A.12 Specifications for the EM 277 PROFIBUS-DP Module

Table A-16   Specifications for the EM 277 PROFIBUS-DP Module

Description Order Number	EM 277 PROFIBUS-DP 6ES7 277-0AA20-0XA0
Physical Size	
Dimensions (W x H x D) Weight Power loss (dissipation)	71 mm x 80 mm x 62 mm 175 g 2.5 W
Communication Features	
Number of Ports	1 port
Electrical interface	RS-485
Isolation (external signal to PLC logic)	500 VAC (Galvanic)
PROFIBUS-DP/MPI baud rates (set automatically) **Protocols**	9.6, 19.2, 45.45, 93.75, 187.5, and 500K baud; 1, 1.5, 3, 6, and12M baud PROFIBUS-DP slave and MPI slave

Cable Length
    Up to 93.75K baud
    187.5K baud
    500K baud
    1 to 1.5M baud
    3 to 12M baud
	
	    1200 m
	    1000 m
	    400 m
	    200 m
	    100 m

Network Capabilities
    Station address settings
    Maximum stations per segment
    Maximum stations per network
	
	0 - 99 (set by rotary switches)
	32
	126, up to 99 EM277 stations

MPI Connections	6 total, 2 reserved (1 for PG and 1 for OP)
Power Consumption +5 VDC (from I/O bus)	 150 mA

24 VDC Input Power Requirements
    Voltage range
    Maximum current
        Module only with port active
        Add 90 mA of 5V port load
        Add 120 mA of 24V port load
	
	20.4 to 28.8 VDC (Class 2 or sensor power from PLC)
	
	    30 mA
	    60 mA
	    180 mA

Ripple noise (<10 MHz) [1]Isolated (input power to module logic)	<1 V peak to peak (maximum) 500 VAC for 1 minute

5 VDC Power on Communication Port
    Maximum current per port
    Transformer isolation from module
    logic and from 24 VDC input power
	
	90 mA
	500 VAC for 1 minute

24 VDC Power on Communication Port
    Voltage range
    Maximum current per port
    Current limit
    Isolated
	
	20.4 to 28.8 VDC
	120 mA
	0.7 to 2.4 A
	Not isolated, same circuit as input 24 VDC

[1] No power is supplied to module logic by the 24 VDC supply. 24 VDC supplies power for the communication port.

Compatibility

The EM 277 PROFIBUS-DP slave module is an intelligent expansion module designed to work with the S7-200 PLCs shown in Table A-17.

Table A-17   EM 277 PROFIBUS-DP Module Compatibility with S7-200 PLCs

CPU	Description	Order Number
CPU 222 Rel. 1.10 or greater	CPU 222 DC/DC/DC	6ES7 212-1AB21-0XB0
	CPU 222 AC/DC/Relay	6ES7 212-1BB21-0XB0
CPU 224 Rel. 1.10 or greater	CPU 224 DC/DC/DC	6ES7 214-1AD21-0XB0
	CPU 224 AC/DC/Relay	6ES7 214-1BD21-0XB0
CPU 226 Rel. 1.00 or greater	CPU 226 DC/DC/DC	6ES7 216-2AD21-0XB0
	CPU 226 AC/DC/Relay	6ES7 216-2BD21-0XB0

Address Switches and LEDs

The address switches and status LEDs are located on the front of the module as shown in Figure A-26. The EM 277 status LEDs are shown in Table A-20.
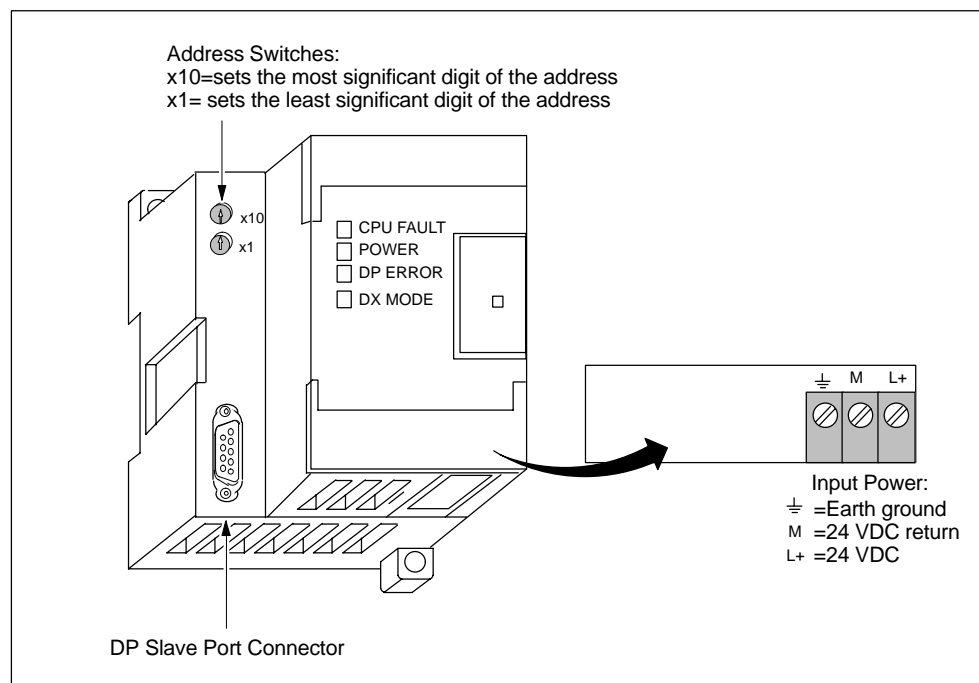

Figure A-26   Front View of the EM 277 PROFIBUS-DP Module

DP Slave Port Connector

The pin-out for the DP slave port connector is shown in Figure A-27.

9-Pin Sub D Connector Pin-out

9-pin D Female Connector

Pin #	Description
1	Chassis ground, tied to the connector shell
2	24V Return (same as M on terminal block)
3	Isolated Signal B (RxD/TxD+)
4	Isolated Request to Send (TTL level)
5	Isolated +5V Return
6	Isolated +5V at 90 mA
7	+24V (120 mA maximum, with reverse voltage protection diode)
8	Isolated Signal A (RxD/TxD-)
9	No Connection

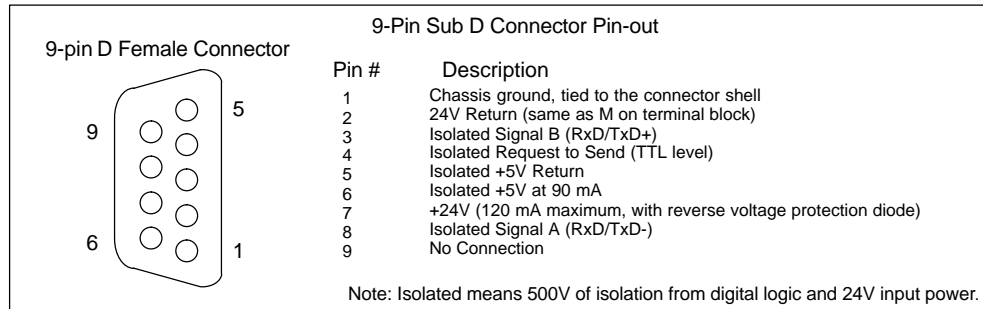Note: Isolated means 500V of isolation from digital logic and 24V input power.

Figure A-27   Pin-out for the DP Slave Port Connector

Distributed Peripheral (DP) Standard Communications

PROFIBUS-DP (or DP Standard) is a remote I/O communication protocol defined by the European Standard EN 50170. Devices that adhere to this standard are compatible even though they are manufactured by different companies. DP stands for distributed peripherals, that is, remote I/O. PROFIBUS stands for Process Field Bus.

The EM 277 PROFIBUS-DP module has implemented the DP Standard protocol as defined for slave devices in the following communication protocol standards:

- EN 50 170 (PROFIBUS) describes the bus access and transfer protocol and specifies the properties of the data transfer medium.

- EN 50 170 (DP Standard) describes the high-speed cyclic exchange of data between DP masters and DP slaves. This standard defines the procedures for configuration and parameter assignment, explains how cyclic data exchange with distributed I/O functions, and lists the diagnostic options which are supported.

A DP master is configured to know the addresses, slave device types, and any parameter assignment information that the slaves require. The master is also told where to place data that is read from the slaves (inputs) and where to get the data to write to the slaves (outputs). The DP master establishes the network and then initializes its DP slave devices. The master writes the parameter assignment information and I/O configuration to the slave. The master then reads the diagnostics from the slave to verify that the DP slave accepted the parameters and the I/O configuration. The master then begins to exchange I/O data with the slave. Each transaction with the slave writes outputs and reads inputs. The data exchange mode continues indefinitely. The slave devices can notify the master if there is an exception condition and the master then reads the diagnostic information from the slave.

Once a DP master has written the parameters and I/O configuration to a DP slave, and the slave has accepted the parameters and configuration from the master, the master now owns that slave. The slave only accepts write requests from the master that owns it. Other masters on the network can read the slave's inputs and outputs, but they cannot write anything to the slave.

Using the EM 277 to Connect an S7-200 CPU to the Network as a DP Slave

The S7-200 CPU can be connected to a PROFIBUS-DP network through the EM 277 PROFIBUS-DP expansion slave module. The EM 277 is connected to the S7-200 CPU through the serial I/O bus. The PROFIBUS network is connected to the EM 277 PROFIBUS-DP module through its DP communication port. This port operates at any PROFIBUS baud rate between 9600 baud and 12 Mbaud. (See Table A-16 for supported baud rates.) As a DP slave device, the EM 277 module accepts several different I/O configurations from the master to transfer different amounts of data to and from the master. This feature allows you to tailor the amount of data transferred to meet the requirements of the application. Unlike many DP devices, the EM 277 module does not transfer only I/O data. The EM 277 moves data to and from a block of variable memory defined in the S7-200 CPU. This allows you to exchange any type of data with the master. Inputs, counter values, timer values, or other calculated values can be transferred to the master by first moving the data to the variable memory in the S7-200 CPU. Likewise, data from the master is stored in variable memory in the S7-200 CPU and can be moved to other data areas.

The DP port of the EM 277 PROFIBUS-DP module can be attached to a DP master on the network and still communicate as an MPI slave with other master devices such as SIMATIC programming devices or S7-300/S7-400 CPUs on the same network.

Figure A-28 shows a PROFIBUS network with a CPU 224 and an EM 277 PROFIBUS-DP module. In this situation, the CPU 315-2 is the DP master and has been configured by a SIMATIC programming device with STEP 7 programming software. The CPU 224 is a DP slave owned by the CPU 315-2. The ET 200 I/O module is also a slave owned by the CPU 315-2. The S7-400 CPU is attached to the PROFIBUS network and is reading data from the CPU 224 by means of XGET instructions in the S7-400 CPU user program.
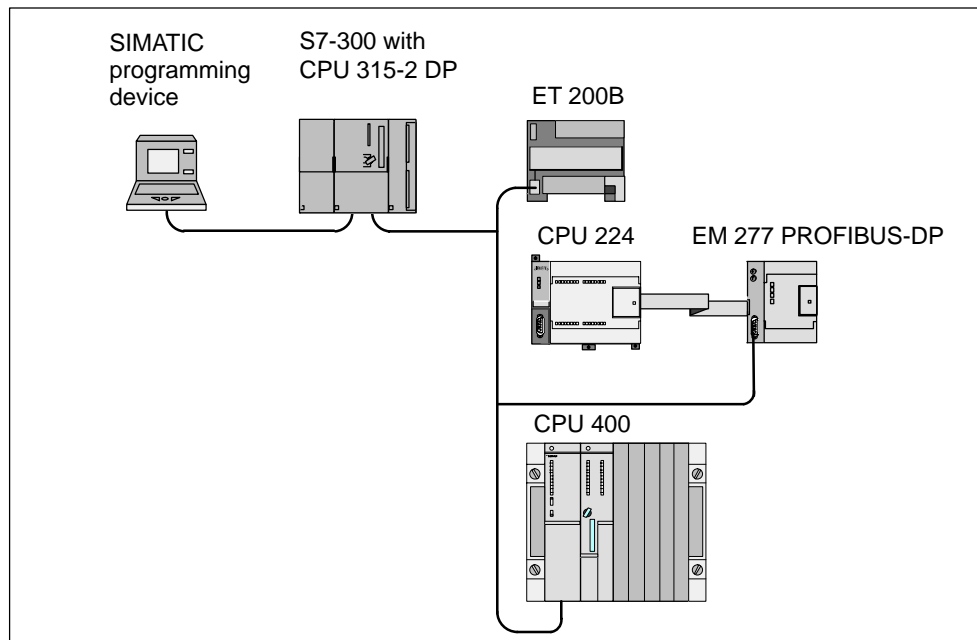
Figure A-28   EM 277 PROFIBUS-DP Module and CPU 224 on a PROFIBUS Network

Configuration

To use the EM 277 as a DP slave, you must set the station address of the DP port to match the address in the configuration of the master. The station address is set with the rotary switches on the EM 277 module. You must power cycle the CPU after you have made a switch change in order for the new slave address to take effect.

The master device exchanges data with each of its slaves by sending information from its output area to the slave's output buffer (called a "Receive mailbox"). The slave responds to the message from the master by returning an input buffer (called a "Send mailbox") which the master stores in an input area (see Figure A-29).

The EM 277 can be configured by the DP master to accept output data from the master and return input data to the master. The output and input data buffers reside in the variable memory (V memory) of the S7-200 CPU. When you configure the DP master, you define the byte location in V memory where the output data buffer should start as part of the parameter assignment information for the EM 277. You also define the I/O configuration as the amount of output data to be written to the S7-200 CPU and amount of input data to be returned from the S7-200 CPU. The EM 277 determines the size of the input and output buffers from the I/O configuration. The DP master writes the parameter assignment and I/O configuration information to the EM 277 PROFIBUS DP module. The EM 277 then transfers the V memory address and input and output data lengths to the S7-200 CPU.

Figure A-29 shows a memory model of the V memory in a CPU 224 and the I/O address areas of a DP master CPU. In this example, the DP master has defined an I/O configuration of 16 output bytes and 16 input bytes, and a V memory offset of 5000. The output buffer and input buffer lengths in the CPU 224 (determined from the I/O configuration) are both 16 bytes long. The output data buffer starts at V5000; the input buffer immediately follows the output buffer and begins at V5016. The output data (from the master) is placed in V memory at V5000. The input data (to the master) is taken from the V memory at V5016.

Note

If you are working with a data unit (consistent data) of three bytes or data units (consistent data) greater than four bytes, you must use SFC14 to read the inputs of the DP slave and SFC15 to address the outputs of the DP slave. For more information, see the S*ystem Software for S7-300 and S7-400 System and Standard Functions Reference Manual.*
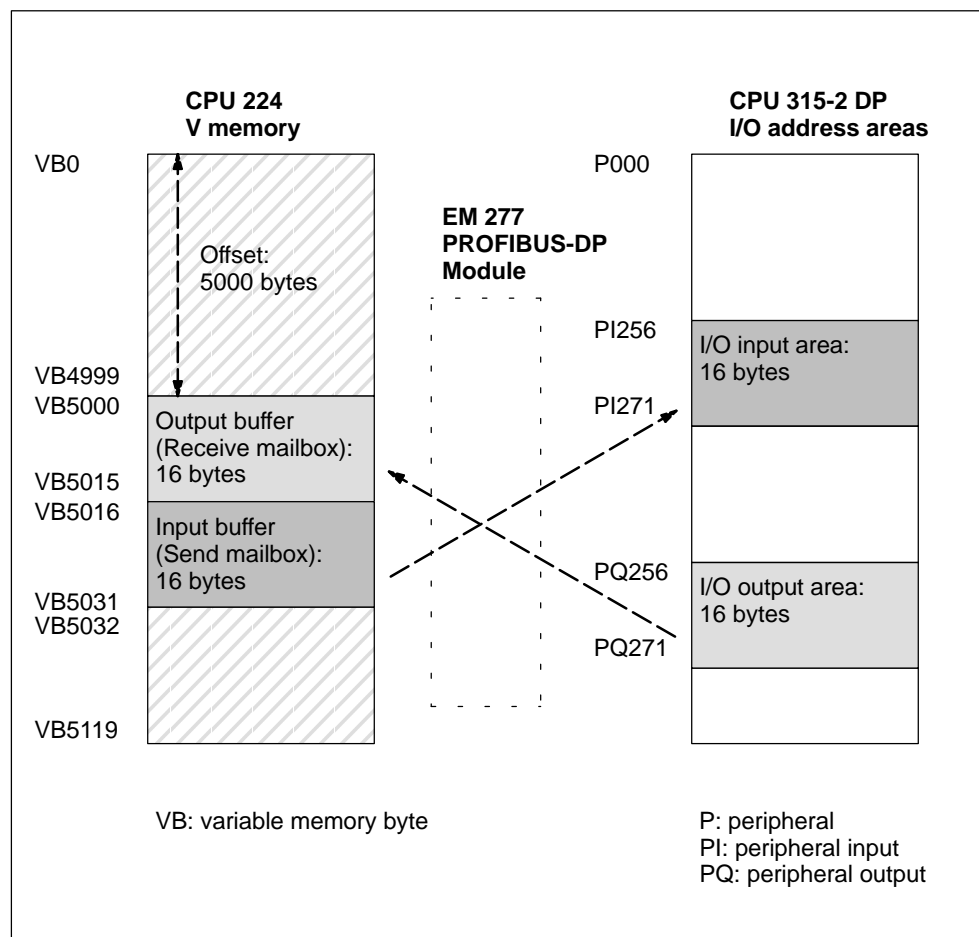

Figure A-29   Example of a CPU 224 V Memory and I/O Address Area of a PROFIBUS-DP Master

Table A-18 list the configurations that are supported by the EM 277 PROFIBUS-DP module. The default configuration for the EM 277 module is two words of input and two words of output.

Table A-18 EM 277 Configuration Options

Configuration	Inputs to Master	Outputs from Master	Data Consistency
1	1 word	1 word	Word Consistency
2	2 words	2 words	
3	4 words	4 words	
4	8 words	8 words	
5	16 words	16 words	
6	32 words	32 words	
7	8 words	2 words	
8	16 words	4 words	
9	32 words	8 words	
10	2 words	8 words	
11	4 words	16 words	
12	8 words	32 words	
13	2 bytes	2 bytes	Byte Consistency
14	8 bytes	8 bytes	
15	32 bytes	32 bytes	
16	64 bytes	64 bytes	
17	4 bytes	4 bytes	Buffer Consistency
18	8 bytes	8 bytes	
19	12 bytes	12 bytes	
20	16 bytes	16 bytes	

The location of the input and output buffers may be configured to be anywhere in the V memory of the S7-200 CPU. The default address for the input and output buffers is VB0. The location of the input and output buffers is part of the parameter assignment information that the master writes to the S7-200 CPU. The master must be configured to recognize its slaves and to write the required parameters and I/O configuration to each of its slaves.

Use the following tools to configure the DP master:

- For SIMATIC S5 masters, use COM PROFIBUS Windows software

- For SIMATIC S7 masters, use STEP 7 programming software

- For SIMATIC 505 masters, use COM PROFIBUS and either TISOFT2 or SoftShop

For detailed information about using these configuration and programming software packages, refer to the manuals for these devices. For detailed information about the PROFIBUS network and its components, refer to the *ET 200 Distributed I/O System Manual*.

Data Consistency

PROFIBUS supports three types of data consistency:

- Byte consistency ensures that bytes are transferred as whole units.

- Word consistency ensures that word transfers cannot be interrupted by other processes in the CPU. This means that the two bytes composing the word are always moved together and cannot be split.

- Buffer consistency ensures that the entire buffer of data is transferred as a single unit, uninterrupted by any other process in the CPU.

Word and buffer consistency force the CPU to halt any other processes, such as user interrupts, while manipulating or moving the DP I/O data within the CPU. Word consistency should be used if the data values being transferred are integers. Buffer consistency should be used if the data values are double words or floating point values. Buffer consistency should also be used when a group of values all relate to one calculation or item.

You set the data consistency as part of the I/O configuration in the master. The data consistency selection is written to the DP slave as part of the initialization of the slave. Both the DP master and the DP slave use the data consistency selection to be sure that data values (bytes, words, or buffers) are transferred uninterrupted within master and slave. Figure A-30 shows the different types of consistency.
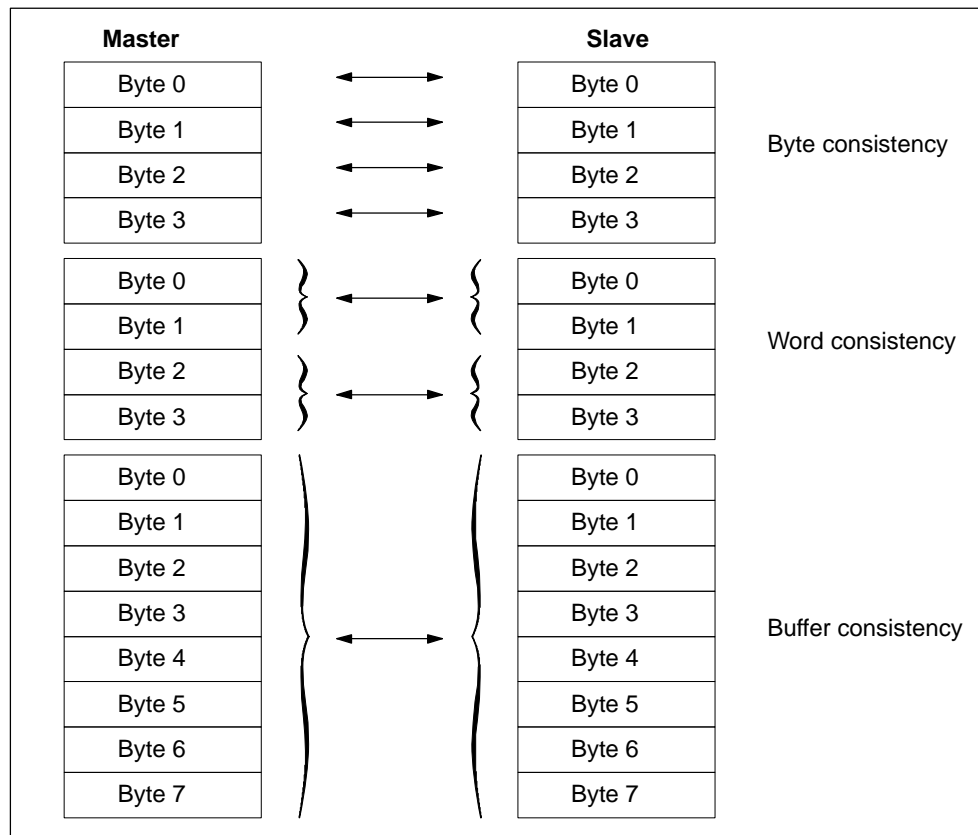

Figure A-30   Byte, Word, and Buffer Data Consistency

User Program Considerations

Once the EM 277 PROFIBUS-DP module has been successfully configured by a DP master, the EM 277 and the DP master enter data exchange mode. In data exchange mode, the master writes output data to the EM 277 PROFIBUS-DP module, the EM 277 module then responds with most current S7-200 CPU input data. The EM 277 module continuously updates its inputs from the S7-200 CPU in order to provide the most recent input data to the DP Master. The module then transfers the output data to the S7-200 CPU. The output data from the master is placed into V memory (the output buffer) starting at the address that the DP master supplied during initialization. The input data to the master is taken from the V memory locations (the input buffer) immediately following the output data.

The starting address of the data buffers in V memory and the size of the buffers must be known at the time the user program for the S7-200 CPU is created. The output data from the master must be moved by the user program in the S7-200 CPU from the output buffer to the data areas where it is to be used. Likewise, the input data to the master must be moved from the various data areas to the input buffer for transfer to the master.

Output data from the DP master is placed into V memory immediately after the user program portion of the scan has been executed. Input data (to the master) is copied from V memory to the EM 277 for transfer to the master at this same time. Output data from the master is only written into V memory when there is new data available from the master. Input data to the master are transmitted to the master on the next data exchange with the master.

SMB200 through SMB249 provide status information about the EM 277 PROFIBUS-DP slave module if it is the first intelligent module in the I/O chain. If the EM 277 is the second intelligent module in the I/O chain, then the EM 277 status is obtained from SMB250 through SMB299. These SM locations show default values if DP communication has not been established with a master. After a master has written parameters and I/O configuration to the EM 277 PROFIBUS-DP module, these SM locations show the configuration set by the DP master. You should check SMB224 to be sure that the EM 277 is currently in data exchange mode with the master before using the information in SMB225 through SMB229 (see Table A-19), or data in the V memory buffer.

Note
You cannot configure the EM 277 PROFIBUS-DP I/O buffer sizes or buffer location by writing to memory locations SMB225 through SMB229 or SMB275 through SMB279. Only the DP master can configure the EM 277 PROFIBUS-DP module for DP operation.

Table A-19 Special Memory Bytes SMB200 to SMB299

DP is First Intelligent Module	DP is Second Intelligent Module	Description
SMB200 to SMB215	SMB250 to SMB265	Module name (16 ASCII characters) "EM277 ProfibusDP"
SMB216 to SMB219	SMB266 to SMB269	S/W revision number (4 ASCII characters) xxxx
SMW220	SMW270	Error code 16#0000　　　　　No error 16#0001　　　　　No user power 16#0002 to 16#FFFF　　Reserved
SMB222	SMB272	DP slave module's station address as set by address switches (0 - 99 decimal)
SMB223	SMB273	Reserved
SMB224	SMB274	DP standard protocol status byte 　　　MSB　　　　　　　　LSB 	0	0	0	0	0	0	S1	S0 | 　S1　S0　DP Standard status byte description 　0　　0　　DP communication not initiated since power on 　0　　1　　Configuration/parameterization error detected 　1　　0　　Currently in data exchange mode 　1　　1　　Dropped out of data exchange mode
SMB225	SMB275	DP standard protocol - address of the slave's master (0 to 126)
SMW226	SMW276	DP standard protocol - V memory address of the output buffer as an offset from VB0.
SMB228	SMB278	DP standard protocol - number of bytes of output data
SMB229	SMB279	DP standard protocol - number of bytes of input data
SMB230 to SMB249	SMB280 to SMB299	Reserved - cleared on power up

Note: SMB225 to SMB229, and SMB275 to SMB279 are updated each time the DP slave module accepts configuration/
parameterization information. These locations are updated even if a configuration/parameterization error is detected.
The locations are cleared on each power up.

EM 277 PROFIBUS-DP LED Status Indicators

The EM 277 PROFIBUS-DP module has four status LEDs on the front panel to indicate the operational state of the DP port:

- After the S7-200 CPU is turned on, the DX MODE LED remains off as long as DP communication is not attempted.

- Once DP communication has been successfully initiated (the EM 277 PROFIBUS-DP module has entered data exchange mode with the master), the DX MODE LED turns green and remains on until data exchange mode is exited.

- If DP communication is lost, which forces the EM 277 module to exit data exchange mode, the DX MODE LED turns OFF and the DP ERROR LED turns red. This condition persists until the S7-200 CPU is powered off or data exchange is resumed.

- If there is an error in the I/O configuration or parameter information that the DP master is writing to the EM 277 module, the DP ERROR LED flashes red.

- If user 24 VDC is not provided, the POWER LED will be off.

Table A-20 summarizes the status indications signified by the EM 277 status LEDs.

Table A-20 EM 277 PROFIBUS-DP Module Status LEDs

LED	OFF	RED	FLASHING RED	GREEN
CPU Fault	Module is good	Internal Module Failure	--	--
POWER	No 24 VDC User Power	--	--	24 VDC User Power Good
DP ERROR	No Error	Left Data Exchange Mode	Parameterization/ Configuration Error	--
DX MODE	Not in Data Exchange Mode	--	--	In Data Exchange Mode

Note   When the EM 277 PROFIBUS-DP module is used exclusively as an MPI slave, only the green Power LED is on.

Additional Configuration Features

The EM 277 PROFIBUS-DP module can be used as a communication interface to other MPI masters, whether or not it is being used as a PROFIBUS-DP slave. The module can provide a connection from the S7-300/400 to the S7-200 using the XGET/XPUT functions of the S7-300/400. STEP 7-Micro/WIN and a network card (such as the CP5611) using the MPI or PROFIBUS parameter set, an OP device or the TD 200 (Rel. 2.0 or greater, order number 6ES7 272-0AA20-0YA0) can be used to communicate with the S7-200 through the EM 277 PROFIBUS-DP module.

A maximum of six connections (six devices) in addition to the DP master can be connected to the EM 277 PROFIBUS-DP module. One connection is reserved for a programming device (PG) and one is reserved for an operator panel (OP). The other four connections can be used by any MPI master. In order for the EM 277 PROFIBUS-DP module to communicate with multiple masters, all masters must be operating at the same baud rate. See Figure A-31 for one possible network configuration.

When the EM 277 PROFIBUS-DP module is used for MPI communication, the MPI master must use the station address of the module for all messages that are sent to the S7-200 to which the module is connected. MPI messages sent to the EM 277 PROFIBUS-DP module are passed on to the S7-200.

The EM 277 PROFIBUS-DP module is a slave module and cannot be used for communication between S7-200 PLCs using the NETR and NETW functions. The EM 277 PROFIBUS-DP module cannot be used for Freeport communication, which is a feature of the S7-200 communication ports.
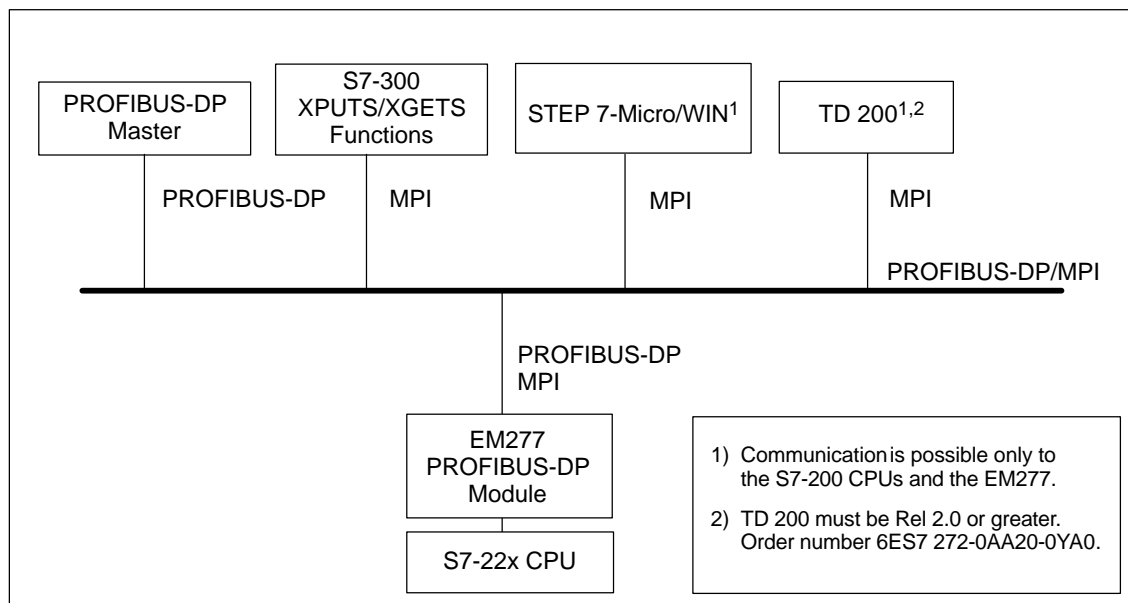
Figure A-31 shows the PROFIBUS-DP MPI Network.

Figure A-31   PROFIBUS-DP/MPI Network

Device Database File: GSD

Different PROFIBUS devices have different performance characteristics. These characteristics differ with respect to functionality (for example, the number of I/O signals and diagnostic messages) or bus parameters such as transmission speed and time monitoring. These parameters vary for each device type and vendor, and are usually documented in a technical manual. To help you achieve a simple configuration of PROFIBUS, the performance characteristics of a particular device are specified in an electronic data sheet called a device database file, or GSD file. Configuration tools based on GSD files allow simple integration of devices from different vendors in a single network.

The device database file provides a comprehensive description of the characteristics of a device in a precisely defined format. These GSD files are prepared by the vendor for each type of device and made available to the PROFIBUS user. The GSD file allows the configuration system to read in the characteristics of a PROFIBUS device and use this information when configuring the network.

The latest versions of the COM PROFIBUS or STEP 7 software include configuration files for the EM 277 PROFIBUS-DP Module. If your version of software does not include a configuration file for the EM 277, you can access the latest GSD file (SIEM089D.GSD) at website www.profibus.com.

If you are using a non-Siemens master device, refer to the documentation provided by the manufacturer on how to configure the master device by using the GSD file.

Listing of the EM 277 PROFIBUS-DP GSD File

```
;========================================================
; GSD File for the EM 277 PROFIBUS-DP with a DPC31
; MLFB  : 6ES7 277-0AA20-0XA0
; DATE  : 07-Oct-1999
;========================================================
#Profibus_DP
;General parameters
GSD_Revision        = 1
Vendor_Name         = "Siemens"
Model_Name          = "EM 277 PROFIBUS-DP"
Revision            = "V1.00"
Ident_Number        = 0x089D
Protocol_Ident      = 0
Station_Type        = 0
FMS_supp            = 0
Hardware_Release    = "1.00"
Software_Release    = "1.00"
9.6_supp            = 1
19.2_supp           = 1
45.45_supp          = 1
93.75_supp          = 1
187.5_supp          = 1
500_supp            = 1
1.5M_supp           = 1
3M_supp             = 1
```

```
6M_supp               = 1
12M_supp              = 1
MaxTsdr_9.6           = 60
MaxTsdr_19.2          = 60
MaxTsdr_45.45         = 250
MaxTsdr_93.75         = 60
MaxTsdr_187.5         = 60
MaxTsdr_500           = 100
MaxTsdr_1.5M          = 150
MaxTsdr_3M            = 250
MaxTsdr_6M            = 450
MaxTsdr_12M           = 800
Redundancy            = 0
Repeater_Ctrl_Sig     = 2
24V_Pins              = 2

; Slave-Specification:
OrderNumber="6ES7 277-0AA20-0XA0"
Periphery="SIMATIC S5"
Slave_Family=10@TdF@SIMATIC

Freeze_Mode_supp      = 1
Sync_Mode_supp        = 1
Set_Slave_Add_Supp    = 0
Auto_Baud_supp        = 1
Min_Slave_Intervall   = 1
Fail_Safe             = 0
Max_Diag_Data_Len     = 6
Modul_Offset          = 0
Modular_Station       = 1
Max_Module            = 1
Max_Input_len         = 128
Max_Output_len        = 128
Max_Data_len          = 256

; UserPrmData-Definition
ExtUserPrmData=1 "I/O Offset in the V-memory"
Unsigned16 0 0-5119
EndExtUserPrmData
; UserPrmData: Length and Preset:
User_Prm_Data_Len=3
User_Prm_Data= 0,0,0
Max_User_Prm_Data_Len=3
Ext_User_Prm_Data_Const(0)=0x00,0x00,0x00
Ext_User_Prm_Data_Ref(1)=1

; Module Definition List
Module = "2 Bytes Out/ 2 Bytes In      -" 0x31
EndModule
Module = "8 Bytes Out/ 8 Bytes In      -" 0x37
EndModule
Module = "32 Bytes Out/ 32 Bytes In    -" 0xC0,0x1F,0x1F
EndModule
Module = "64 Bytes Out/ 64 Bytes In    -" 0xC0,0x3F,0x3F
EndModule
Module = "1 Word Out/ 1 Word In        -" 0x70
EndModule
Module = "2 Word Out/ 2 Word In        -" 0x71
EndModule
```

```
       Module = "4 Word Out/ 4 Word In        -" 0x73
       EndModule
       Module = "8 Word Out/ 8 Word In        -" 0x77
       EndModule
       Module = "16 Word Out/ 16 Word In      -" 0x7F
       EndModule
       Module = "32 Word Out/ 32 Word In      -" 0xC0,0x5F,0x5F
       EndModule
       Module = "2 Word Out/ 8 Word In        -" 0xC0,0x41,0x47
       EndModule
       Module = "4 Word Out/ 16 Word In       -" 0xC0,0x43,0x4F
       EndModule
       Module = "8 Word Out/ 32 Word In       -" 0xC0,0x47,0x5F
       EndModule
       Module = "8 Word Out/ 2 Word In        -" 0xC0,0x47,0x41
       EndModule
       Module = "16 Word Out/ 4 Word In       -" 0xC0,0x4F,0x43
       EndModule
       Module = "32 Word Out/ 8 Word In       -" 0xC0,0x5F,0x47
       EndModule
       Module = "4 Byte buffer I/O            -" 0xB3
       EndModule
       Module = "8 Byte buffer I/O            -" 0xB7
       EndModule
       Module = "12 Byte buffer I/O           -" 0xBB
       EndModule
       Module = "16 Byte buffer I/O           -" 0xBF
       EndModule
```

Sample Program for DP Communication to a CPU 224

A sample program in Statement List for a CPU 224 that uses the DP port information in SM memory is shown in Figure A-32. Figure A-33 shows the same program in ladder logic. This program determines the location of the DP buffers from SMW226 and the sizes of the buffers from SMB228 and SMB229. This information is used in the program the copy the data in the DP output buffer to the process-image output register of the CPU 224. Similarly, the data in the process-image input register of the CPU 224 are copied into the V memory input buffer.

```
   // Sample DP program
   // The DP configuration data in the SM memory area provides the
   // configuration of the DP slave.  The program uses the
   // following data:
   //
   //   SMW220    DP Module Error Status
   //   SMB224    DP STATUS
   //   SMB225    Master Address
   //   SMW226    V memory offset of outputs
   //   SMB228    Number of bytes of output data
   //   SMB229    Number of bytes of input data
   //   VD1000    Output Data Pointer
   //   VD1004    Input Data Pointer
   //
   NETWORK 1
   //
   // Calculate the Output data pointer into V memory.
   //
   LDB= SMB224, 2                // if ( in data exchange mode )
   MOVD   &VB0, VD1000           // Output buffer is an offset from VB0.
   ITD    SMW226, AC0            // Add Vmem offset to get output
   +D     AC0, VD1000            // buffer offset

   NETWORK 2
   //
   // Calculate the Input data pointer into V memory.
   //
   LDB=   SMB224, 2              // if ( in data exchange mode )
   MOVD   VD1000, VD1004         // Get the output pointer address
   BTI    SMB228, AC0            // Add the number of output bytes
   ITD    AC0, AC0              // to the output pointer to get
   +D     AC0, VD1004           // the starting input pointer.

   NETWORK 3
   //
   // Set amount of data to be copied.
   //
   LDB=   SMB224, 2              // if ( in data exchange mode )
   MOVB   SMB228, VB1008         // Get number of output bytes to copy
   MOVB   SMB229, VB1009         // Get number of input bytes to copy

   NETWORK 4
   //
   // Transfer Masters Outputs to CPU's Outputs. Copy CPU's inputs
   // to the Master's inputs.
   //
   LDB= SMB224, 2                // if ( in data exchange mode )
   BMB  *VD1000, QB0, VB1008     // Copy master outputs to CPU outputs
   BMB  IB0, *VD1004, VB1009     // Copy CPU inputs to Master's Inputs
```

Figure A-32   STL Sample Program for DP Communication to a CPU 224

Network 1

Calculate the output data pointer into V memory.

```
SMB224          MOV_DW
─┤ ==B ├──────┬──EN    ENO─
    2         │
              │ &VB0─IN    OUT─VD1000
              │
              │  I_DI
              ├──EN    ENO─
              │
              │SMW226─IN    OUT─AC0
              │
              │ ADD_DI
              └──EN    ENO─
                 AC0─IN1   OUT─VD1000
              VD1000─IN2
```

Network 2

Calculate the input data pointer into V Memory.

```
SMB224          MOV_DW
─┤ ==B ├──────┬──EN    ENO─
    2         │VD1000─IN    OUT─VD1004
              │
              │  B_I
              ├──EN    ENO─
              │SMB228─IN    OUT─AC0
              │
              │  I_DI
              ├──EN    ENO─
              │ ACO─IN    OUT─AC0
              │
              │ ADD_DI
              └──EN    ENO─
                 AC0─IN1   OUT─VD1004
              VD1004─IN2
```

AC0

Network 3

Set amount of data to be copied.

```
SMB224          MOV_B
─┤ ==B ├──────┬──EN    ENO─
    2         │SMB228─IN    OUT─VB1008
              │
              │  MOV_B
              └──EN    ENO─
                SMB229─IN    OUT─VB1009
```

Network 4

Transfer Master Outputs to CPU Outputs. Copy CPU inputs to the Master inputs.

```
SMB224          BLKMO~1
─┤ ==B ├──────┬──EN    ENO─
    2         │
              │*VD1000─IN    OUT─QB0
              │ VB1008─N
              │
              │  BLKMO~1
              └──EN    ENO─
                  IB0─IN    OUT─*VD1004
               VB1009─N
```

Figure A-33   LAD Sample Program for DP Communication to a CPU 224