# User manual
# Universal Fieldbus-Gateway
# UNIGATE®



**UNIGATE RS232/485 - ARCNET**
**UNIGATE RS232/422 - ARCNET**
**UNIGATE SC232/485 - ARCNET**
**UNIGATE SC232/422 - ARCNET**

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.

Art.-No.: V2715E

# 1    Information on CE marking of the module

## 1.1    EU Directive EMC

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

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

Deutschmann Automation GmbH, Carl-Zeiss-Straße 8, 65520 Bad Camberg, Germany

## 1.2    Scope of application

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

| Scope of application | Requirement applicable to | |
|---|---|---|
| | Emitted interference | Interference immunity |
| Industry | EN 55011 Kl. A | EN 61000-6-2 |

## 1.3    Note installation guidelines

The module complies with the requirements if you

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

## 1.4    Installation of the unit

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

## 1.5    Working on switch cabinets

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

# 2 Information for the machine manufacturer

## 2.1 Introduction

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

## 2.2 EU Machinery Directive

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

# 3 Introduction

The UNIGATE RS232/RS485 - or SC232/485 - ARCNET module serves to adapt a serial port to the ARCNET fieldbus to EN 50 170. In this application, it functions as a gateway and operates as ARCNET. It can be operated by any standard-compliant master.

At the UNIGATE RS232/485 various transmission protocols are supported at the serial port:

- Modbus-RTU
- The 3964R protocol popular in Siemens equipment
- Monitoring on the basis of character delay time
- Start / End character
- Constant data lengths (Transparent mode)
- Customized protocols

These protocol variants will probably support most applications.

The module RS or SC essentially consists of the following hardware components:

- Electrically isolated RS 485 interface to the ARCNET
- ARCNET ASIC COM 20020
- Microprocessor 80 C 32
- RAM and EPROM
- Optionally electrically isolated
- Serial port (RS232 and RS485) to the device connected externally

**Please note: This instruction manual is valid for UNIGATE RS (standard gateway with implemented protocols) and also for UNIGATE SC (gateway capable for scripts).**
**The information given in this instruction manual is about the UNIGATE RS and the UNIGATE SC as well, unless differences are explicitly pointed out.**

## 3.1 Master

The examples of application for master and slave, described on the following pages, are only intended for logical understanding.
In case the term slave is used, this participant is addressed. Any other participant in the net is a master.

## 3.2 UNIGATE RS software flow-chart

The following graph shows a typical application flow of a UNIGATE fieldbus-module.
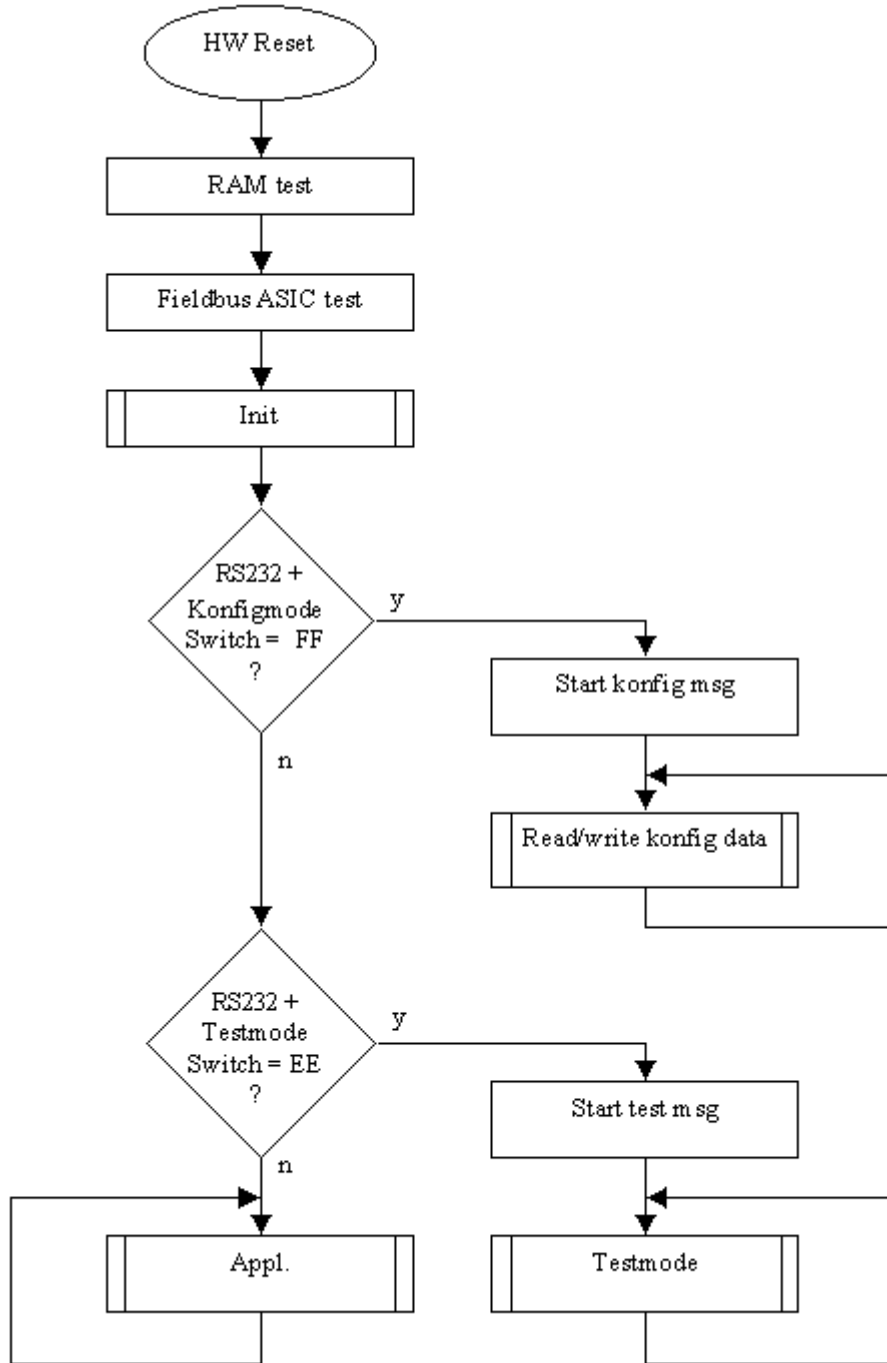
## 3.3    UNIGATE SC software flow-chart

```
                    ┌─────────────┐
                   (   HW Reset   )
                    └──────┬──────┘
                           │
                    ┌──────▼──────┐
                    │   RAM test  │
                    └──────┬──────┘
                           │
                 ┌─────────▼─────────┐
                 │ Fieldbus ASIC test│
                 └─────────┬─────────┘
                           │
                    ┌──────▼──────┐
                    │    Init     │
                    └──────┬──────┘
                           │
                       ◇───▼───◇         y
                      ◇ Konfigmode ◇──────────────┐
                      ◇ Switch = FF ◇             │
                       ◇───┬───◇          ┌───────▼────────┐
                           │ n            │ Start konfig msg│
                           │              └───────┬────────┘
                           │                      │
                           │              ┌───────▼─────────────┐
                           │              │ Read/write konfig data│
                           │              └─────────────────────┘
                       ◇───▼───◇
                      ◇  Test   ◇         y
                      ◇ Debugmode ◇──────────────┐
                       ◇───┬───◇          ┌───────▼────────┐
                           │ n            │   Debugmode    │
                    ┌──────▼──────┐       └────────────────┘
                    │    Appl.    │
                    └─────────────┘
```
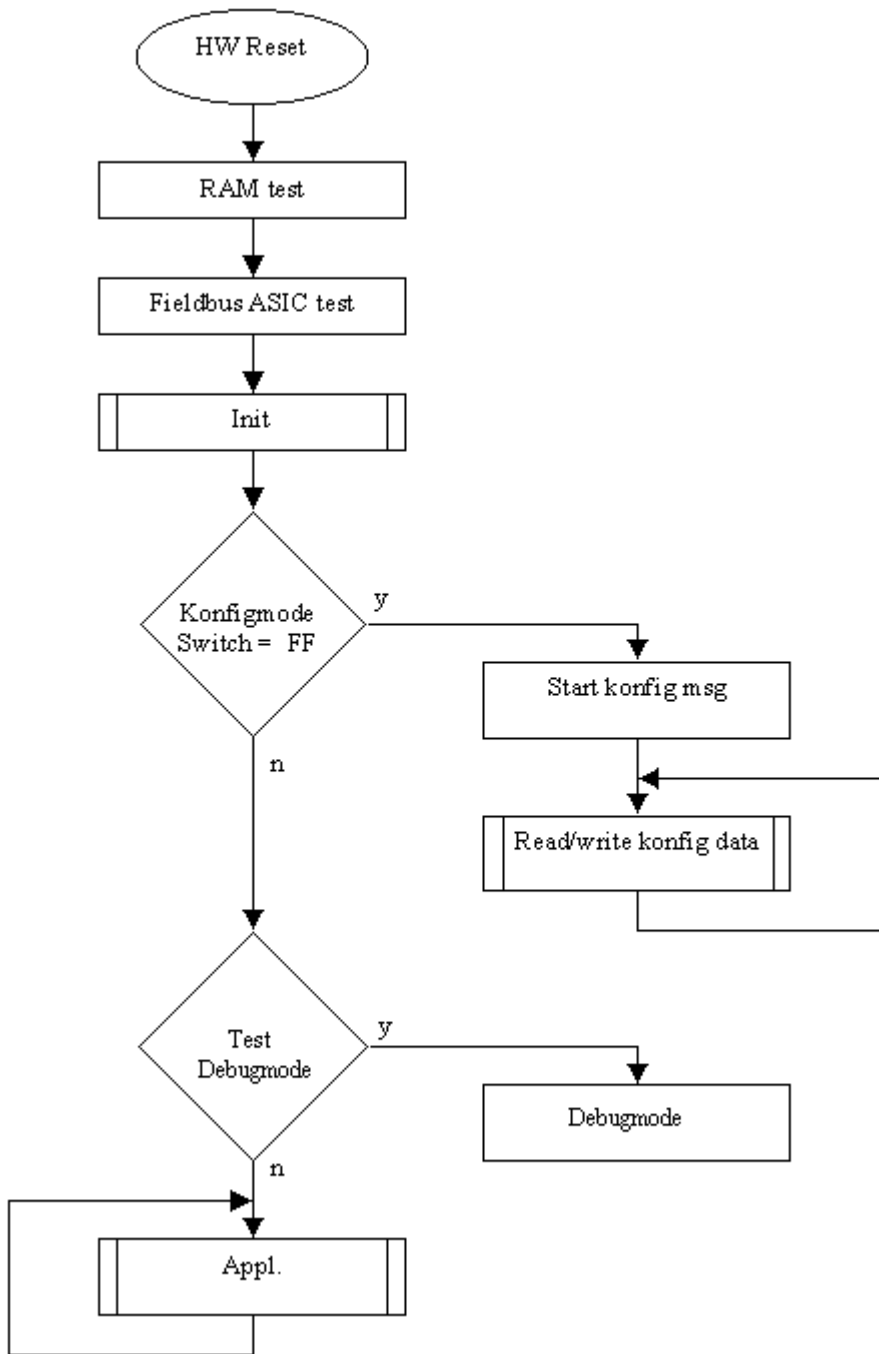
## 3.4    UNIGATE block diagram

The following picture shows a typical UNIGATE-module design.
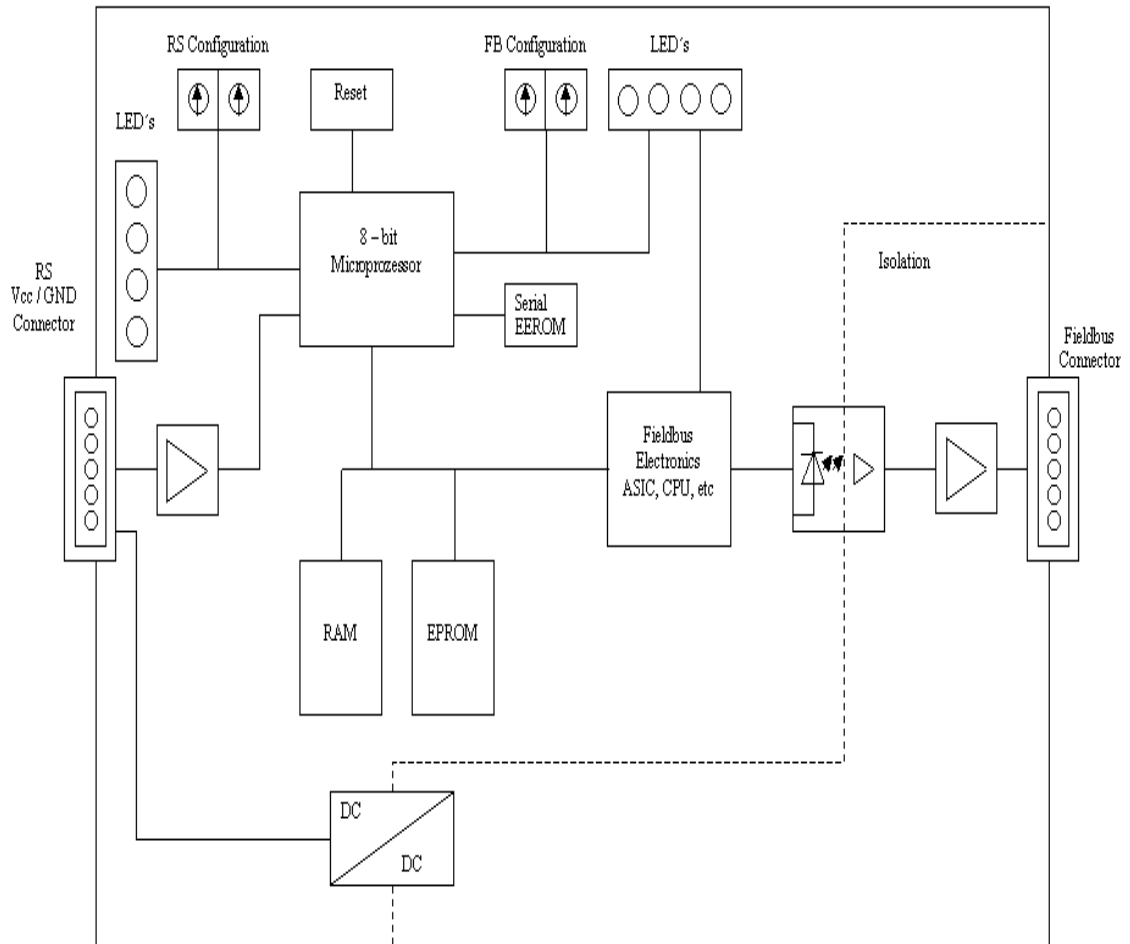


## 3.5    UNIGATE application diagram

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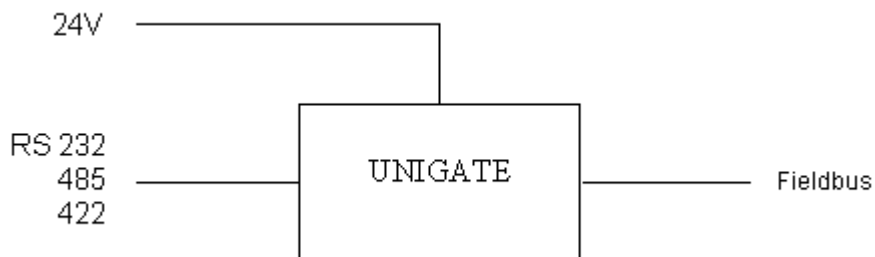
# 4      Operation modes of the gateway

## 4.1      Configuration mode (config mode)

The configuration mode serves to configure the gateway. Adjustments at the gateway's configuration are only possible in this mode. The gateway will be starting in this mode in case both switches S4 as well as S5 are set on position "F" when switching on the gateway and also RS232 is to be selected as interface. Right after switching on the gateway in the configuration mode it will be sending its starting message, that looks analog with the following message:
"RS-AN c(dA) switch=0x0000 Prot=0x00 SN=20790120".

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

**Connection cable from the gateway to the PC**

The cable is supposed to look as follows
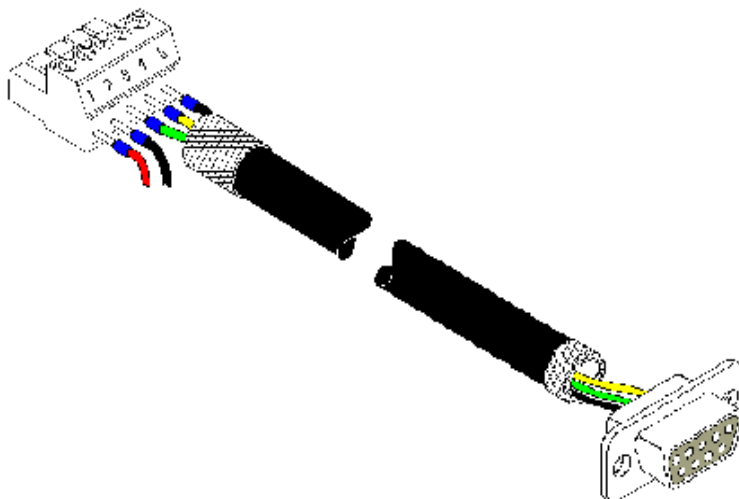


**Connection table 5pin screw-plug connector - PC**

| Screw-plug-connector | Name | D-Sub plug-connector | Name |
|---|---|---|---|
| Pin 3 | Rx | Pin 3 | Tx |
| Pin 4 | Tx | Pin 2 | Rx |
| Pin 5 | GND | Pin 5 | GND |

## 4.2    The Debug cable for UNIGATE SC

The Debug cable consists of the following components: a 9-pole D-sub-socket with two exits, where respectively two cables are connected, one with a 3-pole Phoenix socket with mating connector and one with a 9-pole D-SUB plug.

### Cable 1 (RS-product-side) 3-pole screw-plug connector

| Pin number | Color | Meaning |
|------------|-------|---------|
| 1 | white | Rx-data |
| 2 | green | Tx-data |
| 3 | brown | Gnd |

### D-sub (gateway RS-side), 1. RS-interface

| Pin number | Color | Meaning |
|------------|-------|---------|
| 2 | white | Rx-data |
| 3 | green | Tx-data |
| 5 | brown | Gnd |

### Cable 2 (PC-Com-x) 9-pole D-sub

| Pin number | Color | Meaning |
|------------|-------|---------|
| 2 | white | Tx-diagnosis |
| 3 | green | Rx-diagnosis |
| 5 | brown | Gnd |

### 9-pole D-sub (gateway RS-side), 2. RS-interface

| Pin number | Color | Meaning |
|------------|-------|---------|
| 4 | white | Tx-diagnosis |
| 9 | green | Rx-diagnosis |
| 5 | brown | Gnd |

### View of the connector
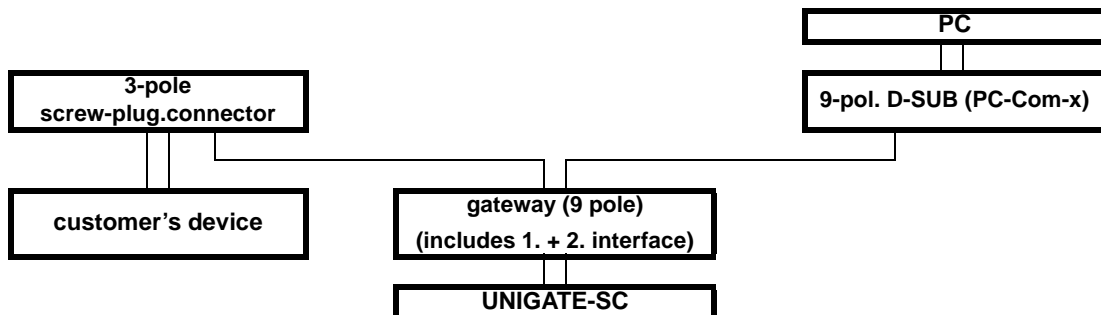


## 4.3    Test mode

### Setting of the test mode

The test mode is set by bringing the switches S4 and S5 in position "E". Beyond it the interface switch has to be set on "232". All other switches will not be taken into consideration for the setting of the test mode. Now the gateway has to be restarted with these settings (by a short disconnection from the power supply).
The test mode is contained from software revision V1.4 on. The test mode may be helpful to integrate the gateway in the relevant environment, for instance to "see" permanent changing data of the fieldbus in the SPS or also in order to test the parameters of the RS-interface.

**Mode of operation of the test mode**

After the restart in the test mode the gateway will be sending the values 0-15 in hexadecimal representation ("0".."F") in ASCII-coding with the current settings for the Baud rate, Parity, Start-, Data-, and Stopbits on the serial side every second. Simultaneously the same values are issued binary on the fieldbus-interface provided that this is possible on the fieldbus at the moment (In case the fieldbus has a data width of more than 1 byte, all characters of the fieldbus will be set to the current test character).

In this mode the State-LED on the RS-side will be flashing red/green, the "Error No/Select ID" LEDs will be displaying the value in a binary way, that is issued that moment. Additionally each character that is received at one of the interfaces will also be output at the same interface as a local echo. On the fielbus-side only the first byte will be used for the local echo, that means on receiving as well as on transmitting only the first byte of the bus data is looked at, the other bus data do not change compared to the last data.

## 4.4    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. As long as the gateway is not in the configuration mode or the test mode, the data exchange mode is active. In the data exchange mode the gateway will carry out the set protocol with those parameters preset through WINGATE.

# 5    RS-interface

## 5.1    Framing Check - only for UNIGATE RS

The length of the stop bit received by the gateway is checked through the function "Framing Check" from the software V 1.4 on. Here the stop bit generated by the gateway is always long enough, so that connected participants can evaluate the stop bit.

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

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

The possible settings for this parameter are "enabled" and "disabled". The presetting for the "Stop Bit Framing Check" is "enabled".

## 5.2    RS-interface at the UNIGATE SC

On principle the hardware cannot be distinguished from the standard gateway. In addition to the regular hardware, a special hardware version is available, which however, is only required for the generation of a script. Due to technical reasons this advanced hardware is not available for all buses; a development can be made on another than the target hardware though.
Compared to the standard gateway, this development gateway is equipped with an extra-interface RS232, which however, is only available to the outside at the version with 9-pole D-SUB. This debug-interface itself is always operated with 9600 baud, no parity, 8 data bits and 1 stop bit. Apart from that there are no further differences, neither in the software nor in the hardware.

# 6 Mode of operation of the system

## 6.1 General explanation

Communication can be split into seven layers, Layer 1 to Layer 7, in accordance with the ISO/OSI Model.

The DEUTSCHMANN AUTOMATION gateways convert Layers 1 and 2 of the customised bus system (RS485 / RS232) to the corresponding fieldbus system. Layers 3 to 6 are blank, and Layer 7 is forwarded transparently on the standard gateways. However, customised adaptations are also possible here (e.g. adaptations to existing profiles of the fieldbus systems).

The gateway can be configured through the software WINGATE$^®$ that is also supplied (see also chapter 11.2).

## 6.2 Interfaces

The gateway features the RS232 and RS485 interfaces. Switchover is performed by means of a slide switch accessible for the customer. The ARCNET gateway thus allows access to all devices connected to the RS485 bus via one single ARCNET address resp. access to the device connected to the RS232 interface.

## 6.3 Data exchange

ARCNET stands for Attached Resource Computer NETwork.

It belongs to the group of the Token-Bus-Networks (all knots receive messages simultaneously). For a flawless bus-access, a transmission permission (the token) is required, which is passed on from one station to the next (token passing).

ARCNET is based on a multi-layer-concept. Each participant is in the position to communicate with any other participant without restrictions.

The length of the receive and transmit buffers is configured via WINGATE$^®$.

The data received via ARCNET are sent in the gateway to the external device in accordance with the selected protocol. The external device responds according to the protocol conventions.

The data received from the external device is written by the gateway into its internal RAM.

A package with the parameter and user data is transferred on the fieldbus as soon as the set data length is achieved.

The first byte on the RS side is always the address byte for the destination address respectively of the participant, who sends the data.

## 6.4 Broadcast

In case the destination address is "0", the data are sent to each participant.

Structure of the data

| ARCNET User ID | User data |
|---|---|

## 6.5 Possible data lengths

The table below shows the maximum transferable data:

| Input data | max. 253 bytes | Variable: maximum value in this case |
|---|---|---|
| Output data | max. 253 bytes | Variable: maximum value in this case |

# 7    Transparent mode - only in the RS-mode

The data is transferred transparently with no time-out monitoring functions whatsoever. The user presets the data on the master. This data is then forwarded to the external device with no time-out monitoring functions whatsoever. A response from the external device is also forwarded to the master with no changes. Any security mechanisms must be encrypted by the user in the net data.

# 8    Character-Delay-Time mode - only at UNIGATE RS

The 'Character-delay-time mode' is not a protocol but a special variant of the "Universal 232" protocol' (see corresponding chapter).

## 8.1    Receive direction

Data received is entered in the transmit buffer until the character delay time expires after reception of the last character. This time can be configured.
Transmit direction: The data is transmitted transparently.

# 9    Implemented protocols in UNIGATE RS

## 9.1    Universal 232 protocol

### 9.1.1    Data structure

Data structure universal 232 protocol
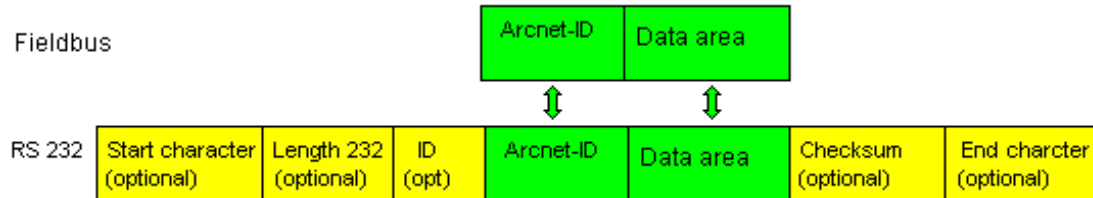


### 9.1.2    RS232 parameter table

#### 9.1.2.1    ARCNET-ID

This byte shows the destination address indicated by the user. Each transmission from the gateway via the RS232-interface incudes this byte, the source address.

#### 9.1.2.2    Start character

If this character is defined, the gateway evaluates only the data at the RS232 interface following this start character. Each transmission from the gateway via the RS232 interface is initiated with the start character in this case.

#### 9.1.2.3    Length 232

If this byte is activated, the gateway, at the receive end, awaits as many bytes of useful data (without checksum) as specified in this byte by the RS232 transmitter. At the transmission end, the gateway then sets this byte to the number of useful data items transmitted by it (without checksum). If byte "Length232" is not defined, the gateway, on reception at the RS232 interface, waits for the end criterion if this is defined. If no end criterion is defined either, as many characters as can be transferred in the fieldbus transmit buffer are read in via the RS232 interface.
As a special case for this parameter also a length byte with additional Timeout monitoring can be set in WINGATE. In that case the received characters will be discarded at a Timeout.

> **Attention:**
> **If "Timeout" is selected as end character, then this byte has no significance.**

#### 9.1.2.4    ID

This byte is present only for reasons of compatibility. It is never activated.

#### 9.1.2.5    Data area

The useful data is transferred in this field.

#### 9.1.2.6    Checksum

At the universal 232 protocol the following checksums can be selected:
XOR, bytewise sum, XOR with negated result and bytewise sum with negated result.

The checksum is always generated on the basis of bytes "Length232", "ID" and "Data area" if present. The checksum is generated by the gateway at the transmit end independently. On reception from the RS232 interface, the gateway checks the checksum and then transfers the useful data (without checksum) to the fieldbus buffer if no checksum errors have been detected. Otherwise, a local error message is issued.

### 9.1.2.7    End character

If this character is defined, the gateway receives data from the RS232 interface up to this character. The "Timeout" criterion can be defined as a special case. In this case, the gateway continues to receive characters until a defined pause occurs. In the special case "Timeout" the "Length 232-byte" has no significance. At the transmit end, the gateway inserts the end character, if defined, as the last character of a transmission.
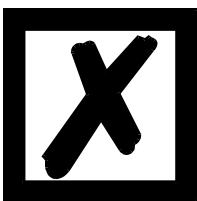
*Attention:*
*The configuration of an end character together with a check sum should be avoided, as a check sum that exactly corresponds with the end character might be the result. In such a case a misinterpretation and following a checksum-error is the result.*

### 9.1.3    Communication sequence

The useful data (data area) arriving via the fieldbus is copied in accordance with chapter 9.1.1 transparently into the RS232 data field and transferred via the RS interface, whereby the protocol is supplemented in accordance with the configuration (start character, end character...). NO acknowledgement is issued!

Receive data at the RS interface is evaluated in accordance with the configured protocol, and the data field (data area (see chapter 9.1.1)) is sent to the fieldbus-master. If more characters have been received than the fieldbus block length, the trailing bytes are truncated and an Rx Overrun is indicated. If less have been received, padding with 0 occurs.

## 9.2    The 3964 R protocol

The 3964 protocol is used to transfer data between two serial devices. One partner must be a high-priority partner and the other must be a low-priority partner in order to resolve initialization conflicts.

### 9.2.1    Data structure 3964R
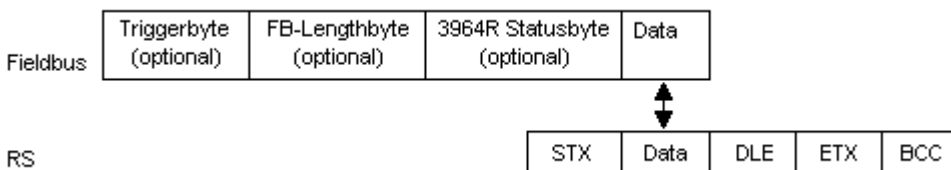


### 9.2.2    Protocol definitions

The telegram format is as follows:

| STX | Data | DLE | ETX | BCC |
|-----|------|-----|-----|-----|

• The received net data is forwarded (transparently) in both directions unchanged.
  **Attention:** The DLE-doubling is excluded from it; that means one DLE (10H) on the bus-side is sent on the RS-side twice. A double DLE on the RS-side is only sent once to the bus-master.

- Data blocking is not scheduled.
- The net data length is restricted to 236 bytes per telegram.
- Communication always runs between high-priority and low-priority communication partners.



***Attention:***
***The gateway is always using "Even Parity", as stipulated in the specification.***

### 9.2.3    Data communication

#### 9.2.3.1    Initiation of data communication by the low-priority user

If the low-priority user also receives an STX in response to a transmitted STX, it interrupts its transmit request, reverts to Receive mode and acknowledges the received STX with DLE.

A DLE in the data string is duplicated and included in the checksum. The BCC is computed from XORing all characters.

#### 9.2.3.2    Conflicts

#### 9.2.3.3    Time-out times

The time-out times are preset by the definition of the 3964R protocol and cannot be overwritten!!!
tq = acknowledgement time-out time (2 s).

The acknowledgement time-out time is started after transmission of control character STX. If no positive acknowledgement arrives within the acknowledgement time-out time, the job is repeated (max. 2 x). If it has not been possible to complete the job positively after two repetitions, the high-priority device nevertheless attempts to establish contact with the low-priority partner by transmitting STX (cycle corresponds to tq).

tz = character time-out time (200 ms)
If the 3964 R driver receives data, it monitors arrival of the individual characters within period tz. If no character is received within the time-out time, the protocol terminates transfer. No acknowledgement is sent to the coupling partner.

#### 9.2.3.4    Retries

In the event of negative acknowledgement or time-out, a telegram transmitted by the high-priority user is repeated twice. After this, the gateway signals communication as disturbed but still attempts to re-establish the connection.

#### 9.2.3.5    Initiation of data communication by the high-priority user

In the case of a negative acknowledgement or time-out, a telegram transmitted by the external device is repeated twice before a fault is signalled.

### 9.2.4    State of the 3964R communication

The current state of the 3964R communication will be mapped in the fieldbus, if the parameter 3964R is activated in WINGATE. The states can be taken from the below table. This parameter takes effect from software revision 3.41 on and can be adjusted by means of the WINGATE software.
This information is only presented in the bus data from the gateway to the Master, however, it applies to the communication via 3964R in both directions.

| Name | Value | Description |
|---|---|---|
| 3964R_NO_ACTION | 0 | If this value is presented, no 3964R communication is active. |
| 3964R_WAIT_AFTER_STX | 1 | After the transmission of the STX character the sender waits until the receiver has sent its confirmation. |
| 3964R_WAIT_QUITTUNG | 2 | The receipt character is waited for. |
| 3964R_WAIT_DATA | 5 | The gateway waits as reveiver for the useful data. |
| 3964R_WAIT_ZVZ | 9 | An execution time is waited for. |

## 9.3    The RK512-protocol

The RK512-protocol is based on the Siemens protocol 3964R, which represents the layer 2 and RK512 describes the transport layer that is put on it. For the exact sequence 3964R, please take a look at the preceding chapter.

The complete RK512-protocol, where "consecutive telegrams" are used for the transmission of any data lengths, can not be supported by the gateway, as consequently the handshake to the fieldbus-master is getting more complex as when the gateway processes only 3964R and the higher protocol (4 byte receipt and if necessary reply data) are handled directly by the field-bus-master.

But UNIGATE supports a simple kind of the RK512-protocols, whereas the data exchange is restricted to one word (fixed) though.
UNIGATE reduces larger data lengths to one word on the part of the RS-side.
For this the end user does not have to care about the problems of quasi-full-duplex operation, since he receives a fixed reply to any command.
And apart from that the complete data exchange takes place through 8 Byte I/O, which can be handled by any PLC very easily and quickly.

In detail the data exchange takes place as follows:
Data structure (identical for both directions):

| Byte | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
|  | Cmd | Typ | DB | DW | DatH | DatL | ReplyH | ReplyL |
| = RK512-Byte | 3 | 4 | 5 | 6 | 11 | 12 |  |  |

```
            |
            +-->cxxaxxxx [x = possible commands: 41H(=Send-DB), 45H(=Fetch), 4FH(=Send-DX)]
                 |   |
                 |   +--   Toggle bit reply (after switch on = 0)
                 +-------  Toggle bit command (after switch on = 0)
```
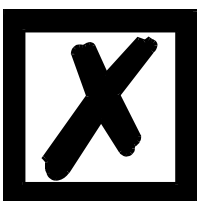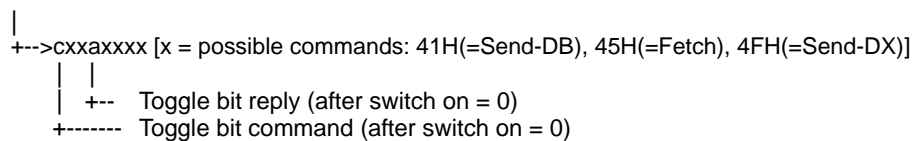
*Attention:*
*The gateway is always using "Even Parity", as stipulated in the specification.*

### 9.3.1    Operating sequence of the data transmission

The first 6 bytes of the above described data always contain an RK512-command, that is initiated by the sender.
The last two bytes either contain 2 byte data (as a reply to a FETCH-command) or 2 byte receipt (as a reply to a SEND-command).

In order to signal to the receiver of the 8 byte data block, which data (command or reply) are valid, the toggle-flags (see above) are used. That means in case bit 7 is changed (MSB) of the first byte, the bytes 1 to 6 have to be evaluated. When it comes to a change of bit 4, the bytes 7 and 8 have to be evaluated.

These bits can be used as toggle-bits, as in the first byte only the commands 41H, 45H and 4FH are possible. Thus the bits 4 and 7 are not used.

Examples 1:

PLC will describe DB3, DW7 with 1234H:

Data to UNIGATE = C1H 44H 03H 07H 12H 34H xxH xxH
(Toggle-bit command = 1, if it was 0 before)

The UNIGATE replies:

Data to the PLC = 1xH xxH xxH xxH xxH xxH 00H 00H
(Toggle-bit reply = 1,if it was 0 before)

Examples 2:

RS-device gets the data word from DB2 DW9 from PLC (it says 4711H there)

Data to the PLC = C5H 44H 02H 09H xxH xxH
(Toggle-bit command = 1, if it was 0 before)

The PLC replies:

Data to the UNIGATE = 1xH xxH xxH xxH xxH xxH 47H 11H
(Toggle-bit reply = 1, if it was 0 before)

> **Attention:**
> **At the RK512 all messages received through the RS-interface are sent to all ARCNET-participants as Broadcast by the UNIGATE.**
> **The other way round all messages that are send to the UNIGATE via ARCNET are passed on to the RS-interface.**

## 9.4 Modbus-RTU

### 9.4.1 Notes

$\rightarrow$ For reasons of simplicity, "Modbus-RTU" is referred to as "Modbus" in the text below.

$\rightarrow$ "Modbus-ASCII" is currently not supported.

$\rightarrow$ The terms "input" and "output" are always viewed from the gateway's point of view, i. e. field-bus input data is the data sent by the fieldbus-master to the gateway.

### 9.4.2 UNIGATE as MODUS-master

#### 9.4.2.1 Preparation

Before data exchange is commenced, the "Baud rate" and "Parity" parameters must be set. The number of "Start bits", "Stop bits" and "Data bits" are permanently preset.

In addition, a "Response time" which corresponds to the maximum time up to which the Modbus slave responds after a request must be set.

Since the Modbus operates with a variable data format - dependent on the required function and data length - but since the fieldbus requires a fixed data length, this must be preset by means of WINGATE fieldbus blocklength (input and output are identical). This length should be selected by the user such that the longest Modbus request resp. response can be processed. If a Modbus response is longer than the preset fieldbus length, the gateway signals an "Rx buffer overflow".

### 9.4.2.2 Data structure
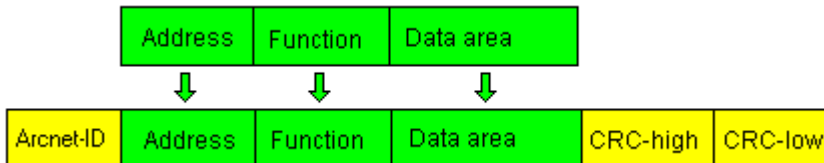


### 9.4.2.3 Communication sequence

The gateway always acts as the slave with respect to the fieldbus and always acts as the master at the Modbus end. Thus, data exchange must always be started by the fieldbus-master. The gateway fetches this data which must be structured in accordance with chapter "Data structure", from the fieldbus-master, determines the valid length of the Modbus data if the length byte is not activated, adds the CRC checksum and sends this data record as a request on the Modbus.

The response of the selected slave is then sent to the fieldbus-master by the gateway - without CRC checksum. If no response occurs within the stipulated "Response time", the gateway signals a "TIMEOUT ERROR".

## 9.4.3 UNIGATE as Modbus-slave

### 9.4.3.1 Preparation

Before data exchange is commenced, the parameters "Trigger byte" and "Length byte", "Baud rate", "Parity", "Start bits", "Stop bits" and "Data bits" must be set.

In addition, a "Response time" which corresponds to the maximum time up to which the fieldbus-master responds after a request must be set and at the rotary switch on the RS-side the Modbus-ID has to be set, under which the gateway is addressed in the Modbus.

### 9.4.3.2 Data structure
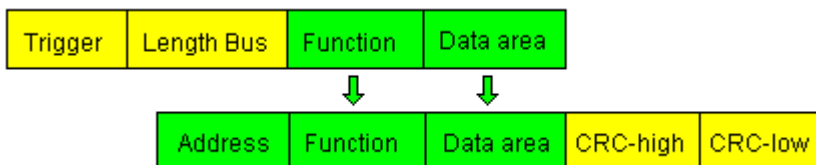


### 9.4.3.3 Communication sequence

The gateway always acts as the slave with respect to the fieldbus and also acts as slave at the Modbus end. A data exchange is always initiated by the Modbus-master via the RS-interface. If the Modbus-address (1st Byte) which is sent out by the Modbus-master is identical with the address set on the gateway, the gateway sends the received data (without Modbus-address and CRC-check sum) to the fieldbus-master (look picture above). With it the gateway optionally completes as an introduction a Trigger byte and a Length byte.

The fieldbus-master detects when it has to analyse a record via the Trigger byte which is incremented by the gateway at every inquiry. The number of the following Modbus-data is to be found in the length byte.

Now the fieldbus-master has to analyse the Modbus-inquiry and it has to send back the answer in the same format (optionally with the leading Trigger byte and Length byte) via the fieldbus to the gateway.

The gateway then takes this answer and completes the Modbus-address and the CRC and sends the data to the Modbus-master via the RS-interface. With it the data exchange is completed and the gateway waits for a new inquiry from the Modbus-master.

### 9.4.3.4    Status report

If no response occurs within the stipulated "Response time" from the fieldbus-master, the gateway a "Timeout-Error".

The last Modbus-ID that was transferred to the RS-interface is indicated by the yellow LEDs.

# 10   Generating a script - only for UNIGATE SC

## 10.1   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.

## 10.2   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.

## 10.3   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.

## 10.4   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.

## 10.5   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.

## 10.6 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.

## 10.7 Accuracies of the baud rates at UNIGATE SC

The baud rate of the serial interface is derived from the processor's crystal frequency.

Meanwhile all Script-gateways, except for the MPI-Gateways (20 MHz), are working with a crystal frequency of 40 MHz.

You can enter any desired integer baud rate into the script. After that the firmware adjusts the baud rate, that can be derived the most precisely from the crystal frequency.

The baud rate the gateway is actually working with (BaudIst) can be determined as follows:

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

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

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

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

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

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

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

In practise errors below 2% can be tolerated!

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

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

## 10.8   Script processing times

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

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

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

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

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

# 11 Hardware ports, switches and LEDs

## 11.1 Drawing of the unit

### 11.1.1 Model UNIGATE RS/SC 232/485-ARCNET
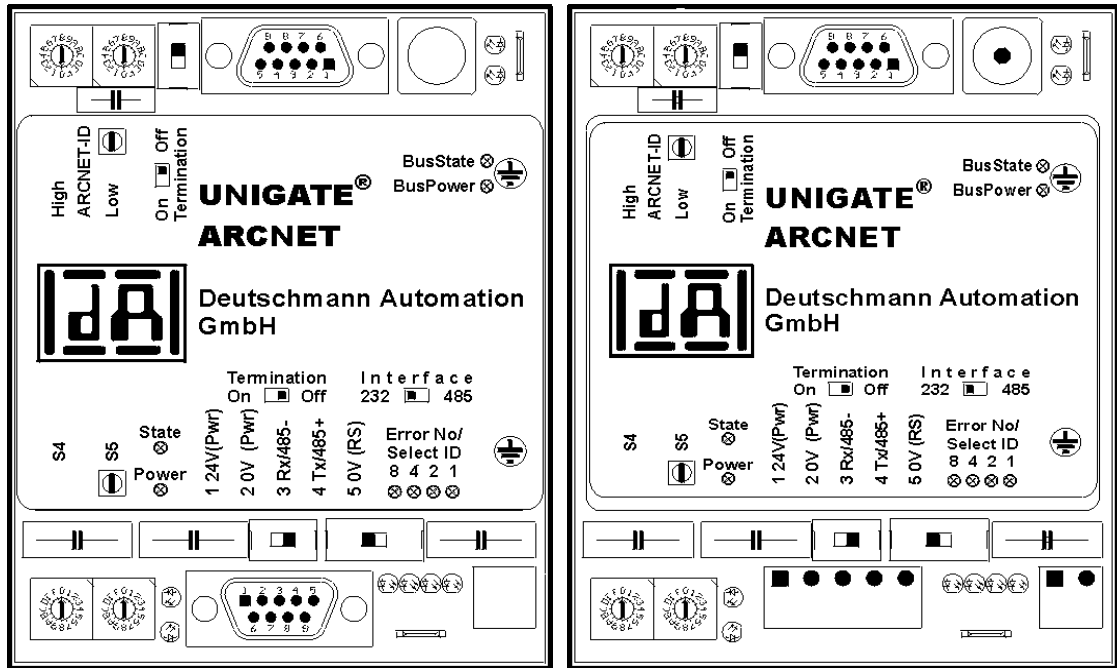


D-SUB-version                                                Phoenix-version

### 11.1.2   Model UNIGATE RS232/RS422-ARCNET
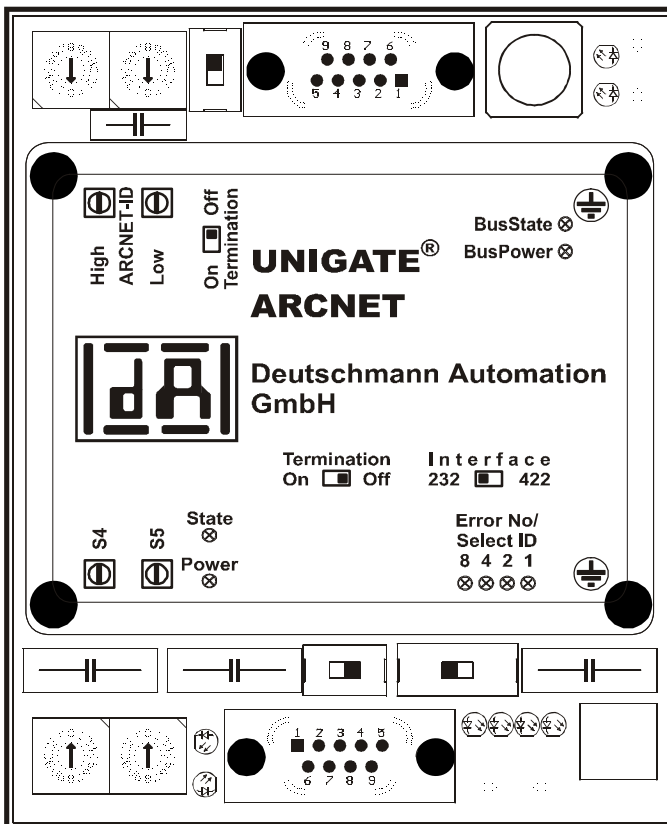


## 11.2   Configuration of the UNIGATE RS

The gateway is delivered by the manufacturer with the following configuration
- Transparent data transmission (i.e. Layer 7 is transferred unchanged).
The configuration of the gateway can be changed by the customer. That is what the software
WINGATE® that comes along with the gateway is meant for.
For the configuration the gateway has to be brought to the configuration mode. For that reason
the switches S4 and S5 have to be set to the position "F" each and the interface-switch has to be
set to "232". Consequently a connection to the PC has to be established and the gateway has to
be started once more. The program WINGATE® automatically selects the interface parameters
correctly. For the operation of WINGATE® please take a look at the WINGATE® Online help.

### 11.2.1   ARCNET

- Baud rate: 2.5 MBaud ("Extended Bus Timeout" can be set via WINGATE, default 41µs)
- Short Packet
- ARCNET-ID: FF

### 11.2.2   RS232/RS485/RS422

- Start bit:          1
- Data bits:         8
- Stop bit:          1
- Parity:            None
- Baud rate:         9600 Baud

The supplied WINGATE® software can be used to change this configuration. Likewise, it can be used to select customized protocols. A description is given below.

## 11.3 Connectors

### 11.3.1 Connector to the external device (RS-interface)

The connection cable to the external device must be plugged in at the connector accessible on the underside of the device.
Pin assignment (5-pin screw-type plug connector; not available for RS422)

| Pin No. | Name | Function |
|---------|------|----------|
| 1 | 10.8..30 V/DC power supply | Power supply |
| 2 | 0 V power supply | Power supply |
| 3 | RX / RS485- (RS485 B) | Receive signal |
| 4 | TX / RS485+ (RS485 A) | Transmit signal |
| 5 | GND | Reference for PIN 3 + 4 |

Pin assignment (9-pin Sub-D, plug)
(Standard for the RS232/422-model, optional for the RS232/485-model)

| Pin No. | Name | Function |
|---------|------|----------|
| 1 | Shield | |
| | Rx | Receive signal |
| | RS485- | Transmit-receive signal |
| 2 | RS422- (Tx) | Transmit signal |
| | Tx | Transmit signal |
| | RS485+ | Transmit-receive signal |
| 3 | RS422+ (Tx) | Receive signal |
| 4 | | |
| 5 | GND | Ground connection, reference for PIN 2+3+6+7 |
| 6 | RS422- (Rx) | Receive signal |
| 7 | RS422+ (Rx) | Receive signal |
| 8 | | |
| 9 | | |
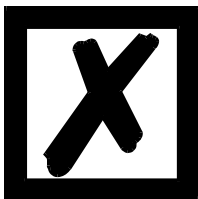


***Attention:***
***The assignment of the 9-pin Sub-D plug may differ from the above pin assignment and also a customized configuration is possible.***



***Attention:***
***In case the RS-interface is <u>NOT</u> potentially divided, "GND" and "supply 0V" are connected internally!***
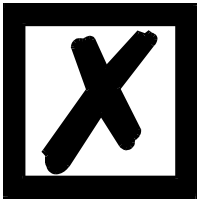
**Attention:**
***In case RS422 is selected, then the termination switch has to be set to ON, in order to avoid communication errors!***

Pin assignment (2-pin screw-type/plug connector; only in conjunction with 9-pin D-Sub.)

| Pin No. | Name | Function |
|---------|------|----------|
| 1 | 10.8..30 V / DC | 10.8..30 V supply voltage |
| 2 | 0 V / DC | 0 V supply voltage |

### 11.3.2   ARCNET connector

The connector (labelled: ARCNET) for connection to ARCNET is located on the upper side of the device.

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

### 11.3.3   Debug plug

Please compare to chapter 4.2.

### 11.3.4   Power supply

The device must be powered with 10.8-30 VDC. Please note that the devices of the series UNIGATE can not be operated with AC voltage.
On the version with 5-pin screw-type/plug connector, the power supply is routed via this connector; on the version with 9-pin D-Sub connector, the power supply is routed via the separate 2-pin screw-type/plug connector.

### 11.3.5   Shield terminal lead

The shield signal for the electronic circuitry is connected to the top-hat rail via the connector provided. The shield signal for the ARCNET cable shield is not electrically connected to the shield signal of the electronic circuitry for reasons relating to interference immunity.

## 11.4   LEDs

The UNIGATE RS features 8 LEDs with the following significance:

| LED Bus Power | Green | ARCNET supply voltage |
|---------------|-------|----------------------|
| LED Bus State | Red/green | Interface status, ARCNET |
| LED Power | Green | RS485/RS232 supply voltage |
| LED State | Red/green | Interface status RS485/RS232 |
| LED Error No / Select ID | Yellow | Binary display of the connection/error number |

The gateway UNIGATE SC has also 8 LEDs available with the following significance:

| LED Bus Power | green | ARCNET supply voltage |
|---|---|---|
| LED Bus State | red/green | Interface state, ARCNEt |
| LED Power | green | Supply voltage RS485/RS232 |
| LED State | red/green | User-defined |
| LED Error No. / Select ID | yellow | User-defined |

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

### 11.4.1 LED "Bus Power"

This LED is connected directly to the electrically isolated supply voltage of the ARCNET end.

### 11.4.2 LED "Bus State"

| Lights green | Fieldbus data exchange took place |
|---|---|
| Flashes green | Gateway in the net |
| Blinks green/red | No net |
| Flashes red | General ARCNET error |
| Blinks red | Double net ID |

### 11.4.3 LED "Power"

This LED is connected directly to the (optionally also electrically isolated) supply voltage of the RS485/RS232 end.

### 11.4.4 LED "State"

| Lights green (only RS) | Data exchange active via RS485/RS232 |
|---|---|
| Flashes green (only RS) | RS485/RS232 ok but no permanent data exchange |
| Flashes green/red (only RS) | No data exchange since switching on |
| Lights red | General gateway error (see LEDs Error No.) |
| Flashes red (only RS) | UNIGATE is in the configuration mode |

### 11.4.5 LEDs "Error No. / Select ID" at UNIGATE RS

If these 4 LEDs flash and LED "State" simultaneously lights red, the error number is displayed in binary notation (conversion table, see Annex) in accordance with the table in Chapter "Error handling". Otherwise, the address with which communication is currently running via the RS485 interface is displayed, also in binary notation.

## 11.5 Switches

The gateway features 7 switches with the following functions:

Rotary coding switch, ARCNET High    ARCNET ID (High Byte)
Rotary coding switch, ARCNET Low     ARCNET ID (Low Byte)
Slide switch "Termination"           Switchable ARCNET terminating resistor
Rotary coding switch S4              RS485 ID (High Byte)
Rotary coding switch S5              RS485 ID (Low Byte)
Slide switch "Interface"             Selector switch for RS485 or RS232 interface
Slide switch "Termination"           Switchable RS485 terminating resistor

### 11.5.1 Rotary coding switch (ARCNET ID)

These two switches are used to set the ARCNET ID of the gateway in hexadecimal notation. A conversion table from decimal to hexadecimal can be found in the Annex. This value is read in only once when the gateway in activated and cannot be changed via the ARCNET.

### 11.5.2 Slide switch Termination ARCNET

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

### 11.5.3 Rotary coding switches S4 + S5 (RS485 ID)

These two switches are used to set the RS485 ID of the gateway in hexadecimal notation provided an ID is required for the bus. Please refer to the Annex for a conversion table from decimal to hexadecimal. This value is read in only once when the gateway is activated.

### 11.5.4 Slide switch (RS485/RS232 interface)

This slide switch is used to select whether an RS485 interface or an RS232 interface is connected at the connector to the external device.

### 11.5.5 Slide switch (RS485/RS422 termination)

If the gateway is operated as the first or last physical device in the RS485 bus, there must be a bus termination at this gateway. In order to do this, either a bus terminating resistor in the connector or the resistor (150 Ω) integrated in the gateway must be activated. In order to do this, slide the slide switch to position ON. In all other cases, the slide switch must remain in position OFF. Please refer to the general RS485 literature for further information on the subject of bus terminations.

If the integrated resistor is used, please allow for the fact that this also activates a pull-down resistor (390 Ω) to ground and a pull-up resistor (390 Ω) to VCC.

At the RS422-interface the transmission line is terminated. The receive line is always firmly terminated.

# 12  Error handling

## 12.1  Error handling at UNIGATE RS

If the gateway detects an error, the error is signalled by the "State" LED lighting red and, simultaneously, the error number being indicated by means of LEDs "Error No." as shown in the table below. In addition, this error number is transferred as an external diagnostic byte via the ARCNET to the master. A distinction can be made between two error categories:

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

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

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

| LED8 | LED4 | LED2 | LED1 | Error no. resp. ID | Error description |
|------|------|------|------|---------|-------------------|
| 0 | 0 | 0 | 0 | 0 | Reserved |
| 0 | 0 | 0 | 1 | 1 | Initialization error of the RS485/RS232 interface |
| 0 | 0 | 1 | 0 | 2 | EEROM error |
| 0 | 0 | 1 | 1 | 3 | Stack error |
| 0 | 1 | 0 | 0 | 4 | Hardware fault of the fieldbus ASIC |
| 0 | 1 | 0 | 1 | 5 | Configuration error of the gateways (unknown protocol) |
| 0 | 1 | 1 | 0 | 6 | Reserved |
| 0 | 1 | 1 | 1 | 7 | RS485/RS232 transmit buffer overflow |
| 1 | 0 | 0 | 0 | 8 | RS485/RS232 receive buffer overflow |
| 1 | 0 | 0 | 1 | 9 | Timeout on reception RS485/RS232 interface |
| 1 | 0 | 1 | 0 | 10 | Transmit error of the RS485/RS232 interface |
| 1 | 0 | 1 | 1 | 11 | Parity- or frame-check-error |
| 1 | 1 | 0 | 0 | 12 | Addressing error of the RS485/RS232 interface |
| 1 | 1 | 0 | 1 | 13 | Configuration error by ARCNET-master |
| 1 | 1 | 1 | 0 | 14 | General error of the RS485/RS232 interface |
| 1 | 1 | 1 | 1 | 15 | Internal error |

Table 1: Error handling at UNIGATE RS

## 12.2  Error handling at UNIGATE SC

| LED8 | LED4 | LED2 | LED1 | Error no. resp. ID | Error description |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | Reserved |
| 0 | 0 | 0 | 1 | 1 | Hardware fault |
| 0 | 0 | 1 | 0 | 2 | EEROM error |
| 0 | 0 | 1 | 1 | 3 | Internal memory error |
| 0 | 1 | 0 | 0 | 4 | Fieldbus hardware fault or wrong fieldbus ID |
| 0 | 1 | 0 | 1 | 5 | Script error |
| 0 | 1 | 1 | 0 | 6 | Reserved |
| 0 | 1 | 1 | 1 | 7 | RS-transmit buffer overflow |
| 1 | 0 | 0 | 0 | 8 | RS-receive buffer overflow |
| 1 | 0 | 0 | 1 | 9 | RS-time out |
| 1 | 0 | 1 | 0 | 10 | General fieldbus error |
| 1 | 0 | 1 | 1 | 11 | Parity- or frame-check-error |
| 1 | 1 | 0 | 0 | 12 | Reserved |
| 1 | 1 | 0 | 1 | 13 | Reserved |
| 1 | 1 | 1 | 0 | 14 | Fieldbus buffer overflow |
| 1 | 1 | 1 | 1 | 15 | Reserved |

Table 2: Error handling at UNIGATE SC

# 13 Installation guidelines

## 13.1 Installation of the module

The module of size (90 x 127 x 55 mm W x H x D) has been developed for switch cabinet use (IP 20) and can thus be mounted only on a standard mounting channel (deep top-hat rail to EN 50022).

### 13.1.1 Mounting

• Engage the module from the top in the top-hat rail and swivel it down so that the module engages in position.
• Other modules may be rowed up to the left and right of the module.

• There must be at least 5 cm clearance for heat dissipation above and below the module.
• The standard mounting channel must be connected to the equipotential bonding strip of the switch cabinet. The connection wire must feature a cross-section of at least 10 mm².
• An earthing terminal must be positioned next to the module so as to allow the shield connection on the device to be implemented as short as possible with a flexible wire (1.5 mm²).

### 13.1.2 Removal

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

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

## 13.2 Wiring

### 13.2.1 Connection systems

The following connection systems must resp. may be used when wiring the module:
• Standard screw-type/plug connection (power supply + RS)
• Push-lock terminals (connection terminals for earthing)
• 9-pin SUB-D plug connectors (ARCNET and RS232 connection)
a) In the case of standard screw-type terminals, one lead can be clamped per connection point. It is best to then use a screwdriver with a blade width of 3.5 mm to firmly tighten the screw.

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

b) The plug-in connection terminal strip is a combination of standard screw-type terminal and plug connector. The plug connection section is coded and can thus not be plugged on the wrong way round.

c) The 9-pin SUB-D plug connectors are secured with two screws with "4-40-UNC" thread. It is best to use a screwdriver with a blade width of 3.5 mm to screw the screw tight.
Tightening torque: 0.2... 0.4 Nm

### 13.2.2    ARCNET communication interface

#### 13.2.2.1  Bus line with copper cable

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

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

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

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

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

#### 13.2.2.2  Power supply

The device must be powered with 10,8...30 V DC.

• Connect the supply voltage to the 5-pin or optional 2-pin plug-in screw terminal in accordance with the labelling on the front panel of the device.

#### 13.2.2.3  Shield connection

The module features two contact points for equipotential bonding and the shield of the RS end. The shield of the ARCNET cable is connected to the equipotential bonding system via an RC snubber circuit. This means that there are two electrically isolated shields in the device. This guarantees higher interference immunity of the module since the "cable shield current" which may be up to a few Amperes owing to potential differences between two bus users is not discharged via the device.

If the device is subject to high mechanical or chemical stress, it is advisable to use a tin-plated top-hat rail in order to ensure greater contact stability of the shield connection!

#### 13.2.2.4  Equipotential bonding connection

• Fit an earthing terminal to the top-hat rail directly next to the module. The earthing terminal automatically establishes an electrical connection to the top-hat rail.

• Connect the shield connection terminal to the earthing terminal using a flexible wire with a diameter of 1.5 mm² which should be as short as possible.

• Connect the top-hat rail to the equipotential bonding rail with as low an impedance as possible. Use a flexible earthing wire with a cross-section of at least 10 mm² for this.

### 13.2.3    Line routing, shield and measures to combat interference voltage

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

### 13.2.4    General information on line routing

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

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

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

|         | Group A | Group B | Group C |
|---------|---------|---------|---------|
| **Group A** | 1 | 2 | 3 |
| **Group B** | 2 | 1 | 3 |
| **Group C** | 3 | 3 | 1 |

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

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

### 13.2.4.1  Shielding of lines

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

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

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

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

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

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

In the case of data lines for serial couplings, always use metallic or metallized plugs and connectors. Attach the shield of the data line to the plug or connector housing. Do not connect the shield to PIN 1 of the multipole connector!

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

Please note the following points when shielding:

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

Shielded data lines and unshielded power supply lines (< 60 V DC) are routed to and connected to the module. All cable shields must be earthed at both ends in order for the module to comply with all required EMC limits.

• Downstream of the entry point into the switch cabinet, the ARCNET cable shield must be connected to the equipotential bonding strip.

• You must earth the shielded RS232C connection cable via the shield terminal on the module using a flexible wire with a cross-section of at least 1.5 mm² which is as short as possible.

• You must also earth the other end of the cable shield of the RS232C connection cable.
  (see also chapter 13.2.2.3).

# 14  Representation of the data in ARCNET

Any standard-compliant ARCNET-master can exchange data with the gateway.

For the user, the components of the protocol are not visible any more as they take place in the Layer 1, which is realized in hardware.

Five protocol elements are distinguished. They all have the Alert Burst in common, which consists of six ones. Each useful byte is introduced by a 110 bit series.

• **ITT** - Invitation to Transmit

  ITT is the token, it is passed on from one knot to the other.

| Alert Burst | ITT | DID | DID |
|---|---|---|---|

• **FBE** - Free Buffer Enquiry

  FBE serves for an inquiry, in order to initiate a data transfer to another participant.

| Alert Burst | ENQ | DID | DID |
|---|---|---|---|

• **PAK** - Data Packet

  PAK serves for the actual data transfer.

| Alert Burst | PAK | SID | DID | DID | COUNT | SC | DATA // DATA | CRC | CRC |
|---|---|---|---|---|---|---|---|---|---|

• **ACK** - Acknowledgement

  ACK confirms a successful operation. It is used as an answer to an FBE and as conclusion of a successful data transfer as well.

| Alert Burst | ACK |
|---|---|

• **NAK** - Negative Acknowledgement

  NAK is used as a negative answer to an FBE. A faulty data transfer (CRC error) is recognized through a time-out from the transmitter.

| Alert Burst | ACK |
|---|---|

## 14.1  Definitions

| | |
|---|---|
| DID | Destination ID |
| SID | Source ID |
| COUNT | Number of data bytes |
| DATA | Data (1 - 507 byte) |
| CRC | Cyclic Redundancy Check |
| ACK | Acknowledgement |
| NAK | Negative Acknowledgement |

## 14.2  Safety mechanisms

The data transfer in the ARCNET net is multiple secured on the lowest level.

• The receiving readiness of the addressed knot is checked through FBE before the data transfer.
• A 16 bit CRC is attached to each data package and it is checked by the receiver.
• If a token get lost, a reconfiguration is initiated and the network is reconstructed automatically.
• Additionally the ARCNET-controllers make diagnosis registers available.

# 15  Technical data

## 15.1  Device data

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

| No. | Parameter | Data | Explanations |
|---|---|---|---|
| 1 | Location | Switch cabinet | Top-hat rail mounting |
| 2 | Enclosure | IP24 / IP67 | Protection against foreign bodies and water to IEC 529 (DIN 40050) |
| 4 | Service life | 10 years | |
| 5 | Housing size | 90 mm x 127 mm x 55 mm | W x H x D |
| 6 | Installation position | Any | |
| 7 | Weight | 0.3 kg | |
| 8 | Operating temperature | 0 ºC ... +45ºC (without mandatory convection) <br> 0 ºC ... +65ºC (with mandatory convection) | |
| 9 | Storage/transport temperature | - 40 ºC ... + 70 ºC | |
| 10 | Atmospheric pressure <br> during operation <br> during transport | <br> 795 hPa ... 1080 hPa <br> 660 hPa ... 1080 hPa | |
| 11 | Installation altitude | 2000 m <br> 4000 m | Unrestricted <br> Restricted - <br> Ambient temperature $\leq$ 40 ºC |
| 12 | Relative humidity | Max. 80 % | No condensation, <br> no corrosive atmosphere |
| 13 | Particles / dirt | Sand and dust may not penetrate the device | |
| 14 | External <br> power supply | 10,8...30 V DC | Standard power supply unit to DIN 19240 |
| 15 | Current consumption at 24 V DC | Typ. 120 mA <br> max 150 mA | At 10.8V: typ. 350 mA |
| 16 | Power supply at the <br> ARCNET interface | 5 V DC / max. 50 mA | |
| 17 | Reverse voltage protection | Yes | But does not function! |
| 18 | Short-circuit protection | Yes | |
| 19 | Overload protection | Poly-switch | Thermal fuse |
| 20 | Undervoltage detection <br> (USP) | $\leq$ 9 V DC | |
| 21 | Emergency power supply | $\geq$ 5 ms | Device fully operable |
| 22 | Insulation voltage | 500 V DC | IEC 1131-2 |

Table: Technical data of the module

The table below lists all tests, standards and regulations on the basis of which the module has been tested.

| No. | Parameter | Data | Explanations |
|---|---|---|---|
| 1 | Vibration test | $5\ Hz \leq f \leq 26\ Hz$, amplitude = 0.75 mm<br>$26\ Hz \leq f \leq 500\ Hz$, acceleration = 20 m/s$^2$<br>$\rightarrow$ Frequency sweep : 1 octave/min.<br>$\rightarrow$ 10 frequency sweeps each in x, y, z | (IEC 68-2-6Fc sinusoidal) |
| 2 | Shock test | Shock waveform = semi-sinusoidal<br>Acceleration = 15g (150 m/s$^2$)<br>Shock duration = 11 ms<br>$\rightarrow$ 3 shocks in +/- direction in x, y, z | (IEC 68-2-27-Ea) |
| 3 | ESD | 8 kV discharge in air<br>4 kV contact discharge | EN 50082-2 |
| 4 | Electromagnetic fields | 10 V/m | EN 50082-2 |
| 5 | BURST | 2 kV / 5 kHz supply voltage<br>1 kV / 5 kHz data lines | EN 50082-2 |
| 6 | Emitted interference | Limit value class A | EN 55011 |

Table: Tests, standards and regulations

### 15.1.1   Interface data

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

| No. | Interface designation<br>Physical interface | ARCNET<br>RS485 | RS232-C<br>RS232-C | RS485/RS422<br>RS485/RS422 |
|---|---|---|---|---|
| 1 | Standard | EIA Standard | DIN 66020 | EIA Standard |
| 2 | Transmission mode | Symmetrical asynchronous serial half-duplex<br><br>→ Difference signal | Asymmetrical asynchronous serial full duplex<br><br>→ Level | Symmetrical asynchronous serial half-duplex full duplex at RS422<br>→ Difference signal |
| 3 | Transmission method | Master / master | Master / slave | Master / slave |
| 4 | Number of users:  - Transmitters<br>                        - Receivers | <br>255 | 1<br>1 | 32<br>32 |
| 5 | Cable length: - Maximum<br><br>            - Baud rate-dependent | 1200 m<br><br>2.5 MBd → 200 m | 15 m<br><br>No | 1200 m<br><br><93.75 kBd → 1200 m<br>312 kBd → 500 m<br>625 kBd → 250 m |
| 6 | Bus topology | Line | Point-to-point | Line |
| 7 | Data rate:    - Maximum<br><br>        - Standard values | 5 Mbit/s<br><br>2.5 Mbit/s<br>5 MBit/s | 120 kBit/s<br>2.4 k/Bit/s<br>4.8 k/Bit/s<br>9.6 kBit/s<br>19.2 kBit/s<br>38.4 kBit/s | 625 kBaud<br>2.4 kBit/s<br>4.8 kBit/s<br>9.6 kBit/s<br>19.2 kBit/s<br>57.6 kBit/s<br>312.5 kBit/s<br>625 kBit/s |
| 8 | Transmitter:      - Load<br>              - Maximum voltage<br>              - Signal, unloaded<br>              - Signal, loaded | 54 Ω<br>- 7 V ... 12 V<br>± 5 V<br>± 1.5 V | 3 ... 7 kΩ<br>± 25 V<br>± 15 V<br>± 5 V | 54 Ω<br>- 7 V ... 12 V<br>± 5 V<br>± 1.5 V |
| 9 | Receiver:     - Input resistance<br>            - Max. input signal<br>            - Sensitivity | 12 Ω<br>- 7 V ... 12 V<br>± 0.2 V | 3 ... 7 Ω<br>± 15 V<br>± 3 V | 12 Ω<br>- 7 V ... 12 V<br>± 0.2 V |
| 10 | Transmit range (SPACE):<br>            - Voltage level<br>            - Logic level | <br>- 0.2 ... + 0.2 V<br>0 | <br>+ 3 ... + 15 V<br>0 | <br>- 0.2 ... + 0.2 V<br>0 |
| 11 | Transmit pause (MARK):<br>            - Voltage level<br>            - Logic level | <br>+ 1.5 ... +5 V<br>1 | <br>- 3 ... −15 V<br>1 | <br>+ 1.5 ... +5 V<br>1 |

Table: Technical data of the interfaces and ports on the module

# 16 Commissioning guide

## 16.1 Note

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

## 16.2 Components

You will require the following components to commission the UNIGATE:
• UNIGATE
• Connection cable from gateway to the process
• Connector for ARCNET connection to the gateway
• ARCNET cable (this cable is generally already installed on site!)
• 10.8..30 V DC power supply (DIN 19240)

## 16.3 Installation

The UNIGATE ARCNET module features enclosure IP 20 and is thus suitable for switch cabinet use. The device is designed for snapping onto a 35 mm top-hat rail.
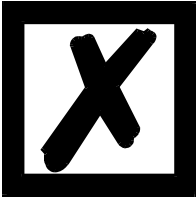
## 16.4 Dimensional drawing DIN-rail mounting
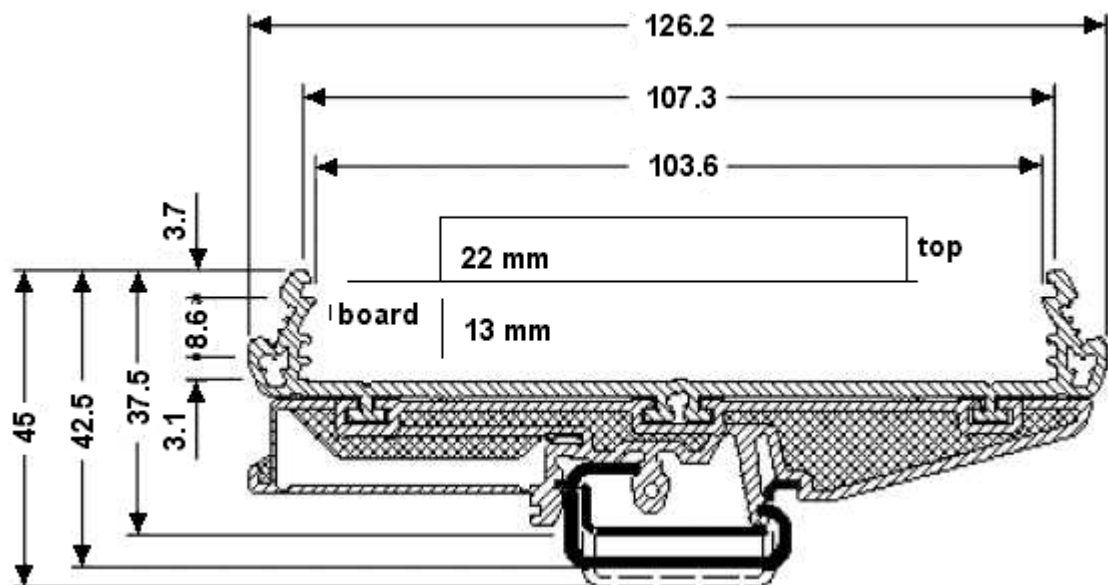


## 16.5 Commissioning

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

## 16.6 Setting the ARCNET address

Set the ARCNET address at the fieldbus end of the module on the two rotary switches designated "Address".

**Attention:**
**The ARCNET address set must correspond to the planned address!**
**It is read in only on power-up of the gateway!**

## 16.7   ARCNET connection

Connect the device to the ARCNET at the interface labelled "ARCNET".

## 16.8   Connection to the process device

Please also read the User Manual provided for the process device when commissioning the process device.

## 16.9   Connecting the supply voltage

Please connect 10,8...30 DC voltage to the terminals provided for this.

## 16.10 Shield connection

Connect the PE wire at the terminal provided for this. Earth the top-hat rail onto which the module has been snapped.

## 16.11 Literature

We recommend the book "ARCNET Der verkannte Feldbus", author Michael Hüttmann, ISBN 3-8007-2258-5 to help you quickly get to grips with the subject of the ARCNET and the mode of operation of the available ASICs.


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# 17 Servicing

Should questions which are not covered in this Manual crop up, 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

You can reach us during hotline hours which are as follows

Monday to Thursday from 8 am to midday and from 1 pm to 4 pm, Friday from 8 am to midday.

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D-65520 Bad-Camberg
Germany

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Fax sales department                       +49-(0)6434-9433-40
Fax technical hotline                      +49-(0)6434-9433-44

E-mail technical hotline                   hotline@deutschmann.de

## 17.1 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.

## 17.2 Downloading PC software and GSD files etc.

You can download the current version of WINGATE$^®$ free of charge from our Internet server.

http://www.deutschmann.de

# 18 Annex

## 18.1 Hexadecimal table

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