User's Guide

Interbus-S

Option Cards for
Unidrive and Mentor II

Part Number: 0460-0027
Issue Number: 3

Safety Information

Persons supervising and performing the electrical installation or maintenance of a Drive and/or an external Option Unit must be suitably qualified and competent in these duties. They should be given the opportunity to study and if necessary to discuss this User Guide before work is started.

The voltages present in the Drive and external Option Units are capable of inflicting a severe electric shock and may be lethal. The Stop function of the Drive does not remove dangerous voltages from the terminals of the Drive and external Option Unit. Mains supplies should be removed before any servicing work is performed.

The installation instructions should be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the Drive and external Option Unit, and the way in which they are operated and maintained complies with the requirements of the Health and Safety at Work Act in the United Kingdom and applicable legislation and regulations and codes of practice in the UK or elsewhere.

The Drive software may incorporate an optional Auto-start facility. In order to prevent the risk of injury to personnel working on or near the motor or its driven equipment and to prevent potential damage to equipment, users and operators, all necessary precautions must be taken if operating the Drive in this mode.

The Stop and Start inputs of the Drive should not be relied upon to ensure safety of personnel. If a safety hazard could exist from unexpected starting of the Drive, an interlock should be installed to prevent the motor being inadvertently started.

General Information

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

The contents of this User 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 the User Guide, without notice.

Copyright:	© September 1997 CT SSPD	
Issue Code:	3	
Software version:	UD70 System File	V2.06.07
	Interbus-S Interface Firmware	V3.00
	MD-IBS Firmware	V1.01

Contents

1 Introduction

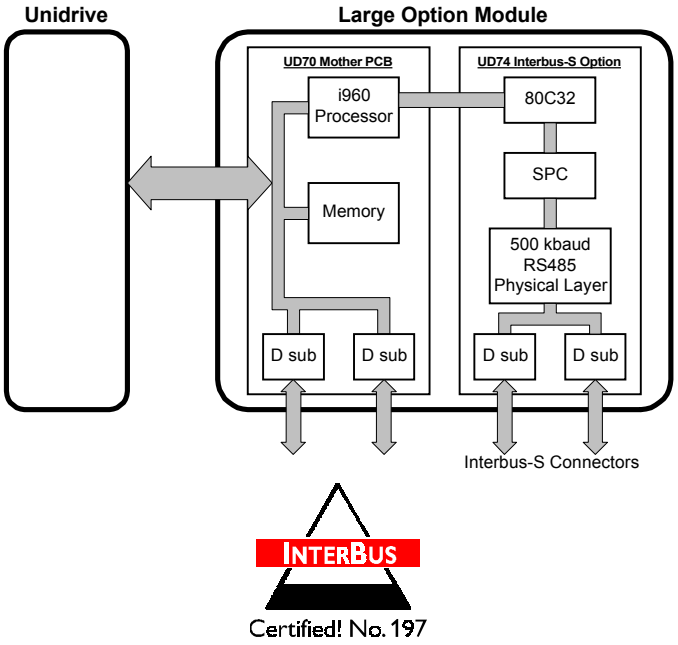
1.1 Using this Guide

Drive parameters are denoted in this manual by “#MM.PP”, where MM refers to the menu number, and PP refers to the parameter number within that menu. Please refer to the Unidrive and Mentor II manuals for parameter definitions.

1.2 Unidrive - UD70 with Interbus-S Interface

The UD70 with Interbus-S Interface module for Unidrive is supplied in a large option module. It is an add-on card for the UD70 Applications card. An 80C32 processor and System Protocol Chip system handle all network activity, and use a Dual-Port RAM interface to transfer data between the 80C32 and the UD70.

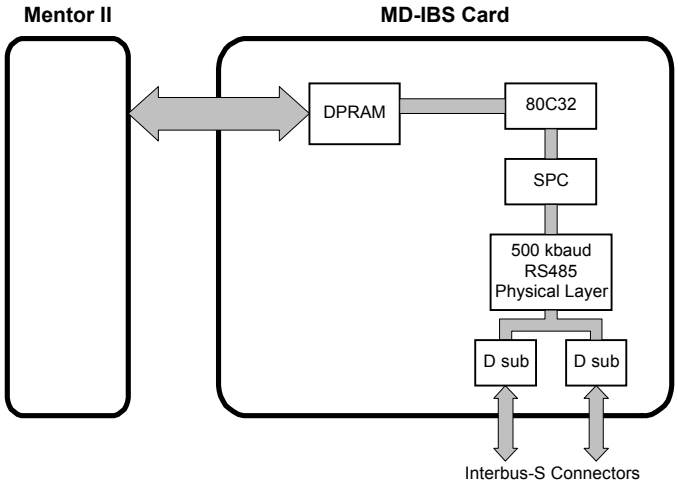
The UD70 retains full functionality, allowing the user to download normal DPL application programs. No program modifications are required to allow existing DPL programs to run. A different UD70 operating system file (“IBSPROFI.SYS”) is used, and the UD70 comes with the system file pre-loaded. The UD70 also uses a DPRAM interface to transfer data to and from the drive.



1.3 Mentor - MD-IBS

The MD-IBS Interbus-S Interface card for Mentor II is a single add-on card. It fits onto the 40 pin header on the MDA-2B card on the Mentor II itself. An 80C32 processor and System Protocol Chip handle all network activity, and use a Dual-Port RAM interface to transfer data between the 80C32 and the Mentor II.

The MD-IBS does not have the MD29 hardware, and is unable to run DPL application programs. One MD21 application program can be included in the PROM, and this must be specified when the MD-IBS card is ordered.

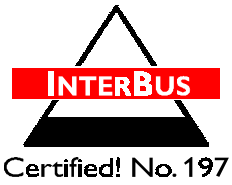


2 Product Conformance Certification

Interbus-S Conformance Certification is granted by the Interbus-S Club to manufacturers of Interbus-S products that have been shown to meet the Interbus-S specification. Tests are carried out by approved independent test houses to ensure the integrity and functionality of both the hardware and software of the product.

These tests are designed to ensure that different pieces of equipment from different manufacturers will all function together on a single network. Provided each piece of equipment has Interbus-S Conformance Certification, there should be no problems experienced by mixing equipment from different manufacturers.

2.1 Interbus-S Conformance Mark



The Interbus-S Conformance Mark is an official symbol of the Interbus-S Club. It may only be attached to Interbus-S products that have a full Conformance Certificate from the Interbus-S Club. It provides an easy way for Interbus-S users to identify which equipment has been fully tested and granted full certification.

2.2 UD70 with Interbus-S Interface

Control Techniques has updated the UD70 with Interbus-S Interface module, and permission has been granted by the Interbus-S Club for Control Techniques to apply the Interbus-S Conformance Mark to all new UD70 with Interbus-S Interface modules.

If the Interbus-S Club logo does not appear on the label on the module, it does NOT have Product Conformance Certification from the Interbus-S Club.

3 Mechanical Installation

IMPORTANT

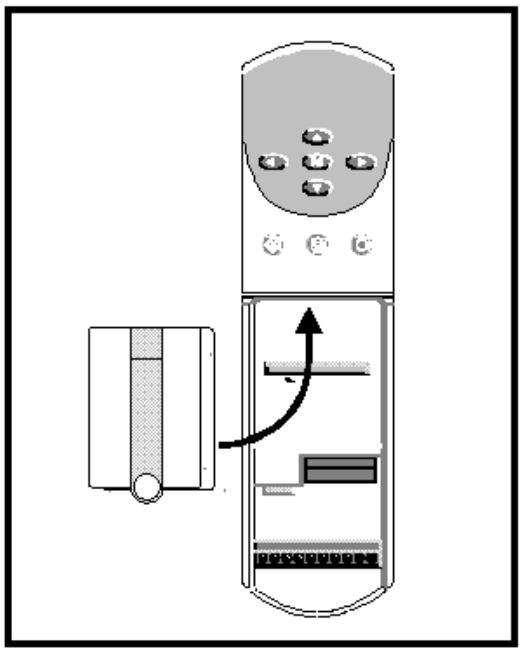
The Unidrive or Mentor II must be disconnected from the mains supply before installing or removing an option module.

3.1 Unidrive

Isolate the drive from the mains supply and allow 5 minutes for the DC Bus capacitors to discharge.

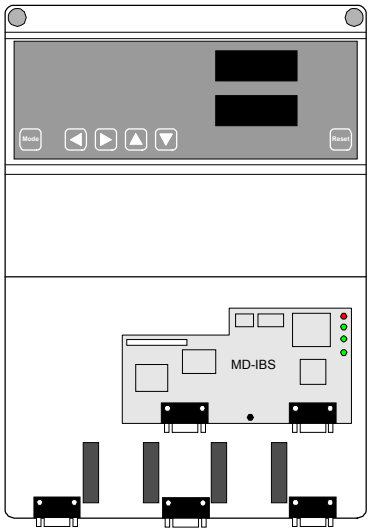
Insert Large Option Module as shown below. Ensure that it is correctly inserted. The module will click firmly into place.

To remove the module, pull on the black tab, and the module will disengage from the connector and pull out of the drive.



3.2 Mentor II

The MD-IBS is to be located upon a 40-way pin header on the MDA2B circuit board, as shown below.



Warning

Please take extreme care when locating the board onto this connector - do not force it on. Excessive force may bend and break the pins of the header.

3.3 MD-IBS Links

There are 2 configuration links on the MD-IBS card that must be set as required.

3.3.1 LK1 - Number of Data Words

Fitted MD-IBS will transmit and receive 4 data words on each network cycle.

Not fitted MD-IBS will transmit and receive 3 data words on each network cycle.

3.3.2 LK2 - Reset

AUTO Reset at power up and when the drive is reset.

RST MD-IBS permanently held is reset.

Not fitted Reset at power up only.

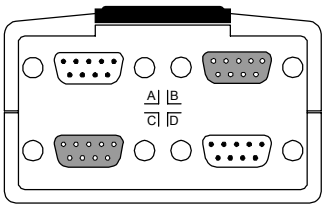
It is advisable to set LK2 to the AUTO position while setting up the Interbus-S parameters and network. This allows changes to become effective at drive reset. Once the network set-up is complete, it is generally best leave LK2 not fitted.

4 Electrical Installation

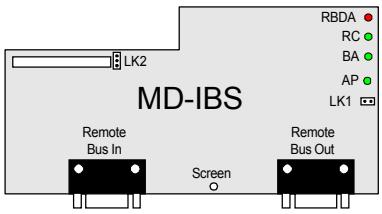
4.1 Interbus-S Connectors

Both the UD70 with Interbus-S Interface and MD-IBS have two Interbus-S 9-way D-Type connectors - Remote Bus IN (A) and Remote Bus OUT (B). The incoming cable must be connected to the Remote Bus IN connector, and the link to nodes “downstream” must be connected to the Remote Bus OUT connector.

The connections are shown below:



Unidrive Large Option Module

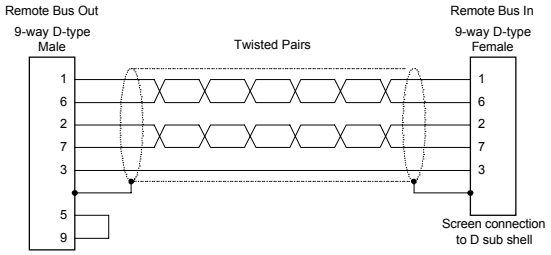


Mentor II Interbus-S Card

The pin out of the connectors are:-

Function	9 way D-type	Description
DO	1	Data OUT line
/DO	6	Data OUT line
DI	2	Data IN line
/DI	7	Data IN line
Last Node	5	Terminate network ring
Last Node	9	Terminate network ring
0V common	3	0V common
Screen	Shell	Cable screen

All connections **including data ground** must be connected, as show below:



Pins 5 and 9 on the Remote Bus OUT connector must be linked to tell the node that there are further nodes “downstream”, and therefore the network ring should not be closed off locally.

4.2 Cable specification

The following 6 core **shielded twisted pair** cable should be used for the connections:-

Characteristic	Minimum value	Nominal Value	Maximum value	Comments
Impedance		120Ω		
Conductor area	0.2 mm2			
Capacitance (line - line)			60pF/m	
Capacitance (line - shield)			90pF/m	
Resistance			96Ω/km	
Line length			400m	Maximum line length between each node.

Belden 9843 is a suitable type of cable for an Interbus-S network.

4.3 Screen

The screen of the cable must be connected to the metal D-type shell.

- On the UD70 with Interbus-S Interface, the shell of the Remote Bus OUT (Female D-Type) is connected to the drive’s internal 0V connection. The Shell of the Remote Bus IN is connected to 0V via a resistor capacitor network.
- On the MD-IBS the D-sub connections are brought to a central fixing on the PCB (TP1): it is the user’s responsibility to connect this to a ‘clean earth’ by a low inductance conductor when appropriate.

4.4 Network Termination

The Interbus-S network is a point-to-point network, so network termination resistors are fitted as standard to each node. No external termination resistors are required.

4.5 Network Repeaters

Network repeaters are not required, as the Interbus-S network is a point-to-point network. This means that each Remote Bus OUT port only drives one Remote Bus IN port. The maximum line length between consecutive nodes is 1200m.

5 Getting Started

5.1 Initial MD-IBS Set-up

The configuration of the MD-IBS card can be set using drive parameters (same method as the UD70 with Interbus-S Interface), or it can be configured from the main controller using the Peripheral Communications Protocol. (See section 7. Non-Cyclic Data Channel, page 24). To set up the MD-IBS card using the Mentor II parameters and keypad, the Manual Mapping mode (#14.01 = 1) should be selected. The UD70 with Interbus-S Interface cannot be set-up using PCP, so no initial set-up is required.

#14.01 Parameter Map Source Data Default = 1

0 = EEPROM mode. Data is retrieved from the on-board MD-IBS EEPROM. The MD-IBS must be set up using the PCP in the main controller. All mapping changes made via the PCP are stored in the MB-IBS EEPROM.

1 = Manual mode. Mapping information is set using Mentor II parameters, allowing changes to be made through the drive keypad interface. Mapping data is stored in the Mentor II EEPROM memory.

Any changes made to the mapping settings using the PCP are stored in the MD-IBS EEPROM, irrespective of the setting of #14.01.

#14.02 Time-out Trip Default = 1

If the network fails, or invalid data is received, the MD-IBS card can be set to trip. This parameter specifies the trip delay time in 20ms intervals. (5 = 100ms).

#14.03 Process OUT Enable Default = 48

0 = enabled. Data will be accepted from the controller, and transferred to the drive.

>1 = disabled. No action is taken on any incoming data.

If any of the above parameters are changed, they must be stored in the Mentor II, and the MD-IBS must be reset before they take effect. (See section 3.3 MD-IBS Links, page 5).

5.2 Interbus-S Node address

Interbus-S nodes do not require addresses to be set. When the network is first powered up, the master controller scans the network to determine what nodes are connected to the network, and assigns an address to them. The addresses are assigned sequentially to each node as their physical position on the ring.

5.3 Network Data Rate

The data rate for Interbus-S networks is fixed at 500 KBits/sec.

5.4 Network Start-up

The UD70 does not accept any data from the Interbus-S Interface during the first 50 network cycles, after network initialisation. This is a safety requirement that allows the PLC to calculate the full control word before the drive starts accepting control words. This prevents any possibility of spurious RUN signals getting to the drive before the PLC has fully initialised the control word.

5.5 Trip Action On Network Failure

Once the Interbus-S network has started, the UD70 with Interbus-S Interface and MD-IBS activate a watchdog function which continually monitors the state of the network.

5.5.1 Unidrive

The UD70 with Interbus-S Interface can be configured to wait for a period of time when the Interbus-S network stops, before the trip signal is issued. The drive will trip on tr60 only if #17.14 = 1. This network loss trip time is set in #20.11, and is specified in milliseconds. When the UD70 is reset, it will round the trip time up to the next multiple of 16ms. #20.11 can range from 16ms to 992 ms. #20.50 shows the current number of network cycles per second.

If short time delays (16ms or 32ms) are set, spurious network loss trips can result. For this reason, the default value for the network loss trip time is 48ms.

The worst case delay between loss of network and drive trip will be 2 * configured network trip time.

Mode	Action	Enabled by
Ride-through	The Unidrive will continue to operate with the previous values received from the network	#17.14 = 0
Trip	The Unidrive will trip on “tr60” Maximum delay for trip = 2 * #20.11 ms	#17.14 = 1

If a DPL program is present in the UD70, this will continue to run as normal. (An ERROR task is not raised). If #17.14 is changed, the UD70 must be reset by setting #MM.00 to 1070, and pressing RESET to make the trip mode change take effect.

5.5.2 Mentor II

If the network stops, the MD-IBS will trip immediately, and the red RBDA LED will come on. The drive can be made to trip “IbS” after a period of time, defined in #14.02 in multiples of 20 ms.

Mode	Action	Enabled by
Ride-through	The Mentor II will continue to operate with the previous values received from the network.	#14.02 = 0
Trip	The Mentor II will trip on “IbS”. Total time to trip = #14.02 * 20 ms	#14.02 = 1

If #14.02 is changed, the MD-IBS must be reset by pressing RESET on the Mentor II.

Some master bus controllers may take up to 100ms to start the cyclic data on the network. The trip time-out should be set to for a longer delay than the start-up delay, otherwise nuisance tripping at network start-up may occur.

5.6 Network Interruptions

If a Unidrive or Mentor II trips, then provided it is not due to an Interbus-S network error, the whole network will continue to operate. OUT cyclic data (such as speed or torque references) received by the UD70 with Interbus-S Interface or MD-IBS will be passed to the drive, however, the data will have no effect while the drive is tripped. Care must be taken if the reference forms part of a closed loop system. It may be possible for the reference to saturate, and cause problems when the trip is reset. IN cyclic data being read back from the drive will be frozen at the value when the trip occurred.

The important point to note is that the rest of the network will continue to function normally.

If power is lost to a drive on the network, the Interbus-S network ring is broken. Since the network operates like a shift register (see Appendix), each node must be powered up in order to pass data downstream to the next node, and receive data from the upstream node.

5.7 UD70 with Interbus-S Interface Status LEDs

LED	Indication	Colour	Description
RC or CC	Cable Check	Green	Indicates that the cable connection is good. LED will go off during reset.
BA	Bus Active	Green	Indicates that the bus is active, and data is being transferred.
TR	Transmit Receive	Green	Indicates that the PCP connection has been made, and data is being transferred through the PCP channel.
RD	Remote Bus Disable	Red	Indicates that the outgoing remote bus is switched off.
LD or US	Local Bus Disable	Red	Indicates that the Interbus-S interface is powered up. Local bus is permanently disabled.

NOTE

The LEDs on the UD70 with Interbus-S Interface module are inside the plastic, and cannot be seen under normal operating conditions. They can be seen by removing the top cover of the option module, but this should only be done by suitably qualified personnel during commissioning.

5.8 MD-IBS Status LEDs

LED	Indication	Colour	Description
RC	Remote Bus Check	Green	Indicates that the cable connection is good. LED will go off during reset.
RBDA	Remote Bus Disable	Red	Indicates that the outgoing remote bus is switched off.
BA	Bus Active	Green	Indicates that the bus is active, and data is being transferred.
AP	Application	Green	The non-cyclic data channel (PCP) connection has been successfully established.

6 Cyclic Data Channel Set-up

The Interbus-S data window contains four 16-bit words for input and four 16-bit words for output data. (The MD-IBS can be configured for 3 data words by removing LK1). The first input and output words are reserved for non-cyclic parameter access and therefore cannot be used as cyclic data channels. The mapping of the six remaining words (three input and three output) can be programmed to any Unidrive or Mentor II parameter, or UD70 virtual parameter. The mapping cannot be changed dynamically, as a reset of the UD70 or MD-IBS must be performed to make the changes active.

On Mentor II, the internal values of the “real” parameters have a higher resolution than the display values. Therefore, when writing a value to a Mentor II “real” parameter, the value must be multiplied by 16 before being converted to hexadecimal.

Example. to write a value of 1000 (0x03E8) to #1.18, the actual value that must be transmitted via the Interbus-S network is 0x3E80.

This also permits higher resolution on the speed loop. To write a value of 235.5 to #1.18, transmit 0xEB8 to the Mentor II. Although this fraction will not be shown on the display, the internal values in the Mentor II will use this extra resolution.

6.1 Mapping Parameters on Unidrive

The mapping for Unidrive and UD70 with Interbus-S Interface is set using menu 20 parameters. Default mapping status is shown in the table below.

Cyclic Channel	Mapping Parameter	Default Mapping Status
IN Word 0	----	Reserved for the non-cyclic channel.
IN Word 1	#20.07	Default map = #90.11, drive status word.
IN Word 2	#20.03	Default map = #2.01, post-ramp speed reference.
IN Word 3	#20.04	Default map = #4.02, torque-producing current.
OUT Word 0	----	Reserved for the non-cyclic channel.
OUT Word 1	#20.06	Default map = #90.11, drive control word.
OUT Word 2	#20.01	Default map = #1.21, digital speed reference 1.
OUT Word 3	#20.02	Default map = #4.08, torque reference.

If any mapping parameter is set to an invalid value (target parameter does not exist), the mapping will revert back to the default value when the UD70 is reset. If a cyclic channel is not being used, it can be disabled by setting the mapping to -1. The data word is still transmitted over the network, but it will not be written to or read from by the UD70 with Interbus-S interface.

The control and status words can be used by mapping to virtual parameter #90.11. When #90.11 is written to, it will decode the data value as the control word. When #90.11 is read from, it will return the status word. The control and status words can be assigned to any cyclic data channel.

6.2 32 Bit Cyclic Data Channel (Unidrive only)

A 32 bit cyclic channel can be created for either IN data, OUT data or both, by combining channels 2 and 3. This allows 32 bit registers (_Pxx%, _Qxx%, _Rxx% and _Sxx%) in the UD70 to be written to and read from by the controlling PLC. (See the “User’s Guide” for the UD70 for more information).

The 32 bit channel is configured by mapping IN or OUT cyclic data channel 2 (#20.01 or #20.03) to a 32 bit register, and setting the mapping for IN or OUT cyclic data channel 3 (#20.02 or #20.04) to -2. These are addressed as #70.xx for _Pxx% registers up to #73.xx for _Sxx% registers. Channel 3 will contain the data high word (upper 16 bits of the register) and channel 2 contains the data low word (lower 16 bits of the register).

NOTE

If the mapping for both channel 2 and channel 3 are directed to 32 bit registers, only the low 16 bits of each register will be written to or read from.

6.3 Saving Unidrive Parameters

6.3.1 Menu 1 through 19

All parameters in these menus are saved in the EEPROM in the Unidrive. To initiate the non-volatile save sequence, set #MM.00 to 1000 and press the red RESET button on the keypad.

6.3.2 Menu 20 and PLC Parameters

All menu 20 parameters and PLC parameters (_Pxx% and _Qxx%) are stored in the flash memory of the UD70 in the large option module. To initiate the non-volatile save sequence for these parameters, set #17.19 to 1. The UD70 will then save Menu 20, clear #17.19 back to zero and reset. The Interbus-S interface will also be reset. These parameters can also be stored automatically at power-down, by setting #17.20 to 1.

6.4 Mapping Parameters on Mentor II

The mapping for Mentor II and MD-IBS is set using menu 11 parameters. Default mapping status is shown in the table below.

Cyclic Channel	Mapping Parameter	Default Mapping Status
IN Word 0	----	Reserved for the non-cyclic channel
IN Word 1	#11.01	Default map = 1941, status word.
IN Word 2	#11.02	Default map = #3.02, speed feedback.
IN Word 3	#11.03	Default map = #5.01, current feedback.
OUT Word 0	----	Reserved for the non-cyclic channel
OUT Word 1	#11.04	Default map = 1940, control word.
OUT Word 2	#11.05	Default map = #1.18, digital speed reference 2.
OUT Word 3	#11.06	Default map = #4.08, torque reference.

If any mapping parameter is set to an invalid value (target parameter is read-only or does not exist), the mapping will revert back to the default value. When default values are restored to the Mentor II, the mapping parameters actually display “000”, but default mapping takes over since “000” is an invalid parameter.

Unlike Unidrive, the MD-IBS card does not change the values displayed in the menu 11 mapping parameters, so care must be taken when setting up the mapping. The actual default values in #11.01 to #11.06 will be 0. The control and status words can be programmed to any channel.

If a cyclic channel is not being used, it cannot be disabled by setting the mapping to 0 as it must be mapped to a valid parameter. The mapping should be set to a valid parameter that is not being used.

6.5 Saving Mentor II Parameters

To initiate the non-volatile save sequence, set #MM.00 to 1 and press RESET.

6.6 Control Word

The control word is an efficient way of remotely controlling the drive. Each bit in the control word has a particular function, and provides a method of writing to the bit parameters which control the operation of the drive (RUN, JOG, DIRECTION, etc.) with a single data word.

6.6.1 Unidrive

The control word on Unidrive is mapped to word 1 (default) by setting #20.06 to 9011. To map data word 2 or 3 to the control word, set #20.01 or #20.02 to 9011.

b15	b14	b13	b12	b11	b10	b9	b8
M6	M5	#18.33	M3	M2	M1	M0	#18.32

b7	b6	b5	b4	b3	b2	b1	b0
#18.31	#1.46	#1.45	Trip	#6.32	#6.31	#6.30	#6.15

The bits shown as “Mx” are individual mask bits which allow the corresponding “bx” to be masked. The “Trip” bit will cause a “tr52” trip when set to 1. Parameters #18.31 to #18.33 are general user parameters and do not have mask bits.

NOTE

If as Mx bit is reset to 0, the bit parameter that it masks will remain at the previous value set.

All direct control of the sequencing bits (#6.30 - #6.32) from digital inputs must be disabled before the control word will can be used. (Set #8.16, #8.19 and #8.21 to another value or 0). The sequencing bits have the following functions when set to 1.

Parameter	Sequencing bit	PLC Mode (#6.04 = 3)	Wire-proof PLC Mode (#6.04 = 4)
#6.15	Enable	Enable	Enable
#6.30	0	Run	Run Forward
#6.31	1	Jog	Jog
#6.32	2	Reverse	Run Reverse

ENABLE - the display will show “**inh**” when set at 0, and depends on #6.30 and #6.32 when set to 1. Setting #6.15 to 0 overrides #6.30 and #6.32, and immediately disables the drive. Motor will coast to rest if it is running when the drive is disabled.

JOG - the jog bit must be set, along with the appropriate run and direction signals.

To reset the drive using the Interbus-S network, DPL code can be used with one of the spare bit parameters (#18.31 to #18.33) to reset the drive from a tripped condition. Alternatively, the PCP (non-cyclic) communications channel can be used to reset the drive by setting #10.38 to 100.

6.6.2 Example Unidrive Control Word Values (PLC Mode)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Value	Action
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0x0200	Drive disable
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0x1E01	Enabled + stopped
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	0x1E03	Enabled + run fwd.
0	0	0	1	1	1	1	0	0	0	0	0	1	0	1	1	0x1E0B	Enabled + run rev
0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0x1E07	Enabled + jog rev

6.6.3 Example Unidrive Control Word Values (Wire Proof PLC Mode)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Value	Action
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0x0200	Drive disable
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0x1E01	Enabled + stopped
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	0x1E03	Enabled + run fwd.
0	0	0	1	1	1	1	0	0	0	0	0	1	0	0	1	0x1E09	Enabled + run rev
0	0	0	1	1	1	1	0	0	0	0	0	1	1	0	1	0x1E0C	Enabled + jog rev

6.6.4 Mentor II

The control word on Mentor II can be mapped to any OUT channel by setting the appropriate mapping parameter to 1940.

b15	b14	b13	b12	b11	b10	b9	b8
Valid	#15.31	#15.29	#15.25	Reset	#15.23	#15.22	#15.21

b7	b6	b5	b4	b3	b2	b1	b0
#2.02	#5.17	#4.13	#4.12	#1.13	#1.12	#1.11	#4.10

The VALID bit (b15) must be set to 1 for the Mentor II to accept and implement the message. The RESET bit will reset the drive from a trip condition.

NOTE

The reset sequence on Mentor II takes approximately 3 seconds, and the "Drive Healthy" signal is not returned until the sequence has finished.

Digital input control of the logic functions (#1.11 - #1.13) must be disabled by setting #8.21 to 1. The logic bits have the following functions when set to 1.

Parameter	Function	Description
#1.11	Run Permit	Must be set for the drive to run.
#1.12	Reverse	Sets the direction of the motor.
#1.13	Inch (Jog)	Selects the inch or jog reference (#1.05).
#5.17	Inhibit	Set to 1 to enable the thyristor bridge firing pulses.

(See Mentor II manual for more information).

6.6.5 Example Mentor II Control Word Values

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Value	Action
1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0x8040	Disabled
1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0x8082	Run fwd. with ramps
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0x8006	Run rev, no ramps
1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0x808E	Inch rev with ramps
1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0x8012	Torque control

6.6.6 Control Word Mapping

Bit	Unidrive		Mentor II	
	Parameter	Description	Parameter	Description
0	#6.15	Drive enable	#4.10	Current limit selector
1	#6.30	Sequencing bit 0	#1.11	Reference ON
2	#6.31	Sequencing bit 1	#1.12	Reverse selector
3	#6.32	Sequencing bit 2	#1.13	Inch selector
4	TRIP	Drive Trip (tr52)	#4.12	Torque Mode 0
5	#1.45	Pre-set select 0	#4.13	Torque Mode 1
6	#1.46	Pre-set select 1	#5.17	Inhibit firing
7	#18.31	Application bit	#2.02	Ramp enable
8	#18.32	Application bit	#15.21	Application bit
9	M0	Mask bit 0	#15.22	Application bit
10	M1	Mask bit 1	#15.23	Application bit
11	M2	Mask bit 2	RESET	Set to reset drive
12	M3	Mask bit 3	#15.25	Application bit
13	#18.33	Application bit	#15.29	Application bit
14	M5	Mask bit 5	#15.31	Application bit
15	M6	Mask bit 6	VALID	VALID bit

The upper bits (b9-b15) of the Unidrive control word are individual mask bits which allow the corresponding bits (b0-b6) to be masked. If M0 (b9) is set, b0 of the control word controls parameter #6.15.

6.7 Mapping Conflicts

When the mapping parameters for the Interbus-S cyclic data channels are set, care must be taken to ensure that there are no clashes with the mapping of the analogue and digital inputs within the drive. Neither the UD70 with Interbus-S Interface module the MD-IBS card will indicate if there is a conflict of mapping parameters. This only applies to analogue and digital inputs, and OUT data on the Interbus-S network.

If a parameter is written to from two different sources, the value of this parameter will depend entirely upon the scan times for the analogue or digital input and the Interbus-S network. Further confusion may be caused due to the update rate of the display. A parameter may appear to be steady at a particular value, but occasionally glitch in the value will be seen. In reality, this value may be changing continuously, leading to erratic drive behaviour.

Drive Input	Unidrive Mapping Parameter	Mentor II Mapping Parameter	Drive Input	Unidrive Mapping Parameter	Mentor II Mapping Parameter
Analogue 1	#7.10	#7.11	Digital 2	#8.13	#8.12
Analogue 2	#7.14	#7.12	Digital 3	#8.16	#8.13
Analogue 3	#7.18	#7.13	Digital 4	#8.19	#8.14
Analogue 4		#7.14	Digital 5	#8.21	#8.15
Speed		#7.15	Digital 6	#8.23	#8.16
IN Word 1	#20.06	#11.04	Digital 7		#8.17
IN Word 2	#20.01	#11.05	Digital 8		#8.18
IN Word 3	#20.02	#11.06	Digital 9		#8.19
Digital 1	#8.10		Digital 10		#8.20

To ensure that there are no mapping conflicts, check that each Unidrive mapping parameter and each Mentor II mapping parameter has a different value programmed. Analogue and digital inputs can be de-programmed by setting the value to 0.

With Mentor II, for example, analogue input channel 4 defaults to the torque reference, #4.08. This is also the default for polled data word 3, so either analogue input 4 (#7.14) or polled data channel 3 (#11.06) must be re-mapped before #4.08 can be controlled properly by either source.

6.8 Status Word

The status word is an efficient way of remotely monitoring and diagnosing the status of the drive. Each bit in the status word indicates the status of a particular function of the drive, e.g. at speed, zero speed, drive healthy, etc., and provides a quick method of checking the current status of the drive.

6.8.1 Unidrive

The status word on Unidrive can be mapped to any IN channel by setting the appropriate mapping parameter to 9011.

b15	b14	b13	b12	b11	b10	b9	b8
X	#10.15	#10.14	#10.13	#10.12	#10.11	#10.10	#10.09

b7	b6	b5	b4	b3	b2	b1	b0
#10.08	#10.07	#10.06	#10.05	#10.04	#10.03	#10.02	#10.01

6.8.2 Mentor II

The status word on Mentor II can be mapped to any IN channel by setting the appropriate mapping parameter to 1941.

b15	b14	b13	b12	b11	b10	b9	b8
Error	#15.26	#10.09	0	#10.07	0	#10.05	#10.04

b7	b6	b5	b4	b3	b2	b1	b0
#10.03	#10.02	#10.01	0	#10.13	#4.25	#4.24	#10.12

6.8.3 Status Word Mapping

Bit	Unidrive		Mentor II	
	Parameter	Description	Parameter	Description
0	#10.01	Drive healthy	#10.12	Drive healthy
1	#10.02	Drive running	#4.24	Taper threshold 1 exceeded
2	#10.03	Zero speed	#4.25	Taper threshold 2 exceeded
3	#10.04	Running at or below minimum speed	#10.13	I*t Alarm
4	#10.05	Below set speed	0	Not used
5	#10.06	At speed	#10.01	Forward velocity
6	#10.07	Above set speed	#10.02	Reverse Velocity
7	#10.08	Load reached	#10.03	Current limit
8	#10.09	In current limit	#10.04	Bridge 1 enabled
9	#10.10	Regenerating	#10.05	Bridge 2 enabled
10	#10.11	Dynamic brake active	0	Not used
11	#10.12	Dynamic brake alarm	#10.07	At speed
12	#10.13	Direction commanded	0	Not used
13	#10.14	Direction running	#10.09	Zero speed
14	#10.15	Mains Loss	#15.26	Application bit
15	X	Not used	ERROR	Set if there is an error on one of the cyclic channels

6.9 Disabling Cyclic Data Channels

If an application only requires 2 cyclic data channels, the remaining channel can be disabled. This means that the data received from that channel will not be written to any drive parameter. It does not actually remove the channel from the network.

6.9.1 Unidrive

Set the appropriate channel mapping parameter to -1, and reset the UD70.

6.9.2 Mentor II

Set the appropriate channel mapping parameter to 1999, and reset the drive.

7 Non-Cyclic Data Channel

7.1 Unidrive Parameter Addressing

Unidrive parameters are not addressed directly using the Peripheral Communications Protocol channel. PCP V2.0 has been implemented in the V3.00 firmware.

Three defined objects are provided to allow access to the drive parameters.

7.1.1 Writing To A Drive Parameter

Index: 0x5000

This object is used to change the value of a parameter within the drive. Four bytes are written to this object:

1 Menu number

2 Parameter number

3 Data high-byte

4 Data low-byte

To check that the write command has been implemented successfully, read the status byte in object 0x5002.

7.1.2 Defining A Read Parameter

Index: 0x5001

Reading a parameter value from the drive is done in two stages. Object 0x5001 defines the parameter that needs reading. Two bytes are written to this object:

1 Menu number

2 Parameter number

The actual value returned from the parameter must be read from object 0x5002. The menu and parameter defined in this object are retained, until a new menu and parameter are defined.

7.1.3 Reading A Parameter And Status Byte

Index: 0x5002

This object returns the value of a parameter defined in 0x5001, plus a status byte. It returns 5 bytes in total:

1 Menu number

2 Parameter number

3 Read data high-byte

4 Read data low-byte

5 Status byte

The status byte indicates whether the read or write action was implemented successfully, and is updated whenever a read or write command via the PCP channel is requested. The possible values of this byte are:

0x80 READY

0xC0 ERROR

An error can be set by addressing an invalid parameter, writing a value out of range, and writing to a read-only parameter.

When reading a parameter value, the actual value of the target parameter is not read until this object is transmitted. This means that once a READ object has been defined, the parameter can be continuously updated simply by re-reading the parameter value and status byte.

NOTE

The decimal point is ignored. A parameter with a value of 1.23 will return the value 123 (0x7B).

Menu 0 parameters cannot be written to or read from, with the exception of #0.00.

7.2 Mentor II Parameter Addressing

The Mentor II parameter set is organised on the Peripheral Message Specification (PMS) Index as a series of 15 arrays, each consisting of 63 words. The array mimics the menu structure in Mentor II. A PMS index is linked to a menu as follows:

INDEX = 0x5FF0 + (Mentor menu number - 1)

The parameter number in the menu is defined in the sub-index parameter. To access menu 1 parameter 18 (#1.18),

INDEX 0x5FF0

SUB-INDEX0x0012

Menu 0 and parameter 0 in any menu cannot be accessed.

7.3 Data Casts

There are several different data types stored in the Mentor II, but they all have to be cast to a 16 bit word by the communications software.

7.3.1 Bits

The bit value is placed in the least significant bit in the word. All other bits must be zero.

To set bit #3.12,

INDEX 0x5FF2

SUB-INDEX 0x0C

DATA 0x0001

7.3.2 Integers

These parameters are stored in 8 bits, and are unsigned values. They are directly cast to the least significant byte in the 16 bit communication word. The most significant byte (8 bits) must be 0x00.

To set #15.11 to 45,

INDEX 0x5FFE

SUB-INDEX 0x0B

DATA 0x002D

7.3.3 Real

The “real” parameters in Mentor have the range of ±1000 or ±1999, plus 4 binary fraction bits. The parameter plus fraction are mapped to the 16 bit word as a two’s complement word * 16.

To set #16.06 to -987.0,

First multiply -987.0 by 16 = -15792

INDEX 0x5FFF

SUB-INDEX 0x06

DATA 0xC250

To set #1.18 to 59.125,

DATA 0xFC4E

To set #2.05 to 1876,

DATA 0x7540

7.3.4 Long Integers

These parameters are 16 bit unsigned values. They are written directly to the 16 bit word.

To set #15.60 to 0x195A,

INDEX 0x5FFE

SUB-INDEX 0x3C

DATA 0x195A

When this parameter is viewed in the Mentor II, only the 4 most significant digits (0649) are displayed.

7.3.5 Application Program Description

A text description of the resident application can be read as a PMS object from index 0x5FEF. A visible string is read back, with a maximum length of 45 characters. If no application program is present, a string of spaces (32 decimal) is returned.

7.4 Process I/O Data Mapping

When data is received at the MD-IBS card, mapping parameters must be set up to direct the data to the appropriate parameter. The following communication objects are defined in MD-IBS to allow the user to set up the mapping information.

NOTE

Data direction is with respect to the controller. OUT data is sent OUT from the PLC to the drive, IN data is read IN by the PLC from the drive.

7.4.1 Process IN Data Description

Index: 0x6000

This object maps the sources for data from the drive to the master. Note that the index of the status word is 0x6041.

Set up the following mapping:

```
Channel 1 #3.02
Channel 2 status word
Channel 3 #15.06
INDEX       0x6000    /*  Process IN map record
SUB-INDEX   0x00      /*  Write to whole record
DATA        0x06      /*  Number of bytes
                      /*  Start of record
DATA        0x5F      /*  Index of 1st word (MSByte)
DATA        0xF2      /*  Index of 1st word (LSByte)
DATA        0x02      /*  Sub index of 1st word
DATA        0x60      /*  Index of 2nd word (MSByte)
DATA        0x41      /*  Index of 2nd word (LSByte)
DATA        0x00      /*  Sub index of 2nd word
DATA        0x5F      /*  Index of 3rd word (MSByte)
DATA        0xFE      /*  Index of 3rd word (LSByte)
DATA        0x06      /*  Sub index of 3rd word
```

7.4.2 Process Out Data Description

Index: 0x6001

This object maps the destinations for data from the master to the drive. Note that the index of the control word is 0x6041.

Set up the following mapping:

```
Channel 1 #1.20
Channel 2 control word
Channel 3 #15.07
INDEX          0x6001      /*  Process OUT map record
SUB-INDEX      0x00        /*  Write to whole record
DATA           0x06        /*  Number of bytes
                           /*  Start of record
DATA           0x5F        /*  Index of 1st word (MSByte)
DATA           0xF0        /*  Index of 1st word (LSByte)
DATA           0x14        /*  Sub index of 1st word
DATA           0x60        /*  Index of 2nd word (MSByte)
DATA           0x40        /*  Index of 2nd word (LSByte)
DATA           0x00        /*  Sub index of 2nd word
DATA           0x5F        /*  Index of 3rd word (MSByte)
DATA           0xFE        /*  Index of 3rd word (LSByte)
DATA           0x07        /*  Sub index of 3rd word
```

NOTE

By specifying a non-zero sub-index, an individual record element may be accessed. To change the mapping of data word 1 from #4.02 to #4.25:

```
INDEX          0x6000
SUB-INDEX      0x03        /*  3rd element of the record
DATA           0x18
```

If a record element is modified as above, the MD-IBS card will check that the new mapping is valid. If not, the default mapping value will be used. If the user wishes to change the mapping to 0x6041 (status word), then the whole record must be re-written, since two elements will need changing to give a valid map source.

If the Process OUT record is modified, the MD-IBS card automatically disables the Process OUT data channel. Once the Process OUT record has been written and a positive acknowledgement received, the user must re-enable the channel. (See Process OUT Data Enable).

7.4.3 Process Out Data Enable

The Process OUT Data Channel can be enabled or disabled using object 0x6002. This object must be set to 0x00 to enable the channel, while 0xFF will disable it.

```
INDEX          0x6002
SUB-INDEX      0x00
DATA           0x00
```

7.4.4 Time Out Trip

The MD-IBS card has a process data monitoring function whereby the drive will be made to trip of the process data is not updated in a defined time period. This time period is defined by the user using the object INDEX = 0x6003. The value entered is a 16 bit integer, and defines the time to trip in milliseconds, ranging from 0x0000 to 0xFFFE (0 to 65534). Setting this object to 0xFFFF disables the process data monitoring function.

If no process data is transferred for a time > 0x6003, the drive will trip “IbS” with a trip code of 1. In addition, the MD-IBS will automatically disable the process data time out trip. If communication is re-established, an abort request will be sent to the master.

Any communication error (e.g. master failure, physical layer damage, CRC error) will prevent a process data update. An intermittent CRC error will only cause a trip if the error persists continually.

NOTE

If no process data is transferred, the data is frozen at the previous successful transfer.

The MD-IBS also has a watchdog function which monitors its own healthy condition. If a fatal error occurs on the MD-IBS, the drive will trip on “Pc2”.

All changes made to the objects described in this section are stored in non-volatile memory on the MD-IBS card. To retrieve and use these values under normal operation, EEPROM mode (#14.01 = 0) must be selected. Any subsequent changes made by the controller will be retrieved from EEPROM memory at power up or reset, depending on the setting of LK2.

7.5 Error Handling

The MD-IBS card will return error codes if problems are encountered trying to implement certain instructions. These values are will be returned to specific locations within the PLC module itself. See PLC Interbus-S Interface Card documentation for further details. All are ERROR CLASS = 6.

Error	Error Code	Additional Code
Object does not exist.	0x07	0x00
Non-zero sub-index on a simple variable OR sub-index is out of range on an array/record.	0x05	0x10
Length of data is wrong for object type.	0x08	0x00
Object cannot be mapped. Possible reasons are that the object does not exist, object is read only (for OUT data), number of process bytes must be 4 or 6 (depending on LK1).	0x00	0x41
Drive parameter does not exist.	0x00	0x10
Data to be written is outside the permissible range for the drive parameter.	0x00	0x30
Parameter does not exist, or value is out of range, after the write command.	0x00	0x01
Drive parameter is read only.	0x00	0x3F

8 Interbus-S Network Configuration

8.1 Network Data Rate

The network data rate is fixed at 500 Kbits/sec.

8.2 Node Identification Code

Identification Code	UD70 with Interbus-S Interface	MD-IBS
E3		Issue 4 PCB and earlier.
F3	V2.02 firmware and later	

The Identification Code of E3 informs the controller that the MD-IBS card supports DRIVECOM communications. MD-IBS does not support DRIVECOM, but this does not affect the operation of the MD-IBS card in any way.

8.3 Firmware and System Files (Unidrive only)

8.3.1 Firmware 3.00 and later

Modules fitted with V3.00 firmware MUST use UD70 system file IBSPROFI.SYS V2.06.07 or later. Earlier system files will not work reliably with these modules.

8.3.2 Firmware V2.03 and later V2.xx

Modules fitted with V2.03 firmware MUST use UD70 system file IBSPROFI.SYS V2.60 to V2.63 only. Earlier system files will not work at all with these modules.

8.3.3 Firmware V2.02 and earlier

Modules fitted with V2.02 or V1.xx firmware MUST use UD70 system file IBSPROFI.SYS V2.50 or earlier.

9 Diagnostics

The information from the parameters described below should always be noted before contacting Control Techniques for technical support.

9.1 Fieldbus Code (Unidrive only)

The identification of the high speed communications option module can be read from #20.14 and #89.04. This parameter is only written to once during UD70 initialisation, and this parameter should not be used by user programs.

#20.14 = (Fieldbus ID Code *100) + Flavour Code*10 + Hardware Code

Fieldbus ID Code for Interbus S = 2

Flavour Code for Interbus-S = 0

Hardware Code for old units = 0

Hardware Code for certified units = 1

e.g. Certified Interbus S module: #20.14 = 201

9.2 Firmware Version (Unidrive only)

The version of firmware fitted to the UD70 with Interbus-S Interface module can be read from #20.15 and #89.02 (in hex). This parameter is only written to once during UD70 initialisation, and this parameter should not be used by user programs. The firmware value is returned as an integer value.

Example: If #20.15 = 300, the firmware version will be V3.00.

9.3 Number of Network Cycles (Unidrive only)

The number of Profibus-DP network cycles processed by the option module since power up is given in #89.03.

#20.50 displays the number of network cycles per second This parameter is useful for giving an indication that the network is operating, but is only updated once every second.

9.4 Determining If Network Is Active On Unidrive

To determine if the Interbus-S network is active from a DPL program, use #89.03. This parameter shows the total number of network cycles processed since power up.

The following example shows how to trip the drive from a DPL program when the Interbus-S network goes unhealthy.

```
CLOCK   {
new_cycles% = #89.03
IF new_cycles% - old_cycles% = 0 THEN
   #10.38 = 60
ENDIF
old_cycles% = new_cycles%
}
```

9.5 Cannot Establish Interbus-S Connection

- Check the cabling connections.
- Check the controller configuration settings.
- Download the system file “IBSPROFI.SYS” V2.06.07 to the UD70.
- With Mentor II, check that #14.03 = 0 to enable the internal data transfer.

9.6 Network Not Updating Drive Parameters

- Check the mapping parameters have been programmed correctly.
- Store the parameters, and reset the UD70 or Mentor II to ensure that the changes take effect.
- Check that there are no mapping parameter conflicts, i.e. the analogue and digital inputs are not trying to control the same parameters as the cyclic OUT channels. Parameter #20.50 on Unidrive shows the number of network cycles per second, if the network is actually running.

9.7 Unidrive Trip Codes

If certain errors occur, the Unidrive will trip and show the trip code in the upper window.

Trip Code	Error
tr52	This code indicates that the trip originated from the setting of bit 4 in the control word.
tr56	The UD70 does not contain the correct operating system. Download the system file “IBSPROFI.SYS” from the MD29 Toolkit
tr57	An illegal operating system call has been made, e.g. “WRNET”. This is a CTNet command, and is not available with Interbus-S.
tr60	This trip indicates that the time-out trip has been activated. The number of network cycles per second has dropped to zero in the trip time period when cycles were counted in the previous trip time period.

To reset the Unidrive using the Interbus-S network, write a value of 100 to #10.38 using the non-cyclic data channel. (Refer to Unidrive Manual).

9.8 Mentor II Trip Codes

Trip Code	Error
IbS	This trip indicates that no activity has been detected on the Interbus-S network for the time defined in #14.02.
Pc2	This trip indicates that there is a fatal error on the MD-IBS card. This is most likely to be caused by a hardware failure.

To reset the Mentor II using the Interbus-S network, set b11 of the control word to 1. This will cause the Mentor II to reset, equivalent to pressing the RESET button on the Mentor II itself. Note that the reset sequence on Mentor II takes approximately 3 seconds to complete.

10 General Information

10.1 Interbus-S Timing

The cycle time of the network depends on the number of data words (data width) required from the network.

Cycle Time (µs) = 350 + (53 * N)

where: N = total number of data words per cycle

Consider a network with 50 nodes and 4 words per node. There is a master controller node, which transmits to and receives from each node on every cycle. The network length is 50m. The theoretical minimum network update time is 10.95ms. Minimum update times for an identical network using other communications protocols are given below.

Network	Min Update Time (ms)	Network Data Rate
Interbus-S	10.95	500k
Profibus-DP	31.50	1.5M

As can be seen from the above table, Interbus-S achieves very high data throughput rates compared to Profibus-DP. Nodes are assigned addresses at power up and network initialisation, and hence the amount of addressing information that needs transmitting is kept to a minimum. The disadvantage of this method is that the network is not very flexible when it comes to adding or removing nodes. Extensive changes may be required to the main PLC program, particularly if the node is not added at the end of the network, but is inserted in the middle. The required location of IN and OUT data words within the PLC data arrays would change.

10.2 System Propagation Delays

The worst case propagation delay for an Interbus-S network can be calculated by considering all delays through each stage of the system. Consider a system with 15 nodes, each node having 4 data words, and one node is a digital I/O module. What delay may be seen between a switch being operated at the I/O module to a change reflected within a drive?

The delays present within the system are:

- I/O module update delay
- Interbus-S cycle time
- Interbus-S module to drive update time

The I/O module will have a specified maximum update time, typically around 3ms. This is the period of time from the switch being changed to the buffer where the status word is read from being updated. For our example network, the data width is 15 nodes * 4 words per node = 60 words, so minimum cycle time is 3.5ms. A Interbus-S cycle time of 5ms could be selected.

In the worst case, the buffer will change just after the node has read the buffer and sent the information to the controller. The change will not be seen until the next Interbus-S cycle, so a delay of up to 5ms is seen. On the next cycle, the data is transferred to the PLC. When the cycle is complete, the PLC will see the change and modify the data for the target drive. This adds another 5ms to the delay. On the third Interbus-S cycle, the data is transferred to the drive, but is not consumed until the cycle is complete. This adds 3.5ms to the delay.

The delay due to the network can be up to 13.5ms. Within the Control Techniques Interbus-S module, it can take up to 2 ms for data to be transferred to the UD70.

For the example network, worst case propagation delay is
3 + 5 + 5 + 3.5 + 2 = 18.5ms.

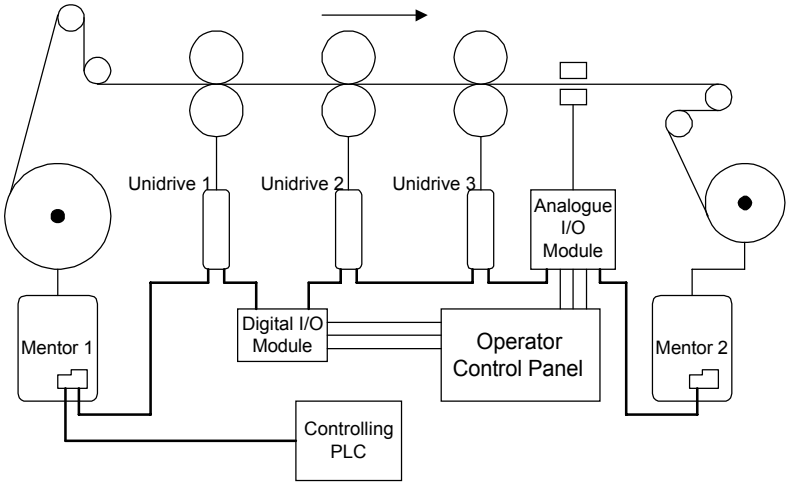
The worst case delays within the external nodes (I/O modules and drives modules) are fixed; the variable part of the delay depends entirely on the network configuration. The higher the number of data words per cycle, the higher the propagation delays will be.

11 Example Application

11.1 System Overview

Consider a drawing process as shown below. The material is unwound under constant tension, and passed between 3 sets of grip rolls. The material is “drawn” to the required thickness by introducing a ratio between each set of grip rolls. The machine operator has a control panel next to the machine, while the controlling PLC is located some 100m in a another building.

A typical control system is shown, consisting of 2 * Mentor II drives with tacho feedback and MD-IBS cards, 3 * Unidrives with encoder feedback and UD70 with Interbus-S interfaces, 1 * digital I/O module, 1 * analogue I/O module and a controlling PLC. The operator panel connects to the digital and analogue I/O modules to both input and display information to and from the PLC. This means that there is no need to run masses of control cables back to the PLC.



Unidrive 3 is the master drive in the system. This receives the master speed reference from the PLC, and transmits the post-ramp speed reference back to the PLC. The post-ramp speed reference is scaled, and becomes the line speed reference for the Mentor II drives.

Unidrive 2 is running in digital lock with Unidrive 3. It uses the encoder feedback from Unidrive 3 to generate its own speed reference, and stay locked to it. The draw ratio is calculated by the PLC, and the digital lock ratio is transmitted from the PLC. Unidrive 1 is locked to Unidrive 2, and also receives a digital lock ratio from the PLC.

The Mentor II drives are running in torque control, with Coiler software fitted to the MD-IBS cards. They receive the line speed reference and the material tension reference, and the torque output is varied as the roll diameter changes.

Machine control is implemented using the digital and analogue I/O modules. References are set using potentiometers into the analogue module, and switches into the digital I/O module, and read by the PLC. Displays are controlled in the same manner, with the PLC writing to the digital and analogue I/O modules, and the outputs being displayed using lamps and analogue meters. The draw ratio is read in from 4 thumb wheel switches in BCD format, providing an accuracy of 4 decimal places.

Node	Device	Function
1	Mentor II 1	Unwind drive, with Coiler software to provide tension control.
2	Unidrive 1	Slave drive running in digital lock with Unidrive 2. Digital lock ratio is passed over network.
3	Digital I/O	Digital inputs to read status of operator panel switches. Outputs are used to control status lamps and displays on operator panel.
4	Unidrive 2	Slave drive running in digital lock with Unidrive 3 (Master drive). Digital lock ratio is passed over network.
5	Unidrive 3	Master drive, running in speed control. Post-ramp reference is used as the line speed reference.
6	Analogue I/O	Analogue inputs to read the material depth transducer feedback signal, line speed, unwind and rewind tension references. Outputs control analogue meters on the operator panel.
7	Mentor II 2	Rewind drive, with Coiler software to provide tension control.

11.2 IN Cyclic Data

To specify the network requirements, it is necessary to analyse each node, and identify the time critical data for each node. Data channels can then be assigned for each node. This will determine the requirements of the network, and the maximum theoretical performance.

Node	Device	Channel 1	Channel 2	Channel 3	
1	Mentor II 1	Status word	Current feedback	Calculated roll diameter	
2	Unidrive 1	Status word	Motor speed	Active current	
3	Digital I/O	Thumb wheel draw ratio	Control panel status		
4	Unidrive 2	Status word	Motor speed	Active current	
5	Unidrive 3	Status word	Line speed reference	Active current	
6	Mentor II 2	Status word	Current feedback	Calculated roll diameter	
7	Analogue I/O	Master line speed reference	Material thickness	Unwind tension reference	Rewind tension reference

The IN data words are read from each node to provide information about the actual performance of the line. The roll diameter calculation from each Mentor II gives the diameter relative to the initial reel diameter, so the PLC can then calculate the actual roll diameter. This allows the line speed to be ramped up and down automatically as required when rolls need to be replaced.

11.3 OUT Cyclic Data

Node	Device	Channel 1	Channel 2	Channel 3	Channel 4
1	Mentor II 1	Control word	Line speed reference	Tension reference	
2	Unidrive 1	Control word	Ratio 2	Maximum torque limit	
3	Digital I/O	Control panel display word 1	Control panel display word 2		
4	Unidrive 2	Control word	Ratio 1	Maximum torque limit	
5	Unidrive 3	Control word	Master line speed reference		
6	Mentor II 2	Control word	Line speed reference	Tension reference	
7	Analogue I/O	Material depth display	Scaled line speed	Scaled material unwind tension	Scaled material rewind tension

The control words are written to each drive, thus making it a fully remote controlled system. For safety reasons, the ENABLE terminal on all drives would have to be hard-wired into an emergency stop circuit. This would ensure that all drives are disabled instantly if the emergency stop is pressed.

11.4 Network Set-up

Node	OUT words	IN words	Configuration (inc. message word)
Mentor II 1	3	3	4
Unidrive 1	3	3	4
Digital I/O	2	2	2
Unidrive 2	3	3	4
Unidrive 3	3	3	4
Mentor II 2	3	3	4
Analogue I/O	4	4	4

This gives a network data width of 26 words, with a minimum cycle time of 1.728ms.

The actual network cycle time will depend upon the update time required, and the processing capability of the controlling PLC.

11.5 Digital I/O

The digital I/O module has 32 inputs and 32 outputs. Utilisation is as follows:

4 * 4 inputs	draw ratio 1 in BCD format. Provides the overall draw ratio of 0.xxxx.
16 inputs	inputs for run, jog, enable and emergency stop signals.

The digital outputs are used to control display indication lamps, etc. on the operator's control panel.

11.6 Analogue I/O

The analogue I/O module has 4 input and 4 outputs. Utilisation is as follows:

1 input	feedback from material thickness transducer
1 input	master line speed reference
2 inputs	material tension references for unwind and rewind sections

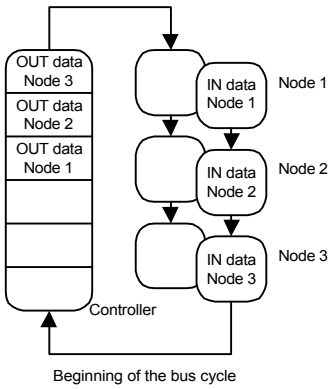
The analogue outputs are scaled by the PLC to produce real unit readings on analogue meters.

1 output	material thickness, displayed in mm.
1 output	actual line speed, displayed in metres/minute.
2 outputs	material tension, displayed in Newtons.

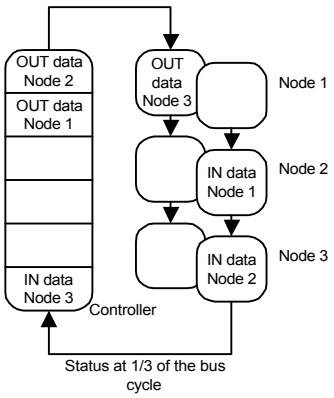
12 Appendix

12.1 Interbus-S Network Operation

The Interbus-S network can be considered as a series of shift registers. As each OUT data word is transmitted, each node moves each data word “downstream” to the next node. Since the network is a ring construction, the last node on the network moves IN word data into the PLC. The IN words from a particular node are therefore received at the same time as OUT words are transmitted. When all OUT data words have been transmitted, they will all be in their correct destination node. At this point, the data is “consumed”, each node updates its reference information, and latches its feedback information ready for the next cycle. This “latch” phase ensures that all OUT data words are consumed synchronously, and IN data words are latched synchronously.

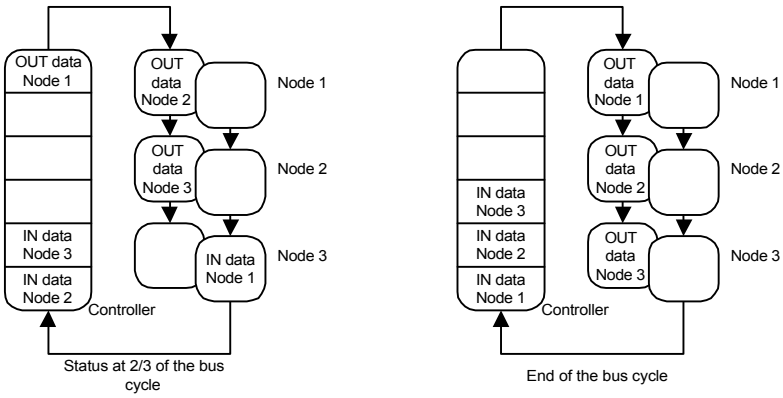


Beginning of the bus cycle



Status at 1/3 of the bus cycle

The OUT and IN word data arrays within the PLC will be identical in set-up, as each node must transmit equal numbers of OUT and IN words. Interbus-S controllers assign node numbers during the “Network Identification” phase, and these numbers depend upon the physical position within the network of each node. Therefore, if a node is added in the middle of the network, the position within the array of all “downstream” node data words will be changed. This will require changes in the PLC program to ensure that data is written to and read from the correct part of each array.



12.2 Error Detection

During the latch phase, the validity of the data is checked using the CRC word. If the data is valid, then it is written to the destination parameter. Error correction information is not transmitted, as data passing through the cyclic channels has a very limited lifetime (1 network cycle), and error correction data would take up additional network bandwidth. If the data is corrupted, it is not transferred to the drive.

12.3 Connecting to 8-Wire Interbus-S Systems

Older designs of Interbus-S incorporated 8 twisted pair connections between nodes on the ring. The dual cable accounted for 4 connections: 1 data, with the remaining 3 used for bus control and synchronisation. The 8 wire Remote Bus system runs at 350k data rate, and uses 25 way D-type connectors throughout the ring.

This was replaced in the early 1990s with the 2 wire mode of operation, which eliminated the need for control and synchronisation links. These functions were implemented in a low level protocol, which was transparent to the Interbus-S user. Since the new protocol introduced an overhead, the overall data rate was increased to 500k to overcome this. 9 way D-type connectors are used on 2-wire networks.

Control Techniques Interbus-S products only support the 2-wire mode of operation. Bus Terminal Modules are available to interface between 8-wire and 2-wire systems.

12.3.1 8-Wire Remote Bus Connectors

Function	25 way D-type connector	Colour
RC	1	white green
SLO	2	red
CKO	3	violet
CRO	4	grey
DO	5	yellow
SLI	6	white
CKI	7	grey brown
CRI	8	white pink
DI	9	red blue
COM	14	brown green
/SLO	15	blue
/CKO	16	black
/CRO	17	pink
/DO	18	green
/SKI	19	brown
/CKI	20	white grey
/CRI	21	pink brown
/DI	22	grey pink

Terminals 13 and 25 should be linked together.

13 Quick Parameter Reference

13.1 Set-up and Mapping Parameters

Function	Unidrive (Default)	Mentor II (Default)
EEPROM/Manual Mode		#14.01 = 0 - EPROM mode #14.01 = 1 - Manual mode
Network Loss Trip	#20.11 = network loss trip delay time #17.14 = 1 - enable tr60 trip	#14.02 = 0 - disable IbS trip #14.02 > 0 - enable IbS trip
Data Transfer Disable		#14.03 = 0 - enable #14.03 = 1 - disable
IN Channel 1 Mapping	#20.07 (Status word)	#11.01 (Status word)
IN Channel 2 Mapping	#20.03 (#2.01)	#11.02 (#3.02)
IN Channel 3 Mapping	#20.04 (#4.02)	#11.03 (#5.01)
OUT Channel 1 Mapping	#20.06 (Control word)	#11.04 (Control word)
OUT Channel 2 Mapping	#20.01 (#1.21)	#11.05 (#1.18)
OUT Channel 3 Mapping	#20.02 (#4.08)	#11.06 (#4.08)

13.2 General Drive Functions

Action	Unidrive	Mentor II
Activate mapping changes	Set #MM.00 to 1070 and press the RESET button.	Press RESET button when the drive is disabled.
Save and activate mapping changes	Set #17.19 to 1.	Set #MM.00 to 1 and press RESET.
Remote drive reset	Set #10.38 to 100.	Set bit 11 of the Control word to 1.

13.3 Control Words

Bit	Unidrive		Mentor II	
	Parameter	Description	Parameter	Description
0	#6.15	Drive enable	#4.10	Current limit selector
1	#6.30	Sequencing bit 0	#1.11	Reference ON
2	#6.31	Sequencing bit 1	#1.12	Reverse selector
3	#6.32	Sequencing bit 2	#1.13	Inch selector
4	TRIP	Drive Trip (tr52)	#4.12	Torque Mode 0
5	#1.45	Preset select 0	#4.13	Torque Mode 1
6	#1.46	Preset select 1	#5.17	Inhibit firing
7	#18.31	Application bit	#2.02	Ramp enable
8	#18.32	Application bit	#15.21	Application bit
9	M0	Mask bit 0	#15.22	Application bit
10	M1	Mask bit 1	#15.23	Application bit
11	M2	Mask bit 2	RESET	Set to reset drive
12	M3	Mask bit 3	#15.25	Application bit
13	#18.33	Application bit	#15.29	Application bit
14	M5	Mask bit 5	#15.31	Application bit
15	M6	Mask bit 6	VALID	VALID bit

13.4 Status Words

Bit	Unidrive		Mentor II	
	Parameter	Description	Parameter	Description
0	#10.01	Drive healthy	#10.12	Drive healthy
1	#10.02	Drive running	#4.24	Taper threshold 1 exceeded
2	#10.03	Zero speed	#4.25	Taper threshold 2 exceeded
3	#10.04	Running at or below minimum speed	#10.13	I*t Alarm
4	#10.05	Below set speed	0	Not used
5	#10.06	At speed	#10.01	Forward velocity
6	#10.07	Above set speed	#10.02	Reverse Velocity
7	#10.08	Load reached	#10.03	Current limit
8	#10.09	In current limit	#10.04	Bridge 1 enabled
9	#10.10	Regenerating	#10.05	Bridge 2 enabled
10	#10.11	Dynamic brake active	0	Not used
11	#10.12	Dynamic brake alarm	#10.07	At speed
12	#10.13	Direction commanded	0	Not used
13	#10.14	Direction running	#10.09	Zero speed
14	#10.15	Mains Loss	#15.26	Application bit
15	X	Not used	ERROR	Set if there is an error on one of the cyclic channels