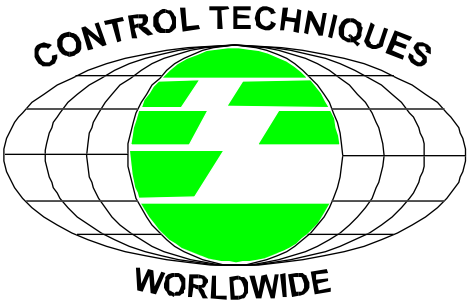
Unidrive Serial Comms



Unidrive Serial Communications

Large Option Module Preliminary Manual

Issue 1

Safety Information

Variable speed drives and associated options units can be hazardous if they are not correctly installed, maintained and operated. Persons supervizing and performing the electrical maintenance of a Drive and/or any external option unit must be suitable qualified and competent in these duties.
They should be given the opportunity to study, and if necessary, to discuss the User Manual before work is started.
Important safety information is given throughout this manual.

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate negligence or incorrect installation or adjustment of the operating perameters of the equipment or from mismatching the Drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of this guide without notice.

Warnings Cautions and Notes

Warning, Caution and Notes paragraphs appear throughout the text of this instruction manual. These reminders are for the installers and operators of this equipment.

Warning
A Warning indicates that there may be danger, loss of life or personal injury unless the instructions are not strictly observed.
Caution
A Caution indicates that there may be danger or damage to the equipment if the procedures and practices are not followed and strictly observed.
Note
A Note draws to the attention of the personnel using the equipment to information that will assist in their understanding of the equipment or its operation.

Safety and Operating Instructions for Drive Converters (In conformity with the low voltage directive 73/23/EEC)

1 General

In operation, drive converters, depending on their degree of protection, may have live, uninsulated, and possibly also moving parts, as well as hot surfaces.
In case of inadmissible removal of the required covers, of improper use, wrong operation or maloperation, there is a danger of serious personal injury and damage to property.
For further information, see documentation.
All operations serving transport, installation and commissioning as well as maintenance are to be carried out by skilled technical personnel (Observe IEC364 or CENELEC HD 384 or DIN VDE 0100 and national wiring regulations and accident prevention rules).
For the purposes of these basic safety instructions, “skilled technical personnel” means personnel who are familiar with the product, and have the qualifications needed for the performance of their functions.

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2. Intended Use

Drive converters are components designed for inclusion in electrical installations or machinery.
In case of installation in machinery, commissioning of the drive converter (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions of the directive 89/392/EEC (Machinery Safety Directive-MSD). Account is to be taken of EN60204.
Commissioning (i.e. starting of normal operation) is admissible only when conformity with the EMC directive (89/336/EEC) has been established.
The drive converters meet the requirements of the low voltage directive 73/23/EEC. They are subject to the harmonised standards of the series DIN VDE 0160 in conjunction with VDE 0660, part 500 and EN 60146/ VDE 0558
The technical data as well as information concerning the supply conditions shall be taken from the rating plate and from the documentation and shall be strictly observed

3. Transport & Storage

The instructions for transport, storage and proper use shall be complied with.
The climatic conditions shall be in conformity with this manual.

4. Installation

The installation and cooling of the appliances shall be in accordance with the specification in the pertinent documentation. The drive converters shall be protected against excessive strains. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact shall be made with electronic components and contacts.
Drive converters contain electrostatic sensitive components which are liable to damage through improper use. Electric components must not be mechanically damaged or destroyed (potential health risk).

5. Electrical Connection

When working on live drive converters, the applicable national accident prevention rules (e.g. VBG 4) must be complied with. The electrical installation shall be carried out in accordance with the relevant requirements (e.g. cross-sectional areas of conductors, fusing, PE connectors). For further information, see documentation.
Instructions for the installation in accordance with EMC requirements, like screening, earthing, location of filters and wiring, are contained in the drive converter documentation. They must be complied with, also for drive converters bearing the CE marking.
Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or service.

6. Operation

Installations which include drive converters shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements, e.g. Act respective technical equipment, accident prevention rules etc. Changes to the drive converters by means of the operating software are admissible.
After disconnecting the drive converter from the voltage supply, live appliance parts and power terminals must not be touched immediately because of possibly energised capacitors. In this respect, the corresponding signs and markings of the drive converter must be respected.
During operation, all covers and doors shall be kept closed.

7. Maintenance & Servicing

The manufacturer's documentation shall be followed.

Keep safety instructions in a safe place.

Serial Communications

Contents

Introduction

A serial communications link enables one or more drives to be used in systems controlled by a host unit such as a PLC or computer. The communications link for the drives uses the EIA RS485 standard.
A drive may also act as the host in a system, controlling other drives or other devices fitted with a suitable interface.
The host controller can operate up to thirty-two EIA RS485 devices with the use of line buffers. Each transmitter and receiver of the Serial Communications module loads the line by 2 unit loads. Therefore in two wire mode each drive loads the line by 4 unit loads. This means that only 7 drives can be connected in a single group allowing upto 4 units for the line buffer. Up to 15 drives can be connected if four wire mode is used.
When line buffers are used, up to 81 devices can be operated.In this case the devices are organized in up to 9 groups of 9. A particular group or groups can be given commands without affecting other devices or groups of devices.

The communications ports of the drive are the D-type connectors on the option module.It may be used in either 4-wire or 2-wire modes. The EIA RS485 port is fully opto-isolated.EIA RS422 is also supported.
Note:-
The EIA RS232 port is recommended for commissioning purposes only.

1. Installation

1. Switch off the Unidrive for 15 minutes and disconnect from the supply.
2. Insert Large Option Module as shown in Fig 1. Ensure it is correctly connected.
3. Ensure that the connecting cable is correctly manufactured as per Table 1.
4. Connect cable to correct connector on Large Option Module.

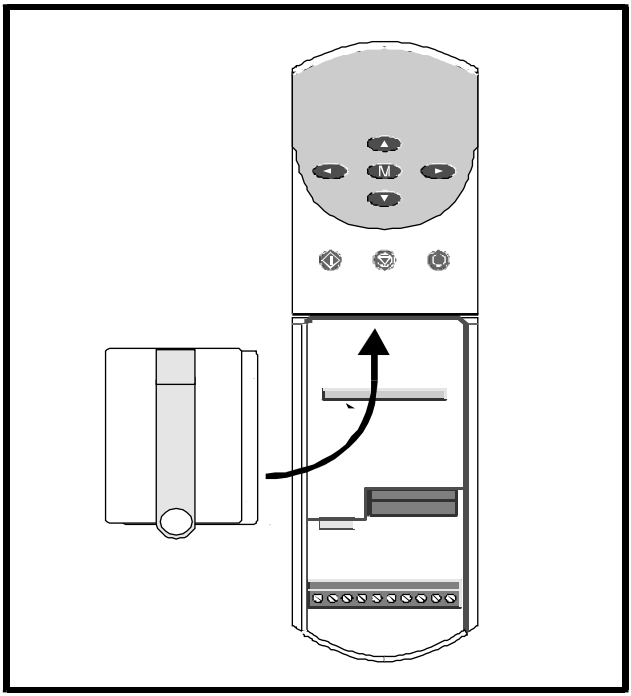


Figure 1. Installation of Module

2. Hardware connections

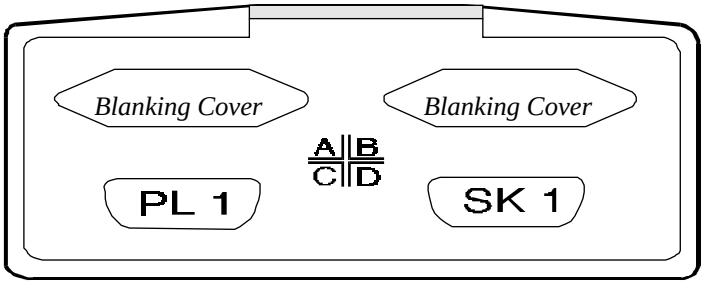
The following table (Table 1) details the hardware connections for the EIA RS485 communications port.

Pin	EIA RS485 4 Wire PL1	EIA RS485 2 Wire PL1	EIA RS232 SK1	Host 9way
1	0V	0v	CD*	CD*
2	$\overline{\text{Tx}}$	$\overline{\text{Tx/Rx}}$**	TXD	RXD
3	$\overline{\text{Rx}}$	$\overline{\text{Tx/Rx}}$**	RXD	TXD
4	NC	NC	DTR*	DTR*
5	NC	NC	0V	0V
6	Tx	Tx/Rx **	DSR*	DSR*
7	Rx	Tx/Rx **	RTS*	RTS*
8	NC	NC	CTS*	CTS*
9	NC	NC	NC	RI*

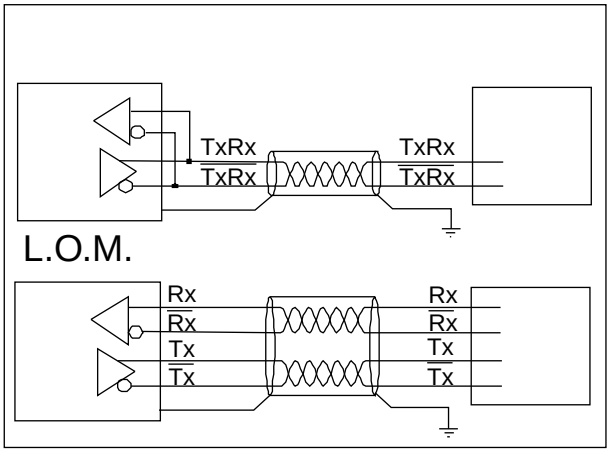
(NC = no connection).

* Depending on the host software being used it may not be necessary to connect the terminals marked.

** Pins 2 and 3, and pins 6 and 7 must be connected together in two wire mode.



End View of Large Option Module



EIA RS485 4 wire connections

Notes

1. It is recommended that the shield of the data communications cable should be connected by a low inductance path to a 'clean' earth.

2. A data communications cable should not run parallel to any power cables, especially ones that connect drives to motors. If parallel runs are unavoidable, ensure a minimum spacing of 300mm (12 in.) between the communications cable and the power cable.

3. Cables crossing one another at right-angles are unlikely to give trouble. The maximum cable run length for a EIA RS485 link is 1200 metres (4,000 feet).

4. Care must be taken to ensure that other units in the system do not have the termination resistor fitted. Excessive signal loss will occur if resistors are connected to units other than the last one.

3. Unidrive Serial Communications Parameter Description

Parameter 11.23	Serial Address	
Type:	Read % Write Unipolar Protected	
Range:	0.0 - 9.9	
Units:	Group.Unit	
Default settings:	Open Loop Closed loop Vector Servo	1.1 1.1 1.1

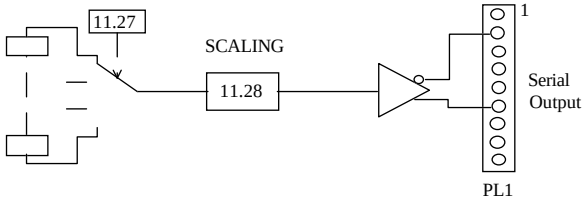
Used in ANSI comms to define the unique address for the drive. Any number in the permitted range 0.0 to 9.9 which has a zero in it should not be used as these are used in addressing groups of drives.

Parameter 11.24	Serial Mode	
Type:	Read & Write Unipolar Threshold Reset required, Protected	
Range:	0 - 2	
Units:		
Default settings:	Open Loop Closed loop Vector Servo	0 0 0

This is the mode of operation of the serial port.
0 ANSI ANSI protocol half duplex serial communications.
1 OUtPUt Output variable defined by 11.27 (CT protocol)
2 INPUt Input variable to parameter defined by 11.27 (CT protocol)

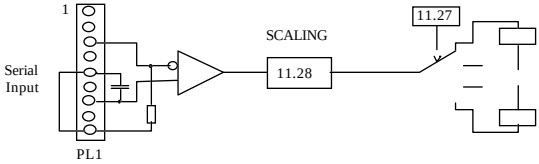
Modes 1 and 2 are for transfer of a variable from one drive to another. In both cases data is transferred at a rate of at least 140Hz. Although the data rate is slightly slower than that of Mentor II and CDE, the protocol and baud rate are identical and it is possible to connect a UNIDRIVE to a Mentor II or CDE for data transfer in either direction.

Mode 1 output variable to another drive.



In the event of the drive tripping a value of zero is transmitted.

Mode 2 input variable from another drive.



Once data has been received in this mode, a comms loss trip will occur if the comms link is lost and the last data received is non zero.

Parameter 11.25	**Baud Rate**	
Type:	Read & Write	
	Unipolar	
	Threshold	
	Protected	
Range:	0 - 2	
Units:		
Default settings:	Open Loop	0
	Closed loop Vector	0
	Servo	0

Used in ANSI comms mode to select the comms port baud rate. Three available options are:

0 4800 4,800 baud.
1 9600 9,600 baud.
2 19200 19.2 kbaud.

Parameter 11.26	**Two Wire Mode**	
Type:	Read & Write	
	Bit	
Default settings:	Open Loop	0
	Closed loop Vector	0
	Servo	0

Since the ANSI protocol we use is half duplex, it is possible to connect the RX and TX together and the RX and TX together and operate the comms with only 2 data connections. If this is done this parameter must be set.

Parameter 11.27	**Serial Programmable Source / Destination**	
Type:	Read & Write	
	Unipolar	
	Reset required	
	Protected	
Range:	0.00 - 20.50	
Units:	Menu.Parameter	
Default settings:	Open Loop	0
	Closed loop Vector	0
	Servo	0

This parameter is used in serial comms modes 1 and 2 to define the parameter being output or input respectively. In comms mode 2 any new value programmed will only be implemented after a drive reset. Only non-bit parameters can be input or output and for inputs the parameter must not be protected. If a non valid parameter is programmed the drive will not input or output data.

Parameter 11.28	Serial scale factor	
Type:	Read & Write Unipolar	
Range:	0.000 - 4.000	
Units:		
Default settings:	Open Loop	1.000
	Closed loop Vector	1.000
	Servo	1.000

Can be used to scale the data being output or input in serial modes 1 or 2. However in most cases it is not necessary as the input or output is automatically scaled such that for a full scale input or output the destination or source parameter will be at its maximum.

4. Serial Communications modes

The drive has three communication modes as follows:

ANSI Mode (11.24 = 0)

Standard 4-wire EIA RS485 using ANSI protocol.

OUTPUT Mode (11.24 = 1)

A high-speed binary protocol is used to continually transfer the data in the parameter defined by parameter 11.27 on to the serial communications port.

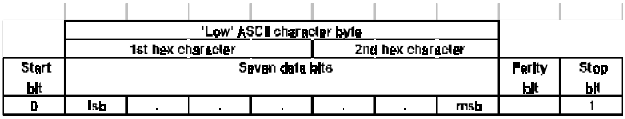
INPUT Mode (11.24 = 2)

A high-speed binary protocol is used to continually transfer the data from the serial port in to the parameter defined by parameter 11.27.

ANSI Mode

Data is transmitted at a fixed speed or *baud rate* in the form of a *character*. A character is comprized of seven bits.
In order for a receiver to recognize valid data, a *frame* is placed around each character. This frame contains a *start bit,* a *stop bit,* and a *parity bit*. Without this frame, the receiver will be unable to synchronize itself with the transmitted data.
A frame is shown overleaf:

Serial Communications



This is known as a 10-bit frame, since there are 10 bits transmitted in total. The format is often described as follows:

1 start bit, 7 data bits, even parity, 1 stop bit.

lsb refers to the least significant bit (ie. bit 0)
msb refers to the most significant bit (bit 7)
The *Parity bit* is used by the receiver to check the integrity of the data it has received

The character set used in the drive is called the low ASCII set. The set comprizes 128 characters decimally numbered from 0 to 127. The first 32 characters in the ASCII set (hex. 00 to 1F) are used to represent special codes. These are the *control* codes, each of which has a particular meaning (eg. start of text is called STX and is ASCII code 02.)

Control characters
Commands and requests are sent to the drive in message packets. Each message is started with a special control character, and may contain control characters.A list of all the control characters that can be used when sending a message, and receiving is as follows:

Character	Meaning	ASCII code (decimal)	Keyed as...
EOT	Reset Tells the DRIVE to prepare for a new message.Also indicates parameter does not exist.	04	Ctrl D
ENQ	Enquiry Used when interrogating the DRIVE.	05	Ctrl E
STX	Start of text Used to start a command.	02	Ctrl B
ETX	End of text Used at the end of a command.	03	Ctrl C
ACK	Acknowledge (message accepted)	04	Ctrl F
NAK	Negative acknowledge (message not understood)	21	Ctrl U
BS	Backspace (go to previous parameter)	08	Ctrl H

Addressing
Each drive on a ANSI communications bus must be given a unique identity or *address* so that only the target drive will respond. The address comprizes two parts:
The *Group Address* which is the first digit.
The *Unit Address* which is the second digit.
Both the group address and unit address have a range of 1 to 9.A group or unit address of 0 is not allowed (addresses 01, 10, 20, etc. are invalid). The reason for this is that drive can be grouped together (up to 9 units per group), and a message can be sent over the ANSI communications bus to all units of the group. To address a particular group, the unit address of zero (0) is used. For example, to address all units of group 6 the full address is 60.

Serial Communications

An additional feature is that a message can be sent to all units of all groups simultaneously using the address 00. This address can be used to send a Speed command to a group of drives which are mechanically coupled together to drive a conveyor line. All the drives will then start simultaneously.
Note
It is important to realize that when using group addressing, the drive will not acknowledge the command.(If several drives try to reply at the same time, they would cause meaningless data to appear on the serial communications bus.)
For security, the format of the transmitted address requires that each digit of the two-digit address is repeated: the address of drive number 23 is sent as four characters, eg:
2 2 3 3
The serial address follows immediately after the first control character of the message (usually EOT).

Parameter identification

For transmission, all parameters are identified by four digits representing the menu and the parameter number, but without the decimal point.
Example:
To send a message to menu 4, parameter 26, write **0426** (the leading zero **must** be included)
To send to menu 16, parameter 3, write **1603**.
Data field
Data to be sent or requested occupies the characters immediately after the parameter number. The minimum length of the data field within a message structure is two characters.
The data is normally expressed as a decimal numeric value where the first character is one of the following.
Space (32 dec.)
+
–

Block Checksum (BCC)

In order to ensure that the messages from or to the drive do not become corrupted during transmission, the data responses are terminated by the block checksum character (BCC). See for calculation of the BCC value.

Reading data
To read a parameter, the following message is sent:

Control	Add ress				Param eter				Control
EOT	GA	GA	UA	UA	M1	M2	P1	P2	ENQ

Where:
GA =Group Address
UA =Unit Address
M1M2 =Menu number
P1P2 =Parameter number
Note:- No BCC character is sent in this message.

Serial Communications

The drive will reply with the following structure if the message is understood:

Control	Parameter				Data			Control	BCC
STX	**M1**	**M2**	**P1**	**P2**	**D1**	**....**	**Dn**	**ETX**	**bcc**

Where:
M1 M2 = Menu number
P1 P2 = Parameter number
D1...DN = Data
First character:
Space or + for positive values
– for negative values
BCC = Block checksum
If a requested parameter does not exist, the drive will reply with an **EOT** character (ASCII 04).

Example:
To read the value of parameter 1.17 on the drive that is addressed as unit 2 of group 1, send:

Control	Address				Parameter				Control
EOT	**1**	**1**	**2**	**2**	**0**	**1**	**1**	**7**	**ENQ**

The drive replies:

Control	Parameter				Data					Control	BCC
STX	**0**	**1**	**1**	**7**	**-**	**0**	**4**	**7**	**6**	**ETX**	

Re-reading data
Once a READ message has been received and understood by a drive (ie. valid data was returned), to request the parameter again, request the next parameter, or the previous parameter, a single control code character may be sent.These control codes are:

Control Code	Function	Keyed as...
NAK	Return the value of the same parameter	Ctrl U
ACK	Read the next parameter	Ctrl F
BS	Read the previous parameter	Ctrl H

This facility can be used to save time when monitoring a parameter over a period of time.

Writing data
To WRITE data to a drive parameter, the message structure is comprized as follows:

Contr'l	Address				Contr'l	Parameter				Data (Variable)			Contr'l	BCC
EOT	**GA**	**GA**	**UA**	**UA**	**STX**	**M1**	**M2**	**P1**	**P2**	**D1**	**....**	**Dn**	**ETX**	

Where:
GA = Group address
GU = Unit adddress
M1 M2 = Menu number

Serial Communications

P1 P2 = Parameter number
D1...DN = Data
First character:
Space or + for positive values
– for negative values
BCC=Block checksum
The data field can be of a variable length with the maximum length being dependent on the parameter being edited.

The drive will respond with a single control character, as follows:

Control Code	Meaning
ACK	Acknowledge — Message has been understood and implemented.
NAK	Message invalid. Data is too long or out of range, parameter is invalid, parameter is read-only, or the BCC is incorrect.

Example:
Set parameter 1.25 at +76.4 for a drive (unit 6, group 2) send:

Control	Address				Control	Parameter				Data (Variable)						Control	BCC
EOT	2	2	6	6	STX	0	1	2	5	+	0	7	6	-	4	ETX	%

Re-writing data
Once a WRITE message which includes the address field has been sent to a drive, and accepted with either a <ACK> or <NAK> response, subsequent write messages to that particular drive use a re-write message structure.The address does not need to be re-transmitted.The re-write structure is as follows:

STX	M1	M2	P1	P2	D1	...	Dn	ETX	BCC

When a different drive is addressed, or an invalid character is received, the re-write facility no longer functions. The drive can be addressed again only by using the full write message with the address.

Calculating the block checksum (BCC)
The block checksum is calculated by applying an exclusive OR function to all of the characters of a message after the STX control character.

XOR truth table

A	B	Out
0	0	0
0	1	1
1	0	1
1	1	0

For example, the serial command to set parameter 1.25 at 34.5Hz in reverse.

The message will be:

The first character of the BCC calculation is **0** (00110000 in binary), the value of which is taken as a starting or result value. The next character is **1** (00110001 in binary), which now has the exclusive OR (XOR) operator act upon it. With the previous result value, a new result occurs of 00000001 in binary.
The complete calculation is show in the table below:

Character	Binary Value	XOR result
0	0011 0000	–
1	0011 0001	0000 0001
2	0011 0010	0011 0011
5	0011 0101	0000 0110
–	0010 1101	0010 1011
3	0011 0011	0001 1000
4	0011 0100	0010 1100
.	0010 1110	0000 0010
5	0011 0101	0011 0111
ETX	0000 0011	0011 0100

The final value is the BCC, provided that its equivalent decimal value exceeds 31 (ASCII characters from 00 to 31 are used as control codes).
When the final XOR result produces a decimal value less than 32, then 32 is added. In this example, 0011 0100 is 52 decimal, so this is the final BCC value. 52 decimal is the character 4.The complete message will be:

EOT	1	1	2	2	STX	0	1	2	5	-	3	4	.	5	ETX	4

Example
QuickBasic program to calculate BCC:

```
mess$ = CHR$(4)+"1122"+CHR$(2)+"0125"+"-34.5"+CHR$(3)
bcc% = 0
FOR n% = 7 to LEN(mess$)'start at the character after 'chr$(2).
bcc% = bcc% XOR MID$(mess$, n%, 1)
NEXT
IF bcc% < 32 THEN bcc% = bcc% + 32
mess$ = mess$ + NCHR$(bcc%)
```

Serial Communications

Unidrive
Serial Communications
Large Option Module
Preliminary Manual