SIMATIC NET

DP/RS 232C Link

User Description   Date 05/30/1997

SIEMENS

Anwenderbeschreibung

des Gateways

DP/RS 232C Link

Version: 1.2
Date: 06/30/1997

SIEMENS

Disclaimer of liability
Although we have checked the contents of this publication for agreement with the actual hardware and software, responsibility for complete agreement cannot be accepted. The information in this document is reviewed at regular intervals and necessary corrections included in later releases. Your suggestions are welcome.

1 Notes on CE Seal of the Interface

EU guidelines
on EMC 89/336/EEC

The following information applies to the interface described in this manual.

Products bearing the CE seal meet the requirements of EU guidelines 89/336/EEC on electromagnetic compatibility and the harmonized European standards contained therein.

The EU declarations of conformity are available at the following address for viewing by responsible authorities in accordance with article 10 of the above stated EU guidelines.

> Siemens Aktiengesellschaft
> Bereich Antriebs-, Schalt- und Installationstechnik
> ASI 2
> Postfach 1954
> D-92220 Amberg

Application area

The interface modules are designed for use in industrial applications and meet the following requirements.

Application Area	Requirements on	
	Interference Emission	Interference Immunity
Industry	EN 50081-2 : 1993	EN 50082-2 : 1995

When individual approval is granted, the interface module can also be used in residential areas (e.g., residential, business and commercial zones and small businesses).

Application Area	Requirements on	
	Interference Emission	Interference Immunity
Residential areas	Individual approval	EN 50082-1 : 1992

Individual approval must be obtained from an appropriate authority or inspection office. In Germany, this document can be obtained from the Bundesamt für Post und Telekommunikation and its branches.

Adherence to
setup guidelines

The interface module complies with the requirements when the following guidelines are adhered to.

1. Setup guidelines for installation and operating contained in the operating instructions
2. The following rules covering the installation of the device and work on switching cabinets

Installation

Interface modules must be installed in electrical equipment rooms or in closed housings (e.g., control boxes of metal or plastic).
In addition, the device and the metal control box or at least the top hat rail (plastic box) snapped onto the interface must be grounded.

Work on switching

To protect the modules from discharge of static electricity, personnel must

cabinets　　　　　　　　discharge themselves electrostatically before opening the switching cabinets or control boxes.

Notes for the Manufacturer of Machines

Introduction   Since the DP/RS232 interface is not a machine in the sense of the EU guidelines, it does not require a declaration of conformity in accordance with EU guideline 89/392/EEC on machines.

**EU guidelines
on machines
89/392/EEC**   EU guideline 89/392/EEC on machines covers the requirements for machines. A machine is defined as an entity of connected parts or devices. See also paragraph 3.1 of EN 292-1.

Since the interface is part of the electrical equipment of a machine, the manufacturer of the machine must include it in the declaration of conformity procedure.

2 Introduction

The DP/RS232 interface is used to adapt a serial interface on PROFIBUS-DP in accordance with EN 50 170. In this application, it is used as a gateway and operates as a PROFIBUS-DP slave. It can be operated by any standard master. Two transmission procedures are supported by the serial interface.

- The 3964R procedure widely used by Siemens devices
- A free ASCII protocol with control over Character delay time, Start / End delimiter or constant data length

These two procedures cover the great majority of applications.

The interface consists of the following primary hardware components.

- Floating RS 485 interface to PROFIBUS DP
- SPC3 PROFIBUS ASIC
- 80 C 32 micro-processor
- RAM and EPROM
- Serial interface to the externally connected device

PROFIBUS-master

Configuring with COM PROFIBUS

serial procedure

Process
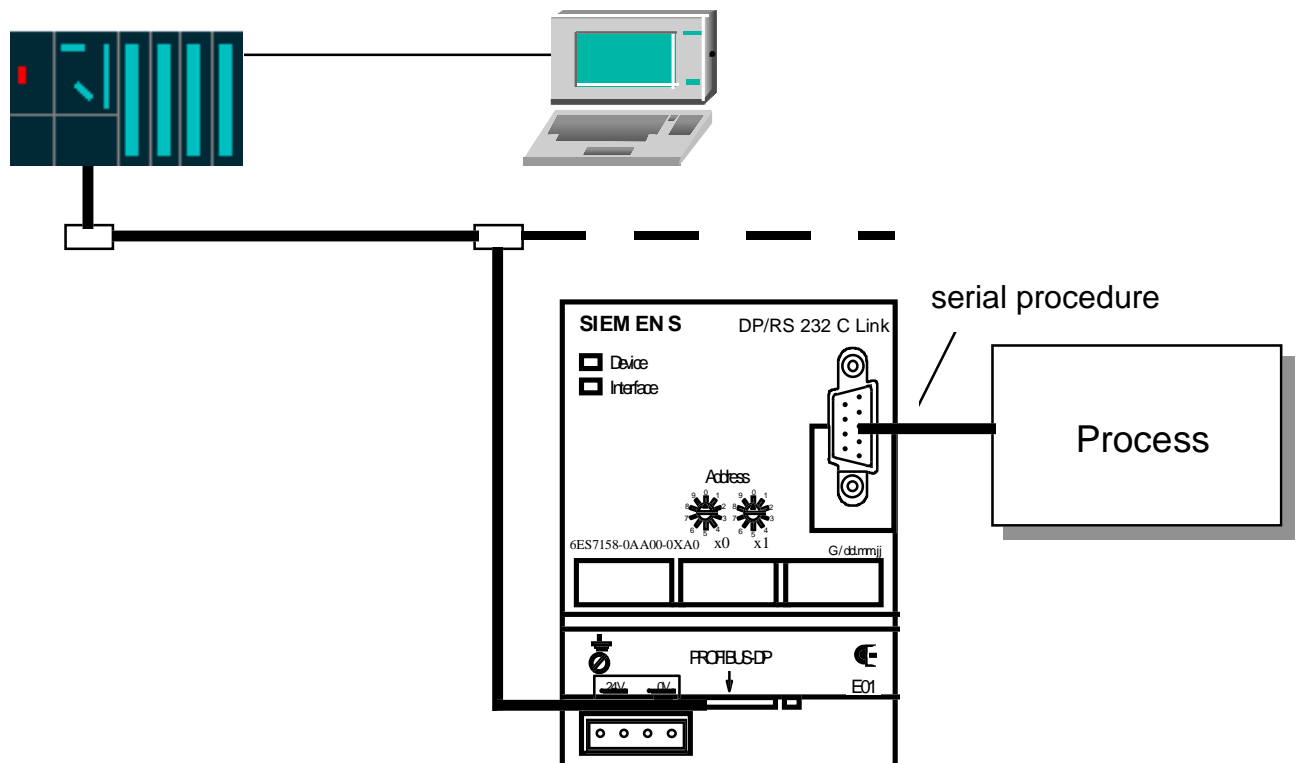
Figure 1: Overview

3 The System

3.1 Data Communication

The PROFIBUS master sends the output data cyclically to the gateway. The gateway compares the data received from the master with the previous telegram. When changes are detected, the gateway sends the data to the external device in accordance with the selected procedure. When no changes are detected, the telegram is not sent to the external device (i.e., each telegram is only sent once to the external device). The external device responds in accordance with procedure conventions. The gateway always sends the data received from the external device to the master without changes.
The gateway writes the data received from the external device in the internal RAM of the SPC3. The updated data are transferred during the next polling cycle with the gateway.

> **All data are transferred in both directions by the gateway with consistency. The maximum length of consistent data must be adhered to during data communication between the master and the CPU. This is usually dependent on the master interface and CPU being used.**

Construction of data:

Triggerbyte	Byte
Number of characters	Byte
Userdata	Bytes

Triggerbyte and Number of characters are only present when the corresponding flag is set.

Master	Gateway	external device

Data telegram 1

Send telegram 1 to the external device

Response to telegram 1

free flowing data from the external device

Data telegram 1

Response to telegram 1

Data telegram 2

Send telegram 2 to the external device

Response to telegram 2

Data telegram 2

Response to telegram 2

free flowing data from the external device
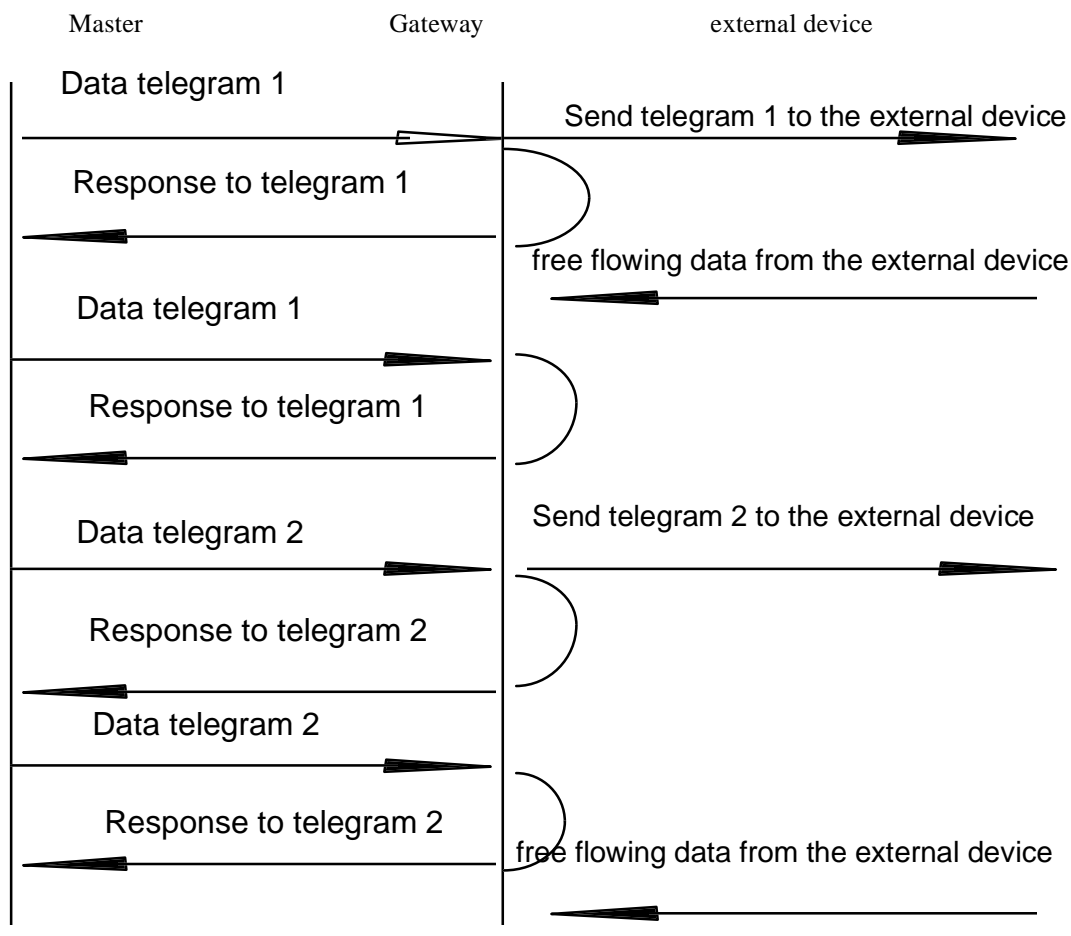
Figure 2: Data communication

3.2 Possible Data Lengths

The following table shows the maximum data which can be transferred. To transfer the data with consistency, one or more buffers have been set up on the SPC3 for each service. The number of buffers required by the SPC3 for this service is indicated in parentheses.

Input data	(3)	224 bytes x 3 = 672	3 buffers for consistent data transmission	Varies: Maximum value is given here.
Output data	(3)	224 bytes x = 672	3 buffers for consistent data transmission	Varies: Maximum value is given here.

Parameter (1)	9 bytes x 1 = 9	7 bytes are required by the system.	Permanently specified here
Configuration data (2)	8 bytes x 2 = 16	The I/O configuration can be written with 4 bytes.	Permanently specified
Diagnosis (2)	8 bytes x 2 = 16	7 bytes of standard diagnosis without user diagnosis	Permanently specified
Auxiliary buffer (2)	9 bytes x 2 = 18	Select to accommodate the longest telegram from configuration, parameterization and Set Slave Address	Permanently specified
Total data Reserved	1403 1416		

The sum of all buffers on the SPC3 may not exceed 1472 bytes modulo 8 since each buffer starts at an 8-byte boundary.

3.3 Booting Phase

During the booting phase, the master parameterizes and configures the gateway. Data communication with the external device is not started until the booting phase has been concluded successfully.
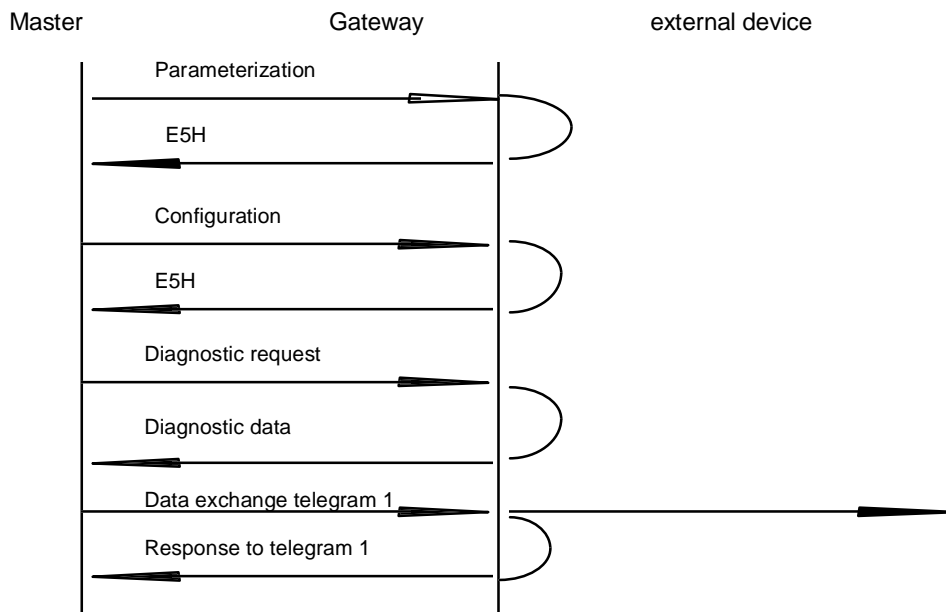
Figure 3: Booting phase

4 The Triggerbyte

As the data transmission on PROFIBUS is done cyclically the gateway has to recognize when new data should be transferred via the serial interface. Normally this is done by comparing the internal data with the new received data from PROFIBUS. In some cases this procedure doesn´t work, f.e. when the same data should be send twice or more. The user can influence this behaviour by adjusting the triggerbyte..In this mode the data is only send when the triggerbyte changes.
In the normal mode the program in the gateway cannot detect whether the gateway has received several same telegrams. But when the trigger byte mode is switched on the gateway increments the triggerbyte at

anytime it has received a new telegram. When the trigger byte mode is switched on it is always the first byte in the data unit.

If the Send-Ready-Trigger is used, the lower 7 bits of the Triggerbytes in the input-data is used like described above However the MSB toggles each time a send-telegram has finished.

5 Adjusting the Length of the Send Data

The meaning of one bit in the flags register is to tell the fuser programm in the gateway whether the length of the data to be send is included in the data unit. The gateway will only send as much data as it is defined. This mode only makes sense in combination with the trigger byte. In the receive direction the gateway stores the number of received characters in this byte.

6 The 3964R Driver

The 3964 driver package is used to transfer data between 2 serial devices. To resolve initialization conflicts, one partner must have high priority and the other low priority.

The interface consists of 3 parts.

- The initialization part
- The cyclical part
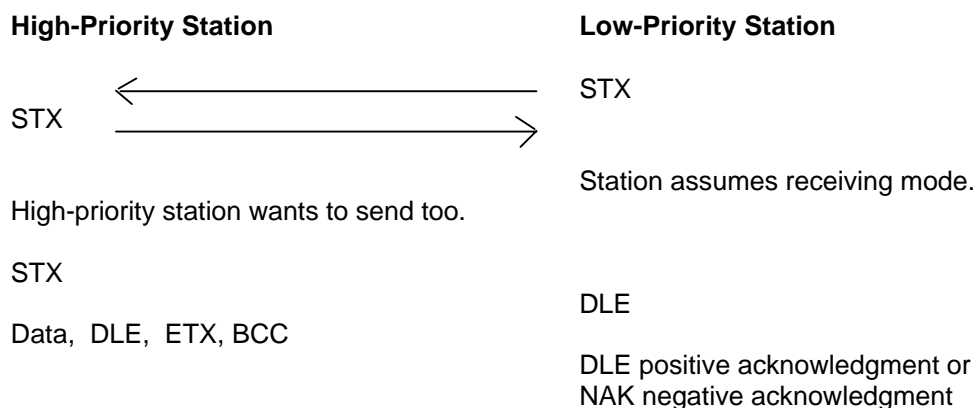- The functions in the interrupt handlers

6.1 Procedure Specifications

The telegram format is described below.

  STX, data, DLE, ETX, BCC (1 start bit, 8 data bits, 1 stop bit, even parity)
- The received user data are transferred in both directions without changes (i.e., transparent).
- Data blocking is not provided.
- The user data length is restricted to 224 bytes per telegram.
- Communication is always performed between high and low-priority communication partners.

6.2 Data Communication

6.2.1 Introduction of Data Communication by the Low-Priority Station

When the low-priority station receives an STX in response to an STX, it interrupts its request to send, assumes receiving mode, and acknowledges the received STX with DLE.

High-Priority Station   **Low-Priority Station**

                        ⟵─────────────────   STX

STX   ─────────────────⟶

                                                            Station assumes receiving mode.

High-priority station wants to send too.

STX
                                                            DLE

Data, DLE, ETX, BCC

                                                            DLE positive acknowledgment or
                                                            NAK negative acknowledgment

A DLE in the data string is doubled and included in the checksum. BCC is calculated from the XOR linking of all characters.

6.2.2 Conflicts

6.2.2.1 Monitoring Times

t_q = Acknowledgment monitoring time (2 sec)

The acknowledgment monitoring time is started after the STX control character is sent. When a positive acknowledgment is not received during the acknowledgment monitoring time, the job is repeated a maximum of 2 times. When the job could not be concluded positively despite 2 retries, the high-priority device attempts to contact the low-priority station by sending the STX control character. The cycle corresponds to t_q.

t_z = Character monitoring time (200 msec)

When the 3964R driver receives data, it monitors the arrival of the individual characters during time t_z. When no character is received during the monitoring time, the procedure concludes the transmission. An acknowledgment is not sent to the other station.

6.2.2.2 Retries

When acknowledgment is negative or the time is exceeded, a telegram sent by the high-priority station is repeated twice.

6.2.3 Introduction of Data Communication by the High-Priority Station

High-Priority Station	Low-Priority Station
STX	
	DLE
Data DLE ETX BCC	
	DLE positive acknowledgment or NAK negative acknowledgment

When acknowledgment is negative or the time is exceeded, a telegram sent by the external device is repeated twice.

7 Start-End Delimiter Protocol

Protocol: (< Start delimiter>), Net data, < End delimiter> (< 2nd End delimiter>)

The character in brackets are optional.
The Start-End delimiter are transmitted transparently that means they have to be sttored iin the send buffer by the user.

Receive direction:

When the start delimiter is switched on the gateway sxnchronises the gateway with this character. If not the gateway stores the next received character in the receive buffer. The telegram ends when the end delimiter is recognized.

send direction:
When the flag ´length byte´is set the required length is transmitted. If not the data is transmitted until the end delimiter is detected. The maximum data that can be transmitted always corresponds to the adjusted length in th configuration telegram.

8 Character Delay Mode

no protocol

Receive direction:
The received data are stored in the send buffer until the character delay time has run out. This time monitoring is adjusted in the parameterization telegram.

send direction:
The data is transmitted transparently.

9 Number of Character-Protocol

The data are transferred transparently without time monitoring. The user specifies the data for the master. When changes are detected, these data are sent to the external device without monitoring. A response from the external device is also sent to the master unchanged. Any desired security mechanisms for user data must be provided by the user.

10 Hardware Connection, Switches and LED

10.1 Address Setting

The PROFIBUS address must be set with the two rotary type switches accessible on the front plate. The tens position of the address is set with rotary switch x10. The ones position is set with rotary switch x1.

Caution
The address 99 is reserved for test purposes.
The black dot indicates the respective switch position. The slit on the switch is vertical to the dot.

10.2 LEDs

Two LEDs on the front plate show the current state of the device.

LED	Color	Meaning
DEVICE	--	Device is not turned on.
	Red	Device malfunction. No function possible.
	Green	Device is ready for operation.
INTERFACE	---	PROFIBUS-DP interface malfunction. Communication with external device is okay.
	Red	PROFIBUS-DP interface malfunction. Communication with external device is unclear.
	Yellow	PROFIBUS-DP interface is okay. Communication malfunction.
	Green	PROFIBUS-DP interface is okay. Communication with external device is okay.

10.3 Plug Connector

10.3.1 Plug Connector to External Device

The connection cable to the external device must be plugged into the plug connector accessible on the front plate.

Pin assignment (9-pin sub D male connector)

Pin No.	Name	Function
1		--
2	M24	0 V supply voltage
3	A	Non-inverting input/output signal for communication with the external device
4		
5	M24	0 V supply voltage
6	E	Input signal
7	P24	24 V supply voltage
8	B	Inverting input/output signal for communication with the external device
9		

10.3.2 PROFIBUS-DP Plug Connector

The plug connector (labeled PROFIBUS-DP) for connection to PROFIBUS is located on the underside of the device.

Pin assignment (9-pin sub D female connector)

Pin No.	Name	Function
1	Shield	
2		
3	B	Non-inverting input/output signal of PROFIBUS
4		
5	M5	DGND - data reference potential
6	P5	5 V supply voltage
7		
8	A	Inverting input/output signal of PROFIBUS
9		

10.3.3 Power Supply

The device must be supplied with 24 V via a 4-pin, plug-in, screw-type terminal.
The 24 V supply can be looped through.

Pin No.	Name	Function
1	P24	24 V supply voltage
2	P24	24 V supply voltage
3	M24	0 V supply voltage
4	M24	0 V supply voltage

10.3.4 Shield Termination

The shield signal for the electronic circuit is connected to the top hat rail with the shied plate. For reasons of interference immunity, the shield signal for the cable shield is not connected to the shield signal of the electronic circuit. It must be applied to the screw terminal on the front plate.

11 Representation of the Data on PROFIBUS-DP

All standard PROFIBUS-DP masters can exchange data with the gateway. The data structure permits very simple master interfaces to be used.
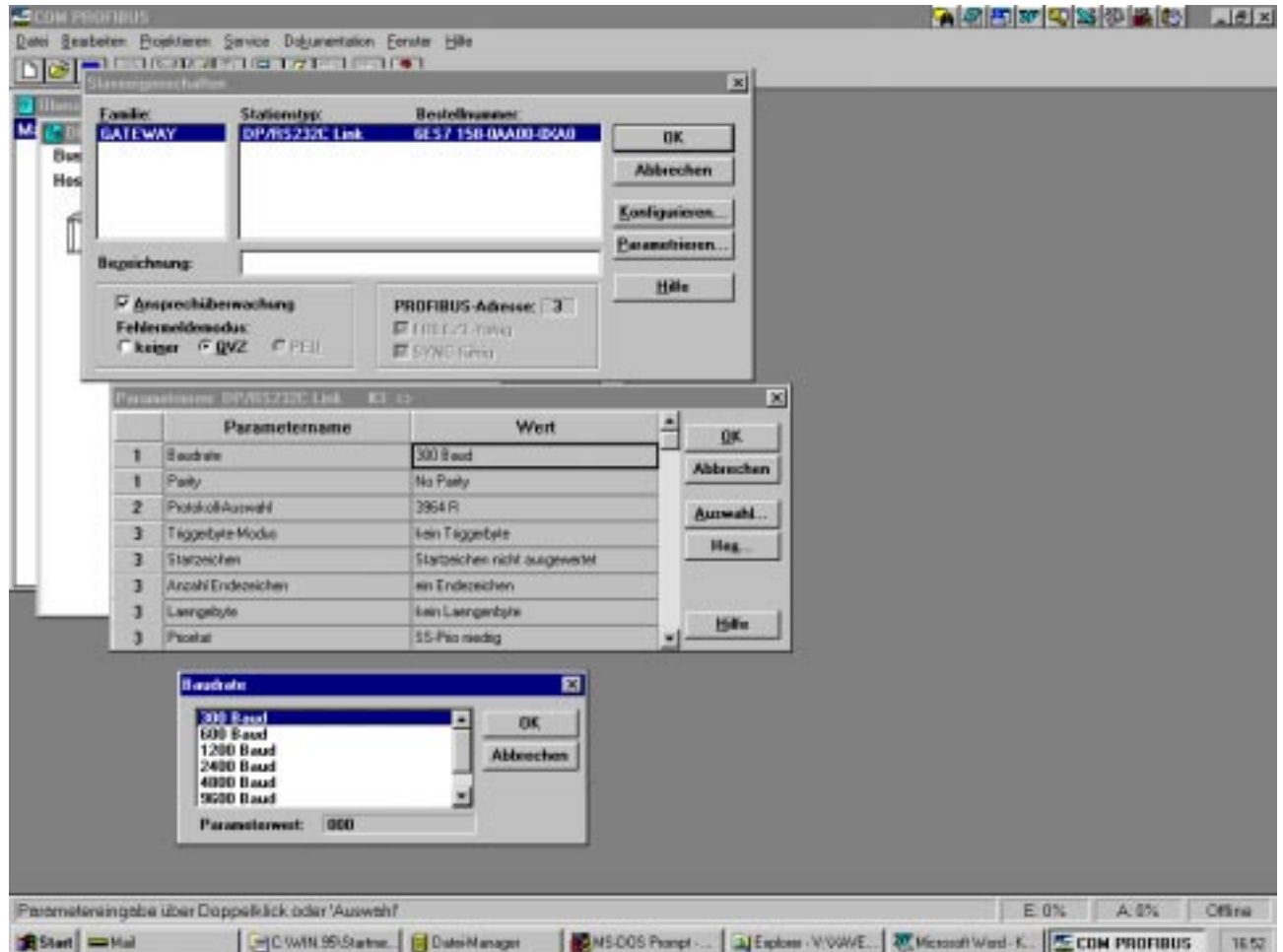
11.1 Parameterization

The master uses the parameterization telegram to identify itself to the slave and specify the mode which the slave is to use.
The following parameterization capabilities are standard.
- The slave operates with/without the watchdog. This is required for security reasons to determine whether a master is still active.
- Specification of the TSDR (i.e., minimum time before which a slave cannot respond after adherence to the bus quiet time)
- Freeze/sync mode (e.g., for drives and counters)
- DP slave is/is not enabled for other masters.
- Specification of a group allocation for global control telegrams. Each bit stands for one group.
- Master address for clear identification
- User-related parameters (e.g., reaction when master assumes clear state)

11.1.1 Layout of the Parameterization Telegram (from Octet 8)

In most cases the user constructs the parameterization telegram by using a commissioning tool (for example COM PROFIBUS)

If this methode is not possible the user data of the parameterization telegram is shown here.

Octet	Bitposition								Designation
	7	6	5	4	3	2	1	0	
8	0	0	0	0	0	WD_Base	Dis_Stop	Dis_Start	Spec_User_Prm_Byte_1
9	reserved			Parity		reserved	Baudrate		Spec_User_Prm_Byte_2
10	Protocol (default: 3964R)								Spec_User_Prm_Byte_3
11	Flags (default: alle 0)								Spec_User_Prm_Byte_4
12	Character delay time (TZ) (default: 200ms)								Spec_User_Prm_Byte_5
13	End delimiter								Spec_User_Prm_Byte_6
14	2nd. End delimiter								Spec_User_Prm_Byte_7
14	Start delimiter								Spec_User_Prm_Byte_8

Byte 8: Spec_User_Prm_Byte_1

Bit	Name	Meaning	Default Status
0	Dis_Startbit	This bit is used to disable start bit monitoring on the receiver.	Dis_Startbit = 1 (i.e., start bit monitoring is disabled)
1	Dis_Stopbit	This bit is used to disable stop bit monitoring on the receiver.	Dis_Stopbit = 0 (i.e., stop bit monitoring is not disabled)
2	WD_Base	This bit specifies which time base is to be used to pulse the watchdog. WD_Base = 0: Time base of 10 msec WD_Base = 1: Time base of 1 msec	WD_Base= 0 (i.e., time base is 10 msec)
3-7	res	Must be 0	0
Byte 9: Spec_User_Prm_Byte_2			
Bit	Name	Meaning	Default Status
0,1	Parity	Setting of the parity	0= no parity, 1= even parity, 2= ODD Parity
2	Prio	Setting of the priority of the gateway	0= SS priority of gateway low 1= SS priority of gateway high For 3964R procedure only
3	Mode	Setting of the protocol	0= 3964R protocol 1= Free ASCII protocol
4 - 6	Baud	Setting of the transmission speed	0 = 300 baud 1 = 600 baud 2 = 1200 baud 3 = 2400 baud 4 = 4800 baud 5 = 9600 baud 6 = 19200 baud 7 = 38400 baud
7	Flags	3964R is to operate without timeout monitoring for test purposes.	0=Disable timeout 1= Enable timeout

Byte 10: Protocol selection	
Protocol	Value
3964R	0
Character delay time	1
Start-/End delimiter	2
Number of Characters	3
reserved	4-255

Byte 11: Flags

Bit	Name	meaning	state
0	Trigger-Byte	Using Triggerbyte-Mode	0=no Triggerbyte 1= using Triggerbytes
1	Start character	Using Start delimiter (only Start-/End character mode)	0=switch off Start delimitzer 1=switch on Start delimiter
2	2nd End delimiter	Number of end delimiters	0=one end delimiter 1=two end delimiters
3	Lengthbyte	Using the length byte	0= no length byte 1= lengthbyte is used
4	Priority	Priority during initialisation conflict (only 3964R)	0= Interface Priority is low 1= Interface Priority is high
5	Disable TO	switch off Timeout-Monitoring for test purposes	0=Timeout monitoring on 1= Timeout monitoring off
6	Send-Done-Detection	The MSB of the triggerbytes toggles each time a send-telegram has been finished . Requires Triggerbyte!	0=Send-Done-Detection off 1=Send-Done-Detection on
7	reserved		fixed 0

Byte 12: Character delay time

Character delay time 10 ms. valid range: 2 - 255 (20ms up to 2,55s)

Byte 13: End delimiter

1. character of the end delimiter

Byte 14: 2nd . End delimiter

2. character of the end delimiter

Byte 15: Start delimiter

character of the start delimiter

The response of a slave to a parameterization telegram is E5H (i.e., short acknowledge). The slave does not indicate an erroneous parameterization until the master sends a diagnostic request later. In this case, the gateway does not begin data communication.

*) The time base for the watchdog time is specified as 10 msec in octets 2 and 3. One octet should at least contain the value 2 as the time base, and the other octet should at least contain the value 1 to ensure that the watchdog time does not immediately expire. Due to 12 Mbaud technology, a time base of 1 msec is specified for some ASICs in the user parameters.
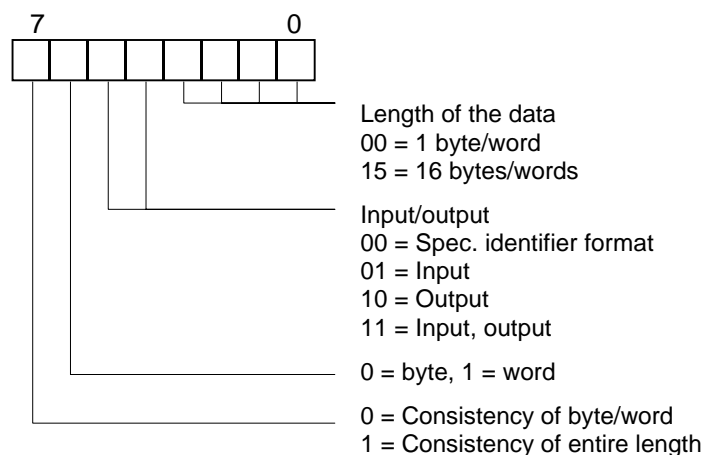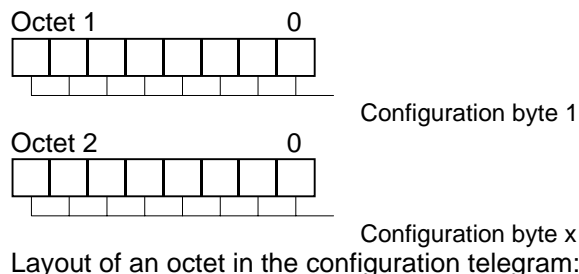
11.2 Configuration Telegram

After parameterization, the master must send a configuration telegram to the appropriate slave. After receiving the configuration telegram, the slave compares the sent configuration with the stored configuration.

Up to 16 bytes or words can be written in an octet of the data unit (i.e., DU). Inputs and outputs with the same format can be combined in one octet. Otherwise, use as many octets as you have bytes/words which cannot be combined in one octet.

The acknowledgment of a configuration telegram is E5H. If the slave detects differences from the entries in the GSD file, it reports the incorrect configuration to the master when a diagnosis is requested later. In this case, the slave is not ready for user data communication.

Configuration telegram

Octet 1   0

Configuration byte 1

Octet 2   0

Configuration byte x

Layout of an octet in the configuration telegram:

7   0

Length of the data
00 = 1 byte/word
15 = 16 bytes/words

Input/output
00 = Spec. identifier format
01 = Input
10 = Output
11 = Input, output

0 = byte, 1 = word

0 = Consistency of byte/word
1 = Consistency of entire length

When the current configuration is unknown to a class-2 master, the master can read the configuration of the slave with "Get_Cfg" and then send it to the slave for checking. This service is particularly useful for modular systems.

11.3 Diagnosis

Diagnostic data are high-priority data. The gateway generates an external diagnosis when the connection to the external device is faulty.

Representation of the messages in the external diagnostic byte:

The diagnostic information of a DP slave consists of 6 bytes of diagnostic information and any user-related diagnostic information.

Telegram for request for diagnosis:

Octet 1   0
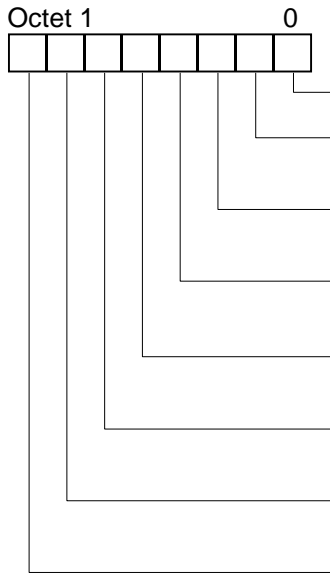
Diag. station does not exist. Master sets.

Diag.station_not_ready: Slave is not ready for data communication.

Diag.cfg_Fault
Configuration data are incorrect.

Diag.ext_diag
Slave has external diagnostic data.

Diag. not supported: Requested function is not supported by slave.

Diag.invalid_slave_response. Slave sets permanently to 0.

Diag.prm_fault
Wrong parameterization (e.g., ident number, etc.)

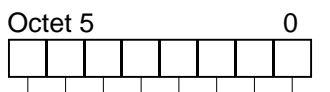Diag.master_lock. Master sets.
Slave is parameterized by another master.

Octet 2   0
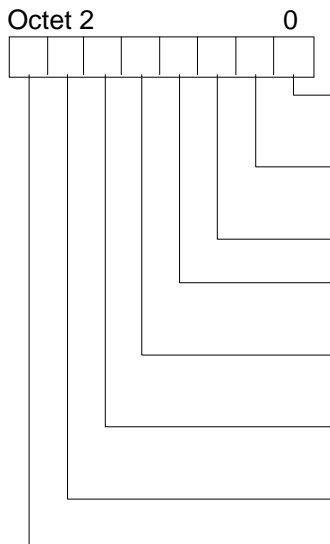
Diag.Prm_req
Slave must be parameterized again.

Diag.Stat_diag
Static diagnosis (diagnostic bits byte)

Fixed at 1

Diag.WD_ON
Watchdog active

Diag.freeze_mode
Freeze command received

Sync_mode
Sync command received

Reserved

Diag.deactivated. Master sets.

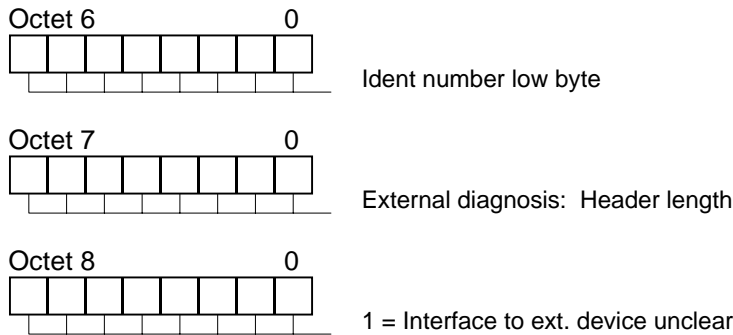Octet 3   0
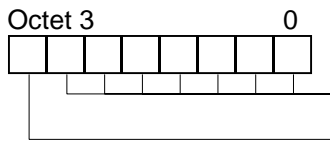
Reserved

Diag.ext_overflow

Octet 4   0
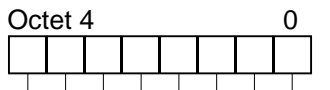
Diag.master_add: Master address after parameterization. FF = No parameterization.

Octet 5   0

Ident number high byte

Octet 6   0

Ident number low byte

Octet 7   0

External diagnosis: Header length

Octet 8   0

1 = Interface to ext. device unclear

11.4 Data Exchange

After the master recognized the state for data exchange the master only sends telegrams for data exchange. The received input and output data is either stored in the dedicated area in the master or the user program has to handle the data by using Function blocks.

12 User Interface

To operate an external device, the user must enter the maximum amount of user data to be transferred in both directions in the GSD file. If the lengths of the individual telegrams differ, the remaining positions of the telegram must be filled with zeros.

13 Technical Data

General

Permissible ambient and storage temperature	0° C to +55° C
Installation altitude	Up to 2000 m above sea level
Protection rating	IP20
Dimensions (H x W x D in mm)	95 x 70 x 80
Installation position	Vertical
Weight	0.3 kg
Mounting	Snap-on mounting on 35 mm top hat rail in acc. w. DIN 50 022
EMC interference immunity	In acc. w. EN 50 082/2/95
EMC interference emission	In acc. w. EN 50 081 / 1 / 93

Auxiliary current circuit

Incoming voltage	24 V
Operational range	24V DC; 0.85 to 1,2 x Us (DIN 19240)
Current consumption	Max of 300 mA
Power consumption	6 W
Power failure bypass time	$\leq$ 20 msec
Connection technique	4-pin, plug-type terminal with screw connection (jumpered 2x2 in device)
Turning moment	0.8 Nm

Communication interface to PROFIBUS-DP

Interface design	RS 485
Transmission medium	Twisted, shielded two-wire line
Max. distance	See RS 485 specifications.
Standards met	EN 50 170
Max. transmission speed	12 Mbaud

Addressing	Via two rotary-type switches (0 to 99 decimal)
Communication interface to external device	
Interface design	RS 232
Connection technique	9-pin sub D socket
Distance to connection of external device	See RS 232 specifications.
Max. transmission speed	38.4 kbaud
	1

# 14 Commissioning Guidelines

Caution	
!	The DP/RS232C interface *(MLFB:* **6ES7158-0AA00-XA0***)* may only be commissioned by trained personnel under observance of safety regulations.

Components
The following components are required to commission the DP/RS232C Link interface.

- DP/RS232C Link interface
- Connection cable from the DP/ RS232C Link interface to the process
- Connection plug for connection of PROFIBUS to the interface
- *PROFIBUS cable. (This cable has usually already been installed on site.)*
- 24 V DC voltage supply (DIN 19240)
- Floppy disk with type or GSD file and operating instructions *(enclosed with the interface)*
- Configuration tool for the PROFIBUS master *(COM PROFIBUS for Siemens master)*
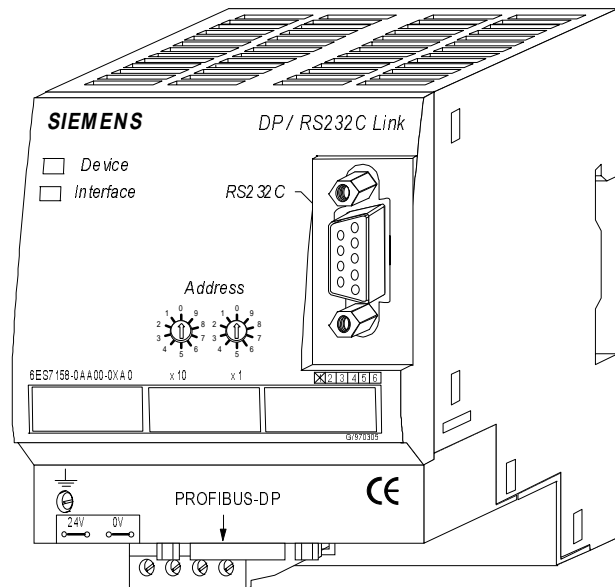
Mounting
The DP/RS232C Link interface has a protection rating of IP20 and can be installed in the switching cabinet. The device is designed to be snapped onto a 35-mm top hat rail.

Commissioning
To ensure correct operation of the interface, performance of the following commissioning steps is mandatory.

- Set PROFIBUS address
  ⇨ Use the two rotary-type switches labeled "**Address**" on the front of the interface to set the PROFIBUS address. Use the rotary switch labeled "**x10**" to set the tens position and the rotary switch labeled "**x1**" to set the ones position.

Caution	
!	The PROFIBUS address set with the rotary switches must match the address configured with COM PROFIBUS.

- PROFIBUS connection
  ⇨ Connect the device to the PROFIBUS on the interface labeled **"PROFIBUS-DP"**.
- Process device connection
  ⇨ Connect the process device to the interface labeled **"RS232C"**.
  ⇨ Read the operating instructions for commissioning the process device.
- Supply voltage connection
  ⇨ Connect the 24 V direct current to the terminals provided for this purpose.
- Shield connection
  ⇨ Connect the protective conductor to the terminals provided for this purpose.
  ⇨ Ground the top hat rail on which the interface was snapped on.
- Configuration with COM PROFIBUS

⇨ To configure, use COM PROFIBUS (for Siemens devices) or another configuration tool suitable for the PROFIBUS master you are using. The required GSD file has already been defined.

⇨ If the required GSD file was not included with your configuration tool, copy this file from the included floppy disk or download it from mailbox no. ++ 49 911 73 79 72.

15 List of Related Literature

For a quick and intensive introduction to the subject of PROFIBUS-DP and how the available ASICs operate, we recommend "The Rapid Way to PROFIBUS-DP" by Manfred Popp. The book is available from the PROFIBUS User Organization under order no. 4.071.
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