YASKAWA ELECTRIC

TOEZ-S646-2

HIGH FREQUENCY INVERTER
Varispeed™-646HS3
INSTRUCTION/MAINTENANCE MANUAL

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

CONTENTS

1. RECEIVING

This VS-646HS3 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.
- Connectors are enclosed. (25 pins for control, 8 pins for transmission.)

If any part of VS-646HS3 is damaged or lost, immediately notify the shipper.

WARNING

(1) After turning off the main circuit power supply, do not touch circuit components until "CHARGE" lamp is extinguished. The capacitors are still charged and can be quite dangerous.

(2) Do not connect or disconnect wires and connectors while power is applied to the circuit.

(3) Do not check signals during operation.

(4) Be sure to ground VS-646HS3 using the ground terminal (E).

(5) Never connect main circuit output terminals (U) (V) (W) to AC main circuit power supply.

CAUTION

(1) All the potentiometers of VS-646HS3 have been adjusted at the factory. Do not change their settings unnecessarily.

(2) Do not make withstand voltage test on any part of the VS-646HS3 unit. It is electronic equipment using semiconductors and vulnerable to high voltage.

(3) Control PC board employs CMOS ICs which are easily damaged by static electricity. Do not touch the CMOS elements.

2. INSTALLATION

CAUTION

Never move, lift or handle the VS-646HS3 cabinet by front cover or terminal stands. Lift the cabinet from the bottom.

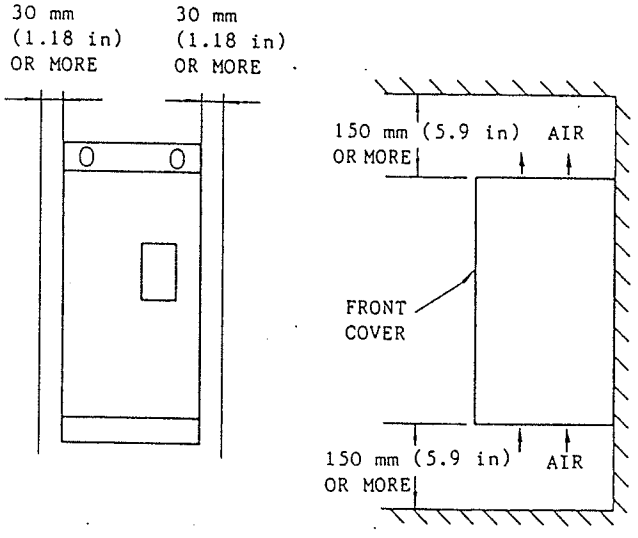
2.1 LOCATION

Location of the equipment is important to achieve proper performance and normal operating life. The VS-646HS3 units should be installed in areas where the following conditions exist.

- Ambient temperature: +14 to 131°F, -10 to +55°C
- 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.
- Free from magnetic noise.

2.2 MOUNTING SPACE

Install VS-646HS3 vertically and allow sufficient space for effective cooling as shown in Fig. 1.



(a) Front View (b) Side View

[Allowable Temperature]

- +14 to 131°F, -10 to +55°C

Fig. 1 Mounting Spaces

3. WIRING

3.1 INTERCONNECTIONS

Interconnect as shown in Fig. 2. With digital operator, the motor can be operated by wiring the main circuit only.

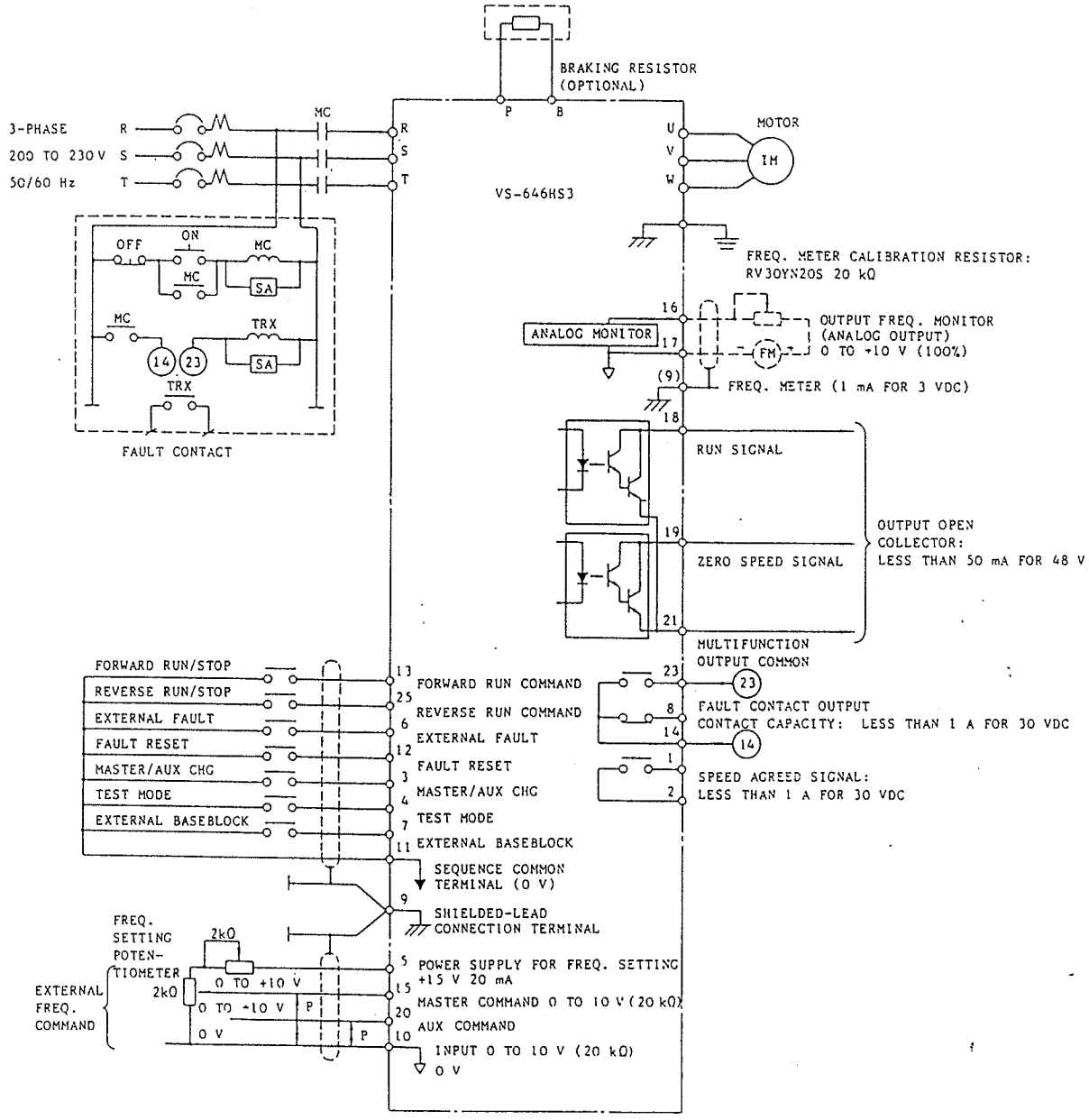


Fig. 2 Interconnections

3.2 WIRING

3.2.1 Molded-case Circuit Braker (MCCB) and Power Supply Magnetic Contactor (MC)

Be sure to connect MCCBs between power supply and VS-646HS3 input terminals (R) (S) (T). Recommended MCCBs are listed in Table 1.

When a ground fault interrupter is used, select the one with no influence for high frequency, and setting current should be 200 mA or over and operating time, 0.1 sec or over to prevent malfunction.

Table 1 Molded-case Circuit Breakers and Magnetic Contactors

Voltage Class	200 V
VS-646HS3 Model	CIMR-HFS23P7
Capacity kVA	6
Rated Output Current A	18
Molded-case Circuit Breaker	NF30 30 A
Yaskawa Magnetic Contactors Model	HI-20E

3.2.2 Surge Absorver

For the surge absorbers should be connected to the coils of relays, magnetic contactors, magnetic valves, or magnetic relays. Select type from Table 2.

Table 2 Surge Absorbers

Coils of Magnetic Contactor and Control Relay		Surge Absorber*		
		Model	Specifications	Code No.
200 to 230 V	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

* Made by MARCON Electronics.

3.2.3 Notes in Wiring

(a) Control circuit and transmission circuit

The external interconnection wiring must be performed with following procedures.

After completing VS-646HS3 interconnections, be sure to check that connections are correct. Never use control circuit buzzer check.

(1) Control circuit leads (2 CON) and transmission circuit leads (12 CON) must be separated from main circuit leads (R) (S) (T) (E) (U) (V) (W) (B) (P) and other power cables to prevent erroneous operation caused by noise interference.

(2) Control circuit leads (1) (2) (8) (14) (23) (contact output) must be separated from leads (3) to (7), (9) to (13), (15) to (21) and (25).

(3) Use the twisted or twisted-pair shielded lead for the control circuit line and connect the shield sheath to the inverter terminal. See Fig. 3. It is recommended that the wiring distance of the signal leads be 50 meters below.

(4) Use the twisted shielded lead for the transmission circuit line and connect the shield sheath to the inverter connector. See Fig. 3. It is recommended that the wiring distance of the signal leads be 5 meters below.

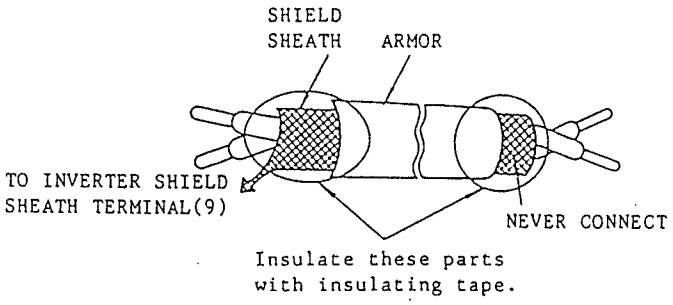


Fig. 3 Shielded Lead Termination

(b) Main circuit input/output

(1) Phase rotation of input terminals (R) (S) (T) is available in either direction, clockwise and counterclockwise.

(2) When inverter output terminals (U) (V) (W) are connected to motor terminals (U) (V) (W), respectively, motor rotates counterclockwise, viewed from opposite drive end, upon forward operation command. To reverse the rotation interchange any two of motor leads.

(3) Never connect AC main circuit power supply to output terminals (U) (V) (W).

(4) Care should be taken to prevent contact of wiring leads with VS-646HS3 cabinet, for short-circuit may result.

(5) Never connect power factor correction capacitor or noise filter to VS-646HS3 output.

(6) Never open or close contactors in the output circuit unless inverter is properly sized.

(c) Grounding

Ground the casing of the VS-646HS3 using ground terminal (E).

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

(2) Never ground VS-646HS3 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 the ground leads which comply with AWG standards and make the length as short as possible.

(4) Where several VS-646HS3 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-646HS3 in parallel, and ground only one of VS-646HS3 to the ground pole is also permissible (Fig. 4). However, do not form a loop with the ground leads.

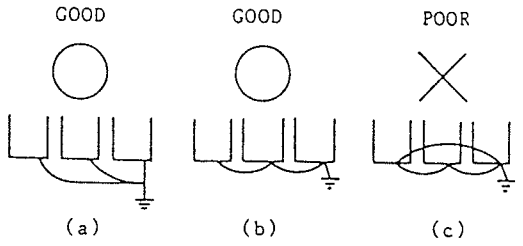


Fig. 4 Grounding of Three VS-646HS3 Units

3.2.4 Wire Sizes

The wire sizes and types are shown in Table 3.
Refer to Table 4 for the placement of the closed-loop connectors.

Table 3 Wire Size

VS-646HS3 Model	Circuit	Capacity kVA	Terminal Symbol	Terminal Screw	Wire Size mm² *	AWG	Wire Type
CIMR-HFS23P7	Main	6	(R) (S) (T) (U) (V) (W) (B) (P)	M5	3.5–5.5	12–10	Power cable : 600 V vinyl sheathed lead or equivalent †
			(E)		2–5.5	14–10	
	Control	Control connector	Honda Tsushin KK MR-25M (G) 25 pins		0.5–2	20–14	Twisted shielded cable (instrumentation polyethylene insulation vinyl sheath cable with shielding)
		Transmission connector	Honda Tsushin KK MR-8M (G) 8 pins				

* Lead size should be determined considering voltage drop of leads.

† Use multi-code cables for the output lines.

Table 4 Round Pressure Terminals

Wire Size mm²	Wire Size AWG	Terminal Screw	Round Pressure Terminals
2	14	M5	2-5
3.5	10	M5	3.5-5
5.5	8	M5	5.5-5

PROCEDURES FOR MAIN CIRCUIT MEGGER TEST

Use a 500 V megger for the main circuit megger test (withstand voltage test) and perform the following procedures.

As shown in Fig. 5, connect the VS-646HS3 AC main circuit input terminals (R) (S) (T) (U) (V) (W) (B) and (P) with a common line. Then connect the control circuit connector pins (1) to (25) (except for (9)) and the transmission connector pins (1) to (8) (except for (7)) with another common line. Perform the megger test only between the main circuit common terminals and the ground (grounding terminal (E)). Do not make withstand voltage test on any part of the VS-646HS3 except on the main circuit.

Normally, megger deflection must be 1MΩ or above.

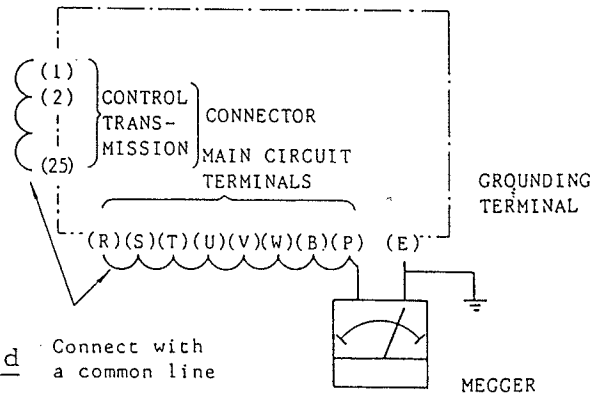


Fig. 5 Connections for Megger Test

4. TEST OPERATION

To assure safety, prior to test operation disconnect the coupling or belt which connects the motor with the machine so that motor operation is isolated. If an operation must be performed while the motor is directly connected to the machine, use great care to avoid any possible hazardous condition.

4.1 CHECK BEFORE TURNING POWER ON

After completion of installation and wiring, check for

(1) Proper wiring

(2) Short circuit due to wire clippings

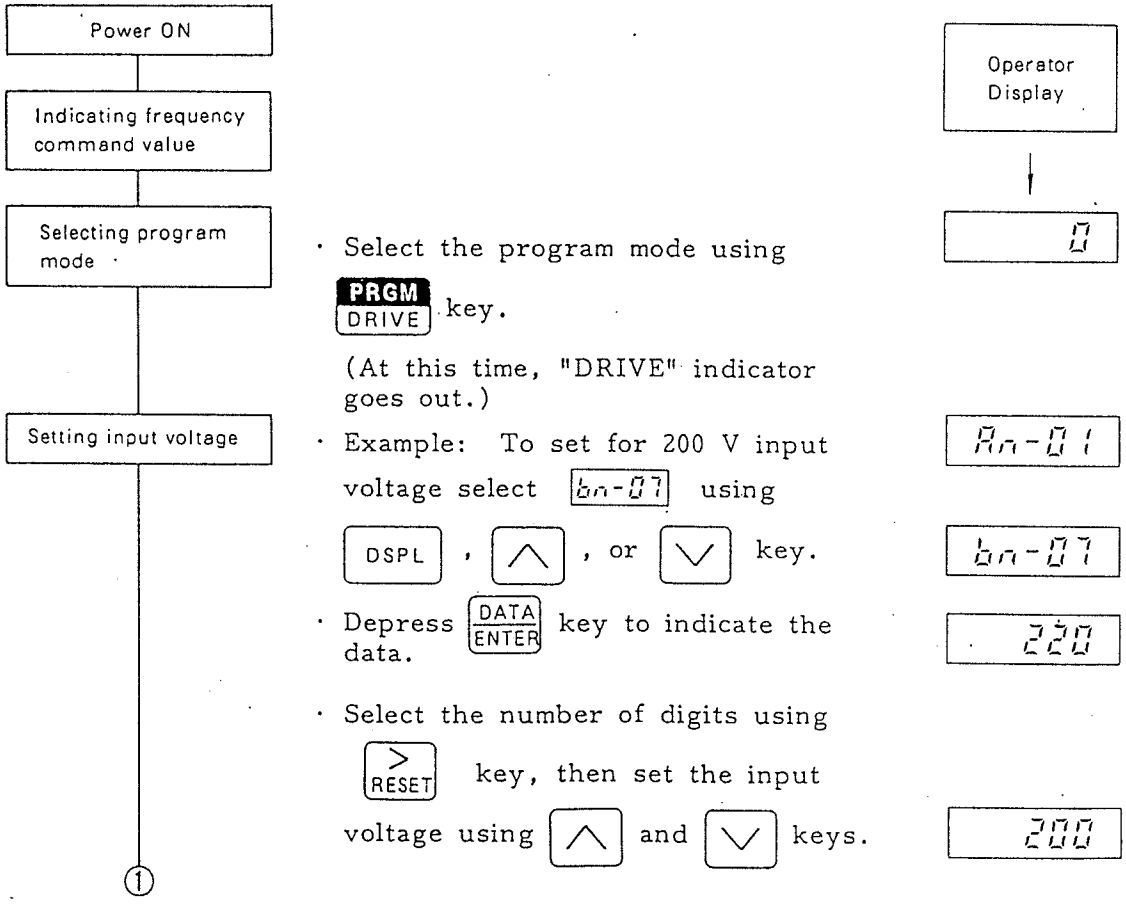
(3) Loose screw-type terminals

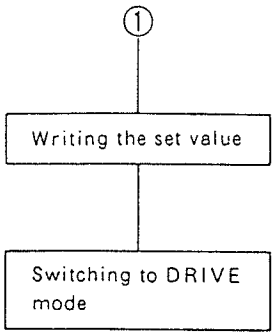
(4) Loose control connectors

(5) Proper load

4.2 SETTING THE INPUT VOLTAGE

The factory setting is 220 V.
The example below shows the setting change of input voltage from 220 V to 200 V.





· Depress DATA/ENTER key to check that END is displayed.

End

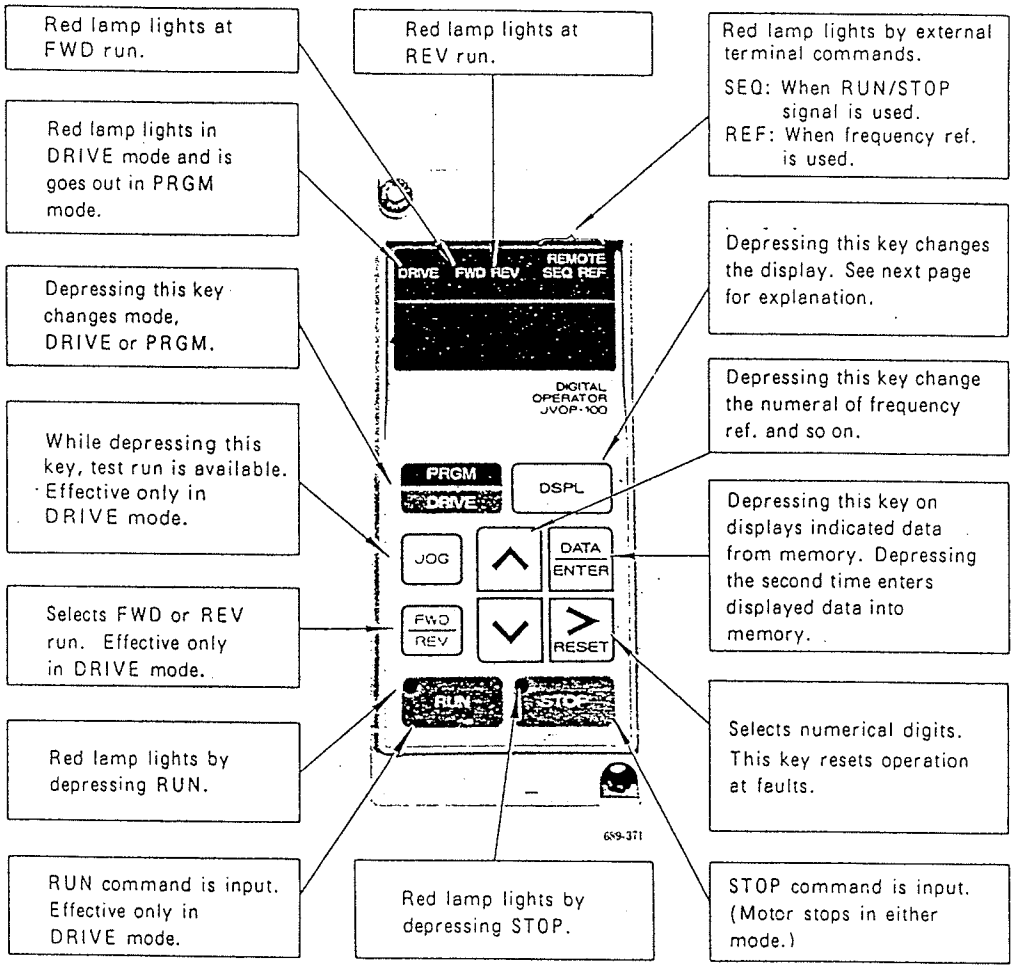
· Switch to DRIVE mode using PRGM/DRIVE key.

200

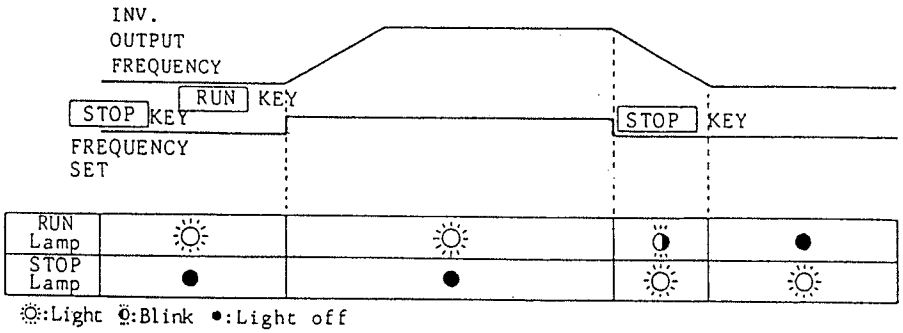
5. OPERATION

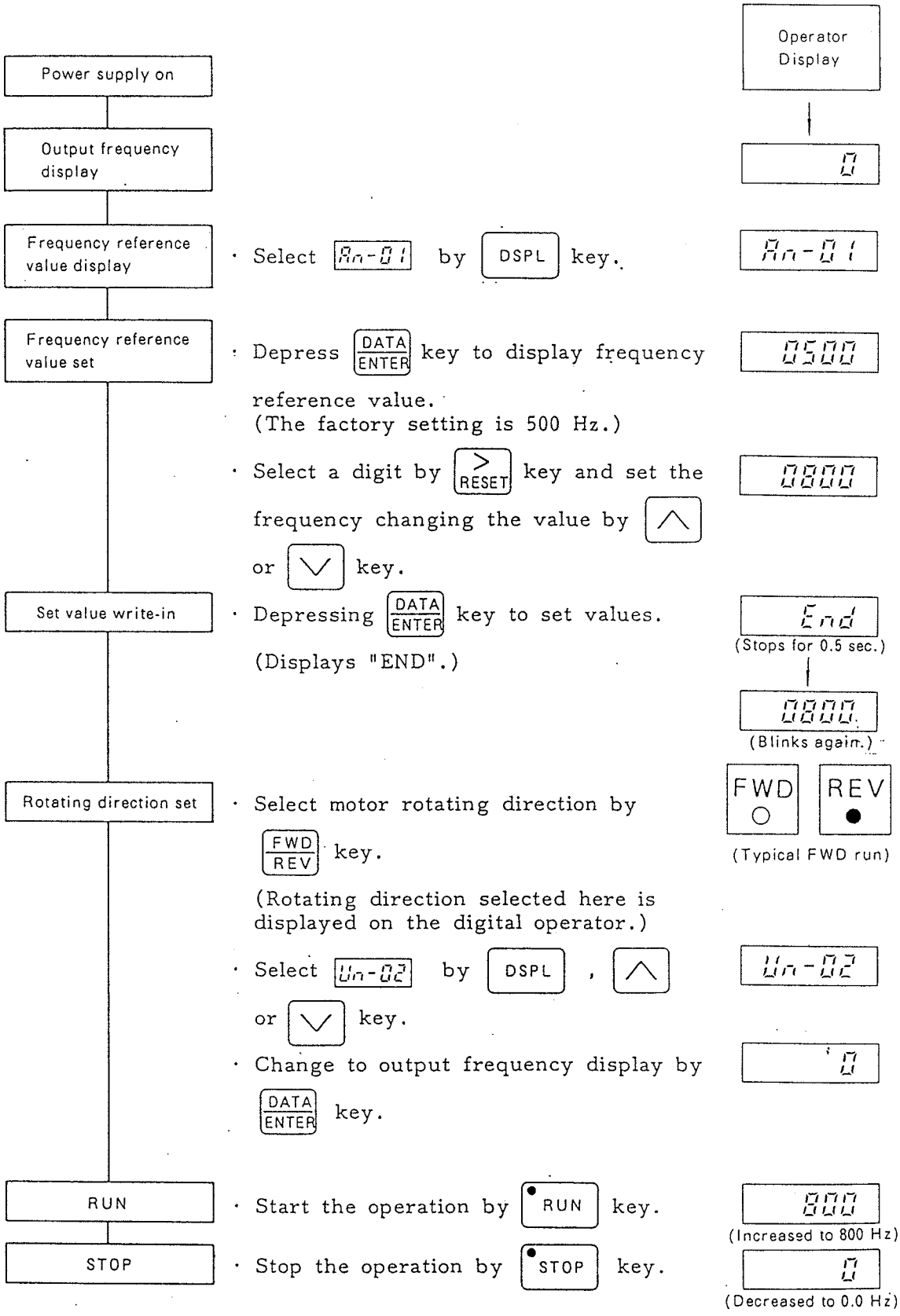
5.1 DIGITAL OPERATOR

Digital operator has DRIVE mode and PRGM mode. Selecting DRIVE mode enables the inverter to operate. PRGM mode enables the programs to be written-in. DRIVE and PRGM modes can be switched by DRIVE/PRGM key only when stopped.

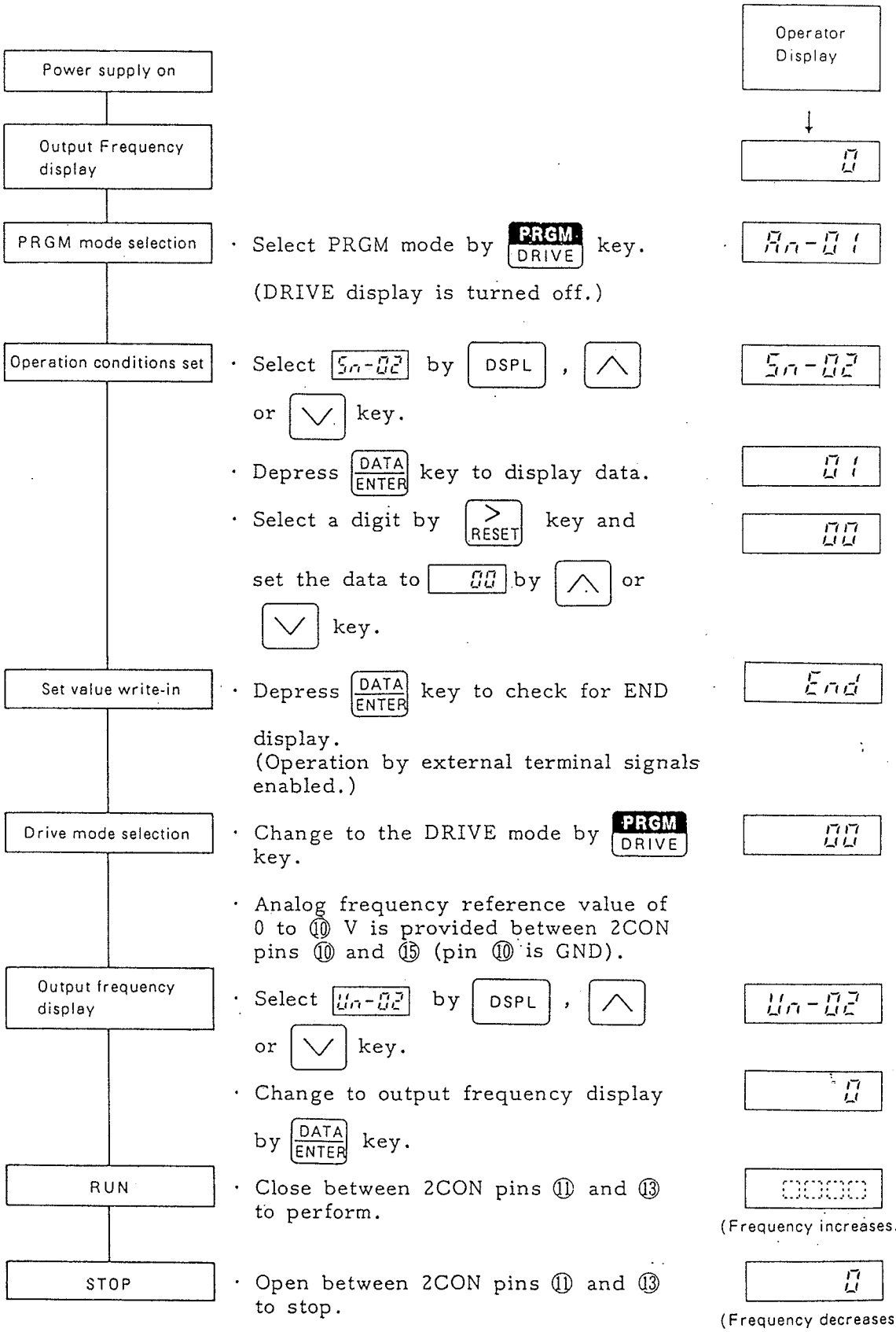


RUN or STOP lamp changes in accordance with the following operations.



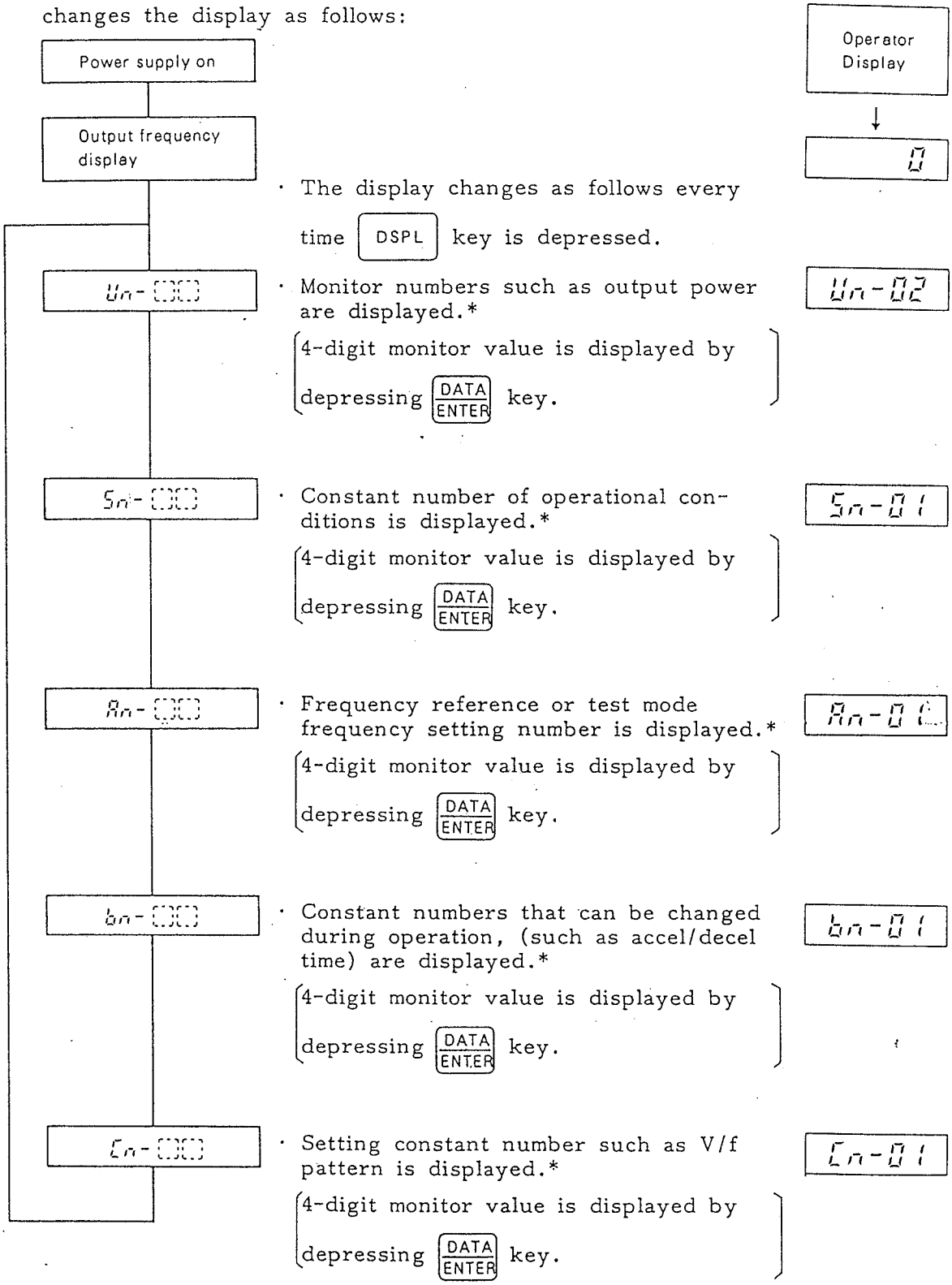

Operator Display
Power supply on
Output frequency display
0
Frequency reference value display
· Select An-01 by DSPL key.
An-01
Frequency reference value set
· Depress DATA ENTER key to display frequency reference value.
(The factory setting is 500 Hz.)
0500
· Select a digit by RESET key and set the frequency changing the value by ∧ or ∨ key.
0000
Set value write-in
· Depressing DATA ENTER key to set values.
(Displays "END".)
End
(Stops for 0.5 sec.)
0000
(Blinks again.)
Rotating direction set
· Select motor rotating direction by FWD REV key.
(Rotating direction selected here is displayed on the digital operator.)
FWD ○
REV ●
(Typical FWD run)
· Select Un-02 by DSPL , ∧ or ∨ key.
Un-02
· Change to output frequency display by DATA ENTER key.
0
RUN
· Start the operation by RUN key.
800
(Increased to 800 Hz)
STOP
· Stop the operation by STOP key.
0
(Decreased to 0.0 Hz)

OPERATION BY EXTERNAL TERMINAL SIGNALS



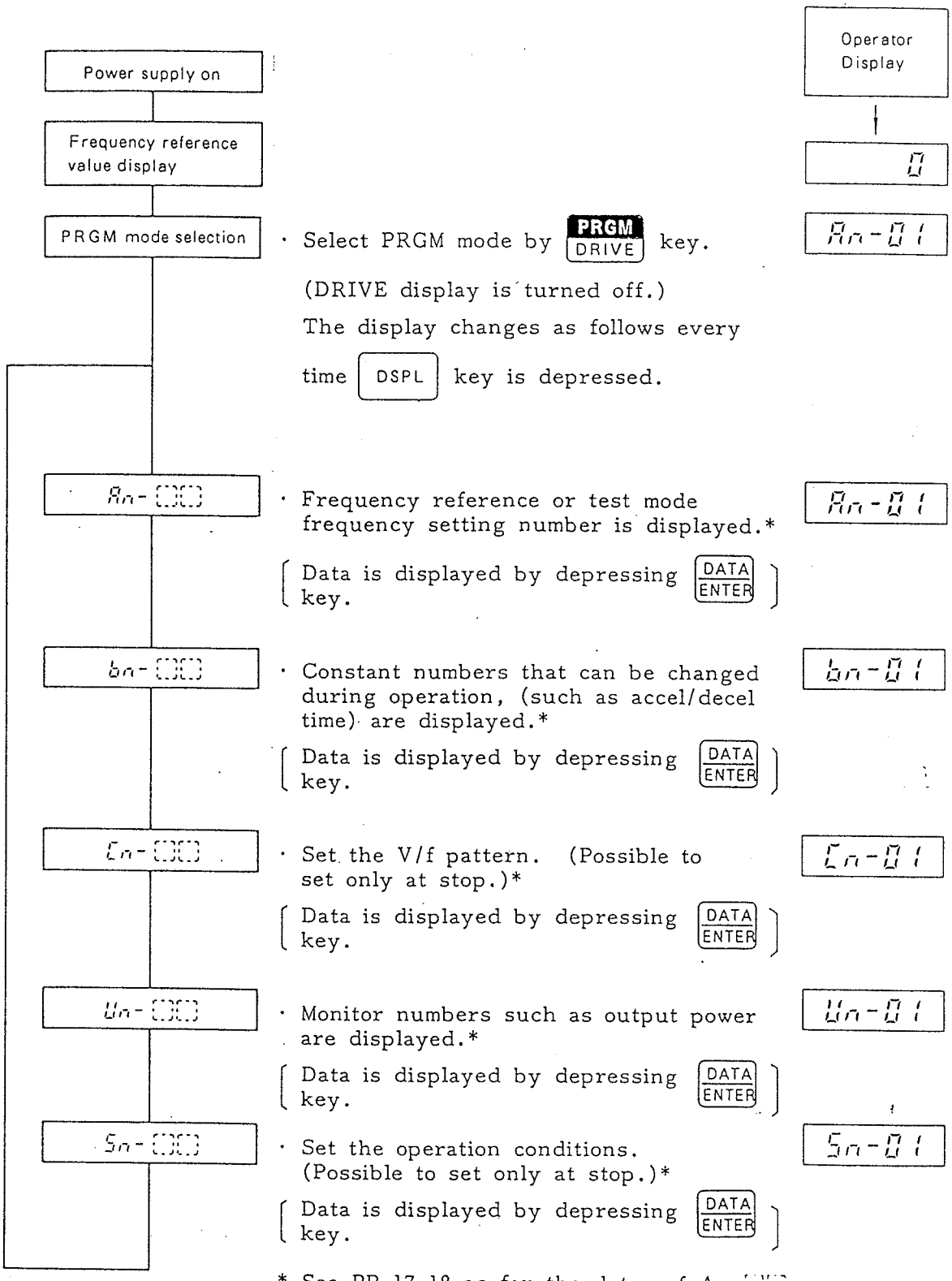
5.2 DRIVE MODE

Depressing [DSPL] (display selection key) changes the display as follows:



* Check for display constants in 17 and 18 pages.

5.3 PROGRAM (PRGM) MODE



* See PP 17-18 as for the datas of An-[][], bn-[][], Sn-[][], Cn-[][].

Typical Setting of Accel Time

Either DRIVE or PRGM mode can be selected.

(1) Depress [DSPL] key to select accel time constant [bn-01] .

(2) Depress [DATA/ENTER] key to display internal data of accel time constant. (Setting prior to shipment: [10.0])

(3) Set required acceleration time by using [>/RESET] , [∧] or [∨] key. The time can be set up to 60 seconds in multiples of 0.1 second. (Example of 12.5 seconds set: [12.5])

(4) Depress [DATA/ENTER] key to store the data. (If display reads end for approx. 1 sec, data has been accepted.)

6. OPERATION CONSTANTS (PARAMETERS)

6.1 LIST OF OPERATION CONSTANTS

Un-□□ (Monitor Type)

No.	Item	Display	Unit
Un-01	Frequency reference	F500	Hz
Un-02	Output frequency	500	Hz
Un-03	Output current	5.5A	A
Un-04	Voltage reference	150u	V

Sn-□□ (Operation Conditions Setting at Stopping)

No.	Operational Conditions		Data (Digits) 4	3	2	1	Setting Prior to Shipment
Sn-01	Inverter kVA selection					6	6
Sn-02	Operation reference from external terminal				0	0	01
	Operation reference from digital operator				0	1	
	Operation reference from serial transmission				1	0	
	Operation reference from external terminal Only speed reference from serial transmission				1	1	
Sn-03	All data set prior to shipping		0	0	0	0	*
	At normal operation		—	—	—	1	0001
	Reverse run possible		—	—	0	—	
	Reverse run not possible		—	—	1	—	
	Normal operation PAM control		—	0	—	—	
	Normal operation PAM/PWM common control		—	1	—	—	
	Test mode frequency soft start	Provided	0	—	—	—	
		Not provided	1	—	—	—	

* Only input from the digital operator is effective. When input by serial transmission, the value differs from the one set prior to shipping.

An-□□ (Frequency Setting)

No.	Item	Setting Range	Setting Prior to Shipment	Unit
An-01	Frequency reference	25–3000	0500	Hz
An-02	Test mode frequency reference	1.0–10.0	05.0	Hz
An-03	Test mode voltage reference	0.0–40.0	05.0	V

bn-□□ (Constant Possible to Change in Drive Mode)

No.	Item	Setting Range	Setting Prior to Shipment	Unit
bn-01	Accel time (0 → F5)	0.1–30.0	10.0	s
bn-02	Decel time (F5 → 0)	0.1–60.0	10.0	s
bn-03	Frequency reference gain (analog input)	50.0–200	100.0	%
bn-04	Output frequency gain (analog monitor)	50.0–200	100.0	%
bn-05	Accel voltage forcing (% of set value voltage)	80–120	100	%
bn-06	Decel voltage forcing (% of set value voltage)	80–120	100	%
bn-07	Power supply voltage	200–230	220	V

Cn-□□ (Constant Setting at Stopping)

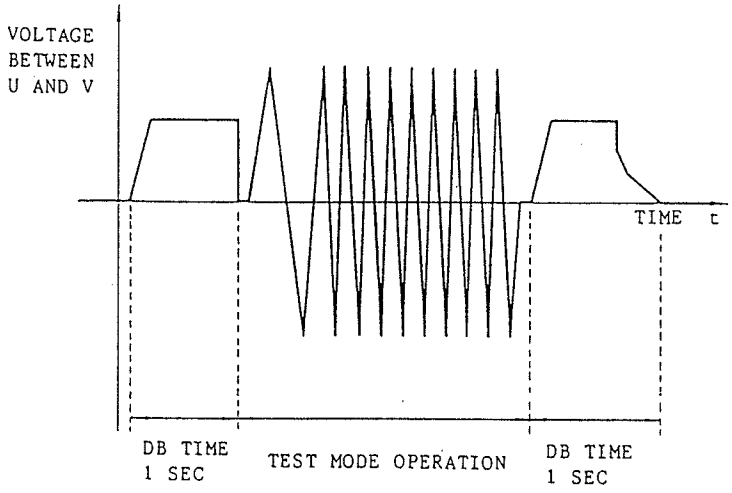
No.	Item	Setting Range	Setting Prior to Shipment	Unit
Cn-01	Max frequency (F5)	50–3000	2000	Hz
Cn-02	Voltage at F5	100–230	130	V
Cn-03	Frequency at F4	50–F5	2000	Hz
Cn-04	Voltage at F4	100–230	130	V
Cn-05	Frequency at F3	0–F4	1700	Hz
Cn-06	Voltage at F3	0–230	150	V
Cn-07	Frequency at F2	0–F3	1500	Hz
Cn-08	Voltage at F2	0–150	150	V
Cn-09	Frequency at F1	0–F2	0600	Hz
Cn-10	Voltage at F1	0–150	130	V
Cn-11	Min frequency	5–200	020	Hz
Cn-12	DC braking start level	5–500	050	Hz
Cn-13	DC braking time	0–15.0	04.0	s
Cn-14	DC braking voltage	0–30	05	V
Cn-15	Frequency (speed) agreed range	2–100	020	Hz
Cn-16	Stall prevention start current	30–150	100	%
Cn-17	Stall prevention limit current	50–170	150	%
Cn-18	Normal stall prevention current	50–170	130	%

6.2 PARAMETER SETTING

6.2.1 Test Mode

Item	Related Constant	Setting Prior to Shipment
Test Mode Frequency Reference	An-02	5.0 Hz
Test Mode Voltage Reference	An-03	5.0 V

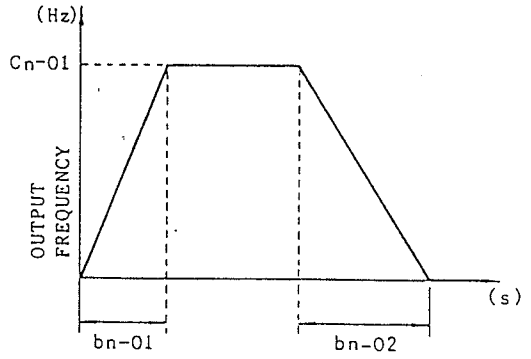
· Test mode operation has phase sequence different from that of normal operation. (UVW → UWV)



6.2.2 Setting of Accel/Decel Time

Item	Related Constant	Setting Prior to Shipment
Accel Time (0 → F5)	bn-01	10.0 s
Decel Time (F5 → 0)	bn-02	10.0 s

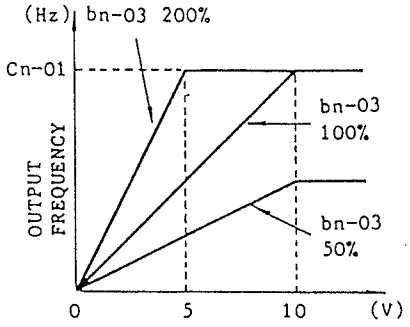
· Accel time can be set from 0.1 up to 30.0 seconds and decel time from 0.1 to 60.0 seconds.



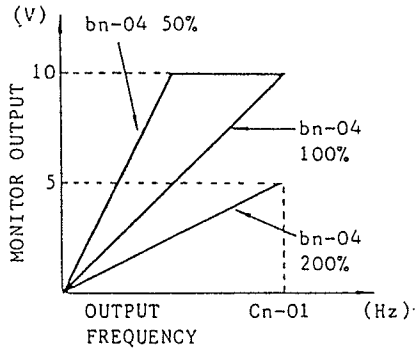
6.2.3 Frequency Reference Gain and Output Frequency Gain

Item	Related Constant	Setting Prior to Shipment
Frequency Reference Gain (Analog Input)	bn-03	100%
Output Frequency Gain (Analog Monitor)	bn-04	100%

- Frequency reference (analog) 100%/10 V × frequency reference gain/100% = internal frequency reference
  Therefore, when the frequency gain is 200%;
  Frequency reference 100%/10 V × 200%/100% = frequency reference 100%/5 V
  The above indicates that frequency reference becomes 100% at 5V input.
- Input the % of output frequency made from analog monitor output voltage of 10 V.



Analog Frequency Ref. Voltage

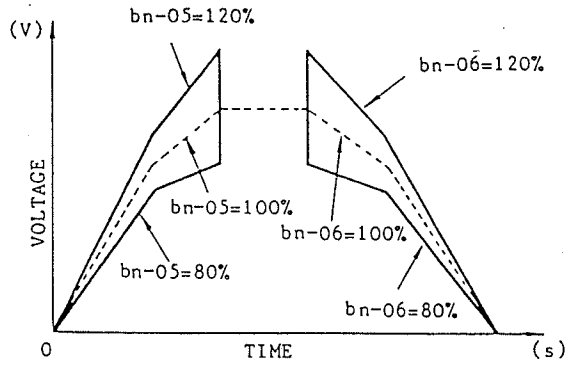


Analog Monitor Output Voltage

6.2.4 Accel/Decel Voltage Forcing

Item	Related Constant	Setting Prior to Shipment
Accel Voltage Forcing	bn-05	100%
Decel Voltage Forcing	bn-06	100%

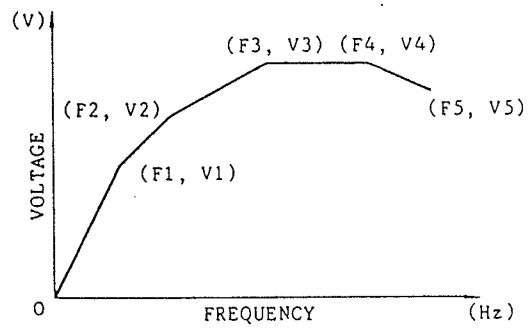
- At acceleration or deceleration, output voltage can be changed in the range of 80% to 120% for the V/f setting voltage. This is used for torque shortage at acceleration or when torque limit is required. Also it is used when the deceleration characteristic is increased.



6.2.5 V/f Setting

Item		Related Constant	Setting Prior to Shipment
Max frequency	(F5)	Cn-01	2000 Hz
Voltage at F5	(V5)	Cn-02	130 V
Frequency at F4	(F4)	Cn-03	2000 Hz
Voltage at F4	(V4)	Cn-04	130 V
Frequency at F3	(F3)	Cn-05	1700 Hz
Voltage at F3	(V3)	Cn-06	150 V
Frequency at F2	(F2)	Cn-07	1500 Hz
Voltage at F2	(V2)	Cn-08	150 V
Frequency at F1	(F1)	Cn-09	600 Hz
Voltage at F1	(V1)	Cn-10	130 V

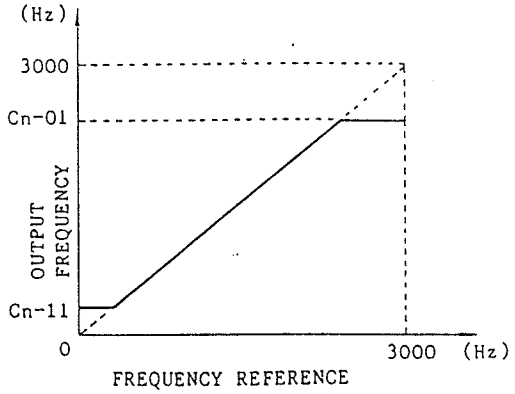
- Five points of (F1, V1), (F2, V2), (F3, V3), (F4, V4) and (F5, V5) can be set. The neighboring line linking these points makes the setting V/f curve.
- Set the V/f curve so that frequency values will be F5 > F4 > F3 > F2 > F1.
- Use a rectifier type voltmeter (Yokogawa Denki 2017 or equivalent) for output voltage measurement.



6.2.6 Setting of Output Frequency Limit

Item	Related Constant	Setting Prior to Shipment
Max Frequency (F5)	Cn-01	2000 Hz
Min Frequency	Cn-11	20 Hz

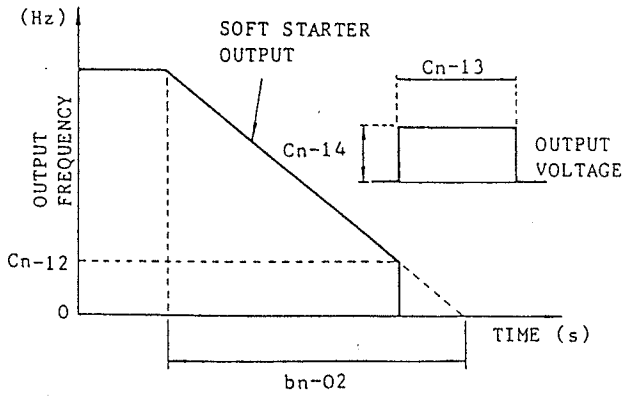
- The frequency range that can be set by the digital operator is from 25 Hz to 3000 Hz.



6.2.7 DC Injection Braking

Item	Related Constant	Setting Prior to Shipment
DC Injection Braking Start Level	Cn-12	50 Hz
DC Injection Braking Time	Cn-13	4.0 s
DC Injection Braking Voltage	Cn-14	5 V

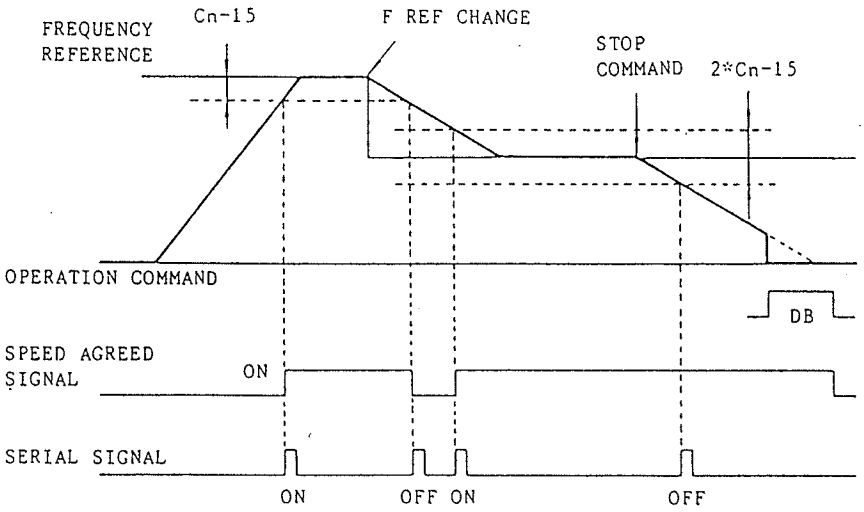
- DC injection braking starts when the output frequency becomes the DC injection braking start level or below.
- DC injection braking voltage is voltage between U and V.



6.2.8 Speed Agreement

Item	Related Constant	Setting Prior to Shipment
Range of Frequency (Speed) Agreement	Cn-15	20 Hz

- When the stop command is input, the speed agreed signal is turned OFF after completion of DC injection braking.
- Only serial signals that are related to the speed agreement are selected. Zero-speed signal or operation signal is omitted.

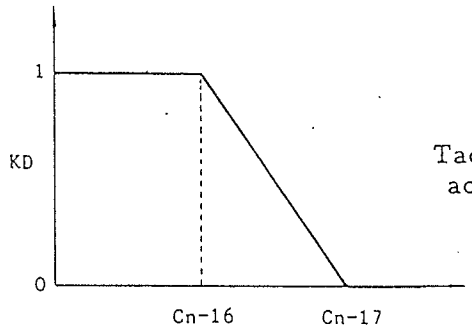


6.2.9 Stall Prevention

Item	Related Constant	Setting Prior to Shipment
Stall Prevention Start Current	Cn-16	100%
Accel/Decel Operation Stop Current Level	Cn-17	150%
Normal Stall Prevention Current	Cn-18	130%

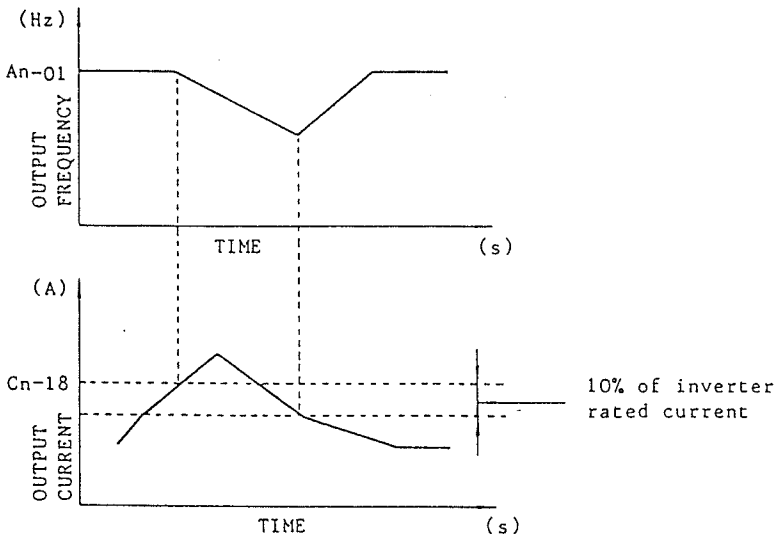
Note : The set values of Cn-16, -17 and -18 are the percentage of the inverter rated current.

- When output current exceeds the value of Cn-16 during acceleration, the acceleration time is extended according to the value. The same procedure is applied to the deceleration.



$$\text{Tacc (Practical accel time)} = \frac{\text{Tacc (bn-01 setting value)}}{\text{KD}}$$

- When the inverter output current exceeds the Cn-18 level during normal operation, the output frequency is reduced. The deceleration and acceleration rates become values set by deceleration time (bn-02) and acceleration time (bn-01), respectively.



7. MAINTENANCE

7.1 PERIODICAL INSPECTION

VS-646HS3 requires very few routine checks. It will function longer if it is kept clean, cool and dry, while observing the precautions listed in "Location" . Check for tightness of electrical connections, discoloration or other signs of overheating. Use Table 5 as the inspection guide. Before servicing, turn off AC main circuit power and be sure that CHARGE lamp is off.

Table 5 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 or oil mist.	Clean the board. If dust and oil cannot be removed, 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.

7.2 CHECK OF MAIN CIRCUIT PARTS

Measure the diode module, IGBT module and fuse terminal resistance values by using a tester and check that they are the reference values shown in Table 6. In this case, set the tester range to ×1.

Table 6 Reference Values for Main Circuit Parts

Name Type	Device Symbol	Tester Terminal*		Tester Normal Indication
		+	−	
Input Side Diode Module RM15TB-H (800 V, 30 A)	1RF	R	⊕	25 kΩ min
		⊕	R	10–200Ω
		S	⊕	25 kΩ min
		⊕	S	10–200Ω
		T	⊕	25 kΩ min
		⊕	T	10–200Ω
		R	⊖	10–200Ω
		⊖	R	25 kΩ min
		S	⊖	10–200Ω
		⊖	S	25 kΩ min
		T	⊖	10–200Ω
		⊖	T	25 kΩ min
Chopper Side IGBT Module 2MBI 50-060 (600 V, 50 A)	1TRS	C1	C2E1	10–200Ω
		C2E1	C1	25 kΩ min
		C2E1	E2	10–200Ω
		E2	C2E1	25 kΩ min
Output Side IGBT Module 6MBI 75-060 (600 V, 75 A)	2TRS	⊕	U	10–200Ω
		U	⊕	25 kΩ min
		⊕	V	10–200Ω
		V	⊕	25 kΩ min
		⊕	W	10–200Ω
		W	⊕	25 kΩ min
		⊖	U	25 kΩ min
		U	⊖	10–200Ω
		⊖	V	25 kΩ min
		V	⊖	10–200Ω
		⊖	W	25 kΩ min
		W	⊖	10–200Ω
Fuse CR2LS 250 V, 50 A	1F 2F	—		0 Ω

* When a tester with positive (+) terminal connected to the internal battery negative (−) side.

7.3 PARTS REPLACEMENT

It is recommended that worn parts be replaced for a longer and more stable use of the VS-646HS3. When ordering replacement parts, specify the parts according to Table 7.

Table 7 Standard of Parts Replacement

Parts Name	Standard Replacement Period	Replacing Method, Others
Cooling Fan	2–3 years	Replace.
Smoothing Capacitor	5 years	Replace. (Determine after checking.)
Relay	—	Determine after checking.
Fuse	10 years	Replace.
Aluminum Capacitor on Printed Circuit Board	5 years	Replace. (Determine after checking.)

Note : Operational Conditions

- Ambient temperature : 86°F (30°C) average/year
- Load factor : 80% or less
- Operation range : Less than 20 hours/day

NOTE

The following shows the precautions when the parts are checked and replaced:

(1) When a lead wire without any number is removed, provide it with a number so that it can be connected properly later.

(2) Ensure that parts are mounted and lead wires are connected properly. Only a single missing or loosened screw may cause a malfunction.

8. SPARE PARTS

It is strongly recommended that replacement parts be kept in stock in accordance with the critically of the facility where the VS-646HS3 is used. Table 8 is the list of replacement parts.

When ordering replacement parts, specify Parts Name, Type, Code No. and Quantity.

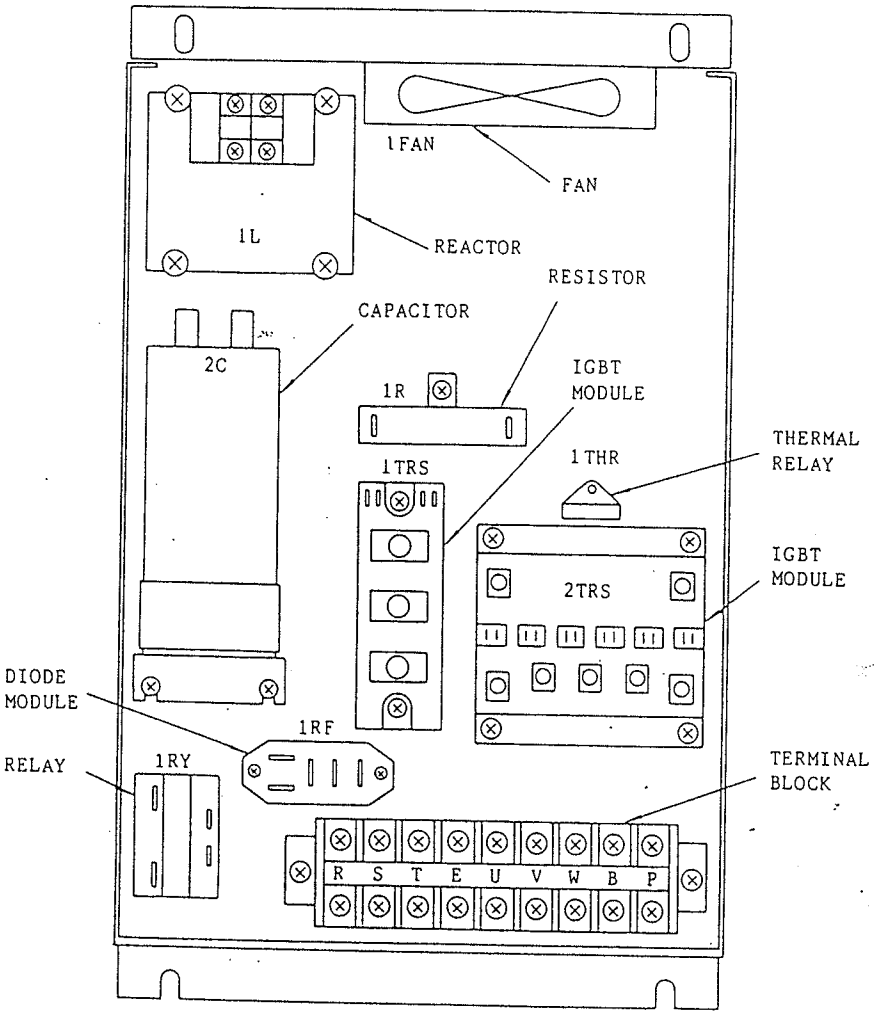
Table 8 Spare Parts

VS-646HS3 Model		CIMR-HFS23P7		
Specifications		Model	Code No.	Q' ty
Parts Name	Main Circuit Diode	RM15TB-H	SID000394	1
	Main Circuit Transistor	6MBI75-060		1
	Chopper Circuit Transistor	2MBI50-060		1
	Fuse	CR2LS-50	FU000797	2
	Digital Operator	JVOP-100	CDR000070	1
	Cooling Fan	ASE10456		1
	Control Module Board	—	ETC640030	1
	Power Module Board	—	ETP640010	1

Precautions on Installation of Diode Module or Transistor Module

When diode module or transistor module is installed, apply thermal compound, "JOINTAL Z" (made by Nihon Keikinzoku) on the module mounting face. This is to strengthen the adhesion of the module and its mounting face and increase the cooling efficiency.

ARRANGEMENT OF MAIN PARTS



9. FAILURE INDICATION AND DETAILS

As Table 9 shows, the failures that the VS-646HS3 detects are classified into troubles and alarms. If a problem occurs, the fault contact is output and the unit coasts to a stop. When an alarm is issued, the digital operator indicates the alarm for warning.

CAUTION

Do not replace the DC bus fuse without first checking the output transistors.

Table 9 Failure Indication and Details

Indication	Type of Fault	Description	Corrective Action	Fault Code
OC1	Overcurrent (chopper section)	Stop at approx. 150% of rated current	· Check the motor winding and ground fault. · Increase the accel time.	E01
OC2	Overcurrent (inverter section)	Stop at approx. 290% of rated current		E02
OU1	Overvoltage (inverter section)	Detection level : approx. 395 VDC or more	Increase the decel time.	E03
OU2	Overvoltage (chopper input section)	Detection level : approx. 395 VDC or more		E04
UU	Low voltage	Chopper input section voltage < 210 VDC	· Check the wiring of line units. (at power supply side) · Correct the power supply voltage.	E05
OH	Radiation fin overheated	Fin temperature (90°C ± 5°C)	Check fan or ambient temperature (less than 45°C, 113°F).	E06
EL	Ground fault	Motor output drops on the ground	Check the wiring and motor winding	E07
Ub	Unbalance, open-phase	Motor output current is unbalanced.	Check the wiring and motor winding	E08
OL1	Overload (chopper section)	Inverter overload	Reduce load, extend accel time or reset V/f value.	E09
OL2	Overload (inverter section)			E10
Eb	External fault	Stop by fault signal from external terminal	Check the cause of external fault.	E11
OPE	Constant setting fault	Constant logic mismatch	Recheck constant setting range.	NAK*
Ebb	External baseblock	External baseblock is input.	—	E14
.....	Control function Hardware fault	Inverter failure	Replace control PC board.	E13
AdEn	A/D converter fault in CPU			E15
CPF00	Transmission error or control function hardware fault	Transmission between inverter and operator is not established 5 seconds after power supply ON (displayed on operator.)	Check the cables or connectors between inverter and operator. If a fault occurs after power supply is turned on again, replace operator or control PC board.	—
OPF01	Transmission error with operator	Transmission error occurs for 2 seconds or more after power supply ON and transmission between inverter and operator once established (displayed on operator.)		

* If a constant setting fault occurs in the serial transmission, fault code "NAK" is returned. No code is returned if a constant setting fault occurs in the digital operator.

[APPENDIX]

1. SPECIFICATIONS

Item		Specification
Voltage Class		200 V class
Inverter Model		CIMR-HFS23P7
Output Characteristics	Inverter Capacity kVA	6
	Rated Output Current A	18
	Max Output Voltage	230 V (Proportional to input voltage)
	Max Output Frequency	3000 Hz
Power Supply	Rated Input Voltage and Frequency	3-Phase 200/220 V 50 Hz 200/220 V/230 V 60 Hz
	Allowable Voltage Fluctuation	Voltage ±10% Regulation within ±3%
	Allowable Frequency Fluctuation	±5%
Control Characteristics	Control Method	Sine wave PAM
	Frequency Control Range	1 : 20
	Frequency Accuracy	Digital command : ±0.01% Analog command : ±0.3% +14 to 119 °F 77±18 °F −10 to 55 °C 25±10 °C
	Overload Capacity	150% rated output current for 60 seconds
	Frequency Setting Signal	0 to 10 VDC (20 kΩ)
	Accel/Decel Time	0.1 to 30 sec (Accel time) 0.1 to 60 sec (Decel time)
	Accel/Decel Voltage Forcing	Setting voltage 80% to 120%
	Braking Method	Regenerative braking + DC braking
	V/F Setting	Any desired 5 points can be set.
Operation Characteristics	Operation Method	Digital operator, external contact signals, serial transmission (RS-232C)
	Test Mode	1 to 10 Hz (low speed operation), operation enabled by external terminal input.
	Frequency Setting	Digital input [digital operator, serial transmission] Analog input [main/aux speed (10 V/100%) by external terminal input.]
	Coasting to a Stop	Enabled by external baseblock signal
Protective Functions	Motor Overload Protection	Electric thermal overload relay
	Instantaneous Overcurrent	Chopper section (150% rated current) Inverter section (290% rated current)
	Overload	Motor coasts to a stop for 1 minute at 120% rated output current.
	Over Voltage	Motor coasts to a stop if converter output voltage exceeds 395 V.
	Under Voltage	Motor coasts to a stop if converter output voltage drops to 210 V or below.
	Momentary Power Loss	Continuous system operation during power loss less than 0.3 sec
	Fin Overheat	Thermostat
	Stall Prevention	Stall prevention at acceleration/deceleration and constant speed operation.
	Ground Fault	Provided by electronic circuit
	Power Charge Indication	Charge lamp stays ON during converter output voltage charge.
	Load Balance, Open-phase	MAX (Iu, Iv, Iw) − MIN (Iu, Iv, Iw) > Stop at 5 A
Environmental Conditions	Location	Indoor (protected from corrosive gases and dust)
	Ambient Temperature	+14 to 131 °F (−10 to + 55 °C)
	Storage Temperature *	−4 to 140 °F (−20 to + 60 °C)
	Humidity	90%RH (non-condensing)
	Vibration	1 G less than 20 Hz, up to 0.2 G at 20 to 50 Hz
	Height	1000 m or below
Unit Configuration		Built-in type
Cooling Method		Forced air-cooling
External Dimensions		250 × 550 × 195
Approx. Weight		13 kg (29 lb)

* Short-term temperature during transportation.

2. FUNCTIONS OF TERMINALS AND CONNECTORS

2.1 MAIN CIRCUIT

Voltage Class	200 V Class
Model	CIMR-HFS23P7
(R)	Main circuit input power supply
(S)	
(T)	
(E)	Ground terminal
(U)	Inverter output
(V)	
(W)	
(B)	Braking resistor
(P)	

2.2 CONTROL CIRCUIT CONNECTOR

Connectors: Made by Honda Tsushin KK [25 pins MR-25M (G)]

Type	Pin No.	Functions	Signal
Sequence Input Signal	13	Forward operation (at closed) –stop signal (at open)	Photo-coupler insulation input +24 V
	25	Reverse operation (at closed) –stop signal (at open)	
	6	External fault input : available to select fault (at closed)/ normal (at open) according to operation constants	
	12	Fault reset at closed	
	3	Master/aux change : aux frequency command at closed	
	4	Test mode operation (at closed) –stop signal	
	7	External baseblock : inverter output stop at closed	
	11	Sequence control input common	
Analog Input Signal	5	Power supply for speed setting	+15 V (Internal power supply 20 mA max)
	15	Master speed frequency reference	0 to +10 V/100% (20 kΩ)
	20	Aux frequency reference	
	10	Common terminal for control circuit	0 V
	9	Connection to shield sheath of signal lead	—
Sequence Output Signal	1	Speed agreed signal NO (at closed)	Contact capacity : 30 VDC 1 A or less
	2		
	18	Run signal : L level during operation	Contact capacity : 48 VDC 50 mA or less
	19	Zero speed signal : L level during zero speed	
	21	Open collector output common	—
	8	Fault contact output NONC : Open between (8) and (14) at fault Closed between (23) and (14) at fault	Contact capacity : 30 VDC 1 A or less
	14		
	23		
Analog Output Signal	16	Frequency meter output	Monitor output : 0 to +10 V
	17	Common	

2.3 TRANSMISSION CONNECTOR (RS-232C)

Pin No.	Signal
1	OV
2	TX (Transmitting data)
3	RX (Receiving data)
4	DTR (Data terminal READY)
5	RTS (Request for transmission)
6	—
7	GROUND (Shielded)
8	—

3. SERIAL TRANSMISSION (RS-232C)

3.1 TRANSMISSION SPECIFICATIONS

Item	Description
Transmission Line	EiA RS-232C
Baud Rate	2400 BPS
Data Bit	8 bits
Stop Bit	2 bits
Parity Bit	—
Character Code	JIS (ASCII)
Transmission Distance	5 m or below

3.2 LIST OF TRANSMISSION COMMAND

Item	Signal Direction	Command	
Inverter Activation (FWD Run)	NC → INV	M03	
Inverter Activation (REV Run)	NC → INV	M04	
Inverter Stop	NC → INV	M05	
Test Mode ON	NC → INV	M01	
Test Mode OFF	NC → INV	M11	
Fault Reset	NC → INV	M12	
Speed Agreement ON	INV → NC	M13	
Speed Agreement OFF	INV → NC	M23	
External Fault ON	NC → INV	M14	
External Fault OFF	NC → INV	M24	
Zero-speed ON	INV → NC	M15	
ON During Operation, Zero-speed OFF	INV → NC	M16	
OFF During Operation	INV → NC	M26	
Initialization Command	NC → INV	M02 *	
Data Save	NC → INV	ROM †	
Transmission Response Time	NC → INV	WAI [XX]	#
Speed Reference	NC → INV	S00 [XXXX]	**
Fault Code	INV → NC	Enn (nn = 00 to 16)	‡ [1]
Operation Constant Reference	NC → INV	Snn (nn = 01 to 03) Ann (nn = 01 to 06) Bnn (nn = 01 to 07) Cnn (nn = 01 to 19) Unn (nn = 01 to 04)	[2]

* Stop command (M05) and speed reference (S00) clear commands are provided simultaneously.

† Operation constant set to RAM by serial transmission is stored to EE-PROM.

‡ When no data are provided for commands containing data, the currently set data are echoed back.

\# Timing between NC and transmission time is taken.

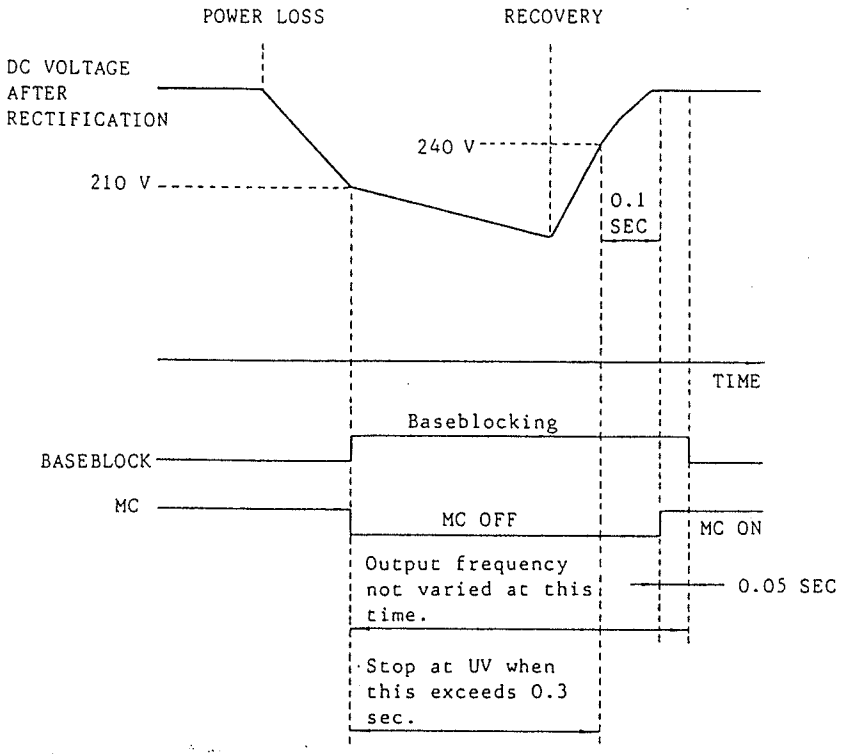
** Speed is referenced by revolution number (in the units of 10 r/min : for 2-pole motor).

[1] For fault codes, refer to Table 9 "Failure Indication and Details".

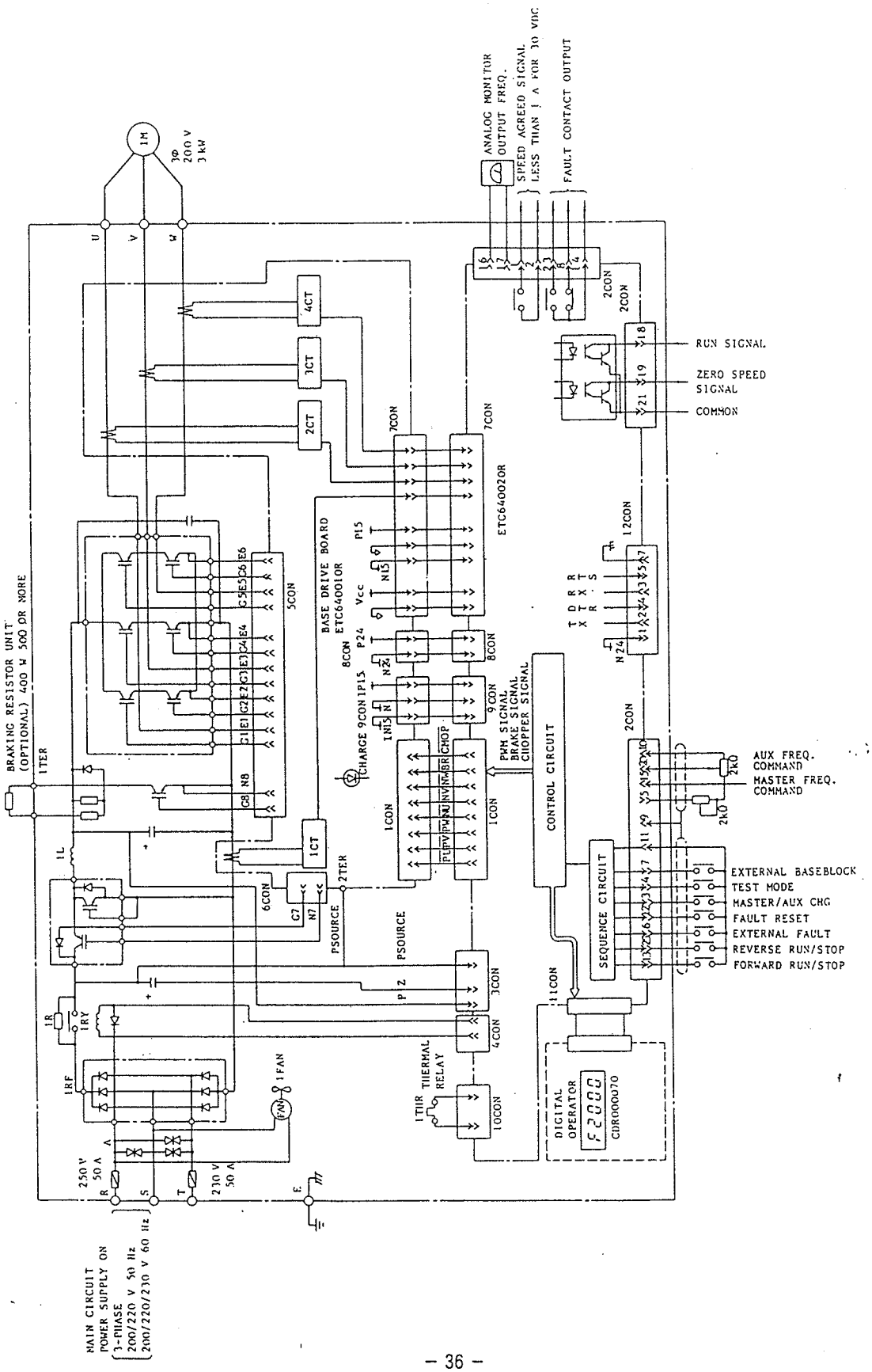
[2] Refer to Par. 6.1 "LIST OF OPERATION CONSTANTS".

4. MOMENTARY POWER LOSS RECOVERY

If a momentary power loss occurs, baseblock is performed when the main circuit DC voltage becomes 210 V or less after rectification. Then the motor coasts and the MC (magnetic contactor) is turned off at the same time. When the momentary power loss is recovered and the DC voltage exceeds 240V, it is regarded as momentary power loss recovery and a serial operation of MC ON and beseblock stop is performed.



5. CONNECTION DEVELOPMENT



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