**CONTROL TECHNIQUES**

Advanced User Guide

# **SM Profibus-DP**

Unidrive SP

Part Number: 0471-0008
Issue Number: 1

www.controltechniques.com

**Safety Information**

The solutions module and its associated drive are intended as components for professional incorporation into complete equipment or systems. If installed incorrectly the drive may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy and is used to control mechanical equipment that can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and User Guide carefully.

Careful consideration must be given to the functions of the drive and solutions module, which might result in a hazard, either through their intended functions e.g. auto-start or through incorrect operation due to a fault or trip e.g. stop/start, forward/reverse, maximum speed, loss of communications link.

In any application where a malfunction of the drive or solutions module could lead to damage, loss or injury, a risk analysis must be carried out and where necessary further measures taken to reduce the risk. To ensure mechanical safety additional safety devices such as electro-mechanical interlocks may be required. The drive must not be used in a safety critical application without high-integrity protection against hazards arising from a malfunction.

## 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

Unidrive SP 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 SP manual for full parameter definitions.

## 1.1 SM Profibus-DP Module for Unidrive SP

The SM Profibus-DP module for Unidrive SP is an option module that can be fitted to any one of the three expansion slots in the Unidrive SP. The SM Profibus-DP module uses a 16-bit processor and is capable of communicating at 12 Mbit/s, currently the fastest data rate available for Profibus-DP.

### Figure 1-1  Unidrive SP Option Module
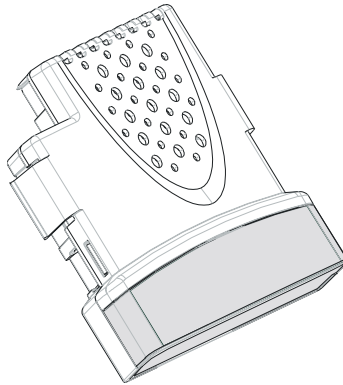


The SM Profibus-DP module is powered from the Unidrive SP internal power supply. The Unidrive SP can be connected to a back-up power supply. This keeps the control electonics and option modules powered up, allowing the SM Profibus-DP module to continue communicating with the Profibus-DP master controller when the main supply to the Unidrive SP is switched off.

## 1.2 Product Conformance Certificate

The SM Profibus-DP module has been submitted to the Profibus Nutzerorginization (PNO) to be tested for full Profibus-DP Conformance Certification.

## 1.3 Overview Specification

- Supported data rates (bit/s): 12M, 6.0M, 3.0M, 1.5M, 500k, 187.5k, 93.25k, 19.2k, 9.6k.
- 1 to 32 input/output cyclic data words supported
- Parameter Process Objects (PPOs) fully supported
- CT Single Word or PPO 4 Word mode non-cyclic data channel (optional)

# 2 Mechanical Installation

⚠️ **CAUTION**

The Unidrive SP must be disconnected from the mains supply before installing or removing the Advanced User Guide module.

## 2.1 Installing The SM Profibus-DP Module

- Locate the SM Profibus-DP module into the required slot, and press down until the module clicks into place

**Figure 2-1 .Installing The SM Profibus-DP Module**
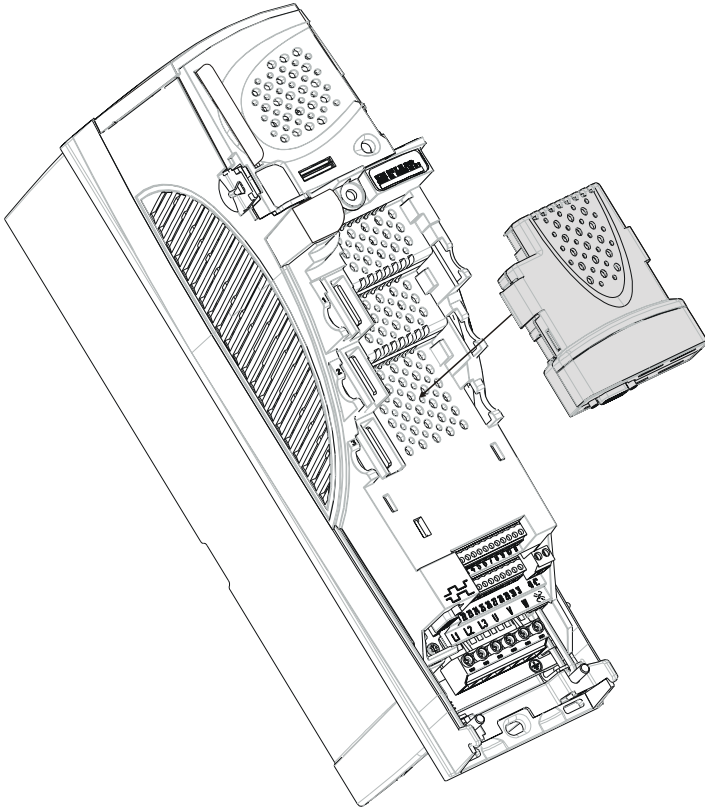
## 2.2 Removing The SM Profibus-DP Module

• To remove the SM Profibus-DP module from the slot, press both clips inwards (A) and lift the module away (B) from the Unidrive SP.

**Figure 2-2  Removing The SM Profibus-DP Module**
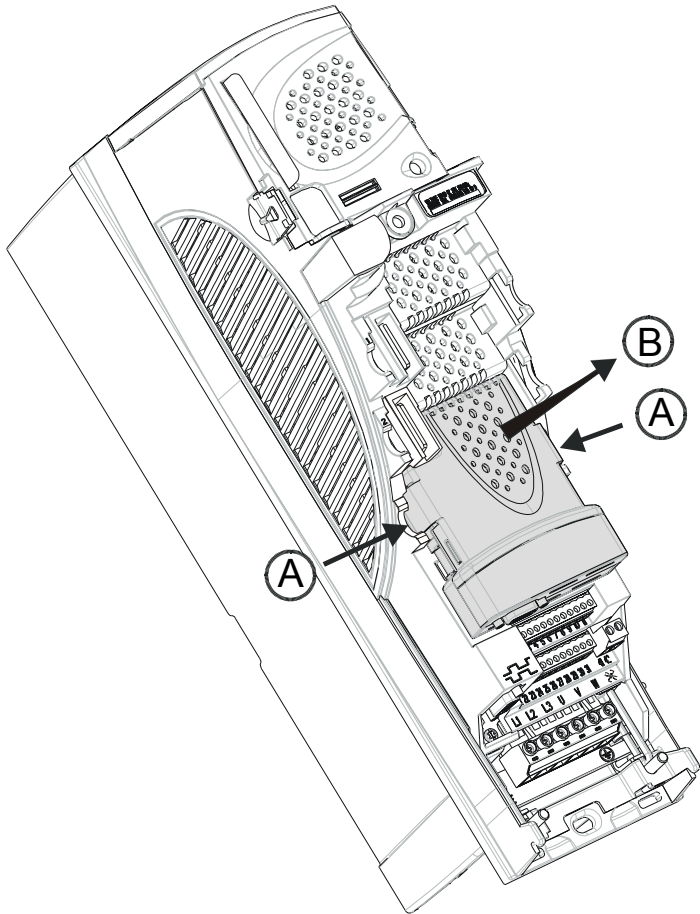
# 3 Electrical Installation

## 3.1 SM Profibus-DP Module

The SM Profibus-DP module has a standard 9-way female D-type connector for the Profibus-DP network.

**Figure 3-1 SM Profibus-DP Module - Front View**
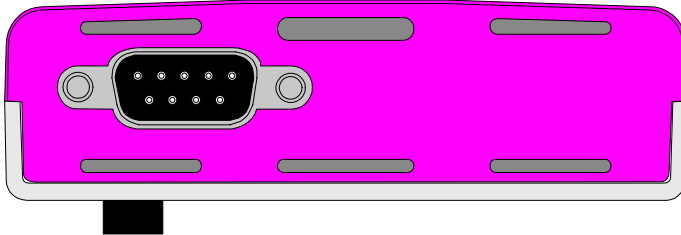


The terminal functions are given in the Table 3.1.

**Table 3.1 SM Profibus-DP Module Connector**

| D-type Terminal | Function | Description |
|---|---|---|
| 3 | RxTxB | Positive data line |
| 8 | RxTxA | Negative data line |
| 6 | +5V ISO | +5V isolated, use only for termination resistors |
| 5 | 0V ISO | 0V isolated, use only for termination resistors |
| 1, Shell | Shield | Cable screen connection |

Control Techniques strongly recommends that Profibus-certified connectors are used. These connectors accept 2 Profibus-DP cables and have 4 screw terminals inside, one for each data connection. They also have a screen clamp arrangement to ensure good screen continuity, and help to keep the noise immunity of the Profibus-DP network.

## 3.2 Profibus-DP Connections

The SM Profibus-DP module has been designed to accept the Erbic "vertical" range of Profibus-DP connectors from ERNI. The grey connector (Part No: 103658L) can be used on all nodes in the middle of the Profibus-DP network, and a special yellow termination connector (Part No: 103659L) containing the necessary Profibus-DP termination resistor network is also available.

Some Siemens connectors may also be used with the SM Profibus-DP module. Suitable connectors are Part No: 6GK1500-0FC00 and Part No: 6GK1500-0EA00.

For futher details visit the Profibus web site at www.profibus.com, and search for "Network Components".

NOTE Other companies also make PNO-certified Profibus-DP connectors, but the mechanical design of some connectors may make them incompatible with Unidrive SP and the SM Profibus-DP module.

Figure 3-2 illustrates a Profibus-DP connection using an Erbic connector from ERNI. (See section 3.3.)

**Figure 3-2  Profibus-DP Network Connections**



Illustrated connector is
Erbic Part No. 103658L
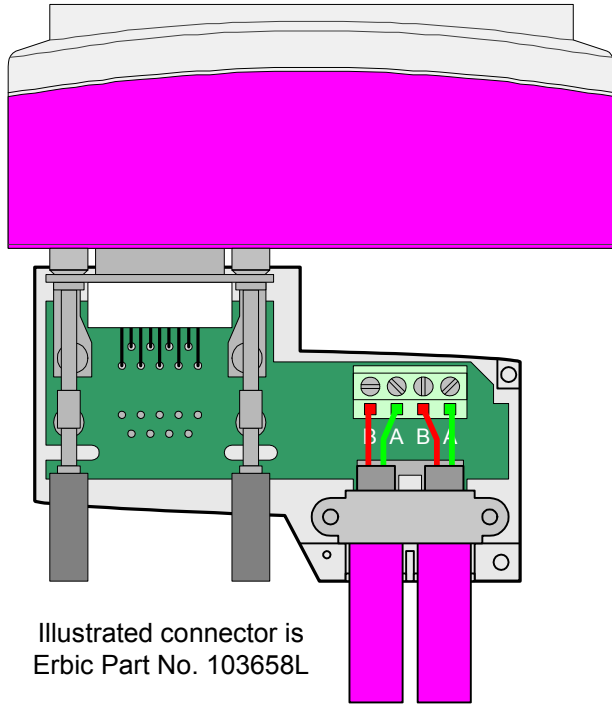
## 3.3      Profibus-DP Cable

Profibus-DP cable has a single twisted pair with overall screening.  Profibus-DP has a specified colour code, and it is strongly recommended that this code is maintained.

**Table 3.2  Profibus-DP Cable Colour Codes**

| Cable | Data Signal | Terminal | Description |
|---|---|---|---|
| Red | TxRxB | 3 | Positive data line |
| Green | TxRxA | 8 | Negative data line |
| Braided Shield | Screen | 1, Shell | Cable screen |

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 Nutzerorganisation (PNO) web site at at www.profibus.com.

**NOTE** Control Techniques can only guarantee correct and reliable operation of the SM Profibus-DP module if all other equipment installed on the Profibus-DP network (including the network cable) has been approved by the PNO.

## 3.4 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.

Erbic termination connectors are available from ERNI. These terminals (illustrated in Figure 3-3) have the termination resistor network built in, and only a single pair of terminals for the data wires. Siemens connectors have a built-in switch that allows the termination resistor network to be enabled or disabled as required.

**Figure 3-3  Profibus-DP Network Termination**

Illustrated connector is
Erbic Part No. 103659L
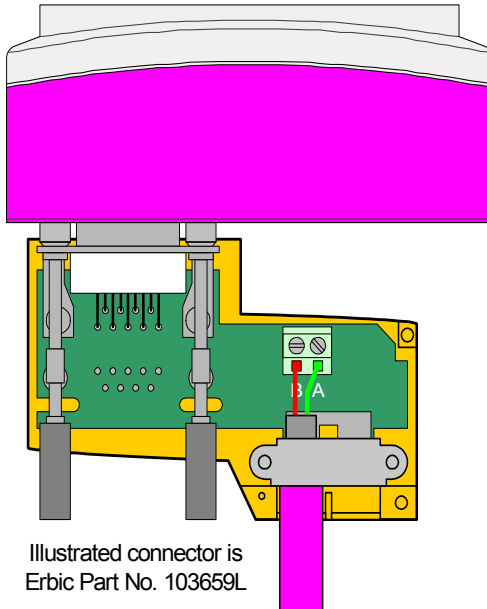
**NOTE** Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination resistors are not fitted, the noise immunity of the network is greatly reduced.

If too many termination resistor networks are fitted on a Profibus-DP network, the network will be over-loaded, resulting in reduced signal levels. This may cause nodes to miss some bits of information, resulting in transmission errors being reported. If network overload is excessive, the signal levels may be so low that nodes cannot detect any network activity at all.

## 3.5 Profibus-DP Cable Screen Connections

The electrical noise immunity of the Profibus-DP network can be increased if the screens of the Profibus-DP cables are earthed at every Unidrive SP, on their external surfaces before they enter the connector. This precaution is recommended unless there are specific reasons for avoiding earthing.   This can be achieved by exposing the cable screen of each Profibus-DP cable and clamping them to the Earthing Bracket of the Unidrive SP using a tie-wrap.  Provided that the exposed length of cable screen is at minimum of 18mm, (as shown in Figure 3-4) the tie-wrap will ensure a good earth connection for the Profibus-DP cable screen.

**Figure 3-4  Profibus-DP Cable Screen Arrangement**



Use a tie-wrap to clamp the exposed Profibus-DP cable screen to the Earthing Clamp

18mm minimum
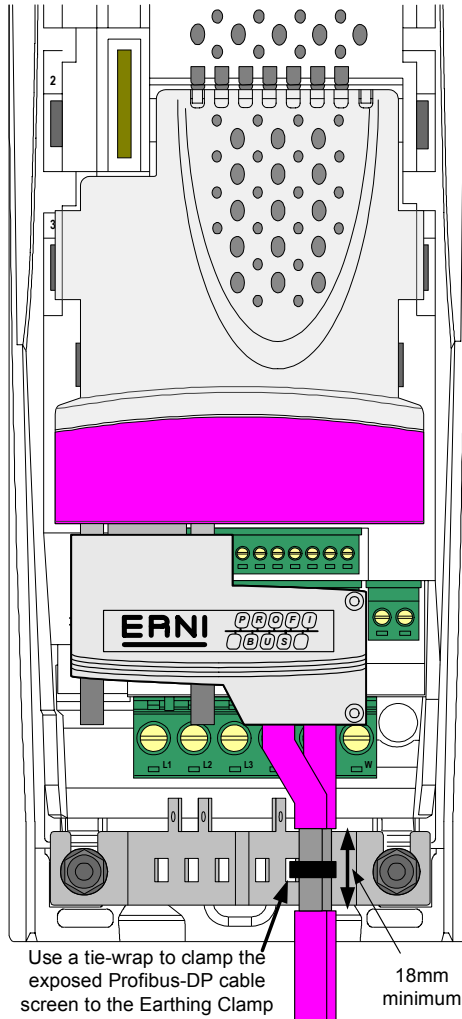
## 3.6 Maximum Network Length

The maximum number of nodes that can be connected to a single Profibus-DP network segment is 32 nodes. The maximum lengths of cable for a segment depend on the data rate, and are shown in Figure 3.3.

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 3.3  Profibus-DP Maximum Network Lengths7**

| 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 | 1200 |
| 3.0M | 100 | 45.45k | 1200 |
| 1.5M | 200 | 19.2k | 1200 |
| 500k | 400 | 9.6K | 1200 |

# 4    Getting Started

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

| NOTE | The Unidrive SP must be fitted with firmware V0.10.00 or later for use with the SM Profibus-DP module. |

Unidrive SP has 3 slots available for option modules, and each slot has a dedicated menu of configuration parameters.

**Figure 4-1  Unidrive SP Slot Arrangement**
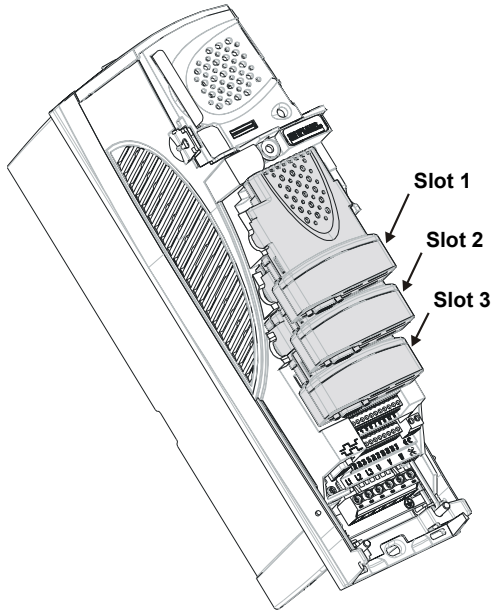


The SM Profibus-DP module can be fitted to any slot, and each slot has a corresponding menu of parameters.  When referring to a specific parameter for any slot, e.g. Profibus-DP Node Address, the parameter will be referred to as #MM.03.

**Table 4.1  Slot Configuration Menu**

| Slot | Menu |
|------|------|
| 1 | #15.PP |
| 2 | #16.PP |
| 3 | #17.PP |

## 4.1    Libra Wizard

Libra does not currently have any wizards specified, although it is intended to include wizards at a later date.

## 4.2 Basic Communications Quick Start

The SM Profibus-DP module can be configured using the keypad to establish basic Profibus-DP communications. The instructions below assume that the SM Profibus-DP module is located in slot 3.

- Power up the Unidrive SP, and ensure that #0.50 is set to "L2".
- Set the node address (#17.03) as required.
- Set #MM.00 to 1000 and press RESET to store the configuration in the Unidrive SP.
- The SM Profibus-DP module will reset and use the updated configuration parameters from the Unidrive SP, and configure itself accordingly.

**Table 4.2 Basic Configuration Settings**

| Function | Parameter | Recommended Setting |
|---|---|---|
| Node Address | #17.03 | 1 to 125 |
| Data Format | #17.05 | 5 |

## 4.3 Profibus-DP Node Address

| Name | Profibus-DP Node Address | | |
|---|---|---|---|
| Slot 1 | #15.03 | Default | 0 |
| Slot 2 | #16.03 | Range | 1 to 125 |
| Slot 3 | #17.03 | Access | RW |

Every node on a Profibus-DP network must be given a unique network node address. If two or more nodes are assigned the same address, they will attempt to transmit at the same time, leading to corrupt messages on the Profibus-DP network. The SM Profibus-DP module must be reset to make a change of node address take effect.

If an invalid node address is set, the SM Profibus-DP module will reject the configured address, default to 125, and set the Profibus-DP node address (#MM.03) to 125.

## 4.4 Profibus-DP Data Rate

| Name | Profibus-DP Data Rate | | |
|---|---|---|---|
| Slot 1 | #15.04 | Default | N/A |
| Slot 2 | #16.04 | Range | -1 to 9 |
| Slot 3 | #17.04 | Access | RO |

The SM Profibus-DP module will automatically detect the Profibus-DP network data rate, and synchronise to it. For this reason, the data rate is controlled by the Profibus-DP master controller. #MM.04 will indicate the data rate that has been detected by the SM Profibus-DP module.

**NOTE** The Profibus-DP Data Rate parameter can be changed from the Unidrive SP keypad, but this will not affect the data rate at which the SM Profibus-DP module communciates. The Data Rate display will be updated when the Profibus-DP network is re-initialised.

-1 indicates that the SM Profibus-DP module has not detected any activity on the Profibus-DP network, and is waiting for the master controller to start communciating.

**Table 4.3 Profibus-DP Data Rates**

| #MM.04 | bit/s | | #MM.04 | bit/s |
|---|---|---|---|---|
| -1 | Auto-detecting | | 5 | 187.5k |
| 0 | 12M | | 6 | 93.75k |
| 1 | 6.0M | | 7 | 45.45k |

**Table 4.3 Profibus-DP Data Rates**

| #MM.04 | bit/s | | #MM.04 | bit/s |
|--------|-------|---|--------|-------|
| 2 | 3.0M | | 8 | 19.2k |
| 3 | 1.5M | | 9 | 9.6k |
| 4 | 500k | | | |

## 4.5 Profibus-DP Data Format

| Name | Profibus-DP Data Format | | |
|------|-------------------------|---------|----------|
| Slot 1 | #15.05 | Default | 5 |
| Slot 2 | #16.05 | Range | 0 to 228 |
| Slot 3 | #17.05 | Access | RO |

The default data format is 5 Cyclic Words. Each cyclic data channel is mapped to a Unidrive SP parameter, with default mappings as shown in the table below.

**Table 4.4 Default Data Mapping**

| Cyclic Word | Data Width | Data Word | Default Mapping Status |
|-------------|------------|-----------|------------------------|
| IN Channel 0 | 16 bit | Word 0 | #10.40, status word |
| IN Channel 1 | 32 bit | Word 1, 2 | #2.01, post-ramp speed reference |
| IN Channel 2 | 16 bit | Word 3 | #4.20, motor Load as % of rated load |
| IN Channel 3 | 16 bit | Word 4 | Not mapped |
| OUT Channel 0 | 16 bit | Word 0 | #6.42, control word |
| OUT Channel 1 | 32 bit | Word 1, 2 | #1.21, digital speed reference 1 |
| OUT Channel 2 | 32 bit | Word 3, 4 | #4.08, torque reference |

Other data formats are also supported. For further details. see section 5.3.

**NOTE** If a cyclic data channel is mapped to a Unidrive SP 32-bit parameter, it will use two 16-bit data words to transfer the data. Refer to section 5.2 for a list of 32-bit parameters.

## 4.6 Profibus-DP Network Status

| Name | Profibus-DP Network Status | | |
|------|----------------------------|---------|-----------|
| Slot 1 | #15.06 | Default | N/A |
| Slot 2 | #16.06 | Range | -3 to 9999 |
| Slot 3 | #17.06 | Access | RO |

The Profibus-DP network activity can be monitored in the Profibus-DP Network Status parameter, #MM.06. When the SM Profibus-DP module is communicating successfully with the Profibus-DP master controller, the Profibus-DP Network Status will give an indication of the number of data messages per second that are being processed.

**Table 4.5 Profibus-DP Network Status Codes**

| #MM.06 | Parameter | Description |
|--------|-----------|-------------|
| >0 | Network Healthy | Indicates the number of successful network cycles per second. |
| 0 | Network Healthy, No Data Transfer | Indicates that the Profibus-DP master has established communications with the SM Profibus-DP module. If Network Status changes briefly to -1 and returns to 0, the slave configuration does not match the configuration in the master controller. |

**Table 4.5  Profibus-DP Network Status Codes**

| #MM.06 | Parameter | Description |
|--------|-----------|-------------|
| -1 | Initialised | Indicates that the SM Profibus-DP module has initialised correctly, and is waiting for the Profibus-DP master to initialise communications. |
| -2 | Internal Hardware Failure | Indicates that part of the SM Profibus-DP module initialisation sequence was not successful.  If this fault persists after a power cycle, replace the SM Profibus-DP module. |
| -3 | Configuration Error | Indicates that there is an invalid setting in the SM Profibus-DP module configuration parameters. |

If a configuration error or network error is detected, the Unidrive SP may trip.  Refer to section  for details about the Unidrive SP trip display.

## 4.7    Resetting the SM Profibus-DP Module

| Name | SM Profibus-DP Reset | | |
|------|------|------|------|
| Slot 1 | #15.32 | **Default** | 0 (OFF) |
| Slot 2 | #16.32 | **Range** | 0 (OFF) to 1 (ON) |
| Slot 3 | #17.32 | **Access** | RW |

Changes to the Profibus-DP configuration in menu 15, 16 and 17 parameters will not take effect until the SM Profibus-DP module has been reset.

To reset an SM Profibus-DP module in slot 3:

1.  Set #17.32 to ON.
2.  When the reset sequence has been completed, #17.32 will be reset to OFF.
3.  The SM Profibus-DP module will re-initialise using the updated Profibus-DP configuration.

**NOTE** This sequence does NOT store the Profibus-DP parameters in the Unidrive SP or the SM Profibus-DP FLASH memory.

## 4.8    Reset All option Modules

It is possible to reset all of the option modules fitted on a Unidrive SP at the same time. To reset all Unidrive SP option modules:

•   Set #MM.00 to 1070.
•   Press the red RESET button on the Unidrive SP.

**NOTE** This sequence does NOT store the Profibus-DP parameters in the Unidrive SP or the SM Profibus-DP FLASH memory.  See section  for details about storing Profibus-DP configuration parameters.

# 5 Cyclic Data

"OUT data" and "IN data" describe the direction of data transfer as seen by the Profibus-DP 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 data bytes over the Profibus-DP network, and relying on local mapping information within the SM Profibus-DP module and Profibus-DP master controller to ensure that 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 Unidrive SP.

The flexibility of the SM Profibus-DP module means that each cyclic data OUT channel can be directed to any read-write Unidrive SP parameter. Similarly, each cyclic data IN channel can use any Unidrive SP parameter as a source of data.

| NOTE | The cyclic data mapping cannot be changed dynamically, as changes to the mapping parameters will only take effect during initialisation of the SM Profibus-DP module, i.e. after a reset, or at power up. |
|---|---|

## 5.2 32-bit Parameters

If a 32-bit parameter is mapped as a source or destination parameter, two polled or cyclic 16-bit data words will be allocated, affecting the mapping between the Profibus-DP master controller registers and Unidrive SP parameters.

Some Unidrive SP and UT70 parameters are 32 bit parameters. The table below lists all 32 bit parameters that can be set as target parameters for cyclic or polled data.

**Table 5.1 Unidrive SP 32-bit Parameters**

| Menu | 32-bit Parameters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Menu 1 | #1.01 | #1.02# | #1.03 | #1.04 | #1.06 | #1.07 | #1.17 | #1.18 | #1.21 | #1.22 |
| | #1.23 | #1.24 | #1.25 | #1.26 | #1.27 | #1.28 | #1.36 | #1.37 | #1.39 | |
| Menu 2 | #2.01 | #2.07 | #2.11 | #2.12 | #2.13 | #2.14 | #2.15 | #2.16 | #2.17 | #2.18 |
| | #2.19 | #2.21 | #2.22 | #2.23 | #2.24 | #2.25 | #2.26 | #2.27 | #2.28 | #2.29 |
| Menu 3 | #3.01 | #3.02 | #3.03 | #3.10 | #3.18 | #3.22 | #3.27 | | | |
| Menu 4 | #4.01 | #4.02 | #4.08 | #4.17 | | | | | | |
| Menu 5 | #5.01 | #5.03 | #5.04 | #5.07 | #5.08 | #5.24 | #5.25 | | | |
| Menu 7 | #7.51 | | | | | | | | | |
| Menu 11 | #11.32 | | | | | | | | | |
| Menu 15 | #15.03 | #15.19 | #15.35 | | | | | | | |
| Menu 16 | #16.03 | #16.19 | #16.35 | | | | | | | |
| Menu 17 | #17.03 | #17.19 | #17.35 | | | | | | | |
| Menu 20 | #20.21 to #20.40 | | | | | | | | | |
| Menu 21 | #21.01 | #21.02 | #21.04 | #21.05 | #21.07 | #21.08 | #21.14 | #21.24 | | |
| Menu 70 to 75 | #70.00 to #70.99 | | | #71.00 to #71.99 | | | #72.00 to #72.99 | | | |
| | #73.00 to #73.99 | | | #74.00 to #74.99 | | | #75.00 to #75.99 | | | |
| Menu 100 to Menu 105 | #100.00 to #100.99 | | | #101.00 to #101.99 | | | #102.00 to #102.99 | | | |
| | #103.00 to #103.99 | | | #104.00 to #104.99 | | | #105.00 to #105.99 | | | |

**Table 5.1 Unidrive SP 32-bit Parameters**

| Menu | 32-bit Parameters | | |
|---|---|---|---|
| Menu 130 to Menu 135 | #130.00 to #130.99 | #131.00 to #131.99 | #132.00 to #132.99 |
| | #133.00 to #133.99 | #134.00 to #134.99 | #135.00 to #135.99 |
| Menu 160 to Menu 165 | #160.00 to #160.99 | #161.00 to #161.99 | #162.00 to #162.99 |
| | #163.00 to #163.99 | #164.00 to #164.99 | #165.00 to #165.99 |

Parameters in menus 15, 16 and 17 are only 32-bit if one of the intelligent encoder modules is fitted in the appropriate Unidrive SP slot.

## 5.3 Profibus-DP Data Formats

| Name | Profibus-DP Data Format | | |
|---|---|---|---|
| Slot 1 | #15.05 | Default | 5 |
| Slot 2 | #16.05 | Range | 0 to 228 |
| Slot 3 | #17.05 | Access | RW |

The SM Profibus-DP module can be configured with up to 32 cyclic IN and OUT data words. IN and OUT cyclic data words are mapped using 10 mapping parameters each, with a "block mapping" mode (see section 10.4) available for the additional data words. CT Single Word or PPO 4 Word modes of non-cyclic data using cyclic data can also be enabled.

The Profibus-DP Data Format is specified as "NNPP", where NN is the non-cyclic data mode, and PP is the number of cyclic data words.

**Table 5.2 Valid Profibus-DP Data Formats**

| #MM.05 | NN | PP | Non-cyclic Mode | Cyclic Words |
|---|---|---|---|---|
| 1 to 32 | 0 | 1 to 32 | None | 1 to 32 |
| 100 to 131 | 1 | 0 to 31 | CT Single Word | 1 to 31 |
| 200 to 228 | 2 | 0 to 28 | PPO 4 Word | 1 to 28 |

Data is mapped to and from Unidrive SP parameters using 10 mapping parameters each for IN and OUT cyclic data. The number of words used for each parameter depends on the data size of the source (IN) or destination (OUT) parameter. If a channel is mapped to a 32-bit parameter (see section 5.2) in the Unidrive SP or a UT70 module, 2 words will be used for the data value. For all other Unidrive SP parameters, 1 word will be used.

For example, #1.21 (digital speed ref 1) is a 32-bit double word parameter, and is mapped (by default settings) to OUT words 1 and 2. By default, the SM Profibus-DP module uses the "big endian" data format, so OUT word 1 will contain the high data word, and OUT word 2 will contain the low data word. (Refer to section section 10.3 for more details.)

The method used to map data to and from the Profibus-DP network is similar to the method used in Unidrive SP for mapping analogue and digital inputs and outputs. The reference for the source or target parameter is entered in the mapping parameter in the form MMPP, where MM = menu number of the target/source parameter and PP = parameter number of the target/source parameter.

**Table 5.3  SM Profibus-DP Module Mapping Parmaeters**

| IN Channel | Mapping Parameter | | | OUT Channel | Mapping Parameter | | |
|---|---|---|---|---|---|---|---|
| | Slot 1 | Slot 2 | Slot 3 | | Slot 1 | Slot 2 | Slot 3 |
| 0 | #15.10 | #16.10 | #17.10 | 0 | #15.20 | #16.20 | #17.20 |
| 1 | #15.11 | #16.11 | #17.11 | 1 | #15.21 | #16.21 | #17.21 |
| 2 | #15.12 | #16.12 | #17.12 | 2 | #15.22 | #16.22 | #17.22 |
| 3 | #15.13 | #16.13 | #17.13 | 3 | #15.23 | #16.23 | #17.23 |
| 4 | #15.14 | #16.14 | #17.14 | 4 | #15.24 | #16.24 | #17.24 |
| 5 | #15.15 | #16.15 | #17.15 | 5 | #15.25 | #16.25 | #17.25 |
| 6 | #15.16 | #16.16 | #17.16 | 6 | #15.26 | #16.26 | #17.26 |
| 7 | #15.17 | #16.17 | #17.17 | 7 | #15.27 | #16.27 | #17.27 |
| 8 | #15.18 | #16.18 | #17.18 | 8 | #15.28 | #16.28 | #17.28 |
| 9 | #15.19 | #16.19 | #17.19 | 9 | #15.29 | #16.29 | #17.29 |

"Block Mapping" can be used to map several words to consecutive Unidrive SP parameters. Full details about "block mapping" can be found in section 10.4.

**NOTE**  If a mapping parameter is set to an invalid value, e.g. destination parameter is read only, or parameter does not exist, the SM Profibus-DP module will indicate "Mapping Error" in the Network Status parameter, #MM.06. The reason for the mapping error will be indicated by the Mapping Error Status parameter, #MM.49. Refer to section 5.6 for more details.

When the Data Format is configured using #MM.05, the SM Profibus-DP module will communicate using the same number of data words for IN and OUT data. It is, however, possible to configure the SM Profibus-DP module to communicate with different numbers of IN and OUT cyclic data words. Refer to section 10.9 for full details.

**NOTE**  The cyclic data channels do not use decimal points. For example, in Open Loop mode, the Unidrive SP 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.

The following sections show some example data formats that can be selected, and the parameter mapping that will apply (by default) to each format.

### 5.3.1  5 Cyclic Words Only (Default)

This data format provides five 16-bit cyclic data words, with no non-cyclic data channel. The total data length is 10 bytes. To select this data format, set #MM.05 = 5. This data format is selected by default.

**Table 5.4  Mapping for 5 Cyclic Data Words**

| Data Word | Slot 1 | Slot 2 | Slot 3 | Default Mapping Status |
|---|---|---|---|---|
| IN Word 0 | #15.10 | #16.10 | #17.10 | #10.40, status word (See section ) |
| IN Words 1,2 | #15.11 | #16.11 | #17.11 | #2.01, post-ramp speed reference |
| IN Word 3 | #15.12 | #16.12 | #17.12 | #4.20, motor load as % of rated load |
| IN Word 4 | #15.13 | #16.13 | #17.13 | 0, not mapped |

**Table 5.4  Mapping for 5 Cyclic Data Words**

| Data Word | Slot 1 | Slot 2 | Slot 3 | Default Mapping Status |
|---|---|---|---|---|
| OUT Word 0 | #15.20 | #16.20 | #17.20 | #6.42, control word (See section ) |
| OUT Word 1,2 | #15.21 | #16.21 | #17.21 | #1.21, digital speed reference 1 |
| OUT Word 3,4 | #15.22 | #16.22 | #17.22 | #4.08, torque reference |

### 5.3.2  5 Cyclic Words with CT Single Word (Mode 1) Non-Cyclic Data

This data format provides five 16-bit cyclic data words, plus an additional word for CT Single Word (Mode 1) non-cyclic data.  (See section 7.1)  The total data length is 12 bytes.  To select this data format, set #MM.05 = 105.

**Table 5.5  Mapping for 5 Cyclic Data Words with CT Single Word Non-Cyclic Data**

| Data Word | Slot 1 | Slot 1 | Slot 1 | Default Mapping Status |
|---|---|---|---|---|
| IN Word 0 | #15.10 | #16.10 | #17.10 | #90.50, CT Mode 1 non-cyclic data |
| IN Word 1 | #15.11 | #16.11 | #17.11 | #10.40, status word (See section ) |
| IN Word 2,3 | #15.12 | #16.12 | #17.12 | #2.01, post-ramp speed reference |
| IN Word 4 | #15.13 | #16.13 | #17.13 | #4.20, motor load as % of rated load |
| IN Word 5 | #15.14 | #16.14 | #17.14 | 0, not mapped |
| OUT Word 0 | #15.20 | #16.20 | #17.20 | #90.50, CT Mode 1 non-cyclic data |
| OUT Word 1 | #15.21 | #16.21 | #17.21 | #6.42, control word (See section ) |
| OUT Word 2,3 | #15.22 | #16.22 | #17.22 | #1.21, digital speed reference 1 |
| OUT Word 4,5 | #15.23 | #16.23 | #17.23 | #4.08, torque reference |

### 5.3.3  10 Cyclic Words Only

This data format provides ten 16-bit cyclic data words, with no non-cyclic data channel. The total data length is 20 bytes.  To select this data format, set #MM.05 = 10.

**Table 5.6  Mapping for 10 Cyclic Data Words**

| Data Word | Slot 1 | Slot 2 | Slot 3 | Default Mapping Status |
|---|---|---|---|---|
| IN Word 0 | #15.10 | #16.10 | #17.10 | #10.40, status word (See section ) |
| IN Word 1,2 | #15.11 | #16.11 | #17.11 | #2.01, post-ramp speed reference |
| IN Word 3 | #15.12 | #16.12 | #17.12 | #4.20, motor load as % of rated motor load |
| IN Word 4-9 | #15.13 to #15.19 | #16.13 to #16.19 | #17.13 to #17.19 | Not mapped |
| OUT Word 0 | #15.20 | #16.20 | #17.20 | #6.42, control word (See section ) |
| OUT Word 1,2 | #15.21 | #16.21 | #17.21 | #1.21, digital speed reference 1 |
| OUT Word 3,4 | #15.22 | #16.22 | #17.22 | #4.08, torque reference |
| OUT Word 5-9 | #15.23 to #15.29 | #16.23 to #16.29 | #17.23 to #17.29 | 0, not mapped |

### 5.3.4  16 Cyclic Words with PPO 4 Word (Mode 2) Non-Cyclic Data

This data format provides sixteen * 16-bit cyclic data words, plus an additional 4 words for PPO 4 Word (Mode 2) non-cyclic data.  (See section 7.2)  The total data length is 40 bytes.  To select this data format, set #MM.05 = 216.

**Table 5.7  Mapping for 16 Cyclic Data Words with PPO 4 Word Non-Cyclic Data**

| Data Word | Slot 1 | Slot 1 | Slot 1 | Default Mapping Status |
|---|---|---|---|---|
| IN Word 0-3 | #15.10 | #16.10 | #17.10 | #90.51, Mode 2 non-cyclic data |
| IN Word 4 | #15.11 | #16.11 | #17.11 | #10.40, status word (See section ) |
| IN Word 5,6 | #15.12 | #16.12 | #17.12 | #2.01, post-ramp speed reference |
| IN Word 7 | #15.13 | #16.13 | #17.13 | #4.20, motor load as % of rated motor load |

**Table 5.7 Mapping for 16 Cyclic Data Words with PPO 4 Word Non-Cyclic Data**

| Data Word | Slot 1 | Slot 1 | Slot 1 | Default Mapping Status |
|---|---|---|---|---|
| IN Word 8-19 | #15.14 to #15.19 | #16.14 to #16.19 | #17.14 to #17.19 | 0, not mapped |
| OUT Word 0-3 | #15.20 | #16.20 | #17.20 | #90.51, Mode 2 non-cyclic data |
| OUT Word 4 | #15.21 | #16.21 | #17.21 | #6.42,control word (See section ) |
| OUT Word 5,6 | #15.22 | #16.22 | #17.22 | #1.21, digital speed reference 1 |
| OUT Word 7,8 | #15.23 | #16.23 | #17.23 | #4.08, torque reference |
| OUT Word 9-19 | #15.24 to #15.29 | #16.24 to #16.29 | #17.24 to #17.29 | 0, not mapped |

Block mapping can be used to map the remaining un-used data words to Unidrive SP or UT70 parameters. See section 10.4.

### 5.3.5 Parameter Process Data Objects (PPOs)

Five Parameter Process Data Objects are fully supported by the SM Profibus-DP module. Refer to section 10.10 for full details about these PPOs.

## 5.4 Unidrive SP Mapping Conflicts

Care must be taken to ensure that there are no clashes with the mapping of the analogue and digital inputs within the Unidrive SP. The SM Profibus-DP module will not indicate if there is a conflict with Unidrive SP mapping parameters. This only applies to analogue and digital inputs, and OUT data on the Profibus-DP network. The table below shows the parameters that need to be checked for possible mapping conflicts.

**Table 5.8 Unidrive SP Destination Parameters**

| Function | Mapping Parameter | Function | Mapping Parameter |
|---|---|---|---|
| Analogue Input 1 | #7.10 | Cyclic OUT Slot 1 Channel 7 | #15.27 |
| Analogue Input 2 | #7.14 | Cyclic OUT Slot 1 Channel 8 | #15.28 |
| Analogue Input 3 | #7.18 | Cyclic OUT Slot 1 Channel 9 | #15.29 |
| Digital Input 1 | #8.21 | Cyclic OUT Slot 2 Channel 0 | #16.20 |
| Digital Input 2 | #8.22 | Cyclic OUT Slot 2 Channel 1 | #16.21 |
| Digital Input 3 | #8.23 | Cyclic OUT Slot 2 Channel 2 | #16.22 |
| Digital Input 4 | #8.24 | Cyclic OUT Slot 2 Channel 3 | #16.23 |
| Digital Input 5 | #8.25 | Cyclic OUT Slot 2 Channel 4 | #16.24 |
| Digital Input 6 | #8.26 | Cyclic OUT Slot 2 Channel 5 | #16.25 |
| Logic Output 1 | #9.10 | Cyclic OUT Slot 2 Channel 6 | #16.26 |
| Logic Output 2 | #9.20 | Cyclic OUT Slot 2 Channel 7 | #16.27 |
| Motorised Pot Output | #9.25 | Cyclic OUT Slot 2 Channel 8 | #16.28 |
| Comparator 1 Output | #12.07 | Cyclic OUT Slot 2 Channel 9 | #16.27 |
| Comparator 2 Output | #12.27 | Cyclic OUT Slot 3 Channel 0 | #17.20 |
| Variable Select 1 Output | #12.11 | Cyclic OUT Slot 3 Channel 1 | #17.21 |
| Variable Select 2 Output | #12.31 | Cyclic OUT Slot 3 Channel 2 | #17.22 |
| PID Output | #14.16 | Cyclic OUT Slot 3 Channel 3 | #17.23 |
| Cyclic OUT Slot 1 Channel 0 | #15.20 | Cyclic OUT Slot 3 Channel 4 | #17.24 |
| Cyclic OUT Slot 1 Channel 1 | #15.21 | Cyclic OUT Slot 3 Channel 5 | #17.25 |
| Cyclic OUT Slot 1 Channel 2 | #15.22 | Cyclic OUT Slot 3 Channel 6 | #17.26 |
| Cyclic OUT Slot 1 Channel 3 | #15.23 | Cyclic OUT Slot 3 Channel 7 | #17.27 |

**Table 5.8 Unidrive SP Destination Parameters**

| Function | Mapping Parameter | Function | Mapping Parameter |
|---|---|---|---|
| Cyclic OUT Slot 1 Channel 4 | #15.24 | Cyclic OUT Slot 3 Channel 8 | #17.28 |
| Cyclic OUT Slot 1 Channel 5 | #15.25 | Cyclic OUT Slot 3 Channel 9 | #17.27 |
| Cyclic OUT Slot 1 Channel 6 | #15.26 | | |

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. Internally, this value may be changing continuously between 2 values, leading to unusual behaviour from the Unidrive SP.

## 5.5 Cyclic Data Mapping Errors

The SM Profibus-DP module will scan and check the Profibus-DP mapping parameter configuration for errors during initialisation, i.e. after reset. If an error is detected, the Profibus-DP Network Status parameter (#MM.06) will indicate -3, and the mapping error detected will be indicated in Profibus-DP Mapping Conflict parameter, #MM.49. See section 9.6 for full details.

## 5.6 Disabling Data Channels

If any data words are not being used in an application, the un-used mapping parameters should be set to 0. Although the data word will still be transmitted over the Profibus-DP network, any incoming data value will be discarded. Unmapped data words being passed back to the Profibus-DP master controller will be set to 0.

## 5.7 Storing Profibus-DP Configuration Parameters

| Name | Store to SM Profibus-DP FLASH Memory | | |
|---|---|---|---|
| Slot 1 | #15.31 | **Default** | OFF |
| Slot 2 | #16.31 | **Range** | OFF (0) to ON (1) |
| Slot 3 | #17.31 | **Access** | RW |

Menu 15, 16 and 17 parameters are stored in the Unidrive SP. The SM Profibus-DP module will always use these values during initialisation to configure itself, so if a new SM Profibus-DP module is fitted, it will communicate using the same settings as the previous SM Profibus-DP module.

**NOTE** If the stored values in the Unidrive SP are for a different type of option module, the SM Profibus-DP module will trip the Unidrive SP on "SLx.dF". The slot configuration parameters will be set to the default values for Profibus-DP, but the default values will NOT be stored in the Unidrive SP.

The Profibus-DP configuration parameters can also be stored in the FLASH memory on the SM Profibus-DP module. If the Unidrive SP is replaced, the Profibus-DP configuration parameters can be restored to the Unidrive SP.

### 5.7.1 Saving Unidrive SP Parameters

To store Unidrive SP parameters:
1. Set #MM.00 to 1000.
2. Press the red RESET button.

The Unidrive SP will store all parameters (except Menu 20) but the operation of the SM Profibus-DP module will not be affected.  Changes made to the Profibus-DP configuration parameters will not take effect until the SM Profibus-DP module is reset.

### 5.7.2  Storing Parameters to Profibus-DP FLASH Memory

To store the Profibus-DP configuration parameters in the FLASH memory in the SM Profibus-DP module in slot 3:

1.  Set #17.31 to ON.
2.  Set #MM.00  to 1000.
3.  Press the red RESET button.

The Unidrive SP will store its parameters, and Profibus-DP communication will be halted immediately.  The Profibus-DP configuration parameters will be saved within the SM Profibus-DP module FLASH memory.  The SM Profibus-DP module will then reset and re-initialise using the updated configuration parameter values.

# 6 Control and Status Words

## 6.1 Unidrive SP Control Word

The Control Word allows the digital control of the Unidrive SP to be implemented using a single data word. Each bit in the control word has a particular function, and provides a method of controlling the output functions of the Unidrive SP (RUN FWD, JOG, TRIP, etc.) with a single data word

**NOTE** The Unidrive SP Control Word (#6.42) must be enabled by setting Control Word Enable (#6.43) to 1. When the Control Word is enabled, the source of the control signals (ENABLE, RUN FWD, JOG, etc.) is selected using the AUTO bit.

| b15 | b14 | b13 | b12b | b11 | b10 | b9 | b8 |
|-----|-----|-----|------|-----|-----|-----|-----|
|     | KEYPAD WDOG | RESET |      |     |     |     | REMOTE |

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| AUTO | NOT STOP | RUN | FWD REV | RUN REV | JOG | RUN FWD | ENABLE |

**NOTE** For safety reasons, the external HARDWARE ENABLE signal (terminal 31) must be present (connected to +24V, terminal 22) before the fieldbus control word can be used to start the Unidrive SP. Typically, this terminal is controlled by the external Emergency Stop circuit to ensure that the Unidrive SP is disabled in an emergency situation.

To select external fieldbus control, set the AUTO bit to 1. This selects the Control Word (#6.42) as the source for the control functions of the Unidrive SP. When AUTO is reset to 0, the Unidrive SP will revert to terminal control.

To select the Profibus-DP speed reference, set the REMOTE bit to 1. As the REMOTE bit directly controls #1.42, this will select the digital speed reference as the main speed reference for the Unidrive SP. When REMOTE is reset to 0, the Unidrive SP will revert to using the external analogue speed reference

**NOTE** By default, the Digital Speed Reference will be #1.21, which is also the default mapping for the fieldbus speed reference. The actual Digital Speed Reference selected when REMOTE is set to 1 will depend on the setting of the Digital Speed Reference Selector, #1.15

**Table 6.1 Unidrive SP Control Word Bit Functions**

| Bit | Function | Description |
|-----|----------|-------------|
| 0 | ENABLE | Set to 1 to enable the Unidrive SP. Resetting to 0 will immediately disable the Unidrive SP, and the motor will coast to stop. The external HARDWARE ENABLE signal must also be present before the Unidrive SP can 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 Unidrive SP will decelerate the motor to a controlled stop before the PWM output stack is disabled |
| 2 | JOG | Set to 1 to jog the motor. JOG must be set BEFORE setting RUN FWD or RUN REV to enable the Unidrive SP. The direction is specified by RUN FWD and RUN REV. (The motor can also be jogged by using the RUN and FWD REV bits instead of RUN FWD and RUN REV.) |

**Table 6.1  Unidrive SP Control Word Bit Functions**

| 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 Unidrive SP will decelerate the motor to a controlled stop before the PWM output stack is disabled |
| 4 | FWD REV | Set to 1 to select the reverse direction when operating with a RUN and DIRECTION signal. Set to 0 to run in the forward direction.  The RUN signal is used to start and stop the motor. |
| 5 | RUN | Set to 1 to run the motor when operating with a RUN and DIRECTION signal. FWD REV is used to select the direction of motor rotation.  When reset to 0, the Unidrive SP will decelerate the motor to a controlled stop before the PWM output stack is disabled. |
| 6 | NOT STOP | Set to 1 to allow the sequencing bit to be latched.  If NOT STOP is zero, all latches are cleared and held at 0. |
| 7 | AUTO | Set to 1 to enable the Unidrive SP Control Word.  The Control Word Enable (#6.43) must also be set to 1.  When reset to 0, the Unidrive SP will operate under under terminal control. |
| 8 | REMOTE | Set to 1 to select digital speed reference 1 (#1.21), and reset to 0 to select Analogue Reference 1 (#1.36).  REMOTE directly controls #1.42, so Reference Selector (#1.14) and Preset Selector (#1.15) must both be set to 0 (default) for the REMOTE bit to work properly. |
| 9-12 | Reserved | |
| 13 | RESET | A 0-1 transition of the RESET bit will reset the Unidrive SP from a trip condition.  If the reason for the trip is still present, for another fault condition has been detected, the Unidrive SP will immediately trip again.  When resetting the Unidrive SP, it is recommended to check the status word to ensure that the reset was successful, before attempting to re-start the Unidrive SP. |
| 14 | KEYPAD WDOG | Reserved for use with external keypad modules. |
| 15 | Reserved | |

| NOTE | When a trip occurs, the Unidrive SP control word MUST be set to a safe, disabled state. This ensures that the Unidrive SP does not re-start unexpectedly when it is reset   This can be achieved by continuously monitoring the Unidrive SP status word, and interlocking it with the Control Word. |
|------|--------|

Figure 6-1 (below) shows the key for the Unidrive SP control word sequencing logic diagram (Figure 6-2) on page 22.

**Figure 6-1  Control Word Logic Diagram Key**



Latch
1. If Enable is 0, Output follows Input
2. If Enable is 1, Output is always 0 if Reset is active
3. If Enable is 1 and Reset is 0, Output latches and stays at 1 if Input is 1

Exclusive OR gate with timer
1. Output is the exclusive OR of Input1 and Input 2
2. If both Input1 and Input2 become active, Output becomes 0 after delay of 60ms

Toggle
1. Output changes state on each non-active to active transition on Input

Minimum Jog Time
1. When Input becomes active, Output remains active while Input is active, and then remains active for a further 100ms
2. Jog must be active before the Sequence Run is active for the Jog function to become active.
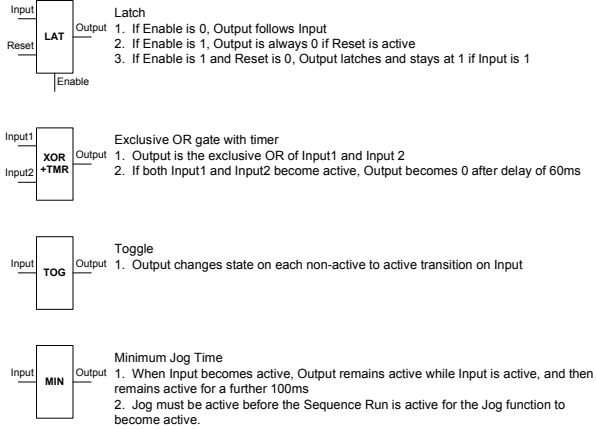
**Figure 6-2  Control Word Logic Diagram**
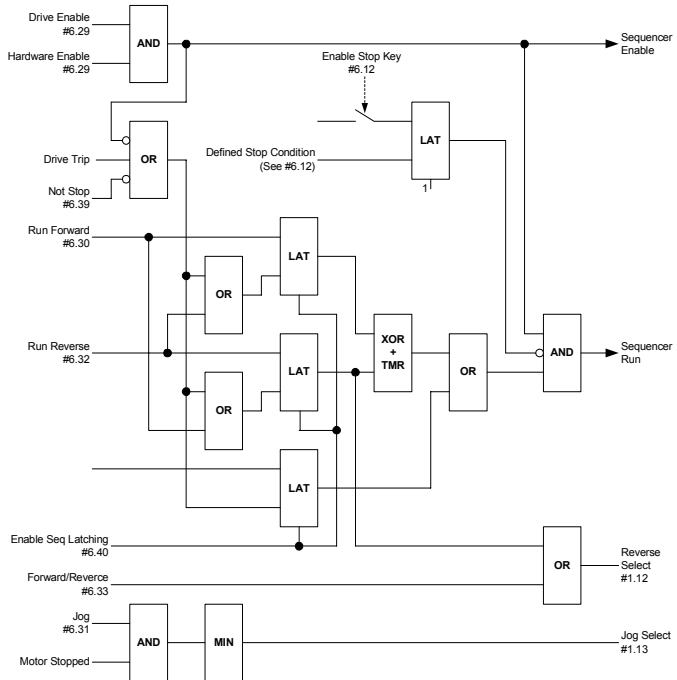
Some example Unidrive SP control word values are given in the table below.

**Table 6.2 Example Profibus-DP Control Words**

| Control Word (Hex) | Control Word (Dec.) | Action |
|---|---|---|
| 0x0000 | 0 | Control word disabled, Unidrive SP will operate under terminal control |
| 0x0080 | 128 | Disabled |
| 0x0081 | 129 | Enabled, stopped |
| 0x0183 | 387 | Enabled, run fwd, digital speed ref |
| 0x0189 | 393 | Enabled, run rev, digital speed ref |
| 0x0083 | 131 | Enabled, run fwd, analogue speed ref |
| 0x0089 | 137 | Enabled, run rev, analogue speed ref |
| 0x01A1 | 417 | Enabled, run fwd, digital speed ref |
| 0x01B1 | 433 | Enabled, run rev, digital speed ref |
| 0x00A1 | 161 | Enabled, run fwd, analogue speed ref |
| 0x00B1 | 177 | Enabled, run rev, analogue speed ref |
| 0x0085 > 0x0087 | 133 > 135 | Enabled, jog  >  Enabled, jog fwd |
| 0x0085 > 0x008D | 135 > 141 | Enabled, jog  >  Enabled, jog rev |
| Not yet implemented |  | Trip Unidrive SP |
| 0x2080 | 8320 | Reset Unidrive SP into fieldbus control, disabled |
| 0x2000 | 8192 | Reset Unidrive SP into terminal control |

## 6.2 Unidrive SP Status Word

The status word returns the status of multiple functions within the Unidrive SP, e.g. At Speed, Zero Speed, Drive Healthy, etc., and provides a quick method of checking the current status of the Unidrive SP.  The status word is mapped to polled data as #10.40.

| b15 | b14 | b13 | b12b | b11 | b10 | b9 | b8 |
|---|---|---|---|---|---|---|---|
| Not Used | #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 |

The table below 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 Unidrive SP Status Word Bit Functions**

| Bit | Parameter | Description |
|---|---|---|
| 0 | #10.01 | Drive Healthy<br>Indicates the Unidrive SP is not in the trip state. If the Auto-reset feature is being used, this bit is not reset until all auto-resets have been attempted and the next trip occurs. |
| 1 | #10.02 | Drive Active<br>Indicates that the output stage of the Unidrive SP is active. |

**Table 6.3  Unidrive SP Status Word Bit Functions**

| Bit | Parameter | Description |
|---|---|---|
| 2 | #10.03 | Zero Speed<br>In Open Loop mode, Zero Speed indicates that the absolute value of the post-ramp speed reference (#2.01\|) is at or below the zero speed threshold defined by #3.05.<br>In Closed Loop and Servo modes, Zero Speed indicates that the absolute value of speed feedback (#3.02) is at or below the zero speed threshold defined by #3.05. |
| 3 | #10.04 | Running At Or Below Minimum Speed<br>In bipolar mode (#1.10 = 1) #10.04 is the same as Zero Speed, #10.03. (See above.)<br>In unipolar mode, #10.04 is set if the absolute value of the post-ramp speed reference (#2.01) or speed feedback (#3.02) is at or below minimum speed + 0.5Hz, or minimum speed + 5rpm.  (Minimum speed is defined by #1.07.)  This parameter is only set if the Unidrive SP is running. |
| 4 | #10.05 | Below Set Speed<br>Only set if the Unidrive SP is running.  Refer to #3.06, #3.07 and #3.09 in the Unidrive SP Advanced User Guide. |
| 5 | #10.06 | At Speed<br>Only set if the Unidrive SP is running.  Refer to #3.06, #3.07 and #3.09 in the Unidrive SP Advanced User Guide. |
| 6 | #10.07 | Above Set Speed<br>Only set if the Unidrive SP is running.  Refer to #3.06, #3.07 and #3.09 in the Unidrive SP Advanced User Guide. |
| 7 | #10.08 | Load Reached<br>Indicates that the modulus of the active current is greater or equal to the rated active current, as defined in menu 4.  Refer to the Unidrive SP Advanced User Guide for more details. |
| 8 | #10.09 | In Current Limit<br>Indicates that the current limits are active. |
| 9 | #10.10 | Regenerating<br>In Open Loop, Closed Loop Vector and Servo modes, Regenerating indicates that power is being transferred from the motor to the Unidrive SP.<br>In Regen mode, Regenerating indicates that power is being transferred from the supply to the Unidrive SP. |
| 10 | #10.11 | Dynamic Brake Active<br>Indicates that the braking IGBT is active. If the IGBT becomes active, this parameter will remain on for at least one second. |
| 11 | #10.12 | Dynamic Brake Alarm<br>Dynamic Brake Alarm is set when the braking IGBT is active, and the braking energy accumulator is greater than 75%. |
| 12 | #10.13 | Direction Commanded<br>Direction Commanded is set to 1 if the Pre-ramp Speed Reference (#1.03) is negative, and reset to 0 if the Pre-ramp Speed Reference is zero or positive. |
| 13 | #10.14 | Direction Running<br>In Open Loop mode, Direction Running is set to 1 if the Post-ramp Speed Reference (#2.01) is negative, and reset to 0 if the Post-ramp Speed Reference is zero or positive.<br>In Closed Loop Vector and Servo modes, Direction Running is set to 1 if the Speed Feedback (#3.02) is negative, and reset to 0 if the Speed Feedback is zero or positive. |

**Table 6.3 Unidrive SP Status Word Bit Functions**

| Bit | Parameter | Description |
|---|---|---|
| 14 | #10.15 | Mains Loss<br>In Open Loop, Closed Loop Vector and Servo modes, Mains Loss indicates that the drive has detected mains loss from the level of the DC link voltage. This parameter can only become active if mains loss ride through or mains loss stop modes are selected.  Refer to #6.03 in the Unidrive SP Advanced User Guide the for more details.<br>In Regen mode, Mains Loss is the inverse of #3.07.  Refer to the Unidrive SP Advanced User Guide the for more details. |
| 15 | Not Used | Reserved |

# 7 Non-Cyclic Data

CT Mode Single Word non-cyclic data is available on the SM Profibus-DP module. This method uses an additional cyclic data word to implement the Single Word protocol to access any Unidrive SP parameter.

PPO 4 Word non-cyclic data is also available on the SM Profibus-DP module. This method uses 4 cyclic data words to access any Unidrive SP parameter.

**NOTE** As non-cyclic data control is implemented entirely in the Profibus-DP master controller, the method used will depend entirely on the type of master controller used. For this reason, Control Techniques is unable to offer any specific technical support with implementing non-cyclic data transfer for any particular Profibus-DP scanner and PLC combination.

The Unidrive SP Profibus-DP module provides several data formats that allow CT Mode Single Word or PPO 4 Word modes to be used. Refer to section 5.3 for more details.

**Table 7.1  SM Profibus-DP Module Non-Cyclic Data Modes**

| Non-Cyclic Mode | Format | #MM.05 |
|---|---|---|
| Disabled | None | 0PP |
| Mode 1 | CT Single Word | 1PP |
| Mode 2 | PPO 4 Word | 2PP |

The non-cyclic data channel does not use decimal points. For example, in Open Loop mode, 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 Mode 1 - CT Single Word Mode

The CT Single Word Format (Mode 1) of non-cyclic data uses one word for non-cyclic data. The non-cyclic sub-protocol for Unidrive SP requires a specific sequence of 6 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.

### 7.1.1 Mapping For CT Single Word Non-Cyclc Data

To configure an SM Profibus-DP module in slot 3 for CT Single Word Mode non-cyclic data, the following steps must be performed:

1. Select a data format that supports CT Single Word mode. (Refer to section 5.3 for full details.)
2. Set #17.05 to the the required mode.
3. Set #17.32 to ON to reset and reconfigure the SM Profibus-DP module.

When the SM Profibus-DP module re-initialises, it will map polled data IN Word 0 and OUT Word 0 to the CT Single Word protocol parameter, #90.50. All existing mapping parameters will be moved down by 1 word, i.e. the previous mapping set in #17.10 and

#17.20 will now appear in #17.11 and #17.21. The table below shows what happens to the mappings when the data format is changed from 5 Polled Words to 5 Polleds Words with Mode 1 Non-Cyclic Data.

**Table 7.2  CT Single Word Non-Cyclic Data Mapping**

| Mapping Parameter | Before Format Change (#17.05 = 5) | | After Format Change (#17.05 = 105) | |
|---|---|---|---|---|
| | Value | Mapping | Value | Mapping |
| #17.10 | 1040 | #10.40, status word | 9050 | #90.50, CT Single Word parameter |
| #17.11 | 201 | #2.01, post ramp speed reference | 1040 | #10.40, status word |
| #17.12 | 420 | #4.20, motor load as % of rated load | 201 | #2.01, post ramp speed reference |
| #17.13 | 0 | Not mapped | 420 | #4.20, motor load as % of rated load |
| #17.14 to #17.19 | 0 | Not mapped | 0 | Not mapped |
| #17.20 | 642 | #6.42, control word | 9050 | #90.50, CT Single Word parameter |
| #17.21 | 121 | #1.21, digital speed reference 1 | 642 | #6.42, control word |
| #17.22 | 408 | #4.08, torque reference | 121 | #1.21, digital speed reference 1 |
| #17.23 | 0 | Not mapped | 408 | #4.08, torque reference |
| #17.24 to #17.29 | 0 | Not mapped | 0 | Not mapped |

**NOTE**  If all IN or OUT mapping parameters are being used when the data format change is implemented, the last mapping parameter value will be lost.

### 7.1.2  CT Single Word Protocol

All parameter values for Unidrive SP must be written as signed 32-bit data values. Decimal point information is inserted automatically when the data value is written to the Unidrive SP, and removed when the data value is read. Hence, the number of decimal places of the target parameter must be known. Writing a value of 1234 to a parameter with 2 decimal places will produce a value of 12.34 in the target parameter. Similarly, reading a value of 12.34 will return a 32-bit integer value of 1234.

| b15 | b14 | b13 | b12 | b11 | b10 | b9 | b8 |
|---|---|---|---|---|---|---|---|
| READ | ERR | Reserved | 32-BIT | Stamp Number | | | |

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| Data Byte | | | | | | | |

**Table 7.3 CT Single Word Format**

| 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 6 | 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 | 32-BIT | 0 = 16-bit data 1 = 32-bit data | Specifies whether a 16-bit or 32-bit data value is to be written to or read from the Unidrive SP. All data values for Unidrive SP will be returned as 32-bit values |
| 13 | Reserved | 0 | Reserved for future use. Always set to 0 |
| 14 | ERR | 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 | Defines whether the data word is part of a READ or WRITE cycle. |

**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.

### 7.1.3 Reading Parameters Using CT Single Word

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 mid-high data byte.
- Telegram 5 Request mid-low data byte.
- Telegram 6 Request low data byte.

**Figure 7-1 CT Single Word Read Sequence**
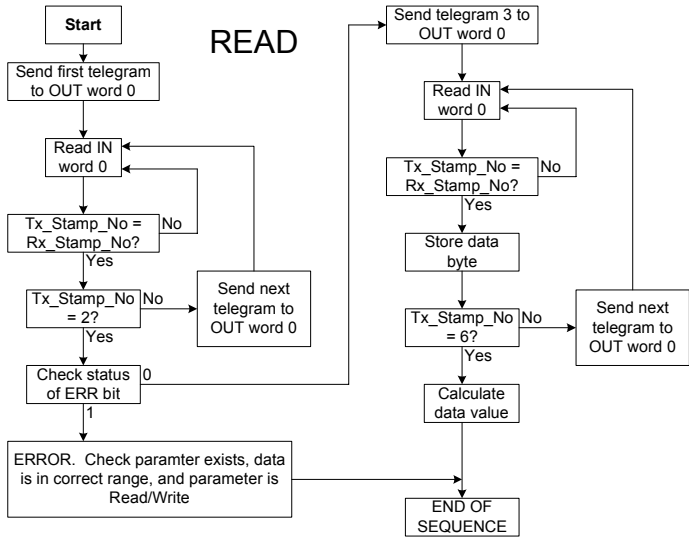


The following example telegrams show how to read the post-ramp speed reference (in rpm with 2 decimal places) from #2.01 in the Unidrive SP.

## 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 | 1001 | 0001 | 0000 | 0010 |

Data word = 0x9102

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 | 1001 | 0010 | 0000 | 0001 |

Data word = 0x9201

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 | 1101 | 0010 | XXXX | XXXX |

Data word = 0xD2XX

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 | 1001 | 0011 | 0000 | 0000 |

Data word = 0x9300

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 | 1001 | 0011 | 0000 | 0000 |

Data word = 0x9300

Stamp number = 3

Data high byte = 0x00 = 0

## TELEGRAM 4

The fourth telegram from the Profibus-DP master acts as the indication to the slave to send the mid-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 | 1001 | 0100 | 0000 | 0000 |

Data word = 0x9400

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 high byte of the parameter value into the data byte.

| Bit | b15-b12 | b11-b8 | b7-b4 | b3-b0 |
|---|---|---|---|---|
| Value | 1001 | 0100 | 0000 | 0001 |

Data word = 0x9401

Stamp number = 4

Data high byte = 0x01 = 1

## TELEGRAM 5

The fifth telegram from the Profibus-DP master acts as the indication to the slave to send the mid-low 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 | 1001 | 0101 | 0000 | 0000 |

Data word = 0x9500

Stamp number = 5

When the fifth 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 mid-low byte of the parameter value into the data byte.

| Bit | b15-b12 | b11-b8 | b7-b4 | b3-b0 |
|---|---|---|---|---|
| Value | 1001 | 0101 | 0010 | 0101 |

Data word = 0x9505

Stamp number = 5

Data high byte = 0x25 = 37

## TELEGRAM 6

The sixth telegram from the Profibus-DP master acts as the indication to the slave to send the low 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 | 1001 | 0110 | 0000 | 0000 |

Data word = 0x9600

Stamp number = 6

When the sixth 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 | 1001 | 0110 | 1101 | 1100 |

Data word = 0x96DC

Stamp number = 6

Data low byte = 0xDC = 220

$$\text{Speed} = (\text{High byte} * 2^{24}) + (\text{Mid-high byte} * 2^{16}) + (\text{Mid-low byte} * 2^{8}) + \text{Low byte}$$
$$= (0 * 16777216) + (1 * 65536) + (37 * 256) + 220$$
$$= 75228$$
$$= 7522.8 \text{ rpm}$$

### 7.1.4 Writing Parameters Using CT Single Word

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 mid-high data byte.
- Telegram 5 Send mid-low data byte.
- Telegram 6 Send low data byte.

**Figure 7-2  CT Single Word Read Sequence**
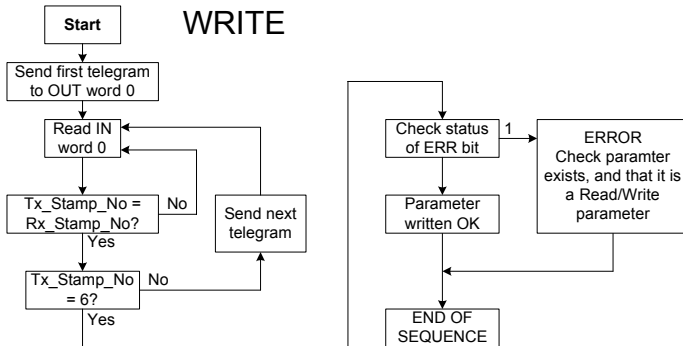


The following example telegrams show how to set the digital speed reference 1 (#1.21) to 12553.9 rpm (32-bit value is 125539) in the Unidrive SP.

**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 | 0001 | 0001 | 0000 | 0001 |

Data word = 0x1101

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 | 0001 | 0010 | 0001 | 0101 |

Data word = 0x1215

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 | 0001 | 0011 | 0000 | 0000 |

Data word = 0x1300

Stamp number = 3

Data high byte = 0x00

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 mid-high data byte for the parameter being written to.

| Bit | b15-b12 | b11-b8 | b7-b4 | b3-b0 |
|---|---|---|---|---|
| Value | 0001 | 0100 | 0000 | 0001 |

Data word = 0x1401

Stamp number = 4

Data mid-high byte = 0x01 = 1

When the fourth 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 fifth telegram can be transmitted.

## TELEGRAM 5

The fifth telegram from the Profibus-DP master has the stamp number set to 5. The data bits contain the mid-low data byte for the parameter being written to.

| Bit | b15-b12 | b11-b8 | b7-b4 | b3-b0 |
|---|---|---|---|---|
| Value | 0001 | 0101 | 1110 | 1010 |

Data word = 0x15EA

Stamp number = 5

Data mid-low byte = 0xEA = 234

When the fifth 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 sixth telegram can be transmitted.

**TELEGRAM 6**

The sixth telegram from the Profibus-DP master has the stamp number set to 6. 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 | 0001 | 0110 | 0110 | 0011 |

Data word = 0x1663

Stamp number = 6

Data low byte = 0x63 = 99

When the sixth telegram has been received and processed in the slave node, it will write the data (#1.21 = 12553.9) as transmitted. (The decimal point is automatically inserted when the data is transferred to the Unidrive SP.) 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 | 0001 | 0110 | 0110 | 0011 |

Data word = 0x1663

Stamp number = 6

Data low byte = 0x63 = 99

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 | 0101 | 0110 | XXXX | XXXX |

Data word = 0x56XX

Stamp number = 6

## 7.1.5 Abort CT Single Word 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 Mode 2 - PPO 4 Word Mode

The PPO 4 Word Format (Mode 2) of non-cyclic data uses 4 cyclic or polled data words for non-cyclic data. This allows any Unidrive SP parameter to accessed using a single combination of data words.

### 7.2.1 Mapping For PPO 4 Word Non-Cyclc Data

To configure an SM Profibus-DP module in slot 3 for PPO 4 Word Mode non-cyclic data, the following steps must be performed:

1. Select a data format that supports PPO 4 Word mode. (Refer to section 5.3.)
2. Set #17.05 to the the required mode.
3. Set #17.32 to ON to reset and reconfigure the SM Profibus-DP module.

When the SM Profibus-DP module re-initialises, it will map IN Words 0 to 3 and OUT Words 0 to 3 to the PPO 4 Word protocol parameter, #90.51. All existing mapping parameters will be moved down by 1 channel, i.e. the previous mappings set in #17.10 and #17.20 will now appear in #17.11 and #17.21 respectively. The table below shows what happens to the mappings when the data format is changed from 10 Polled Words (#MM.05 = 10) to 10 Polleds Words with Mode 2 Non-Cyclic Data. (#MM.05 = 210)

**Table 7.4  PPO 4 Word Mode Mapping**

| Mapping Parameter | Before Format Change (#17.05 = 10) | | After Format Change (#17.05 = 210) | |
|---|---|---|---|---|
| | Value | Mapping | Value | Mapping |
| #17.10 | 1040 | #10.40, status word | 9051 | #90.51, PPO 4 Word parameter |
| #17.11 | 201 | #2.01, post ramp speed reference | 1040 | #10.40, status word |
| #17.12 | 420 | #4.20, motor load as % of rated load | 201 | #2.01, post ramp speed reference |
| #17.13 | 0 | Not mapped | 420 | #4.20, motor load as % of rated load |
| #17.14 to #17.19 | 0 | Not mapped | 0 | Not mapped |
| #17.20 | 642 | #6.42, control word | 9051 | #90.51, PPO 4 Word parameter |
| #17.21 | 121 | #1.21, digital speed reference 1 | 642 | #6.42, control word |
| #17.22 | 408 | #4.08, torque reference | 121 | #1.21, digital speed reference 1 |
| #17.23 | 0 | Not mapped | 408 | #4.08, torque reference |
| #17.24 to #17.29 | 0 | Not mapped | 0 | Not mapped |

**WARNING** If all IN or OUT mapping parameters are being used when the data format change is implemented, the last mapping parameter value will be lost.

## 7.2.2 PPO 4 Word Protocol

Decimal point information is inserted automatically when the data value is written to the Unidrive SP, and removed when the data value is read. Hence, the number of decimal places of the target parameter must be known. Writing a value of 1234 to a parameter with 2 decimal places will produce a value of 12.34 in the target parameter. Similarly, reading a value of 12.34 will return a 32-bit integer value of 1234.

Table 7.5 shows the data structure required on the OUT data to implement PPO 4 Word request.

**Table 7.5 PPO 4 Word OUT Data Structure**

| OUT Data Word | Function | | |
|---|---|---|---|
| | b15-b12 | b11 - b8 | b7-b0 |
| OUT Word 0 | TASK ID | 0000 | MENU |
| OUT Word 1 | PARAMETER | | Reserved |
| OUT Word 2 | DATA HIGH WORD | | |
| OUT Word 3 | DATA LOW WORD | | |

The PPO 4 Word protocol is controlled by the TASK ID and REQUEST ID. The TASK ID specifies the transaction required, and the remainder of the data words carry the data for the transaction. Table 7.6 lists the possible RESPONSE ID codes.

**Table 7.6 TASK ID Codes**

| TASK ID | Function | Description |
|---|---|---|
| 0 | No Task | No non-cyclic transaction required |
| 1 | FIeldbus Specific | |
| 2 | FIeldbus Specific | |
| 3 | FIeldbus Specific | |
| 4 | Not Implemented | Reserved |
| 5 | Not Implemented | Reserved |
| 6 | Request Parameter Value | Read parameter value from Unidrive SP. Specify MENU and PARAMETER, set DATA HIGH WORD and DATA LOW WORD to 0. |
| 7 | Change Parameter Value (16 bit) | Write 16-bit parameter value to Unidrive SP. Specify MENU, PARAMETER and DATA LOW WORD. (Any value in DATA HIGH WORD will be discarded.) This function can be used to write to 32-bit Unidrive SP parameters, but the range of values is limited to 16-bits. |
| 8 | Change Parameter Value (32 bit) | Write 32-bit parameter value to Unidrive SP. Specify MENU, PARAMETER, DATA HIGH WORD and DATA LOW WORD. This function can be used to write to 16-bit Unidrive SP parameters, but if DATA HIGH WORD is not set to 0, a value over-range error will be reported. |
| 9 | Request Last Parameter Reference | Returns the last parameter for the specified menu. Specify MENU. (Values in PARAMETER, DATA HIGH WORD and DATA LOW WORD will be discarded.) |

Table 7.7 shows the data structure of a PPO 4 Word response that will be returned by a SM Profibus-DP module on the IN data.

**Table 7.7  PPO 4 Word IN Data Structure**

| IN Data Word | Function | | |
|---|---|---|---|
| | b15-b12 | b11-b8 | b7-b0 |
| IN Word 0 | RESPONSE ID | 0000 | MENU |
| IN Word 1 | PARAMETER | | |
| IN Word 2 | DATA HIGH WORD | | |
| IN Word 3 | DATA LOW WORD | | |

The RESPONSE ID indicates the success or otherwise of the requested transaction. Table 7.8 lists the possible RESPONSE ID codes.

**Table 7.8  RESPONSE ID Codes**

| RESPONSE ID | Function | Description |
|---|---|---|
| 0 | No Task | No non-cyclic transaction active |
| 1 | Fieldbus Specific | Refer to |
| 2 | Fieldbus Specific | Refer to |
| 3 | Not Implemented | |
| 4 | Transfer Parameter Value (16-bit) | Returns a 16 bit data value from the Request Parameter Value specified by TASK ID 6, or the successful Change Parameter Value (16-bit) specified by TASK ID 7. |
| 5 | Transfer Parameter Value (32-bit) | Returns a 32 bit data value from the Request Parameter Value specified by TASK ID 6, or the successful Change Parameter Value (32-bit) specified by TASK ID 8. |
| 6 | Transfer Last Parameter Reference | Returns the highest parameter for the menu specified by Request Last Parameter Reference, TASK ID 8. |
| 7 | Error - TASK ID Could Not Be Executed | The previously specified TASK ID could not be completed. Word 3 will return an error code to indicate the reason for the TASK ID failure. See Table 7.9 *PPO 4 Word Error Codes* . |
| 8 | Error - Read Only Parameter | Target parameter specified by TASK ID 7 or TASK ID 8  is read only, and cannot be modified. |

If RESPONSE ID 7 has been received, the error code can be read from Word 3.    This will indicate the reason why the TASK ID request failed.

**Table 7.9  PPO 4 Word Error Codes**

| ERROR CODE | Error | Description |
|---|---|---|
| 0 | Invalid Menu | The specified menu does not exist. |
| 1 | Parameter Is Read Only | The specified parameter is read only, and cannot be written to. |
| 2 | Value Out Of Range | The specified data value is out of range for the parameter. |
| 3 | Invalid Parameter | The specified parameter does not exist. |

### 7.2.3 Reading Parameters Using PPO 4 Word

The diagram below shows the sequence of events required to read a Unidrive SP parameter using the PPO 4 Word non-cyclic channel.

**Figure 7-3 PPO 4 Word Read Sequence**
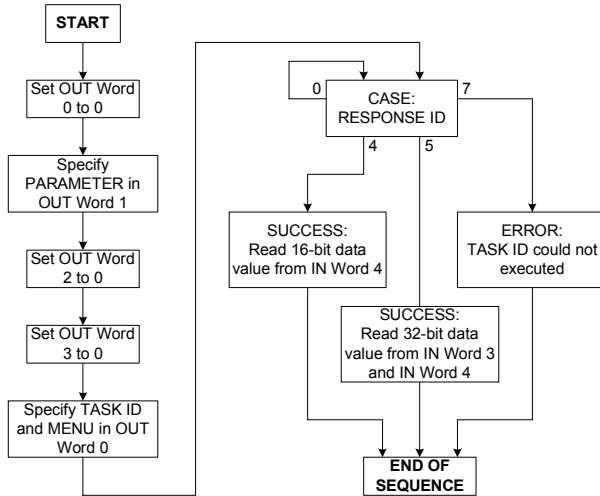


Table 7.10 shows the possible TASK ID and RESPONSE ID combinations that may be seen when attempting to read a parameter value from a Unidrive SP.

**Table 7.10 PPO 4 Word Read TASK ID and RESPONSE ID Combinations**

| Function | TASK ID | RESPONSE ID | Message Status |
|---|---|---|---|
| No Task | 0 | 0 | No message active |
| Request Parameter Value (16 bit) | 6 | 4 | Parameter read successfully, 16 bit value returned in Word 3 |
| Request Parameter Value (32 bit) | 6 | 5 | Parameter read successfully, 32 bit value returned in Words 2 and 3 |
| Request Parameter Value (16 bit) | 6 | 7 | TASK ID 6 could not be executed. Check the error code in IN Word 3 for the reason why. |
| Request Last Parameter Reference) | 9 | 6 | The highest parameter reference in specified menu is available in IN Word 3. |
| Request Last Parameter Reference | 9 | 7 | TASK ID 9 could not be executed. Check the error code in IN Word 3 for the reason why. |

Table 7.11 shows an example set of data words for PPO 4 Word mode. This example will read the value in the post ramp speed reference (#2.01) in the Unidrive SP.

**Table 7.11 PPO 4 Word Read Request Example**

| OUT Data Word | Hex Value | Function | | |
|---|---|---|---|---|
| | | b15-b12 | b11 | b10-b0 |
| OUT Word 0 | 0x6002 | TASK ID = 6 | 0 | MENU = 2 |
| OUT Word 1 | 0x0001 | PARAMETER = 1 | | |
| OUT Word 2 | 0x0000 | DATA HIGH WORD = 0 | | |
| OUT Word 3 | 0x0000 | DATA LOW WORD = 0 | | |

Table 7.12 shows an example successful read response to the read instruction illustrated above.  The value returned is 15284, which equates to 1528.4 rpm.

**Table 7.12  PPO 4 Word Read Response Example**

| IN Data Word | Hex Value | Function | | |
|---|---|---|---|---|
| | | b15-b12 | b11 | b10-b0 |
| IN Word 0 | 0x5002 | RESPONSE ID = 5 | 0 | MENU = 2 |
| IN Word 1 | 0x0001 | PARAMETER = 1 | | |
| IN Word 2 | 0x0000 | DATA HIGH WORD = 0 | | |
| IN Word 3 | 0x3BB4 | DATA LOW WORD = 15284 | | |

### 7.2.4  Writing Parameters Using  PPO 4 Word

The diagram below shows the sequence of events required to write to a Unidrive SP parameter using the PPO 4 Word non-cyclic channel.

**Figure 7-4  PPO 4 Word Write Sequence**
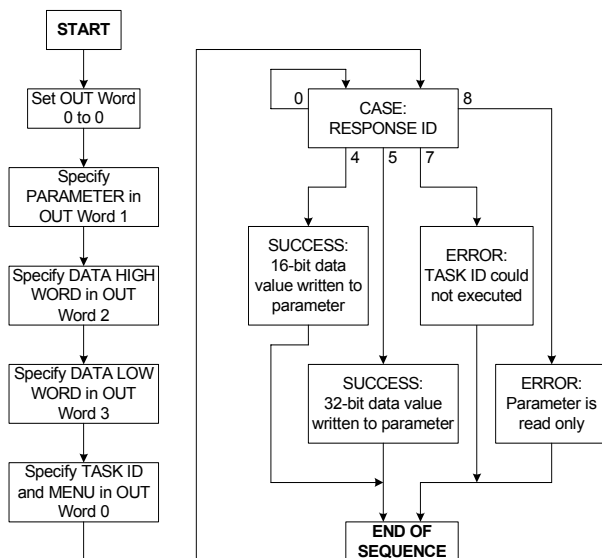


Table 7.13 shows the possible TASK ID and RESPONSE ID combinations that may be seen when attempting to write to the should be expected.

**Table 7.13  PPO 4 Word Write TASK ID and RESPONSE ID Combinations**

| Function | TASK ID | RESPONSE ID | Message Status |
|---|---|---|---|
| No Task | 0 | 0 | No message active |
| Request Parameter Value (16 bit) | 7 | 4 | Parameter (16 bit) written successfully |
| Request Parameter Value (32 bit) | 8 | 5 | Parameter (32 bit) written successfully |

**Table 7.13 PPO 4 Word Write TASK ID and RESPONSE ID Combinations**

| Function | TASK ID | RESPONSE ID | Message Status |
|---|---|---|---|
| Request Parameter Value (16 bit) | 7 | 7 | TASK ID 7 could not be executed. Check the error code in IN Word 3 for the reason why. |
| Request Parameter Value (32 bit) | 8 | 7 | TASK ID 8 could not be executed. Check the error code in IN Word 3 for the reason why. |
| Request Parameter Value (32 bit) | 8 | 8 | Parameter is read only, and cannot be written to. |

Table 7.14 shows an example set of data words for PPO 4 Word mode. This example will write a value of 1553.9 rpm (32-bit value is 15539) to the digital speed reference 1 (#1.21) to in the Unidrive SP.

**Table 7.14 PPO 4 Word Write Request Example**

| OUT Data Word | Hex Value | Function | | |
|---|---|---|---|---|
| | | b15-b12 | b11 | b10-b0 |
| OUT Word 0 | 0x8001 | TASK ID = 8 | 0 | MENU = 1 |
| OUT Word 1 | 0x0015 | PARAMETER = 21 | | |
| OUT Word 2 | 0x0001 | DATA HIGH WORD = 1 | | |
| OUT Word 3 | 0x3CB3 | DATA LOW WORD = 15539 | | |

Table 7.15 shows an example successful write response to the write instruction illustrated above.

**Table 7.15 PPO 4 Word Write Response Example**

| IN Data Word | Hex Value | Function | | |
|---|---|---|---|---|
| | | b15-b12 | b11 | b10-b0 |
| IN Word 0 | 0x5001 | RESPONSE ID = 5 | 0 | MENU = 1 |
| IN Word 1 | 0x0015 | PARAMETER = 21 | | |
| IN Word 2 | 0x0000 | DATA HIGH WORD = 0 | | |
| IN Word 3 | 0x3CB3 | DATA LOW WORD = 15539 | | |

## 7.3  Fieldbus Specific TASK IDs

The PPO 4 Word non-cyclic data is derived from the Variable Speed Drive Profile for Profibus-DP. TASK IDs 2, 3 and 4 are specific to Profibus-DP, and are not used in the SM Profibus-DP module.

## 7.4  Profibus-DP Set-up using Non-Cyclic Data

The SM Profibus-DP module can also be configured using Explicit Data, CT Single Word or PPO 4 Word non-cyclic data. The configuration parameters for the slot in which the SM Profibus-DP module is located can be accessed as #82.PP.

Changes made to the SM Profibus-DP module configuration will not take effect until the module has been reset. The SM Profibus-DP module can be reset by writing a value of 1 to #82.32. A brief interruption in Profibus-DP communications may be seen while the reset sequence is in progess.

# 8 GSD Files

## 8.1 What are GSD Files?

GSD files are text files that are used by Profibus-DP network configuration software tools. They contain information about the device timings, features supported and available data formats for the Profibus-DP device. GSD files are available from your local Control Techniques Drive Centre.

**Table 8.1 Generic EDS Files**

| Drive | GSD File | PNO-Certified |
|-------|----------|---------------|
| Unidrive | CTU_3345.GSD | Yes |
| Mentor II | CTM_3345.GSD | No |
| Commander SE | CTSE04FA.GSD | Yes |
| Unidrive SP | CTSM0672.GSD | Pending |

Drive icon files are also supplied for use with the Profibus-DP configuration software being used. GSD files must usually be installed into the software package being used to configure a Profibus-DP network. Refer to the software documentation for instructions on how to install GSD files. Control Techniques cannot provide specific technical support for any of these software packages.

## 8.2 Data Consistency

There is a potential problem with "data skew" when transferring blocks of data to a Profibus-DP master controller. If the the PLC operating system interrupts the transfer of data to the Profibus-DP master controller, there is a possibility that the master controller will send a Profibus-DP message containing a mixture of "new" and "old" data values. This effect is known as "data skew".

To prevent data skew, Profibus-DP has a feature know as "Data Consistency". Consistent Data defines a block or data words that must ALL be updated in the Profibus-DP master controller before ANY of the "new" data values are transmitted. Consequently, the message sent over the Profibus-DP network will have all "old" or all "new" data values.

Some PLCs have special functions implemented within their operating systems to transfer blocks of "consistent data" to a Profibus-DP master controller, and guarantee that "data skew" cannot occur. For example, the Siemens S7 range of PLCs requires the use of SFC14 and SFC15 to transfer data to a blocks of consistent registers.

### 8.2.1 Using CT Single Word Non-Cyclic Data

CT Single Word non-cyclic data uses only 1 word of data, so there are no problems with consistency. The GSD file provides the "CT Single Word" module which consists of 1 IN/OUT word without consistency.

### 8.2.2 Using PPO 4 Word Non-Cyclic Data

Data consistency is important when using PPO4 Word (Mode 2) non-cyclic data, as each non-cyclic message consists of 4 words. If there is data skew between any of the non-cyclic words, this could result is the wrong data value being written to the wrong parameter.

The GSD file provides the "PPO 4 Word" module which consists of 4 IN/OUT words with consistency.Data Format Specification

## 8.3 Data Configuration

The flexibility of the SM Profibus-DP module allows 2372 different data formats to be configured and used. Obviously, this is too many formats to list in the GSD file, so each data format can be configured using up to 8 different modules. This reduces the number of modules that must be defined in the GSD file to 76 modules.

The total number of cyclic IN and OUT data words configured in the master and the SM Profibus-DP module must be the same to establish communications over Profibus-DP network. If non-cyclic data is required, the non-cyclic "CT Single Word" and/or the "PPO 4 Word" modules must be selected. A total of 8 different modules can be selected to configure the data format required.

### 8.3.1 Using Data Format Parameter (#MM.05)

The Data Format parameter takes the form of #MM.05 = NNCC, where:

NN = non-cyclic mode

CC = number of cyclic data words.

- If non-cyclic data is required, select the module for the desired non-cyclic mode.
- If the data format is specified using #MM.05, the number of IN and OUT cyclic data words will be equal.
- For 1 to 16 cyclic words, simply choose the IN module with the appropriate number of IN words. Repeat for the OUT module.
- For 17 to 32 cyclic words, choose 2 IN modules so that the total number of IN words from both modules is correct. Repeat for the OUT modules.
- If consistency is required, ensure that selected modules are listed as having consistency enabled.

**Table 8.2**

| Data Format (#MM.05) | IN/OUT Cyclic Words | Non-Cyclic Mode | Consistency | Possible Modules |
|---|---|---|---|---|
| 5 | 5 | None | None | 5 IN Words<br>5 OUT Words |
| 30 | 30 | None | None | 16 IN Words<br>14 IN Words<br>16 OUT Words<br>14 OUT Words |
| 109 | 9 | CT Single Word | Full | CT Single Word<br>9 IN Words - Consistency<br>9 OUT Words - Consistency |
| 118 | 18 | CT Single Word | None | CT Single Word<br>6 IN Words<br>12 IN Words<br>6 OUT Words<br>12 OUT Words |
| 210 | 10 | PPO 4 Word | None | PPO 4 Word<br>10 IN Words<br>10 IN Words |
| 224 | 24 | PPO 4 Word | Full | PPO 4 Word<br>16 IN Words - Consistency<br>8 IN Words - Consistency<br>16 OUT Words - Consistency<br>8 OUT Words - Consistency |

### 8.3.2 Using PPO Format Parameter (#MM.38)

When a PPO is selected, the data format is pre-defined by the PROFIDRIVE profile. Simply select the required PPO module, with or without consistency.

**Table 8.3**

| PPO Selected (#MM.38) | Consistency | Modules |
|---|---|---|
| 1 | None | PPO 1 |
| 2 | None | PPO 2 |
| 3 | Full | PPO 3 - Consistency |
| 4 | None | PPO 4 |
| 5 | Full | PPO 5 - COnsistency |

For further details about selecting PPOs, refer to section 10.10.

### 8.3.3 User-defined Data Formats (#MM.39 and #MM.40)

The number of IN words is specified in #MM.39, and the number of OUT words is specified by #MM.40. (See section 10.9 for more details.)

- If non-cyclic data is required, specify the CT Single Word module and/or PPO 4 Word module.
- If CT Single Word mode is used, this will account for 1 IN and 1 OUT word of the cyclic words specified in #MM.39 and #MM.40.
- If PPO 4 Word mode is used, this will account for 4 IN and 4 OUT words of the cyclic data words specified in #MM.39 and #MM.40.
- For IN words, specifiy up to 3 IN modules such that the total number of specified IN data words is equal to the cyclic words remaing when non-cyclic data has been accounted for.
- For OUT words, specifiy up to 3 OUT modules such that the total number of specified IN data words is equal to the cyclic words remaing when non-cyclic data has been accounted for.

**Table 8.4**

| IN Words (#MM.39) | Non-Cyclic Mode | Non-Cyclic Words | IN Cyclic Words | Consistency | Possible Modules |
|---|---|---|---|---|---|
| 5 | None | 0 | 5 | None | 5 IN Words<br>5 OUT Words |
| 12 | CT SIngle Word | 1 | 11 | None | CT Single Word<br>11 IN Words<br>11 OUT Words |
| 18 | None | 0 | 18 | Full | 12 IN Words - Consistency<br>6 IN Words - Consistency<br>12 OUT Words - Consistency<br>6 OUT Words - Consistency |
| 26 | PPO 4 Word | 4 | 22 | None | PPO 4 Word<br>12 IN Words<br>11 IN Words<br>12 OUT Words<br>10 OUT Words |

**Table 8.5**

| OUT Words (#MM.40) | Non-Cyclic Mode | Non-Cyclic Words | OUT Cyclic Words | Consistency | Possible Modules |
|---|---|---|---|---|---|
| 9 | None | 0 | 9 | None | 9 IN Words<br>9 OUT Words |
| 17 | CT SIngle Word | 1 | 16 | None | CT Single Word<br>16 IN Words<br>16 OUT Words |
| 18 | None | 0 | 18 | Full | 9 IN Words - Consistency<br>9 IN Words - Consistency<br>9 OUT Words - Consistency<br>9 OUT Words - Consistency |
| 24 | PPO 4 Word | 4 | 20 | None | PPO 4 Word<br>7 IN Words<br>13 IN Words<br>7 OUT Words<br>13 OUT Words |

# 9 Diagnostics

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

## 9.1 Module ID Code

| Name | Module ID Code | | |
|---|---|---|---|
| Slot 1 | #15.01 | Default | N/A |
| Slot 2 | #16.01 | Range | 0 to 499 |
| Slot 3 | #17.01 | Access | RO |

The Module Code indicates the type of module that is fitted in the corresponding slot. The table below shows the modules available for Unidrive SP.

**Table 9.1  Option Module ID Codes**

| Module Code | Module Type | Category |
|---|---|---|
| 0 | None fitted | None |
| 101 | Resolver | Position Feedback |
| 102 | Intelligent Encoder | Position Feedback |
| 103 | DriveLink | Position Feedback |
| 201 | I/O Expansion | I/O Expansion |
| 301 | SM Applications Plus | Applications Module |
| 302 | SM Application | Applications Module |
| 403 | Profibus-DP | Fieldbus |
| 407 | DeviceNet | Fieldbus |

## 9.2 SM Profibus-DP Firmware Version

| Name | SM Profibus-DP Firmware - Major Version | | |
|---|---|---|---|
| Slot 1 | #15.02 | Default | N/A |
| Slot 2 | #16.02 | Range | 00.00 to 99.99 |
| Slot 3 | #17.02 | Access | RO |

| Name | SM Profibus-DP Firmware  - Minor Version | | |
|---|---|---|---|
| Slot 1 | #15.51 | Default | N/A |
| Slot 2 | #16.51 | Range | 0 to 99 |
| Slot 3 | #17.51 | Access | RO |

The full version of the SM Profibus-DP module firmware version can be read for the corresponding slot.  This manual was written for SM Profibus-DP modules fitted with V0.01.00 firmware.  The table below shows how to construct the full firmware version from these values.

**Table 9.2  SM Profibus-DP Firmware Version**

| Major Version | Minor Version | Firmware Version |
|---|---|---|
| 1.01 | 5 | V1.01.05 |

## 9.3 Profibus-DP Node Address

| Name | Profibus-DP Node Address | | |
|------|--------------------------|---------|-----------|
| Slot 1 | #15.03 | **Default** | 0 |
| Slot 2 | #16.03 | **Range** | 1 to 125 |
| Slot 3 | #17.03 | **Access** | RW |

Every node on a Profibus-DP network must be given a unique network node address. If two or more nodes are assigned the same address, they will attempt to transmit at the same time, leading to corrupt messages on the Profibus-DP network. The SM Profibus-DP module must be reset to make a change of node address take effect.

If an invalid node address is set, the SM Profibus-DP module will reject the configured address, default to 125, and set the Profibus-DP node address (#MM.03) to 125.

## 9.4 Profibus-DP Data Rate

| Name | Profibus-DP Data Rate | | |
|------|-----------------------|---------|---------|
| Slot 1 | #15.04 | **Default** | N/A |
| Slot 2 | #16.04 | **Range** | -1 to 9 |
| Slot 3 | #17.04 | **Access** | RO |

The SM Profibus-DP module will automatically detect the Profibus-DP network data rate, and synchronise to it. For this reason, the data rate is controlled by the Profibus-DP master controller. #MM.04 will indicate the data rate that has been detected by the SM Profibus-DP module.

**NOTE** The Profibus-DP Data Rate parameter can be changed from the Unidrive SP keypad, but this will not affect the data rate at which the SM Profibus-DP module communciates. The Data Rate display will be updated when the Profibus-DP network is re-initialised.

-1 indicates that the SM Profibus-DP module has not detected any activity on the Profibus-DP network, and is waiting for the master controller to start communicating.

**Table 9.3  Profibus-DP Data Rates**

| #MM.04 | bit/s | | #MM.04 | bit/s |
|--------|-------|---|--------|-------|
| -1 | Auto-detecting | | 5 | 187.5k |
| 0 | 12M | | 6 | 93.75k |
| 1 | 6.0M | | 7 | 45.45k |
| 2 | 3.0M | | 8 | 19.2k |
| 3 | 1.5M | | 9 | 9.6k |
| 4 | 500k | | | |

## 9.5 Profibus-DP Network Status

| Name | Profibus-DP Network Status | | |
|------|---------------------------|---------|-----------|
| Slot 1 | #15.06 | Default | N/A |
| Slot 2 | #16.06 | Range | -3 to 9999 |
| Slot 3 | #17.06 | Access | RO |

The Profibus-DP network activity can be monitored in the Profibus-DP Network Status parameter, #MM.06. When the SM Profibus-DP module is communicating successfully with the Profibus-DP master controller, the Profibus-DP Network Status will give an indication of the number of data messages per second that are being processed.

**Table 9.4 Profibus-DP Network Status Codes**

| #MM.06 | Parameter | Description |
|--------|-----------|-------------|
| >0 | Network Healthy | Indicates the number of successful network cycles per second. |
| 0 | Network Healthy, No Data Transfer | Indicates that the Profibus-DP master has established communications with the SM Profibus-DP module. If Network Status changes briefly to -1 and returns to 0, the slave configuration does not match the configuration in the master controller. |
| -1 | Initialised | Indicates that the SM Profibus-DP module has initialised correctly, and is waiting for the Profibus-DP master to initialise communications. |
| -2 | Internal Hardware Failure | Indicates that part of the SM Profibus-DP module initialisation sequence was not successful. If this fault persists after a power cycle, replace the SM Profibus-DP module. |
| -3 | Configuration Error | Indicates that there is an invalid setting in the SM Profibus-DP module configuration parameters. |

## 9.6 Profibus-DP Mapping Conflicts

| Name | Profibus-DP Mapping Status | | |
|------|---------------------------|---------|-----------|
| Slot 1 | #15.49 | Default | 0 |
| Slot 2 | #16.49 | Range | 0 to 255 |
| Slot 3 | #17.49 | Access | RO |

If the Profibus-DP Network Status parameter (#MM.06) indicates -3, a mapping configuration error has been detected. The reason for the error is indicated by the Profibus-DP Mapping Status parameter, #MM.49. When an mapping error has been corrected, reset the SM Profibus-DP module by setting #MM.32 to ON (1).

**Table 9.5 Generic Mapping Error Codes**

| Error | Mapping Status | Description |
|-------|----------------|-------------|
| No Error Detected | 0 | No error detected with IN or OUT data mapping configuration. |
| Direct Data Mapping Error | 2 | Non-cyclic data cannot be used when direct data mapping is enabled. |
| Invalid Non-Cyclic Mode | 3 | An invalid non-cyclic data mode has been selected |
| Multiple Non-Cyclic Modes | 4 | Only 1 non-cyclic mode can be used. More than one has been mapped in the IN and OUT mapping parameters. |
| Multiple Non-Cyclic Mapping Error | 104 | A non-cyclic data mode has been mapped more than once in the IN data mapping configuration parameters. (#MM.10 to #MM.19) |

**Table 9.5 Generic Mapping Error Codes**

| Error | Mapping Status | Description |
|---|---|---|
| Configuration Read Error | 110 | An error has occurred reading the IN data mapping configuration parameters (#MM.10 to #MM.19) from the Unidrive SP. |
| Invalid Source Parameter | 111 | One or more parameters specified in the IN data mapping configuration (#MM.10 to #MM.19) is outside of the allowed range for Profibus-DP. The allowable parameter range is from #0.00 to #199.99. |
| Read Mismatch | 112 | One or more parameters specified in the IN data mapping configuration (#MM.10 to #MM.19) cannot be used as a source parameter for IN data. The parameter may not exist, or is a write-only parameter. |
| Hole In IN Data Mapping Configuration | 113 | IN data mapping parameters (#MM.10 to #MM.19) are not contiguous. It is not possible have an un-used parameter in the middle of the polled/cyclic data. |
| Too Many IN Data Objects Mapped | 120 | After expanding ranges of block mappings, more than 32 IN mappings are defined. |
| Mapping Over Length | 121 | Total size of all IN data mappings has exceeded the total size of the polled/cyclic data. |
| Register Mode Objects Exceeded | 122 | More than 10 cyclic/polled IN data words have been selected with Register Mode. |
| Multiple Non-Cyclic Mapping Error | 204 | A non-cyclic data mode has been mapped more than once in the OUT data mapping configuration parameters. (#MM.20 to #MM.29) |
| Configuration Read Error | 210 | An error has occurred reading the OUT data mapping configuration parameters (#MM.20 to #MM.29) from the Unidrive SP. |
| Invalid Destination Parameter | 211 | One or more parameters specified in the OUT data mapping configuration (#MM.20 to #MM.29) is outside of the allowed range for Profibus-DP. The allowable parameter range is from #0.00 to #199.99. |
| Write Mismatch | 212 | One or more parameters specified in the OUT data mapping configuration (#MM.20 to #MM.29) cannot be used as a destination parameter for OUT data. The parameter may not exist, or is a read-only parameter. This error will also occur if an attempt is made to map OUT data to the configuration parameters of a fieldbus option in another slot, unless that fieldbus module is configured in Register Mode, i.e. #MM.09 = ON (1). |
| Hole In OUT Data Mapping Configuration | 213 | OUT data mapping parameters (#MM.20 to #MM.29) are not contiguous. It is not possible have an un-used parameter in the middle of the polled/cyclic data. |
| Duplicate Mapping Error | 214 | Two or more OUT data mapping comfiguration parameters (#MM.20 to #MM.29) have been configured wit the same destination parameter reference. |
| Too Many OUT Data Objects Mapped | 220 | After expanding ranges of block mappings, more than 32 OUT mappings are defined. |
| Mapping Over Length | 221 | Total size of all OUT data mappings has exceeded the total size of the polled/cyclic data. |
| Register Mode Objects Exceeded | 222 | More than 10 cyclic/polled OUT data words have been selected with Register Mode. |

There are some additional error codes that are specific to the SM Profibus-DP module. These are listed in section 9.6.

**Table 9.6  SM Profibus-DP Module Specific Mapping Error Codes**

| Error | Mapping Status | Description |
|---|---|---|
| Configuration Error | 30 | No data format has been selected.  Data Format (#MM.05), Parameter Process Object (#MM.38) and Profibus-DP IN and OUT Cyclic Words (#MM.39 and #MM.40) are all set to 0. |
| PPO Error | 31 | The pre-defined PPOs (1 to 5) cannot be used when direct data mapping is enabled. |
| PPO and Data Format Error | 32 | PPOs can only be selected if the Data Format parameter (#MM.05) is set to 0. |

## 9.7    Unidrive SP Trip Display Codes

If the SM Profibus-DP module detects an error during operation, it will force a trip on the Unidrive SP.  However, the trip code displayed on the Unidrive SP will only indicate which slot initiated the trip, and not the exact reason for the trip.

The table below shows the possible trip codes that will be displayed on the Unidrive SP when a problem is detected with the SM Profibus-DP module, or when the SM Profibus-DP module inititiates a trip.

**Table 9.7  Unidrive SP Trip Display Codes**

| Slot Where Trip Was Initiated | | | Fault | Description |
|---|---|---|---|---|
| Slot 1 | Slot 2 | Slot 3 | | |
| SL1.HF | SL2.HF | SL3.HF | Hardware Fault | Unidrive SP has detected that an option module is present, but is unable to communicate with it. |
| SL1.tO | SL2.tO | SL3.tO | Watchdog Timeout | Not used by SM Profibus-DP module. |
| SL1.Er | SL2.Er | SL3.Er | Error | User trip generated by the SM Profibus-DP module |
| SL1.nF | SL2.nF | SL3.nF | Not Fitted | SM Profibus-DP module was disconnected while operational, or SM Profibus-DP module has crashed.  This trip will also occur if a Unidrive SP slot is configured for a SM Profibus-DP module, but the module is not fitted in the slot. |
| SL1.dF | SL2.dF | SL3.dF | Different Fitted | The slot configuration parameters stored in the Unidrive SP are not valid Profibus-DP configuration parameters.  This trip will also occur when a SM Profibus-DP module is fitted to a previously un-used slot. |

## 9.8 SM Profibus-DP Trip Code

| Name | SM Profibus-DP Error Code | | |
|---|---|---|---|
| Slot 1 | #15.50 | **Default** | N/A |
| Slot 2 | #16.50 | **Range** | 0 to 255 |
| Slot 3 | #17.50 | **Access** | RO |

If the Profibus-DP module detects an error during operation, it will force a trip the Unidrive SP, and update the Profibus-DP Error Code parameter. The table below shows the Profibus-DP Trip Codes.

**Table 9.8  SM Profibus-DP Trip Codes**

| Error Code | Fault | Description |
|---|---|---|
| 52 | User Control Word Trip | |
| 60 | Hardware Initialisation Error | The Profibus-DP module could not complete the initialisation procedure. |
| 61 | Configuration Error | An invalid configuration has been detected. Refer to #MM.49 for Configuration Error Code |
| 62 | Configuration Changed | |
| 65 | Network Loss | No new messages have been received for the specified Network Loss Trip Time. |
| 70 | FLASH Transfer Error | The Profibus-DP module was unable to upload the configuration parameters from its FLASH memory to the Unidrive SP |
| 74 | SM Profibus-DP Module Overtemperature | When the temperature inside the SM Profibus-DP module exceeds 90 degrees, the SM Profibus-DP module will switch the Unidrive SP to full speed. If the temperature exceeds 100 degress, the SM Profibus-DP module will trip the Unidrive SP. |
| 90 - 99 | Internal Software Fault | If this fault is seen, cycle the power to the Unidrive SP. If fault persists, replace the SM Profibus-DP module. |

# 10 Advanced Features

## 10.1 Profibus-DP Network Loss Trip

| Name | Profibus-DP Network Loss Trip Timeout | | |
|---|---|---|---|
| Slot 1 | #15.07 | **Default** | 200 |
| Slot 2 | #16.07 | **Range** | 0 to 3000 |
| Slot 3 | #17.07 | **Access** | RW |

The SM Profibus-DP module resets an internal timer when a valid message is received from the Profibus-DP network. The trip is triggered when no new messages are received before the timer times out.

The trip is not enabled internally until polled or cyclic data has been detected. This prevents spurious network loss trip while the Profibus-DP master controller is initialising the Profibus-DP network.

**Figure 10-1  Profibus-DP Network Loss Trip**
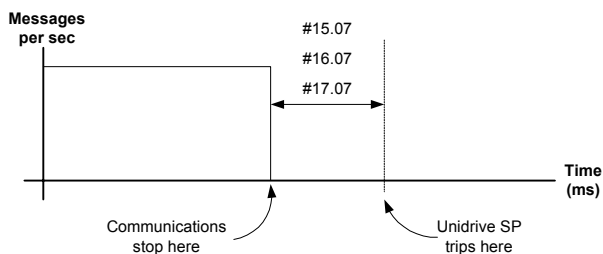


As the trip delay time is reduced, the network loss trip will occur more quickly in the event of a network loss event. However, if the network loss trip time is reduced too far, spurious network loss trips may occur due to time-out occurring before the next message has chance to arrive.

The minimum network loss trip time that can be set depends entirely on the number of messages per second being received under normal operation. As a rough guide, the network loss trip time should be set such that a minimum of 4 messages will be received in the specified time period under normal operating conditions.

**WARNING**

The Network Loss trip can be disabled by setting #15.07, #16.07 or #17.07 to 0, but the Unidrive SP 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.

## 10.2 UT70 Parameters

SM Profibus-DP modules fitted with V0.01.00 firmware do not currently allow direct access to UT70 parameters. This feature will be implemented in future versions of firmware.

If the Profibus-DP mapping is configured to read and write data from and to menu 18, 19 and 20 user parameters in the Unidrive SP, this will allow the UT70 to access the data being transmitted over the Profibus-DP network.

## 10.3    Data Endian Format

| Name | Profibus-DP Data Endian Format | | |
|------|-------------------|------|------|
| Slot 1 | #15.08 | **Default** | OFF |
| Slot 2 | #16.08 | **Range** | OFF (0) or ON (1) |
| Slot 3 | #17.08 | **Access** | RW |

All UT70 parameters (and some Unidrive SP parameters) are 32-bit double word parameters, while most Unidrive SP parameters are 16-bit word parameters.  However, when data is sent over the Profibus-DP network, it is transmitted as 8-bit bytes.  Therefore, when a 32-bit double word or 16-bit word data value is split into four or two 8-bit bytes, it is important that the receiving node reconstructs the received 8-bit bytes correctly to arrive at the 32-bit or 16-bit data value that was originally transmitted.  The order in which 8-bit bytes are transmitted is known as the "Data Endian Format".

| Data Endian Format | #MM.08 | 16-bit Value | 32-bit Value | |
|--------------------|--------|--------------|--------------|---|
| | | **Byte Order** | **Word Order** | **Byte Order** |
| Big | 0 | High byte first<br>Low byte second | High word first<br>Low word second | High byte first<br>Mid high byte second<br>Mid low byte third<br>Low byte fourth |
| Little | 1 | Low byte first<br>High byte second | Low word first<br>High word second | Low byte first<br>Mid low byte second<br>Mid high byte third<br>High byte fourth |

For example, #1.21 (digital speed ref 1) is a 32-bit double word parameter, and is mapped (by default settings) to OUT words 1 and 2.  By default, the SM Profibus-DP module uses the "big endian" data format, so OUT word 1 will contain the high data word, and OUT word 2 will contain the low data word.

Most Profibus-DP master controllers use the "big endian" format by default, and many also allow the "little endian" to be selected.  However, some older PLCs are known to use "little endian" format, and do not offer any facility to select "big endian" format.  Contact the manufacturer of the master controller to be find out which endian format is used

## 10.4    Block Mapping

The Unidrive SP provides 10 mapping parameters each for IN data and OUT data.  However, the SM Profibus-DP module is capable of more than 10 words of IN and OUT data, so "block mapping" is provided to allow these additional words to be mapped.

Block mapping can only be used when mapping data to Unidrive SP user parameters in #18.PP, #19.PP and #20.PP, and UT70 parameters.  If successive mapping parameters are mapped to different higher parameters within the same Unidrive SP user menu or UT70 PLC parameter menu, the mappings will be interpreted as indicating a range of parameters.

### 10.4.1  IN Data

"IN" refers to data as seen by the Profibus-DP master controller.  Hence, IN data is data that is being transmitted from the Unidrive SP to the Profibus-DP master controller.  Consider a Unidrive SP with the following configuration:

•    Slot 1 - UT70 module.
•    Slot 2 - UT70 module.

- Slot 3 - SM Profibus-DP module, configured for Data Format = 28.

**Table 10.1 IN Data Block Mapping Example**

| Mapping Parameter | Target Parameter | Data Width | Description |
|---|---|---|---|
| #15.10 | #10.40 | 16-bit | Status word |
| #15.11 | #2.01 | 32-bit | Post-ramp speed reference (32-bit parameter in Unidrive SP) |
| #15.12 | #4.20 | 16-bit | Motor load as % or rated speed |
| #15.13 | #18.11 | 8*16-bit | Block mapping of 8 * 16-bit words to Unidrive SP parameters #18.11 to #18.18 |
| #15.14 | #18.18 | | |
| #15.15 | #20.21 | 5*32-bit | Block mapping of 5 * 32-bit words to Unidrive SP parameters #20.21 to #20.25 |
| #15.16 | #20.25 | | |
| #15.17 | 0 | ---- | Not mapped |
| #15.18 | 0 | ---- | Not mapped |
| #15.19 | 0 | ---- | Not mapped |

**Table 10.2 IN Data Block Mapping Data Structure Example**

| Data Word | Target Parameter | Data Word | Target Parameter |
|---|---|---|---|
| Word 0 | #10.40 | Word 12,13 | #20.21 |
| Word 1,2 | #2.01 | Word 14,15 | #20.22 |
| Word 3 | #4.20 | Word 16,17 | #20.23 |
| Word 4 | #18.11 | Word 18,19 | #20.24 |
| Word 5 | #18.12 | Word 20,21 | #20.25 |
| Word 6 | #18.13 | Word 22 | Not mapped |
| Word 7 | #18.14 | Word 23 | Not mapped |
| Word 8 | #18.15 | Word 24 | Not mapped |
| Word 9 | #18.16 | Word 25 | Not mapped |
| Word 10 | #18.17 | Word 26 | Not mapped |
| Word 11 | #18.18 | Word 27 | Not mapped |

### 10.4.2 OUT Data

"OUT" refers to cyclic data as seen by the Profibus-DP master controller. Hence, OUT data is data that is being transmitted from the Profibus-DP master controller to the Unidrive SP. Consider a Unidrive SP with the following configuration:

- Slot 1 - UT70 module.
- Slot 2 - UT70 module.
- Slot 3 - SM Profibus-DP module, configured for Data Format = 28.

**Table 10.3 OUT Data Block Mapping Example**

| Mapping Parameter | Target Parameter | Data Width | Description |
|---|---|---|---|
| #15.20 | #6.42 | 16-bit | Control word |
| #15.21 | #1.21 | 32-bit | Digital speed reference 1 |
| #15.22 | #4.08 | 32-bit | Torque reference |
| #15.23 | #19.15 | 9*16-bit | Block mapping of 9 * 16-bit words to Unidrive SP parameters #19.15 to #19.23 |
| #15.24 | #19.23 | | |
| #15.25 | #20.31 | 6*32-bit | Block mapping of 6 * 32-bit words to Unidrive SP parameters #20.31 to #20.36 |
| #15.26 | #20.36 | | |

**Table 10.3  OUT Data Block Mapping Example**

| Mapping Parameter | Target Parameter | Data Width | Description |
|---|---|---|---|
| #15.27 | 0 | ---- | Not mapped |
| #15.28 | 0 | ---- | Not mapped |
| #15.29 | 0 | ---- | Not mapped |

**Table 10.4  OUT Data Block Mapping Data Structure Example**

| Data Word | Target Parameter | Data Word | Target Parameter |
|---|---|---|---|
| Word 0 | #6.42 | Word 12 | #19.22 |
| Word 1,2 | #1.21 | Word 13 | #19.23 |
| Word 3,4 | #4.08 | Word 14,15 | #20.31 |
| Word 5 | #19.15 | Word 16,17 | #20.32 |
| Word 6 | #19.16 | Word 18,19 | #20.33 |
| Word 7 | #19.17 | Word 20,21 | #20.34 |
| Word 8 | #19.18 | Word 22,23 | #20.35 |
| Word 9 | #19.19 | Word 24,25 | #20.36 |
| Word 10 | #19.20 | Word 26 | Not mapped |
| Word 11 | #19.21 | Word 27 | Not mapped |

**NOTE** When mapping to a 32 bit parameter, one word will contain the high data word and the other word will contain the low data word.  The order in which the data words are received depends on the Endian Format used by the SM Profibus-DP module.  Refer to section 10.3 for more details.

## 10.5  Direct Data Mapping

| Name | Direct Mapping Enable | | |
|---|---|---|---|
| Slot 1 | #15.09 | Default | OFF (0) |
| Slot 2 | #16.09 | Range | OFF (0) or ON (1) |
| Slot 3 | #17.09 | Access | RW |

By default, #MM.10 to #MM.29 are used as pointers to specify the destination parameter for OUT data received from the master controller, and the source parameter of IN data to be transmitted to the master controller.

When Direct Data Mapping is enabled, #MM.10 to #MM.29 are used as the actual destination and source parameters for OUT data and IN data respectively.  Hence, OUT data values arriving from the PLC will be written directly into #MM.20 to #MM.29.

**NOTE** CT Single Word and PPO 4 Word non-cyclic data modes cannot be used when Direct Data Mapping mode is enabled.

When Direct Data Mapping mode is enabled, all mapping parameters (#MM.10 to #MM.29) will be reset to 0.

**Table 10.5  Direct Data Mapping Configurations**

| #MM.05 | #MM.38 | #MM.39, #MM.40 | Description |
|---|---|---|---|
| 1 to 10 | 0 | ---- | The first 10 OUT words will be written directly to #MM.20 to #MM.29, and the first 10 IN words will be read directly from #MM.10 to #MM.19. |
| 0 | 0 | 0 to 10 | |

**Table 10.5  Direct Data Mapping Configurations**

| #MM.05 | #MM.38 | #MM.39, #MM.40 | Description |
|---|---|---|---|
| 11 to 32 | 0 | ---- | Cyclic data is limited to 10 IN and 10 OUT cyclic data words. Network Status will indicate -3, and Mapping Status will indicate 122 or 222. Refer to section 9.6. |
| 0 | 0 | 11 to 32 | |
| 100 to 131 200 to 228 | 0 | ---- | Non-cyclic data cannot be used in Direct Data Mapping mode. Network Status will indicate -3, and Mapping Error Code will indicate 2. Refer to section 9.6. |
| 0 | 1 to 5 | ---- | Direct Data Mapping mode cannot be used with pre-defined Parameter Process Objects. Network Status will indicate -3, and Mapping Status will indicate 4. Refer to section 9.6. |

## 10.6  Menu 82 - Local Option Module Parameter Access

The menu used to configure the SM Profibus-DP module depends on the slot in the Unidrive SP where the SM Profibus-DP module is fitted. Menu 82 can be used to ensure that the Profibus-DP configuration parameters can be accessed without necessarily knowing in which Unidrive SP slot the SM Profibus-DP module is fitted.

When a Menu 82 parameter is accessed from Profibus-DP, the SM Profibus-DP module will re-direct it to the menu in the Unidrive SP that is associated with the slot where the SM Profibus-DP module is fitted.

**Table 10.6  Local Slot Configuration Parameter Access**

| Parameter | SM Profibus-DP module in Slot 1 | SM Profibus-DP module in Slot 2 | SM Profibus-DP module in Slot 3 |
|---|---|---|---|
| #82.01 - #82.51 | #15.01 - #15.51 | #16.01 - #16.51 | #17.01 - #17.51 |

Menu 82 parameters are only accessible from the Profibus-DP network using explicit or non-cyclic data.

## 10.7  Restore SM Profibus-DP Defaults

| Name | Restore SM Profibus-DP Defaults | | |
|---|---|---|---|
| Slot 1 | #15.30 | **Default** | OFF (0) |
| Slot 2 | #16.30 | **Range** | OFF (0) or ON (1) |
| Slot 3 | #17.30 | **Access** | RW |

If the SM Profibus-DP module detects that the Unidrive SP has been restored to default values, it will over-write the slot configuration parameters with the Profibus-DP default values.

| NOTE | If the stored values in the Unidrive SP are for a different type of fieldbus interface, the SM Profibus-DP module will trip "SLx.DF" with Error Code 70. It will over-write the parameter values with the Profibus-DP default values, but will NOT store these values in the Unidrive SP. |
|---|---|

#MM.30 specifies whether the default values should be written to the SM Profibus-DP FLASH memory. If #MM.30 is set to ON, the default values will be written into the SM Profibus-DP module FLASH memory.

The full sequence of events to restore default settings for a SM Profibus-DP module fitted in slot 3 is as follows:

1. Set #17.00 to 1233 to restore European defaults to the Unidrive SP.
2. Profibus-DP communications will be stopped.
3. The Unidrive SP will load and store its default parameter values.

4. The SM Profibus-DP module will overwrite all #17.PP parameters with Profibus-DP default values.
5. If #17.30 is set to ON (1), the Profibus-DP default parameter values will be stored in the SM Profibus-DP module FLASH memory.
6. The SM Profibus-DP module will reset and re-initialise using the default values.

## 10.8 Restore Previous SM Profibus-DP Configuration

| Name | Upload from SM Profibus-DP FLASH Memory | | |
|---|---|---|---|
| Slot 1 | #15.33 | **Default** | OFF (0) |
| Slot 2 | #16.33 | **Range** | OFF (0) or ON (1) |
| Slot 3 | #17.33 | **Access** | RW |

If Profibus-DP configuration parameters have been stored in the SM Profibus-DP module FLASH memory, these values can be restored to the Unidrive SP. When the parameter values have been uploaded to the Unidrive SP, the SM Profibus-DP module will reset and re-configure using the updated parameter values.

This feature allows a pre-configured SM Profibus-DP module to be fitted to a Unidrive SP without losing the Profibus-DP configuration.

**NOTE** If the SM Profibus-DP module is unable to upload the configuration parameters to the Unidrive SP, or configuration parameters have never been stored in the SM Profibus-DP FLASH memory, the Unidrive SP will trip "SLx.ER" with a Trip Code of 70.

When #MM.33 is set to ON, the Profibus-DP module will transfer the configuration parameters from its FLASH memory to the Unidrive SP, over-writing the existing values in the Unidrive SP.

The full sequence of events for restoring values from a SM Profibus-DP module fitted in slot 3 is as follows:
1. Set #17.33 to ON.
2. Profibus-DP communications will be stopped.
3. The SM Profibus-DP module will overwrite all #17.PP parameters with the Profibus-DP values stored in its internal FLASH memory.
4. #17.33 will be reset to OFF.
5. The SM Profibus-DP module will reset and re-initialise using the default values.

**NOTE** This procedure will NOT store the updated Unidrive SP parameters.

## 10.9 Custom Profibus-DP Data Formats

| Name | Profibus-DP IN Cyclic Words | | |
|---|---|---|---|
| Slot 1 | #15.39 | **Default** | 5 |
| Slot 2 | #16.39 | **Range** | 0 to 32 |
| Slot 3 | #17.39 | **Access** | RW |

| Name | Profibus-DP OUT Cyclic Words | | |
|---|---|---|---|
| Slot 1 | #15.40 | **Default** | 5 |
| Slot 2 | #16.40 | **Range** | 0 to 32 |
| Slot 3 | #17.40 | **Access** | RW |

If the number of cyclic words is specified using the Profibus-DP Data Format parameter, #MM.05, the number of IN and OUT cyclic words will be the same. (See section 5.3) #MM.389 and #MM.40 will alsways display the current number of IN and OUT cyclic data words being used.

When the Profibus-DP Data Format (#MM.05) and the PPO Type (#MM.38) are both set to 0, the number of IN and OUT data words can be specified separately in #MM.39 and #MM.40 respectively. This allows different numbers of IN and OUT cyclic data words to be specified.

CT Single Word or PPO 4 Word non-cyclic data can also be enabled by mapping IN and OUT words to the appropriate source/destination parameter.

**Table 10.7 Customised Non-Cyclic Channel Mapping**

| Source/Destination Parameter | Non-Cyclic Mode | Description |
|---|---|---|
| #90.50 | CT Single Word | 1 IN and 1 OUT word must be assigned for use as the CT Single Word non-cyclic channel. |
| #90.51 | PPO 4 Word | 4 IN and 4 OUT words must be assigned for use as the PPO 4 Word non-cyclic channel. |

## 10.10   PPO Types

| Name | Parameter Process Data Object (PPO) | | |
|---|---|---|---|
| Slot 1 | #15.38 | **Default** | 0 |
| Slot 2 | #16.38 | **Range** | 0 to 5 |
| Slot 3 | #17.38 | **Access** | RW |

All defined Parameter Process Data Objects (PPOs) are supported by the SM Profibus-DP module. Each PPO defines the IN and OUT data format, so it is not possible to have different IN and OUT PPOs configured at the same time.

NOTE  Full details about supported aspects of the PROFIDRIVE profile will be included in later versions of this manual. For further details about the PROFIDRIVE profile and Parameter Process Objects, please refer to the Profibus web site at www.profibus.com.

The data formats of the PPOs are shown in Table 10.8.

**Table 10.8 PPO Formats**

| PPO Mode (#MM.38) | Total Words | Non-Cyclic Mode | Cyclic Words |
|---|---|---|---|
| 0 | Mapping dependant | Mapping dependant | Specified by #MM.39 and #MM.40 |
| 1 | 6 | PPO 4 Word | 2 |
| 2 | 10 | PPO 4 Word | 6 |
| 3 | 2 | None | 2 |
| 4 | 6 | None | 6 |
| 5 | 14 | PPO 4 Word | 10 |

The data mapping for the first 2 IN and OUT cyclic data words in each PPO is fixed and cannot be changed. However, if a PPO has additional cyclic data words included, these IN and OUT words can be mapped as normal using the IN and OUT data mapping parameters. (See section 5.3.)

NOTE  A single mapping parameter will map 2 cyclic words if the target parameter specified is a 32 bit parameter. See section 5.2 for a list of 32 bit parameters.

When a PPO data word has fixed mapping, the corresponding mapping parameter will indicate -1. This shows that the word is in use for a PPO, and the mapping cannot be modified.

When a PPO is selected, existing mappings are over-written by the PPO fixed mappings. The table below shows the change in a set of mapping parameters when the SM Profibus-DP module configuration is changed from 10 Cyclic Words with PPO 4 Word (Mode 2) non-cyclic data to PPO 5. The actual data format over the Profibus-DP remains the same, but the mapping for the first 6 words in PPO5 mode are fixed.

**Table 10.9 CT Single Word Non-Cyclic Data Mapping**

| Mapping Parameter | Before Format Change (#17.05 = 210) | | After Format Change (#17.05 = 0, #17.38 = 5)) | |
|---|---|---|---|---|
| | Value | Mapping | Value | Mapping |
| #17.10 | 9051 | PPO 4 Word non-cyclic data | -1 | PPO 4 Word non-cyclic data |
| #17.11 | 1040 | #10.40, status word | -1 | Profibus-DP status word |
| #17.12 | 201 | #2.01, post ramp speed ref | -1 | Profibus-DP speed feedback |
| #17.13 | 420 | #4.20, motor load as % of rated load | 420 | #4.20, motor load as % of rated load |
| #17.14 | 1401 | #14.01, PID output | 1401 | #14.01, PID output |
| #17.15 | 401 | #4.01, motor current | 401 | #4.01, motor current |
| #17.15 to #17.19 | 0 | Not mapped | 0 | Not mapped |
| #17.20 | 9051 | PPO 4 Word non-cyclic data | -1 | PPO 4 Word non-cyclic data |
| #17.21 | 642 | #6.42, control word | -1 | Profibus-DP control word |
| #17.22 | 121 | #1.21, digital speed ref 1 | -1 | Profibus-DP speed reference |
| #17.23 | 408 | #4.08, torque reference | 408 | #4.08, torque reference |
| #17.24 | 1410 | #14.10, PID loop P gain | 1410 | #14.10, PID loop P gain |
| #17.25 to #17.29 | 0 | Not mapped | 0 | Not mapped |

## 10.10.1 PPO 1

| OUT Data Word | Function |
|---|---|
| OUT Word 0 | PPO 4 Word Non-Cyclic data See section 7.2 |
| OUT Word 1 | |
| OUT Word 2 | |
| OUT Word 3 | |
| OUT Word 4 | Profibus-DP Control Word |
| OUT Word 5 | Main Setpoint |

| IN Data Word | Function |
|---|---|
| IN Word 0 | PPO 4 Word Non-Cyclic data See section 7.2 |
| IN Word 1 | |
| IN Word 2 | |
| IN Word 3 | |
| IN Word 4 | Profibus-DP Status Word |
| IN Word 5 | Main Actual Value |

**10.10.2 PPO 2**

| OUT Data Word | Function |
|---|---|
| OUT Word 0 | PPO 4 Word Non-Cyclic data<br>See section 7.2 |
| OUT Word 1 | |
| OUT Word 2 | |
| OUT Word 3 | |
| OUT Word 4 | Profibus-DP Control Word |
| OUT Word 5 | Main Setpoint |
| OUT Word 6 | |
| OUT Word 7 | |
| OUT Word 8 | |
| OUT Word 9 | |

| IN Data Word | Function |
|---|---|
| IN Word 0 | PPO 4 Word Non-Cyclic data<br>See section 7.2 |
| IN Word 1 | |
| IN Word 2 | |
| IN Word 3 | |
| IN Word 4 | Profibus-DP Status Word |
| IN Word 5 | Main Actual Value |
| IN Word 6 | |
| IN Word 7 | |
| IN Word 8 | |
| IN Word 9 | |

**10.10.3 PPO 3**

| OUT Data Word | Function |
|---|---|
| OUT Word 0 | Profibus-DP Control Word |
| OUT Word 1 | Main Setpoint |

| IN Data Word | Function |
|---|---|
| IN Word 0 | Profibus-DP Status Word |
| IN Word 1 | Main Actual Value |

### 10.10.4 PPO 4

| OUT Data Word | Function |
|---|---|
| OUT Word 0 | Profibus-DP Control Word |
| OUT Word 1 | Main Setpoint |
| OUT Word 2 | |
| OUT Word 3 | |
| OUT Word 4 | |
| OUT Word 5 | |

| IN Data Word | Function |
|---|---|
| IN Word 0 | Profibus-DP Control Word |
| IN Word 1 | Main Actual Value |
| IN Word 2 | |
| IN Word 3 | |
| IN Word 4 | |
| IN Word 5 | |

### 10.10.5 PPO 5

| OUT Data Word | Function |
|---|---|
| OUT Word 0 | PPO 4 Word Non-Cyclic data See section 7.2 |
| OUT Word 1 | |
| OUT Word 2 | |
| OUT Word 3 | |
| OUT Word 4 | Profibus-DP Control Word |
| OUT Word 5 | Main Setpoint |
| OUT Word 6 | |
| OUT Word 7 | |
| OUT Word 8 | |
| OUT Word 9 | |
| OUT Word 10 | |
| OUT Word 11 | |
| OUT Word 12 | |
| OUT Word 13 | |

| IN Data Word | Function |
|---|---|
| IN Word 0 | PPO 4 Word Non-Cyclic data See section 7.2 |
| IN Word 1 | |
| IN Word 2 | |
| IN Word 3 | |
| IN Word 4 | Profibus-DP Status Word |
| IN Word 5 | Main Actual Value |
| IN Word 6 | |
| IN Word 7 | |

| IN Data Word | Function |
|---|---|
| IN Word 8 | |
| IN Word 9 | |
| IN Word 10 | |
| IN Word 11 | |
| IN Word 12 | |
| IN Word 13 | |

# 11 Quick Reference

## 11.1 Complete Parameter Reference

**Table 11.1**

| Slot 1 | Slot 2 | Slot 3 | Default | Description |
|--------|--------|--------|---------|-------------|
| #15.01 | #16.01 | #17.01 | ---- | Module ID Code |
| #15.02 | #16.02 | #17.02 | ---- | Major Firwmare Version |
| #15.03 | #16.03 | #17.03 | 0 | Node Address |
| #15.04 | #16.04 | #17.04 | ---- | Data Rate |
| #15.05 | #16.05 | #17.05 | 5 | Data Format |
| #15.06 | #16.06 | #17.06 | ---- | Network Status |
| #15.07 | #16.07 | #17.07 | 200 | Network Loss Trip Timeout |
| #15.08 | #16.08 | #17.08 | OFF (0) | Endian Format Select |
| #15.09 | #16.09 | #17.09 | OFF (0) | Direct Data Mapping Enable |
| #15.10 | #16.10 | #17.10 | 1040 | IN Mapping 0 |
| #15.11 | #16.11 | #17.11 | 201 | IN Mapping 1 |
| #15.12 | #16.12 | #17.12 | 420 | IN Mapping 2 |
| #15.13 | #16.13 | #17.13 | 0 | IN Mapping 3 |
| #15.14 | #16.14 | #17.14 | 0 | IN Mapping 4 |
| #15.15 | #16.15 | #17.15 | 0 | IN Mapping 5 |
| #15.16 | #16.16 | #17.16 | 0 | IN Mapping 6 |
| #15.17 | #16.17 | #17.17 | 0 | IN Mapping 7 |
| #15.18 | #16.18 | #17.18 | 0 | IN Mapping 8 |
| #15.19 | #16.19 | #17.19 | 0 | IN Mapping 9 |
| #15.20 | #16.20 | #17.20 | 642 | OUT Mapping 0 |
| #15.21 | #16.21 | #17.21 | 121 | OUT Mapping 1 |
| #15.22 | #16.22 | #17.22 | 408 | OUT Mapping 2 |
| #15.23 | #16.23 | #17.23 | 0 | OUT Mapping 3 |
| #15.24 | #16.24 | #17.24 | 0 | OUT Mapping 4 |
| #15.25 | #16.25 | #17.25 | 0 | OUT Mapping 5 |
| #15.26 | #16.26 | #17.26 | 0 | OUT Mapping 6 |
| #15.27 | #16.27 | #17.27 | 0 | OUT Mapping 7 |
| #15.28 | #16.28 | #17.28 | 0 | OUT Mapping 8 |
| #15.29 | #16.29 | #17.29 | 0 | OUT Mapping 9 |
| #15.30 | #16.30 | #17.30 | 0 | Restore SM Profibus-DP Defaults |
| #15.31 | #16.31 | #17.31 | 0 | Store to SM Profibus-DP FLASH Memory |
| #15.32 | #16.32 | #17.32 | 0 | Reset SM Profibus-DP Module |
| #15.33 | #16.33 | #17.33 | 0 | Restore Previous Configuration from SM Profibus-DP FLASH memory |
| #15.34 | #16.34 | #17.34 | 0 | Reserved |
| #15.35 | #16.35 | #17.35 | ---- | Serial Number |
| #15.36 | #16.36 | #17.36 | 0 | Reserved |
| #15.37 | #16.37 | #17.37 | 0 | |
| #15.38 | #16.38 | #17.38 | 0 | PPO Selected |
| #15.39 | #16.39 | #17.39 | 5 | IN Cyclic Data Words |

**Table 11.1**

| Slot 1 | Slot 2 | Slot 3 | Default | Description |
|--------|--------|--------|---------|-------------|
| #15.40 | #16.40 | #17.40 | 5 | OUT Cyclic Data Words |
| #15.41 | #16.41 | #17.41 | 0 | Reserved |
| #15.42 | #16.42 | #17.42 | 0 | |
| #15.43 | #16.43 | #17.43 | 0 | |
| #15.44 | #16.44 | #17.44 | 0 | |
| #15.45 | #16.45 | #17.45 | 0 | |
| #15.46 | #16.46 | #17.46 | 0 | |
| #15.47 | #16.47 | #17.47 | 0 | |
| #15.48 | #16.48 | #17.48 | 0 | |
| #15.49 | #16.49 | #17.49 | ---- | SM Profibus-DP Mapping Conflicts |
| #15.50 | #16.50 | #17.50 | ---- | SM Profibus-DP Trip Codes |
| #15.51 | #16.51 | #17.51 | ---- | Minor Firmware Version |