



# Instruction Manual

**T8348**      programmable indoor transmitter  
of temperature and CO<sub>2</sub> concentration  
with RS232 serial output

**T8448**      programmable indoor transmitter  
of temperature and CO<sub>2</sub> concentration  
with RS485 serial output

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To damages caused by using the device in conflict with this manual can not be provide free repairs during the warranty period.

Read carefully instruction manual before the first device connection.

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## General description

The transmitters are designed for online measurement of carbon dioxide concentration and temperature of air in a building interiors.

device type	construction type	output	galvanic isolated output
<b>T8348</b>	ambient air	RS232	no
<b>T8448</b>	ambient air	RS485	yes

The CO<sub>2</sub> concentration is measured using the dual wavelength NDIR sensor with multiple point adjustment. The dual wavelength NDIR CO<sub>2</sub> sensing procedure compensates aging of the sensing element and offers maintenance free operation and outstanding long term stability. Measured values can be read in „SLOW mode“ (filtered, averaged) or in „FAST mode“ (current values without averaging). SLOW mode has advantages in applications like climate control because of filtering short time peaks. As an example exhaled air from an employee passing the sensor could affect the climate control negatively with a short response time because the control would trigger a change of the ventilation based on this one-time measurement. On the contrary in „FAST mode“ no software filter is used for calculating the output value. This fact adds a noise of typ.  $\pm 30$ ppm which has to be considered in terms of accuracy. The measured value of CO<sub>2</sub> concentration depends on the value of air pressure, (the altitude at the place of installation). For this reason, it is suitable for accurate measurement to set the altitude of the installation site by TSensor software - see below.

Measured values are displayed on dual line LCD display. The visual indication of CO<sub>2</sub> concentration is provided by three-color LED.

After power up of the device starts internal test. During this time (about 20s) LCD display shows (----) instead of CO<sub>2</sub> concentration value.

Supported communication protocols are Modbus RTU, protocol compatible with standard Advantech-ADAM and protocol ARION. Devices are preset from manufacturer to Modbus RTU communication protocol. If you would like to use different communication protocol then Modbus RTU, it is necessary preset them throw user's software – see below.

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Use software *Tsensor* for setting of all device parameters (recommended). It is free to download at [www.cometsystem.cz](http://www.cometsystem.cz). It supports make the adjustment of the device too. This procedure is described at file „*Calibration manual.pdf*“ which is installed commonly with the software. Change of some parameters is possible to do without user's software with Windows hyperterminal (change of communication protocol, its parameters, LCD display setting). It is described in file “*Description of communication protocols*” ( free to download at [www.cometsystem.cz](http://www.cometsystem.cz) ).

**Models marked TxxxxZ** are non-standard versions of the transmitters. Description is not included in this manual.

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## Device setting from the manufacturer

If special setting was not required in the order device is set from the manufacturer to the following parameters:

communication protocol:	Modbus RTU
device address:	1
communication speed:	9600Bd, without parity, 2 stop bits
display:	switched ON
value displayed at higher line:	CO <sub>2</sub> concentration
value displayed at lower line:	temperature
temperature unit:	°C
measurement CO <sub>2</sub> mode:	“SLOW“
LED indication:	up to 1000 ppm lights green LED, between 1000 and 1200 ppm lights yellow LED and over 1200 ppm lights red LED
altitude:	300 m above sea level at the installation site

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## Device installation

Devices are designed for indoor applications. It is recommended to mount them on universal wiring box (common installation box KU68) with using two enclosed mounting screws. For correct function there is necessary to find proper device place. It shouldn't be placed at places where it can be affected by sunshine, near radiators, heating elements and other heat sources, air handlers, windows, doors, into racks and shelves and similar places. For buildings with less thermal insulation there is not suitable to place them on external walls of building. If there are communication conductors placed into conduit, there is strongly recommended make it caulk, to restrict air flow around device.

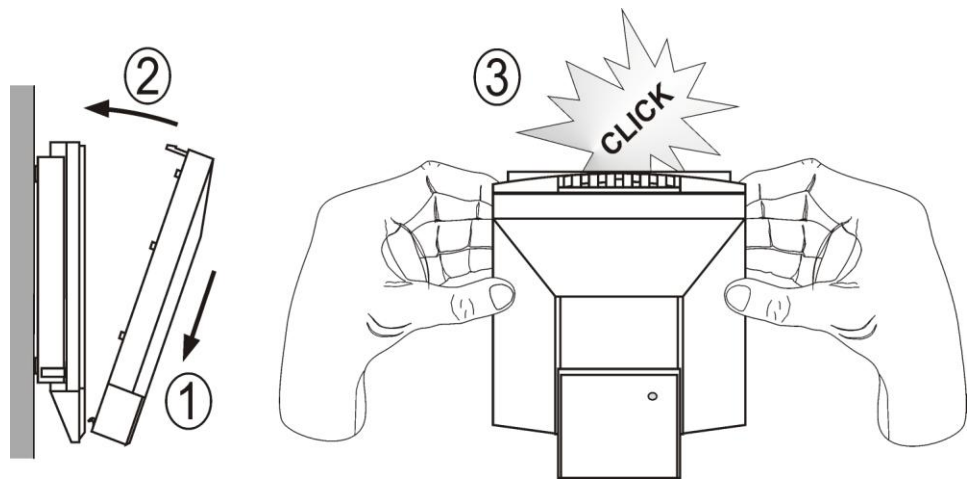
For devices with RS485 output there is recommended to use shielded twisted copper cable, maximal length 1200m. The cable must be located at indoor rooms. Connect cables to terminals with respecting the signal polarity. Terminals are self-clamping and can be opened by a suitable screwdriver (for the opening, insert the screwdriver to upper terminal hole and lever by him). Nominal cable impedance should be 100  $\Omega$ , loop resistance max. 240  $\Omega$ , cable capacity max. 65 pF/m. Suitable cable is e.g. SYKFY 2x2x0.5 mm<sup>2</sup>, where one wire pair serves for device powering and the other pair for communication link. The cable should be led in one line, i.e. not to „tree“ or „star“. Termination resistor should be located at the end. For short distance other topology is allowed. Terminate the network by a termination resistor. The value of the resistor is recommended about 120  $\Omega$ . For short distance termination resistor can be left out.

The devices with RS232 interface can be powered from external power source only. Maximal communication cable length is restricted to 15 m

The cables should not be led in parallel along power cabling. Safety distance is up to 0.5 m, otherwise undesirable induction of interference signals can appear.

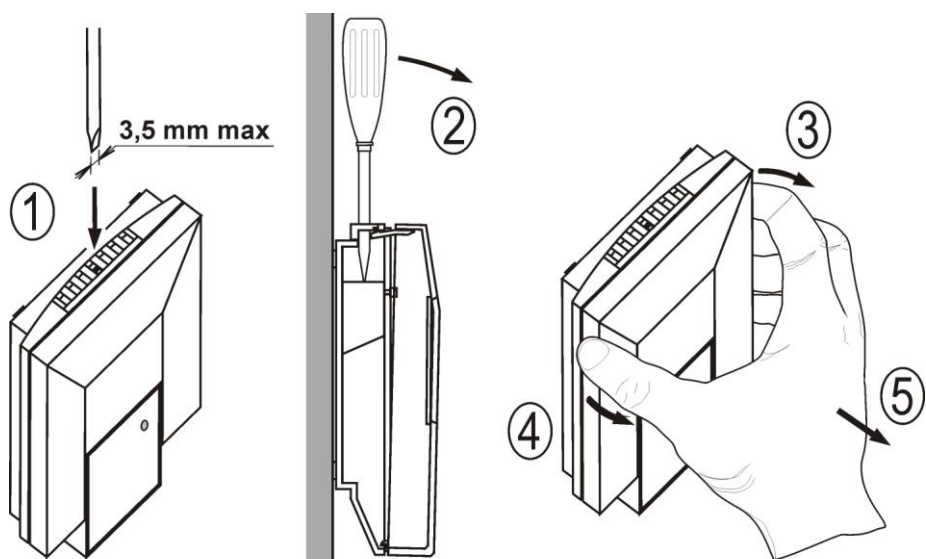
Firstly mount the rear part of the device on the wiring box with two screws and connect cables to terminals. Finish the installation by inserting the front part of the unit.

**Electrical system (wiring) may do only worker with required qualification by rules in operation.**



### ***Device demounting***

If there is necessary demount the device, insert flat bladed screwdriver max. 3.5 mm wide from top side into middle device's air hole. There is fastening member placed, insert screwdriver beyond the fastening member about 2 cm deep. Then slightly move screwdriver in arrow direction, it unlock fastening member and the device is partially opened. Remove the screwdriver and take front part of device at top. Pull front part with pendulum motion and remove front cover. If there is necessary remove rear part of the device, please disconnect cables and unscrew two holding screws.

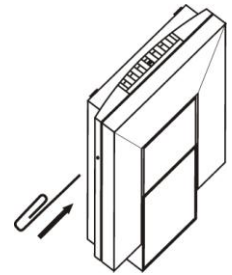




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## Info mode

If in doubt of setting of installed device, verification of its address is enabled even without using computer. Power supply should be connected and jumper should be opened. Jumper is accessible after removing the front part of device (jumper is placed at the right bottom corner at the same side as button). Shortly press button behind small hole on the left side of the device using thin instrument (for example paper clip). Actual adjusted address of the device is displayed on LCD display at decimal base. Next press of button exits info mode and actual measured values are displayed. Devices with RS232 interface have address always set to one. No measurement and communication is possible during info mode. If device stays in info mode for longer than 15 s, device automatically returns to measuring cycle.



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# Description of communication protocols

Detailed description of each communication protocols including examples of communication is available in individual document “*Description of communication protocols*” which is available at [www.cometsystem.cz](http://www.cometsystem.cz) (see appropriate transmitter pages).

**Note:** After switching on the power of the device it can last up to 2 s before the device starts to communicate and measure!

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## Modbus RTU

Control units communicate on master-slave principle in half-duplex operation. Only master can send request and only addressed device responds. During sending of request no other slave station should respond. During communication, data transfer proceeds in binary format. Each Byte is sent as eight bit data word in format: 1 start bit, data word 8 bit (LSB first), 2 stop bits (device sends two stop bits, for receive one stop bit is enough), without parity. Device supports communication speed from 110Bd to 115200Bd.

Sent request and response have syntax:  
ADDRESS OF DEVICE – FUNCTION – Modbus CRC

### ***Supported function***

**03 (0x03):** Reading of 16-bit registers (Read Holding Registers)

**04 (0x04):** Reading of 16-bit input gates (Read Input Registers)

**16 (0x10):** Setting of more 16-bit registers (Write Multiple Registers)

### ***Jumper and button***

If communication protocol Modbus is selected the function of jumper and button is as follows:

- Jumper opened – device memory is protected from writing, from device side it is only enabled to read measured value, writing to memory is disabled (no change of device address, communication speed and LCD setting is enabled ...)

- Jumper closed – writing to device memory is enabled by means of User's software
- Jumper opened and button shortly pressed – device goes to Info mode, see chapter „Info mode“
- Jumper closed and button pressed for longer than six seconds – causes restoring of manufacturer setting of communication protocol, i.e. sets Modbus RTU communication protocol, device address sets to 1 and communication speed to 9600Bd (after button press there is “dEF” message blinking at LCD display. Six seconds later message “dEF” stays shown, it means manufacturer setting of communication protocol is done).

### **Modbus registry snímače**

Variable	Unit	Address [hex] <sup>x</sup>	Address [dec] <sup>x</sup>	Format	Size	Status
Measured temperature	[°C][°F]*	0x0031	49	Int*10	BIN16	R
CO <sub>2</sub> concentration displayed on LCD	ppm	0x0034	52	Int	BIN16	R
CO <sub>2</sub> concentration „FAST“ mode	ppm	0x0054	84	Int	BIN16	R
CO <sub>2</sub> concentration „SLOW“ mode	ppm	0x0055	85	Int	BIN16	R
Serial number of device Hi	[-]	0x1035	4149	BCD	BIN16	R
Serial number of device Lo	[-]	0x1036	4150	BCD	BIN16	R
Address of device	[-]	0x2001	8193	Int	BIN16	R/W*
Code of communication speed	[-]	0x2002	8194	Int	BIN16	R/W*
Version of Firmware Hi	[-]	0x3001	12289	BCD	BIN16	R
Version of Firmware Lo	[-]	0x3002	12290	BCD	BIN16	R

#### **Explanation:**

\* depends on device setting (by User's software)

Int\*10 register is in format integer\*10

R register is designed only for reading

- 
- W\* register is designed for writing, for details see description of communication protocols
- X register addresses are indexed from zero – register 0x31 is physically sent as value 0x30, 0x32 as 0x31 (zero based addressing).

**Note:** In case there is a need for reading of measured values from the device with higher resolution than one decimal, measured values in device are stored also in „Float“ format, which is not directly compatible with IEEE754.

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## Protocol compatible with Advantech-ADAM standard

Control units communicate on master-slave principle in half-duplex operation. Only master can send requests and only addressed device responds. During sending request any of slave devices should respond. During communication data is transferred in ASCII format (in characters). Each Byte is sent as two ASCII characters. Device supports communication speed from 1200Bd to 115200Bd, parameters of communication link are 1 start bit + eight bit data word (LSB first) + 1 stop bit, without parity.

### *Jumper*

Jumper is located next to connection terminals. If communication protocol compatible with standard Advantech-ADAM is selected, its function is the following:

- If jumper during switching ON the power is closed, device always communicates with following parameters regardless stored setting in the device: communication speed 9600 Bd, without check sum, device address 0.
- If jumper is closed during device operation, device temporarily changes its address to 0, it will communicate in the same communication speed as before closing jumper and will communicate without check sum. After jumper is opened setting of address and check sum is reset in accordance with values stored in the device.

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- If jumper during switching ON the power is not closed, device communicates in accordance with stored setting.
  - Communication speed and check sum are possible to change only if jumper is closed.
  - Jumper closed and button pressed for longer than six seconds – causes restoring of manufacturer setting of communication protocol, i.e. sets Modbus RTU communication protocol, device address sets to 1 and communication speed to 9600Bd (after button press there is “dEF” message blinking at LCD display. Six seconds later message “dEF” stays shown, it means manufacturer setting of communication protocol is done).

### ***Command format for value reading***

For communication with device which measure more than one value, there is necessary to add at the end of command the number of communication channel, where the measured value is mapped. Command for value reading is **#AAx(CRC) cr**, where **AA** is device address, **x** is number of communication channel, **CRC** is check sum (can be used or not).

Measured value	Number of communication channel
Temperature	0
CO <sub>2</sub> concentration	3

**Command #AA(CRC) cr** for reading all measured values at once is supported for multi-channel devices since firmware version 02.60.

Response:

>(temperature)(relative humidity)(dew point temperature)(absolute humidity)  
(specific humidity)(mixing ratio)(specific enthalpy)(CO<sub>2</sub> concentration)cr

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## **ARION communication protocol - AMiT company**

The device supports communication protocol ARiON version 1.00. For more details see file “*Description of communication protocols*” at [www.cometsystem.cz](http://www.cometsystem.cz) (see appropriate transmitter pages) or you can visit [www.amit.cz](http://www.amit.cz).

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# Troubleshooting

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## Error states of the device

Device continuously checks its state during operation. In case error is found LCD displays corresponding error code:

- Error 0** - first line displays „Err0“. Check sum error of stored setting inside device's memory. This error appears if incorrect writing procedure to device's memory occurred or if damage of calibration data appeared. At this state device does not measure. It is a serious error, contact distributor of the device to fix.
- Error 1** - there is a reading „Err1“ on LCD display. Measured temperature is over upper limit of allowed full scale range. This state appears in case of measured temperature is higher than approximately 600°C (i.e. high non-measurable resistance of temperature sensor, probably opened circuit).
- Error 2** - there is a reading „Err2“ on LCD display. Measured temperature is below lower limit of allowed full scale range or CO<sub>2</sub> concentration measurement error occurred. Value read from the device is -999.9.. This state appears in case of measured temperature is lower than approximately -210°C (i.e. low resistance of temperature sensor, probably short circuit).
- Error 3** - there is a reading „Err3“ on LCD display upper line. Error of internal A/D converter appeared (converter does not respond, probably damage of A/D converter). At this state device does not measure temperature. This error does not affect CO<sub>2</sub> concentration measurement. It is a serious error, contact distributor of the device.
- Error 4** - there is a reading „Err4“ on LCD display. It is internal device error during CO<sub>2</sub> concentration sensor initialization. Under this condition device does not measure concentration of CO<sub>2</sub>. Value read from device is -999. It is a serious error, contact distributor of the device.

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## Technical support and service

Technical support and service is provided by distributor. For contact see warranty certificate. You can use discussion forum at web address [www.forum.cometsystem.cz](http://www.forum.cometsystem.cz).

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## Technical data

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### Measured values

**CO<sub>2</sub> concentration:**

Accuracy:	± (50 ppm + 2 % of measuring value) at 25 °C (77 °F) and 1013 hPa
Range:	0 to 2000 ppm
Temperature depend.:	typ. 2 ppm CO <sub>2</sub> / °C in the range 0 to +50 °C (32 to 122 °F)
Long term stability:	typ. 20 ppm / year
Resolution:	1 ppm
Response time:	t <sub>90</sub> < 195 s in „SLOW“ measurement mode t <sub>90</sub> < 75 s in „FAST“ measurement mode

**Temperature:**

Accuracy:	± 0.5 °C (±0.9 °F)
Measuring range:	-10 to +50 °C (14 to 122 °F)
Resolution:	0.1 °C
Response time:	t <sub>90</sub> < 6 min (air flow approximately 0.3 m/s) t <sub>90</sub> < 11 min (no air flow)

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### General specifications

**RS485 interface:**

Receiver-Input Resistance:	96 kΩ
Devices on bus:	max. 256 (1/8 Unit Receiver Load)

**Power supply voltage:**

9 to 30 Vdc

**Power consumption:**

0,5 W during normal operation  
3 W for 50 ms with 15 s period

**Measuring interval:**

temperature	0,5 s
CO <sub>2</sub> concentration	15 s

**Protection:**

IP20

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**Recommended calibration interval:**

2 years (CO<sub>2</sub> concentration 5 years, temperature 2 years)

**Storage temperature range:**

-40 to +60 °C (-40 to 140 °F)

**Storage relative humidity range:**

5 to 95 %RH (no condensation)

**Storage pressure range:**

700 to 1100 hPa

**Electromagnetic compability:**

EN 61326-1

**Weight:**

approximately 150 g

**Housing material:**

ABS

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## Operating conditions

**Operating temperature range:**

-10 to +50 °C (14 to 122 °F)

**Operating relative humidity range:**

5 to 95 %RV (no condensation)

**Operating pressure range:**

850 to 1100 hPa

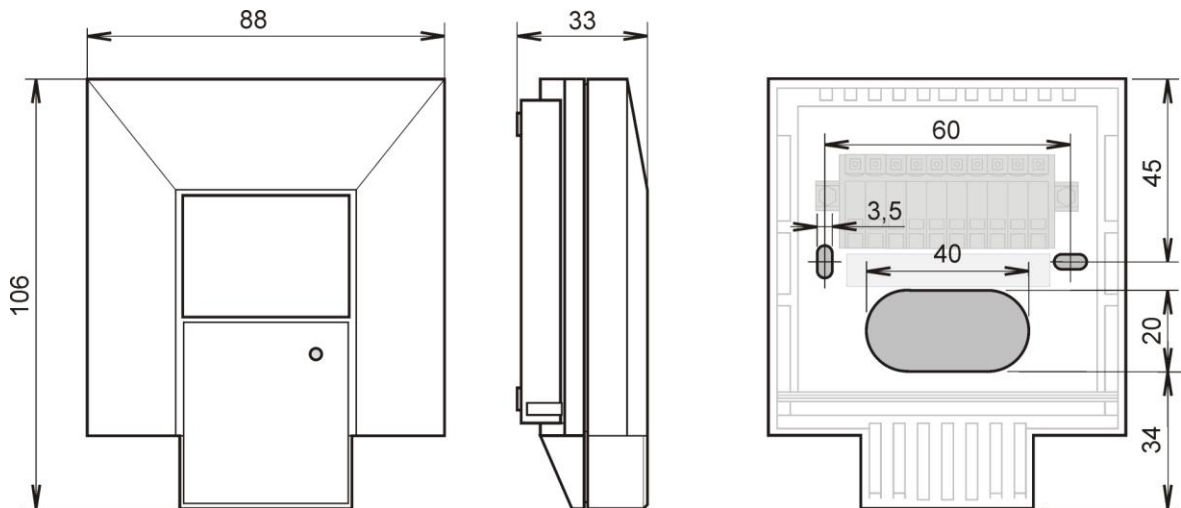
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## End of operation

Dispose of the device according to statutory regulations.

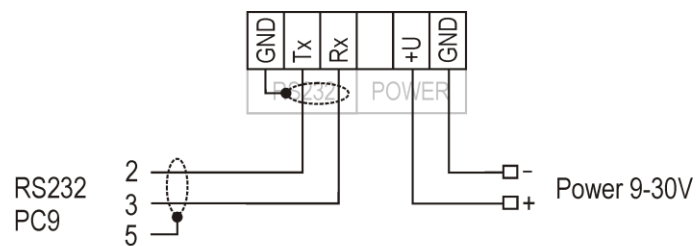


## Dimensions

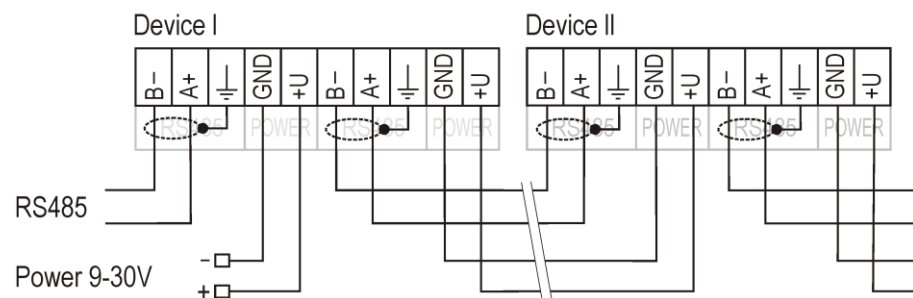


## Typical application wiring

### T8348



### T8448

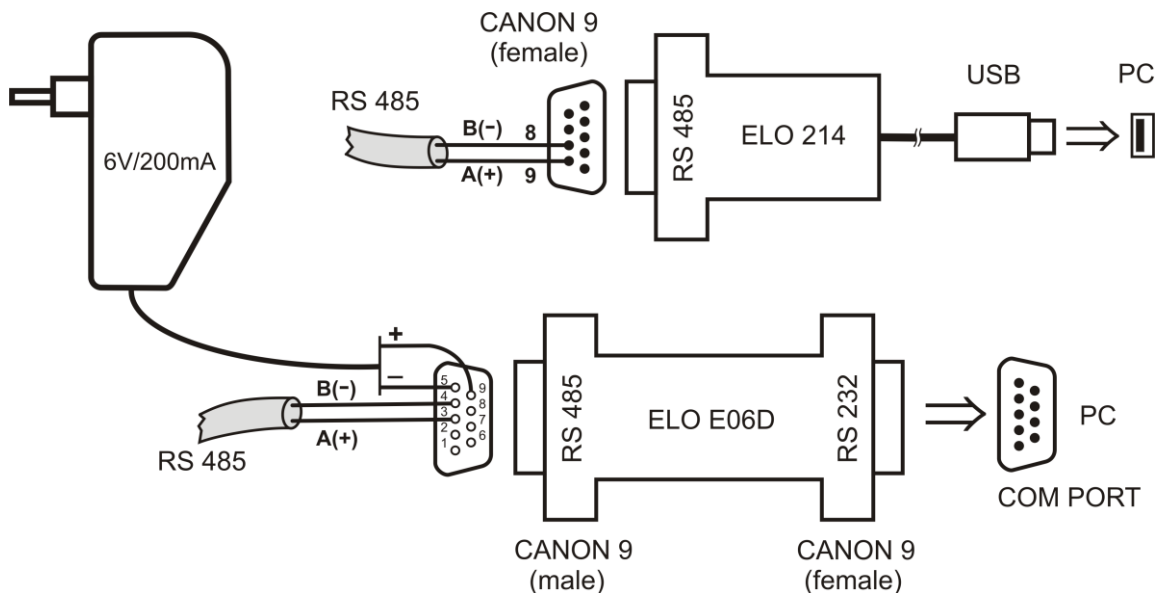


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## Appendix A

### Connection of T8448 transmitter to the PC

The **ELO E214** converter is an optional accessory for connection of transmitter with RS485 interface to the PC via USB port. Link RS485 is connected across pin 9 A(+) and pin 8 B(-). The pull up, pull down and termination resistors are part of the transmitter. These internal resistors can be connected to the bus by connecting the corresponding pins of CANON connector (for more information see the operation manual for ELO E214).



The **ELO E06D** converter is an optional accessory for connection of transmitter with RS485 interface to the PC via serial port RS232. Connector marked RS232 connect directly to the PC. Power voltage +6V DC from an external acdc adapter connect to pin 9 of connector marked RS485, 0V connect to pin 5 and link RS485 connect across pin 3 A(+) and pin 4 B(-). Time out setting is performed by connecting the corresponding pins of connector marked RS485 (for more information see the operation manual for ELO E06D).