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Modbus/RTU

5.20 Modbus/RTU

TesiMod operating terminals allow for a simple connection to the AEG-Modicon 984 PLCs thus makingTesiMod operating terminals the perfect man-machine-interface for your Modicon 984 PLC.

The hardware and software components of the TesiMod system are fully adapted to the parameters and marginal conditions of the programming unit interface.

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

– Random read and write access to any data within the PLC.

– The operating terminal automatically polls the freely definable data areas for cyclic data.

– No configuration required within the PLC.

– The programming unit protocol is handled entirely by the firmware of the PLC. A PLC program (function blocks, etc.) in the PLC is not required for the handling of the communication.

– The protocol provides error control. Transmission errors are detected and, if possible, eliminated by repeating the transmission.

– The interface parameters of the communications interface SER1 are defined in TSwin in a protocol-specific manner and are stored in the mask definition. Modifying of the parameters is also possible in the set-up mask or any other I/O mask of the terminal at a later point of time.

– The graphical operator guidance offers the user a maximum of assistance in defining the variable addresses within the list of variables. The definitions (abbreviations) used here are the definitions familiar to the users of 984 PLCs.

The operating terminal can perform a master or a slave function when connected to the Modbus.

The protocol parameters that are used to determine whether the operating terminal is to serve as master or slave can be set via TSwin.

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5.20.1 Protocol Parameters

It is **not** necessary to alter the interface parameters in the PLC as the TesiMod operating terminal adapts to the default parameters of the programming unit interface.
To ensure proper connection do **not** modify the parameters.

Baud rate:	300, 600, 1200, 2400, 4800, **9600**, 19200, 38400, 375000, 500000 Baud
Parity:	none, even, **odd**
Data bits:	5, 6, 7, **8**
Stop bits:	**1**, 5.1, 2
Handshake:	**no handshake**, software handshake, hardware handshake

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

5.20.1.1 Parameter Maximum Waiting Time for Response

This parameter indicates the period of time that the operating terminal waits for the response from the PLC.
Permitted values are in the range of 10 ms to 2550 ms.
The default value is 1000 ms.

5.20.1.2 Parameter Delay Until Connection Setup

This parameter indicates the period of time that the operating terminal waits before making the initial access to the PLC.
Permitted values are in the range of 1000 ms to 25000 ms.
The default value is 5000 ms.

5.20.1.3 Parameter Slave Number

This parameter indicates whether the operating terminal performs as a master or as a slave.
– 0 for master
– 1 to 255 for slave
The default value is 0.

5.20.1.4 Parameter Half Duplex

This parameter indicates, whether the connection between the operating terminal and the controller is established as a half duplex or full duplex connection.
The default setting is full duplex connection.

5.20.1.5 Parameter Initialize Range B

If you have marked the check box for this parameter, the master must write into the B area during the first communication. The B area is initialized by that. Please refer to chapter *5.20.5 Data Exchange*.

5.20.1.6 Parameter Controller

This parameter indicates the connected controller. Select the connected controller by marking the apropriate check box.
Possibilities:
- Address is decremented by 1, F-Codes 1, 2, 3, 4, 5, 6, 15, 16
- Address remains unchanged, F-Codes 1, 2, 3, 4, 5, 6
- Address remains unchanged, F-Codes 1, 2, 3, 4, 5, 6, 15, 16
- Address remains unchanged, F-Codes 1, 2, 3, 4, 15, 16

5.20.2 Master / Slave Connection

Master Connection
The TesiMod operating terminal is connected to the programming unit interface, Modbus-interface, of the Modicon 984 PLC.
The Modicon 984 PLC always represents a slave at the programming unit interface while the operating terminal is always required to perform as a master.
The programming unit interface is a RS232-interface. It allows only point-to-point-connections, i.e. one terminal, one PLC.
With an appropriate interface conversion of the Modicon 984-RS232 to RS485, a bus system can be established on the RS485 basis, in which the operating terminal is capable of addressing several PLCs.

The interconnection between the TesiMod operating terminal and the Modicon 984 PLCs is effected in the RTU mode by means of the Modbus protocol.

Slave Connection
Each bus using the Modbus protocol allows TesiMod operating terminals to be connected as a slave.

5.20.3 Data Type Structure

a) Alphanumerical Texts
The texts are stored in the memory byte for byte in ascending address order.

b) Binary Variables with a Length of 1, 2 or 4 Bytes
Data with a length of 2 bytes are interpreted in the PLC-conformal byte order for words.
Data with a length of 4 bytes are interpreted in the byte order for long words.

c) Floating Point Numbers
Floating point numbers are interpreted in the IEEE floating point format.

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5.20.3.1 Data Types

The following data types are available for a direct user access.
The access is specified by means of the reference number.
The address must be programmed as a 6-digit number.

Type	Description	Access
000000	Bit	Read and Write
100000	Bit	Read Only
300000	Word	Read Only
400000	Word	Read and Write

Table 5.20-1: Data types

Variable Name	Address
Read and Write Bit from Data Area 0	0xxxxx
Read Only Bit from Data Area 1	1xxxxx
Read Only Word from Data Area 3	3xxxxx
Read and Write Word from Data Area 4	4xxxxx

Table 5.20-2: Input syntax for the variable list of TSwin sorted by data areas

Variable Name	Address	Function Code
Read and Write Bit from Data Area 0	B1xxxxx	Read with FC1 / Write with FC5 or 15
Read Only Bit from Data Area 1	B2xxxxx	Read with FC2
Read Only Word from Data Area 3	W4xxxxx	Read with FC4
Read and Write Word from Data Area 4	W3xxxxx	Read with FC3 / Write with FC6 or 16
Read Only Double Word from Data Area 3	D4xxxxx	Read with FC3
Read and Write Double Word from Data Area 4	D3xxxxx	Read with FC3 / Write with FC6 or 16

Table 5.20-3: Input syntax for the variable list of TSwin sorted by function codes

5.20.4 Additional Functions

In addition to the random read and write access to PLC variables, a memory area comprising 12 bytes (default) is specified in the mask definition as poll area.

Only marginal conditions regarding this memory area:
– the PLC must be able to access in bit-mode and the operating terminal in word-mode
– the memory area must be contiguous.
The address position of this memory area is specified in TSwin.

This area must be programmed with the reference 4, i.e. word area.

Example: The cyclic poll area is set to 400010 in the programming system.

Word Address	Reference	High Byte	Low Byte
Word Address + 0	400010	Write Coordination Byte	Reserved
Word Address + 1	400011	Message Channel High Byte	Message Channel Low Byte
Word Address + 2	400012	Function Keys LED 1 to 4	Function Keys LED 5 to 8
Word Address + 3	400013	Function Keys LED 9 to 12	Function Keys LED 13 to 16
Word Address + 4	400014	Function Keys LED 17 to 20	Function Keys LED 21 to 24
Word Address + 5	400015	Function Keys LED 25 to 28	Function Keys LED 29 to 32

Table 5.20-4: Word structured poll area

5.20.5 Data Exchange

The exchange of data between operating terminal and master is effected by means of a cyclic exchange of two data areas, a read area and a write area. These areas must be available in both, slave as well as the master.
The master ensures that the data of these areas are exchanged.
The areas are limited to a size of **200** bytes each.
The master exchanges the data via the address 4xxxxx or the function code 3.

The operating terminal, being a slave, is not capable of initiating bus events. All operating terminal accesses to data are therefore made to the local non-retentive RAM area.
This RAM is strictly divided into two address areas:

Area A:
This address area contains all of the variables that are modified by the PLC.
These variables are only displayed by the operating terminal.
These variables can also be read by the PLC.
Examples: output variables, poll area, status messages

This area is addressed by the master and the operating terminal via the base address **0x0000**.

Area B :
This address area contains variables which are modified and displayed by the operating terminal (i.e. by the operator or the firmware of the operating terminal).
These variables are only read by the PLC and are backed by the battery of the PLC.
Examples: editing variables, mask number, read coordination byte

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This area is addressed by the master and the operating terminal via the base address **0x03e8 (1000$_{dec}$)**.

Write operations by the master are only to be made to area A.
Read operations by the master may be made from areas A and B.

Tasks Performed Once by the Bus Master

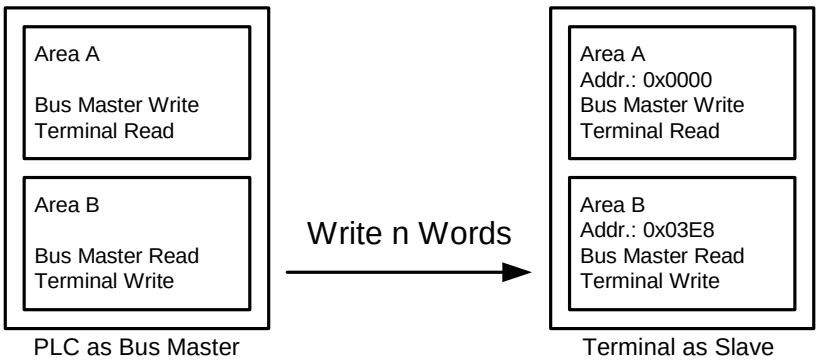


Figure 5.20-1: Initialisation of area B by the master

To prevent incorrect values from being processed by the operating terminal, this initialisation process must be performed prior to any other commmunication.
Upon any access made prior to the initialisation, the operating terminal will transmit error code 200 as part of a telegram, thereby informing the master of the initialisation not having occurred.

Tasks Performed by the Bus Master at Cyclic Intervals

Via the Modbus commands, the bus master is responsible for mutually updating both areas by means of the commands WRITE n WORDS or READ n WORDS.

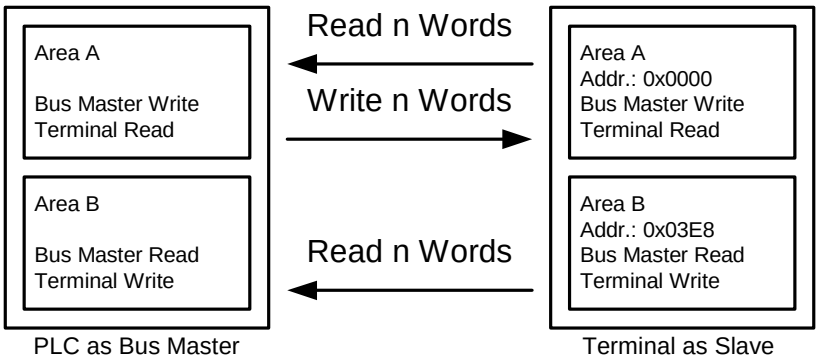


Figure 5.20-2: Initialisation of area B by the master

After area B has been initialized, this area is not to be written to by the master. Error code 202 will be transmitted as part of a telegram.

If the terminal has been switched off, another write operation to area B, i.e. an initialization, is required. If new initialization data need to be transmitted from the master to the terminal, the operating terminal must be switched off in order to activate a new initialization.

Note:

Poll Area:
The poll area contains the memory location for the message of the serial message channel. The coordination of the transmissions between PLC and operating terminal is subject to a fixed sequence. The message number written by the PLC is reset to 0 by the operating terminal. This informs the PLC that the message has been fetched.
This is the only event in which the operating terminal writes to area A!
By reading area A, the master detects the acknowledgment indicating that the message has been fetched.

Bit Access:
The different data types are physically located either on area A and area B on the same address area of the operating terminal. That means the bit and word area are not separated.
Example:
The address 400000 contains the address 000000 to 000015 (Area A).
The address 401000 contains the address 001000 to 001015 (Area B).

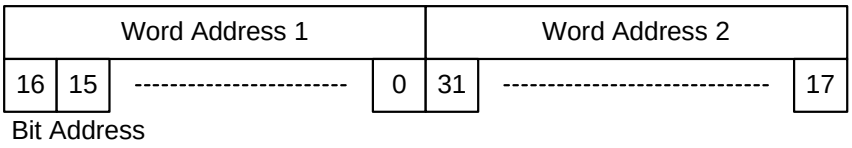


Figure 5.20-3: Word and bit address

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5.20.6 Physical Interfacing

Pin	Designation	Function
1	nc	not connected
2	RD	Receive Data
3	TD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	nc	not connected
7	RTS	Request To Send
8	CTS	Clear To Send
9	nc	not connected

Table 5.20-5: Pin assignment X2 RS232

Pin	Designation	Function
6	TD	Transmit Data
15	CTS	Clear To Send
17	RTS	Request To Send
18	RD	Receive Data
25	SGND	Signal Ground

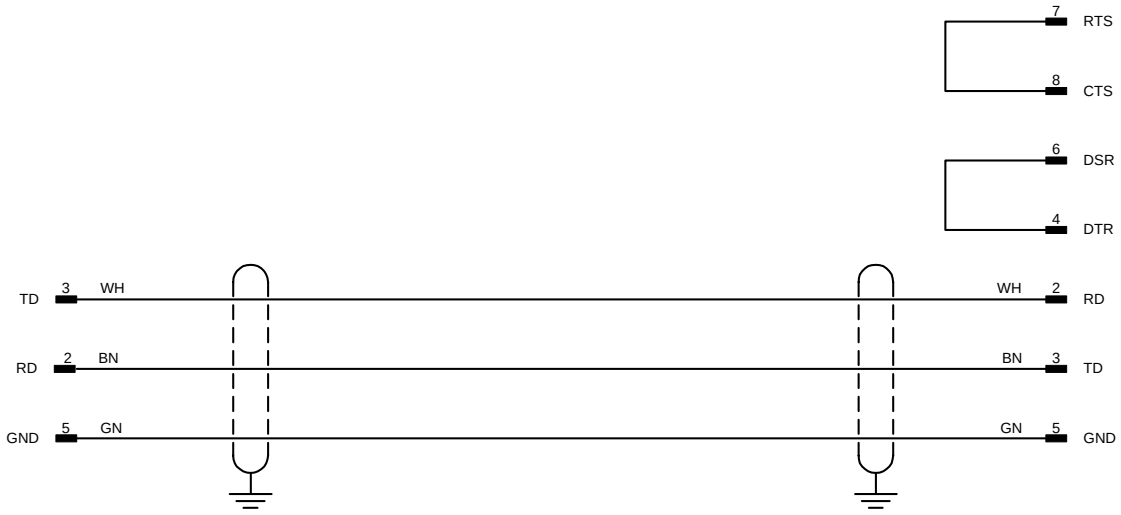
Table 5.20-6: Pin assignment universal interface SER1 RS232

5.20.6.1 Connecting Cable RS232 - Modicon 984 Modbus (9-pin)

The following wiring diagram does not apply to terminals with univeral interface.

TesiMod
Operating Terminal

AEG
Modicon 984



D-Subminiature
Male Connector
9-pin

D-Subminiature
Male Connector
9-pin

Each end of the shield is connected to the metallic enclosure

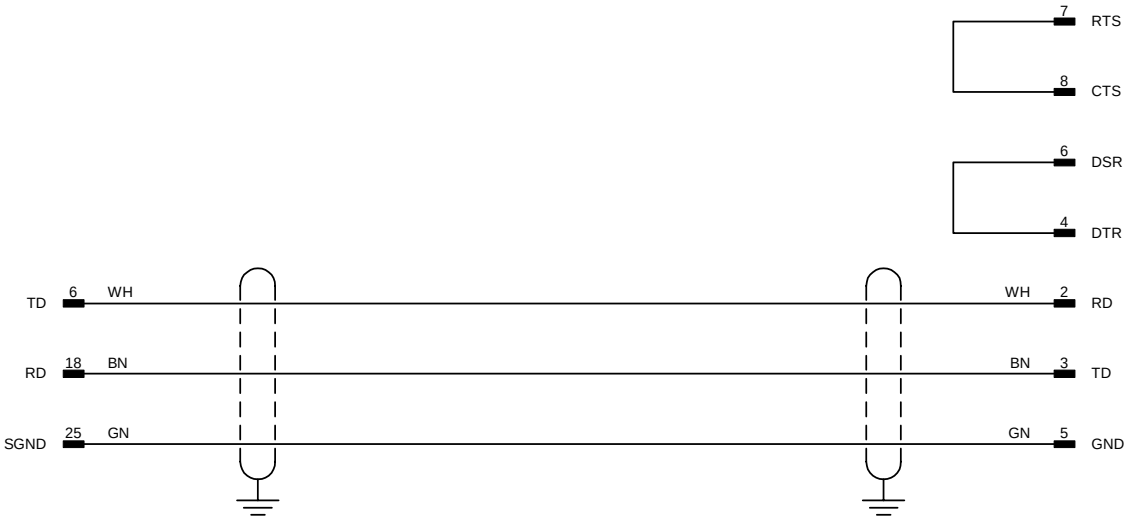
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5.20.6.2 Connecting Cable Universal Interface SER1 RS232 - Modicon 984 Modbus (9-pin)

The following wiring diagram applies to terminals with univeral interface only.

TesiMod
Operating Terminal

AEG
Modicon 984



D-Subminiature
Male Connector
25-pin

D-Subminiature
Male Connector
9-pin

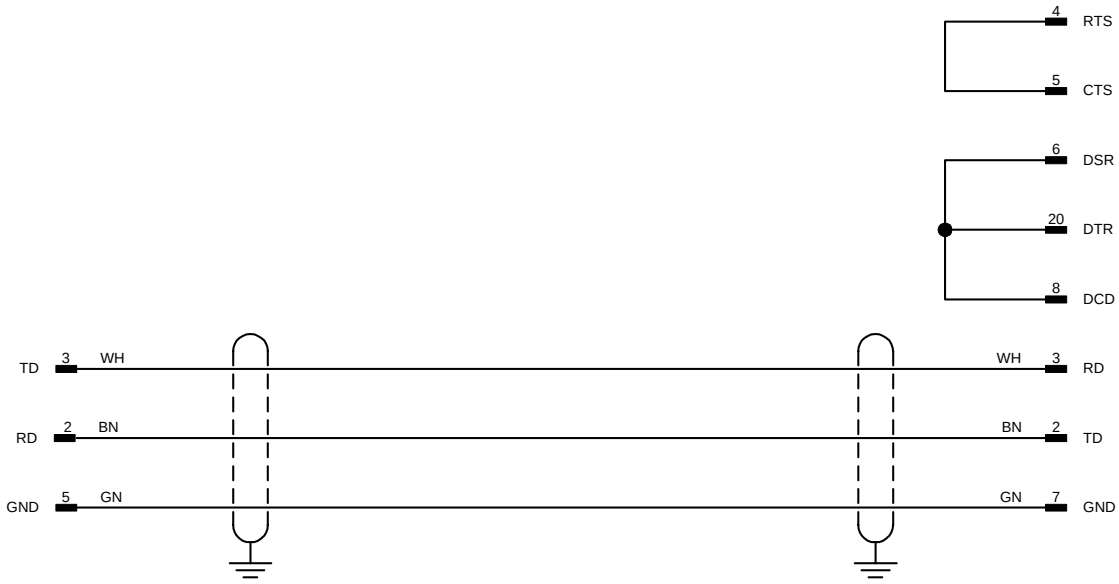
Each end of the shield is connected to the metallic enclosure

5.20.6.3 Connecting Cable RS232 - Modicon 984 Modbus (25-pin)

The following wiring diagram does not apply to terminals with univeral interface.

TesiMod
Operating Terminal

AEG
Modicon 984



D-Subminiature
Male Connector
9-pin

D-Subminiature
Male Connector
25-pin

Each end of the shield is connected to the metallic enclosure

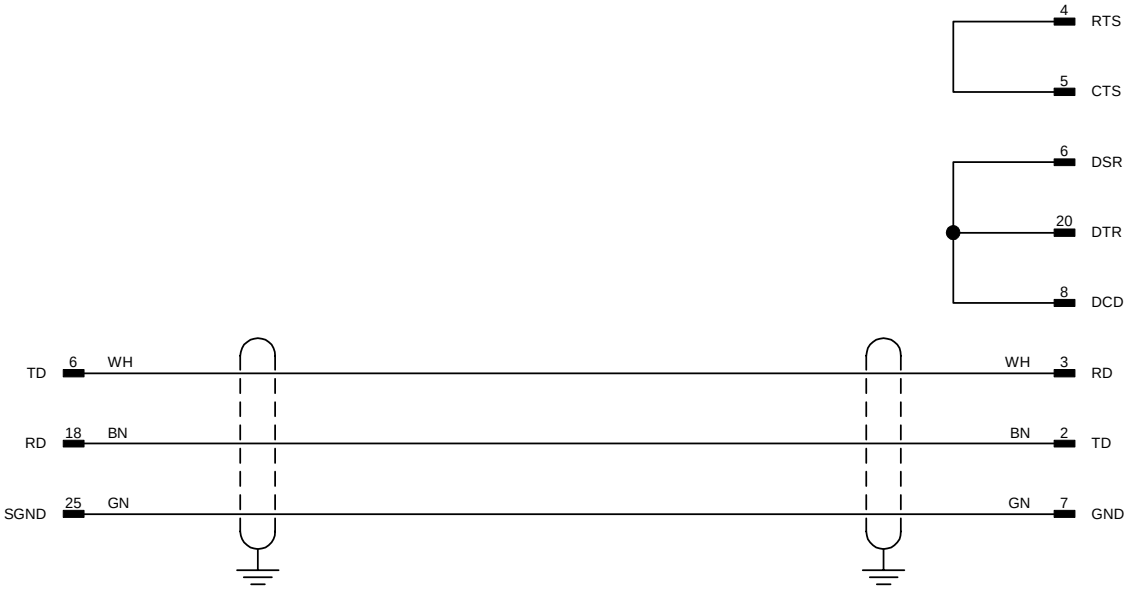
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5.20.6.4 Connecting Cable Universal Interface SER1 RS232 - Modicon 984 Modbus (25-pin)

The following wiring diagram applies to terminals with univeral interface only.

TesiMod
Operating Terminal

AEG
Modicon 984



D-Subminiature
Male Connector
25-pin

D-Subminiature
Male Connector
25-pin

Each end of the shield is connected to the metallic enclosure

5.20.7 Error Messages

Code 1

Subcode

1	E_SLAVE_NOT_READY	Slave not ready
2	E_PROTOKOL	Sequence of the packets
3	E_FRAME	Protocol frame error
4	E_TIMEOUT	Timeout error
5	E_CRC_BCC	CRC error
6	E_PARITIY	Parity error
7	E_SEND_ABORT	Send process aborted
8	R_REC_ABORT	Receive process aborted
9	E_BUF_SIZE	Insufficient cyclic buffer
10	E_NO_DEFINE	No cyclic data defned
12	E_DEFINE	Cyclic data already defined
15	E_NO_PROTOCOL	Selected protocol is not supported
16	E_OVERRUN	Receive overrun
40	E_SYS_ADDRESS	Undefined system variable
50	E_FREE_MEMORY	No free memory for slave mode

Code 2

Subcode

60	E_RESPONSE_TIMEOUT	Master mode: no response from slave
68	E_RECEIVE_COUNT	Number of data received is incorrect
70	E_NO_POLL	Slave mode: terminal is not polled

Code 3 Error messages when operating terminal is set to master mode

Subcode

1	Invalid function code
2	Invalid address
3	Invalid data value
4	General abort
8	Address is write-protected

Error messages in the reply telegram when operating terminal is set to slave mode

Subcode

200	Area B is not initialised
202	Master writes to area B (after initialisation)

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