TOSHIBA

HIGH PERFORMANCE TRANSISTOR INVERTER
IGBT DIGITAL SERIES

TOSVERT-130G2+

OPERATION MANUAL

October, 1994
Part #34470

IMPORTANT NOTICE

The instructions contained in this manual are not intended to cover all of the details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should additional information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Toshiba sales office.

The contents of this instruction manual shall not become a part of or modify any prior or existing agreement, commitment, or relationship. The sales contract contains the entire obligation of Toshiba International Corporation's Inverter Division. The warranty contained in the contract between the parties is the sole warranty of Toshiba International Corporation's Inverter Division and any statements contained herein do not create new warranties or modify the existing warranty.

Toshiba International Corporation reserves the right, without prior notice, to update information, make product changes, or to discontinue any product or service identified in this publication.

Any electrical or mechanical modification to this equipment, without prior written consent of Toshiba International Corporation, will void all warranties and may void UL listing and/ or CSA certification.

AC ADJUSTABLE SPEED DRIVE

Please complete the Extended Warranty Card supplied with this inverter and return it by prepaid mail to Toshiba. This activates the extended warranty. If additional information or technical assistance is required, call Toshiba's marketing department toll free at (800) 231-1412 or write to: Toshiba International Corporation, 13131 W. Little York Road, Houston, TX 77041-9990.

Please complete the following information for your records and to remain within this equipment manual:

Model Number: _____

Serial Number: _____

Date of Installation: _____

Inspected By: _____

Reference Number: _____

INTRODUCTION

Thank you for purchasing the **TOSVERT-130G2+**. This adjustable frequency solid state AC drive features pulse width modulation, digital control, and user programmability. The very latest microprocessor and insulated gate bipolar transistor technology is used. This, combined with Toshiba's high performance software, gives unparalleled motor control and reliability.

It is the intent of this operation manual to provide a guide for ***safely*** installing, operating, and maintaining the drive. This operation manual contains a section of general safety instructions and is marked throughout with warning symbols. **Read this operation manual** thoroughly before installing and operating this electrical equipment.

All safety warnings must be followed to ensure personal safety.

Follow all precautions to attain proper equipment performance and longevity.

We hope that you find this operation manual informative and easy to use. If additional information or technical assistance is needed, please call toll free (800) 231-1412 or write to: Toshiba International Corporation, 13131 W. Little York Road, Houston, TX 77041-9990.

Again, thank you for the purchase of this product.

TOSHIBA INTERNATIONAL CORPORATION

GENERAL SAFETY INSTRUCTIONS

Warnings in this manual appear in either of two ways:

1) *Danger warnings* - The danger warning symbol is an exclamation mark enclosed in a triangle which precedes the 3/16" high letters spelling the word "DANGER". The Danger warning symbol is used to indicate situations, locations, and conditions that can cause serious injury or death:

 **DANGER**

2) *Caution warnings* - The caution warning symbol is an exclamation mark enclosed in a triangle which precedes the 3/16" high letters spelling the word "CAUTION". The Caution warning symbol is used to indicate situations and conditions that can cause operator injury and/or equipment damage:

 **CAUTION**

Other warning symbols may appear along with the *Danger* and *Caution* symbol and are used to specify special hazards. These warnings describe particular areas where special care and/or procedures are required in order to prevent serious injury and possible death:

1) *Electrical warnings* - The electrical warning symbol is a lighting bolt mark enclosed in a triangle. The Electrical warning symbol is used to indicate high voltage locations and conditions that may cause serious injury or death if the proper precautions are not observed:

2) *Explosion warnings* - The explosion warning symbol is an explosion mark enclosed in a triangle. The Explosion warning symbol is used to indicate locations and conditions where molten, exploding parts may cause serious injury or death if the proper precautions are not observed:

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1.0 Inspection/Storage/Disposal

1.1 Inspection of the New Unit

Upon receipt of the TOSVERT-130G2+, a careful inspection for shipping damage should be made. After uncrating:

1) Check the unit for loose, broken, bent or otherwise damaged parts due to shipping.

2) Check to see that the rated capacity and the model number specified on the nameplate conform to the order specifications.

1.2 Storage

1) Store in a well ventilated location and preferably in the original carton if the inverter will not be used immediately after purchase.

2) Avoid storage in locations with extreme temperatures, high humidity, dust, or metal particles.

1.3 Disposal

Please contact your state environmental agency for details on disposal of electrical components and packaging in your particular area.

2.0 Safety in Installation and Operation

2.1 Installation Precautions  CAUTION

1) Install in a secure and upright position in a well ventilated location that is out of direct sunlight. The ambient temperature should be between -10° C and 40° C (up to 50° C when not enclosed in a cabinet).

2) Allow a clearance space of 4 inches (10 cm) for the top and bottom and 2 inches (5 cm) on both sides. This space will insure adequate ventilation. Use care not to obstruct any of the ventilation openings.

3) Avoid installation in areas where vibration, heat, humidity, dust, steel particles, or sources of electrical noise are present.

4) Adequate working space should be provided for adjustment, inspection and maintenance.

5) Adequate lighting should be available for troubleshooting and maintenance.

6) A noncombustible insulating floor or mat should be provided in the area immediately surrounding the electrical system where maintenance is required.

7)  Always ground the unit to prevent electrical shock and to help reduce electrical noise. A separate ground cable should be run inside the conduit with the input, output, and control power cables (See Grounding Section 4.3). ***The metal of the conduit is not an acceptable ground.***

8) Connect three phase power of the correct voltage to input terminals L1, L2, L3 (R, S, T) and connect three phase power from output terminals T1, T2, T3 (U, V, W) to a motor of the correct voltage and type for the application. Size the conductors in accordance with *Selection of Main Circuit Wiring Equipment and Standard Cable Sizes* Section 4.2.

9) If conductors of a smaller than recommended size are used in parallel to share current then the conductors should be kept together in sets i.e. U1, V1, W1 in one conduit and U2, V2, W2 in another. National and local electrical codes should be checked for possible cable derating factors if more than three power conductors are run in the same conduit.

10) Install a molded case circuit breaker (MCCB) between the power source and the inverter. Size the MCCB to clear the available fault current of the power source.

11) Use separate metal conduits for routing the input power, output power, and control circuits.

12) Installation of inverter systems should conform to the *National Electrical Code*, regulations of the *Occupational Safety and Health Administration*, all national, regional or industry codes and standards.

13) Do not connect control circuit terminal block return connections marked CC to inverter earth ground terminals marked GND(E). See *Simple Connection Diagrams* Section 4.1 and *Terminal Connections and Functions* Section 4.10.

2.1 Installation Precautions (cont'd) CAUTION

14) If a secondary Magnetic Contactor (MC) is used between the inverter output and the load, it should be interlocked so the ST-CC terminals are disconnected before the output contactor is opened. If the output contactor is used for bypass operation, it must also be interlocked so that commercial power is never applied to the inverter output terminals (U,V,W).

2.2 Operating Precautions CAUTION

1) Do not power up the inverter until this entire operation manual is reviewed.

2) The input voltage must be within +/-10% of the specified input voltage. Voltages outside of this permissible tolerance range may cause internal protection devices to turn on or can cause damage to the unit. Also, the input frequency should be within +/-2 Hz of the specified input frequency.

3) Do not use this inverter with a motor whose rated input is greater than the rated inverter output.

4) This inverter is designed to operate NEMA B motors. Consult the factory before using the inverter for special applications such as an explosion proof motor or one with a repetitive type piston load.

5) **DANGER** Do not touch any internal part with power applied to the inverter. First remove the source power and check that the charge and power LED's are out. ***A hazard exists temporarily for electrical shock even if the source power is removed.***

6) Do not operate this unit with the cabinet door open.

7) Do not apply commercial power to the output terminals T1 (U), T2 (V), or T3 (W) even if the inverter source power is off. Disconnect the inverter from the motor before applying a test or bypass voltage to the motor.

8) Use caution when setting output frequency. Overspeeding of the motor can cause serious damage to the motor and/or the driven load equipment.

9) Use caution when setting the acceleration and deceleration time. Unnecessarily short times can cause undue stress and tripping of the drive.

10) The G2+ series of inverters can be operated in a special PWM high carrier frequency mode for low acoustical noise. When operating in this special mode, where the carrier frequency is greater than 3 KHz, special programming procedures and operating precautions must be followed. ***Failure to follow these special programming procedures and operating precautions may result in damage to the inverter and can invalidate the factory warranty*** **(Contact Toshiba for additional operating and programming information).**

11) Interface problems can occur when this inverter is used in conjunction with some types of process controllers. ***Signal isolation may be required to prevent controller and/or inverter damage*** **(Contact Toshiba or the process controller manufacturer for additional information about compatibility and signal isolation).**

2.2 Operating Precautions (cont'd) CAUTION

12) Do not open and then re-close a secondary magnetic contactor (MC) between the inverter and the load until the inverter has been turned OFF (output frequency has dropped to zero) and the motor has stopped rotating. ***Abrupt re-application of the load while inverter is ON or motor is rotating can cause inverter damage.***

13) Personnel who have access to the adjustments and operation of this equipment should be familiar with these drive operating instructions and with the machinery being driven.

14) The operator of the drive equipment should be properly trained in the operation of the equipment.

15) ***Follow all warnings and precautions; do not exceed equipment ratings.***

2.3 Confirmation of Wiring CAUTION

Make the following final checks before applying power to the unit:

1) Confirm that source power is connected to terminals L1, L2, L3 (R, S, T). ***Connection of incoming source power to any other terminals will damage the inverter.***
2) The 3-phase source power should be within the correct voltage and frequency tolerances.
3) The motor leads must be connected to terminals T1, T2, T3 (U, V, W).
4) Make sure there are no short circuits or inadvertent grounds and tighten any loose connector terminal screws.

2.4 Start-Up and Test CAUTION

Prior to releasing an electrical drive system for regular operation after installation, the system should be given a start-up test by competent personnel. This assures correct operation of the equipment for reasons of reliable and safe performance. It is important to make arrangements for such a check and that time is allowed for it.

When power is applied for the first time the inverter will come up in the factory settings (See section 6.7 and 6.8). If these settings are incorrect for the application trial run then, before activating the run button, the correct settings should be programmed from the control panel. ***The inverter can be operated with no motor connected.*** Operation with no motor connected or use with a small trial motor is recommended for initial adjustment or for learning to adjust and operate the inverter.

2.5 Maintenance CAUTION

1) Periodically check the operating inverter for cleanliness.
2) Keep the heatsink free of dust and debris.
3) Periodically check electrical connections for tightness ***(make sure power is off and locked out).***

3.0 Standard Specifications

MODEL	RATING					INPUT POWER (Volt/Freq)	
	RATED KVA	MOTOR HP/KW	OUTPUT CURRENT AMPS	OUTPUT VOLTAGE	OVERLOAD CURRENT	MAIN CIRCUIT 3-PHASE	CONTROL CIRCUIT SINGLE PHASE
*G2+2010	1	0.75/0.9	3.5	200-230V 3-PHASE (MAX VOLTAGE UNDER NO LOAD)	150% FOR 120 SEC. 110% CONTINUOUS	200V/50Hz or 200-230V/60Hz VOLTAGE +/- 10% FREQUENCY +/- 2Hz	NO EXTERNAL CONTROL SOURCE REQUIRED
*G2+2015	1.5	1/1.2	5				
*G2+2025	2.5	2/1.8	7				
*G2+2035	3.5	3/2.5	10				
*G2+2055	5.5	5/4.0	16				
*G2+2080	8	7.5/5.5	22				
*G2+2110	11	10/7.5	30				
*G2+2160	16	15/11	45				
*G2+2220	22	20/15	60				
*G2+2270	27	25/18	70				
*G2+2330	33	30/23	90				
*G2+4015	1.5	1/0.75	2.7	400-460V 3-PHASE (MAX VOLTAGE UNDER NO LOAD)		400V/50Hz or 400-460V/60Hz VOLTAGE +/- 10% FREQUENCY +/- 2Hz	
*G2+4025	2.5	2/1.5	3.5				
*G2+4035	3.5	3/2.2	5				
*G2+4055	5.5	5/3.7	8				
*G2+4080	8	7.5/5.5	11				
*G2+4110	11	10/7.5	15	380-460V 3-PHASE MAX VOLTAGE UNDER NO LOAD)		380V/50Hz or 400-460V/60Hz VOLTAGE +/- 10% FREQUENCY +/- 2Hz	
*G2+4160	16	15/11	22				
*G2+4220	22	20/15	30				
*G2+4270	27	25/18.5	38				
*G2+4330	33	30/22	45				
*G2+4400	40	40/30	55				
*G2+4500	50	50/37	69				
*G2+4600	60	60/45	83				
*G2+4750	75	75/55	104				
*G2+410K	100	100/75	138				
*G2+412K	125	125/90	172		130% FOR 195 SEC. 110% CONTINUOUS		
*G2+415K	150	150/110	206				
*G2+420K	200	200/150	275				
*G2+425K	250	250/200	343				
**G2+430K	300	300/225	415				

* These units are UL/CUL (Underwriters Laboratories Inc.) listed and CSA (Canadian Standards Association) certified.

** Unit is UL/CUL listed only.

3.0 Standard Specifications (Cont'd)

ITEM		STANDARD SPECIFICATIONS
Control	Control Method	Sinusoidal PWM control
	Output voltage regulation	Same as power line.
	Output frequency	0.5 to 400Hz (0.1 to 80Hz setting when shipped); maximum frequency range is 30 to 400Hz *
	Frequency setting resolution	0.1Hz: Operating panel input; 0.03Hz: Analog input; 0.01Hz: Input through computer interface (against a 60Hz)
	Frequency accuracy	±0.5% (at 25°C; ±10°C) against the maximum frequency
	Voltage/frequency characteristics	Either constant V/f or second-order nonlinear mode for variable torque. "Max voltage" frequency adjustment (25 to 400Hz), voltage boost adjustment (0 to 30%), start-up frequency adjustment (0 to 10Hz)
	Frequency setting signals	3k ohms potentiometer (a 1k to 10k ohms-rated potentiometer can be connected). 0 to 10Vdc (input impedance: 30k ohms), 0 to 5Vdc (15k ohms), 4 to 20mAdc (250 ohms)
	Output frequency characteristics of IV terminal input signal	Can be set to an arbitrary characteristic by setting 2 points.
	Frequency jump	3-point setting; setting jump frequency and band width
	Upper/lower limit frequencies	Upper limit frequency: 0 to maximum frequency Lower limit frequency: 0 to upper limit frequency
	PWM carrier frequency switching	Adjusted in the range of 0.5kHz to 3kHz
Operating functions	Acceleration/deceleration time	0.1 to 6000 seconds, switching of acceleration time 1 or 2, selection of S-shaped 1 or 2, or selection of acceleration/ deceleration patterns
	Electrical braking	G2+2010 to G2+430K; IGBT7 dynamic braking
		DC injection braking: Start-up frequency adjustment (0 to 10Hz), braking voltage adjustment (0 to 20%), braking time adjustment (0 to 5 seconds)
	Forward or reverse run	Forward run when F-CC closed; reverse run when R-CC closed; reverse run when both F-CC and R-CC closed; coasting stop when ST-CC open; emergency coast stop by a command from operating panel
	Jogging run	Jogging run engaged when N.O. contact is closed. (adjustment range 0 to 20Hz)
	Multispeed run	By opening and closing different combinations of CC, SS1, SS2, and SS3, the set speed or seven preset speeds can be selected.
	Automatic fault latch reset	When a protective function is activated, the system checks main circuit devices, and attempts the restart up to 5 times (deactivated when shipped)
	Soft stall	Sustains a run in overload mode (set at OFF when shipped)
	Automatic restart	Smoothly recovers a normal run of a free-running motor utilizing motor speed detection control.
	Programmable RUN patterns	Allows setting of 7 different patterns of automatic operation
Protection	Protective functions	Stall prevention, current limit, overcurrent, overvoltage, short-circuit at load, load-end ground fault, undervoltage, momentary power interrupt, electronic thermal overload, main circuit over-current at start-up, load-end overcurrent at start-up, regenerative discharge resistor overcurrent or overload, fin overheat, and emergency stop. Provisions for external fault signal.
	Electronic thermal characteristics	Standard motor/constant torque V/f motor switching, and electronic thermal stall prevention activating level adjustment
	Reset	Resets inverter when N.O. contact is closed.

* Consult the factory for applications above 80 Hz.

3.0 Standard Specifications (Cont'd)

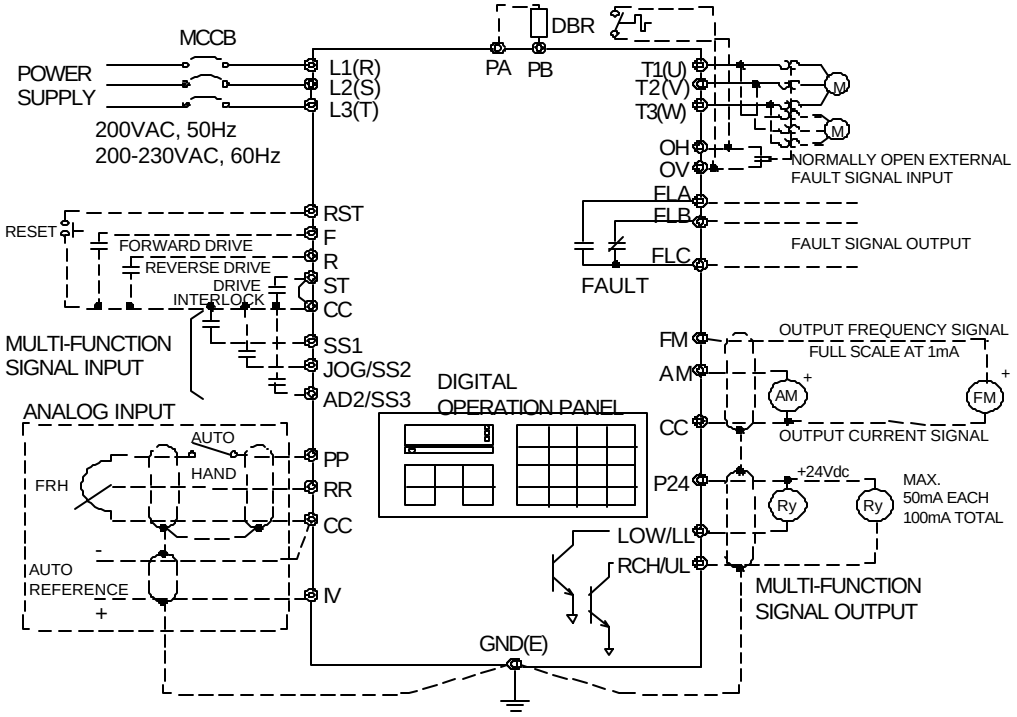
ITEM		STANDARD SPECIFICATIONS	
Display	4-digit, 7-segment LEDs	Output frequency/ OFF	Frequency range 0.0 to 400Hz and OFF state
		Warning indications	Stall preventive warning, overvoltage limit warning, overload warning, power-end undervoltage warning, DC main circuit undervoltage warning, setting errors, EEPROM abnormality, and data transfer abnormality warnings
		Fault indications	Overcurrent, overvoltage, load-end ground fault, overload, armature overcurrent at start-up, load-end overcurrent at start-up, regenerative discharge resistor overcurrent or overload, and fin overheat
		Data and status	Inverter status (forward/reverse run, frequency set value, output current, etc.) and each set value
		Speed scaling	An arbitrary unit (revolution speed, linear velocity or the like) as well as output frequency can bedisplayed
		Data storage	A number is assigned to each inverter (for 0 to 31 inverters).
	LED	Charging indicator	Main circuit capacitors charging indicator
Output signals	Fault detection signal	One form C contact (250AC / 30Vdc)	
	Low speed/reach signals	Open collector output (24Vdc, 50mA maximum)	
	Upper limit/lower limit frequency signals	Open collector output (24Vdc, 50mA maximum)	
	Frequency meter output and ammeter output	Ammeter rated at 1mAdc at full scale, or voltmeter rated at 7.5Vdc, 1mA	
Enclosure type		Type 1 (standard), type 12 (option kits available) *	
Cooling method		Convection-cooled G2+2010 thru G2+2055 and G2+4015 thru G2+4080 Fan-cooled G2+2080 thru G2+2330 and G2+4110 thru G2+430K	
Color		Sherwin Williams Precision Tan #F63H12	
Service conditions	Service environment	Indoor, altitude 1000m (3,300 ft) maximum. Must not be exposed to direct sunlight, or subjected to corrosive or explosive gas or mists.	
	Ambient temperature	From -10 to 40°C (up to +50°C without the cover)	
	Relative humidity	90% maximum (no condensation allowed)	
	Vibration	Acceleration at 0.5G maximum (20 to 50Hz), amplitude at 0.1mm maximum (50 to 100Hz)	

* Enclosure for G2+430K has a removable bottom panel that must be drilled or punched in the field to accomodate the wiring system conduit.

4.0 Wiring, PWB Layout, Jumpers, and Terminal Connections

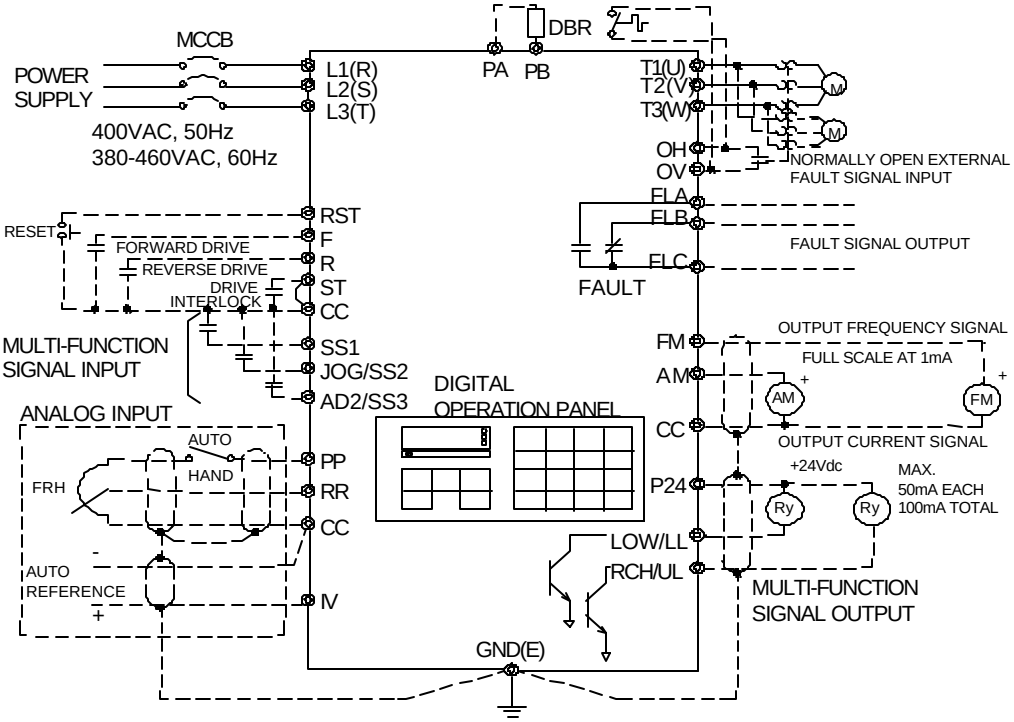
4.1 Simple Connection Diagrams

TOSVERT-130G2+
STANDARD CONNECTION
MODEL 2010 TO 2330



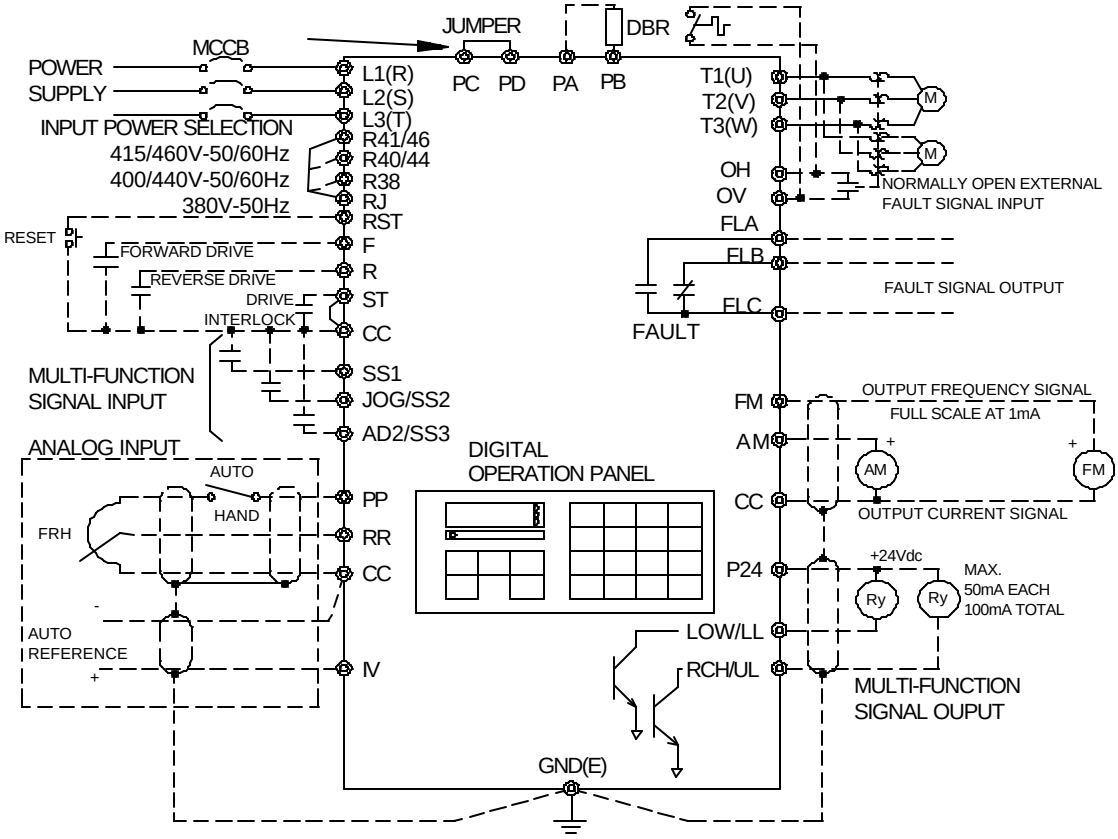
4.1 Simple Connection Diagrams (Cont'd)

TOSVERT-130G2+
STANDARD CONNECTION
MODEL 4015 TO 4080



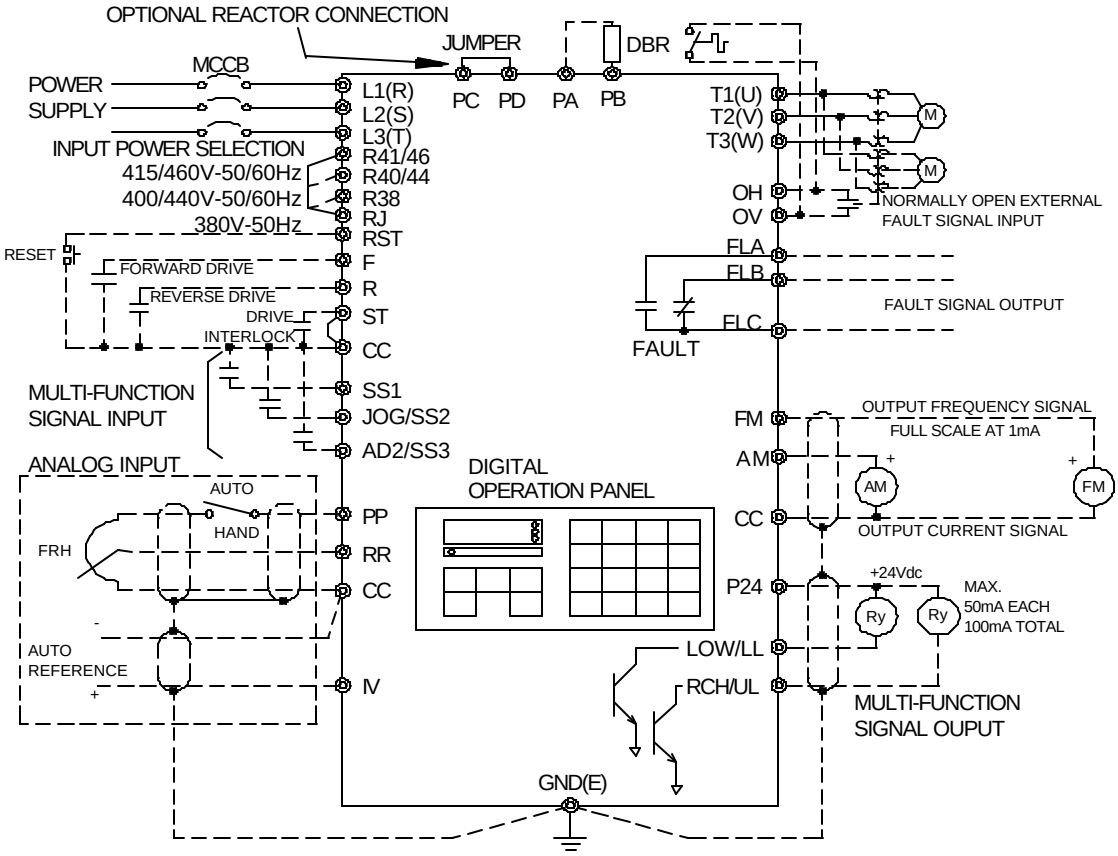
4.1 Simple Connection Diagrams (Cont'd)

TOSVERT-130G2+
STANDARD CONNECTION
MODEL 4110 TO 412K



4.1 Simple Connection Diagrams (Cont'd)

TOSVERT-130G2+
STANDARD CONNECTION
MODEL 415K TO 430K



4.2 Selection of Main Circuit Wiring Equipment and Standard Cable Sizes

Inverter	*Molded case circuit breaker (MCCB)	Ampacity (FLA x 1.25)	**Typical cable size (AWG)			
Type form	Amp rating (A)	(A)	Main power and motor load	230Vac and 460Vac control power source	Frequency command input, frequency meter, ammeter	Other signal circuits
G2+2010	15	4	#14	#14	3-core shield cable (speed reference) 2-core shield cable #20	#18
G2+2015	15	5.1	#14			
G2+2025	20	9.8	#14			
G2+2035	20	13.8	#14			
G2+2055	30	21.9	#12			
G2+2080	50	31.6	#10			
G2+2110	70	40	#8			
G2+2160	90	60	#6			
G2+2220	100	78	#4			
G2+2270	125	98	#3			
G2+2330	150	115	#2			
G2+4015	15	2.5	#14			
G2+4025	15	4.9	#14			
G2+4035	15	6.9	#14			
G2+4055	15	10.9	#14			
G2+4080	30	15.8	#14			
G2+4110	30	20.1	#12			
G2+4160	40	30.2	#10			
G2+4220	50	38.8	#8			
G2+4270	70	48.8	#8			
G2+4330	90	57.5	#6			
G2+4400	100	74.8	#4			
G2+4500	100	93.4	#3			
G2+4600	125	110.7	#2			
G2+4750	175	138	#1/0			
G2+410K	200	178.3	#3/0			
G2+412K	225	224.3	#4/0			
G2+415K	300	258.8	*** 2 (#2/0)			
G2+420K	350	345	*** 2 (#4/0)			
G2+425K	400	428	*** 2(#4/0)			
G2+430K	600	472	*** 2(#350)			

See next page for notes.

4.2 Selection of Main Circuit Wiring Equipment and Standard Cable Sizes (Cont'd)

* The customer supplied Molded Case Circuit Breaker (MCCB) or Magnetic Circuit Protector (MCP) should be coordinated with the available short circuit current. The units are rated for output short circuit faults of 5000A (1 - 50 HP), 10,000A (51 - 200 HP), and 18,000A (201 - 400 HP) according to the UL 508 "Standard for Industrial Control Equipment" Table 57B.4 or CSA Standard C22.2 No.14-M1987 "Industrial Control Equipment" Table 24. The selection of breakers for this table is in accordance with 1987 NEC Article 430. The selection of these breakers takes into consideration motor starting at the low end of the output voltage specifications but does not consider the use of high efficiency motors.

* For multiple motor applications, the magnetic only MCP should be replaced by a thermal magnetic MCCB. The MCCB should be sized according to 1.25 X (largest motor Full Load Amps) + (sum of all other motor Full Load Amps) to meet National Electric Code (NEC) or Canadian Electrical Code (CEC) requirements.

** Wire sizing is based upon NEC table 310-16 or CEC Table 2 using 75 deg C cable, an ambient of 30 deg C, cable runs for less than 300 FT., and copper wiring for not more than three conductors in raceway or cable or earth (directly buried). The customer should consult the NEC or CEC wire Tables for his own particular application and wire sizing.

** For cable runs greater than 300 FT., consult the factory before installing.

*** Use two parallel conductors instead of a single conductor (this will allow for the proper wire bending radius within the cabinet). Use separate conduits for routing parallel conductors. This prevents the need for conductor derating (see note 3 this page).

Notes:

1.) Auxiliary relays used to switch inverter signals should be capable of switching low current signals (i.e. 5mA).

2.) The inverter has internal overload protection, but the Local, National, or Canadian Electrical Codes may require external motor overload protection.

3.) When wiring with parallel conductors, the conductors should be kept together in phase sets with U1, V1, W1 in one conduit and parallel conductors U2, V2, W2 in another conduit. The ground conductor should be in one of these conduits.

CAUTION ***Use separate conduits for routing incoming power, power to motor, and control conductors. Use no more than three power conductors and a ground conductor per conduit.***

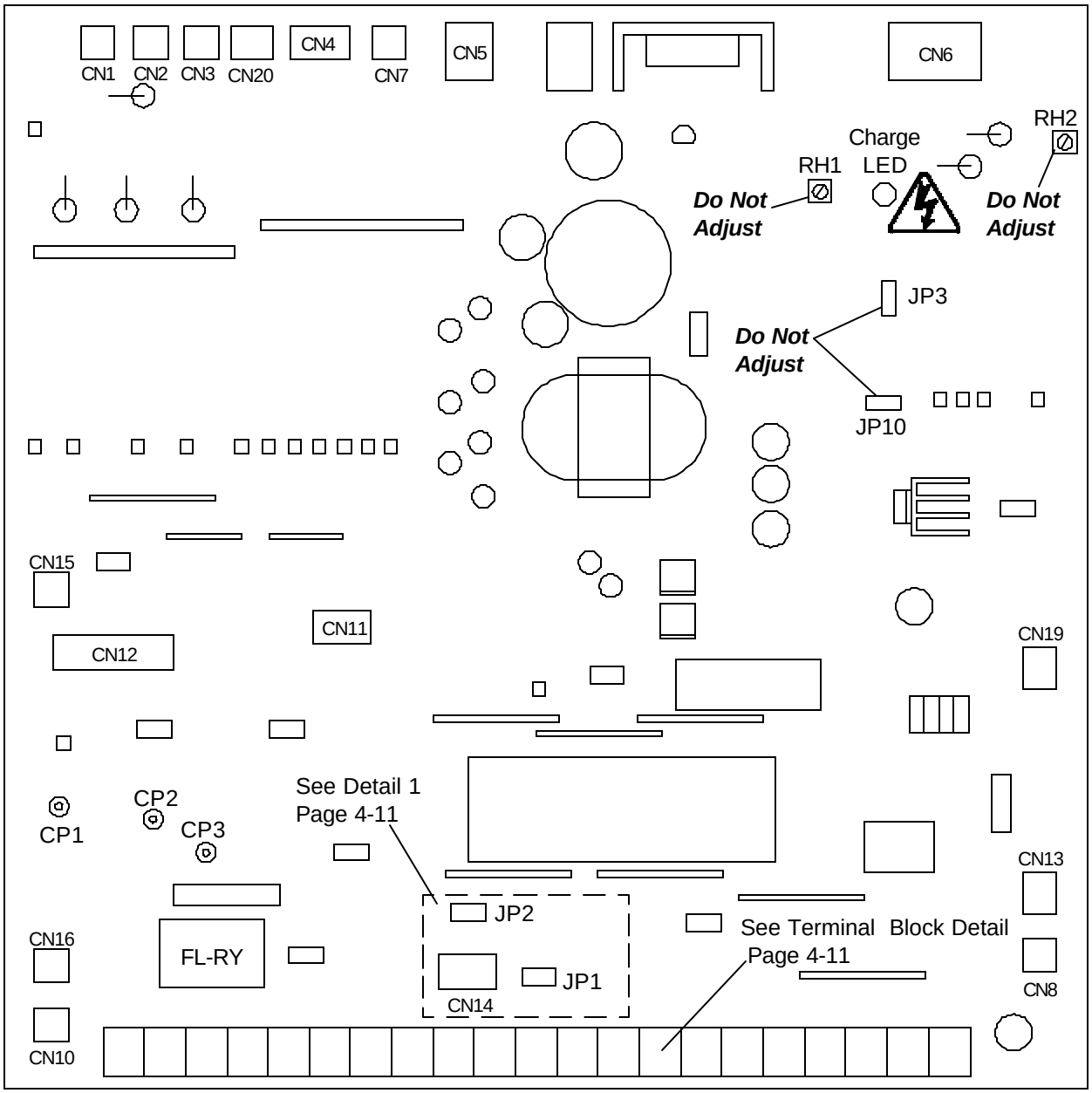
4.3 Grounding

The inverter should be grounded in accordance with Article 250 of the National Electrical Code or Section 10 of the Canadian Electrical Code, Part I and the grounding conductor should be sized in accordance with NEC Table 250-95 or CEC, Part I Table 16.

CAUTION ***Conduit is not a suitable ground for the inverter.***

4.4 Control/Driver Board for G2+2010 through G2+2220

The following pictorial shows a layout of the major components located on the control/driver board VF3B-0100.



Note:

1) Potentiometer ***RH1*** is used for control power supply stabilization. This adjustment is factory set and any ***ADJUSTMENT BY THE USER SHOULD NOT BE ATTEMPTED.***

2) Potentiometer ***RH2*** is used for voltage detection level bias. This adjustment is factory set and any ***ADJUSTMENT BY THE USER SHOULD NOT BE ATTEMPTED.***

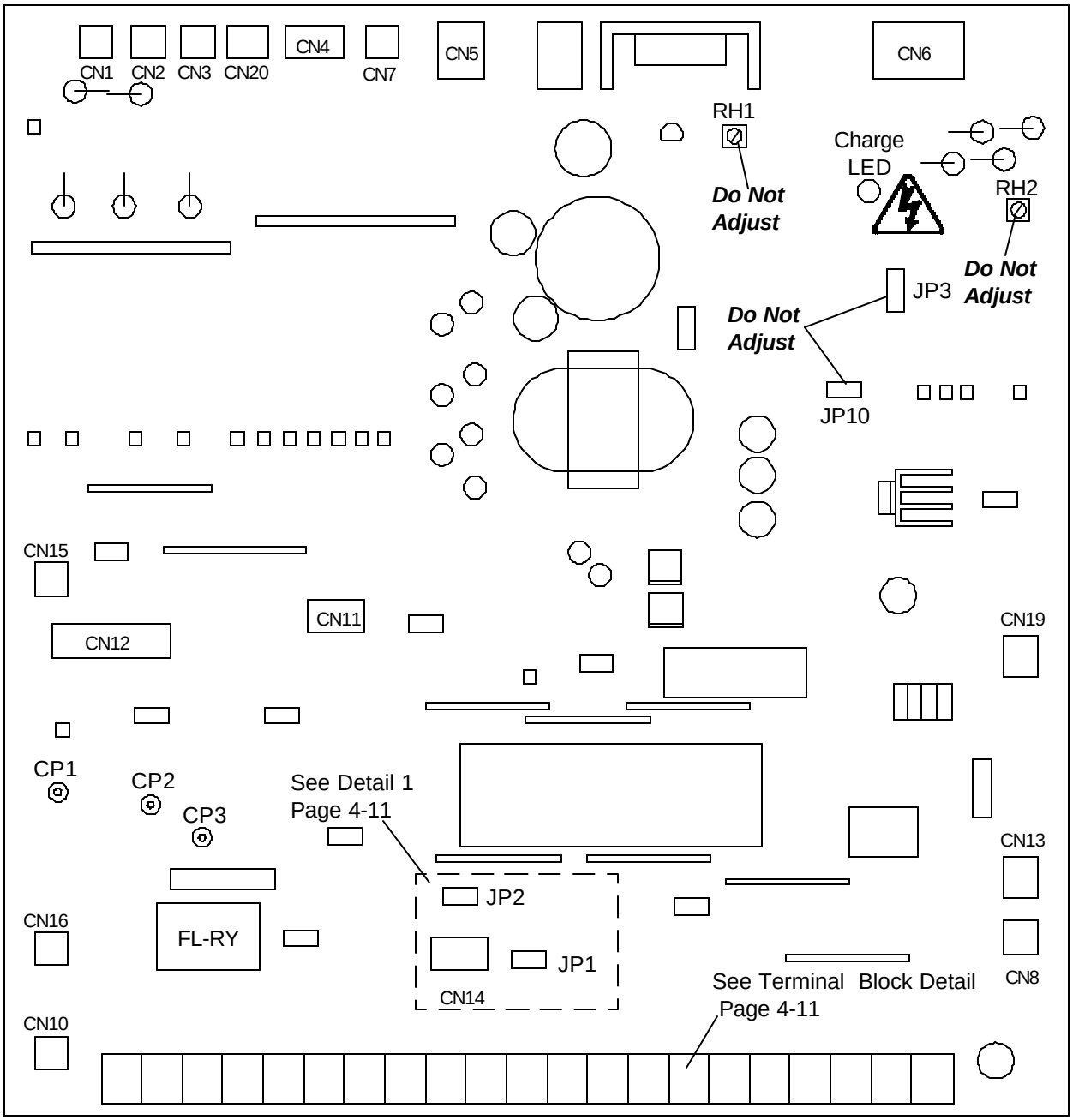
3) CP1, CP2,and CP3 are service testpoints.

4) ***Do not adjust JP3 and JP10.***

5) Charge LED indicates charged capacitors. ***DO NOT TOUCH internal parts if lighted.***

4.5 Control/Driver Board for G2+4015 through G2+4220

The following pictorial shows a layout of the major components located on the control/driver board VF3B-0101.



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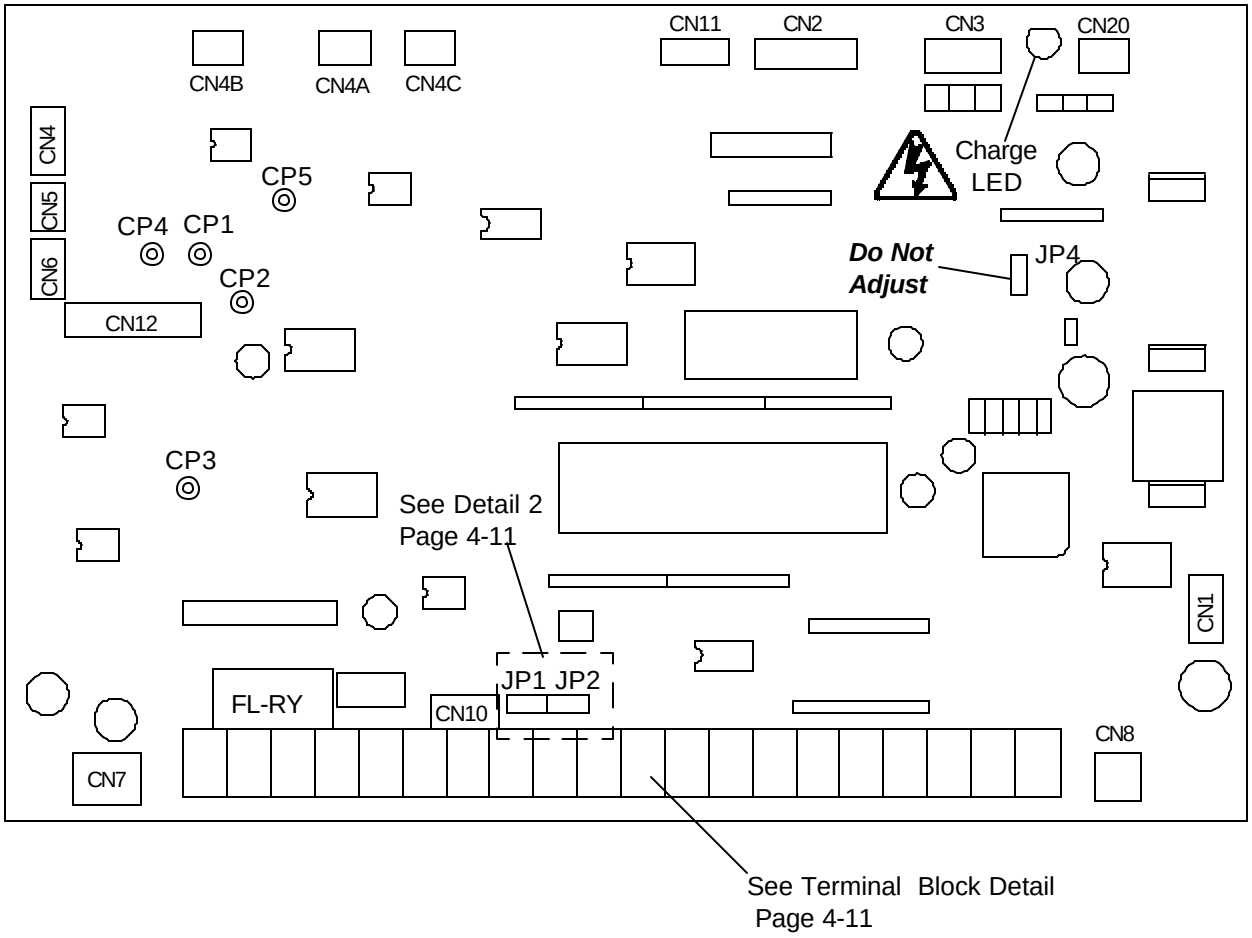
3) CP1, CP2, and CP3 are service testpoints.

4) ***Do not adjust JP3 and JP10.***

5) Charge LED indicates charged capacitors. ***DO NOT TOUCH internal parts if lighted.***

4.6 Control Board for G2+2270 through G2+2330 and G2+4270 through G2+430K

The following pictorial shows a layout of the major components located on the control board VF3C-1200.



Note:

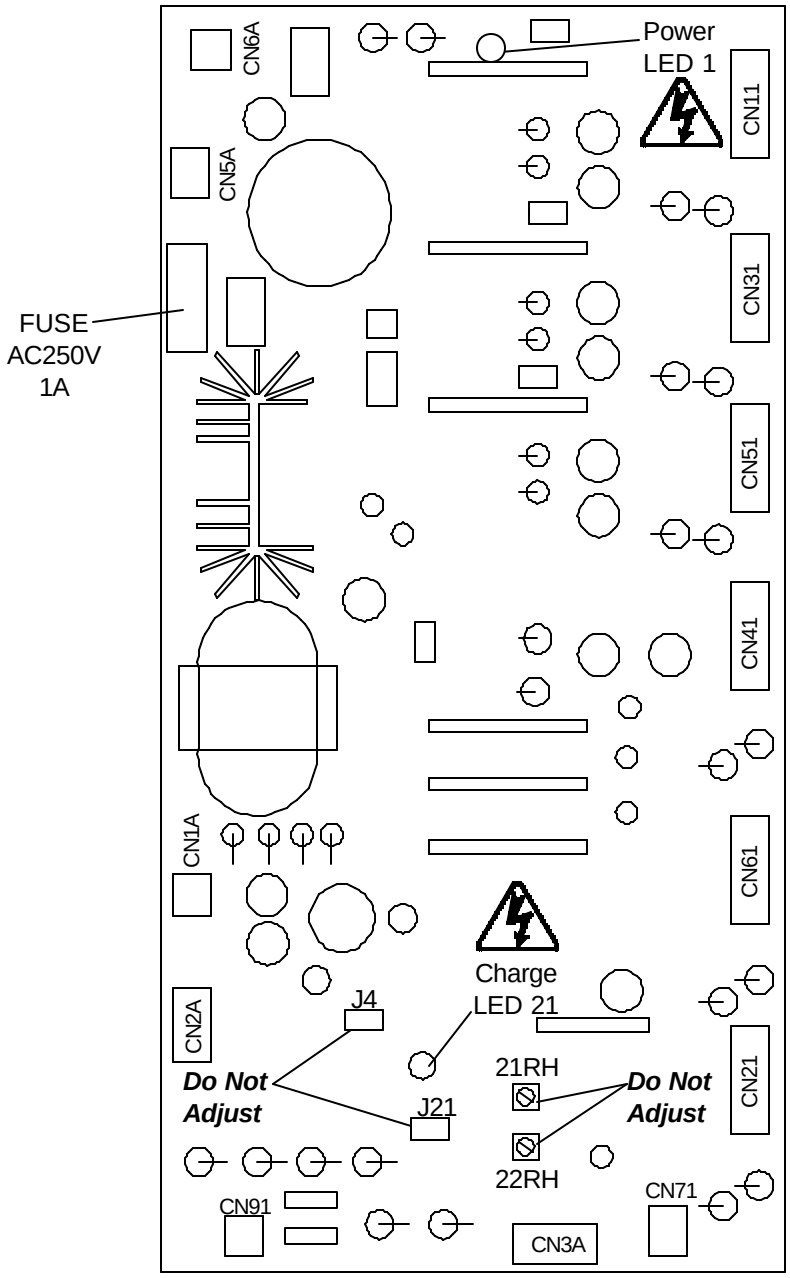
1) CP1, CP2, CP3, CP4, and CP5 are service testpoints.

2) ***Do not adjust JP4.***

3) Charge LED indicates charged capacitors. ***DO NOT TOUCH internal parts if lighted.***

4.7 Driver Board for G2+2270 through G2+2330 and G2+4270 through G2+430K

The following pictorial shows a layout of the major components located on the driver board 35589/VT3D-2039



Note:

1) Potentiometer ***21RH (OP)*** is the main circuit overvoltage detection trip set. This adjustment is factory set and any ***ADJUSTMENT BY THE USER SHOULD NOT BE ATTEMPTED.***

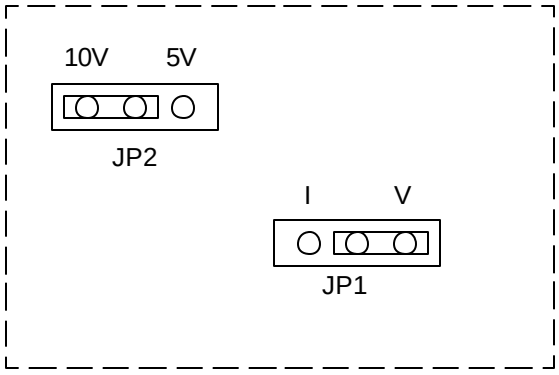
2) Potentiometer ***22RH (MUV)*** is the main circuit undervoltage detection trip set. This adjustment is factory set and any ***ADJUSTMENT BY THE USER SHOULD NOT BE ATTEMPTED.***

3) ***Do not adjust J4 and J21.***

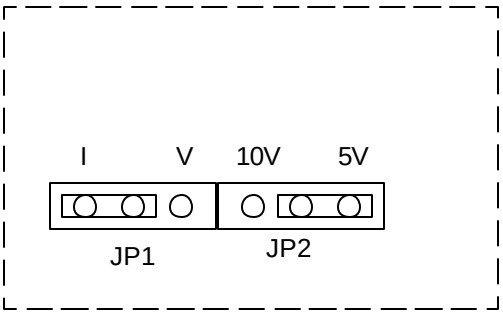
5) Charge LED indicates charged capacitors. ***DO NOT TOUCH internal parts if lighted.***

4.8 Jumper Details

The jumper connections for each of the printed wiring boards on Pages 4-7 through 4-9 are shown in the enlarged details below. ***Only jumpers JP1 and JP2 should be adjusted by the user.*** See Page 8-12 for jumper adjustments.



Detail 1 (Reference pages 4-7 and 4-8)

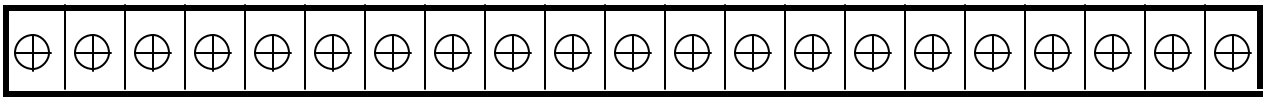


Detail 2 (Reference page 4-9)

4.9 Control/Driver Board Terminal Block Details

The control/driver board terminal block is shown in detail below. Each of the twenty-one terminals is functionally labeled. See Pages 4-12 and 4-13 for a list of terminal functions. See sections 8.4, 8.5, and 8.6 for terminal connection applications.

Control/Driver Board Terminal Block Detail (Reference pages 4-7, 4-8, and 4-9)



4.10 Terminal Connections and Functions

Terminal name	Terminal functions	Terminal location
L1, L2, L3 (R, S, T)	Connect these terminals to either a 3-phase 50Hz, 200Vac power supply or to a 3-phase 60Hz, 200 to 230Vac power supply for models G2+2010 to G2+2330.	Bus bar or power terminal block 
	Connect these terminals to either a 3-phase 50HZ, 400Vac power supply or to a 3-phase 60HZ, 400 to 460Vac power supply for models G2+4015 to G2+430K.	
T1, T2, T3 (U, V, W)	Connect these terminals to a 3-phase induction motor of the proper voltage.	
PA, PB	Connect these terminals to a regenerative discharge resistor.	
FLA, FLB, FLC	This form C contact changes state when a protective function has been activated (250Vac - 2A).	Control PWB terminal block
P24	Unregulated 24Vdc power supply (24Vdc, 100mA maximum).	
RCH(UL)	Outputs a signal when the upper limit frequency is reached, when an acc/dec is complete, or when the output frequency is within a specified range. The choice is determined by the function selection terminal RCH(UL). Terminal provides an open-collector output (50mAdc).	
LOW(LL)	Outputs a signal when a preset low speed or a preset lower limit is reached. The choice is determined by the function selection of the terminal. Terminal provides an open-collector output (50mAdc max).	
FM	This terminal can be connected to an external analog frequency meter. Use either an ammeter rated at 1mAdc at full scale or a voltmeter rated at 7.5Vdc at full scale.	
AM	This terminal can be connected to an external analog ammeter. Use either an ammeter rated at 1mAdc at full scale or a voltmeter rated at 7.5Vdc at full scale.	
PP	Provides a 10Vdc power supply to be used with terminal RR for remote terminal input.	
RR	Provides an input terminal for a 0~5Vdc or 0~10Vdc input reference signal. Also used for wiring a 1k~10k ohm (3k ohm recommended) potentiometer to allow for remote speed control operation.	
IV	Input a frequency reference signal to this terminal. 0 to 5 Vdc (with JP1 set at V), or 4 (0) to 20mAdc (with JP1 set at I)	
CC	This is the common end of the FM, AM, and P24 terminals. ***Do not connect to GND(E).***	

4.10 Terminal Connections and Functions (Cont'd)

Terminal name	Terminal functions	Terminal location
ST	With ST-CC shorted, the inverter is ready to run. With ST-CC open, a coasting stop phases in. This terminal can be used as a run interlock.	Control PWB terminal block
F	With F-CC shorted, a forward run is engaged. With F-CC open, deceleration phases in for a complete stop. (ST-CC is shorted.)	
R	With R-CC shorted, a reverse run is engaged. With R-CC open, deceleration phases in for a complete stop. (ST-CC is shorted.) (If both F-CC and R-CC are shorted simultaneously, a reverse run will result.)	
CC	This is the common end of the PP, RR, and IV terminals. ***Do not connect to GND(E).***	
SS1	With SS1-CC shorted, a multispeed run is engaged.	
JOG(SS2)	With JOG-CC shorted, a jogging run is engaged: With SS2-CC shorted, a multispeed run is effected. (See Section 8.4.3)	
AD2(SS3)	With AD2-CC shorted, an ACC/DEC run is engaged; or with SS3-CC shorted, a multispeed run will result. (See Section 8.4.4)	
RST	With RST-CC shorted, the inverter's protective function resets.	
CC	This is the common return for the ST, F, R, SS1, JOG(SS2), AD2(SS3), and RST terminals. ***Do not connect to GND(E).***	
OH	External fault signal input.	Terminal block
OV	Common connection for OH terminal.	
GND(E)	The inverter earth ground terminal. ***Do not connect to common return terminal (CC)***	Frame screw or lug
R41/46 *	Jumper to RJ when using 415V-50Hz/460V-60Hz incoming. ***Do not jumper to R40/44 or R38.***	Terminal block
R40/44 *	Jumper to RJ when using 400V-50Hz/440V-60Hz incoming. ***Do not jumper to R41/46 or R38.***	
R38 *	Jumper to RJ when using 380V-50Hz incoming. ***Do not jumper to R41/46 or R40/44.***	
RJ *	Common control voltage jumper terminal. Connects to R41/46 or R40/44 or R38. ***Do not jumper to more than one terminal.***	

* Supplied only on the G2+4110 - G2+430K units.

5.0 Features

5.1 Function Setting and Status Monitoring

- **Multifunctional User-Friendly Operating Panel**
  Commands are easily entered via the inverter's keyboard type operating panel. The operating panel enables the user to run/stop the inverter, read/change the operating function settings, and monitor the operating conditions of the inverter. All these operations are accomplished via the inverter's user-friendly software, keypad, and 7 segment LED display. See section 6 for details on the operating panel.
- **Direct Access of All Functions**
  With the G2+, the user can directly access and change any of the built-in functions. The software was designed to make programming and set-up time extremely fast and easy. There is no need to scroll through a long list of functions or flip numerous dip switches just to set one particular function.
- **Ability to Change Function Settings Even While Motor is Running**
  Accessing and setting the individual functions can be performed with or without a motor being attached. In fact, all but two of the inverter's functions can be accessed and changed while an attached motor is running.
- **One Touch Status Monitoring**
  Monitoring the inverter's operating conditions requires the pressing of a single key. Items which can be monitored include the inverter's output current and output voltage. See section 7.5 for a complete list of items.
- **Remote Operating Panel**
  The NEMA 4/12 operating panel can be placed up to 5M (15ft) from the inverter's chassis, without any additional electronics, simply by using an optional cable. This feature allows for the continued ease of operation should the inverter be placed inside an enclosure.
- **Ability to Reset All Functions to Initial Factory Settings**
  In cases where an unknown number of functions may become misadjusted when setting up for a particular application, it is usually easier to reset the inverter to factory settings and start over rather than search for the misadjusted functions. Refer to "First and Second Functions Factory Setting Overview" section 6.6 for these settings.

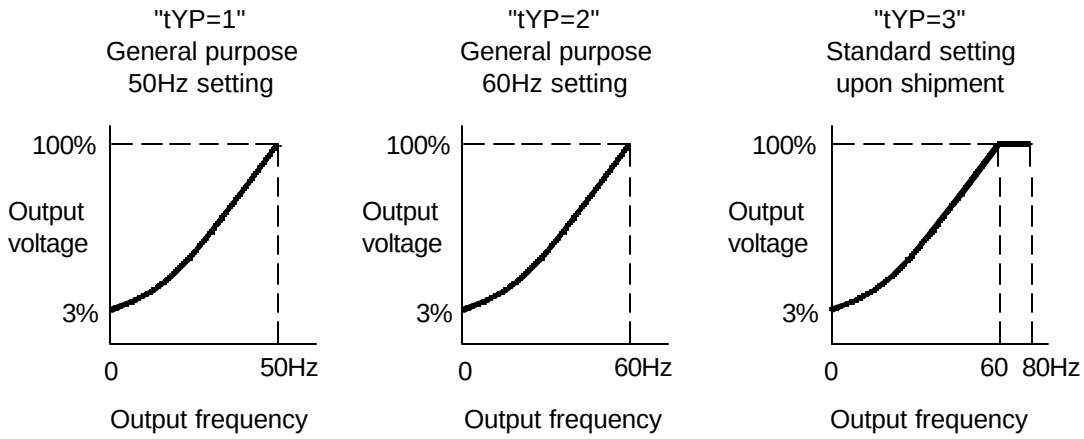
The example on the following page shows how easy it is to access and set a function. The standard setting mode of function 0 establishes the nominal operating frequency of the motor that is selected. This function is also used to set all functions back to their original factory settings. The example shows this is done by setting "typ" to 3.

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
-	Frequency setting	FC	0.1~400	Hz	0	UL LL	8-6
0	Standard setting mode	typ	1: 50Hz motor 2: 60Hz motor 3: Factory set		3	Err0	8-21
	Maximum frequency	FH	30 to 400	Hz	80	Err0 Err4	8-21

5.1 Function Settings and Status Monitoring (Cont'd)

V/F Characteristics of the Standard Setting Mode



KEY	ACTION	DISPLAY
	Assume the inverter is in the **monitor mode** and not running.	0.0
MON	The inverter is now in the **function mode** and has accessed Function #0.	tYP
READ	Displays the value currently set for "tYP". When reading this function and only this function the value displayed will always be zero.	0
3 **WRT**	Resets all 96 built-in functions back to factory settings. 3 ⟶ Init ⟶ 0.0 Used in cases where starting over is easier than searching for misadjusted functions.	0.0

5.2 "96" Built-in Functions for Complete Operating Control

The G2+ inverters have a wide variety of operating functions with each function having a wide adjustment range. To the user, this means that almost any application can be controlled to produce maximum output at minimum cost. For ease of programming, functions are classified into first and second functions. See the Factory Overview Chart on page 6-7 for a complete list of the Built-in Functions.

5.3 Voltage Matching

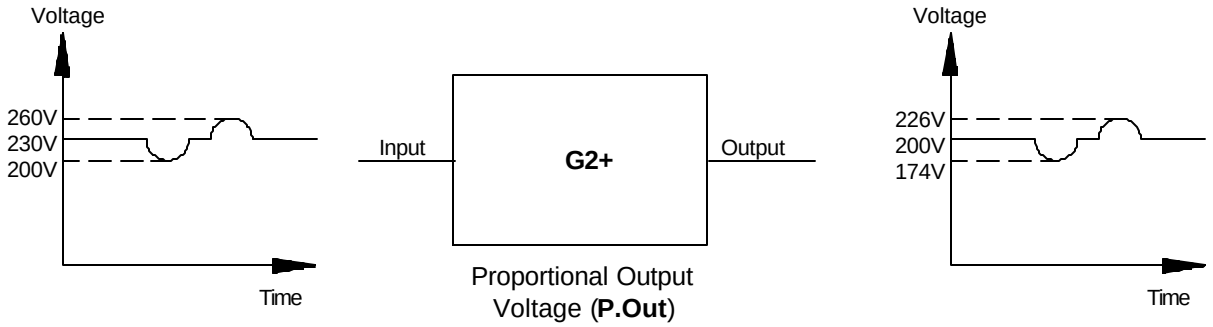
5.3.1 Proportional Output Voltage (Standard)

This feature allows programming the inverter to deliver an output voltage that is an exact percentage of the input voltage. The output voltage can range from 0% to 100% of the input voltage. The word "proportional" comes from the fact that if the input voltage level rises or falls during operation, the output voltage follows in direct proportion. The following examples illustrate this feature.

Function Parameters

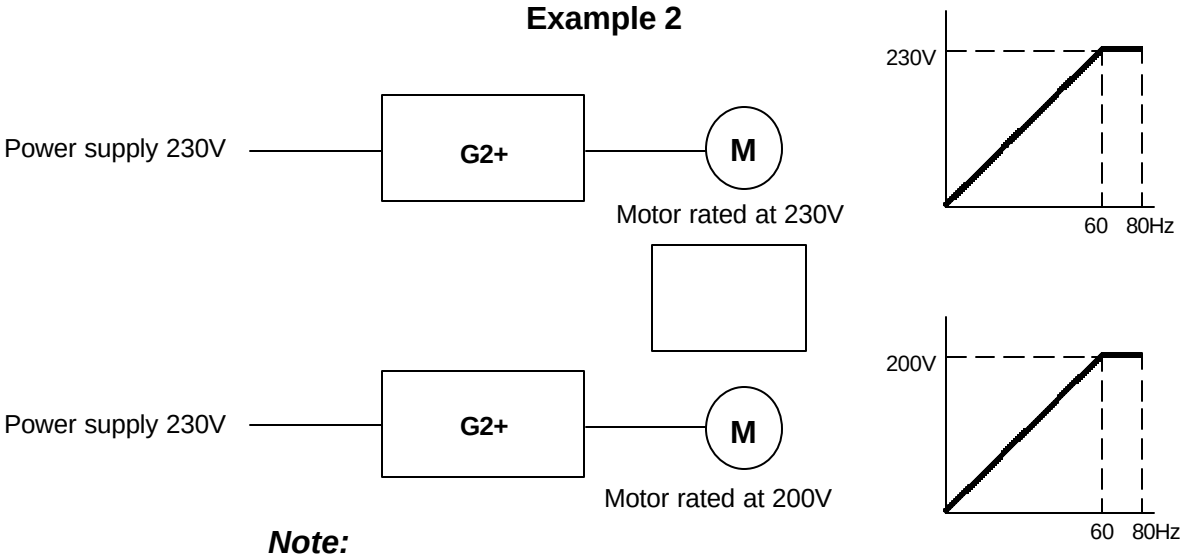
Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 4	Output voltage adjustment	POUT	0 to 100 (Option: 0 to 120)	%	100	Err0	8-27
	Dynamic brake resisitor	Pb	0: Non DBR 1: DBR, No OLr detection (*1 pg 6-10) 2: DBR, OLr detection (*1 pg 6-10)		0	Err0	8-27
	Auto deceleration on the : Pb=0	OPS.S	0: On 1: Off		0	Err0	8-27

Example 1



Proportional Output Voltage (**P.Out**) set to 87%

Example 2



Note:

For ease of identification the inverters are listed in horsepower. However the real determining factor, when sizing an inverter, is the rated current capability. Therefore, the user must be aware that a reduction in motor voltage means higher currents will be required.

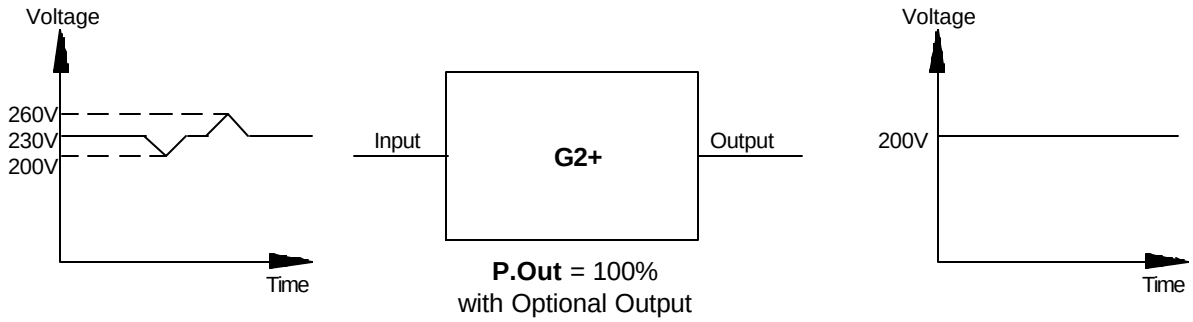
CAUTION ***Be sure that the inverter's rated current capability is always greater than the total current required.***

5.3.2 Output Voltage Regulation (Optional)

This optional feature enables the user to maintain a constant output voltage even if voltage fluctuations occur at the input. For minimal fluctuations, the V/F characteristics can be maintained at a constant level by automatically regulating the output voltage. Instantaneous fluctuations should be minimized by the use of an input AC line reactor. The use of this feature insures that the proper V/F characteristics will be applied in critical applications. Also this minimizes the danger of motor over excitation due to an elevated input voltage.

Note:

Contact TOSHIBA for latest information concerning this option.



P.Out = 100%
with Optional Output
Voltage Regulation

5.4 Tosvert-130 G2+ Options

5.4.1 3-Component Remote Station

This remote station includes a speed potentiometer, on/off selector switch, and a analog frequency meter.

5.4.2 4-Component Remote Station

This remote station includes a speed potentiometer, a analog frequency meter, and start and stop push buttons (user must supply relay logic to hold start signal).

5.4.3 Multi-Function Option Board

The Tosvert-130 G2+ Multi-Function Option Board will perform the following ten (10) functions:

1.) Computer interface (RS232C)
2.) Speed feedback control (TG or PG)
3.) Seven pre-set speeds using acceleration/deceleration time one or two.
4.) BCD or 12 bit binary input for frequency setting
5.) +/- 10Vdc forward/reverse frequency setting signal input
6.) Pulse input for frequency setting
7.) Control signal output to switch between inverter and bypass contactor
8.) Overload detection output proportional to frequency and current
9.) 0-1 mAdc analog signal output proportional to frequency and current
10.) Ninety six (96) times frequency pulsed output

Although the Multi-Function Option Board performs these ten (10) separate functions, some functions cannot be used simultaneously with other functions. Consult the Toshiba Inverter Marketing department for each individual function to determine what options cannot be used with that corresponding function.

5.4.4 RS232C Option Board

Computer interface (RS232C) only option board

5.4.5 RS232 Cable

Cable connects option board to IBM ***(TM)*** compatible computer

5.4.6 RS485 Multi-Function Option Board

The Tosvert-130 G2+ RS485 Multi-Function Option Board will perform the following five (5) functions:

1.) Computer interface (RS485)
2.) PG speed feedback control
3.) Pre-set speeds with Accel/Decel 1 & 2
4.) BCD or 12 bit binary for frequency setting
5.) Pulse input for frequency setting

Although the RS485 Multi-Function Option Board performs these (5) separate functions, some functions cannot be used simultaneously with other functions. Consult the Toshiba Inverter Marketing department for each individual function to determine what options cannot be used with that corresponding function.

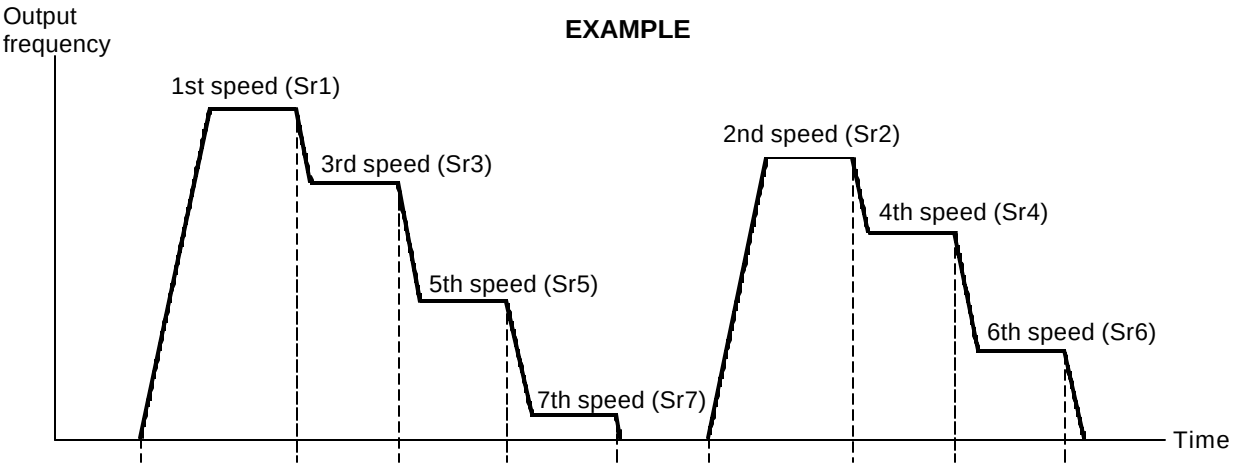
5.4.7 TG/PG Option Board

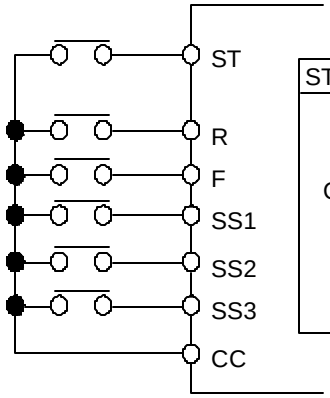
Tach generator or pulse generator speed feedback control only.

5.5 Multiple Preset Speeds

- Up to 7 different preset speeds can be executed without any external potentiometers.
- These 7 preset speed frequency values can be accessed either through the terminal input (Remote Control) or through the keypad (Panel Control). Also note that an 8th speed can be executed when the inverter has an operating frequency set through the terminal input reference signal.
- The preset frequencies are set to particular frequencies via Function #6 - parameters SR1 thru SR7.

EXAMPLE



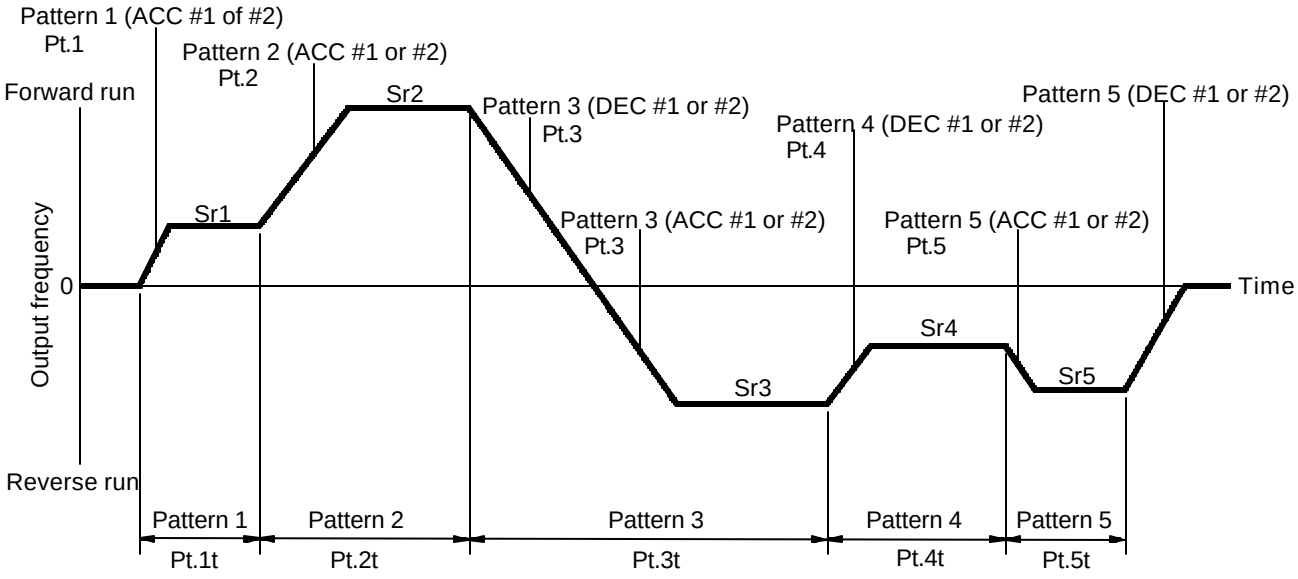


ST-CC	F/R-CC	SS3-CC	SS2-CC	SS1-CC	Operating Frequency Selection
ON	ON	OFF	OFF	OFF	Operating Frequency set via PP, RR, IV terminal
		OFF	OFF	ON	1st Operating Speed Frequency
		OFF	ON	OFF	2nd Operating Speed Frequency
		OFF	ON	ON	3rd Operating Speed Frequency
		ON	OFF	OFF	4th Operating Speed Frequency
		ON	OFF	ON	5th Operating Speed Frequency
		ON	ON	OFF	6th Operating Speed Frequency
		ON	ON	ON	7th Operating Speed Frequency

Preset Functions Required To Run the Preset Speeds

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	1st speed	:Sr1	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	2nd speed	:Sr2	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	3rd speed	:Sr3	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	4th speed	:Sr4	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	5th speed	:Sr5	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	6th speed	:Sr6	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	7th speed	:Sr7	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
8	Multi-function input	:In.tb	0 : SS2, SS3 1 : JOG, SS3 2 : SS2, AD2 3 : JOG, AD2		0	:Err0	8-24

5.6 Programmable Run Patterns



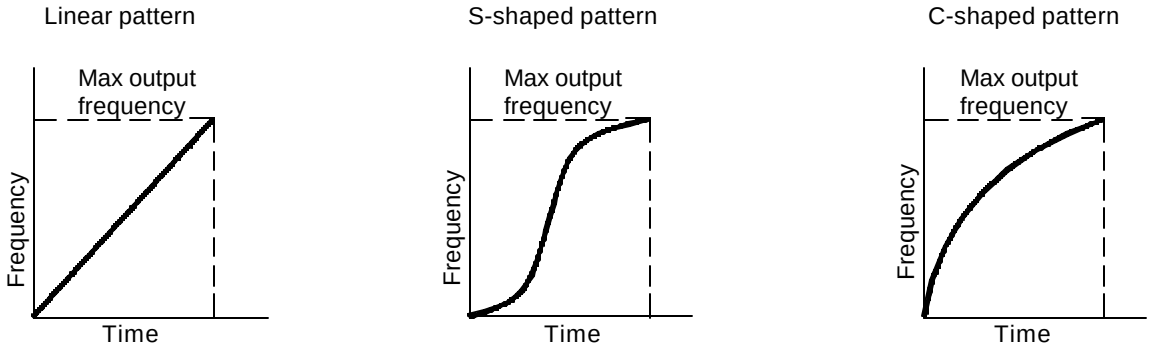
- Up to 7 different preset speed patterns can be automatically executed to produce what is known as a Pattern Run.
- Each speed can be set to operate in the range of 0 to 8000 seconds or minutes.
- Each pattern can be set to accelerate/decelerate using either one of the two acceleration/deceleration functions.
- Each pattern can be set to operate in either the forward or reverse direction.
- Pattern may be repeated 0 to 254 times or repeat infinitely.

Preset Functions Required To Perform the Pattern Run

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	1st speed	:Sr1	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	2nd speed	:Sr2	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	3rd speed	:Sr3	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	4th speed	:Sr4	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	5th speed	:Sr5	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	6th speed	:Sr6	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	7th speed	:Sr7	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
2ND 8	Pattern run activation mode	:PSEL	0: Off 1: Terminal operation 2: Touch pad operation 3: Computer communication		0	:Err0	8-28
	Time unit	: Pt.t	0: Seconds 1: Minutes		0	:Err0	8-28
	Cycle times	: Pt.n	0 to 255 (255: Infinity operating)		0	:Err0	8-28
	Pattern drive time #1 to 7	:Pt.1t to :Pt7t	0 to 8000	sec min	0	:Err0	8-28
	Pattern drive characteristics #1 to 7 F/R, ACC/DEC	:Pt.1 to :Pt.7	0: Forward run, #1 ACC/DEC 1: Forward run, #2 ACC/DEC 2: Reverse run, #1 ACC/DEC 3: Reverse run, #2 ACC/DEC		0	:Err0	8-28

5.7 Accelerating/Decelerating Characteristics

- ACC/DEC time can be set in the range of 0.1~6000 seconds.
- ACC/DEC time 1 or 2 can be selected either through the keypad (Panel Control) or an input terminal (Remote Control).
- ACC/DEC characteristics can be selected from the linear, S-shaped, or C-shaped pattern.



The S-shaped pattern gradually accelerates a motor in a range where the motor provides a low torque, and is suited for material handling machinery.
The C-shaped pattern quickly accelerates a motor in a range where the motor provides a low torque, and is suited for a high speed run.

5.8 Display Frequency Scaler

This versatile unit indication system permits the indication of not only the output frequencies, but also revolution speeds, linear velocities, or other linear multiples of the frequencies.

[Contents of digital displays]=Constant X [Output frequency]
The constant can be set within the range 0.01~200; also the unit measure (Hz) LED turns off when the Display Frequency Scaler function is activated.
Example:
When a 4 pole motor is driven at 0~60Hz, the setting "dSP.2=30" makes the monitor display indicate 0~1800 (rpm).
For linear speed of 6m/sec at 60Hz, set "dSP.2=0.1". When speed scaling is used, the unit of measure LED is turned off.

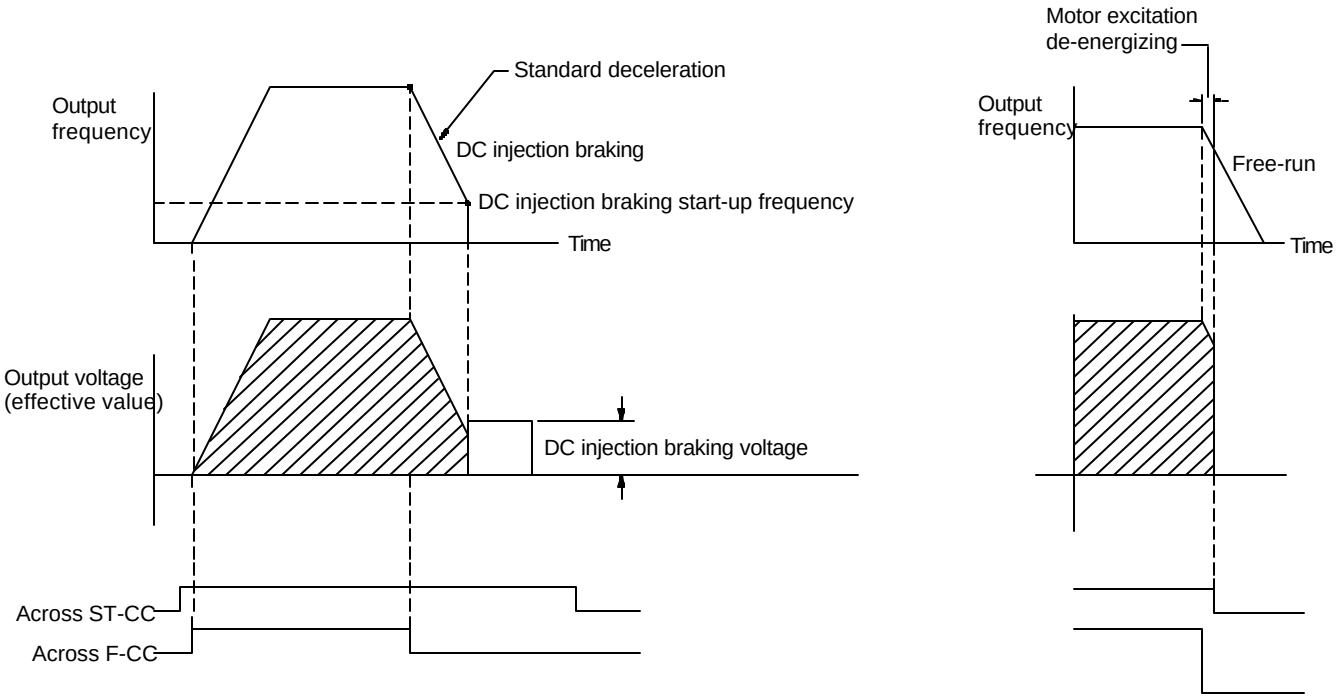
5.9 Memory Function

A number from 0 to 31 can be assigned to and stored in the non-volatile memory of the inverter. This allows electronic tagging and on-line identification of each unit.
This function can be utilized for sorting of inverter unit numbers and various set data through the optional computer interface.

5.10 Braking Characteristics

5.10.1 DC Injection

The DC injection braking function creates smooth operating characteristics with continuous phase control. It is used primarily for alignment applications. It controls the final coast of the motor by injecting DC voltage into the motor. This allows the capability of starting and stopping at the same point every time when used in conjunction with a position sensor. The amount of DC energy that is available for injection is limited by the current limiting feature of the inverter. Care should be taken when using DC injection because of additional motor heating.



Note:

See standard specifications (page 3-2) for adjustment ranges.

5.10.2 Dynamic Braking

Dynamic braking is used to rapidly decelerate the motor load (especially high inertia loads) by converting the energy generated by the motor into heat. The heat is dissipated through the DB resistor. Models G2+2010 through G2+430K can be equipped with an optional dynamic braking resistor (DBR) to boost the braking torque. When DBR's are installed:

1) ***Install a magnetic contactor (MC) or a molded case circuit breaker (MCCB) with a trip coil on the inverter's power supply side.*** This opens the power circuit when the inverter's built-in fault detecting relay (FL) or an externally mounted overload relay is activated.

2) For all models, connect the dynamic braking resistor (DBR) bank to the PA-PB terminals of the main circuit terminal block.

3) The DB resistors should not be installed where the ambient temperature of the inverter will exceed 40°C.

5.10.2 Dynamic Braking (cont'd)

4) DB resistors should be installed as near to the inverter as possible with temperature constraints in mind.

5)  **CAUTION** Exercise caution when working around the DB resistors; they can become extremely hot when used in conjunction with long duty cycles and high inertia loads.

6)  **DANGER**  PA-PB dynamic braking resistor (DBR) terminals are at high DC bus voltage potential. Do not touch PA - PB terminals when the charge or power LED lamp is on.

Note:

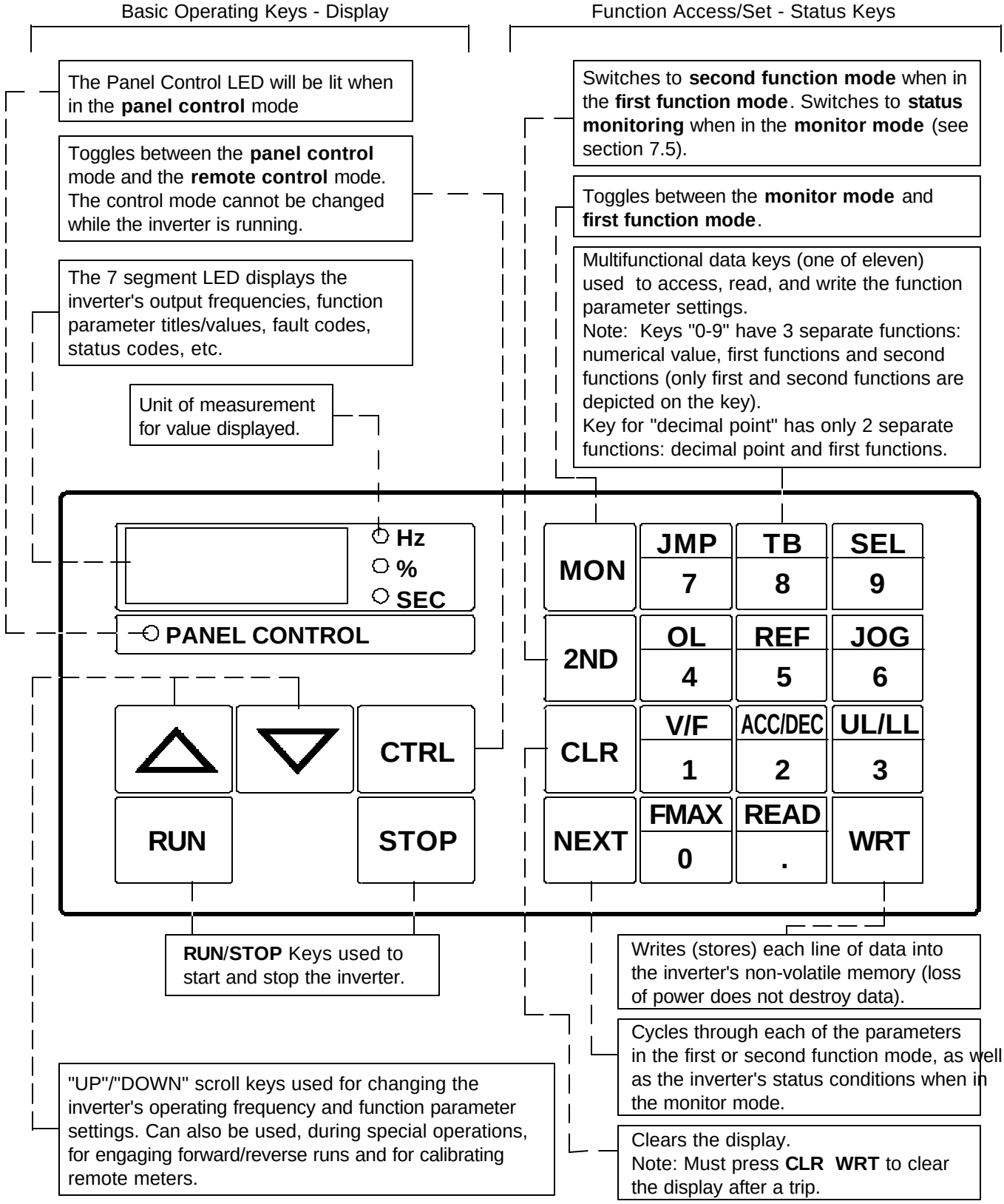
Consult factory for DBR sizing.

6.0 Functions

6.1 Operating Panel

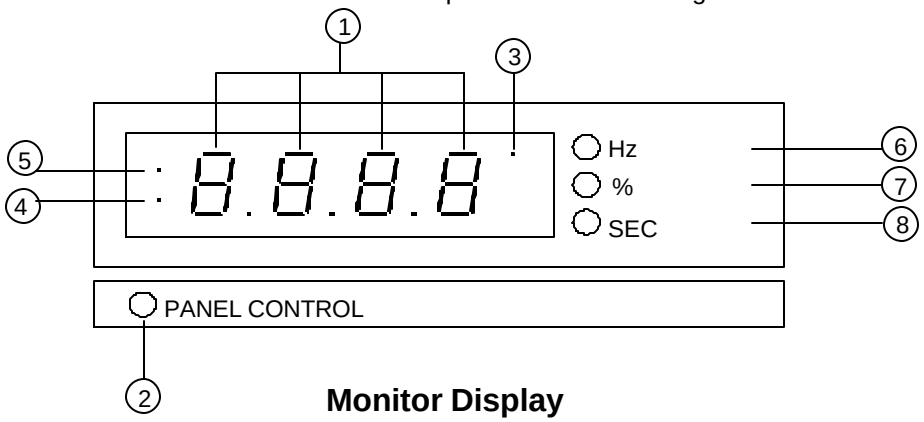
The operating panel enables the user to run or stop (RUN/STOP) the inverter, read and/or change the operating function parameter values (READ/WRT), and monitor (MON/NEXT) the operating conditions of the unit (see key function section 6.5).

Operating Panel



6.2 LED Display

The LED display provides the user with the operating frequency, function settings, and status information necessary to easily monitor and set the operating parameters. The individual LED's are identified and explained in the following chart.



Monitor Display

Item	Name	Function/status
①	Monitor display	7-segment, 4-column LED Displays frequency, title, data, etc.
②	Panel control LED	When ON the unit is in the panel control mode When OFF the unit is in the remote control mode When FLASHING the unit is in the panel control mode and the motor is running
③	Super mode LED	When ON the computer interface option is enabled. (Contact Toshiba for information.)
④ ⑤	Monitor display LED	○ ○ Normally OFF when displaying operating frequency or unit frequency scaler. ● ○ ON when unit is in a patterned run sequence ● ● ON when in function setting mode via operating panel and unit is not running. Ø Ø Flashing when in function setting mode via operating panel and the motor is running. ○ ● ON when function setting mode via operating panel is disabled.
⑥	Hz display LED	Displays the unit of the number displayed
⑦	% display LED	When displaying data units other than Hz, %, or SEC, the LED's are OFF.
⑧	Time display LED	Time in seconds

Note:

When the command mode function is set to disable all inputs, LED's [2] and [3] will be flashing and [4] and [5] will be ON.

6.3 Monitor Display Alphanumerics

The 7 segment LED display has a limited number of output characters, therefore the following figures and letters will be used for the display.

Numerics	LED display
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Characters	LED display
A	
b	
C	
d	
E	
F	
G	
H	
I	
J	
L	
M	
n	
O	or
P	
r	
S	
t	
U	
v	
y	
-	

6.4 Basic Operating Keys

Key	Function
CTRL	Toggles between the **Panel Control** and **Remote Control** Modes. Disabled while the inverter is running.
△	Increases frequency setting values and various other data values. Engages forward run during special operations (jog, multispeed). Also used for calibrating remote meters (FM, AM).
▽	Decreases frequency setting values and various other data values. Engages reverse run during special operations (jog, multispeed). Also used for calibrating remote meters (FM, AM).
RUN	Issues a command for starting a normal run, multispeed run, jog run, or pattern run.
STOP	Issues a command for stopping a normal run, multispeed run, jog run, or pattern run.

6.5 Function Access/Set - Status Keys

Note:

Each key (0-9) has three separate functions: numerical value, first function, and second function. See Operating Panel (Section 6.1)

Key	Function
MON	Toggles between the **monitor** and **function** mode.
2ND	Switches to the second function mode. Used to initiate several functions (ie. JOG, Preset Run, Pattern Run).
NEXT	Displays the next item within the function. Also cycles through the inverter's status codes.
CLR	Clears the display. Also clears inverter after a trip. ***(Must press CLR/WRT to reset inverter after a trip)***
WRT	Stores each piece of data into the inverters memory (file).
READ **.**	"." is a decimal point. "READ" displays the inverter's data contents for an individual function.
FMAX **0**	"0" is the numerical zero. 1st FUNCTION MODE: Selects the ***standard setting mode***. Also sets the ***maximum frequency*** (disabled during a run). 2nd FUNCTION MODE: Sets the ***start-up frequency*** and ***run frequency***. Also sets the ***run frequency hysteresis***.
V/F **1**	"1" is the numerical one. 1st FUNCTION MODE: Sets the voltage ***boost***, ***auto torque boost***, ***maximum voltage frequency***, and ***V/F pattern***. 2nd FUNCTION MODE: Sets the ***DC injection starting frequency***, ***DC injection voltage***, and ***DC voltage injection time***.
ACC/DEC **2**	"2" is the numerical two. 1st FUNCTION MODE: Sets the ***ACC/DEC time*** for ACC 1, 2 and DEC 1, 2. Selects the ***ACC/DEC pattern*** for 1, 2. Selects ***ACC/DEC 1 or 2***. 2nd FUNCTION MODE: Sets the multiply factor of ***display frequency scaler***.
UL/LL **3**	"3" is the numerical three. 1st FUNCTION MODE: Sets ***upper and lower frequency limits***. 2nd FUNCTION MODE: Sets low speed detection output. Selects speed reach selection output option. Sets ***speed reach detection*** range and ***speed reach reference*** frequency.
OL **4**	"4" is the numerical four. 1st FUNCTION MODE: Sets ***overload detection level*** (% of rated current), ***stall activation level***, and also selects the ***overload detection curve*** characteristics. 2nd FUNCTION MODE: Sets the ***output voltage adjustment*** (% of input voltage). Selects the ***dynamic braking resistor*** option and the ***OLr option***. Selects the ***auto deceleration option*** when no dynamic braking resistor is used.

6.5 Program Function Access/Set - Status Keys (Cont'd)

Key	Function
REF 5	"5" is the numerical five. 1st FUNCTION MODE: Sets ***output frequencies (F-P1, F-P2)*** based upon percent of terminal IV input signal. Also sets the ***percent of the terminal IV input signal*** (P1, P2). Selects ***option for IV or RR terminal*** input to be on. *2nd FUNCTION MODE: Selects option of TG/PG or PID to be on or off. Sets ***proportional gain***, ***integration gain***, ***differential gain***, ***lag time constant***, and ***TG/PG feedback gain***. Selects ***PG feedback control options***. (* Optional board required for TG/PG selection.)
JOG 6	"6" is the numerical six. 1st FUNCTION MODE: Sets the ***jog run drive frequency***. Selects the ***jog run stop control*** options. Sets the ***1st~7th speed*** run frequencies. 2nd FUNCTION MODE: Sets the ***PWM carrier frequency***.
JMP 7	"7" is the numerical seven. 1st FUNCTION MODE: Sets the ***jump frequencies*** (1, 2, 3) and the (1, 2, 3) ***jump frequency band widths***. 2nd FUNCTION MODE: Selects ***communication options*** (See Table 1 pg. 6-12), selects ***identification #*** for the inverter, selects communication ***baud rate***, selects ***parity check*** and ***stop bit*** (See Table 2 pg. 6-12), and selects inverter to ***AC line transfer signal*** to be on or off.
TB 8	"8" is the numerical eight. 1st FUNCTION MODE: Selects how the ***multi-function I/O*** terminals will be used. 2nd FUNCTION MODE: Selects the ***pattern run activation mode***, units of ***time***, number of ***cycles***. Sets ***pattern drive time*** for Pt.1t~Pt.7t and selects the***pattern drive characteristics*** for the pattern run (i.e.FOR or REV, ACC/DEC 1 or 2).
SEL 9	"9" is the numerical nine. 1st FUNCTION MODE: Selects ***FOR or REV run***, selects ***trip retention*** on or off option, selects ***retry*** (auto-reset) on or off option, selects ***auto-restart*** after momentary power interrupt on or off option, and selects ***regeneration power ride through*** control on or off option. 2nd FUNCTION MODE: Selects eight ***command mode*** options, selects eight ***frequency reference setting mode*** options, and selects four ***parameter setting mode*** options.

6.6 First and Second Functions Factory Setting Overview

FUNCTION NUMBER	FUNCTION DISPLAY	FUNCTION DESCRIPTION	FACTORY SETTING
-	:FC	Frequency setting *	0Hz
0	:tYP	Standard setting mode	3
	:FH	Maximum frequency	80Hz
1	:ub	Voltage boost	3%
	:A.ub	Auto torque boost	0
	:uL	Max. voltage frequency	60Hz
	:Pt.	V/f pattern	0
2	:ACC 1,2	Acceleration time 1 or 2	10 sec.
	:dEC 1,2	Deceleration time 1 or 2	10 sec.
	:Pt.1,2	Pattern of acc./dec. 1 or 2	0
	:SEL2	Selection of acc./dec. 1 or 2	0
3	:UL	Upper limit frequency	80Hz
	:LL	Lower limit frequency	0Hz
4	:tHr	Electronic thermal protection level	100%
	:StL	Stall prevention activation level	150%
	:SEL4	Electronic thermal protection characteristic selection	0
5	:P 1,2	IV Terminal point 1 or 2 setting signal	20, 100%
	:F-P1,2	Output frequency or point 1 or 2	0, 80Hz
	:rr.LL	RR terminal priority	0
6	:JOG	Jog run frequency	5Hz
	:JSTP	Jog stop pattern	0
	:Sr 1-7	Multispeed run frequencies 1-7	0Hz
7	:FJ1-3	Jump frequency 1-3	0Hz
	:bFJ1-3	Jump width 1-3	0Hz
8	:I.tb	Input terminal selection	2
	:O.tb	Output terminal selection	3
9	:F.r.	Forward/reverse run selection	1
	:tr.tL	Trip retention selection	0
	:rtry	Automatic restart selection	0
	:Arst	Selection of automatic restart after instantaneous power failure	0
	:Uu.C	Regeneration power ride through control	0

* This is the frequency setting parameter that the inverter will automatically default to when power is first applied. It is not a part of the first or second functions and is shown for reference.

FUNCTION NUMBER	FUNCTION DISPLAY	FUNCTION DESCRIPTION	FACTORY SETTING
2ND 0	:F-St	Start-up frequency	0Hz
	:F.run	Run frequency	0Hz
	:F.HYS	Run frequency histerisis	0Hz
2ND 1	:dbF	DC injection braking start frequency	0.0Hz
	:dbu	DC injection braking voltage	0%
	:dbt	DC injection braking time	0.00 sec.
2ND 2	:dSP.2	Multiplication factor of display frequency scaler	0.00
2ND 3	:LF	Low speed detection	0.5Hz
	:rCH	Speed reach selection	0
	:rrCH	Speed reach detection range	2.5Hz
	:FrCH	Speed reach reference	0.0Hz
2ND 4	:P.OUt	Output voltage adjustment	100%
	:Pb	Regenerative braking selection	0
	:OPS.S	Auto deceleration on the :Pb=0	0
2ND 5	:Fb.PI	TG/PG feedback or PID control selection	0
	:GP	Proportional gain	0
	:GI	Integration gain	0
	:GA	Differential gain	0
	:GFS	Lag time constant	0
	:PG	TG/PG feedback select	0
	:CONu	PG feedback gain	0
2ND 6	:CF	Carrier frequency	1.5kHz
2ND 7	:OPt	Option selection	0
	:I.no.	Memory function	0
	:b.rAt	Baud rate	0
	:SNOd	RS232C data bits	0
	:SSCr	Parity check and stop bit	0
	:C.CHG	Inverter to AC line transfer operation	0
2ND 8	:P.SEL	~~Pattern run mode~~ signal	0
	:Pt.t	~~Pattern run mode~~	0
	:Pt.n	Time unit Cycle times	0
	:Pt.1t to :Pt.7t	Pattern run 1-7 changeover time (secs.)	0 Sec.
	:Pt.1 to :Pt.7	Fwd/Rev and acc/dec	0
2ND 9	:C.NOd	sel. of pattern runs 1-7 ~~Command mode select~~	7
	:F.NOd		7
	:P.NOd	Freq. seting mode select Parameter setting mode select	3

6.7 First Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
-	Frequency setting	FC	0.1~400 *	Hz	0	UL LL	8-6
0	Standard setting mode	Ld9P	1: 50Hz motor 2: 60Hz motor 3: Factory set (Reset to default) (Always 0 display in this mode.)		3	Err0	8-21
	Maximum frequency	FH	30 to 400	Hz	80	Err0 Err4	8-21
1	Voltage boost	Ub	0 to 30	%	3	Err0	8-21
	Auto torque boost (voltage)	A.Ub	0: Off 1: On		0	Err0	8-21
	Max. voltage frequency	UL	25 to 400	Hz	60	Err0 Err4	8-21
	V/f pattern	PtC	0: Constant torque 1: Variable torque		0	Err0	8-21
2	Acceleration time #1	AC1	0.1 to 6000 **(SEE NOTE #1 PG. 6-9)**	sec	10	Err0 Err4	8-21
	Deceleration time #1	dEC1	0.1 to 6000	sec	10	Err0 Err4	8-21
	Acc/Dec #1 pattern	Pt1	0: Linear 1: S-curve 2: C-curve		0	Err0	8-21
	Acceleration time #2	AC2	0.1 to 6000 **(SEE NOTE #1 PG. 6-9)**	sec	10	Err0 Err4	8-21
	Deceleration time #2	dEC2	0.1 to 6000	sec	10	Err0 Err4	8-21
	Acc/Dec #2 pattern	Pt2	0: Linear 1: S-curve 2: C-curve		0	Err0	8-21
	Acc/Dec #1, #2 select	SEL2	0: Acc/Dec #1 1: Acc/Dec #2		0	Err0	8-21
3	Upper limit frequency	UL	0 to Max. frequency	Hz	80	FH	8-21
	Lower limit frequency	LL	0 to upper limit frequency	Hz	0	UL	8-21
4	Overload detection	OLn	10 to 100	%	100	Err0 Err4	8-22
	Stall protection	STL	10 to 150	%	150	Err0 Err4	8-22
	Overload detection curve	SEL4	0: STD-motor, No soft stall 1: STD-motor, Soft stall 2: VF-motor, No soft stall 3: VF-motor, Soft stall		0	Err0	8-22
5	IV-ref. setting point #1	P1	0 to 100	%	20	Err0	8-23
	#1 output frequency	F-P1	0 to Max. frequency	Hz	0	FH	8-23
	IV-ref. setting point #2	P2	0 to 100	%	100	Err0	8-23
	#2 output frequency	F-P2	0 to Max. frequency	Hz	80	FH	8-23
	RR terminal priority	rrCC	0: IV terminal input "on" 1: RR terminal input "on"		0	Err0	8-23

* This is the operating frequency setting parameter. It is located within the monitor mode but is not a true first function parameter. It is used to set an operating frequency by scrolling up or down the frequency range, using the "up" or "down" keys until the desired frequency is reached, rather than by entering data for a particular output frequency (see section 7.2 and 8.3).

6.7 First Function Parameters (Cont'd)

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	Jog run frequency	JOG	0 to 20	Hz	5	Err0	8-23
	Jog stop control pattern	JOGP	0: Deceleration stop 1: Coast stop 2: DC injection stop		0	Err0	8-23
	Multi-speed frequency #1	SP1	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #2	SP2	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #3	SP3	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #4	SP4	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #5	SP5	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #6	SP6	LL to UL setting value	Hz	0	LL:UL:FH	8-23
	Multi-speed frequency #7	SP7	LL to UL setting value	Hz	0	LL:UL:FH	8-23
7	Jump frequency point #1	FJ1	0 to Max. frequency	Hz	0	FH	8-23
	Jump frequency band #1	bFJ1	0 to Max. frequency	Hz	0	FH	8-23
	Jump frequency point #2	FJ2	0 to Max. frequency	Hz	0	FH	8-23
	Jump frequency band #2	bFJ2	0 to Max. frequency	Hz	0	FH	8-23
	Jump frequency point #3	FJ3	0 to Max. frequency	Hz	0	FH	8-23
	Jump frequency band #3	bFJ3	0 to Max. frequency	Hz	0	FH	8-23
8	Multi-function input terminal selection	I.tb	0: SS2, SS3 1: JOG, SS3 2: SS2, AD2 3: JOG, AD2		2	Err0	8-24
	Mult-function output terminal selection	O.tb	0: LL, UL 1: LOW, UL 2: LL, RCH 3: LOW, RCH		3	Err0	8-24
9	Forward/Reverse run selection	F.r	0: Reverse 1: Forward		1	Err0	8-24
	Fault trip saving selection	ltr.CL	0: Cleared when powered off 1: Data retained when powered off		0	Err0	8-24
	Retry (Auto-reset)	rtry	0: Off 1: On		0	Err0	8-24
	Auto-restart	ARst	0: Off 1: On		0	Err0	8-25
	Regeneration power ride through control	Uv.C	0: Off 1: On *		0	Err0	8-25

* Approximately 100 mS

CAUTION ***The acceleration and deceleration times should not be set below 3 seconds in the 75-300 horsepower units.***

6.8 Second Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 0	Start-up frequency	F-St	0.0 to 10	Hz	0.0	Err0	8-26
	Run frequency	F.run	0 to Max. frequency	Hz	0	IFH	8-26
	Run frequency hysterisis	F.HYS	0 to Max. frequency	Hz	0	IFH	8-26
2ND 1	DC injection braking start frequency	dbIF	0.0 to 10	Hz	0.0	Err0	8-26
	DC injection voltage	dbV	0 to 20	%	0	Err0	8-26
	DC injection time	dbt	0.0 to 5	sec	0.00	Err0	8-26
2ND 2	Multiplication factor of display frequency scaler	dSP2	0.00 to 200 (0.00 = OFF)		0.00	Err0	8-27
2ND 3	Low speed detection	LF	0.0 to Max. frequency	Hz	0.5	IFH	8-27
	Speed reach selection	r-CH	0: Complete ACC/DEC 1: Frequency reach reference		0	Err0	8-27
	Speed reach detection range	rrCH	0.0 to Max. frequency	Hz	2.5	IFH	8-27
	Speed reach reference	Fr-CH	0.0 to Max. frequency	Hz	0.0	IFH	8-27
2ND 4	Output voltage adjustment	POUt	0 to 100 (Option: 0 to 120)	%	100	Err0	8-27
	Dynamic brake resistor	Pb	0: Non DBR 1: DBR, No OLr detection 2: DBR, OLr detection *		0	Err0	8-27
	Auto deceleration on the :Pb=0	dPS.S	0: On 1: Off		0	Err0	8-27
2ND 5	TG/PG feedback or PID control selection	Fb.PI	0: Off 1: TG/PG feedback *** 2: PID control		0	Err0	8-27
	Proportional gain	GP	0 to 9999		0		8-27
	Integration gain	GI	0 to 9999		0		8-27
	Differential gain	GA	0 to 255		0	Err0	8-27
	Lag time-constant	GFS	0 to 255		0	Err0	8-27
	TG/PG feedback selection	PG	0: TG 1: PG (500p/r) 2: PG (100p/r)		0	Err0	8-27
	PG feedback gain	COnu	0 to 9999		0		8-27
2ND 6	PWM carrier frequency	CF	0.5 to 3 **	kHz	1.5 / 0.5	Err0	8-28

* The OLr function is available in model G2+2010 to G2+2220 and G2+4015 to G2+4220 only.

** Special high PWM carrier frequency (10kHz) mode of operation is available. Consult Toshiba for details and special precautions concerning this special operation.

*** TG/PG feedback requires the use of multi-option board.

6.8 Second Function Parameters (Cont'd)

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 7	Option selection	OPt	0 to 12 **(SEE TABLE #1 PG. 6-12)**		0	Err0	8-28
	Inverter number	inv.	0 to 31		0	Err0	8-28
	Baud rate	bAUd	RS232: 0: 150, 1: 300, 2: 600, 3: 1200, 4: 2400 / RS485: 0: 1200, 1: 2400, 2: 4800, 3: 9600, 4: 19200		0	Err0	8-28
	RS232C data bits	bNGd	0: 7 bits 1: 8 bits		0	Err0	8-28
	Parity check and stop bit	SSCr	0 to 5 **(SEE TABLE #2 PG. 6-12)**		0	Err0	8-28
	Inverter to AC line transfer operation signal	C.CHG	0: Off 1: On		0	Err0	8-28
2ND 8	Pattern run activation mode	P.SEL	0: Off 1: Terminal operation 2: Touch pad operation 3: Computer communication		0	Err0	8-28
	Time unit	Pt.t	0: Seconds 1: Minutes		0	Err0	8-28
	Cycle times	Pt.n	0 to 255 (255: Infinity operating)		0	Err0	8-28
	Pattern drive time #1 to 7	Pt.1t to Pt7t	0 to 8000	secs/ mins	0	Err0	8-28
	Pattern drive characteristics #1 to 7 F/R, ACC/DEC	Pt.1 to Pt.7	0: Forward run, #1 ACC/DEC 1: Forward run, #2 ACC/DEC 2: Reverse run, #1 ACC/DEC 3: Reverse run, #2 ACC/DEC		0	Err0	8-28
2ND 9	Command mode selection	CMOd	0: Disables all inputs 1: Terminal input only 2: Touch pad only 3: Enable changing of terminal & touch pad 4: Host input only 5: Enable changing of terminal & host input 6: Enable changing of touch pad & host input 7: Enable changing of all input modes		7	Err0	8-28
	Frequency reference setting mode selection	FMOd	0: Disable all input 1: Terminal input only 2: Touch pad only 3: Enable changing of terminal & touch pad 4: Host input only 5: Enable changing of terminal & host input 6: Enable changing of touch pad & host input 7: Enable changing of all input modes		7	Err0	8-28
	Parameter setting mode selection	PMOd	0: Disable all input 1: Touch pad only 2: Host input only 3: Enable changing of touch pad & host input		3	Err0	8-28

6.8 Second Function Parameters (Cont'd)

TABLE 1
OPTION SELECTIONS

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 7	Option selection	:OPt	0: Off 1: 12 bit binary absolute input 2: 12 bit binary relativity input 3: 3 number BCD input (tenths) 4: 3 number BCD input (units) 5: Pulse frequency reference input 6: Multi-speed input 7: Item 1 with write signal 8: Item 2 with write signal 9: Item 3 with write signal 10: Item 4 with write signal 11: Item 5 with write signal 12: Item 6 with write signal		0	:Err0	8-28

TABLE 2
COMPUTER COMMUNICATION PARITY CHECK AND STOP BIT SELECTIONS

Function No.	Function Name	Display	Adjustment Range	Parity Check	Stop Bit	Error Message	Ref. Page
2ND 7	Parity check and stop bit	:SSCr	0:	Even	1	:Err0	8-28
			1:	Even	2		
			2:	N/A	1		
			3:	N/A	2		
			4:	Odd	1		
			5:	Odd	2		

7.0 Basic Operations

This inverter's almost limitless capabilities are made possible by the use of highly sophisticated software. The software allows keys to be used for more than one function. Identification of the inverter's basic keys, simple operation examples, method for accessing available functions, and the monitoring codes are presented in Section 7.

Note:

The inverter can be operated from either the keypad (**PANEL CONTROL**) or through remote signal inputs (**REMOTE CONTROL**).

7.1 Basic Keys

[CTRL] [△] [▽] [RUN] [STOP] See Section 6.4.

[MON] [2ND] [NEXT] [CLR] [WRT] [READ] See Section 6.5.

Every function/feature available with the inverter can be accessed, changed, monitored, and/or activated by using these keys in conjunction with the numerical keys (0 thru 9).

As shown in Section 6.5, each numerical key has three (3) separate functions assigned to it: numerical value, 1st Function, and 2nd Function. The operating function of this key depends on the key sequence preceding the numerical key data entry.

7.2 Simple Operation

The following example illustrates how easy it is to set, change, and run the inverter at different frequencies.

Key	Action	Display
	Power must first be applied to the inverter.	0.0
[CTRL]	"PANEL CONTROL" LED lights, signifying the inverter is in the **panel control** mode. NOTE: Pressing **CTRL** again will cause the LED to go off signifying the inverter is in the **remote control** mode.	0.0
[6] [0] [WRT]	Sets the inverter to 60Hz. Pressing the **WRT** key enters the data into the FC file. The display will flash "60" and "FC" alternately indicating the setting has been made. :60 → FC → :60	:60
[▽] [WRT]	Pressing this key decreases the value displayed. Once 55Hz is reached the **WRT** key can be pressed. The display will flash "55" and "FC" indicating the setting has been made. 55 → :FC ↔ : 55 Note: Pressing the [△] key increases the value displayed.	: 55
[RUN]	Engages the run command. The inverter output frequency will "ramp up" to 55Hz, causing the motor to accelerate to its 55Hz speed. Pressing the **STOP** key engages the stop command. The inverter's output frequency will "ramp down" to 0Hz, causing the motor to decelerate to a stop.	55.0

Note:

The inverter's operating frequency can be changed during any normal run, without stopping the motor.

7.2 Simple Operation (Cont'd)

Key	Action	Display
	Assume the inverter is running at 55Hz.	55.0
5 0 WRT	Sets the inverter to 50Hz. The monitor will display "50" and "FC" alternately. The inverter's frequency and motor's speed is decreased to 50Hz, at the selected deceleration rate. Note the flashing semi-colon ":". It signifies the motor is running but that the frequency displayed is not necessarily the inverter's actual output frequency. 50 → FC ↔ : 50	: 50
RUN	Displays the actual output frequency.	50.0
△ WRT	Press the △ key to raise the frequency to 60Hz. If the **WRT** key is not pressed the 60Hz frequency will not be retained in memory should the inverter lose power.	60.0
RUN	Displays the actual output frequency.	60.0
STOP	The inverter's output frequency will "ramp down" to 0Hz, causing the motor to decelerate to a stop.	0.0

Note:

When an ***invalid entry*** is attempted, an error message and the "entered data" are alternately displayed. For example, if a set frequency entered (FC) is higher than the maximum frequency (FH) then the error message "FH" and the "entered data" are alternately displayed. In this case, the set value entered will not be accepted and therefore a correct set value must be entered.

Key	Action	Display
	Assume the maximum frequency parameter (FH) is set to 80Hz, the inverter is in the **monitor mode,** and the unit is not running.	0.0
9 0 WRT	Attempted to set inverter frequency to 90Hz (FC=90) but instead of displaying :90 → FC → :90 the unit will display :90 → FH → :90 This signals a conflict between the value entered and the maximum frequency FH.	:90
8 0 WRT	The unit will accept this value since there is no conflict between the value entered and FH. :80 → FC → :80	:80

7.3 Function Access/Set Methods

7.3.1 First Functions

Accessing and setting the first functions are accomplished by using the following procedure. The example below illustrates how to access, read, and set the ACC/DEC file, which is located in First Function #2.

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2	Acceleration time #1	:ACC1	0.1 to 6000	sec	10	:Err0:ErrU	8-21
	Deceleration time #1	:dEC1	0.1 to 6000	sec	10	:Err0:ErrU	8-21
	Acc/Dec #1 pattern	:Pt.1	0: Linear 1: S-curve 2: C-curve		0	:Err0	8-21
	Acceleration time #2	:ACC2	0.1 to 6000	sec	10	:Err0:ErrU	8-21
	Deceleration time #2	:dEC2	0.1 to 6000	sec	10	:Err0:ErrU	8-21
	Acc/Dec #2 pattern	:Pt2	0: Linear 1: S-curve 2: C-curve		1	:Err0	8-21
	Acc/Dec #1, #2 select	:SEL2	0: Acc/Dec #1 1: Acc/Dec #2		0	:Err0	8-21

Accessing First Functions

Key	Action	Display
MON	The inverter must always be placed in the **function mode** before accessing any function.	:no.0 → :typ
ACC/DEC **2**	The function parameter ACC1 will be displayed. This means that the ACC1 parameter has been accessed.	:no.2 → :ACC1
READ	Reads and displays the current value assigned to ACC1.	: 10.0
5 **.** **5** **WRT**	The ACC1 parameter is set to 5.5 seconds. The display will flash "5.5" and "ACC1" indicating the setting has been made. 5.5 → :ACC1 ↔: 5.5	: 5.5
△ ▽ **WRT**	The parameter can also be changed by using the scroll keys "up" △ or "down" ▽. When 7.5 has been reached the **WRT** key should be pressed to set the new value. : 7.5 → :ACC1 ↔: 7.5	: 7.5
NEXT	The next parameter within the ACC/DEC file is accessed (dec1)	:dEC1
NEXT	The next parameter within the ACC/DEC file is accessed (Pt.1)	:Pt.1
MON	Returns to the **monitor mode.**	0.0

Note:

Continued "pressing" or "holding down" of the NEXT key causes the inverter to cycle through the entire function currently accessed. For the above example the inverter would cycle through and display the following parameters: ":ACC1", ":dec1", ":Pt.1", ":ACC2", ":dec2", ":Pt.2", and ":Sel2".

7.3.1 First Functions (Cont'd)

If an invalid value should be attempted to be set during a write, the inverter will alternately display an error message and the invalid value. If this occurs, check the value in error and input a correct value. When this occurs the invalid value will not be stored in memory.

Before the run command can be engaged the inverter must first be placed in the **monitor mode**. This is accomplished by pressing the **MON** key until the current operating frequency is displayed. The run command can now be engaged by pressing the **RUN** key.

If incorrect data has been entered press **CLR** once to clear the display and then enter the correct data.

7.3.2 Second Functions

Accessing and setting the second functions are accomplished by using the following procedure. With the exception of the **2nd** key, the methods used are the same as those for the first functions.

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 0	Starting frequency	F-St	0.0 to 10	Hz	0	:Err.0	8-26

Accessing Second Functions

Key	Action	Display
MON	The inverter must always be placed in the **function mode** before accessing any function.	:no.0 → :typ
2ND	When this key is pressed the inverter is placed into the second function files.	:2nd
FMAX / **0**	F-St appears. The function F-St will be displayed. This means that the starting frequency has been accessed.	:no.10 →: F-St

7.4 Frequency Setting (FC)

Both the keypad (Panel Control) and the input signal terminals (Remote Control) can be used for setting the inverter's operating frequencies. For details on frequency setting see section 8.3 (Panel Control) and section 8.4 (Remote Control).

The inverter's output frequency can be set from the keypad either by directly entering the frequency or by pressing the "up" △ and "down" ▽ keys until the desired frequency is reached.

Key	Action	Display
MON	The inverter must always be placed in the **monitor mode** before setting the operating frequency and engaging the run command.	0.0
6 **0** **WRT**	Sets the inverter's operating frequency to 60Hz. The inverter will not run until the **RUN** command is pressed. :60 → FC ↔ :60	:60
RUN	Engages the run command. The inverter's output frequency will "ramp up" to 60Hz, causing the motor to accelerate to its 60Hz speed.	60.0
△ or ▽ **WRT**	Pressing the "up" △ or "down" ▽ scroll keys will increase or decrease the inverter's output frequency, respectively. For example: :[value] → :FC ↔ :[value]	:[value]

7.5 Status Monitoring

The inverter's current status conditions can be monitored at any time while in the **monitor mode**. In addition, if the inverter were to trip, the status conditions which existed at the time of the trip could also be monitored. This is provided that monitoring is performed before resetting the inverter.

7.5.1 Normal Status Monitoring

The following two tables give examples of what could possibly be seen under normal conditions. The second table illustrates additional conditions which can be monitored by pressing the **NEXT** key.

Normal Monitoring

Display	Status
OFF	Not ready for run (with ST-CC opened)
0.0	0Hz (ready to run with ST-CC shorted)
60.0	60.0Hz (running at 60.0Hz)
200	200Hz (running at 200Hz)
C 50.0	Stall prevention activated *
P 50.0	Overvoltage limitation activated *
L 50.0	Overload detection activated *
POFF	Power supply undervoltage (The input voltage supplied to the inverter is too low).
NOFF	DC main circuit undervoltage (The inverter's internal DC main voltage is too low).

* Displays a flashing C, P, and L

Additional Normal Monitoring

Key	Display	Status
		Assume the unit is in the **monitor mode** and not the **function mode**.
NEXT	:F. or r.	Indicates a forward (F) or reverse (r) run. If not running, the display refers to the direction the unit would run.
NEXT	: 60.0	Displays the inverter's set output frequency.
NEXT	:C 90	The inverter's output current is 90% (90% of the inverter's rated output current).
NEXT	:P 90	The inverter's output voltage is 90% (90% of the inverter's rated output voltage).
NEXT	:I-40	Input terminal status code. See section 7.5.3
NEXT	:O-33	Output terminal status code. See section 7.5.4
NEXT	:u.5.2	Inverter's software version
NEXT	:u.P2.0	Keypad's software version
NEXT		Returns to the original display.

7.5.2 Tripped Status Monitoring

If a trip should occur, one of the following fault codes could appear.

Fault Codes

Display	Status
OC1	Overcurrent during acceleration (an overcurrent occurred during an acceleration).
OC2	Overcurrent during deceleration (an overcurrent occurred during a deceleration).
OC3	Overcurrent during run (an overcurrent occurred during a run).
OCA	Overcurrent detected at start-up (suspect inverter damage).
OCL	Overcurrent detected at start-up (suspect short circuit at load side).
OCr	Overcurrent in regenerative discharge resistor (an overcurrent flowed in the regenerative discharge resistor). *
OP2	Overvoltage during deceleration (an overvoltage was generated during deceleration).
OP	Overvoltage (an overvoltage was generated).
OL	Overload (the motor was overloaded).
OLr	Overload of regenerative discharge resistor (the regenerative discharge resistor was overloaded). *
OH	Overheat (the inverter body was overheated).
EF	Ground fault (a ground fault overcurrent in the load side circuit).
E	Emergency stop (an emergency stop was executed by a command from the panel during an automatic run or a remote control operation).
Err.1	Frequency setting signal error (this is a warning only and is not a trip). Points 1 and 2 of a frequency setting signal are too close together. Correct the setting of points 1 and 2 by providing an adequate distance between them.
Err.2	The main RAM in the main CPU is abnormal (the main RAM must be replaced).
Err.3	The main ROM in the main CPU is abnormal (the main ROM must be replaced).
Err.4	The RAM in the digital operating panel CPU is abnormal (the RAM in the digital operating panel must be replaced).
Err.5	The ROM in the digital operating panel CPU is abnormal (the ROM in the digital operating panel must be replaced).
Err.6	A key in the digital operating panel keypad is defective (the keypad must be replaced).
EEP	Data stored in the EEPROM is abnormal (the EEPROM must be replaced).
EEP2	EEPROM abnormality (abnormalities were found in the "past trip cause" data).
EEP3	EEPROM abnormality (An abnormality was found in a set value).
Err.E	Communication abnormality (an abnormality was found in transmission). **
POFF	Power supply undervoltage (the input voltage supplied to the inverter is to low).
nOFF	DC main circuit undervoltage (the internal DC main circuit voltage is to low) .
EOFF	An EMERGENCY STOP procedure has been activated. Caused by pressing STOP while in REMOTE CONTROL (see section 8.1.3 for details).
:Err.0 :Err.U	Not Actual fault codes, however these errors can be seen when attempting to set function parameters with incorrect data values (see section 6.7 and 6.8 for error messages).

* The OCr & OLr functions are available only in the units listed: G2+2010 to G2+2220 and G2+4015 to G2+4220.

** The "Err.t" display involves a trip.

7.5.2 Tripped Status Monitoring (Cont'd)

In the event of a trip, the following statuses could be observed provided monitoring is done prior to resetting the inverter. These statuses reflect the conditions which existed at the time the inverter tripped.

Additional Tripped Status Monitoring

Key	Display	Status
NEXT	:20.0	Operating frequency at trip was 20.0Hz.
NEXT	:F.	Rotating direction at trip was in the forward direction.
NEXT	:50.0	The set value of operating frequency at trip was 50.0Hz.
NEXT	:C150	The output current at trip was 150% (150% of the inverter's rated output current).
NEXT	:P100	The output voltage at trip was 100% (100% of the inverter's rated voltage).
NEXT	:1-60	Input terminal status code at trip. See section 7.5.3
NEXT	:0-33	Output terminal status code at trip. See section 7.5.4
NEXT	:u.5.2	Inverter's software version
NEXT	:u.P2.0	Keypad's software version
NEXT	Original fault display	Returns to the original display.

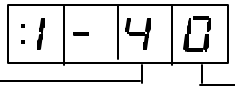
Note:

Resetting the drive after a trip can be accomplished either of two ways:

1) Reset from panel - press CLR WRT

2) Reset from remote - momentary contact closure between terminals RST and CC.

7.5.3 Input Terminal Status Code



Display	RR-CC	ST-CC	F-CC	R-CC
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
A	ON	OFF	ON	OFF
b	ON	OFF	ON	ON
C	ON	ON	OFF	OFF
d	ON	ON	OFF	ON
E	ON	ON	ON	OFF
F	ON	ON	ON	ON

Display	SS1-CC	JOG-CC (SS2)	AD2-CC (SS3)	RST-CC
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
A	ON	OFF	ON	OFF
b	ON	OFF	ON	ON
C	ON	ON	OFF	OFF
d	ON	ON	OFF	ON
E	ON	ON	ON	OFF
F	ON	ON	ON	ON

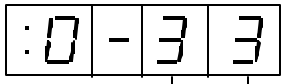
ON: Implies a closed contact or short between terminals.
OFF: Implies an open contact or no connection between terminals.

Terminal Connections	Inverter's Status when terminal connections are closed (ON).
RR-CC	Connect terminals PP-CC (see terminal connections page 8 -12).
ST-CC	RUN ENABLED
F-CC	FORWARD RUN ENABLED
R-CC	REVERSE RUN ENABLED
SS1-CC	MULTI-SPEED RUN ENABLED
SS2-CC	MULTI-SPEED RUN OR JOG RUN ENABLED (Dependent upon SS2's usage)
SS3-CC	MULTI-SPEED RUN OR ACC/DEC 2 ENABLED (Dependent upon SS3's usage)
RST-CC	RESET MODE ENABLED (Reset occurs after momentary contact closure)

Note:

If both F-CC and R-CC are ***on*** then a reverse run is enabled.

7.5.4 Output Terminal Status Codes



Display	RCH	UL
0	OFF	OFF
1	OFF	ON
2	ON	OFF
3	ON	ON

Display	LOW	LL
0	OFF	OFF
1	OFF	ON
2	ON	OFF
3	ON	ON

RCH: Output frequency is within the set reach frequency range or accel/decel is complete.
LOW: Output frequency is equal to or greater than low speed frequency.
UL: Output frequency has reached the upper limit frequency (UL).
LL: Output frequency is equal to or greater than the lower limit frequency (LL).

7.5.5 Monitoring Details of Faults

The inverter has the ability to store fault information, in the non-volatile memory, making it possible to trace reoccurring faults. Up to four consecutive faults can be stored simultaneously. This information is available by utilizing the **"2nd"** and **"9"** keys while in the **monitor mode**.

Key	Display	Status
2ND	:2nd	Initial key used to activate the inverter's special features. The unit must be in the **monitor mode** before pressing this key.
9	:1 ↔ OC1	Displays the previous fault (for example, "OC1" or "OP")
NEXT	:2 ↔ OP	The retrospective second fault
NEXT	:3 ↔ OH	The retrospective third fault
NEXT	:4 ↔ OP	The retrospective fourth fault
NEXT	Original display	Returns to the original display

Notes:

1) If no previous faults are recorded, the message ":E" alternately flashes.

2) When the inverter functions are reset to the factory's settings ("typ"=3), all of the past fault data will be erased.

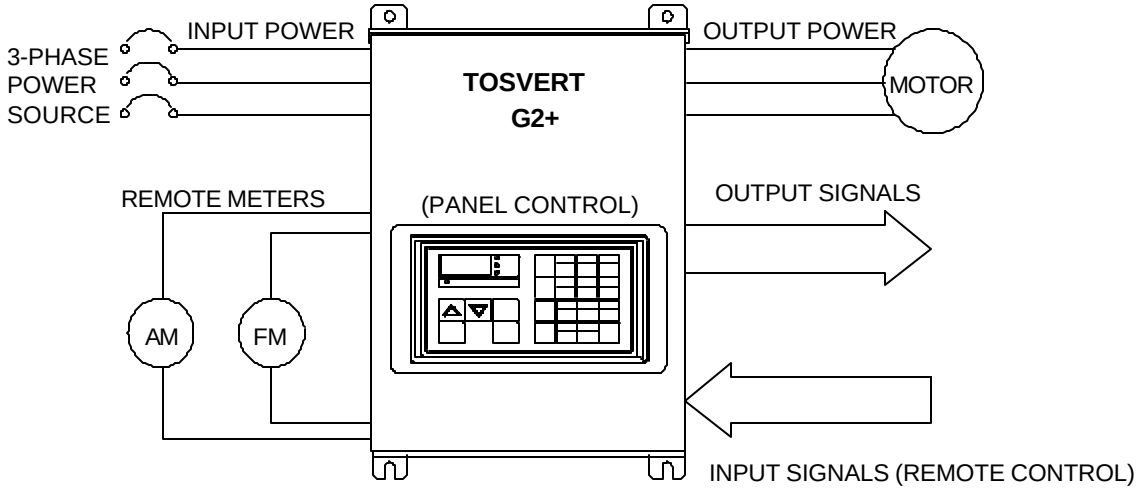
8.0 Operating Procedures

A thorough understanding of the G2+ inverter's operating procedures and functions is necessary to gain maximum use of the many versatile features. This includes understanding the uses for all of the available functions, how the software is structured, and the programming techniques used. An understanding of the use of the input and output terminals is also necessary.

Section 8 identifies operating procedures and teaches keyboard data flow and terminal functions so the user can program the inverter to fit almost any application.

Section 8 is broken into separate sub-sections that explain the functions of both the keypad data entry and the terminal input logic. Each function is explained and some step-by-step procedures are shown with keystroke, action, and display examples.

The figure and table shown below, as well as the flowchart and program sequence on the next page, help to illustrate the basic fundamentals, software structure, and programming format of the inverter.

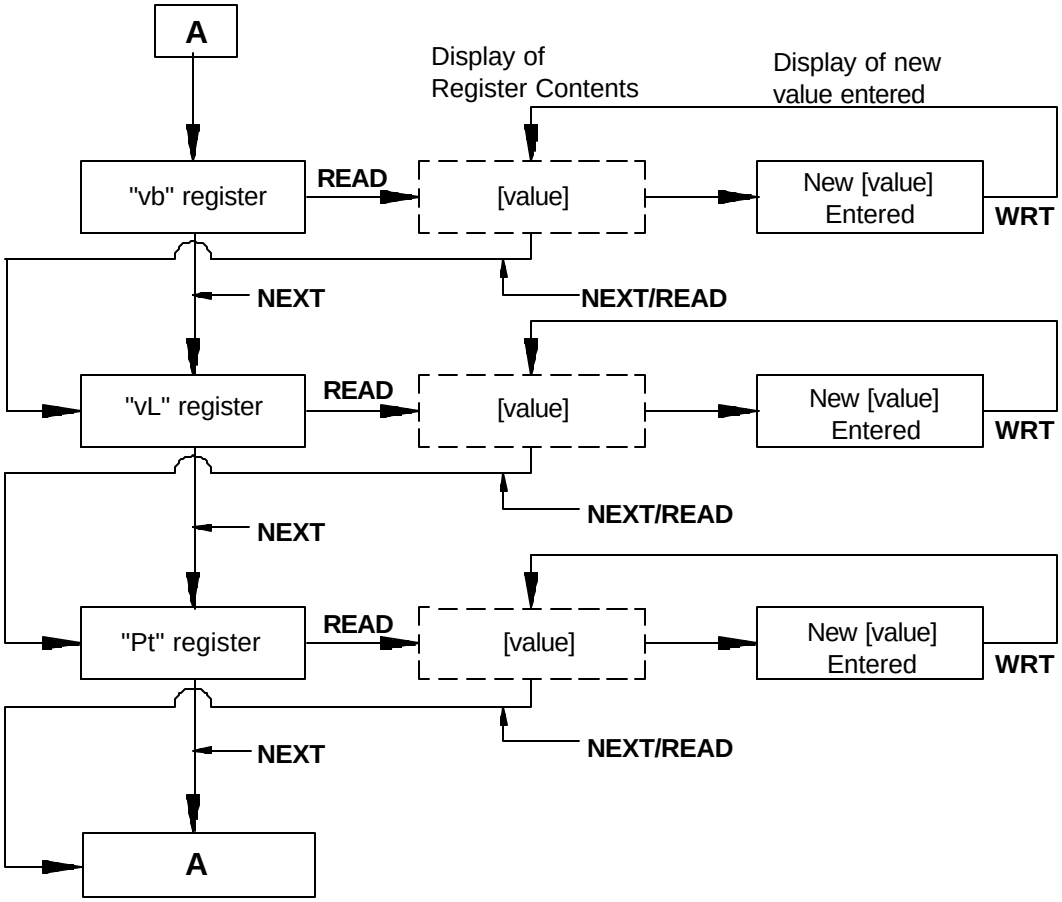


Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
1	Voltage Boost	vib	0 to 30	%	3	Err0	8-21
	Auto torque boost (voltage)	AUb	0: Off 1: On		0	Err0	8-21
	Max. voltage frequency	UL	25 to 400	Hz	60	Err0 ErrU	8-21
	V/f pattern	PtN	0: Constant torque 1: Variable torque		0	Err0	8-21

8.0 Operating Procedures (Cont'd)

Function #1 Flowchart (Once function is accessed the flowchart is as follows)



Accessing Function #1

Key	Action	Display
MON	The inverter must always be placed in the **function mode** before accessing any function.	:no.0 → :typ
V/F / **1**	Accesses the voltage boost parameter.	:vb
READ	Displays the current "vb" setting.	:[value]
NEXT or **READ**	Accesses the maximum voltage frequency parameter	:vl
READ	Displays the current "vL" setting.	:[value]
NEW VALUE and **WRT**	Enter new value followed by the **WRT** key. The unit will then display the new current "vL" setting.	:[new value]
NEXT or **READ**	Accesses the V/f parameter.	:Pt
READ	Displays the current "Pt" setting.	:[value]

Note:

Current value of each parameter does not have to be read. Press **NEXT** key for next parameter.

8.1 Starting/Stopping - Panel Control

(FORWARD/REVERSE, Run, Coast to Stop, and Emergency Stop)

8.1.1 FORWARD/REVERSE

When wired, make sure the motor rotates in the correct direction selected by the FORWARD/REVERSE function parameter. If it does not, then reverse two (2) of the motor's three (3) leads to change the direction. This will ensure the motor's correct rotation in all possible situations. The FORWARD/REVERSE function is the first parameter in function #9. Accessing this function is illustrated in the following table and uses the programming sequence shown below.

First Function Parameters

Function No.	Function Name	Display	Adjustment Range	Factory Set	Error Message	Ref. Page
9	Forward/Reverse	:F.r.	0: Reverse 1: Forward	1	:Err0	8-24
	Fault trip saving	:ltr-CL	0: Cleared when powered off 1: Data retained when powered off	0	:Err0	8-24
	Retry (Auto-reset)	:rtry	0: Off 1: On	0	:Err0	8-24
	Auto-restart	:ArSt	0: Off 1: On	0	:Err0	8-25
	Regen power ride through	:Uu.C	0: Off 1: On	0	:Err0	8-25

Accessing the FORWARD/REVERSE Function Parameter

Key	Action	Display
MON	The inverter must always be placed in the **function mode** before accessing any program function.	:no.0 → :typ
SEL **9**	Accesses the First Function #9 parameters.	:F.r.
READ	Displays the current "F.r." setting.	:[value]
new value **WRT**	Should a new value be necessary, it can be set by entering the new value followed by the **WRT** command. :[new value] → :F.r. → :[new value]	:[new value]
MON	Returns to the inverter's **monitor mode**. Assumming the inverter is not running the display will read "0.0".	0.0
6 **0** **WRT**	Starting the inverter via the panel requires first entering a specified run frequency followed by the **WRT** command. Example 60Hz :60 → FC → :60	:60
RUN	Engages the run command. The inverter's output frequency will "ramp up" to 60Hz, causing the motor to accelerate to its 60Hz speed.	60.0
STOP	Engages the stop command. The inverter's output frequency will "ramp down" to 0Hz, causing the motor to decelerate to a stop.	0.0

8.1.2 Coast to Stop

This inverter is capable of instantly removing power from a rotating motor and allowing it to coast to a stop. This can be accomplished without removing power from the inverter. The procedure will override the inverter's normal deceleration pattern. Activation of the coast to stop function is illustrated below:

Activating the Coast to Stop

Key	Action	Display
	Assume the inverter is operating at 60HZ as shown in the previous table and is in the **monitor mode**.	60.0
2ND **STOP**	Engages the COAST to STOP command. The inverter releases it's control of the motor allowing it to "free wheel" and coast to a stop.	0.0

8.1.3 Emergency Stop

The emergency stop function can only be used when operating by remote control. When activated, the inverter can perform the same coast to a stop function as described in section 8.1.2. In an emergency, valuable time can be saved by being able to remove power to the motor from the local inverter instead of from the distant remote control station. Activation of the emergency stop is illustrated below:

Activating the Emergency Stop

Key	Action	Display
	Assume the inverter is operating at 60HZ due to some type of remote input signal (REMOTE CONTROL).	60.0
STOP	"EOFF" flashes but the unit continues running. Pressing **STOP** once more will activate the stop, however pressing **CLR** **CLR** will cancel the procedure.	EOFF
STOP	Activates the emergency stop function. A fault detection signal is ouput via terminals FLA, FLB, FLC.	E
CLR **WRT**	Resets the inverter and its fault detection contacts. The inverter is now ready for normal operation.	0.0

Note:

Resetting the inverter from a remote location is accomplished by momentarily short-circuiting terminals RST to CC. These terminals are located on the inverter's terminal strip.

8.1.4 Emergency Stop From a Remote Location

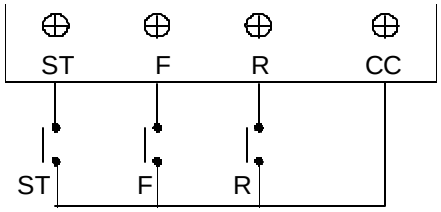
A SPST normally closed latch-in type of switch should be connected between ST-CC. This switch can then be located in a remote location. When the switch is "toggled" to latch open, the motor will coast to a stop.

CAUTION ***Do not toggle this switch ON again until the inverter is turned OFF (the output frequency reads zero) and the motor load has stopped rotating.***

8.2 Starting/Stopping-Remote Control

The remote STARTING/STOPPING possibilities are identified in the following figure and table.

START/STOP Terminals Connections



Remote START/STOP Connections Possibilities

Terminal Connection			Action
ST-CC	F-CC	R-CC	
OFF	ON/OFF	ON/OFF	The inverter is OFF. OFF will be displayed. If running when ST-CC is broken the motor will coast to a stop.
ON	OFF	OFF	The inverter is ON but not running.
ON	ON	OFF	The inverter is ON and will run in a FORWARD direction if an input signal is applied.
ON	OFF	ON	The inverter is ON and will run in a REVERSE direction if an input signal is applied.
ON	ON	ON	Same as REVERSE connection above.

ON = short circuit
OFF = open circuit

Note:

1) With ST-CC (ON), switching F-CC or R-CC (OFF) will cause the motor to decelerate to a stop.

2) If input power is turned off (with MCCB) while inverter is running, the motor will coast to a stop.

3) Acceleration and Deceleration rates are determined by the preset values of 1st Function #2 (ACC/DEC).

4) When switching from a forward run to a reverse run the motor will decelerate to a stop, then accelerate in the reverse direction.

CAUTION ***Avoid using the input power switch (MCCB) to start and stop the inverter. Use for an emergency stop only.***

8.3 Frequency Setting - Panel Control

(Digital, Scroll, Jog, 7 Preset Speeds, Pattern Run)

The inverter's panel control is operational when the inverter is in the **panel control** mode. Press the **CTRL** key until the "PANEL CONTROL" LED is on.

8.3.1 Digital

Frequency changes are made by inputting the desired frequency via the numerical keypad, **0 - 9**, followed by the **WRT** and/or **RUN** keys. When running, frequency changes are not made until the **WRT** and/or **RUN** key is pressed.

8.3.2 Scroll

Frequency changes are made by inputting the desired frequency via the "up" △ and "down" ▽ keys. The user can scroll through the frequency range until a desired frequency is reached. When running, the scrolled frequency changes are immediate; however, when not running, the **RUN** key must first be pressed (see operating frequency setting parameter on page 6-8).

The following procedure illustrates frequency setting:

Frequency Setting

Key	Action	Display
	Power must first be applied to the inverter.	0.0
CTRL	"PANEL CONTROL" LED lights, signifying the inverter is in the **panel control** mode. NOTE: Pressing **CTRL** again will cause the LED to go off signifying the inverter is in the **remote control** mode.	0.0
6 **0** **WRT**	Sets the inverter to 60Hz. Pressing the **WRT** key enters the data into the FC file. The display will flash "60" and "FC" alternately indicating the setting has been made. :60 → FC → 60	:60
RUN	Engages the run command. The inverter's output frequency will accelerate or decelerate to the new set speed designated by "FC".	60.0
1 **0** **WRT**	Pressing **1 0 WRT** sets the inverter's new frequency and begins a deceleration to that frequency. NOTICE the flashing semicolon ":" ,which signifies the motor is running but that the inverter is not necessarily displaying the actual output frequency. :10 → FC → :10	:10
RUN	Even though the inverter is decelerating, the actual output frequency is not displayed until the **RUN** key is pressed.	10.0
△ **WRT**	Pressing the "up" △ key increases the value displayed. The output frequency automatically increases. Once 55.4Hz is reached the **WRT** key can be pressed. The display will flash "55.4" and "FC" indicating the setting has been made. :55.4 → FC → :55.4 Note: Pressing the "down" ▽ key will automatically decrease the inverter's output frequency.	:55.4
RUN	Displays the inverter's actual output frequency. In this case, the actual output frequency will be the same as that displayed because of the incremental changes of the "up" △ and "down" ▽ keys.	55.4

Note:

Operating frequency can be changed during a run.

8.3.3 Jog

The jog frequency is immediately output regardless of the predetermined acceleration time. The jog frequency (JOG) and the type of jog stop pattern (J.StP) must be pre-selected.

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	Jog drive frequency	JOG	0 to 20	Hz	5	Err0	8-23
	Jog stop control	J.StP	0: Deceleration stop 1: Coast stop 2: DC injection stop		0	Err0	8-23
2ND	DC injection starting frequency	dbF	0.0 to 10	Hz	0	Err0	8-27
1	DC injection voltage	dbV	0 to 20	%	0	Err0	8-27
	DC injection time	dbt	0.0 to 5	sec	0	Err0	8-27

The following table identifies the STOP pattern and the next table illustrates a JOG RUN in which the parameters "JOG" and "J.Stp" equal 5Hz and 1, respectively.

Jogging Stop Pattern

J.StP	Pattern
0	Motor will decelerate to a stop at the rate of DEC1, or DEC2, (dependent upon SEL2).
1	Motor will coast to a stop.
2	Motor will have DC injection applied based upon the DC injection parameters located in the 2nd Function #1.

Activating the JOG Feature

Key	Action	Display
MON	The inverter must be placed in the **monitor mode** and stopped before activating the **jog feature**.	0.0
2ND **0**	Engages the **jog feature**.	JOG
△	Sets a forward run jog.	JOG
▽	Sets a reverse run jog.	JOG -
RUN	When held down the inverter will run at the preset jog speed.	5
RUN	When released the motor coasts to a stop (J.StP=1).	JOG
CLR or **STOP**	Disables the **jog feature**. The inverter returns to the **monitor mode**.	0.0

8.3.4 7 Preset Speeds

The multispeed function provides the user with up to seven preset speed frequencies. An eighth speed is available when including the remote input reference signal. These frequencies (Sr1~Sr7) must be pre-selected. By presetting parameters Sr1~Sr7 the user is able to operate at any of these speed frequencies, either forward or reverse, simply by using the method illustrated below:

Multi-Speed Run Frequencies

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	1st speed	:Sr1	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	2nd speed	:Sr2	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	3rd speed	:Sr3	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	4th speed	:Sr4	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	5th speed	:Sr5	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	6th speed	:Sr6	LL to UL setting value	Hz	0	:LL :UL :FH	8-23
	7th speed	:Sr7	LL to UL setting value	Hz	0	:LL :UL :FH	8-23

Note:

All acc/dec times reflect the acc/dec parameter settings which are in effect. These acc/dec settings are located in 1st Function #2.

Activating the Preset Speed Function

Key	Action	Display
MON	The inverter must be placed in the **monitor mode** and stopped (0.0Hz) before activating any of the preset speeds.	0.0
2ND **1** thru **7**	Engages the **preset speed feature**. Pressing a key **1-7** selects the respective preset speed frequency (Sr1~Sr7).	2nd Sr1-7
△	△ Sets a forward run	Sr1-7
▽	▽ Sets a forward run	Sr1-7-
RUN	The inverter's output frequency increases to the selected preset frequency. The attached motor will accelerate to that frequency.	[:value]
STOP	The inverter's output frequency decreases to zero (0Hz). The attached motor will decelerate to a stop.	0.0

8.3.5 Pattern Run

The pattern run enables the user to run up to seven (7) different speeds automatically, in either forward or reverse directions. It is an extension of the 7 Preset Speeds described in Section 8.3.4. Unlike the Preset Speed Function, the user can pre-select the length of time in which the inverter will operate at each frequency (Sr1-Sr7), as well as the acc/dec pattern used to reach each frequency.

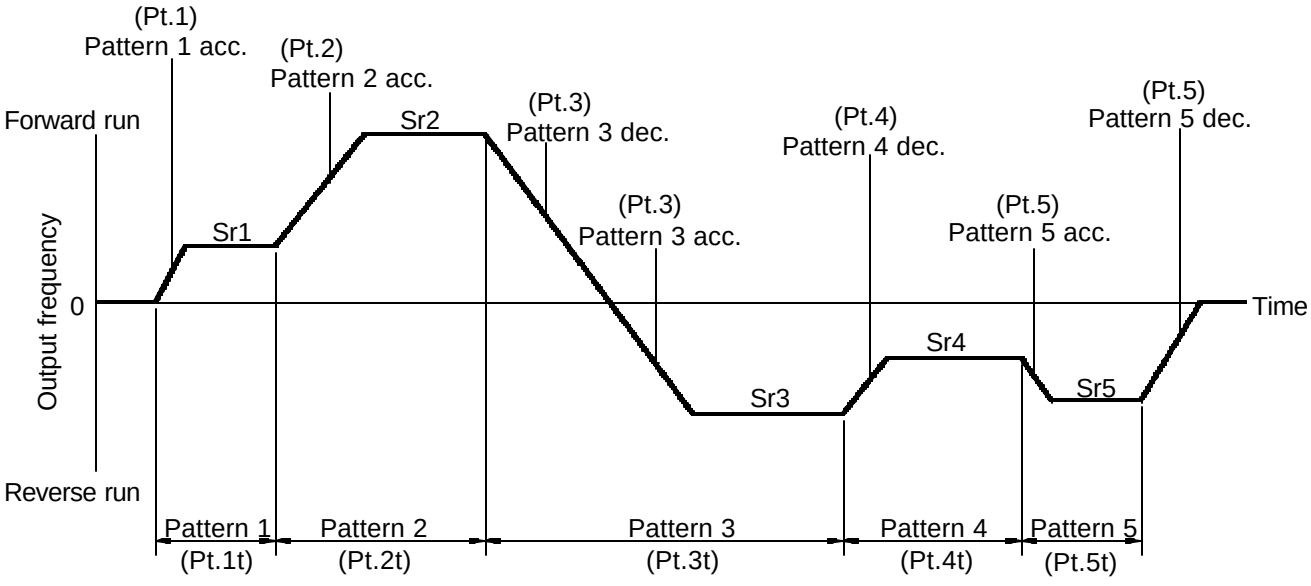
The required preset function parameters are as follows:

1) Actual run frequencies (Sr1~Sr7) are located in 1st Function #6 (Section 8.3.4).
2) The run time for each of these frequencies in the pattern (Pt.1t~Pt.7t) is located in 2nd Function #8.
3) The particular ACC/DEC drive characteristics to be used, as well as the run direction (Pt.1~Pt.7) located in 2nd Function #8.

Function Parameters

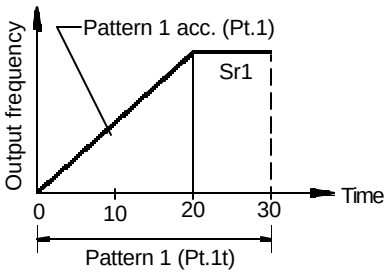
Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
2ND 8	Pattern run activation mode	:P.SEL	0: Off 1: Terminal operation 2: Touch pad operation 3: Computer communication		0	:Err0	8-28
	Time unit	:Pt.t	0: Seconds 1: Minutes		0	:Err0	8-28
	Cycle times	:Pt.n	0 to 255 (255: Infinity operating)		0	:Err0	8-28
	Pattern drive time #1 to 7	:Pt.1t to :Pt.7t	0 to 8000	sec min	0	:Err0	8-28
	Pattern drive characteristics #1 to 7 F/R, ACC/DEC	:Pt.7 to :Pt.1	0: Forward run, #1 ACC/DEC 1: Forward run, #2 ACC/DEC 2: Reverse run, #1 ACC/DEC 3: Reverse run, #2 ACC/DEC		0	:Err0	8-28

The following graph shows a sample of a typical pattern run:



8.3.5 Pattern Run (Cont'd)

The run time set for each pattern includes the ACC/DEC time required to reach that particular run frequency. Therefore, care must be taken when choosing run times. For example, if the pattern run time is set for 30 seconds and the acceleration time required to reach the preset frequency is 20 seconds, then the actual run frequency would last only 10 seconds.



Activating the Pattern Run

Key	Action	Display
MON	The inverter must be placed in the **monitor mode** and stopped (0.0Hz) before activating the pattern run. no.0 → :typ	:typ
2ND **8**	Engages the **pattern run** feature. no.18 → :P.SEL	:P.SEL
READ	Reads the standard factory default setting "off".	0
2 **WRT**	Writes the new touchpad operation adjustment "2" to memory. :P.SEL ↔ 2	2
MON	Takes the inverter out of function setting mode.	0.0
CLR	Resets the microprocessor.	CLr
WRT	Engages pattern run.	• 0.0

Notes:

1.) Pressing the **STOP** key at any time during the pattern run will cause a deceleration to a stop.

2.) Pressing **2ND** and then **STOP** will cause a coast to a stop.

3.) Resuming the pattern run is accomplished by pressing **RUN**, however be aware that the run proceeds from the point of interruption unless **2ND** is pressed before **RUN** is pressed.

4.) In order to deactivate the pattern run function the above procedure should be followed in the same order except that 0 should be stored for P.SEL at step 4.

8.3.5 Pattern Run (Cont'd)

Use the following procedure to monitor a pattern run. For this example the inverter is running in pattern 1 at 10Hz and there are 12.3 minutes remaining in pattern 1.

Monitoring During a Pattern Run

Key	Action	Display
	A pattern run frequency is displayed	: 10.0
NEXT	Displays current pattern number	:Pt.1
NEXT	Displays balance of time remaining in the current run pattern	:12.3
NEXT	Displays remaining patterns	:Ptn
NEXT	Displays current forward/reverse status. Continued pressing of the **NEXT** key provides monitoring of the inverters status information. The items appear in the sequence listed in section 7.5.1	: F. or r.
MON **MON**	Returns to displaying the current patterned run frequency.	: 10.0

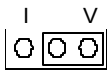
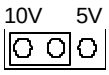
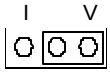
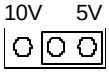
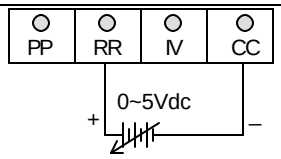
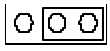
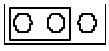
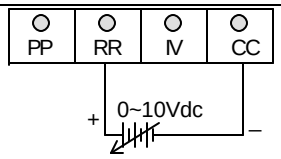
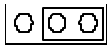
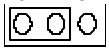
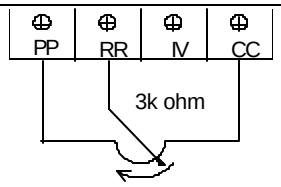
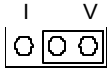
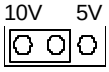
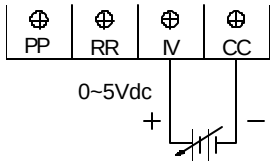
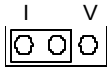
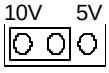
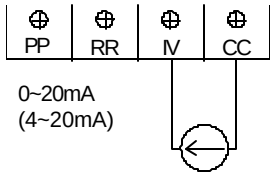
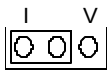
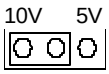
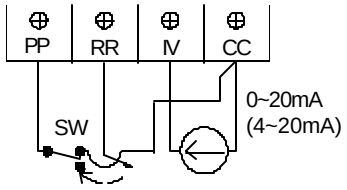
8.4 Frequency Setting - Remote Control

The inverter's remote control is operational when the inverter is in the **remote control** mode. **The "PANEL CONTROL" LED is off.** All frequency setting input signals (0-5Vdc, 0-10Vdc, 0-20mA, 4-20mA, 3k ohm pot, JOG, and Preset Speeds) are applied to the drive through the terminal block which is located on the control/driver printed wiring board (see page 4-11 for terminal block and jumper details).

8.4.1 Proportional/Follower Input Signals

The following table illustrates the connections required for receiving the different analog input signals.

Terminal/Jumper Connections for Input Reference Signals

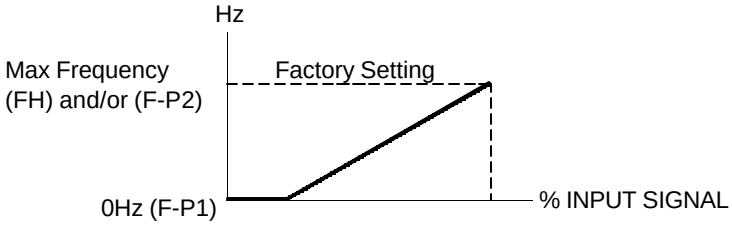
	JP1	JP2	Terminal Connections	Function
1			NO CONNECTIONS, JP1 & JP2 should be set as shown for normal panel operation.	Required for normal panel operation.
2				Required for standard 0~5Vdc input reference signal. Function No. 5 RR terminal priority should be set to 1 "on" when using this feature. See Ref. page 8-23.
3	 **N/A**			Required for standard 0~10Vdc input reference signal. Function No. 5 RR terminal priority should be set to 1 "on" when using this feature. See Ref. page 8-23.
4				Required when using a 3k ohm pot. A 1K to 10K ohm pot can also be used but the pot adjustments will be more critical.
5		 **N/A**		Required for standard 0~5Vdc input reference signal. Function No. 5 RR terminal priority should be set to the normal setting of 0 "off" when inputting a signal to the IV terminal. See Ref. page 8-23.
6		 **N/A**		Required for standard 0~20mA, 4~20mA input reference signal. Function No. 5 RR terminal priority should be set to the normal setting of 0 "off" when inputting a signal to the IV terminal. See Ref. page 8-23.
6*				When switch is closed (ON), the remote pot will override the 0~20/4~20mA input reference signal. Function No. 5 RR terminal priority should be set to the normal setting of 0 "off".

8.4.2 Terminal IV

Terminal IV (IV | CC) is a special terminal which is used in conjunction with 1st Function key **#5** to output exact frequencies based upon specific input reference signals. These output frequencies do not necessarily have a one-to-one ratio with the input reference signals. The following graphs and examples illustrate how this function can be adjusted.

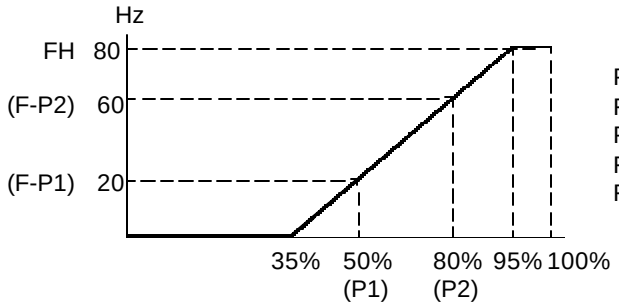
Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
5	IV-ref. setting point #1	:P1	0 to 100	%	20	:Err0	8-23
	#1 output frequency	:F-P1	0 to Max. frequency	Hz	0	:FH	8-23
	IV-ref. setting point #2	:P2	0 to 100	%	100	:Err0	8-23
	#2 output frequency	:F-P2	0 to Max. frequency	Hz	80	:FH	8-23
	RR terminal priority	:rr.CC	0: IV terminal input "on" 1: RR terminal input "on"		0	:Err0	8-23



	0%	20%	100%	
IV	0V		5Vdc	JP1=V
IV	0mA	4mA	20mAdc	JP1=I
REF	0V		5Vdc	JP2=5V
REF	0V		10Vdc	JP2=10V

Example: Application requiring the following output characteristics is shown below:

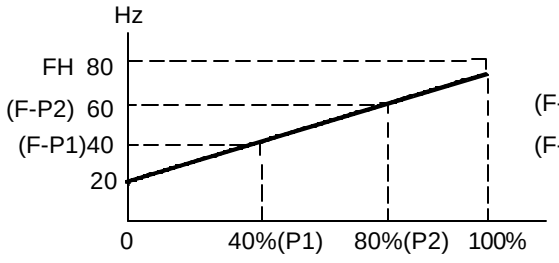


P1=50% of maximum input signal
F-P1=20Hz
P2=80% of maximum input signal
F-P2=60Hz
FH=80Hz

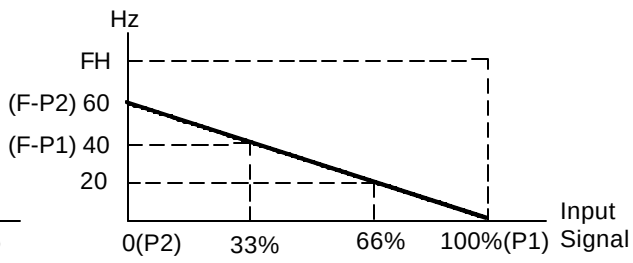
In the above graph the inverter has no output frequency until the input signal has reached 35% of its maximum. This is due to the linear characteristics of the IV Function. Also notice that the maximum frequency is reached before 100% of the input signal is applied.

Note:

In most cases the value of UL is less than FH.The value of UL cannot be greater than FH.



In the above graph the inverter has an output frequency of 20Hz even with a 0% input signal. Also notice that the maximum output frequency is never reached unless the input signal goes above 100%. (i.e. a 7Vdc input signal is considered a 140% input signal when using a 0~5Vdc input.



In the above graph the inverter has a negative output. In other words, as the input signal increases the output frequency decreases. Notice that at 0% and 100% input the inverter outputs 60Hz and 0Hz, respectively.

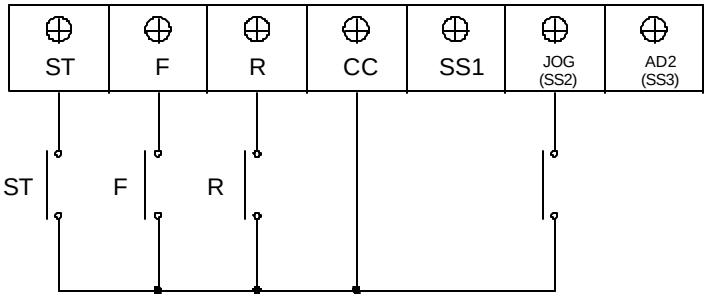
8.4.3 Jog

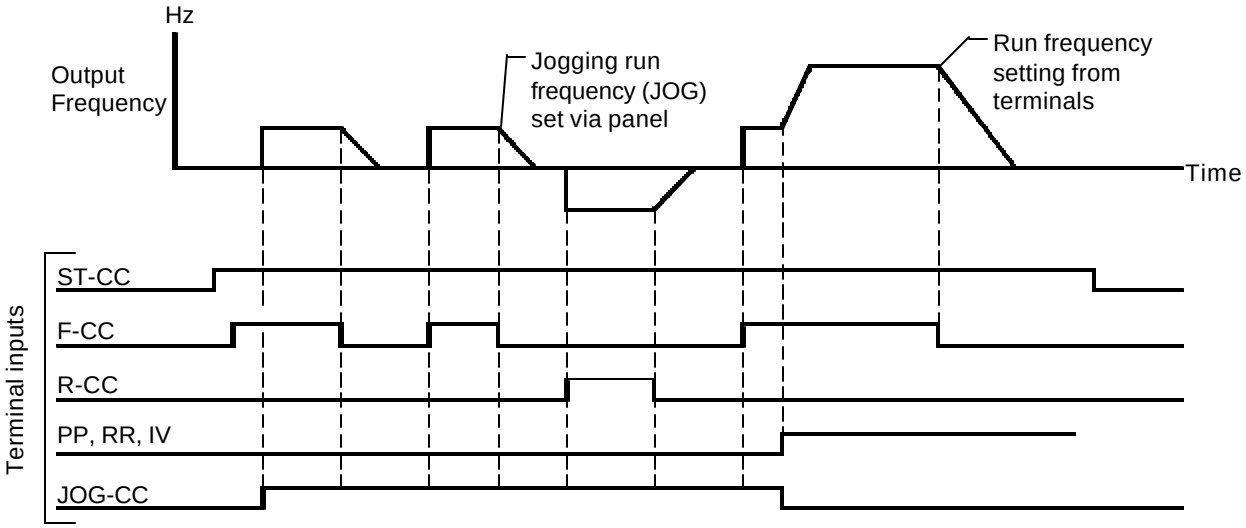
The jogging frequency is immediately output when the remote JOG is activated. The functions "JOG" and "J.StP" must be preset. Use 1st Function **#6** key to access these functions. In addition, the JOG(SS2) terminal must be set for "JOG". This is accomplished by setting the function parameter "1.tb" to 1 or 3. Use 1st Function **#8** key to access this function. The terminal connections, function parameters, and input/output graph are all shown below:

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
6	Jog drive frequency	JOG	0 to 20	Hz	5	Err0	8-23
	Jog stop control	J.StP	0: Deceleration 1: Coast stop 2: DC injection stop	Hz	0	Err0	8-23
8	Multifunction input	1.tb	0: SS2, SS3 1: JOG, SS3 2: SS2, AD2 3: JOG, AD2		2	Err0	8-24

Terminal Connections Required For Remote Jog





Notes:

1) A jogging run cannot be engaged by closing the JOG switch during a run.

2) The inverter will decelerate at the selected rate during: deceleration stop, coast to stop, injection stop.

3) F-CC must be broken for DC injection to be applied; breaking only JOG(SS2)-CC allows the inverter to accept other input signals and is not a "true" off.

4) See table on next page for terminal inputs and actions.

8.4.3 Jog (Cont'd)

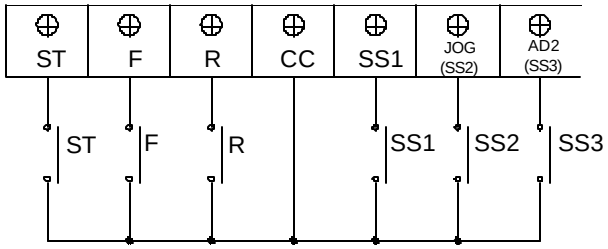
Terminal inputs and actions

Terminal Connections				Action
ST	JOG (SS2)	F	R	
ON	ON	OFF	OFF	Jogging Stop
ON	ON	OFF	ON	Reverse Jogging Run
ON	ON	ON	OFF	Forward Jogging Run
ON	ON	ON	ON	Reverse Jogging Run

8.4.4 7 Preset Speeds

For remote operation the following preset functions, terminals, and chart must be used. Follow the same procedure as in section 8.3.4 for setting the preset speed frequencies.

Terminal Connections Required for Remote Preset Speeds



Terminals SS2 and SS3 have dual functions, however only one function can be used at a time. Enabling the other functions (JOG, AD2) disables functions SS2 and SS3, thus limiting the number of accessable preset frequencies. The following chart identifies the functions of the 3 terminals (SS1, SS2, SS3) and their corresponding accessable preset frequencies.

Terminal Inputs

Setting selection of parameter1.tb	Terminal Selection 1.tb			Frequency setting via terminals
	AD2/SS3-CC	JOG/SS2-CC	SS1-CC	
0 (SS2) (SS3)	OFF	OFF	OFF	Operating frequency set via PP, IV, RR terminals
	OFF	OFF	ON	1st operating frequency
	OFF	ON	OFF	2nd operating frequency
	OFF	ON	ON	3rd operating frequency
	ON	OFF	OFF	4th operating frequency
	ON	OFF	ON	5th operating frequency
	ON	ON	OFF	6th operating frequency
	ON	ON	ON	7th operating frequency
1 (JOG) (SS3)	OFF	OFF	OFF	Operating frequency set via PP, IV, RR terminals
	OFF	ON	OFF	Jogging
	OFF	OFF	ON	1st operating frequency
	ON	OFF	OFF	2nd operating frequency
	ON	OFF	ON	3rd operating frequency
2 (SS2) (AD2)	*ON/OFF	OFF	OFF	Operating frequency set via PP, IV, RR terminals
	*ON/OFF	OFF	ON	1st operating frequency
	*ON/OFF	ON	OFF	2nd operating frequency
	*ON/OFF	ON	ON	3rd operating frequency
3 (JOG) (AD2)	*ON/OFF	OFF	OFF	Operating frequency set via PP, IV, RR terminals
	*ON/OFF	ON	OFF	Jogging
	*ON/OFF	OFF	ON	1st operating frequency

Note:

When "1.tb" (accessible by TB KEY #8) is set to 2 or 3 the AD2 function is activated. This function enables the user to remotely switch between the ACC/DEC patterns 1 and 2, provided SEL2=0. If SEL2=1 then the only pattern available is given by ACC2, DEC2, Pt.2. With AD2-CC terminals shorted (ON) all ACC/DEC patterns are run using the settings of the ACC2, DEC2, Pt.2 parameters.

8.5 Output Signals

The inverter provides terminals for outputting signals to external components. A number of selectable "operating" output signals, as well as "fault" output signals, are available. These output signal terminals are located on the terminal board. The terminals and type of selections available are shown below.

Output Terminals

⊕ RCH (UL)	⊕ LOW (LL)

⊕ FLA	⊕ FLB	⊕ FLC

8.5.1 Selectable Outputs

Function Parameters

Function No.	Function Name	Display	Adjustment Range	Unit	Factory Set	Error Message	Ref. Page
8	Multifunction output	0.tb	0: LL, UL 1: LOW, UL 2: LL, RCH 3: LOW, RCH		3	Err0	8-24
2ND 3	Low speed detection	LF	0.0 to Max. frequency	Hz	0.5	0.0	8-28
	Speed reach selection	rCH	0: Complete ACC/DEC 1: Frequency reach reference		0	Err0	8-28
	Speed reach detection range	rrCH	2.5 to 25	Hz	2.5	0.0	8-28
	Speed reach reference	FrCH	0.0 to Max. frequency	Hz	0	0.0	8-28

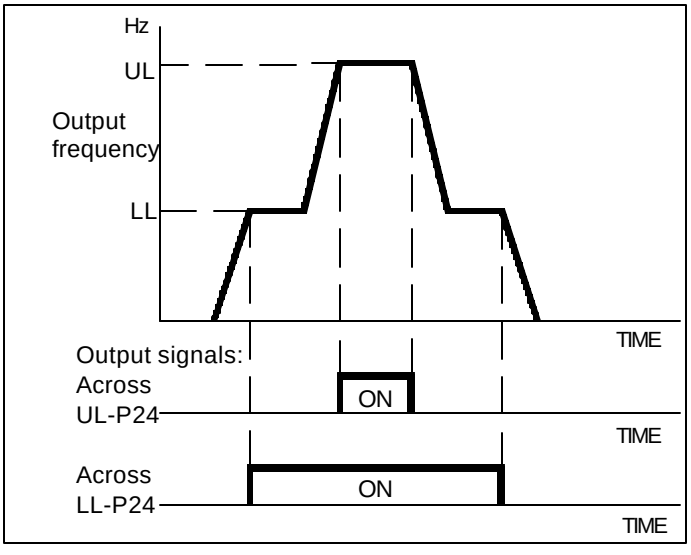
Terminal Output Signal Selections

Setting on 0.tb	Function
0	LL, UL (for lower limit and upper limit frequency signal)
1	LOW, UL (for low speed and upper limit frequency signal)
2	LL, RCH (for lower limit frequency and speed reach signals)
3	LOW, RCH (for low speed and speed reach signals)

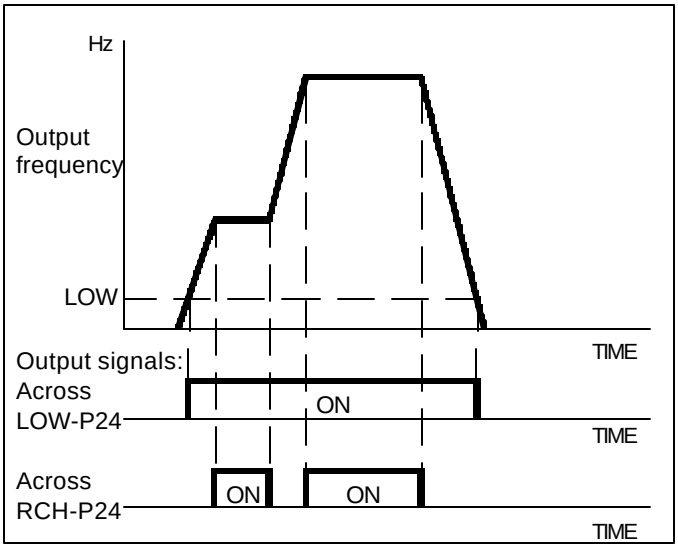
Selectable function output signals (open-collector with 50mAdc~24Vdc ratings)

Terminal	Function
LL	Outputs a signal when frequency is = or > the LL value.
UL	Outputs a signal when frequency is = UL value.
LOW	Outputs a signal when frequency is = or > the LOW SPEED DETECTION VALUE "LF".
RCH	Outputs a signal based upon the selection of the RCH parameters rCH, rrCH, FrCH.

Upper/lower limit frequency signal output



Low speed/speed reach signal output with rCH=0

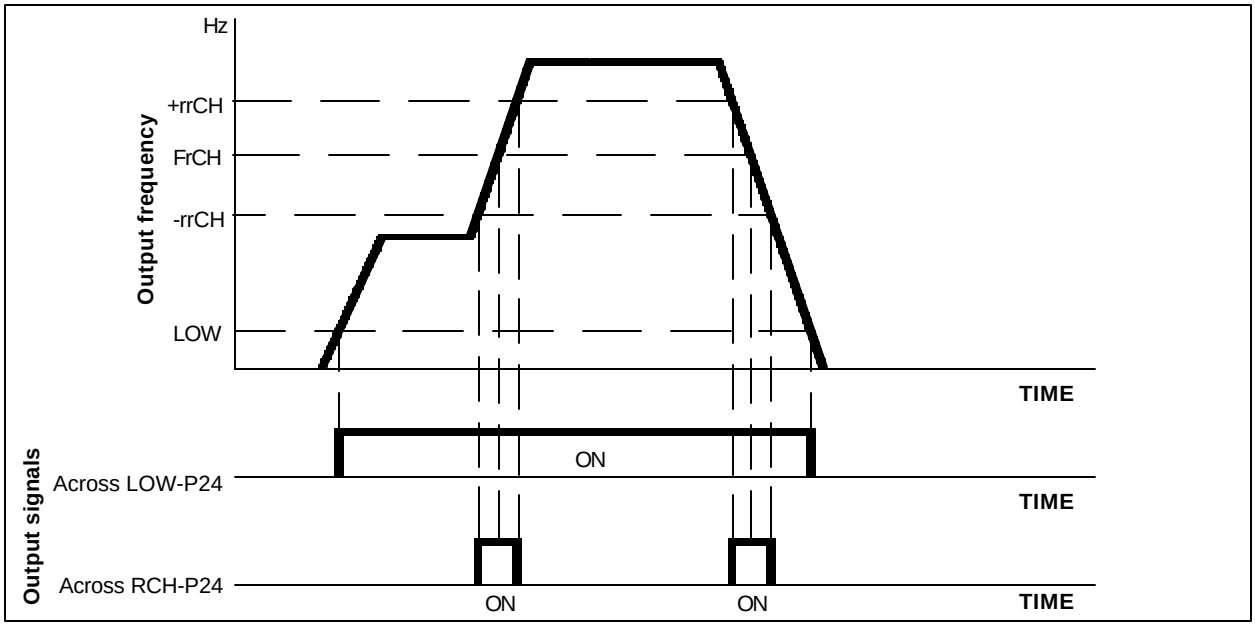


8.5.1 Selectable Outputs (Cont'd)

Reach Selection

rCH function	Action
0	Outputs a signal when an acc/dec is complete and inverter is at a constant frequency. Note: Output signal is off only during an ACC or DEC.
1	Outputs a signal when the inverter's output frequency is within a range of frequencies specified by parameters FrCH and rrCH.

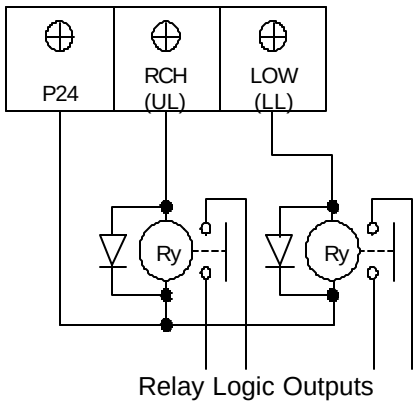
Low speed/speed reach signal output with rCH=1



8.5.2 Inverter to Relay/PC Connections

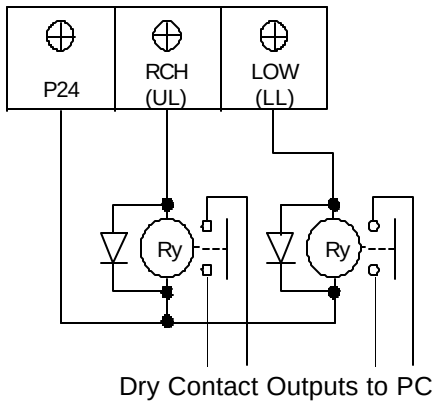
Terminals RCH (UL) and LOW (LL) of the control circuit terminal block are open collector outputs which float in an open state. When the designated frequency has been reached the terminals can sink 24Vdc at 50mAdc to ground. P24 supplies 24Vdc through the relay coils to the RCH (UL) and LOW (LL) terminals for relay activation. Connections are shown below for either relay logic or programmable controller inputs. Notice that there is no difference in the circuits except how the relay outputs are utilized.

Inverter-to-relay connections



Relay Logic Outputs

Inverter-to-programmable controller connections



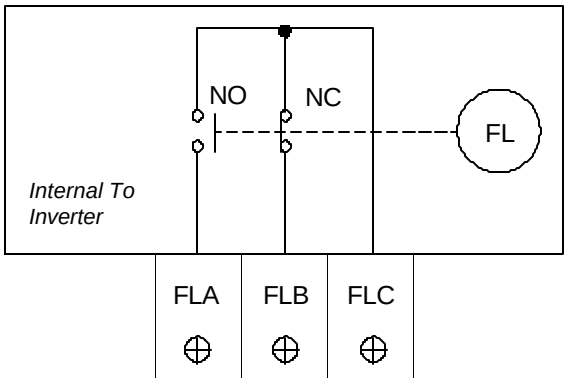
Dry Contact Outputs to PC
(Consult factory for specific applications)

Note:

When an output frequency fluctuates in the vicinity of a frequency to be reached, the reach signal may alternately turn on and off because of the lack of hysteresis in the reach signal.

8.5.3 Fault-Detection Output Terminals

When any of the inverter's system protection features are activated and the inverter trips (see list of probable causes in section 7.5.2), the cause of the problem will be displayed and the fault-detection relay will be activated. This will cause the contacts associated with the Fault-Detection Output Terminals to change state. The fault-detection terminals FLA, FLB, and FLC are provided as a NO, NC form C contact rated for a 250Vac/30Vdc 2A output.



Terminal Connections

8.5.4 Resetting After a Trip

The inverter can be reset after a trip by two methods:

1) Pressing the **CLR** and **WRT** keys on the operating panel resets the inverter locally.

2) Momentarily closing a normally open contact between terminals **RST** and **COM** resets the inverter remotely.

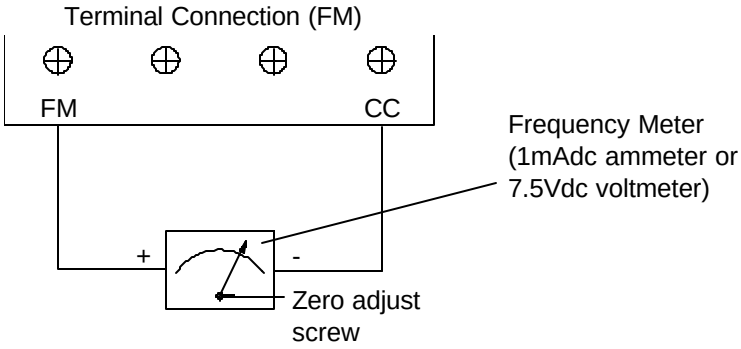
CAUTION

When the inverter trips due to an emergency stop or the activation of one or more of its protective functions, the cause of the fault must be corrected before resetting the inverter. A forced restart with out prior fault correction measures could damage the inverter and connected devices.

8.6 Calibration of Remote Meters (FM & AM)

Many times an application requires that a frequency meter or ammeter be remotely located. With the G2+ inverter, calibration of the remote meters is very easy. Attachment of the meter between its appropriate terminals is the only wiring necessary. Actual calibrating is performed with the keypad.

8.6.1 Frequency Meter (FM) Connection and Procedures



Calibration Procedure (FM)

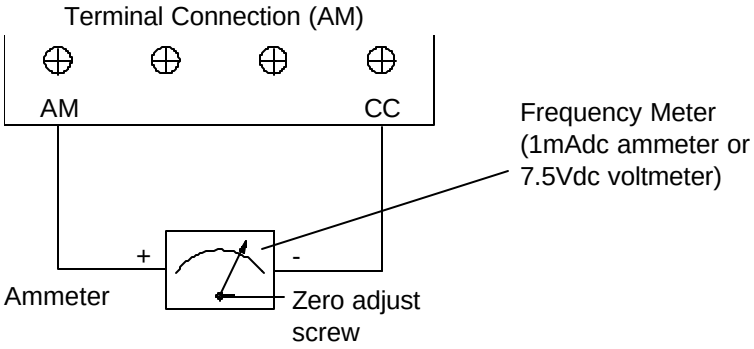
Key	Action	Display
	For this example the inverter is running at 60Hz, and in the **monitor mode**.	60.0
2ND **MON**	Engages the "FM" calibration mode	:FM
RUN	Display indicates the inverter's output frequency	60.0
△ or ▽	Adjusts the frequency value of the analog meter. Press the "up" △ or "down" ▽ key until the meter value equals the displayed inverter value.	60.0
WRT	Calibration of "FM" meter is complete	:FM
MON	Returns to the actual frequency display.	60.0

Notes:

1) The adjustment operation can be interrupted at any time by pressing the **STOP** key.

2) Although the above example shows calibration of the remote meter at a running frequency of 60Hz; better resolution of the meter can be obtained if the inverter is running at the maximum frequency. ***Disconnect the motor load for FM calibration at the highest frequency.***

8.6.2 Ammeter (AM) Connection and Procedures



Calibration Procedure (AM)

Key	Action	Display
	Adjustments should be made during a run. For this example the inverter is running at 60Hz, and in the **monitor mode**.	60.0
2ND **MON**	Engages the "FM" calibration mode.	:FM
NEXT	Engages the "AM" calibration mode.	:AM
RUN	Display indicates the output current values	:C [value]
△ or ▽	Adjusts the current value of the analog meter. Press the "up" △ or "down" ▽ key until the meter value equals the displayed inverter value.	:C [value]
WRT	Calibration of "AM" meter is complete	:AM
MON	Returns to actual frequency display	60.0

Notes:

The calibration procedure can be interrupted at any time by pressing the **STOP** key.

8.7 Operating Functions - Descriptions and Examples

Some features not previously introduced, but just as important, are found in this section along with all of the other features and functions.

FIRST FUNCTIONS

Selects *standard setting mode* and sets *maximum safe frequency* (FH) for motor being run.

FMAX
0

VOLTAGE BOOST - Increases the start-up torque of the motor being run.

V/F
1

AUTO TORQUE BOOST - Automatically increases the percentage of voltage boost when starting torque requirements are abnormally high.

FREQUENCY at MAXIMUM VOLTAGE - Sets the frequency at which the output voltage is 100%.

V/f PATTERN - Selects a constant or variable torque pattern.

ACC/DEC
2

ACC1, DEC1, Pt1/ACC2, DEC2, Pt2 - Sets the times required to ACC/DEC between 0Hz and the maximum frequency value FH. Also selects the pattern by which the ACC/DEC times are run (see section 5.7)

SEL2 - Selects which ACC/DEC/Pt will be used (#1 or #2).

Note: ACC/DEC times are the times required to go between 0Hz and the maximum frequency FH.

UL/LL
3

UPPER LIMIT - Sets the upper frequency limit. The inverter will never operate above this upper limit.

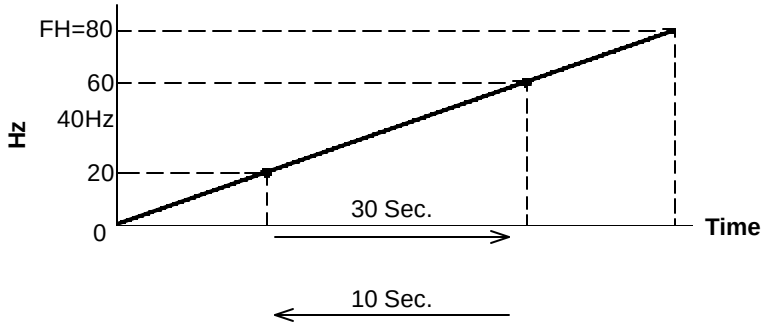
Note: The value of FH must always be equal to or greater than the value of UL.

LOWER LIMIT - Sets the lower frequency limit. The inverter will never operate below this lower limit.

Application Example - The inverter is used to control a 50Hz motor which has a safe operating frequency of 80Hz. This motor drives a conveyor belt which must run according to the following specifications: "tyP=1" "FH=80" ACC/DEC times are the times required to go between 0Hz and FH.

1) For this example, a VOLTAGE BOOST OF 10% is needed to move the conveyor at low start-up speeds: "ub=10"
2) Although a 50Hz motor is used, specifications require 100% output voltage at 60Hz: "uL=60"
3) Conveyor belt systems require a constant torque: "Pt=0"
4) When running the conveyor the inverter must run no faster than 60Hz and no slower than 20Hz: "LL=20" "UL=60"
5) The maximum acceleration and deceleration between 20Hz and 60Hz must be 30 seconds and 10 seconds respectively. A linear pattern is required.

Choosing Acceleration



8.7 Operating Functions - Descriptions and Examples (Cont'd)

Because ACC/DEC times are based upon the change in Hz/SEC the following formula must be used.

FH/Frequency range X (ACC/DEC time of frequency range) = ACC/DEC

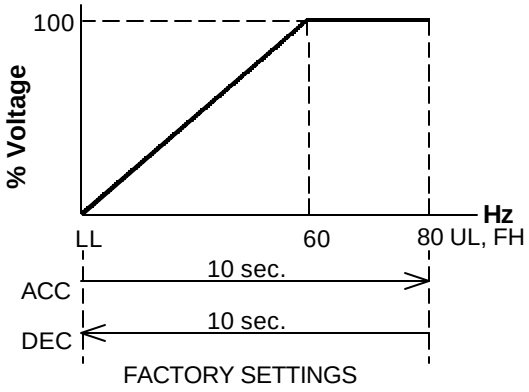
ACC1 = 80Hz ÷ (60-20Hz) X 30 sec. = 60 sec. ACC1=60

DEC1 = 80Hz ÷ (60-20Hz) X 10 sec. = 20 sec. DEC1=20

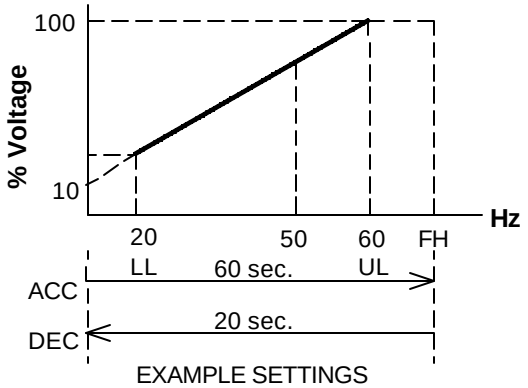
Note:

Specifications required only one ACC/DEC rate, therefore ACC2/DEC2/Pt2 settings were not needed: SEL2=0

Setting ACC2/DEC2/Pt2 would be suggested if a different pattern was required. Switching between the two patterns would then simply require switching between SEL2=0 and SEL2=1.



FACTORY SETTINGS



EXAMPLE SETTINGS

OL
4

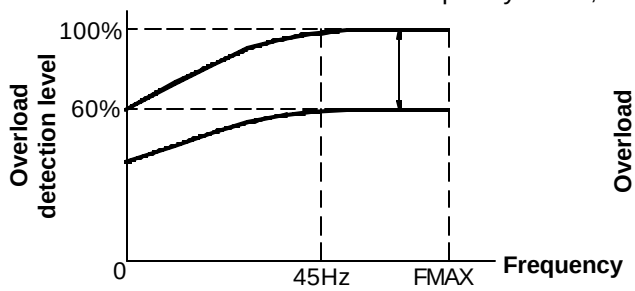
OVERLOAD PROTECTION - Sets the thermal overload detection level to match the ratings and characteristics of the motor being used (10% to 100% of rated output current). The inverter will run continuously at 110% of the **overload protection** (i.e. Setting: inverter rated current = 50amps, overload level set at 60% leads to set rated current = 50 X 60% = 30amps and continuous set rated current = 30 X 110% = 33amps).

STALL PROTECTION - Sets the activation level of the stall protection function (90% to 150% of rated output current). When the stall level is reached the inverter will begin stalling by lowering the frequency and voltage to prevent **overcurrent** tripping. Once a soft stall has occurred the output current will be clocked. If output current is not reduced within a specified time a fault will occur. (See section 3.0 for ratings and section 7.5.2 for fault codes.)

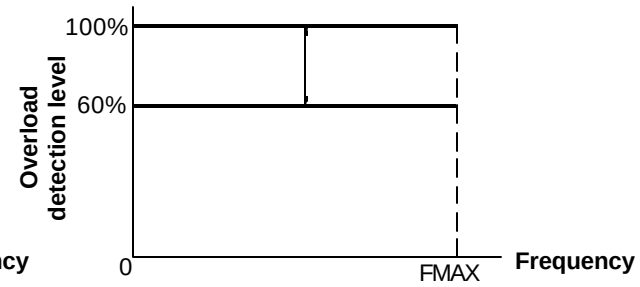
Note:

Instantaneous trip current limits are factory set and are dependent upon inverter size as well as the motor ripple current. The inverter's soft stall function is particularly effective in situations where load current decreases as revolution speed decreases (i.e. wind and hydraulic power machinery).

OVERLOAD DETECTION CURVE - Selects an overload detection curve for a standard motor or a variable frequency motor, with and without soft stall.



FOR STANDARD MOTORS



FOR VF MOTORS

8.7 Operating Functions - Descriptions and Examples (Cont'd)

Note:

"100% of overload detection level" refers to the value of the inverter's rated output current.

Setting of SEL4

Setting of SEL4	Function
0	Standard motor without soft stall function
1	Standard motor with soft stall function
2	VF motor without soft stall function
3	VF motor with soft stall function

Application Example - A 3HP 230V G2+ inverter is used to drive a 2HP 230V motor rated at 6.8 amps full load. Because the inverter is rated at 10 amps there is a danger of burning up the motor. By using the overload features of the inverter the output current can be limited and the stall protection level adjusted accordingly.

REF 5

IV - REFERENCE POINT #1 - Sets the % of the terminal IV input signal which is used to reference the output frequency designated by F-P1.

#1 OUTPUT FREQUENCY [F-P1] - Sets the output frequency used for reference point #1.

IV - REFERENCE POINT #2 - Same as reference point #1, except makes reference to F-P2.

#2 OUTPUT FREQUENCY [F-P2] - Sets the output frequency used for reference point #2.

SEE SECTION 8.4.2 FOR EXAMPLES.

RR TERMINAL PRIORITY - Activates the terminal into which the analog reference signal will be input.

JOG 6

JOGGING DRIVE FREQUENCY - Sets the frequency at which the inverter will operate while in the JOG mode. Used for moving small increments when precise-positioning of motor-driven equipment is required.

JOGGING STOP CONTROL - Selects between three methods of stopping during a jog run.

1ST SPEED ~ 7TH SPEED - Sets the frequencies used in the 7 speed run and the patterned run.

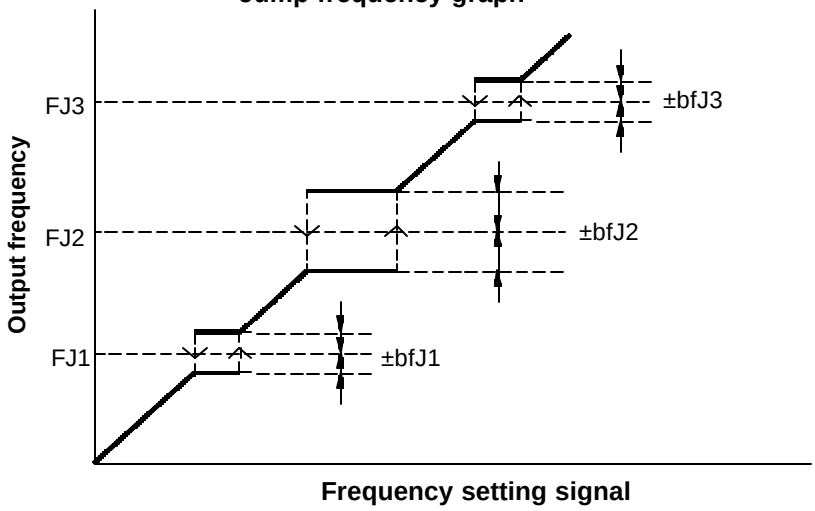
SEE SECTION 8.4.3 FOR DETAILS.

JMP 7

JUMP FREQUENCY POINT #1 AND BAND #1 - Sets the frequency range to be skipped when running a motor. This function is used when the resonance of the loaded machine must be avoided. Jump frequency ranges 2 and 3 are also available. See jump frequency graph on page 8-24.

8.7 Operating Functions - Descriptions and Examples (Cont'd)

Jump frequency graph



Note:

Frequency jumps cannot be used during preset acceleration/deceleration runs. When a frequency setting signal reaches the jump frequency range, the inverter's output frequency will remain fixed while the display frequency will continue to rise or fall. Once the input signal reaches the opposite end of the jump range the inverter will jump up or down to the allowable frequency.

• • • • • • • • •

TB
8

MULTIFUNCTION INPUT - Selects the way in which terminals JOG(SS2) and AD2(SS3) are to be used.

SEE SECTION 8.4.3 and 8.4.4 FOR DETAILS.

MULTIFUNCTION OUTPUT - Selects the way in which terminals RCH(UL) and LOW(LL) are to be used.

SEE SECTIONS 8.5.1 and 8.5.2 FOR DETAILS.

• • • • • • • • •

SEL
9

FORWARD/REVERSE - Selects between a forward and reverse run.

FAULT TRIP SAVING - Selects between saving or not saving the fault code information when power is removed from the inverter. When this function is set to save fault data (active) the auto reset function will become inactive.

AUTO-RESET - When selected, the inverter will automatically try to restart when a protective function activates an inverter fault trip (unless the fault trip saving function is activated).

Setting on retry	Function
0	OFF - If the inverter trips, the system will retain the tripped condition but will not try to restart.
1	ON - If the inverter trips, the system will automatically try to restart but only under the following conditions (see next page for chart of auto-reset conditions).

8.7 Operating Functions - Descriptions and Examples (Cont'd)

Auto Reset Conditions

Cause of fault	Reset Process	Reset Failure Conditions
Overcurrent Overload	Tries to restart 5 times in succession 1st reset: 1 sec. after problem occurs. 2nd reset: 2 sec. after initial restart. 3rd reset: 4 sec. after 2nd restart try. 4th reset: 8 sec. after 3rd restart try. 5th reset: 16 sec. after 4th restart try.	The reset process follows this chart unless a fault, other than those listed, occurs. If this happens the inverter will not try to reset.
Overvoltage	Trips, displays OP, sets fault relay until overvoltage condition is removed. Fault relay will be cleared after reset.	

Note:

The cause of the fault(s) could be from an instantaneous power interrupt.

While preparing for a reset, the auto-reset function causes the fault code "0.0" to be displayed alternately on the monitor display. Fault-detection signals are not output during the inverter's reset process. If the cause of the failure has not been corrected, then the intervals before each attempted reset will be prolonged. See above chart.

If the load exhibits an extremely large amount of inertia $(WK)^2$, automatic restart using the procedure described above may not work.

Note:

No restart is tried when any of the following messages is displayed on the inverter's monitor display:

"OCA" Overcurrent (transistor short-circuited at start-up)
"OCL" Overcurrent (load end short-circuit at start-up)
"OCr" Overcurrent (overcurrent through the regenerative discharge resistor)
"EF" Ground fault
"E" Emergency stop
"EEP" E^2PROM failure

CAUTION

Before using the inverter's retry (auto-reset) function, check to be certain that the auto-reset procedure will not damage or otherwise cause problems for the load machine system when the inverter's retry operations are being executed.

AUTO-RESTART - When selected, the inverter will automatically restart into a free-rotating motor. This restart will occur only after an instantaneous power interruption has occurred. The function allows the inverter to sample the speed of the free-rotating motor during the interruptions and output a matching frequency when power is reapplied. This assures smooth restarts of a free-running motor when an instantaneous power loss has occurred such as when the system is switched from a commercial bypass run to an inverter run.

Note:

With ArSt=0, the inverter will restart at 0Hz and increase up to the initial running frequency. With ArSt=1, the inverter will restart at the running frequency of the motor and will increase up to the initial frequency of the inverter.

REGENERATION POWER RIDE THROUGH CONTROL - Uses regenerative energy to extend the inverter's power ride through capability during momentary power dropouts.

8.7 Operating Functions - Descriptions and Examples (Cont'd)

SECOND FUNCTIONS

2ND

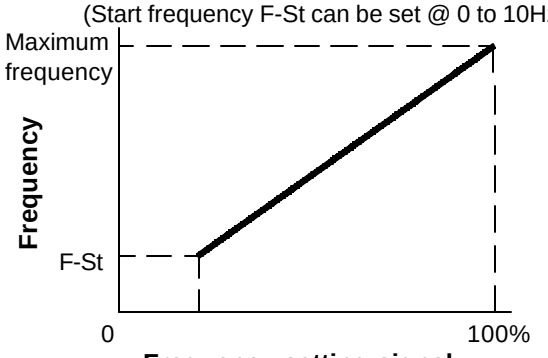
FMAX

0

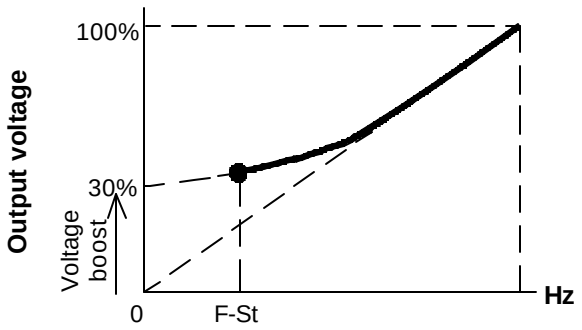
START-UP FREQUENCY - Sets the frequency at which the inverter will begin operating. In the panel control setting mode the frequency display will change as the "up" △ and "down" ▽ keys are pressed. However, an actual output does not occur until the start-up frequency is reached. In the terminal input mode the display will remain at zero until the start-up frequency is reached. This function, along with the voltage boost function, enables the user to obtain an optimum voltage boost level. See figures below.

Start-Up Frequency

(Start frequency F-St can be set @ 0 to 10Hz)



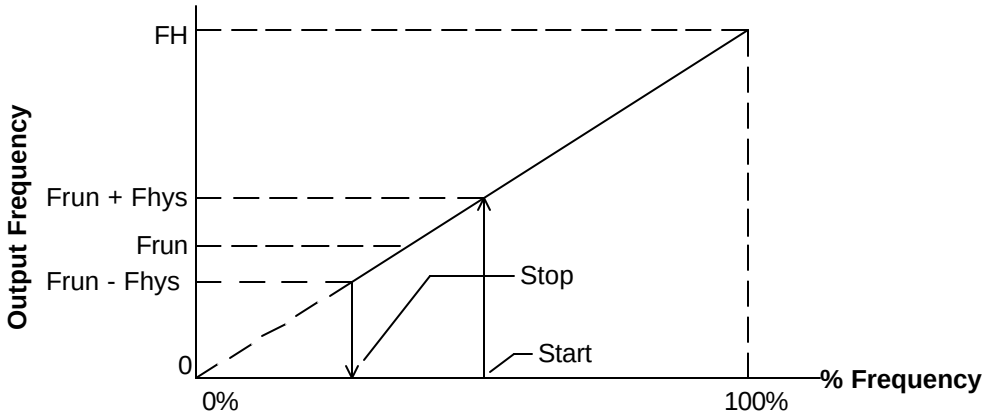
Start-Up Frequency with Voltage Boost



RUN FREQUENCY - Selects a frequency to initiate inverter run/stop control.

RUN FREQUENCY HYSTERESIS - Used to offset inverter run frequency.

When the frequency reference signal reaches the Frun + Fhys point, the drive will ramp the motor to that speed. The inverter will continue to follow the reference signal until it falls below the Frun - Fhys at which time the drive will ramp the motor to a stop. See figure below.



Reference Signal

2ND

V/F

1

DC INJECTION START FREQUENCY - Specifies the frequency at which DC injection is applied to a motor during a decelerating stop. Used for precise positioning (inching) of the motor driven equipment.

DC INJECTION VOLTAGE - Specifies the percent of voltage applied during the DC injection.

DC INJECTION TIME - Specifies the length of time the DC voltage applied.

SEE SECTION 5.10.

8.7 Operating Functions - Descriptions and Examples (Cont'd)

2ND

DISPLAY FREQUENCY SCALER - Used to display revolution speed and linear speed.

ACC/DEC
2

SEE SECTION 5.8 FOR EXAMPLE.

2ND

LOW SPEED DETECTION - Outputs a signal when the inverter's output frequency is greater than or equal to the selected low speed detection frequency.

UL/LL
3

SPEED REACH SELECTION - Selects the option to output a signal when an ACC/DEC is complete or when the inverter's output frequency is within a selected range. The range is selected by the following two functions.

SPEED REACH DETECTION RANGE - Specifies a range of frequencies, above and below the speed reach reference frequency, which when detected will output a signal.

SPEED REACH REFERENCE - Specifies the speed reach detection frequency. When the inverters output frequency is within the range specified by the Speed reach reference (± speed reach accuracy), a signal will be output.

SEE SECTION 8.5 FOR EXAMPLES.

2ND

OUTPUT VOLTAGE ADJUSTMENT - Specifies the percent of input voltage which is seen as the inverter's output voltage.

OL
4

REGENERATIVE BRAKING SELECTION - Selection of the appropriate parameter informs the inverter system whether or not a dynamic braking resistor (DBR) is used. If (yes), then whether or not there is overload detection.

LENGTHENED DECELERATION (Auto-deceleration on the : Pb=0) - Automatically lengthens the deceleration time to prevent over-voltage trips.

2ND

TG/PG * or PID - Informs the inverter of either tach generator (TG)/pulse generator (PG) feedback, proportional/integral/differential (PID) control, or nothing at all.

REF
5

PROPORTIONAL GAIN - Sets the gain of the TG/PG or PID controlled input signal.

INTEGRATION GAIN - Adjusts the period of integration when comparing the set point to the feed back signal.

DIFFERENTIAL GAIN - Stabilizes the system when hunting occurs.

LAG-TIME GAIN - Adjusts the time of response when a change in the feed back signal is seen.

TG/PG FEEDBACK SELECTION - Selects the type of speed feedback control signal to be used.

PG FEEDBACK GAIN (Coefficient of TG/PG conversion) - Adjusts the drive to respond correctly to the external pulse generator.

* TG/PG requires the use of multi-option board.

8.7 Operating Functions - Descriptions and Examples (Cont'd)

2ND PWM CARRIER FREQUENCY - Selects the inverter's PWM carrier frequency.

JOG
6

• • • • • • • • •

2ND OPTION TERMINAL SELECTION * - Used in conjunction with multi-function option boards binary input.

JMP
7 INVERTER NUMBER * - Allows an inverter identification number to be assigned to the unit.

BAUD RATE * - Selects baud rate.
SEE SECTION 5.4.

RS232C COMMUNICATION DATA BITS * - Used to select the number of RS232C communication bits for host computer control.

PARITY AND STOP BITS * - Used to select the parity check and stop bits for host computer control.

INVERTER TO LINE TRANSFER SIGNAL * - Allows a motor load to be transfered between the inverter and line power by a signal to the inverter.

• • • • • • • • •

2ND PATTERN RUN ACTIVATION MODE - Used to activate a pattern run by determining where the start command will be taken from.

TB
8 PATTERN TIME SELECTION - Sets the run time of each individual preset speed to either seconds or minutes.

PATTERN REPEATABILITY - determines how many times the pattern run will repeat itself.

PATTERN DRIVE TIME (#1~#7) - Sets the run time of each individual preset speed frequency (SR1~SR7) to be used in the patterned run.

PATTERN DRIVE CHARACTERISTIC (#1~#7) - Selects the type of run for reach pre-set speed frequency. The selection can be a forward or reverse run, using either ACC/DEC #1 or ACC/DEC #2.

• • • • • • • • •

2ND COMMAND MODE SELECTION - Determines where the inverter can be started and stopped; (via the touch-pad, terminal strip, or the host computer).

SEL
9 FREQUENCY REFERENCE SETTING MODE SELECTION - Determines where the frequency signal is accepted by the inverter; (via the touch-pad, terminal strip, or the host computer).

PARAMETER SETTING MODE SELECTION - Determines where the parameters can be programmed; (via the touch-pad, or the host computer).

SEE PAGES 8-29 AND 8-30 FOR EXAMPLES

* These parameters require the use of multi-option board

8.7 Operating Functions - Descriptions and Examples (Cont'd)

The three (3) parameters in **2nd** Function **9** on the G2+ allow the user to do a number of different setups. The access to the inverter can be totally locked out, or select functions can be locked out. By using these three parameters the inverter can be programmed to function in a number of different ways.

The following example shows how to **Start-Stop** the unit via the touch-pad only and have the **frequency** set by an external source only by changes to the paramenters located in **2nd** function **9.**

Key	Action	Display
MON	The inverter must always be placed in the function mode before accessing any function. :no.0 → :typ	:typ
2ND	When this key is pressed the inverter is placed into the second function files.	:2nd
9	When this key is pressed the inverter is placed into the second function file number 9.	:F.170d
READ	When this key is pressed the standard factory adjustment range setting of 7 is displayed.	7
2 **WRT**	When the keys **2** and **WRT** are pressed in order then the factory adjustment range setting of 2 is written into memory replacing the factory setting of 7. :F.170d → 2	2
NEXT	When this key is pressed the second menu item under the 2nd 9 functions is displayed.	:F.170d
READ	When this key is pressed the standard factory adjustment range setting of 7 is displayed.	7
1 **WRT**	When the keys **1** and **WRT** are pressed in order then the factory adjustment range setting of 1 is written into memory replacing the factory setting of 7. :F.170d → 1	1
MON	Returns the inverter to the original monitor mode.	0.0

Note:

This setup accepts an external signal (4-20 mA, 0-5 VDC, & etc.) through the terminal strip and allows the user to start and stop the unit via the touch-pad.

8.7 Operating Functions - Descriptions and Examples (Cont'd)

The following example shows how to **Start-Stop** the unit remotely and have the **frequency** set via the touch-pad. To do this, set the paramenters on **2nd** function **9** as follows.

Key	Action	Display
MON	The inverter must always be placed in the function mode before accessing any function. :no.0 → :typ	:typ
2ND	When this key is pressed the inverter is placed into the second function files.	:2nd
9	When this key is pressed the inverter is placed into the second function file number 9.	:F.170d
READ	When this key is pressed the standard factory adjustment range setting of 7 is displayed.	7
1 **WRT**	When the keys **1** and **WRT** are pressed in order then the factory adjustment range setting of 1 is written into memory replacing the factory setting of 7. :F.170d → 1	1
NEXT	When this key is pressed the second menu item under the 2nd 9 functions is displayed.	:F.170d
READ	When this key is pressed the standard factory adjustment range setting of 7 is displayed.	7
2 **WRT**	When the keys **2** and **WRT** are pressed in order then the factory adjustment range setting of 2 is written into memory replacing the factory setting of 7. :F.170d → 2	2
MON	Returns the inverter to the original monitor mode.	0.0

In order to run the inverter, simply enter the desired frequency followed by the **WRT** key. The remote start/stop switch will be put between F (forward) or R (reverse) and CC terminals on the terminal strip. Closing the connection will make the inverter run, opening the connection will make the inverter decelerate to a stop at the programmed deceleration time.

9.0 Spare Parts List/After Sales Service

9.1 Requesting After Sales Service

When requesting after-sales service, report the contents of the following PROBLEM INFORMATION SHEET, which will help repair the system quickly.

Problem Information Sheet

Item		
	Customer's name	
Refer to	Person in charge	
	Address	
	Telephone No.	
Inverter spec.	Model No.	
	Serial No.	
	Test No.	
Delivery date		
Time in service		
Date when problem arose		

	Use	
Status of Use	Motor rating	Poles, Hp, V, Hz.
		Made by Toshiba? Made by another company?
		New? Number of units?
		Alternate? Continuous?
	Ambient condition	Indoor? Outdoor? Temperature range?
		Humidity:
		Dust composition and size:
		Presence of salt and extent of corrosion from it:
		Vibrations, in micrometers:
		Presence of corrosive gas:
		Availability of air conditioning:
Phenome-non	Power source	Number of phases:
		Voltage between L1 phase and L2 phase:
		Voltage between L2 phase and L3 phase:
		Voltage between L3 phase and L1 phase:
		Number of Hz:
	State of motor when problem was found	Problem occurred hours after motor had been started. Motor has been stopped for hours.
		Problem occurred during periodic inspection?
		Problem occurred when motor was started?
		Problem occurred during acceleration?
		Problem occurred during deceleration?
		Problem occurred while motor was not running?
	Frequency of problem	First time? Problem occurred times in the past.
		Problem occurs sometimes?
		Problem occurs every time motor is operated?
		When did problem first occur?
	Trouble indicator	☐ NO DISPLAY ☐ OC1 ☐ OC2 ☐ OC3 ☐ OCA ☐ OCL ☐ OCr ☐ OP2 ☐ OP ☐ OLr ☐ OL ☐ OH ☐ EF ☐ E ☐ Err.1 ☐ EEP ☐ EEP2 ☐ EEP3 ☐ ERR.t

Detailed description of problem:
Temporary diagnosis and corrective action:
Date defective product shipped: To:
Deadline for repairs:

9.2 Recommended Spare Parts

RANK	B	A	B	B	B	A	A	A	B	B
INVERTER UNIT	**PCB1** CONTROL	**PCB2** DRIVER	**MOV 1-3** SURGE ABSORBER	**REC 1-6** BRIDGE RECTIFIER	**R21** SOFT START RESISTOR	**FU1** CONTROL FUSE	**FU2** DC SUPPLY FUSE	**IGBT 1-6**	**IGBT 7**	DC BUS CAP
G2+2010	QTY 1 VF3B-0100A	NOT USED	QTY 3 TNR 23G561K	QTY 1 ME400402	QTY 1 20 OHM-20W	NOT USED	*** QTY 1 6JX10	QTY 1 MG15J6ES1	QTY 1 MG15H1BS1	QTY 1 470 uF 400VDC
G2+2015	QTY1 VF3B-0100A	NOT USED	QTY 3 TNR 23G561K	QTY 1 ME400402	QTY 1 20 OHM-20W	NOT USED	*** QTY 1 6JX10	QTY 1 MG15J6ES1	QTY 1 MG15H1BS1	QTY 1 470 uF 400VDC
G2+2025	QTY 1 VF3B-0100B	NOT USED	QTY 3 TNR 23G561K	QTY 1 ME400402	QTY 1 20 OHM-20W	NOT USED	**** QTY 1 6JX20	QTY 1 MG25J6ES1	QTY 1 MG15H1BS1	QTY 1 680 uF 400VDC
G2+2035	QTY 1 VF3B-0100B	NOT USED	QTY 3 TNR 23G561K	QTY 1 ME400403	QTY 1 20 OHM-20W	NOT USED	**** QTY 1 6JX20	QTY 1 MG50J6ES1	QTY 1 MG15H1BS1	QTY 1 1000 uF 400VDC
G2+2055	QTY 1 VF3B-0100B	NOT USED	QTY 3 TNR 23G561K	QTY 1 ME400403	QTY 1 20 OHM-20W	NOT USED	**** QTY 1 6JX30	QTY 1 MG50J6ES1	QTY 1 MG15H1BS1	QTY 1 1800 uF 400VDC
G2+2080	QTY 1 VF3B-0100C	NOT USED	QTY 3 TNR 23G561K	QTY 1 75L6P43	QTY 1 10 OHM-30W	NOT USED	** QTY 1 A050F040	QTY 3 MG75J2YS9	QTY 1 MG50H1BS1	QTY 1 2700 uF 400VDC
G2+2110	QTY 1 VF3B-0100C	NOT USED	QTY 3 TNR 23G561K	QTY 1 75L6P43	QTY 1 10 OHM-30W	NOT USED	** QTY 1 A050F060	QTY 3 MG100J2YS1	QTY 1 MG50H1BS1	QTY 2 1800 uF 400VDC
G2+2160	QTY 1 VF3B-0100D	NOT USED	QTY 3 TNR 23G561K	QTY 1 100L6P43	QTY 1 6 OHM-40W	QTY 1 AGC3A	** QTY 1 A050F080	QTY 3 MG150J2YS1	QTY 1 MG75H1BS1	QTY 2 2700 uF 400VDC
G2+2220	QTY 1 VF3B-0100D	NOT USED	QTY 3 TNR 23G561K	QTY 3 110L2G43	QTY 2P 10 OHM-30W	QTY 1 AGC3A	** QTY 1 A050F100	QTY 3 MG200J2YS1	QTY 1 MG75H1BS1	QTY 3 2700uF 400VDC
G2+2270	QTY 1 VF3C-1200A	QTY 1 VT3D-2039R	QTY 3 TNR 23G561K	QTY 3 110L2G43	QTY 2P 6 OHM-40W	QTY 1 AGC3A	** QTY 1 A050F150	QTY 3 MG200J2YS1	QTY 1 MG100H1BS1	QTY 3 3300 uF 400VDC
G2+2330	QTY 1 VF3C-1200A	QTY 1 VT3D-2039R	QTY 3 TNR 23G561K	QTY 3 110L2G43	QTY 2P 6 OHM-40W	QTY 1 AGC3A	** QTY 1 A050F150	QTY 3 MG300J2YS1	QTY 1 MG75H1BS1	QTY 3 3900 uF 400VDC
G2+4015	QTY 1 VF3B-0101A	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 100 OHM-20W	QTY 1 6JX3	** QTY 1 A070F020	QTY 1 MG8Q6ES1	QTY 1 MG15N1BS1	QTY 2 330 uF 400VDC
G2+4025	QTY 1 VF3B-0101B	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 100 OHM-20W	QTY 1 6JX3	** QTY 1 A070F020	QTY 1 MG15Q6ES1	QTY 1 MG15N1BS1	QTY 2 470 uF 400VDC
G2+4035	QTY 1 VF3B-0101B	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 100 OHM-20W	QTY 1 6JX3	** QTY 1 A070F020	QTY 1 MG15Q6ES1	QTY 1 MG15N1BS1	QTY 2 680 uF 400VDC
G2+4055	QTY 1 VF3B-0101B	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 40 OHM-30W	QTY 1 6JX3	** QTY 1 A070F020	QTY 1 MG25Q6ES1	QTY 1 MG15N1BS1	QTY 2 1000 uF 400VDC
G2+4080	QTY 1 VF3B-0101C	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 40 OHM-30W	QTY 2 6JX5	** QTY 1 A070F020	QTY 3 MG50N2YS1	QTY 1 MG25Q1BS11	QTY 2 1800uF 400VDC

See notes on page 9-6

9.2 Recommended Spare Parts (Cont'd)

RANK	B	A	B	B	B	A	A	A	B	B
INVERTER UNIT	**PCB1** CONTROL	**PCB2** DRIVER	**MOV 1-3** SURGE ABSORBER	**REC 1-6** BRIDGE RECTIFIER	**R21** SOFT START RESISTOR	**FU1** CONTROL FUSE	**FU2** DC SUPPLY FUSE	**IGBT 1-6**	**IGBT 7**	DC BUS CAP
G2+4110	QTY 1 VF3B-0101B	NOT USED	QTY 3 TNR 23G102K	QTY 1 ME701603	QTY 1 40 OHM-30W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F050	QTY 3 MG50N2YS1	QTY 1 MG25Q1BS11	QTY 2 2700 uF 400VDC
G2+4160	QTY1 VF3B-0101D	NOT USED	QTY 3 TNR 23G102K	QTY 1 50U6P43	QTY 2S 10 OHM-30W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F050	QTY 3 MG75Q2YS1	QTY 1 MG25Q1BS11	QTY 2 3900 uF 400VDC
G2+4220	QTY 1 VF3B-0101D	NOT USED	QTY 3 TNR 23G102K	QTY 1 75U6P43	QTY 2S 10 OHM-30W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F060	QTY 3 MG100N2YS1	QTY 1 MG50Q1BS11	QTY 2 4700 uF 400VDC
G2+4270	QTY 1 VF3C-1200A	QTY 1 35589X	QTY 3 TNR 23G102K	QTY 1 75U6P43	QTY 2S 6 OHM-40W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F100	QTY 3 MG150Q2YS1	QTY 1 MG50Q1BS11	QTY 4 2700 uF 400VDC
G2+4330	QTY 1 VF3C-1200A	QTY 1 35589X	QTY 3 TNR 23G102K	QTY 1 100U6P43	QTY 2S 6 OHM-40W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F100	QTY 3 MG150Q2YS1	QTY 1 MG75Q1BS11	QTY 4 3300 uF 400VDC
G2+4400	QTY 1 VF3C-1200A	QTY 1 35589X	QTY 3 TNR 23G102K	QTY 3 110U2G43	QTY 2S 6 OHM-40W	QTY 2 ATQ 1.6A 500Vac	** QTY 1 A070F100	QTY 3 MG200Q2YS1	QTY 2 MG50Q1BS11	QTY 4 3900 uF 400VDC
G2+4500	QTY 1 VF3C-1200A	QTY 1 35589X	QTY 3 TNR 23G102K	QTY 3 110U2G43	QTY 1 4 OHM-240W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F150	QTY 3 MG200Q2YS1	QTY 1 MG200Q1US1	QTY 6 3300 uF 400VDC
G2+4600	QTY 1 VF3C-1200A	QTY 1 35589W	QTY 3 TNR 23G102K	QTY 3 110U2G43	QTY 1 4 OHM-240W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F150	QTY 6 MG150Q2YS1	QTY 1 MG200Q1US1	QTY 6 3900 uF 400VDC
G2+4750	QTY 1 VF3C-1200A	QTY 1 35589W	QTY 3 TNR 23G102K	QTY 3 110U2G43	QTY 1 4 OHM-240W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F200	QTY 6 MG150Q2YS1	QTY 1 MG200Q1US1	QTY 8 3900 uF 400VDC
G2+410K	QTY 1 VF3C-1200A/ TIH-INV063	QTY 1 35589W	QTY 3 TNR 23G102K	QTY 6 110U2G43	QTY 2S 2 OHM-300W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F300	QTY 6 MG200Q2YS1	QTY 1 MG200Q1US1	QTY 10 3900 uF 400VDC
G2+412K	QTY 1 VF3C-1200A/ TIH-INV058	QTY 1 35589Z	QTY 3 TNR 23G102K	QTY 6 160U2G43	QTY 2S 2 OHM-300W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F300	QTY 6+6 MG300Q1US11 MG300Q1US21	QTY 1 MG200Q1US1	QTY 12 3900 uF 400VDC
G2+415K	QTY 1 VF3C-1200B	QTY 1 35589Z	QTY 3 TNR 23G102K	QTY 6 160U2G43	QTY 2S 2 OHM-300W	QTY 2 ATQ 2.5A 500Vac	** QTY 1 A070F400	QTY 6+6 MG300Q1US11 MG300Q1US21	QTY 1 MG300Q1US1	QTY 14 3900 uF 400VDC
G2+420K	QTY 1 VF3C-1200B	QTY 1 35589Z	QTY 3 TNR 23G102K	QTY 6 160U2G43	QTY 2S 2 OHM-300W	QTY 2 ATQ 3.5A 600Vac	** QTY 1 A070F550	QTY 9+9 MG300Q1US11 MG300Q1US21	QTY 1 MG300Q1US1	QTY 20 3900 uF 400VDC
G2+425K	QTY 1 VF3C-1200B	QTY 1 35589Z	QTY 3 TNR 23G102K	QTY 9 160U2G43	QTY 2P+2S 2 OHM-300W	QTY 2 ATQ 3.5A 600Vac	** QTY 1 A070F700	QTY 9+9 MG400Q1US11 MG400Q1US21	QTY 1 MG400Q1US1	QTY 22 3900 uF 400VDC
G2+430K	QTY 1 VF3C-1200B	QTY 2 35589M	QTY 3 TNR 23G102K	QTY 9 DD200HC-160	QTY 1 1.33 OHM-750W	QTY 2 ATQ 3.5A 600Vac	** QTY 6 6.6-URD32-TTF0700	QTY 9+9 MG500Q1US11 MG500Q1US21	QTY 1 MG500Q1US1	QTY 22 1200 uF 400VDC

See notes on page 9-6

9.2 Recommended Spare Parts (Cond'd)

RANK	B	B	B	B	B	A	A	A	B	B
INVERTER UNIT	**PCB3** TOUCH PAD	**PCB 4-4B** SNUBBER	**PCB5** PA-PB SNUBBER	**PCB 6-6E** G-E CKT	**PCB7** G-E CKT	**FU R,S,T** AC FUSE	FAN FOR CABINET	FAN FOR HEAT SINK	**MS1** CONTACTOR	**MSX** RELAY
G2+2010	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1a-10A	NOT USED
G2+2015	QTY1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1a-10A	NOT USED
G2+2025	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1aF-15A	NOT USED
G2+2035	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JH1a-30A	NOT USED
G2+2055	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 126LH0181	NOT USED	QTY 1 JH1a-30A	NOT USED
G2+2080	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	QTY 1 113XN0181	QTY 1 PC-5	NOT USED
G2+2110	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A025R100	QTY 1 * 113XN0181	QTY 1 113XN0181	QTY 1 PC-5	NOT USED
G2+2160	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A025R100	QTY 1 * 113XN0181	QTY 1 113XN0181	QTY 1 C25A	QTY 1 JC1a-10A
G2+2220	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A025R100	QTY 1 * 113XN0181	QTY 2 113XN0181	QTY 1 C25A	QTY 1 JC1a-10A
G2+2270	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A025R150	QTY 1 * 129XR0281	QTY 2 129XR0281	QTY 1 C35A	QTY 1 JC1a-10A
G2+2330	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A025R150	QTY 1+1 * 113XN0181 113XN0181	QTY 1 148VK0281	QTY 1 C35A	QTY 1 JC1a-10A
G2+4015	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1a-10A	NOT USED
G2+4025	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1a-10A	NOT USED
G2+4035	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1a-10A	NOT USED
G2+4055	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JC1aF-15A	NOT USED
G2+4080	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	QTY 1 * 113XN0181	NOT USED	QTY 1 JH1a30A	NOT USED

See notes on page 9-6

9.2 Recommended Spare Parts (Cont'd)

RANK	B	B	B	B	B	A	A	A	B	B
INVERTER UNIT	**PCB3** TOUCH PAD	**PCB 4-4B** SNUBBER	**PCB5** PA-PB SNUBBER	**PCB 6-6E** G-E CKT	**PCB7** G-E CKT	**FU R,S,T** AC FUSE	FAN FOR CABINET	FAN FOR HEAT SINK	**MS1** CONTACTOR	**MSX** RELAY
G2+4110	QTY1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F040	QTY 1 * 113XN0181	QTY 1 113XN0181	QTY 1 JH1a30A	NOT USED
G2+4160	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F060	QTY 1 * 113XN0181	QTY 2 113XN0181	QTY 1 PC-5	NOT USED
G2+4220	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F080	QTY 1 * 113XN0181	QTY 2 113XN0181	QTY 1 PC-5	NOT USED
G2+4270	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F080	QTY 1 * 129XR0281	QTY 2 129XR0281	QTY 1 C20A	QTY 1 JC1a-10A
G2+4330	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F100	QTY 1 * 129XR0281	QTY 2 129XR0281	QTY 1 C25A	QTY 1 JC1a-10A
G2+4400	QTY 1 35751A/ 38552A	NOT USED	NOT USED	NOT USED	NOT USED	** QTY 3 * A050F150	QTY 1 * 129XR0281	QTY 2 129XR0281	QTY 1 C25A	QTY 1 JC1a-10A
G2+4500	QTY 1 35751A/ 38552A	NOT USED	QTY 1 34499A	NOT USED	QTY 1 34557A	** QTY 3 * A050F150	QTY 1 * 129XR0281	QTY 1 148VK0281	QTY 1 C25A	QTY 1 JC1a-10A
G2+4600	QTY 1 35751A/ 38552A	QTY 3 35081A	QTY 1 34499A	QTY 6 35249A	QTY 1 34557A	** QTY 3 * A050F200	QTY 1+1 * 129XR0281 113XN0181	QTY 2 148VK0281	QTY 1 C35A	QTY 1 JC1a-10A
G2+4750	QTY 1 35751A/ 38552A	QTY 3 35081A	QTY 1 34499A	QTY 6 35249A	QTY 1 34557A	** QTY 3 * A050F200	QTY 1+1 * 129XR0281 113XN0181	QTY 2 148VK0281	QTY 1 C50A	QTY 1 JC1a-10A
G2+410K	QTY 1 35751A/ 38552A	QTY 3 35081A	QTY 1 34499A	QTY 6 35249A	QTY 1 34557A	** QTY 3 * A050F300	QTY 1 129XR0281	QTY 2 148VK0281	QTY 1 C80A	QTY 1 JC1a-10A
G2+412K	QTY 1 35751A/ 38552A	QTY 3 34465A	QTY 1 34499A	QTY 6 34558A	QTY 1 34557A	** QTY 3 * A050F300	QTY 1 129XR0281	QTY 2 148VK0281	QTY 1 C100A	QTY 1 JC1a-10A
G2+415K	QTY 1 35751A/ 38552A	QTY 3 34465A	QTY 1 34499A	QTY 6 34558A	QTY 1 34557A	** QTY 3 6.6-BODK-CA- URB-31TTC-400	QTY 1 129XR0281	QTY 2 148VK0281	QTY 1 C125A	QTY 1 JC1a-10A
G2+420K	QTY 1 35751A/ 38552A	QTY 3 34465A	QTY 1 34499A	QTY 6 34559A	QTY 1 34557A	** QTY 3 6.6-BODK-CA- URB-31TTC-500	QTY 1 148VK0281	QTY 4 148VK0281	QTY 1 C180A	QTY 1 JC1a-10A
G2+425K	QTY 1 35751A/ 38552A	QTY 3 34465A	QTY 1 34499A	QTY 6 34559A	QTY 1 34557A	** QTY 3 6.6-BODK-CA- URB-31TTC-630	QTY 2 148VK0281	QTY 4 148VK0281	QTY 1 C220A	QTY 1 Jc1A-10A
G2+430K	QTY 1 35751A/ 38552A	QTY 6 34465A	QTY 1 34499A	QTY 6 38383A	QTY 1 34557A	** QTY 3 6.6-URD32- TTF0800	QTY 1 148VK0281	QTY 1 McLean 4B1212-230	QTY 1 C220A	QTY 1 Jc1A-10A

See notes on page 9-6

9.2 Recommended Spare Parts (Cont'd)

Notes:

* Optional components
** Semiconductor fuse with 200K amp interrupting capability
*** Semiconductor fuse with 100K amp interrupting capability
**** Semiconductor fuse with 50K amp interrupting capability
Rank A signifies parts of relatively higher necessity.
Rank B signifies parts of relatively lower necessity.

9.3 Parts Service Life

In order to obtain the best performance and to get the maximum service life from the inverter it is necessary to perform timely maintenance repairs on some parts of the system even though the equipment may still be functioning with no apparent problems

Use the following service life chart as a guide for major part periodic replacement when the equipment is used in a standard installation service environment.

Service Life Replacement Chart

Part Name	Service Life	Remarks
Large capacity electrolytic capacitor	5 Years	To be electrified semiannually in case of long term disuse.
Cooling Fan	3 Years	
Contact relays	500,000 operations	
Connectors	100 operations	Replace pin in case of failure.

10.0 Dimensions/Component Layouts/Schematics

10.1 Basic Dimensions

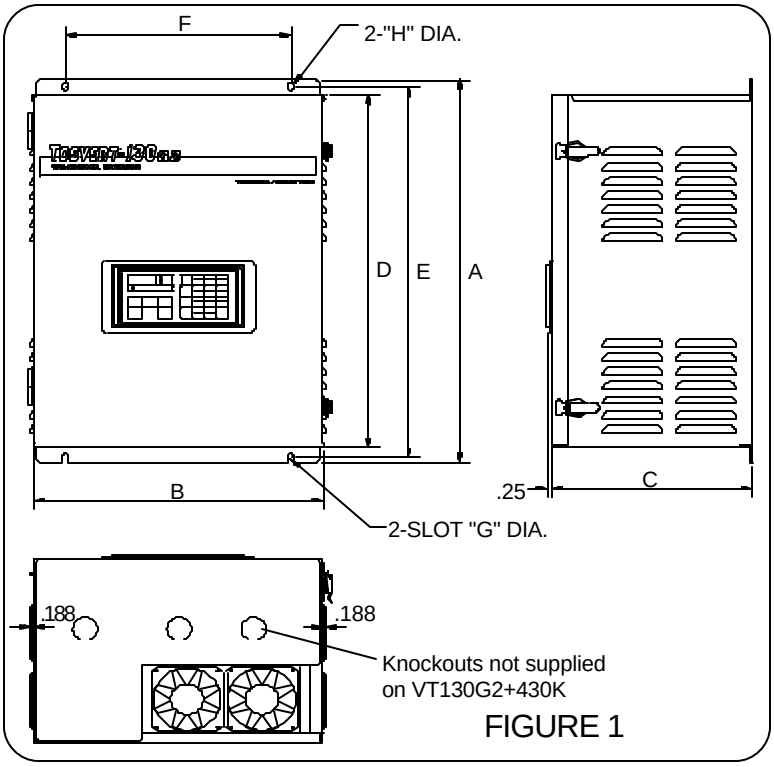


FIGURE 1

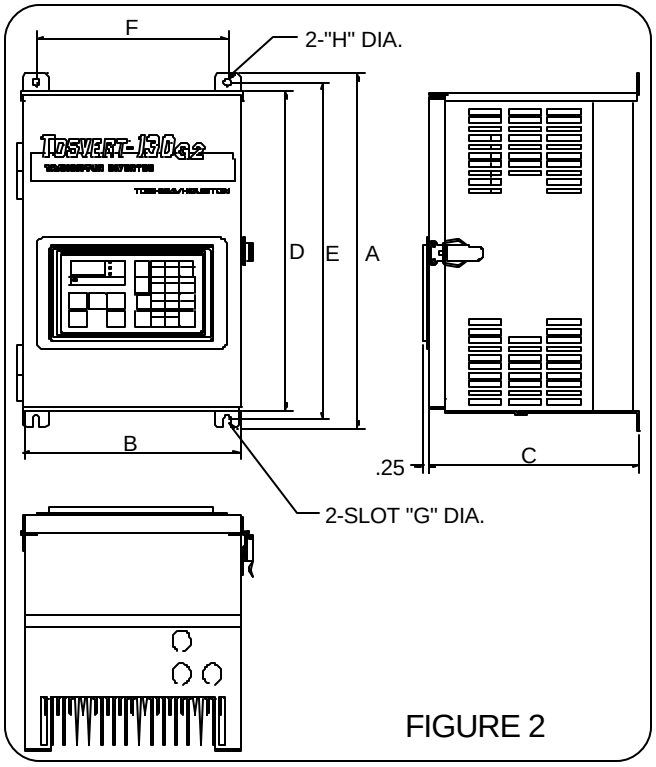
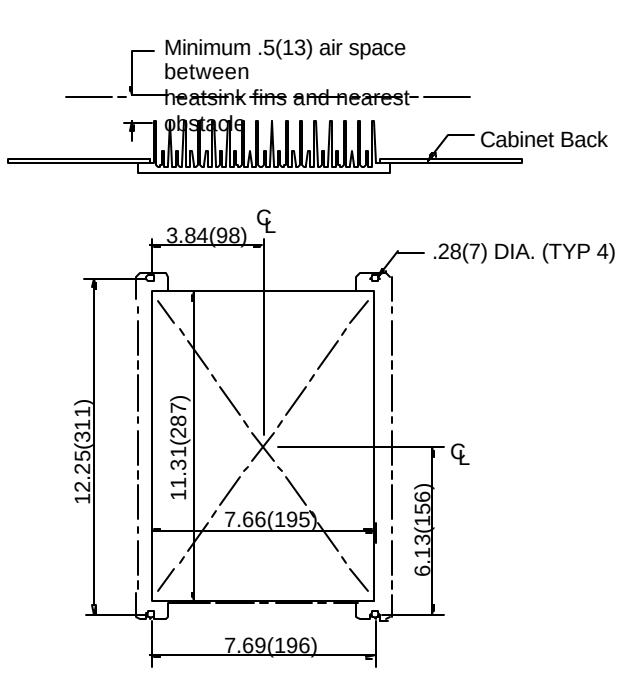


FIGURE 2

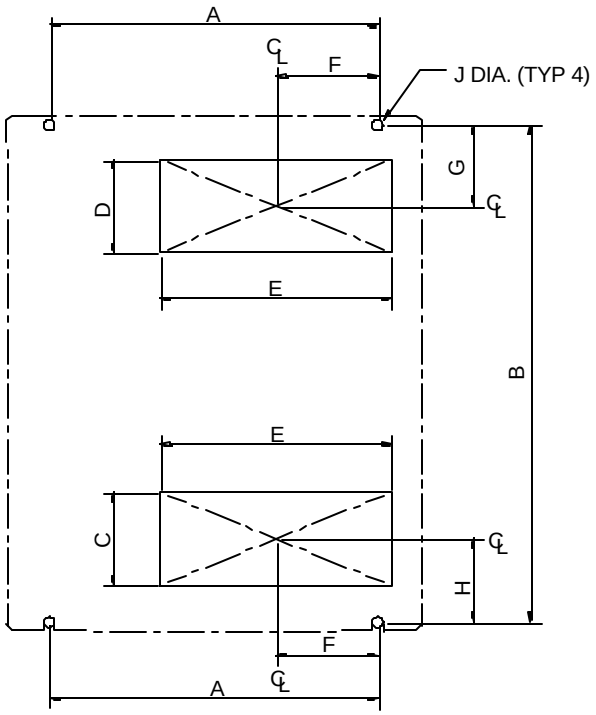
DIMENSIONS in inches(millimeters)

MODEL	FIG	A	B	C	D	E	F	G	H
VT130G2+2010 VT130G2+2015 VT130G2+2025 VT130G2+2035	2	12.63(321)	8.72(221)	7.47(190)	11.38(289)	12.00(305)	7.69(195)	.28(7)	.28(7)
VT130G2+2055	2	12.63(321)	8.72(221)	8.41(214)	11.38(289)	12.00(305)	7.69(195)	.28(7)	.28(7)
VT130G2+2080 VT130G2+2110	1	18.75(476)	14.38(365)	9.94(252)	17.13(435)	18.09(459)	11.25(286)	.38(10)	.38(10)
VT130G2+2160 VT130G2+2220	1	20.75(527)	14.38(365)	9.94(252)	19.13(486)	20.09(510)	11.25(286)	.38(10)	.38(10)
VT130G2+2270	1	23.63(600)	17.38(441)	11.50(292)	21.63(549)	22.75(578)	14.25(362)	.50(13)	.50(13)
VT130G2+2330	1	36.50(927)	19.25(489)	13.56(344)	33.88(861)	35.34(898)	12.63(321)	.63(16)	.63(16)
VT130G2+4015 VT130G2+4025 VT130G2+4035	2	12.63(321)	8.72(221)	7.47(190)	11.38(289)	12.00(305)	7.69(195)	.28(7)	.28(7)
VT130G2+4055 VT130G2+4080	2	12.63(321)	8.72(221)	8.41(214)	11.38(289)	12.00(305)	7.69(195)	.28(7)	.28(7)
VT130G2+4110 VT130G2+4160	1	18.75(476)	14.38(365)	9.94(252)	17.13(435)	18.09(459)	11.25(286)	.38(10)	.38(10)
VT130G2+4220	1	20.75(527)	14.38(365)	9.94(252)	19.13(486)	20.09(510)	11.25(286)	.38(10)	.38(10)
VT130G2+4270 VT130G2+4330 VT130G2+4400	1	23.63(600)	17.38(441)	11.50(292)	21.63(549)	22.75(578)	14.25(362)	.50(13)	.50(13)
VT130G2+4500 VT130G2+4600 VT130G2+4750	1	36.50(927)	19.25(489)	13.56(344)	33.88(861)	35.34(898)	12.63(321)	.63(16)	.63(16)
VT130G2+410K VT130G2+412K VT130G2+415K	1	57.00(1448)	19.25(489)	13.16(334)	54.16(1376)	55.81(1418)	12.63(321)	.69(18)	.69(18)
VT130G2+420K VT130G2+425K	1	59.94(1522)	25.88(657)	14.47(368)	57.00(1448)	58.75(1492)	11.81(300)	.69(18)	.69(18)
VT130G2+430K	1	77.00(1956)	24.00(610)	20.00(508)	72.00(1829)	75.00(1905)	16.00(406)	.69(18)	.69(18)

10.2 Layout Dimensions for Installation in NEMA 12 Enclosures with optional kits.



2010 - 2055
4015 - 4080



2080 - 2330
4110 - 415K

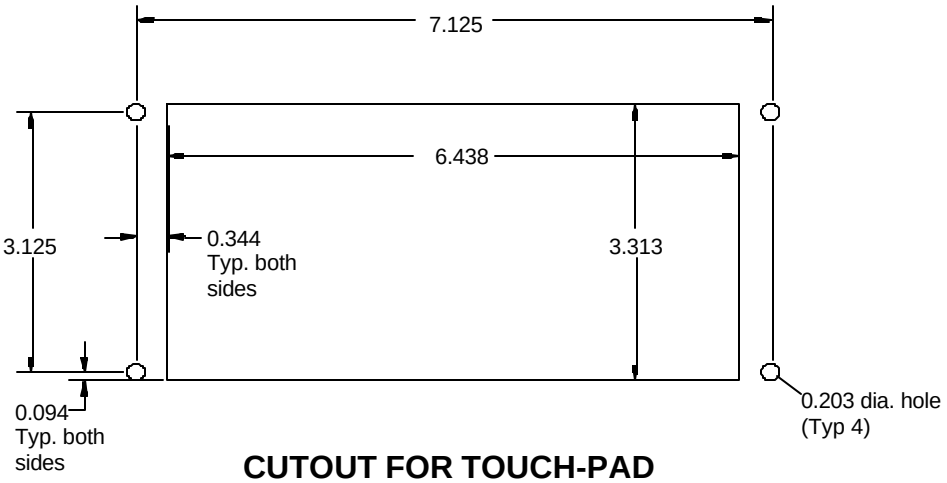
DIMENSIONS in inches(millimeters)

Models	A	B	C	D	E	F	G	H	J
G2+2080 - G2+2110 G2+4110 - G2+4160	11.25(286)	18.09(459)	3.38(86)	3.38(86)	7.91(201)	3.48(88)	2.94(75)	3.03(77)	0.38(10)
G2+2160 - G2+2220 G2+4220	11.25(286)	20.09(510)	3.38(86)	3.38(86)	7.91(201)	3.4888)	2.94(75)	3.03(77)	0.38(10)
G2+2270 G2+4270 - G2+4400	14.25(362)	22.75(578)	3.38(86)	3.38(86)	9.50(241)	4.31(109)	3.06(78)	3.06(78)	0.50(13)
G2+2330 G2+4500 - G2+4750	12.63(321)	35.34(898)	5.13(130)	5.13(130)	11.45(291)	3.51(89)	4.09(104)	4.13(105)	0.63(16)
G2+410K - G2+412K	12.63(321)	55.81(1418)	5.13(130)	5.13(130)	11.45(291)	3.51(89)	5.31(135)	5.13(130)	0.69(18)
G2+415K	12.63(321)	55.81(1418)	5.13(130)	5.13(130)	11.45(291)	3.51(89)	5.31(135)	5.13(130)	0.69(18)
* G2+420K - G2+430K	-	-	-	-	-	-	-	-	-

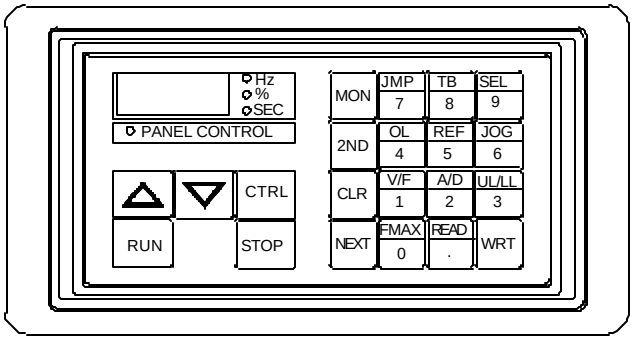
* Not applicable in this model.

10.3 Operating Panel Assembly

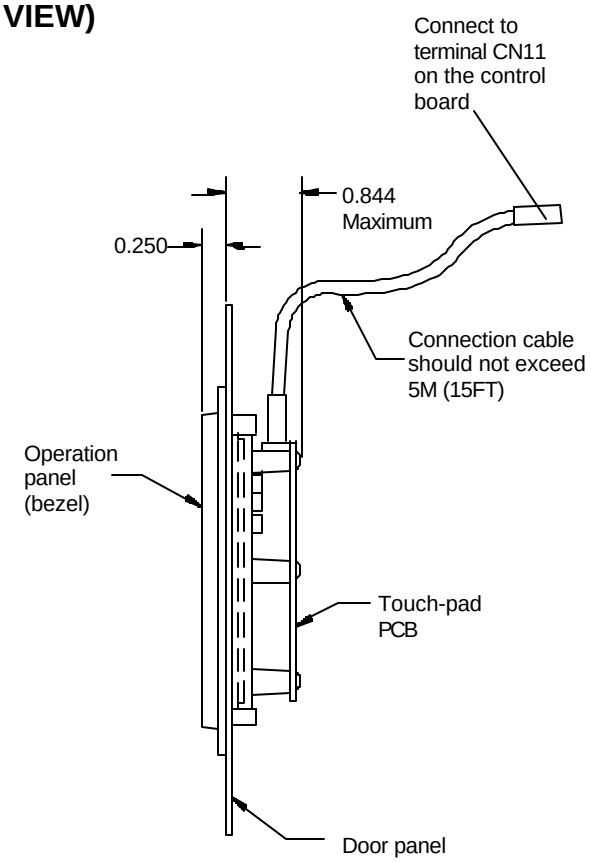
(NEMA 4/NEMA 12 Operation Panel - Standard)



CUTOUT FOR TOUCH-PAD OPERATION PANEL IN DOOR (FRONT VIEW)



FRONT VIEW OF TOUCH-PAD OPERATION PANEL

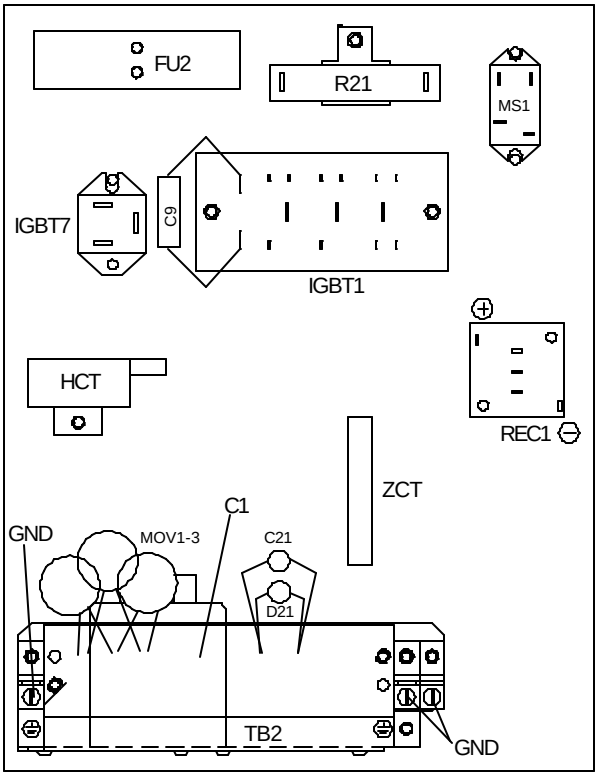


RIGHT SIDE VIEW

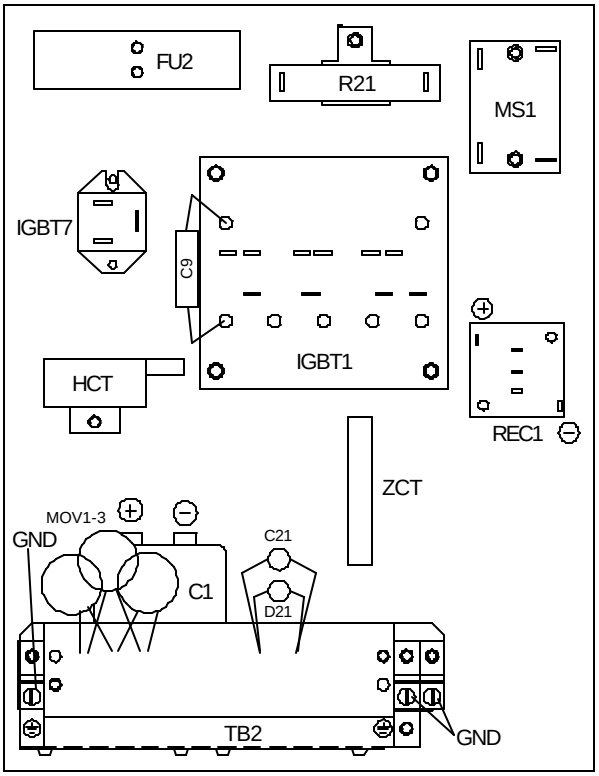
10.4 Shipping Weights

Inverter	Shipping Weight	
Type	Pounds	Kilograms
G2+2015	15.0	6.8
G2+2025	16.0	7.3
G2+2035	17.0	7.7
G2+2055	19.0	8.6
G2+2080	54.0	24.5
G2+2110	54.0	24.5
G2+2160	65.0	29.5
G2+2220	65.0	29.5
G2+2270	105.0	47.7
G2+2330	178.0	80.9
G2+4015	19.0	8.6
G2+4025	19.0	8.6
G2+4035	20.0	9.1
G2+4055	20.0	9.1
G2+4080	23.0	10.5
G2+4110	61.0	27.7
G2+4160	65.0	29.5
G2+4220	67.0	30.5
G2+4270	110.0	50.0
G2+4330	110.0	50.0
G2+4400	111.0	50.5
G2+4500	190.0	86.4
G2+4600	196.0	89.1
G2+4750	200.0	90.9
G2+410K	302.0	137.3
G2+412K	304.0	138.2
G2+415K	310.0	140.9
G2+420K	440.0	200.0
G2+425K	448.0	203.7
G2+430K	777.0	352.4

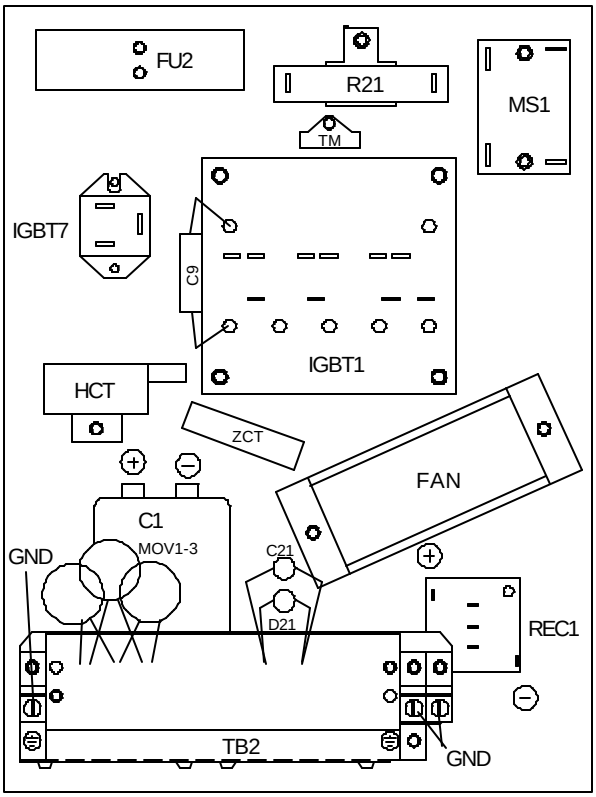
10.5 Component Layouts G2+2010 - G2+2080



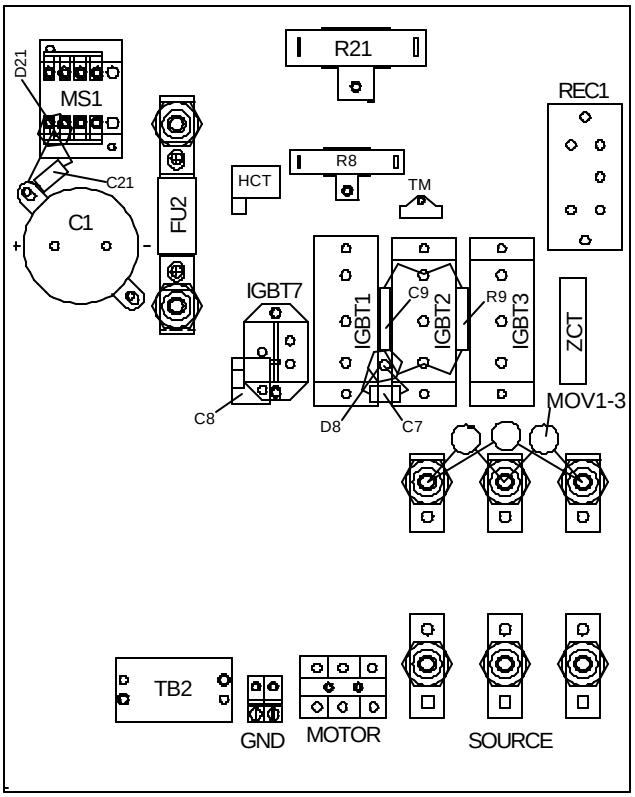
G2+2010 - G2+2025



G2+2035

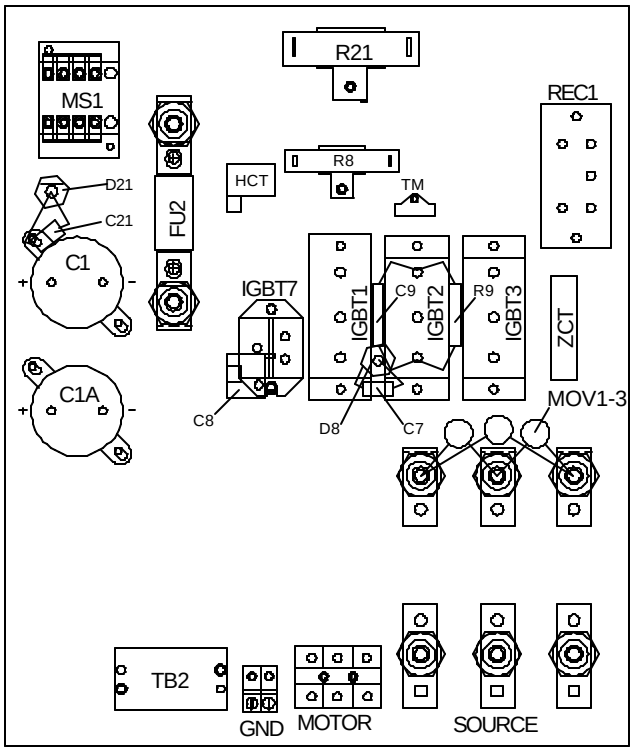


G2+2055

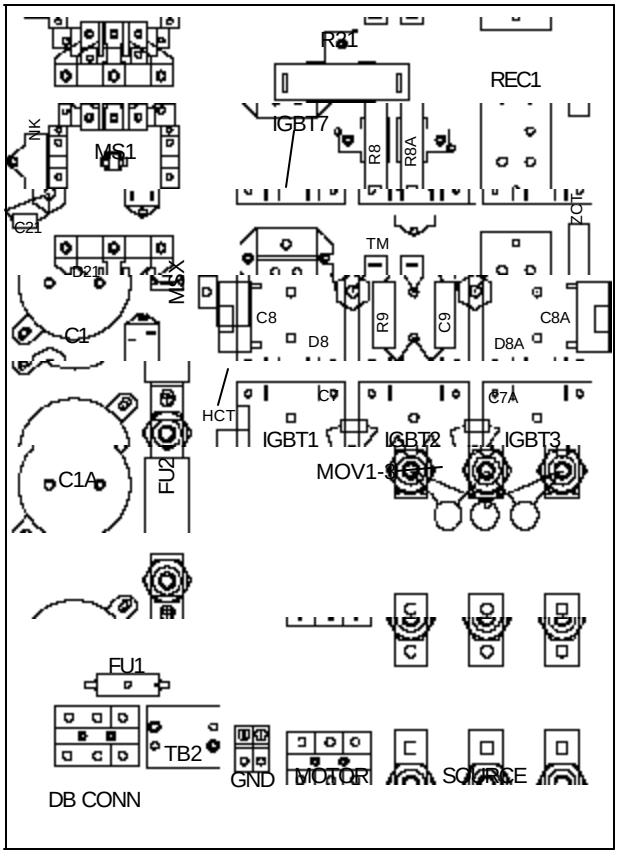


G2+2080

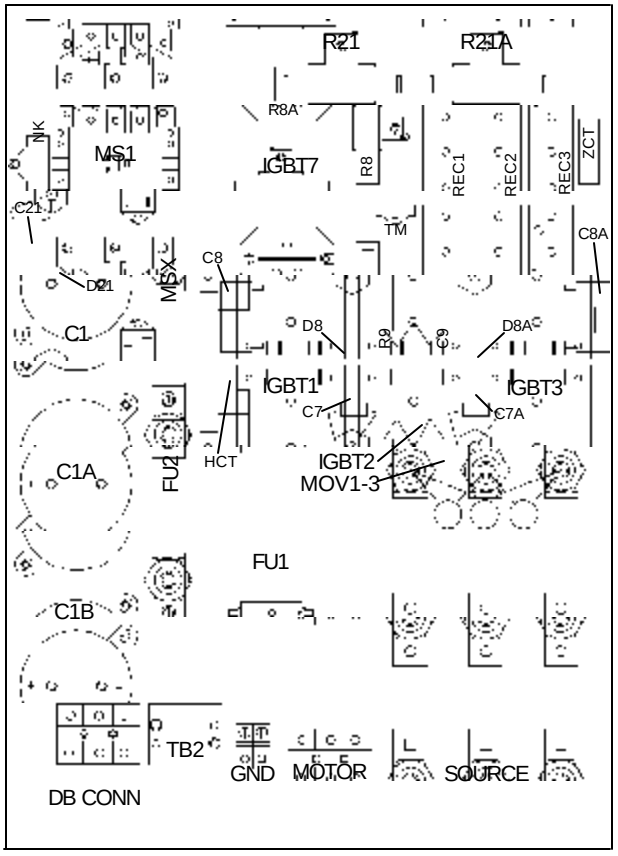
10.5 Component Layouts (Cont'd) G2+2110 - G2+2220



G2+2110

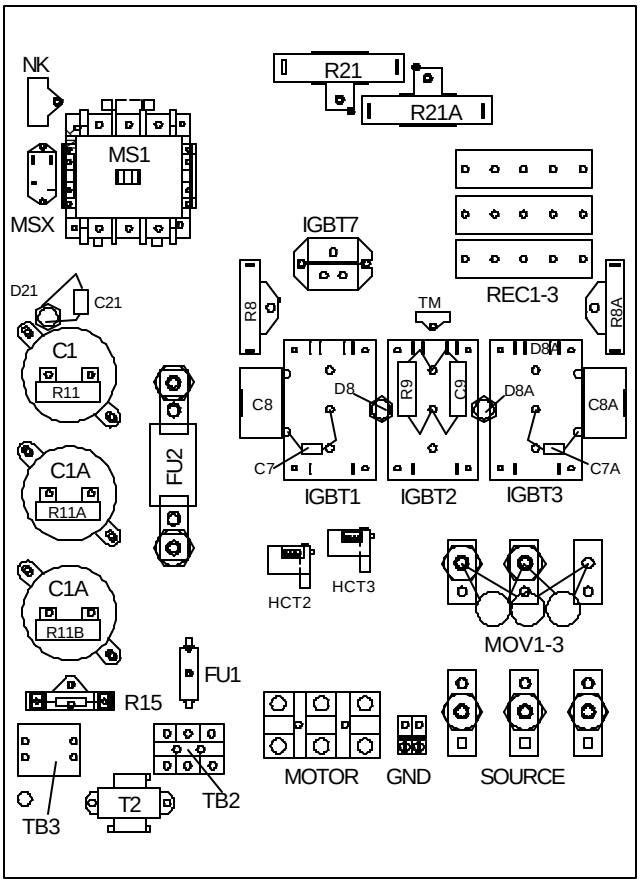


G2+2160

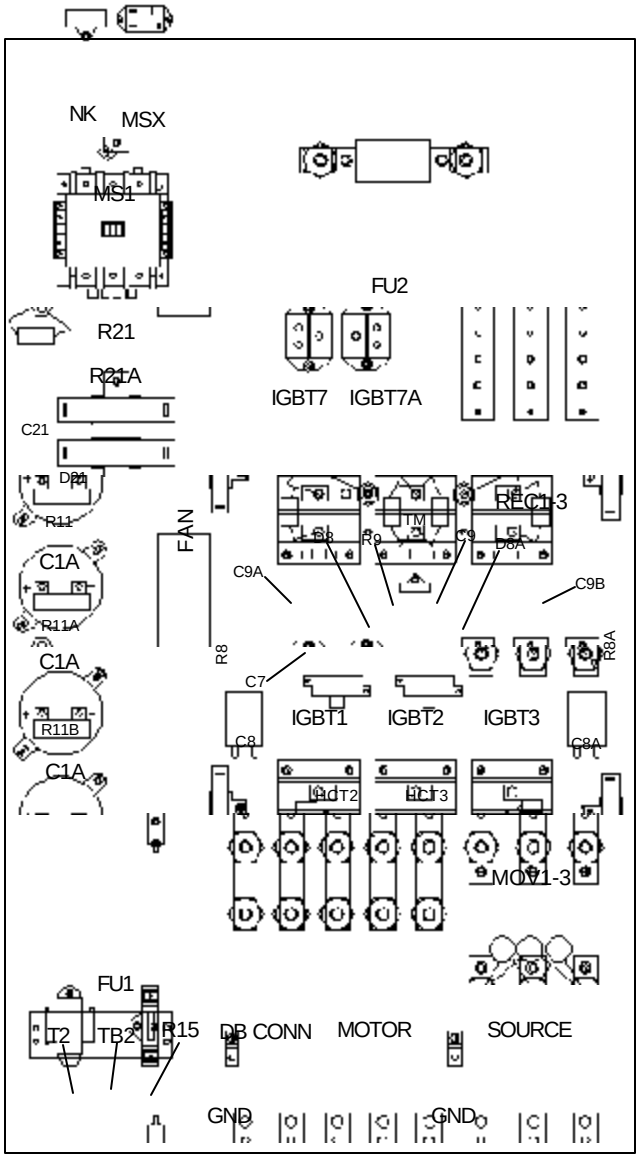


G2+2220

10.5 Component Layouts (Cont'd) G2+2270 - G2+2330

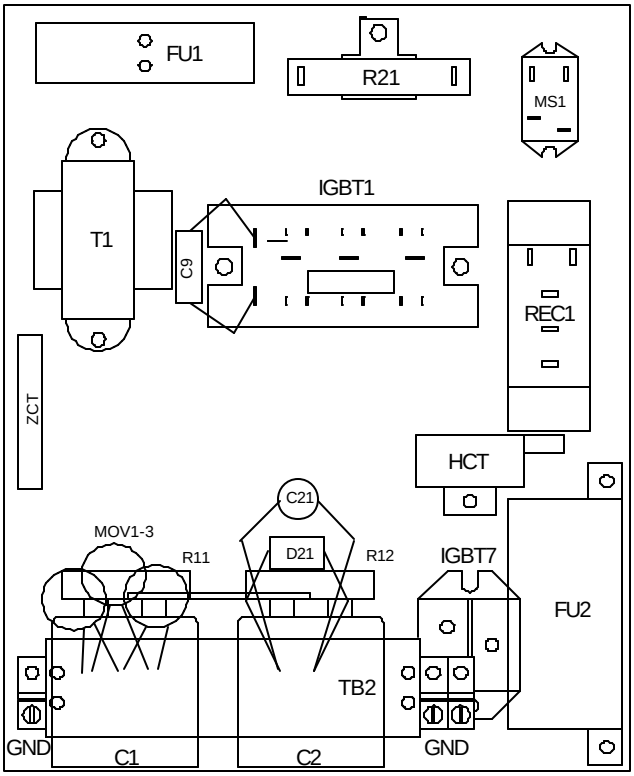


G2+2270

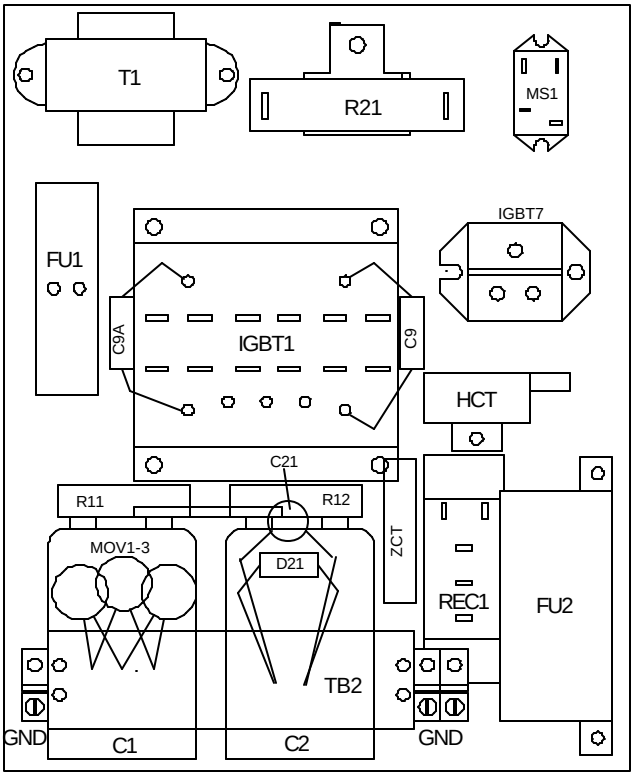


G2+2330

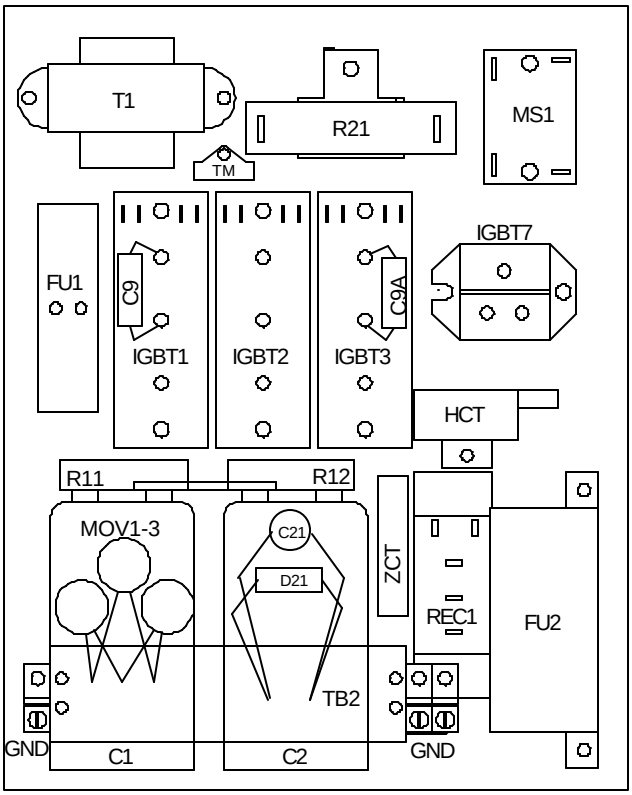
10.5 Component Layouts G2+4015 - G2+4110



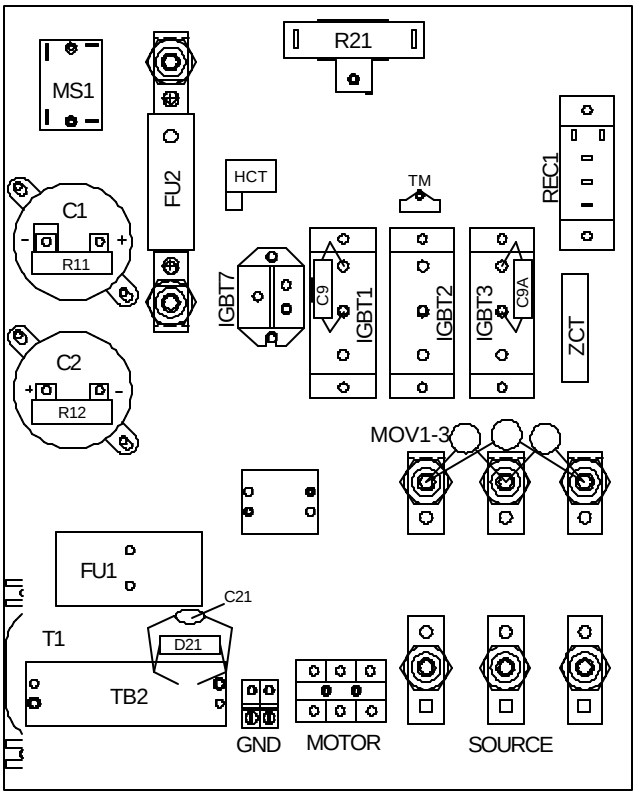
G2+4015 - G2+4035



G2+4055

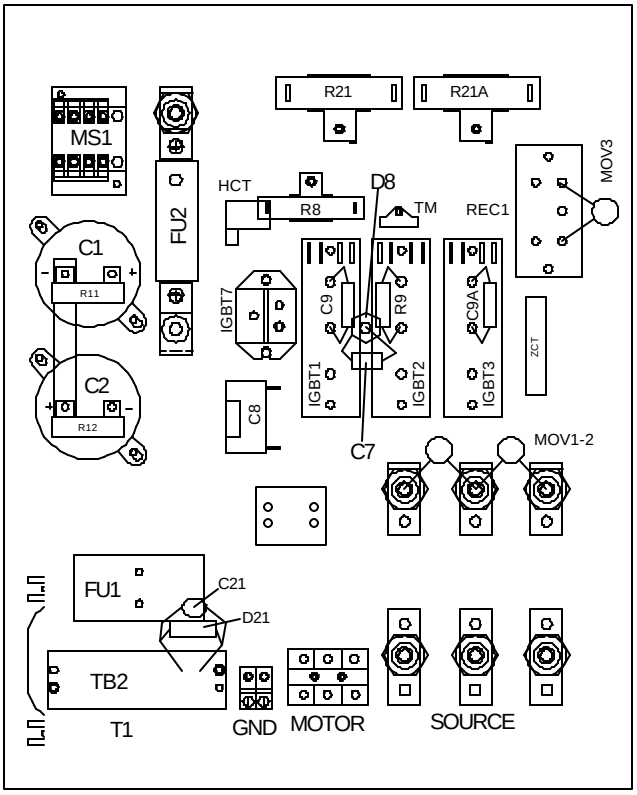


G2+4080

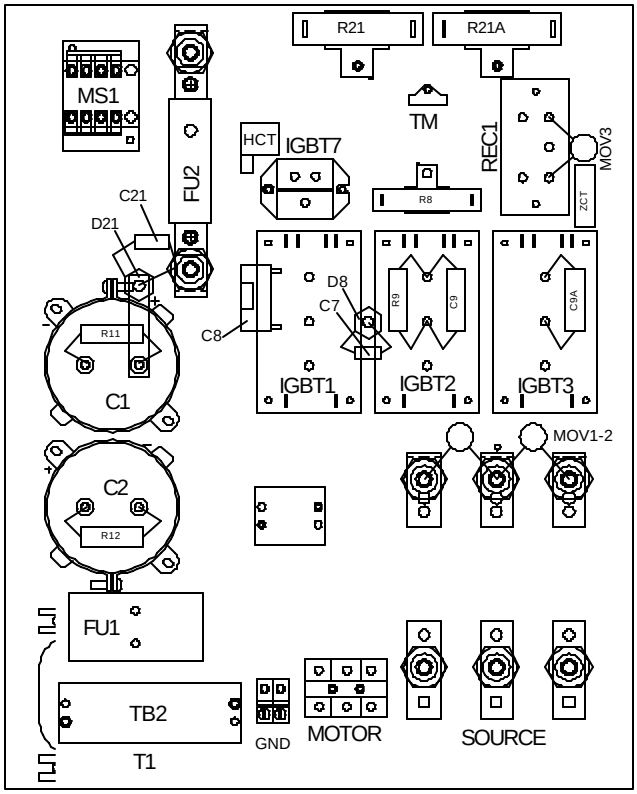


G2+4110

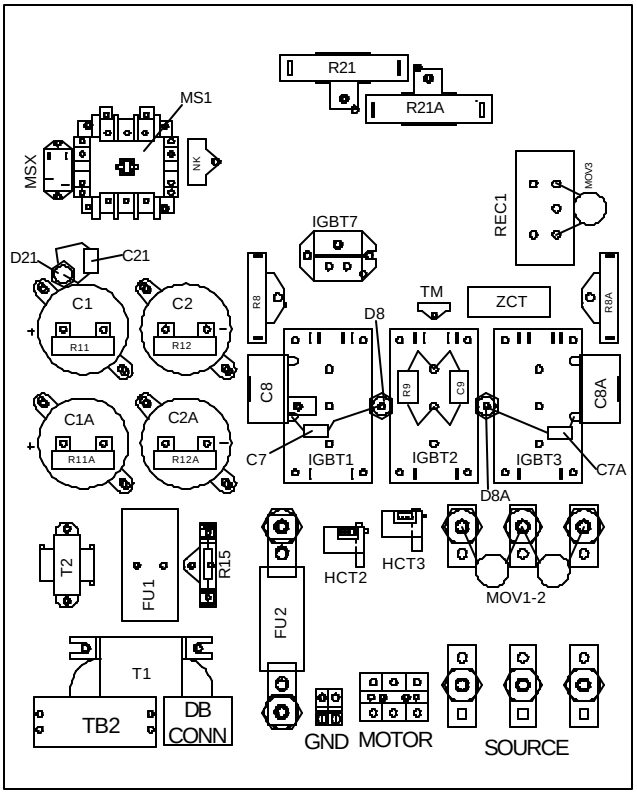
10.5 Component Layouts (Cont'd) G2+4160 - G2+4330



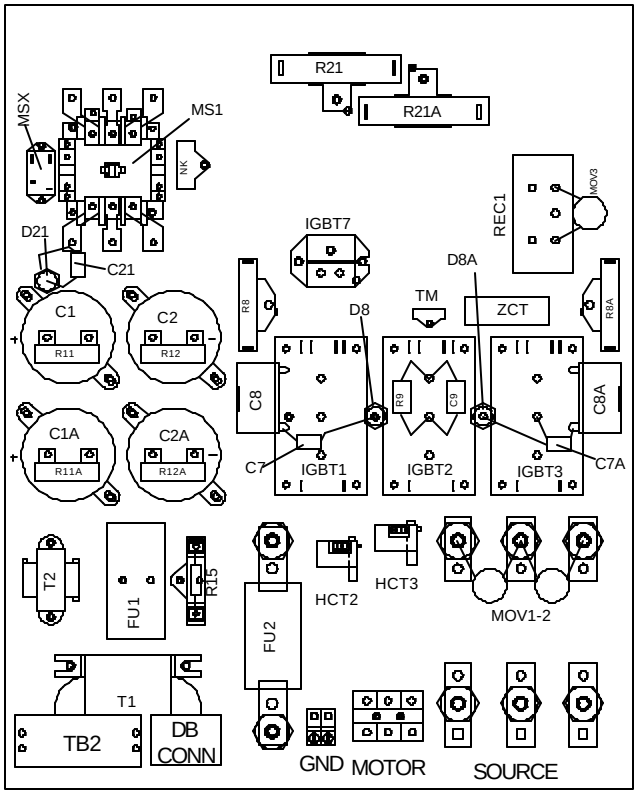
G2+4160



G2+4220

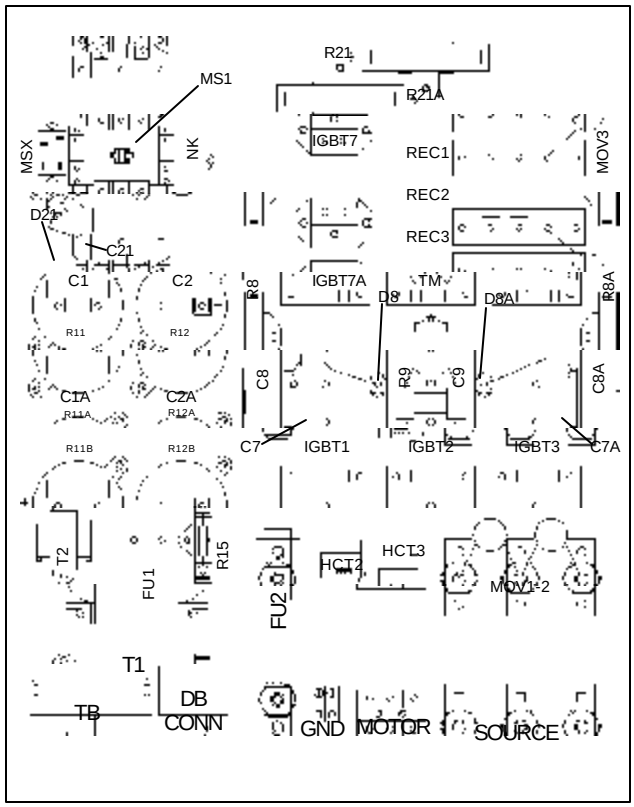


G2+4270

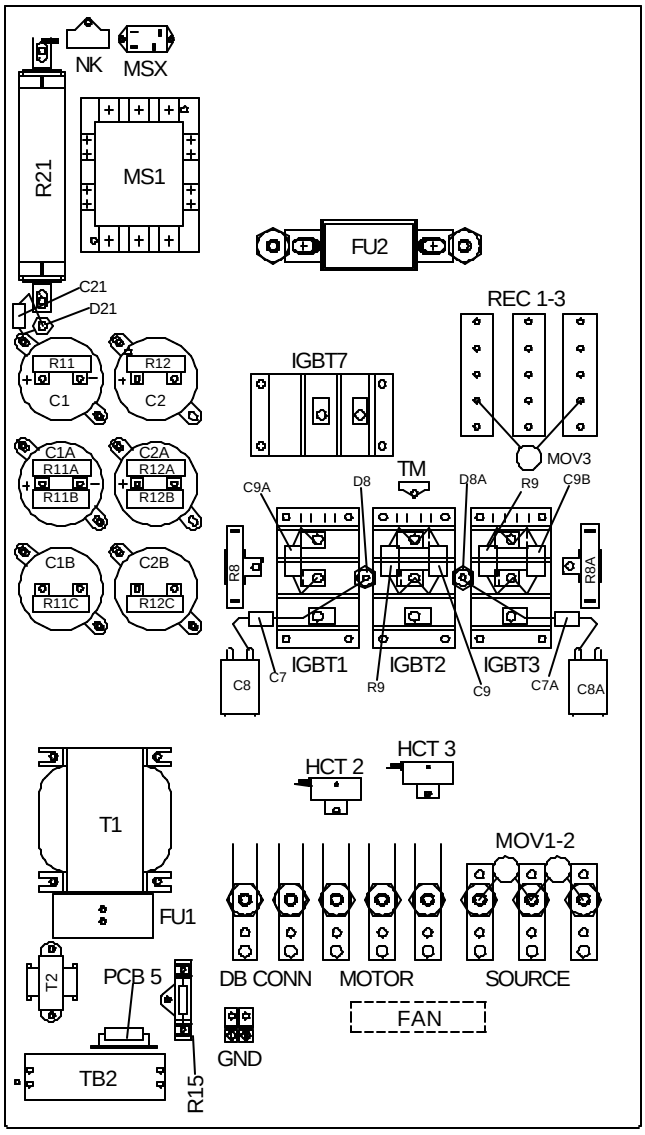


G2+4330

10.5 Component Layouts (Cont'd) G2+4400 - G2+4500

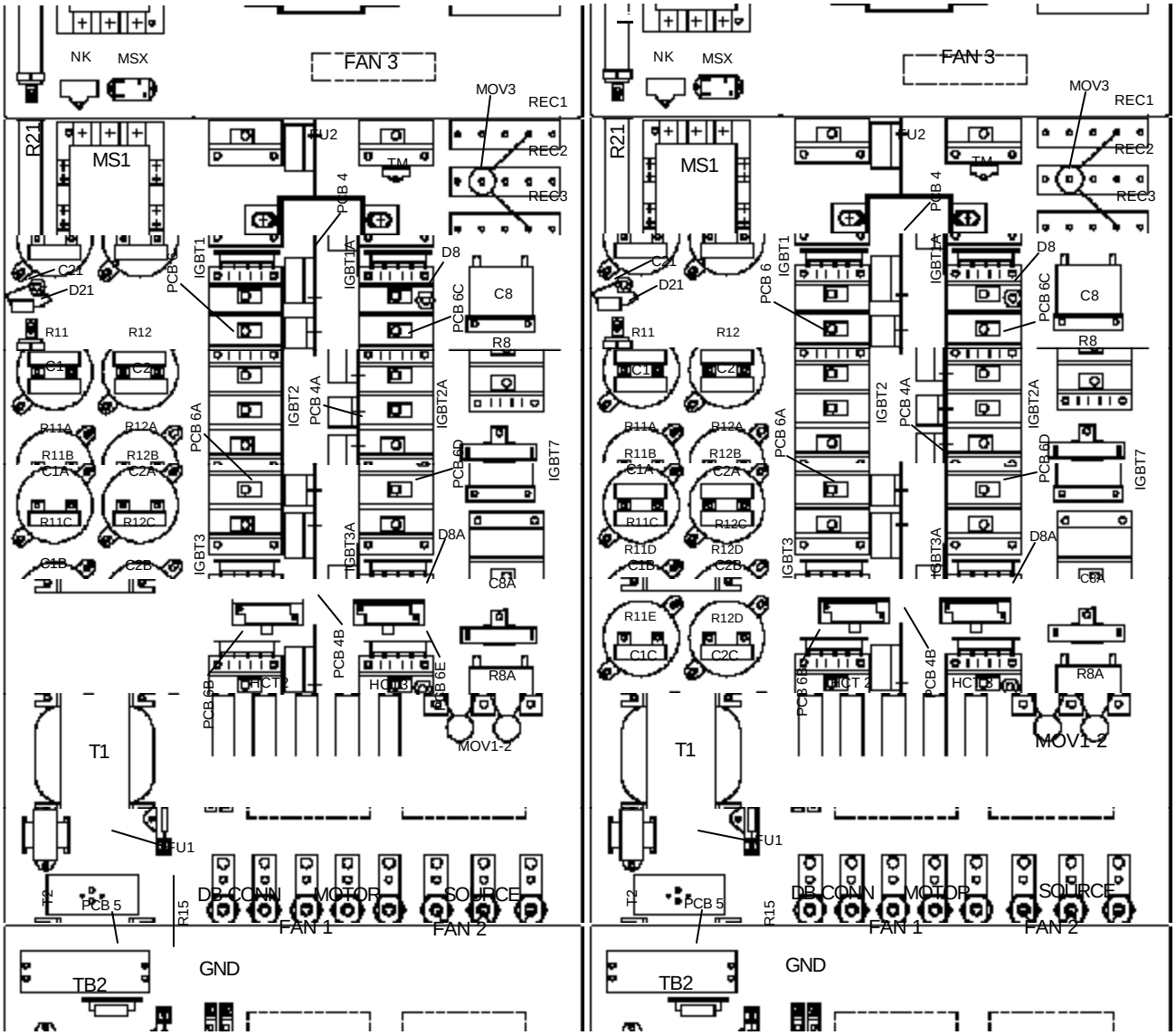


G2+4400



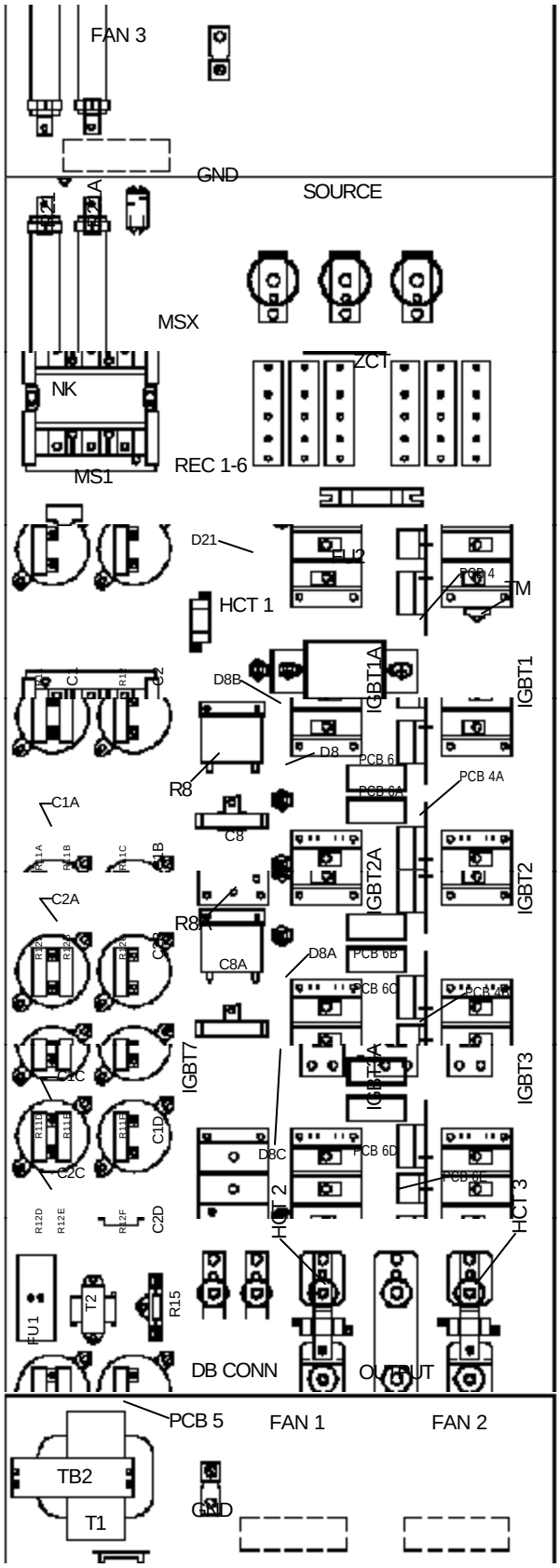
G2+4500

10.5 Component Layouts (Cont'd) G2+4600 - G2+4750

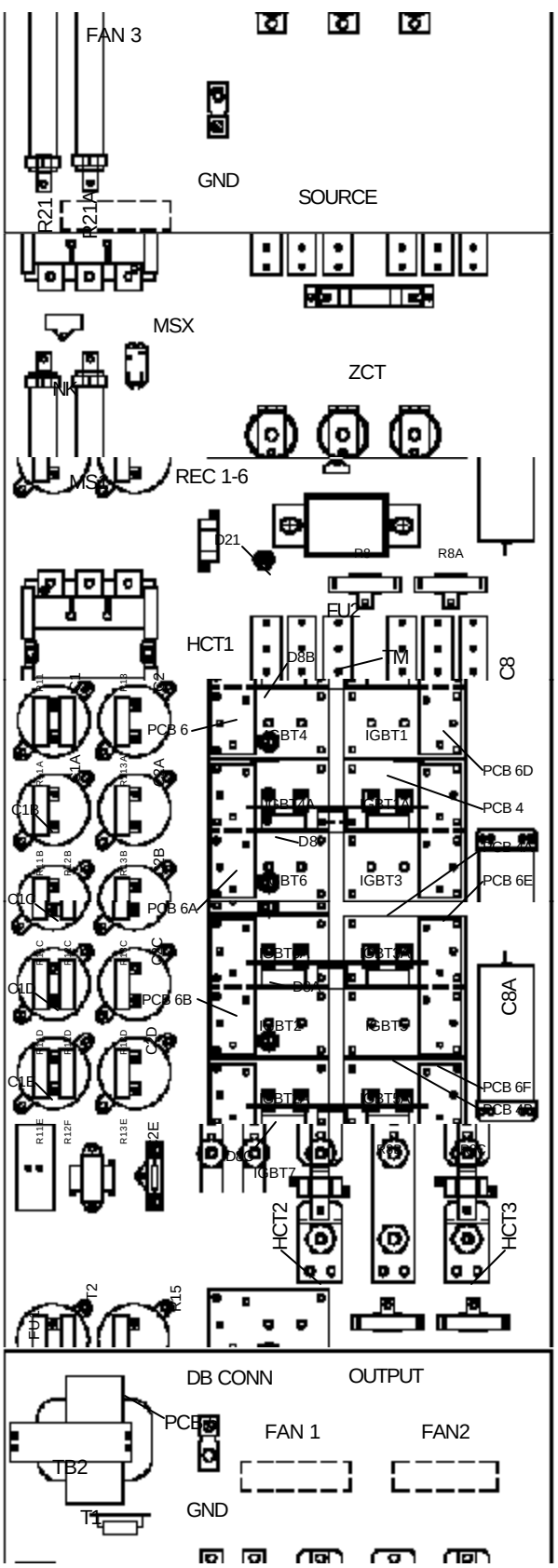


G2+4600 G2+4750

10.5 Component Layouts (Cont'd) G2+410K - G2+412K

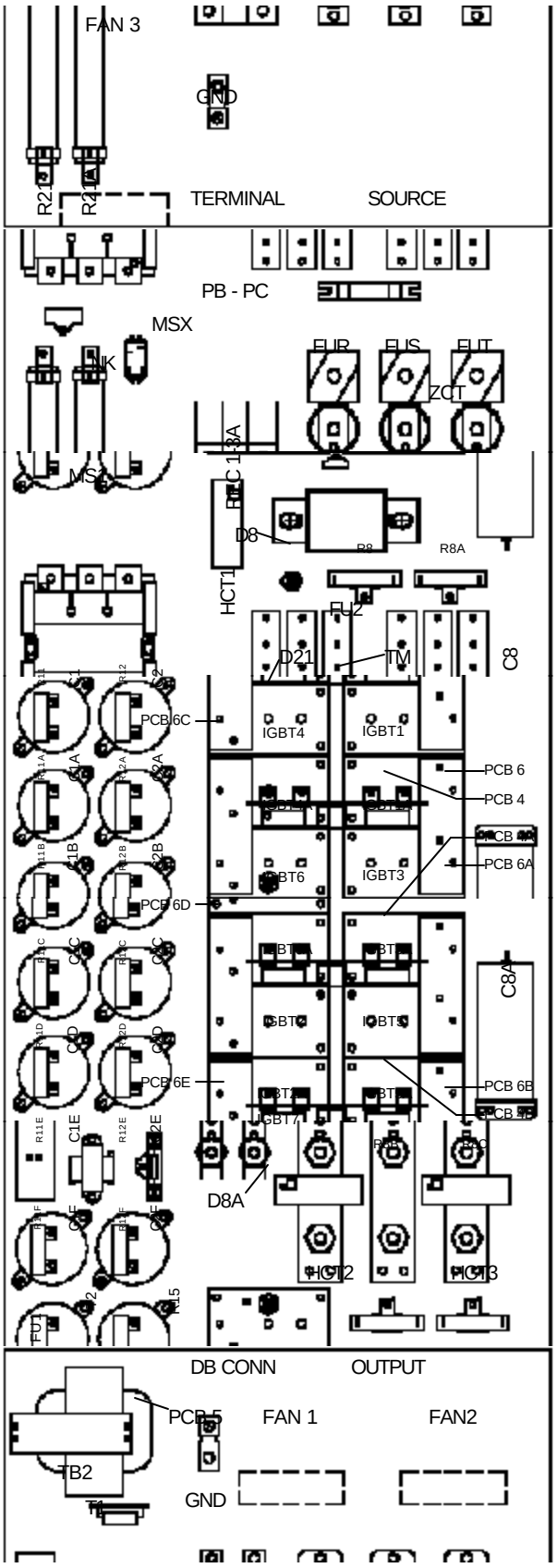


G2-410K



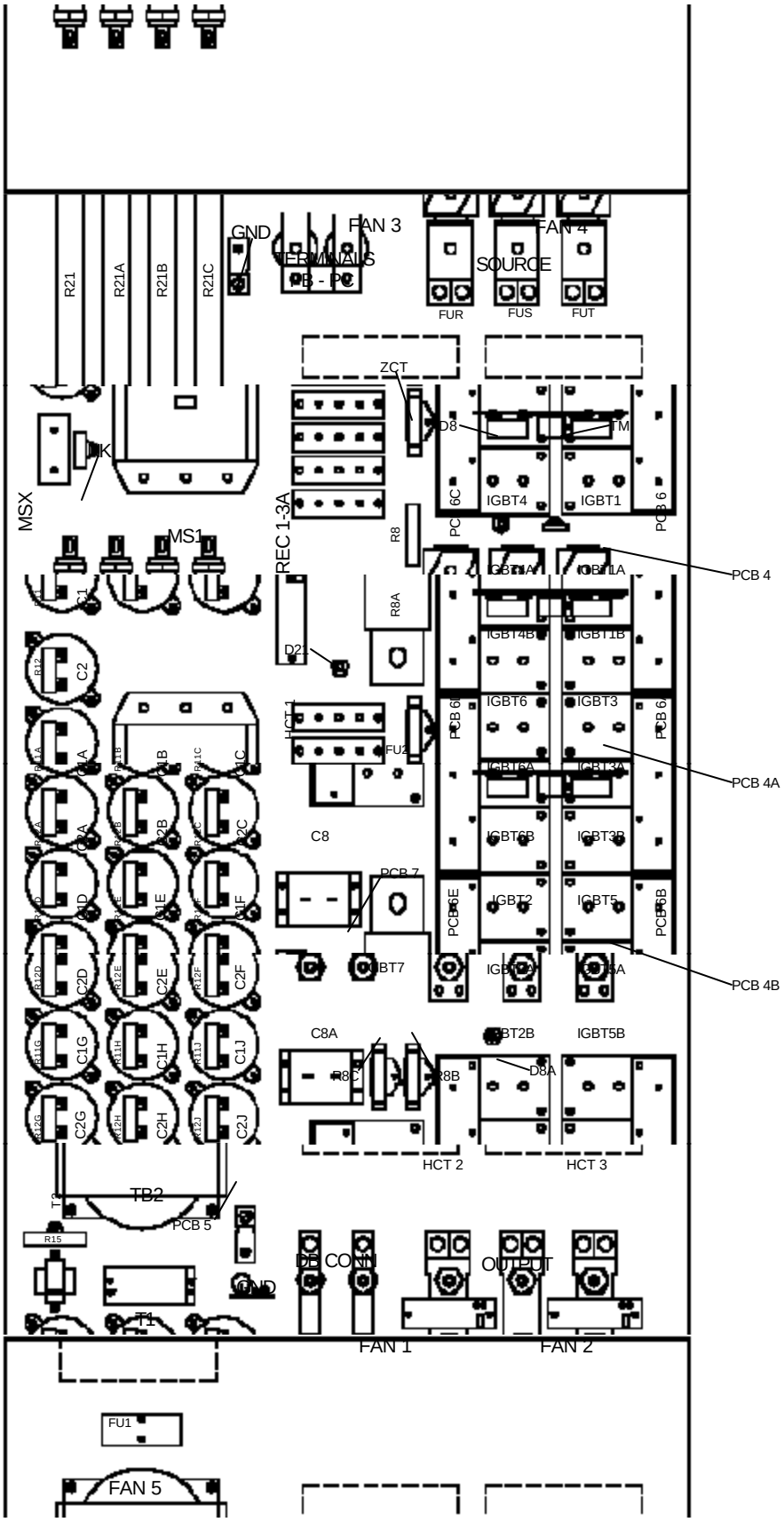
G2-412K

10.5 Component Layouts (Cont'd) G2+415K



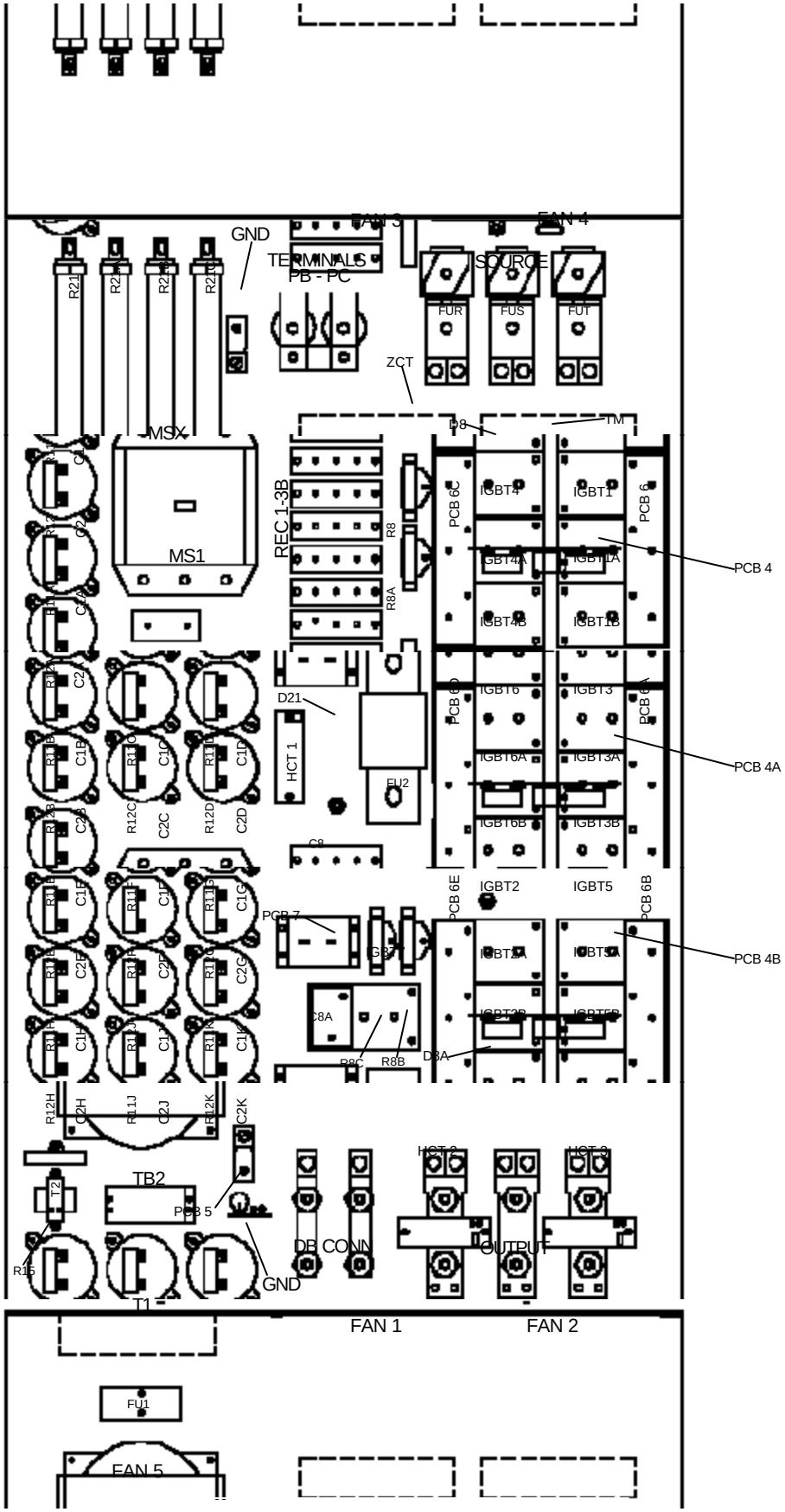
G2+415K

10.5 Component Layouts (Cont'd) G2+420K



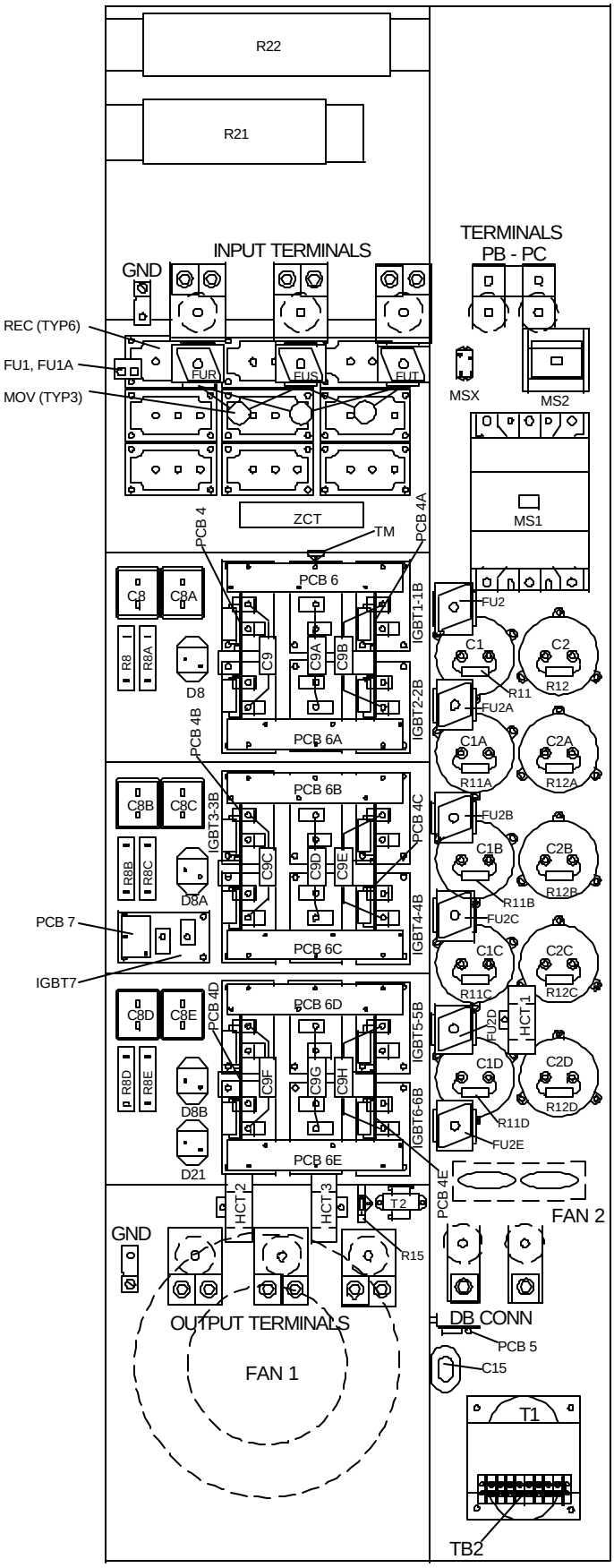
G2+420K

10.5 Component Layouts (Cont'd) G2+425K



G2+425K

10.5 Component Layouts (Cont'd) G2+430K



G2+430K

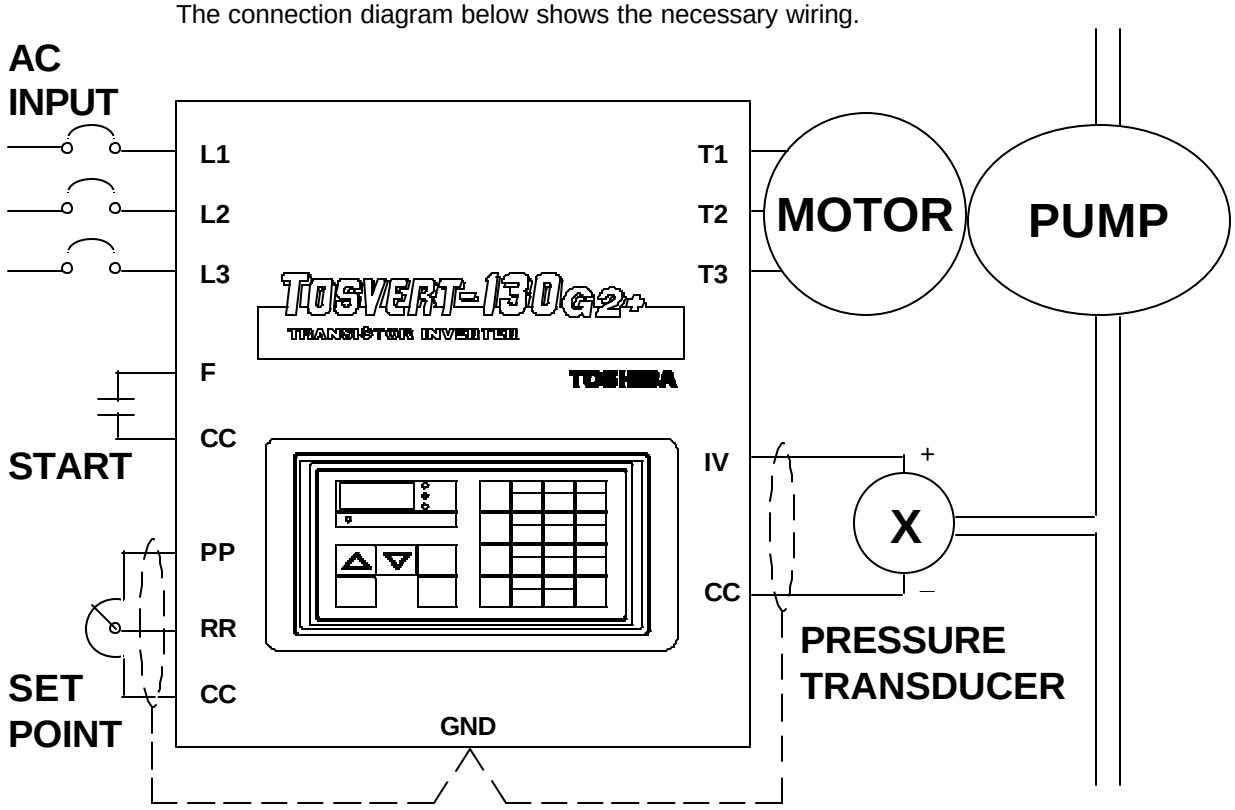
10.6 Schematics

11.0 Expanded Information

11.1 PID Set Point Control

All G2+ inverters come standard with set point control. The following information shows how to install and adjust the inverter using set point control. The feedback signal should be either 0-5 volts or a 4-20mA current. It is connected to terminals IV and CC. The setpoint may be adjusted by either a potentiometer or the touch pad. This diagram shows how a potentiometer should be connected to terminals PP, RR, and CC to control the setpoint. Each of these connections are made to the TB terminal strip located on the main control printed circuit board PCB1.

The connection diagram below shows the necessary wiring.



Use the following procedures to adjust the setpoint control parameters:

INITIAL SETUP

1) With power removed, place the jumper connections JP1 and JP2 (located on the main control printed circuit board PCB1) in the correct positions for the type of feedback signal used; then reapply power.

2) Set acceleration and deceleration times to 5 seconds (1st function # 2).

3) Adjust the bias and gain for the systems feedback signal. For example, typically the motor slows down when the feedback signal goes above the setpoint. This action can be reversed by exchanging the data between F-P1 and F-P2 (1st function # 5).

4) Turn on the set point (PID) control (2nd function # 5).

5) Set proportional gain to 1000 (2nd function # 5).

6) Set integral gain to 500 (2nd function # 5).

7) Set anti-hunting (differential) gain to 0 (2nd function # 5).

8) Set lag-time constant to 255 (2nd function # 5).

9) Run system.

11.0 Expanded Information

11.1 PID Set Point Control (Cont'd)

READJUSTMENT

1) For faster response time set larger proportional gain, shorter integral gain and/or shorter acceleration and deceleration times.

2) To stabilize the system adjust increase anti-hunting gain, increase lag-time constant and/or slow the response time.

SPECIAL ADJUSTMENTS

1) The touch pad may be used to adjust the setpoint by changing the frequency reference setting mode selection to touch pad only (2nd function # 9).

2) The touch pad may be used to start and stop the drive by changing the command mode selection to touch pad only (2nd function # 9).

HAVING TROUBLE?

Please check the following list. These are things which will cause the PID loop in the TOSVERT-130 G2+ to operate incorrectly.

1) FEEDBACK - Make sure that the feedback signal has the correct polarity. Make sure that jumpers JP1 and JP2 (located on main control printed circuit board PCB1) are correctly set.

2) SOFTWARE - Make sure that the inverter main software is Version 5.2 (see Section 7.5 "Status Monitoring").

3) SETPOINT - Make sure that the setpoint potentiometer is connected correctly or that the keypad has been selected to adjust the setpoint.

4) START - Make sure that the drive is given a run command by either contact closure or pressing the keypad ***start*** button.

IF ANY PROBLEMS OCCUR OR IF YOU HAVE QUESTIONS PLEASE CONTACT THE INVERTER MARKETING DEPARTMENT AT 1-800-231-1412.