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GPD 502

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Installation • Operation • Maintenance

Adjustable Frequency Drives

Technical Manual
TM 4240

MagneTek Drives & Systems

CONTENTS

Revision Date 12/4/89

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

The Drive is an AC variable speed drive system for high-precision variable speed applications. It basically consists of a three-phase squirrel cage induction motor, a GPD 502 (referred to throughout this manual as the inverter, or unit), an operator control station, and optional control units. This manual primarily describes the inverter, but contains basic information for the operator control station as well. For details of the operation of individual units, refer to their respective manuals.

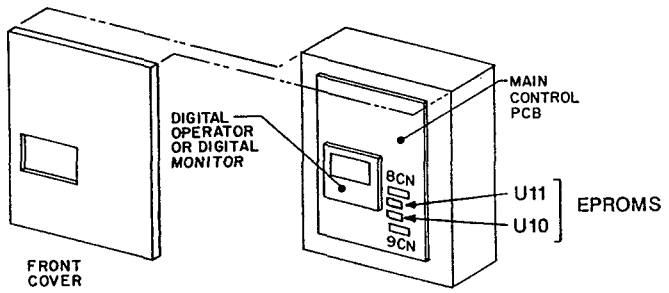
WARNING

DO NOT TOUCH CIRCUIT COMPONENTS UNTIL MAIN AC INPUT POWER HAS BEEN TURNED OFF AND "CHARGE" LAMP IS EXTINGUISHED. THE CAPACITORS ARE STILL CHARGED AND CAN BE QUITE DANGEROUS.

DO NOT CONNECT OR DISCONNECT WIRES AND CONNECTORS WHILE POWER IS APPLIED TO THE CIRCUIT.

CAUTION

CONSTANT SN-03 MUST BE SET TO 0000 OR FOR DRIVE MODE OPERATION.
1110 = FACTORY 2-WIRE CONTROL RESET.
1111 = FACTORY 3-WIRE CONTROL RESET.
KNOW YOUR APPLICATION BEFORE USING THE RESET FUNCTION OF THIS CONSTANT. RESET RETURNS ALL CONSTANTS TO FACTORY SETTINGS. IF THE INVERTER IS CONNECTED FOR 3-WIRE CONTROL AND THIS CONSTANT IS SET TO 1110 (2-WIRE CONTROL RESET), THE MOTOR MAY RUN IN REVERSE DIRECTION WITHOUT A RUN COMMAND APPLIED. EQUIPMENT DAMAGE OR PERSONNEL INJURY MAY RESULT.



NOTE

This manual applies to units with the following EEPROMS (see view at left).
U10: 100102L or 100201L
U11: 100102H or 100201H

IMPORTANT

Always ground unit using ground terminal G(E). See "Grounding" in Section 2.

Never connect main circuit output terminals T1(U), T2(V), T3(W) to AC main circuit power supply.

All constants have been set at the factory. Do not change their settings unnecessarily.

Do not perform a withstand voltage test on any part of the unit. Equipment uses semiconductors and is vulnerable to high voltage.

The Control PC board employs CMOS ICs which are easily damaged by static electricity. Take care not to touch the CMOS elements.

1. INTRODUCTION

1.1 GENERAL

The inverter is a high performance pulse width modulated design which generates a sine-coded, adjustable voltage/frequency three phase output for complete speed control of any conventional squirrel cage induction motor. The inverter can maintain a 150% current overload capability for 60 seconds with automatic stall prevention and voltage boost to prevent nuisance tripping during load or line side transient conditions. The inverter will not induce any voltage line notching distortion back to the utility line and maintains a displacement power factor of not less than 0.95 throughout its speed range.

1.2 STANDARD SPECIFICATIONS

Table 1. Standard Specifications

SECTION A. 230 V UNIT											
INVERTER RATING			1 HP	3 HP	5 HP	7.5 HP	10 HP	15 HP	20 HP	25 HP	30 HP	40 HP
Output Characteristics	Inverter Capacity KVA		2.1	4.1	6.9	10.3	13.7	20.6	27.4	34	41	54
	Continuous Output Current (Note 1)	(Overload Capacity 125% for 1 minute)	5.4	10.8	18	27	36	54	72	86	104	138
		(Overload Capacity 150% for 1 minute)	4.5	9.0	15	22.5	30	45	60	75	90	120
	Max Output Voltage		3 Phase, 200 / 208 / 220 / 230V (matches input voltage)									
	Rated Output Frequency		50, 60, 72, 90, 120, 180 Hz (Up to 400 Hz available)									
Power Supply	Rated Input Voltage and Frequency		3 Phase 200/208/ 220/230V 50/60Hz	3 Phase 200 / 208 / 220V 50Hz 200 / 208 / 220 / 230V 60Hz								
	Allowable Voltage Fluctuation		± 10%									
	Allowable Freq. Fluctuation		± 5%									

Table 1. Standard Specifications (Continued)

SECTION B. 460 V UNIT												
INVERTER RATING			**1 HP**	**3 HP**	**5 HP**	**7.5 HP**	**10 HP**	**15 HP**	**25 HP**	**30 HP**	**40 HP**	**50 HP**	**60 HP**
Output Characteristics	Inverter Capacity KVA		2.1	4.1	6.9	10.3	13.7	20.6	27.4	41	54	68	82
	Continuous Output Current (Note 1)	(Overload Capacity 125% for 1 minute)	2.7	5.4	9.0	13.5	18	27	36	52	69	88	103
		(Overload Capacity 150% for 1 minute)	2.3	4.5	7.5	11.3	15	22.5	30	45	60	75	90
	Max Output Voltage		3 Phase, 380 / 400 / 415 / 440 / 460V (matches input voltage)										
	Rated Output Frequency		50, 60, 72, 90, 120, 180 Hz (Up to 400 Hz available)										
Power Supply	Rated Input Voltage and Frequency		3 Phase 380 / 400 / 415 / 440 / 460V 50 / 60 Hz										
	Allowable Voltage Fluctuation		± 10%										
	Allowable Frequency Fluctuation		± 5%										

SECTION C. ALL UNITS		
Control Characteristics	Control Method	Sine Wave PWM
	Frequency Accuracy	Digital command: 0.01% (-10 to 40°C) (+14 to 104°F)
		Analog command: 0.2% (15 to 35°C) (59 to 95°F)
	Frequency Resolution	Digital Operator reference: 0.1 Hz Analog reference: 0.06 Hz/60Hz
	Output Frequency Resolution	0.01 Hz
	Overload Capability	Up to 150% for one minute.
	Frequency Setting Signal	0 to 10 VDC (20K Ohms), 4-20mA (250 Ohms)
	Accel / Decel Time	0.1 to 1800 sec (Accel / Decel time setting independently)
	Braking Torque	Approximately 20%
	V/F Pattern Selection	15 Standard Patterns: 4 for general purpose; 4 for high starting torque; 4 for fans and pumps; 3 for machine tools. 1 arbitrary pattern: defined by control constant settings.

Table 1. Standard Specifications (Continued)

SECTION C. ALL UNITS (CONTINUED)		
Protective Functions	Motor Overload Protection	Electronic thermal overload relay
	Instantaneous Overcurrent	Motor coasts to a stop at approximately 200% rated current.
	Fuse Blown Protection	Motor coasts to a stop by blown-fuse.
	Overload	Motor coasts a stop after 150% load for one minute.
	Overvoltage	Motor coasts to a stop if inverter output voltage exceeds 395 V (230V unit), 790V (460V unit).
	Undervoltage	Motor coasts to a stop if inverter output voltage drops to 210 V or below (230V unit), 420V or below (460V unit).
	Momentary Power Failure	Factory setting provides for motor to coast to a stop after momentary power failure of more than 0.2 sec. Can be reprogrammed to allow continuous operation (ride-through) during power failure of up to 2 seconds (see Note 2).
	Fin Overheat	Thermostat
	Stall Prevention	Stall prevention at acceleration / deceleration and constant speed operation.
	Ground Fault	Provided by electronic circuit.
	Power Charge Indication	Charge lamp remains lit until bus voltage drops below 50 V.
Environmental Conditions	Location	Indoor (protected from corrosive gases and dust).
	Ambient Temperature	-10 to 40°C
	Storage Temperature (Note 3)	-20 to 60°C
	Humidity	90% RH (no condensation)
	Vibration	1 G at less than 20 Hz, up to 0.2 G at 20 to 50 Hz.

NOTES:
1. A standard 4-pole motor is used for Maximum Applicable Motor Output.
2. For a 460 V unit, ride-through function up to 2 second momentary power failure requires connection of a backup capacitor (2200 uF, 400V) between external main circuit terminals C1 and C2.
3. Temperature during shipping Storing in this temperature for a long period may deteriorate main circuit capacitor.

1.3 RECEIVING

This unit has been put through demanding tests at the factory before being shipped. After unpacking, verify the part numbers with the purchase order sheet (invoice). Any damages or shortages evident when the equipment is received must be reported immediately to the commercial carrier who transported the equipment. Assistance, if required, is available from your sales representative.

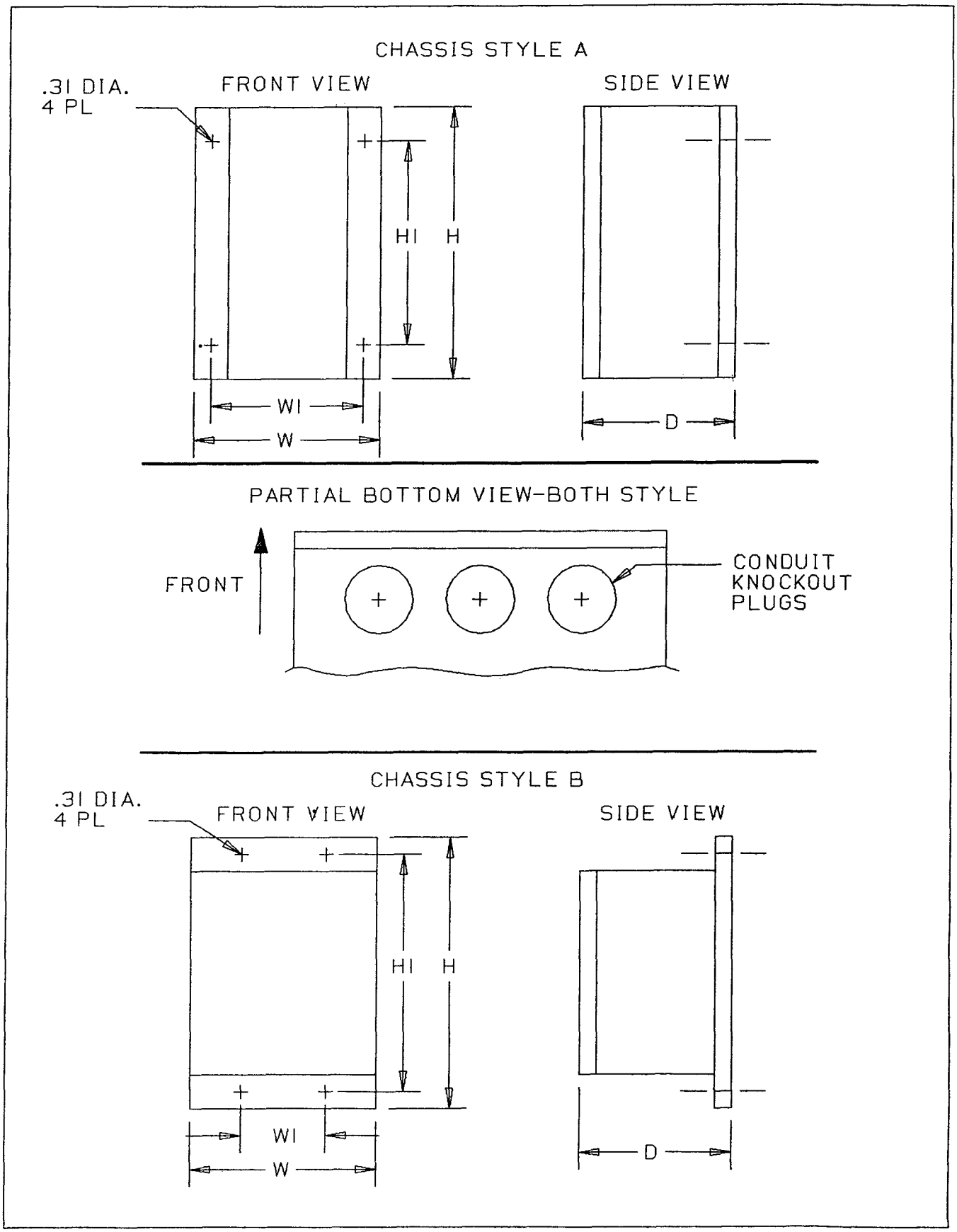


Figure 1. Unit Dimensions

2. INSTALLATION

2.1 PHYSICAL

A. Location and Positioning

Location of the inverter is important to achieve proper performance and normal operating life. The unit should be installed in an area where it will be protected from:

- Direct sunlight, rain or moisture.
- Corrosive gases or liquids.
- Vibration, airborne dust or metallic particles.

CAUTION

NEVER MOVE, LIFT OR HANDLE THE UNIT BY THE FRONT COVER.

For effective cooling as well as proper maintenance, the unit must be installed vertically to the ground using the four mounting screws. There MUST be a MINIMUM 6 in. clearance above and below the unit. MINIMUM 2 in. clearance is required on each side on the unit.

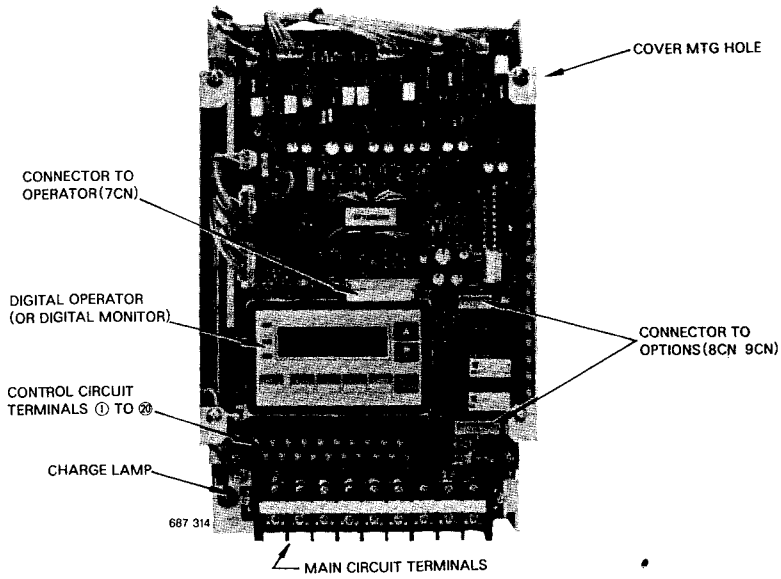
B. Standard Dimensions

Table 2. Unit Size and Weight

UNIT RATING		ENCLOSURE TYPE	PHYSICAL DIMENSIONS (IN.)			MOUNTING DIM. (IN.)		WEIGHT (LB.)	CHASSIS STYLE (FIG. 1)
VOLTS	HP		H	W	D	H1	W1		
230	1 to 5	NEMA 1	11 81	7.91	8.07	11.22	7.09	22	B
	7.5, 10	NEMA 1	15.75	9.84	8.50	11.81	9.06	31	A
	15		23.62	11.81	10.08	19.69	11.02	53	
	20		25.59	14.76	9.72	21.65	13.98	68	
	25, 30		27.56	18 50	10.24	23.62	17.52	84	
	40		43.31	24 41	11.42	31.50	23.43	221	
460	1 to 5	NEMA 1	15.75	9.84	9.29	11.81	9.06	33	A
	7.5, 10		19.69	10.83	10.08	15.75	10.04	37	
	15, 25		23.62	11.81	11.61	19.69	11.02	60	
	30		27.56	18.50	10 24	23.62	17.52	101	
	40, 50		34.45	19.29	11.22	30.51	18.31	143	
	60		34.45	19.29	11.22	30.51	18.31	147	

C. Major Control Component Location

(a) 230 V Unit



(b) 460 V Unit

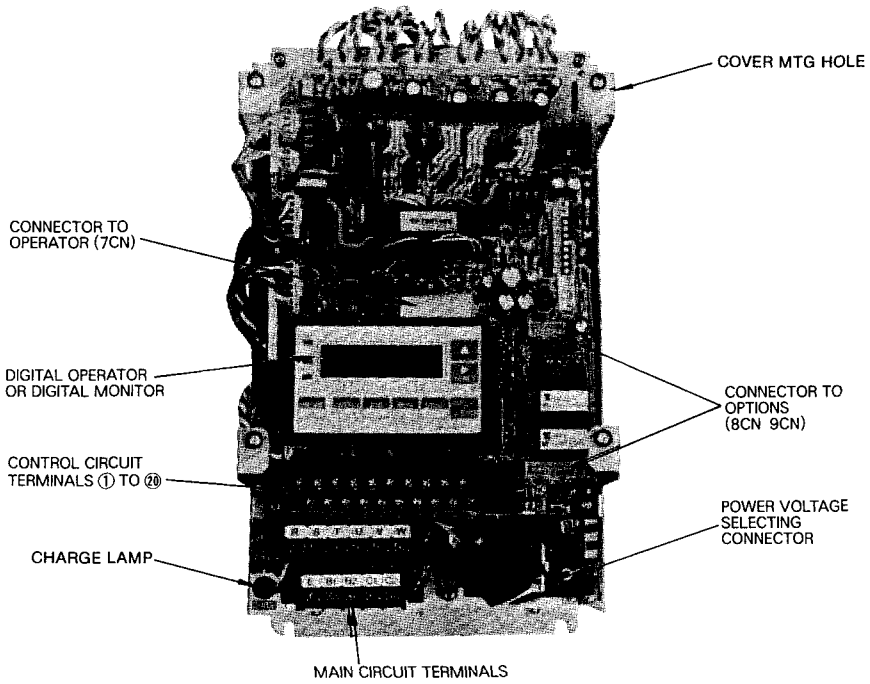


Figure 2. Major Control Component Location

2.2 ELECTRICAL

A. Interconnections

All interconnections required for initial start-up (using the Digital Operator) are shown on either Figure 5 or Figure 6.

CAUTION

USE ONLY FACTORY SUPPLIED INSTALLATION INSTRUCTIONS TO INSTALL DYNAMIC BRAKING RESISTORS. FAILURE TO DO SO MAY CAUSE EQUIPMENT DAMAGE OR PERSONAL INJURY.

B. Wiring Instructions

Remove the inverter front cover for access to terminals.

1. Main Circuit Input/Output.

   Complete wiring interconnections for the main circuit according to Tables 3 and 4, while observing the following precautions.

   - Use 600 V vinyl-sheathed lead or equivalent. Wire size should be determined considering voltage drop of leads.
   - Never connect AC main power to output terminals T1(U), T2(V), and T3(W).
   - NEVER allow wire leads to contact inverter enclosure. Short-circuit may result.
   - NEVER connect power factor correction capacitors or noise filter to unit output.

Table 3. Wire Sizing For Main Circuit

UNIT HP RATING	TERMINAL SYMBOL	TERMINAL SCREW	WIRE SIZE	
			AWG	MM^2
1	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W), G(E)	M4	14 - 10	2 - 5.5
3, 5	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W)	M4	12 - 10	3.5 - 5.5
	G(E)	M4	14 - 10	2 - 5.5
7.5, 10	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W), G(E)	M5	14 - 10	2 - 5.5
15, 20, 25	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W)	M6	8 - 6	8 - 14
	G(E)	M6	14 - 10	12 - 5.5
30 (230 V)	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W)	M8	4 - 1	22 - 38
	G(E)	M4	14 - 10	2 - 5.5
30 (460 V)	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W)	M6	8 - 6	8 - 14
	G(E)	M4	14 - 10	2 - 5.5
40, 50, 60	L1(R), L2(S), L3(T), T1(U), T2(V), T3(W)	M8	4 - 1	22 - 38
	G(E)	M6	14 - 10	2 - 5.5

Table 4. Terminal Functions and Voltages of Main Circuit

SECTION A. 230V UNITS			
TERMINAL	FUNCTION	1 HP	3 TO 40 HP
L1(R) L2(S) L3(T)	Main circuit input power supply	Three phase 200 / 208 / 220 / 230V at 50 / 60 Hz	Three phase 200 / 208 / 220V at 50Hz 200 / 208 / 220 / 230V at 60Hz
T1(U) T2(V) T3(W)	Inverter (main circuit) output	Three phase, 0 to 200 / 208 / 220 / 230V (matches input voltage)	
G(E)	Ground Terminal	– – – –	

SECTION B. 460V UNITS		
TERMINAL	FUNCTION	1 TO 60 HP
L1(R) L2(S) L3(T)	Main circuit input power supply	Three phase 380 / 400 / 415 / 460V at 50 / 60 Hz
T1(U) T2(V) T3(W)	Inverter (main circuit) output	Three phase 0 to 380 / 400 / 415 / 440 / 460V (matches input voltage)
C1 C2	Backup capacitor (for 2 second momentary power failure ride-through)	Approximately 300 VDC; capacitor: 2200uF, 400VDC
G(E)	Ground terminal	– – – –

2. Control Circuit

All control circuit (signal) interconnections required for initial start-up are shown in the appropriate diagram:

- Figure 5 shows interconnections for external two-wire control in combination with the Digital Operator.
- Figure 6 shows interconnections for external three-wire control in combination with the Digital Operator.

Make wiring connections according to the diagram and Table 5, observing the following precautions:

- Use twisted shielded or twisted-pair shielded wire, 20-14 AWG (0.5-2mm^2), for control circuit leads. Wire size should be determined considering voltage drop in leads. See Figure 3: connect shield sheath AT THE INVERTER END ONLY; the far end should be dressed neatly and left unconnected.

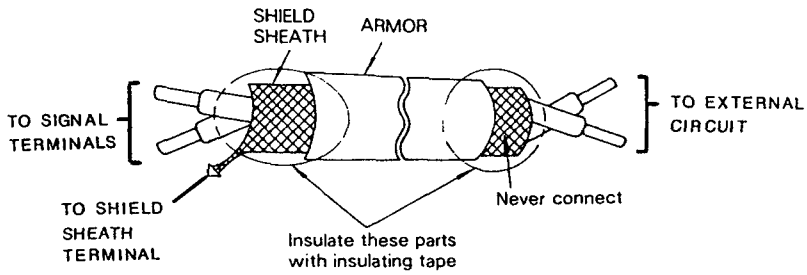


Figure 3. Shielded Sheath Termination

- Signal leads 1 thru 20 must be separated from main circuit leads L1(R), L2(S), L3(T), T1(U), T2(V), T3(W) and any other power cables, to prevent erroneous operation caused by noise interference.
- Control circuit leads 9, 10, 18, 19, and 20 (contact output) must be separated from leads 1-8 and 11-17.
- Lead length should NOT EXCEED 164 feet (50 meters).

Table 5. Terminal Functions and Signals of Control Circuit

TERMINAL	FUNCTIONS		LEVELS
1	2-WIRE CONTROL: Forward operation-stop signal (See NOTE 1)		Run at closed, stop at open
	3-WIRE CONTROL: Run signal		Run at closed
2	2-WIRE CONTROL: Reverse operation-stop signal (See NOTE 1)		Run at closed, stop at open
	3-WIRE CONTROL: Stop signal		Stop at open
3	External fault input		Fault at closed. When the External Fault input is applied, the inverter's Fault relay trips (shutdown) and the motor coasts to a stop. The Digital Operator displays "Eb" failure.
4	Fault reset input (external)		Fault reset at closed. The Fault Reset input will reset the Fault relay, if the inverter is in "stopped" condition. With 2-wire control, both Forward Run signal and Reverse Run signal must be OPEN.
5 - 8	External signal inputs; functions as defined by settings of system constants Sn-08 thru Sn-11. See Table 7 and Appendix 1.		
9, 10	One of eight functions are available; by setting of system constant Sn-12. See Appendix 1. (N.O.)		Contact capacity: 250 VAC at 1A or below 30 VDC at 1A or below
11	Sequence control input common for terminals(1 - 8).		Sequence control input 0 V
12	Connection for shield sheath of signal lead		- - - -
13	Auto speed frequency reference input		0 to +10V (20K ohms)
14			4-20 mA (250 ohms)
15	Manual frequency reference input		+15V (Control power supply for frequency setting: max 20 mA)
16			0 to +10V/100% (20K ohms)
17			0 V
18	Fault contact output (N.O./N.C.)	Closed at fault	Contact capacity:
19		Open at fault	250 VAC at 1A or below
20		Common	30 VDC at 1A or below

NOTES:

1. When Forward Operation-Stop and Reverse Operation-Stop inputs are both closed for more than 500 ms, the Digital Operator flashes "Eb" and the motor (if rotating) is decelerated by the inverter to a stop. This stop condition is not stored by the inverter (on Digital Operator, red lamp at STOP does not light); **IF ONE OF THE INPUTS IS OPENED, THE MOTOR WILL IMMEDIATELY START UP AGAIN.**

3. Grounding

The inverter must be solidly grounded using main circuit ground terminal G(E).

- Ground resistance should be 100 ohms or less.
- NEVER ground the unit in common with welding machines, motors, or other large-current electrical equipment. Run the ground lead in a separate conduit from leads for large-current electrical equipment.
- Use ground lead size listed in Table 3, and make the length as short as possible.
- Where several units are used side by side, all units should be grounded directly to the ground poles. However, it is permissible to connect all the ground terminals in parallel and ground only one unit to the ground pole (see Figure 4). DO NOT FORM A LOOP WITH THE GROUND LEADS.

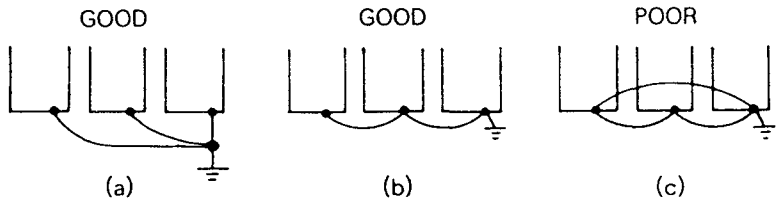


Figure 4. Grounding of Three Units

NOTES FOR FIGURE 5

✲ – INDICATES COMPONENTS NOT SUPPLIED.

☐ – INDICATES CUSTOMER CONNECTION TERMINAL. WIRE ONLY TO TERMINALS SHOWN.

( ) – INDICATES ALTERNATE TERMINAL MARKING, I.E., (R) AND L1.

▲ – FUNCTION LABELS SHOWN FOR THESE TERMINALS ARE DETERMINED BY FACTORY SETTINGS OF SYSTEM CONSTANTS SN-08 THROUGH SN-12.

1. IF ONLY A REMOTE MANUAL SPEED POT (1RH) IS USED, 3SS IS NOT NEEDED. JUMPER MUST BE ADDED BETWEEN TERMINALS 5 AND 11.

2. THE INVERTER DOES NOT CONTAIN OVERLOAD 1OL; 1OL IS A SEPARATE ITEM. ALSO THE CONTACTS FROM THE SEPARATELY SUPPLIED OVERLOAD RELAY SHOULD BE INTERLOCKED WITH THE INVERTER AS SHOWN. IT SHOULD BE THE MANUAL RESET TYPE TO PREVENT AUTOMATIC RESTART FOLLOWING A MOTOR FAULT AND SUBSEQUENT CONTACT RECLOSURE AFTER COOL DOWN.

3. INSULATED TWISTED SHIELDED WIRE IS REQUIRED.
   2-CONDUCTOR #18 GA. (BELDON #8760 OR EQUIVALENT).
   3-CONDUCTOR #18 GA. (BELDON #8770 OR EQUIVALENT).
   CONNECT SHIELD ONLY AT INVERTER END. STUB AND ISOLATE OTHER END.

4. DIGITAL OPERATOR IS STANDARD ON ALL UNITS. REMOTE OPERATORS, AS SHOWN, MAY NOT BE REQUIRED.

5. CUSTOMER TO CONNECT TERMINAL G(E) TO EARTH GROUND.

6. WIRE ONLY ONE AUTO MODE SPEED REFERENCE INPUT.

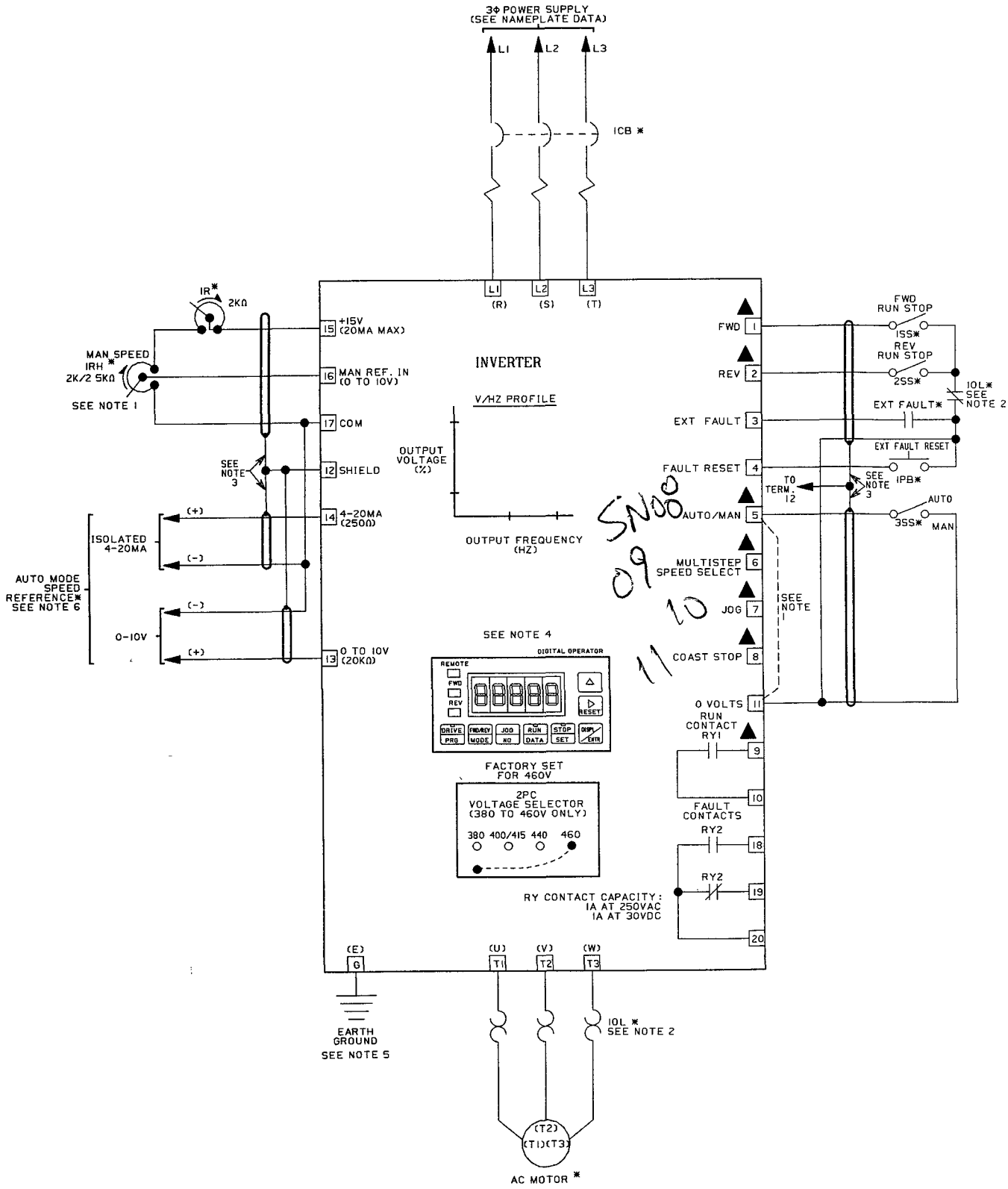


Figure 5. Initial Interconnection - 2-Wire Control (with constant Sn-04 set to 0000, and Sn-11 set to 06)

NOTES FOR FIGURE 6

✲ – INDICATES COMPONENTS NOT SUPPLIED.

☐ – INDICATES CUSTOMER CONNECTION TERMINAL. WIRE ONLY TO TERMINALS SHOWN.

( ) – INDICATES ALTERNATE TERMINAL MARKING, I.E., (R) AND L1.

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   2-CONDUCTOR #18 GA. (BELDON #8760 OR EQUIVALENT).
   3-CONDUCTOR #18 GA. (BELDON #8770 OR EQUIVALENT).
   CONNECT SHIELD ONLY AT INVERTER END. STUB AND ISOLATE OTHER END.

4. DIGITAL OPERATOR IS STANDARD ON ALL UNITS. REMOTE OPERATORS, AS SHOWN, MAY NOT BE REQUIRED.

5. CUSTOMER TO CONNECT TERMINAL G(E) TO EARTH GROUND.

6. WIRE ONLY ONE AUTO MODE SPEED REFERENCE INPUT.

CAUTION

SN-03 MUST BE SET TO "0000". RESETTING DRIVE CONSTANT SN-03 TO "1110" MAY CAUSE THE MOTOR TO RUN IN THE REVERSE DIRECTION WITHOUT A RUN COMMAND, AND POSSIBLY RESULT IN DAMAGE TO THE EQUIPMENT OR PERSONAL INJURY.

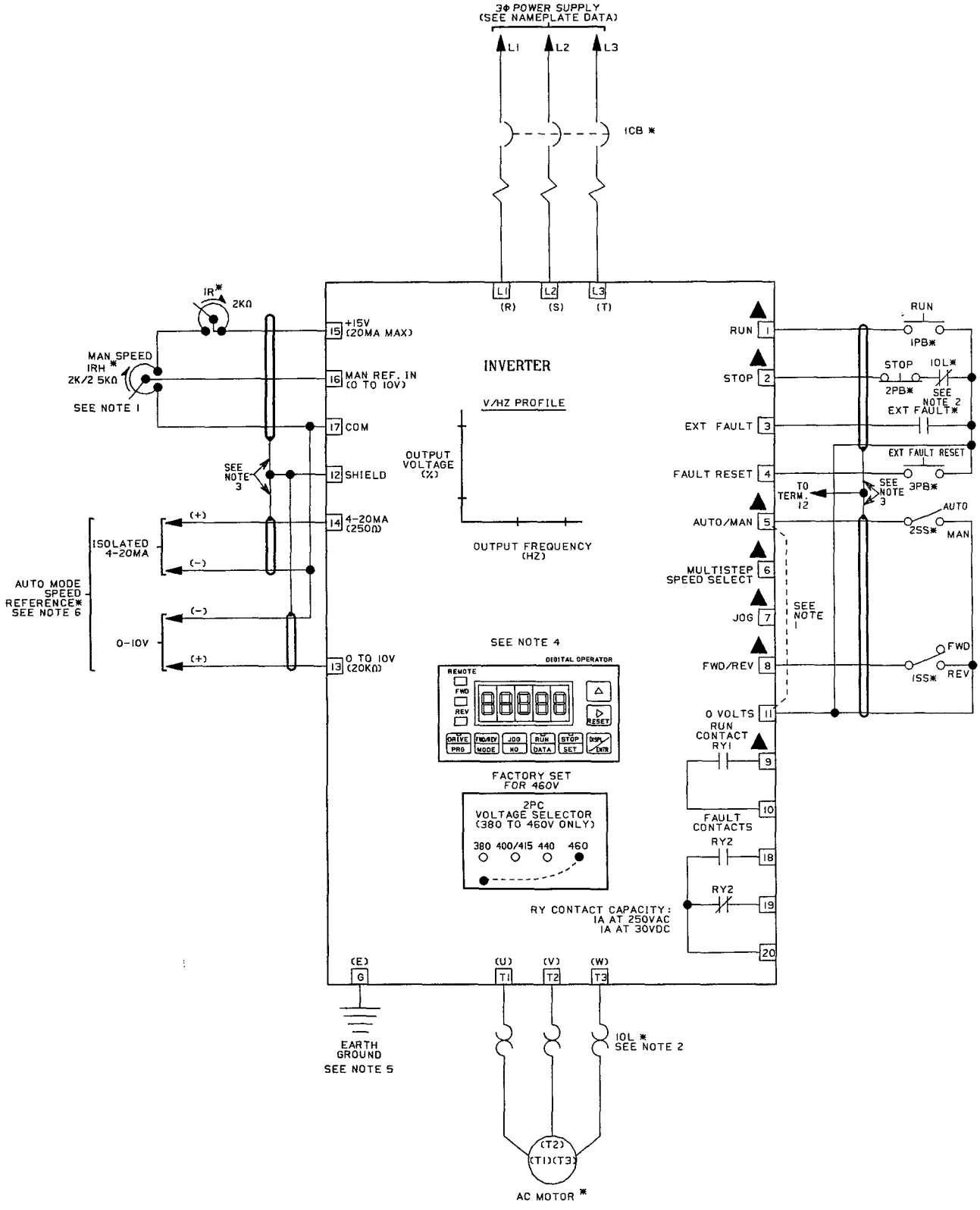


Figure 6. Initial Interconnections - 3-Wire Control (with constant Sn-04 set to 0000, and Sn-11 set to 18)

3. DESCRIPTION OF DIGITAL OPERATOR

3.1 GENERAL

- A two-colored key (see Figure 7) is marked on the top half with the function it performs in the Drive mode, and on the bottom half with the function it performs in the Program mode (see paragraph 3.2).
- Data set with the Digital Operator is stored after the power is turned off.
- When selecting the monitor function display, first press and hold **DSPL/ENTR** and then press Δ.
- If the Digital Operator is replaced with a Digital Monitor after data has been set (programmed in constants), the set data cannot be changed. This protects the data.
- If a fault state occurs, the contents of fault will be stored even after power is removed. Thus, the contents can be checked after power is reapplied.
- Frequency setting, direction of motor rotation, and monitor display selection can be changed during operation.
- The Program mode can be used ONLY WHEN THE INVERTER IS NOT OPERATING.

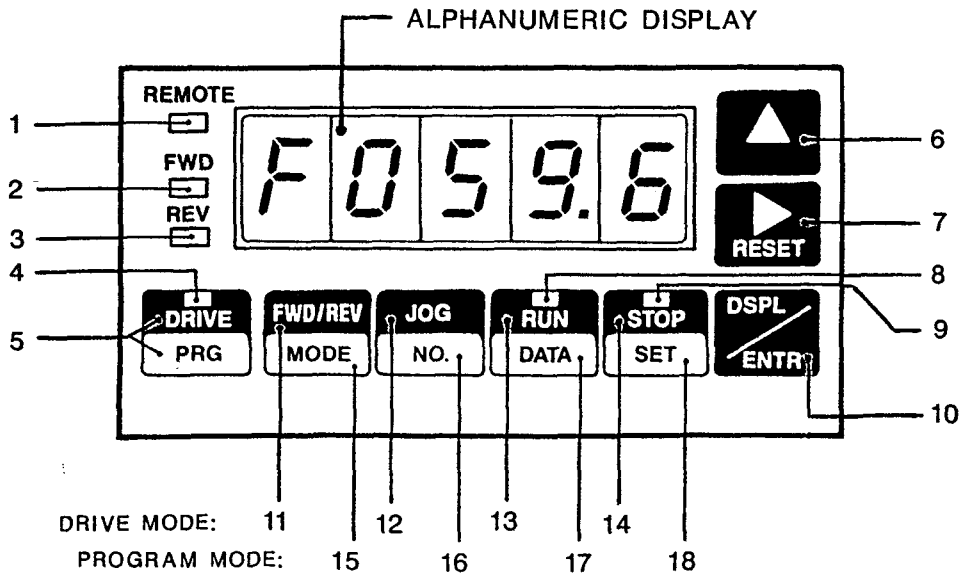


Figure 7. Digital Operator Keypad

3.2 KEYPAD FUNCTIONS

1. REMOTE INDICATOR

Lights when inverter is programmed for run/stop from external signals at terminal strip.

2. FORWARD INDICATOR

Lights when inverter is programmed to run motor in forward direction.

3. REVERSE INDICATOR

Lights when inverter is programmed to run motor in reverse direction.

4. DRIVE INDICATOR

Lights when inverter is in Drive mode.

5. **DRIVE/PRG** KEY

Places inverter in either Drive mode (for operation) or Program mode (for setting of constants).

6. △ KEY

- Selects value of digit being set (+1 direction only; increasing "9" or "F" changes to "0").
- Scrolls through sequence of faults.
- Scrolls monitor display when pressed with **DSPL/ENTR** key.

7. ▷ **RESET** KEY

▷ - Selects the digit of frequency command to be set (Drive mode); Selects the digit of constant data to be set (Program mode). Key has wrap-around effect.

RESET - Resets fault condition.

8. RUN INDICATOR

Lights when inverter is running.

9. STOP INDICATOR

Lights when stop command has been entered.

10. **DSPL/ENTR** KEY

DSPL - When held, allows scrolling of monitor display with △ key.

ENTR - Sets frequency command (Drive mode); Stores constant setting data in EEPROM (Program mode).

DRIVE MODE FUNCTIONS

11. **FWD/REV** KEY

Selects direction of motor rotation.

12. **JOG** KEY

Runs motor at preset jog speed while depressed.

13. **RUN** KEY

Runs motor at set frequency.

14. **STOP** KEY

Stops operation.

PROGRAM MODE FUNCTIONS

15. **MODE** KEY

Selects type of constant (System Constant, Control Constant, Check Function or Order Constant).

16. **NO.** KEY

Selects constant number.

17. **DATA** KEY

Displays data stored for given constant.

18. **SET** KEY

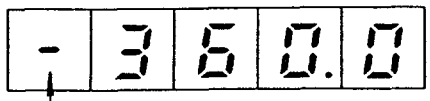
Sets (temporarily stores) new constant setting data in RAM.

3.3 MONITOR FUNCTION DISPLAY SELECTION

When the inverter is in the Drive Mode, the operator can use the DSPL/ENTR and Δ keys (see "Frequency Setting" in Table 6) to select one of four monitored functions to be displayed. The monitor function can be changed (except to Previous Fault Display) while the Drive is running.

A. Output Frequency Display.

The output frequency appears in increments of 0.1 (Hz).

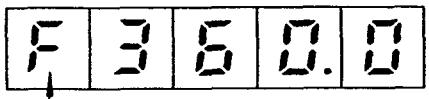


└— (-) appears when motor is in "reverse" rotation

B. Frequency Command Display.

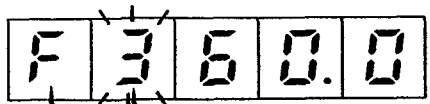
The frequency command is displayed in increments of 0.1 (Hz).

1. Operation by frequency command from the external terminal. No digit blinks. The frequency setpoint specified from the external terminal appears.



└— indicates frequency command is displayed

2. Operation by frequency command from the Digital Operator. The frequency command set at the Digital Operator appears. The first digit blinks, as shown below.



—— blinking

└— indicates frequency command is displayed

C. Output Current Display.

The inverter output current is displayed in increments of 0.1 A.

——indicates current is flowing

D. Previous Fault Display.

This display is explained in paragraph 7.2.

4. INITIAL START-UP

4.1 PRE-POWER CHECKS

- Wires are properly connected and no erroneous grounds exist.
- All debris inside enclosure is removed. Check especially for loose wire clippings.
- All mechanical connections inside unit are tight.
- Motor not connected to load.
- For 460V rated Unit only: Check the power voltage selecting connector in the unit (see Figures 2(b) and 8). If necessary, reposition to the correct connection for input power being used. Voltage is preset to 460V at the factory.

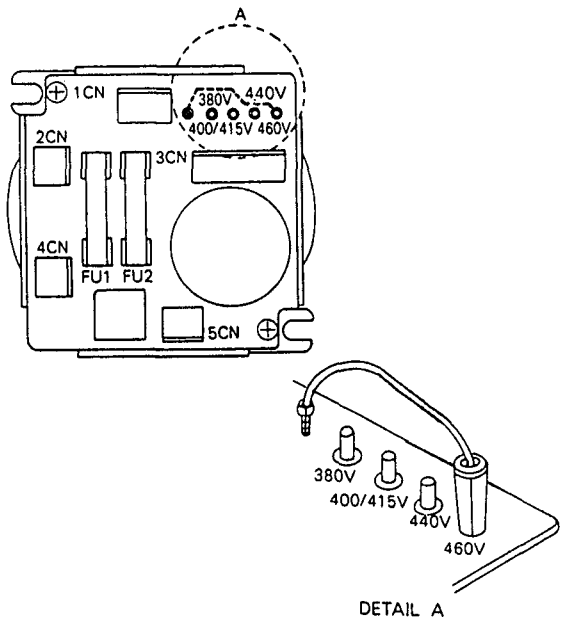


Figure 8. Power Voltage Selection (460V Unit)

4.2 INITIAL START-UP USING DIGITAL OPERATOR ("LOCAL" CONTROL)

The operation described in Table 6 and shown in Figure 9 is for a standard 60 Hz motor.

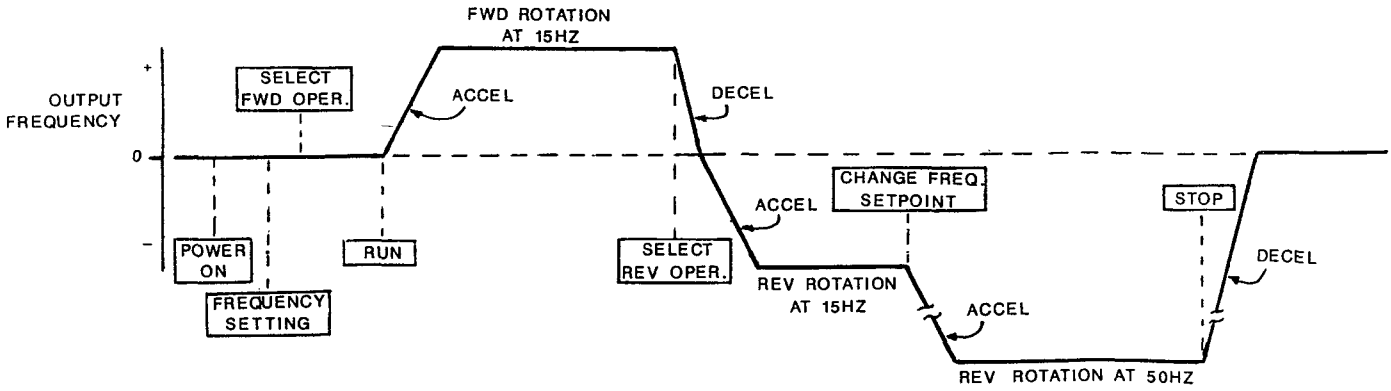


Figure 9. Example of Simple Operation

Table 6. Initial Start-Up With Digital Operator

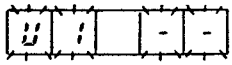
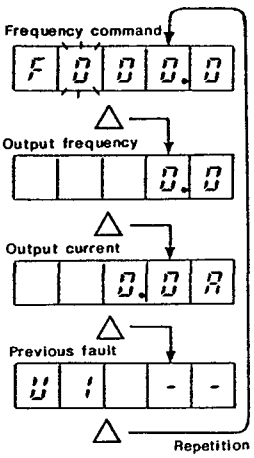
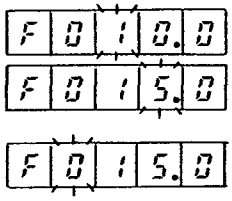
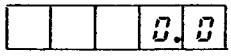
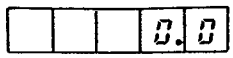
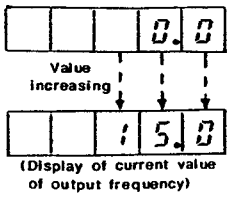
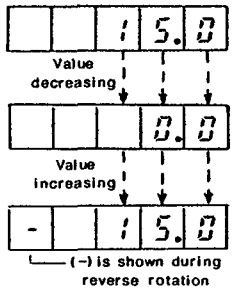
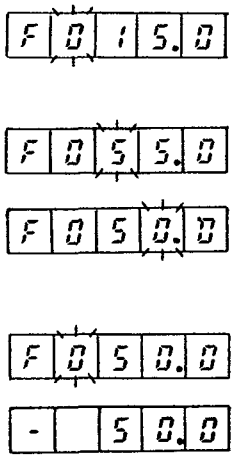
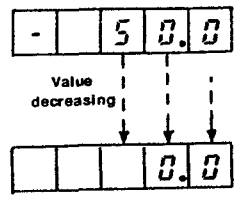
OPERATING PROCEDURE	OPERATION AT DIGITAL OPERATOR	DIGITAL DISPLAY	DESCRIPTION
Power On	Red indicator at **STOP** lights. (REMOTE indicator remains off).	 blinking for 5 seconds, then last selected monitor display (see below).	When power is applied, the last display before power off is indicated.
Frequency Setting	Select Drive mode by using **DRIVE/PROG** key. Red indicator lights. Press △ while holding **DSPL/ENTR** to display frequency command.		Inverter is ready for controlling motor operation. Monitor function display selection. *See "DISPLAYING THE SEQUENCE OF FAILURE OCCURRENCE" in Section 7.
	Example: Setting frequency command to 15 Hz: Move to the setting digit by using ▷ and make the setting with △ . Store the frequency command value with **DSPL/ENTR**. (This data is stored even when the power is off). Press △ while holding **DSPL/ENTR** and monitor the output frequency.	 	Initial setting becomes frequency command.
Select Forward Operation	Select the rotation of motor with **FWD/REV**. (Red FWD indicator lights).		Inverter is set for forward motor operation, but is still in "stopped" condition.
Run	Give run command with **RUN.** (Red indicator lights. Red indicator at **STOP** goes off).		Motor begins a smooth start and runs. Inverter output (and motor speed) increases smoothly at preset acceleration rate, then holds steady at 15 Hz.

Table 6. Initial Start-Up With Digital Operator (Continued)

OPERATING PROCEDURE	OPERATION AT DIGITAL OPERATOR	DIGITAL DISPLAY	DESCRIPTION
Select Reverse Operation	Press **FWD/REV.** (Red FWD indicator goes off, and red REV indicator lights).		Inverter output (and motor speed) decreases smoothly, at preset deceleration rate, to zero. Then motor begins rotation in reverse direction, accelerating smoothly, then holds steady at 15 Hz.
Change Frequency Setpoint	Press △ while holding **DSPL/ENTR** to display frequency command. Example: Set 50 Hz as new value of frequency command. Change the frequency set point by using ▷ and △ . Store frequency command value by **DSPL/ENTR.** Press △ while holding **DSPL/ENTR** and monitor the output frequency.		Motor continues running at 15 Hz. Motor continues running at 15 Hz. Motor immediately begins accelerating, then holds steady at 50 Hz.
Stop	Press **STOP** . (Red indicator lights. Red indicator at **RUN** goes off). REV indicator stays lit. **DRIVE/PROG** indicator stays lit.		Motor speed decreases under inverter control, at preset deceleration rate, to zero. (See NOTE 1) Motor remains stopped. Lamps and display remain on as long as power is applied.

NOTES:

1. For coast-to-stop operation, refer to Appendix 4.

4.3 PRE-OPERATION CONSIDERATIONS

- After completing the initial start-up, connect the motor to the load.
- Additional control circuit wiring can be added, and constants in the inverter can be programmed to configure the Drive to your specific application, including "Remote" (2-wire or 3-wire) Control. (See Section 5.)

4.4 STORAGE FUNCTION

The inverter uses internal NV-RAM to store information when power is removed or in the event of a power failure. Therefore, when power is reapplied, operation will begin with the same state as when power was removed.

The following information is stored:

1. Last monitor display selection (in Drive mode).
2. Last frequency command setting and forward/reverse selection from Digital Operator.
3. The sequence of failure conditions that occurred before power was removed (including content of CPF failure).

5. ADJUSTMENT AND SETTINGS (PROGRAMMING)

5.1 GENERAL

The inverter control circuit uses two types of constants to select functions and characteristics of the unit.

1. System constants (Sn-01 to Sn-16): Mainly used to select V/f and the function of control circuit terminals. These constants are listed in Table 7 and described in Appendix 1.

2. Control constants (Cn-01 to Cn-33): Mainly used to change characteristics of the unit. These constants are listed in Table 8 and described in Appendix 2.

Before beginning operation at load, determine whether any of the factory set constants must be changed to meet the specific requirements of your application. Constant settings are changed by use of the Program mode procedure described in this section.

Table 7. System Constants (Sn-##)

CONSTANT No. AND NAME	FACTORY SETTING (NOTE 1)	FUNCTION		
Sn-01 HP (KW) Selection	(See Table 11, in Appendix 1)	Factory set according to inverter capacity.		
Sn-02 V/f Pattern Selection	01 (See Table 13, in Appendix 1)	16 V/f patterns available, so that operation will suit motor and load type: 15 preset patterns in inverter memory; one arbitrary pattern, defined by customer setting of control constants Cn-01 thru Cn-07.		
Sn-03 ---	0000 (Note 2)	---		
Sn-04 Operation Signal	0011 (Note 3)	DIGIT	DATA	
		XXXΔ	0	Frequency command by external frequency setting input signal.
			1	Frequency command set by Digital Operator.
		XXΔX	0	Run command by external signal input.
			1	Run command from Digital Operator.
		XΔXX	0	Output frequency directly proportional to frequency command. 0-10V=0-100% 4-20mA=0-100%
			1	Output frequency inversely proportional to frequency command. 0-10V=100-0% 4-20mA=100-0%
		ΔXXX	0	Reverse allowed.
			1	No reverse allowed.

Table 7. System Constants (Sn-##) (Continued)

CONSTANT No. AND NAME	FACTORY SETTING (NOTE 1)	FUNCTION		
Sn-05 Protection Characteristics Selection	0000	DIGIT	DATA	
		XXX<u>X</u>	0	Operation stops at a momentary power failure.
			1	Operation continues thru a momentary power failure.
		XX<u>X</u>X	0	Operation stalls during deceleration.
			1	Operation does not stall during deceleration.
		X<u>X</u>XX	0	Motor protected by inverter's electronic thermal circuit.
			1	Motor not protected by inverter's electronic thermal circuit.
		<u>X</u>XXX	0	Electronic thermal protection for variable torque.
			1	Electronic thermal protection for constant torque.
Sn-06 Overtorque Detector	0000	XXX<u>X</u>	0	Overtorque not detected.
			1	Overtorque detected.
		XX<u>X</u>X	0	Overtorque detected only during speed synchronization.
			1	Overtorque always detected.
		X<u>X</u>XX	0	Operation continues.
			1	Coasting stop.
		<u>X</u>XXX	-	Does not matter (undefined)
Sn-07 Optional Function Selection	0000	**DIGIT**	**DATA**	
		XX<u>X</u>X	Multiplier of output frequency (F) 00 = 6F 01 = 10F 10 = 12F 11 = 36F	For Pulse Monitor Option, Model No. L732
		<u>X</u>XXX	00 = DI-8 is disconnected 01 = Binary 10 = BCD (Hz) 11 = BCD (%)	For Input Interface (DI-8)/ F-I Monitor Option, Model No. DS826

Table 7. System Constants (Sn-##) (Continued)

CONSTANT No. AND NAME	FACTORY SETTING (NOTE 1)	FUNCTION	
Sn-08 Control Term. 5	00	Selects terminal 5 function (see Table 15, in Appendix 1).	
Sn-09 Control Term. 6.	03	Selects terminal 6 function (see Table 15, in Appendix 1).	
Sn-10 Control Term. 7	05	Selects terminal 7 function (see Table 15, in Appendix 1).	
Sn-11 Control Term. 8	06 (or 18; Note 3)	Selects terminal 8 function (see Table 15, in Appendix 1).	
Sn-12 Control Term. 9 & 10 Output	00	Selects N.O. contact output function (see Table 17, in Appendix 1).	
Sn-13 DO-4 Output 1	00	Selects function of Output 1 (see Table 17, in Appendix 1).	For Output Interface (DO-4) Option, Model No. DS827
Sn-14 DO-4 Output 2	00	Selects function of Output 2 (see Table 17, in Appendix 1).	
Sn-15 DO-4 Output 3	00	Selects function of Output 3 (see Table 17, in Appendix 1).	
Sn-16 DO-4 Output 4	00	Selects function of Output 4 (see Table 17, in Appendix 1).	

NOTES:

1. If constants in your unit have been set to other than standard settings prior to shipments, a separate listing will be provided, which supersedes this table.
2. See the CAUTION at the front of this manual concerning constant Sn-03.
3. If Sn-04 is factory set to 0000 and Sn-11 is factory set to 18, the unit is set for 3-wire control. In that case, DO NOT CHANGE THESE TWO SETTINGS.

Table 8. Control Constants (Cn-##)

CONSTANT NO.	NAME	UNIT (INCRE-MENT)	SETTING RANGE 230V & 460V OR 230V (460 V)	STANDARD FACTORY SETTING (NOTE 1)
Cn-01 *	Max Frequency (F_{MAX})	0.1 Hz	50.0 - 400.0 Hz	60.0 Hz
Cn-02 *	Max Voltage (V_{MAX})	0.1 V	0.0 - 230.0V (460.0V)	200.0V (400.0V)
Cn-03 *	Max Voltage Frequency (F_A)	0.1 Hz	0.0 - 400.0 Hz	60.0 Hz
Cn-04 *	V/f Constant (F_B)	0.1 Hz	0.0 - 400.0 Hz	3.0 Hz
Cn-05 *	V/f Constant (V_C)	0.1 V	0.0 - 230.0V (460.0V)	13.0V (26.0V)
Cn-06 *	Min Output Frequency (F_{MIN})	0.1 Hz	0.0 - 400.0 Hz	1.5 Hz
Cn-07 *	Min Output Freq. Voltage (V_{MIN})	0.1 V	0.0 - 230.0V (460.0V)	7.0V (14.0V)
Cn-08	Accel Time (See Note 3)	0.1 s	0.1 - 1800.0 s	10.0 s
Cn-09	Decel Time (See Note 3)	0.1 s	0.1 - 1800.0 s	10.0 s
Cn-10	DC Braking Voltage	0.1 V	0.0 - 100.0V (200.0V)	8.0V (15.0V)
Cn-11	DC Braking Time at stop	0.1 s	0.0 - 100.0 s	0.5 s
Cn-12	DC Braking Time at start	0.1 s	0.0 - 25.0 s	0.0 s
Cn-13	Frequency Command Gain	0.01	0.01 - 2.00	1.00
Cn-14	Frequency Command Bias	0.1 %	0.0 - 25.5%	0.0%
Cn-15	Freq. Command Upper Limit	1%	0 - 110%	100%
Cn-16	Freq. Command Lower Limit	1%	0 - 110%	0%
Cn-17	Setting Prohibited Frequency 1	0.1 Hz	0.0 - 400.0 Hz	0.0 Hz
Cn-18	Setting Prohibited Frequency 2	0.1 Hz	0.0 - 400.0 Hz	0 0 Hz
Cn-19	Setting Prohibited Frequency 3	0.1 Hz	0.0 - 400.0 Hz	0.0 Hz
Cn-20	Motor Rated Current	0.1 A	0.1 - 120.0 A	See Table 11, Appendix 1
Cn-21	Carrier Frequency Lower Limit	1 Hz	380 - 2500 Hz	380 Hz
Cn-22	Torque Compensation Gain	0.1	0.0 - 9.9	1.0
Cn-23	Over Torque Detecting Level	1%	30 - 200%	160%
Cn-24	Freq. Monitor Gain	0.01	0.01 - 2.00	1.00
Cn-25	Current Monitor Gain	0.01	0.01 - 2.00	1.00
Cn-26	Jog Frequency	0.1 Hz	0.0 - 400.0 Hz	6.0 Hz
Cn-27	Freq. Command 1 for Multi-step Run	0.1 Hz	0.0 - 400.0 Hz	0.0 Hz
Cn-28	Freq. Command 2 for Multi-step Run	0.1 Hz	0.0 - 400.0 Hz	0.0 Hz

Table 8. Control Constants (Cn-##) (Continued)

CONSTANT NO.	NAME	UNIT (INCRE-MENT)	SETTING RANGE 230V & 460V OR 230V (460 V)	STANDARD FACTORY SETTING (NOTE 1)
Cn-29	Accel/Decel Time (See Note 3)	0.1 s	0.1 - 1800.0 s	10.0 s
Cn-30	Energy-Saving Gain	1%	0 - 120%	80%
Cn-31	Slip Compensation Gain	0.1	0 0 -9.9	0.0
Cn-32	Indication Gain	1	0 - 39999	0
Cn-33	Programmable Speed Coincidence	0.1 Hz	0.0 - 400.0 Hz	0.0 Hz

NOTES:

1. If constants in your unit have been set to other than standard settings prior to shipment, a separate listing will be provided, which supersedes this table.
2. * indicates control constants used to define arbitrary V/f pattern, only when system constant Sn-02 is set to 0F.
3. The setting of Cn-29 supersedes the accel and decel time settings of Cn-08 and Cn-09, when an acceleration/deceleration time switching command is an input to the inverter (see setting value 0A for Sn-08 to Sn-11 in Table 15, in Appendix 1).

5.2 USE OF PROGRAM MODE

- Setting and storing data in the Program mode must be completed while the Drive is stopped. Setting and storing data is NOT POSSIBLE DURING INVERTER OPERATION.

- After setting data, be sure to finally press **DSPL/ENTR**. Otherwise, new settings become invalid and previous data remains.

- Motor operation is not possible when the inverter is in the Program mode. Therefore, **DRIVE/PROG** must be pressed at the completion of operating in the Program mode, to return the inverter to the Drive mode.

Table 9. Operating Procedure in Program Mode

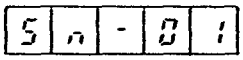
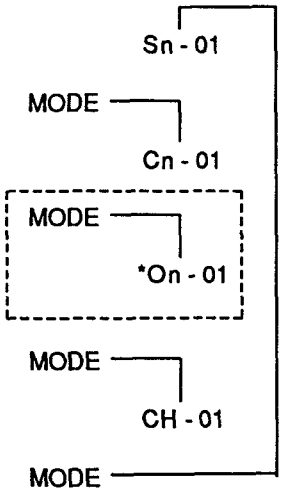
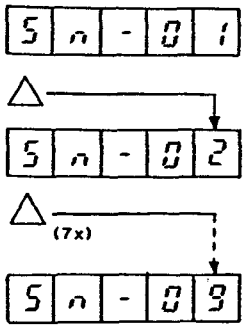
OPERATING PROCEDURE	OPERATION AT DIGITAL OPERATOR	DIGITAL DISPLAY	DESCRIPTION
Power On	Red indicator at **STOP** lights.	---	---
Select Program Mode	Press **DRIVE/PROG**. Red indicator goes off.		Inverter is set for use of the Program mode.
Select Type of Constant	Press **MODE** until the type of constants to be examined and/or set is displayed.		System constants. Control constants. Order Constants * Will appear only when Sn-03 is set to 1010. (See Appendix 4) Check functions (See Appendix 3)
Select Number of Desired Constant	Press △ until the desired constant number is displayed.	Example: to select Sn-09 	

Table 9. Operating Procedure in Program Mode (Continued)

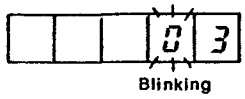
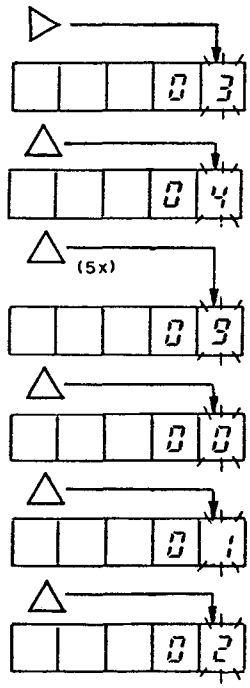
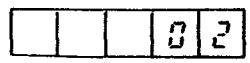
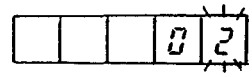
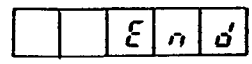
OPERATING PROCEDURE	OPERATION AT DIGITAL OPERATOR	DIGITAL DISPLAY	DESCRIPTION
Display Present Constant Setting	Press **DATA.**		Factory setting or previous customer setting is displayed. NOTE: If displayed setting is acceptable, press **MODE**, and return to "Select Type of Constant" Operating Procedure; or press **NO.** and return to "Select Number of Desired Constant" Operating Procedure.
Change and Set Data in the Constant	Press △ to move blinking position of display. Press ▷ to change value of blinking digit.	Example: change value to "2". 	Change individual digits in the display until the desired new setting value for the constant is shown.
	Press **SET.**	 for approximately 5 sec., then 	The new value is set (temporarily stored) in RAM memory.
	Press **DSPL/ENTR.**		The new constant setting value is stored (entered in EEPROM).

Table 9. Operating Procedure in Program Mode (Continued)

OPERATING PROCEDURE	OPERATION AT DIGITAL OPERATOR	DIGITAL DISPLAY	DESCRIPTION
Select Additional Constant to be Examined or Set	Press **MODE.**		Return to "Select Type of Constant" Operating Procedure.
Return to Drive Mode After Constant Setting is Completed	Press **DRIVE/PROG.** Red indicator lights.	 (Display depends on last monitor display selection made when previously in Drive mode).	Inverter is ready to be used for controlling motor operation.

6. OPERATION AT LOAD

After completing the initial start-up, and programming of constants, turn off the AC main circuit power. Make additional wiring connections required for the external control functions selected by the constant programming. Connect the driven machine to the motor. Verify that the driven machine is in running condition, and that no dangerous conditions exist around the drive system.

OPERATING PRECAUTIONS

- Before applying a RUN command to the inverter, verify that the motor is stopped. If the application requires the capability of restarting a coasting motor, control constant 12 (Cn-12) must be set to give DC Braking Time at Start.

- When a standard motor is used with the inverter, there is some increase of motor temperature, noise and vibration as compared to line operation.

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

- **NEVER** use a motor whose current exceeds the inverter rating.

- When two or more motors are operated by one inverter, verify that the total motor current **DOES NOT EXCEED** the inverter rating.

- When starting and stopping the motor, use the operation signals (RUN/STOP, FWD/REV), NOT the magnetic contactor on the power supply side.

Run the motor under load with control by the Digital Operator using the same procedure as for the test run (Table 6). If Digital Operator is used in combination with external commands or external commands only are used, the procedure must be altered accordingly.

For preset starting (one-touch operation after setting the frequency), perform the following:

1. Set the frequency and press **RUN** to start the motor and accelerate it (at the rate corresponding to the preset acceleration time) to the preset frequency. The acceleration time is set too short relative to the load if the RPM of the accelerating motor does not increase smoothly (stall prevention during acceleration is functioning) or if a fault is displayed on the Digital Operator.

2. Press **STOP** to decelerate the motor (at the rate corresponding to the preset deceleration time) to a stop. The deceleration time is set too short relative to the load if the RPM of the decelerating motor does not decrease smoothly (stall prevention during deceleration is functioning) or if a fault is displayed on the Digital Operator.

7. FAILURE INDICATION AND DETAILS

7.1 GENERAL

A failure in the Drive can fall into one of two categories, as listed in Table 10.

An Alarm indication is a warning that an inverter trouble condition will soon occur, or that a problem in the external circuitry exists. The inverter will continue to operate during an Alarm indication.

A Trouble indication is displayed when the inverter's Fault relay has tripped (inverter shutdown). The motor coasts to a stop, and a fault signal output is present at control circuit terminals 18 - 20.

Table 10. Failure Indication and Details

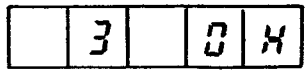
INDICATION (DISPLAY)	FAILURE INDICATION ITEM	DESCRIPTION	FAILURE CATEGORY
UU Blinking	A low voltage is being detected	Two seconds are being counted after the detection of low voltage.	Alarm
OU Blinking	Overvoltage during stop	The DC voltage is higher than the specified value.	Alarm
OH2 Blinking	Inverter overheat is predicted	An external overheat prediction command is inputted to the inverter.	Alarm
OL3 Blinking	Overtorqueis being detected	Operation continues despite overtorque.	Alarm
Eb Blinking	Both forward run and reverse run commands are closed	Deceleration stop. (Not stored internally.)	Alarm
UU	Undervoltage	The DC voltage is lower than the specified value.	Trouble
FU	Fuse blown	The main circuit fuse is blown.	Trouble
OC	Overcurrent	A current surge of about 200% or more occurs.	Trouble
OV	Overvoltage	The DC voltage is higher than the specified value.	Trouble
OH	Heat sink overtemperature	The thermo-switch for the heat sink operates.	Trouble
OL1	Motor Overload	Protect the motor.	Trouble
OL2	Drive Overload	Protect the inverter.	Trouble
OL3	Overtorque detected	Inverter shuts down; motor coasts to a stop.	Trouble
Eb	External failure	An external failure signal stops operation.	Trouble
CPF	Control function self-diagnosis function is faulty	When **DSPL/ENTR** is pressed, CPF content appears	Trouble
OPE	Illegal constant is set	Constant logic is not coincident.	Trouble
.....	Control function hardware is faulty.	Watchdog error.	Trouble

7.2 DISPLAYING THE SEQUENCE OF FAILURE OCCURRENCE

Whenever the Fault relay trips (inverter shutdown), the display code of the failure that caused the trip (except for Illegal Constant or Control Function Hardware) is entered into a register in NV-RAM memory. This register retains, in sequence, that fault code and those of up to three immediately preceding shutdown failures.

The contents of this register can be displayed when the inverter is in the Drive mode.

A. After Inverter Fault Shutdown (With Power Still Applied).

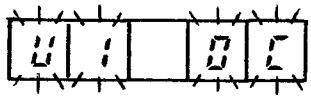
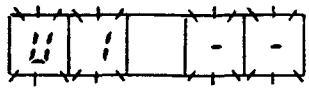
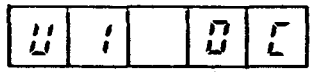
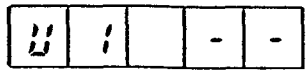
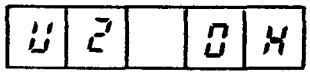
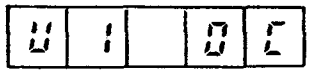
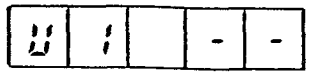
STEP	OPERATION PROCEDURE	DIGITAL DISPLAY
1	Before a RESET command is entered, the failure that caused Fault trip (shutdown) is displayed.	
2	Press △ . The display indicates that this is currently the first code in the memory register.	
3	Continue pressing △ to display the other codes in the memory register. After the last register code is displayed, the sequence will return to the first code.	  

After the failure sequence has been examined, troubleshoot the most recent failure or enter a RESET command (from Digital Operator or external signal) to prepare the inverter for restart of operation.

B. At Power-Up.

NOTE

In the following chart, digital display A occurs if there was a Fault trip (shutdown) before turning off power, and digital display B occurs if there was no shutdown.

STEP	OPERATION PROCEDURE	DIGITAL DISPLAY	
		A	B
1	Turn on power.	 Blinking for 5 seconds, then last selected monitor display.	 Blinking for 5 seconds, then last selected monitor display.
2	Press △ while holding **DSPL/ENTR** to select Previous Fault Display.		
3	Continue pressing △ to display the other codes in the memory register. After the last code is displayed, the sequence will return to the first code.	 	 

After the failure sequence has been examined, refer to Table 6, beginning at "Frequency Setting".

8. TROUBLESHOOTING

If the unit malfunctions, locate the cause and take corrective action by following the flowcharts given in this section.

A. TROUBLESHOOTING MOTOR SYMPTOMS

B. TROUBLESHOOTING FOR FAULT CONDITIONS

WARNING

OSCILLOSCOPE CHASSIS MAY BE AT VOLTAGES POTENTIALLY HAZARDOUS TO LIFE IF NOT PROPERLY GROUNDED. IF OSCILLOSCOPE IS USED TO MEASURE HIGH VOLTAGE WAVEFORMS, USE ONLY A DUAL CHANNEL OSCILLOSCOPE IN THE DIFFERENTIAL MODE WITH X100 PROBES. ALWAYS CONNECT OSCILLOSCOPE CHASSIS TO EARTH GROUND.

WARNING

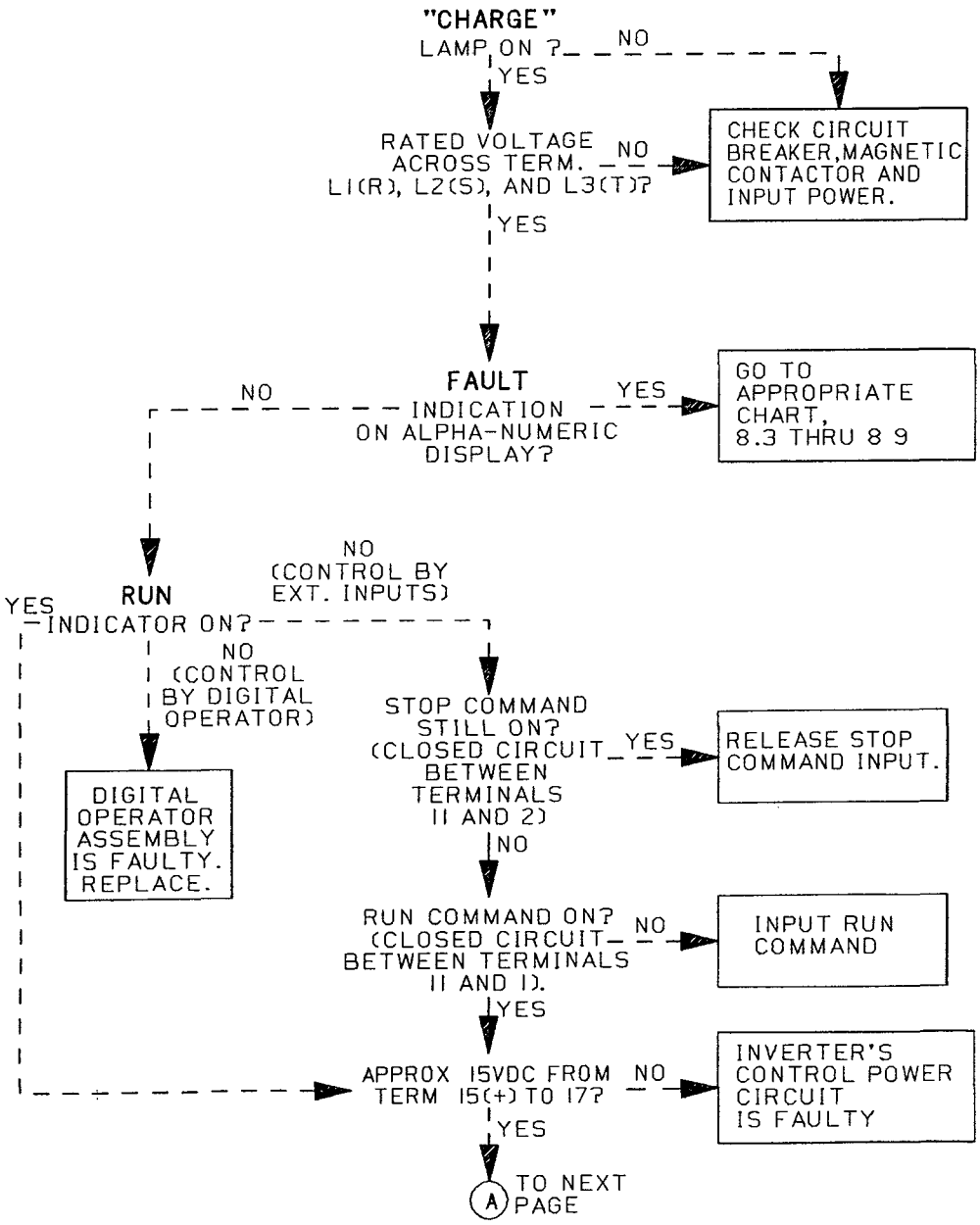
VOLTAGES DANGEROUS TO LIFE EXIST WHEN EQUIPMENT IS OPEN AND ENERGIZED. DO NOT WORK ALONE.

CAUTION

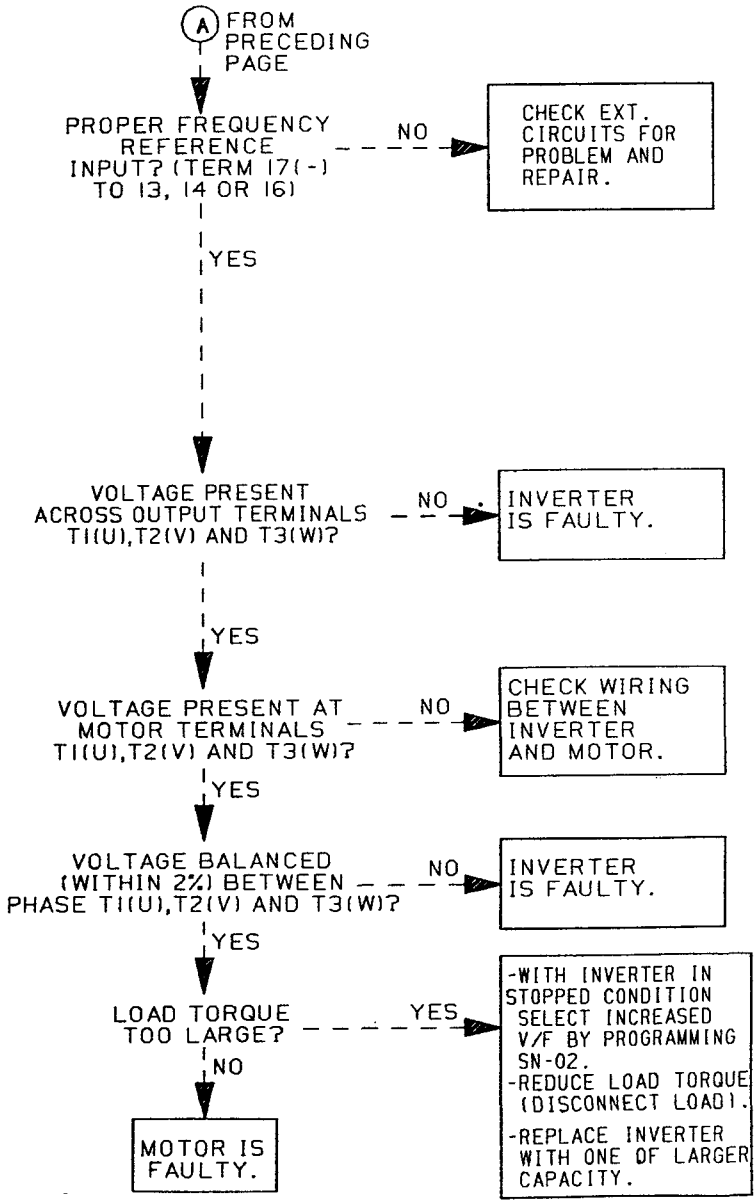
TO PREVENT EQUIPMENT DAMAGE ALWAYS REMOVE INCOMING THREE-PHASE POWER BEFORE TEST EQUIPMENT IS CONNECTED OR REMOVED.

TROUBLESHOOTING CHART 8.1

MOTOR WILL NOT RUN

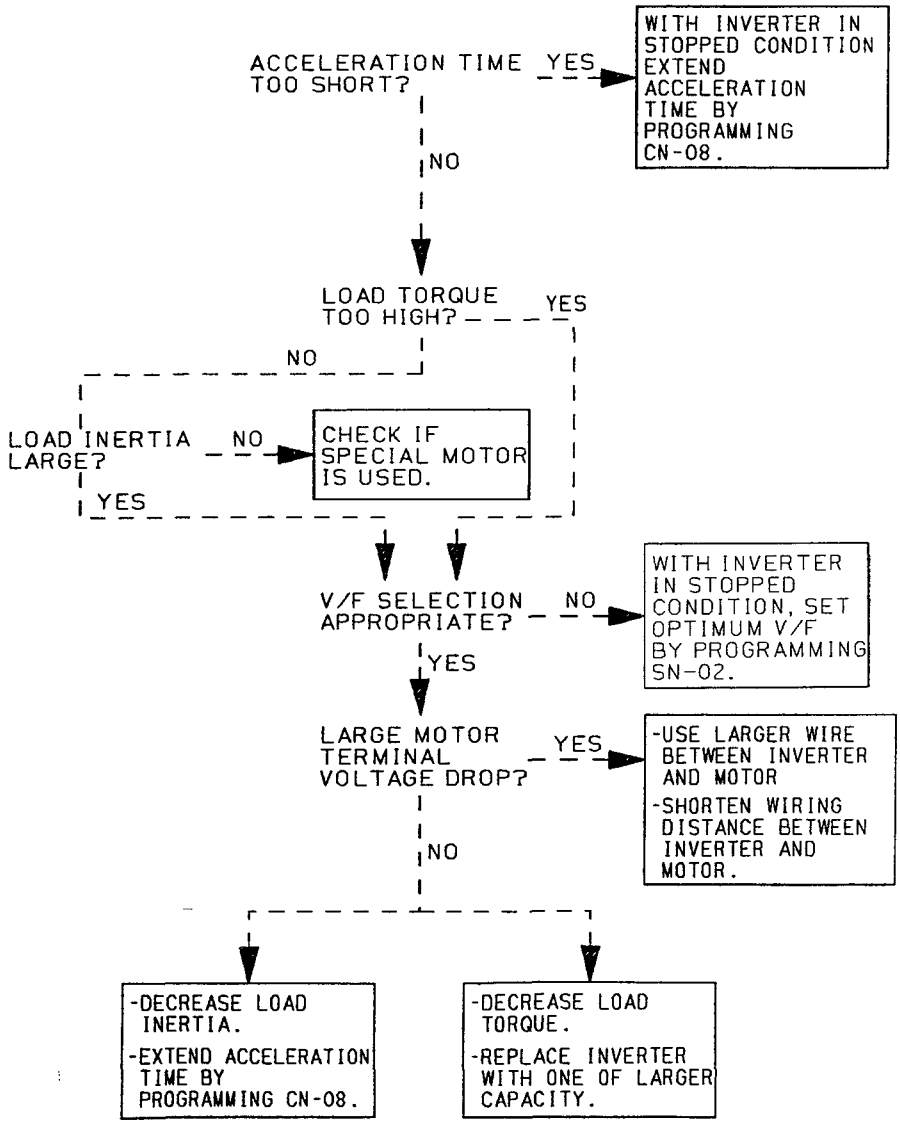


TROUBLESHOOTING CHART 8.1 (Continued)



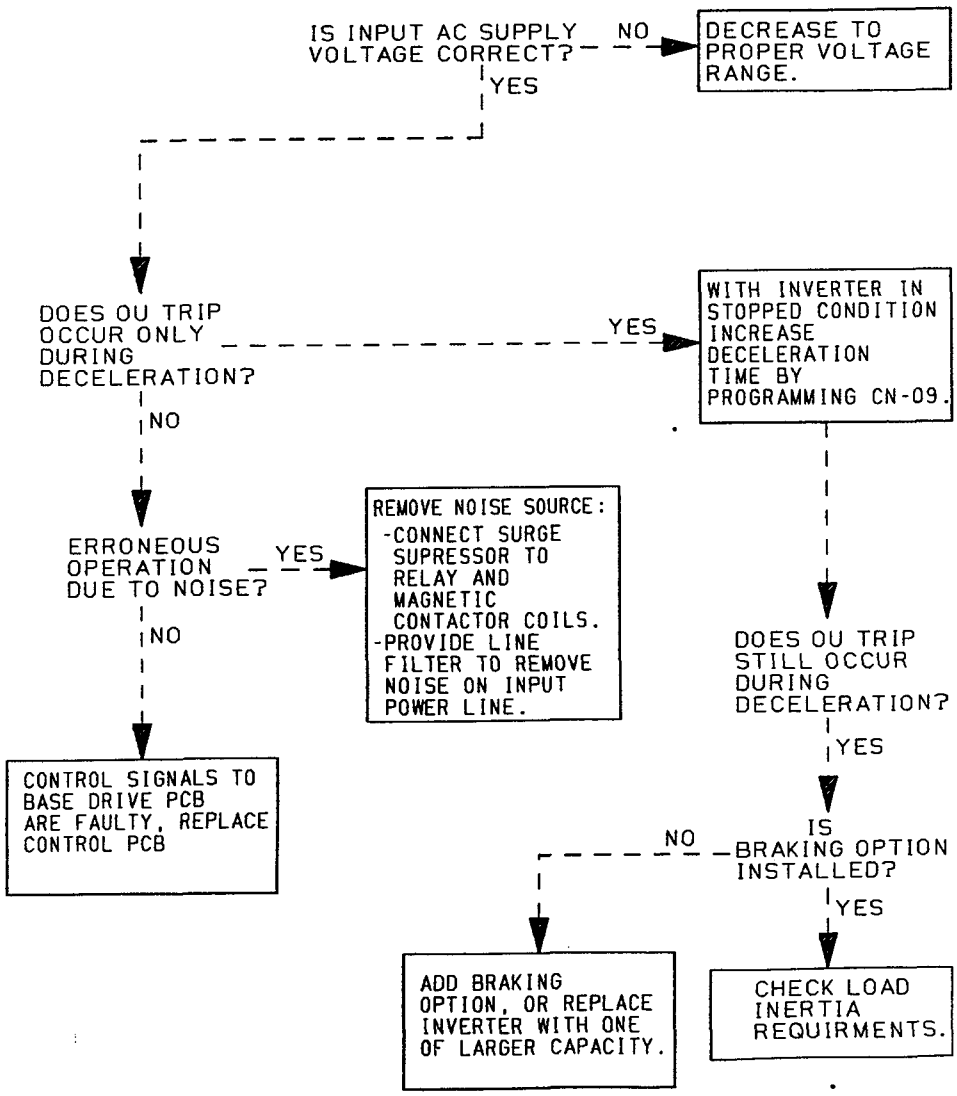
TROUBLESHOOTING CHART 8.2

MOTOR STALLS DURING ACCELERATION



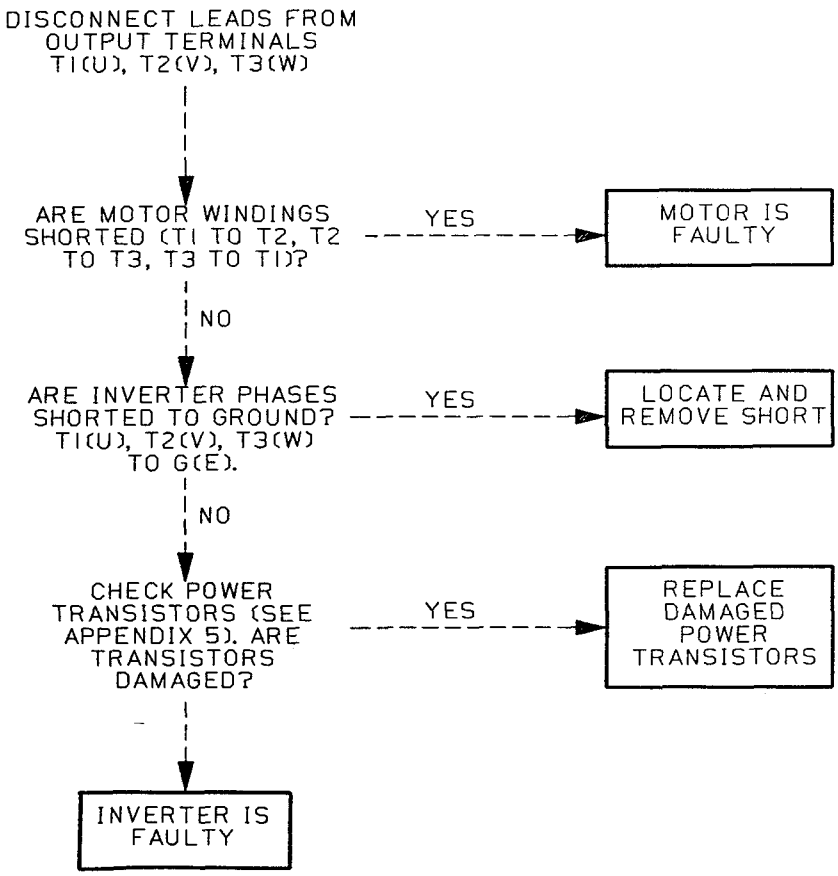
TROUBLESHOOTING CHART 8.3

OVERVOLTAGE (OU) FAULT INDICATION



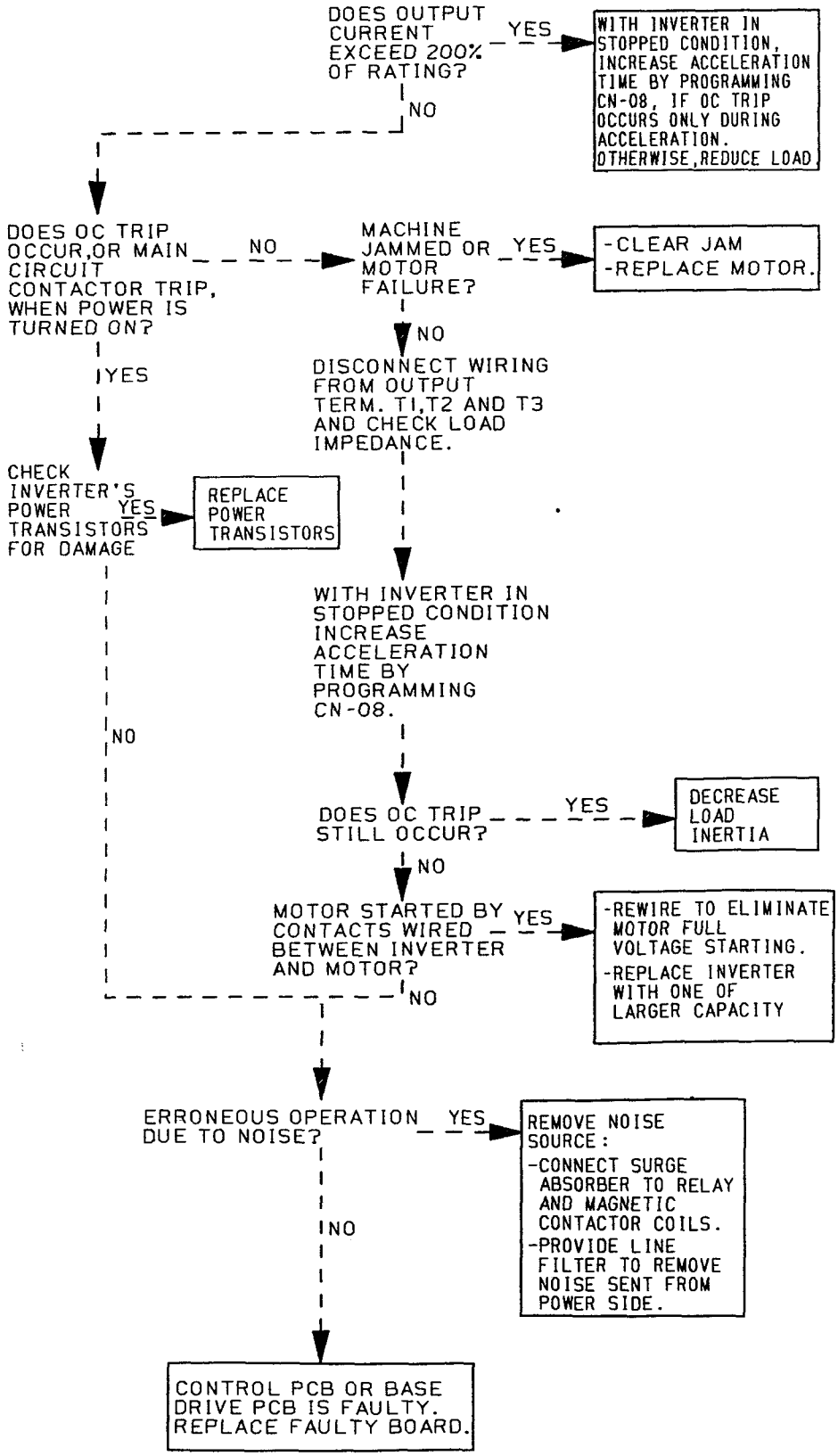
TROUBLESHOOTING CHART 8.3.1

BLOWN FUSE (FU) FAULT INDICATION



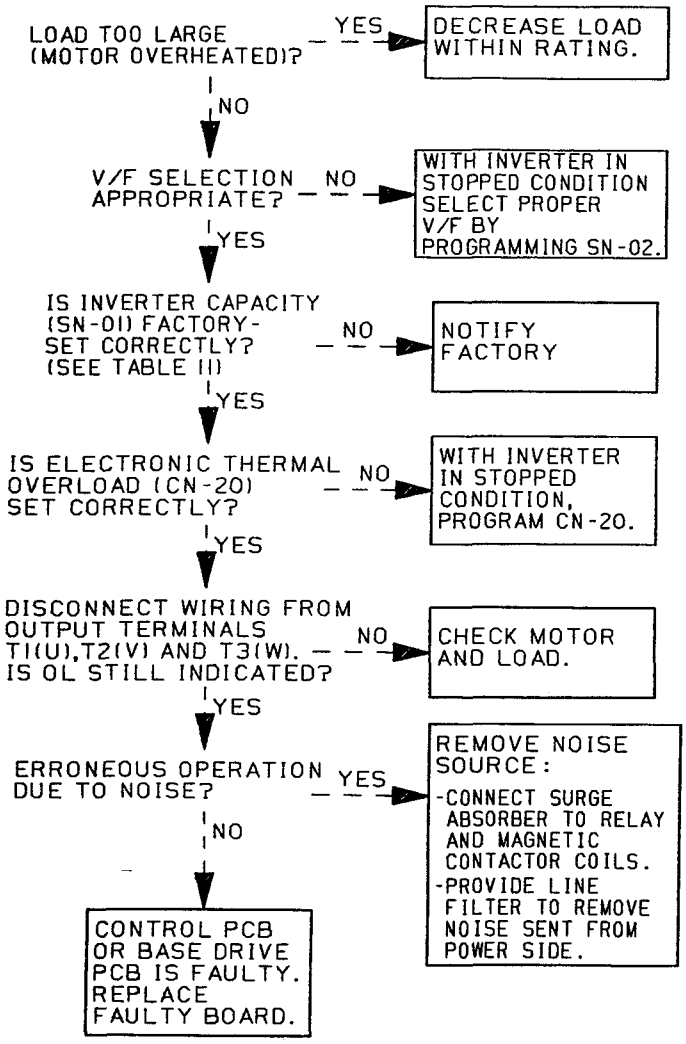
TROUBLESHOOTING CHART 8.4

OVERCURRENT (OC) FAULT INDICATION



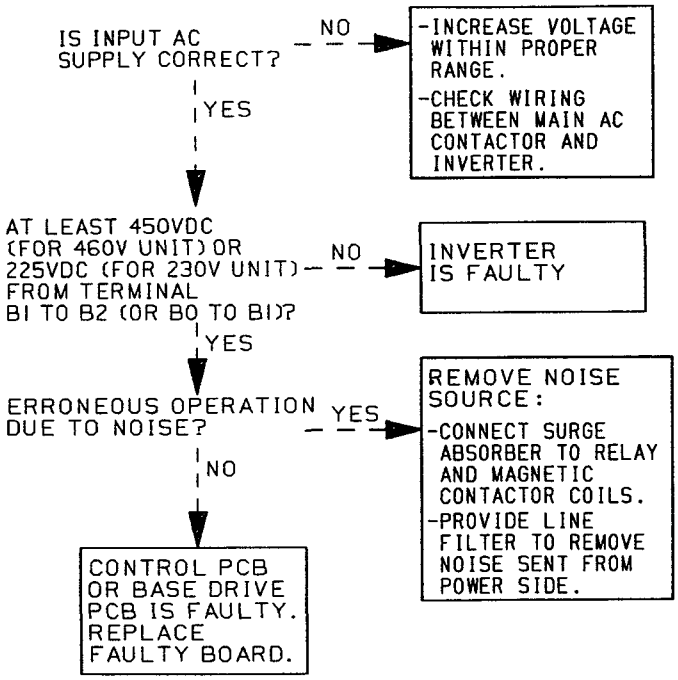
TROUBLESHOOTING CHART 8.5

OVERLOAD (OL) FAULT INDICATION



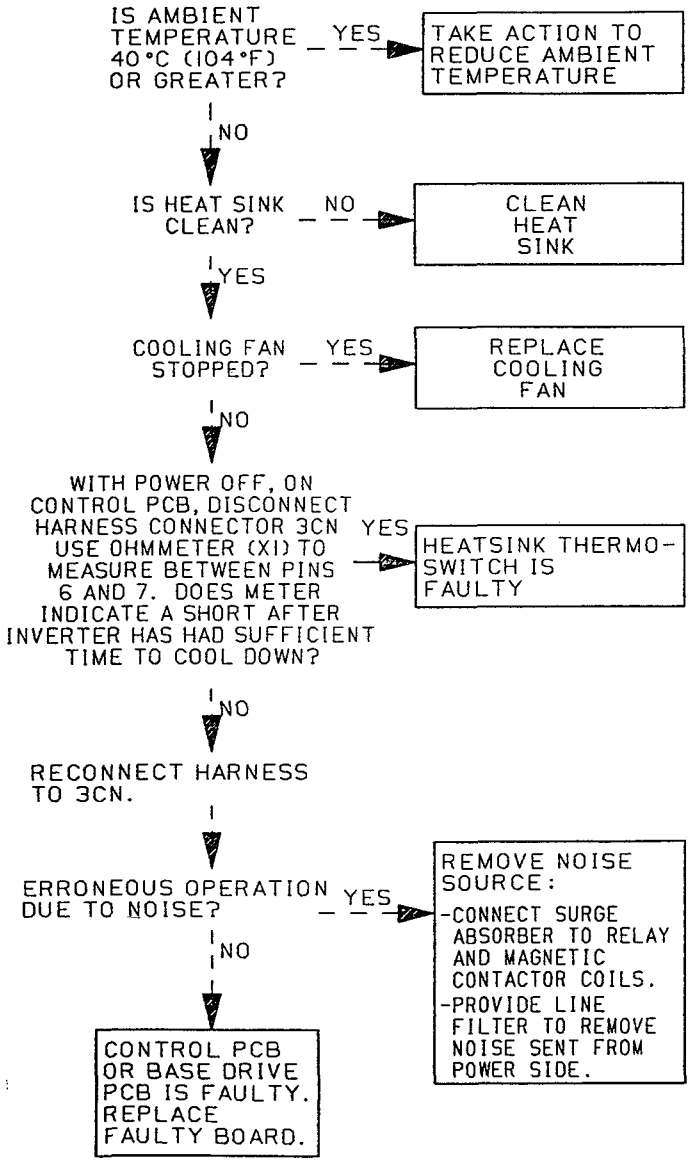
TROUBLESHOOTING CHART 8.6

UNDERVOLTAGE (UU) FAULT INDICATION



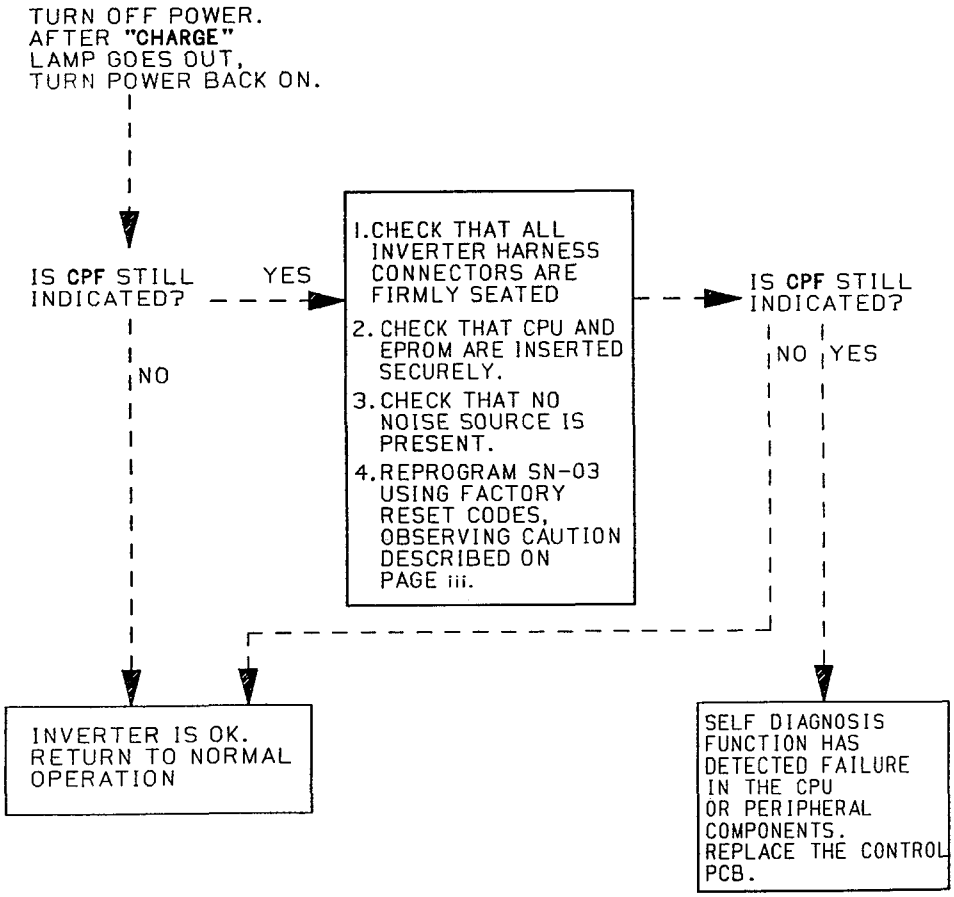
TROUBLESHOOTING CHART 8.7

INVERTER OVERHEATED (OH) FAULT INDICATION



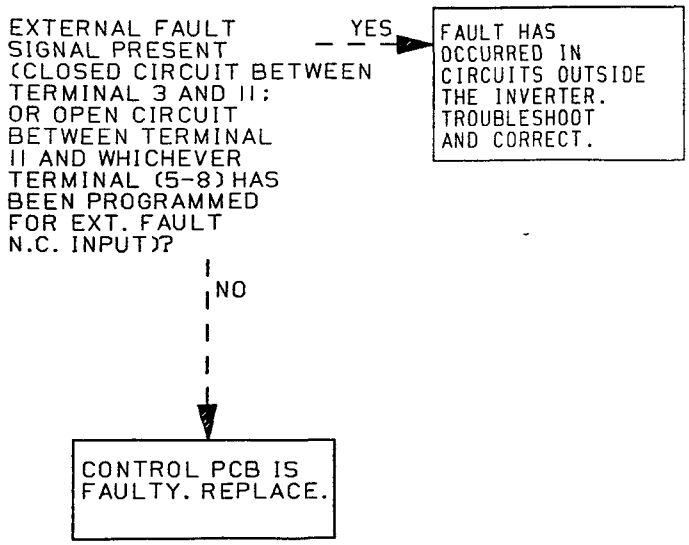
TROUBLESHOOTING CHART 8.8

CONTROL FUNCTION ERROR (CPF) FAULT INDICATION



TROUBLESHOOTING CHART 8.9

EXTERNAL FAULT (Eb) INDICATION



APPENDIX 1. DESCRIPTION OF SYSTEM CONSTANTS

Sn-01: INVERTER CAPACITY

This system constant is factory preset to match the unit voltage and horsepower rating. Table 11 identifies the set value. If the Control PCB is replaced, the new board must be ordered based on Table 12 criteria.

Table 11. Inverter Capacity

Sn-01 Set Value	Unit Rating [HP]	Max Motor Output [HP(KW)]	Motor Rated Current [A] (Cn-20; Note 1)	Reference Current For Setting Constants [A] (Note 2)
230V Units				
01	1	1 (0.75)	3.4	4.5
02	3	3 (2.2)	8.5	9.0
03	5	5 (3.7)	13.7	15
04	7.5	7.5 (5.5)	20.5	23
05	10	10 (7.5)	26.8	30
06	15	15 (11)	40.3	45
07	20	20 (15)	53.4	60
08	25	25 (18.5)	66.8	75
09	30	30 (22)	77.0	90
0A	40	40 (30)	105.0	120
460V Units				
11	1	1 (0.75)	1.7	2.3
12	3	3 (2.2)	4.3	4 5
13	5	5 (3.7)	6.9	8.9
14	7.5	7.5 (5.5)	10.3	12
15	10	10 (7.5)	13.4	15
16	15	15 (11)	20.2	23
17	20/25	25 (18.6)	26.7	30
19	30	30 (22)	36.5	45
1A	40	40 (30)	52.3	60
1B	50	50 (37)	65.3	75
1C	60	60 (45)	78.0	90

Notes:
1. Cn-20 is factory preset.
2. See descriptions of Cn-23 in Appendix 2 and On-18 in Appendix 4.

Table 12. Model and Code Number of Control PC Board

INPUT [V]	UNIT RATING [HP]	MODEL (NOTE 1)	CODE NO. (NOTE 2)	PART NO. 501848-
230	1, 3, 5	JPAC-C356.##	ETC00872X-S@@@@	19
	7.5, 10	JPAC-C357.##	ETC00873X-S@@@@	20
	15, 20	JPAC-C358.##	ETC00874X-S@@@@	21
	25, 30, 40	JPAC-C405.##	ETC00938X-S@@@@	67
460	1, 3, 5	JPAC-C360.##	ETC00876X-S@@@@	22
	7.5, 10	JPAC-C361.##	ETC00877X-S@@@@	23
	15, 20, 25	JPAC-C362.##	ETC00878X-S@@@@	24
	30, 40, 50, 60	JPAC-C405.##	ETC00938X-S@@@@	67

Notes:

1. ## indicates the revision level in effect at time of board manufacture. Replacement boards must have the same or higher digits in these positions.

2. @@@@ indicates the factory EPROM revision number. Replacement boards must have the same digits in the code number.

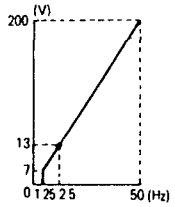
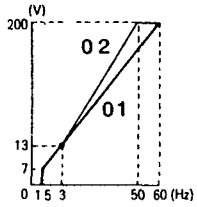
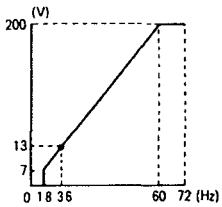
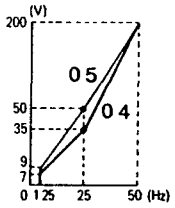
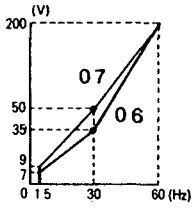
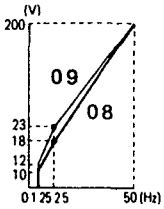
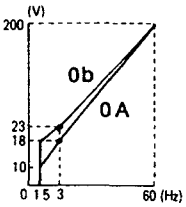
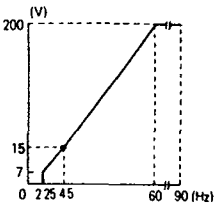
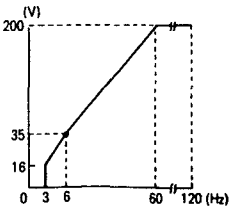
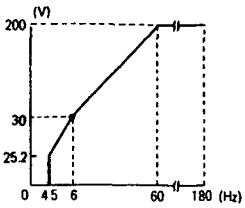
Table 12A. Model and Code Number of Base Drive PC Board

INPUT [V]	UNIT RATING [HP]	MODEL	CODE NO.	PART NO. 501739-
230	25, 30	JPAC-C250	ETC00779X	46
	40	JPAC-C253	ETC00782X	47
460	30, 40	JPAC-C263	ETC00792X	14
	50, 60	JPAC-C266	ETC00795X	16

Sn-02: V/f PATTERN

This system constant is factory preset at 01. Table 13 describes 14 other preset patterns which may be better suited for your specific application and load characteristics. However, if none of these patterns are suitable, the system constant can be set to 0F (arbitrary V/f pattern). The exact V/f pattern can then be defined by Cn-01 thru Cn-07 as described in Appendix 2.

Table 13. V/f Pattern Selection

Application	Specification		Sn-02 DATA	V/f PATTERN (NOTE 3)
General Purpose	50Hz		00	
	60Hz	60Hz Saturation	01	
		50Hz Saturation	02	
	72Hz		03	
Variable Output Operation (Fans and Pumps)	50Hz	Variable Torque 1	04	
		Variable Torque 2	05	
	60Hz	Variable Torque 1	06	
		Variable Torque 2	07	
High Starting Torque	50Hz	Starting Torque Low	08	
		Starting Torque High	09	
	60Hz	Starting Torque Low	0A	
		Starting Torque High	0b	
Constant Output Operation (Machine Tools)	90Hz		0C	
	120Hz		0d	
	180Hz		0E	

Notes:

1. The following conditions must be considered when selecting a V/f pattern:
   - Pattern matches the voltage-frequency characteristic of the motor.
   - Maximum motor speed.
2. V/f pattern for high starting torque should be selected for:
   - Wiring distance.
   - Large voltage drop at start.
   - AC reactor connected to inverter input or output.
   - Use of motor rated below inverter max. output.
3. Patterns shown are for 200V input; for other input, multiply all (V) values by (V_{IN}/200). Example: For 400V input, multiply by 400/200 = 2.

Sn-04: RUN SIGNAL SELECTION

This four digit system constant determines which commands will affect Drive operation (see Table 14).

(1) XXXX digit: Frequency command selection

0 = Frequency command follows input from external terminal.

1 = Frequency command set by Digital Operator.

(2) XXXX digit: Run command selection

0 = Operation starts by Run command input from external terminal.

1 = Operation starts by Run command from Digital Operator.

(3) XXXX digit: Auto speed frequency command

Setting of this digit determines how the frequency command varies with respect to changes in the auto-speed frequency command input signal. See Figure 10.

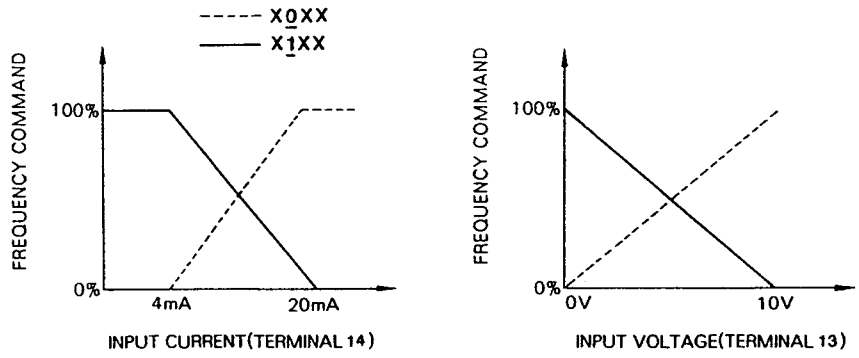


Figure 10.

(4) XXXX digit: Reverse prohibit

0 = Reverse operation is allowed.

1 = Reverse operation prohibited. Inverter disregards reverse run command from external terminal or Digital Operator.

Table 14. Combination of Frequency and Run Commands

From	Command	Sn-04 Setting Value (XXXX Digits) A = Useable operation signal or function. D = Disabled function, or input signal disregarded by inverter.			
		00	01	10	11
External Terminal	Forward Run command	A	A	D Note 4	D Note 4
	Reverse Run command	A	A	D Note 4	D Note 4
	External fault	A	A	A	A
	Fault reset	A Note 2	A Note 2	A	A
	Command at terminal 5	A	A	A	A
	Command at terminal 6	A	A	A	A
	Command at terminal 7	A	A	A	A
	Command at terminal 8	A	A	A Note 1	A Note 1
	Auto freq. command	A	D	A	D Note 4
	Manual freq. command	A	D	D Note 4	D Note 4
Inverter Output Signals	Fault contact output at terminals 18,19,20	ALWAYS USEABLE			
	Contact output at terminals 9 & 10	ALWAYS USEABLE			

NOTES:

1. Forward/Reverse command of 3-wire control input is not available.
2. Valid only when the forward run command, reverse run command, and DB command are open.
3. When the **STOP** key is pressed, the motor decelerates and stops while red lamp at STOP key flashes. This command is stored in the inverter. Therefore, to resume operation, both the forward run command and reverse run command external inputs must first be opened.
4. When Sn-04 XXXX digits are set to 10 or 11, switching to external commands for frequency reference and run/stop is possible by setting value 11 in one of the system constants Sn-08 to Sn-11 (see Table 15).

Table 14. Combination of Frequency and Run Commands (Continued)

From	Command	Sn-04 Setting Value (XXXX Digits) A = Useable operation signal or function. D = Disabled function, or input signal disregarded by inverter.			
		00	01	10	11
Digital Operator	Set Freq. command	D	A	D	A
	RUN key	D	D	A	A
	JOG key	D	D	A	A
	STOP key	A Note 3	A Note 3	A	A
	FWD/REV key	D	D	A	A
	RESET key	A Note 2	A Note 2	A	A
	DRIVE/PRG key	Effective only during stop	Effective only during stop	Effective only during stop	Effective only during stop
	"REMOTE" indicator	ON	ON	OFF	OFF
	Monitor function display selection	A	A	A	A

Sn-05: PROTECTIVE CHARACTERISTICS SELECTION

This system constant is comprised of four digits.

(1) XXXX digit: Operation response to momentary power failure

0 = A momentary power failure, when detected, is regarded as a fault in the power supply and the operation stops after coasting.

1 = When a momentary power failure is less than 2 seconds, the operation continues; if longer than 2 seconds, the operation stops after coasting.

(2) XXXX digit: Stall or no stall during deceleration

0 = Stall during deceleration.

1 = No stall during deceleration.

Sn-05: PROTECTIVE CHARACTERISTICS SELECTION (Continued)

(3) XXXX digit: Motor protection

0 = The electronic thermal overload protects the inverter and motor from overheating.

1 = The electronic thermal overload protects only the inverter from overload.

(4) XXXX digit: Motor selection

0 = Protection is made with the overload characteristics of a variable torque motor.

1 = Protection is made with the overload characteristics of a constant torque motor.

Sn-06: OVERTORQUE DETECTION

This function operates ONLY below base speed.

This system constant is comprised of four digits.

(1) XXXX digit: Overtorque detection enable

0 = No overtorque is detected.

1 = Overtorque is detected (different function from the stall-prevention operation).

The overtorque detection function detects the following condition:

Inverter output current $\geq$ overtorque detection level (Cn-23; factory set to 160%).

(2) XXXX digit:

0 = Overtorque is detected only during constant speed.

1 = Overtorque is always detected (except during stopping and DB).

(3) XXXX digit: Drive response to overtorque detection

0 = When overtorque is detected, the Digital Operator flashes "OL3" while operation continues.

1 = When overtorque is detected, the Digital Operator displays a steady "OL3". Operation stops (shutdown) after coasting (regarded as trouble, and fault contact is output).

(4) XXXX digit: Undefined (has no effect on Drive operation).

Sn-07: OPTIONAL FUNCTION SELECTION

This system constant is comprised of four digits (2 pairs).

(1) XXXX digits: Pulse Monitor output signal multiplier.

Sets the multiplier of the output frequency (F) that is outputted from the Pulse Monitor option, Model No. L732.

00 = Outputs 6 x F

01 = Outputs 10 x F

10 = Outputs 12 x F

11 = Outputs 36 x F

(2) XXXX digits: DI-8 interface

Sets the mode of 8-bit input for the DI-8 option, Model No. DS826.

00 = DI-8 is disconnected

01 = Binary (OFFH = 100%)

10 = BCD (HZ; increments of 1HZ)

11 = BCD (%; increments of 1%)

NOTE

The lower four bits of BCD input represents a decimal value from 0 - 9. The upper four bits represent a hexadecimal value from 0 to F.

Example:	UPPER	LOWER	
	1011	1001	... Binary (8 Bits)
	B	9	... Hexadecimal
	11	9	... Decimal
		119	...Actual input value

Sn-08 thru Sn-11: TERMINAL FUNCTIONS

These four system constants set the function of terminals 5 thru 8 respectively as shown in Table 15. Although these constants can be independently set, NOT selecting values 00 thru 03 inclusive, establishes that inverter operation will be controlled by the Auto-Speed Frequency command.

System constant settings are checked whenever power is applied to the inverter, or each time the **ENTR** key is pressed while in the Program mode. A constant set value failure (OPE) will occur if any of the following conditions are detected among system constants Sn-08 to Sn-11.

(1) Set values are not arranged in sequence, with the smallest value in Sn-08 and largest value in Sn-11.

(2) Except for value 0F, the same value appears in more than one constant.

(3) Both speed search functions (values 07 and 08) have been selected.

(4) Auto/Man selector for forward run (value 01) and Auto/Man selector for reverse run (value 02) have not been selected in COMBINATION.

(5) Multi-step speed setting (value 03) has been selected, but Auto/Man selector (value 00) has NOT.

(6) Override (value 04) is selected, but is not set in Sn-08.

(7) 3-wire sequence (value 18) is selected, but is not set in Sn-11.

Table 15. Terminal 5 to 8 Functions

Setting Value	Function	Description
00	Auto/man selector	Open: Auto frequency command Closed: Man. frequency command
01	Auto/man selector for forward run	With forward run command on. Open: Auto frequency command Closed: Man. frequency command
02	Auto/man selector for reverse run	With reverse run command on. Open: Auto frequency command. Closed: Man. frequency command
03	Multi-step speed setting	
04	Override	(Must be set in Sn-08). Closed: Override
05	Jog operation	Closed: Jog frequency selection
06	External coasting stop command	Closed: Coasting stop
07	Speed search	Closed: Speed search from top freq.*
08	Speed search	Closed: Speed search from setting value*
09	Energy-saving operation	Closed: Energy saving operation
0A	Accel/Decel time selector	Open: Accel/decel is executed by Cn-08 and Cn-09. Closed: Accel/decel is executed by Cn-29.
0b	Inverter overheat prediction	OH2 blinks on Digital Operator.
0C	DC brake command	Closed: DC braking activates if DC brake command is closed under the conditions of min. output freq. & below at deceleration stop.

Table 15. Terminal 5 to 8 Functions (Continued)

Setting Value	Function	Description
0d, 0E 0F	Not defined	Will not affect Drive operation
10	External fault	Open: Coasting stop and fault contact output Closed: No external fault
11	Local/Remote	Allows switching from Digital Operator to ext. auto freq. ref. and operation signals (with Sn-04 set to XX00). (See NOTE 1) Closed: Controlled locally (Digital Operator) Open: Controlled remotely (external terminal inputs)
12 thru 17	Not defined	Will not affect Drive operation
18	3-wire sequence	**(MUST BE SET IN Sn-11).** Terminal 1 is RUN command, terminal 2 is STOP command, and terminal 8 is FWD/REV command.

NOTES:

1 All signals must be maintained. The search function of setting values 07 and 08 works with a pulse input signal of 20ms or longer.

Description of Sn-08 to Sn-11 Setting Value Functions

00 - Auto/manual selector

In both forward and reverse operations, this contact-input signal enables switching between the auto speed and manual speed command.

Open: The auto speed frequency command is the frequency command.

Close: The manual frequency command is the frequency command.

01 - Auto/manual switching for forward run

02 - Auto/manual switching for reverse run

These setting values allow switching auto speed and manual speed separately for forward and reverse motor rotation. To be effective, they must be selected in COMBINATION.

Open: The auto speed frequency command controls motor rotation.

Close: The manual frequency command controls motor rotation.

03 - Multi-step speed setting

This set value must be selected in conjunction with Auto/Manual switching (value 00). The combination of inputs at the associated terminals selects one of four frequency commands, as indicated in Table 16.

TERM. 5 - TERM 6

Table 16. 4-step Speed Setting Method

Auto/Manual Switching Input	Multi-step Speed Setting Input	Frequency Command
Open	Open	Auto freq. command
Closed	Open	Manual freq. command
Open	Closed	Freq. command 1 for multi-step speed setting. Value set by Cn-27.
Closed	Closed	Freq. command 2 for multi-step speed setting. Value set by Cn-28.

04 - Override function, when set in Sn-08

Open: Operation is controlled by the auto speed frequency command (override cut).

Close: Override is carried out as shown in Figure 11. The override gain is controlled by the manual frequency command (0 to +10 V/O to 200%).

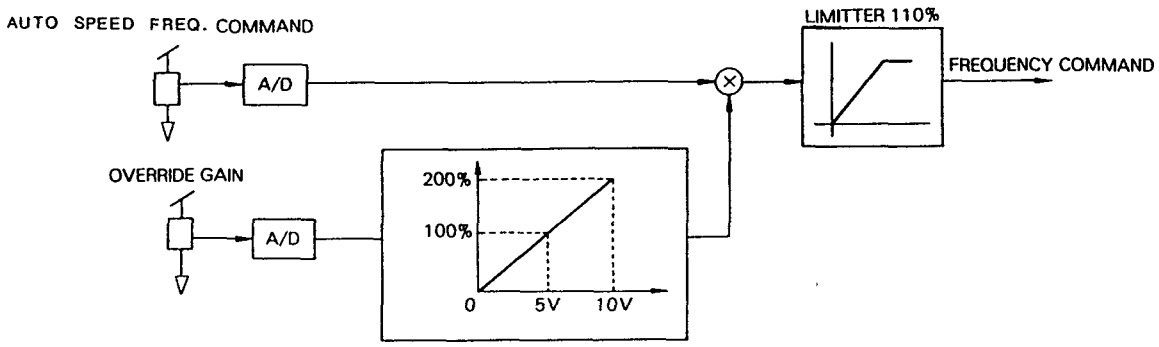


Figure 11. Block Diagram of Override

05 - Jog operation

Close: When a Run command is applied while this input is closed, the motor will be operating at the jog frequency (Cn-26; factory set at 6HZ) rather than the frequency command. The direction of motor rotation is determined by the FWD/REV command, or by the forward run command or reverse run command. See Figure 12.

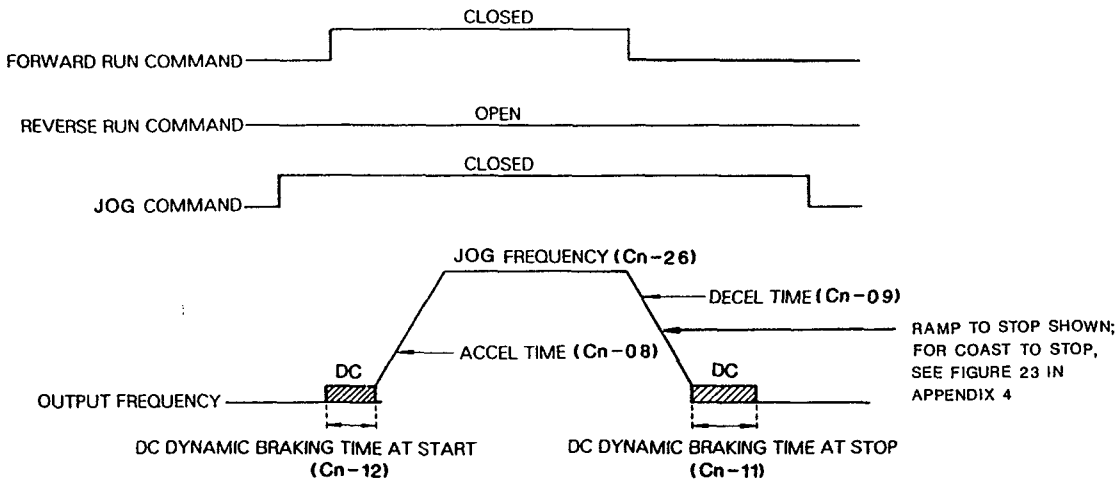


Figure 12. Jog Operation Timing

06 - External coasting stop command

When the external coasting stop command is closed, the operation depends on the input state of the forward run command and reverse run command.

- When either the forward run command or reverse run command is closed, and the external coasting stop command is also closed, only coasting stop is accomplished and the frequency is maintained.

- When both the forward run command and reverse run command are open, and the external coasting stop command is closed, coasting stop is accomplished and the frequency is changed to 0HZ.

07 - Speed search from maximum frequency

08 - Speed search from frequency command

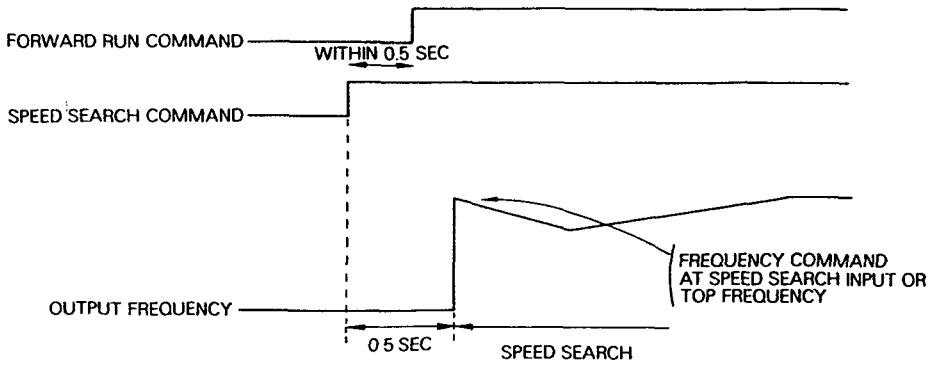
When the external search command is closed, the base is blocked for 0.5 second, then the speed search is made. The operation depends on the selected setting value, either 07 or 08.

IMPORTANT

Setting values 07 and 08 CANNOT be selected in combination.

- When 07 is set,the speed search begins with the maximum frequency.

- When 08 is set, the speed search begins with the frequency command that has been set after the search command was input.



Note:
When using this function by continuous operation mode at momemtary stop, hold speed search command externally.

Figure 13. Speed Search Operation Timing

09 - Energy-saving opertion

When the external energy-saving operation command is closed during speed synchronization, the energy-saving operation shown in Figure 14 is enabled. In the energy saving operation, the output voltage is the value of the energy saving gain (Cn-30; factory set at 80%) multiplied by the V constants defined by Cn-02, Cn-05 and Cn-07.

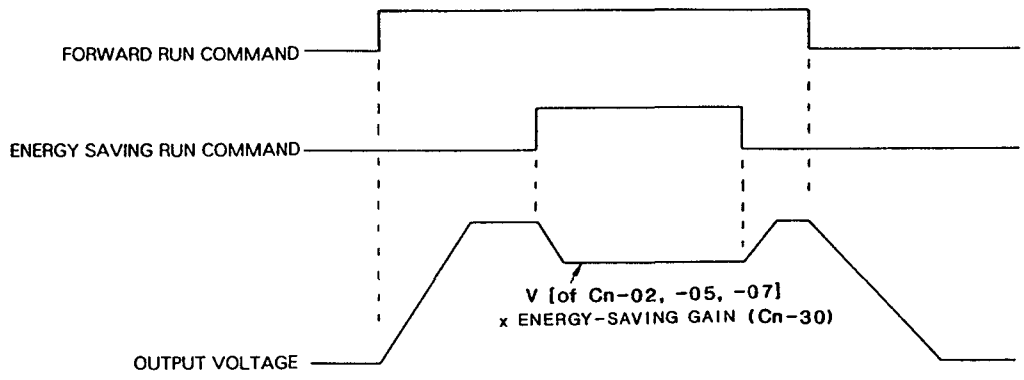


Figure 14. Energy-Saving Run Timing

0A - Acceleration/deceleration time switching

When the external acceleration/deceleration time switching command is closed, the acceleration/deceleration times change. This function is also effective during jog operation.

Open: Operation made with acceleration time of Cn-08 and deceleration time of Cn-09.

Close: Operation made with acceleration/deceleration time of Cn-29.

0b - Inverter overheat prediction/display function

When the external inverter overheat prediction command is closed, the inverter flashes "OH2" on the Digital Operator display. No other operation is carried out (motor operation continues).

0C - DC braking function

When both the forward run command and reverse run command are open, and the DC braking command is closed, the DC braking operation is carried out, as shown in Figure 15. The level of voltage output for DC braking is set by Cn-10.

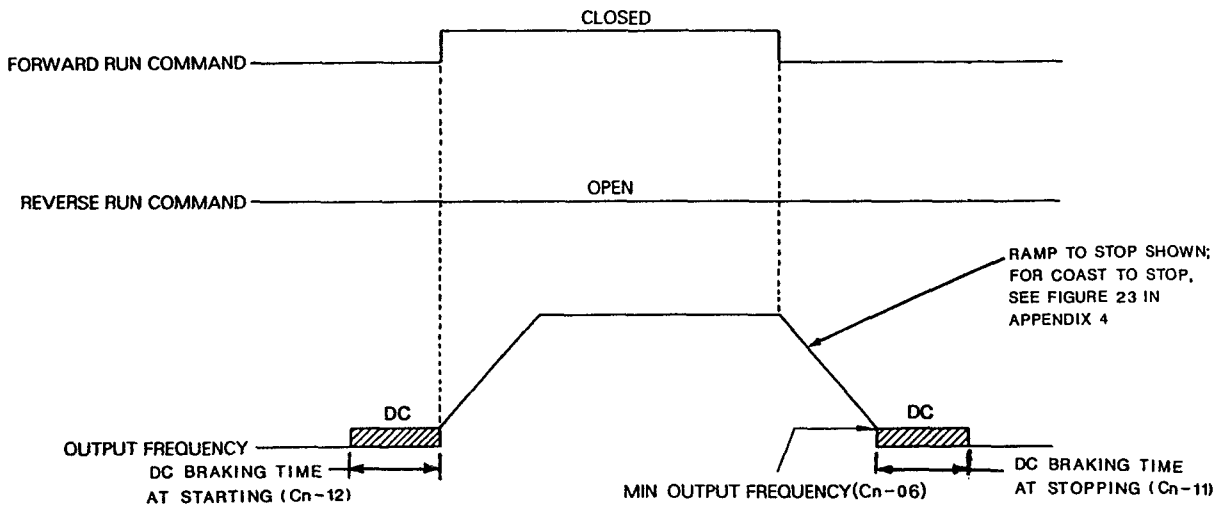


Figure 15. DC Braking Timing

0d, 0E, 0F - Undefined values.

10 - External fault

11 - Local/remote

When the XXXX digits of Sn-04 are set to select the Digital Operator as the source for frequency reference and operation commands, the use of a local/remote command input allows switching between Digital Operator control and external terminal input signals, without the need of re-programming Sn-04.

Close: Controlled locally (Digital Operator)

Open: Controlled remotely (external terminal inputs and auto reference.)

12 thru 17 - Undefined values.

18 - 3-wire sequence.

When this value is set in Sn-11, the following terminals are redefined as inputs for 3-wire control operation commands.

Terminal 1 - RUN command
Terminal 2 - STOP command
Terminal 8 - FWD/REV command

Sn-12: CONTACT OUTPUT SELECTION

This constant selects the N.O. contact to be outputted at external terminals 9 and 10. Table 17 shows the relationship between the set value of Sn-12 and the contact to be outputted.

Table 17. Contact Output Functions

Setting Value	Description	
	Name	Signal Level (Closed)
0	Contact during run	Closed: Either the forward run command or the reverse run command is closed, or when the inverter is producing a voltage.
1	Contact at zero speed	Closed: The inverter output frequency is 0 Hz.
2	Speed synchronized Contact	Closed: Either the forward run command or the reverse run command is closed, and the speeds are synchronized. Speed synchronization set condition: Software start input - output 0.5% Speed synchronization reset condition: Software start input-output 3%
3	Overtorque detected Contact	Closed: The inverter detects an overtorque.
4	Contact during UV	Closed: The inverter is measuring momentary power failure time (when the XXXX digit of Sn-05 is set to 1, for operation to continue during momentary power failure).
		Open: The inverter trips after a period exceeding the momentary power failure time-compensation period. Use this contact combined with fault contact output, at term. 18, 19, 20.
5	Programmable speed coincidence	Closed: Speed is synchronized and output frequency is within ±3% of the setting of Cn-33.
6	Output freq. detect	Closed: Output frequency is equal to or greater than the setting of Cn-33.
7	Output freq. detect	Closed: Output frequency is equal to or less than the setting of Cn-33.

Sn-13 thru Sn-16 - DO-4 Interface Outputs

These four system constants select the function of the N.O. contacts available at output 1 thru 4 of the DO-4 Interface (Digital Output Option), Model No. DS827, when present. Table 17 shows the relationship between the set value of Sn-13 to Sn-16 and the contact to be outputted. Note that with the DO-4 Interface present, five of the contact output functions can be used for external circuits.

APPENDIX 2. DESCRIPTION OF CONTROL CONSTANTS

V/f PATTERN

These seven control constants are used to define the arbitrary V/f pattern, when Sn-02 is set to 0F. (If Sn-02 is set to any other value, these seven control constants will have NO EFFECT on the V/f pattern). Figure 16 shows how these constants relate to each other and the V/f pattern.

Cn-01: MAX FREQUENCY (F_{MAX})

Cn-02: MAX VOLTAGE (V_{MAX})

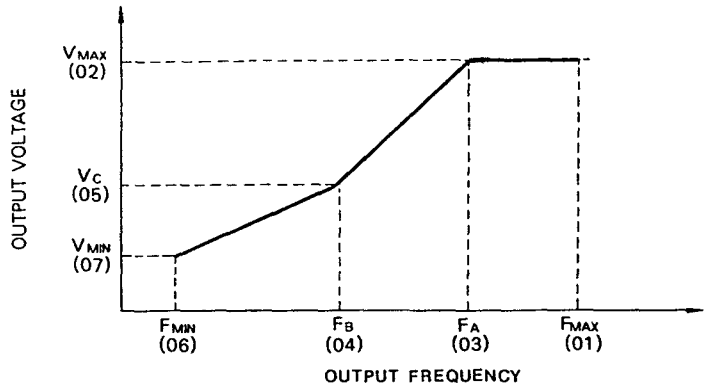
Cn-03: MAX VOLTAGE FREQUENCY (F_A)

Cn-04: V/f CONSTANT (F_B)

Cn-05: V/f CONSTANT (V_C)

Cn-06: MIN OUTPUT FREQUENCY (F_{MIN})

Cn-07: MIN OUTPUT FREQUENCY VOLTAGE (V_{MIN})



Note: Parenthesized values indicate the control constant number.

Figure 16. V/f Characteristics by Cn-01 to Cn-07

NOTE

To establish a V/f pattern with a straight line from F_{MIN} to F_A, set $F_B = F_{MIN}$. The setting of V_C is then disregarded (does not affect the V/f pattern).

IMPORTANT

V_{MAX}, V_C and V_{MIN} MUST BE SET to values related to 200V or 400V input voltage. To find the setting needed for each of these constants, use the following formula:

$$\text{SETTING} = \begin{matrix}\text{DESIRED} \\ \text{OUTPUT} \\ \text{VOLTAGE}\end{matrix} \times \frac{\text{(200V or 400V)}}{\text{ACTUAL } V_{IN}}$$

IMPORTANT

Control constant settings are checked whenever power is applied to the inverter, or each time the **ENTR** key is pressed while in the Program mode. A constant set value failure (OPE) will occur if any part of the following relationships among Cn-01 to Cn-07 is not true.

(a) $F_{MAX} \geq F_A \geq F_B \geq F_{MIN}$

(b) $V_{MAX} > V_C \geq V_{MIN}$

Cn-08: ACCELERATION TIME (Tace)

Sets acceleration time during which inverter output frequency changes from 0% to 100%.

Cn-09: DECELERATION TIME (Tdec)

Sets deceleration time during which inverter output frequency changes from 100% to 0%.

Cn-10: DC BRAKING VOLTAGE (DCVOL)

Sets the DC voltage that the inverter outputs at DC braking time, in increments of 0.1V.

Cn-11: DC BRAKING TIME AT STOPPING (DCTIM)

Sets the braking time, in increments of 0.1 second, during which DC braking is applied at stopping. When the DC braking time is 0, the operation stops after coasting, with the minimum output frequency (Cn-06).

Cn-12: DC BRAKING TIME AT STARTING (DCTWM)

Sets the braking time, in increments of 0.1 second, during which DC braking is applied at starting (by inputting a forward run command or reverse run command). When the DC braking time is 0, acceleration begins with the minimum output frequency.

Cn-13: FREQUENCY COMMAND GAIN (FGAIN)

Sets the auto-speed frequency command gain, in increments of 0.01. (See Figure 17).

Cn-14: FREQUENCY COMMAND BIAS (FBIAS)

Sets the auto-speed frequency command bias, in increments of 0.1%. (See Figure 17).

Cn-15: FREQUENCY COMMAND UPPER LIMIT (FCUL)

Sets the upper limit of the auto speed frequency command in ratio to the maximum frequency, in increments of 1%. (See Figure 17.)

Cn-16: FREQUENCY COMMAND LOWER LIMIT (FCLL)

Sets the lower limit of the auto speed frequency command in ratio to the maximum frequency, in increments of 1%. (See Figure 17.)

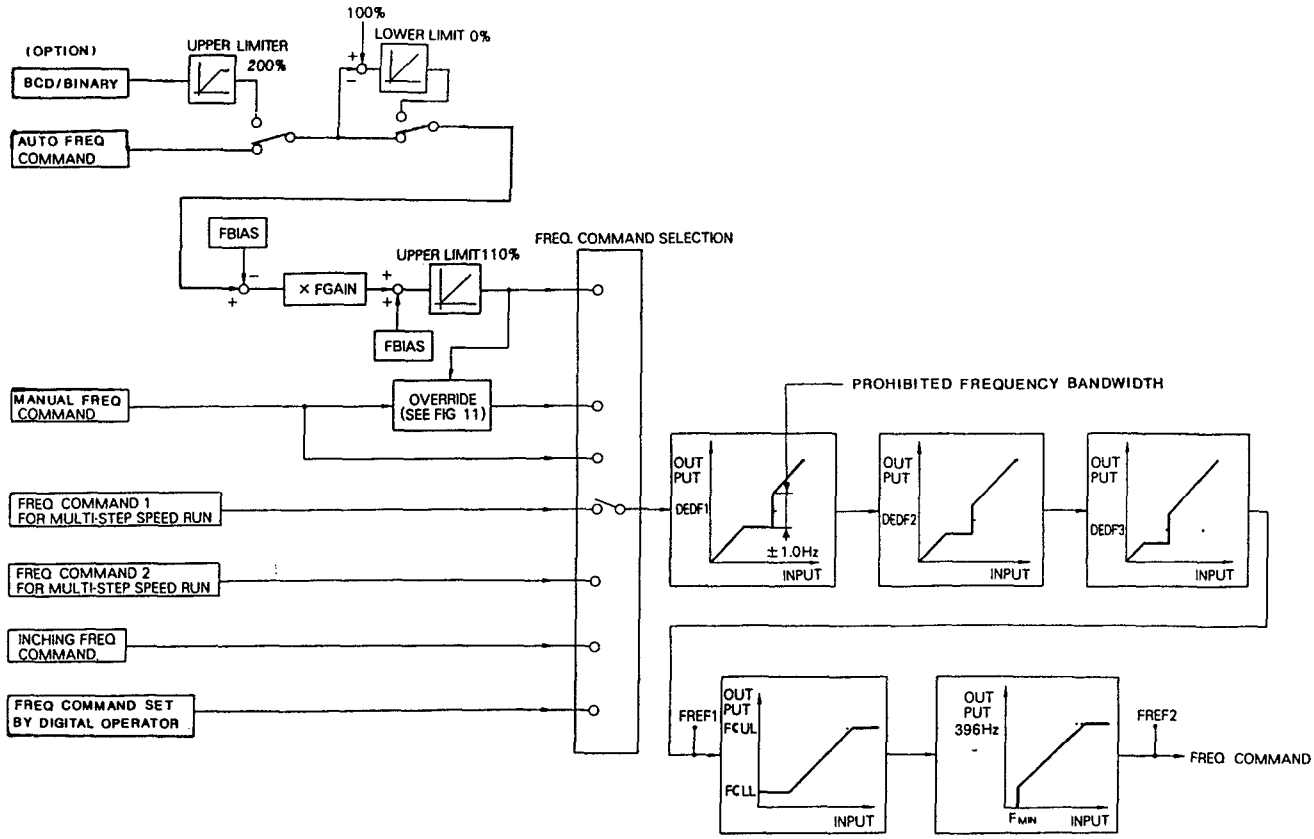


Figure 17. Block Diagram of Frequency Command Circuit

Cn-17: SETTING PROHIBITED FREQUENCY 1 (DEDF1)

Cn-18: SETTING PROHIBITED FREQUENCY 2 (DEDF2)

Cn-19: SETTING PROHIBITED FREQUENCY 3 (DEDF3)

Each of these constants identifies a value of output frequency which will be skipped (stepover), in increments of 0.1 Hz, to eliminate drive/machine resonance problems. When the frequency command dictates an output frequency within the prohibited frequency bandwidth (factory set for 1 Hz above and below the prohibited frequency setting), the inverter output will remain at a frequency level just below the low bandwidth limit (see Figure 17.) When all three of these constants are set to 0.0, no output frequency value will be skipped.

NOTE

See description of order constant On-02, in Appendix 4, for changing the prohibited frequency bandwidth.

Cn-20: MOTOR RATED CURRENT (Im100)

Sets the motor rated current, in increments of 0.1A. (The motor rated current is used in the electronic thermal overload to protect the motor.) (See Table 11.)

Cn-21: CARRIER FREQUENCY LOWER LIMIT (CARRIER)

Sets the low limit of the inverter's carrier frequency, in increments of 1HZ. Although the carrier frequency depends on the output frequency and load, the minimum carrier frequency is set here. Figure 18 shows the relationship between the carrier frequency and the output frequency.

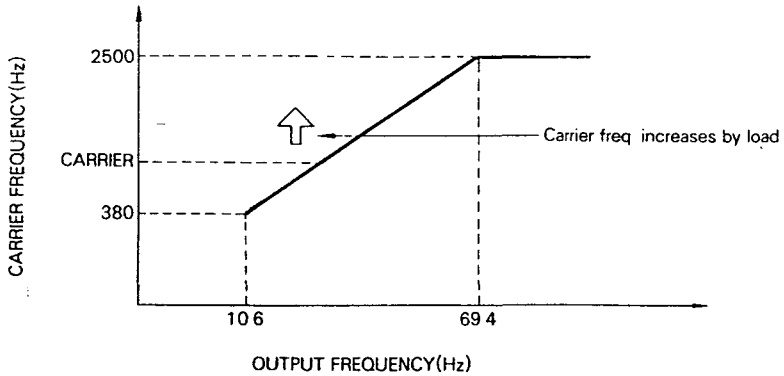


Figure 18. Carrier Frequency and Output Frequency

Cn-22: TORQUE COMPENSATION GAIN (K_T)

Sets the torque compensation gain in units of 0.1. When the maximum applicable inverter motor has the same capacity as that of the motor actually used, this gain is 1. When a smaller motor is actually used, the gain is set to 1.0 or more.

Cn-23: OVERTORQUE DETECTION LEVEL

Sets the overtorque detection level in ratio to the reference current for setting constants (see Table 11), in increments of 1%. Note the overtorque detection function differs from the stall-during-operation function.

Cn-24: FREQUENCY MONITOR GAIN (K_F)

Sets, in increments of 0.01, the gain of the F-I Monitor (Model L731) frequency meter outputs. (See Figure 19.)

Cn-25: CURRENT MONITOR GAIN (K_I)

Sets, in increments of 0.01, the gain of the F-I Monitor (Model L731) ammeter output. (See Figure 19.)

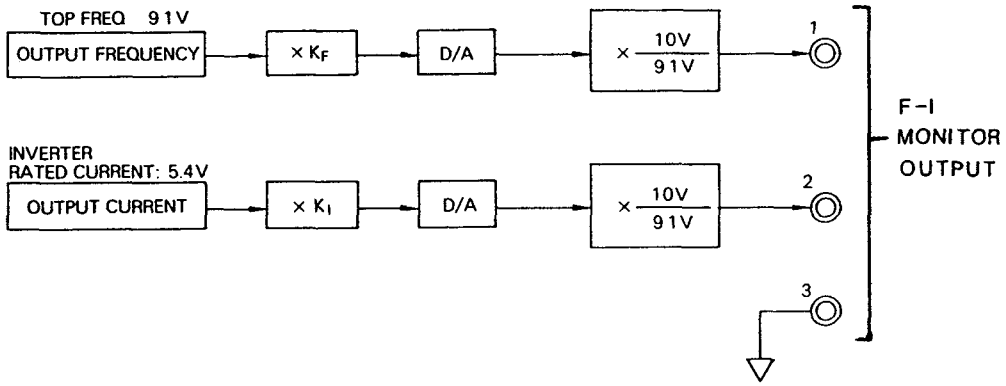


Figure 19. Block Diagram of F-I Monitor

Calibrate the meter as follows:

In Program mode, when Cn-24 is selected, the maximum frequency (about 10V) is available at F-I Monitor terminal 1; when Cn-25 is selected, the inverter rated current (about 6V) is available at F-I Monitor terminal 2.

Maximum frequency: About 10V from terminals 1 to 3

Inverter rated current: About 6V from terminals 2 to 3

Cn-26: JOG FREQUENCY (NFJOG)

Sets jog frequency, in increments of 0.1 Hz. (See Appendix 1 for description of jog operation - Sn-08 to Sn-11 setting value 05.)

Cn-27: FREQUENCY COMMAND 1 FOR MULTI-STEP RUN (FREF1)

Cn-28: FREQUENCY COMMAND 2 FOR MULTI-STEP RUN (FREF2)

Sets frequency commands, in increments of 0.1 Hz, used for multi-step run operation. (See Appendix 1 for description of multi-step run - Sn-08 to Sn-11 setting value 03.)

Cn-29: ACCELERATION/DECELERATION TIME

Sets the acceleration/deceleration time, in increments of 0.1 second, when the acceleration/deceleration time switching command is closed. (See Sn-08 thru Sn-11 setting value 0A in Table 15, in Appendix 1.)

Cn-30: ENERGY-SAVING GAIN (KSENG)

Sets, in increments of 1%, the level to which the output voltage is controlled in the energy-saving operation.

In the energy-saving operation, the output voltage is determined by (V [set by Cn-02, -05, -07] x energy-saving gain.) (See Figure 20.)

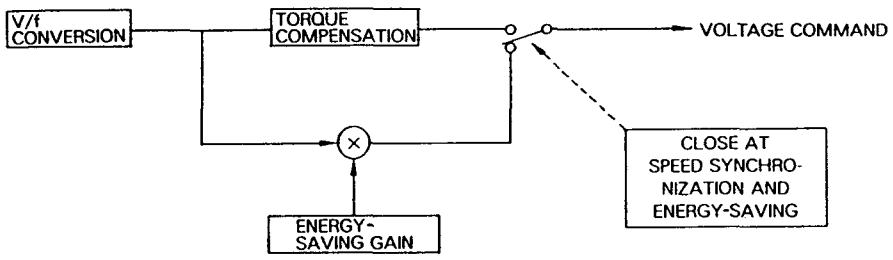
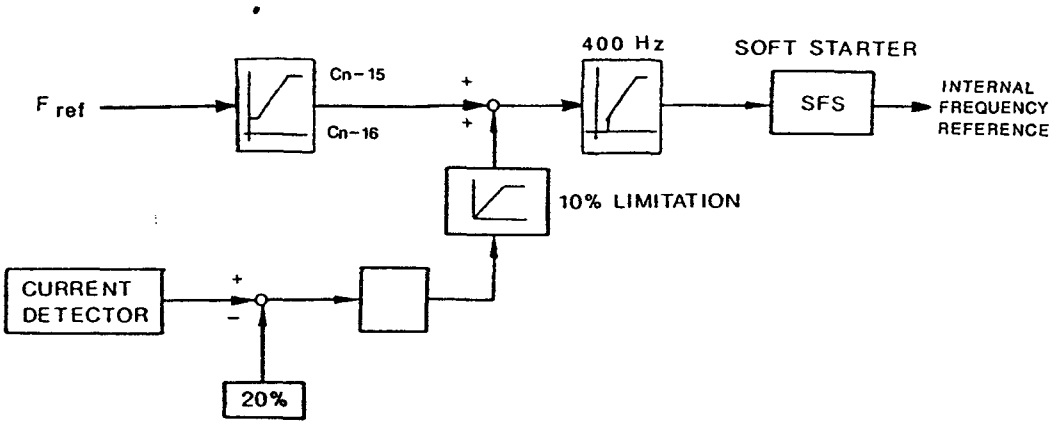


Figure 20. Output Voltage During Energy-Saving Run

Cn-31: SLIP COMPENSATION GAIN

Sets the level of slip compensation gain, in increments of 0.1. When gain is 1, the frequency compensation is increased by 1% of maximum frequency with the inverter rated current. (See Figure 21.)

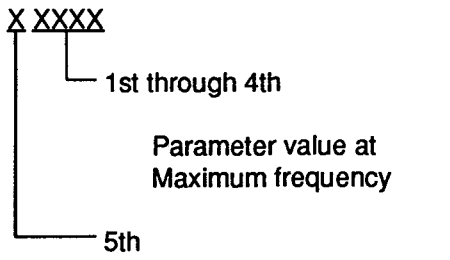


Note: When Fref is smaller than Cn-06, this function does not work.

Figure 21. Slip Compensation Block Diagram

Cn-32: INDICATION GAIN

Sets the type of Drive parameter indicated on the Digital Operator display when the inverter is in Drive mode and monitoring of "output frequency" has been selected.

SETTING VALUE	PARAMETER DISPLAYED
0	Output frequency, in increments of 0.1Hz.
1 to 10 (Number of motor poles)	Motor synchronous speed, in increments of 1 RPM. NOTE: When motor synchronous speed exceeds 9999 RPM, 9999 is displayed.
00011 to 39999	Line speed or other parameter. Five digits are required:  EXAMPLE: To display Line Speed (54.32 FPM at 60Hz), setting value = 25432.

Cn-33: PROGRAMMABLE SPEED COINCIDENCE

Sets the speed coincidence frequency, in increments of 0.1 Hz.

APPENDIX 3. DESCRIPTION OF CHECK FUNCTIONS

Use the Program mode to select constant CH-01 or CH-02, to check the operational status of the Digital Operator's display (LCD) and the status of signals at external terminals 1 thru 8.

CH-01: Press the **RUN/DATA** key. All LCD elements should turn on (seven segments and decimal point in each digit position). If any element remains off, the Digital Operator is defective and should be replaced.

CH-02: Press the **RUN/DATA** key. The elements of the display which turn on (see Figure 22) indicate the open/closed state of inputs at inverter terminals 1 thru 8.

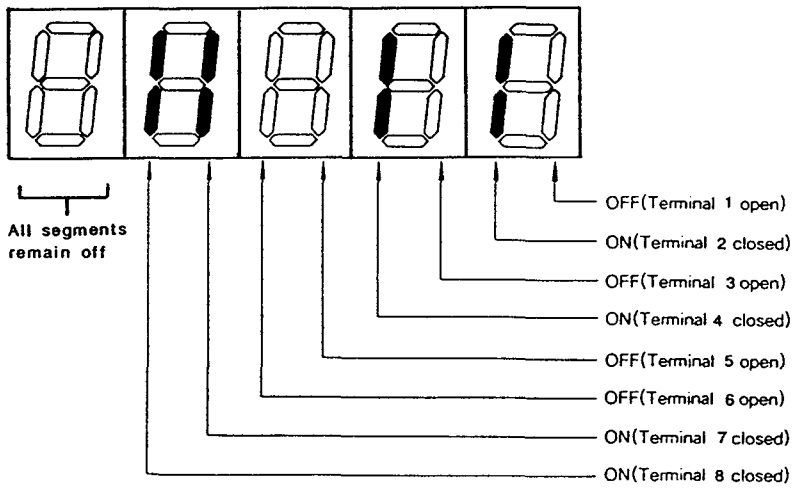


Figure 22. Example of CH-02 Display

APPENDIX 4. DESCRIPTION OF ORDER CONSTANTS

Order constants (On-##) are used to establish special operational characteristics for the drive system, when required by the specific application.

Table 18. Order Constants (On-##)

CONSTANT NO.	NAME	UNITS	SETTING RANGE	STANDARD FACTORY SETTING
On-01	(Bit 0) Coast to Stop	Hex	0000 - FFFF	0000 *
On-02	Prohibited Frequency Bandwidth	0.1 Hz	0.0 - 10.0	1.0
On-03	Number of Auto-restart attempts	–	00 - 10	00
On-18	Stall Prevention Level	1%	30 - 200	160

* Other values may be factory set for individual orders.

On-01: (Bit 0) - Coast to Stop

When a stop command is inputted, the output transistors are immediately turned off, allowing the motor to coast to stop. The DC time at stop is set by Cn-11.

The timing chart for DC braking stop at coast to stop is shown in Figure 23.

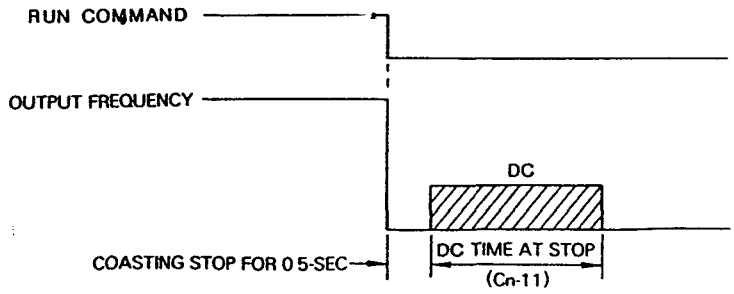
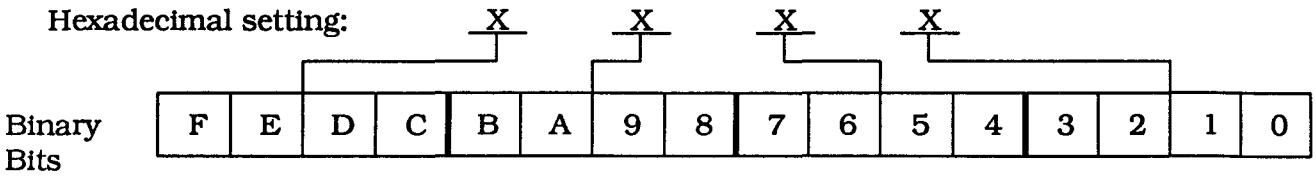


Figure 23. DC Braking Timing at Coast to Stop

NOTE

The setting of On-01 is four hexadecimal (base 16) coded digits, which the inverter translates to a sixteen-bit binary word to identify enable (1)/disable (0) conditions for sixteen functions:



Since Bit 0 is used for enable/disable of coast to stop, ONLY the XXXX digit of On-01 should be increased by 1 to enable coast to stop.

To activate the coast to stop function, perform the following procedure:

1. With the inverter in STOP condition,press **DRIVE/PROG** to select Program mode (red indicator goes off). Display should show "Sn-01".
2. Use ▷ and △ to change display to "Sn-03".
3. Press **DATA** to display the data in Sn-03. Record this data.
4. Using ▷ and △ , change display to read "1010".
5. Press **SET** to temporarily store setting "1010" in Sn-03.
6. Press **MODE**. Display again shows "Sn-01".
7. Press **MODE** twice. Display should show "On-01".
8. Press **DATA** to display the data in "On-01".

IMPORTANT

If the data in On-01 is not 0000, certain other drive parameters have been factory enabled by means of this constant; these settings MUST NOT be disabled without first consulting MagneTek.

9. Examine the XXXX digit of the display. Use ▷ and △ to change that digit to the next higher (i.e. "+1") numeric or alpha value, for enabling coast to stop.

NOTE

Setting this constant to "0000" will disable the coast to stop function, as well as all other drive parameters that may have been factory enabled by means of this constant.

10. Press **SET** to temporarily store the new data for On-01.
11. Press **DSPL/ENTER.** Data is stored (entered in EEPROM) for On-01.

12. Press **MODE**. Display again shows "On-01".

NOTE

If another order constant is to be changed, see its description and enter its setting procedure at step 8.

13. Press **MODE** twice. Display shows "Sn-01".

14. Use ▷ and △ to change display to "Sn-03".

15. Press **DATA**. Display shows "1010".

16. Use ▷ and △ to change display to show data recorded at step 3.

17. Press **SET**. Data is temporarily stored for Sn-03.

18. Press **DSPL/ENTR**. Data is stored (entered in EEPROM) for Sn-03.

19. Press **DRIVE/PROG** to return unit to Drive mode (red indicator lights).

On-02: Prohibited Frequency Bandwidth

The factory-set bandwidth of a prohibited frequency is within ±1 Hz of the value set in Cn–17, Cn-18 or Cn-19. This should be satisfactory for most drive system applications.

If a different bandwidth is required, it can be set in this constant, within a range of 0.0 to 10.0 Hz, in units (increments) of 0.1 Hz. The setting procedure is as follows:

1. With the inverter in STOP condition, press **DRIVE/PROG** to select Program Mode (red indicator goes off). Display should show "Sn-01".

2. Use ▷ and △ to change display to "Sn-03".

3. Press **DATA** to display the data in Sn-03. Record this data.

4. Using ▷ and △ , change display to read "1010".

5. Press **SET** to temporarily store setting "1010" in Sn-03.

6. Press **MODE**. Display again shows "Sn-01".

7. Press **MODE** twice. Display should show "On-01".

8. Use ▷ and △ to change display to "On-02".

9. Press **DATA** to display the data in On-02.

10. Use ▷ and △ to change display to show the desired ± bandwidth. (Example: "02.0" indicates ± 2.0 Hz).

11. Press **SET** to temporarily store the new data for On-02.

12. Press **DSPL/ENTER**. Data is stored (entered in EEPROM) for On-02.

13. Press **MODE**. Display again shows "On-01".

NOTE

If another order constant is to be changed, see its description and enter its setting procedure at step 8.

14. Press **MODE** twice. Display shows "Sn-01".

15. Use ▷ and △ to change display to "Sn-03".

16. Press **DATA**. Display shows "1010".

17. Use ▷ and △ to change display to show data recorded at step 3.

18. Press **SET**. Data is temporarily stored for Sn-03.

19. Press **DSPL/ENTR**. Data is stored (entered in EEPROM) for Sn-03.

20. Press **DRIVE/PROG** to return unit to Drive mode (red indicator lights).

On-03: Number of Auto-restart Attempts

When a fault occurs (except FU, Eb or CPF) during operation, the inverter can be programmed to carry out auto-restart operation to automatically reset the fault.

Auto-restart operation will use the number of reset attempts set in this constant, up to a maximum of 10. Figure 24 shows the timing chart for auto-restart operation in case of fault.

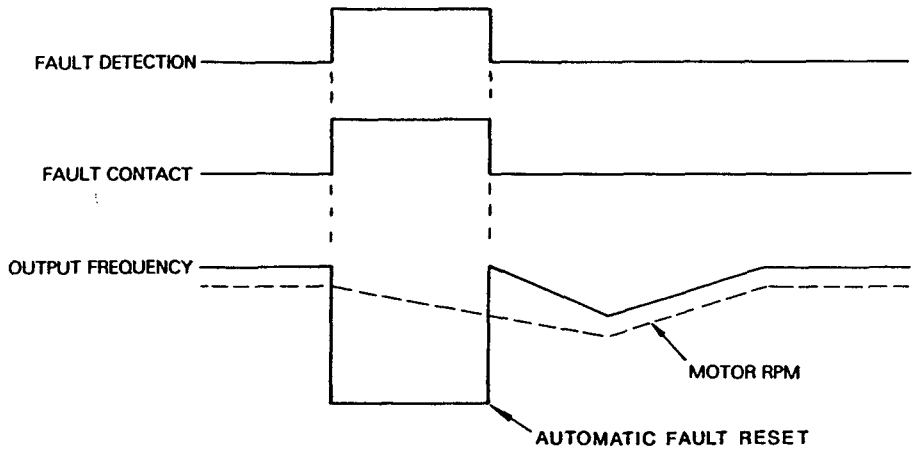


Figure 24. Auto Restart Operation Timing

The setting procedure is as follows:

1. With the inverter in STOP condition, press **DRIVE/PROG** to select Program mode (red indicator goes off). Display should show "Sn-01".

2. Use ▷ and △ to change display to "Sn-03".

3. Press **DATA** to display the data in Sn-03. Record this data.

4. Using ▷ and △ , change display to read "1010".

5. Press **SET** to temporarily store setting "1010" in Sn-03.

6. Press **MODE**. Display again shows "Sn-01".

7. Press **MODE** twice. Display should show "On-01".

8. Use ▷ and △ to change display to "On-03".

9. Press **DATA** to display the data in On-03.

10. Use ▷ and △ to change display to show the desired number of retry attempts. (Example: "05" indicates 5 attempts).

11. Press **SET** to temporarily store the new data for On-01.

12. Press **DSPL/ENTER**. Data is stored (entered in EEPROM) for On-03.

13. Press **MODE**. Display again shows "On-01".

NOTE

If another order constant is to be changed, see its description and enter its setting procedure at step 8.

14. Press **MODE** twice. Display shows "Sn-01".

15. Use ▷ and △ to change display to "Sn-03".

16. Press **DATA**. Display shows "1010".

17. Use ▷ and △ to change display to show data recorded at step 3.

18. Press **SET**. Data is temporarily stored for Sn-03.

19. Press **DSPL/ENTR**. Data is stored (entered in EEPROM) for Sn-03.

20. Press **DRIVE/PROG** to return unit to Drive mode (red indicator lights).

On-18: Stall Prevention Level

During operation (while the speed is being synchronized), if the inverter output current exceeds the stall prevention level set in this constant (factory set to 160%), the output frequency begins dropping at a rate of half that established by the deceleration time setting (Cn-09 or Cn-29). When the output current has dropped below the stall prevention level, the output frequency is accelerated to the set value at the rate established by the acceleration time setting (Cn-08 or Cn-29).

The stall prevention level can be set, in units (increments) of 1%, in ratio to the reference current for setting constants (see Table 11).

The setting procedure is as follows:

1. With the inverter in STOP condition, press **DRIVE/PROG** to select Program Mode (red indicator goes off). Display should show "Sn-01".
2. Use ▷ and △ to change display to "Sn-03".
3. Press **DATA** to display the data in Sn-03. Record this data.
4. Using ▷ and △, change display to read "1010".
5. Press **SET** to temporarily store setting "1010" in Sn-03.
6. Press **MODE**. Display again shows "Sn-01".
7. Press **MODE** twice. Display should show "On-01".
8. Use ▷ and △ to change display to "On-18".
9. Press **DATA** to display the data in On-18.
10. Use ▷ and △ to change display to show the desired stall-during-operation level. (Example: "120" indicates 120% of reference current value).
11. Press **SET** to temporarily store the new data for On-01.
12. Press **DSPL/ENTER**. Data is stored (entered in EEPROM) for On-18.
13. Press **MODE**. Display again shows "On-01".

NOTE

If another order constant is to be changed, see its description and enter its setting procedure at step 8.

14. Press **MODE** twice. Display shows "Sn-01".
15. Use ▷ and △ to change display to "Sn-03".
16. Press **DATA**. Display shows "1010".
17. Use ▷ and △ to change display to show data recorded at step 3.
18. Press **SET**. Data is temporarily stored for Sn-03.
19. Press **DSPL/ENTR**. Data is stored (entered in EEPROM) for Sn-03.
20. Press **DRIVE/PROG** to return unit to Drive mode (red indicator lights).

APPENDIX 5. CHECKING OF DIODE AND TRANSISTOR MODULES

Diode Module

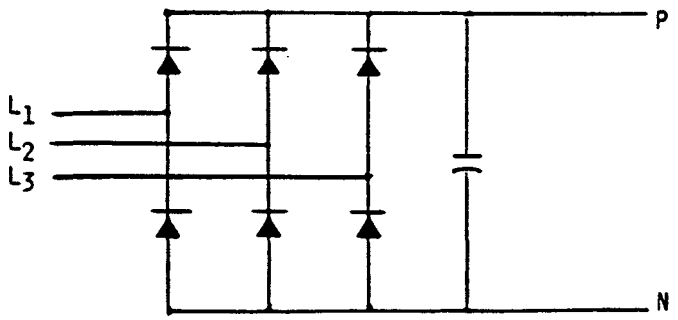
Measure the resistance across the module terminals with a volt-ohm meter. Set the meter at the X1 range. The measured resistance should be within the values listed in Table 19.

Table 19. Diode Module Resistances

+ ON	- ON	NORMAL READING (OHMS)	ABNORMAL READING (OHMS)
L1	P	10 to 50	0 or INFINITE
L2	P		
L3	P		
N	L1		
N	L2		
N	L3		

+ ON	- ON	NORMAL READING (OHMS)	ABNORMAL READING (OHMS)
L1	N	INFINITE	LESS THAN
L2	N		
L3	N		
P	L1		
P	L2		
P	L3		
P	N	MAGNITUDE OF CAP CHARGE TO INFINITE	0 or INFINITE

RESISTANCE TEST FOR 3Ø CONVERTER MODULES (BRIDGE RECT)



VOM RESISTANCE SCALE RX1
+ IS THE POSITIVE POLARITY LEAD*
- IS THE NEGATIVE POLARITY LEAD

*THE VOM RED LEAD IS NOT NECESSARILY THE POSITIVE POTENTIAL IN THE RESISTANCE MODE. FOR THESE TESTS THE + LEAD REFERS TO THE POSITIVE POTENTIAL. MAKE SURE YOU KNOW WHICH POLARITY YOU HAVE ON YOUR VOM.

Transistor Module

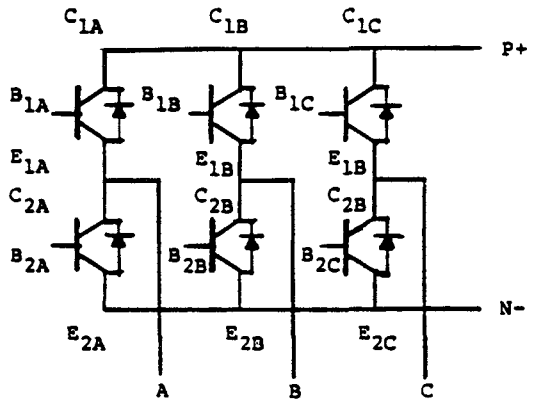
Measure the resistance across the module terminals with a volt-ohm meter. Set the meter to the X1 range. The measured resistance should be within the values listed in Table 20.

Table 20. Transistor Module Resistances

+ ON	- ON	NORMAL READING (OHMS)	ABNORMAL READING (OHMS)
P	A		
P	B	GREATER	
P	C		
A	N	THAN	0
B	N		
C	N	50K OHMS	
A	P		
B	P		
C	P	10 to 50	0 or INFINITE
N	A		
N	B		
N	C		

+ ON	- ON	NORMAL READING (OHMS)	ABNORMAL READING (OHMS)
B1A	A		
B1B	B		GREATER
B1C	C	10 to 50	
B2A	N		THAN
B2B	N		
B2C	N		10K OHMS
A	B1A		
B	B1B		
C	B1C	200 to 5K	0 or INFINITE
N	B2A		
N	B2B		
N	B2C		

RESISTANCE TEST FOR 3Ø TRANSISTOR MODULES



VOM RESISTANCE SCALE RX1
+ IS THE POSITIVE POLARITY LEAD*
- IS THE NEGATIVE POLARITY LEAD

*THE VOM RED LEAD IS NOT NECESSARILY THE POSITIVE POTENTIAL IN THE RESISTANCE MODE. FOR THESE TESTS THE + LEAD REFERS TO THE POSITIVE POTENTIAL. MAKE SURE YOU KNOW WHICH POLARITY YOU HAVE ON YOUR VOM.

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