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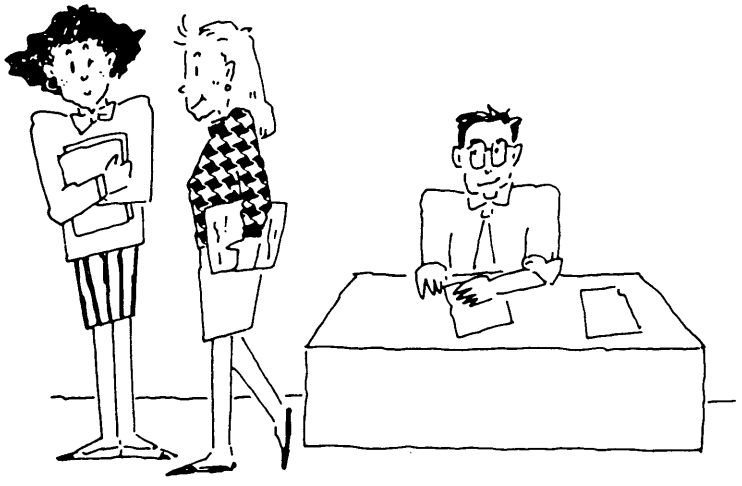
TOSHIBA



Compact Inverter Instruction Manual

Toshiba Tosvert VF-SX inverter

TOSVERT VF-SX series

Three Phase	standard	200V	0.1～3.7kW
	low noise	200V	0.1～15kW
Single Phase		200V	0.1～1.5kW

CAUTION

1. Please hand this instruction manual to the operator before using the inverter unit.
2. Please read this manual before installing and operating the inverter unit.
   Always keep this manual in safe after reading.

Safety notices

[1] To prevent electric shock, please obey the following guidelines.

1. Do not touch the terminal block or other charged components when the "CHARGE" lamp is on. Due to residual charge on the unit's internal electrolytic capacitors, there is a risk of electric shock. Also, when changing motor terminal wiring, please ensure that the inverter's input power is switched "OFF", and that the "CHARGE" lamp is extinguished.

2. Please do not insert anything into or touch the internal components of the inverter when power is applied. This could cause damage to the unit or an electric shock.

3. Please ground the G/E terminal of the unit. Also, ensure that the motor is grounded. (Leakage current poses a risk of electric shock.)

[2] About retry function.

1. This inverter has a retry function that will automatically reset the inverter in the event of a trip. However, when this function is selected, be certain to confirm the following items.

   Please use caution around the motor and other rotating machines, even if the inverter is tripped. When the retry function is selected.

   Take special care after an overload trip. The retry function may restart the motor up to 5 minutes after the inverter has tripped.

[3] To prevent fire, please obey the following guidelines.

1. Connect the R/L1, S/L2, and T/L3 inputs to a 3-phase power supply that is rated within the rating requirements stamped on the nameplate of the inverter. If a 400V power supply is accidentally connected to a 200V class inverter, the internal components of the inverter may explode.

2. Because this inverter does not have internal fuses, install a suitable molded case circuit breaker (MCCB).

[4] Refer to following chapter about other cautions.

Introduction

Thank you for purchasing the Toshiba Compact inverter "TOSVERT VF-SX series".

The "VF-SX" is an inverter that has various built-in functions so that it can be used for many applications. This inverter is simple to use with a keyboard type operation panel for carrying out each operation. A simple operation method is used for the basic operations and setting so that you do not have to refer to the instruction manual each time. The latest control technologies (current limiting function, retry function and stall prevention function) are built into the compact body, so the inverter does not trip often, and tough operations are possible.

Please read this manual before using the "VF-SX" so that the outstanding functions of this unit can be used to the fullest.

Please keep this manual near the "VF-SX" during use for reference during inspection and maintenance.

CONTENTS

Chapter 1 Inspection and Cautions at Delivery

(1) Confirm that no parts have been damaged during shipping.

(2) Confirm that the model number inscribed on the nameplate is the same as that ordered.

(3) When not using the inverter immediately after purchase, store it in a place with no dust and with good ventilation.

(4) Caution is taken during the production, packaging and shipment of this product, but if there should be any problems, please contact the dealer.

Chapter 2 Cautions for Installation

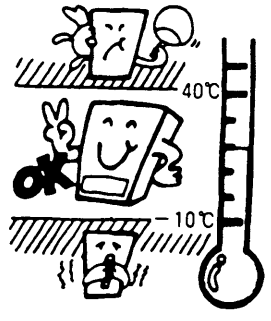
This inverter unit is an electronic controller. Take plenty of care to the installation environment.

- Confirm that the input power voltage is within ±10% of the rating. The protective circuit will be activated if the permissible input power voltage range is exceeded, and the inverter may be damaged.

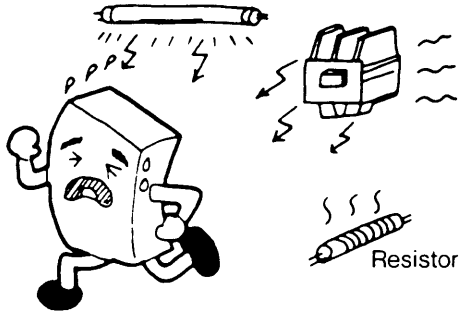
- Avoid installation in places with high temperatures, humidity, dust, metallic particle and metallic powder.
- Install the inverter in an area free of machine oil, corrosive gas and so on.

- Do not install in locations with large vibrations.

- Use the unit within an ambient temperature of -10 to 40 °C.



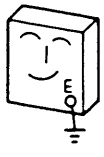
The inverter is a heat generating unit so when installing in a panel, make sure that there is ventilation and space in the panel. We recommend removing the seal on the top part of the cover when using the inverter in a panel for longer use.



When the following equipment is installed near the inverter, the inverter may malfunction so carry out the following measures.

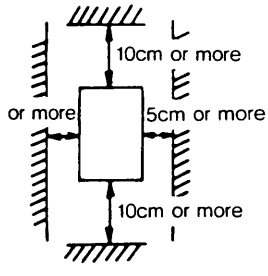
- Magnetic contactor(MC) ... Install an exciter coil to the surge suppressor.
- Fluorescent lamp
- Resistor···Distance from the inverter

- Always earth the unit to prevent electrocution and malfunction due to noise.



200V series:
Grounding/Earthing
(Grounding/earthing resistance 100Ω max.)

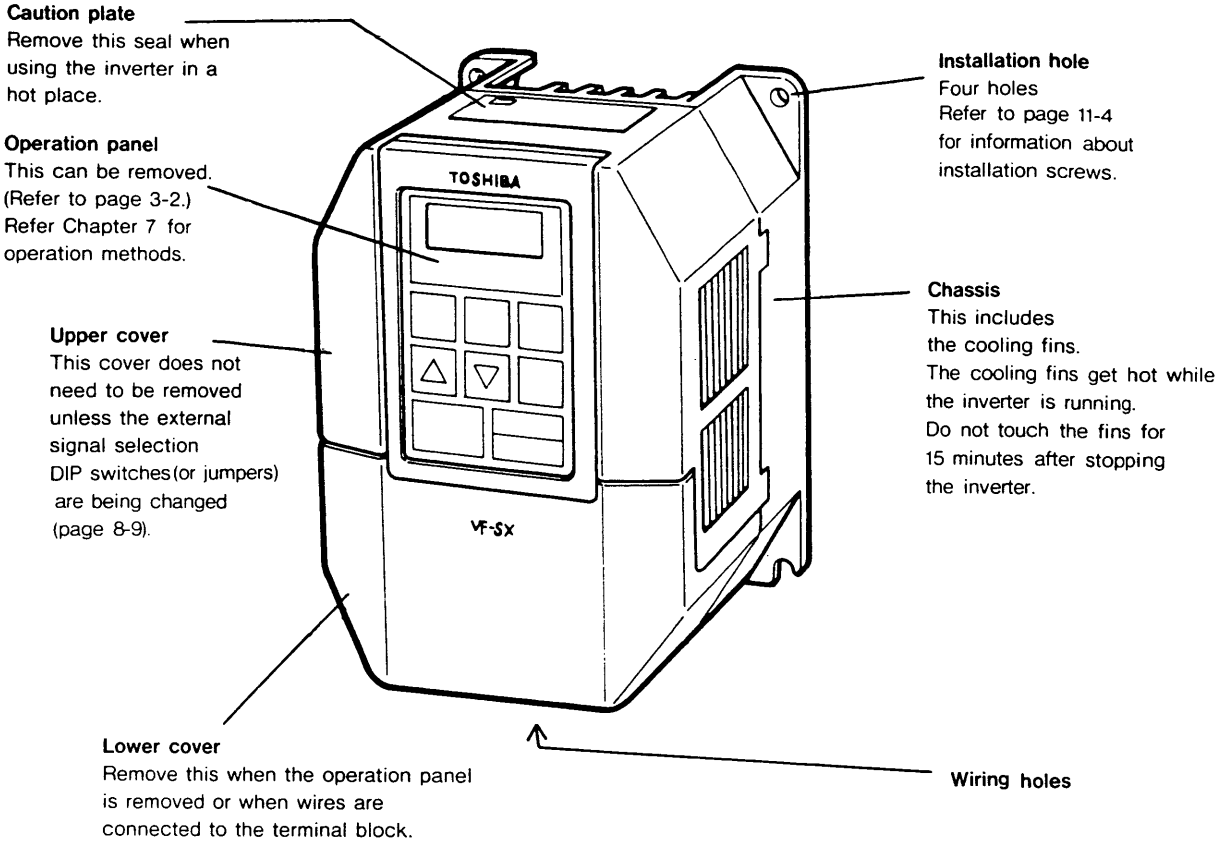
* Install the inverter on an incombustibles such as a metal panel.When installing on a high heat insulating panel, install after mounting the inverter on a metal panel (50cm × 50cm, or more).To maintain ventilation, secure the following installation space, and install the inverter vertically in the lengthwise direction. When installing inverters in a row, leave a space more than 10cm between each unit. This space can be decreased by according to the installation environment or adding fans. Consult with the engineering department for details.



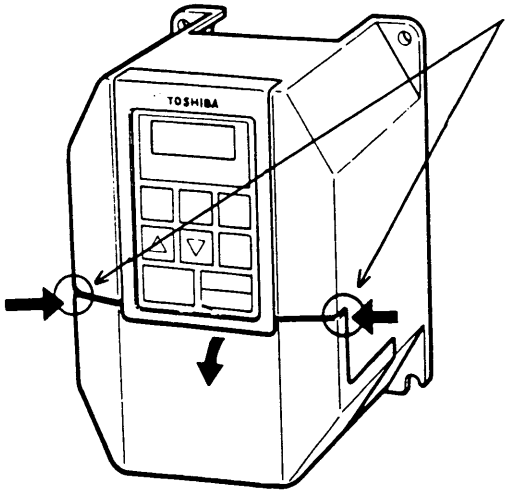
★Install the inverter in the lengthwise direction on a wall.

Chapter 3 External View and Names of Each Part

★ 0.1kW~3.7kW model



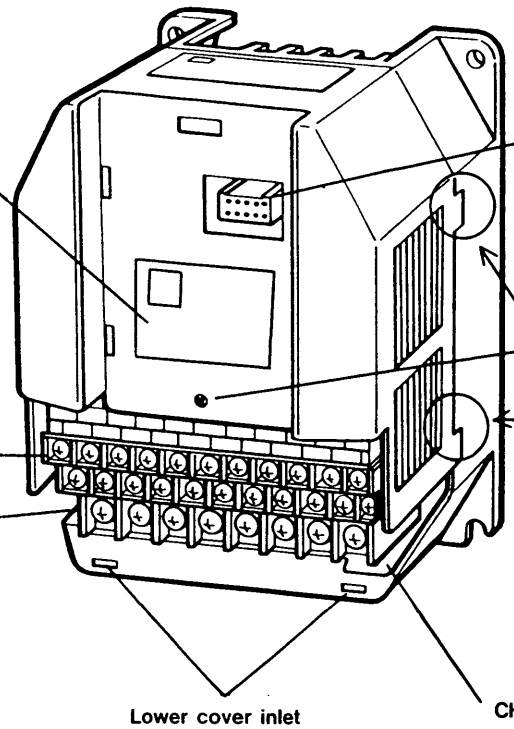
How to remove the lower cover



Press these parts on both sides of the lower cover inward, and pull the cover out forward.
When installing the cover, insert the lower cover clasps into the upper cover inlets and press in.

★ 0.1kW~3.7kW model

(With the operation panel and lower cover removed)



Rating nameplate

Connector for operation panel connection
This is also used for the connection of the operation panel extension cable.

Screw holds for operation panel installation

Control circuit terminal block
For details on the terminal block, refer to section 6.2 (page 6-4).

Main circuit terminal block
This is the terminal block for the input power, output, earthing and braking resistor.

Lower cover inlet

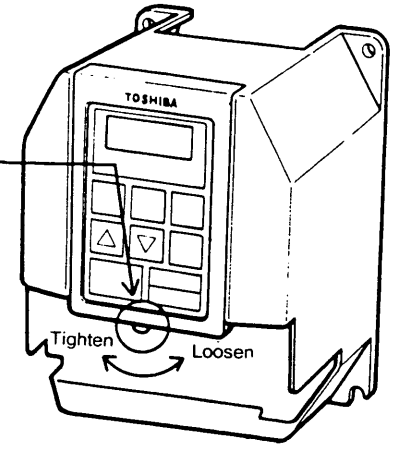
How to remove the upper cover

Insert a minus screwdriver into the four clasps on both sides of the upper cover and pull of the cover.

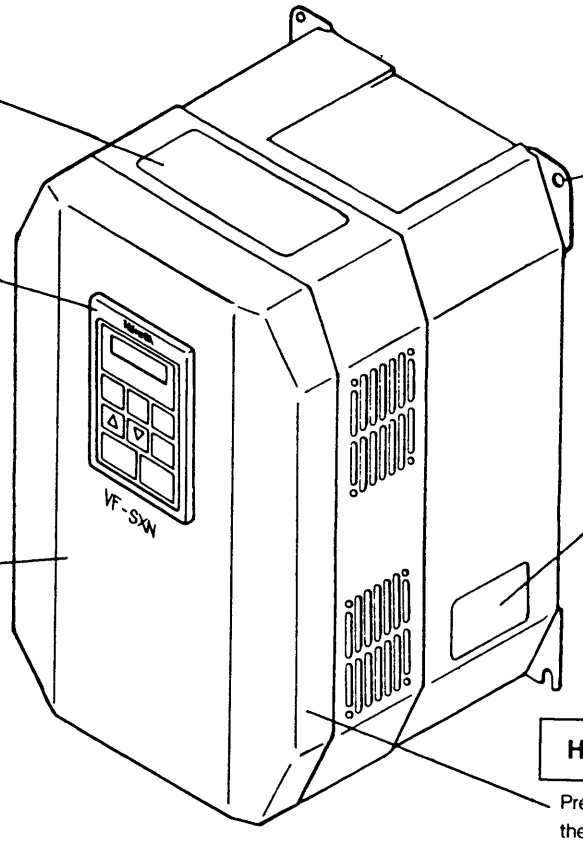
CHARGE lamp
Do not change the wiring or remove the upper cover when this lamp is lit.

How to remove the operation panel

1 Remove the lower cover.
2 Turn the screw at the bottom of the panel completely to the right unit it is loose.
3 Pull up the panel and pull out.



★ 5.5kW～15kW model



Caution plate
Remove this seal when using the inverter in a hot place.

Operation panel
This can be removed. (Refer to page 3-2.) Refer Chapter 7 for operation methods.

Cover
Remove this when the operation panel is removed or when wires are connected to the terminal block.

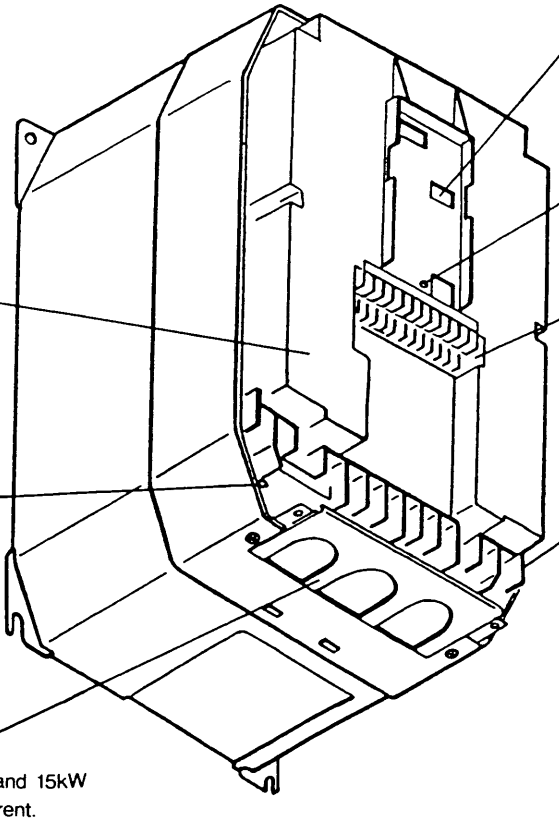
Installation hole
Four holes

Rating nameplate

How to remove the cover

Press these parts on both sides of the cover inward, and pull the cover out forward.

(With the operation panel and cover removed)



Connector for operation panel connection
This is also used for the connection of the operation panel extension cable.

Screw holds for operation panel installation

Inner cover

Control circuit terminal block
For details on the terminal block, refer to section 6.2 (page 6-4).

CHARGE lamp
Do not change the wiring or remove the inner cover when this lamp is lit.

Main circuit terminal block
This is the terminal block for the input power, output, earthing and braking resistor.

Wiring holes
Holes on 11kW and 15kW models are different.
Refer to section 11.2 (page 11.3).

Chapter 4 Cautions for Application

Please take caution to the following points when using the VF-SX.

1. Cautions regarding motor

(1) The VF-SX uses sinusoidal PWM control, but the output voltage and current are not completely sinusoidal but rather are distorted waveforms close to sinusoidal waveforms. Therefore, when running the inverter, temperature rise, sound, and vibration of the motor will increase slightly as compared to when running with a commercial power source.

(2) The VF-SX is a variable frequency drive between 0.5 to 240Hz but, when driving a general-purpose motor, the cooling effect will be lost during low speeds, so a torque reduction is necessary. When torque operation is required at low speeds,use a Toshiba VF Motor exclusive for inverters.

(3) The VF-SX has an electronic thermal overload detection function set to the torque. Characteristics of the Toshiba general-purpose motor. The standard current values of the electronic thermal overload detection function are set to the rated current values shown in Table 11-1~3.

(4) Note that if the inverter-driven motor is applied to an exceptionally small load (5% or less of loading ratio) or to a load with an extremely small moment of inertia, an unstable run may occur (abnormal vibration, overcurrent trip). In this case, lower the PWM carrier frequency.

(5) When using the VF-SX with the following types of motor or loads, an unstable run may occur. Check the inverter combination beforehand.

1. When the motor has an output rating higher than the motor recommended for the inverter unit.
2. When using with a special motor such as an explosion proof motor.
3. When using with a special load such as a reciprocating motion piston.

(6) Note that if the inverter-driven motor is applied to a load with a negative torque, the overvoltage protection or overcurrent protection may be activated. In this case, install a braking resistor that meets the load requirements.

(7) In high speed operation that exceeds 60Hz, vibration and sound will increase, and there will be limits to the mechanical strength and bearings. Contact your Toshiba representative for details.

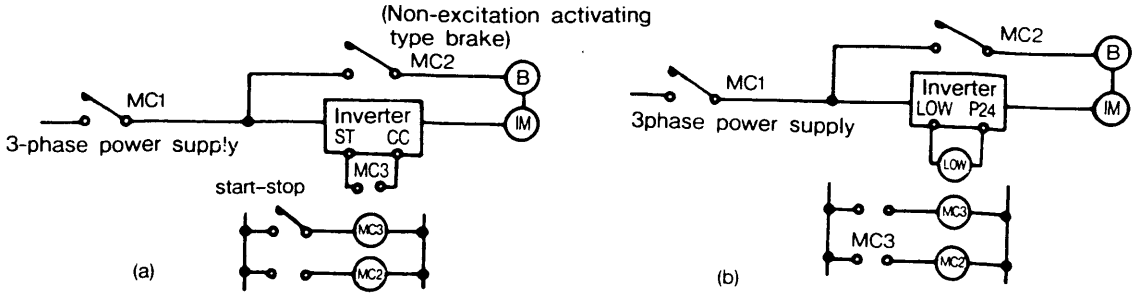
(8) When running a lubrication type reducer or gear motor, the lubrication will deteriorate in low speed areas, so please consult with the reducer manufacturer for the permissible operation range.

(9) The motor will coast to a stop even when the power is turned off. To stop the motor immediately, an auxiliary brake device is required. Select the optimum stopping method from the electrical braking method (page 7-16) or mechanical braking method, etc.

(10) When using a braking motor, if you connect the braking circuit directly to the inverter's output terminal the brake cannot be released because of the lowered activating voltage.
There will be a delay from the time that terminals ST-CC are opened to the time that inverter output stops, therefore, the following circuit compositions are recommended:

(A) Turning the brakes on and off with MC2 and MC3 as shown in Fig. (a). If this method is not used, a constrained condition current will flow when the brakes are activated, and an overcurrent trip may occur.

(B) Turning the brakes on and off with the low speed signal LOW as shown in Fig. (b).



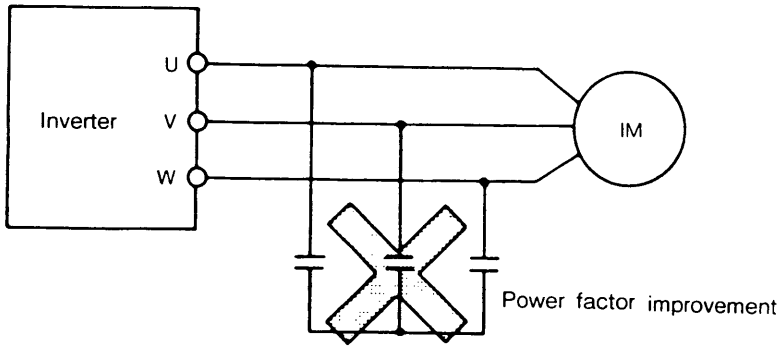
In some cases, turning the brakes on-off with the low limit frequency signal output (terminal LOW function) is better, such as when using in elevating applications. Consult with your Toshiba representative for details.

2. Cautions regarding the inverter

(1) An overcurrent trip is incorporated as a protective function of the "VF-SX" but the current setting level is set according to the maximum applicable motor.
Therefore, if a small capacity motor (kW) is run with a large capacity (kVA) inverter, the current setting level must be readjusted according to the application (for example, starting a load with an extremely large moment of inertia).

(2) When running a large capacity motor with small capacity (kVA) inverter, the current ripple will be above the permissible level even if the current display is below the inverter's rated current. Do not use this type of application.

(3) A power factor improvement capacitor cannot be installed on the inverter's output side. Remove the capacitor when running a motor with a power factor improvement capacitor.



(4) The inverter cannot be applied to voltages other than the rated voltage value. When using other voltages, increase or decrease the voltage to the rated voltage with a transformer, etc.

[Cautions regarding disposal]

When disposing of the inverter unit, take care to the following points:

(1) If the electrolytic condenser is placed in a furnace, the internal electrolytic fluids will expand and may explode.

(2) If the plastic cases used for the cover, etc., are burned, toxic gases may be generated, so take special care.

Chapter 5 Wiring Precautions

Wiring to the inverter (refer to page 5-2)

(1) It is not easy to remove the upper cover after wiring, so changeover the DIP switch selection on the PCB for the "external signal selection" before wiring the inverter.
When a signal between 0 to 5V is used as frequency signal, switching the DIP switch is necessary. Refer to page 8-11 for details.

(2) Before wiring always turn the switch on the switchboard OFF and confirm that there is no voltage with a tester before wiring.

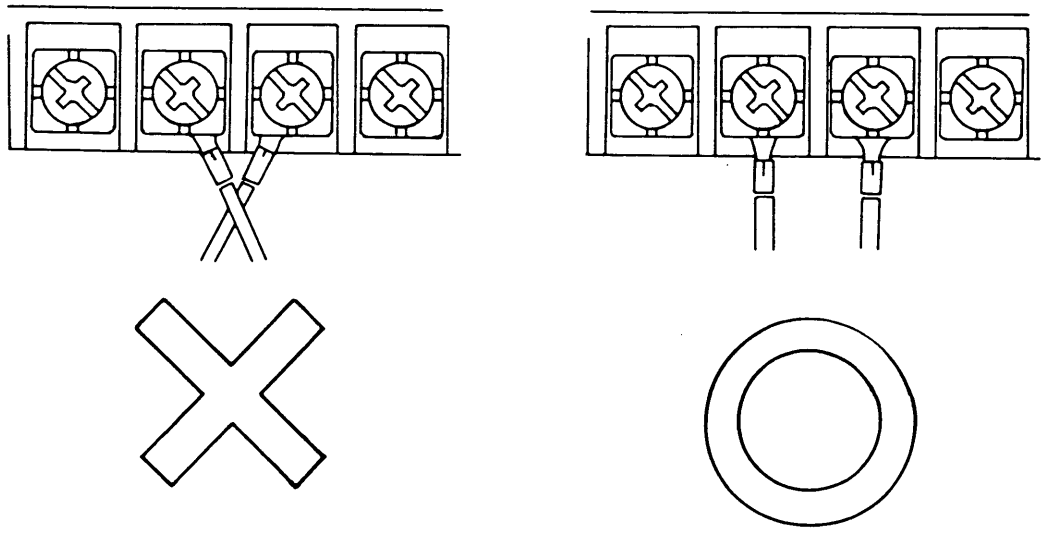
(3) When changing the wiring, start after the CHARGE lamp in the inverter has turned off. There is a capacitor that stores the electric charge in the inverter, and electrocution may occur if the electric charge is not discharged. Do not touch the terminal parts or remove the upper or lower covers while the lamp is lit.

(4) If the input power is applied on the output terminals (U,V,W), The inverter may be damaged. Do not wire this way.
Confirm the power side (R,S,T) and motor side (U,V,W).

(5) Take care to the following parts in regard to the control signals.
1) Use a small load relay.
Install a surge suppressor on the relay exciting coil.
2) Use a shielded wire or twisted wire for the control circuit wiring.
Distance this from the main circuit wiring.
3) High voltage wiring (R,S,T,U,V,W,PA,PB,FLA,FLB,FLC wiring) should be physically and electrically separated from low voltage signal wires (control terminals excluding FLA, FLB, FLC).

[Wire sizes]
Frequency setting signal input and frequency meter, ammeter
.....0.3 mm^2 or larger shielded wire
Other signals.....0.75 mm^2 or larger Polyvinyl chloride wire

(6) Because the distance between main circuit terminals is small, use insulated lugs for main circuit wiring.
Take care when making connections to avoid accidental shorts between terminals.



The main circuit wiring is shown in Fig.5-1.

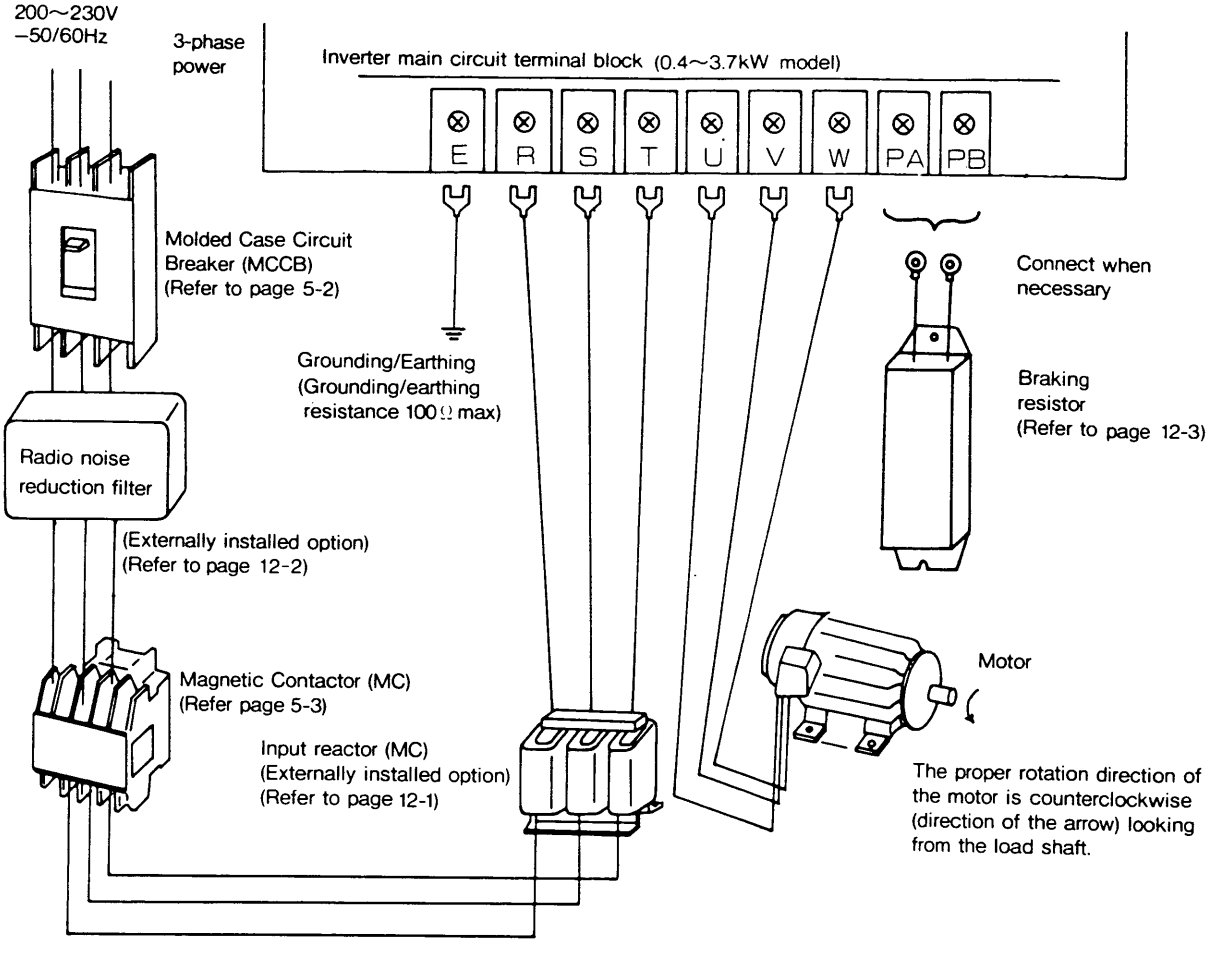


Fig. 5-1 Main circuit wiring

Installation of the Molded Case Circuit Breaker (MCCB)

(Selection examples of equipment for wiring →Refer to page 5-5)

(1) Install a Molded Case Circuit Breaker (MCCB) on the power side as protection for the wiring.
(2) Avoid running and stopping often by turning the MCCB ON and OFF.
(3) Run and stop by turning the terminals of F (or R) and CC ON and OFF.

Installation of the primary Magnetic Contactor (MC)

(Selection examples of equipment for wiring → Refer to page 5-5)

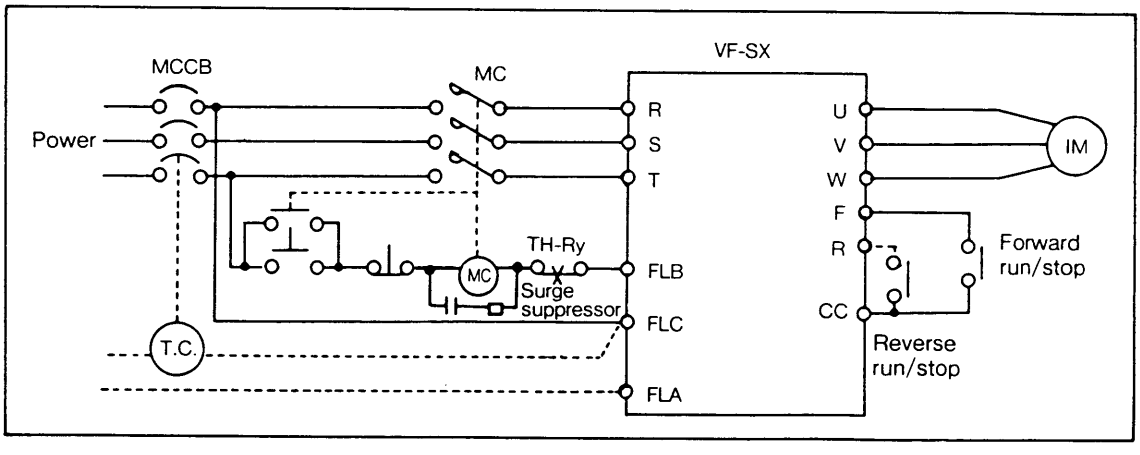
(1) When preventing restarting after a power interruption, tripping of the overload relay (Th-Ry) and operation of the inverter protective circuit, install a Magnetic Contactor (MC) on the inverter power side.

(2) A fault detection relay (FL) is built in the VF-SX. The MC can be opened when the inverter protective circuit operates by connecting this contact point to the primary MC operation circuit.

(3) The inverter can be used without the MC. In this case, open the primary circuit with the MCCB with shunt release when the inverter protective circuit activates.
When using a braking resistor with an overload relay, install an MC or an MCCB with shunt release onto the inverter power side. Connect these so that the power circuit will open when the internal fault detection relay (FL) or externally-installed overload relay operates. Emergency stop is also possible by connecting the overload relay contact point between the terminals of SS3 (EX) and CC of the inverter.

(4) Start and stop by turning ON and OFF between the terminals of F (or R) and CC.
Avoid running and stopping often by turning the inverter ON and OFF with primary MC, because repeated inrush currents will shorten the life of the DC-DC converter.

(5) Install a surge suppressor on the MC exciting coil.



Explanation of leakage current

Certain grounding methods will produce slightly higher leakage currents with the VF-SXN than those associated with general purpose inverters (due to the higher carrier frequencies employed in the VF-SXN).

(1) When a GFCI (Ground Fault Circuit interuption) breaker is connected to some inverters, the activiation current level of the GFCI breaker should be increased.
(2) The distance from the inverter to motor should be short.
(3) The GFCI breaker that has countermeasures for harmonic distortion should be used.

Installation of the secondary Magnetic Contactor (MC)

(1) When installing an MC between the inverter and motor, avoid turning ON and OFF during operation as possible. (If the secondary MC is turned ON and OFF during operation, excessive rush current can flow to the inverter and possibly cause damage.)

(2) If an output contactor is used it should be interlocked so the ST-CC terminals are disconnected before the output contactor is opened. If the output contactor is being used for bypass operation, it must also be interlocked so that commercial power is never applied to the inverter output terminals (U,V,W). Please contact your dealer or Toshiba for more information.

Installation of an overload relay (thermal relay)

(Selection examples of equipment for wiring → Refer to page 5-5)

(1) An electronic thermal overload protection function is built in VF-SX. However in the following cases, install an overload relay that meets the electronic thermal operation level adjustment and the motor used, between the inverter and motor.
   1) When using a motor having a rated current value different from the Toshiba general-purpose motor (adjustment of electronic thermal relay level).
   2) When operating with a single motor smaller than the standard specification application motor output or when running several units simultaneously (an overload relay must be installed on each load).

(2) When running the VF-SX with a constant torque motor "Toshiba VF Motor", changeover the electronic thermal protective characteristics to the VF motor side. (Refer to page 10-1)

(3) To have proper protection while running the motor at a low speed, we recommend using a motor with a motor with thermal protection.

Explanation of the power factor improvement capacitor

Power correction capacitors should not be connected to the inverter inputs or outputs. The inverter generates waveforms that can be detrimental to the capacitors and the capacitors can cause damage to the inverter. Install an input reactor (optional) on the inverter primary side for power factor improvement.

Explanation of radio wave obstruction

There may be electric wave interference to the audio equipment used near the inverter. In this case, install a noise filter (optional) to the inverter power side, and shield the cable to the motor with a wire tube.
This will decrease the interference. Contact Toshiba for details.

Cautions for earthing accidents

Operate the inverter after checking between the motor and inverter for mis-wiring or short circuits in the motor. Do not earth the neutral point of the motor star-wiring.

Installation of an input reactor

The input reactor is used to ease obstruction to the inverter such as improvement of the input power factor, suppressing of the high frequency elements and sudden changes in the power fluctuations. Install an input reactor when the inverter is connected to the following types of systems.

(1) When the power capacity is 200kVA or over and the power capacity is 10 times or more the inverter capacity.

(2) When the inverter is connected to the same system as the thyristor commutation type controller.

(3) When connected to a distortion source such as an arc furnace or the same system as a large capacity inverter.

Selection examples of wiring equipment

Voltage class	Applicable motor (kW)	Inverter	MCCB		MC		Overload relay Th-Ry		Surge suppressor	Wire size		
		Model	*1	*2	*1	*3	*4	*2	Model (Note 2)	*5	*6	*7
3-phase 200V class	0.1	2001	5	SS30	12	C12A	0.7	T11A	Toshiba Model SS-2 or Malcon Electronics Model RFM2E224KD	2.0	0.75	–
	0.2	2002	5	SS30	12	C12A	1.3	T11A		2.0		
	0.4	2004	5	SS30	12	C12A	2.3	T11A		2.0		1.25
	0.75	2007	10	SS30	12	C12A	4.2	T11A		2.0		
	1.5	2015	15	SS30	12	C12A	6.6	T11A		2.0		2.0
	2.2	2022	20	SS30	12	C12A	9.3	T11A		2.0		
	3.7	2037	30	SS30	18	C20A	15	T20A		3.5		
	5.5	2055	50	ES50	35	C35A	22.0	T35A		8.0		5.5
	7.5	2075	60	EH100	50	C50A	28.0	T35A		14		
	11	2110	100	EH100	65	C65A	43.0	T65A		14		8.0
	15	2150	125	EH225	80	C80A	57.0	T65A		22		
Single-phase 200V class	0.1	2001	5	SS30(2P)	12	C12A	0.7	T11A	Toshiba Model SS-2 or Malcon Electronics Model RFM2E224KD	2.0	0.75	–
	0.2	2002	5	SS30(2P)	12	C12A	1.3	T11A		2.0		
	0.4	2004	10	SS30(2P)	12	C12A	2.3	T11A		2.0		1.25
	0.75	2007	15	SS30(2P)	12	C12A	4.2	T11A		2.0		
	1.5	2015	20	SS30(2P)	25	C25A	6.6	T11A		2.0		2.0

*1: Rated current (A)
*2: Toshiba model
*3: Toshiba model (Note 1)
*4: Adjusted voltage value (A) [Reference value]
*5: Main circuit (mm^2) (Note 3)
*6: Control circuit (mm^2)(Note 4)
*7: Regenerative discharge braking resistor (mm^2)

(Note) 1. When selecting an MC with auxiliary contact point 2a, and using this auxiliary contact point on the control circuit, use the 2a contact point in parallel connection to improve the contact point reliability.
2. Install a surge suppressor on the MC or relay exciting coil.
3. The input side R,S and T and output side U,V and W wire sides are shown. Select a wire distance 30 m or less. When exceeding 30 m, increase the wire size.
4. Use a shielding wire.
5. Use a wire size 3.5mm^2 or more for earthing.

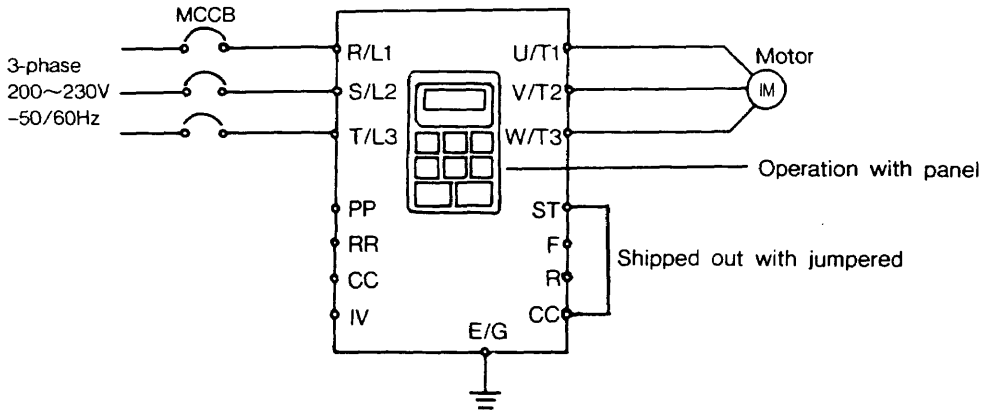
Chapter 6 Standard Connection

The items printed in italics in the explanation are parameter names.
Refer to page 7-14 for how to set the parameters and pages A-1 to A-4 for the parameter list.

6.1 Examples of Standard Wiring

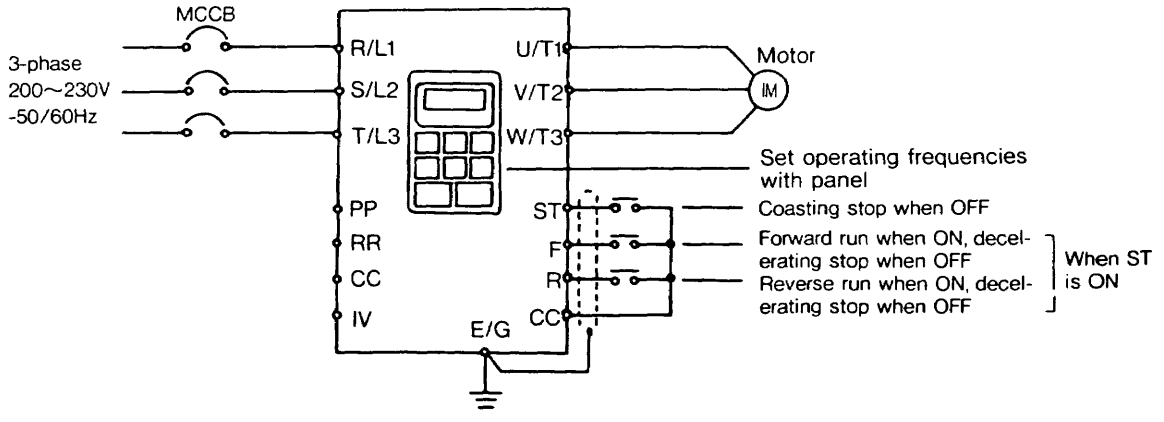
6.1.1 For Three Phase Input

Example 1	To set the operation frequencies, and conduct forward/reverse run and/or decelerating stop from the panel.



Setting: The parameter group Cr.St (Input/output setting parameters) *command mode selection* is set to 3 (terminal,panel changeover). The *Frequency setting mode selection* is set to 3 (terminal, panel changeover).

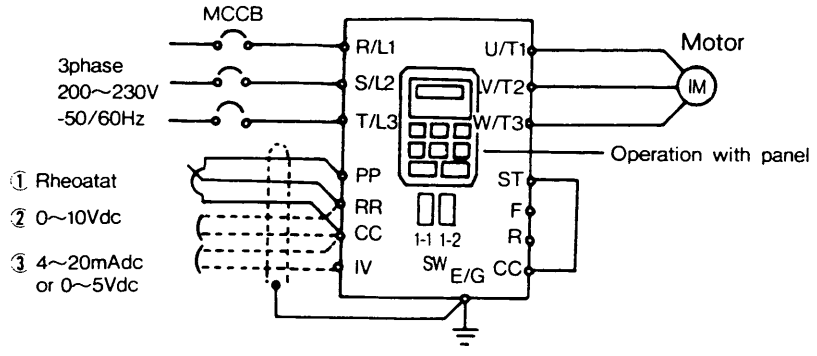
Example 2	To set the operating frequencies from the panel, and conduct forward/reverse run, decelerating stop, and/or coasting stop with external signals.



Setting: The parameter group Cr.St (input/output setting parameters) *Command mode selection* is set to 3 (terminal, panel changeover), and the *Frequency setting mode selection* is set to 2 (only panel input valid).

Note 1) Emergency stop is possible with the panel when STOP/RESET is preased twice.

Example 3	To set the operating frequencies with external signals and conduct the forward/ reverse run and decelerating stop from the panel.

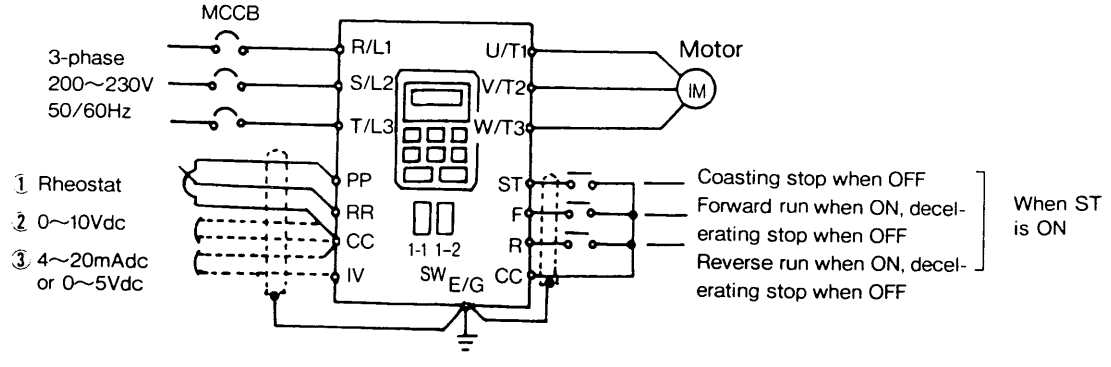


Setting: The parameter group Gr.SE (input/output setting parameters) *Command mode selection* is set to 2 (only panel input valid), and the *Frequency setting mode selection* is set to 1 (only terminal input valid).

Note 1) Set DIP switch SW1-1 to the 10V side when the external operation frequency signal is ② 0~10Vdc.

Note 2) Set the IV input selection to I (engaged), RR terminal input priority to 0 (IV priority), and DIP switch SW1-2 to the I side when the external operation frequency is ③ 4~20mAdc. Set the IV input selection to I (engaged), RR terminal input priority to 0 (IV priority), and DIP switch SW1-2 to the V side when 0~5Vdc.

Example 4	To set the operation frequencies, and conduct forward/reverse run, decelerating stop and coasting stop with external signals.



Setting: The parameter group Gr.SE (input/output setting parameters) *Command mode selection* is set to 3 (terminal, panel changeover), and the *Frequency setting mode selection* to 3 (terminal, panel changeover; (standard default settings).

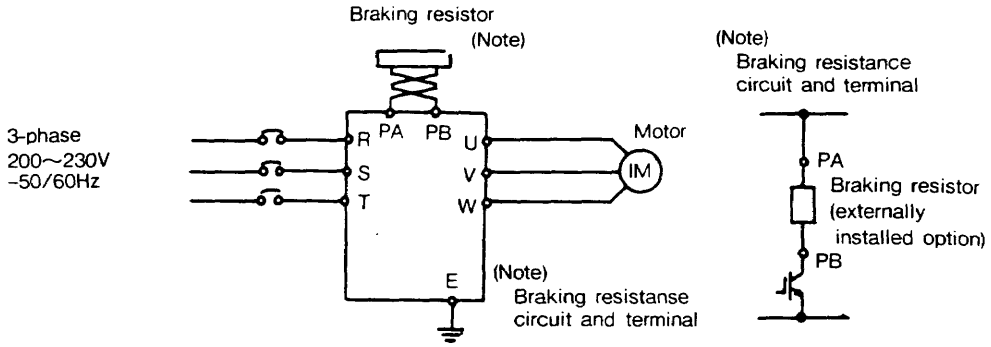
Note 1) Set DIP switch SW1-1 to the 10V side when the external operation frequency signal is ② 0~10Vdc.

Note 2) Set the IV input selection to I (engaged), RR terminal input priority to 0 (IV priority), and DIP switch SW1-2 to the I side when the external operation frequency is ③ 4~20mAdc. Set the IV input selection to I (engaged), RR terminal input priority to 0 (IV priority), and DIP switch SW1-2 to the V side when 0~5Vdc.

Note 3) If operating automotically with the ③ 4~20mAdc signals, and manually with the ① rheostat, set the RR terminal input priority to I (engaged) and IV input selection to I. Turn the rheostat and the manual setting will be engaged when a voltage is generated between RR and CC.

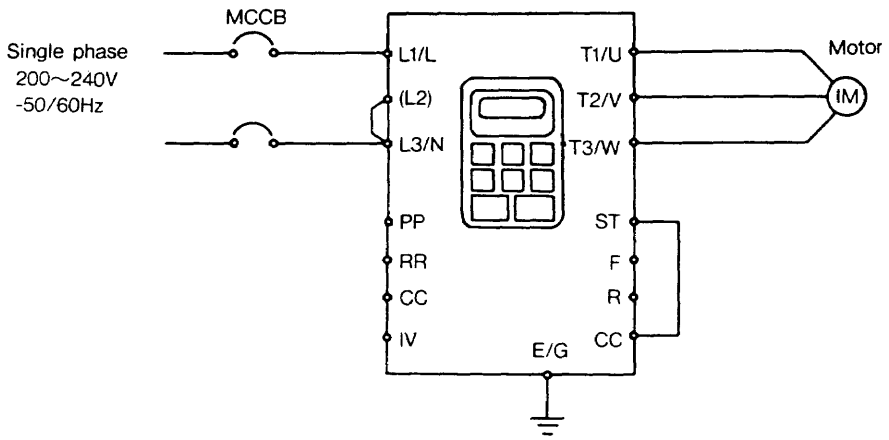
Note 4) Emergency stop will be possible on the panel when STOP/RESET is pressed twice.

Example 5	When braking resistor (optional) is connected (for 0.4 to 15kW models)



Setting: Set the parameter Pb of Gr.Pr group to 2 (regenerative discharge braking, with overload detection)

6.1.2 For Single-Phase Input



Other than input power connection, the single phase input units use the same output and control wiring as three phase units. Please refer to the previous example (1 to 5 for the 6.1.1 three-phase input) for wiring samples.

6.2 Terminal Functions

The arrangement of the terminal block is as follows. The functions of the terminal block are shown on the next page.

Control circuit terminals

RST	AD2	CC	SS1	SS2 (JOG)	SS3 (EX)	CC	FM (AM)	CC	FLA	FLB	FLC

F	R	ST	CC	PP	RR	IV	CC	RCH (UL)	LOW (LL)	P24

(M3 screw)

Main circuit terminals (3phase input models 0.1, 0.2kW)

E/G	R/L1	S/L2	T/L3	U/T1	V/T2	W/T3

Main circuit terminals (3phase input models 0.4～3.7kW)

E/G	R/L1	S/L2	T/L3	U/T1	V/T2	W/T3	PA	PB

Main circuit terminals (3phase input models 5.5, 7.5kW)

PB	PA

PO	R/L1	S/L2	T/L3	U/T1	V/T2	W/T3

G/E	PC

Main circuit terminals (3phase input models 11, 15kW)

PA	PC

PB	PO	R/L1	S/L2	T/L3	U/T1	V/T2	W/T3	G/E

Main circuit terminals (Single phase input models 0.1, 0.2kW)

G/E	L1/L	(L2)	L3/N	T1/U	T2/V	T3/W

Main circuit terminals (Single phase input models 0.4～1.5kW)

G/E	L1/L	(L2)	L3/N	T1/U	T2/V	T3/W	PA	PB

Inverter model

VFSX-2001～2007 : M3.5 screw
VFSX-2015～2037 : M4 screw
VFSXN-2001～2004 : M3.5 screw
VFSXN-2007～2037 : M4 screw
VFSXN-2055, 2075 : M5 screw
VFSXN-2110, 2150 : M6 screw(G/E terminal : M5 screw)
VFSXS-2001～2004 : M3.5 screw
VFSXS-2007, 2015 : M4 screw

Fig. 6-2 Terminal block arrangement diagram

The functions of each terminal are as found below.
The terminal block arrangement is shown in Fig.6-2.

Terminal name	Terminal function	Terminal block type
E	The inverter housing's ground terminal.	Main circuit terminal block
R,S,T(L,N) * *	Connect to a 3-phase 200～230V 50/60Hz power supply.	
U,V,W	Connect to the motor (3-phase induction motor).	
PA,PB	Connect to the braking resistor (optional). (Only for the 0.4～15kW models)	
F	Forward run with F-CC shorted, and decelerating stop with F-CC opened. (When ST-CC is shorted)	Contrl circuit terminal block (M3 screw)
R	Reverse run with R-CC shorted and decelerating stop with R-CC opened. (When ST-CC is shorted) Reverse run will occur when F-CC and R-CC are shorted simultaneously.	
ST	This inverter is ready to run with ST-CC shorted. Coasting stop with ST-CC opened. ST can be used for an interlocked operation. (Operation preparation/coasting terminal)	
CC *	Common terminal for F, R and ST terminals.	
PP	Output for the frequency setting reference voltage.	
RR	Input the frequency setting signal. 3kΩ rheostat (a 1～10kΩ rating rheostat can be connected), 0～10Vdc (SW1-1 to 10V side) or 0～5Vdc (SW1-1 to 5V side)	
IV	Input the frequency setting signal. 0～5Vdc (SW1-2 to V side) or 4～20mAdc (SW1-2 to I side)	
CC *	Common terminal for PP, RR and IV terminal.	
RCH(UL)	Output when the speed reached is detected or when the upper limit frequency reached is detected. This is an open collector output. (Maximum 50mAdc)	
LOW(LL)	Output when the low speed is detected or when the lower limit frequency reached is detected. This is an open collector output. (Maximum 50mAdc)	
P24	Connect to the external relay, etc. (24Vdc, maximum 100mA)	
RST	The inverter protection function operation retention can be reset with RST-CC are shorted. (External fault reset)	
AD2	Runs at the Acc./Dec. 2 with AD2-CC shorted.	
CC *	Common end for RST and AD2 terminals.	
SS1	Runs with multispeed operation with SS1-CC shorted.	
SS2(JOG)	Multispeed run with SS2-CC shorted, or jogging operation with JOG-CC shorted.	
SS3(EX)	Multispeed run with SS3-CC shorted, or emergency stop with EX-CC shorted.	
CC *	Common end for SS1, SS2 (JOG), and SS3 (EX) terminals.	
FM(AM)	Connect to the external frequency meter or ammeter. The output signals are analog outputs between 0～1mAdc and 0～7.5Vdc. Use either an ammeter rated at 1mAdc at full scale or a voltmeter rated at 7.5Vdc-1mA at full scale.	
CC *	Common end for the FM(AM) terminals.	
FLA,FLB,FLC	Operates when the activation of the inverter protective function is detected. (During contact point rating 250Vac-2A , 30Vdc-2A resistance load, and 1.5A during inductive load.) The FLA-FLC is closed and FLB-FLC is opened when the protective function is activated.	

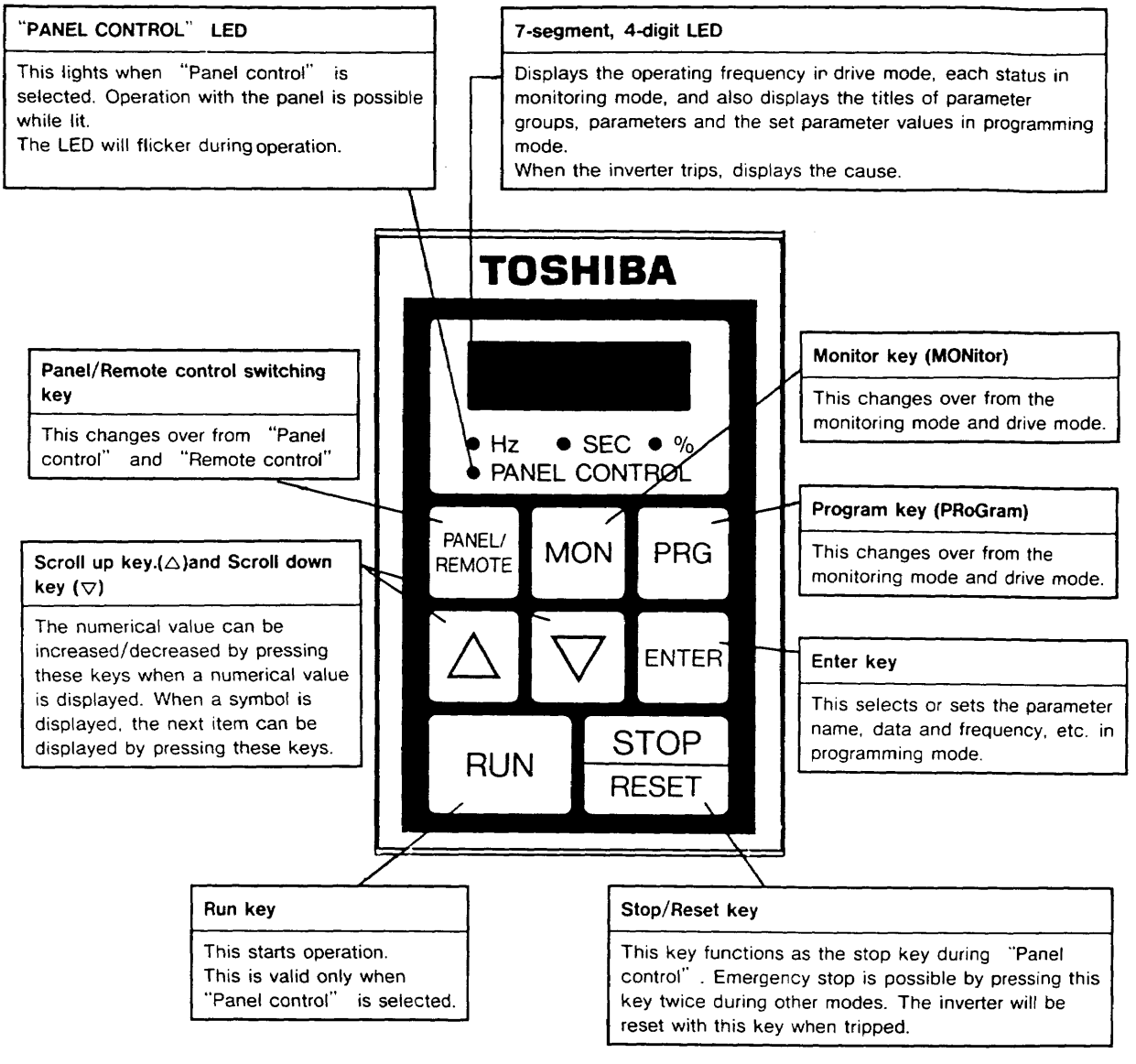
* Each CC terminal is connected internally.

* * The terminal signal is L, N for single-phase input models, and is connected to a single-phase 200～240V-50/60Hz.

Chapter 7 Operation and Adjustment

7.1 Operation Panel

The inverter operation, functions and data settings can be monitored with the operation panel (hereinafter panel).



7.2 Basic Operation

After confirming that the wiring is not mistakenly connected, simple operation is carried out with the standard default values set before shipment. Carry out operation with the following procedure.
The standard default values of this machine is as shown on appendix 1(page A-1).
It is recommended to start from a low operation frequency of about 10Hz when carrying out test operations.

(1) Operation and stop with the panel

Procedure	Operation
1) Power ON	Turn the power Molded Case Circuit Breaker (MCCB) ON. If the display is OFF, the operation conditions are not set, so operation will not be possible. Close the terminal block ST to CC. Operation preparation is complete if the display is 0.0.
2) PANEL/ REMOTE	Changeover to "Panel control". The "PANEL CONTROL" lamp will light. Operation with the panel will be possible. (The lamp will go out when this key is pressed again.)
3) △ ▽ ENTER	Set the operation frequency. The frequency command can be increased/decreased by pressing the UP key △ or DOWN key ▽. When the key is pressed, the "PANEL CONTROL" lamp will flicker, and show that the numerical value is being changed. When the desired frequency is found, press the ENTER key, and the display will show FC and the frequency in order.
4) RUN	The frequency will rise according to the acceleration time, and the motor will rotate. The panel control lamp will flicker during operation.
5) STOP RESET	The frequency will lower according to the deceleration time, and the motor will decelerating stop.

CAUTION

If the power switch is turned OFF during step 4), the motor will coast to stop, but do not carry this out unless it is an emergency.
Avoid starting and stopping the inverter often by turning the power switch ON and OFF.

(2) Changing the frequency during operation

Procedure	Operation
1) △ ▽ ENTER	The frequency can be changed during operation by pressing the UP key △ or DOWN key ▽. Note that, in this case, the operation frequency will change simultaneously with the frequency command value. The operation frequency can be changed without pressing the key, but when the power is turned OFF, the frequency setting value will return to the value before changes.

(3) Setting and adjusting functions

Follow the procedure below when changing the standard settings.

First confirm how the symbol name for the function to be changed is displayed in the parameter group in the table shown on pages A-1 to A-4.

Group categories

- U : User parameter
  - (USER)
- F : Fundamental parameters (V/f, acceleration/deceleration, etc.)
  - (FUNDAMENTAL)
- St : Terminal selection parameter
  - (SELECTION OF TERMINAL)
- Pr : Protective function parameters
  - (PROTECTION)
- CC : Control and communication parameters
  - (CONTROL & COMMUNICATION)
- AN : Adjustment parameters
  - (ADJUSTMENT)

Gr.U	shows only the parameter when the user changes the setting value of each parameter to a setting that differs from the standard default value. [Edit function] The parameter settings can be changed in this group. However, when the same setting value as the standard dafault setting is input again, the value will not be displayed in this parameter group.

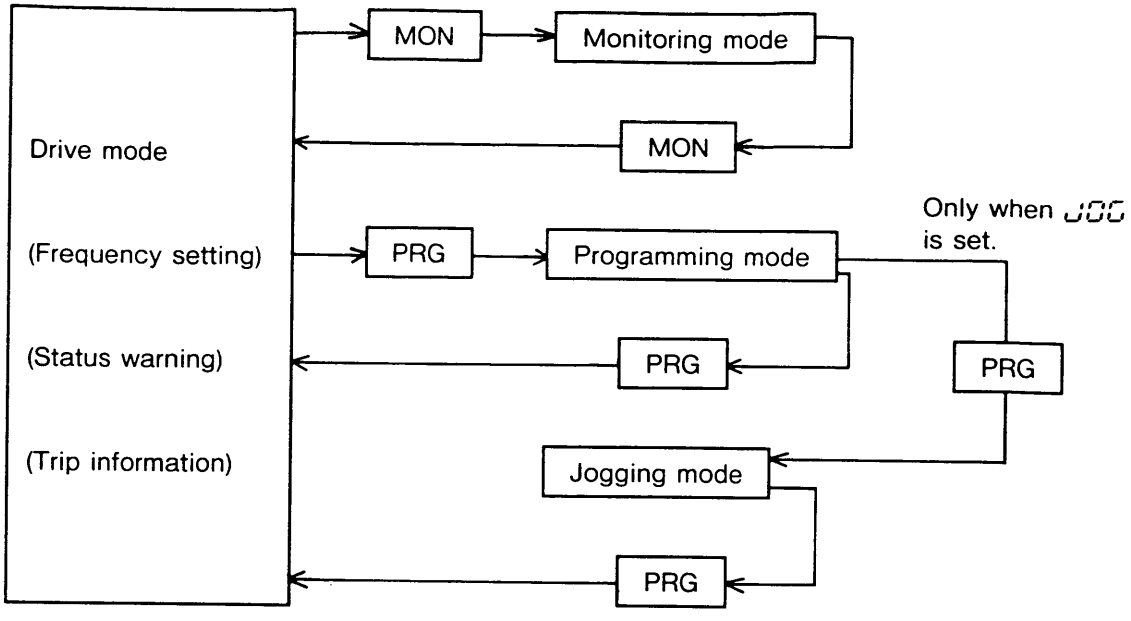
The setting changes of the base frequency (Gr.F , display uL) will be explained as an example below.

Key operation	LED display	Operation
	0.0	The operating frequrncy is displayed, and the programming mode will be entered from the drive mode.
1) PRG	: Gr.U	Gr.U , the head group name, will be displayed.
2) △ ▽ ENTER	: Gr.U ↓ : Gr.F	The group signal is selected with the △ ▽ keys. ⇄U⇄F⇄St⇄Pr⇄CC⇄AN⇄U⇄ Press the ENTER key when the desired group is displayed and set it. From here, the display will change to the parameter name display.
3) △ ▽ ENTER	: FH ↓ : uL ↓ : 60.0	Select the parameter to be changed with the △ ▽ keys. Press the ENTER key when the desired parameter is displayed to set. The parameter current value will be displayed.
4) △ ▽ ENTER	: 50.0 : uL ⟷ 50.0 (Alternate display) : uL	Change the data with the △ ▽ keys. Press the ENTER key when the desired data is displayed. The data will be determined and stored. After the parameter name and data are displayed in order, the parameter display setting will be shown.
5) ENTER ↓ Return to the data setting in 3) above. (Next parameter will be displayed.)	or PRG ↓ Return to the drive mode.	or MON ↓ Move to the monitoring mode.	or △ ▽ ↓ Return to the parameter selection in 3) above.

Other modes can be moved to by pressing PRG and MON anywhere above, but if the ENTER key is not pressed, the data will not be registered in the unit and, when the power is turned OFF, the setting will return to the former setting. Always press ENTER after changing the settings.

7.3 Display Modes

This inverter has four types of operations and display modes as shown below.



7.3.1 Drive mode

The drive mode will be automatically executed when the power is turned ON. In this mode, the inverter output frequency monitoring and the setting of the frequency command value is carried out. The status warning is displayed during operation and trip information is displayed during inverter tripping.

(1) Setting function of the frequency command value

This function can be activated by pressing the △ ▽ keys during the drive mode. The monitoring mode will be activated by pressing MON and the programming mode by pressing PRG. (The drive mode will be executed when the same key is pressed again.) If the frequency command value is changed during operation, the operating frequency will also change accordingly. If the command value is ahead of the operating frequency, acceleration and deceleration will be carried out according to the acceleration/deceleration time.

This function can be invalidated (change not possible) by setting the parameter of *Frequency setting mode selection* (FMOd of Gr.5E). (Refer to page 7-13.)

(2) Status warning

A warning character and a frequency value are sometimes displayed in order on the LED during the drive mode. The following three types of warning characters are displayed.

C ·····When a current over the overcurrent stall level has flowed.

P ·····When a voltage over the overvoltage stall level has occurred.

L ·····When the overload trip value has reached more than 75% of trip value.

These alarm displays will go out automatically when the alarm conditions are released.

(3) Trip information

When a trip occurs, the trip display will be displayed immediately on the drive mode.

Display	Contents
OC1 or OC1P	Overcurrent trip (OC) during acceleration
OC2 or OC2P	Overcurrent trip (OC) during deceleration
OC3 or OC3P	Overcurrent trip (OC) during operation
OCL	Load side overcurrent (output terminal check) trip at start-up
OCA	Arm overcurrent (GTR check) trip at start-up
OP	Overvoltage (OP) trip between DC middle circuit
OP2	Overvoltage (OP) trip between DC middle circuit during deceleration
OH	Inverter overheating (OH) trip
OL	Motor overload (OL) trip
E	Emergency stop
EEP	EEPROM abnormality (adjustment or other data)
E-r2	RAM abnormality
E-r3	ROM abnormality
OLr	Overload trip in regenerative discharge braking resistor

Furthermore, the registered trip status (those trip that occured previously) can be read out.

Example of trip occurrence (Overcurrent trip occurs during operation)

Key operation	Display example	Contents
	OC3	Drive mode (trip flicker display) Motor is coasting.
MON	: 50.0	Operating frequency during trip
▽	: Fr F	Operation direction during trip
▽	: 60.0	Operating frequency command value during trip
▽	: C150	Load current during trip (%)
▽	: V100	Input voltage durring trip (%) (AC200V input convension)
▽	: P 90	Output voltage during trip (%)
▽	: ''''''	Input terminal information during trip (refer to page A-6)
▽	: '''	Output terminal information during trip (refer to page A-6)

The six parameters for the software versions and past trips are shown below in the same manner. If the MON key is pressed next, the initial display OC3 will be shown.

If the ▽ key is pressed continuously durring the above procedure, the item will change every 0.5 seconds and display in order. The display can be changed to the trip information display status by pressing the MON key anywhere during this procedure.

★ The trip status monitor will continue until the power is turned OFF or the trip is cleared.
Refer to page 7-17 for how to reset the trip.

7.3.2 Monitoring mode

This function monitors each status (setting frequency, output voltage, current, terminal information, etc). This mode is activated when the [MON] key is pressed in the drive mode. To leave this mode or move to another mode, move to the programming mode with the [PRG] key or move to the drive mode with the [MON] key.

Monitor operation examples in the drive mode
(With motor running)

Key operation	Display example	Contents
	60.0	Drive mode (frequency display)
MON	: Fr F	Forward (F)/reverse (r) run
▽ △	: 60.0	Frequency command value
▽ △	: C 50	Load current (%) being monitored (Note)
▽ △	: 0100	Input voltage (%) (AC200V input conversion) being monitored
▽ △	: P 75	Output voltage (%)
▽ △	: ''''	Input terminal information (refer to page A-7)
▽ △	: '''	Output terminal information (refer to page A-7)
▽ △	: U200	The version number of software on the CPU
▽ △	: UE 1	The version number of software on the EEPROM
▽ △	: OC3 ↔ 1	(Alternate display) The past trip 1
▽ △	: OH ↔ 2	(Alternate display) The past trip 2
▽ △	: OP ↔ 3	(Alternate display) Past trip 3
▽ △	: OL ↔ 4	(Alternate display) Past trip 4
▽ △	: Fr F	Operation direction display (top menu of the monitoring)

If either of the [△] [▽] keys are pressed continuously during the above procedure, the display will change every 0.5 seconds to the next item.
At any moment during the key operation you can conduct the run/stop, switching to drive mode and programming mode, and also switching to remote control (only when stopped) is possible.
The ← → symbols in the examples show what is displayed on the right display and left display every 0.5 seconds.

Note) At low frequencies, a large measurement error may occur. This error can approach ±30% when the frequency is below 20Hz.

7.3.3 Programming mode

This mode is activated by pressing the [PRG] key in the drive mode. To move to a different mode, move to the drive mode with the [PRG] key or move to the monitoring mode with the [MON] key.
This mode has the parameter display, setting function, adjustment function explained below.
To change the parameter setting, you must enter the Parameter setting disable selection enabled status (PROd = 1 of Gr.St) (standard default value is 1). The *parameter setting disable selection* can be changed even when the parameter setting is 0 (setting disabled). (Refer to page 7-14.)

(1) Parameter settings and display function

Follow the procedure below to set a desired parameter.

1. Press the [PRG] key and enter the programming mode.
2. In group display state, select the group category with the [△] [▽] keys, press [ENTER] and move to the parameter display state.
3. When the parameter name display state, select the parameter name with the [△] [▽] keys, press [ENTER] and move to the value display state.
4. In the value display status, set the data with the [△] [▽] keys.
5. Store the set values into the main memory with the [ENTER] key.

Refer to section 7.2 (3) (page 7-3) for an example on how to operate the keys.
Refer to appendix 1 (pages A-1 to A-4) for the list parameters.

(2) Programming mode and adjustment function (parameter group Gr.AN)

This function is used to calibrate the analog type meters installed for monitoring frequency or current.

The adjustment operation are the same as the parameter setting display functions. However, the changes with the △ ▽ keys are not shown on the LED but are shown with the movement of the meter needle. Adjustment is carried out by matching the value indicated by this needle to the LED value. Refer to appendix 1 (page A-1) for the parameter list.

Carry out this adjustment during operation.

FM (frequency meter) adjustment example

Key operation	Display example	Contents
	60.0	Drive mode (operating frequency is displayed)
PRG	: Gr.U	Change over to the programming mode.
▽ △	: Gr.AN	Select Gr.AN (The group name will change with the △ ▽ keys.) U ⇄ F ⇄ St ⇄ Pr ⇄ CC ⇄ AN ⇄ U
ENTER	: Gr.AN → :FNAN	Select the group. Move to the parameter name display status from here.
▽ △	: FNAN	Select the parameter using the △ ▽ keys, set to FNAN ⇄ FN ⇄ dSP2 : when the standard default setting or previous setting is FN FNAN ⇄ AN ⇄ dSP2 : when the previous setting is AN
ENTER ▽ △ ENTER	: 0 : FNAN ⟷ 0	Select the parameter name. Move to the data display status and select 0 (frequency meter connection) with the △ ▽ keys. 0: Frequency meter connection 1: Ammeter connection
▽	: FN	The next parameter name is displayed, but if the FNAN in the last parameter was 1(ammeter connection) the AN parameter will be displayed here.
ENTER	: 60.0	Determine the parameter name and enter the FM adjustment mode. (Operation frequencies are displayed)
△ ▽ ↓	: 60.0	Adjust the frequency meter with the △ ▽ keys. (Display begins to flicker) →(The meter needle begins to move with the LED constant) →(Adjust with the △ ▽ keys until the LED and meter are the same value)
ENTER	60.0	Store the adjusted value into the inverter unit. (Flicker will stop)
PRG	60.0	Move to the drive mode (frequency display)

(3) Set value warning displays

When a parameter for the frequency setting is selected, the set value and following warning displays will show on the LED alternatively and display the setting value error.
The value cannot be registered even when [ENTER] is pressed if this warning is displayed.

H1 warning: The setting value is beyond its upper limit or the current set value exceeds its upper limit by changing any parameter. (Then, the value is corrected to the upper limit value)

LO warning: The setting value is beyond its lower limit or the current set value exeeds its lower limit by changing any parameter. (Then, the value is corrected to the lower limit value)

Parameters that have a limited setting value with an LL or UL as those of the multispeed run frequency, cannot be set exceeding the LL and UL value.
In some cases, the set value may be exceeded as a result of changing the FH , UL and/or LL values. In this case, if the parameter that has exceeded the range is selected, a warning will be displayed. A warning will be displayed as soon as either key [△] [▽] is pressed to change the parameter setting value, and the set value will change to the value in the normal range.

When higher than UL , the same value as UL is set.
When lower than LL , the same value as LL is set.

Example for setting to Sr 1 = 80 with UL = 60Hz, LL =40Hz
(Proceeded from the programming mode)

Key operation	Display example	Contents
[PRG]	: Gr.U	
[△] [▽]	: Gr.St	Select Gr.St
[ENTER]	: CNOd	
[△] [▽] [ENTER]	: Sr 1 : 80.0	
[△]	: 60.0 ⟷ H1	(Upper limit warning) Becomes the UL value (Same with the [▽] key)
[▽]	: 59.9 : "Down" : 40.0 : 40.0 ⟷ LO	Continuously press the [▽] key LL (lower limit frequency) reached Hereafter, this is displayed alternatively with the warning while the [▽] key is pressed.

7.3.4 Jogging mode

This is used to operate the inverter at a low speed. Short time operation (inching) can be carried out easily. The following operations use the panel, but when using the terminal block signals, refer to section 8.6.2 (page 8-15).

Activate this mode with the following procedure.

Set the jogging run frequency (JOG of Gr.SE) and jogging stop pattern (JSTP of Gr.SE) in the programming mode before entering this mode.

Key operation	Display example	Contents
PRG PRG	: Gr.U : FJOG	Press the PRG key twice. The jogging mode will not be activated when other keys are pressed. When using the panel control mode, and the jogging run frequency setting is not 0 Hz, the jogging mode will be activated with the second PRG key press. (Forward jogging run) When not using panel control mode or when the jogging run frequency is not set, the drive mode (frequency display) will be returned to with the second PRG key press.
▽	: rJOG	Press the ▽ key to reverse jogging run. Press the △ key to forward jogging run.
RUN	5.0	The jogging setting frequency will be output while the RUN key is pressed.
PRG	0.0	The drive mode is activated by pressing the PRG key.

7.4 Command Mode Selection

In this section, the methods to operate and adjust from the operation panel, validate and invalidate the operation command from the terminal block, select stopping methods and reset methods will be explained.

7.4.1 Switching of PANEL/REMOTE control

The panel control mode and remote control mode are available.

- When using the remote control mode (REMOTE), the commands from the panel are ignored.
- When using the panel control mode (PANEL), the commands from the terminal block are ignored.

The switching of PANEL/REMOTE control is carried out with the PANEL REMOTE key, but can only be changed while stopped. (OFF or 0.0 as the frequency displays are displayed when stopped.) The terminal block operation mode will be activated if the following input modes are not set as explained below when the power is turned ON. The "PANEL CONTROL" lamp will light during panel control.

7.4.2 RUN/STOP command [CMOd of Gr.St]

The following methods can be selected for the run/stop command (command mode).
Refer to appendix 3(A-6) for relation between input terminal and command mode.

CMOd setting	Function
0	No input is enabled.
1	Only terminal input valid
2	Only panel input valid
3	Terminal, panel changeover

7.4.3 Function for setting frequency command value [FMOd of Gr.St]

This function can be used by pressing the △ ▽ keys in the drive mode.
However, the use of this function will be as follows according to *Frequency setting mode selection* (FMOd of Gr.St)

Refer to appendix 3 (A-6) for the relation between input terminal and command mode.

FMOd setting	Function
0	No input is enabled.
1	Only terminal input valid
2	Only panel input valid
3	Terminal, panel changeover

7.4.4 Function for setting parameters [PROd of Gr.SE]

The parameters can be set in the drive mode as explained on page 7-9, but the following will occur according to *Parameter setting disable selection* (PROd of Gr.SE)

PROd setting	Function
0	Setting disabled
1	Setting enabled

7.4.5 Setting of standard parameter groups [tYP of Gr.F]

With the setting of the parameter tYP , the parameter group can be changed to a standard setting with one operation. The procedure is as follows, but cannot be set during operation. Carry this operation out after stopping the inverter.

Key operation	LED display	Operation
	0.0	Frequency display (stop status)
PRG	: Gr.U	The programming mode is activated from the drive mode. The head group name Gr.U will be displayed.
△ ▽ ENTER	: Gr.U ↓ : Gr.F	Select the group signal with the △ ▽ keys. ⇄ U ⇄ F ⇄ SE ⇄ Pr ⇄ CC ⇄ AN ⇄ U ⇄ Press the ENTER key when the desired group is displayed. The status will move to the parameter name display.
△ ▽ ENTER	: FH ↓ : tYP ↓ : 0	Select the parameter with the △ ▽ keys. Press the ENTER key when the desired parameter is displayed. 0 will be displayed regardless of the present setting.
△ ▽ ENTER	: 3 InIt	Change the data with the △ ▽ keys. 1: Standard setting for the base frequency 50Hz (Fig. 7-5) 2: Standard setting for the base frequency 60Hz (Fig. 7-5) 3: Standard default setting, all parameters will return to the standard default setting. (Fig. 7-5) 4: Clear trip, all past trip data will be erased. Press the ENTER key when the desired data is displayed. InIt will be displayed, and the drive mode will be activated.

CAUTION

1. When tYP = 1 is selected, only the maximum frequency FH ,base frequency UL , upper limit frequency UL and point 2 output frequency F-2 (page 8-11) will be changed to 50. The other data will not be changed.
2. When tYP = 2 is selected, only the parameter above will change to 60.
3. The tYP cannot be set during operation. Set again after stopping the inverter.

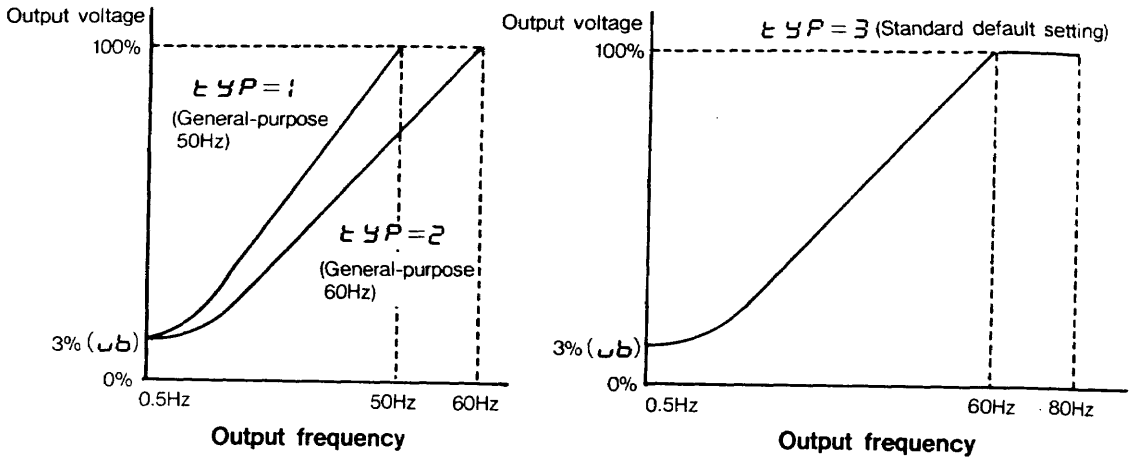


Fig. 7-5 Standard setting pattern

7.4.6 Selection of stopping method using panel

The following methods can be selected for stopping from the panel in addition to the normal decelerating stop (decelerating according to the set deceleration time) using the STOP/RESET key.

Stopping method	Operation	Operation method,setting
Coasting stop	The power supply to the motor from the inverter is stopped so the motor coasts and then stops.	Valid only on the panel controllable mode. 1.Press the PANEL/REMOTE key during panel control. 2.The drive mode will be activated and CtrL will be displayed on the LED. 3.The motor will coast after interrupting the power on the secondary side when the STOP/RESET key is pressed. (The CtrL display will be cleared and canceled when other keys are pressed, or if no keys are pressed for three seconds.)
Emergency stop (Forcible stop using the panel when not in the panel control mode)	Select from the following • Coasting stop • Decelerating stop • Emergency DC injection braking stop Parameter name (Note) EStP of Cr.Pr Coasting stop is set at ship out.	Operation with the remote control. (Normal stopping is possible in the panel control mode.) 1.Press STOP/RESET . 2.The drive mode will be activated and the LED will display EOFF . 3.Press STOP/RESET again. 4. E will be displayed on the LED and emergency stop will be activated. This mode will be canceled when a key other than STOP/RESET is pressed during the EOFF display.

(Note) EStP of Cr.Pr setting: 0 : Coasting stop
1 : Decelerating stop
2 : Emergency DC injection braking stop
When 2 is selected, set the DC injection braking time Edbt ,and DC injection braking amount dbu .

★ When EStP = 2 (emergency DC injection braking stop) is selected, and the DC injection braking is not required during normal stop, set the DC injection braking time to dbt = 0 .

CAUTION

The emergency stop command is a command to forcibly stop the operation by pressing the inverter unit keys when the command is not in the panel control mode. This cannot be prohibited by setting the command mode.
The emergency stop will regarded as a trip and will be registerd as errors.

7.4.7 Error reset

Reset the inverter that has tripped due to trouble or errors after removing the cause.
The inverter will trip again if the cause is not removed.
To reset the trip carry out one of the following.

<Reset>
(1) Turn off the power (for more than ten seconds)
(2) External signals (short circuit between control terminals RST-CC)
(3) Reset from the panel

To reset from the panel, carry out the following.

1. Press the STOP/RESET key for approximately one second. (Confirm that CLr is displayed.)
2. The inverter can be reset if the trip cause is removed by pressing the STOP/RESET key again.

Chapter 8 Various Operation Functions

This machine has various operation and adjustment functions built in. Select and set the necessary functions according to the application. The functions regarding the basic operation are explained in Chapter 7, so the other functions will be explained here.
The setting range and standard default setting for each function are as shown in Appendix 1 (page A-1). The roles, selections and setting methods of each function are explained in the section for each function.

★ The "Drive mode (Eyp) (page 7-14)", "Maximum frequency (FH) (page 8-2)" and "Motor tone selection (CFS) (page 8-23)" cannot be adjusted during operation. Adjust these after stopping the inverter.

★ Do not touch the PCB, terminal block or main circuit while the CHARGE lamp is lit as this is dangerous.

★ When driving a motor with the inverter, the variable speed range will be limited, since any general-purpose motor that can be driven by the inverter is designed as constant rating operation motor and not as variable motor. For operation over 60 Hz with a general-purpose motor, there will be limits in the bearing life, machine strength, vibration and noise, etc. Please use the inverter within the following ranges.

Table 8-1 Permissible maximum frequency

Motor frame number	Permissible maximum frequency (Hz)		
	No.of poles		
	2	4	6
63	60	120	—
71			
80			120
90			
100			
112			
132			

8.1 Setting of Voltage and Frequency Characteristics

The characteristics of the output voltage for the output frequency are set.
The standard pattern is as shown in Fig.8-1.
Adjust the "Voltage/frequency characteristic setting" for the following cases.

- To operate with a frequency higher than 80 Hz.
- To increase the start-up torque.
- To set with a base frequency other than 50 Hz or 60 Hz.

8.1.1 Maximum frequency [FH of Gr.F]

The range of the output frequency is set.
The maximum frequency (FH) can be set from 30 to 240 Hz.

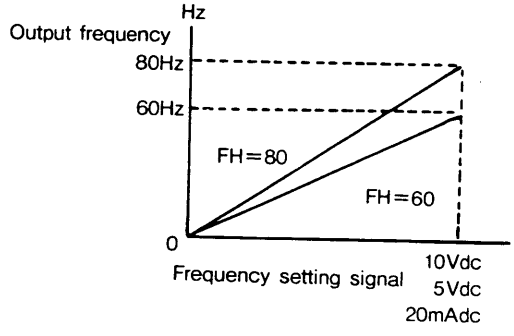


Fig. 8-1 Setting of the maximum frequency

★ The maximum frequency cannot be set during operation.
Stop the inverter to set the maximum frequency.

8.1.2 Torque boost [ub of Gr.F]

Adjust the torque boost to increase the start-up torque.
The torque boost value (ub) can be set from 0% to 30% of the rated output voltage.

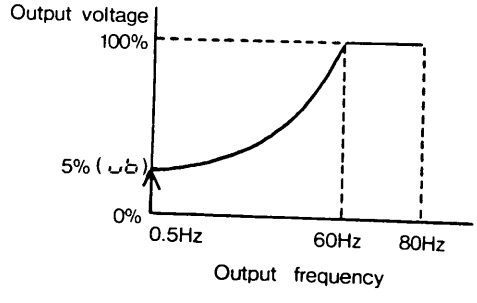


Fig. 8-2 Setting to increase the start-up torque

★ Note that an overcurrent trip may occur, or in the worst case the inverter may be damaged, if the torque boost value is too high.

8.1.3 Automatic torque boost [ub of Gr.F ; Aub, CU-0, ubH of Gr.CC]

The torque boost can be adjusted automatically.
The automatic torque boost adjusts the output voltage within the range of the slanted line shown in Fig.8-3 according to the state of the load current.

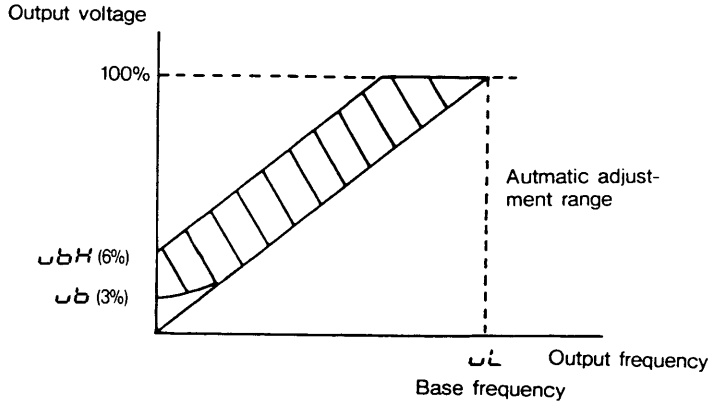


Fig. 8-3 Automatic torque boost

Aub setting	Function
0	Disengaged (OFF)
1	Engaged(ON)

(1) No-load current setting

The parameter of (CU-0 of Gr.CC) can be set at the standard value (standard default value 10%). Additional adjustment is generally not necessary. However, in the following cases, adjustment of the parameter will be effective.

* If an over-excited state occurs during low voltage output (when output frequency is low, etc.), slightly increase this parameter. On the other hand, when the torque is slightly insufficient, lower this parameter slightly. The starting point of the voltage boost can be adjusted with the torque boost setting value (ub of Gr.F). (ub of Gr.F) regulates the lower limit of the automatic torque boost functions.

* This parameter is also used as the setting data of the no-load current in the slip frequency compensation function.
When this parameter is changed, the setting data for the no-load current in slip frequency compensation function will also changed.

* The value will not always be the same as the no-load current value noted on the applicable motor data sheet or rating nameplate.

(2) Torque boost maximum value setting

The maximum value of the automatic adjustment range is set by the parameter of (ubH of Gr. CC). (Standard default value 6%)

* The minimum value of the automatic adjustment at low frequencies range is the torque boost seting value (ub of Gr.F). (Standard default value 3%).

8.1.4 Base frequency [uL of Gr.F]

Sets the frequency at which the maximum output voltage is reached.
The base frequency (uL) can be set between 25 Hz and 240 Hz.
Set the base frequency to 50 Hz when operating a 50 Hz rated motor.
The setting example of basic frequencies other than 50 Hz or 60 Hz is shown in Fig.8-4.

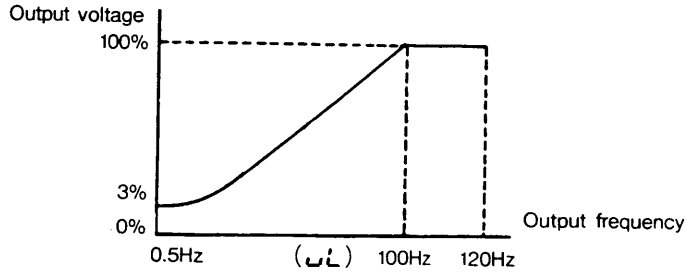


Fig. 8-4 Example of base frequency setting

8.1.5 V/f pattern [Pt of Gr.F]

A constant torque that is suitable for the conveyer and variable torque characteristic that is suitable for the energy saving operation of the fan and pump, etc.,can be selected with the V/f pattern.

Pt setting	Function
0	For constant torque characteristics
1	For variable torque characteristics (Energy saving operation is possible. The motor noise can be decreased.)

Pt = 0 : Constant torque characteristics

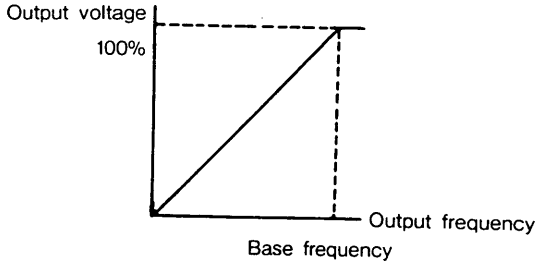


Fig. 8-5 V/f pattern setting (1)

Pt = 1 : Variable torque characteristics

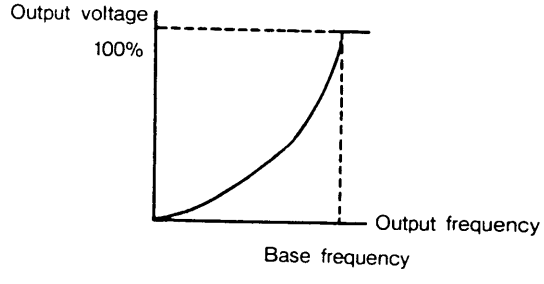


Fig. 8-6 V/f pattern setting (2)

8.2 Acceleration and Deceleration Times

This sets the "acceleration time" for reaching the maximum frequency (FH) from the output frequency 0 and the "deceleration time" for the output frequency to reach 0 from the maximum frequency (FH).

8.2.1 Acceleration/deceleration time [ACC1, dEC1, ACC2, dEC2 of G-.F]

The acceleration/deceleration times 1 and 2 (ACC1, dEC1, ACC2, dEC2) can be set between 0.1 to 3600 seconds each.

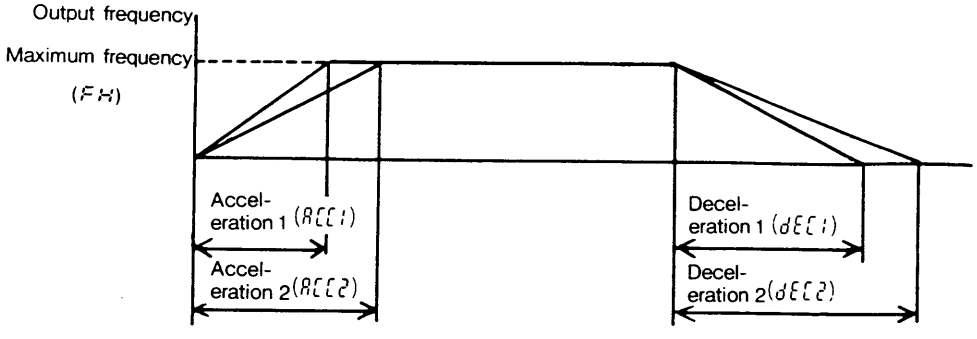


Fig. 8-7 Acceleration/deceleration time

8.2.2 Acceleration/deceleration pattern [Pt1, Pt2 of G-.F]

The acceleration/deceleration pattern (Pt1, Pt2) for the acceleration/deceleration times 1 and 2 can be selected.

Pt1 and Pt2 setting	Function
0	Straight line pattern
1	S-character 1 pattern (The motor acceleration torque gradually accelerates at a small speed in this pattern. This pattern is suitable for transfer machines.)
2	S-character 2 pattern (The motor acceleration torque gradually accelerates at a small speed in this pattern. This pattern is suitable for high speed operation.)

0 : Straight line pattern 1 : S-character 1 pattern 2 : S-character 2 pattern

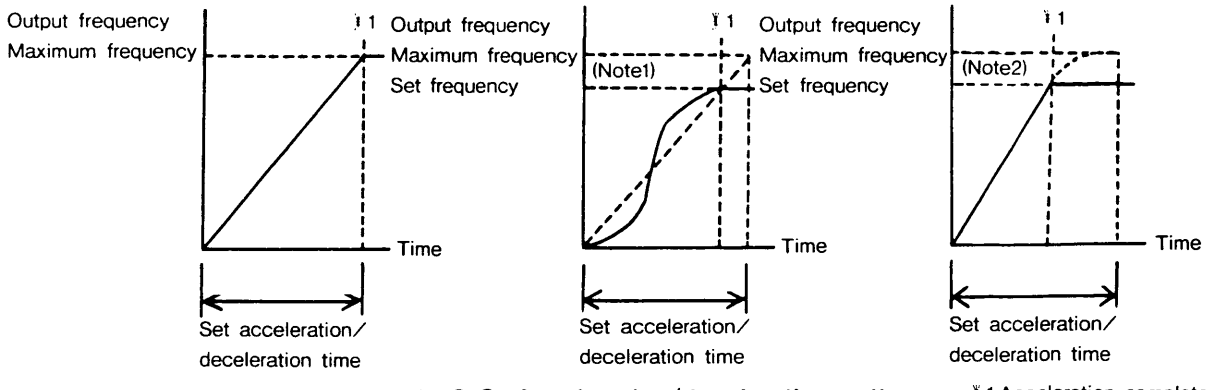
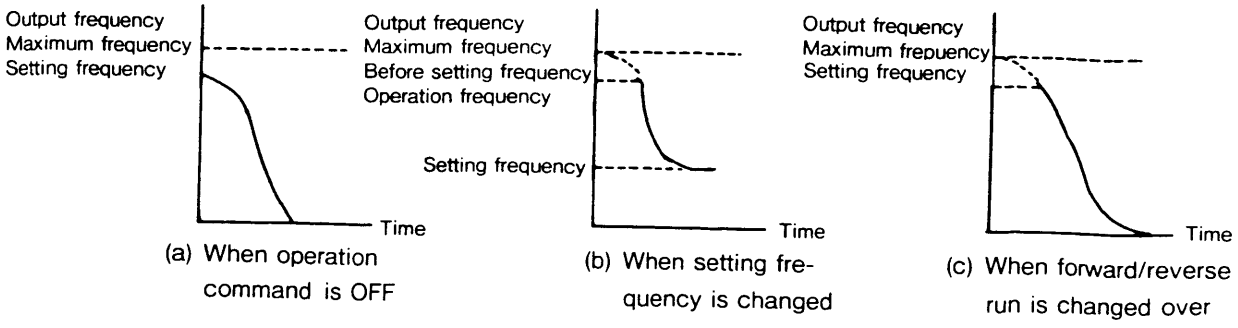


Fig. 8-8 Acceleration/deceleration pattern *1:Acceleration completed.

Note 1) The deceleration pattern for when S-character 1 pattern is set is shown in Fig.8-9.



(a) When operation command is OFF

(b) When setting frequency is changed

(c) When forward/reverse run is changed over

Fig. 8-9 S-character 1 deceleration pattern

Note 2) The S-character 2 pattern is based on the maximum frequency.

8.2.3 Selection of acceleration/deceleration 1 and 2 [Ad2, Ad2F of Gr.F]

(1) Selection of acceleration/deceleration 1 and 2

The acceleration/deceleration time 1 and 2 can be selected with the terminal input AD2 and parameter Ad2 .

RUN/STOP command	Parameter Ad2	AD2-CC	Function
Panel input	0	------	Select ACC1, dEC1.
	1	------	Select ACC2, dEC2.
	2	------	Select ACC1, dEC1. when under the Ad2F frequency. Select ACC2, dEC2. when over the Ad2F frequency.
Terminal input	0, 1	Open	Select ACC1, dEC1.
		Shorted	Select ACC2, dEC2.
	2	Open	Select ACC1, dEC1. when under the Ad2F frequency. Select ACC2, dEC2. when over the Ad2F frequency.
		Shorted	Select ACC2, dEC2. when under the Ad2F frequency. Select ACC1, dEC1. when over the Ad2F frequency.

★ Concerning RUN/STOP command selection, refer to RUN/STOP command (CMOd of Gr.St) paragraph (page 7-13).

★ When RUN/STOP command is selected to panel input, the AD2-CC terminal input is ignored. The inverter driving function is selected by parameter Ad2.

★ When RUN/STOP command is selected to terminal input, and parameter Ad2 is set to 0 or 1 , acceleration and deceleration time are selected by terminal input AD2 condition.

(2) Automatic changeover of the acceleration/deceleration time

By using a combination of the terminal input AD2 and parameter Ad2, Ad2F, the acceleration/deceleration time can be easily changed over automatically. (When Ad2 = 2) An example of automatic changeover of the acceleration/deceleration time is shown in Fig.8-10.

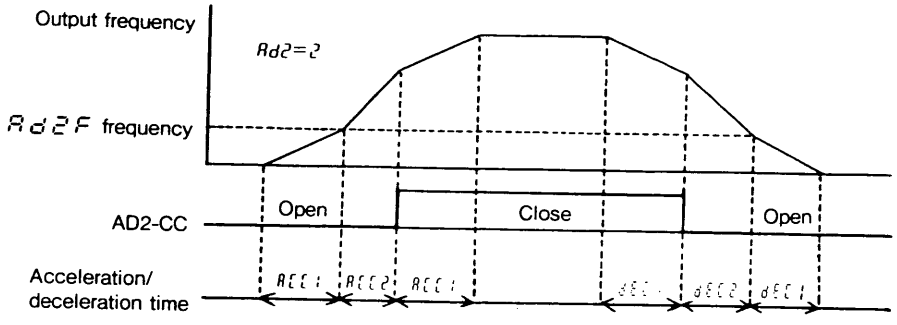


Fig. 8-10 Automatic changeover of acceleration/deceleration time

8.3 Forward Run, Reverse Run, Coasting Stop and Emergency Stop

"Forward run", "reverse run", and "coasting stop" of the motor is possible with the panel control or the remote control with external signals. During automatic operation and remote operation, "emergency stop" of the motor is possible from the panel.
Install an emergency stop circuit for unexpexted failures.
Also, when the inverter protective circuit is engaged or emergency stop is selected, the motor will coast to stop. In this case, a mechanical brake is needed to stop the motor.

8.3.1 Operation with the panel [Fr of Gr.F]

(1) "Forward run" and "reverse run" (Fr)

1) Select "forward run" and "reverse run" (Fr). (This can be changed during operation.)

Setting of Fr	Function
0	Reverse run
1	Forward run

2) The motor will "operate" with the RUN key (the "PANEL CONTROL" lamp will flicker).
The motor will decelerating stop with the STOP/RESET key.

★ Confirm that the "PANEL CONTROL" lamp is lit before operating.

(2) Coasting stop, emergency stop

Refer to section 7.4.6 (page 7-16).

★ Emergency stop is not possible in the panel control mode. However, emergency stop is possible using the EX terminal while in terminal input control. The inverter will decelerating stop. Emergency stop is possible from the panel in modes other than the panel control mode (the "PANEL CONTROL" lamp is not lit) such as automatic operation and remote operation.

★ Short ST-CC. If ST -CC is left open, the output will be 0 and the motor will coast to stop. OFF will be displayed on the monitor display.

8.3.2 Operation with external signals [ESEP, Edbt of Cr, Pr]

(1) Forward run, reverse run and coasting stop

Wire with the following procedure.

[Wiring procedure]

1) Remove the jumper that is connected between ST and CC.

★ Forward run and reverse run is possible even with ST-CC shorted. However, coasting stop will not be possible.

2) Install the "switches" to the control circuit terminal block as shown in Fig. 8-11.

3) Input the frequency setting signal in the terminal.

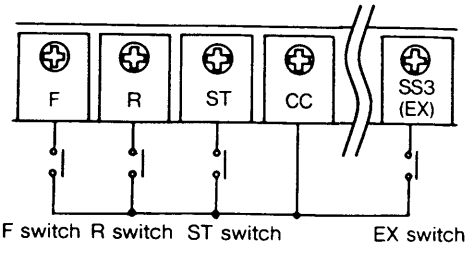


Fig. 8-11 Installation of forward/reverse run switches

4) An example of forward/reverse run is shown in Fig.8-12.

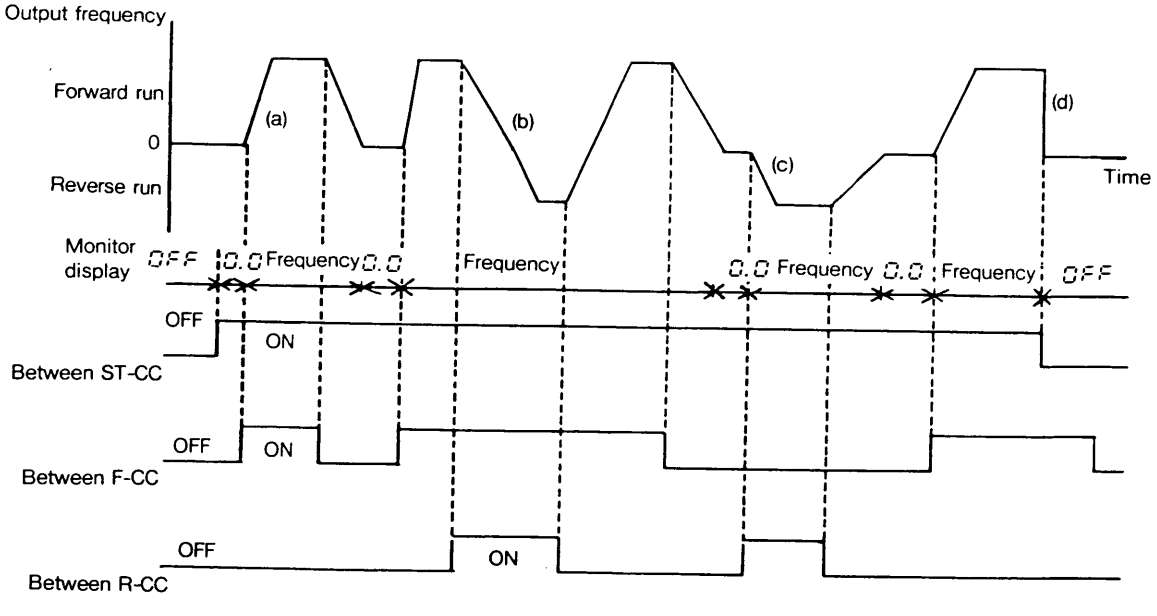


Fig. 8-12 Example of forward/reverse run

Table 8-2 Terminal input and operations

Terminal			Operation
ST	F	R	
OFF	ON/OFF	ON/OFF	Output OFF, coasting stop
ON	OFF	OFF	Stop
ON	OFF	ON	Reverse run
ON	ON	OFF	Forward run
ON	ON	ON	Reverse run

Operate with the following procedure.

[**Operation procedure and explanation of operation**]

1) Confirm that the "PANEL CONTROL" lamp is not lit. (Turn OFF the "PANEL CONTROL" lamp by pressing the PANEL/REMOTE key.)
2) Turn the ST switch ON.
3) The monitor display will turn from OFF to 0.0 .
4) Turn the F switch ON.
5) "Forward run" will be activated as shown in Fig.8-12(a).
6) The motor will "reverse run" in (b) as both the F switch and R switch are ON.
7) The motor will "reverse run" in (c).
8) When the ST switch is turned OFF, the motor will "coasting stop" as shown in (d).
9) "Coasting stop" will be activated when the input power switch of MCCB is turned OFF with the ST switch and F switch ON.

> Do not carry out step 9) unless it is an "emergency". Avoid operating and stopping by turning the input power switch of MCCB ON/OFF with the ST switch and F switch ON.

★ The procedure above is for the Acc./Dec. 1 operation. To operate with Acc./Dec. 2, short AD2-CC.

(2) Emergency stop

Wire and operate with the following procedure.

[**Operation procedure and explanation of operation**]

1) Connect an "emergency stop switch" between EX-CC on the control circuit terminal block as shown in Fig. 8-10.
2) Confirm with the operation panel that the input terminal selection (Itb of Cr.St) is set to Itb = 2 or 3 . (the standard default value: Itb=0)
   Refer to section 9.2.1 (page 9-1) for how to set Itb .
3) The type of emergency stop (ESTP of Cr.Pr) can be selected with the operation panel. Refer to Table 8-3.
4) When the "EX switch" is turned ON, emergency stop will be activated according to the type selected in ESTP , the inverter will trip (E will flicker), and the FL relay will operate.

Table 8-3 Types of emergency stop and operations

Setting of ESTP	Function
0 1 2	Coast to stop. (Immediately E trip.) E trip after deceleration stop. After DC injection braking stop with the time set in Edbt and voltage set in dbv , the inverter will E trip.

When setting input terminal selection (ITb of Cr.St)=2 or 3, and the EX switch is activated, the inverter will stop according to the selection (ESTP of Cr.Pr).
It is not required to be in terminal input mode.

8.4 Frequency Setting Signals (when set with external signals)

The "output frequency" is controlled externally using the PP, RR, IV and CC terminals on the control circuit terminal block shown in Fig. 8-13.

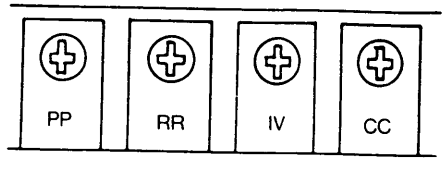


Fig. 8-13 Frequency setting signal terminals

8.4.1 Types of frequency setting signals

The frequency setting signals are changed over with the "DIP switch SW1-1 and SW1-2" on the control PCB.
The DIP switch positions and combinations of parameters (IvIn : *IV input*, rrCC : *RR terminal input* prioritization) and each function of the parameters are shown in Fig.8-14.

8.4.2 RR terminal input priority [rrCC, IvIn of Cr.St]

The frequency setting signals input from the terminal block can be changed over.

Setting of rrCC	Setting of IvIn	Function
0	0	Only RR terminal is vaid
0	1	IV terminal prioritized (combination with RR terminal)
1	0	Only RR terminal is valid
1	1	RR terminal prioritized (combination with IV terminal)

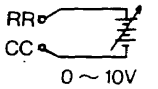
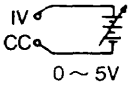
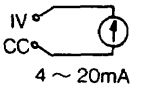
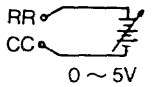
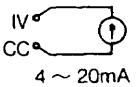
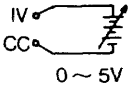
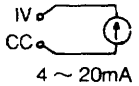
	RR terminal input	IV terminal input	SW1-1	SW1-2	rrCC	IuIn	Function
0	——	——	10V	I	0	0	Standard default status
1		Not used	10V	I or V	0 or 1	0	Runs with RR terminal input (0~10V).
						1	Always set IV terminal input to 0 when IuIn=1
2	or 			V	0	1	Runs with IV terminal input (0~5V). Runs with RR terminal input (0~10V) when IV terminal input is 0.
					1		Runs with RR terminal input (0~10V). Runs with IV terminal input (0~5V) when RR terminal input is 0.
3				I	0	1	Runs with IV terminal input (4~20mA). Runs with RR terminal input (0~10V) when IV terminal input is 0.
					1		Runs with RR terminal input (0~10V). Runs with IV terminal input (4~20mA) when RR terminal input is 0.
4		Not used	5V	I or V	0 or 1	0	Runs with RRterminal input (0~5V)
						1	Always set IV terminal input to 0 when IuIn=1
5				V	0	1	Runs with IV terminal input (0~5V). Runs with RR terminal input (0~5V) when IV terminal input is 0.
					1		Runs with RR terminal input (0~5V). Runs with IV terminal input (0~5V) when RR terminal input is 0.
6				I	0	1	Runs with IV terminal input (4~20mA). Runs with RR terminal input (0~5V) when IV terminal input is 0.
					1		Runs with RR terminal input (0~5V). Runs with IV terminal input (4~20mA) when RR terminal input is 0.
7	Not used		10V or 5V	V	0	1	Runs with IV terminal input (0~5V).
					1		Always set RR terminal input to 0 within rrCC=1
8				I	0	1	Runs with IV terminal input (4~20mA).
					1		Always set RR terminal input to 0 within rrCC=1

Fig.8-14 Changeover of frequency setting signals and each function

8.4.3 Frequency setting signal [rr-b, rr-G of Gr.AN
P1, F-P1, P2, F-P2 of Gr.St]

(1) RR terminal frequency setting signal characteristics

The characteristics of the frequency signals input to the RR terminal and output frequency signals are as shown in the figure below.

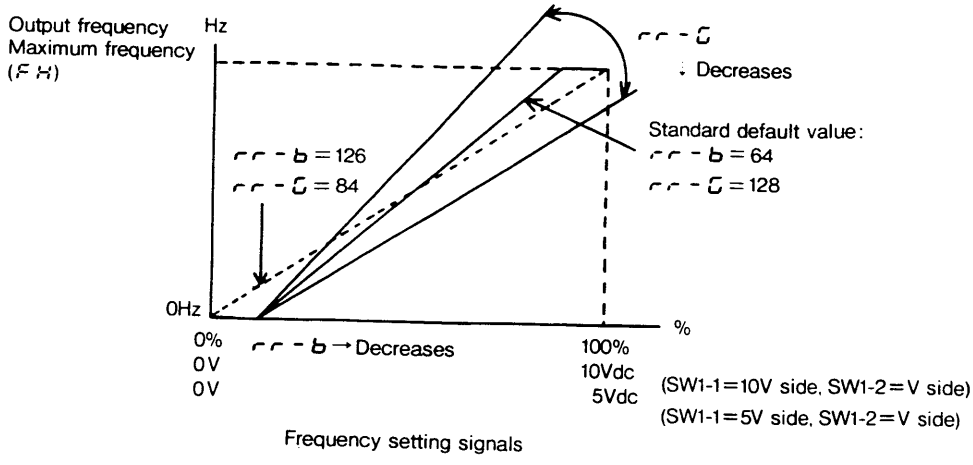


Fig. 8-15 Frequency setting signal characteristics (RR terminal)

★ Adjustment of the RR analog terminal input

Adjustment of the RR input terminal bias (rr-b of Gr.AN)

At the standard default setting, the adjustment has been given an allowance to output the inverter output for the first time with a slight voltage applied on the RR terminal.

To decrease this allowance, increase the rr-b value. If the value is too large, the inverter output will be output even when 0V is input.

Adjustment of the RR input terminal gain (rr-G of Gr.AN)

At the standard default setting, the maximum frequency will be reached when the RR input is slightly below the upper limit voltage (this can be set to 10V/5V with the DIP switch).

To set so that the maximum frequency is reached with the upper limit voltage, lower the rr-G value. However, if this is lowered too far, the maximum frequency will not be output even when the upper limit voltage is input.

* To adjust the RR input terminal so that 0 Volts corresponds to an inverter output of 0 Hz, set rr-b =126 (a change of one corresponds to about 0.01 V.)
To adjust the RR input terminal so that the maximum input voltage corresponds to the maximum inverter output frequency, set rr-G =84 (a change of one corresponds to about 0.03 V).

* To adjust, adjust the rr-b first, and then adjust rr-G .

> ***NOTE***
> *To rr-G function is affected by changes in the rr-b function. If rr-b is increased, the value of rr-G should be decreased to compensate.*

(2) IV terminal frequency setting signal characteristics (bias and gain)

The charcteristics of the frequency setting signals which are input to the IV terminal can be adjusted by setting the (Iu In of Gr.St) parameter to 1 ("Engaged"). Then the characteristics are set with two points.

- The point 1 setting signal (P1) can be set between 0 and 100%.
- The point 1 output frequency (F-P1) can be set between 0 and the maximum frequency.
- The point 2 setting signal (P2) can be set between 0 and 100%.
- The point 2 output frequency (F-P2) can be set between 0 and the maximum frequency.

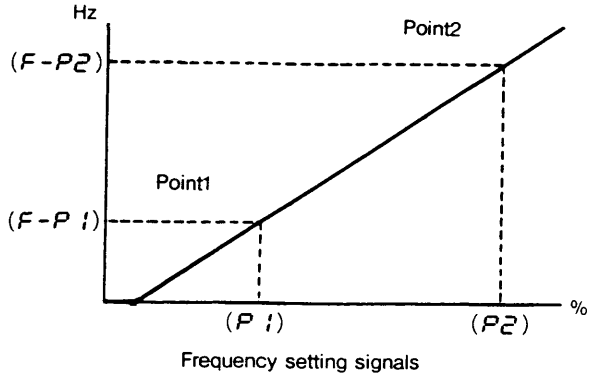


Fig. 8-16 Frequency setting signal characteristics (IV terminal)

★ The following setting is used to use a 0~50Hz output frequency characteristics for a 4~20 mAdc input signal. This can be set by selecting in the drive mode selection (typ).

Input signal point 1 (P1) : 20%
Point 1 output frequency (F-P1) : 0 Hz
Input signal point 2 (P2) : 100%
Point 2 output frequency (F-P2) : 50 Hz

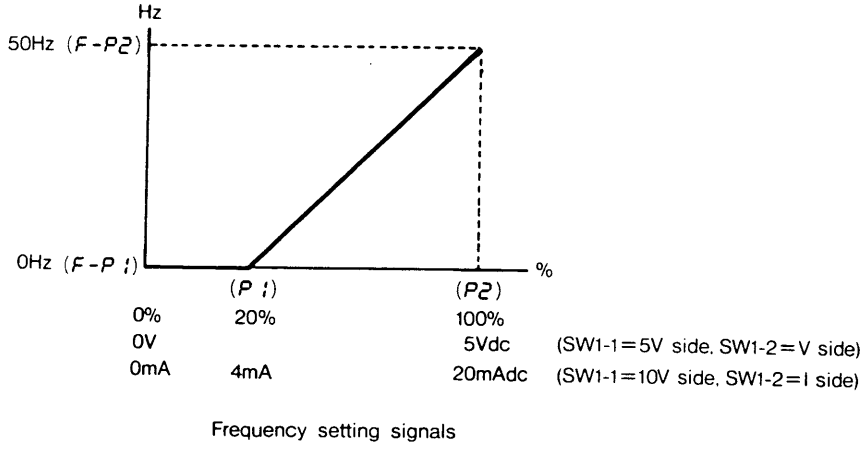


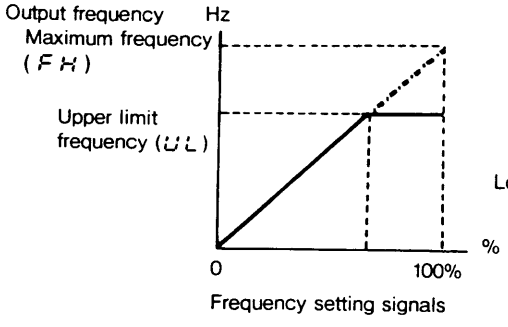
Fig. 8-17 Frequency setting signal characteristics (50Hz)

★ Separate point 1 and 2 by at least 10%.
The Err.1 error will be displayed when point 1 and 2 are closer than 10%.

8.5 Upper Limit Frequency and Lower Limit Frequency

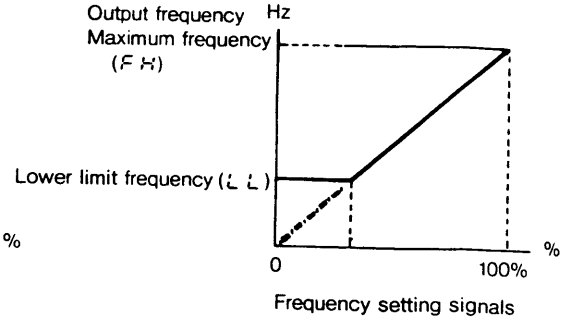
[UL, LL of Gr.F]

The "upper limit frequency (UL)" for determining the upper limit of the output frequency and the "lower limit frequency (LL)" for determining the lower limit of the output frequency are set.
The upper limit frequency can be set between 0 and the maximum frequency.
The lower limit frequency can be set between 0 and the upper limit frequency.



★ Frequencies exceeding the UL will not be output.

Fig.8-18 Upper limit frequencies



★ Frequencies below the LL will not be output.

Fig.8-19 Lower limit frequencies

★ The operation frequencies set from the panel can only be set within the upper limit frequency and lower limit frequency range.

An error (HI ⟷ 50.0 altenate display) will occur when the operation frequency is set over 50 Hz from the panel in the state of that the upper limit frequency is set to 50 Hz.

8.6 Jogging Run [JOG, JSEP of Gr.SE]

The "jogging run" is used when the motor is slowly operated.
When the jogging run signal is input, the jogging run frequency will be output immediately regardless of the set acceleration time.
The jogging run frequency (JOG) can be set between 0 and 20 Hz.
When the jogging run frequency is set to a value other than 0, selection of "the jogging stop pattern" (JSEP) is enabled.

Setting of JSEP	Function
0	Decelerating stop (decelerating stop according to the deceleration pattern set in dEC 1)
1	Coasting stop
2	DC injection braking stop (stops according to the DC injection braking patern set in dbF, dbu, dbt)

8.6.1 Operation with the panel

Refer to section 7.3.4 (page 7-12) for the operation procedure.

8.6.2 Operation with external signals

Wire and operate with the following procedure.

[Operation procedure and explanation of operation]

1) Connect the "JOG switch" between JOG and CC on the control circuit terminal block as shown in fig. 8-20.
2) Confirm with the operation panel that the input terminal selection (I_{tb} of $Gr.St$) is set to $I_{tb} = 1$ or 3. (the standard default value: $I_{tb} = 0$)
   Refer to section 9.2.1 (page 9-1) for how to set I_{tb} .
3) Confirm that the "PANEL CONTROL" lamp is not lit. (Turn the "PANEL CONTROL" lamp OFF by pressing the PANEL/REMOTE key.)
4) Turn the "JOG switch" ON and the motor will rotate at the jogging run frequency while the "F switch" or "R switch" is ON.

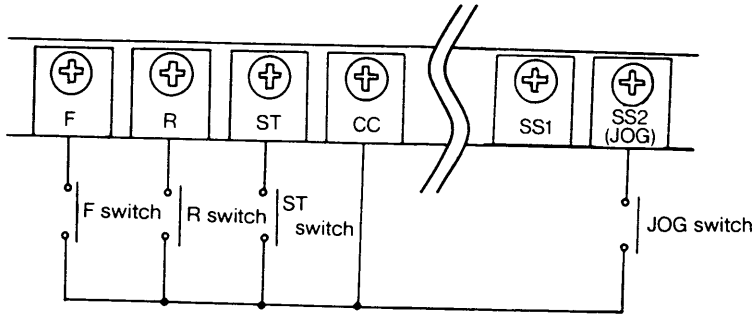
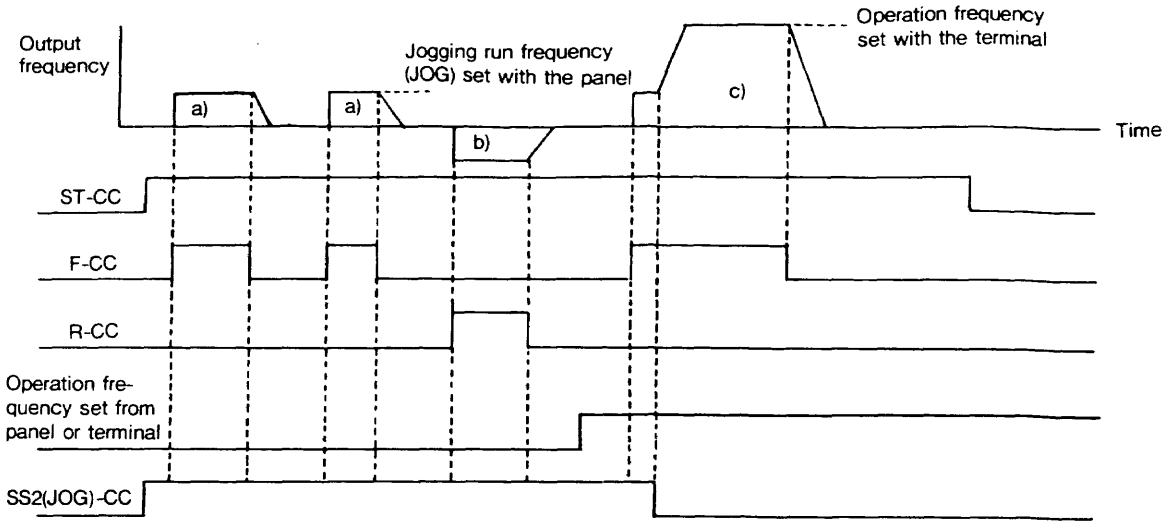


Fig. 8-20 Connection of Jog switch

★ The "JOG switch" functions as the jog mode selector.
Carry out jogging run with the "F switch" or "R switch".

5) An example of operation with the "JOG switch" is shown in Fig. 8-21.



a) : Forward jogging run
b) : Reverse jogging run
c) : When the operation frequency is set from the terminal or panel in advance, a test run will be carried out with the set frequency when JOG-CC is opened.

★ "Jogging run" will not be carried out even when the "JOG switch" is turned ON during operation.

Fig. 8-21 Example of operation with JOG switch

Table 8-4 Terminal input and operation

Terminal				Operation
F	R	ST	JOG	
OFF	OFF	ON	ON	Jogging stop
OFF	ON	ON	ON	Reverse jogging run
ON	OFF	ON	ON	Forward jogging run
ON	ON	ON	ON	Reverse jogging run

8.7 Multispeed Run [SR.n SR1~SR7 of GR.SE]

7-speed run is possible. (8-speed run is possible when the operation frequency is included.)
First set the parameter (SR.n of GR.SE) to 1 ("multispeed run").
With this, each speed (SR1~SR7) can be set between the "lower limit frequency (LL)" and "upper limit frequency (UL)".
However, panel control is not possible in this mode.

Wire and operate with the following procedure.

[Operation procedure and explanation of operation]

1) Connect the "SS1, SS2 and SS3 switches" between SS1, SS2, SS3 and CC on the control circuit terminal block respectively as shown in Fig. 8-23.
2) Confirm with the operation panel that the input terminal selection (ITB of GR.SE) is set to ITB = 0. (Standard default value: ITB = 0)
   Refer to section 9.2.1 (page 9-1) for how to set ITB .
3) Multispeed run is possible by turning the SS1, SS2 and SS3 switches ON and OFF.

SS1-CC	SS2-CC	SS3-CC	Selected operation frequency
OFF	OFF	OFF	Operation frequency set from terminal or panel
ON	OFF	OFF	1st speed run operation frequency
OFF	ON	OFF	2nd speed run operation frequency
ON	ON	OFF	3rd speed run operation frequency
OFF	OFF	ON	4th speed run operation frequency
ON	OFF	ON	5th speed run operation frequency
OFF	ON	ON	6th speed run operation frequency
ON	ON	ON	7th speed run operation frequency

4) An example of multispeed run is shown in Fig. 8-22.

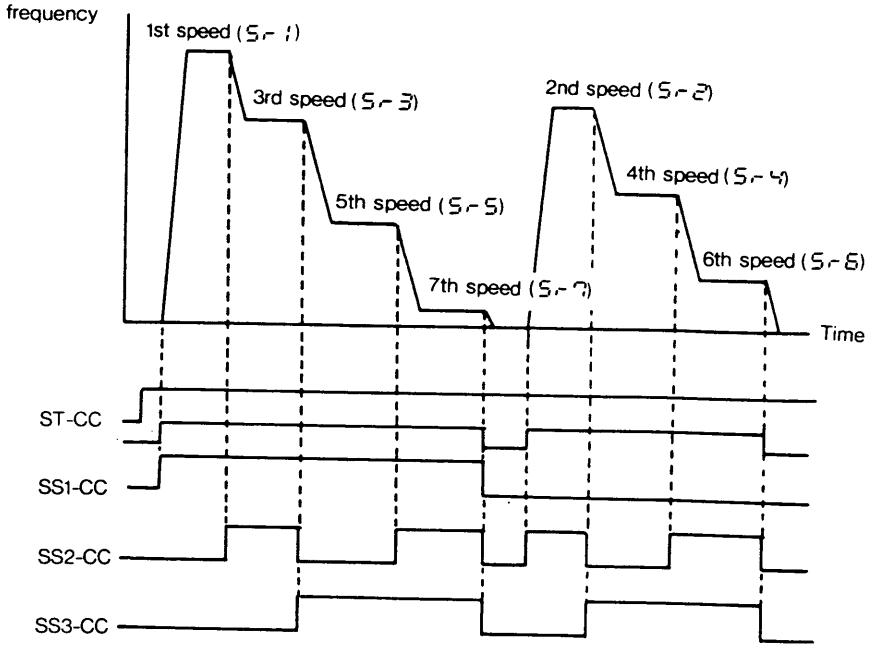


Fig. 8-22 Example of multispeed run (7-speed)

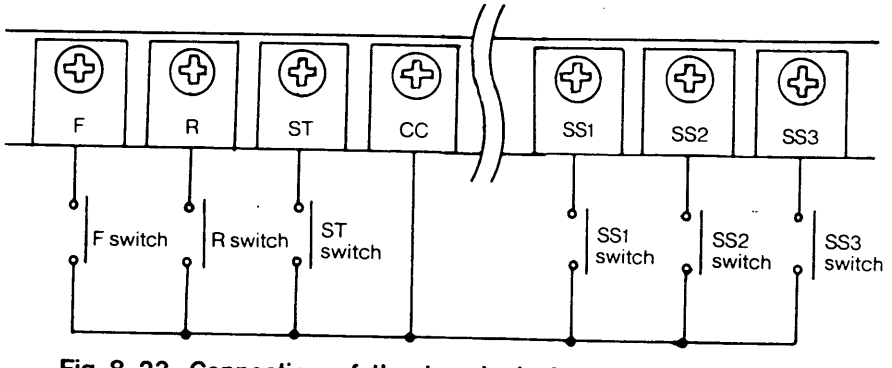


Fig. 8-23 Connection of the terminals for multispeed run signals

8.8 Frequency Jump [Fu.n, Fu1, bFu1~Fu3, bFu3 of Gr.CC]

The frequency jump is used for operating while avoiding the overload machine system resonation points.

The frequency jump jumps the frequency setting signal, and avoids constant run in the jump frequency range.

During acceleration and deceleration the output frequency constantly changes according to the acceleration/deceleration ratio.

First, by setting the parameter (Fu.n of Gr.CC) to 1 ("jump function engaged"), three jump points can be set.

The jump frequency 1 to 3 (Fu1, Fu2, Fu3) can be set between 0 and the maximum frequency (Hz).

The jump width 1 to 3 (bFu1, bFu2, bFu3) can be set between 0 and ±30 Hz in 0.1 Hz units.

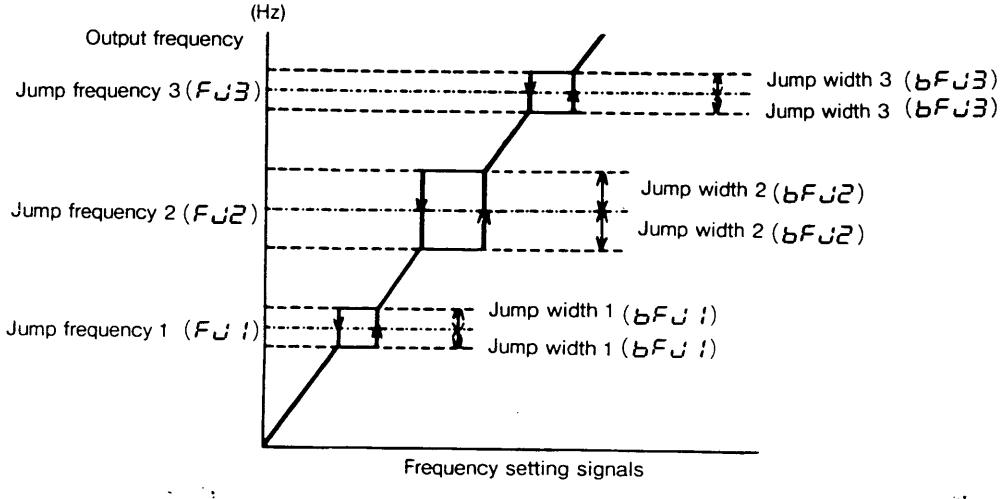


Fig. 8-24 Frequency jump

★ Frequency jump cannot be applied during acceleration and deceleration.

8. 9 Start-up Frequency [F-St of Gr.CC]

The motor start-up torque characteristics, with the torque boost, can be adjusted to a suitable setting. The start-up frequency can be set between 0.5 and 10 Hz.
The set start-up frequency is output instantly.

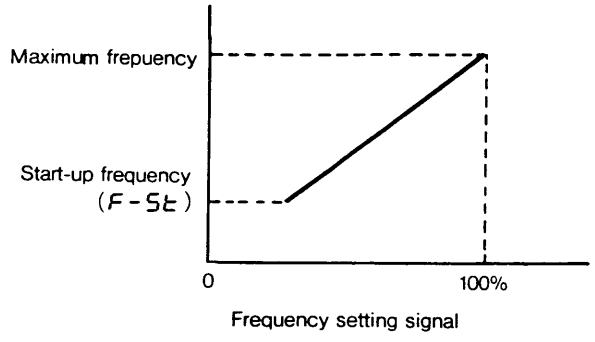


Fig. 8-25 Start-up frequency

8.10 Operation Starting Frequency [Frun, FHYS of Gr.CC]

The inverter operation and stopping can be controlled by using only the frequency setting signals. By setting the operation starting frequency (Frun) and the hysteresis width (FHYS), the inverter will start running when the frequency setting signal is above the B point in Fig. 8-26, and stop when below the A point.

★ The inverter can be stopped when, for example, the frequency setting signal drops below 30 Hz during automatically operating with the room temperature signal in a ventilation fan.

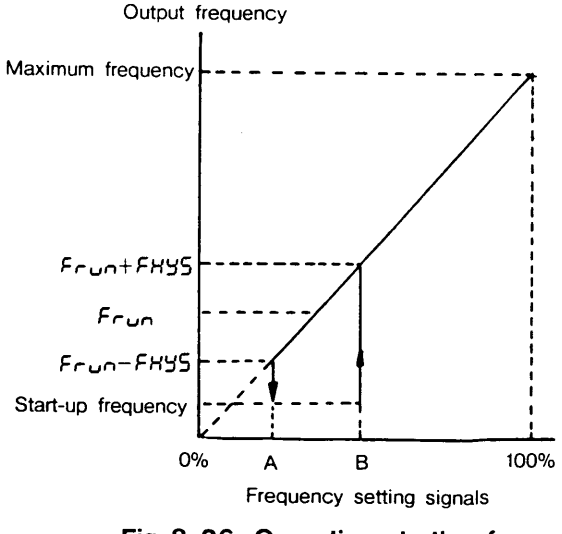


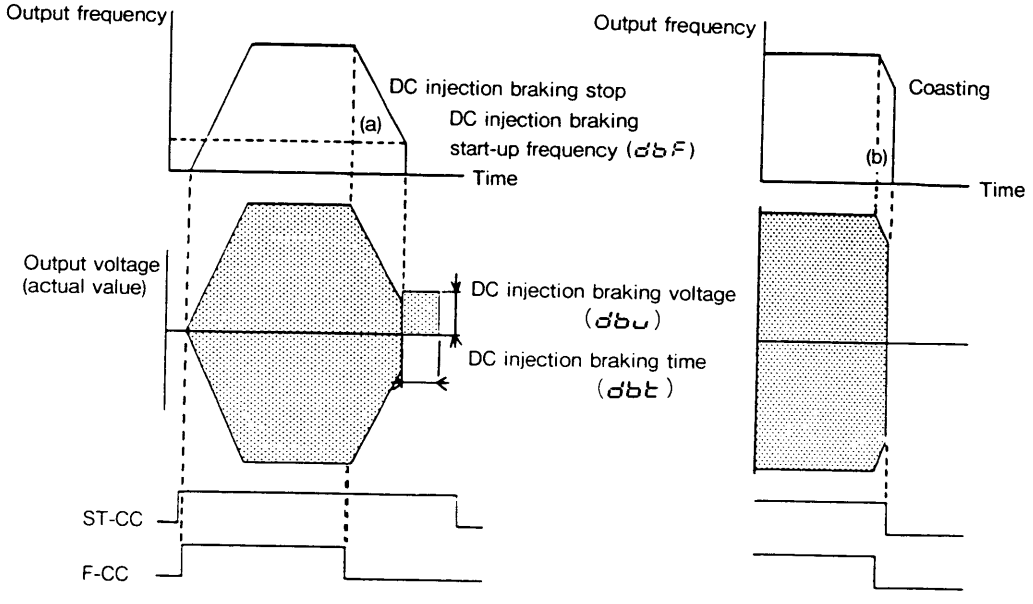
Fig. 8-26 Operation starting frequency

8.11 DC Injection Braking [dbF, dbu, dbt of Gr.Pr]

The inverter can be stopped with "DC injection braking" during decelerating stop.
The LED will display db when the "DC injection braking" function is operating.
Simple positioning is possible with the "DC injection braking" function.

The DC injection braking start-up frequency (dbF) can be set between 0 to 10 Hz. If dbF is set to a value other than 0, the DC injection braking voltage (dbu) can be set between 0 and 20%, and the DC injection braking time (dbt) can be set between 0 and 5 seconds.

An example of "DC injection braking" operation is shown in Fig. 8-27.
If the F switch is turned OFF, the motor will decelerate with the regenerative braking according to the deceleration time set with dEC , and the "DC injection braking" will be activated with the DC injection braking start-up frequency set with dbF . Then the motor will stop.



(a) : DC injection braking stop
If the dbu setting is 0 , "Coasting stop" will be executed after dbF .
(b) : "Coasting stop" will be executed if the ST switch is turned OFF before the DC injection braking start-up.

Fig. 8-27 Example of DC injection braking operation

★ The DC injection braking is a function that forcibly stops the motor so do not set the DC injection braking voltage (dbu) or DC injection braking time (dbt) higher than necessary.

If the DC injection braking voltage (dbu) is set too high, an overcurrent trip or other trip may result.

Note

When reference frequency is decreased and the output frequency is brought below the start-up frequency, the DC injection braking function will activate.

8.12 Regenerative Discharge Brake [Pb, OPSS of Gr.Pr]

The regenerative discharge brake can be selected when carrying out overvoltage trip during rapid deceleration and decelerating stop.

Setting of Pb	Function
0	No regenerative discharge brake
1	Regenerative discharge brake, no braking resistor overload detection (when the standard resistor is not used) Carry out overload protection with the overload relay.
2	Regenerative discharge brake, braking resistor overload detection (when the standard resistor is used)

Setting of OPSS	Function
0	Overvoltage stall operations (This setting will be ignored when Pb = 1, 2)
1	No overvoltage stall operations

(Note) 1. The overvoltage stall operation refers to when the DC voltage rises during deceleration, the deceleration rate is automatically controlled to prevent overvoltage tripping. Thus, the deceleration time may be longer than the set time.

2. Use the braking resistor prepared as an option with the following conditions.(0.4 ~3.7 kW)

   Regenerative time (once) : Within 5 seconds
   Usage rate : 3% ED or less

   When these conditions are exceeded, always connect the necessaary heat capacity braking resistor between PA-PB.
   (0.1 kW, 0.2 kW unit do not have a regenarative discharge brake circuit built in.)

   When using a braking resistor other than prepared as an option, be sure to select a "non-inductive" resistor.

If a resistor other than a "non-inductive" resistor is used, extremely high surge voltages may occur, resulting in inverter damage.

★ The resistor will heat up if high operations are repeated (approx. 150°C). Take plenty of caution to the installation place.

★ If the fault mode occurs due to an abnormally high power voltage or element error in the inverter and a current flows constantly to the resistor, the thermal fuse in the braking resistor will blow. In this case, a small amount of smoke rises from the resistor and the surface temperature will be extremely high. Thus do not install the resistor on a inflammable such as wood.

CAUTION

When using a braking resistor other than the option, install an MC or MCCB with release to the inverter power side. Set this up so that the power circuit will open with the operation of the FL in the inverter or the overload relay installed externally.

8.13 Setting and Display of Universal Unit Multiplication Factor [dSP2 of Gr.AN]

The monitor frequency display can be changed to the number of rotation or speed display.
The frequency setting from the panel can be changed to the number of rotation or speed setting.
Set the frequency display scale with the universal unit multiplication factor (dSP2) .
The universal unit multiplication factor (dSP2) can be set to 0 (OFF) and between 0.01 and 200.

"Monitor display" = "universal unit multiplication factor" × "output frequency"
The "monitor display" is from 0.00 to 9999.

[Setting example]

1) Setting and display of number of rotations
When using the 4P motor, if the "universal unit multiplication factor (dSP2) is set to 30, 0~1800 (min^{-1}) with the operation frequency between 0 Hz and 60 Hz will be displayed. Set the frequency setting from the panel with the number of rotations (0~1800).

2) Setting and display of line speed
When the relation between output frequency and line speed rate is 0.1, and the universal unit multiplication factor (dSP2) is set to 0.1, then line speed 0~6 (m/s) will be displayed corresponding to output frequency 0~60 Hz. Set the frequency setting from the panel with the line sqeed.

★ The frequency setting can also be input with universal units. All data regarding the frequencies (maximum frequency FH etc.) will become universal unit multiplication factor.

8.14 PWM Carrier Frequency Changeover [CF, CFS of Gr.CC]

The acoustic motor noise tone can be switched by changing the PWM carrier frequency. Changing the PWM carrier frequency is effective when a resonation occurs between the load machine motor fan cover.
The PWM carrier frequency (in low range) (CF) can be set between 0.5 and 3 kHz (For the VF-SXN, 5 to 15 kHz).
To reduce the annoying acoustic motor noise select
1 : Integral sound
in the motor tone selection (CFS) . The audible sounds will be reduced.

Setting of CFS	Function
0	Monotonous tone
1	Integral tone

★ For the VF-SXN, when setting the PWM carrier frequency (CF) to 12kHz or higher, it is necessary to derate the rated current according to the inverter type and application.

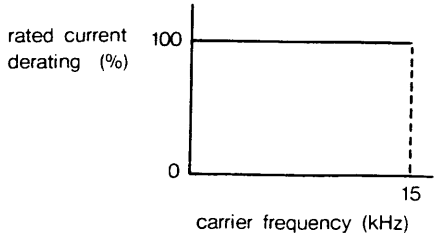


Fig. A

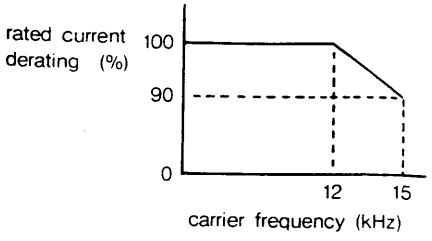


Fig. B

Inverter type	Ambient temperature	Figure
VFSXN-2075, 2150	40°C or less	A
	From 40°C to 50°C (Note)	B
VFSXN-2001~2055, 2110	50°C or less (Note)	A

8.15 Output Voltage Reduction, Power Voltage Compensation [POUt, PRdJ of Gr.CC]

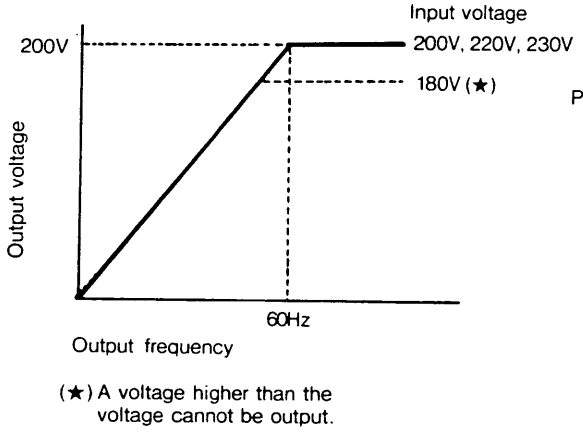
The V/f characteristics can be set for the motor with a lower rated voltage by using the output voltage reduction function. When the power voltage compensation function is used, the output V/f characteristics are automatically compensated to be constant even when the power voltage changes, so the best V/f control is possible at all times. (However, an output voltage value compensation over the power voltage value is not possible.) This is suitable for machinery requiring a large start-up torque.

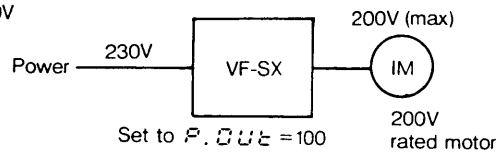
(1) Output voltage reduction function

The output voltage can be reduced according to the input voltage.
The output voltage can be set between 0 and 100%.

(2) Power voltage compensation function

If the parameter (PRdJ) is set to 1 ("compensated") the output voltage absolute value can be set between 0 and 120% of 200V (100% = 200V)
The voltage value should be 200V at 100% and set with (POUt) .
The rated output voltage can be set according to the motor rated voltage.
Even when moving into areas with differing input voltages, the V/f characteristics do not need to be readjusted or the motor rated voltage changed.





Ex.) The POUt value is 115% for a 230V rated moter. This will be 110% for a 220V rated moter.

Fig. 8-28 Example of output voltage adjustment

8.16 Slip Frequency Compensation [SFC, CU-0, SFr of Gr.CC]

The motor speed is controlled to a constant speed according to the fluctuation of the load.

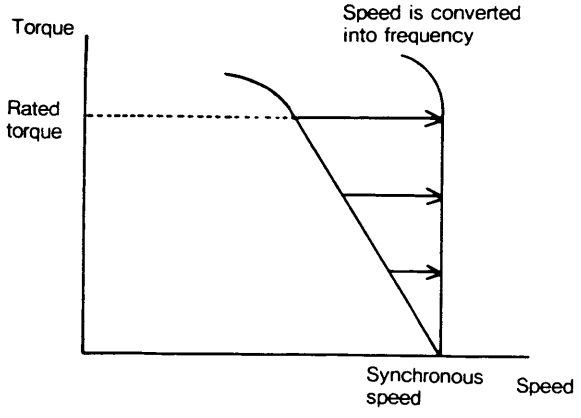


Fig. 8-29 Slip Frequency Compensation

SFC Setting	Function
0	No compensated
1	Compensate

(1) No-load current setting

The parameter of (CU-0 of Gr.CC) can be set at the standard value (standard default value 10%). Additional adjustment is generally not necessary. However, in the following cases, adjustment of the parameter will be effective.

* This parameter will affect the slip compensation starting point.
  When the value of (CU-0 of Gr.CC) is increased, the value of the output torque when compensation begins will increase slightly.
* This parameter is also used as the setting data of the no-load current in the automatic torque boost function.
  When this parameter is changed, the setting data for the no-load current in automatic torque boost function will also change.

* The value will not always be the same as the no-load current value noted on the applicable motor data sheet or rating nameplate.

(2) Motor rating slip frequency

The rated slip frequency is set. (Standard default value 3.0 Hz).
Set this value while referring to the data sheet for the applicable motor or the rating nameplate.
(Setting example) When 4P-3.7 kW standard motor, 60 Hz during operation, rated speed 1710 min^{-1}.

$$\text{Rated slip frequency} = \frac{\text{Synchronous speed} - \text{Rated speed}}{\text{Synchronous speed}} \times \text{Output frequency}$$

$$= \frac{1800 - 1710}{1800} \times 60 = 3 \text{ Hz} \leftarrow \text{Set data}$$

$$\text{Synchronous speed} = \frac{120 \times f}{P} = \frac{120 \times 60}{4} = 1800 \text{ min}^{-1}$$

f:Frequency, P:No. of motor pole

Chapter 9 Signals and Connection for Automatic Operation Control

9.1 Connection of Signals

Each operation was explained in Chapter 8. Automatic operation and energy saving are possible by using these functions effectively and using the inverter with a combination of other controllers. The inverter has various signals for automatic operation and consideration has been made for the most suitable operation.
The signals and functions are explained below.
The "Toshiba EX series general-purpose programmable controllers" are suitable for control devices.

9.1.1 Operation signals

In Chapter 8, the wirring examples using switches at each control terminal were explained. The F, R, ST, SS1, SS2 (JOG), SS3 (EX) and RST signals can also be controlled with the programmable controller, etc.'s, "transistor output (contactless switch)". Use a transistor that operates at 24Vdc, 5mA.
An example of wiring using transistor output is shown in Fig. 9-1.

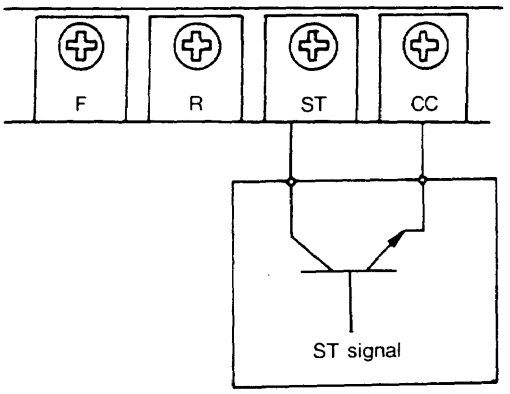


Fig. 9-1 Example of wiring using transistor output

9.2 Terminal Selection

The functions of the input terminal and output terminal can be selected.

9.2.1 Input terminal [*ttb* of *Cn.St*]

1) The functions of the control terminals SS1, SS2/JOG and SS3/EX can be selected.

Setting of *ttb*	Function
0	SS2, SS3 (for 7-speed run)
1	JOG, SS3, (for jogging run and 3-speed run)
2	SS2, EX (for 3-speed run and external emergency stop)
3	JOG, EX (for jogging run and external emergency stop)

2) The ON and OFF of the SS1, SS2/JOG and SS3/EX switches and the selected operation frequencies are as shown below.

Table 9-1 Selection of input terminals and operation frequencies

Input terminal selection	Terminal			Selected operation frequency
	SS1	SS2/JOG	SS3/EX	
0: SS2 SS3	OFF	OFF	OFF	Operation ftequency set from terminal
	ON	OFF	OFF	1st speed run operation frequency
	OFF	ON	OFF	2nd speed run operation frequency
	ON	ON	OFF	3rd speed run operation frequency
	OFF	OFF	ON	4th speed run operation frequency
	ON	OFF	ON	5th speed run operation frequency
	OFF	ON	ON	6th speed run operation frequency
	ON	ON	ON	7th speed run operation frequency
1: JOG SS3	OFF	OFF	OFF	Operation frequency set from terminal
	ON/OFF	ON	ON/OFF	Jogging run frequency
	ON	OFF	OFF	1st speed run operation frequency
	OFF	OFF	ON	2nd speed run operation frequency
	ON	OFF	ON	3rd speed run operation frequency
2: SS2 EX	OFF	OFF	OFF	Operation frequency set from terminal
	ON	OFF	OFF	1st speed run operation frequency
	OFF	ON	OFF	2nd speed run operation frequency
	ON	ON	OFF	3rd speed run operation frequency
	ON/OFF	ON/OFF	ON	Emergency stop
3: JOG EX	OFF	OFF	OFF	Operation frequency set from terminal
	ON/OFF	ON	OFF	Jogging run frequency
	ON	OFF	OFF	1st speed run operation frequency
	ON/OFF	ON/OFF	ON	Emergency stop

9.2.2 Output terminal selection [Ob6 of Gr.St]

1) The functions of the frequency reached signal output terminals RCH (UL) and LOW (LL) can be selected.

Setting of Ob6	Function
0	LL, UL (for lower limit/upper limit frequency signal)
1	LOW, UL (for low speed signal and upper limit frequency signal)
2	LL, RCH (for lower limit frequency and speed reached signal)
3	LOW, RCH (for low speed signal and speed reached signal)

2) When the frequency that has been preset is reached during operation, the reached signal is output to the output terminal RCH (UL) and LOW (LL).
The output signal is an "open collector output" (24Vdc, 50mAdc max).
The control side receives the signals with the "relay" or "programmable controller" 24Vdc input.

The "speed reached signal connection" example using a relay is shown in Fig. 9-2.
The "speed reached signal connection" example using a programmable controller is shown in Fig. 9-3.

[Each terminal rating]

RCH, LOW terminal : 24Vdc, Max 50mA
P24 terminal : 24Vdc, 0.1 A

★ Exceeding the terminal rating may cause inverter failure.

[RECOMMENDED RELAY]

OMRON : MY1
Operation coil : 24Vdc

Always install a surge absorbing diode (200V-1A class) near the relay coil.
Note that the surge absorbing diode and the control board of inverter may be damaged if the diode is connected incorectly. Please observe polarity closely.

Please ensure that the diode polarity is correct BEFORE applying power.

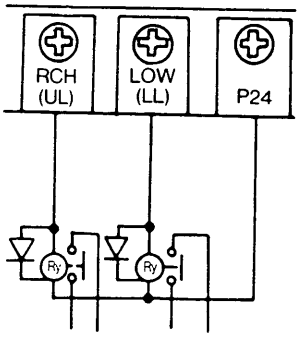


Fig. 9-2 Example of speed reached signal wiring (for relay)

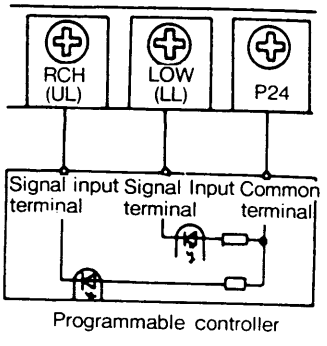


Fig. 9-3 Example of speed reached signal wiring (for programmable controller)

★ The speed reached signal does not have a hysteresis so the reached signal may turn ON and OFF if the output frequency fluctuates near the reached frequency. In this case, adjust the speed reached detection with in $r-CH$ (See 9.2.4).

9.2.3 Upper limit/lower limit frequency signal output [UL, LL of Gr.F]

When the output frequency reaches the preset upper limit frequency or lower limit frequency during operation, the reached signal will be output. The upper limit frequency is set with (UL of Gr.F) and the lower limit frequency with (LL of Gr.F)

The operation examples and output signals are shown in Fig. 9-4 below.

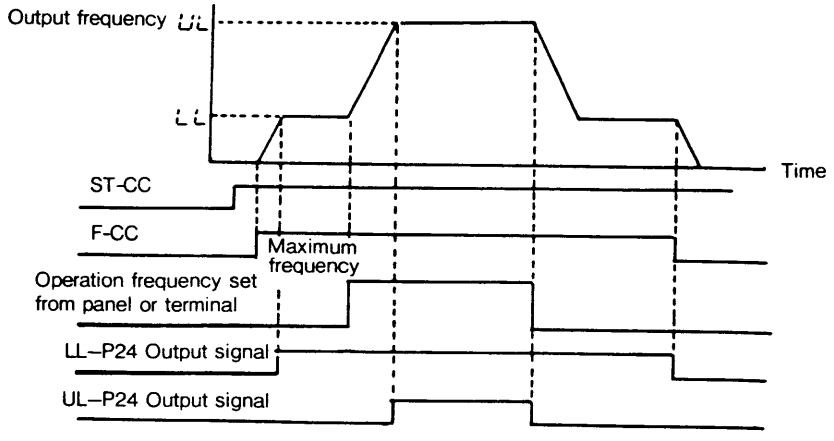


Fig. 9-4 Example of upper limit/lower limit frequency signal operation

★ Note that the reached signal mau turn ON and OFF when the upper limit frequency (UL) or lower limit frequency (LL) is adjusted during operation.

9.2.4 Low speed signal output, speed reached signal outut

[LF, LFHL, Fr-CH, r-CH, rr-CH of Gr.St]

When the output frequency reaches the preset low speed during operation, and when the output frequency reaches the set frequency, the reached signal will be output.

(1) Low speed signal output

The low speed signal output frequency (LF) can be set between 0 and the maximum frequency (Hz).

The signal output can also be selected logically. Carry this out with LFHL of Gr.St.

Setting of LFHL	Function
0	Open collector output OFF when under low speed signal output frequency [LF]
1	Open collector output ON when under low speed signal output frequency [LF]

(2) Speed reached signal output

The speed-reach specifying frequency can be set in (F-CH of Gr.5E) and the speed reached conditions in (r-CH of Gr.5E).

Setting of r-CH	Function
0	Open collector output ON when acceleration/deceleration is completed.
1	Open collector output ON when specifying frequency [F-CH] is reached.

The speed reached detection range (r-rCH) can be set between 0 and the ±maximum frequency (Hz) in 0.1 Hz units.

The speed reached set frequency (F-CH) can be set between 0 and the maximum frequency.

(3) The operation example and output signals are shown in Fig. 9-5.

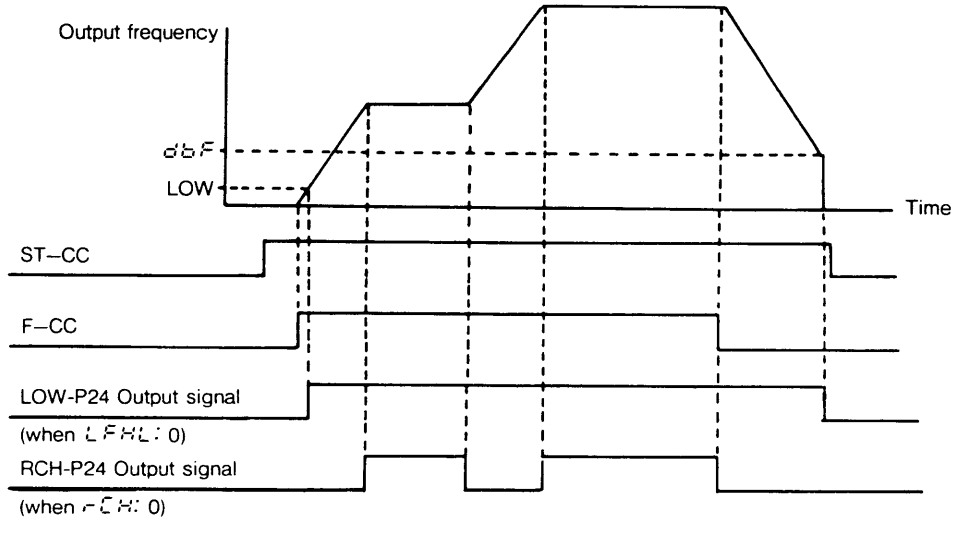


Fig. 9-5 Examples of low speed signal operation and speed reached signal operation

★ The speed reached signal is also output when the multispeed is reached.

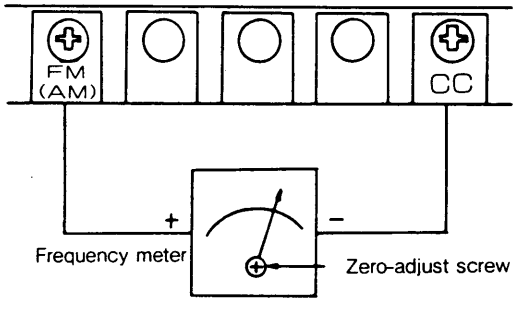
★ The low speed signal will turn OFF when a "DC injection braking" is applied during decelerating stop.

9.3 Connectable Meters [FMAM of Gr.AM]

A "frequency meter" or an "ammeter" can be connected.
The output signal from the FM (AM) terminal is 0~1mAdc or 0~7.5Vdc analog signals.
Use a ful scale 1mAdc ammeter, full scale 7.5Vdc-1mA DC voltmeter, or rectifying AC voltmeter for the meters.
The meter zero-adjust is carried out with the meter adjustment screw. Calibration is carried out on the panel. It is not necessary to connect a variable resistor for calibration externally.

9.3.1 Connection of the frequency meter [FM of Gr.AM]

A "frequency meter" can be connected between FM and CC on the control circuit terminal block.
Take note to the polarity.
Refer to section 7.3.3 "programming mode" item (2) for calibration.
The connection of the frequency meter is shown in Fig. 9-6.

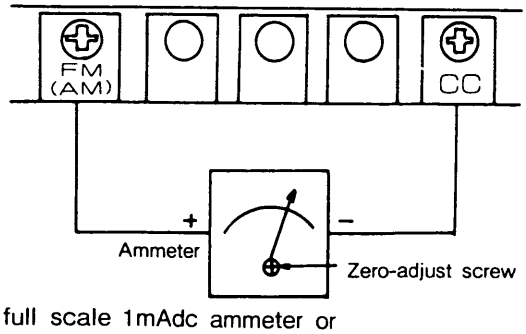


A full scale 1mAdc ammeter or full scale 7.5Vdc–1mA voltmeter.

Fig. 9-6 Connection of frequency meter

9.3.2 Connection of ammeter [AM of Gr.AM]

An "ammeter" can be connected between AM and CC on the control circuit terminal block. Take note to the polarity.
Refer to section 7.3.3 "programming mode" item (2) for calibration.
The connection of the ammeter is shown in Fig. 9-7.

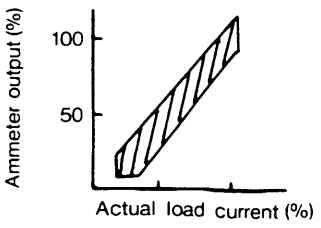


A full scale 1mAdc ammeter or
full scale 7.5Vdc – 1mA voltmeter

★ Set the maximum graduation of the ammeter to more than 2.5 times of the inverter rated output current.
★ The AM output voltage will be low when the inverter is operating at low frequency.
Operate the inverter at 40Hz or high during meter calibration (motor should be connected).

Fig. 9-7 Connection of ammeter

★ The characteristics of the ammeter output will change slightly according to the conductive current as shown in the figure on the right. Take note to this especially during light loads.
If the cables from inverter to motor are long, the detected current will rise due to leakage current.



★ At low frequencies, a large measurement error may occur. This error can approach ±30% when the frequency is below 20Hz.

9.4 Connection of Fault Detection Signal

When the protective function operates and the inverter trips (refer to section 7.3.1 (3) (page 7-6) "Trip information"), the "trip cause" will be shown on the monitor display, and the "fault detection signal" will be output. The "fault detection signal" is output at the relay contact point.

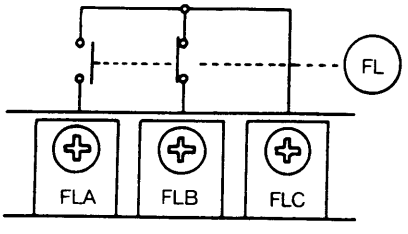


Fig. 9-8 Terminals for the fault detection signal

★ Use the relay contact point within the following ratings.

250Vac-2A : Resistance load
30Vdc-2A : Resistance load
1.5A : Inductive load

If the trip retention (trCL of Gr.Pr) is set to 1 and the power is turned ON again, the trip cause will be displayed and the inverter will be tripped. However, this fault detection signal relay (FL) will be reset.

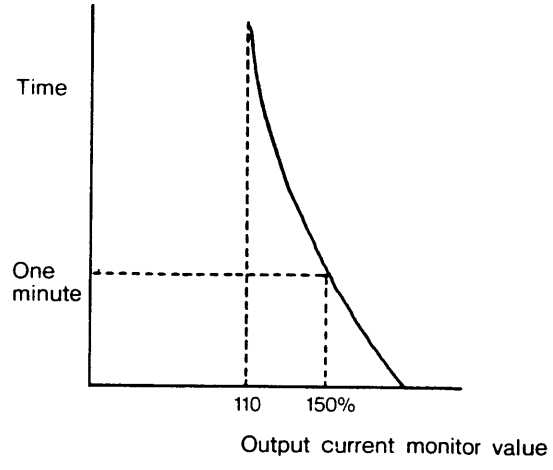
Chapter 10 Protective Functions

This machine has protective functions that can be set according to the motor, load machine and system characteristics.

10.1 Electronic Thermal Function [ETH of GR.PR]

The electronic thermal operation level (ETH) can be adjusted according to the motor rating and characteristics.
The electronic thermal standard level (ETH) can be set between 10 and 100% of the rated output current.

★ The output current monitor value (%) will change when the electronic thermal operation standard level (ETH) is adjusted.



The output current value will display

the rated output current $\times \frac{\text{ETH setting value}}{100}$ as 100%

Fig. 10-1 Electronic thermal operation characteristics

10.2 Stall Prevention Function [STL of GR.PR]

The stall prevention function (STL) can be set between 10 and 150% of the rated output current. If the load current exceeds the stall prevention operation level, the frequency will be controlled and the stalling will be prevented. When this function operations, the acceleration time will be slightly longer than the set acceleration time. The stall prevention function will not be set when set to 200%.

10.3 Electronic Thermal Characteristics selection

[OLN of Gr.Pr]

The electronic thermal characteristics (OLN) can be changed over from/to the "standard motor" or "VF motor" according to the type of motor. Furthemore, the soft-stall function can be selected.

OLN setting	Function
0	Standard motor, without soft-stall function
1	Standard motor, with soft-stall function
2	VF motor, without soft-stall function
3	VF motor, with soft-stall function

Soft-stall function : If the inverter detects an overload, the output frequency is automatically lowered before overload tripping, and operation is continued without tripping at the frequency where the load current is balanced.
This is applied to variable torque characteristics loads such as fans, pumps, and blowers, etc. in which the load current decreases when the operation speed decreases.

CAUTION

Do not apply soft-stall to constant torque characteristic loads (loads with a constant load current regardless of speed).

OLN=0 or 1 : Standard motor
Electronic thermal operation level

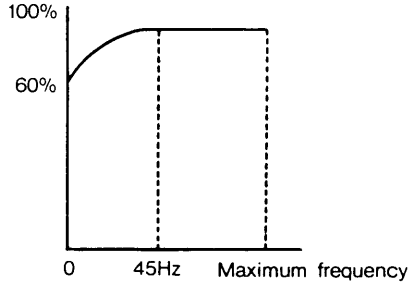


Fig. 10-2 Standard motor electronic thermal operation characteristics

OLN=2 or 3 : VF motor
Electronic thetmal operation level

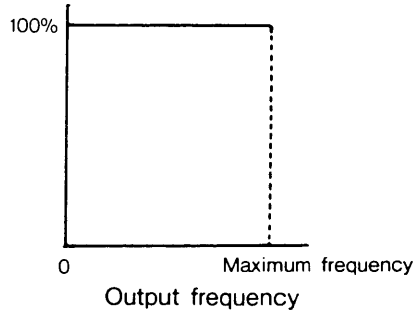


Fig. 10-3 VF motor electronic thermal operation characteristics

★ The electronic thermal operation level is set to the inverter rated output current .

★ The actual load current and inverter detected current will differ slightly.
Especially in the case of long motor cables, the inverter will detect higher output current due to leakage current, which may result in an overload trip. In this case, adjust the electronic thermal operation level.

10.4 Retention of Trip [trCL of Gr.Pr]

The trip status can be registered even when the power is turned OFF if the inverter trips due to the operation of the protective functions.

trCL setting	Function
0	Clear the trip status with power OFF (The trip status will be cleared when the power is turned ON again. Thus the operation will restart when the operation signal is input.)
1	Register trip cause when power is turned OFF (The trip cause will display when the power is turned ON again. Restart is possible by resetting.)

★ Refer to section 7.4.7 (page 7-17) on how to reset the trip.

If the trip retention [trCL of Gr.Pr] is set to 1 and the power is turned ON again, the trip cause will be displayed and the inverter will be tripped. However, this fault detection signal relay (FL) will be reset.

10.5 Retry Function [rtry of Gr.Pr]

The restart function can be operated when the inverter trips due to the protective function.

rtry setting	Function
0	OFF (The trip status is protected, and automatic start does not occur when the inverter trips.)
1	ON (Automatic restart occurs when the inverter trips with the following conditions.)

CAUTION

When selecting the retry function, confirm properly that there are no problems in the load machine and system even if retry is carried out automatically.

Restarting may not be possible if the load GD^2 is too large. Confirm GD^2 when installing.

When the retry function is selected, the inverter will automatically restart after the power is turned on after a "momentary power interruption" or during faults due to "overcurrent", "overvoltage" or "overload".

The fault indication and retry processes are shown in Table 10-1.

Table 10-1 Fault indication and retry process

Fault indication	Retry process	Stop conditions
Momentary power interruption Overcurrent Overvoltage Overload	Restarts continuously up to five times 1st time: approximately 1 seconds after fault occurrence 2nd time: approximately 2 seconds after 1st time 3rd time: approximately 4 seconds after 2nd time 4th time: approximately 8 seconds after 3rd time 5th time: approximately 16 seconds after 4th time	If trouble other than momentary power interruption, overcurrent, overvoltage, overload occurs during retry. If restart is not possible all five times.

★ Retry will not be carried out when the monitor display trip display shows the following.

- OCA : Arm overcurrent (GTR check) trip during starting
- OCL : Load side overcurrent (output terminal check) at start-up
- E : Emergency stop
- EEP : EEPROM abnormality
- Err2 : RAM abnormality
- Err3 : ROM abnormality

★ During retry preparation, the "trip cause" and rtry will display alternately on the monitor display.

★ The fault detection signal will not be output during retry.

★ The intervals shown above may be longer if there is an error remaining as the retry will be carried out after the error is removed.

★ Retry will not be carried out when trip retention is selected (trCL = 1).

★ Use a latch type emergency stop switch (EX-CC). (Emergency stop will not be executed during retry preparation if a one-touch switch is used.)

10.6 Power Control Function [UUC of Cr.Pr]

This function continues operation by using the regenerative energy from the motor when a momentary power interruption. There are some cases when continuously operation is not possible due to the other machine's inertia or load states so use this in combination with the retry function.

Parameter UUC	Function
0	Power control function not used
1	Power control function used

★ The power control function will activate in response to power interruptions up to 100 ms. long.

Chapter 11 Machine Specifications

11.1 Machine Specifications

Table 11-1 Machine type and main standard specifications

Item			Contents						
Voltage class			200V class						
Applicable motor output (kW)			0.1	0.2	0.4	0.75	1.5	2.2	3.7
Machine model ratings	Model		VFSX-						
	Type (Note 1)		2001P	2002P	2004P	2007P	2015P1	2022P1	2037P1
	Capacity (kVA) (Note 2)		0.3	0.6	1.2	2.0	3.0	4.0	6.5
	Rated output current (A)		0.8	1.5	3.0	4.5	7.5	10.0	16.5
Power	Voltage, frequency		3-phase 200~230V-50/60Hz						
	Permissible variations		Voltage ±10%, Frequency ±5%						
Main control specifications	Control method		Sinusoidal PWM control						
	Rated output voltage		3-phase 200~230V (proportional to power voltage)						
	Output frequency range		0.5~240Hz, set to 0.5~80Hz at ship out, maximum frequency (30~240Hz) adjustment						
	Frequency setting resolution		Analog reference: (Maximum setting frequency/1024)Hz Digital reference (Operation panel):0.1Hz (0.01Hz) *Refer to section 8.13 (page 8-23)						
	Frequency precision		±0.01% to maximum output frequency (digital setting, -10~+50°C) (analog setting 25°C±10°C)						
	Voltage/frequency characteristics		V/f constant pattern and variable torque pattern changeover Base frequency (25~240Hz) adjustment, torque boost (0~30%) adjustment, start-up frequency (0.5~10Hz) adjustment						
	Overload current rating		150% for 1 minute						
	Frequency setting signal		3kΩ rheostat (1~10kΩ rating rheostat can be connected) 0~10Vdc (input interpedence: 30kΩ), 0~5Vdc (15kΩ), 4~20mAdc (250Ω)						
Main operation specifications	Acceleration/decelerating time		0.1~3600seconds, Acc./Dec. time 1/2 changeover, S-character Acc./Dec. pattern selection						
	Protective function	Regenerative discharge brake	None	External braking resistor (optional)					
		DC injection brake	Braking start frequency (0~10Hz), braking voltage (0~20%), braking control time (0~5s), emergency DC injection braking stop control time (0~10s) adjustments						
Electrical control	Protective functions		Stall prevention, current limit, overcurrent, overcurrent during braking, load side short circuit, (detection), undervoltage, momentary power failure, power control function, overload due to electronic thermal, arm overcurrent at start, load side overcurrent at start, braking resistance overload, fin overheating, emergency stop.						

Continued on the next page.

Item		Contents	
protective functions	Electrical thermal characteristics	Changeover of standard motor/VF motor for constant torque, adjustment of electronic thermal stall prevention operation level.	
	Reset	Reset when 1a contact point is "closed", or with panel. Set trip retention and clear.	
Display function	4-digit 7-segment LED	Display of output frequency, OFF, alarm, trip cause, parameter name, data and universal units	
	Charging indication LED	Main circuit condenser charge indication	
Output signals	Fault detection signal	Output of 1C contact point (during 250Vac-2A 30Vdc-2A resistance load, and 1.5A during inductive load)	
	Low speed, speed reached, upper limit, lower limit frequency signal output	Open collector output (24Vdc, max, 50mA) 2 points	
	Frequency meter output/ammeter output	Analog output. 1mAdc full scale ammeter or 7.5Vdc-1mA DC voltmeter/rectifying AC voltmeter	
Enclosure		Closed type	
Cooling method		Self-cooled	Fan-cooled
Color		Munsell symbol N1.5	
Working environment	Service environment	Indoor, altitude under 1000 m, locations not in direct sunlight, and where there is no corrosive or explosive gases or steam.	
	Ambient temperature (Note 3)	-10~40°C (maximum 50°C when the caution plate is removed)	
	Relative humidity	90% or less (non condensing)	
	Vibration	4.9m/s² or less (20~50Hz), 0.1mm or less (50~100Hz)	

(Note 1) Models with a B instead of a P are the closed structure type with no panel.
(Note 2) The rated capacity is for when the output voltage is 230V.
(Note 3) The storing temperature is between -20 °C to +65 °C (short term temperatures during shipping, etc.)

Table 11-2 Machine type and main standard specifications

Item		Contents									
Voltage class		200V class									
Applicable motor output (kW)		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Machine model ratings	Model	VFSXN-										
	Type (Note 1)	2001P	2002P	2004P	2007P1	2015P1	2022P1	2037P1	2055P	2075P	2110P	2150P
	Capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0	3.0	4.0	6.5	9.5	13	19	25
	Rated output current (A)	0.8	1.5	3.0	5.0	7.5	10.0	16.5	25	33	49	66
Power	Voltage, frequency	3-phase 200~230V-50/60Hz										
	Permissible variations	Voltage ±10%, Frequency ±5%										
Cooling method		Self-cooled			Fan-cooled							

Other specifications are as shown in Table 11-1.

Table 11-3 Machine type and standard specifications (single phase input model)

Item		Contents				
Voltage class		Single phase -200V class				
Applicable motor output (kW)		0.1	0.2	0.4	0.75	1.5
Machine model ratings	Model	VFSX-				
	Type (Note 1)	2001PY-C1	2002PY-C1	2004PY-C1	2007P1Y-C1	2015P1Y-C1
	Capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0	3.0
	Rated output current (A)	0.8	1.5	3.0	5.0	7.5
Power	Voltage, frequency	Single phase 200~240V-50/60Hz				
	Permissible variations	Voltage ±10%, Frequency ±5%				
Rated output voltage		Three phase 200~230V (proportional to power voltage)				
Cooling method		Self-cooled				Fan-cooled

Other specifications are as shown in Table 11-1.

11.2 External Dimensions

When installing the machine, note that the external dimensions and mass weights differ according to the capacity. The external dimensions and mass weights for each machine are shown in Table 11-3.

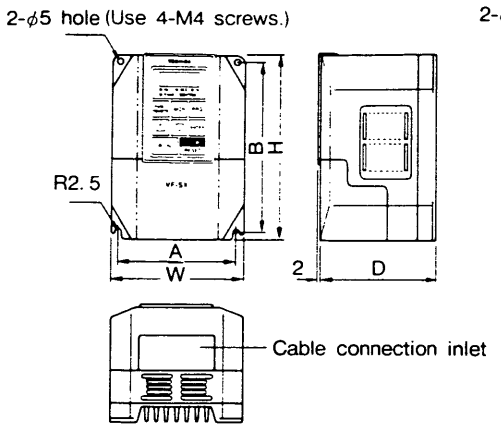


Fig. A

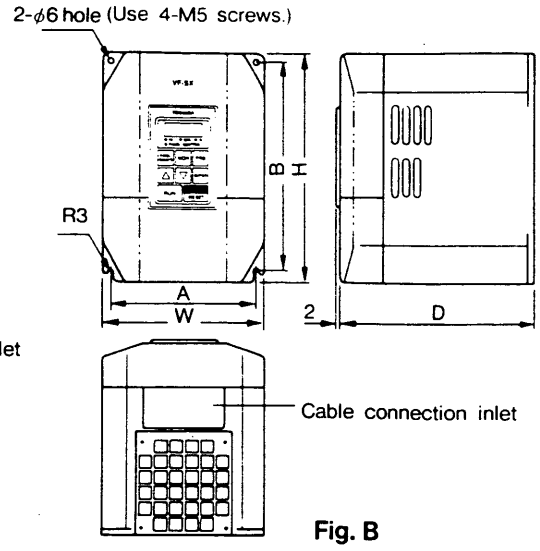


Fig. B

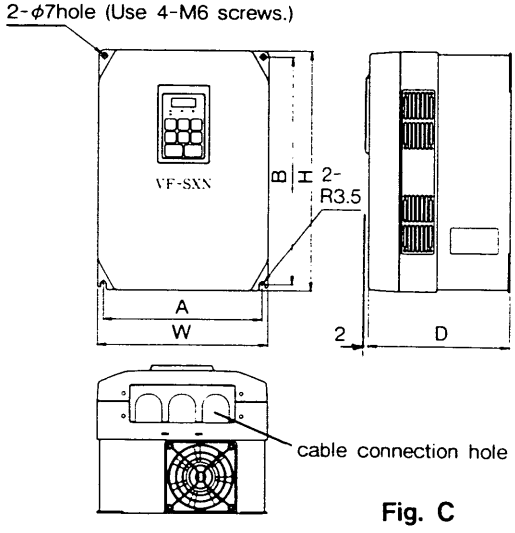


Fig. C

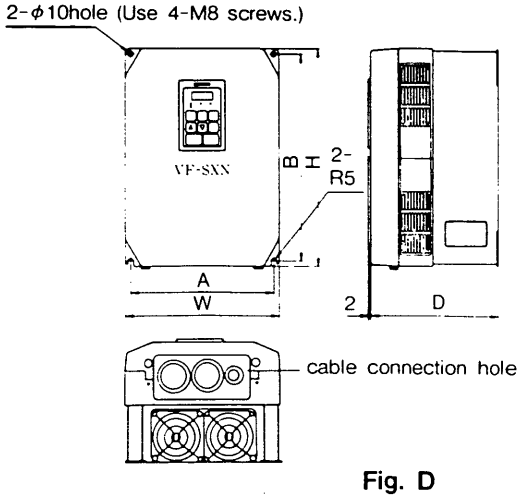


Fig. D

External installation of table.

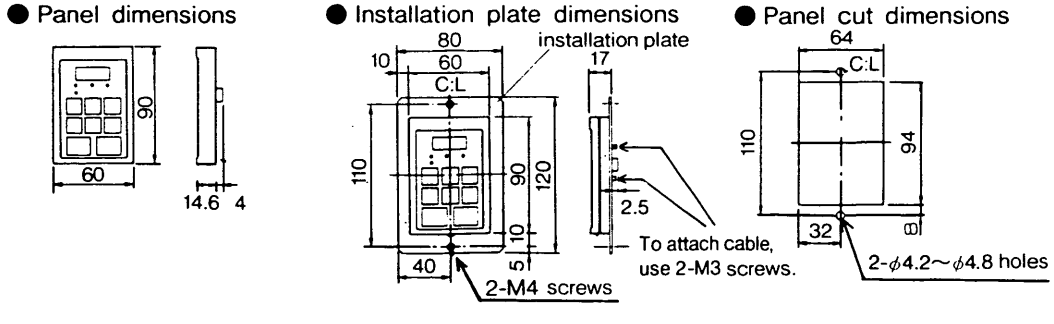


Fig. 11-1 External dimensions

Table 11-3 External dimensions and weight (3 phase input models)

Outer shield structure	Applicable motor output (kW)	Inverter model	Dimensions (mm)					Figure	Approx. weight (kg)
			W	H	D	A	B		
Closed type	0.1	VFSX-2001P	105	150	80	93	138	A	0.9
	0.2	VFSX-2002P	105	150	80	93	138		0.9
	0.4	VFSX-2004P	105	150	90	93	138		0.9
	0.75	VFSX-2007P	105	150	120	93	138		1.3
	1.5	VFSX-2015P1	140	200	155	126	186	B	2.5
	2.2	VFSX-2022P1	140	200	155	126	186		2.7
	3.7	VFSX-2037P1	140	200	155	126	186		2.9

Outer shield structure	Applicable motor output (kW)	Inverter model	Dimensions (mm)					Figure	Approx. weight (kg)
			W	H	D	A	B		
Closed type	0.1	VFSXN-2001P	105	150	80	93	138	A	0.9
	0.2	VFSXN-2002P	105	150	80	93	138		0.9
	0.4	VFSXN-2004P	105	150	120	93	138		1.3
	0.75	VFSXN-2007P1	140	200	155	126	186	B	2.6
	1.5	VFSXN-2015P1	140	200	155	126	186		2.6
	2.2	VFSXN-2022P1	140	200	155	126	186		2.7
	3.7	VFSXN-2037P1	140	200	155	126	186		2.9
	5.5	VFSXN-2055P	200	280	167	186	266	C	5.4
	7.5	VFSXN-2075P	200	280	167	186	266		5.4
	11	VFSXN-2110P	245	390	187	225	370	D	11.0
	15	VFSXN-2150P	245	390	187	225	370		11.7

The terminal screw sizes for the main circuit and control circuit are as follows.
VFSX-2001 to 2007 : Main circuit and ground terminal are M3.5, control terminal is M3.
VFSX-2015 to 2037 : Main circuit and ground terminal are M4, control terminal is M3.
VFSXN-2001 to 2004 : Main circuit and ground terminal are M3.5, control terminal is M3.
VFSXN-2007 to 2037 : Main circuit and ground terminal are M4, control terminal is M3.
VFSXN-2055, 2075 : Main circuit and ground terminal M5, control terminal is M3.
VFSXN-2110, 2150 : Main circuit is M6, ground terminal is M5, control terminal is M3.

Table 11-4 External dimensions and weight (Single phase input models)

Outer shield structure	Applicable motor output (kW)	Inverter model	Dimensions (mm)					Figure	Approx. weight (kg)
			W	H	D	A	B		
Closed type	0.1	VFSX-2001PY-C1	105	150	80	93	138	A	0.9
	0.2	VFSX-2002PY-C1	105	150	90	93	138		0.9
	0.4	VFSX-2004PY-C1	105	150	120	93	138		1.3
	0.75	VFSX-2007P1Y-C1	140	200	155	126	186	B	2.6
	1.5	VFSX-2015P1Y-C1	140	200	155	126	186		2.9

The terminal screw sizes for the main circuit and control circuit are as follows.
VFSXS-2001 to 2004 : Main circuit and ground terminal are M3.5, control terminal is M3.
VFSXS-2007 to 2015 : Main circuit and ground terminal are M4, control terminal is M3.

Chapter 12 Options

The "input reactor", "radio noise reduction filter", "braking resistor" and "operation panel extension cable" are available as externally installed options.

(1) Input reactor

This is installed to improve the power factor, or suppress the harmonic currents and line surge. This is also installed when the inverter is connected to a large capacity power over 200 kVA or when any distortion source such as a thyristor or the arc furnace is connected to the same wiring system, or a large capacity inverter is connected.

Outline drawing

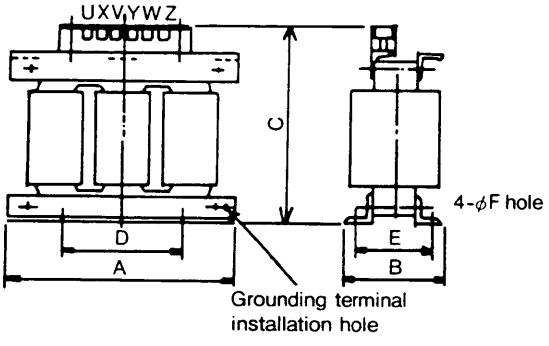


Fig. A

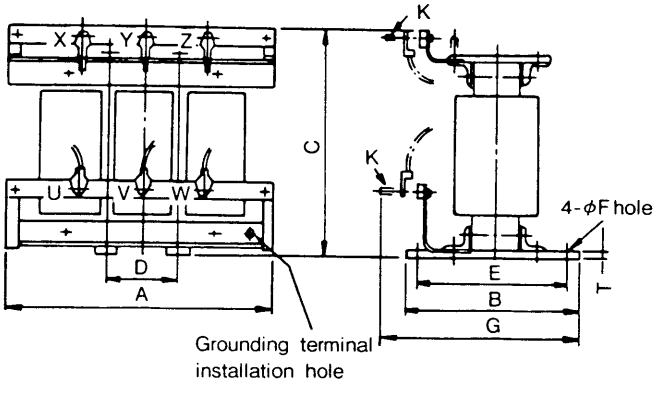
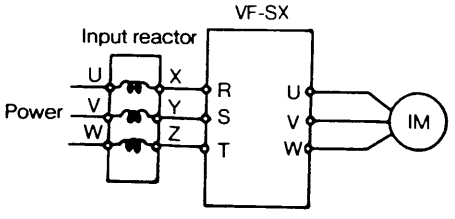


Fig. B

Wiring diagram



Model, rating and dimensions

Inverter model	Reactor model	Rating	Dimensions (mm)									Figure	Terminal	Approx. weight (kg)
			A	B	C	D	E	F	G	T	K			
-2001~2022	PFL2012	3×2V-12.5A-50/60Hz	170	95	185	80	70	7	–	–	–	A	Harmonic Terminal	7
-2037, 2055	PFL2025	3×2V-25A-50/60Hz	170	95	195	80	70	7	–	–	–			8
-2075, 2110	PFL2050	3×2V-50A-50/60Hz	190	180	220	55	150	9	205	6	M8	B	Stud type Terminal	10
-2150	PFL2100	3×2V-100A-50/60Hz	200	180	230	65	150	9	220	6	M10			11

(2) Radio noise reduction filter

This is installed when there is a radio, etc., near the inverter or when audio noise occurs.

Outline drawing

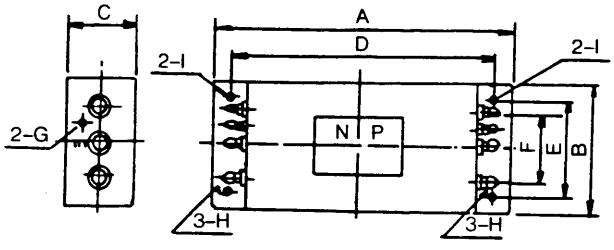
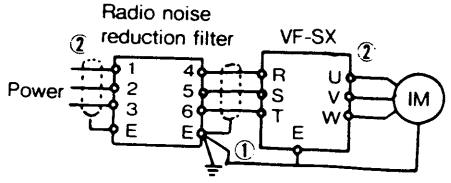


Fig. A

Wiring diagram



Remarks:

1. Connect the radio noise reduction filter to the inverter main circuit primary side.
2. Separate the power wiring and output wiring when installing.

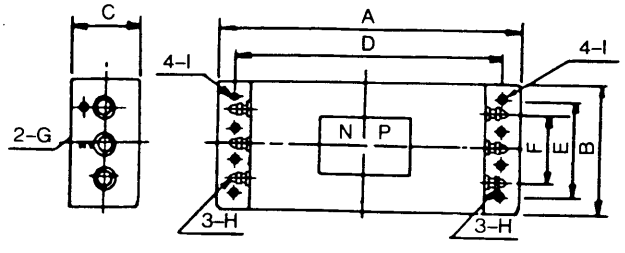
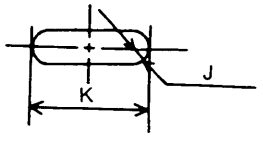


Fig. B

Installation hole details



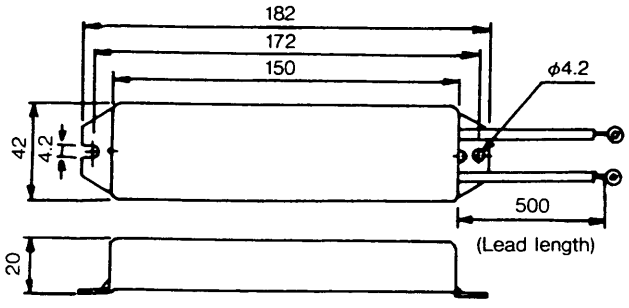
Model, ratings, and dimensions

Inverter model	Radio filter model	Rated current (A)	Dimensions (mm)											Figure	Approx. weight (kg)
			A	B	C	D	E	F	G	H	I	J	K		
-2001~2007	HF3005A-Z	5	220	95	50	195	70	50	M4	M4	φ4.5	2.25	6	A	1.3
-2015~2022	HF3015A-Z	15													
-2037	HF3020A-Z	20													1.5
-2055	HF3030A-Z	30	274	110	70	230	80	60	M4	M5	φ5.5	2.75	7		2.5
-2075	HF3040A-Z	40	355	120	80	320	90	70	M4	M5	φ6.5	3.25	8	B	4.8
-2110	HF3050A-Z	50													
-2150	HF3080A-Z	80	420	160	100	380	130	90	M6	M8	φ6.5	3.25	8		11

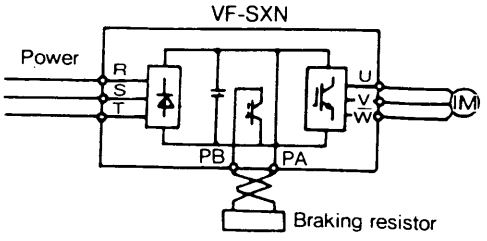
(3) Braking resistor

This is used for rapid decelerating stop, or to increase the braking torque during deceleration when using a load with a large inertia.

Outline drawing



Wiring diagram

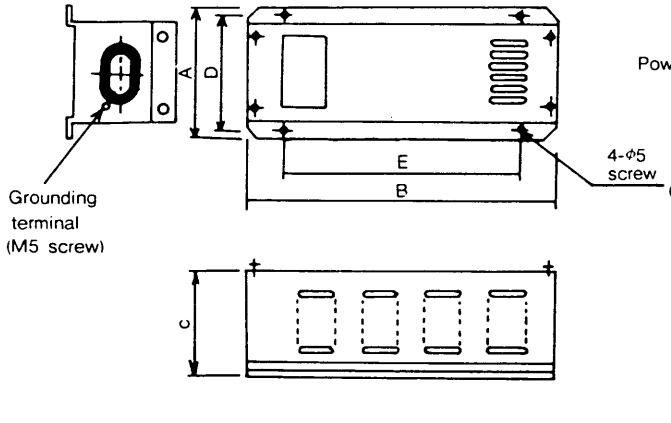


Note) The braking resistor will heat up when decelerating stop is carried out often.
Take care to the installation place and heat discharge.

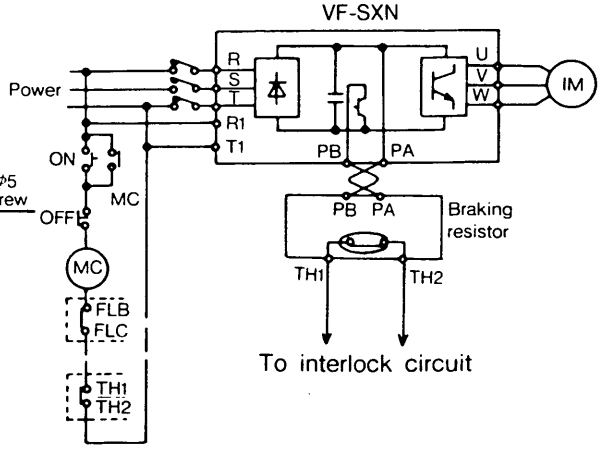
Model, ratings, and dimensions

Inverter model	Braking resistor model	Rating
-2004	PBR-2007	120W-200Ω
-2007		
-2015	PBR-2022	120W-75Ω
-2022		
-2037	PBR-2037	120W-40Ω

Outline drawing



Wiring diagram



Note) The braking resistor will heat up when decelerating stop is carried out often.
Take care to the installation place and heat discharge.

Model, ratings, and dimensions

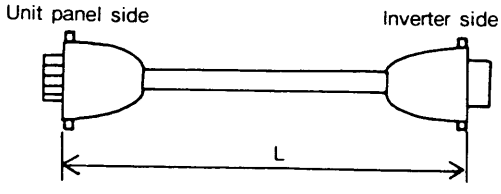
Inverter model	Braking resistor model	Rating	Dimensions (mm)					Approx weight (kg)
			A	B	C	D	E	
-2055	PBR3-2055	40Ω-120W×2P	120	320	100	110	230	4
-2075	PBR3-2075	30Ω-220W×2P		350	190			5.5
-2110	PBR3-2110	30Ω-220W×3P						6
-2150	PBR3-2150	30Ω-220W×4P						6.5

Note) When using a braking resistor other than those listed above, be sure to select a "non-inductive" resistor.
If a resistor other than a "non-inductive" resistor is used, extremely high surge voltages may occur, resulting in inverter damage.

(4) Operation panel extention cable

Use this connection cable when using the panel unit away from the inverter unit or when installing on the storage panel.

Outline drawing



Model	L(m)
PU-CABLE＊1M	1
PU-CABLE＊3M	3
PU-CABLE＊5M	5

Chapter 13 Error Displays, Contents and Remedies

The trip cause and remedies are shown in table 13-1, and other unusual phenomenon cause and remedies are shown in table 13-2. Identify trip cause in table 13-1, 13-2. Then if spare parts are needed or the problem can not be solved according to the tables, contact your dealer or nearest business office, branch shop or branch office. Do not attempt to repair the inverter. Contact a qualified service center.

13.1 Inverter Trip Causes and Remendies

The trip cause display and warning indication, and displays and remedies are shown below.

Table 13-1 Trip displays, contents and remedies

Display	Contents	Remedies
OC1 OC1P	Overcurrent trip (OC) during acceleration	1. Lengthen the acceleration time (ACC) setting. 2. Decrease the torque boost rate (ub). 3. Decrease the stall prevention function activation level.
OC2 OC2P	Overcurrent trip (OC) during deceleration	1. Length the deceleration time (dEC) setting.
OC3 OC3P	Overcurrent trip (OC) during operation	1. The load changed suddenly. 2. Decrease the load variation. 3. If the inverter trips at start-up, refer to OCL.
Note) There are causes other than those listed above for OC1P, OC2P and OC3P (over 5.5kW)		1. The overheating protection has functioned. Refer to OH.
OCA	Arm overcurrent (GTR check) trip during starting	1. Check the main circuit device. The device must be replaced.
OCL	Load side overcurrent (output terminal check) at start-up.	1. The output main circuit wiring or motor insulation is defective. 2. Check the wiring and insulation. 3. Check the main circuit device. If the device is damaged, it must be replaced.
OP2	Overvoltage (OP) trip between DC middle circuit during deceleration	1. Lengthen the deceleration time (dEC) setting. 2. Install a braking resistor (optional).
OP	Overvoltage (OP) trip between DC middle circuit	1. Check the power voltage.
POFF	Undervoltage (Note)	1. The input voltage has decreased. 2. Check the power status and input side wiring.

Continued on the next page.

Display	Contents	Remedies
OL	Motor overload (OL) trip	1. The load is heavy so lighten it. 2. The V/f characteristics or torque boost amount are inappropriate. Check that a 50Hz rating motor is not being operated at a 60Hz base frequency setting, and try increasing/decreasing the torque boost amount. 3. Increase the inverter rating.
OLr	Overload trip in braking resistor	1. Reduce the amount of stops. 2. Increase the deceleration time (dEC) setting. 3. Increase the braking resistor capacity.
OH	Inverter overheating (OH) trip.	1. Check that the cooling fan is operating. 2. Check that the ambient temperature is not too high. Remove the caution plate on the cover top if the ambient temperature is too high.
E	Emergency stop	1. The automatic operation or remote operation has been stopped with the panel.
EOFF	Confirmation of emergency stop	1. The automatic operation or remote operation has been stopped with the panel. Emergency stop will be activated when STOP/RESET is pressed. To cancel, press a different key. (see Section 7.4.6)
Err.1	Frequency setting signal abnormality (Note)	1. The frequency setting signal point 1 and point 2 are too close. Reset with a distance between point 1 and point 2.
Err.2	RAM abnormality	1. There is an error in the main unit microcomputer RAM. Repair is necessary.
Err.3	ROM abnormality	1. There is an error in the main unit microcomputer ROM. Repair is necessary.
EEP	EEPROM abnormality	1. Data error in the EEPROM. Repair is necessary.
C	Stall prevention warning	1. Lengthen the acceleration time (ACC) setting. 2. Increase/decrease the torque boost amount.
P	Overvoltage warning	1. Lengthen the deceleration time (dEC) setting. 2. Install the optional braking resister.
L	Overload warning	1. The load is heavy so lighten it. 2. Increase the inverter rating.
HI LO	Set value error warning (Error display and data are alternatively displayed twice)	1. There is a set value error during data read-out and write in. Check that there is no mistake in the setting value, and reset. (See Section 7.3.3.(3))

(Note) POFF, Err.1 and each warning are only displayed and the inverter will not trip.

13.2 Other Error Symptoms

The other error symptom causes and remedies are shown below.

Table 13-2 Error symptom causes and remedies

Error symptom	Cause and remedy
Motor does not rotate	1. Mis-wiring, open-phase or power failure in the input, output or power line. Confirm that the CHARGE lamp is lit. 2. When operating with the panel, confirm that the "PANEL CONTROL" lamp is lit. Press [PANEL REMOTE] to turn the light on. When operating with the external signals, confirm that the "PANEL CONTROL" lamp is not lit. Press [PANEL REMOTE] to turn the light off. 3. Confirm that the operating frequency is set. 4. Is the ST-CC is shorted? Short ST-CC. 5. Confirm Whether a trip has occurred, or whether retry preparation is on. When tripped, remove the cause and reset. During retry, take care as the inverter will restart automatically. 6. The load on the motor is heavy. Lighten the load.
The motor rotation direction is backwards.	1. Reverse the output terminal U,V and W phase order. Or short R-CC.
The motor rotates but the speed does not change.	1. The load is heavy. Lighten the load. 2. The soft-stall function is activated. Turn the soft-stall function OFF. 3. The upper limit frequency (UL) set value is low. Increase the upper limit frequency (UL) set value. 4. The frequency setting signal is low. Check the signal value and circuit. 5. Check the setting characteristics of the frequency setting signal.
The motor acceleration/ deceleration is not smooth.	1. The setting for the acceleration time (ACC) and deceleration time (dEC) is short. Lengthen the acceleration time (ACC) and deceleration time (dEC).
The motor rotation is high or low.	1. The motor voltage specifications are not appropriate. Adjust the motor voltage to the specifications. 2. The motor terminal voltage is low. Check the output voltage decrease and output voltage adjustment set value. [POUE, PRdJ of Gr.CC] Increase the cable diameter. 3. The increased deceleration rate for the gear, etc. is not correct. Check the increased deceleration rate for the gear, etc. 4. The output frequency setting is not correct. Check the setting of the output frequency range. 5. Adjust the base frequency.

Error symptom	Cause and remedy
The revolution fluctuates during operation	1. The load is too heavy or too light. Decrease the load variation. 2. The inverter and motor rating values do not match. Increase the inverter and motor rated values.
The motor rotation does not rise (is unstable.)	1. Lower the carrier frequency.

Chapter 14 Maintenance and Inspection

14.1 Preventative Maintenance and Periodic Inspection

Carry out preventative maintenance to use this machine for a long period in a normal status.

Carry out a periodic Inspection once every three to six months depending on the status of use. When carring out the inspection, always turn the power switch of MCCB OFF and confirm that the "CHARGE" lamp is not lit.

[**Inspection places**]

1. Check that there is no looseness in the wire terminal screw fixings.
   Tighten with a screwdriver.

2. Check that the wire terminal screw fixing crimps are properly.
   Visually check that the crimped areas do not show signs of overheating.

3. Visually check that there is no damage to the wires or cables.

4. Clean the dirt and dust off the machine with a vacuum cleaner.
   When cleaning, take special care to the ventilation ports and printed circuit board. Unexpected trouble will occur when dirt or dust is adhered on these parts, so keep them clean.

5. When the machine is not used for long periods of time, pass electricity through at least once every two years and confirm the operation.
   To confirm the electrical conductivity, remove the motor and operate for five hours or more.
   Do not directly input commercial power into the inverter. It is recommended to use a Slidac and gradually increase the input voltage before electrical conductivity.

6. When carrying out an insulation test, use only the main circuit terminal block with 500V megaohmmeter.
   Do not carry out the insulation test to other elements, or the control circuit terminals on the printed circuit board.
   ★ When carrying out the motor insulation test, remove the output terminal U, V, and W connections, and only test the motor.

7. Pressure resistance test
   Do not carry out the dielectric strength test. It is possible that internal damage will result.
   Check the operating inverter for cleanliness about once every month.

8. Voltage and temperature test.
   Measuring the input and output voltage with a tester during normally operating is effective for finding errors. The output side voltage specified value may differ according to the type of tester or voltmeter used. Consider the characteristics of your tester or voltmeter and record the daily specified value.
   On the input side, measure the voltage values between R-S, S-T and R-T.
   On the output side, measure the voltage values between U-V, V-W and W-U.

[**Recommended voltmeter**] Input side : Moving-iron type voltmeter ()
Output side : Rectifying AC voltmeter ()

Constant measurement of the inverter ambient temperature at start-up, during operation, and when stopping, is effective for finding errors.

Chapter 15 Storage and Warranty

15.1 Storage

pay attention to the following points when storing the unit temporarily without using after purchase or when storing for long periods.

1. Avoid storage in hot and humid places with large quantities of dust and metalic particles.
2. Always store the inverter with it's protective packaging to protect if from dirt and static electricity.
   Always remove the cover before connecting to power.
3. When not using the machine for a long period, pass electricity through once every two years, and restore the large capacity electlytic condencer characteristics.
   Do not directly input commercial power to the inverter. It is recommended to use a Slidac and gradually increase the input voltage before inputting the power.
   (The power should be on for more than five hours.)
   The large capacity electrolytic capacitor used for the inverter will deteriorate if left for a long time without passing power through.

15.2 Warranty

Breakdowns and damages that occur during the warranty period will be repaired for free of charge.

The warranty period of this machine is twelve months from delivery.

The following cases will be charged for even during the warranty period.

1) Breakdowns and damages that occur due to misuse of the machine or inappropriate repairs or alterations.
2) Breakdowns and damages that occur due to dropping or transporting after purchased.
3) Breakdowns and damages that occur to natural causes such as fire, salt damage, gas damage, earthquakes, wind and water, lightening or erroneous voltage, etc.
4) Damages that occur due to use of the machine other than as an inverter.

If there are other warranty conditions that are predetermined, those will be prioritized.

★ Please carry out maintenance and inspection properly.

Appendix

Appendix 1 Table of parameters

Parameter group	GR.	U : User Parameter F : Fundamental SE : Selection of Terminal PR : Protection CC : Control and Communication AM : Adjustment of AM/FM Meter

Group	Function	Title	Adjustment range	Unit	Shipment	Page
GR.U	(Display of use-modified parameters) * Only the parameters that have a set value that differs from the standard default value will be displayed. * When the same setting value as the standard default value is reinput, that parameter will be removed from this group.	XX	XX (According to each parameter adjustment range.)	XX	XX	7-3
GR.F	Maximum frequency	FH	30~240	0.1Hz	80	8-2
	Base frequency	UL	25~240	0.1Hz	60	8-4
	Torque boost	Ub	0~30	1%	3	8-2
	V/f pattern	Pt	0: Constant torque 1: Reducing torque	—	0	8-4
	Upper limit frequency Lower limit frequency	UL LL	0.5~Maximum frequency 0, 0.5~Upper limit frequency	0.1Hz 0.1Hz	80 0	9-4
	Forward/reverse run selection	Fr	0: Reverse run 1: Forward run	—	1	8-7
	Acceleration time 1 Deceleration time 1 Acc./Dec. 1 pattern	ACC1 dEC1 Pt1	0.1~3600 0.1~3600 0: Linear 1: S-character 1 2: S-character 2	0.1sec. 0.1sec.	10 10 0	8-5
	Acceleration time 2 Deceleration time 2 Acc./Dec. 2 pattern	AC2 dEC2 Pt2	0.1~3600 0.1~3600 0: Linear 1:S-character 1 2:S-character 2	0.1sec. 0.1sec.	10 10 1	8-5
	Acc./Dec. 1 or 2 selection	Ad2	0: Acc./Dec. 1 1: Acc./Dec. 2 2: Changeover of Acc./Dec. 1 or 2	—	0	8-6
	2 Frequency for switching between Acc./Dec. 1 and 2	Ad2F *	0, 0.5~Maximum frequency	0.1Hz	0	
	Drive mode selection	tyP	0: No input is enabled 1: General-purpose 50Hz adjustment 2: General purpose 60Hz adjustment 3: Standard default value adjustment 4: Clear past errors	(0 will always be displayed when this parameter is read out.)		7-14

Continued on the next page.

Group	Function	Title		Adjustment range	Unit	Shipment	Page
Gr.St	Command mode selection	CMOd		0: No input is enabled. 1: Only terminal input valid 2: Only panel input valid 3: Terminal, panel changeover	–	3	7-13
	Frequency setting mode selection	FMOd		0: No input is enabled. 1: Only terminal input valid 2: Only panel input valid 3: Terminal, panel changeover	–	3	7-13
	Parameter setting disable selection	PMOd		0: Setting disabled 1: Setting enabled	–	1	7-14
	Input terminal selection	Itb		0: SS2,SS3 1: JOG, SS3 2: SS2, EX 3: JOG, EX	–	0	9-1
	Output terminal selection	Otb		0: LL, UL 1: LOW, UL 2: LL,RCH 3: LOW, RCH	–	3	9-2
	Low-speed signal output frequency	LF		0, 0.5~Maximum frequency	0.1Hz	0.5	9-4
	Low-speed signal logic selection	LFHL		0: Open collector output OFF 1: Open collector output ON	–	0	9-4
	Speed-reach specifying frequency	FrCH		0, 0.5 ~Maximum frequency	0.1Hz	0	9-4
	Other than 0: Speed reached selection	rCH	*	0: Acc./Dec. is completion signal output 1: Specified frequency reach signal output	–	0	
	Other than 0: Speed reached detection range	rrCH	*	0~Maximum frequency	0.1Hz	2.5	
	IV input	IuIn		0: Disengaged 1: Engaged	–	0	8-10
	1 IV point 1 setting signal	P1	*	0~100	1%	20	
	IV point 1 frequency	F-P1	*	0, 0.5~Maximum frequency	0.1Hz	0	
	IV point 2 setting signal	P2	*	0 ~100	1%	100	
	IV point 2 frequency	F-P2	*	0, 0.5~Maximum frequency	0.1Hz	80	
	RR terminal input prioritization	rrCC		0: Normal 1: RR prioritized	–	0	8-11
	Jogging run frequency	JOG		0, 0.5~20	0.1Hz	0	8-14
	Other than 0: Jogging stop pattern	JStP	*	0: Decelerating stop 1: Coasting stop 2: DC injection braking stop	–	0	
	Multispeed run	Sr.n		0: Multispeed run disengaged 1: Multispeed run engaged	–	0	8-17
	1 1st speed run operation frequency	Sr1	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	2nd speed run operation frequency	Sr2	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	3rd speed run operation frequency	Sr3	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	4th speed run operation frequency	Sr4	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	5th speed run operation frequency	Sr5	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	6th speed run operation frequency	Sr6	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	
	7th speed run operation frequency	Sr7	*	Lower limit frequency ~upper limit frequency	0.1Hz	0	

Continued on the next page.

Group	Function	Title		Adjustment range	Unit	Shipment	Page
br.Pr	Regenerative discharge braking selection	Pb		0: Regenerative discharge braking disengaged 1: Regenerative discharge braking engaged, without overload detection 2. Regenerative discharge braking engaged, with overload detection	–	0	8-22
	Overvoltage limiting action selection	OPSS		0: Engaged 1: Disengaged	–	0	8-22
	DC injection braking start-up frequency	dbF		0, 0.5~10	0.1Hz	0	8-21
	Other than 0 : DC injection braking voltage	dbv	*	0~20	1%	0	
	Other than 0 : DC injection braking time	dbt	*	0~5	0.1sec.	0	
	Emergency stop	ESTP		0: Coasting stop 1: Decelerating stop 2: Emergency DC injection Braking stop (EDB)	–	0	8-8
	2 : Emergency DC injection braking stop control time	Edbt	*	0~10	0.1sec.	0.1	
	Retry selection	rtry		0: OFF 1: ON	–	0	10-3
	Power control function selection	UuC		0: OFF 1: ON	–	0	10-4
	Electronic thermal protective level	tHr		10~100	1%	100	10-1
	Stall prevention function activation level	StL		10~150, 200 (Non-operating)	1%	150	10-1
	Electronic thermal protection characteristic selection	OLn		0: Standard motor, without SS 1: Standard motor, with SS 2: VF motor, without SS 3: VF motor, with SS (SS: Soft stall)	–	0	10-2
	Trip retention selection	trCL		0: Clear with power OFF 1: Retain even when power OFF	–	0	10-3
br.CC	Start-up frequency setting	F-St		0.5~10	0.1Hz	0.5	8-20
	Operation starting frequency	Fr.n		0, 0.5 ~Maximum frequency	0.1Hz	0	8-20
	Operation starting frequency hysteresis	FHYS		0 ~Maximum frequency	0.1Hz	0	8-20
	Jump frequency	FJ.n		0:Jump function disengaged 1:Jump function engaged	–	0	8-19
	1 : Jump frequency 1	FJ1	*	0, 0.5 ~Maximum frequency	0.1Hz	0	
	Jump width 1	bFJ1	*	0 ~30	0.1Hz	0	
	Jump frequency 2	FJ2	*	0, 0.5~Maximum frequency	0.1Hz	0	
	Jump width 2	bFJ2	*	0 ~30	0.1Hz	0	
	Jump frequency 3	FJ3	*	0, 0.5~Maximum frequency	0.1Hz	0	
	Jump width 3	bFJ3	*	0 ~30	0.1Hz	0	
	PWM carrier frequency	CF		0.5 ~3 [5 ~15]	0.1kHz	2 [12]	8-23
	Motor tone selection	CFS		0: Monotonous tone 1: Integral tone	–	0	8-23
	Output voltage adjustment	POUt		0~100(0~120)	1%	100	8-24
	Power voltage compensation	PRdJ		0: No compenstated 1: Compensated	–	0	8-24

Continued on the next page.

The numerals in brackets are for the VF-SXN.

Group	Function	Title	Adjustment range	Unit	Ship-ment	Page
Gr.CC	Automatic torque boost	AUb	0: Disengaged 1: Engaged	–	0	8-3
	1 No-load current Torque boost maximum value	CU-0 * ubH *	0~50 0~30	1% 1%	10 6	
	Slip frequency compensation	SFC	0: No compensated 1: Compensated	–	0	8-25
	1 No-load current Motor rating slip frequency	CU-0 * SFr *	0~50 0, 0.5~10	1% 0.1Hz	10 3	
Gr.AN	Connected meters adjustment	FNAN	0: Frequency meter connection 1: Ammeter connection	–	0	7-10
	0 Frequency meter adjustment	FN *	–	–	–	
	1 Ammeter adjustment	AN *	–	–	–	9-6
	Adjustment of the RR input terminal bias	rr-b	0~255	1	64	8-12
	Adjustment of the RR input terminal gain	rr-G	0~255	1	128	8-12
	Universal unit multiplication factor	dSP2	0(OFF), 0.01~200		0	8-23

<Skip function>

The parameters marked with a * mark will be displayed as detailed parameters only when the upper column parameter function is selected.

Appendix 2 Table of Trips Indications

● **Trip (trips that are registered as past errors)**

Display	Contents
nErr	No error (appears only in past error displays)
OC1 or OC1P	Overcurrent trip (OC) during acceleration
OC2 or OC2P	Overcurrent trip (OC) during deceleration
OC3 or OC3P	Overcurrent trip (OC) during operation
OCL	Overcurrent trip on load side at start-up (output terminal check)
OCA	Overcurrent trip on alarm at start-up (GTR check)
OP	Overvoltage trip in DC circuit (OP)
OP2	Overvoltage trip in DC circuit during deceleration (OP)
OH	Inverter overheating trip (OH)
OL	Motor overload trip (OL)
E	Emergency stop
EEP	EEPROM abnormalrty (adjustment, other data)
Err.2	RAM abnormality
Err.3	ROM abnormality
OLr	Overload trip in discharge resistor for regenerative discharge braking

● Messages (those that do not trip)

POFF	Undervoltage display
rtry	Display during retry
Err.1	External frequency setting error
CLr	Indication of clear
EOFF	Indication of emergency stop
CtrL	Indication of control for coasting stop
HI	Set value has reached upper limit, and cannot be set higher
LO	Set value has reached lower limit, and cannot be set lower

Appendix 3 The relation between input terminal and each command mode.

terminal	command mode / frequency setting mode								
	panel / panel	panel / terminal	panel / disable	terminal / Panel	terminal / terminal	terminal / disable	disable / panel	disable / terminal	disable / disable
F	×	×	×	○	○	○	×	×	×
R	×	×	×	○	○	○	×	×	×
ST	○	○	○	○	○	○	○	○	○
RST	○	○	○	○	○	○	○	○	○
AD2	×	×	×	○	○	○	×	×	×
SS1	×	×	×	○	○	○	×	×	×
SS2	×	×	×	○	○	○	×	×	×
JOG	×	×	×	○	○	○	×	×	×
SS3	×	×	×	○	○	○	×	×	×
EX	○	○	○	○	○	○	○	○	○
RR	×	○	×	×	○	×	×	○	×
IV	×	○	×	×	○	×	×	○	×

○: The commands from the terminal block are enabled.
×: The commands from the terminal block are ignored.

Input terminal setting (16 of Cr.5t) selects SS2 or JOG.
Input terminal setting (16 of Cr.5t) selects SS3 or EX.

ST is always enabled.
RST is enabled only after the inverter has tripped.

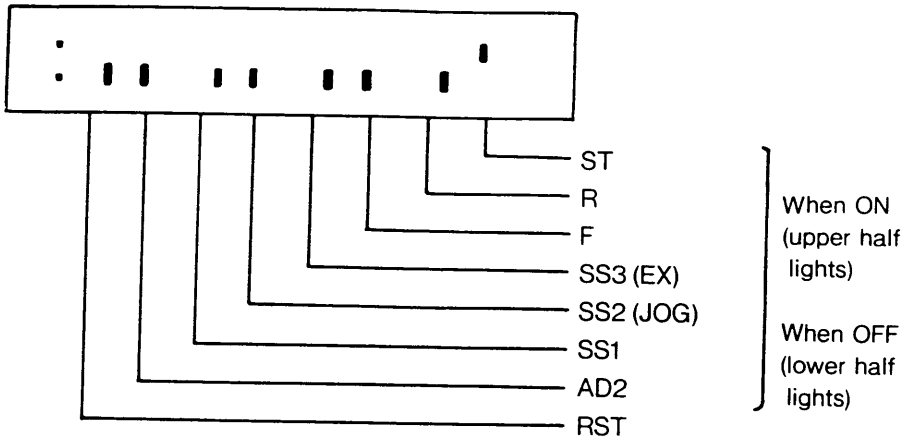
EX selected by input terminal setting, is disable after the inverter is tripped.

When multiple preset speed operation is selected by terminal input, the seven preset speed references have priority over RR, IV terminal input.

Appendix Diagram 1 Input Terminal Information and Output Terminal Information

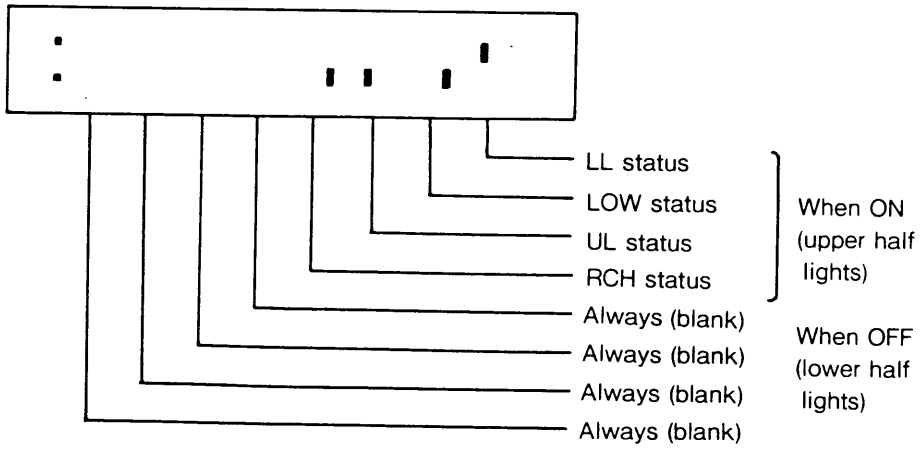
Input terminal information

The eight input terminals correspond to the following bits.



Output terminal information

The two output terminals correspond to the following bits.



Appendix Diagram 2 Character Code

Character codes (for numerics)

0	1	2	3	4	5	6	7	8	9	–
										

Character codes (for alphabets)

A a	B b	C c	D d	E e	F f	G g	H h	I i	J j
									

K k	L l	M m	N n	O o	P p	Q q	R r	S s	T t
									

U u	V v	W w	X x	Y y	Z z