Chapter 8

Appendices

Contents Page

Chapter 8 Appendices

APPENDIX A - APPLICATION NOTES

General

Always use gold flash relays, or others designed for low current operation (5mA), on all control wiring.

All power factor correction equipment must be removed from the motor side of the inverter before an inverter can be used.

Motors with low efficiency and small cos ø (power factor) should be avoided since they require a larger kVA rated inverter to produce the correct shaft kW.

Minimum Connection Requirements.

The diagram below shows the minimum connection requirements in order to operate the drive.

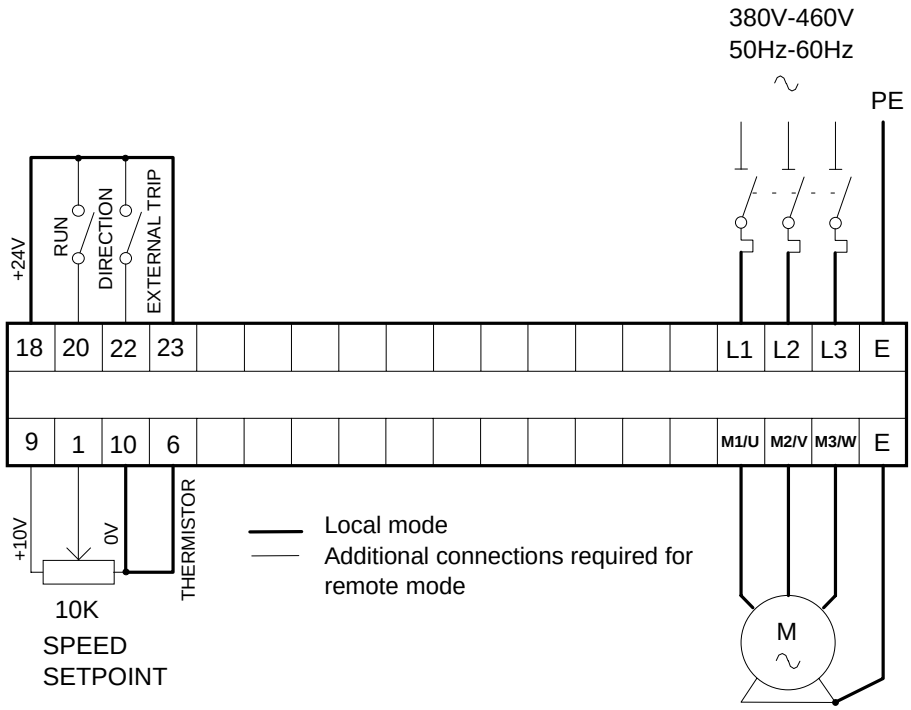


Figure A.1 - Minimum Connection Requirements

Synchronous Motors

Although intended primarily for use with induction (asynchronous) motors, inverters can also be used for speed control of synchronous motors. Synchronous motors can offer economic solutions in applications where tight control of speed is required together with the low maintenance characteristics of an AC motor.

The two most common types of synchronous AC motor are permanent magnet and wound rotor. In contrast to induction motors, synchronous motors run at synchronous speed whether on no load or full load. Synchronous speed is set by the frequency of the supply applied to the stator. The stator flux can be kept constant by keeping the stator volts/frequency ratio constant as with an induction motor.

Torque is produced in the motor by a increase in load angle between the stator and rotor fluxes. Maximum torque occurs when the load angle approaches 90°. If the load angle exceeds this value then torque drops and the motor will stall. Systems involving synchronous motors need careful design to ensure that the motor can accelerate the load and handle transient load changes without stalling.

Brake Motors

Brake motors are used in applications requiring a mechanical brake for safety or other operational reasons. The motor can be a standard induction motor fitted with an electromechanical brake or it could be a special conical rotor machine. In the case of a conical rotor machine the spring-loaded brake is controlled by the motor terminal voltage as follows:

a) At rest the motor is braked;

b) When the motor is energised an axial component of the magnetic field, due to the conical air-gap, overcomes the force of the brake spring and draws the rotor into the stator. This axial displacement releases the brake and allows the motor to accelerate like a normal induction motor;

c) When the motor is de-energised the magnetic field collapses and the brake spring displaces the rotor, pushing the brake disc against the braking surface.

d) Inverters can be used to control the speed of conical rotor brake motors since the linear V/F characteristic maintains the motor magnetic field constant over the speed range. It will be necessary to set the **FIXED BOOST** parameter to overcome motor losses at low speed.

Using Line Chokes

Line chokes are not required to limit input current to Eurotherm Drives inverters. Controllers from 5.5kW (400v) or 2.2kW (230v) upwards are fitted with DC link chokes to limit the ripple current seen by the DC link capacitors and thus prolong their life.

Line chokes may be used to reduce the harmonic content of the supply current where this a particular requirement of the application or where greater protection from mains borne transients is required.

Using Output Contactors

The use of output contactors is permitted. It is recommended that this type of operation be limited to emergency use only or in a system where the drive can be inhibited before closing or opening this contactor.

Using Motor Chokes

Installations with motor cable runs in excess of 50m may suffer from nuisance overcurrent trips. This is due to the capacitance of the cable causing current spikes to be drawn from the inverter output. A choke may be fitted in the inverter output which limits the capacitive current. Screened cable has a higher capacitance and may cause problems in shorter runs. The recommended choke values are shown in Table A.1.

Table A.1 - Recommended Choke Values For Cables Up To 300m

Drive kW	Choke Inductance	RMS Current Rating	Eurotherm Part No.
0.75	2mH	7.5A	CO055931
1.1			
1.5			
2.2			
4.0	0.9mH	22A	CO057283
5.5			
7.5			
11	0.45mH	33A	CO057284
15			
18	0.3mH	44A	CO057285
22	50uH	70A	CO055193
30			
37	50uH	99A	CO055253
45	50uH	99A	CO055253
55	25uH	120A	-
75	25uH	160A	-
90	25uH	200A	-

Using Multiple Motors On A Single Drive

It is possible to use a single large inverter to supply several smaller motors provided that each individual motor has overload protection.

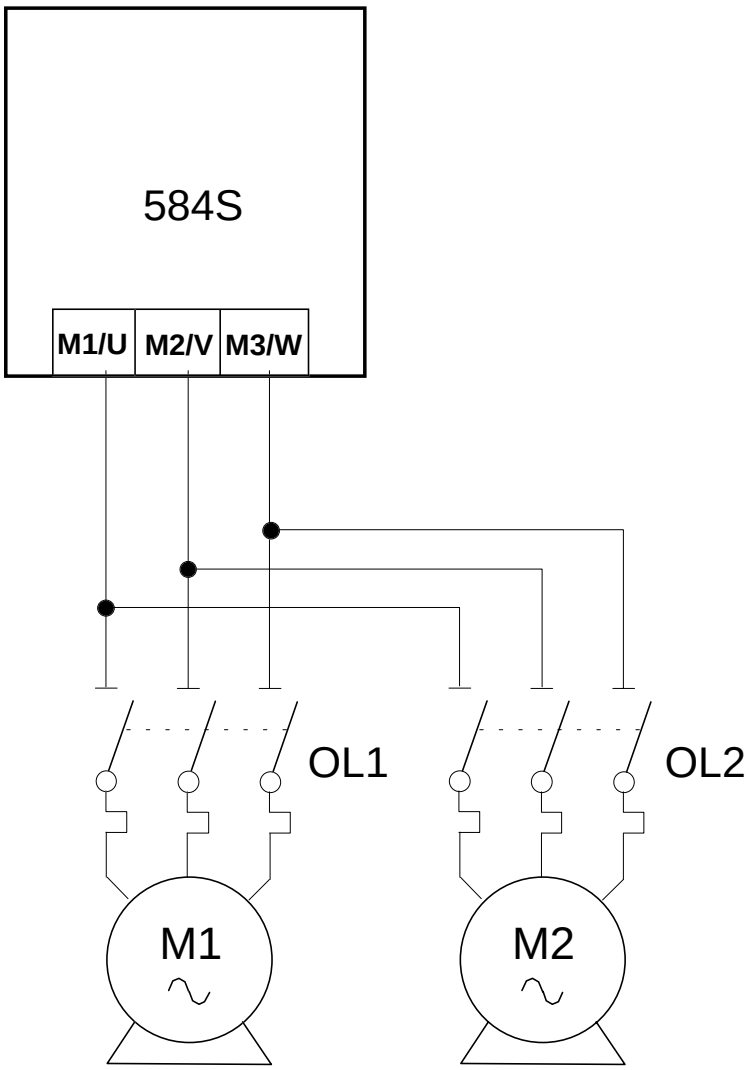


Fig. A.2 - Multiple Motors on a Single Drive

The drive must be rated to supply the **total motor current**. It is not sufficient to simply sum the power ratings of the motors, since the drive has also to supply the magnetising current for each motor.

Note that the overload device will not prevent the motor overheating due to inadequate cooling at low speed. Force vented motors may be required; consult your motor supplier.

Caution

MULTIPLE MOTOR INSTALLATIONS SHOULD RESTRICT THE TOTAL CABLE LENGTH AS FOLLOWS:

50M WITH NO OUTPUT CHOKE FITTED

300M WITH CHOKE AS RECOMMENDED IN TABLE A.1.

High Starting Torque

Applications requiring high motor starting torque (greater than 100% of rated torque) need careful set up of the drive voltage boost feature. For most motors a **FIXED BOOST** parameter setting of 6.0% is usually adequate. Setting the **FIXED BOOST** parameter level too high can cause the drive current limit feature to operate. If this occurs, the drive will be unable to ramp up in frequency. The **OVERLOAD STATUS** diagnostic will indicate **OVERLOAD** when the current limit feature is operating. Simply reducing the level of the **FIXED BOOST** parameter will remove this problem. It is important to use the minimum level of **FIXED BOOST** necessary to accelerate the load. Using a level of **FIXED BOOST** higher than necessary will lead to increased motor heating and increased risk of drive overload.

It should be noted that motor torques greater than 100% require high currents to be drawn from the drive. Thus, the **MOTOR I LIMIT** parameter will have to be set accordingly such that the drive current limit feature will not activate when accelerating the load.

The best motor starting performance can be achieved by setting up the drive **SLIP COMP** parameter. The procedure for setting the **SLIP COMP** parameter is outlined in chapter 4. Also setting the **BASE VOLTS** parameter to 115.4% and the **SWITCHING FREQ** parameter to 3kHz, can help to start difficult loads in the most extreme cases.

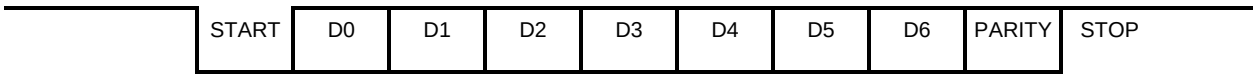
APPENDIX B - SERIAL COMMUNICATIONS OPTION

This option provides an opto-isolated RS422/485 serial data port to allow an intelligent device to monitor or update the parameters of a network of drives. The option takes the form of a PCB which is plugged into the drive control board at the bottom right-hand side (refer to Figure B.1). The option board carries 6 screw terminals for the serial link connections.

The 584S supports both ASCII and Binary communication modes. ASCII is more commonly used so this section concentrates mainly on ASCII communications. Binary communications is explained later in this chapter.

Specification

Transmission Standard	:	RS485 (RS422) (bi-directional)
Protocol	:	ANSI-X3.28-2.5-B1
Data Rates	:	300,600,1200,2400,4800 or 9600 baud
Character Format (300 to 9600 baud)	:	ASCII + 1 start, 1 parity and 1 stop bit [10 BIT]
Parity	:	Defaults to Even



	RS422	RS485
Electrical Connections	4-wire differential	4-wire differential
No. of drivers and receivers allowed per line	1 driver 16 receivers	32 drivers 32 receivers
Maximum cable length	4000ft/1200 metres	

NOTE: RS485 supports multiple drivers however EI (Eurotherm International) protocol supports one driver.

Terminal Connections

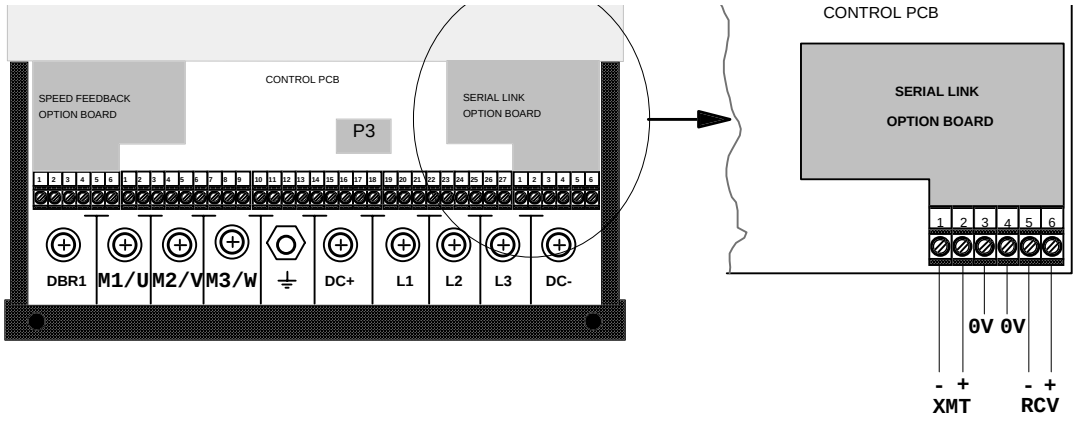


Figure B.1 - Serial Link Option Board

ASCII Communications

Reading Data

Control Characters

Control Characters are ASCII binary codes which define actions rather than information. The six ASCII codes used are defined in Table B.1.

Table B.1 - Control Character Definitions

ASCII-HEX	Mnemonic	Definition
02	(STX)	Start of Text
03	(ETX)	End of Text
04	(EOT)	End of Transmission
05	(ENQ)	Enquiry
06	(ACK)	Positive Acknowledge
15	(NAK)	Negative Acknowledge

Enquiry

The computer initially has master status with the 584S in slave status. The computer begins communication by transmitting a message, known as the "establish connection" message, which is represented by the following format:-

(EOT) (GID) (GID) (UID) (UID) (C1) (C2) (ENQ)

These symbols are defined as follows:

(EOT)	This control character resets all instruments on the link and causes them to examine the next four transmitted characters to see if they correspond with their group/unit address identifiers.
(GID)	These characters represent the group address identifier, repeated for security.
(UID)	These characters represent the required unit address identifier, repeated for security. (Together GID and UID define the address of a particular instrument). If, for example, GID = 3 and UID = 4, then the instrument to be addressed is number 34.
(CI)(C2)	These characters specify the parameter by mnemonic.
(ENQ)	This character indicates the end of the message, and that it is an enquiry.

The transmission of this message initiates a response procedure from the 584S.

Valid Response of the 584S to this Message

After the message has been sent, the computer adopts slave status and expects to receive a reply from the 584S. In so doing, the 584S assumes Master status and, providing the 584S has successfully received the message in full, it responds in the following form:

(STX) (C1) (C2) (D1) (D2) (D3) (Dn) (ETX) (BCC)

which constitutes a message defined as:

(STX)	Start of text.
(C1)(C2)	Parameter specified by mnemonic.
(D1 to Dn)	Value of the requested parameter (string may be of any length as determined by the data). The 584S responds with the shortest message which represents the data value. If the data value is an integer then it does not send a decimal point. Trailing zeros in the decimal part are not sent.
(ETX)	End of text.
(BCC)	Block check character which is the character generated by taking the exclusive OR of the ASCII values of all the characters transmitted after and excluding (STX) up to and including (ETX). e.g. if a message with (D1 - Dn) is 5 characters (BCC) = (C1) EOR (C2) EOR (D1) EOR (D2) EOR (D3) EOR (D4) EOR (D5) EOR (ETX) where EOR = Exclusive OR

The computer must check this (BCC) before accepting this reply as valid. Also the software must be able to extract the number from the data string taking into account the protocol of the data transmission.

NOTE: If the 584S receives the message but does not recognise the mnemonic it will respond with (EOT). The (EOT) hands back control to the computer.

Further Enquiry and Termination

The computer then assumes master status again and three options are available:

1. Repeat Parameter Facility (NAK). If the computer transmits a (NAK) after the valid reply, it causes the 584S to repeat the parameter that was just received. This allows continuous monitoring of the same parameter without having to re-establish the connection.

2. Scroll Mode Facility (ACK). If the computer transmits an (ACK) after a valid 'reply', it causes the 584S to fetch the next parameter from the parameter list. This facility enables the computer to sequence continuously through all the parameters of the 584S.

3. Terminate Communication (EOT). The termination procedure is entered when the selection of a particular instrument is no longer required or when a 584S does not respond to a message or replies with an (EOT) character. The computer assumes Master status and transmits an (EOT) character to enable all the instruments on the data link to respond to the next GID-UID address parameter.

No Response

Under certain circumstances the computer may not receive a response from the 584S. This could be due to any of the following reasons:

1. Group/Unit address identifiers not recognised.
2. An error (e.g. parity) is found in one or more of the characters up to and including ENQ.
3. Communications loop failure, perhaps due to noise or wrong baud rate being selected.
4. Hardware failure.

In these cases the computer should be programmed to "time-out", i.e. wait for a response for a short time (160ms minimum) before trying again.

The sequence diagram for the data read function is given in Figure B.2.

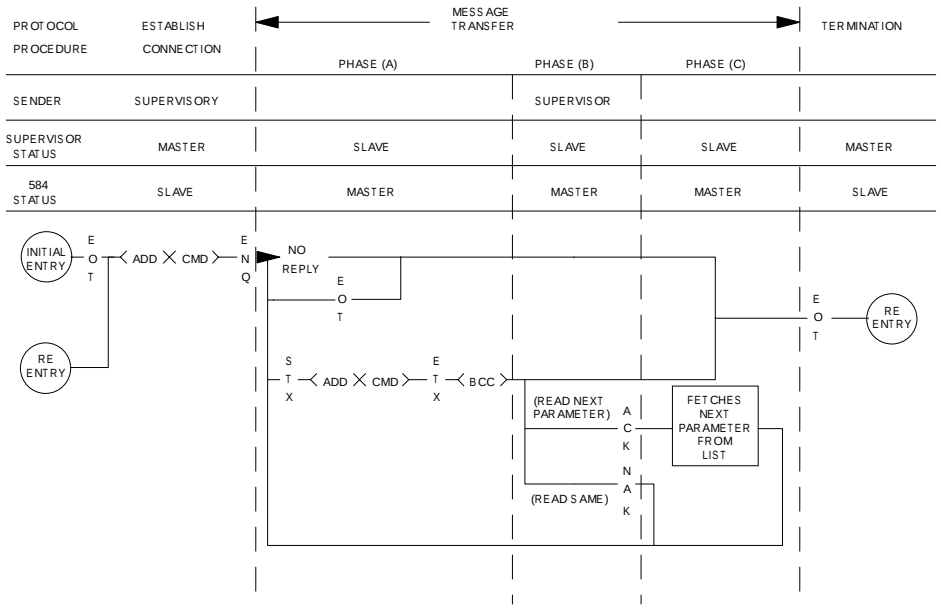


Figure B.2 - Reading Data From The 584S

Sending Data

Establish Connection

Connection is established with a particular 584S by sending:

(EOT) (GID) (GID) (UID) (UID)

followed immediately by the data transfer:

(STX) (C1) (C2) (D1) (D2) (D3) (DN) (ETX) (BCC)

(Note that the data transfer message is identical to that transmitted by a 584S when giving a "valid reply").

The symbols of this message are defined as follows:

(STX)	start of text character
(C1)(C2)	parameter specified by mnemonic
(D1 to DN)	parameter value
(ETX)	end of text character
(BCC)	Block Check Character (verification check digit which is again the exclusive OR of (C1) to (ETX) inclusive and must be calculated by the computer before transmission)

Responses

After transmission of the whole message, the 584S responds to it by sending (ACK), (NAK) or by giving no reply.

1. Positive acknowledgement (ACK)

   When the 584S has received the message, it performs the following tasks:

a) Checks for any parity errors in the message.

b) verifies that the (BCC) character corresponds to the data pattern received.

c) verifies that the (C1), (C2) command characters are a valid mnemonic that may be written to.

d) verifies that the data (D1 to DN) is valid and not out-of-range*.

e) updates the selected parameter with the new value contained in the message.

   Only when all these tasks have been successfully completed does the 584S send the (ACK) response to the computer. This signifies that the message was correctly received and implemented.

2. Negative acknowledgement (NAK)

   If the message fails any of the above checks, the 584S sends (NAK) response to the computer. This signifies that the message received by the 584S contained an error and accordingly it has not updated the selected parameter. One possible reason is the incorrect calculation of (BCC). At this point, the selected command may be repeated by sending the data transfer string without re-establishing connection, until the (ACK) response is received by the computer.

   * Data out-of-range returns NAK and is discarded.

3. No Reply

   Under certain circumstances, the computer may not receive a response from the 584S. This could be due to any of the following reasons:

   1. Unit address identifiers not recognised.
   2. An error (e.g. parity) is found in one or more of the characters up to and including (BCC).
   3. Communications loop failure perhaps due to noise or wrong baud rate selected.
   4. Hardware failure.

In these cases the computer should be programmed to 'time-out', i.e. wait for a response for a short time (160ms minimum) before trying again.

The sequence diagram for the data send function is given in Figure B.3.

Termination

The termination procedure is used if the computer wishes to stop selecting a particular 584S and establish connection with another. This is achieved by sending the 'establish connection' sequence. The computer retains Master status and transmits an (EOT) character to reset all instruments on the data link to be responsive to the next GID-UID address parameter.

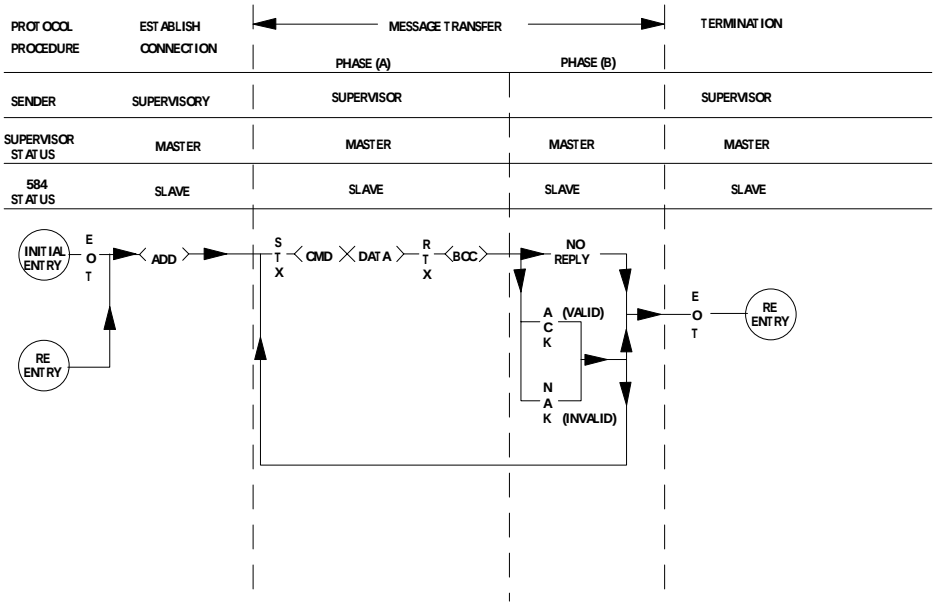


Figure B.3 - Sending Data to the 584S

Binary Communications

This mode has many similarities with the ASCII mode. This document mainly concentrates on presenting those parts which are different from the ASCII mode.

Specifications

Character Format

Each data-word is transmitted as 11 bits rather than adapting the 10-bit format used by the ASCII mode. This is because a control bit is used which is cleared in control characters and set in data characters. The format is as follows:

1 Start bit (lo)
7 Data bits (LSB first)
1 Control bit*
1 Even parity bit
1 Stop bit (hi)

* Logic 0 = Control character
* Logic 1 = Data character

The Message

The message received from the supervisor can be in any of several types. They can be divided into two categories:

a) "main messages"
b) "continuation messages"

Before presenting the format of these messages, the following gives the symbols they use. These symbols used in the messages are divided into two types; "control characters" and "data characters".

Control Characters

(EOT)	Indicates the end of transmission. It therefore clears the line and is sent by the Master at the start of a new message.
(STX)	This is the start of text character.
(ENQ)	This is the enquiry character. It is sent by the Master as the last character of any type of polling message.
(ETX)	This is the end of text character. It is followed by another character containing the checksum.
(ETB)	This is the end of block character. It is sent by the 584S instead of the (ETX) when it wishes to reply to a multi parameter enquiry. The (ETB) indicates the end of a block, but not the end of a message. Each block contains information on up to eight parameters. The (ETB) is used to reply to enquiry polling and multi-parameter polling (these are explained in "**TYPES OF MESSAGES**").
(ACK)	This is the positive acknowledgement character.
(NAK)	This is the negative acknowledgement character.

Data Characters

(INO)	This is the instrument number. It contains the address of the slave drive and is equivalent to the combination of the GID, UID characters of the ASCII mode.
(PNO)	This is the parameter number. It is equivalent to the combination of the C1 and C2 characters of the ASCII mode and is sent as a hexadecimal number rather than two ASCII characters.
(D1), (D2) and (D3)	These three characters contain both the value and the mode number. The format is explained in "**DATA FORMAT**".
(CCC)	This is the connection check control character. It contains the checksum of all the characters following the (EOT) character in the message.
(BCC)	Block check character which is generated by taking the Exclusive OR of the ASCII values of all character transmitted after and excluding (STX) up to and including (ETX)

Types of Messages

As described above there are two types of message:

Main Messages

The main messages are in four types:

1. Selection

   The supervisor writes to one parameter.

   (EOT) (INO) (CCC) (STX) (PNO) (D1) (D2) (D3) (ETX) (BCC)

   where the (BCC) character contains the checksum of all characters following the (STX).

2. Polling

   The supervisor requests to read the value of one parameter.

   (EOT) (INO) (PNO) (CCC) (ENQ)

3. Enquiry Polling

   The supervisor requests to read all those parameters in block 1 that have changed since the last read by an amount greater than or equal to changeband (PNO 4).

   (EOT) (INO) (CCC) (ENQ)

4. Multi-parameter polling

   The supervisor requests to read a given number of parameters. That number is referred to as the count number ("CNO"), it is included in the request message and the reply will be sent by the drive in blocks of up to 8 parameters.

   (EOT) (INO) (PNO) (CNO) (CCC) (ENQ)

   NOTE: The CCC is the checksum of the characters following an (EOT) and is therefore equal to (INO) in selection and enquiry-polling messages.

   If PNO is the first in a block (i.e. 0, 8, 16, etc.) and CNO = 8, then a pseudo - enquiry poll is performed on the block, controlled by PNO 7. Further details are given in the 'Serial Link' menu option described in Chapter 4.

Continuation messages:

In addition to the above, there are two types of continuation message (sent by the supervisor).

1. Next : (send next item from a list)
   Only valid if sent following a multi-parameter poll.
   (ACK)

2. Repeat : (repeat last reply)
   Only valid if sent following any type of poll. It requests a repetition of the previous reply. (NAK)

Data Format

Data values are presented in three consecutive characters, D1, D2 and D3. These characters include the mode name as well as the value read from, or to be written to, one of the parameters. A data character is represented by setting its MSB (bit 7). The contents of these characters are as follows:

D1 :	bits 2 to 6 :	mode number Number format is: 0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX 4 = .XXXX
	bits 0 and 1 :	bits 14 and 15 of the value.
D2 :	bits 0 to 6 :	bits 7 to 13 of the value.
D3 :	bits 0 to 6 :	bits 0 to 6 of the value.

Baud Rate:

This can be any one of 6 values: 300, 600, 1200, 2400, 4800 or 9600 baud

Serial Transmission

During serial communications, the 584S acts as a slave and replies to messages sent from a supervisor. It responds by transmitting a reply which can be one of two types:

a. one character

It can be one of the following:

1. (ACK) : sent after the correct reception of a selection message.
2. (NAK) or (EOT) : in the case of detecting a fault.

b. more than one character

This is the case when sending a reply to any type of a polling message. The reply is in the form:

(STX) (PNO) (D1) (D2) (D3) (ETX) (BCC)

In the case of multi-parameter polling, the reply can consist of more than one message. Such a reply is divided into a group of messages (blocks). The (ETX) character is only sent at the end of the last message. In other messages, the (ETX) is replaced by an (ETB) to indicate an end of a block rather than the end of reply, as explained earlier.

Serial Link Mnemonics And Parameter Number Allocation

Eurotherm Group Standard Parameters

Each of the Eurotherm Group instruments which support ASCII protocol contains a minimum set of parameters. These are known as the Prime Set and allow access to the following:

Mnemonic	Description	Access	Function
BL	Buffer length	R/O	Returns 4646_{16} indicating that both transmit and receive buffers are 46_{16} bytes long.
CI	Configuration Information	R/O	Returns $4CCC_{16}$ indicating that the drive supports both fixed and variable length data formats, and that the drive is a single-function device.
EE	Error report	R/W	Returns one of the following to indicate the status of serial link transmissions : 00C0 No errors 01C7 Unknown mnemonic 02C2 Block check character fail 03C1 Parity error on received data 03C2 Framing or overrun error 05C8 Attempt to write to a read-only mnemonic 07C7 Invalid message format 08C8 Value in selection message out of range Writing any value to mnemonic EE resets it to 00C0.
II	Instrument	R/W	Returns the value of a parameter, the default value of which is 5840_{16}.
MN	Mode Number	R/O	Returns a fixed value 08C1 (the full Eurotherm standard is not supported).
VO	Version Number	R/O	Returns the issue number in the upper two characters, and the release number in the lower two characters. For example issue 2.1 returns 0201.

In addition to the Prime Set, each drive or instrument supports an application set of parameters to allow fast access to commonly required variables such as:

a. Process variables.

b. Setpoints.

c. PI gains.

All parameters can be found by polling the instrument identifier parameter and then sequentially polling until the instrument identifier parameter is repeated. This will result in a circular list that contains all supported by the instrument.

PNO Allocation

Block 0: (Binary Protocol Only)

PNO	Access	Description		
0	R/O	Instrument Identifier. Same as ASCII mnemonic II.		
1	R/W	Error report. Same as ASCII mnemonic EE		
2		Reserved		
3	R/O	Option Version of field bus option.		
4	R/W	Changeband. In an enquiry poll or pseudo-enquiry poll R/W (see PNO 7), a value must have changed by an amount equal to or greater than the hysteresis before it will be reported. Hysteresis is measured in the smallest units applicable to each parameter. For example, if hysteresis = 10, then a parameter with one decimal point must change by 1.0, and a parameter with two decimal points must change by 0.10 before they will be reported		
5	R/O	Serial link configuration.		
		Bit nos.	Description	
		0 - 3	Baud rate	0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 (default)
		4 - 15	Reserved	
6	R/O	Field Bus option "network" address.		
7	R/W	Control word for multi-parameter polling. For the purpose of multi-parameter polling, the PNOs are arranged in 16 blocks of 8. Bit 0 of this parameter controls block 0 (PNO 0 to 7), bit 1 controls block 1 (PNO 8 to 15) bit 15 controls block 15 (PNO 120 to 127). When a bit is 1 (default), a multi-parameter poll on this block operates normally. When a bit is 0, a multi-parameter poll on this block with PNO = multiple of 8, and CNO = 8 performs an enquiry poll instead (a pseudo-enquiry poll).		

Block 1 :

PNO	ASCII mnemonic	Tag No.	Access	Bit number	ASCII data format	Binary data format	Limits	Description
8	08	38	R/O	-	21	xxx.xx	-	DRIVE CURRENT (%)
9	09	60	R/O	-	21	xxx.xx	-	DRIVE LOAD (%)
10	0A	62	R/O	-	21	xxx.xx	-	EXT TORQUE LIMIT (%)
11	0B	39	R/O	-	21	xxx.xx	-	INVERTER FREQUENCY (%)
12	0C	61	R/O	-	21	xxx.xx	-	SPEED SETPOINT (%)
13	0D	85	R/O	-	21	xxx.x	-	INVERTER FREQUENCY (Hz)
14	0E	84	R/O	-	21	xxx.x	-	SPEED SETPOINT (Hz)
15	0F	58	R/O	-	23	xxxxx	-	DRIVE STATUS
	-	-	0				-	DRIVE STOPPED
	-	-	1				-	DRIVE RUNNING
	-	-	2				-	DRIVE AT ZERO SPEED
	-	-	3				-	DRIVE AT SPEED SETPOINT
	-	-	4				-	DRIVE RUNNING WITH I*T WARNING
	-	-	5				-	RESERVED
	-	-	6				-	RESERVED
	-	-	7				-	EXTERNAL TRIP
	-	-	8				-	D.C. LINK OVERVOLTAGE TRIP
	-	-	9				-	D.C. LINK UNDERVOLTAGE TRIP
	-	-	10				-	OVERCURRENT TRIP
	-	-	11				-	I*T TRIP
	-	-	12				-	STALL TRIP
	-	-	13				-	4-20MA CONTROL TRIP
	-	-	14				-	HEATSINK OVERTEMP TRIP
	-	-	15				-	MOTOR OVERTEMP TRIP

Block 2 :

PNO	ASCII mnemonic	Tag No.	Access	Bit number	ASCII data format	Binary data format	Limits	Description
16	10	14	R/W	-	21	xxx.x	0.1 3000.0	RAMP UP TIME (sec)
17	11	13	R/W	-	21	xxx.x	0.1 3000.0	RAMP DOWN TIME (sec)
18	12	6	R/W[2]	-	21	xxx.xx	0 100.00	MAX SPEED (%)
19	13	7	R/W[2]	-	21	xxx.xx	0 100.00	MIN SPEED (%)
20	14	17	R/W	-	21	xxx.xx	50.00 150.00	MOTOR CURRENT LIMIT (%)
21	15	12	R/W[2]	-	21	xxx.xx	6.25 100.00	BASE FREQUENCY (%)
22	16	18	R/W	-	21	xxx.xx	0.00 25.00	FIXED BOOST (%)
23	17	59	R/O	-	23	xxxxx	-	DIGITAL INPUTS
-	-	-	0				-	RUN /STOP
-	-	-	1				-	FRAMP
-	-	-	2				-	DIRECTION
-	-	-	3				-	EXTERNAL TRIP
-	-	-	4				-	JOG
-	-	-	5				-	PRESET 1
-	-	-	6				-	PRESET 2
-	-	-	7				-	MANUAL/AUTO
-	-	-	8				-	LOCAL BUTTON
-	-	-	9				-	PROG BUTTON
-	-	-	10				-	DIRECTION BUTTON
-	-	-	11				-	JOG BUTTON
-	-	-	12				-	STOP BUTTON
-	-	-	13				-	START BUTTON
-	-	-	14 - 15					RESERVED

Block 3 :

PNO	ASCII mnemonic	Tag No.	Access	Bit number	ASCII data format	Binary data format	Limits	Description
24	18	8	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 1 (%)
25	19	9	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 2 (%)
26	1A	10	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 3 (%)
27	1B	11	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 4 (%)
28	1C	31	R/W	-	21	xxx.xx	50.00 105.00	I*T THRESHOLD (%)
29	1D	5	R/W	-	21	xxx.xx	-100.00 100.00	AUX SETPOINT (%)
30	1E	165	R/W	-	21	xxx.xx	-100.00 100.00	JOG SPEED (%)
31	1F		-	-	23	xxxxx	(Note 1)	
	-	44	R/W	0			0 → 1	EXT TORQUE LIM SELECT
	-	55	R/W	1			0 → 1	AUX RUN
	-	56	R/W	2			0 → 1	AUX FRAMP
	-	57	R/W	3			0 → 1	AUX DIRECTION
	-	167	R/W	4			0 → 1	AUX JOG
	-	147	R/W[2]	5			0 → 1	AUTO BOOST ENABLE
	-	-	-	6 - 15				RESERVED

Block 4 :

PNO	ASCII mnemonic	Tag No.	Access	Bit number	ASCII data format	Binary data format	Limits	Description
32	20	19	R/W	-	21	xxx.xx	0.00 100.00	SKIP FRQ 1 CENTRE (%)
33	21	23	R/W	-	21	x.xx	0.00 8.34	SKIP FRQ 1 DELTA (%)
34	22	20	R/W	-	21	xxx.xx	0.00 100.00	SKIP FRQ 2 CENTRE (%)
35	23	24	R/W	-	21	x.x	0.00 8.34	SKIP FRQ 2 DELTA (%)
36	24	43	R/W	-	21	xxx.x	0.1 3000.0	FRAMP TIME (sec)
37	25	53	R/W	-	21	x.xx	0.00 4.17	SLIP COMP (%)
38	26	86	R/W	-	21	xxx.xx	-100.00 100.00	SERIAL LINK SETPOINT (%)
39	27		-	-	23	xxxxx	(Note 1)	
	-	27	R/W	0			0 → 1	SKIP FRQ 1 SELECT
	-	28	R/W	1			0 → 1	SKIP FRQ 2 SELECT
	-	-		2 - 15			-	RESERVED

Block 5 :

PNO	ASCII mnemonic	Tag No.	Access	Bit number	ASCII data format	Binary data format	Limits	Description
40	28	21	R/W	-	21	xxx.xx	0.00 100.00	SKIP FRQ 3 CENTRE (%)
41	29	25	R/W	-	21	x.xx	0.00 8.34	SKIP FRQ 3 DELTA (%)
42	2A	22	R/W	-	21	xxx.xx	0.00 100.00	SKIP FRQ 4 CENTRE (%)
43	2B	26	R/W	-	21	x.xx	0.00 8.34	SKIP FRQ 4 DELTA (%)
44	2C	171	R/W[2]	-	21	xxx.xx	0 100.00	S-RAMP % (%)
45	2D	213	R/W	-	21	x.xxxx	3.0000 -3.0000	MANUAL SETPOINT RATIO
46	2E	214	R/W	-	21	x.xxxx	3.0000 -3.0000	MANUAL SETPOINT DIVIDER
47	2F		-	-	23	xxxxx	(Note 1)	
	-	29	R/W	0				SKIP FRQ 3 SELECT
	-	30	R/W	1			0 → 1	SKIP FRQ 4 SELECT
	-	-	-	2 - 15			0 → 1	RESERVED

Block 6 :

PNO	ASCII mnemonic	Tag No.	Access	ASCII data format	Binary data format	Values		Description
48	30	2	R/W	21	xxxxx	0	0V TO 10V SPEED SETPOINT	MANUAL SETPOINT
						1	-10V TO + 10V SPEED SETPOINT	
						2	AUX SPEED SETPOINT	
						3	PRESET SPEED 1	
						4	PRESET SPEED 2	
						5	PRESET SPEED 3	
						6	PRESET SPEED 4	
						7	PRESET SPEED 5	
						8	PRESET SPEED 6	
						9	PRESET SPEED 7	
						10	PRESET SPEED 8	
						11	DIGITAL MOP	
49	31	3	R/W	21	xxxxx	0	0 TO 20mA SPEED SETPOINT	AUTO SETPOINT SELECT
						1	20 TO 0mA SPEED SETPOINT	
						2	4 TO 20mA SPEED SETPOINT	
						3	20 TO 4mA SPEED SETPOINT	
						4	SERIAL LINK SPEED SETPOINT	
						5	DIGITAL PRESET SPEED SELECT	
						6	SPEED FEEDBACK	
50	32	4	R/W[2]	21	xxxxx	0	120 Hz LIMIT	ULF SELECT
						1	240 Hz LIMIT	
						2	480 Hz LIMIT	
51	33	15	R/W[2]	21	xxxxx	0	RAMP DOWN	STOPPING MODE SELECT
						1	COAST DOWN	
						2	INJECTION BRAKING	
						3	RAMP DOWN + DC HOLDING PULSE	
52	34	16	R/W[2]	21	xxxxx	0	LINEAR	VF CHARACTERISTIC
						1	FAN LAW	
53	35	32	R/W[2,3]	21	xxxxx	0	3k Hz CARRIER	SWITCH FREQUENCY SELECT
						1	6k Hz CARRIER	
						2	9k Hz	
54	36	36	R/W[2]	21	xxxxx	0	ZERO SPEED	RELAY 1 CONFIG
						1	AT SPEED	
						2	RUN CONFIRM	
						3	BRAKE CONTROL	
						4	AT LOAD	
						5	AT FEEDBACK SPEED	
55	37	37	R/W[2]	21	xxxxx	0	ZERO SPEED	RELAY 2 CONFIG
						1	AT SPEED	
						2	RUN CONFIRM	
						3	BRAKE CONTROL	
						4	AT LOAD	
						5	AT FEEDBACK SPEED	

Block 7

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits and values	Description
56	38	115	R/W		21	xxx.xx	-150.00 - 50.00	REGEN CURRENT LIMIT (%)
57	39	202	R/W	-	21	xxxxx	0 MANUAL & AUTO 1 MANUAL ONLY 2 AUTO ONLY	TRIM CHOICE
58	3A	131	R/W[2]		21	xxx.xx	0.00 100.00	BASE VOLTS (%)
59	3B	132	R/W	-	21	xxxxx	0 MICRO AC DRIVE 1 SPEED SP (Hz) 2 DRIVE FREQUENCY 3 MOTOR CURRENT 4 MOTOR LOAD 5 EXT TORQUE LIM 6 DRIVE STATUS 7 DIGITAL INPUTS 8 TORQUE MODE 9 PID ERROR 10 PID CLAMPED 11 PID OUTPUT 12 SPEED FB (RPM) 13 SPEED FB (HZ) 14 SPEED SP (RPM) 15 MANUAL SP (HZ) 16 AUTO SP (HZ)	MENU POSITION
60	3C	54	R/W	-	21	x.xx	0.00 4.17	STABILISATION (%)
61	3D	134	R/W	-	21	xxxx.x	0.1 3000.0	STALL TRIP TIME (SEC)
62	3E	136	R/W	-	21	xxx.xx	10.00 100.00	OP CURRENT CAL (%)
63	3F		-	-	23	xxxxx	(Note 1)	
	-	116	R/W	0			0 → 1	REGEN LIM SELECT
	-	128	R/W	1			0 → 1	RAMP HOLD SELECT
	-	133	R/W	2			0 → 1	STALL TRIP ENABLE
	-			3-15			-	RESERVED

Block 8

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits	Description
64	40	137	R/W	-	21	xxx.xx	50.00 150.00	I*T UPPER LIMIT (%)
65	41	138	R/W	-	21	xx.x	5.0 60.0	I*T TIME (sec)
66	42	140	R/W	-	21	xxx.xx	0.00 150.00	BRAKE RELAY ON LOAD LEVEL (%)
67	43	141	R/W	-	21	xxx.xx	0.00 100.00	BRAKE RELAY ON FREQUENCY LEVEL (%)
68	44	142	R/W	-	21	xxx.xx	0.00 100.00	BRAKE RELAY OFF FREQUENCY LEVEL (%)
69	45	215	R/W	-	21	x.xxxx	3.0000 -3.0000	AUTO SETPOINT RATIO
70	46	216	R/W	-	21	x.xxxx	3.0000 -3.0000	AUTO SETPOINT DIVIDER
71	47							RESERVED

Block 9

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits and values	Description
72	48	144	R/W	-	21		0 MIN TO MAX 1 0 TO LIMIT FREQ 2 0 TO MAX	RAMP OUTPUT TERMINAL CHOICE
73	49	172	R/W[2]	-	21		0 LINEAR RAMP 1 PARABOLIC RAMP 2 S RAMP	RAMP TYPE
74	4A	168	R/W	-	21	xxx.xx	100.00 - 100.00	MAX MOP SPEED (%)
75	4B	169	R/W	-	21	xxx.xx	100.00 -100.00	MIN MOP SPEED (%)
76	4C	170	R/W	-	21	xxx.xx	100.00 -100.00	MOP PRESET SPEED (%)
77	4D	159	R/W	-	21	xxx.xx	100.00 0	ZERO SPEED THRESHOLD
78	4E	160	R/W	-	21	xxx.xx	100.00 0	AT SPEED THRESHOLD
79	4F							RESERVED

Block 10

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits and values	Description
80	50	161	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 5 (%)
81	51	162	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 6 (%)
82	52	163	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 7 (%)
83	53	164	R/W	-	21	xxx.xx	-100.00 100.00	PRESET SPEED 6 (%)
84	54	166	R/W[2]	-	21		0 4 PRESET & JOG 1 8 PRESETS 2 DIGITAL MOP & PRESET	RECONFIG I/PS
85	55	178	R/W	-	21	xxx.xx	150.00 0	LOAD THRESHOLD (%)
86	56	179	R/W	-	21	xxx.xx	100.00 0	FEEDBACK SPEED THRESHOLD (%)
87	57	210	R/W	-	23	xxxxx	FFFF 0	AUTO RESTART TRIP MASK

Block 11:

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits and values	Description
88	58	205	R/W	-	21	xxx.xx	600.0 0.5	AUTO RESTART ATTEMPT DELAY (S)
89	59	211	R/W	-	21	xx	10 1	AUTO RESTART NUMBER OF ATTEMPTS
90	5A	217	R/O	-	21	xx	-	AUTO RESTART ATTEMPTS LEFT
91	5B	212	R/W	-	21	xxx.x	600.00 0.1	AUTO RESTART CANCEL TIME
92	5C							RESERVED
93	5D							RESERVED
94	5E							RESERVED
95	5F	-	-		23	xxxxx	(Note 1)	
	-	204	R/W	0			0 → 1	AUTO RESTART ENABLE
	-		-	1→15				RESERVED

Blocks 12 & 13:

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits	Description
96	60	91	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 112 (MNEMONIC 70)
97	61	92	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 113 (MNEMONIC 71)
98	62	93	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 114 (MNEMONIC 72)
99	63	94	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 115 (MNEMONIC 73)
100	64	95	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 116 (MNEMONIC 74)
101	65	96	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 117 (MNEMONIC 75)
102	66	97	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 118 (MNEMONIC 76)
103	67	98	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 119 (MNEMONIC 77)
104	68	99	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 120 (MNEMONIC 78)
105	69	100	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 121 (MNEMONIC 79)
106	6A	101	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 122 (MNEMONIC 7A)
107	6B	102	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 123 (MNEMONIC 7B)
108	6C	103	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 124 (MNEMONIC 7C)
109	6D	104	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 125 (MNEMONIC 7D)
110	6E	105	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 126 (MNEMONIC 7E)
111	6F	106	R/W	-	21	xxxxx	0 → 255	POINTER FOR PNO 127 (MNEMONIC 7F)

Blocks 14 & 15:

These blocks on PNOs and mnemonics are configurable. The tags to which they point are defined by PNOs 60 to 6F in blocks 12 and 13.

PNO	ASCII mnemonic	Tag No.	Access	Bit No.	ASCII data format	Binary data format	Limits	Description
112	70	(PNO 96)	*	-	*	*	*	CONFIGURABLE MNEMONIC 1
113	71	(PNO 97)	*	-	*	*	*	CONFIGURABLE MNEMONIC 2
114	72	(PNO 98)	*	-	*	*	*	CONFIGURABLE MNEMONIC 3
115	73	(PNO 99)	*	-	*	*	*	CONFIGURABLE MNEMONIC 4
116	74	(PNO 100)	*	-	*	*	*	CONFIGURABLE MNEMONIC 5
117	75	(PNO 101)	*	-	*	*	*	CONFIGURABLE MNEMONIC 6
118	76	(PNO 102)	*	-	*	*	*	CONFIGURABLE MNEMONIC 7
119	77	(PNO 103)	*	-	*	*	*	CONFIGURABLE MNEMONIC 8
120	78	(PNO 104)	*	-	*	*	*	CONFIGURABLE MNEMONIC 9
121	79	(PNO 105)	*	-	*	*	*	CONFIGURABLE MNEMONIC 10
122	7A	(PNO 106)	*	-	*	*	*	CONFIGURABLE MNEMONIC 11
123	7B	(PNO 107)	*	-	*	*	*	CONFIGURABLE MNEMONIC 12
124	7C	(PNO 108)	*	-	*	*	*	CONFIGURABLE MNEMONIC 13
125	7D	(PNO 109)	*	-	*	*	*	CONFIGURABLE MNEMONIC 14
126	7E	(PNO 110)	*	-	*	*	*	CONFIGURABLE MNEMONIC 15
127	7F	(PNO 111)	*	-	*	*	*	CONFIGURABLE MNEMONIC 16

* = The access, data format and limits depend on the tag to which the corresponding pointer points.

Tag List

Tag	Description	Default	Min	Max		User Setting
0	Unallocated	-	-	-	-	-
1	Eprom version number	-	-	-	RO	-
2	Manual setpoint select	0V to 10V	0	11	RW	
3	Auto setpoint select	0mA to 20mA	0	6	RW	
4	Limit frequency select	120Hz	0	2	RW	
5	Aux speed setpoint	0.00%	-100.00%	100.00%	RW	
6	Max speed	41.67%	0%	100.00%	RW	
7	Min speed	0.00%	0%	100.00%	RW	
8	Preset speed 1	0.00%	-100.00%	100.00%	RW	
9	Preset speed 2	0.00%	-100.00%	100.00%	RW	
10	Preset speed 3	0.00%	-100.00%	100.00%	RW	
11	Preset speed 4	0.00%	-100.00%	100.00%	RW	
12	Base speed	41.67%	6.25%	100.00%	RW	
13	Ramp down time	10.0s	0.1s	3000.0s	RW	
14	Ramp up time	10.0s	0.1s	3000.0s	RW	
15	Stopping mode	Ramp down	0	3	RW	
16	Vf characteristic	Linear law	0	1	RW	
17	Motor current limit	100.00%	50.00%	150.00%	RW	
18	Fixed Boost	0.00%	0%	25.00%	RW	
19	Skip frequency 1 centre	0.00%	0%	100.00%	RW	
20	Skip frequency 2 centre	0.00%	0%	100.00%	RW	
21	Skip frequency 3 centre	0.00%	0%	100.00%	RW	
22	Skip frequency 4 centre	0.00%	0%	100.00%	RW	
23	Skip frequency 1 delta	0.00%	0%	8.34%	RW	
24	Skip frequency 2 delta	0.00%	0%	8.34%	RW	
25	Skip frequency 3 delta	0.00%	0%	8.34%	RW	
26	Skip frequency 4 delta	0.00%	0%	8.34%	RW	
27	Skip frequency 1 select	Disabled	0	1	RW	
28	Skip frequency 2 select	Disabled	0	1	RW	
29	Skip frequency 3 select	Disabled	0	1	RW	
30	Skip frequency 4 select	Disabled	0	1	RW	
31	I*t threshold	105.00%	50.00%	105.00%	RW	
32	Switch frequency select	3kHz	0	2	RW	
33	MMI menu delay	20	0	200	RW	
34	Reserved					

Tag	Description	Default	Min	Max		User Setting
35	Reserved	-	-	-	-	-
36	Relay 1 configuration	Zero speed	0	5	RW	
37	Relay 2 configuration	At speed	0	5	RW	
38	Drive current	-	-200.00%	200.00%	RO	
39	Inverter frequency	-	-100.00%	100.00%	RO	
40	Enter password	0x0000	0	FFFF	RW	
41	Change password	0x0000	0	FFFF	RW	
42	Reserved	-	-	-	-	-
43	Framp time	1.0s	0.1s	3000.0s	RW	
44	External torque limit select	Disabled	0	1	RW	
45	Reserved	-	-	-	-	-
46	Reserved	-	-	-	-	-
47	Reserved	-	-	-	-	-
48	Reserved	-	-	-	-	-
49	Reserved	-	-	-	-	-
50	Reserved	-	-	-	-	-
51	Reserved	-	-	-	-	-
52	Reserved	-	-	-	-	-
53	Slip compensation	0.0Hz	0%	4.17%	RW	
54	Stabilisation	0.6Hz	0%	4.17%	RW	
55	Aux run	Enabled	0	1	RW	
56	Aux framp	Enabled	0	1	RW	
57	Aux direction	Enabled	0	1	RW	
58	Drive status	-	0	FFFF	RO	
59	Digital inputs	-	0	00FF	RO	
60	Drive load	-	-200.00%	200.00%	RO	
61	Speed setpoint	-	-100.00%	100.00%	RO	
62	External torque limit	-	0%	150.00%	RO	
63	Reserved	-	-	-	-	-
64	Reserved	-	-	-	-	-
65	P1 serial link enable	Enabled	0	1	RO	
66	P3 serial link enabled	Enabled	0	1	RO	
67	P1 GID	0	0	7	RO	
68	P3 GID	0	0	7	RO	
69	P1 UID	0	0	15	RO	
70	P3 UID	0	0	15	RO	

Tag	Description	Default	Min	Max		User Setting
71	P1 mode	ASCII	0	1	RO	
72	P3 mode	ASCII	0	1	RO	
73	P1 baud	9600	0	5	RO	
74	P3 baud	9600	0	5	RO	
75	P1 esp support (ASCII)	Disabled	0	1	RW	
76	P3 esp support (ASCII)	Disabled	0	1	RW	
77	P1changeband (bin)	0.0%	0%	327.67%	RW	
78	P3 changeband (bin)	0.0%	0%	32.767%	RW	
79	P1 error report	-	0	FFFF	RO	
80	P3 error report	-	0	FFFF	RO	
81	P1 pno.7	0xFFFF	0	FFFF	RW	
82	P3 pno.7	0xFFFF	0	FFFF	RW	
83	P1 parity	Even	0	1	RO	
84	Speed setpoint (Hz)	-	-120.0Hz	120.0Hz	RO	
85	Inverter frequency (Hz)	-	-100.00%	100.00%	RO	
86	Serial link setpoint	0.0Hz	-100.00%	100.00%	RW	
87	Serial link buffer length	-	0	FFFF	RO	
88	Serial link config information	-	0	FFFF	RO	
89	Serial link instrument identifier	-	0	FFFF	RO	
90	Serial link mode number	-	0	FFFF	RO	
91	Pointer for pno 112	0 or 129*	0	255	RW	
92	Pointer for pno 113	0	0	255	RW	
93	Pointer for pno 114	0	0	255	RW	
94	Pointer for pno 115	0	0	255	RW	
95	Pointer for pno 116	0	0	255	RW	
96	Pointer for pno 117	0	0	255	RW	
97	Pointer for pno 118	0	0	255	RW	
98	Pointer for pno 119	0	0	255	RW	
99	Pointer for pno 120	0	0	255	RW	
100	Pointer for pno 121	0	0	255	RW	
101	Pointer for pno 122	0	0	255	RW	
102	Pointer for pno 123	0	0	255	RW	
103	Pointer for pno 124	0	0	255	RW	
104	Pointer for pno 125	0	0	255	RW	
105	Pointer for pno 126	0	0	255	RW	
106	Pointer for pno 127	0	0	255	RW	

* Factory Default

Tag	Description	Default	Min	Max		User Setting
107	Reserved	-	-	-	-	-
108	Reserved	-	-	-	-	-
109	Reserved	-	-	-	-	-
110	Reserved	-	-	-	-	-
111	Reserved	-	-	-	-	-
112	Reserved	-	-	-	-	-
113	Reserved	-	-	-	-	-
114	Reserved	-	-	-	-	-
115	Regen current limit	-100.00%	-150.00%	-50.00%	RW	
116	Regen current limit select	Enabled	0	1	RW	
117	Feedback source	None	0	1	RW	
118	Pole pairs	2	1	4	RW	
119	Encoder lines	1000	1	10000	RW	
120	Speed feedback (rpm)	-	-24000	24000	RO	
121	Speed feedback	-	-100.00%	100.00%	RO	
122	Encoder sign	Positive	0	1	RW	
123	Option version	0.00	0	327.67	RO	
124	Reserved	-	-	-	-	-
125	Reserved	-	-	-	-	-
126	Reserved	-	-	-	-	-
127	Option address	0	0	32767	RO	-
128	Ramp hold select	Disabled	0	1	RW	
129	EEPROM write (parameter save)	Inactive	0	2	RW	
130	Reserved	-	-	-	-	-
131	Base volts	100.00%	0%	115.47%	RW	
132	Menu position	Micro AC drive	0	16	RW	
133	Stall enable	Enabled	0	1	RW	
134	Stall trip time	600.0s	0.1s	3000.0s	RW	
135	Reserved	-	-	-	-	-
136	Op current cal	100.00%	10.00%	100.00%	RW	
137	I*t upper limit	150.00%	50.00%	150.00%	RW	
138	I*t time	60.0s	5.0s	60.0s	RW	
139	Reserved	-	-	-	-	-
140	Brake relay on load level	50.00%	0%	150.00%	RW	
141	Brake relay on frequency level	4.17%	0%	100.00%	RW	
142	Brake relay off frequency level	2.50%	0%	100.00%	RW	
143	Reserved	-	-	-	-	-

Tag	Description	Default	Min	Max		User Setting
144	Ramp output terminal choice	Min to max	0	2	RW	
145	Reserved	-	-	-	-	
146	Torque mode	Const torque	0	1	RO	
147	Auto boost enable	Disabled	0	1	RW	
148	Reserved	-	-	-	-	
149	Reserved	-	-	-	-	-
150	Reserved	-	-	-	-	-
151	Reserved	-	-	-	-	-
152	Reserved	-	-	-	-	-
153	Reserved	-	-	-	-	-
154	Reserved	-	-	-	-	-
155	Reserved	-	-	-	-	-
156	Reserved	-	-	-	-	-
157	Reserved	-	-	-	-	-
158	Reserved	-	-	-	-	-
159	Zero speed relay threshold	0.83%	0%	100.00%	RW	
160	At speed relay threshold	0.83%	0%	100.00%	RW	
161	Preset speed 5	0.00%	-100.00%	100.00%	RW	
162	Preset speed 6	0.00%	-100.00%	100.00%	RW	
163	Preset speed 7	0.00%	-100.00%	100.00%	RW	
164	Preset speed 8	0.00%	-100.00%	100.00%	RW	
165	Jog speed	4.17%	-100.00%	100.00%	RW	
166	Reconfig i/ps	4 presets & jog	0	2	RW	
167	Aux jog	Enabled	0	1	RW	
168	Max mop speed	100.00%	-100.00%	100.00%	RW	
169	Min mop speed	0.00%	-100.00%	100.00%	RW	
170	Mop preset speed	0.00%	-100.00%	100.00%	RW	
171	S-ramp %	100.00%	0%	100.00%	RW	
172	Ramp type	Linear ramp	0	2	RW	
173	Reserved	-	-	-	-	-
174	Reserved	-	-	-	-	-
175	Reserved	-	-	-	-	-
176	Reserved	-	-	-	-	-
177	Reserved	-	-	-	-	-
178	Load relay threshold	50.00%	0%	150.00%	RW	
179	Feedback speed relay threshold	8.34%	0%	100.00%	RW	

Tag	Description	Default	Min	Max		User Setting
180	Change torque mode	Inactive	0	3	RW	
181	PID derivative tc	0.000s	0s	10.000s	RW	
182	PID integral tc	1.00s	0.01s	100.00s	RW	
183	PID filter tc	2.000s	0s	10.000s	RW	
184	PID prop gain	1.0	0	100.0	RW	
185	PID positive limit	100.00%	0%	105.00%	RW	
186	PID negative limit	-100.00%	0%	-105.00%	RW	
187	PID o/p scaler (trim)	0.0417	-3.0000	3.0000	RW	
188	PID enable	Disabled	0	1	RW	
189	PID integral defeat	Off	0	1	RW	
190	PID input 1	0.00%	-300.00%	300.00%	RW	
191	PID input 2	0.00%	-300.00%	300.00%	RW	
192	PID ratio1	1.0000	-3.0000	3.0000	RW	
193	PID ratio 2	1.0000	-3.0000	3.0000	RW	
194	PID divider 1	1.0000	-3.0000	3.0000	RW	
195	PID divider 2	1.0000	-3.0000	3.0000	RW	
196	PID error	-	-300.00%	300.00%	RO	
197	PID clamped	-	0	1	RO	
198	PID output	-	-300.00%	300.00%	RO	
199	PID sp choice	None	0	4	RW	
200	PID fb choice	None	0	4	RW	
201	PID op choice	None	0	4	RW	
202	Trim choice	Manual & auto	0	2	RW	
203	PID op mode	Unipolar	0	1	RW	
204	Auto restart enable	Disabled	0	1	RW	
205	Auto restart attempt delay	10.0s	0.5s	600.0s	RW	
206	Flycatching Enable	Disabled	1	0	RW	
207	Speed setpoint (rpm)	-	-28000	28000	RO	
208	Manual speed setpoint	-	-100.00%	100.00%	RO	
209	Auto speed setpoint	-	-100.00%	100.00%	RO	
210	Auto restart trip mask	0x1F00	0	FFFF	RW	
211	Auto restart number of attempts	5	1	10	RW	
212	Auto restart cancel time	300.0s	0.1s	600.0s	RW	
213	Manual setpoint ratio	1.0000	-3.0000	3.0000	RW	
214	Manual setpoint divider	1.0000	-3.0000	3.0000	RW	
215	Auto setpoint ratio	1.0000	-3.0000	3.0000	RW	

Tag	Description	Default	Min	Max		User Setting
216	Auto setpoint divider	1.0000	-3.0000	3.0000	RW	
217	Auto restart attempts left	-	0	10	RO	
218	Flycatching search volts	15.00%	0%	100.00%	RW	
219	Reserved	-	-	-	-	-
220	Reserved	-	-	-	-	-
221	Flycatching search time	5.0s	0.1s	10.0s	RW	
222	Flycatching reflux time	2.0s	0.1s	10.0s	RW	
223	Flycatching search mode	Bidirectional	0	2	RW	
224	Reserved	-	-	-	-	-
225	Flycatching min search speed	8.34%	0%	100.00%	RW	
226	Reserved	-	-	-	-	-
227	Reserved	-	-	-	-	-
228	Reserved	-	-	-	-	-
229	Local speed setup	0.00%	0%	100.00%	RW	
230	Local speed setpoint	0.00%	0%	100.00%	RW	
231	Control mode	Remote	0	1	RW	
232	Local direction setup	Forward	0	1	RW	
233	Local mode setup	Disabled	0	1	RW	
234	Start button	Enabled	0	1	RW	
235	Stop button	Enabled	0	1	RW	
236	Jog button	Enabled	0	1	RW	
237	Direction button	Enabled	0	1	RW	
238	Local button	Enabled	0	1	RW	
239	Local speed setpoint buttons	Enabled	0	1	RW	
240	Local setpoint	-	0%	100.00%	RO	
241	Language	English	0	3	RW	
242	Local setpoint ratio	1.0000	-3.0000	3.0000	RW	
243	Local setpoint divider	1.0000	-3.0000	3.0000	RW	
244	Reserved	-	-	-	-	-
245	Reserved	-	-	-	-	-
246	Overload status	Normal	0	1	RO	
247	Reserved	-	-	-	-	-
248	Reserved	-	-	-	-	-
249	DC Pulse Time	2.0	0.1	20.0	RW	-
250	Regen Slip Comp	Disabled	0	1	RW	-

Tag	Description	Default	Min	Max		User Setting
251	Reserved	-	-	-	-	-
252	Ramp Up Time	10.0	0.1	3000.0	RW	
253	Ramp Down Time	10.0	0.1	3000.0	RW	
254	Framp	Framp	0	2	RW	
		-	-	-	-	-

Additional Features

1. There is a option on the way in which the 2 state (binary) parameters return values when polled. These are accessible only via the configurable PNOs. If ESP SUPPORT is disabled the data part of the message consists of

   >x

   where x = 0 or 1. Thus the message length is minimised.

   If ESP SUPPORT is enabled the data part of the message consists of

   >0 0 0 x

   where x = 0 or 1. This option is intended for use with Eurotherm ESP devices. When sending a selection message to these parameters any leading zeros are ignored.

2. On the main RS485 serial port (P1) the parity is EVEN by default, but may be switched to ODD using the keypad.

References

1. Eurotherm International Bisynch Communications Handbook Part No. HP022047C

Notes

1. The reserved bits in these parameters return zero for a poll. The state for a selection is immaterial.
2. Access to these parameters is read/write if the drive is not running or read-only if the drive is running.
3. The range of this parameter is restricted as a function of the drive power rating. For Type 5, 6 and 7 power ratings the switching frequency is limited to 6kHz.

APPENDIX C - PARAMETER LANGUAGE

This appendix contains a list of MMI parameter language codes with English description. Space is provided for translation into non-supported language.

D - DIAGNOSTICS			
D_1	Speed sp (Hz)		**D_1**
D_2	Drive frequency		**D_2**
D_3	Motor current		**D_3**
D_4	Motor load		**D_4**
D_5	Overload status		**D_5**
	0 = Normal		
	1 = Overload		
D_6	External torque limit		**D_6**
D_7	Torque mode		**D_7**
	0 = Constant torque		
	1 = Quadratic torque		
D_8	Drive status		**D_8**
D_9	Digital inputs		**D_9**
D_10	PID error		**D_10**
D_11	PID clamped		**D_11**
	0 = False		
	1 = True		
D_12	PID output		**D_12**
D_13	Auto setpoint (Hz)		**D_13**
D_14	Manual setpoint (Hz)		**D_14**
D_15	Local setpoint (Hz)		**D_15**
D_16	Speed feedback (RPM)		**D_16**
D_17	Speed feedback (Hz)		**D_17**
D_18	Speed setpoint (RPM)		**D_18**

P - PARAMETERS				
P_1	Base frequency			**P_1**
P_2	Max imum speed			**P_2**
P_3	Minimum speed			**P_3**
P_4	Ramps			**P_4**
	P_4.1	Ramp up time 1		**P_4.1**
	P_4.2	Ramp down time 1		**P_4.2**
	P_4.3	S ramp %		**P_4.3**

	P_4.4	Ramp type		**P_4.4**
		0 = Linear ramp		
		1 = Parabolic ramp		
		2 = S ramp		
	P_4.5	Ramp hold		**P_4.5**
		0 = Disabled		
		1 = Enabled		
	P_4.6	Ramp up time 2		**P_4.6**
	P_4.7	Ramp down time 2		**P_4.7**
P_5	V/F shape			**P_5**
	0 = Linear			
	1 = Fan law			
P_6	Current limits			**P_6**
	P_6.1	Motor current limit		**P_6.1**
	P_6.2	Regen current limit		**P_6.2**
	P_6.3	Regen limit select		**P_6.3**
		0 = Disabled		
		1 = Enabled		
	P_6.4	External torque limit		**P_6.4**
		0 = Disabled		
		1 = Enabled		
	P_6.5	Output current cal		**P_6.5**
P_7	Voltage boost			**P_7**
	P_7.1	Fixed boost		**P_7.1**
	P_7.2	Auto boost		**P_7.2**
		0 = Disabled		
		1 = Enabled		
P_8	Stopping mode			**P_8**
	0 = Ramp			
	1 = Coast			
	2 = Injection			
	3 = Ramp + injection			
P_34	Stopping Control			**P_34**
	P_34.1	DC Pulse Time		**P_34.1**
	P_34.2	Inj Timeout		**P_34.2**
P_9	Setpoint select			**P_9**
	P_9.1	Manual setpoint		**P_9.1**
		0 = 0 to +10V		
		1 = -10V to +10V		

		2 = Auxiliary setpoint		
		3 = Preset speed 1		
		4 = Preset speed 2		
		5 = Preset speed 3		
		6 = Preset speed 4		
		7 = Preset speed 5		
		8 = Preset speed 6		
		9 = Preset speed 7		
		10 = Preset speed 8		
		11 = MOP		
	P_9.2	Auto setpoint		**P_9.2**
		0 = I loop SP 0-20mA		
		1 = I loop SP 20-0mA		
		2 = I loop SP 4-20mA		
		3 = I loop SP 20-4mA		
		4 = Serial link		
		5 = Digital preset		
		6 = Speed feedback		
	P_9.3	Trim choice		**P_9.3**
		0 = Manual & auto		
		1 = Manual		
		2 = Auto		
P_10	Setpoint scale			**P_10**
	P_10.1	Manual ratio		**P_10.1**
	P_10.2	Manual divider		**P_10.2**
	P_10.3	Auto ratio		**P_10.3**
	P_10.4	Auto divider		**P_10.4**
	P_10.5	Local ratio		**P_10.5**
	P_10.6	Local divider		**P_10.6**
P_11	Framp time			**P_11**
P_12	Jog speed			**P_12**
P_13	Digital MOP			**P_13**
	P_13.1	Maximum MOP speed		**P_13.1**
	P_13.2	Minimum MOP speed		**P_13.2**
	P_13.3	MOP preset speed		**P_13.3**
P_14	Preset speeds			**P_14**
	P_14.1	Preset 1		**P_14.1**
	P_14.2	Preset 2		**P_14.2**

	P_14.3	Preset 3		**P_14.3**
	P_14.4	Preset 4		**P_14.4**
	P_14.5	Preset 5		**P_14.5**
	P_14.6	Preset 6		**P_14.6**
	P_14.7	Preset 7		**P_14.7**
	P_14.8	Preset 8		**P_14.8**
P_15	Skip frequency			**P_15**
	P_15.1	Skip freq. selection		**P_15.1**
	P_15.1.1	Skip frequency 1		**P_15.1.1**
		0 = Disabled		
		1 = Enabled		
	P_15.1.2	Skip frequency 2		**P_15.1.2**
		0 = Disabled		
		1 = Enabled		
	P_15.1.3	Skip frequency 3		**P_15.1.3**
		0 = Disabled		
		1 = Enabled		
	P_15.1.4	Skip frequency 4		**P_15.1.4**
		0 = Disabled		
		1 = Enabled		
	P_15.2	Skip frequency 1		**P_15.2**
	P_15.3	Skip frequency 1 band		**P_15.3**
	P_15.4	Skip frequency 2		**P_15.4**
	P_15.5	Skip frequency 2 band		**P_15.5**
	P_15.6	Skip frequency 3		**P_15.6**
	P_15.7	Skip frequency 3 band		**P_15.7**
	P_15.8	Skip frequency 4		**P_15.8**
	P_15.9	Skip frequency 4 band		**P_15.9**
P_16	Auxiliary setpoint			**P_16**
P_17	Auxiliary digital inputs			**P_17**
	P_17.1	Auxiliary run		**P_17.1**
		0 = Disabled		
		1 = Enabled		
	P_17.2	Auxiliary framp		**P_17.2**
		0 = Disabled		
		1 = Enabled		
	P_17.3	Auxiliary jog		**P_17.3**
		0 = Disabled		
		1 = Enabled		

	P_17.4	Auxiliary direction		**P_17.4**
		0 = Disabled		
		1 = Enabled		
P_18	I*T alarm			**P_18**
	P_18.1	I*T threshold		**P_18.1**
	P_18.2	I*T upper limit		**P_18.2**
	P_18.3	I*T time		**P_18.3**
P_19	Slip compensation			**P_19**
	P_19.1	Comp level		**P_19.1**
	P_19.2	Regen Slip Comp		**P_19.2**
		0 = Disabled		
		1 = Enabled		
P_20	Speed feedback			**P_20**
	P_20.1	Feedback source		**P_20.1**
		0 = None		
		1 = Encoder		
	P_20.2	Encoder sign		**P_20.2**
	P_20.3	Encoder lines		**P_20.3**
	P_20.4	Pole pairs		**P_20.4**
P_21	PID			**P_21**
	P_21.1	Proportional gain		**P_21.1**
	P_21.2	PID output		**P_21.2**
	P_21.2.1	PID output choice		**P_21.2.1**
		0 = None		
		1 = Ramp out as trim		
		2 = Ramp in as trim		
		3 = Ramp in as speed		
	P_21.2.2	PID output mode		**P_21.2.2**
		0 = Unipolar		
		1 = Bipolar		
	P_21.3	PID feedback choice		**P_21.3**
		0 = None		
		1 = Speed feedback		
		2 = Manual setpoint		
		3 = Auto setpoint		
		4 = Local setpoint		
	P_21.4	PID setpoint choice		**P_21.4**
		0 = None		

		1 = Ramp output		
		2 = Manual setpoint		
		3 = Auto setpoint		
		4 = Local setpoint		
	P_21.5	Divider 2		**P_21.5**
	P_21.6	Ratio 2		**P_21.6**
	P_21.7	Input 2		**P_21.7**
	P_21.8	Divider 1		**P_21.8**
	P_21.9	Ratio 1		**P_21.9**
	P_21.10	Input 1		**P_21.10**
	P_21.11	Integral defeat		**P_21.11**
		0 = Off		
		1 = On		
	P_*34*	Enable		**P_*34***
		0 = Disabled		
		1 = Enabled		
	P_21.12	Output scalar		**P_21.12**
	P_21.13	Negative limit		**P_21.13**
	P_21.14	Positive limit		**P_21.14**
	P_21.15	Filter time constant		**P_21.15**
	P_21.16	Derivative time constant		**P_21.16**
	P_21.17	Integral time constant		**P_21.17**
P_22	Flycatching			**P_22**
	P_*34*	Enable		**P_*34***
		0 = Disabled		
		1 = Enabled		
	P_22.1	Minimum search speed		**P_22.1**
	P_22.2	Search volts		**P_22.2**
	P_22.3	Search time		**P_22.3**
	P_22.4	Reflux time		**P_22.4**
	P_22.5	Search mode		**P_22.5**
		0 = Unidirectional		
		1 = Bidirectional		
		2 = Reflux at speed		
P_23	Auto restart			**P_23**
	P_*34*	Enable		**P_*34***
		0 = Disabled		
		1 = Enabled		
	P_23.1	Attempt delay		**P_23.1**

	P_23.2	Attempts		**P_23.2**
	P_23.3	Attempts left		**P_23.3**
	P_23.4	Trip mask		**P_23.4**
	P_23.5	AR cancel time		**P_23.5**
P_24	Switching frequency			**P_24**
P_25	Stabilisation			**P_25**
P_26	Start up			**P_26**
	P_26.1	Menu position		**P_26.1**
	P_26.2	Control mode		**P_26.2**
		0 = Remote		
		1 = Local		
P_27	Stall trip time			**P_27**
P_28	Inhibit alarms			**P_28**
	P_28.1	Stall alarm		**P_28.1**
		0 = Disabled		
		1 = Enabled		
P_29	Reconfigure outputs			**P_29**
	P_29.1	At speed threshold		**P_29.1**
	P_29.2	Feedback speed threshold		**P_29.2**
	P_29.3	Load threshold		**P_29.3**
	P_29.4	Brake control		**P_29.4**
	P_29.4.1	On load level		**P_29.4.1**
	P_29.4.3	Off frequency level		**P_29.4.2**
	P_29.4.4	On frequency level		**P_29.4.3**
	P_29.5	0 speed threshold		**P_29.5**
P_30	Ramp output			**P_30**
	0 = Min speed to max speed			
	1 = 0 to limit frequency			
	2 = 0 to maximum speed			
P_31	Limit frequency select			**P_31**
P_32	Op station			**P_32**
	P_32.1	Initial setup		**P_32.1**
	P_32.1.1	Direction		**P_32.1.1**
	P_32.1.2	Auto start		**P_32.1.2**
		0 = Disabled		
		1 = Enabled		
	P_32.1.3	Speed setpoint		**P_32.1.3**
	P_32.2	Key inhibits		**P_32.2**

	P_32.2.1	Start		**P_32.2.1**
		0 = Disabled		
		1 = Enabled		
	P_32.2.2	Stop		**P_32.2.2**
		0 = Disabled		
		1 = Enabled		
	P_32.2.3	Jog		**P_32.2.3**
		0 = Disabled		
		1 = Enabled		
	P_32.2.4	Speed setpoint		**P_32.2.4**
		0 = Disabled		
		1 = Enabled		
	P_32.2.5	Direction		**P_32.2.5**
		0 = Disabled		
		1 = Enabled		
	P_32.2.6	Local/remote		**P_32.2.6**
		0 = Disabled		
		1 = Enabled		
P_33	Base volts			**P_33**

PA - PASSWORD			
PA_1	Enter password		**PA_1**
PA_2	Clear password		**PA_2**
PA_3	Change password		**PA_3**

AL - ALARMS			
AL_1	Last alarm		**AL_1**

M - MENUS			
M_1	Menu delay		**M_1**
M_2	Language		**M_2**

EP - EPROM (PARAMETER SAVE)			
EP_1	Up to action		**EP_1**

C - COMMS (SERIAL LINK)				
C_1	Main port (P1)			**C_1**
	C_1.1	Serial link enable		**C_1.1**
		0 = Disabled		
		1 = Enabled		

	C_1.2	Group ID (GID)		**C_1.2**
	C_1.3	Unit ID (UID)		**C_1.3**
	C_1.4	Protocol		**C_1.4**
		0 = ASCII		
		1 = Binary		
		2 = Option		
	C_1.5	Baud rate		**C_1.5**
	C_1.6	ESP support		**C_1.6**
		0 = Disabled		
		1 = Enabled		
	C_1.7	Changeband (BIN)		**C_1.7**
	C_1.8	Error report		**C_1.8**
	C_1.9	PNO 7		**C_1.9**
	C_1.10	Parity		**C_1.10**
		0 = Even		
		1 = Odd		
	C_1.11	Option version		**C_1.11**
C_2	Auxiliary port (P3)			**C_2**
	C_2.1	Serial link enable		**C_2.1**
		0 = Disabled		
		1 = Enabled		
	C_2.2	Group ID (GID)		**C_2.2**
	C_2.3	Unit ID (UID)		**C_2.3**
	C_2.4	ASCII / binary		**C_2.4**
		0 = ASCII		
		1 = Binary		
	C_2.5	Baud rate		**C_2.5**
	C_2.6	ESP support		**C_2.6**
		0 = Disabled		
		1 = Enabled		
	C_2.7	Changeband (BIN)		**C_2.7**
	C_2.8	Error report		**C_2.8**
	C_2.9	PNO 7		**C_2.9**
C_3	PNO configuration			**C_3**
	PNO 112 to 127			

S - SYSTEM				
S_1	Reconfigure outputs			**S_1**
	S_1.1	Relay 1		**S_1.1**
		0 = Zero speed		
		1 = At speed		
		2 = Run confirm		
		3 = Brake control		
		4 = At load		
		5 = At FB speed		
	S_1.2	Relay 2		**S_1.2**
		0 = Zero speed		
		1 = At speed		
		2 = Run confirm		
		3 = Brake control		
		4 = At load		
		5 = At FB speed		
S_2	Reconfigure inputs			**S_2**
	S_2.1	Presets & JOG		**S_2.1**
		0 = 4 Presets & JOG		
		1 = 8 Presets		
		2 = Digital MOP & presets		
	S_2.2	Framp		**S_2.2**
		0 = Framp		
		1 = PID Reset		
		2 = 2ND Ramp Rates		
S_3	Torque Mode			**S_3**
		0 = Constant Torque		
		1 = Quadratic Torque		

OP STATION DISPLAY			
REF.	Setpoint reference		**REF.**
O/P.	Drive output frequency		**O/P.**
JOG	JOG		**JOG**
[+]	Forward		**[+]**
[-]	Reverse		**[-]**
0	Stopped		**0**
1	Running		**1**

MS - MESSAGES			
MS_1	Reading		**MS_1**
MS_2	Saving		**MS_2**
MS_3	Finished		**MS_3**
MS_4	Initialising		**MS_4**
MS_5	'M' to reselect		**MS_5**
MS_6	Please remember		**MS_6**
MS_7	Now save parameters		**MS_7**
MS_8	Password cleared		**MS_8**
MS_9	No active alarms		**MS_9**

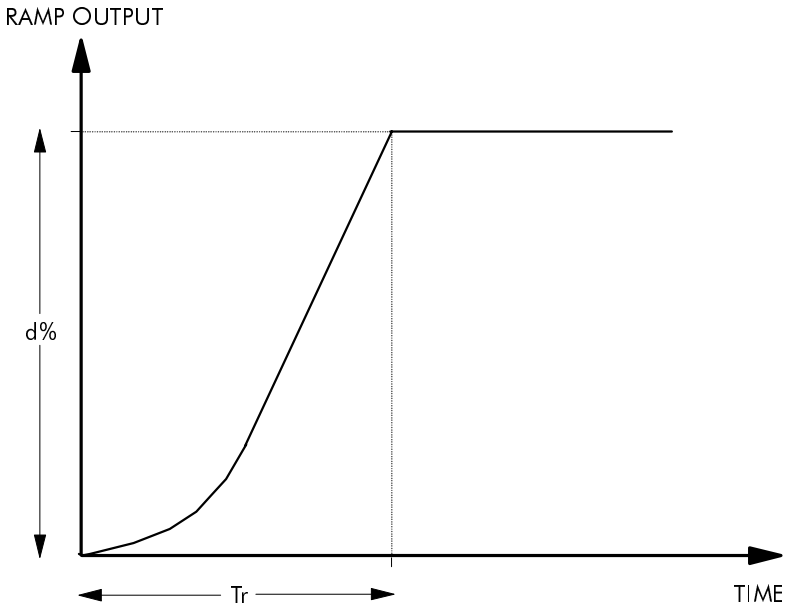
W - WARNINGS / ERRORS			
W_1	Drive running!		**W_1**
W_2	Not selected!		**W_2**
W_3	Read only!		**W_3**
W_4	Password???		**W_4**
W_5	Key inhibited!		**W_5**
W_6	Incorrect build!		**W_6**
W_7	C20 high!		**W_7**
W_8	C24 high!		**W_8**
W_9	Auxiliary run high!		**W_9**
W_10	Auxiliary jog high!		**W_10**

A - ALARMS			
A_1	I*T integrating		**A_1**
A_2	Link overcurrent		**A_2**
A_3	Link overvolts		**A_3**
A_4	I*T overload		**A_4**
A_5	Motor stalled		**A_5**
A_6	Heatsink temperature		**A_6**
A_7	Motor temperature		**A_7**
A_8	Current loop loss		**A_8**
A_9	Link undervolts		**A_9**
A_10	External trip		**A_10**
A_11	Multiple alarms		**A_11**
A_12	Fault or braking		**A_12**
A_13	Checksum failed		**A_13**
A_14	EE version error		**A_14**
A_15	EE write error		**A_15**

APPENDIX D - PARABOLIC RAMP TIMES

This appendix contains a simple look up table method of calculating the response times for the parabolic ramp for a given setpoint step size, **d%**, and **S RAMP %**. Note, 100% is assumed to be equal to the **LIMIT FREQUENCY**.

Parabolic Ramp



Which Formula?

The formula required to calculate the parabolic ramp response time is dependent on the size of the change in setpoint, **d%**. For a given value of **S RAMP %**, the table below indicates which response time formula is relevant for a given **d%**.

S RAMP %	Formula 1	Formula 2
0	linear Ramp	linear Ramp
10	d% < 2.6%	d% > 2.6%
20	d% < 5.6%	d% > 5.6%
30	d% < 8.8%	d% > 8.8%
40	d% < 12.5%	d% > 12.5%
50	d% < 16.7%	d% > 16.7%
60	d% < 21.4%	d% > 21.4%
70	d% < 26.9%	d% > 26.9%
80	d% < 33.3%	d% > 33.3%
90	d% < 40.9%	d% > 40.9%
100	d% < 50.0%	d% > 50.0%

Formula 1

The first response time formula, formula 1, is given below:

$$\mathrm{Tr} = \mathrm{RAMPTIME} \times \sqrt{2 \times \frac{\mathrm{d\%}}{100\%} \times \frac{\mathrm{SRAMP\%}}{200\% - \mathrm{SRAMP\%}}}$$

This can be simplified as follows:

$$Tr = RAMPTIME \times A \times B$$

The factors A and B are given for varying values of **S RAMP %** and **d%** in the tables below:

S RAMP %	A
0	0
10	0.032
20	0.047
30	0.059
40	0.071
50	0.082
60	0.093
70	0.104
80	0.116
90	0.128
100	0.141

d%	B
0	0
10	3.16
20	4.47
30	5.48
40	6.32
50	7.07
60	7.75
70	8.37
80	8.94
90	9.49
100	10.0

Formula 2

The second response time formula, formula 2, is given below:

$$\mathrm{Tr} = \mathrm{RAMPTIME} \times \left[\frac{\mathrm{d\%}}{100\%} + \frac{1}{2} \times \frac{\mathrm{SRAMP\%}}{200\% - \mathrm{SRAMP\%}} \right]$$

This can be simplified as follows:

$$Tr = RAMPTIME \times [A + B]$$

The factors A and B are given for varying values of **S RAMP %** and **d%** in the tables below:

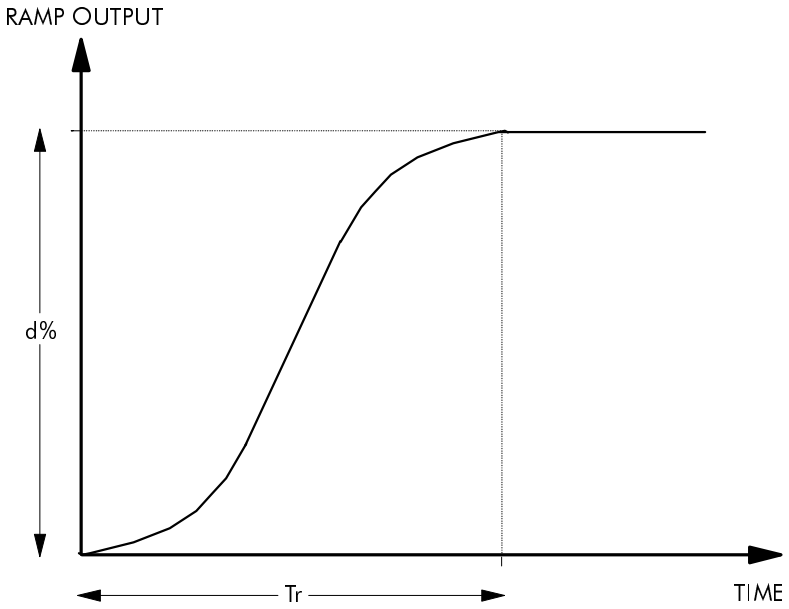
SRAMP%	A
0	0
10	0.026
20	0.056
30	0.088
40	0.125
50	0.167
60	0.214
70	0.269
80	0.333
90	0.409
100	0.500

d%	B
0	0
10	0.1
20	0.2
30	0.3
40	0.4
50	0.5
60	0.6
70	0.7
80	0.8
90	0.9
100	0.10

APPENDIX E - S RAMP TIMES

This appendix contains a simple look up table method of calculating the response times for the s ramp for a given setpoint step size, **d%**, and **S RAMP %**. Note, 100% is assumed to be equal to the **LIMIT FREQUENCY**.

S Ramp:



Which Formula?

The formula required to calculate the s ramp response time is dependent on the size of the change in setpoint, **d%**. For a given value of **S RAMP %**, the table below indicates which response time formula is relevant for a given **d%**.

S RAMP %	Formula 1	Formula 2
0	linear Ramp	linear Ramp
00	d% < 5.3%	d% > 5.3%
20	d% < 11.1%	d% > 11.1%
30	d% < 17.6%	d% > 17.6%
40	d% < 25.0%	d% > 25.0%
50	d% < 33.3%	d% > 33.3%
60	d% < 42.9%	d% > 42.9%
70	d% < 53.8%	d% > 53.8%
80	d% < 66.7%	d% > 66.7%
90	d% < 81.8%	d% > 81.8%
100	d% < 100.0%	d% > 100.0%

Formula 1

The first response time formula, formula 1, is given below:

$$Tr = RAMPTIME \times 2 \times \sqrt{\frac{d\%}{100\%} \times \frac{SRAMP\%}{200\% - SRAMP\%}}$$

This can be simplified as follows:

$$Tr = RAMPTIME \times A \times B$$

The factors A and B are given for varying values of **S RAMP %** and **d%** in the tables below:

S RAMP %	A
0	0
10	0.046
20	0.067
30	0.084
40	0.100
50	0.116
60	0.131
70	0.147
80	0.163
90	0.181
100	0.200

d%	B
0	0
10	3.16
20	4.47
30	5.48
40	6.32
50	7.07
60	7.75
70	8.37
80	8.94
90	9.49
100	10.0

Formula 2

The second response time formula, formula 2, is given below:

$$Tr = RAMPTIME \times \frac{d\%}{100\%} \times \frac{200\%}{200\% - SRAMP\%}$$

This can be simplified as follows:

$$Tr = RAMPTIME \times A \times B$$

The factors A and B are given for varying values of **S RAMP %** and **d%** in the tables below:

S RAMP %	A
0	1
10	1.05
20	1.11
30	1.18
40	1.25
50	1.33
60	1.43
70	1.54
80	1.67
90	1.82
100	2

d%	B
0	0
10	0.1
20	0.2
30	0.3
40	0.4
50	0.5
60	0.6
70	0.7
80	0.8
90	0.9
100	1.0

APPENDIX F - 584S TYPE 7 MECHANICAL OUTLINE DRAWINGS

IP20

NOTES

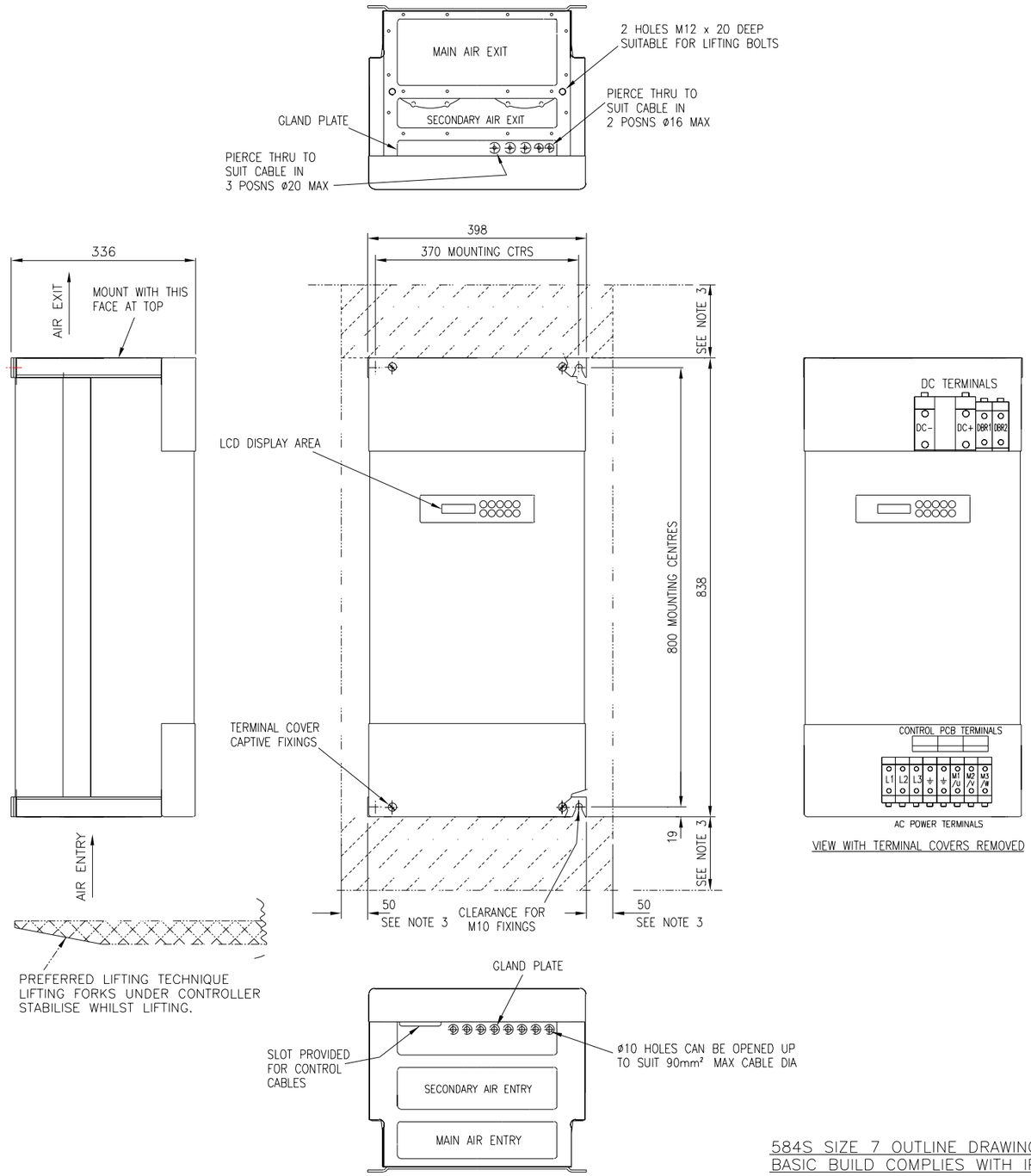
1. AC POWER TERMINALS AND DC TERMINALS.
   DBR1 & DBR2 ARE CAPABLE OF ACCEPTING
   90mm² (4/0 AWG) CABLE.
   DC+ & DC– ARE CAPABLE OF ACCEPTING
   150mm² (6/0 AWG) CABLE.
   CONTROL PCB TERMINALS ARE CLAMP STYLE
   LOOPS CAPABLE OF ACCEPTING 1.5mm² CABLE.
   ALL NECESSARY FIXINGS FOR ELECTRICAL
   CONNECTIONS ARE SUPPLIED, GLANDS
   & MECHANICAL FIXINGS ARE NOT SUPPLIED.

2. TERMINAL COVERS MAYBE REMOVED BY
   RELEASING RETAINING SCREWS TO GIVE
   ACCESS TO POWER TERMINALS AND
   CONTROL TERMINALS.

3. AIR FLOW CLEARANCE AS INDICATED IS
   250mm MIN FREE SPACE TOP AND BOTTOM
   AND AT SIDES AS SHOWN.

4. AC POWER TERMINALS AND DC TERMINALS.
   DBR1 & DBR2 REQUIRE 6mm A/F HEXAGONAL
   DRIVER TO SECURE CABLES, RECOMMENDED
   TIGHTENING TORQUE 20Nm (15lb/ft).
   DC+ & DC– REQUIRE 8mm A/F HEXAGONAL
   DRIVER TO SECURE CABLES, RECOMMENDED
   TIGHTENING TORQUE 30Nm (22lb/ft).

5. TO PRESERVE IP20 RATING MAX DIAMETERICAL
   CLEARANCE OVER ANY CABLE TO BE 5mm.



584S SIZE 7 OUTLINE DRAWING
BASIC BUILD COMPLIES WITH IP20

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UL Type 1

NOTES

1. AC POWER TERMINALS AND DC TERMINALS.
   DBR1 & DBR2 ARE CAPABLE OF ACCEPTING 90mm² (4/0 AWG) CABLE.
   DC+ & DC– ARE CAPABLE OF ACCEPTING 150mm² (6/0 AWG) CABLE.
   CONTROL PCB TERMINALS ARE CLAMP STYLE LOOPS CAPABLE OF ACCEPTING 1.5mm² CABLE.
   ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS ARE SUPPLIED, GLANDS & MECHANICAL FIXINGS ARE NOT SUPPLIED.

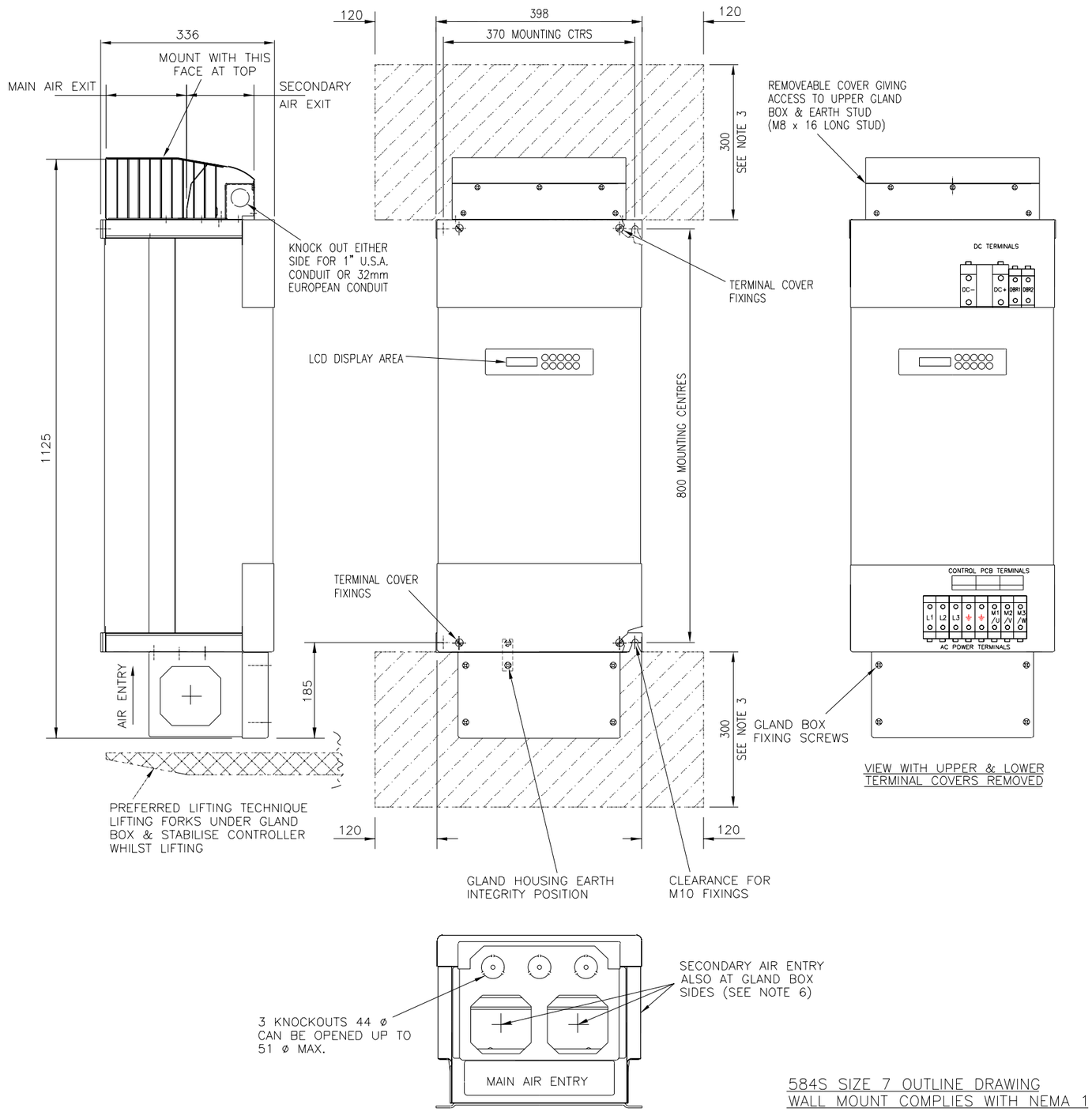
2. TERMINAL COVERS MAYBE REMOVED BY RELEASING RETAINING SCREWS TO GIVE ACCESS TO POWER TERMINALS AND CONTROL TERMINALS.

3. AIR FLOW CLEARANCE AS INDICATED

4. AC POWER TERMINALS AND DC TERMINALS.
   DBR1 & DBR2 REQUIRE 6mm A/F HEXAGONAL DRIVER TO SECURE CABLES, RECOMMENDED TIGHTENING TORQUE 20Nm (15lb/ft).
   DC+ & DC– REQUIRE 8mm A/F HEXAGONAL DRIVER TO SECURE CABLES, RECOMMENDED TIGHTENING TORQUE 30Nm (22lb/ft).

5. TO PRESERVE IP20 RATING MAX DIAMETERICAL CLEARANCE OVER ANY CABLE TO BE 5mm.

6. AIR FILTERS MAY BE FITTED AT THESE APERTURES (4 POSITIONS).



584S SIZE 7 OUTLINE DRAWING
WALL MOUNT COMPLIES WITH NEMA 1

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Through Panel Mount