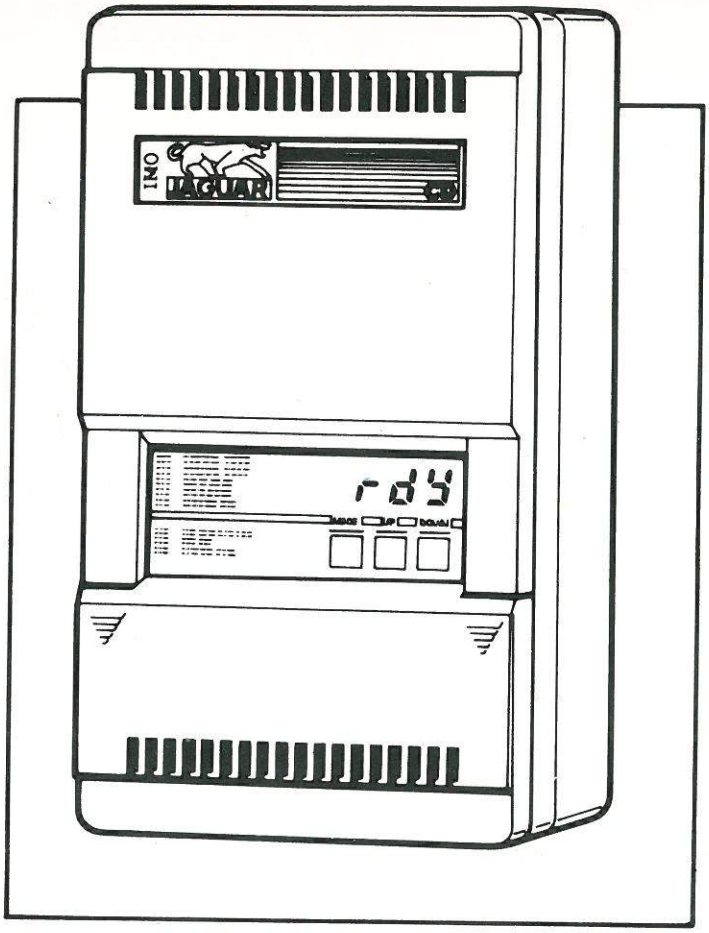


Jaguar CD
Range 0.75 ~ 7.5kW

User Manual

"Failure to read these instructions prior to installation and use, may result in damage to the drive and driven equipment and invalidation of the warranty".

IMO Ltd 1,000 North Circular Road London NW2 7JP
Phone 01-452 6444 Fax 01-450 2274 Telex 28514

REF: DCA 6/89
Code: 0177 — 7007

This manual applies to drives built after July 1989, fitted with version 5 software.

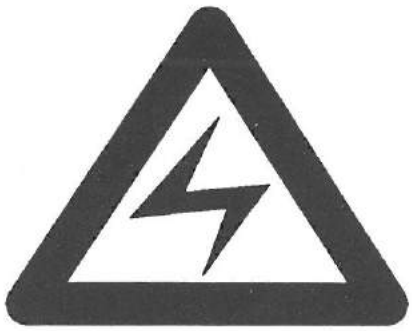
AC INVERTER

USER GUIDE

0.75 - 7.5 Kw

HEALTH AND SAFETY AT WORK

Electrical devices can constitute a safety hazard. It is the responsibility of the user to ensure the compliance of the installation with any local acts or bylaws in force. Only qualified personnel should install this equipment, after reading and understanding this users guide. The installation instructions should be adhered to, if in any doubt, consult with your supplier.



DANGER
ELECTRIC SHOCK RISK

Please note!

This equipment is supplied under warranty conditions, in force at the time of purchase, at your supplier. Contact your supplier for details. There are no user serviceable parts to this equipment, and only the front terminal access cover should be removed, when installing. Any attempt to dis-assemble or modify the unit will render any warranty agreement invalid.

The contents of this guide are believed to be accurate at the time of printing. The manufacturers, however, reserve the right to change the content, product specification, and performance criteria, without notice. No liability is accepted for the inappropriate, negligent, or incorrect set-up of the drive operational parameters, by the user, either by manual or automated means.

CONTENTS

1 GENERAL

1.0 KEY FEATURES

MODELS

- ❑ 0.75, 1.1, 1.5, 2.2, 4.0, 5.5, 7.5 kW
  for 380 V to 460 V, +/- 10 %, 3 phase supply.

- ❑ 2, 3, 5 hp
  for 220 V to 240 V, +/- 10 %, 3 phase supply.

P.W.M. CHARACTERISTIC

- ❑ User selectable, constant, high P.W.M. switching frequencies, (2.9, 5.9, 8.8, 11.7 kHz), to suit your application.

- ❑ Motor speeds digitally controlled from 0 Hz, to 480 Hz, with smooth rotation throughout.

- ❑ Motor is sinusoidally excited over the complete speed range, with no quasi-square wave mode of operation.

- ❑ Current limiting by modification of P.W.M. waveforms.

FEATURES PROVIDED BY THE MICRO-CONTROLLER

- ❑ Slip compensation as standard.

- ❑ Dc injection or dynamic braking is available

- ❑ Precise digital control of all inverter operations, eg. motor speed, applied voltage, etc. Sophisticated control is achieved without the use of extensive analogue circuitry.

- ❑ Many protection features are included to enable the drive to run under adverse operating conditions.

- ❑ All set-up parameters and diagnostics are saved during power down, to enable quick restarting of the drive, when power is re-applied.

- ❑ Ensures that motor is correctly fluxed under all load conditions.

DIGITAL COMMUNICATION

- ❑ Industrial and noise immune RS485 serial interface is standard, to provide control and monitoring of drive set-up, operation, and diagnostics.

- ❑ Protocol used is ANSI x 3.28 (revision 1976, subcat. 2.5 & A4).

1.0 KEY FEATURES

LED DISPLAY AND KEYPAD

- Used for stand alone commissioning and operation of the drive. The display will also show the reason for drive tripping.
- Provides accurate setting of all drive adjustments without the need for a multi-meter.

POWER ELECTRONICS

- Insulated Gate Bipolar Transistors (IGBT), form the inverter bridge power circuit and give high power, high speed switching, but require only low drive power.
- Auto-protecting IGBT gate drive circuits, allow fast phase to phase, and phase to earth short circuit protection.
- A fast response, flux balancing current transducer is used for current control and protection, within the inverter.
- Two Switched Mode Power Supplies (SMPS). The first, operating at 40 kHz, directly from the DC link, provides auxiliary voltage supplies for the control circuits. Regulation is maintained from 250 V DC to over 850 V DC, so the inverter will operate over a wide input voltage range. The second SMPS, provides isolated supplies to the IGBT drive circuits.

HARDWARE

- The package size is the same for all models, and the footprint is the smallest in it's class.
- A removable cover allows easy access to customer input and output connections, without the risk of contacting live parts of the inverter.
- Rugged flameproof plastic mouldings, attached to a custom heatsink, house the inverter control and power electronics. There are only two printed circuit boards, giving minimal interconnections and a simple and reliable assembly.
- The control board is a four layer pcb, with a ground plane, to minimise unwanted noise. Surface mount technology is used to miniaturise the circuits.

OPTIONS

- A braking unit, IBD-1, is available as a retro-fit option. This fits inside the drive, and terminals are provided for the connection of external power resistors.
- Add on boards available for multiple pre-set speeds and bipolar speed reference.

1.1 DESCRIPTION

The Inverter Drive is suitable for speed control of standard 3 phase induction motors, and special high frequency motors. The range covers 7 motor power ratings from 0.75 kW to 7.5 kW, with a 380 V (-10%) to 460 V (+10%) input voltage; and 3 motor power ratings from 2 to 5 hp, with a 220 V (-10%) to 240 V (+10%) input voltage. The motor is sinusoidally excited over the complete speed range. Maximum frequencies of 120, 240, or 480 Hz can be selected, with voltage / frequency characteristics being widely adjustable.

The block diagram shows the basic inverter drive configuration. The input AC supply is rectified to DC, and smoothed by the DC link capacitors. The IGBT output stage converts this DC voltage into a 3 phase P.W.M. output suitable for induction motors. The electronics power supply is derived from the DC link, by use of a Switch Mode Power Supply.

The control circuitry comprises of a digital micro-controller, (a complete microprocessor and memory system on a chip), and a digital custom integrated circuit, (P.W.M. ASIC). The micro-controller allows accurate frequency and voltage control, without the problems of drift, offsets or noise found in analogue controlled drives. The custom I.C. generates the required output waveforms, and also controls the LED display and inverter protection circuits.

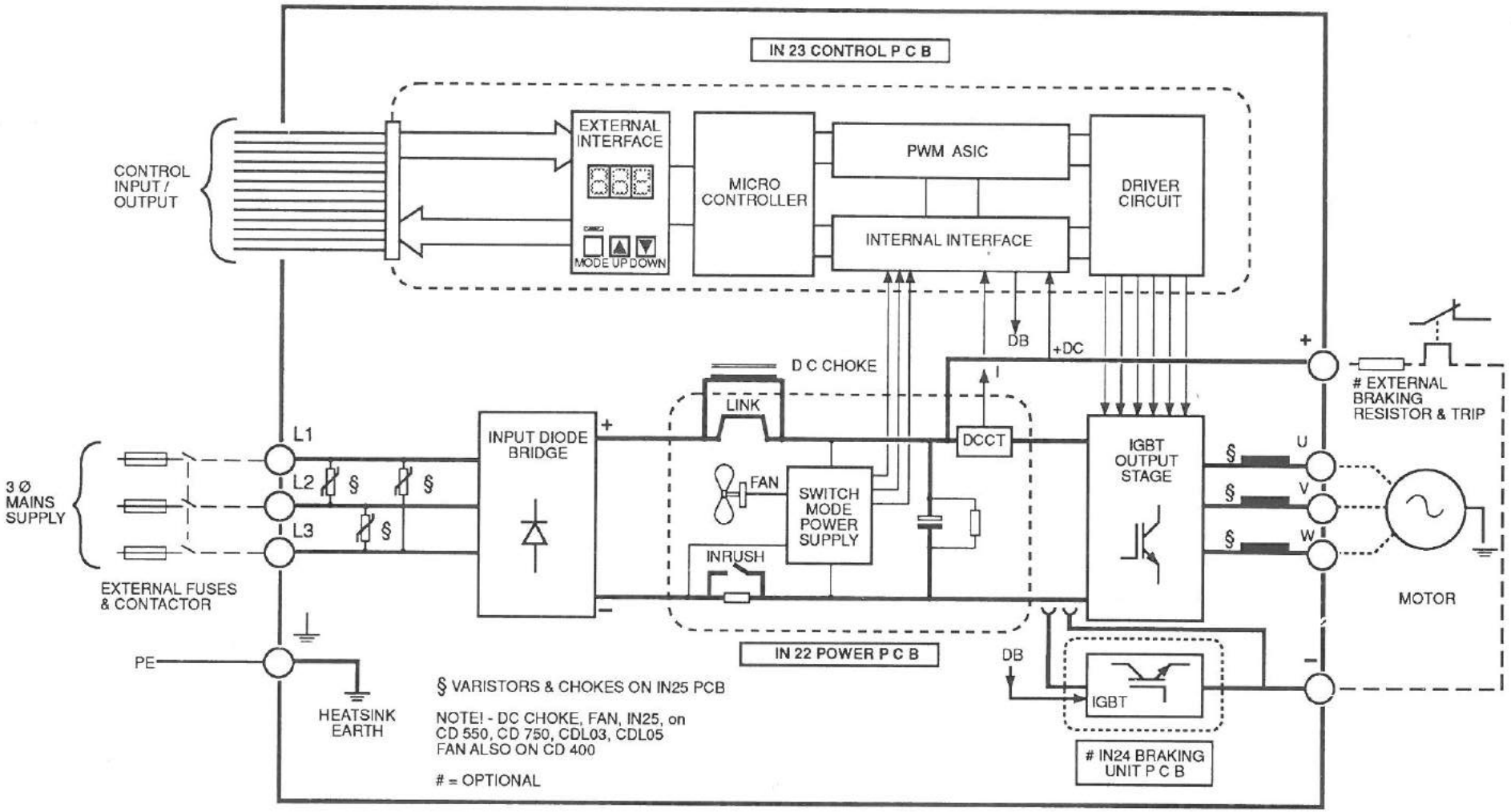
There are four levels of protection which ensure the drive will not trip unnecessarily, but will protect itself under all abnormal working conditions.

1. Current limiting in the frequency control loop.
2. Current limiting by modifying the P.W.M. waveform.
3. Instantaneous current trip
4. Individual power device protection

DC injection braking is available, over the complete speed range. Alternatively, dynamic motor braking from set speed, down to zero speed, is possible by use of the optional braking card, IBD-1 (IN24), and external power resistors.

The drive has a DIGITAL control system, so there are no preset potentiometers to set, or jumper-link options to set-up. Instead, all drive parameters are digitally set with the aid of the KEYPAD and LED display. These can be used to set the motor speed, and to monitor performance. The LED display can be set to indicate actual frequency, or to indicate the actual percentage full loading of the drive.

The drive is capable of communicating with a host computer system, via the serial interface. This facility provides remote control and monitoring of the drives' performance, as well as access to the diagnostic features. The electrical interconnection standard used is RS485, whilst the software protocol standard used is ANSI x 3.28.


IN 23 CONTROL P C B
CONTROL INPUT / OUTPUT
EXTERNAL INTERFACE
MODE UP DOWN
MICRO CONTROLLER
PWM ASIC
INTERNAL INTERFACE
DRIVER CIRCUIT
DB
+DC
D C CHOKE
LINK
I
DCCT
IGBT OUTPUT STAGE
EXTERNAL BRAKING RESISTOR & TRIP
L1
L2
L3
3 Ø MAINS SUPPLY
INPUT DIODE BRIDGE
FAN
SWITCH MODE POWER SUPPLY
INRUSH
U
V
W
MOTOR
EXTERNAL FUSES & CONTACTOR
PE
HEATSINK EARTH
IN 22 POWER P C B
DB
IGBT
IN24 BRAKING UNIT P C B
§ VARISTORS & CHOKES ON IN25 PCB
NOTE! - DC CHOKE, FAN, IN25, on CD 550, CD 750, CDL03, CDL05 FAN ALSO ON CD 400
= OPTIONAL

1.2 SPECIFICATION

STANDARD RANGE							
Model	CD75	CD110	CD150	CD220	CD400	CD550	CD750
Motor Rating kW	0.75	1.1	1.5	2.2	4.0	5.5	7.5
Max cont output current amps.	2.1	2.8	3.8	5.6	9.5	12.0	16.0
Input Voltage	Three phase 380 Vac -10% to 460 Vac +10%, 50 or 60 Hz						
Output Voltage	Three phase, voltage from zero to input level						
Cooling	Natural Ventilation				Fan		
Input Current A	3.0	4.0	5.5	8.0	13.0	12.0	15.0
Input p.f. lag	0.95					0.86	
Input kVA (415V)	2.2	2.9	4.0	5.8	9.3	8.6	10.8
Output kVA(415V)	1.5	2.0	2.7	4.0	6.8	8.6	11.5
Heat loss Watts (at 2.9 kHz)	45	50	60	90	130	170	220
Weight kg	3.4			4.1	4.3	5.5	

LOW VOLTAGE RANGE			
Model	CDL02	CDL03	CDL05
Motor Rating hp	2	3	5
Max cont output current amps.	8	11	17
Input Voltage	Three phase 220 Vac -10% to 240 Vac +10%, 50 or 60 Hz		
Output Voltage	Three phase, voltage from zero to input level		
Cooling	Natural Ventilation	Fan	
Input Current A	10	13	16
Input p.f. lag	0.95	0.86	
Input kVA (230V)	4.0	5.2	6.4
Output kVA(230V)	3.2	4.4	6.8
Heat loss Watts (at 2.9 kHz)	110	160	250
Weight kg	4.1	5.5	

Output Frequency Ranges 3 Upper Limit Frequencies (ULF) selectable:
0-120 Hz, 0-240 Hz, 0-480 Hz
resolution +/ 0.1, 0.2, 0.4 Hz, rspt.

Maximum Output Current 150% of Full Load Current, (FLC), for 30 s.

Output Waveform asynchronous sinewave P.W.M., with constant switching frequency, selectable from : 2.9, 5.9, 8.8, 11.7 kHz.

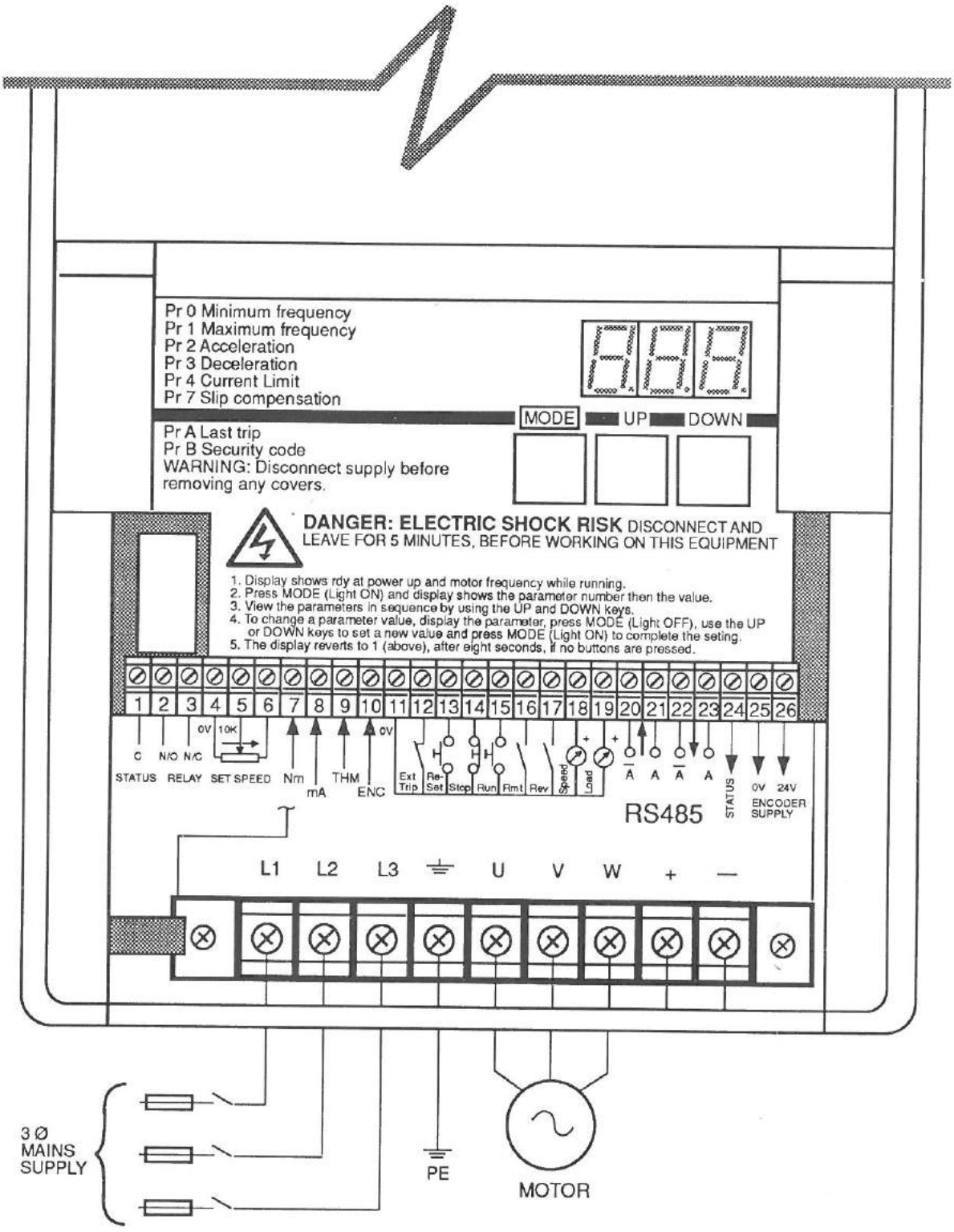
Control Technology digital, using a micro-controller and custom designed ASIC.

Operating Temperature -10 degC to +50 degC.

Humidity 5%-95% RH at 40 degC, non-condensing.

Altitude above 1000 m, derate 1%/100 m, to 4000 m max.

Enclosure Dimensions 305 H x 190 D x 165 W mm
IP10, flame retarding injection moulding.



FRONT VIEW OF DRIVE, WITH ACCESS COVER REMOVED.

1.3 CONTROL INPUT & OUTPUT

***** All inputs and outputs are isolated from the high voltage supplies *****

ANALOGUE INPUTS

Analogue reference terminal 6	+10 V reference, for potentiometer inputs, 5 mA.	
Analogue common terminal 4	zero volt (0V) common, for analogue inputs.	
Set speed (frequency) terminal 5	either LOCAL by	(i) potentiometer, 10k min. (ii) 0 to +10 V, 94k impedance
terminal 8	or REMOTE by	(i) 4/20 mA, 100 ohm impedance. (ii) 20/4 mA, 100 ohm impedance. (iii) 0/20 mA, 100 ohm impedance.
Set torque terminal 7		(i) potentiometer, 10k min. (ii) 0 to +10 V, 94k impedance
Motor Thermistor terminal 9	resistance input, for over-temperature shutdown. Trip above 3000 ohm, +/- 10%, resets at 1800 ohm. Must be linked out, if not required.	

DIGITAL INPUTS

Encoder /	open collector, 0 to +5 V, at 2mA. 15 pulses per motor pole per revolution.
Digital speed reference terminal 10	Output frequency to motor is equal to $^{1}/_{30}$ digital input frequency.
Digital common terminal 11	zero volt (0V) common, for digital inputs.
Drive trip terminal 12	open collector, 0 to +24 V, at 1mA. or N/C contact to 0V, impulse open to trip.
Drive reset terminal 13	open collector, 0 to +24 V, at 1mA. or N/O contact to 0V, impulse close to reset.
Drive stop terminal 14	open collector, 0 to +24 V, at 1mA. or N/C contact to 0V, impulse open to stop.
Drive run terminal 15	open collector, 0 to +24 V, at 1mA. or N/O contact to 0V, impulse close to run.
Local/Remote terminal 16	open collector, 0 to +24 V, at 1mA. or N/O contact to 0V, close to select remote reference
Forward/Reverse terminal 17	open collector, 0 to +24 V, at 1mA. or N/O contact to 0V, close to select reverse.
Serial Interface terminal 20,21	RS485, 2 lines for differential RECEIVE. T20 = $\overline{A}$, T21 = A.

1.3 CONTROL INPUT & OUTPUT

**** All inputs and outputs are isolated from the high voltage supplies *****

ANALOGUE OUTPUTS

Analogue common terminal 4	zero volt (0V) common, for analogue outputs.
Frequency (speed) terminal 18	0 to +10 V, at 5mA, = 0 to <Pr1> accuracy = +/- 2%
Load (torque) terminal 19	0 to +/-10 V, at 5mA, = 0 to 150% FLT + = motoring, – = regenerating. accuracy = +/- 10%, above 15 Hz, (matched motor).

DIGITAL OUTPUTS

Serial Interface terminal 22,23	RS485, 2 lines for differential TRANSMIT. T22 = $\overline{A}$, T23 = A.
Drive Status terminal 1,2,3	status (run/fault) relay, volt free C/O contact. 240 V, 7A, ac resistive. T1 = common, T2 = N/O, T3 = N/C, in FAULT or POWER OFF conditions.
Drive Running / Low Speed terminal 24	open collector, 0V to +24V, at 50 mA (current sink). low speed or drive running indication. Selected by bit parameter b4. 0V represents either drive running or speed less than (or equal to) Pr0.
Encoder supply terminal 26	+24Vd.c. at 50mA, for encoder supply.
Encoder common terminal 25	Zero volt (0V) common, for encoder supply.

1.4 CONTROL ADJUSTMENTS

PARAMETER VALUES

By use of the KEYPAD and the LED display, 10 drive parameters can be readily adjusted and monitored. These parameters are numbered Pr0 to Pr9 , and are used to set-up the drive for it's intended application. (They are analogous to pre-set potentiometers, found in analogue drives). Before adjusting these values it is necessary to enter a 3 digit security code into Prb when the drive is powered up. Once this is done Pr0 to Pr9 are continuously adjustable. Parameters may be read without entering the security code, they can also be accessed via the serial link. The effect of adjusting parameters is immediate, ie the drive will respond to the parameter whilst it is being altered.

Note : to distinguish between the parameter reference, and it's actual value, the following notation is used :

reference number = Pr2 , actual value = <Pr2>

The initial factory set value is shown in { }

Pr0 - Minimum frequency , 0 to <Pr1>, in Hertz.
{ 0.0 Hz }

Pr1 - Maximum frequency , <Pr0> to ULF, in Hertz.
{ 50.0 Hz }

Pr2 - Acceleration time , 0.2 to 600 seconds, from 0 to ULF Hz.
{ 5.0 s }

Pr3 - Deceleration time , 0.2 to 600 seconds, from ULF to 0 Hz.
{ 10.0 s }

Pr4 - Current limit (timed) value , <Pr5> to 150% of full load current.
{ 150 % }

Pr5 - Continuous output current , 10% to the lesser of <Pr4> or
{ 100 % } 105% of full load.

Pr6 - Voltage (torque) boost , up to 25.5% of maximum voltage.
{ 5.1 % }

Pr7 - Slip compensation , up to 5, 10, or 20 Hertz, (for 120, 240 or 480Hz U.L.F.) at <Pr5>% load. Will not function in alternative dynamic braking mode (b2 & b7= 1).
{ 0.0 Hz }

Pr8 - DC braking level , 40% to 150% of full load current.
{ 150 % }

Pr9 - Serial interface address (00-99).
{ 11 }

Once the security code has been set, these parameters can be monitored or adjusted whilst the drive is running, simply by pressing the MODE key, and using the UP and DOWN keys, to call up the parameter reference number. The LED display will then alternate between the number of the parameter and it's current value, for 8 seconds, before reverting to displaying frequency, (or load).

1.4 CONTROL ADJUSTMENTS

BIT PARAMETERS

There are 16 bit parameters , which define how the drive is to function. These are the digital equivalent of jumper-links or switch selectors, found in analogue drives, which define the drive set-up options. For this reason, to access the bit parameters it is necessary to enter a 3 digit security code into parameter Prb after power up and ensure that the drive is in a ready state, (not running), immediately before adjusting a parameter, i.e the drive must show [rdY]. Bit parameters may be read whilst the drive is running and also without entering the security code Most of the bit parameters are of binary format, ie they are either a '1' or a '0'. Some, however, are multi-choice. In either case they are adjusted in the same way as the parameter values are, by use of the UP and DOWN keys.

		factory set
b 0 =	speed or torque control mode.	{ 1 = speed }
b 1 =	auto start or manual start mode	{ 0 = auto }
b 2 = **b 7**	Braking mode. Coast, ramp, DC or dynamic brake.	{ 0 = ramp & } { 0 dynamic }
b 3 =	auto boost or fixed boost	{ 0 = auto }
b 4 =	low speed or drive running output	{ 1 = run }
b 5 =	open loop or encoder feedback	{ 1 = open }
b 6 =	master or slave drive for serial I/O	{ 0 = master }
b 8 =	frequency or load indication on LED's	{ 0 = freq. }
b 9 =	terminal or keypad control	{ 1 = term. }
b10 =	even or odd serial I/O parity	{ 0 = even }
b11 =	define current loop type: 4.20 or 20.4 or 0.20 mA.or select frequency input : Fr.	{ 4/20 ma }
b12 =	define serial I/O BAUD rate : 4.8 (4800) or 9.6 (9600)	{ 4.8 BAUD }
b13 =	set all parameters to their DEFAULT values (1 to set, 0 to release, <PrA> = [Et])	{ 0 = release }
b14 =	define drive switching frequency and Upper Limit Frequency 2.9 or 5.9 or 8.8 or 11.7 kHz : 120 , 240 or 480 Hz.	{ 2.9 kHz } { 120 Hz }
Prc =	sets the maximum voltage frequency point between U.L.F. and U.L.F./16 Hz.	{ 50 Hz }

The security code is initially factory set to zero, <Prb> = [0]

1.4 CONTROL ADJUSTMENTS

DIAGNOSTICS : LAST TRIP

Another parameter which can be accessed, is PrA , which contains the original cause of any drive trip that occurs. There are 10 possible trip conditions, and these have fault codes which appear, (flashing), on the display, when the trip occurs. The first trip is stored in parameter 'A', and subsequent trips are ignored. If the drive is powering down, after a trip, but before being reset, then the display will show [_ UU] indicating power loss, but on powering up, PrA will hold the cause of the trip, and not [UU], (unless that was the trip). Note : The display normally indicates [rdY], if in a ready (to run) state, or motor frequency/load, if running.

Fault Codes:

[Et] = external trip, (contact to terminal 12 opens).
(appears in PrA if bit 13 is used to reset parameters to factory settings)

[cL] = current loop loss (when 4/20 or 20/4mA option selected)

[th] = motor thermistor overload trip, (if used).

[It] = integrating overload, Ixt trip.

[OI] = overcurrent, instantaneous trip, caused by short circuit, or earth fault, or excessive shock load.

[UU] = undervoltage, low mains volts (or powering down).

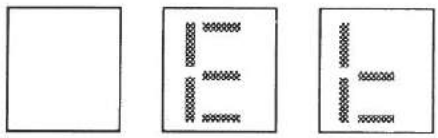
[OU] = overvolts, due to high mains volts, or excessive deceleration rate.

[Oh] = overheat, internal temperature of heatsink too high.

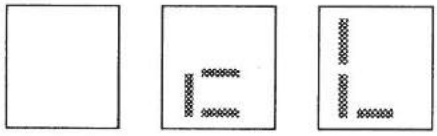
[PS] = power supply fault, (internal), { factory use only }

[Err] = error, a hardware fault within the drive.
{ factory use only }

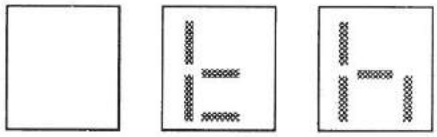
External Trip



Current Loop Loss

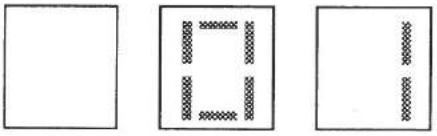


Thermistor (Motor)

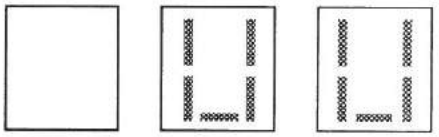


Integrating Overload

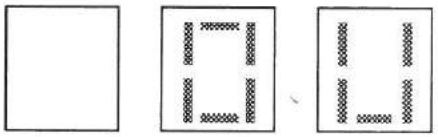
Over Current



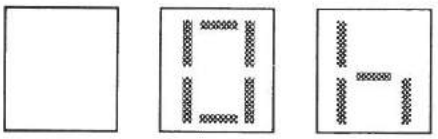
Under Voltage



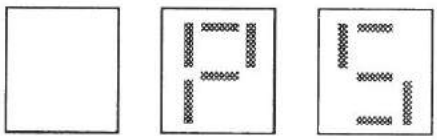
Over Voltage



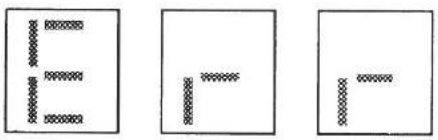
Overheat



Power Supply



Hardware Error

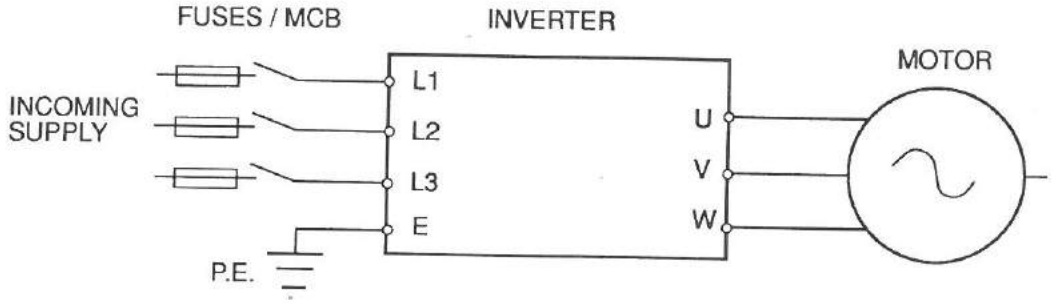


2 INSTALLATION & APPLICATION GUIDE

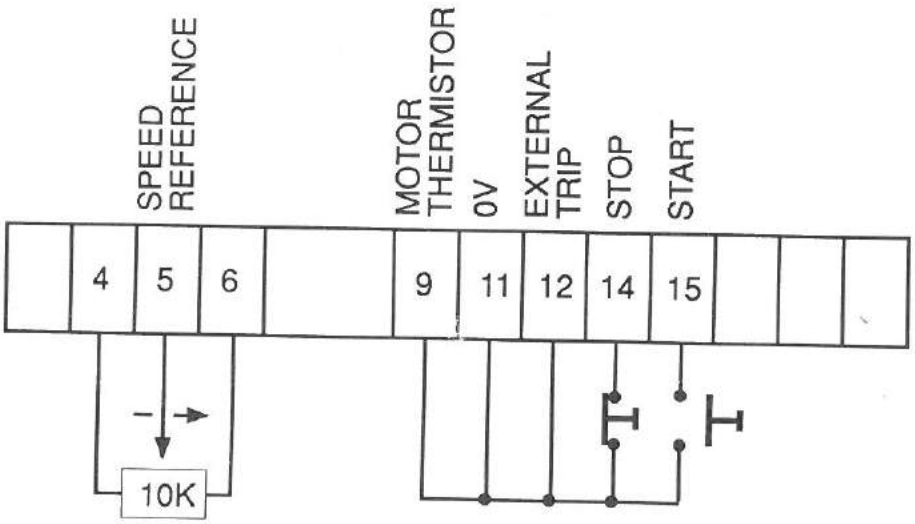
2.0 GETTING STARTED - BASIC SET UP

NOTE! Failure to adhere to the instructions in this section will render any warranty invalid. For detailed explanation refer to relevant section in user guide.

The inverter is used to control the speed of a standard 3-phase induction motor by electronically varying the supply to the motor. The drive therefore must be connected in-line with the motor as shown below (see sections 2.2 and 3.0).



In order to allow control of the motor, by the user, various electronic inputs to the inverter are required. The most basic arrangement being shown below (see sections 2.2 and 3.0).



If power is now applied to the drive, the motor can be started, stopped and its speed varied. The inverter will need setting up to match the system requirement. This can be achieved by use of the drives adjustable parameters and drive bit parameters. A parameter value is continually adjustable whilst the drive is running and is used to set functions such as maximum and minimum speeds, acceleration rates, current limits etc (see sections 1.4 and 3.1). A drive bit parameter can only be adjusted when the drive is not running, ie in a "ready" state (rdY). Bit parameters are used to set up functions such as, method of stopping, type of input reference, serial communications characteristics etc (see sections 1.4 and 3.2)

2.1 MECHANICAL

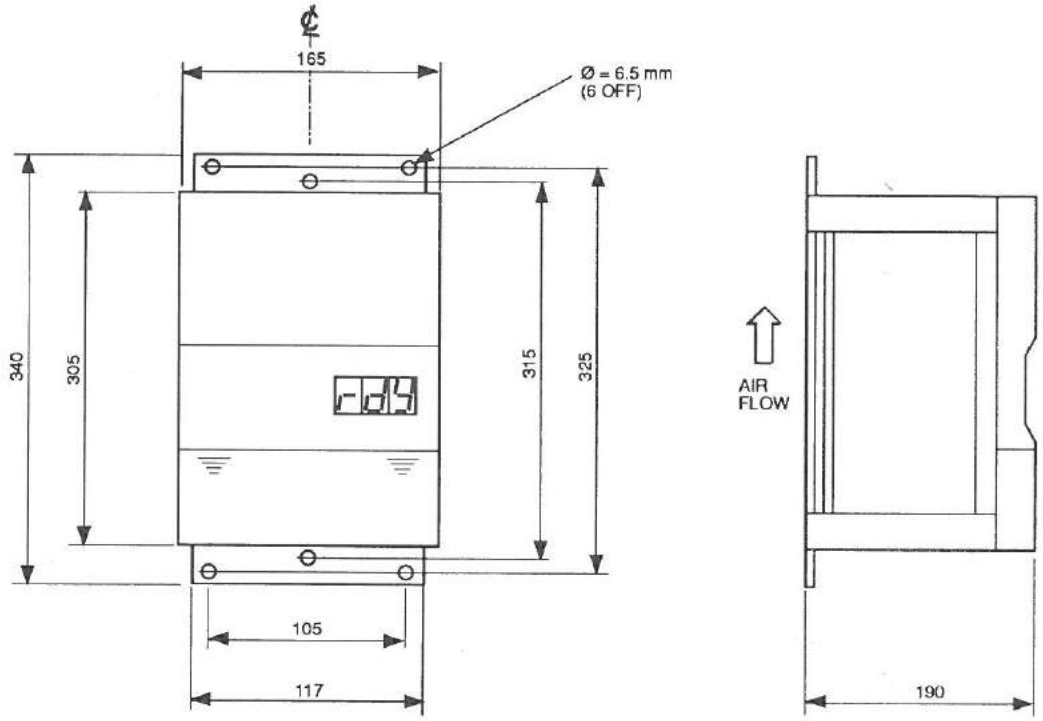
The drive is constructed to IP10 and consequently is intended to be mounted inside a protected electrical control equipment enclosure. The installation should be free from harmful dust, corrosive gases, and any liquids. Care should be taken to avoid condensation of vaporised liquids.

It is important that the heat dissipated by the drive, (see Watts lost data, in section 1.2), plus that from any other heat source, does not raise the mounting enclosure's internal temperature to above the maximum allowed operating ambient, of +50 degC. De-rate, or force cool if necessary. Note that low ambient temperatures not only reduce the need to de-rate at high switching frequencies, (see 2.3), but will also increase the operational life of the drive's electrical and electronic component parts.

It is essential that the unit is mounted vertically, and that there is sufficient clearance around the unit, to ensure correct air flow over the heatsink cooling fins. Allow 100mm clear space above and below the unit, and 50 mm clear space at the sides and from the front face.

The mounting detail, shown below, gives the overall dimensions, and mounting bracket fixing centres. Fit the upper bracket to the mounting plate first, then hook the lower bracket into the unit's lower end moulding. Hook the unit onto the upper bracket, and secure the lower bracket to the mounting plate.

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



NOTE! 4 hole fixing is sufficient.

2.2 ELECTRICAL

!!! DANGER !!! ELECTRIC SHOCK RISK
DISCONNECT THE MAINS SUPPLY TO THE DRIVE, AND LEAVE FOR 5 MINUTES, BEFORE WORKING ON THE EQUIPMENT, OR REMOVING THE TERMINAL ACCESS COVER.

Connect the 3 phase mains supply to the large terminals, L1-L2-L3. Discard the " WARNING: FIT FUSES.." label. Connect the motor connections, to the large terminals, U-V-W. The inverter MUST BE EARTHED. The mains supply should be fed via an isolator, contactor, or M.C.B.. For up to 1 start per hour, mains switching alone, may be used to stop / start the drive. Use the electronic stop / start control, if more frequent starts are required, to reduce contactor wear.

!!! IMPORTANT !!! THE MAINS SUPPLY TO THE DRIVE MUST BE PROTECTED BY EITHER FUSES, OR AN M.C.B.

Adhere to local regulations when choosing fuse and cable types and sizes, refer to section 1.2 for input currents, on full load.
Typical sizes are :

MODEL	FUSE	POWER CABLE
CD 75,CD110	6A	1.0 mm^2
CD150,CD220	10A	1.5 mm^2
CD400,CD550,CDL02,CDL03	16A	2.5 mm^2
CD750,CDL05	20A	2.5 mm^2

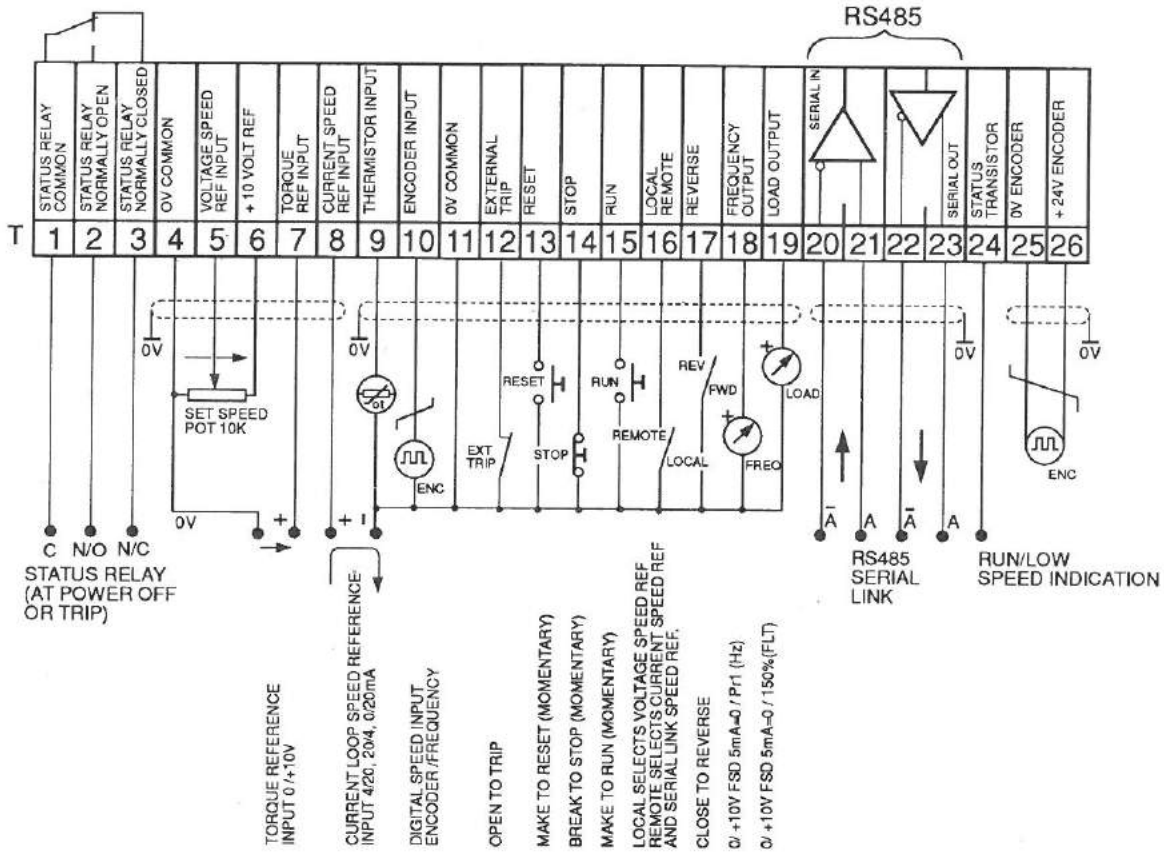
The power cable should be rated 600V / 1000V (ac / dc), for the STANDARD RANGE, and 300V / 600V for the LOW VOLTAGE RANGE. The same power cable can be used for the motor connections. Physically segregate power cables from control cables.

The power connections to the motor, from the drive output, may be switched, for isolation purposes, but not for control purposes, as the drive may trip. Installations prone to mains voltage disturbances may need special considerations; if so, consult with your supplier.

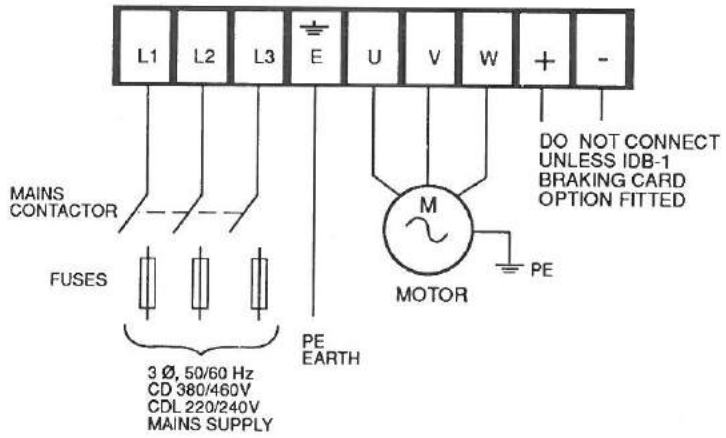
Installations with long cable runs, to the motor, may need the addition of motor line chokes, to prevent nuisance tripping of the drive, <PrA> = [_ OI], caused by capacitative leakage effects. Refer to table below .

Table showing length of cable above which motor line chokes may be required							
Drivesize	CD75	CD110	CD150	CD220	CD400	CD550/750	Required Choke Value
Cable Length(m)	30	40	50	60	80	140	1mH
	90	125	145	165	200	300	2mH
	5A	5A	5A	9A	9A	20A	Current rating

For control interconnections, use cable of 0.5 mm^2, overall screened. Connect the screen to 0V at the drive end only. Segregate control cables and encoder / digital reference signals, from power cables. Use screened twisted pair cables, for the RS485 Serial Link and encoder/digital speed reference signals. All contactor coils, solenoid and brake coils should be suppressed, with an RC network, or equivalent.



CD CONTROL CIRCUIT INTERCONNECTION



NOTE!

1. FUSES MUST BE FITTED (OR MCB). FOR VALUES SEE SECTION 2.2
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

2.3 ELECTRONIC

TERMINAL CONTROL <b9> = 1

The drive is despatched set for speed control by an external speed reference signal, which enters via the control terminals. When T16 is open circuit, ie LOCAL, the speed reference comes from T5. When T16 is switched to 0V, the speed reference is fed from one of three REMOTE sources. If bit parameter 6 is set to '0', ie MASTER, the remote source is the current loop reference input, from T8 or frequency input from T 10. The type of current loop, (4/20 or 20/4 or 0/20 mA) or frequency input, can be selected using bit parameter 11. If bit parameter 6 is set to '1', ie SLAVE the remote source is from the Serial Interface. T16 also controls the source of the torque reference signal, either LOCAL = T7, or REMOTE = Serial Link. In any of the above configurations, the speed and torque reference signals can always be read via the Serial Link. The torque reference input is always active, with 0V = 10%, and +10V = 100% of <Pr4>. If torque control is selected by setting b0 = 0, the speed reference is fixed at +/- <Pr1>.

REVERSING

Connecting T17 to 0V, will cause the motor to reverse direction. The drive will ramp down to zero speed, reverse, and ramp up, to set speed. If the DB braking system is fitted, it will operate during deceleration.

EXTERNAL TRIP

If the normally closed contact between, T12 and T11, opens, then the drive will trip, and the display will flash [_ Et]. The motor will coast to stop.

RESET

A trip condition may be reset, either by switching the mains supply OFF / ON, or by momentarily switching terminal T13 to 0V. After a trip the drive may be reset immediately but will not start until 1 second after the trip has cleared. If reset is pressed before the 1 second start up delay, the display will stop flashing and the fault code will become steady. One second after the fault has cleared the drive will either restart (auto start) or display [rdY] (manual start) and can then be restarted.

If the reset occurs more than 1 second after the fault has cleared the drive will restart (auto start) or display [rdY] (manual start) immediately

KEYPAD CONTROL <b9> = 0

This method of control is recommended for commissioning purposes rather than for normal drive control. By changing bit 9 to a '0', control of speed, stop/start, and reset, can be achieved using the keypads alone. All control inputs are inhibited, except for the serial link, reverse input T17, and the motor thermistor input, T9, (T9 can be linked to T11, if not used)

The serial link can adjust the speed and torque references, provided that both REMOTE (T16=0V), and SLAVE (b6 =1), have been selected. As in TERMINAL control, the serial link can READ both the speed and torque set points.

If auto start, <b1>=0, has been selected, the drive will, on power-up, accelerate to the last speed set. If manual start, <b1>=1, has been selected, the drive will, on power-up, display [rdY]. To start the drive, just press either the UP or DOWN keys, and the drive will accelerate to the last speed set. The output frequency can be increased or decreased by using the UP or DOWN keys. The display shows the set point frequency, SP, and not the actual frequency, AC, (which is indicated in TERMINAL control).

2.3 ELECTRONIC

KEYPAD CONTROL <b9> = 0
If the drive should trip whilst in keypad control, it can be reset by pressing either the UP or DOWN key. To stop the drive, firstly, reduce the speed to minimum, Pr1, using the DOWN key, then wait 8 seconds and the drive will stop itself, and the display will show [rdY]. To re-enter TERMINAL CONTROL, stop the drive to obtain [rdY], enter bit parameters, and set b9 to 1.

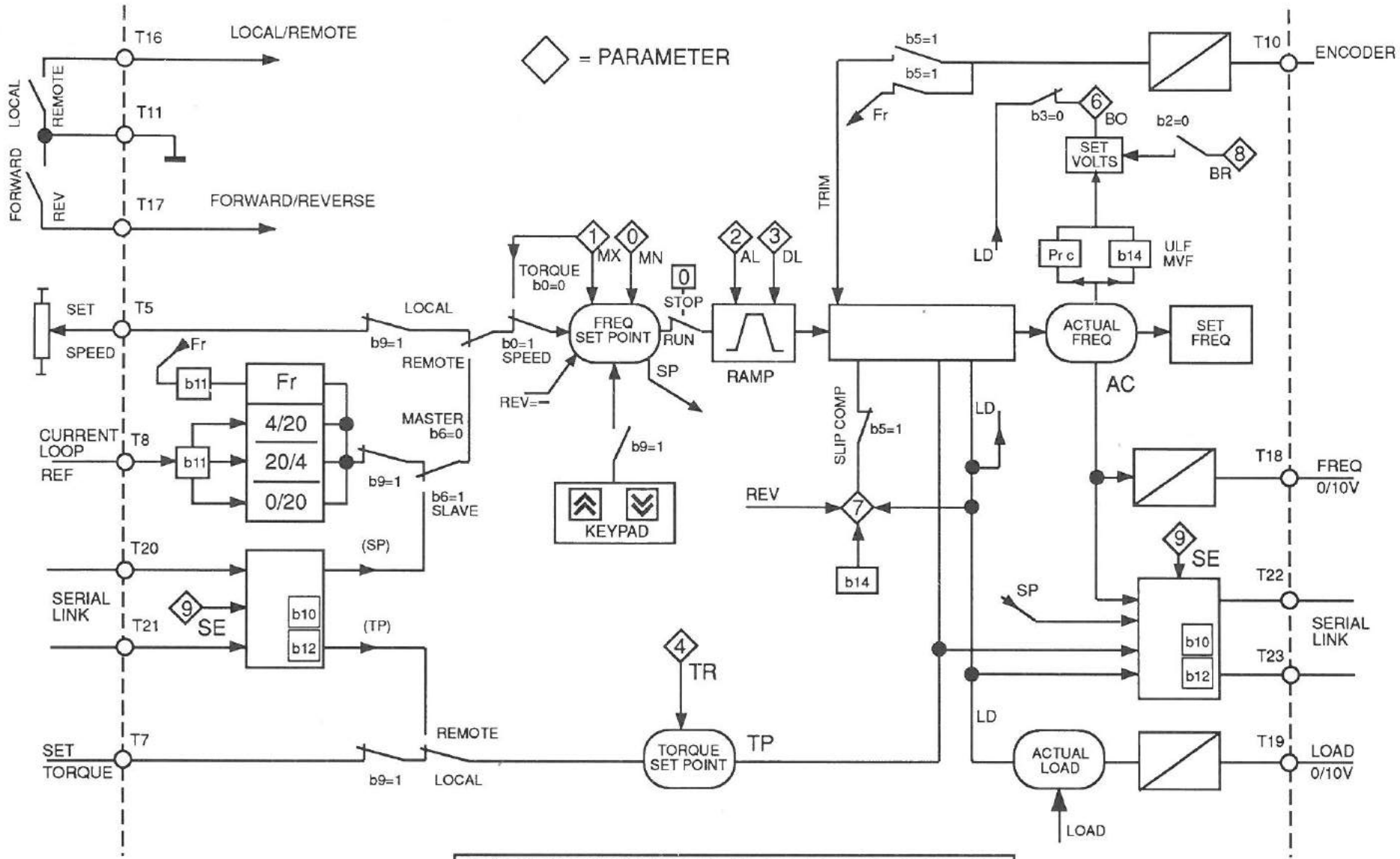
Reversal of the motor can be performed by use of the FWD/REV Terminal T17.

ENCODER SPECIFICATION
Encoder feedback may be selected <b5>=0, see section 3.3.

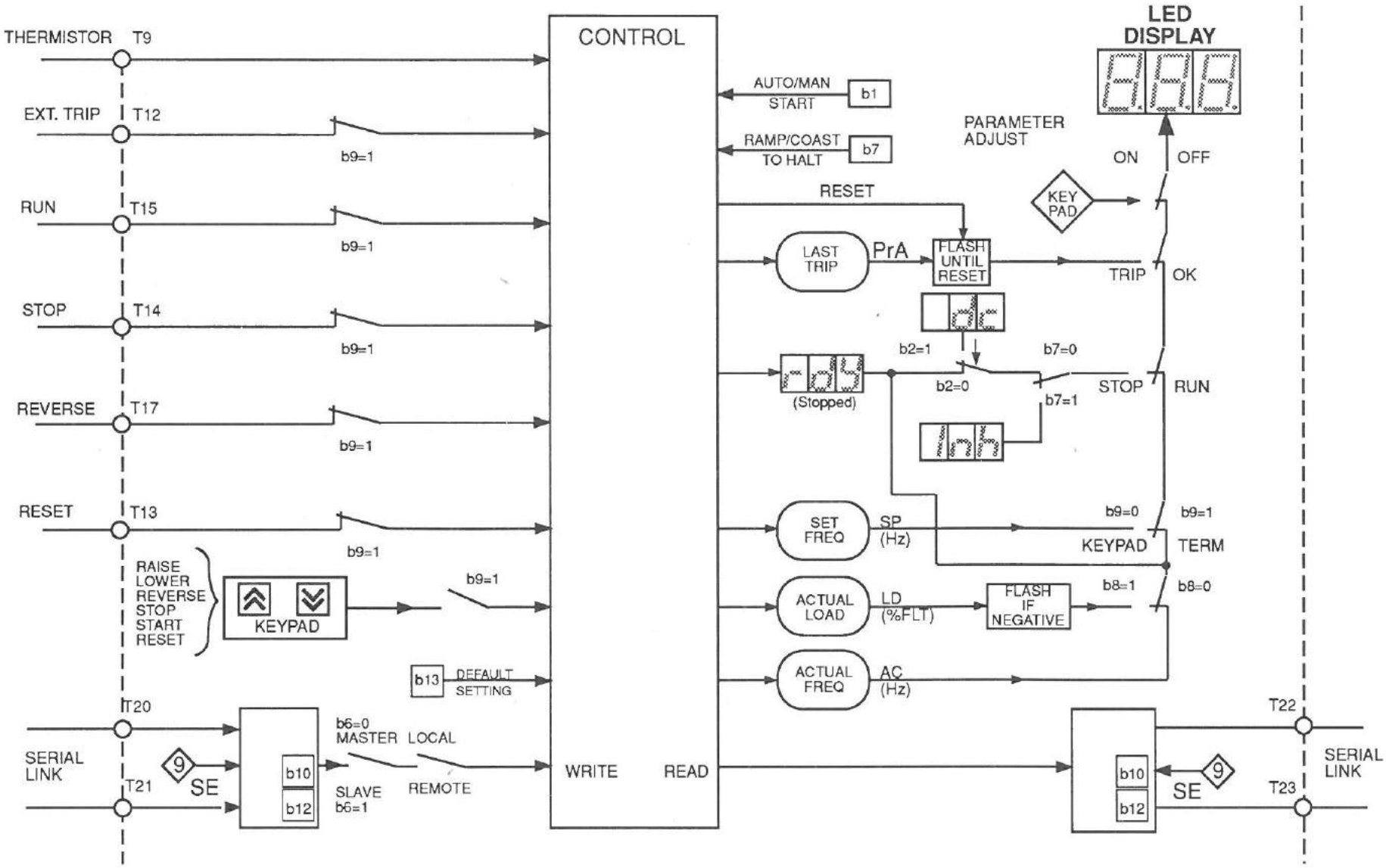
The encoder must have the following specifications.

Pulse rate -	15 pulses per rev per motor pole ie. 30 pulse per rev for a 2 pole machine 60 pulse per rev for a 4 pole machine.
Output -	Rectangular squarewave (quadrature or complement signals not required) Amplitude nominally equal to supply. Mark space ratio 40:60 to 60:40. Rise and fall times not to exceed 50 micro-seconds.
Supply Requirements -	The inverter will accept either 1) 24V signal (current sink) 2) 5V signal (source and sink) The inverter will supply +24V at 50mA max via terminals 25 (0V) and 26.(+24v)
Cable Requirements -	Minimum Requirement - 3 core overall screened to 0V. (short distance) Ideal Requirement - 2 twisted pairs, overall screened to 0V. 1 pair power supply, 0V. 1 pair signal, 0V.

0V and screen can be earthed, but experience shows that this can increase the received noise level.



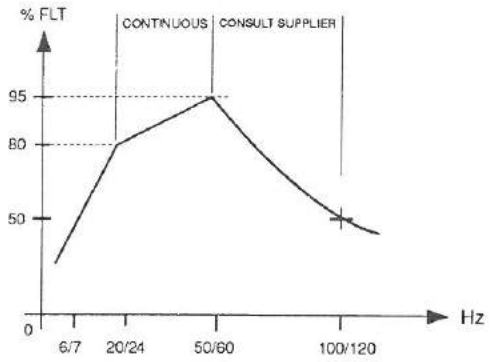
CD FREQUENCY AND LOAD REFERENCE CONTROL

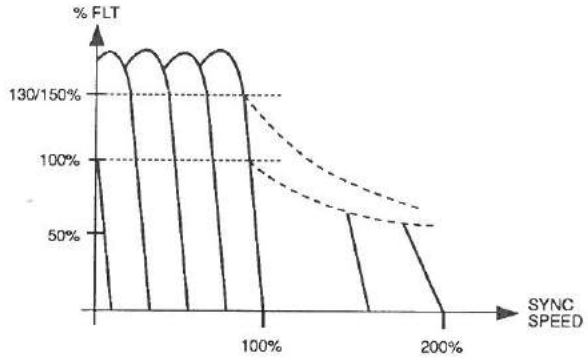


CD COMMAND AND DISPLAY CONTROL

2.4 DRIVE AND MOTOR SELECTION

MOTOR RATING





When the speed of a standard induction motor is reduced, the speed of the cooling fan is also reduced, and with it the amount of air necessary to ensure effective motor cooling. In addition, because the Inverter output is not exactly sinusoidal, the motor losses are slightly increased. Accordingly, the available motor output torque will be less than the rated value, ie de-rated, unless class F insulated motors are used.

To protect the motor at low speeds, it should be equipped with thermistors to trip the drive (T9). Alternately, thermal relays could be used to trip the drive (T12). If using a motor of next larger size than the drive, de-rate the drive by another 10%, to allow for the lower inductance. Consult your supplier, for further information.

DRIVE RATING

The ratings given in section 1.2 , are for the 2.9 kHz switching frequency, at 50 degC ambient. For higher switching frequencies, the maximum allowable continuous output current may have to be reduced.ie Pr5 de-rated. The chart below indicates whether de-rating is required for each model, at different switching frequencies, for ambient temperatures of 25 and 40 degC.

drive	switching frequency kHz 5.9	8.8	11.7	Tamb degC
CD 75				>25
				>40
CD 110				>25
				>40
CD 150				>25
		▒▒▒	▒▒▒	>40
CD 220			▒▒▒	>25
		▒▒▒	▒▒▒	>40
CD 400				>25
				>40
CD 550				>25
			▒▒▒	>40
CD 750		▒▒▒	▒▒▒	>25
	▒▒▒	▒▒▒	▒▒▒	>40
CDL 02			▒▒▒	>25
		▒▒▒	▒▒▒	>40
CDL 03				>25
			▒▒▒	>40
CDL 05		▒▒▒	▒▒▒	>25
	▒▒▒	▒▒▒	▒▒▒	>40

▒▒▒ = de-rate.

Ambient temperature is that outside of CD, ie that of the enclosure in which the CD is mounted.

To derate, refer to the curves at the end of this guide. For the known Tamb, and a switching frequency, read off the max motor amps allowed. Adjust Pr5 to suit this value.
eg CD220, 11.7 kHz, 30 degC ambient.
max amps = 4.45 Amp
= 79.5% FLC
set <Pr5> = 79.5

2.4 DRIVE AND MOTOR SELECTION

Note that Pr4 may still be set at 150% FLC, even if Pr5 is de-rated. Note also, that the drive has an in-built thermistor thermal trip protection system, <PrA> = [_ Oh], to prevent overheating. Low switching frequencies give high starting torques, whilst high switching frequencies give a smoother sine wave motor current, and will produce almost no audible noise.

2.5 SPECIAL CONSIDERATIONS

RFI : In common with all inverter drives, the unit will produce a certain level of Radio Frequency Interference. It is the users' responsibility, to ensure compliance with local requirements for RFI control. Filters specifically designed for use with the inverter are available from your supplier. In some cases general purpose mains supply RFI filters may be sufficient. Note that lowest levels of RFI emissions occur at the lowest switching frequencies.

MOTOR SPEED : *** WARNING *** Standard induction motors are not designed to operate at 240 or 480 Hz. Any attempt to run such a motor at above twice synchronous speed may result in catastrophic motor failure. Consult your motor supplier for advice and details of special high frequency motors.

2.6 OPTIONS

a) IBD-1

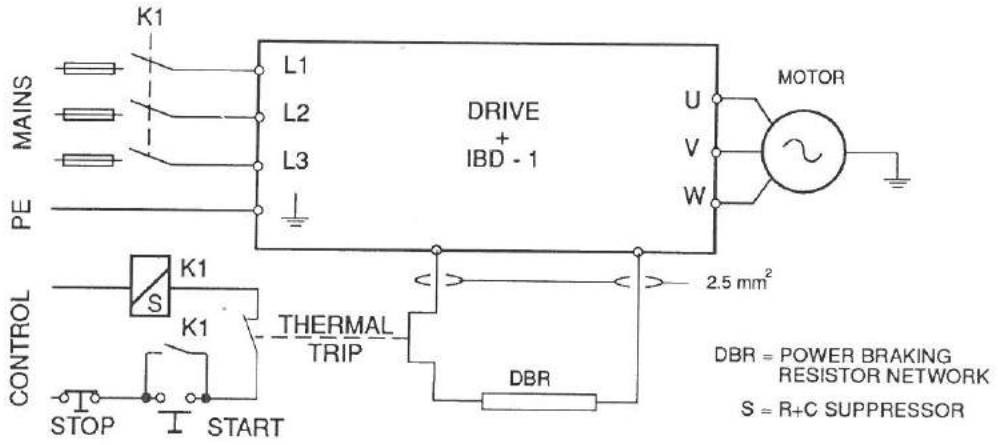
A dynamic braking unit, the IBD-1, is available as an option. This unit MUST be fitted by your supplier, who should be contacted for details. External braking resistors should be wired to the + and - terminals. It is most important that the thermal trip contact, should be wired into the mains supply contactor control circuit, such that it will open the contactor, in the event of a fault.
Two methods of controlling the operation of DB braking are available. Standard control is used in the majority of applications, whilst an alternative version can be chosen for systems requiring fast stopping, especially with high inertia loads.

Braking current : 20 A dc for 20 seconds max
Braking torque : dependent on system inertia and resistor values.
Braking duty : 30% on and 70% off max.
Protection : by external thermal trip and mains supply contactor
Trip type : Weber T12 series. Type T12-221SN.
Trip time : 15 seconds nominal (at 415V mains supply)

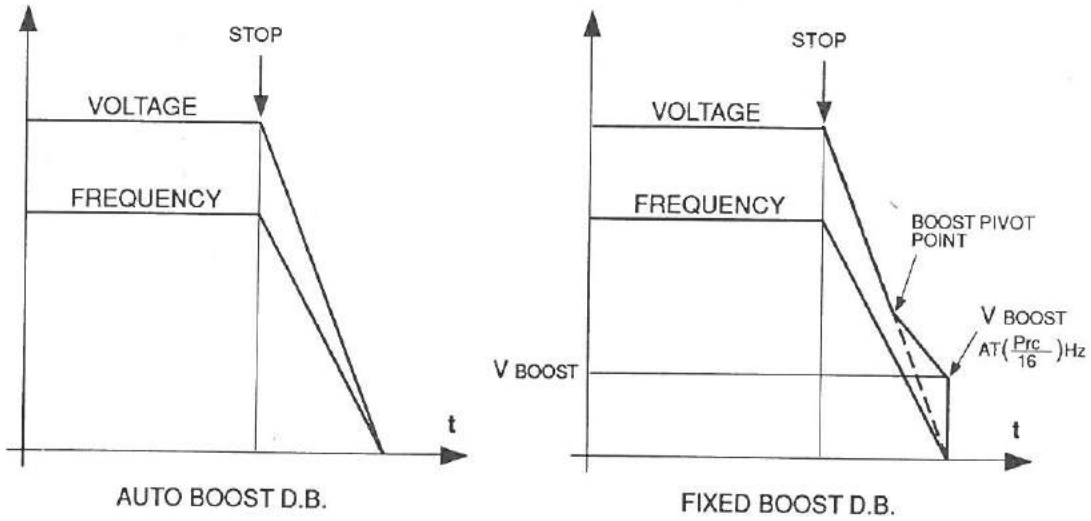
Standard DB braking can be selected by setting bit parameters b2 and b7 to 0.
Alternative DB braking can be selected by setting bit parameters b2 and b7 to 1.
Slip comp (Pr7) is not available in this mode, Pr 7 is then used to set the level of an instantaneous frequency drop when mains power loss is detected. This prevents some undervoltage trips and causes the drive to STOP. The drive must then be restarted.
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. With standard DB braking this effect does not occur if auto-boost has been selected. DB braking also operates when reversing, and when reducing the speed reference.

DB RESISTOR + THERMAL TRIP VALUES					
	Standard DB	Alternative DB			Either
Drive size	CD 75-CD 750	CD 75-CD 150	CD 220-CD 400	CD 550-CD 750	CDL
Resistor value	150R	200R	80R	50R	50R
Trip value	1.5A	1.2A	3A	5A	2A

2.6 OPTIONS IBD -1



Effect of boost when using standard DB braking



2.6 OPTIONS

b) MULTIPLE PRE-SET SPEED BOARD

The multiple pre-set speed board allows a choice of pre-selected speed demand inputs to be used. A choice from either 1 of 3 on board potentiometers VR1/2/3 or an external input is available.
Choice of speed input is made by using 2 input terminals, see table below.

Control Terminals

TI 'Ref1' Logic Input { Open collector, 0V+24V, at 2 mA
T2 'Ref2' Logic Input { or C/O contact
T3 '0V' OV
T4 'SPEED' External set speed: (i) Potentiometer, 10k min.
(ii) 0 to 10V, 94k input impedance.

Control Input		Speed Demand
T1	T2	
0	1	VR1
1	0	VR2
0	0	VR3
1	1	T4

0 = Connect terminal to 0V
1 = Open terminal or logic high

The Multiple Pre Set Speed board is fitted to the Control terminal block of the inverter.

c) BI-POLAR SPEED REFERENCE BOARD

The bi-polar speed reference board allows the user to provide the drive with a +/-10V speed demand signal. The add on board converts the input demand to a 0 to+10V signal with a reverse command to the drive when the signal is negative.

Control Terminals

T1 0V
T2 Speed reference 0 to +/- 10V impedance 22k
T3 +24V at 50mA

The Bi Polar Speed reference board is fitted to the Control terminal block of the inverter.

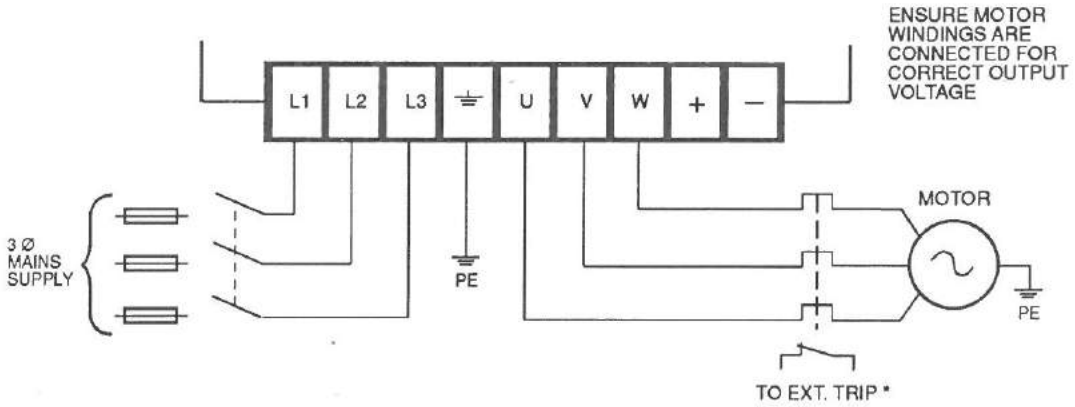
N.B. Only one of the options (b) and (c) can be fitted to the drives control terminal block at one time.

3 STARTING & ADJUSTING

3.0 ADJUSTING PARAMETERS

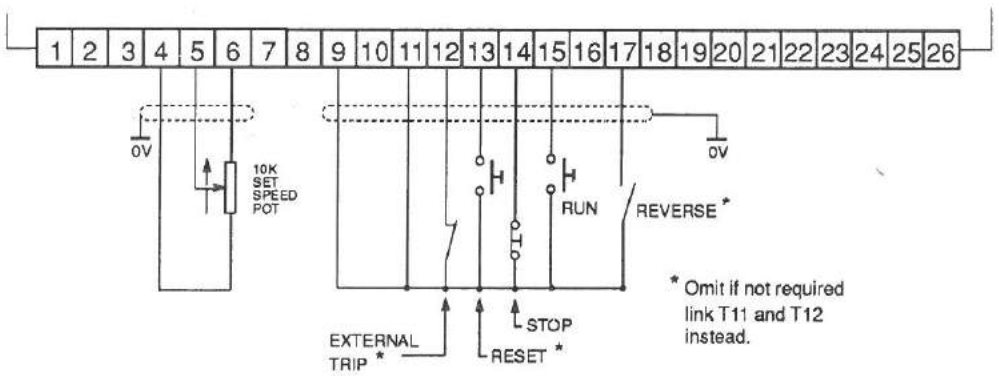
(i) POWER CONNECTIONS

Connect the 3 phase mains supply, and motor connections to the power terminals. A typical circuit is shown below.



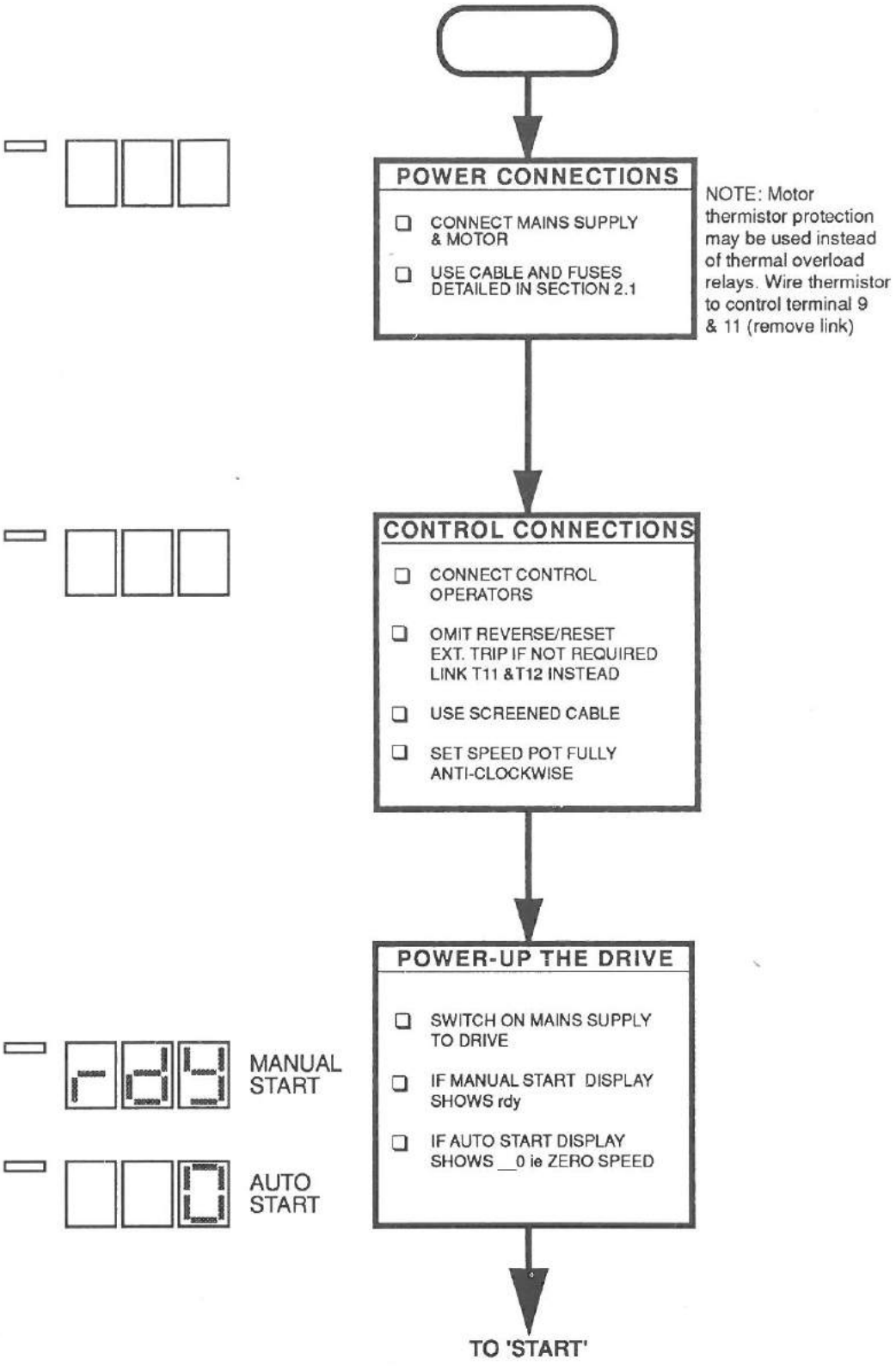
(ii) CONTROL CONNECTIONS

Connect the control operators to the 26 way control terminal. A basic circuit is shown below. Set the speed pot to minimum. The thermistor input, T9, should be linked to 0V, T11, if motor thermistors are not available.



(iii) POWER-UP THE DRIVE

At power-up the display will show "__ 0 ", if all is O.K., and the drive has not been set to MANUAL-START . (The drive is despatched set for AUTO-START). The auto start delay is approximately 100 mS.


POWER CONNECTIONS
CONNECT MAINS SUPPLY & MOTOR
USE CABLE AND FUSES DETAILED IN SECTION 2.1
NOTE: Motor thermistor protection may be used instead of thermal overload relays. Wire thermistor to control terminal 9 & 11 (remove link)
CONTROL CONNECTIONS
CONNECT CONTROL OPERATORS
OMIT REVERSE/RESET EXT. TRIP IF NOT REQUIRED LINK T11 &T12 INSTEAD
USE SCREENED CABLE
SET SPEED POT FULLY ANTI-CLOCKWISE
POWER-UP THE DRIVE
SWITCH ON MAINS SUPPLY TO DRIVE
IF MANUAL START DISPLAY SHOWS rdy
IF AUTO START DISPLAY SHOWS _0 ie ZERO SPEED
MANUAL START
AUTO START
TO 'START'

(iv) RUN THE DRIVE Adjust the speed pot to increase output frequency. The display will indicate either the motor frequency, (as supplied), or motor load, (if this option has been selected). If MANUAL START has been selected, press the run control, to start the drive.

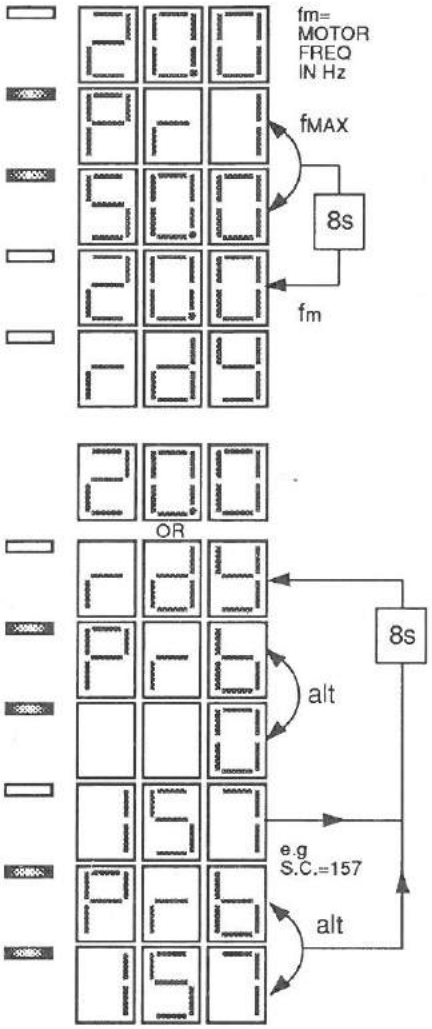
(v) DRIVE PARAMETER SECURITY Drive parameter information is protected by a 3 digit security code which prevents unauthorised adjustment of drive set up. Parameter values may however be read without entering the security code.

(vi) READING DRIVE PARAMETERS There are 10 parameters which can readily be monitored, as 3 digit values, see section 1.4. The value of these parameters can be obtained simply by pressing the MODE key once, and, whilst the green LED is on, pressing either of the UP or DOWN keys, until the required parameter number is shown. The parameter number and it's value alternately appear on the display, for about 8 seconds, after which the display will revert back to indicating frequency (or load), and the green LED will extinguish. Repeat this process to see the parameter value again, or to see the value of another.

(vi) STOPPING THE DRIVE Press the stop control to stop the drive, and the motor will stop. The display will show [rdY].

(vii) ENTERING A SECURITY CODE Before adjustment of drive parameters (and bit parameters section 3.2) a 3 digit security code needs to be entered into the drive. This code requires entering once, after the drive has been powered up. After power up the drive will display either motor frequency (auto start) or [rdY] (manual start), press MODE , and use the UP and DOWN keys to select Prb . The display will alternate between Prb and zero. Press MODE again, and use the UP and DOWN keys to select the security code. (The drive is despatched with a code of zero, to allow ease of set-up. However, once this code is altered, only code numbers in the range 100 to 255 and 0 can be set via the keypad). Press MODE again to enter the code into Prb , and the display will alternate between Prb and the code number. The security code is now entered.

FROM 'POWER UP THE DRIVE'



START

- PRESS RUN
- SET SPEED

To select % load on the display, rather than frequency, refer to section 3.2

READ PARAMETERS

- PRESS MODE
- DISPLAY ALTERNATIVES SHOWING Pr 'n' AND ITS VALUE
- PRESS UP/DOWN TO READ OTHER PARAMETERS
- 8 SECONDS AFTER LAST KEY PRESSED, DISPLAY REVERTS TO ORIGINAL MODE

REPEAT AS REQUIRED

STOP

- PRESS STOP
- DRIVE 'READY'

NOTE: Parameters 'Roll over', viz— Pr9, PrA, Prb, b1, b14, Prc, Pr1

ENTER SECURITY CODE

- DRIVE RUNNING OR rdy
- PRESS MODE
- PRESS UP/DOWN KEYS UNTIL DISPLAY ALTERNATIVES BETWEEN Prb & 0
- PRESS MODE TO FREEZE DISPLAY
- USE UP/DOWN KEYS TO OBTAIN CORRECT NUMBER OF SECURITY CODE (0 at factory setting)
- PRESS MODE TO ENTER THIS NUMBER
- DISPLAY ALTERNATES BETWEEN Prb AND THE SECURITY CODE

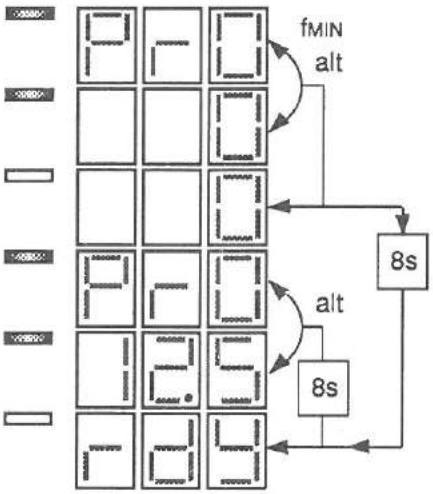
3.0 ADJUSTING PARAMETERS

(vii) ADJUSTING PARAMETERS (with drive stopped, i.e. [rdY])

To adjust a parameter, ensure that the security code has been entered, then select the desired parameter number by pressing the MODE key once, and, whilst the green LED is on, press either of the UP or DOWN keys, until the desired parameter number is shown. The parameter number and it's value alternately appear on the display, for about 8 seconds, after which the display will revert back to [rdY] and the green LED will extinguish. Before this 8 seconds elapses, press the MODE key again, and the display will become steady, showing the actual parameter value. Use the UP or DOWN keys to raise or lower the value shown. Once satisfied the correct value is displayed, press the MODE key once again to enter this new value. The display will now alternately show the new value and the parameter number, and will revert to [rdY] after about 8 seconds. The drive can now be started, as described in (iv), above.

(viii) ADJUSTING PARAMETERS (with drive running)

To adjust a parameter, ensure that the security code has been entered then select the desired parameter number using the same method as above. The display will revert back to indicating frequency (or load), within about 8 seconds, rather than [rdY]. Before this 8 seconds elapses, press the MODE key again, and the display will become steady, showing the parameter value. Use the UP or DOWN keys to raise or lower the value shown. Press the MODE key again to enter this new value. The display will now show alternately the new value and the parameter number, and will revert back to indicating frequency (or load), and the green LED will extinguish. The drive can now be stopped, as described in (vi), above.



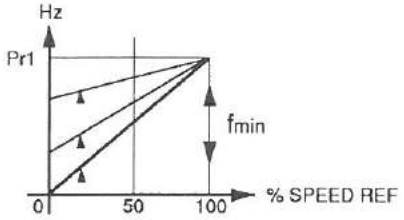
ADJUST PARAMETERS

- ENSURE SECURITY CODE ENTERED
- PRESS MODE
- DISPLAY ALTERNATES SHOWING Pr'n' AND ITS VALUE
- PRESS UP/DOWN TO ACCESS CHOSEN PARAMETER NUMBER
- PRESS MODE
- DISPLAY SHOWS CURRENT VALUE OF CHOSEN PARAMETER
- USE UP/DOWN KEYS TO ADJUST VALUE
- PRESS MODE TO SET NEW VALUE
- DISPLAY ALTERNATES SHOWING PARAMETER NUMBER & ITS NEW VALUE
- AFTER 8 SECONDS, DISPLAY REVERTS TO ORIGINAL MODE
- NOTE: IF NO KEYS PRESSED WITHIN AN 8 SECOND PERIOD DISPLAY WILL REVERT TO ORIGINAL MODE

Repeat as required

ABOVE SHOWS F MIN (Pr0) BEING SET TO 12.5 Hz

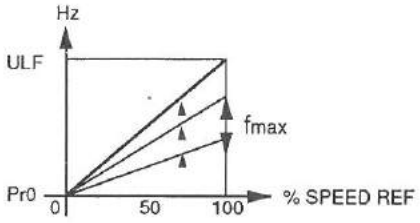
PARAMETER FUNCTIONS	Pr 0 MINIMUM FREQUENCY



f min = <Pr0>

0 ≤ F max ≤ ULF

PARAMETER FUNCTIONS	Pr 1 MAXIMUM FREQUENCY



f max = <Pr1>

ULF ≥ fmax ≥ f min ≥ 0

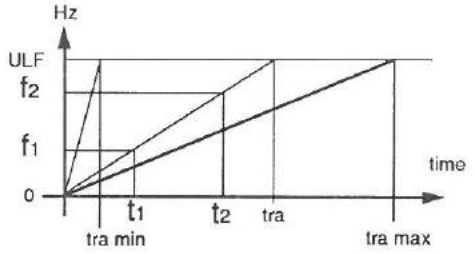
PARAMETER FUNCTIONS	Pr 2 ACCELERATION TIME

t ra min = 0.2 seconds
t ra max = 600 seconds

TIME TAKEN TO ACCELERATE FROM

f1 TO f2 = t12
t ra = <Pr2>

$$t12 = \frac{(f1 - f2) \times tra}{ULF}$$



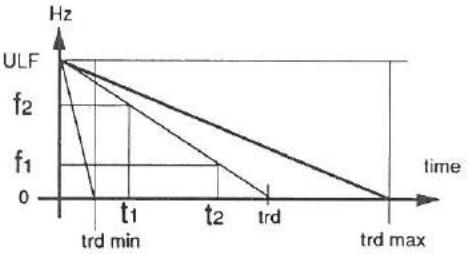
PARAMETER FUNCTIONS	Pr 3 DECELERATION TIME

t rd min = 0.2 seconds
t rd max = 600 seconds

TIME TAKEN TO DECELERATE FROM

f1 TO f2 = t12
t rd = <Pr3>

$$t12 = \frac{(f1 - f2) \times trd}{ULF}$$



3.1 PARAMETER DEFINITIONS

(v) **Pr4** CURRENT LIMIT (TIMED)

Function : sets the maximum current limit, ie the level of sustained overload current while timing out on i x t overload
Range : <Pr5> to 150 % of full load.
Factory set : 150 %

(vi) **Pr5** MAX CONTINUOUS CURRENT

Function : sets the maximum continuous current, ie the % of full load at which continuous current can be provided, without entering Ixt overload. From the 150% current limit value before tripping allowable current decreases exponentially with time toward <Pr5>. If current demand exceeds this value, the drive will trip on Ixt overload. The Ixt threshold is <Pr5>. During Ixt 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.

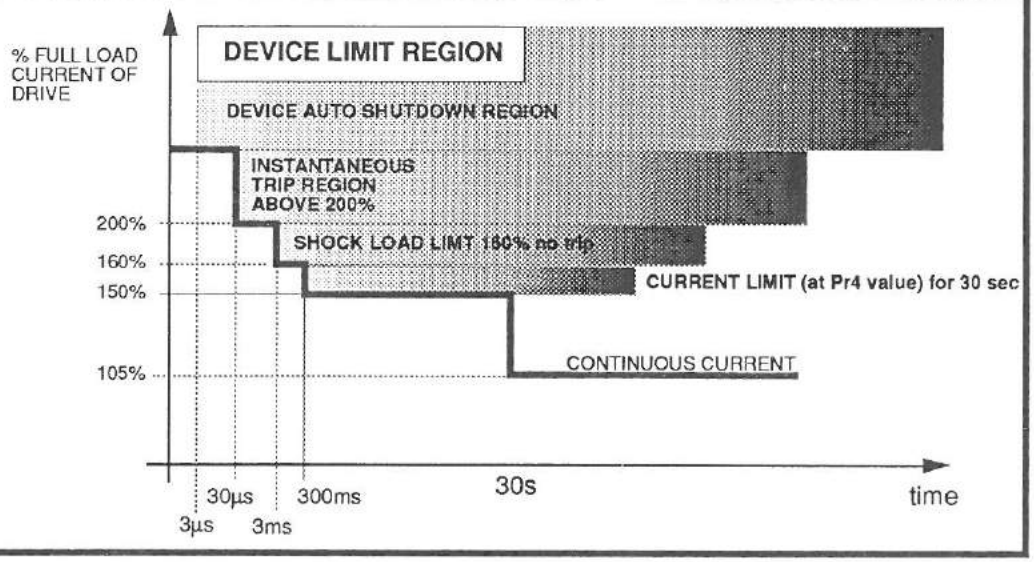
$$\text{Trip time} = \frac{12.86 \times \text{<Pr5>}}{(\text{actual \% current} - \text{<Pr5>})^2} \text{ seconds}$$

The trip time for <Pr5> = 105%, at 150% FLC, is 30 s.
Range : 10.0 % to 105 % full load, must be less than <Pr4>
Factory set : 100 %

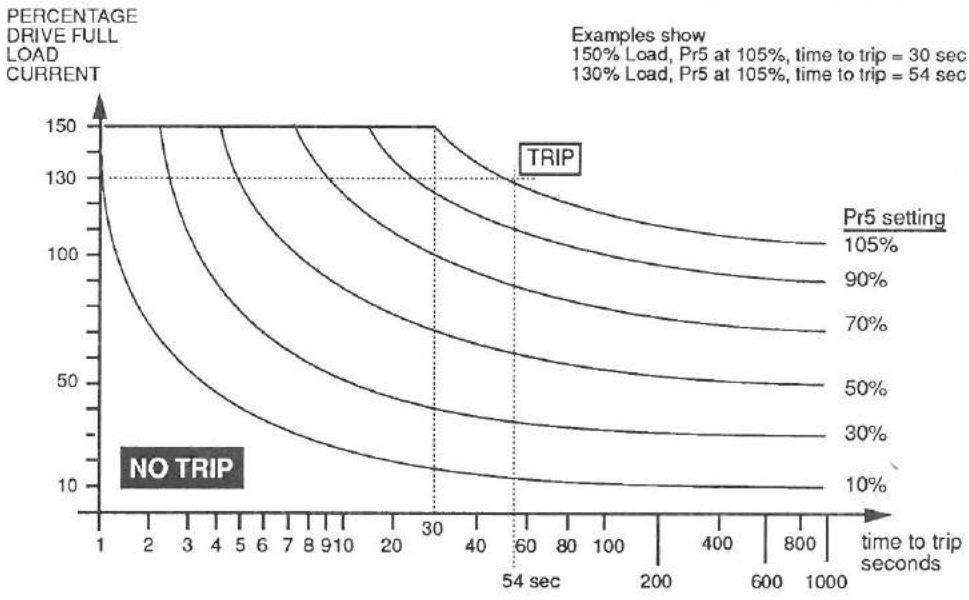
(vii) **Pr6** VOLTAGE (TORQUE) BOOST

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, (see section 3.2). 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 losses in the motor, and will reduce it's life and may cause motor to stall on start up.
Range : 0.0 to 25.5 % (of nominal supply volts).
Factory set : 5.1%

OVER CURRENT PROTECTION

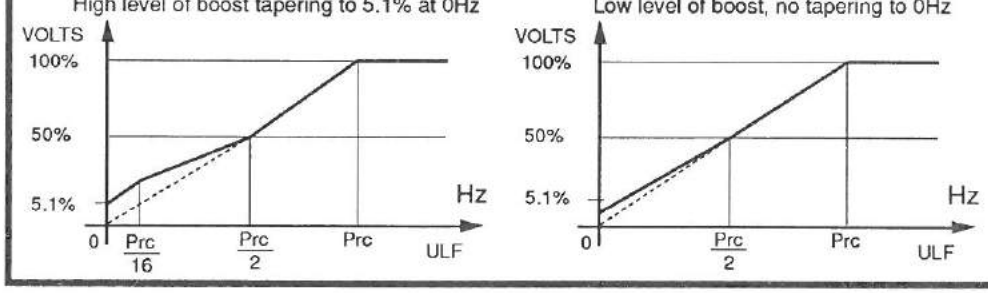


IxT CHARACTERISTICS



PARAMETER FUNCTIONS

Pr 6 VOLTAGE BOOST



3.1 PARAMETER DEFINITIONS

(viii) **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, 220, 440 Hz, respt.
Factory set : 0.0 Hz

(ix) **Pr8** DC BRAKING LEVEL

Function : sets the DC injection braking level, expressed as a % of the drives current rating. For DC braking to be available , bit parameter 2 should be set to '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 whilst 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 whilst reversing. During D.C. braking, the LED display shows [_dc].

Range : 40% to 150% of full load current rating.
Factory set : 150%

(x) **Pr9** SERIAL INTERFACE ADDRESS

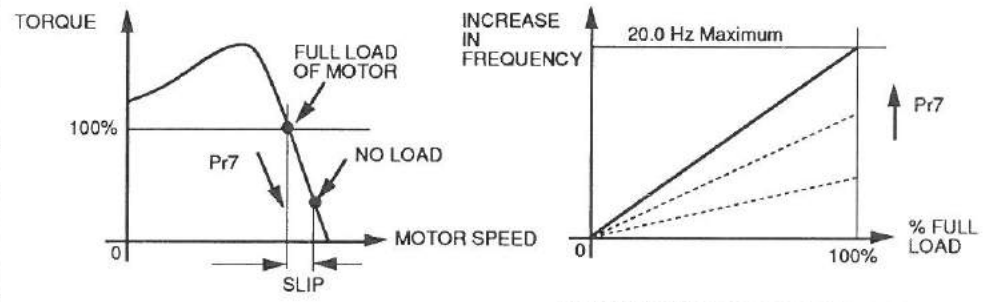
Function : sets the serial interface address to give the drive it's own identity, (number), when communicating to other systems. (Used mainly for multi-drive applications).
Range : 00 to 99
Factory set : 11

PARAMETER RESOLUTIONS

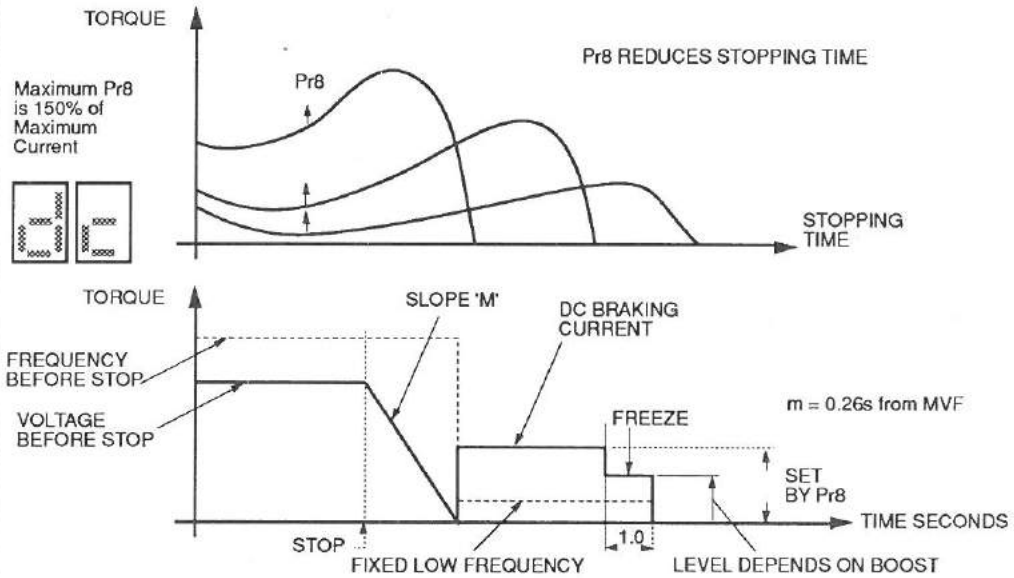
When set via the serial link, parameters 0 to 8 have a resolution of +/- 0.1 unit. This is true if set via the keypad, except for :

(a) values above 100, where the resolution is +/- 1.0 unit.
(b) Pr2 and Pr3 , whose resolution becomes coarser towards 600 s.
(c) Pr0 , Pr1 , Pr7 , whose resolution is +/- 0.2 Hz for ULF = 240 Hz and +/- 0.4 Hz for ULF = 480 Hz.
(d) Pr6 , whose resolution is +/- 0.4 %.

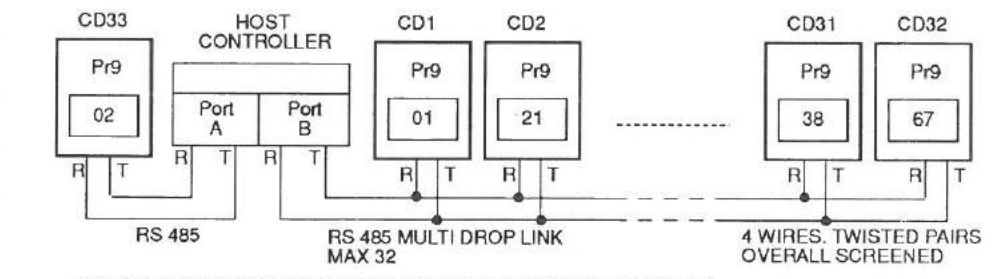
PARAMETER FUNCTIONS | Pr 7 SLIP COMPENSATION



PARAMETER FUNCTIONS | Pr 8 DC BRAKING LEVEL



PARAMETER FUNCTIONS | Pr 9 SERIAL INTERFACE ADDRESS



3.2 SELECTING BIT PARAMETERS

BIT PARAMETER SECURITY

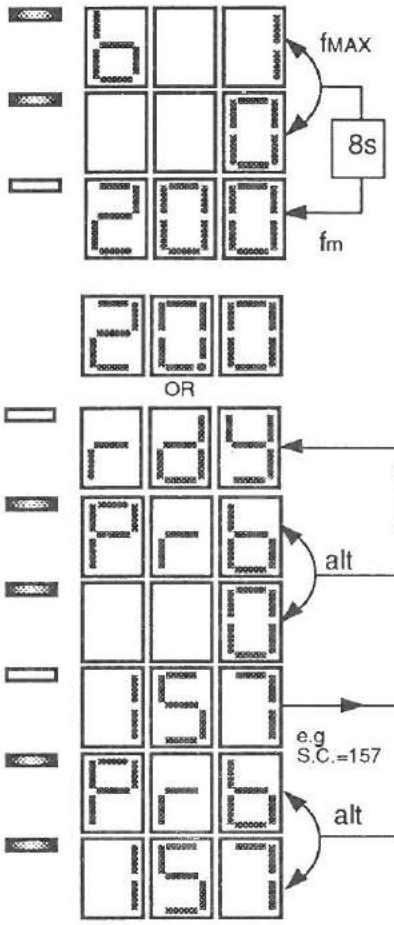
Bit parameter security information is protected by a 3 digit security code which prevents unauthourised adjustment of drive set up.
Bit parameter values may however be read without entering the security code.

READING BIT PARAMETERS

There are 16 bit parameters which can readily be monitored.The value of these bit parameters can be obtained simply by pressing the MODE key once, and, whilst the green LED is on, pressing either of the UP or DOWN keys, until the required bit parameter number is shown. The bit parameter number and it's value alternately appear on the display, for about 8 seconds, after which the display will revert back to indicating frequency (or load), and the green LED will extinguish. Repeat this process to see the bit parameter value again, or to see the value of another.

ENTERING A SECURITY CODE

Before adjustment of bit parameters (and drive parameters section 3.0) a 3 digit security code needs to be entered into the drive. This code requires entering only once, after the drive has been powered up. After power up, the drive will display either motor frequency (auto start) or [rdY] (manual start), press MODE, and use the UP and DOWN keys to select Prb . The display will alternate between Prb and zero. Press MODE again, and use the UP and DOWN keys to select the security code. (The drive is despatched with a code of zero, to allow ease of set-up. However, once this code is altered, only code numbers in the range 100 to 255 and 0 can be set via the keypad). Press MODE again to enter the code into Prb , and the display will alternate between Prb and the code number. The security code is now entered.



READ BIT PARAMETERS

- PRESS MODE
- DISPLAY ALTERNATES SHOWING Pr 'n' or b 'n' AND ITS VALUE
- PRESS UP/DOWN TO READ OTHER BIT PARAMETERS
- 8 SECONDS AFTER LAST KEY PRESSED, DISPLAY REVERTS TO ORIGINAL MODE

REPEAT AS REQUIRED

ENTER SECURITY CODE

- DRIVE RUNNING OR rdy
- PRESS MODE
- PRESS UP/DOWN KEYS UNTIL DISPLAY ALTERNATES BETWEEN Prb & 0
- PRESS MODE TO FREEZE DISPLAY
- USE UP/DOWN KEYS TO OBTAIN CORRECT NUMBER OF SECURITY CODE (0 at factory setting)
- PRESS MODE TO ENTER THIS NUMBER
- DISPLAY ALTERNATES BETWEEN Prb AND THE SECURITY CODE

3.2 SELECTING BIT PARAMETERS

CHANGING A BIT PARAMETER

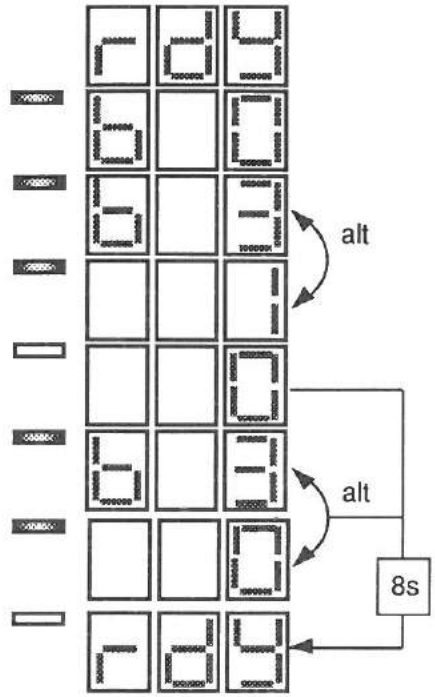
Ensure that the security code has been entered as previous section.The drive must be in either a ready [rdY] state or in a trip condition before attempting to change a bit parameter setting. To adjust a bit parameter, ensure the above two conditions are met and then press MODE key. The display alternates between a parameter and its value. Use the UP and DOWN keys to access the required bit parameter number. Press MODE key to freeze the display on the value, and use UP and DOWN keys to scan through the choices,for that bit. Once the desired choice is shown, set the parameter to this choice, by pressing MODE once more. The display then alternates between the new choice and the bit number, and will revert back to ready [rdY], in about 8 seconds.

CHANGING SECURITY CODE

To enter a new security code it is necessary to enter bit parameter Prb as described above. ie original security code must have been entered before it is possible to change to a new value.When Prb is entered the display will alternate between [Prb] and the previously set code. (Note if security code has not been entered the value will read 0). Whilst the drive is alternating press the MODE key and use the UP and DOWN keys to select a number between 100 and 255, or 0. Then press MODE key to set the number into Prb. To activate the new security code, the drive must be powered down to the point where all display indications are extinguished. When the drive is next powered up the security code will be this new value.

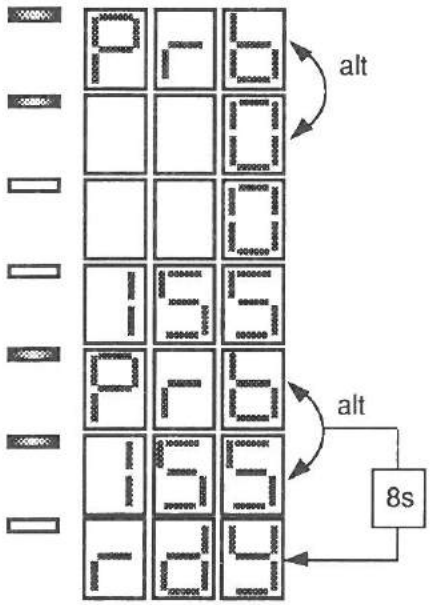
Note : the serial link can set and read all code numbers in the range 000 to 255.

Note : if the code is correctly entered, bit parameter 13 can be accessed, and then used to force the code to it's default value of zero. (this also resets all other parameters to default values)



CHANGING BIT PARAMETER

- ENSURE SECURITY CODE ENTERED
- STOP DRIVE rdy
- PRESS MODE KEY
- USE UP/DOWN KEYS TO SELECT BIT NUMBER
- DISPLAY ALTERNATES BETWEEN BIT NUMBER & VALUE
- PRESS MODE TO FREEZE DISPLAY
- USE UP/DOWN KEYS TO CHANGE BIT VALUE
- PRESS MODE TO SET NEW CHOICE
- DISPLAY ALTERNATES BETWEEN NEW VALUE & BIT No.
- DISPLAY REVERTS TO rdy AFTER 8 SECONDS



CHANGE SECURITY CODE

- ENSURE ORIGINAL SECURITY CODE ENTERED
- PRESS MODE
- PRESS UP/DOWN TO SELECT Prb
- PRESS MODE
- USE UP/DOWN KEYS TO ENTER NEW NUMBER
- PRESS MODE
- UNIT REVERTS TO rdy AFTER 8 SECONDS
- SECURITY CODE IS SET WHEN DRIVE IS POWERED OFF

3.3 BIT PARAMETER DEFINITIONS

b 0 SPEED or TORQUE CONTROL MODE

Function : selects the control system type. SPEED control uses the chosen speed reference input, (see 2.2), 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.

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 : 0 = auto start

b 2 & b 7 METHOD OF STOPPING

Function : selects the method of stopping the drive. Choices are COAST, RAMP with standard DYNAMIC BRAKE, DC INJECTION or ALTERNATIVE DYNAMIC BRAKING using the IBD braking card. If COAST TO HALT 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 a halt, 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 3.1 (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 overvolt condition, the ramp is disabled until the overvoltage has cleared, when the unit will continue to ramp down again. The IBD-1 can be fitted in this mode to give standard DB braking.
DC braking injects dc into the motor, and dissipates the energy there as heat. DC braking level is set by Pr8, see 3.1 (ix)
ALTERNATIVE 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 2.4.

choices :

b2	0	0	1	1
b7	0	1	0	1
STOP	RAMP	COAST	DC	RAMP
DB	STANDARD		N/A	ALT

Factory set : b2 = 0 } RAMP
b7 = 0 } (STANDARD DB)

3.3 BIT PARAMETER DEFINITIONS

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

b4 LOW SPEED OR RUN INDICATION OUTPUT

Function : selects the function of open collector output to terminal T24. Output indicates drive running or low speed. Low (0V) output represents drive running or 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, 240, 480 Hz.
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 REMOTE 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), whilst SLAVE is the speed reference value, from the serial link. Refer to 2.2 .

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 in Hertz, load is in % Full Load Torque.

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.

3.3 BIT PARAMETER DEFINITIONS

b 9 TERMINAL or KEYPAD CONTROL

Function : selects the drive control method. Control of speed, stop, start, and reset can be either by external operators or by the KEYPAD alone, see 2.2 Keypad control is normally used for commissioning purposes only.

Choices : 0 = keypad control 1 = terminal control

Factory set : 1 = terminal control

b10 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

b11 DEFINE CURRENT LOOP TYPE OR FREQUENCY INPUT

Function : selects the type of current loop or, frequency input (digital speed reference) used for the speed reference signal. There are 3 current loop choices and a frequency input, which can be selected by using the UP & 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 approx 3.0 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 V)
Output motor frequency = 1/30 input signal frequency

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

Factory set : 4.20 (4/20 mA).

b12 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

b13 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

b14 DEFINE ULF and SWITCHING FREQUENCIES

Function : Any one of three 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 key's to choose, and the MODE key to set your choice. Then press MODE again to obtain the three Upper Limit Frequency options. Use the UP and DOWN key's to choose, and the MODE key to set your choice. Note that the combination of ULF = 480 Hz with a SF = 2.9 kHz is not possible. Note that parameter Prc will normally need to be adjusted if ULF is altered.

Choices : SF's = 2.9, 5.9, 8.8, 11.7 kHz; ULF = 120,240,480 Hz

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

3.3 BIT PARAMETER DEFINITIONS

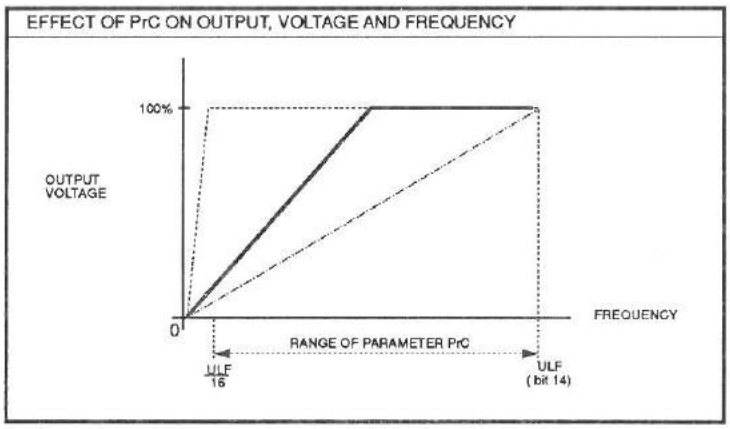
Prc MAXIMUM VOLTAGE FREQUENCY

Function : defines the maximum voltage frequency. ie 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 drive.
Prc can be set above parameter Pr1 (max frequency).

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	
480	480	

Range : Prc is adjustable from ULF (b14) to ULF/16 Hz
Factory set : 50Hz.
Warning : Setting Prc too low, i.e. high volts/hertz ratio, will cause standard motors to overheat.



3.4 USING SERIAL COMMUNICATIONS

INTRODUCTION

The Serial Communication Link, standard on all models, allows access to all drive parameters, for READING, WRITING or CONTROLLING. Up to 32 drives can be interconnected together, to a host communicating device, such as a computer. This is achieved by use of the 4 wire RS 485 link, terminals 20 to 23. Other link standards can also be connected, such as RS 232-C, see page 48.
The messages and data that are communicated, follow a protocol standard known as ANSI-x3.28-2.5-A4. Each drive has it's own I.D., (identification number), or SERIAL ADDRESS, which should be set in Pr9 . Also the drive's BAUD rate b12 , and parity b10 , should be set to match the host. To WRITE data or CONTROL the drive, via the serial link, then REMOTE mode (T16 connected to T11), and SLAVE mode, <b6> = 1, must be selected. Data, drive status and set-up information can be READ from the drive, in any mode, provided that it is powered-up.

FORMAT OF CHARACTERS

Characters are formatted as follows:

Start	Seven Data Bits	Parity	Stop
0	l/sb, , , , , , ,	msb,	1 ,

3.4 USING SERIAL COMMUNICATIONS

READING DATA

The drive will send to the host, a complete set of variable and bit parameter settings, provided that the request is valid. The format is,

Host request : reset - I.D. - mnemonic - end

Drive reply : start - mnemonic - 6 chars. - end - BCC

reset=<EOT>={ctrl} D start=<STX>={ctrl} B end=<ETX>={ctrl} C

The mnemonic comprises 2 characters which represent various parameters, a list is shown on page 47 . The 6 characters of data, are the actual value of the parameter, or a character which has a binary code representing various bit parameter states. A checksum, (BCC), is used to ensure that the communication is correct. ({ctrl} @ means press the control key, at the same time as the character @)

For example, to read drive number 12's speed set-point,send :

<EOT>, 1 , 1 , 2 , 2 , S , P ,<ENQ> (Do not send the commas)

reset = <EOT>, is {ctrl} D end = <ENQ>, is {ctrl} E

each I.D. character is sent twice SP = speed set-point mnemonic

The drive replies : <STX>, S , P ,<data>,<ETX>,<BCC>

start = <STX>, is {ctrl} B end = <ETX>, is {ctrl} C

for SP, <data> = 6 characters in the range +480.0 to -480.0

for SP, -047.0 = 47 Hz reverse

<BCC> is the block checksum character, (see WRITING DATA section).

Repeat enquiry To obtain data again from the same drive, and the same mnemonic, simply transmit a negative acknowledgement character,

<NAK> ie {ctrl} U

Next parameter To obtain data on the next mnemonic, from the same drive, simply transmit a positive acknowledgement character, <ACK> ie {ctrl} F

The order of access is as given in the mnemonic table.

Invalid mnemonic If the host sends an invalid mnemonic, say XY , the drive will respond by sending the following characters

<STX>, X , Y ,<EOT> ie {ctrl} B , X , Y ,{ctrl} D

Reading the security code Check the drive address (eg 11), (Pr9), and enter the following characters, (not the commas).

{ctrl} D , 1 , 1 , 1 , 1 , S , C ,{ctrl} E

The drive will reply

{ctrl} B , S , C , , , , > ,n,m,{ctrl} C ,x

The SC characters are the mnemonic for the security code. The x is a checksum value which can be ignored.

The two characters which follow the > character, form the Hex value of the security code. eg n=6, m=4 means SC $=64_{16}$ $=100_{10}$

So set Prb to 100 to gain access to the bit parameters.

Note that the above can be done regardless of the all bit settings, even bits b10 (parity), and b12 (baud). If the BAUD rate or parity are not correct, you will get no response, so just try the other 3 combinations of bit 10 and bit 12, until successful.

3.4 USING SERIAL COMMUNICATIONS

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 etc. To change the drive set-up, it must be in a [rdY] state, in REMOTE (T16 = 0V), and b6 = 1, (SLAVE).
The format is,
Host Command : reset - I.D. - start - mnemonic - 6 chars. - end - BCC
reset=<EOT>={ctrl} D start = <STX>={ctrl} B end=<ETX>={ctrl} C
The drive will reply, with either a positive or negative acknowledgement.
<ACK>={ctrl} F if message understood, (implemented or not).
note: message only implemented if in [rdY]
<NAK>={ctrl} U if message invalid/data too long/BCC incorrect

Note if a value is set outside a parameter setting, the drive will default to the maximum allowable parameter value. Reverse signals are sent by the use of a "-" sign before the value.

Block Checksum BCC

<BCC> is a single ASCII character, representing a block checksum on the mnemonic, 6 <data> and the <ETX> characters. Firstly, a binary exclusive OR of all 9 ASCII characters, is done.

bcc = EXOR (all 9 characters)

To prevent control codes being sent as the BCC, 32_{10} , is added to the value of bcc , if it is less than 32.

IF **bcc** < 32 THEN **bcc** = **bcc** + 32

The transmitted ASCII character <BCC> corresponds to bcc

<BCC> = CHR$ (**bcc**)

To set the speed of drive number 14 to reverse 47.6 Hz, send
{ctrl} D , 1 , 1 , 4 , 4 ,{ctrl} B , S , P , - , 0 , 4 , 7 , . , 6 ,{ctrl} C , &
The <BCC> = & is calculated as follows :

character	**binary code** (msb is parity bit, EVEN parity used)	
S	0101 0011	SP is the speed set point
P	0101 0000	
	0000 0011	
-	0010 1101	- is reverse
	0010 1110	
0	0011 0000	047.6 is 47.6 Hz
	0001 1110	
4	0011 0100	
	0010 1010	
7	0011 0111	
	0001 1101	
.	0010 1110	
	0011 0011	
6	0011 0110	
	0000 0101	
<ETX>	0000 0011	
bcc =	0000 0110	= 6 in decimal

bcc is < 32 so add 32 **bcc** = 38 = 0010 0110 = & ie <BCC> = &

3.4 USING SERIAL COMMUNICATIONS

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 a 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	R r/w
Maximum Frequency	MX	Hertz	Pr1	R r/w
Acceleration Rate	AL	seconds	Pr2	R r/w
Deceleration Rate	DL	seconds	Pr3	R r/w
Current Limit	TR	% of FLC	Pr4	R r/w
Continuous Current	TH	% of FLC	Pr5	R r/w
Voltage Boost	BO	% of Vmax	Pr6	R r/w
Slip Compensation	SL	Hertz	Pr7	R r/w
DC Braking Level	BR	% of Vmax	Pr8	R r/w
Serial Address	SE	00-99 in Hex	Pr9	I r/o
Security Code	SC	Code in Hex	Prb	I r/w
STATUS WORD	SW	Code in Hex		I r/o
DRIVE SET-UP	DS	Code in Hex	b0-b12	I r/w *
Switching Frequency	FQ	Code in Hex	b14	I r/w *
Base Speed	BS	Hertz	Prc	R r/w *
COMMAND WORD	CW	Code in Hex		I r/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 AC will be - 5Hz (ie reverse)

3.4 USING SERIAL COMMUNICATIONS

SWITCHING FREQUENCY (FQ)
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 11

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.

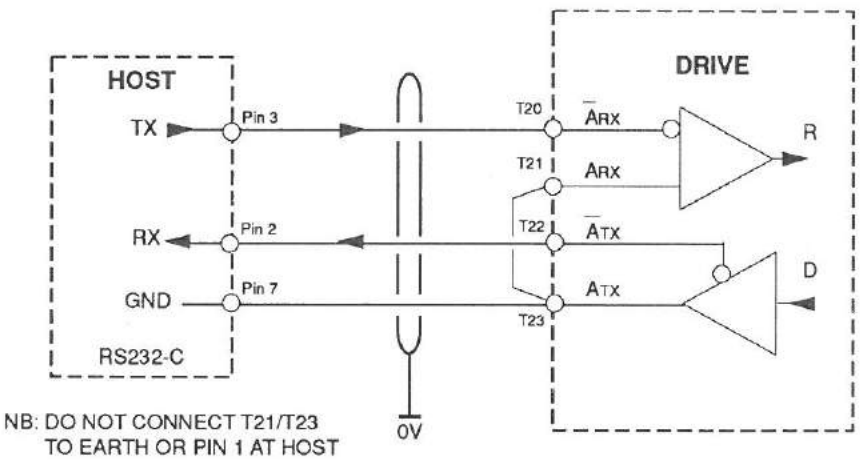
To write to the drive, the following would be done :

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

FQ CODES

HEX CODE	SWITCHING FREQUENCY	MAX. VOLTS FREQUENCY
00	2.9 kHz	120 Hz
01		240
10	5.9 kHz	120 Hz
11		240
12		480
20	8.8 kHz	120 Hz
21		240
22		480
30	11.7 kHz	120 Hz
31		240
32		480

RS232C INTERCONNECTION



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

3.4 USING SERIAL COMMUNICATIONS

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 11

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 following 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)	Ixt overload	[_ It]	0	1
E	1(msb)	current peak trip	[_ OI]	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.

3.4 USING SERIAL COMMUNICATIONS

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 of bit parameters b 0, 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	b0	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
Current loop (b) 0 } 0/20mA speed reference

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

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

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

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** can not be written to via the serial link, (relevent bits are ignored).

3.4 USING SERIAL COMMUNICATIONS

COMMAND WORD (CW)
This is a one 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} **B , 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	teminal 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).

VALUES 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

4 PROBLEM SOLVING

4.0 FAULT FINDING

LED display does not light, and drive does not run .....

.... Check mains supply fuses to drive. Replace fuses if failed, but only do this once. Change the drive if they blow again.

Motor fails to run, display shows [rdY].....

.... Check control wiring and stop/run/trip contacts operate correctly.

Motor fails to run, display shows [_ 0].....

.... Check wiring of speed reference, and that the correct mode (REMOTE/LOCAL) has been selected. Check that KEYPAD mode has not been selected.

Display, or [PrA] shows a fault code .....

.... Refer to section 1.4 , for possible cause. Note that thermal type trips should not be continually reset/tripped. [_ OI] trips can be caused by shock loads, short circuits, too long a cable to the motor, or trying to accelerate too large a motor. Decelerating too fast may cause [_ OU] trips, (low inertia), or [_ OI] trips, (high inertia). Increase the value of Pr3 , and check b 7 and 2 are set for ramp stop. If [_ PS] or [Err] are shown, try powering down the drive, wait 2 minutes, then power up again. If the trip condition still exists, replace the drive. Note : the [_ PS] and [Err] codes are for factory use only, and form part of the drive's in-built self diagnostic features.

Motor fails to turn the load, and is noisy .....

.... Too high fixed boost setting, reduce Pr6 . Also check the setting of current limit/output Pr4 / Pr5

Drive fails to respond to serial communications .....

.... Check that the parity b10 , baud rate b12 , master/slave b6 , local/remote, and address Pr9 are all set correctly. Check wiring and termination of the serial link.

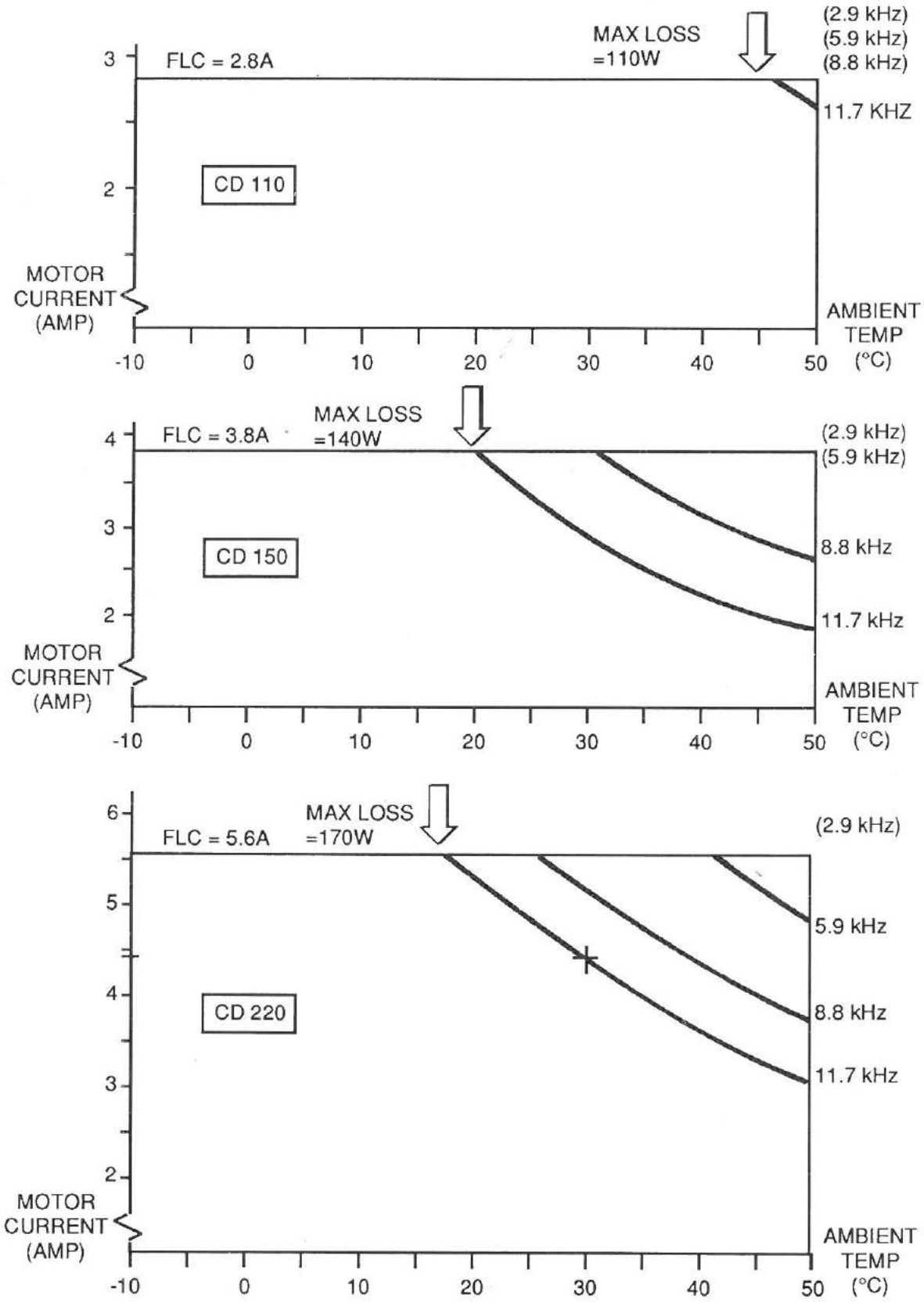
Drive appears to be set up to an un-usable state .....

.... Enter Prb , and set the security code, to gain access to b13. Set b13 to 1, to reset all parameters to their default values. After doing this, the security code changes to zero. If the security code is not known, it can be accessed via the serial link using a 'dumb' RS232c terminal. Set the BAUD rate to 4800, and the parity to EVEN, connect to the drive as per section 3.4., and follow the Reading the Security Code section. (Try other BAUD rates and parities if the serial link gives no response).

If, after carrying out the above checks, the inverter will still not function, contact your supplier who is a specialist trained to assist you.

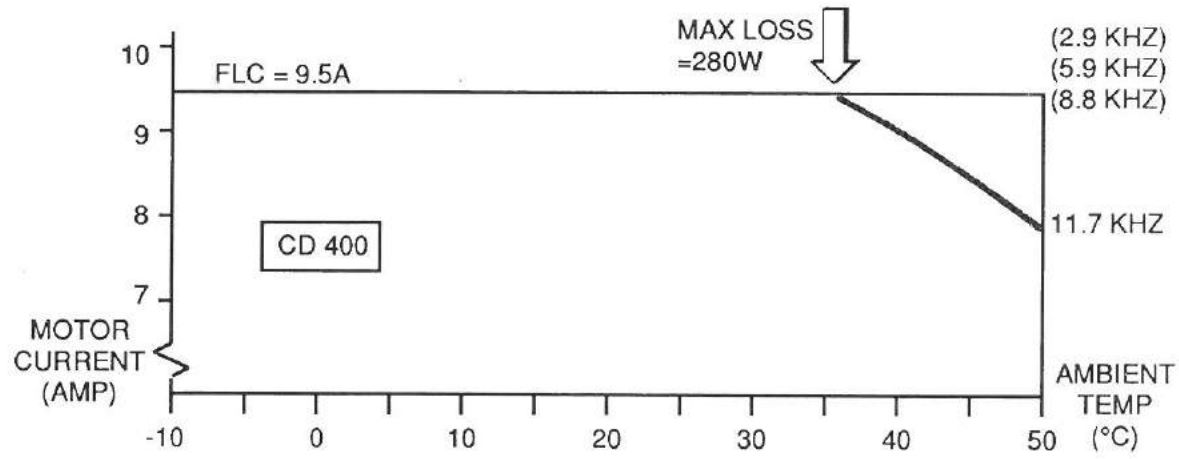
5 REFERENCE SECTION

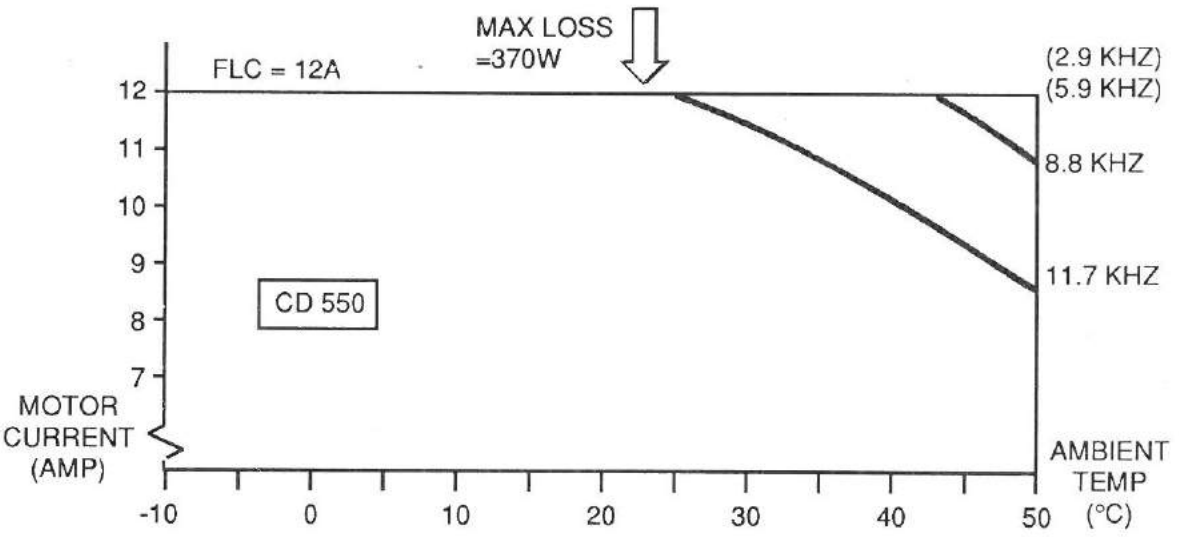
5.0 DE-RATING CURVES

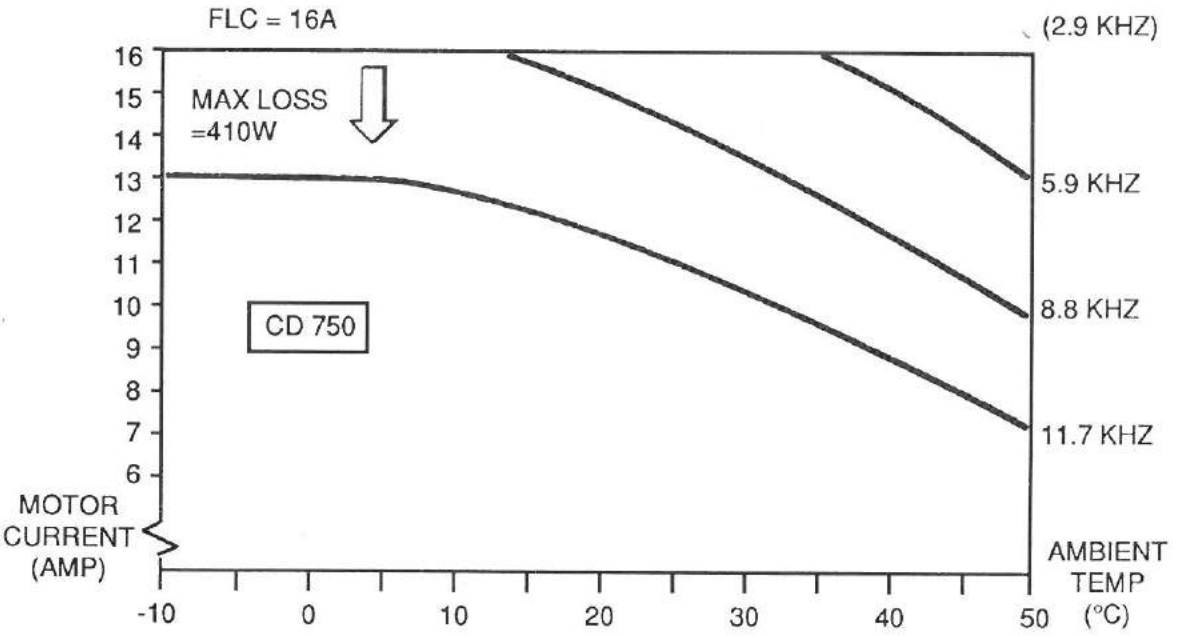


(CD75 - NO DE-RATING REQUIRED. MAX LOSS = 75W, AT 50°C)

5.0 DE-RATING CURVES







USER SET UP INFORMATION

Minimum Frequency	Pr 0	
Maximum Frequency	Pr 1	
Acceleration Time	Pr 2	
Deceleration Time	Pr 3	
Current Limit Timed	Pr 4	
Max Continuous Current	Pr 5	
Voltage Torque Boost	Pr 6	
Slip Compensation	Pr 7	
DC Braking Level	Pr 8	
Serial Interface Address	Pr 9	
Security Code	Pr b	
Speed or Torque Control Mode	b 0	
Auto or Manual Start Mode	b 1	
Method of	b 2	
Stopping	b 7	
Auto or Fixed Boost	b 3	
Low Speed or Run Indic'n Output	b 4	
Open Loop or Encoder Feedback	b 5	
Master or Slave Drive	b 6	
Frequency or Load on Display	b 8	
Terminal or Keypad Control	b 9	
Even or Odd Serial I/O Parity	b 10	
Define current Loop or Freq Input	b 11	
Serial Link Baud Rate	b 12	
Switching Frequency + U.L.F.	b 14	
Maximum Voltage Frequency	Pr C	
SET BY:		DATE:

USER SET UP INFORMATION

Minimum Frequency	Pr 0	
Maximum Frequency	Pr 1	
Acceleration Time	Pr 2	
Deceleration Time	Pr 3	
Current Limit Timed	Pr 4	
Max Continuous Current	Pr 5	
Voltage Torque Boost	Pr 6	
Slip Compensation	Pr 7	
DC Braking Level	Pr 8	
Serial Interface Address	Pr 9	
Security Code	Pr b	
Speed or Torque Control Mode	b 0	
Auto or Manual Start Mode	b 1	
Method of	b 2	
Stopping	b 7	
Auto or Fixed Boost	b 3	
Low Speed or Run Indic'n Output	b 4	
Open Loop or Encoder Feedback	b 5	
Master or Slave Drive	b 6	
Frequency or Load on Display	b 8	
Terminal or Keypad Control	b 9	
Even or Odd Serial I/O Parity	b 10	
Define current Loop or Freq Input	b 11	
Serial Link Baud Rate	b 12	
Switching Frequency + U.L.F.	b 14	
Maximum Voltage Frequency	Pr C	
SET BY:		DATE: