



Procontrol P14

87TP50R1210

Module and Application Description
Coupling Module Modbus

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Coupling Module Modbus

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TABLE OF CONTENTS

| | |
|--|-----------|
| TABLE OF CONTENTS | 5 |
| 1. APPLICATION | 7 |
| 2. FEATURES | 7 |
| 3. DATA EXCHANGE BETWEEN PROCONTROL AND EXTERNAL SYSTEM 8 | |
| 4. DESIGN OF THE MODULE | 8 |
| 5. FUNCTION | 8 |
| 5.1 Addressing | 8 |
| 5.2 Programming | 8 |
| 5.3 Settings..... | 9 |
| 6. MODBUS PROTOCOL | 10 |
| 6.1 Protocols | 10 |
| 6.2 Mode of operation..... | 10 |
| 6.2.1 Function | 10 |
| 6.2.2 Protocol Control | 10 |
| 6.2.3 Data exchange | 10 |
| 6.2.4 Transmission mode | 10 |
| 6.2.5 Telegram format | 10 |
| 6.3 Protocol sequence..... | 11 |
| 6.3.1 Function codes..... | 11 |
| 6.3.2 Execption responses..... | 11 |
| 6.3.3 Transmission sequence | 12 |
| 7. TYPE AND STRUCTURE OF DATA RECORDS | 13 |
| 7.1.1 Binary values..... | 13 |
| 7.1.2 Analog values..... | 13 |
| 8. CONFIGURATION WITH THE ABB MODBUS CONFIGURATION TOOL .. | 14 |

| | | |
|------------|---|-----------|
| 8.1.1 | General Settings | 14 |
| 8.1.2 | Modbus RTU | 14 |
| 8.1.3 | Modbus TCP | 14 |
| 8.1.4 | Settings for signal mapping | 15 |
| 9. | INTERFACES..... | 17 |
| 9.1 | Interface for the Modbus system | 17 |
| 9.2 | Interface for the service computer | 17 |
| 10. | DIAGNOSIS AND ANNUNCIATION FUNCTIONS | 18 |
| 10.1 | Disturbance annunciations on the module | 18 |
| 10.2 | Disturbance messages to the annunciation system | 18 |
| 10.3 | External system diagnosis | 22 |
| 11. | FUNCTION DIAGRAM..... | 24 |
| 12. | MODULE DESIGN | 25 |
| 13. | SYSTEM DATA..... | 27 |
| 14. | TECHNICAL DATA..... | 27 |
| 14.1 | Power supply | 27 |
| 14.2 | Interfaces | 27 |
| 14.2.1 | Modbus system | 27 |
| 14.2.2 | Service Computer | 28 |
| 14.2.3 | Interference Immunity (of the Process Inputs and Outputs) | 28 |
| 15. | ORDERING DATA | 28 |
| 16. | THIRD PARTY SOFTWARE COMPONENTS AND LICENSES | 29 |
| 16.1 | The GNU General Public License (GPL-2.0)..... | 29 |
| 16.2 | MIT License..... | 32 |
| 16.3 | Microsoft Public License | 32 |
| 17. | REVISION HISTORY | 33 |

1. APPLICATION

The Coupling Module 87TP50R1210 is used to connect external systems to the PROCONTROL system using the Modbus protocol. It is intended to control the data exchange between the PROCONTROL station bus and the interface of an external device.

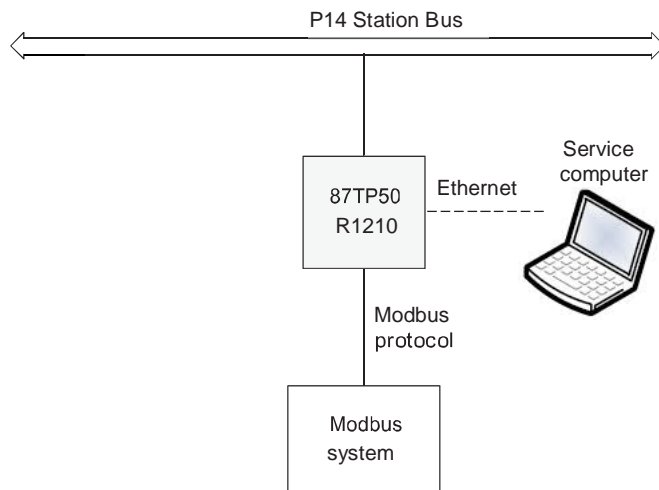


Figure 1: 87TP50R1210 System Overview

2. FEATURES

The module can be plugged into any station of PROCONTROL systems using Master Station, FDDI or HSR. It uses a standard interface with the PROCONTROL station bus. For general module compatibility refer to Product Note "8VZZ000410T0001 Product Note Module Compatibility Procontrol P14".

The module 87TP50R1210 controls the protocol to the Modbus system and performs the required data conversions.

The module requires redundant +24 V operating voltages USA and USB. The operating voltages refer to reference conductor Z.

On the module front, indicators signal the following conditions:

- ST Disturbance
- SG Module disturbance
- SK1 Disturbance of communication with the Procontrol system
- SK2 Disturbance of communication with the external system

- RUN Active
- DKS Data communication with the service computer
- DK1 Data communication with the Procontrol system
- DK2 Data communication with the external system

- LNK Link status, Ethernet connected
- ACT Display link and activity status combined

The interface for the connection to the external device is available on the process connector.

On the module, 3 potential-isolated interfaces are provided for serial protocol MODBUS RTU. RS232, RS485, RS422 interfaces are used as a point-to-point connection.

Analog and binary signals are exchanged between the PROCONTROL system and the external system. Format and assignments of these signals depend on the protocol used.

The module uses a service interface according:

- Structuring the signal connections between PROCONTROL and external system via signallist,
- Configuration of protocol settings

3. DATA EXCHANGE BETWEEN PROCONTROL AND EXTERNAL SYSTEM

A maximum of 5000 signals can be transferred according to the following allocations in both directions:

- 1 up to 15 single binary signals using 1 telegram or
- 1 analog value using 1 telegram

The data formats depend on the protocol used.

According to the allocations defined above, each 87TP50R1210 coupling module can be used to maximally transmit the following telegrams:

Data telegrams from PROCONTROL to an external system

- 1000 send-location telegrams (reception via address list)

Data telegrams from an external system to PROCONTROL

- 200 send-location telegrams

For increasing the number of data telegrams from the external system to PROCONTROL up to three slots can be reserved besides the 87TP50R1210 slot. Due to the mechanical design the 87TP50R1210 reserves two slots per default.

4. DESIGN OF THE MODULE

The module essentially consists of:

- Station bus interface
- Processing section
- Ethernet and serial interface

5. FUNCTION

After loading the configuration data from the service computer, the module automatically generates the address lists and the configuration which is necessary to handle the protocol with the external system. Depending on the priority (master/slave) the module starts transmitting the data or waits for the appropriate protocol calls from the external system. In accordance with the default PROCONTROL standard protocol, data is transferred in event mode and additionally in cyclic mode between the 87TP50R1210 module and the PROCONTROL system. Please refer to chapter 6.5 for detailed information.

According to the Modbus system protocol used, the program performs the required format conversions and marshalling operations on the 87TP50R1210.

The following converting operations are possible:

- Single-bit marshalling from any bit position in the PROCONTROL telegram to any position in the external-system data format and vice versa.
- Format-conversions for analog values
- Generation of standard telegrams.

5.1 Addressing

The 87TP50R1210 can send up to 800 send-location telegrams under 4 consecutive slot addresses. Using its own slot address, the module sends 200 send-location telegrams. First transmission as well as subsequent value changes in the telegrams are transmitted over the PROCONTROL bus per event. Then, transmission will be cyclic.

The PROCONTROL address for the output of send-location telegrams is generated from:

- System address: corresponding to the system address of the bus system.
- Station address: corresponding to the station address where the 87TP50R1210 is plugged into.
- Module address: corresponding to the slot address of the module (also slot address +1...3 possible for putting out send-location telegrams in the range 200-800; these addresses must not be used by adjacent modules).
- Register address: 0 ... 199; specified by the user.

The PROCONTROL data type is specified by the user.

5.2 Programming

All data required for data transmission, mainly address and marshalling information as well as parameters for the interface (e.g. type and baud rates) are transferred from the service computer to the module in XML lists using the required format.

Refer to *8VZZ000480T0001 Procontrol P14 User Manual Modbus Configuration Tool* for detailed description.

5.3 Settings

The module must be configured with the options switch S1 for operation within a HSR system, FDDI system or a Master Station system in order to support the corresponding remote bus protocol.

Options switch S1:

| No. | Position | Meaning |
|-----|----------------------------|--|
| 1 | OFF | Not used |
| 2 | OFF | Not used |
| 3 | OFF | Not used |
| 4 | OFF | Not used |
| 5 | OFF | Not used |
| 6 | OFF | Not used |
| 7 | OFF (Default) ON | HSR or FDDI remote bus protocol (Default) Master Station remote bus protocol |
| 8 | OFF | Not used |

In transmission mode RTU, the usage of the RS485 interface requires a bus termination, whereas the usage of RS232 or RS422 interface don't allow a bus termination.

The termination is enabled/disabled by the jumpers X134, X135, X136 and X137.

All jumpers must always be set to the same position!

Jumpers X134 – X137:

| Jumper Position | Meaning |
|------------------------|------------------------------------|
| 1 – 2 | bus termination is enabled |
| 2 – 3 (Default) | bus termination is disabled |

6. MODBUS PROTOCOL

6.1 Protocols

The following protocols are implemented:

- MODBUS RTU
- MODBUS TCP

6.2 Mode of operation

6.2.1 Function

MODBUS protocol is implemented on 87TP50R1210 with priority Master and Slave.

Master mode

In master mode the device exchanges data with the slave via point-to-point connection. The 87TP50R1210 controls the data exchange with the external system.

Maximum 5 slaves are supported using RTU mode with RS485 or TCP mode with Ethernet, RTU mode with RS422 and RS232 will support only one slave.

Slave mode

In slave mode the device exchanges data with a master via point-to-point connection. The external system controls the data exchange with the 87TP50R1210.

6.2.2 Protocol Control

The MODBUS protocol is an order-based protocol. The protocol control always follows orders/instructions from the master to the slave. The slave responds to the orders with appropriate answers/data and executes the instructions. The slave does not send by itself.

6.2.3 Data exchange

The 87TP50R1210 is **only** used for the **process data exchange** between the PROCONTROL control system and an external system. **(Data level)**

Therefore it can **not** transmit, display and/or change hard-coded values, structures or programs in both directions. **(System level)**

The 87TP50R1210 only uses the programmed addresses, data and structures. Optional accesses outside the range from the 87TP50R1210 to the external system or from the external system to the 87TP50R1210 are not allowed.

Direct access from operate, display, diagnostic, programming or documentation systems are not supported.

6.2.4 Transmission mode

The 87TP50R1210 can operate with both possible transmission settings, TCP or RTU.

| | |
|-----|--|
| TCP | Transmission Control Protocol Transmission in TCP/IP packages |
|-----|--|

| | |
|-----|--|
| RTU | Remote Terminal Unit Transmission in HEX-format |
|-----|--|

The settings for the character format, checksum and record format are described in the 'Reference Guide' (refer to <http://www.modbus.org/tech.php>).

6.2.5 Telegram format

The general protocol sequence provides the master sending an order telegram to the slave. The slave executes the order and responds with the appropriate data.

For the detailed structure and the assignment of the individual bytes in the telegrams refer to the 'Reference Guide' (refer to <http://www.modbus.org/tech.php>). With Modbus TCP all telegrams are automatically packed into TCP/IP frames on the device.

Basic telegram structure:

| | |
|-----------------|---------------|
| - Address | Slave address |
| - Function code | Order |
| - Data | Data field *) |
| - Error check | Checksum |

*) At the beginning the data field can contain address and length information of the transmitted data field.

6.3 Protocol sequence

The MODBUS-protocol specifies several requests and instructions, so-called function codes, for the control of the protocol sequence by the master and the data exchange. The slave responds with data or with one of the defined response codes, the so-called exception response codes.

The 87TP50R1210 operates with the following settings:

| | |
|----------|--------|
| Priority | Master |
| | Slave |
| Mode | RTU |
| | TCP |

The master is not using any diagnostic functions. When using diagnostic function code 08 the call data record is returned mirrored.

The following described instructions and responses are part of the 87TP50R1210. The functional scope in the connected external system are manufacturer-specific and not part of this description. It can deviate from the functional scope of the 87TP50R1210.

6.3.1 Function codes

The 87TP50R1210 can execute the following orders passive or active in each function.

| <i>Function code</i> | <i>Description</i> | <i>Meaning</i> |
|----------------------|--------------------------|------------------------------|
| 01 | read coil status | read single value output |
| 02 | read input status | read single value input |
| 03 | read holding registers | read register output |
| 04 | read input registers | read register input |
| 08* | loopback diagnostic test | diagnosis loop test |
| 15 | force multiple coils | write multiple single values |
| 16 | force multiple registers | write multiple registers |

Only the function codes listed above are implemented on 87TP50R1210!

*At function code 08 the call data record is returned mirrored.

The write and read functions are necessary for the process data exchange between the 87TP50R1210 and the external system. They are executed automatically in the protocol sequence.

6.3.2 Exception responses

The 87TP50R1210 can create or process the following response codes in each function.

| <i>Response code</i> | <i>Description</i> | <i>Meaning</i> |
|----------------------|----------------------|--------------------|
| 01 | illegal function | not allowed action |
| 02 | illegal data address | false data address |
| 03 | illegal data value | false data value |

All other response codes are not supported!

6.3.3 Transmission sequence

Several operating modes can be passed during data transmission. The autostart behavior of the 87TP50R1210 ensures the new set up of data transmission after a connection failure.

INITIALIZATION

After power ON or after loss of connection the program of the 87TP50R1210 runs through the initialization. Settings for the protocol are loaded from the programmed configuration list and work files for the data implementation are applied. The address list is generated and the protocol for the telegram receiving is started. Errors occurring during the creation of the assignment and work files are displayed via the LEDs on the front panel of the device.

Then all programmed data are read from the external system, checked to formal correctness and integrity and saved on the internal memory. Errors occurring during this process are displayed via the LEDs on the front panel of the device.

After the current data from both systems are available they are released for sending to the partner system. All latest data are transmitted.

The duration of the initialization depends on the number of number of the signals, which needs to be transmitted to the Modbus system. Approximately 1 minute can be assumed.

OPERATION

After the first complete transmission the device switches to the operate mode.

All programmed data from the external system are read cyclically via the MODBUS-protocol and checked for changes through old/new value comparison. Changed data are transmitted to the PROCONTROL-system for event transmission.

All telegrams from the PROCONTROL-system are checked for changes through old/new value comparison. Changed data are transmitted to the external system or hold for transmission, depending on the configuration.

MONITORING

All data are checked for correctness and integrity. The LEDs on the front panel of the device display recognized errors.

Monitoring of transmission

All transmitted data sets are secured with a parity bit and CRC (cyclical redundancy check) checksum.

The received data set is checked. Faulty data sets are rejected and requested again. After 3 (default value) unsuccessful requests an error message occurs.

The continuous process of the protocol is monitored with different times:

- **Character Supervision Time (only for Modbus RTU)**
The monitoring time between two received characters is managed by hardware. After this time the next characters are considered as a new telegram, independent from the last transmission.
- **Response Supervision Time**
The monitoring time between order and response at the master is configurable.
The default setting is 2500 ms. After this time the order is repeated.
- **Retry Count**
The maximum number of repeats is configurable.
The default setting is 3. If no correct transmission is achieved an error message occurs.

Drain monitoring

A separate drain monitoring checks all data to be received from both systems. If the monitoring responds, an error will be displayed via the LEDs on the front panel.

Reaction in case of disturbance

All transmitted data are checked for errors. Incorrect data are not processed from the 87TP50R1210. The LEDs on the front panel of the device display recognized errors.

In case of transmission errors the 87TP50R1210 tries to get a correct transmission by repetition (default = 3 times). If one of the actions cannot be executed correctly, the next action of the protocol sequence is executed. The result is an error message via LEDs.

PROCONTROL to external system

Disturbed received and marked telegrams (fault bit) are not processed. The old value is transmitted to the external system. An error message follows.

External system to PROCONTROL

Disturbed received data from the external system are not processed. The old value is transmitted to the PROCONTROL-system with fault bit. An error message follows.

7. TYPE AND STRUCTURE OF DATA RECORDS

The MODBUS-protocol provides the following data formats. They all can be created and processed from the 87TP50R1210.

Procontrol P14 data types 25 and 26 are not supported by 87TP50R1210. All other P14 data types are supported.

7.1.1 Binary values

The binary value in the MODBUS-system can be a single binary value or a binary value within a 16-bit register.

SINGLE BINARY VALUE

MODBUS-indication: LOGIC

Value: 0, 1 B (Binary)

Single binary values of one system can be marshalled on the 87TP50R1210 from any bit position in one system to any bit position of the other system.

Marshalling in standard feedback telegrams to the PROCONTROL system is also possible. For this purpose, data types DA = 19, 20, 21, 22, 23, 24 are available in the PROCONTROL system.

15 single binary values from the external system can be grouped and transmitted within the PROCONTROL system using data type DA=1 (bit position 1-15). Bit position=0 is used for the disturbance bit (SB).

Single binary values from the PROCONTROL system can be transmitted as single values or grouped in one register to the external system.

BINARY REGISTER

MODBUS-indication: REG16

Value 0000 H – FFFF H (Hexadecimal)

Binary registers from the external system will be transmitted in unchanged condition in the PROCONTROL system using data type DA=0 (bit position 0-15). With this data type, there is no disturbance bit (SB) on bit position=0. Bit 0 also includes a process signal.

Attention: If values from these registers are connected to the Process Operator Station (POS), there will be a fault flag for the measuring circuit at bit 0= 1. For signals directed to the POS, bit position 0 must therefore not be used for process data.

Binary registers from the PROCONTROL system are transmitted in unchanged condition (bit position 0-15) to the external system.

7.1.2 Analog values

DATA TYPE INT16

MODBUS-indication: INT16

Value: -32767 < 0 < +32767 D (Decimal)

In the PROCONTROLsystem, data type INT16 corresponds to an analog value of data type DA=5 within value range -100% <0%< +100 %, or a counter reading of 0 - +32767, represented in the form of data type DA=29. In the case of analog values of DA=5 (without disturbance) smaller than -6.25 %, the 87TP50 will set the disturbance bit (SB) in the PROCONTROL telegram.

PROCONTROL telegrams of DA=5 or counter readings of DA=4, DA=29, can be converted into MODBUS format INT16.

DATA TYPE UINT16

MODBUS-indication: UINT16

Value: 0 < +65535 D (Decimal)

In the PROCONTROL system, MODBUS data type UINT16 corresponds to an analog value of data type DA=5 within a value range of 0%< +100 %, or a counter reading of 0 < +65535, represented in the form of data type DA=29.

PROCONTROL telegrams of DA=5 or counter readings of DA=4, DA=29, can be converted into MODBUS format UINT16.

In the case of overflow of DA=4, the highest value will be transmitted together with a disturbance bit.

Gain and offset are taken into consideration. In the case of range violations, the highest/lowest value will be transmitted together with a disturbance bit.

8. CONFIGURATION WITH THE ABB MODBUS CONFIGURATION TOOL

The following specifications needs to be done during the configuration of the interface. They can be taken from the Modbus system application description and signallist.

All configurations are done in the Modbus Configuration Tool and transferred with the configuration list to the 87TP50R1210.

See 8VZZ000480T0001 Procontrol P14 User Manual Modbus Configuration Tool for details.

8.1.1 General Settings

These entries are necessary for the configuration of the MODBUS-interface. All can be set with a default value. Adaptations needs to be done in planning, if the external system interface deviates from the default.

| <i>Meaning</i> | <i>Default setting</i> | <i>Possible input</i> | <i>Unit/Step</i> |
|--------------------|------------------------|-------------------------|------------------|
| Module Type: | 87TP50R1210 | Fixed | |
| Module Address: | x,xxx,xx | System, Station, Device | |
| Module Location: | NNCCNN CCNNN | KKS, AKS | |
| Protocol Type: | - | MODRTU, MODTCP | |
| Address Expansion: | 0 | 0-3 | |
| Analog Supression: | 10000 (= 10 s) | 0-10000 | 1 ms |
| Analog Treshold: | 68 | 1-68 | 0,1% Step= 1 |

8.1.2 Modbus RTU

| <i>Meaning</i> | <i>Default setting</i> | <i>Possible input</i> |
|-------------------------|------------------------|---|
| Priority: | M | M (Master), Sxxx (Slave, xxx = Slave address) |
| Transmission rate: | 9600 | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 |
| Interface Type: | RS232 | RS232, RS422, RS485 |
| <u>Character format</u> | | |
| Start bit: | 1 | |
| Data bit: | 8 | |
| Parity bit: | even | even, odd, none |
| Stop bit: | 1 | 1, 2(only if parity is none) |

The following specifications may only be changed during commissioning for optimization.

| <i>Meaning</i> | <i>Default setting</i> | <i>Possible input</i> | <i>Unit/Step</i> |
|-----------------------------|------------------------|---|------------------|
| Retry Count: | 3 | 0-9 | 1 |
| Request delay: | 0 (= 0 ms) | 0-2550 | 1 ms |
| Character supervision time: | 20 (= 20 ms) | 0-2550 | 1 ms |
| Response supervision time: | 2500 (= 2500 ms) | 0-25500 | 1 ms |
| Read Cycle Interval: | 0 (= Event Mode) | 1-8; 0; 10 | 1 s |
| | | 0 means Event Mode | |
| | | 10 means Toggle Mode (Read cycle / Write cycle) | |
| Write Cycle Interval: | 1 (= 1 s) | 0-8 | 1 s |

8.1.3 Modbus TCP

| <i>Meaning</i> | <i>Default setting</i> | <i>Possible input</i> |
|-----------------|------------------------|---|
| Priority: | M | M (Master), Sxxx (Slave, xxx = Slave address) |
| Interface Type: | Ethernet | Fixed |

Allocation of Slave-Address to IP-Address

| | | |
|----------------|-----------------|-------|
| Slave Address: | xxx | 1-254 |
| IP-Address: | xxx.xxx.xxx.xxx | |

The following specifications may only be changed during commissioning for optimization.

| <i>Meaning</i> | <i>Default setting</i> | <i>Possible input</i> | <i>unit/step</i> |
|----------------------------|------------------------|---|------------------|
| Retry Count: | 3 | 0-9 | 1 |
| Request delay: | 0 (= 0 ms) | 0-2550 | 1 ms |
| Response supervision time: | 2500 (= 2500 ms) | 0-25500 | 1 ms |
| Read Cycle Interval: | 0 (= Event Mode) | 1-8; 0; 10 0 means Event Mode 10 means Toggle Mode (Read cycle / Write cycle) | 1 s |
| Write Cycle Interval: | 2 (= 2 s) | 0-8 | 1 s |

8.1.4 Settings for signal mapping

| <i>Meaning</i> | <i>Possible input</i> |
|--|--|
| Signal Type: | EG, AG (AG = output, EG = input) |
| Signal Designation Code: | KKS, AKS |
| Signal Designation Code 2: | Additional KKS |
| Signal Definition: | Textual description of the signal |
| Signal status: | Textual description of the signal status |
| P-Address | System, Station, Device |
| P14 System address: | 0...3 |
| P14 Station address: | 1...249 |
| P14 Device address: | 1...58 |
| P-Register: | 0...199 |
| P-Bit: | 0...15 |
| P-DA (P14 Data type): | 0...28 |
| P-MD (P14 Measurement Range): | 0...3 |
| F-Slave Address | Function Code + Modbus register |
| Function Code: | HC, IC, HR, IR |
| Modbus Register: | 0-9999 |
| F-Signaladdress: | 1-254 |
| F-Bit: | |
| F-Signalttype (Modbus system Signal Type): | LOGIC, REG16, UINT16, INT16 |
| Signal 0%: | -32767...32767 |
| Signal 100%: | -32767...32767 |

Examples for MODBUS-addresses:

The Modbus address consist of the Function code which is represented by the nomenclature as described in the following table and the Modbus address (without offset).

| Modbus Function Code | Function Code | Meaning | Description | Modbus Signal Type |
|----------------------|---------------|------------------------------|--------------------------|--------------------|
| 01 | HC | read single value output | read coil status | LOGIC |
| 02 | IC | read single value input | read input status | LOGIC |
| 03 | HR | read register output | read holding registers | REG16, INT16 |
| 04 | IR | read register input | read input registers | REG16, INT16 |
| 15 | HC | write multiple single values | force multiple coils | LOGIC |
| 16 | HR | write mutiple registers | force multiple registers | REG16, INT16 |

HR0019 : Read register 0019
HC0001 : Write coil 0001

Examples for Signal 0% and Signal 100%:

In the P14 system all values are represented in %. Therefore a conversion of an integer value, which is per definition for a signed integer (INT16) a value between -32768 and 32767, is always mandatory.

Per default 0% in P14 systems corresponds to an integer value of 0.

100% in P14 systems corresponds to an integer value of 32767.

It is also possible to define other ranges e.g. 0% to 200%. This can be done with the following configuration in the signallist:

Signal 0% = 0

Signal 100% = 16384

If an integer value of 32767 is received from Modbus it will be interpreted as 200% in the P14 system.



9. INTERFACES

9.1 Interface for the Modbus system

TCP/IP-Interface is available on the front-side of the module on connector X1.

The three possible RTU interfaces according to RS232, RS422 and RS485 are available on connector X21. However, only one type of interface with the Modbus system can be used at the same time.

Please consider to connect signal transmit data link (TXD) with signal receive data link (RXD) and vice versa.

INTERFACE ACCORDING TO RS232 (STANDARD)

| <i>Signal</i> | <i>Meaning</i> |
|---------------|-----------------------------|
| RXD | Receive data |
| TXD | Transmit data |
| SGND | Signal ground |
| Screen | Connection for cable screen |

INTERFACE ACCORDING TO RS422 (STANDARD)

| <i>Signal</i> | <i>Meaning</i> |
|---------------|----------------|
| RXD+ | Receive data |
| RXD- | Receive data |
| TXD+ | Transmit data |
| TXD- | Transmit data |
| SGND | Signal ground |

INTERFACE ACCORDING TO RS485 (STANDARD)

| <i>Signal</i> | <i>Meaning</i> |
|---------------|----------------|
| RXD/TXD-A | Receive data |
| RXD/TXD-B | Transmit data |
| SGND | Signal ground |

9.2 Interface for the service computer

The service computer is connected to 87TP50R1210 via connector X2 on the front-side of the module.

10. DIAGNOSIS AND ANNUNCIATION FUNCTIONS

10.1 Disturbance annunciations on the module

Defects of the module or of the interfaces are recognized and indicated by the diagnostic functions of the module.

On the module front, several LEDs are located for indicating disturbances and operating states.

Disturbance annunciations (red)

| | |
|-----|---|
| ST | All disturbances of the module and disturbances in the data communication with the module. |
| SG | Module disturbance, activated in case of internal module disturbances |
| SK1 | Disturbance of communication 1, activated in case of disturbed data exchange with the Procontrol system |
| SK2 | Disturbance of communication 2, activated in case of disturbed data exchange with the external system |

Status annunciations (green)

| | |
|-----|---|
| RUN | Running signal, activated in steady light, when the processor is operating. Flashing, when the module is ready and waiting for an Ethernet connect or a valid configuration list is missing. |
| DKS | Data communication with service computer, activated when data transfer is taking place on the interface to the service computer |
| DK1 | Data communication 1, activated when any data exchange with the Procontrol system is taking place |
| DK2 | Data communication 2, activated when any data exchange with the external system is taking place |
| LNK | The green LED is on if the Ethernet is connected (Link). |
| ACT | The yellow LED is asserted (solid ON) when the link is up. Receive or activity causes the LED to blink regardless of the link status (Activity combined with Link). |

Diagnosis- and Status- Information stored on the module can be read out using PDDS by selecting operation mode Diagnosis and entering commands RRE, RDI and RST.

10.2 Disturbance messages to the annunciation system

The annunciation system and the Control Diagnosis System CDS receives the disturbance messages from the module via the Procontrol remote bus.

Diagnosis

In the processing section of the module the received telegrams, the generation of the telegrams to be transmitted and the internal signal processing are monitored for errors (self-diagnosis).

If a disturbance occurs, the type of the disturbance is stored in the diagnosis register 246 and a disturbance signal is transmitted to the PROCONTROL system at the same time.

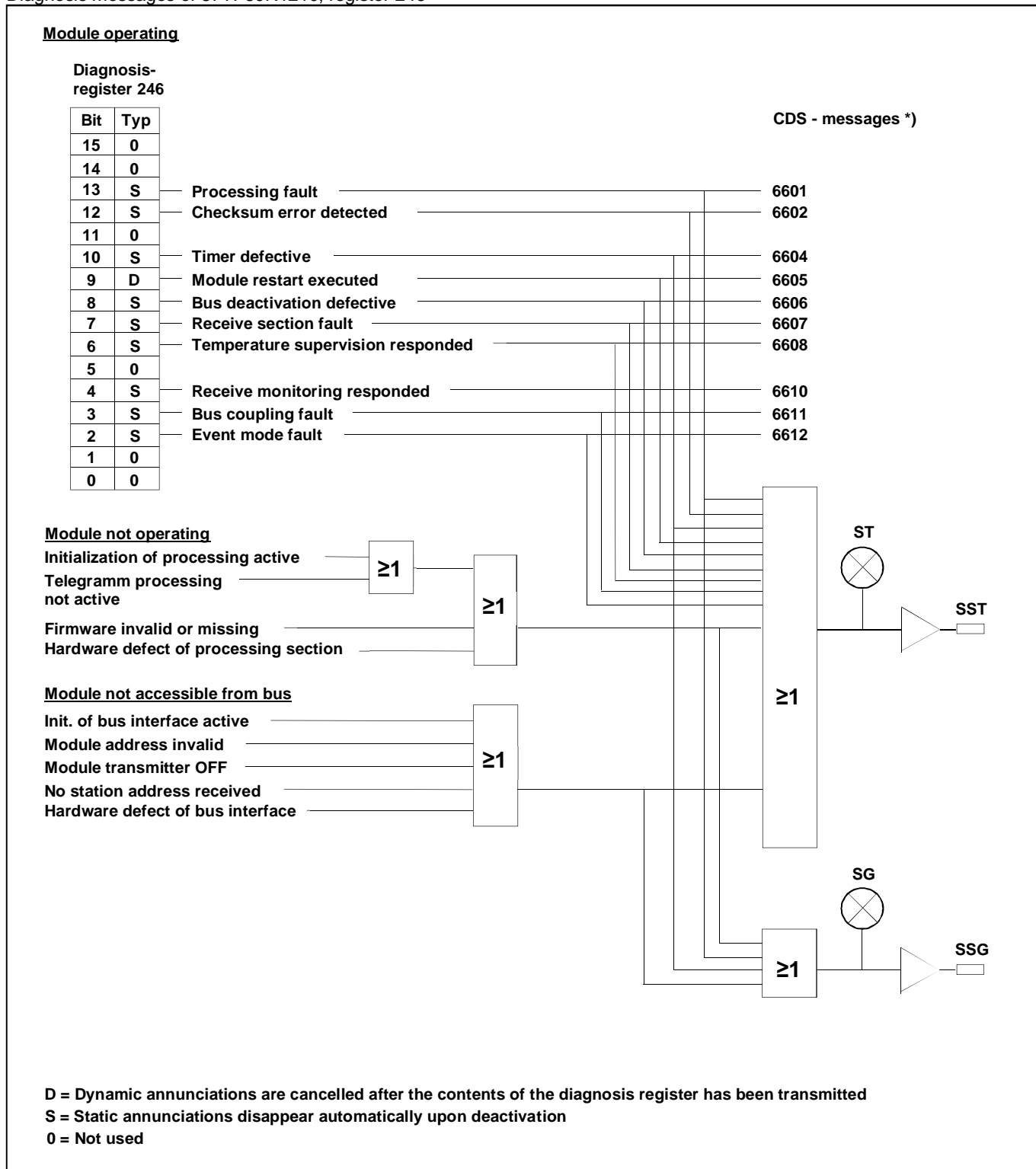
When requested, the module transmits a telegram which contains the data stored in the diagnosis register (register 246). The contents of the diagnosis register, the signals on the general disturbance lines, the messages on the CDS, and lamps ST and SG are shown below.

If message "Processing fault" is indicated in the diagnosis register, this may be due to one of the following reasons:

- No valid configuration list.
- Mismatch Procontrol module address - Configured module address
- Internal module voltages disturbed.
- Hardware fault on the module.

For detailed information regarding diagnosis message "Processing fault" background register 227 is to be evaluated.

Diagnosis messages of 87TP50R1210, register 246



- *) The Control Diagnosis System (CDS) provides a description for every message number. This description comprises:
- Information on cause and effect of the disturbance
 - Recommendations for elimination.
- Thus, fast disturbance elimination is ensured.

Any detected disturbance of the Procontrol system sets the LED **SK1** On.

Background register 204

EG number of missed P14-signal

If several EG numbers are missed, the last recognized EG number is displayed.

| Bit | diagnosis information |
|----------|------------------------|
| 15 -0 | EG number missed (dec) |

Background register 206

| Bit | Status information |
|----------|---|
| 15 -0 | Processing status, Disturbed: 06 ; Active: 09 |

Background register 210

| Bit | Status information |
|----------|-------------------------------------|
| 15 -8 | Typcode (fix) of the module: 7B hex |
| 7-0 | Firmware Version (hex) |

Background register 224

| Bit | status information |
|----------|----------------------------------|
| 15 -0 | IP address High configured (hex) |

Background register 225

| Bit | Status information |
|----------|---------------------------------|
| 15 -0 | IP address Low configured (hex) |

Background register 227
Detailed diagnosis for "processing fault" (register 246/bit 13)
Detailed diagnosis for "bus coupling fault" (register 246/bit 3)

| Bit | Diagnosis information (register 246/bit 3) |
|------------|---|
| 15 | <i>Not used</i> |
| 14 | <i>Ethernet link disturbed</i> |
| 13 | <i>Configuration list not loaded</i> |
| 12 | <i>Configuration list checksum error</i> |
| 11 | <i>Not used</i> |
| 10 | <i>Not used</i> |
| 9 | <i>Not used</i> |
| 8 | <i>Not used</i> |
| Bit | Diagnosis information (register 246/bit 13) |
| 7 | <i>Not used</i> |
| 6 | <i>Not used</i> |
| 5 | <i>Data exchange with the Modbus system is disturbed</i> |
| 4 | <i>Data exchange with the Procontrol system is disturbed (Receive monitoring responded)</i> |
| 3 | <i>Not used</i> |
| 2 | <i>No connection to Modbus: no response from any slave / no query from a master</i> |
| 1 | <i>Not used</i> |
| 0 | <i>Mismatch Procontrol module address - Configured module address</i> |

10.3 External system diagnosis

Any detected disturbance of the external system sets the LED **SK2** On.
The LED **SK2** will be set Off after three Modbus polling cycles without any disturbance.

Modbus errors detected by the protocol stack as well as the current status of each configured slave connection are stored in following background registers.

Background register 205

| Bit | diagnosis information |
|----------|--|
| 15 -0 | Current Modbus poll cycle time in sec (range 0.00 – 99.99) |

Background register 211

AG number of missed Modbus signal:
If several AG numbers are missed, the last recognized AG number is displayed.

| Bit | diagnosis information |
|----------|------------------------|
| 15 -0 | AG number missed (dec) |

Background register 229

Bits 1 to 10 are valid in Master configuration only: 0:slave is not planned 1: slave is planned.

| Bit | Status information |
|-----|---|
| 15 | Not used |
| 14 | Not used |
| 13 | Not used |
| 12 | Not used |
| 11 | Not used |
| 10 | Slave 10 planning status |
| 9 | Slave 09 planning status |
| 8 | Slave 08 planning status |
| 7 | Slave 07 planning status |
| 6 | Slave 06 planning status |
| 5 | Slave 05 planning status |
| 4 | Slave 04 planning status |
| 3 | Slave 03 planning status |
| 2 | Slave 02 planning status |
| 1 | Slave 01 planning status |
| 0 | Modbus Configuration; 0=Slave, 1=Master |

Background register 235

Bits 1 to 10 are valid in Master configuration only: 0:slave is inactive 1: slave is active.

In the case of three/four configured module addresses of 87TP50R1210, the next one/two module slots on the right side of the module must not be used.

| Bit | Status information |
|-----|--|
| 15 | Not used |
| 14 | Count of engineered module addresses (max. 4 supported) of 87TP50, indicated in Hex format |
| 13 | |
| 12 | |
| 11 | Not used |
| 10 | Slave 10 connection status |
| 9 | Slave 09 connection status |
| 8 | Slave 08 connection status |
| 7 | Slave 07 connection status |
| 6 | Slave 06 connection status |
| 5 | Slave 05 connection status |
| 4 | Slave 04 connection status |
| 3 | Slave 03 connection status |
| 2 | Slave 02 connection status |
| 1 | Slave 01 connection status |
| 0 | Master / Slave configuration, 0: Modbus slave, 1:Modbus master |

The most important errors detected by the Modbus protocol stack are available in three Modbus error counters, which are stored in background registers 237 to 239.

Background register 237

| Bit | diagnosis information |
|----------|--|
| 15 -0 | Modbus exception code counter 1: Invalid Function Type |

Background register 238

| Bit | diagnosis information |
|----------|---|
| 15 -0 | Modbus exception code counter 2: Invalid Data |

Background register 239

| Bit | diagnosis information |
|----------|--|
| 15 -0 | Modbus exception code counter 3: Invalid Address |

11. FUNCTION DIAGRAM

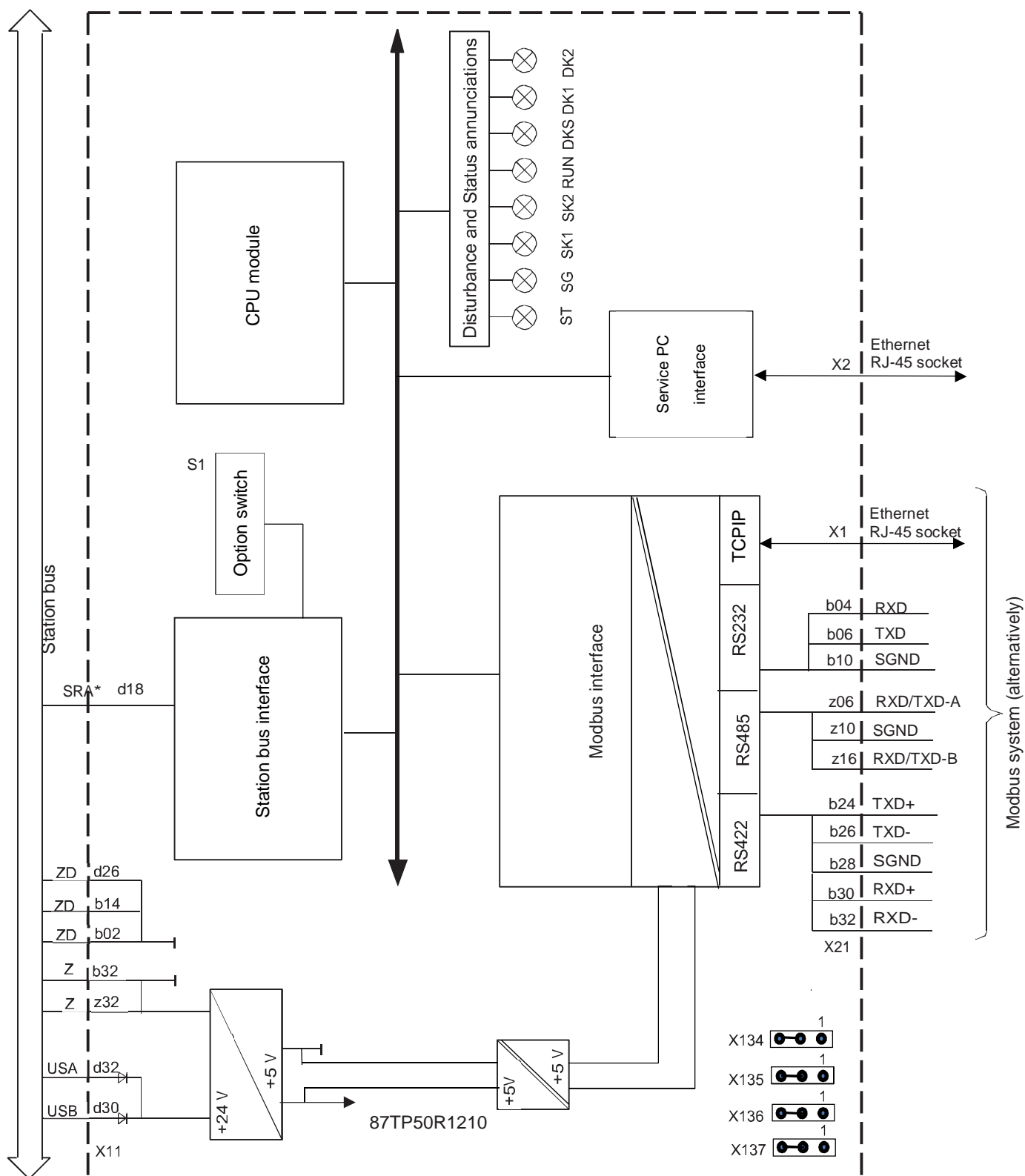
The module is equipped with the connectors X1, X2, X11 and X21.

X2 is the Ethernet interface to service PC,

X1 is the Ethernet interface for Modbus TCP/IP,

X21 contains all interfaces for Modbus RTU,

X11 incorporates the standard interface with the station bus and the operating voltages of the module.



* For proper module function, connector X11/d18 has to be connected to ZD (once per subrack).

12. MODULE DESIGN

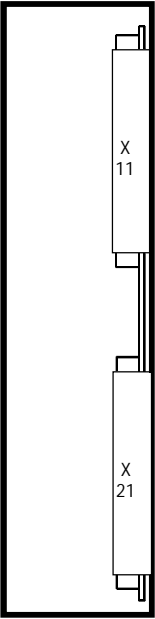
Module size (HxWxL): 261mm x 40mm x 198mm (2 division)

Connector: according to DIN 41 612

- 1 x for station bus connection, 48 pole edge connector, type F (connector X11)
- 1 x for process connection, 32 pole edge connector, type F (connector X21)

Weight: 0,408 kg

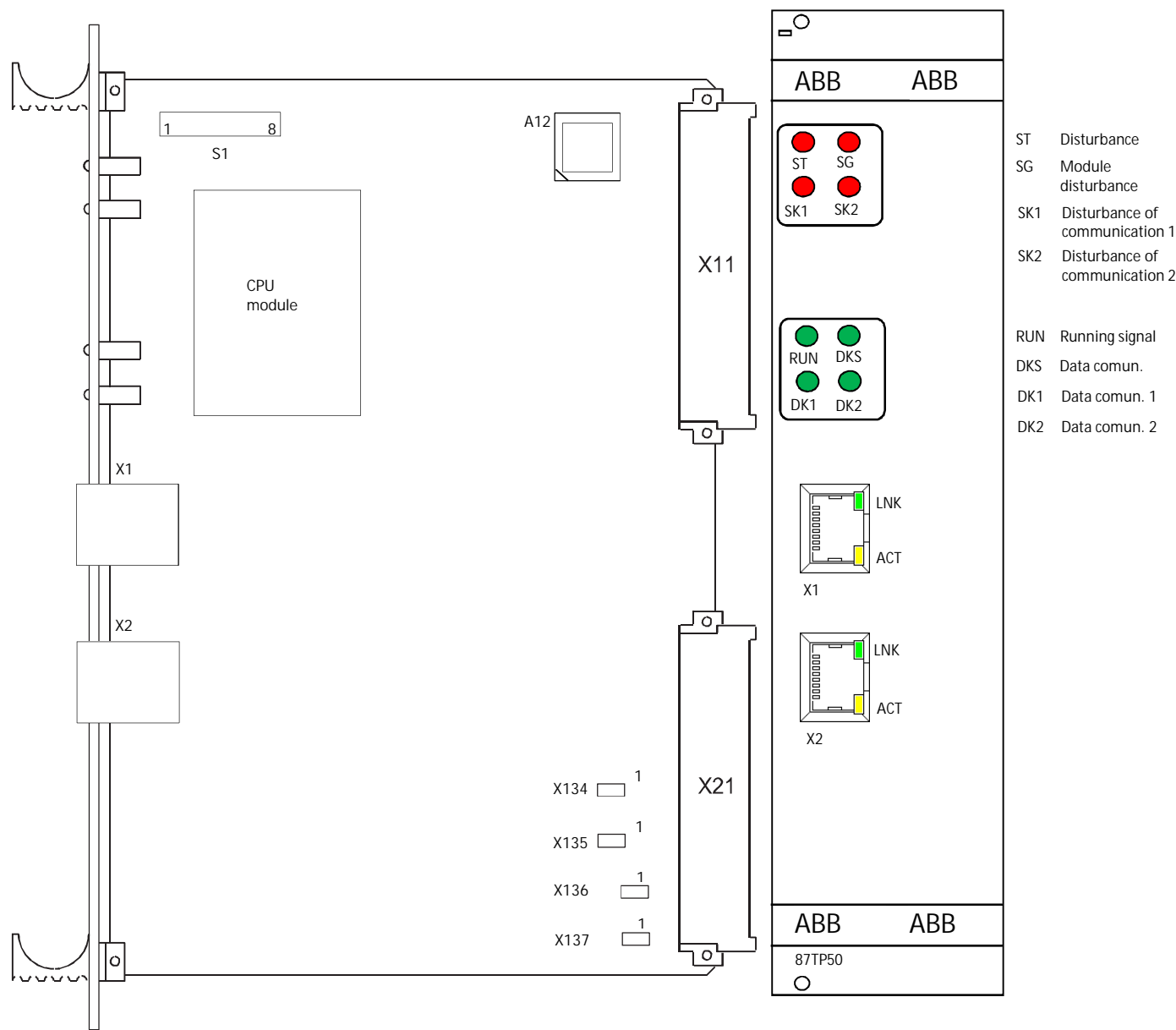
View of connector side:



Contact assignments of process connector X21

| | b | z |
|----|------|-----------|
| 02 | | |
| 04 | RxD | |
| 06 | TxD | RXD/TXD-A |
| 08 | | |
| 10 | SGND | SGND |
| 12 | | |
| 14 | | |
| 16 | | RXD/TXD-B |
| 18 | | |
| 20 | SGND | |
| 22 | | |
| 24 | TxD+ | |
| 26 | TxD- | |
| 28 | SGND | |
| 30 | RxD+ | |
| 32 | RxD- | |

View of module side and module front



13. SYSTEM DATA

| Kind of influence | Environmental Parameter | Standard | Characteristic/Value |
|--|--|--|--|
| Operating conditions | | | |
| Climatic environment | Ambient temperature | IEC/EN 60068-2-2 | 0°C to +70°C, 16h |
| | Relative humidity | IEC/EN 60068-2-78 | 5% to 95% RH |
| | Atmospheric pressure | IEC/EN 60068-1 | 86 kPa to 106 kPa |
| Electromagnetic compatibility (EMC) | Electrostatic discharge immunity | IEC/EN 61000-4-2 Class 3 | Air discharge 8 kV Contact discharge 6 kV |
| | Radiated, radio-frequency, electromagnetic field immunity | IEC/EN 61000-4-3 Class 3 | 80 MHz to 6000 MHz, 10 V/m, 80 % AM (1 kHz) |
| | Electrical fast transient/burst immunity • Supply lines for DC 24 V • Signal lines (I/O and bus lines) | IEC/EN 61000-4-4 Class 3 | 5/50 ns 4 kV 2 kV |
| | Surge immunity • Supply lines for DC 24 V • Signal lines (I/O and bus lines) | IEC/EN 61000-4-5 Class 1/1 Class 3 | 1.2/50 ns 0.5/0.5 kV 2 kV |
| | Immunity to conducted disturbances, induced by radio-frequency fields | IEC/EN 61000-4-6 Class 3 | 0.15 MHz to 80 MHz, 10 V, 80% AM (1 kHz), Source impedance 150 Ω |
| | Radiated emission | CISPR16 / EN 55016 Class A | 30 MHz to 6000 MHz, Limit Class A, group 1 |
| | Immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz • Supply lines for DC 24 V • Signal lines (I/O and bus lines) | IEC/EN 61000-4-16 | 10 / 100 V 10 / 100 V |
| | Ripple on d.c. input power port immunity • Supply lines for DC 24 V | IEC/EN 61000-4-17 | 10 % |
| | Damped oscillatory wave immunity • Supply lines for DC 24 V • Signal lines (I/O and bus lines) | IEC/EN 61000-4-18 | 1 MHz, 10 MHz 1 kV CM, 0.5 kV DM |
| | Voltage dips, short interruptions and voltage variations on d.c. input power port immunity • Supply lines for DC 24 V | IEC/EN 61000-4-29 | Requirements fulfilled through redundant power supply |
| Conditions of storage and transport | | | |
| Climatic environment | Ambient temperature | IEC/EN 60068-2-2 | -40°C to +85°C, 16h |
| | Relative humidity | IEC/EN 60068-2-30 | 5% to 100% RH +25°C to 40°C (6 cycles) |
| | Atmospheric pressure | IEC/EN 60068-1 | 70 kPa to 106 kPa |

14. TECHNICAL DATA

14.1 Power supply

Operating voltage USA/USB
Current consumption
Power dissipation

typ. 24 V, 19,5 ... 30V
approx. 160 mA
4 W

14.2 Interfaces

14.2.1 Modbus system

Type
Baud rate
Maximum distance
Cable type

RS232
2400 ... 19200 baud
15 m
RD-Y(ST)Y-4x2x0,22

| | |
|------------------|----------------------|
| Type | RS422, RS485 |
| Baud rate | 9600 ... 115200 baud |
| Maximum distance | 200 m |
| Cable type | RD-Y(ST)Y-4x2x0,22 |

| | |
|------------------|---------|
| Type | TCP/IP |
| Baud rate | 100Mbps |
| Maximum distance | 100 m |

Number of signals / number of P14 data telegrams

PROCONTROL system to EXTERNAL system: max. 5000 signals out of 1000 P14 telegrams

EXTERNAL system to PROCONTROL system: max. 5000 signals in 800 P14 telegrams,
max. 1000 signals per Modbus slave

Data throughput between an 87TP50R1210 and an external system

The transmission time between the 87TP50R1210 and the external system depends on the signal quantities, the protocol and the response of the external system. Details are given in the application descriptions of the protocols concerned.

Performance

| | |
|-----------------------------------|--|
| Number of telegrams per second | |
| Serial interface with 9600 Baud | 200 telegrams/s \approx 200 analog signals or 3000 binary signals |
| Serial interface with 115200 Baud | 800 telegrams/s (restricted by max. number of P14 data telegrams) \approx 800 analog signals or 12000 binary signals |
| Ethernet interface with 100 Mbps | 800 telegrams/s (restricted by max. number of P14 data telegrams) \approx 800 analog signals or 12000 binary signals |

14.2.2 Service Computer

| | |
|------------------|--------------------------|
| Type | RJ45 100 Base-T Ethernet |
| Baud rate | 100Mbps |
| Maximum distance | 100 m |

14.2.3 Interference Immunity (of the Process Inputs and Outputs)

The product is in conformity with the provisions of the following European Directive:

| | |
|------------|---|
| 2014/30/EC | Directive of the European Parliament and of the Council of 26. Februar 2014 on the harmonization of the laws of member States relating to electromagnetic compatibility (EMC Directive) |
|------------|---|

Conformity to the stated Directive is assured through the application of the following harmonized standards:

| | |
|----------------------------|---|
| EN 61000-6-4: 2007/A1:2011 | Emission standard for industrial environments |
| EN 61000-6-2: 2005/AC:2005 | Immunity for industrial environments |
| EN 61000-6-5: 2015 | Immunity for equipment used in power station and substation environment |

See 2VAA002182R0601_CE-Conformity-P14.pdf for detailed technical data.

15. ORDERING DATA

Order number for complete module:

Type designation: 87TP50R1210

Order number: GKWE860700R1210

Technical data are subject to change without notice!

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- GNU Toolchain 4.2 – GNU General Public Licence (GPL-2.0)

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17. REVISION HISTORY

| Rev. | Chap. | | Date / Initial |
|------|-------|--|------------------|
| A | | Initial document | 08-12-2017 CG |
| B | 6.3.1 | Changed list of supported function codes | 03-01-2018 CG |
| C | 8.2 | Changed diagnosis messages of background register 227 | 20-04-2018 CG |
| D | 7.1 | Correction of interface description | 15-08-2018 CG |
| E | 7 | Not supported data types 25 and 26 | 27-12-2018 |
| F | 10.2 | Adopted diagnosis messages of background register 227 and 229 | 02-04-2019 CG |
| F | 10.2 | Adopted diagnosis messages of background register 204, 205 and 227 | 10-04-2019 SL |
| F | 10.3 | Added diagnosis message of background register 211 | 10-04-2019 SL |
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Power Generation

Wickliffe, Ohio, USA

E-Mail: powergeneration@us.abb.com

www.abb.com/controlsystems

ABB AG

Power Generation

Mannheim, Germany

E-Mail: powergeneration@de.abb.com

www.abb.com/controlsystems

ABB Pte. Ltd.

Power Generation

Singapore

E-Mail: powergeneration@sg.abb.com

www.abb.com/controlsystems