



FIELDBUS APPENDIX PROFIBUS DP

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1 Fieldbus Introduction

This section provides information about the Profibus organisation and network.

1.1 Introduction to Profibus-DP

Profibus has an international user organisation called Profibus International, PI, and local national organisations, PNO.

Technical questions regarding the fieldbus should be addressed to your local Profibus User Group in the first instance. Address list is available on the Profibus Internet site; www.Profibus.com. For general help on Profibus, contact Profibus International on e-mail; Profibus_international@compuserve.com.

Profibus-DP is normally used in industrial automation, to transfer fast data for motor controllers, MMI, I/O units and other industrial equipment.

1.2 Network Overview

The media for the fieldbus is a shielded copper cable consisting of a twisted pair. The baudrate for the bus is between 9.6kbaud to max. 12Mbaud. The Profibus-DP network can consist of 126 nodes and the total amount of data for Profibus-DP are 244 Byte out per module and 244 Byte in per module.

PLEASE NOTE: Node No. 126 is only used for commissioning purposes and should not be used to exchange user data.

The figure below gives an overview of a Profibus-DP network.

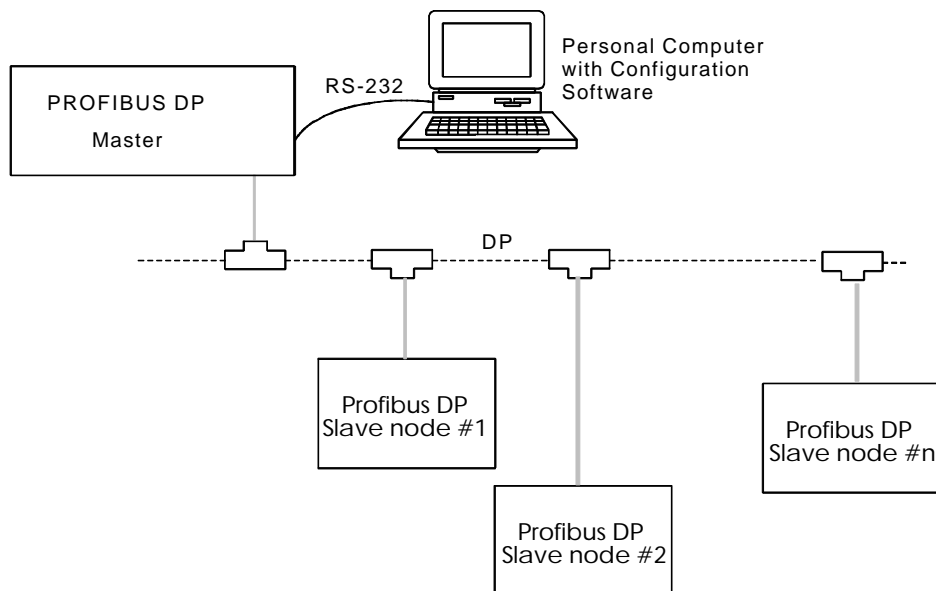


Figure 1. PROFIBUS-DP Overview



1.3 Technical Features for Profibus-DP

The table below gives a summary of the technical features and the figure on the next side shows the bus cycle time of a Profibus-DP system.

Summary Technical Features PROFIBUS-DP	
Transmission Technique: PROFIBUS DIN 19245 Part 1	<ul style="list-style-type: none"> EIA RS 485 twisted pair cable or fibre optic kbit/s up to 12 Mbit/s, max. distance 200m at 1.5 Mbit/s extendible with repeaters
Medium Acces: hybrid medium access protocol according to DIN 19245 Part 1	<ul style="list-style-type: none"> Mono-Master or Multi-Master systems supported Master and Slave Devices, max. 126 stations possible
Communications: Peer-to-Peer (user data transfer) or Multicast (synchronisation)	<ul style="list-style-type: none"> Cyclic Master-Slave transfer and acyclic Master-Master data transfer
Operation Modes:	<ul style="list-style-type: none"> Operate: cyclic transfer of input and output data Clear: inputs are read and outputs are cleared Stop: only Master-Master functions are possible
Synchronization: enables synchronization of the inputs and/or outputs of all DP-Slaves	<ul style="list-style-type: none"> Sync-Mode: Outputs are synchronized Freeze-Mode: Inputs are synchronized
Functionality:	<ul style="list-style-type: none"> Cyclic user data transfer between DP-Master(s) and DP-Slave(s) Activation or deactivation of individual DP-Slaves Checking of the configuration of the DP-Slaves Powerful diagnosis mechanisms, 3 hierarchichal levels of the diagnosis messages Synchronization of inputs and/or outputs Address assignments for the DP-Slaves over the bus with Master class 2 Configuration of the DP-Master (DPM1) over the bus Max. 244 bytes input and output data per DP-Slave, typical 32 bytes
Security and protection mechanisms:	<ul style="list-style-type: none"> All messages are transmitted with Hamming Distance HD=4 Watch-Dog Timer at the DP-Slaves Access protection for the inputs/outputs at the DP-Slaves Data transfer monitoring with configurable timer interval at the DP-Master (DPM1)
Cabling and Installation:	<ul style="list-style-type: none"> Connecting or disconnecting of stations without affection of other stations



2 Module Overview

This section provides an overview over the Profibus-DP Communications Adapter module.

2.1 Mechanical Overview

The module for Profibus-DP is a slave node that can be read and written to, from a Profibus-DP master. The Communications Adapter will not initiate communication to other nodes, it will only respond to incoming commands. The Adapter is connected to the application via the Application Connector. Via this connector the application has an instant connection to Profibus-DP.

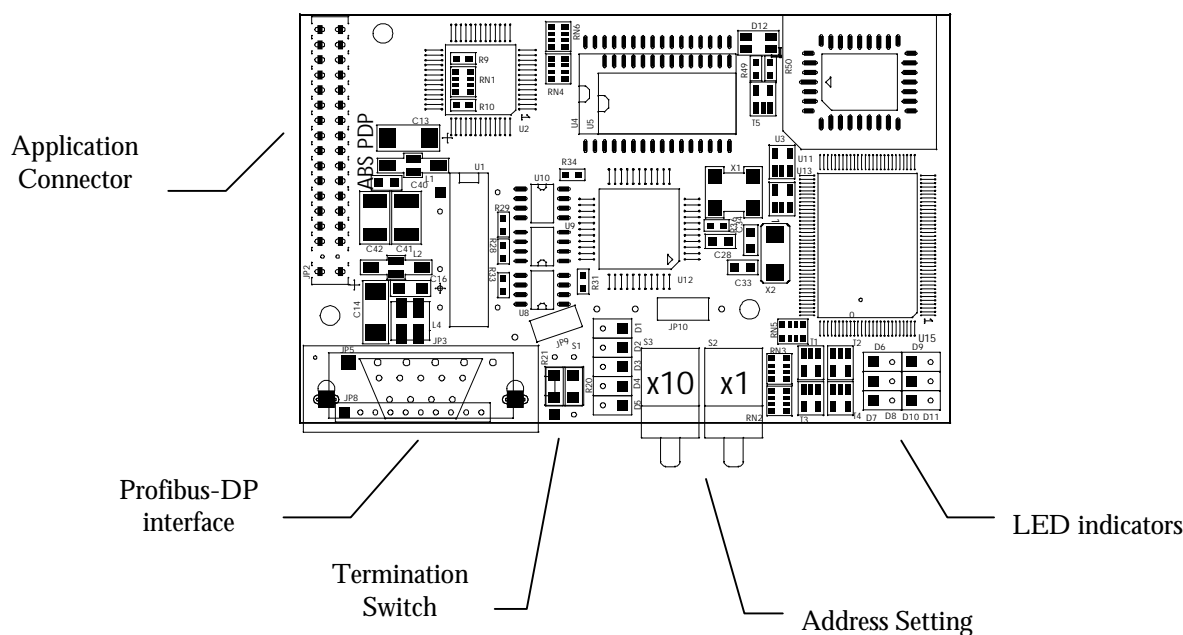


Figure 2. Communications Adapter board for Profibus-DP

2.2 Protocol & Supported Functions

- Fieldbus type: PROFIBUS-DP EN 50 170 (DIN 19245)
- Protocol version: ver. 1.10
- Protocol stack supplier: SIEMENS
- Extended functions supported: Diagnostics & User Parameter data, accessed via mailbox telegram.
- Auto baudrate detection supported. Baudrate range: 9.6 kbit-12Mbit
- Hardware prepared for DP-V1 extensions.
- Save/Load configuration in Flash supported.



2.3 Physical Interface

- Transmission media: Profibus bus line, type A or B specified in EN50170
- Topology: Master-Slave communication
- Fieldbus connectors: 9 pin female DSUB, as standard.
- Cable: Shielded copper cable, Twisted pair
- Isolation: The bus is galvanically separated from the other electronics with an on board DC/DC converter. Bus signals (A-line and B-line) are isolated via opto couplers.
- Profibus-DP communication ASIC: SPC3 chip from Siemens.

2.4 Configuration & Indications

- Address range: 1-99, extendable to 1-126 via mailbox telegram.
- Input/Output/User Parameter data/Diagnostics format defined via mailbox initialisation telegram.
- Maximum cyclic I/O data size: 244 bytes in, max 244 bytes out, max. 416 bytes total¹.
- Maximum User Parameter data/Diagnostics length: 237 bytes.
- Bus termination switch onboard.
- LED-indications: ON-line, OFF-line, Fieldbus related diagnostic.

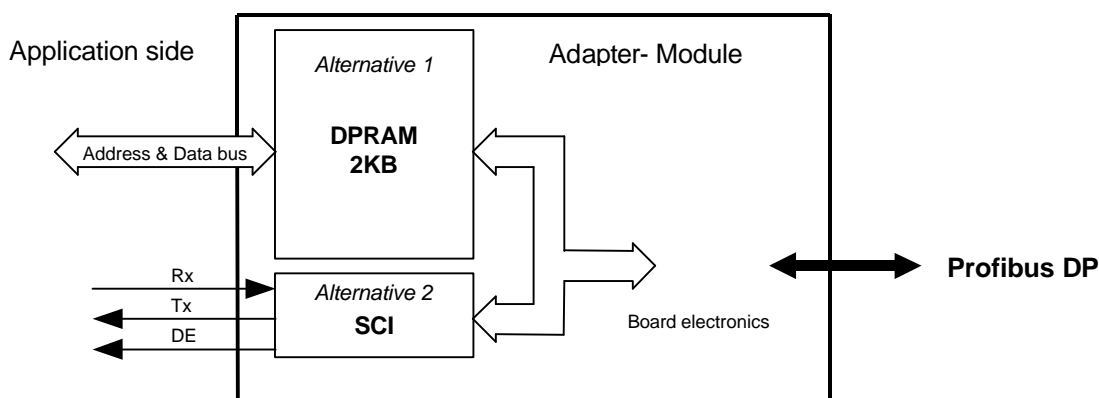
2.5 Data Exchange

- Only compatible with Profibus DP & DeviceNet Communications Adapter.
- I/O data transmission: The module only supports cyclic I/O data transmission. Acyclic data transmission(DP-V1) will be available in a later state.

2.6 Application Interface

This section describes the two access methods available from the application side between the Profibus-DP Adapter module and the application.

- Parallel: Through a Dual Port RAM memory (DPRAM).
- Serial: Through an asynchronous interface



¹ If the extended functions User Parameter data and Diagnostics are used the max. total I/O length is less.



3 Installation & Configuration

3.1 Fieldbus Connectors

The Profibus-DP standard EN 50170 (DIN 19245) recommends the use of a 9 pin female D-sub connector. Depending on the protection class and type of application, other connector designs are also allowed.

Guideline: If the module should be used with larger data transfer rates than 1500kbit/s, the D-sub connector is recommended to use.

3.1.1 D-SUB

Pin	Name	Function
Housing	Shield	Connected to PE
1	Not Connected	-
2	Not Connected	-
3	B-Line	Positive RxD/TxD according to RS 485 specification
4	RTS	Request To Send *
5	GND BUS	Isolated GND from RS 485 side *
6	+5V BUS	Isolated +5V from RS 485 side *
7	Not Connected	-
8	A-Line	Negative RxD/TxD according to RS 485 specification
9	Not Connected	-

3.2 Configuration

3.2.1 Baudrate

The baudrate on a Profibus-DP network is set during configuration of the master and only one baudrate is possible in a Profibus-DP installation. Profibus-DP Adapter module has an auto baudrate detection function and the user does not have to configure the baudrate on the module. Baudrates supported by the Profibus-DP module are:

Baudrates supported by Profibus DP Adapter
9.6 kbit/s
19.2 kbit/s
93.75 kbit/s
187.5 kbit/s
500 kbit/s
1.5 Mbit/s
3 Mbit/s
6 Mbit/s
12 Mbit/s



3.2.2 Termination

The end nodes in a Profibus-DP network has to be terminated to avoid reflections on the bus line. The Profibus DP Adapter module is equipped with a termination switch to accomplish this in an easy way. If the module is used as the first or last module in a network the termination switch has to be in ON position. Otherwise the switch has to be in OFF position.

PLEASE NOTE: If an external termination connector is used the switch must be in OFF position.

Termination switch ON	Bus termination enabled If the module is the last or first module, the bus termination has to be set on, or an external termination connector has to be used
Termination switch OFF	Bus termination disabled

3.2.3 Node Address

Before configuring the Profibus-DP Adapter module the node address has to be set. This is done with two rotary switches on the module, this enables address settings from 1-99 in decimal format. Looking at the front of the module, the leftmost switch is used for the ten setting and the rightmost switch is used for the setting of the integers.

Example:

$$\text{Address} = (\text{Left Switch Setting} \times 10) + (\text{Right Switch Setting} \times 1)$$

PLEASE NOTE: Another way of setting the node address is via the mailbox telegram FB_SET_NODE_ADDRESS. The node address range is then extended to 1-125.

See chapter that describes FB_SET_NODE_ADDRESS telegram.

PLEASE NOTE: The node address can not be changed during operation.

3.2.4 GSD file

Each device on a Profibus-DP network is associated with a GSD file, containing all necessary information about the device. This file is used by the network configuration program during configuration of the network.



3.3 Indications

The module is equipped with four LED's mounted at the front and one LED on the board, used for debugging purposes. The front LED's can be mounted in two ways, either top mounted or angle mounted. The function of the LED's are described in the table and figure below.

1. Not used
2. On-Line
3. Off-Line
4. Fieldbus diagnostics

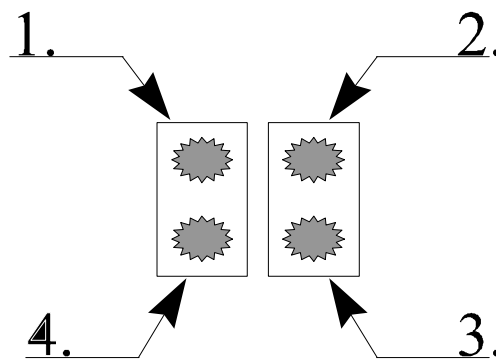


Figure 5. Adapter LED's, angle mounted

There is also one additional Bicolour Watchdog LED on the module. The functionality of this LED is the same for all modules, and is specified in the Communications Adapter manual

Name	Colour	Function
Fieldbus Diagnostics	Red	Indicates certain faults on the Fieldbus side. Flashing Red 1 Hz - Error in configuration: IN and/or OUT length set during initialisation of the module is not equal to the length set during configuration of the network. Flashing Red 2 Hz - Error in User Parameter data: The length/contents of the User Parameter data set during initialisation of the module is not equal to the length/contents set during configuration of the network. Flashing Red 4 Hz - Error in initialisation of the Profibus communication ASIC. Turned Off - No diagnostics present
On-Line	Green	Indicates that the module is On-Line on the fieldbus. Green - Module is On-Line and data exchange is possible. Turned Off - Module is not On-Line
Off-Line	Red	Indicates that the module is Off-Line on the fieldbus. Red - Module is Off-Line and no data exchange is possible. Turned Off - Module is not Off-Line



4 Functions & Operation

4.1 Memory map structure of the Profibus-DP Module

4.1.1 IN/OUT Data Area

Area Parallel interface (Byte adr. HEX)	Area Serial interface (Word adr. HEX)	Contents	Access
		IN area	
000h - 0F3h	0000h - 0079h	Input data area ; 244 bytes	R/W
0F4h - 1FFh	007Ah - 03FFh	Not used	-
		OUT area	
200h - 2F3h	1000h - 1079h	Output data area; 244 Bytes	R/O
2F4h - 3FFh	107Ah - 13FFh	Not used	-

The application exchanges data with the fieldbus via the DPRAM IN and OUT data areas. Before the module can be used, the length of the IN and OUT area has to be defined. This is accomplished during initialisation of the module, The communications Adapter has the possibility to use both fast data and slow data, but all data transferred on the Profibus-DP Fieldbus can be considered as fast data. Thus, the configuration of the IN and OUT area is very simple; The total length of the IN and OUT area are set to the same value as the cyclic I/O length.

The IN and OUT lengths set during initialisation of the module must be equal to the lengths set during configuration of the network. If they do not comply, the module will indicate this with the Fieldbus Diagnostics LED

4.1.2 Control Area

These registers contain information about the status and control environment, both for the fieldbus and the module itself, e.g. Fieldbus type, Module Software version, Module Type, configuration, etc. For further information about the Control Area contents, please see the following registers table.



Address	Size (words)	Name	Description
21E0h	1	Bootloader version	The version of the bootloader in the module
21E1h-21E2h	3	-	Not used
21E3h-21E4h	2	Module serial number	Unique module serial number
21E5h	1	Vendor ID	Manufacturer ID number (HMS, other)
21E6h	1	Fieldbus type	Fieldbus type identifier
21E7h	1	Module software version	Software version
21E8h	1	ComMode	The bitrate and timeout time used by the serial interface.
21E9h	1	Slow data priority	The priority level for Parameter data and Mailbox messages.
21Eah	1	Heartbeat min. time	The minimum time between two heartbeat messages.
21EBh-21EFh	5	-	Not used
21F0h	1	Module type	Module type (AnyBus-S, Master, other)
21F1h	1	Module status	Bit information, Freeze, clear, etc.
21F2h-21F7h	6	-	Not used
21F8h	1	IN I/O length	Size of I/O IN data (bytes)
21F9h	1	-	Not used
21FAh	1	IN total length	Total number of IN bytes supported
21FBh	1	OUT I/O length	Size of I/O OUT data (bytes)
21FCh	1	-	Not used
21FDh	1	OUT total length	Total number of OUT bytes supported
21FEh	1	Reserved	Reserved for future 16-bit compatibility

Table 7 - Control register area memory map, 62 bytes

4.2 Data Exchange

The master will read/write data every bus cycle. The amount of data copied is determined in the configuration phase of the fieldbus initialisation. The data will be exchanged via the I/O data areas.



5 Electrical specification

The table below describes the general pin configuration for the Application interface

Contact Pin	Description	Symbol	Min	Typ	Max	Unit
1	+5V BUS	V_{CC}	4.75	5.0	5.25	V
	Bus Electronic	I_{IN}	-	80	100	mA
2	GND BUS Ground					
3-4	No Connection					
5	+5V Power	V_{CC}	4.5	5.0	5.5	V
	Electronic	I_{IN}	-	230	250	mA
6	GND Ground					
7-31 33-34	Depending on Interface, please see tables below					
32	RES IN	V_{IH}	0.7 V_{CC}			V
	Reset	V_{IL}			0.3 V_{CC}	V
	(pulse duration)	t_w	1.0			μS

Description of the Host connector characteristics:

If an external device like an optical transceiver is connected to the bus interface, the current consumption of this external device is not to be greater than 80 mA. Please consult the data sheets of the external device for correct information.

I_{max} , Bus Electronic then equals I external device + 100 mA.

Parallel Pin	Description
7-8	Not Used (asynchronous data)
9-18	Address pins
19-26	Data pins
27	BUSY
28	IRQ
29	RD
30	WR
31	CE
33	Address pin
34	Not Connected

Alternative 1. Interface with DP-RAM

SCI Pin	Description
7	TX
8	RX
9-12	Not Connected
13	RTS
14-31	Not Connected
33-34	Not Connected

Alternative 2. Asynchronous Serial Interface

For more information about timing and Electrical Characteristics of the DUAL PORT Memory see appendix DPRAM or Cypress Data book. Type CY7C136