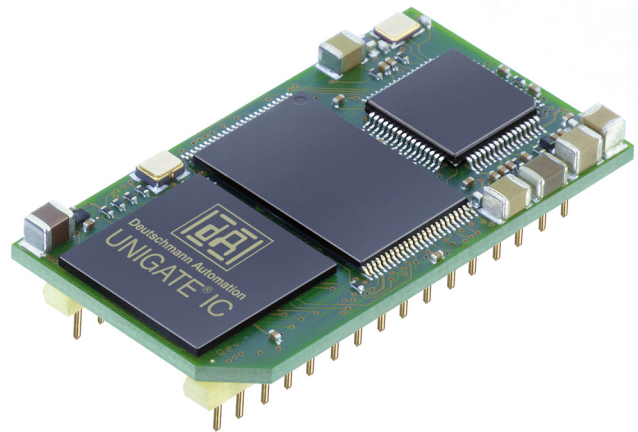




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your ticket to all buses

**Instruction Manual
Universal Fieldbus-Gateway
UNIGATE[®] IC-EtherNet/IP 2Port**



Deuschmann Automation GmbH & Co. KG
www.deuschmann.com | wiki.deuschmann.de

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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.

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1 General introduction

In the past the integration of a fieldbus connection required an enormous effort from the progress engineers. On account of the large variety of communication systems it is not enough to compile the right combination of communication hardware; due to their standards and fundamentals different busses also require the corresponding skills of the engineers.

This does not apply in case of the UNIGATE[®] IC by Deutschmann Automation any more. All digital functions, software, stack and driver as well as optocoupler are integrated on a UNIGATE[®] IC in correspondence with the standard. In addition to the reduction of the required size, also different fieldbusses can easily be integrated.

Through the flexible firmware of UNIGATE[®] IC no software-changes are required on the side of the customer!

Since 1997 Deutschmann Automation has experience in the field of fieldbus gateways; this enormous experience results in the UNIGATE[®] IC as a consistent sequel of this successful product line.

Terminology

In the entire document and in all parts of the software that is to be used, the terms Input and Output are used. Input and Output are ambiguous, always depending on the viewpoint. We see the fieldbus as central interface and as integral component of your device; therefore in all places it is always referred to data from the viewpoint of the Slave, that is Input data, as data from the Master to the Slave - regardless of the used bus.

Representation of numbers

Numbers in decimal format are always represented without prefix and without suffix as well. Hexadecimal numbers are always marked with the prefix 0x.

2 The UNIGATE® IC

2.1 Technical introduction

The UNIGATE® IC by Deutschmann Automation contains all components that are required for the communication in a fieldbus in one single module. Therefore a developer does not have to take care for that detail any more, only a hardware redesign is necessary in order to integrate the UNIGATE® IC and the required plug connectors.

2.2 Availability

The module is available as EtherNet/IP. Further fieldbusses are either planned or being worked on. They will only differ in the connections of the busses. The meaning of the general pins 1 - 9 as well as 24 and 26 - 32 will remain unchanged also for further fieldbus implementations.

You can find an up-to-date list for all UNIGATE® ICs under:
<http://www.deutschmann.de>.

2.3 Firmware

UNIGATE® IC is programmed via scripts. On principle any script, that has been developed for a UNIGATE® SC, can also be operated on the UNIGATE® IC.

2.4 The serial standard interface

Intelligent devices, that already feature a micro controller or a microprocessor, are generally supplied with a serial asynchronous interface with a TTL-level. It is directly connected with the TTL-interface of the UNIGATE® IC. For more information on this serial interface see chapter 4.

2.5 The synchronous interface

In addition to the standard interface there is also the possibility of the synchronous input and output. That way for instance digital IOs can be connected through shift register components or also analog IOs can be connected through a DA-converter with serial in-/output. For synchronous IOs 256 signals at the most can be used (256 bit). Wiring examples can be found in chapter 3.5 and for software examples see chapter 5. This interface can also be used to connect modules or devices with SPI-interface. It is also possible to build, for instance digital or analogous I/O-modules, with the customer's device not being equipped with an own controller. The fieldbus IC is also operable autonomously without that controller.

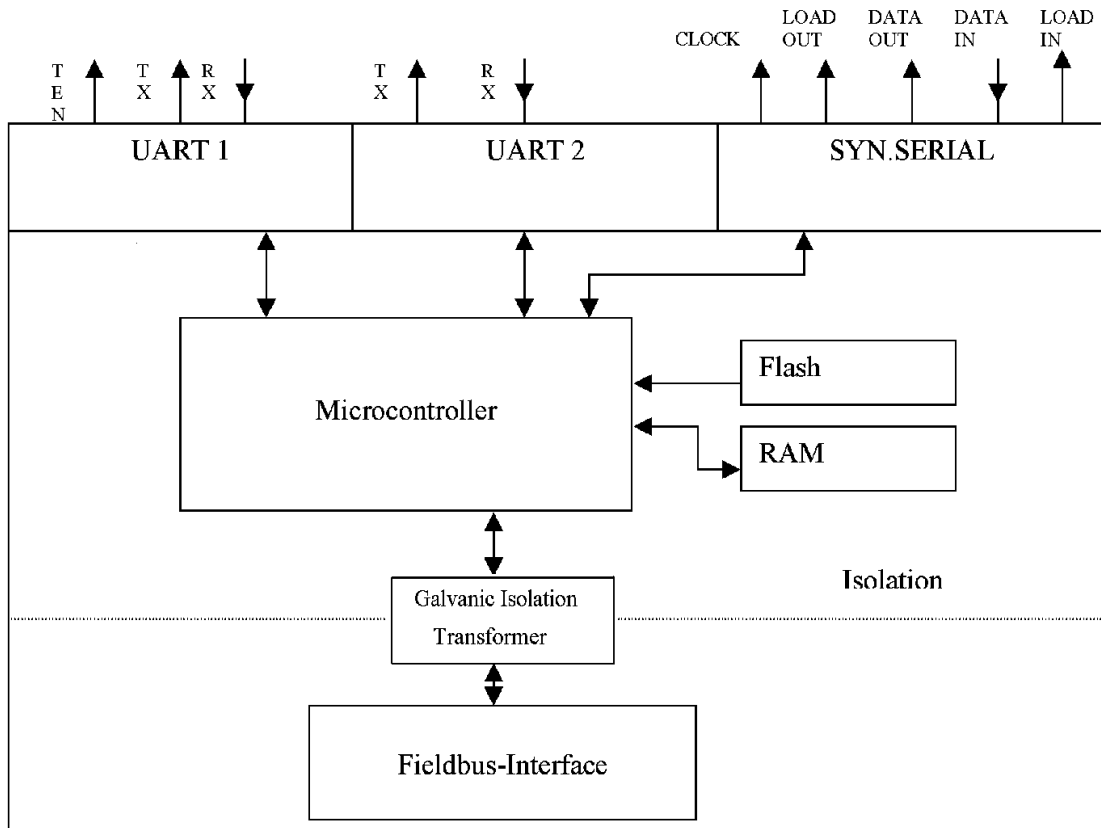
2.6 The Debug-interface

The UNIGATE® IC features a Debug-interface, which allows to process a script step by step and also to monitor or manipulate data. This is indispensable for the development of a script. Usually a script is developed with the software Protocol Developer. For more details take a look at the instruction manual Protocol Developer. You'll find further information on the Debug interface in chapter 6.

All interfaces can independently be used at the same time.

2.7 UNIGATE® IC hardware survey

The hardware of the UNIGATE® IC consists of some few standard components. The picture below shows the functional structure of the IC.



3 Hardware design

This chapter gives basic advise, that is required in order to load UNIGATE® IC into your own hardware designs. In the following all ports of UNIGATE® IC are described in detail.

3.1 Ports

UNIGATE® IC features 32 pins in its layout as a DIL 32 component. The exact mechanical dimensions can be taken from chapter 16.



In the layout boreholes for ALL 32 pins have to be planned.

3.2 Pinout

| Pin | Technical specifications | Name | Description | Remark |
|-----|--------------------------|-----------------|---|--|
| 1* | 3.3V ± 5% < 460mA | Vcc | +3.3V voltage supply | |
| 2 | IN _{Logic} | -BE | boot enable | |
| 3 | OUT _{Driver} | Load out (SS0-) | strobe signal for synchronous, serial interface | |
| 4 | OUT _{Driver} | Data out (SS1-) | output data for synchronous, serial interface | |
| 5 | IN _{Logic} | Data in (MISO) | input data of the synchronous, serial interface | internally pulled up with 10 kΩ |
| 6 | OUT _{Logic} | Load in (MOSI) | strobe signal input data of the synchronous, serial interface | |
| 7 | OUT _{Driver} | Clock (SCK) | clock pulse signal for synchronous, serial interface | |
| 8 | IN _{Reset} | -Reset in | reset-input of the IC | internally pulled up with 100 kΩ |
| 9* | connected to pin 1 | Vcc | +3.3V voltage supply | |
| 10 | according to norm | Error-LED | Anode of the red LED | |
| 11 | according to norm | LED-LINK-ACT1 | Ethernet-link pulse found / Networkdata traffic Port 1 | |
| 12 | nc | nc | not connected | |
| 13 | according to norm | RD1- | Ethernet-signal RD- Port1 | galvanically isolated insulation voltage 1000 Vrms |
| 14 | according to norm | RD1+ | Ethernet-signal RD+ Port1 | |
| 15 | according to norm | TD1- | Ethernet-signal TD- Port1 | |
| 16 | according to norm | TD1+ | Ethernet-signal TD+ Port1 | |
| 17 | according to norm | TD2+ | Ethernet-signal TD+ Port2 | |
| 18 | according to norm | TD2- | Ethernet-signal TD- Port2 | |
| 19 | according to norm | RD2+ | Ethernet-signal RD+ Port2 | |
| 20 | according to norm | RD2- | Ethernet-signal RD- Port2 | |
| 21 | nc | nc | not connected | |
| 22 | according to norm | LED-LIN-KACT2 | Ethernet-link pulse found / Network data traffic Port2 | |
| 23 | nc | nc | not connected | |
| 24* | connected to pin 32 | GND | Ground supply voltage of the IC | |
| 25 | | State-LED | Bus status LED (Anode of the green LED) | |
| 26 | IN _{Logic} | -Config Mode | Signal to start in configuration mode | internally pulled up with 100 kΩ |
| 27 | OUT _{Logic} | DbgTX | serial Debug TX | |
| 28 | IN _{Logic} | DbgRX | serial Debug RX | internally pulled up with 100 kΩ |
| 29 | IN _{Logic} | RX | serial data RX | internally pulled up with 100 kΩ |
| 30 | OUT _{Logic} | TX | serial data TX | |

| | | | | |
|----|----------------------|-----|---------------------------------|--|
| 31 | OUT _{Logic} | TE | Transmit enable | |
| 32 | GND | GND | Ground supply voltage of the IC | |

* The supply voltage is 3.3V +/- 5 %, max. 460 mA DC.

| 3.3V ± 5%, < 460mA | V _{IL} | V _{IH} |
|-----------------------|-----------------|-----------------|
| IN _{Reset} | < 0.25V / 1mA | >1.5V / 10µA |
| IN _{Logic} | < 0.5V / 0.4mA | >1.5V / 10µA |
| | V _{OL} | V _{OH} |
| OUT _{Logic} | < 0.6V / 1mA | >2.3V / 0,1mA |
| OUT _{Driver} | < 0.5V / 4mA | >2.5V / 4mA |

3.2.1 -Boot enable

The IC is started in the firmware update mode with the level GND during the power up process. See also chapter 15.

3.2.2 Load out (SPI-Master: SS0-)

Strobe signal for the synchronous serial interface. With the positive edge at this output data is taken from the connected shift registers to the physical outputs. In SPI mode this Pin serves as a low-active Slave-Select-Signal.

3.2.3 Data out (SPI-Master: SS1-)

On this line data is output on the synchronous serial interface. The most significant bit of the data is output first. In SPI mode this Pin serves as a low-active Slave-Select-Signal.

3.2.4 Data In (SPI: MISO)

Data is read in on the synchronous serial interface via this signal. The most significant bit of the data is expected first. In SPI mode this Pin serves as data transfer from Slave to Master.

3.2.5 Load In (SPI: MOSI)

This pin is the strobe signal for the input data of the synchronous serial interface. In SPI mode this Pin serves as data transfer Master to Slave.

3.2.6 Clock (SPI: SCK)

This signal is the clock line for the synchronous serial interface. That signal is equally valid for data input and data output.

3.2.7 -Reset In

- A reset generator (Max 809) is on board; with it in the normal case the reset input is not required. In this case the reset input has to be connected with VCC, in order to avoid interferences (see chapter 3.6).
- If the the customer's application has to initiate a reset of the UNIGATE® IC, then the reset input can also be connected with a reset output of the customer's application instead of connecting it with VCC. Here all specifications of the reset signal, mentioned in chapter 3.2 have to be kept. The reset-impulse is supposed to last at least 10 ms.

3.2.8 LED-LINKACT 1

A green LED can be connected to this line (see chapter 3.6). This is directly accessed by the Processor and is glowing when the Gateway on Port 1 is an operational network (it will receive link pulses) and flickers if there is network traffic.

3.2.9 LED-LINKACT 2

A green LED can be connected to this line (see chapter 3.6). This is directly accessed by the Processor and is glowing when the Gateway on Port 2 is an operational network (it will receive link pulses) and flickers if there is network traffic.

3.2.10 State-LED

A green LED can be connected to this line (see chapter 3.6). It shows the Bus Status and is glowing in the state of "Ethernet ok, data exchange active". It is flashing in the state "Waiting for link connection".

3.2.11 -Config Mode

If the pin has the level GND, then the IC starts in the configuration mode.

3.2.12 DbgTX, DbgRx

They are transmission line and receive line as well of the IC's Debug-interface. For the function description of the Debug-interface see chapter 6.

3.2.13 TE

The transmit enable signal allows the connection of RS485 drivers to the IC's serial interface. The signal is set to High whenever the IC sends via the line TX.

3.2.14 TX, RX

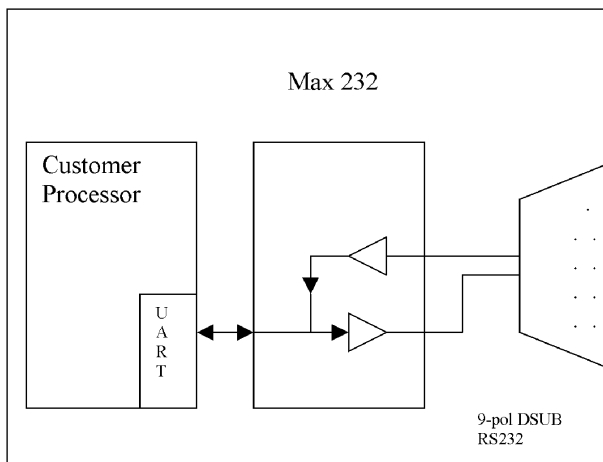
Transmission and receive line of the serial interface. This interface is programmable in accordance with the description in chapter 4.

3.3 Software

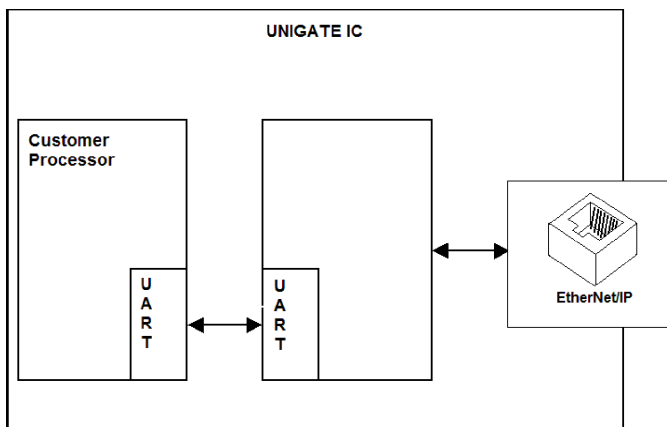
The software executes script-commands, which in turn control the IC's hardware and they process their complete protocol by software. The script itself can be generated by the company Deutschmann Automation or with the software Protocol Developer by yourself. For a detailed description of the script.commands of the Protocol Developer see the instruction manual Protocol Developer and the online documentation concerning script-commands.

3.4 Basic line of proceeding

In theory it is enough to replace the RS232-driver that is included in your application by the UNIGATE® IC.



Your device, which on the whole is supposed to be assembled as shown above, will now be modified in a way that the EtherNet/IP is available at the 9-pol. socket. However, a hardware redesign is necessary in order to keep the assignment in standard form.

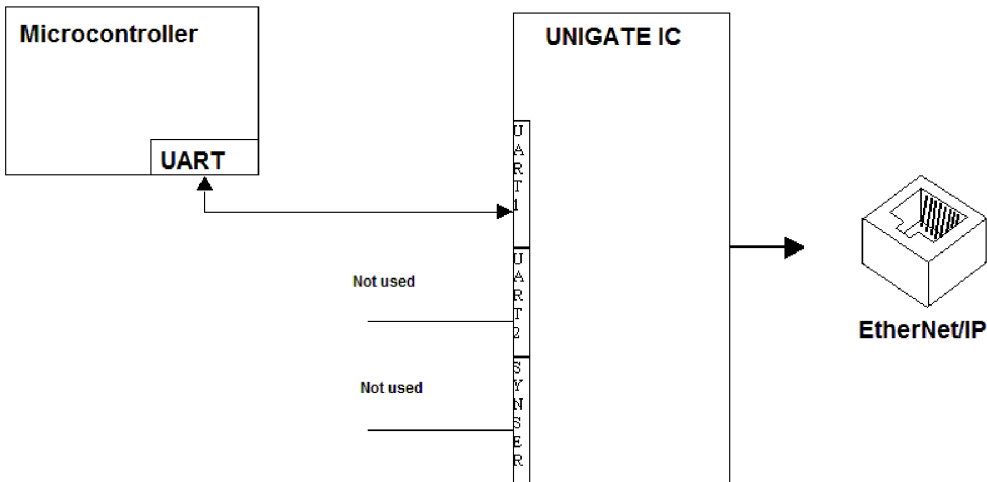


After the RS232-driver has been replaced by the UNIGATE® IC, EtherNet/IP is available at an RJ45-socket.

3.5 Connection examples

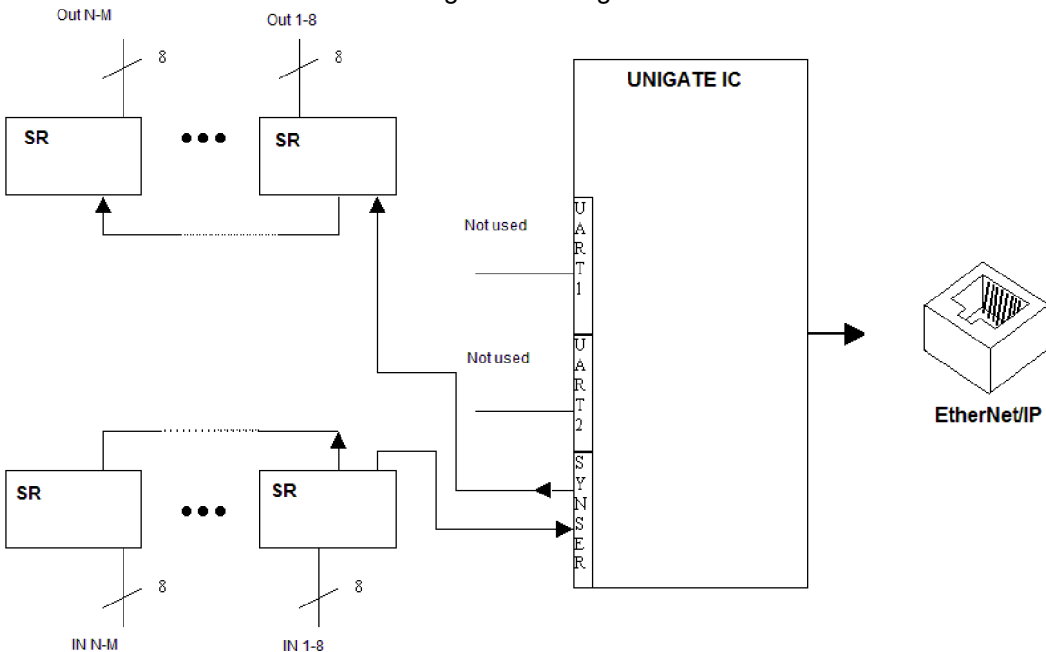
Here you will find some advise that offers help for a re-design. In the following several versions are listed, that should make it easier for you to decide.

Version 1: Use as a pure link module for the bus



The UNIGATE[®] IC independently processes the communication with the customer's device via the TTL-interface.

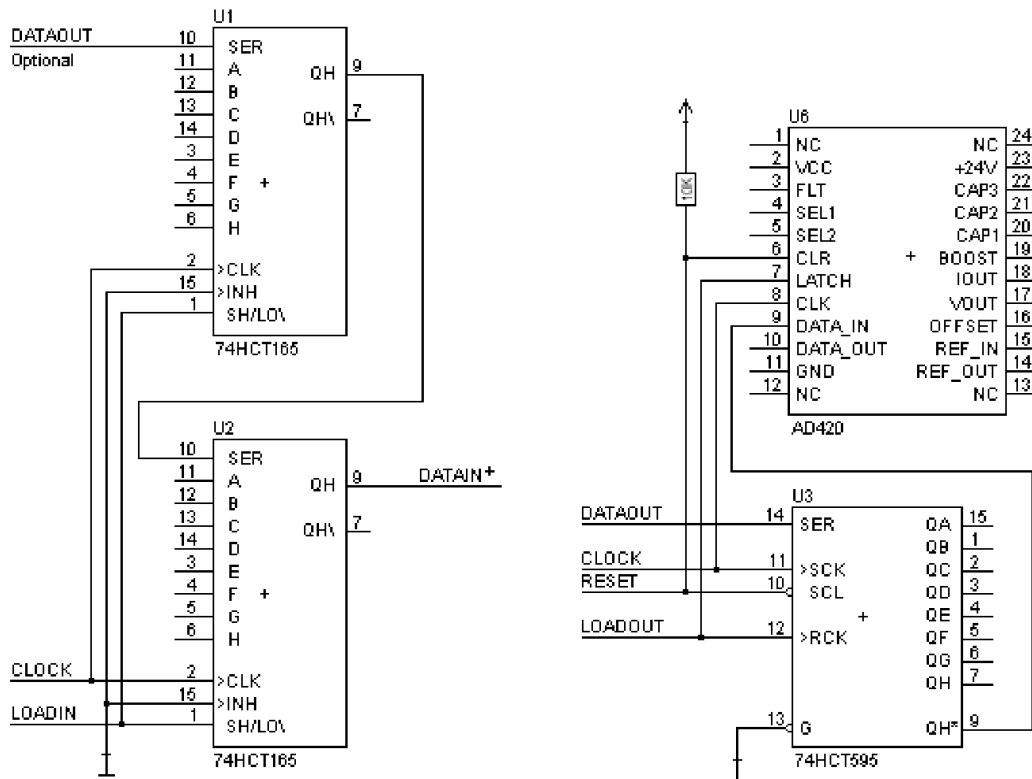
Version 2: Use of UNIGATE[®] IC for digital or analog I/O-modules



Here only the synchronous serial interface is used, the asynchronous serial interface is basically of no account. If you want to program the script in your completed application, then the use of a connector for the asynchronous interface is recommended. With it you can carry out the ISP-programming.

For this operating mode no additional controller is required on your application!

The following circuit diagram is an example for how shift register components can be connected to the IC.

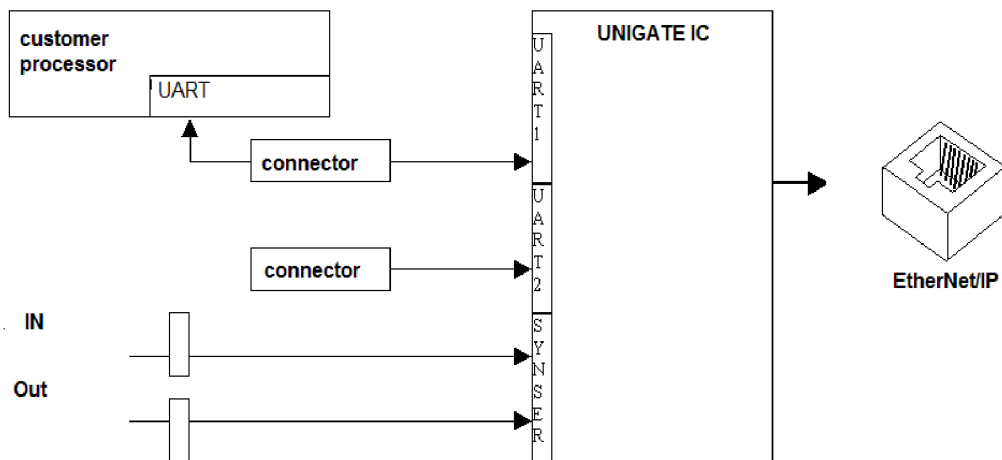


Version 3: Example for digital I/Os

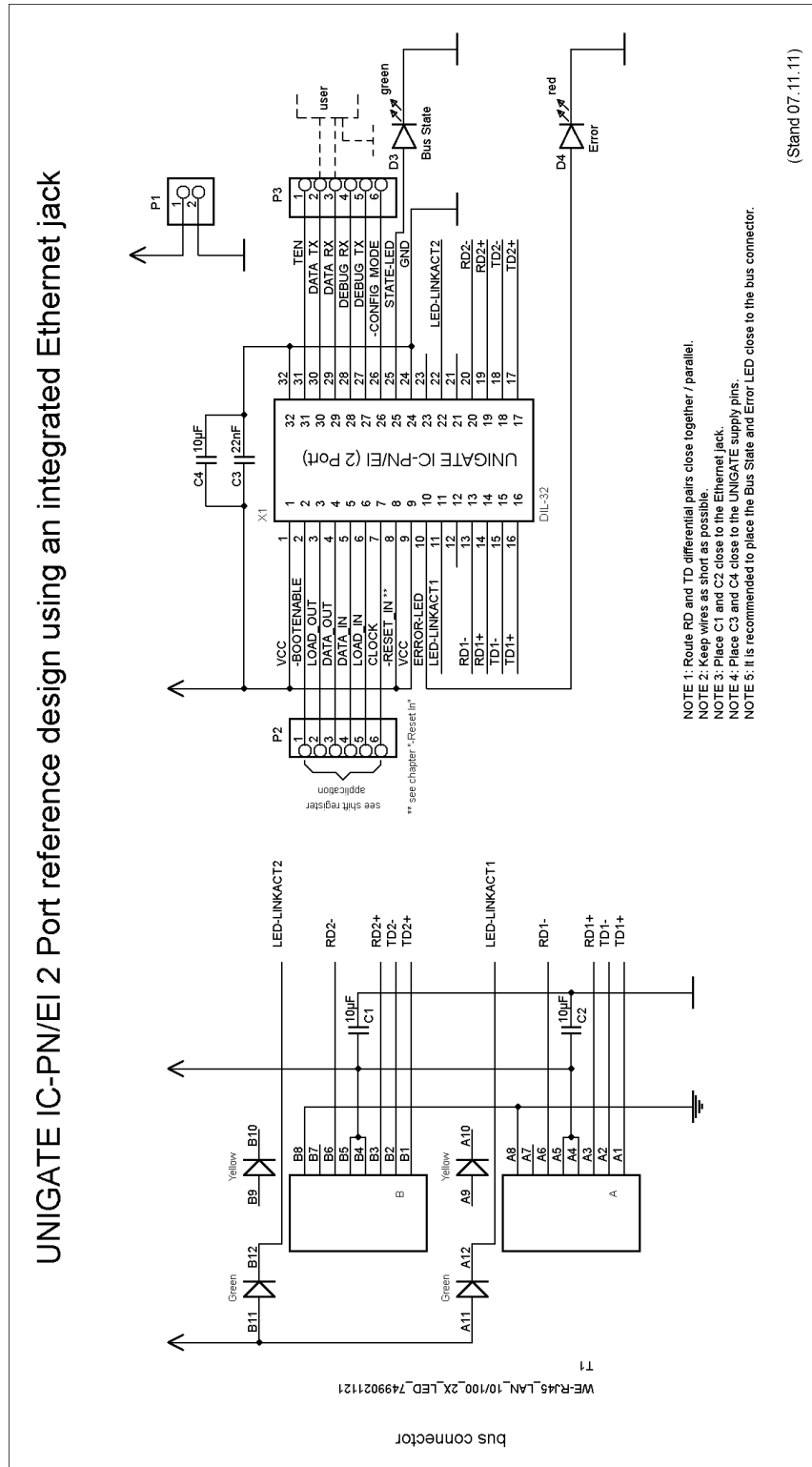
The serial synchronous and the asynchronous interface as well can be operated by UNIGATE® IC at the same time. Here the possibility results that an existing application can be extended by additional digital or analog I/Os.

In chapter 5.2 you find an example for a script, that operates these I/Os.

Valid for all versions: A planned plug connection of the serial interface in the application offers the possibility of an update of the firmware or the software via an external connection.

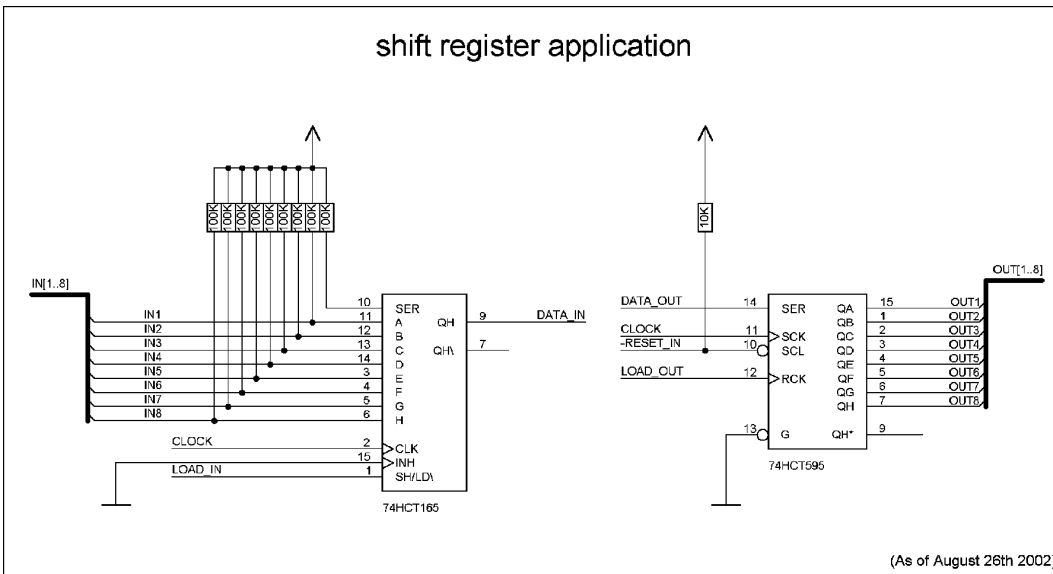
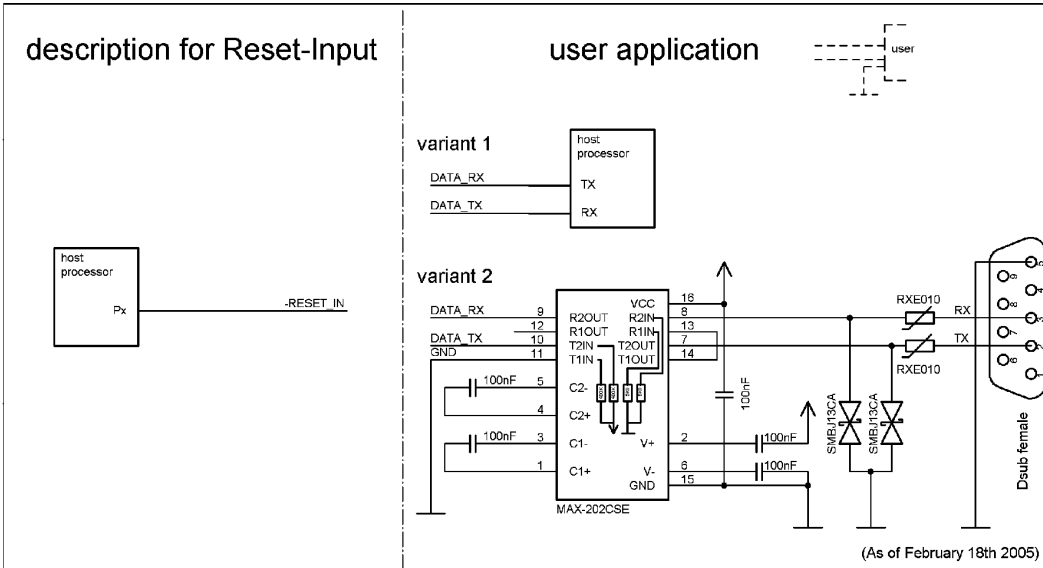


UNIGATE IC-PN/EI 2 Port reference design using an integrated Ethernet jack





When connecting the UG-IC and the RJ45-connector it is important to make sure the signal lines RD1-/RD1+ resp. TD1-/TD1+ also RD2-/RD2+ resp. TD2-/TD2+ run as short a possible, parallel and equal in length. Because this is for analog signals, it is also advisable not to place digital lines in close proximity.





The 74HCT595 used in this example has an undefined on-position, but therefor can set the outputs to the tri-state condition via the OutEnable-Pin 13. If it is more important to have a defined on-position in an application, and the OutEnable-pin is not necessary, the 74HCT594 can be used here.

Note:

The following recommendations result from the reference design of the Micrel Switch used in the UNIGATE® IC-EI 2Port:

Compatible isolation transformers:

- Pulse H1102
- Transpower HB726
- Bel Fuse S558-5999-U7
- YCL PT163020
- DELTA LF8505

3.7 Handling (mounting the UNIGATE® IC on the carrier board)

Depending on the application and the expected shock- and vibration-conditions you can choose from the following possibilities for the UNIGATE® IC's installation on the carrier board:

- Mounting on a socket in the carrier board. If necessary solder the UNIGATE® IC to 2 or 4 pins in the socket. Normally the IC can easily be pulled out after the soldering points have been removed.
- Make arrangements for two holes next to the socket in the layout. After the UNIGATE® IC was plugged in the socket pull an isolated wire over the IC and solder it on the carrier board at the specified holes.
- Fasten the UNIGATE® IC With a wire or a tie wrap on the socket.
- Manual soldering directly on the carrier board.
- Automatic soldering directly on the carrier board, whereas „selective“ soldering is essential (no wave soldering)

The advantage of the socketed variant is the easy download of Script- and Firmware-updates, if the carrier board is not designed for it. Besides, that way the Fieldbus can be changed easily by changing the UNIGATE® IC if the corresponding plug connectors are provided on the carrier board. Another advantage is, that - normally - only a reflow soldering of the carrier board is necessary.

The advantage of the soldered variant is, that the installation height is lower and a higher shock- and vibration-safety is provided.

3.8 Requirement for Ethernet-Interface

Since there is an extremely large number of suppliers for RJ45 connectors (with and without integrated Ethernet transformer), or single Ethernet transformers on the market, it is not possible for us to test all possibilities. If you consider that there are various qualities (SMD / THT, with / without LED, vertical / horizontal, with / without EMC springs tab at the top / bottom, single / multiple times, etc.) with RJ45 connectors alone, it is probably understandable.

In General, RJ45 connectors and the external or built-in Ethernet transformer must meet the following properties:

Required parameters for Ethernet Transformer:

Turns ratio 1 CT: 1 CT \pm 5%

Open Circuit Inductance 350 μ H (min) @ 10 mV, 10 kHz

Insertion Loss 1.1 dB (max)

1500 Vrms dielectric, 1 minute

Required parameters for RJ45 connector:

CAT5, shielded if possible

To enable a quick start in the selection of appropriate components, we have compiled a list of order numbers of Würth Elektronik below, where we source our components. Of course, other manufacturers are possible, so the following list is to be considered exemplary.

Ethernet transformer 10/100 Base-T 1:1

We mainly use: Order-No. 749 010 014

RJ45 connector with transformer

We mainly use: Order-No. 615 008 140 121

RJ45 connector (single or multiple) with integrated transformer

To be cost-effective and more flexible we don't use RJ45 connectors with integrated transformers. Technically, however, nothing speaks against it.

We exemplary tested: Order-No. 749 905 100 1

Further information:

We had bad experiences with SMT connectors in the past, because in the field they got demolished every now and then due to mechanical loads.

4 The serial interface

4.1 Overview

The serial interface is the most important connection between the UNIGATE® IC and the micro controller of your application. The interface is designed in a way so that your application at least does not have to be changed on the software-side. The wide range of services of the UNIGATE® IC's serial interface constitutes the basis for it. The UNIGATE® IC allows to connect of controllers with a baudrate of 110 baud to 520 kbaud. The baudrate for the communication itself is permanently stored in the module. The maximum size for IO-data can be read-out with the Script command `"Get RSOutBufFree16"`.

Depending on the read-in Script of the UNIGATE® IC, the module carries out actions independently, in order to identify data from the connected device. For customers who already have a software-adaptation at the company Deutschmann Automation, this protocol as well or a Script after an adaptation can be processed by the IC.

Anyway, the IC will take over the communication with the fieldbus independently.

4.2 Initialization of the serial interface

The initialization of the interface is carried out by script-commands, such as `"Set baudrate"`, `"Set databits"`, `"Set parity"`. For a detailed description of these commands see the online documentation for the Protocol Developer or the instruction manual for the Protocol Developer.

4.3 Use of the serial interface

The serial interface can freely be programmed by the user. Efficient script-commands for sending and receiving data are available; just to mention some possibilities: such as waiting with timeout for a character, waiting for a fixed number of characters or also sending and receiving data in the Modbus RTU. A reference to these commands is offered in the online documentation for the Protocol Developer as well as in the instruction manual for the Protocol Developer.

4.4 Further operation modes

In the configuration mode the serial interface also serves to configure the standard software or to carry out a Script-update. More details on that can be found in chapter 7.

5 Synchronous serial interface

The synchronous serial interface of the UNIGATE® IC is used to connect clocked shift registers or components that have a Serial Peripheral Interface (SPI).

It allows

- the expansion of the IC for digital inputs and outputs (for example for driving LEDs or for reading switch positions)
- communicate with microcontrollers or
- the control of DA and AD converters.

Connection examples are give in chapter 3.

By using the synchronous serial interface can realize products that can work without another microcontroller (stand-alone mode). Examples are sensor products or digital IO modules

5.1 Shift register operation

Before the interface can be used, it has to be initialized by setting various Script parameters. (see chapter 5.1.1)

The parameters „ShiftRegisterInputType“ and „ShiftRegisterOutputType“ allow the use of different shift register types, which differ in the polarity of the shift register signals. To use the shift register types 74595 and 74165, for example, the values „RiseClk_RiseLoad“ and „RiseClk_LowLoad“ can be set.

The shift register width is set by the parameter „ShiftRegisterInputBitLength“ and „ShiftRegisterOutputBitLength“ The maximum width is 256 bits.

The data exchange with the connected shift registers ensues with the commands „WriteShiftRegister“, „ReadShiftRegister“ or bidirectional with the command „ShiftRegisterDataExchange“. The clock rate is approx. 45 kHz.

Further information on the commands and parameter values can be found in the Help section of the Protocol Developer Software. On request, the Deutschmann Script language can be complemented by additional parameter values in order to support other types of shift registers.

5.1.1 Example-Script

Note: The script example refers to the circuit example in chapter 3.5.

```
var InBuffer: Buffer[2];
var OutBuffer: Buffer[2];
MoveConst( OutBuffer[0], #0x58#0x21 );

Set( ShiftRegisterInputType, RiseClock_FallLoad );
Set( ShiftRegisterOutputType, RiseClock_RiseLoad );
```

```
Set( ShiftRegisterInputBitLength, 16 );
Set( ShiftRegisterOutputBitLength, 16 );

WriteShiftRegister( OutBuffer[0] );
ReadShiftRegister( InBuffer[0] );

// Input data is now in the INBuffer
// 0x58 is applied to the outputs of the analog converter
// 0x21 at the shift register`s outputs
```

5.2 SPI mode

Before the interface can be used in SPI mode, this must be initialized. The command `InitSPI` sets the operating type, the mode (signal polarity and phase) and the clock frequency.

The data exchange ensues with the command `ExchangeSPI`. The maximum clock frequency is between 1 and 5 MHz, depending on the hardware. For details please see the IC-Pinout list in the download area of our website.

Please also refer to the script commands documentation in the online help of the Protocol Developer.

5.2.1 Example-Script

```
var L_Freq      : long;
var b_Channel   : byte;
var w_Len       : word;
var a_BufOut    : buffer[100];
var a_BufIn     : buffer[100];

moveconst( L_Freq, 1000000); // 1 MHz
InitSPI( 1 , 0 , L_Freq );

moveconst( b_Channel, 0 );
moveconst( w_Len, 11 );
moveconst( a_BufOut[0], "Hello World" );
ExchangeSPI( b_Channel , w_Len , a_BufOut[0] , a_BufIn[0] );
```

6 The Debug-interface

6.1 Overview of the Debug-interface

The UNIGATE® IC 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® IC (power up) the firmware will output the binary character 0 (0x00) after a self-test was carried out on this interface. If the IC 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.

6.5 Commands of the Debug-interface

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

7 Script and configuration

7.1 Overview

The script stored in the UNIGATE® IC, as well as the configuration, can be replaced or updated via the serial interface (application) in the configuration mode.

7.2 The configuration mode

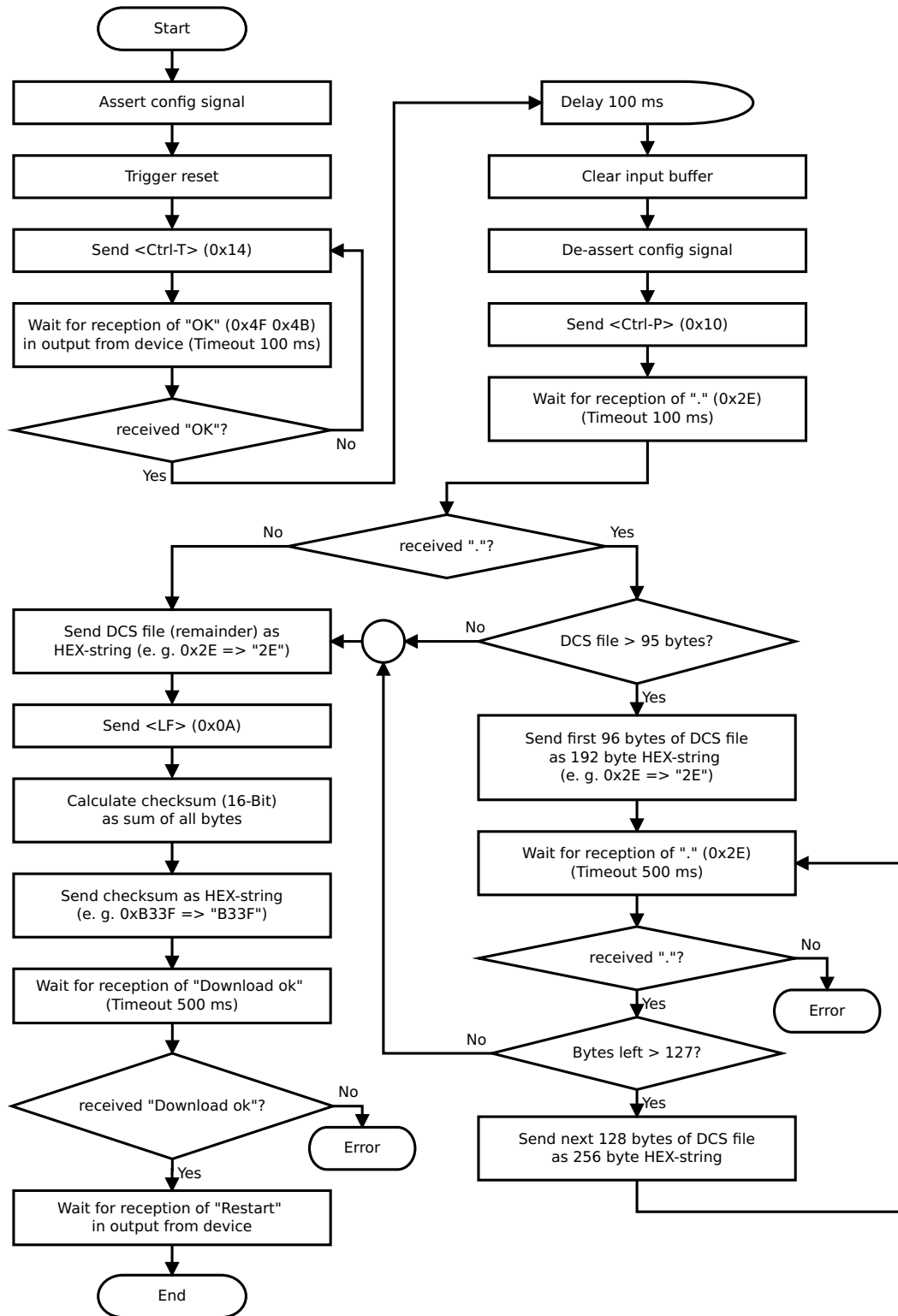
If the pin „ConfigMode“ pulled to GND during the PowerUp or Reset, then the UNIGATE® IC starts in the configuration mode. In this mode it is possible to communicate with the IC without processing the regular software. In this mode it is possible to change the UNIGATE® IC's settings of the standard software or to write a new script in the UNIGATE® IC. It shows its start in the configuration mode by issuing a status message (it may take up to 1 minute), which might look as follows:

```
IC-EI-SC V4.0 [36] (c)dA Script(C:51/16320,V:0/8192)=""Leer" Author="Deutschmann  Automa-
tion GmbH" Version="1.0" Date=21.08.2001 SN=47110001 IP=0.0.0.0 MAC=00-14-11-15-19-81
```

7.3 Update the script

- The preferred option is to insert the UNIGATE® IC into the base board from Deutschmann (Developer Board UNIGATE® IC-AB) and use the Deutschmann tools (software WINGATE with „Write Script“ under „File“ or with the software ScriptProgramTool).
- You can also automatically replace the script in your application from your host (see flowchart).

Script Download



The operational sequence is as follows:

The Gateway has to be in the config-mode.

The script-download is initiated with "Ctrl-P (=0x10)".

After that the data follows byte by byte as ASCII-hex-characters.

The download is terminated with a "LF (=0x0A)".

Afterwards the word-checksum follows as ASCII-hex-characters.

The Gateway responds with a clear text reply to that download and carries out a warm start.

Example:

The following 4-bytes script is supposed to be downloaded: 0x01 0x12 0x5A 0x23

The sum of the bytes is 0x0090 as checksum.

Then the following sequence is to be sent:

1. 0x10 Ctrl-P
2. 0x30 '0'
3. 0x31 '1'
4. 0x31 '1'
5. 0x32 '2'
6. 0x35 '5'
7. 0x41 'A'
8. 0x32 '2'
9. 0x33 '3'
10. 0x0A LF
11. 0x30 '0'
12. 0x30 '0'
13. 0x39 '9'
14. 0x30 '0'

Gateway's reply: "Download ok"

7.4 Configuration of the UNIGATE® IC

UNIGATE® IC is delivered with an empty script.

The configuration of the UNIGATE® IC - EtherNet/IP is restricted to the setting of the Ethernet-address.

7.4.1 Ethernet

- Baud rate: 10 and 100 MBaud autodetect
- IP-address (Gateway)
- Ethernet (MAC-address)
- IP-destination host

7.4.2 RS232/RS485/RS422

- RS-type: RS232
- Start bit: 1
- Data bits: 8
- Stop bit: 1
- Parity: None
- Baud rate: 9600 Baud
- Default setting. This configuration can be changed via the Script.

8 Generating a script

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. These values have to be known as fixed values and are not available for the runtime. 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.

9 FTP-Server

This UNIGATE® features an integrated FTP-Server, which allows access to the file system of the device. The FTP-Server is password protected. With the predefined user name "deutschmann" and the password "deutschmann" a connection can be established. The login data can be defined by setting the Script parameters „FTP_Password“ and „FTP_UserName“.

Note: On write access to the file system the actual write process to the non-volatile memory is taking place delayed (5 seconds after the last write access to the file system or when disconnecting the FTP connection). Before restarting the device one must wait for the write process to the non-volatile memory to complete to prevent data loss.

9.1 Script-update via FTP

In the Protocol Developer save the compiled script (DCS file) using the file name "script.dcs". Transfer the file to the UNIGATE®. After completion of the write process, please disconnect from the FTP server and restart the device. Upon device startup the UNIGATE® takes over the script contained in the file and deletes the file afterwards.

9.2 System configuration update via FTP

In WINGATE save the configuration (GWC file) using the file name "system.gwc". Transfer the file to the UNIGATE®. After completion of the write process, please disconnect from the FTP server and restart the device. Upon device startup the UNIGATE® takes over the configuration contained in the file and deletes the file afterwards.

10 WEB-Server

This UNIGATE® has an integrated web server. The delivery condition has a HTML-Page in the file system, which shows the system parameters of the device.

The Web Page can be changed by the customer as desired, or replaced with a self-created web page. It can be written into the file system via FTP (see chapter 9).

10.1 Server-Side-Includes (SSI)

„*Server-Side Includes*“ functionality (SSI) is available in order to generate dynamic web pages, which for example can portray process data.

The web server only scans the index.html file and files with the extensions "shtml" or "sml" for SSI directives. In all other HTML files the SSI directives are ignored.

If a client is asking for a web page with SSI directives the web server replaces the directives with the web server's instructions with the appropriate values and sends the generated page.

SSI directives are listed within HTML comments and have the following syntax:

```
<!--#exec="Command"-->
```

The following commands are a selection of supported commands.

A complete list of all commands can be found in the Online help of the Protocol Developer.

| Command | Instruction (incl. Commentary) is replaced with |
|--------------------|---|
| DisplayFWVersion | Firmware version |
| DisplayBLVersion | Bootloader version |
| DsisplaySerial | Serial number |
| DisplayMacID | Ethernet MAC address |
| DsplayDeviceName | Device name |
| DisplayStationName | |
| DisplayStationType | Station type |
| DisplayVendorID | Vendor ID |
| DisplayDeviceID | Device ID |
| DisplayIP | IP address des UNIGATE® |
| DisplaySubnet | IP subnet mask |
| DisplayGateway | IP address default gateway |

To issue any process data, additional Script variables can be given to the Web-Server with the Script-Commands „SetHTMLOutputString“. The command assigns the variable a name, which then can be used in the following command:

| Command | Instruction (incl. Commentary) is replaced with |
|----------------------------|---|
| DisplayScriptVar, variable | Content of variable |

10.2 HTML-Forms

The supporting of HTML Forms allows the Web Server to design interactive web pages. So, for example, input forms for process values can be realized.

The script command „SetHTMLInputString“ assigns a name to a script variable, which then can be used in the HTML form.

10.3 Examples

The interaction between Gateway-Script and HTML page can be taken from the example HTML page „ssi.shtml“ and the example Script „example_Set_HTML_String.dss“. Both files are accessible in the download area of our website www.deutschmann.com.

11 File System

The UNIGATE® has a file system which is being used by the integrated FTP-Server and the integrated Web-Server (view chapter 10). Furthermore it's also used by some devices for storing of device parameters.

If necessary the device parameter files can be created and initialized by the UNIGATE® automatically. The following table shows an example of the contents of the file system in delivery condition (contents may vary depending on the device, subject to change without prior notice).

Table 1 File system content at delivery (example)

| File | Remark |
|---------------------|-------------------------------|
| devname.txt | device name |
| nvdata | non-volatile device parameter |
| bg.jpg | device web site |
| bg_container.jpg | |
| bg_footer.jpg | |
| bg_topnavi.gif | |
| bottom.gif | |
| da-logo.gif | |
| deutschmann.css | |
| down.gif | |
| favicon.ico | |
| h4_pre.gif | |
| header_schatten.jpg | |
| headline.jpg | |
| index.html | |
| line.gif | |
| profinet.gif | |
| rnavmain_bg.gif | |
| ssi.html | |
| teaser_header.jp | |

Please note that

- files can not be overwritten or edited on the device. If you want to replace a file with a modified version, you must delete the file stored on the device first, and write the modified file again or transfer to the device.
- during a writing procedure, the execution of the firmware will cut out for a few seconds (depending on the length of the file). The access to the file system is buffered, so the actual writing access is delayed by several seconds.

It is possible to reformat the file system via FTP. It will lose all data stored in the file system. To perform the formatting of your command-line please use the FTP client on Microsoft® Windows® (Command Prompt -> ftp.exe). Make a connection to the FTP server of the UNIGATE® and then run the command "del *.*". The string "*" is understood as a request by UNIGATE® to format the file system.

12 EtherNet/IP

If you are speaking of EtherNet/IP, then the CIP about Ethernet is meant. The end device's protocol is being converted in the UNIGATE® via a Script.

12.1 Data exchange mode

The gateway has to be in the data exchange mode, so that a data exchange between the RS-side of the gateway and the fieldbus is possible. This mode is always active as long as the gateway is not in the configuration mode, the firmware update- or Debugmode. In the data exchange mode the gateway will carry out the downloaded Script.

12.2 EtherNet/IP address-assignment

The Ethernet/IP address can either be assigned through WINGATE, the Script or via DHCP.

12.3 Project planning

Use any project planning tool for project planning.

A sample EDS-file can be found on the Internet (www.deutschmann.com) free of charge. Generating the EDS-file is also provided as service from Deutschmann Automation.

12.4 Possible data lengths

The table below shows the maximum transferable data:

| | | |
|-------------|-----------------|--------------------------------------|
| Input data | max. 1060 bytes | Variable: maximum value in this case |
| Output data | max. 1060 bytes | Variable: maximum value in this case |

12.5 Literature

We recommend the book "The Common Industrial Protocol and the Family of CIP Networks" (PUB 00123RO), to help you quickly get to grips with the subject of Ethernet/IP. The book can be ordered from the ODVA User Organisation (web: www.odva.org).

13 Calculating the MAC address from the serial number

Basically you can see the MAC-address from the IC's status signal (see chapter 7.2 'The configuration mode').

With the following calculation formula you can calculate the MAC-address from the serial number (SN), that is attached to the IC:

$$\text{MAC} = (\text{SN} - 28950000) + 86184558592$$

Since the MAC is issued as a 6-digit hex-number, anyways (xx-xx-xx-xx-xx-xx), the following calculation is probably better:

Issue: MAC1-MAC2-MAC3-MAC4-MAC5-MAC6

Calculation:

$$\text{MAC1} = 00$$

$$\text{MAC2} = 14$$

$$\text{MAC3} = 11$$

$$\text{MAC4} = (\text{SN} - 28950000) / 65536$$

$$\text{MAC5} = ((\text{SN} - 28950000) / 256) \bmod 256$$

$$\text{MAC6} = (\text{SN} - 28950000) \bmod 256$$

Consequently the device with the SN 32180349 has the MAC 00-14-11-31-4A-8D

14 Error handling at UNIGATE® IC

A distinction can be made between two categories of system-errors:

Serious errors (1-4): 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.

The system-error can be read-out via the Script.

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

| Error no. | Error description |
|-----------|-------------------------------|
| 0 | Reserved |
| 1 | Hardware fault |
| 2 | EEROM error |
| 3 | Internal memory error |
| 4 | Fieldbus hardware error |
| 5 | Script error |
| 6 | Reserved |
| 7 | RS-transmit buffer overflow |
| 8 | RS-receive buffer overflow |
| 9 | RS timeout |
| 10 | General fieldbus error |
| 11 | Parity-or frame-check-error |
| 12 | Reserved |
| 13 | Fieldbus configuration error |
| 14 | Fieldbus data buffer overflow |
| 15 | Reserved |

Table 1: Error handling at UNIGATE® IC

15 Firmware-update

15.1 Overview

UNIGATE® IC has a memory for the firmware. It can be replaced via the UNIGATE® IC's Ether-Net/IP-interface.

15.2 Execution of the firmware-update

The safest way for the firmware-update is the use of the basic board combined with the software "FDT.EXE" (firmware-download-tool). These tools are available from Deutschmann Automation (see chapter 17).

A Firmware-update can be carried out in the following operational modes:

Konfiguration mode (via the IP-address UNIGATE®)

Firmware-update-mode (via the fixed IP-address 10.10.10.10)

15.3 Starting in firmware-update-mode

15.3.1 Adjustment by hardware

UNIGATE® IC can be brought to the firmware-update-mode by the hardware. For it the signal \overline{BE} (boot enable) has to be pulled to the potential GND during the Power-up-process.

15.4 Note on safety

The firmware-update should only be carried out when there is no other possibility left. A firmware-update-process that has already been started CANNOT be undone. With it the previously used firmware is permanently unusable.

15.5 Operation mode of the IC

Data exchange mode

This mode is required for the regular use of the IC. In this mode the IC will process all script-commands and normally exchange the corresponding user data. The bus as well is operated in this mode through the IC.

Configuration mode

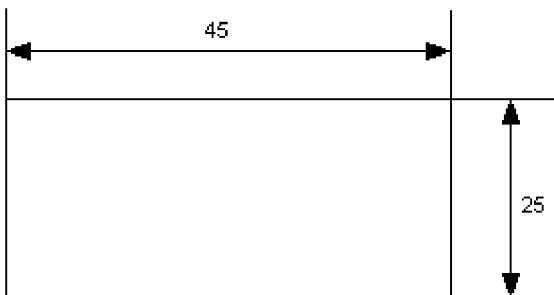
In the configuration mode the UNIGATE® IC will carry out a self-test after the start (or after a reset). After a successful self-test it will wait for further commands. Here it is possible to load a translated Script (File extension: *.dcs) into the unit or to configure the device.

16 Technical data

In this chapter you will find all necessary technical data on UNIGATE® IC.
All measurements in mm.

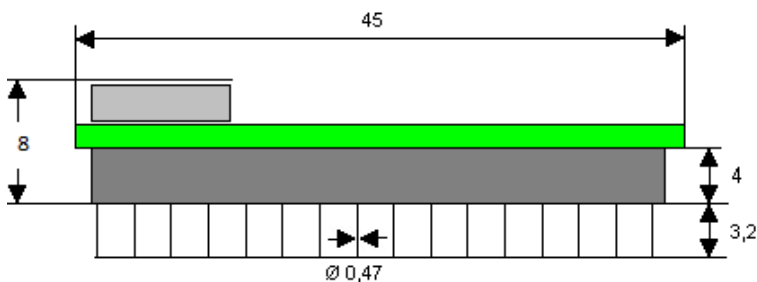
16.1 Mechanics of the UNIGATE® IC

16.1.1 General dimensions of UNIGATE® IC

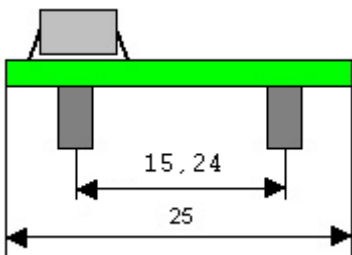


Max. height = 20 mm; including pin

16.1.2 Dimensions UNIGATE® IC (EtherNet/IP 2Port only)



The pins of UNIGATE® IC - EtherNet/IP 2Port are arranged with a grid spacing of 2.54 mm.



DIP-Spacing Code 6

In case you intend to use other fieldbus ICs, the maximum overall height of ≤ 20 mm (including pins) has to be taken into consideration.

16.2 Technical data UNIGATE® IC - EtherNet/IP 2Port

| Characteristics | Explanation |
|---------------------------------|--|
| Supply voltage | 3.3V ± 5 %, max. 460 mA DC |
| Interface | 2 UART interfaces, 1 synchronous serial interface |
| IP-address | Set via WINGATE or assigned via DHCP |
| Bus-baud rate | 10 and 100 MBaud autodetect |
| UART-baud rate | Up to 520 Kbaud (adjustable via script) |
| Supported Ethernet protocols | UDP/IP, TCP/IP |
| Technology | 32-bit-processor "Fido 1100" |
| Others | I/Os, analogous signals, shift registers, LEDs, switches and so on can be connected externally |
| Dimensions | 45 x 25 x 8 mm (WxDxH) |
| Installation | 32 DIL |
| Weight | Approx. 9 g |
| Operating temperature | -40°C ..+85°C |
| Storage / transport temperature | -40°C..+100°C |
| Built-in position | Any |

17 Accessory

The following tools are available from Deutschmann Automation.

17.1 Adapter RS232

In an application the adapter RS232 offers the possibility to replace an existing driver MAX 232 (only in DIL-16-housing) by this adapter. This board allows the use of the IC according to chapter 3.4 on page 15. Please note that with it the Ethernet does not offer a connection conforming to the standards. With a plug adapter, however, at least the operation of Ethernet is possible.

The hardware is only meant for development purposes. It offers the possibility to make an existing application capable for bus connection in no time and to test the IC's utilizability and functionality.

17.2 Adapter RS485

From the functionality's point of view the RS485 adapter is the same as the RS232 adapter. It offers the possibility to replace a module LS 176 (only in DIL-8-housing) by the IC.

There are the same restrictions as for the RS232 adapter.

17.3 FirmwareDownloadTool (FDT)

The FirmwareDownloadTool is available for download from our homepage: it is required for an update of the firmware. Condition for it is, that a PC can be connected to the serial of the IC. The software describes the procedure of an update itself.

17.4 Protocol Developer

The Protocol Developer is the development environment for scripts, that also contain the Debugger. This software package also contains the documentation to all script-commands. This software is available for download from our homepage at <http://www.deutschmann.com>. The instruction manual for the Protocol Developer, which is available in pdf-format, gives further advise on how to use the software.

17.5 Developerkit UNIGATE® IC-AB IC

The Developerkit IC contains

- a Developerboard UNIGATE® IC (see chapter 17.5.1)
- a plug-in power pack to supply the Developerboard
- connection cables for appl. RS232, Debug RS232 and appl. RS422/485
- USB-cable
- Software and documentation to complete the packet.

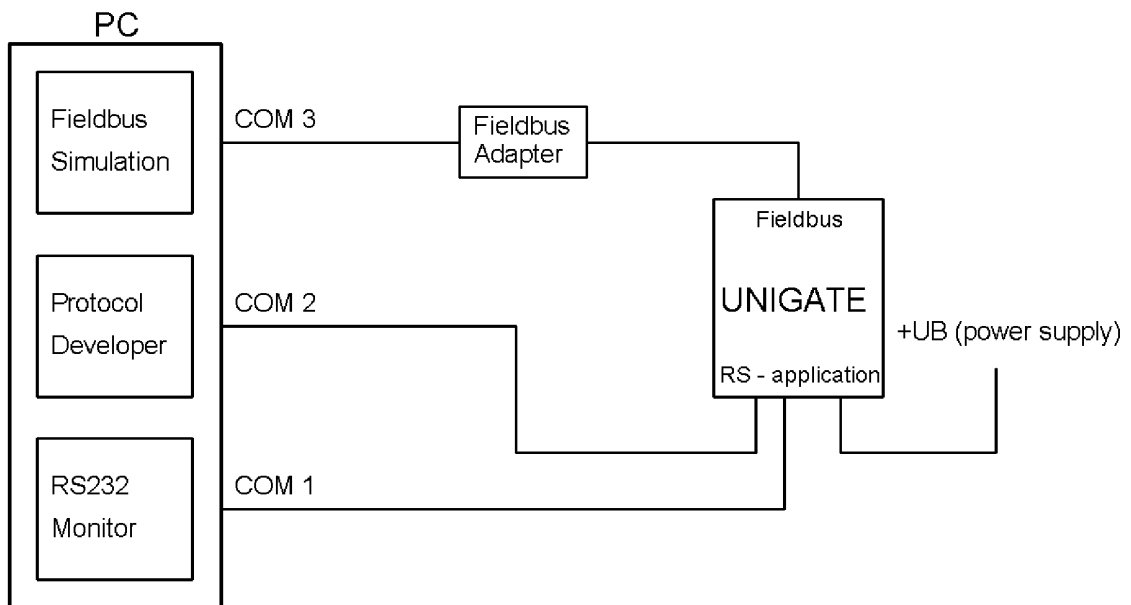
17.5.1 Developerboard UNIGATE® IC-AB

The Developer Board was developed so that the fast implementation of the Deutschmann All-in-one bus node UNIGATE® IC into your electronic system can be guaranteed. The board is suitable for all Fieldbuses and Industrial Ethernet Buses supported by Deutschmann Automation.



The required UNIGATE® IC / ICs are ordered separately. The required voltage (5V or 3.3V, depending on the version) can be adjusted. An RS232-interface or a USB-connection is available for the connection to the PC (Debug-interface). The application can be connected either through the USB, RS232, RS485 or the RS422. The bus-connections according to standard or market standard are available to test the respective bus-side. Optionally Deutschmann Add-on packages (bus-master simulation) are available. The board contains 32 bit input and 16 bit output, provided with one LED each. Different connectors allow an easy coupling to your processor. A hole matrix field with the most important signals (voltage, IOs) allows a customized hardware extension (e. g. to connect a D/A converter).

17.5.2 Quick start



For a transparent data exchange you will find example scripts for the respective Fieldbus under "File->New" in the Protocol Developer.

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).

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

Central office and sales department +49 6434 9433-0
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) |
| IC2 | = | Product group IC2 (IC-design DIL32) |
| IO8 | = | Option I/O8 |
| 16 | = | Script memory expanded to 16KB |
| 5V | = | Operating voltage 5V |
| 3,.3V | = | Operating voltage 3.3V |

Fieldbus

| | | |
|--------|---|--|
| 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-IO |
| PBDP | = | PROFIBUS DP |
| PBDPL | = | PROFIBUS DP-version L (see comparison table UNIGATE® IC for the respective product) |

product)
PBDPX = PROFIBUS DP-version X (see comparison table UNIGATE® IC for the respective product)
PBDPV0 = PROFIBUS DPV0
PBDPV1 = PROFIBUS DPV1
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 |

20 Annex

20.1 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-IO
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

20.2 Hexadecimal table

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| C | 12 | 1100 |
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