CONTROL TECHNIQUES

Advanced User Guide

SE73-PROFIBUS-DP

Commander SE

Part Number: 0452-0055-04
Issue Number: 4

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 variable speed drive (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.

Drive software version

This product is supplied with the latest version of user-interface and machine control software. If this product is to be used in a new or existing system with other Drives, there may be some differences between their software and the software in this product. These differences may cause this product to function differently. This may also apply to Drives returned from a Control Techniques Service Centre.

If there is any doubt, contact a Control Techniques Drive Centre.

Contents

1   Introduction

Commander SE 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 Commander SE manual for full parameter definitions.

1.1   SE73-PROFIBUS-DP Module

The SE73-PROFIBUS-DP module is a single option card that fits on to the Commander SE, and provides an interface to a PROFIBUS-DP communicaiotions network. The SE73-PROFIBUS-DP module uses a 16-bit processor and is capable of communicating at 12 Mbits/sec, currently the fastest data rate available for PROFIBUS-DP networks. SESoft V1.04.00 and later provides full support the SE73-PROFIBUS-DP module.

Parameter data is transferred to and from the Commander SE using a 2-wire RS485 link into the RJ-45 serial communications connector on the Commander SE.

Although power is taken from the Commander SE under normal operating conditions, an optional back-up power supply can also be connected to the SE73-PROFIBUS-DP module. This ensures that the SE73-PROFIBUS-DP module is kept powered up, and continues to communicate with the PROFIBUS-DP master, even when the SE73-PROFIBUS-DP is disconnected from the Commander SE, e.g. to use SESoft, or when the Commander SE is powered down.

1.2   Product Conformance Certificate Z00561

The SE73-PROFIBUS-DP module has been awarded full Profibus Conformance Certification. (Profibus Certificate No. Z00561) More details are available from the Profibus Nutzerorginaziation web site at www.profibus.com.

1.3   Overview Specification

- Auto slave configuration of data format and data consistency during PROFIBUS-DP network initialisation.
- Auto-configuration of the serial communications port when the SE73-PROFIBUS-DP module is connected to the Commander SE.
- Supported data rates (bits/sec): 12M, 6M, 3M, 1.5M, 500k, 187.5k, 93.75k, 19.2k, 9.6k
- Choice of two or three 16 bit input/output words
- Non-cyclic data channel (optional)

2 Mechanical Installation

Care should be taken when handling the SE73-PROFIBUS-DP card, as it may be damaged by electrostatic discharge. To prevent inadvertent damage, touch an earthed bare metal surface to discharge yourself before removing the SE73-PROFIBUS-DP card from the anti-static bag.

NOTE The Commander SE must be disconnected from the mains supply before installing or removing an option module.

2.1 Commander SE Size 1

1. Remove the two terminal blocks from the option card. Slide the SE73-PROFIBUS-DP card diagonally into the Commander SE.
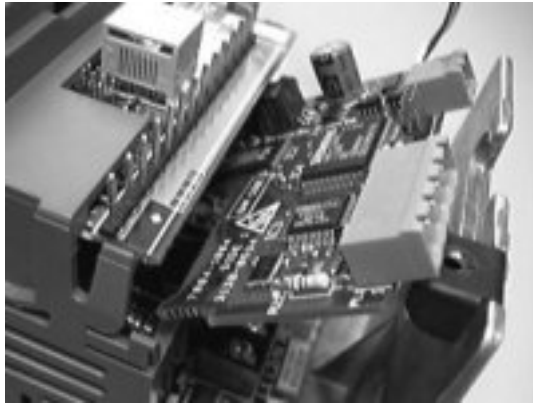
2. Ensure that the SE73-PROFIBUS-DP card is aligned between the runners moulded into the plastic casing, and slide into the Commander SE.

3. Push the SE73-PROFIBUS-DP card firmly into the Commander SE until the plastic spring clips latch it securely in place.

4. Plug the flylead into the RJ45 socket on the Commander SE.

2.2 Commander SE Sizes 2, 3, 4 and 5

1. Locate the right hand side of the SE73-PROFIBUS-DP card under the flange.
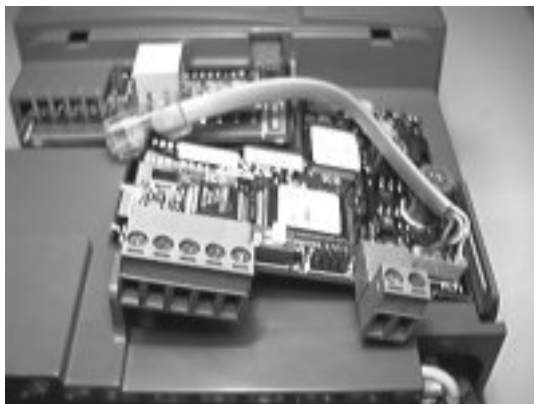
2. Push the left hand side of the SE73-PROFIBUS-DP card down to clip into place. Connect the fly-lead to the RJ-45 connector on the Commander SE.

3 Electrical Installation

3.1 SE73-PROFIBUS-DP Module

The SE73-PROFIBUS-DP module has a 5-way screw terminal block connector for the PROFIBUS-DP data connections, and a 2-way screw terminal block for the +24V Back-up power supply.

Figure 3-1 SE73-PROFIBUS-DP Module

RJ-45 connector to Commander SE

1   5   6 7
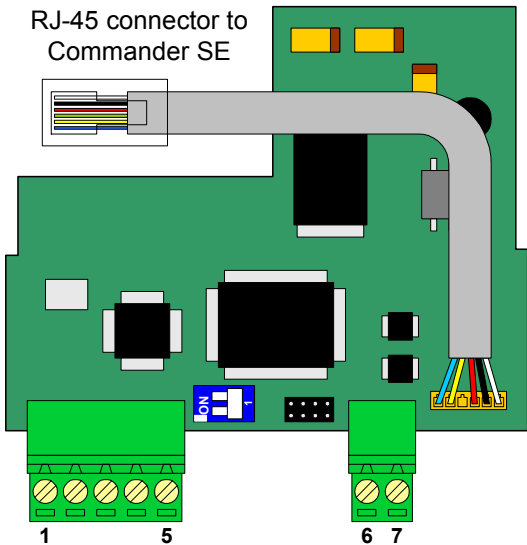
The terminal connections are shown in Table 3.1.

Table 3.1 SE73-PROFIBUS-DP Module Connectors

Terminal	Function	Description
1	RxD/TxD-N	Negative data line IN (A)
2	RxD/TxD-P	Positive data line IN (A)
3	Screen	Cable braided screen connection
4	RxD/TxD-N	Negative data line OUT (A)
5	RxD/TxD-P	Positive data line IN (A)
6	+24V Back-up	+24V Back-up power supply
7	0V Back-up	0V Back-up power supply

NOTE If the PROFIBUS-DP network contains equipment with 9-way D-type connectors, such as UD73-PROFIBUS-DP, MD24-PROFIBUS-DP or SM-PROFIBUS-DP modules, connect A (IN or OUT) to pin 8, and B (IN or OUT) to pin 3 on the D-type connectors. The screen should be connected to the shell of the D-type connector.

3.2 SE73-PROFIBUS-DP Connections

To connect the SE73-PROFIBUS-DP module to the PROFIBUS-DP network, make the connections as shown in the diagram below. The length of the "pigtail" screen connection should not be longer than 20mm.

Figure 3-2 SE73-PROFIBUS-DP Connections

20mm max
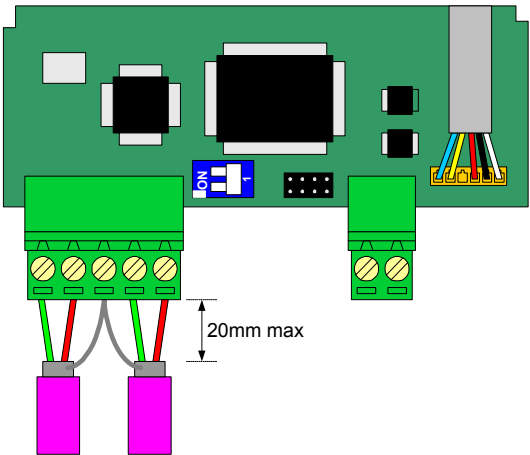
NOTE Additional impedance is fitted between the terminals and the data signal transceivers to improve the performance of the network. This means that it is not possible to connect 2 data wires into a single terminal.

3.3 PROFIBUS-DP Cable

PROFIBUS-DP cable has a single twisted pair plus overall screening. The data wires are usually red and green, and are generally connected as shown in the table below.

Table 3.2 PROFIBUS-DP Cable Colour Codes

Cable	Data Signal	Terminal	Description
Green	A1, A2	1, 4	Negative data line, connect to pin 8 on a PROFIBUS-DP D-type connector
Red	B1, B2	2, 5	Positive data line, connect to pin 3 on a PROFIBUS-DP D-type connector
Braided Shield	Screen	3	Cable screen, connect to the shell (or pin 1) a PROFIBUS-DP D-type connector

PROFIBUS-DP networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Cable specifications and a list of approved manufacturers of cable for use on PROFIBUS-DP networks is available on the Profibus web site at www.profibus.com.

NOTE Control Techniques can only guarantee correct and reliable operation of its PROFIBUS-DP modules if all other equipment installed (including the network cable) has been approved by the Profibus Nutzerorganisation. (PNO)

3.4 SE73-PROFIBUS-DP Cable Screen Connections

An EMC Bracket Kit is available for each size of Commander SE. This plate must be fastened to the Commander SE gland plate, and provides a path to earth via the Commander SE heatsink.

Table 3.3 EMC Bracket Kits

Commander SE	Kit Part No	Kit Name	Commander SE	Kit Part No	Kit Name
Size 1	9500-0014	SE11	Size 4	9500-0018	SE14
Size 2	9500-0016	SE12	Size 5	9500-0041	SE15
Size 3	9500-0017	SE13			

The screen(s) of the PROFIBUS-DP cable(s) should be clamped to the EMC bracket, which is earthed via the Commander SE gland plate and heatsink. The end of the screen should be formed into a short "pigtail" (max length of 20mm) and connected to pin 3 on the PROFIBUS-DP connector.

Figure 3-3 SE73-PROFIBUS-DP Screen Connections
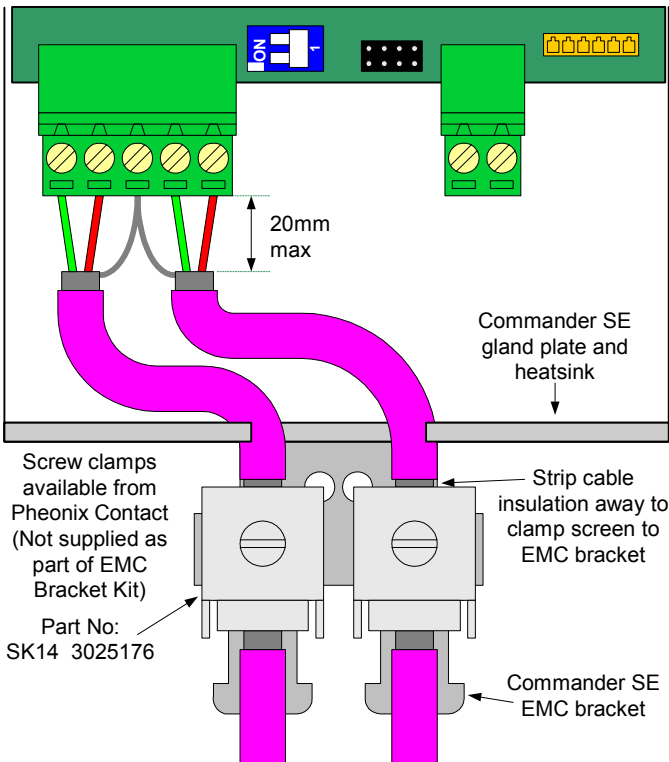
With this arrangement, the PROFIBUS-DP network will work equally well when powered by the Commander SE internal power supply, or from an external 24V back-up power supply. (See section 3.6.)

3.5 PROFIBUS-DP Network Termination

It is very important in high-speed communications networks that the network communications cable is fitted with the specified termination resistor network at each end of the cable. This prevents signals from being reflected back down the cable and causing interference.

Termination resistors are fitted to the SE73-PROFIBUS-DP module, and can be switched into the circuit by setting SW1 to the ON position, as indicated by the arrow in the diagram below.

Figure 3-4 SE73-PROFIBUS-DP Termination

20mm max
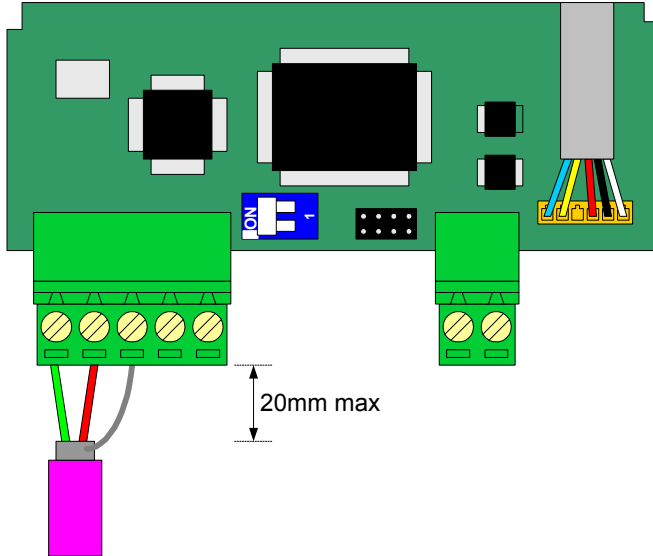
To maintain PROFIBUS-DP network integrity in the event of power loss to the Commander SE, it is strongly recommended that a +24V back-up power-supply is connected to an SE73-PROFIBUS-DP if the termination resistors are enabled. Instances when power loss can occur are if:

•   An input fuse fails on the main supply to the Commander SE.
•   The SE73-PROFIBUS-DP module is disconnected from the Commander SE, possibly to use SESoft for configuration changes.
•   The Commander SE can be powered down at any time during normal operation.

NOTE If termination is not fitted, the noise immunity of the network is greatly reduced, while if too many nodes have their internal termination resistor networks enabled, the network will be over-loaded and may not operate at all.

3.6   Back-up Power Supply

Usually, the SE73-PROFIBUS-DP module will draw power via the RJ-45 communications lead from the unregulated +28V rail of the Commander SE. If the SE73-PROFIBUS-DP is disconnected to check and update the configuration of the Commander SE using SESoft, it will power down, and this may cause network errors on the PROFIBUS-DP network master.

Figure 3-5 Backup Power Supply Connections
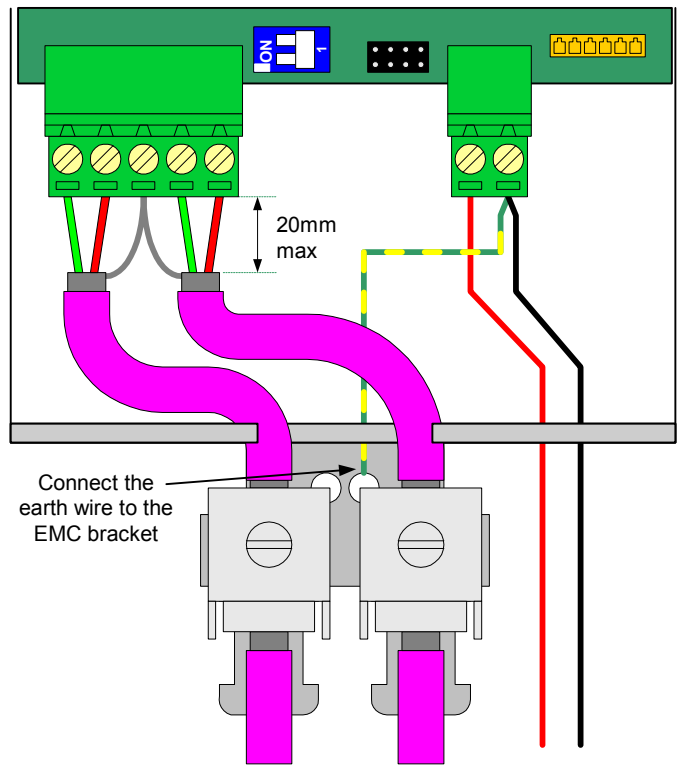
By connecting a +24V back-up power-supply to the SE73-PROFIBUS-DP, the node will continue to communicate with the master controller, and no network errors will be detected. The SE73-PROFIBUS-DP will indicate (using the status word) to the master controller that it is not currently communicating with the Commander SE. When the SE73-PROFIBUS-DP module is re-connected to the Commander SE, communications will be re-established automatically.

Table 3.4 SE73-PROFIBUS-DP Back-up Power Supply Connections

Terminal	Function	Description
6	+24V Backup	+24V, fully isolated from the Commander SE. This allows a back-up power supply to keep the PROFIBUS-DP circuitry operating if the Commander SE is switched off
7	0V Backup	0V Isolated, fully isolated from the 0V of the Commander SE

NOTE Use of a back-up power supply is strongly recommended on the nodes that provide network termination. The resistor network ties the lines to +5V and 0V through 390Ω resistors, so a power supply must be present at all times while the PROFIBUS-DP network is operating.

The back-up power supply should be +24V ±20%, and should have sufficient current capability to supply all SE73-PROFIBUS-DP modules connected to it. This condition will occur if the main power supply is lost. The consumption of the SE73-PROFIBUS-DP module is dependent on the supply voltage, with typical and maximum currents listed in the table below.

Table 3.5 SE73-PROFIBUS-DP Module Current Consumption

Back-up Supply Voltage	Nominal Current (Commander SE is off)	Typical Current (Commander SE is on)
19.2V (24V -20%)	70mA	5mA
21.6V (24V -10%)	62mA	19mA
24V nominal	57mA	44mA
26.4V (24V +10%)	52mA	52mA
28.8V (24V+20%)	49mA	48mA

Under normal operating conditions, the Commander SE and the back-up power supply share the power supply requirements of the SE73-PROFIBUS-DP module. An in-rush current of 2.0 * nominal current should be allowed for at power-up, although this factor will typically be 1.7.

NOTE A dedicated external 24V back-up power supply should be used, as interference from other equipment may cause disturbance to the PROFIBUS-DP system.

3.7 Maximum Network Length

The maximum number of nodes that can be connected to a single PROFIBUS-DP network segment is 32. The maximum lengths of cable for a segment depend on the data rate, and are shown in Figure 3.6.

Repeaters can be used to extend the network to allow more than 32 nodes to be connected, and/or to extend the maximum length of the PROFIBUS-DP network.

For full details on designing and installing a PROFIBUS-DP network, refer to "Installation Guidelines for Profibus-DP/FMS". This document is available from the Profibus web site at www.profibus.com.,

Table 3.6 PROFIBUS-DP Maximum Network Lengths

Data Rate (bit/s)	Maximum Trunk Length (m)		Data Rate (bit/s)	Maximum Trunk Length (m)
12M	100		187.5k	1000
6.0M	100		93.75k	1000
3.0M	100		45.45k	1000
1.5M	200		19.2k	1000
500k	400		9.6K	1000

4 Getting Started

Full explanations of the cyclic data and data formats are given in Chapter 5. Non-cyclic data and node configuration using non-cyclic data are described in Chapter 7.

NOTE The Commander SE must be fitted with firmware V1.08.00 or later for use with a fieldbus module. SESoft V1.04.00 or later provides support for all Commander SE fieldbus modules.

4.1 SESoft Wizard

The SESoft Wizard guides the user through the basic configuration of the Commander SE. Specify the power supply and motor details in pages 1 and 2 of the Wizard. For the "Speed Input References" screen (page 3), follow the instructions below:

- Set the Speed Input to "**Fieldbus**".
- Set the Fieldbus Type to **"PROFIBUS-DP"**.
- Specify the Node Address for the Commander SE. (Not required for the SE74-INTERBUS module.)
- Specify the Data Rate to be used. (Not required for SE73-Profibus-DP or SE74-INTERBUS modules.)

Complete the remainder of the Wizard, and click **DOWNLOAD** to download the configuration to the Commander SE. When complete, click **FINISH** to exit the Wizard.

The Wizard will download all appropriate information to the Commander SE, configure it to use the digital speed reference #1.21, change the communications mode to "FbuS", and save all parameters in the Commander SE.

- Power down the Commander SE.
- Plug the SE73-PROFIBUS-DP card into the Commander SE.
- Power up the Commander SE.

The SE73-PROFIBUS-DP module is now ready to communicate with the PROFIBUS-DP master controller.

4.2 Basic Communications Quick Start

The SE73-PROFIBUS-DP module can also be configured to establish basic PROFIBUS-DP communications from the Commander SE keypad and display.

- Connect the SE73-PROFIBUS-DP to the Commander SE.
- Power up the Commander SE, and ensure that #0.10 is set to "L2".
- Set the Communications Mode (#0.41) to "FbuS".
- Set the Node Address (#0.45) as required and press the M key.
- Power down the Commander SE.

NOTE "FbuS" mode must be selected to allow keypad access to #0.45, #0.46 and #0.47.

When the SE73-PROFIBUS-DP module is next powered up, it will read the updated configuration parameters from the Commander SE, and configure itself accordingly. The data format is auto-detected when the master controller initialises the network.

Table 4.1 Basic Quick Start Parameters

Function	Parameter	Recommended Setting
Communications Mode	#0.41	"FbuS"
Node Address	#0.45	1 to 125
Data Rate	#0.46 (RO)	The data rate is automatically detected on PROFIBUS-DP networks, and displayed in #0.46
Network Status	#0.47 (RO)	Indicates the current status of the PROFIBUS-DP network

4.3   Commander SE Communications Mode

Name	Commander SE Communications Mode		
Slot 1	#0.41	Default	ANSI (0)
Access	RW	Range	ANSI (0), RTU (1), FBUS (2)

The Commander SE has several communications mode that can be selected by #0.41. When a SE73-PROFIBUS-DP module is connected to the Commander SE, it will automatically change the communications mode to "FbuS". This change will take effect immediately without any need to store the parameters or reset the Commander SE.

4.4   SE73-PROFIBUS-DP Node Address

Name	SE73-PROFIBUS-DP Node Address		
Param	#0.45	Default	0
Access	RW	Range	0 to 125

Every node on a PROFIBUS-DP network must be given a unique node address. If 2 or more nodes are assigned the same address, they may prevent the network from operating. The valid range of addresses is from 1 and 125.

If an invalid node address is set in #0.45, the SE73-PROFIBUS-DP module will reject the configured address, default to 125, and update #0.45 with the address that is actually being used. If the configured node address in #0.45 is 0, the stored node address in the PROFIBUS-DP module will be used. If this is also 0, the SE73-PROFIBUS-DP module will be disabled until a valid node address is set.

NOTE Changes to #0.PP parameters in the Commander SE are automatically stored when the MODE button is pressed after the value has been set.

4.5 SE73-PROFIBUS-DP Data Rate

Name	SE73-PROFIBUS-DP Data Rate		
Param	#0.46	Default	N/A
Access	RO	Range	0 to 9

The SE73-PROFIBUS-DP module automatically detects the network data rate, and displays the data rate in #0.46. The data rates supported by the SE73-PROFIBUS-DP module are listed in Table 4.2.

Table 4.2 SE73-PROFIBUS-DP Supported Data Rates

#0.46	bits/s	#0.46	bits/s
0	12.0M	5	187.5K
1	6.0M	6	93.75K
2	3.0M	7	Reserved
3	1.5M	8	19.2K
4	500K	9	9.6K

4.6 SE73-PROFIBUS-DP Data Format

The SE73-PROFIBUS-DP module automatically detects the required data format when the master controller initialises the network. Data consistency is optional, and is also detected during network initialisation.

3 Cyclic Words with CT Mode 1 non-cyclic data (with or without consistency) is the same data format as used on Unidrive and Mentor II. Each cyclic data word is mapped to a Commander SE parameter with default mappings as shown in the table below..

Table 4.3 SE73-PROFIBUS-DP Default Data Mappings

Cyclic Channel	Default Mapping Status
IN Word 0	Reserved for non-cyclic PCP communications
IN Word 1	Status word
IN Word 2	Post-ramp speed reference
IN Word 3	Motor load current as % of rated load current
OUT Word 0	Reserved for non-cyclic PCP communications
OUT Word 1	Control word
OUT Word 2	Digital speed reference 1
OUT Word 3	Not mapped

Other data formats are also supported. See section 5.2 for details.

4.7   PROFIBUS-DP Network Status

Name	PROFIBUS-DP Netowrk Status		
Param	#0.47	Default	N/A
Access	RO	Range	-2 to 999

The status of the SE73-PROFIBUS-DP module and PROFIBUS-DP network is displayed in #0.47, and can be viewed on the display on the Commander SE.

Table 4.4 PROFIBUS-DP Network Status

#0.47	Status	Description
>0	Network healthy	Indicates the number of network cycles per second, and the slave is exchanging data with the master controller.
0	Network healthy, no data transfer	Indicates that the master controller has established communications with the node, but data transfer has not yet started.
-1	No network master	Indicates that the PROFIBUS-DP interface has initialised correctly, and is waiting for the master controller to initialise communications
-2	Internal failure	Indicates that part of PROFIBUS-DP interface initialisation test was not successful. Replace the module if this error persists.

4.8   Network Loss Trip

4.8.1   Loss of PROFIBUS-DP Network

If the PROFIBUS-DP network stops operating, the SE73-PROFIBUS-DP module will trip the Commander SE on "t60". The default time delay between network loss and Commander SE trip is 200ms, so the actual delay trip time will be between 200 and 400ms. (See section 10.1 for more details.) The master controller will automatically detect that the slave node is no longer communicating on the network, and will update its own internal status registers. Refer to the master controller documentation for details.

4.8.2   Loss of RS485 "FbuS" Link

The Commander SE has a serial communications watchdog that must be updated at least once every second. The SE73-PROFIBUS-DP module ensures that the watchdog is updated regularly while the RS485 link is healthy. If the RS485 link is broken, the watchdog in the Commander SE will not get updated, and the Commander SE will trip "SCL".

If the SE73-PROFIBUS-DP module remains powered up, it will continue to communicate with the PROFIBUS-DP master controller. The loss of the RS485 link to the Commander SE is indicated by bit 15 of the status word being set to 1. (All other bits in the status word are reset to 0 in this state.) Bit 15 is reset to 0 when the RS485 link is re-established.

NOTE   If bit 15 of the status word is set to 1, the remaining IN polled data words will continue to hold the last values read from the Commander SE. Bit 15 is an important check for the validity of the IN data.

More more details about the status word, refer to section 6.2.

4.9 Restore SE73-PROFIBUS-DP Default Values

Name	Restore Default Values		
Ref	#15.30	Default	0
Access	RW	Range	0 or 1

Default SE73-PROFIBUS-DP values can be restored using either SESoft or the Universal Keypad. This resets ALL SE73-PROFIBUS-DP configuration parameters (including node address) back to the factory default values.

Table 4.5 Restore Defaults

#15.30	Status
0	No action
1	Restore default settings

NOTE   To restore communications to the node, the node address (#0.45) must be set to the required value, and the Commander SE powered down. Communications will be re-established (with default settings) when power is re-applied to the Commander SE. (This does not apply to the INTERBUS module.)

The +24V bac-up power supply should be switched off or switched while default parameters are restored.

4.9.1 SESoft

- Power down the Commander SE and disconnect the SE73-PROFIBUS-DP module.
- Connect the SESoft communications lead, and power up the Commander SE.
- In SESoft, go to **MENU 15**, and click **LOAD DEFAULTS**.
- Power down the Commander SE and re-connect the SE73-PROFIBUS-DP module.
- Re-apply power to the Commander SE.
- The SE73-PROFIBUS-DP module will overwrite all #15.PP parameters with their default values. The default values will take effect immediately.

4.9.2 Universal Keypad

- Set #15.30 to 1.
- Store the Commander SE parameters from the Universal Keypad by setting #MM.00 to 1000, and pressing the red **RESET** button.
- Power down the Commander SE, and re-connect the SE73-PROFIBUS-DP module.
- The SE73-PROFIBUS-DP module will overwrite all #15.PP parameters with their default values. The default values will take effect immediately.

4.10   Restore Previous SE73-PROFIBUS-DP Configuration

The SE73-PROFIBUS-DP module stores the last set of configuration parameters in its own FLASH memory. These values can be restored to the Commander SE using SESoft or the Universal Keypad.

NOTE A brand new Commander SE will have #15.01 set to 0 by default. When a previously confiured SE73-PROFIBUS-DP module is connected, it will detect that #15.01 is set to 0, and will automatically revert to the configuration values stored in its internal FLASH memory.

4.10.1 SESoft

- Go to the Menu 15 Screen
- Set the Fieldbus Type to "**None**" and click on the **PROGRAM** button. SESoft will set #15.01 to 0 and store all parameters.
- Power down the Commander SE, and re-connect the SE73-PROFIBUS-DP module.
- Re-apply power to the Commander SE.
- The SE73-PROFIBUS-DP module will detect that #15.01 is 0, and download the previously stored values (including the node address) to all #15.PP parameters. The stored values will take effect immediately.

4.10.2 Universal Keypad

- Set #15.01 to 0.
- Store the Commander SE parameters from the Universal Keypad by setting #MM.00 to 1000, and pressing **RESET**.
- Power down the Commander SE, and re-connect the SE73-PROFIBUS-DP module.
- Re-apply power to the Commander SE.
- The SE73-PROFIBUS-DP module will detect that #15.01 is 0, and download the previously stored values (including the node address) to all #15.PP parameters. The stored values will take effect immediately.

NOTE Universal Keypads must have V1.04.00 or later fitted to allow access to #15.01.

5   Cyclic Data

"OUT data" and "IN data" describe the direction of data transfer as seen by the PROFIBUS-DP network master controller.

5.1   What is Cyclic Data?

Cyclic data is a method of data transfer that must be set-up during network configuration, but is transmitted automatically once configuration is complete. The high-speed data transfer is achieved by transmitting only a 16-bit data value for each cyclic channel over the PROFIBUS-DP network, and relying on local mapping information within the SE73-PROFIBUS-DP to ensure the correct data is sent to the correct locations. This method relies on the master controller program writing and reading data values to and from the registers allocated to the node during network configuration, and the source and destination of IN and OUT data being set-up correctly in the SE73-PROFIBUS-DP module itself.

The flexibility of the SE73-PROFIBUS-DP module means that each cyclic data OUT channel can be directed to any read-write Commander SE parameter. Similarly, each cyclic data IN channel can use any Commander SE parameter as a source of data.

The cyclic data mappings cannot be changed dynamically, as changes to the mapping parameters will only take effect during initialisation of the SE73-PROFIBUS-DP module, i.e. at power up.

5.2   SE73-PROFIBUS-DP Data Formats

Name	SE73-PROFIBUS-DP Data Format		
Param	#15.05	Default	N/A
Access	RO	Range	0.02 to 1.03

The SE73-PROFIBUS-DP module will auto-detect the data format required during network initialisation, and indicate the data format being used in #15.05. All data formats can be set to have full data consistency or no data consistency.

Table 5.1 SE73-PROFIBUS-DP Data Formats

Format (#15.05)	Non-cyclic data mode	Cyclic Words	Consistency	Comment
0.02	0	2	Full	PPO3
0.02	0	2	None	
0.03	0	3	Full	
0.03	0	3	None	
1.03	1	3	Full	These modes are the formats used by the Unidrive and Mentor II PROFIBUS-DP modules
1.03	1	3	None	

To implement a change in the data format, the SE73-PROFIBUS-DP module must be powered down. If a back-up power supply is connected, this must also be removed to allow changes to take effect.

The mapping for the cyclic data channels on the SE73-PROFIBUS-DP module can be changed using either SESoft or a Universal Keypad. The mapping method is similar to the method used in Commander SE for mapping analogue inputs and outputs. The value entered in the mapping parameter takes the form MMPP, where MM = menu number of the target parameter and PP = parameter number of the target parameter.

NOTE If a mapping parameter is set to an invalid value, e.g. destination parameter is read only, or parameter does not exist, the Commander SE will reset the mapping parameter (#15.PP) to 0.

If a cyclic data channel is not required, setting the mapping value to 0 will disable it. The data word will still be transmitted over the network to the SE73-PROFIBUS-DP module, but no data value will be written to any Commander SE parameter. This helps to improve the update time of all parameters by reducing the number of messages that must be transmitted over the RS485 link to the Commander SE.

NOTE The cyclic data channels do not use decimal points. For example, the digital speed reference 1 (#1.21) has units of Hertz, accurate to 1 decimal place. To write a value of 24.6Hz to #1.21, the value must be transmitted as 246.

5.2.1 2 Cyclic Words Only

This data format provides two 16-bit cyclic data words with no non-cyclic data. To select this data format, choose "`Cyc=2W, NCyc=None, full cons`" for full data consistency, or "`Cyc=2W, NCyc=None`" for no data consistency.

Table 5.2 Mapping for 2 Cyclic Data Words

Data Word	Mapping Parameter	Default Mapping Status
IN Word 0	----	Status word
IN Word 1	#15.11	#2.01, post-ramp speed reference
OUT Word 0	----	Control word
OUT Word 1	#15.21	#1.21, digital speed reference 1

5.2.2 3 Cyclic Words Only

This data format provides three 16-bit cyclic data words with no non-cyclic data. To select this data format, choose "`Cyc=3W, NCyc=None, full cons`" for full data consistency, or "`Cyc=3W, NCyc=None`" for no data consistency.

Table 5.3 Mapping for 3 Cyclic Data Words

Data Word	Mapping Parameter	Default Mapping Status
IN Word 0	----	Status word
IN Word 1	#15.11	#2.01, post-ramp speed reference
IN Word 2	#15.12	#4.20, motor load as % of rated motor load
OUT Word 0	----	Control word
OUT Word 1	#15.21	#1.21, digital speed reference 1
OUT Word 2	#15.22	Not mapped

5.2.3   3 Cyclic Words with CT Mode (Mode 1) Non-Cyclic Data

This data format provides three 16-bit cyclic data words with CT Mode non-cyclic data. (See Chapter 7.) To select this data format, choose "`Cyc=3W, NCyc=Mode 1, full cons`" for full data consistency, or "`Cyc=3W, NCyc=Mode 1`" for no data consistency.

Table 5.4 Mapping for 3 Cyclic Data Words with CT Single Word Non Cyclic Data

Data Word	Mapping Parameter	Default Mapping Status
IN Word 0	----	Reserved for PCP communications
IN Word 1	----	Status word
IN Word 2	#15.11	#2.01, post-ramp speed reference
IN Word 3	#15.12	#4.20, motor load as % of rated motor load
OUT Word 0	----	Reserved for PCP communications
OUT Word 1	----	Control word
OUT Word 2	#15.21	#1.21, digital speed reference 1
OUT Word 3	#15.22	Not mapped

5.3   Mapping Conflicts

When the mapping parameters for the SE73-PROFIBUS-DP cyclic 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 Commander SE. The SE73-PROFIBUS-DP module will not indicate if there is a conflict of mapping parameters. This only applies to analogue and digital inputs, and OUT data on the PROFIBUS-DP network.

If a numerical 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 PROFIBUS-DP 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 an occasional glitch in the displayed value may be seen. In reality, this value may be changing continuously, leading to unusual behaviour from the Commander SE.

Table 5.5 Commander SE Destination Parameters

Function	Mapping Parameter	Function	Mapping Parameter
Analogue Input 1	#7.10	Logic Output 1	#9.10
Analogue Input 2	#7.14	Motorised Pot Output	#9.25
Digital Input 1	#8.21	Comparator 1 Output	#12.07
Digital Input 2	#8.22	Source Select Output	#12.11
Digital Input 3	#8.23	PID Output	#14.16
Digital Input 4	#8.24	Cyclic OUT Word 2	#15.21
Digital Input 5	#8.25	Cyclic OUT Word 3	#15.22
Digital Input 6	#8.26		

The Linking Screen in SESoft displays all mapping parameters within the Commander SE, allowing the user to easily check that there are no mapping conflicts.

5.4 Storing SE73-PROFIBUS-DP Parameters

Menu 15 parameters are stored in the Commander SE and the SE73-PROFIBUS-DP module. If the Commander SE has previously stored SE73-PROFIBUS-DP settings, these will always be used by the SE73-PROFIBUS-DP module. All #15.PP parameters will be read and stored automatically in FLASH memory on the SE73-PROFIBUS-DP module.

NOTE If the stored values in the Commander SE are for a different type of fieldbus module, the SE73-PROFIBUS-DP module will download its stored values to the Commander SE, and configure itself using those values.

5.4.1 Commander SE

Menu 0 parameters are automatically stored when they are edited using the keypad on the Commander SE. All other parameters can be stored using SESoft by selecting **TOOLS** and **SAVE PARAMETERS IN DRIVE**.

If a Universal Keypad is being used, set #MM.00 to 1000 and press the red **RESET** button to store all Commander SE parameters.

5.4.2 SE73-PROFIBUS-DP Module

When the SE73-PROFIBUS-DP module establishes the "FbuS" communications link, it checks the value in #15.01.

1. If this is set to 1, it uploads all menu 15 parameters from the Commander SE and stores them in the FLASH memory.
2. If #15.01 is not set to 1 and #15.30 is set to 0, the previous set of values stored in the FLASH memory are downloaded to theCommander SE.
3. If #15.01 is not set to 1, and #15.30 is set to 1, default values are downloaded to the Commander SE, and these values are stored in the FLASH memory.

5.5 Disabling Data Channels

If any data words are not being used in an application, the mapping parameter should be set to 0. Although the data word will still be transmitted over the PROFIBUS-DP network, no corresponding message will be generated to read or write a parameter over the "FbuS" RS485 link to the Commander SE. This reduces the number of "FbuS" messages required to complete a single data cycle, and improves the efficiency of data transfer over the RS485 link, allowing each parameter to be updated more frequently.

6 Control and Status Words

6.1 SE73-PROFIBUS-DP Control Word

Name	SE73-PROFIBUS-DP Control Word		
Param	#90.12	Default	0
Access	WO	Range	0 to 255

The SE73-PROFIBUS-DP control word allows digital control of the Commander SE to be implemented using a single data word. Each bit in the SE73-PROFIBUS-DP control word has a particular function, and provides a method of controlling the output functions of the Commander SE (RUN FWD, JOG, TRIP, etc.) with a single data word.

b15	b14	b13	b12b	b11	b10	b9	b8
Reserved							

b7	b6	b5	b4	b3	b2	b1	b0
TRIP	RESET	DIG REF	FBUS CTRL	RUN REV	JOG	RUN FWD	ENABLE

To enable fieldbus control of the Commander SE, set the FBUS CTRL bit to 1. The 0-1 transition of the FBUS CTRL bit will cause the SE73-PROFIBUS-DP module to set #6.43 to 1 in the Commander SE, and enable fieldbus control of the Commander SE. When the FBUS CTRL bit is reset to 0, the SE73-PROFIBUS-DP module will reset #6.43 to 0, thus putting the Commander SE back into terminal control mode.

NOTE For safety reasons, the HARDWARE ENABLE signal (terminal 9) must be present (connected to +24V, terminal 7) before the SE73-PROFIBUS-DP control word can be used to start the Commander SE. This signal is usually linked to the external Emergency Stop circuit to ensure that the Commander SE is disabled in an emergency situation.

The DIG REF bit allows the source of the speed reference to be changed via the fieldbus. The 0-1 transition of the DIG REF will cause the SE73-PROFIBUS-DP module to set #1.14 to 3, selecting digital speed reference as the source of the speed reference. (By default, this will Digital Speed Reference 1, #1.21.) When the DIG REF bit is reset to 0, the SE73-PROFIBUS-DP module will set #1.14 to 1, selecting the analogue input as the source of the speed reference. (The actual digital speed reference selected will depend on the setting of the Digital Speed Reference Selector, #1.15)

A full description of each bit in the control word is given in the table below.

Table 6.1 SE73-PROFIBUS-DP Control Word

Bit	Function	Description
0	ENABLE	Must be set to 1 to put the Commander SE in READY mode. Resetting to 0 will immediately disable the Commander SE, and the motor will coast to stop. The external HARDWARE ENABLE signal (terminal 9) must also be present before the Commander SE can be enabled and run.
1	RUN FWD	Set to 1 (with ENABLE set to 1) to run the motor in the forward direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
2	JOG	Set to 1 with RUN FWD or RUN REV bit also set to one to jog the motor in the appropriate direction. The Commander SE will ramp the motor to the normal speed reference if the bit is reset to 0

Table 6.1 SE73-PROFIBUS-DP Control Word

Bit	Function	Description
3	RUN REV	Set to 1 (with ENABLE set to 1) to run the motor in the reverse direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
4	FBUS CTRL	A 0-1 transition of this bit will set #6.43 to 1 to enable fieldbus control of the Commander SE. #6.43 can subsequently be over-written by a digital input if a terminal or fieldbus control selector switch is required. A 1-0 transition will reset #6.43 to 0, setting the Commander SE back into terminal control.)
5	DIG REF	A 0-1 transition of this bit will set #1.14 to 3 to select digital speed reference control. #1.14 can subsequently be over-written by a digital input controlling #1.42 if an analogue/digital reference select switch is required. A 1-0 transition will reset #1.14 to 1 to select analogue reference control.
6	RESET	A 0-1 transition will reset the Commander SE from a trip condition. If the cause of the trip has not been cleared, the Commander SE will trip again immediately
7	TRIP	A 0-1 transition will force a "t52" trip on the Commander SE. If the RESET and TRIP bits change from 0 to 1 on the same cycle, the TRIP bit will take priority
8-15	Reserved	

When a trip occurs, the Commander SE will automatically reset the control word (#6.42) to 0. This ensures that, for safety reasons, the Commander SE is in a safe, disabled state and cannot re-start immediately when it is reset.

However, the control word in the SE73-PROFIBUS-DP module is not affected by a Commander SE trip. As the SE73-PROFIBUS-DP module will only update the Commander SE control word (#6.42) when it sees a change in the SE73-PROFIBUS-DP control word, if the Commander SE control word is not updated. Hence. the Commander SE will not automatically restart when full communications is re-established. A change to the SE73-PROFIBUS-DP control word is required before the Commander SE will restart.

For this reason, it is necessary (and good safety practice!!) for the master controller program to monitor the status word, and reset the SE73-PROFIBUS-DP control word to a safe state if any Commander SE trip, SE73-PROFIBUS-DP fault or RS485 "FbuS" link loss error is detected. When both PROFIBUS-DP and "FbuS" communications links are healthy again, and it is safe to re-start the Commander SE, the appropriate SE73-PROFIBUS-DP control word can be set, a change of SE73-PROFIBUS-DP control word is detected, the SE73-PROFIBUS-DP module will update the Commander SE control word (#6.42) and the Commander SE will restart.

Some example SE73-PROFIBUS-DP control words are shown in the table below..

Table 6.2 Example SE73-PROFIBUS-DP Control Words

Control Word (Hex)	Control Word (Dec)	Action
0x0000	0	Control word disabled, Commander SE will run under terminal control
0x0010	16	Disabled
0x0011	17	Enabled, stopped
0x0033	51	Enabled, run fwd, digital speed ref
0x0039	57	Enabled, run rev, digital speed ref
0x0013	19	Enabled, run fwd, analogue speed ref
0x0019	25	Enabled, run rev, analogue speed ref
0x0017	23	Enabled, jog fwd

Table 6.2 Example SE73-PROFIBUS-DP Control Words

Control Word (Hex)	Control Word (Dec)	Action
0x001D	29	Enabled, jog rev
0x0080	128	Trip Commander SE
0x0070	112	Reset Commander SE into fieldbus control
0x0040	64	Reset Commander SE into terminal control

6.2   SE73-PROFIBUS-DP Status Word

Name	SE73-PROFIBUS-DP Status Word		
Param	#90.12	Default	0
Access	RO	Range	0x0 to 0xFFFF

The status word returns the status of multiple functions within the Commander SE, e.g. At Speed, Zero Speed, Drive Healthy, etc., and provides a quick method of checking the current operating status of the Commander SE. The status word is mapped to cyclic data as #90.12.

b15	b14	b13	b12b	b11	b10	b9	b8
FBUS LOSS	#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

Bit 15 will be set to 1 (with all other bits reset to 0) if the "FbuS" communications link between the SE73-PROFIBUS-DP module and the Commander SE is lost.

NOTE	Bit 15 of the status word effectively indicates that the master controller does not have control of the Commander SE. Under this condition, it is the User's responsibility to ensure that the master controller takes appropriate action to ensure system safety is maintained, in all respects.

Table 6.3 shows the function indicated by each bit in the status word when set to 1. A bit set to 0 indicates that the condition is false

Table 6.3 SE73-PROFIBUS-DP Status Word

Bit	Parameter	Description
0	#10.01	Drive Healthy
1	#10.02	Drive Running
2	#10.03	Zero Speed
3	#10.04	Running At Or Below Minimum Speed
4	#10.05	Below Set Speed
5	#10.06	At Speed
6	#10.07	Above Set Speed
7	#10.08	Load Reached
8	#10.09	In Current Limit
9	#10.10	Regenerating
10	#10.11	Dynamic Brake Active
11	#10.12	Dynamic Brake Alarm

Table 6.3 SE73-PROFIBUS-DP Status Word

Bit	Parameter	Description
12	#10.13	Direction Commanded
13	#10.14	Direction Running
14	#10.15	Mains Loss
15	FBUS LOSS	"FbuS" Communications Link lost

6.3   Selecting Control Source Externally

A selector switch can be used to select whether the RUN FWD, JOG, RUN REV functions are controlled externally by the digital inputs, or remotely PROFIBUS-DP master. This allows a machine to be run in a "manual" mode temporarily, e.g. while feeding new material though a machine, and switched to "automatic" mode, running under PLC control once material loading has been completed.

Another switch can also be used to select the source of the speed reference for the Commander SE. This may allow the speed of the machine to be controlled manually while new material fed through at a slow speed, and switched to automatic PLC control once material is flowing freely.

6.3.1   FBUS CTRL

When a 0-1 transition of the FBUS CTRL bit in the PROFIBUS-DP control word occurs, the SE73-PROFIBUS-DP module will set #6.43 to 1. This will disable terminal control of the Commander SE, and allow the fieldbus to control the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE. Similarly, when FBUS CTRL is reset to 0, the SE73-PROFIBUS-DP module will set #6.43 to 0 to enable terminal control again.

If a digital input is configured to directly control #6.43 in the Commander SE, the value written to #6.43 by the SE73-PROFIBUS-DP module will be immediately overwritten by the digital input. This allows the source of the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE to be selected externally.

NOTE   Use SESoft or the Universal Keypad to configure a spare digital input to control #6.43.

6.3.2   DIG REF

When a 0-1 transition of the DIG REF bit in the PROFIBUS-DP control word occurs, the SE73-PROFIBUS-DP module will set #1.14 to 3. This will select the digital speed references as the source of the Commander SE speed reference. When DIG REF is reset to 0, the SE73-PROFIBUS-DP module will set #1.14 to 1 to re-select the analogue reference as the source of the speed reference.

If a digital input is configured to directly control #6.43 in the Commander SE, the value written to #6.43 by the SE73-PROFIBUS-DP module will be immediately overwritten by the digital input. This allows the source of the ENABLE, RUN FWD, JOG and RUN REV functions of the Commander SE to be selected externally.

NOTE   #1.14 cannot be controlled directly by a digital input, but #1.42 can be used to select digital speed reference externally. Use SESoft or the Universal Keypad to configure a spare digital input to control #1.42.

Refer to the Commander SE User Guide for details on how to configure digital inputs.

7 Non-Cyclic Data

The non-cyclic data channel provides a method for the master controller to read from or write to any parameter within the Commander SE. This channel can be used for single infrequent data transfers, or uploading and downloading parameter sets to or from a particular node.

Non-cyclic data access to Commander SE parameters is controlled entirely by the master controller program, and is not configured in any way when the PROFIBUS-DP network map is defined.

The SE PROFIBUS-DP module currently provides one format for non-cyclic data, plus the option to disable non-cyclic data.

Table 7.1 SE73-PROFIBUS-DP Non-Cyclic Data Modes

Non-Cyclic Mode	Data Format (#15.05)	Description
Disabled	0.xx	Non-cyclic data disabled
Mode 1	1.xx	CT Single Word Format, as used in Unidrive and Mentor II. Word 0 is reserved and used for non-cyclic data transfers

The actual configuration for the non-cyclic data format is selected when the network master controller is configured. The GSD file will offer all supported data formats, and the user must select the option that offers the correct number of non-cyclic data words and the desired non-cyclic data format. #15.05 will not be updated in the Commander SE until the SE73-PROFIBUS-DP module has been plugged in and the PROFIBUS-DP master controller has initialised the node.

NOTE: The non-cyclic data channel does not use decimal points. For example, the digital speed reference 1 (#1.21) has units of Hertz, accurate to 1 decimal place. To write a value of 24.6Hz to #1.21, the value must be transmitted as 246.

7.1 CT Single Word Mode (Mode 1)

The CT Single Word Format (Mode 1) of non-cyclic data uses one word for non-cyclic data. The non-cyclic sub-protocol requires a specific sequence of 4 words or "telegrams" to implement the parameter access. Each non-cyclic word or telegram is split into 2 bytes to implement the sub-protocol, with the high byte containing the control codes for each telegram, and the low byte containing the data for each telegram.

b15	b14	b13	b12	b11	b10	b9	b8
READ	ERROR	Reserved		Stamp Number			

b7	b6	b5	b4	b3	b2	b1	b0
Data Byte							

Table 7.2 CT Single Word Control

Bit	Function	Values	Description
0 to 7	Data	0 to 255	Depending on the stamp number of the telegram, this byte contains the menu or parameter number, or high data or low data byte
8 to 11	Stamp number	0 to 4	Indicates the stamp number of the word. This shows which part of the message is currently in progress. Setting the stamp number to 0 resets the internal non-cyclic state machine
12, 13	Not Used	0	These should be set to 0
14	ERROR	0 = Data OK 1 = Error	Indicates the success or failure of the message. Failure could occur if the parameter does not exist, or is a read-only or write-only parameter
15	READ	0 = Write 1 = Read	SPecifies a READ message when set to 1, and a WRITE message when set to 0

NOTE X = don't care. Generally, these bits should be set to 0. If a message is aborted part way through, the non-cyclic OUT word should be reset to 0. This will reset the non-cyclic state machine, and allow the message sequence to be restarted.

7.1.1   Reading parameters using Mode 1

To read parameters using the non-cyclic channel, the following "telegrams" must be transmitted to construct the final message.

- •   Telegram 1 Define menu number.
- •   Telegram 2 Define parameter number.
- •   Telegram 3 Request high data byte.
- •   Telegram 4 Request low data byte.

Figure 7-1 CT Single Word Read Sequence
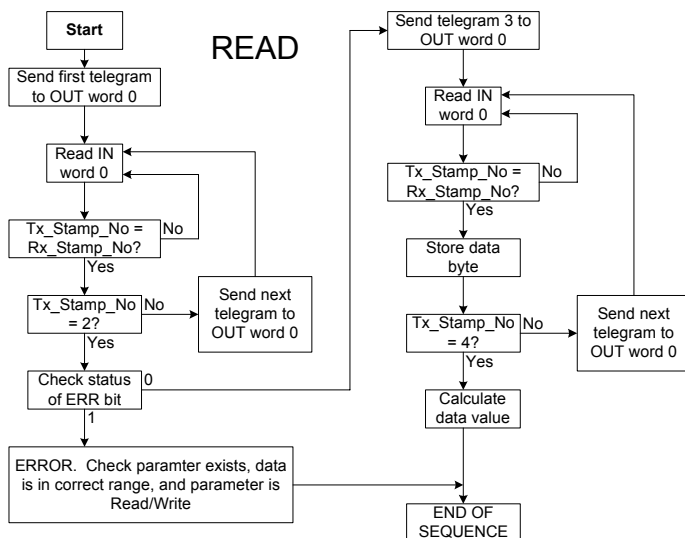
The following example telegrams show how to read the post-ramp frequency reference (in Hz) from #2.01 in the Commander SE.

TELEGRAM 1

The first telegram from the PROFIBUS-DP master indicates a READ cycle, and the stamp number is 1. The data byte would contain the menu number for the parameter that is to be read.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0001	0000	0010

Data word = 0x8102

Stamp number = 1

Menu = 2

When the first telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word back to the PLC. This is the signal to the master controller program that the first telegram of the message has been received and understood, and the second telegram can be transmitted.

TELEGRAM 2

The second telegram from the PROFIBUS-DP master also indicates a READ cycle, but the stamp number is now 2. The data byte would contain the parameter number for the parameter that is to read.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0010	0000	0001

Data word = 0x8201

Stamp number = 2

Parameter = 1

When the second telegram has been received and processed in the slave, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the second telegram of the message has been received and understood, and the third telegram can be transmitted.

If telegrams 1 and 2 were not received correctly, or an invalid parameter was specified, e.g. parameter is write only, or does not exist, the PROFIBUS-DP interface will set the ERROR bit to 1 (b14 = 1). The data bits will have no significance.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1100	0010	XXXX	XXXX

Data word = 0xC2XX

Stamp number = 2

If an error is reported, it is recommended that the non-cyclic data word is set to 0 to ensure that the non-cyclic state machine is completely reset, and ready for the next non-cyclic READ or WRITE sequence.

TELEGRAM 3

The third telegram from the PROFIBUS-DP master acts as the indication to the slave to send the high data byte from the requested parameter. The data byte is not used in this telegram, and should be set to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0010	0000	0000

Data word = 0x8300

Stamp number = 3

When the third telegram has been received and processed in the slave node, the node will mirror the stamp number in the non-cyclic IN word, and load the high byte of the parameter value into the data byte.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0011	0000	0101

Data word = 0x8305

Stamp number = 3

Data high byte = 5

TELEGRAM 4

The fourth telegram from the PROFIBUS-DP master acts as the indication to the slave to send the high data byte from the requested parameter. The data byte is not used in this telegram and should be set to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0100	0000	0000

Data word = 0x8400

Stamp number = 4

When the fourth telegram has been received and processed in the slave node, the node will mirror the stamp number in the non-cyclic IN word, and load the low byte of the parameter value into the data byte.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	1000	0100	1101	1100

Data word = 0x84DC

Stamp number = 4

Data low byte = 220

Speed feedback = (Data high byte * 256) + Data low byte

$$= (5 * 256) + 220$$

$$= 1500$$

$$= 150.0 \text{ Hz}$$

7.1.2 Writing parameters using Mode 1

To write to parameters using the non-cyclic channel, the following telegrams must be sent on each network cycle to construct the final message.

- Telegram 1 Define menu number.
- Telegram 2 Define parameter number.
- Telegram 3 Send high data byte.
- Telegram 4 Send low data byte.

Figure 7-2 CT Single Word Read Sequence
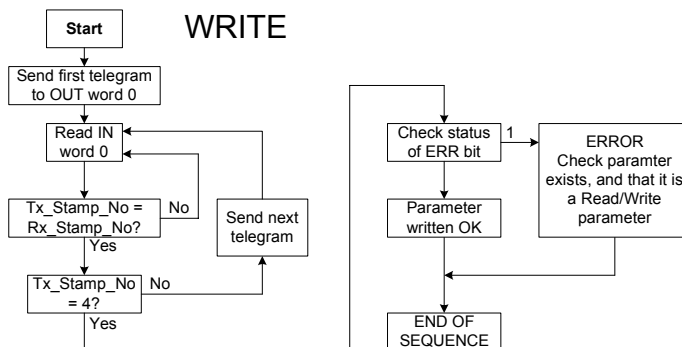
The following example telegrams show how to set the digital speed reference 1 (#1.21) to 40.0Hz (400) in the Commander SE.

TELEGRAM 1

The first telegram from the PROFIBUS-DP master indicates a WRITE cycle by setting the R/W bit to 0. The stamp number is set to 1. The data byte contains the menu number for the parameter that is to be written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0001	0000	0001

Data word = 0x0101

Stamp number = 1

Menu = 1

When the first telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the first telegram of the message has been received and understood, and the second telegram can be transmitted.

TELEGRAM 2

The second telegram from the PROFIBUS-DP master also indicates a Write cycle, but the stamp number is now set to 2. The data byte would contain the parameter number for the parameter that is to be written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0010	0001	0101

Data word = 0x0215

Stamp number = 2

Parameter = 21

When the second telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the second telegram of the message has been received and understood, and the third telegram can be transmitted.

TELEGRAM 3

The third telegram from the PROFIBUS-DP master has the stamp number set to 3. The data bits contain the high data byte for the parameter being written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0011	0000	0001

Data word = 0x0301

Stamp number = 3

Data high byte = 1

When the third telegram has been received and processed in the slave node, it is mirrored in the non-cyclic IN word. This is the signal to the master controller program that the third telegram of the message has been received and understood, and the fourth telegram can be transmitted.

TELEGRAM 4

The fourth telegram from the PROFIBUS-DP master has the stamp number set to 4. The data bits contain the low data byte for the parameter that is being written to.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0100	1001	0000

Data word = 0x0490

Stamp number = 4

Data low byte = 144

When the fourth telegram has been received and processed in the slave node, it will write the data (#1.21 = 40.0) as transmitted. (The decimal point is automatically inserted iwhen the data is transferred to the Commander SE.) If the operation is successful, the ERR bit is reset to 0 and the telegram is reflected in the non-cyclic IN word.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0100	1001	0000

Data word = 0x0490

Stamp number = 4

Data low byte = 144

If there was a problem with writing the data to the defined parameter, e.g. parameter is read only, does not exist, or data is out of range, the ERR bit is set to 1.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0100	0100	XXXX	XXXX

Data word = 0x44XX

Stamp number = 4

7.1.3 Abort Mode 1 Non-cyclic Message

The internal state machine that controls the non-cyclic data transfer will only accept a new telegram if it contains the next expected telegram, i.e. after accepting telegram 2, the state machine will only respond to telegram 3. If telegram 4 is received, it will be ignored.

If an error occurs in the master controller that causes the telegrams to get out of step, the master controller program should time-out, abort the message and reset the non-cyclic state machine.

A Mode 1 non-cyclic message can be be abandoned by resetting the state machine. This is done be setting the non-cyclic word to 0.

Bit	b15-b12	b11-b8	b7-b4	b3-b0
Value	0000	0000	0000	0000

Data word = 0x0000

Stamp number = 0

7.2 SE73-PROFIBUS-DP Set-up using Non-Cyclic Data

The SE73-PROFIBUS-DP module can also be configured via the non-cyclic data channel. Menu 15 contains the parameter values currently being used, and these can be modified as required using a non-cyclic data WRITE command.

Cyclic data mapping parameters can be edited via the non-cyclic data. Any changes made to the data mapping will take effect immediately, but changes are not stored automatically. Setting #15.31 (not available in Commander SE) to 1 will store the mapping changes in the SE73-PROFIBUS-DP module, and reset the SE73-PROFIBUS-DP module. This will cause a temporary interruption in communications with the master controller.

The parameters listed below are the parameters that can be written to configure the SE73-PROFIBUS-DP module. However, care must be taken when writing to certain parameters. For example, if the master changes the node address parameter (#15.03 or #0.45) controller, and the SE73-PROFIBUS-DP module is reset, it will appear on the PROFIBUS-DP network at the new address.

Table 7.3 SE73-PROFIBUS-DP Configuration Parameters

Parameter	Default	Description
#15.03	63	Node Address. Also displayed in menu zero #0.45
#15.04	4	Data Rate. Also displayed in #0.46
#15.05	0.03	Data Format. Indicates the number of non-cyclic and cyclic data words as X.YY, where X = non-cyclic data mode, YY = number of cyclic data words
#15.07	200	Trip Delay Time (ms). Specifies the time-out period for the PROFIBUS-DP network. If no network messages are received in this time period, the network loss trip is invoked. (See section 9.1)
#15.08	0	Endian Format Select. See section 10.2 for more details
#15.11	2.01	IN Channel 2 Mapping
#15.12	4.20	IN Channel 3 Mapping

Table 7.3 SE73-PROFIBUS-DP Configuration Parameters

Parameter	Default	Description
#15.21	1.21	OUT Channel 2 Mapping
#15.22	0	OUT Channel 3 Mapping
#15.30	0	Load Option Defaults

The parameters listed in the table below return information about the PROFIBUS-DP interface. Writing to these parameters will not affect the operation of the node.

Table 7.4 SE73-PROFIBUS-DP Status Parameters

Parameter	Description
#15.01	Option ID Code. (See section 9.1)
#15.02	Software Version Vxx.yy (See section 9.2)
#15.06	Fieldbus Diagnostic. Indicates the status of the node, also displayed in #0.47
#15.50	Software Version - zz (See section 9.2)

Other parameters are available (and stored) in the SE73-PROFIBUS-DP module, but not in the Commander SE. These can only be accessed using the PROFIBUS-DP non-cyclic data channel.

Table 7.5 SE73-PROFIBUS-DP Internal Parameters

Parameter	Default	Description
#15.10	90.12	IN Channel 1 Mapping
#15.20	90.12	OUT Channel 1 Mapping
#15.31	0	Save Option Parameters. (See section 9.2)

7.3   SE73-PROFIBUS-DP Parameter Store/Reset

Name	SE73-PROFIBUS-DP Parameter Store/Reset		
Param	#15.31	Default	0
Access	RW	Range	0 or 1

Set #15.31 to 1 to store the current configuration parameters, and reset the SE73-PROFIBUS-DP module to make the changes take effect. #15.31 is not available in the Commander SE, and can only be accessed using non-cyclic data.

7.4   Restore SE73-PROFIBUS-DP Defaults

Default values can be restored using the PROFIBUS-DP non-cyclic data channel. This resets ALL fieldbus parameters (including node address) back to the default values.

   •   Set #15.30 to 1.
   •   Set #15.31 to 1. (See section 7.3)

The SE73-PROFIBUS-DP module will restore default values (including the node address) in all #15.PP parameters, download these values to the Commander SE, and reset. The default values (including node address) will take effect immediately.

NOTE As the node address will be reset to 0, communications between the SE73-PROFIBUS-DP module and the PROFIBUS-DP master will be lost. To re-establish communications, re-enter the required node address in #0.45.

7.5   Restore Previous SE73-PROFIBUS-DP Configuration

The SE73-PROFIBUS-DP module itself stores the last set of configuration parameters that were used. These values can be restored to the Commander SE using the non-cyclic data channel.

- Set #15.01 to 0.
- Set #15.31 to 1 to store the parameters. (See section 7.3)
- The SE73-PROFIBUS-DP module will store all values and reset.

On re-initialisation, the SE73-PROFIBUS-DP module will detect that #15.01 is 0, and write it's stored values (including the node address) to all #15.PP parameters. The stored values will take effect immediately.

8 PROFIBUS-DP GSD Files

8.1 What are GSD Files?

GSD files are text files that are used with the PROFIBUS-DP network configuration software. They contain information about the device capabilities, such as supported data rates, delay timings, supported data formats, etc.

GSD files are not actually downloaded to the master controller or scanner. The information they contain is used when the network configuration file is generated, but they are necessary and are only used during network configuration. They must usually be installed into the network configuration software, or copied to a specific directory. Refer to the software documentation for instructions about installing GSD files.

Control Techniques cannot offer specific technical support on any of the software packages available for configuring PROFIBUS-DP networks or on the use and configuration of any specific PLC with PROFIBUS-DP.

NOTE A device cannot be included in the configuration for a PROFIBUS-DP network without an associated GSD file.

8.2 SE73-PROFIBUS-DP GSD File

A GSD file is available for the SE73-PROFIBUS-DP module, and can be obtained from your local Control Techniques Drive Centre, or the Profibus web site at www.profibus.com. This file contains a full description of the performance capabilities of the SE73-PROFIBUS-DP module.

Most configuration tools for PROFIBUS-DP will group slaves together, depending on what type of device they are. The Commander SE can usually be found under "**ADDITIONAL FIELD DEVICES**", sub-heading "**DRIVES**".

Table 8.1 Control Techniques' GSD Files

Drive	Filename
Commander SE	CTSE04FA.GSD
Unidrive	CTU_3345.GSD
Mentor II	CTM_3345.GSD

8.3 Data Consistency

Data consistency provides a method of ensuring that all data is updated at the same time, thus preventing any form of data skew.

Using data consistency can often put restrictions on data manipulation within the master controller, and require data bytes or words to be written in a certain order. Using data consistency can increase the master controller cycle time, so it should only be used if really necessary.

8.4 SE73-PROFIBUS-DP Data Formats

The GSD file will present the user with 6 options when it is added to a PROFIBUS-DP network. These options represent the different data formats that can be used with the SE73-PROFIBUS-DP option. For more details on each data format, refer to section 5.4.

All data formats can be set to have full data consistency or no data consistency. The first cyclic data word is always the control word.

Table 8.2 SE73-PROFIBUS-DP Data Formats

Format (#15.05)	Non-cyclic data mode	Cyclic Words	Consistency	Comment
0.02	0	2	Full	PPO3
0.02	0	2	None	
0.03	0	3	Full	
0.03	0	3	None	
1.03	1	3	Full	These modes are the formats used by the Unidrive and Mentor II PROFIBUS-DP modules
1.03	1	3	None	

When the master initialises the network, it will transmit format configuration byte to each slave. If the configuration byte matches one of the three modes above, the slave will automatically configure itself for this type of data.

If the telegram does not match any of the above data formats, the node will not be initialised and the master will indicate that there is an error on the network. The SE73-PROFIBUS-DP module (#0.47) will indicate an error status of -1.

9 Diagnostics

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

9.1 Fieldbus Module Codes

Name	Fieldbus Module ID Code		
Param	#15.01	Default	N/A
Access	RO	Range	0 to 6

The fieldbus code identifies the type of fieldbus option module last fitted to the Commander SE. 0 indicates that the Commander SE does not have any valid fieldbus module configuration parameters in #15.PP,.

Table 9.1 Fieldbus Module Codes

Fieldbus Code (#15.01)	Fieldbus Module Type
0	No module fitted
1	Profibus-DP
2	INTERBUS
3	Reserved
4	Reserved
5	DeviceNet
6	CANopen

9.2 SE73-PROFIBUS-DP Firmware Version

Name	SE73-PROFIBUS-DP Major Firmware Version		
Param	#15.02	Default	N/A
Access	RO	Range	0 to 999

Name	SE73-PROFIBUS-DP Minor Firmware Version		
Param	#15.50	Default	N/A
Access	RO	Range	0 to 99

The SE73-PROFIBUS-DP module firmware version can be read from #15.02 and #15.50 in the Commander SE. Thiese parameters shoudl always be checked before contacting Control Techniques for technical support.

Table 9.2 SE73-PROFIBUS-DP Firmware Version

Major Code (#15.02)	Minor Code (#15.50)	Firmware Version
1.01	2	V1.01.02

9.3 SE73-PROFIBUS-DP Node Address

Name	SE73-PROFIBUS-DP Node Address		
Param	#15.03	Default	N/A
Access	RW	Range	0 to 125

Every PROFIBUS-DP node must be assigned a unique node address. If two or more nodes have the same address, this will cause a conflict when the master attempts to initialise the network.

Ideally, the node address should be configured on each node BEFORE any attempt is made to connect it to the network. #15.03 can also be accessed as #0.45, allowing the node address to be modified using the keypad on the Commander SE itself.

9.4 SE73-PROFIBUS-DP Data Rate

Name	SE73-PROFIBUS-DP Data Rate		
Param	#15.04	Default	N/A
Access	RO	Range	0 to 9

The SE73-PROFIBUS-DP module automatically detects the network data rate, and displays the data rate in #15.04. The data rates supported by the SE73-PROFIBUS-DP module are listed in the table below. #15.04 can also be accessed as #0.46, allowing the data rate to be viewed on the Commander SE itself.

Table 9.3 SE73-PROFIBUS-DP Supported Data Rates

#0.46	bits/sec		#0.46	bits/sec
0	12.0M		5	187.5K
1	6.0M		6	93.75K
2	3.0M		7	Reserved
3	1.5M		8	19.2K
4	500K		9	9.6K

9.5 PROFIBUS-DP Network Status

Name	SE73-PROFIBUS-DP Network Status		
Param	#15.06	Default	N/A
Access	RO	Range	-2 to 999

The node status can be monitored in #15.06. #15.06 can also be accessed as #0.47, allowing the data rate to be viewed on the Commander SE itself. When the SE73-PROFIBUS-DP module is communicating with the PROFIBUS-DP network, the approximate number of messages per second is displayed. If cyclic data transfer is stopped by the master, but is not due to any network errors, #0.47 will show 0.

-1 indicates that the SE73-PROFIBUS-DP module has initialised correctly, but is waiting for the master to initiate communications.

- Check that the PROFIBUS-DP cables and screens have been wired correctly, and the physical connections are good.
- Ensure that the SE73-PROFIBUS-DP module is connected to the RJ-45 communications connector on the Commander SE and that the network status parameter indicates that the network is running.
- Ensure that the network has been terminated.

- Check that the node address has been set correctly and only one node on the network has that particular address.
- Check that the node has been configured correctly in the master.
- Data format selected is correct.

-2 indicates an interface initialisation failure. If this fault persists, replace the SE73-PROFIBUS-DP module.

9.6 No Data Transfer

If data is not being transferred from the master controller to the Commander SE, make the following checks:

- The mapping parameters have been programmed correctly. If an incorrect mapping was entered, it will have been reset to 0.
- Check that there are no mapping parameter conflicts, i.e. an analogue input is not trying to control the same parameter as a cyclic OUT channel. The "Linking Screen" in SESoft shows all input and output mapping parameters on a single screen for this purpose.
- Check that the Network Status (#0.47) is >0. (See section 4.7)

9.7 SE73-PROFIBUS-DP Trip Codes

If the SE73-PROFIBUS-DP detects an error, it will trip the Commander SE. The trip codes are listed in Table 9.4.

Table 9.4 SE73-PROFIBUS-DP Trip Codes

| Trip Code	Error
t52	This code indicates that the trip was caused by bit 7 in the control word being set to 1. The trip is initiated by a 0-1 transition of bit 7 in the control word. (See section 6.1)
t60	PROFIBUS-DP Network Loss. The node has not received a cyclic data message for a time period specified in #15.07. This trip can be caused by a network fault, e.g. broken wire, disconnected node, missing termination resistors, etc. "t60" may also occur if the master controller stops the network while it is being re-programmed or reset. (See section 10.1)
SCL	RS485 "FbuS" link failure. Communications between the PROFIBUS-DP interface card and the Commander SE (RJ45) port have been interrupted. (See section 4.8.2)

10   Advanced Features

10.1   PROFIBUS-DP Network Loss Trip

Name	SE73-PROFIBUS-DP Node Address		
Param	#15.07	Default	200
Access	RW	Range	0 to 2000

The SE73-PROFIBUS-DP module counts the number of valid network cycles received in a time period specified by #15.07. The trip is triggered if no messages are received in a given sample period, and messages were received in the previous sample period. The default setting for #15.07 is 200ms.

Figure 10-1 Network Loss Trip
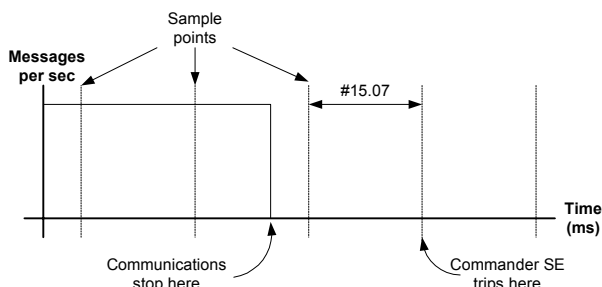
As can be seen from the diagram, the actual time from network loss to the network loss trip actually occurring will range from #15.07 ms to 2 * #15.07 ms. By decreasing #15.07, the maximum trip time will be reduced, but if the trip time is set too low, spurious network loss trips will be seen.

The actual network loss trip time depends entirely on the number of messages per second being received under normal operation. As a rough guide, the Network Loss Trip time (#15.07) should be set such that a minimum of 5 messages will be received in any given sample period under normal operating conditions.

⚠ **CAUTION**

The Network Loss trip can be disabled by setting #15.07 to 0, but the Commander SE will continue to operate using the last received values in the case of a network loss. It is the User's responsibility to ensure that adequate safety precautions are taken to prevent damage or injury in the event of a communications network loss.

The slave WATCHDOG feature must also be disabled when configuring the master controller to prevent the PROFIBUS-DP ASIC from automatically resetting the OUT data in the SE73-PROFIBUS-DP module to 0. If the slave WATCHDOG is enabled, all OUT data in the SE73-PROFIBUS-DP module will be reset to 0 when the connection with the master controller is lost. (Refer to master controller documentation for more information.)

10.2 Data Endian Format

Name	SE73-PROFIBUS-DP Data Endian Format		
Param	#15.08	Default	0
Access	RW	Range	0 or 1

The SE73-PROFIBUS-DP module uses word (16-bit) format, but the master controller must split each word into 2 bytes (high byte and low byte) for transmission over the PROFIBUS-DP network. The "endian format" defines whether the high byte or low byte is transmitted first. Provided that the master controller and slave device are using the same endian format, the data word value will be reconstructed correctly.

Table 10.1 Data Endian Byte Order

#15.08	Endian Format	Byte Order
0	Big	High byte transmitted first
1	Little	Low byte transmitted first

The Commander SE uses big endian format by default, where the high byte is transmitted first, followed by the low byte. However, some master controllers use the little endian format. This results in "byte swapping" when the data value is reconstructed at the other end of the network. For example, a value of 0x0102 (258 decimal) may be reconstructed as 0x0201. (513 decimal)

If #15.08 is set to 1, the SE73-PROFIBUS-DP module will treat all data received as little endian, and assume that the first byte received is the low byte, followed by the high byte. Refer to the master controller documentation for details of the endian format used.

11 Quick Reference

11.1 Complete Parameter Reference

Table 11.1 SE73-PROFIBUS-DP Configuration Parameters

Parameter	Default	Cross Reference	
#15.01	----	Section 9.1	Option ID Code
#15.02	----	Section 9.2	Major Software Version
#15.03	0	Section 4.4	Node Address
#15.04	----	Section 4.5	Data Rate
#15.05	----	Section 4.6	Data Format
#15.06	----	Section 9.5	Network Status
#15.07	200	Section 10.1	Netowrk Loss Trip
#15.08	0	Section 10.2	Endian Select
#15.11	2.01	Section 5.2	IN Channel 2 Mapping
#15.12	4.20		IN Channel 3 Mapping
#15.21	1.21		OUT Channel 2 Mapping
#15.22	0.00		OUT Channel 3 Mapping
#15.30	0	Section 4.9	Load Option Defaults
#15.50	----	Section 9.2	Minor Software Version (Read only)

11.2 PROFIBUS-DP Data Formats

Table 11.2 SE73-PROFIBUS-DP Data Formats

Format (#15.05)	Non-cyclic data mode	Cyclic Words	Consistency	Comment
0.02	0	2	Full	PPO3
0.02	0	2	None	
0.03	0	3	Full	
0.03	0	3	None	
1.03	1	3	Full	These modes are the formats used by the Unidrive and Mentor II PROFIBUS-DP modules
1.03	1	3	None	

11.3   PROFIBUS-DP Control Word

Table 11.3 SE73-PROFIBUS-DP Control Word

Bit	Function	Description
0	ENABLE	Must be set to 1 to put the Commander SE in READY mode. Resetting to 0 will immediately disable the Commander SE, and the motor will coast to stop. The external HARDWARE ENABLE signal (terminal 9) must also be present before the Commander SE can be enabled and run.
1	RUN FWD	Set to 1 (with ENABLE set to 1) to run the motor in the forward direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
2	JOG	Set to 1 with RUN FWD or RUN REV bit also set to one to jog the motor in the appropriate direction. The Commander SE will ramp the motor to the normal speed reference if the bit is reset to 0
3	RUN REV	Set to 1 (with ENABLE set to 1) to run the motor in the reverse direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
4	FBUS CTRL	A 0-1 transition of this bit will set #6.43 to 1 to enable fieldbus control of the Commander SE. #6.43 can subsequently be over-written by a digital input if a terminal or fieldbus control selector switch is required. A 1-0 transition will reset #6.43 to 0, setting the Commander SE back into terminal control.)
5	DIG REF	A 0-1 transition of this bit will set #1.14 to 3 to select digital speed reference control. #1.14 can subsequently be over-written by a digital input controlling #1.42 if an analogue/digital reference select switch is required. A 1-0 transition will reset #1.14 to 1 to select analogue reference control.
6	RESET	A 0-1 transition will reset the Commander SE from a trip condition. If the cause of the trip has not been cleared, the Commander SE will trip again immediately
7	TRIP	A 0-1 transition will force a "t52" trip on the Commander SE. If the RESET and TRIP bits change from 0 to 1 on the same cycle, the TRIP bit will take priority
8-15	Reserved	

11.4   PROFIBUS-DP Status Word

Table 11.4 SE73-PROFIBUS-DP Status Word

Bit	Parameter	Description
0	#10.01	Drive Healthy
1	#10.02	Drive Running
2	#10.03	Zero Speed
3	#10.04	Running At Or Below Minimum Speed
4	#10.05	Below Set Speed
5	#10.06	At Speed
6	#10.07	Above Set Speed
7	#10.08	Load Reached
8	#10.09	In Current Limit
9	#10.10	Regenerating
10	#10.11	Dynamic Brake Active
11	#10.12	Dynamic Brake Alarm
12	#10.13	Direction Commanded
13	#10.14	Direction Running
14	#10.15	Mains Loss
15	FBUS LOSS	"FbuS" Communications Link lost

11.5   SE73-PROFIBUS-DP Trip Codes

Table 11.5 SE73-PROFIBUS-DP Trip Codes

Trip Code	Error
t52	This code indicates that the trip was caused by bit 7 in the control word being set to 1. The trip is initiated by a 0-1 transition of bit 7 in the control word. (See section 5.6)
t60	PROFIBUS-DP Network Loss The node has not received a cyclic data message for a time period specified in #15.07. This trip can be caused by a network fault, e.g. broken wire, disconnected node, missing termination resistors, etc. "t60" may also occur if the master controller stops the network while it is being re-programmed or reset. (See section 9.1)
SCL	RS485 "FbuS" link failure. Communications between the PROFIBUS-DP interface card and the Commander SE (RJ45) port have been interrupted. (See section 4.8.2)