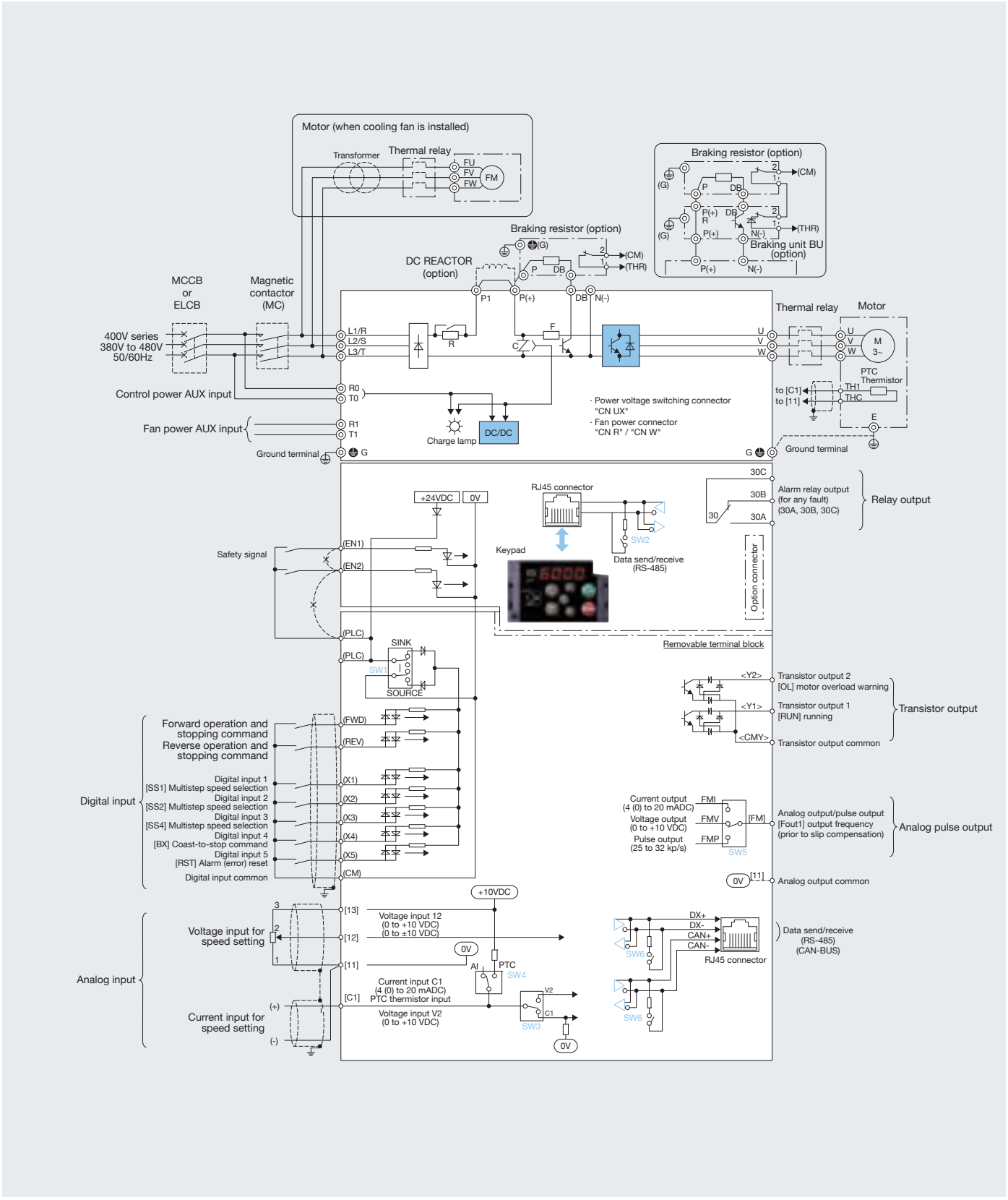
■Standard compliance (cominng soon)

Europe
EC Directives (CE Mark)

North America/Canada
UL Standard (cUL Certified)

Basic wiring diagram

Standard terminal block board model



NOTE	This wiring diagram is to be used as a reference only when using standard terminal block model. When wiring your inverter and/or before applying power, please follow always the connection diagrams and the relevant information written in the User's Manual.

Standard specifications

Item			Specifications						
Type	FRN□□□□E2S-4□		0059	0072	0085	0105	0139	0168	0203
Nominal applied motor [kW] (*1)		ND	30	37	45	55	75	90	110
		HD	22	30	37	45	55	75	90
		HND	22	30	37	45	55	75	90
		HHD	18.5	22	30	37	45	55	75
Output rating	Rated capacity [kVA] (*2)	ND	45	55	65	80	106	128	155
		HD	34	46	57	69	85	114	134
		HND	34	46	57	69	85	114	134
		HHD	30	34	46	57	69	85	114
	Voltage [V] (*3)		Three-phase 380–480V (with AVR function)						
	Rated current [A] (*4)	ND	59.0	72.0	85.0	105	139	168	203
		HD	45.0	60.0	75.0	91.0	112	150	176
		HND	45.0	60.0	75.0	91.0	112	150	176
		HHD	39.0	45.0	60.0	75.0	91.0	112	150
	Overload current rating	HD	150% of rated output current -1 min						
		ND, HND	120% of rated output current -1 min						
		HHD	150% of rated output current -1 min, 200% -0.5s						
Input power	Main power (phase, voltage, frequency)		3-phase 380 to 480V, 50Hz/60Hz						3-phase 380 to 440V, 50Hz 3-phase 380 to 480V, 60Hz
	Voltage/frequency variation		Voltage: +10 to -15% (Voltage unbalance: 2% or less (*7)), Frequency: +5 to -5%						
	Rated current (no DCR) [A] (*5)	ND	77.9	94.3	114	140	—	—	—
		HD	60.6	77.9	94.3	114	140	—	—
		HND	60.6	77.9	94.3	114	140	—	—
		HHD	52.3	60.6	77.9	94.3	114	140	—
	Rated current (with DCR) [A] (*5)	ND	57.0	68.5	83.2	102	138	164	201
		HD	42.2	57.0	68.5	83.2	102	138	164
		HND	42.2	57.0	68.5	83.2	102	138	164
		HHD	35.5	42.2	57.0	68.5	83.2	102	138
	Required power supply capacity (with DCR) [kVA] (*6)	ND	39	47	58	71	96	114	139
		HD	29	39	47	58	71	96	114
		HND	29	39	47	58	71	96	114
		HHD	25	29	39	47	58	71	96
Braking	Braking torque [%] (*7)	ND	12%		5 to 9%				
		HD	15%		7 to 12%				
		HND	15%		7 to 12%				
		HHD	20%		10 to 15%				
	DC braking		Starting frequency: 0.1 to 60.0Hz, Braking time: 0.0 to 30.0s, Braking level: 0 to 100% (HHD specifications), 0 to 80% (HHD/HD specifications), 0 to 60% (ND specifications)						
	Braking transistor		Built-in		Optional				
	Braking resistor		Optional						
DC reactor (DCR)		ND	Optional				Standard		
		HD, HND	Optional					Standard	
		HHD	Optional						Standard
Protective structure (IEC60529)			IP20 closed type, UL open type		IP00 open type, UL open type				
Cooling system			Fan cooled						
Weight [kg]			9.5	10	25	26	30	33	40

*1 "Nominal applied motor" refers to the use of a Fuji Electric 4-pole standard motor.
*2 "Rated capacity" refers to 440V rating
*3 Output voltage cannot exceed the power supply voltage.
*4 Must be reduced if carrier frequency (function code F26) is higher than the following settings.
ND/HD: Model FRN0059E2S-4□ or higher 4 kHz
HND: Model FRN0059E2S-4□; 10kHz: FRN0072E2S-4□ to FRN0168E2S-4□; 6 kHz, FRN0203E2S-4□; 4 kHz
HHD: Model FRN0059E2S-4□ to FRN0168 E2S-4□; 10kHz: FRN0203 E2S-4□; 6 kHz
*5 With a power supply of 500 kVA (if the inverter capacity is over 50 kVA, then 10 times inverter capacity), indicates the calculated value when connected to a %X=5% power supply. When the applied motor has a capacity of 75kW or higher, use a DC reactor.
*6 When DC reactor is connected
*7 Average braking torque value for the motor alone (varies depending on motor efficiency).
*8 Voltage unbalance [%] = (Max. voltage [V] – Min. voltage [V])/Three-phase average voltage [V] × 67 (see IEC/EN 61800-3). Use AC reactor (ACR, optional) for unbalance rates between 2% and 3%.

NOTES

When running general-purpose motors

• Driving a 400V general-purpose motor
When driving a 400V general-purpose motor with an inverter using extremely long cables, damage to the insulation of the motor may occur. Use an output circuit filter (OFL) if necessary after checking with the motor manufacturer. Fuji's motors do not require the use of output circuit filters because of their reinforced insulation.

• Torque characteristics and temperature rise
When the inverter is used to run a general-purpose motor, the temperature of the motor becomes higher than when it is operated using a commercial power supply. In the low-speed range, the cooling effect will be weakened, so decrease the output torque of the motor. If constant torque is required in the low-speed range, use a Fuji inverter motor or a motor equipped with an externally powered ventilating fan.

• Vibration
When the motor is mounted to a machine, resonance may be caused by the natural frequencies, including that of the machine. Operation of a 2-pole motor at 60Hz or more may cause abnormal vibration.
* Study use of tier coupling or dampening rubber.
* It is also recommended to use the inverter jump frequencies control to avoid resonance points.

• Noise
When an inverter is used with a general-purpose motor, the motor noise level is higher than that with a commercial power supply. To reduce noise, raise carrier frequency of the inverter. High-speed operation at 60Hz or more can also result in more noise.

When running special motors

• Explosion-proof motors
When driving an explosion-proof motor with an inverter, use a combination of a motor and an inverter that has been approved in advance.

• Brake motors
For motors equipped with parallel-connected brakes, their braking power must be supplied from the primary circuit (commercial power supply). If the brake power is connected to the inverter power output circuit (secondary circuit) by mistake, problems may occur.
Do not use inverters for driving motors equipped with series-connected brakes.

• Geared motors
If the power transmission mechanism uses an oil-lubricated gearbox or speed changer/reducer, then continuous motor operation at low speed may cause poor lubrication. Avoid such operation.

• Single-phase motors
Single-phase motors are not suitable for inverter-driven variable speed operation. Use three-phase motors.

Environmental conditions

• Installation location
Use the inverter in a location with an ambient temperature range of -10 to 50°C.
The inverter and braking resistor surfaces become hot under certain operating conditions. Install the inverter on nonflammable material such as metal.
Ensure that the installation location meets the environmental conditions specified in "Environment" in inverter specifications.

Combination with peripheral devices

• Installing a molded case circuit breaker (MCCB)
Install a recommended molded case circuit breaker (MCCB) or an earth leakage circuit breaker (ELCB) in the primary circuit of each inverter to protect the wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

• Installing a magnetic contactor (MC) in the output (secondary) circuit
If a magnetic contactor (MC) is mounted in the inverter's secondary circuit for switching the motor to commercial power or for any other purpose, ensure that both the inverter and the motor are fully stopped before you turn the MC on or off. Remove the surge killer integrated with the MC.

• Installing a magnetic contactor (MC) in the input (primary) circuit
Do not turn the magnetic contactor (MC) in the primary circuit on or off more than once an hour as an inverter fault may result. If frequent starts or stops are required during motor operation, use FWD/REV signals.

• Protecting the motor
The electronic thermal facility of the inverter can protect the general-purpose motor. The operation level and the motor type (general-purpose motor, inverter motor) should be set. For high-speed motors or water-cooled motors, set a small value for the thermal time constant to protect the motor.
If you connect the motor thermal relay to the motor with a long cable, a high-frequency current may flow into the wiring stray capacitance. This may cause the relay to trip at a current lower than the set value for the thermal relay. If this happens, lower the carrier frequency or use the output circuit filter (OFL).

• Discontinuance of power-factor correcting capacitor
Do not mount power factor correcting capacitors in the inverter (primary) circuit. Use a DC REACTOR to improve the inverter power factor. Do not use power factor correcting capacitors in the inverter output circuit (secondary). An overcurrent trip will occur, disabling motor operation.

• Discontinuance of surge killer
Do not mount surge killers in the inverter output (secondary) circuit.

• Reducing noise
Use of a filter and shielded wires are typical measures against noise to ensure that EMC Directives are met.

• Measures against surge currents
If an overvoltage trip occurs while the inverter is stopped or operated under a light load, it is assumed that the surge current is generated by open/close of the phase-advancing capacitor in the power system.
We recommend connecting a DC REACTOR to the inverter.

• Megger test
When checking the insulation resistance of the inverter, use a 500V megger and follow the instructions contained in the Instruction Manual.

Wiring

• Wiring distance of control circuit
When performing remote operation, use twisted shielded wire and limit the distance between the inverter and the control box to 20m.

• Wiring length between inverter and motor
If long wiring is used between the inverter and the motor, the inverter will overheat or trip as a result of overcurrent (due to high-frequiency current flowing into the stray capacitance). Ensure that the wiring is shorter than 50m. If this length must be exceeded, lower the carrier frequency or mount an output circuit filter (OFL).
When wiring is longer than 50m, and sensorless vector control or vector control with speed sensor is selected, execute off-line tuning.

• Wiring size
Select cables with a sufficient capacity by referring to the current value or recommended wire size.

• Wiring type
Do not use multicore cables that are normally used for connecting several inverters and motors.

• Grounding
Securely ground the inverter using the grounding terminal.

Selecting inverter capacity

• Driving general-purpose motor
Select an inverter according to the applicable motor ratings listed in the standard specifications table for the inverter. When high starting torque is required or quick acceleration or deceleration is required, select an inverter with a capacity one size greater than the standard.

• Driving special motors
Select an inverter that meets the following condition: Inverter rated current > Motor rated current.

Transportation and storage

When transporting or storing inverters, follow the procedures and select locations that meet the environmental conditions according to the inverter specifications.

Fuji Electric Co., Ltd.

Gate City Ohsaki, East Tower, 11-2,
Osaki 1-chome, Shinagawa-ku,
Tokyo 141-0032, Japan
Phone: +81-3-5435-7057 Fax: +81-3-5435-7420
URL: http://www.fujielectric.com/

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