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Instruction Manual
Universal Fieldbus-Gateway
UNIGATE® EL PROFIBUS DP

Deutschmann Automation GmbH & Co. KG
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Disclaimer of liability

We have checked the contents of the document for conformity with the hardware and software described. Nevertheless, we are unable to preclude the possibility of deviations so that we are unable to assume warranty for full compliance. The information given in the publication is, however, reviewed regularly. Necessary amendments are incorporated in the following editions. We would be pleased to receive any improvement proposals which you may have.

1   Information on CE marking of the module

1.1   EU Directive EMC

The following applies to the module described in this User Manual:

Products which bear the CE mark comply with the requirements of EU Directive „Electromagnetic Compatibility" and the harmonized European Standards (EN) listed therein.
The EU Declarations of Conformity are available at the following location for perusal by the responsible authorities in accordance with the EU Directive, Article 10:

Deutschmann Automation GmbH & Co. KG, Carl-Zeiss-Straße 8, 65520 Bad Camberg, Germany.

1.2   Scope of application

The modules are designed for use in the industrial sector and comply with the following requirements.

Scope of application	Requirement applicable to	
	Emitted interference	Interference immunity
Industry	EN 55011, cl. A (2007)	EN 61000-6-2 (2005)

1.3   Note installation guidelines

The module complies with the requirements if you

1. comply with the installation guidelines described in the User Manual when installing and operating the module.
2. also follow the rules below on installation of the equipment and on working on switch cabinets.

1.4   Installation of the unit

Modules must be installed in electrical equipment rooms/areas or in enclosed housings (e.g. switch boxes made of metal or plastic). Moreover, you must earth the unit and the switch box (metal box) or at least the top-hat rail (plastic box) onto which the module has been snapped.

1.5   Working on switch cabinets

In order to protect the modules against static electrical discharge, the personnel must discharge themselves electrostatically before opening switch cabinets or switch boxes.

2 Information for the machine manufacturers

2.1 Introduction

The UNIGATE® module does not constitute a machine as defined by the EU "Machinery" Directive. Consequently, the module does not have a Declaration of Conformity in relation to the EU Machinery Directive.

2.2 EU Machinery Directive

The EU Machinery Directive stipulates the requirements applicable to a machine. The term "machine" is taken to mean a totality of connected parts or fixtures (see also EN 292-1, Paragraph 3.1)
The module is a part of the electrical equipment of the machine and must thus be included by the machine manufacturer in the Declaration of Conformity process.

3   Introduction

The UNIGATE® EL-PROFIBUS DP module serves to adapt an Ethernet port to the PROFIBUS DP to EN 50 170. In this application, it functions as a Gateway and operates as the PROFIBUS DP Slave. It can be operated by any standard-compliant PROFIBUS Master.

The module EL-PROFIBUS DP essentially consists of the following hardware components:

• Electrically isolated RS485 interface to the PROFIBUS DP
• PROFIBUS ASIC
• Microprocessor 89C51RE2
• RAM and EPROM
• Serial interface (RS232, RS485 and RS422)
• 10/100 Base-T Ethernet LAN (RJ-45 connector)

Conceptual
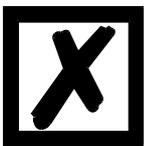
In the further course of this manual, the term "Fieldbus" is frequently used. In these cases this applies to the PROFIBUS DP interface.

3.1 UNIGATE® EL software flow-chart
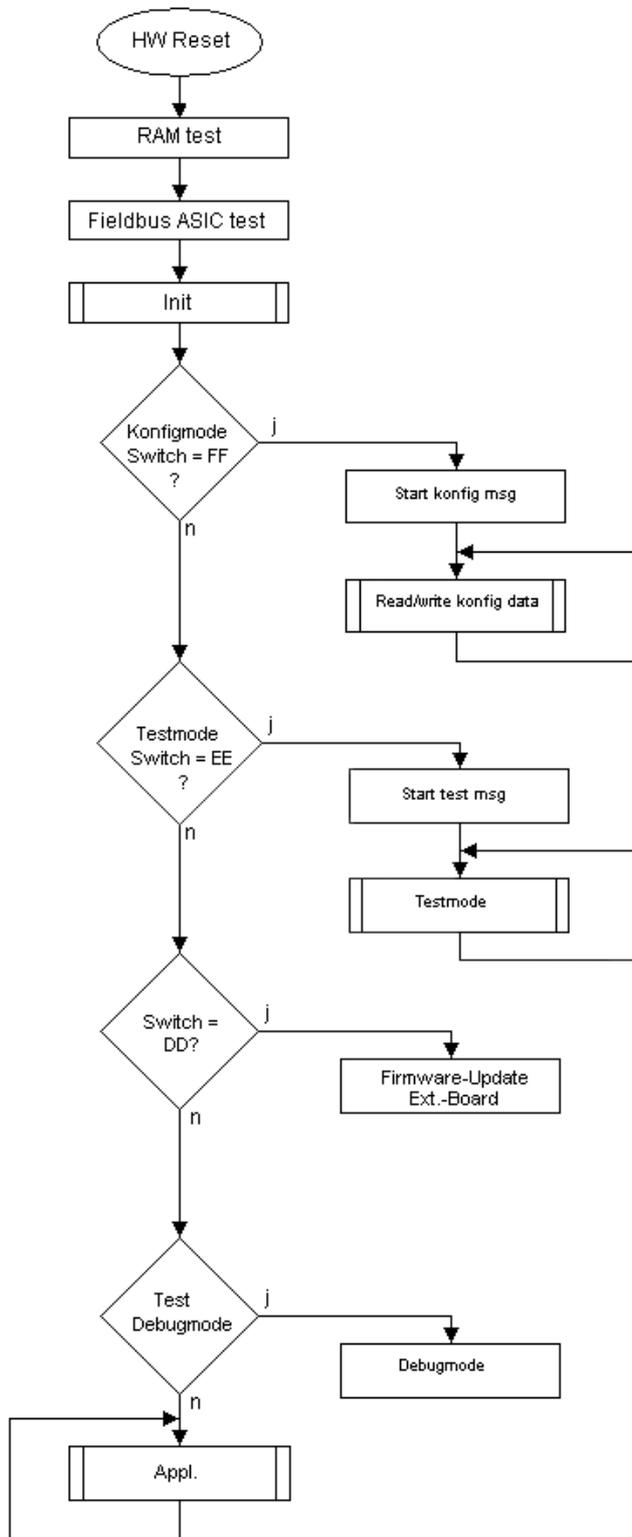
3.2   UNIGATE® block diagram

The following picture shows a typical UNIGATE®-module design.
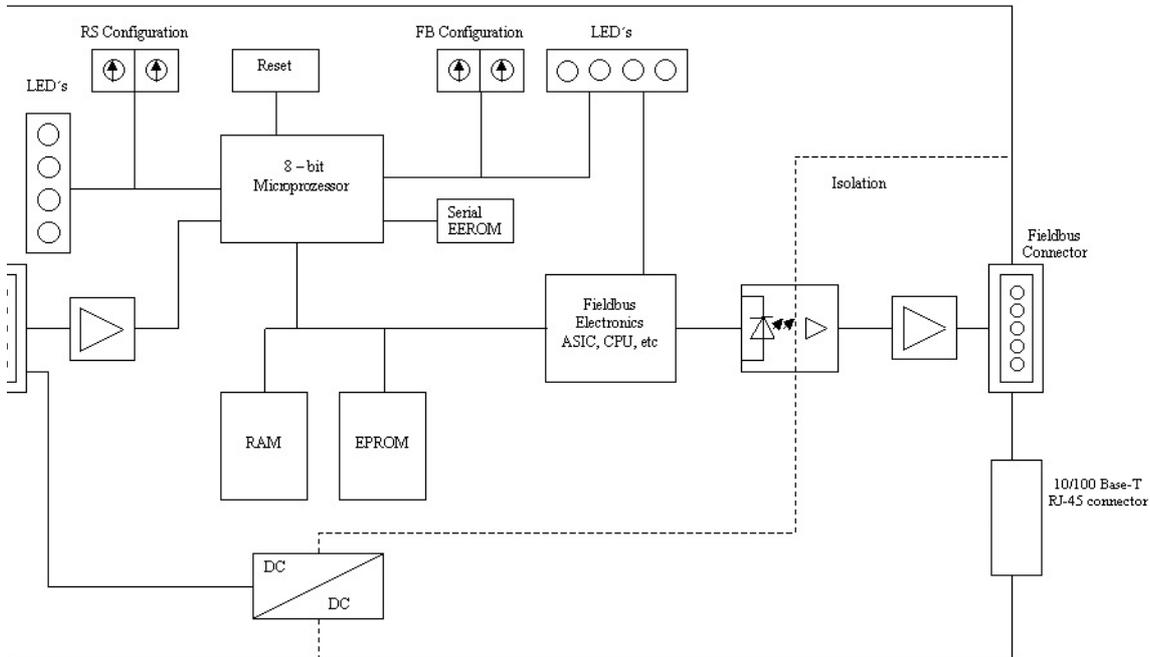
3.3   UNIGATE® EL application diagram

The following graph shows a typical connection scheme.
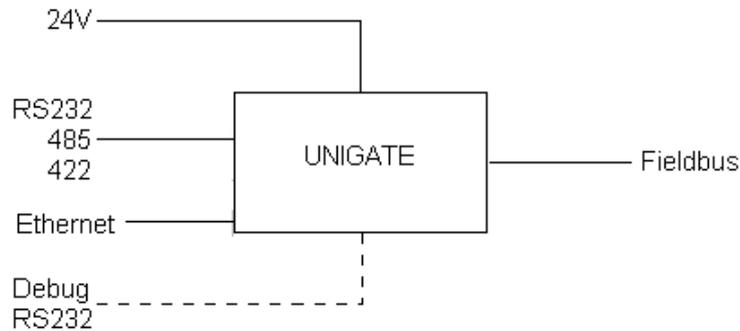
4   Operation modes of the Gateway

4.1   Configuration mode (config mode)

The configuration mode serves to configure the Gateway. The following adjustments are possible in this mode.

• Loading a Script
• Updating the firmware (only CL- basis)
• Configuring the Gateway (via WINGATE Version V2.82 or higher)

The Gateway will be starting in this mode in case both switches S4 as well as S5 are set on position "F" when switching on the Gateway. Right after switching on the Gateway in the configuration mode it will be sending its starting message, that looks analog with the following message:

RS-PBV1-CL (RS+Ext.Board) V8.1.1[41] (c)dA[40MHz] Switch=0x04FF
Script(C:11292/16128,V:7539/8192)="Universalscript Deutschmann EL" Author="G/S"
Version="V 1.0" Date=08.10.2015 SN=47110001 ID=4
Ext-Board: CL-Erweiterung(EL-IO-DICNET) V1.3 (c)dA 47110211
FE: IP=0.0.0.0 MAC=00-14-11-15-1A-53 Data-Flash=1MB

In the configuration mode the Gateway always operates with the settings 9600 Bauds, no Parity, 8 Databits and 1 Stopbit, the RS-State LED will always be flashing red, the "Error No/Select ID" LEDs are of no account for the user. All software revisions contain the configuration mode.

4.1.1   Data structure on the Ethernet-Side in configuration mode

10/100 Base-T: 1. + 2. Byte Echo of the received Ethernet data
                                  3. Byte Zero
                                  4. Byte Echo of the received Ethernet data
                                  5. Byte FF
                            6. - 8. Byte Version of the Ext. Card e.g. 13

Connection setting for 10/100 Base-T (RJ45 connector)

This connector has four channels (sockets) with the following transport protocols:

Channel	Transport protocol	Config mode	Test mode	data exchange mode	
Channel 1	TCP server (TCP/IP server) port 23	✓	✓	default	
Channel 2	Web server	✓	✓	✓	
Channel 3	FTP (Control)	✓	✓	✓	
Channel 4a	FTP (Data)	✓	✓	✓	
Channel 4b	UDP (UNIGATE® Scan)	✓	✓	✓	After FTP connection UDP connection is erased

4.2   Test mode

Setting of the test mode
The test mode is set by bringing the switches S4 and S5 in position "E". All other switches will not be taken into consideration for the setting of the test mode. Now the Gateway has to be restarted with these settings (by a short disconnection from the power supply).
In the test mode the Gateway always operates with the settings 9600 baud, no parity, 8 databits and 1 stopbit.
The test mode may be helpful to integrate the Gateway in the relevant environment, for instance to test the parameters of the RS-interfaces.

Mode of operation of the test mode
After the restart in the test mode the Gateway will be sending the values 0-15 in hexadecimal representation ("0".."F") in ASCII-coding on the serial side every second. Simultaneously the same values are issued binary on the fieldbus-interface.
In this mode the State-LED on the RS-side will be flashing red, the "Error No/Select ID" LEDs will be displaying the value in a binary way, that is issued that moment. Additionally each character that is received at one of the interfaces will also be output at the same interface as a local echo. On the fieldbus-side only the first byte will be used for the local echo, that means on receiving as well as on transmitting only the first byte of the bus data is looked at, the other bus data do not change compared to the last data.

8 Bytes are output on the Ethernet interface:
The first 6 Byte are an echo of the received Ethernet data, the 7. Byte is incremented every second 0-255 and then again from 0. The 8. Byte is also incremented every second, but always cyclically from 0-9.

In test mode the Gateway always operates with TCP/IP (server) port 23.

4.3   Data exchange mode

The Gateway has to be in the data exchange mode, so that a data exchange between the Ethernet-side of the Gateway and the PROFIBUS is possible. As long as the Gateway is not in the configuration-, test-, firmware-update-, or debug mode, the data exchange mode is active. In the data exchange mode the Gateway will execute the downloaded Script `UniversalScript_EL.dcs(ScriptName „Universalscript Deutschmann EL")`.

5 RS-interface

5.1 RS-interfaces at the UNIGATE® EL

The UNIGATE® EL - PROFIBUS DP has the interfaces RS232, RS422 and RS485 available. The hardware always features a DEBUG-interface, see chapter 6.

5.2 Buffer sizes at the UNIGATE® EL

UNIGATE® EL features at the serial side a buffer with the size of 1024 bytes for input data and output data each.
The FIFO of the application interface (RS-interface) can be changed in any Gateway form Script revision 26 on, that is capable for Script. For it please check in the Protocol Developer under "Device Control" - "Hardware".

5.3 Framing Check

The length of the stop bit received by the Gateway is checked through the function "Framing Check". Here the stop bit generated by the Gateway is always long enough, so that connected participants can evaluate the stop bit.

Please be aware that the function "Framing Check" becomes effective only in case of 8 data bit and the setting "No parity".

An error is detected and indicated by the Error LEDs in case the stop bit does not show the length 1 bit during the activated check.

The possible setting for this parameter can be controlled by the Script (see online help from Protocol Developer). The presetting for the "Stop Bit Framing Check" is "enabled".

6   The Debug-interface

6.1   Overview of the Debug-interface

The UNIGATE® features a Debug-interface, that allows a step-by-step processing of a Script. Normally this interface is only required for the development of a Script.

6.2   Starting in the Debug-mode

When applying power to the UNIGATE® (power up) the firmware will output the binary character 0 (0x00) after a self-test was carried out on this interface. If the UNIGATE® receives an acknowledgement via this interface within 500 ms, it is in the Debug-mode. The acknowledgement is the ASCII-character O (0x4F).
With the start in the Debug-mode the further execution of Script commands will be put to a stop.

6.3   Communication parameter for the Debug-interface

The Debug-interface is always operating with 9600 baud, no parity, 8 data bit, 1 stop bit. It is not possible to change this parameter in the Protocol Developer. Please consider the fact that these settings have to be in accordance with those of the PC-COM-interface and that the flow control (protocol) has to be set on „none" there.

6.4   Possibilities with the Debug-interface

Usually the Protocol Developer is connected to the Debug-interface. With it a step-by-step processing of a Script, monitoring jumps and decisions and looking at memory areas is possible. Moreover breakpoints can be set. It basically possesses all characteristics a software-development tool is typically supposed to have. However, it is also possible to carry out a Scrip-update via this interface.
From Script version [27] on you can also output data with the Script command "SerialOutputToDebugInterface". Please also pay attention to the remark in the manual 'Protocol Developer'.

6.5   Commands of the Debug-interface

The commands for the use of the Debug-interface are described in the instruction manual Protocol Developer.

Restriction:

- Script commands that make a data exchange with the Ext. Card are not supported in Debug mode.

- The command „SerialOutputToDebugInterface", referred to in chapter 6.4, as well as the command „SerialInDebugInterface", is not supported.

- Redirection of the Debug interface to the Application interface (X1).
  With the script command „ScriptStartBehaviour(DbgOverApl);" debugging to connector X1 of the application is possible again, so that the commands for the Ext. Cards are supported.

Note: The script command „ScriptStartBehaviour(DbgOverApl);" must be placed directly after the script info.
First, the script must be loaded, because only after a reboot it is possible to debug via the application interface. If the command is taken out, the script has to be started once before you can debug on the Debug interface.

If debugging is redirected to the application, no script or command that wants to carry out communication via the application interface is supported. These are e.g.:
SendRS and ReceiveSomeCharRS.

7   Mode of operation of the system

7.1   General explanation

Communication can be split into seven layers, Layer 1 to Layer 7, in accordance with the ISO/OSI model.
The Deutschmann Automation Gateways convert Layers 1 and 2 of the customized bus system (RS485 / RS232 / RS422) to the corresponding Fieldbus system. Layers 3 to 6 are blank, and Layer 7 is converted in accordance with chapter 7.3.

7.2   Interfaces

The Gateway features the RS232-, RS422- and RS485-interfaces as well as 10/100 Base-T LAN (RJ-45).

7.3   Data exchange

All data is transferred by the Gateway in dependence of the downloaded Script.

7.4   Possible data lengths

The table below shows the maximum transferable data:

	Input data	max. 244 bytes	Variable: maximum value in this case
	Output data	max. 244 bytes	Variable: maximum value in this case
PROFIBUS	Parameters	8 bytes	No user parameters *
	Configuration data	max. 16 bytes	Dependent on configuration *
	Diagnosis	max. 8 bytes	1 user diagnostic bit = error code *
EL	In- and Output data	max. 1536 byte	dynamic

*) Contrary to this default setting these parameters can be altered through special Script commands.
   The commands can be found in the Protocol under "Bus specific"-"Profibus":
   Set Profibus Config Data
   Set Profibus Parameter InBuf
   Set Profibus Diagnose
   Further information can be found in the online help of the Protocol Developer.

7.5   Startup phase

The Gateway is parametrized and configured by the Master during the startup phase. Only after a correct termination of the startup phase the data exchange with external devices will take place.

8   Generating a Script
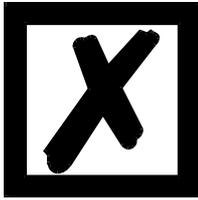
Note: All commands relating to the extension do not work in the debug mode! (see Chapter 6.5)

8.1   What is a Script?

A Script is a sequence of commands, that are executed in that exact order. Because of the fact that also mechanisms are given that control the program flow in the Script it is also possible to assemble more complex processes from these simple commands.

The Script is memory-oriented. It means that all variables always refer to one memory area. While developing a Script you do not have to take care of the memory management though. The Protocol Developer takes on this responsibility for you.

8.2   Memory efficiency of the programs

A Script command can carry out e. g. a complex checksum like a CRC-16 calculation via data. For the coding of this command only 9 byte are required as memory space (for the command itself). This is only possible when these complex commands are contained in a library.
A further advantage of this library is, that the underlying functions have been in practical use for a couple of years and therefore can be described as 'void of errors'. As these commands are also present in the native code for the controller, at this point also the runtime performance of the Script is favorable.

8.3   What can you do with a Script device?

Our Script devices are in the position to process a lot of commands. In this case a command is always a small firmly outlined task. All commands can be put into classes or groups. A group of commands deals with the communication in general. This group's commands enable the Gateway to send and receive data on the serial side as well as on the bus-side.

8.4   Independence of buses

Basically the Scripts do not depend on the bus, they are supposed to operate on. It means that a Script which was developed on a PROFIBUS Gateway can also be operated on an Interbus without changes, since the functioning of these buses is very similar. In order to also process this Script on an Ethernet Gateway, perhaps further adjustments have to be made in the Script, so that the Script can be executed reasonably.
There are no fixed rules how which Scripts have to operate properly. When writing a Script you should take into account on which target hardware the Script is to be executed, so the necessary settings for the respective buses can be made.

8.5   Further settings at the Gateway

Most devices require no further adjustments, except for those made in the Script itself. However, there are also exceptions to it. These settings are made by means of the software WINGATE. If you know our UNIGATE®-series, you are already familiar with the proceeding with it. An example

is the adjustment of the IP-address and the net-mask of an Ethernet-Gateway. Another reason for the configuration of the values in WINGATE is the following: After an update of the Script these values remain untouched, i. e. the settings that were made once are still available after a change of the Script.
Only this way it is also possible that the same Script operates on different Ethernet-Gateways, that feature different IP-addresses.

8.6   The use of the Protocol Developer

The Protocol Developer is a tool for an easy generation of a Script for our Script Gateways. Its operation is exactly aimed at this use. After starting the program the Script that was loaded the last time is loaded again, provided that it is not the first start.
Typical for Windows Script commands can be added by means of the mouse or the keyboard. As far as defined and required for the corresponding command, the dialog to the corresponding command is displayed, and after entering the values the right text is automatically added to the Script. The insertion of new commands by the Protocol Developer is carried out in a way that existing commands will not be overwritten. Generally a new command is inserted in front of the one where the cursor is positioned. Of course the commands can also be written by means of the keyboard or already written commands can also be modified.

8.7   Accuracies of the baud rates

The baud rate of the serial interface is derived from the processor's crystal frequency.
Meanwhile all Script-Gateways are working with a crystal frequency of 40 MHz.
You can enter any desired integer baud rate into the Script. After that the firmware adjusts the baud rate, that can be derived the most precisely from the crystal frequency.
The baud rate the Gateway is actually working with (BaudIst) can be determined as follows:

BaudIst= (F32 / K)
F32   = Crystal frequency [Hz] / 32
K   = Round (F32 / BaudSoll);
         Round () is a commercial roundoff

Example:
The actual baud rate is to be calculated, when 9600 baud are pre-set, where the Gateway is operated with 40 MHz:

F32   = 40000000 / 32 = 1250000
K   = Round(1250000 / 9600) = Round(130.208) = 130
BaudIst= 1250000 / 130 = 9615.38

I. e.: The baud rate actually adjusted by the Gateway is 9615.38 baud

The resulting error in per cent can be calculated as follows:

Error[%] = (abs(BaudIst - BaudSoll) / BaudSoll) * 100

In our example the following error results:
Error = (abs(9615.38 - 9600) / 9600) * 100 = 0.16%

In practise errors below 2% can be tolerated!

In the following please find a listing of baud rates at a 40 MHz-crystal frequency with the corresponding errors:

4800 baud:	0.16%
9600 baud:	0.16%
19200 baud:	0.16%
38400 baud:	1.35%
57600 baud:	1.35%
62500 baud:	0%
115200 baud:	1.35%
312500 baud:	0%
625000 baud:	0%

8.8   Script processing times

The Script is translated by the Protocol Developer and the consequently generated code is loaded into the Gateway. Now the processor in the Gateway interprets this code. In this case, there are commands that can be processed very fast (e. g. "`Set Parameter`"). There are also commands, however, that take longer (e. g. copying 1000 bytes). Consequently, for one thing the processing time differs due to the kind of Sript command. But the processing time of the Script commands is considerably more determined by the processor time that is available for this process. Since the processor has to carry out several tasks simultaneously (multitasking system) only a part of the processor's capacity is available for the Script processing. The following tasks - in the order of priority - are executed on the processor:

- Sending and receiving data at the Debug-interface (provided that the Protocol Developer has been started on the PC)
- Sending and receiving data at the RS-interface
- Sending and receiving data at the Fieldbus-interface
- Tasks controlled via internal clock (1 ms) (e. g. flashing of an LED)
- Processing of the Script

From experience approximately 0.5 ms can be calculated for each Script line. This value confirmed itself again and again in many projects as a standard value. He is always quite right if the processor has enough time available for the Script processing.
By means of the tasks mentioned above, the following recommendation can be formulated in order to receive a rather fast Script processing:

- Deactivate the Debug-interface (it is the normal case in the serial use)
- Keep the data length at the RS-interface as small as possible. The baud rate is not the problem here, but the amount of characters which are transfered per second.
- Do not unnecessarily extend the data length at the Fieldbus side. Especially at acyclical bus data, if possible do only send them when changes were made. The data length at buses that are configured to a fixed length (e. g. PROFIBUS) should not be longer than absolutely necessary.

If the processing time should be too large in spite of these measures, there is the possibility to generate a customized Script command, that executes several tasks in one Script command. Please contact our support department for this purpose.

9   Hardware ports, switches and LEDs

9.1   Device labeling
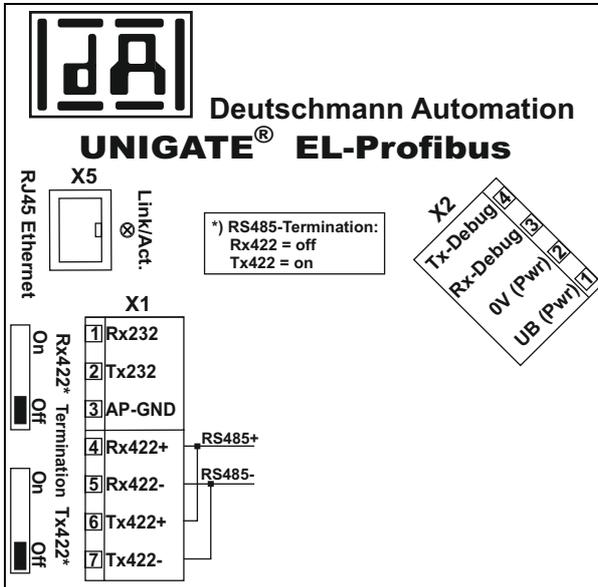
Picture 1: Terminal labeling and termination
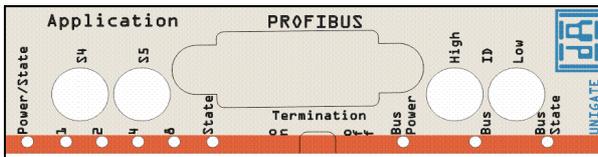
Picture 2: Front panel: Rotary switches, LEDs and termination PB
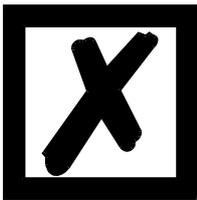
In case the front panel should pop out it does not affect the device's function or quality. It can be put in again without problems.

9.2   Connectors

9.2.1   Connector to the external device (RS-interface)

The serial interface is available at the plug accessible on the upper side of the device.

Pin assignment X1 (3-pole and 4-pole screw-type plug connector)

Pin No.	Name	Function
1	Rx 232	Receive signal
2	Tx 232	Transmit signal
3	AP-GND	Application Ground
4	Rx 422+ (485+)	Receive signal
5	Rx 422- (485-)	Receive signal
6	Tx 422+ (485+)	Transmit signal
7	Tx 422- (485-)	Transmit signal
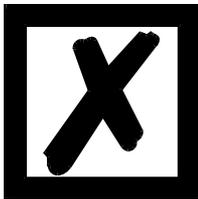
For the operation at a 485-interface the two pins labeled "485-" have to be connected together.
Also the two pins "485+".

9.2.2   Connector supply voltage and DEBUG-interface

Pin assignment X2 (4-pole screw-plug connector, on the bottom side, at the back)

Pin No.	Name	Function
1	UB (Pwr)	10..33 V supply voltage / DC
2	0 V (Pwr)	0 V supply voltage / DC
3	Rx-Debug	Receive signal Debug
4	Tx-Debug	Transmit signal Debug
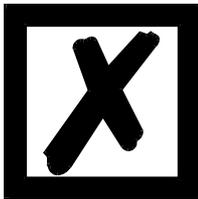
Attention:
The 0V (Pwr)-signal can be used as reference (Ground) for the Debug interface.

Pin 3 Rx-Debug: Avoid long cable + open (not connected at the end), otherwise it may malfunction.

9.2.3   Ethernet interface connector

The accessible plug (label: RJ45 Ethernet) at the top (rear) is the Ethernet interface.

Pin assignment X5 (RJ45)

Pin No.	Name	Function
1	TD+ (RD+*)	Transmission line+ (receive line+*)
2	TD- (RD-*)	Transmission line- (receive line-*)
3	RD+ (TD+*)	Receive line+ (transmission line+*)
4		
5		
6	RD- (TD-*)	Receive line- (transmission line-*)
7		
8		

*) the device supports „autocrossover"

9.2.4 PROFIBUS DP-connector

The plug (labeled: PROFIBUS) for the connection to PROFIBUS is available on the front side of the device.

Pin assignment (9-pole D-SUB, socket)

Pin No.	Name	Function
1	Shield	
2		
3	B	Not inverting input-/output-signalfrom PROFIBUS
4	CNTR-P	Control signal / repeater
5	M5	DGND-data reference potential
6	P5	5 V supply voltage
7		
8	A	Inverting input-/output-signal from PROFIBUS
9		

9.2.5 Power supply

The device must be powered with 10-33 VDC, The voltage supply is made through the 4-pole screw-plug connector at the device's bottom side.

Please note that the devices of the series UNIGATE® should not be operated with AC voltage.

9.3 LEDs

The Gateway UNIGATE® EL - PROFIBUS features 10 LEDs with the following significance:

RJ45 LED	LED Link/Act.	green	Ethernet link pulses found Network data traffic Ethernet interface
LEDs at zhe front-side	LED Power/State	red/green	Interface state Ethernet
	LEDs 1 / 2 / 4 / 8 (Error No. / Select ID)	green	User-defined / general Gateway error
	LED State	red/green	User-defined / general Gateway error
	LED Bus Power	green	Supply voltage PROFIBUS
	LED Bus	red	PROFIBUS error
	LED Bus State	red/green	Interface state PROFIBUS

9.3.1 LED "Link/Act."

Note: This LED is located next to the RJ45 port X5.

The LED is directly controlled by the Ethernet controller and is illuminated when the Gateway is located in an operational network (link pulses are being received) and it flickers when network data traffic takes place.

9.3.2 LED "Power/State"

The Power/State LED signals the status and operating condition of the Ethernet interface and can have the following conditions in the data exchange mode:

green bright	There is a FE connection
green flashing	There is at least one FE connection in the Gateway established
red flashing	Flash command of the UNIGATE-SCAN-Tool

More conditions in Configuration-, Test- or Update-Mode

green/red flashing	UNIGATE® is in test mode
red flashing	UNIGATE® is in configuration mode / error (see error table chapter 10)
red bright	CL basis stopped, PC connection with Ext.-Board active (Firmware update,see chapter 12)

9.3.3   LEDs 1 / 2 / 4 / 8 (Error No. / Select ID)

If these 4 LEDs flash and LED "State" simultaneously lights red, the error number is displayed in binary notation (conversion table, see Annex) in accordance with the table in chapter 10.

9.3.4   LED "State"

Lights green	Controllable via Script
Flashes green	Controllable via Script
Flashes green/red	Controllable via Script
Lights red	General Gateway error (see LEDs Error No.), controllable via Script
Flashes red	UNIGATE® is in the configuration / test mode, controllable via Script

9.3.5   LED "Bus Power"

This LED is connected directly to the electrically isolated supply voltage of the PROFIBUS-side.

9.3.6   LED "Bus"

This LED is directly controlled by the PROFIBUS ASIC and goes out in the state "DATA EXCHANGE".

9.3.7   LED "Bus State"

Lights green	PROFIBUS in the state data exchange
Flashes green	Gateway waits for PROFIBUS communication data
Flashes green/red	Gateway waits for PROFIBUS parameter data
Lights red	General PROFIBUS error

9.4   Switches

The Gateway features 8 switches with the following functions:

Termination Rx 422	switchable Rx 422-terminating resistor for the serial interface
Termination Tx 422	switchable Tx 422- or RS485-terminating resistor for the serial interface
Rotary coding switch S4	ID High for serial interface i. e. configmode
Rotary coding switch S5	ID Low for serial interface i. e. configmode
Termination (Profibus)	switchable PROFIBUSDP-terminating resistor
Rotary coding switch High	PROFIBUS-ID (high byte)
Rotary coding switch Low	PROFIBUS-ID (low byte)

9.4.1   Termination Rx 422 + Tx 422 (serial interface)

If the Gateway is operated as the physically first or last device in an RS485-bus or as 422, there must be a bus termination at this Gateway. In order to do this the termination switch is set to position ON. The resistor (150 Ω) integrated in the Gateway is activated. In all other cases, the switch remains in position OFF.
Please refer to the general RS485 literature for further information on the subject of bus terminations.

If the integrated resistor is used, please allow for the fact that this also activates a pull-down resistor (390 Ω) to ground and a pull-up resistor (390 Ω) to VCC.
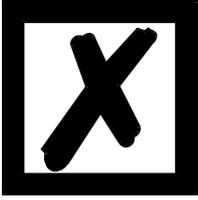
At RS48 only the Tx 422-switch must be set to ON.
The Rx 422-switch has to be on OFF.

9.4.2   Rotary coding switches S4 + S5 (serial interface)

These two switches can be read out through the Script command
`"Get (RS_Switch, Destination)"` and the value can be used for further functions. This value is read in when the Gateway is switched on or always after a Script command has been executed. The switch positions "EE" (testmode) and "FF" (config mode) are not possible for RS422- or RS485-operation.
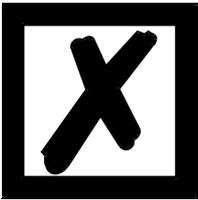
The switch position "DD" (ie, S4 and S5 in position "D") is reserved for internal purposes, Firmware-Update Ext.-Board. The Gateway should only be switched into this mode for a Firmware-Update. For more details see chapter 12.

Switch positions

Switch postions S4	Switch postions S5	Function	Description
D	D	Firmware-Update Ext.-Board	(Description see chapter 12)
E	E	Test mode	(Description see chapter 4.2) **Note:** This mode can only be terminated by a reboot.
F	F	Config mode	(Description see chapter 4.1) **Note:** This mode can only be terminated by a reboot.

9.4.3   Termination (PROFIBUS)

If the Gateway is operated as the first or last physical device in the PROFIBUS DP, there must be a bus termination at this Gateway. In order to do this, either a bus terminating resistor must be activated in the connector or the resistor (220 Ω) integrated in the Gateway must be activated. In order to do this, slide the slide switch to position ON. In all other cases, the slide switch must remain in position OFF. Please refer to the general PROFIBUS literature for further information on the subject of bus termination.

Note: To activate or deactivate the bus termination, please remove the bus-connector and carefully set the switch to the desired position.

9.4.4   Rotary coding switches High + Low (PROFIBUS-ID)

With these two switches the Gateway's PROFIBUS-ID (00... 7D) is set in hexadecimal notation. Please refer to the Annex for a conversion table from decimal to hexadecimal. This value is read in only once when the Gateway is activated.The value can also be read-out or analyzed through the Script command "`Get (FieldbusID, LongTemp)`". See also chapter 17.6.

10 Error handling

10.1 Error handling at UNIGATE® EL

If the Gateway detects an error, the error is signalled by the "State" LED lighting red and, simultaneously, the error number being indicated by means of LEDs "Error No." as shown in the table below. A distinction can be made between two error categories:

Serious errors (1-5): In this case, the Gateway must be switched off and switched back on again. If the error occurs again, the Gateway must be exchanged and returned for repair.

Warnings (6-15): These warnings are displayed for one minute simply for information purposes and are then automatically reset. If such warnings occur frequently, please inform After-Sales Service.

For user-defined errors the flash frequency is 0.5 hertz. The error is displayed as long as defined by "Set Warning Time".

In the configuration mode these displays are not valid and only meant for internal use.

LED8	LED4	LED2	LED1	Error no. resp. ID	Error description System error (2x/sec)	Error description with Universal Script-EL (Delivery status) User error (1x/sec)
0	0	0	0	0	Reserved	
0	0	0	1	1	Hardware fault	
0	0	1	0	2	EEROM error	
0	0	1	1	3	Internal memory error	CL hardware not supported
0	1	0	0	4	Fieldbus hardware error or wrong Fieldbus-ID	
0	1	0	1	5	Script error	Hardware for "Universal EL" script not supported
0	1	1	0	6	Reserved	unknown protocol
0	1	1	1	7	RS-transmit buffer overflow	
1	0	0	0	8	RS-receive buffer overflow	
1	0	0	1	9	RS timeout	Modbus TCP (server) Timeout response Modbus TCP client: no response from server
1	0	1	0	10	General fieldbus error	
1	0	1	1	11	Parity-or frame-check-error	Modbus TCP (server) response error
1	1	0	0	12	Reserved	Modbus TCP client Universal
1	1	0	1	13	Fieldbus configuration error	
1	1	1	0	14	Fieldbus data buffer overflow	Modbus TCP (server)
1	1	1	1	15	Reserved	Modbus TCP (client) general error general script error*

Table 1: Error handling at UNIGATE® EL

*A detailed error diagnosis can be recorded with an activated "Diagnosis Monitor" via the application interface. For this you only need to connect/start a RS232 Monitor tool, such as Deutschmann Starterkit tool "RS232 module" via a PC. (9600/1/8/N).

UNIGATE® is turned ON	(START)0x00
IP Adresse at Ethernet port	(EL-IP:172.016.048.203)0x00
Info for internal purposes	(EL-ComChl:00)0x00
State of the 4 Ethernet ports	(EL-State:202010E2)0x00
Ethernet port initialized	(EL-online)0x00
Configured transport protocol	EL-TCP server (port23)0x00
State of the 4 Ethernet ports	(EL-State:202020E2)0x00 Note: is always updated when a state of a channel changes
State of the Fieldbus ports	(CL-State:000000E0)0x00
State of the 4 Ethernet ports	(EL-State:E32020E2)0x00, (EL-State:212020E2)0x00, (EL-State:202020E2)0x00, (EL-State:E32020E2)0x00

An error can be as follows: „(E:21)0x00(ExtErr:030)0x00".

Note: "E" shows a script error, the value afterwards in Hex stands for the error number. The error number can be evaluated in the Protocol Developer Help under Appendix -> Return codes.
"ExtErr:" is for a more detailed fault localization. The script source code can be searched with the following number (ExtErr:**030**).

10.1.1 Error on the extension

An error on the extension will be signaled through red flashing of the Power/State-LED. The LED of the according error number turns off. This is followed by a short, then the flashing sequence is repeated.
Example: With an SRAM-Error 3 the LED lights red, turns off 3 times, lights up again for a moment and everything starts over. The following errors are possible on the extension.

Error Number	Error description
1	HARDWARE_ERROR
2	STACK_ERROR FLASH_INIT_ERR
3	SRAM_ERROR FLASH_ERROR
4	CL_KOMM_ERROR, e.g. CL Firmware doesn't support an extension yet
5	BUS_ID_ERROR FLASH_CHECK_ERR
6	CL_KOMM_RX_ERR
7	CL_KOMM_TX_ERR
8	NSW_DATA_ERROR
9	TIMOUT_ERROR
10	TX_ERROR
11	RX_ERROR
12	ID_ERROR, e.g. double Dicnet-ID, or ID not in net 24V_ERROR, overload (only at Option I/O8)
13	PARA_ERROR
14	BUS_ERROR
15	NSW_PROG_ERROR

11 Installation guidelines

11.1 Installation of the module

The module with the dimensions 23 x 117 x 111 mm (W x D x H) has been developed for switch cabinet use (IP 20) and can thus be mounted only on a standard mounting channel (deep DIN-rail to EN 50022).

11.1.1 Mounting

• Engage the module from the top in the top-hat rail and swivel it down so that the module engages in position.
• Other modules may be rowed up to the left and right of the module.
• There must be at least 5 cm clearance for heat dissipation above and below the module.
• The standard mounting channel must be connected to the equipotential bonding strip of the switch cabinet. The connection wire must feature a cross-section of at least 10 mm².

11.1.2 Removal

• First disconnect the power supply and signal lines.
• Then push the module up and swivel it out of the top-hat rail.

Vertical installation
The standard mounting channel may also be mounted vertically so that the module is mounted turned through 90°.

11.2 Wiring

11.2.1 Connection systems

The following connection systems must resp. may be used when wiring the module:
• Standard screw-type/plug connection (power supply + RS)
• 9-pin D-SUB plug connector (PROFIBUS DP)

a) In the case of standard screw-type terminals, one lead can be clamped per connection point. It is best to then use a screwdriver with a blade width of 3.5 mm to firmly tighten the screw.

Permitted cross-sections of the line:
• Flexible line with wire-end ferrule: 1 x 0.25 ... 1.5 mm²
• Solid conductor: 1 x 0.25 ... 1.5 mm²
• Tightening torque: 0.5 ... 0.8 Nm

b) The plug-in connection terminal strip is a combination of standard screw-type terminal and plug connector. The plug connection section is coded and can thus not be plugged on the wrong way round.
c) The 9-pin D-SUB plug connector is secured with two screws with "4-40-UNC" thread. It is best to use a screwdriver with a blade width of 3.5 mm to screw the screw tight.
Tightening torque: 0.2... 0.4 Nm

11.2.1.1 Power supply

The device must be powered with 10..33 V DC.

• Connect the supply voltage to the 4-pole plug-in screw terminal in accordance with the labelling on the device.

11.2.1.2 Equipotential bonding connection

The connection to the potential equalization automatically takes place it is put on the DIN-rail.

11.2.2 PROFIBUS DP communication interface

11.2.2.1 Bus line with copper cable

This interface is located on the module in the form of a 9-pin D-SUB socket on the front side of the housing.

• Plug the PROFIBUS connector onto the SUB-D socket labelled "PROFIBUS DP".

• Firmly screw the securing screws of the plug connector tight using a screwdriver.

• If the module is located at the start or end of the PROFIBUS line, you must connect the bus terminating resistor integrated in the gateway. In order to do this, slide the slide switch to the position labelled ...on...

• If the module is not located at the start or at the end, you must set the slide switch to position "off".

11.2.3 Line routing, shield and measures to combat interference voltage

This chapter deals with line routing in the case of bus, signal and power supply lines, with the aim of ensuring an EMC-compliant design of your system.

11.2.4 General information on line routing

- Inside and outside of cabinets
In order to achieve EMC-compliant routing of the lines, it is advisable to split the lines into the following line groups and to lay these groups separately.

$\Rightarrow$ Group A: • shielded bus and data lines (e. g. for PROFIBUS DP, RS232C and printers etc.)
                • shielded analogue lines
                • unshielded lines for DC voltages $\geq$ 60 V
                • unshielded lines for AC voltage $\geq$ 25 V
                • coaxial lines for monitors
$\Rightarrow$ Group B: • unshielded lines for DC voltages $\geq$ 60 V and $\geq$ 400 V
                • unshielded lines for AC voltage $\geq$ 24 V and $\geq$ 400 V
$\Rightarrow$ Group C: • unshielded lines for DC voltages > 400 V

The table below allows you to read off the conditions for laying the line groups on the basis of the combination of the individual groups.

	Group A	Group B	Group C
Group A	1	2	3
Group B	2	1	3
Group C	3	3	1

Table 3: Line laying instructions as a function of the combination of line groups

1) Lines may be laid in common bunches or cable ducts.
2) Lines must be laid in separate bunches or cable ducts (without minimum clearance).
3) Lines must be laid in separate bunches or cable ducts inside cabinets but on separate cable racks with at least 10 cm clearance outside of cabinets but inside buildings.

11.2.4.1 Shielding of lines

Shielding is intended to weaken (attenuate) magnetic, electrical or electromagnetic interference fields.

Interference currents on cable shields are discharged to earth via the shielding bus which is connected conductively to the chassis or housing. A low-impedance connection to the PE wire is particularly important in order to prevent these interference currents themselves becoming an interference source.

Wherever possible, use only lines with braided shield. The coverage density of the shield should exceed 80%. Avoid lines with foil shield since the foil can be damaged very easily as the result of tensile and compressive stress on attachment. The consequence is a reduction in the shielding effect.

In general, you should always connect the shields of cables at both ends. The only way of achieving good interference suppression in the higher frequency band is by connecting the shields at both ends.

The shield may also be connected at one end only in exceptional cases. However, this then achieves only an attenuation of the lower frequencies. Connecting the shield at one end may be more favorable if

- it is not possible to lay an equipotential bonding line
- analogue signals (a few mV resp. mA) are to be transmitted
- foil shields (static shields) are used.

In the case of data lines for serial couplings, always use metallic or metallized plugs and connectors. Attach the shield of the data line to the plug or connector housing.

If there are potential differences between the earthing points, a compensating current may flow via the shield connected at both ends. In this case, you should lay an additional equipotential bonding line.

Please note the following points when shielding:

- Use metal cable clips to secure the shield braiding. The clips must surround the shield over a large area and must have good contact.
- Downstream of the entry point of the line into the cabinet, connect the shield to a shielding bus. Continue the shield as far as the module, but do not connect it again at this point!

12   Firmware Update

The UNIGATE® EL consists of a basic hardware and an ext. board. The firmware versions are output in the configuration mode (see Chapter 4.1). The start-up message of the basic appears, following the message of the ext. board that looks similar to the following:

Ext-Board: CL-Erweiterung(EL-IO-DICNET) V1.2 (c)dA 47110211 FE: IP=0.0.0.0
MAC=00-14-11-15-1A-53 Data-Flash=1MB

The switch position "DD" serves for the Firmware-Update of the ext. board.
The gateway will start in this mode when the switches S4 and S5 are in position "D" during start up of the gateway. Then the follwing messsage appears.:

"If you want to download a new firmware for the expansion board press the FDT 'Firmware Download' button within 10 seconds."

Within 10 seconds the firmware update can be started via the Firmware-Download-Tool FDT (Firmware download).

There will be a timeout if the firmware download is not started within 10 seconds.

Timeout: Restart UNIGATE!"

The firmware update of the basic hardware takes place in configuration mode. (see chapter 4.1)

13 PROFIBUS DP

13.1 Description of the DPV1-/DPV2-functions

13.1.1 DPV1

Die DPV1-Erweiterung besteht aus folgenden Funktionen:

1. Acyclic data exchange with Class1-Master (e. g.: PLC)

This function is optional for a DPV1-Slave. Our gateways support this function as a default. By means of this function the Class1-Master can read and write data from the slave acyclically. This data is processed by the script in the gateway. The channel for the acyclic data exchange is set up firmly during the parameterization.

2. Acyclic data exchange with Class2-Master (e. g.: control unit)

This option is optional for a DPV1-Slave as well. Our gateways support this function as a default. By means of this function the Class2-Master can read and write data from the slave acyclically. This data is processed by the script in the gateway. The channel for the acyclic data exchange is set up prior to every data exchange and closed again afterwards.

3. Alarm handling

Aso the alarms are optional. If they are activated, they replace the device-specific diagnosis. At present our gateway does not support alarms.

Every DPV1-Slave must support the extended parameterization since it is determined in Octet 8 of the parameterization telegram whether it is a DPV0- or a DPV1-Slave.
A DPV1-Slave can also be operated at a DPV0-Master if the DPV1-functions remain turned off.

13.1.2 DPV2

Die DPV2-enlargement consists of the following functions:

*1. **Iso**chron **M**ode (IsoM)*

It means the clock-synchronous behavior of a bus system. This function is optional for a DPV2-Slave and is activated via the GSD-file. At present our gateway does not support this mode.

*2. **D**ata **Ex**change **B**roadcast (DxB)*

It means the communication between Slaves (inter-communication). This function is optional for a DPV2-Slave and is activated via the GSD-file. At present our gateway only supports the function of the „Publisher" (sending data to other Slaves). The function „Susbcriber" (receiving data from other Slaves) is not supported at present.

3. Up- And Download

This function is also optional for a DPV2-Slave and at present it is not supported by our gateway.

4. Time-synchronization (Time stamp)

This function is also optional for a DPV2-Slave and at present it is not supported by our gateway.

5. Redundancy concept

This function is also optional for a DPV2-Slave and at present it is not supported by our gateway.

13.2 Representation of the data in PROFIBUS DP

Any standard-compliant PROFIBUS DP Master can exchange data with the gateway. It is also possible to use very "simple" Master connections owing to the data structure.

13.2.1 Configuration telegram

After programming, the Master must send a configuration telegram to the corresponding Slave. The configuration telegram provides the Slave with information on the length of the input/output data. If the user has set the 'Length byte' flag, this means the maximum data lengths. Otherwise, it means the actual lengths.

The user normally also configures the configuration telegram in the project planning tool where he may also, if necessary, enter the address range in which the useful data is stored.

You can write up to 16 bytes or words in one octet of the DataUnit (DU). Inputs and outputs having the same format can be combined in one octet. Otherwise, you must use as many octets as the number of different bytes/words you wish to use and which cannot be combined in one octet. If the module detects, during the check, that the maximum permitted input/output data lengths have been exceeded, it signals incorrect configuration to the Master during a subsequent diagnostic scan. It is then not ready for useful data communication.

13.2.2 Configuration telegram

Octet 1   0

Configuration byte 1

Octet 2   0

Configuration byte x
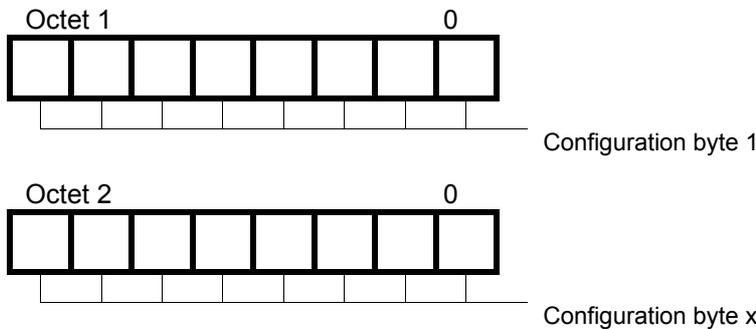
Structure of an octet in the configuration telegram:

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

Input/output
00 = specific ID format
01 = input
10 = output
11 = input-output

0 = byte, 1 = word

0 = consistent over byte / word
1 = consistency total length
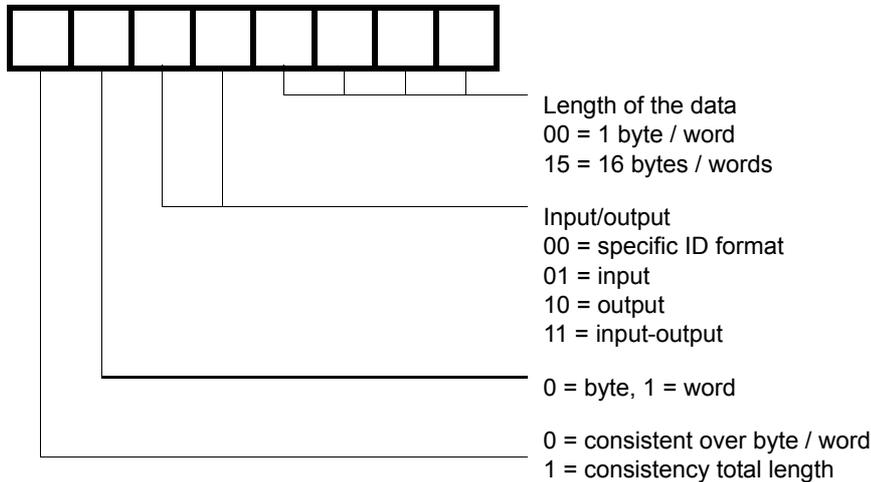
13.2.3 Diagnosis

Diagnostic data is high-priority data. The gateway runs an external diagnostic if it detects an internal error.

Representation of the information in the external diagnostic byte:

The diagnostic information of a DP Slave consists of standard diagnostic information items (6 bytes) and a user-specific diagnostic information item. (Error number)

Telegram for diagnostic request:

Octet 1   0

Diag.station does not exist (sets Master)

Diag.station not_ready: Slave is not ready for data exchange

Diag.cfg_Fault
Configuration data does not correspond

Diag.ext_diag
Slave has external diagnostic data

Diag.not supported: Requested function is not supported in the Slave

Diag.invalid_slave_response (sets Slave permanently to 0).

Diag.prm_fault
Incorrect programming (identification number etc.)

Diag.master_lock (sets Master)
Slave has been programmed by another Master

Octet 2   0

Diag.Prm_req
Slave must be reprogrammed

Diag.Stat_diag
Static diagnostic (byte Diag-Bits)

Permanently set to 1

Diag.WD_ON
Response monitoring active

Diag.freeze_mode
Freeze command received

Sync_mode
Sync command received

reserved

Diag.deactivated (sets Master)

Octet 3   0

reserved

Diag.ext_overflow

Octet 4   0

Diag master_add: Master address after
programming (FF without programming)

Octet 5   0

Ident. number high byte

Octet 6   0

Ident. number low byte

Octet 7   0

External diagnosis: header, length entry

Octet 8   0

UNIGATE error number

13.2.3.1 Diagnosis in DPV1

The "external diagnosis" of DPV0 (old PB) is used differently at DPV1. At DPV1 the alarms and the status messages are transfered there. Since the gateway's error numbers have been transfered in the external diagnosis it became necessary then to carry out an adaptation at DPV1. Now the 3 bytes "0x81, 0x00, 0x00" have been inserted in front of the actual error message in order to be compatible with DPV1-masters. With it a DPV1-master identifies our gateway's error as status message now.

This results in a different representation of our gateway error in PROFIBUS. At DPV0 the error number is transmitted in unmodified form as 1 byte external diagnosis. In case DPV1 has been activated in the gateway through the GSD-file, the error number occurs as 1 byte status message.
Supposing the DPV1 is activated and a master (which does not support the alarms and status messages) is connected, then our gateway error number is presented as "external diagnosis" with 4 bytes (see above), at which point the 4th byte contains the error number and the preceding 3 bytes (0x81, 0x00, 0x00) can be ignored.

13.2.4   Data exchange

After the Master, in the diagnostic, detects that the Slave is ready for data exchange, it sends data exchange telegrams. Either the Master stores the data in the input/output direction in the address area specified during project planning or the control program must fetch or retrieve the data using specific function blocks.

14 Ethernet

Each Ethernet-Client processor with TCP/IP network-protocol in a 10/100 Mbaud Ethernet can exchange data with the Gateway.

14.1 Network-addresses, network-connections

After switching on, the Gateway is waiting for data communication with a network-participant. In this case the Gateway is always prepared to react to ICMP messages (e. g. **PING** Request and Reply). The functions of the ARP-protocol are also available.

14.2 TCP-connection setup

In the characteristic application in the TCP/IP-protocol, after switching on, the Gateway is in the state "Passive Open" under an IP-address and port number that was determined in the configuration. A Client processor is in the position to open a TCP/IP connection with the Gateway under the port determined in the configuration. After a successful connecting, data can be exchanged.

14.3 Data exchange

At the protocol TCP/IP, a full duplex data connection is available after establishing a connection between the Gateway and the attached Ethernet-Client. The data stream is protected by the TCPI/IP-protocol in both directions.
When operating with UDP/IP-protocol, no connection is established before data is transferred. In this case the application is responsible for the control of the data flow as well as for the backup of the data.

14.3.1 TCP or UDP?

TCP is a connection-oriented protocol: Here a fixed logical connection between Client and Server exists in the course of the data communication. TCP features all mechanisms, that are required, in order to open a connection and to guarantee a flawless data transfer across the network and then again close the connection. For that reason the protocol software creates and administers own buffers for each connection. In case a lot of UNIGATE®-servers are to be addressed from one processor at the same time, storage limits in the processor might result in an extreme case.

In contrast to TCP, UDP does not have mechanisms available to repeat data packets or to check them on their completeness. The data communication with UDP is to be recommended if a parent protocol guarantees a flawless transmission between the terminal device at the UNIGATE®-server and the application on the TCP/IP-station anyhow.

14.4 Data exchange mode

The Gateway has to be in the data exchange mode, so that a data exchange between the Ethernet-side of the Gateway and the PROFIBUS is possible. As long as the Gateway is not in the configuration mode or the test mode, the data exchange mode is active. In the data exchange mode the Gateway will carry out the Script with those parameters preset through WINGATE and in the Script.

14.5 UNIGATE®-SCAN-function

The Gateway has the support of the UNIGATE®-SCAN-tool integrated. Which means that by default a channel is established in the Fast Ethernet that procresses these scan requests. Thus, a channel is already activ immediately after switching on.

UNIGATEscan.exe is a program with which you can find Deutschmann Ethernet devices in a network and set an IP address.

The devices can be in the configuration mode as well as in the data exchange mode (Note: the 4. communication channel must not be occupied) and have to be connected to the Ethernet network.

The program is started. After initialization, the program displays a selection box with the name "Adapter IP", that shows the Ethernet network adapter, located on the computer, with the base addresses of the respective network.

For the scan mode you first select the desired adapter. Subsequently a search process is initiated by pressing the scan button. The big window of the UNIGATE®-Scan displays the UNIGATE® devices found in the network with MAC address, IP address, type and software revision.

From the list of displayed UNIGATE® devices you now select the device that you want to configure with a new IP address. With the flash function you can make sure wether you have selected the desired UNIGATE®. After pressing the flash button the bus Power/State LED on the selected UNIGATE® device flashes red for 5 seconds. (Note: the flash function is only available in the data exchange mode.)

Via the Set-IP-button, and if the correct UNIGATE® device is selected, you can configure the device with the address shown in the "IP-address" window.
Here, the IP address is stored in the volatile memory and is immediately available. After a reboot (Power Off/On) the old IP address from the EPROM is active again.

If you want to permanently save the address in the UNIGATE® you have to check the field "set_perm". Here, the IP address is only acive after a restart. If the UNIGATE® is in Run mode and the default script "Universalscript Deutschmann EL" is loaded, the UNIGATE® automatically restarts. (It may take up to 10 seconds)

After turning the UNIGATE® off and then back on again, it can be checked with another scan, whether the new address has been transferred correctly.

IOn delivery or after a "Reset Device" with WINGATE, the IP address 0.0.0.0 is stored in EPROM. Since 0.0.0.0 is not allowed the UNIGATE announces the address „169.254.25.138" in the SCAN-Tool. (xx.yy = the last two digits of the MAC Addresse)

15 Implemented protocols in UNIGATE® EL

On delivery the UNIGATE® EL is supplied with the Script "Universalscript Deutschmann EL". The configuration is carried out in the configuration mode (see chapter 4.1) with the software WINGATE from Version V2.82 and wcf-file from 403.

Attention:
If a Reset Device is carried out it is possible (depending on the firmware version of the UNIGATE®) that the "Universal Script" will get lost and must be played in again.
The Script can be found on the Deutschmann Support-DVD in the folder \Software\Scripts\UniversalScript\EL.

15.1 Implemented protocols (Transport protocols at the EL interface)

- TCP server (port23) default
- UDP
- TCP server
- TCP client
- Modbus TCP server
- Modbus TCP client
- Universal Modbus TCP server
- Universal Modbus TCP client
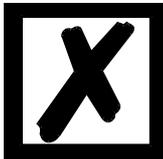
Note: A data exchange is only possible when the PROFIBUS is in „Data-Exchange".

15.2   Configuration options for the individual transport protocols

(EL) Transport protocol / Parameter	TCP server (port 23)	UDP	TCP server	TCP client	Modbus TCP server	Modbus TCP client	Universal Modbus TCP server	Universal Modbus TCP client
(EL) IP address UNIGATE	✓	✓	✓	✓	✓	✓	✓	✓
(EL) Subnet mask	✓	✓	✓	✓	✓	✓	✓	✓
(EL) IP address gateway	✓	✓	✓	✓	✓	✓	✓	✓
(EL) IP address target		✓		✓		✓		✓
(EL) Send port (dec)		✓	✓	✓				
(EL) Receive port (dec)		✓	✓	✓				
(EL) TCP response time (0 off 1..65sec)			✓	✓	✓	✓	✓	✓
Modbus Timeout (10ms)								✓
RX Poll Retry								✓
RX Poll Delay (10 ms)								✓
Req. 1-22 Slave ID								✓
Req. 1-22 Modbus Function								✓
Req. 1-22 StartAdr (hex)								✓
Req. 1-22 No of Points (dec)								✓
Req. 1-22 Fieldbus Map Adr(Byte)								✓

15.2.1   Parameter TCP response time (0 off 1..65 sec)

This parameter is available since Universal script Deutschmann EL V1.5.0 in conjunction with WCF file 408.
The TCP connection to the Ethernet interface can be monitored with this parameter.
If after the set response time no more data is received from the Ethernet interface the TCP connection will be automatically disconnected and then rebuilt.
The response time can be set between 1-65 seconds. If the value is set to "0" (default), the parameters or the monitoring is inactive.

15.3 Operation of individual transport protocols

15.3.1 TCP server

TCP (server), Send + Receive Port 23
Transparent data exchange with fieldbus (PROFIBUS)

**Data structure**
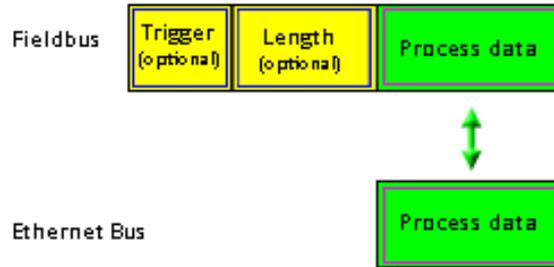
15.3.2 UDP

Data structure
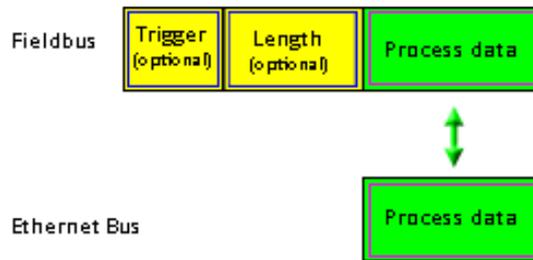
#### 15.3.2.1 UDP (with one remote participant)

Configuration: (EL) IP Address Target = 0
If the parameter is 0 another UDP participant has to send a UDP packet to the UNIGATE® first, the UNIGATE® remembers the IP address of the sender and sends it back there.
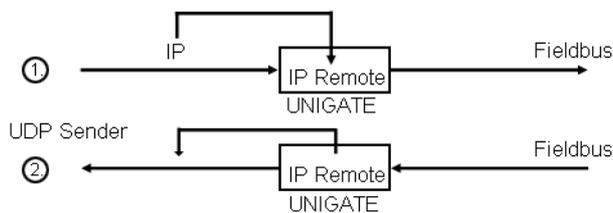
15.3.2.2 UDP (with more than one remote participant)

Configuration: (EL) IP Address Target = 0
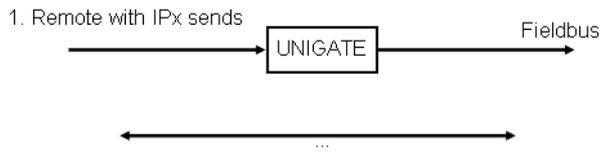
The UNIGATE® keeps sending back to IPx till IPy sends a UDP packet to the UNIGATE 2x consecutively.
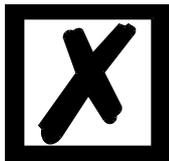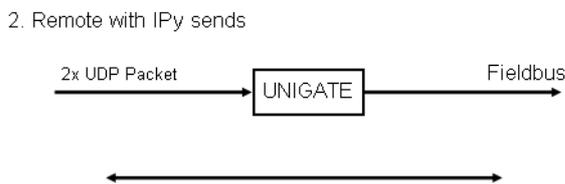
 Note: This mechanism was built in the UNIGATE® for security reasons.

15.3.2.3 UDP - Configuration: (EL) IP Address Target > 0

If this parameter is set with a valid IP address, the UNIGATE® sends the process data independently. The process data is sent there until a remote participant with another IP address sends a packet to the UNIGATE®, then the UNIGATE® behaves as described above, as if target IP was set to 0.

The configured Target IP is valid again after a reboot.
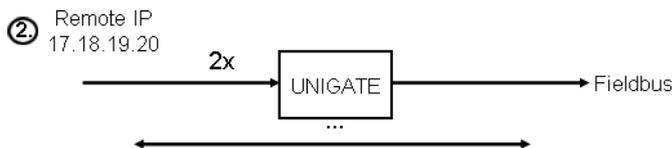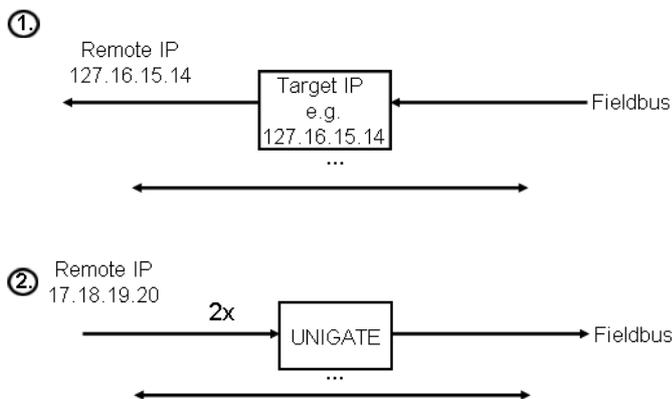
15.3.3 TCP (server)

Once a remote participant starts a connection to the UNIGATE® as Client, the status switches to data exchange (the green Power/State LED changes from flashing green to bright green.)

With this type of connection, it is irrelevant who sends a packet first, as the Client actively produced a connection to the UNIGATE.
No second TCP/IP connection can be established.
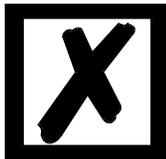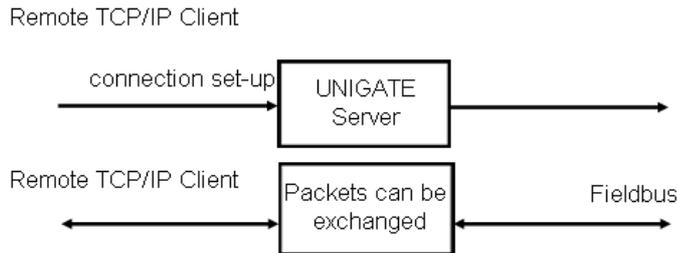
Note: If the Client terminates the connection during communication (i.e. the UNIGATE® sends the TCP/IP packets) system error 14 will be displayed on the LED's.

Note: There is no information about the Link-State (e.g. if a RJ45 connector is connected to a counterpart station.

*Note: Automatic timeout after 45 seconds if there is no Acknowledge (ACK) from the counter part when a TCP/IP packet is send.*
*The UNIGATE® closes the connection automatically. The green Power/State LED flashes.*
This can happen if the Client is no longer available. As soon as a Client is available he can open a connection to the UNIGATE®.
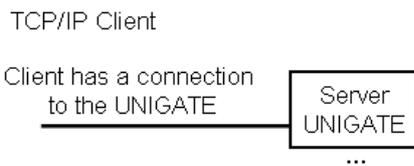
Connection is terminated without the Client notifying the Server UNIGATE®.
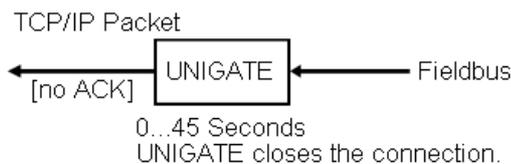
15.3.4 TCP (client)

Configuration: (EL) IP Address Target: >0

During startup (Power ON) the UNIGATE® tries to establish a TCP/IP connection with the remote participant configured under the IP Address Target.

As long as the participant is not available in the network, the UNIGATE® tries to connect to the server cyclically (every 17 ms). The Power/State LED flashes green.

If the participant is started as server, the UNIGATE® changes to data exchange state. (Power/State LED = bright green)
If the server is stopped, the LED changes to flashing, the UNIGATE® leaves data exchange state.
.

Remote TCP/IP (Server)

Power On
sets TCP/IP   TCP/IP Client
connection   UNIGATE
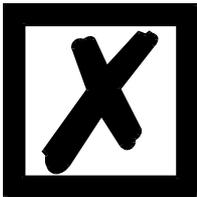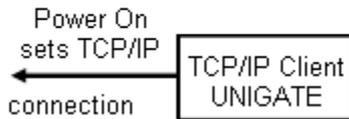
Note: If the cable is pulled during a TCP/IP connection and the UNIGATE sends a message to the TCP/IP server, it may take up a few seconds till the status changes from Data Exchange (Power / State LED = bright green). The UNIGATE tries to establish a connection (Power / State LED = flashing green).
If the connection is re-established, the connection is established again after 5 seconds.

Server ←——————→ Client UNIGATE

Server ←——RJ45——→ Client UNIGATE

0 ... 60 seconds
Status disconnected
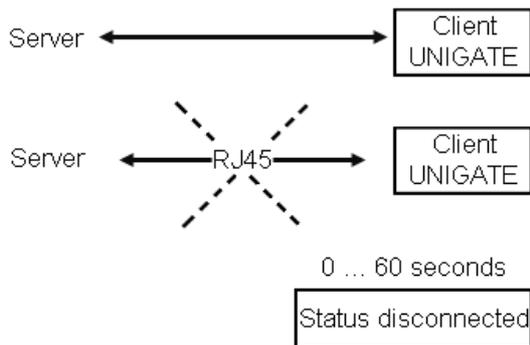
The UNIGATE attempts to restore the connection to the server cyclically.

0 ...5 seconds
RJ45: OK   Client
Server ←——————— UNIGATE

15.3.5   Modbus TCP (server)

The UNIGATE® is Server on the Ethernet side and waiting for a connection.

Remote Modbus TCP/IP (Client) ──────────▶ Modbus TCP server UNIGATE ──────▶ Fieldbus
(port 502)

Client establishes connection
EL Status: Data Exchange (Power / State LED = lights green)

Remote sends Modbus Frame.
E.g. Slave ID = 1
FC = 3
Start Address = 0001
No. Of Reg. = 2

Fieldbus
Configuration: Data_Exchange = On Trigger (recommendation)

Request   Modbus TCP server UNIGATE   01   01   03   00 00   00 02   ──▶ Fieldbus

Trigger Byte — 01
Slave ID — 01
FC — 03
Start Address — 00 00
No. of Reg — 00 02

Response   Modbus TCP server UNIGATE   01   01   03   04   31   32   33   34   ...   Fieldbus

Byte count — 04
Process data — 31 32 33 34
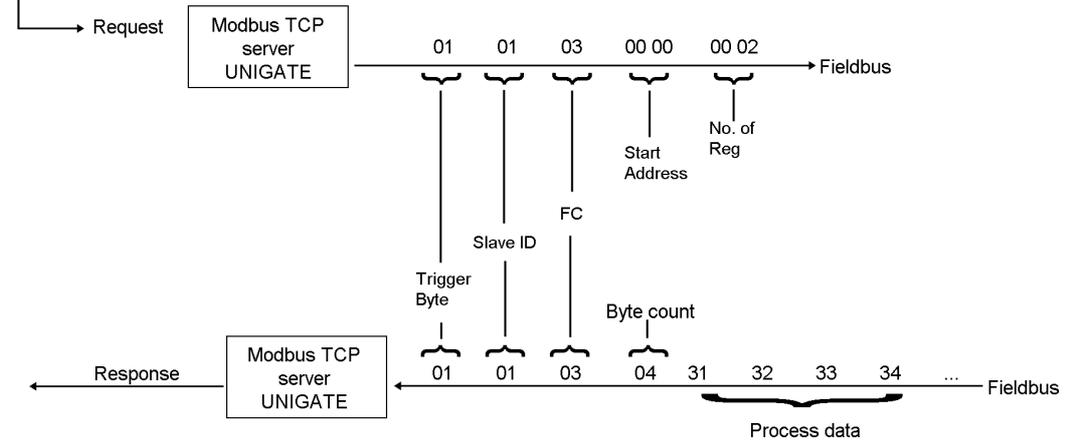
15.3.6 Modbus TCP (client)

After switching on the same behaviour as under TCP/IP (Client) beschrieben (see chapter 15.3.4).
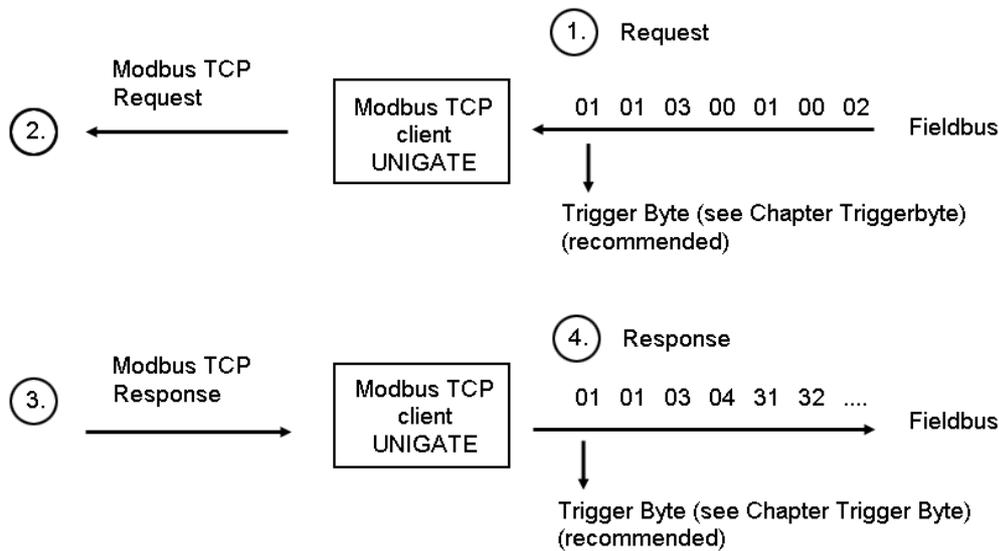
Explanation

1.
The fieldbus SPS sends a request in Modbus RTU format, without checksum

2.
The UNIGATE® sends a TCP Frame as Modbus TCP Req. The transmission length is automatically calculated by the UNIGATE®.

3.
The Modbus TCP Server (Remote) sends the required response back to the UNIGATE®

4.
The UNIGATE® then sends the Modbus TCP Response in Modbus RTU-Format back to the fieldbus SPS.
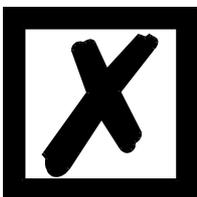
Note: A new request should only be started after completing the 4 steps.

15.3.7   Universal Modbus TCP Server

The UNIGATE® acts as Dual-Port-RAM.

Note: Modbus Slave ID is not evaluated.

Modbus TCP Frame:

6 Byte Header	Modbus RTU Frame (without checksum)
Is automatically processed by the firmware.	Is processed in the Script.
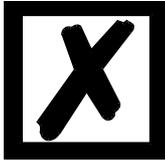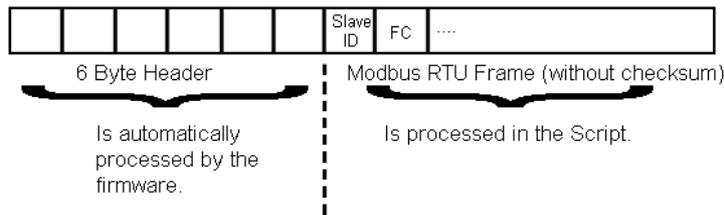
Maximum query length: FC3   => 125 - 3 = 122 Byte =   61 registers
                                     +
                                 FC4

Maximum Write contract length
at Address 0x0000 (raw value): FC16   => 125 - 7 = 118 Byte = 59 registers

For more information, refer to figure 1.

Introduction of the Universal Modbus server protocol
I
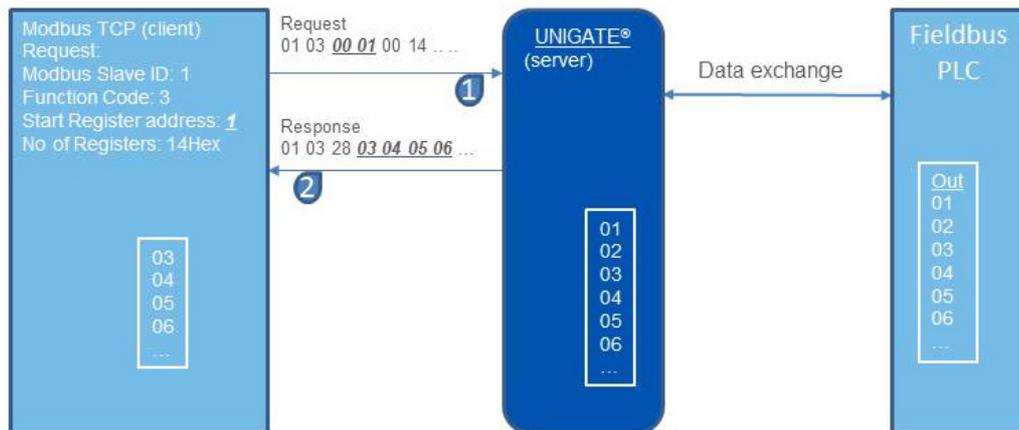
Figure 1: Universal Modbus server protocol

Storage division at Universal Modbus TCP (Server)
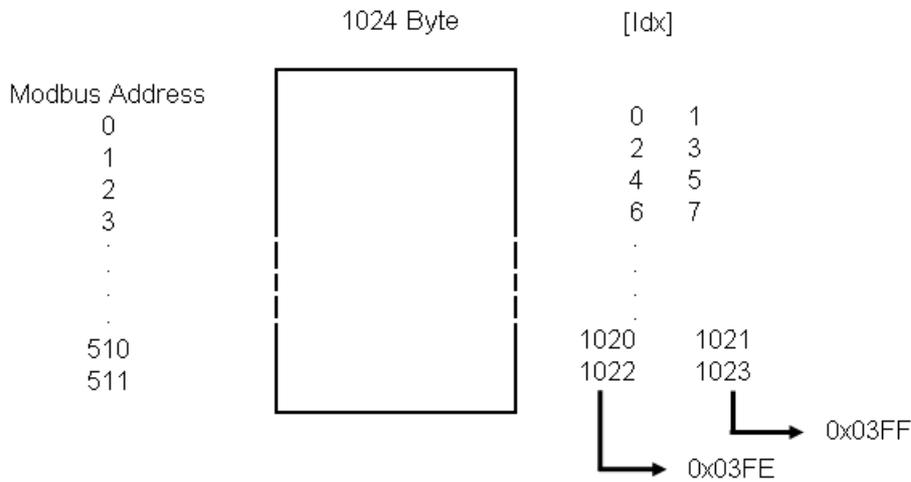
Example: Description of last Reg.Adr. (511)
FC16: [Slv ID] [FC] 01 FF 00 01 02 xx yy ...
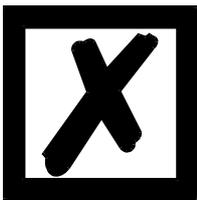
Note: In configuration tools (e.g. Modscan) or descriptions, the address is provided with an Offset of +1, i.e.: 0200. 01FF is transmitted as real raw value for the address, and will also be evaluated in the script.
There is a "Exception Response 2" if a register address from and including 512 (raw value) is described.
If you try to write over the memory space of 1024 Byte, it is automatically limited to 1024. There is no Exception Response.

Transferred to Little Endian Format
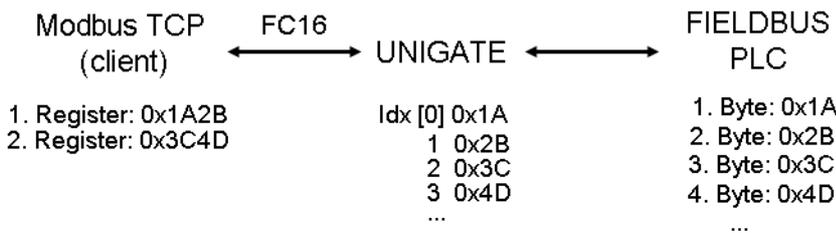
Note: FC1 (Coil status):
Client reads Coil
As start address you have to take a multiple of 8. Starting with 0. Thus 0, 8, 16, 24, ... 120 (raw value) are permitted.
This also applies to the write command „Force Coils".

FC17 (user-specific)

Byte 1 ... 4   Fieldbus State of the UNIGATE® CL base
Byte 5 +6   Script Error (see Protocol Developer Help)
Byte 7 + 8   System Error (see Chapter 10).

15.3.8   Universal Modbus TCP (client)

Modbus Timeout: 0 (not allowed)
The [EL] TCP response time is adjustable from 1 to 65 Sekunden (0 = without Response Time).
It is recommended to set a time.

Note: If an incorrect read response occurs, the data is automatically set to 0xFF gesetzt.

15.3.8.1 Data structure Fieldbus side (e.g. PROFIBUS):

Applies to In and Out

1.   Byte: Trigger byte, optional (see chapter 15.5, Trigger Byte)
2.   Byte: Fieldbus length byte, optional (see chapter 15.6, Length Byte)
3.   Process data

Data structure
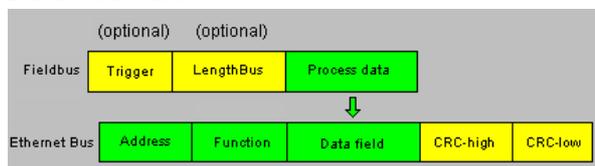
15.3.8.2 Data structure Ethernet side:

According to Modbus RTU Master Definition.

Supported functions:

     Read coil status FC1   (No. of Points = Bit)
     Read input status FC2   (No. of Points = Bit)
     Read multiple register FC3   (No. of Points = Word)
     Read input registers FC4   (No. of Points = Word)
     Force single coil FC5   (No. of Points – not used = fix 1 Bit)
     Preset single register FC6   (No. of Points – not used = fix 1 Word)
     Force multiple coils FC15   (No. of Points = Bit)
     Preset multiple register FC16   (No. of Points = Word)

Note:
status and coil = 1 Bit, register = 16 Bit.

FC 1 + 2 as well as FC 3 + 4 are the same in principle, the only difference being the definition of the start address.

    At FC1 it starts at,Zero, at FC2 at 10 000.
    At FC3 it begins at 40 000, at FC4 at 30 000

Note FC5:
There is only 1 Bit set, even if you can adjust NoOfPoints in WINGATE.

15.3.8.3 Configuration: via WINGATE since wcf file Version 403

Parameter Name	value range	Explanation
Modbus Timeout (10ms)	1 ... 255 (10ms ... 2550ms)	Max. Waiting time for the "Response" before an error 9 is generated by timeout. If "RX Poll Retry" > 0 an error is only generated after retries.
RX Poll Retry		Retry of the last, invalid replied "Request"
RX Poll Delay (10ms)		Pause before the next "Request"

Configuration parameter for a Modbus Request:

Req. 1 Slave ID: Slave ID of the Modbus slave participant
Req. 1 Modbus Function: see "supported functions"
Req. 1 StartAdr (hex): Start address (High / Low) of the Modbus register from which should be read/written
Req. 1 No. of Points (dec): Number of the to read/to write register/coils
Req. 1 Fieldbus Map Adr(Byte): Position of the to be copied process value from/to the fieldbus range, depending on the write/read-command. If the value is NULL the process data is automatically lined up behind the other.

Up to 22 requests can be configured.

Additional configuration possibilities in the setting „Req. ... Modbus Function":

jump to Req. 1: jump to 1. request entry
disable this Req.: skip this request and perform the next request entry.

„(10ms)" : adjustable in 10ms steps
„(hex)": Enter in hexadecimal style.
„(dec)": Enter in decimal style.
„(Byte)": Counting in bytes, starting at the position Null. Attention: For read commands, e.g. FC3, after the trigger- and lenghtbyte the first process value is the postion nulll, which is copied to the fieldbus to the PLC.
For write commands, e.g. FC16, the position Null is the trigger byte.

For more information see figure 2.

Universal Modbus
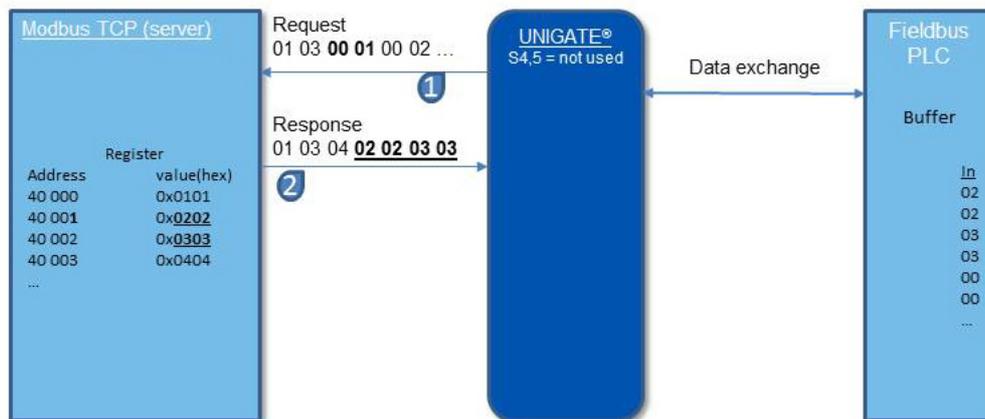
Figure 2: Universal Modbus TCP client protocol

15.4   Delivery status (factory setting)

- TCP server (port 23), Protocol description (see Chapter 15.3.1).

15.4.1   Erstinbetriebnahme (Quick Start)

Upon delivery the device is in an operable state.

Information: DHCP is not supported

1. EL IP Addresse assigned:
   - WINGATE
   or
   - UNIGATE Scantool

2. Set PROFIBUS ID with rotary coding switch High + Low, e.g. ID = 5, High = 0, Low = 5

3. Configure PROFIBUS Master with UGIC3218.GSD and select e.g. Model 8 Byte In/Out.

4. Start UNIGATE® in Data Exchange mode (S4 + S5 = 00), start TCP/IP (Client).
   Now process data can be send in both directions.

15.5 Trigger Byte

Since the data is always transferred cyclically on PROFIBUS, the gateway must detect when the user wishes to send new data via the serial interface. This is normally done by the gateway comparing the data to be transferred via the PROFIBUS with the old data stored internally - data exchange on change (Fieldbus Data exchange -> On Change). In many cases however, this cannot be used as the criterion, e.g. whenever the same data is to be sent. For this reason, the user can set control of transmission via a trigger byte (Fieldbus Data exchange -> On Trigger). In this mode, the gateway always sends (and only then) when the trigger byte is changed.

Accordingly, the application program in the control in Normal mode cannot detect whether the gateway has received several identical telegrams. If Trigger-Byte mode is activated, the gateway increments the trigger byte each time a telegram has been received.

The first byte in the PROFIBUS input/output data buffer is used as the trigger byte if this mode is activated.

15.6 Length Byte

The user can configure whether the transmit length is also to be stored as a byte in the input/output data area (Fieldbus length byte -> active). In transmit direction, as many bytes as specified in this byte are sent. On reception of a telegram the gateway enters the number of characters received.

15.7 Swap word

With activated "Swap word" the data is word-swapped to and from the fieldbus. I.e. High and Low byte are word-swapped and transferred in a 16-bit word. It affects the entire fieldbus Buffer.

16 Technical data

16.1 Device data

The technical data of the module is given in the table below.

No.	Parameter	Data	Explanations
1	Location	Switch cabinet	DIN-rail mounting
2	Enclosure	IP20	Protection against foreign bodies and water to IEC 529 (DIN 40050)
4	Service life	10 years	
5	Housing size	23 x 117 x 111 mm (screw-plug-connector included) 23 x 117 x 100 mm (screw-plug connector not included)	W x D x H
6	Installation position	Any	
7	Weight	160 g	
8	Operating temperature	-40ºC ... +85ºC	The negative temperatures are only valid for the usual conditions (not condensing)
9	Storage/transport temperature	-40ºC ... +85ºC	
10	Atmospheric pressure during operation during transport	795 hPa ... 1080 hPa 660 hPa ... 1080 hPa	
11	Installation altitude	2000 m 4000 m	Unrestricted Restricted - Ambient temperature $\leq$ 40ºC
12	Relative humidity	Max. 80 %	No condensation, no corrosive atmosphere
14	External power supply	10...33 V DC	Standard power supply unit to DIN 19240
15	Current consumption at 24 VDC	Typ. 160 mA max 200 mA	At 10.8V. typ. 350 mA
16	Supply at the PROFIBUS-interface	5 V DC / max. 50 mA	(Max. 50 mA at < 30°C ambient temperature)
17	Reverse voltage protection	Yes	But does not function!
18	Short-circuit protection	Yes	
19	Overload protection	Poly-switch	Thermal fuse
20	Undervoltage detection (USP)	$\leq$ 9 V DC	
21	Emergency power supply	$\geq$ 5 ms	Device fully operable

Table: Technical data of the module

16.1.1   Interface data

The table below lists the technical data of the interfaces and ports on the device. The data has been taken from the corresponding Standards.

No.	Interface designation Physical interface	PROFIBUS DP RS485	RS232-C RS232-C	RS485/RS422 RS485/RS422	Ethernet Ethernet 10/100BASE-T
1	Standard	EIA Standard	DIN 66020	EIA Standard	
2	Transmission mode	Symmetrical asynchronous serial half-duplex → Difference signal	Asymmetrical asynchronous serial full duplex → Level	Symmetrical asynchronous serial half-duplex full duplex at RS422 → Difference signal	Symmetrical asynchronous serial full duplex half-duplex → Difference signal
3	Transmission method	Master / Slave	Master / Slave	Master / Slave	Multimaster CSMA/CD
4	Number of users : - Transmitters - Receivers	 32 32	 1 1	 32 32	 512 512
5	Cable length: - Maximum - Baud rate-dependent	 1200 m 93.75 kBd → 1200 m 187.5 kBd → 1000 m 500 kBd → 400 m 1.5 MBd → 200 m >1.5 MBd → 100 m	 15 m no	 1200 m <93.75 kBd → 1200 m 312, kBd → 500 m 625 kBd → 250 m	 100 m
6	Bus topology	Line	Point-to-point	Line	Star
7	Data rate: - Maximum - Standard values	 12 Mbit/s 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	 120 kBit/s 2.4 k/B 4.8 k/B 9.6 kBit/s 19.2 kBit/s 38.4 kBit/s	 625 kBaud 2.4 kBit/s 4.8 kBit/s 9.6 kBit/s 19.2 kBit/s 57.6 kB 312.5 kB 625 kB	 100 Mbit/s 10 Mbit/s 100 Mbit/s (autodetect)
8	Transmitter: - Load - Maximum voltage - Signal, unloaded - Signal, loaded	 54 Ω - 7 V ... 12 V ± 5 V ± 1.5 V	 3 ... 7 kΩ ± 25 V ± 15 V ± 5 V	 54 Ω - 7 V ... 12 V ± 5 V ± 1.5 V	 100 Ω
9	Receiver: - Input resistance - Max. input signal - Sensitivity	 12 Ω - 7 V ... 12 V ± 0.2 V	 3 ... 7 Ω ± 15 V ± 3 V	 12 Ω - 7 V ... 12 V ± 0.2 V	 100 Ω

10	Transmit range (SPACE):				
	- Voltage level	- 0.2 ... + 0.2 V	+ 3 ... + 15 V	- 0.2 ... + 0.2 V	
	- Logic level	0	0	0	
11	Transmit pause (MARK):				
	- Voltage level	+ 1.5 ... +5 V	- 3 ... –15 V	+ 1.5 ... +5 V	
	- Logic level	1	1	1	

Table: Technical data of the interfaces at the module

17   Commissioning guide

17.1   Note

Only trained personnel following the safety regulations may commission the UNIGATE®.

17.2   Components

You will require the following components to commission the UNIGATE®:
- UNIGATE®
- Connection cable from gateway to the process
- Connection cable for Ethernet connector
- Connector for PROFIBUS connection to the Gateway
- PROFIBUS cable (this cable is generally already installed on site!)
- 10..33 V DC power supply (DIN 19240)
- Type file or GSD file and user manual (a sample file as well as the user manual can be ordered separately or downloaded free of charge from our homepage at www.deutschmann.de).

17.3   Installation

The UNIGATE® EL - PROFIBUS DP module features protection type IP20 and is thus suitable for switch cabinet use. The device is designed for snapping onto a 35 mm DIN-rail.

17.4   Dimensional drawing UNIGATE® EL - PROFIBUS DP
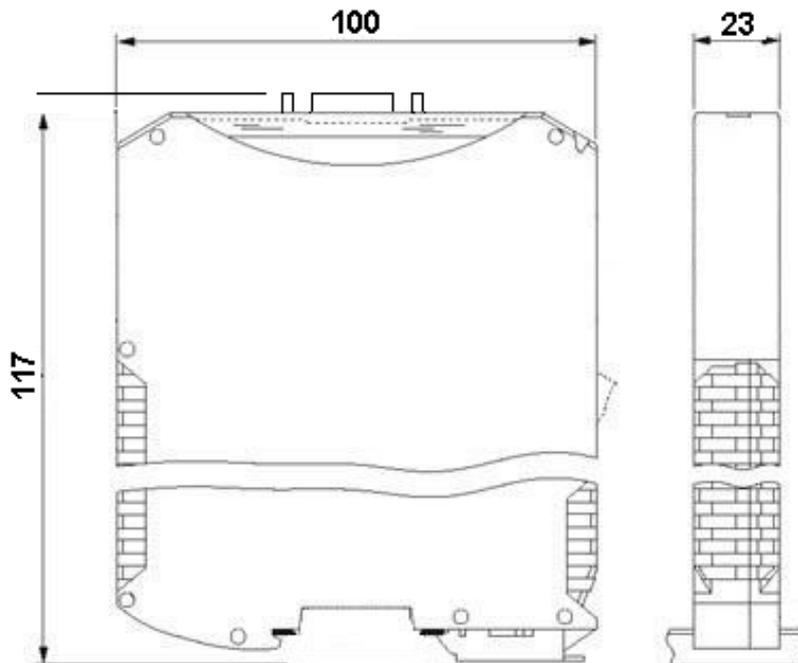
17.5   Commissioning

It is essential that you perform the following steps during commissioning in order to ensure that the module operates correctly:

17.6 Setting the PROFIBUS address

Set the PROFIBUS address at the fieldbus end of the module on the two rotary switches designated "PROFIBUS-ID High" and "PROFIBUS-ID Low" This adjustment is carried out in a hexadecimal way.
Example:
The PROFIBUS-ID is 26 decimal = 1A hexadecimal
The switch "PROFIBUS-ID High" has to be set to 1 and the switch "PROFIBUS-ID Low has to be set to A.

If the rotary switch is set to "7E" (=126) on the PROFIBUS-side (PROFIBUS-ID), the gateway operates with a PROFIBUS-address, that is stored in the EEROM. In the state of delivery this address is set to 126 and can only be changed by a PROFIBUS-master via the PROFIBUS itself. The address 126 is reserved in the PROFIBUS for this purpose; that means that a slave with this address can never carry out a data exchange, but it can only be configured with a new ID.

In case the rotary switch is set to a value between 0...125, the gateway operates - with this PROFIBUS-ID and a change via the master is not possible.

The ID can also be set through the Script command "`Set (Fieldbus ID, xx)`" (xx = PROFIBUS-ID in decimal form).

Flow diagram
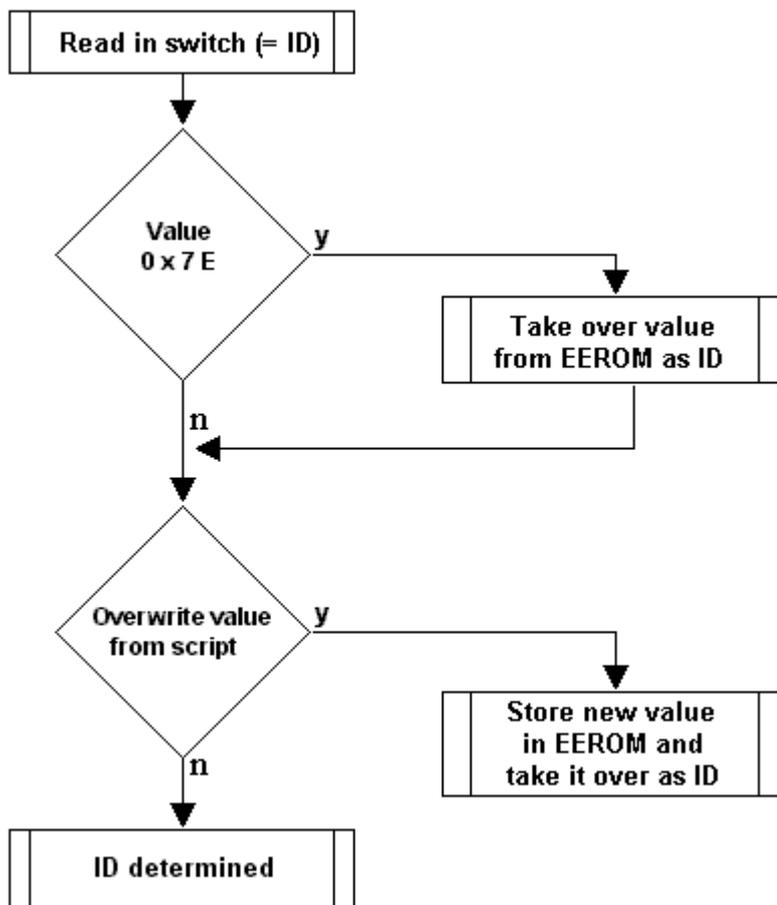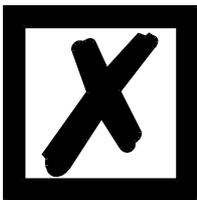
Attention:
The PROFIBUS address set must correspond to the planned address under COM PROFIBUS!
It is read in only on power-up of the gateway!

17.7 PROFIBUS connection

Connect the device to the Profibus at the interface labelled "PROFIBUS".

17.8 Ethernet connection

Connect the device to the Ethernet network at the interface X5 with the label "RJ45 Ethernet".

17.9 Connection to the process device

Please also read the manual for the process device when commissioning the process device.

17.10 Connecting the supply voltage

Please connect 10..33 DC voltage to the terminals provided for this.

17.11 Shield connection

Earth the top-hat rail onto which the module has been snapped.

17.12 Project planning

Use any project planning tool for project planning.
If the required GSD file was not supplied with your project planning tool, a sample file can be found on the Internet (www.deutschmann.de).

17.13 Literature

We recommend that you read book "Schnelleinstieg in PROFIBUS DP", author M. Popp, to help you quickly get to grips with the subject of the PROFIBUS DP and the mode of operation of the available ASICs. The book can be ordered from the PROFIBUS User Organisation, Order No. 4.071. (German-language).
Address:
PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
D-76131 Karlsruhe
Germany
Tel: 0721 9658 590

18 Servicing

Should questions arise that are not covered in this manual you can find further information in our

- FAQ/Wiki area on our homepage www.deutschmann.com or directly in our Wiki on
  www.wiki.deutschmann.de

If your questions are still unanswered please contact us directly.

Please note down the following information before calling:
- Device designation
- Serial number (S/N)
- Article number
- Error number and error description

Your request will be recorded in the Support center and will be processed by our Support Team as quickly as possible (Usually in 1 working day, rarely more than 3 working days.).

Technical Support hours are as follows:
Monday to Thursday from 8 am to midday and from 1 pm to 4 pm, Friday from 8 am to midday (CET).

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Technical Support	+49 6434 9433-33
Fax sales department	+49 6434 9433-40
Fax Technical Support	+49 6434 9433-44
E-mail Technical Support	support@deutschmann.de

18.1 Returning a device

If you return a device, we require as comprehensive a fault/error description as possible. We require the following information in particular:

- What error number was displayed?
- What is the supply voltage (±0.5 V) with Gateway connected?
- What were you last doing or what last happened on the device (programming, error on
  power-up, ...)?

The more precise information a fault/error description you provide, the more exactly we will be able to pinpoint the possible causes.

18.2 Downloading PC software

You can download current information and software free of charge from our Internet server.
http://www.deutschmann.com

19 Annex

19.1 Explanations of the abbreviations

General

CL	=	Product group CL (Compact Line)
CM	=	Product group CM (CANopen Line)
CX	=	Product group CX
EL	=	Product group EL (Ethernet Line)
FC	=	Product group FC (Fast Connect)
GT	=	Galvanic separation RS-side
GY	=	Housing color gray
MB	=	Product group MB
RS	=	Product group RS
SC	=	Product group SC (Script)
232/485	=	Interface RS232 and RS485 switchable
232/422	=	Interface RS232 and RS422 switchable
DB	=	Additional RS232 DEBUG-interface
D9	=	Connection of the RS through 9-pin D-SUB instead of 5-pin screw-plug connector
PL	=	Board only without DIN-rail module and without housing cover
PD	=	Board only without DIN-rail module and with housing cover
AG	=	Gateway installed in a die-cast aluminum housing
EG	=	Gateway installed in a stainless steel housing
IC	=	Product group IC (IC-design DIL32)
IO8	=	Option I/O8
16	=	Script memory expanded to 16KB
5V	=	Operating voltage 5V
3,.3V	=	Operating voltage 3.3V

Fieldbus

ASI	=	AS-Interface (AS-i)
BI	=	BACnet/IP
BMS	=	BACnet MSTB
CO	=	CANopen
C4	=	CANopen V4
C4X	=	CANopen V4-version X (see comparison table UNIGATE$^®$ IC for the respective product)
DN	=	DeviceNet
EC	=	EtherCAT
EI	=	Ethernet/IP
FE	=	Ethernet 10/100 MBit
FEX	=	Ethernet 10/100 MBit-version X (see comparison table UNIGATE$^®$ IC for the respective product)
IB	=	Interbus
IBL	=	Interbus
LN62	=	LONWorks62
LN512	=	LONWorks512
ModTCP	=	ModbusTCP
MPI	=	Siemens MPI$^®$
PL	=	Powerlink

PN	=	PROFINET
PBDP	=	ProfibusDP
PBDPL	=	ProfibusDP-version L (see comparison table UNIGATE® IC for the respective product)
PBDPX	=	ProfibusDP-version X (see comparison table UNIGATE® IC for the respective product)
PBDPV0	=	ProfibusDPV0
PBDPV1	=	ProfibusDPV1
RS	=	Serial RS232/485/422

19.2 Hexadecimal table

Hex	Decimal	Binary
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
A	10	1010
B	11	1011
C	12	1100
D	13	1101
E	14	1110
F	15	1111