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DIN Messbus

5.8 DIN-Messbus

TesiMod operating terminals allow for a simple interfacing to process computers or PLCs via the DIN-Messbus (DIN 66348 - part 2).
The DIN-Messbus has a master-slave type structure, i.e. the bus master polls the connected bus slaves. Thus, within this description a distinction is made between the master and the slave interfacing.

5.8.1 DIN-Messbus-Master

5.8.1.1 Process Computer as Bus Master

Any process computer complying with the following marginal conditions is suitable as bus master:

- Communication in accordance with DIN66348 - part 2 (specifies the data transmission layers 1 and 2 of the ISO/OSI - layer model)
- Interpretation of the data contents in compliance with the SÜTRON TesiBus specification

The services (DIN-Messbus-user data contents) are defined in an address-transparent manner. A number of different address formats are available for the interfacing. A SÜTRON-internal address format is used for indirect PLC interface connections whereas a linear, byte-structured memory addressing technique with an address area of 2^{24} bits is implemented for regular process computer interface connections.

5.8.1.2 Gateway as Bus Master

The DIN-Messbus allows a number of operating terminals to be connected to a PLC (via the programming unit interface) which is particularly interesting in applications where the PLC-interface itself represents only a point-to-point connection.

This requires the use of a gateway which is responsible for the adaptation of the protocol between the DIN-Messbus (TesiBus) and the respective PLC-protocol.

At the same time the gateway will function as the bus master on the DIN-Messbus and poll the slave terminals at cyclic intervals.

The gateway offers all functions of a full-size terminal, however, due to the implementation of the DIN-Messbus protocol on interface X3 the following functions are not available:
- Printing and
- Scanning.

The gateway offers the following additional functions, which are not available in the standard TesiMod operating terminals:
- Extended poll area,
- Cache function for read-only data,
- Image of the network status.

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5.8.1.3 Poll Area

The cyclic poll area makes the following functions available on the master terminal or slave terminal, respectively:
- Write Coordination byte (WCB)
- Serial message channel
- LEDs of the function keys

The functionality has been increased in comparison with the standard poll area of the direct PLC-interface connection. The mapping of this poll area to the functions of the terminal does not occur in a static fashion but is rather transmitted via the trigger byte in an event-controlled and slave-specific manner. I.e. the controller enters values into the poll area and transfers it to the gateway via bit 7 (value 0x80) of the trigger tyte. After the function has been executed, the gateway will write the return value and the code 0x40 back into the trigger byte. Subsequently, the data area will again be under the control of the PLC.

The poll area is classified as either byte structured or word structured depending on the specified address and has the following fixed structure:

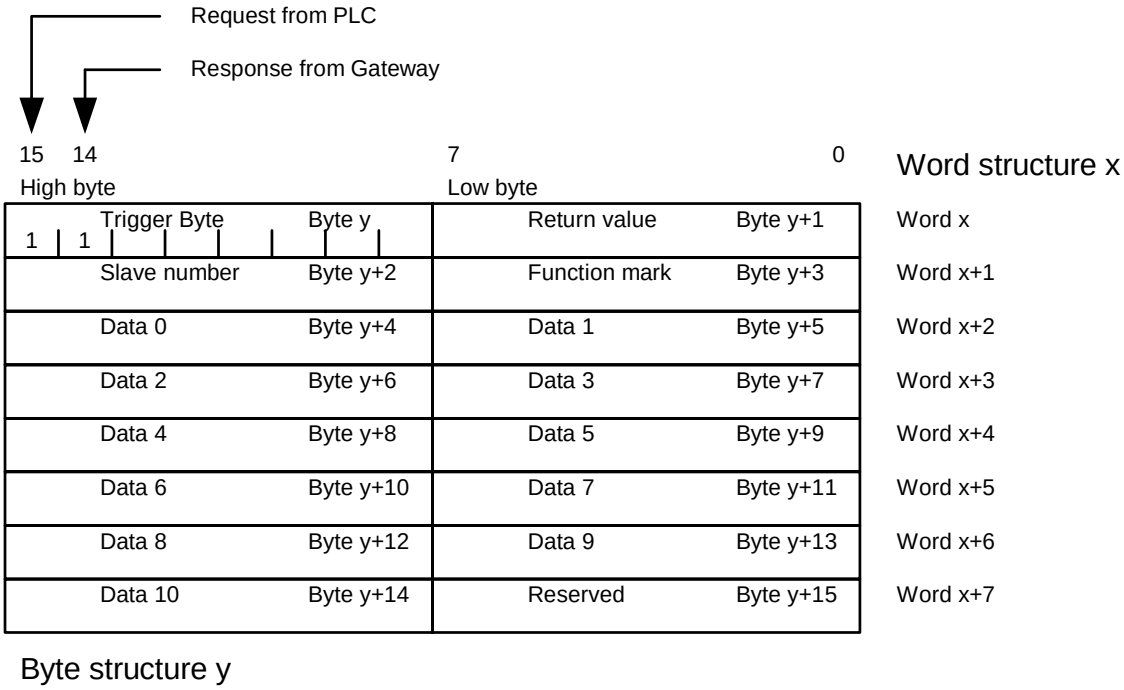


Figure 5.8-1 Structure of the poll area

The functions of the bytes are as listed below:

Slave number:
0 Data are intended for the gateway itself
1...31 Slave number to which the event will be transmitted by order-only

Function code:
1 Transmit new WCB
2 Transmit message
3 Activate/deactivate LEDs

Return value:
0 Ok-acknowledge signal
1 Slave is not ready to receive
2 General DIN-Messbus error
3 Invalid function code
4 Slave not synchronized

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Data contents:

Function *transmit new Write Coordination Byte (WCB)*:
Data 0 WCB
Data 1 free

Function *transmit message*:
Data 0 Message number Highbyte
Data 1 Message number Lowbyte

Funtion *activate LEDs*:
Data 0 LED 1...4
Data 1 LED 5...8
Data 2 LED 9...12
Data 3 LED 13...16
Data 4 LED 17...20
Data 5 LED 21...24
Data 6 LED 25...28
Data 7 LED 29...32
Data 8 LED 33...36
Data 9 LED 37...40
Data 10 LED 41...44

5.8.1.4 Cache Function for Read-Only Data

The cache function will poll a memory area of up to 62 bytes in the PLC and will then broadcast the information to all connected slave-terminals at cyclic intervals . This greatly reduces the load on the bus and allows simultaneous transmission of all data to the terminals.

Since the broadcast service on the communications layer 2 is not subject to monitoring, the slave-terminals implement a definable timeout to monitor the receipt of the broadcasted data packets.

If a slave-terminal has a read request which is located within the cache area, no communication will be carried out via the gateway to the PLC, but the data are rather copied locally from of the terminal cache.

Variables which have been assigned the attribute *display once* and which are located within the cache area, will be displayed once more after receipt of the next cache packet. The gateway transmits the cache data in an equidistant fashion thus permitting the execution of a high-priority and speedy output which is independent of the general cyclic output cycle.

5.8.1.5 Status of the Network

A 4-byte area is used by the gateway to transmit the status of the network to the PLC. Each slave which is detected in the network and which is synchronized, is represented by a bit which is set to “1”.

During the synchronization of a slave (i.e. its bit is set from "0" to "1"), **the external data release for this slave will be reset and the function keys for this slave will be deactivated** (the write coordination byte assumes the value "0"). In such an event, the PLC might be required to put the terminal back into the appropriate status via the poll area!

The figure below illustrates the general structure of the 4-byte area which is classified as either byte-structured or word-structured depending on the specified address:

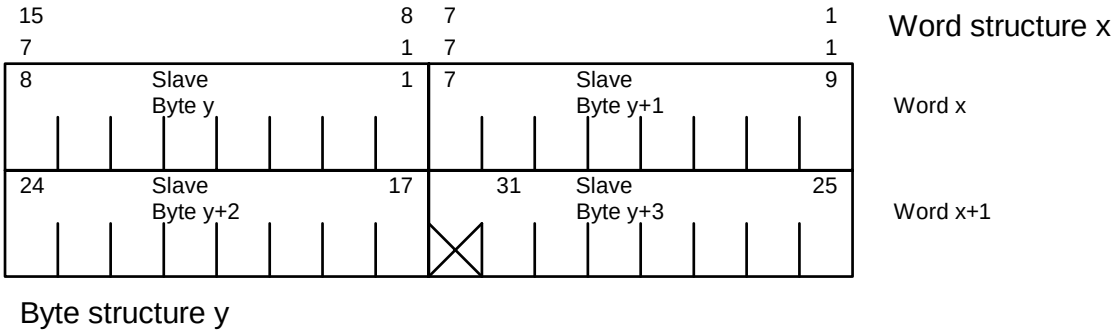


Figure 5.8-2: Structure of the net status

5.8.1.6 Parameters Interface X2 for PLC-Interfacing

The communication via interface X2 is effected by the same communications protocol through the same loadable driver as is used for the communication via a comparable direct PLC-interface connection.

The respective interface parameters are listed in the corresponding section of chapter 5.

5.8.1.7 Protocol Parameters for DIN-Messbus - Master

The DIN-Messbus - master interface connection requires setting of the following parameters for the interface X3:

Baud rate: **19200** Baud
Parity: **even**
Data length: **7**
Stop bits: **1**
Handshake: **no handshake**

It is also possible to select a smaller baud rate. The baud rate setting for the gateway and the setting for the slave terminal must be in agreement.

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5.8.1.7.1 Parameter Minimum Slave Number

This value specifies the lower limit for the slave numbers which the network will be scanned for. Permitted values are in the range of 1 to 31.

5.8.1.7.2 Parameter Maximum Slave Number

This value specifies the upper limit for the slave numbers which the network will be scanned for. The value must be greater than or be equal to the minimal slave number (see 5.8.1.7.1). Keeping the number of non-existing slaves within the range of values to a minimum, will contribute to a more speedy synchronization of the slaves by the gateway.
Permitted values are in the range of 1 to 31.

5.8.1.7.3 Parameter Test Cycle for the Synchronization

This parameter specifies the period of time that is allowed to elapse between each test communication when scanning the bus. The input must be equal to a multiple of 1/10 second.
Permitted values are in the range of 2 to 255.

5.8.1.7.4 Parameter Cache Size

This parameter specifies **in bytes** the size of the read-only data cache. Defining a word-structured area as cache address will require a cache size comprising an **even number** of bytes!
Permitted values are in the range of 0 to 62 bytes.

5.8.1.7.5 Parameter Cache Address

This parameter specifies the cache address, i.e. the beginning of the read-only data cache. No address must be specified here when operating the bus without the cache function.

The following address levels are possible as starting addresses :
– Flag byte / flag word
– Data word
If variables from other address types are to be cached, it will be necessary to copy them from the PLC to the cache address area.

5.8.1.7.6 Parameter Intervals for the Cache Update

This time period specifies the length of time in 1/10 second that is allowed to elapse between the cache update cycles.
Permitted values are in the range of 2 to 255.

5.8.1.7.7 Parameter Network Status Address

Specifies the address to which a 4-byte sequence, representing the network status, is transmitted to the PLC. All commonly used PLC addresses are valid here. No address must be defined, if the network status is not to be transmitted to the PLC.

5.8.1.8 Additional Error Messages

Since the gateway represents a full-size terminal, all error messages which might be generated with the associated direct PLC-interfacing, could be generated here as well. For details on these messages see the respective sub-chapter 5.x.

The following additional messages might be generated for the gateway:

Code	41	E_CACHE_READ	Error during read-access to the PLC-cache
	42	E_EGB_READ	Error during read-access to the gateway-poll area
	43	E_EGB_WRITE	Error during write-access to the gateway-poll area
	44	E_NETZ_ADDRESS	The address-syntax (variable definition) of one of the slave-terminals does not match the PLC-protocol of the gateway.
	45	E_NETZ_WRITE	Error during transmission of the network status to the PLC.
	46	E_NO_GATEWAY_PARA	No gateway parameters are available. If necessary, store and compile files once more using a new TS programming software.

In the event of these error messages, the sub-code will always supply the error numbers of the respective communications protocol (see error numbers of the respective direct PLC-interfacing in chapter 5.x).

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5.8.2 DIN-Messbus - Slave

5.8.2.1 General Information

TesiMod operating terminals allow for a simple networking via the DIN-Messbus regardless of the bus master being used. Every slave-terminal in the network has access to the data of the bus master.

Connecting the slave-terminals to a PLC by means of a gateway (see 5.8.1), allows the masks and variable definitions to be created in accordance with the same procedure as is used with the direct PLC-interfacing. It is merely necessary to adapt the interface parameters to the DIN-Messbus.

This offers the user of TesiMod operating terminals the following advantages:

– Random write and read access to any data within the PLC. Data of existing PLC programs can be displayed and modified directly in the operating terminal. It is not necessary to adapt the PLC program in any respect since it is not required that communications data be stored in a specified address area or data type area.

– The transmission of messages, the write coordination byte as well as the status of the function key LEDs is effected by the bus master in the event-controlled mode.

– No configuration required within the PLC.

– The protocol provides error control. Transmission errors are detected and, if possible, eliminated by repeating the transmission. A noise-immune interface hardware in accordance with the RS485 interface standard permits the application even in a harsh industrial environment.

– Interface parameters are stored in the mask definition. Altering of the parameters is also possible in the setup mask of the terminal at any time.

– The graphical operator guidance offers the user a maximum of assistance in defining the variable addressses within the mask definition. The definitions (abbreviations) used here are identical with the definitions used within a PLC program (e.g. F3 = flag 3).

5.8.2.2 Technical Description

The bus master (process computer or gateway to the PLC) is connected to the slave through the DIN-Messbus (DIN 66348).

The services (user data of the DIN-Messbus protocol) required for the exchange of data are defined in the TesiBus specification.

To reduce the load on the bus, it is possible for each slave-terminal to be equipped with its own read-only data cache. The address location as well as the size of this cache will be determined by way of negotiation between bus master (gateway) and slave-terminal during the synchronization process. The

bus master broadcasts the cache data to each slave-terminal in an equidistant fashion. The cache data will then be stored locally by each slave-terminal.

If a slave-terminal has a read request which is located within the cache area, no communication will be carried out via the gateway to the PLC, but the data are rather copied locally from the terminal cache.

Variables which have been assigned the attribute display once and which are located within the cache area, will be displayed once more after receipt of the next cache packet. The gateway transmits the cache data in an equidistant fashion thus permitting the execution of a high-priority and speedy output which is independent of the general cyclic output cycle.

5.8.2.3 Protocol Parameters for DIN-Messbus -Slave

The DIN-Messbus - slave interfacing requires setting of the following parameters for the interface X2:

Baud rate: 300, 600, 1200, 2400, 4800, 9600, **19200**, 38400, 375000, 500000 Baud
Parity: none, **even**, odd
Data length: 5, 6, **7**, 8
Stop bits: **1**, 1.5, 2
Handshake: **no handshake**, hardware handshake, software handshake

The default settings are printed in **bold**.



It is also possible to select a smaller baud rate. The baud rate setting for the gateway and the setting for the slave terminal must be in agreement.

5.8.2.3.1 Parameter Timeout for Order-Reply

Whenever the slave requires data from the controller, it will start a timer. This timer allows monitoring of the following two processes: whether the slave-terminal is polled by the master and whether the response is received from the bus master within this period of time.
Permitted values are in the range of 0 to 65000 ms.
Specify a value of 0 if you wish to work without the function *timeout monitoring*. The absolute time value depends on the number of stations in the network, it should, however, be equal to a value of approximately 2000 to 5000 milliseconds.

5.8.2.3.2 Parameter Timeout for Cache-Update

Since the receiving station can not acknowledge the broadcast service, the slave-terminal employs a timeout to monitor the point of time at which broadcasted data were received. This will ensure that local cache data are not “of any given point of time in the past”.
Permitted values are in the range of 0 to 65000 ms.
The value depends on the cache-update interval of the bus master (see gateway parameters). The default value should correspond to a value of 5000 milliseconds.

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5.8.2.3.3 Parameter Slave Number

Allows defining of the slave number of the respective slave-terminal. To be able to load the same mask definition into every slave-terminal, an invalid slave number can be entered here. Subsequently, when connecting the terminal to the network, a correct slave number must be entered into the setup mask with the aid of the system variable **ComSlaveNr**.
Permitted slave numbers are in the range of 1 to 31.
Any invalid values will be set to 255 (OxFF) during the terminal startup.

5.8.2.4 Data Types

In general, all data types available for the comparable direct PLC-interfacing are available here as well.

5.8.2.5 Additional Functions

The transmission of the functions:
– Messages,
– Write coordination byte,
– LEDs of the function keys,
is effected by the bus master (gateway) in an event-controlled mode.

5.8.2.6 Physical Interfacing

TesiBus - Pinning

Slave-terminals			Gateway	
1	Shield	<———>	1	Shield
2	**TD+**	<———>	**3**	**RD+**
3	**RD+**	<———>	**2**	**TD+**
4	RTS+		4	RTS+
5	CTS+		5	CTS+
6	TxC-		6	TxC-
7	RxC-		7	RxC-
8	SGND	<———>	8	SGND
9	**TD-**	<———>	**10**	**RD-**
10	**RD-**	<———>	**9**	**TD-**
11	RTS-		11	RTS-
12	CTS-		12	CTS-
13	TxC+		13	TxC+
14	RxC+		14	RxC+
15	n.c.		15	n.c.

The following applies:
– all slave-terminals in the network are connected in parallel
– the TD connector of the master must be connected to the RD connector of the slave and vice versa.
– the termination at the first and the last of the terminals in the network must be activated.

5.8.2.7 Bus Cable Gateway - Slave - Terminals

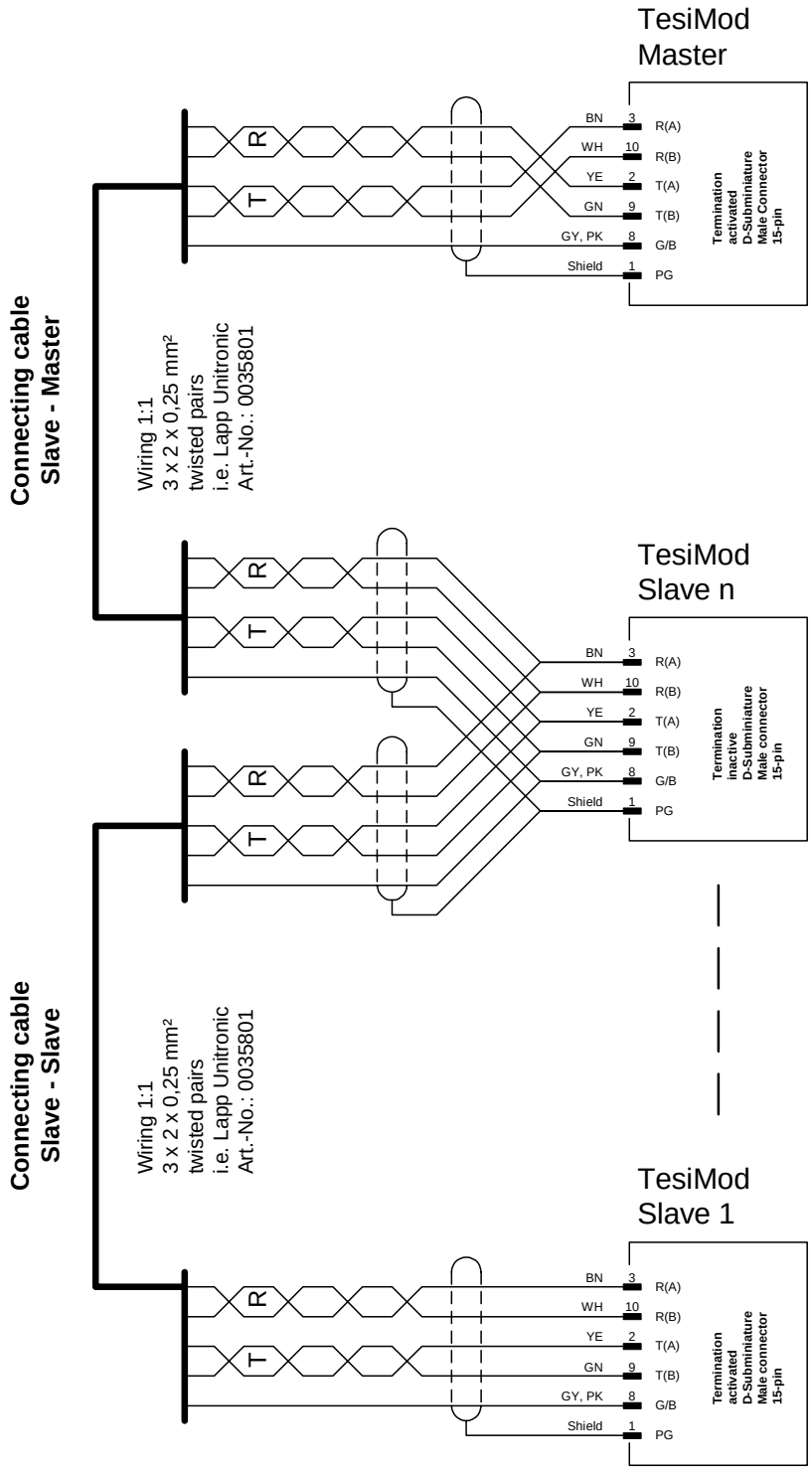


Figure 5.8-3: Connecting Cable for DIN-Messbus

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5.8.2.8 Error Messages

Code	30	E_SLAVE_NAK	Even after a repeated attempt, slave was unable to transmit transmission data to master (NAK from the master)
	31	E_SLAVE_TIMEOUT	Even after a repeated attempt, slave was unable to transmit transmission data to master (TA has elapsed)
	32	E_SEND_ORDER_TIMEOUT	Slave was unable to transmit its order within the timeout.
	33	E_ORDER_REPLY_TIMEOUT	Slave has not received the reply to the transmitted order within the timeout.
	34	E_CACHE_TIMEOUT	Slave has not received the data broadcasted by the cache within the timeout.