EN CE

akytec

MSD200

Data Logger

User guide

MSD200_3-EN-120596-1.1

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1 Introduction

This manual describes functionality, configuration, operating and installation of data logger MSD200, hereinafter referred to as device or logger.

1.1 Terms and abbreviations

- **CSV** – plane text format designed for tabular data representation, used in the device to create log files on a memory card, can be opened in MS Excel.
- **Modbus** – application layer messaging protocol for client/server communication between devices connected on different types of buses or networks, originally published by Modicon (now Schneider Electric), currently supported by an independent organization Modbus-IDA (***www.modbus.org***).
- **MSD200 Configurator** – configuration software for MSD200, hereinafter referred to as configurator or program.

1.2 Symbols and key words

WARNING
WARNING indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION
CAUTION indicates a potentially dangerous situation that could result in minor injuries.

NOTICE
NOTICE indicates a potentially dangerous situation that could result in damage to property.

NOTE
NOTE indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

1.3 Intended use

The device has been designed and built solely for the intended use described here, and may only be used accordingly. The technical specifications contained in this document must be observed.
The device may be operated only in properly installed condition.

1.4 Improper use

Any other use is considered improper. Especially to note:

- The device may not be used for medical appliances applied to maintain human life or health, its control or other effect on them.
- The device may not be used in explosive environment.
- The device may not be used in atmosphere in which there are chemically active substances.

1.5 Limitation of liability

Our company does not bear any responsibility with respect to breakdowns or damages caused by using the product in a manner other than described in the Manual or in violation of the current regulations and technical standards.

1.6 Safety

WARNING
Ensure the mains voltage matches the voltage marked on the nameplate.
Ensure the device is provided with its own power supply line and electric fuse.

NOTICE
De-energize the device before working on it.
Switch on the power supply only after completing all works on the device.

NOTICE
Supply voltage may not exceed 33 V. Higher voltage can damage the device.
If the supply voltage is lower than 20 V DC, the device cannot operate properly but will not be damaged.

NOTICE
If the device is brought from a cold to a warm environment, condensation may form inside the device. To avoid damage to the device, keep the device in the warm environment for at least 30 minutes before powering on.

2 Overview

MSD200 is intended for data monitoring and logging in industrial automatic control systems. The device can operate as Master or Slave via Modbus RTU / ASCII or AKYTEC protocol over RS485 interface.
The device can be configured with *MSD200 Configurator* software (free) over USB or RS485 interface (*Sect. 4.2*). The software can be downloaded from our homepage ***akYtec.de***.

2.1 Basic features

- 4 analog inputs 0-5 mA, 0-20 mA or 4-20 mA.
- Scaling of measured value.
- RS485 (RS1) and USB interfaces to connect to PC.
- RS485 (RS2) interface to connect to other devices in Modbus network.
- Master or Slave in Modbus network.
- Monitoring of data received from other devices via Modbus over RS485 interface.
- Logging and storing the received data to a memory card in a CSV file.
- Remote access over external modem.
- *MSD200 Configurator* software provides the device configuration and visual tools for process data analyzing.
- Real-time clock.
- 4 status indicators.

2.2 Design

The device is designed in a plastic enclosure for DIN-rail mounting (*Sect. 6*).

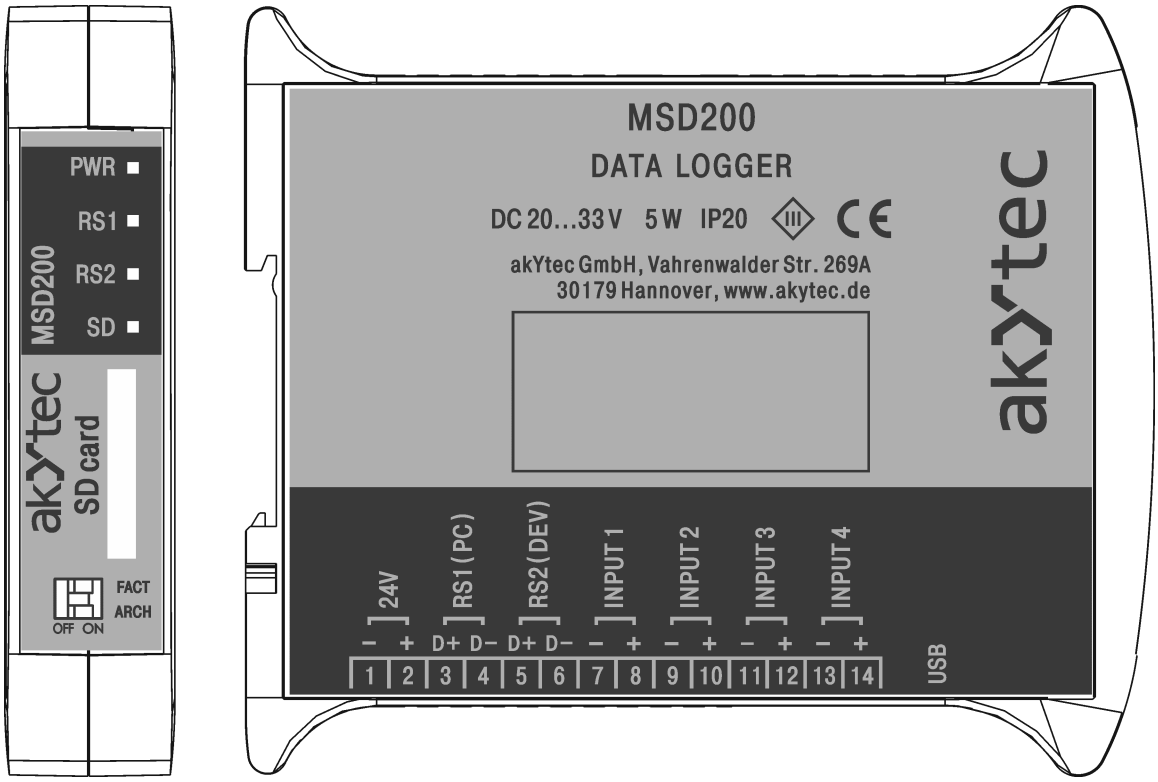


Fig. 2.1 Front and side views

2.3 Control elements

Four LEDs and two DIP switches are on the front panel.

Table 2.1 DIP switches

DIP switch	State	Description
FACT	Off	RS1 interface parameters (device address and baud rate) are set to user settings
	On	RS1 interface parameters are reset to default: Device address = 16 Baud rate = 9.6 kbit/s
ARCH	Off	Stop data logging
	On	Start data logging

Table 2.2 LEDs

LED	Color	State	Description
PWR	—	Off	Supply voltage off or outside the permissible range
	Green	On	Supply voltage inside the permissible range
RS1	—	Off	No data transmission over RS1 or USB
	Green	Flashing	RS1 or USB with user settings, data transmission in progress
	Yellow	On	RS1 or USB with default settings
		Flashing	RS1 or USB with default settings, data transmission in progress
RS2	—	Off	No data transmission over RS2
	Green	On	Interval between data packets
		Flashing	Data packet received over RS2
	Yellow	On	Interval between data packets, query cycle exceeded, no timeout
	Red	On	Interval between data packets, timeout
SD	Red	On	No memory card, data stored to the built-in flash memory
		Flashing	Data loss, memory card or built-in flash memory is full
	Green	On	Logging paused, memory card can be removed
		Flashing	Logging in progress, memory card inserted and CANNOT be removed
	Yellow	On	Memory card inserted, logging stopped

3 Specifications

3.1 Specification tables

Table 3.1 General specification

Characteristic	Value
Power supply	24 (20…33) V DC
Appliance class	III
Power consumption, max.	5 W
Interfaces	2x RS485 (RS1, RS2); 1x USB
Dimensions (with terminal blocks)	23 x 109 x 120 mm
Weight	Approx. 150 g

Table 3.2 Analog inputs

Characteristic	Value
Quantity	4
Input signal	0-5 mA, 0-20 mA, 4-20 mA
Sampling time	100 ms
Basic accuracy	±1.0%
Input resistance	133 Ω
Galvanic isolation between inputs	None

Table 3.3 Logging

Characteristic	Value
Log channels	64
Dataset size (per channel), max.	20 Byte
Memory card type	SD, SDHC, microSD
Memory card capacity, max.	32 GB
Memory card fie system	FAT32
File type	*.CSV
Logging cycle	1…65535 s
Backup battery	CR2032
Backup time	2 years

Table 3.4 RS485 interfaces

Characteristic		Value
RS1 (PC)	Operation mode	Slave
	Protocol	Modbus RTU
RS2 (DEV)	Operation mode	Master, Slave, Slave Ext, Spy*
	Protocol	Modbus RTU, Modbus ASCII, AKYTEC
Baud rate		1.2…115.2 kbit/s
NOTE * With AKYTEC protocol only		

Table 3.5 USB interface

Characteristic	Value
Type	USB 2.0
Transport layer protocol	CDC
Application layer protocol	Modbus RTU
Baud rate	79 kB/s
Cable type	USB A/B

3.2 Galvanic isolation

The device has 4 potential groups:
- 24 VDC power supply;
- Analog inputs, USB interface;
- RS1 interface;
- RS2 interface.

Galvanic isolation from each group to chassis 500 V AC / 1 min
Galvanic isolation between groups 500 V AC / 1 min

3.3 Operating conditions

The module is designed for natural convection cooling. It should be considered when choosing the installation site.
The following environment conditions must be observed:
- clean, dry and controlled environment, low dust level;
- closed non-hazardous areas, free of corrosive or flammable gases.

Table 3.6 Operating conditions

Condition	Permissible range
Ambient temperature	-10…+55°C
Transportation and storage	-15…+55°C
Relative humidity	Up to 80% (at +25°C, non-condensing)
Altitude	Up to 2000 m ASL
IP Code	IP20
EMC immunity	Conforms to IEC 61000-6-2
EMC emission	Conforms to IEC 61000-6-4

4 MSD200 Configurator

The program is available in English language only.

4.1 User interface

Table 4.1 User interface basic elements

Name		Description
Main menu		
File	Load from file	Load configuration from file
	Save to file	Save configuration to file
	Exit	Close program
Device	Read all	Read configuration from device
	Save all	Save configuration to device
	Save changes	Save only changed parameters to device
	Default settings	Apply default settings to device
Language		Select language
Help		About software
Toolbar		
Read all		Read configuration from device
Save all		Save configuration to device
Save changes		Save only changed parameters to device
Save to file		Save configuration to file
Load from file		Load configuration from file
Start / Stop		Connect / disconnect PC
Connection active / inactive		Connection status
Tabs		
Channels		Logging channels configuration (*Sect. 4.3*)
File Manager		Log file management (*Sect. 4.4*)
View data		View current values or statuses of all channels (*Sect. 4.5*)
Settings		RS2 interface parameters Digital signature Common logging parameters Date and time Scheduled logging
Analog inputs		Analog inputs parameters
Memory card synchronization		Parameters for copying memory card data to PC (*Sect. 5.3*)
RS1 (PC) settings		The pane with MSD200-PC connection parameters, visible on the right side in all tabs (*Sect. 4.2*)

The status of parameter is indicated by its background color (*Tab. 4.2*).

Table 4.2 Background color

Background color	Meaning
white	The parameter in the program and in the device are synchronized
pink	The parameter has been changed but is not yet synchronized with the parameter in the device
grey	The parameter is unavailable and cannot be changed

4.2 MSD200-PC connection

To establish connection between MSD200 and PC:

1. Start *MSD200 Configurator* on the PC.
2. In the pane ***RS1 (PC) settings*** (*Fig. 4.1*), select ***COM port***. Appropriate port number can be found in *Device Manager* under a topic *Connections (COM and LPT)*. If the device driver is successfully installed, a virtual COM port will appear in the list.
3. Select the connection type:
   – ***RS-232*** – for connection over USB or over RS1 with RS485-RS232 adapter (for further steps see *Sect. 4.2.1*).
   – ***Modem*** – for connection over modem (for further steps see *Sect. 4.2.2*).

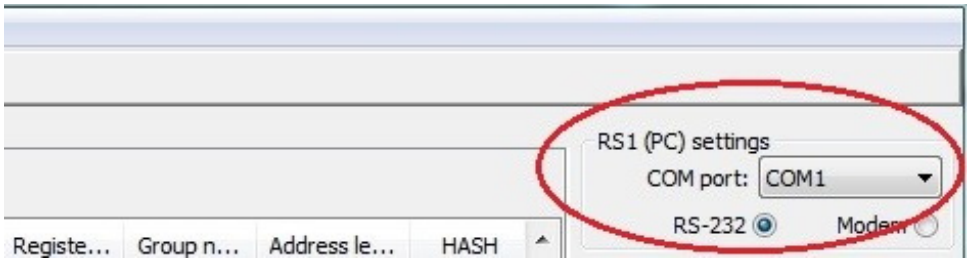


Fig. 4.1

4. Connect MSD200 to PC over USB or connect RS1 interface to serial port of the PC using RS485-RS232 adapter.

NOTE
When the device is connected over USB, the RS1 interface is temporarily disabled. The RS1 interface is available again when the USB interface is disconnected.

4.2.1 RS-232 connection type

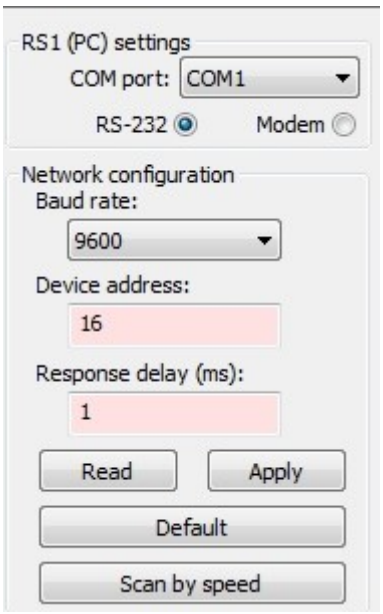


Fig. 4.2

1. Set the network parameters and click ***Apply*** to save parameters to device (*Fig. 4.2*). If the parameters in the program and in the device are equal, connection will be established.
2. If the device network parameters are unknown, set the network parameters in the device and in the program to default values:
   – set DIP-switch ***FACT*** on the front panel of the device to ***ON*** (*Tab. 2.1*);
   – click ***Default*** to set the network parameters in the program to default values;
   – click ***Apply***.
3. If you know only the baud rate of the device COM port, you can use the button ***Scan by speed*** to find the device in the network.

4.2.2 Modem connection type

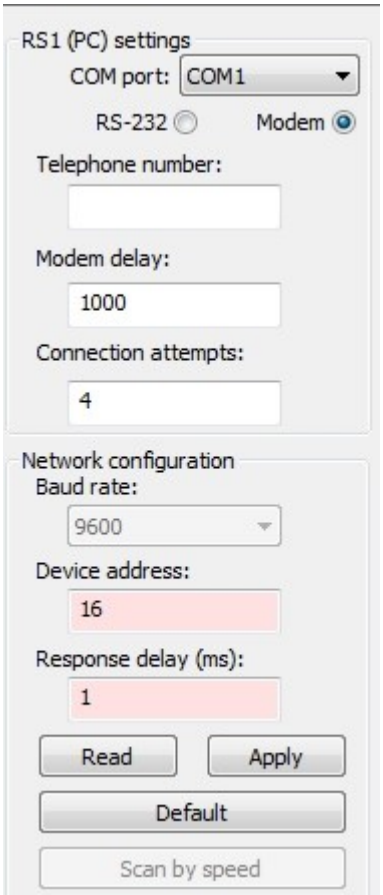


Fig. 4.3

1. Set the modem parameters:
   – ***Telephone number*** (SIM card telephone number MSISDN);
   – ***Modem delay*** (data exchange latency for mobile network, 5000 ms recommended);
   – ***Connection attempts*** (maximum number of retries after connection failure).
2. Set the network parameters.
3. Click ***Apply*** to save the parameters to device. If the parameters in the configurator and in the device are equal, connection will be established.

4.2.3 Connection control

Use the toolbar item ***Start / Stop*** to control the connection (*Fig. 4.4*). The next item to the right (colored circle) indicates the status of connection:

– green – connection active;
– red – connection inactive.

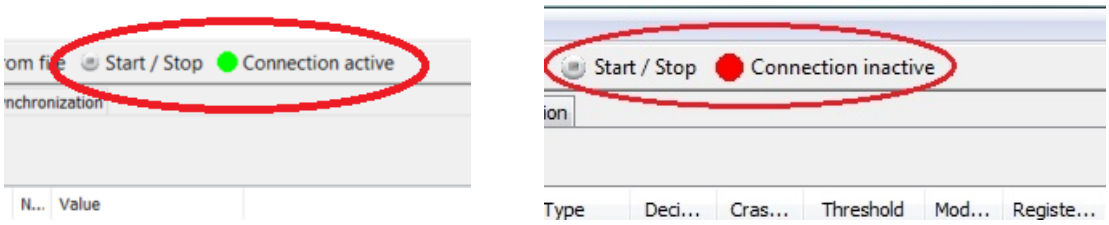


Fig. 4.4 Connection control

When the connection to the device is established, its parameters are read out, displayed and can be changed.

4.3 Channels

To configure the logging channels, use the tab ***Channels*** (*Fig. 4.5*). There are 64 logging channels at your disposal.

NOTE
Before changing the parameters in "Channels" tab, it is recommended to set the DIP-switch ARCH to OFF to stop logging. If not, the device may pause the logging by itself for up to two minutes to accept the new parameters and some data can be lost.

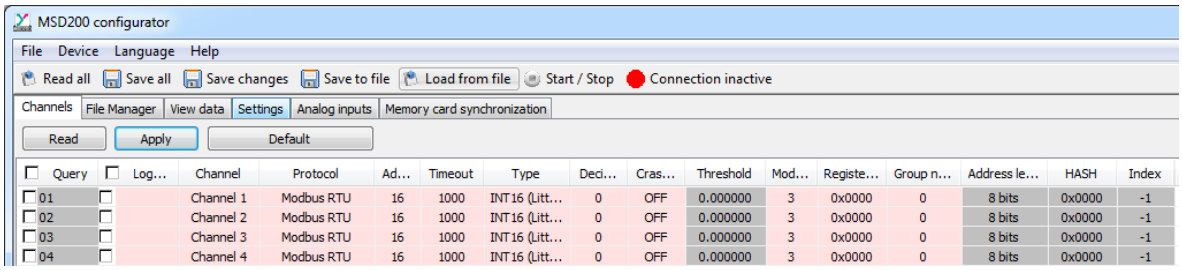


Fig. 4.5 "Channels" tab

Table 4.3 "Channels" tab

Parameter	Description	Mode
Query	If marked, the channel will be queried in Master mode	Master, Spy
Logging	If marked, the channel data sent by Master will be logged	Master, Spy
Channel	Channel name in the log file (up to 30 characters)	All
Protocol	Network protocol or connection to one of the analog inputs: – Modbus RTU – Modbus ASCII – AKYTEC – Input 1 – Input 2 – Input 3 – Input 4	All
Address	Network address of the target device	Master, Spy

Parameter	Description	Mode
Timeout	Maximum time to wait for response (0…65535 ms)	Master, Spy
Type	Data type and byte order for data exchange over RS2 interface. Most significant byte first (0-1-2-3): – INT16 (Big-endian) – UINT16 (Big-endian) – INT32 (Big-endian) – UINT32 (Big-endian) – FLOAT32 (Big-endian) Least significant byte first (3-2-1-0): – INT16 (Little-endian) – UINT16 (Little-endian) – INT32 (Little-endian) – UINT32 (Little-endian) – FLOAT32 (Little-endian) Mixed byte order (1-0-3-2): – INT32 (Middle-endian) – UINT32 (Middle-endian) – FLOAT32 (Middle-endian)	All
Decimal point	Number of decimal places for FLOAT32 (0...5) or power of ten for INT16 and UINT32 (-5...+5)	All
Crash logging	Enable / disable data logging in case of error (no data, overload, line break etc.)	All
Threshold	Extra logging in case of a sudden change in the measured value. The unscheduled recording is performed if the difference between the measured value and the last recorded value is greater than the value specified in the parameter. If the ***Threshold*** = 0, the extra logging is disabled. The data type specified in the ***Type*** column must be used for input. *Available only when **Crash logging** is enabled*	All
Modbus function	Read function in request: – 0x03 (read holding registers) – 0x04 (read input registers). *Modbus only*	Master
Register address	Register address for read function in request. *Modbus only*	Master
Group number	Used for group request on several channels. Assign the same number (non-zero) for the channels to be grouped. The grouped channels have to use the same network address, the same Modbus function and consecutive Register addresses. Different data types are allowed. *Modbus only*	Master
Address length	Address bits in request (8…11 bits). *AKYTEC only*	Master, Spy

Parameter	Description	Mode
HASH	HASH parameter in request. *AKYTEC only*	Master, Spy
Index	Index in request (-1…+32767). -1 means that the index is not used in the request. *AKYTEC only*	Master, Spy

The buttons ***Read***, ***Apply*** and ***Default*** are applicable to all parameters in the table.

4.4 File Manager

The ***File Manager*** tab is divided into 2 panes:
– the left pane shows the file tree on the PC;
– the right pane shows the file tree on the memory card.
The tab integrates all the necessary tools for operations with log files located on the memory card:
– view the file tree, information about storage capacity and free space on the card;
– copy files to PC;
– delete files etc.

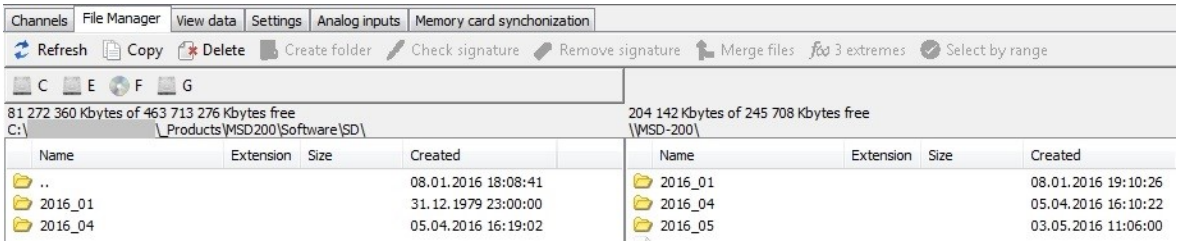
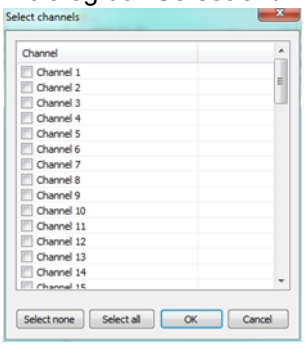


Fig. 4.6 “File Manager” tab

Table 4.4 “File Manager” toolbar

Icon	Name	Description	Pane	
			PC (left)	Card (right)
	Refresh	Refresh the file tree	*	*
	Copy	Copy selected folders and/or files from the memory card (right pane) to the opened folder on PC (left pane). The opposite direction is not possible. Use CTRL+LMB for multiple choice, SHIFT+LMB to select adjacent files		*
	Delete	Delete selected files/folders. Only empty folder can be deleted on the card	*	*
	Create folder	Create a new folder on PC	*	
	Check signature	Verification of CSV log file integrity using digital signature (*Sect. 4.6.2*)	*	
	Remove signature	Create a copy of a log file without digital signature	*	
	Merge files	Merge several CSV log files on PC into one	*	

Icon	Name	Description	Pane	
			PC (left)	Card (right)
	3 extremes	The function searches for 3 minima and 3 maxima in the selected channels. Proceed as follows: 1. Select a log file on PC and click ***3 extremes***. A dialog box ***Select channels*** opens:  2. Select channels and click ***OK*** to view the results	*	*
	Select by range	Search in log data according to specified range	*	*

4.5 View data

Use the tab to view the current channel value or channel status.

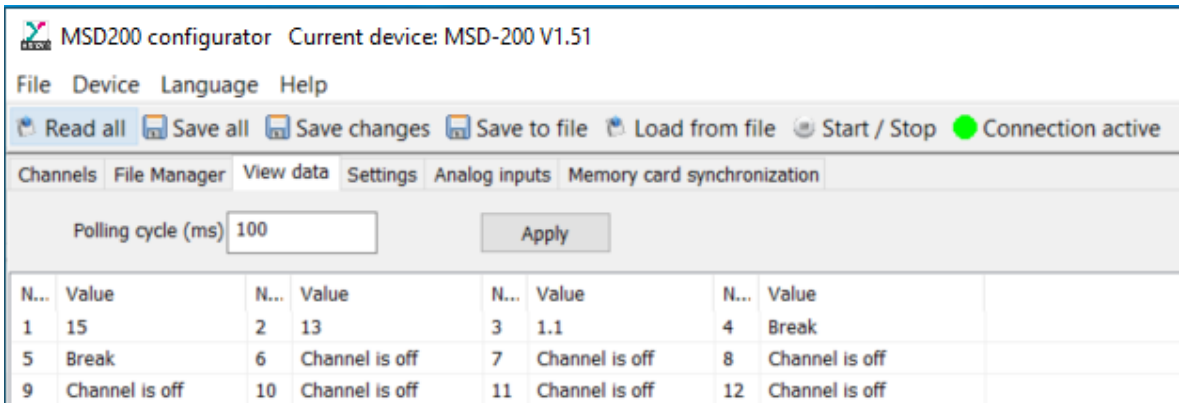


Fig. 4.7 "View data" tab

Set ***Polling cycle*** parameter in milliseconds to define a refresh interval.
The minimal value depends on channel settings and in the best case is about 500 ms. If the ***Polling cycle*** is set to less than 500 ms, the next request will be sent right after receiving the response (as soon as possible).
Click ***Apply*** to apply the changed value.

4.6 Settings

The tab ***Settings*** contains all settings for data logging. The tab consists of 5 panes:

– ***RS2 settings (Devices)*** – parameters of connection with other devices over RS2 interface (*Sect. 4.6.1*);
– ***Digital signature*** – log file integrity control (*Sect. 4.6.2*);
– ***Common settings*** common logging parameters (*Sect. 4.6.3*);
– ***Date and time settings*** – device date/time settings (*Sect. 4.6.4*);
– ***Scheduled logging*** – logging timetable (*Sect. 4.6.5*).

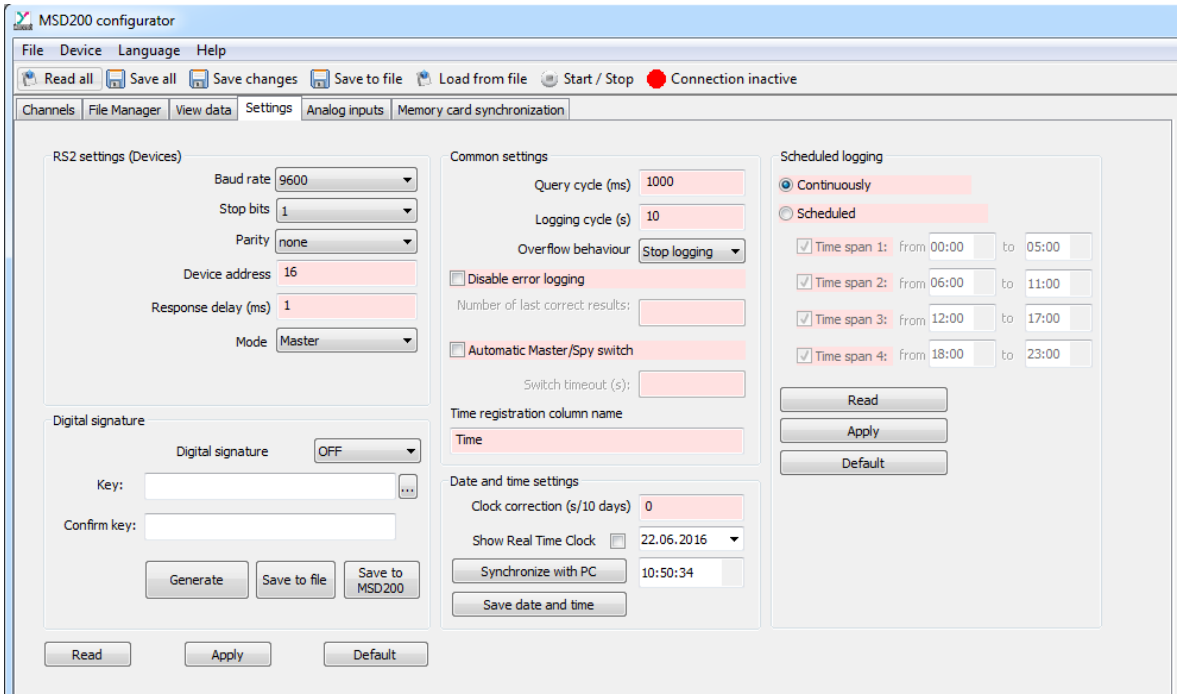


Fig. 4.8 "Settings" tab

The buttons ***Read***, ***Apply*** and ***Default*** in the lower part of the window are applicable for all parameter groups except ***Scheduled logging***, which has separate control buttons.

4.6.1 RS2 settings

The pane contains parameters of connection with other devices over RS2 interface.

Table 4.5 "RS2 settings" pane

Parameter	Description
Baud rate	Data exchange rate (9600…15200 bit/s)
Stop bits	Number of stop bits (1, 2)
Parity	(none, even, odd)
Device address	Device network address as Slave (1…247)
Response delay	Response delay (0…50 ms)
Mode	Network mode: – Master (*Modbus RTU / ASCII, AKYTEC*) – Slave (*Modbus RTU only*) – Slave Ext (*Modbus RTU only*) – Spy (*AKYTEC only*)

4.6.1.1 Mode overview

Master

– Polling and logging data from the analog inputs and all Slaves connected to RS2 interface.

Slave

(see *App. B.* for example of configuration)

– Logging the data, received from Master using the function 16 (Write Multiple Registers).
– Logging the measured values of analog inputs is unavailable.
– Required settings:
  – ***Channels*** tab (*Sect. 4.3*):
    ♦ ***Logging***
    ♦ ***Channel***
    ♦ ***Type***
    ♦ ***Decimal point***
    ♦ ***Register address***
  – ***Settings*** tab, ***RS2 settings*** pane (*Sect. 4.6.1*):
    ♦ ***Device address***
    ♦ ***Response delay***

Slave Ext

– As slave mode, except for the logging period, which in this mode is defined in the ***Logging cycle*** parameter (*Tab. 4.6*).
– If the data from the master comes sooner than the set period, the data row will be saved immediately to prevent data loss.

Spy

– The device listens in on the network via the RS2 interface. If it detects the response of another device to master's request, it performs logging of the response data.
– Logging the measured values of analog inputs is unavailable.
– The configuration in Spy mode is similar to the configuration in Master mode with the following exceptions:
  – The parameter ***Query cycle*** is not used, the period is defined by the Master. Thus, ***Logging cycle*** should be adapted to the query cycle of the Master.
  – If no data is received over the channel during ***Logging cycle***, the string "*no data*" will be written in the log row for this channel, the RS2 indicator will change to red.
  – ***Response time*** parameter is not used.

4.6.2 Digital signature

The pane is used for log file integrity control.
The digital signature is intended to check the integrity of the log file after removing the memory card from the data logger or copying files to PC.
Use the parameter ***Digital signature*** to enable / disable the digital signature.
To create a digital key, proceed as follows:

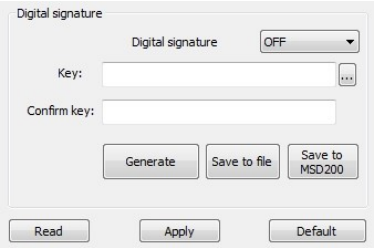


Fig. 4.9

Generated key

1. Set ***Digital signature*** to ***ON*** to enable the feature.
2. Click ***Generate*** to generate a key.
3. Click ***Save to MSD200*** to save the generated key in the device (saving takes 20...60 seconds).
4. Click ***Save to file*** to save the key to a file on PC.
5. Click ***Apply*** to initialize the key.

Manually specified key

1. Select ***ON*** to enable the feature
2. Enter the desired key (1…16 characters) into the fields ***Key*** and ***Confirm key***.
3. Click ***Save to MSD200*** to save the generated key in the device (saving takes 20...60 seconds).
4. Click ***Save to file*** to save the key to a file on PC, or just write it down.
5. Click ***Apply*** to initialize the key.

The key cannot be read from the device memory.
The digital signature is formed in the log file on the memory card (*Sect. 5*). This occurs when the data from the RAM buffer are transferred to the memory card and takes up to 60 seconds when the device is on.

4.6.2.1 Check log file integrity

The log file created on the memory card is protected by a digital signature. To check the integrity of a copy of the log file on your PC, proceed as follows:

1. Establish connection between the logger and the program.
2. Open File Manager tab.
3. Click ***Refresh*** to update the file trees on both panes.
4. Select the file on the memory card (right pane).
5. Select the target folder on the PC (left pane) to which the file will be copied, and click ***Copy***.
6. Select the copied file and click ***Check signature***.
7. In the open dialog box, enter the key previously saved in MSD200.

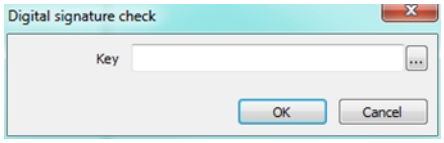


Fig. 4.10

Click the ellipsis button  to search for a key file previously saved on the PC, select it and click ***OK***.
If it is a manually specified key, you can optionally enter the noticed key into the input field.
The message "*Digital signature matches*" appears if the log file copy has not been changed.

4.6.3 Common settings

The pane contains common logging parameters.

Table 4.6 “Common settings” pane

Parameter	Description
Query cycle (ms)	Polling period in Master mode. The parameter has no effect in other modes. – If all channels respond and the total polling time does not exceed ***Query cycle***, the RS2 indicator lights green (*Tab. 2.2*). – If the total polling time of all logged channels exceeds ***Query cycle***, the color of RS2 indicator lights yellow. – If at least one of the polled channels does not respond, the RS2 indicator lights red
Logging cycle (s)	Logging period ***Logging cycle*** should be several times longer than ***Query cycle*** in order to avoid data loss
Overflow behavior	Behavior in the case of memory card overflow with two options: – ***Stop logging*** – ***Rewrite memory*** – data records, starting from the earliest, will be deleted and logging will be continued
Disable error logging	If marked, the previous correct value will be repeated in case of error
Number of last correct results	Number of repetitions of the last correct value
Automatic Master/ Spy switch	*Spy mode only* If marked, network Master activity is monitored. If no Master activity detected, the device is switched from Spy to Master mode. When the primary Master fails, the logger records the values measured on its analog inputs. When the primary Master resumes operation, the logger returns to the Spy mode
Time registration column name	The name of the time column in the header of the log file

4.6.4 Date and Time

Use the pane ***Date and time*** to control the Real-Time Clock of the device.

Table 4.7 “Date and time settings” pane

Parameter	Description
Clock correction (s/10 days)	Systematic clock error correction (-10000…10000 s/10 days)
Show Real Time Clock	If marked, the device RTC time and date are displayed
Synchronize with PC	Copy time and date from PC clock to the device RTC
Save date and time	Apply the entered time and date to the device

RTC synchronization function ignores “Summer time”.
CR2032 backup battery enables powering of RTC for 2 years minimum.

4.6.5 Scheduled logging

Use the pane to specify logging timetable.

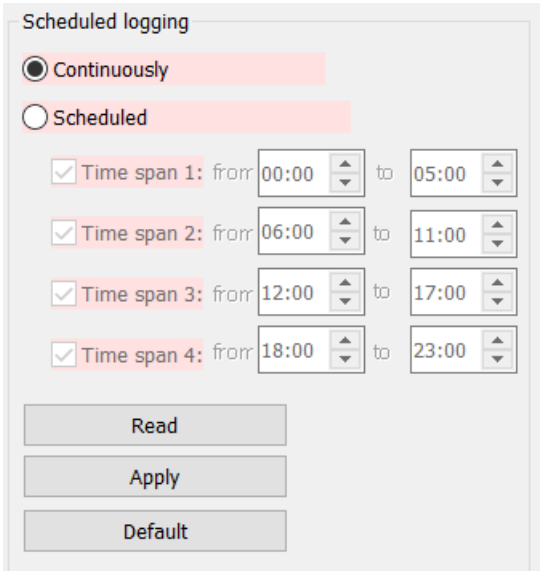


Fig. 4.11 "Scheduled logging" pane

4.7 Analog inputs

Use the tab to set the parameters of analog inputs.

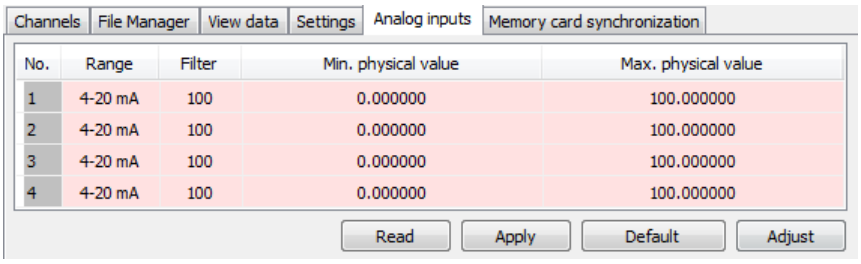


Fig. 4.12 Analog inputs tab

Table 4.8 Analog inputs tab

Parameter	Description
Range	Selection of input type: 4-20 mA, 0-20 mA, 0-5 mA
Filter	Time constant of the input low-pass filter (100…65535 ms)
Min. physical value	Scaling of the measured value – lower measuring limit
Max. physical value	Scaling of the measured value – upper measuring limit

The buttons ***Read***, ***Apply*** and ***Default*** are applicable to all parameters in the pane.
Adjust button:
The device is factory calibrated. However, if some accuracy deviation appeared, you can perform the adjustment to correct it. Proceed as follows:

1. Set the Range to 0-20 mA.
2. Connect a current reference source of accuracy class at least 0.1 to the input.
3. Set the current to 20 mA.
4. Click ***Adjust*** button.

The new adjustment coefficients will be calculated and saved in the device. The message with the information about adjustment results will appear.

5 Memory card

The data received from analog inputs and/or over RS485 interface is transferred to memory card in two steps:

1. Data is stored in a standard data buffer (16 kB).
2. Data is transferred from the buffer to memory card with the period of 60 s or sooner if the buffer is full.

The data is recorded in a log file created on the card one file per day (*Sect. 5.2*).

NOTICE
Do not create new files or copy files from PC to the memory card to avoid damaging the file structure of the memory card. However unnecessary files on the card can be deleted.

5.1 Memory card replacement

Data transfer from the buffer to the card occurs once per minute and lasts 3-4 seconds. This process is indicated by SD indicator flashing green (*Tab. 2.2*).
Memory card should be removed from the logger during data accumulation in the data buffer between two transfers. This interval is indicated by constant green light of SD indicator.

NOTICE
Do not remove the memory card when recording is not completed, in order to avoid violation of the file structure on the card.

When the card is removed, the data continues to be stored in the standard buffer. After 1 minute or when the standard buffer is full, the data is stored in an extra buffer (60 kB). This gives you an extra 30 seconds to remove the card.

NOTICE
Frequent use of the extra buffer is not recommended, this will wear out the memory faster.

If the both buffers become full, but the new card is not yet inserted, some data may be lost. This is indicated by a red flashing SD indicator.

5.2 Log file

	A	B	C	D	E	F	G	
1	Time	Temp 1	Temp 2	Temp 3	Temp 4	Temp 5	Temp 6	Temp
2	09:26:47	25,3	28,5	28,5	28,5	30,5	30,4	
3	09:41:47	26,3	28,7	28,8	28,8	30,6	30,6	
4	09:56:47	27,1	29,2	29,3	29,2	31,3	31,3	
5	10:11:47	28,2	30,2	30,3	30,3	31,8	31,8	
6	10:26:47	28,3	30,7	30,8	30,7	32	32	
7	10:41:47	28,6	31,5	31,5	31,5	32,5	32,5	
8	10:56:47	29,1	31,8	31,8	31,8	33,1	33,1	
9	11:11:47	28,8	31,9	31,9	31,9	33	33	
10	11:26:47	29,1	31,9	31,9	31,9	33,5	33,5	
11	11:41:47	29,1	31,5	31,5	31,5	33,5	33,4	
12	11:56:47	28,5	31,5	31,6	31,5	33,5	33,5	
13	12:11:47	28,9	31,5	31,6	31,5	33,6	33,6	
14	12:26:47	29,3	32	32,1	32	33,8	33,9	
15	12:41:47	28,9	32,1	32,1	32,1	33,9	33,9	
16	12:56:47	29,3	32,2	32,3	32,3	34	33,9	

Fig. 5.1 Log file

– If logging is enabled, a folder with the name in format YYYY_MM is created in the root directory of the memory card for each month.
– A CSV file with the name in format YYYY_MM_DD is created in this folder for each day of the month.
– The first line contains the user defined channel names.
– Each of the 64 channels corresponds one column.
– The first column of the file contains the logging time (timestamp) in format HH:MM:SS.
– Subsequent channel data fields are separated by semicolon.
– If the logging for a channel is disabled, only semicolon is recorded in the corresponding data cell.
– If digital signature is enabled (*Sect. 4.6.2*), it is recorded to the end of the last line, in the column 66.

11:26:20	32,5	37,4	30,2	30,2				
11:26:21	32,5	37,5	30,2	30,2				
11:26:22	32,5	37,5	30,2	30,2				
11:26:23	32,5	37,5	30,2	30,2	#0ED844528279D6A626AA3C220D7A2EF3#			

Fig. 5.2 Digital signature

– The digital signature is represented by a string of 32 characters (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F) with a grid (#) at the beginning and at the end, e.g. *#0ED844528279D6A626AA3C220D7A2EF3#*.

5.3 Memory card synchronization

The tab contains controls to copy the log file from the card to PC.

Table 5.1 "Memory card synchronization" tab

Parameter	Type	Description
Execute on start	Checkbox	Copy log file from card to PC at program start
In background	Checkbox	Execute copying in background
Periodic synchronization (h)	Checkbox	Copy log file from card to PC periodically. If marked, the period in hours can be defined.
Synchronization folder	Input field	Enter the path to copy log file or use the ellipsis button  to specify the folder on PC
Synchronize files	Radiobut-tons	Specify files to copy: all or CSV only

Click ***Apply*** to save settings.

6 Installation

Must be observed:
– operating conditions from the *Sect. 3.3* when choosing an installation site;
– safety requirements from the *Sect. 1.6* during installation.

6.1 Mounting

– According *Fig. 6.1.A*.
– Wire external connections in accordance with *Sect. 6.2* using plug-in terminal blocks (included).

Removal

– Take off the terminal blocks without disconnecting the wires.
– Insert a screwdriver into the eyelet of the slide interlock, push it, then remove the device from the rail (*Fig. 6.1.B*).

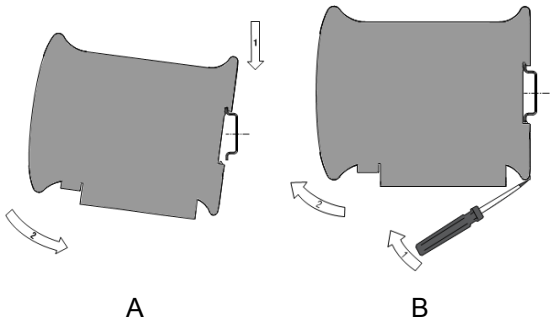


Fig. 6.1

6.2 Wiring

WARNING
The device must be powered off before connecting to other equipment or PC. Switch on the power supply only after the wiring of the device has been completed.

NOTICE
Ensure that the input signal is connected to the correct input terminals and that the input configuration corresponds to the signal. Non-observance can cause the device damage.

NOTE
To ensure compliance with the EMC requirements:
– ***Signal cables should be routed separately or screened from supply cables.***
– ***Shielded cable should be used for signal lines.***

– The electrical connections are shown in *Fig. 6.2* and the terminal assignments in *Tab. 6.1*.
– Connect the power supply to the terminals 24V / 0V.
– The maximum conductor cross-section for power supply is 1.5 mm².
– The USB interface enables hot plugging. The USB cable length should not exceed 3 m.

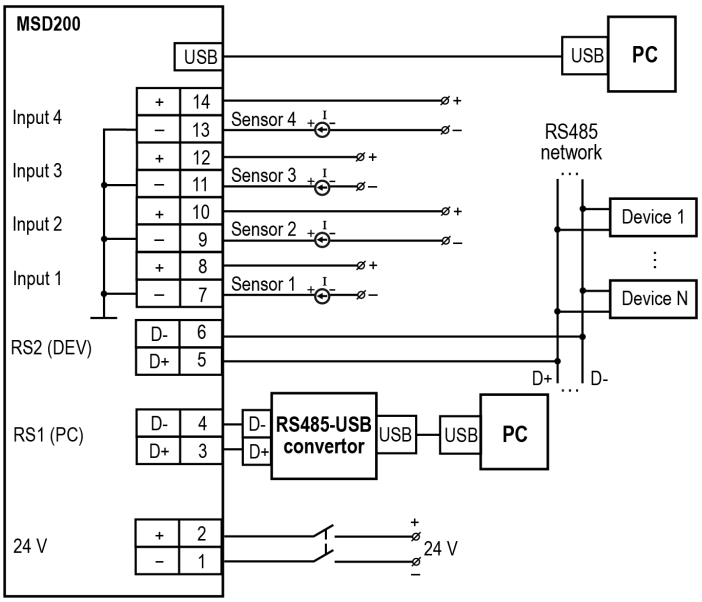


Fig. 6.2 Connection diagram

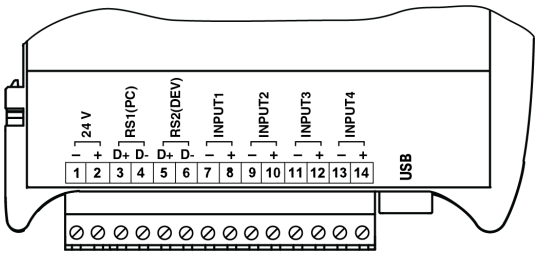


Fig. 6.3 Plug-in connector

Table 6.1 Terminal assignments

No	Marking	Description
1	24 V -	24VDC power supply
2	24 V +	
3	RS1 (PC) D+	Connection to PC (RS485 Slave)
4	RS1 (PC) D-	
5	RS2 (DEV) D+	Connection to other devices (RS485 Master / Slave)
6	RS2 (DEV) D-	
7	INPUT 1 -	AI1
8	INPUT 1 +	
9	INPUT 2 -	AI2
10	INPUT 2 +	
11	INPUT 3 -	AI3
12	INPUT 3 +	
13	INPUT 4 -	AI4
14	INPUT 4 +	

6.3 RS485 network

RS485 standard is used for data exchange. The RS485 serial interface is based on two-wire technology and half-duplex mode. The protocols Modbus RTU and Modbus ASCII are supported.
Devices are connected to a network according to linear (bus) topology. It means that the line goes from the first device to the second one, from the second one to the third one, etc. Star connections and spur lines are not allowed. The maximum distance between the first and last device along the line is 1200 m.
The network consists of a master device and can contain up to 32 slave devices. The number of slave devices and the network length can be increased using a RS485 interface repeater.
Line reflections always occur at the open bus ends (the first and the last node). The higher the data transmission rate, the stronger they are. Terminating resistors on the both ends of line can be useful to minimize reflections. Terminating resistors of 120…150 Ω, 0.25 kW are recommended.

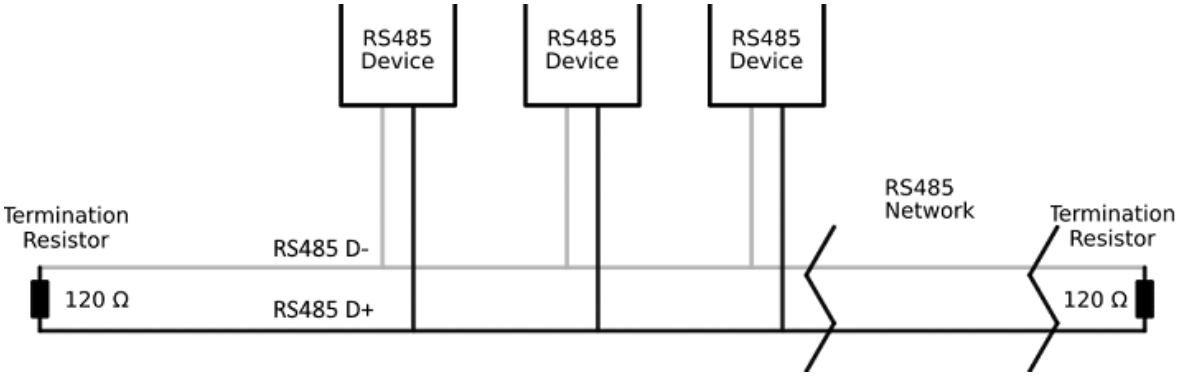


Fig. 6.4 RS485 network

Shielded twisted pair cable for RS485-bus is recommended. Maximum cable length is 1200 m.
Connect the RS485 lines to terminals D+ and D-.

6.4 Quick replacement

The device is equipped with plug-in terminal blocks which enable quick replacement of the device without disconnecting the existing wiring (*Fig. 6.5*).
To replace the device:

1. Power off all connected lines including power supply.
2. Remove all detachable parts of the terminal blocks.
3. Replace the device.
4. Connect detachable parts with existing wiring to the device.

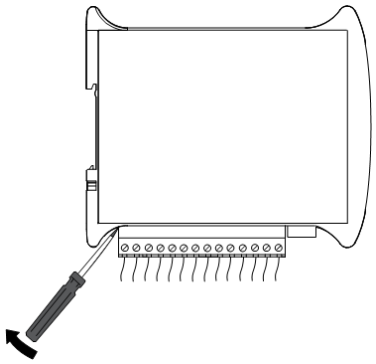


Fig. 6.5 Terminal block replacement

7 Maintenance

The safety information from *Sect. 1.6* must be observed.
The maintenance includes:

- cleaning the enclosure and terminal blocks from dust, dirt and debris;
- checking the fastening of the device;
- checking the wiring (connecting leads, fastenings, mechanical damage);
- check the Real-Time Clock and correct if necessary.

NOTICE
The device should be cleaned with a damp cloth only. No abrasives or solvent-containing cleaners may be used.

8 Transportation and storage

Pack the device in such a way as to protect it reliably against impact for storage and transportation. The original packaging provides optimum protection.
If the device is not taken immediately after delivery into operation, it must be carefully stored at a protected location. The device should not be stored in an atmosphere with chemically active substances.
The environmental conditions from the *Sect. 3.3* must be taken into account during transportation and storage.

NOTICE
The device may have been damaged during transportation.
Check the device for transport damage and completeness!
Report the transport damage immediately to the shipper and akYtec GmbH!

9 Scope of delivery

– MSD200	1
– Short guide	1
– Terminal blocks (set)	1
– SD memory card	1

Appendix A. Modbus application

The protocol Modbus is applied for device network communication in the Master, Slave and Slave Ext modes.
Table list:

– A.1 – Modbus functions
– A.2 – Modbus errors
– A.3 – *RS1 (PC) interface* parameters
– A.4 – *Settings* tab parameters
– A.5 – *Date and time* pane parameters
– A.6 – Digital key
– A.7 – *Channels* tab parameters
– A.8 – *Analog inputs* tab parameters
– A.9 – *View data* tab and other operation parameters
– A.10 – *Analog inputs* – Measured values
– A.11 – *Analog inputs* – Adjustment result

Specifics of the protocol application in the device:

– The broadcast address 0 and addresses greater than 247 are not answered by the device.
– The response time should be calculated as follows:

  1 second + 2x transmission time (depends on the data transfer rate in the channel) + 2x delay time for data transfer in the GSM channel when working via modem (set in configuration).

– The command execution time can be up to 30 s (time to delete a file of 1GB).
– If the command cannot be executed within 1 second, error 07 (*Tab. A.2*) will be returned. Until the current command execution is completed, further commands will be responded with the error 08 and the current function code.
– It is not possible to cancel the execution. After the command execution, the communication continues as usual.
– When attempting to write “read only” parameters or access nonexistent registers with the function 16, the error 01 will be returned.
– When attempting to read “write only” parameters or access nonexistent registers with the function 03, the error 02 will be returned.
– When attempting to read (03) or write (16) several parameter groups, the error 03 will be returned.
– The parameters can be requested with one command and only in groups represented in *tables A.3… A.11*. They cannot be requested individually, except the parameters of the tab ***View data*** (*Tab. A.9*) which can be requested individually or with one command in a group of up to 40 consecutive channels, beginning from any.
– If the configurator is connected to the device over USB, the requests of the configurator connected to RS1 will be answered with the error 09.
– The logger cannot to send or receive packets of the size multiple of 64 bytes over the USB interface. To solve this problem, it is recommended to transmit only odd-length packets over USB. When transmitting an even-length packet, an extra byte 0x00 must be added at the end of the packet (after CRC).

Table A.1 Modbus functions

Code	Name	Description
03 (0x03)	Read Holding Registers	Read the contents of a contiguous block of holding registers
04 (0x04)	Read Input Registers	Read from 1 to 125 contiguous input registers
16 (0x10)	Write Multiple Registers	Write a block of contiguous registers (1 to 123 registers)
17 (0x11)	Report slave ID	Reading the device name and the firmware version

Table A.2 Modbus errors

Code	Name	Description
01	Illegal Function	Function code received in the query is not recognized or allowed by slave
02	Illegal Data Address	Data address of some or all the required entities are not allowed or do not exist in slave
03	Illegal Data Value	Value is not accepted by slave
04	Slave Device Failure	Unrecoverable error occurred while slave was attempting to perform requested action
07	Negative Acknowledgement (NAK)	The program function just requested cannot be performed
08	Memory Parity Error	Interface is used, when execution of the last command is not yet completed
09	Custom error	Interface is used, when attempting to use RS1 with USB already connected

*Table A.3 RS1 (PC) interface**

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
3 registers (R / W)						
1	***Baud rate***	0x0000	0	1.2 kbit/s	UINT16	3 (16 kbit/s)
			1	2.4 kbit/s		
			2	4.8 kbit/s		
			3	9.6 kbit/s		
			4	14.4 kbit/s		
			5	19.2 kbit/s		
			6	28.8 kbit/s		
			7	38.4 kbit/s		
			8	57.6 kbit/s		
			9	115.2 kbit/s		
2	***Device address***	0x0001	1…247		UINT16	16
3	***Response delay (ms)***	0x0002	0…50 ms		UINT16	1

NOTE
* The request to change the parameters of the RS1 interface is responded with the same interface parameters, the next one – with the new parameters.

Table A.4 Settings

No	Parameter	Regi-ster	Valid value	Description	Data type	Default (Comment)
13 registers (R / W)						
1	***Baud rate***	0x0040	0	1.2 kbit/s	UINT16	3
			1	2.4 kbit/s		
			2	4.8 kbit/s		
			3	9.6 kbit/s		
			4	14.4 kbit/s		
			5	19.2 kbit/s		
			6	28.8 kbit/s		
			7	38.4 kbit/s		
			8	57.6 kbit/s		
			9	115.2 kbit/s		
2	***Stop bits***	0x0041	0	1 bit	UINT16	0
			1	2 bits		
3	***Parity***	0x0042	0	none	UINT16	0
			1	even		
			2	odd		
4	***Device address***	0x0043	1…247		UINT16	16 (Slave)
5	***Response delay (ms)***	0x0044	0…50	0…50 ms	UINT16	1 (Slave)
6	***Mode***	0x0045	0	Master	UINT16	0
			1	Slave (Modbus)		
			2	Slave Ext (Modbus)		
			3	Spy (AKYTEC)		
7	***Query cycle (ms)***	0x0046	2...65535	2...65535 ms	UINT16	1000
8	***Logging cycle (s)***	0x0047	1...65535	1...65535 s	UINT16	10
9	***Overflow behavior***	0x0048	0	Stop logging	UINT16	0
			1	Rewrite memory		
10	***Clock correction****	0x0049	-10000...+10000 s/10 days		INT16	0

No	Parameter	Regi-ster	Valid value	Description	Data type	Default (Comment)
11	***Automatic Master / Spy switch***	0x004A	0	OFF	UINT16	0
			1...65535	Timeout in case of absence of master (s)		
12	***Digital signature***	0x004B	0	OFF	UINT16	0
			1	ON		
13	***Disable error logging***	0x004C	0	OFF	UINT16	0
			1…100	Number of repetitions of the last correct value		

NOTE
* When attempting to write a value outside the valid range, error code 90 is returned.

Table A.5 Date and time

No	Parameter	Register	Valid value	Data type	Default (Comment)
6 registers (R / W)					
1	***Seconds***	0x0080	0…59	UINT16	0
2	***Minutes***	0x0081	0…59		0
3	***Hours***	0x0082	0…23		0
4	***Day***	0x0083	1…31		1
5	***Month***	0x0084	1…12		1
6	***Year***	0x0085	2010…2100		2011

Table A.6 Digital key

No	Parameter	Register	Description	Data type	Default (Comment)
8 registers (W only)					
1	***Key***	0x00C0 ... 0x00C7	Key length: 128 bits	UINT16[8]	0

*Table A.7 Channels**

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
31 registers (R / W)						
1	***Query / Logging***	0x0100 + (n-1) * 64	bit 0 (***Logging***)		UINT16	0 (channel number n = 1...64)
			0	OFF		
			1	ON		
			bit 1 (***Query***)			
			0	OFF		
			1	ON		
2	***Channel name***	0x0101 ... 0x0111	ASCII string, ends with 0x00		CHAR[32]	“Channel n”
3	***Protocol***	0x0112	0	Modbus RTU	UINT16	0
			1	Modbus ASCII		
			2	AKYTEC		
			3	Input 1		
			4	Input 2		
			5	Input 3		
			6	Input 4		
4	***Address***	0x0113	0…2039	11 address bits	UINT16	16 (AKYTEC)
			0…254	8 address bits		
			1..247			16 (Modbus)
5	***Timeout, ms***	0x0114	10… 65535	10…65535 ms	UINT16	1000
6	***Data type***	0x0115	Little-endian (0-1-2-3)		UINT16	0
			0	INT16		
			1	UINT16		
			2	INT32		
			3	UINT32		
			4	FLOAT32		
			Big-endian (3-2-1-0)			
			5	INT16		
			6	UINT16		
			7	INT32		
			8	UINT32		
			9	FLOAT32		
			Middle-endian (1-0-3-2)			
			10	INT32		

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
			11	UINT32		
			12	FLOAT32		
7	***Decimal point***	0x0116	-5...5 (INT, UINT)		UINT16	0
			0...5 (FLOAT)			
8	***Crash logging***	0x0117	0	OFF	UINT16	0
			1	ON		
9	***Threshold***	0x0118, 0x0119	0…999999995904 (use format of ***Data type***)		FLOAT32	0 (extra logging disabled)
10	***Modbus function***	0x011A	0	3	UINT16	0 (Modbus)
			1	4		
11	***Register address***	0x011B	0..0xFFFF		UINT16	0 (Modbus)
12	***Group number***	0x011C	0…32	group number	UINT16	0 (no group) (Modbus)
13	***Address length***	0x011D	0	8 bits	UINT16	0 (AKYTEC)
			1	11 bits		
14	***HASH code***	0x011E	0…0xFFFF		UINT16	0 (AKYTEC)
15	***Index***	0x011F	0… 0xFFFF	-1…32767	UINT16	0xFFFF (-1) (AKYTEC)

NOTE
* Only one channel can be requested with read / write command.

*Table A.8 Analog inputs tab**

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
6 * 4 = 24 registers (R / W)						
1	***Range***	0x1100...0x1105	0	4-20 mA	UINT16	0
			1	0-20 mA		
			2	0-5 mA		
2	***Filter, ms***	0x1106...0x110B	100…65535		UINT16	100
3	***Min. physical value***	0x110C...0x1111	-10^9…10^9		FLOAT32	0
4	***Max. physical value***	0x1112...0x1117	-10^9…10^9		FLOAT32	100

NOTE
* All channels are requested with one read / write command.

*Table A.9 View data and other operation parameters**

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
Channel data (3x 64 = 192 registers (R only))*						
1	***Status***	0x2000 + (n-1) * 3… …0x20BF	byte 0, bits 0…3 (channel status)		UINT16	(channel number n = 1…64)
			0	ON		
			1	OFF		
			2	Timeout		
			3	Overload (AI only)		
			4	Sensor break (AI 4-20 mA)		
			5	Error code in response, see byte 1		
			byte 0, bits 4…7 (data type)			
			0	INT16		
			1	UINT16		
			2	INT32		
			3	UINT32		
			4	FLOAT32		
			byte 1 (error code)			
2	***Channel value***		byte 2...5		FLOAT32	(For short data types, the most significant bytes are set to zero)
Device status (19 registers (R only))						
3	***Last program start cause***	0x20C0	bit 0 (Hardware reset)		UINT16	
			bit 1 (Power on reset)			
			bit 2 (Software reset)			
			bit 3 (Independent watchdog timer)			
			bit 4 (Window watchdog timer)			
			bit 5 (Low voltage)			
4	***Last network error code***	0x20C1	0…255		UINT16	0 (at power on)
5	***Memory signature***	0x20C2… 0x20D1			UINT16 [16]	

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
6	***Status flag***	0x20D2	bit 0 (Default values)		UINT16	
			bit 1 (Flash memory failure)			
			bit 2 (ARCH switch state)			
			bit 3 (Log data loss)			
			bit 15 (No memory card)			

NOTE
* The parameters in this table can be requested individually or in a group of up to 40 consecutive channels.

Table A.10 Analog inputs – Measured values

No	Parameter	Register	Description	Data type	Default (Comment)
Analog inputs (8 registers (R only))					
1	***Measured value***	0x3000...0x3007		FLOAT32[4]	

Table A.11 Analog inputs – Adjustment result

No	Parameter	Register	Valid value	Description	Data type	Default (Comment)
Adjustment (5 registers (R only))						
1	***Result***	0x3010	0	OK	UINT16	
			1	ErrRMS*		
			2	ErrValue		
			3	ErrFlash		
			4	Timeout		
			byte 1-2 (RMS*)		FLOAT32	
			byte 3-4 (Value)		FLOAT32	

NOTE
** Root Mean Square Error.*

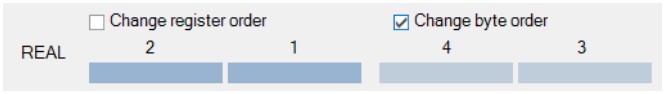
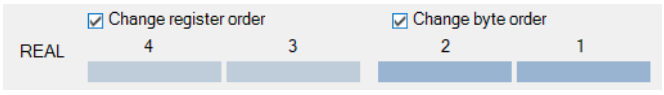
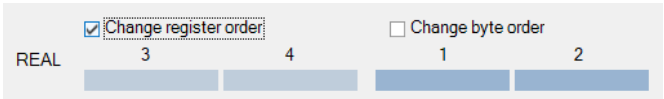
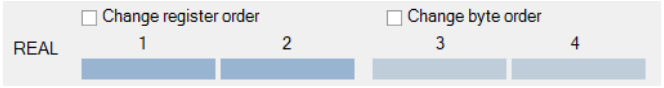
Appendix B. Slave configuration example

MSD200 is set to Slave Ext mode and should record the values, send by PR200 as a Master.
To establish connection, Master and Slave must have the same:

– Protocol;
– Baud rate;
– Stop bits;
– Parity;
– Target address of PR200 and Slave address of MSD200.

For successful data exchange, it is necessary to reconcile the data types and the order of registers and bytes in the register:

Table B.1 Coordination of the register and byte order

Data type in Master (PR200 / SMI200)	Byte order of the slave, set in master	Data type in Slave (MSD200)
INT		UINT 32 (Little-endian)
REAL		FLOAT32 (Little-endian)
INT		UINT 32 (Middle-endian)
REAL		FLOAT32 (Little-endian)
INT		UINT 32 (Big-endian)
REAL		FLOAT32 (Big-endian)
INT		No usage
REAL		

When configuring the master, consider the following:

– values can only be transferred to MSD200 with write function 16 (0x10);
– for INT variables, always set the number of registers to 2.

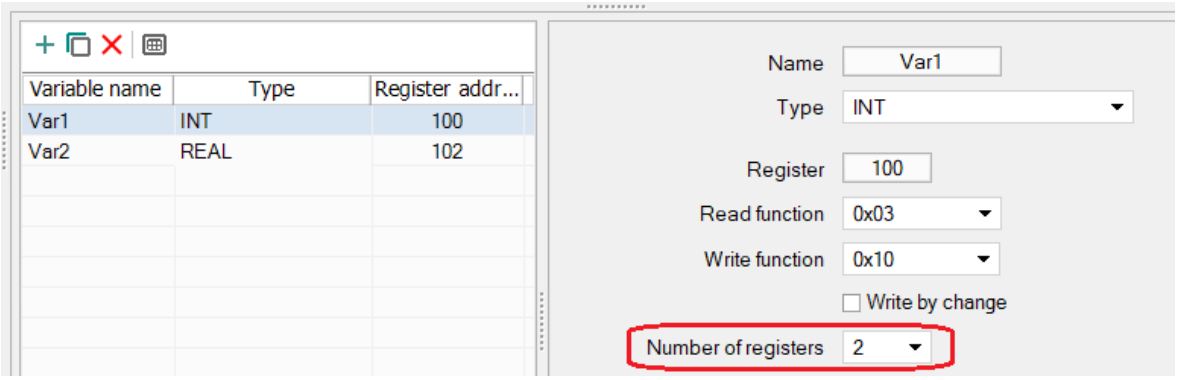


Fig. B.1