

Built-in EMI noise filter
Introducing the world's top class compact inverter



1-phase 240V 0.2kW to 2.2kW
 3-phase 240V 0.4kW to 15kW
 3-phase 500V 0.4kW to 15kW
 3-phase 600V 0.75kW to 15kW

New Global Standard Inverter TOSVERT™

VF-S11

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.
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In Touch with Tomorrow
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They look the same,
but if you crack the shell you can see the difference.
The VF-S11 reveals the potential and future of inverters.



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ISO-9001 certification
This product is designed and manufactured at plants that have acquired ISO-9001 certification, the worldwide quality assurance benchmark.

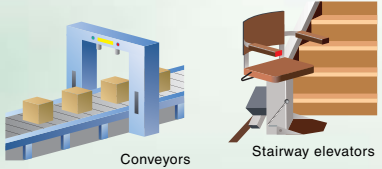
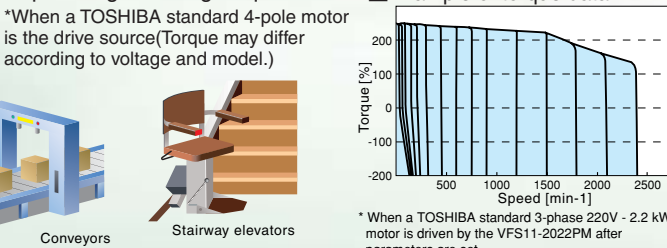
ISO-14001 certification
The plants that manufacture this product are registered as compliant with ISO-14001, the environmental management system.

Compatible with the World's Main Standards
(EC Directive (CE marking), UL, CSA)

VF-S11 - The easy-to-use inverter for a variety of machines and facilities

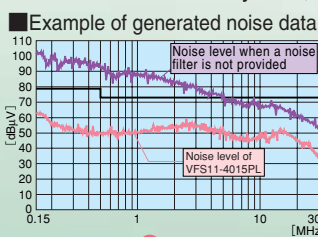
For users who need large starting torque

Conveyors, hoists, stairway elevators, and other conveyance machinery often need a large torque at startup. The VF-S11 incorporates a TOSHIBA proprietary control system -- current vector calculation control -- to generate starting torque of 1Hz - 200% or more*. This provides sufficient leeway in applications that require large starting torque.



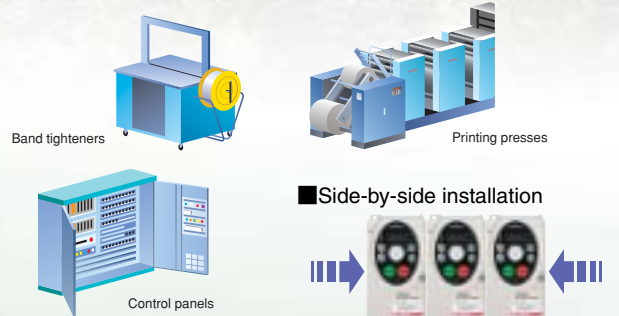
For users troubled by electromagnetic noise

Equipment such as commercial ironing boards, car washers and indoor running machines, that are used in the fields of health, medicine and welfare care, the environment and in our daily lives, cause a great deal of trouble to the surrounding area if they generate electromagnetic noise. The VF-S11 incorporates a noise filter in its compact body to drastically reduce any generated electromagnetic noise. The VF-S11 also complies with the EU EMC Directive. (See page 4.)



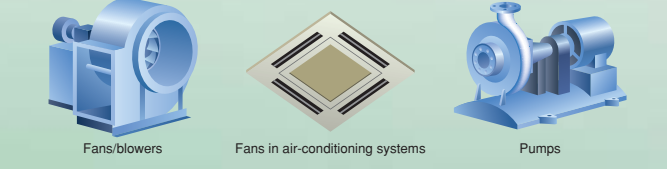
For users with limited installation space

The VF-S11 has been downsized considerably in comparison with conventional models. In addition, side-by-side installation means that you can further save space as two or more units can be installed in close proximity next to each other.



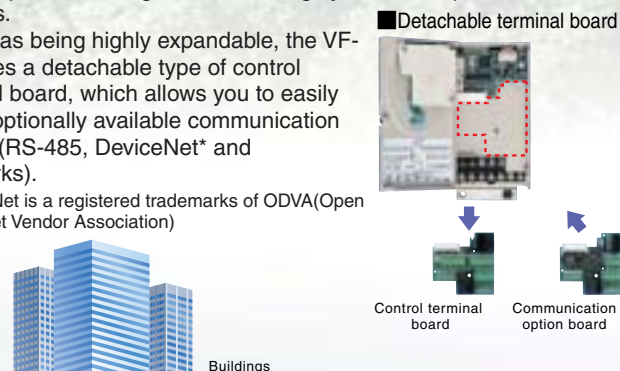
For users who place importance on maintenance

Fans, pumps, blowers, and air-conditioning equipment must be maintained on a regular basis. The VF-S11 monitors the expected replacement period of spare parts and outputs an alarm to serve as a rough guideline for when to perform maintenance. Capacitors on the main circuit have been designed to have a life of 10 years*. In addition, the VF-S11 can be used in an ambient temperature of up to 60°C and demonstrates excellent environmental resistance.



For users who need expandability

You often need to control and monitor systems by communications, for example, in building air-conditioning systems and plant line control systems. As well as being highly expandable, the VF-S11 uses a detachable type of control terminal board, which allows you to easily mount optionally available communication boards (RS-485, DeviceNet* and LonWorks). * DeviceNet is a registered trademarks of ODVA (Open DeviceNet Vendor Association)



For users who need a wide capacity and range of models

For obtaining spare parts and easy maintenance for the same machinery and facilities, wouldn't you like a lineup of the same kind of inverters? For an inverter in its class, the VF-S11 boasts a broad capacity range extending up to 15 kW. The VF-S11 also comes in a lineup of totally enclosed box types that can be used in severe installation environments subject to lots of water and dust.

Line-up

Input Voltage Class	Applicable motor (kW)										
	0.2	0.4	0.55	0.75	1.5	2.2	4.0	5.5	7.5	11	15
1-phase 240V	IP20										
	IP54*2										
3-phase 240V	IP20										
	IP54*2										
3-phase 500V	IP20										
	IP54*2										
3-phase 600V	IP20										

* 1: 0.55kW model is 3-phase 240V class IP20 type only.
* 2: IP54 type is possible to bring into compliance with IP55 specification.

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VF-S11

Applicable specification by each segment

The VF-S11 is provided with a wide range of useful functions for machinery and facilities in various industrial sectors and applications.

Fan & Pumps Air-conditioning systems, various fans, blowers, pumps, plumbing/sewerage systems, clean rooms, driers Noise filter, Replacement alarm, Life 10 years, 60C*, Capacity range, Totally enclosed Energy savings, Deceleration, Restart, Non-stop, One-touch, PID control, Ground capacitor, Standards	Conveyance machinery Conveyors, automatic vertical storage units, hoists, lifts, dumbwaiters High torque, Compact, Side-by-side, Capacity range, Totally enclosed Braking resistance, 8 inputs, 2 output functions, Step width, Free unit, Speed control, Standards
Food processing machinery Bread, confectionery, tea, and noodle making machines, rice, wheat and powder milling machines, mixers, slicers, and fruit selection machines High torque, Noise filter, Compact, Side-by-side, 60C*, Capacity range Totally enclosed box type, Deceleration, Braking resistance, 8 inputs	Packaging machinery Trimming machines, packing machines, wrapping machines, band tighteners High torque, Noise filter, Compact, Side-by-side, Detachable, Communications Capacity range, Totally enclosed, Deceleration, Braking resistance
Medical equipment Stairway elevators, nursing beds, Jacuzzis, health equipment (treadmills), medical equipment (X-ray machines) High torque, Noise filter, Compact, Side-by-side, Detachable Braking resistance, Free unit, Ground capacitor	Commercial facility equipment Commercial ironing boards, car washing machines, raw garbage disposal, dust collectors High torque, Noise filter, Compact, Side-by-side, Communications, Capacity range Braking resistance, Ground capacitor
Amusement machinery Batting machines, pinball feeders, game machines High torque, Noise filter, Compact, Side-by-side, 60C*, Totally enclosed Braking resistance, Ground capacitor	Semiconductor production equipment Semiconductor production equipment, LCD production equipment, electronic component production and assembly machinery High torque, Noise filter, Compact, Side-by-side, Life 10 years, Capacity range Speed control, Ground capacitor
Printing machinery Platemakers, binding machines, printing presses High torque, Compact, Side-by-side, Capacity range Step width, Free unit	Woodworking machinery Lumber machinery, woodworking machinery, plywood making machinery High torque, Compact, Capacity range, Totally enclosed 500 Hz, Power voltage
Agricultural machinery Rice and wheat milling machines, fruit selection machines High torque, Noise filter, Compact, Side-by-side, 60C*, Totally enclosed Braking resistance, Ground capacitor	Chemical machinery Mixers, extruding machines, centrifugal separators, painting machines, pulverizers High torque, Compact, Capacity range Restart, Non-stop, Pulse train
Machine tools Lathes, drilling machines, hobbing machines, grinding machines, boring machines High torque, Compact, Capacity range 500 Hz	Metal processing machinery Various rolling and shearing machinery, mechanical pressing, winding and take-up machines High torque, Compact, Capacity range Braking resistance
Textile machinery Weaving machines, knitting machines, dyeing/finishing machines, sewing machine Compact, Detachable, Communications 500 Hz	Panel manufacturer Control panels, special control panels Compact, Side-by-side, 60C*, Detachable, Capacity range, Ground capacitor
General General related items, common items, other History, Log details, 28 monitors, Storage	



Explanation of symbols

High torque	High torque (1 Hz - 200% or more)	Capacity range	Wide capacity range up to 15 kW.	8 inputs	8 logic inputs	Standards	Compatible with main standards (CE, UL, CSA)
Noise filter	Built-in noise filter	Totally enclosed	Totally enclosed box type (IP54, IP55 compatible)	2 output functions	2 output terminal functions are assigned.	Sink/source	Sink/source logic switching
Compact	Small-sized, compact	Energy savings	Dynamic energy saving function	Step width	Variable step width setting	History	History function
Side-by-side	Side-by-side installation	Deceleration	Dynamic deceleration time reduction	Free unit	Free unit multiplication factor, bias setting	Log details	Detailed information of past tripping
Replacement alarm	Expected replacement period alarm for spare parts	Restart	Instantaneous power interruption restart (frequency scan system)	500 Hz	Max. frequency 500 Hz	28 monitors	28 monitor functions (power, watt-hour power)
Life 10 years	Main circuit capacitor designed to have a life of 10 years	Non-stop	Instantaneous power interruption non-stop control function	Pulse train	Pulse train output	Storage	Storage of user parameter settings
60°C	Possible installed in an ambient temperature 60°C	One-touch	One-touch fan replacement	Speed control	Speed control accuracy		
Detachable	Detachable terminal block	PID control	PID control with wait time	Power voltage	Wide power supply voltage range (240 V, 500 V)		
Communications	Built-in communications options	Braking resistance	Built-in braking resistor drive circuit	Ground capacitor	Ground capacitor disconnection switch		

Dynamic Automatic Energy Savings

Energy savings Dynamic automatic energy savings: A new function exclusively for fans and pumps in addition to the conventional energy savings mode. With this function, you can expect considerable energy savings.

Deceleration Dynamic deceleration time reduction control: Conventional deceleration time reduction control has been further modified. With this function, you can expect a certain amount of reduction in deceleration time even without the aid of a braking resistor.

28 monitors Energy saving effect monitor: Besides monitoring of input/output power (momentary values), the effect of energy savings can be easily checked as the input/output watt-hour power (electric energy) can be monitored.

Restart Instantaneous power interruption restart function: The inverter can be restarted smoothly without any shock as it employs a frequency scan system.

Non-stop Instantaneous power interruption non-stop control: This function uses the regenerative energy from the motor to continue inverter operation when a power interruption occurs during operation. In the same way, regenerative energy can be used to decelerate the motor to a stop without the inverter running free and then stopping.

PID control PID control: Conventional PID control functions have been enhanced for even easier use. New functions are a wait time for applying a time period in which PID control is disabled at startup and a function for resetting integrated amounts.

Various Input Terminals

8 inputs 8 contact input terminals: Analog input terminals can be selected as contact inputs. This means that up to eight contact inputs can be set to support more complex settings.

8 inputs 76 menus: A variety of operation specifications are supported as functions selected from 66 menus can be individually assigned to contact input terminals.

8 inputs Use of external power supply possible: A PLC terminal is provided for input of an external +24 V power supply. This is convenient when the inverter is connected to a programmable controller. A +24 V power supply is also integrated into the inverter which can also be used for contact input.

Various Output Terminals

2 output functions 3 contact output terminals: Various outputs are provided on three terminals, relay contact (1c) output, relay contact (1a) output, and open collector output.

Pulse train Pulse train output: Open collector output is insulated from other circuits so that it can also be used as pulse train output.

2 output functions 58 menus: Functions selected from 58 menus can be individually assigned to contact output terminals. Moreover, two menus can be simultaneously assigned to a single terminal. A hold function for holding the state of an input once it turns ON is also provided. This enables inverter compatibility with various operation specifications.

2 output functions Analog output terminal: Any of 0 to 10 V, 0 to 1 mA and 4 to 20 mA can be selected. Also, data can be selected from 20 menus.

Compatibility with World's Main Standards

Standards Compatibility with main standards: All models are compatible with the World's Main Standards (EC Directive (CE marking), UL, and CSA. Some of C-tick complied models are also available.

Sink/source Sink/source logic switching: Sink or source (i.e. positive - negative) on input terminals can be easily switched by the bit switch on the circuit board.

Noise filter Built-in noise filter: A noise filter is built into all models.

Model	Built-in Filter	European EMC Directive
Single-phase models, 500 V models	High-attenuation EMI filter	Compatible on standard products
3-phase 240 V models	Standard filter	Optionally* compatible

*1. A noise reduction filter (EU-compatible) compatible with the EMC Directive is available. See page 20.

Full Lineup of Monitor and Display Functions

28 monitors Extensive monitor menus: 28 monitor values including load current and torque current can be viewed in real time.

Log details Monitor at trip: 28 momentary monitor values for when a trip occurs can be viewed. Ten monitor values are stored in memory for the last four inverter operations, which is effective in pin-pointing the cause of a trip.

Storage Storage of user parameter settings: All parameter settings made by the user can be stored in memory. Stored parameters can be immediately called even they have been changed.

History History function: This function is for displaying the latest five changes made to parameter settings. This is displayed in the top menu (AUH), which is handy when parameters are frequently changed or repeatedly adjusted.

Free unit Free unit display: Bias can also be set in addition to the multiplication factor in the free unit display. This display shows speed of rotation, line speed and other units in addition to frequency.

Step width Variable step width setting: The change increment of the frequency when an arrow key on the panel is pressed can be set as desired. For example, this is convenient when you want to change the frequency in 10 Hz increments each time that a key is pressed.

Safe Maintenance

One-touch One-touch fan replacement: The cooling fan, one of the service parts, can be easily removed for replacement. The fan, of course, is designed to last a long time as it has a temperature-based ON/OFF control function.

Ground capacitor Ground capacitor disconnection switch: Even when current leakage is a problem, it is possible to reduce current leakage easily with a ground condenser cutoff switch. (Only on single-phase 240 V models and 3-phase 500 V models)

Extensive Communication Functions

Detachable Built-in communications option board: The detachable terminal block board can be detached and swapped with various internal option boards. Communications option boards including RS-485, DeviceNET and LonWorks are available.

Communications Communications protocol: TOSHIBA inverter protocol and Modbus-RTU protocol are supported. The inverter can also be connected directly by communications to touch panels made by Digital Electronics Corporation.

Communications Block communications: Block read/write functions have been added on as communications methods to simplify high-speed transmission of instructions and monitoring. Inverter-to-inverter communications is also supported, which enables master/slave control on just inverters without the aid of a host controller.

Other Features

Power voltage Wide power supply voltage range: 200 to 240 V range on 200 V class models, and 380 to 500 V range on 400 V class models are supported.

Speed control Speed control accuracy: Speed control accuracy is improved by high startup torque and current vector calculation control, a TOSHIBA proprietary control system.

500 Hz Output frequency: The VF-S11 can be used in a wide range of applications as its maximum output frequency is 500 Hz.

Braking resistance Built-in braking resistor drive circuit: A drive circuit for an external braking resistor is integrated into all models to enable large regenerative energy loads to be stopped in a short time.

Applicable specification by each segment

Applicable specification by each segment

Standard specifications

3-phase 240V

Item	Specification										
Input voltage class	3-phase 240V										
Applicable motor (kW)	0.4	0.55	0.75	1.5	2.2	4.0	5.5	7.5	11	15	
Rating	Type	VFS11									
	Form	2004PM	2005PM	2007PM	2015PM	2022PM	2037PM	2055PM	2075PM	2110PM	2150PM
	Capacity (kVA) Note 1)	1.3	1.4	1.8	3.0	4.2	6.7	10	13	21	25
	Rated output current (A) Note 2)	3.3 (3.3)	3.7 (3.3)	4.8 (4.4)	8.0 (7.9)	11.0 (10.0)	17.5 (16.4)	27.5 (25.0)	33 (33)	54 (49)	66 (60)
	Output voltage Note 3)	3-phase 200V to 240V									
Overload current rating	150%-60 seconds, 200%-0.5 second Note 4)										
Power supply	Voltage-frequency	3-phase 200V to 240V - 50/60Hz									
	Allowable fluctuation	Voltage + 10%, -15% Note 5), frequency ±5%									
Protective method	IP20 Enclosed type (JEM1030)										
Cooling method	Self-cooling					Forced air-cooled					
Color	Munsel 5Y-8/0.5										
Built-in filter	Basic filter Note 7)										

3-phase 500V

Item	Specification										
Input voltage class	3-phase 500V										
Applicable motor (kW)	0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15		
Rating	Type	VFS11									
	Form	4004PL	4007PL	4015PL	4022PL	4037PL	4055PL	4075PL	4110PL	4150PL	
	Capacity (kVA) Note 1)	1.1	1.8	3.1	4.2	7.2	11	13	21	25	
	Rated output current (A) Note 2)	1.5 (1.5)	2.3 (2.1)	4.1 (3.7)	5.5 (5.0)	9.5 (8.6)	14.3 (13.0)	17.0 (17.0)	27.7 (25.0)	33 (30)	
	Output voltage Note 3)	3-phase 380V to 500V									
Overload current rating	150%-60 seconds, 200% -0.5 second Note 4)										
Power supply	Voltage-frequency	3-phase 380V to 500V - 50/60Hz									
	Allowable fluctuation	Voltage + 10%, -15% Note 5), frequency ±5%									
Protective method	IP20 Enclosed type (JEM1030)										
Cooling method	Forced air-cooled										
Color	Munsel 5Y-8/0.5										
Built-in filter	High-attenuation EMI filter Note 8)										

1-phase 240V

Item	Specification													
Input voltage class	1-phase 240V						3-phase 600V Note 6)							
Applicable motor (kW)	0.2	0.4	0.75	1.5	2.2	0.75	1.5	2.2	4.0	5.5	7.5	11	15	
Rating	Type	VFS11S						VFS11						
	Form	2002PL	2004PL	2007PL	2015PL	2022PL	6007P	6015P	6022P	6037P	6055P	6075P	6110P	6150P
	Capacity (kVA) Note 1)	0.6	1.3	1.8	3.0	4.2	1.7	2.7	3.9	6.1	9.0	11	17	22
	Rated output current (A) Note 2)	1.5 (1.5)	3.3 (3.3)	4.8 (4.4)	8.0 (7.9)	11.0 (10.0)	1.7 (1.5)	2.7 (2.4)	3.9 (3.5)	6.1 (5.5)	9.0 (8.1)	11.0 (9.9)	17.0 (15.3)	22.0 (19.8)
	Output voltage Note 3)	3-phase 200V to 240V						3-phase 525V to 600V						
Overload current rating	150%-60 seconds, 200%-0.5 second Note 4)						150%-60 seconds, 200%-0.5 second Note 4)							
Power supply	Voltage-frequency	1-phase 200V to 240V - 50/60Hz						3-phase 525V to 600V - 50/60Hz						
	Allowable fluctuation	Voltage + 10%, -15% Note 5), frequency ±5%						Voltage + 10%, -15% Note 5), frequency ±5%						
Protective method	IP20 Enclosed type (JEM1030)						IP20 Enclosed type (JEM1030)							
Cooling method	Self-cooling			Forced air-cooled			Forced air-cooled							
Color	Munsel 5Y-8/0.5						Munsel 5Y-8/0.5							
Built-in filter	High-attenuation EMI filter Note 8)						No filter							

Note 1. Capacity is calculated at 220V for the 240V class, at 440V for the 500V class and at 575V for the 600V models.

Note 2. Indicates rated output current setting when the PWM carrier frequency (parameter F300) is 4kHz or less.

Note 3. Maximum output voltage is the same as the input voltage.

Note 4. May differ according to voltage and model.

Note 5. ±10% when the inverter is used continuously (load of 100%).

Note 6. If you are using 600V model, be sure to connect an input reactor (ACL).

Note 7. Built-in standard filter: Core and capacitors With RFI noise filter option: Complies EN55011 Class A Group 1 (Max.5m*) and Class B Group 1 (Max.1m*)

* Length of motor connecting cable.

Note 8. Built-in high-attenuation EMI filter: Complies EN55011 Class A Group 1 (Max.5m*) With RFI noise filter option: Complies EN55011 Class B Group 1 (Max.20m*) and Class A Group 1 (Max.50m*)

* Length of motor connecting cable.

Note 9. Above 40°C: Remove the protective seal from the top of the inverter. Above 50°C: Remove the seal from the top of the inverter and use the inverter with the rated output current reduced.

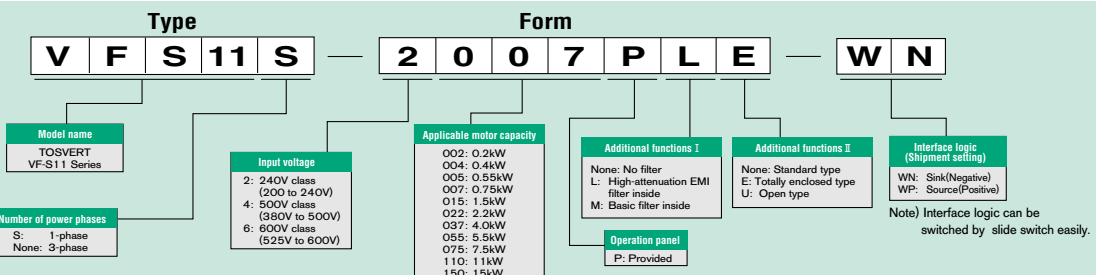
Note 10. If inverters are installed side by side (with no sufficient space left between them) installation: Remove the seal from the top of each inverter.

When installing the inverter where the ambient temperature will rise above 40°C, remove the seal from the top of the inverter and use the inverter with the rated output current reduced.

Common specification

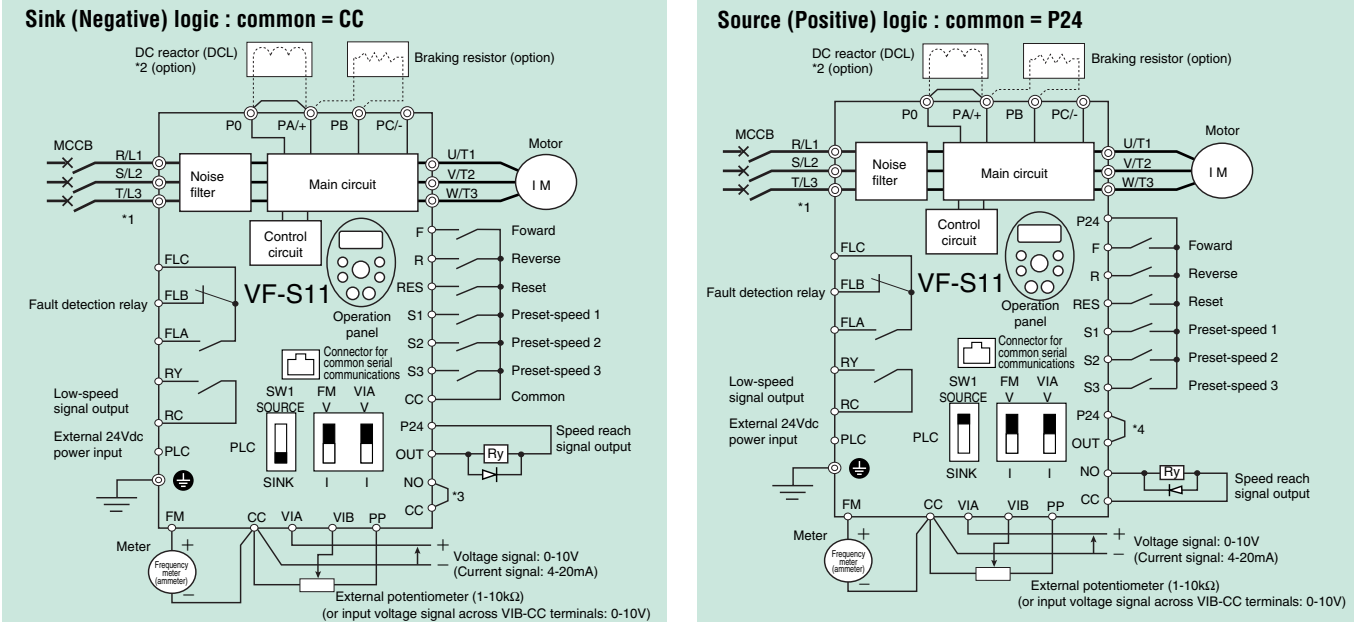
Item	Specification	
Principal control functions	Control system	Sinusoidal PWM control
	Rated output voltage	Adjustable within the range of 50 to 600V by correcting the supply voltage (not adjustable above the input voltage)
	Output frequency range	0.5 to 500.0Hz, default setting: 0.5 to 80Hz, maximum frequency: 30 to 500Hz
	Minimum setting steps of frequency	0.01 Hz: operation panel setting, 0.1 Hz: analog input (when the max. frequency is 100Hz).
	Frequency accuracy	Digital setting: within ±0.01% of the max. frequency (-10 to +60°C) Analog setting: within ±0.5% of the max. frequency (25°C ±10°C)
	Voltage/frequency characteristics	V/f constant, variable torque, automatic torque boost, vector control, automatic energy-saving, dynamic automatic energy-saving control. Auto-tuning. Base frequency (25 - 500Hz) adjusting to 1 or 2, torque boost (0 - 30%) adjusting to 1 or 2, adjusting frequency at start (0.5 - 10Hz)
	Frequency setting signal	Potentiometer on the front panel, external frequency potentiometer (connectable to a potentiometer with a rated impedance of 1 - 10kΩ), 0 - 10Vdc (input impedance: VIA/VIB=30kΩ), 4 - 20mAdc (input impedance: 250Ω).
	Terminal board base frequency	The characteristic can be set arbitrarily by two-point setting. Possible to set individually for three functions: analog input (VIA and VIB) and communication command.
	Frequency jump	Three frequencies can be set. Setting of the jump frequency and the range.
	Upper- and lower-limit frequencies	Upper-limit frequency: 0 to maximum frequency, lower-limit frequency: 0 to upper-limit frequency
PWM carrier frequency	Adjustable within a range of 2.0 to 16.0Hz (default: 12kHz).	
PID control	Setting of proportional gain, integral gain, differential gain and control wait time. Checking whether the amount of processing amount and the amount of feedback agree.	
Operation specifications	Acceleration/deceleration time	Selectable from among acceleration/deceleration times 1, 2 or 3 (0.0 to 3200 sec.). Automatic acceleration/deceleration function. S-pattern 1 or 2, and S-pattern value adjustable. Forced rapid deceleration and dynamic rapid deceleration function.
	DC braking	Braking start-up frequency: 0 to maximum frequency, braking rate: 0 to 100%, braking time: 0 to 20 seconds, emergency DC braking, motor shaft fixing control
	Dynamic braking	Control and drive circuit is built in the inverter with the braking resistor outside (optional).
	Input terminal function (programmable)	Possible to select from 76 functions, such as forward/reverse run signal input, jog run signal input, operation base signal input and reset signal input, to assign to 8 input terminals. Logic selectable between sink and source.
	Output terminal functions (programmable)	Possible to select from 58 functions, such as upper/lower limit frequency signal output, low speed detection signal output, specified speed reach signal output and failure signal output, to assign to FL relay output, open collector output and RY output terminals.
	Forward/reverse run	The RUN and STOP keys on the operation panel are used to start and stop operation. The switching between forward run and reverse run can be done from one of the three control units: operation panel, terminal board and external control unit.
	Jog run	Jog mode, if selected, allows jog operation from the operation panel or the terminal board.
	Preset speed operation	Base frequency + 15-speed operation possible by changing the combination of 4 contacts on the terminal board.
	Retry operation	Capable of restarting automatically after a check of the main circuit elements in case the protective function is activated. 10 times (Max.) (selectable with a parameter)
	Various prohibition settings	Possible to write-protect parameters and to prohibit the change of panel frequency settings and the use of operation panel for operation, emergency stop or resetting.
Protective function	Regenerative power ride-through control	Possible to keep the motor running using its regenerative energy in case of a momentary power failure.
	Auto-restart operation	In the event of a momentary power failure, the inverter reads the rotational speed of the coasting motor and outputs a frequency appropriate to the rotational speed in order to restart the motor smoothly. This function can also be used when switching to commercial power.
	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	The sum of two analog signals (VIA/VIB) can be used as a frequency command value.
	Failure detection signal	1c-contact output: (250Vac-0.5A-cos φ =0.4)
	Protective function	Stall prevention, current limitation, over-current, output short circuit, over-voltage, over-voltage limitation, undervoltage, ground fault, power supply phase failure, output phase failure, overload protection by electronic thermal function, armature over-current at start-up, load side over-current at start-up, over-torque, undercurrent, overheating, cumulative operation time, life alarm, emergency stop, braking resistor over-current/overload, various pre-alarms
	Electronic thermal characteristic	Switching between standard motor and constant-torque VF motor, switching between motors 1 and 2, setting of overload trip time, adjustment of stall prevention levels 1 and 2, selection of overload stall
	Reset function	Function of resetting by closing contact 1a or by turning off power or the operation panel. This function is also used to save and clear trip records.
	Alarms	Stall prevention, overvoltage, overload, under-voltage, setting error, retry in process, upper/lower limits
	Causes of failures	Over-current, overvoltage, overheating, short-circuit in load, ground fault, overload on inverter, over-current through arm at start-up, over-current through load at start-up, CPU fault, EEPROM fault, RAM fault, ROM fault, communication error. (Selectable: Over-current through braking resistor/overload, emergency stop, under-voltage, low voltage, over-torque, motor overload, output open-phase)
Display function	Monitoring function	Operation frequency, operation frequency command, forward/reverse run, output current, voltage in DC section, output voltage, torque, torque current, load factor of inverter, integral load factor of PBR, input power, output power, information on input terminals, information on output terminals, version of CPU1, version of CPU2, version of memory, PID feedback amount, frequency command (after PID), integral input power, integral output power, rated current, causes of past trips 1 through 4, information on life alarm, cumulative operation time
	Past trip monitoring function	Stores data on the past four trips: number of trips that occurred in succession, operation frequency, direction of rotation, load current, input voltage, output voltage, information on input terminals, information on output terminals, and cumulative operation time when each trip occurred.
	Output for frequency meter	Analog output (1mAdc full-scale DC ammeter or 7.5Vdc full-scale DC voltmeter/rectifier type AC voltmeter, 4 to 20mA/O to 20mA output)
	4-digit 7-segments LED	Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P", overload alarm "L", overheat alarm "H". Status: inverter status (frequency, cause of activation of protective function, input/output voltage, output current, etc.) and parameter settings. Free-unit display: arbitrary unit (e.g. rotating speed) corresponding to output frequency.
	Indicator	Lamps indicating the inverter status by lighting, such as RUN lamp, MON lamp, PRG lamp, % lamp, Hz lamp, frequency setting potentiometer lamp, UP/DOWN key lamp and RUN key lamp. The charge lamp indicates that the main circuit capacitors are electrically charged.
Environments	Use environments	Indoor, altitude: 1000m (Max.), not exposed to direct sunlight, corrosive gas, explosive gas / vibration (less than 5.9m/s ²) (10 to 55Hz)
	Ambient temperature	-10 to +60°C Note 9,10)
	Storage temperature	-25 to +70°C
	Relative humidity	20 to 93% (free from condensation and vapor).

Contents of the product code

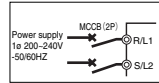


Connection diagram and selection of wiring devices

Standard connection diagram



Main circuit power supply
 240V class: three-phase 200-240V -50/60Hz
 500V class: three-phase 380-500V -50/60Hz
 600V class: three-phase 525-600V -50/60Hz



*1: The T/L3 terminal not provided for signal-phase models. Use the R/L1 and S/L2 terminal as input terminals.
 *2: The inverter came with the PO and the PA/+ terminals shorted by means of a shorting bar. Before installing the DC reactor (DCL), remove the bar.
 *3: When using the OUT output terminal in sink logic mode, short-circuit the NO and CC terminals.
 *4: When using the NO output terminal in source logic mode, short-circuit the P24 and OUT terminals.

wiring devices

Voltage class	Capacity applicable motor (kW)	Inverter model	Wire size (mm ²)						
			Molded-case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB)	Magnetic contactor (MC)	Overload relay (Th-Ry)	Main circuit (mm ²) Note 4,8	DC reactor (optional)(mm ²)	Braking resistor (optional)(mm ²)	Grounding cable (mm ²)Note 6
3-phase 240V class	0.4	VFS11-2004PM	5(5)	9(9)	2.3	2.0(2.0)	1.25	2.0	3.5
	0.55	VFS11-2005PM	10(5)	9(9)	2.7	2.0(2.0)	2.0	2.0	3.5
	0.75	VFS11-2007PM	10(5)	9(9)	3.6	2.0(2.0)	2.0	2.0	3.5
	1.5	VFS11-2015PM	15(10)	9(9)	6.8	2.0(2.0)	2.0	2.0	3.5
	2.2	VFS11-2022PM	20(15)	12(12)	9.3	2.0(2.0)	2.0	2.0	3.5
	4.0	VFS11-2037PM	30(30)	25(18)	15	3.5(2.0)	2.0	2.0	3.5
	5.5	VFS11-2055PM	50(40)	32(25)	22	5.5(2.0)	3.5	5.5	5.5
	7.5	VFS11-2075PM	60(50)	38(38)	28	8.0(5.5)	5.5	5.5	8.0
3-phase 500V class	11	VFS11-2110PM	100(75)	65(50)	44	14(8.0)	8.0	5.5	14
	15	VFS11-2150PM	125(100)	80(65)	57	14(14)	14	5.5	14
	0.4	VFS11-4004PL	5(5)	9(9)	1.0	2.0(2.0)	2.0	2.0	3.5
	0.75	VFS11-4007PL	5(5)	9(9)	1.6	2.0(2.0)	2.0	2.0	3.5
	1.5	VFS11-4015PL	10(10)	9(9)	3.6	2.0(2.0)	2.0	2.0	3.5
	2.2	VFS11-4022PL	15(10)	9(9)	5.0	2.0(2.0)	2.0	2.0	3.5
	4.0	VFS11-4037PL	20(15)	12(9)	6.8	2.0(2.0)	2.0	2.0	3.5
	5.5	VFS11-4055PL	30(20)	18(18)	11	2.0(2.0)	2.0	2.0	3.5
1-phase 240V class	7.5	VFS11-4075PL	30(30)	25(18)	15	3.5(2.0)	2.0	2.0	3.5
	11	VFS11-4110PL	50(40)	32(25)	22	5.5(2.0)	3.5	2.0	5.5
	15	VFS11-4150PL	60(50)	38(38)	28	8.0(5.5)	5.5	2.0	8.0
	0.2	VFS11S-2002PL	5(5)	9(9)	1.3	2.0(2.0)	2.0	2.0	3.5
	0.4	VFS11S-2004PL	10(5)	9(9)	2.3	2.0(2.0)	2.0	2.0	3.5
	0.75	VFS11S-2007PL	15(10)	9(9)	3.6	2.0(2.0)	2.0	2.0	3.5
	1.5	VFS11S-2015PL	20(15)	18(12)	6.8	2.0(2.0)	2.0	2.0	3.5
	2.2	VFS11S-2022PL	30(30)	25(18)	9.3	2.0(2.0)	2.0	2.0	3.5
3-phase 600V class	0.75	VFS11-6007P	5(5)	9(9)	1.0	2.0(2.0)	2.0	2.0	3.5
	1.5	VFS11-6015P	10(10)	9(9)	1.6	2.0(2.0)	2.0	2.0	3.5
	2.2	VFS11-6022P	10(10)	9(9)	3.6	2.0(2.0)	2.0	2.0	3.5
	4.0	VFS11-6037P	15(15)	12(12)	5.0	2.0(2.0)	2.0	2.0	3.5
	5.5	VFS11-6055P	20(20)	18(18)	6.8	2.0(2.0)	2.0	2.0	3.5
	7.5	VFS11-6075P	30(30)	25(25)	11	2.0(2.0)	2.0	2.0	3.5
	11	VFS11-6110P	30(30)	25(25)	15	3.5(3.5)	3.5	2.0	3.5
	15	VFS11-6150P	40(40)	33(33)	22	5.5(5.5)	5.5	2.0	3.5

- Note) 1. Be sure to attach surge killer to the exciting coil of the relay and the magnetic contactor.
 2. 500V and 600V class: For the operation and control circuit, regulate the voltage at 240V or less with a step-down transformer.
 3. When using the auxiliary contacts 2a of the magnetic contactor MC for the control circuit, connect the contacts 2a in parallel to increase reliability.
 4. Size of the wires connected to the input terminals R, S and T and the output terminals U, V and W when the length of each wire does not exceed 30m.
 5. For the control circuit, use shielded wires 0.75 mm² or more in diameter.
 6. For grounding, use a cable with a size equal to or larger than the above.
 7. The wire sizes specified in the above table apply to HIV wires (copper wires shielded with an insulator with a maximum allowable temperature of 75°C) used at an ambient temperature of 50°C or less.
 8. The numeric values in parentheses refer to the sizes of wires to be used when a DC reactor is connected.

Terminal functions

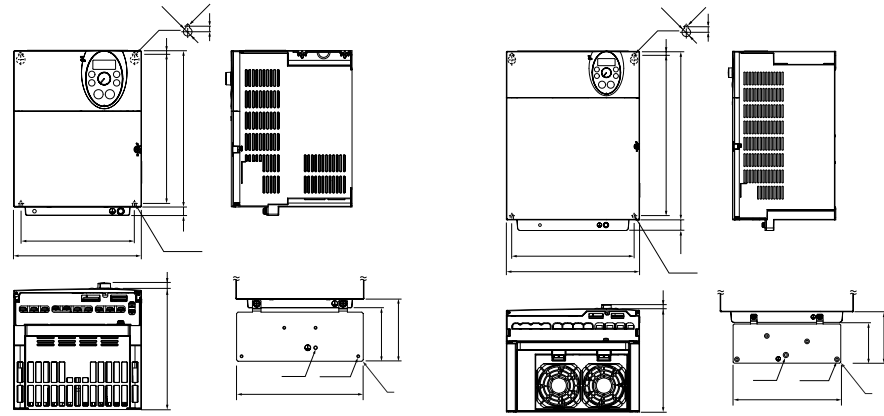
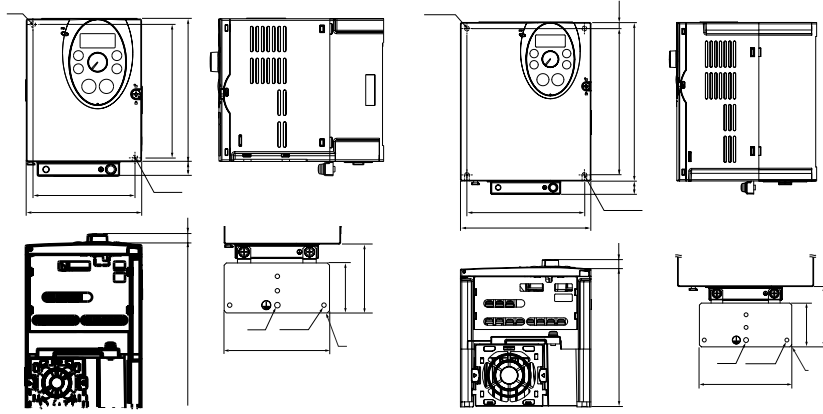
Main circuit terminal functions

Terminals symbol	Terminal function
	Grounding terminal for connecting inverter. There are 3 terminals in total. 2 terminals in the terminal board, 1 terminal in the cooling fin.
R/L1, S/L2, T/L3	240V class: single-phase 200~240V-50/60Hz three-phase 200~240V-50/60Hz 500V class: three-phase 380~500V-50/60Hz 600V class: three-phase 525~600V-50/60Hz * Single-phase input: R/L1 and S/L2 terminals
U/T1, V/T2, W/T3	Connect to a (three-phase induction) motor.
PA/+, PB	Connect to braking resistors. Change parameters <i>F304, F305, F308, F309</i> if necessary.
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. Before installing DCL, remove the short bar.

Control circuit terminal functions

Terminal symbol	Function	Electrical specifications	Wire size	
F	Shorting across F-CC causes forward rotation; open causes slowdown and stop.	Dry contact input 24Vdc - 5mA or less	Solid wire : 0.3 to 1.5 (mm ²) Stranded wire : 0.3 to 1.5 (mm ²) (AWG22 to 16) Sheath strip length : 6 (mm)	
R				Shorting across R-CC causes reverse rotation; open causes slowdown and stop.
RES				Shorting across RES-CC causes a held reset when the inverter protector function is operating. Note that when the inverter is operating normally, it will not operate even if there is a short across RES-CC.
S1	Shorting across S1-CC causes preset speed operation.	*Sink/Source/ PLC selectable using SW		
S2				Shorting across S2-CC causes preset speed operation.
S3				Shorting across S3-CC causes preset speed operation.
PLC	External 24Vdc power input	(Insulation resistance: 50Vdc)		
CC	Control circuit's equipotential terminal (sink logic). 3 common terminals for input/output.			
PP	Power output for analog input setting.	10Vdc (permissible load current: 10mA)		
VIA	Multifunction programmable analog input. Standard default setting: 0-10Vdc input and 0-60Hz frequency. The function can be changed to 4-20 mA (0-20 mA) current input by flipping the VIA slide switch to the I position.	10Vdc (internal impedance: 30kΩ) 4~20mA (Internal impedance: 250Ω)		
VIB	Multifunction programmable analog input. Standard default setting: 0-10Vdc input and 0-50Hz (50Hz setting) or 0-60Hz (60Hz setting) frequency.	10Vdc (internal impedance: 30kΩ)		
FM	Multifunction programmable analog output. Standard default setting: output frequency. Connect a 1mA full-scale ammeter or 7.5Vdc (10Vdc)-1mA full-scale voltmeter. The function can be changed to 0-20mA (4-20mA) current output by flipping the FM slide switch to the I position.	1mA full-scale DC ammeter or 7.5Vdc 1mA full-scale DC voltmeter 0-20mA (4-20mA) full-scale DC ammeter		
P24	When the source logic is used, a common terminal 24Vdc is connected.	24Vdc - 100mA		
OUT NO	Multifunction programmable open collector output. Standard default settings detect and output speed reach signal output frequencies. The NO terminal is an isoelectric output terminal. It is insulated from the CC terminal. These terminals can also be used as multifunction programmable pulse train output terminals.	Open collector output: 24Vdc - 50mA Pulse train output 10mA or more		
RC RY	Multifunction programmable relay contact output. Contact ratings: 250Vac - 2A (cosφ = 1), 30Vdc - 1A, 250Vac - 1A (cosφ = 0.4). Standard default settings detect and output low-speed signal output frequencies.	250Vac - 1A: at resistance load 30Vdc - 0.5A, 250Vac - 0.5A (cosφ = 0.4)		
FLA FLB FLC	Multifunction programmable relay contact output. Contact ratings: 250Vac-1A (cosφ = 1), 30Vdc-0.5A, 250Vac-0.5A (cosφ = 0.4). Detects the operation of the inverter's protection function. Contact across FLA-FLC is closed and FLB-FLC is opened during protection function operation.	250Vac - 1A: at resistance load 30Vdc - 0.5A, 250Vac - 0.5A (cosφ = 0.4)		

- Note 1: By changing parameter setting, this terminal can also be used as a multifunction programmable contact input terminal. When the inverter is used in a sink logic configuration, a resistor (4.7kΩ at 0.5W) should be inserted between the P24 and VIA/VIB terminals. Also, the slide switch for the VIA terminal needs to be turned to the V position.
 Note 2: Multifunction output terminals to which two different functions can be assigned.



Other basic parameters

Title	Function	Adjustment range	Default setting	Remarks
CPD	Command mode selection	0: Terminal board 1: Operation panel (Extension panel)	1	
FND	Frequency setting mode selection 1	0: Built-in potentiometer 1: VIA 2: VIB 3: Operation panel (Extension panel) 4: Serial communication 5: UP/DOWN from external contact 6: VIA + VIB (Override)	0	
FNSL	Meter selection	0: Output frequency 1: Output current 2: Set frequency 3: DC voltage 4: Output voltage command value 5: Input power 6: Output power 7: Torque 8: Torque current 9: Motor cumulative load factor 10: Inverter cumulative load factor 11: PBR (braking reactor) cumulative load factor 12: Frequency setting value (after PID) 13: VIA Input value 14: VIB Input value 15: Fixed output 1 (Output current: 100%) 16: Fixed output 2 (Output current: 50%) 17: Fixed output 3 (Other than the output current: 100%) 18: Serial communication data 19: For adjustments (Fn set value is displayed.)	0	

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.

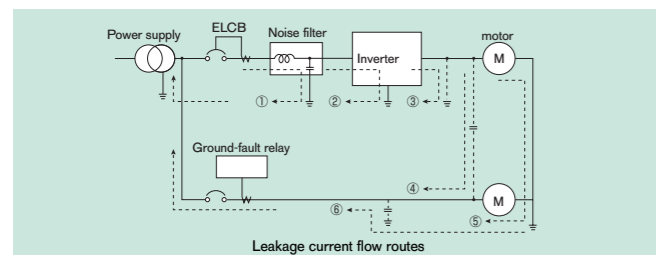
[Effects of leakage current]

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



[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) This inverter allows you to decrease the frequency up to 2.0kHz.

If the carrier frequency reduce, the acoustic noise caused by the motor increase.

Ground fault

Before beginning 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.

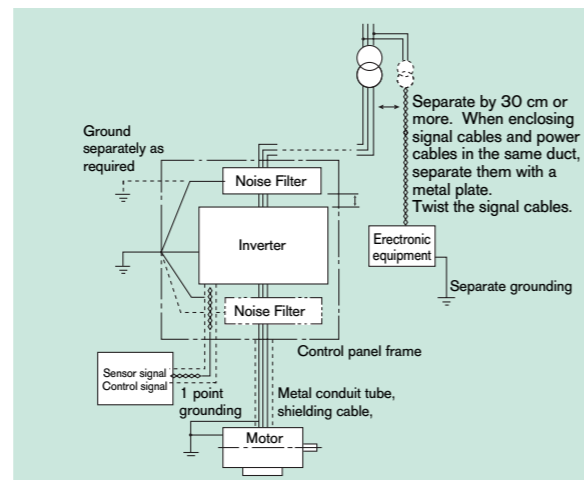
[Measures against noises]

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.

The single-phase 240V and three-phase 500V models have built-in noise filters which significantly reduce noise.



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 reactors

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 200kVA 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]

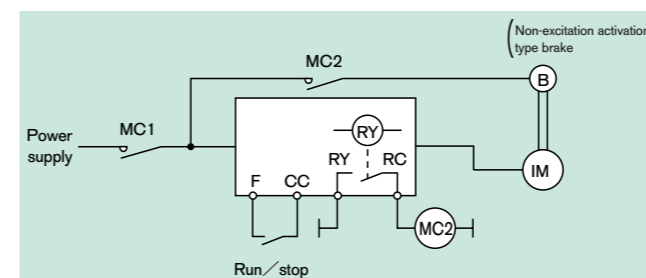
- (1) As a rule, if a magnetic contactor is installed between the inverter and the motor, do not turn ON/OFF while running. (If the secondary-side contactor is turned ON/OFF while running, a large current may flow in the inverter, causing inverter damage and failure.)
- (2) A magnetic contactor may be 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) All control terminals, except FLA, FLB and FLC are electronic circuits. Therefore, input signal must insulate with power 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 an 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 be 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

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 motors. 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.

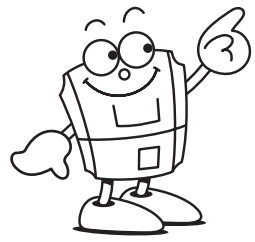
Single-phase motor

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 available a 3-phase motor can be driven by using a single-phase input inverter to convert it into a 3-phase 240V output. (A special inverter and a 3-phase motor are required.)

Braking motor

When using a braking motor, if the braking circuit is directly connected to the inverters' 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 left. Usually, braking motors produce larger noise in low speed ranges.

Note: In the case of the circuit shown on the left, assign the function of detecting low-speed signals to the RY and RC terminals. Make sure the parameter F130 is set to 4 (factory default setting).



For inverter users

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.

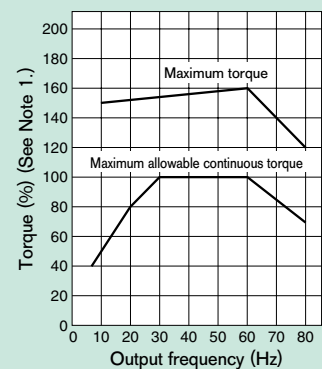
Acceleration time	$t_a = \frac{(JM+JL) \times \Delta N}{9.56 \times (TM - TL)}$ (sec.)
Deceleration time	$t_d = \frac{(JM+JL) \times \Delta N}{9.56 \times (TB + TL)}$ (sec.)
Conditions	<p>JM : Moment of inertia of motor (kge.m²) JL : Moment of inertia of load (kge.m²) (converted into value on motor shaft) ΔN : Difference in rotating speed between before and after acc. or dec. (min.⁻¹) TL : Load torque (Ne.m) TM : Motor rated torque x 1.2-1.3 (Ne.m) ... V/f control : Motor rated torque x 1.5 (Ne.m) ... Vector operation control TB : Motor rated torque x 0.2 (Ne.m) (When a braking resistor or a braking resistor unit is used : Motor rated torque x 0.8-1.0 (Ne.m))</p>

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.

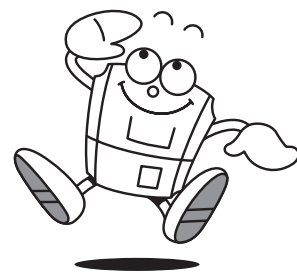
When constant-torque operation must be performed at low speeds, use a Toshiba VF motor designed specifically for use with inverters.

[An example of V/f control at a base frequency of 60 Hz]



Note 1. 100% of torque refers to the amount of torque that the motor produces when it is running at a 60Hz-synchronized speed. The starting torque is smaller in this case than that required when power is supplied from a commercial power line. So, the characteristics of the machine to be operated need to be taken into consideration.

Note 2. The maximum allowable torque at 50Hz can be calculated approximately by multiplying the maximum allowable torque at a base frequency of 60Hz by 0.8.



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. (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.

Harmonic current and influence to power supply

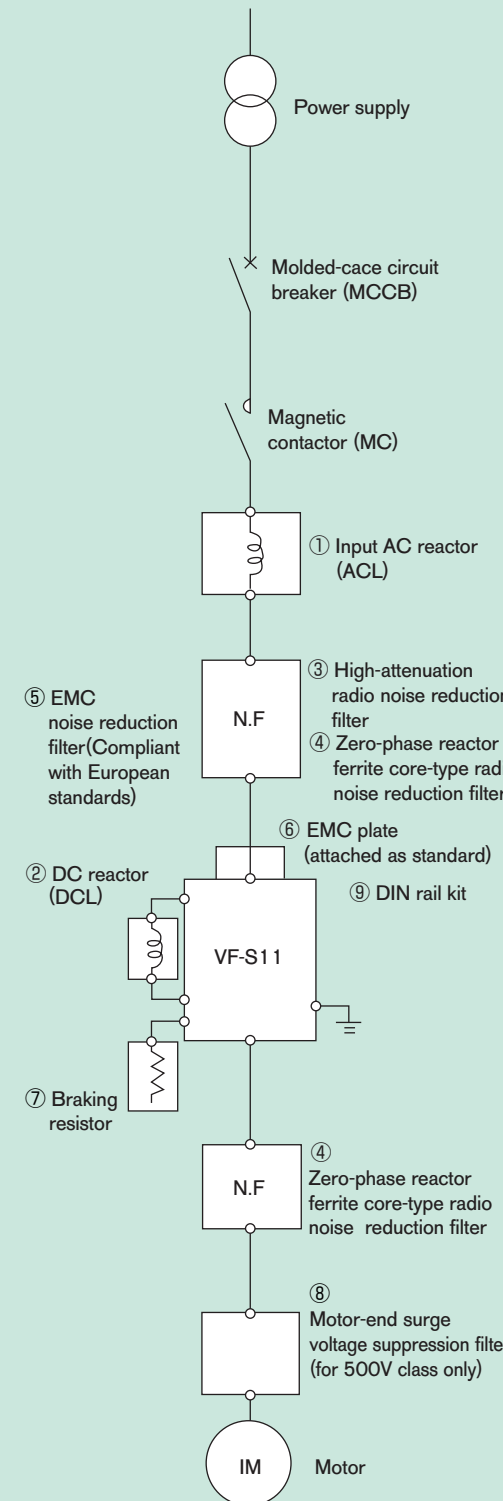
Harmonics are defined as sinusoidal waves that is multiple frequency of commercial power (base frequency: 50Hz or 60Hz). Commercial power including harmonics has a distorted waveform.

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.

Peripheral devices



No.	Device	Function and purpose	Refer to
①	Input AC reactor (ACL)	Used to improve the input power factor, reduce the harmonics, and suppress external surge on the inverter power source side. Install when the power capacity is 200 kVA or more and 10 times or more than the inverter capacity or when a distorted wave generation source such as a thyristor unit or a large-capacity inverter is connected in the same distribution system.	P.17
②	DC reactor (DCL)	Generally, a DC reactor improves the power factor more than a DC reactor. When the inverter is used along with equipment for which a high degree of reliability is required, an input AC reactor capable of suppressing external surges should be used along with a DC reactor.	
③	High-attenuation radio noise filter (NF type)	These types of filters are not necessary because all single-phase 240V or 3-phase 500V models have a built-in EMI noise filter, conforming to Class A, as standard. But install these filters if necessarily of noise reduction move and more. <ul style="list-style-type: none"> • Effective to prevent interference in audio equipment used near the inverter. • Install on the input side of the inverter. • Provided with wide-range attenuation characteristics from AM radio bands to near 10MHz. • Use when equipment readily affected by noise is installed in the peripheral area. 	P.18
④	Zero-phase reactor ferrite core-type	<ul style="list-style-type: none"> • Effective to prevent interference in audio equipment used near the inverter. • Effective in noise reduction on both input and output sides of the inverter. • Provided with attenuation characteristics of several dB in frequencies from AM radio bands to 10MHz. • For noise countermeasures, insert on the secondary side of the inverter. 	P.18
⑤	EMC noise filter (Compliant with European standards)	A high-attenuation compact EMI noise filter that can be Foot-mounted and Side-mounted. With this filter on, the inverter complies with the following standards. Three-phase 240V model: EN55011: Class A, Group 1 (Motor connecting cable length: 5 m or less) And EN55011: Class B, Group 1 (Motor connecting cable length: 1 m or less) Single-phase 240V, three-phase 500V models: EN55011: Class B, Group 1 (Motor connecting cable length: 20 m or less) And EN55011: Class A, Group 1 (Motor connecting cable length: 50 m or less)	P.20
⑥	EMC plate (attached as standard)	A steel plate used to connect shielded earth wires from inverter's power cables or to connect earth wires from external devices.	P.9
⑦	Braking resistor	Use when rapid deceleration or stop is frequently required or when it is desired to reduce the deceleration time with large load. This resistor consumes regenerative energy during power generation braking. <ul style="list-style-type: none"> • Braking resistor - With (resistor + protective thermal relay) built in. 	P.18
⑧	Motor-end surge voltage suppression filter (for 500V class only)	Use an insulation-reinforced motor or install the surge voltage restraint filter to prevent degrading motor insulation caused by surge voltage generation depending on cable length and wiring method, or use of a 400V class motor driven with an inverter.	P.19
⑨	DIN rail kit	Available for the 2.2kW (or 1.5kW) or less. (Model: DIN003Z, DIN005Z)	P.20
⑩	Parameter writer	Use this unit for batch read, batch copy, and batch writing of setting parameters. (Model: PWU001Z)	
⑪	Extension panel	Extended operation panel kit provided with LED indication section, RUN/STOP key, UP/DOWN key, Monitor key, and Enter key. (Model: RKPO01Z)	P.19
⑫	RS232C communication conversion cable	This unit allows you to connect a personal computer to inverters for data communications. (Model: RS20035)	
⑬	RS485 communication conversion unit	This unit allows you to connect a personal computer to multiple inverters for data transfer. (Models: RS4001Z, RS4002Z)	P.19
⑭	USB communication 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. (Type: USB 001Z)	-
⑮	Internal communication card	These boards allow you to connect an upper controller to multiple inverters for data transfer. Removable terminal board is replaced by these boards. RS485, DeviceNet and Lonworks are prepared. (Models: RS4003Z, DEV001Z, LIU005Z)	P.20
⑯	Remote panel	This panel includes a frequency meter, a frequency regulator and RUN/STOP (forward/reverse run) switches. (Model: CBVR-7B1)	P.19
⑰	Conduit pipe attachment kit	Attachment kit used for conformance to NEMA TYPE1.	-
⑱	Communication cable for totally enclosed box type	This cable allows you to connect a personal computer for the totally enclosed box type while retaining the protective construction of the IP54 (or IP55). (Type: CAB 0031)	-

Devices External dimensions and connections

Motor-end surge voltage suppression filter (for 500V class only)	Motor-end surge voltage suppression filter I	Inverter type	Dimensions (mm)			Terminal screw	Grounding screw	Approx. weight (kg)
			Width	Hight	Depth			
	MSF-4015Z	VFS11-4004~4015PL	310	300	255	M4	M4	12
	MSF-4037Z	VFS11-4022, 4037PL	310	300	255	M4	M4	20
	MSF-4075Z	VFS11-4055, 4075PL	310	350	315	M5	M5	30
	MSF-4150Z	VFS11-4110, 4150PL	330	400	350	M5	M5	40

Parameter writer
Parameter writer type: PWU001Z
Cable type (1m): CAB0011 (3m): CAB0013 (5m): CAB0015

Extension panel
Extension panel type: RKP001Z
Cable type (1m): CAB0011 (3m): CAB0013 (5m): CAB0015

RS232C communication conversion cable
Type: RS20035

RS485 communication conversion unit
·2-port type : RS4001Z ·8-port type : RS4002Z

Note: For information about the software program that enables you to set parameters using a personal computer.

Cable type (1m): CAB0011, (3m): CAB0013, (5m): CAB0015

Remote panel CBVR-7B1

Panel hole: Painting: JIS mark 5Y7/1 (Panel front N1.5) Weight: 0.7kg

Note: The wire length should be 30m or less the inverter and the remote panel.

Frequency meter QS60T
Frequency meter <QS-60T (80Hz-1mAcd)>

Panel cut dimensions: Color: (N1.5) Approx. weight: 75g

FRH kit
Frequency setting resistor <RV30YN-20S-B302>

Frequency setting panel

Frequency setting knob <K-3>

Devices External dimensions and connections

EMC noise reduction filter (Compliant with European standards)

Foot mount installation Side mount installation

How to wire

A high-attenuation compact EMI noise filter that can be Foot-mounted and Side-mounted. With this filter on, the inverter complies with the following standards.

Three-phase 240V model:
EN55011: Class A, Group 1 (Motor connecting cable length: 5 m or less)
And EN55011: Class B, Group 1 (Motor connecting cable length: 1 m or less)

Single-phase 240V, three-phase 500V models:
EN55011: Class B, Group 1 (Motor connecting cable length: 20 m or less)
And EN55011: Class A, Group 1 (Motor connecting cable length: 50 m or less)

Type	Rated current	Inverter type	Dimensions (mm)							Approx. weight (kg)	Approx. leakage current (mA) Note 1)		
			W	H	D	W1	H1	E	F		G	Power source A	Power source B
EMFS11S-2009AZ	9	VFS11S-2002~2007PL	72	195	37	52	180	5	8.5	10	0.5	3	47
EMFS11-2007AZ	7	VFS11-2004~2007PM	72	195	37	52	180	5	8.5	10	0.6	7	45
EMFS11S-2016BZ	16	VFS11S-2015PL	105	195	35	85	180	5	8.5	10	0.9	3	47
EMFS11-4015BZ	15	VFS11-2015, 2022PM VFS11-4004~4015PL	105	195	42	85	180	5	8.5	10	0.8	8	48
EMFS11S-2022CZ	22	VFS11S-2022PL	140	235	35	120	215	5	8.5	10	1.3	15	96
EMFS11-4025CZ	25	VFS11-2037PM VFS11-4022, 4037PL	140	235	50	120	215	5	8.5	10	0.8	20	125
EMFS11-4047DZ	47	VFS11-2055, 2075PM VFS11-4055, 4075PL	180	305	60	140	285	5.5	9.5	11	2.6	40	249
EMFS11-2083EZ	83	VFS11-2110, 2150PM	245	395	80	205	375	5.5	9.5	11	5.0	23	147
EMFS11-4049EZ	49	VFS11-4110, 4150PL	245	395	60	205	375	5.5	9.5	11	3.8	47	293

Note 1. These values are referential ones of single piece of RFI filter. For 240V class, 60Hz/200V power source. For 500V class, 60Hz/400V power source. For power system A and B, refer to table below.

Select an earth leakage breaker with consideration of leakage current above and leakage current from the inverter unit.

Internal communication card

Type	Inverter type	Approx. weight (kg)
DIN003Z	VFS11S-2002PL~2007PL VFS11-2004PM~2007PM VFS11S-2015PL	0.2
DIN005Z	VFS11-2015PM, 2022PM VFS11-4004PL~4015PL VFS11-6007P, 6015P	0.3

DIN rail kit

