

# Variable Speed Drive **VF-S15**



# **Features**

# 1. <u>Easy setting, Simple operation</u>

#### Easy setting, simple operation with the large dial

Just turn and push the large setting dial to browse and select the right parameter. The reference frequency can be also set by the large setting dial.



#### Parameter can be set without power supply to the inverter

Using the optional parameter writer, you can read/write/ retain/set parameters.

It is useful in case of incorporate numbers of inverters to the machine.



#### Showing most frequently used parameter in EASY mode.

EASY key allows you switch between EASY mode and Standard mode.

EASY mode: Scrolls through a list of most frequently used parameter.(32 parameters in maximum.) Standard mode: Show all existing parameters.

### 2. <u>Eco Design</u>

#### Long lifetime

Long life main-circuit capacitor is used to achieve 10 years lifetime design.

\*Average ambient temperature 40°C, load factor 80% or less, 24-hour and 365 days operation.

#### Harmonize with environment

- 1. Compliance with the European RoHS Directive.
- Built-in noise filters to suppress electromagnetic noise.
   1-Phase 240V models and 3-Phase 500V models: Built-in EMC noise filter complies with the European EMC Directive.
- 3-Phase 240V models: Built-in basic noise filter.
- 3. Complies with the Ecodesign Directive (ErP Directive) Conforms to IEC61800-9-2 IE2.

#### Side-by-side installation

Side-by-side installation is possible for all VF-S15 models. It means that you can further save space as two or more units can be installed in close proximity next to each other.



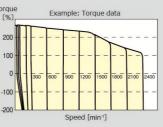
#### Along with the motor, achieve energy savings.

- 1. High energy saving performance PM motor can be driven normally.
- Auto-tuning can set motor constant easily. 2. Energy saving mode for induction motor.
- Improve the energy saving effect of variable torque load such as fan and pump.



#### Easy operation of high torque load.

Vector control mode generate stable, high torque power from motor startup to a desired motor operating speed. Further, if you set the starting frequency to 0.1Hz, motor can start smoothly with strength.



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#### Auto-tuning can setup motor constant easily.

With vector control mode and PM motor control mode, auto-tuning function leads you easy access to motor constant setup and fully use of all the advantages of motor.

#### Motor information is required for the auto-tuning:

- •Motor rated capacity (kW)
- •Motor rated current (A)
- Motor rated speed (min<sup>-1</sup>)
- •Motor rated Voltage (V) (In case of PM: Induced voltage(RMS between the line) \*Please find the information on the motor's name plate.

#### Easily adjust the lifting application by learning function.

A learning function for setting and storing to memory required parameters while performing actual operations is also provided to facilitate adjustments. Every model is built-in braking resistor drive circuit.

# 5. Expandability of the system

#### Built-in RS485 is equipped as standard

Modbus-RTU protocol /TOSHIBA protocol is complied. Communication speed: Maximum 38.4kpbs

#### Variety of communication options

CC-Link, PROFIBUS-DP, PROFINET, DeviceNet<sup>™</sup>, EtherNet/IP<sup>™</sup>, EtherCAT<sup>®</sup>, CANopen<sup>®</sup>

Voltage class (Input/Output)			ļ	\pplic	able r	notor(	(kW)			
(input/output)					2.2	4.0	5.5			15
3¢240V/3¢240V		$\checkmark$								
1Ф240V/3Ф240V	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$					-
3Ф500V/3Ф500V		√	$\checkmark$							

### **Useful function and specification**

#### Simplify the system

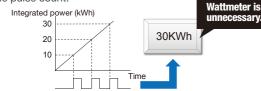
#### Panel display control

Contents of your requests, such as load condition, could be viewed on the inverter's panel. (Using the communications)



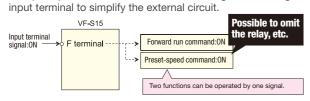
#### Shows power by the pulse count

Integrated power can be output by the pulse. Even without the external wattmeter, power can be shown by the pulse count.



#### **Flexible terminals**

The terminal function settings can be changed. Multiple input terminal functions can be assigned with single



#### **Useful for OEM**

#### Parameters can be set easily

•Application easy setting

6 parameters for particular usages are available. Parameters match to your machine can be displayed and setup easily by using the application easy setting.

#### AUA Application easy setting

- 1: Initial easy setting
- 2: Conveyor
- 3: Material handling
- 4: Hoisting
- 5: Fan
- 6: Pump
- 7: Compressor

#### •Protection of the setting parameters.

VF-S15 provides protection for the setting parameters. Four-digit password is required to reinforce the security. VF-S15 can save and restore a set of parameters.

#### •Setting from extension parameter writer.

•Setting and management on a PC: PCM002Z. (Refer to Page 4)

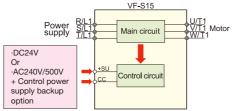
#### Easy wiring

•Detachable control terminal board Remove the terminal board to wiring efficiently.

#### Useful to building the system

#### Control power supply backup

Control power supply is supplied from the inverter's main circuit and also supplied by another input. It can maintain the output signal and trip indication, when the main circuit power supply circuit is also turned off due to inverter trip.



#### Continuously adjustment from analog input

Can be adjusted continuously by analog input, the value to be set by the parameter.

#### < Adjustment parameters >

Acceleration/Deceleration time Upper limit frequency Torque boost value Motor electronic-thermal protection level etc.

\*For processing by the internal, parameter settings are not changed

#### **International Standards**

•Compliant with UL standard UL61800-5-1

### €€®®

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

#### •Sink/Source control logic It can be configured for both sink logic and source logic.

#### •Built-in EMC filter

1-phase 240V and 3-phase 500V model have built-in noise filter complied with the European EMC Directive.

#### Wide variety of applied conditions

<ul> <li>wide variety of ap</li> </ul>	plied conditions
	240V class model is for 200~240V, 500V class model is for 380V~500V(UL:480V). It can correspond to a wide range of power supply
	It can be used maximum ambient temperature of $60^{\circ}$ (UL: $50^{\circ}$ or $40^{\circ}$ C (240V class model 0.75kW or less))* <sup>1</sup>
	Maximum altitude 3000(UL:1000)meter (Corner-earthed system:2000meter or less)*1
*1 The maximum output curre	ent may be limited depend on the operating conditions

#### **Easy maintenance**

#### •Monitor number of starting

Displaying number of starting and output the alarm signal are helpful for maintenance.

#### •Details on history trip records

Output current, input voltage etc, a monitor to identify the cause of the problem and help to find countermeasures. VF-S15 can keep memories of the last eight trips even after resetting.

• Tracing function (Refer to page 4)

### **Safety function**

Safety function prevents a disaster caused by a complex Machine, not only operator but also machine design regards to safety precaution. It is insulating the output reliability in the event of an emergency. And it can simply the system and reduce the wiring and external devices cost. ISO13849-1 Category 3 PL "d"

#### Compliant with safety standards:

Possible to disconnect the output corresponding to the safety standard.

- •EN954-1 Category 3
- •IEC61800-5-2/IEC61508 SIL2
- IEC62061 SIL2 CL
- •ISO13849-1 Category 3 PL "d"
- •IEC60204-1 Category stop 0, 1

#### PM motor drive technology

The VF-S15 can drive Interior Permanent Magnetic Motor(IPM) and Surface Permanent Magnetic Motor(SPM) for high efficiency, high torque energy saving, downsizing and lightening.



### **Dual rating (CT/VT)**

The VF-S15 can be used the constant torque and variable torque applications by dual rating operation. For example, if variable application (fan and pump) required 15kW drives, it can be operated by 11kW rated of VF-S15.

#### Constant torque application

The torque value of constant torque application require the high torque level of different motor speed for conveyors, Machine tools, Food machine and Elevator.

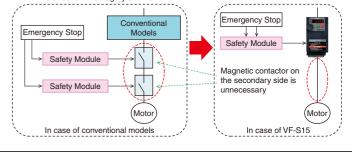


#### Variable torque application

The torque value of variable torque application such as Fan, Pump and HVAC require low torque unit to operating speed.



Caution: VT mode isn't compliant with UL and CSA standard.



#### **My function**

My function enhances programming capability to inverter's input/output signals to respond to customer needs without external relays or a PC in some cases. Easy programming tool (PCL001Z) is available.

•Easy programming(PCL001Z) My function parameter can be set easily by the PCL001Z



#### **Communication**

•Built-in RS-485 communications: Modbus-RTU protocol/TOSHIBA protocol.



### **Useful function for** wide range

VF-S15 for machinery and



tunction to						Machinery	and Facil	ities					
ange appli hinery and facilities in	various industrial sector and appilication	Material handling (Horizontal)	Material handling (Vertical)	Fans & Pumps	Food processing machinery	Packaging machinery	Daily–life– related machinery	Medical equipment	Textile line	Chemical machinery	Printing machinery	Machine tools Processing machinery	Semiconductor facility equipment
		Conveyor	Crane	Pumps	Food machines	Band tighteners	Car washing machine	X-ray machines	Textile machines	Mixers	Printing presses	Machine tools	
		√∶ideal	Hoist	Fans/blowers			Commercial ironing boards	Treadmill  • Nursing beds • Water beds	Weaving machines     Knitting machines     Dyeing/finishing     machines			Cutters     Welding machines     Grinding machines     Woodworking	Semiconductor production equipment LCD production
	on & Advantage	$\sqrt{4}$ applicable	storage units		Driers	Packing machines	Shutter	Massage machines		Painting machines	Binding madchines	machinery	equipment
External parameter writer	Parameter can be set without power supply.	$\checkmark$		$\sqrt{4}$	<b>√</b> √	<b>1</b>	<b>1</b>	<b>V</b>	√	√	√	√	
Easy setting mode	Show most frequently used parameters in EASY mode.	$\checkmark$		$\sqrt{}$	$\checkmark$					$\checkmark$	$\checkmark$	$\checkmark$	
Application easy setting	6 parameters for particular usages are available.	$\checkmark\checkmark$	$\sqrt{}$	$\sqrt{4}$									
Password lock	A four-digit password is required to change the parameters if necessary.	$\checkmark$	$\checkmark$		<b>V</b>	$\sqrt{}$	<b>V</b>	$\sqrt{}$	√	$\checkmark$	$\checkmark$	$\checkmark$	$\sqrt{}$
Side-by-side installation	Two or more inverter units can be installed in close proximity next to each other	$\checkmark$			<b>√</b> √	√	<b>1</b> 1	√	~~		√		
Ambient temperature: 60°C	Maximum ambient tenperature: 60°C			V	<b>1</b> 1		<b>1</b>		√	V			
Long lifetime	Designed for 10 years lifetime design	√		<b>1</b>					√				
Built-in noise filter	Built-in EMC noise filter comply with European EMC Directive			√	√	√	<b>1</b>	~~					<b>V</b>
Random mode	Improves hearing impression by changing the pattern of the low carrier frequency				√		<b>1</b>	~~					
PM motor	PM motor can drive for high efficiency, downsizing and lightening.(For variable torque)			<b>V</b>									
Energy saving mode	Energy can be saved in all speed areas by detecting load current and following the optimum current that fits the load			<b>V</b> V	~	1	~	√					
High torque drive	VF-S15 supports sensorless vector control mode to generate stable, high-torque power from motor startup to a predenfined, desired motor operating speed.	$\sqrt{4}$	<b>VV</b>		√	1	√	√	√	<b>√</b> √		~~	√
Auto-tuning	This auto-tuning function allows you to set the motor constant easily, which needs to be set when operating in vector control or PM motor drive	<b>VV</b>	$\sqrt{}$	<b>V</b> V	√	√	√	√	√	<b>VV</b>		<b>V</b>	√
Learning function	Setting and storing to memory required parameter while performing actual operation is also provided to facilitate adjustments	$\checkmark$	$\sqrt{}$										
Override function	Preventing loads from concentrating at a specific motor because of a load imbalance when multiple inverters are used to operate one machine	$\checkmark$			$\checkmark$		√	√		√		$\checkmark$	
ACC/DEC pattern (S-pattern) function	To minimize the shocks caused in starting and stopping and change the ACC/DEC rate according to the machine characteristics and its applications.	$\sqrt{}$			√		√			V			
DC brake function	A large braking torque can be obtained by applying a direct current to the motor	<b>√</b> √	√		1		√			√			
Dwell function	Suspends acceleration and deceleration to match the timing of brake	$\checkmark$			√	√	√		~~	√		~~	√
Auto-restart control	Detects the rotating speed rotational direction of the motor during coasting at the event of momentary power failure, and then after power has been restored, restarts the motor smoothly	<b>√</b> √		<u>۷</u> ۷					√				
PID control	To use temperature, pressure, flow and motion control			~~	~		√						
Sleep function	Additional energy saving can be realized by stopping at lower limit setting			<b>V</b>	√		√			V			
Bumpless function	When switching from Remote mode to Local mode, the status of start and stop, and operating frequency at Remote mode move to Local mode.			<b>V</b> V			√			V			
Network communication	Built-in RS485. Can be connected to the common industrial communication	√	√	~~	~~		<b>1</b> 1	~~	~~	V	√		√
Panel display control (Using the communication)	Contents of your requests, such as condition, can be viewed on the inverter's panel	$\checkmark$		√	~~		<b>1</b> 1	~~	√	<b>√</b> √			
Parameter adjustment by Analog input	Parameters adjustable from external analog input	<b>11</b>			~		√	1		11		√	
Control power supply can supplied from another input	Control power supply is supplied from the inverter's main circuit and also supplied by another input. It can maintain the output signal and trip indication, when the inverter become trip.	11	<b>VV</b>	~~					11	~~	<b>V</b>	11	<b>V</b>
Other	For more details of each functions, please confirm with Toshiba representative offices or Toshiba authorized distributors in your country.	Torque limit	Low voltage operation function, Shock monitoring function	Fire control enables forced operation					Traverse function Synchronized deceleration				

Easy setting Simple operation

Eco Design

Energy savings & Powerful operation

Applicability

Expandability of the system

### **Panel and operation procedure**



#### Values set by each setup parameter

Title	Fund	tion	<i>E 납</i> (Mainly in Europe)	년 5 문 (Mainly in North America)	용ら / R (Mainly in Asia, Oceania) <sub>Note 1)</sub>	<i>¦ ¦₽</i> (Mainly in Japan)
UL/UL/F 170/ F204/F2 13/ F2 19/F330/ F367/F8 14	Frequ	iency	50.0(Hz)	60.0(Hz)	50.0(Hz)	60.0(Hz)
υĽυ/ ΓΙΤΙ	Base frequency	240V class	230(V)	230(V)	230(V)	200(V)
FĪĪI	voltage 1, 2	500V class	400(V)	460(V)	400(V)	400(V)
PE	V/F control m	ode selection	0	0	0	2
F 3 0 7	Supply volta (output volta		2	2	2	3
F 3 19	Regenerative ouppe	over-excitation r limit	120	120	120	140
F4 17	Motor rat	ed speed	1410(min <sup>-1</sup> )	1710(min <sup>-1</sup> )	1410(min <sup>-1</sup> )	1710(min⁻¹)

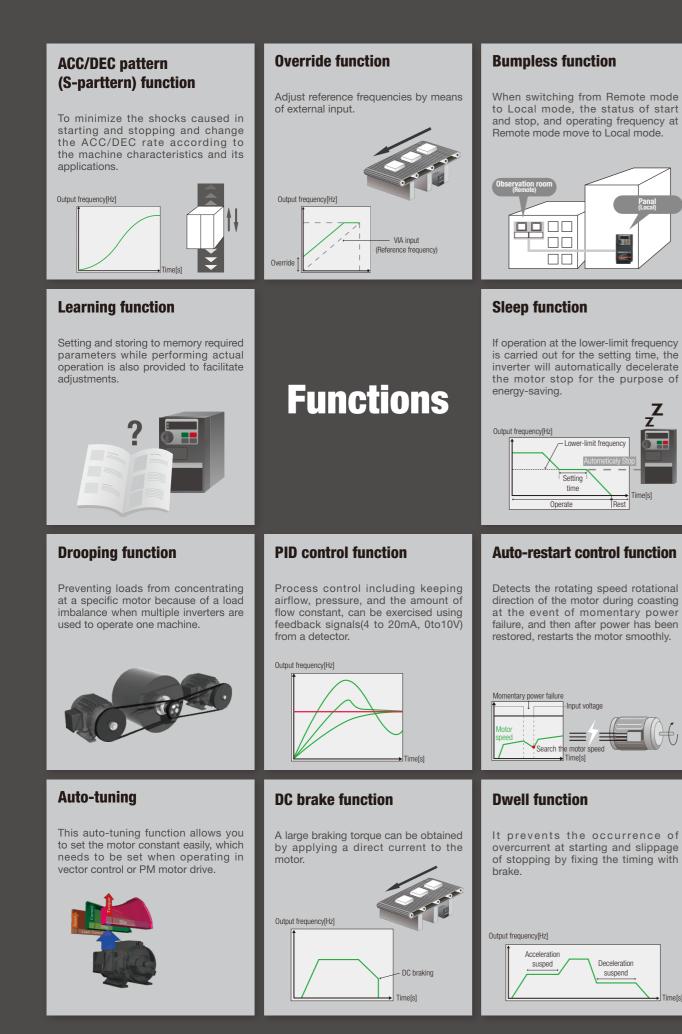
### Monitor display

The LEDs on the operation panel display the following symbols indicate operations and parameters. LED (number)

	•	,								
0	1	2	3	4	5	6	7	8	9	-
0	1	2	3	Ч	5	6	7	8	9	-

#### LED (alphabet)

	(		-/																										
Aa	Bb	С	С	Dd	Ee	Ff	Gg	Н	h	Ι	i	Jj	Kk	LI	Mm	Nn	0	0	Рр	Qq	Rr	Ss	Tt	Uu	Vv	Ww	Хх	Yy	Zz
8	Ь	Ľ	С	d	Ε	F	5	Н	h	1	1	រ	$\lor$	L	Π	n	0	0	ρ	9	٢	5	Ł	U	U	$\square$	$\square$	У	



# TOSVERT **VF-S15**

#### Power on (setup parameter)

V

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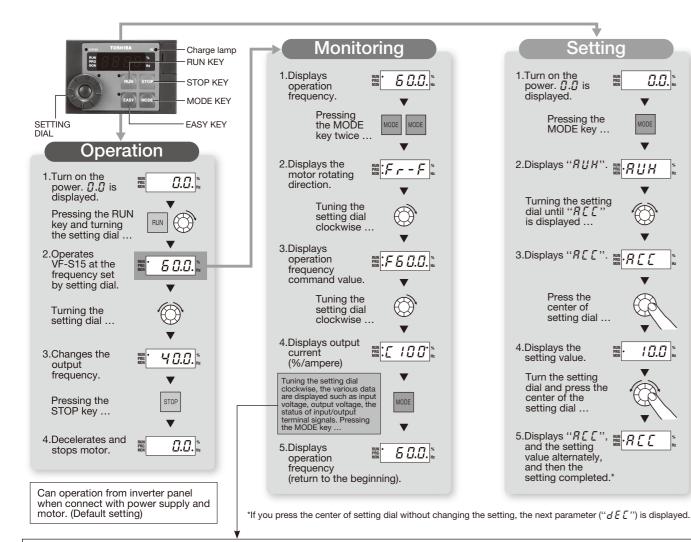
▼

V

T

0.0.

- 1. When power on the inverter for the 5EEfirst time, 5 E E is blinking.
- 2.Select an area code by the setting dial. JP/USR/RS IR/EU
- 3. Press the center of the setting dial to confirm your change. When  $\{ n \} \in$  is displayed and then  $\square \square$ , you finish setting setup parameter.



Item Panel displayed operated LED Description displa The output frequency is displayed (Operation at CPU1 Output 60.0 60Hz). (When standard monitor display selection version frequency F 7 1 🖞 is set at 🖞 [output frequency]) CPU2 Parameter The first basic parameter "###" (history function) version MODE RUH setting mode is displayed. Inverter rated curre The direction of rotation is displayed

setting mode	MODE	нин	is displayed.	Inverter	٢	R 3 3.0	The inverter rated current (A) is displayed.
Direction of rotation	MODE	Fr-F	The direction of rotation is displayed. ( $F - F$ : forward run, $F - r$ : reverse run)	rated current Overload and			The inverter overload characteristic and region
Frequency			The frequency command value (Hz/free unit) is	region setting	Ô	C-EU	setting is displayed.
command value *	Ø	F 6 0.0	displayed. (In case of $F \neq I = 2$ )	Past trip 1	Ô	0P2⇔1	Past trip 1 (displayed alternately)
			The inverter output current (load current) (%/A)	:			
Output current *	Ø	C 80	(In case of $F = 1$ )	Past trip 8	Ô	nErr⇔8	Past trip 8 (displayed alternately) The status of signal transmission and reception
Input voltage *	٢	y 100	The inverter Input voltage (DC detection) (%/V) is displayed. (In case of $F$ 7 $f$ $f$ = $3$ )				of communication are displayed in bits.
Output voltage*	٢	P 100	The inverter output voltage (%/V) is displayed. ( In case of $F$ 7 14=4 )	Communication	Ô	51 ,,	RX: signal receiving
Input power *	٢	h 12.3	The inverter input power (kW) is displayed. (In case of $F$ 1 $15=5$ )	Status	w		TX: signal transmitting —/
Output power *	٢	н I I.8	The inverter output power (kW) is displayed. (In case of $F$ 7 $f_{E}=F$ )				receiving or transmitting : /
Inverter load factor *	٢	L 70	The inverter load factor (%) is displayed. (In case of $F = 1 + 1 = 2 = 1$ )				not receiving or not transmitting: , The ON/OFF status of each of the cooling fan,
Output frequency *	٢	o 6 0.0	The output frequency (Hz/free unit) is displayed. (In case of $F \ 1 \ H = 0$ )				circuit board capacitor, main circuit capacitor of parts replacement alarm, cumulative operation
Input terminal	٢		The ON/OFF status of each of the control signal input terminals (F, R, RES, S1, S2, S3, VIB, VIA) are displayed in bits.	Parts replacement alarm information	٢	ΠΙ	time or number of starting are displayed in bits.
			The ON/OFF status of each of the control signal output termi-	Cumulative operation time	٢	E 10.1	The cumulative operation time is displayed. (0.10=10 hours, 1.00=100 hours)
Output terminal	٢	0,11	nals (RY-RC, OUT, FL) are displayed in bits.	Number of starting	٢	n 3 4.5	Number of starting (10000 times)
			ON: { OFF: ,	Default display mode	MODE	60.0	The output frequency is displayed (Operation at 60Hz).

Panel

 $\bigcirc$ 

 $\bigcirc$ 

LED

J 10 I

uc () 1

Description

The version of the CPU1 is displayed.

The version of the CPU2 is displayed.

\*Monitor items can be selected by setting parameters F 7 10 to F 7 18, (F 720).

### **Dimensions and weight**

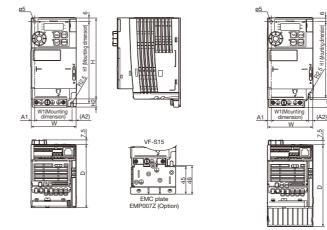
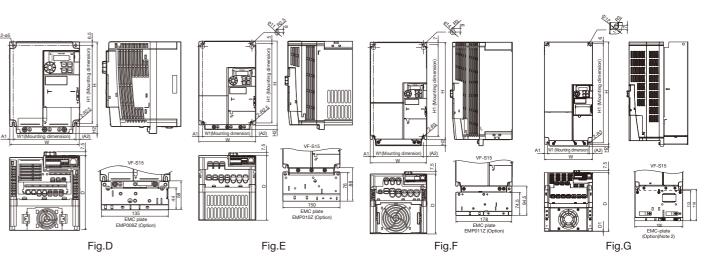


Fig.A



Note 1. The models shown in Fig. A, Fig. B and Fig. C are fixed at two points: in the upper left and lower right corners. Note 2. The model shown in Fig. A and Fig. B are not equipped with a cooling fan. Note 3. The cooling fan of 1-phase 240V-1.5, 2.2kW models and 3-phase 500V-0.4 to 1.5kW models are on the upper side of the inverter. Note 4. H2 means Height of EMC plate mounting area

	Applicable					Dimensi	ons (mm)				_	Approx.
Voltage class	motor (kW)	Inverter type	W	72 120	D	W1	H1	H2	A1	A2	Drawing	mass (kg)
	0.4	VFS15-2004PM-W1	70		120	60			5.5	6.5		0.9
	0.75	VFS15-2007PM-W1	72	130		60	121.5	13	5.5	0.5	В	1.0
	1.5	VFS15-2015PM-W1	105	130	130	93	121.5	13	6	6	С	1.4
	2.2	VFS15-2022PM-W1	105			93			0	0	U	1.4
3-phase 240V	4.0	VFS15-2037PM-W1	140	170	150	126	157	14	7	7	D	2.2
	5.5	VFS15-2055PM-W1	150	000	170	130	010	12			Е	3.5
	7.5	VFS15-2075PM-W1	150	220	170	130	210	12	10	10	E	3.6
	11	VFS15-2110PM-W1	180	310	190	160	295	20	10	10	F	6.8
	15	VFS15-2150PM-W1	160	310 190		160	295	20			Г	6.9
	0.2	VFS15S-2002PL-W1			101		131				А	0.8
	0.4	VFS15S-2004PL-W1	72		120	60		13	5.5	6.5	В	1.0
1-phase 240V	0.75	VFS15S-2007PL-W1		130	135		121.5				D	1.1
	1.5	VFS15S-2015PL-W1	105	1	150	93	121.0	12	6	6	С	1.6
	2.2	VFS15S-2022PL-W1	105		150	93		12	0	0	U	1.6
	0.4	VFS15-4004PL1-W1										1.2
	0.75	VFS15-4007PL1-W1	105	130	150	93	121.5	12	6	6	С	1.2
	1.5	VFS15-4015PL1-W1										1.3
	2.2	VFS15-4022PL1-W1	140	170	150	126	157	14	7	7	D	2.1
	4.0	VFS15-4037PL1-W1	140	170	150	120	157	14			U	2.2
3-phase 500V	5.5	VFS15-4055PL-W1	150	220	170	130	210	12			E	3.9
	7.5	VFS15-4075PL-W1	150	220	170	130	210	12	10	10		4.0
	11	VFS15-4110PL-W1		310	190	160	295	20		10	F	6.4
	15	VFS15-4150PL-W1	180	310	190	100	295	20				6.5
	18.5	VFS15-4185PL-W1	100	384	220.5	156	371.5	6	12	12	G	10
	22	VFS15-4220PL-W1		304	220.5	001	3/1.5	Ø	12	12	G	10

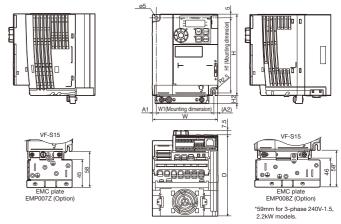


Fig.B



### **Specifications**

#### Standard specification

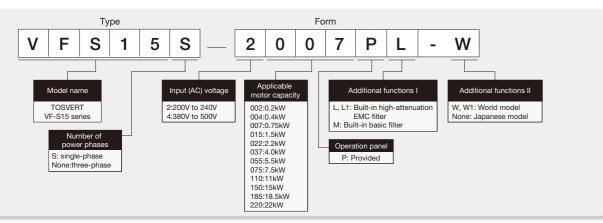
	Item					Specification	1								
In	out voltage					3-phase 240V	/								
Ap	oplicable motor (kW)	0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15					
	Туре					VFS15									
	Form	2004PM-W1	2007PM-W1	2015PM-W1	2022PM-W1	2037PM-W1	2055PM-W1	2075PM-W1	2110PM-W1	2150PM-W1					
ğ	Capacity (kVA) Note 1)	1.3	1.8	3.0	4.2	12.6	20.6	25.1							
Hating	Rated output current (A) Note 2)	3.3 (3.3)	4.8 (4.4)	8.0 (7.9)	11.0 (10.0)	17.5 (16.4)	27.5 (25.0)	33.0 (33.0)	54.0 (49.0)	66.0 (60.0)					
	Output voltage Note 3)		3-phase 200V to 240V												
	Overload current rating	150%-60 seconds, 200%-0.5 second													
ply	Voltage-frequency		3-phase 200V to 240V - 50/60Hz												
. supply	Allowable fluctuation			V	oltage 170V to	0 264V Note 4),	frequency ±5	%							
Power	Required Power supply capacity (kVA) Note 5)	1.4	2.5	4.3	5.7	9.2	13.8	17.8	24.3	31.6					
Pr	otective method (IEC60529)	IP20													
С	ooling method	Self-cooling Forced air-cooled													
С	blor					RAL7016									
Βι	uilt-in filter	Basic filter													

	Item								Specif	ication							
In	out voltage		1-p	hase 24	40V						3-р	hase 50	00V				
Ap	Applicable motor (kW) 0.2 0.4 0.75 1.5 2.2						0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22
	Туре	VFS15S						VFS15									
	Form	2002PL-W1	2004PL-W1	2007PL-W1	2015PL-W1	2022PL-W1	4004PL1-W1	4007PL1-W1	4015PL1-W1	4022PL1-W1	4037PL1-W1	4055PL-W1	4075PL-W1	4110PL-W1	4150PL-W1	4185PL-W1	4220PL-W1
g	Capacity (kVA) Note 1)	0.6	1.3	1.8	3.0	4.2	1.1	1.8	3.1	4.2	7.2	10.9	13.0	21.1	25.1	40.4	47.1
Rating	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)	1.5 (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)	33.0 (30.0)	40.0 (40.0)	46.0 (46.0)
	Rated output voltage Note 3)		3-phas	e 200V t	to 240V		3-phase 380V to 500V										
	Overload current rating	150%-	60 seco	nds, 200	150%-60 seconds, 200% -0.5 second												
ply	Voltage-frequency	1-ph	ase 200	V to 240	DV - 50/6	60Hz	3-phase 380V to 500V - 50/60Hz										
r supply	Allowable fluctuation	Voltage	170V to 2	264V Note	4), freque	ncy±5%			Vo	ltage 32	3V to 55	OV Note	a 4), frequ	lency ±	5%		
Power	Required Power supply capacity (kVA) Note 5)	0.8	1.4	2.3	4.0	5.4	1.6	2.7	4.7	6.4	10.0	15.2	19.5	26.9	34.9	48.5	56.5
Pr	Protective method (IEC60529) IP20						IP20										
Сс	Cooling method Self-cooling Forced air-coole					ir-cooled	d Forced air-cooled										
Сс	Color RAL7016						RAL7016										
Bu	uilt-in filter		E	MC filte	er						E	MC filte	er				

Note 1. Capacity is calculated at 220V for the 240V models, at 440V for the 500V models. Note 2. Indicates rated output current setting when the PWM carrier frequency (parameter *F* ∃ *G G*) is 4kHz or less. When exceeding 4kHz, the rated output current setting is indicated in the parentheses. It needs to be further reduced for PWM carrier frequencies above 12 kHz. The rated output current is reduced even further for 500V models with a supply voltage of 480V or more. The default setting of the PWM carrier frequency is 12kHz.

Note 3. Maximum output voltage is the same as the input voltage. Note 4. At 180V-264V for the 240V models, at 342V-550V for the 500V models when the inverter is used continuously (load of 100%). Note 5. Required power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).

#### Explanation of the type-form



#### **Common specification**

	ltom	
-	Item Control system	Sinusoidal PWM control
	Output frequency range	0.1 to 500.0Hz, default setting: 0.5 to 60Hz, maximum fi
	Minimum setting steps of frequency	Analog input : 1/1000 of the max. frequency (At 60Hz : ( Operation panel setting : 0.01Hz (99.99Hz or less) , 0.1H Communication setting : 0.01Hz
ctions	Frequency accuracy	Analog setting: within ±0.5% of the max. frequency (25° Digital setting : within ±0.01% of the max. frequency (-1
Principal control functions	Voltage/frequency characteristics	V/f constant, variable torque, automatic torque boost, v (for fan and pump), PM motor control, V/F 5-point settin adjusting to 1 & 2, adjusting frequency at start (0.1-10H
ipal co	Frequency setting signal	Setting dial on the front panel, external frequency poten 0-10Vdc / -10-+10Vdc (input impedance: $30k\Omega$ ), 4-20m.
rinc	Terminal block base frequency	The characteristic can be set arbitrarily by two-point set
۳.	Frequency jump	Three frequencies can be set. Setting of the jump freque
	Upper- and lower-limit frequencies	Upper-limit frequency: 0.5 to max. frequency, lower-limit
	PWM carrier frequency PID control	Adjustable range of 2.0k to 16.0kHz (default: 12.0kHz). Setting of proportional gain, integral gain, differential ga value agree.
	Acceleration/deceleration time	Selectable from among acceleration/deceleration times acceleration/deceleration 1 & 2 and S-pattern adjustable
	DC braking	Braking start-up frequency: 0 to maximum frequency, but tor shaft fixing control.
	Dynamic Braking Drive Circuit	Control and drive circuit is built in the inverter with the b
	Input terminal function	Possible to select from among about 110 functions, suc
	(programmable)	and reset signal input, to assign to 8 input terminals. Lo
	Output terminal functions (programmable)	Possible to select from among about 150 functions, such fied speed reach signal output and failure signal output, t
ons	Forward/reverse run	The RUN and STOP keys on the operation panel are use communication and logic inputs from the terminal block
cati	Jog run	Jog mode, if selected, allows jog operation from the term
ecifi	Preset speed operation	Frequency references + 15-speed operation possible by
ion sp	Retry operation	Capable of restarting automatically after a check of the (selectable with a parameter)
Operation specifications	Various prohibition settings / Password setting	Possible to write-protect parameters and to prohibit the emergency stop or resetting. Possible to write-protect p
0	Regenerative power ride-through control	Possible to keep the motor running using its regenerativ
	Auto-restart operation	In the event of a momentary power failure, the inverter r to the rotational speed in order to restart the motor smo
	Light-load high-speed operation Drooping function	Increases the operating efficiency of the machine by inc When two or more inverters are used to operate a single
	Override function	External input signal adjustment is possible to the operate
	Relay output signal	1c- contact output and 1a- contact output Note1) Maximum switching capacity : 250Vac-2A , 30Vdc-2 250Vac-1A (coso=0.4) , 30Vdc-1A (L/R=7ms) Minimum permissible load : 5Vdc-100mA, 24Vdc-5r
/e function	Protective function	Stall prevention, current limitation, over-current, output tion, input phase failure, output phase failure, overload p side over-current at start-up, over-torque, undercurrent, overcurrent / overload, various pre-alarms
Protectiv	Electronic thermal characteristic	Switching between standard motor and constant-torque of stall prevention levels 1 & 2, selection of overload sta
Pro	Reset function	Panel reset / External signal reset / Power supply reset.
	Alarms	Overcurrent, overvoltage, overload, overheat, communic
	Causes of failures	Overcurrent, overvoltage, overheat, output short-circuit, load side at start-up, CPU fault, EEPROM fault, RAM fa emergency stop, under-voltage, small current, over-torq
	Monitoring function	Output frequency, frequency command value, operation tion), output voltage, torque, inverter load factor, motor input terminals, information on output terminals, overloa frequency, causes of past trips 1 to 8, parts replacement
<b>Display function</b>	Past trip monitoring function	Stores data on the past eight trips: number of trips that verse run, output current, input voltage (DC detection), o cumulative operation time when each trip occurred.
Display	Output for frequency meter	Analog output for meter: 1mA dc full-scale dc amn 0 - 20mA (4 to 20mA) output: DC ammeter (allowable lc 0 - 10V output: DC voltmeter (allowable lc Maximum resolution: 1/1000
	4-digit 7-segments LED	Frequency:         inverter output frequency.           Alarm:         overcurrent pre-alarm "£", overvoltage pre- overheat pre-alarm ", communication pi inverter status (frequency, cause of activation Free-unit display: arbitrary unit (e.g. rotating speed) corr
	Indicator	Lamps indicating the inverter status by lighting, such as The charge lamp indicates that the main circuit capacito
Sat	fety function	Safe Torque Off (STO) function according to EN/IEC 61508
Its	Location of use	Indoors; not exposed to direct sunlight, corrosive gas, expl
mer	Elevation	3000 m (UL:1000m) or less (Corner-earthed system:200
Environments	Ambient temperature	-10 to +60°C (UL:50°C or 40°C (240V class model 0.75k
Env	Storage temperature Relative humidity	-25 to +70°C (Temperature applicable for a short term.) 5 to 95% (free from condensation and vapor).
Note	,	ias and Gain parameters of each analog input.
Note	e 2. A chattering (momentary ON/O	FF of contact) is generated by external factors of the vibratic y with input unit terminal of programmable controller. Please

Note 2. A chattering (momentary ON/OFF of contact) is generated by external factors of the vibration and the impact, etc. In particular, please set the filter of 10ms or more, or timer for mea-sures when connecting it directly with input unit terminal of programmable controller. Please use the OUT terminal as much as possible when the programmable controller is connected. Note 3. Current must be reduced by 1% for each 100 m over 1000 m. For example, 90% at 2000m and 80% at 3000m. Note 4. When using the inverter in locations with temperatures above 40°C, remove the protective label on the top of the inverter and use the inverter with the output current reduced accord-ing to the instruction manual. To align the inverters side-by-side horizontally, remove the protective label on the top of the inverter before use. When using the inverter in locations with temperatures above 40°C, use the inverter with the output current reduced.

#### frequency: 30 to 500Hz

0.06Hz); VIA, VIB terminal (0-10V), VIC terminal (4-20mA) 1Hz (100 0Hz or more)

5°C ±10°C) -10 to +60°C)

vector control, automatic energy-saving. dynamic automatic energy-saving control ing, Auto-tuning. Base frequency (20-500Hz) adjusting to 1 & 2, torque boost (0-30%)

entiometer (connectable to a potentiometer with a rated impedance of  $1k-10k\Omega$ ). mAdc (Input impedance: 250Ω).

etting. Possible to set: analog input (VIA, VIB, VIC).

ency and the range.

nit frequency: 0 to upper-limit frequency

gain and control waiting time. Checking whether the PID set value and the feedback

s 1 & 2 & 3 (0.0 to 3600 sec.). Automatic acceleration/deceleration function. S-pattern le. Control of forced rapid deceleration and dynamic rapid deceleration.

braking rate: 0 to 100%, braking time: 0 to 25.5 seconds, emergency DC braking, mo-

braking resistor outside (optional).

ich as forward/reverse run signal input, jog run signal input, operation base signal input ogic selectable between sink and source.

ch as upper/lower limit frequency signal output, low speed detection signal output, speci-, to assign to FL relay output, open collector output terminal, and RY output terminals. sed to start and stop operation, respectively. Forward/reverse run possible through

rminal block and also from remote keypad.

by changing the combination of 4 contacts on the terminal block.

main circuit elements in case the protective function is activated. 10 times (Max.)

ne change of panel frequency settings and the use of operation panel for operation, t parameters by setting 4 digits password and terminal input.

tive energy in case of a momentary power failure (default: OFF)

r reads the rotational speed of the coasting motor and outputs a frequency appropriate noothly. This function can also be used when switching to commercial power. ncreasing the rotational speed of the motor when it is operated under light load.

le load, this function prevents load from concentrating on one inverter due to unbalance. ration frequency command value.

-2A (cosø=1: at resistive load),

5mA

short circuit, over-voltage, over-voltage limitation, undervoltage, ground fault detecprotection by electronic thermal function, armature over-current at start-up, load t, overheating, cumulative operation time, life alarm, emergency stop, braking resistor

e VF motor, switching between motors 1 & 2, setting of overload trip time, adjustment

. This function is also used to save and clear trip records.

nication error, under-voltage, setting error, retry in process, upper/lower limits

, ground fault, overload on inverter, arm overcurrent at start-up, overcurrent on the fault, ROM fault, communication error. (Selectable: dynamic braking resistor overload, rque, low- torque, motor overload, input phase failure, output phase failure)

on frequency command, forward/reverse run, output current, input voltage (DC detec-r load factor, braking resistor load factor, input power, output power, information on and and region setting, version of CPU1, version of CPU2, PID feedback value, stator ent alarm, cumulative operation time, number of starting

at occurred in succession, output frequency, frequency command value, forward/re-, output voltage, information on input terminals, information on output terminals, and

meter

load resistance: 6000 or less load resistance: 1kΩ or more

re-alarm "P", overload pre-alarm "L",

pre-alarm "+

on of protective function, input/output voltage, output current, etc.) and parameter settings rresponding to output frequency.

as RUN lamp, MON lamp, PRG lamp, % lamp, Hz lamp.

tors are electrically charged.

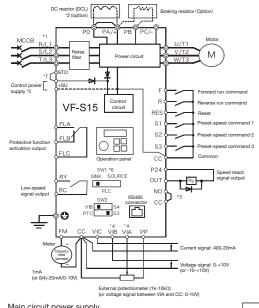
8 SIL2 and ISO 13849-1 category 3 PL"d".

plosive gas, flammable gas, oil mist, or dust; and vibration of less than 5.9m/s<sup>2</sup> (10 to 55Hz). 000meter or less) (current reduction required over 1000 m) Note 2)

5kW or less)) Note 3)

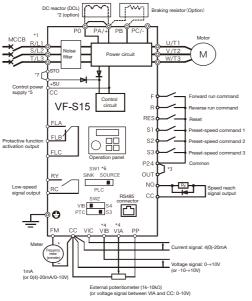
### **Connection diagram**

#### Standard connection diagram - SINK (Negative) (common:CC)



Main circuit power supply 3ph-240V class: three-phase 200-240V-50/60Hz 1ph-240V class: single-phase 200-240V-50/60Hz 3ph-500V class: three-phase 380-500V-50/60Hz \*1: The T/L3 terminal is not provided for single-phase models. Use the R/L1 and S/L2/N terminals as Input terminals. \*2: The inverter is supplied with the PO and the PA/+ terminals shorted by means of a shorting bar. Before installing the DC reactor (DCL), remove the bar.

#### Standard connection diagram - SOURCE (Positive) (common:P24)



(er voltage signal between VA and CC:0-109)
\*3: When using the OUT output terminal in sink logic mode, short the NO and CC terminals. When using the NO output terminal is nource logic mode, short the P24 and OUT terminals.
\*4: When VIA or VIB terminal is used as logic input terminal, refer to the instruction manual.
\*5: To supply control power from an external power supply for backing up the control power supplied from the inverter, an optional control power backup device (CPS0022) is required in such a case, the backup device is used at the same time with the internal power supply of the inverter.
The optional control power backup unit can be used with both 240V and 500V models.
\*6: Set the slide switch SW1 to sink side or source side Refer to the instruction manual for details. Default setting is PLC side.
\*7: When STO terminal is used as compliance with safety standards. Refer to Safety function manual.

manual

			Input current (A)		Molded -case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB) Note3)		Magnetic co Note		Wire size (mm²) Note5)7)					
Voltage	Applicable motor	Inverter type			Rated current (A)		Rated current (A)		Pow	er circuit	<b>D</b> 0			
class	(kW)								Input			DC reactor	Grounding cable	
			Without DCL	With DCL	Without DCL	With DCL	Without DCL	With DCL	Without DCL	With DCL	Output	(optional)	Note6)	
	0.4	VFS15-2004PM-W1	3.6	1.8	5	5	20	20	1.5	1.5	1.5	1.5	2.5	
	0.75	VFS15-2007PM-W1	6.3	3.4	10	5	20	20	1.5	1.5	1.5	1.5	2.5	
	1.5	VFS15-2015PM-W1	11.1	6.5	15	10	20	20	1.5	1.5	1.5	1.5	2.5	
3-phase 240V	2.2	VFS15-2022PM-W1	14.9	9.2	20	15	20	20	2.5	1.5	1.5	1.5	2.5	
	4.0	VFS15-2037PM-W1	23.8	15.9	30	20	32	20	4.0	2.5	2.5	4.0	4.0	
	5.5	VFS15-2055PM-W1	35.6	21.5	50	30	50	32	10	4.0	6.0	6.0	10	
	7.5	VFS15-2075PM-W1	46.1	28.9	60	40	60	32	16	6.0	10	10	16	
	11	VFS15-2110PM-W1	63.1	41.5	100	60	80	50	25	10	16	16	16	
	15	VFS15-2150PM-W1	82.1	55.7	125	75	100	60	35	16	25	25	16	
	0.2	VFS15S-2002PL-W1	3.4	2	5	5	20	20	1.5	1.5	1.5	1.5	2.5	
	0.4	VFS15S-2004PL-W1	5.9	4	10	5	20	20	1.5	1.5	1.5	1.5	2.5	
1-phase 240V	0.75	VFS15S-2007PL-W1	10.0	7.6	15	10	20	20	1.5	1.5	1.5	1.5	2.5	
2401	1.5	VFS15S-2015PL-W1	17.8	14.6	30	20	32	20	2.5	2.5	1.5	2.5	2.5	
	2.2	VFS15S-2022PL-W1	24	20.1	30	30	32	32	4.0	4.0	1.5	4.0	4.0	
	0.4	VFS15-4004PL1-W1	2.1	0.9	5	5	20	20	1.5	1.5	1.5	1.5	2.5	
	0.75	VFS15-4007PL1-W1	3.6	1.8	5	5	20	20	1.5	1.5	1.5	1.5	2.5	
	1.5	VFS15-4015PL1-W1	6.4	3.4	10	5	20	20	1.5	1.5	1.5	1.5	2.5	
	2.2	VFS15-4022PL1-W1	8.8	4.8	15	10	20	20	1.5	1.5	1.5	1.5	2.5	
0	4.0	VFS15-4037PL1-W1	13.7	8.3	20	15	20	20	2.5	1.5	1.5	1.5	2.5	
3-phase 500V	5.5	VFS15-4055PL-W1	20.7	11.2	30	15	32	20	4.0	1.5	2.5	2.5	4.0	
	7.5	VFS15-4075PL-W1	26.6	15.1	40	20	32	20	6.0	2.5	2.5	4.0	6.0	
	11	VFS15-4110PL-W1	36.6	21.7	50	30	50	32	10	4.0	6.0	6.0	10	
	15	VFS15-4150PL-W1	47.7	29	60	40	60	32	16	6.0	10	10	16	
	18.5	VFS15-4185PL-W1	55.3	35.6	75	50	60	50	16	10	10	16	16	
	22	VFS15-4220PL-W1	64.6	41.7	100	60	80	50	25	10	16	25	16	

Note 1: Be sure to attach a surge absorber to the exciting coil of the relay and the magnetic contactor.
 Note 2: When using the auxiliary contacts 2a of the magnetic contactor MC for the control circuit, connect the contacts 2a in parallel to increase reliability.
 Note 3: Select an MCCB with a rated interrupting current appropriate to the capacity of the power supply, because short-circuit currents vary greatly depending on the capacity of the power supply and the condition of the wiring system.
 The MCCB, MC and ELCB in this table were selected, on the assumption that a power supply with a normal capacity would be used.
 Note 3: 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 5: For the control circuit, use shielded wires 0.75 mm<sup>2</sup> or more in diameter.

MCCB(2P) 

Power ----

supply

R/L1

Ġ S/L2/N

Note 5: Note 6: Note 7:

For grounding, use a cable with a size equal to or larger than the above. 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.

#### Power circuit

Terminal symbol	1
Ť	Grounding terminal for connecting inverter. There are 3 terr
R/L1,S/L2,T/L3	240V class : Three-phase 200 to 240V-50/60Hz : Single-phase 200 to 240V-50/60Hz 500V class : Three-phase 380 to 500V-50/60Hz * Single-phase inputs are R/L1 and S/L2/N terminals.
U/T1,V/T2,W/T3	Connect to three-phase motor.
PA/+, PB	Connect to braking resistors. Change parameters $F = 0.4$ , $F = 0.5$ , $F = 0.8$ , $F = 0.9$ if
PA/+	This is a positive potential terminal in the internal DC main
PC/-	This is a negative potential terminal in the internal DC main
PO, PA/+	Terminals for connecting a DC reactor (DCL: optional exter short bar when shipped from the factory. Before installing

The arrangements of power circuit terminals are different from each range. Refer to the instruction manual for details

#### Control circuit terminals

Terminal symbol	Input / output	Function	Electrical specifications				
F	Input	Shorting across F-CC or P24-F causes forward rotation; open causes deceleration stop. (When Standby ST is always ON) . = 3 different functions can be assigned.					
R	Input	Shorting across R-CC or P24-R causes reverse rotation; open causes deceleration stop.         (When Standby ST is always ON)         3 different functions can be assigned.	No voltage logic input 24Vdc-5mA or less				
RES	Input	<ul> <li>Shorting across R-CC or P24-R causes reverse rotation; open causes deceleration stop. (When Standby ST is always ON)</li> <li>3 different functions can be assigned.</li> <li>This inverter protective function is reset if RES-CC or P24-RES is connected. Shorting RES-CC or P24-RES has no effect when the inverter is in a normal condition.</li> <li>2 different functions can be assigned.</li> <li>Shorting across S1-CC or P24-S1 causes preset speed operation.</li> <li>2 different functions can be assigned.</li> <li>Shorting across S2-CC or P24-S2 causes preset speed operation.</li> <li>By changing parameter <i>F</i> 14 <i>f</i> setting, this terminal can also be used as a pulse train input terminal.</li> <li>By changing slide switch SW2 and parameter <i>F</i> 14 <i>f</i> setting, this terminal can also</li> </ul>	Sink/Source and PLC selectable using slide switch SW1 (Default setting is PLC side) Pulse train input (S2 terminal)				
S1	Input	Shorting across S1-CC or P24-S1 causes preset speed operation.	Pulse frequency range: 10pps~2kpps Duty: 50±10%				
S2	Input	Shorting across S2-CC or P24-S2 causes preset speed operation. By changing parameter $F$ 14 $F$ setting, this terminal can also be used as a pulse train input terminal.	DTC input (C2 terminal)				
S3	Input	Shorting across S3-CC or P24-S3 causes preset speed operation. By changing slide switch SW2 and parameter <i>F 14</i> 7 setting, this terminal can also be used as a PTC input terminal.	PTC input (S3 terminal)				
CC	Common to Input / output	Control circuit's equipotential terminal (3 terminals)					
PP	Output	Analog power supply output	10Vdc (permissible load current: 10mAdc)				
VIA Note 1)	Input	Multifunction programmable analog input. Default setting: 0-10Vdc (1/1000 resolution) and 0-60Hz (0-50Hz) frequency input (1/2000 resolution). By changing parameter $F$ $I_{IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII$	10Vdc (internal impedance: 30kΩ)				
VIB Note 1)	Input	Multifunction programmable analog input. Default setting: 0-10Vdc (1/1000 resolution) and 0-60Hz (0-50Hz) frequency input. The function can be changed to -10-+10V input by parameter $F + 12 = 1$ setting. By switching slide switch SW2 and changing parameter $F + 12 = 1$ setting, this terminal can also be used as a multifunction programmable logic input terminal.	10Vdc (internal impedance: 30kΩ)				
VIC	Input	Multifunction programmable analog input. 4-20mA (0-20mA) input.	4-20mA (internal impedance: 250Ω)				
FM	Output	Multifunction programmable analog output. Default setting: output frequency. The function can be changed to meter option (0-1mA), 0-10Vdc voltage, or 0-20mAdc (4- 20mA) current output by parameter <i>F &amp; B I</i> setting. Resolution Max. 1/1000.	1mAdc full-scale ammeter or QS60T (option) 0-20mA (4-20mA) DC ammeter Permissible load resistance: $600\Omega$ or less 0-10V DC volt meter Permissible load resistance: $1k\Omega$ or more				
P24	Output	24Vdc power output, by changing SW1 to SINK or SOURCE side.	24Vdc-100mA				
F24	Input	This terminal can be used as a common terminal when an external power supply is used by changing SW1 to PLC side.	-				
	Input	DC power input terminal for operating the control circuit. Connect a control power backup device (option or 24Vdc power supply) between +SU and CC.	Voltage: 24Vdc±10% Current: 1A or more				
+SU Note 2)	Output	It is used with STO for safety function. +SU and STO terminals are short-circuited by metal bar and the inverter is put into a standby state at default setting. When the circuit between them is opened, the motor is coasting stop.	-				
STO Note 3)	Input	When +SU and STO are short-circuited, the inverter is put into a standby state. (Default setting) And when the circuit between them is opened, the motor is coasting stop. These terminals can be used for inter lock. This terminal is not a multifunction programmable input terminal. It is a terminal with the safety function that complies with SIL II of the safety standard IEC61508.	Independently of SW1 ON: DC17V or more OFF: DC12V or less (OFF: Coast stop)				
OUT NO	Output	Multifunction programmable open collector output. Default setting detect and output speed reach signal. Multifunction output terminals to which two different functions can be assigned. The NO terminal is an equipotential terminal. It is isolated from the CC terminal. By changing parameter $F \ bar{b} \ bar{$	Open collector output 24Vdc-100mA To output pulse trains, a current of 10mA or more needs to be passed. Pulse frequency range: 10~2kpps				
FLA FLB FLC Note 4)	Output	Multifunction programmable relay contact output. Detects the operation of the inverter's protection function. (Default setting) Contact across FLA-FLC is closed and FLB-FLC is opened during protection function operation.	Max. switching capacity 250Vac-2A 30Vdc-2A (cosø=1) : at resistive load 250Vac-1A (cosø=0.4)				
RY RC Note 4)	Output	Multifunction programmable relay contact output. Default settings detect and output low-speed signal output frequencies. Multifunction output terminals to which two different functions can be assigned.	30Vdc-1A (L/R=7ms) Min. permissible load 5Vdc-100mA 24Vdc-5mA				

Note 1) When VIA terminal is used as logic input terminal, be sure to connect a resistor between P24 and VIA in case of sink logic, between VIA and CC in case of source logic. (Recommended resistance: 4.7kΩ-1/2W) It is not needed for VIB terminal. Note 2) When use a communication option, a diode is required between +SU terminal and Control power supply backup unit or external 24Vdc power supply. (Diode rating: voltage 400V or

Note 3) When STO terminal is used as the safety function, refer to Safety function manual.
 Note 3) When STO terminal is used as the safety function, refer to Safety function manual.
 Note 4) A chattering (momentary ON/OFF of contact) is generated by external factors of the vibration and the impact, etc. In particular, please set the filter of 10ms or more, or timer for measures when connecting it directly with input unit terminal of programmable controller. Please use the OUT terminal as much as possible when the programmable controller is connected.

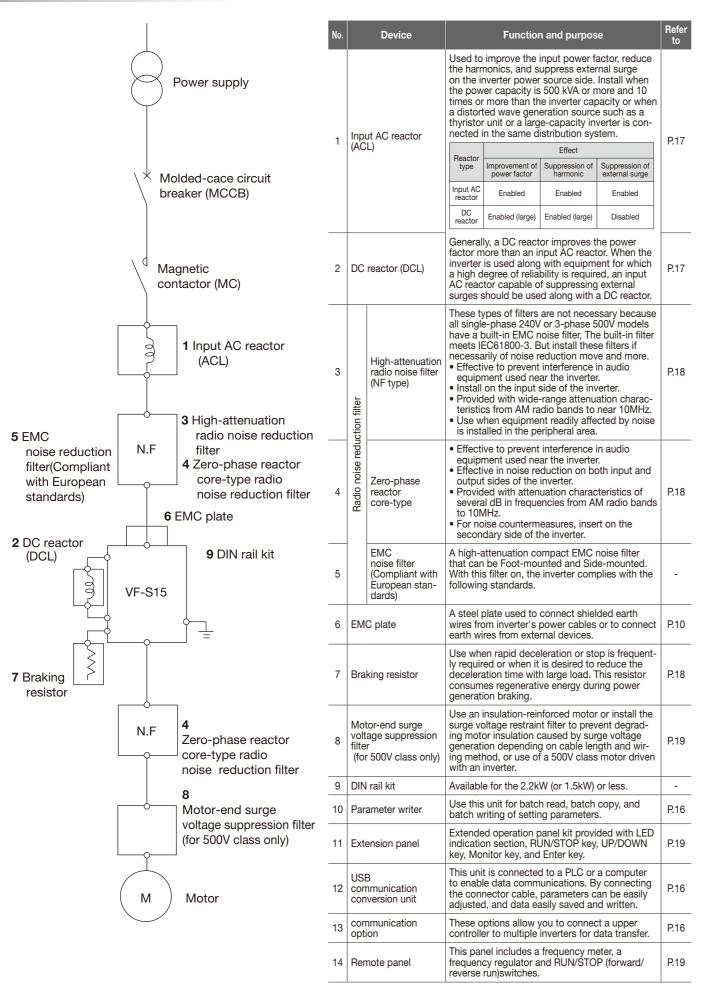
13

rminals in cooling fin or mounting part of EMC plate.

necessarv

- n circuit. DC common power can be input with PC/- terminal.
- ain circuit. DC common power can be input with PA/+ terminal.
- ernal device). Shorted by a
- DCL, remove the short bar

### **Peripheral devices**



#### External options

Voltage Inverter model		Applicable	Input AC	DC reactor	Radio noise re	eduction filter	Buoking register	Motor-end surge	DIN rail	
class	Inverter model	motor (kW)	reactor	DC reactor	High-attenuation	Core-type	Braking resister	voltage suppression filter	DIN rall	
	VFS15-2004PM-W1	0.4	PFL-2005S	DCL3-4015	NF3005A-MJ	RC5078ZZ	PBR-2007	-	DIN003Z	
	VFS15-2007PM-W1	0.75	PFL-2005S	DCL3-2007	NF3005A-MJ	RC5078ZZ	PBR-2007	-	DIN003Z	
	VFS15-2015PM-W1	1.5	PFL-2011S	DCL3-2015	NF3015A-MJ	RC5078ZZ	PBR-2022	-	DIN005Z	
<b>.</b> .	VFS15-2022PM-W1	2.2	PFL-2011S	DCL3-2022	NF3015A-MJ	RC5078ZZ	PBR-2022	-	DIN005Z	
3-phase 240V	VFS15-2037PM-W1	4.0	PFL-2018S	DCL3-2037	NF3020A-MJ	RC5078ZZ	PBR-2037	-	-	
2401	VFS15-2055PM-W1	5.5	PFL-2025S	DCL3-2055	NF3030A-MJ	RC9129ZZT	PBR7-004W015	-		
	VFS15-2075PM-W1	7.5	PFL-2050S	DCL3-2075	NF3040A-MJ	RC9129ZZT	PBR7-004W015	-	-	
	VFS15-2110PM-W1	11	PFL-2050S	DCL3-2110	NF3050A-MJ	RC9129ZZT	PBR7-008W7R5	-	-	
	VFS15-2150PM-W1	15	PFL-2100S	DCL3-2150	NF3080A-MJ	RC9129ZZT	PBR7-008W7R5	-	-	
	VFS15S-2002PL-W1	0.2	PFL-2005S	DCL3-4015		RC5078ZZ	PBR-2007	-	DIN003Z	
4	VFS15S-2004PL-W1	0.4	PFL-2005S	DCL3-2007	] [	RC5078ZZ	PBR-2007	-	DIN003Z	
1-phase 240V	VFS15S-2007PL-W1	0.75	PFL-2011S	DCL3-2015	] [	RC5078ZZ	PBR-2007	-	DIN003Z	
2401	VFS15S-2015PL-W1	1.5	PFL-2018S	DCL3-2037	] [	RC5078ZZ	PBR-2022	-	DIN005Z	
	VFS15S-2022PL-W1	2.2	PFL-2018S	DCL3-2037	] [	RC5078ZZ	PBR-2022	-	DIN005Z	
	VFS15-4004PL1-W1	0.4	PFL-4012S	DCL3-4004	The EMC	RC5078ZZ	PBR-2007	MSF-4015Z	DIN005Z	
	VFS15-4007PL1-W1	0.75	PFL-4012S	DCL3-4007	noise filter is	RC5078ZZ	PBR-2007	MSF-4015Z	DIN005Z	
	VFS15-4015PL1-W1	1.5	PFL-4012S	DCL3-4015	built into the	RC5078ZZ	PBR-2007	MSF-4015Z	DIN005Z	
	VFS15-4022PL1-W1	2.2	PFL-4012S	DCL3-4022	1ph-240V and 3ph-500V	RC5078ZZ	PBR-2007	MSF-4037Z	-	
	VFS15-4037PL1-W1	4.0	PFL-4012S	DCL3-4037	models by the	RC5078ZZ	PBR-4037	MSF-4037Z	-	
3-phase 500V	VFS15-4055PL-W1	5.5	PFL-4025S	DCL3-4055	standard.	RC9129ZZT	PBR7-004W060	MSF-4075Z	-	
500*	VFS15-4075PL-W1	7.5	PFL-4025S	DCL3-4075		RC9129ZZT	PBR7-004W060	MSF-4075Z	-	
	VFS15-4110PL-W1	11	PFL-4025S	DCL3-4110	] [	RC9129ZZT	PBR7-008W030	MSF-4150Z	-	
	VFS15-4150PL-W1	15	PFL-4050S	DCL3-4150	] [	RC9129ZZT	PBR7-008W030	MSF-4150Z	-	
	VFS15-4185PL-W1	18.5	PFL-4050S	DCL2-4185	] [	RC9129ZZT	PBR7-008W030	-	-	
	VFS15-4220PL-W1	22	PFL-4050S	DCL2-4220		RC9129ZZT	PBR7-017W015	-	-	

#### Communication

	Name	Type-form
CC-Link commu	nication option	CCL003Z
PROFIBUS-DP of	communication option	PDP003Z
PROFINET comr	nunication option	PNE001Z
Device Net com	munication option	DEV003Z
EtherNet/IP - Mo	odbus TCP communication option	IPE002Z
EtherCAT comm	unication option	IPE003Z
CAN open Communication option	RJ45 connector 2 port type	CAN001Z
Communication	SBP009Z	

Mount the option

Mount it to the front

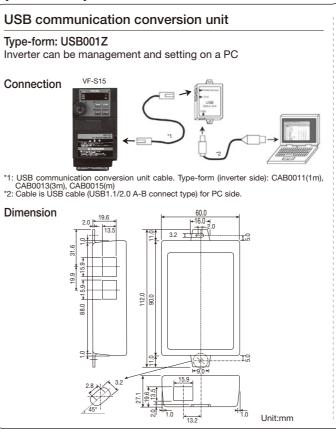
of inverter. The

25mm.

depth is increase

Option adapter is necessary to use the communication option.

#### **Operation option**



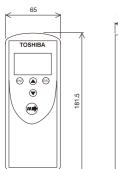
#### Parameter writer

#### Type-form: PWU003Z

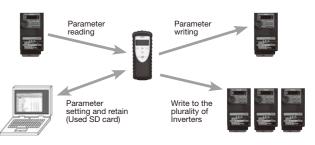
Parameter can be read/write without power supply to the inverter. And inverter can be management and setting on a PC.

#### Connect to inverter

#### Outline drawing



#### Read/write/restore of parameters

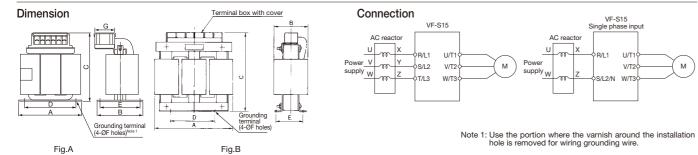


#### Specification

Items	Specification
Battery	AA size battery or Nickel metal hydride: Used 4 batteries Note) Batteries are not attached
languages	Japanese, English, Spanish, German, Italian, French
Data storage	SD card, SDHC card (Format is FAT32)
Attachment	USB cable, RJ45 cable(1m), SD card, Carry case, Shock- absorb cover, Wrist strap, Manual(Japanese/English)

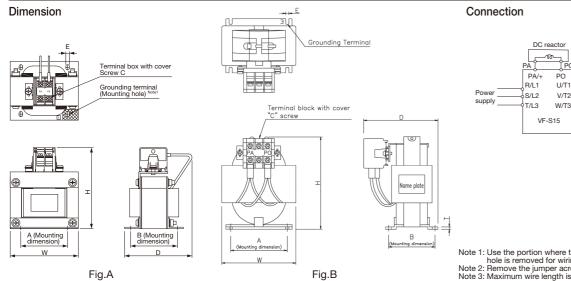
#### **Dimension and Connection**

#### Input AC reactor



Reactor	Rating	Inverter model			Dimer	nsions	Diagram	Terminolo	Approx.			
model	Raung	inverter model		В	С	D	E	F	G	Diagram	Terminals	mass (kg)
PFL-2005S	3-phase 240V class -5.5A-50/60Hz	VFS15-2004PM-W1, 2007PM-W1 VFS15S-2002PL-W1, 2004PL-W1	105	65	115	90	55	5	40		M3.5	1.2
PFL-2011S	3-phase 240V class -11A-50/60Hz	VFS15-2015PM-W1, 2022PM-W1 VFS15S-2007PL-W1	130	70	140	115	60	5	50	A	M4	2.3
PFL-2018S	3-phase 240V class -18A-50/60Hz	/FS15-2037PM-W1 /FS15S-2015PL-W1, 2022PL-W1		70	140	115	60	5	50		M4	2.5
PFL-2025S	3-phase 240V class -25A-50/60Hz	VFS15-2055PM-W1	125	100	130	50	83	7	-		M4	2.6
PFL-2050S	3-phase 240V class -50A-50/60Hz	VFS15-2075PM-W1, 2110PM-W1	155	115	140	50	95	7	-	В	M6	3.4
PFL-2100S	3-phase 240V class -100A-50/60Hz	VFS15-2150PM-W1	230	150	210	60	90	8	-		M8	8.2
PFL-4012S	3-phase 500V class-12.5A-50/60Hz	VFS15-4004PL1-W1~4037PL1-W1	125	95	130	50	79	7	-		M4	2.3
PFL-4025S	3-phase 500V class -25A-50/60Hz	VFS15-4055PL-W1~4110PL-W1	155	110	155	50	94	7	-	В	M4	4.9
PFL-4050S	3-phase 500V class -50A-50/60Hz	VFS15-4150PL-W1~4220PL-W1	155	140	165	50	112	7	-		M6	6.6

#### DC reactor

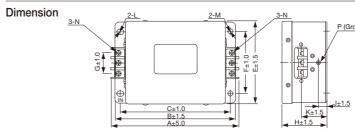


PO U/T1 V/T2 w/тз∲-

Note 1: Use the portion where the varnish around the installation hole is removed for wiring grounding wire. Note 2: Remove the jumper across terminals PO-PA/+. Note 3: Maximum wire length is 5m.

Reactor	Inverter model		Approx.						
model	inverter model	W	н	D	A	В	С	E	mass (kg)
DCL3-2007	VFS15-2007PM-W1, VFS15S-2004PL-W1								1.0
DCL3-2015	VFS15-2015PM-W1, VFS15S-2007PL-W1	75	116	78	54	51	M4	5	1.0
DCL3-2022	VFS15-2022PM-W1								1.1
DCL3-2037	VFS15-2037PM-W1, VFS15S-2015PL-W1, 2022PL-W1	96	118	100	66	66	M4	5	2.2
DCL3-2055	VFS15-2055PM-W1	96	123	97	66	66	M5	5	2.2
DCL3-2075	VFS15-2075PM-W1	120	134	116	86	76	M5	5	3.6
DCL3-2110	VFS15-2110PM-W1	144	180	128	104	83	M6	7	5.7
DCL3-2150	VFS15-2150PM-W1	144 100	120	104	00	1010	'	6.1	
DCL3-4004	VFS15-4004PL1-W1								1.0
DCL3-4007	VFS15-4007PL1-W1	75	116	78	54	51	M4	5	1.0
DCL3-4015	VFS15-2004PM-W1, VFS15S-2002PL-W1, VFS15-4015PL1-W1	75	110					5	1.0
DCL3-4022	VFS15-4022PL1-W1								1.1
DCL3-4037	VFS15-4037PL1-W1	96	118	97	66	66	M4	5	2.2
DCL3-4055	VFS15-4055PL-W1	120	134	116	86	76	M5	5	3.4
DCL3-4075	VFS15-4075PL-W1	120	134	110	00	10	1015	5	3.5
DCL3-4110	VFS15-4110PL-W1	144	180	128	104	83	M6	7	5.8
DCL3-4150	VFS15-4150PL-W1	144	100	132	104	03		'	6.5
DCL2-4185	VFS15-4185PL-W1	128	152	127	112	71	ME	5.5	4.4
DCL2-4220	VFS15-4220PL-W1	138	137	141	119	84	M5	6.5	5.0

#### High attenuation radio noise reduction filter

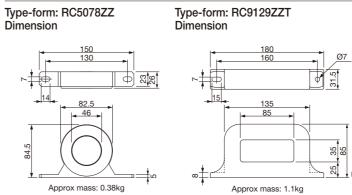


Filter model Rated		Inverter model						Dim	iensio	ns (m	n)					Approx.
Filler model	current (A)	A) Inverter model		В	С	E	F	G	Н	J	K	L	М	Ν	Р	mass (kg)
NF3005A-MJ	5	VFS15-2004PM-W1~2007PM-W1 VFS15S-2002PL-W1														1.0
NF3015A-MJ	15	VFS15-2015PM-W1, 2022PM-W1 VFS15S-2004PL-W1~2015PL-W1	174.5	160	145	110	80	32	70	20	45	R2.75		M4	M4	
NF3020A-MJ	20	VFS15-2037PM-W1										Length 7	ø5.5			1.6
NF3030A-MJ	30	VFS15-2055PM-W1 VFS15S-2022PL-W1														
NF3040A-MJ	40	VFS15-2075PM-W1	217.5	200	185	120	90	44	70	20	43			M5	M4	2.7
NF3050A-MJ	50	VFS15-2110PM-W1	267.5	250	235	170	140	44	90	30	60	R3.25	ø6.5	M6	M4	4.6
NF3080A-MJ	80	VFS15-2150PM-W1	294.5	280	260	200	150	57	100	30	65	Length 8	00.5	M8	M6	7.0
NF3010C-MJ	10	VFS15-4004PL1-W1~4037PL1-W1														1.4
NF3015C-MJ	15	VFS15-4055PL-W1	174.5	160	145	110	80	32	70	20	45	D0 75		N44	M4	1.6
NF3020C-MJ	20	VFS15-4075PL-W1										R2.75 Length 7	ø5.5	M4	1014	1.6
NF3030C-MJ	30	VFS15-4110PL-W1	214	200	185	120	90	32	70	20	43	Longui				1.6
NF3040C-MJ	40	VFS15-4150PL-W1	217.5	200	100	120	90	44	10	20	43			M5	M4	2.7

l Init<sup>,</sup> mm

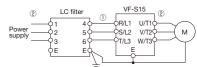
Note: For the inverter models ending with -PL, same noise filter as the ones described here is built-in standard.

#### Zero-phase reactor core-type radio noise filter

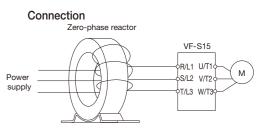


#### Connection

P (Grounding terminal)



Note: (1)Noise filter should be connected to the inverter main circuit primary side. (2)Output wire should be kept away from the input wire.

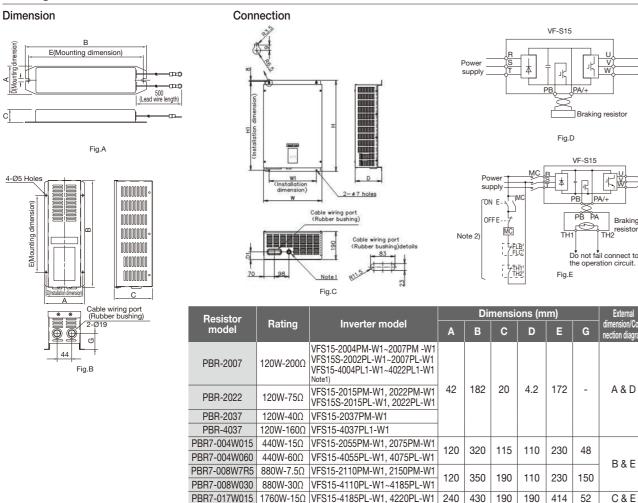


Go the wires of each phase through the reactor at once and coil it in the same direction.
 In case of using for input side, coil wires four times or more, or go wires through four or more reactors.

In case of using for output side, coil wires four times or more. When the wiring between the inverter and the motor is long (50m or more), use wires with high permissible temperature or go wires through four or more reactors. RC5078ZZ is recommended for the models 4.0kW or less.

#### Braking resistor

4-Ø5 H

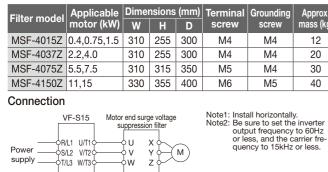


Note1: Braking resisters for VFS15-4004PL1-W1~4022PL1-W1 are the same type of those for VFS15-2004PM-W1~2007PM-W1. Note2: In case of 500V class, please apply the 200V to the operation circuit by using control transformer or 200V power supply.

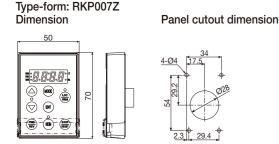
Type-form: CPS002Z 240V/500V

Control power supply backup unit

#### Motor end surge voltage suppression filter (for 500V class only)



#### Extension panel





Communication cable model: CAB0071 (1m), CAB0073 (3m), CAB0075 (5m)

### To users of our inverters

#### 1. For inverter users Notes

#### Leakage current

This inverter uses high-speed switching semiconductors 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. Installation of radio noise reduction filter may also increase leakage current. The intensity of such a leakage current depends on the PWM carrier frequency setting, 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]

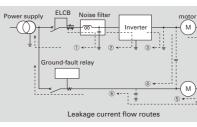
Leakage current which increases when an inverter is used may pass through the followina routes:

Route (1) ... Leakage due to the capacitance between the ground and the noise reduction 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

- troubles · Malfunction of a leakage circuit
- breaker(ELCB) 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 rated 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 (ELCB)
- (1) Decrease the PWM carrier frequency of the inverter. Note) (2) Use radio-frequency interference-proof

ELCBs as ground-fault interrupters

inverter can operate with high PWM carrier frequency.

- (3) When connecting multiple inverters
- ELCB. 2) Measures against malfunction of groundfault relay:
- the inverter. Note)
- (2) Install ground-fault relays with a highfrequency protective function in both

high PWM carrier frequency. 3) Measures against noise produced by other electric and electronic systems: (1) Separate the grounding line of the in-

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 (Not apply 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 ground-

(1) Separate the inverter's grounding wire

rately to the grounding point.

(2) Use the shortest possible cables (100m or less) to connect the inverter to the motor. If the wire length is long, especially with the models of 4.0kW or less. perhaps over current trip occurs by charging current through the capacitance of cable. Use the separate cable to reduce the capacitance of cable, or install the reactor or the filter between the inverter and the motor as countermeasures against over current trip. (3) If the inverter has a high-attenuation EMC noise reduction filter, change the grounding capacitor switch to reduce the leakage current. Note that doing so leads to a reduction in the noise at-

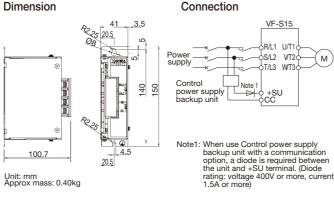
- tenuating effect.

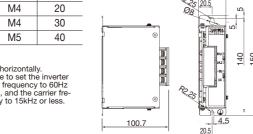
#### Ground fault

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 starconnected motor.

#### Radio interference

[Noise produced by inverters] Since this inverter performs PWM control, it produces noise and sometimes affects nearby instrumental devices, electrical and





Unit: mm Approx mass: 0.40kg

K 👯 🕅

A & D

B & E

C & F

0.28

3.4

5.4

10

in not only the system into which the inverter is incorporated but also other systems. When ELCBs are used, the

to a single ELCB, use an ELCB with a high current sensitivity or reduce the number of inverters connected to the

(1) Decrease the PWM carrier frequency of

the same and other lines. When ELCBs are used, the inverter can operate with

verter from that of the affected electric

from that of other systems or install the grounding wire of each system sepa-

In the case of this inverter, the PWM carrier frequen-cy can be decreased to 2.0kHz. Decrease the carrier frequency results in an increase in electromagnetic noise from the motor.

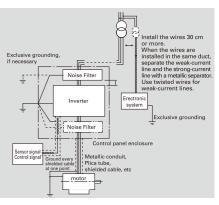
electronic systems, etc. The effects of noise greatly vary with the noise resistance of each individual device, its wiring condition, the distance between it and the inverter, etc. [Measures against noises]

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

On 1ph-240V and 3ph-500V models, noise can be greatly reduced as they have a builtin EMC noise reduction filter on their input side



#### Power factor improvement capacitors

Do not install power factor improvement capacitors on the output side of the inverter. Installing a power factor improvement capacitor on the 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 a DC reactor or an input AC reactor on the primary side of the inverter.

#### Installation of input AC rectors

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

(1) When the power source capacity is 500kVA or more, and when it is 10 times or more greater than the inverter capacity.

- (2) When the inverter is connected the same power distribution system as a thyristorcommitted 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.

#### 2. 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 inertia of the load, and can be calculated by the following equations. The acceleration and deceleration times of

an inverter can be set individually. In any case, however, they should be set longer than their respective values determined by the following equations.

Acceleration time	ta= <u>(JM+JL) x ΔN</u> 9.56 x (TM-TL)(sec.)
Deceleration time	$ta = \frac{(JM+JL) \times \Delta N}{9.56 \times (TB+TL)} (sec.)$
Conditions	<ul> <li>JM :Moment of inertia of motor (kg·m<sup>2</sup>)</li> <li>JL :Moment of inertia of load (kg·m<sup>2</sup>) (converted into value on motor shaft)</li> <li>ΔN :Difference in rotating speed between before and after acc. or dec. (min<sup>-1</sup>)</li> <li>TL :Load torque (N·m)</li> <li>TM :Motor rated torque x</li> <li>1.2-1.3 (N·m)V/f control</li> <li>:Motor rated torque x</li> <li>1.5 (N·m)Vector operation control  In case of variable torque characteristic TM :Motor rated torque x</li> <li>1.1 (N·m)Vf control</li> <li>:Motor rated torque x</li> <li>1.2 (N·m)Vector operation control</li> <li>TB :Motor rated torque x 0.2 (N·m)</li> <li>TB :Motor rated torque x 0.2 (N·m)</li> </ul>

#### [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. Regarding the allowable torque characteristic, please confirm with the motor manufacturer.

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

#### [Starting characteristics]

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

#### 3. When installing, wiring and operating the inverter

#### Installing and wiring

- [Installing precautions] (1) Do not install in any location of high
- temperature, high humidity, moisture condensation and freezing. Do not install the inverter where there are gases that corrode metal or solvents that adversely affect plastic.
- Avoid locations where there is exposure to water and/or where there may be large amounts of dust and metallic fragments. In this case, please install inverters in the enclosure type cabinet. The cabinet must be considered its size and the cooling method to allow the specifications of an ambient temperature for inverters.
- (2) Must be installed in non-inflammables such as metals. The rear panel gets very hot. If installation is in an inflammable object, this can result in fire.
- (3) Inverters should be arranged in horizontal rows.

#### [Wiring precautions]

F (or R)-CC.

- 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. To turn on/off the motor frequently, close/break the control terminals

#### 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 To turn on/off the motor frequently, close/ break the control terminals F (or R)-CC.
- (5) Install surge suppressor on any magnetic contactor and relay coils used around the inverter.
- (6) If using a braking resistor, install a magnetic contactor (MC) to the power supply of the inverter, so that the power circuit opens when the internal overload relay of the braking resistor is activated.

#### Installing a magnetic contactor [MC] [secondary sidel

(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) Because all of the control terminals
- except FLA. FLB. FLC. RY or RC are connected to electronic circuits, insulate these terminals to prevent them from coming into contact with the main circuit.

#### Installing an overload relay

- (1) This 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, change the protective characteristic of the electronic thermal relay according to the setting of the constant-torgue 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.

#### Wiring

- (1) Do not connect input power to the output (motor side) terminals (U/T1.V/T2.W/T3). That will destroy the inverter and may result in fire. Please pay attentions of wiring before power supply turns-on.
- (2) The DC terminals (PA/+, PO and PB) are for specified options. Do not connect other devices to these terminals.
- (3) Within 15 minutes after turning off input power, do not touch wires of devices (MCCB) connected to the input side of the inverter.

#### Grounding

The inverters and motors must be connected to ground securely. In case of grounding for inverters, please use the grounding terminal of the inverter.

#### Operating precautions

- (1) When the inverter operates in abnormal circumstances, the protective function activates to shut off the inverter output. However, the inverters can not stop the motors quickly. Please install the mechanical brake or maintenance function in the mechanical equipment and the device for which the emergency stop is necessarv.
- (2) When you drive the machine and the device that hangs the load repeatedly with the inverter, the semiconductor within inverter might cause thermal fatigue and it come to have a short life if a big current flows repeatedly when driving and stopping. In this case, it is possible to extend life span by controlling the start-

ing current and the load current low or setting the PWM career frequency low. If you can not decrease the starting current, please select larger capacity of inverters for current margins.

#### 4. When changing the motor speed

#### Application to standard motors Vibration

When a motor is operated with an 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. In this case, using jump frequency to avoid resonant frequencies or changing PWM carrier frequency is also effective.

#### Acoustic noise

The magnetic noise of motors with inverter drives is changed by PWM carrier frequency. In case of high PWM carrier frequency settings, its acoustic noise is almost same as commercial power supply drives. Moreover, when the motors are operated over rated rotation, the windy noise of the motors is increased.

#### 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 affect at low speeds.

When operating at 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 over 60 Hz, confirm that this operating range is acceptable for the motor.

#### Starting method

When you drive the motor with changeable connection between star-connection and delta-connection for decreasing starting current, please connect delta-connection only. If you change motor connection while inverter drives, the protective function of inverter activates.

#### Application to special motors

#### Geared motor

When using an inverter to drive a geared motor, inquire of the motor manufacturer about its continuous operation range due to the followings:

- The low-speed operation of a geared motor may cause insufficient lubrication
- The loss of a gear may be increased than commercial power supply drives.
- In case of the operation on high frequency exceeding 60Hz, the acoustic noise and motor temperature may be higher.

#### Pole-changing motor

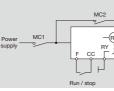
Pole-changing motors can be driven by this inverter. Before changing poles, however, be sure to let the motor come to a complete stop. If you change motor connection while inverter drives, the protective function of inverter may activate.

rated current than general motors. The current ratings of underwater 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. When the lengths of the motor cable are long, please use thicker cable than a table of "Wiring devices" because the maximum torque is decreased by the voltage dropping. Moreover, please pay attention to select leakage circuit breakers.

#### Single-phase motor Because single-phase motors are equipped with a centrifugal switch and capacitors for starting, they cannot be driven by an inverter. When single phase motors are driven by inverters, a centrifugal switch and capacitors may be broken. In case of a single-phase, power system, a 3-phase motor can be driven by using a single-phase input inverter to convert it into a 3-phase 200V output. (A special inverter and a 3-phase 200V motor are required.)

#### Brake motor

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



#### 5. Disposal of the inverter

used inverter yourself but ask an industrial waste disposal agent. Disposing of the inverter improperly could cause its capacitor to explode and emit toxic gas, causing injury to persons.

Note that underwater motors have higher



For safety's sake, do not dispose of the dis-

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.

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#### **Toshiba Industrial Products and Systems Corporation**

Global Sales Group Motor Drive Division

10th Floor, LAZONA Kawasaki TOSHIBA building, 72-34, Horikawa-cho, Saiwai-ku, Kawasakishi, Kanagawa 212-8585, Japan Tel: +81-44-520-0828 Fax: +81-44-520-0508 http://www.toshiba-tips.co.jp/en/

#### VIET NAM DISTRIBUTOR:

#### Toshiba Industrial Products Asia Co., Ltd

Plot 309, Road 9, Amata IP, Long Binh Ward, Bien Hoa, Dong Nai. Tel: 84-251-3936969 \* Fax: 84-251-3936847

