TOSHIBA

Transistor Inverter

High-performance Inverter TOSVERT™

VF-AS1

Flexible for you

I need the most suitable inverter for my application,
which has low noise, low harmonics,
minimal parameter setting, high torque and control.

We meet all your requirements with VF-AS1.
It has outstanding Performance, including high torque,
fast response, high accuracy and excellent environmental
compatibility with easy operation.
The VF-AS1 is an advanced inverter
evolved to satisfy all your needs
in one comprehensive product.

1

For your Commercial facilities, offices and factories

- Feature: Reduce high-frequency noise[1], Reduce harmonics[1]
  - Applications: Washing machines, Treadmill, Showcase refrigerators, Medical equipment, stage equipment

2

For machinery that requires simple function

- Feature: EASY key, 8 basic parameters
  - Applications: Drilling machines, Handling machines, Conveyors, Semiconductor production Equipment, Cutting machines, Woodworking machinery

3

For machinery that requires high torque and a large capacity

- Feature: Starting torque of 0.3Hz-200%[2], Up to 500kw for a 400V class
  - Applications: Cranes, Mining machinery, refrigerator, Presses, Compressers, Crushing machine

4

For system devices that requires flexibility

- Feature: My function, High-precision and high-speed torque control with or without sensors
  - Applications: Process lines, Printing machines, Coilers/uncoilers

Renewal: "Power Removal" safety function[3]

Built-in Power Removal safety function which complies with EN954-1 category 3 and IEC/EN61508-1 SIL2.
It saves the installation of a line side or motor side contactor.

Conventional Drive — M → Power Removal → VF-AS1 — M
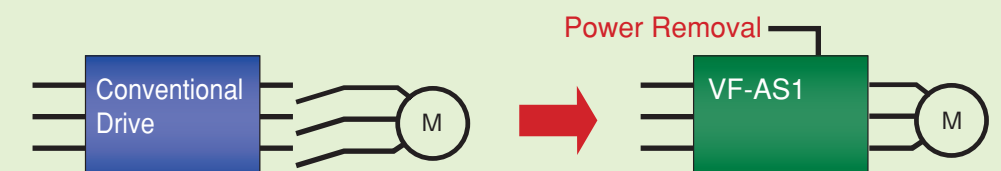
*1 Depends on the voltage and capacity range
*2 When a TOSHIBA standard 3-phase, 0.4 to 3.7kw 4-pole motor are driven
*3 The units with the type-WN1 or WP1 have Power Removal safty function.

High-performance Inverter TOSVERT™

VF-AS1

- Built-in thermal protection function which complies with NEC® 2005
- Comply with SEMI F47(Semiconductor Equipment and Materials International)

Compatible with the World's Main Standards
(CE marking, UL, CSA, C-tick)

* UL and CSA compliancy conditions partially differ from the standard specifications. Consult us separately for details.

ISO-9001 Certification Acquired
This product is designed and manufactured in factories that have acquired certification of "ISO-9001," the international quality assurance standard.

ISO-14001 Certification Acquired
The factories manufacturing this product are ISO-14001, environmental management system, registered factories.

Voltage Class (input/rated output)	Applicable Motor Output (kW)																								
	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	355	400	500
3ø200V/3ø200V																										
3ø400V/3ø400V																										

Up to 5.5kw, 3-phase 200V class can be applied to 1-phase input power supply by using 1 size-up rating

Contents

For your commercial facilities, offices and factories

This makes the inverter ideal for your electronic applications such as washing machines treadmill, showcase refrigerators for stores, medical equipment, and stage equipment where attention must be paid to peripheral devices.

*1:Photos of machinery are for illustrative purposes only.

Point 1 — Harmonics Reduction, Power Factor Improvement

Effect of built-in reactor

Input current

Input current/voltage waveform

Conventional models (400 V, 30 kW)
Input current value 87.6 A
Overall input power factor 59%

VF-AS1 (400 V, 30 kW)
Input current value 58.8 A
Overall input power factor 88%

• A compact, space-saving new type of DC reactor is built into 200 V class 11 to 45 kW and 400 V 18.5 to 75 kW models.
In addition to reducing harmonics, this reactor limits the input current to 110% of the rated output current, and it has been designed to be compatible with power supply systems containing transformers, molded-case circuit breakers, and power lines.
Adding on the optional DC reactor enables compliance with IEC harmonics standards.

Point 2 — High-frequency Noise Reduction

Effect of built-in filter

Example of generated noise data

EN61800-3 1st Environment Category C2

Built-in EMC filter

• High-frequency noise is drastically reduced on models with built-in noise filters. Built-in noise filters are ideal for sites from commercial facilities and offices through to factories where attention must be paid to peripheral devices.

Compared with filter not integrated models, space and wiring savings have been achieved by incorporating the filter in the panel. Also, models with built-in EMC noise filter comply with the European EMC Directive as individual inverter units.

European EMC Directive : IEC/EN61800-3, 1st Environment, C2 (200V-0.4 to 1.5kW / 400V-0.75 to 3.7kW)
or
IEC/EN61800-3, 2nd Environment, C3

200V class models, 0.4 to 7.5kW   : EMI noise filter (complies with the European EMC Directive) built-in standard
200V class models, 11 to 45kW   : Basic noise filter (not complies with the European EMC Directive) built-in standard
400V class models, 0.75 to 75kW : EMI noise filter (complies with the European EMC Directive) built-in standard
400V class models, 90 to 500kW   : EMI noise filter (complies with the European EMC Directive) built-in standard

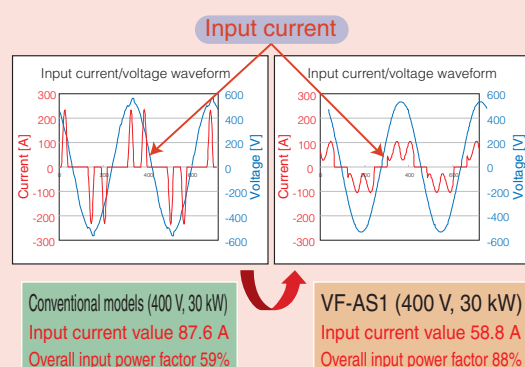# For machinery that requires simple function

This makes the inverter ideal for drilling machines, handling machines, conveyors, semiconductor production equipment, cutting machines, and woodworking machinery that require simple function.

*1:Photos of machinery are for illustrative purposes only.

Point 3 — Simple Setup by EASY Key

EASY key

Quick mode (EASY)

Title	Function
AU4	Parameter setting macro function
Pt	V/f control mode selection
FH	Maximum frequency
ACC	Acceleration time 1
dEC	Deceleration time 1
tHr	Motor overload protection level 1
FM	FM terminal meter adjustment
PSEL	Parameter display selection

• In the Quick mode, pressing the EASY key on the panel allows you to operate the inverter by eight basic parameters.
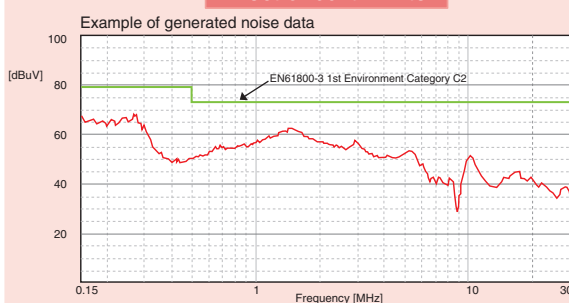When setting each of the functions, press the EASY key to move to the standard mode by one-touch operation. In this mode, you can access all parameters.

• You can customize the Quick mode display, maximum of 32 target parameters are displayed to suit your specific setup requirements.
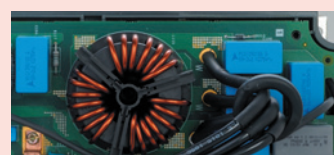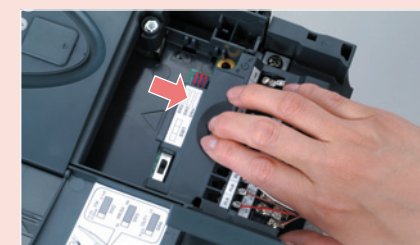
• You can also use the EASY key as a panel/remote key to switch between panel and remote operation, and as a shortcut key to directly access any specific setup or display screen.

Point 4 — Easy Installation, Easy commissioning, and Easy maintenance

Side-by-side installation

Removable control terminal board

Side-by-side installation
• Side-by-side installation of inverters is possible up to the inverter's total capacity. This allows effective utilization of space inside control panels. Heat sink can be installed outside of the panel as an option.

Removable control terminal board
• A removable terminal board is used. This allows you to use the control wiring when replacing the inverter, which also makes maintenance easier.

ON/OFF control of cooling fan
• Temperature-based ON/OFF control reduces noise while the inverter is being stopped, saves energy and extends the cooling fan's life.

Monitoring of serviceable parts/alarm output
• The expected replacement cycle of main circuit capacitors, capacitors on control board, and cooling fan is monitored, and an alarm is output when the cycle is reached.
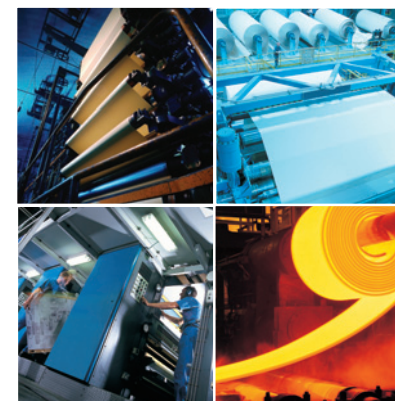
For machinery that reguires high torque and a large capacity

This makes it ideals for cranes, mining machinery, refrigerator, presses, compressers, crushing machine and other machinery that require a high torque and large capacity.

*1: Photos of machinery are for illustrative purposes only.

Point 5 — Excellent Motor Control Performance

Example of torque characteristics

Torque [%]
*1: When a TOSHIBA standard 3-phase, 200 V - 2.2 kW 4-pole motor is driven, (Note, however, that torque differs according to voltage and capacity.)
Speed [min⁻¹]

Speed response to reference changes

Speed recovery response

Fast response

Fast recovery against impact load

- Motor constants required for vector control can be easily set by auto-tuning to enable 1:120 speed control. Moreover, the VF-AS1 also features a robust structure that is unlikely to be influenced by motor temperature.
- On inverters provided with a sensor, high-torque operation of 200%^{*2} from zero velocity is possible, achieving a speed control range of 1:1000.
- High-speed response frequencies of 40 Hz without sensor and 50 Hz with sensor are achieved respectively, to maintain fixed speed in response to sudden changes in load.
- Modifying software enables high-frequency output up to 1000 Hz, which is ideal for spindle rotation of woodworking and metalworking machinery.

*2: When a TOSHIBA standard 3-phase, 0.4 to 3.7 kW 4-pole motor are driven.

Point 6 — Dedicated Functions Ideal for Lifting Applications

Setup by teaching

Brake sequence/light-load, high-speed functions
- The inverter has two built-in functions, the brake sequence function and light-load, high-speed function, as standard. The brake sequence function measures the timing with braking by an external motor to achieve smooth operation at start and stop of braking operation. The light-load, high-speed function automatically increases the speed when operating light loads according to the lifting load to improve conveyance efficiency. A learning function for setting and storing to memory required parameters while performing actual operations is also provided to facilitate adjustments.

Built-in transistor for dynamic braking
- The VF-AS1 has a built-in transistor for dynamic braking up to 160 kW, which makes it ideal for lifting applications.
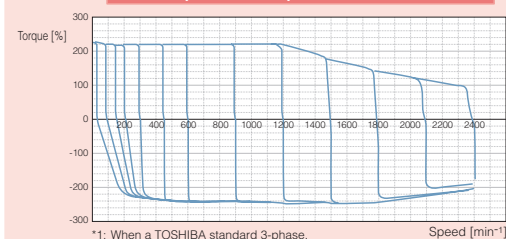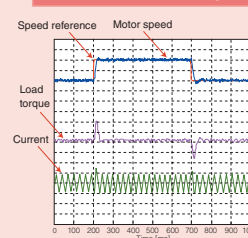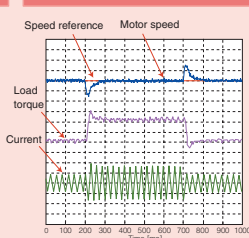
For system devices that requires flexibility

This makes the inverter ideal for process lines, printing machines, coilers/uncoilers.

*1:Photos of machinery are for illustrative purposes only.

Point 7 — Customizing by "My Function"

My function
Number of program steps : 28
Internal relays : 8
Internal counters : 2
Logic commands : ST, STN, AND, ANDN, OR, ORN, SET, RSET, HOLD ON/OFF DELAY TIMER
Data commands : EQ, NE, GT, GE, LT, LE, ASUB

- With "My function", you can create programs containing up to 28 steps. This achieves logic operations and internal data operations. Parameters can also be set according to analog input and minimum-peak hold of analog outputs. For example:
 (Ex.1) Inverter is automatically switched to commercial operation without the external sequence when the inverter is tripped.
  (Ex.2) A signal is output when torque reaches 120% and frequency is 5 Hz.
  (Ex.3) "Forward rotation operation," "preset-speed operation frequency 3" and "No.2 acceleration/deceleration" are simultaneously turned ON by input on a single terminal.
  (Ex.4) The acceleration/deceleration time is changed dynamically by a voltage within the range 0 to 10 V.

Point 8 — Communications and Network

Programmable controller
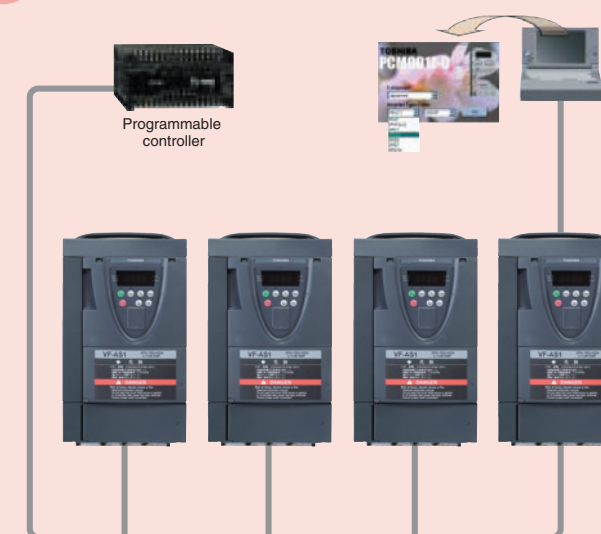
RS-485 communications
- RS-485 communications is equipped as standard, and Modbus-RTU protocol is supported in addition to TOSHIBA protocol.

Network options
- Use of communication options enables support of DeviceNet^{*2}, PROFIBUS and CC-Link^{*3} and other main fieldbuses.

Data tracing
- The PCM001Z communications software allows you to edit, monitor, and trace parameter data on a PC, enabling easier data management from inverter startup through to maintenance.

*2: DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendor Association).

*3: CC-Link is a registered trademark of Mitsubishi Electric Corporation.

For machinery that requires expansion
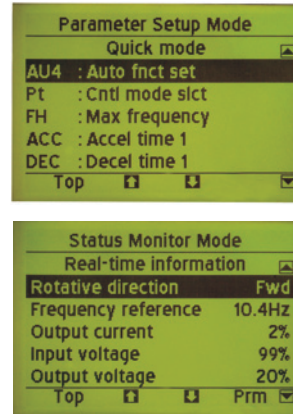
Point 9 — Outstanding Lineup of Options

LCD Extension Panel Option

This panel is an 23-character x 8-line display, and can be used for simple setup and monitoring by selection of parameters using the jog dial. The display language can be switched between English and Japanese. (German, Italian, Spanish, and Chinese will be available soon.)
Type: RKP004Z

Parameter Setup Mode
Quick mode
AU4 : Auto fnct set
Pt : Cnti mode slct
FH : Max frequency
ACC : Accel time 1
DEC : Decel time 1
Top

Status Monitor Mode
Real-time information
Rotative direction   Fwd
Frequency reference   10.4Hz
Output current   2%
Input voltage   99%
Output voltage   20%
Top

* The photograph shows a screen currently in development.

LED Extension Panel Option

Our customers require a "display that is easily visible from a long way away." In response to this need, we developed this panel using 20 mm LEDs, the largest in its class in the market, to ensure outstanding visibility.
It has also been designed to be fitted into panels for use as an extension panel or display.
In addition, it can be used as a parameter copy and is capable of storing parameters for up to three models.
Type: RKP002Z

20mm
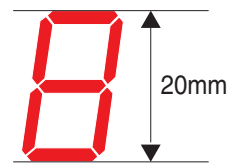
Expanded Terminal Block Option
Fieldbus Option
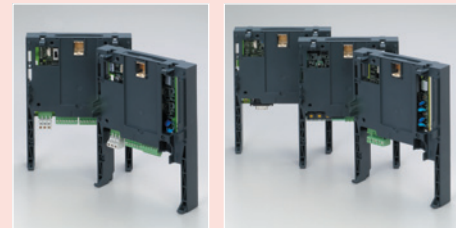
This I/O terminal block can be added on to enhance your system for extra compatibility with a wide range of systems:
• Contact inputs (4) • Contact outputs (2) • Analog inputs (2)
• Analog outputs (2) • PTC input (1) • Relay output (1 circuit)
• Pulse train input (1)
Type: ETB003Z, ETB004Z

Main fieldbuses are supported to enable connection to a host controller to achieve savings in space and centralized control of systems.
• DeviceNet[*1]   • PROFIBUS   • CC-Link[*2]
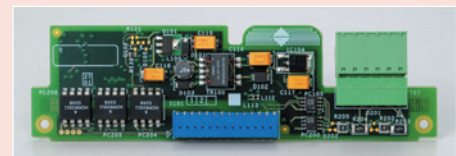Type: DEV002Z   Type: PDP002Z   Type: CCL001Z

[*1] DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendor Association).
[*2] CC-Link is a registered trademark of Mitsubishi Electric Corporation.

Encoder Feedback Option

Three encoder feedback options are provided to match output for support of vector control with a sensor.
• Line driver output (RS-422)   ,Type: VEC007Z
• Open collector/complimentary output (12 V) ,Type: VEC004Z
• Open collector/complimentary output (15 V) ,Type: VEC005Z

Point 10 — Wide Range of Applications

Safety Environmental Compatibility

Ambient temperature 60°C

The VF-AS1 can be used at a rating up to an ambient temperature of 50°C and in environments up to 60°C at a derating current.

Eco Design

88% of materials used on the VF-AS1 are recyclable, which design more than meets of the European WEEE (Waste Electrical and Electronic Equipment) Directive of 70%.

Various Drive Performance

Permanent Magnet Motor (PM) Drive

The PM is driven efficiently by a TOSHIBA oriented control argorithm to achieve savings in energy and space.

High-frequency 1000 Hz Output

Software modification increases output up to a high frequency of 1000 Hz, making it ideal for woodworking and metalworking machinery.

New DC Braking

A newly developed DC braking function allows the stop time to a quarter of that on conventional models.

A Further Enhanced of Functions

Multi-PID Control

As well as process-type PID control (e.g. temperature, pressure, flow rate), the VF-AS1 incorporates speed-type PID control that is compatible with speed feedback, for example, in follow-up operation or winding, for line compatibility with line control.

• Traverse
• Power interruption synchronized control

Two extra controls are achieved, traverse control during rewinding that is mandatory on fabric machinery, and power interruption synchronized control for preventing thread breakage when a power interruption occurs.

• Drooping
• Speed gain switching
• Zero speed lock
• Dwell

Drooping distributes the load of 2-shaft drive on conveyance machinery, for example. Speed gain switching enables adaptation to changes in inertia during operation. Zero speed is hold when the inverter is stopped. And dwell controls acceleration/deceleration, for example, when conveying heavy loads.

Basic functions

Each "setup item" that determines the control characteristics of the inverter is called a "parameter."
For example, to change the acceleration time, you choose the acceleration time parameter (titled " A C C ").

Quick mode (EASY)

To enter the Quick mode, press the EASY key on the panel. In this mode, you can set eight of the basic parameters.

Standard mode

In this mode, you can set all parameters.
For details of parameters, refer to the Instruction Manual.

Title	Function
AU4	Parameter setting macro function
Pt	V/f control mode selection
FH	Maximum frequency
ACC	Acceleration time 1
dEC	Deceleration time 1
tHr	Motor overload protection level 1
Fn	FM terminal meter adjustment
PSEL	Parameter display selection

■ Basic parameters

Title	Function	Adjustment Range	Default
FC	Frequency of operation panel	LL-UL Hz	0

Title	Function	Adjustment Range	Default
AUH	History function		-
AU1	Automatic acceleration/deceleration	0:Deselect 1:Automatic setting 2:Automatic setting (during acceleration only)	0
AU2	Automatic torque boost	0:Deselect 1:Automatic torque boost + auto-tuning 1 2: Sensorless vector control 1+ auto-tuning 1	0
AU4	Automatic function setting	0:Disabled 1:Frequency setting by means of voltage 2:Frequency setting by means of current 3:Voltage/current switching from external terminal 4:Frequency setting on operation panel and operation by means of terminals 5: Frequency setting and operation on operation panel	0
CMOd	Command mode selection	0:Terminal input enabled 1:Operation panel input enabled (including LED/LCD option input) 2:Operation panel RS485 (2-wire) communication input 3:Internal RS485 (4-wire) communication input 4:Communication option input	0
FMOd	Frequency setting mode selection 1	1:VI/II (voltage/current input) 2:RR/S4 (potentiometer/voltage input) 3:RX (voltage input) 4:Operation panel input enabled (including LED/LCD option input) 5:Operation panel RS485 (2-wire) communication input 6:Internal RS485 (4-wire) communication input 7:Communication option input 8:Optional AI1 (differential current input) 9:Optional AI2 (voltage/current input) 10:UP/DOWN frequency 11:RP pulse input 12:High-speed pulse input 13:Binary/BCD input	2
Pt	V/f control mode selection	0:Constant torque characteristics 1:Voltage decrease curve 2:Automatic torque boost 3:Sensorless vector control 1 (speed) 4:Sensorless vector control 2 (speed/torque) 5:V/f 5-point setting 6:PM control 7:PG feedback vector control 1 (speed) 8:Sensorless vector control 2 (speed/torque)	0
ub	Manual torque boost 1	0.0~30.0%	Depends on the capacity
uL	Base frequency 1	25.0~500.0Hz	WN1:60, WP1:50.0
uLu	Base frequency voltage 1	200V class:50~330V 400V class:50~660V	Depends on the capacity
FH	Maximum frequency	30.0~500.0Hz	80.0
UL	Upper limit frequency	0.0~FH Hz	WN1:60.0, WP1:50.0
LL	Lower limit frequency	0.0~UL Hz	0.0
ACC	Acceleration time 1	0.1~6000 sec.	Depends on the capacity
dEC	Deceleration time 1	0.1~6000 sec.	Depends on the capacity
AuF2	RR/S4 input point 2 frequency	0.0~FH Hz	WN1:60.0, WP1:50.0
A1F2	VI/II input point 2 frequency	0.0~FH Hz	WN1:60.0, WP1:50.0
Sr1	Preset speed operation frequency 1	LL-UL Hz	0.0
Sr2	Preset speed operation frequency 2	LL-UL Hz	0.0
Sr3	Preset speed operation frequency 3	LL-UL Hz	0.0
Sr4	Preset speed operation frequency 4	LL-UL Hz	0.0
Sr5	Preset speed operation frequency 5	LL-UL Hz	0.0
Sr6	Preset speed operation frequency 6	LL-UL Hz	0.0
Sr7	Preset speed operation frequency 7	LL-UL Hz	0.0
Fr	Forward run/reverse run selection (operation panel operation)	0:Forward run 1:Forward run 2:Forward run (Forward/reverse switchable on operation panel) 3:Reverse run (Forward/reverse switchable on operation panel)	0
tHr	Motor overload protection level 1	10~100%	100
OLn	Motor overload protection characteristic selection	(Setting / Motor type / Overload protection / OL stall table)	0
dSPU	Current/voltage unit selection	0:%, 1:A (ampere)/V (volt)	0
FMSL	FM terminal meter selection	0~64 (0:Output frequency, 1:Frequency command value, 2:Output current, 3:Input voltage, 4:Output voltage, etc.)	0
Fn	FM terminal meter adjustment	-	-
AMSL	AM terminal meter selection	0~64 (0:Output frequency, 1:Frequency command value, 2:Output current, 3:Input voltage, 4:Output voltage, etc.)	2
Am	AM terminal meter adjustment	-	-
CF	PWM carrier frequency	1.0~16.0kHz (large capacity model 2.5~8.0kHz)	Depends on the capacity
uuS	Auto-restart control selection	0:Deselect 1:At auto-restart 2:ST ON/OFF switching 3:1+2 4:Starting	0
uuC	Regenerative power ride-through control	0:Deselect 1:Power ride-through 2:Deceleration stop during power failure 3:Synchronized deceleration/acceleration (synchronized acceleration/deceleration signal) 4:Synchronized deceleration/acceleration (synchronized acceleration/deceleration signal+power failure)	0
Pb	Dynamic braking selection	0:Deselect 1:Select (braking resistance overload detect) 2:Select (braking resistance overload not detect)	0
Pbr	Dynamic braking resistance	0.5~1000Ω	Depends on the capacity
PbCP	Allowable continuous braking resistance	0.01~600.0kW	Depends on the capacity
tYP	Factory default setting	0: - 1:50 Hz default setting 2:60 Hz default setting 3:Factory default setting 4:Trip cleared 5:Cumulative operation time cleared 6:Type information initialized 7:User-defined parameter recorded 8:Item 7 above reset 9:Cumulative fan operation time cleared 10:Acceleration/deceleration time setting 0.01 sec.~600.0 sec. 11:Acceleration/deceleration time setting 0.1 sec.~6000sec.	0
PSEL	Parameter display selection	0:Standard setting mode at time of activation of motor 1:Quick mode at time of activation of motor 2:Quick mode only	0
F1---F9--	Extended parameters	Set parameters in more detail.	-
Gru	Automatic edit function	-	-

OLn table:
Setting	Motor type	Overload protection	OL stall
0	Standard Motor	(protect)	(not stall)
1		(protect)	(stall)
2		(not protect)	(not stall)
3		(not protect)	(stall)
4	VF Motor	(protect)	(not stall)
5		(protect)	(stall)
6		(not protect)	(not stall)
7		(not protect)	(stall)

■ Extended parameters

About 500 extended parameters are available. For details on extended parameters, please visit our web site (http://www.inverter.co.jp/).

Standard specifications

■ Standard specifications (200 V class - 0.4 to 45 kW, 400 V class -0.75 to 75 kW model)

200 V class

Item		Specification													
Applicable Motor (kW)		0.4	0.75	1.5	2.2	3.7/4.0	5.5	7.5	11	15	18.5	22	30	37	45
Rating	Type	VFAS1–													
	Form	2004PL	2007PL	2015PL	2022PL	2037PL	2055PL	2075PL	2110PM	2150PM	2185PM	2220PM	2300PM	2370PM	2450PM
	Output Capacity (kVA) Note 1)	1.1	1.8	3.0	4.2	6.7	10	13	21	25	29	34	46	55	67
	Output Current (A) Note 2)	3.0 (3.0)	4.8 (4.5)	8.0 (8.0)	11 (10.5)	17.5 (16.6)	27.5 (25.0)	33 (33)	54 (49)	66 (64)	75 (66)	88 (75)	120 (88)	144 (120)	176 (140)
	Output Voltage	3-phase, 200 to 240 V (The maximum output voltage is the same as the input voltage.)													
	Overload Current Rating	150%–1 minute													
Electric Braking	Dynamic Braking Circuit	Built-in													
	Dynamic Breaking Resistor	Compatible with external options													
Power Supply	Voltage/frequency	3-phase, 200 to 240 V – 50/60 Hz													
	Allowable Fluctuation	Voltage +10% - 15% Note 3) Frequency ±5%													
Protective method		IP20 enclosed type (JEM1030)								IP00 open type (JEM1030) Note 4)					
Cooling method		Forced air cooling													
Cooling fan noise (dBA)		43	43	43	55	55	56	58	60	60	60	60	64	64	64
Color		RAL7016													
Built-in Filter		EMI noise filter Note 5)								Basic noise filter Note 6)					
DC Reactor		External option								Built-in					

400 V class

Item		Specification													
Applicable Motor (kW)		0.75	1.5	2.2	3.7/4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Rating	Type	VFAS1–														
	Form	4007PL	4015PL	4022PL	4037PL	4055PL	4075PL	4110PL	4150PL	4185PL	4220PL	4300PL	4370PL	4450PL	4550PL	4750PL
	Output Capacity (kVA) Note 1)	1.8	3.1	4.4	8.0	11	13	21	25	31	37	50	60	72	88	122
	Output Current (A) Note 2)	2.3 (2.3)	4.1 (4.0)	5.8 (4.6)	10.5 (8.6)	14.3 (13)	17.6 (17)	27.7 (25)	33 (32)	41 (37)	48 (38)	66 (53)	79 (60)	94 (75)	116 (93)	160 (120)
	Output Voltage	3-phase, 380 to 480 V (The maximum output voltage is the same as the input voltage.)														
	Overload Current Rating	150%–1 minute														
Electric Braking	Dynamic Braking Circuit	Built-in														
	Dynamic Breaking Resistor	Compatible with external options														
Power Supply	Voltage/frequency	3-phase, 380 to 480 V – 50/60 Hz														
	Allowable Fluctuation	Voltage +10% - 15% Note 3) Frequency ±5%														
Protective method		IP20 enclosed type (JEM1030)								IP00 open type (JEM1030) Note 4)						
Cooling method		Forced air cooling														
Cooling fan noise (dBA)		43	43	43	55	56	56	58	60	60	60	64	64	64	64	64
Color		RAL7016														
Built-in Filter		EMI noise filter Note 5)														
DC Reactor		External option								Built-in						

Note 1) Capacity is calculated at 220V for the 200V models and at 440V for the 400V models.
Note 2) Rated output current when the PWM carrier frequency (parameter CF) is 4kHz or less. The values between parentheses refer to rated output currents when set to 12kHz.
Note 3) ±10% when the inverter is used continuously (load of 100%)
Note 4) Inverters, 18.5kW or greater, do not have wiring port covers. They have large openings, but there is no space to bend the external cables inside the unit. If they are fitted external to the cabinet, please use an optional wiring port cover.
Note 5) Complies with the Europian EMC Directive IEC/EN61800-3, 1st environment, category C2 or IEC/EN61800-3, 2nd environment, category C3
Note 6) Not complies with the European EMC Directive Core and capacities with external filter (optional) : Complies with the Europien EMC Directive.

Standard specifications

■ Standard specifications (200 V class -55 to 75 kW, 400 V class -90 to 500 kW model)

200 V class

Item		Specification	
Applicable Motor (kW)		55	75
Rating	Type	VFAS1–	
	Form	2550P	2750P
	Output Capacity (kVA) Note 1)	84	109
	Output Current (A) Note 2)	221	285
	Output Voltage	3-phase, 200 to 240 V (The maximum output voltage is the same as the input voltage.)	
	Overload Current Rating	150%–1 minute	
Electric Braking	Dynamic Braking Circuit	Built-in	
	Dynamic Breaking Resistor	Compatible with external options	
Power Supply	Voltage/frequency	3-phase, 200 to 240 V – 50/60 Hz	3-phase, 200 to 220 V – 50 Hz 3-phase, 200 to 240 V – 60 Hz
	Allowable Fluctuation	Voltage +10% − 15% Note 3) Frequency ±5%	
Protective method		IP00 open type (JEM1030) Note 4)	
Cooling method		Forced air cooling	
Cooling fan noise (dBA)		61	72
Color		RAL7016	
Built-in Filter		External filter (optional)	
DC Reactor		Attached DC reactor Note 5)	

400 V class

Item		Specification									
Applicable Motor (kW)		90	110	132	160	200	220	280	355	400	500
Rating	Type	VFAS1–									
	Form	4900PC	4110KPC	4132KPC	4160KPC	4200KPC	4220KPC	4280KPC	4355KPC	4400KPC	4500KPC
	Output Capacity (kVA) Note 1)	136	164	197	239	295	325	419	511	578	717
	Output Current (A) Note 2)	179	215	259	314	387	427	550	671	759	941
	Output Voltage	3-phase, 380 to 480 V (The maximum output voltage is the same as the input voltage.)									
	Overload Current Rating	150%–1 minute									
Electric Braking	Dynamic Braking Circuit	Built-in				Compatible with external options					
	Dynamic Breaking Resistor	Compatible with external options									
Power Supply	Voltage/frequency	Note 6)		3-phase, 380 to 440 V – 50 Hz 3-phase, 380 to 480 V – 60 Hz							
	Allowable Fluctuation	Voltage +10% − 15% Note 3) Frequency ±5%									
Protective method		IP00 open type (JEM1030) Note 4)									
Cooling method		Forced air cooling									
Cooling fan noise (dBA)		61	72	73	73	76	76	76	76	76	78
Color		RAL7016									
Built-in Filter		EMI noise filter Note 7)									
DC Reactor		Attached DC reactor Note 5)									

Note 1) Capacity is calculated at 220V for the 200V models and at 440V for the 400V models.
Note 2) Indicates the value when the PWM carrier frequency (parameter $\mathcal{LF}$) is 2.5 kHz or less.
　　　　When low noise (PWM carrier frequency 8 kHz) is required at 18.5 kW or more, use an inverter of capacity one rank higher than the motor capacity.
Note 3) ±10% when the inverter is used continuously (load of 100%)
Note 4) Inverters, 18.5kW or greater, do not have wiring port covers. They have large openings, but there is no space to bend the external cables inside the unit. If they are fitted
　　　　external to the cabinet, please use an optional wiring port cover.
Note 5) For 200V-55kW, 400V-90kW or larger model, be sure to install DC reactor.
　　　　However, this is unnecessary for DC input specifications.
Note 6) Three-phase 380~480V-50/60Hz for 4900PC
Note 7) Complies with the European EMC Directive
　　　　IEC/EN61800-3, 2nd environment, category C3

■ Common Specifications

Item			Specification
Control specifications	Control system		Sinusoidal PWM control
	Output voltage adjustment		Main circuit voltage feedback control. (Switchable between automatic adjustment/fix/control off)
	Output frequency range		Setting between 0.01 to 500Hz. Default max. frequency is set to 0.01 to 60Hz. Maximum frequency adjustment (30 to 500Hz)
	Minimum setting steps of frequency		0.01Hz: operation panel input (60Hz base), 0.02Hz: analog input (60Hz base, 11 bit/0 to 10Vdc)
	Frequency accuracy		Within ±0.2% (25°C±10°C): analog input ±0.01% (25°C±10°C): digital input
	Voltage/frequency characteristics		V/f constant, square reduction torque control, automatic torque boost, vector calculation control, base frequency adjustment 1, 2, 3, and 4 (25 to 500Hz), V/F 5-point arbitrary setting, torque boost adjustment (0 to 30%), start frequency adjustment (0 to 10Hz), stop frequency adjustment (0 to 30Hz)
	Frequency setting signal		3kΩ potentiometer (possible to connect to 1 to 10kΩ-rated potentiometer) 0 to 10Vdc (input impedance Zin: 30kΩ) 0 to ±10Vdc (Zin: 22kΩ) 4 to 20mAdc (Zin:242Ω)
	Terminal board base frequency		The characteristic can be set arbitrarily by two-point setting. Compliant with 6 types of input; analog input (RR, VI/II, RX, RX2), pulse input and binary/BCD input (*RX2, binary/BCD input: optional)
	Frequency jump		3 places. Setting of jump frequency and width.
	Upper and lower limit frequencies		Upper limit frequency: 0 to max. frequency, lower limit frequency: 0 to upper limit frequency
	PWM carrier frequency		200V-45kW or less, 400V-75kW or less : adjustable between 1.0 to 16kHz 200V-55kW or more, 400V-90kW or more : adjustable between 2.5 to 8kHz
	PID control		Adjustment of proportional gain, integral time, differential time and delay filter
	Torque control		Voltage command input specification: DC 0 to ±10V
Operation specifications	Acceleration/deceleration time		0.01 to 6000 sec. Selectable from among acceleration/deceleration. times 1, 2, 3 and 4. Automatic acceleration/deceleration function. S-pattern acceleration/deceleration 1 and 2 pattern adjustable.
	DC braking		Adjustment of braking start frequency (0 to 120Hz), braking (0 to 100%) and braking time (0 to 10 sec.). With emergency stop braking function and motor shaft fix control function.
	Forward run/reverse run Note 1)		With F-CC closed to forward run, with R-CC closed to reverse run, with both closed to stop. With ST-CC opened to coast stop. Emergency stop by panel operation or terminal board.
	Jog run Note 1)		Jog mode, if selected, allows jog operation from the operation panel Jog run operation by terminal board is possible by setting the parameters.
	Preset speed operation Note 1)		By changing the combination of open/close between S1, S2, S3, RR/S4-CC, set frequency + 15-speed operation. Selectable between acceleration/deceleration time, torque limit and V/f by set frequency.
	Retry		Capable of restarting after a check of the main circuit elements in case the protective function is activated. Max. 10 times selectable arbitrarily. Waiting time adjustment (0 to 10 sec.)
	Soft stall		Automatic load reduction control at overloading. (Default: OFF)
	Cooling fan ON/OFF		The cooling fan will be stopped automatically to assure long life when unnecessary.
	Operation panel key operation ON/OFF control		Key prohibition selectable between Stop key only, Mode key only, etc. All key operations can be prohibited.
	Regenerative power ride-through control		Possible to keep the motor running using its regenerative energy in case of a momentary power failure. (Default: OFF)
	Auto-restart operation		Possible to restart the motor in coasting in accordance with its speed and direction. (Default: OFF)
	Simplified pattern operation		Possible to select each 8 patterns in 2 groups from 15-speed operation frequency. Max. 16 types of operation possible. Terminal board operation/repeat operation possible.
	Commercial inverter switching		Possible to switch operation by commercial power source or inverter
	Light-load high-speed operation		Increases the operating efficiency of the machine by increasing the rotational speed of the motor when it is operated under light load.
	Drooping function		When two or more inverters are used to operate a single load, this function prevents load from concentrating on one inverter due to unbalance.
	Override function		External input signal adjustment is possible to the operation frequency command value.
Protective function	Protective function		Stall prevention, current limit, overcurrent, overvoltage, short circuit on the load side, ground fault on the load side (Note 5), undervoltage, momentary power failure (15ms or more), non-stop control at momentary power failure, overload protection, arm overload at starting, overcurrent on the load side at starting, overcurrent and overload at dynamic braking resistance, fin overheat, emergency stop
	Electronic thermal characteristic		Switchable between standard motor/constant torque VF motor, adjustment of overload protection and stall prevention level.
	Reset		Reset by 1a contact closed (or 1b contact opened), or by operation panel. Or power source OFF/ON. This function is also used to save and clear trip records.
Display functions	4-digit and 7-segment LED	Alarms	Stall prevention during operation, overload limit, overload, undervoltage on power source side, DC circuit undervoltage, setting error, in retry, upper limit, lower limit.
		Causes of failures	Overcurrent, overvoltage, fin overheat, short circuit on the load side, ground fault on the load side, inverter overload, arm overcurrent at starting, overcurrent on the load side at starting, EEPROM error, RAM error, ROM error, transmission error, (dynamic braking resistor overcurrent/overload), (emergency stop), (undervoltage), (low current), (overtorque), (motor overload), (output phase failure) The items in the parentheses are selectable.
		Monitoring function	Operation frequency, operation frequency command, forward run/reverse run, output current, DC voltage, output voltage, compensated frequency, terminal board input/output information, CPU version, control EEPROM version, past trip history, cumulative operation time, speed feedback, torque, torque command, torque current, exiting current, PID feedback value, motor overload factor, inverter overload factor, PBR overload factor, PVBR load factor, input power, output power, peak output current, peak DC voltage, Motor counter pseudo PG, position pulse, RR input, VI/II input, RX input, RX2 input, FM output, AM output, meter adjustment fix output, flash memory version, main circuit EEPROM version, types of connection option, previous default setting, previous automatic control (AU2)
		Free unit display	Display of optional units other than output frequency (motor speed, line speed, etc), current ampere/% switch, voltage volt/% switch
		Automatic edit function	Searches automatically parameters that are different from the standard default setting parameters. Easy to find changed parameters.
		User default setting	User parameter settings can be saved as default settings. Allows to reset the parameters to the user-defined parameter settings.
	LED	Charge display	Displays main circuit capacitor charging.
	Input/output terminal input function		Possible to select positive logic or negative logic with programmable input/output terminal function menu. Note 1) Note 2) (Default setting: positive logic)
	Sink/source switching		Possible to switch between minus common (CC) and plus common (P24) for control terminal. (Default setting: minus common (CC))
Output signal	Failure detection signal		1c contact output (250Vac-2A-cosΘ=1, 250Vac-1A-cosΘ=0.4, 30Vdc-1A)
	Low speed/speed reach signal output Note 2)		Open collector output (24Vdc, max. 50mA, output impedance: 33Ω)
	Upper/lower limit frequency signal output Note 2)		Open collector output (24Vdc, max. 50mA, output impedance: 33Ω)
	Output for frequency meter/output for ammeter Note 3)		Analog output. 1mAdc full-scale DC ammeter or 7.5Vdc-1mA voltmeter
	Pulse train frequency output		Open collector output (24Vdc, max. 50mA)
	Communication function		RS-485 standard 2-channel equipped (connector: modular 8P)CC-Link, DeviceNet and PROFIBUS-DP are optional.
Environments	Operating environments		Indoor use. Altitude: 3000m or less (current reduction necessary if 1000m or more.) Place not exposed to direct sunlight and free of corrosive and explosive gases.
	Ambient temperature		-10 to +60°C (Remove the upper cover if 40°C or more, max. 60°C) Note 4)
	Storage temperature		-25 to +70°C
	Relative humidity		20 to 93% (free from condensation)
	Vibration		5.9m/s²(0.6G) or less (10 to 55Hz) (Compliant with JIS C60068-2-6)

Note 1) 16 contact input terminals (of which 8 are options) are programmable contact input terminals, and they make it possible to arbitrarily select from 136 types of signals.
Note 2) Programmable ON/OFF output terminals make it possible to arbitrarily select from 150 types of signals.
Note 3) Programmable analog output terminals make it possible to arbitrarily select from 55 types of signals.
Note 4) When using inverters where the ambient temperature will rise above 50°C, remove the upper cover and operate each inverter at a current lower than the rated one.
Note 5) This function protects inverters from overcurrent due to output circuit ground fault.

External dimensions

■ **200 V class - 0.4 to 55 kW, 400 V class -0.75 to 90 kW model**

Figure A
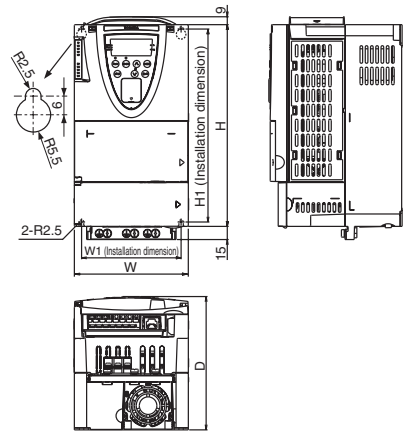
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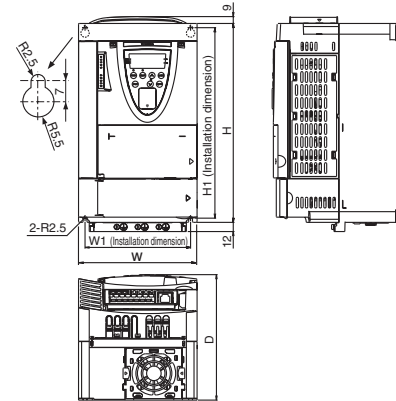
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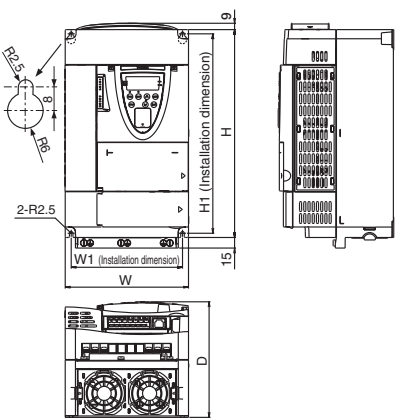
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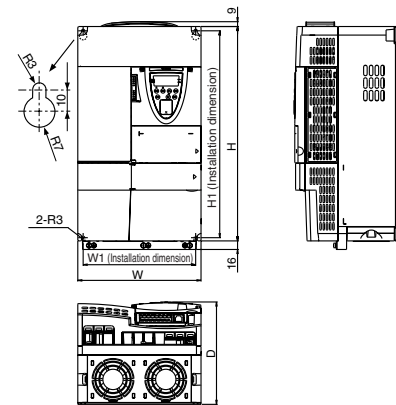
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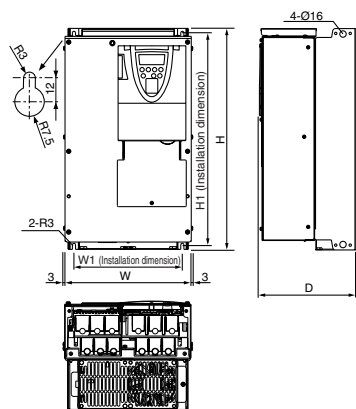
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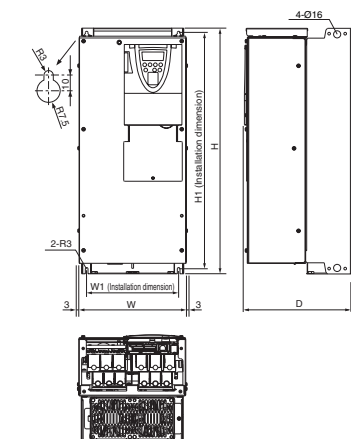
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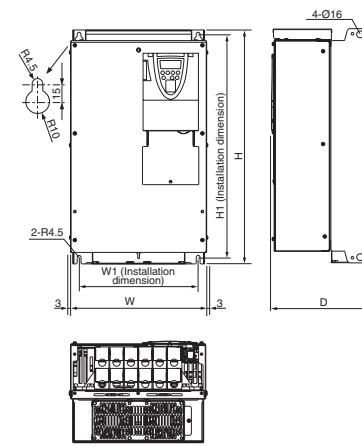
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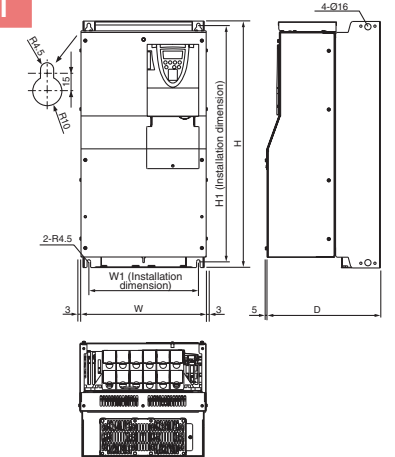
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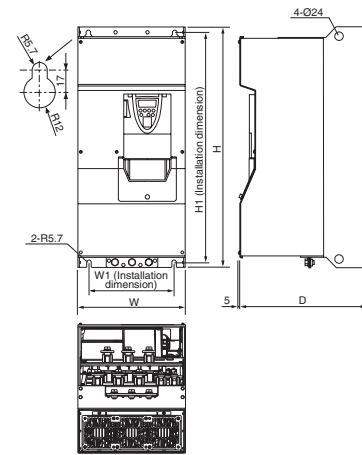
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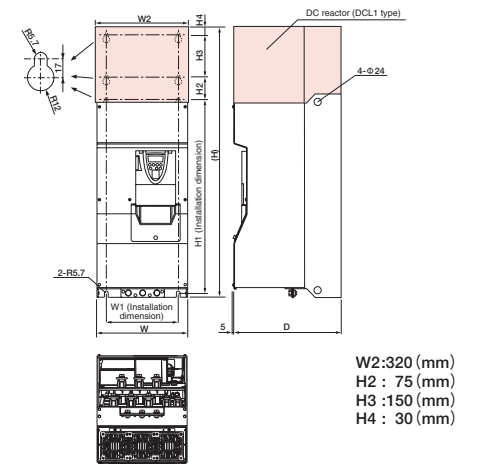
W2 :320（mm）
H2 : 75（mm）
H3 :150（mm）
H4 : 30（mm）

Input Voltage Class	Applicable Motor (kW)	Inverter Type	Dimensions (mm)					External Dimension Drawing	Approx. Weight (kg)
			W	H	D	W1	H1		
200V	0.4	VFAS1-2004PL	130	230	152	114	220	A	3
	0.75	VFAS1-2007PL							3
	1.5	VFAS1-2015PL							3
	2.2	VFAS1-2022PL	155	260	164	138	249	B	4
	3.7/4.0	VFAS1-2037PL							4
	5.5	VFAS1-2055PL	175	295	164	158	283	C	5.5
	7.5	VFAS1-2075PL	210	295	191	190	283	D	7.5
	11	VFAS1-2110PM	230	400	191	210	386	E	14
	15	VFAS1-2150PM							14
	18.5	VFAS1-2185PM	240	420	212	206	403	F	21
	22	VFAS1-2220PM							21
	30	VFAS1-2300PM	320	550	242	280	525	H	41
	37	VFAS1-2370PM							41
	45	VFAS1-2450PM							41
	55	VFAS1-2550P	310	680（920）	370	250	650	J（J'）	59（87）
400V	0.75	VFAS1-4007PL	130	230	152	114	220	A	3
	1.5	VFAS1-4015PL							3
	2.2	VFAS1-4022PL							3
	3.7/4.0	VFAS1-4037PL	155	260	164	138	249	B	4
	5.5	VFAS1-4055PL	175	295	164	158	283	C	5.5
	7.5	VFAS1-4075PL							5.5
	11	VFAS1-4110PL	210	295	191	190	283	D	8
	15	VFAS1-4150PL	230	400	191	210	386	E	13
	18.5	VFAS1-4185PL							16
	22	VFAS1-4220PL	240	420	212	206	403	F	21
	30	VFAS1-4300PL	240	550	242	206	529	G	29
	37	VFAS1-4370PL							29
	45	VFAS1-4450PL	320	630	290	280	605	I	48
	55	VFAS1-4550PL							48
	75	VFAS1-4750PL							48
	90	VFAS1-4900PC	310	680（920）	370	250	650	J（J'）	59（89）

Note) Value in (　) includes attached DC reactor.

External dimensions

■ 200 V class - 75 kW, 400 V class - 110 to 500 kW model
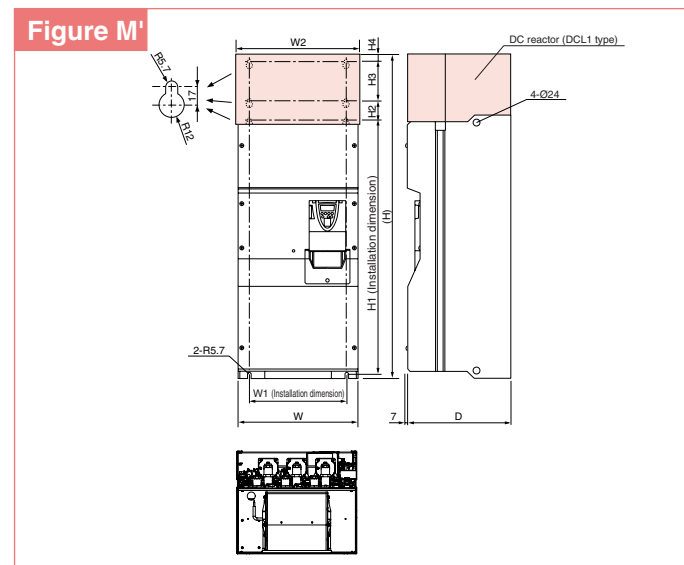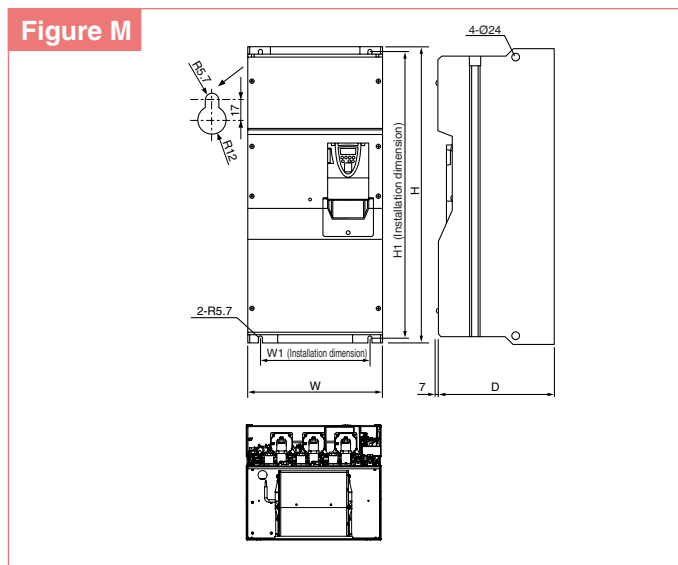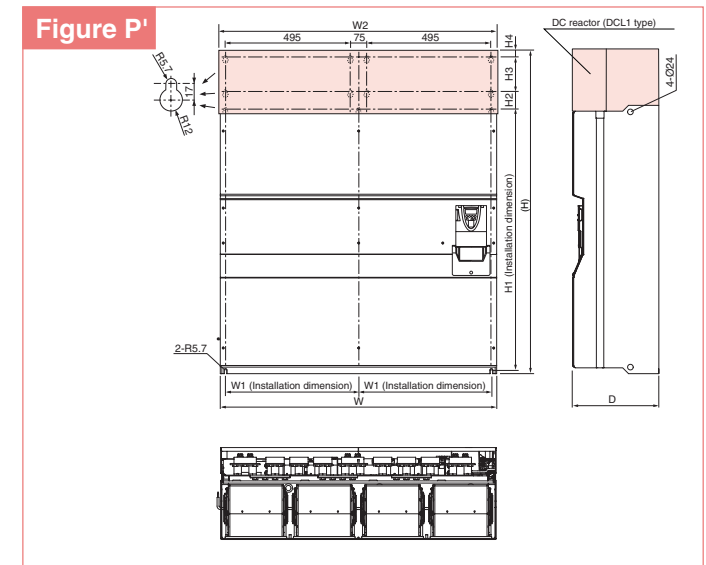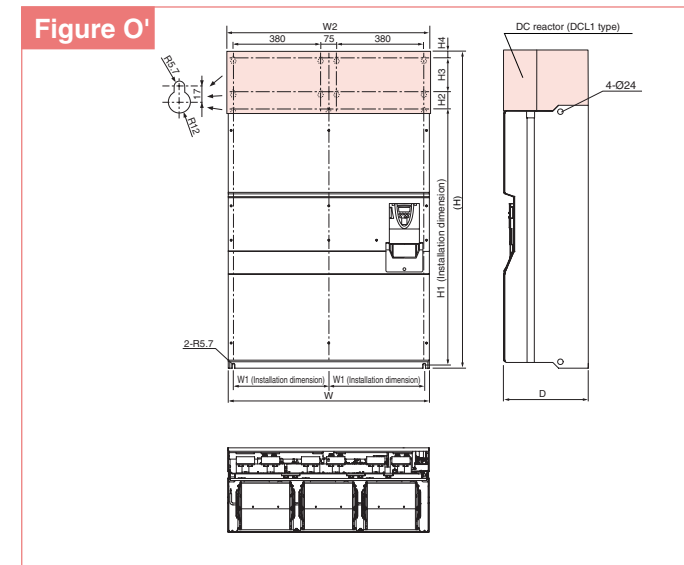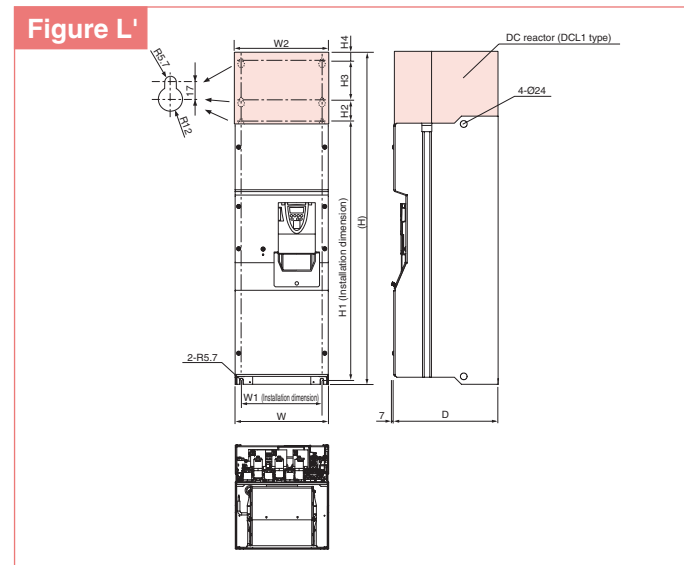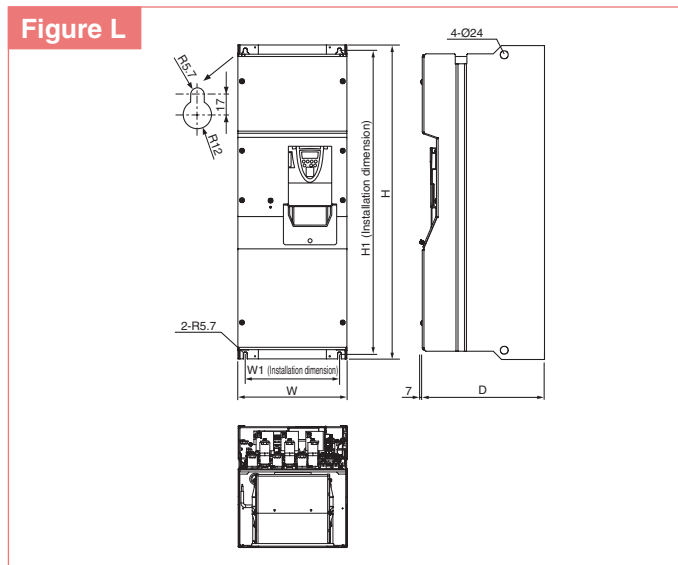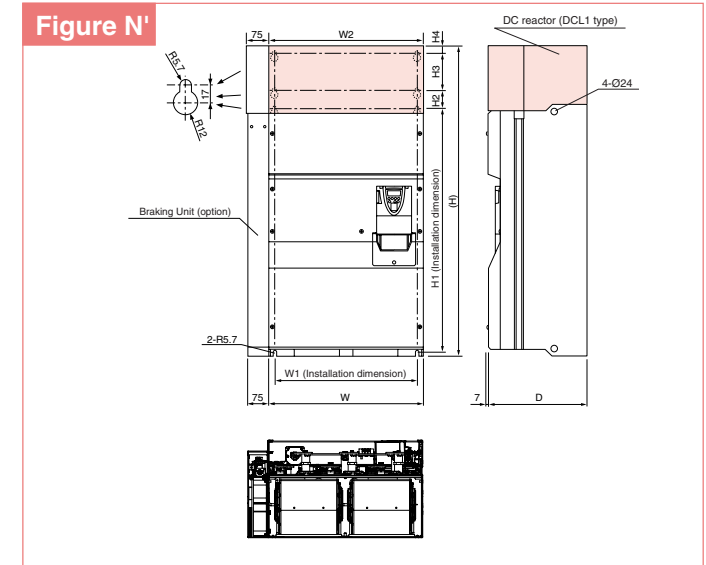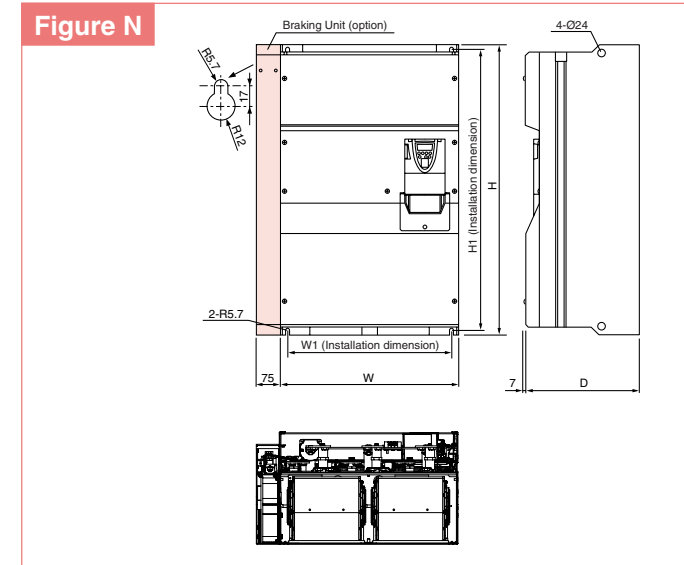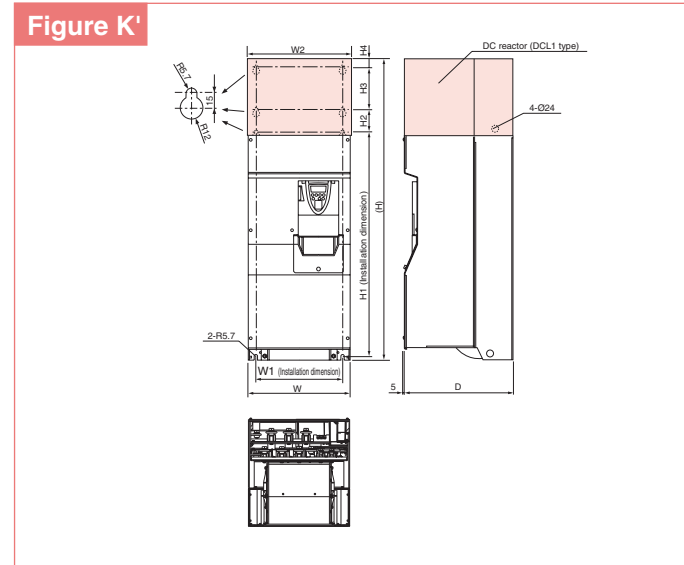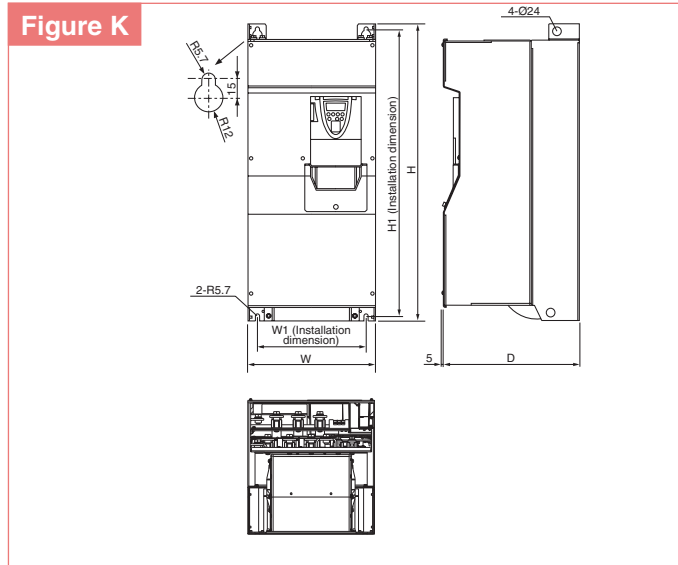
Figure K

Figure K'

Figure N

Figure N'

Figure L

Figure L'

Figure O'

Figure P'

Figure M

Figure M'

Input Voltage Class	Applicable Motor (kW)	Inverter Type	Dimensions (mm)										External Dimension Drawing	Approx. Weight (kg)
			W	H	D	W1	H1	W2	H2	H3	H4		
200V	75	VFAS1-2750P	350	782 (1022)	370	298	758	360	72	150	30	K (K')	72 (103)
400V	110	VFAS1-4110KPC	350	782 (1022)	370	298	758	360	72	150	30	K (K')	74 (108)
	132	VFAS1-4132KPC	330	950 (1190)	370	285	920	340	75	150	30	L (L')	82 (118)
	160	VFAS1-4160KPC	430	950 (1190)	370	350	920	440	75	150	30	M (M')	104 (161)
	200	VFAS1-4200KPC	585	950 (1190)	370	540	920	595	75		150	30	N (N')	134 (194)
	220	VFAS1-4220KPC												136
	280	VFAS1-4280KPC												(204)
	355	VFAS1-4355KPC	880	1150 (1390)	370	418	1120	890	75	150	30	(O')	260 (370)
	400	VFAS1-4400KPC												
	500	VFAS1-4500KPC	1108	1150 (1390)	370	533	1120	1120	75	150	30	(P')	330 (462)

Note) Value in ( ) includes attached DC reactor .

Standard connection diagrams

■ Standard connection diagram : Sink logic (common : CC)

Main circuit power supply

200V class:
0.4～75kW   3-phase, 200 to 240V-50/60Hz
400V class:
0.75 to 90kW   3-phase, 380 to 240V-50/60Hz
110 to 500kW   3-phase, 380 to 440V-50Hz
                3-phase, 380 to 480V-60Hz

VF-AS1

Forward run signal
Reverse run signal
Reset
Preset speed 1
Preset speed 2
Preset speed 3
Common

Factory default settings

Voltage signal:-10～+10V
Voltage signal:0～10V or curent signal:4(0)～20mA

Ammeter or voltmeter   External potentiometer (or voltage signal between RR/S4 and CCA:0～10V)

＊1：The inverter is shipped with the terminals PO and PA/+ shorted with a bar (200V-45kW or amaller, 400V-75kW or smaller).
    Remove this shorting bar when installing a DC reactor (DCL). For 200V-55kW or more, and 400V-90kW or more models, be sure to install the DC rector.
＊2：The DC reactor is built in for models 200V-11kW～45kW and 400V-18.5kW～75kW.
＊3：The noise filter is built in for models 200V-45kW or smaller and all of 400V.
＊4：External braking resistor (option). Dynamic braking drive circuit built-in (GTR7)as standard for models 160kW or smaller.
＊5：Power generation braking Unit (option).when the external braking resistor (optional) is used on 200kW or more models, the separate power braking unit (optional) is required.
＊6：To supply a DC power, connect the cables to the PA/+ and PA/- terminals.
＊7：If want to use DC power supply to operate the inverter (200V: 18.5kW or more, 400V: 22kW or more), be sure to contact
    your supplier customer support center, because an inrush current limiting circuit is required in such a case.
＊8：For models 200V-75kW and 400V-110kW or larger, three-phase power input is necessary to drive the fan if you want to use a DC power supply.
＊9：The functions assigned to terminals OUT1. VI/II and RR/S4 can be swiched by changing parameter settings.
＊10：To supply control power from an external power supply for backing up the control power supplied from the inverter. an
     optional control power backup device (CPS002Z) is required, Insuch a case , the backup device is used at the same time with the
     internal power supply of the inverter. The optional control power backup unit can be used with both 200V and 400V models.
＊11：The rating of 400V-355 to 500kW have the double terminals of R/L1, S/L2, T/L3 for power input, and PO for DC reactor. Please refer the following figure for the wiring.

Main circuit power source
355～500kW Three-phase 380～440V-50Hz
        Three-phase 380～480V-60Hz
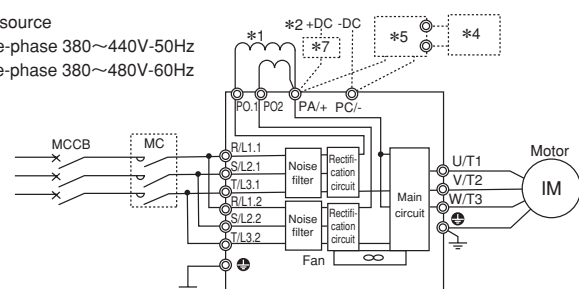
■ Standard connection diagram : Source logic (common : P24)

Terminal functions

■ Main circuit terminal

Terminal Symbol	Terminal Function
⏚	Grounding terminal for inverter casing
R/L1, S/L2, T/L3	200V class: 0.4~75kW Three-phase 200~240V-50/60Hz 400V class: 0.75~90kW Three-phase 380~480V-50/60Hz / 110~500kW Three-phase 380~440V-50Hz Three-phase 380~480V-60Hz (355 to 500kW have the double terminals)
U/T1, V/T2, W/T3	Connect to a (3-phase induction) motor.
PA/+, PB	Connect a braking resistor. (For the optional dynamic braking unit, connect it between PA/+ and PC/-.) Change the parameters Pb, Pbr and $PbCP$ if necessary. 200kW models and smaller are not equipped with terminal PB. If your are using such a model and you wish to use a braking resistor, you will need to purchase a braking unit separately.
PC/-	This is a negative potential terminal in the internal DC main circuit. DC common power can be input across the PA/+ terminals (positive potential).
PO, PA/+	Terminals for connecting a DC reactor (DCL: optional external device). Shorted by a short bar when shipped from the factory (200V: 45kW or smaller, 400V: 75kW or smaller). Before installing DCL, remove the short bar. (355 to 500kW have the double terminals of PO)
RO, SO, TO	200V class: 75kW 400V class:110kW~500kW Inverter's cooling power input terminals. When using a DC power supply, connect three-phase power cables.

■ Control circuit terminal

The terminal function settings can be changed according to the application.
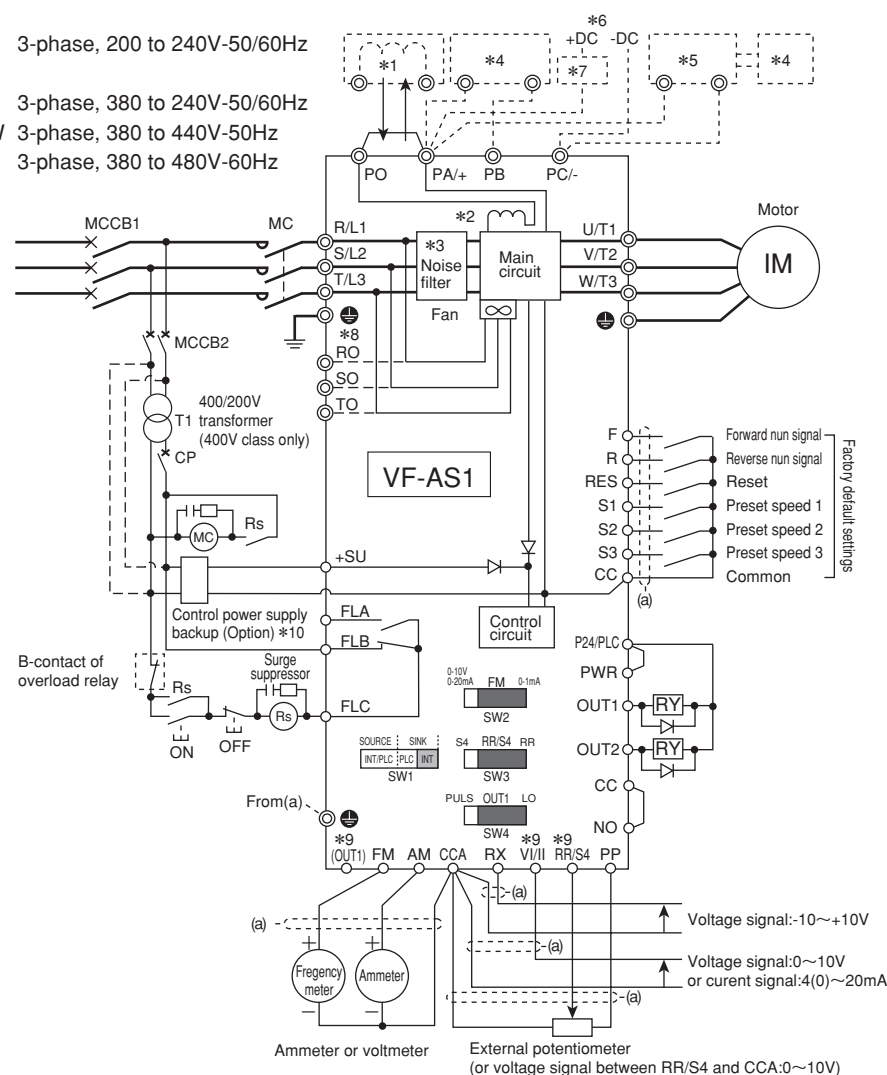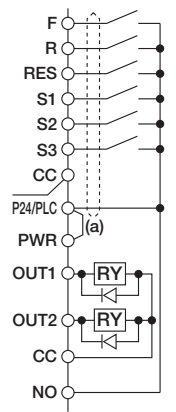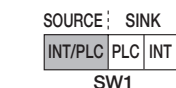
Terminal Symbol	Input/output		Function	Electrical Specifications
F	Input	Multifunction programmable contact input	Shorting across F-CC causes forward rotation; open causes deceleration stop. (Across ST-CC is short state.)	Voltage free contact input 24Vdc-5mA or less
R	Input		Shorting across R-CC causes reverse rotation; open causes deceleration stop. (Across ST-CC is short state.)	Lan current signal. Choose low current contacts to avoid poor attaching.
RES	Input		Shorting and then opening RES-CC cancels the status held by an inverter protective function. When the inverter is operating normally, shorting and then opening RES-CC produces no effect.	* Sink/source selectable with SW1 Sink input Source input ON : Less than DC10V ON : DC11V or more OFF : DC16V or more OFF : Less than DC5V
S1	Input		Shorting across S1-CC causes preset speed operation.	Note:
S2	Input		Shorting across S2-CC causes preset speed operation.	Even when an external power supply is used (in sink logic mode, i.e., when SINK (PLC) is selected), connect the reference potential-side (0V side) cable from the power supply to the CC terminal.
S3	Input		Shorting across S3-CC causes preset speed operation.	
RR/S4	Input		SW3: When SW4 is in the S4 position, S4 and CC are shorted and preset speed operation is selected.	
P24/PLC	Output		24Vdc power output (when SW1 is in any position other than PLC) 24V internal output terminal	24Vdc-200mA
	Input		If SW1 is turned to the PLC position, this terminal can be used as a common terminal when an external power supply is used.	—
CC*1	Common to input/output		Digital signal equipotential (0V) terminal for the control circuit and equipotential (0V) terminal for an optional control power backup.	—
PP	Output		Analog input setting power output	10Vdc (Permissible load current:10mAdc)
PWR*2	Input		If P24/PLC and PWR are short-circuited, the motor is put into a standby state. And if the circuit between them is opened, the motor coasts and stops. These terminals can be used for interlock. This terminal is not a multifunction programmable input terminal. It is a terminal with the power removal safety function that complies with EN954-1 category 3 and IEC/EN61508-1 SIL II.	Regardless of the setting of SW1 ON : DC17V or more OFF: Less than DC2V (OFF: Coast stop)
RR/S4	Input		SW3: Multifunction programmable analog input terminal when SW4 is in the RR position. Standard default setting:0~10Vdc input and 0~60Hz frequency.	10Vdc (Internal impedance:30 kΩ)
VI/I I	Input		Multifunction programmable analog input.Standard default setting: 0~10Vdc input and 0~60Hz frequency. This terminal can also be used as a 4-20mAdc (0-20mAdc) input terminal, if the parameter $F108$ set to 1.	10Vdc (Internal impedance:30 kΩ) 4~20mA (Internal impedance:242Ω)
RX	Input		Multifunction programmable analog input. Standard default setting:0~±10Vdc input and 0~60Hz frequency.	10Vdc (Internal impedance:22 kΩ)
FM	Output		Multifunction programmable analog output. Standard default setting: output frequency Connect a 1mAdc full-scale ammeter or 7.5Vdc (10Vdc)-1mA full-scale voltmeter. This terminal can also be used as a 0-20mAdc (4-20mA) terminal, if the parameter $F681$ set to 1 and the SW2 switch is set to OFF.	1mA full-scale DC ammeter or 7.5Vdc-1mA full-scale DC voltmeter 0-20mA (4-20mA) Full-scale DC ammeter
AM	Output		Multifunction programmable analog output. Standard default setting: output current Use this terminal to connect a 1mAdc full-scale ammeter or 7.5Vdc (10Vdc)-1mA full-scale voltmeter.	1mA full-scale DC ammeter or 7.5Vdc-1mA full-scale DC voltmeter
OUT1	Output		Multifunction programmable open collector output. The default setting is to output a signal when output low speed threshold has been reached. Depending on the SW4 setting, pulses are output with frequencies of 1.00kHz to 43.20kHz. Standard default setting:3.84kHz	Open collector output 24Vdc-50mA
OUT2			Multifunction programmable open collector output. By default, it is set to output a signal indicating the completion of acceleration or deceleration.	
NO			Digital output signal equipotential (0V) terminal for the control circuit. It is insulated from the CC terminal.	*Sink logic/source logic switchable
CCA*1	Common to input/output		Analog input/output signal equipotential (0V) terminal for the control circuit.	—
+SU	Input		DC power input terminal for operating the control circuit. Connect a control power backup device (optional) between +SU and CC.	Voltage:24Vdc±10% Use a power supply with a current rating of 1.1A or more.
FLA FLB FLC	Output		Relay contact output. Contact rating Used to detect the activation of the inverter's protective function. Contact across FLA-FLC is closed and FLB-FLC is opened during protection function operation.	250Vac-2A 30Vdc-1A :at resistance load 250Vac-1A :cosF=0.4

*1: Although the CC terminal and the CCA terminal are not insulated, they should be used separately, one for the logic circuit and the other for the analog circuit.
*2: The PWR terminal is not the same as the ST (standby signal input) terminal provided for conventional models. To use the ST function, assign it to a multifunction terminal
    (F, R, RES or S1 to S4) that is not currently in use.
    Example: When assigning the ST function to the S3 terminal.
        Set $F110$ to 0, and Set $F117$ to 6.
    These settings put the motor into a standby state if S3 and CC are short-circuited, or coast and stop the motor if the circuit between S3 and CC is opened.

For inverter users

When studying how to use our inverters

Notes

Leakage current

This inverter uses high-speed switching devices for PWM control.
When a relatively long cable is used for power supply to an inverter, current may leak from the cable or the motor to the ground because of its capacitance, adversely affecting peripheral equipment. The intensity of such a leakage current depends on the PWM carrier frequency, the lengths of the input and output cables, etc., of the inverter. To prevent current leakage, it is recommended to take the following measures.

[Effects of leakage current]

Leakage current which increases when an inverter is used may pass through the following routes:

Route (1) ... Leakage due to the capacitance between the ground and the noise filter
Route (2) ... Leakage due to the capacitance between the ground and the inverter
Route (3) ... Leakage due to the capacitance between ground and the cable connecting the inverter and the motor
Route (4) ... Leakage due to the capacitance of the cable connecting the motor and an inverter in another power distribution line
Route (5) ... Leakage through the grounding line common to motors
Route (6) ... Leakage to another line because of the capacitance of the ground

Leakage current which passes through the above routes may cause the following trouble.

- Malfunction of a leakage circuit breaker in the same or another power distribution line
- Malfunction of a ground-relay installed in the same or another power distribution line
- Noise produced at the output of an electronic device in another power distribution line
- Activation of an external thermal relay installed between the inverter and the motor, at a current below the rate current

Leakage current flow routes
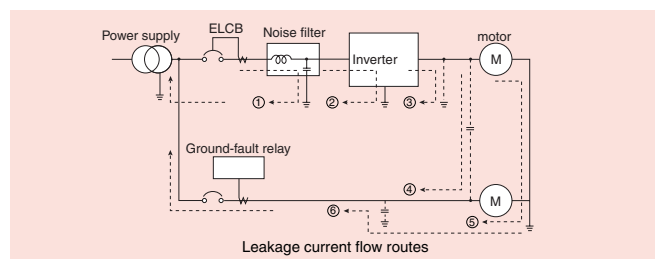
[Measures against effects of leakage current]

The measures against the effects of leakage current are as follows:

1) Measures to prevent the malfunction of leakage circuit breakers
　(1) Decrease the PWM carrier frequency of the inverter. Note)
　(2) Use radio-frequency interference-proof ELCBs as ground-fault interrupters in not only the system into which the inverter is incorporated but also other systems. When ELCBs are used, the PWM carrier frequency needs to be increased to operate the inverter.
　(3) When connecting multiple inverters to a single ELCB, use an ELCB with a high current sensitivity or reduce the number of inverters connected to the ELCB.

2) Measures against malfunction of ground-fault relay:
　(1) Decrease the PWM carrier frequency of the inverter. Note)
　(2) Install ground-fault relays with a high-frequency protective function (e.g., Toshiba CCR12 type of relays) in both the same and other lines. When ELCBs are used, the PWM carrier frequency needs to be increased to operate the inverter.

3) Measures against noise produced by other electric and electronic systems:
　(1) Separate the grounding line of the inverter from that of the affected electric and electronic systems.
　(2) Decrease the PWM carrier frequency of the inverter. Note)

4) Measures against malfunction of external thermal relays:
　(1) Remove the external thermal relay and use the electronic thermal function of the inverter instead of it. (Unapplicable to cases where a single inverter is used to drive more than one motor. Refer to the instruction manual for measures to be taken when thermal relays cannot be removed.)
　(2) Decrease the PWM carrier frequency of the inverter. Note)

5) Measures by means of wiring and grounding
　(1) Use a grounding wire as large as possible.
　(2) Separate the inverter's grounding wire from that of other systems or install the grounding wire of each system separately to the grounding point.
　(3) Ground (shield) the main circuit wires with metallic conduits.
　(4) Use the shortest possible cables to connect the inverter to the motor.

(5) If the inverter has a high-attenuation EMI filter, turn off the grounding capacitor detachment switch to reduce the leakage current. Note that doing so leads to a reduction in the noise attenuating effect.

Note) In the case of this inverter, the PWM carrier frequency can be decreased to 1.0kHz. However, that it should not be set to less than 2.0kHz during vector control. Decreasing the carrier frequency results in an increase in electromagnetic noise from the motor.

Ground fault

Before begining operation, thoroughly check the wiring between the motor and the inverter for incorrect wiring or short circuits. Do not ground the neutral point of any star-connected motor.

Radio interference

[Noise produced by inverters]
Since this inverter performs PWM control, it produces noise and sometimes affects nearby instrumental devices, electrical and electronic systems, etc. The effects of noise greatly vary with the noise resistance of each individual device, its wiring condition, the distance between it and the inverter, etc.

[Measures against noises]
According to the route through which noise is transmitted, the noises produced by an inverter are classified into transmission noise, induction noise and radiation noise.

[Examples of protective measures]
- Separate the power line from other lines, such as weak-current lines and signal lines, and install them apart from each other.
- Install a noise filter in each inverter. It is effective for noise prevention to install noise filters in other devices and systems, as well.
- Shield cables and wires with grounded metallic conduits, and cover electronic systems with grounded metallic cases.
- Separate the power distribution line of the inverter from that of other devices and systems.
- Install the input and output cables of the inverter apart from each other.
- Use shielded twisted pair wires for wiring of the weak-current and signal circuits, and always ground one of each pair of wires.
- Ground the inverter with grounding wires as large and short as possible, separately from other devices and systems.

On 200V 0.4 to 7.5kW and 400V 0.75kW to 500kW models, noise can be greatly reduced as they have a built-in EMI noise filter on their input side.
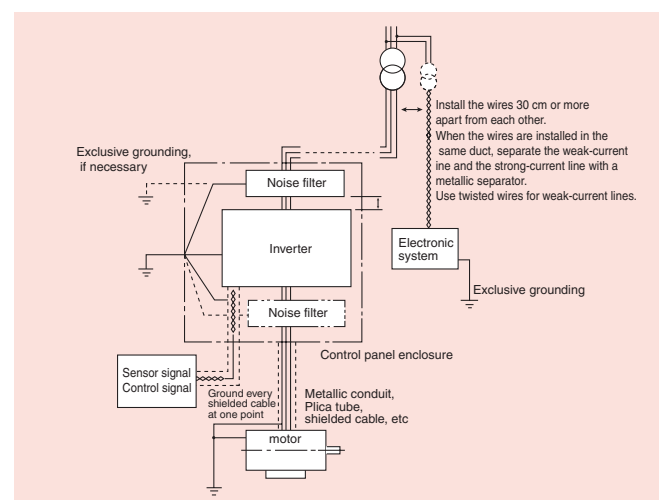
Power factor improvement capacitors

Do not install a power factor improvement capacitors on the input or output side of the inverter.
Installing a power factor improvement capacitor on the input or output side causes current containing harmonic components to flow into the capacitor, adversely affecting the capacitor itself or causing the inverter to trip. To improve the power factor, install an input AC reactor or a DC reactor (optional) on the primary side of the inverter.

Installation of input AC rectors

These devices are used to improve the input power factor and suppress high harmonic currents and surges. Install an input AC reactor when using this inverter under the following conditions:

(1) When the power source capacity is 500kVA or more, and when it is 10 times or more greater than the inverter capacity.
(2) When the inverter is connected the same power distribution system as a thyristor-committed control equipment.
(3) When the inverter is connected to the same power distribution system as that of distorted wave-producing systems, such as arc furnaces and large-capacity inverters.

When wiring the inverter

Wiring precautions

Installing a molded-case circuit breaker [MCCB]

(1) Install a molded-case circuit breaker (MCCB) on the inverter's power supply input to protect the wiring.
(2) Avoid turning the molded-case circuit breaker on and off frequently to turn on/off the motor.
(3) To turn on/off the motor frequently, close/break the control terminals F (or R)-CC.

Installing a magnetic contactor [MC] [primary side]

(1) To prevent an automatic restart after the power interruption or overload relay has tripped, or actuation of the protective circuit, install an electro-magnetic contact in the power supply.
(2) The inverter is provided with a failure detection relay (FL), so that, if its contacts are connected to the operation circuit of the magnetic contactor on the primary side, the magnetic contactor will be opened when the protective circuit of the inverter is activated.
(3) The inverter can be used without a magnetic contactor. In this case, use an MCCB (equipped with a voltage tripping device) for opening the primary circuit when the inverter protective circuit is activated.
(4) Avoid turning the magnetic contactor on and off frequently to turn on/off the motor.
(5) To turn on/off the motor frequently, close/break the control terminals F (or R)-CC.

Installing a magnetic contactor [MC] [secondary side]

(1) As a rule, if a magnetic contactor is installed between the inverter and the motor, do not turn of ON/OFF while running. (If the secondary-side contactor is turned of ON/OFF while running, a large current may flow in the inverter, causing inverter damage and failure.)
(2) A magnetic contactor may be installed to change the motor or change to the commercial power source when the inverter is stopped. Always use an interlock with the magnetic contactor in this situation so that the commercial power supply is not applied to the inverter's output terminals.

External signal

(1) Use a relay rated for low currents. Mount a surge suppressor on the excitation coil of the relay.
(2) When wiring the control circuit, use shielded wires or twisted pair cables.
(3) Because all of the control terminals except FLA, FLB and FLC are connected to electronic circuits, insulate these terminals to prevent them from coming into contact with the main circuit.

Installing an overload relay

(1) The inverter has an electronic-thermal overload protective function.
However, in the following cases, the thermal relay operation level must be adjusted or an overload relay matching the motor's characteristics must be installed between the inverter and the motor.
　(a) When using a motor having a rated current value different from that of the equivalent.
　(b) When driving several motors simultaneously.
(2) When using the inverter to control the operation of a constant-torque motor (VF motor), change the protective characteristic of the electronic thermal relay according to the setting of the VF motor.
(3) In order to adequately protect a motor used for low-speed operation, we recommend the use of a motor equipped with a embedded thermal relay.

When changing the motor speed

Application to standard motors

Vibration

When a motor is operated with an industrial inverter, it experiences more vibrations than when it is operated by the commercial power supply. The vibration can be reduced to a negligible level by securing the motor and machine to the base firmly. If the base is weak, however, the vibration may increase at a light load due to resonance with the mechanical system.

Reduction gear, belt, chain

Note that the lubrication capability of a reducer or a converter used as the interface of the motor and the load machine may affected at low speeds.
When operating at a frequencies exceeding 60 Hz or higher, power transmission mechanisms such as reduction gear, belts and chains, may cause problems such as production of noise, a reduction in strength, or shortening of service life.

Frequency

Before setting the maximum frequency to 60 Hz or higher, confirm that this operating range is acceptable for the motor.

Application to special motors

Braking motor

When using a braking motor, if the braking circuit is directly connected to the inverters's output terminals, the brake cannot be released because of the lowered starting voltage. Therefore, when using a braking motor, connect the braking circuit to the inverter's power supply side, as shown on the below. Usually, braking motors produce larger noise in low speed ranges.
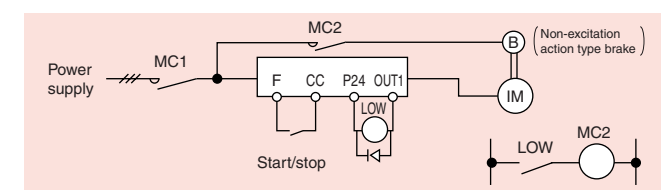
Gear motor

When using an industrial inverter to drive a gear motor, inquire of the motor manufacturer about its continuous operation range, since low-speed operation of a gear motor may cause insufficient lubrication.

Toshiba Gold Motor (High-efficiency power-saving motor)

Inverter-driven operation of Toshiba Gold Motors is the best solution for saving energy. This is because these motors have improved efficiency, power factor, and noise/vibration reduction characteristics when compared to standard motors.

Pole-changing motor

Pole-changing motors can be driven by this inverter. Before changing poles, however, be sure to let the motor come to a complete stop.

Hight-pole-count motors

Note that hight-pole count motors(8 or more poles), which may be used for fans,etc., have higher rated current than 4-pole moters.
The current ratings of multipole motors are relatively high. So, when selecting an inverter, you must pay special attention to its current rating so that the current rating of the motor is below that of the inverter.

Single-phase motor

Because single-phase motors are equipped with a centrifugal switch and capacitors for starting, they cannot be driven by an inverter. If only a single-phase, power system is availabls a 3-phase motor can be driven by using a single-phase input interter to convert it into a 3-phase 200V output. (A special inverter and a 3-phase motor are required.)

For inverter users

■ Selecting peripheral and wiring sizes devices

Voltage Class	Applicable Motor (kW)	Inverter model	Input current (A) Without Reactor	Input current (A) With Reactor	MCCB Rated current (A) Without Reactor	MCCB Rated current (A) With Reactor	MC Operational current (A) AC1 Without Reactor	MC Operational current (A) AC1 With Reactor	Input terminal (R,S,T) AWG	Input terminal mm²	Output terminal (U,V,W) AWG	Output terminal mm²	DC terminal AWG	DC terminal mm²	Braking resistor/Braking unit AWG	Braking mm²	Ground lead AWG	Ground mm²	Main Circuit Terminal	GND Terminal
200V	0.4	VFAS1-2004PL	3.5	2.1	5	5	25	25	14	1.5	14	1.5	14	1.5	14	1.5	14	2.5	M4	M5
	0.75	VFAS1-2007PL	6.1	3.2	10	5	25	25	14	1.5	14	1.5	14	1.5	14	1.5	14	2.5		
	1.5	VFAS1-2015PL	11.5	6.4	15	10	25	25	14	1.5	14	1.5	12	1.5	14	1.5	14	2.5		
	2.2	VFAS1-2022PL	15	9.3	20	15	25	25	12	1.5	12	1.5	10	2.5	14	1.5	14	2.5		
	3.7/4.0	VFAS1-2037PL	26	15.5	30	30	32	25	10	4	10	4	8	6	14	1.5	12	4		
	5.5	VFAS1-2055PL	35	22.5	50	40	40	25	8	6	8	6	6	10	14	1.5	10	6	M5	M5
	7.5	VFAS1-2075PL	45	34.5	60	40	50	40	8	10	8	10	4	16	12	2.5	10	10	M6	M6
	11	VFAS1-2110PM	-	53.5	-	75	-	80	4	16	4	16	3	16	10	4	10	16		
	15	VFAS1-2150PM	-	72	-	100	-	80	4	25	4	25	1	25	8	6	10	16	M8	M8
	18.5	VFAS1-2185PM	-	77	-	100	-	80	3	25	3	25	1/0	35	8	10	8	16		
	22	VFAS1-2220PM	-	88	-	125	-	125	2	25	2	25	2/0	35	6	16	8	16		
	30	VFAS1-2300PM	-	125	-	150	-	125	2/0	50	2/0	50	4/0	70	4	25	6	25	M12 Note 13	M8
	37	VFAS1-2370PM	-	140	-	175	-	250	3/0	70	3/0	70	250MCM	95	3	35	6	35		
	45	VFAS1-2450PM	-	165	-	200	-	250	4/0	70	4/0	70	300MCM	95	2	50	6	35		
	55	VFAS1-2550P	-	200	-	250	-	275	3/0×2	70×2	3/0×2	120	4/0×2	95×2	1/0	50	2	70		M10
	75	VFAS1-2750P	-	270	-	350	-	350	4/0×2	95×2	250MCM×2	70×2	300MCM×2	120×2	1/0	35×2	2	95		
400V	0.75	VFAS1-4007PL	3.7	2.1	5	4	25	25	14	1.5	14	1.5	14	1.5	14	1.5	14	2.5	M4	M5
	1.5	VFAS1-4015PL	5.8	3.8	10	6.3	25	25	14	1.5	14	1.5	14	1.5	14	1.5	14	2.5		
	2.2	VFAS1-4022PL	8.2	5.7	14	10	25	25	14	1.5	14	1.5	14	1.5	14	1.5	14	2.5		
	3.7/4.0	VFAS1-4037PL	14	8.7	18	14	25	25	12	1.5	12	1.5	10	2.5	14	1.5	14	2.5		
	5.5	VFAS1-4055PL	20.5	12.7	32	25	25	25	10	2.5	10	2.5	8	4	14	1.5	12	2.5		
	7.5	VFAS1-4075PL	27	16.3	32	32	25	25	10	4	10	4	8	6	14	1.5	12	4	M5	M5
	11	VFAS1-4110PL	36.5	21.5	50	30	40	32	8	6	8	6	6	10	14	1.5	10	6		
	15	VFAS1-4150PL	48	33.5	60	40	50	40	6	10	6	10	4	16	12	2.5	10	10	M6	M6
	18.5	VFAS1-4185PL	-	45.5	-	60	-	50	6	10	6	10	4	16	10	2.5	10	10		
	22	VFAS1-4220PL	-	50	-	60	-	50	6	10	6	10	4	16	10	4	10	10	M8	M8
	30	VFAS1-4300PL	-	66	-	100	-	80	4	16	4	16	2	25	8	6	10	16		
	37	VFAS1-4370PL	-	84	-	100	-	125	3	25	3	25	1	35	8	10	8	16		
	45	VFAS1-4450PL	-	105	-	125	-	125	1	35	1	35	2/0	50	6	16	8	16		
	55	VFAS1-4550PL	-	120	-	150	-	125	1/0	50	1/0	50	3/0	70	6	16	6	25	M8	M8
	75	VFAS1-4750PL	-	165	-	200	-	250	3/0	70	3/0	70	250MCM	95	3	35	6	35		
	90	VFAS1-4900PC	-	170	-	200	-	250	1/0×2	95	1/0×2	95	1/0×2	95×2	1/0	35	2	70		M10
	110	VFAS1-4110KPC	-	200	-	250	-	275	3/0×2	95×2	3/0×2	120	2/0×2	120×2	1/0	50	2	95		
	132	VFAS1-4132KPC	-	240	-	300	-	315	4/0×2	95×2	4/0×2	150	4/0×2	120×2	4/0	70	1/0	95		
	160	VFAS1-4160KPC	-	290	-	350	-	350	300MCM×2	120×2	300MCM×2	95×2	350MCM×2	150×2	4/0	95	1/0	120		
	200	VFAS1-4200KPC	-	360	-	500	-	500	4/0×3	150×2	4/0×3	120×2	3/0×3	150×3	300MCM	150	1/0	150		
	220	VFAS1-4220KPC	-	395	-	500	-	500	250MCM×3	150×3	250MCM×3	120×2	4/0×3	150×3	300MCM	150	2/0	150	M12 Note 13	
	280	VFAS1-4280KPC	-	495	-	700	-	700	350MCM×3	150×3	350MCM×3	185×2	300MCM×3	150×4	300MCM	150	3/0	120×2		
	355	VFAS1-4355KPC	-	637	-	1000	-	1000	400MCM×2×2 Note 12	120×2×2 Note 12	400MCM×4	150×3	500MCM×4	185×4	350MCM×2	185×2	4/0	120×2	M12	M12
	400	VFAS1-4400KPC	-	709	-	1000	-	1000	500MCM×2×2 Note 12	150×2×2 Note 12	500MCM×4	185×3	500MCM×4	185×4 Note 11	350MCM×2	185×2	4/0	150×2		
	500	VFAS1-4500KPC	-	876	-	1200	-	1600	400MCM×3×2 Note 12	150×3×2 Note 12	400MCM×5	185×4	500MCM×4	180×4 Note 11	350MCM×2	185×2	250MCM	150×2		

Note 1) Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50Hz.
Note 2) Choose the MCCB according to the power supply capacity. For comply with UL and CSA standard, use the fuse certified by UL and CSA.
Note 3) When the motor is driven by commercial power supply switching, for example, use an electromagnetic contactor that is matched to AC-3 class motor rated current.
Note 4) Attach surge killers to the magnetic contactor and exciting coil of the relay.
Note 5) In the case the magnetic contactor (MC) with 2a-type auxiliary contacts is used for the control circuit, raise the reliability of the contact by using 2a-type contacts in parallel connection.
Note 6) The recommended cable size is that of the cable (e.g. 600V class, HIV cable) with continuous maximum permissible temperature of 75°C. Ambient temperature is 40°C or less and the wiring distance is 30m or less.
Note 7) For the control circuit, use shielded wires whose size (cross-section) is 0.75 mm2 or more.
Note 8) The screw size of the control terminals is M3.
Note 9) Choose the wiring size according to the braking resistor value.
Note 10) On 200 V class 55 kW or more, and 400 V class 90 kW or more models, be sure to install the DC reactor.
Note 11) The recommended cable is 600V class HIV cable with permissible temperature of 90°C.
Note 12) The number refers to a cable composition. For example, in the case of "150×2×2"; 150×2×2 ← Number of cables connected in parallel on the terminal board ← Number of cables connected to each terminal board ← Wire size 150mm²

Note 13) The screw sizes of terminal R/L1, S/L2, T/L3, U/T1, V/T2, and W/T3, for VFAS1-2500～2750P, 4900～4132KPC are M10.

Selecting the Capacity (model) of the Inverter

selection

Capacity
Refer to the applicable motor capacities listed in the standard specifications. When driving a high-pole motor, special motor, or multiple motors in parallel, select such an inverter that the sum of the motor rated current multiplied by 1.05 to 1.1 is less than the inverter's rated output current value.

Acceleration/deceleration times
The actual acceleration and deceleration times of a motor driven by an inverter are determined by the torque and moment of inertia2 of the load, and can be calculated by the following equations. The acceleration and deceleration times of an inverter can be set individually. In any case, however, they should be set longer than their respective values determined by the following equations.

Acceleration time	$ta = \dfrac{(JM+JL) \times \Delta N}{9.56 \times (TM-TL)}$ (sec.)
Deceleration time	$ta = \dfrac{(JM+JL) \times \Delta N}{9.56 \times (TB+TL)}$ (sec.)
Conditions	JM : Moment of inertia of motor (kg.m²) JL : Moment of inertia of load (kg.m²) (converted into value on motor shaft) ΔN : Difference in rotating speed between before and after acc. or dce. (min.⁻¹) TL : Load torque (N.m) TM : Motor rated torque x 1.1 (N.m) ... V/f control / Motor rated torque x 1.2 (N.m) ... Vector operation control TB : Motor rated torque x 0.2 (N.m) (When a braking resistor or a braking resistor unit is used: Motor rated torque x 0.8-1.0 (N.m))

Allowable torque characteristics
When a standard motor is combined with an inverter to perform variable speed operation, the motor temperature rises slightly higher than it normally does during commercial power supply operation. This is because the inverter output voltage has a sinusoidal (approximate) PWM waveform. In addition, the cooling becomes less effective at low speed, so the torque must be reduced according to the frequency.
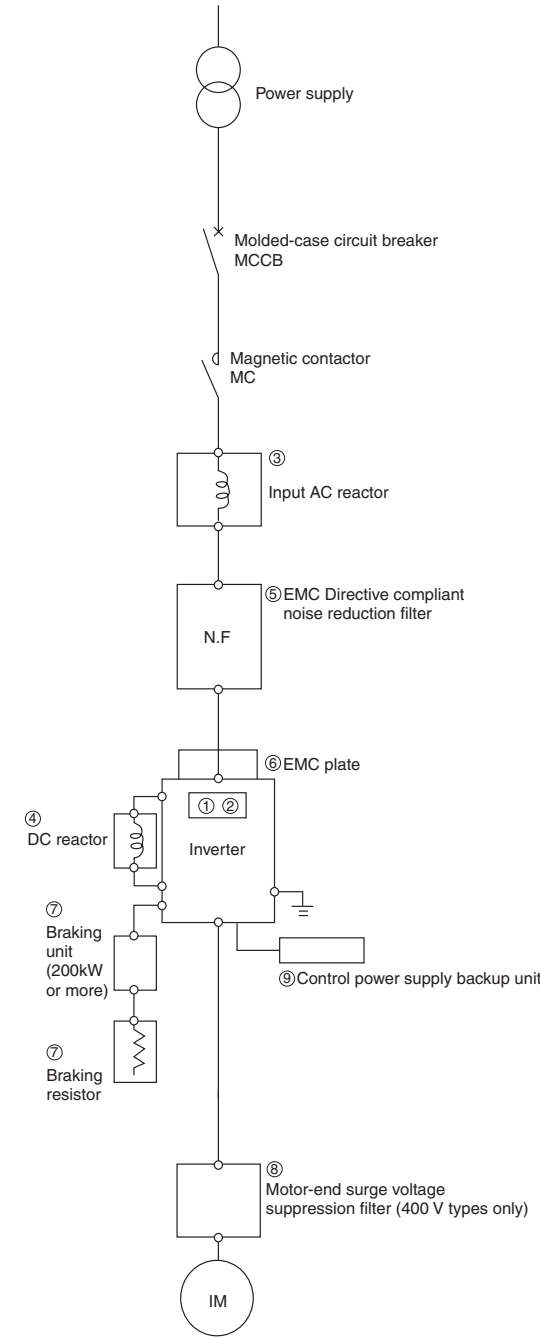When constant-torque operation must be performed at low speeds, use a Toshiba VF motor designed specifically for use with inverters.

Starting characteristics
When a motor is driven by an inverter, its operation is restricted by the inverter's overload current rating, so the starting characteristic is different from those obtained from commercial power supply operation.
Although the starting torque is smaller with an inverter than with the commercial power supply, a high starting torque can be produced at low speeds by adjusting the V/f pattern torque boost amount or by employing vector control. When a larger starting torque is necessary, select an inverter with a larger capacity and examine the possibility of increasing the motor capacity.

Peripheral devices

Diagram labels:
- Power supply
- Molded-case circuit breaker MCCB
- Magnetic contactor MC
- ③ Input AC reactor
- N.F
- ⑤ EMC Directive compliant noise reduction filter
- ⑥ EMC plate
- ④ DC reactor
- ① ② Inverter
- ⑦ Braking unit (200kW or more)
- ⑨ Control power supply backup unit
- ⑦ Braking resistor
- ⑧ Motor-end surge voltage suppression filter (400 V types only)
- IM

■ Built-in options

No.	Name	Function/Purpose, etc.	Refer to
①	Expanded terminal block card	This option is convenient for adding on special functions. (Type : ETB003Z, ETB004Z)	P23
	CC-Link communications card	This option enables CC-Link communications with a host controller or other PLC. (Type : CCL001Z)	
	DeviceNet communications card	This option enables DeviceNet communications with a host controller or other PLC. (Type :DEV002Z)	
	PROFIBUS communications card	This option enables PROFIBUS communications with a host controller or other PLC. (Type : PDP002Z)	
②	PG feedback card (complimentary output/line driver output)	Higher performance operation is possible by combining with a motor equipped with a sensor. (Type : VEC004Z, VEC005Z, VEC007Z)	

■ External options

No.	Name	Function/Purpose, etc.	Refer to
③	Input AC reactor	This is used to improve the input power factor of the inverter power supply, reduce harmonics or suppress external surges. Install this option when the power supply capacity is 500 kVA or more and the power supply capacity is 10 times or more than that of the inverter's capacity, or when a distortion-generating source such as a thyristor or a large-capacity inverter is connected to the same wiring leads. The effect of this option changes according to the impedance of the reactor. Consult us separately for details.	P25
④	DC reactor	(see effect table below) The DC reactor is more effective than the input reactor in improving the power factor. We recommend joint use of the input reactor, that is effective in suppressing external surges, when facilities where the inverter is to be applied require high reliability.	P26
⑤	EMC Directive compliant noise reduction filter (for European market)	This high-attenuation type EMC noise filter takes up little space, and adopts a system (foot mount or side mount) that mounting on the rear or side of the inverter (separate-standing for large-capacity class models).	P27
⑥	EMC plate	A steel plate used to connect shielded earth wires from inverter's power cables or to connect earth wires from external devices. Some models have it as a standard attachment or as an option.	P28
⑦	Braking resistor Braking unit	This operation is used when sudden deceleration or stops are frequently performed, or when the deceleration time must be shortened on loads having a large inertia. This resistor is for taking up energy during power generation braking. For 200kW or more inverter, it requires the braking unit.	P29-30
⑧	Motor-end surge voltage suppression filter (400 V types only)	On systems that run 400 V class general-purpose motors by voltage-type PWM system inverters using ultra high-speed switching devices (e.g. IGBT), surge voltage, that is dependent on cable length, cable laying methods, cable constants, and other factors, sometimes causes the insulation of the motor winding to deteriorate. For this reason, measures for suppressing surge voltage are performed by installing a DC reactor or surge suppression filter on the inverter output end where the insulation-reinforced motor is used.	P28
⑨	Control power supply backup unit	Control power need not be input separately as it is supplied internally on the inverter from the main circuit power supply. Use this option when backing up only by the control power supply when the main circuit is shut off. This is +24 VDC output common to both 200 and 400 V models. (Model : CPS002Z)	P34
⑩	USB communications conversion unit	This unit is connected to a PLC or a computer to enable data communications. By connecting the connector cable, parameters can be easily adjusted, and data easily saved and written. ■Monitor function ■Parameter setup function ■Command function ■Additional functions (Model : USB001Z)	P33
⑪	Communications cable	Connector cable for USB conversion unit and LED remote keypad. (Model : CAB0011, CAB0013, CAB0015)	P33
⑫	LCD remote keypad (installable on body)	LCD remote keypad is for extension. It is provided with an LCD display, RUN/STOP key, "hiragana" and Kanji display facilitates parameter setup. The dedicated cable for the LCD remote keypad is required for connecting it to the inverter. (Model : RKP004Z)	P31
⑬	LCD cable	Connector cable for LCD remote keypad (Model : CAB0071, CAB0073, CAB0075, CAB00710)	P31
⑭	LED remote keypad (w/ parameter writer function)	LED remote keypad is for extension. It is provided with an LED display, RUN/STOP key, UP/DOWN key, monitor key, and enter key. Setup parameters for three inverters can be stored to this unit. (Model : RKP002Z)	P31
⑮	Heat sink outside protrusion option	This allows heat generated inside panels to be reduced.	P32-33
⑯	Operation panel	Has a built-in frequency type, frequency setter and RUN-STOP (forward run, reverse run) switch. (Model : CBVR-7B1)	P34

Reactor / Effect

Reactor	Improved Power Factor	Harmonics	External Surge Suppression	
Input AC Reactor	○	○	○	○very: very effective ○: effective ×: ineffective
DC Reactor	○very	○very	×	

Harmonic current and influence to power supply

Harmonics are defined as sinusoidal waves that is multiple frequency of commercial power (base frequency: 50Hz or 60Hz). Commercial power including harmonics has a distorted waveform.
Some electrical and electronic devices produce distorted waves in their rectifying and smoothing circuits on the input side. Harmonics produced by a device influence other electrical equipment and facilities in some cases (for example, overheating of phase advancing capacitors and reactors).

Measures for suppressing higher harmonics

No	Measures	Description
1	Connecting a reactor	The leakage of a harmonic current from an inverter can be restricted by connecting an input AC reactor (ACL) on the input side of the inverter or a DC reactor (DCL) to the DC section of the inverter.
2	Connecting a higher harmonic suppressing unit (SC7)	A PWM converter that shapes the waveform of an input current into a substantially sinusoidal waveform. The leakage of a harmonic current from a power supply can be restricted by connecting a harmonic suppressing unit.
3	Connecting a higher harmonic suppressing phase advancing capacitor	A harmonic current can be absorbed by the use of a phase advancing capacitor unit composed of a phase advancing capacitor and a DC reactor.
4	Multi-pulse operation of transformation	For delta-delta connection and delta-Y connection transformers, the effect of 12 pulses can be obtained by distributing the load evenly, and thus currents containing fifth-order and seventh-order harmonics can be suppressed.
5	Other measures	Harmonic currents can also be suppressed by the use of passive (AC) and active filters.

Built-in options

Here are the internal devices optionally available. There are two types of optional devices: Add-on type and Plug-in type.

■ Table of optional devices

Option name		Function, purpose	Model	Type of installation
Expansion terminal function	Expansion I/O card1	Used to extend input and output terminals.	ETB003Z	Add-on
	Expansion I/O card2		ETB004Z	Add-on
Communication function	CC-Link communication card	Used to connect to a CC-Link network for control.	CCL001Z	Add-on
	DeviceNet communication card	Used to connect to a DeviceNet network for control.	DEV002Z	Add-on
	PROFIBUS-DP communication card	Used to connect to a PROFIBUS-DP network for control.	PDP002Z	Add-on
PG feedback	Push-pull 12V	Used to issue motor pulse train rate commands or used for sensor vector control.	VEC004Z	Plug-in
	Push-pull 15V		VEC005Z	Plug-in
	RS422-5V		VEC007Z	Plug-in

Up to two Add-on type devices and one Plug-in type device can be installed at the same time. Note, however, that two identical optional devices and two identical optional communication devices cannot be connected and used.

■ Function of Expansion I/O card

Model	ETB003Z	ETB004Z
Multifunction programmable contact input	Multifunction programmable contact input : 4 points No-voltage contact input (24Vdc-5mA or less) Sink logic input (at a common voltage of 24V) Source logic input ON: Less than 10Vdc ON: 11Vdc or more OFF: 16Vdc or more OFF: Less than 5Vdc	
Multifunction programmable open collector output	Multifunction programmable open collector output : 2 points Driving current: Max. 50mA when an external power source is used Max. 20mA when the internal power source is used Driving voltage: 12V (min) to 30V (max)	
Multifunction programmable relay contact output	1C contact configuration 250Vac-2A (cosφ=1), 250Vac-1A (cosφ=0.4), 30Vdc-1A	
Differential current input	Disable	Current input: 20mA or less Voltage input: Differential voltages 5V or less, -10V or more, +10V or less
Analog input	Disable	Current input: 20mA or less Voltage input: 0V to 10V
Monitor output	Disable	Voltage output: -10V to 10V, 0V to 10V Current output: 0mA to 20mA
Pulse train input	Disable	Input pulse specifications Voltage: Max. 5V Current: Max. 15mA Frequency: Max. 30kHz Duty: 50±10%
External thermal trip input	Resistance between TH+ and TH- Error: Approx. 50Ω or less or approx. 3kΩ or more Recovery from error: Approx. 1.8kΩ	
24V power output	24Vdc - 60mA max	
-10V power output	-10Vdc -10mA	
Contact input common terminal	Common terminals for contact input	

■ How to install

Add-on type devices and insertion type devices are installed in different ways. Install them correctly, as shown in the figures below.
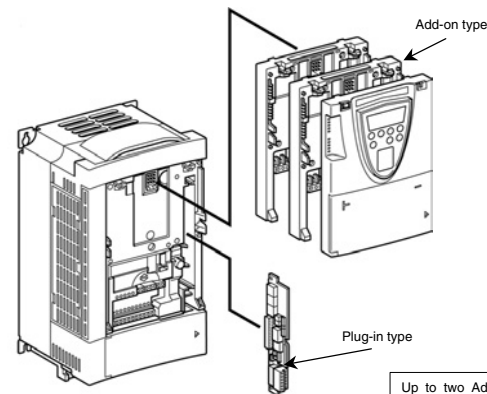

Add-on type

Plug-in type

Up to two Add-on type devices and one Plug-in type device can be installed at the same time. Note. however, that two identical optional devices and two identical communication devices cannot be connected and used.

■ Function of PG feedback card

| Model	VEC004Z, VEC005Z	VEC007Z
Sensor vector control operation	Speed control operation: Zero-speed - 120% torque Speed control range: 1:1000 (1000ppr PG)	
PG method	Complementary method, open collector method	Line drive method
PG cable length	Max. 100m (complementary method)	Max. 30m
PG supply power	VEC004Z: 12V-160mA VEC005Z: 15V-150mA	5V-160mA
Maximum pulse input frequency	300kHz or less * If a two-phase open collector is used, a study needs to be made to determine the derating factor. For details, refer to the operating manual for the optional device. Pulse duty: 50±10%	
Pulse input voltage	12Vdc–24Vdc	Line driver (LTC485 or equivalent)

■ Dimension of depth that installed option

Depending on the capacity, the installation of an Add-on type device may increase the depth of the inverter.

200V 0.4 to 45kW/400V 0.75 to 37kW

22 44

400V 45 to 75kW

290 290 19 290
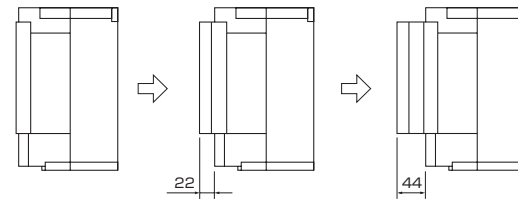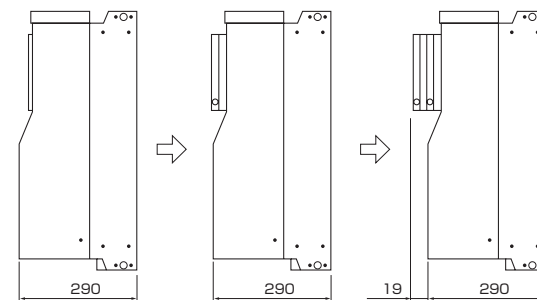
200V 55, 75kW/400V 90 to 500kW

Note) The inverters of these capacities come equipped with an Add-on type option case as standard. When installing an optional Add-on type device, remove the case.

370 370 370
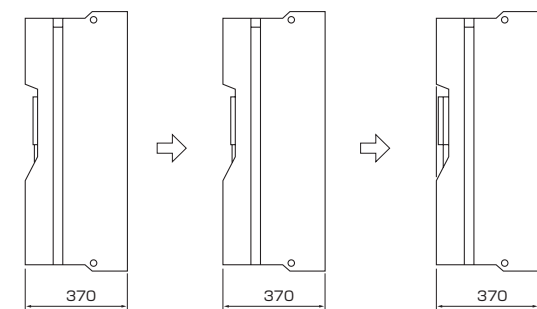
Standard type / Standard type + one Add-on / Standard type + two Add-on

External options

Voltage class	Applicable motor (kW)	Inverter model	Input AC reactor (ACL)	DC reactor (DCL) Note 4)	EMC Directive compliant noise reduction filter	Braking resistor Note 1), 2)	Motor end surge voltage suppression filter
200V class	0.4	VFAS1-2004PL	PFL-2005S	DCL-2007	Built-in	PBR-2007	–
	0.75	VFAS1-2007PL					
	1.5	VFAS1-2015PL	PFL-2011S	DCL-2022		PBR-2022	
	2.2	VFAS1-2022PL					
	3.7/4.0	VFAS1-2037PL	PFL-2018S	DCL-2037		PBR-2037	
	5.5	VFAS1-2055PL	PFL-2025S	DCL-2055		PBR3-2055	
	7.5	VFAS1-2075PL	PFL-2050S	DCL-2110		PBR3-2075	
	11	VFAS1-2110PM		Built-in	EMF3-4072E	PBR3-2110	
	15	VFAS1-2150PM				PBR3-2150	
	18.5	VFAS1-2185PM	PFL-2100S		EMF3-4090F		
	22	VFAS1-2220PM				PBR3-2220	
	30	VFAS1-2300PM	PFL-2150S		EMF3-4180H	PBR-222W002	
	37	VFAS1-2370PM					
	45	VFAS1-2450PM	PFL-2200S				
	55	VFAS1-2550P	PFL-2300S	Attached as standard	EMF3-4300I	DGP600W-B1 [DGP600W-C1]	
	75	VFAS1-2750P	PFL-2400S				
400V class	0.75	VFAS1-4007PL	PFL-4012S	DCL-2007 Note 3)	Built-in	PBR-2007	MSF-4015Z
	1.5	VFAS1-4015PL					
	2.2	VFAS1-4022PL		DCL-2022 Note 3)			MSF-4037Z
	3.7/4.0	VFAS1-4037PL				PBR-4037	
	5.5	VFAS1-4055PL	PFL-4025S	DCL-4110		PBR3-4055	MSF-4075Z
	7.5	VFAS1-4075PL				PBR3-4075	
	11	VFAS1-4110PL				PBR3-4110	MSF-4150Z
	15	VFAS1-4150PL		DCL-4220		PBR3-4150	
	18.5	VFAS1-4185PL	PFL-4050S				MSF-4220Z
	22	VFAS1-4220PL				PBR3-4220	
	30	VFAS1-4300PL					MSF-4370Z
	37	VFAS1-4370PL	PFL-4100S				
	45	VFAS1-4450PL				PBR-417W008	MSF-4550Z
	55	VFAS1-4550PL	PFL-4150S				
	75	VFAS1-4750PL					MSF-4750Z
	90	VFAS1-4900PC	PFL-4300S			DGP600W-B2 [DGP600W-C2]	–
	110	VFAS1-4110KPC					
	132	VFAS1-4132KPC	PFL-4400S				
	160	VFAS1-4160KPC					
	200	VFAS1-4200KPC	PFL-4600S			PB7-4200K Note 2) DGP600W-B3 [DGP600W-C3]	
	220	VFAS1-4220KPC					
	280	VFAS1-4280KPC	PFL-4800S	Attached as standard		PB7-4200K Note 2) DGP600W-B4 [DGP600W-C4]	
	355	VFAS1-4355KPC	PFL-4450S ×2 (parallel)			PB7-4400K Note 2) DGP600W-B3 ×2 (parallel) [DGP600W-C3 ×2 (parallel)]	
	400	VFAS1-4400KPC					
	500	VFAS1-4500KPC	PFL-4613S ×2 (parallel)			PB7-4400K Note 2) DGP600W-B4 ×2 (parallel) [DGP600W-C4 ×2 (parallel)]	

Note 1) Model in square brackets is fitted with top cover.
Note 2) To use a 400V/200kW inverter or larger in combination with an external braking resistor (DGP600 series), a braking unit (PB7) is also needed.
Note 3) These reactors are usable for each of 200V class and 400V class.
Note 4) Be sure to connect DC reactor to 200V-55kW or more and 400V-90kW or more inverter. (Not necessary for DC power input.)

Input AC reactor

External dimensions

Fig.A

Fig.B

Terminal box with cover

4-φF holes

Fig.C

Fig.D

4-φF holes

Grounding

Fig.E

4-φF holes

Grounding M12

Grounding

Fig.F

Connection diagram

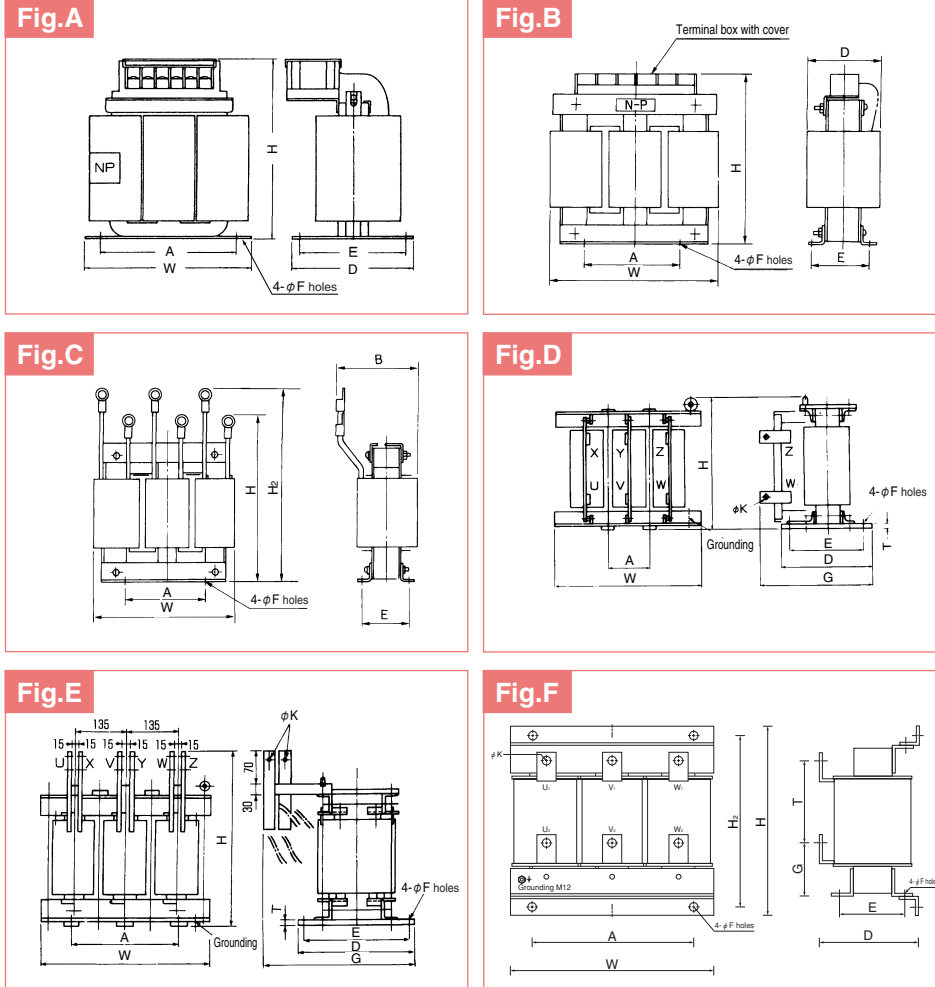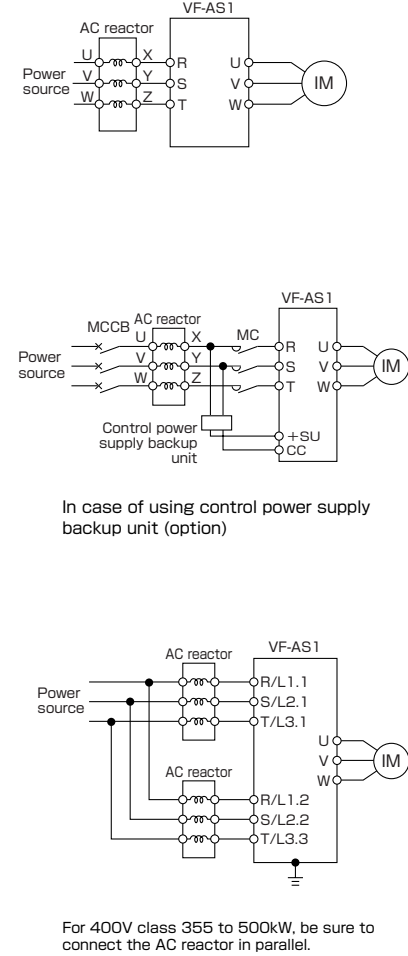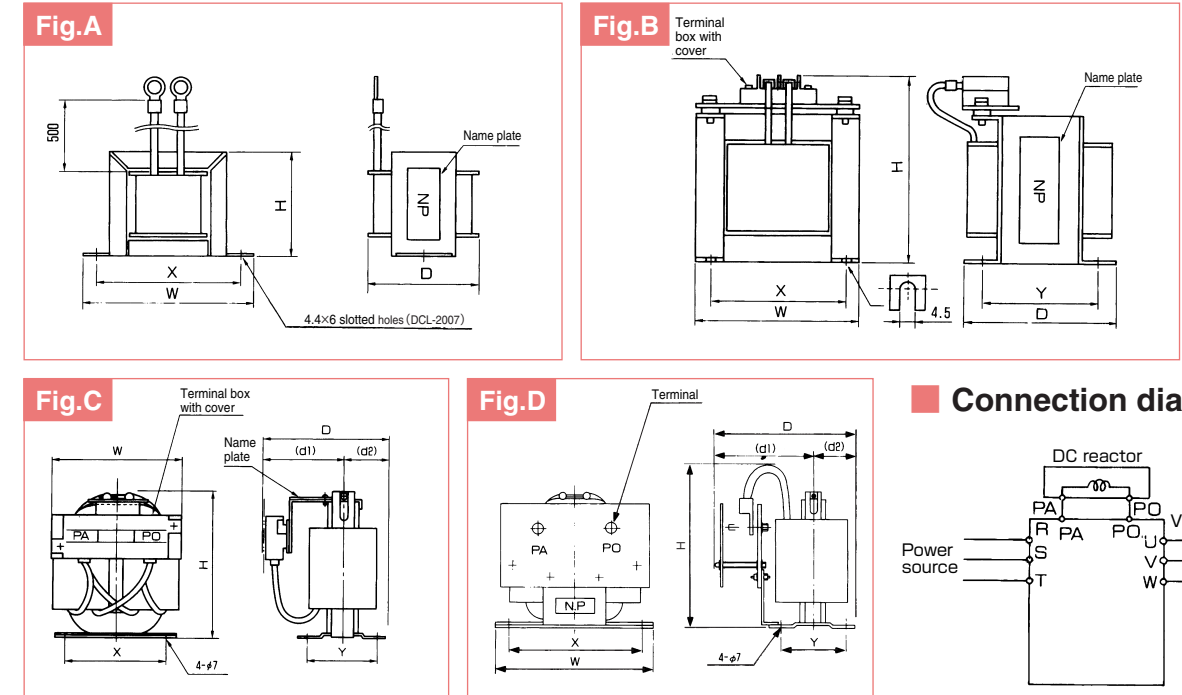AC reactor

VF-AS1

Power source

In case of using control power supply backup unit (option)

Control power supply backup unit

For 400V class 355 to 500kW, be sure to connect the AC reactor in parallel.

Model	Rating	Inverter type	Dimensions (mm)										External dimension diagram	Terminals	Approx. weight (kg)
			W	H	D	H2	A	E	F	G	T	K			
PFL-2005S	3φ-230V-5.5A-50/60Hz	VFAS1-2004PL、2007PL	105	115	72.5	—	90	55	5	—	—	—	A	Terminal block M3.5	1.2
PFL-2011S	3φ-230V-11A-50/60Hz	VFAS1-2015PL、2022PL	130	140	85	—	115	60	5	—	—	—		Terminal block M4	2.3
PFL-2018S	3φ-230V-18A-50/60Hz	VFAS1-2037PL	130	140	85	—	115	60	5	—	—	—			2.5
PFL-2025S	3φ-230V-25A-50/60Hz	VFAS1-2055PL	125	130	100	—	50	83	7	—	—	—			2.6
PFL-2050S	3φ-230V-50A-50/60Hz	VFAS1-2075PL〜VFAS1-2110PM	155	140	115	—	50	95	7	—	—	—	B	Terminal block M6	3.4
PFL-2100S	3φ-230V-100A-50/60Hz	VFAS1-2150PM、2185PM、2220PM	230	210	150	—	60	90	8	—	—	—		Terminal block M8	8.2
PFL-2150S	3φ-230V-150A-50/60Hz	VFAS1-2300PM、2370PM	175	220	160	290	60	110	8	—	—	—		Ring terminal 60-10	11.3
PFL-2200S	3φ-230V-200A-50/60Hz	VFAS1-2450PM	195	240	170	320	65	115	10	—	—	—	C	Ring terminal 80-10	15.1
PFL-2300S	3φ-230V-300A-50/60Hz	VFAS1-2550P	235	280	200	370	75	128	10	—	—	—		Ring terminal 150-10	23.1
PFL-2400S	3φ-230V-400A-50/60Hz	VFAS1-2750P	260	330	230	—	90	200	12	300	9	13	D	φ13	30
PFL-4012S	3φ-460V-12.5A-50/60Hz	VFAS1-4007PL〜VFAS1-4037PL	125	130	95	—	50	79	7	—	—	—		Terminal block M4	2.3
PFL-4025S	3φ-460V-25A-50/60Hz	VFAS1-4055PL〜VFAS1-4110PL	155	155	110	—	50	94	7	—	—	—			4.9
PFL-4050S	3φ-460V-50A-50/60Hz	VFAS1-4150PL、4185PL、4220PL	155	165	140	—	50	112	7	—	—	—	B	Terminal block M6	6.6
PFL-4100S	3φ-460V-100A-50/60Hz	VFAS1-4300PL、4370PL、4450PL	235	250	170	—	75	105	10	—	—	—		Terminal block M8	17.6
PFL-4150S	3φ-460V-150A-50/60Hz	VFAS1-4550PL、4750PL	235	280	190	360	75	115	10	—	—	—	C	Ring terminal 80-10	20.3
PFL-4300S	3φ-460V-300A-50/60Hz	VFAS1-4900KPC、4110KPC	260	380	230	—	90	200	12	280	9	13	D	φ13	38
PFL-4400S	3φ-460V-400A-50/60Hz	VFAS1-4132KPC、4160KPC	260	380	230	—	90	200	12	300	9	13		φ13	42
PFL-4600S	3φ-460V-600A-50/60Hz	VFAS1-4200KPC、4220KPC	440	465	290	—	280	250	15	445	12	18	E	φ18	75
PFL-4800S	3φ-460V-800A-50/60Hz	VFAS1-4280KPC	440	540	290	—	280	250	15	445	12	18		φ18	90
PFL-4450S	3φ-480V-450A-50/60Hz	VFAS1-4355KPC Note 1)、4400KPC Note 1)	385	230	320	—	340	225	11	250	—	13	F	φ13	68
PFL-4613S	3φ-480V-613A-50/60Hz	VFAS1-4500KPC Note 1)	400	245	385	—	400	300	13.5	26.5	—	13		φ13	85

Note 1) Be sure to connect the AC reactor in parallel.
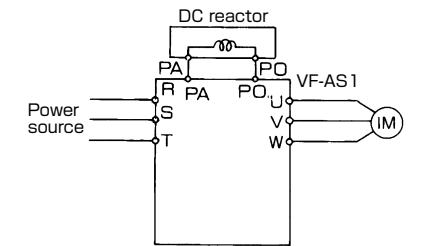
DC reactor

For 200V class 11 to 45kW and 400V class 18.5 to 75kW, DC reactor is built-in standard. Please use these external options when requiring the further improvement of the power factor and reducing harmonics.

External dimensions

Fig.A

Name plate

4.4×6 slotted holes (DCL-2007)

Fig.B

Terminal box with cover

Name plate

Fig.C

Terminal box with cover

Name plate

Fig.D

Terminal

Connection diagram

DC reactor

VF-AS1

Power source

Model	Rated current	Inverter type	Dimensions (mm)							External dimension diagram	Terminal	Approx. weight (kg)
			W	H	D	X	Y	d1	d2			
DCL-2007 Note 2)	7A	VFAS1-2004PL、2007PL	92	65	70	82	—	—	—	A	Ring terminal V2-3.5	1.2
DCL-2022	14A	VFAS1-2015PL、2022PL	86	110	80	71	64	—	—	B	M4	2.2
DCL-2037	22.5A	VFAS1-2037PL	86	110	85	71	70	—	—			2.5
DCL-2055	38A	VFAS1-2055PL	75	130	140	50	85	85	55		M5	1.9
DCL-2110	75A	VFAS1-2075PL〜VFAS1-2110PM	100	150	150	65	85	95	55	C	M6	2.4
DCL-2220	150A	VFAS1-2150PM、2185PM、2220PM	117	170	190	90	90	130	60		M8	4.3
DCL-2370	225A	VFAS1-2300PM、2370PM	150	215	200	130	95	135	65	D	M8	5.9
DCL-2450	300A	VFAS1-2450PM	150	225	230	130	125	150	80		M10	7.8
DCL1-2550	316A	VFAS1-2550P Note 3)					Refer to external dimension of Inverter.					
DCL1-2750	382A	VFAS1-2750P Note 3)										
DCL-2007 Note 2)	7A	VFAS1-4007PL、4015PL Note 1)	92	65	70	82	—	—	—	A	Ring terminal V2-3.5	1.2
DCL-2022	14A	VFAS1-4022PL、4037PL Note 1)	86	110	80	71	64	—	—	B	M4	2.2
DCL-4110	38A	VFAS1-4055PL、4075PL、4110PL	95	150	165	70	90	105	60		M5	3.0
DCL-4220	75A	VFAS1-4150PL、4185PL、4220PL	105	160	185	80	100	120	65	C	M6	3.7
DCL-4450	150A	VFAS1-4300PL、4370PL、4450PL	150	180	225	120	125	145	80		M8	9.8
DCL-4750	225A	VFAS1-4550PL、4750PL	170	215	230	150	125	150	80	D	M8	11.5
DCL1-4900	243A	VFAS1-4900PC Note 3)										
DCL1-4110K	290A	VFAS1-4110KPC Note 3)										
DCL1-4132K	351A	VFAS1-4132KPC Note 3)					Refer to external dimension of Inverter.					
DCL1-4160K	486A	VFAS1-4160KPC Note 3)										
DCL1-4200K	575A	VFAS1-4200KPC Note 3)										
DCL1-4280K	702A	VFAS1-4220KPC、4280KPC Note 3)										

Note 1) These reactors are usable for each of 200V class and 400V class.
Note 2) Please modify the terminal according to size of inverter main terminal.
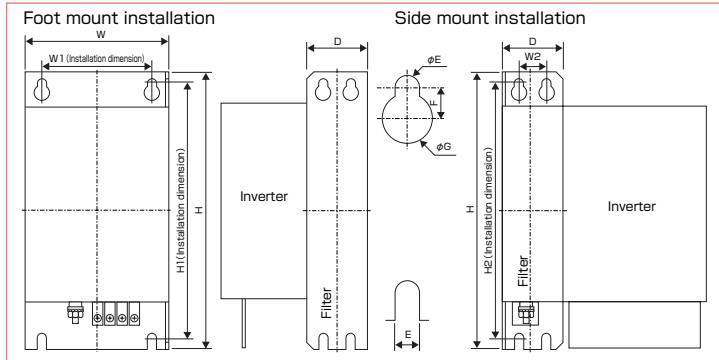Note 3) Be sure to connect DC reactor to 200V-55kW or more and 400V-90kW or more inverter.

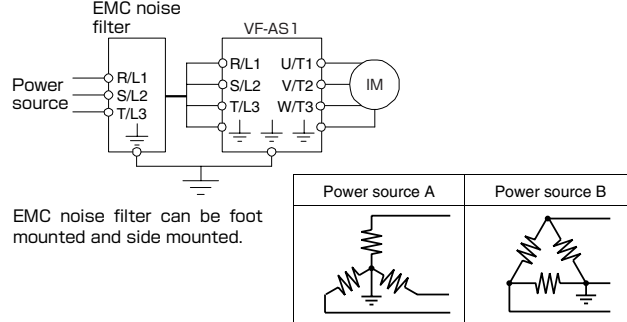## EMC Directive compliant noise reduction filter

For 200V class 0.4 to 7.5kW and 400V class 0.75 to 500kW, EMC noise filter is built-in standard. Please use these external options depended on the length of the cable between inverter and motor.

Inverter type	Requirements		Conducted noise IEC61800-3 category C2 (EN55011 classA Group1)	Conducted noise IEC61800-3 category C3 (EN55011 classA Group2)
	PWM carrier frequency (kHz)	Length of motor connecting cable(m)		
VFAS1-2004PL-2022PL VFAS1-4007PL-4037PL	4	10	Built-in filter	—
	16	5		
VFAS1-2037PL-2075PL VFAS1-4055PL-4150PL	4	10	—	Built-in filter
	16	5		
VFAS1-4185PL-4750PL	2.5	25		
	16	25		
VFAS1-4900PC-4500KPC	2.5	50		

(1) Foot mount type EMC noise filter

■ Connection diagram

EMC noise filter can be foot mounted and side mounted.

	Rated current (A)		Dimensions (mm)										Approx. leakage current (mA) Note 1)		Approx. weight (kg)
Model		Inverter type	W	H	D	W1	H1	W2	H2	E	F	G	Power source A	Power source B	
EMF3-4012A	12	VFAS1-2004PL~2015PL	130	290	39	105	275	—	275	4.5	11	10	5	35	2.5
		VFAS1-4007PL~4022PL											9	70	
EMF3-4026B	26	VFAS1-2022PL~2037PL	155	324	49	130	309	—	309	4.5	11	10	6	42	3.5
		VFAS1-4037PL											11	83	
EMF3-4035C	35	VFAS1-2055PL	175	370	59	150	355	—	355	5.5	11	11	4	25	5.0
		VFAS1-4055PL, 4075PL											6	44	
EMF3-4046D	46	VFAS1-2075PL	210	380	59	190	365	—	365	5.5	11	11	12	91	6.0
		VFAS1-4110PL											24	183	
EMF3-4072E	72	VFAS1-2110PM,2150PM	230	498.5	62	190	460	—	479.5	6.6	11	12	25	195	11
		VFAS1-4150PL, 4185PL											52	390	
EMF3-4090F	90	VFAS1-2185PM,2220PM	240	521.5	79	200	502.5	40	502.5	6.6	11	12	36	268	15
		VFAS1-4220PL											70	535	
EMF3-4092G	92	VFAS1-4300PL,4370PL	240	650	79	200	631	40	631	6.6	11	12	70	535	16
EMF3-4180H	180	VFAS1-2300PM~2450PM	320	750	119	280	725	80	725	9	18	18	70	537	40
		VFAS1-4450PL~4750PL											142	1075	

Note 1) These values are referential ones of single piece of EMC noise filter. For 200V class, 200V-60Hz power source. For 400V class, 400V-60Hz power source.

(2) EMC noise filter

■ External dimensions diagram

EMF3-4300I

EMF3-4600J

■ Connection diagram

For 200V class 55 to 75kW, 400V class 90 to 280kW

For 400V class 355 to 500kW

Model	Rated current (A)	Inverter type	Terminal		Approx. weight (kg)	Approx. leakage current(mA) Note 2)	
			Main circuit	Grounding		Power source A	Power source B
EMF3-4300I	300	VFAS1-2550P, 2750P	Busbar 25*6 M10	M12	13.2	3	180
		VFAS1-4900PC~4132KPC				5	350
EMF3-4600J	580	VFAS1-4160KPC~4280KPC, 4355KPC Note 1), 4400KPC Note 1) 4500KPC Note 1)	Busbar 32*8 M10	M12	15	5	350

Note 1) Be sure to connect the EMC noise filter in parallel.
Note 2) These values are referential ones of single piece of EMC noise filter. For 200V class, 200V-60Hz power source. For 400V class, 400V-60Hz power source.
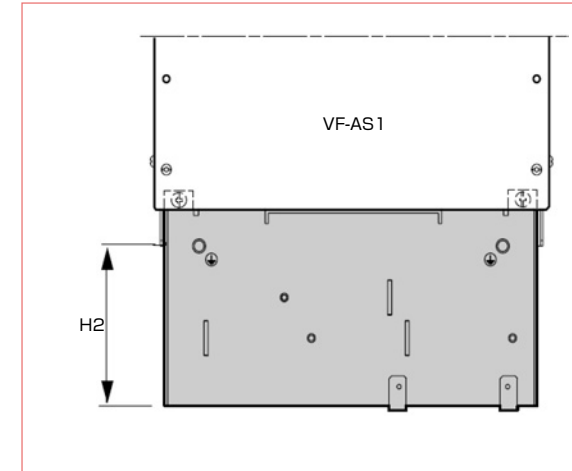
EMC plate

EMC plate is attached in standard for 400V class of WP1 type up to 18.5kW.

■ External dimensions

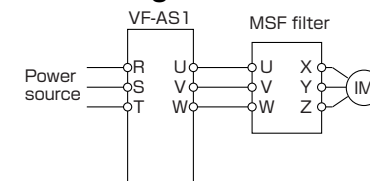| Model	Inverter type	Dimension (mm)
		H2
EMP101Z	VFAS1-2004~2015PL	55
	VFAS1-4007~4022PL	
EMP102Z	VFAS1-2022~2037PL	
	VFAS1-4037PL	
EMP103Z	VFAS1-2055PL, 2075PL	65
	VFAS1-4055~4110PL	
EMP104Z	VFAS1-2110,2150PM	
	VFAS1-4150, 4185PL	
EMP105Z	VFAS1-2185,2220PM	
	VFAS1-4220PL	
EMP106Z	VFAS1-4300,4370PL	120
EMP107Z	VFAS1-2300~2450PM	
EMP108Z	VFAS1-4450~4750PL	

The wire clamps and screws are attached to the EMC plate for fixing the shielded cables on the EMC plate.

Motor end surge voltage suppression filter (Only 400V class)

■ External dimensions

Fig.A

Fig.B

Fig.C
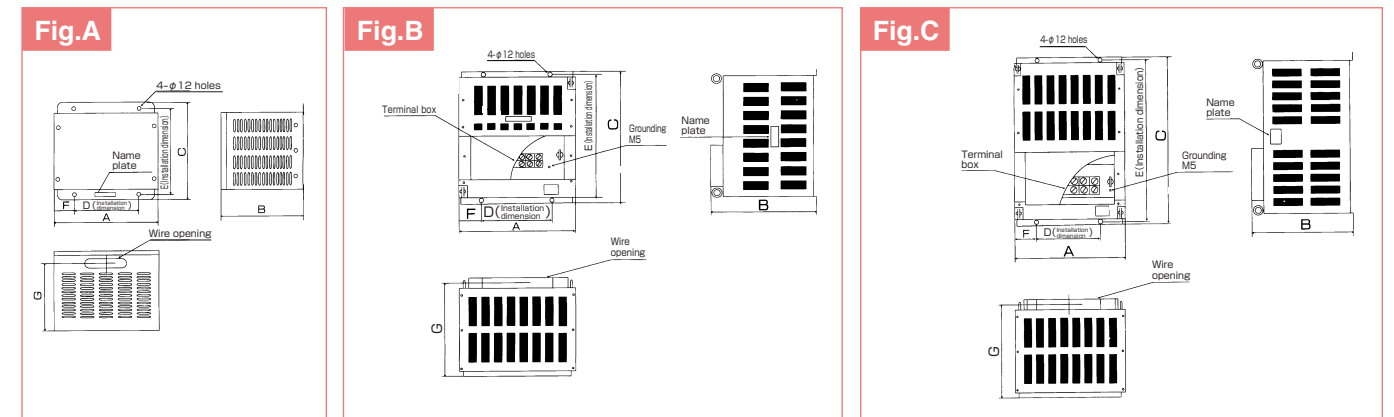
■ Connection diagram

■ Countermeasure of motor end surge voltage

At the system of operation of the 400V class motor by the voltage type PWM inverter with using super high-speed switching device(ex.IGBT). the degradation of insulation of motor wiring may be occurred by the length conditions of the cable, laid down of the cable and the constants of the cable.
In this case, the following countermeasures are suggested.
1) Use of the enhanced insulation type of motor
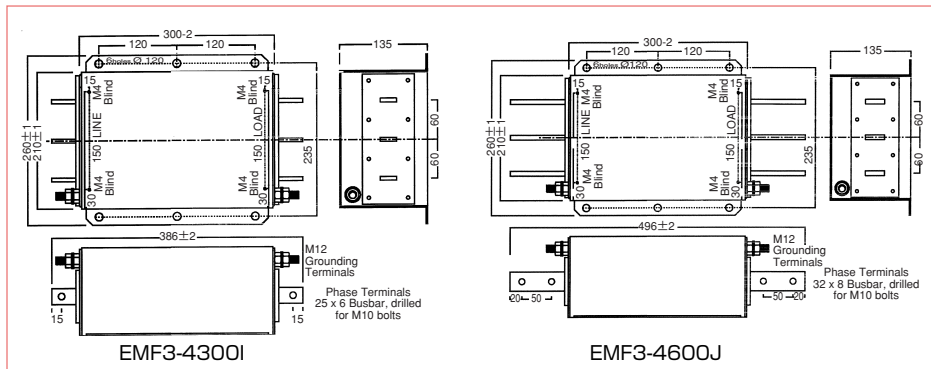2) Suppress the surge voltage by AC reactors in the load side or surge suppression filter.

Model	Applicable motor (kW)	Dimensions (mm)							External dimension diagram	Terminal screw	Approx. weight (kg)
		A	B	C	D	E	F	G			
MSF-4015Z	0.4、0.75、1.5	310	255	300	200	270	55	189	A	M4	12
MSF-4037Z	2.2、3.7	310	255	300	200	270	55	209		M4	20
MSF-4075Z	5.5、7.5	310	315	350	200	320	55	249		M5	30
MSF-4150Z	11、15	330	350	400	200	370	65	289		M6	40
MSF-4220Z	18.5、22	330	400	400	200	370	65	279		M6	52
MSF-4370Z	30、37	426	375	512	260	490	83	350	B	M8	75
MSF-4550Z	45、55	450	395	632	260	610	95	365	C	M10	110
MSF-4750Z	75	450	415	700	260	678	95	385		M10	120

Braking resistor

External dimensions, connection diagram

Fig.A

Fig.B

Fig.C

Fig.D

Fig.E

VF-AS1

Fig.F

VF-AS1

Note) In case of 400V class, please apply the 200V to the operation circuit by using control transformer or 200V power supply.

Fig.G

Note 1) In case of 400V class, please apply the 200V to the operation circuit by using control transformer or 200V power supply.
Note 2) Please twist the wire by 10 cm pitch. The distance between resistor power wiring and the control wiring should be over 20 cm.
Note 3) In case of TOSHIBA thermal relay, please make a short circuit with 8 mm2 wire between the 2/T1 and 6/T3 of the thermal relay.

Fig.H

VF-AS1

For 200kW or more inverter, in requires the braking unit.

Braking resistor (PBR)

Voltage class	Type	Model Note 1)	Rating Note 2), 3)	Dimensions (mm) A	B	C	D	E	G	External dimension diagram	Connection diagram	Approx. weight (Kg)
200V	Standard	PBR-2007	120W-200Ω	42	182	20	4.2	172	—	A	E	0.28
		PBR-2022	120W-75Ω	42	182	20	4.2	172	—	A	E	0.28
		PBR-2037	120W-40Ω	42	182	20	4.2	172	—	A	E	0.28
		PBR3-2055	20Ω-240W (40Ω-120W×2P)	120	320	115	110	230	50	B		4
		PBR3-2075	15Ω-440W (30Ω-220W×2P)	120	350	190	110	230	150	B		4.5
		PBR3-2110	10Ω-660W (30Ω-220W×3P)	120	350	190	110	230	150	B		5
		PBR3-2150	7.5Ω-880W (30Ω-220W×4P)	120	350	190	110	230	150	B		5.5
		PBR3-2220	3.3Ω-1760W (27Ω-220W×8P)	248	430	200	190	414	47	C	F	13
		PBR-222W002	2Ω-2200W (20Ω-220W×10P)	297	445	200	220	429	47	C	F	13
	200W class	PBR-202W □□□	40Ω、75Ω-240W	120	320	115	110	230	50	B		3
	500W class	PBR-208W □□□	15Ω、20Ω、40Ω、75Ω-880W	120	350	190	110	230	150	B		6
	1.5kW class	PBR-217W □□□	15Ω、20Ω、40Ω、75Ω-1760W	248	430	200	190	414	47	C		13
	2.5kW class	PBR-226W □□□	2Ω、3.3Ω、7.5Ω、10Ω、15Ω、20Ω、40Ω-2640W	297	445	200	220	429	47	C		14
	3.5kW class	PBR-235W □□□	3.3Ω、7.5Ω、15Ω、20Ω-3520W	397	445	200	320	429	47	D		19
	5kW class	PBR-252W □□□	2Ω、3.3Ω、7.5Ω、15Ω-5280W	520	616	220	420	600	47	D		36
400V	Standard	PBR-2007	120W-120Ω	42	182	20	4.2	172	—	A	E	0.28
		PBR-4037	120W-160Ω	42	182	20	4.2	172	—	A	E	0.28
		PBR3-4055	80Ω-240W (160Ω-120W×2P)	120	320	115	110	230	50	B		4
		PBR3-4075	60Ω-440W (120Ω-220W×2P)	120	350	190	110	230	150	B		4.5
		PBR3-4110	40Ω-660W (120Ω-220W×3P)	120	350	190	110	230	150	B		5
		PBR3-4150	30Ω-880W (120Ω-220W×4P)	120	350	190	110	230	150	B		5.5
		PBR3-4220	15Ω-1760W (30Ω-220W×4P2S)	248	430	200	190	414	47	C	F	13
		PBR-417W008	8Ω-1760W (16Ω-220W×4P2S)	248	430	200	190	414	47	C	F	13
	200W class	PBR-402W □□□	160Ω-240W	120	320	115	110	230	50	B		3
	500W class	PBR-408W □□□	40Ω、60Ω、80Ω、160Ω-880W	120	350	190	110	230	150	B		6
	1.5kW class	PBR-417W □□□	30Ω、40Ω、60Ω、80Ω-1760W	248	430	200	190	414	47	C		13
	2.5kW class	PBR-426W □□□	8Ω、15Ω、30Ω、40Ω-2640W	297	445	200	220	429	47	C		14
	3.5kW class	PBR-435W □□□	15Ω、30Ω、40Ω-3520W	397	445	200	320	429	47	D		19
	5kW class	PBR-452W □□□	8Ω、15Ω、30Ω、40Ω-5280W	520	616	220	420	600	47	D		36

Note 1) □□□ in the type-form are numeric character. Please refer the "Selection of braking resistor" in the next page.
Note 2) The rating shows the synthetic resistor value (Ohm) and the synthetic resistor power (Wait). The word in the parentheses shows the composition of resistor elements.
Note 3) The allowable continuous regenerative power differs on the resistor value or power tolerance. Please refer the "Selection of braking resistor" in the next page.

Braking resistor (DGP600)

Model Standard	With cover Note 1)	Rating	Dimensions (mm) note 2) A/A1	D/D1	E/E1	F/F1	External dimension diagram	Connection diagram	Thermal relay (Th-Ry) Setting value(A)	Approx. weight (kg)
DGP600W-B1	DGP600W-C1	1.7Ω-3.4kW	283/303	207/192	620/700	725/780	G	H	46	50
DGP600W-B2	DGP600W-C2	3.7Ω-7.4kW	493/513	417/402	620/700	725/780	G	H	44	100
DGP600W-B3	DGP600W-C3	1.9Ω-8.7kW	703/723	627/612	620/700	725/780	G	H	71	150
		2.5Ω-10.5kW	703/723	627/612	620/700	725/780			65	150
		5Ω-10kW							45	150
DGP600W-B4	DGP600W-C4	1.4Ω-14kW	913/933	837/822	620/700	725/780			110	200
		1.7Ω-10kW	913/933	837/822	620/700	725/780			77	200

Note 1) The braking resistors are designed for indoor type. Please use them with drip cover in case of water drop. But please note it is not for water proof protection type.
Note 2) A,D,E,F are the dimensions of standard type. A1,D1,E1,F1 are the dimensions of those with drip cover type.

Selection of braking resistor

This is used for the quick deceleration, the frequent deceleration stop or shortening the deceleration time at the large inertia load. This resistor consumes the regenerative energy when regenerative braking operation.
In case of over 3% ED, please select the allowable continuous regenerative power (Watt) in the following table.
1) The continuous regenerative load likes an elevator
2) Deceleration stops at large inertia machine
3) Frequent deceleration stop by using braking resistors

Voltage class	Applicable motor (kW)	Inverter type Note 1)	Standard type PBR Note 3)	DGP600 Note 4) Standard	With cover Note 5)	High frequency type Note 2) PBR 500W class	1.5kW class	2.5kW class	3.5kW class	5kW class	DGP600 10kW class (Note 4)
200V	0.4	VFAS1-2004PL	PBR-2007 (200Ω-90W)	–	–	PBR-208W075 (75Ω-540W)	–	–	–	–	–
	0.75	VFAS1-2007PL		–	–		PBR-217W075 (75Ω-1200W)	–	–	–	–
	1.5	VFAS1-2015PL	PBR-2022 (75Ω-90W)	–	–	PBR-208W040 (40Ω-570W)	PBR-217W040 (40Ω-1160W)	PBR-226W040 (40Ω-1630W)	–	–	–
	2.2	VFAS1-2022PL		–	–				–	–	–
	3.7/4.0	VFAS1-2037PL	PBR-2037 (40Ω-90W)	–	–				–	–	–
	5.5	VFAS1-2055PL	PBR3-2055 (20Ω-96W)	–	–	PBR-208W020 (20Ω-270W)	PBR-217W020 (20Ω-950W)	PBR-226W020 (20Ω-1580W)	PBR-235W020 (20Ω-2330W)	–	–
	7.5	VFAS1-2075PL	PBR3-2075 (15Ω-130W)	–	–		PBR-217W015 (15Ω-640W)	PBR-226W015 (15Ω-1350W)	PBR-235W015 (15Ω-2080W)	PBR-252W015 (15Ω-3330W)	–
	11	VFAS1-2110PM	PBR3-2110 (10Ω-200W)	–	–		PBR-217W010 (10Ω-470W)	PBR-226W010 (10Ω-1250W)	PBR-235W010 (10Ω-1860W)	PBR-252W010 (10Ω-3520W)	–
	15	VFAS1-2150PM	PBR3-2150 (7.5Ω-270W)	–	–			PBR-226W7R5 (7.5Ω-870W)	PBR-235W7R5 (7.5Ω-1380W)	PBR-252W7R5 (7.5Ω-3210W)	–
	18.5	VFAS1-2185PM		–	–						–
	22	VFAS1-2220PM	PBR3-2220 (3.3Ω-610W)	–	–					PBR-252W3R3 (3.3Ω-2700W)	–
	30	VFAS1-2300PM		–	–						–
	37	VFAS1-2370PM	PBR-222W002 (2Ω-1000W)	–	–					PBR-226W7R5 ×3 (parallel) (2.5Ω-2610W)	DGP600W-B4/C4 (1.7Ω-10kW)
	45	VFAS1-2450P		–	–						
	55	VFAS1-2550P		–	–						
	75	VFAS1-2750P	–	DGP600W-B1 (1.7Ω-3.4kW)	DGP600W-C1 (1.7Ω-3.4kW)						
400V	0.75	VFAS1-4007PL	PBR-2007 (200Ω-90W)	–	–	PBR-408W160 (160Ω-570W)	–	–	–	–	–
	1.5	VFAS1-4015PL		–	–		PBR-417W080 (80Ω-1090W)	–	–	–	–
	2.2	VFAS1-4022PL	PBR-4037 (160Ω-90W)	–	–	PBR-408W080 (80Ω-270W)		–	–	–	–
	3.7/4.0	VFAS1-4037PL		–	–		PBR-417W060 (60Ω-1000W)	PBR-426W040 (40Ω-1250W)	PBR-435W040 (40Ω-1900W)	PBR-452W040 (40Ω-2250W)	–
	5.5	VFAS1-4055PL	PBR3-4055 (80Ω-96W)	–	–						–
	7.5	VFAS1-4075PL	PBR3-4075 (60Ω-130W)	–	–						–
	11	VFAS1-4110PL	PBR3-4110 (40Ω-190W)	–	–		PBR-417W040 (40Ω-490W)				–
	15	VFAS1-4150PL	PBR3-4150 (30Ω-270W)	–	–			PBR-426W030 (30Ω-870W)	PBR-435W030 (30Ω-1680W)	PBR-452W030 (30Ω-2700W)	–
	18.5	VFAS1-4185PL		–	–						–
	22	VFAS1-4220PL	PBR3-4220 (15Ω-540W)	–	–					PBR-452W015 (15Ω-1740W)	–
	30	VFAS1-4300PL		–	–						–
	37	VFAS1-4370PL		–	–						–
	45	VFAS1-4450PL	PBR-417W008 (8Ω-1000W)	–	–					PBR-426W030 ×3 (parallel) (10Ω-2610W)	DGP600W-B3/C3 (5Ω-10kW)
	55	VFAS1-4550PL		–	–						
	75	VFAS1-4750PL		–	–						
	90	VFAS1-4900PC	–			–	–	–	–	–	–
	110	VFAS1-4110KPC	–	DGP600W-B2 (3.7Ω-7.4kW)	DGP600W-C2 (3.7Ω-7.4kW)	–	–	–	–	–	DGP600W-B3/C3 (2.5Ω-10.5kW)
	132	VFAS1-4132KPC	–			–	–	–	–	–	
	160	VFAS1-4160KPC	–			–	–	–	–	–	
	200	VFAS1-4200KPC	–	PB7-4200K DGP600W-B3 (1.9Ω-8.7kW)	PB7-4200K DGP600W-C3 (1.9Ω-8.7kW)	–	–	–	–	–	–
	220	VFAS1-4220KPC	–			–	–	–	–	–	–
	280	VFAS1-4280KPC	–	PB7-4200K DGP600W-B4 (1.4Ω-14kW)	PB7-4200K DGP600W-C4 (1.4Ω-14kW)	–	–	–	–	–	–
	355	VFAS1-4355KPC	–	PB7-4400K DGP600W-B3 ×2 (parallel)	PB7-4400K DGP600W-C3 ×2 (parallel)	–	–	–	–	–	–
	400	VFAS1-4400KPC	–			–	–	–	–	–	–
	500	VFAS1-4500KPC	–	PB7-4400K DGP600W-B4 ×2 (parallel)	PB7-4400K DGP600W-C4 ×2 (parallel)	–	–	–	–	–	–

Note 1) For 200kW or more inverter, it requires the braking unit.
Note 2) The figures in the parentheses show the synthetic resistor value (Ohm) and the allowable continuous regenerative power (Wait).
Note 3) The guideline of the maximum braking at the standard type.
Note 4) The necessary power in case of deceleration from 60Hz at one time per 120 seconds periods at 30 seconds deceleration time for the 10 times of the motor inertia. please contact our agency when large inertia or quick deceleration.
Note 5) The braking resistors are designed for indoor type. Please use them with drip cover in case of water drop. But please note it is not for water proof protection type.

Applicable motor (kW)	Maximum braking power	Braking time
0.4~1.5	150%	6
2.2	100%	6
3.7~55	100%	3
75	100%	2

External dimensions

PB7-4200K is mechanically mounted on the left-hand side of the inverter.
Approx. weight 30kg

Braking unit PB7-4200K
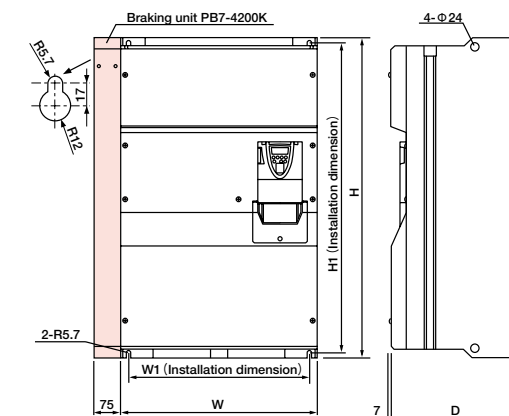
PB7-4400K
Approx. weight 80kg
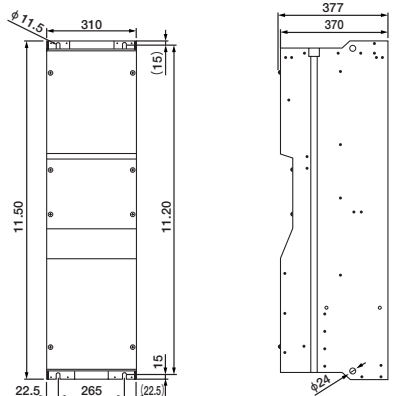
Braking unit

Model	PB7-4200K	PB7-4400K
Threshold voltage	785V ±1%	
Maximum DC voltage	850V	
Maximum braking power at 785VDC	420kW	750kW

LCD Remote Keypad

■ External dimensions

LCD Remote keypad RKP004Z

■ Installation on the unit

■ Installation on the panel

Make a hole in the board, as shown in the figure below.

IP54 attachment (option) (SBP006Z)

Remote Keypad (RKP004Z)

LCD cable (option)
Model : CAB0071 (1m)
CAB0073 (3m)
CAB0075 (5m)
CAB00710 (10m)

■ Palm top operation

Connector (option) (CNT001Z)
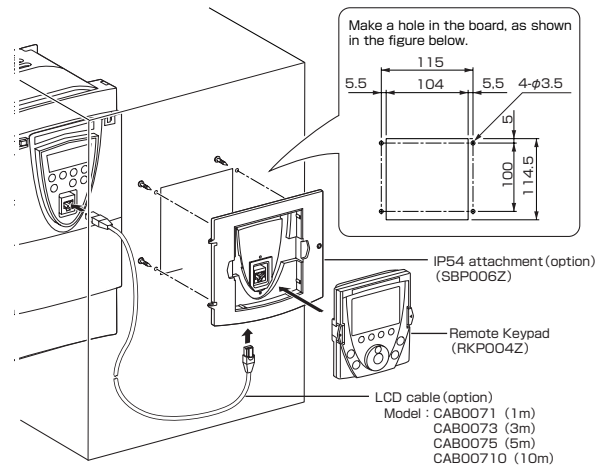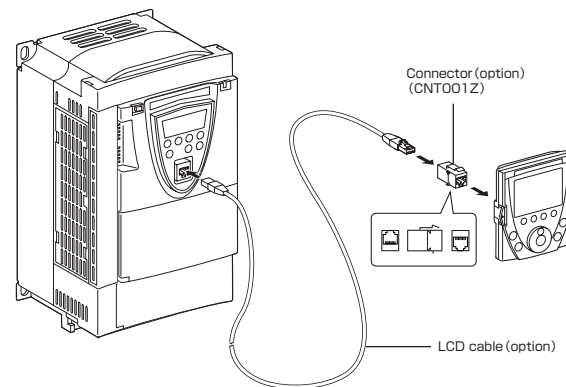
LCD cable (option)

LED Remote Keypad

■ External dimensions

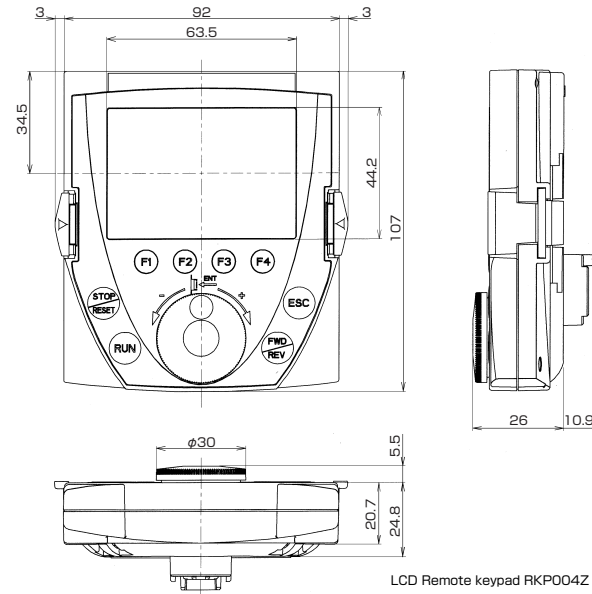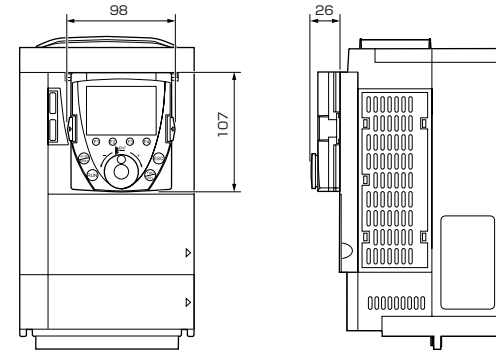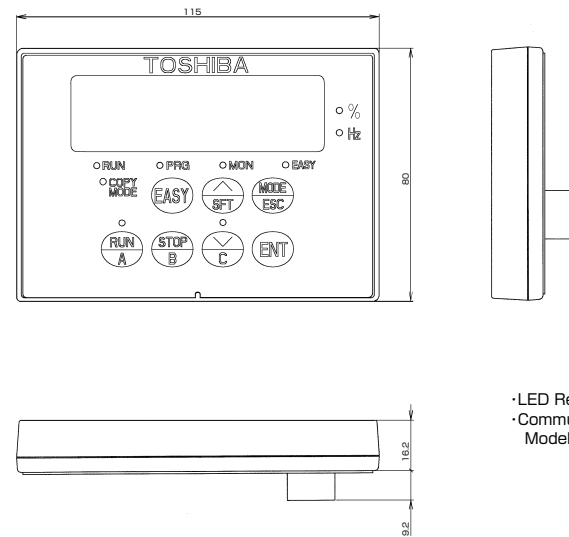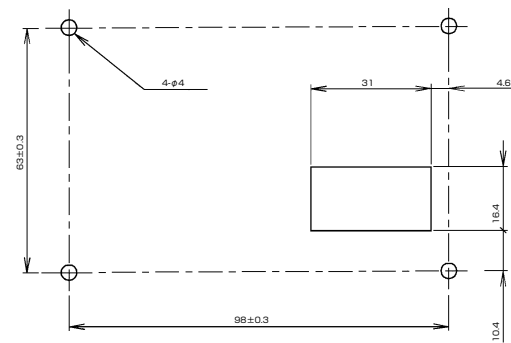・LED Remote Keypad:RKP002Z
・Communication cable (option)
Model:CAB0011 (1m)
CAB0013 (3m)
CAB0015 (5m)

■ Panel cutout dimensions

Heatsink outer option

This options enable the heatsink parts of the backside of inverter that generate much heat to be located at the outside of the panel. This is effective for the small sizing of the totally-enclosed box by reducing the heat values inside the box.

Fig.A

■ Panel cutout dimensions

Model	Inverter type	Dimensions (mm)														Approx. weight (kg) Note)
		a	b	h	A	B	C	D	E	F	G	H	J	K	L	
FOT001Z	VFAS1-2004PL,2007PL,2015PL VFAS1-4007PL,4015PL,4022PL	170	351	15	103	54	222	397	8.5	102.5	8	47	327.5	127	138.6	2.3
FOT002Z	VFAS1-2022PL,2037PL VFAS1-4037PL	198	384.5	14	101	68	250	430	8.5	116.5	8.6	46.5	365.5	137.5	166.6	2.9
FOT003Z	VFAS1-2055PL VFAS1-4055PL,4075PL	215	419	14.5	98	73	268	465	9	125	8.5	46	400.5	149.5	183.6	3.2
FOT004Z	VFAS1-2075PL VFAS1-4110PL	250	438	13	101	95	303	482	9	142.5	8.5	45.7	419	155	220.2	4.1
FOT005Z	VFAS1-2110PM,2150PM VFAS1-4150PL,4185PL	270	537.5	15.5	98	99	325	585	10	152.5	8	45	520.5	189.5	240.2	4.8

Note) The approx. weight shows the heatsink outer option only.

Fig.B

■ Panel cutout dimensions

FOT006Z   FOT007Z

Model	Inverter type	Dimensions (mm)										Approx. weight (kg) Note)
		A	B	C	D	E	F	G	H	J	K	L	
FOT006Z	VFAS1-2185PM,2220PM VFAS1-4220PL	116.7	94.8	340	649	12	19	158	68.7	547.3	53.6	232	4.4
FOT007Z	VFAS1-4300PL,4370PL	144	97.3	340	768	12	19	158	69	677	51	232	5.1

Note) The approx. weight shows the heatsink outer option only.

Fig.C

■ Panel cutout dimensions

FOT008Z   FOT009Z

Model	Inverter type	Dimensions (mm)										Approx. weight (kg) Note)
		A	B	C	D	E	F	G	H	J	K	L	
FOT008Z	VFAS1-2300PM,2370PM,2450PM	143.5	97.8	420	757.5	29	11.5	498	69	673.5	44	313.2	5.1
FOT009Z	VFAS1-4450PL,4550PL,4750PL	178	111.8	420	837.5	29	11.5	578	69	753.5	44	313.2	5.4

Note) The approx. weight shows the heatsink outer option only.

Fig.D

■ Panel cutout dimensions

FOTO10Z　　FOTO11Z　　FOTO12Z

Model	Inverter type	Dimensions (mm)								Approx. weight (kg) Note)
		A	B	C	D	E	F	G	H	
FOTO10Z	VFAS1-2550P VFAS1-4900PC	245	165	420	850	25	15	230	50	5.1
FOTO11Z	VFAS1-2750P VFAS1-4110KPC	140	230	440	885	22	10	230	23	3.6
FOTO12Z	VFAS1-4132KPC	143	227	442	1061	26	20.5	224.5	85.5	4.3

Note) The approx. weight shows the heatsink outer option only.

Fig.E

■ Panel cutout dimensions

FOTO13Z　　FOTO14Z FOTO15Z

Model	Dimensions (mm)			
	D1	a1	J	J1
FOTO14Z	90	610	645	215
FOTO15Z	165	685	720	240

Model	Inverter type	Dimensions (mm)								Approx. weight (kg) Note)
		D	B	C	D	E	F	G	H	
FOTO13Z	VFAS1-4160KPC	143	227	542	1061	26	20.5	224.5	85.5	4.4
FOTO14Z	VFAS1-4200KPC,4220KPC,4280KPC	143	227	697	1061	26	20.5	224.5	85.5	4.7
FOTO15Z	VFAS1-4200KPC,4220KPC,4280K with using PB7-4220K	143	227	772	1061	26	20.5	224.5	85.5	4.9

Note) The approx. weight shows the heatsink outer option only.

USB communications conversion unit

VF-AS1

· USB communications conversion unit
　Model:USB001Z
· Inverter unit connection cable
　Model:CAB0011 (1m)
　　　　CAB0013 (3m)
　　　　CAB0015 (5m)
· USB cable (A-B connection type)
　Use a commercially available USB cable.
　(Compliant with USB1.1/2.0)

Control power supply backup unit

■ External dimensions

Model:CPS002Z
＊CPS002Z can be used for both 200V and 400V class.

■ Connection diagram

Operation panel (Model: CBVR-7B1)

■ External dimensions

Panel cutout dimension

Color : JIS mark 5Y7/1
　　　　(Panel front N1.5)
Approx. weight : 0.7kg

■ Connection diagram

Note) The wire length should be 30m or less the inverter and the operation panel.

Frequency meter 〈QS-60T（80Hz-1mAdc）〉

(Front)　　(Side)　　(Rear)

Panel cutout dimension

Color : N1.5

Approx. weight : 75g

Unit : mm

FRH-KIT

Potentiometer 〈RV30YN-20S-B302〉

Panel cutout dimension

Potentiometer panel
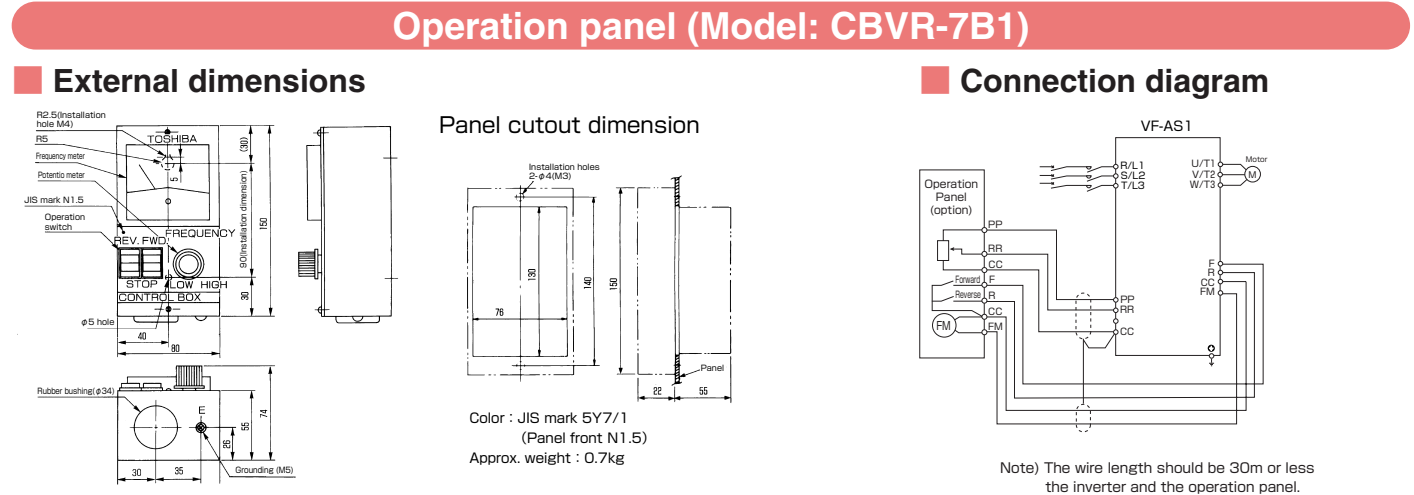

t = 0.2

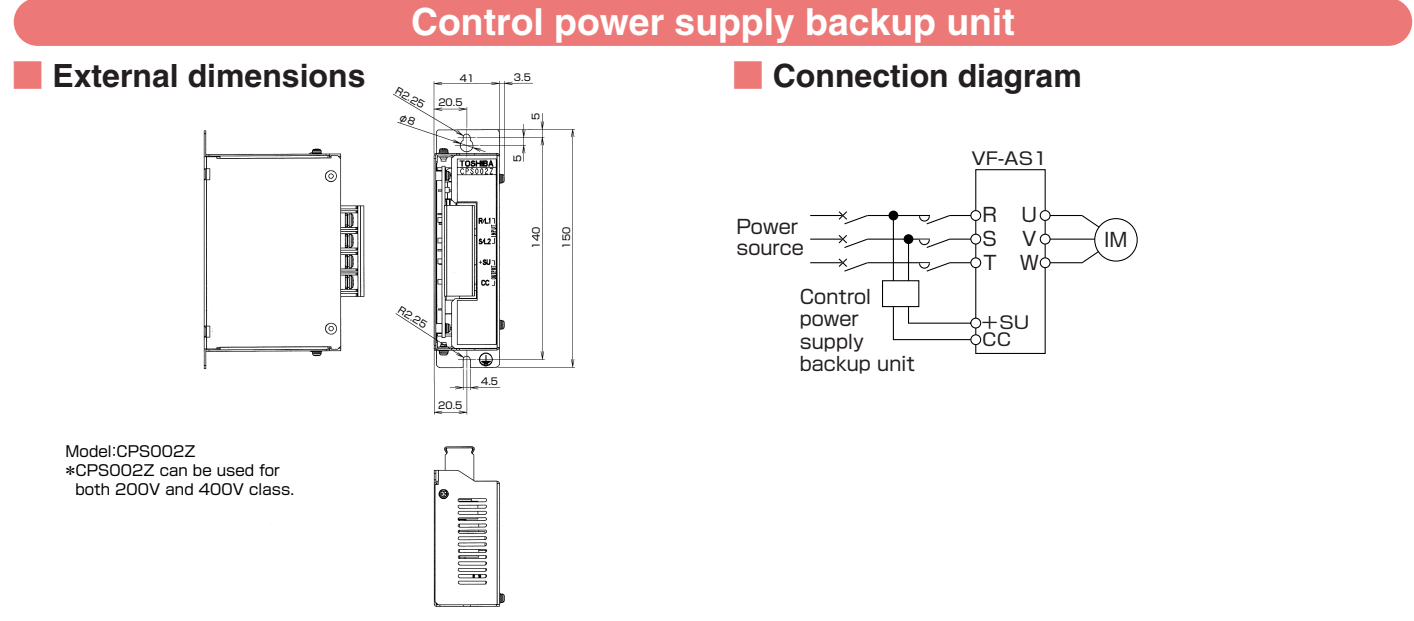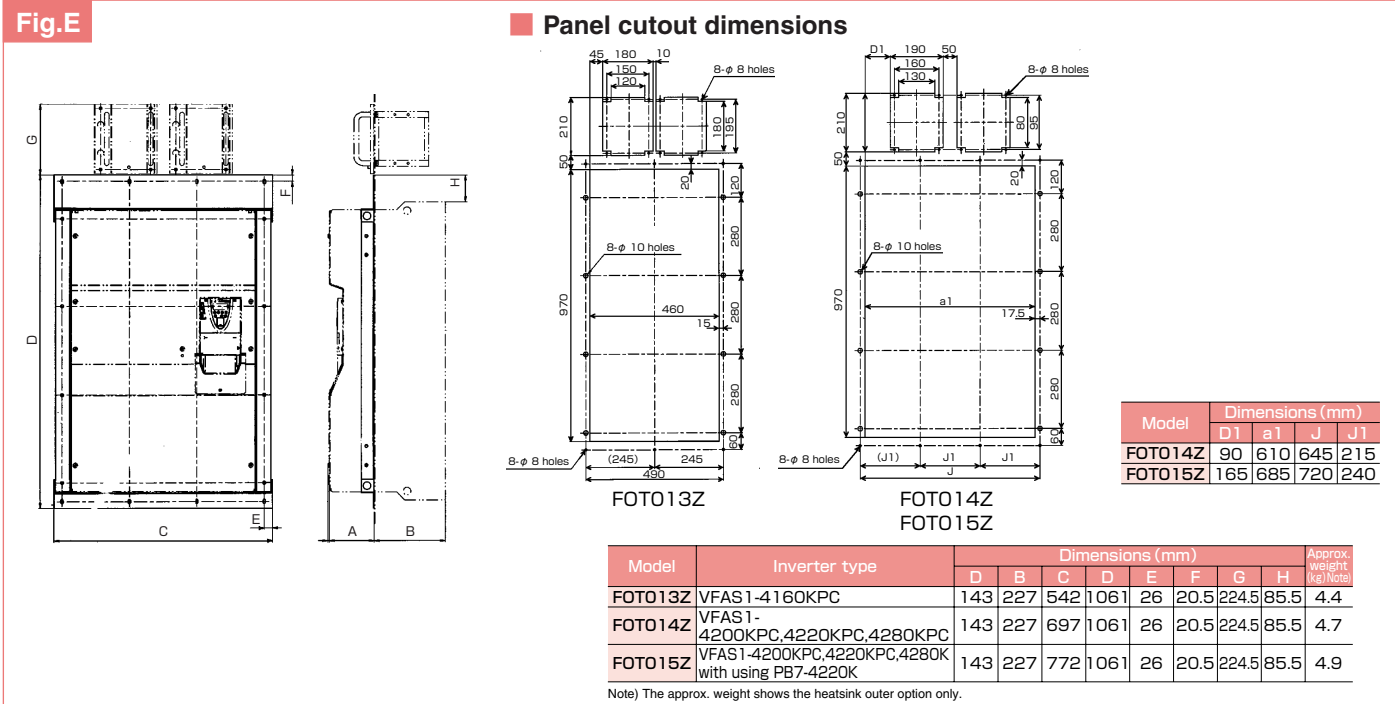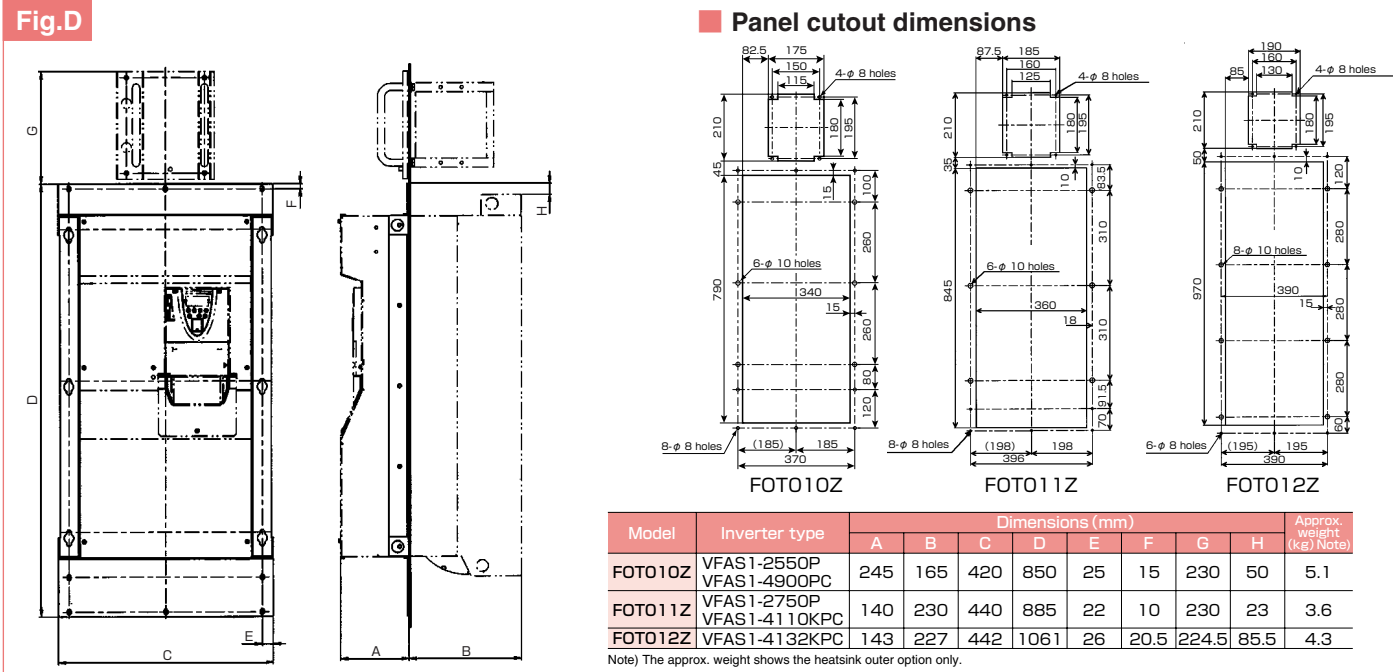### Potentiometer knob 〈K-3〉

White mark

Screw M4×5 P0.7

To users of our inverters : Our inverters are designed to control the speeds of three-phase induction motors for general industry.

⚠ **Precautions**

* Read the instruction manual before installing or operating the inverter unit and store it in a safe place for reference.
* When using our inverters for equipment such as nuclear power control, aviation and space flight control, traffic, and safety, and there is a risk that any failure or malfunction of the inverter could directly endanger human life or cause injury, please contact our headquarters, branch, or office printed on the front and back covers of this catalogue. Special precautions must be taken and such applications must be studied carefully.
* When using our inverters for critical equipment, even though the inverters are manufactured under strict quality control always fit your equipment with safety devices to prevent serious accident or loss should the inverter fail (such as issuing an inverter failure signal).
* Do not use our inverters for any load other than three-phase induction motors.
* None of Toshiba, its subsidiaries, affiliates or agents, shall be liable for any physical damages, including, without limitation, malfunction, anomaly, breakdown or any other problem that may occur to any apparatus in which the Toshiba inverter is incorporated or to any equipment that is used in combination with the Toshiba inverter. Nor shall Toshiba, its subsidiaries, affiliates or agents be liable for any compensatory damages resulting from such utilization, including compensation for special, indirect, incidental, consequential, punitive or exemplary damages, or for loss of profit, income or data, even if the user has been advised or apprised of the likelihood of the occurrence of such loss or damages.

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