

Variable Speed Drive **TOSVERT**[™] **VF-FS1**



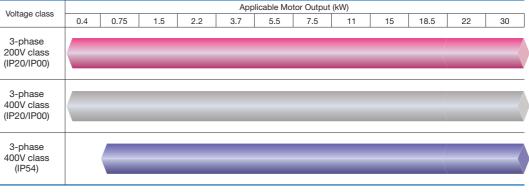
Three-phase 200V class 0.4kW to 30kW Three-phase 400V class 0.4kW to 30kW



Inverter dedicated to fan and pump for HVAC

TOSVERT VF-FS1 CEDEC Compatible with the World's Main Standards

(CE marking, UL, CSA, RCM)



Note:VF-FS1 is not applicable for apparatus which needs sudden deceleration and stop.



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POINT

Half installation space and less wiring



Half installation space

Reactor-less harmonic suppress technologies and builtin filter reduce 50% of installation space, save time and cost of wiring.

And side-by-side installation realizes effective utilization of space in control panels.

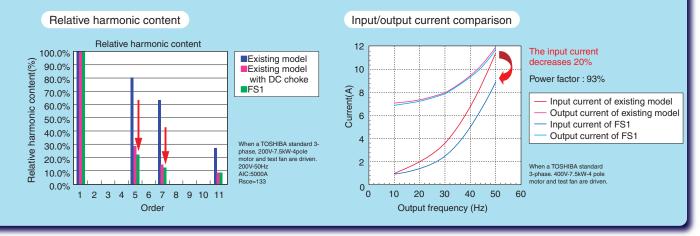


Reactor-less harmonics reduction and high-frequency noise reduction



Harmonics reduction, Power factor improvement

Toshiba unique technologies suppress harmonics, particularly 5th and 7th harmonic current that affect power sources. And the power factor in all models has been improved. Harmonics are controlled to within the Total Harmonic Distortion (THD) of international standard IEC61000-3-12 without any external reactor. (Rsce ≥120)

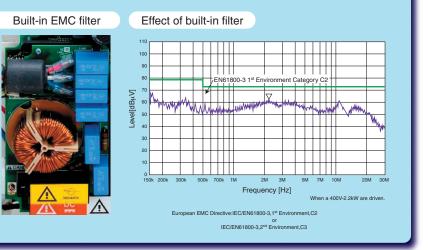


High-frequency noise reduction

High-frequency noise is drastically reduced on models with built-in noise filters. Built-in noise filters are ideal for office, commercial facilities, and factories where special attention for peripheral devices are needed.

Compared with existing model, less space and wiring are realized by incorporating filter in the panel. In addition, models with built-in EMC noise filter comply with the European EMC Directive as individual inverter units.

400V class models : EMI noise filter (complies with the European EMC Directive) built-in standard 200V class models : Basic noise filter (not complies with the European EMC Directive) built-in standar



Long life and easy maintenance 3 POINT

Long life and easy maintenance

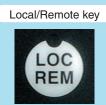
- 15 years life designed main capacitors
- An alarm warns when the main circuit capacitors, circuit boards capacitors, or cooling fan needs to be replaced.
- Cooling fan's On/Off control extend its life
- Easy replacement of cooling fan by one touch
- The inverter unit can be replaced by removable terminal block without disconnecting cables.



Special softwares for fan and pump application are built-in POINT 🦺

Ideal functions are built-in for fan and pump application.

- The local or remote operation can be selected by one touch.
- Bumpless function realize seamless operation between local and remote.



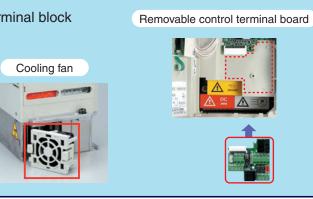
• Fire control enables forced operation in emergency. In case of emergency, forced control will run by specified frequency. The forced operation signal will be saved when the signal turns ON.

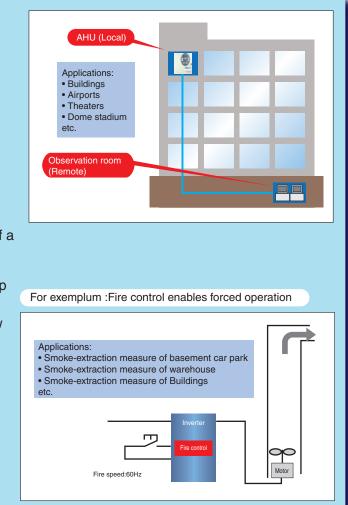
Motor does not stop in the event of the occurrence of a soft fault.

- Speed reference can manage on/off operation. (sleep function)
- Low current detection can notice a broken belt or low load for pump application
- PTC thermistor input
- Built-in RS485 (TOSHIBA/Modbus protocol) communication as standard. Optional fieldbuses for LONWORKS[®], BACnet[®], Metasys[®]N2 and APOGEE[®] FLN as built in option.

LONWORKS® is a registered trademark of Echelon Corporation. BACnet® is a registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers, Incorporated. Metasys®N2 is a registered trademark of Johnson Controls, Incorporated. APOGEE® FLN is a registered trademark of Siemens Building Technologies, Incorporated,







More energy saving

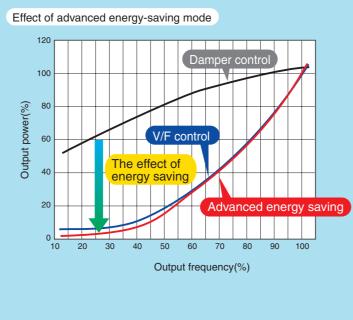
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POINT

The advanced energy-saving mode optimizes fan and pump efficiency even at normally inefficient in low speeds.

The effect can be monitored by operation panel or through serial communication data.





Output power	н 75	FE30	The inverter output power (kW) is displayed.
Integral output power	Н 75	FE77	The integrated amount of power (kWh) supplied from the inverter is displayed.

Easy operation

A wizard function enable set the 10 most often used parameter quickly.

It can be sequentially, such as installing the PC software.

Macro function for basic parameters by one setting is available as shown below.

- The coast stop
- The 3-wire operation
- External input UP/DOWN setting
- 4 to 20mA current input operation

The startup or adjustments are supported by the history function that displays the latest 5 changed parameters.

Quick settin	ng wizard
Title	Function
RUI	Automatic acceleration/deceleration
REE	Acceleration time 1
dE[Deceleration time 1
11	Lower limit frequency
ΠΓ	Upper limit frequency
EHr	Motor electronic-thermal protection level 1
FN	Meter adjustment
PE	V/F control mode selection
υL	Base frequency 1
uLu	Base frequency voltage 1



Communications software

and maintenance.



Options

USB communications conversion unit

This is a unit which converts USB port signal to VF inverter serial port for data communication.

Optional cables to USB and inverter unit are required. By using serial data communication, all parameters and monitoring data can be accessed for commissioning and

Network

maintenance.

Built-in HVAC fieldbuses option are available to communicate with a host controller for centralized control.

- LONWORKS[®]
- BACnet[®]
- Metasys[®] N2
- APOGEE[®] FLN

LED extension panel

The panel with 20 mm height LEDs displays frequency and parameters very clearly at sight.

In addition, it can save and download up to three sets of individual parameters as a parameter writer.

External EMC directive compliant noise reduction filter

It can be complied to the following directives by installing this filter

 400V class:IEC/EN61800-3,1st Environment,C1 or IEC/EN61800-3, 1st Environment,C2

200V class:IEC/EN61800-3,1st Environment,C2

or IEC/EN61800-3,2nd Environment,C3



Standard Specifications

Standard specifications

■200V class

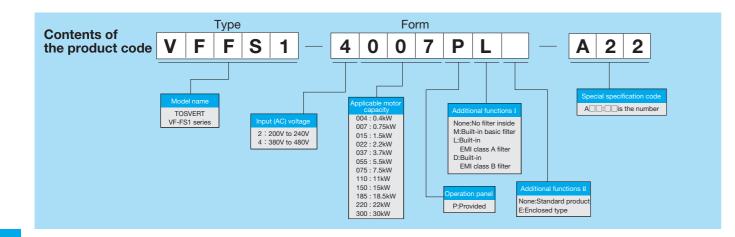
	Item						Specif	ication						
Inp	ut voltage						3-phas	e 200V						
Арр	blicable motor (kW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	5 18.5 22 30			
	Туре						VFF	-S1						
	Form	2004PM	2007PM	2015PM	2022PM	2037PM	2055PM	2075PM	2110PM	2150PM	2185PM	2220PM	2300PM	
D	Capacity (kVA) Note 1)	1.1	1.8	2.9	4.0	6.7	9.2	12.2	17.6	23.2	28.5	33.5	44.6	
Rating	Rated output/current (A) Note 2)	2.8	4.6	7.5	10.6	17.5	24.2	32	46.2	61	74.8 (67.3)	88.0 (79.2)	117.0 (105.3)	
	Output voltage Note 3)						3-phase 20	0V to 240V						
	Overload current rating					110%	-60 seconds	s, 180%-2 se	econd					
ply	Voltage-current					3-pl	hase 200V to	240V -50/6	0Hz					
Power supply	Allowable fluctuation					Voltage +	10%, -15% N	lote 4), frequ	iency ±5%					
Pro	tective method (IEC60529)					IP	20					IP00 N	lote 5)	
Co	oling method						Forced a	ir-cooled						
Col	or						Munsel	5Y-8/0.5						
Bui	It-in filte						Basic	c filter						

■400V class

	Item		Specification										
Inp	ut voltage	3-phase 400V											
Ар	olicable motor (kW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30
	Туре						VFF	-S1					
	Form	4004PL	4007PL	4015PL	4022PL	4037PL	4055PL	4075PL	4110PL	4150PL	4185PL	4220PL	4300PL
0	Capacity (kVA) Note 1)	1.1	1.6	2.8	3.9	6.9	9.1	12.2	17.1	23.2	28.2	33.2	44.6
Rating	Rated output current	- 4	0.0	0.7	F 1	0.1	10.0	10.0	00.5	00.5	37.0	43.5	58.5
£	(A) Note 2)	1.4	2.2	3.7	5.1	9.1	12.0	16.0	22.5	30.5	(33.3)	(39.2)	(52.7)
	Rated output voltage Note 3)						3-phase 38	0V to 480V					
	Overload current rating					110%	-60 seconds	s, 180% -2 s	econd				
Power supply	Voltage-current					3-pł	nase 380V to	480V - 50/6	60Hz				
Po/ gus	Allowable fluctuation					Voltage +1	0%,-15% N	Note 4), frequ	uency ±5%				
Pro	tective method (IEC60529)					IP	20					IP00 N	lote 5)
Co	oling method						Forced a	ir-cooled					
Color				Munsel 5Y-8/0.5									
Bu	lt-in filter						EMI	filter					

Note 1: Capacity is calculated at 220V for the 200V models, at 440V for the 400V model Note 2: The rated output current in the parenthesis is at 12kHz of PWM carrier frequency (F 300) setting.

Note 2: The rated output current in the parenthesis is at 12MR of PMM carrier incomency of **abo**, **endow** Note 3: Maximum output voltage is the same as the input voltage. Note 4: 10% when the inverter is used continuously (load of 10%). Note 4: 10% when the inverter is used continuously (load of 10%). Note 5: Inverter, 22kW or greater, do not have wining 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.



Common specifications

Upper Inspired 0.5 to 200.0Hz, default setting: 0.5 to 200. Immum setting steps of frequency 0.1Hz: analog input (when the max. frequency Voltage/frequency accuracy 0.1Hz: analog input (when the max. frequency Voltage/frequency characteristics Voltage/frequency characteristics Voltage/frequency characteristics Voltage/frequency characteristics Voltage/frequency setting signal External frequency potentiomater (connect impedance: VVVMB-30kf, 4 - 20mAct (in the characteristics on be set abilitrary) by (MA and VB) and communication comman frequency jump Frequency imp Three frequencies can be set. Setting of the Upper and lower-limit frequencies Juper-limit frequency connection deceleration deceleration PID control Setting of proportional gain, integrap gain, or processing amount and the amount of foce sociatale from among acceleration/deceleration dynamic rapid deceleration DC braking Input terminal function (programmable) Possible to select from among 57 functions (programmable) Frequency dependencies Output setting advance frequency 0.10 threas: frequency deceleration The RUM and STOP keys on the operation (programmable) Input terminal function (programmable) Cossible to select from among 57 functions (programmable) Setting automation/deceleration (programmable) Frequency function The RUM and STOP keys on the operation (programmable) </th <th>Output voltage adjustment Adjustable within the range of 50 to 860. Output frequency range Output frequency range 0.5 to 200.0Hz, default setting: 0.5 to 800. Minimum setting steps of frequency. Voltage/frequency characteristics UP constant, variable torque, automatic turing: Base frequency 2.00H4, adju stati. (0.5 - 10H2) Voltage/frequency setting signal External frequency potentinenter (corner preduency with -0.05% of the max. (0.5 - 10H2) Frequency setting signal External frequency potentinenter (corner preduency WMH = advorted) Frequency iump The characteristic can be set arbitrarily b (WA and WB) and communication commi- preduency iump Frequency iump More frequency and participation time Selectable from among acceleration/deceleration (upper- and lower-limit frequencies) Upper- inter frequency of to max. (upper- and iower-limit frequencies) DC braking Braking start-up frequency: 0 to maximu DC braking Possible to select from among a Selectalon/deceleration/ (programmable) Doward run and reverse run The RUN and STOP Keys on the operation (programmable) Possible to select from among S function reset signal input; to assign to 4 input ter (programmable) Preset speed operation Base frequency + 7-speed operation pos- corror in init. Preset speed operation Base frequency + 2-speed operation pos- corror ininit. Preset speed operation</th> <th></th> <th>Item</th> <th></th>	Output voltage adjustment Adjustable within the range of 50 to 860. Output frequency range Output frequency range 0.5 to 200.0Hz, default setting: 0.5 to 800. Minimum setting steps of frequency. Voltage/frequency characteristics UP constant, variable torque, automatic turing: Base frequency 2.00H4, adju stati. (0.5 - 10H2) Voltage/frequency setting signal External frequency potentinenter (corner preduency with -0.05% of the max. (0.5 - 10H2) Frequency setting signal External frequency potentinenter (corner preduency WMH = advorted) Frequency iump The characteristic can be set arbitrarily b (WA and WB) and communication commi- preduency iump Frequency iump More frequency and participation time Selectable from among acceleration/deceleration (upper- and lower-limit frequencies) Upper- inter frequency of to max. (upper- and iower-limit frequencies) DC braking Braking start-up frequency: 0 to maximu DC braking Possible to select from among a Selectalon/deceleration/ (programmable) Doward run and reverse run The RUN and STOP Keys on the operation (programmable) Possible to select from among S function reset signal input; to assign to 4 input ter (programmable) Preset speed operation Base frequency + 7-speed operation pos- corror in init. Preset speed operation Base frequency + 2-speed operation pos- corror ininit. Preset speed operation		Item				
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Monitoring function Operation frequency, operation frequency, voltage, torque, torque current, load fai information on output terminals, version or command (after PID), integral input power normal state communication counter, cause normal state communication counter, cause or command (after PID), integral input power normal state communication counter, cause or paration time when each trip occurred. Past trip monitoring function Stores data on the past four trips: number or load current, input voltage, output voltage, operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale DC ammer Max. 1mAdc, 7.5Vdc full-scale), 4 to 20mA 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P Status: inverter status (frequency, cause of parameter settings. Free-unit display: arbitrary unit (e.g. rotating). Free-unit display: arbitrary unit (e.g. rotating). Indicator Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2	Monitoring function Operation frequency, operation on output terminals, version command (after PID), integral input pownormal state communication counter, cau on the past four trips: number load current, input voltage, output voltage, operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Status: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm Status: inverter status (frequency, cause parameter settings. Free-unit display: arbitrary unit (e.g. rotat Learns indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not expose (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)		Causes of failures	Over-current, overvoltage, overheating, sho			
Monitoring function Operation frequency, operation frequency, voltage, torque, torque current, load fainformation on output terminals, version or command (after PID), integral input power normal state communication counter, cause normal state communication counter, cause or command (after PID), integral input power normal state communication counter, cause or peration time when each trip occurred. Past trip monitoring function Stores data on the past four trips: number or load current, input voltage, output voltage, operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale DC ammer Max. 1mAdc, 7.5Vdc full-scale), 4 to 20mA 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P Status: inverter status (frequency, cause of parameter settings. Free-unit display: arbitrary unit (e.g. rotating). Free-unit display: arbitrary unit (e.g. rotating). Indicator Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2 Storage temperature -20 to +65°C	Monitoring function Operation frequency, operation frequency voltage, torque, torque current, load information on output terminals, version command (after PID), integral input por normal state communication counter, cau on the past trip monitoring function Past trip monitoring function Stores data on the past four trips: number load current, input voltage, output voltage operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Status: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm Status: inverter status (frequency, cause parameter settings. Free-unit display: arbitrary unit (e.g. rotatter) Indicator Lamps indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not expose (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)			start-up, over-current through load at start-			
Voltage, torque, torque current, load fainformation on output terminals, version on command (after PID), integral input power normal state communication counter, cause normal state communication counter, cause of counters, input voltage, output voltage, output voltage, operation time when each trip occurred. Past trip monitoring function Stores data on the past four trips: number of load current, input voltage, output voltage, operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale DC ammer Max. 1mAdc, 7.5Vdc full-scale), 4 to 20mA 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P Status: inverter status (frequency, cause of parameter settings. Free-unit display: arbitrary unit (e.g. rotating key lamp, UP/DOWN key lamp and RUN key lamp, UP/DOWN key lamp and RUN key electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Voltage, torque, torque current, load information on output terminals, version command (after PID), integral input por normal state communication counter, cau load current, input voltage, output voltage operation time when each trip occurred. Past trip monitoring function Stores data on the past four trips: number load current, input voltage, output voltage operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale) A to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Max. 1mAdc, 7.5Vdc full-scale), 4 to 20m Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm Status: inverter status (frequency, cause parameter settings. Free-unit display: arbitrary unit (e.g. rotat Indicator Indicator Lamps indicating the inverter status by lig key lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not expose (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)			(Selectable: Emergency stop, under-voltage			
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Past trip monitoring function Stores data on the past four trips: number load current, input voltage, output voltage, operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale DC amme Max. 1mAdc, 7.5Vdc full-scale), 4 to 20mA 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P Status: inverter status (frequency, cause of parameter settings. Free-unit display: arbitrary unit (e.g. rotating). Indicator Indicator Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN key electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2)	Past trip monitoring function Stores data on the past four trips: number load current, input voltage, output voltage operation time when each trip occurred. Output for frequency meter Analog output: (1mAdc full-scale) DC anm Max. 1mAdc, 7.5Vdc full-scale), 4 to 20n Max. 1mAdc, 7.5Vdc full-scale, 4 to 20n Hatter, 4 to 20n Max. 1mAdc, 7 to 20n Max. 1mAdc, 7 to 20n Max.			command (after PID), integral input powe			
4-digit 7-segments LED Frequency: inverter output frequency. 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm "P Status: inverter status (frequency, cause of parameter settings. Free-unit display: arbitrary unit (e.g. rotating Indicator Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN key electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	4-digit 7-segments LED Frequency: inverter output frequency. 4-digit 7-segments LED Frequency: inverter output frequency. Alarm: stall alarm "C", overvoltage alarm Status: inverter status (frequency, cause parameter settings. Indicator Lamps indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not expose (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)	~		normal state communication counter, cause			
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Indicator Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN key lamp, UP/DOWN key lamp, UP/DOWN key lamp and RUN key lamp, UP/DOWN key lamp, UP/DOWN key la	Status: inverter status (frequency, cause parameter settings. Free-unit display: arbitrary unit (e.g. rotation in the parameter setting). Indicator Lamps indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposing (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)		4-digit 7-segments LED	Frequency: inverter output frequency.			
parameter settings. Free-unit display: arbitrary unit (e.g. rotating) Indicator Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN key letertically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	state parameter settings. Free-unit display: arbitrary unit (e.g. rotation indicator Indicator Lamps indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not expose (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variation)			Alarm: stall alarm "C", overvoltage alarm "P			
Indicator Free-unit display: arbitrary unit (e.g. rotating Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN ke electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Steep Indicator Lamps indicating the inverter status by lig key lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposing to the temperature -10 to +60°C Note1) Note2) Ambient temperature -20 to +65°C Relative humidity			Status: inverter status (frequency, cause of			
Indicator Lamps indicating the inverter status by light key lamp, UP/DOWN key lamp and RUN key lamp, UP/DOWN key lamp and RUN key electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Indicator Lamps indicating the inverter status by ligkey lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposing (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)						
Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Storage temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variation of the temperature)			Free-unit display: arbitrary unit (e.g. rotating			
Key lamp, UP/DOWN key lamp and RUN key electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposed (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	see key lamp, UP/DOWN key lamp and RUN electrically charged. Use environments Indoor, altitude: 1000m (Max.), not exposition to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)		Indicator	Lamps indicating the inverter status by light			
Storage temperature -10 to +60°C Note2) Storage temperature -20 to +65°C -20 to +65°C	generation Use environments Indoor, altitude: 1000m (Max.), not exposision (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and variable)			key lamp, UP/DOWN key lamp and RUN key			
Image: second system (10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and value)			electrically charged.			
(10 to 55Hz) Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C	Image: Storage temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and value)	ŝ	Use environments	Indoor, altitude: 1000m (Max.), not exposed			
Ambient temperature -10 to +60°C Note1) Note2) Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and vapore)		ents					
Storage temperature -20 to +65°C Relative humidity 5 to 95% (free from condensation and vapor)		mu	Ambient temperature	-10 to +60°C Note1) Note2)			
Image: Belative humidity 5 to 95% (free from condensation and vapor)		Jviro	Storage temperature	-20 to +65°C			
	late 1. Above 40°C. Remove the seal from the tap of the investor and use the investor with the roted output surrent reduced	ш	Relative humidity	5 to 95% (free from condensation and vapo			

Note 1: Above 40°C: Remove the seal from the top of the inverter and use the inverter with the rated output current reduced. Note 2: If inverters are installed side by side (with no sufficient space left between them): 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 nverter with the rated output current reduced.

5	pecification
0	peemeanon

- by correcting the supply voltage (not adjustable above the input voltage , maximum frequency: 30 to 200Hz
- ency is 100Hz), 0.01Hz: Operation panel setting and communication setting. requency (-10 to +60°C)
- requency (25°C ±10°C)

rque boost, vector control, automatic energy-saving, PM motor control. Autoting to 1 or 2, torque boost (0 - 30%) adjusting to 1 or 2, adjusting frequency at

table to a potentiometer with a rated impedance of 1 - 10kΩ), 0 - 10Vdc (input nput impedance: 250Ω).

two-point setting. Possible to set individually for three functions: analog input

ne jump frequency and the range.

Iower-limit frequency: 0 to upper-limit frequency

0 kHz (default: 8 kHz or 12 kHz). differential gain and control wait time. Checking whether the amount of

dback agree.

eration times 1 and 2 (0.0 to 3200 sec.). Automatic acceleration/deceleration on 1 and 2 and S-pattern adjustable. Control of forced rapid deceleration and

frequency, braking rate: 0 to 100%, braking time: 0 to 20 seconds, emergency

s, such as forward/reverse run signal input, operation base signal input and ninals. Logic selectable between sink and source.

ns, such as upper/lower limit frequency signal output, low speed detection signal at and failure signal output, to assign to FL relay output, RY output terminals. panel are used to start and stop operation, respectively. The switching between rom one of the three control units: operation panel, terminal board and external

ible by changing the combination of 3 contacts on the terminal board. check of the main circuit elements in case the protective function is activated.

to prohibit the change of panel frequency settings and the use of operation panel

the inverter reads the rotational speed of the coasting motor and outputs a ed in order to restart the motor smoothly. This function can also be used when

the load torque current.

rrent, output short circuit, over-voltage, over-voltage limitation, undervoltage, output phase failure, overload protection by electronic thermal function, armature rent at start-up, over-torque, undercurrent, overheating, cumulative operation re-alarms

onstant-torque VF motor, switching between motors 1 and 2, setting of overload els 1 and 2, selection of overload stall

or by turning off power or the operation panel. This function is also used to save

der-voltage, setting error, retry in process, upper/lower limits ort-circuit in load, ground fault, overload on inverter, over-current through arm at -up, CPU fault, EEPROM fault, RAM fault, ROM fault, communication error. ge, low voltage, over-torque, motor overload, output open-phase)

command, forward/reverse run, output current, voltage in DC section, output actor of inverter, input power, output power, information on input terminals, of CPU1, version of CPU2, version of memory, PID feedback amount, frequency er, integral output power, rated current, output speed, communication counter, es of past trips 1 through 4, parts replacement alarm, cumulative operation time

of trips that occurred in succession, operation frequency, direction of rotation, information on input terminals, information on output terminals, and cumulative

eter or 7.5Vdc full-scale DC ammeter/Rectifier-type AC voltmeter, 120% current V0 to 20mA output

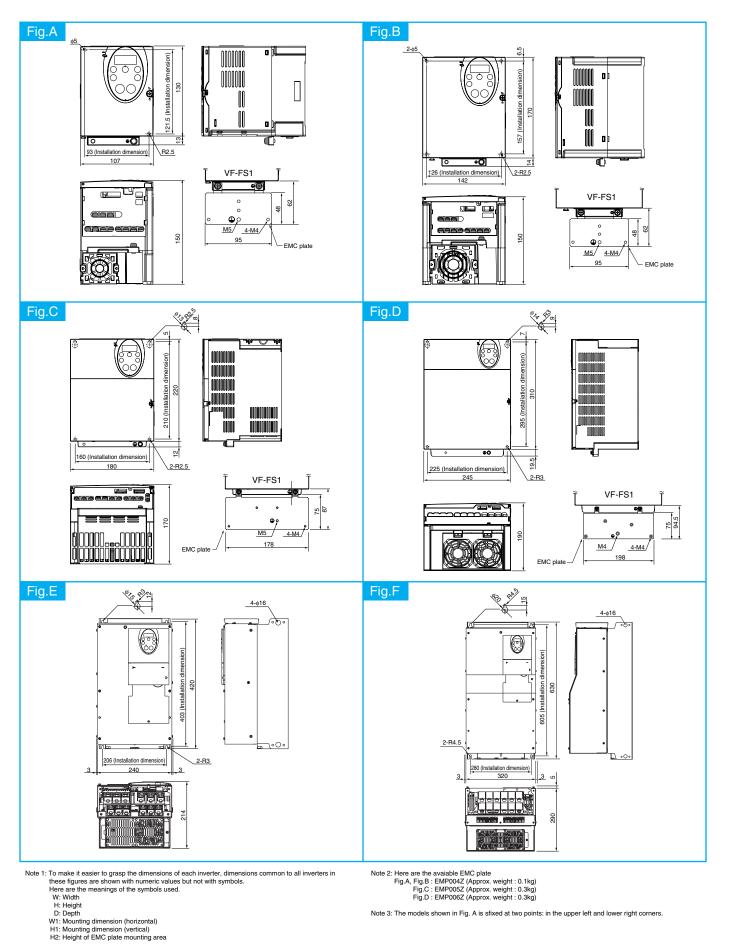
". overload alarm "L". overheat alarm "H". activation of protective function, input/output voltage, output current, etc.) and

g speed) corresponding to output frequency.

ting, such as RUN lamp, MON lamp, PRG lamp, % lamp, Hz lamp, LOC/REM ey lamp. The charge lamp indicates that the main circuit capacitors are

d to direct sunlight, corrosive gas, explosive gas or vibration (less than 5.9m/s2)

External dimension

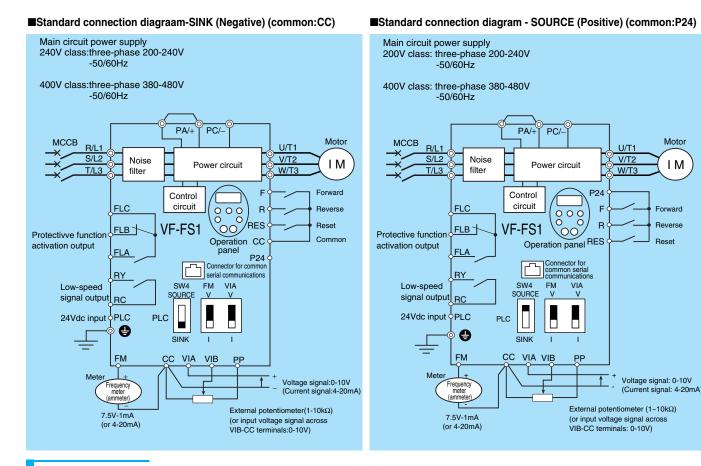


Voltage class	Applicable motor	Inverter type				Drowing	Approx. weight			
vollage class	(kW)	Inverter type	w	н	D	W1	H1	H2	Drawing A B C D A B C A B C C D C D E C D E E E	(kg)
	0.4	VFFS1-2004PM								
	0.75	VFFS1-2007PM	107	130	150	93	121.5			1.2
	1.5	VFFS1-2015PM	107	130	150	93	121.5	13	A	1.2
	2.2	VFFS1-2022PM								
	3.7	VFFS1-2037PM	142	170	150	126	157	14	В	2.1
3-phase	5.5	VFFS1-2055PM	180	220	170	160	210	12	6	4.3
200V	7.5	VFFS1-2075PM	160	220	170	100	210	12		4.5
	11	VFFS1-2110PM							D	8.6
	15	VFFS1-2150PM	245	310	190	225	295	19.5		0.0
	18.5	VFFS1-2185PM								8.9
	22	VFFS1-2220PM	240	420	214	206	403	—	E	16.4
	30	VFFS1-2300PM	320	630	290	280	605	—	F	38.0
	0.4	VFFS1-4004PL								
	0.75	VFFS1-4007PL	107	130	150	93	121.5	13	А	1.4
	1.5	VFFS1-4015PL	107	130	150					1.4
	2.2	VFFS1-4022PL								
	3.7	VFFS1-4037PL	142	170	150	126	157	14	D	2.4
3-phase	5.5	VFFS1-4055PL	142	170	150	120	157	14	В	2.4
400V	7.5	VFFS1-4075PL	180	220	170	160	210	12	6	4.7
	11	VFFS1-4110PL	180	220	170	100	210	12	C	4.7
	15	VFFS1-4150PL	245	310	190	225	295	10.5	D	9.0
	18.5	VFFS1-4185PL	240	310	190	225	295	19.5		9.0
	22	VFFS1-4220PL	240	420	214	206	403		E	15.4
	30	VFFS1-4300PL	240	420	214	200	403		E	10.4

Note 3: The models shown in Fig. A is sfixed at two points: in the upper left and lower right corners.

Standard connection diagram

This diagram shows a standard wiring of the main circuit.



Wiring devices

Voltage class	Capacity of applicable motor	Input cu	rrent (A)	Wire size (For IEC603	See Note 4) 64-5-523/54	Molded case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB)	Magnetic contactor (MC)
	(kW)	200V class:200V 400V class:380V	200V class:240V 400V class:480V	Power circuit (mm ²) Note 1)	Earth cable (mm²)	Rated current (A)	Operational current(A) AC-1
	0.4	1.9	1.6	1.5	2.5	3	25
	0.75	3.3	2.7	1.5	2.5	5	25
	1.5	6.1	5.1	1.5	2.5	10	25
	2.2	8.7	7.3	1.5	2.5	15	25
	3.7	15.7	13.0	2.5	2.5	30	25
Three-phase	5.5	20.8	17.3	4	4	40	32
200V class	7.5	27.9	23.3	6	6	50	40
	11	42.1	34.4	10	10	75	50
	15	56.1	45.5	16	16	100	80
	18.5	67.3	55.8	25	16	100	80
	22	80.4	66.4	25	16	125	100
	30	113.3	89.5	50	25	175	125
	0.4	1.0	0.8	1.5	2.5	3	25
	0.75	1.7	1.4	1.5	2.5	3	25
	1.5	3.2	2.5	1.5	2.5	5	25
	2.2	4.6	3.6	1.5	2.5	10	25
	3.7	8.1	6.4	1.5	2.5	15	25
Three-phase 400V class	5.5	10.9	8.6	1.5	2.5	20	25
Note 9)	7.5	14.7	11.7	1.5	2.5	30	32
	11	21.1	16.8	4	4	40	32
	15	28.5	22.8	6	6	50	40
	18.5	34.8	27.8	6	6	60	50
	22	41.6	33.1	10	10	75	80
	30	56.7	44.7	16	16	100	80

Note 1: Sizes of the wires connected to the input terminals R/L1, S/L2 and T/L3 and the output terminals U/T1, V/T2 and W/T3 when the length of each wire does not exceed 30m. Note 2: For the control circuit, use shielded wires 0.75 mm² or more in diameter. Note 3: For grounding, use a cable with a size equal to or larger than the above. Note 4: The wire sizes specified in the above table apply to HIV wires (cupper wires shielded with an insulator with a maximum allowable temperature of 75°C) used at an ambient temperature of 40°C or less. or less.

Note 5: If there is a need to comply with UL standard , use correct size of UL wires.

Note 6: Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-

Note 6: Selections for use of the Toshiba 4-pole standard motor with power supply voltage or 2009/4009 50Hz.
 Note 7: 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 8: When using on the motor side during commercial-power supply operation, choose the MC with class AC-3 rated current for the motor rated current.
 Note 9: Attach surge killers to the magnetic contactor and exciting coil of the relay.
 Note 10: 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.

Main circuit terminal							
Terminal symbol							
•	Grounding terminal for connecting inverter. There are 3 terminals in total. 2 terminals in the terminal t						
R/L1, S/L2, T/L3	200V class: three-phase 200 to 240V-50/60Hz 400V class: three-phase 380 to 480V-50/60Hz						
U/T1, V/T2, W/T3	Connect to a (three-phase induction) motor.						
PA/+, PC/-	PA/+ terminal: Positive potential terminal for the internal I PC/- terminal: Negative potential terminal for the internal DC power can be supplied through the PA/+ and PC/- te						

Control circuit terminal

Terminal symbol	Input/output		Function	Electrical specifications
F	Input	ion able out	Shorting across F-CC causes forward rotation; open causes slow-down and stop. (When ST is always ON)	No voltage contact input
R	Input	Multifunction programmable contact input	Shorting across R-CC causes reverse rotation; open causes slow-down and stop. (When ST is always ON)	24Vdc-5mA or less
RES	Input	Mul	This inverter protective function is disabled if RES are CC is connected. Shorting RES and CC has no effect when the inverter is in a normal condition.	*Sink/Source/PLC selectable using SW4
PLC	Input (common)		24Vdc power input 9 source logic is used, a common terminal is connected.	24VDC (Insulation resistance: DC50V)
СС	Common to Input/output	Control c	ircuit's equipotential terminal (2 terminals)	_
PP	Output	Analog p	ower supply output	10Vdc (permissible load current: 10mA)
VIA	Input	Factory of The func (SW3) di By chang program	tion programmable analog input. default setting: $0 \sim 10Vdc/0 \sim 60Hz$ ($0 \sim 50Hz$) frequency input. tion can be changed to $4 \sim 20mAdc$ ($0 \sim 20mA$) current input by flipping the VIA p switch to the I position. ging parameter setting, this terminal can also be used as a multifunction mable contact input terminal. When using the sink logic, be sure to insert a resistor P24-VIA ($4.7 k\Omega$ -1/2 W). Also move the VIA (SW3) dip switch to the V position.	10Vdc (internal impedance: 30kΩ) 4-20mA (internal impedance: 250Ω)
VIB	Input	Standarc	tion programmable analog input. I default setting: 0~10Vdc/0~60Hz (0~50Hz) frequency input. mal input	10Vdc (internal impedance: $30k\Omega$)
FM	Output	The func	tion programmable analog output. Standard default setting: output frequency. tion can be changed to 0-20mAdc (4-20mA) current output by flipping the FM de switch to the I position.	1mAdc full-scale ammeter or 7.5Vdc (10Vdc)1mA full-scale voltmeter 0-20mA (4-20mA) DC ammeter Permissible load resistance: 750Ω or less
P24	Output	24Vdc pc	wer output	24Vdc-50mA
FLA FLB FLC	Output	Detects t	tion programmable relay contact output. he operation of the inverter's protection function. across FLA-FLC is closed and FLB-FLC is opened during protection function	250Vac-1A(cosø=1): at resistance load 30Vdc-0.5A, 250Vac-0.5A(cosø=0.4)
RY RC	Output	Standarc	tion programmable relay contact output. I default settings detect and output low-speed signal output frequencies. tion output terminals to which two different functions can be assigned.	250Vac-1A(cosø=1): at resistance load 30Vdc-0.5A, 250Vac-0.5A(cosø=0.4)

Terminal function

board, 1 terminal in the cooling fin.

I DC main circuit al DC main circuit terminals.

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 "REE").

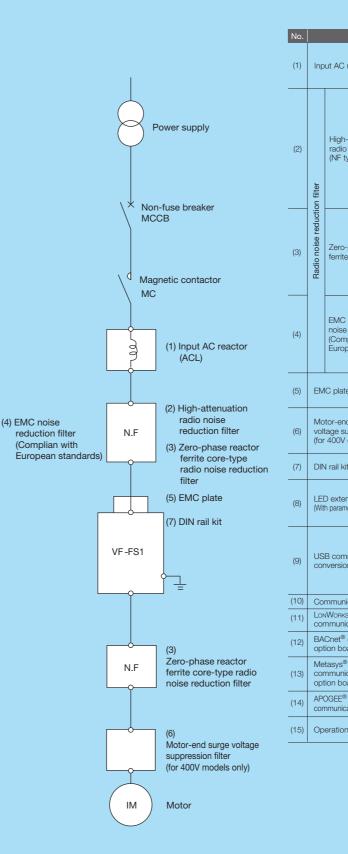
wizard function

A wizard function enable set the 10 most often used parameter quickly. It can be sequentially, such as installing the PC software.

Title	Function
RUI	Automatic acceleration/deceleration
REE	Acceleration time 1
dEE	Deceleration time 1
11	Lower limit frequency
UL	Upper limit frequency
EHr	Motor electronic-thermal protection level 1
FN	Meter adjustment
PE	V/F control mode selection
uL	Base frequency 1
uLu	Base frequency voltage 1

Basic parameters

Title	Function	Adjustment range	Default setting
FC	Operation frequency of operation panel	LL-UL	0.0
Title	e Function	Adjustment range	Default setting
RUF	Wizard function	The wizard function refers to the special function of calling up ten frequently used parameters.	-
RUH	History function	Displays parameters in groups of five in the reverse order to that in which their settings were changed.	-
		* (Possible to edit)	
RU I	Automatic acceleration/deceleration	0: Disabled (manual) 1: Automatic 2: Automatic (only at acceleration)	0
RUH	Parameter setting macro function	0: Disabled 1: Coast stop 2: 3-wire operation 3: External input UP/DOWN setting	0
		4: 4-20 mA current input operation	
C/10	Command mode selection	0: Terminal board 1: Operation panel 2: Serial communication	0
FNO	Frequency setting mode selection 1	1: VIA 2: VIB 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact	1
FNS	L Meter selection	0-19 (0:Output frequency 1:Output current 2:Set frequency 3:DC voltage 4: Output voltage command value, etc.)	0
FN	Meter adjustment	-	-
ESP	Default setting	0: - 1: 50Hz default setting 2: 60Hz default setting 3: Default setting (Initialization)	0
		4: Trip record clear 5: Cumulative operation time clear 6: Initialization of type information	
		7: Save user setting parameters 8. Call user-defined parameters	
		9. Cumulative fan operation time record clear	
Fr	Forward/reverse run selection	0: Forward run 1: Reverse run 2: Forward run (F/R switching possible)	0
		3: Reverse run (F/R switching possible)	
REE		0.0-3200	Depends on capacity
JEC		0.0-3200	Depends on capacity
FH	Maximum frequency	30.0-200.0	80.0
UL	Upper limit frequency	0.5- FH	50.0 (WP)/60.0 (WN)
LL	Lower limit frequency	0.0- <i>UL</i>	0.0
UL	Base frequency 1	25.0-200.0	50.0 (WP)/60.0 (WN)
ULU	Base frequency voltage 1	50-330 (200V class),	Depends on capacity
		50-660 (400V class)	
PĿ	V/F control mode selection	0: V/F constant 1: Variable torque 2: Automatic torque boost control 3: Vector control	1
		4: Energy-saving 5: - (Do not select) 6: PM motor control	
ub	Torque boost 1	0.0-30.0	Depends on capacity
EHr		10-100	100
DLA		0-3: Standard motor (Overload protection, OL stall)	0
-	characteristic selection	4 -7: VF motor (Overload protection, OL stall)	
Sr 8			15.0
Srð			20.0
Sr 3			25.0
Sr 4			30.0
<u>Sr S</u>		LL-UL	35.0
Sr 6			40.0
Sr 7	· · · · · · · · · · · · · · · · · · ·		45.0
F	Extended parameters	Set parameters in more detail	-
Gr.	L Automatic edit function	-	-



Peripheral devices



About 170 extended parameters are available. For details on extended parameters, please visit our web site. (http://www.inverter.co.jp/)

Device	Function and purpose
reactor (ACL)	Effective to reduce the harmonics (PWHD) and suppress external surge on the inverter power source side. Install when a distorted wave generation source such as a thyristor unit or a large capacity inverter is connected in the same distribution system.
n-attenuation o noise filter type)	 These types of filters are not necessary because all 3-phase 400V models have a built-in EMI noise filter, as standard. But install these filters if necessarily of noise reduction move and more. 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-phase reactor e core-type	 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.
) e filter npliant with ipean 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. 400V class: EC/EN61800-3, 1st Environment, C1 or IEC/EN61800-3, 1st Environment, C2 200V class: EC/EN61800-3, 1st Environment, C2 or IEC/EN61800-3, 2nd Environment, C3
te	A steel plate used to connect shielded earth wires from inverter's power cables or to connect earth wires from external devices. Some models have it as a standard attachment or as an option.
nd surge suppression filter / 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.
sit	Available for the 2.2kW or less. (Model: DIN005Z)
ension panel neter 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)
nmunications on 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)
nications cable	Connector cable for LED extension
is® lications	This option enables LowWorks® communications with a host controller or other PLC. (Type :LIU007Z)
© communications bard	This option enables BACnet [®] communications with a host controller or other PLC. (Type :BCN002Z)
[®] N2 lications pard	This option enables Metasys [®] N2 communications with a host controller or other PLC. (Type :MTS003Z)
[®] FLN cations option board	This option enables APOGEE® FLN communications with a host controller or other PLC. (Type :APG002Z)
n panel	Has a built-in frequency type, frequency setter and RUN-STOP (forward run, reverse run) switch. (model type: CBVR-7B1)

For inverter users

When studying how to use our inverters

Notes

Application of this inverter

VF-FS1 is not applicable for apparatus which needs sudden deceleration and stop. Also it can not be used for machine which requires continuos electrical braking (generaters regeneration power) such as a winding machine.

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:

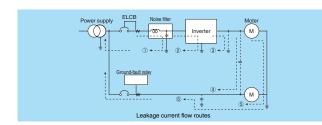
- Route(1)...Leakage due to the capacitance between the ground and the noise filter Route(2)...Leakage due to the capacitance between the ground and the inverter Route(3)...Leakage due to the capacitance between ground and the cable
- connecting the inverter and the motor Route(4)...Leakage due to the 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)
- (1)Decrease the PWM carrier requency 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. (Inapplicable 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 Note) This inverter allows you to decrease the frequency up to 6.0kHz.
- If the carrier frequency reduce, the acoustic noise caused by the motor increase.

- 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.

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,

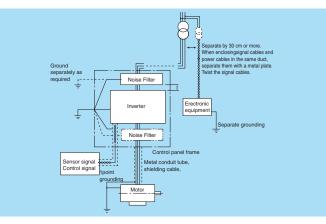
its wiring condition, the distance between it and the inverter, etc.

[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 three-phase 400V 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 (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 inverter is connected the same power distribution system as a thyristor-committed control equipment.
- (2) 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]

- Install a molded-case circuit breaker (MCCB) on the inverter's power supply input to protect the wiring.
 Avoid turning the molded-case circuit breaker on and off frequently to turn on/off
- (a) 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

- 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-FS1 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

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.

Multipolar motors

Note that multipolar motors(8 or more poles), which may be used for fans, etc., have higher rated current than 4-pole motors.

The current ratings of multipolar 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.

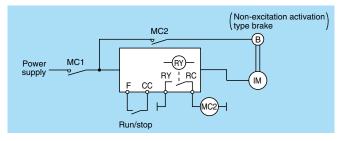
Single-phase motor

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'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 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).



MEMO

Selecting the capacity (model) of the inverter

Selection

Capacity

Acceleration time

Deceleration time

Conditions

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.

ΔN: Difference in rotating speed between before and after acc. or dce.

 $ta = \frac{(J_M + J_L) \times \Delta N}{9.56 \times (T_M - T_L)} \text{ (sec)}$

 $ta = \frac{(J_{M}+J_{L}) \times \Delta N}{9.56 \times (T_{B}+T_{L})} \text{ (sec)}$

JM: Moment of inertia of motor (kge.m²) JL: Moment of inertia of load (kge.m²) (converted into value on motor shaft)

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).

For this inverter,Toshiba unique technologies suppress harmonics, particularly 5th and 7th harmonic current that affect power sources. And the power factor in all models has been improved. Harmonics are controlled to within the Total Harmonic Distortion (THD) of international standard IEC61000-3-12 without any external reactor. (Rsce ≥120) Optional AC reactor enables to comply with Partial Weighted Harmonic Distortion (PWHD) of IEC 61000-3-12. (Rsce ≥120)

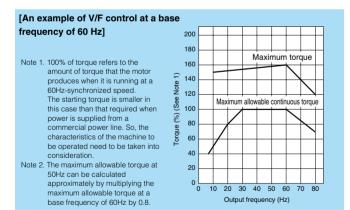
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(min.-1) TL: Load torque (Ne.m)

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.

TM: Motor rated torque x 1.1 (Ne.m) ... V/f control



Starting characteristics

When a motor is driven by an inverter, its operation is restricted by the inverter's overload current rating, so the starting characteristic is different from those obtained from commercial power supply operation.

Although the starting torque is smaller with an inverter than with the commercial power supply, a high starting torque can be produced at low speeds by adjusting the V/f pattern torque boost amount or by employing vector control. When a larger starting torque is necessary, select an inverter with a larger capacity

and examine the possibility of increasing the motor capacity. If you need bigger starting torque, please consider both upgrading inverter rating

and motor rating.



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For users of the products : Our variable speed drives are designed to control the speeds of three-phase motors for general industry.

A Precautions

* Please read the instruction manual before installing or operating the drive unit.

* This product is intended for general purpose uses in industrial application. It cannot be used applications where may cause big impact on public uses, such as power plant and railway, and equipment which endanger human life or injury, such as nuclear power control, aviation, space flight control, traffic, safety device, amusement, or medical.

It may be considerable whether to apply, under the special condition or an application where strict quality control may not be required. Please contact our headquarters, branch, or local offices printed on the front and back covers of this catalogue.

- * When exporting Toshiba variable speed drive separately or combined with your equipment, please be sure to satisfy the objective conditions and inform conditions listed in the export control policies, so called Catch All restrictions, which are set by the Ministry of Economy, Trade and Industry of Japan, and the appropriate export procedures must also be taken.
- * Please use our product in applications where do not cause serious accidents or damages even if product is failure, or please use in environment where safety equipment is applicable or a backup circuit device is provided outside the system.
- * Please do not use our product for any load other than three-phase 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 variable speed drive is incorporated or to any equipment that is used in combination with the Toshiba variable speed drive. 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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