"SECO" CD Inverter Instruction Manual

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1.0 INTRODUCTION

This instruction manual contains installation, operating and troubleshooting procedures and a complete technical description of the SECO CD solid state variable frequency inverter drive.

A complete set of block diagrams, interconnection diagrams and a recommended spare parts list are included.

2.0 GENERAL

2.1 GENERAL DESCRIPTION

This inverter drive is designed for operating Nema type B AC induction motors and special high frequency motors (consult factory for application assistance on high frequency motors).

The CDL series is for operation on 230VAC power, while the CDM series will run on 380, 415, and 460VAC power.

Control circuitry is based around a digital micro-controller. This results in complete digital control of operation and customer application settings. Adjustments and jumpers previously used in inverters are replaced by programmable parameters, enabling both ease of set-up, as well as simple duplication of settings.

A built-in LED display and 3 button keypad allows setting of all inverter parameters, monitoring of output frequency or load, indicates current limiting, and dispays 10 different fault codes. The keypad may be programmed to operate the inverter, by means of switches (cover mounted) for Start, Stop, and Forward/Reverse operation .

Two methods of braking are available. DC injection braking is built into the inverter. It may be selected by setting parameter b2 to 1. Dynamic braking is available as a separate option. Instructions on dynamic braking are supplied with the option.

A serial communications port is built into the inverter. It is RS485 and conforms to ANSI x 3.28 - 2.5 - A4 protocol. This serial port may also be connected for RS232C use. The port may be used to set parameters in the inverter, control operation of the inverter, or to read/check information in the inverter.

All parameters in the inverter may be secured so that access is available only to those in possession of a "security code". Inverters are shipped without a security code, and the user, may if he desires, program in a security code to restrict access to the inverter parameters. If a security code is lost or forgotten, SECO can assist customers in regaining access to the inverter.

2.2 MODEL NUMBERS

HP	VOLT	TYPE	MODEL NO.
3	230v	Chassis	CDLC03
5	230v	Chassis	CDLC05
2	230v	NEMA 1 Enclosed	CDLE02
3	230v	NEMA 1 Enclosed	CDLE03
5	230v	NEMA 1 Enclosed	CDLE05
3	230v	NEMA 4/12 Enclosed	CDLE03-12
5	230v	NEMA 4/12 Enclosed	CDLE05-12
1	460v	Chassis	CDMC01
2	460v	Chassis	CDMC02
3	460v	Chassis	CDMC03
5	460v	Chassis	CDMC05
7 1/2	460v	Chassis	CDMC07
10	460v	Chassis	CDMC10
15	460v	Chassis	CDMC15
1	460v	NEMA 1 Enclosed	CDME01
2	460v	NEMA 1 Enclosed	CDME02
3	460v	NEMA 1 Enclosed	CDME03
5	460v	NEMA 1 Enclosed	CDME05
7 1/2	460v	NEMA 1 Enclosed	CDME07
10	460v	NEMA 1 Enclosed	CDME10
15	460v	NEMA 1 Enclosed	CDME15
1	460v	NEMA 4/12 Enclosed	CDME01-12
2	460v	NEMA 4/12 Enclosed	CDME02-12
3	460v	NEMA 4/12 Enclosed	CDME03-12
5	460v	NEMA 4/12 Enclosed	CDME05-12
7 1/2	460v	NEMA 4/12 Enclosed	CDME07-12
10	460v	NEMA 4/12 Enclosed	CDME10-12
15	460v	NEMA 4/12 Enclosed	CDME15-12

2.3 STANDARD FEATURES

* Sine-Coded PWM Type Output Waveform
* Output Short Circuit/Ground Fault Protection
* Electronic Inverse Time Overload
* Adjustable Current Limiting up to 150% for 30 Seconds
* Instantaneous Overcurrent Protection
* Over and Undervoltage Protection
* Electronic Reversing
* 0 to 10VDC, 0 to 20ma, 4 to 20ma & 20 to 4ma Speed Command Inputs
* Isolated Low Voltage Electronics
* Analog Slaving
* Analog Frequency Signal Output
* Analog Load Signal Output
* Standard or Encoder Feedback
* Speed or Torque Control
* Status Relay
* Serial Port (RS232C or RS485)
* Built-in LED Display and Keypad
* Microprocessor-Based Control Circuitry
* Surface Mount Technology

2.4 GENERAL SPECIFICATIONS

Input Voltage (CDL).....220 to 240VAC (+/-10%), 3 phase
(CDM).....380 to 460VAC (+/-10%), 3 phase

Input Frequency.....48 to 62Hz

Output Voltage.....0 to input voltage, 3 phase

Output Frequency.....0.1 to 240Hz

Speed Regulation.....Standard: Approx. 3-5% for 95% load change, motor-dependant
Encoder Feedback: +/-0.1Hz

Voltage Regulation.....+/-10%

Frequency Regulation.....+/-0.1%

Maximum Load.....150% full rated current for 30 seconds

Min. Frequency.....Continuously adjustable from 0 to Max. Frequency setting

Max. Frequency.....Continuously adjustable from Min. Frequency setting to 240Hz

Acceleration Time.....0.2 to 600 seconds

Deceleration Time.....0.2 to 600 seconds

DC Injection Braking.....0 to 150% of output current rating

Slip Compensation.....0 to 10 Hz (at full load current)

Voltage Boost.....0 to 25.5% of maximum voltage

Control Type.....Sine-Coded PWM

Indication.....3 digit LED display (Power on, output Hz/output load, fault & fault type, current limit)

Protective Features.....Phase to phase output short circuit, phase to ground output short circuit, Bus overvoltage, input undervoltage, running overcurrent and instantaneous overcurrent protection

Ambient Operating Temperature.....0 to 50°C (32°F to 122°F) Chassis
0 to 40°C (32°C to 104°F) Enclosed

Storage Temperature.....-20°C to 60°C (-4°F to 140°F)

Altitude.....Up to 1000 meters (3300 feet)

Humidity.....95% RH at 40°C, non-condensing

2.5 DRIVE RATING

	HORSE POWER						
	1	1-1/2	2	3	5	7-1/2	10
AC 230V/3/60 RATED AC LINE AMPS				11.3	14.3		
RATED OUTPUT AMPS (1)				9.6	15.2		
RATED OUTPUT KVA				3.8	6		
HEAT LOSS WATTS *				135	222		
AC 460V/3/60 RATED AC LINE AMPS	2.6	3.7	4.9	6.9	10.4	11	13.1
RATED OUTPUT AMPS (1)	1.8	2.6	3.4	4.8	7.6	11	14
RATED OUTPUT KVA	1.4	2.1	2.7	3.8	6	8.8	11.1
HEAT LOSS WATTS *	38	48	58	76	112	155	193

230V/3/60	3	5
INPUT POWER FACTOR	.86	.86
TYPE OF VENTILATION	FAN	
WEIGHT LBS	12	

460V/3/60	1	1-1/2	2	3	5	7-1/2	10
INPUT POWER FACTOR	.95					.86	
TYPE OF VENTILATION	NATURAL				FAN		
WEIGHT LBS	7.5			9	9.5	12	

* AT 2.9kHz SWITCHING FREQUENCY. LOSS WILL BE HIGHER AT HIGHER SWITCH FREQUENCIES.

3.0 THEORY OF OPERATION

In the following pages, the operation of the SECO CD will be divided into key sections. The inverter description will begin with a brief review of AC motor theory.

3.1 AC MOTOR THEORY

The synchronous speed of an AC motor is a function of the applied frequency and the number of poles in the motor according to the following formula:

$$\text{Synchronous Speed} = \frac{\text{Frequency} \times 120}{\text{Number of Poles}}$$

Using the above formula to calculate the synchronous speed of a four pole motor operating on 60Hz yields:

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{4 \text{ Poles}} = 1800 \text{ RPM}$$

The synchronous speed is the speed of the rotating magnetic field in the air gap of the motor. The actual rotor speed of the induction motor will be slightly less than the synchronous speed due to the slip required to produce torque at the shaft of the induction motor. This reduction in speed (or slip) is typically 3 to 5% for a fully loaded Nema Design B motor.

3.2 INVERTER THEORY

It is evident that the speed of the motor can be varied by simply varying the frequency. However, if the frequency alone is controlled, without changing the motor voltage, the motor will overheat at reduced speeds due to over-excitation. In order to maintain proper motor operation, the voltage as well as the frequency are controlled, producing the correct voltage to frequency (V/Hz) ratio.

To implement this, the inverter rectifies the incoming AC power, producing a fixed DC Bus voltage. By controlling the switching of the six power devices in the inverter stage, variable frequency/voltage is developed and applied to the motor, accomplishing variable speed control. The output switching uses a sine coded Pulse Width Modulation (PWM) scheme and produces near sinusoidal current in the motor to reduce motor heating.

3.3 DESCRIPTION OF PC BOARDS

All of the electronics, as well as the converter and inverter stages are contained on two PC boards and a heat sink assembly. They are:

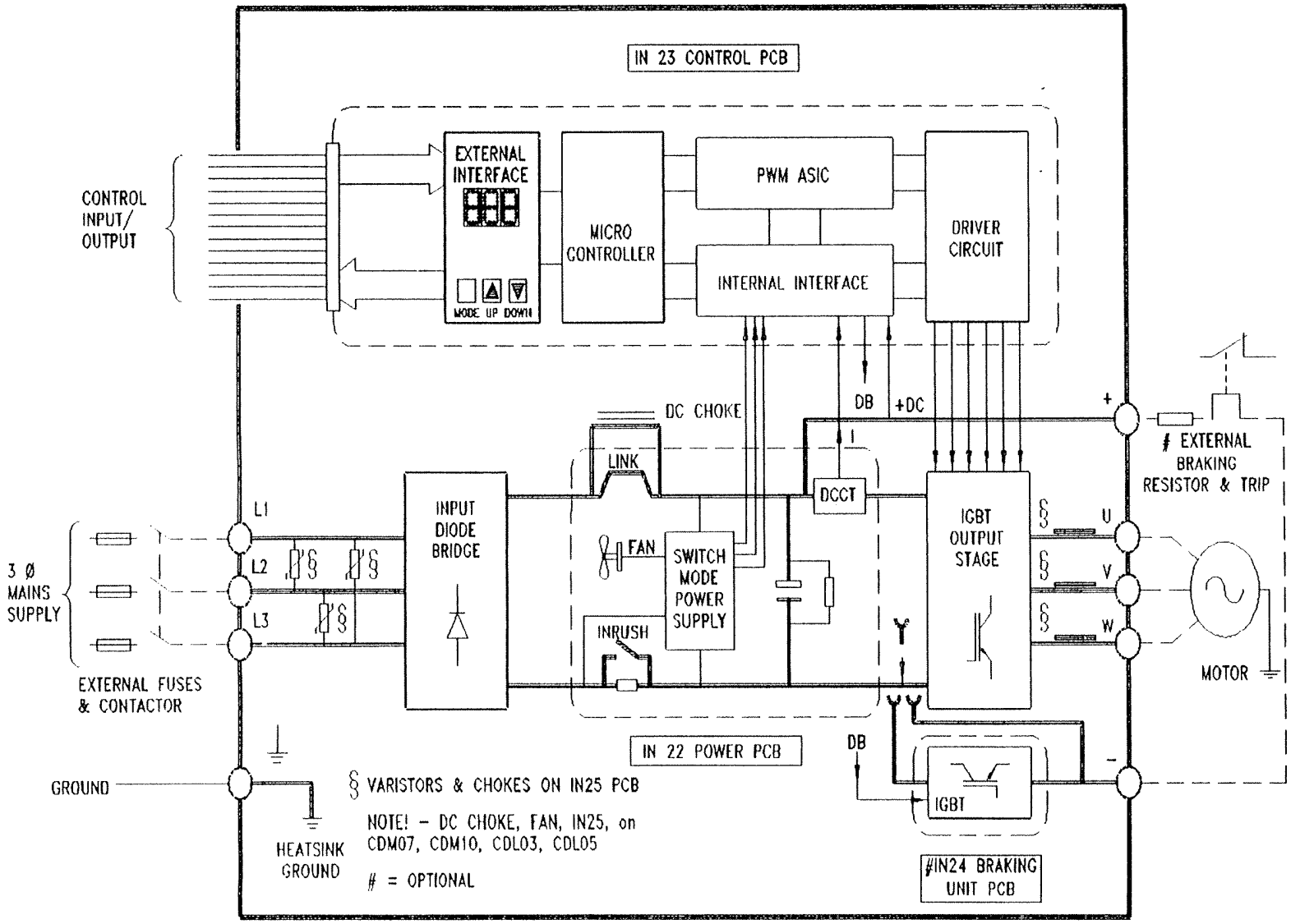
IN22 Power Board: contains inrush resistor and contactor, switchmode power supply and Bus filter capacitors.

IN23 Control Board: contains all low-level electronics.

Heat Sink Assembly: Input and output power devices are located here.

IN22 PC Board: The IN22 PC board handles the high voltage DC Bus power. This voltage (referred to as the Bus) is filtered by capacitors. To prevent high inrush currents through the diodes and the filter capacitors during power up, a resistor is in series with the filter capacitors. A bypass relay is in parallel with the resistor, and shorts it out after input AC power is applied. A switchmode power supply is located on this board supplying the power for the IN23 P.C. board and Bus current sensing is also incorporated on this board.

IN23 PC BOARD: All of the low level electronics are contained on this board. A terminal strip for control wiring and the LED display/3 button keypad for programming are also located on this board When the inverter is in operation, the display indicates output frequency or load. Also present on this board is the serial communications port, which may be connected for RS232C or RS485 operation.


IN 23 CONTROL PCB
CONTROL INPUT/ OUTPUT
EXTERNAL INTERFACE
MODE UP DOWN
MICRO CONTROLLER
PWM ASIC
INTERNAL INTERFACE
DRIVER CIRCUIT
DB
+DC
DC CHOKE
LINK
I
DCCT
FAN
SWITCH MODE POWER SUPPLY
INRUSH
INPUT DIODE BRIDGE
IGBT OUTPUT STAGE
U
V
W
+
-
EXTERNAL BRAKING RESISTOR & TRIP
MOTOR
L1
L2
L3
3 Ø MAINS SUPPLY
EXTERNAL FUSES & CONTACTOR
GROUND
HEATSINK GROUND
IN 22 POWER PCB
DB
IGBT
#IN24 BRAKING UNIT PCB
§ VARISTORS & CHOKES ON IN25 PCB
NOTE! - DC CHOKE, FAN, IN25, on CDM07, CDM10, CDL03, CDL05
= OPTIONAL

Speed Command:

A 0-10VDC, 4-20mA, 20 to 4mA, or 0 to 20mA signal may be selected as the speed command or speed may be controlled from the keypad.

Remote Indication:

Analog signals proportional to output frequency and load are brought out to terminals, allowing remote indication of output frequency and load.

Reversing:

Electronic reversing is included as a standard feature. To select direction, a switch or relay contact can be connected to the inverter to control motor direction.

Current Limit:

The inverter has an inner current loop with foldback current limiting which provides precise control of motor current and true "torque limiting". When the drive is in current limit, the decimal point on the LED will flash.

Encoder Feedback:

With an encoder mounted on the motor, the encoder feedback mode may be selected for improved speed regulation.

Torque Control:

A torque control mode may be selected, which converts the inverter to current control. This enables the output current to be controlled by a 10k ohm potentiometer or an external 0 to 10VDC signal.

4.0 INSTALLATION

4.1 SAFETY PRECAUTIONS

DANGER!

DANGEROUS HIGH VOLTAGES ARE PRESENT IN THIS EQUIPMENT.

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY RESULT IF PROPER SAFETY PROCEDURES ARE NOT FOLLOWED!

1) This equipment must be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of both electrical and mechanical equipment involved.

2) Circuit breakers or disconnects feeding this equipment must be locked open before wiring or servicing. If no lockout device exists, remove fuses and tag box to prevent unauthorized personnel from reapplying power.

3) To insure safety, all equipment, motors, controllers etc. must be properly grounded.

4) The National Electrical Code requires that an approved circuit disconnecting device be installed in incoming power lines ahead of this equipment, mounted in a location readily accessible to personnel installing or working on this equipment.

5) The user is responsible for understanding and conforming with the National Electrical Code and other applicable local codes which govern installation of this equipment and associated motor, operator's controls, transformers, etc.

INSTALLATION

WARNING!

1) Do not connect any external circuits other than as shown on the interconnection diagram supplied with the equipment. If your installation requires the use of accessory equipment other than as shown, consult SECO for proper interconnection instructions.

2) Do not allow wires to ground on chassis when making connections to the terminal strip. Remove only enough insulation to make a firm connection and make certain that loose strands do not short between terminals or the chassis.

3) This equipment is designed to operate from 230VAC (CDL series) or 380 to 460VAC (CDM series) three phase power. If the correct voltage is not available for the unit, an appropriately sized transformer must be installed.

4) Be certain to check that the motor is connected for the correct voltage (230VAC for CDL, 380, 415, or 460VAC for CDM).

5) **DO NOT MEGGER OR HI-POT** this equipment without first consulting SECO.

INSTALLATION

CAUTION!

EQUIPMENT MALFUNCTION MAY BE CAUSED BY OTHER PLANT EQUIPMENT OPERATING IN THE VICINITY OF THIS EQUIPMENT!

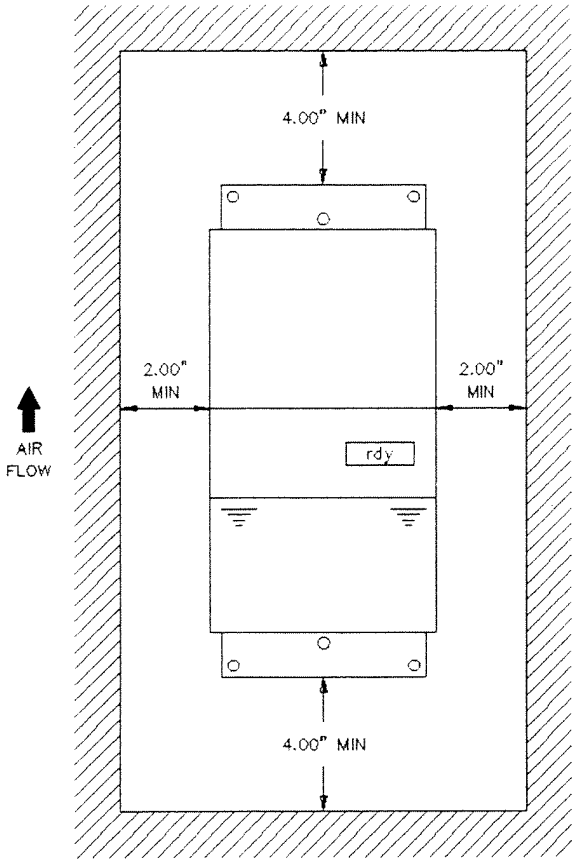
1) The use of Power Factor Correction Capacitors on this equipment may cause erratic operation and/or nuisance tripping. If Power Factor Correction Capacitors must be used, consult SECO for proper application.

2) Erratic operation and/or nuisance tripping may be caused by power line disturbances from welders or other high power high frequency equipment, or by the switching of highly inductive or capacitive devices such as brake coils or Power Factor Correction Capacitors. In this case, operation may be improved by installing isolation transformers or powering equipment from a different source.

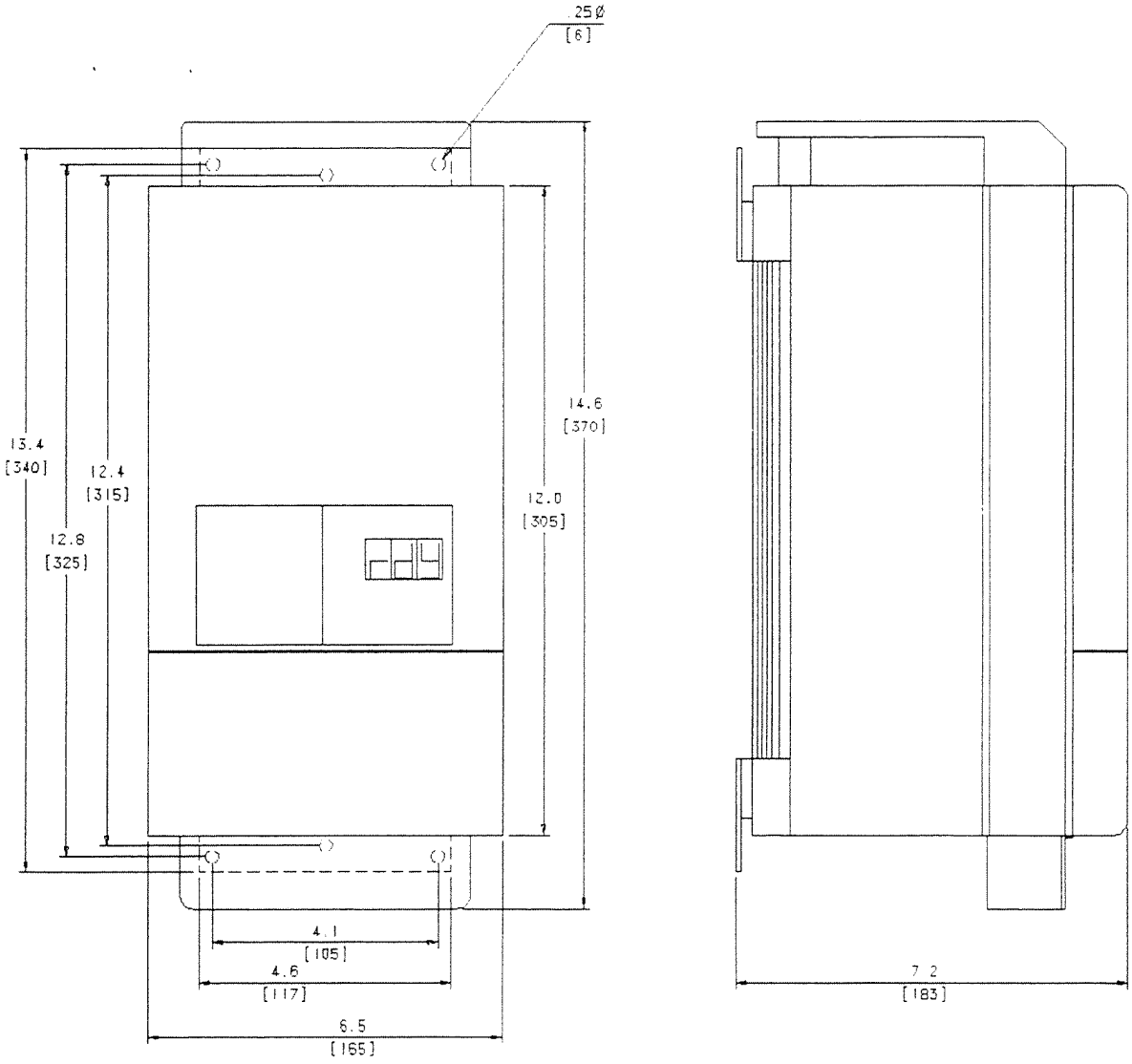
INSTALLATION

4.2 MOUNTING

FREE AIR SPACE REQUIRED FOR INVERTERS

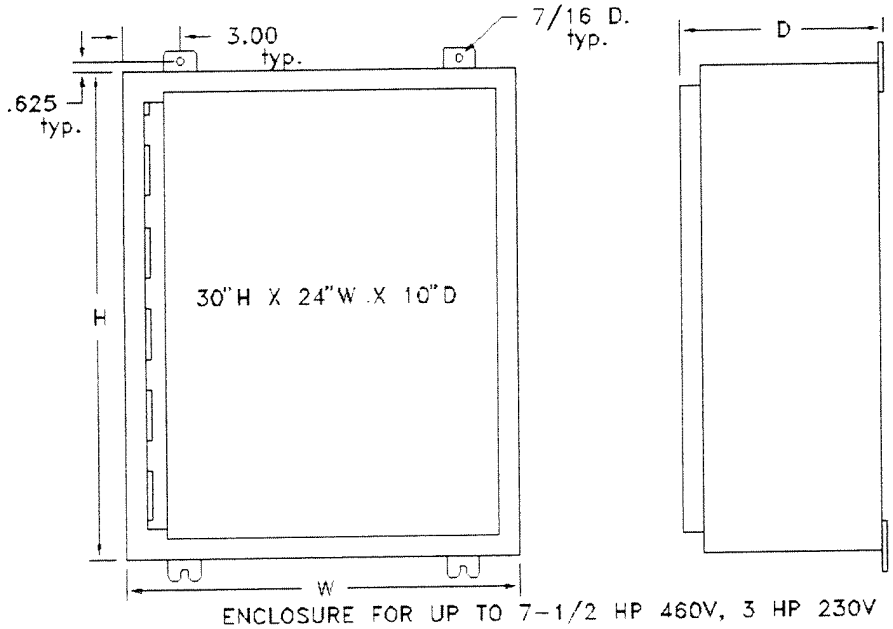


NOTES:
1) Mount the inverter vertically.
2) Maximum ambient temperature is 40°C for enclosed inverters and 50°C for open or chassis inverters.

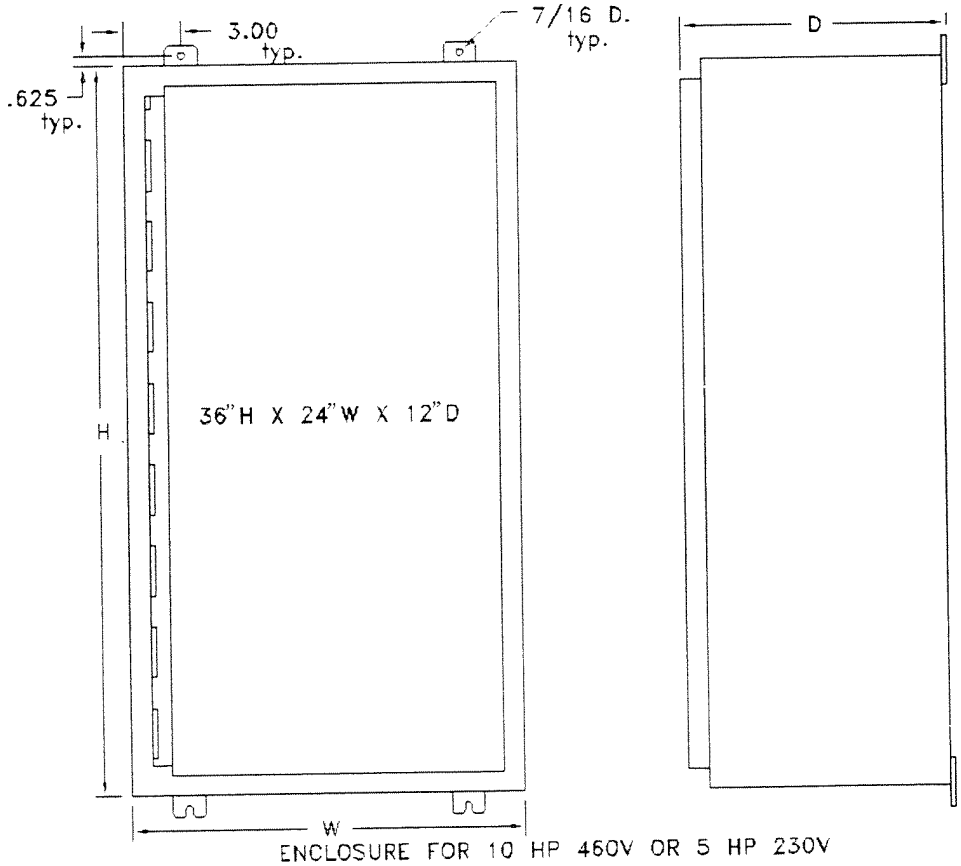


CHASSIS AND NEMA 1 MOUNTING DIMENSIONS

NEMA 4/12 ENCLOSURES



ENCLOSURE FOR UP TO 7-1/2 HP 460V, 3 HP 230V



ENCLOSURE FOR 10 HP 460V OR 5 HP 230V

4.3 ELECTRICAL SYSTEM CONSIDERATIONS

OUTPUT (MOTOR) CONTACTORS

If contactors are installed between the drive's output and the motors, they must be operated only when the drive is stopped.

SMALLER THAN RATED MOTOR

A single motor of HP rating less than the drive HP may be operated by the drive if the motor HP is not less than 25% of the drive HP, i.e., a motor rated at 1/2 HP may be operated by a 2 HP drive.

POWER FACTOR CORRECTING CAPACITORS

Power factor correcting capacitors must not be connected to the drive output. If they are already connected at the motor terminals, they must be disconnected.

AC POWER LINE CONTACTOR STARTING

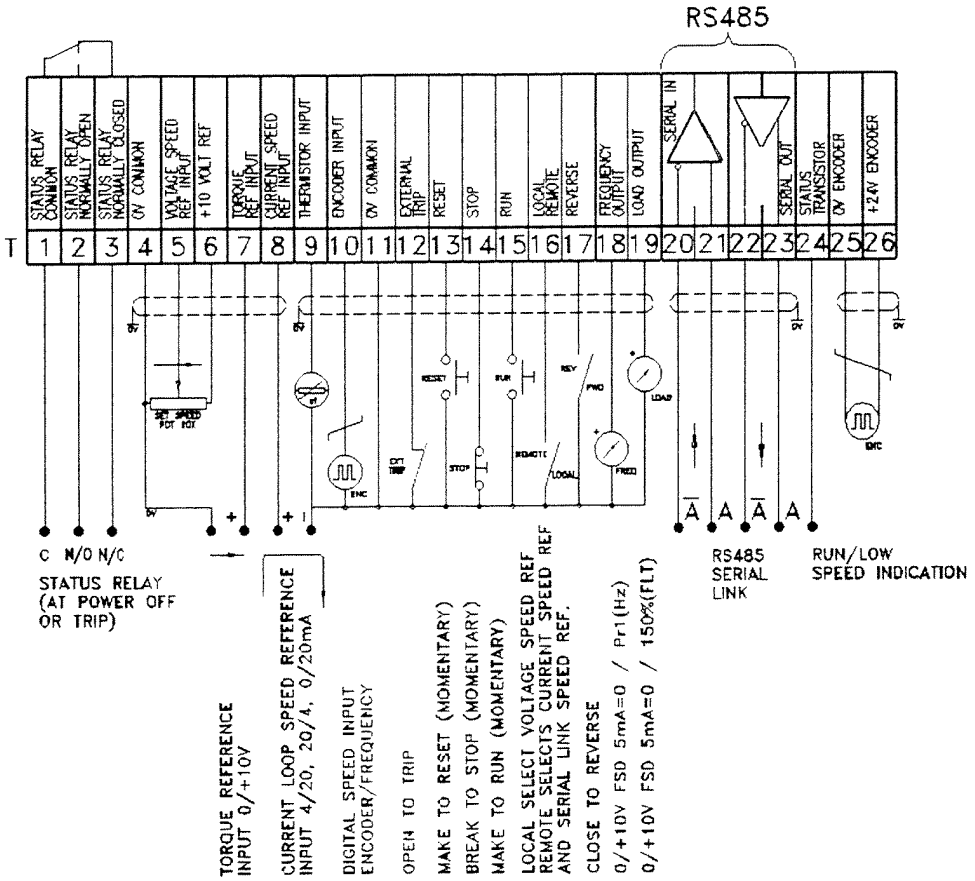
The drive may be started and stopped by an AC power line contactor at the drive's power line input terminals. A maintained run contact must then replace the momentary start contacts of the front panel Start/Stop Switch. Contact Seco for assistance.

OVERLOAD RELAYS

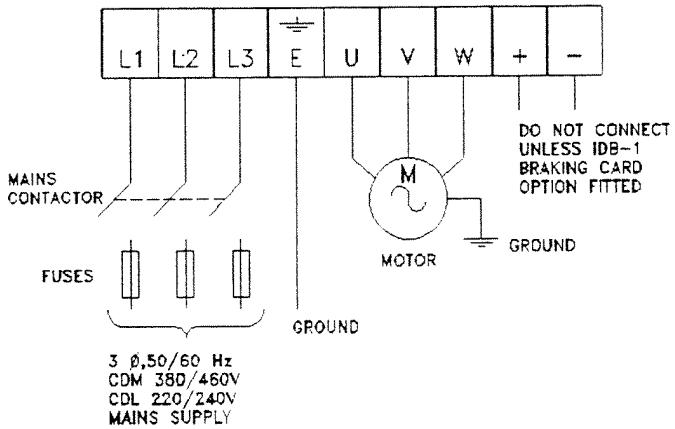
Overload relay coils or heaters may be connected between the motor (or motors) and the drive output. The overload relay contacts (normally closed) must be connected in the drive stop control-circuit (if a contactor is used).

SYNCHRONOUS RELUCTANCE MOTORS

Special considerations must be observed when the drive is to power a synchronous reluctance type motor. These motors have full load power factors in the range of 50 to 70% which is less than the drive's rated range of 80 to 95%. When selecting a drive for these motors, increase the drive HP rating one size (i.e., use a 2 HP drive with a 1 HP synchronous reluctance motor). These motors will not operate satisfactorily above a maximum frequency of 60 Hz.



CD CONTROL CIRCUIT INTERCONNECTION



NOTE!

1 FUSES MUST BE FITTED (OR MCB). FOR VALUES SEE SECTION 4.11

2 REMOVE WARNING LABEL FROM L1/L2/L3 TERMINALS BEFORE CONNECTION.

3 MOTOR THERMISTOR SHOULD BE CONNECTED TO T9 & T11. IF NOT FITTED THEN FIT THERMAL OVERLOAD RELAY BETWEEN U,V,W & MOTOR WIRE TRIP CONTACT TO EXT TRIP, T11 & T12.

CD POWER CIRCUIT INTERCONNECTION

4.4 RECEIVING AND UNPACKING

This equipment is carefully packaged to protect it from damage caused by normal handling during shipment. However, extreme shocks or loads caused by dropping, mishandling or stacking may cause damage to the inverter. Unpack the equipment as soon as it is received and carefully inspect it for possible damage.

If shipping damage is found, notify the carrier and SECO immediately. Since equipment is shipped by SECO F.O.B. shipping point, ownership transfers when the equipment leaves SECO. Therefore, all shipping damage claims must be filed by the consignee directly with the shipping carrier. SECO will assist with information necessary to file the claim.

Carefully unpack the equipment and remove all packing materials. Note that on some inverters, mounting brackets are taped to the packing material. Remove these brackets before discarding the packing material. Inspect heatsinks and any moving parts for packing materials which may interfere with movement or free air circulation.

4.5 LOCATION

Select a location for the inverter in accordance with the following considerations:

1) The inverter is designed for mounting upright on a vertical surface to promote air flow through the heatsinks by natural (or forced) convection.

2) Do not mount the inverter on wood or other combustible surfaces. "Hot Spot" temperature of the inverter back panel may exceed 100°C (212°F) under normal operating conditions.

3) To insure proper cooling, the inverter requires the free circulation of clean, dry air over the heatsinks. The maximum ambient air temperature for chassis mounted units is 50°C (122°F) and 40°C for Nema 1 and Nema 12 enclosed units. Do not locate the inverter over, on, or near a heat source.

4) The inverter must not be mounted where it will experience excessive shock or vibration.

5) Select a dry location where the inverter will not be subjected to dripping or splashing liquids.

6) When mounting the inverter, take extreme care to prevent metal chips from the drilling of conduit holes or mounting holes from entering the inverter. Either cover the inverter or remove it from the enclosure before drilling. Also, remove all metal chips from the inside of the enclosure by using a brush or a vacuum cleaner.

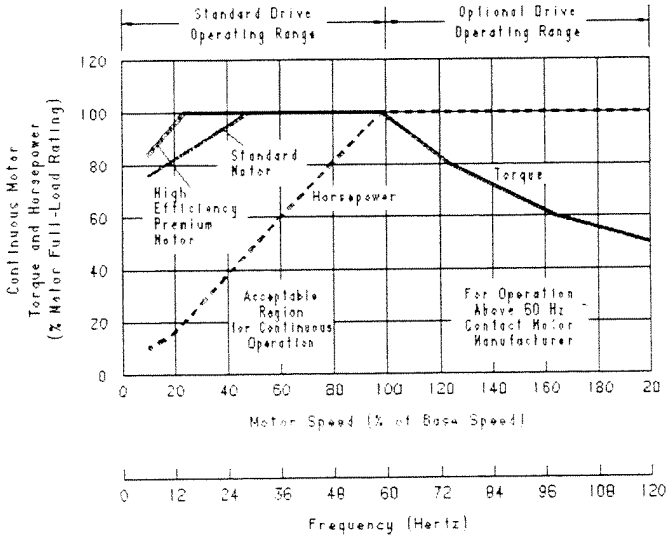
4.6 MOTOR RATING

It is important to remember that standard AC induction motors were originally designed to operate at full speed. Their inherent self-cooling capability does not allow continuous operation at reduced speeds unless the torque rating is reduced.

Also, although the inverter produces a near-sinusoidal waveform, motor losses are somewhat increased when operated from an inverter. This produces additional heat in the motor.

For absolute motor protection at low speeds, an internal motor thermistor is suggested or an internal motor thermal switch.

If using a motor of next larger size (HP) then the drive HP rating, derate the drive by 10%. This must be done because of the lower power factor of the oversize motor when operated below its full load rating.



TYPICAL MOTOR DERATING CHARACTERISTICS

4.7 INVERTER RATING

The ratings listed in the General Specifications are for inverter operation with the switching frequency (b14) set for 2.9kHz and assume up to a 50°C ambient for chassis units and 40°C ambient for enclosed units.

Higher switching frequencies of 5.9kHz, 8.8kHz or 11.7kHz may be selected. Higher switching frequencies are usually selected to decrease the audible noise and/or to make it less annoying. However, due to higher internal losses in the inverter at higher switching frequencies, the inverter must be de-rated. The de-rating curves at the end of this manual must be used to find the inverter rating at these other switching frequencies.

4.8 ISOLATION TRANSFORMERS

While the standard inverter normally does not need to be used with an isolation transformer, in some applications one may be used, such as when the plant voltage must be stepped up or down. Proper transformer sizes can be found in the following chart:

230VAC

HP	TRANSFORMER KVA
1	3
2	6
3	6
5	7.5

460VAC

HP	TRANSFORMER KVA
1	3
2	6
3	6
5	7.5
7.5	11
10	15

4.9 OUTPUT INDUCTORS

When the motor is located a long distance from the inverter, nuisance tripping may be encountered. This can be due to the capacitance of the motor leads, which may cause a false ground fault. For applications where the motor is located a long distance away from the inverter and false ground fault tripping is occurring, adding output inductors in series with the motor leads will normally eliminate the problem. Select the proper inductor from the following chart:

INVERTER MODEL #	DISTANCE FROM MOTOR TO INVERTER	INDUCTOR REQUIRED
CDLC03, CDLE03, CDLC05, & CDLE05	>420ft	PTR5010-00
CDMC01 & CDME01	> 90ft	PTR5009-00
CDMC02 & CDME02	>150ft	PTR5009-00
CDMC03 & CDME03	>180ft	PTR5009-00
CDMC05 & CDME05	>240ft	PTR5009-00
CDMC07 & CDME07 CDMC10 & CDME10	>420ft	PTR5010-00

Note: Use three inductors per inverter. Mount them as close to the inverter as possible. Inductors are supplied open style only, the user must make provisions for enclosure.

Inductor specification:
PTR5009-00: 2mh @ 10amps
PTR5010-00: 2mh @ 20amps

4.10 OVERLOAD PROTECTION

MOTOR CURRENT OVERLOAD PROTECTION DEVICE

The Canadian Electrical Code and National Electrical Code require that an overload protection device responsive to motor current be installed in each power wire of the motor or that a thermal protection device responsive to motor heat be built into or attached to the windings of the motor to provide motor branch-circuit protection. In the case of an AC motor operating at speeds below one half the motor's rated speed, the current responsive type of protection device (motor overload relay) will not provide adequate protection for a fan-cooled motor because of the reduction in fan cooling action due to reduced speed. Therefore, it is recommended that the thermal responsive style of protection device be used because it monitors the actual temperature of the motor windings in all instances.

In multiple motor applications, it is important to place an overload in each motor to adequately protect them.

The protective device can either be connected to open an AC contactor located in the incoming power wiring, or connected to the stop control circuitry.

WARNING

A contactor or switch connected between the drive and its motor must not be turned off or on while the drive and its motor are operating.

4.11 **WIRING**

Wire the inverter, motor, and operators controls per the interconnection diagrams in this manual for standard inverters, or by the interconnection diagram provided with the equipment if this is a modified inverter. Follow the guidelines below where applicable:

1) Size power wiring per N.E.C. or applicable local codes. Long wire runs may require a larger wire size and output inductors.

2) The user is advised to fuse the AC input to the NEMA 1 & chassis inverter using the following chart as a guide for proper fuse size:

INVERTER MODEL #	FUSE TYPE
CDLC03, CDLE03	BUSSMAN KTK-20 or equal
CDLC05, CDLE05	BUSSMAN KTK-20 or equal
CDMC01, CDME01	BUSSMAN KTK-15 or equal
CDMC02, CDME02	BUSSMAN KTK-15 or equal
CDMC03, CDME03	BUSSMAN KTK-15 or equal
CDMC05, CDME05	BUSSMAN KTK-15 or equal
CDMC07, CDME07	BUSSMAN KTK-20 or equal
CDMC10, CDME10	BUSSMAN KTK-20 or equal

3) Use shielded, twisted-pair wiring for all low level signal leads such as the Start and Stop push buttons, speed potentiometer, speed meter, etc. per the interconnection diagram. To minimize the possibility of noise pickup, these signals must be run in a separate conduit from power and AC control wiring. Also connect the shields at the inverter end only to circuit common (OV)

4) Be certain to connect the motor for the correct voltage for the application.

5) Be certain to properly ground the motor frame. Also ground the inverter by connecting the ground terminal to ground.

6) After completion of wiring, check all connections for integrity and for shorts to other wiring or to earth ground before applying power.

5.0 DESCRIPTION OF PARAMETERS

5.1 PARAMETER TABLE

PARAMETER	PARAMETER NUMBER	INFORMATION DISPLAYED	FACTORY SETTING
Minimum Frequency	Pr0	Hz	0.0
Maximum Frequency	Pr1	Hz	60.0
Acceleration Time	Pr2	0.2 to 600 Seconds	5.0
Deceleration Time	Pr3	0.2 to 600 Seconds	10.0
Current Limit	Pr4	<P15> to 150% of full load	150
Rated Current	Pr5	Up to 100% of full load	100
Boost V Min	Pr6	Up to 25.5% of max volts	5.1
Slip Compensation	Pr7	Up to 20Hz at full load	0.0
DC Braking	Pr8	40 to 150% of full load	150
Serial Address	Pr9	00 to 99	11
Last Fault	PrA	Fault code of last fault	
Security Code	PrB	0 or 100 to 255	0

NOTE: INVERTER MUST BE IN "rdY" TO ALLOW ACCESS TO "b" PARAMETERS

Speed/Torque	b0	0 = Torque, 1 = Speed (Terminal Control Only)	1
Auto/Manual Start	b1	0 = Auto, 1 = Manual	1
DC or Dynamic Braking	b2	0 = Dynamic, 1 = DC Braking	0
Auto/Fixed Boost	b3	0 = Auto, 1 = Fixed Boost	0
Output Switch	b4	0 = Low Speed, 1 = Run	1
Open Loop/Encoder Feedback	b5	0 = Encoder, 1 = Open Loop	1
Master/Slave	b6	0 = Master, 1 = Slave	0
Ramp/Coast To Stop	b7	0 = Ramp, 1 = Coast to stop	0
Frequency/Load Indication	b8	0 = Frequency, 1 = Load (Terminal Control Only)	0
Terminal/Keypad	b9	0 = Keypad, 1 = Terminal	0
Even/Odd Parity	b10	0 = Even, 1 = Odd	0
Current Input	b11	4 -20, 20-4, or 0-20ma or Fx	4-20
I/O Baud Rate	b12	4800 or 9600	4800
Set Defaults	b13	0 = Release, 1 = Set defaults	0
Switching Frequency	b14	2.9, 5.9, 8.8, or 11.7KHz	2.9
Max Volt Frequency	b14	120 or 240Hz	120
Max. Voltage Freq	PrC	ULF (<b14>) to ULF/16 Hz	60

5.2 READING AND SETTING PARAMETERS

Built into each inverter is an LED display with a 3 button keypad. This device has several functions:

- Displays either output frequency or load
- Can display all parameters
- Can reprogram all parameters
- Annunciates 10 different fault codes
- Indicates Current Limit by flashing

There are 2 types of parameters. The first type are "Pr" parameters, which allow setting Minimum Frequency, Maximum Frequency, etc..., as indicated in the above chart. These parameters may be monitored and changed at any time.

The second parameter type is a "b" parameter. This type allows setting of various functions such as Speed/Torque regulation, Auto/Manual Start, etc..., as indicated in the above chart. These parameters can only be monitored and changed when the inverter is stopped. This is indicated by the LED display showing "rdY".

As received from the factory, all parameters are set to standard values (called defaults). These defaults are shown in the preceding parameter table. They normally are sufficient for most applications and do not require resetting. In case the user wants to change a setting, the procedure is as follows:

1) Apply power to the inverter.

2) Observe the LED display shows "rdY" and zero alternately. Press the Mode button momentarily and observe the green "Mode" LED above the Mode button lights.

3) The LED display will now alternately indicate parameter numbers and their values. Press the UP or Down buttons to scroll to the desired parameter.

4) When the desired parameter is displayed, press the Mode button. Now the LED display will hold the value of that parameter. It may be changed by pressing the Up or Down buttons. The LED display will alternately display the parameter number and the setting when the mode button is pressed momentarily again.

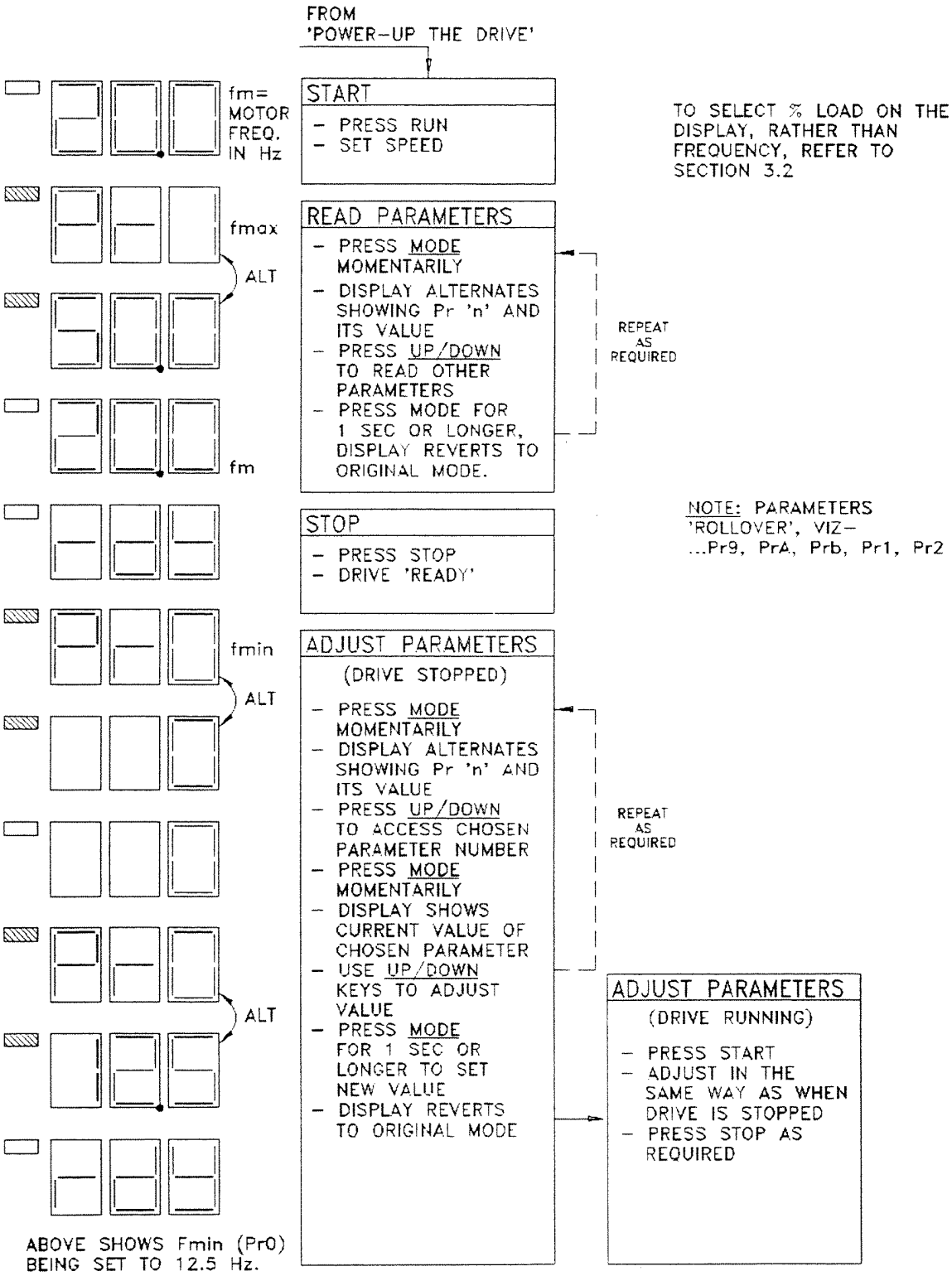
5) Now press the Mode button for one second or more. This stores the new setting and the display will revert to rdy or output frequency.

5.3 SECURITY

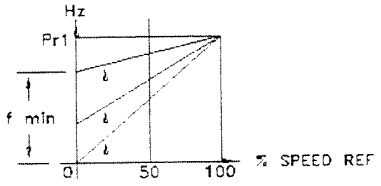
As received from the factory, the user has full access to all of the parameters. The user may, however, wish to restrict access to the inverter parameters. This may be done by programming in a security code. This code is any number from 100 to 255 that the user chooses. To insert a security code, apply power to the inverter. Press (*) the Mode button, then the Up button until the LED display shows "Prb". Now press (*) the Mode button again, and use the Up button to select the desired security code. When it is displayed, press the Mode button for one second or longer to store the code. Now power down the inverter, then re-apply power. This clears the security code from "Prb", requiring the code to be re-entered to change any parameters.

In an emergency situation where the security code has been forgotten or is not known, consult the factory for instructions on how to change parameters.

* "Pressing Momentarily" means for less than one second.


FROM
'POWER-UP THE DRIVE'
START
- PRESS RUN
- SET SPEED
TO SELECT % LOAD ON THE DISPLAY, RATHER THAN FREQUENCY, REFER TO SECTION 3.2
fm= MOTOR FREQ. IN Hz
fmax
ALT
fm
READ PARAMETERS
- PRESS MODE MOMENTARILY
- DISPLAY ALTERNATES SHOWING Pr 'n' AND ITS VALUE
- PRESS UP/DOWN TO READ OTHER PARAMETERS
- PRESS MODE FOR 1 SEC OR LONGER, DISPLAY REVERTS TO ORIGINAL MODE.
REPEAT AS REQUIRED
NOTE: PARAMETERS 'ROLLOVER', VIZ- ...Pr9, PrA, Prb, Pr1, Pr2
STOP
- PRESS STOP
- DRIVE 'READY'
fmin
ALT
ADJUST PARAMETERS
(DRIVE STOPPED)
- PRESS MODE MOMENTARILY
- DISPLAY ALTERNATES SHOWING Pr 'n' AND ITS VALUE
- PRESS UP/DOWN TO ACCESS CHOSEN PARAMETER NUMBER
- PRESS MODE MOMENTARILY
- DISPLAY SHOWS CURRENT VALUE OF CHOSEN PARAMETER
- USE UP/DOWN KEYS TO ADJUST VALUE
- PRESS MODE FOR 1 SEC OR LONGER TO SET NEW VALUE
- DISPLAY REVERTS TO ORIGINAL MODE
REPEAT AS REQUIRED
ALT
ADJUST PARAMETERS
(DRIVE RUNNING)
- PRESS START
- ADJUST IN THE SAME WAY AS WHEN DRIVE IS STOPPED
- PRESS STOP AS REQUIRED
ABOVE SHOWS Fmin (Pr0) BEING SET TO 12.5 Hz.

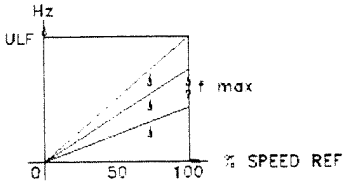
PARAMETER FUNCTIONS	Pr0 MINIMUM FREQUENCY



f min = <Pr0>

0 ≤ f min ≤ f max

PARAMETER FUNCTIONS	Pr1 MAXIMUM FREQUENCY



f max = <Pr1>

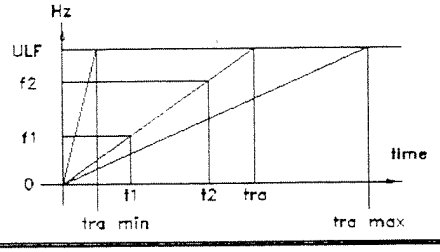
ULF ≥ f max ≥ f min ≥ 0

PARAMETER FUNCTIONS	Pr2 ACCELERATION TIME

tra min = 0.2 seconds
tra max = 600 seconds

TIME TAKEN TO ACCELERATE FROM

f1 TO f2 = t12
tra = <Pr2>
$t12 = \frac{(f1 - f2)}{ULF} \times tra$

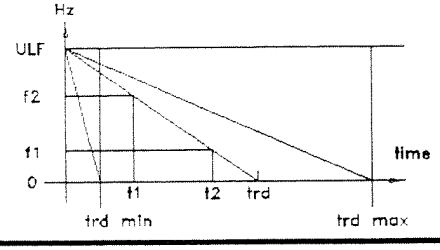


PARAMETER FUNCTIONS	Pr3 DECELERATION TIME

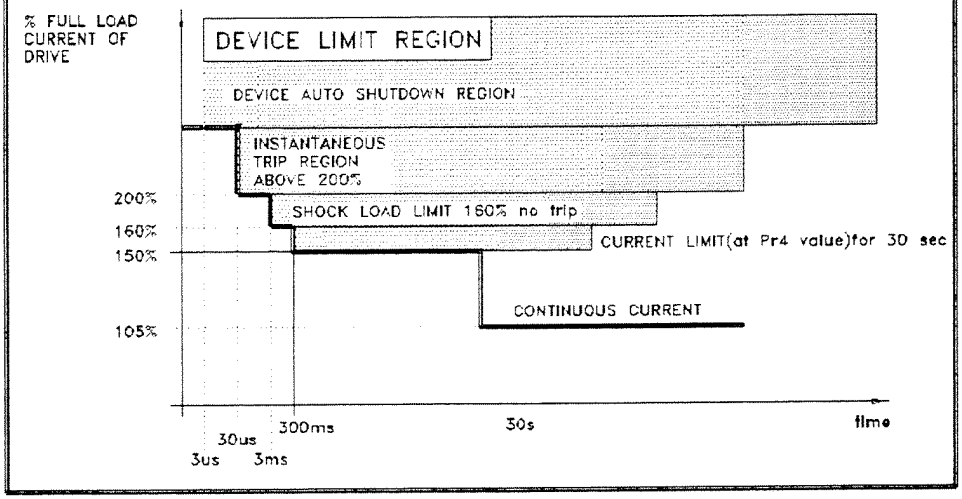
trd min = 0.2 seconds
trd max = 600 seconds

TIME TAKEN TO DECELERATE FROM

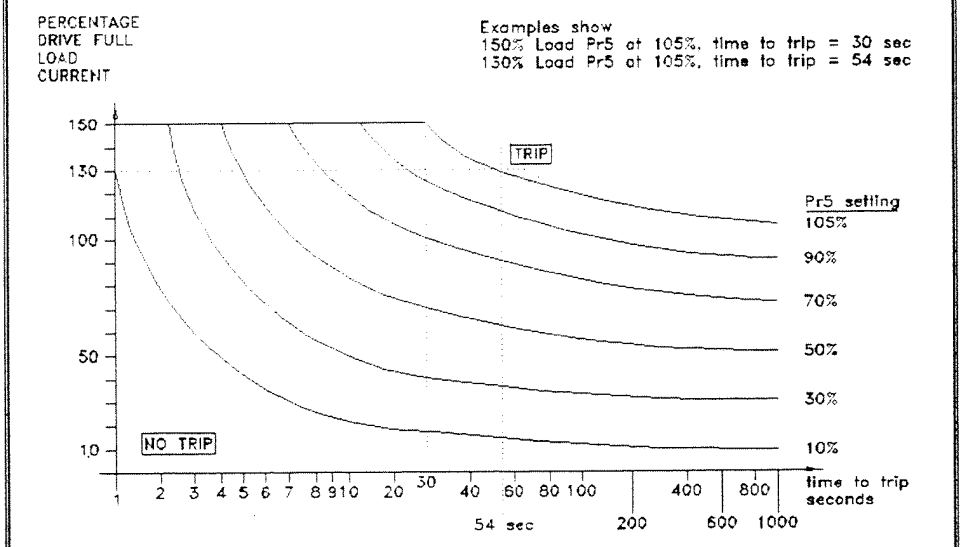
f1 TO f2 = t12
trd = <Pr3>
$t12 = \frac{(f1 - f2)}{ULF} \times trd$



OVER CURRENT PROTECTION

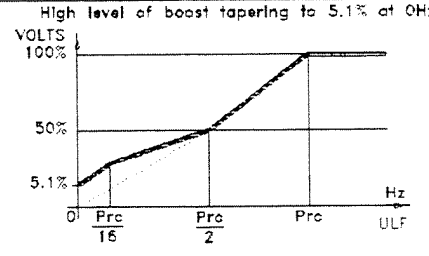


IxT CHARACTERISTICS



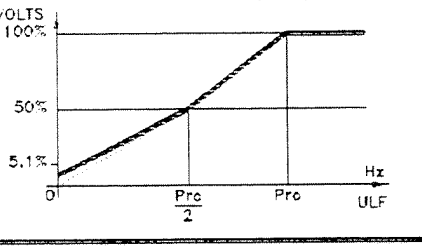
PARAMETER FUNCTIONS

High level of boost tapering to 5.1% at 0Hz

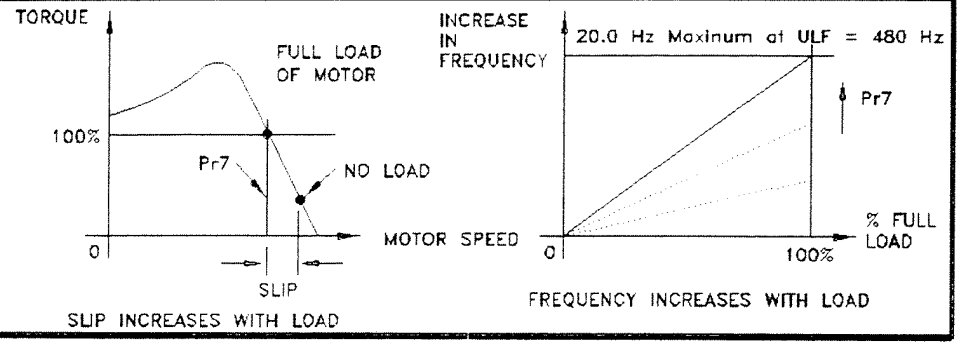


Pr6 VOLTAGE BOOST

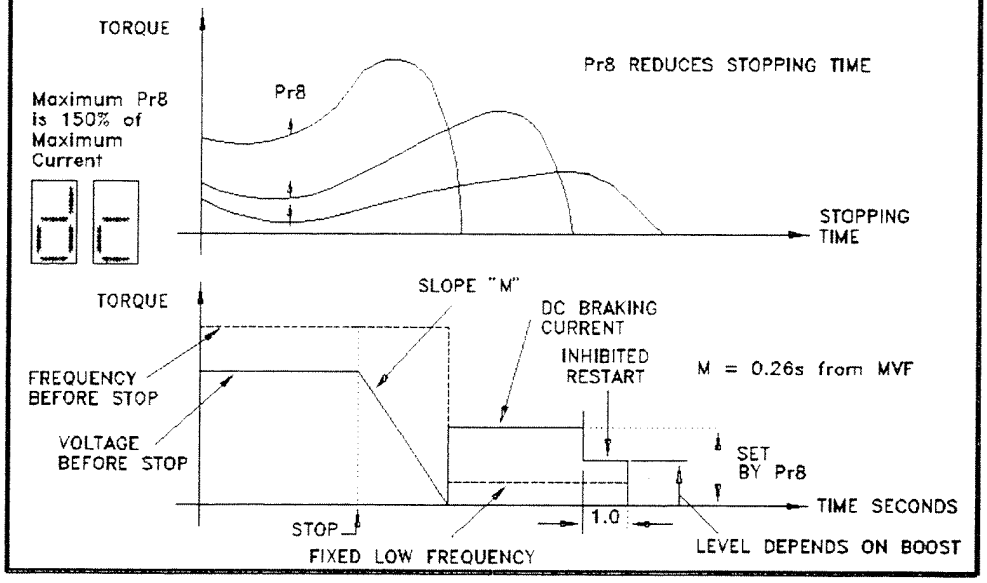
Low level of boost, no tapering to 0Hz



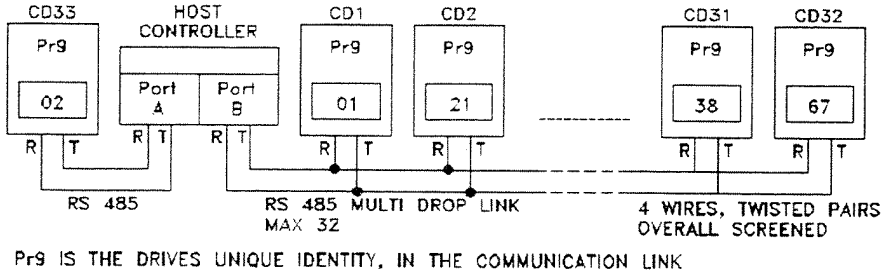
PARAMETER FUNCTIONS | Pr7 SLIP COMPENSATION



PARAMETER FUNCTIONS | Pr8 DC BRAKING LEVEL



PARAMETER FUNCTIONS | Pr9 SERIAL INTERFACE ADDRESS



Pr9 IS THE DRIVES UNIQUE IDENTITY, IN THE COMMUNICATION LINK

5.4 TERMINAL/KEYPAD CONTROL

Inverters are shipped in the KEYPAD mode. This means that the LED display/3 button keypad functions as a display programming device and provides speed control.

The inverter will operate as follows: To start, press the start button. The inverter will now run at the last speed selected. To change speed, press the "UP" or "DOWN" buttons. For changing direction, press the "REVERSE' button and the inverter will reverse direction. The "UP" and "DOWN" buttons may now be used to set speed.

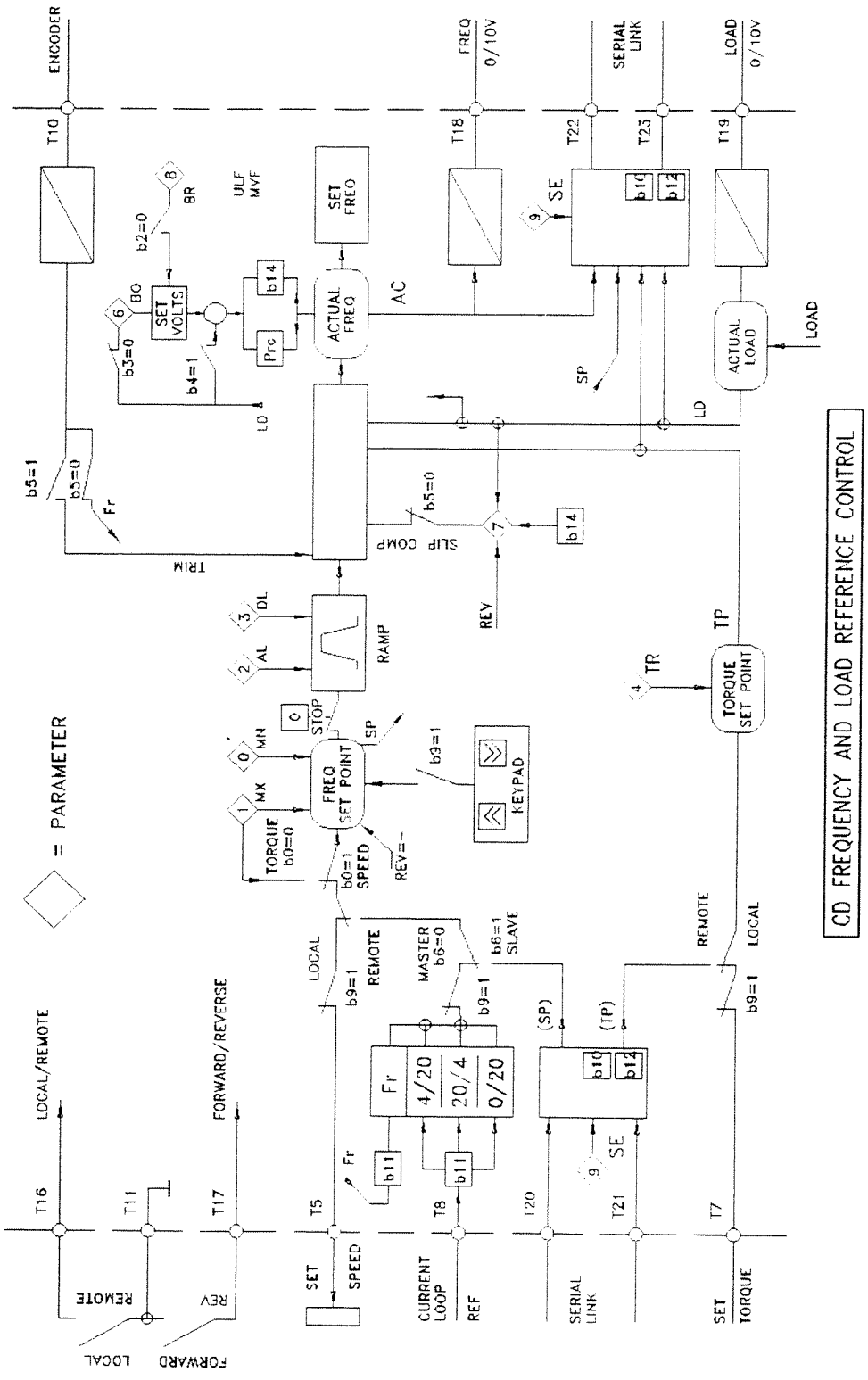
If the inverter trips while running, press either the "UP" or "DOWN" button to reset.

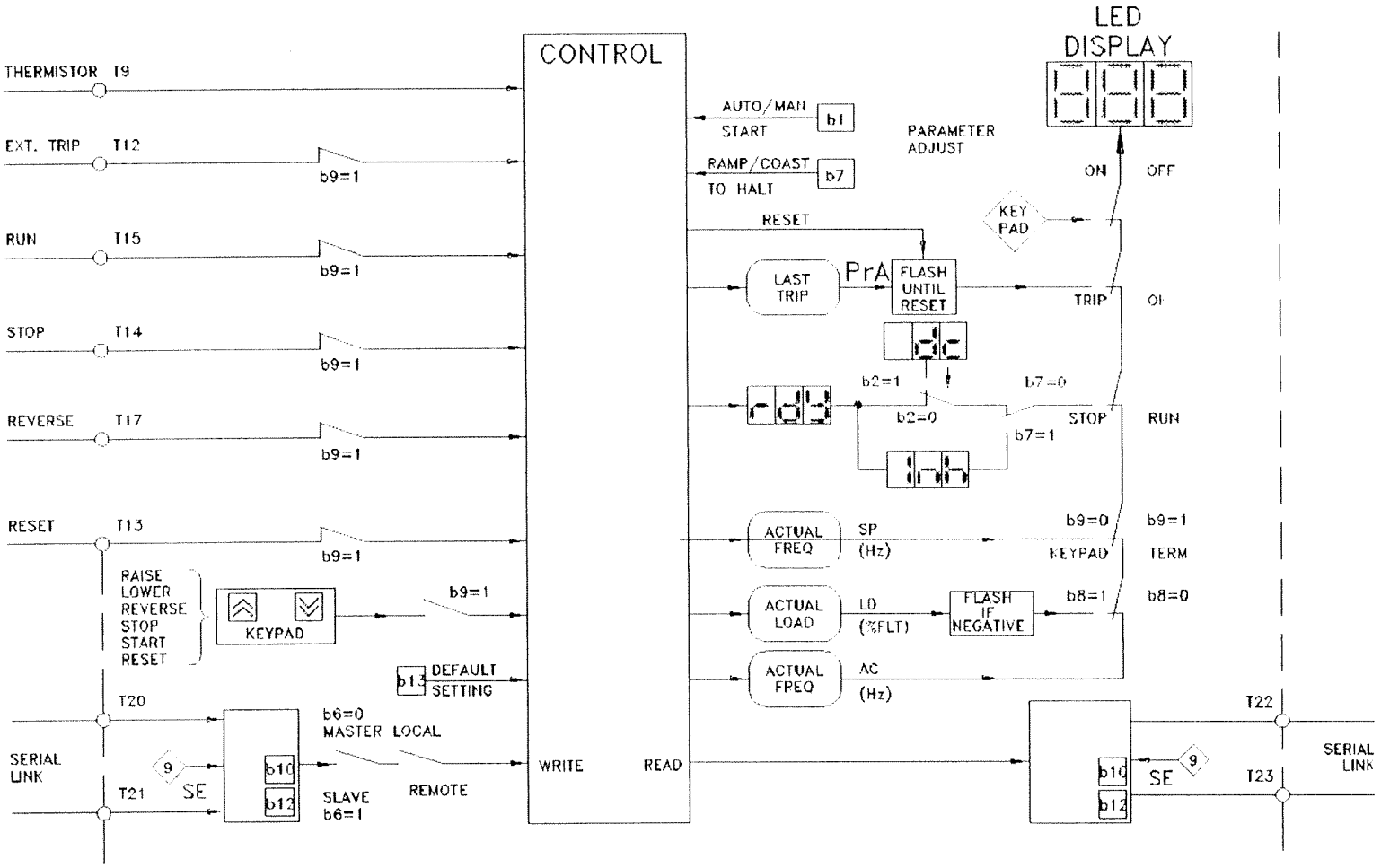
To stop, press the stop button. The inverter will shut itself off (the LED display will show "rdY").

To put the inverter into the TERMINAL mode, select "b9" and set it to 0 (inverter must be displaying "rdY" to gain access to "b9"). Speed will be controlled by speed pot at remote operators station.

5.5 SPECIAL APPLICATIONS (PrC)

Parameter PrC sets the frequency at which the motor voltage reaches maximum. It is set at the factory for maximum motor voltage at 60Hz (PrC = 60). For applications that need maximum motor voltage to occur at a different frequency, reset PrC to the desired frequency at which maximum motor voltage is required (Example: If maximum motor voltage is to occur at 120Hz, set PrC to 120). PrC has a range of 7.5 to the ULF (b14 setting, either 120 or 240).


CD FREQUENCY AND LOAD REFERENCE CONTROL
= PARAMETER
ENCODER
FREQ 0/10V
SERIAL LINK
LOAD 0/10V
T10
T18
T22
T23
T19
SET FREQ
ACTUAL FREQ
AC
ULF MVF
SET VOLTS
BO
BR
b2=0
b3=0
b4=1
Prc
b14
LD
SE
SP
ACTUAL LOAD
LOAD
b5=1
b5=0
Fr
TRIM
SLIP COMP
REV
RAMP
DL
AL
STOP
FREQ SET POINT
MN
MX
TORQUE b0=0
b0=1 SPEED
REV=-
KEYPAD
b9=1
TR
TP
TORQUE SET POINT
LOCAL
REMOTE
MASTER b6=0
b6=1 SLAVE
4/20
20/4
0/20
b11
b10
b12
(SP)
(TP)
T16
T11
T17
T5
T8
T20
T21
T7
LOCAL/REMOTE
FORWARD/REVERSE
REMOTE
LOCAL
REV
FORWARD
SET
SPEED
CURRENT LOOP
REF
SERIAL LINK
SET
TORQUE

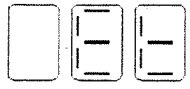


CD COMMAND AND DISPLAY CONTROL

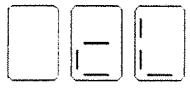
6.0 DIAGNOSTICS

The inverter includes complete diagnostic information in case of a fault. In addition, when a fault occurs, it is stored in parameter PrA (the stored fault is the original fault that caused the inverter to trip). In the event of a fault, the fault code is displayed on the 3 digit LED display (flashing). The display continues to indicate the fault until the inverter is reset or the inverter is powered down and the powered back up. After re-powering the inverter, the last fault can be read at parameter PrA. Note that the inverter will indicate "UU" when power is shut off (undervoltage trip).

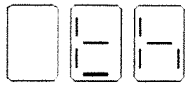
FAULT CODES



[_Et] = External trip (contact or jumper from terminal 12 to 11 is open).



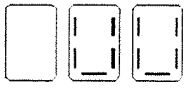
[_cL] = Current loop loss (if inverter is in the current follower mode).



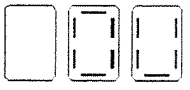
[_th] = Motor thermistor trip (if used).

[_It] = Inverse time overload trip (Ixt).

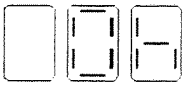
[_OI] = Overcurrent trip (instantaneous or ground fault).



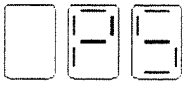
[_UU] = Undervoltage trip (low AC line voltage or inverter powering down).



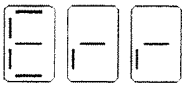
[_OU] = Overvoltage trip (high lines or too much regenerative energy).



[_Oh] = Overtemperature (heatsink temperature too high).



[_PS] = Internal power supply fault.



[Err] = Hardware error within the inverter.

7.0 START-UP PROCEDURE

7.1 SAFETY PRECAUTIONS

DANGER!

DANGEROUS HIGH VOLTAGES ARE PRESENT IN THIS EQUIPMENT.

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY RESULT IF PROPER SAFETY PROCEDURES ARE NOT FOLLOWED!

1) This equipment must be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of both electrical and mechanical equipment involved.

2) Dangerous high voltages may be present in this equipment even after power has been removed. Before attempting to service this equipment, connect a 1000VDC voltmeter across the Bus. Do not attempt to service any component until this voltage has completely discharged to zero. This may take several minutes. NEVER ATTEMPT TO SERVICE THE INVERTER IF THE LED DISPLAY IS LIT!

3) When making voltage checks or adjustments to the drive, keep one hand behind your back. Do not use your other hand to brace yourself against the controller, panel or enclosure. Personal injury could result if you accidentally touch a component at line voltage.

START-UP PROCEDURE

WARNING!

IMPROPER CONNECTION MAY RESULT IN DAMAGE TO THE EQUIPMENT!

1) Before applying power to this equipment, check that the motor windings are not shorted or grounded. Check control wiring for accidental grounds.

2) **DO NOT MEGGER OR HI-POT** this equipment without first consulting SECO.

CAUTION!

EQUIPMENT MALFUNCTION MAY BE CAUSED BY OTHER PLANT EQUIPMENT OPERATED IN THE VICINITY OF THIS EQUIPMENT!

1) Erratic operation and/or nuisance tripping may be caused by power line disturbances from welders or other high power high frequency equipment, or by the switching of highly inductive or capacitive devices such as brake coils or Power Factor Correction Capacitors. In this case, operation may be improved by installing isolation transformers or powering equipment from a different power source.

2) Erratic operation and/or nuisance tripping may be caused by radio transmitters operated in the vicinity of this equipment. Exercise caution when using portable transmitters while adjusting or troubleshooting this equipment.

START-UP PROCEDURE

IMPROPER ADJUSTMENT MAY CAUSE ERRATIC OPERATION AND/OR EQUIPMENT DAMAGE!

1) If the inverter is used to operate multiple motors, individual motor overload devices or motor overtemperature thermal switches (preferred) must be used for proper motor protection. Consult SECO for application assistance for multiple motor applications.

2) Rapid deceleration of high inertia loads should be avoided. Consult the adjustment section for procedure for setting the deceleration rate. If your application requires a faster deceleration rate, a Braking module may be added. Consult SECO.

7.2 START UP PROCEDURE (KEYPAD CONTROL)

1. Before turning on AC power, uncouple load from motor or be sure that the motor can rotate without damaging equipment or causing injury to personnel.

2. If start, stop, reverse, etc., will be controlled by external relay contacts be sure they are operating properly, before applying AC power.

3. Turn on AC power and measure voltage at terminals L1, L2, and L3. The voltage must be the same as the nameplate voltage rating. If it is not, turn off AC power immediately.

4. If voltage is correct, check that digital display alternates between "rdY" and 0.0 (set frequency).

5. Press MODE button momentarily and note that a "Pr" or "b" parameter and its set value are displayed.

6. Compare this value to the factory setting shown on page 24. Note any different values.

7. These inverters are factory set to be controlled by the cover mounted switches and speed control by UP and DOWN buttons when received and first AC powered.

8. Press "START" switch and note that "0.0" only is displayed. Press STOP switch and note that "rdY" and "0.0" alternate again.

9. Press "START" switch again. Then press "UP" button and motor should begin to rotate. Change speed by pressing UP or DOWN buttons.

10. Press "REVERSE" switch and note motor reversal. Press STOP switch.

11. Follow procedure on pages 24 and 25 to set parameters to desired values. Couple motor to load.

12. Start-up procedure is completed.

7.3 START-UP PROCEDURE (REMOTE CONTROL)

1) If possible, the inverter should first be started with the motor shaft uncoupled from the load. If not, be certain that the motor can turn without damaging equipment or causing personal injury.

2) If the inverter is following a speed reference signal from other equipment, temporarily disconnect the speed reference signal and connect a manual speed potentiometer per the interconnection diagram in this manual.

3) Turn the speed potentiometer to zero (full CCW).
Set parameter b9 to 1 following instructions in section 5.3.

4) If Start/Stop logic is controlled by relays from another source or by a programmable controller, check that they are functioning properly BEFORE applying power to the inverter.

5) Apply input power to the inverter and check that the proper voltage (198 to 264 for CDL, 342 to 506 for CD) is applied to terminals L1, L2, and L3. If the voltage measured does not fall within this range, DO NOT OPERATE THE INVERTER. IMMEDIATELY SHUT OFF THE POWER! THE CORRECT VOLTAGE LEVEL MUST BE PRESENT BEFORE ATTEMPTING TO OPERATE THE INVERTER!

6) With the proper input voltage applied, note that the 3 digit display indicates "rdY". Depress the "Start" button and note that the display now shows "0.0"

7) Depress the "Stop" button and note that the display reverts to "rdY". If "0.0" remains displayed, check the Start/Stop wiring for errors. Do not attempt to run the inverter until the stop circuit functions properly.

8) Gradually advance the speed potentiometer until the motor starts to turn. If it turns smoothly, advance the speed potentiometer to the desired setting. If rotation is not smooth, consult the troubleshooting section of this manual.

9) Depress the Stop button. The inverter will decelerate the motor at the rate set by parameter Pr3 (assuming the connected load inertia is not too great).

NOTE: If the inverter indicates an Overcurrent trip (OI displayed) during acceleration, depress the Stop button, and then the Reset button. A longer acceleration time may be required, so increase the Acceleration Time parameter (Pr2). If this does not solve the tripping, then the Boost parameter (Pr6) may need to be reduced.

If the inverter indicates an Overcurrent or Overvoltage trip (OI or OU displayed) during deceleration, depress the Stop button, and then the Reset button. A longer deceleration time may be required, so increase the Deceleration Time parameter (Pr3). If this does not solve the problem, the application may require the Braking module option. Consult factory.

8.0 TROUBLESHOOTING

8.1 SAFETY PRECAUTIONS

DANGER!

DANGEROUS HIGH VOLTAGES ARE PRESENT IN THIS EQUIPMENT! PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY RESULT IF PROPER SAFETY PROCEDURES ARE NOT FOLLOWED!

1) This equipment must be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of both electrical and mechanical equipment involved.

2) Circuit breakers or disconnects feeding this equipment must be locked open before wiring or servicing. If no lockout device exists, remove the fuses and tag the box to prevent unauthorized personnel from reapplying power.

3) Dangerous high voltages may be present in this equipment even after power has been removed. Before attempting to service this equipment, connect a 1000VDC voltmeter across the Bus. Do not attempt to service any components until this voltage has completely discharged to zero. This may take several minutes.

4) When using an oscilloscope or other AC line powered test equipment, an isolation transformer must be used to isolate test equipment ground from earth and the power line.

5) Exercise extreme caution when using oscilloscopes and other test equipment, as the instrument case may be at high potential with respect to ground. Set the instrument on an insulated surface only. Keep one hand behind your back while adjusting the equipment. Do not make instrument connections or touch the instrument case while power is applied to the drive or voltage is present across the Bus.

6) When making voltage checks or adjustments to the drive, keep one hand behind your back. Do not use your other hand to brace yourself against the controller, panel, or enclosure. Personal injury could result if you accidentally touch a component at line potential.

TROUBLESHOOTING

WARNING!

1) **DO NOT MEGGER OR HI-POT** this equipment without first consulting SECO.

CAUTION!

EQUIPMENT MALFUNCTION MAY BE CAUSED BY OTHER PLANT EQUIPMENT OPERATED IN THE VICINITY OF THIS EQUIPMENT!

1) The use of Power Factor Correction Capacitors on this equipment may cause erratic operation and/or nuisance tripping. If Power Factor Correction Capacitors must be used, consult SECO application.

2) Erratic operation and/or nuisance tripping may be caused by power line disturbances from welders or other high power high frequency equipment, or by the switching of highly inductive or capacitive devices such as brake coils or Power Factor Correction Capacitors. In this case, operation may be improved by installing isolation transformers or powering the equipment from a different power source.

3) Erratic operation and/or nuisance tripping may be caused by radio transmitters operated in the vicinity of this equipment. Exercise caution when using portable transmitters while adjusting or troubleshooting this equipment.

TROUBLESHOOTING

CAUTION!

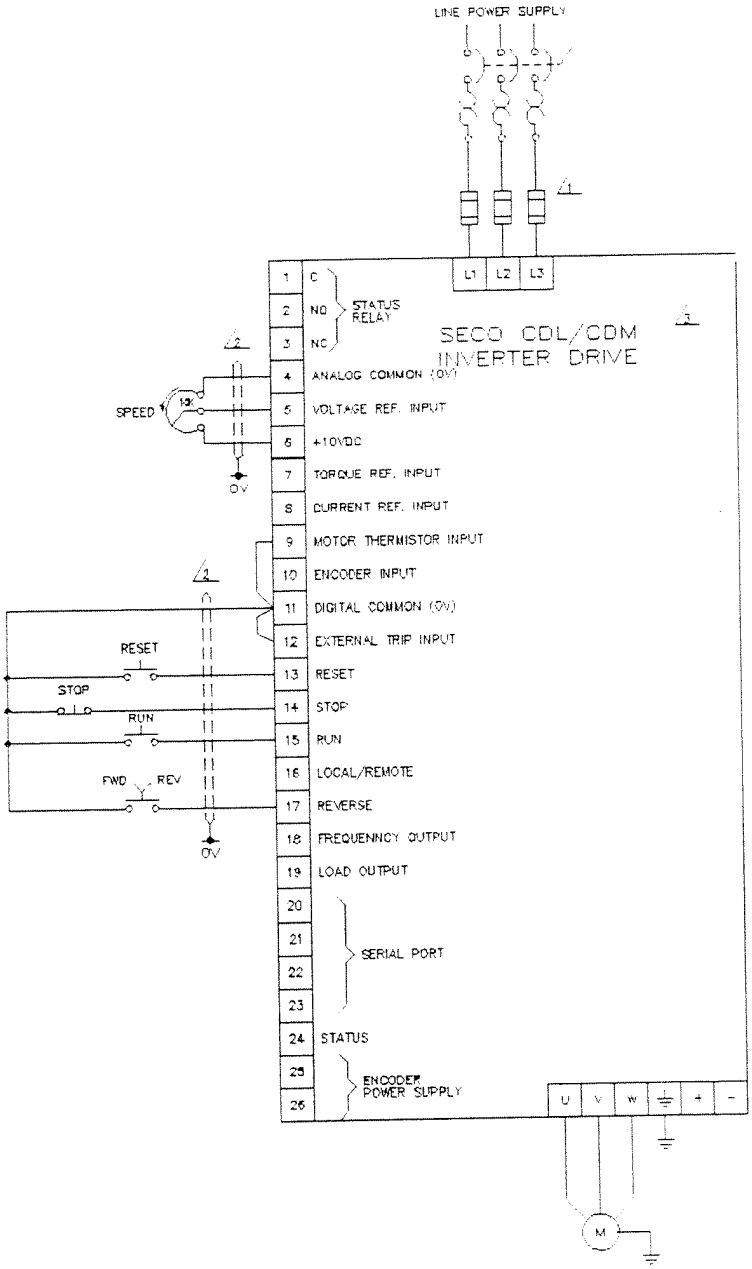
IMPROPER ADJUSTMENT MAY CAUSE ERRATIC OPERATION AND/OR EQUIPMENT DAMAGE!

1) If the inverter is used to operate multiple motors, individual motor overload devices or motor overtemperature thermal switches (preferred) must be added for proper motor protection. Consult SECO for application assistance for multiple motor applications.

2) Rapid deceleration of high inertia loads should be avoided. Consult the adjustment section for procedure for setting the deceleration rate. If your application requires a faster deceleration rate, the optional Braking Module may be added. Consult SECO.

8.2 TROUBLESHOOTING PROCEDURE

FAULT	POSSIBLE CAUSE	ACTION
3 Digit LED's are not lit.	Input power not energized.	Check for AC voltage on terminals L1, L2 & L3.
	Input fuses open.	Check fuses.
Motor does not run. 3 Digit display shows "rdY".	Inverter does not have a Start command.	Check to see that the inverter is receiving a Start command.
	Inverter may require resetting.	Reset inverter with switch or momentarily connect term 11 to term13.
Motor does not run. 3 digit display shows "0.0".	Inverter has no speed command.	Check speed pot wiring.
		Check for speed command on term 4(-) & term 5(+).
Motor does not run. 3 digit display shows a 2 letter code.	Inverter has had a fault trip.	Check fault codes on page 26 for cause.
Motor runs, but does not accel load.	Boost is set too low.	Increase Pr6 setting.
	Current limit is set too low.	Increase Pr4 setting.
	Rated current is set too low.	Set Pr5 to 100%.
	Load on motor is too high.	Check motor amps. They should not be greater than the motor nameplate or the inverter rating.
Inverter trips during accel.	Boost is set too high.	Reduce Pr6 setting.
	Accel is set too fast.	Increase Pr2 setting.
	Load on motor is too high.	Check motor amps. They should not be greater than the motor nameplate or the inverter rating.
Inverter trips during decel.	Decel is set too fast.	Increase Pr3 setting.
	Load has high inertia.	Add optional Braking module.
3 digit display is flashing.	Inverter is in current limit.	Motor load is too high.



STANDARD INTERCONNECTION DIAGRAM

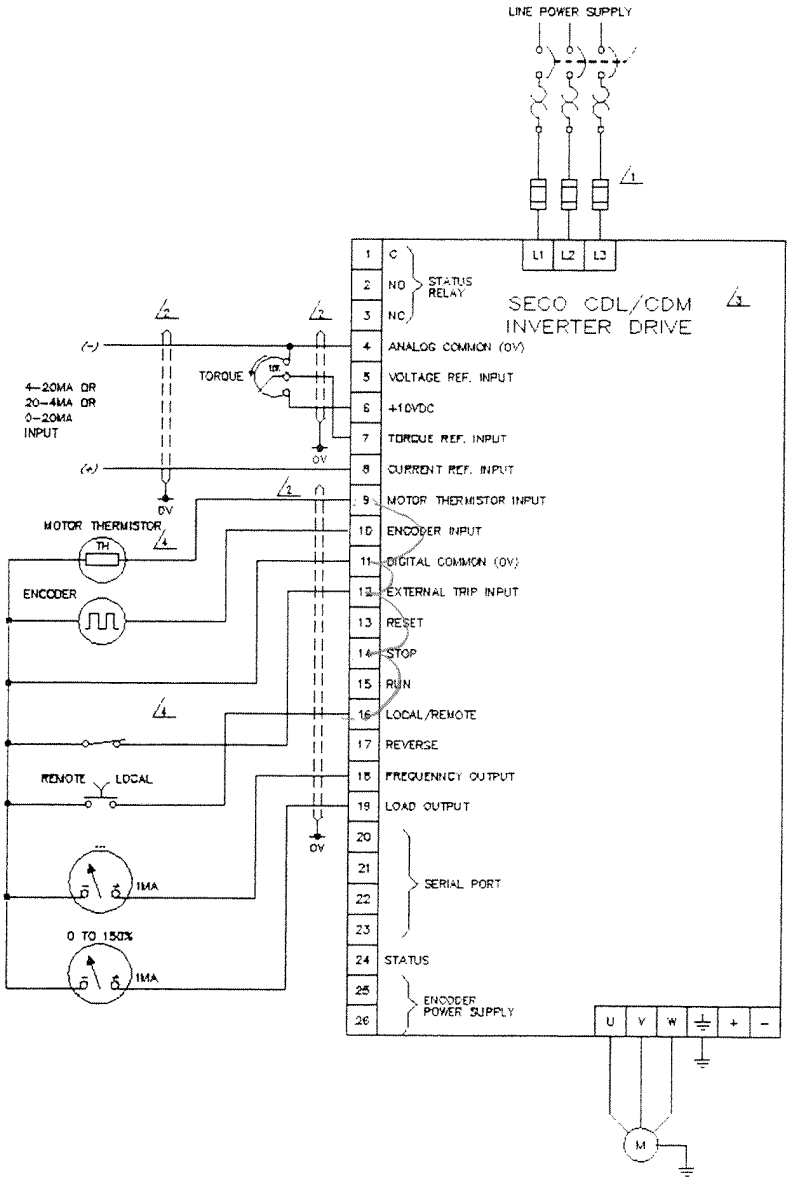
NOTES:

1. RECOMMENDED FUSE SIZES:

   CDL03–05
   CDM07–10 KTK20
   CDM01–05 KTK15

2. USE SHIELDED CABLE
   GROUND AT INVERTER END ONLY.
   RUN IN SEPARATE CONDUIT,
   AWAY FROM AC CONTROL AND
   POWER WIRING.

3. CDL = 208 TO 230VAC INPUT
   CDM = 380 TO 460VAC INPUT



OPTIONAL INTERCONNECTION DIAGRAM

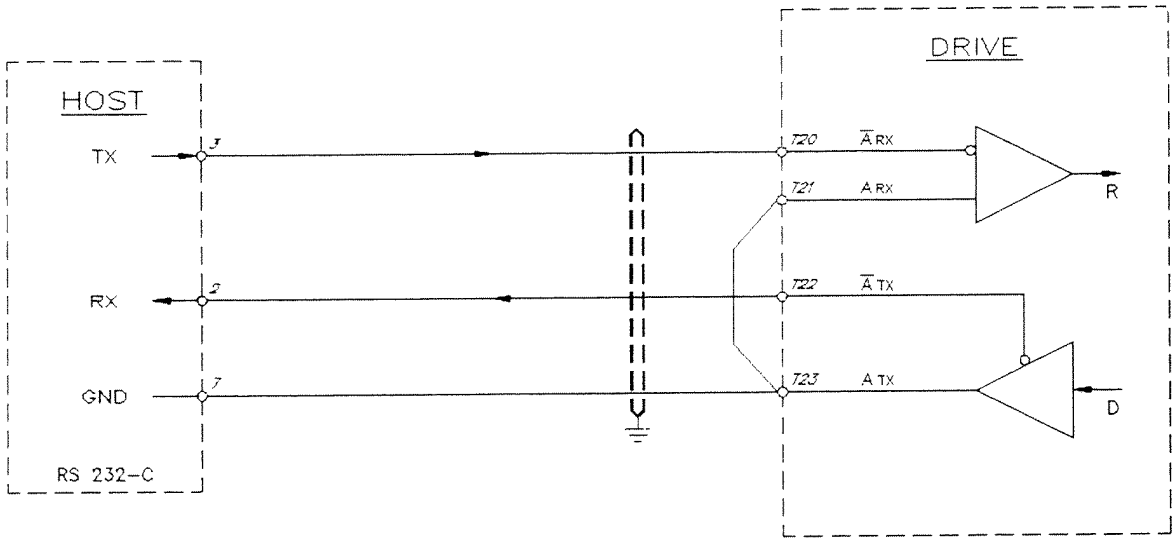
NOTES:

1. RECOMMENDED FUSE SIZES:

CDL03-05	
CDM07-10	KTK20
CDM01-05	KTK15

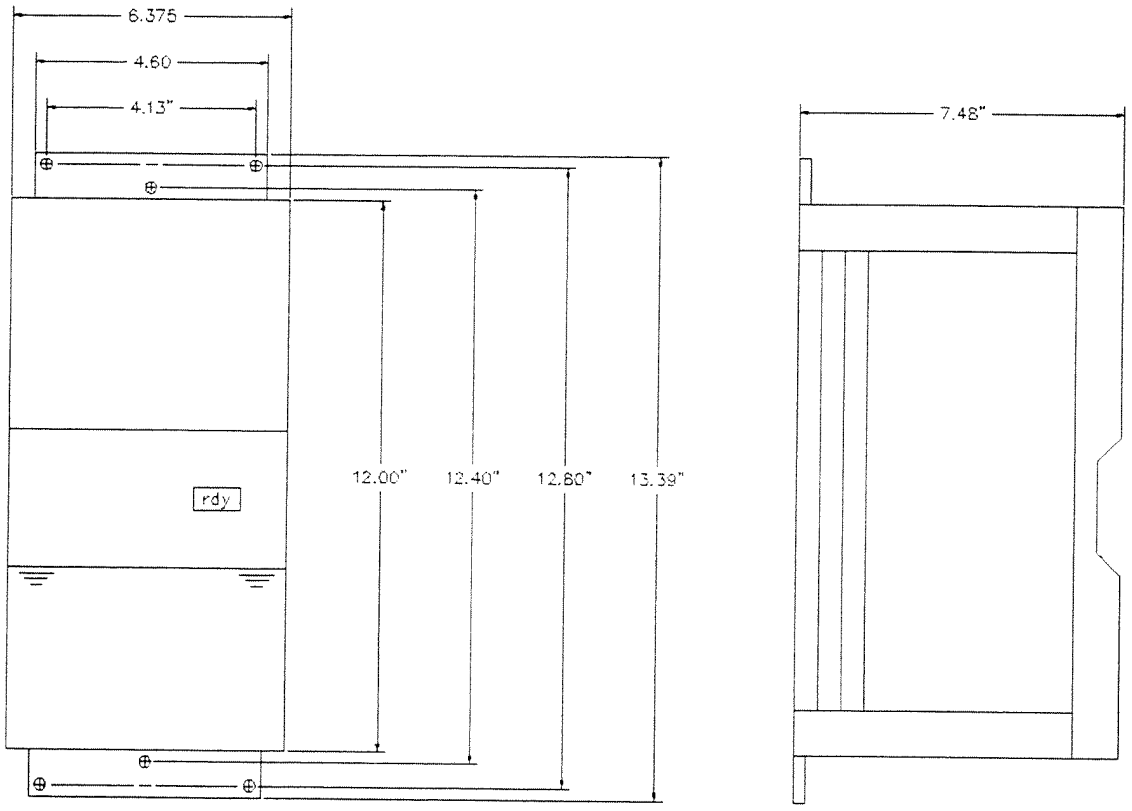
2. USE SHIELDED CABLE. GROUND AT INVERTER END ONLY. RUN IN SEPARATE CONDUIT, AWAY FROM AC CONTROL AND POWER WIRING.
3. CDL = 208 TO 230VAC INPUT
   CDM = 380 TO 460VAC INPUT
4. JUMPER TO TERMINAL 11 IF NOT USED

RS232 INTERCONNECTION



DO NOT CONNECT T21/T23 TO GROUND, OR PIN 1 AT HOST

DIMENSIONS



MOUNTING HOLE DIAMETER: .025" (6 PLACES)

Notes:

1) The mounting details give the overall dimensions and mounting bracket center dimensions. Mount the upper bracket to the mounting surface first, then hook the lower bracket into the unit's lower end molding. Hook the unit onto the upper bracket, and secure the lower bracket to the mounting surface.

2) The front terminal access cover is removed by pressing gently downwards on both of the ribbed arrow-heads, and lifting it clear of the unit.

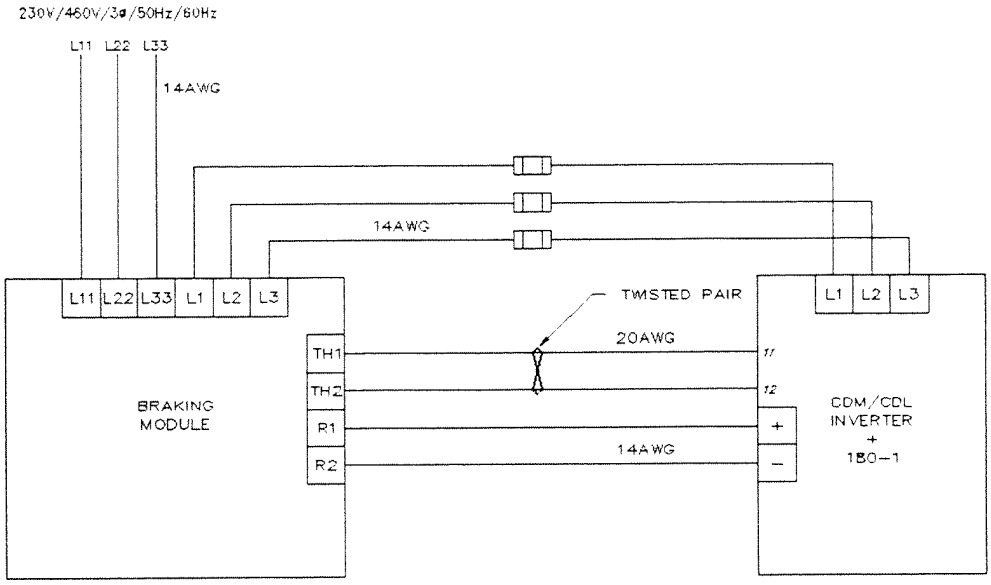
9.0 OPTIONS

9.1 DYNAMIC BRAKING IBD-1

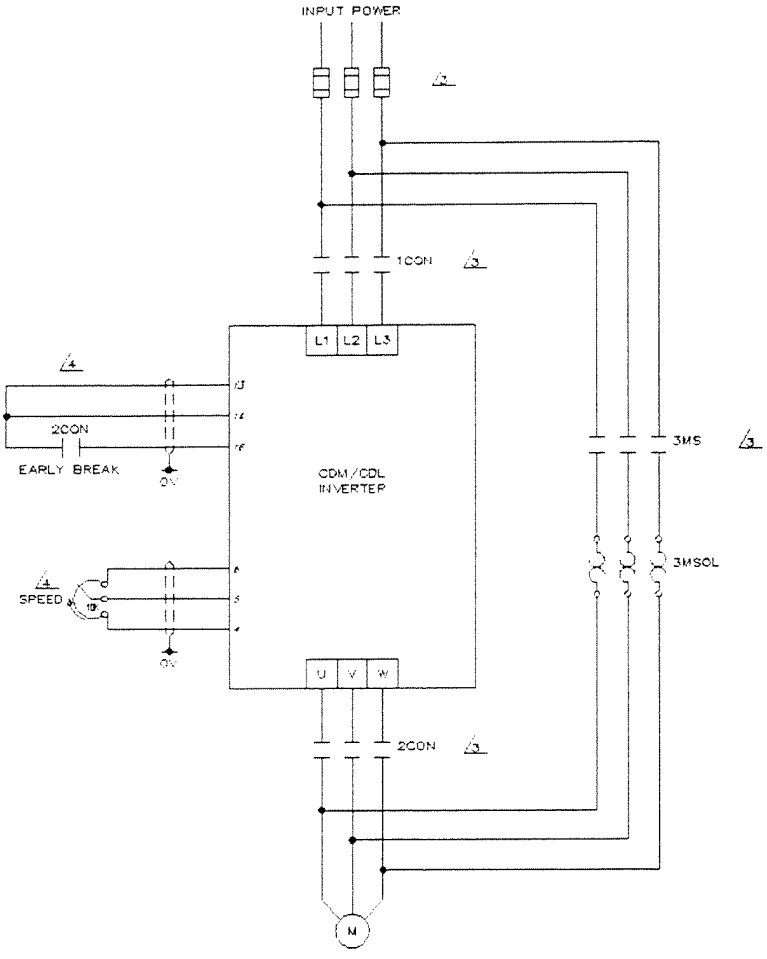
A dynamic braking unit, the IBD-1, is available as an option. This unit must be factory installed. External braking resistors should be wired to the + and -terminals. It is most important that the thermal trip contact, should be wired into the main contactor control circuit, such that it will open the contactor, if the thermal trips.

Braking current	: 20A DC for 20 seconds max.
Braking torque	: set by external resistor
Braking duty	: 30% on, 70 % off max.
Protection	: by external thermal trip

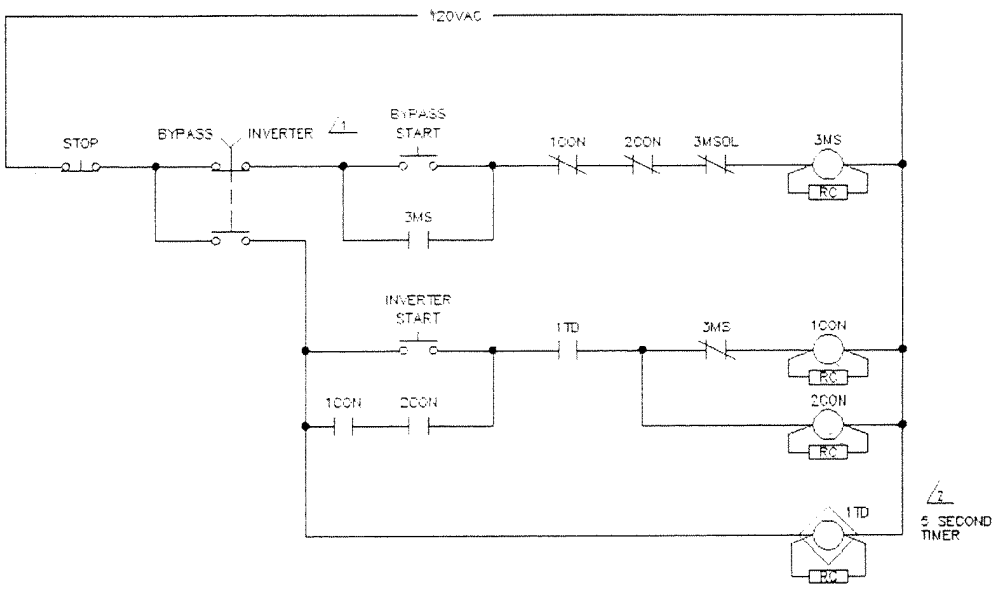
DB braking can be selected by setting bit parameter b2 to '0'. Braking is initiated by a stop command. Both voltage and frequency reduce to zero under control. If fixed boost has been selected, then a bonus effect is that DC injection will take place at low speed, down to approx. 3 Hz. This effect does not occur if auto-boost has been selected. DB braking also operates when reversing, and when reducing the speed reference, (decelerating).



9.2 BY-PASS OPERATION



Typical connection for inverter bypass operation



Notes:

1. The logic is designed for motor transfer from inverter to power lines. Do not attempt to switch the motor from the power lines to the inverter.

2. The timer is a "delay on" type and is set for approximately 5 seconds.

3. Observe local electrical codes for feeders, contactors, and fuse sizing.

4. Use twisted shielded wire. Ground shield at the inverter end only, and run wires in separate conduit, away from AC control and power wires.

9.3 ENCODER SPECIFICATION

Type

Magnetic reluctance or optical

Pulse Rate

Two pulse rates required:

a) For 2-pole machines 30 pulses per rev.

b) For 4-pole machines 60 pulses per rev.

Speed range 2 to 6000 RPM

Output

Rectangular squarewave, quadrature or complement signals not required.

Amplitude nominally equal to supply.

Mark space ratio 40:60 to 60:40

Rise Times and Fall Times not to exceed 50us.

Power Supply

5 thru 24 VDC +/- 10% 50 mA.

Operating Temperature

0-70 deg. C

10. SERIAL COMMUNICATION

10.1 INTRODUCTION

The Serial Communications Link, standard on all models, allows access to all of the drive's parameters. The user can, through this link, READ and WRITE these parameters - thereby monitoring and controlling the drive. Up to 32 drives can be interconnected together to a host device such as a computer, a PLC, or a "dumb" terminal. This connection is made via a 4 line RS-485 interface using standard ANSI-x3.28-2.5-A4 protocol. (The "protocol" simply defines the way data is sent and received). The drive can also be connected as an RS-232C device, the standard for IBM PC's. (see pg.59).

To communicate with a drive an address or ID must be used in order to identify it. The drive's address is set in Pr9, the address is a unique number for each drive and has a value of 0-99. Likewise the communications rate or "BAUD" and the "parity" must be set equal to the HOST's value. To WRITE to the drive, via the serial link, the drive must be in REMOTE SLAVE mode. This is accomplished by connecting T16 to T11 and setting b6 = 1. The drive's data can be read, however, at any time and in any mode while powered-up.

The drive communicates to the HOST by using 7 data bits, 1 stop bit and a user selectable parity bit (b10). The HOST must be set accordingly. The recommended data rate is the fastest: 9600 baud (9600 characters/sec or ~1 mS/char.), however 4800 baud can be selected if the HOST is limited to this slower rate.

If the host is an IBM PC (or compatible) the user can select any one of many communications software packages such as ProComm and Xtalk. These programs can readily be put into the "chat" or "dumb" mode through their menu system. The serial port on the computer can then be set to "match" the drive. The user can then see, on the same screen, what he is sending to the drive and its response.

10.2 READING DATA

The complete set of variables and bit parameters can be read by the HOST by useing the following format:

HOST sends (requests data): "RESET" "ID" "MNEMONIC" "END"

"RESET" Tells all the drives connected on the serial link to "listen", it is equal to a {ctrl}D[1].

"ID" tells the drives which specific drive this message is for, it is sent as two characters 00-99 (= Pr9 of the desired drive) and each character of the ID is sent twice in succession. An example: ID address 23 would be sent as 2233 (NOT 2323).

"MNEMONIC" tells the ID'ed drive what the HOST wants. A list of MNEMONICS (all 2 digits long) is given on pg.58 .

"END" terminates this transmission and allows the ID'ed drive to respond, it is equal to a {ctrl} C[1].

The Drive replies: "START" "MNEMONIC" "DATA" "END" "BCC"

"START" tells the HOST the reply is coming, it is equal to a {ctrl} B[1].

"MNEMONIC" tells the HOST what variable the data to follow is (see pg.58 MNEMONIC TABLE).

"DATA" is of course the DATA and is either equal to the value of the parameter or is a binary coded number that must be decoded (see pg.59-62). The data has to be 6 characters long when sent to the drive and will always be 6 characters long when the drive responds, (a "space" is considered a valid "padding" type character). If the drive sends the character ">" then the valid data will follow that > character. (The ">" will often be preceded by "space" pad characters).

"END" tells the HOST the DATA is complete, it is a {ctrl}C[1].

"BCC" is a checksum and it allows the HOST (and the drive if its DATA is written to one of its variables) to check the integrity of this last transmission. (see pg.56)

Ex.: Drive ID (address) #24 (stored in Pr9)
read the speed set-point SP (see MNEMONICS TABLE, pg.58)

Send: {ctrl}D 2 2 4 4 S P {ctrl}C
if the drives speed was set at 44.8 Hz then it would reply:
{ctrl}B S P + 0 4 4 . 8 {ctrl}C <BCC>
indicating a forward (+) speed of 44.8 Hz. Had the drive been set for reverse a negative speed (indicated by a "-") would have been sent. (see "Checksum" for an explanation of <BCC>).

[1] This is accomplished by holding the "CTRL" key down and pushing the subsequent letter, ex.: {ctrl}D = push CTRL and D simultaneously. A complete ASCII table is given in Appendix A for all HEX and control code equivalents.

Repeat Inquiry. To obtain data again from the same drive and mnemonic, transmit a negative ackowledge character {ctrl}U.

Next parameter. To obtain data on the next parameter listed in the MNENONIC table, transmit a positive acknowledge character {ctrl}F.

Invalid Mnemonic. If the host sends an invalid mnenonic (one not listed in the table) the drive will respond by echoing the invalid mnenonic as follows {ctrl}B X Y {ctrl}D (where XY represents the invalid mnemonic characters).

Reading the Security Code. The security code can de read by sending its mnemonic to the drive. Ex.: drive address = 17 (Pr9)

send: {ctrl}D 1 1 7 7 S C {ctrl}C

the drive will respond with: {ctrl}B S C _ _ _> 6 4 {ctrl}C x

(The _ represents a "space" sent by the drive, the x the BCC which can be ignored). The security code would the be 64_{16} or 100_{10}[2]. This number (100) can then be entered into Prb. If the baud rate (b12) and the parity are unknown (b10) simply set the Host to the other 3 possible combinations of these 2 parameters (trying one at a time, of course) until the drive acknowledges the transmission by sending its security code.

[2] To convert a number from hex (base 16) to decimal multiply the 2nd number from the right by 16 and add in the first number. In hex the following are valid numbers "A" = 10, "B" = 11, "C" = 12, "D" = 13, "E" = 14, "F" = 15. Ex.: $24_{16} = 2 \times 16 + 4 = 36_{10}$, $3D_{16} = 3 \times 16 + 13 = 61_{10}$. $FF_{16} = 255_{10}$.

10.3 WRITING DATA

The drive can receive data written to it by the host, in order that the host can control drive parameters, such as speed. To write the drive and change its set-up it must be in a [rdY] state, in REMOTE (T16 = OV), and b6 = 1, (SLAVE). The format is as follows:

HOST sends: "RESET" "ID" "START" "MNEMONIC" "DATA" "END" "BCC"

where: RESET = {ctrl}D START = {ctrl}B END = {ctrl}C

As in READING DATA, the ID is sent twice (ex.: address Pr9=23 would be sent as 2233) and the mnemonic required can be found in the Mnemonic Table, pg.58.

The drive will reply with either a positive or negative acknowledgement.
<ACK> = {ctrl}F if message understood, (only implemented if in the [rdY] state).
<NAK> = {ctrl}U if message invalid, data too long, or BCC incorrect

NOTE: If a value is set outside the range of a parameter the drive will default to the maximum allowable parameter value. Reverse signals are sent by using a "-" sign before the value.

10.3.1 Block Checksum BCC

<BCC> is a single ASCII character representing the "combined state" of the characters sent back and forth and thereby providing a means of validating the received messages. It is calculated by taking an exclusive OR of the MNEMONIC, the 6 data characters, and the END character ({ctrl}C). To prevent this resultant value from being outside of an expected range, it is incremented by 32 (decimal NOT hex) if its total value is less than 32_{10}. The equivalent ASCII value for this total is then sent as the BCC character. An example follows.

To set the speed of drive number 14 to reverse 47.4 Hz send:

{ctrl}D 1 1 4 4 {ctrl}B S P - 0 4 7 . 6 {ctrl}C &

The <BCC> is the ASCII character "&" and it is calculated as follows:

CHARACTER	BINARY VALUE*		FUNCTION
S	0 101 0011	S	speed mnemonic
P	0 101 0000	P	" "
EXOR SUBTOTAL	0 000 0011		
-	0 010 1101	-	reverse indicator
EXOR SUBTOTAL	0 010 1110		
0	0 011 0000	0	047.6 (47.6 Hz)
EXOR SUBTOTAL	0 001 1110		
4	0 011 0100	4	
EXOR SUBTOTAL	0 010 1010		
7	0 011 0111	7	
EXOR SUBTOTAL	0 001 1101		
.	0 010 1110	.	
EXOR SUBTOTAL	0 011 0011		
6	0 011 0110	6	
EXOR SUBTOTAL	0 000 0101		
{CTRL}C	0 000 0011	"END"	({ctrl}C)
EXOR TOTAL	0 000 0110 = 6 decimal		

Since BCC is less than 32 need to add 32 to it:

BCC = 6 + 32 = 38 = 26_{16} = &

NOTE: The first bit above is et to "0" if the parity is even and set to a "1" if the parity is odd. An example is the character "S"= 0 101 0011 if even parity and 1 101 0011 if odd parity.

* See ASCII TABLE (pg.74-75)
The first "0" listed in the BINARY VALUE.

10.4 SERIAL COMMUNICATION TIMING

There is a finite time taken for transmitting or receiving messages and also a delay for the drive to process the information. To update a drive with the new parameter value will take 43.5 msec at 4800 baud (25.8 msec at 9600 baud). To read a drive parameter will take 47.4 msec at 4800 baud (27.9 msec at 9600 baud).

MNEMONIC TABLE

PARAMETER	MNEMONIC	INFORMATION	ITEM	TYPE
Set Frequency	SP	Hertz		Rr/w
Set Torque	TP	% of FLC		Rr/w
Actual Frequency	AC	Hertz		Rr/o
Load	LD	% of FLC		Rr/o
Minimum Frequency	MN	Hertz	Pr0	Rr/w
Maximum Frequency	MX	Hertz	Pr1	Rr/w
Acceleration Rate	AL	seconds	Pr2	Rr/w
Deceleration Rate	DL	seconds	Pr3	Rr/w
Current Limit	TR	% of FLC	Pr4	Rr/w
Continuous Current	TH	% of FLC	Pr5	Rr/w
Voltage Boost	BO	% of Vmax	Pr6	Rr/w
Slip Compensation	SL	Hertz	Pr7	Rr/w
DC Braking Level	BR	% of Vmax	Pr8	Rr/w
Serial Address	SE	00-99 in Hex	Pr9	Ir/o
Security Code	SC	Code in Hex	Prb	Ir/w
STATUS WORD	SW	Code in Hex		Ir/o
DRIVE SET-UP	DS	Code in Hex	b0-b12	Ir/w*
Switching Frequency	FQ	Code in Hex	b14	Ir/w*
Base Speed	BS	Hertz	Prc	Rr/w*
COMMAND WORD	CW	Code in Hex		Ir/w

Notes:
R r/w = REAL read/write (display in actual numbers)
R r/o = REAL read only (display in actual numbers)
I r/w = INTEGER read/write (display in HEX code)
I r/o = INTEGER read/only (display in HEX code)
* = write only, when drive is in a ready state.
Those value and bit parameters, which affect serial communications, can not be written to, ie Pr9, b6, b10, b12, b13.

N.B. Mn + Mx take higher precedent than SP

If you set Mn to 5Hz and SP is equal to zero (0), then A.C. will be + 5Hz
(ie forward)

If you set Mn to 5Hz and SP is minus zero (-0), then A.C. will be - 5Hz
(ie reverse)

10.4.1 SWITCHING FREQUENCY

This is a 1 Byte Hex value word, (2 characters), which enable the bit parameter 14 to be read. The 2 Hex characters decode into binary states, as follows. eg for drive 13

To read FQ send {ctrl}D 1 1 1 1 F Q {ctrl}E

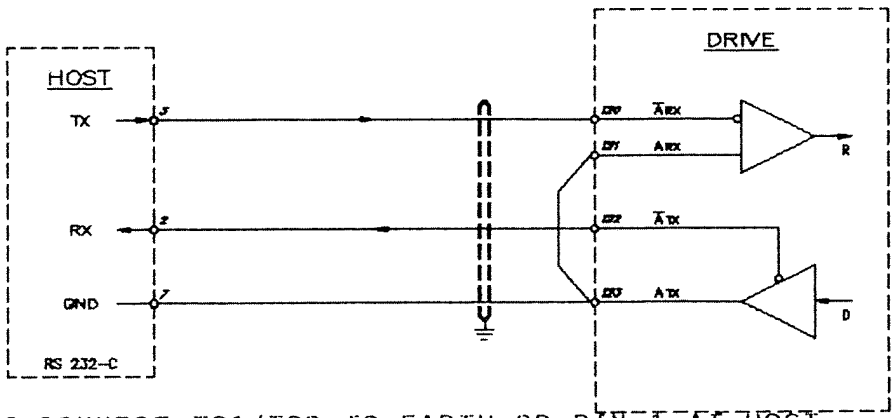
The drive replies {ctrl}B F Q _ _ _> 3 0 {ctrl}C

The data following the > character is in Hex, and decodes into the 15 possible states, as shown in the table, below.

To write to the drive, the following would be done:

{ctrl}D 1 1 1 1 {ctrl}B F Q _ _ _> 3 0 {ctrl}C

FQ CODES		
HEX CODES	SWITCHING FREQUENCY	MAX. VOLTS FREQUENCY
00 01	2.9 kHz	120 Hz 240
10 11	5.9 kHz	120 Hz 240
20 21	8.8 kHz	120 Hz 240
30 31	11.7 kHz	120 Hz 240



NB: DO NOT CONNECT T21/T23 TO EARTH OR PIN 1 AT HOST

10.4.2 STATUS WORD (SW)

This is a 2 Byte Hex value word, (4 characters), which enables the status of the drive to be read. The 4 Hex characters decode into states indicating the drives status, RUN/LAST TRIP/ERROR and the PrA trip codes. eg for drive 13

To read SW send {ctrl}D 1 1 1 1 S W {ctrl}E

The drive replies {ctrl}B S W _> 0 E 1 C {ctrl}C >

The data folowing the first > character is in Hex, and decodes thus:

hex	binary	flags		ok	fault
0	0 (msb)	not used			
	0	drive over temp	[_Ot]	0	1
(1st ch)	0	motor over temp	[_th]	0	1
	0 (lsb)	lxt overload	[_It]	0	1
E	1 (msb)	current peak trip	[_Ol]	1	0
	1	power supply fail	[_PS]	1	0
(2nd ch)	1	under voltage	[_UU]	1	0
	0 (lsb)	over voltage	[_OU]	1	0
1	0 (msb)	not used			
	0	current loop loss	[_cL]	0	1
(3rd ch)	0	error flag	[Err]	0	1
	1 (lsb)	tripped flag (status relay)		0	1
C	1 (msb)	run flag			
	1	ready flag			
(4th ch)	0	status of T16, 0 =LOCAL, 1 =REMOTE			
	0 (lsb)	not used			

There are 4 possible states of run/ready flags:
Run Flag 0} drive stopping on ramp control
Ready Flag 0}

Run Flag 0} drive stopped
Ready Flag 1} drive ready to run [rdY] on the display

Run Flag 1} drive running
Ready Flag 0}

Run Flag 1} drive waiting to run, but tripped
Ready Flag 1} awaiting reset, PrA flashing on display

So in the example above, the 4 characters decode to overvolt trip, drive waiting to run, awaiting reset.
Note that the trip states are from PrA and therefore still exist, even after a reset.
The trip itself is only still present if the tripped flag (status relay) equals "fault". To detect an external trip, <PrA> = [_Et], note the tripped flag (status relay) going to "1", and then check command word, CW, for external trip at terminal input.

10.4.3 **DRIVE SET-UP (DS)**

This is a 2 Byte Hex value word, (4 characters), which enables the drive set-up to be read or set.
The 4 Hex characters decode into states indicating the state bit parameters b0, to b12.
eg for drive 11

To read DS send {ctrl}D 1 1 1 1 D S {ctrl}E

The drive replies {ctrl}B D S _> 4 F 8 4{ctrl}C t

The data following the > character is in Hex, and decodes thus:

hex	binary	bit parameter	bit	=0	1
4	0 (msb)	not used			
	1	control type	bo	torque	speed
(1st ch)	0	start type	b1	auto	manual
	0 (lsb)	braking type	b2	DB	DC
F	1 (msb)	boost	b3	auto	fixed
	1	low speed or run	b4	low speed	run
(2nd ch)	1	feedback loop	b5	encoder	open
	1 (lsb)	master or slave	b6	master	slave
8	1 (msb)	halt method	b7	ramp	coast
	0	display	b8	freq	load
(3rd ch)	0	control	b9	key pad	terminal
	0 (lsb)	parity	b10	even	odd
4	0 (msb)	current loop (a)	b11		
	1	current loop (b)	b11		
(4th ch)	0	not used			
	0 (lsb)	BAUD rate	b12	4800	9600

There are 4 possible states of current loop:

Current loop (a) 0}0/20mA speed reference
Current loop (b) 0}

Current loop (a) 0}4/20mA speed reference
Current loop (b) 1}

Current loop (a) 1}20/4mA speed refernce
Current loop (b) 0}

Current loop (a) 1}digital (frequency) speed input
Current loop (b) 1}

To write to the drive, the following would be done:
{ctrl} D, 1, 1, 1, 1, {ctrl}B, D, S, , >, 4, F, 8, 4, {ctrl}C, t

The drive replies <ACK> ie {ctrl} F
Note that b6, b10, b12 cannot be written to via the serial link, (relevent bits are ignored).

10.4.4 COMMAND WORD (CW)

This is a 1 Byte Hex value word, which enables the drive to be controlled via the serial link. (Note that even in REMOTE mode, the terminal command inputs are still operative). Bits 0 to 5 decode into states which can control the drives RUN/STOP/RESET/TRIP command functions, see below. Note that to REVERSE the drive, a negated speed reference is sent, using SP. eg for drive 11

To read CW send {ctrl}D 1 1 1 1 C W {ctrl}E

The drive replies {ctrl}D C W _ _ _ > 1 6 {ctrl}C .

The data following the > character is in Hex, and decodes as shown in the table, below.

To write to the drive, the following would be done:

{ctrl}D 1 1 1 1 {ctrl}B C W _ _ _ > 1 6 {ctrl}C .

CW CODES			
Hex	binary	function	terminal input status
1	0 (msb)	not used	
	0	not used	
(1st ch)	0	RESET	0 = open,1 = closed (reset)
	1 (lsb)	EXT TRIP	0 = open, (tripped),1 = closed
6	0 (msb)	DIRECTION	0 = open,1 = closed (reverse)*
	1	LOCAL/REMOTE	0 = open,1 = closed (remote)*
(2nd ch)	1	STOP	0 = open (stop),1 = closed
	0 (lsb)	RUN	0 = open,1 = closed (run)

* = not alterable by serial link, (read only).

VALUE OF CW IN TYPICAL SITUATIONS						
function selected	drive status during.....					no action
	power-up	start	stop	reset	ext trip	
in forward and remote	>16	>17	>14	>36	>06	>16
in reverse and remote	>1E	>1F	>1C	>3E	>0E	>1E
in forward and local	>12	>13	>10	>32	>02	>12
in reverse and local	>1A	>1B	>18	>3A	>0A	>1A

11. RECOMMENDED SPARE PARTS LIST

The inverter does not contain any user serviceable parts. It is suggested that a complete inverter be furnished for applications requiring spare parts.

HORSEPOWER	VOLTS	MODEL	PART NUMBER
3	230	CDL03	
5	230	CDL05	
1	460	CDMC01	
2	460	CDMC02	
3	460	CDMC03	
5	460	CDMC05	
7.5	460	CDMC075	
10	460	CDMC10	

12. APPENDIX 1 PARAMETERS

12.1 PARAMETER DEFINITIONS

MVF = maximum voltage frequency. This is the frequency at which output voltage stops increasing. It can be adjusted via BIT parameter Prc

ULF = upper limit frequency. This is the maximum attainable frequency, and can be set using the bit parameters

PrO MINIMUM FREQUENCY

Function: sets the minimum frequency (fmin) equivalent to minimum speed reference input, e.g. 25 Hz = 0 volt

Range: 0 to fmax Hz. Cannot be set above the maximum frequency, Pr1 (the display will flash if this is attempted).

Factory set: 0 Hz

Pr1 MAXIMUM FREQUENCY

Function: sets the maximum frequency (fmax) equivalent to maximum speed reference input, e.g. 75 Hz = +10 volt

Range: fmin to ULF. Cannot be set below the minimum frequency, PrO (the display will flash if this is attempted).

Factory set: 60 Hz

Pr2 ACCELERATION TIME

Function: sets the time taken to increase frequency, from 0 Hz to the ULF, for a 0 to 100% change in input speed reference. e.g., if the ULF is 120 Hz, and fmax, <Pr1> = 30 Hz, then <Pr2> = 10 s will give an acceleration time of 2.5s (to increase from 0 to 30 Hz).

Range: 0.2 to 600 seconds

Factory set: 5.0 second

Pr3 DECELERATION TIME

Function: sets the time taken to decrease frequency, from the ULF to 0 Hz, for a 100 to 0% change in input speed reference, e.g., if the ULF is 120 Hz, and fmax, <Pr1> = 60 Hz, then <Pr3> = 10 s will give a deceleration time of 5 s (to decrease from 60 to 0 Hz).

Range: 0.2 to 600 seconds

Factory set: 10.0 second

Pr4 CURRENT LIMIT (TIMED)

Function: sets the maximum current limit, i.e. the level of sustained overload current available for up to 30 seconds.

Range: <Pr5> to 150% of full load.

Factory set: 150%

Pr5 MAX CONTINUOUS CURRENT

Function: sets the maximum continuous current, i.e. the % of full load at which continuous current can be provided, without entering lxt overload. From the 150% current limit value allowable current decreases exponentially toward <Pr5>. If current demand exceeds this value, the drive will trip on lxt overload. The lxt threshold is <Pr5>. During lxt time-out, the unused decimal points on the LED display will flash. Normally,

$$\text{<Pr5>} = \frac{\text{motor full load amp rating}}{\text{inverter full load amp rating}} \times 100\%$$

<Pr5> can be adjusted to 5% above the inverter full load rating.

$$\text{Trip time} = \frac{12.86 \times \text{<Pr5>}}{(\text{actual \% current} - \text{<Pr5>})} \text{ seconds}$$

The trip time for <Pr5> = 105% FLC, is 30 s.

Range: 10.0% to 105% full load, must be less than <Pr4>

Factory set: 100%

Pr6 VOLTAGE (TORQUE) BOOST

Function: sets the level of maximum voltage (torque) boost allowable. Pr6 is used to overcome motor losses at low speed, and so increase the available starting torque. The level of boost is set at a frequency equal to Prc/16 Hz (Prc = maximum voltage frequency). The maximum boost is 25.5% of supply voltage, tapering to zero at Prc/2 Hz. For frequencies below Prc/16, boost either reduces along the set gradient (see graph) or tapers to 5.1% of supply voltage, whichever is lower. Boost is either AUTOMATIC or FIXED, depending on bit parameter 3. Automatic Boost varies boost linearly with load current, i.e. 0% boost at 0% current, to <Pr6>% boost, at <Pr5>% full load current. Fixed boost should be set just sufficient to accelerate the motor and load. Setting a value too high will increase the losses in the motor and will reduce its life.

Range: 0.0 to 25.5% (of nominal supply volts).

Factory set: 5.1%

Pr7 SLIP COMPENSATION

Function: sets the amount of increase in frequency, when <Pr5>% full load current is flowing. Slip compensation gives better speed regulation, for changing loads. It also can be used to enable synchronous speeds to be attained.
Range: 0.0 to 5.0, 10.0, 20.0 Hz (at <Pr5>% load), for ULF's 120 or 220.
Factory set: 0.0 Hz

Pr8 DC BRAKING LEVEL

Function: sets the DC injection braking level, expressed as a % of the drive's current rating. For DC braking to be available, bit parameter 2 should be set to a `1' and bit parameter 7 set to 0. DC braking is initiated by the STOP command. Braking is effected by rapidly reducing the voltage applied to the motor and then supplying a low frequency waveform until the motor is almost at standstill. The inverter then applies a D.C. output for about 1 second. The drive cannot be restarted until this 1-second delay has elapsed. So, if STOP is pressed while at zero speed, there will be a 1-second period of D.C. injection (holding torque) before RUN is allowed. D.C. braking does not operate while reversing. During D.C. braking, the LED display shows [_dc].
Range: 40% to 150% of full load current rating.
Factory set: 150%

Pr9 SERIAL INTERFACE ADDRESS

Function: sets the serial interface address to give the drive its own identity (number) when communicating to other systems. (Used mainly for multi-drive applications.)
Range: 00 to 99 (integer)
Factory set: 11

When set via the serial link, parameters 0 to 8 have a resolution of +/-0.1 unit. This is true if set via the keypad, except for:

(a) values above 100, where the resolution is +/-1.0 unit.
(b) Pr2 and Pr3, whose resolution becomes coarser toward 600s.
(c) Pr0, Pr1, Pr7, whose resolution is +/-0.2 Hz for ULF 240 Hz.
(d) Pr6, Pr8, whose resolution is +/-0.4%.

12.2 BIT PARAMETER DEFINITIONS

b 0 SPEED or TORQUE CONTROL MODE

Function: selects the control system type. SPEED control uses the chosen speed reference input to set the motor frequency (speed). The torque reference input can be used to scale the current limit, with 0V = 10% FLC, and +10V (or no connection) = <Pr4>. TORQUE control sets the speed to +/- <Pr1>, and the chosen torque reference input sets the maximum current output (torque), as in SPEED control. This can be used as an external current limit controller, for tension control schemes. (This function is only operative when in Terminal mode)

Choices: 0 = torque control 1 = speed control

Factory set: 1 = speed control

b 1 AUTO START or MANUAL START MODE

Function: selects the start up method. Manual start requires a RUN command to start after applying power. Auto start will start the motor just after power is applied by carrying out a RUN command automatically, unless a STOP [rdY] command occurs. This mode is useful for auto restarting after a temporary loss of supply.

Choices: 0 = auto start 1 = manual start

Factory set: 1 = manual start

b 2 &7 METHOD OF STOPPING

Function: selects the method of stopping the drive. Choices are COAST, RAMP, with standard BRAKEING, DC INJECTION or DYNAMIC BRAKING using the IBD braking card. If COAST TO REST is selected, the time taken to stop will depend on frictional & windage losses, and the load inertia. When a STOP command occurs and the motor is coasting to rest, the display will indicate INHIBIT, [Inh] (unless a trip condition occurs). If RAMP is selected, the motor speed decelerates to zero, in a time proportional to the deceleration time, Pr3; see pg.64 (iv). RAMP is used if longer or shorter stopping times, other than the natural coast to stop time, are required. RAMP also provides a controlled linear deceleration rate. If the rate of deceleration is such that it causes an overvoltage condition, the ramp is disabled until the overvoltage has cleared, when the unit will continue to ramp down again.

DC braking injects dc into the motor and dissipates the energy there as heat. DC braking level is set by Pr8. DYNAMIC BRAKING gives fast stopping in certain applications, especially with high inertia loads. The IBD-1 braking card must be fitted, plus external power resistors, to dissipate the energy. The IBD-1 operation is described in section 9.1.

Choices:	b2	0	0	1
	b7	0	1	0
	STOP	RAMP	COAST	DC
	DB	STANDARD		N/A
Factory set:	b2 = 0} RAMP			
	b7 = 0 } (STANDARD BRAKING if FITTED)			

b 3 AUTO BOOST or FIXED BOOST

Function: selects the low speed voltage (torque) boost method. Boost is either fixed or will automatically increase with load demand. Refer to 3.1 (vii).

Choices: 0 = auto boost 1 = fixed boost

Factory set: 0 = auto boost

b 4 LOW SPEED OR RUN INDICATION OUTPUT

Function: selects the function of open collector output to terminal T24. Output indicates drive running speed, Low (0V) output drive running speed less than or equal to Pr0 (min speed).

Choices: 0 = run indication 1 = low speed

Factory set: 1 = run

b 5 OPEN LOOP or ENCODER FEEDBACK

Function: selects ENCODER FEEDBACK or normal OPEN LOOP operation. With ENCODER feedback, a digital trim system enables the motor frequency to be locked into an encoder signal, giving (integral) absolute tracking. If the encoder signal is lost, the frequency will increase slightly, depending on the ULF chosen (for any set frequency) viz: +7.5, +15, +30 Hz, for ULF = 120 OR 240.

Encoder pulse rate = 30 pulses per rev 2 pole machine
60 pulses per rev 4 pole machine

slip compensation and frequency input are operational only in OPEN loop.

Choices: 0 = encoder feedback 1 = open loop
Factory set: 1 = open loop

b 6 MASTER or SLAVE DRIVE

Function: selects the source of the REMOTE SPEED reference signal. Provided T16 is switched to 0v, and TERMINAL CONTROL is selected, b6 selects either MASTER or SLAVE speed signal, from the remote source. MASTER is the current loop signal from T8 (or frequency from T10), while SLAVE is the speed reference value from the serial link.

Choices: 0 = master (current loop) 1 = slave (serial link)
Factory set: 0 = master

b 8 FREQUENCY or LOAD ON DISPLAY

Function: selects whether the display indicates the motor FREQUENCY or the motor LOAD. Frequency is Hertz, load is in % Full Load Torque. (This function is only operative when controlling speed from a potentiometer)

Choices: 0 = frequency 1 = load
Factory set: 0 = frequency

Note if both UP and DOWN push buttons are pressed simultaneously, the not selected function will be displayed. This provides an easy method of checking load (or frequency) without having to stop the inverter and changing b8.

b 9 TERMINAL or KEYPAD CONTROL

Function: selects the drive control method. Control of speed, stop, start, reset and reversing can be either by external operators or by the KEYPAD alone. Keypad control is normally used.

Choices: 0 = keypad control 1 = terminal control
Factory set: 0 = keypad control

b 10 EVEN or ODD serial I/O parity

Function: selects the parity type for serial link communications.

Choices: 0 = even parity 1 = odd parity
Factory set: 0 = even parity

b 11 DEFINE CURRENT LOOP TYPE OR FREQUENCY INPUT

Function: selects the type of current loop or frequency input used for the speed reference signal. There are 3 current loop choices and a frequency input, which can be selected by using the UP and DOWN keys to scan through the options; press MODE to set. If either 4/20 or 20/4 mA are chosen, then if a current signal of less than 3.5 mA is detected, the drive will trip, indicating [_cL], current loop loss. This only applies if in MASTER and REMOTE modes; see 2.2.
Frequency signal amplitude = 0 to 5V or open collector (to 24 Volts) Output motor frequency = 30 times input signal

Choices: 4.20 (4/20 mA), 20.4 (20/4 mA), 0.20 (0/20 mA), Fr.

Factory set: 4.20 (4/20 mA)

b 12 SERIAL LINK BAUD RATE

Function: selects the serial link BAUD rate.

Choices: 4.8 for 4800 BAUD 9.6 for 9600 BAUD

Factory set: 4.8 for 4800 BAUD

b 13 RESET ALL PARAMETERS TO THEIR DEFAULT VALUES

Function: forces all parameters to go to their default values and settings. Note that default settings may differ from factory settings. <PrA> = [_Et] when this is done.
Note resetting all parameters sets security code to 0.

Choices: 1 = set default values 0 = no action

Factory set: 0

b 14 DEFINE ULF and SWITCHING FREQUENCIES

Function: Either of two Upper Limit Frequencies, and any one of four Switching Frequencies can be chosen with this bit. On entering bit 14, it is the SF's that can be selected first. Use the UP and DOWN keys to choose, and the MODE key to set your choice.
Note that parameter Prc will normally need to be adjusted if ULF altered.

Choices: SF's=2.9, 5.9, 8.8, 11.7 kHz; ULF=120, 240Hz.

Factory set: SF = 2.9 kHz, ULF = 120 Hz

Prc **MAXIMUM VOLTAGE FREQUENCY**

Function: defines the maximum voltage frequency, i.e. the frequency at which output voltage reaches its maximum level. Prc is used in conjunction with bit parameter b14 to define the voltage to frequency characteristics of the inverter.

Standard relationships between ULF (b14) and MVF (Prc)

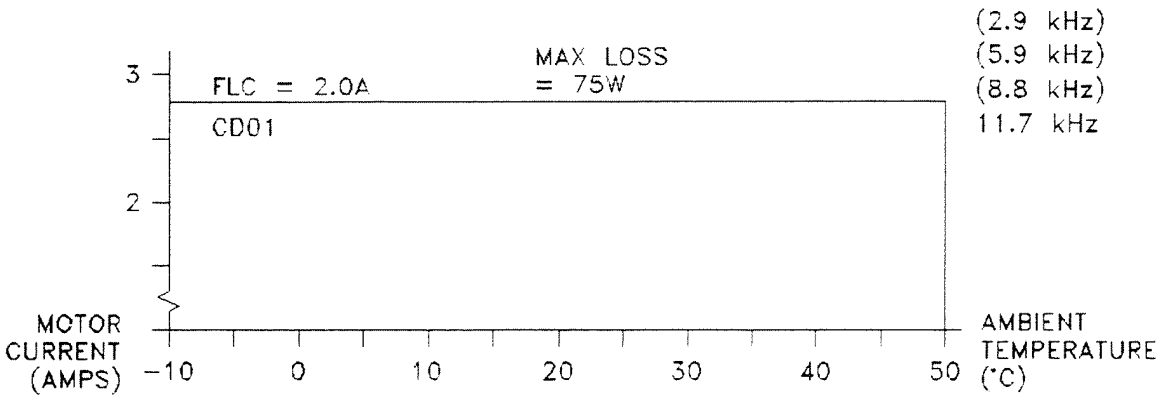
ULF	MVF	
120	50	} Use same ULF setting for
120	60	} 50 and 60 Hz machines.
240	240	

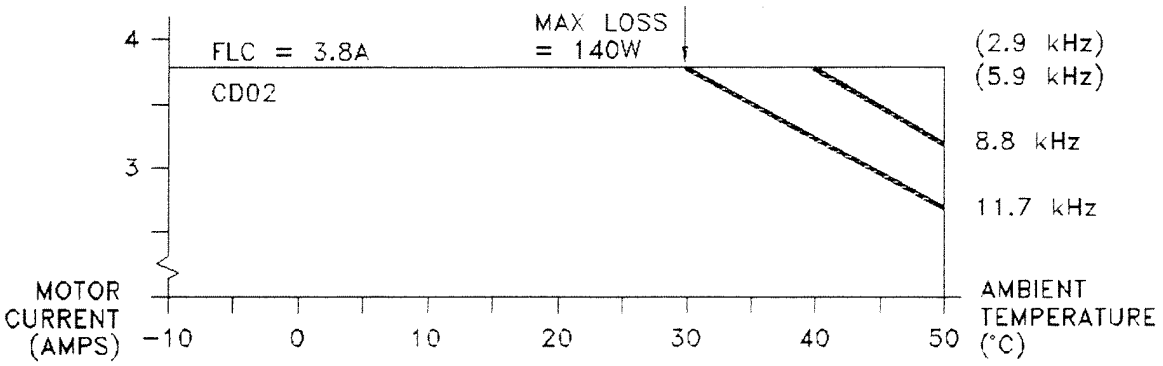
Range: Prc is adjustable from ULF (b14) to ULF/16 Hz

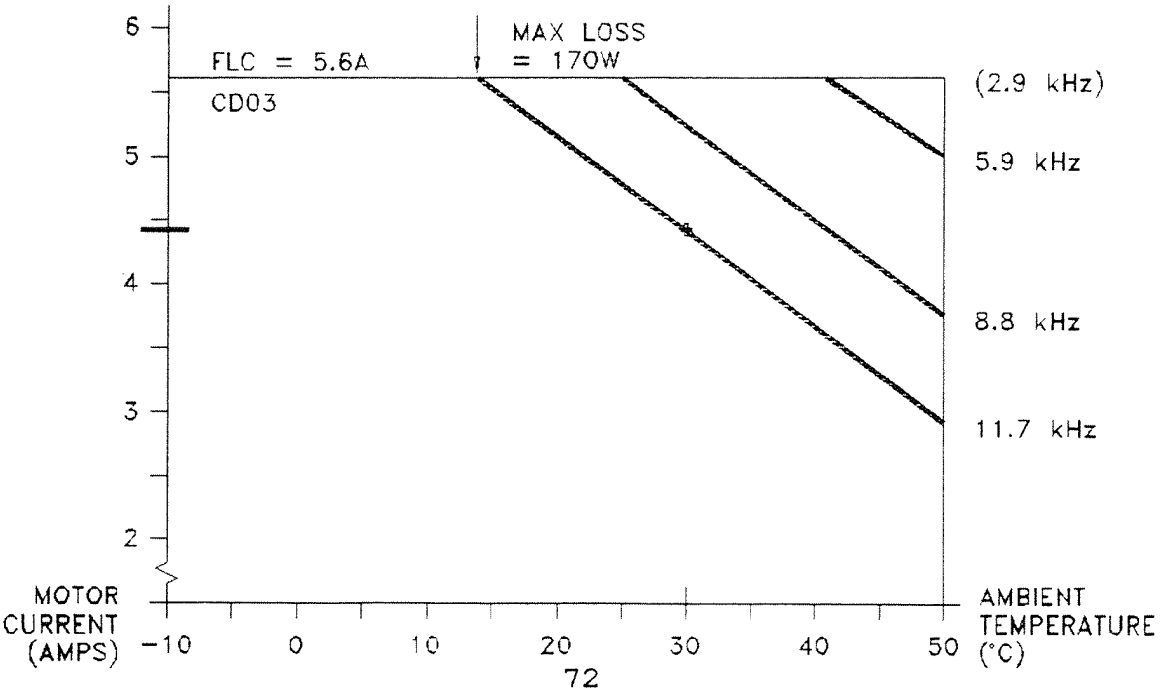
Factory set: 60 Hz

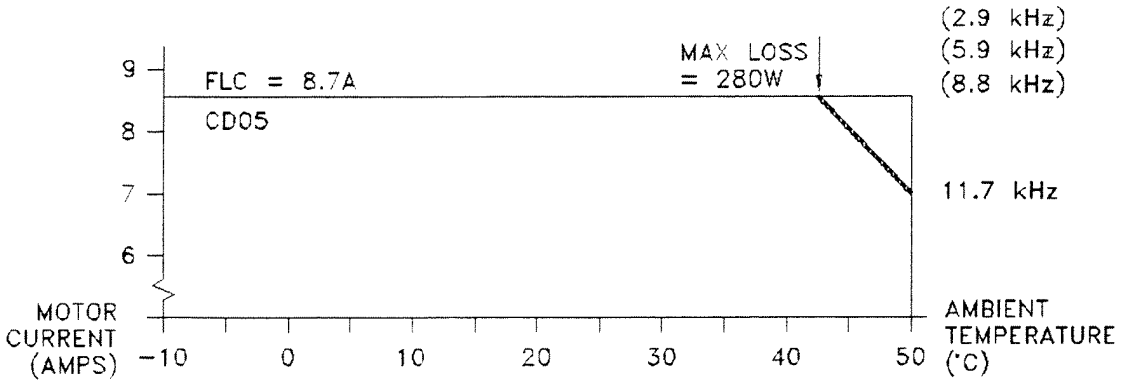
13. APPENDIX 2

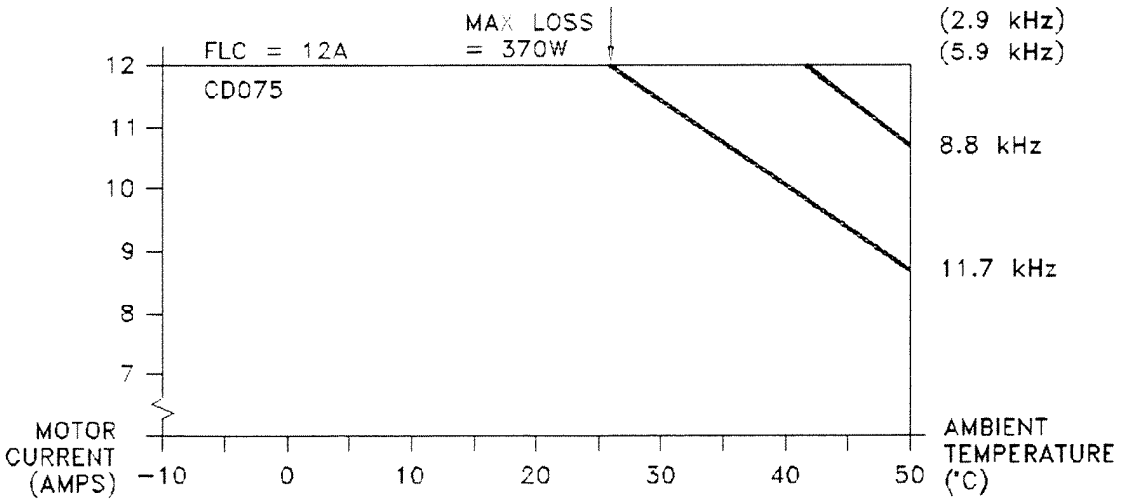
AC Drive De-rating Curves

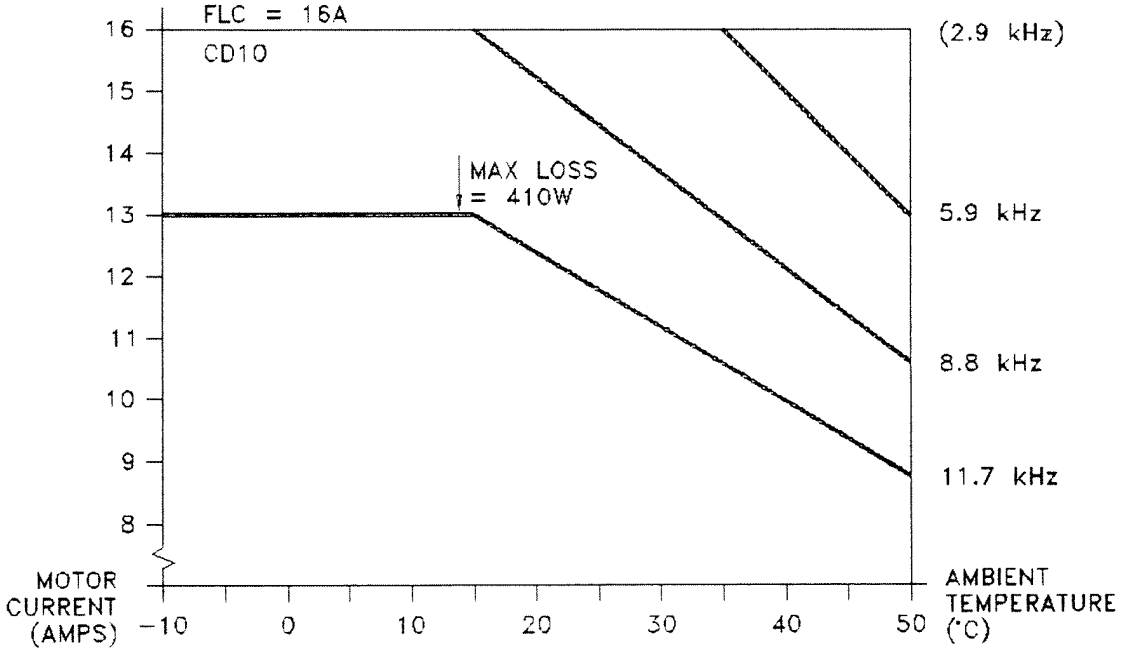







FLC = 8.7A
CD05
MAX LOSS
= 280W
(2.9 kHz)
(5.9 kHz)
(8.8 kHz)
11.7 kHz
9
8
7
6
MOTOR CURRENT (AMPS)
−10
0
10
20
30
40
50
AMBIENT TEMPERATURE (°C)


FLC = 12A
CD075
MAX LOSS
= 370W
(2.9 kHz)
(5.9 kHz)
8.8 kHz
11.7 kHz
12
11
10
9
8
7
MOTOR CURRENT (AMPS)
−10
0
10
20
30
40
50
AMBIENT TEMPERATURE (°C)


FLC = 16A
CD10
MAX LOSS
= 410W
(2.9 kHz)
5.9 kHz
8.8 kHz
11.7 kHz
16
15
14
13
12
11
10
9
8
MOTOR CURRENT (AMPS)
−10
0
10
20
30
40
50
AMBIENT TEMPERATURE (°C)

14. APPENDIX 3

ASCII TABLE

The following ACSII table is for 7 bit ASCII

VALUE			ASCII	CONTROL	VALUE			ASCII
DEC	HEX	BIN	CHAR.	CODE	DEC	HEX	BIN	CHAR.
0	00	000 0000	NUL	{ctrl}@	64	40	100 0000	@
1	01	000 0001	SOH	{ctrl}A	65	41	100 0001	A
2	02	000 0010	STX	{ctrl}B	66	42	100 0010	B
3	03	000 0011	ETX	{ctrl}C	67	43	100 0011	C
4	04	000 0100	EOT	{ctrl}D	68	44	100 0100	D
5	05	000 0101	ENQ	{ctrl}E	69	45	100 0101	E
6	06	000 0110	ACK	{ctrl}F	70	46	100 0110	F
7	07	000 0111	BEL	{ctrl}G	71	47	100 0111	G
8	08	000 1000	BS	{ctrl}H	72	48	100 1000	H
9	09	000 1001	HT	{ctrl}I	73	49	100 1001	I
10	0A	000 1010	LF	{ctrl}J	74	4A	100 1010	J
11	0B	000 1011	VT	{ctrl}K	75	4B	100 1011	K
12	0C	000 1100	FF	{ctrl}L	76	4C	100 1100	L
13	0D	000 1101	CR	{ctrl}M	77	4D	100 1101	M
14	0E	000 1110	SO	{ctrl}N	78	4E	100 1110	N
15	0F	000 1111	SI	{ctrl}O	79	4F	100 1111	O
16	10	001 0000	DLE	{ctrl}P	80	50	101 0000	P
17	11	001 0001	DC1	{ctrl}Q	81	51	101 0001	Q
18	12	001 0010	DC2	{ctrl}R	82	52	101 0010	R
19	13	001 0011	DC3	{ctrl}S	83	53	101 0011	S
20	14	001 0100	DC4	{ctrl}T	84	54	101 0100	T
21	15	001 0101	NAK	{ctrl}U	85	55	101 0101	U
22	16	001 0110	SYN	{ctrl}V	86	56	101 0110	V
23	17	001 0111	ETB	{ctrl}W	87	57	101 0111	W
24	18	001 1000	CAN	{ctrl}X	88	58	101 1000	X
25	19	001 1001	EM	{ctrl}Y	89	59	101 1001	Y
26	1A	001 1010	SUB	{ctrl}Z	90	5A	101 1010	Z
27	1B	001 1011	ESC	{ctrl}[	91	5B	101 1011	[
28	1C	001 1100	FS	{ctrl}\	92	5C	101 1100	\
29	1D	001 1101	GS	{ctrl}]	93	5D	101 1101	]
30	1E	001 1110	RS		94	5E	101 1110	
31	1F	001 1111	US		95	5F	101 1111	
32	20	010 0000	SPace		96	60	110 0000	`
33	21	010 0001	!		97	61	110 0001	a
34	22	010 0010	"		98	62	110 0010	b
35	23	010 0011	#		99	63	110 0011	c
36	24	010 0100	$		100	64	110 0100	d
37	25	010 0101	%		101	65	110 0101	e
38	26	010 0110	&		102	66	110 0110	f
39	27	010 0111	'		103	67	110 0111	g
40	28	010 1000	(		104	68	110 1000	h
41	29	010 1001	)		105	69	110 1001	i
42	2A	010 1010	*		106	6A	110 1010	j
43	2B	010 1011	+		107	6B	110 1011	k
44	2C	010 1100	,		108	6C	110 1100	l
45	2D	010 1101	-		109	6D	110 1101	m

The following ACSII table is for 7 bit ASCII

VALUE DEC	VALUE HEX	VALUE BIN	ASCII CHAR.	VALUE DEC	VALUE HEX	VALUE BIN	ASCII CHAR.
46	2E	010 1110	.	110	6E	110 1110	n
47	2F	010 1111	/	111	6F	110 1111	o
48	30	011 0000	0	112	70	111 0000	p
49	31	011 0001	1	113	71	111 0001	q
50	32	011 0010	2	114	72	111 0010	r
51	33	011 0011	3	115	73	111 0011	s
52	34	011 0100	4	116	74	111 0100	t
53	35	011 0101	5	117	75	111 0101	u
54	36	011 0110	6	118	76	111 0110	v
55	37	011 0111	7	119	77	111 0111	w
56	38	011 1000	8	120	78	111 1000	x
57	39	011 1001	9	121	79	111 1001	y
58	3A	011 1010	:	122	7A	111 1010	z
59	3B	011 1011	;	123	7B	111 1011	{
60	3C	011 1100	<	124	7C	111 1100	|
61	3D	011 1101	=	125	7D	111 1101	}
62	3E	011 1110	>	126	7E	111 1110	~
63	3F	011 1111	?	127	7F	111 1111	DEL

The ASCII CHAR. is the character that is sent, if that character is not a recognizable keyboard character (ETX for example) then generate the character by sending the appropriate CONTROL CODE. The CONTROL CODE is generated by pushing both the CONTROL (CTRL) key and the letter simultaneously.

USER SET UP INFORMATION		
Minimum Frequency	Pr0	
Maximum Frequency	Pr1	
Acceleration Time	Pr2	
Deceleration Time	Pr3	
Current Limit Timed	Pr4	
Max Continuous Current	Pr5	
Voltage Torque Boost	Pr6	
Slip Compensation	Pr7	
DC Braking Level	Pr8	
Serial Interface Address	Pr9	
Last Fault	PrA	
Security Code	Prb	
Speed or Torque Control Mode	b0	
Auto or Manual Start Mode	b1	
Method of Stopping	b2,b7	
Auto or Fixed Boost	b3	
Low Spead or Run Indic'n Output	b4	
Open Loop or Encoder Feedback	b5	
Master or Slave Drive	b6	
Frequency or Load on Display	b8	
Terminal or Keypad Control	b9	
Even or Odd Serial I/O Parity	b10	
Define current Loop or Freq Input	b11	
Serial Link Baud Rate	b12	
Set Defaults	b13	
Switching Frequency + U.L.F.	b14	
Maximum Voltage Frequency	PrC	
SET BY:		DATE: