USER MANUAL

version without display	version with LCD display

SUSPENDED DUST, PRESSURE, HUMIDITY AND TEMPERATURE TRANSDUCER
AR258

CE

Version 1.1.0
2020.01.30

Thank you for choosing our product.
This manual will enable proper handling, secure
use and full use of the device.
Before assembling and starting the device please read
and understand this manual.
If you have additional questions, please contact our technical consultant.

CONTENT

⚠ Special attention should be paid to texts marked with this sign

The manufacturer reserves the right to make changes to the design and software of the device without any deterioration of technical parameters (some functions may not be available in older versions).

1. SAFETY PRINCIPLES

- before using the device, please read this manual carefully
- in order to avoid electric shock or damage to the device mechanical and electrical assembly should be commissioned to qualified personnel
- before turning on the power, make sure that all cables have been connected correctly
- before making any modifications to the wiring connections, turn off the voltage supplied to the device
- ensure proper working conditions, in accordance with the technical specifications of the device (supply voltage, humidity, temperature, chapter 5)

2. INSTALLATION GUIDELINE

The device has been designed to provide an adequate level of resistance to most of the disturbances that can occur in industrial and home environments. In environments with an unknown level of interference, it is recommended to use the following measures to prevent any possible disruption of the device's operation:

a) do not supply power to the device from the same lines as large capacity devices without proper mains filters

b) use shielding of power, sensor and signal wires, and screen-grounding should be single-point, made as close as possible to the device

c) avoid laying measuring (signal) wires in the immediate vicinity and parallel to power and supply cables

d) it is recommended to twist signal wires in pairs or use a ready UTP wire

e) avoid the proximity of remotely controlled devices, moving iron meters, high power loads, loads with phase or group power control and other devices generating large impulse noise

f) ground or neutralize the metal rails on which the rail devices are mounted

Before starting working with the device, remove the protective foil of the LCD display.

3. GENERAL CHARACTERISTICS OF THE TRANSDUCER

- high class digital sensor of suspended dust (PM), humidity (RH) and temperature (T) of air and atmospheric pressure (p)
- application in many fields and applications (for industrial, office and home environment, outdoor and indoor, e.g. HVAC installations, production, food sector, weather stations, laboratories and others)
- laser dust sensor with **MCERTS** certification, in accordance with **DIN EN 15267** (European air quality norm)
- very accurate measurement of solid particles up to 2.5 μm in diameter (most dangerous to human health)
- probe integrated with the enclosure
- 0/4 ÷ 20 mA current output, 0/2 ÷ 10 V voltage output or RS485 interface
- programmable ranges of processing measured values
- LCD display with keyboard (option) for viewing measurements and configuration of parameters
- parameter configuration from the keyboard via RS485 or PRG port (AR956 or AR955 programmer) and a free ARsoft-CFG computer program that allows you to quickly set and copy all configuration parameters
- high stability of measurements
- IP65 protection level ensured by the enclosure, increasing work reliability thanks to high resistance to the penetration of water and dust as well as surface condensation of water vapor inside the device, IP20 probe
- when used outdoors, additional protection of the measurement probe from direct contact with water is required
- calculation of dew/frost point [°C], absolute humidity [g/m3] (calculation for atmospheric pressure 1013 hPa) with the possibility of linking the calculated values to an analog output

NOTE: ⚠️

For humidity and temperature, it is recommended to periodically check / calibrate the device in accordance with the requirements binding at the installation site or every 12 months.

CAUTION: ⚠️

- **before using the device, read this user manual**
  and correctly perform electrical and mechanical installation and parameter configuration.
- **when setting transducer parameters using the AR955, AR956 programmer it is necessary to**
  configure the ARsoft-CFG program properly

A detailed description of the transducer configuration parameters is available in chapter 9.

4. CONTENTS OF THE SET

- ■ transducer
- ■ instructions for use
- ■ warranty card

5. TECHNICAL DATA

| Measuring range for the probe (Sensirion and Bosch sensors)		$1 \div 1000$ µg/m^3, $0 \div 100$ %RH, $-10 \div 60$ °C, $300 \div 1100$ hPa **do not pour the water over the measurement probe**
Sensor cover (cover made of ABS material)		cover gap width: 3mm, dimensions: 63 x 91 x 25 mm
Measurement accuracy	suspended dust	typically ±10 µg/m^3 in the range of $0 \div 100$ µg/m^3 typically ±10 % in the range of $100 \div 1000$ µg/m^3 **(1)**
	humidity	typically ±2 % RH in the whole measurement range, maximum ±2,5 %RH in the range of $0 \div 90$ %RH **(1)**
	temperature	type. ±0.3°C, max. ±0.4°C in the whole measurement range **(1)**
	pressure	typically ±1 hPa, max. ±2 hPa in the whole measurement range
Additional errors	repeatability	±0,1 %RH, ±0,1 °C
	longterm stability	< 0,25 %RH / year **(2)**, < 0.03 °C / year, ±1 hPa / year
Response time (τ 63%) to the step change in the measured value		10s for humidity and temperature measurement, 1s for suspended dust and pressure measurement **(airflow required >3,6 km/h)**
Measurement period		1s
LCD display (option)		4 digits, 10mm high, without backlighting
Reading measurement resolution		programmable: 0,1 or 1 [%RH, °C, g/m^3], constant for the measurement of suspended dust and pressure: 1 [µg/m^3,hPa]
Analogue outputs (without galvanic isolation from the power supply)	current (active) $0/4 \div 20$mA	maximum resolution ~14,5µA, ampacity R_o [Ω] < (Uzas - 5)V / 22 mA
	voltage $0/2 \div 10$V	max resolution ~9,1mV, ampacity Io<4,5mA (Rw>2,5kΩ)
	output error	basic, <0,1%, additional ±0,01%/°C of the output range

Communication interfaces (RS485 and PRG, do not use simultaneously)	PRG programming connector, standard	- 2,4 kb/s speed (0,6÷115,2 kb/s for the version with RS485) - 8N1 character format (8 bits of data, 1 bit of stop, no parity bit) - MODBUS-RTU protocol (SLAVE) - without galvanic isolation from the supply voltage
	RS485, only in RS version	
Power-supply (power consumption of the LCD display is negligible)	version 0/4÷20mA	12÷36 Vdc, max. current consumption ~50 mA + (Io1+Io2)
	version 0/2÷10V	18÷30 Vdc, current consumption without output load max. ~40 mA
	RS485 version	9÷28 Vac or 9÷36 Vdc, current consumption max. ~65 mA for 9V, max. ~35 mA for 24V
Rated operating conditions		-10 ÷ 60 ℃
Working environment		air and neutral gases
Degree of enclosure protection and mounting method		IP65 (transducer), IP20 (sensor), wall mounting
Operating position		vertical (sensor cover towards the ground)
Weight		~185 g (with integrated probe and LCD)
Electromagnetic compatibility (EMC)		resistance: according to PN-EN 61000-6-2 norm
		emissivity: according to PN-EN 61000-6-4 norm

Note: In the "Rated operating conditions" row, the value is: -10 ÷ 60 ℃ | for humidity <100 %RH (without condensation, do not pour water over the probe)

CAUTIONs: **(1)** - The sensor manufacturer performs factory calibration and guarantees typical measurement accuracy for 90% of its products.
(2) - it is recommended to periodically calibrate the device in accordance with the requirements binding at the installation site or every 12 months

6. ENCLOSURE DIMENSIONS AND INSTALLATION DATA

a) general data and dimensions

Enclosure type	industrial IP65 (probe IP20)
Material	polycarbonate (ABS probe)
Enclosure dimensions	58 x 94 x 35 mm
Probe dimensions	58 x 91 x 25 mm
Mounting	2 holes Φ9 mm, 80mm spacing, **narrower part of the hook holder with a max. diameter Φ5 mm**
Cable cross sections	1,5 mm^2
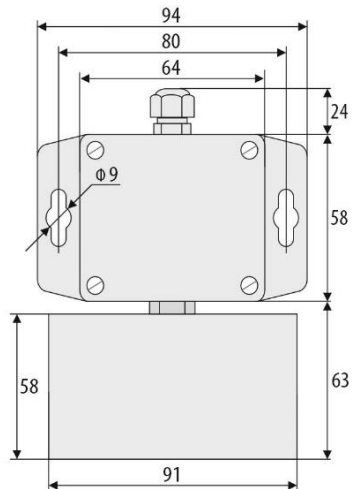
c) wiring assembly
- **before any changes to the wiring disconnect the supply voltage**
- unscrew 4 screws in the transducer front cover and remove it from the device
- in LCD version **carefully** remove the display from the bolt connectors (perpendicularly to the front surface)
- connectors for connecting power, output and signal cables become accessible, chapter 7
- lead the electric cables into the enclosure through the upper cable gland
- after completing activities connected with mounting the device and installation of the wiring carefully assemble the device in the reverse order to that described above
- obtaining IP65 tightness class requires precise tightening of cable gland nuts and transducer enclosure cover

CAUTION:
To avoid possible mechanical and electrostatic damage, special care should be taken during assembly activities inside the device.

7. DESCRIPTION OF TERMINAL STRIPS AND ELECTRICAL CONNECTIONS

Table 7.1. Numbering and description of terminal strips, version with current output

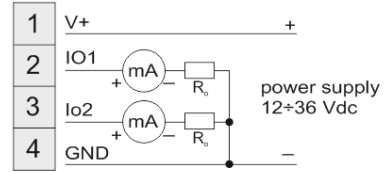| Terminals	Description
1	power supply input V+
2	Io1 current output (0/4÷20mA) configurable by parameter 6: out 1, 7: tYP 1, chapter 9, Table 9.1,
3	Io2 current output (0/4÷20mA) configurable by parameter 8: out2, 9: tYP2, chapter 9, Table 9.1,
4	common ground (minus for outputs and power supply)

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Table 7.2. Numbering and description of terminal strips, version with voltage output

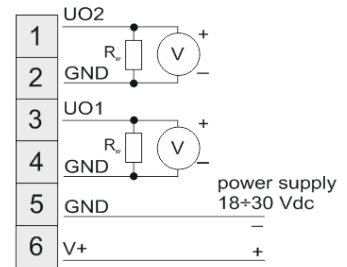| Terminals	Description
1	voltage output Uo2 (0/2÷10V) configurable by parameter 8: out2, 9: tYP2, chapter 9, Table 9.1
3	voltage output Uo1 (0/2 ÷ 10V) configurable by parameter 6: out 1, 7: tYP 1, chapter 9, Table 9.1
2,4,5	common ground (minus for outputs and power supply)
6	power supply input V+

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Table 7.3. Numbering and description of terminal strips, RS485 version

Terminals	Description
1-2	Vac, Vdc power supply input
3	+ RS
4	- RS
JP1	electrical jumper terminating the line of the RS485 interface with a 120 Ω resistor (termination is on when the JP1 is shorted)

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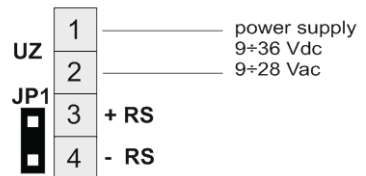
V+ - power supply voltage
(mA) - measuring device (milliamperometer)
(V) - measuring device (voltmeter)
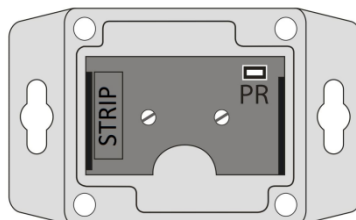Ro, Rw - load resistance, internal of the meter, controller, etc.

Fig.7. Location of the terminal strip and the programming socket **PR**

Fig. 8. Description of the control panel

7-segment LCD display

indicator of the measured size unit (%RH or °C)

programming buttons

a) button functions in the measurement display mode

Button	Description [and marking in the contents of the manual]
▲ + ▼	**[UP]** and **[DOWN]** (simultaneously): input in the parameter configuration menu (after hold time longer than 1s), chapter 9

b) button functions in the parameter configuration menu (chapter 9)

Button	Description [and marking in the contents of the manual]
SET	**[SET]** : - selection of the item displayed in the configuration menu (entering a lower level) - edits the current parameter (the parameter value blinks) - approves and saves the edited parameter value
▲ or ▼	**[UP]** or **[DOWN]**: - moves to the next or previous parameter (submenu) - changes the value of the edited parameter
▲ + ▼	**[UP]** and **[DOWN]** (simultaneously): - canceling changes to the edited value (the blinking stops) and return to the previous menu (one level above) - returns to the measurement display mode after hold time longer than 0,5 s.

CAUTION: ⚠️
Connecting other devices than the AR955 or AR956 programmer to the PR socket may result in damage to the connected device and the transducer.

9. SETTING OF THE CONFIGURATION PARAMETERS

All the configuration parameters of the device are stored in the non-volatile internal memory.
There are two parameter configuration methods:

1. From the keyboard on the control panel (available only with LCD version):
    - from the mode where the input measurements are displayed in the configuration menu (press the **[UP]** and **[DOWN] buttons** simultaneously for more than 1 second) until the `ConF` message appears
    - after entering the configuration menu (with the message `ConF`) the upper display shows the mnemonic parameter name (`dot` <-> `FiLt` <-> `diSi` <-> etc.)
    - press the **[UP]** or **[DOWN]** button to go to the relevant parameter
    - to change the value of the current parameter, briefly press the **[SET]** button (blinks in the edition mode)
    - use the **[UP]** or **[DOWN]** buttons to change the value of the edited parameter
    - approve the changed value of the parameter by pressing the **[SET]** button or cancel it by pressing the **[UP]**

and **[DOWN]** buttons (simultaneous, short press) - press **[UP]** and **[DOWN]** again to return to the main configuration menu (one level above)
- to exit the configuration: press the **[UP]** and **[DOWN]** buttons for a longer time or wait approx. 2 min

2. Use the AR955/AR956 programmer and the ARSOFT-CFG software to (additional description in chapter11):
- connect the device to a computer port and to start and configure the ARSOFT-CFG application
- after the connection has been established, the current measured values and are displayed in the software's window
- setting and viewing of the device parameters is possible in the parameter edition window
- new parameter values must be approved with the ***Approve changes*** button
- the current configuration can be saved in a file or set using values read from a file

NOTE: ⚠️
- before disconnecting the device from the computer, press ***the Disconnect device*** button (ARSOFT-CFG)
- in the event of no response:
   - check in the configuration edition, port number, ***MODBUS address of the device*** (default transmission speed for the version with RS485 is 2400 bit/s, MODBUS address=1),
   - make sure that the serial port drivers in the computer have been properly installed for AR955/AR956 programmer
   - disconnect for a few seconds and then reconnect the AR955/AR956 programmer
   - restart the computer

If a difference is found between the indications and the actual measured values, it is possible to tune the zero for the specific sensor: parameters `co-H`, `co-t`, `co-P` (calibration of the zero point).

In order to restore the default settings you can use the file with the default configuration in the ARSOFT-CFG software.

CAUTION: ⚠️
Default transmission parameters (for version with RS485) in the ARSOFT-CFG software: 2400 bit/s, MODBUS address = 1

Table 9.1. Configuration parameters for versions with 0/4÷20mA current output or 0/2÷10V voltage output

Parameter	Range of parameter variability and description		Default settings
0: `dot` display resolution **(1)**	`0`	resolution **1** [%RH, °C, g/m³, µg/m³, hPa]	`1`
	`1`	resolution **0.1** [%RH, °C, g/m³]	
1: `Filt` filtration **(2)**	`3÷10`	digital filtration of measurements (response time)	`5`
2: `d.51` 1st displayed value	`rEHu`	measured relative humidity [%RH]	`rEHu` [%RH]
	`tEMP`	measured sensor temperature [°C]	
	`AbHu`	calculated absolute humidity [g/m³] **(3)**	
	`dEPt`	calculated dew/frost point [°C] **(3)**	
	`PM 1`	suspended dusts not exceeding 1 µm in diameter [µg/m³]	
	`PM2.5`	suspended dusts not exceeding 2,5 µm in diameter [µg/m³]	
	`PM 4`	suspended dusts not exceeding 4 µm in diameter [µg/m³]	
	`PM 10`	suspended dusts not exceeding 10 µm in diameter [µg/m³]	
	`PrES`	atmospheric pressure measurement [hPa]	
3: `d.52` 2nd displayed value	`rEHu÷PrES`	analogously to parameter 2: `d.51`	`PM2.5` [µg/m³]
4: `d.53` 3rd displayed value	`rEHu÷PrES`	analogously to parameter 2: `d.51`	`PrES` [hPa]

5: `dPEr` switching time of displayed values	`10 ÷ 10.0`	display time of values selected with parameters 2: `d.i51`, 3: `d.i52`, 4: `d.i53` (4)	`40` s
6: `out1` control signal for output 1, Io1 or Uo1	`rEHu ÷ PrES`	selection of the measured value to control output 1, analogously to parameter 2: `d.i51`	`PM25`
7: `tYP1` output 1 type	depending on the type of transducer: for current output `0-20` or `4-20` mA, for voltage output `0-10` or `2-10` V		`0-20` mA (`0-10` V)
8: `out2` control signal for output 2, Io2 or Uo2	`rEHu ÷ PrES`	selection of the measured value to control output 2, analogously to parameter 2: `d.i51`	`rEHu`
9: `tYP2` output 2 type	depending on the type of transducer: for current output `0-20` or `4-20` mA, for voltage output `0-10` or `2-10` V		`0-20` mA (`0-10` V)
10: `Lo1` lower value of the measurement range of the Io1 or Uo1 output	`-50 ÷ 2000`	indication for 0/4 mA or 0/2 V on output 1, unit depending on the setting of parameter 6: `out1`	`0` [μg/m³]
11: `Hi1` upper value of the measurement range of the Io1 or Uo1 output	`-50 ÷ 2000`	indication for 20 mA or 10 V on output 1, unit depending on the setting of parameter 6: `out1`	`100` [μg/m³]
12: `Lo2` lower value of the measurement range of the Io2 or Uo2 output	`-50÷2000`	indication for 0/4 mA or 0/2 V on output 2, unit depending on the setting of parameter 8: `out2`	`0` [%RH]
13: `Hi2` upper value of the measurement range of the Io2 or Uo2 output	`-50 ÷ 2000`	indication for 20 mA or 10 V on output 2, unit depending on the setting of parameter 8: `out2`	`100` [%RH]
14: `co-H` zero point calibration for humidity [%RH]	`-200 ÷ 200`	zero point offset for relative humidity	`00` [%RH]
15: `co-t` zero point calibration for temperature [°C]	`-200 ÷ 200`	zero point offset for the sensor's temperature	`00` [°C]
16: `co-P` zero point calibration for atm pressure [hPa]	`-200 ÷ 200`	zero point offset for atmospheric pressure measurement	`00` [hPa]
17: `SEn` power supply of the suspended dust sensor	`on` `oFF`	the parameter enables deactivation of the suspended dust sensor when `SEn` = `oFF`, the measurement result is 0.	`on`

Table 9.2. Configuration parameters for the RS485 version

Parameter	Range of parameter variability and description		Default settings
0: `dot` display resolution (1)	`0`	resolution **1** [%RH, °C, g/m³, μg/m³]	`1`
	`1`	resolution **0.1** [%RH, °C, g/m³]	
1: `Filt` filtration (2)	`3 ÷ 10`	digital filtration of measurements (response time)	`5`
2: `d.i51` 1st displayed value	`rEHu`	measured relative humidity [%RH]	`rEHu` [%RH]
	`tEMP`	measured sensor temperature [°C]	
	`AbHu`	calculated absolute humidity [g/m³] (3)	
	`dEPt`	calculated dew/frost point [°C] (3)	
	`PM1`	suspended dusts not exceeding 1 μm in diameter [μg/m³]	
	`PM25`	suspended dusts not exceeding 2,5 μm in diameter [μg/m³]	
	`PM4`	suspended dusts not exceeding 4 μm in diameter [μg/m³]	

	`PM10`	suspended dusts not exceeding 10 µm in diameter [µg/m^3]	
	`PrES`	atmospheric pressure measurement [hPa]	
3: `d.52` 2nd displayed value	`rEHu` ÷ `PrES`	analogously to parameter 2: `d.51`	`PM25` [µg/m^3]
4: `d.53` 3rd displayed value	`rEHu` ÷ `PrES`	analogously to parameter 2: `d.51`	`PrES` [hPa]
5: `dPEr` switching time of displayed values	`10` ÷ `100`	display time of values selected with parameters 2: `d.51`, 3: `d.52`, 4: `d.53` (4)	`40` s
6: `co-H` zero point calibration for humidity [%RH]	`-200` ÷ `200`	zero point offset for relative humidity	`0.0` [%RH]
7: `co-t` zero point calibration for temperature [°C]	`-200` ÷ `200`	zero point offset for the sensor's temperature	`0.0` [°C]
8: `co-P` zero point calibration for atm pressure [hPa]	`-200` ÷ `200`	zero point offset for atmospheric pressure measurement	`0.0` [hPa]
9: `SEn` power supply of the suspended dust sensor	`on` `oFF`	the parameter enables deactivation of the suspended dust sensor when `SEn` = `oFF`, the measurement result is 0.	`on`
10: `Addr` MODBUS address	`1` ÷ `247`	MODBUS address of the device	`1`
11: `br` transmission speed	`06` ÷ `115.2`	transmission speed [kb/s], for RS485 and AR955 programmer	`2.4`

Notes: (1) - only for displaying data on the control panel, not for PM measurement (fixed position of dot 0)

(2) - response time depends on the degree of filtration `FiLt`. A higher degree of filtration means a smoothened value of the measurement and longer response time. Response time = sensor response + filtration level / 2 [s]

(3) - values calculated on the basis of the measurement of relative humidity % RH and temperature °C for atmospheric pressure P = 1013hPa

(4) - in order to display the value of only one quantity, the following condition must be met: `d.51` = `d.52` = `d.53`

10. MESSAGES AND ERROR SIGNALING

a) examples of displaying measured values and units (dot position 1):

`41.2¯`	relative humidity 41,2 %RH (unit indicator - horizontal line at the top of the display)
`6.3`	absolute humidity 6.3 g/m^3 (no unit indicator, empty segment on the right side of the display)
`15.8.`	temperature 15,8 °C or dew point temperature 15.8 °C (unit indicator - horizontal line at bottom of display)
`17`	suspended dust concentration 17 µg/m^3 (no unit indicator, digit in the segment on the right side of the display)
`998`	atmospheric pressure is 998 hPa (no unit indicator, value adjusted to the right side of LCD)

b) measurement errors:

Code	Possible causes of error
`‾‾‾‾`	exceeding the measurement range from top
`____`	exceeding the measurement range from the bottom
`----`	no communication with the sensor (sensor damage or interruption of electrical connections)

c) other messages:

Code	Description of the message
`ConF`	access to the parameter configuration menu

11. CONNECTION TO PC AND AVAILABLE SOFTWARE

Connecting the transducer to a computer may be useful (or necessary) to configure parameters, copy settings to other transducers of the same type. As a standard, the transducers are equipped with a **PR** port enabling connection to a computer via the AR955, AR956 programmer using the MODBUS-RTU communication protocol. The following application is available for download from the **www.apar.pl** website in the "*Download*" section, for Windows 7/8/10 operating systems):

Name	Description of the software
ARsoft-CFG (free)	- displaying current measurement data from the connected device - setting configuration parameters such as the type of measurement signal, range of indications, options, display, etc. - creating on a disk the file with the extension "cfg" containing the current configuration of parameters for reuse (copying of configuration) - the program requires communication with the device via the **PR** port (AR956 or AR955)

NOTE: ⚠️

Before establishing the connection, make sure that the transmission speed (applies to the version with RS485) and the MODBUS address in the options of the ARsoft program are the same with the device settings. In addition, in the ARSoft program options, set the number of the COM serial port used (for the AR956 or AR955 programmer or RS485/USB converter, it is the number assigned by the operating system during the installation of the drivers).

12. RS485 COMMUNICATION INTERFACE (according to EIA RS-485)

The installation specification for the interface in the RS485 standard is as follows:
- maximum cable length - 1 km (follow installation guideliness, chapter 2, sub-items b, c, d
- maximum number of devices in a RS485 line - 30, in order to increase the number, use RS485/RS485 amplifiers
- termination and polarizing resistors when the MASTER is at the start of the line (Fig.12):
    - at the start of the line - 2 x 820Ω to the ground and +5V MASTER-A and 150Ω between lines
    - at the end of the line - 150Ω between lines
- terminating and polarizing resistors when the MASTER is in the centre of the line:
    - at the converter - 2 x 820Ω, to the ground and +5V of the converter
    - at both ends of the line - 150Ω each between the lines
Equipment from different manufacturers that form the RS485 network (e.g. RS485 converters/USB) may have integrated polarizing and terminating resistors; in such a case there is no need to use external elements.
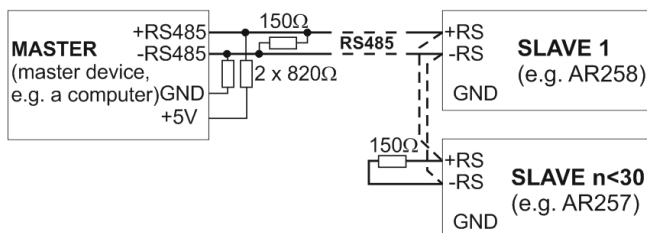

Fig.12. Pictorial diagram of the RS485 network

Character format: 8 bits, 1 stop bit, no parity bit
Available functions: READ - 3 or 4, WRITE - 6

Table 13.1. Query frame format for the READ function (frame length - 8 bytes):

address of the device	function 4 or 3	read register address: 0 ÷ 31 (0x001F)	number of read registers: 1 ÷ 32 (0x0020)	CRC checksum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 13.1. Reading of a register with address 0: 0x01 - 0x04 - 0x0000 - 0x0001 - 0x31CA

Table 13.2. Query frame format for the WRITE function (frame length - 8 bytes):

address of the device	function 6	write register address: 0 ÷ 31 (0x001F)	write register value	CRC checksum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 13.2. Entry in a register with address 10 (0xA) with the value 0: 0x01 - 0x06 - 0x000A - 0x0000 - 0xA9C8

Table 13.3. Response frame format for the READ function (minimum frame length - 7 bytes):

address of the device	function 4 or 3	number of bytes in the data field (max. 32*2=64 bytes)	data field - register value	CRC checksum
1 byte	1 byte	1 byte	2 ÷ 64 bytes (HB-LB)	2 bytes (LB-HB)

Example 13.3. Response frame for register value equal to 0: 0x01 - 0x04 - 0x02 - 0x0000 - 0xB930

Table 13.4. Query frame format for the WRITE function (frame length - 8 bytes):

copy of the query frame for the WRITE function (Table 13.2)

Table 13.5. Special answer (errors: function field = 0x84 or 0x83 in the case of the READ function and 0x86 in the case of the WRITE function):

Error code (HB-LB in data field)	Error description
0x0001	non-existing register address
0x0002	wrong write register value
0x0003	incorrect function number

Example 13.5. Error frame for a non-existing read register address:
0x01 - 0x84 - 0x02 - 0x0001 –0x5130

Table 13.6. Maps of registers for the MODBUS-RTU protocol for the transducer version with the RS485

Register address HEX (DEC)	Value (HEX or DEC)	Description of register and access type (R- read only register, R/W - read and write register)		
0x00 (0)	-	not used or reserved		R
0x01 (1)	2580 ÷2589	device ID		R
0x02 (2)	0 ÷ 99	software version		R
0x03 ÷ 0x05	-	not used or reserved		R
0x06 (6)	0 ÷ 1000	measured value of the relative humidity [%RH]	value in the U2 code, no comma (resolution 0,1)	R
0x07 (7)	-300 ÷ 800	measured value of the temperature [℃]		R
0x08 (8)	0 ÷ 999	calculated value of the absolute humidity [g/m^3]		R

0x09 (9)	-300 ÷ 1000	calculated value of the dew /frost point [°C]	[%RH, °C, g/m^3]	R
0x0A (10)	0 ÷ 1000	value of the suspended dust concenration PM 1 [µg/m^3]	value in the U2 code, no comma **(resolution 1)** [µg/m^3]	R
0x0B (11)	0 ÷ 1000	value of the suspended dust concenration PM 2.5 µg/m^3]		R
0x0C (12)	0 ÷ 1000	value of the suspended dust concenration PM 4 [µg/m^3]		R
0x0D (13)	0 ÷ 1000	value of the suspended dust concenration PM 10 [µg/m^3]		R
0x0E (14)	3000 ÷ 11000	measured atmospheric pressure value [hPa]	value in the U2 code, no comma **(resolution 0,1)** [hPa]	R
0x0F ÷ 0x13	-	not used or reserved		R
Configuration parameters (chapter 9, table 9.2)				
0x14 (20)	0 ÷ 1	parameter 0: `dot` dot position, display resolution		R/W
0x15 (21)	3 ÷ 10	parameter 1: `F rLt` degree of digital filtration		R/W
0x16 (22)	0 ÷ 8	parameter 2: `d.S1` 1st displayed value		R/W
0x17 (23)	0 ÷ 8	parameter 3: `d.S2` 2nd displayed value		R/W
0x18 (24)	0 ÷ 8	parameter 4: `d.S3` 2nd displayed value		R/W
0x19 (25)	10 ÷ 100	parameter 5: `dPEr` switching time of displayed values		R/W
0x1A (26)	-200 ÷ 200	parameter 6: `co-H` zero point calibration for relative humidity		R/W
0x1B (27)	-200 ÷ 200	parameter 7: `co-t` zero point calibration for sensor temperature		R/W
0x1C (28)	-200 ÷ 200	parameter 8: `co-P` zero point calibration for atmospheric pressure measurement		R/W
0x1D (29)	0 ÷ 1	parameter 9: `SEn` of power supply of the suspended dust sensor		R/W
0x1E (30)	1 ÷ 247	parameter 10: `Addr` MODBUS address		R/W
0x1F (31)	0 ÷ 9	parameter 11: `br` transmission speed		R/W

14. INFORMATION AND RECOMMENDATIONS FOR MEASURING SUSPENDED DUST

A Sensirion sensor measures the mass concentration of airborne dust particles. The measured quantity PM2.5 determines the mass of all particles with a size of 0.3 ÷ 2.5 μm in a cubic meter of air [μg/m^3]. Therefore, it is possible that PM1.0 value is similar or the same as PM2.5. This means that there are few or no particles in the range of 1 ÷ 2,5 μm in a given environment. Similarly, when PM4 = PM10, there are no particles with a size of 4 ÷ 10 μm in the air.

The sensor takes into account the measured aerosol profile and calculates the expected PM4 and PM10 values based on the spectrum of all visible smaller particles and their distribution. Coarse particle estimation (PM4, PM10) works best for events that are dominated by one source, such as most indoor pollution. The algorithm for calculating PM4 and PM10 works worse in complex situations, such as outdoor measurements, in which particle sources can be complex and filtered by distance and time (such as sandstorms). The latter can result in very complex particle profiles and cannot be calculated accurately from the distribution of small particles.