TOSHIBA
INSTRUCTION
AND
MAINTENANCE
MANUAL

IMVT130H

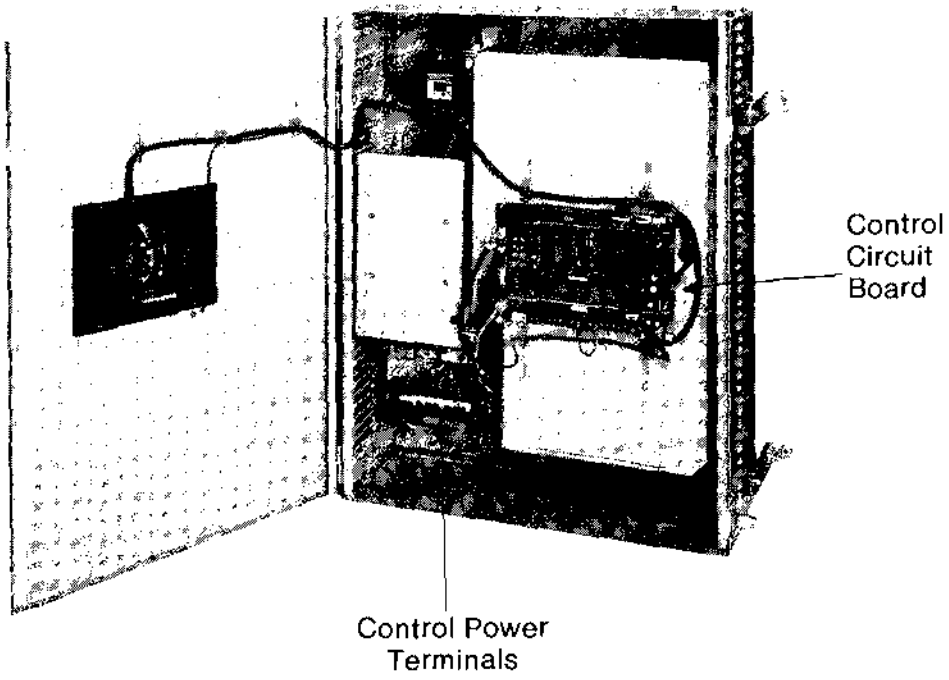
TOSVERT-130H/H1
TRANSISTOR INVERTER

230V/3.5-80KVA
460V/5.5-100KVA

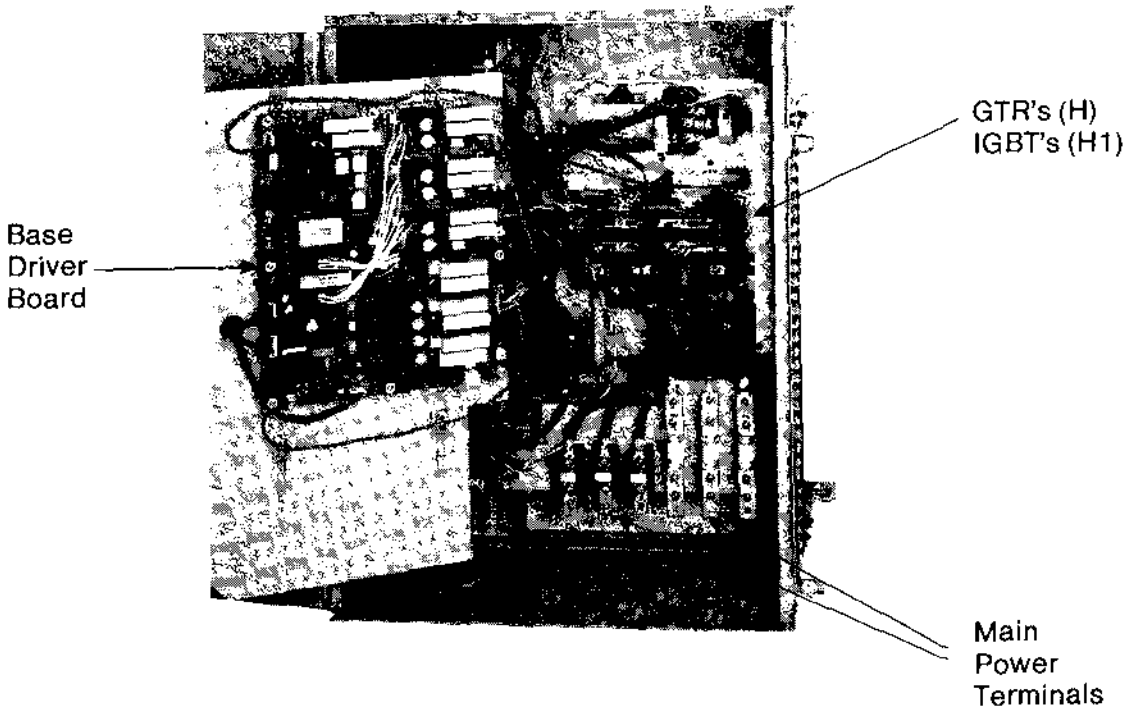
TOSHIBA/HOUSTON
INTERNATIONAL CORPORATION
13131 West Little York Road
Houston, Texas 77041

JANUARY 88

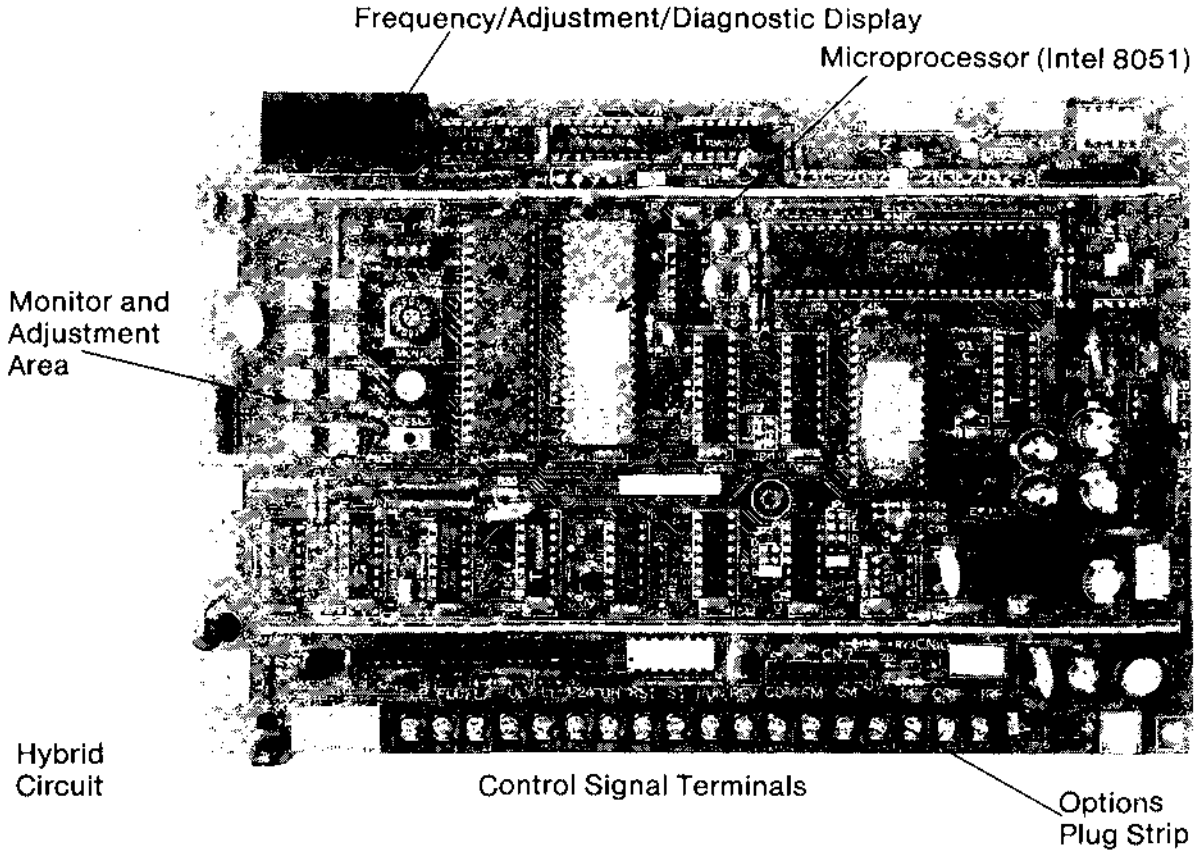
LIST PRICE $25.00



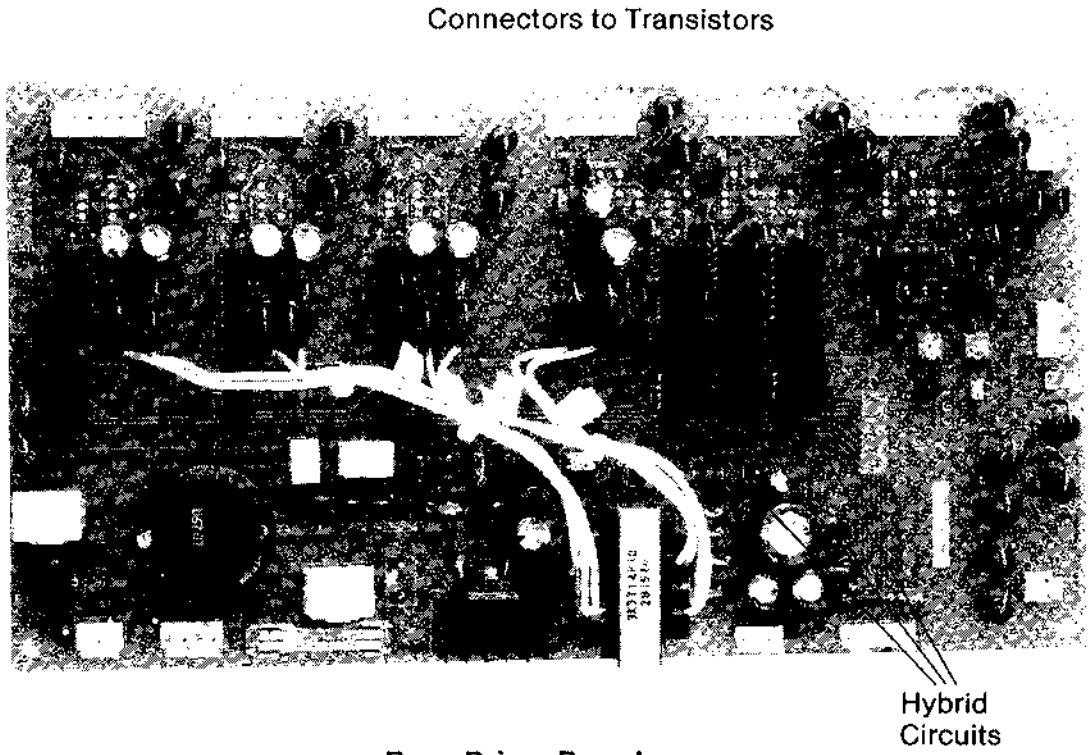
Typical Internal View
With Internal Panel Closed



Typical Internal View
With Internal Panel Open



Control Circuit Board

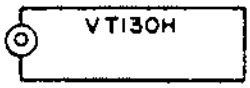
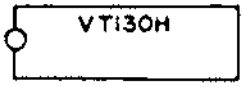
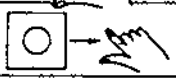
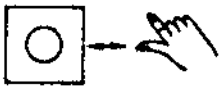
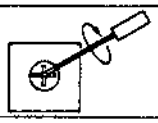
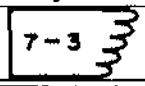


Base Driver Board

PREFACE

This Instruction Manual describes the specifications, functions, handling and maintenance of the Toshiba low noise inverter TOSVERT-130H/H1. Before installing and starting-up the drive, please review this manual for correct installation, wiring and adjustment procedures.

Explanation of Symbols

No.	Symbol	Explanation
1		Terminal strip (terminals for wiring external to the inverter chasis)
2		Internal connector (connections made to terminals to components within the inverter chasis.)
3		Push and hold the push-button.
4		Release the push button.
5		Momentarily push the push-button and then release it.
6		Adjust the potentiometer/rotary switch with the screw driver. (a crosstip (+) driver is attached to each unit)
7		Discontinue adjustment of the potentiometer/rotary switch.
8		Turn the speed potentiometer.
9		Refer to section numbered in box.
10		Digital LED indicator for frequency/monitor.
11		A caution mark. Observe all specified cautions.

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Chapter I
INSPECTION UPON RECEIPT

1-1 Unpacking:

Verify the following: (If you find any defect, contact Toshiba or the local supplier.)

(1) Check for shipping damage.

(2) Verify that the rated capacity and voltage conform to your order requirements. Please refer to "Description of Type-Form" on the following page.

1-2 Storage:

If the inverter will not be used immediately upon receipt, and will be put into temporary or long-time storage, observe the following cautions:

(1) Avoid storage in high temperature, high humidity, and areas which are dusty or contain metal particles. Select a well-ventilated place for storage.

(2) If the inverter has printed circuit boards provided with an electrostatic charge prevention cover, do not remove them while in storage. When powering up the inverter, be sure to take off the electrostatic covers on the printed circuits boards.

(3) If the inverter powered up for more than 6 months, it should be electrically connected on a semi-annual basis to maintain the electrical characteristics of the large-capacity electrolytic capacitors. At the same time, check the functionality of the inverter. If left unused for a long period of time, the large-capacity electrolytic capacitor bank will deteriorate, and will require reconditioning. (For its inspection, see section 11-5.)

1-3 Warranty:

Should the drive unit fail to operate or is damaged for any reason related to our design, manufacture and testing, it will be repaired or replaced free of charge, provided that such failure or damage has occurred during the following warranty period:

The warranty period of this inverter is 18 months from the date of shipment or 12 months from the start of operation, whichever is shorter. However, the repair or replacement of the drive will be charged to the customer during the warranty period if failure or damage has been caused by the following:

(1) A wiring or operational error, or unreasonable repair or unauthorized modification;

(2) Unit damaged by a fall after purchase or during transportation;

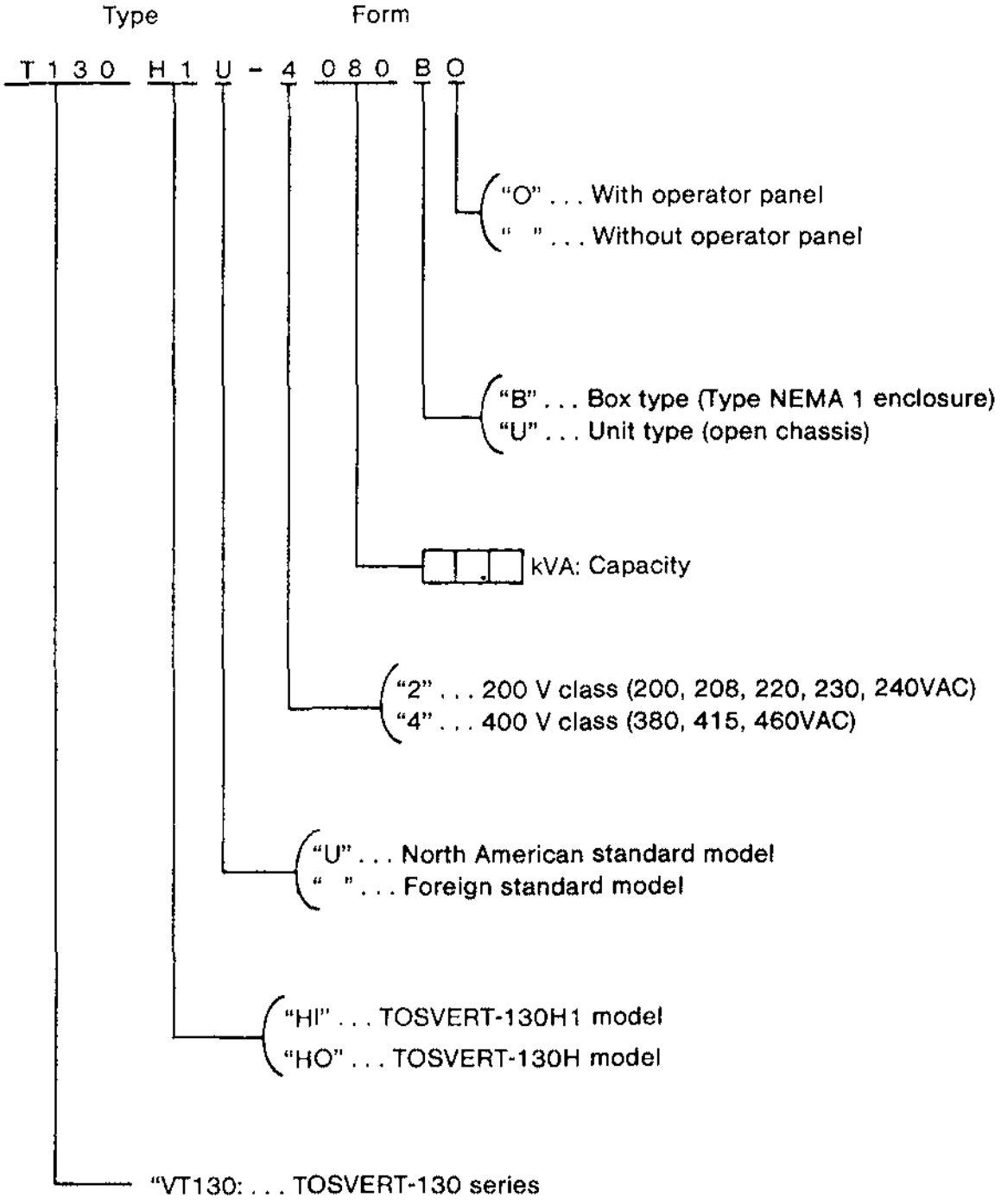
(3) Fire, acid, corrosive gas, earthquake, wind, flood, lightning, abnormal voltage and/or voltage spikes, or any other natural disaster or an act of God;

(4) Use for a purpose other than those designed by the manufacturer;

(5) The warranty will be limited should the enclosed self addressed stamped warranty card not be returned to the manufacturer, see the Extended Warranty Registration card in the front of this manual.

NOTE: Description of the Type-Form Code

The type and form of the TOSHIBA low-noise inverter TOSVERT-130H/H1 for HVAC are described below.

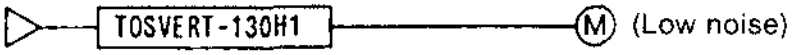


EXAMPLE: T130H1U-4080BO Describes a Tosvert-130H1 model inverter, with 400 VAC class line operation, of 80 KVA (75 HP max - see section 7-3-2) with a NEMA 1 enclosure with operator panel.

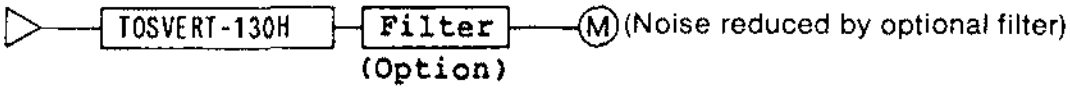
Chapter II
Characteristics of TOSVERT-130H/H1

1. The drive's quiet operation closely approximates the motor smoothly operating across the sinusoidal AC power line:
   (1) The TOSVERT-130H1 Series allows low-noise operation by using IGBT's (Insulated Gate Bipolar Transistors - a Bipolar type MOS-FET), a new high-frequency high power switching device developed by Toshiba. On the other hand, the TOSVERT-130H Series uses conventional G-TR's (Bipolar type transistors), and Toshiba's custom designed sine wave PWM method, which also reduces motor noise. If the TOSVERT-130H is configured with a noise filter, the motor noise is reduced to nearly that of the TOSVERT-130H1. This noise level is about 10dB(A) lower than the conventional PWM transistorized inverters:

   1) TOSVERT-130H1 Series:



   2) TOSVERT-130H Series:



   (2) The carrier frequency for the sine wave PWM control can be changed to prevent resonance in the mechanical system. This allows for smoother and quieter operation for a wider range of applications.

2. The inverter is especially designed for energy-saving systems, such as an air handling equipment in buildings, and fans, pumps, blowers, etc.
   (1) Energy-Saving Control:
      1) Energy-saving voltage/frequency (V/F) pattern adjustments have been provided.
      2) Energy-saving operation can be automatically selected.
   (2) To enable continuous operation of the inverter under adverse power sources and load conditions, the following advanced functions are provided as the standard features:
      1) Automatic restart after instantaneous power failures.
      2) Automatic restart in case of fault, for up to 5 times, in the event of overcurrent.
      3) Stall Protection.
      4) Soft stall control (Selectable between overload trips).
      5) Deceleration limit control.
      6) Ground fault.
   (3) Easy operation from external control circuits.
      1) 6 types of frequency reference signals are standardly available for selection:
         - o 3K ohm potentiometer (manual operation)
         - o 0 - 10 (12) V DC
         - o 0 - 5V DC
         - o 4 - 20mA DC
         - o 0 - 20mA DC
         - o Input resistance 0 - 135 ohm

2) PI Control (set point control option) allows automatic control of delivery pressure and flow rate of fan, pump and blower.

3) The upper and lower limit output frequency can be preset. When the output frequency has reached its' upper or lower limit, an open collector transistor output is available for external use in each case.

(4) In case of fault, a Form C contact signal (dry contact) is activated.

(5) Acceleration and deceleration time can be separately selected within the range of 0.1 to 300 seconds.

3. Easy Start-up

(1) By using the monitor function, the various inverters parameters (inverter mode, inverter status, current level, etc.) can be read from the built-in digital indicator (4 digit, 7 segment LED).

(2) Adjustments can be made from the front of the inverter through a small door on the operation panel, and read digitally on the digital LED indicator by depressing the monitor functions button.

1) Voltage/Frequency (V/F) patterns can be easily selected the V/F pattern rotary selector switch.

- o 14 V/F patterns
- o 2 Energy-saving patterns

2) By adjusting the potentiometers (acceleration/deceleration time, upper/lower limits, etc.), the monitor function is automatically activated, and the set value of the potentiometer is displayed on the digital indicator when selected. If an illegal/abnormal value is set, the built-in alarm system alerts the operator by flashing the display on the digital indicator. (e.g.-upper limit is incorrectly set lower than lower limit setting).

3) A reset push-button switch is provided on the printed circuit board, and can be operated through the small door of the control panel. Reset terminals are also provided for external reset (dry contact).

4. Diagnostic and Protection feature

(1) In an instantaneous power failure, the inverter operates continuously if power recovers within 30 msec.

(2) Grounding fault protection is assured as a standard function (optional in Foreign models)

(3) Standard protective functions also include stall prevention, overcurrent, overload, short-circuit, overvoltage, undervoltage, overheat and internal fusing.

(4) As another standard function, a current limit circuit is included which limits the load current automatically at the time of overcurrent.

(5) A voltage limit circuit is also provided standardized for automatic prevention over voltage on the DC voltage in the event of overhauling loads with rapid deceleration times.

(6) In the event of fault, the cause of the fault flickers on the digital LED indicator. Also, the monitor function allows you to read out the inverter status from memory for diagnosis of the fault.

(7) A charge lamp LED is provided to indicate that the main DC capacitor bank is charged.

5. **Enclosures:**
   (1) 3 types are available: Box type with operator panel (BO type: Box type with front cover, upper and lower covers, and operator panel), Box type without operator panel (B type: Box type with front cover, upper and lower covers, and without control panel), and open chasis type (U type: Unit type without front cover, upper and lower covers and control panel). Consult local supplier for units which are normally stocked in your area.
   (2) Both the incoming and outgoing power cables enter through the bottom for all size ratings.
   (3) The heat sink fins can be modified for mounting in a fully enclosed cubicle.
   (4) Units based on the UL standards are available. For details, please contact Toshiba.

6. **Other:**
   (1) Built-in microcontroller and custom LSI construction assure high performance and increased reliability.

Chapter III
STANDARD SPECIFICATION

The standard specifications are specified below.

Type	Form		Description
	200V* Class	400V* Class	
VT130H1	2035 - 2080 (3.5-8kVA)	4055 - 4160 (5.5-16kVA)	TOSVERT-130H1, Standard Type
VT130H0	2110 - 2800 (11-80kVA)	4220 - 4100K (22-100kVA)	TOSVERT-130H, Standard Type
VT130H1U	2035 - 2080 (3.5-8kVA)	4055 - 4160 (5.5-16kVA)	TOSVERT-130H1, North American Model
VT130H0U	-	4220 - 4500 22-100kVA)	TOSVERT-130H, North American Model

(Note 1) VT130H0/H1: A Series
VT130HOU/H1U: B Series

(Note 2) The capacity of VT130H1 will be expanded as the IGBT device capacity is increased.
For details, please refer to Chapter IV.

3-1 Ambient Conditions

Item	Description	Remarks
Installation place	Indoors	See Chapter IV
Ambient temperature	−10°C - 50°C (−10°C - 40°C if equipped with covers	
Ambient humidity	Less than 90% RH (relative humidity); There must be no condensation	
Vibration	Less than 0.5G	
Environmental requirements	No corrosive gas. No dust or metal filings	

* 200V class for: 203V, 220V, 230V, 240V
400V class for: 380V, 415V, 460V

3-2 Rating of Equipment

No.	Model /type	Capacity (kVA) (Note 1)	Rated Current (A)	Max. applicable motor rating (4 poles) (kW, HP)				
				200V	208V	220V	230V	--
	VT130H1-							
1	2035	3.5	10	2.2kW	3 HP	2.2kW	3 HP	
2	2055	5.5	16	3.7	5	3.7	5	
3	2080	8	20	–	7.5	5.5	7.5	
	VT130HO-							
4	2110	11	28	5.5	10	7.5	10	
5	2160	16	40	7.5	–	11	15	
6	2220	22	56	11	15	15	20	
7	2270	27	68	15	20	18.5	25	
8	2330	33	80	18.5	25	22	30	
9	2400	40	100	22	30	30	40	
10	2500	50	126	30	40	37	50	
11	2600	60	155	37	50	45	65	
12	2800	80	200	55	75	55	75	
				380V	400V	415V	440V	460V
	VT130H1-							
13	4055	5.5	7	–	–	–	3.7kW	5HP
14	4080	8	10	4 kW	3.7kW	5 HP	5.5	7.5
15	4110	11	14	5.5	5.5	7.5	7.5	10
16	4160	16	20	9.2	7.5	10	11	15
	VT130HO-							
17	4220	22	28	11	11	15	15	20
18	4270	27	34	155	15	20	18.5	25
19	4330	33	40	18.5	18.5	25	22	30
20	4400	40	50	22	22	30	30	40
21	4500	50	63	30	30	40	37	50
22	4600	60	77	37	37	50	45	60
23	4800	80	100	45	45	65	55	75
24	4100K	100	126	55	55	75	75	100

(Note 1) The above capacities are calculated values at 230V for the 200V class (No.1-12) and 460V for the 400V class (No. 13-24).

(Note 2) When selecting an inverter based on the motor, please refer to 4-1.

(Note 3) VT130H1U and VT130H0U have the same specifications as VT130H1 and VT130H0, respectively, but their construction is different.

(Note 4) When applying a motor noise reduction filter (option) to VT130H0 or VT130H1, or when changing the PWM control carrier frequency, always refer to 4-1.

3-3 Specifications of Input Power Source

Item	Description	Remarks
Phase, Voltage, frequency	200 V class 3-phase, 200/220/230V, 50Hz 3-phase, 200/208/220/230V, 60Hz 400V class 3-phase, 380/400/415V, 50Hz 3-phase, 400/440/460V, 60Hz	
Tolerance	Voltage: ±10%, Freqency: ±2Hz	

3-4 Specifications of Control System

Item	Description	Remarks
Control method	Sinusoidal PWM control	
Output voltage	Max. output voltage = Input voltage	
Output frequency	3-67/3-80/3-120 Hz	See 4-3
Frequency resolution	Set frequency resolution: 0.07Hz. Output frequency resolution: 0.001Hz	See 4-2
Frequency accuracy	±0.5% to maximum frequency (at 25°C±10°C)	
Voltage/frequency ratio	16 voltage/frequency (V/F) patterns set by rotary switch: 14 patterns: Set patterns 2 patterns: Automatic energy-saving patterns	See 4-3
Overload (current)	120% - 60 seconds, 100% - Continuous	See 4-4
Frequency set signal (Frequency command signal)	0-5(6)V DC, 0-10(12)V DC, 4-20mADC, Resistance 0-135 (Selectable by jumper pin)	See 8-1

3-5 Operational Functions (1/2)

Item	Description	Remarks
Acceleration time	0.1 - 30/1 - 300 sec	See 9-2
Deceleration time	0.1 -30/1 - 300 sec	See 9-2
Upper limit	Possible to set upper limit to frequency command value	See 9-2
Lower limit	Possible to set lower limit to frequency command value	See 9-2
REF bias	Possible to set bias to frequency command value	See 9-2
REF gain	Possible to set gain to frequency command value	See 9-2
Start	To be operated with dry contact at "close" (Terminals ST to COM jumpered)	See 7-2
Stop	Coast stop of motor with dry contact at "open" (Terminals ST to COM open)	See 7-2
Forward/reverse rotation	Forward rotation with dry contact at "open" (Terminals REV to COM open) Reverse rotation with dry contact at "close" (Terminals REV to COM jumpered)	See 7-2
Brake	Braking by capacitor charge (Approx. 20% torque)	See 8-8
Energy-saving operation control	Operation by energy-savng pattern (Selected by rotary switch for V/F pattern setting) and automatic energy-saving operation	See 4-3
Speed limit signal output	Open collector signal is outputted when the speed reached the upper or lower limit (Terminals P24 to UL or LL)	See 4-6
Instantaneous power failure control	In case of instantaneous power failure, the instantaneous power failure control is activated	See 4-7
Automatic restart	In case of a fault abnormality detected by the inverter, the operation can be automatically restarted.	See 4-8
Soft Stall (Overload protection control)	If the current load exceeds the overload (OL) detection level, the inverter allows continued operation without tripping the inverter by reducing the speed until the current load is less than the overload detection value. (Selection of trip or soft stall is possible.)	See 4-9

3-6 Protective Functions

Item	Description	Remarks
Protective functions	Stall prevention, overcurrent, overload, short-circuit, overvoltage, undervoltage, instantaneous power failure (30msec), overheat protection, fused power circuitry, ground fault circuit detection are standard in North American models.	See 4-11, 4-14
Fault signal output	NC or NO contact point signal is ouputted if any of the following functions are activated: Overcurrent protection, overload protection, short-circuit protection, overvoltage protection, overheat protection, and ground fault detection. However, if the soft stall is selected at the time of overload or the automatic restart is selected, no fault signal is outputted.	See 4-4, 4-8, 4-9, 7-4, 9-3
Fault reset	Reset by reset push-button on PCB or dry contact (Terminals COM to RST)	See 7-2

3-7 Monitor Functions and Display

Item	Description	Remarks
Output frequency	In normal operation, output frequency and the inverter status are displayed on the digital LED indicator.(OFF, LS, 3.0 - 67.0/80.0/120)	See 4-10 and 4-11
Cause of fault	In case of a fault, a possible cause is flickered on the digital indicator. (OC, OCA, OCL, OL, OP, OPS, OH, FE, null)	See 4-10 and 4-11
Monitor data	By sequencing the monitor push-button, or the adjustable rheostat, various items can be displayed on the digital indicator. (inverter mode, inverter status, frequency command value, voltage command value, current value, command frequency bias/gain, upper/lower limits of output frequency, acceleration/deceleration time)	See 4-10, 4-11, and 4-12
Charging of main DC circuit capacitor	Indicated by a LED on the front panel.	See 3-12

3-8 Output for Instruments

Item	Description	Remarks
Output for frequency meter	0-1mA Dc full scale meter or 7.5V DC full scale meter	See 8-2
Output for ammeter	0-1mA Dc full scale meter or 7.5V DC full scale meter	See 8-2

3-9 Enclosure

Item	Description			Remarks
Type	1) Box type with control panel (BO), NEMA Type 1 2) Box type (B), NEMA Type 1 3) Unit type (U), open chasis			See Chapt. 13
Protective structure	Type \ Item	Description	Code	
	1) BO type	Semi-closed type NEMA type 1	IP30	Type 1
	2) B type	Semi-closed type NEMA Type 1	IP30	Type1
	3) U type	Open Chassis type	IP00	Open
Cooling method	2035 and 4055 and below: Convection All others: Forced air cooling			
Other	All models conform to the UL (Underwriters' Laboratories Inc.) standards.			

3-10 Block Diagrams

Block diagrams of VT130H1 and VT130H series are shown in Fig. 3-9-1 and Fig. 3-9-2, respectively. The inverter is roughly divided into the main power circuit and the control circuit. The main power circuit inputs the source power and outputs the motor power at a given voltage/frequency. The control circuit generates the operating signals and controls the inverter for correct operation.

The main circuit is primarily composed of:

(1) Rectifier: Consisting of 6 diode bridges, it converts AC power to DC power.

(2) Filter: Comprising a large-capacity electrolytic compacitor, it minimizes the ripple of the rectified voltage to maintain near constant DC voltage.

(3) Inverter: Composed of 6 G-TR's (IGBTs), it converts DC power to AC power at variable voltage and frequency through sinusoidal PWM control.

The control circuitry primarily consists of:

(1) Control power:
Generates control power sources.

(2) Frequency command signal input:
Interfaces frequency commands.

(3) Microcontroller:
Supervises various inverter controls.

(4) A to D converter:
Converts analog signals to digital signals to be inputted to micro controller.

(5) PWM processor:
Executes sinusoidal PWM control as commanded by the micro controller.

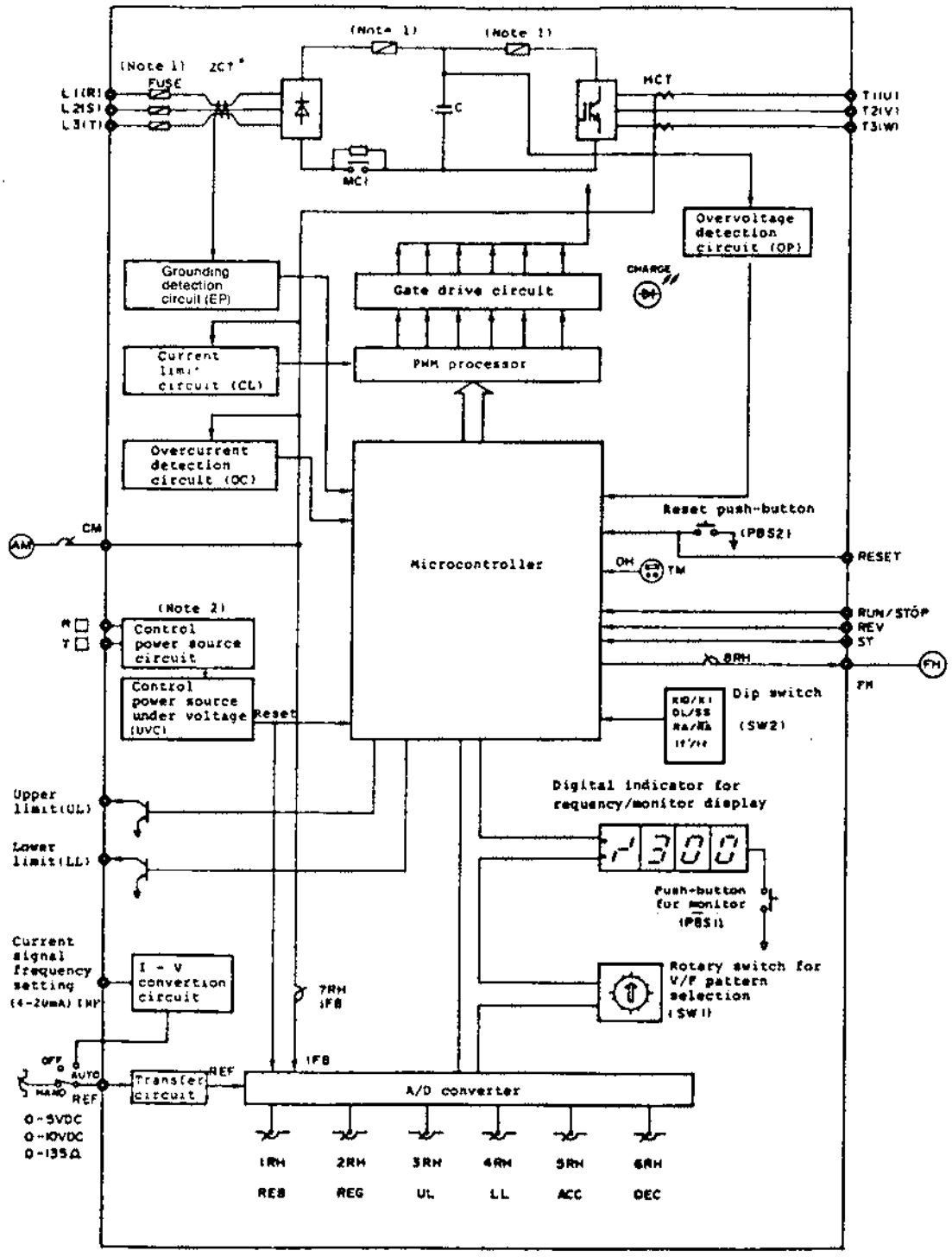
(6) Gate drive circuit (Base drive circuit):
Generates signals transmitted to G-TR gate (base) switching the G-TR or IGBT.

(7) Signal detector:
Detects voltage and current in the inverter for control and protection.

(8) Outside signal receptor:
Interfaces outside sequence commands such as run, stop, reverse, upper/lower limit signals.

(9) Adjustment area:
Sets V/F patterns and acceleration/deceleration time.

(10) Display: Digital LED indicator displays frequency/monitor data.

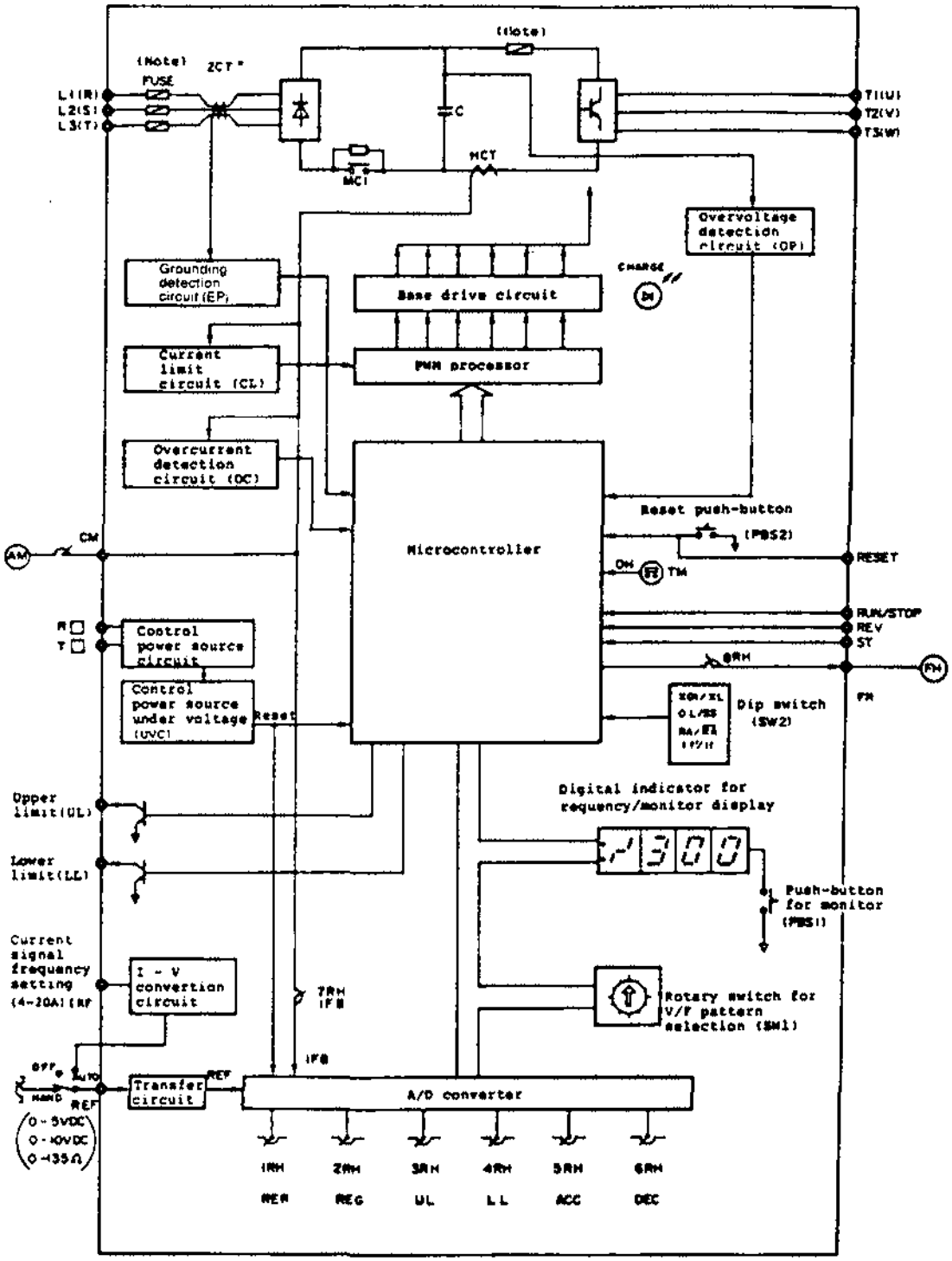


* Standard for North American models.

Figure 3.9.1 Block Diagram of VT130H1 Series

(Note 1) For the 200V class of 8kVA and below, only one DC fuse is inserted on the DC (input) side of the inverter; and on 11kVA or greater, three AC fuses on the input side are used with no DC fuse.
For the 400V class of 5.5kVA to 8kVA, one fuse is provided on the DC (output) side and, those greater than 8kVA have three fuses on the input side and 1 fuse on the DC (output) side.

(Note 2) For the 200V class of less than 8kVA, the control power source is obtained from the DC side of the main circuit.



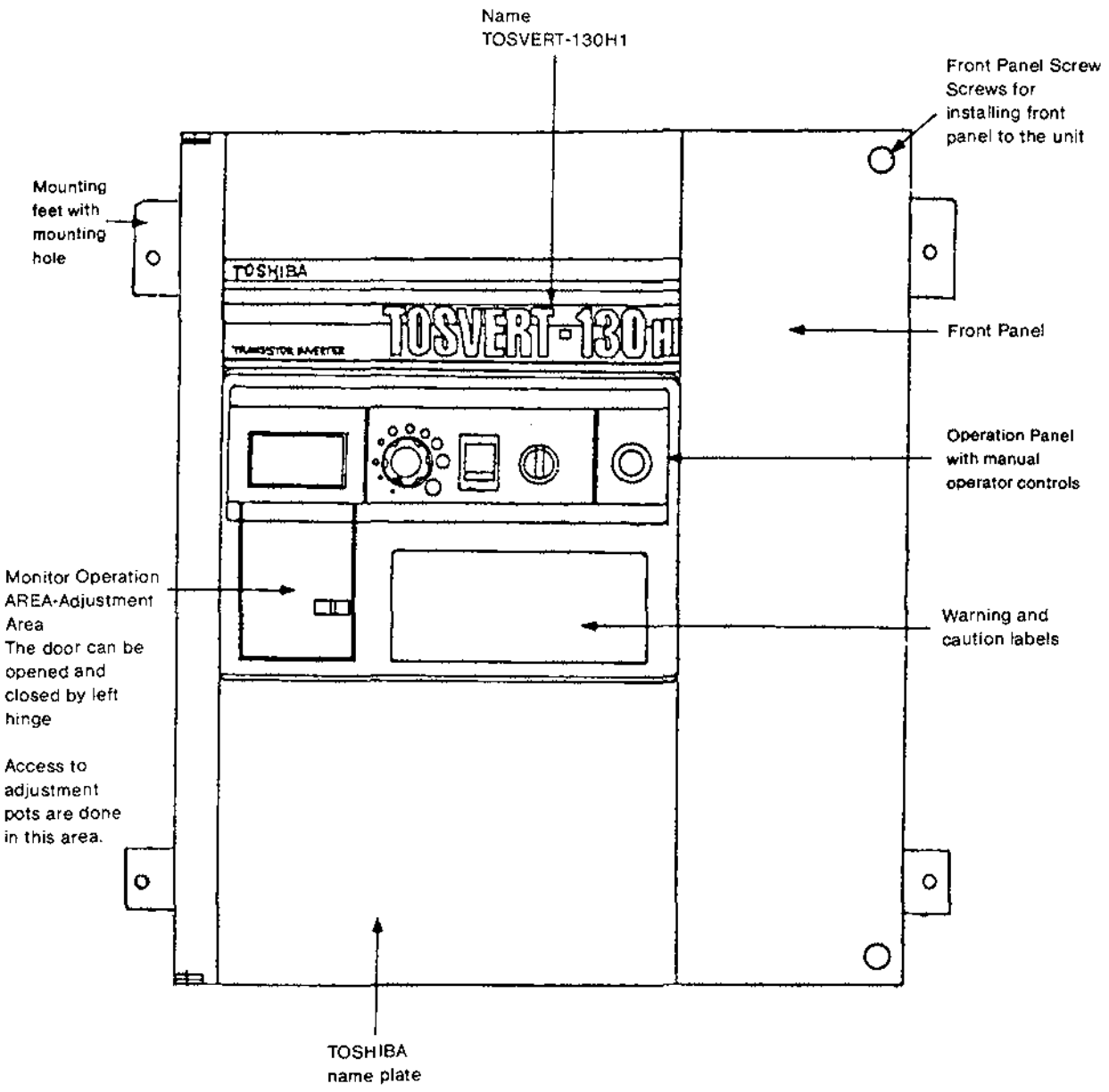
* Standard in North American models

Fig. 3.9.2 Block Diagram of VT130H0 Series

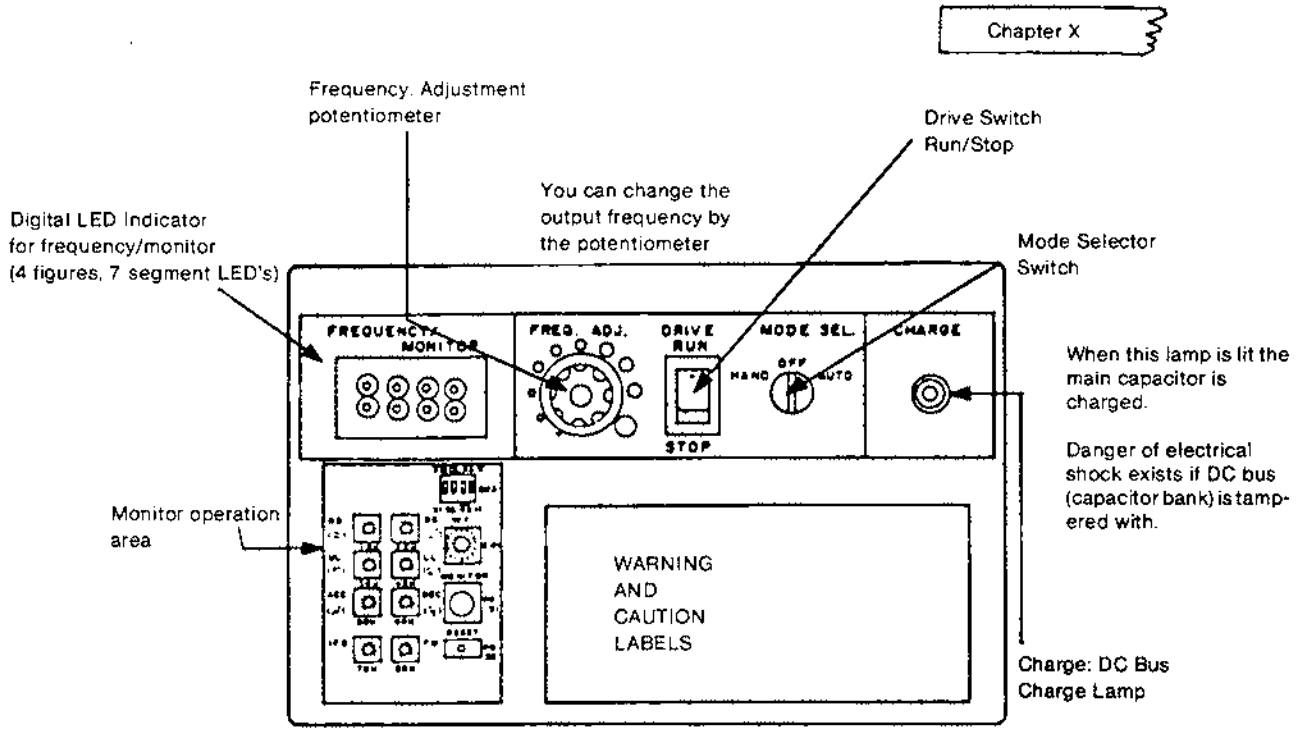
(Note) Three AC fuses are inserted on the input side for both the 200V and 400V class. For the 400V class, another fuse is added on the DC side.

3-11 Outside Appearance

(Box type with operation panel VT130H1-2035BO)



3-12 Names of Components on operator control Panel and Adjustment Area



Inside the MONITOR AREA (Adjustment area)

- The inside of the adjustment area, located on printed circuit board, is easily accessible by opening the small adjustments door.
- The following adjustments can be made from the adjustment area:
  1) SW2: DSW: Dip switch 9-3
     Allows to select the following operations by this switch.
     1] Selection of If/If' (carrier frequency)
     2] Selection for use or no use of bias/gain in response to frequency command (4-20 ma application).
     3] Selection of either trip or soft stall when experiencing overload.
     4] **Selection of acceleration/deceleration time multiplier (x 1 or X 10)**
  2) SW1: V/F patterns:
     Rotary switch for V/F pattern selection 4-3
     Allows selection of one of 16 V/F patterns.
  3) PBS1: MPBS:
     Monitor push-button switch 4-10
     Monitor mode (shows set value) of parameters by pushing this switch.
  4) PBS2: RESET:
     Reset push-button switch 4-10
     After eliminating the cause of a fault, reset the fault by pushing this switch.
  5) ☐ RH:
     Potentiomenta Rheostat for adjustments 9-2
     Allows the settings of acceleration/deceleration (ACC/DEC) time, Upper/lower limits (UL/LL), reference frequency bias/gain (RB/RG), and etc.

Chapter IV
DESCRIPTION OF STANDARD SPECIFICATIONS

4-1 Rated Current of the Inverter:

4-1-1 Rated Current of Inverter and Selection of Motor:

The table of the standard specifications shows the maximum applicable motor rating of a Toshiba 3-phase, 4-pole motor. It should be noted that the capacity of an inverter varies with the rated voltage of each motor.

Generally, the required rated current needs tends to increase in special motors such as a multipole motors, explosion-proof motors, submergible motors and high-frequency motors. Special care should be taken when applying inverters to such motors.

When selecting an inverter based on the motor rating, the selection should be based on the respective rated current and not on the inverter capacity (kVA), and the following formula should be established:

$I_{INV} > I_M$ (Inverter ampere are greater than motor full load amperes)

I_{INV}: Rated current (A) of inverter

I_M: Rated current (A) of motor (Load current, if available)

4-1-2 Selection of Motor (sizing) Due to Carrier Frequency Change Considerations:

If the carrier frequency is changed, the motor sizing should be selected according to Table 4-1 as compared with rating in Table 3.2.

Further, when a large capacity motor (greater than 100 HP) is used on a light load, motors should be limited to those that are one rank above. If a motor of larger capacity than the maximum applicable motor rating is used, the invertor may become unstable and not function properly.

Table 4-1 Motor Sizing Consideration due to Carrier Frequency Selection.

Model (Type)	SW2 / JP2	If		If'	
		Carrier Frequency	Selection	Carrier Frequency	Selection
VT130H1	A	16kHz	•	8 kHz	○
	B	12 kHz	○	6 kHz	○
VT130H	C	0.5k-1.5kHz	•	1.5 kHz(*)	•
	D	0.5-1kHz	○	1 kHz	○

(*): Used when motor noise reduction filter is used.

(Note 1) Explanation of codes

○ : Standard selection (no derating of unit ampacity)

• : Derate by 10% reduction of units ampacity (90% of table 3-2 rated current)

(Note 2) Jumper pins A and B are on VT130H1 models only.
Jumper pins C and D are on VT130H0 models only.

4-2 Frequency Resolution

This inverter has 2 types of frequency resolution: resolution of frequency command signal (which is A/D converted and is inputted to the microcontroller), and resolution of output frequency to the motor.
When the maximum output frequency is 67Hz, then:

1) Resolution of frequency command value (10 bits) is 0.07 Hz (Set frequency resolution) and
2) Resolution of output frequency in operation (16 bits) is 0.001Hz (Output frequency resolution)

These resolutions are illustrated in Fig. 4-2. Thus, the frequency command value varies at 0.07Hz resolution, while the actual output frequency of the inverter varies at 0.001Hz in acceleration and deceleration, which allows for a very smooth acceleration and operation.

(Note) When the maximum frequency is 67Hz, the 10-bit resolution will be:

$$67\text{Hz} \times 1/2_{10} = 0.065 = 0.07\text{Hz},$$

indicating that the frequency changes about every 0.07Hz.
With the same maximum frequency, the 16-bit resolution will be:

$$67\text{Hz} \times 1/2_{16} = 0.001\text{Hz},$$

meaning that the output frequency changes about every 0.001Hz.

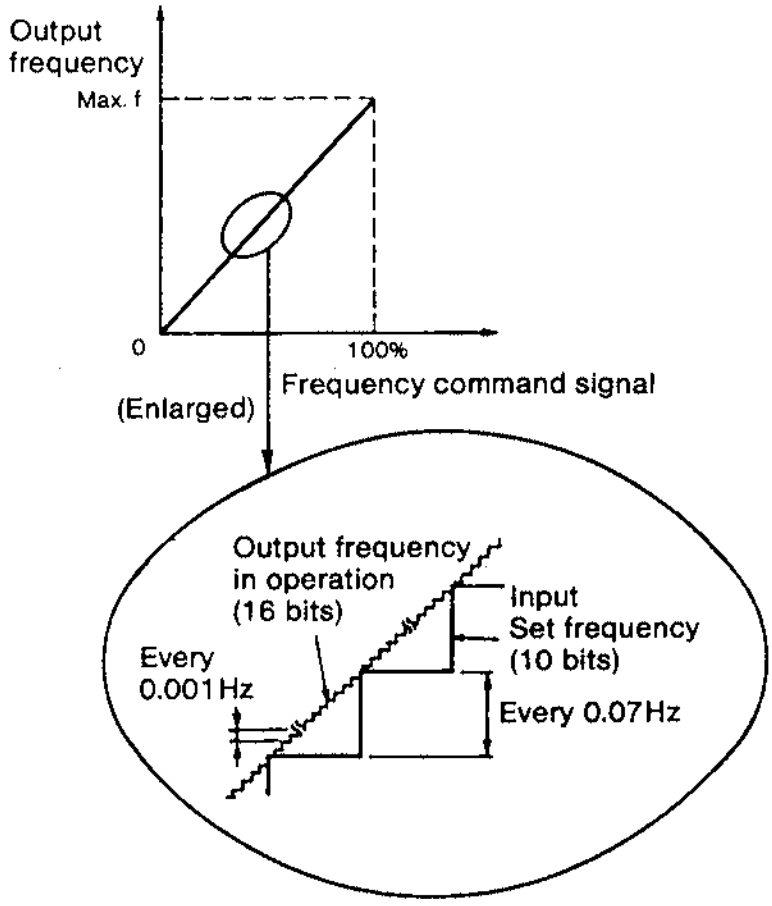


Fig. 4-2 Resolution of Frequency

4-3 Voltage/Frequency (V/F) Pattern Setting

A rotary switch for Voltage/Frequency (V/F) pattern selection is provided to adjust the output voltage/frequency pattern for optimum operation suited to the application. This rotary switch provides the following functions:

(1) Selection of maximum frequency: 67/80/120Hz and
(2) Selection of voltage/frequency (V/F) ratio

Fig. 4-3 shows the positions of the rotary switch notches and the V/F pattern characteristics. Maximum output frequency of 67Hz (normally 50Hz motors) can be selected at notches 0-6, 120Hz, at notches 7 and 8, and 80Hz at notches 9-F. (normally 60HZ motors)
Table 4-3 shows the criteria for V/F pattern selection.

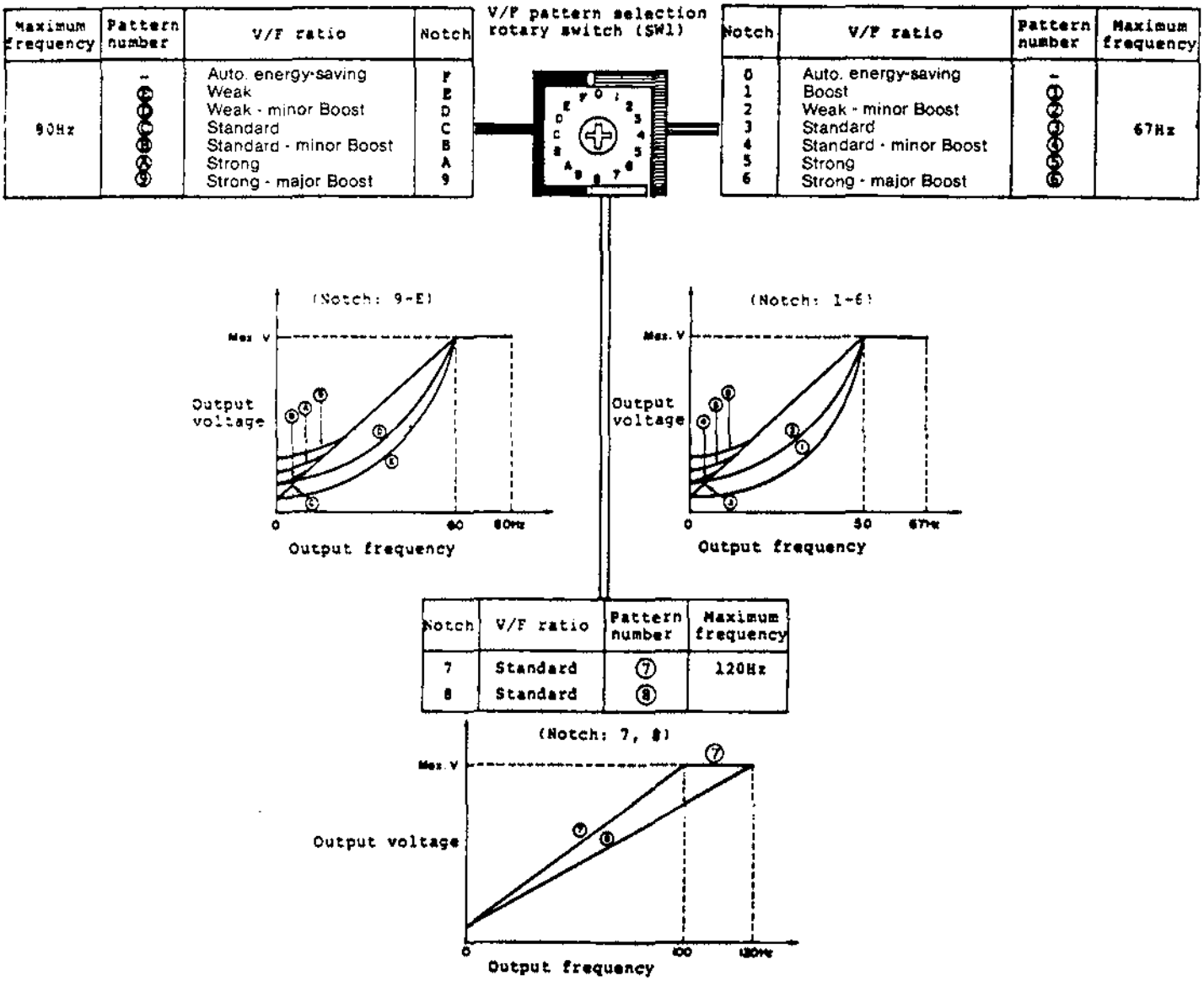


Fig. 4-3 Positions of Notches of V/F Pattern Selection Rotary Switch and V/F Pattern Characteristics

Adjustment of the V/F ratio is made based on the factors described below. It is necessary to select the best V/F pattern suitable for the operating conditions and load of the application. An incorrect selection of the V/F pattern may result in a rough motor start, and may activate the stall prevention circuit or the overcurrent protection circuit.

(1) V/F Adjustment Factors:

1) Load torque characteristics:
As the torque increases, the V/F pattern should be increased.

2) Voltage drop due to cable length between inverter motor:
The smaller diameter and the longer the cable is, the higher the V/F pattern should be selected (overcoming cable loss).

3) Inverter carrier frequency:
If the higher carrier frequency is selected, a higher V/F pattern should be selected.

4) Normal input voltage fluctuation:
If the power line is lower than normal, a higher V/F pattern should be selected.

(2) How to select V/F patterns:
If a V/F pattern higher than necessary is selected it may deteriorate the motor efficiency and increase motor noise. It is desirable to select the lowest possible V/F pattern which is sufficient enough to run the motor.
At a higher V/F ratio, certain types of motors may become "unstable" and may result in the current hunting or activate the overcurrent and overvoltage protection circuits of the inverter.
A V/F pattern selection may be made using the following procedures:

1) Set a sufficiently long acceleration time (100 - 300 seconds)

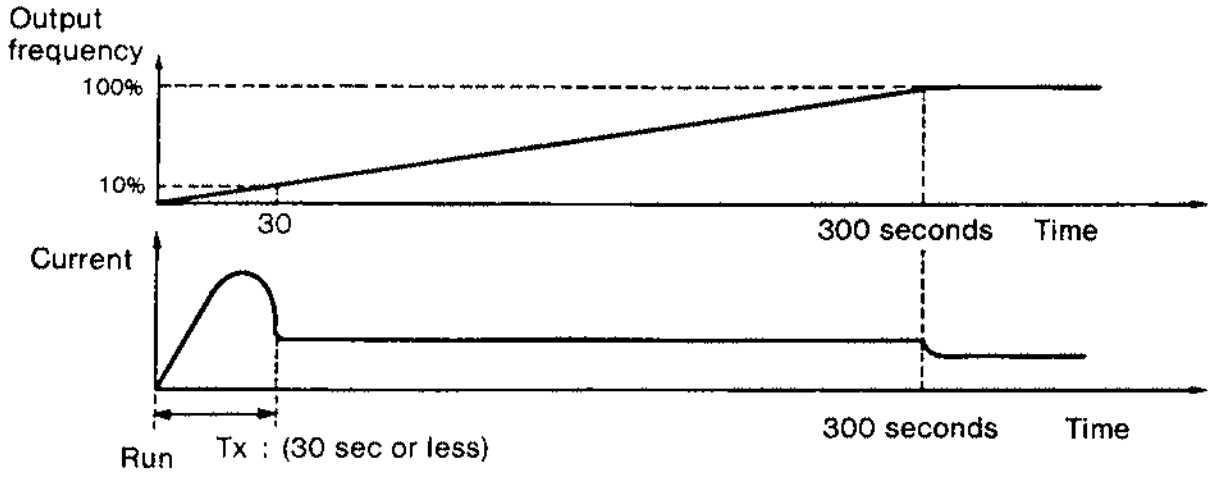
2) Select a lower V/F pattern by operating the rotary switch (SW1) as follows:
Max. frequency 67Hz: Notch "1" (50Hz motor)
Max. frequency 80Hz: Notch "E" (60Hz motor)

3) When the load is small enough to allow observation of the motor rotation, check if the motor starts to rotate when the output frequency is less than 5Hz. If so, the operation can be continued with the present setting. If the motor does not start as less than 5Hz, stop the inverter at once and increase the V/F pattern by one step ("2" or "D"), and again try starting the motor.

4) If it is impossible to observe the motor rotation, a correct V/F pattern can be selected from the starting current by using the monitor function; i.e., set the accelerating time at 300 seconds, push the monitor push-button to obtain the monitor mode, and display the feedback current (IFB) " C "on the digital indicator.

In this condition, run the motor, and note to see the time (Tx) from the initial current increase until a decrease in current is noted. This time (Tx) should be less than 30 seconds (1/10 of the accelerating time).
If Tx is less than 30 seconds, leave the notch setting in that position. If it is more than 30 seconds, stop the inverter, and increase the V/F pattern by 1 step ("2" or "D") and check the above again. By repeating these procedures, select a V/F pattern with which the current decrease time (Tx) is within 30 seconds.

5) Set the acceleration time at a time matching the load. If the acceleration time cannot be achieved as selected, increase the V/F pattern until it is achieved, or you are at the maximum setting. (If faster acceleration is required, you may have to increase the rating of the inverter.)



(Note) Automatic energy-saving operation:
The output voltage will be automatically adjusted according to the load current level. (i.e., if the load current decreases, then the output voltage will be decreased if in the energy-saving operation. (Notch 'F' on SW1 for 60Hz operation.)

4-4 Overload

This inverter has an overload capacity of 120% for 60 seconds.
The inverter has a 110% continuous current rating operation. Any current loads over 110% are detected as an overload.

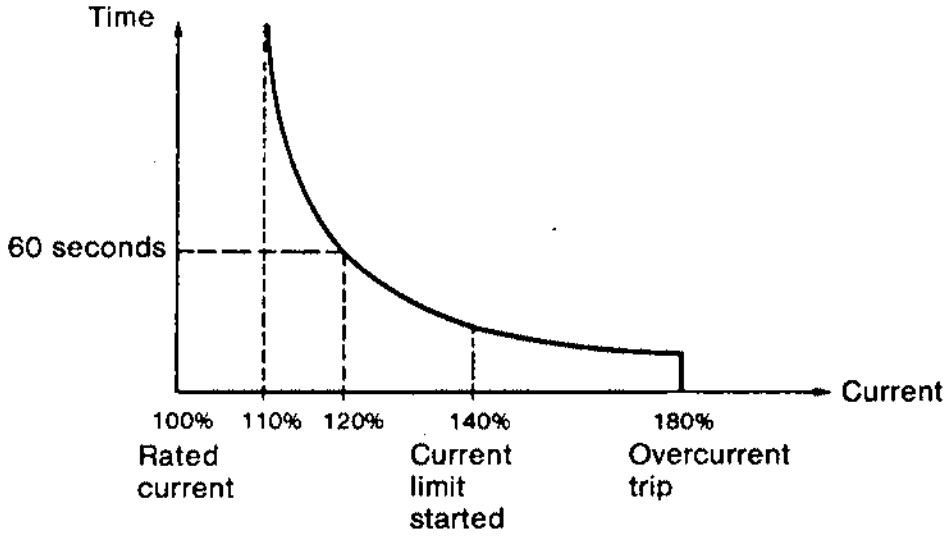


Fig. 4-4 Overload Detection

Overload detection is essentially to provide protection to the inverter. If the motor on the inverter will not be damaged by the inverting overload levels, then no thermal relay is necessary on the motor side. However, if the rated motor current is less than this detection level, a thermal overload relay is needed for motor protection. The overload detection level can be decreased by increasing the feedback current which is done by the adjustment of the rheostat 7RH located in the adjustment area (See Section 9-2). Note that if this is adjusted it will also decrease the stall activation level. If an overload condition exists, the following protective functions will be activated (See 9-3):

(1) Overload trip (Fault):
"OL" is flashed on the digital indicator, and the motor stops in the coast stop mode.

(2) Soft stall: (phase back)
The output frequency is flickered on the digital indicator, and the output frequency is lowered to decelerate the motor until the overload detection is released. This selection allows continued operation, but overrides the acceleration time which was selected. Soft stall control is possible if the load requirement is reduced at lower speeds.

4-5 Frequency Set Signals

Five types of frequency command signals (frequency command values) can determine the output frequency. They are: 0-5V DC, 0-10V DC, 4-20mADC, 0-20mADC, and 0-135Ω resistance input. They can be selected by selecting the mode selection switch or the jumper pins (JP9, JP10) (Section 8-1).
The input impedence for each type is as follows:

1) 0-5(6)V DC (Approx. 20kΩ)
2) 0-10(12)V DC (Approx. 40kΩ)
3) 4-20mA DC (Approx. 240Ω)
4) 0-20mA DC (Approx. 240Ω)
5) Resistance 0 - 135Ω (Approx. 4kΩ)

Fig. 4-5 shows the relation between the frequency set signals and output frequency. Note this figure shows the values before any adjustments of the bias/gain of frequency command values.

(Note 1) Even if an operating command has an input, if a frequency command reference value is below 3Hz, "LS" is displayed and the inverter does not run. However, if the frequency command reference value is above 3Hz, the inverter starts smoothly from 0Hz.

(Note 2) **To set the bias/gain of a frequency command value by the potentiometers (1RH and 2RH), it is necessary to select "RA" at the dip switch SW2 (For adjustment methods, see section 9-2.)**

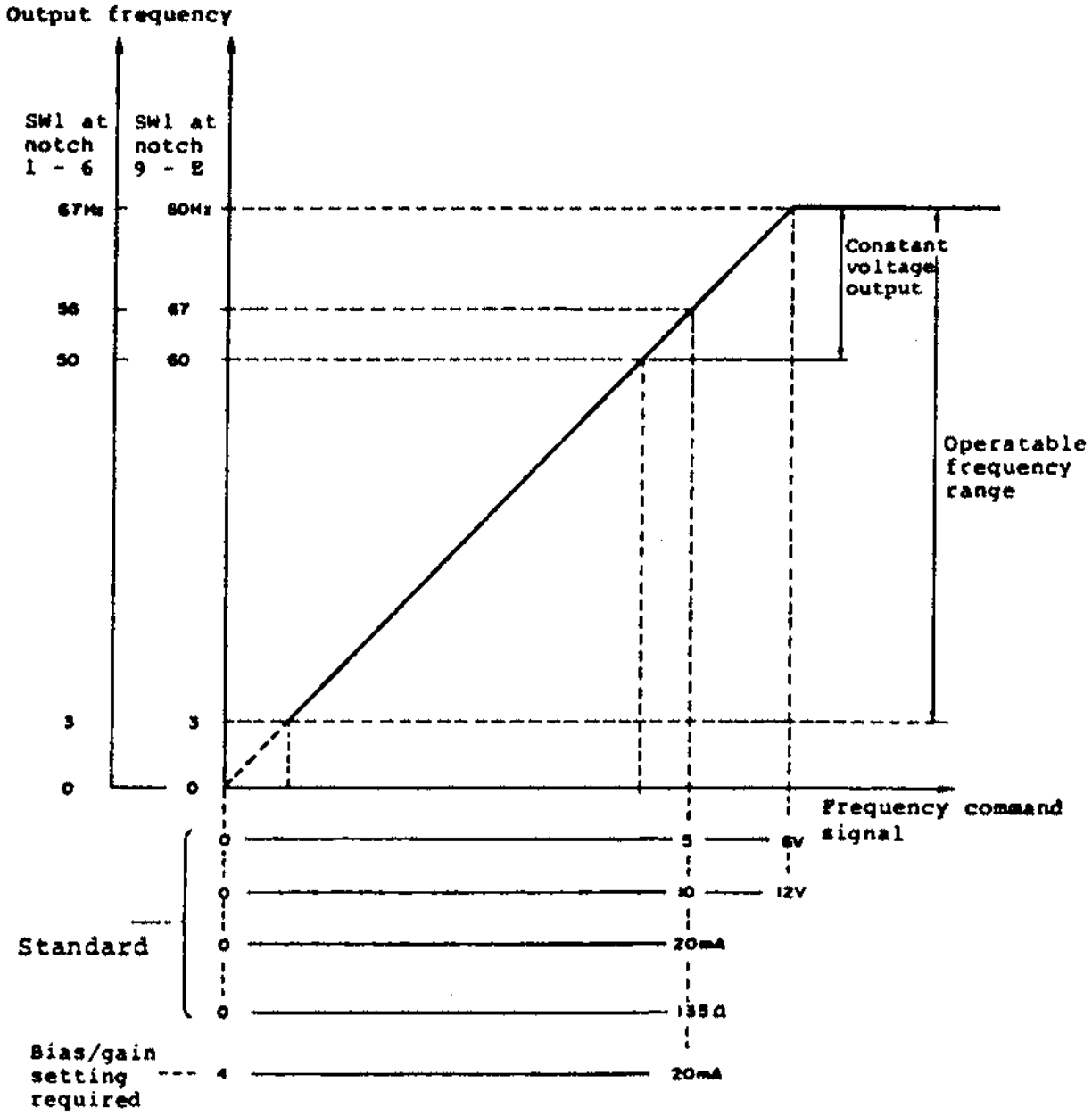


Fig. 4-5 Frequency Command Signals and Output Frequency

4-6 Output signals when the Upper/Lower Limit Output Frequency is reached.

When the upper/lower limit output frequency is set and the output frequency has reached either limit, the corresponding open collector signal is activated. These signals may be used for external sequencing of multiple units. The outputs (open collector) may be used with an internal (P24) or external power source. A maximum of 40 ma total may be drawn from P24 for this purpose. A low power relay option board is available for higher output ratings.

The outputs (open collector) are rated for 0.5 amps (maximum) at 24 VDC (maximum) when used with an external power source. An interposing relay may be utilized for larger loads.

CAUTION: The external power source voltage must not exceed the P24 supply voltage.

Fig. 4-6 shows the relation of the upper/lower limit with the signal output (open collector.)

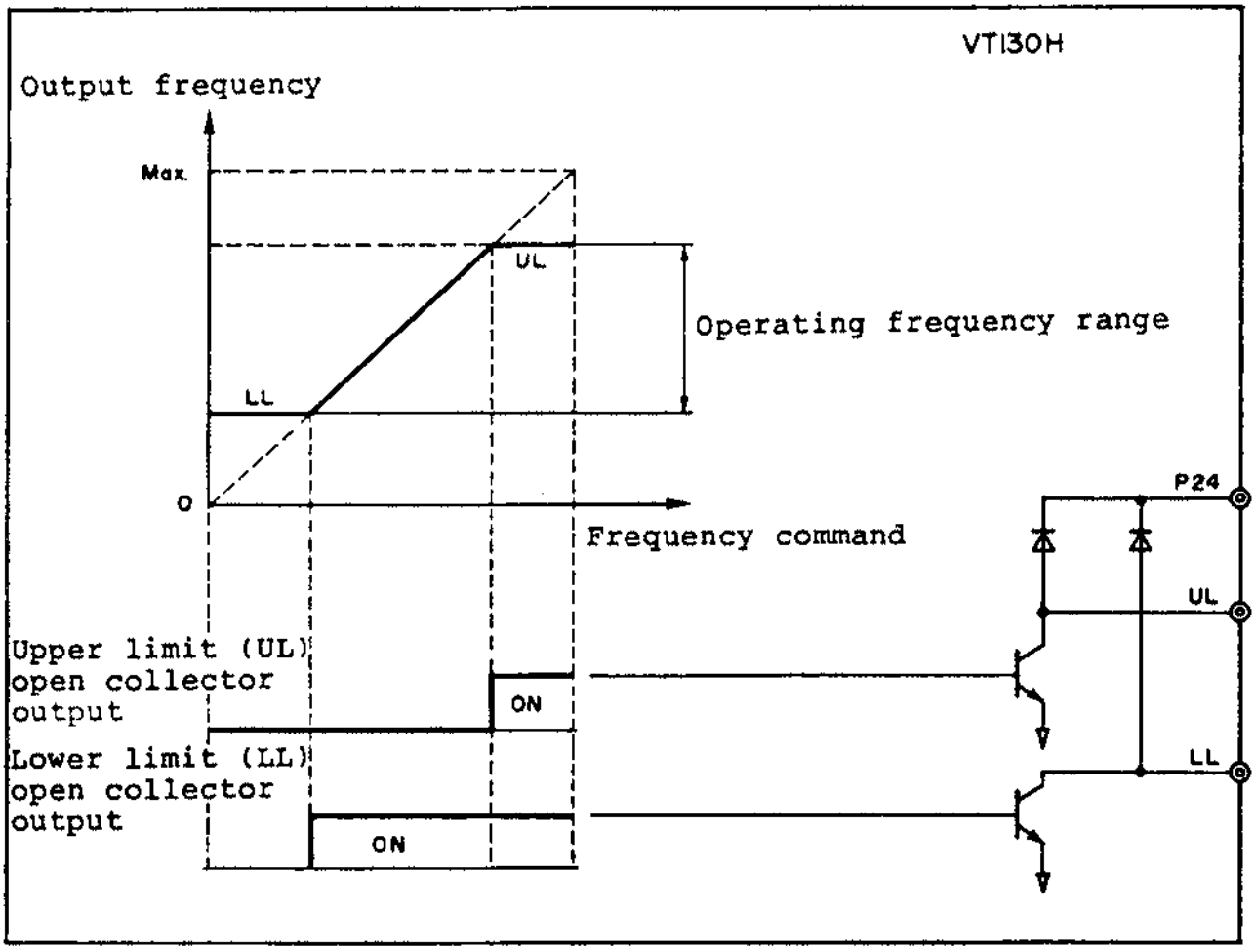


Fig. 4-6 Upper/Lower Output Frequency Limit and Output Signals

4-7 Instantaneous Power Failure Control

In case of a power failure, the inverter will continue operation according to the following chart:

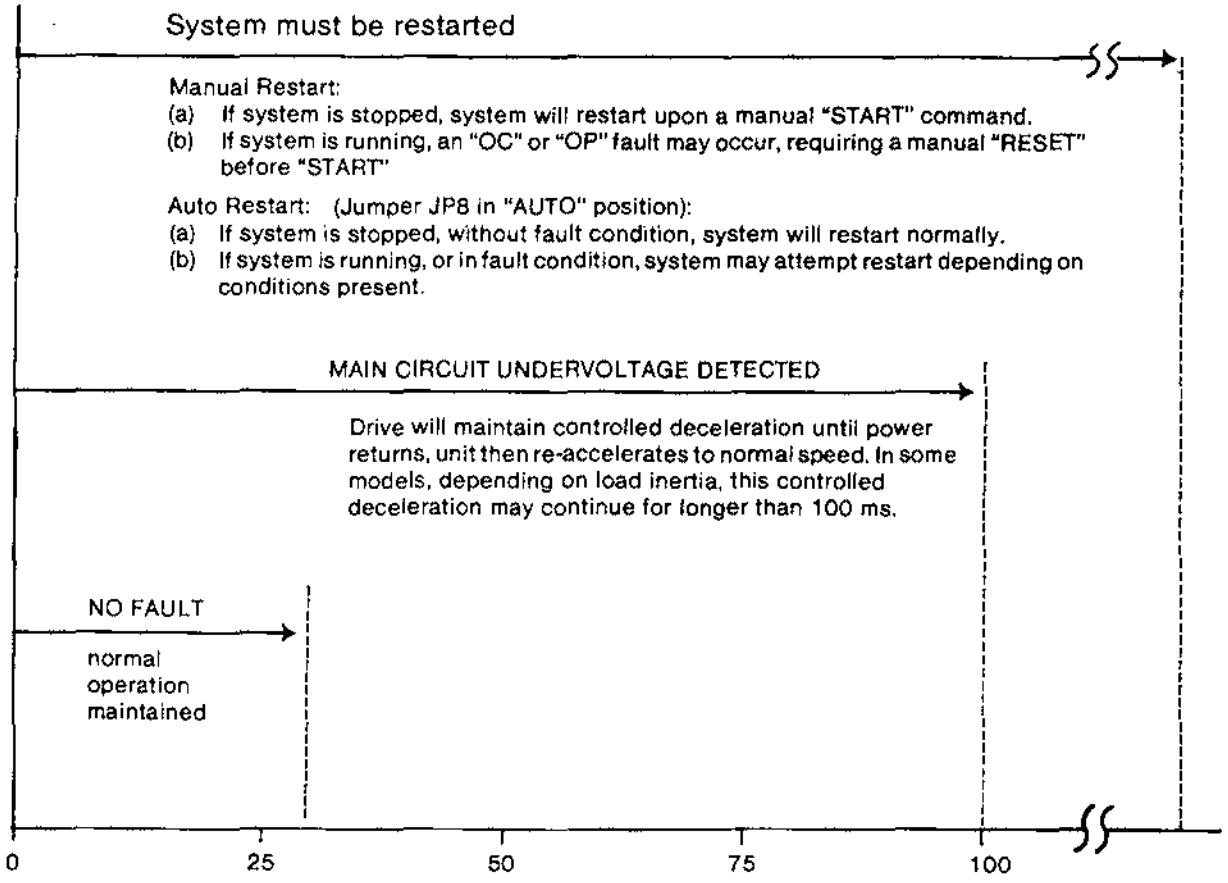


Fig. 4.7 Momentary Power Failure Recovery Chart

The above deceleration control is performed as long as to the control power sources (+5, +24, +15, −15,) are retained on the main control PCB and gate (base) drive PCB.

(1) Instantaneous power failure of less than 30 msec:
As long as the DC main circuit voltage is held above the voltage drop detection level, the DC-DC power source converter continues normal operation. If a voltage drop is detected when the DC main circuit voltage decreases to 85% of the rated voltage of the main circuit input power source, then there is deceleration control.

(2) Momentary power failure of less than 100 msec:
If the main circuit voltage drops below 85% of the rated voltage of the inverter unit during an instantaneous power failure, the control circuit detects a "MUV" (Main Circuit Under Voltage). At this time, a forced deceleration operation is activated which will decelerate the loaded motor (regeneration mode), such that main DC Bus circuit voltage is maintained at a higher level by the regenerated energy of the motor. If the main circuit power source is recovered whle in this condition, the inverter reverts to the normal operation with smooth acceleration of motor to selected speed. This control remains activated as long as the control power sources are retained by the motor's regenerated energy.

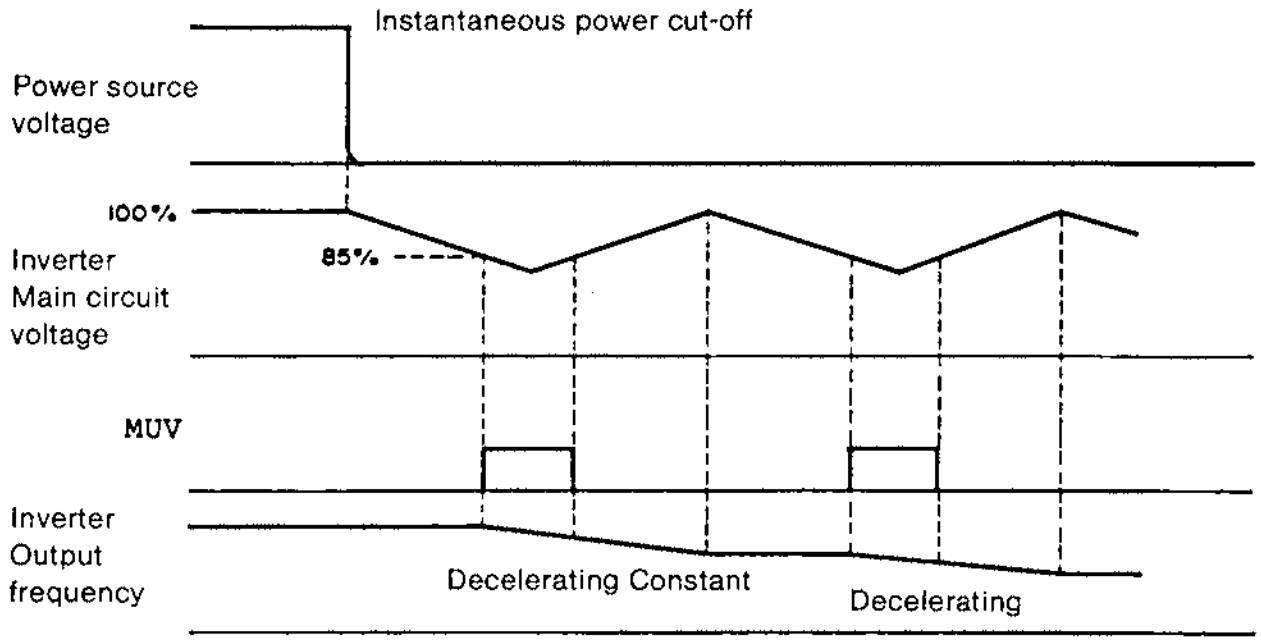


Figure 4-8 Momentary Power Failure of Less than 100 Milliseconds

(Note) In the type-forms VT130H1-2080 and below, control power is supplied from the DC side of the main circuit through a DC-DC converter. Therefore, the inverter may continuously run smoothly, even when instantaneous power failure is greater than 100 msec., if the load wk^2 is large enough to supply regenerated energy from the load.

(3) Instantaneous power failure of more than 100 msec.:
If the run operation command (Run and ST) and a frequency command is present the inverter will attempt to restart. However, if the motor is still rotating the inverter may fault on overcurrent (OC) or overvoltage (OPS). The inverter would have to be reset (at push-button PB2 or reset terminals) before operation could restart. To automatically restart into a rotating motor see section 4-8.

4-8 Automatic Restart (Jumper J-8 set to on)

When automatic restart is selected, the inverter will restart on power failures of greater than 100 msec. It will attempt to restart when certain faults are detected, as listed in Table 4-8.

Table 4-8 Automatic Restart Modes

Faults Detected Where Inverter Will Attempt Restart	Faults Detected Where Inverter Will Not Attempt Restart
OC-overcurrent up to 5 time	OC-overcurrent after 5th attempt OCA-short circuit of transistor OCL-phase to phase short OL-overload (if load remains over 120% for more than 60 sec.)
OP-overvoltage (due to short decel time or incorrect V/F pattern)	OPS-overvoltage at the inverter input OH-overheating EF-earth (ground) fault Null-incomplete microprocessor initilization
Instantaneous power failure	

Note: See Table 12-1 for possible causes and corrective measures of the above faults.

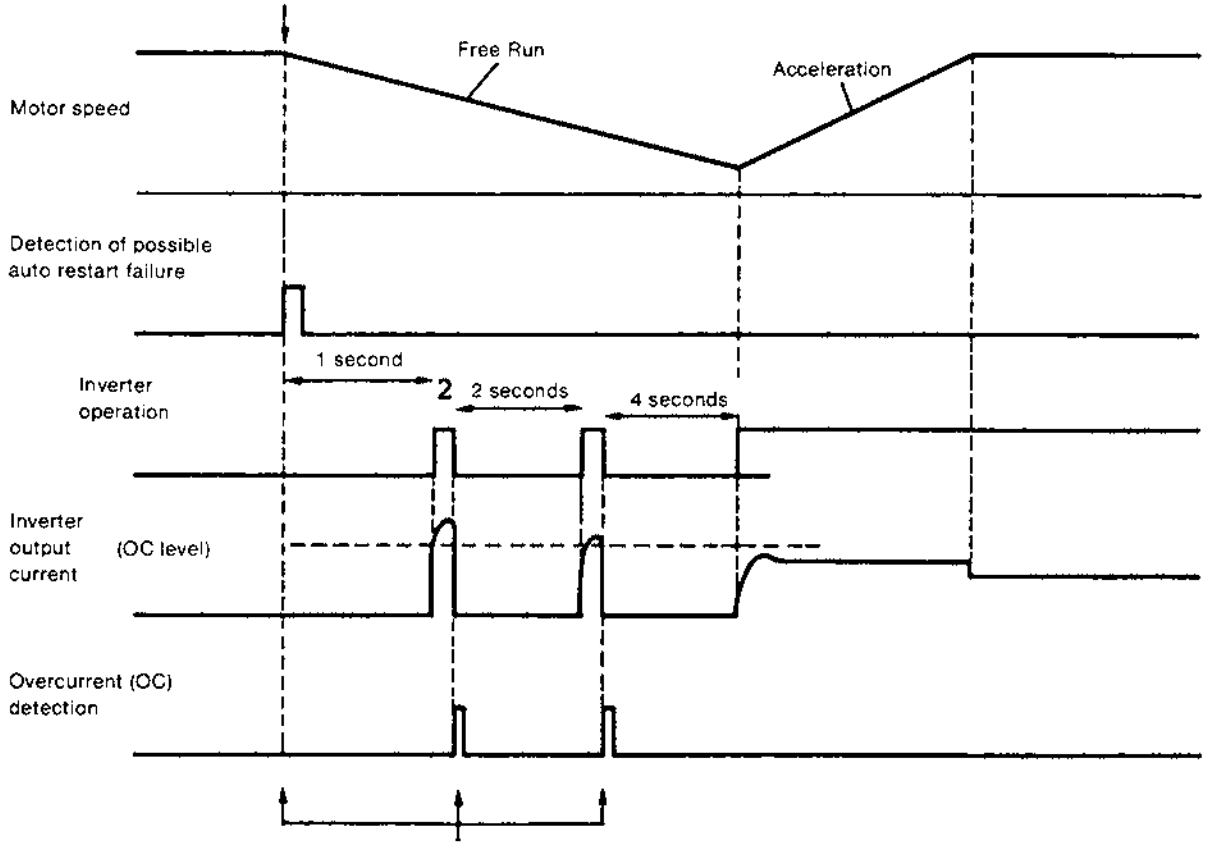


Fig. 4-9 Time Chart for Automatic Restart

4-9 Soft Stall Protection

The inverter has an overload capability of 120% for 60 sec. This should be adequate for variable torque loads of centrifugal fans, pumps and blowers. In the event additional current is needed to go from a lower speed to a higher speed and a large accelerating current (torque) is required (depends on the acceleration time and inertia of load), an acceleration time override can be selected which allows the frequency to decrease. This will reduce output current below that of an overload, and acceleration such as not to trip the overload (i.e., the acceleration time may take longer than selected on 5RH.) This feature is termed "soft stall".

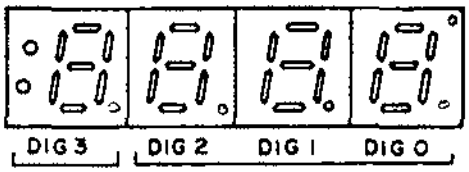
If soft stall prevention is not desired, Dip Switch (SW2) bit 2 (second switch from left) can be switched to OL position.

4-10 Monitor

This inverter has a digital LED indicator that displays various data including output frequency, values set on the adjustment potentiometers, inverter status and the cause of a fault. The monitor function allows the user to select what data is to be displayed. The monitor function is selected using the blue push button.

4-10-1 Digital Indicator

Fig. 4-10-1 shows the layout of the digital indicator.



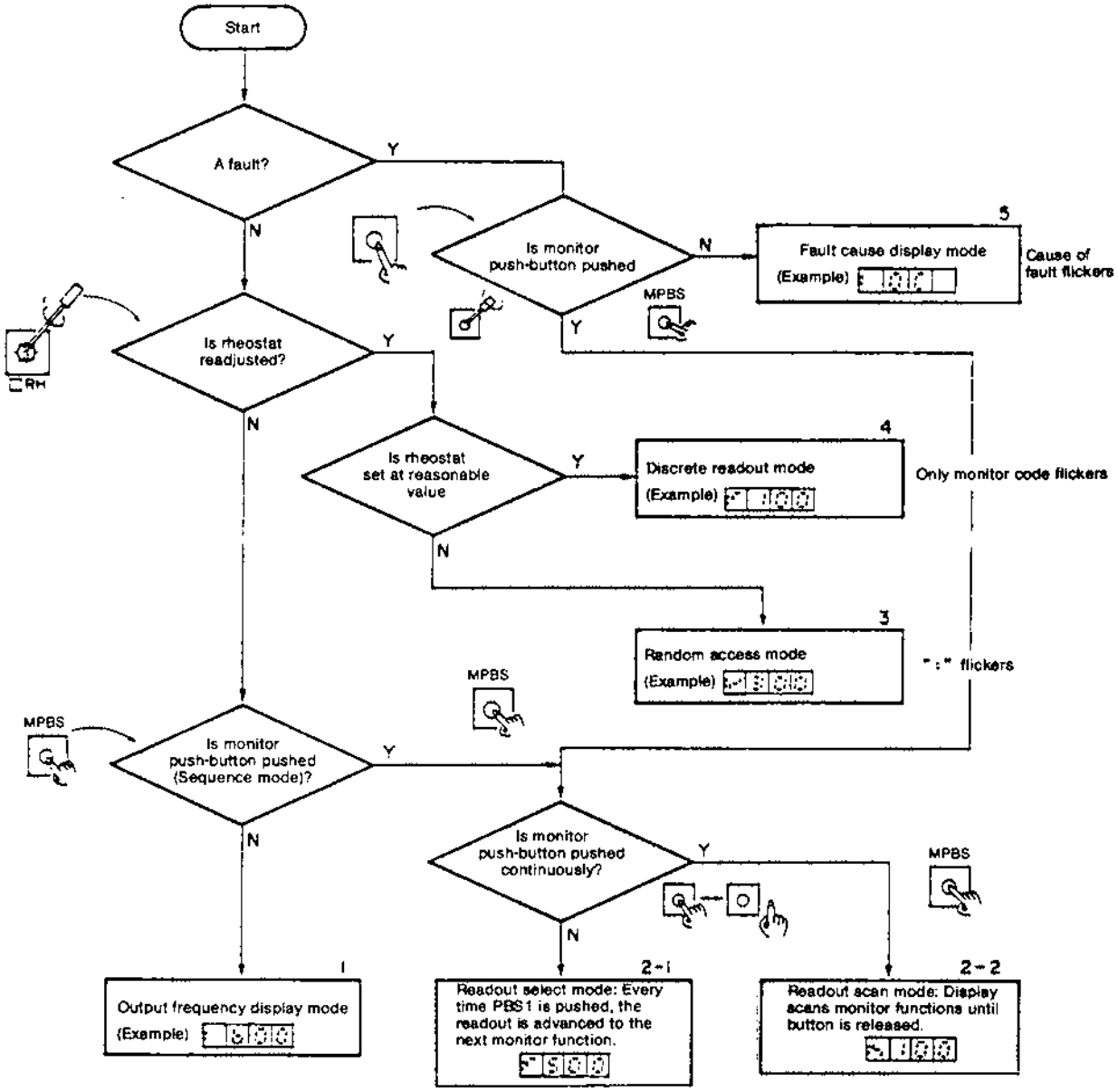
DIG3: Monitor code display area
(2 dots ":" flickers in the monitor mode and displays it's monitor code, see Table 4-10-3)
DIG2, DIG1, DIG0: Data display area
(Frequency, time in seconds, %, etc. area displayed in alphanumerics)

Fig. 4-10-1 Construction of Digital Indicator

4-10-2 Monitor Flow Chart

Fig. 4-10-2 is the flow chart showing typical monitor operation. It shows how the monitor shifts to the corresponding mode according to the status of the monitor push-button, the potentiometer adjustment, fault trip, etc.

4-10-3 Five (5) monitor modes are available. Table 4-10-3 describes the control, operation, and display involved in each monitor mode.



MPBS = Blue Monitor Push Button RH = Adjustment Potentiometers

Fig. 4-10-2 Monitor Flow Chart

Table 4-10-3 Monitor Mode (1/3)

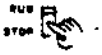
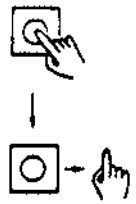
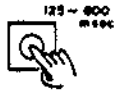
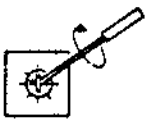
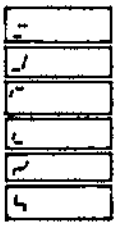
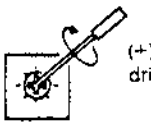
No.	Display sample (Before operation)	Control (Operation)	Display sample (After operation)	Monitor mode	Description
1	OFF	Turn drive switch to RUN. 	LS	Output frequency display mode.	
	LS	Turn frequency setting rheostat to right. (CW) 	60.0		In normal operating mode, output frequency (3 to 67/80/120 Hz) and inverter status (OFF, LS) are displayed.
	50.0	Turn frequency setting rheostat to left. (CCW) 	LS		
	30.0 LS	Turn DRIVE SWITCH to STOP. 	OFF		
	40.0	Turn OFF MODE SEL. SWITCH. 	LS		
2	OFF or LS or 60.0	Push monitor push-button briefly until display changes. 	HI 0	Sequential access mode	Data shown in Table 4-10-4 can be displayed in a set order, based on the inverter status. Search for the desired data according to the displayed monitor code. Either discrete or continuous scan readout mode is selected based on how long the monitor push-button is pushed. ":" flickers on DIG 3 (See time chart).
1)	HI 0	Push monitor push-button momentarily. 	5	1) Discrete readout mode	Read displayed function data.
	5	Push monitor push-button momentarily. 	U		The next function is sequenced and displayed each time the monitor push-button is pushed.

Table 4-10-3 Monitor Mode (2/3)

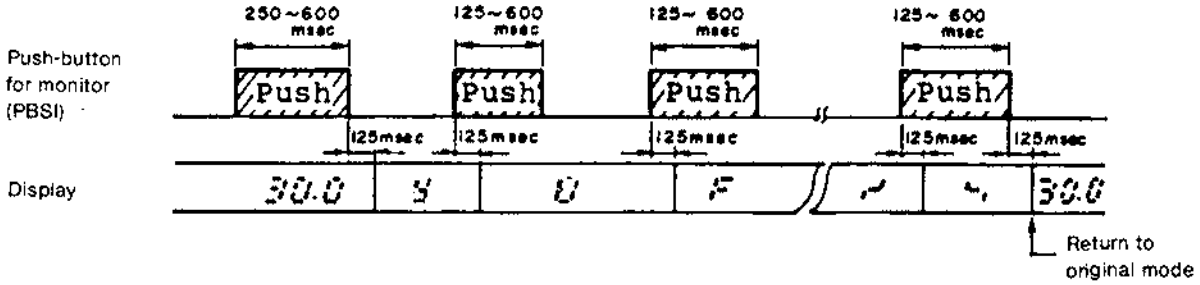
No.	Display sample (Before operation)	Control (Operation)	Display sample (After operation)	Monitor mode	Description
2)		Push and hold monitor push-button.		2) Continuous scan readout mode	Data functions are contiuously scanned every 600 ms, in the set order. Removing hand from push-button stops scan at displayed function.
Ex.		For example, continue pushing MPB even during operation (60Hz). 			
	60.0		U		Output frequency display mode shifts to monitor readout mode. Monitor data is sequencially displayed.
	U		F		
	F		C		
	C		P		
	P		=		
	=		J		
	J		r		
	r		L		
	L		n		
	n		5		
	5		60.0		
		 Take finger off monitor push-button.			Sequencing of data stops. Displayed data remains unchanged if you keep pushing the switch. The monitor returns to the original output frequency display mode.

Table 4-10-3 Monitor Mode (3/3)

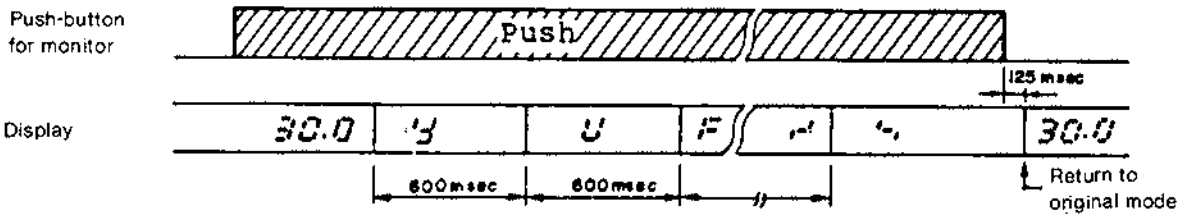
No.	Display sample (Before operation)	Control	Display sample (After operation)	Monitor mode	Description
3	OFF LS 60.0	Turn adjustment rheostat.  (+) driver		Random access mode	A set value of the adjusted rheostat is automatically displayed. ":" flickers on DIG3. After 3 seconds from adjustment, the monitor automatically returns to the original mode (output frequency display mode for example) For about 10 seconds after turning on the control power, this random access mode is not available. (See time chart.)
4	F 60.0	Turn adjustment rheostat.  (+) driver	C 10.0 (Monitor Code Flickers)	Set value alarm mode	Monitor code flickers to alert of an unreasonable setting. Correct the unreasonable setting. (See 4-12.)
5	60.0 OC	Occurrence of fault Push reset push-button 	OC (Flickers) OF (Flickers) OH (Flickers)	Fault cause display mode	Should a fault occur in operation, a possible cause is flickered on display. By pushing the monitor push-button, the monitor shifts to the sequencial access mode, and reads out the data related to the faulty condition (inverter status, current level, set value, etc.). Random access mode is not available Reset the monitor, If the automatic restart has been selected, the inverter will be automatically restarted.

Time Chart in Sequential Access Mode (Example)

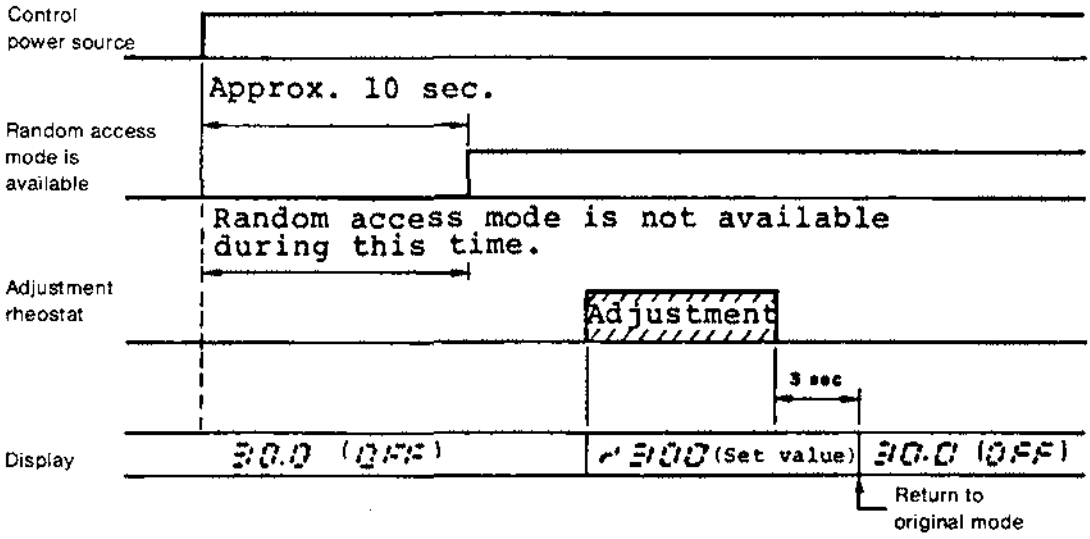
1) Discrete readout mode



2) Continuous readout mode



Time Chart in Random Access Mode (Example)



4-10-4 Monitor Data and Display Order

Table 4-10-4 lists what data are displayed in what order when the sequential access mode has been obtained by pushing the monitor push-button (PBSI). Line No. 0 in the table represents the display before the monitor mode is activated. The number in [ ] indicates the order of data displayed on the digital indicator in the sequential access mode. After displaying line No. 1 - No. 12 data, it returns to the display of line No. 13, which is the original display (No. 0) before the monitor mode.

CAUTION:

If a fault on the inverter is activated, and the cause of the fault is flickering, the corresponding inverter data can be obtained by using the monitor function. Write the data down to aid in determining the cause, and how to eliminate the fault, before resetting.

Table 4-10-4 Monitor Data and Display Order

Monitor Data					Available monitor data and display order by inverter status				Remarks
					STOP	RUN	RUN	RUN, STOP	DRIVE SWITCH
No.	Data Name	Code	Monitor code	Display Description	Stop	STOP (Below 3Hz)	RUN (Above 3Hz)	Fault	Inverter status
0	Output frequency/fault	-	-	Operating frequency/ fault cause	OFF	LS	30.0	(Example) OC (Flickers)	Before monitoring
1	Firmware version No.		H	Firmware type and version number	Note 1 [1]	[1]	[1]	[1]	Start of monitoring
2	Inverter mode	INVM	y	V/F pattern and dip switch position	[2]	[2]	[2]	[2]	
2	Inverter mode status	INVS	U	Operating condition (Accelerating, decelerating, etc.)	[3]	[3]	[3]	[3]	
4	Frequency command value	FC	F	frequency command value (Hz)	[4]	[4]	[4]	[4]	
5	Current value	IFB	C	Detected current value (%)	[5]	[5]	[5]	[5]	
6	Voltage command value	VC	P	Voltage command valve (%)	[6]	[6]	[6]	[6]	
7	Bias of frequency command value	RB	=	Ooutput frequency (Hz) at 20% frequency command value	[7]	[7]	[7]	[7]	
8	Gain of frequency command value	RG	J	Output frequency (Hz) at 100% frequency command value	[8]	[8]	[8]	[8]	
9	Frequency upper limit	UL	r	Upper limit of output frequency (Hz)	[9]	[9]	[9]	[9]	
10	Frequency lower limit	LL	L	Lower limit of output frequency (Hz)	[10]	[10]	[10]	[10]	
11	Accelerating time	ACC	r'	Accelerating time (sec.) from 0 to Max. frequency	[11]	[11]	[11]	[11]	
12	Decelerating time	DEC	L'	Decelerating time (sec.) from Max. frequency to 0.	[12]	[12]	[12]	[12]	
13 (0)	Output frequency/fault	-	-	Operating frequency/ fault cause	[13] OFF	[13] LS	[13] 30.0	[13] OC (Flickers)	After monitoring (Return to No.0)

(Note 1) The number in [ ] indicates the readout order in the sequential mode.

(Note 2) When a fault occurred [13], the monitor displays the frequency at the time of the fault, preceded by A, such as A 60.0 (Data is retained for 1.25 msec. following the occurrence of a fault.)

(Note 3) Explanation of inverter status mode

Display (Hex.)	Detail of Status			
	RUN / RUN	FOR / REV	ACC / ACC	DEC / DEC
0	$\overline{\text{RUN}}$	REV	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$
1	$\overline{\text{RUN}}$	REV	$\overline{\text{ACC}}$	DEC
2	$\overline{\text{RUN}}$	REV	ACC	$\overline{\text{DEC}}$
3	$\overline{\text{RUN}}$	REV	ACC	DEC
4	$\overline{\text{RUN}}$	FOR	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$
5	$\overline{\text{RUN}}$	FOR	$\overline{\text{ACC}}$	DEC
6	$\overline{\text{RUN}}$	FOR	ACC	$\overline{\text{DEC}}$
7	$\overline{\text{RUN}}$	FOR	ACC	DEC
8	RUN	REV	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$
9	RUN	REV	$\overline{\text{ACC}}$	DEC
A	RUN	REV	ACC	$\overline{\text{DEC}}$
b	RUN	REV	ACC	DEC
C	RUN	FOR	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$
d	RUN	FOR	$\overline{\text{ACC}}$	DEC
E	RUN	FOR	ACC	$\overline{\text{DEC}}$
F	RUN	FOR	ACC	DEC

Display (Hex.)	Detail of Status			
	ACUV / ACUV	MUV / MUV	MTV / MTV	STALL / STALL
0	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
1	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	STALL
2	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	MTV	$\overline{\text{STALL}}$
3	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	MTV	STALL
4	$\overline{\text{ACUV}}$	MUV	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
5	$\overline{\text{ACUV}}$	MUV	$\overline{\text{MTV}}$	STALL
6	$\overline{\text{ACUV}}$	MUV	MTV	$\overline{\text{STALL}}$
7	$\overline{\text{ACUV}}$	MUV	MTV	STALL
8	ACUV	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
9	ACUV	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	STALL
A	ACUV	$\overline{\text{MUV}}$	MTV	$\overline{\text{STALL}}$
b	ACUV	$\overline{\text{MUV}}$	MTV	STALL
C	ACUV	MUV	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
d	ACUV	MUV	$\overline{\text{MTV}}$	STALL
E	ACUV	MUV	MTV	$\overline{\text{STALL}}$
F	ACUV	MUV	MTV	STALL

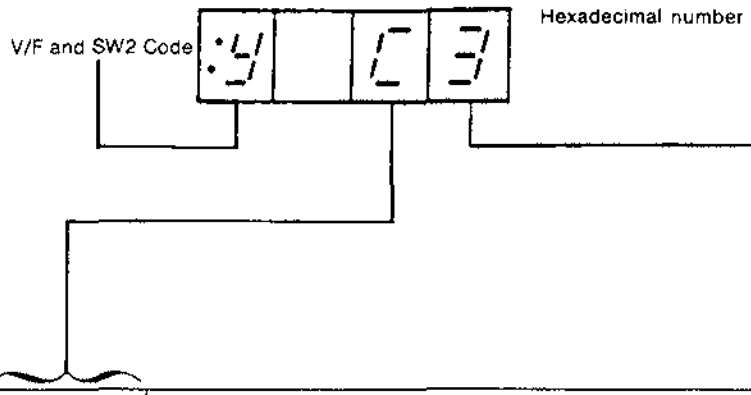
Inverter status mode examples:

Example	Display	Detail of Inverter Status							
1	00	$\overline{\text{RUN}}$	REV	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
2	01	$\overline{\text{RUN}}$	REV	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
3	08	$\overline{\text{RUN}}$	REV	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$	ACUV	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$
4	92	RUN	REV	$\overline{\text{ACC}}$	DEC	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	MTV	$\overline{\text{STALL}}$
5	A1	RUN	REV	ACC	$\overline{\text{DEC}}$	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	STALL
6	C0	RUN	FORD	$\overline{\text{ACC}}$	$\overline{\text{DEC}}$	$\overline{\text{ACUV}}$	$\overline{\text{MUV}}$	$\overline{\text{MTV}}$	$\overline{\text{STALL}}$

Inverter status mode abbreviation descriptions:

RUN: Inverter is running.
REV: Inverter is running in reverse rotation.
ACC: Inverter is accelerating.
DEC: Inverter is decelerating.
ACUV: Inverter detected undervoltage of AC main circuit.
MUV: Inverter detected undervoltage of DC main circuit.
MTV: Inverter detected peak voltage of DC main circuit.
STALL: Stall-prevention circuit is activating.
RUN: Inverter is not running.
FORD: Inverter is running in forward rotation.
ACC: Inverter is not accelerating.
DEC: Inverter is not decelerating.
ACUV: Inverter detects no undervoltage of AC main circuit.
MUV: Inverter detects no undervoltage of DC main circuit.
MTV: Inverter detects no peak voltage of DC main circuit.
STALL: Stall-prevention circuit is not activating.

(Note 4) Explanation of inverter mode: V/F and SW 2 Data



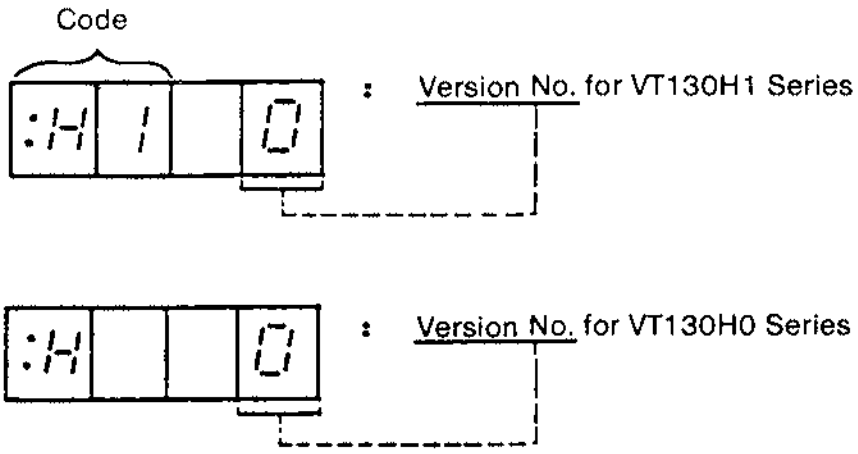
Display (Hexadecimal)	Selection of dip switch (SW2) 1 = ON / 0=OFF	If / If'	RA / RA	OL / SS	x10 / x1
0	0000	If	RA	SS	X1
1	0001	If	RA	SS	X10
2	0010	If	RA	OL	X1
3	0011	If	RA	OL	X10
4	0100	If	RA	SS	X1
5	0101	If	RA	SS	X10
6	0110	If	RA	OL	X1
7	0111	If	RA	OL	X10
8	1000	If'	RA	SS	X1
9	1001	If'	RA	SS	X10
A	1010	If'	RA	OL	X1
B	1011	If'	RA	OL	X10
C	1100	If'	RA	SS	X1
D	1101	If'	RA	SS	X10
E	1110	If'	RA	OL	X1
F	1111	If'	RA	OL	X10

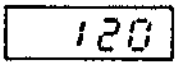
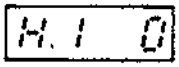
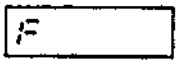
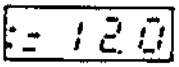
(See 9-3.)

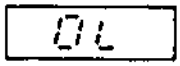
Display (Hexadecimal)	Switch Position number (SW1)
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	A
B	B
C	C
D	D
E	E
F	F

(See 4-3.)

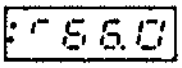
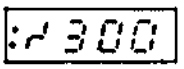
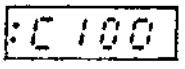
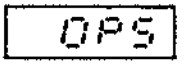
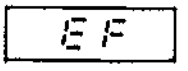
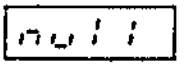
(Note 3) Explanation of firmware version No.



Item	Display example	Display Conditions and Data Displayed
Output frequency display		Output frequency Output frequency is displayed in integal numbers. Output frequency from "3" to "120" Hz is displayed when the V/F pattern selection rotary switch is set on "8" or "9".
Inverter status		Firmware version number (Type of software)
		Inverter mode: (Data on jumper pins, dip switch and V/F pattern) **(Hexadecimal)**
		Inverter status (Status of inverter in operation) **(Hexadecimal)**
		Frequency command (Hz)
		Potential (voltage) command (%)
Set value of adjustment rheostat		1RH: RB: Reference bias Set bias of frequency command (Hz) (Frequency at 20% reference frequency)
		2RH: RG: Reference gain Set gain of frequency command (Hz) (Frequency at 100% reference frequency)

Item	Display example	Display Conditions and Data Displayed	(*)
Fault causes display		OC: Over current (instantaneous) If the inverter detects 180% of the rated current, the inverter trips, and "OC" flickers on the indicator.	O
		OCA: Short circuit at starting (an output transistor short-circuit is likely to occur on start). If this is the case, the inverter trips, and "OCA" flickers on the indicator.	X
		OCL: Load side short circuit at start up Phase to phase short-circuit is likely to occur on the load side at starting, the inverter trips, and "OCL" is flickered on the idicator.	X
		OL: Over load When the inverter detects overload, it trips, and "OL" is flickered on the indicator. If the soft stall has been selected, the inverter does not trip but continues running and phases back the frequency.	X
		OP: Over Potential (voltage) When the inverter detects over voltage on the DC Buss (200V series of DC400V; 400V Series of DC 800V) it trips, and "OP" is flickered on the indicator.	O

(*): Restart (O: will be; X: will not be) attempted.

Item	Display example	Display Conditions and Data Displayed	
Set value of adjustment rheostat		3RH: UL: Upper Limit Value set on potentiometer 3RH for the upper limit of the frequency command (Hz)	
		4RH: LL: Lower Limit Value set on potentiometer 4RH for the lower limit of the frequency command (Hz)	
		5RH: ACC: Acceleration time Value set on potentiometer 5RH for the acceleration time (sec.)	
		6RH: DEC: Deceleration time Value set on potentiometer 6RH for the deceleration time (sec.)	
		7RH: IFB: Current meter % of Rated Current (%)	
Fault causes display		OPS: Overvoltage failure If the inverter detects over voltage on the incoming supply voltage, it trips and "OPS" flickers on the indicator.	X
		OH: Overheat When the inverter detects an over-temperature condition, it trips and "OH" flickers on the indicator.	X
		EF: Ground (earth) fault detection When the inverter detects a ground fault, it trips and "EF" is flickered on the indicator.	X
		null: Initial unmatch "null" is flickered if the inverter fails to initialize.	X

(*): Possibility of automatic restart (O: Possible, X: Impossible)

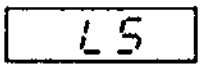
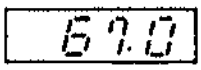
4-11 Display Digital Indicator

The output frequency of the inverter and its status, the values set of the adjustment potentiometers, and fault causes are displayed on the digital indicator of the control panel, as shown in Table 4-11.

CAUTION

If a fault on the inverter is activated, and the cause of the fault is flickering, the corresponding inverter data can be obtained by using the monitor function. Write the data down to aid in determining the cause and how to eliminate the fault before resetting.
To reset the inverter after a fault, open the small door on the front panel and do one of the following: 1. push the reset push-button on the main control PCB, 2. activate a remote reset signal if it is wired to the inverter terminals, 3. or remove control power to the inverter and restore the control power. All three methods will reset the inverter. For more detail, refer to Chapter XIII on Troubleshooting.

Table 4-11 Data Displayed on Digital Indicator (1/5)

Item	Display example	Display Conditions and Data Displayed
Output frequency displays		OFF: "OFF" is displayed when MCCB is turned ON and DRIVE SWITCH is in the STOP position.
		LS: Low Speed "LS" is displayed when operating commands (RUN and ST) are received and the frequency command value is below 3Hz. While "LS" is being displayed, the inverter does not produce output power.
		Output frequency Output frequency is displayed with one digit after the decimal point, Frequency from "3.0" to "67.0" Hz is displayed when the V/F pattern selection rotary switch is set on 0, 1, 2, 3, 4, 5, or 6
		Output frequency Output frequency is displayed with one digit after the decimal point, Frequency from "3.0" to "80.0" Hz is displayed when the V/F pattern selection rotary switch is set on 9, A, B, C, D, E, or F.

4-12 Flickering of the Digital Indicator

The digital indicator may flicker during the operation of the inverter or when adjusting a potentiometer.

Flickering occurs due to the following possible causes:

1. The stall prevention circuit is activated during operation (Normal).
2. The values set on the adjusted potentiometers are not normal (for example LL is greater than UL).
3. The frequency (3-67, 3-80, 3-120 Hz) range was changed by the V/F pattern selection rotary switch after the inverter was put in the run condition.
4. A fault occurred.
5. The automatic restart routine is in progress.

Table 4-12 shows possible causes of the flickering of the digital indicator. The flickering will stop when the cause has been eliminated and the inverter returns to a normal operation or status.

Table 4-12 Causes of Digital Indicator Flickering

Category	Monitor mode	Cause		Corrective Action
inverter indicates	Output frequency display mode (that is, the frequency flickers)	Stall prevention circuit is activating (Excess of 120% rated current)		1) Reduce load 2) Review selection of V/F pattern 3) Review accel/decel times 4) Check input power
		Soft stall is activating (When soft stall is selected under 120% - 60% sec. overload)		
		Acceleration/deceleration is terminated while setting an upper/lower limit.		Normal operation will resume when adjustment is completed.
		Automatic restart is activated.		Flickering of "LS" is normal until actual restart occurs.
Alarm	Random access mode, Set value alarm mode, Sequential mode (that is, a monitor code flickers.)	Following abnormal setting was made:		Readjust and obtain a legal setting. When setting "(UL)« (LL)", the monitor code of "LL" flickers.
		(UL) « (LL) (UL) « (FC) (LL) » (FC) (RB) + (RG) = Maximum frequency	UL: Upper limit LL: Lower limit FC: Frequency command RB: Frequency command bias RG: frequency common gain	
Alarm	Output frequency display mode, Sequential access mode (that is, a monitor code flickers.)	Upon starting the operation, a V/F pattern with different maximum frequency (67, 80, 120Hz) was selected by adjusting the V/F pattern selection rotary switch.		Return to the V/F pattern with the same maximum frequency as before the adjustment. Any of the 16 V/F patterns can be selected if the inverter is not selected to RUN upon turning on the power. If you wish to select a V/F pattern with different frequency after starting the operation, turn off the power once, or reset the inverter.
Fault	Fault cause display mode (that is, fault cause display flickers.)	Occurrence of a fault being flickered on display.		Eliminate the cause, push the reset push-button and restart the operation.

4-13 Setting and Adjustment

Regarding the setting and adjusting of each function, refer to Chapter IX, Adjustments.

4-14 Operation by Software

The following 9 functions are handled by the software in the built-in microcontroller:

Table 4-14 Operation by Software

No.	Item	Description
1	Run/Stop	Controls running and stop of the inverter.
2	Emergency stop at fault	When a fault occurs, the software trips the inverter under certain conditions.
3	Automatic restart	When fault occurs, the inverter determines if the automatic restart may be possible. If possible, it executes the automatic restart program.
4	Voltage/Frequency (V/F) pattern selection	Selects and controls one of 16 V/F patterns.
5	Stall detection	When the main circuit current (IFB) exceeds the stall activation level, the software functions to prevent the stall.
6	Overload detection	When the main circuit current (IFB) exceeds the overload detection level, the software starts calculating the overload.
7	Deceleration limit	When the regenerated power from the motor is so large as to increase the DC voltage above the set value during deceleration, the software extends the deceleration time.
8	Momentary power failure control	When an instantaneous power failure occurs, the software prevents a stall of the motor by controlling the output frequency of the inverter in harmony with the voltage drop of the DC main circuit, to assure smooth operation upon recovery of the power.
9	Monitor control	Displays data on the digital indicator.

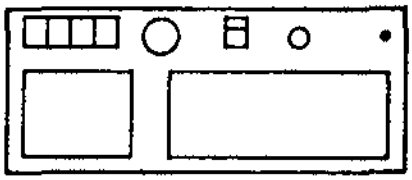
Chapter V
SPECIFICATIONS OF OPTIONS

Various options are available. Please refer to the separate Option Guide for correct connections and adjustment of the optional functions. If you wish to order an additional option, please contact Toshiba.
The following information outlines the major options:

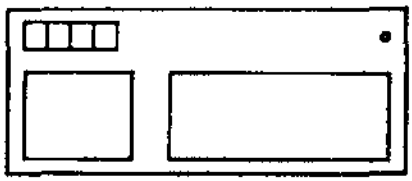
5-1 Built-in Options

(1) The PI control operates from a signal of (1-5VDC or 4-20mADC) from a process detector used to control pressure or flow rate of pumps, fans and blowers.

(2) Control Panel (With control equipment: Applicable to BO type)



(3) Control Panel (Without control equipment: B type)



(4) Coating of PCBs
When the inverter is likely to operate in an environment involving high temperature, humidity, or a corrosive gas. A coated PCB has a longer service life than an uncoated one. Please contact your local Toshiba representative.

(5) Relay PCB
This PCB uses relay contacts for indication of the upper limit "UL" and lower limit "LL"

(6) Pneumatic Controller
This option board has a pressure transducer mounted on the board to convert a 0-15 PSI pressure signal into a speed reference to control inverter frequency.

(7) Preset Speed/Run Indication
This option board provides two functions. It provides a contact closure indicating that the inverter is running. It also provides selection of a preset speed for functions such as "jogging".

(8) Pneumatic Controller with Preset Speed/Run Indication
This option board combines the functions of the Pneumatic Controller with the functions of the Preset Speed/Run Indication board, all on one single board.

5-2 Externally Mounted

(1) RFI Noise Reduction Filter
This is used to reduce the RF (EMI) noise near an inverter in operation.

(2) Remote Control Station
It allows manual operation control.

(3) Control equipment
The following control components are available for remote control of the inverter operation:

- Frequency meter: (Analog display)
- Frequency potentiometer: For setting frequency.
- Frequency POT dial: Precision potentiometer setting indicator dial.
- Drive switch: Runs/stops inverter.
- H-O-A selection switch: For selecting HAND, OFF or AUTO.

5-3 External Options Requiring Partial Adjustment

(1) Motor Noise Reduction Filter (For TOSVERT-130H only)
An inverter using the PWM control generally causes a higher motor noise level than experienced with an across the line power source. This filter is used on 130H (not required on 130H1) if motor noise reduction is required. By using this option, the noise can be reduced to a level almost equal to that of an across the line noise of the motor. Refer to section 4-1-2 for adjustments.
NOTE: The unit requires a 10% derating of output current for this option.

5-4 External Options Requiring Inverter Modification

(1) External digital display
This is used to take out the digital indicator (4-digit 7-segment LED) for displaying frequency/monitor data outside the unit. It can be used at the maximum distance of 3m (8 feet) from the unit.

(2) RS232 Serial Communication link with Basic Software.
Used to monitor and limited control of the inverter throught a personal computer.

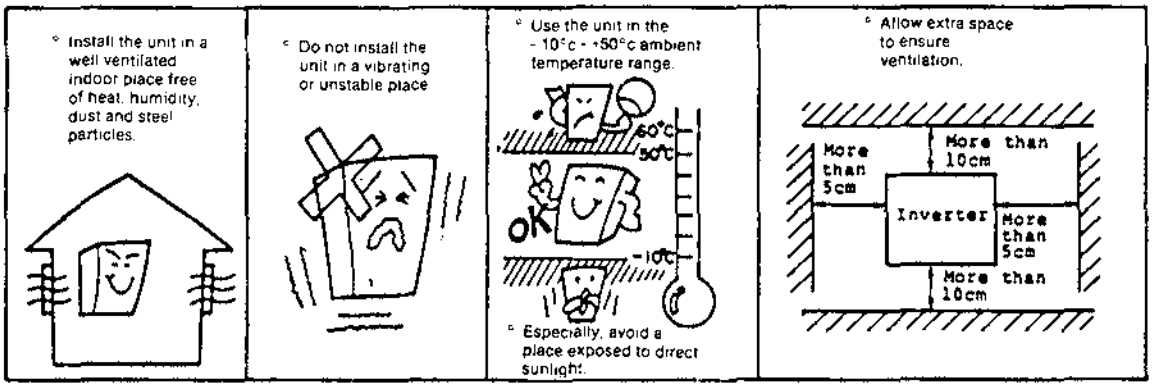
(Note) The following options are scheduled to be added:
1) 3-step speed selection
2) 6144f output
3) JOG
4) BINARY code input (8 bits)
5) D/A conversion

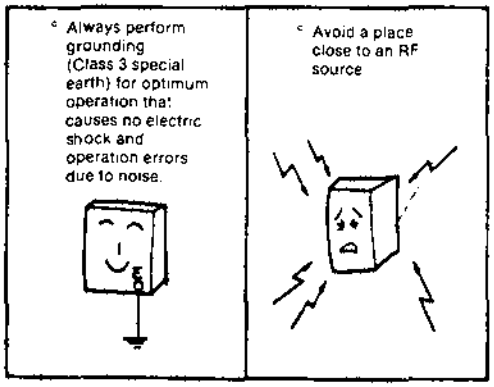
Contact your local Toshiba representative for availability.

Chapter VI
INSTALLATION

This inverter must be always installed in the upright position.

1) The ambient temperature should be between −10°C - +50°C. (−10°C - +40°C if the unit is equipped with covers). When installing the inverter inside (a self-standing enclosure cubicle or a large self-standing cubicle,) complete ventilation should be assured to maintain the ambient temperature of between −10°C - +50°C.
2) Avoid a hot, condensating humidity, dusty, and metal filings.
3) Select a place free of corrosive gases and machining solvents.
   In a hostile environment, coating (option) on the PCB is recommended.
4) The drive should be installed in an environment (AC line) free of vibrations and noise. It should be accessible for maintenance and inspection.
5) Do not submit the chassis to mechanical shock or distortion.
6) When incorporating the unit into a cubicle, the cubicle's inside ambient temperature must be considered.



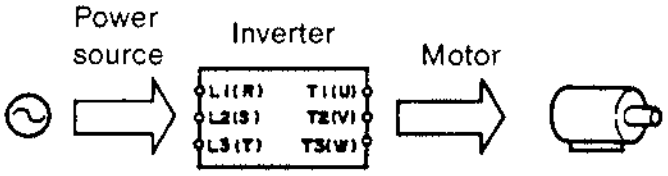


Chapter VII
WIRING

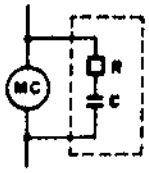
7-1 Cautions for Wiring

Correct wiring should be assured by referring to the Standard Connection Diagram (Fig. 7-2) and the Standard Cable Size and Selection for the Main Circuit Wiring Equipment (Table 7-3).

(1) Do not connect the commercial power source to the output terminals U, V, W. This is not covered by warranty.



(2) Always connect a surge suppressor across the MC exciter coil of the contactor, by using the shortest possible wiring.



Recommended surge killer:
Marcon Electric K.K.
DCR2-10A25 (0.1 μF & 100 Ω) or
DCR2-22A25 (0.22 μF & 220 Ω).

(3) The ground terminal E must be grounded with a cable thicker than 3.5 mm² (12 ga)
200V Series: Class 3 Ground resistance: Under 100 Ω
400V Series: Class 3 Ground resistance: Under 10 Ω

(4) The input terminals of the AC power source should be correctly connected to the correct source voltage. (Do not put 460V on 230V unit).

(5) Use a shielded cable for outside wiring coming from the Input terminals (CRF, REF, IRF, 0V) for frequency potentiometer, and the output terminals (FM, CM OV) for the instruments, and for external control connections (ST, RUN, REV, RST, COM)

(6) Use a 0-1mA DC meter if connecting an external frequency meter and ammeter. The connection of the ammeter also requires installation of a 20K potentiometer for scale calibration.

(7) If the reverse rotation command is not inputted on terminal REV, the inverter starts running in the normal rotation by drive command RUN. To make it start in the reverse rotation, input the reverse rotation command to the terminal REV.
If the rotation is opposite that of desired, reverse any two output motor leads.

(8) The 4 - 20mA current input signals are not isolated from the control circuit.

(9) Wiring Routes

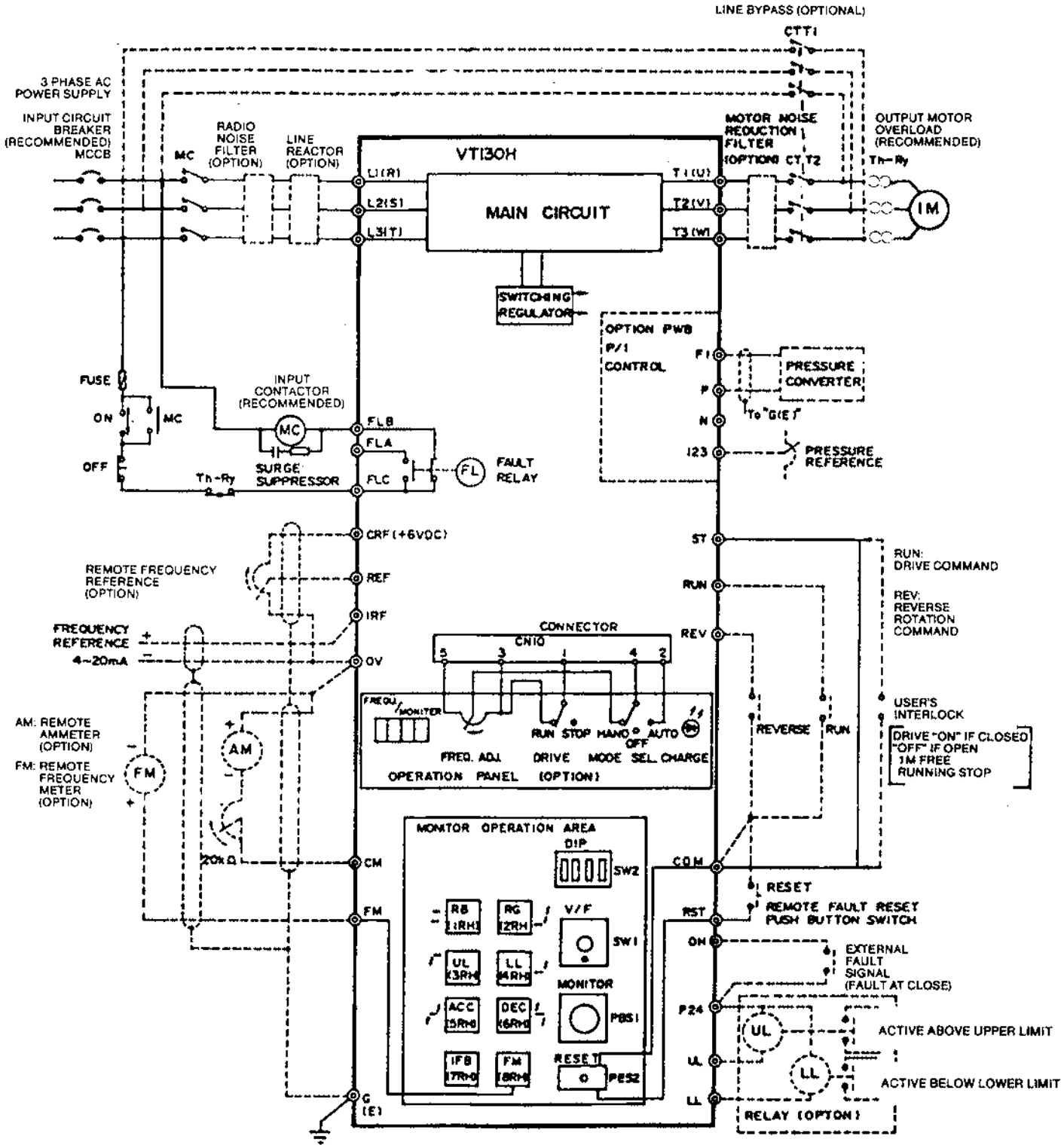
The main three phase power leads should be separated from the DC and AC control voltage wiring by at least 10 cm (3 inches). In cases where these wires must cross, they should be crossed at right angles. If it is impossible to maintain a 10 cm (3 inch) separation, the control wires should be placed in metal conduit which is grounded on the receiving end only. All small signal pair wires (such as frequency set, frequency meter, current meter) should be twisted pair (even in the metal conduit). Do not put three phase power cables and control power wiring in the same conduit.

(10) Accidental trip of the ground fault protection circuit.

When a motor is driven by an inverter, an accidental ground fault trip may occur due to harmonic current which can flow from the ground through the motor and the cable leakage capacitance. This condition can be corrected by adjusting the ground fault sensitivity current adjustment and/or the addition of a harmonic filter.

7-2 Standard Connection Diagram

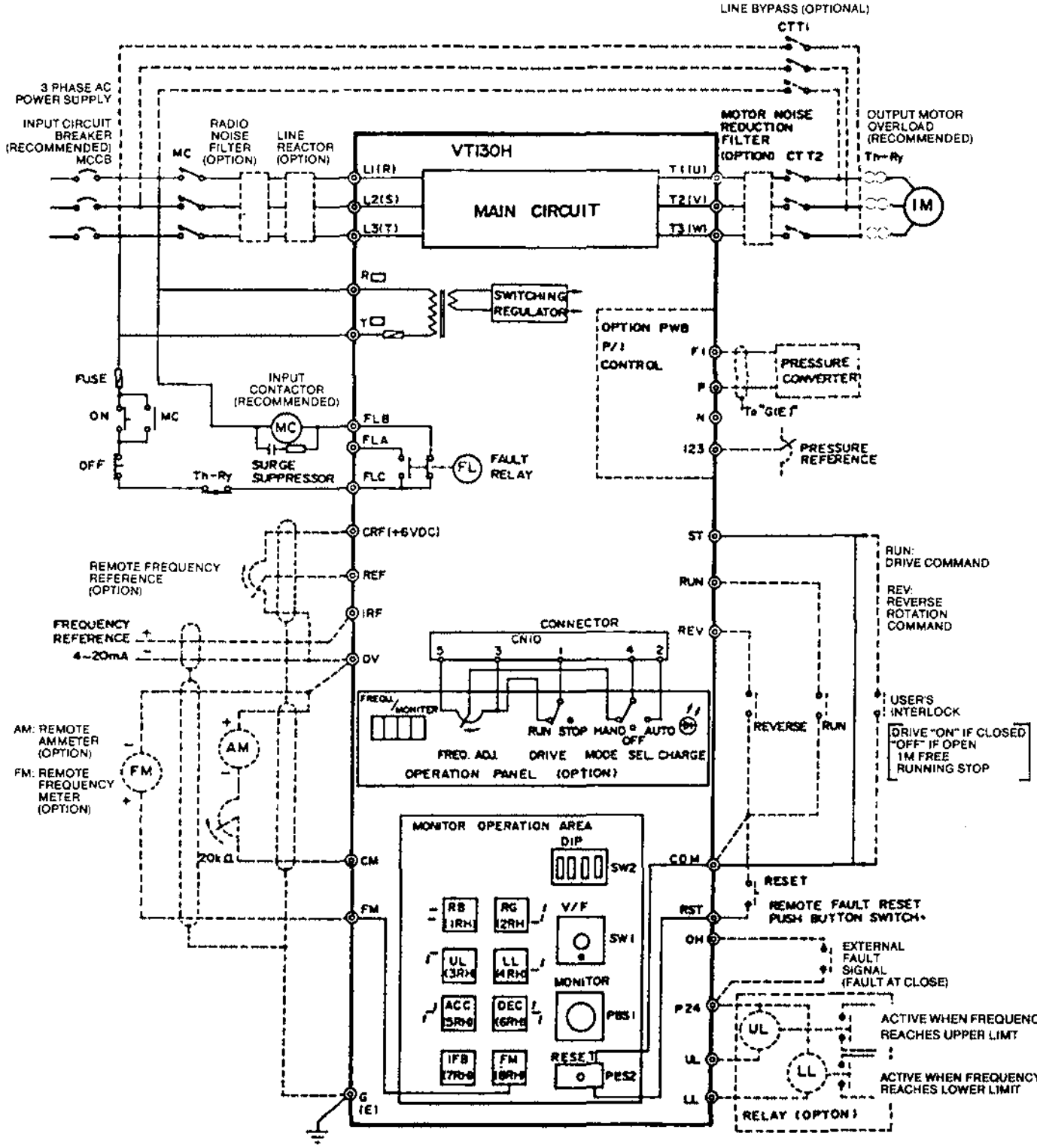
(1) 200V Class 2035 - 2080 (1/4)
208V, 220V, 230V



NOTE: MCCB-Circuit Breaker (Disconnect), MC-Magnetic Contactor, Th-Ry (OLR)-Over Load Relay. On-PB-On push button, OFf-PB-Off push button, CTT1 & CTT2-Bypass Contactors, Fault Fuse are not provided with the inverter power unit. All dashed line symbols are optional connections and components.

◎ Wiring terminal symbol.

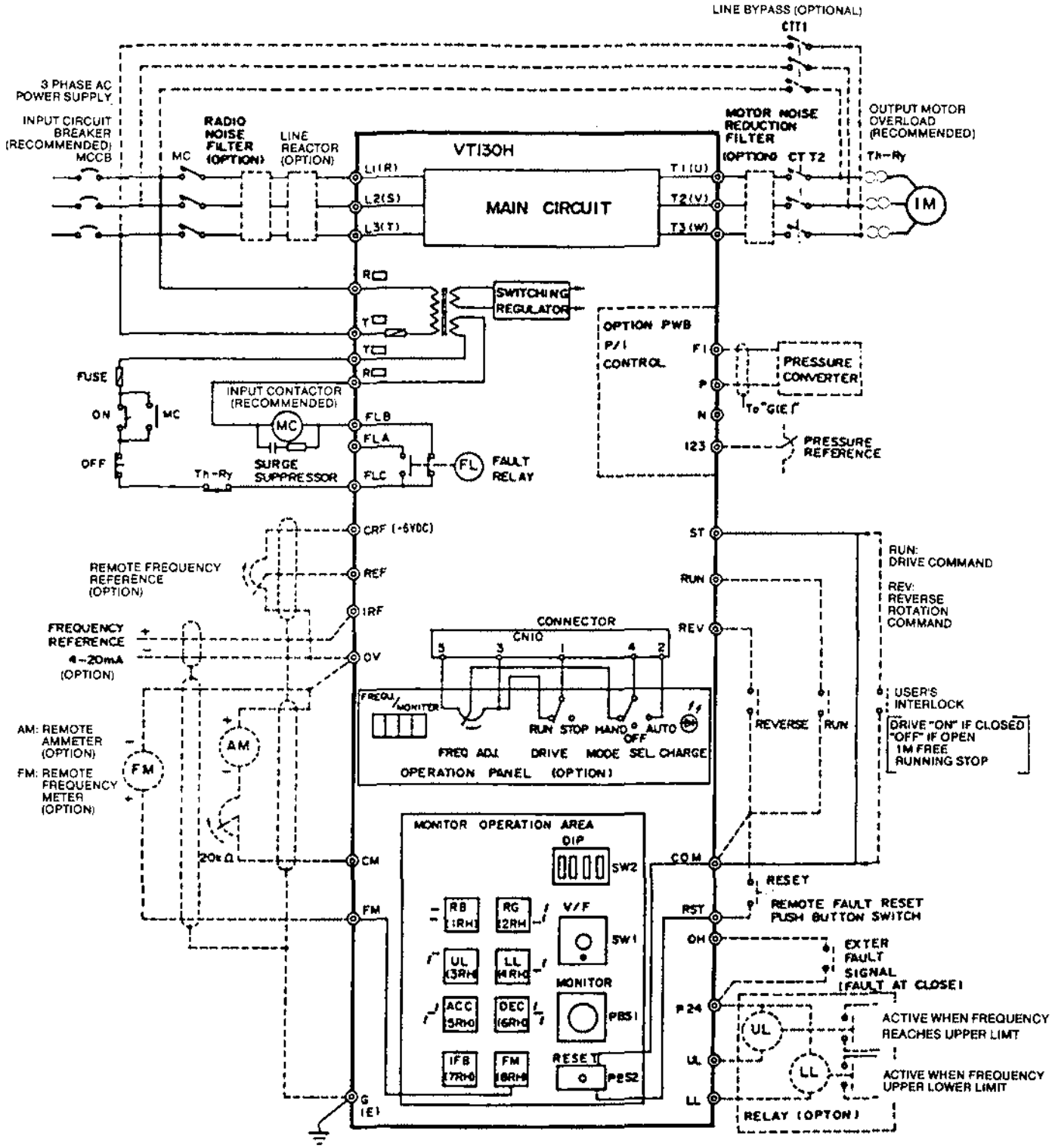
(2) 200V Class 2110 - 2800 (2/4)
208V, 220V, 230V



NOTE: MCCB-Circuit Breaker (Disconnect), MC-Magnetic Contactor, Th-Ry (OLR)-Over Load Relay. On-PB-On push button, Off-PB-Off push button, CTT1 & CTT2-Bypass Contactors, Fault Fuse are not provided with the inverter power unit. All dashed line symbols are optional connections and components.

◎ Wiring terminal symbol.

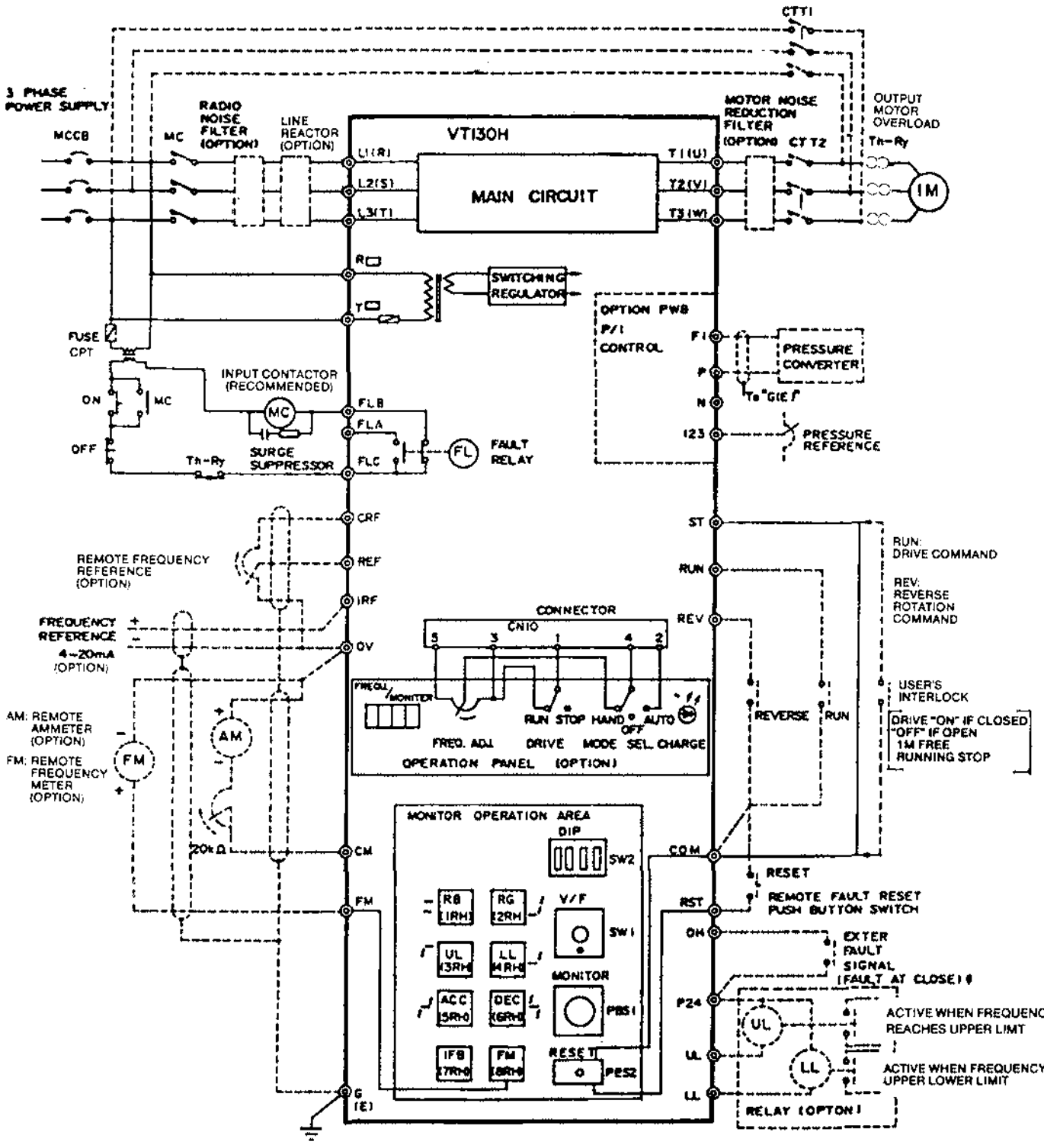
(3) 400V Class 4055 - 4330 (3/4)
380V, 415V, 460V



NOTE: MCCB-Circuit Breaker (Disconnect), MC-Magnetic Contactor, Th-Ry (OLR)-Over Load Relay. On-PB-On push button, Off-PB-Off push button, CTT1 & CTT2-Bypass Contactors, Fault Fuse are not provided with the inverter power unit. All dashed line symbols are optional connections and components.

◎ Wiring terminal symbol.

(4) 400V Class 4400 - 4100K (4/4)
380V, 415V, 460V



NOTE: MCCB-Circuit Breaker (Disconnect), MC-Magnetic Contactor, Th-Ry (OLR)-Over Load Relay. On-PB-On push button, Off-PB-Off push button, CTT1 & CTT2-Bypass Contactors, Fault Fuse are not provided with the inverter power unit. All dashed line symbols are optional connections and components.

◎ Wiring terminal symbol.

7-3 Wiring Sizes

7-3-1 Standard Cable Size

For connecting the main power circuit, use the cable sizes equal to or greater in current capacity than those listed on the table below.
For wiring the control circuit, cables of at least 0.75mm² (18 AWG).
Shielded cables (3-core or 2-core shield cables of more than 0.3mm²) (20 AWG) should be used for connecting the signal circuits (Speed pot, meter output, current input signal, etc.), to prevent interference by other circuits.

Type-form	Main power source/motor mm² (AWG)	Control Power (R,T)	Frequency speed command input, Frequency meter, Ammeter	Other signal circuit
VT130H1-2035	2.0 (14)	2.0mm² (14 AWG or larger)	3-core shield cable 2-core shield cable more than 0.3mm² (20 AWG or larger) (Twisted)	0.75 mm² (18 AWG or larger)
VT130H1-2055	3.5 (12)			
VT130H1-2080	5.5 (10)			
VT130H0-2110	8 (8)			
VT130H0-2160	14 (6)			
VT130H0-2220	22 (4)			
VT130H0-2270	30 (3)			
VT130H0-2330	38 (2)			
VT130H0-2400	50 (1)			
VT130H0-2500	50 (1)			
VT130H0-2600	80 (00)			
VT130H0-2800	80 (00)			

Type-form	Main power source/motor mm² (AWG)	Control Power (R,T)	Frequency speed command input, Frequency meter, Ammeter	Other signal circuit
VT130H1-4055	2.0 (14)	2.0 mm² (14 AWG or larger)	3-core shield cable 2-core shield cable more than 0.3mm² (20 AWG or larger)	0.75 mm² (18 AWG or larger)
VT130H1-4080	3.5 (12)			
VT130H1-4110	5.5 (10)			
VT130H1-4160	8 (8)			
VT130H0-4220				
VT130H0-4270	14 (6)			
VT130H0-4330				
VT130H0-4400	22 (4)			
VT130H0-4500	22 (4)			
VT130H0-4600	30 (3)			
VT130H0-4800	38 (2)			
VT130H0-4100k	50 (1)			

7-3-2 Table of Main Circuit Wiring Equipment

The following table lists recommended reference equipment used with a standard interface outside the inverter unit:

Inverter Model		Nominal Motor size variable torque	Distribution circuit-breaker MCCB	Electro-magnetic contactor MC	Overload relay Th-Ry		Auxiliary relay Run
Type-form	Cap. (KVA)	Output (KW)	TOSHIBA Type-form	TOSHIBA Type-form	TOSHIBA Type-form		Type-form
VT130H1 -2035	3.5	2.2/3	E30B-3P-15A	C-10V-12A	R-10S	-9.3A	
VT130H1 -2055	5.5	3.7/5	E30B-3P-20A	C-20V-18A	R-20	-15A	
VT130H1 -2080	8	5.5/7.5	E50B-3P-30A	C-35-35A	R-35	-22A	
VT130H0 -2110	11	7.5/10	E50B-3P-50A			-28A	
VT130H0 -2160	16	11/15	E100B-3P-75A	C-65-65A	R-65	-43A	
VT130H0 -2220	22	15/70				-57A	
VT130H0 -2270	27	18.5/25	E100B-3P-100A	C-100-93A	R-80	-70A	
VT130H1 -2330	33	22/30	E225B-3P-150A		R-100	-85A	FRL23N
VT130H1 -2400	40	30/40		C-180-180A		-108A	200/4WE1
VT130H0 -2500	50	37/50	E225B-3P-175A			-138A	
VT130H0 -2600	60	45/60	E225B-3P-225A	C-250-240A	R-150	-162A	
VT130H0 -2800	80	55/75	E250B-3P-250A				
VT130H1 -4055	5.5	3.7/5	S30B-3P-15A	C-10V-12A	R-10	-8A	Fujitsu
VT130H1 -4080	8	5.5/7.5	E50B-3P-20A	C-25-26A	R-20	-11A	
VT130H1 -4110	11	7.5/10	E50B-3P-30A	C-25-26A	R-20	-15A	
VT130H1 -4160	16	11/15	E50B-3P-40A	C-35-35A	R-35	-22A	
VT130H0 -4220	22	15/20	E50B-3P-50A	C-50-50A	R-35	-28A	
VT130H1 -4270	27	18.5/25	E50B-3P-50A	C-65-65A	R-65	-35A	
VT130H0 -4330	33	22/30	E100B-3P-75A	C-65-65A	R-65	-43A	
VT130H0 -4400	40	30/40	E100B-3P-75A	C-80-80A	R-65	-57A	
VT130H0 -4500	50	37/50	E100B-3P-100A		R-100	-70A	
VT130H0 -4600	60	45/60	E225B-3P-125A	C-100-93A		-85A	
VT130H0 -4800	80	55/75	E225B-3P-150A	C-180-180A	R-100	-108A	
VT130H0 -4100k	100	75/100	E225B-3P-200A	C-180-180A	R-150	-138A	

The above table shows recommended equipment for your reference. A distribution circuit-breaker (MCCB) should be selected in accordance with the impedance of the power system connected with the inverter.

7-4 PCB Arrangement and Details of Terminal Board

7-4-1 PCB Arrangement Diagram

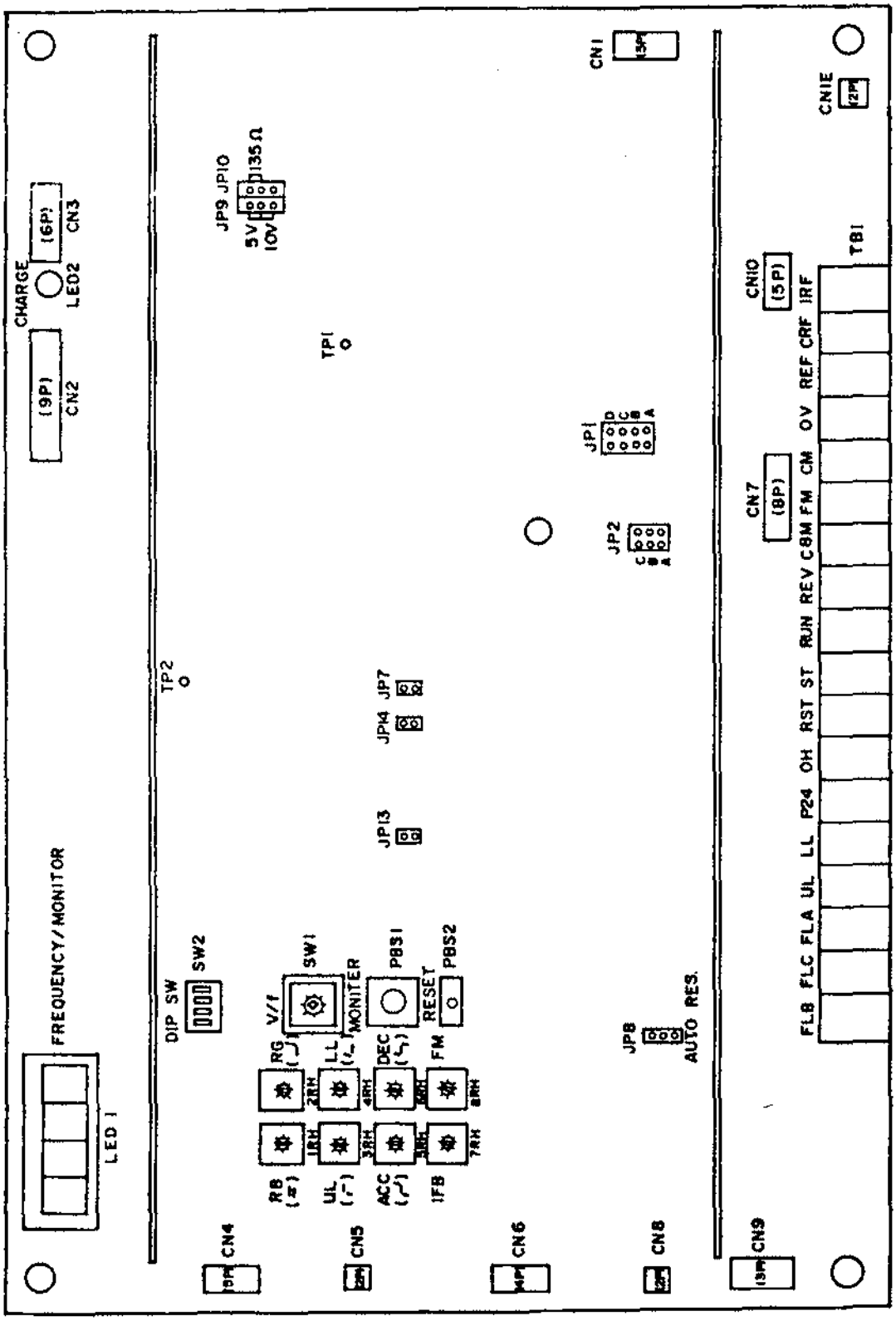


Fig. 7-4-1 (a) Main Control PCB (VT3C-2032 □)

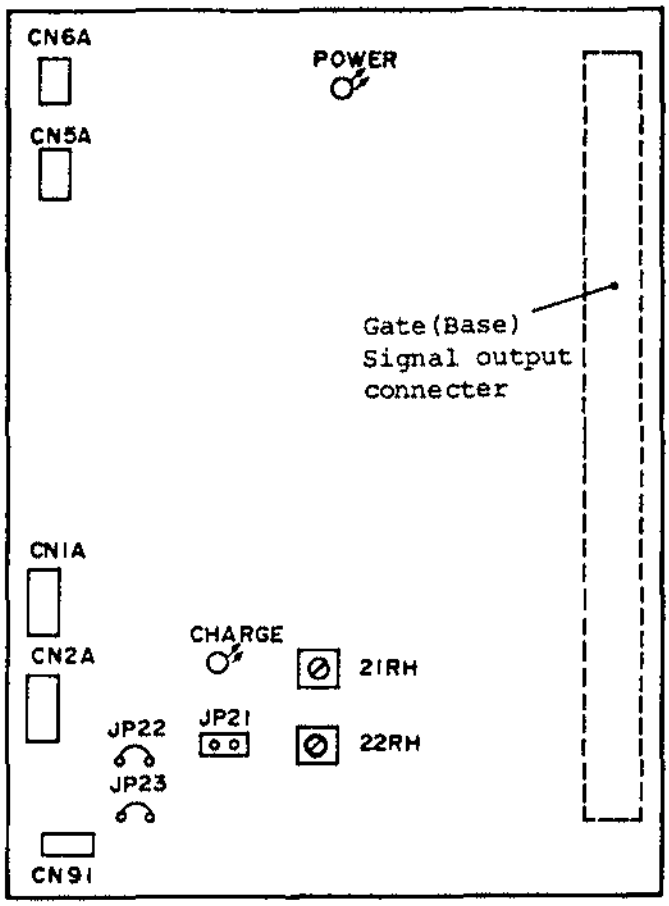
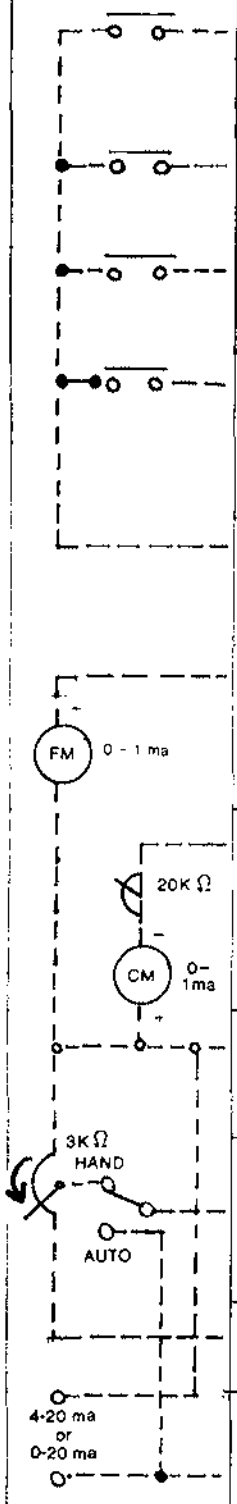
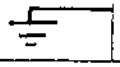


Fig. 7-4-1 (b) Base Drive PCB

7-4-2 Details of Terminal Board

Outside connection	Terminal code	Terminal function (internal use (connection)	Terminal position	Remarks
	L1 (R) L2 (S) L3 (T)	Main circuit power input terminal	Main terminal board	
M	T1 (U) T2 (V) T3 (W)	Output terminal for motor		
	R □ T □	Control power input terminal		
	R □ T □	Contactor control power output (Option)		
	FLB	N.C. contact point output when protective function is active (No electric potential) Rating: 250V-3A	Main control PCB terminal board	
	FLC	Common terminal of FLA and FLB		
	FLA	N.O. contact point output when protective function is active (No electric potential) Rating: 250V-3A		
	UL	Arrival at output frequency UL signal output terminal (Open collector output - see 4-6)		
	LL	Arrival at output frequency UL signal output terminal (Open collector output - see 4-6)		
	P24	+24V power source		
	OH	Overheat protection contact point signal input terminal (N.O. contact)		

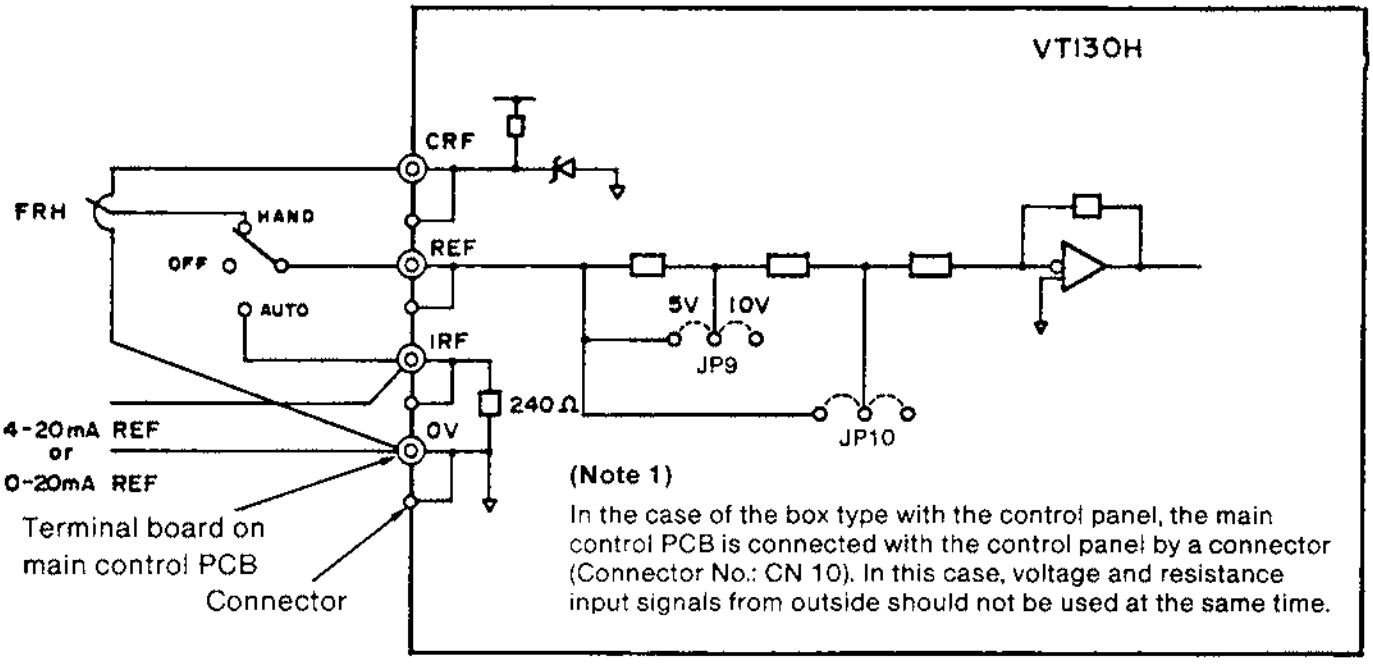
NOTE: N.C. Normally Closed
N.O. Normally Open

Outside connection	Terminal code	Terminal function	Terminal position	Remarks
	RST	Reset signal input terminal Fault reset by connection with COM terminal	Main control PCB terminal board	
	ST	Drive start enable input. When connected to COM, the drive becomes ready to start.		
	RUN	RUN command input terminal. Run by connection with ST (COM)		
	REV	Reverse rotation run command input terminal. Run in reverse rotation by connection with ST (COM)		
	COM	Common terminal of control circuit terminals OV, RST, ST, RUN, REV, FM and AM.		
	FM	PWM singal output terminal for outside frequency meter O - 1mADC generated between OV terminal		
	CM	Analog signal output terminal for ammeter, 0 - 1ma DC generated between COM, connection of a 20kΩ external calibration potentiometer rheostat is required		
	OV	Common terminal for control circuit terminals OV, FM CM, REF, CRF, and IRF.		
	REF	Frequency set signal input terminal. Inputs 0 - 5 (6)V DC /0-10 (12)V DC, 0-135 signal between OV and REF.		
	CRF	Reference voltage 6V for frequency setting		
	IRF	Current signal input terminal for frequency setting. Inputs 4-20mA, 0-20mADC between OV.		
	G(E)	Ground terminal	On chassis inside unit	

Chapter VIII
EXAMPLES OF OPERATIONS AND CONNECTIONS

8-1 Connection of Frequency Set (Speed) Input Signals

The input circuit of frequency set (frequency command) input signals is connected as follows:



The following 5 types of frequency command input signals can be used for this inverter:

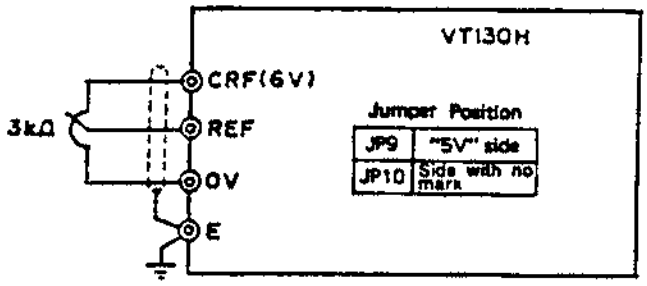
(1) 0 - 5 (6)V DC
(2) 0 - 10 (12)V DC
(3) 4 - 20mADC
(4) 0 - 20mADC
(5) Resistance 0 - 135 Ω

For each frequency command signal, the following jumper positions are required:

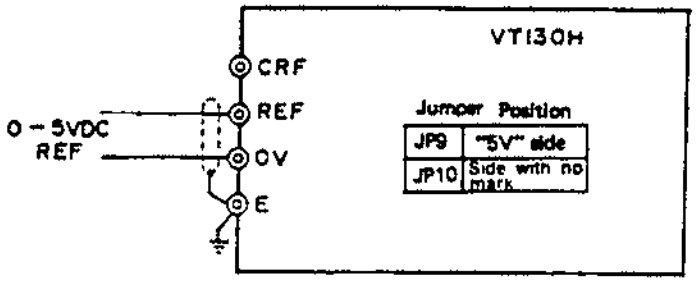
Jumper pin / Frequency command	JP9 See Fig. 7-4-1	JP10 See Fig. 7-4-1
0 - 5(6)V DC	5V side	no mark side
0 - 10(12)V DC	10V side	
4(0) - 20mADC	10V side	
Resistance 0 - 135 Ω	10V side	135 Ω side

8-1-1 Example of Standard Connection

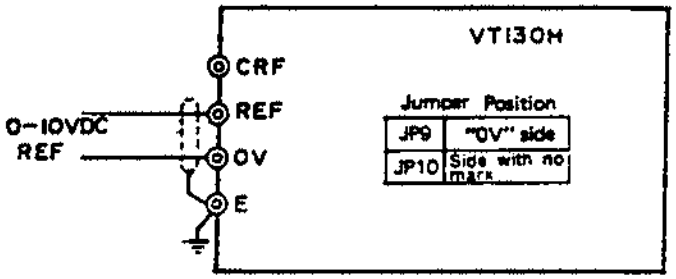
(1) Connection using potentiometer (0-5(6)V DC)



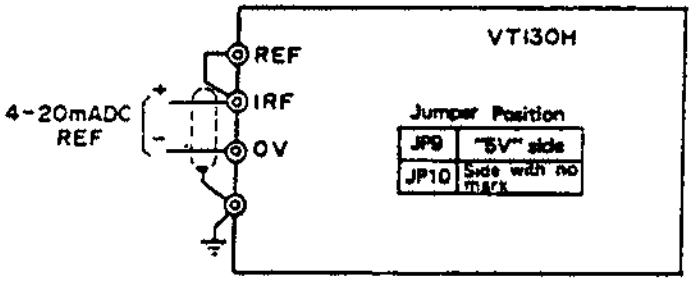
(2) Connection using voltage input signal (0-5(6)V DC)
(Potentiometer cannot be used)



(3) Connection using voltage input signal (0-10(12)V DC)
(Potentiometer cannot be used)

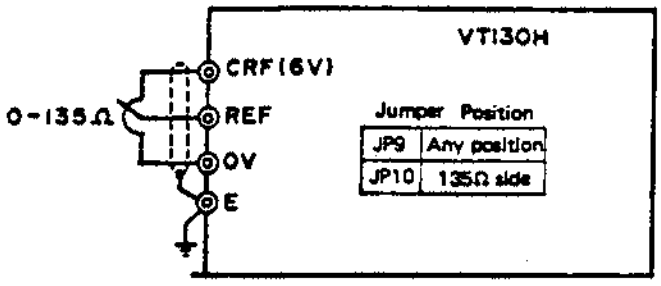


(4) Connection using current input signal (4-20mADC, 0-20mADC)

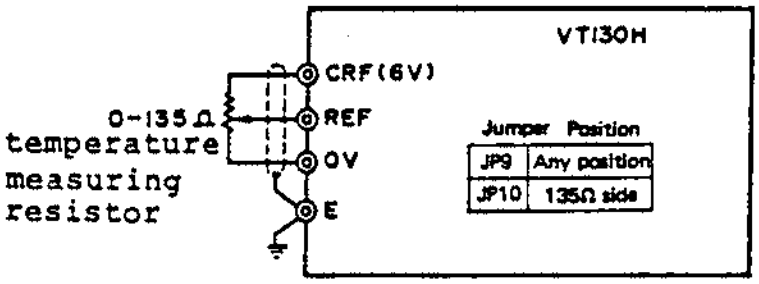


(5) Connection using 0 - 135Ω resistance input

1) Manual control

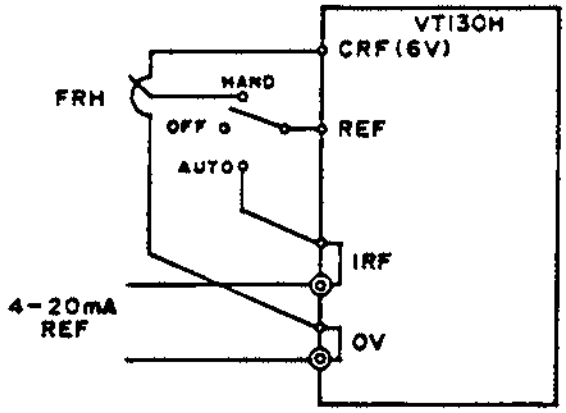


2) Automatic control



(Note)
Do not use a temperature measuring resistor which has a compensation wire.

(6) Connection using HOA selector, potentiometer and current input

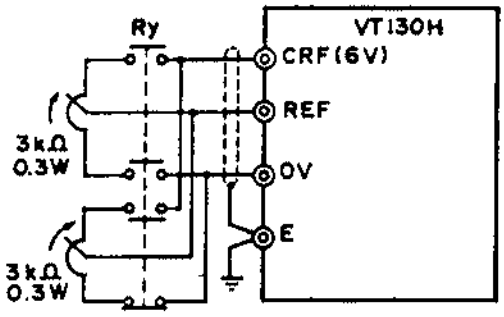


○ If the unit is equipped with the control panel, the following selections can be made by operating the selection switch:
"HAND": 0-5(6)V DC
"OFF": None of the frequency set signals is input
"AUTO": 4(0)-20mADC The jumper pin (JP10) should be also positioned at "5V".

○ Use a selection switch designed for low current. (Current flowing through the change-over switch shall be 0 to 300 μ A.)

8-1-2 Examples of applied connections

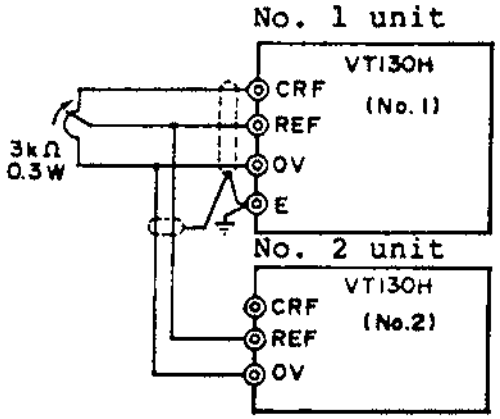
(1) Set speed by selecting more than one rheostat (potentiometer).



The figure shows how to set and select different frequency by more than one speed pot.
Use a switching relay designed for low current.

(2) Multiple inverters set and input by a single frequency command signal

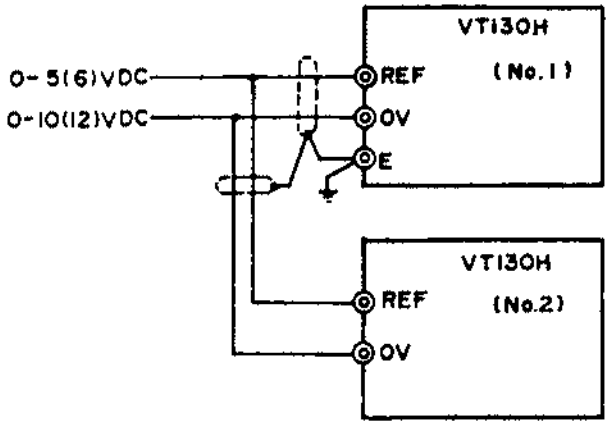
1) Frequency reference



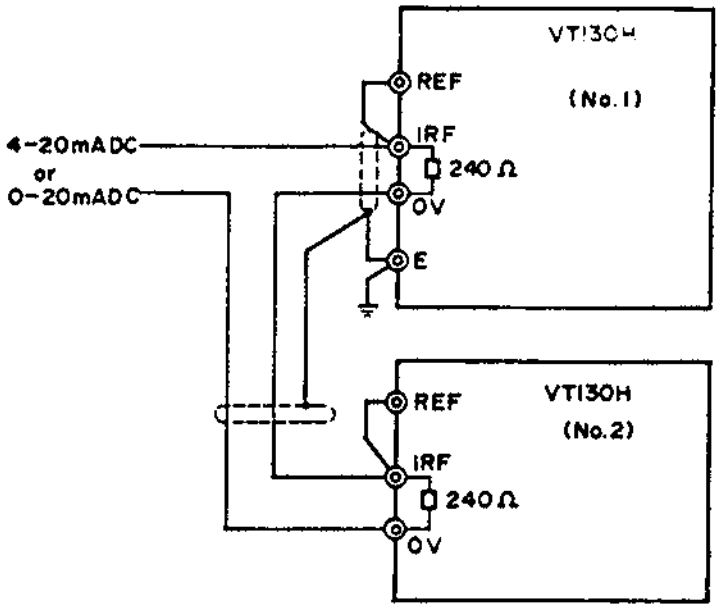
Keep in mind that OV potential of the control circuit becomes common to all inverter units.

*For more than two units contact Toshiba

2) Voltage input signal



3) Current input signal

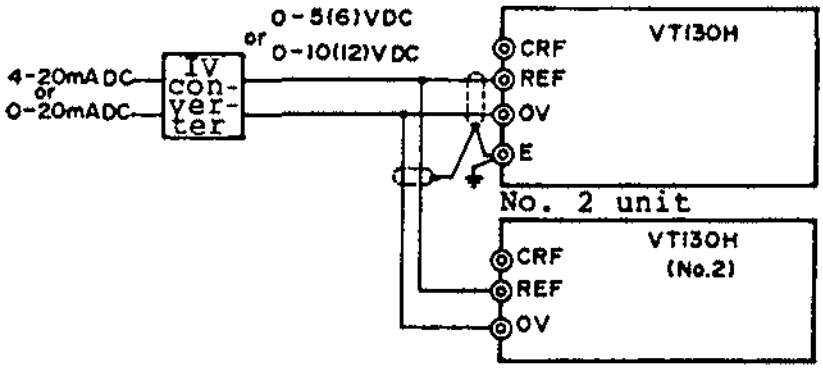


○ The input resistance of an inverter for 4(0)-20mA DC current input signal is specified at 240Ω .
Frequency of multiple inverters can be set by single current signal as long as the following inequality is established connecting the maximum output voltage rating "Eo" of the current signal output device:

If; Eo > (240 Ω x n) x 20mA

n = Number of operatable inverters

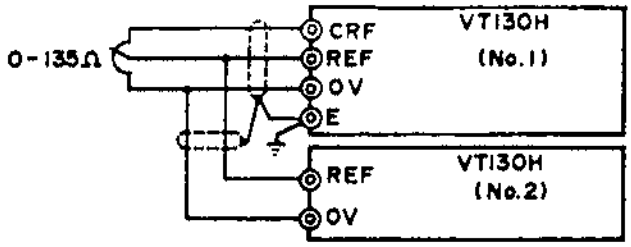
In this case, potentials of all inverter units are connected in series. It is necessary to pay attention to the potential relation among the control circuits of all inverter units.



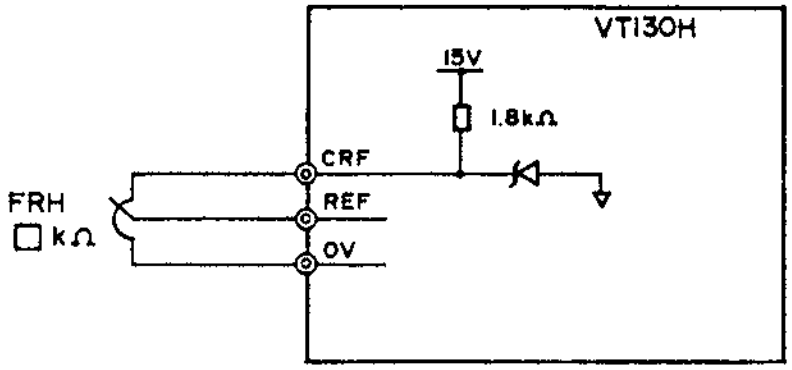
If; Eo < (240 Ω x n) x 20mA

Convert the current signal to voltage signal by an external device for frequency command.

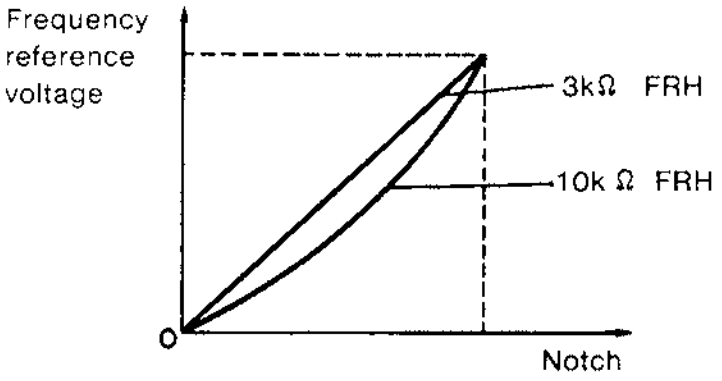
4) Resistance input



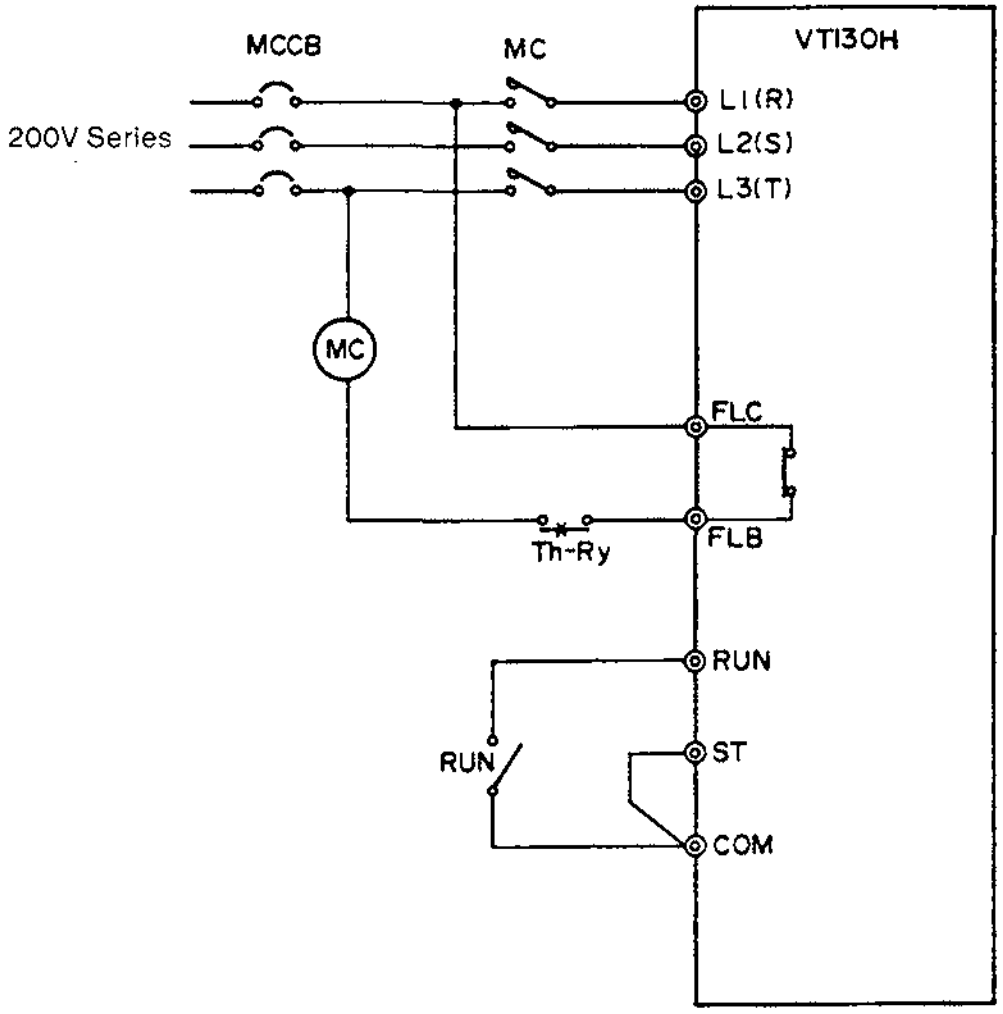
(3) Rheostat set at a value other than 3kΩ



The rheostat can be set from 2kΩ to 5k Ω . However, if the resistance is too high, it will deteriorate the linearity of setting against the notch selection as follows:



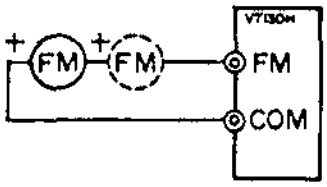
(4) Sequence of restart after recovery of power cut-off



- When power returns after an outage, the inverter is restarted if "RUN" has been selected.
- If "RUN" is open, the inverter decelerates and stops.
- The inverter should be started and stopped by opening and closing "RUN".

8-2 Connection of Frequency Meter and Ammeter

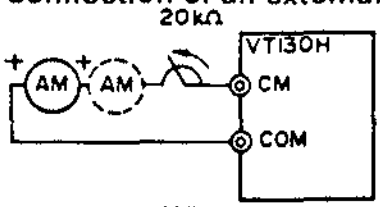
8-2-1 Connection Frequency Meter (FM)



The figure shows the connection for displaying the operating frequency outside the built-in digital indicator.

- ○ Use a meter rated at 0-1 ma DC
- ○ When connecting more than one meter, connect those with the same rating by serial connection. Normally, up to 5 meters can be connected serially, depending on the internal resistance.
- ○ The scale calibration of a meter should be adjusted in conformity with the indication (true value) of the digital indicator by using the built-in potentiometer. Note, however, that the meter indication includes calibration errors as against the actual operating frequency.

8-2-2 Connection of an external ammeter (AM)

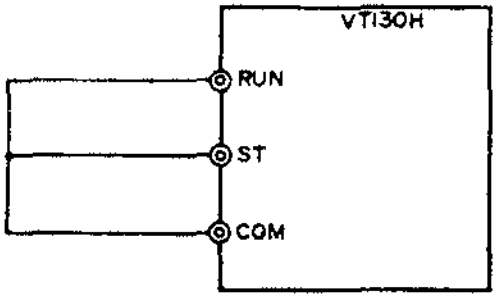


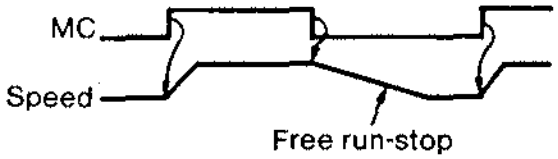
- ○ Use a meter rated at 0-1 ma DC for connection.
- ○ Install a 20k rheostat for scale calibration.
- ○ When connecting more than one meter, connect those with the same rating by serial connection. Normally, up to 5 meters can be connected serially, depending on the internal resistance.
- ○ The scale calibration of a meter should be adjusted in conformity with the actual measurement of the motor current.

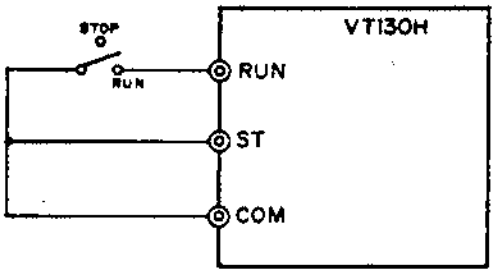
8-3 Connection of Operating Signals (normal and reverse rotation)

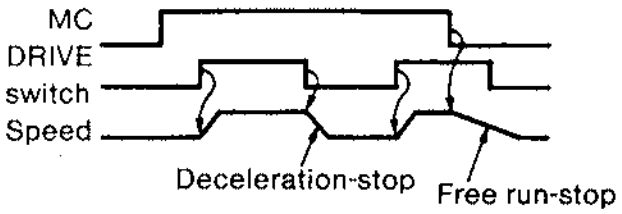
8-3-1 Operation in single direction

- ○ When the inverter is to be operated by contacting and releasing the contactor on the input side of the main circuit (MC), connect either MC contact with RUN and ST terminals, and connect the other with the COM terminal.



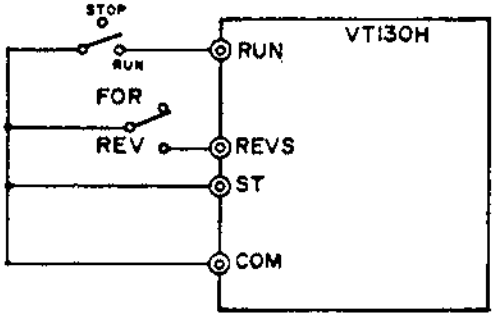


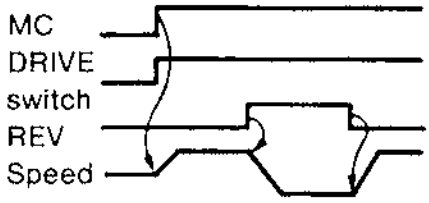




8-3-2 Operation in two directions (Forward ←——→ Reverse)

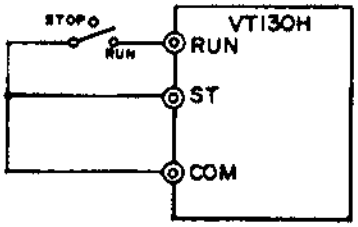
○ Operation by FOR-REV selection switch

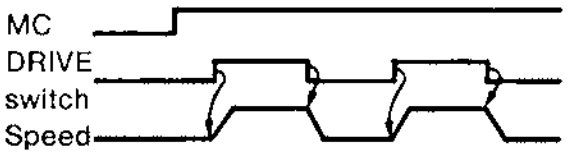




8-3-3 Simplified Jog at Run Speed

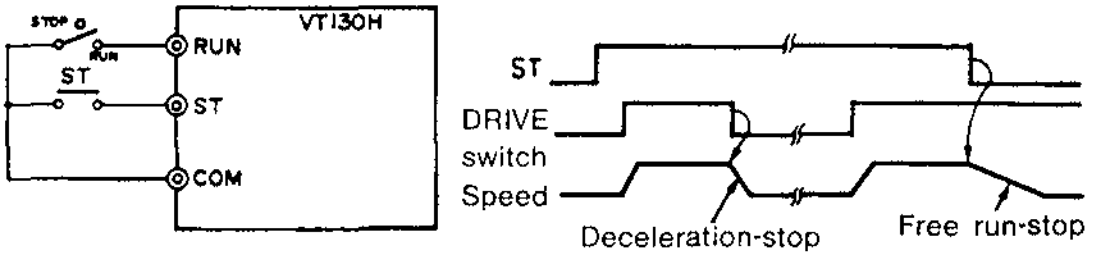
○ A simplified inching/jog is available by turning ON RUN and STOP the DRIVE switch (by the DRIVE switch on the control panel if the latter is equipped with the unit). It should be noted that, while the DRIVE switch is turned ON, the output frequency increases in accordance with the set value of the acceleration limit circuit.



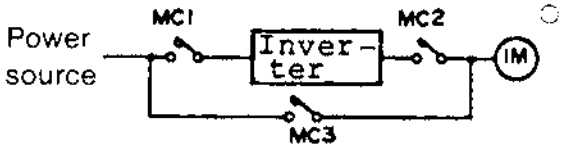


(Note) The operating frequency changes according to the previously set acceleration/deceleration time. If a short time has been set, the jog operation may activate the protective circuits to detect abnormality such as OC (over current) and OP (over voltage), due to the load wk^2. When the fault signal relay is activated, determine the cause, and take an action such as extending the set time.

8-3-4 Conditions for coast stop and ramp stop of the motor. Either the coast stop or the ramp stop is determined by the "ST signal".



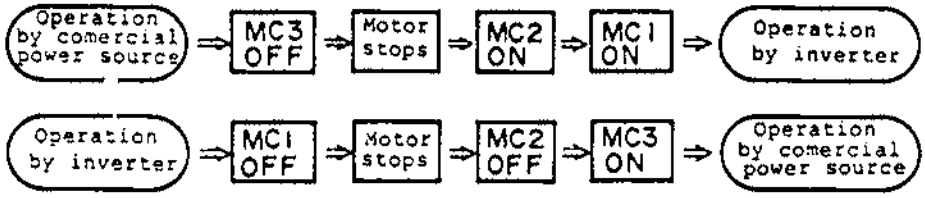
8-4 Transfer to Commercial Power Source (By Pass)



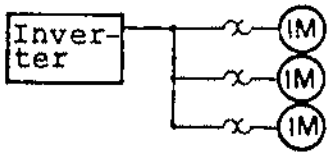
○ MC2 must be always installed. Do not input a commercial power source to the output side of the inverter, as it will damage the transistors and void drive warranty.

○ MC2 and MC3 should be equipped with a mechanical and electrical interlock. Both are recommended for best operation.

○ While the motor is rotating, transferring to inverter operation may activate a protective circuit and cause a trip.



8-5 Multiple motor operation



○ The figure shows the method of operating more than one motor at an indentical speed by a single inverter.

○ The rating of the inverter should be the total of multiple current (ΣI_M) including the start and stop of the motor.

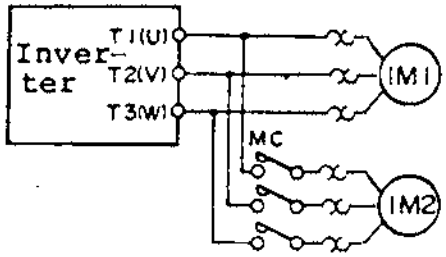
The capacity of the inverter should be determined so that the following inequality can be established for the current (I_{INV}):

○ Although the inverter is equipped with an overload protection, this is not enough to protect all motors. Add a thermal relay for each motor for complete protection.

○ The acceleration time should conform to the maximum inertial moment (wk^2) to prevent the activation of the stall prevention control.

○ Contact Toshiba for assistance

8-6 Slam Start of an Additional Motor



○ The figure illustrates the method for starting one or more additional motors when the inverter is in operation.

○ The capacity of the inverter should be determined so that the following inequality can be established among the current of the motor in operation (ΣI_M), the start current of the additional motors(s) (ΣI_{MST}), and the rated current of the inverter (I_{INV}):

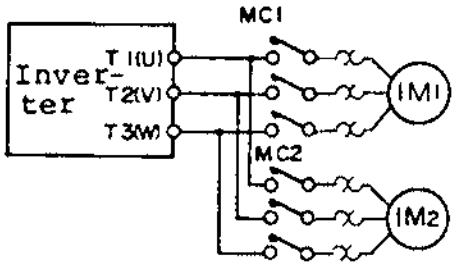
$I_{INV} > (\Sigma I_M + \Sigma I_{MST})$ (starting time should be less than 60 seconds.)

(I_{MST} may be up to 6 times the full load current).

○ If the capacity of the inverter is not sufficient, the over-current protection may be activated during the start of the additional motor(s), as the inverter will be subject to a large amount of current (normally 6-7 times larger than the rated current in case of an induction motor) combining the current of the motor in operation and the starting current of the additional motor(s).

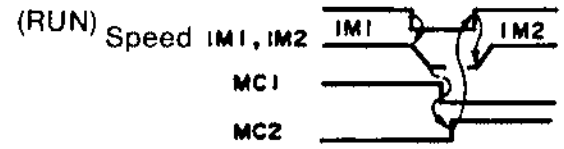
○ Contact Toshiba for assistance.

8-7 Transfer of Motor



○ The figure shows how to transfer from one motor to another.

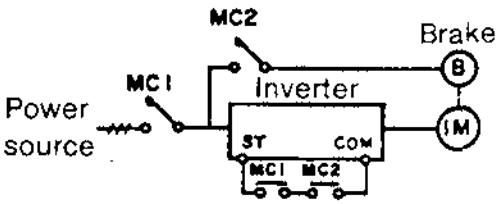
○ Transfer from motor IM1 to motor IM2
Turn OFF the operating signal (RUN) and, when the motor has stopped, turn OFF MC1 and turn ON MC2, and turn ON the operating signal.



○ While the motor is rotating, transfer to another motor may activate the overcurrent protection.

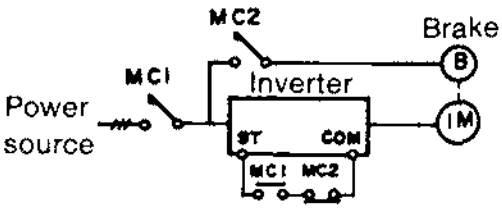
8-8 Operation of Motors with Brake

8-8-1 Connection for non-excitive operation type brake



- ○ Use an interlock to prevent simultaneous operation of the brake and the inverter start signal (ST).
- ○ The brake power source should be connected from the line side of the inverter.

8-8-2 Connection for excitive operation type brake



- ○ Use an interlock to prevent simultaneous operation of the brake and the inverter start signal (ST).
- ○ The brake power source should be connected from the power source side of the inverter.

NOTE: The inverter has approximately 20% inherent dynamic braking (DB) capacity if no external braking circuit is utilized. This valve depends on system efficiency (motor plus inverter). Contact the factory if further details are required.

Chapter IX
ADJUSTMENTS

The present inverter is equipped with the following adjustment devices:

1) Voltage/frequency (V/f) pattern selection rotary switch (SW1)
2) Potentiometers (1RH - 8RH), (21RH - 22RH)
3) Dip switch for inverter mode selection (SW2)
4) Jumper pins (JP1 - JP14), (J21 - J23)

These adjustment devices allow for the optimum adjustments suited to the purpose, load level and operating method.
The actual adjustment procedures are detailed in the following paragraphs.
No adjustments on JP1, JP7, JP13, JP14, J21, J22, J23, 21RH & 22RH are required, as they are completed at the factory delivery in accordance with the type of inverter, its capacity and voltage.
If a monitor code starts flickering on the digital indicator during setting/adjusting, refer to 4-12.

9-1 Voltage/frequency (V/f) Pattern Setting

See 4-3 Voltage/frequency (V/f) Pattern Setting.

9-2 Adjustment of (rheostats) potentiometers.

The adjustment potentiometers have been factory adjusted. Unless specifically required, do not make additional adjustment. If readjustments are needed, they should be made in small increments while checking the frequency/monitor display digital indicator on the operation panel, with reference to Table 9-2, Description of Potentiometers (RH). Refer to the PCB Arrangement Diagram (7-4) for the location of the potentiometers (RH).

9-2-1 Cautions for Adjustment

1) Compact, high-precision potentiometers have been used. To adjust use a flat-heat screw driver with a edge thin enough and which has an insulated handle.
2) When the power is turned on, high voltage is present on parts of the PCB. Care should be taken when making adjustments.

CAUTION
For about 3 minutes after the power is turned off, do not touch the internal equipment, as charged voltage still remains in the large-capacity electrolytic capacitors. Always confirm that the charge lamp on the operation panel is turned off before touching.

3) When an oscilloscope or other probe is used for observing the waveform, it should be installed and removed with the power turned off.

Table 9-2 Description of Potentiometers (□ RH)

PCB	RH No.	Symbol	Adjustment function	When RH is turned clockwide	Allowable setting range	(*)	(**)	Remarks (***)
(a)	1RH	RB	Ref input bias	Bias increase	0-max.f	Hz	0.0	"="
	2RH	RG	Ref input gain	Gain increase	0-max.f	Hz	max. f	"⌐"
	3RH	UL	Ref input upper limit	Limit value increase	0-max.f	Hz	max. f	"⌐"
	4RH	LL	Ref input lower limit	Limit value increase	0-max.f	Hz	0.0	"⌐"
	5RH	ACC	Acceleration time	Acceleration time elongates	1-300	Sec	300	"⌐"
	6RH	DEC	Deceleration time	Deceleration time elongates	1-300	Sec	300	"⌐"
	7RH	IFB	Current feedback	Current feed-back amount increases	0-250	%	2V-100%	Do not touch-voids warranty
	8RH	FM	Calibration of external frequency meter	Frequency meter deflection increases	-	-	-	Should be adjusted at the time of calibration
(b)	21RH	OP	Overvoltage detection value	Detection value increase			400V DC or 800V DC	Do not touch-voids warranty
	22RH	MUV	DC main circuit undervoltage detection value	Detection value increase			85%	Do not touch-voids warranty

(a): Main control PCB (b): Gate/Base drive PCB (*): Unit

(**): Factory settings (***): Monitor code displayed on LED

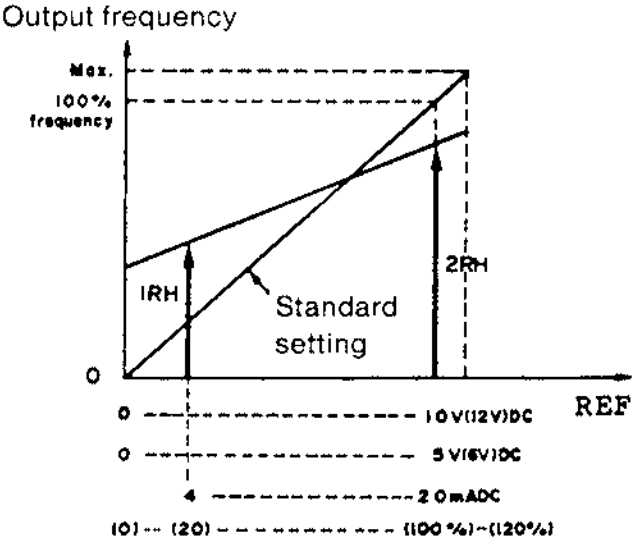
9-2-2 Adjustment of Potentiometers

Manually adjusting a potentiometer automatically activates the monitor function, putting the inverter in the random access mode, and the set value of the potentiometer being adjusted is displayed on the digital indicator.
Adjustment should be made while checking this set value.
The set value of a potentiometer is increased by turning RH clockwise.

(1) 1RH, 2RH: Adjustment of frequency command (REF) input signal
Adjustment of 1RH and 2RH is required for changing the output frequency range in response to the frequency command (REF) input signal.

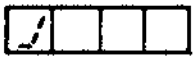
1) Turn the RA/$\overline{RA}$ of dip switch (SW2) to RA side.
2) Adjust 1RH,while observing the digital indicator, to obtain the desired output frequency at the 20% REF input signal point (Bias adjustment).
3) While observing the digital indicator, adjust 2RH to set the proper output frequency for 100% REF signal (Gain adjustment).
4) Put the monitor into the monitor mode, and reconfirm the adjusted values of 1RH and 2RH.

(Note) It is not necessary to actually input the 20% and 100% frequency command.

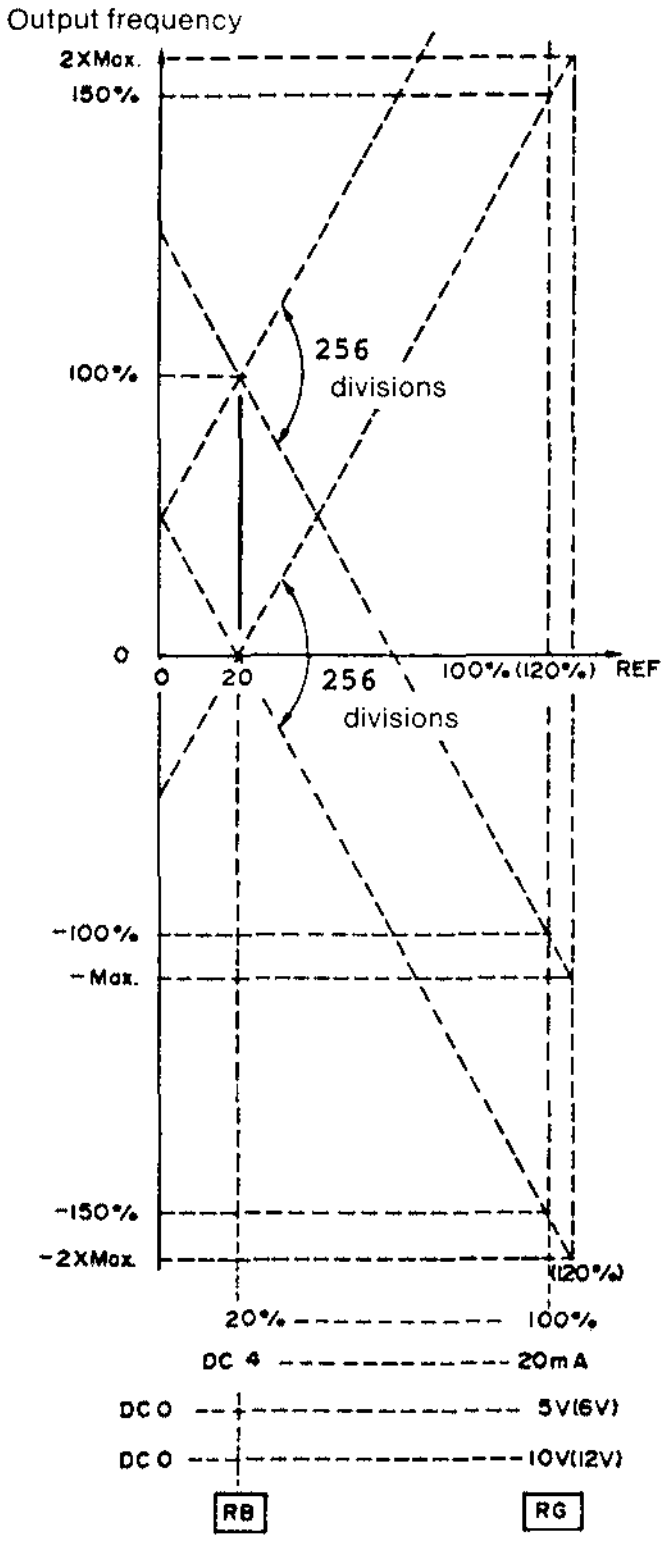


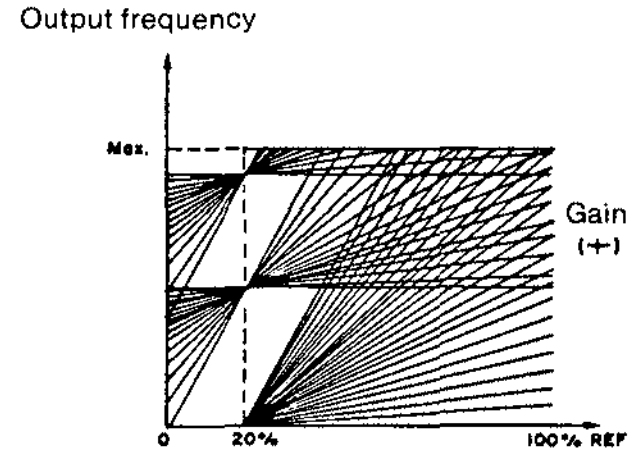
Adjustment range
1RH (REF bias): 0-Max. frequency (Hz)
2RH (REF gain): (−1.5 ~ +1.5) x 100% frequency (Hz)
Display on digital indicator

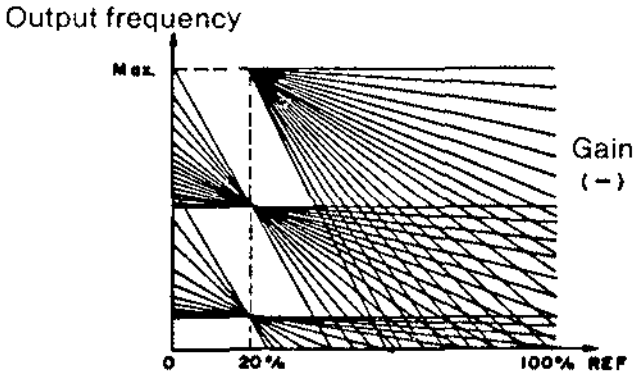
1RH: 

2RH: 

This inverter allows setting the frequency command (REF) signal bias/gain adjustments over the following range:

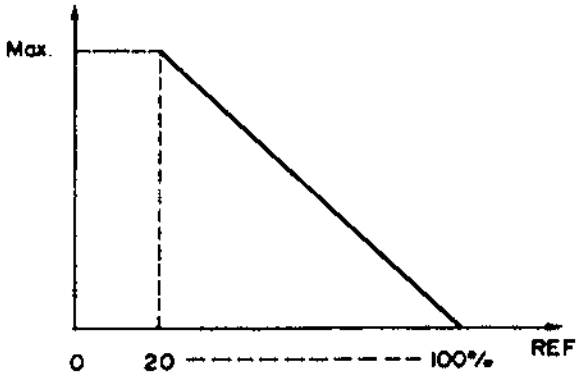






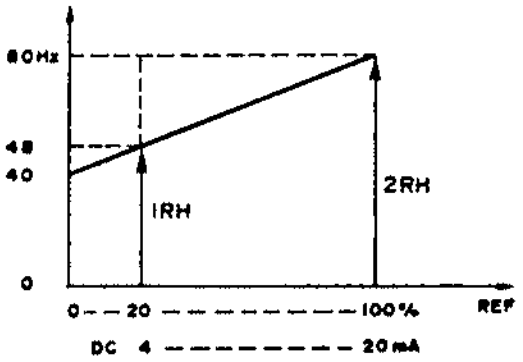
It is possible to decrease the output frequency as the REF signal increases as follows:

Output frequency



Adjustment of bias/gain by using the monitor may be varied by variations of input resistance.
For precise adjustment of bias/gain, input the actual frequency command value (4mADC, 20mADC, etc.), and set the rheostats 1RH and 2RH while referring to the frequency command value "F" by using the monitor function.

(Example)
Output frequency



1RH = F 48.0

2RH = F 80.0

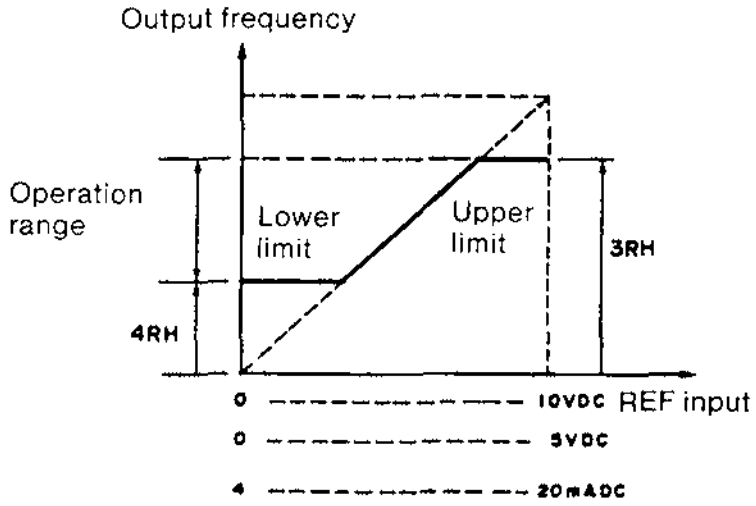
(2) 3RH, 4RH: Upper/lower limits of output frequency
3RH and 4RH is used to set the upper and the lower limits of output frequency in the inverter without regard to the REF input signal. These would ensure the overspeed prevention of a fan and the minimum delivery pressure of a pump.

1) Upper limit (UL) adjustment
Adjust the upper limit of output frequency by using 3RH while checking the digital indicator.

2) Lower limit (LL) adjustment

Adjust the lower limit of output frequency by using 4RH while checking the digital indicator.

When upper/lower limits have been set, " ⌜ " or " ⌞ " flickers and the set value if displayed on the digital indicator if the REF signal has reached the upper or lower limit.

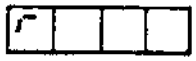


Adjustment range

3RH (Upper limit): 0 - Max. frequency (Hz)

4RH (Lower limit): 0 - Max. frequency (Hz)

Display on digital indicator

3RH: 

4RH: 

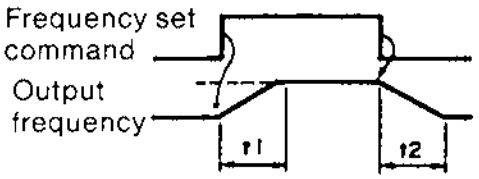
(3) 5RH, 6RH: Adjustment of acceleration/deceleration time

5RH and 6RH are used to set the acceleration time (t_1) in the 0 - Max. frequency range and the deceleration time (t_2) in the Max. - 0 frequency range, according to the load characteristics. Selection of x10/x1 by the dip switch (SW2) allows to set 1 - 300 sec./0.1 - 30 sec.

1) Readjustment of acceleration time (5RH)

When the load torque or load wk^2 is large, setting a short acceleration time will activate the stall prevention protective circuit, which automatically extends the acceleration time to prevent stalls of motor. If, however, the motor stalls due to a load exceeding the capacity of the stall prevention protective circuit or if the inverter is tripped by overcurrent, the operator must extend the acceleration time (Turn 5RH clockwise).

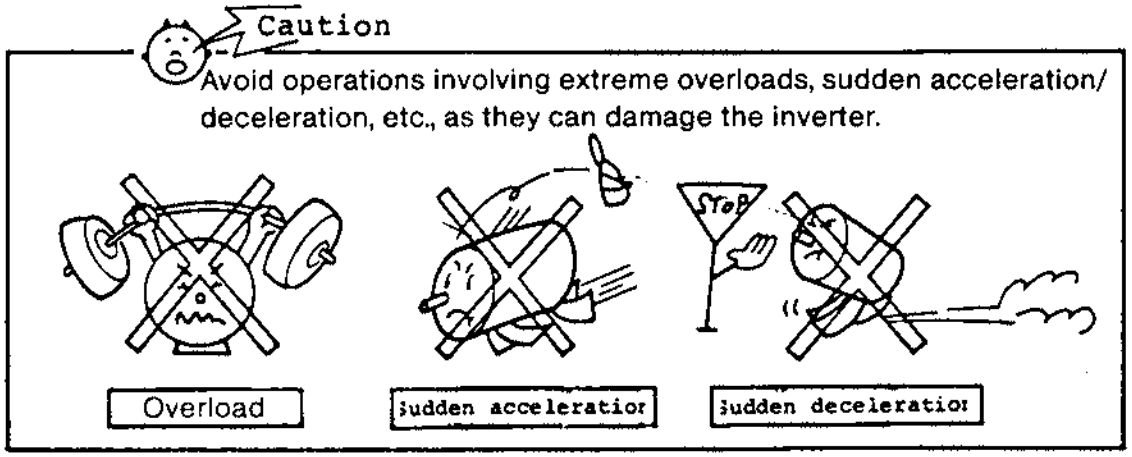
2) Readjustment of deceleration time (6RH)
When the load torque or load wk^2 is large, setting a short deceleration time will increase the regenerated energy of the motor, which may activate the overvoltage protective circuit and trip the inverter. In this case, it is necessary to extend the deceleration time (Turn 6RH clockwise).



Adjustment range
5RH (Acceleration time): 1 - 300 sec./0.1 - 30 sec.
6RH (Deceleration time): 1 - 300 sec./0.1 - 30 sec.
Display on digital indicator

5RH: 

6RH: 



If 5RH and 6RH are adjusted during acceleration of an inverter, the running speed is accelerated/decelerated according to the adjusted acceleration/-deceleration times.

(4) 7RH: Adjustment of current feedback

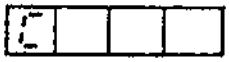
7RH is used to change the output current feedback (IFB). It has been set at 2V - 100% at the time of delivery.

Unless directed by Toshiba no additional adjustment should be made.

Adjustment range

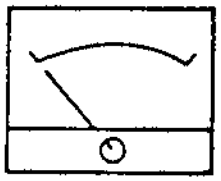
7RH (Current feedback): 0 - 250%

Display on digital indicator

7RH: 

(5) 8RH: Adjustment of external frequency meter

Adjustment is requried when installing an external frequency meter.



Zero adjustment of the instrument

1) Before turning on the power, confirm the zero adjustment of the instrument.
2) Set the meter at the frequency displayed on the digital indicator (frequency monitor) on the operation panel by adjusting 8RH.

9-3 Dip Switch Setting

Fig. 9-3 illustrates the dip switch (SW2) for inverter mode selection.

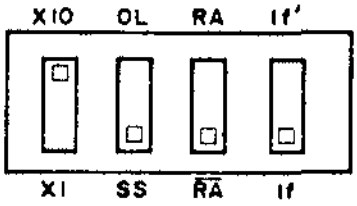


Fig. 9-3 Dip Switch (SW2)

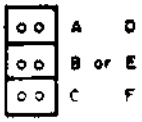
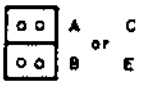
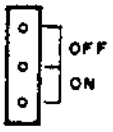
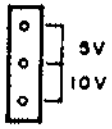
The dip switch allows the following inverter mode selections:

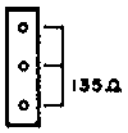
1) x10/x1 : Adjustment of multiplier of acceleration/deceleration time.
   x10 side: 1 - 300 sec.
   x 1 side: 0.1 - 30.0 sec. (setting at time of shipment)
2) OL/SS : Selection of either trip or soft stall under overload.
   OL side: Trip
   SS side: Soft stall
3) RA/$\overline{RA}$: Selection of either to set or not to set the bias/gain against the frequency command value.
   (REF arrangement)
   RA side: Set bias/gain
   $\overline{RA}$ side: Not to set bias/gain
4) If'/If : Selection of PWM carrier frequency mode.
   (See 4-1-2)

9-4 Change of Jumper Pin Connections

The jumper pins have already been connected as specified at the time of factory delivery. Unless specially required, do not make a change.
The position of the jumper pins are shown in 7-4 PCB Arrangement. Table 9-4 describes the function of the jumper pins.
Connection of the jumper pins should be changed only if necessary and with the power turned off. All jumper pins must always be connected on one side or the other. Where "Do not touch" is cautioned in the Remarks column in the Table 9-4, never touch the related jumper pins, as they must be set at the Toshiba factory and changing these voids the warranty.

Table 9-4 Functions of Jumper Pins (JP□)

PCB	JP No.	Code on PCB	Status	Functions	Factory setting	Remarks
	JP1			Selection of deadtime clock	As required	Do not touch voids warranty
	JP2			Selection of carrier freqeuncy	As required	Do not touch unless required (See 4-1-2)
(a)	JP7			Selects x1/x3 of the value selected by JP1	As required	Do not touch voids warranty
	JP8		OFF ON	Selection of automatic restart Automatic restart is not executed. Automatic restart is executed.	ON	
	JP9		5V 10V	Selection of frequency command (REF) signal at either 0-5VDC or 0-10VDC. REF input: 0 - 5VDC REF input: 0 - 10VDC	5V	

PCB	JP No.	Code on PCB	Status	Functions	Factory setting	Remarks
(a)	JP10		No Mark 135 Ω	Selection of frequency command (REF) signal at either 0-5VDC or 0-5/10 VDC, 4-20mADC or 0-135 resistance input REF input: 0-5/10DC, 4-20mADC REF input: 0-135 resistance	No Mark	5/10V 4-20mA
	JP13			Selection of either VT130H1 or VT130H	As required	Do not touch
	JP14		Open Close	Used when testing the control circuit Normal Test	Open	Do not touch unless required
	J21		Open Close	Selected when taking out the CHARGE LED display LED on main board No LED on main board	As required	Do not touch voids warranty
(b)	J22		Open Close	Selects the overvoltage detection level for either 200V class or 400V class 200V Class 400V Class	As required	Do not touch voids warranty
	J23		Open Close	Selects the main under-voltage level for either 200V class or 400V class 200V Class 400V Class	As required	Do not touch voids warranty

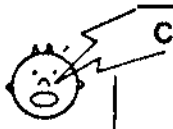
(Note) (a): Main control PCB (b): Gate (Base) drive PCB

Chapter X
OPERATION

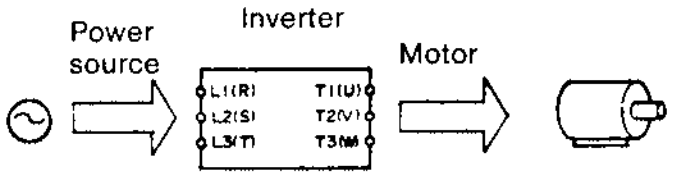
10-1 Before Applying the Power

Before applying the power, confirm the following:

1) Check once again that the wiring is correct.



CAUTION Make sure that the power source is connected to the input terminals L1(R), L2(S), L3(T), and the motor with the output terminals T1(U), T2(V), T3(W).



2) Is the power source voltage correct?
   Confirm that the input power source voltage is in the range of rated voltage ±10%. (Do not put 460V on a 230V inverter.)
   An excess of this range may activate a protective device or damage the inverter.
3) Are the control terminals (R□, T□) connected as suited to the power source voltage?
4) Are there short-circuit possibilities?
5) Are there any loose screw terminals or connectors?
6) Ensure ST to COM is connect through aux relay or jumpered directly.

10-2 Pre-operation Adjustments

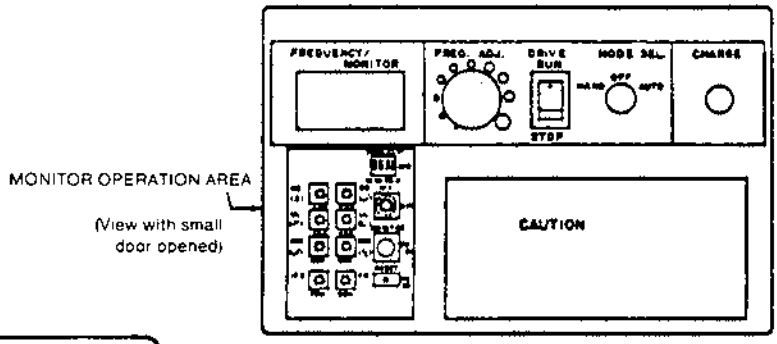
Readjustment may be required on some of the adjustment devices depending on the application and the load level. For adjustment procedures, refer to Chapter IX.

Before switching to the run position, also check the following:

1) Are the V/F pattern and maximum output frequency suitable to the load level?
2) Are the adjustment parameters correct?
   Push the monitor push-button switch to obtain the monitor mode, and confirm:
   i) Bias/gain of frequency reference settings
   ii) Upper/lower limit of output reference settings
   iii) Acceleration/deceleration time

10-3 Operation Procedures

The inverter with the operator control panel should be operated as follows, as based on the standard connection diagram (5-2).



Before turning on power

Before turning on power:
Confirm the following status of the control equipment on the control panel:
- (RUN-STOP (DRIVE SWITCH): "STOP")
- (HOA) Mode selection switch (MOD. SEL): "OFF"
- Speed reference (REF. ADJ): "Zero"
- Charge lamp (CHARGE): OFF
- V/F pattern selection rotary switch inside the small window. As selected (Additional selection is impossible after start of operation)

Turn on power

Turn on distribution circuit-breaker (MCCB) (Supplies control power to inverter)

Confirm "OFF" is displayed on the digital indicator of the inverter. Make necessary setting by using the monitor function and adjusting the potentiometers.

Push on (or Start PB) to close magnetic contactor (MC) supplies main three phase power to inverter.

When the main circuit is activated and the charge lamp (CHARGE) lights up on the operation control panel.

If the "CHARGE" lamp is lit, never touch the internal equipment of the inverter.

If the unit is equipped with an internal cooling fan, the fan starts rotating at the same time.

Selection of frequency reference

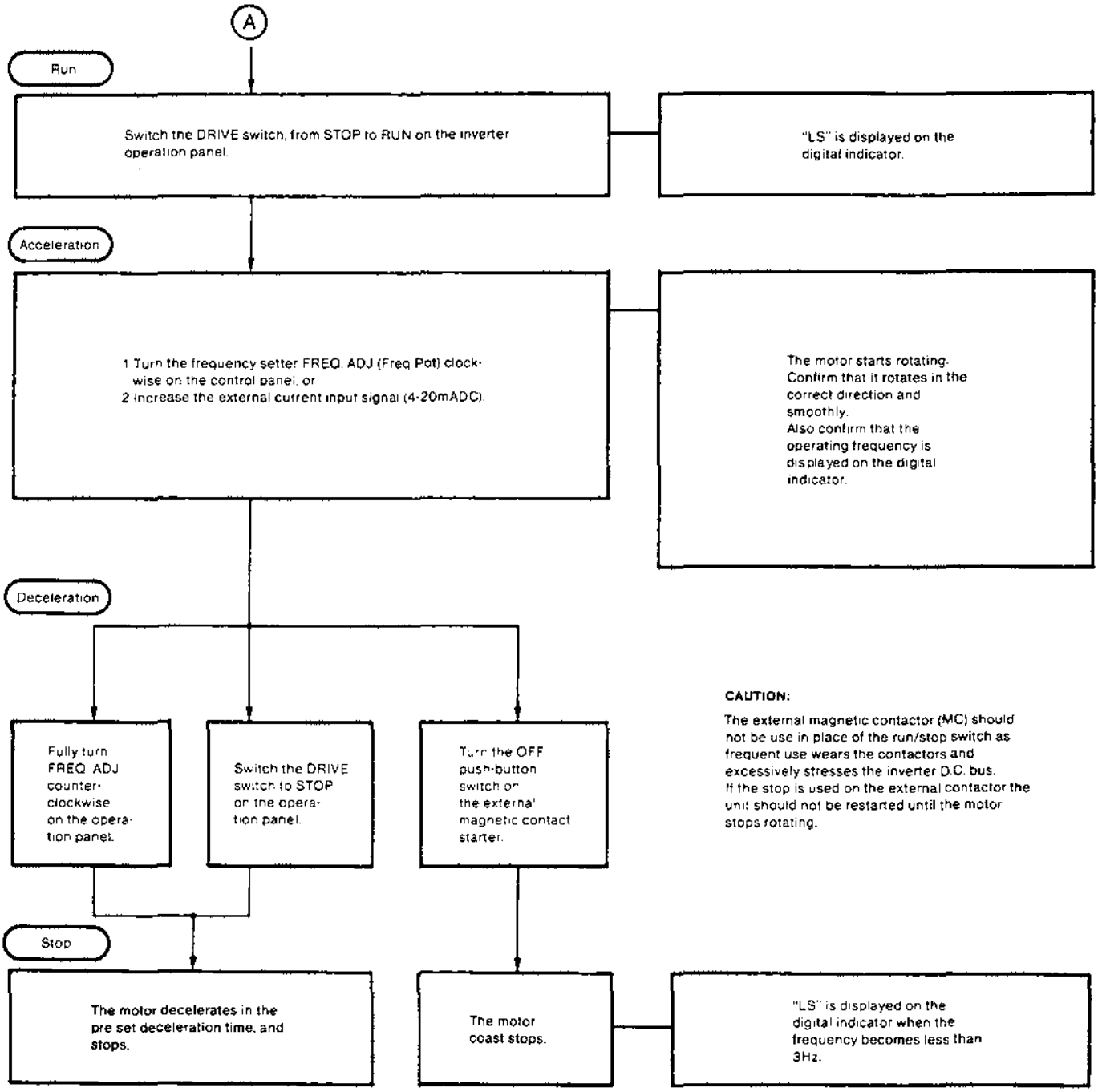
Select frequency command signal by the mode selection switch MODE SEL. (HOA) on the operation panel.

"HAND"
Adjust the output frequency by the frequency setter (FREQ. ADJ) (speed pot) on the operation panel

"AUTO"
Adjust the output frequency by the external current input signal (4-20mA DC)

Ⓐ

(continued on next page)


A
Run
Switch the DRIVE switch, from STOP to RUN on the inverter operation panel.
"LS" is displayed on the digital indicator.
Acceleration
1 Turn the frequency setter FREQ. ADJ (Freq Pot) clockwise on the control panel, or
2 Increase the external current input signal (4-20mADC).
The motor starts rotating. Confirm that it rotates in the correct direction and smoothly.
Also confirm that the operating frequency is displayed on the digital indicator.
Deceleration
Fully turn FREQ. ADJ counter-clockwise on the operation panel.
Switch the DRIVE switch to STOP on the operation panel.
Turn the OFF push-button switch on the external magnetic contact starter.
CAUTION:
The external magnetic contactor (MC) should not be use in place of the run/stop switch as frequent use wears the contactors and excessively stresses the inverter D.C. bus.
If the stop is used on the external contactor the unit should not be restarted until the motor stops rotating.
Stop
The motor decelerates in the pre set deceleration time, and stops.
The motor coast stops.
"LS" is displayed on the digital indicator when the frequency becomes less than 3Hz.

(Note 1) The output frequency display starts counting at 0.5Hz.

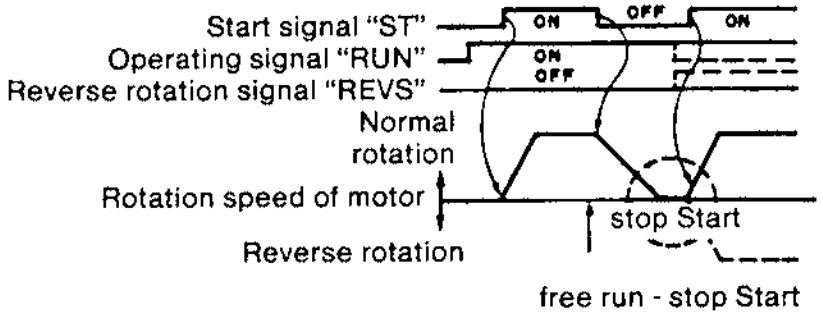
(Note 2) When the frequency reference signal becomes more than 3Hz, the inverter will start running, and accelerates in the pre-set acceleration rate from 0 to 3Hz.
When the frequency reference signal level becomes less than 3Hz, the inverter decelerates in the pre-set deceleration time from 3 to 0 Hz. While "LS" is displayed, the output of the inverter is not displayed. Only at the start of the operation will the output be displayed from 0.5Hz to 3Hz.

(Note 3) The output frequency must be at 3Hz or more. A set value of less than 3Hz is not available.

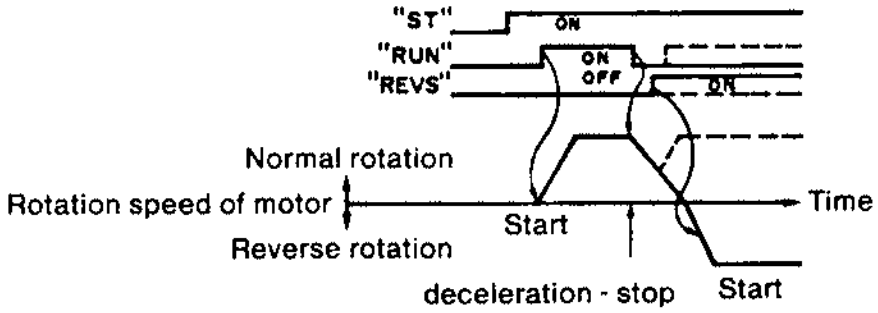
(Note 4) The operating frequency (output frequency of the inverter) changes in accordance with the previously pre-set acceleration/deceleration times. The rotational speed of the motor also varies in relation with the changes of the operating frequency.

(Note 5) Confirm no excessive vibration of the motor and its mounting base by slowly accelerating and decelerating.

(Note 6) Operation patterns of the inverter:



- ○ When the "ST" signal turns off, the motor coast stops.
- ○ The inverter should be restarted after a coast stop only when the motor has come to a stop.
- ○ If during a coast stop (the motor is rotating), and the inverter is restarted into a rotating motor the inverter may activate the overcurrent protection.



- ○ If "RUN" signal is switched to stop (or opened) while the "ST" signal is "ON", the motor decelerates and stops. (controlled stop).
- ○ If the deceleration time is too short, the overvoltage protection may be activated due to motor regeneration.

Chapter XI
MAINTENANCE AND INSPECTION

For continued safe operation and prolonged inverter life conduct the following daily and periodic inspection:

CAUTION

Before inspection, always turn off the distribution circuit-breaker (MCCB) and wait at least 3 minutes to confirm that the "CHARGE" lamp is not lit and there is no voltage present on the main circuit DC capacitor (between + and − terminals).

11-1 Daily Inspection

1) Noise ... Check for unusual noise of the transformer, reactor, motor, etc.
2) Temperature and smell ... Check for abnormal heating or any burning smell around the insulators.
3) Note if there are any abnormal fluctuations of the frequency meter or the motor speed.
4) Note and keep records on the power source voltage, output voltage, output current and output frequency.
5) Ensure the ambient temperature is within the −10°C −40°C range.
6) Ensure the humidity at less tha 90% (relative), and there is no condensation.
7) Keep the environment free from dust and corrosive gases.
8) Note if there are any abnormal vibrations present at the inverter, motor, etc.

11-2 Periodic Inspection

1) Are there any loose terminals?
2) Are there any damaged cables?
3) Are any vent holes clogged with debris or dust?
4) Is the cooling fan operating?
5) Are the PCBs free from accumulated dust?
6) Check and clean out any dust or debris inside the inverter.
7) When the unit is unused for more than 6 months, power up the unit on a semi-annual basis and confirm normal functioning.

11-3 Guidance for Parts Replacement

Performance and service life of the control equipment, timely repairs are required on worn components. The following table specifies the expected service life of the major parts used for this inverter.

Table 7.3.3

Parts name	Service life	Remarks
Large-capacity electrolytic condenser	5 years	Needs to be reconditioned semiannually in event of non-use of the inverter See Section 11-5
Fuses	7 years	
Cooling fan	25,000H	
Contact relays	500,000 times	
Connectors	100 times	Replace pin in event of failure

(Note) This table shows the service life of the respective equipment if used as specified in the standard installation environment.

11-4 Measuring Instruments

As PWM control is adopted for the output waveforms of this inverter, output measurements may be distorted depending on measurement instrument types. Measuring instruments and measured points should be based on the following table:

Measured item	Measuring instrument	Measured point
Output voltage	• Rectifier type volt-meter • Average rectifier type analog tester	• Output terminals, U, V and W
Current	Moving vane, iron type + current transformer	• Each phase current
Electric power	• electrodynamic type	• Input side of the inverter

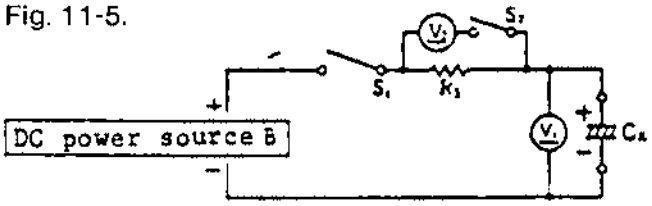
11-5 Inspection of the Electrolytic Capacitor(s)

An electrolytic capacitor left unused for a long period of time (more than 6 months) will have increased current leakage and deteriorated characteristics. Therefore, if left uncharged it must be subject to the following conditioning procedures every 6 months to ensure proper capacitor electrical characteristics are maintained:

1) Checking the Leakage Current

a) Measuring Circuit:

The measuring circuit of the voltage drop method is shown in Fig. 11-5.



RS : Standard resistor V_1 : Voltmeter

V_2 : DC Voltmeter or Electronic voltmeter

S_1 : Switch Cx : Capacitor to be tested

S_2 : Voltmeter protective changeover switch

Fig. 11-5 Voltage Drop Method

b) Measurement:

Using the power source and circuit shown in Fig. 11-5, apply rated voltage of the capacitor (400V) to both terminals of a capacitor to be tested through a resistor (R) of which resistance has been adjusted as necessary so that terminal voltage reaches the rated voltage within one minute. Then calculate the leakage current 5 minutes after the rated voltage has been reached by the below method.

c) Calculation of the leakage current:

Based on a measured value obtained by the measurement, calculate leakage current according to the following formula:

I = E/Rs where I : Leakage current of test capacitor

Rs : Resistance of standard resistor

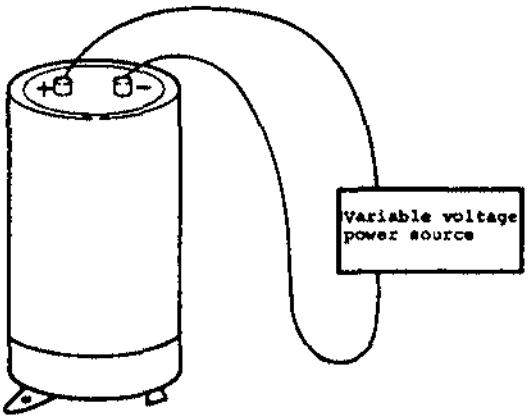
E : Voltage value indicated on DC voltmeter

d) Judgement:

If I = 5mA or less than the capacitor is normal.

If leakage current is above 5mA, the capacitor should be subjected to the following reconditioning procedures.

2) Capacitor Reconditioning procedure



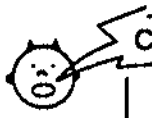
If the leakage current is over 5mA, apply DC voltage to 400V gradually. After the capacitor has been changed for 30 - 60 min. the capacitor is reconditioned.

3) Storage of Loose Capacitors

The capacitor should be stored in a cool and dark place if possible. Higher temperatures deteriorate the characteristics faster. Sunlight may cause discoloration of the sleeve as well as deterioration of sealing rubber. High humidity may cause solderability problems on the terminals.

Chapter XII
TROUBLESHOOTING

Should a fault occur, the inverter will stop, and display the possible fault cause on the frequency/monitor display digital indicator.
Table 12-1 lists the failure codes, their possible causes and corrective actions. Before restarting, consult this table and take corrective actions.



CAUTION

The inspection shall be performed only after ensuring that "CHARGE" lamp on the operation panel is OFF and no voltage is existing in the main circuit capacitor (between the "+" and "−" terminals).

CAUTION

Do not apply main power (3 phase line) to the inverter if any of the following connectors are disconnected: CN11, CN21, CN31, CN41, CN51 or CN61. Damage to the circuit boards may occur.

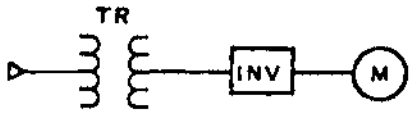
Table 12-1 Possible Causes and Countermeasures (1/5)

Failure code	Possible cause	Corrective Actions
OC Flicker display	Improper inverter sizing in relation to motor size or load type.	Corrective inverter capacity based on current requirements.
	Short-circuit on output wiring T1(U), T2(V), T3(W) Phase to phase or ground fault.	Inspect wiring from the inverter to the motor. Ensure motor has not grounded.
	Overload, sudden load fluctuation or stall of motor	Inspect load level, eliminate cause of the overload or reduce load.
	Acceleration/deceleration time set too short	Extend the acceleration/ deceleration time by adjusting 5RH(ACC)/6RH(DEC) in adjustment area.
	Instability phenomenon due to an open input phase (including one of the input fuses blowing)	Inspect power source and input fuses. If damaged, replace.
	Internal fault of inverter	Based on troubleshooting, inspect internal wiring and correct any shorts.
	Instability phenomenon due to incorrect V/F pattern of selection with respect to the load characteristics.	Select proper V/F pattern on selector switch in the adjustment area.

Failure code	Possible cause	Corrective Action
OC Flicker display	Unstable phenomenon due to instantaneous outage	Inspect power source voltage and make necessary corrections.
	Unstable phenomenon due to under voltage of incoming power.	Inspect power source voltage and make necessary corrections.
	Fault due to external RFI noise.	Locate RFI source and shield.
OCA Flicker display	Output transistor short	Inspect G-TR devices and repair/replace if necessary.
OCL Flicker display	Output short-circuit due to incorrect wiring.	Inspect output wiring
	Line to line short-circuit of motor winding.	Inspect motor and repair/replace if necessary.
	Phase to phase short-circuit due to deteriorated output cables	Inspect cable and replace if necessary.
	Phase to phase short-circuit terminal shorts on inverter in motor caused by small animal.	Inspect and repair wiring between inverter and motor.

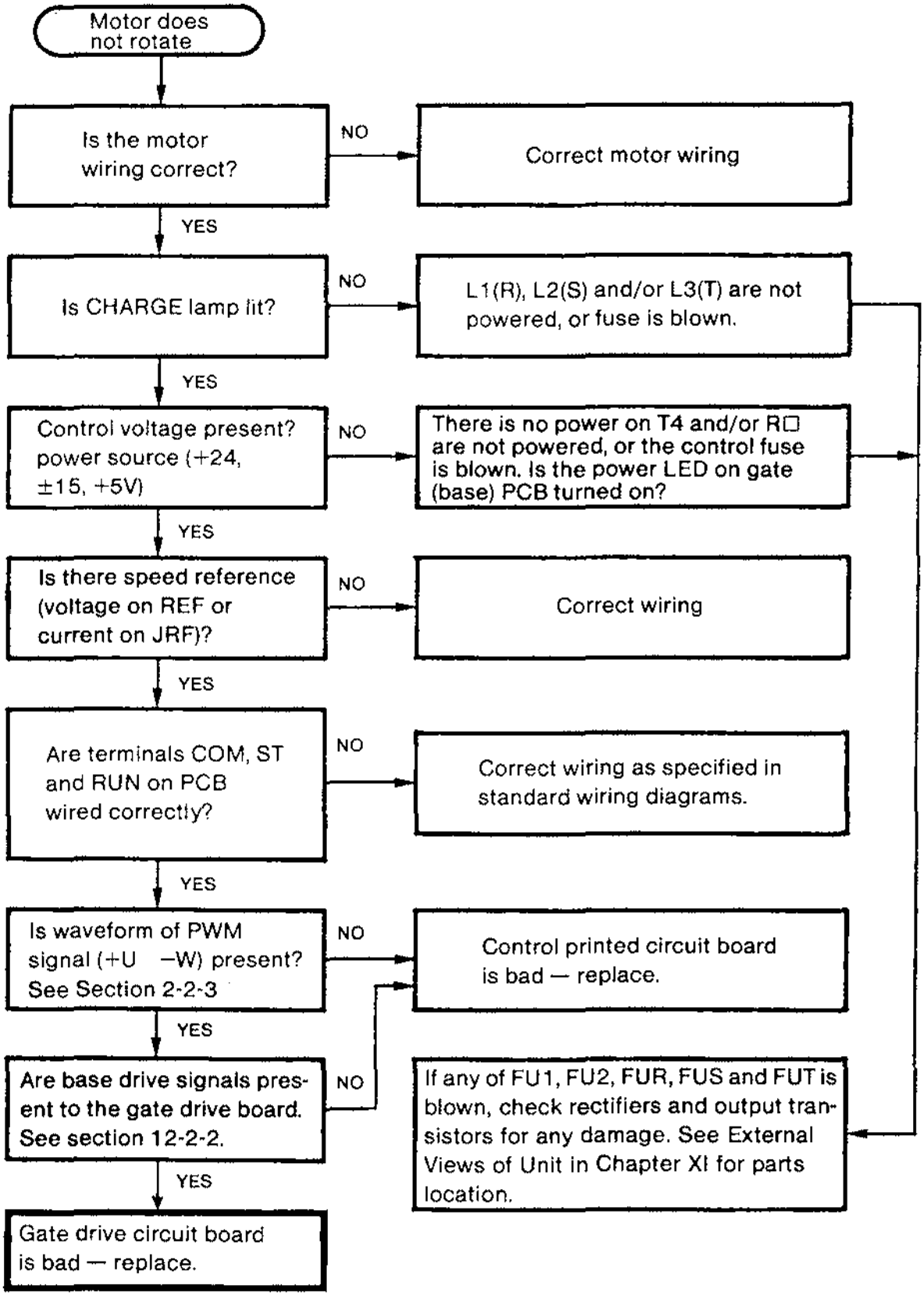
Failure code	Possible cause	Corrective Action
OL Flicker display	Overload (120%-60 sec of rated current) and load fluctuation	Inspected load level, eliminate cause of overload and reduce load.
OP Flicker display	Deceleration time is set to short and motor is regenerating	Extend the deceleration time by adjusting 6RH (DEC) in adjustment area.
	Unstable phenomenon due to incorrect V/F pattern of inverter with respect to load level and/or type.	Correct V/F pattern at V/F selector switch in adjustment area.
OPS Flicker display	Overvoltage too large power source at the supply voltage (including high voltage transients) instantaneous voltage)	Inspect power source voltage.
	Voltage fluctuation due to power line disturbances.	Inspect power source voltage, and install AC reactor on input side if fluctuation is momentary.
	Excessive high voltage fluctuation due to use of power factor correction capacitors.	Inspect power source voltage, and install AC reactor on input side if fluctuation is momentary, or remove P.F. correction capacitors
OH Flicker display	Failed cooling fan (if unit is equipped with fan)	Repair or replace cooling fan.
	Poor ventilation	Inspect and improve ventilation.

Failure code	Possible cause	Corrective Action
OH Flicker display	High ambient temperature	Lower ambient temperature by fans or air conditioners.
	Over temperature of the current limiting resistor ("cement" resistor) exceeding 90°C	Inspect any damage to "cement" power resistor.
	External interlock signal is activated between OH and P24.	Inspect external interlock signal and correct
EL Flicker display	Ground fault on output terminals T1(U), T2(V), T3(W)	Inspect and remove cause of ground fault, and repair any damaged portion.
nwII Flicker display	Incomplete initialization or initializing conditions	Turn off control power source, and re-apply.
Blown-out main circuit fuses (AC fuse) (DC fuse)	Fault of main circuit inside inverter	Rectifier (diode) may be damaged. Inspect rectifier and replace if damaged. Inspect AC fuse and replace if necessary. G-TR may be damaged. Inspect G-TR and replace if damaged Inspect AC/DC fuses and replace if necessary

Failure code	Possible cause	Corrective Action
	Short-circuit of main circuit capacitor	Inspect capacitor and replace if necessary.
Blown main circuit fuses (AC fuse) (DC fuse)	Extremely small input impedance on incoming powerline (Too large input kVA compared to inverter capacity)	 1) If the transformer KVA rating is 10 times larger (or more) than the inverter KVA rating, AC input line reactors will be required to limit inrush current into the inverter. 2) If the transformer KVA is between 5 to 10 times the inverter KVA rating, AC line reactors may be required depending on other transformer and power line factors. 3) Normally no line reactor is required if the transformer is smaller than 5 times the inverter KVA rating.
		If any fuse has blown, inspect driver board.
Blown control board fuse	Circuit ground fault on terminals R and T.	Inspect and eliminate cause fault and replace fuse if necessary.

12-2 Troubleshooting Flowchart

12-2-1 The following describes how to check if the motor does not rotate:



12-2-2 Test Points for Waveshape Tests

Two red check terminals (TP1 and TP2) are provided on the main control PCB. The U-phase PWM patterns and 6144f signals can be checked based on the table below.

A more detailed inspection can also be made by checking the input signal of the base drive circuit and the voltage of the control power source by using the connector pins CN2 and CN7 on the main control PCB.

Fig. 10-2 shows connection of the connectors.

Test point code	Function	Sample waveform
TP1 to 0V	U-phase PWM pattern output signal	PWM signal of U-phase sinusoidal distribution (3-phase control) 
TP2 to 0V	6144f output signal	Pulse output of output frequency multiplied by 6144
Connector CN2 CN2-1 to 0V 2 to 0V 3 to 0V 4 to 0V 5 to 0V 6 to 0V	Base drive circuit input signal U-phase V-phase W-phase X-phase Y-phase Z-phase	PWM signal of sinusoidal distribution (3-phase control) 
Connector CN7 CN7-1 to 0V 2 to 0V 3 to 0V 4 to 0V	Control power source voltage + 5V 0V +15V −15V	Each DC voltage waveform +5V DC voltage 0V COMMON +15V DC voltage −15V DC voltage
Connector CN1-2 to 0V	+24V	+24V DC voltage

Care should be taken when testing the connector pins to prevent shorting of one pin to its neighbor.

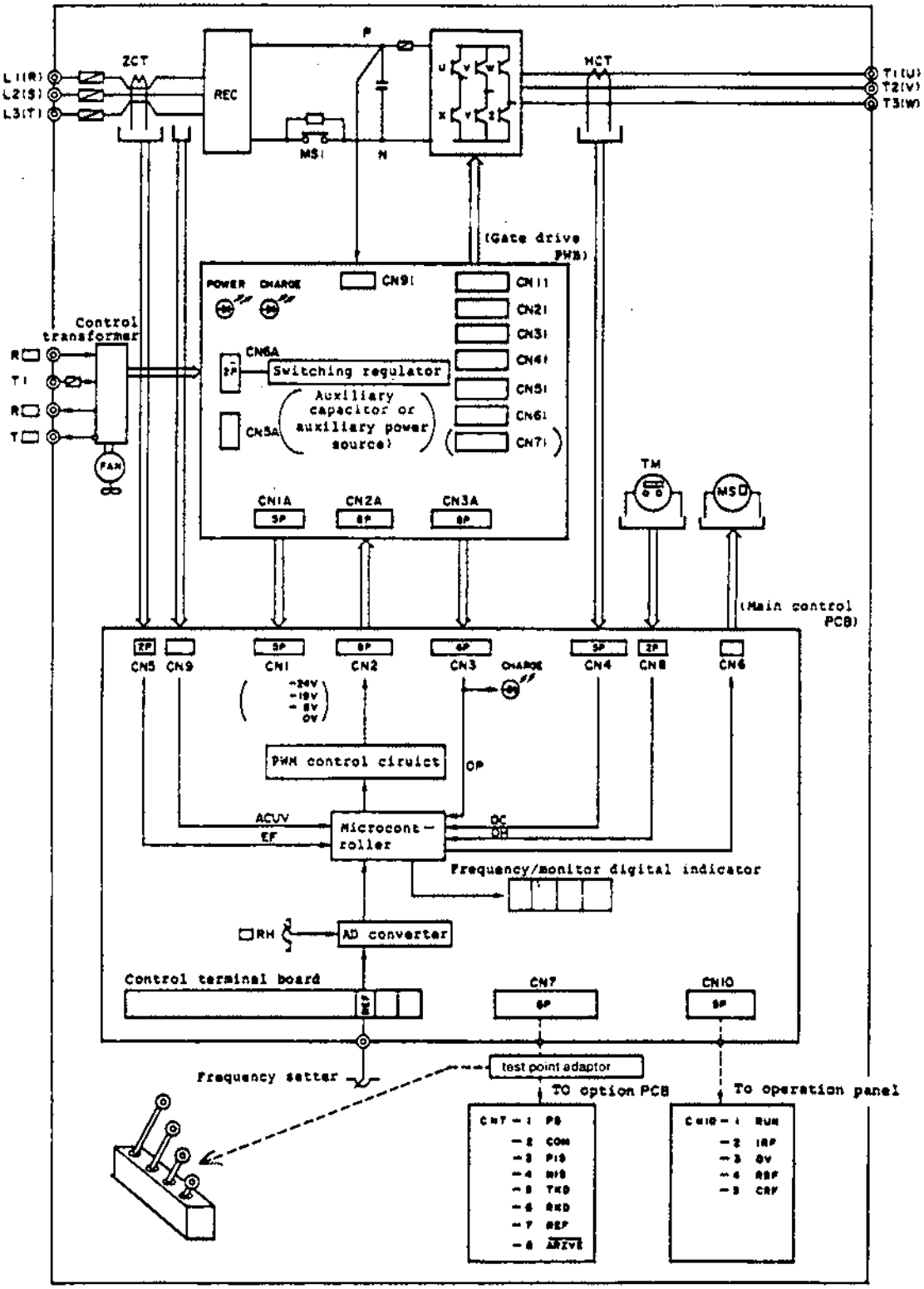


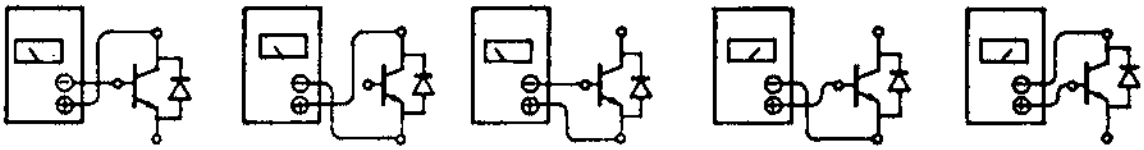
Fig. 12-2 Connection of Connectors

(Note) On Type-form VT130H1□-2035 - 2080, the gate drive PCB and main control PCB are incorporated on one board.

12-2-3 Testing of G-TR

Type of instrument

Ohmmeter



<G-TR>	More than 50K	More than 50K	Less than 500K	Less than 500K	Less than 500K
<IGBT>					

Evaluation of G-TR (Normal resistor value)

(Note) ○ The power switching device IGBT transistors used on VT130H1 has a voltage drive type gate and if charge is accumulated on the gate, the ON state is kept on. Therefore, before testing an IGBT, short the gate to the emitter.

CAUTION: The IGBT is sensitive to static electricity as compared to bipolar G-TR's. Care should be taken to discharge static electricity from the body, tools, etc.

12-3 Parts Replacement

CAUTION

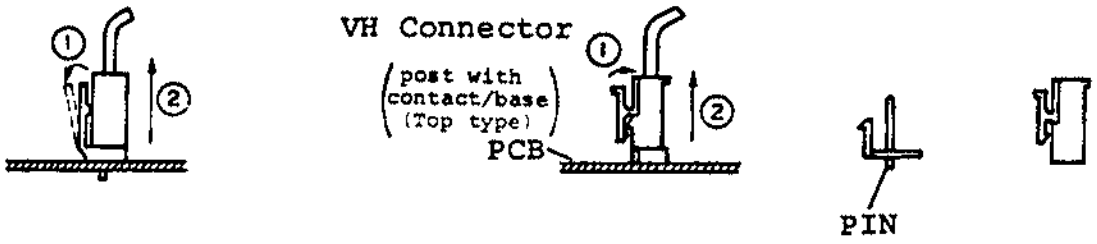
Before replacing a part, always confirm that the main circuit capacitor is not charged and the CHARGE lamp is not lit.

Advanced techniques are required for replacing and removing parts on the PCBs. Improper techniques may damage the PCB patterns and aggravate the failure. Replacement should be referred to an authorized service center or the factory.

12-3-1 Replacement of PCBs

The PCBs are supported at their 4 corners by locking supports. Remove the PCB by releasing the stoppers of the locking supports.

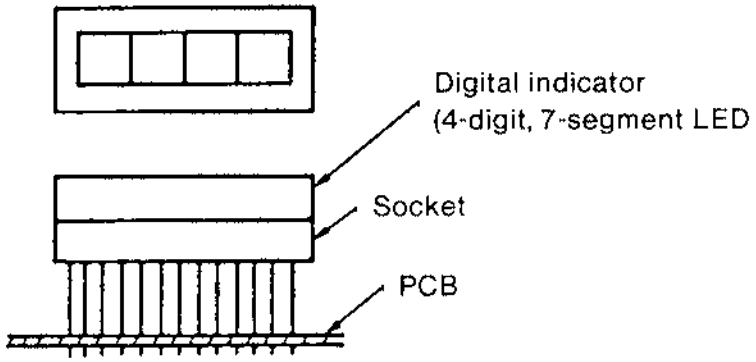
1) How to remove connectors on PCB's.
   A lock mechanism is provided with the connectors to prevent them from becoming loose. Release the lock mechanism as shown below. Avoid excessive force to prevent damage to the connector.



2) How to insert connectors
The connector should be pushed in until the lock mechanism is engaged. Push it in with a moderate force while supporting the PCB, to prevent damage to the PCB. Ensure the proper connector is plugged into the proper location and that the pins are properly aligned.

12-3-2 Replacement of the frequency/monitor display digital indicator (4-digit, 7-segment LED)

Since it is socketed, the digital indicator can be replaced with ease. As a rule, however, it would not be replaced, as improper replacement will cause damage. If the replacement is necessary, make sure that the new display is installed in the correct position and orientation.



12-3-3 Replacement of Fuses

For the locations of the fuses, refer to External Views of Unit in Chapter XI. Attention should be paid to their positions, as certain types of fuse are installed in the center of the unit.

12-3-4 Replacement of main circuit capacitor, G-TR

No cable number is provided to the connecting cables. For replacement, it is necessary to affix a temporary label to each cable before removal, and care should be taken to avoid wrong wiring when rewiring.
Apply a silicon compound on the G-TR surface in contact with the cooling fins.
Examples of silicon compound:
Alcan: Manufacturd by Alcan, Jointal S-200: by Nikkei Chemical Industry K.K.
Fastening torque for G-TR: 30kg-cm

12-4 Recommended Spare Parts

In order to minimize down time of the equipment, it is recommended to maintain the following spare parts:
"A" rank indicates parts of relatively high requirement, and "B" rank those of relatively low requirement.
Generally, these recommended spare parts should be reserved in the following quantities:
1) Fuses: 100% of normal usage
2) Other: 20% of normal usage
If the calculated quantity of any part is less than 100%, the recommended quantity of such parts should be 1 (one).

A-Rank Spare Parts (for VT130H1)

Type of inverter	DC fuse (FU2)		AC fuse (FUR, FUS, FUT)		Control fuse (FU1)		G-TR (IGBT)	
	Type	Qt.	Type	Qt.	Type	Qt.	Type (Rating)	Qt.
VT130H1-2035	60PEF20(KTK20)	1	-	-	AGC3(250V-3A)	1	MG25H2CS1 (25A)	3
VT130H1-2055	60PEF30(KTK30)	1	-	-	AGC3(250V-3A)	1	MG50H2YS1 50A	3
VT130H1-2080	A50P400(KWH40)	1	-	-	AGC3(250V-3A)	1	MG50H2YS1 50A	3
VT130H1-2110	-	-	25SH75 (FWx100)	3	AGC3(250V-3A)	1	100A	
VT130H1-2160	-	-	25SH75 (FWx100)	3	AGC3(250V-3A)	1	100A	
VT130H1-2220	-	-	25SH100 (FWx100)	3	AGC3(250V-3A)	1	200A	
VT130H1-2270	-	-	25SH100 (FWx100)	3	AGC3(250V-3A)	1	200A	
VT130H1-2330	-	-	25SH150 (FWx100)	3	AGC3(250V-3A)	1	200A	
VT130H1-2400								
VT130H1-2500								
VT130H1-2600								
VT130H1-2800								
VT130H1-4055	70PFL20(A70P20)	1	-	-	PC1-3A(KTK3)	1	MG25N2YS1 25A	3
VT130H1-4080	70PFL20(A70P20)	1	-	-	PC1-3A(KTK3)	1	MG25N2YS1 25A	3
VT130H1-4110	70SHA35(A70P40)	1	50SHA35 (FWH40)	3	PC1-3A(KTK3)	1	50A	
VT130H1-4160	70SHA55(A70P60)	1	50SHA35 (FWH60)	3	PC1-3A(KTK3)	1	50A	
VT130H1-4220	70SHA75(A70P80)	1	50SHA75 (FWH80)	3	PC1-3A(KTK3)	1	100A	
VT130H1-4270	70SHA75(A70P80)	1	50SHA75 (FWH80)	3	PC1-3A(KTK3)	1	100A	
VT130H1-4330	70SHA75(A70P80)	1	50SHA75 (FWH80)	3	PC1-3A(KTK3)	1	100A	
VT130H1-4400								
VT130H1-4500								
VT130H1-4600								
VT130H1-4800								
VT130H1-4100K								

B-Rank Spare Parts (for VT130H1)

Type of inverter	Main circuit electrolytic condenser		Main Control PCB		Gate drive PCB	
	Rating	Qt.	Type	Qt.	Type	Qt.
VT130H0-2035	400V-1000uF	1	VT3B-2038□	1	(Included in left-listed)	-
VT130H0-2055	1800uF	1	VT3B-2038□	1	(Included in left-listed)	-
VT130H0-2080	2700uF	1	VT3B-2038□	1	(Included in left-listed)	-
VT130H0-2110	1800uFx2P	2	VT3C-2032□	1	VT3D-2039 □	1
VT130H0-2160	2700uFx2P	2	VT3C-2032□	1	VT3D-2039 □	1
VT130H0-2220	1800uFx3P	3	VT3C-2032□	1	VT3D-2039 □	1
VT130H0-2270	1800uFx4P	4	VT3C-2032□	1	VT3D-2039 □	1
VT130H0-2330	2700uFx4P	4	VT3C-2032□	1	VT3D-2039 □	1
VT130H0-2400						
VT130H0-2500						
VT130H0-2600						
VT130H0-2800						
VT130HO-4055	400V-680uFx2S	2	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4080	1000uFx2S	2	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4110	1800uFx2S	2	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4160	2700uFx2S	2	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4220	1800uFx2Px2S	4	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4270	2700uFx2Px2S	4	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4330	2700uFx2Px2S	4	VT3C-2032□	1	VT3D-2039□	1
VT130HO-4400						
VT130HO-4500						
VT130HO-4600						
VT130HO-4800						
VT130HO-4100K						

A-Rank Spare Parts (for VT130H)

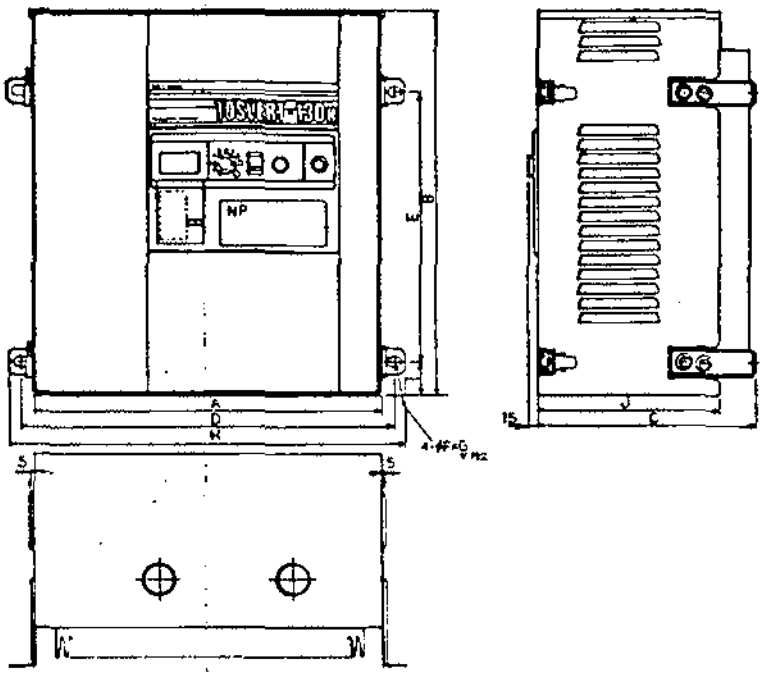
Type of inverter	DC fuse (FU2)		AC fuse (DUR, FUS, FUT)		Control fuse (FU1)		G-TR (Bipolar type TR)	
	Type	Qt.	Type	Qt.	Type	Qt.	Type (Rating)	Qt.
VT130H0-2035	60PEF20(KTK20)	1	-	-	AGC3(250V-3A)	1	MG30G6EL1	1
VT130H0-2055	60PEF30(KTK30)	1	-	-	AGC3(250V-3A)	1	MG50G6EL1	1
VT130H0-2080	NON50(KWH50)	1	-	-	AGC3(250V-3A)	1	MG50G6EL1	1
VT130H0-2110	-	-	25SH75 (FWx100)	3	AGC3(250V-3A)	1	MG75H2CL1	3
VT130H0-2160	-	-	25SH75 (FWx100)	3	AGC3(250V-3A)	1	MG100H2CL1	3
VT130H0-2220	-	-	25SH100 (FWx100)	3	AGC3(250V-3A)	1	MG200H1AL2	6
VT130H0-2270	-	-	25SH100 (FWx100)	3	AGC3(250V-3A)	1	MG200H1AL2	6
VT130H0-2330	-	-	25SH150 (FWx150)	3	AGC3(250V-3A)	1	MG200H1AL2	6
VT130H0-2400	-	-	25SH200 (FWx200)	3	AGC3(250V-3A)	1	MG300H1FL1	6
VT130H0-2500	-	-	25SH200 (FWx200)	3	AGC3(250V-3A)	1	MG300H1FL1	6
VT130H0-2600	-	-	25SH300 (FWx300)	3	AGC3(250V-3A)	1	MG400H1FL1	6
VT130H0-2800	-	-	25SH400 (FWx400)	3	AGC3(250V-3A)	1	MG300H1FL1x2P	12
VT130H0-4055	70PFL20(A70P20)	1	-	-	PC1-3A(KTK3)	1	MG25N6EK1	1
VT130H0-4080	70PFL20(A70P20)	1	-	-	PC1-3A(KTK3)	1	MG25N6EK1	1
VT130H0-4110	70SHA35(A70P40)	1	50SHA35 (FWH40)	3	PC1-3A(KTK3)	1	MG50M2CK2	3
VT130H0-4160	70SHA55(A70P60)	1	50SHA55 (FWH60)	3	PC1-3A(KTK3)	1	MG50M2CK2	3
VT130H0-4220	70SHA55(A70P60)	1	50SHA55 (FWH60)	3	PC1-3A(KTK3)	1	MG75Q2YK1	3
VT130H0-4270	70SHA75(A70P80)	1	50SHB75 (FWH80)	3	PC1-3A(KTK3)	1	MG100Q2YK1	3
VT130H0-4330	70SHA75(A70P80)	1	50SHB75 (FWH80)	3	PC1-3A(KTK3)	1	MG100Q2YK1	3
VT130H0-4400	70SHB100 (A70P100)	1	50SHB100 (FWH100)	3	PC1-3A(KTK3)	1	MG150Q2YK1	3
VT130H0-4500	70SHB100 (A70P100)	1	50SHB100 (FWH100)	3	PC1-3A(KTK3)	1	MG150Q2YK1	3
VT130H0-4600	70SHB150 (A70P150)	1	50SHB150 (FWH150)	3	PC1-5A(KTK5)	1	MG300N1UK1	6
VT130H0-4800	70SHB200 (A70P200)	1	50SHB200 (FWH200)	3	PC1-5A(KTK5)	1	MG300N1UK1	6
VT130H0-100K	70SHB300 (A70P300)	1	50SHB300 (FWH300)	3	PC1-5A(KTK5)	1	MG300N1UK1	6

B-Rank Spare Parts (for VT130H1)

Type of inverter	Main circuit electrolytic condenser		Main Control PWB		Base drive PWB	
	Rating	Qt.	Type	Qt.	Type	Qt.
VT130H0-2035	400V-1000uF	1	VT3B-2033□	1	(Included in left-listed)	-
VT130H0-2055	1800uF	1	VT3B-2033□	1	(Included in left-listed)	-
VT130H0-2080	2700uF	1	VT3B-2033□	1	(Included in left-listed)	-
VT130H0-2110	1800uFx2P	2	VT3C-2032	1	VT3D-2034 □	1
VT130H0-2160	2700uFx2P	2	VT3C-2032	1	VT3D-2035 □	1
VT130H0-2220	1800uFx3P	3	VT3C-2032	1	VT3D-2035 □	1
VT130H0-2270	1800uFx4P	4	VT3C-2032	1	VT3D-2035 □	1
VT130H0-2330	2700uFx4P	4	VT3C-2032	1	VT3D-2035 □	1
VT130H0-2400	2700uFx6P	6	VT3C-2032	1	VT3D-2035 □	1
VT130H0-2500	2700uFx8P	8	VT3C-2032	1	VT3D-2023 x2	1
VT130H0-2600	2700uFx10P	10	VT3C-2032	1		2
VT130H0-2800						
VT130HO-4055	400V-680uFx2S	2	VT3C-2032	1	VT3D-2034□	1
VT130HO-4080	1000uFx2S	2	VT3C-2032	1	VT3D-2034□	1
VT130HO-4110	1800uFx2S	2	VT3C-2032	1	VT3D-2034□	1
VT130HO-4160	2700uFx2S	2	VT3C-2032	1	VT3D-2034□	1
VT130HO-4220	1800uFx2Px2S	4	VT3C-2032	1	VT3D-2034□	1
VT130HO-4270	2700uFx2Px2S	4	VT3C-2032	1	VT3D-2035□	1
VT130HO-4330	2700uFx2Px2S	4	VT3C-2032	1	VT3D-2035□	1
VT130HO-4400	2700uFx3Px2S	6	VT3C-2032	1	VT3D-2035□	1
VT130HO-4500	2700uFx3Px2S	6	VT3C-2032	1	VT3D-2035□	1
VT130HO-4600	2700uFx4Px2S	8	VT3C-2032	1	VT3D-2036□	1
VT130HO-4800	2700uFx5Px2S	10	VT3C-2032	1	VT3D-2036□	1
4100K	2700uFx6Px2S	12	VT3C-2032	1	VT3D-2036□	1

Chapter XIII
DIMENSIONAL VIEWS OF UNIT

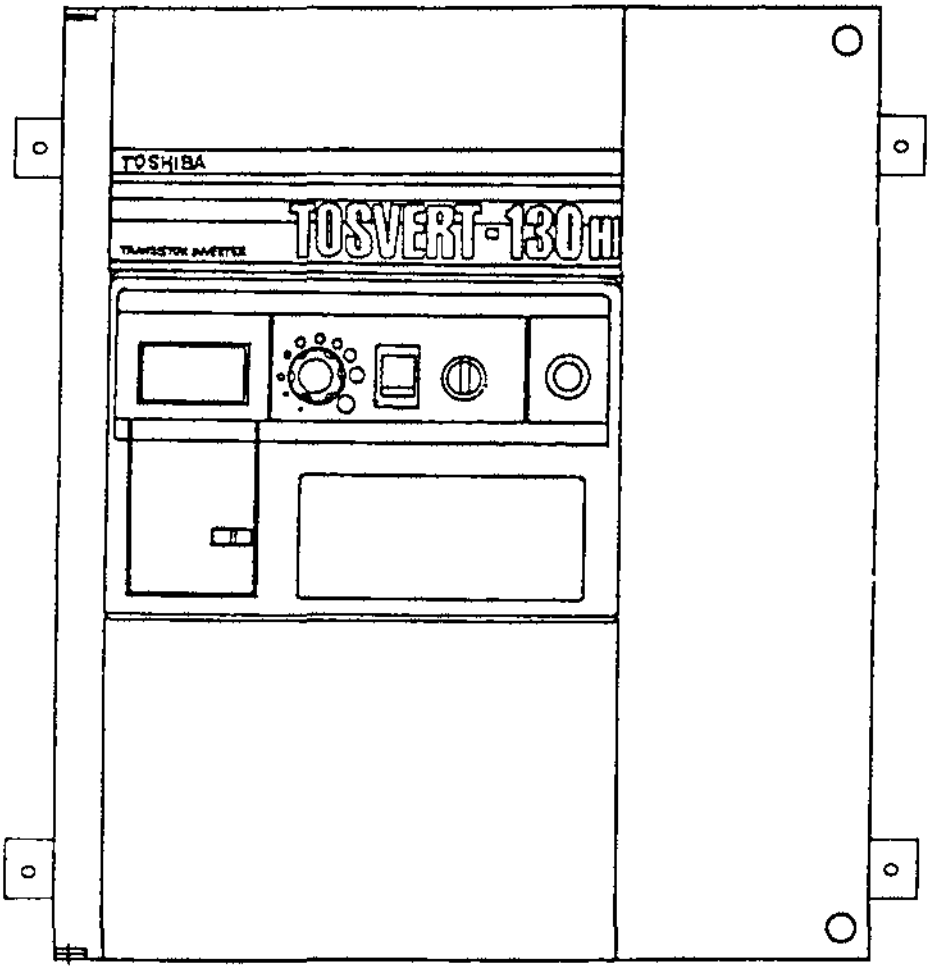
13-1 Inverter Unit based on UL Standard ("BO" Box Type)



Model	Demensions (mm)										Approx. weight (kg)
	A	B	C	D	E	F	G	H	I	J	
VT130H1U-203SBO	290	355	200	316	240	10	14	336	30	150	13
VT130H1U-205SBO	290	355	200	316	240	10	14	336	30	150	13.5
VT130H1U-208SBO	385	475	275	423	327	15	21	453	30	190	22
VT130H1U-405SBO	350	490	220	375	275	10	14	395	30	180	19
VT130H1U-408SBO	385	475	275	423	327	15	21	453	30	190	22
VT130H1U-411SBO	385	475	275	423	327	15	21	453	30	190	23
VT130H1U-416SBO	385	475	275	423	327	15	21	453	30	190	24
VT130H0U-422SBO	450	570	275	565	375	15	21	535	30	190	35
VT130H0U-427SBO	450	570	275	565	375	15	21	535	30	190	36
VT130H0U-433SBO	450	570	275	565	375	15	21	535	30	190	37
VT130H0U-440SBO	510	650	310	550	482	15	21	580	30	220	45
VT130H0U-450SBO	510	650	310	550	482	15	21	580	30	220	46
VT130H0U-460SBO	510	920	335	560	860	15	21	590	50	215	85
VT130H0U-480SBO	510	920	335	560	860	15	21	590	50	215	87
VT130H0U-4100KBO	510	920	335	560	860	15	21	590	50	215	90

Figure 13.1 Outline (UL unit)

Chapter XIV
SERVICING



14-1
CAUTION
If any failure is suspected, check the points listed in Table 14-1 before troubleshooting or requesting maintenance services.

If the unit is still faulty after checking, proceed to the troubleshooting, and consult with your distributor, authorized service center or factory service center. To better assist in servicing, please have the date available as requested in Table 2.

Table 14-1 When drive does not operate, first of all check the following points (1/2)

	Malfunctions	Possible Causes	Corrective Actions
Power source	No power is supplied	MCCB has not been turned ON.	Turn MCCB ON.
	Does not operate even when the power source is ON.	Improper wiring (Main and control circuits)	Correct wiring.
		Malfunction of MCCB, CTT.	Replace MCCB & CTT.
Motor	Motor fails to run	Wrong wiring to motor	Correct Wiring.
		Motor is overloaded.	Reduce load.
		Wires are unnecessarily long or cable size is too short and voltage drop is large.	Make wires short. Adjust V/f pattern.
		V/f pattern selection is incorrect.	Adjust V/f pattern.
Inverter	Fails to start.	Control power source is not active.	Correct Wiring.
		Protective circuit is in operation (fault).	After removing cause, reset.
		connectors have not been improperly connected.	Re-connect properly
	Charge lamp does not light	No power has been supplied to Inverter.	Correct Wiring.
	Nothing is indicated on the digital indicator	Control power source is not active.	Correct Wiring.
	The monitor does not function.	Hold time while pushing the monitor pushbutton is too short.	Push the monitor pushbutton for more than specified time (250 msec)
	Frequency command value does not match output frequency	Jumper Pins JP9 and JP10 frequency commands have been erroneously selected.	Select jumper pins properly by referring to 6-1 and 9-4.

	Malfunctions	Possible Causes	Corrective Actions
- Inverter	frequency command value does not match output frequency	Dip switch (SW2) RA/$\overline{RA}$ have been erroneously selected.	Select dip switch properly be referring to 9-2-2.
	The motor noise reduction filter is not effective when installed (optional item)	Dip switch lf'/lf, jumper pin JP2 has been erroneously selected.	Select dip switch and jumper pin properly by referring to 4-1-2, 9-3 and 9-4.
	When the motor noise reduction filter has been installed, "oc" occurs or the motor can not start due to "oc".	Dip switch lf'/lf, jumper pin JP2 has been erroneously selected.	Select dip switch and jumper pin properly by referring to 4-1-2, 9-3 and 9-4.
	Bias gain cannot be adjusted for REF input.	Dip switch (SW2) RA/$\overline{RA}$ has been erroneously selected.	Select dip switch properly by referring to 9-2-2.
	The soft stall function does not work.	Dip switch OL/SS has been erroneously selected.	Select dip switch properly by referring to 9-2-2.
	The auto restart function does not work.	Jumper pin JP8 has been erroneously selected.	Select dip switch properly by referring to 9-4.
	"OC" trip occurs	Output short-circuit occurs.	Inspect wiring.
		The electromagnetic contactor (MC) is not provided with a surge suppressor.	Connect a surge suppressor to MC.
		There is a fluorescent light near the inverter, which is frequently turned ON/OFF.	Connect a surge suppressor to the fluorescent light in parallel.

Table 2 Trouble Information Sheet

Item		
Customer Name		
Refer to	Person in-charge	
	Address	
	Telephone	
Inverter spec.	Model No.	
	Serial No.	
	Test No.	
Delivery date		
Days in operation		
Date of trouble caused		
Use		
Status of Use	Motor rating	___P ___KW ___V ___Hz, ___A ○ Toshiba ○ Others ○ New ○ Existing No. of units units (○ alternate ○ Continuous)
	Working environment	○ Indoor ○ Outdoor Temp. – °C Humidity % ○ Dust large (iron, aluminum,) ○ Injury from salt ○ Vibration u——○ ○ Corrosive gas ○ Air conditioner avail ○ No air conditioner avail
	Power source	RS ____ ST ____ TR ____Hz ____PH
Problem	Defect generating state	○ Hr. When restart after stopped for hours ○ Hr. During continuous runnign for hours ○ Under investigation at site ○ When start ○ During acceleration ○ During running ○ During deceleration ○ When stopped
	Frequency of trouble generation	○ First ○ times in the past (○ Sometimes ○ Every time) ○ From
	Trouble indicator	○ Does not light ○ Light (○ OC, ○ OCA, ○ OCL, ○ OL, ○ OP, ○ OPS, ○ OH, ○ EF, ○ NULL)
Detailed contents of trouble		
Temporary diagnosis and corrective action		

Date defective product shipped: To

Deadline for repair:

Date defective product obtained:

Person in-charge

To prevent loss of unit,
Do not return without proper authorization