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**Instruction Manual
Universal Fieldbus-Gateway
UNIGATE® IC2 - PROFIBUS**



Deuschmann Automation GmbH & Co. KG
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Disclaimer of liability

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

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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[®] IC2 by Deutschmann Automation any more. All digital functions, software, stack and driver as well as optocoupler are integrated on a UNIGATE[®] IC2 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[®] 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[®] 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[®] IC2 is a further development of the 1st series of the UNIGATE[®] IC. Equipped with a Cortex-M4 controller, the UNIGATE[®] 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[®] IC2 is also PIN-compatible with the 1st series of the UNIGATE[®] 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 PROFIBUS DP. 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® 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® IC, 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 22.

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 on page 15 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 analog 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.

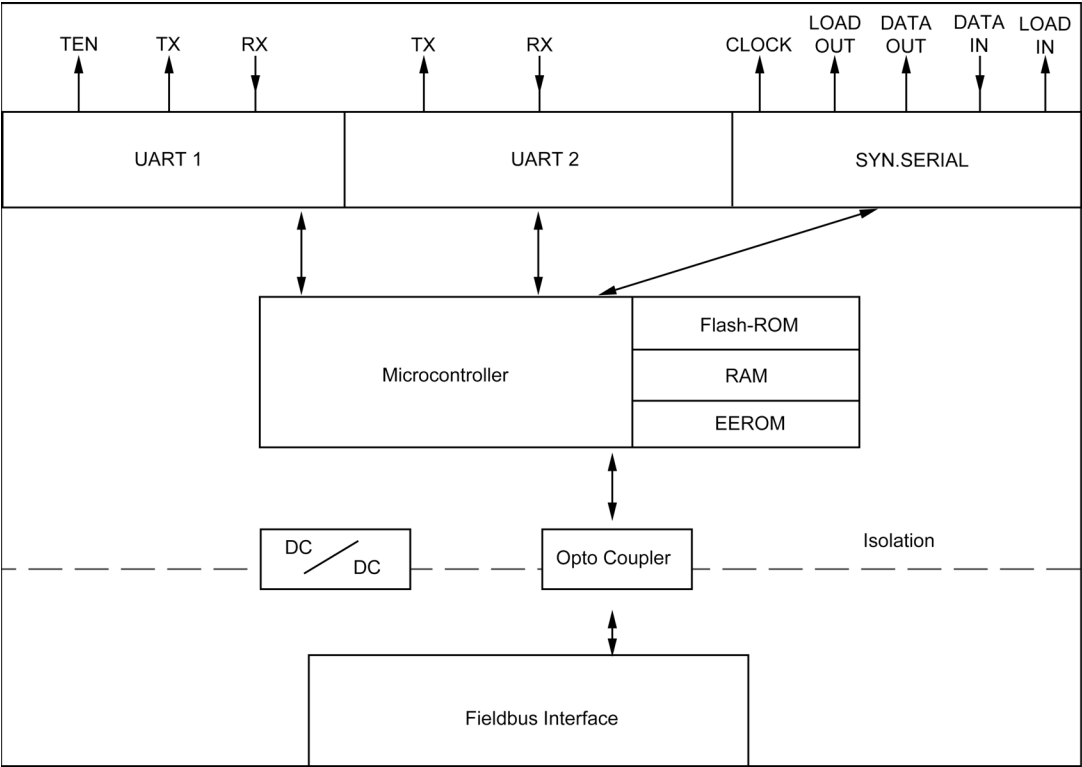
2.6 The Debug-interface

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. Pin 10 -12 and 21 - 23 as well are not wired due to the electrical isolation. The exact mechanical dimensions can taken from chapter 12 on page 37.



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% < Typ 240mA	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	internal pull-up
6	OUT _{Logic}	Load in (MOSI)	input data of the synchronous, serial interface; alternatively strobe signal of the output data	
7	OUT _{Driver}	Clock	clock pulse signal for synchronous, serial interface	
8	IN _{Reset}	-Reset in	reset-input of the IC2	internal pull-up
9	connected to pin 1	Vcc	+ 3 V voltage supply	
10-12	nc	nc	no pin available	
13	according to norm	PB-A TxPB ¹⁾	PROFIBUS-signal according to standard	galvanically isolated insulation voltage 1000 Vrms
14*	according to norm	PB-B RxPB ¹⁾	PROFIBUS-signal according to standard	galvanically isolated insulation voltage 1000 Vrms
15*	according to norm	PB-RTS	PROFIBUS-signal according to standard	galvanically isolated insulation voltage 1000 Vrms
16-18	according to norm	nc	not connected	
19*	according to norm	PB-GND	PROFIBUS-signal according to standard	galvanically isolated insulation voltage 1000 Vrms
20*	according to norm	PB-5V	PROFIBUS-signal according to standard	galvanically isolated insulation voltage 1000 Vrms
21-23	nc	nc	no pin	
24	connected to pin 32	GND	ground supply voltage of the IC2	
25	OUT _{Tristate}	LED-PB	bus error LED of the PROFIBUS	8 mA, internal series resistor 3.3V = 470 R
26	IN _{Logic}	-Config Mode	signal to start the configuration mode	internal pull-up
27	OUT _{Logic}	DbgTX	serial Debug TX	
28	IN _{Logic}	DbgRX	serial Debug RX	internal pull-up
29	IN _{Logic}	RX	serial data RX	internal pull-up
30	OUT _{Logic}	TX	serial data TX	
31	OUT _{Logic}	TE	transmit enable	
32	GND	GND	ground supply voltage of the IC2	

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

¹⁾ Version without 485 (ROFIBUS) - driver (see chapter 3.7 and chapter 3.10.2).

^{*}) The version "LWL" (without galvanic isolation on the PROFIBUS-side) has the TTL-signals directly available at the pins 13, 14 and 15. The pins 19 and 20 are not connected, since for the LWL-version no galvanic separated PROFIBUS-voltage is required or it is generated by itself (see chapter 3.10.3).

	V_{IL}	V_{IH}
IN_{Reset}	$< 0,7V$	$> 2,4V$
IN_{Logic}	$< 1V / 5\mu A$	$> 2,3V / 5\mu A$
	V_{OL}	V_{OH}
Out	$< 0,45V / 4mA$	$> 2,8V / 4mA$

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 36.

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 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 LED-PB

A red LED can be connected to this line. It is controlled by the PROFIBUS ASIC and goes out in the state „Data Exchange“. (see chapter 3.6)

Pin	State	Description
25	glowing red	No connection to the PROFIBUS master
	OFF	Connected to the PROFIBUS master

3.2.9 -Config Mode

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

3.2.10 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.

3.2.11 TE

The Transmit Enable Signal allows the connection of RS485 drivers to the IC2's serial interface. The signal is set to High whenever the IC2 sends via the line TX.

3.2.12 TX, RX

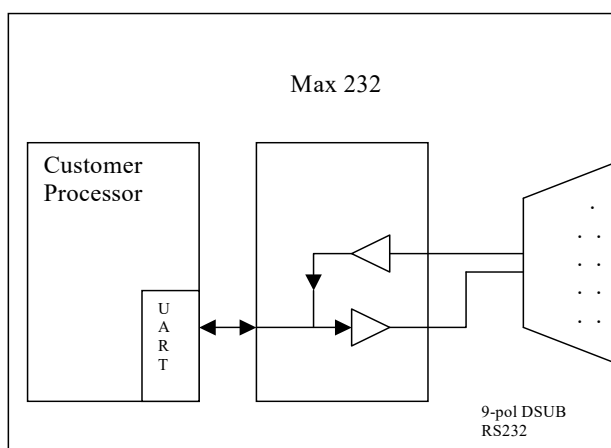
Transmission and receive line of the serial interface. This interface is programmable in accordance with the description in chapter 4.

3.3 Software

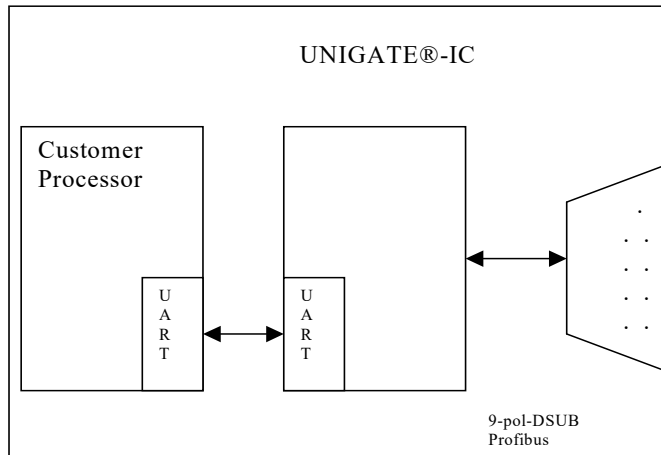
The software executes script-commands, which in turn control the IC2's hardware and they process their complete protocol by software. The script itself can be generated by the company Deutschmann Automation or with the software Protocol Developer by yourself. For a detailed description of the script.commands 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 PROFIBUS is available at the 9-pol. socket. However, a hardware redesign is necessary in order to keep the assignment in standard form.



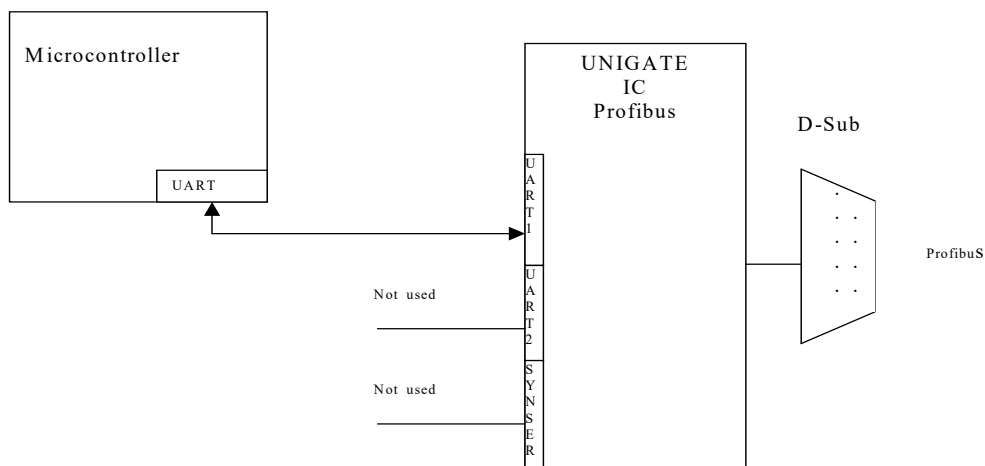
After the RS232-driver has been replaced by the UNIGATE® IC2, the PROFIBUS is available at the 9-pol. D-sub-socket.

Deutschmann Automation is also offering an appropriate adapter board. With it existing devices can be adapted without re-design; see chapter 13.

3.5 Connection examples

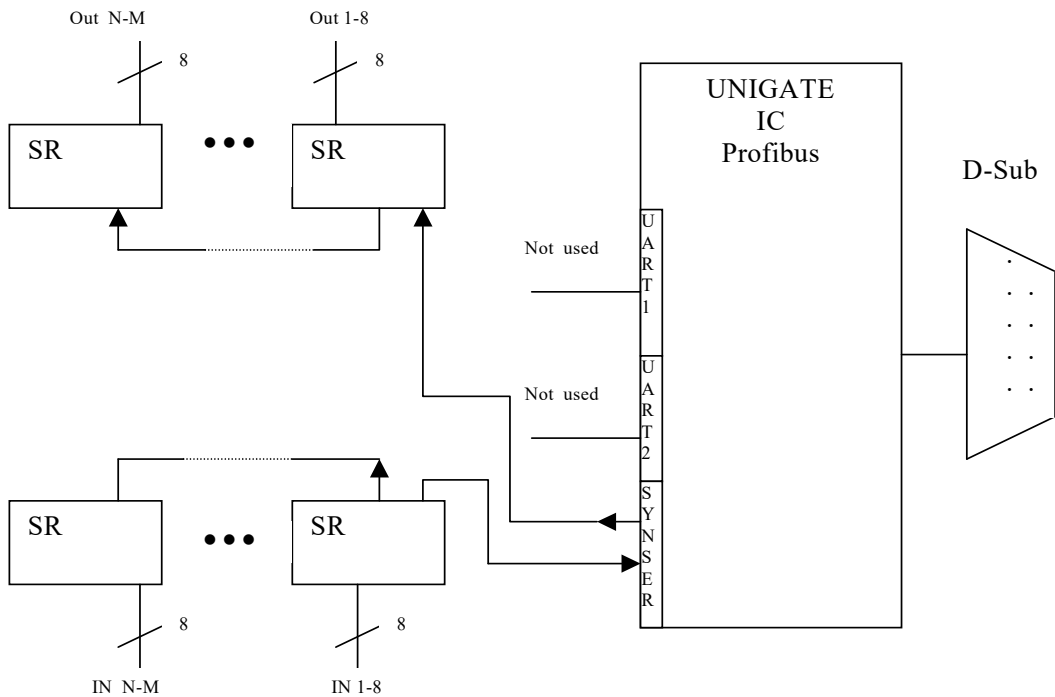
Here you will find some advice that offers help for a re-design. In the following several versions are listed, that should make it easier for you to decide.

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



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

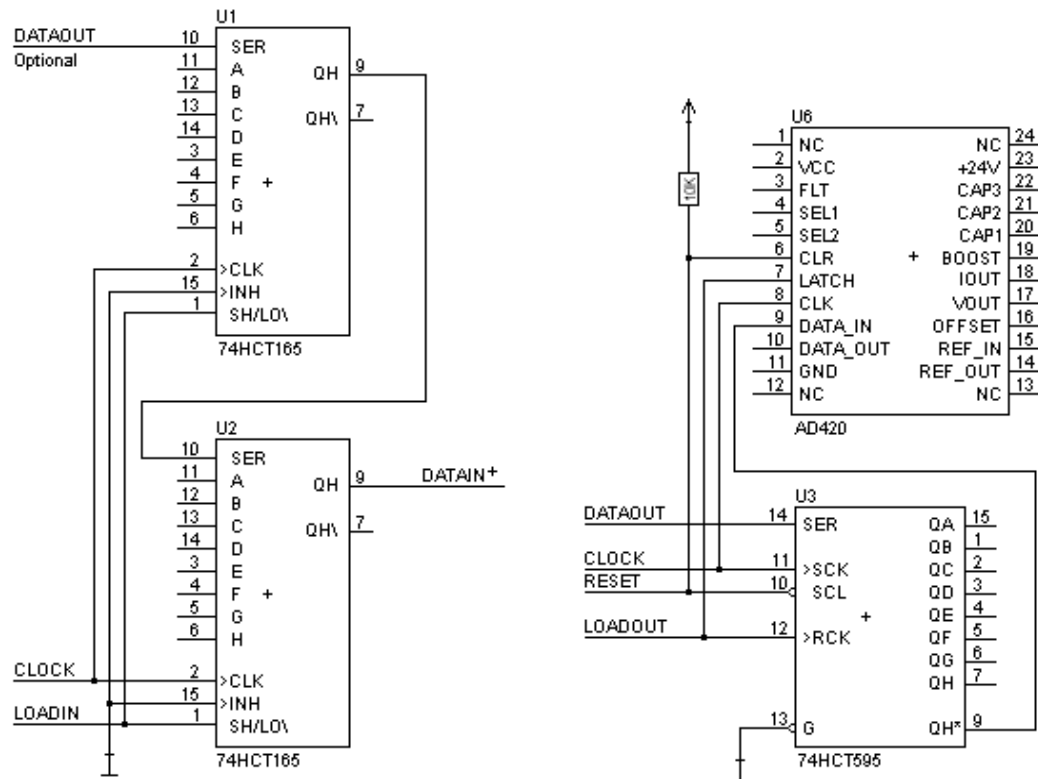
Version 2: Use of UNIGATE® IC2 for digital or analog I/O-modules



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!

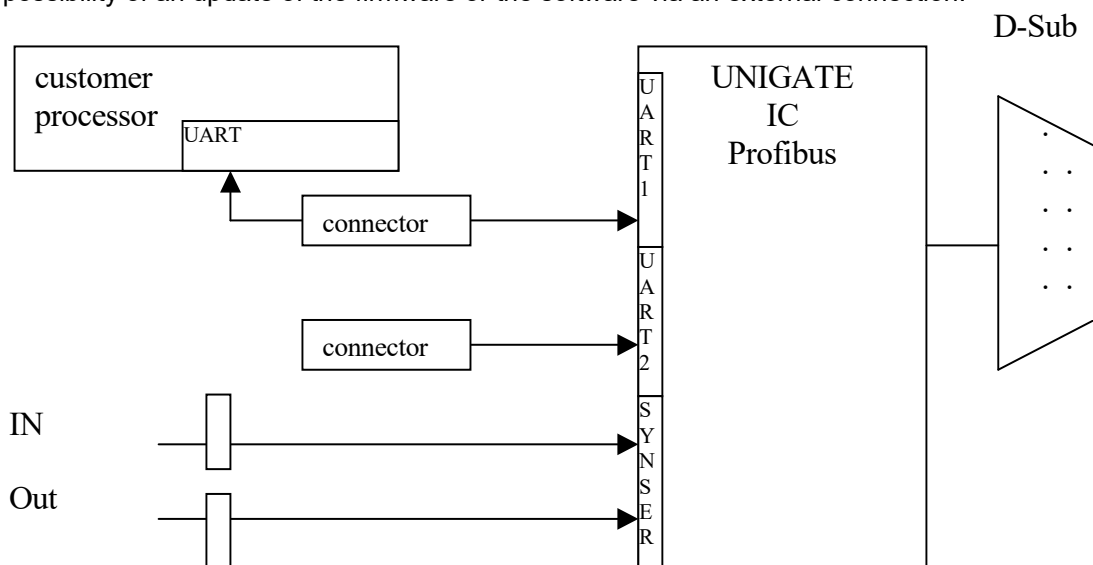
The following circuit diagram is an example for how shift register components can be connected to the IC2.



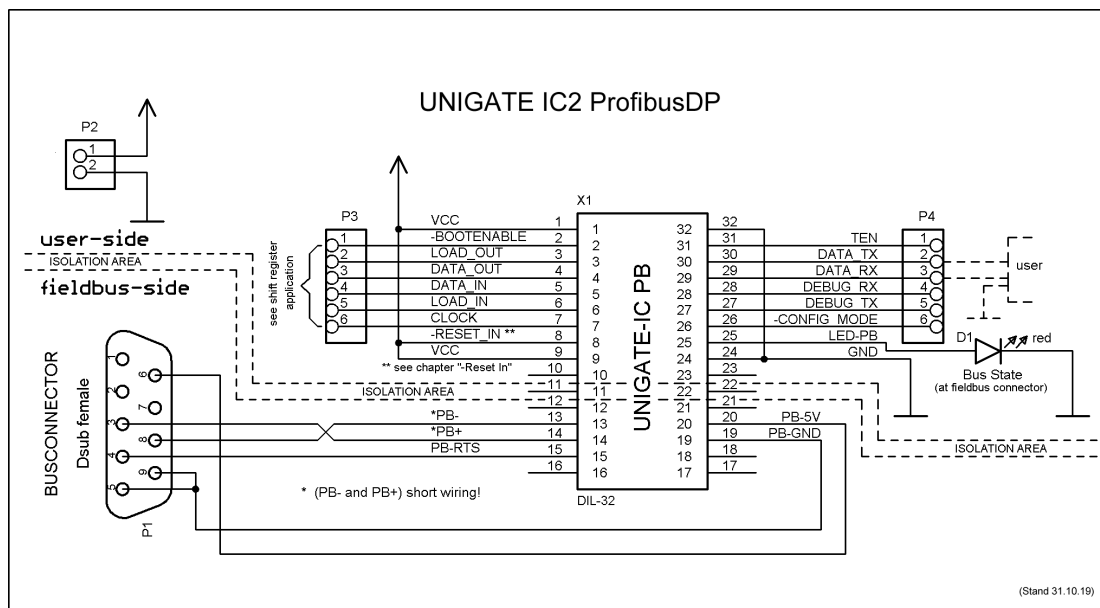
Version 3: Example for digital I/Os

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.

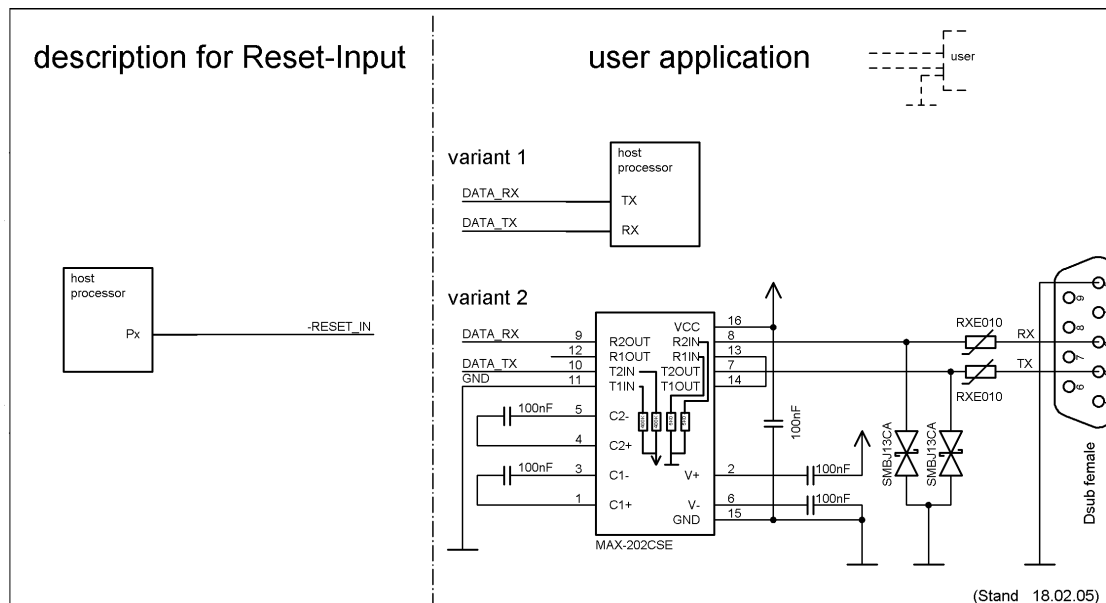


3.6 Layout examples

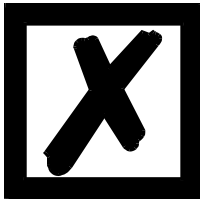
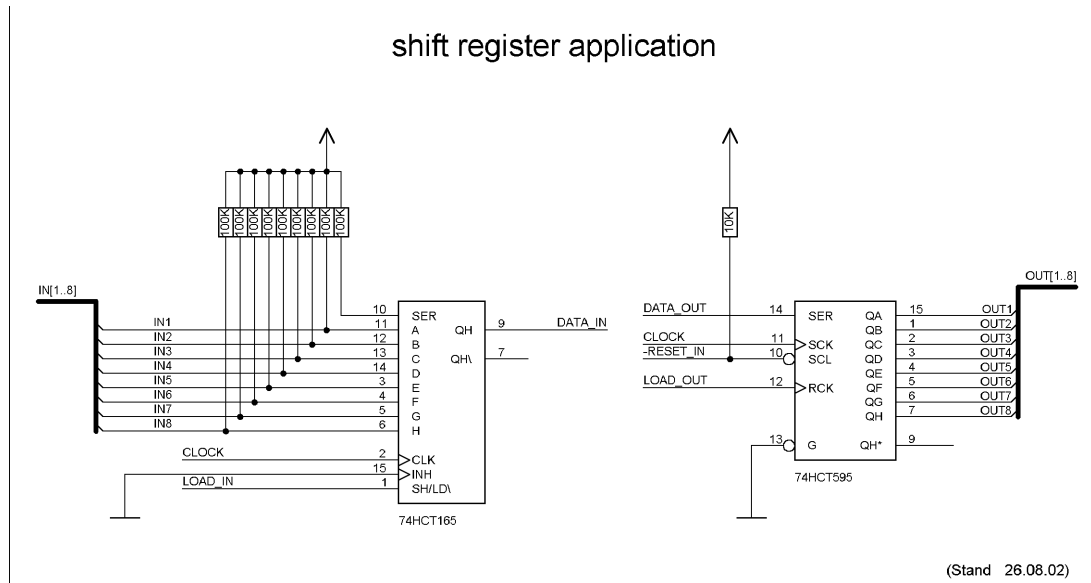


The connection of the two PROFIBUS-lines (PB+ and PB-) are to be implemented as short as possible, in order to avoid reflections and with it disturbances on the PROFIBUS line!

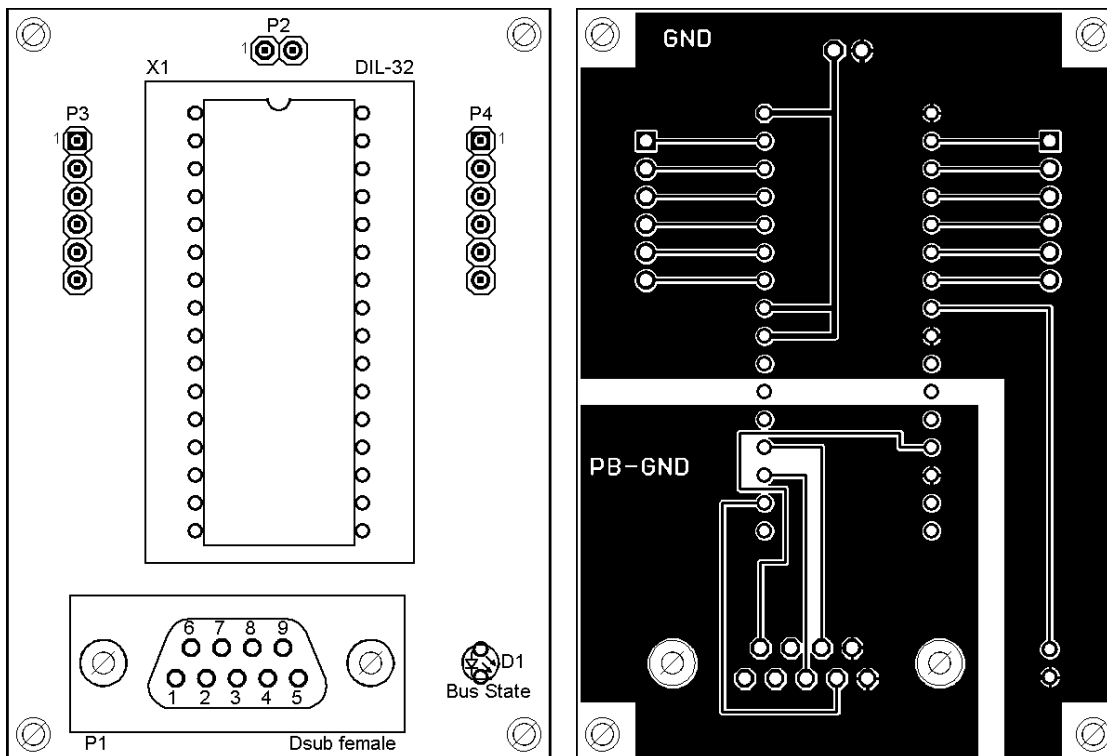
If these stub-lines (PB+ and PB-) are too long, communication problems may arise when operating at higher bus speeds (≥ 1.5 Mbaud). According to the PROFIBUS Test Specification, the max. allowed total length of all stub-lines on a bus segment is 80mm at 12 Mbaud. Over a full bus segment of 32 nodes this equals 25mm.



shift register application



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 Termination (PROFIBUS)

Generally it is recommended to use a PROFIBUS connector with integrated bus termination. If this is not possible a switchable terminating resistor (220 R) can be integrated on the carrier board. In this case furthermore a Pull-Down-resistor (390 R) to PB-GND and a Pull-Up-resistor (390 R) to PB-5V has to be intergrated.

3.8 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 removed.
- 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.

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 controllers with a baudrate of 110 Baud to 6 MBaud. The baudrate for the communication itself is permanently stored in the module. The maximum size for the IO-data kann be taken from the table in chapter 13, line „RS-buffer size“. Furthermore 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 or a Script after an adaptation can be processed by the IC2.

Anyway, 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 modes configuration mode and firmware-update mode the serial interface also serves to configure the standard software or to carry out a firmware-update. More details can be found in chapter 11.5.

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 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 between 280 kHz and 320 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 33 Mbit/s as Master and 10 Mbit/s as Slave. 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.

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® 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 instruction manual Protocol Developer.

7 Script and configuration

7.1 Overview

The script stored in the UNIGATE® 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® 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® IC2'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, which might look as follows:

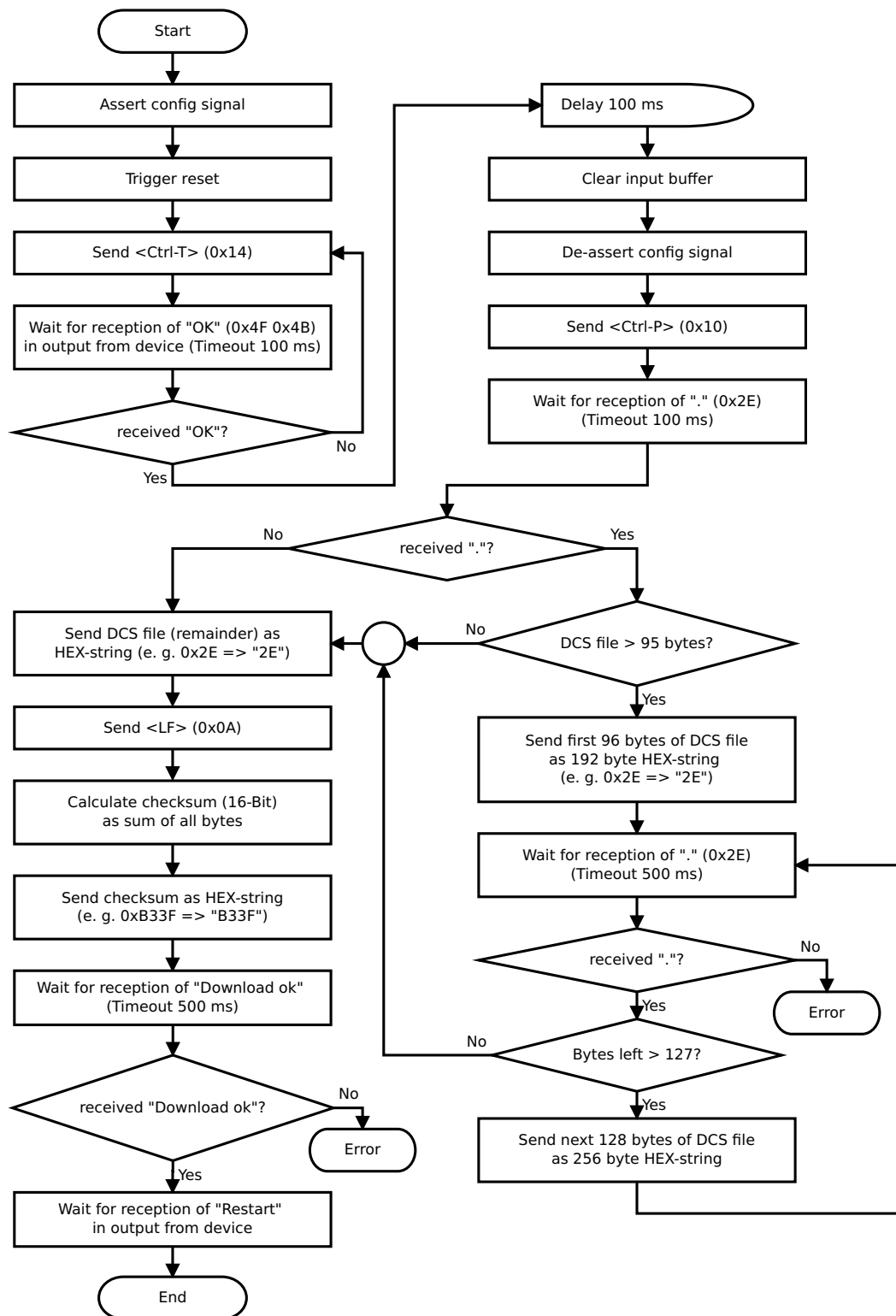
```
IC2-PBDP PV1.0.3[44] (c)dA[220MHz] Script(C:51/16192,V:0/16384)="Leer"  
Author="Deutschmann Automation GmbH" Version="1.0" Date=21.08.2001 SN=47110010 ID=1
```

The configuration of a UNIGATE® IC2 is restricted to setting the PROFIBUS-address (see also chapter 9.2 'Setting the PROFIBUS-address').

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® IC2

UNIGATE® IC2 is delivered with an empty script.

The configuration of the UNIGATE® IC2 - PROFIBUS DP is restricted to the setting of the field-bus address, that can be changed with the software WINGATE®.

7.4.1 PROFIBUS

- Configuration data: In accordance with GSD file
- Diagnostic data : Max. 8 bytes (see chapter Error handling)
- Baud rate: Automatic detection up to 12 MBit/s
- Sync: Supported
- Freeze: Supported

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.

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 0.5 ms can be calculated for each Script line. This value confirmed itself again and again in many projects as a standard value. He is always quite right if the processor has enough time available for the Script processing.

By means of the tasks mentioned above, the following recommendation can be formulated in order to receive a rather fast Script processing:

- Deactivate the Debug-interface (it is the normal case in the serial use)
- Keep the data length at the RS-interface as small as possible. The baud rate is not the problem here, but the amount of characters which are 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 be as short as possible.

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 PROFIBUS DP

At present UNIGATE® IC2 PROFIBUS DP supports PROFIBUS DP as version DPV0 - DPV2. Any imaginable combination of input- and output-quantities is possible. In case a desired combination is not included in the GSD file it can be described by stating configuration octets (see chapter 15).

The UNIGATE® IC2 automatically supports the PROFIBUS functions Sync and Freeze. From V. 7.0 (IC-PB-DPL) on user parameters are supported.

9.1 Description of the DPV1- / DPV2-functions

9.1.1 DPV1

The DPV1-enlargement consists of the following functions:

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

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

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

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

3. Alarm handling

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

Every DPV1-Slave must support the extended parameterization since it is determined in Octet 8 of the parameterization telegram whether it is a DPV0- or a DPV1-Slave.

A DPV1-Slave can also be operated at a DPV0-Master if the DPV1-functions remain turned off.

9.1.2 DPV2

The DPV2-enlargement consists of the following functions:

1. Isochron Mode (IsoM)

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

2. Data Exchange Broadcast (DxB)

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

3. Up- And Download

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

4. Time-synchronization (Time stamp)

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

5. Redundancy concept

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

9.2 Setting the PROFIBUS-address

There are different possibilities to set the IC2's PROFIBUS-address.

1. Setting the address through the configuration
The UNIGATE® IC2 has to be in the configuration mode (see also chapter 7.2 'The configuration mode'). With WINGATE it is now possible to set the address. This address is preserved until it will be changed again.
2. Setting the address through the Script
The address can be stored in the Script as well. This proceeding, however, is likely to be of interest for a few applications only, since it is necessary to change the Script in order to also adjust the PROFIBUS-address (see also the following Script example).
3. Setting the address through the serial interface
The address can also be transmitted to the IC2 through the serial interface. Then the address can be set with the Script command "SetByVar". This possibility should be used in case your device has a control front available and the menu of the front can be extended by the setting "PROFIBUS-address". The adjustment of the PROFIBUS-address through the serial interface is the most convenient possibility for those applications.
4. Setting the address through the bus itself
Address 126 is reserved for devices that do not feature the hardware which is required to set the bus address (such devices with protection class IP 65). Address 126 has to be configured through WINGATE (see point 1.).
5. Connecting the rotary switches to the shift registers
Rotary switches can be connected to a shift register as well as to our basis board. Now it is possible for the Script to read those switches and to set them as fieldbus-address. Basically the following Script can be used for it.

Script example for the initialization of the PROFIBUS

```
var InSize: word;
var OutSize: word;

Set (FieldbusID, 4) ;
// this parameter can also be set by the command SetByVar.
// var PBAAddress: long;
// MoveConst( PBAAddress, 4) ;
// or from the shift registers
// SetByVar();

BusStart;
// the Profibus ASIC is ready now.
// from now on the Master CAN configure the participant.
// However, that does not mean that the configuration of the
// participant has already been carried out by the Master.

wait (Bus_Active);
// the Profibus is now in the state of Data Exchange
// This command might take a very long time and is
// not interruptible!
// Now it is also known to the Script with which configuration
// the Slave was put into operation by the Master.

Get ( BusInputSize, InSize);
Get ( BusOutputSize, OutSize);
// InSize and OutSize are from the IC's point of view!

// It is possible to read out data from the bus
// all available bytes should be read.
var InBuffer: Buffer[100];
Readbus ( InBuffer[0], InSize) ;

// It is now possible to write data.
// You must not write more bytes than available.
var OutBuffer: Buffer[100];
WriteBus ( OutBuffer[0], OutSize );
```

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 or wrong Fieldbus ID
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 BE (boot enable) has to be pulled to the potential GND during the Power-up-process.

11.2.2 Adjustment by software

If the UNIGATE® IC2 is in the configuration mode (see chapter 7.2) it can be brought to the firmware-update-mode interactively through the command CTRL-F (0x06). After sending the command a security query follows, that has to be answered with J or N (J = Yes, N = No). After a positive confirmation the IC2 is re-started in the firmware-update-mode.

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 on page 40).

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

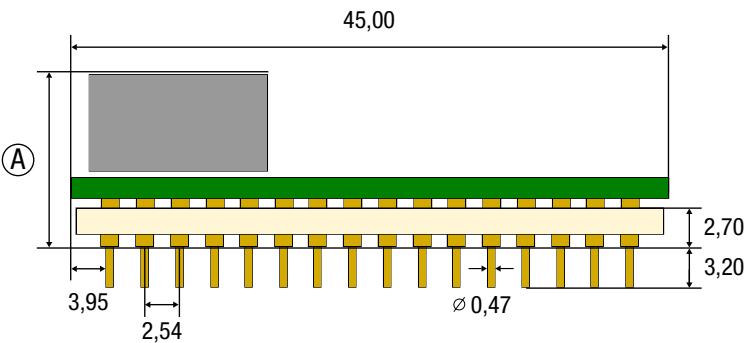
In the configuration mode the UNIGATE® IC2 will carry out a self-test after the start (or after a reset). After a successful self-test it will wait for further commands. Here it is possible to load a translated script into the unit or to initialize the firmware-download-mode.

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



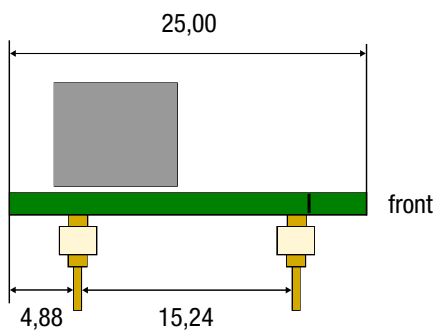
UNIGATE® IC2

	EtherCAT (wt*)	Ethernet TCP/IP + Modbus TCP	Ethernet TCP/IP (wt*) + Modbus TCP (wt*)	PROFIBUS DP	PRROFINET 2Port (wt*)
A= total height (mm)	8	11	8	13	8

*wt = without magnetics

Note: The total height of all UNIGATE® ICs can be found in the "Pinout list for UNIGATE® IC and UNIGATE® IC2". (Download PDF)

The pins of the UNIGATE[®] ICs are arranged in a grid dimension of 2.54 mm



DIP-Spacing Code 6

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

12.2 Technical data UNIGATE® IC2-PROFIBUS

Characteristics	Explanation
Supply voltage	3,3 V \pm 5 %, 240 mA (typ.), 280 mA (max.)
Reverse polarity protection power supply	No
Interface	2 UART interfaces, 1 synchronous serial interface
Physical separation -fieldbus-side	Standard
Fieldbus-ID	Adjustable via script
Fieldbus-baud rate	Up to 12 MBit/s (autodetect)
UART-baud rate	Up to 6 Mbaud (adjustable via script)
Fieldbus data format	Up to 244 byte I/O
Technology	ASIC
Others	Sync, Freeze, e. g. digital I/Os, analogous signals, shift registers, LEDs, switches and so on can be connected externally
Dimensions	45 x 25 x 13 mm (W x D x H)
Installation	32 DIL
Weight	Approx. 9 g
Ambient temperature*	-40°C ..+85°C (industrial temperature range)
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.

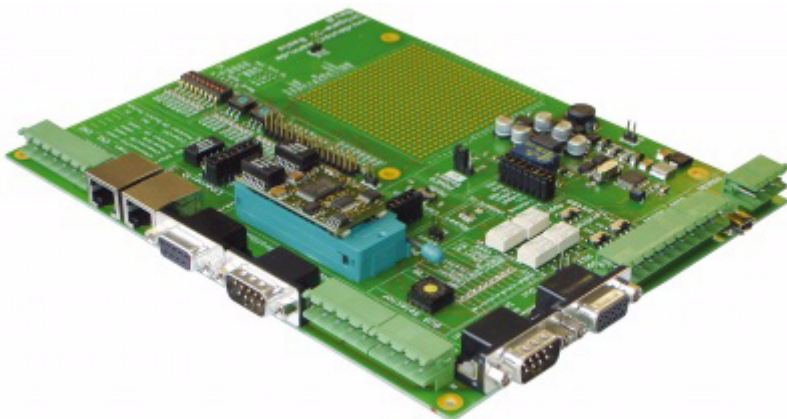
13.3 Developer Kit UNIGATE® IC-AB IC

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.



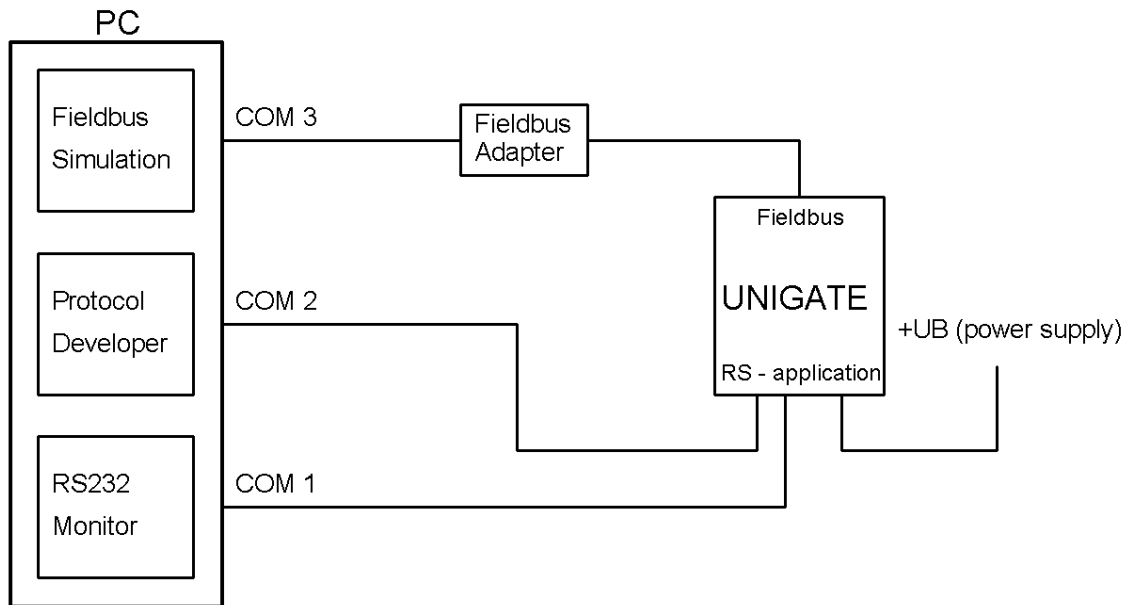
The required UNIGATE® IC2 is/are ordered separately. The required voltage (5V or 3.3V, depending on the version) can be adjusted. An RS232-interface or a USB-connection is available for the connection to the PC (Debug-interface).

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 can load the file
File -> New -> „Profibus_IC2_BasisBoard.dss“
that is stored in the Protocol Developer.

14 Appendix

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
IC2	=	Product group IC2 (IC-design DIL32)
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

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/s
FEX	=	Ethernet 10/100 MBit/s-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)
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 Representation of the data in PROFIBUS DP

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

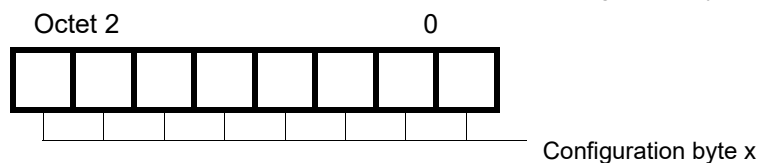
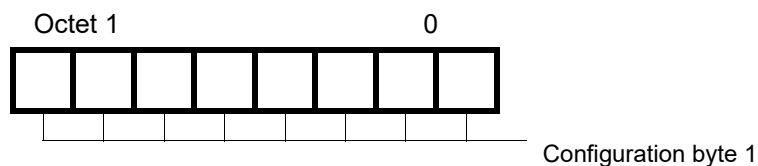
15.1 Configuration telegram

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

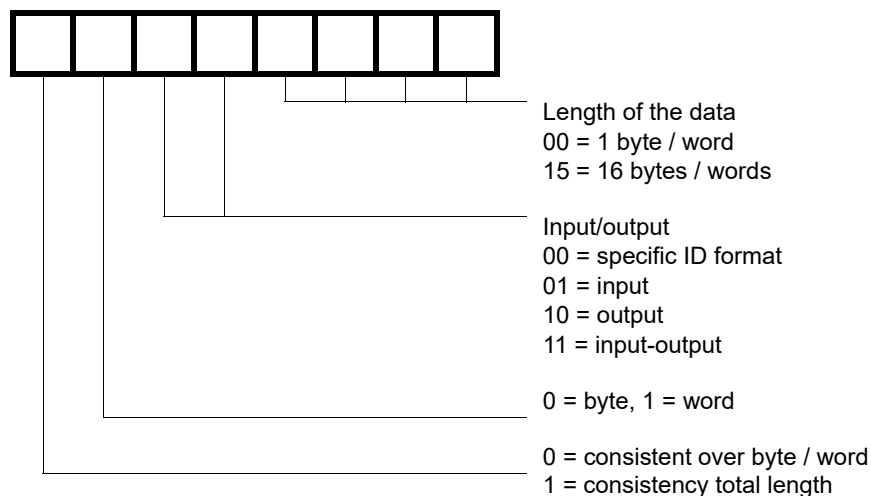
The user normally also configures the configuration telegram in the project planning tool where he may also, if necessary, enter the address range in which the useful data is stored.

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

15.2 Configuration telegram



Structure of an octet in the configuration telegram:



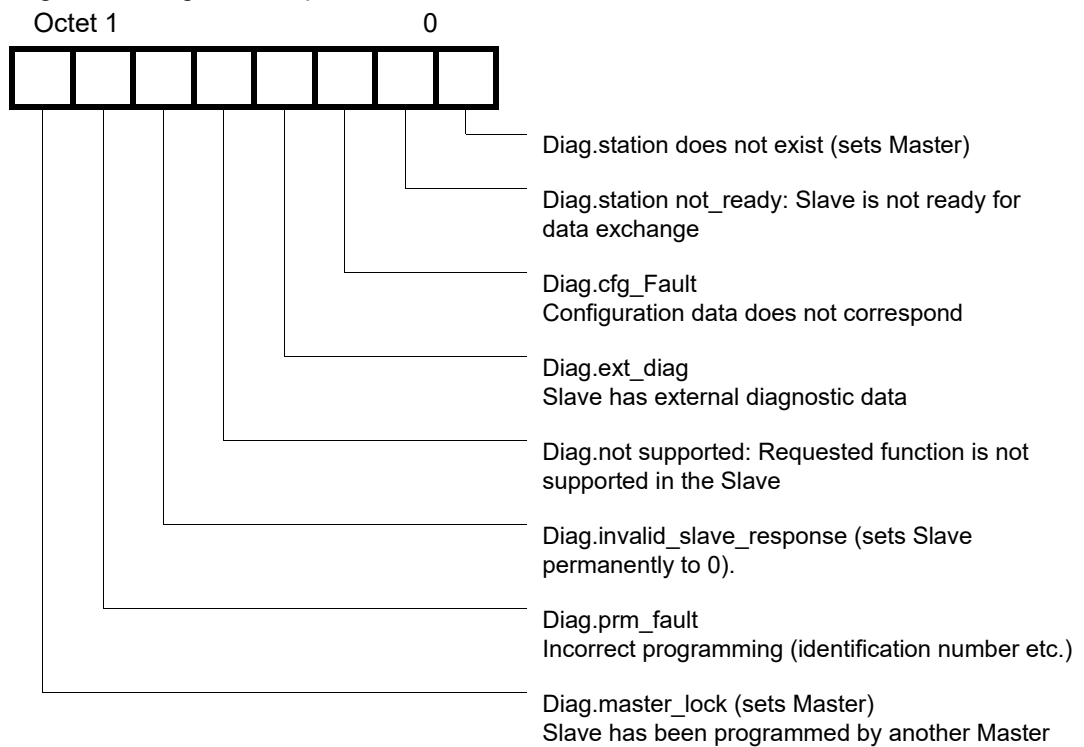
15.3 Diagnosis

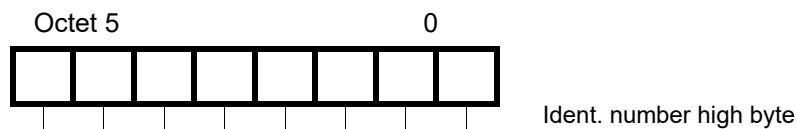
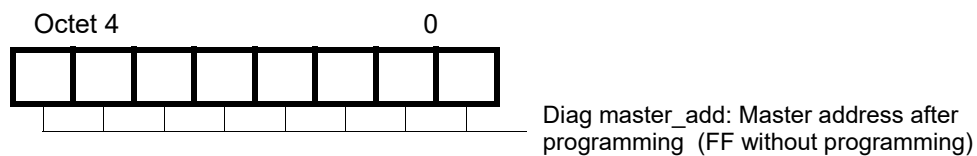
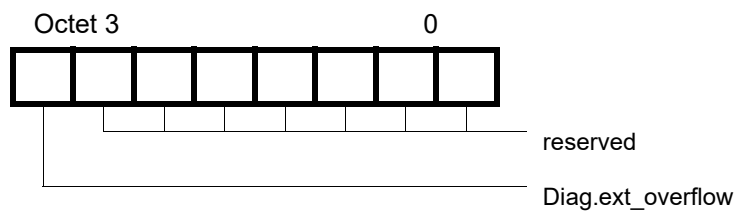
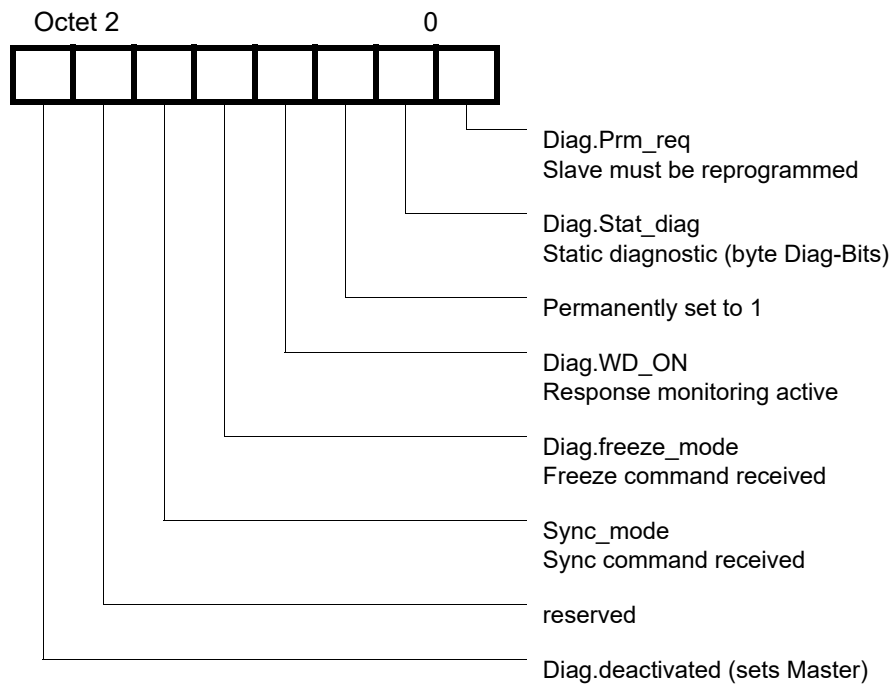
Diagnostic data is high-priority data. The gateway runs an external diagnostic if it detects an internal error.

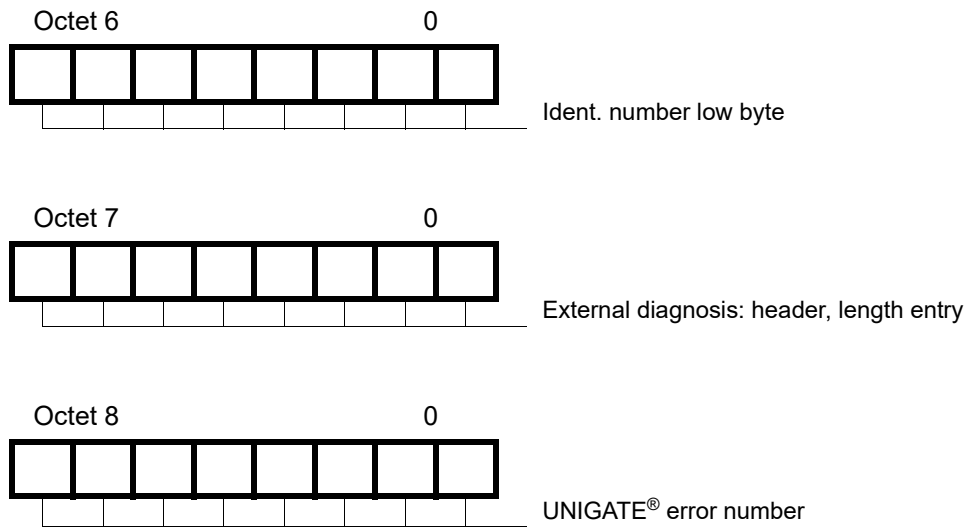
Representation of the information in the external diagnostic byte:

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

Telegram for diagnostic request:







15.3.1 Diagnosis in DPV1

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

This results in a different representation of our gateway error in PROFIBUS. At DPV0 the error number is transmitted in unmodified form as 1 byte external diagnosis. In case DPV1 has been activated in the gateway through the GSD-file, the error number occurs as 1 byte status message.

Supposing the DPV1 is activated and a master (which does not support the alarms and status messages) is connected, then our gateway error number is presented as "external diagnosis" with 4 bytes (see above), at which point the 4th byte contains the error number and the preceding 3 bytes (0x81, 0x00, 0x00) can be ignored.

15.4 Data exchange

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

16 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

16.1 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.

16.2 Downloading PC software

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

