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**Instruction Manual  
Universal Fieldbus-Gateway  
UNIGATE<sup>®</sup> IC2 - EtherCAT<sup>®</sup>**



**Deuschmann Automation GmbH & Co. KG**  
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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<sup>®</sup> IC2 by Deutschmann Automation any more. All digital functions, software, stack and driver as well as optocoupler are integrated on a UNIGATE<sup>®</sup> IC2 in correspondence with the standard. In addition to the reduction of the required size, also different fieldbuses can easily be integrated.

**Through the flexible firmware of UNIGATE<sup>®</sup> IC2 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<sup>®</sup> IC2 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.

The UNIGATE<sup>®</sup> IC2 is a further development of the 1st series of the UNIGATE<sup>®</sup> IC. Equipped with a Cortex-M4 controller, the UNIGATE<sup>®</sup> IC2 achieves much higher transfer rates when communicating via SPI or UART. In addition, the scripting processing time (depending on the commands used) is reduced by a factor of about 50 - 80. Thus, script execution times in the microsecond range are possible.

The UNIGATE<sup>®</sup> IC2 is also PIN-compatible with the 1st series of the UNIGATE<sup>®</sup> IC.

## 2 The UNIGATE® IC2

### 2.1 Technical introduction

The UNIGATE® IC2 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® IC2 and the required plug connectors.

### 2.2 Availability

The module is available as EtherCAT®. Further fieldbuses 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® IC2s under:  
<http://www.deutschmann.com>.

### 2.3 Firmware

UNIGATE® IC2 is programmed via scripts. On principle any script, that has been developed for a UNIGATE® IC2, can also be operated on the UNIGATE® IC2.

### 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® IC2. For more information on this serial interface see chapter 4 on page 24.

### 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 IC2 is also operable autonomously without that controller.

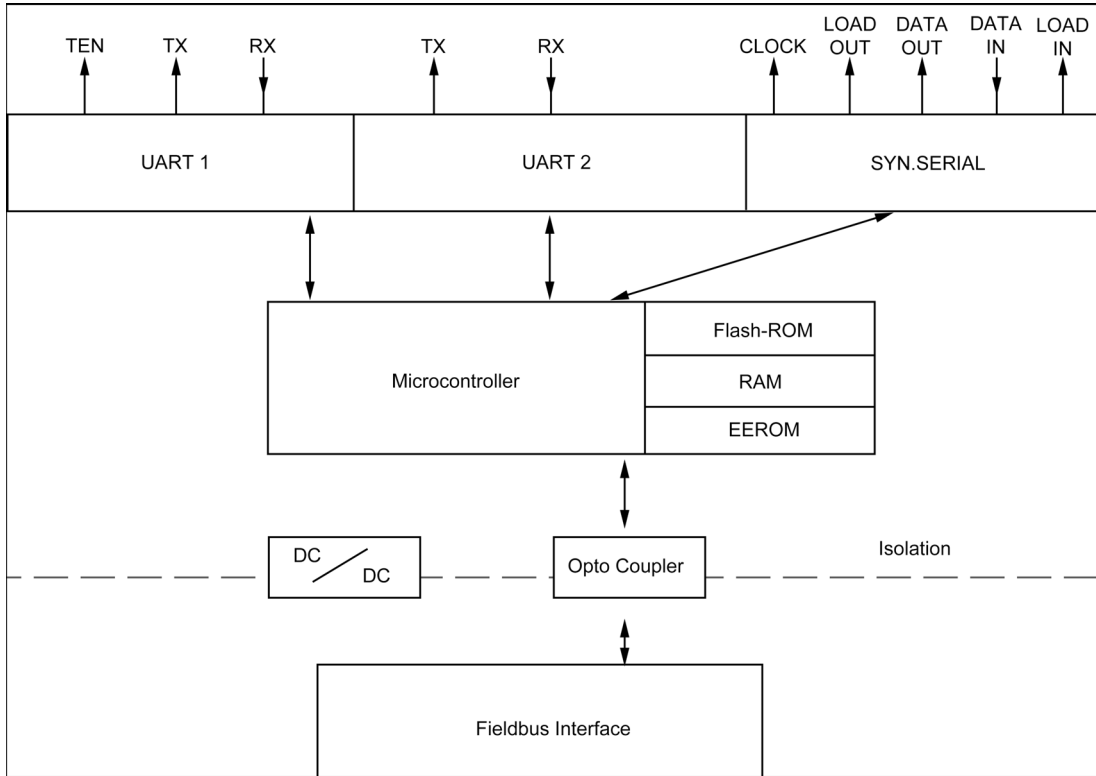
### 2.6 The Debug-interface

The UNIGATE® IC2 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.

**All interfaces can independently be used at the same time.**

## 2.7 UNIGATE® IC2 hardware survey

The hardware of the UNIGATE® IC2 consists of some few standard components. The picture below shows the functional structure of the IC2.



### 3 Hardware design

This chapter gives basic advise, that is required in order to load UNIGATE® IC2 into your own hardware designs. In the following all ports of UNIGATE® IC2 are described in detail.

#### 3.1 Ports

UNIGATE® IC2 features 32 pins in its layout as a DIL 32 component. The exact mechanical dimensions can be taken from chapter 12 on page 36.



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% < 230mA	Vcc	+3.3V voltage supply	
2	IN <sub>Logic</sub>	-BE	boot enable	
3	OUT <sub>Driver</sub>	Load out (SS0-)	strobe signal of the synchronous serial interface's output data	
4	OUT <sub>Driver</sub>	Data out (SS1-)	output data for synchronous, serial interface	From Hardware-Rev.B (from S/N: 36750184): internally pulled up with 10 kΩ
5	IN <sub>Logic</sub>	Data in (MISO)	input data of the synchronous, serial interface	internally pulled up with 10 kΩ
6	OUT <sub>Logic</sub>	Load in (MOSI)	strobe signal of the synchronous, serial interface's input data	internally pulled up with 100 kΩ
7	OUT <sub>Driver</sub>	Clock (SCK)	clock pulse signal for synchronous, serial interface	From Hardware-Rev.B (from S/N: 36750184): internally pulled up with 10 kΩ
8	IN <sub>Reset</sub>	-Reset in	reset-input of the IC2	
9*	connected to pin 1	Vcc	+3.3V voltage supply	
10		Error-LED	anode of the red LED	
11		LED-LinkAct (Out)	Ethernet link pulses found / network data traffic OUT (cathode of the green LED)	exclusively the LED may be connected
12	nc	nc	nc	
13	according to norm	RJ45(6_1"OUT")	Ethernet-signal RD1-	
14	according to norm	RJ45(3_1"OUT")	Ethernet-signal RD1+	
15	according to norm	RJ45(2_1"OUT")	Ethernet-signal TD1-	
16	according to norm	RJ45(1_1"OUT")	Ethernet-signal TD1+	
17	according to norm	RJ45(1_2"IN")	Ethernet-signal TD2+	
18	according to norm	RJ45(2_2"IN")	Ethernet-signal TD2-	
19	according to norm	RJ45(3_2"IN")	Ethernet-signal RD2+	
20	according to norm	RJ45(6_2"IN")	Ethernet-signal RD2-	
21	nc	nc	nc	
22		LED-LinkAct (In)	Ethernet link pulses found / network data traffic IN (cathode of the green LED)	exclusively the LED may be connected
23	according to norm	Ground (PE)	ground	
24*	connected to pin 32	GND	ground supply voltage of the IC2	
25		LED-EC	bus status LED (anode of the green LED)	exclusively the LED may be connected
26	IN <sub>Logic</sub>	-Config Mode	signal to start the configuration mode	internally pulled up with 10 kΩ
27	OUT <sub>Logic</sub>	DbgTX	serial Debug TX	internally pulled up with 10 kΩ
28	IN <sub>Logic</sub>	DbgRX	serial Debug RX	internally pulled up with 10 kΩ

29	IN <sub>Logic</sub>	RX	serial data RX	internally pulled up with 10 kΩ
30	OUT <sub>Logic</sub>	TX	serial data TX	internally pulled up with 10 kΩ
31	OUT <sub>Logic</sub>	TE	transmit enable for RS485	
32*	GND	GND	ground supply voltage of the IC	

\* The supply voltage is 3.3V +/- 5 %, max. 500 mA DC.

The Ethernet signals are galvanically isolated. The insulation voltage is 1000 Vrms.

<b>3,3V±5% &lt; 500mA</b>	V <sub>IL</sub>	V <sub>IH</sub>
IN <sub>Reset</sub>	< 0,7V	>2,5V (max. 4,1V)
IN <sub>Logic</sub>	< 0,8V	>2,0V (max. 5V)
	V <sub>OL</sub>	V <sub>OH</sub>
OUT <sub>Driver</sub>	< 0,4V / 6mA	>2,7V / 6mA

### 3.2.1 -Boot enable

The IC2 is started in the firmware update mode with the level GND during the power up process. See also chapter 11 on page 35.

### 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 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 customer's application has to initiate a reset of the UNIGATE® IC2, 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 Error-LED

A red LED can be connected to this line (see chapter 3.6).  
The Error-LED comes on when an error or system error occurs.

An error can be triggered by the command:  
Set (Errorcode, 5);  
(the 5 is only an example).  
It can only be cleared by setting 0. (Set (Errorcode, 0);).

A system error can be triggered by the command:  
Set (SystemError, 7);  
or by a real system error as described in chapter "Error handling at UNIGATE® IC2" on page 34.

Error-LED	Error	Description
Off	No error	The EtherCAT® communication of the device is in working condition
Blinking	Invalid configuration	General Configuration Error (example: Wrong Object Settings)
Single Flash	Unsolicited State Change	Slave device application has changed the EtherCAT® state autonomously: Parameter "Change" in the AL status register is set to 0x01: change/error
Double Flash	Application Watchdog Timeout	An application watchdog timeout has occurred. (example: 10ms IR Error)

### 3.2.9 LED-LinkAct (Out)

A green LED can be connected to that wire (see chapter 3.6).  
This LED is directly controlled by the EtherCAT® -Controller and shines when the Gateway is located in a working net (link pulses are received) and flickers in case of network data traffic (activity). Only the prescribed LED may be connected to that pin (11) and no other wiring, since this may result in malfunctions of the UNIGATE® IC2-EC.

### 3.2.10 LED-LinkAct (In)

A green LED can be connected to that wire (see chapter 3.6).  
This LED is directly controlled by the EtherCAT®-Controller and shines when the Gateway is located in a working net (link pulses are received) and flickers in case of network data traffic (activity). Only the prescribed LED may be connected to that pin (22) and no other wiring, since this may result in malfunctions of the UNIGATE® IC2-EC.

### 3.2.11 LED-EC

A green LED can be connected to this line (see chapter 3.6). It is glowing in the state of "Ethernet ok, data exchange active" and in the state "Waiting for link connection" it is flashing. Only the prescribed LED may be connected to this pin (25) and no other wiring, as otherwise, the UNIGATE® IC2-EC may malfunction.

LED-EC	Status	Description
Off	INIT	The device is in state INIT
Blinking	PRE-OPERATIONAL	The device is in state PRE-OPERATIONAL
Single Flash	SAFE-OPERATIONAL	The device is in state SAFE-OPERATIONAL
On	OPERATIONAL	The device is in state OPERATIONAL

---

Indicator State	Definition
On	The indicator shall be constantly on.
Off	The indicator shall be constantly off.
Blinking	The indicator shall turn on and off iso-phase with a frequency of 2.5 Hz: on for 200 ms followed by off for 200 ms
Single Flash	The indicator shall show one short flash (200 ms) followed by a long phase off (1000 ms).
Double Flash	The indicator shall show a sequence of two short flashes (200 ms), separated by an off phase (200 ms). The sequence is finished by a long off phase (1000 ms).

### 3.2.12 -Config Mode

If the pin has the level GND, then the IC2 starts in the configuration mode.

### 3.2.13 DbgTX, DbgRx

They are transmission line and receive line as well of the IC2's Debug-interface. For the function description of the Debug-interface see chapter 6 on page 26.

### 3.2.14 TE

The transmit enable signal allows the connection of RS485 drivers to the IC2's serial interface. The signal is set to VCC whenever the IC2 sends via the line TX.

### 3.2.15 TX, RX

Transmission and receive line of the serial interface. This interface is programmable in accordance with the description in chapter 4 on page 24.

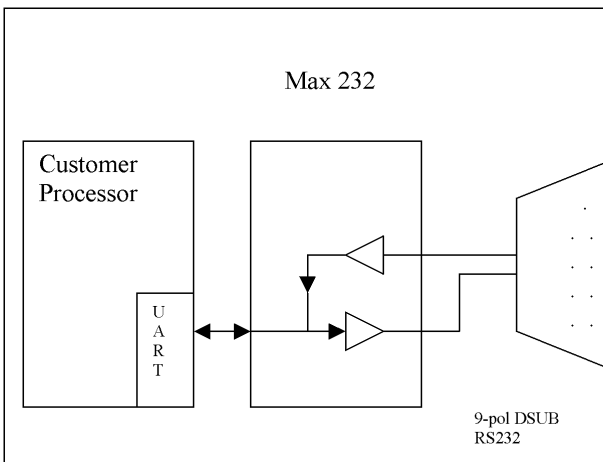


### 3.3 Software

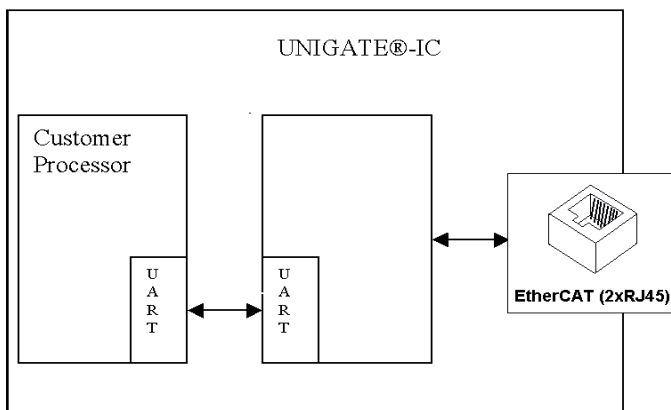
The software executes script-commands, which in turn control the IC2's hardware and they process their complete protocol by software. The script itself can be generated by the company Deutschmann Automation or with the software Protocol Developer by yourself. For a detailed description of the script.commands 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® IC2.



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

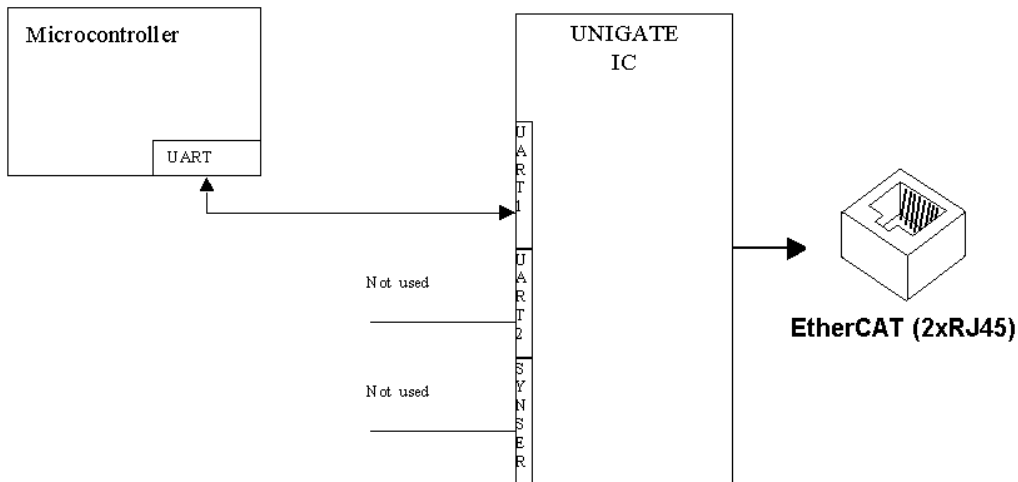


After the RS232-driver has been replaced by the UNIGATE® IC2, EtherCAT® is available at the RJ45-sockets.

### 3.5 Connection examples

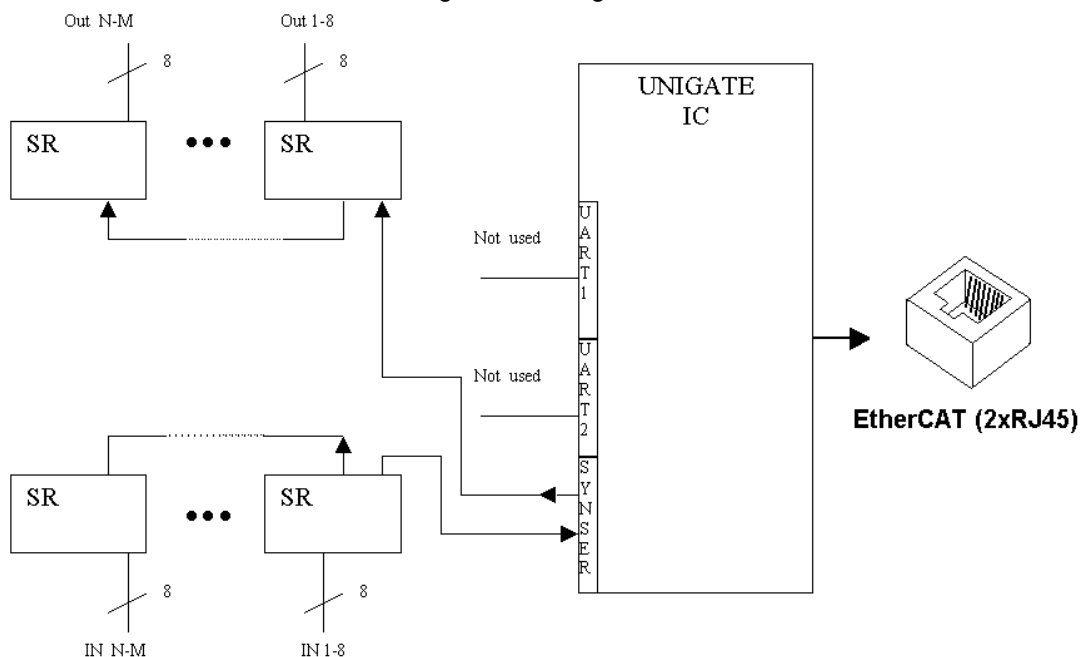
Here you will find some advise that offers help for a re-design. In the following several versions are listed, that should make it easier for you to decide.

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



The UNIGATE<sup>®</sup> IC2 independently processes the communication with the customer's device via the TTL-interface.

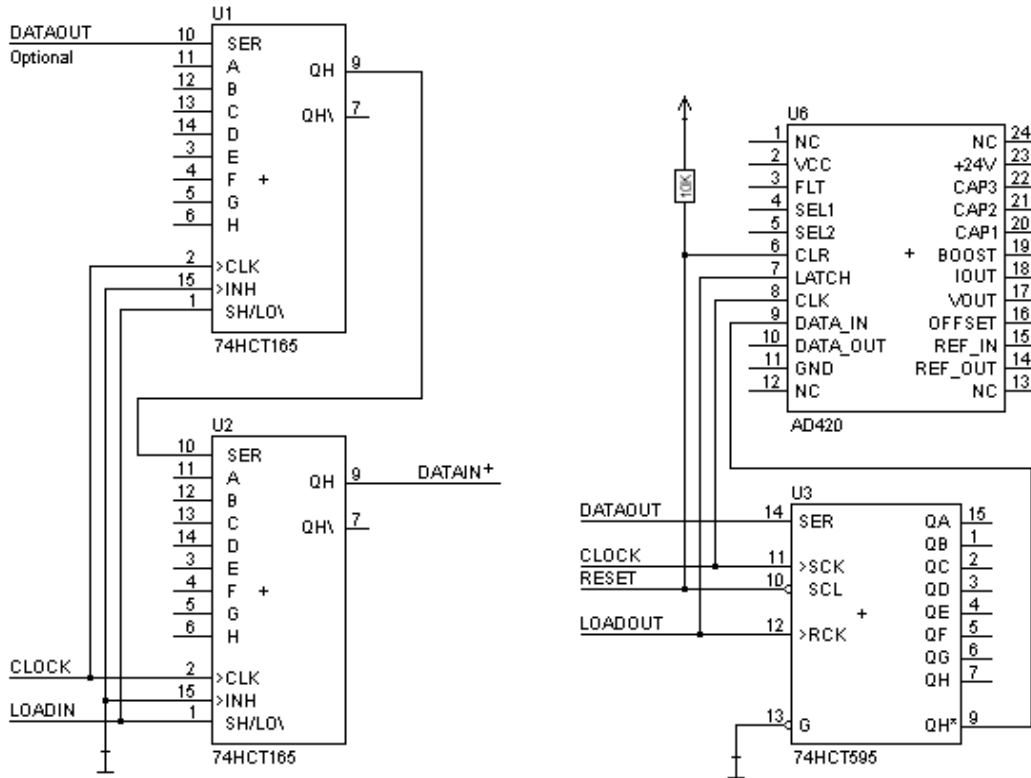
Version 2: Use of UNIGATE<sup>®</sup> IC2 for digital or analog I/O-modules



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 IC2.

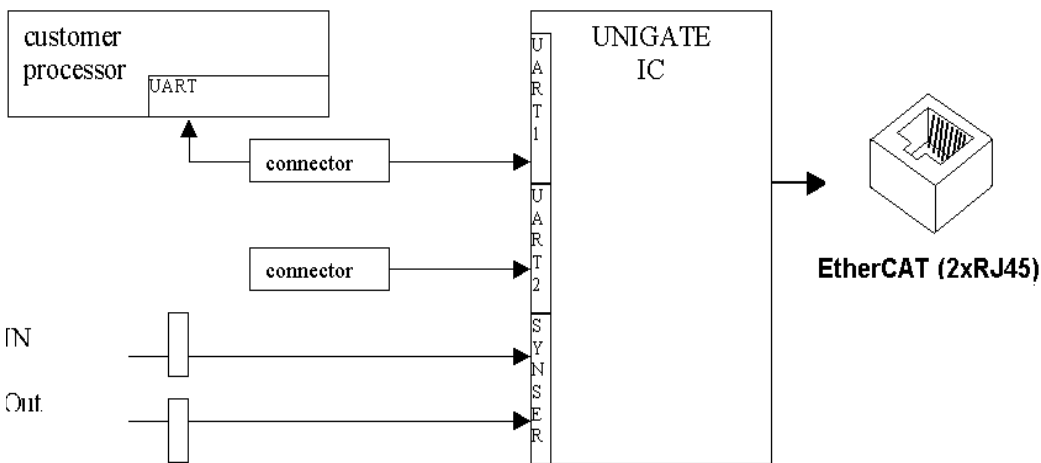


Version 3: Example for digital I/Os

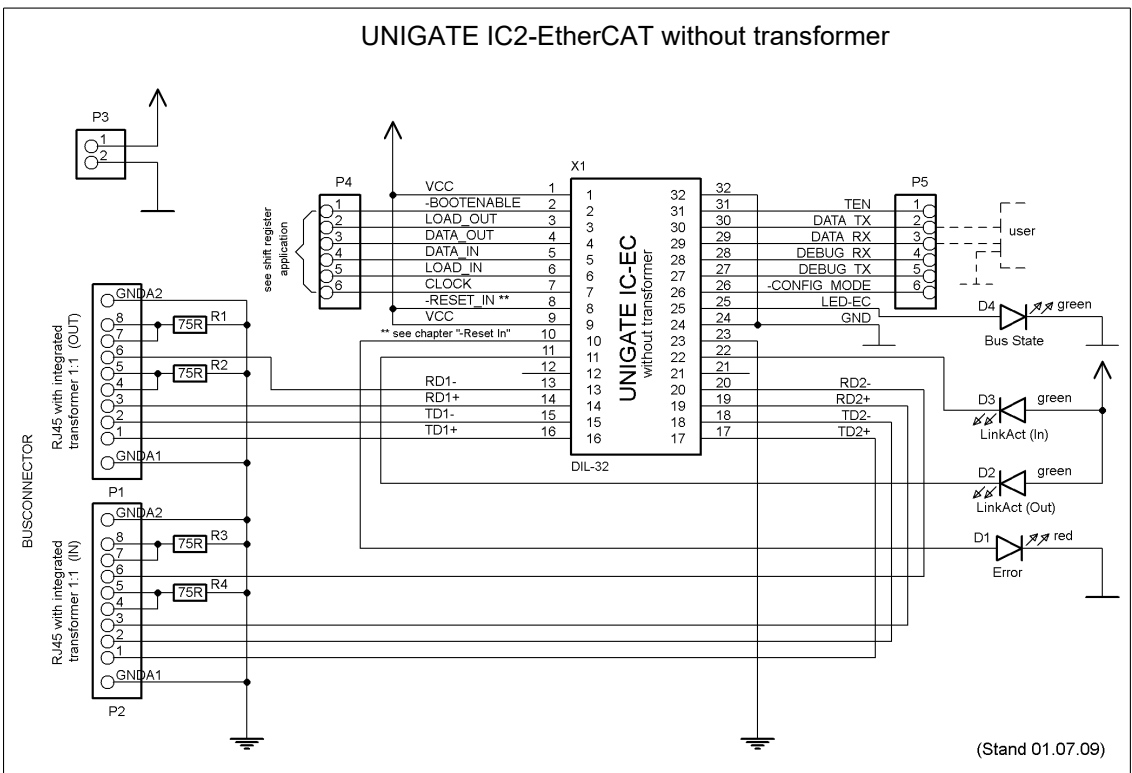
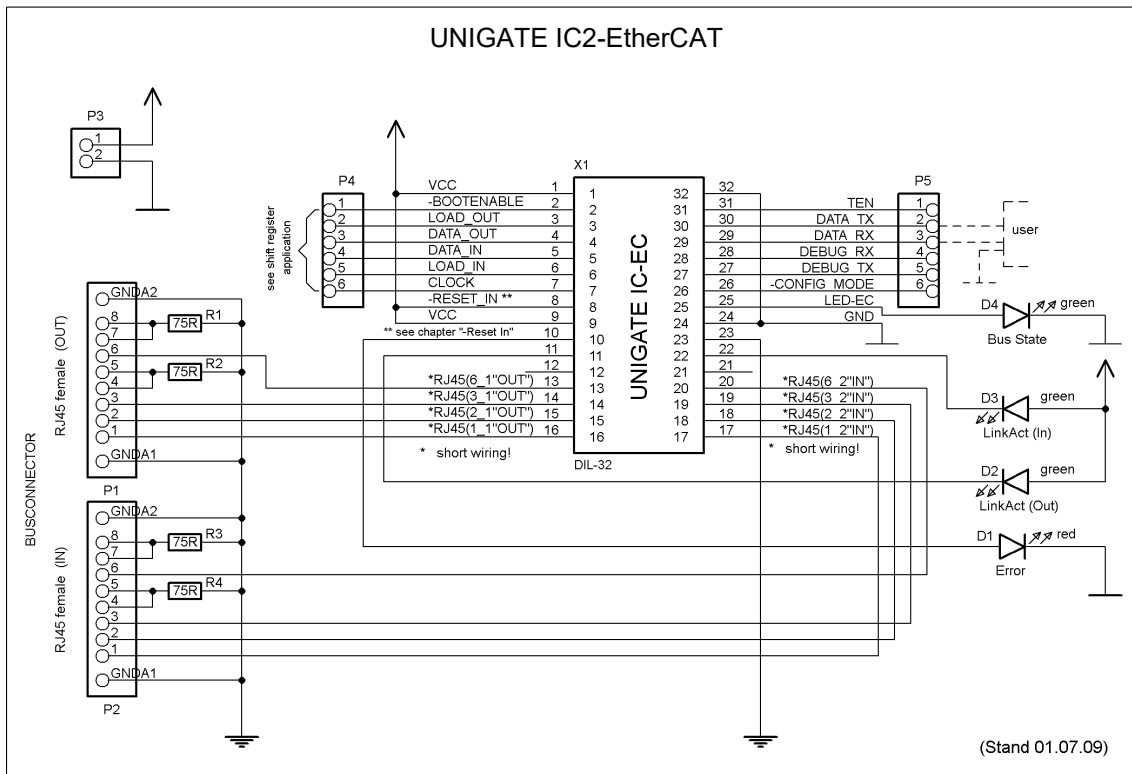
The serial synchronous and the asynchronous interface as well can be operated by UNIGATE® IC2 at the same time. Here the possibility results that an existing application can be extended by additional digital or analog I/Os.

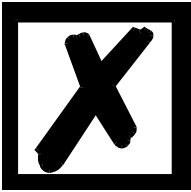
In chapter 5.2 you find an example for a script, that operates these I/Os.

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.

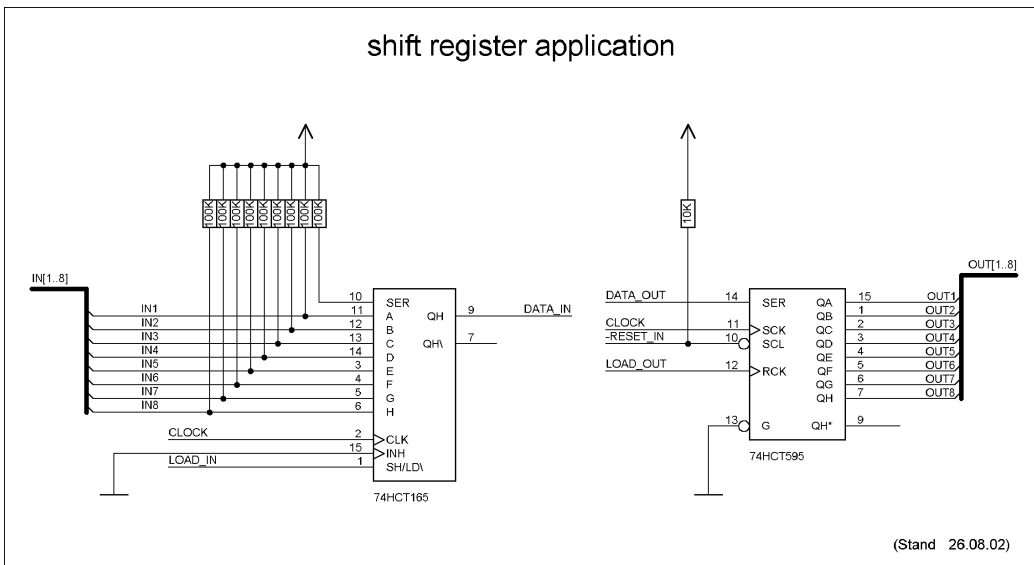
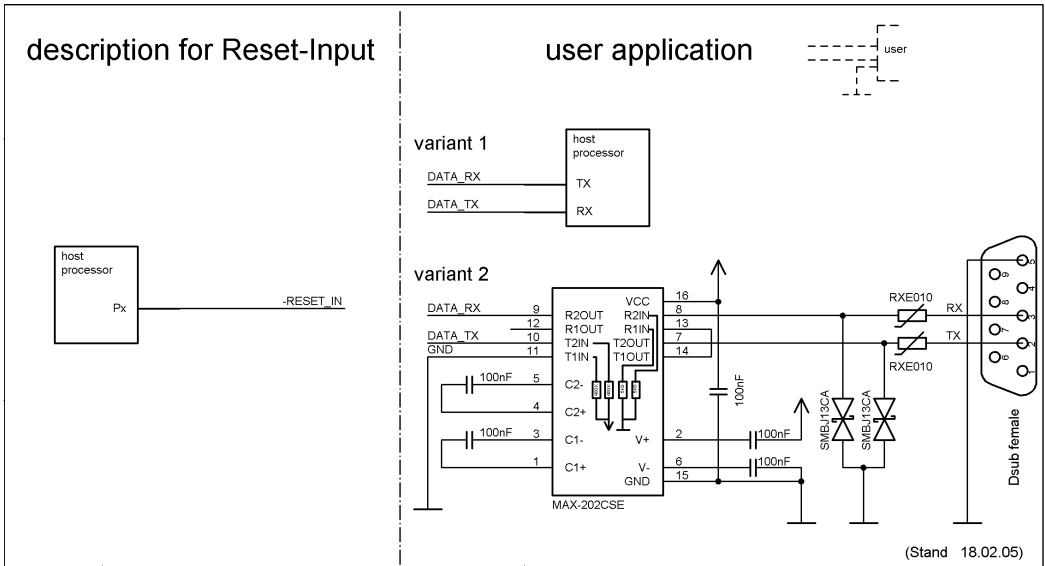


### 3.6 Layout examples





When connecting the UG-IC2 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.

### 3.7 Handling (mounting the UNIGATE® IC2 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® IC2's installation on the carrier board:

- Mounting on a socket in the carrier board. If necessary solder the UNIGATE® IC2 to 2 or 4 pins in the socket. Normally the IC2 can easily be pulled out after the soldering points have been re-moved.
- Make arrangements for two holes next to the socket in the layout. After the UNIGATE® IC2 was plugged in the socket pull an isolated wire over the IC2 and solder it on the carrier board at the specified holes.
- Fasten the UNIGATE® IC2 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® IC2 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

There is an extremely large number of suppliers for RJ45 connectors (with and without integrated Ethernet transformer), or single Ethernet transformers on the market, therefore 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  $\mu$ 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 jack without transformer**

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

#### **RJ45 jack (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

For more 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® IC2 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® IC2's serial interface constitutes the basis for it. The UNIGATE® IC2 allows to connect of controllers with a baud rate of 110 Baud – 7,5 MBaud. The baud rate 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® IC2, 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 as a Script after an adaptation can be processed by the IC2.

In any case the IC2 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 on page 27.



## 5 Synchronous serial interface

The synchronous serial interface of the UNIGATE® IC2 is used to connect clocked shift registers or components that have a Serial Peripheral Interface (SPI).

It allows

- the expansion of the IC2 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 given 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`“.

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.

### 5.2 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 33 Mbit/s as master , 10 Mbit/s as slave, depending on the hardware. For details please see the IC2-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.

## 6 The Debug-interface

### 6.1 Overview of the Debug-interface

The UNIGATE® IC2 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® IC2 (power up) the firmware will output the binary character 0 (0x00) after a self-test was carried out on this interface. If the IC2 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<sup>®</sup> IC2, as well as the configuration, can be replaced or updated via the serial interface (application) in the configuration mode.

### 7.2 The configuration mode

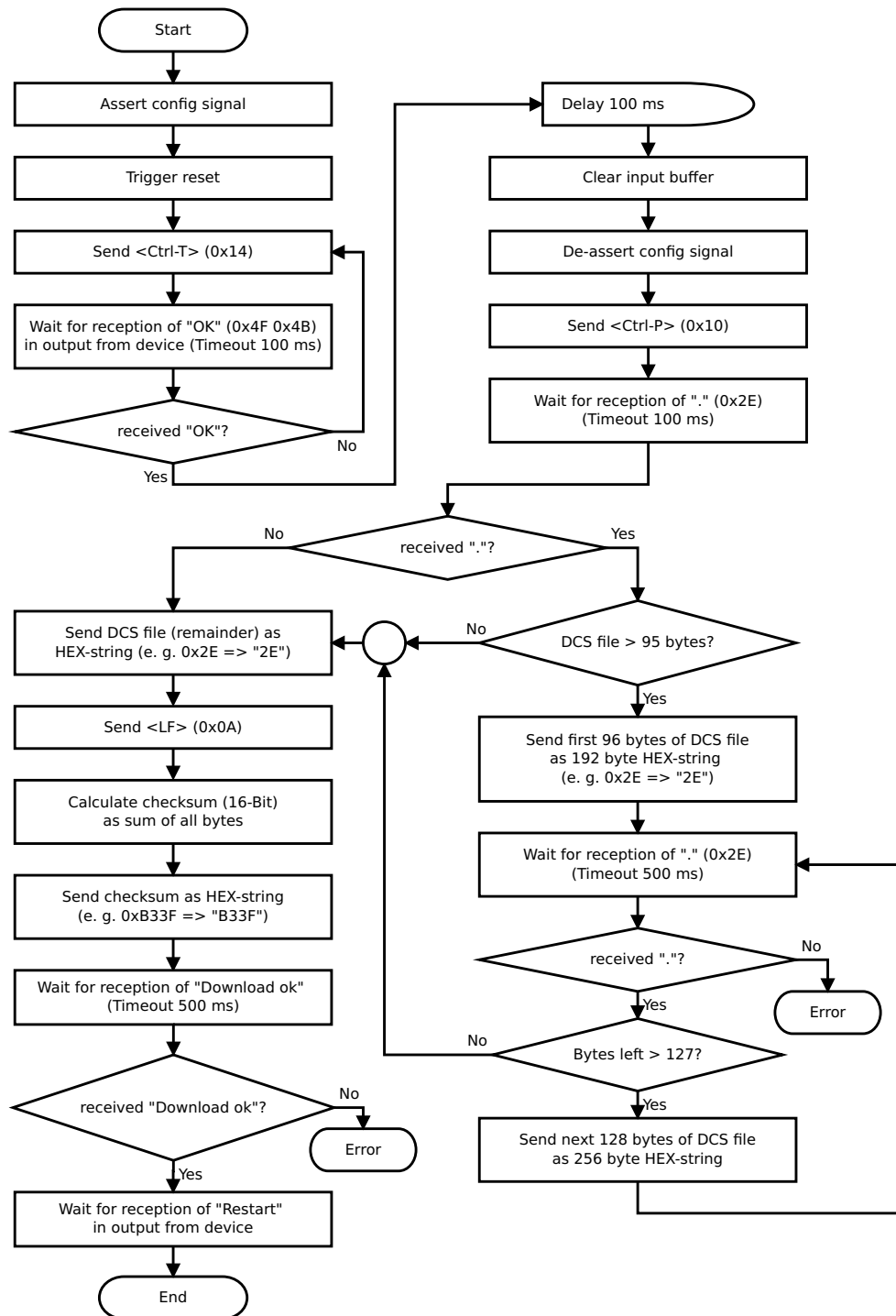
If the pin „ConfigMode“ pulled to GND during the PowerUp or Reset, then the UNIGATE<sup>®</sup> IC2 starts in the configuration mode. In this mode it is possible to communicate with the IC2 without processing the regular software. In this mode it is possible to change the UNIGATE<sup>®</sup> IC2's settings of the standard software or to write a new script in the UNIGATE<sup>®</sup> IC2. It shows its start in the configuration mode by issuing a status message, which might look as follows:

```
IC2-EC V1.0.0[44] (c)dA[220MHz] Script(C:131/16192,V:0/16384)=""Leer"  
Author=""Deutschmann Automation GmbH" Version=""1" Date=21.08.2001 SN=47110100
```

### 7.3 Update the script

- The preferred option is to insert the UNIGATE<sup>®</sup> IC2 into the base board from Deutschmann (Developer Board UNIGATE<sup>®</sup> 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® IC2

UNIGATE® IC2 is delivered with an empty script.  
Another configuration, except for the settings that are carried out in the Script, is not necessary.

### 7.4.1 Ethernet

- Protocol CANopen over EtherCAT®
- Baud rate: 100 MBit/s

### 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 software tool Protocol Developer can be downloaded from our website <http://www.deutschmann.de>.

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 at UNIGATE® IC2

The baud rate of the serial interface is derived from the processor's crystal frequency. The deviation of the real baud rate from the set baud rate is always less than 1.1%.

## 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 Script 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 10 µs 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 accurate 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 transferred 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 EtherCAT®

When one speaks of EtherCAT®, then automatically the 100 MBit/s-version, full-duplex is meant. The end device's protocol is being converted in the UNIGATE® via a Script.

### 9.1 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.

### 9.2 Project planning

Use any project planning tool for project planning.

A sample ESI device description-file can be found on the Internet ([www.deutschmann.com](http://www.deutschmann.com)) free of charge. Generating the ESI device description-file is also provided as service from Deutschmann Automation.

### 9.3 Possible data lengths

The table below shows the maximum transferable data:

Input data	max. 1024 bytes	Variable: maximum value in this case
Output data	max. 1024 bytes	Variable: maximum value in this case

### 9.4 Literature

We recommend to log on to the website [www.ethercat.org](http://www.ethercat.org) to help you quickly get to grips with the subject of EtherCAT®.

## 10 Error handling at UNIGATE® IC2

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® IC2

## 11 Firmware-update

### 11.1 Overview

In the firmware-update-mode the firmware can be replaced via the UNIGATE® IC2's serial interface.

### 11.2 Adjusting the firmware-update-mode

#### 11.2.1 Adjustment by hardware

UNIGATE® IC2 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.

### 11.3 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 13 "Accessory").

It is also possible to use the description and the tools of the manufacturer of the controller (TEMIC, 89C51RD2) as well.

### 11.4 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.

### 11.5 Operation mode of the IC2

#### Standard-operation mode

This mode is required for the regular use of the IC2. In this mode the IC2 will process all script-commands and normally exchange the corresponding user data. The bus as well is operated in this mode through the IC2.

#### Configuration mode

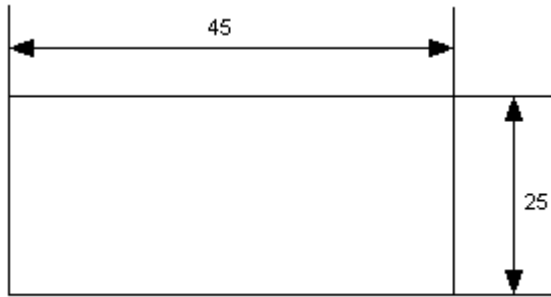
In the configuration mode the UNIGATE® IC2 will carry out a self-test after the start (or after a reset). After a successful self-test it will wait for further commands. Here it is possible to load a translated Script into the unit or to initialize the firmware-download-mode.

## 12 Technical data

In this chapter you will find all necessary technical data on UNIGATE® IC2. All measurements in mm.

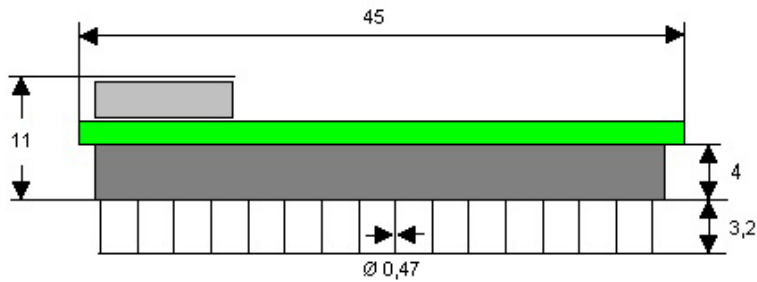
### 12.1 Mechanics of the UNIGATE® IC2

#### 12.1.1 General dimensions of UNIGATE® IC2

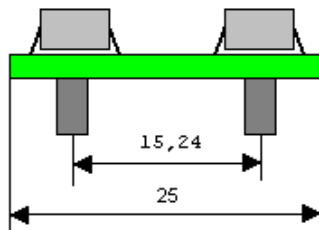


Max. height = 20 mm; including pin

#### 12.1.2 Dimensions UNIGATE® IC2 (EtherCAT® only)



The pins of UNIGATE® IC2 - EtherCAT® are arranged with a grid spacing of 2.54 mm.



DIP-Spacing Code 6

In case you intend to use other fieldbus IC2s, the maximum overall height of  $\leq 20$  mm (including pins) has to be taken into consideration.

## 12.2 Technical data UNIGATE® IC2 - EtherCAT®

Characteristics	Explanation
Supply voltage	3.3V ± 5 %, max. 230 mA DC
Reverse polarity protection power supply	No
Interface	2 UART interfaces, 1 synchronous serial interface
Physical separation EtherCAT®-side	Standard
Bus-baud rate	100 Mbit/s full duplex
UART-baud rate	Up to 7,5 Mbaud (adjustable via script)
Supported protocols	CANopen over EtherCAT® (CoE)
Technology	Ethernet-Controller ET1100
Others	I/Os, analogous signals, shift registers, LEDs, switches and so on can be connected externally
Dimensions	45 x 25 x 11 mm (WxDxH) version "without transformer": 45 x 25 x 8 (WxDxH)
Installation	32 DIL
Weight	Approx. 10 g
Ambient temperature*	-40°C ..+70°C
Storage / transport temperature	-40°C..+100°C
Built-in position	Any

\* When implementing a UNIGATE® IC in your electronics, not only the mechanical dimensions but also the thermal management must be taken into account. The ambient temperature specified in the manual does not take into account the specific installation situation (e.g. closed housing). External factors have a major influence on how well the heat is dissipated from the heat sources. When using the UNIGATE® IC in your electronics, adequate heat dissipation must therefore be ensured.

## 13 Accessory

The following tools are available from Deutschmann Automation.

### 13.1 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 IC2. The software describes the procedure of an update itself.

### 13.2 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.

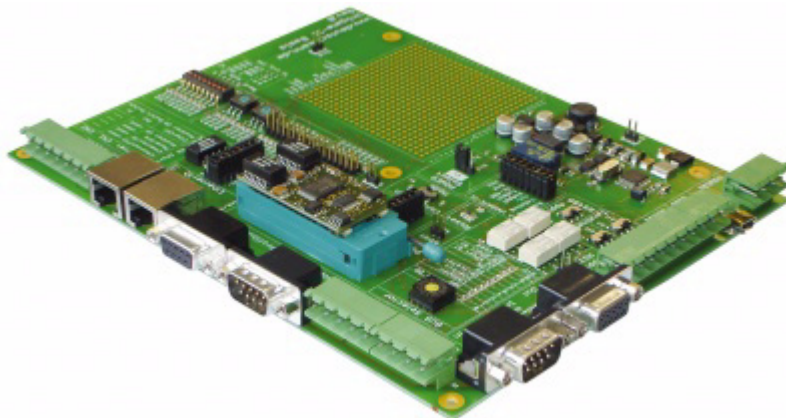
### 13.3 Developer Kit UNIGATE® IC-AB IC

The Developer Kit IC contains

- a Developer Board UNIGATE® IC (see chapter 13.3.1)
- a plug-in power pack to supply the Developer Board
- connection cables for appl. RS232, Debug RS232 and appl. RS422/485
- USB-cable
- Software and documentation to complete the packet.

#### 13.3.1 Developer Board UNIGATE® IC-AB

The Developer Board was developed so that the fast implementation of the Deutschmann All-in-one bus node UNIGATE® IC2 into your electronic system can be guaranteed. The board is suitable for all Fieldbuses and Industrial Ethernet Buses supported by Deutschmann Automation.

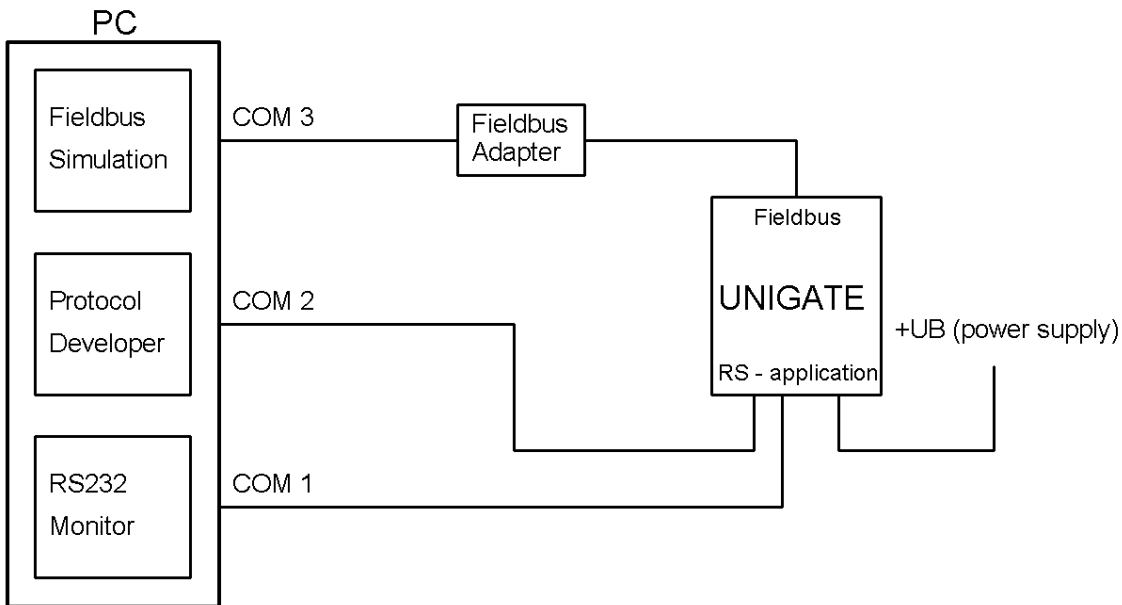


The required UNIGATE® IC2 / IC2s are ordered separately. The required voltage (5V or 3.3V, depending on the version) can be adjusted. An RS232-interface or a USB-connection is available for the connection to the PC (Debug-interface).

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).

### 13.3.2 Quick start



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

## 14 Annex

### 14.1 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 <sup>®</sup> IC for the respective product)
DN	=	DeviceNet
EC	=	EtherCAT
EI	=	Ethernet/IP
FE	=	Ethernet 10/100 MBit/s
FEX	=	Ethernet 10/100 MBit/s-version X (see comparison table UNIGATE <sup>®</sup> IC for the respective product)
IB	=	Interbus
IBL	=	Interbus
LN62	=	LONWorks62
LN512	=	LONWorks512
ModTCP	=	ModbusTCP
MPI	=	Siemens MPI <sup>®</sup>
PL	=	Powerlink
PN	=	PROFINET-IO
PBDP	=	PROFIBUS DP
PBDPL	=	PROFIBUS DP-version L (see comparison table UNIGATE <sup>®</sup> IC for the respective



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

## 15 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](http://www.deutschmann.com) or directly in our Wiki on [www.wiki.deutschmann.de](http://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](mailto:support@deutschmann.de)

### 15.1 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 ( $\pm 0.5$  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.

### 15.2 Downloading PC software

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



