YASKAWA ELECTRIC

TOE-S616-302
INSTRUCTIONS

Before initial operation read these instructions thoroughly, and retain for future reference

TRANSISTOR INVERTER

Varispeed-616HII™

B SERIES

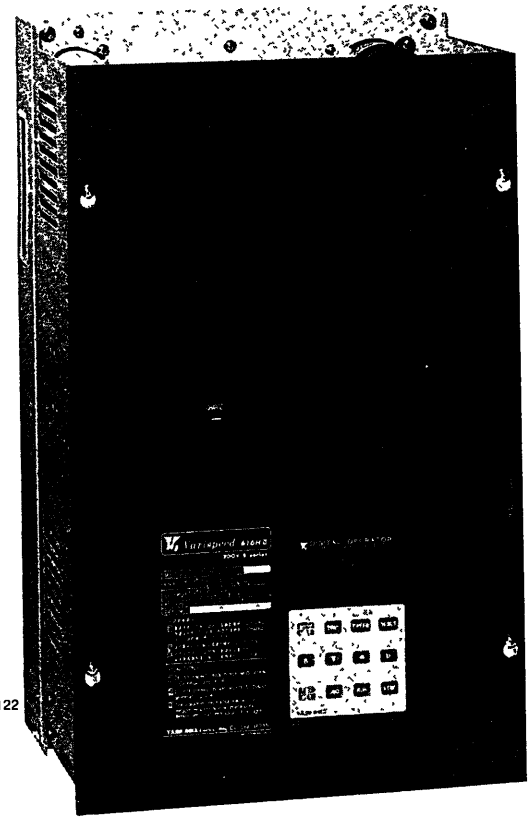
380 TO 460V 18.5 TO 160kW (25 TO 200HP) 25 TO 200kVA

INSTRUCTION MANUAL

When properly installed, operated and maintained, this equipment will provide a lifetime of service. It is mandatory that the person who operates, inspects, or maintains this equipment thoroughly read and understand this manual, before proceeding.

This manual applies to VS-616HII B series Model CIMR-H18.5D, -H22D, -H30D, -H37D, -H45D, -H55D, -H75D -H110D and -H160D.

The VS-616HII Drive is an AC variable speed drive system for high-precision variable speed applications. It basically consists of a three-phase squirrel-cage induction motor, a VS-616HII controller (VS-616HII), an operator control station, and optional control units. This manual primarily describes VS-616HII, but contains basic information for operator control station as well. For details of the operation of individual units, refer to thier respective manuals.



688 122

VS-616HII Inverter
with Digital Operator (Optional)

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DANGER

- Do not touch circuit components until "CHARGE" lamp is extinguished after turning off the AC main circuit power supply. The capacitors are still charged and can be quite dangerous.
- Before changing switch settings (1S to 6S), turn off the power and make sure that CHARGE lamp is off.
- Do not connect or disconnect wires and connectors while power is applied to the circuit.
- Do not check signals during operation.

IMPORTANT

- Be sure to ground VS-616HII using the ground terminal (E) ((G)) . See Par. 4.5.3 on page 14.
- Never connect main circuit output terminals (U) ((T1)), (V) ((T2)), (W) ((T3)) to AC main circuit power supply.
- All the potentiometers of VS-616HII have been adjusted at the factory. Do not change their settings unnecessarily.
- Do not make withstand voltage test on any part of the VS-616HII unit, because it is electronic equipment using semi-conductors and vulnerable to high voltage.
- To make the insulation resistance test with a megger, special precautions must be taken. Before test, see Insulation Resistance Test on page 14.
- Control PC board employs CMOS IC which is easily damaged by static electricity. Take care not to touch the CMOS elements inadvertently.

1. RECEIVING

This VS-616HII has been put through demanding tests at the factory before shipment. After unpacking, check for the following.

- Verify the part numbers with the purchase order sheet and/or packing slip.
- Transit damage.

  If any part of VS-616HII is damaged or lost, immediately notify the shipper.

Table 1 VS-616HII Model Name and Ratings

VS-616HII Model CIMR-	H18 5D	H22D	H30D	H37D	H45D	H55D	H75D	H110D	H160D
Max Motor Output kW (Hp)	18 5 (25)	22 (30)	30 (40)	37 (50)	45 (60)	55 (75)	75 (100)	110 (150)	160 (200)
Inverter Capacity kVA	25	30	40	50	60	75	110	140	200

2. VS-616HII FUNCTIONAL DESCRIPTION

2.1 VS-616HII FUNCTIONAL BLOCK DIAGRAM AND MAJOR CONTROL COMPONENT LAYOUT

VS-616HII functional block diagram is shown in Fig. 1 and major control component layout, in Fig. 2.

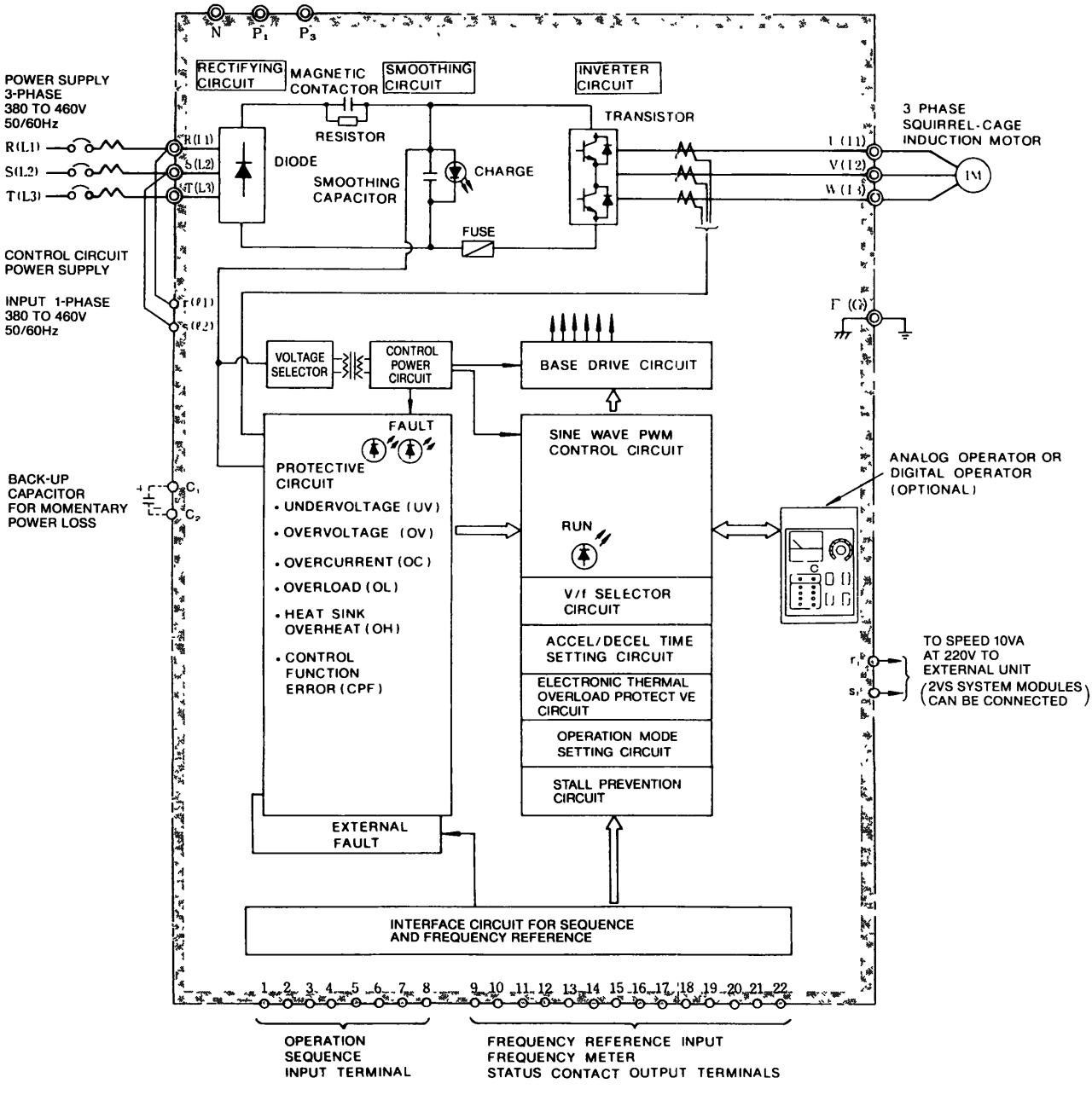


Fig. 1 VS-616HII Functional Block Diagram

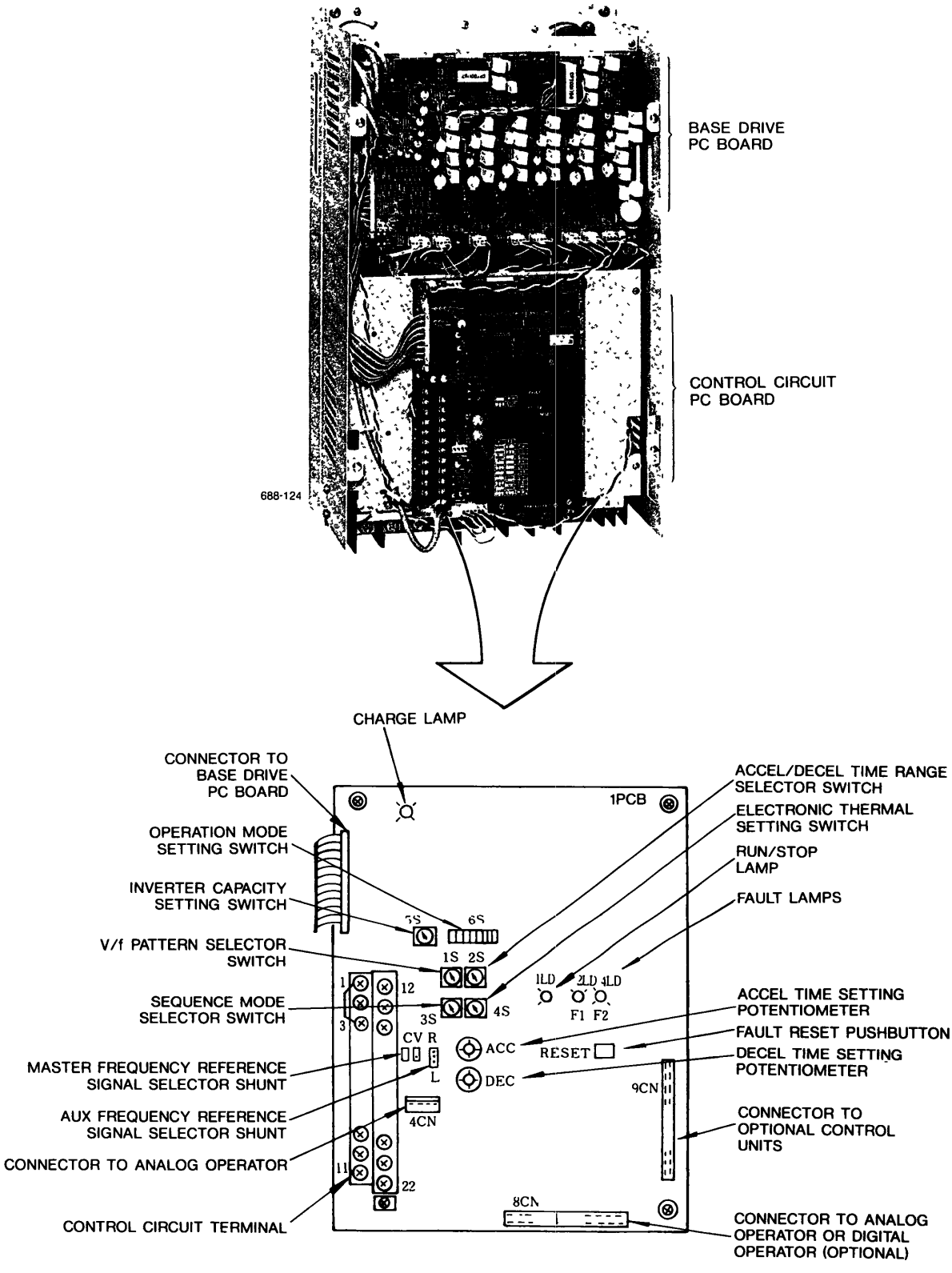


Fig. 2 Major Control Component Layout
of VS-616HII Model CIMR-H22D

2.2 CIRCUIT OPERATIONAL DESCRIPTION

2.2.1 Main Circuit

(1) Rectifying circuit: Converts three-phase AC inputs through diodes to DC voltage.

(2) Smoothing circuit: Smoothes ripples in DC voltage by means of a capacitor.

(3) Inverter circuit: Converts DC voltage to AC voltage of a preset frequency by switching six transistors. The output voltage level is controlled by changing the pulse width ratio, thus generating pseudo-sine waves.

2.2.2 Control Circuit

(1) Base drive circuit: Drives the transistors in the inverter circuit.

(2) Sine wave PWM control circuit: Calculates the pulse width every time a reference signal is received from the V/f control circuit, and outputs a PWM signal approximating a sine wave.

(3) V/f selector circuit: Selects V/f pattern from 15 types of built-in voltage/frequency (V/f) patterns (Fig. 3).

(4) Acceleration and deceleration time setting circuit: Smoothly changes the output frequency upon a rapid change of the frequency reference signal. Acceleration and deceleration times can be independently set by the acceleration (ACC) and deceleration (DEC) time setting potentiometers (Fig. 4).

(5) Stall prevention circuit

- During acceleration - Stops acceleration in the event of overcurrent condition and prevent the motor from stopping due to overcurrent. When the current returns to the rated value, acceleration is resumed.
- During deceleration - Stops deceleration in the event of overvoltage condition and prevents the motor from stopping due to overvoltage. When the voltage returns to the rated value, deceleration is resumed.
- In constant-speed operation - Reduces motor speed in the event of overload condition so as to prevent the motor from stopping due to overload. When overload condition is alleviated, motor resumes running at normal speed.

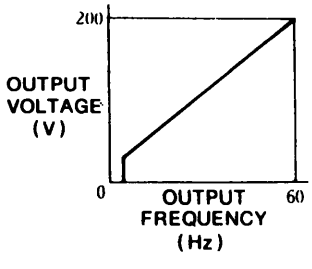


Fig. 3 Example of V/f Pattern

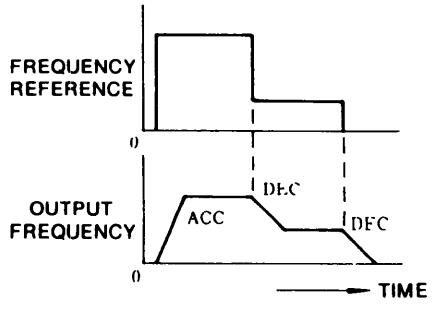


Fig. 4 Accel/Decel Time Setting

(6) Operation mode selector circuit: Selects one of eight operation modes individually to tailor the inverter to a specific applicaiton.

(7) Sequence mode selector circuit: Selects the optimum function from ten modes, according to the application.

2.2.3 Protective Circuits

See 8. Failure Indication and Details on page 26 when protective circuits function.

(1) Undervoltage protective circuit: If the supply voltage drops below a set level or any one of phases is open, the undervoltage protective circuit shuts off the power transistors in the main circuit, and outputs a fault signal (UV operation). With the appropriate operation mode selected, operation can continue if the power is resumed in approximately 0.2 seconds. Ride-through function up to 2 sec momentary power loss is available by connecting the backup capacitor on the control power supply.

(2) Overvoltage protective circuit: If the main circuit DC voltage becomes higher than the set level, the overvoltage protective circuit shuts off the power transistors in the main circuit, and outputs a fault signal (OV operation).

(3) Overcurrent protective circuit: If more than 200% of the rated current flow is detected, the overcurrent protective circuit immediately shuts off the power transistors in the main circuit, and outputs a fault signal (OC operation).

(4) Overload protective circuit: When inverter of motor overload is detected by increased motor current, the overload protective circuit shuts off the power transistors in the main circuit after a specified time, and outputs a fault signal (OL operation).

(5) Electronic thermal overload protective circuit: Automatically adjusts protective characteristics to current and time to maximize operating capability.

3. INSTALLATION

3.1 LOCATION

Location of the equipment is important to achieve proper performance and normal operating life. The VS-616HII units should be installed in areas where the following conditions exist.

- Ambient temperature: −10 to +40℃, +14 to 104°F
- Protected from rain or moisture.
- Protected from direct sunlight.
- Protected from corrosive gases or liquids.
- Free from airborne dust or metallic particles.
- Free from vibration.

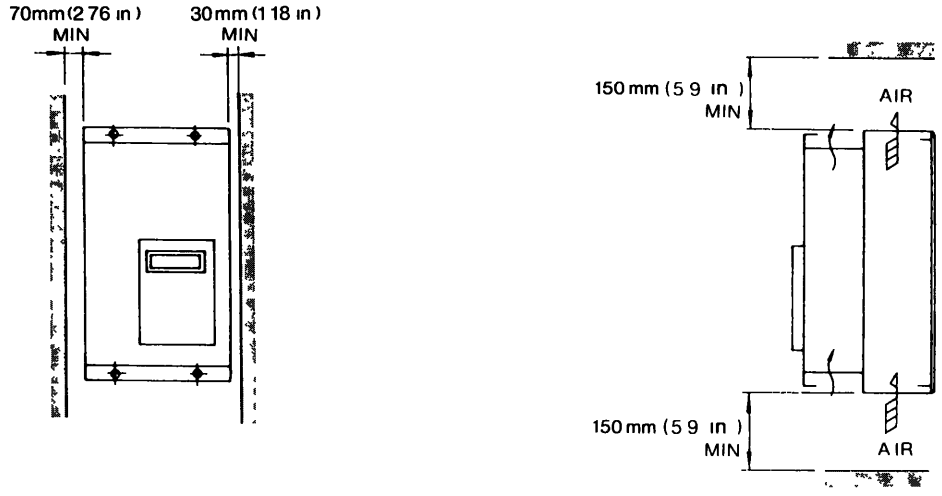
CAUTION

Never move, lift or handle the VS-616HII cabinet by the front cover.

3.2 POSITIONING

For cooling and maintenance purposes, make sure that there is sufficient clearance around the equipment, as shown in Fig. 5.

To keep effective cooling conditions, it must be installed vertically to the ground using the four mounting screws.

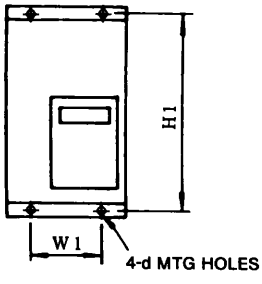


(a) Front View (b) Side View

Fig. 5 VS-616HII Clearance Requirements for Proper Cooling and Maintenance

3.3 MOUNTING DIMENSIONS

The mounting dimensions for the VS-616HII are given in Fig. 6.



Dimensions in mm (in)

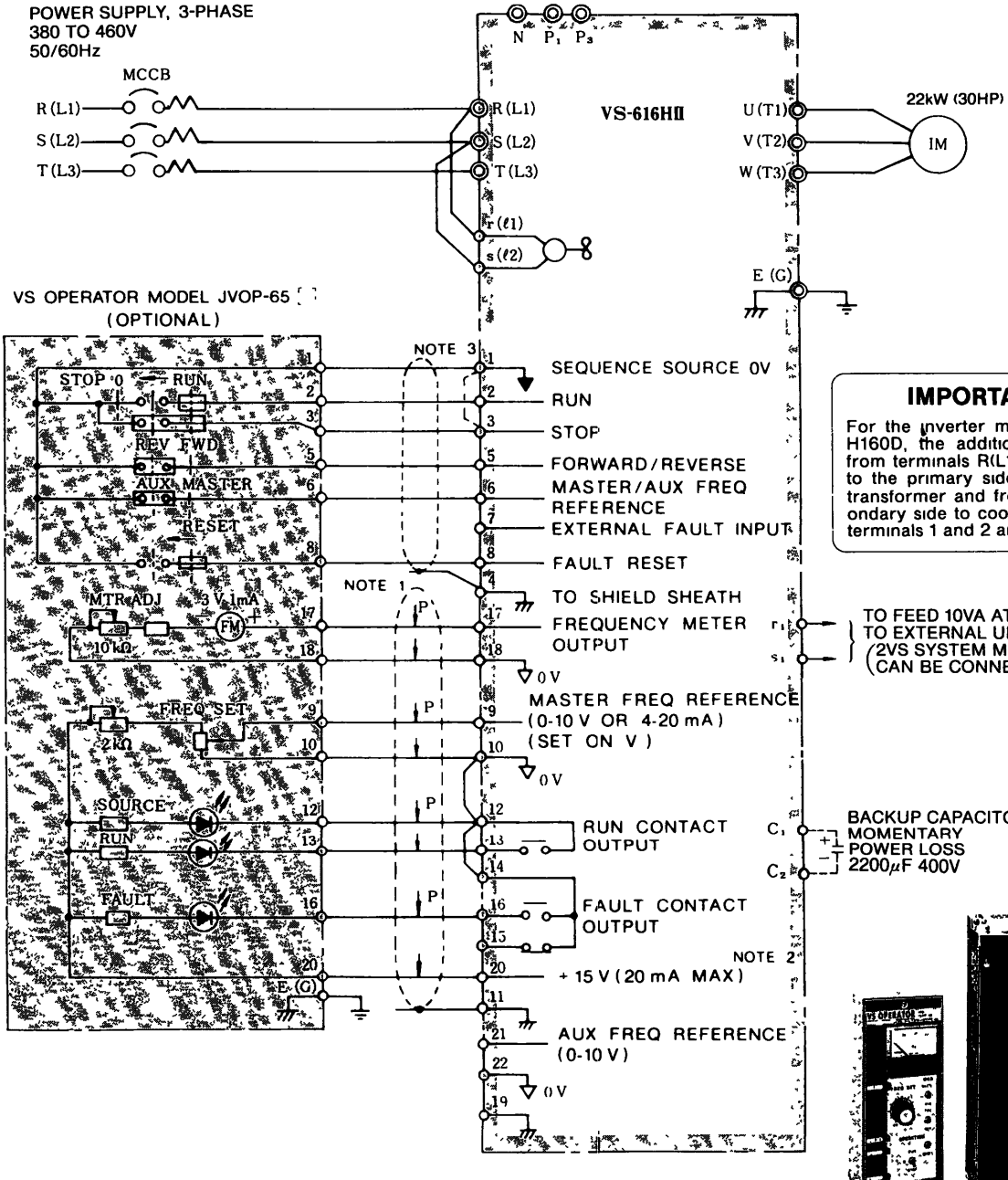
VS-616HII Model CIMR-	H185D	H22D	H30D	H37D	H45D	H55D	H75D	H110D	H160D
W1	265 (10 43)		250 (9 84)			475 (18 70)			500 (19 69)
H1	535 (21 06)		705 (27 76)			900 (35.43)			1565 (61.61)
d	M6		M8			M12			M12

Fig. 6 Cabinet Mounting Dimensions

4. WIRING

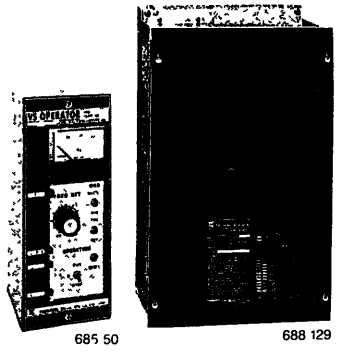
4.1 INTERCONNECTIONS

Fig. 7 shows the connection diagram for combination of VS-616HII with VS operator. Remove the front cover before wiring. Connections should be made correctly, referring to Fig. 7.



IMPORTANT

For the inverter model CIMR-H160D, the additional wirings from terminals R(L1) and S(L2) to the primary side of control transformer and from the secondary side to cooling fan unit terminals 1 and 2 are required



685 50 688 129

Note:

1. ⊣⊢ indicates shielded leads and ⊣⊢, twisted-pair shielded leads.
2. External terminal ⑳ of +15V has maximum output current capacity of 20 mA. It accomodates a single VS operator, if used.
3. When VS operator is used, remove external terminal connections between ① and ③ .
4. Terminal symbol ◎ shows main circuit, and ○ control circuit.

NOTE

Be sure to connect a surge absorber to the coils of relays, magnetic contactors, magnetic valves, or magnetic brakes

Fig. 7 Example of VS-616HII Interconnections

4.2 MOLDED-CASE CIRCUIT BREAKER (MCCB) AND POWER SUPPLY MAGNETIC CONTACTOR (MC)

Be sure to connect MCCBs between power supply and VS-616HII input terminals Ⓡ (Ⓛ1), Ⓢ (Ⓛ2), Ⓣ (Ⓛ3). Recommended MCCBs are listed in Table 2.

When a ground fault interrupter is used to prevent malfunction, setting current should be 200 mA or over and operating time, 0.2 sec or over.

Table 2 Molded-Case Circuit Breakers and Magnetic Contactors

VS-616HII	Model CIMR-	H18 5D	H22D	H30D	H37D	H45D	H55D	H75D	H110D	H160D
	Capacity kVA	25	30	40	50	60	75	110	140	200
	Rated Output Current A	38	45	60	75	90	113	165	210	300
Molded-Case Circuit Breaker	Rated Current*	60A	100A	100A	100A	150A	220A	300A	400A	600A
Yaskawa Magnetic Contactors Model		HI-35E	HI-50E	HI-65E	HI-80E	HI-100E	HI-125E	HI-200E	HI-300E	HI-500E

*Comply with NEMA AB1

4.3 SURGE ABSORBER

For the surge absorbers to be connected to the coils of relays, magnetic contactors, magnetic valves or magnetic relays. Select models from the ones listed in Table 3.

Table 3 Surge Absorbers

Coils of Magnetic Contactor and Control Relay		Surge Absorber*		
		Model	Specifications	Code No
200V to 230V	Large-size Magnetic Contactors	DCR2-50A22E	250 VAC 0 5 μF + 200 Ω	C002417
	Control Relay LY-2, -3 (OMRON) HH-22, -23 (Fuji) MM-2, -4 (OMRON)	DCR2-10A25C	250 VAC 0 1 μF + 100 Ω	C002482
380 to 460V Device		DCR2-50D100B	1000 VDC 0 5 μF + 220 Ω	C002630

4.4 WIRE SIZE

Wire sizes for main and control circuits are listed in Table 4, and Table 5 gives the selection of round pressure terminals according to wire size.

Table 4 Wire Size for Main and Control Circuits

Circuit	VS-616HII Model CIMR-	Inverter Capacity kVA	Terminal Symbols	Termina Screw	Wire Size* mm²	Wire Size* AWG	Lead Type
Main	H18.5D	25	Ⓡ (Ⓛ1), Ⓢ (Ⓛ2), Ⓣ (Ⓛ3) Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), Ⓦ (Ⓣ3) Ⓝ Ⓟ1, Ⓟ3,	M6	8–14	8–6	Power Cable· 600 V vinyl-sheathec lead or equivalent
	H22D	30					
	H30D	40		M8	22–38	4–1	
	H37D	50					
	H45D	60					
	H55D	75		M10	30–100	2–4/0	
	H75D	110			50–100	1/0–4/0	
	H110D	140					
	H160D	200		M12	100–200	4/0–MCM400	
	All models		Ⓔ(Ⓖ)	M4	2–5 5	14–10	
Control			Ⓒ1, Ⓒ2 Ⓡ (ℓ1), Ⓢ (ℓ2), Ⓡ1, Ⓢ1		0 5–2	20–14	
			① to ㉒		0 5–2	20–14	Twisted shielded lead† for for instrumentation

*Lead size should be determined considering voltage drop of leads
†Polyethlene-insulated vinyl-sheathed, with shielding

Table 5 Round Pressure Terminals

Wire Size mm²	Wire Size AWG	Terminal Screw	Round Pressure Terminal
0.5	20	M4	1 25-4
0 75	18		
1.25	16		
2	14	M4	2-4
3.5	12	M4	5 5-4
5.5	10	M5	5 5-5
8	8	M5	8-5
8	8	M6	8-6
14	6		14-6
22	4	M8	22-8
38	1		38-8
38	1	M10	38-10
60	2/0		60-10
80	3/0		80-10
100	4/0		100-10
100	4/0	M12	100-12
150	MCM300		150-12
200	MCM400		200-12

4.5 WIRING INSTRUCTIONS

4.5.1 Control Circuit

(1) Separation of control circuit leads and main circuit leads

·Signal leads ① through ㉒ must be separated from main circuit leads Ⓡ (Ⓛ1), Ⓢ (Ⓛ2), Ⓣ (Ⓛ3), Ⓝ, Ⓟ1, Ⓟ3, Ⓤ (Ⓣ1), Ⓥ (Ⓣ2) and Ⓦ (Ⓣ3) to prevent erroneous operation caused by noise interference. If signal leads ⑫ to ⑯ (contact output) are connected to another power supply, separate them from ① to ⑪ and ⑰ to ㉒.

(2) Control circuit leads

Use the twisted shielded or twisted-pair shielded lead for the control circuit line and connect the shield sheath to the any of the inverter terminals ④, ⑪, or ⑲. See Fig. 8.

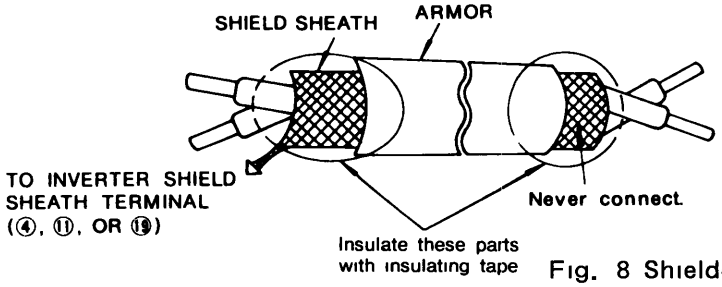


Fig. 8 Shielded Lead Termination

(3) Wiring distance

It is recommended that the wiring distance of the signal leads (① - ㉒) be 50 meters (164 feet) or below.

4.5.2 Main Circuit Input/Output

(1) Direction of phase rotation of power

- Phase rotation of power is available to each direction, clockwise and counterclockwise.
- When inverter output terminals Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), and Ⓦ (Ⓣ3) are connected to motor terminals Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), and Ⓦ (Ⓣ3), respectively, motor rotates counterclockwise, viewed from opposite drive end, upon forward operation command. To reverse the rotation interchange any two of motor leads.

(2) Never connect power supply to output terminals Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), and Ⓦ (Ⓣ3).

(3) Care should be taken to prevent contact of wiring leads with VS-616HII cabinet, for short-circuit may result.

(4) To feed DC power supply from terminals Ⓟ1 and Ⓝ, remove the leads across Ⓡ (Ⓛ1), and ⓡ (ℓ1), and Ⓢ (Ⓛ2) and ⓢ (ℓ2). Connect cooling fan and magnetic contactor power supply (380 to 460V, 50/60Hz) across terminals ⓡ (ℓ1) and ⓢ (ℓ2).

(5) Never connect power factor correction capacitor, noise filter to VS-616HII output.

(6) After completing VS-616HII interconnections, be sure to check that connections are correct. Never use control circuit buzzer check.

4.5.3 Grounding

Make a positive grounding using ground terminal Ⓔ (Ⓖ) on the casing of VS-616GHII.

(1) Ground resistance should be 100Ω or less.

(2) Never ground VS-616HII in common with welding machines, motors, and other large-current electrical equipment, or ground pole. Run the ground lead in a separate conduit from leads for large-current electrical equipment.

(3) Use ground lead listed in Table 3 and make the length as short as possible.

(4) Even when VS-616HII is grounded through its mounting such as channel base or steel plate, be sure to ground VS-616HII using the ground terminal Ⓔ (Ⓖ) .

(5) Where several VS-616HII units are used side by side, all the units should preferably be grounded directly to the ground poles. However, connecting all the ground terminals of VS-616HII in parallel, and ground only one of VS-616HII to the ground pole is also permissible (Fig. 9). However, do not form a loop with the ground leads.

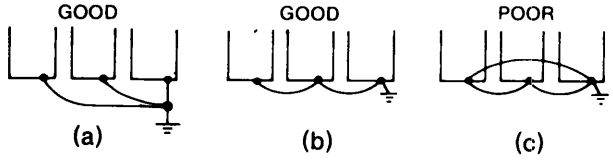


Fig. 9 Grounding of Three VS-616HII Units

INSULATION RESISTANCE TEST

For megger-testing the main circuit, measure the insulation resistance with a 500V megger.

Connect the AC input, output terminals Ⓒ1 to Ⓦ (Ⓣ3), by a common wire, and connect the control terminals ① - ㉒ (excluding ④, ⑪, ⑲) by a common wire as shown in Fig. 10. After that, measure the insulation resistance between the common wire of input/output terminals and ground with a megger. Never measure the insulation resistance of circuit other than main circuit (power line). For both the input and output terminals, a reading above 1MΩ is considered satisfactory.

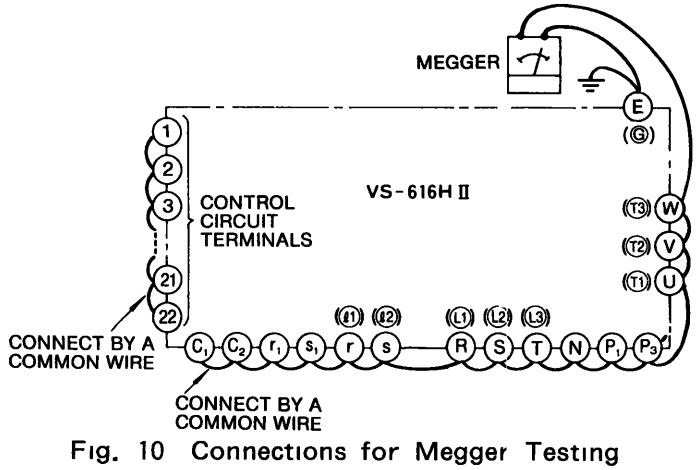


Fig. 10 Connections for Megger Testing

5. TEST RUN

5.1 CHECKS BEFORE TEST RUN

After completing mounting and connection of untis, check for:

- Correct connections
- No short-circuit conditions
- No loose screw terminals (Check especially for loose wire clippings.)
- Proper load condition

5.2 PRESETTING AND ADJUSTMENT BEFORE TEST RUN

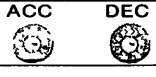
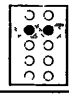
Before setting, be sure to shut off the AC main circuit power and make sure that the CHARGE lamp goes out. If any setting except for accel/decel time is performed with the power on, the following failure indicators will blink:

- FAULT lamp on the inverter
- CPF lamp, if the Analog or Digital operator is used

If any setting is changed during operation, the operation will continue with the setting made before the change. If the VS-616HII is turned off and then on again, it operates with the changed settings.

- The VS operator provides no failure indication for setting with power ON.

Table 6 List of Setting Switches

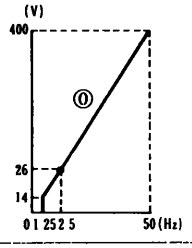
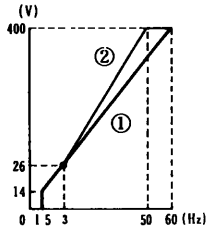
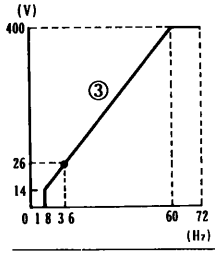
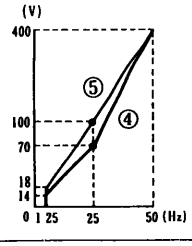
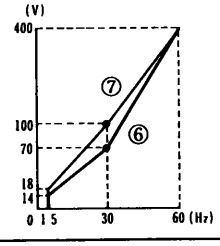
Switch Name			Symbol	Function	Factory-setting
Control PC Board (1PCB)	V/f Pattern Selector Switch		1S	Selects one of 15 V/f patterns to match specific applications	Notch ①
	Accel/Decel Time Setting	Switch	2S	Selects accel/decel time range (0.1 to 1800 seconds)	Notch ①
		Potentiometer	ACC DEC 	Accel/decel times independently adjustable	Scale 5
	Sequence Mode Selector Switch		3S	Selects one of 10 types of sequences according to application requirements	Notch ⓪
	Electronic Thermal Setting Switch		4S	Protects motor and inverter from overcurrent conditions if motor capacity is different from inverter capacity.	(See Tables 9 and 10)
	Inverter Capacity Selector Switch		5S	Set according to inverter capacity	(See Table 11)
	Operation Mode Selector Switch		6S	Selects the operation mode according to specific applications	OFF
	Master Frequency Reference Signal Selector Shunt		C V	Selects either a current signal (4-20 mA) or a voltage signal (0–10 V) to feed frequency reference signal at terminal ⑨	V (Voltage signal)
	Auxiliary Frequency Reference Signal Selector Shunt		R L	Set to input frequency reference at external terminal ㉑ When the Analog operator is used for frequency setting, set the shunt on "L" because signals from external terminal ㉑ are not accepted	R
Voltage Selector PC Board (3PCB)	Power Voltage Selection Connector		 460V 440V 415V 400V 380V	Set according to power voltage to be used	440 V

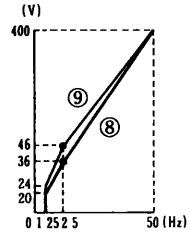
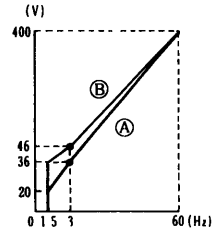
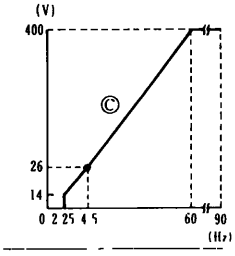
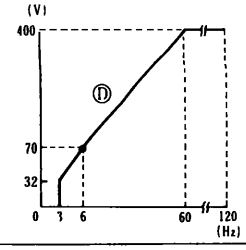
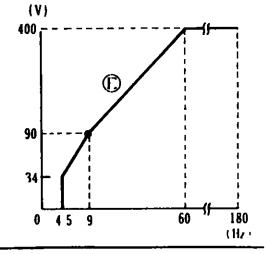
5.2 PRESETTING AND ADJUSTMENT BEFORE TEST RUN (Cont'd)

(1) Setting of V/f pattern selector switch (1S)

The V/f pattern selector switch (1S) has been factory-set at the notch ① for most applications. For specific applications such as fans and pumps, high-starting torques, or machine tools, select the optimum V/f pattern for motor running, according to the load characteristics. (See Table 7.)

Table 7 V/f Pattern Selection (Input Supply Voltage: 400)

Application	Specification		1S Notch	V/f Pattern
General Purpose	50Hz		⓪	
	60Hz	60Hz Saturation	①	
		50Hz Saturation	②	
	72Hz		③	
Variable Output (Fans and Pumps)	50Hz	Variable Torque 2	④	
		Variable Torque 1	⑤	
	60Hz	Variable Torque 2	⑥	
		Variable Torque 1	⑦	

Application	Specification		1S Notch	V/f Pattern
High Starting Torque	50Hz	Starting Torque Low	⑧	
		Starting Torque High	⑨	
	60Hz	Starting Torque Low	Ⓐ	
		Starting Torque High	Ⓑ	
Constant Output (Machine Tools)	90Hz		Ⓒ	
	120Hz		Ⓓ	
	180Hz		Ⓔ	

Note 1 Take account of the following conditions and others when selecting V/f pattern
- Pattern matching the voltage-frequency characteristic of the motor
- According to the maximum motor speed.

2. V/f pattern for high starting torque should be selectcd for
- Long wiring distance.
- Large voltage drop at start
- AC reactor connected to input or output of the inverter
- Use of motor of the rating below the max

For details, contact Yaskawa representative

(2) Setting of acceleration and deceleration times (2S, ACC, DEC)

Set the acceleration and deceleration times using acceleration time range selector switch (2S), and the acceleration (ACC) and deceleration (DEC) time setting potentiometers (Table 8).

2S has been factory-set to notch ① , and the ACC and DEC potentiometers have been individually set to scale 5 (approximately 10 seconds).

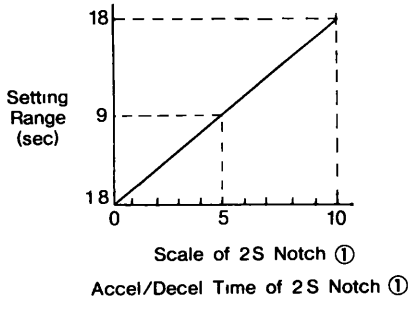


Table 8 Accel/Decel Time Range Setting

2S Notch	Accel/Decel Time Setting Range (sec)
⓪	0.1–6
① (Factory setting)	1.8–18
②	6–60
③	18–180
④	60–600
⑤–Ⓓ	180–1800
Ⓔ	Soft start/stop function not provided
Ⓕ	For calibrating freq meter See para 5.4 on page 25

(3) Selection of sequence mode (3S)

The standard sequence mode selector switch (3S) is paint-locked to notch ⓪.

Notches ① to Ⓕ provide sequences for special applications. For details, contact Yaskawa representative.

(4) Setting of electronic thermal setting switch (4S)

When a motor has a capacity different from the maximum applicable capacity of the inverter, the VS-616HII setting must be changed to suit the motor capacity to protect the motor positively. Table 9 on page 18 shows the selections of Yaskawa standard motors (4 poles). The switch has been factory-set to the notch marked off by shading.

When VS-616HII motors are used, set the switch (4S) according to Table 10 on page 18. (Notch F inactivates the motor protection by the electronic thermal function.)

.Table 9 Notch Selection of Electronic Thermal Overload Protective Switch (Use of Standard Motor)

VS-616HII Model CIMR-	kVA	Max Motor Output kW (Hp)												
		11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)	55 (70)	75 (100)	90 (120)	110 (148)	132 (177)	160 (215)
H18 5D	25	①	③	⑥	—	—	—	—	—	—	—	—	—	—
H22D	30	—	①	③	⑥	—	—	—	—	—	—	—	—	—
H30D	40	—	—	①	③	⑥	—	—	—	—	—	—	—	—
H37D	50	—	—	—	①	③	⑥	—	—	—	—	—	—	—
H45D	60	—	—	—	—	①	③	⑥	—	—	—	—	—	—
H55D	75	—	—	—	—	—	①	③	⑥	—	—	—	—	—
H75D	110	—	—	—	—	—	—	①	③	⑥	—	—	—	—
H110D	140	—	—	—	—	—	—	—	—	①	③	⑥	—	—
H160D	200	—	—	—	—	—	—	—	—	—	—	①	③	⑥

Table 10 Notch Selection of Electronic Thermal Overload Protective Switch (Use of VS-616HII Motor)

VS-616HII Model CIMR-	kVA	Max Motor Output kW (Hp)												
		11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)	55 (70)	75 (100)	90 (120)	110 (148)	132 (177)	160 (215)
H18 5D	25	Ⓔ	Ⓒ	⑨	—	—	—	—	—	—	—	—	—	—
H22D	30	—	Ⓔ	Ⓒ	⑨	—	—	—	—	—	—	—	—	—
H30D	40	—	—	Ⓔ	Ⓒ	⑨	—	—	—	—	—	—	—	—
H37D	50	—	—	—	Ⓔ	Ⓒ	⑨	—	—	—	—	—	—	—
H45D	60	—	—	—	—	Ⓔ	Ⓒ	⑨	—	—	—	—	—	—
H55D	75	—	—	—	—	—	Ⓔ	Ⓒ	⑨	—	—	—	—	—
H75D	110	—	—	—	—	—	—	Ⓔ	Ⓒ	⑨	—	—	—	—
H110D	140	—	—	—	—	—	—	—	—	Ⓔ	Ⓒ	⑨	—	—
H160D	200	—	—	—	—	—	—	—	—	—	—	Ⓔ	Ⓒ	⑨

(5) Selection of inverter capacity (5S)

The switch 5S has been factory-set to agree with the inverter capacity as shown in Table 11.

Table 11 Inverter Capacity Selection

VS-616HII Model CIMR-	kVA	5S Notch
H18 5D	25	⑤
H22D	30	⑥
H30D	40	⑦
H37D	50	
H45D	60	⑧
H55D	75	
H75D	110	Ⓑ
H110D	140	Ⓓ
H160D	200	Ⓕ

(6) Selection of operation modes (6S)

Select the operation modes from Table 12 according to the application, and set the switch (6S) as appropriate. Notches ① to ⑦ have been factory-set to OFF and ⑧ to ON.

Table 12 Selection of Operation Modes

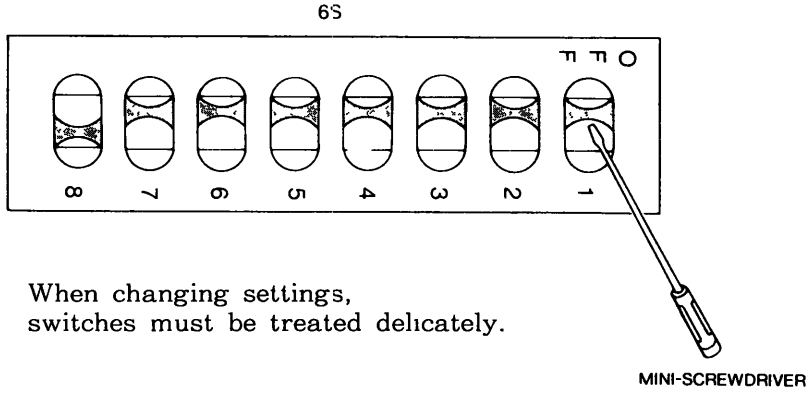
6S Notch	Function	ON/OFF Setting	Description of Operation Mode
①	Dynamic Braking (DB)	OFF	The motor is decelerated until it reaches 1/40 rated speed with the frequency reduced, and DB operation is performed at the speeds less than 1/40 rating
		ON	The motor is decelerated until it reaches 1/40 rated speed with the frequency reduced, and is coasting to a stop
②	Stopping	OFF	The motor stops in the mode set by notch ① of 6S when a STOP command is input
		ON	The motor is coasting to a stop when a STOP command is input ignoring 6S setting of notch ①
③	Stall Prevention during Deceleration	OFF	Too high load GD^2 during deceleration activates stall prevention function and extends the set decel time
		ON	Stall prevention function during deceleration not provided
④	Stopping Free-run Motor	OFF	DB operation is not applied at the start
		ON	Motor starts after DB operation is applied (DB operation within 1/5 decel time)
⑤	Operation Continuation at Momentary Power Loss	OFF	Motor coasts to a stop at momentary power loss
		ON	Motor resumes running after momentary power loss of approximately 2 seconds or less, it coasts to a stop more than 2 seconds of momentary power loss
⑥	Operation Continuation after Momentary Power Loss* (When notch ⑤ of 6S is ON)	OFF	Restarts operation after motor residual voltage is reduced upon recovery from momentary power loss
		ON	Immediately restarts operation upon recovery from momentary power loss†
⑦	Jogging	OFF	Full-voltage operation is performed at 1/10 rated speed when jog command is input
		ON	Frequency acceleration and deceleration is performed at 1/10 rated speed when jog command is input.
⑧	Main Circuit Magnetic Contactor† Interlock	OFF	For inverters rated 200 to 230V
		ON	For inverters rated 380 to 460V

*Speed search function starts when motor speed is decreased due to momentary power failure and load current.

†OC (overvoltage) protective circuit may be activated according to power recovery timing and load conditions. AC reactor should be connected or an inverter one size larger than specified should be selected.

5.2 PRESETTING AND ADJUSTMENT BEFORE TEST RUN (Cont'd)

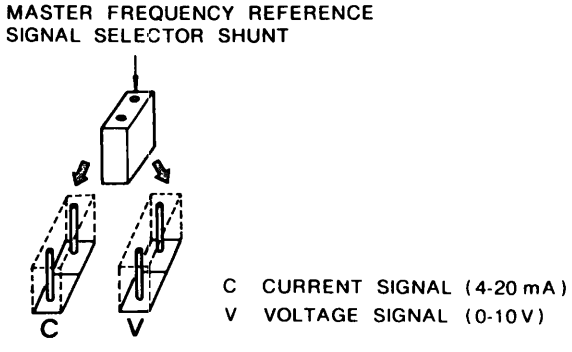
Fig. 11 ON/OFF Switches of 6S (1 to 8)



(7) Selection of master frequency reference signal

When the frequency reference signal is input from input terminal ⑨, select either a current signal (4 to 20mA) or a voltage signal (0 to 10V) (Fig. 12). The voltage reference signal (V) is factory-selected.

Fig. 12 Master Frequency Reference Signal Selection

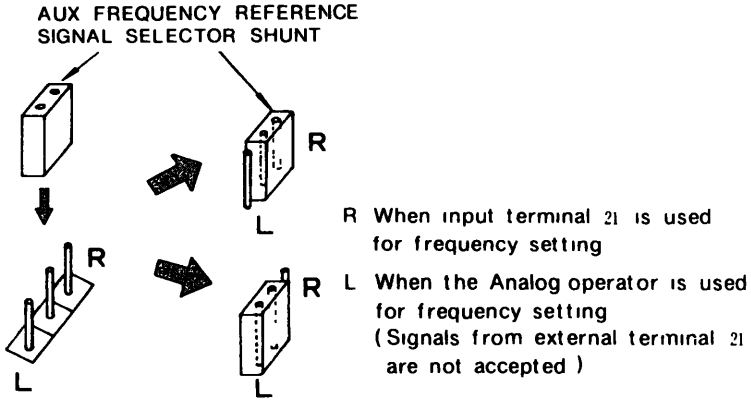


(8) Selection of auxiliary frequency reference signal

When the Analog operator (optional) is not used, input terminal 21 can be used for frequency setting. The auxiliary frequency reference signal selector shunt must be set as illustrated in Fig. 13.

The shunt is factory-set to (L) for use with Analog operator, and to (R) for other applications.

Fig. 13 Auxiliaiy Frequency Reference Signal Selection



(9) Setting power voltage selection connector

Power voltage connector shown in Fig. 15 must be selected according to the type of AC main circuit power supply.
Set the connector to the position corresponding to power voltage to be applied. The connector has been factory-set at 440V.

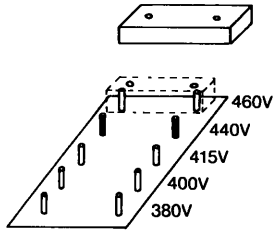


Fig. 14 Selecting Power Voltage

5.3 TRIAL OPERATION/TEST RUN

Whenever possible, uncouple the motor from the driven machine. If the motor must be rotated with the driven machine connected, make sure that all dangerous conditions have been eliminated.

Fig. 15 shows the run-stop time chart when notches ① and ② of operation mode setting switch 6S are set to OFF.

Test run procedure is given in three ways (use of Analog operator, Digital operator, and VS operator). If any fault occurs, isolate the trouble spot, referring to Par. 9 Troubleshooting.

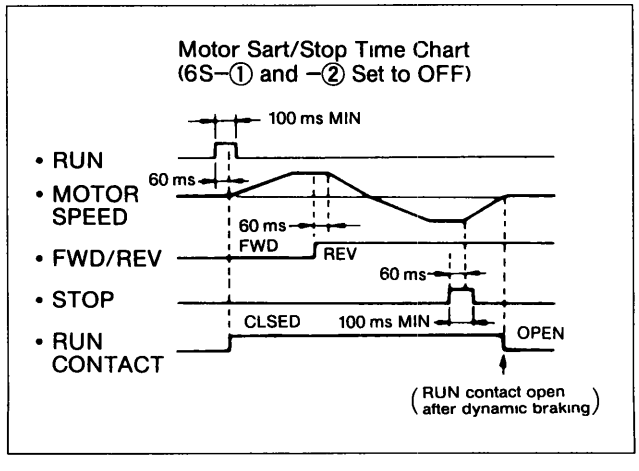


Fig. 15 Run and Stop Time Chart

5.3.1 Use of Analog Operator Model JVOP-72• (Optional) (Fig. 16)

1. Set the AUTO/MAN switch to MAN, move the FWD/REV switch to FWD, and turn the FREQ SET potentiometer fully counterclockwise to LOW.
2. Turn on the VS-616HII AC main circuit power (circuit breaker). The STOP lamp (orange) lights.
3. Move the RUN/STOP switch to RUN with the FREQ SET potentiometer at LOW. It causes the RUN lamp (green) to light.
4. Slowly turning the FREQ SET potentiometer clockwise starts running the motor, with the frequency meter reading the output frequency. Make sure that the motor is running forward. If shaft rotation is incorrect, turn off AC main circuit power, and reverse any two of motor leads Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), Ⓦ (Ⓣ3).
5. By turning the FREQ SET potentiometer slowly clockwise or counterclockwise, the motor accelerates or decelerates smoothly. Set the maximum motor speed by turning the FREQ SET potentiometer fully clockwise to HIGH and check the motor for normal running. After this check, return the FREQ SET potentiometer fully counterclockwise to LOW.
6. To stop the motor, set the RUN/STOP switch to STOP, and the STOP lamp comes on.

PRESET START

To make the preset start (a "one-touch" operation at a preset frequency), use steps 1 to 2 mentioned above and then proceed as follows.

(a) Set the frequency using frequency setting potentiometer. Move the RUN/STOP switch to RUN, and the motor accelerates within the time set in Par. 5.2 (2) on page 17, then keeps on running at the preset frequency. If the motor does not run smoothly during acceleration (with the acceleration stall prevention function working), or if any FAULT lamp comes on, the acceleration time is assumed to have been set too short for the load level; extend the acceleration time.

(b) Set the RUN/STOP switch to STOP to stop the motor. The motor decelerates in the time set in Par. 5.2 (2) on page 17, then stops. If the motor does not run smoothly during deceleration function working), or if any failure indicator comes on, the deceleration time is assumed to have been set too short for the load level; increase the deceleration time.

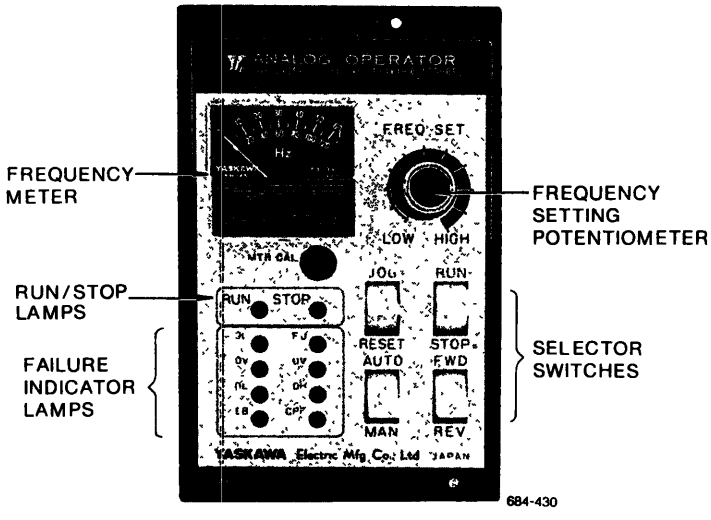


Fig. 16 Analog Operator (Optional)

5.3.2 Use of Digital Operator Model JVOP-71 (Optional) (Fig. 17)

1. Turn on the VS-616HII AC main circuit power (circuit breaker). Then "AUTO," "MONI," "0.0Hz," "STOP," and "FWD" are shown on the Digital operator display.
2. Display "MAN" by pressing [AUTO / MAN] key.
3. Make sure that "FWD" is displayed.

   If "REV" is displayed, press [FWD / REV] key to display "FWD."

4. Confirm that the motor runs forward slowly while [JOG] key is being pressed. If shaft rotation is incorrect, turn off AC main circuit power, and reverse any two of motor leads. (The jog operation mode outlined in Par. 5.2 (6) on page 19 is selected.
5. Display "REV" by pressing [FWD / REV] key again, and make sure that the motor runs in reverse direction with JOG key pressed.
6. Pressing [DISP] key changes "MONI" to "SET," placing the operator in the setting mode. Select a digit to be set by operating [◁] or [▷] key. It is indicated by blinking. Pressing [◁] key moves blinking one space to the left, and [△] key one space to the right. Set the required frequency by operating [△] or [▽]. Pressing [△] key increases the blinking value by one, and [▽] key decreases by one. After finishing the setting, press [ENTER] key.
7. Pressing [RUN] key displays "RUN." The motor then accelerates within the preset acceleration time and keeps on running at the frequency set in step 6.
8. To display the output frequency, press [DISP] key again. "SET" changes to "MONI," and the output frequency appears.
9. Pressing [STOP] key switches "RUN" to "STOP." The motor then decelerates within the preset deceleration time and stops.

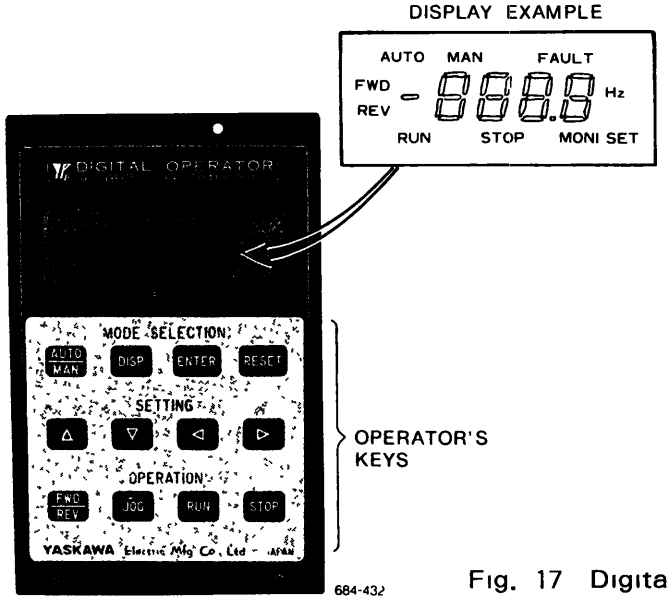


Fig. 17 Digital Operator (Optional)

5.3.3 Use of VS Operator Model JVOP-65• (Optional) (Fig. 18)

Complete the connection of units according to example in Fig. 7, on page 11 and perform the test run using the following procedures.

1. Set the MASTER/AUX switch to MASTER, move the FWD/REV switch to FWD, and turn the FREQ SET potentiometer fully counterclockwise to LOW.
2. Turn on the VS-616HII AC main circuit power (circuit breaker), and the SOURCE lamp (green) will light.
3. Change the RUN/STOP switch to RUN with the FREQ SET potentiometer at LOW, and RUN lamp (green) will light.
4. Slowly turning the FREQ SET potentiometer clockwise causes the motor to start running and the frequency meter to indicate the output frequency. Make sure that the motor is running forward. If shaft rotation is incorrect, turn off AC main circuit power, and reverse any two of motor leads Ⓤ (Ⓣ1), Ⓥ (Ⓣ2), Ⓦ (Ⓣ3).
5. By turning the FREQ SET potentiometer clockwise or counterclockwise, the motor accelerates or decelerates smoothly. Also, set the maximum speed of the motor by turning the FREQ SET potentiometer fully clockwise to HIGH, and check the motor for normal running. After this check, return the FREQ SET potentiometer fully counterclockwise to LOW.
6. To stop the motor, set the RUN/STOP switch to STOP, and the RUN lamp goes out after the motor stops.

PRESET START

To make the preset start (a "one-touch" operation at a preset frequency), apply steps 1 to 2 mentioned above and then proceed as follows.

(a) Set the frequency using frequency setting potentiometer. Set the RUN/STOP switch to RUN, and the motor accelerates within the time set in Par. 5.2 (2) on page 17, then keeps on running at the preset frequency. If the motor does not run smoothly during acceleration (with the acceleration stall prevention function working), or if a FAULT lamp comes on, the acceleration time is assumed to have been set too short for the load level; increase the acceleration time.

(b) To stop the motor, change the RUN/STOP switch to STOP. The motor decelerates within time set in Par. 5.2 (2) on page 17, then stops. If the motor does not run smoothly during deceleration (with the deceleration stall prevention function working), or if a FAULT lamp comes on, the deceleration time is assumed to have been set too short for the load level; increase the deceleration time.

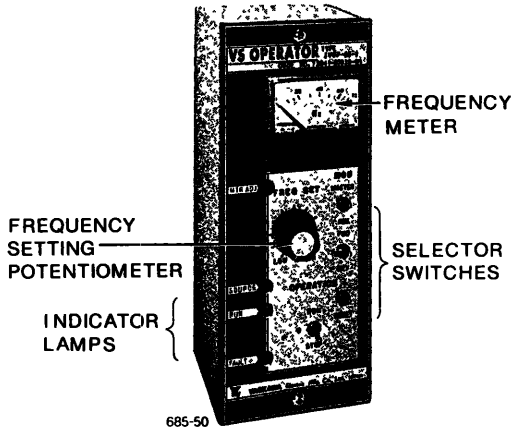


Fig. 18 VS Operator (Optional)

5.4 FREQUENCY METER CALIBRATION

When the Analog or VS operator is used, the frequency meter must be calibrated. The motor need not be run during calibration. Perform the following procedures:

1. Shut off the AC main circuit power.
2. Record the position (notch number) of setting switch 2S on the control PC board.
3. Set 2S to notch Ⓕ.
4. Turning on the main circuit power causes the meter to indicate approximately the rated frequency.
5. Adjust MTR CAL potentiometer of the Analog operator (or MTR ADJ potentiometer of the VS operator) so that the meter reads the rated frequency.
6. After the adjustment, turn off AC main circuit power again, then return setting switch 2S to the recorded position.

6. OPERATION AT LOAD

After the no-load operation, turn off the AC main circuit power, and connect the driven machine to the motor. Make sure that the driven machine is in running condition, and there is no danger around VS-616HII system, and run the motor under load in exactly the same way as for test run.

PRECAUTION

(1) Start the motor after making sure that the motor is stopped. If the operation is started during motor coasting, overvoltage (OV) or overcurrent (OC) protective circuit may be operated.

(2) The motor can be operated by an operation signal from either the inverter-mounted operator or external terminal ②. This selection can be made only when the inverter is standby.

(3) The motor can be stopped unconditionally by a STOP signal from either the inverter-mounted operator or external terminal ③. Either stop command takes priority over any other command in operation.

(4) When a standard motor is driven with the inverter, there is a little increase in motor temperature, noise, and vibration as compared to the operation from the commercial power supply.

(5) The motor cooling effect lowers during low-speed running. The torque needs to be reduced in accordance with the frequency. (For the reduction ratio, refer to the catalog or technical sheet.)

(6) Even with small load, never use a motor whose current exceeds the inverter rating. When two or more motors are operated, check to be sure that the total motor current is not larger than inverter rating.

(7) When starting and stopping the motor, be sure to use the operation signals (RUN and STOP), not the magnetic contactor on the power supply side. Exception: If the magnetic contactor is to be used to start and stop a motor, see A3-2, (5) on page 41. Care should be taken not to start and stop the motor frequently.

7. MAINTENANCE

VS-616HII requires almost no routine checks. It will function efficiently and longer if it is kept clean, cool and dry, observing precautions listed in 3. 1 Location, on page 9. Especially check for tightness of electrical connections, discoloration or other signs of overheating. Use Table 13 as the inspection guide. Before servicing inspection, turn off AC main circuit power and be sure that CHARGE lamp is off.

Table 13 Periodical Inspection

Component	Check	Corrective Action
External terminals, unit mounting bolts, connectors, etc	Loosened screws	Tighten
	Loosened connectors	Tighten
Cooling fins	Build-up of dust and dirt	Blow with a dry compressed air of 4 to 6 kg·cm^2 (57 to 85 lbs in^2) pressure
Printed circuit board	Accumulation of conductive dust and oil mist	Clean the board If dust and oil cannot be removed, replace the board
	Discoloration to brown	Replace the board
Cooling fan	For abnormal noise and vibration Whether the cummulative operation time exceeds 20,000 hours or not	Replace the cooling fan
Power elements	Accumulation of dust and dirt	Blow with a dry compressed air of 4 to 6 kg·cm^2 (57 to 85 lbs in^2) pressure
Smoothing capacitor	Discoloration or odor	Replace the capacitor or inverter unit

8. FAILURE INDICATION AND DETAILS

A failure, if it is detected, can shut off the output power transistor and output FAULT contact signals across control circuit terminals ⑭, ⑮, and ⑯.

When Analog or Digital operator is used, failure indications listed in Table 14 will function. When neither of them is used, failure conditions are shown by FAULT lamps F1 and F2 on the VS-616HII.

Table 14 Failure Indication

Indication		Symptom	VS 616 HII Operation
FU (Fuse Blown)		Main circuit fuse blown	Inverter stops output momentarily (Motor is coasting)
OC (Overcurrent)		More than 200 percent of rated current flow in inverter output side (Instantaneous operation)	
OL (Overload)		Overload of motor and inverter detected by electronic thermal	
OV or OU†‡ (Overvoltage)		Main circuit DC voltage higher than approx 790 V	
UV* or UU*† (Undervoltage)		Main circuit DC voltage lower than approx 420 V	
OH (Heat Sink Overheat)		Thermoswitch operated by overheat of heat sink of main circuit semiconductor	
EB or Eb† (External Failure)		Fault signal is input from external terminal	
CPF	Steady (Major Control Function Error)	CPU and major control function error detected by self-diagnostic function	
	Blinks (Setting error)	Any one of setting switches (1S to 6S) changed with power ON	#

*In operation continuation after a momentary power failure mode (⑤ notch of 6S ON), UV lamp is flashing for approx two seconds
†For Digital operator display
‡FAULT will be displayed with OU on the screen of Digital operator

Inverter continues operation When the setting is returned to the state before change, the display replaces the normal operation status

Table 15 Failure Indication of VS-616HII

Indication F1	Indication F2	Cause	
□	■■	FU (Fuse Blown) Main circuit fuse blown	Inverter stops output momentarily (Motor is coasting)
□	■■■	OC (Overcurrent) More than 200 percent of rated current flow in inverter output side	
□	■	OL (Overload) Overload of motor and inverter detected by electronic thermal overload protective circuit	
■■	■	OV (Overvoltage) DC bus voltage higher than 790 V	
■■■	■	UV 1 (Undervoltage) DC bus voltage lower than approx 420 V with 6S-⑤ set to ON (F1 blinking for 2 seconds UV 1 indication changed to UV 2)	
■	■	UV 2 (Undervoltage) DC bus voltage lower than 420 V	
■■	□	OH (Heat Sink Overheat) Thermoswitch operated by overheat of heat sink of main circuit semiconductor	
■■■	□	EB (External Failure) Fault signal is input from external terminal	
■	□	CPF (Control Function Error) Detection of the failure of CPU and main control function by self-diagnostic function	
■■■	■■■	CPF SEL (Selection Error) Any one of setting switches (1S to 6S) changed with power ON	#

Note Indication status is as follows
□ Light OFF
■■■ Blinking at equal intervals
■■ Blinking at short-long intervals
■ Light ON

Inverter continues operation When the setting is returned to the state before change, the display replaces the normal operation status

9. TROUBLESHOOTING

If the VS-616HII malfunctions, find the cause and take the corrective action by following the flowcharts given in this section.

If the cause cannot still be located by the flowcharts, the inverter or some parts are damaged, or any other problem occurs, contact Yaskawa representative.

9.1 MEASURING POINT AND INSTRUMENT

Since the VS-616HII transistor inverters utilize the PWM control mode, unless specified instruments are used, correct measurement cannot be made.

The measuring points and the measuring instruments are shown in Fig. 19 on page 29 and Table 16.

Table 16 Measuring Points and Instruments

Item	Points	Instrument	Note
Supply Voltage V_1	Across R-S(L1-L2) S-T(L2-L3) T-R(L3-L1) (VR) (VS) (VT) ($V_{L1\,L2}$, $V_{L2\text{-}L3}$, $V_{L3\text{-}L1}$)	Moving-iron type, or rectifier type voltmeter	
Power Supply Current I_1	Line current R, S, T(L1, L2, L3) (AR) (AS) (AT) (A_{L1}, A_{L2}, A_{L3})	Moving-iron type	
Power Supply Power* P_1	R, S, T(L1, L2, L3) and across R-S(L1-L2), S-T(L2-L3) T-R(L3-L1) (WR) (WS) (WT) (W_{L1}, W_{L2}, W_{L3})	Electrodynamometer type, Use 3 identical single-phase meters	$P_1 = W_R + W_S + W_T$
Power Supply Power Factor Pf_1	Calculate from measured supply voltage, supply current, and supply power $Pf_1 = \frac{P_2}{\sqrt{3}V_1I_1} \times 100(\%)$		
Output Voltage V_2	Across U-V(T1-T2), V-W(T2-T3), W-U(T3-T1) (VU) (VV) (VW) ($V_{T1\text{-}T2}$, $V_{T2\text{-}T3}$, $V_{T3\,T1}$)	Rectifier type (YOKOGAWA 2017 or equivalent) Moving-iron type can not be used	1000 V full scale for 400 V circuit
Output Current I_2	Line current at U, V, W(T1, T2, T3) (AU) (AV) (AW) (A_{T1}, A_{T2}, A_{T3})	Moving-iron type	
Output Current P_2	U, V, W(T1, T2, T3) and across U-V(T1-T2), V-W(T2-T3), W-U(T3-T1) (WU) (WV) (WW) (W_{T1}, W_{T2}, W_{T3})	Electrodynamometer type, Three identical rating single-phase meters are used	$P_2 = W_u + W_v + W_w$
Output Power Factor Pf_2	Calculated same as power factor on supply side $Pf_2 = \frac{P_2}{\sqrt{3}V_2I_2} \times 100(\%)$		
Frequency Setting Signal	Across ⑨ – ⑩ Across ㉑ – ㉒	Moving-coil type (Multimeter is OK) (Internal resistance 50 kΩ max)	0 to 10 V DC
Frequency Monitor	Across ⑰ – ⑩		10 VDC at max frequency (Without frequency meter)

*To measure the power, use the power meter incorporating a hall generator HIOKI TYPE 3161 Power meter (made by HIOKI Electric, Japan)

The output voltage Ⓤ (T1), Ⓥ (T2), Ⓦ (T3) has been measured with a YOKOGAWA 2017 (rectifier type) voltmeter before shipping.

Fig. 20 on page 29 shows an example of actually measured output voltage. The rectifier type instruments give different readings, depending on type.

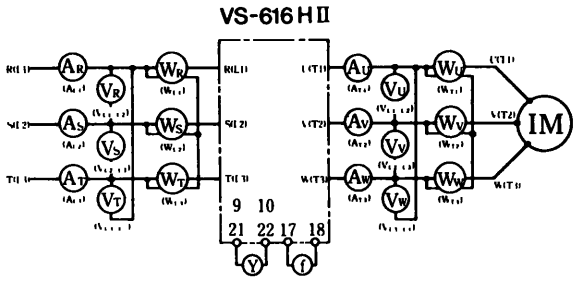


Fig. 19 Points for Measurement

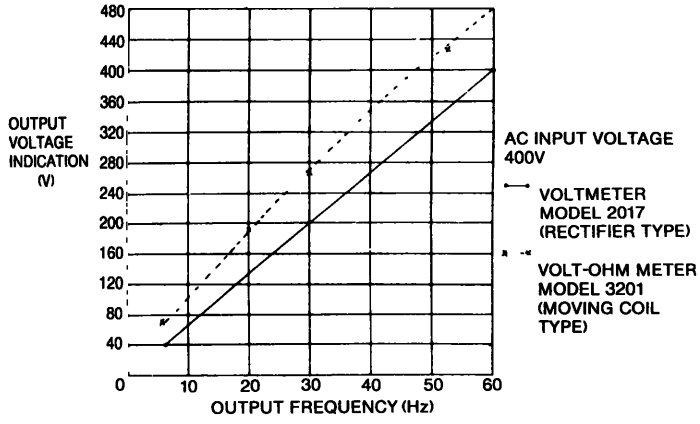


Fig. 20 Output Voltage Measurement

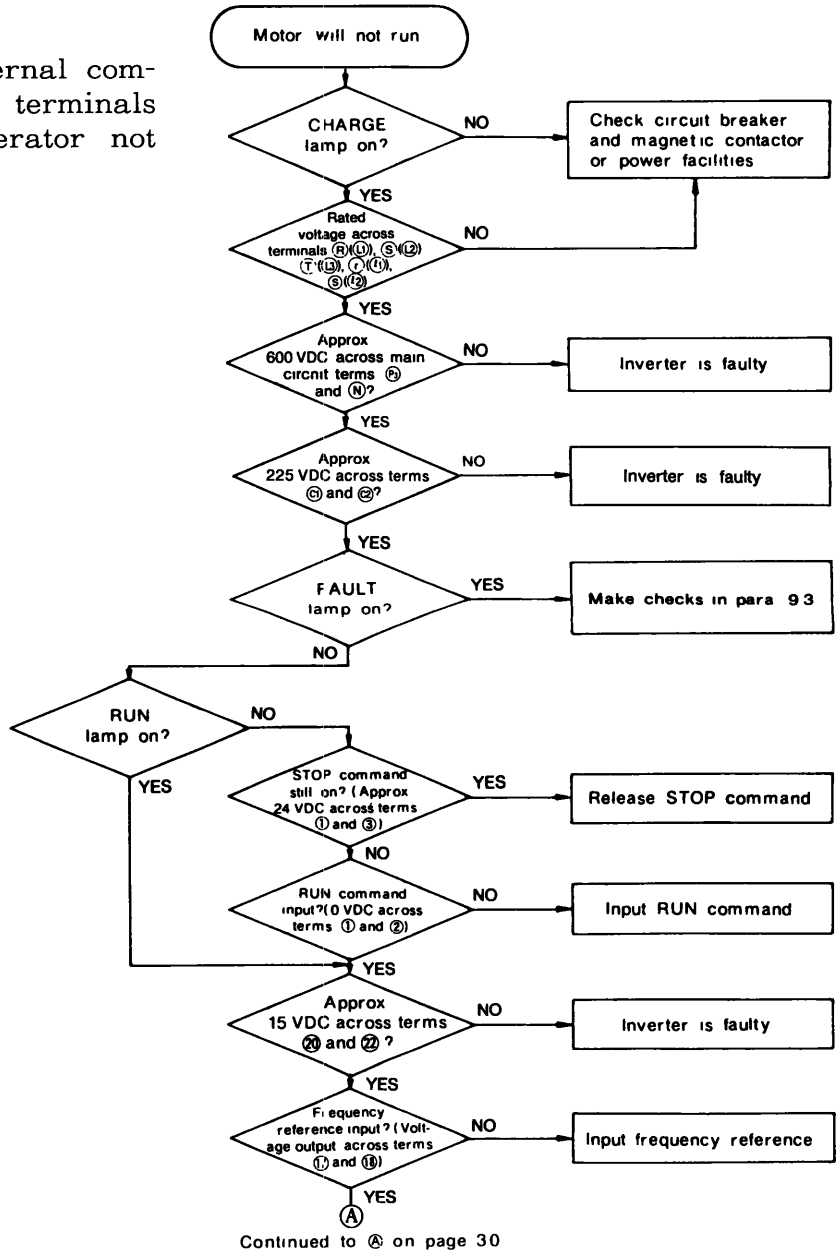
9.2 TROUBLESHOOTING FOR MOTOR SYMPTOM

(1) Motor will not run.

For operation from external command through external terminals (Digital or Analog operator not used)

Legend of Chart Symbols

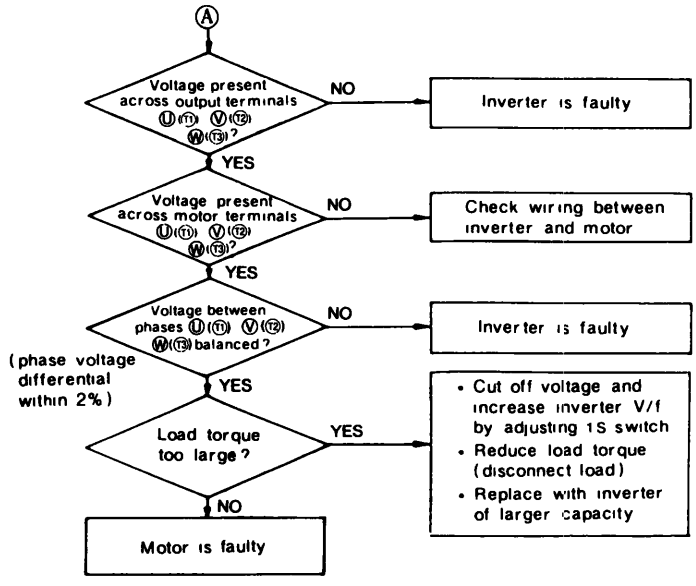
- The beginning of the chart.
- Decision. "YES," or "NO".
- Process. Action is required or description of situation.



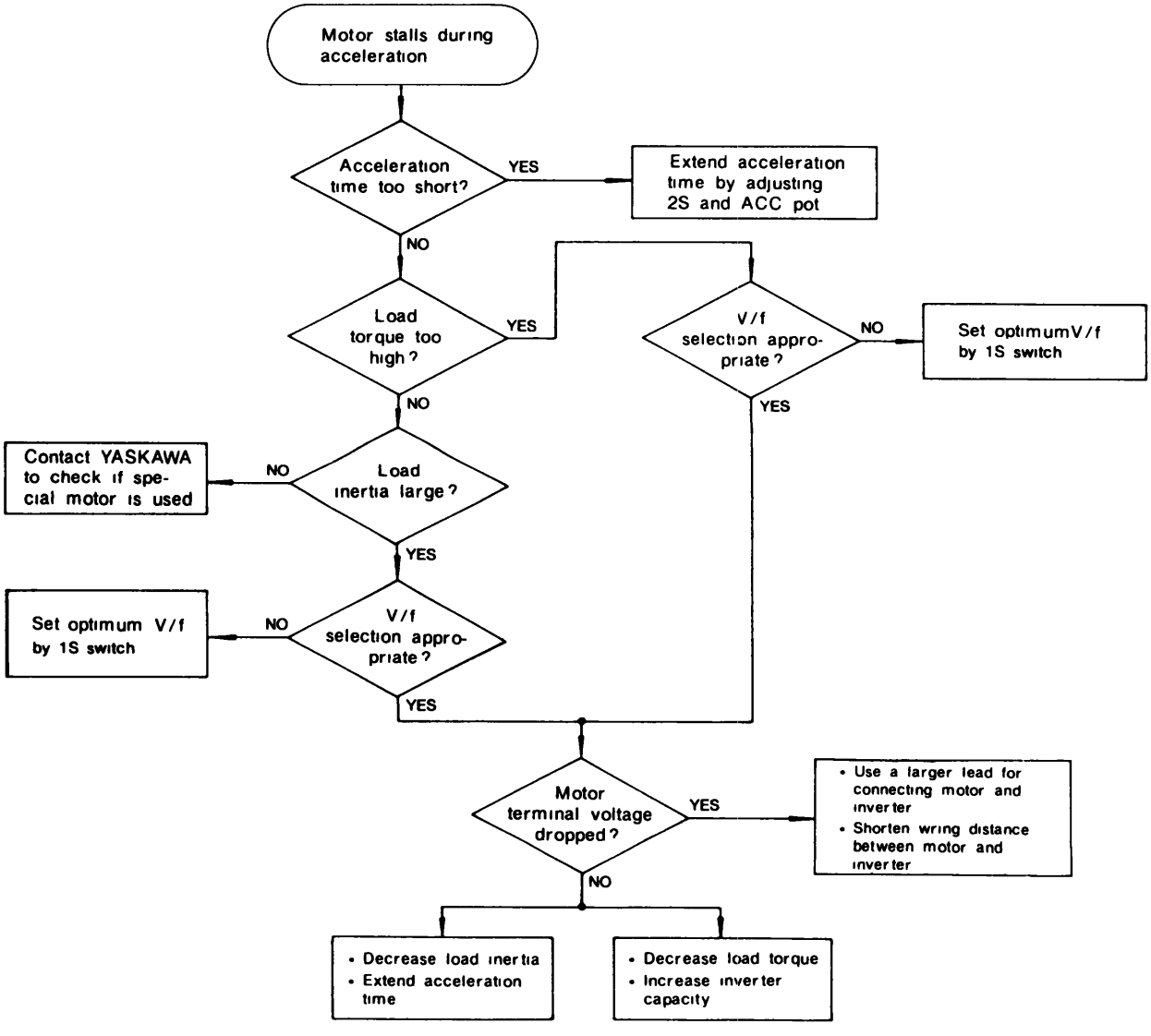
Continued to Ⓐ on page 30

9.2 TROUBLESHOOTING FOR MOTOR SYMPTOM (Cont'd)

Continued from Ⓐ on page 29



(2) Motor stalls during acceleration



9.3 TROUBLESHOOTING FOR FAILURE INDICATIONS

When the inverter protective function works, the malfunctions are detected by failure indicators. The predictable symptoms are as follows:

(1) Fuse blown

(2) Overvoltage of the main circuit DC bus.

(3) Overcurrents in load.

(4) Overloaded operation.

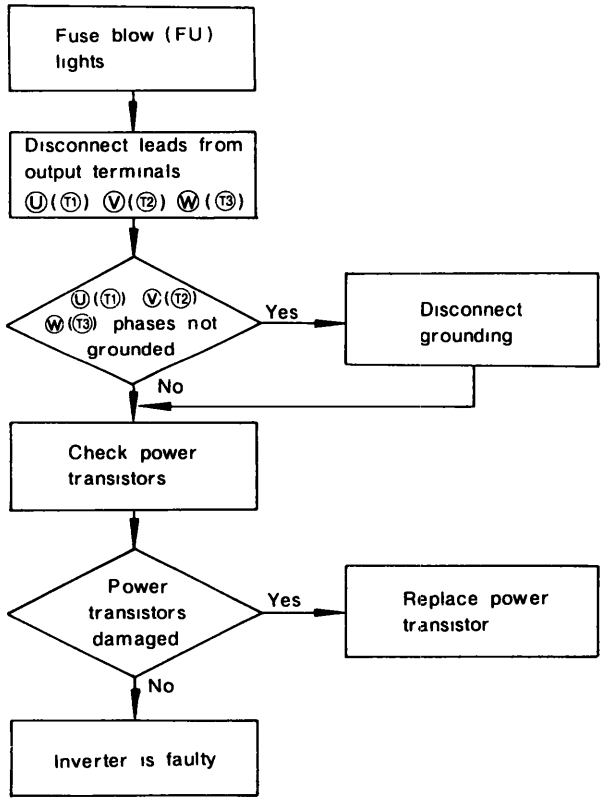
(5) Undervoltage of the main circuit DC bus.

(6) The inverter overheated.

(7) The control function went down.

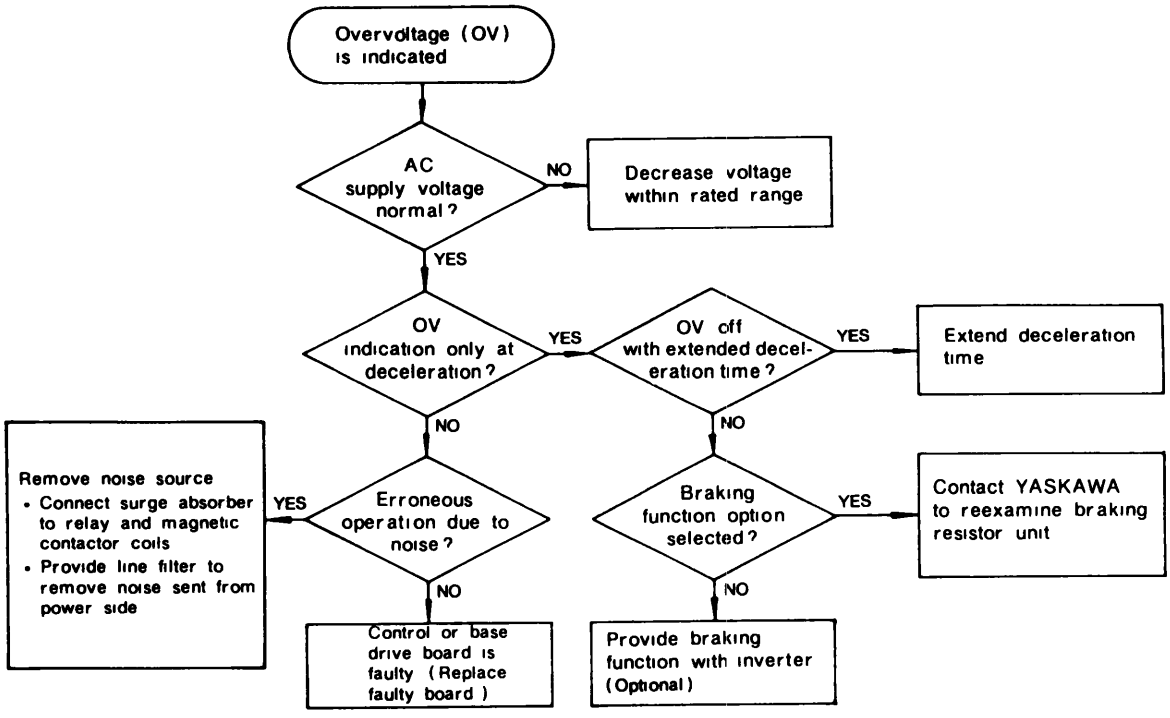
(8) A fault signal input.

(1) Fuse blow (FU) is turned on:
When the fuse blows, be sure to check the power transistor, even when the cause is on the load side.

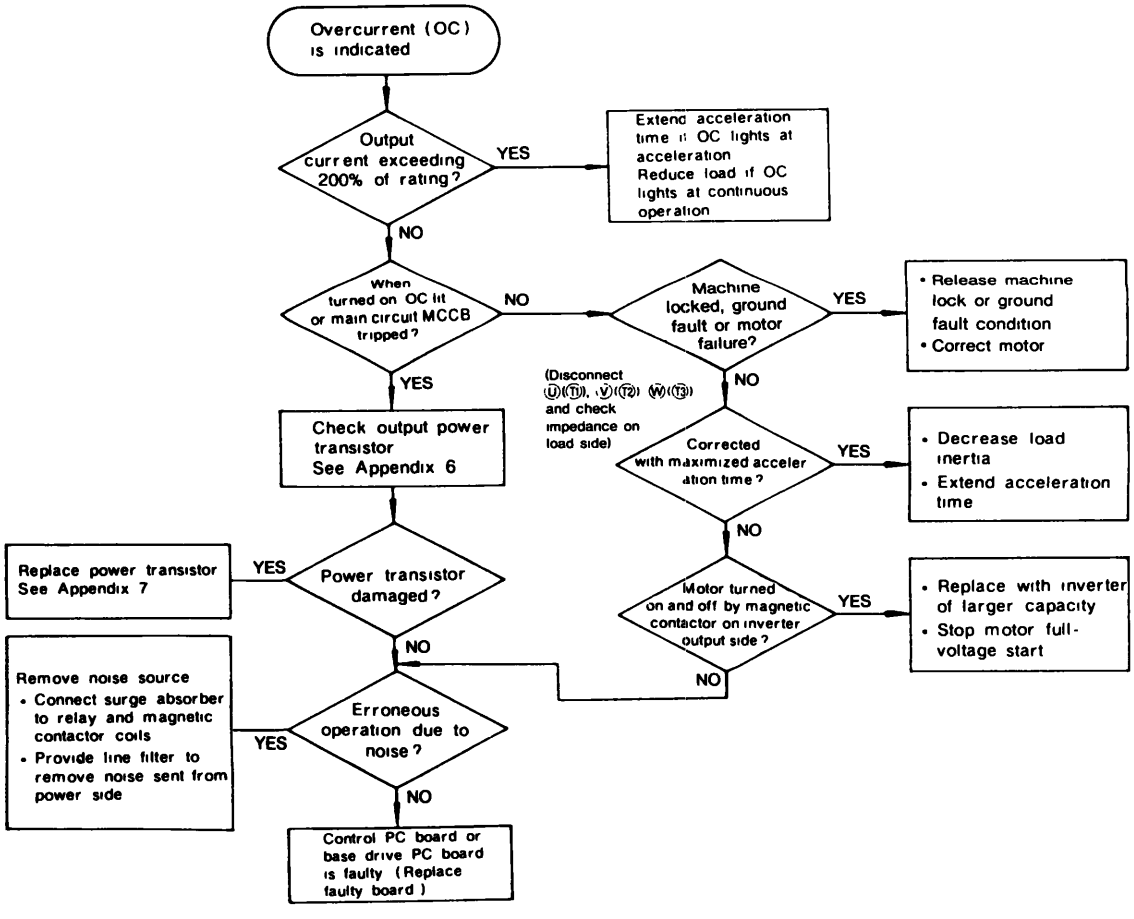


9.3 TROUBLESHOOTING FOR FAILURE INDICATIONS (Cont'd)

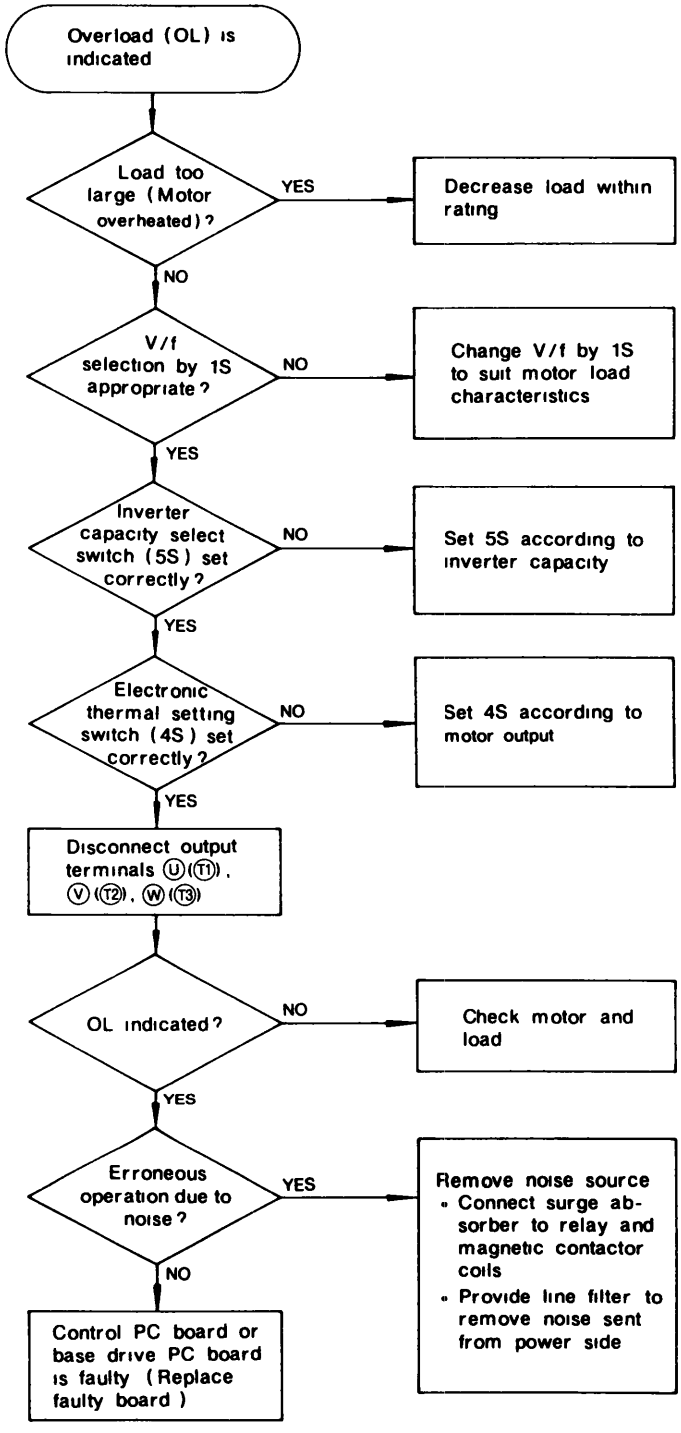
(2) Overvoltage (OV) indication



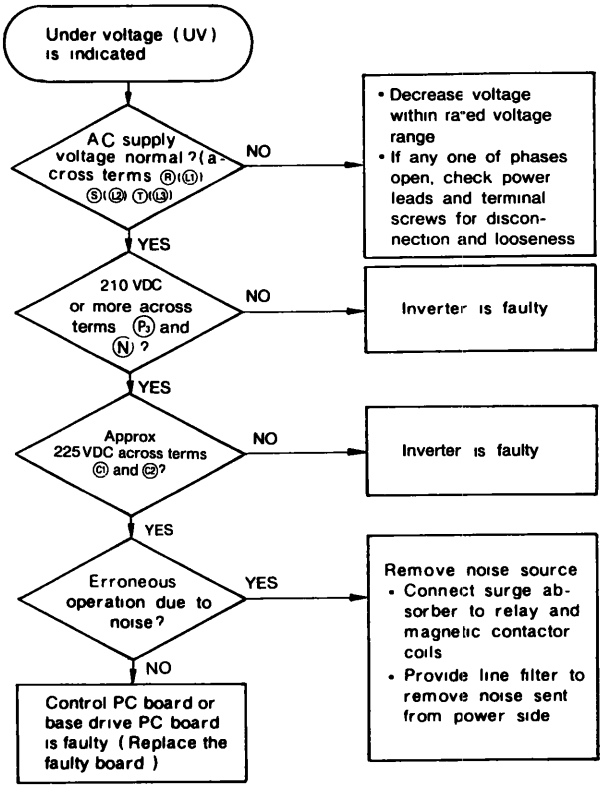
(3) Overcurrent (OC) indication



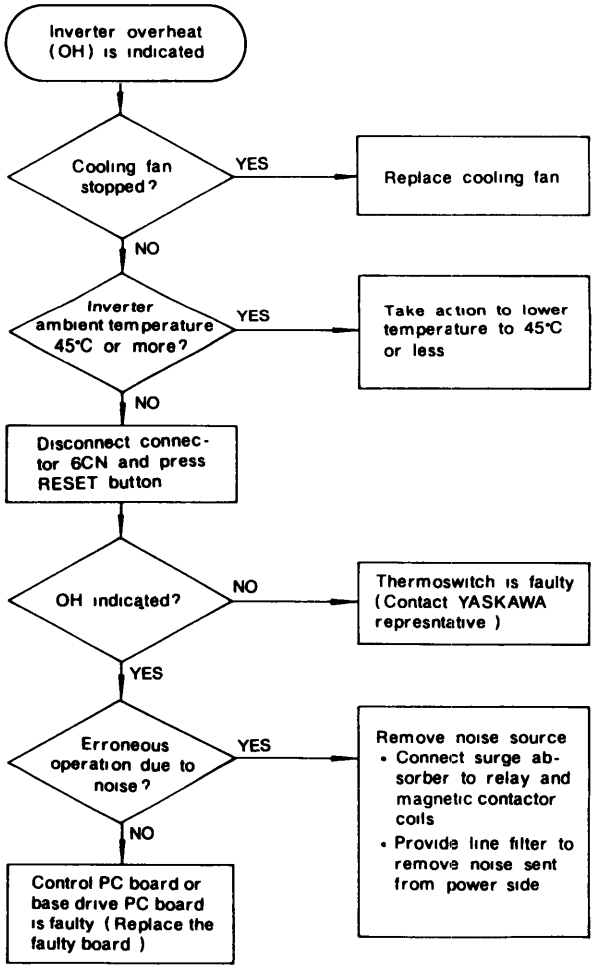
(4) Overload (OL) indication



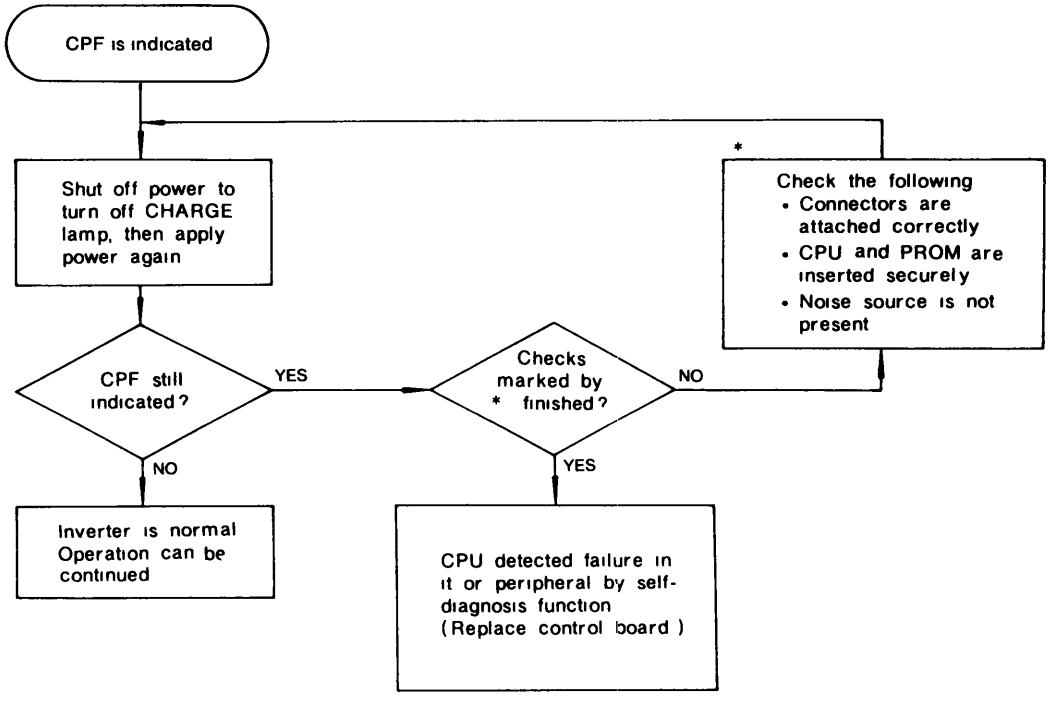
(5) Undervoltage (UV) indication



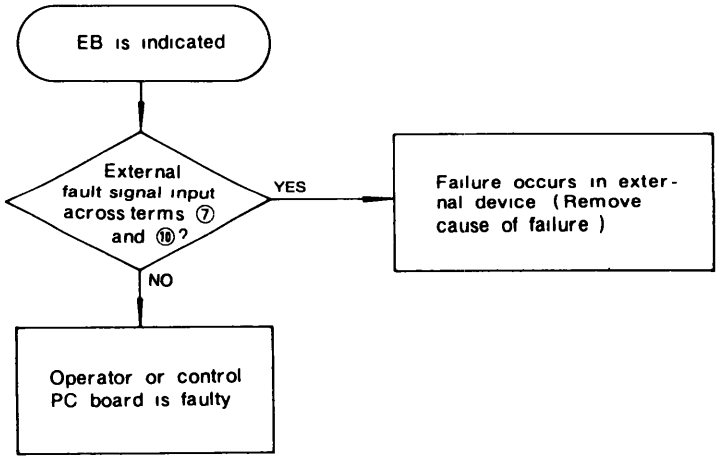
(6) Inverter overheat (OH) indication



(7) CPF indication



(8) EB indication



APPENDIX 1 VS-616HII RATINGS AND SPECIFICATIONS

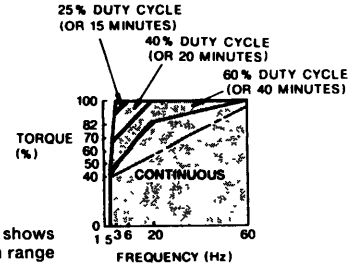
Table 17 VS-616HII Ratings and Specifications (400 Series)

Inverter Model CIMR-□			H18 5D	H22D	H30D	H37D	H45D	H55D	H75D	H110D	H160D
Output Characteristics	Max Applicable Motor Output*	kW (HP)	18 5 (25)	22 (30)	30 (40)	37 (50)	45 (60)	55 (70)	75 (100)	110 (148)	160 (215)
	Inverter Capacity	kVA	25	30	40	50	60	75	110	140	200
	Rated Output Current	A	38	45	60	75	90	113	165	210	300
	Max Continuous Output Current	A	42	50	66	83	100	125	180	230	330
	Max Output Voltage		3-Phase, 380/400/415/440/460 VAC (Proportional to input voltage)								
	Rated Output Frequency		50, 60, 72, 120, 180 Hz (Up to 396 Hz available as an option)								
Power Supply	Rated Input Voltage and Frequency		3-Phase, 380/400/415/440/460 V 50/60 Hz								
	Allowable Voltage Fluctuation		Within ± 10 %								
	Allowable Frequency Fluctuation		Within ± 5 %								
Control Characteristics	Control Method		Sine wave PWM								
	Frequency Control Range		40 1								
	Frequency Accuracy		Digital command 0 01% (−10 to 40°C), Analog command 0 2% (25°C ±10°C)								
	Frequency Resolution		Digital reference with Digital operator, 0 1Hz, with Precision controller 0 004Hz/60Hz Analog reference with Analog operator, 0 06Hz/60Hz, with High-precision AD converter 0 004Hz/60Hz								
	Overload Capacity		150 % for one minute								
	Frequency Setting Signal		0 to 10 VDC, 4-20 mA (500 Ω)								
	Accel/Decel Time		0 1 to 1800 sec, 6 ranges selectable, Accel/Decel time set independently								
	Efficiency		Approx 95 %								
	Braking Torque		Approx 20 % (100 %, provided with braking unit and braking resistor unit 10 % duty cycle)								
	No of V/f Patterns		15 in total 4 For general purpose, 4 For high starting torque 4 For fans and pumps, 3 For machine tools								
Protective Functions	Motor Overload Protection		Electronic thermal relay (4)								
	Instantaneous Overcurrent		Base blocked at approx 200 % rated current								
	Overload		Base blocked at 150 % load for 1 minute								
	Overvoltage		Base blocked if converter output voltage exceeds 790 V								
	Undervoltage		Base blocked if converter output voltage drops to 420 V or below								
	Momentary Power Loss		Immediately stop by momentary power loss detection † (Continues system operation during power loss less than 0 2 sec by setting on notch ⑤ of 6 S switch)								
	Fin Overheat		Thermostat (trips a fin temperature of approx 90°C)								
	Stall Prevention		Stall prevention at acceleration /deceleration and constant-speed operation								
	Ground Fault		Electronic circuit								
	Power Charge Indication		Charge lamp keeps ON until converter output voltage drops below 50 V								
Environmental Condition	Location		Indoor (protected from corrosive gases and dust)								
	Ambient Temperature		10 to 40°C (not frozen)								
	Storage Temperature		− 20 to 60°C †								
	Humidity		90 % RH (no condensation)								
	Vibration		1G less than 20 Hz, up to 0 2 G at 20 to 50 Hz								
Approx Weight		kg (lbs)	30 (66 14)		50 (110 50)			95 (209 95)			170(374 86)
Dimensions mm (in)		Width	325 (12 80)		350 (13 78)			575 (22 64)			600(23 62)
		Height	550 (21 65)		725 (28 54)			925 (36 42)			1600(62 99)
		Depth	255 (10 04)		280 (11 02)			280 (11 02)			456(17 95)

*For standard motors rated 4 poles at 60 Hz

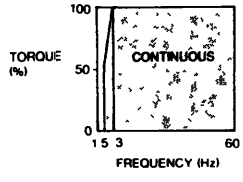
†When external terminals ⑥ and ⑦ are connected with capacitor 2200μF 400V, the ride through function up to approx 2 sec momentary power loss is performed (This function is available for CIMR-160D without the capacitor)

†Temperature during shipping Storing in this temperature for a long-period may deteriorate main circuit capacitor, contact your Yaskawa representative



Note Dashed line shows continuous operation range 75 and 110 kW

General-purpose Motors
For 18 5 to 55 kW



Inverter Motors
For 18 5 to 110 kW

APPENDIX 2 TERMINAL FUNCTIONS

Table 18 Terminal Functions and Voltages of Main Circuit

Terminals	Functions	Levels
R (L1)	Main circuit input power supply	380/400/415/440/460 V (± 10 %) 50/60 Hz
S (L2)		
T (L3)		
r (ℓ 1)	Control circuit power supply input	
s (ℓ 2)		
U (T1)	VS-616HII output	Three-phase 380/400/415/440/460 V (± 10 %) (corresponding to input voltage)
V (T2)		
W (T3)		
P_1, N	For extention of main circuit capacitor (Same capacity as internal inverter can be connected.)	Approx 600 VDC (across the terminals Ⓟ, Ⓟ, -Ⓝ)
P_3, N	For braking unit	
C_1, C_2	For backup capacitor for momentary power loss	Approx 300 VDC
r_1, r_2	External power supply	220 VAC, 50/60 Hz
E	Ground terminal	—

Table 19 Terminal Functions and Signals of Control Circuit

Terminals	Functions		Levels
1	Sequence control input common terminal		Sequence control input 0 V
2	Run signal		Run at closed*
3	Stop signal		Stop at open†
4	Connection to shield sheath of signal lead		—
5	Foward / Reverse operation selector		Forward at open†, Reverse at closed*
6	Master/Aux frequency reference selector		Master speed at open†, Aux at closed
7	External fault input		Fault at closed†
8	Fault reset input (external)		Fault reset at closed*
9	Master speed frequency reference input		0 to + 10 V or 4 – 20mA (500 Ω)
10			0 V
11	Connection to shield sheath of signal lead		—
12	Run contact output‡ (1NC)	Open† during run	Contact capacity· 250 VAC at 1A or below 30 VDC at 1A or below
13			
14	Fault contact output (1NONC)	Common	Contact capacity· 250VAC at 1A or below 30 VDC at 1A or below
15		Closed* at fault	
16		Open† at fault	
17	Frequency meter input		Approx + 10V/100%, output impedance 3kΩ
18			0
19	Connection to shield sheath of signal lead		—
20	Aux frequency input		+15V (VS-616HII internal power supply)
21			+10V/100%
22			0 V

*Short-circuited with terminal ①
†Opening terminal
‡Used as a zero-interlock contact With notches ① and ② of operation mode selector switch 6S set OFF, RUN contact is on at RUN command and off after DB operation at STOP command

APPENDIX 3 INTERNAL CIRCUIT AND INTERCONNECTION DIAGRAMS

VS-616HII used in the internal circuit and interconnection diagrams is of Model CIMR-H160D, 400V, 200kVA.

A3-1 VS-616HII INTERNAL CIRCUIT

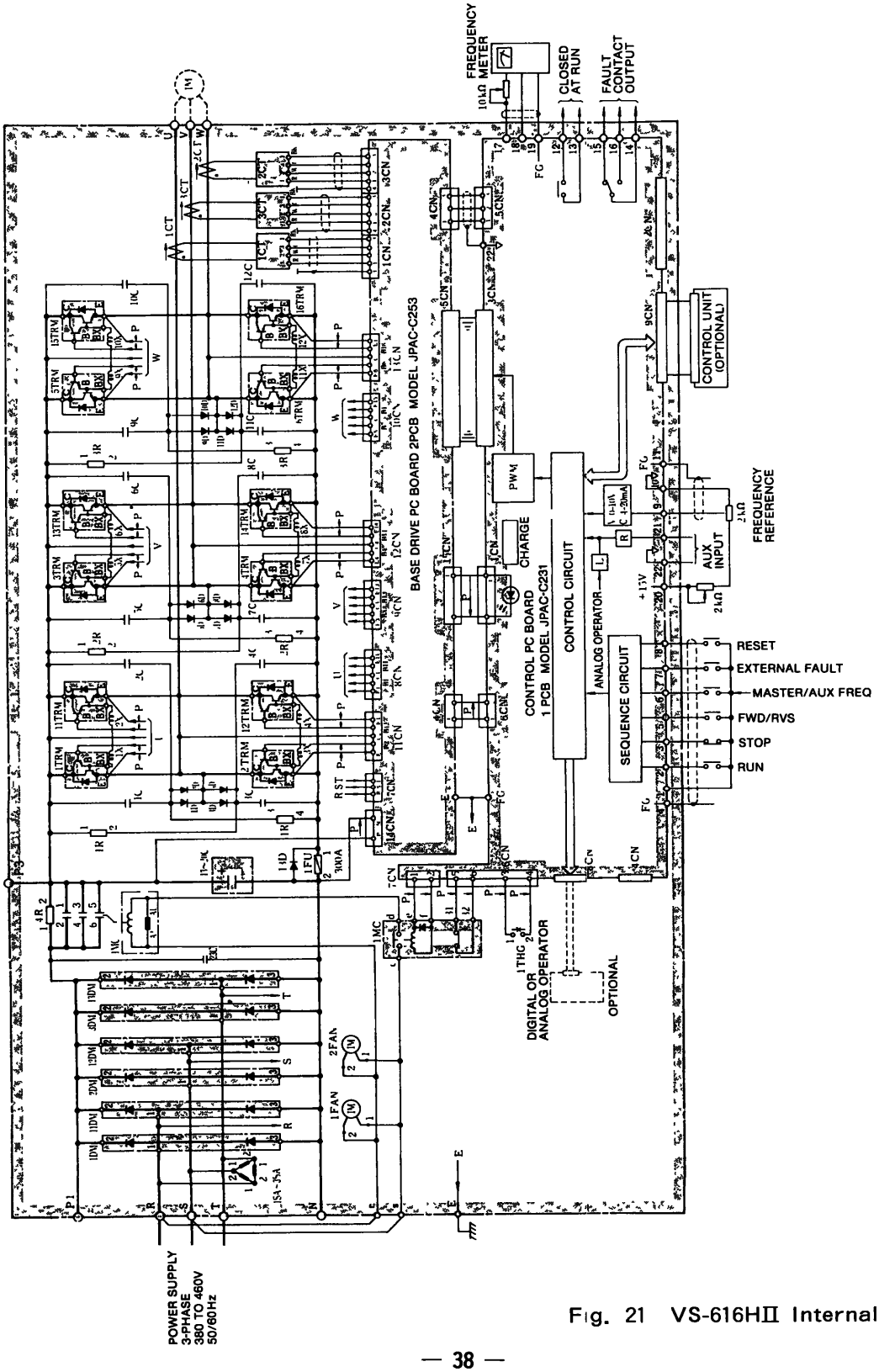


Fig. 21 VS-616HII Internal Circuit

A3-2 INTERCONNECTION DIAGRAMS FOR VS-616HII APPLICATIONS

(1) WITH ANALOG OPERATOR

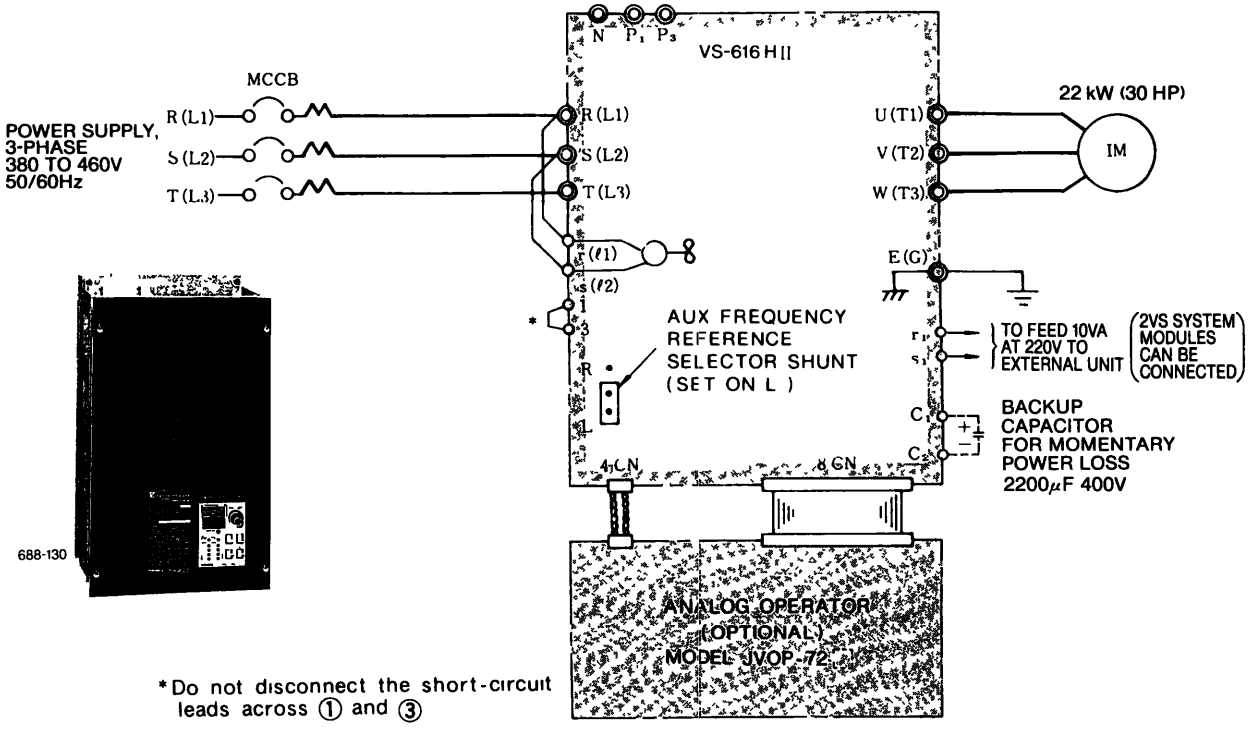


Fig. 22 With Analog Operator

(2) WITH DIGITAL OPERATOR

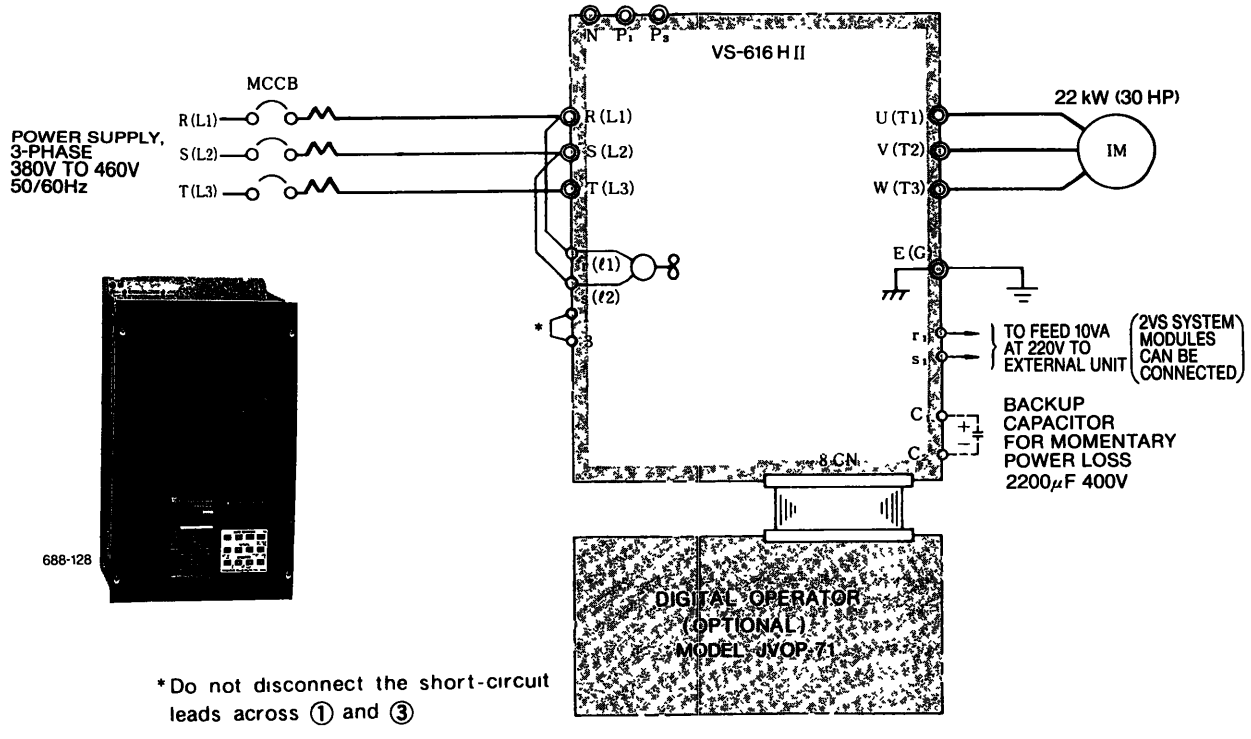
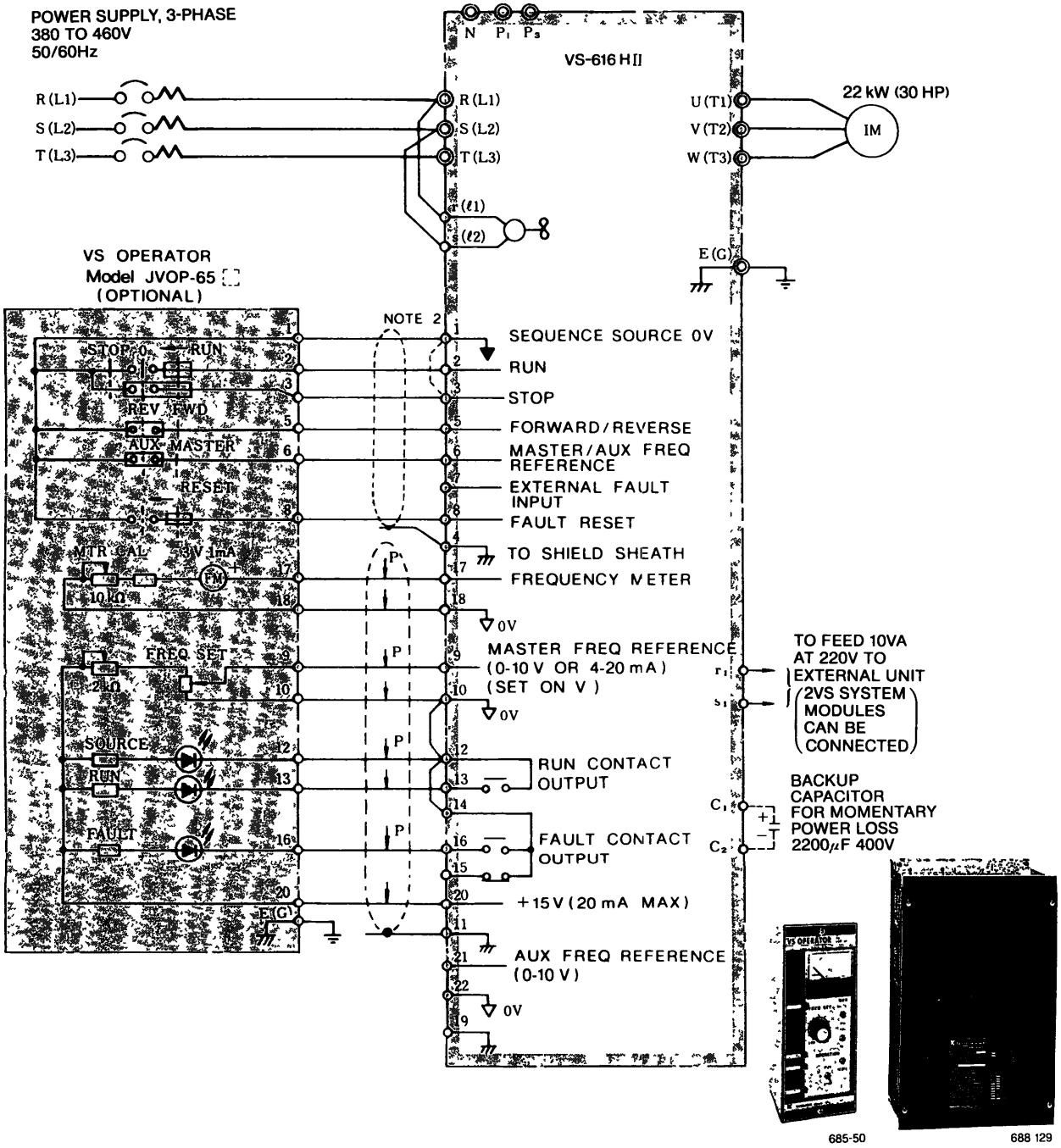


Fig. 23 With Digital Operator

A3-2 INTERCONNECTION DIAGRAMS FOR VS-616HII APPLICATIONS (Cont'd)

(3) WITH VS OPERATOR

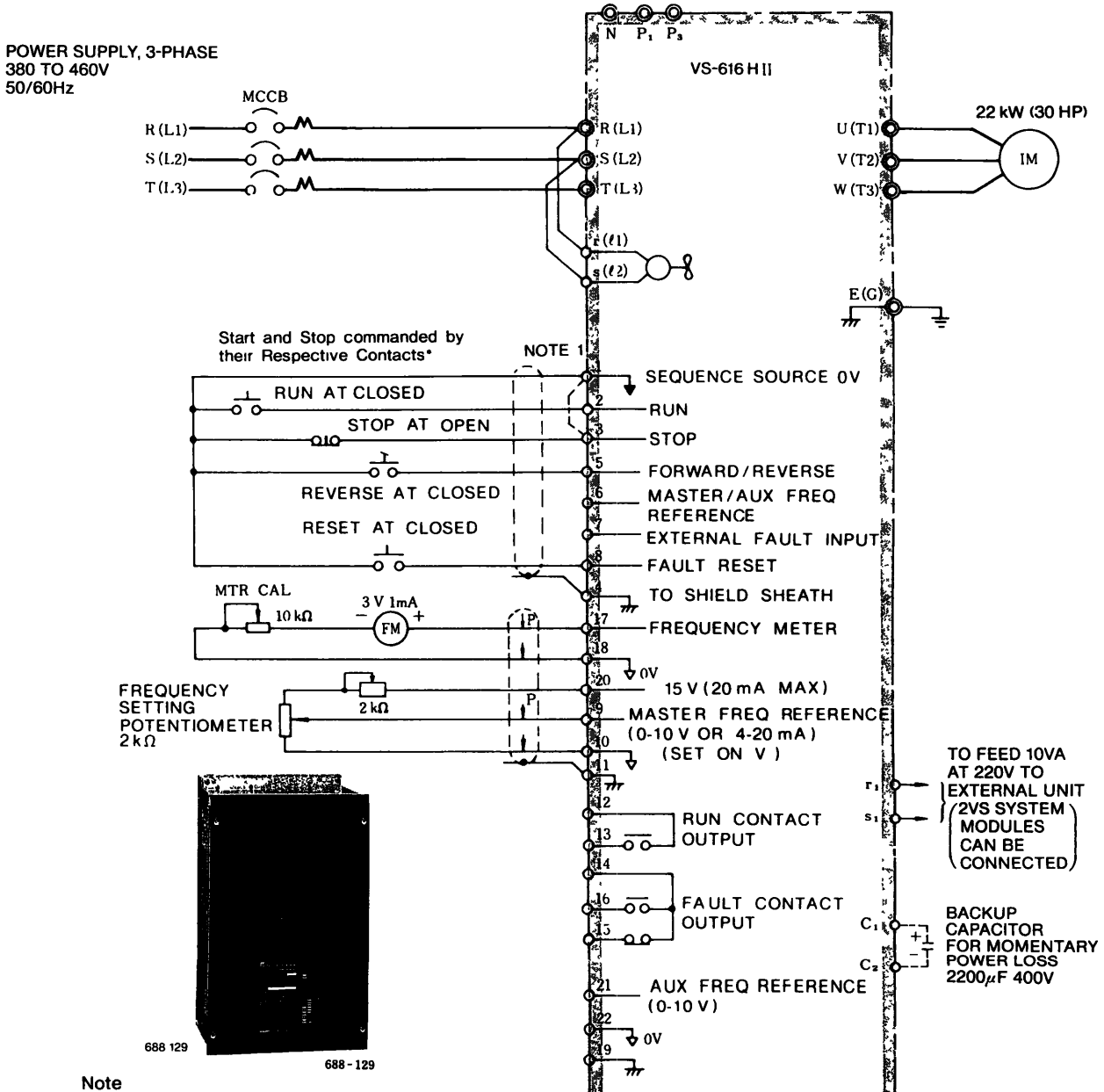


Note:

1. To give frequency reference from VS operator, set the VS operator MASTER/AUX switch to MASTER.
2. Remove the short-circuit leads across ① and ③.

Fig. 24 With VS Operator

(4) WITH USER-ARRANGED OPERATION CIRCUIT



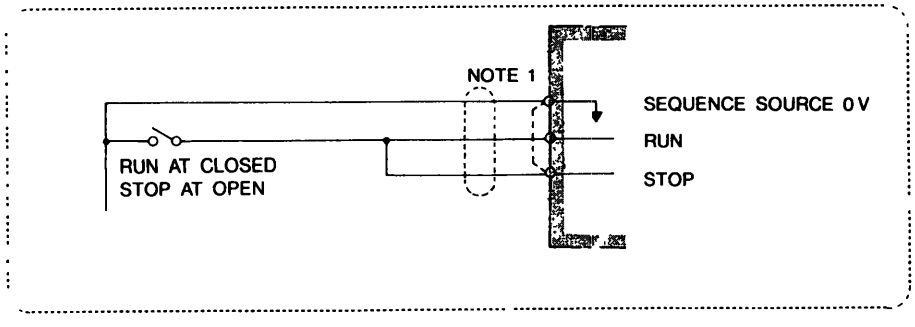
Note

1 Remove the short-circuit lead across external terminals ① and ③

2 Use RUN terminal ② to stop or start the motor

Fig. 25 With User-Arranged Operation Circuit

*Start and Stop commanded by a Single Contact



A3-2 INTERCONNECTION DIAGRAMS FOR VS-616HII APPLICATIONS (Cont'd)

(5) WITH MAGNETIC CONTACTOR FOR START/STOP OPERATION (When MC required to open because of inverter failure)

Before turning on power, never fail to be sure the motor is at rest.
For frequent start/stop operations, this drive circuit is not recommended.

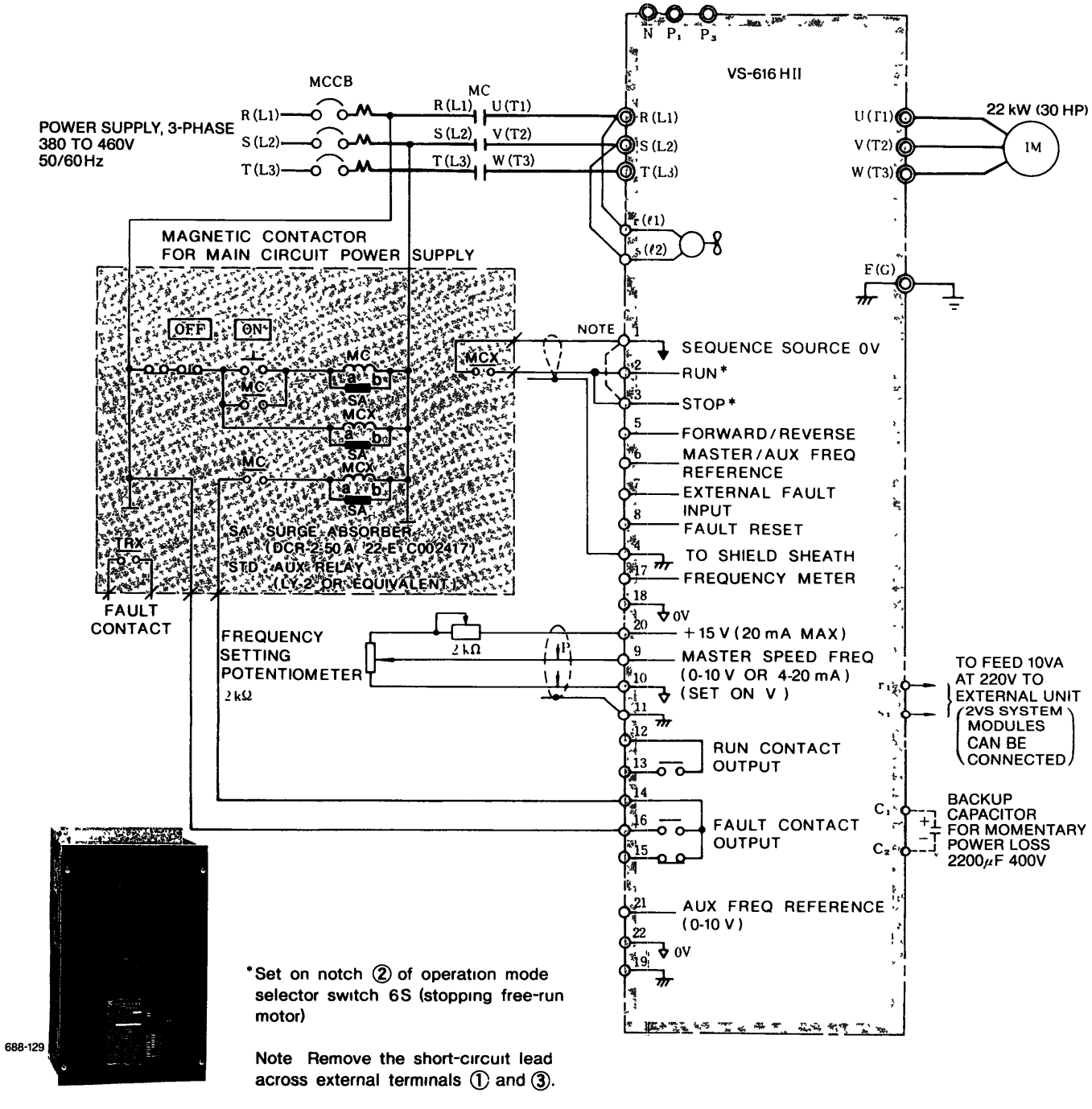
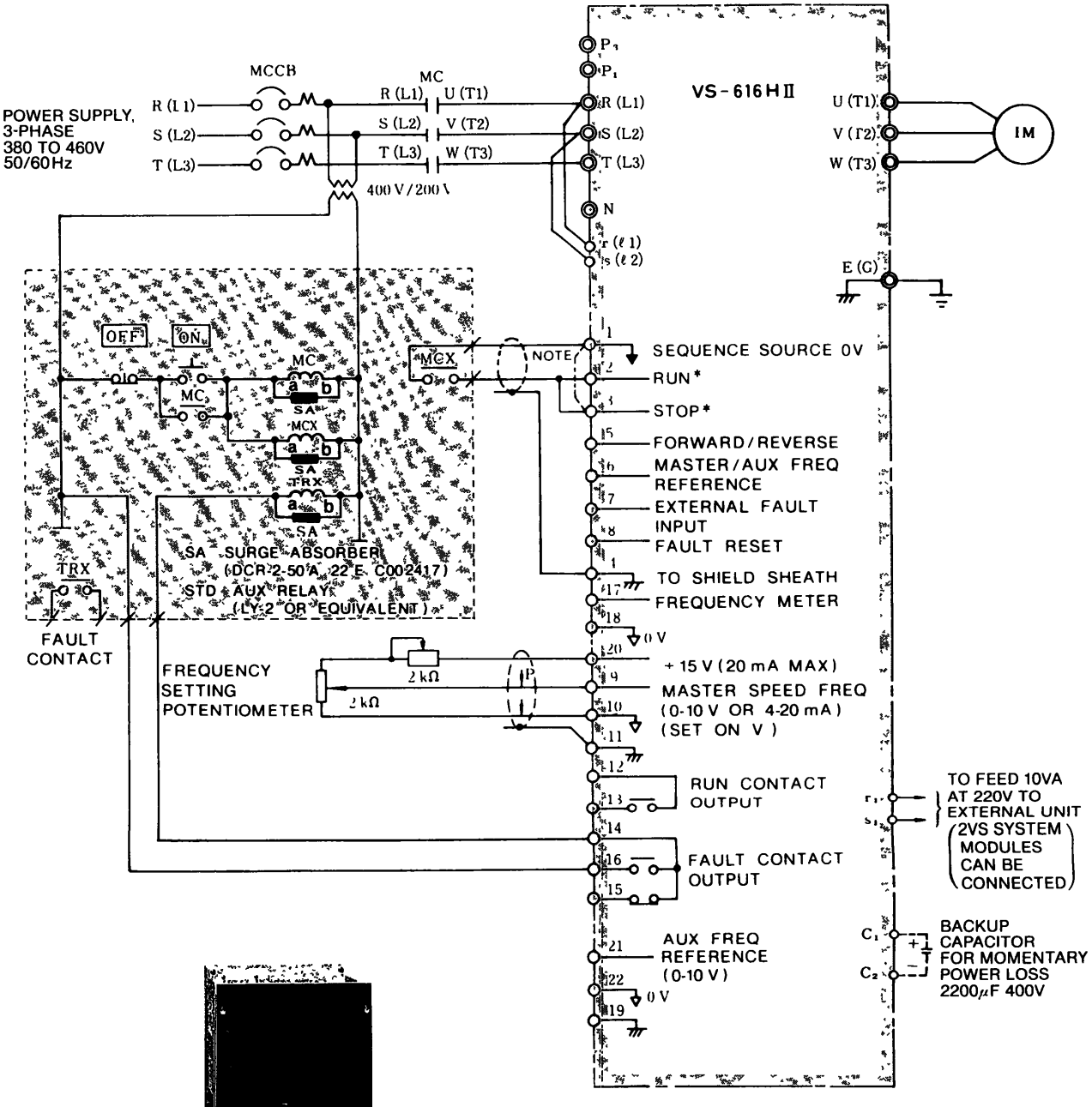


Fig. 26 With Magnetic Contactor for Start/Stop Operation

(6) WITH MAGNETIC CONTACTOR FOR START/STOP OPERATION
(When MC not required to open because of inverter failure)

Before turning on power, never fail to be sure the motor is at rest.
For frequent start/stop operations, this drive circuit is not recommended.



*Set on notch ② of operation mode selector switch 6S (stopping free-run motor)

Note. Remove the short-circuit lead across external terminals ① and ③

Fig. 27 With Magnetic Contactor For Start/Stop Operation

A3-2 INTERCONNECTION DIAGRAMS FOR VS-616HII APPLICATIONS (Cont'd)

(7) WITH VS OPERATOR AND ANALOG OPERATOR

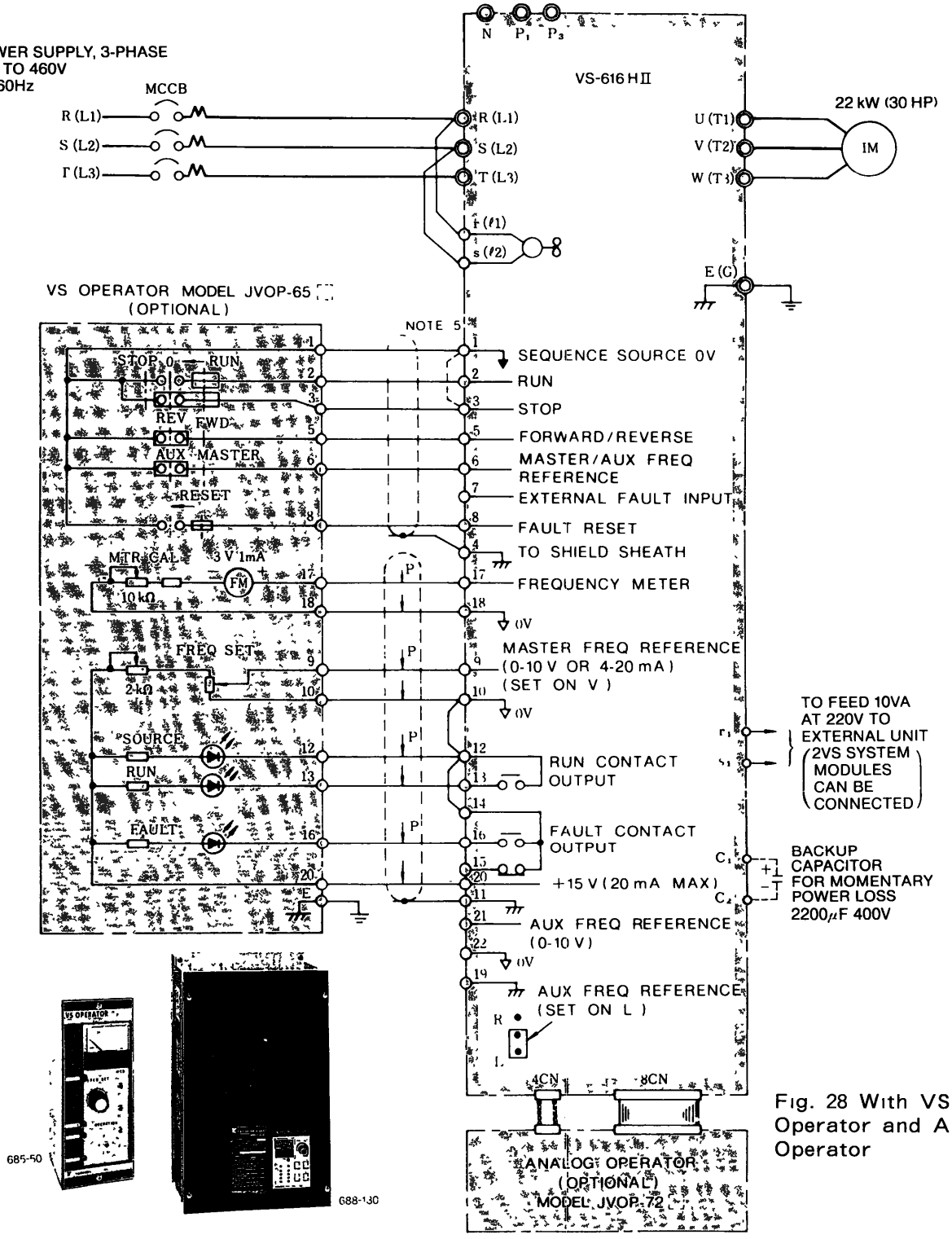
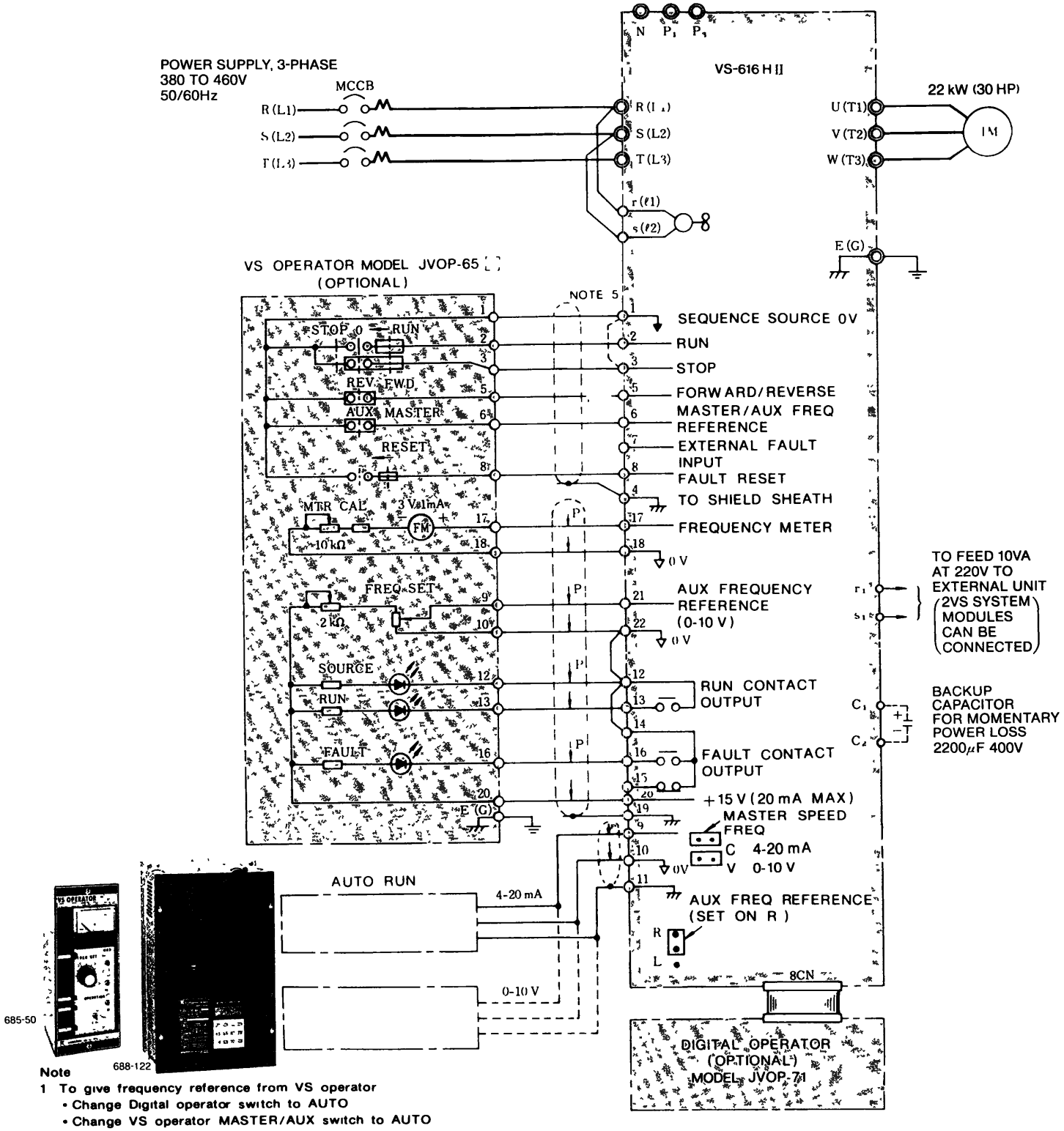


Fig. 28 With VS Operator and Analog Operator

Note

1 To give the frequency reference from VS operator, change the Analog operator AUTO/MAN switch to AUTO, and VS operator MASTER/AUX switch to MASTER
2 To give the frequency reference from Analog operator set the AUTO/MAN switch to MAN
3 Use of Analog operator does not permit the use of auxiliary frequency reference terminal
4 Stop operation can be made by either VS operator or Analog operator Stop command Either stop command takes priority over any command
5 Disconnect the short-circuited terminals ① and ③

(8) WITH VS OPERATOR AND DIGITAL OPERATOR



Note

1 To give frequency reference from VS operator
- Change Digital operator switch to AUTO
- Change VS operator MASTER/AUX switch to AUTO

2 To give frequency reference through automatic operation command,
- Change the Digital operator switch to AUTO
- Change the VS operator MASTER/AUX switch to MASTER
- For voltage reference of 0 to 10 V, set the MASTER SPEED FREQUENCY shunt on (V) and for current reference of 4 to 20 mA, set it on (C)

3 To set frequency reference from Digital operator, set the Digital operator switch to MAN Switching frequency reference from Digital operator to the other devices can be made at motor standstill only

4 Stop operation can be made by either VS operator or Digital operator Either stop command takes priority over any command

5 Disconnect the short-circuited terminals ① and ③

Fig. 29 With VS Operator and Digital Operator

A3-2 INTERCONNECTION DIAGRAMS FOR VS-616HII APPLICATIONS (Cont'd)

(9) WITH BRAKING MODULES AND BRAKING RESISTOR UNIT

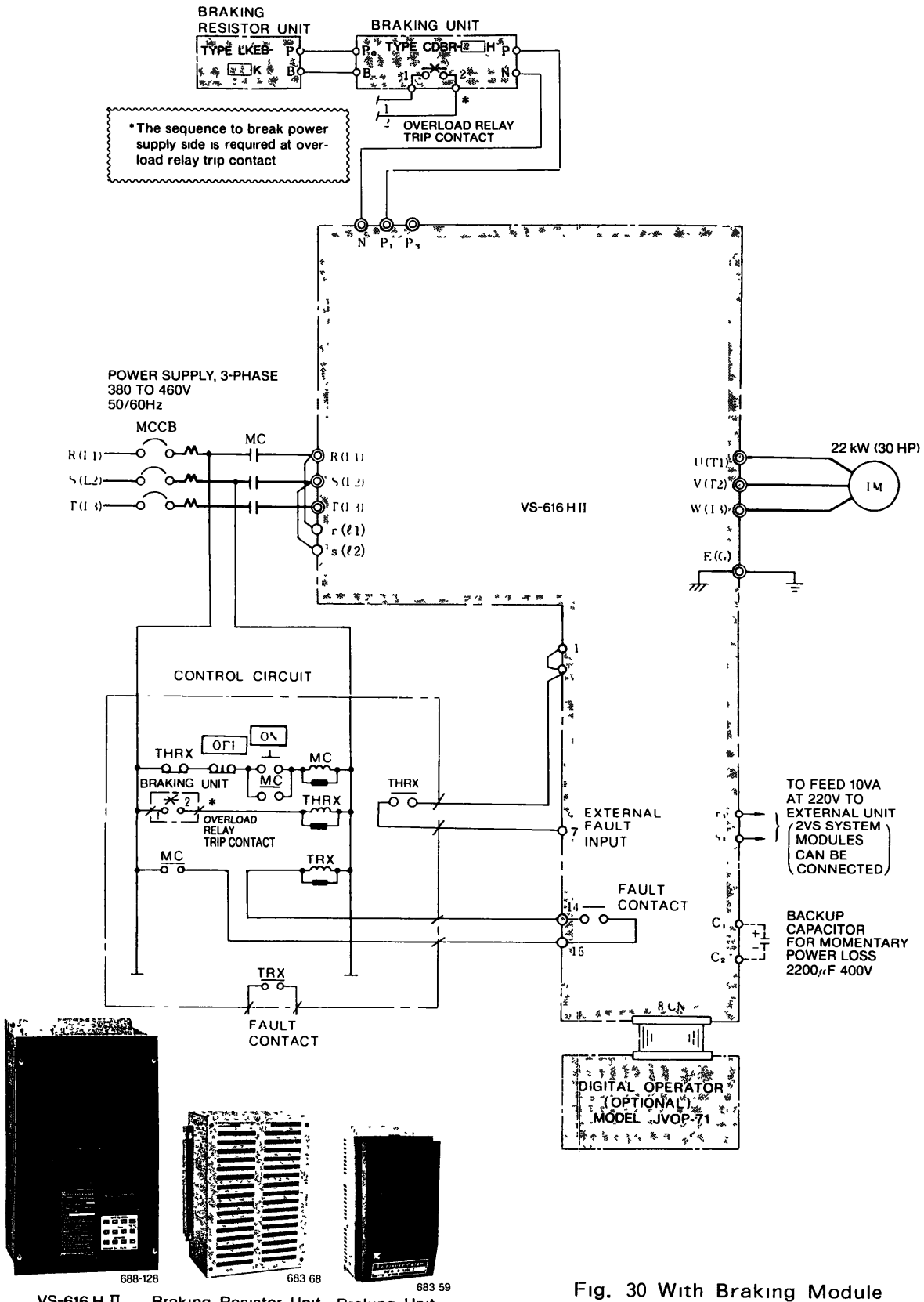
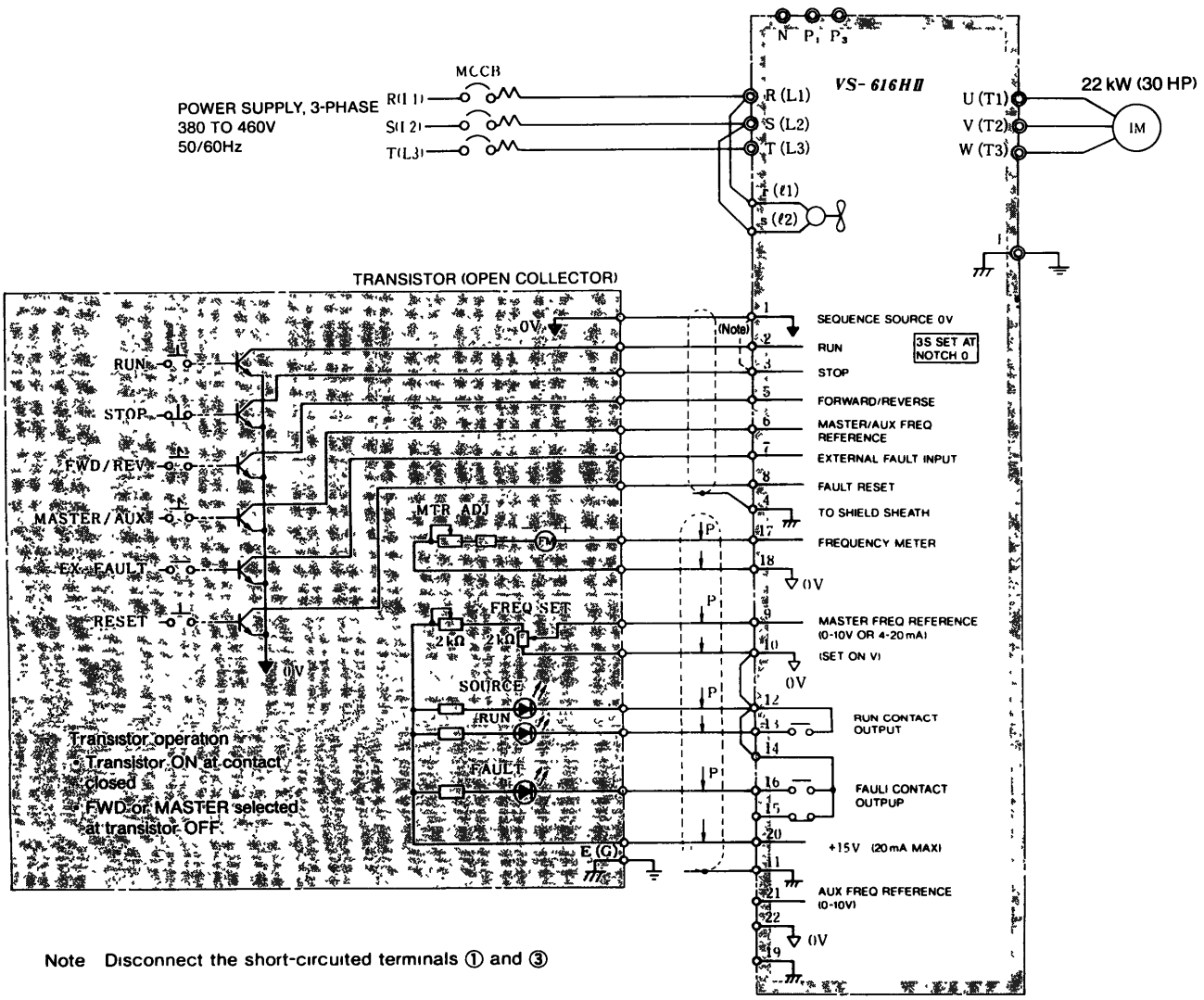


Fig. 30 With Braking Module and Braking Resistor Unit

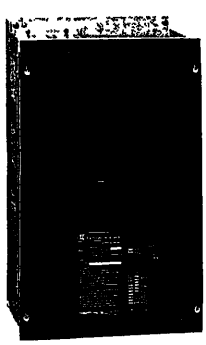
(10) WITH TRANSISTOR (OPEN-COLLECTOR) FOR START STOP OPERATION

To input start /stop signals by relay contacts or transistor (open collector), use the following elements:

- Relay contact:
  Contact capacity — 30 VDC or above
  Rated current — 100 mA or above
- Transistor (open collector):
  Withstand voltage — 35 VDC or above
  Rated current — 100 mA or above



Note Disconnect the short-circuited terminals ① and ③



688 129

Fig. 31 With Transistor (Open-Collector) for Start/Stop Operation

APPENDIX 4 VS-616HII OPTIONAL AND AUXILIARY UNITS

A4-1 VS-616HII OPERATOR, INTERFACE, AND OPTIONAL UNITS

Table 20 Operator and Interface

Name	Model (Code No.)	Function	Mounting	Instruction Manual
VS Operator	JVOP-65 □ (73041-0703X-□□)	Frequency set and indicated in analog value FORWARD/REVERSE, AUTOMATIC/MANUAL switch Fault indication and reset	Separately-mounted	TOE-C730-40 1
Digital Operator	JVOP-71 (73041-0701X)	Frequency set and indicated in digital value FORWARD/REVERSE, jog, remote operation Fault indication and reset	Mounted on the front of the inverter unit	TOE-C736-6
Analog Operator	JVOP-72 □ (73041-0702X-□)	Frequency set and indicated in analog value FORWARD/REVERSE, jog, remote operation Fault indication and reset		TOE-C730-40 3
Programming Operator	JVOP-73 (73041-0700X)	Setting V/f and display Frequency set and indicated in digital value Selection of direct and remote operation Fault indication and reset		TOE-C730-40 5
Serial Interface	JVOP-74 (73041-0704X)	Combined with Digital operator II (RS-232C, 20 mA current loop)		TOE-C736-7
Digital Operator II	JVOP-75 (73041-0705X)	For remote operation (100 m max) of Digital operator Model JVOP-71 Combined with JVOP-74	Seaparately-mounted	
Analog Operator Interface	JVOP-76 (73041-0706X)	Interface and control transmit/receive unit with Analog operator II Combined with Analog operator II	–	–
Analog Operator II	JVOP-77 1 (73041-0707X-01)	For remote operation (10 m max) of Analog operator Model JVOP-72	Separately-mounted (Usually mounted in same cabinet as VS-616H II)	–
	JVOP-77 5 (73041-0707X-01)			
Analog Operator II Cable	(72616-W0002) (72616-W0005) (72616-W0010)	Cable length 2 m Cable length 5 m Cable length 10 m	–	–

Table 21 Optional Units

Name	Model (Code No.)	Function	Mounting	Instruction Manual
Precision Controller	JOHB-C02 (73616-0031X)	• Digital speed setting (16 bits binary, 4-digit BCD) • Frequency monitor pulse output (6f, 10f, 36f, 100f) • Arbitrary V/f setting • Output voltage stabilization	Mounted on the right side of the inverter unit	TOE-C736-3
Memory Module	JOHB-C03 (73616-0032X)	• Back-up memory of frequency command and constant setting value from Programming operator (EE PROM incorporated) • Memory of frequency reference from Digital operator		TOE-C736-5
TG Speed Controller A	JOHB-C04 1 (73616-0033X-01)	Limits motor speed deviation to slip compensation of 0 5%		TOE-C736-8
TG Speed Controller B	JOHB-C04 2 (73616-0033X-02)	• Limits motor speed deviation to slip compensation of 0 5% • Incorporates the memory for frequency or constant values		
Precision AD Converter B	JOHB-C07 2 (73616-0036X-02)	• Changes from analog frequency reference input to digital signals with high resolution (1/16000) • Incorporates the memoery for frequency or constant values		TOE-C736-11
Braking Unit	CDBR-□	Enhances smooth and rapid motor stopping operation in combination with braking resistor unit (200V, 10kVA or above, 400V, 20kVA or above)	Separately-mounted	TOE-S616-20 10
Braking Resistor Unit	LKEB-□	Dissipates motor regenerative energy in the resistor and remarkably shortens the deceleration time		TOE-S730-40 6

• Analog Operator

Model JVOP-72·[ ] Code No 73041-0702X-[ ][ ]

Frequency Meter Max Scale (Double Scale)	60/120 Hz	1	01
	72 Hz	4	04
	90/180 Hz	5	05
	240 Hz	8	08
	360 Hz	9	09

• VS Operator

Model JVOP-65·[ ] Code No 73041-0703X-[ ][ ]

Frequency Meter Max Scale	75Hz	1	01
	150Hz	2	02
	220Hz	3	03

A4-2 VA-616HII AUXILIARY UNITS

Table 22 VS-616HII Auxiliary Units

Name	Function
Main Circuit Magnetic Contactor Model HI-□E	Switches on and off the main circuit, and interlocks the circuit if a failure occurs
Molded-case Circuit Breaker (MCCB) Model NF□	Protects the main circuit wiring and inverter from damage caused by short-circuit current
AC Reactor	Improves the high-frequency content of the power or prevents mutual interference due to voltage waveform distortion when connected to the power side. Betters the current waveform, lowers noise, and increases the motor torque when connected to the output of the inverter
Noise Filter Model LF-□	• Suppresses transmission of high-frequency noise produced by the inverter to the power side (input noise filter) • Suppresses transmission of high-frequency noise produced by the inverter to the motor (output noise filter)
Thermal Overload Relay	Protects the motors from burning when two or more motors are operated by one inverter.
Ground Fault Interrupter	Detects degradation in main circuit insulation, and shuts off the main circuit (Set the Setting to 200 mA, and the operating time to 0 2 sec or more)
Surge Absorber	Prevents problems due to noise when connected coils of the relays, magnetic contactors, magnetic valve, and so on (DCR2-50A22E or -10A25C). (If power waveform distortion is serious, contact YASKAWA representative.)
Frequency Setting Potentiometer	Variable resistor used to set the analog frequency (2 kΩ, 0 5 W or more)
Frequency Meter Calibration Potentiometer	Calibrates the maximum indication value of the frequency meter (10 kΩ, 0 25 W or more)
Frequency Meter	Indicates the output frequency of the inverter (3 V, 1 mA at full scale).
Backup Capacitor for Momentary Power Loss	Provides ride-through function up to 2 sec momentary power loss by connecting to terminals ⊕1 and ⊕2 Model· PWM2C2G222B, 2200μF, Code no C002598

Table 23 Devices of VS Operator Model JVOP-65·□

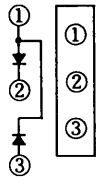
Device	Model	Specifications		Part Code
Frequency Meter	DCF-6A	3V, 1mA	75 Hz at full scale	FM 000067
			150 Hz at full scale	FM 000069
			220 Hz at full scale	FM 000072
Frequency Setting Potentiometer	RV30YN 20S-HV	2 kΩ, 1W		RH 000649

APPENDIX 5 CHECKING OF DIODE AND TRANSISTOR MODULES

A5-1 DIODE MODULE

Measure the resistance across the module terminals with a volt-ohm meter. Use the meter by setting at × 1Ω range. The measured resistance should be within the reference value listed in Table 24.

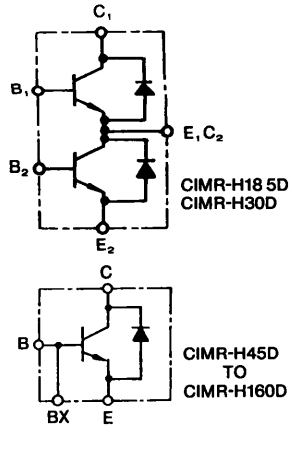
Table 24 Diode Module Resistances

Diode Module Terminals \ Volt-ohm Meter Terminals	⊖	⊕	Reference Resistances	Abnormal Resistances
Model CIMR-H18 5D, to -H160D 	②	①	∞	Approx several 10 ohms
	①	③		
	①	②	Approx several 10 ohms	∞ or 0 ohms
	③	①		

A5-2 TRANSISTOR MODULE

Measure the resistance across the module terminals with a volt-ohm meter. Use the meter by setting at × 1Ω range. The measured resistance should be within the reference value listed in Table 25.

Table 25 Transistor Module Resistances

Transistor Module Terminals		Reference Resistances	Abnormal Resistances	Transistor Module Terminals
VOM Terminal ⊖	VOM Terminal ⊕			
E_1 C_2	C_1	Several 10 ohms	0 ohms or ∞	
C_1	E_1 C_2	Several 100 kiloohms	0 ohms	
B_1	E_1 C_2	Several 10 ohms	Several 10 kiloohms min	
E_1 C_2	B_1	Several 100 ohms to Several kiloohms	0 ohms or ∞	
E_2	E_1 C_2	Several 10 ohms	0 ohms or ∞	
E_1 C_2	E_2	Several 100 kiloohms	0 ohms	
B_2	E_2	Several 10 ohms	Several 10 kiloohms min	
E_2	B_2	Several 100 ohms to Several kiloohms	0 ohms or ∞	

APPENDIX 6 PARTS REPLACEMENT

For checking or replacing parts, observe the following.

- Tag leads to insure correct reconnection before disconnecting the leads without marks.
- Tighten the parts mounting screws or lead terminal screws firmly. Even one loose screw may cause malfunction.

A6-1 REPLACEMENT OF CONTROL PC BOARD

1. Remove the connectors 1CN, 5CN, 6CN, and 7CN by the lead lock. To remove the lead lock, press the top of the locking clip to release from the header and pull out.
2. Remove the connector 3CN. Open the lock lever, and the connector is released.

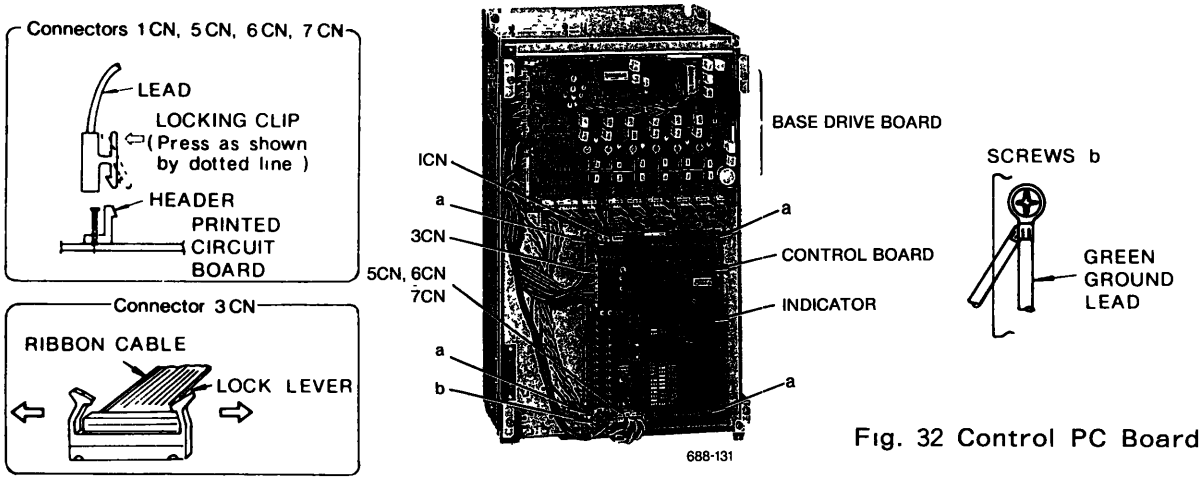


Fig. 32 Control PC Board

3. Remove 4 screws (a) and a ground lead screw (b) to remove the control PC board.
4. Clip the board support located around control board with pliers and take off the control printed PC board.

A6-2 REPLACEMENT OF BASE DRIVE PC BOARD

1. Pull out the connectors 1CN to 14CN.
2. Remove three mounting screws (a) and a ground lead screw (b).
3. Clip the board support located around control board with pliers and remove the base drive PC board with shield plate.

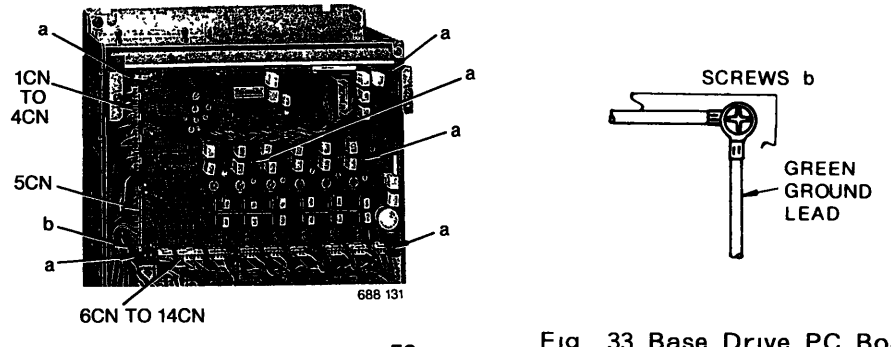


Fig. 33 Base Drive PC Board

A6-3 REPLACEMENT OF DIODE MODULE AND TRANSISTOR MODULE

CAUTION

When remounting transistor or diode modules, apply thermal compound "JOINTAL Z" (Nippon Light Metal Co., Ltd.), or equivalent compound to the mounting surface, to assure good contact and heat conduction between the module and the mounting surface for cooling.

DIODE MODULE REMOVAL

1. Remove the bus bar mounting screws.
2. Remove diode module lead terminal screws.
3. Remove diode module mounting screws.
4. Remove the modules.

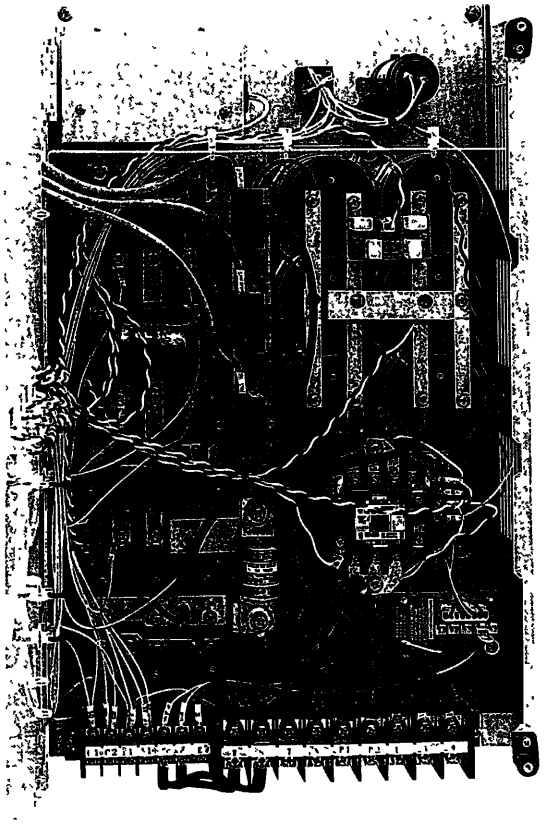


Fig. 34 Removing Diode Module of Model CIMR-H22D, 400V30kVA

A6-4 MAIN CIRCUIT FUSE REMOVAL

Remove main circuit fuse mounting screws and replace the blown fuse.

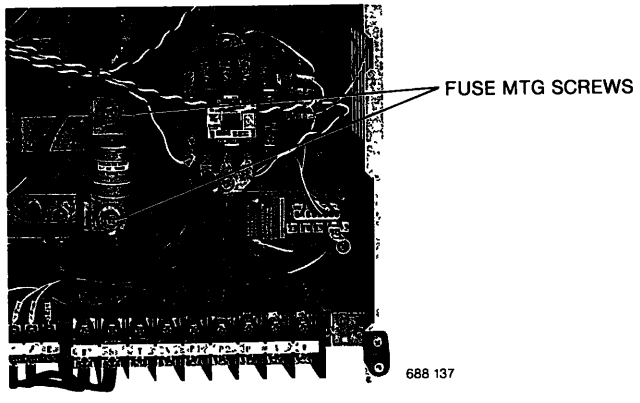


Fig. 35 Removing Main Circuit Fuse of Model CIMR-H22D, 400V, 30kVA

A6-5 REPLACEMENT OF COOLING FAN

Replace the fan after approximately 20,000 hours of cumulative operation.

1. After removing the control PC and base drive PC boards as outlined in Par. A6-1 and A6-2, remove two fan power leads.
2. Loosen four fan mounting screws and take off the fan unit.

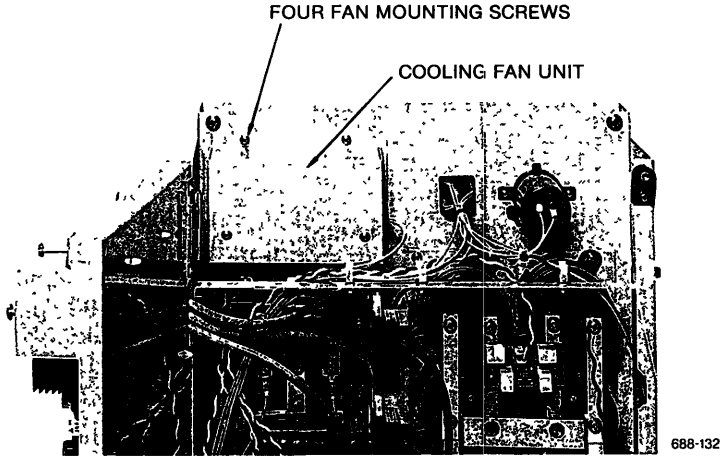


Fig. 36 Cooling Fan Assembly of Model CIMR-H22D, 400V, 30kVA

APPENDIX 7 SPARE PARTS

As insurance against costly downtime, it is strongly recommended that spare parts to be kept on hand in accordance with the table below.
When ordering spare parts, please specify to Yaskawa Electric office or representative; Parts Name, Parts Code No. and Quantity.

Table 26 Spare Parts

Parts Name			Main Circuit Transistor†	Main Circuit Diode	AC Circuit Fuse (Rated Current)	Cooling Fan		Base Drive PC Board	Control PC Board*▲
VS-616HII Model CIMR-	H18 5D	Model	QM150DY-2H	110Q2G43	CR6L-75 (75A)	4715PS-22T-B30-B00		JPAC-C263	Model JPAC-C231-□□ Code No ETC00760X -S□□XX Q'ty 1
		Code	STR000212	SID000409	FU000757	FAN000130		ETC00792X	
		Q'ty	3	3	1	1		1	
	H22D	Model	QM150DY	110Q2G43	CR6L-75 (75A)	4715PS-22T-B30-B00		JPAC-C263	
		Code	STR000212	SID000409	FU000757	FAN000130		ETC00792X	
		Q'ty	3	3	1	1		1	
	H30D	Model	QM200DY-2H	110Q2G43	CR6L-100 (100A)	5915PC-22T-B30-B00		JPAC-C263	
		Code	STR000319	SID000409	FU000758	FAN000131		ETC00795X	
		Q'ty	3	3	1	1		1	
	H37D	Model	QM300HA-2H	160Q2G43	CR6L-150 (150A)	5915PC-22T-B30-B00		JPAC-C266	
		Code	STR000150	SID000410	FU000756	FAN000131		ETC00795X	
		Q'ty	6	3	1	1		1	
	H45D	Model	QM300HA-2H	160Q2G43	CR6L-150 (150A)	5915PC-22T-B30-B00		JPAC-C266	
		Code	STR000150	SID000410	FU000756	FAN000131		ETC00795X	
		Q'ty	6	3	1	1		1	
	H55D	Model	QM400HA1-2H	160Q2G43	CR6L-200 (200A)	5915PC-22T-B30-B00		JPAC-C268	
		Code	STR000248	SID000410	FU000755	FAN000131		ETC00797X	
		Q'ty	6	6	1	2		1	
	H75D	Model	QM300HA-2H	RM250DZ-24	CR6L-300 (300A)	5915PC-22T-B30-B00		JPAC-C268	
		Code	STR000168	SID000411	FU000754	FAN000131		ETC00797X	
		Q'ty	12	3	1	2		1	
	H110D	Model	QM400HA1-2H	RM250DZ-24	CR6L-350 (350A)	5915PC-22T-B30-B00		JPAC-C268	
		Code	STR000248	SID000411	FU000818	FAN000131		ETC00797X	
		Q'ty	12	3	1	2		1	
	H160D	Model	QM400HA1-2H	RM250DZ-24	CS10F-500 (500A)	MRW18 DTA (SENSOR)	THA1R-HS4556	JPAC-C275	
		Code	STR000248	SID000411	FU000680	FAN000108	FAN000109	ETC00804X	
		Q'ty	18	6	1	1	1	1	

*□□of the control PC board model name shows the type of function
Spare board should have the same model name suffix as that of the board in use
†XX of Code No for the control PC board indicates the revision number of the control PC board
New board should have the same code suffix number or larger than that of the board being replaced
A pair or 3 pcs of spare transistor modules should have the same letter of characteristics rank which is stamped on the module surface
†Transistor modules of Models CIMR-H75D to -H160D are connected in parallel, in pairs or 3 pcs
Characteristics of each pair of modules are controlled by block of 1 and 11 TRM, 2 and 12 TRM, 3 and 13 TRM, 4 and 14 TRM, 5 and 15 TRM, and 6 and 16 TRM

(QM 300 HA-H)

Transistor Modules

TRANSISTOR INVERTER

Varispeed-616HII™ B SERIES 380 TO 460V 18.5 TO 160kW (25 TO 200HP) 25 TO 200kVA

INSTRUCTION MANUAL

A Better Tomorrow for Industry through Automation

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