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

*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

High-performance Inverter TOSVERT™

VF-AS1

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

* 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																		■	■	■	■	■	■	■	■	■	■

Coming soon

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.

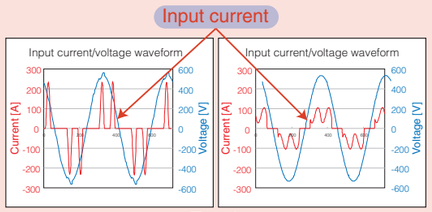
For machinery that requires simple function

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 1 Harmonics Reduction, Power Factor Improvement

Effect of built-in reactor



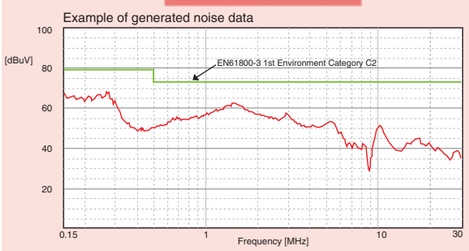
Conventional models (400 V, 30 kW)
Input current value 87.6 A
Overall input power factor 59%

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

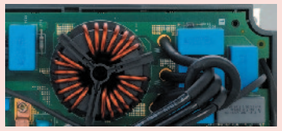
Effect of built-in filter



- 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

Built-in EMC filter



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

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.

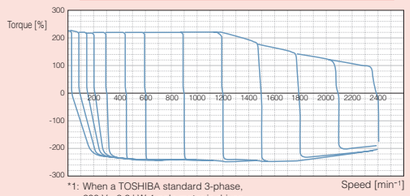
For machinery that reguires high torque and a large capacity

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

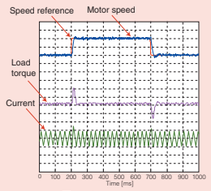


*1: When a TOSHIBA standard 3-phase, 200 V - 2.2 kW 4-pole motor is driven, (Note, however, that torque differs according to voltage and capacity.)

- 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.

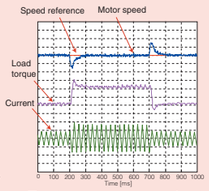
*2: When a TOSHIBA standard 3-phase, 0.4 to 3.7 kW 4-pole motor are driven.

Speed response to reference changes



Fast response

Speed recovery response



Fast recovery against impact load

Point 6 Dedicated Functions Ideal for Lifting Applications

Setup by teaching

Brake sequence/light-load, high-speed functions

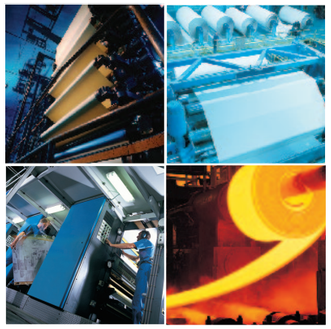
- The inverter has two built-in functions, the brake sequence function and light-load, high-speed function, as standard. The brake sequence function measures the timing with braking by an external motor to achieve smooth operation at start and stop of braking operation. The light-load, high-speed function 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.

VF-AS1

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:

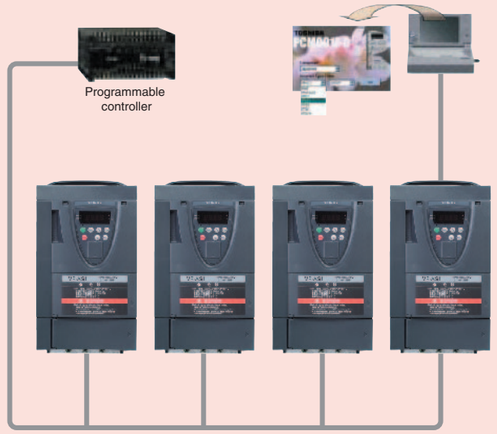
(Ex.1) Inverter is automatically switched to commercial operation without the external sequence when the inverter is tripped.

(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



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 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).

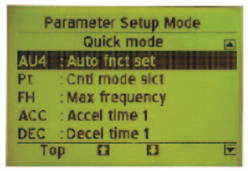
VF-AS1

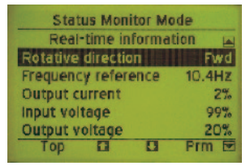
For machinery that requires expansion

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

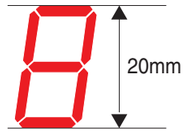




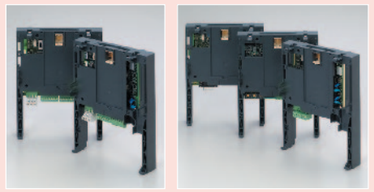
* The photograph shows a screen currently in development.

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



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)

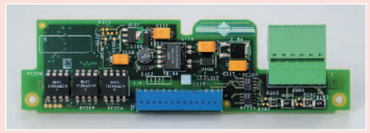
Type: ETB003Z, ETB004Z

Main fieldbuses are supported to enable connection to a host controller to achieve savings in space and centralized control of systems.

- DeviceNet*1 Type: DEV002Z
- PROFIBUS Type: PDP002Z
- CC-Link Type: CCL001Z

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

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 “ ACC ”).

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
FM	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	WN:60, WP:50.0
uLv	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	WN:60.0, WP: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	WN:60.0, WP:50.0
AIF2	VI/II input point 2 frequency	0.0~FH Hz	WN:60.0, WP: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: 0 — Motor type: Standard Motor — Overload protection: ○ (protect) — OL stall: × (not stall) Setting: 1 — Motor type: Standard Motor — Overload protection: ○ (protect) — OL stall: ○ (stall) Setting: 2 — Motor type: Standard Motor — Overload protection: × (not protect) — OL stall: × (not stall) Setting: 3 — Motor type: Standard Motor — Overload protection: × (not protect) — OL stall: ○ (stall) Setting: 4 — Motor type: VF Motor — Overload protection: ○ (protect) — OL stall: × (not stall) Setting: 5 — Motor type: VF Motor — Overload protection: ○ (protect) — OL stall: ○ (stall) Setting: 6 — Motor type: VF Motor — Overload protection: × (not protect) — OL stall: × (not stall) Setting: 7 — Motor type: VF Motor — Overload protection: × (not protect) — OL stall: ○ (stall)	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
FM	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 1.0~8.0kHz)	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.	-
Gr.U	Automatic edit function	-	-

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	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	88	120	144	176
	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, 165%–2 seconds													
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 enclosed type (JEM1030) Note 4)				
Cooling method		Forced air cooling													
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	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 (5.3)	10.5 (8.6)	14.3 (13)	17.6 (17)	27.7 (25)	33 (32)	41	48	66	79	94	116	160
	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, 165%–2 seconds														
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 enclosed type (JEM1030) Note 4)					
Cooling method		Forced air cooling														
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.

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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, 165%–2 seconds	
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		IP20 enclosed type (JEM1030) Note 4)	
Cooling method		Forced air cooling	
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, 165%–2 seconds									
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		IP20 enclosed type (JEM1030) Note 4)									
Cooling method		Forced air cooling									
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 ƒ F) 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, adjustable between 1.0 to 16kHz for 400V-75kW or less200V-55kW or less, adjustable between 1.0 to 8kHz for 400V-90kW or more
	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 reverse run. 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-cosØ=1, 250Vac-1A-cosØ=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 7.7Vdc-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 +65°C
	Relative humidity		20 to 93% (free from condensation)
	Vibration		5.9m/s²{0.6G} or less (10 to 55Hz) (Compliant with JIS C0040)

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.

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External dimensions

200 V class - 0.4 to 45 kW, 400 V class -0.75 to 75 kW model

Figure A

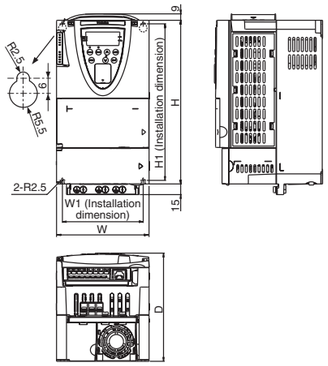


Figure B

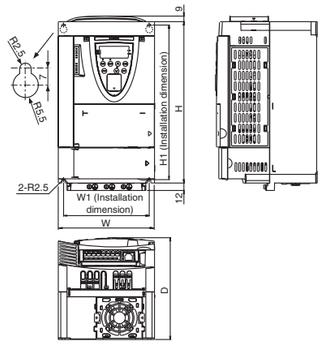


Figure C

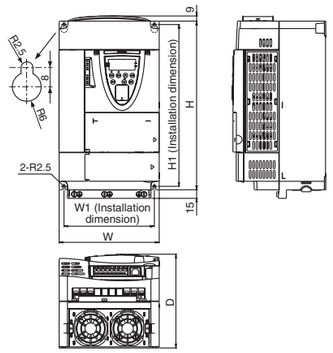


Figure D

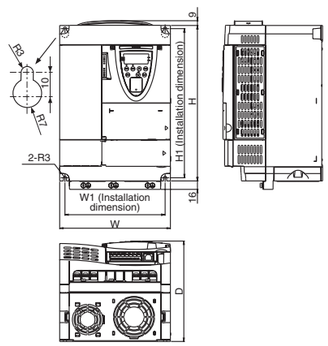


Figure E

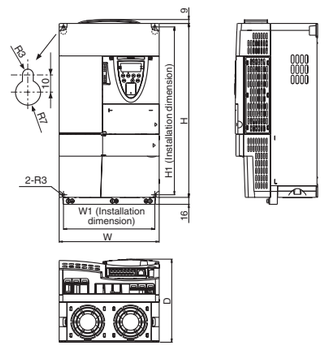


Figure F

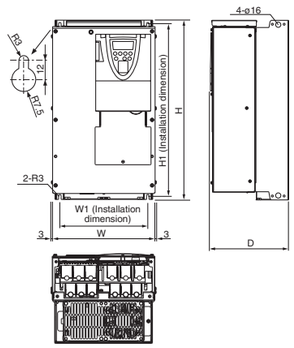


Figure G

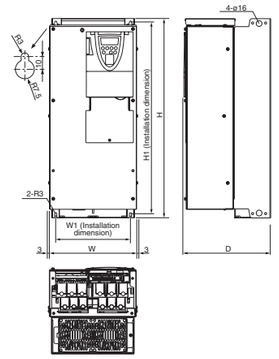


Figure H

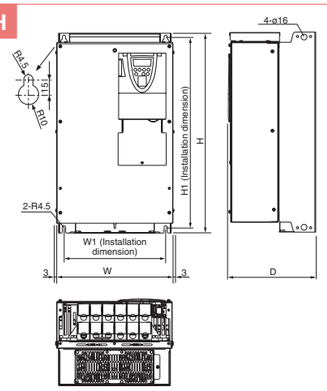
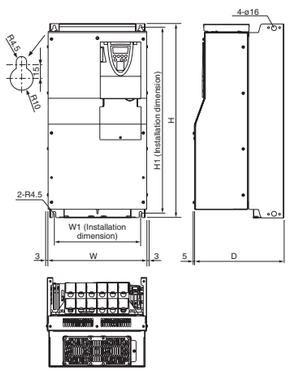


Figure I



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	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
	11	VFAS1-2110PM	230	400	191	210	386	E	9
	15	VFAS1-2150PM							9
	18.5	VFAS1-2185PM	240	420	212	206	403	F	21
	22	VFAS1-2220PM							21
	30	VFAS1-2300PM	320	550	242	280	525	H	39
	37	VFAS1-2370PM							39
	45	VFAS1-2450PM							39
400V	0.75	VFAS1-4007PL	130	230	152	114	220	A	3
	1.5	VFAS1-4015PL							3
	2.2	VFAS1-4022PL							3
	3.7	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	7
	15	VFAS1-4150PL	230	400	191	210	386	E	13
	18.5	VFAS1-4185PL							15
	22	VFAS1-4220PL	240	420	212	206	403	F	21
	30	VFAS1-4300PL	240	550	242	206	529	G	28
	37	VFAS1-4370PL							28
	45	VFAS1-4450PL	320	630	290	280	605	I	47.5
	55	VFAS1-4550PL							47.5
	75	VFAS1-4750PL							47.5

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External dimensions

200 V class - 55 to 75 kW, 400 V class - 90 to 500 kW model

Figure J

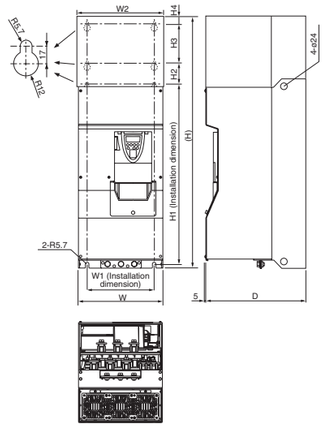


Figure J'

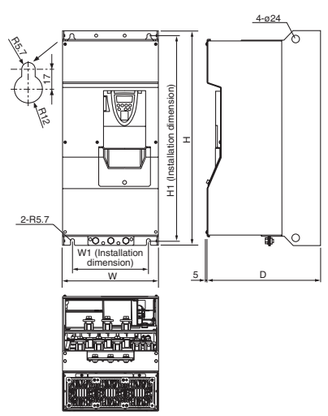


Figure M

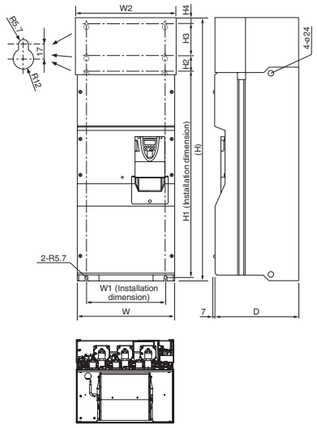


Figure M'

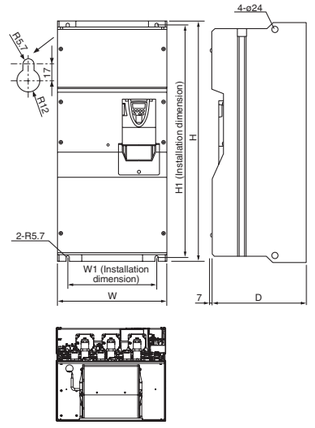


Figure K

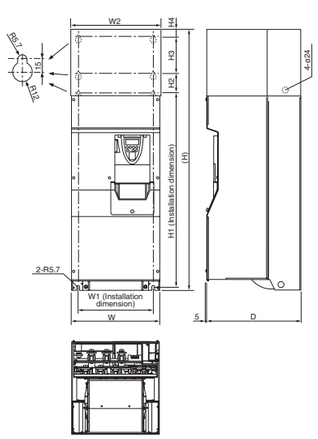


Figure K'

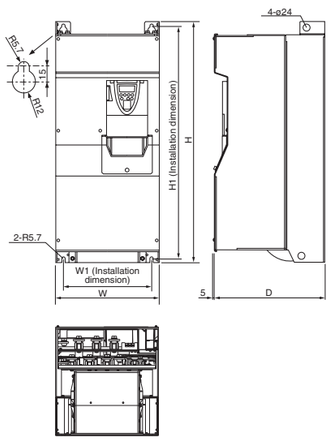


Figure N

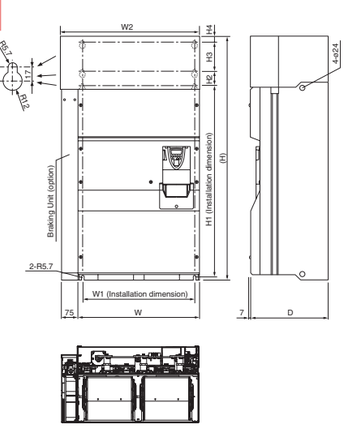


Figure N'

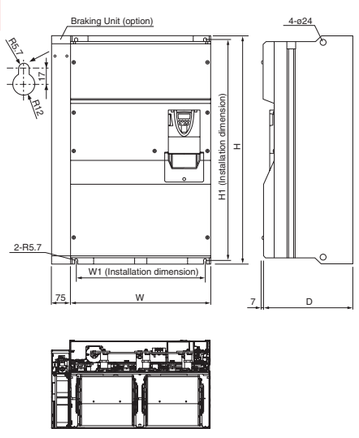


Figure L

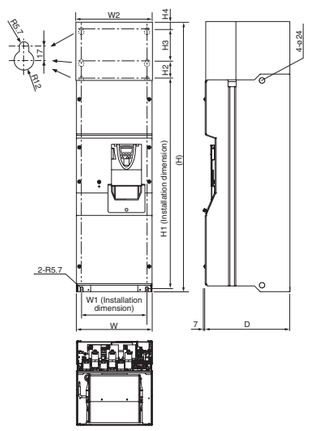
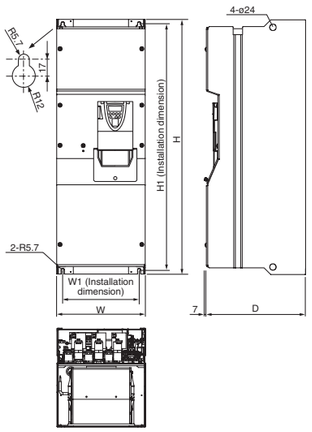


Figure L'



Input Voltage Class	Applicable Motor (kW)	Inverter Type	Dimensions (mm)									Drawing	Approx. Weight (kg)
			W	H	D	W1	H1	W2	H2	H3	H4		
200V	55	VFAS1-2550P	310	920 (680)	370	250	650	320	75	150	30	J (J')	84 (59)
	75	VFAS1-2750P	350	1022 (782)	370	298	758	360	72	150	30	K (K')	106 (72)
400V	90	VFAS1-4900PC	310	920 (680)	370	250	650	320	75	150	30	J (J')	84 (60)
	110	VFAS1-4110KPC	350	1022 (782)	370	298	758	360	72	150	30	K (K')	106 (74)
	132	VFAS1-4132KPC	330	1190 (950)	370	285	920	340	75	150	30	L (L')	116 (80)
	160	VFAS1-4160KPC	430	1190 (950)	370	350	920	440	75	150	30	M (M')	163 (110)
	200	VFAS1-4200KPC	585	1190 (950)	370	540	920	595	75	150	30	N (N')	207 (140)
	220	VFAS1-4220KPC											207 (140)
	280	VFAS1-4280KPC											207 (140)
	355	VFAS1-4355KPC	Coming soon										
	400	VFAS1-4400KPC											
	500	VFAS1-4500KPC											

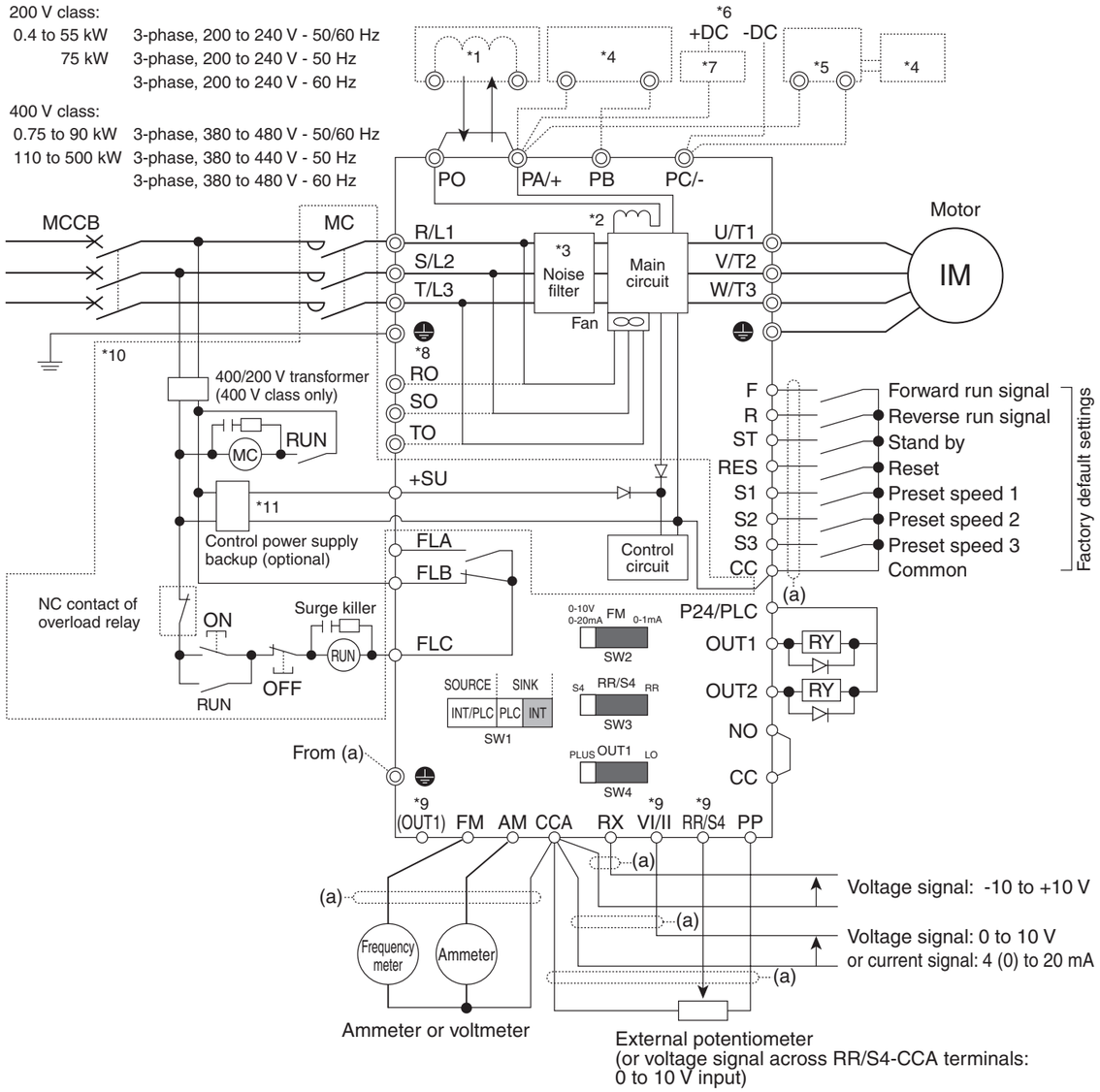
Note) Values in ( ) are not DC reactor attached.

Standard connection diagrams

Main circuit power supply

200 V class:
0.4 to 55 kW 3-phase, 200 to 240 V - 50/60 Hz
75 kW 3-phase, 200 to 240 V - 50 Hz
3-phase, 200 to 240 V - 60 Hz

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



*1: The inverter is shipped with the terminals PO and PA/+ shorted with a bar (200V-45kW or smaller, 400V-75kW or smaller).
Remove this shorting bar when installing a DC reactor (DCL).
For 200 V - 55 kW or more, and 400 V - 90 kW or more models, be sure to install the DC reactor.
*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 200 kW 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 you want to use a 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/VII and RR/S4 can be switched 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. In such a case, the backup device is used at the same time with the internal power supply of the inverter.
*11: The optional control power backup unit can be used with both 200V and 400V models.

Terminal functions

Main circuit terminal

Terminal Symbol	Terminal Function
⏚	Grounding terminal for inverter casing
R/L1, S/L2, T/L3	200V class: 0.4~45kW Three-phase 200~240V-50/60Hz 55kW, 75kW Three-phase 200~220V-50Hz Three-phase 200~240V-60Hz 400V class: 0.75~75kW Three-phase 380~480V-50/60Hz 90~500kW Three-phase 380~440V-50Hz Three-phase 380~480V-60Hz
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.
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 Lan current signal. Choose low current contacts to avoid poor attaching. * Sink/source selectable with SW1 Sink input: ON : Less than DC10V, OFF : DC16V or more Source input: ON : DC11V or more, OFF : Less than DC5V Note: 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.
R	Input	Multifunction programmable contact input: Shorting across R-CC causes reverse rotation; open causes deceleration stop. (Across ST-CC is short state.)	
ST	Input	Multifunction programmable contact input: The motor is on standby if ST and CC are connected. It coasts to a stop if this connection is broken. This terminal can be used for interlocking.	
RES	Input	Multifunction programmable contact 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.	
S1	Input	Multifunction programmable contact input: Shorting across S1-CC causes preset speed operation.	
S2	Input	Multifunction programmable contact input: Shorting across S2-CC causes preset speed operation.	
S3	Input	Multifunction programmable contact input: Shorting across S3-CC causes preset speed operation.	
RR/S4	Input	Multifunction programmable contact 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 supply backup.	—
PP	Output	Analog input setting power output	10Vdc (Permissible load current:10mAdc)
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 *Sink logic/source logic switchable
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.	
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.

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 (manufactured by Toshiba Schneider Inverter Corporation) 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.

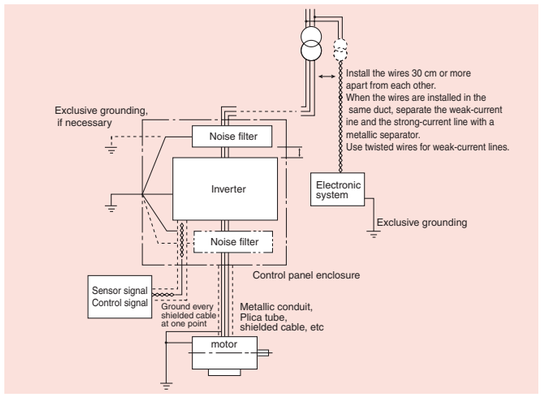
[Measures against noises]

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 0.75 to 750kW 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 VF-S11 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.

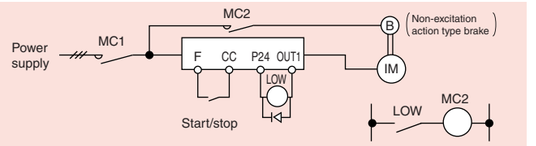
Frequency

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 Type	Molded-case circuit Breaker (MCCB) Current Leakage Breaker (ELCB) Note 2), Note 3) Note 12)				Electromagnetic contactor (MC) Note 2), Note 4), Note 5), Note 6)				Size of Electrical Lead Note 7), Note 8)				Inverter Terminal Screw Size Note 9)	
			No Reactor		DC Reactor Provided		No Reactor		DC Reactor Provided							
			Rated Current (A)	MCCB Type (Figures in parentheses () are for ELCB type. Note 1)	Rated Current (A)	MCCB Type (Figures in parentheses () are for ELCB type. Note 1)	Rated Current (A)	Model Note 1)	Rated Current (A)	Model Note 1)	Main Circuit (mm^2)	DC Reactor (mm^2)	Braking Resistor/ Braking Unit ($m\Omega$) Note 11)	Ground Lead (mm^2)	Main Circuit Terminal Note 10)	GND Terminal
200V	0.4	VFAS1-2004PL	6.3	GV2L10	4	GV2L08	9	LC1D096	9	LC1D096	2.0	2.0	2.0	3.5	M4	M5
	0.75	VFAS1-2007PL	10	GV2L14	6.3	GV2L10	9		9		2.0	2.0				
	1.5	VFAS1-2015PL	18	GV2L20	10	GV2L14	9		9		2.0	2.0				
	2.2	VFAS1-2022PL	25	GV2L22	14	GV2L16	9		9		2.0	2.0				
	3.7	VFAS1-2037PL	32	GV2L32	25	GV2L22	12	LC1D126	9		3.5	2.0				
	5.5	VFAS1-2055PL	50	NJ50EB (NJV50EB)	32	GV2L32	12		12	LC1D126	5.5	3.5	5.5	5.5		
	7.5	VFAS1-2075PL	60	NJ100FB (NJV100FB)	40	NJ50EB (NJV50EB)	32	LC1D326	25	LC1D256	8.0	5.5		8.0	M5	
	11	VFAS1-2110PM	–	–	75	NJ100FB (NJV100FB)	–	–	50	LC1D506	14	8.0		14	M6	
	15	VFAS1-2150PM	–	–	100		–	–	50		14	14				
	18.5	VFAS1-2185PM	–	–	100		–	–	50		22	22	8.0	22	M8	
	22	VFAS1-2220PM	–	–	125	NJ225FB (NJV225FB)	–	–	80	LC1D806	22	22	14		M12 Note 10)	M8
	30	VFAS1-2300PM	–	–	150		–	–	80		38	38				
	37	VFAS1-2370PM	–	–	175		–	–	115	LC1D1156	60	60	22	38		
	45	VFAS1-2450PM	–	–	200		–	–	150	LC1D1506	60	100				
	55	VFAS1-2550P	–	–	250	NJ400F (NJV400F)	–	–	185	LC1F185	100	100		60		M10
	75	VFAS1-2750P	–	–	350		–	–	265	LC1F265	150 Note 10)	150	38 (14×2)	100		
400V	0.75	VFAS1-4007PL	6.3	GV2L10	4	GV2LO8	9	LC1D096	9	LC1D096	2.0	2.0	2.0	3.5	M4	M5
	1.5	VFAS1-4015PL	10	GV2L14	6.3	GV2L10	9		9		2.0	2.0				
	2.2	VFAS1-4022PL	14	GV2L16	10	GV2L14	9		9		2.0	2.0				
	3.7	VFAS1-4037PL	18	GV2L20	14	GV2L16	9		9		2.0	2.0				
	5.5	VFAS1-4055PL	32	GV2L32	25	GV2L22	12	LC1D126	12	LC1D126	2.0	2.0	2.0			
	7.5	VFAS1-4075PL	32		25		18	LC1D186	18		3.5	2.0				
	11	VFAS1-4110PL	50	NJ50EB (NJV50EB)	30	NJ30E (NJV30E)	25	LC1D256	18	LC1D186	5.5	3.5		5.5	M5	
	15	VFAS1-4150PL	60	NJ100FB (NJV100FB)	40	NJ50EB (NJV50EB)	32	LC1D326	25	LC1D256	8.0	5.5		8.0	M6	
	18.5	VFAS1-4185PL	–	–	60	NJ100FB (NJV100FB)	–	–	32	LC1D326	8.0	5.5	5.5		M8	
	22	VFAS1-4220PL	–	–	60		–	–	32		8.0	8.0				
	30	VFAS1-4300PL	–	–	100		–	–	50	LC1D506	14	14		14		
	37	VFAS1-4370PL	–	–	100		–	–	80	LC1D806	22	22	14	22		
	45	VFAS1-4450PL	–	–	125	NJ225FB (NJV225FB)	–	–	80		38					M8
	55	VFAS1-4550PL	–	–	150		–	–	80		38	38				
	75	VFAS1-4750PL	–	–	200		–	–	115	LC1D1156	60	60		38		
	90	VFAS1-4900PC	–	–	200		–	–	150	LC1D1506			22			
	110	VFAS1-4110KPC	–	–	250	NJ400F (NJV400F)	–	–	185	LC1F185	100	100		60		M10
	132	VFAS1-4132KPC	–	–	300		–	–	225	LC1F225	100 Note 10)	150				
	160	VFAS1-4160KPC	–	–	350		–	–	265	LC1F265	150 Note 10)	150		100	M12 Note 10)	
	200	VFAS1-4200KPC	–	–	500	NJ600F (NJV600F)	–	–	400	LC1F400	200	150×2	60 (22×2)	100		M12
	220	VFAS1-4220KPC	–	–	500		–	–	400							
	280	VFAS1-4280KPC	–	–	600		–	–	500	LC1F500	150×2	200×2	100 (60×2)	150		
	355	VFAS1-4355KPC	Coming soon													
	400	VFAS1-4400KPC														
	500	VFAS1-4500KPC														

Note 1) Indicates the recommended model No. of product made by Toshiba Schneider Electric Ltd.
Note 2) Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50Hz.
Note 3) 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 4) 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 5) Attach surge killers to the magnetic contactor and exciting coil of the relay.
Note 6) 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 7) 600 V HIV insulated electrical lead is indicated as the power lead type, and electrical lead R, S and T on the input side and U, V and W on the output side are indicated as the size of the electrical lead on the main circuit. Limit the wiring distance between the inverter and the motor to 30 m. When the wiring exceeds 30 m, increase the size of the electrical lead.
Note 8) For the control circuit, use shielded wires whose size (cross-section) is 0.75 mm^2 or more.
Note 9) The screw size of the control terminals is M3.
Note 10) Terminals R/L1, S/L2, T/L3, U/T1, V/T2, and W/T3 of the VFAS1-2550 to 2750P, and 4900PC to 4132KPC are M10.
Note 11) This is the recommended electrical lead size when an external braking resistor is used. For details on electrical lead size of braking resistors for high frequency regeneration, consult us separately.
Note 12) On 200 V class 55 kW or more, and 400 V class 110 kW or more models, be sure to install the DC reactor (option).

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	$ta = \frac{(JM+JL) \times \Delta N}{9.56 \times (TM-TL)}$ (sec.)
Deceleration time	$ta = \frac{(JM+JL) \times \Delta N}{9.56 \times (TB+TL)}$ (sec.)
Conditions	JM : Moment of inertia of motor ($kg.m^2$) JL : Moment of inertia of load ($kg.m^2$) (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 1.2-1.3 (N.m) ... V/f control : Motor rated torque x 1.5 (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))

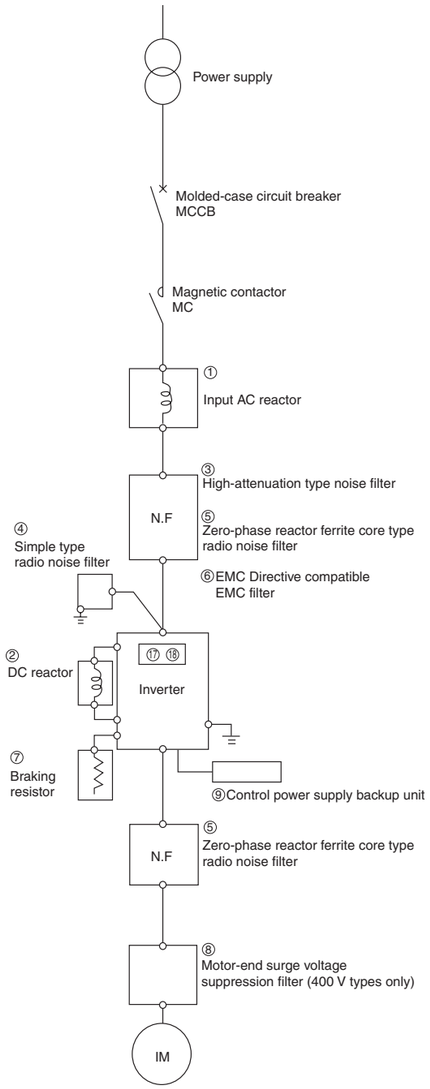
Allowable torque characteristics

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 inverterÅfs 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. (200% in sensorless control mode, though this rate varies with the motor characteristics.) 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



External option

No.	Name		Function/Purpose, etc.
①	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.
②	DC reactor		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.
③	Radio noise reduction filter	High-attenuation type (LC filter) NF type made by Soshin Electric Co., Ltd.	200 V - 7.5 kW or less, and 400 V - 75 kW or less models have a built-in high-attenuation noise filter. However, use this filter when noise must be suppressed even more. ●This is effective in preventing radio wave interference on audio equipment used near the inverter. ●Install it on the input side of the inverter. ●It is effective in attenuating in a wide range from AM radio bands through to 10 MHz. ●Use it when equipment that is susceptible to noise is installed nearby.
④		Simple type (capacitive filter) Capacitor type made by Marucon Electronics	●This is effective in preventing radio wave interference on audio equipment used near the inverter. ●Install it on the input side of the inverter. ●This option is effective in attenuating only specific frequency bands. It is useful as a noise countermeasure for specific AM radio stations (where radio waves are weak, for example, in mountain areas). ●Current leakage increases as it is a capacitor type. Avoid use of many of these options when an ELCB is installed on the power supply side.
⑤		Zero-phase reactor (inductive filter) Ferrite core type made by Soshin Electric Co., Ltd.	●This is effective in preventing radio wave interference on audio equipment used near the inverter. ●This is also effective in reducing noise on the input side and output side of the inverter. ●It has attenuation characteristics of several dB from AM radio bands through to frequency bands up to 10 MHz.
⑥	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).
⑦	Braking resistor		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.
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.
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. (Type : CPS001Z)
⑩	LED extension panel (w/ parameter writer function)		This operation panel unit 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 panel. (Type : RKP002Z)
⑪	LCD extension panel (installable on body)		This operation panel unit is for extension or mounting on the inverter body. Its 11-character, 8-line "hiragana" and Kanji display facilitates parameter setup. The dedicated cable for the LCD extension panel is required for connecting it to the inverter. (Type : RKP004Z)
⑫	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 (Type : USB001Z)
⑬	Communications cable		Connector cable for LED extension
⑭	Operation panel		Has a built-in frequency type, frequency setter and RUN-STOP (forward run, reverse run) switch. (model type: CBVR-7B1)
⑮	Applied control unit		The AP Series that supports various applied control in combination with an inverter is also available.
⑯	Heat sink outside protrusion option		This allows heat generated inside panels to be reduced.

Reactor

Reactor	Effect		
	Improved Power Factor	Harmonics	External Surge Suppression
Input AC Reactor	○	○	○
DC Reactor	○very	○very	×

○very: very effective
○: effective
×: ineffective

■ Built-in options

No.	Name	Function/Purpose, etc.
⑰	Expanded terminal block option card	This option is convenient for adding on special functions. (Type : ETB003Z, ETB004Z)
	CC-Link communications option card	This option enables CC-Link communications with a host controller or other PLC. (Type : CCL001Z)
	DeviceNet communications option card	This option enables DeviceNet communications with a host controller or other PLC. (Type :DEV002Z)
	PROFIBUS communications option card	This option enables PROFIBUS communications with a host controller or other PLC. (Type : PDP002Z)
⑱	Encoder feedback option card (complimentary output/line driver output)	Higher performance operation is possible by combining with a motor equipped with a sensor. (Type : VEC004Z, VEC005Z, VEC007Z)

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 (SC7).
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.

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.

For further information, please contact your nearest Toshiba Representative or International Operations-Producer Goods.
The information in this brochure is subject to change without notice.

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