

## USER INSTRUCTION



version  
without a display



version  
with an LCD display

## CARBON DIOXIDE, HUMIDITY AND TEMPERATURE TRANSDUCER

### AR257



*Thank you for choosing our product.  
This instruction is intended to facilitate correct operation,  
safe use, and taking full advantage of the device's functionalities.  
Before you start the device, please read and understand this instruction.  
In the event of any additional questions, please contact our technical adviser.*

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Please pay particular attention to the text marked with this sign.

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

## 1. SAFETY PRINCIPLES



- before you start to use the device, become familiar with the present instructions;
- in order to avoid electrocution or damage to the device, its mechanical and electrical installation must be performed by qualified workers;
- before switching on the power supply, make sure that all cables and wires are properly connected;
- before making any modifications to the wire and cable connections, switch off the voltage supplied to the device;
- ensure proper operating conditions compliant with the technical specification of the device (chapter 5, power supply voltage, humidity, temperature).

## 2. INSTALLATION GUIDELINES



The device is designed so as to ensure an appropriate level of immunity to most interferences that may occur in industrial and household environments. In environments of unknown level of interferences, it is recommended to implement the following measures so as to prevent potential interference with the operation of the device:

- a) do not supply the device from the same lines as high-power equipment without using appropriate power line filters;
- b) use shielded supply, sensor, and signal cables, whereby the earthing of the shield should be single-point and located as close to the device as possible;
- c) avoid running measurement (signal) cables in the direct vicinity of and parallel to power and supply cables;
- d) it is recommended to twist the signal wires in pairs or to use a finished twisted-pair cable;
- e) avoid proximity of remotely controlled devices, electromagnetic meters, high power loads, loads with phase or group power control, and other devices that cause high impulse disturbances;
- f) ground or zero metal rails on which rail-mounted devices are installed.

Make sure to remove the protective film from the LCD display before the first use of the device.

## 3. GENERAL CHARACTERISTICS OF THE TRANSDUCER

- high-quality digital sensor for carbon dioxide (CO<sub>2</sub>), relative humidity (RH) and temperature (T) in close rooms to improve the comfort and well-being of people staying there;
- application in many fields and applications (for industrial, office and residential environments, inside buildings, e.g. HVAC installations, storage, production, transport, food sector, pharmacy, medicine, gardening, laboratories and others) a probe integrated with the enclosure, external or on a stainless steel pipe;
- a current output, 4-20 mA (2-wire, with power supply from the current loop); a voltage output 0-10 V (3-wire), or an RS485 interface;
- programmable processing ranges for measured values;
- an LCD display with a keypad (option) that enables configuration of parameters;
- configuration of parameters with the keypad, through the RS485 or PRG port (programmer AR956 or AR955) and free ARsoft-CFG software that enables quick setting and copying of all configuration parameters;
- high stability of measurements;
- protection rating IP65 provided by the enclosure which improves reliability of operation thanks to high resistance to penetration of water and dust and surface condensation of steam inside of the device; an IP20 probe;
- calculation of the dew/frost point [°C], relative humidity [g/m<sup>3</sup>] (calculations for atmospheric pressure of 1013 hPa) with possibility to link the calculated values to an analog output;

**NOTE:** 

For humidity and temperature, it is recommended to periodically check / certificate of calibration of the device in accordance with the requirements in force at the installation site or once every 12 months is recommended

**NOTE:** 

- before you start working with the device, become familiar with this user instruction and make sure the electrical and mechanical systems have been made properly and the correct parameters have been set;
- if the parameters of the transducer have been set using the AR956 programmer, the ARsoft-CFG software must be configured properly.

A detailed description of the configuration parameters of the transducer can be found in chapter 9.

## 4. CONTENTS OF THE SET

- the transducer;
- a user instruction;
- a warranty card.

## 5. TECHNICAL DATA

<b>Measurement range for the probe</b> (for SCD30 sensor, produce by Sensirion)		0÷10000 ppm, 0÷95 %RH, 0÷50 °C, <b>do not pour water on measuring probe</b>
<b>The sensor's sheath</b> (ABS sheath)		sheath slot width: 3mm, diameter: 36 x 50 x 20 mm
<b>Measurement accuracy</b> (same as Sensirion SCD30 sensor)	CO2	typically ±(30ppm + 3%) in the entire measurement range <b>(1)</b>
	humidity	typically ±3 %RH in the entire measurement range of transducer
	temperature	typically ±(0.4°C + 0.023 × (T [°C] – 25°C))
<b>Additional errors</b>	repeatability	±10 ppm, ±0,1 %RH, ±0,1 °C
	temperature stability	± 2.5 ppm / °C in temperature 0 ÷ 50 °C
	long-term stability	< 0,25 %RH / year <b>(2)</b> , < 0.03 °C / year
<b>Response time</b> (τ 63%) to step change of the measured value		10s for measure humidity and temperature, 20s for measure CO2 <b>(for air flow &gt;3,6 km/h)</b>
<b>Measurement period</b>		2s ÷ 60s
<b>LCD display (option)</b>		4 digits, 10 mm high, without backlighting
<b>Readout measurement resolution</b>		programmable: 0,1 or 1 [%RH, °C, g/m <sup>3</sup> ], fixed for measuring CO2: 1 [ppm]
<b>Analog outputs</b> (without galvanic separation from power supply)	current(active) 0/4÷20mA	maximum resolution approx. 14,5µA, load capacity R <sub>o</sub> [Ω] < (U <sub>sup</sub> - 5V) / 22 mA
	voltage 0/2÷10V	max. resolution~9,1mV, load capacity I <sub>o</sub> <4,5mA (R <sub>w</sub> >2,5kΩ)
	output error	basic <0,1%, additional ±0,01%/°C of the output range
<b>Communication interfaces</b> (RS485 and PRG, do not use simultaneously)	PRG programming connection, standard	- baud rate 2,4kb/s (0,6÷115,2 kb/s for version with RS485 interface)
	RS485, only in the RS version	- character format 8N1 (8 data bits, 1 stop bit, no parity bit) - MODBUS-RTU protocol (SLAVE) - without galvanic separation from power supply

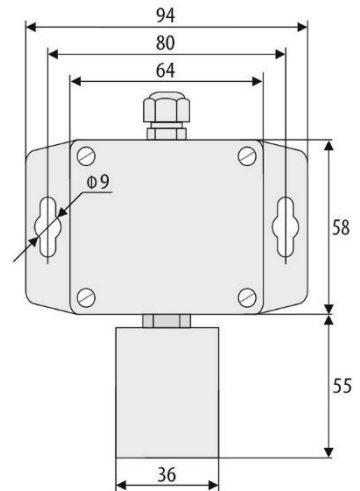
<b>Power supply</b> (power consumption of the LCD display is negligible)	version 0/4÷20mA	12÷36 Vdc, current consumption ~45 mA + (IO1+IO2)
	version 0/2÷10V	18÷30 Vdc, current consumption without load outputs max.~35 mA
	version RS485	9÷28 Vac or 9÷36 Vdc, current consumption max. 60 mA for 9V, maks. ~30 mA for 24V
<b>Rated operating conditions</b>	0 ÷ 50 °C	for humidity <95 %RH (no condensation, do not pour water on the probe)
<b>Operating environment</b>	air and neutral gases, dustless	
<b>Enclosure protection rating and mounting method</b>	IP65 (electronic components), IP20 (sensor), wall mounted	
<b>Operating position</b>	any (or the sensor sheath to the ground when the transducer is exposed to the risk of contact with water or water splashes)	
<b>Weight</b>	~130 g (with integrated probe and LCD)	
<b>Electromagnetic compatibility (EMC)</b>	immunity: according to the PN-EN 61000-6-2 standard	
	emission: according to the PN-EN 61000-6-4 standard	

- Notes:**
- (1) - Accuracy is fulfilled for > 90% sensors after calibration. Rough handling (shipping, assembly) reduces the accuracy of the sensor. Full accuracy is restored using the ASC recalibration function.
  - (2) - periodic calibration of the device in accordance with the requirements in force at the installation site or once every 12 months is recommended.

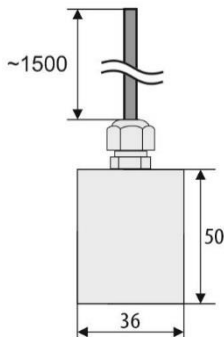
## 6. ENCLOSURE DIMENSIONS AND INSTALLATION DATA

a) general data and dimensions of the standard version (integrated probe)

<b>Enclosure type</b>	industrial IP65 (probe IP20)
<b>Material</b>	polycarbonate (probe ABS)
<b>Enclosure dimensions</b>	58 x 94 x 35 mm
<b>Probe dimensions</b>	36 x 50 x 20 mm
<b>Fixing methods</b>	2 x Ø9 mm holes, distance between the holes 80 mm, narrower part of the hook holder with max. diameter of 5 mm
<b>Conductor cross-sections</b>	1,5 mm <sup>2</sup>



b) dimensions for external probes with a wire AR257/2



c) installation of cabling

**- cut off the power supply before making any changes to the cabling;**

- remove the 4 screws in the front cover and take it off the device;
- in version with an LCD, carefully take out display from bolt connectors (perpendicularly to the front surface);
- terminals to connect power supply cables, outputs cables, and signal cables become accessible – see chapter 7;
- the electric cables must be inserted into the enclosure through cable glands;
- after the device has been mounted and the cabling has been installed, assemble the device carefully performing the work in the reverse order;
- in order to achieve the IP65 rating, the nuts of the cable glands and the enclosure cover must be tightened precisely;



**In order to avoid any mechanical and electrostatic damage, one must be very careful when handling the circuit board of the display.**

## 7. DESCRIPTION OF TERMINAL STRIPS AND ELECTRICAL CONNECTIONS

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

Terminals	Description
1	supply input V+
2	current output IO1 (0/4÷20mA) configurable with parameters 6: <b>OUT1</b> , 7: <b>LYP1</b> , chapter 9, Table 9.1, default for CO2
3	current output IO2 (0/4÷20mA) configurable with parameters 8: <b>OUT2</b> , 9: <b>LYP2</b> , chapter 9, Table 9.1, default for humidity
4	common earth (minus for the outputs and the power supply)

**AR257/I**

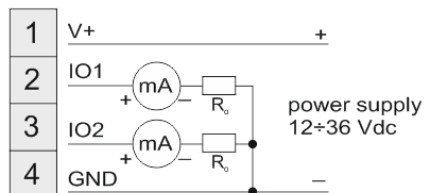


Table 7.2. Numbering and description of terminal strips - the version with the voltage output

Terminals	Description
1	voltage output UO2 (0/2÷10V) configurable with parameters 8: <b>OUT2</b> , 9: <b>LYP2</b> , chapter 9, Table 9.1, default for humidity
3	voltage output UO1 (0/2÷10V) configurable with parameters 6: <b>OUT1</b> , 7: <b>LYP1</b> , chapter 9, Table 9.1, default for CO2
2, 4, 5	common earth (minus for the outputs and the power supply)
6	supply input V+

**AR257/U**

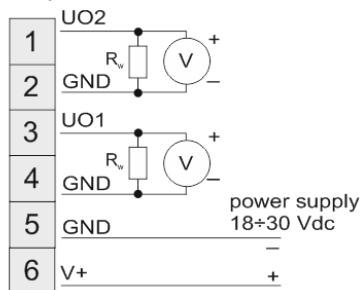
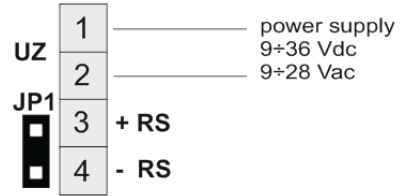


Table 7.3. Numbering and description of terminal strips, version RS485

Terminals	Description
1-2	supply input Vac, Vdc
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)

AR257/R485



V+ - power supply voltage

ⓂA - measuring device (milliammeter)

Ⓥ - measuring device (volt meter)

Ro, R<sub>w</sub> - load resistance, internal meter, controller, etc.

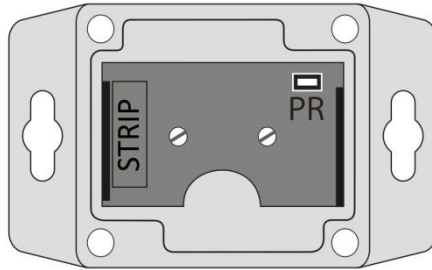




Fig.7. Location of the terminal strip and the programming socket PR

## 8. FUNCTIONS OF THE BUTTONS ON THE CONTROL PANEL


Rys. 8. Description of the control panel







a) button functions in the measurement display mode

Button	Description [and marking in the contents of the instructions]
 + 	<b>[UP]</b> and <b>[DOWN]</b> (simultaneously): input in the parameter configuration menu (after hold time longer than 1 s), chapter 9

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

Button	Description [and marking in the contents of the instructions]
	<b>[SET]</b> : - 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 	<p><b>[UP] or [DOWN]:</b></p> <ul style="list-style-type: none"> <li>- moves to the next or previous parameter (submenu)</li> <li>- changes the value of the edited parameter</li> </ul>
 + 	<p><b>[UP] and [DOWN] (simultaneously):</b></p> <ul style="list-style-type: none"> <li>- canceling changes to the edited value (the blinking stops) and return to the previous menu (one level above);</li> <li>- returns to the measurement display mode after hold time longer than 0.5 s</li> </ul>

**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:

- Using the keypad on the control panel (only available 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 sec.) until the **CONF** message appears;
  - after entering the main configuration menu (with the message **CONF**) the display shows a mnemonic name of the parameter ( **dob** <-> **Filt** <-> **d.S** etc.);
  - press the **[UP]** or **[DOWN]** button to go to the relevant parameter;
  - to change the value of the current parameter, press briefly the **[SET]** button (the parameter blinks in the edition mode);
  - use buttons **[UP]** or **[DOWN]** 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 (briefly press them simultaneously) - by pressing the **[UP]** and **[DOWN]** buttons again, you will return to the main configuration menu (one level above);
  - to exit the configuration: press the **[UP]** and **[DOWN]** buttons for a long moment or wait approx. 2 minutes
- Use the AR956/AR955 programmer and the ARSOFT-CFG software to: (additional description in chapter 11):
  - 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 a computer, press the Disconnect device button (ARSOFT-CFG)
- in the event of no response:
  - in the **Program options** check the configuration of the port and the **MODBUS address of the device** (transmission speed 2,400 bit/s, address MODBUS=1);
  - make sure that the serial port drivers in the computer have been properly installed for the AR956/AR955 programmer;
  - disconnect for a few seconds and then reconnect the AR956/AR955 programmer;
  - restart the computer;
  - if the AR955 programmer is used instead of the AR956 programmer, connect the power supply voltage to the transducer.

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



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



**NOTE:**

The transmission parameters for the AR956 programmer in the ARSOFT-CFG software are the following: 2,400 bit/s, address MODBUS = 1

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

Parameter	Range of variability of the parameter and description		Default settings
0: <b>d0E</b> display indication resolution (1)	<b>0</b>	resolution <b>1</b> [%RH, °C, g/m <sup>3</sup> , ppm]	<b>1</b>
	<b>1</b>	resolution <b>0.1</b> [%RH, °C, g/m <sup>3</sup> ]	
1: <b>F4E</b> filtration (2)	<b>0 ÷ 10</b>	digital filtration of measurements (response time)	<b>5</b>
2: <b>d1S1</b> first displayed value	<b>rEHU</b>	measured relative humidity [%RH]	<b>rEHU</b> [%RH]
	<b>tENP</b>	measured sensor temperature [°C]	
	<b>g6HU</b>	calculated absolute humidity [g/m <sup>3</sup> ] (3)	
	<b>dEPE</b>	calculated dew/frost point temperature [°C] (3)	
	<b>t02</b>	carbon dioxide concentration [ppm]	
3: <b>d1S2</b> second displayed value	<b>rEHU ÷ t02</b>	analogously to parameter 2: <b>d1S1</b>	<b>tENP</b> [°C]
4: <b>d1S3</b> third value displayed	<b>rEHU ÷ t02</b>	analogously to parameter 2: <b>d1S1</b>	<b>t02</b> [ppm]
5: <b>dPER</b> displayed values switching period	<b>10 ÷ 100</b>	display time of the values selected with arameters 2: <b>d1S1</b> , 3: <b>d1S2</b> , 4: <b>d1S3</b> (4)	<b>40</b> s
6: <b>ouE1</b> control signal for output 1, IO1 or UO1	<b>rEHU ÷ t02</b>	selection of the measured value to control output 1, analogously to parameter 2: <b>d1S1</b>	<b>t02</b>
7: <b>tYP1</b> type of output 1	depending on the type of transducer: for current output <b>0-20</b> or <b>4-20</b> mA, for voltage output <b>0-10</b> or <b>2-10</b> V		<b>0-20</b> mA ( <b>0-10</b> V)
8: <b>ouE2</b> control signal for output 2, IO2 or UO2	<b>rEHU ÷ t02</b>	selection of the measured value to control output 2, analogously to parameter 2: <b>d1S1</b>	<b>rEHU</b>
9: <b>tYP2</b> type of output 2	depending on the type of transducer: for current output <b>0-20</b> or <b>4-20</b> mA, for voltage output <b>0-10</b> or <b>2-10</b> V		<b>0-20</b> mA ( <b>0-10</b> V)
10: <b>t01</b> the lower value of the measurement range of the output IO1 or UO1	<b>-50 ÷ 9999</b>	indication for 0/4 mA or 0/2 V on output 1, unit depending on the setting of parameter 6: <b>ouE1</b>	<b>0</b> [ppm]
11: <b>H1</b> the upper value of the measurement range of the output IO1 or UO1	<b>-50 ÷ 9999</b>	indication for 20 mA lub 10 V on output 1, unit depending on the setting of parameter 6: <b>ouE1</b>	<b>2000</b> [ppm]
12: <b>t02</b> the lower value of the measurement range of the output IO2 or UO2	<b>-50 ÷ 9999</b>	indication for 0/4 mA or 0/2 V on output 2, unit depending on the setting of parameter 8: <b>ouE2</b>	<b>0</b> [%RH]
13: <b>H2</b> the upper value of the measurement range of the output IO2 or UO2	<b>-50 ÷ 9999</b>	indication for 20 mA or 10 V on output 2, unit depending on the setting of parameter 8: <b>ouE2</b>	<b>100</b> [%RH]
14: <b>t0-H</b> calibration of the zero point for humidity [%RH]	<b>-200 ÷ 200</b>	zero point offset for relative humidity	<b>0.0</b> [%RH]
15: <b>t0-H</b> calibration of the inclination for humidity[%RH]	<b>0.50 ÷ 1.150</b>	sensitivity (gain) for relative humidity	<b>100.0</b> [%]

16: <b>CO-T</b> calibration of the zero point for temperature [°C]	<b>-200 ÷ 200</b>	zero point offset for temperature sensor	<b>00</b> [°C]
17: <b>CG-T</b> calibration of the inclination for temperature [°C]	<b>050 ÷ 1150</b>	sensitivity (gain) for temperature sensor	<b>1000</b> [%]
18: <b>RPER</b> measuring period	<b>2 ÷ 60</b>	frequency of measurements <b>(2)</b>	<b>2</b> [s]
19: <b>RAPR</b> ambient pressure	<b>700 ÷ 1400</b>	pressure compensation for measuring CO2 concentration	<b>1013</b> [hPa]
20: <b>FC-C</b> calibration of the CO2 sensor (chapter 9.1)	<b>400 ÷ 2000</b>	calibration function for measuring carbon dioxide concentration	<b>410</b>

**Notes:** (1) – applies only do display of data on the control panel, not applicable CO2 (fixed position of the dot 0)

(2) – response time is dependent on the degree of filtration **FLT** and measuring period **RPER**.  
transducer response time = **FLT** \* **RPER** [s]

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

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

Table 9.2. Configuration parameters for the RS485 version

Parameter	Range of variability of the parameter and description		Default settings
0: <b>DOB</b> display indication resolution <b>(1)</b>	<b>0</b>	resolution <b>1</b> [%RH, °C, g/m <sup>3</sup> , ppm]	<b>1</b>
	<b>1</b>	resolution <b>0.1</b> [%RH, °C, g/m <sup>3</sup> ]	
1: <b>FLT</b> filtration <b>(2)</b>	<b>0 ÷ 10</b>	digital filtration of measurements (response time)	<b>5</b>
2: <b>d.51</b> first displayed value	<b>RELH</b>	measured relative humidity [%RH]	<b>RELH</b> [%RH]
	<b>TEMP</b>	measured sensor temperature [°C]	
	<b>ABHD</b>	calculated absolute humidity [g/m <sup>3</sup> ] <b>(3)</b>	
	<b>DEPT</b>	calculated dew/frost point temperature [°C] <b>(3)</b>	
3: <b>d.52</b> second displayed value	<b>RELH ÷ 1002</b>	analogously to parameter 2: <b>d.51</b>	<b>TEMP</b> [°C]
	<b>RELH ÷ 1002</b>	analogously to parameter 2: <b>d.51</b>	<b>1002</b> [ppm]
4: <b>d.53</b> third displayed value	<b>RELH ÷ 1002</b>	analogously to parameter 2: <b>d.51</b>	<b>1002</b> [ppm]
5: <b>RPER</b> displayed values switching period	<b>10 ÷ 100</b>	display time of the values selected with arameters 2: <b>d.51</b> , 3: <b>d.52</b> , 4: <b>d.53</b> <b>(4)</b>	<b>40</b> s
6: <b>CO-H</b> calibration of the zero point for humidity [%RH]	<b>-200 ÷ 200</b>	zero point offset for relative humidity	<b>00</b> [%RH]
7: <b>CG-H</b> calibration of the inclination for humidity [%RH]	<b>050 ÷ 1150</b>	sensitivity (gain) for relative humidity	<b>1000</b> [%]
8: <b>CO-T</b> calibration of the zero point for temperature [°C]	<b>-200 ÷ 200</b>	zero point offset for temperature sensor	<b>00</b> [°C]
9: <b>CG-T</b> calibration of the inclination for temperature [°C]	<b>050 ÷ 1150</b>	sensitivity (gain) for temperature sensor	<b>1000</b> [%]
10: <b>RPER</b> measuring period	<b>2 ÷ 60</b>	frequency of measurements <b>(2)</b>	<b>2</b> [s]
11: <b>RAPR</b> ambient pressure	<b>700 ÷ 1400</b>	pressure compensation for measuring CO2 concentration	<b>1013</b> [hPa]

12: <b>F<sub>CL</sub></b> calibration of the CO2 sensor (chapter 9.1)	<b>400 ÷ 2000</b>	calibration function for measuring carbon dioxide concentration	<b>410</b>
13: <b>R<sub>addr</sub></b> address MODBUS	<b>1 ÷ 247</b>	MODBUS address of the device	<b>1</b>
14: <b>br</b> transmission speed	<b>08 ÷ 1152</b>	transmission speed [kb/s], for the RS485 and the AR956/AR955 programmer	<b>24</b>

- Notes:**
- (1) – applies only do display of data on the control panel, not applicable CO2 (fixed position of the dot 0)
  - (2) – response time is dependent on the degree of filtration **F<sub>TL</sub>** and measuring period **F<sub>PER</sub>**.  
transducer response time =  $F_{TL} * F_{PER}$  [s]
  - (3) – values calculated based on measurement of relative humidity (%RH) and temperature (°C) for atmospheric pressure P=1013 hPa
  - (4) – in order to display the value of only one type, the following condition must be met: **0.51 = 0.52 = 0.53**

## 9.1. SENSOR CALIBRATION FUNCTION

The sensor manufacturer performs a factory calibration and guarantees typical measuring accuracy for 90% of its products. As a result of transport, storage, assembly, aging etc., there may be discrepancies in the measurement results. To compensate for these cases, the sensor is equipped with calibration option, parameter **F<sub>CL</sub>**.

Calibration can be done by changing and saving the parameter value **F<sub>CL</sub>**. The sensor should be placed in an environment with a known concentration of carbon dioxide and then enter this value in the parameter **F<sub>CL</sub>** and save by pressing the **[SET]** button. The manufacturer recommends that before saving the calibration value the sensor should work with the measurement period **F<sub>PER</sub>** = 2s, at least for 2min. in stabilized environmental conditions. The reference value can be 410 ppm (current concentration of carbon dioxide in the atmosphere, February 2019) when the sensor it is exposed to fresh air.

## 9.2. RECOMMENDATIONS CONCERNING MEASUREMENT

The SCD30 sensor measures the level of carbon dioxide in the air using technology MOSens® and NDIR. Generating infrared radiation needed for measurement causes the entire sensor to heat slightly. Therefore, the measured temperature increases and the humidity decreases relative to the actual values. To compensate for these discrepancies, the measurement period can be increased using the parameter **F<sub>PER</sub>**, or make zero point and inclination calibration with parameters **CO-R**, **CO-R1**, **CO-B**, **CO-B1**. Another way is to place the sensor in an air stream, e.g. in a ventilation duct or next to a fan.

When the sensor is placed in the ventilation duct, to improve the accuracy of measuring carbon dioxide concentration, the value of ambient pressure should be compensated with the parameter **APP**.

## 10. MESSAGES AND ERROR SIGNALING

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

<b>41.2</b>	relative humidity 41,2 %RH (unit indicator - a horizontal line at the top of the display)
<b>6.3</b>	absolute humidity 6.3 g/m <sup>3</sup> (no unit indicator, empty segment on the right side of the display)
<b>15.8</b>	temperature 15,8 °C or dew point temperature 15.8 °C (unit indicator - horizontal line at bottom of display)
<b>1015</b>	carbon dioxide concentration 1015 ppm (no unit indicator, segment digit on the right side of the display)

b) measurement errors:

Code	Possible causes of error
---	the measurement range of the sensor is exceeded from the top
---	the measurement range of the sensor is exceeded from the bottom
---	no communication with the sensor (the sensor is defective or the electrical connections are broken)

c) other messages:

Code	Possible causes of error
Conf	the parameter configuration menu was accessed

## 11. CONNECTING THE CONTROLLER TO A COMPUTER AND AVAILABLE SOFTWARE


It may be useful (or necessary) to connect the transducer to a computer in order to configure parameters, which also enables copying the setting to other transducers of the same type.

As a standard, the transducers are equipped with a PR port which enables connection to a computer using an AR956 programmer using the MODBUS-RTU communication protocol and the following transmission parameters: speed = 2,400 bit/s, MODBUS address = 1.

The following application is available (on a CD supplied with the AR956 programmer or to be downloaded from the Internet at [www.apar.pl](http://www.apar.pl), "Download" section, for operating systems Windows Vista/7/8/10):

Name	Software description
<b>ARsoft-CFG</b> (free)	<ul style="list-style-type: none"> <li>- display of current measurement data from the connected device</li> <li>- setting configuration parameters, such as the measurement signal, the indication range, the options, the display, etc.</li> <li>- creation on the disk of a "cfg" file with the current configuration of the parameters for future use (copying of configuration)</li> <li>- the software requires communication with the device via the PR port (AR956 or AR955)</li> </ul>

A detailed description of the aforementioned application can be found in the installation folder.

**NOTE:** 

Before a connection is established, make sure that the MODBUS address and the transmission speed in the options of the ARsoft software are the same as the settings of the device (this applies to the version with the RS485).

Moreover, in the options of the ARsoft software, set the number of the COM serial port in use (in the case of the AR956/AR955 programmer or the RS485/USB converter, it is the number assigned by the operating system during installation of the drivers).

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

The installation specification for the RS485- standard interface is the following:

- maximum cable length - 1 km (observe the installation guidelines, chapter 2, sub-items b, c, and d)
- maximum number of devices in a RS485 line - 30, in order to increase the number, use RS485/RS/485 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 820 Ω to the ground and +5 V of the MASTER and 150 Ω between lines
  - at the end of the line - 150 Ω between lines
- termination and polarizing resistors when the MASTER is in the center of the line:
  - at the converter - 2 x 820 Ω, to the ground and +5 V of the converter
  - at both ends of the line - 150 Ω each between 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.

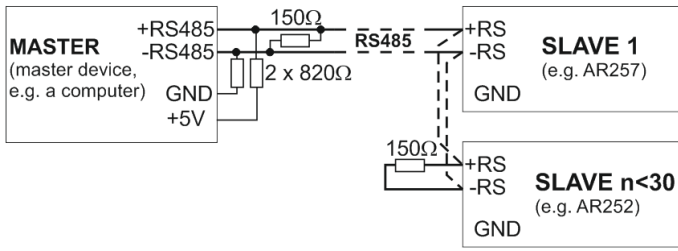


Fig. 12. Pictorial diagram of the RS485 network

### 13. MODBUS–RTU SERIAL TRANSMISSION PROTOCOL (SLAVE)

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 ÷ 34 (0x0022)	number of read registers: 1 ÷ 35 (0x0023)	CRC check sum
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 ÷ 34 (0x0022)	write register value	CRC check sum
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 0 value: 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. 35*2=70 bytes)	data field - register value	CRC check sum
1 byte	1 byte	1 byte	2 ÷ 70 bytes (HB-LB)	2 bytes (LB-HB)

**Example 16.3.** Response frame for register value equal to 0: 0x01 - 0x04 - 0x02 - 0x0000 - 0xB930

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

copy of the claim 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 the data field)	Error description
0x0001	non-existing register address
0x0002	wrong write register value
0x0003	improper 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 ÷ 0x05	0	not used or reserved	
0x06 (6)	0 ÷ 1000	measured value of relative humidity [%RH]	value in the U2 code, without a decimal point (resolution 0.1 [%RH, °C, g/m <sup>3</sup> ])
0x07 (7)	-300 ÷ 800	measured value of temperature [°C]	
0x08 (8)	0 ÷ 999	calculated value of relative humidity [g/m <sup>3</sup> ]	
0x09 (9)	-300 ÷ 1000	calculated value of dew/frost point [°C]	
0x0A (10)	0 ÷ 9999	carbon dioxide concentration [ppm]	
0x0B ÷ 0x13	0	not used or reserved	
<b>Configuration parameters (chapter 9, Table 9.2)</b>			
0x14 (20)	0 ÷ 1	parameter 0: <b>dob</b> position of the period, resolution of the display	R/W
0x15 (21)	3 ÷ 10	parameter 1: <b>fil</b> degree of digital filtration	R/W
0x16 (22)	0 ÷ 4	parameter 2: <b>d1</b> first displayed value	R/W
0x17 (23)	0 ÷ 4	parameter 3: <b>d2</b> second displayed value	R/W
0x18 (24)	0 ÷ 4	parameter 4: <b>d3</b> third displayed value	R/W
0x19 (25)	10 ÷ 100	parameter 5: <b>PER</b> displayed values switching period	R/W
0x1A (26)	-200 ÷ 200	parameter 6: <b>co-H</b> calibration of the zero point for relative humidity	R/W
0x1B (27)	850 ÷ 1150	parameter 7: <b>co-H</b> calibration of the inclination for relative humidity	R/W
0x1C (28)	-200 ÷ 200	parameter 8: <b>co-t</b> calibration of the zero point for temperature sensor	R/W
0x1D (29)	850 ÷ 1150	parameter 9: <b>co-t</b> calibration of the inclination for temperature sensor	R/W
0x1E (30)	2 ÷ 60	parameter 10: <b>PER</b> measuring period	R/W
0x1F (31)	700 ÷ 1400	parameter 11: <b>RPR</b> compensation of ambient pressure	R/W
0x20 (32)	400 ÷ 2000	parameter 12: <b>FR</b> calibration of the carbon dioxide sensor	R/W
0x21 (33)	1 ÷ 247	parameter 13: <b>ADDR</b> MODBUS address	R/W
0x22 (34)	0 ÷ 9	parameter 14: <b>br</b> transmission speed	R/W



