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User Manual EE872

Modular Probe for CO_2, Humidity, Temperature and Ambient Pressure

Modbus

www.epluse.com

Content

1 General Information

This user manual is intended to ensure proper handling and optimal functioning of the device. The user manual shall be read before commissioning the equipment and it shall be provided to all staff involved in transport, installation, operation, maintenance and repair. E+E Elektronik Ges.m.b.H. accepts no liability for any warranty or liability claims arising from this publication or improper handling of the product(s) described.

All information, technical data and diagrams included in this document are based on the information available at the time of writing. The document may contain technical inaccuracies and typographical errors. The contents will be revised on a regular basis and changes will be implemented in subsequent versions. The product(s) described and the contents of this document may be changed or improved at any time without prior notice.

PLEASE NOTE

Find this document and further product information on our website at www.epluse.com/ee872.

1.1 Explanation of Warning Notices and Symbols

Safety precautions

Precautionary statements warn of hazards in handling the device and provide information on their prevention. The safety instruction labeling is classified by hazard severity and is divided into the following groups:

DANGER

Danger indicates hazards for persons. If the safety instruction marked in this way is not followed, the hazard will verly likely result in severe injury or death.

WARNING

Warning indicates hazards for persons. If the safety instruction marked in this way is not followed, there is a risk of injury or death.

CAUTION

Caution indicates hazards for persons. If the safety instruction marked in this way is not followed, minor or moderate injuries may occur.

NOTICE

Notice signals danger to objects or data. If the notice is not observed, damage to property or data may occur.

Informative notes

Informative notes provide important information that is characterised by its relevance.

INFO

The information symbol indicates tips on handling the device or provides additional information on it. This information is useful to achieve optimum performance of the device.

The title field may deviate from “INFO” depending on the context. For instance, it may also read “PLEASE NOTE”.

1.2 Safety Instructions

1.2.1 General Safety Instructions

NOTICE

Improper handling of the device may result in its damage.

- Avoid any unneccessary mechanical stress on the EE872, especially on the filter cap.
- Always operate the EE872 with the filter cap installed.
- Do not apply the supply voltage to the RS485 data lines.
- Use the EE872 only as intended and observe all technical specifications.

1.2.2 Intended Use

The EE872 modular probe is intended for the measurement of CO_2, relative humidity (RH), temperature (T) and ambient pressure (p). In addition to this primary parameters, the device also calculates the dew point temperature (Td).
The probe is designed for the use in harsh and demanding environments, including but not limited to:

- agricultural applications
- lifestock barns
- hatchers and incubators
- greenhouses
- outdoor installations

⚠ WARNING

Non-compliance with the product documentation may cause safety risks for people and the entire measurement installation.

The manufacturer is not liable for any damage caused by improper handling, installation and maintenance of the device.

- Do not use the EE872 in explosive atmospheres or for measurements in aggressive gases.
- Never use this device in safety related, emergency stop, or other critical applications where device malfunction or failure could cause injury to human beings.
- Use only tools specified in this manual when working on the device.

NOTICE

Failure to follow the instructions in this user manual may lead to measurement inaccuracy and device failures.

- The EE872 may only be operated under the conditions described in this user manual and within the specification included in chapter 9 Technical Data.
- Any unauthorised product modifications will invalidate all warranty claims. Modifications may only be carried out with the express authorisation of E+E Elektronik Ges.m.b.H.!

1.2.3 Mounting, Start-up and Operation

The EE872 has been produced under state of the art manufacturing conditions, has been thoroughly tested and has left the factory after fulfilling all safety criteria. The manufacturer has taken all precautions to ensure safe operation of the device. The device shall be set up and installed in a way that does not impair its safe use. All applicable local and international safety guidelines for safe installation and operation of the device have to be observed. This user manual contains information and warnings that must be observed in order to ensure safe operation.

PLEASE NOTE

The manufacturer or his authorised agent can only be held liable in case of willful or gross negligence. In any case, the scope of liability is limited to the corresponding amount of the order issued to the manufacturer. The manufacturer assumes no liability for damage caused by non-compliance with the applicable regulations, operating instructions or the specified operating conditions. Any consequential damage is excluded from liability.

WARNING

Non-compliance with the product documentation may result in accidents, personal injury or property damage.

- Mounting, installation, commissioning, start-up, operation and maintenance of the device may only be carried out by qualified staff. Such staff must be authorised by the operator of the facility to carry out the mentioned activities.
- The qualified staff must have read and understood this user manual and must follow the instructions contained within. The manufacturer accepts no responsibility for non-compliance with instructions, recommendations and warnings.
- All process and electrical connections must be thoroughly checked by authorised staff before commissioning the device.
- Do not install or start-up a device suspected to be faulty. Mark it clearly as faulty and remove it from the process.
- Service operations other than described in this user manual may only be performed by the manufacturer. A faulty device may only be investigated and possibly repaired by qualified, trained and authorised staff. If the fault cannot be fixed, the device shall be removed from the process.

2 Scope of Supply

- EE872 - Modular Probe for CO_2, Humidity, Temperature and Ambient Pressure
- Test report according to DIN EN10204-2.2
- Quick User Guide

3 Product Description

3.1 Operation Principle

The EE872 is available in two different versions.

1. **EE872-M10:** The probe measures the CO_2 concentration. The sensing module is heated in the default factory setting to prevent condensation. The CO_2 measurement value is available at the analogue output or at the digital interface.
2. **EE872-M13:** The probe measures CO_2, RH, T and p, and calculates Td. As the sensing module is not heated in the default factory setting, accurate measurement of RH and T is possible. If the user activates the probe heating, the RH and T data are not available. However, the calculated Td value is still available. All values are only available via the digital interface.

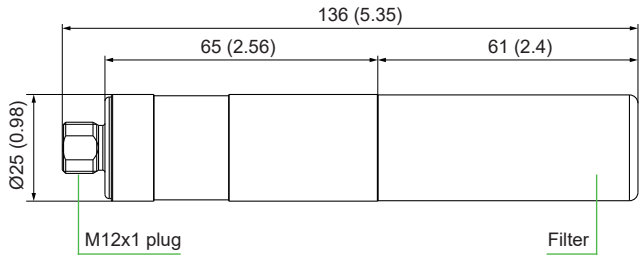
Both versions offer CO_2 measurement with T and p compensation.
The CO_2 measurement is based on the NDIR principle with two wavelengths and two detectors. Infrared light is passed through the gas to be examined. One detector is tuned to 4.2 µm, which is the wavelenght absorbed by CO_2. The second detector is tuned to 3.9 µm, a wavelenght that is not affected by any gas. The CO_2 concentration is calculated from the different outputs of the two according detectors. For more information, please refer to E+E's paper on the principles of CO_2 measurement.

PLEASE NOTE

Changing the factory setup for the heater (on/off) may result in an additional measurement error, which may cause the accuracy of the CO_2 measurement to fall outside the specification.

3.2 Dimensions

Values in mm (inch)



3.3 Electrical Connection

⚠ WARNING

Incorrect installation, wiring or power supply may cause overheating and therefore personal injuries or damage to property.

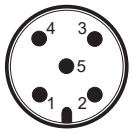
For correct cabling of the device, always observe the presented wiring diagram for the product version used.

The manufacturer cannot be held responsible for personal injuries or damage to property as a result of incorrect handling, installation, wiring, power supply and maintenance of the device.

NOTICE

The device may only be powered with a power supply class III ⧫ (Europe) or with a class 2 supply (North America).

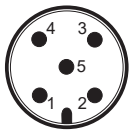
Plug for supply and analogue output



Front view on device

Pin	Assignment	Wire colors for accessories: Couplig flange HA010705 Connection cable HA010819/820/821
1	Supply voltage	Brown
2	Voltage output	White
3	GND	Blue
4	Current output	Black
5	Configuration pin	Grey

Plug for supply and RS485 connection



Front view on device

Pin	Assignment	Wire colors for accessories: Couplig flange HA010705 Connection cable HA010819/820/821
1	Supply voltage	Brown
2	B RS485 (D-)	White
3	GND	Blue
4	A RS485 (D+)	Black
5	Configuration pin	Grey

Tab. 1 Pin and flying leads assignment

PLEASE NOTE

The pin numbers are stamped in the M12 plug.

3.4 Hardware Selection between Analogue Output and RS485 Interface

The “default output” of the EE872 may be analogue or Modbus RTU, depending on the device configuration. The “default output” of a newly delivered EE872 corresponds to the configuration defined by the order code, as specified in the EE872 datasheet.

In case the user altered the factory setup, the “default output” corresponds to the most recent settings uploaded to the EE872 via the PCS10 Product Configuration Software. For details on using the software, refer to the PCS10 help documentation.

Pin	Default: analogue	Default: Modbus RTU
5 open (=high)	10 s timeout[1)], then analogue output	Modbus RTU
5 GND (=low)	Analogue	Analogue

1) For configuration purposes, during the first 10 seconds after power on the EE872 awaits connection with the PCS10 Product Configuration Software.

Tab. 2 Function of the configuration pin (pin 5 of the M12 connector)

4 Mounting and Installation

The best measuring performance is achieved when the entire probe is located within the environment being monitored. This condition is fulfilled, for example, when the EE872 is mounted on a wall using the HA010227 mounting clip (see Fig. 1), or suspended freely from the ceiling by its connection cable. The probe may also be installed in a partition wall using the HA010226 stainless steel mounting flange (see Fig. 2).

Please note that HA010226 and HA010227 are not included in the standard scope of supply. For further details, refer to the accessories datasheet.

If significant temperature differences exist between the two sides of the wall, T gradients may occur along the probe. Although the CO_2 measurement is T-compensated, such gradients can substantially affect the RH and T accuracy of the M13 model. Minimising these temperature gradients is therefore essential. The part of the probe protruding from the wall on the cable side must be kept as short as possible and should be well thermally insulated.

PLEASE NOTE

To achieve the best accuracy for RH and T, the M13 model must be installed horizontally or with the filter cap oriented downwards.

Fig. 1 EE872 with mounting clip HA010227

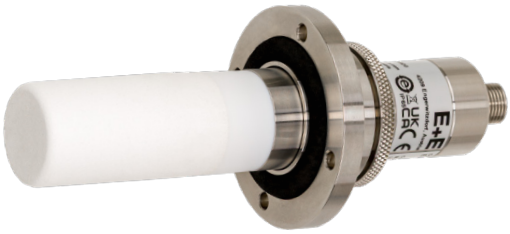
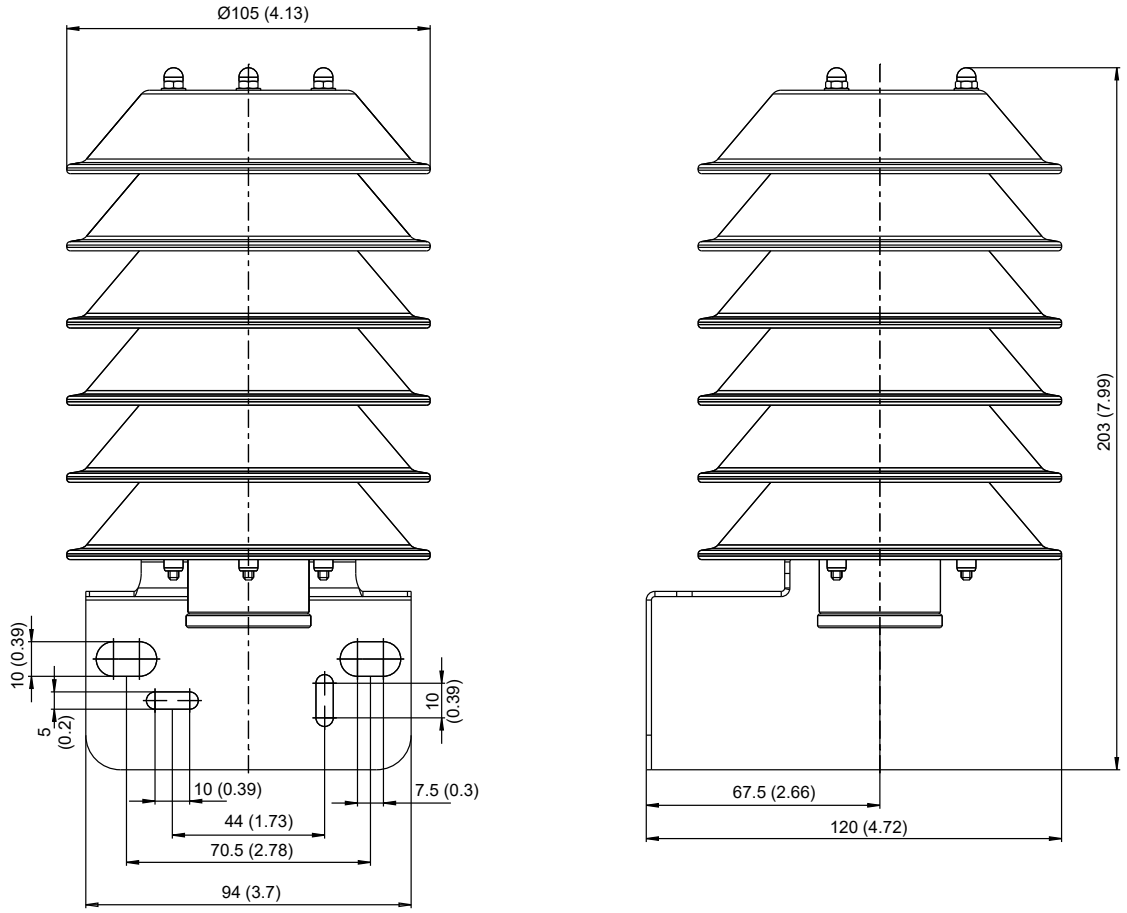


Fig. 2 EE872 with mounting flange HA010226

PLEASE NOTE

For outdoor applications, the EE872 must be used with the radiation shield HA010510 (not included in the scope of supply; see data sheet “Accessories”), which protects the device from rain, snow, ice and solar radiation.

Radiation shield HA010510
(needs to be ordered separately)



5 Setup and Adjustment

The EE872 is ready for use and does not require any user configuration. The factory setup of the EE872 corresponds to the specified order code. Please refer to chapter 3.1 for a model overview and to the datasheet at www.epluse.com/ee872.

If required, the factory setup can be modified via the help of the free PCS10 Product Configuration Software and the Modbus configuration adapter (HA011018). To carry out configuration, pin 5 must be left open (high), refer to chapter 3.4 Hardware Selection between Analogue Output and RS485 Interface.

A device originally configured with an analogue output can be converted to RS485 interface and vice versa. The CO_2 output signal type (analogue ↔ RS485/Modbus RTU), analogue output scaling, and all the digital parameters can be adjusted. Offset correction is available for the p measurement, and the CO_2, RH and T measurements support both offset and 2-point adjustment.

In addition the following functions can be enabled or disabled

- Pressure compensation (factory setting: enabled)
- Sensing module heating (factory setting according to the ordered model)
- NAMUR error indication (factory setting: disabled)

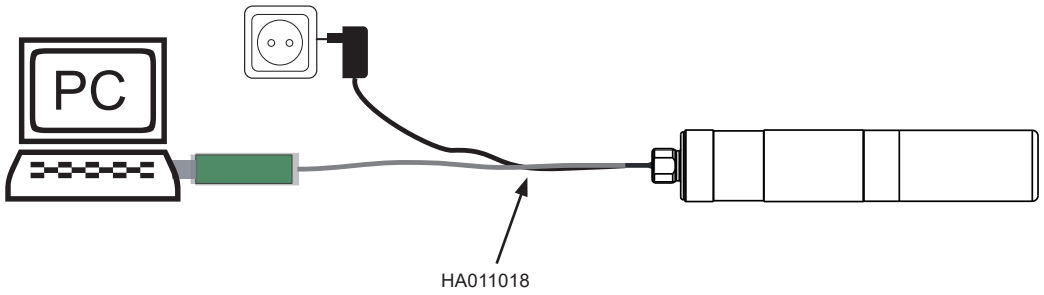


Fig. 3 EE872 connected to a PC running PCS10

PLEASE NOTE

Any modification of the EE872 configuration will invalidate the product label and the packaging label.

5.1 PCS10 Product Configuration Software

Use the software to change the settings and proceed as follows:

1. Download the PCS10 Product Configuration Software from www.epluse.com/pcs10 and install it on a PC.
2. Connect the EE872 to the PC using the Modbus configuration adapter.
3. Start the PCS10 software.
4. Follow the instructions on the PCS10 opening page to scan the ports and to identify the connected device.
5. Click on the desired setup or adjustment mode from the main PCS10 menu on the left. Follow the PCS10 online instructions that are displayed when clicking on the “Tutorial” button.
6. Upload changes to the probe by pressing the “Sync” button.

5.2 RS485 Digital Interface

Modbus RTU Protocol Settings

	Factory settings	Selectable values (via PCS10)
Baud rate	As specified in the order code	9 600, 19 200, 38 400
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Modbus address	237	1...247

Tab. 3 Modbus RTU protocol settings

PLEASE NOTE

- The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1.
- The EE872 represents 1/10 unit load on an RS485 network.

Device address, baud rate, parity and stop bits can be set via:

- PCS10 Product Configuration Software and the Modbus configuration adapter HA011018.
  The PCS10 can be downloaded free of charge from www.epluse.com/pcs10.
- Modbus protocol in the register 1 (0x00) and 2 (0x01).
  See Application Note Modbus AN0103 (available at www.epluse.com/ee872).

The serial number as ASCII-code is located in read-only registers 1 - 8 (0x00 - 0x07).
The firmware version is located in read-only register 9 (0x08) (bit 15...8 = major release; bit 7...0 = minor release).
The sensor name as ASCII-code is located in read-only registers 10 - 17 (0x09 - 0x10).

NOTICE

When reading information that spans multiple registers, it is always necessary to read all registers, even if the desired information requires less.

NOTICE

To obtain the correct floating point values, both registers have to be read within the same reading cycle. The measured value may change between two Modbus requests. This can cause inconsistencies in the exponent and mantissa.

INFO

The Modbus function codes mentioned throughout this document shall be used as described in chapter 6 of of MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, available at https://www.modbus.org/.

Communication settings (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Write register: function code 0x06			
Modbus address[4]	1	00	1
Modbus protocol settings[4]	2	01	1

Device information (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Read register: function code 0x03 / 0x04			
Serial number (as ASCII)	1	00	8
Firmware version	9	08	1
Sensor name (as ASCII)	10	09	8

1) Register number (decimal) starts from 1.
2) Register address (hexadecimal) starts from 0.
3) Number of registers
4) For Modbus address and protocol settings see Application Note Modbus AN0103 (available at www.epluse.com/ee872).

Tab. 4 EE872 registers for device setup

5.3 Modbus Register Map

The measurement data is saved as 32 bit floating point values (data type FLOAT32) and as 16 bit signed integer values (data type INT16).

FLOAT32

Parameter	Unit[1)]	Register number[2)] [DEC]	Register address[3)] [HEX]
Read register: function code 0x03 / 0x04			
CO_2 (average)	ppm	1061	424
CO_2 (raw)	ppm	1063	426
Pressure*	mbar	1201	4B0
Pressure*	psi	1203	4B2
Relative humidity**	%	1021	3FC
Temperature**	°C	1003	3EA
Temperature**	°F	1005	3EC
Temperature**	K	1009	3F0
Dew point temperature***	°C	1105	450
Dew point temperature***	°F	1107	452
Dew point temperature***	K	1147	47A

INT16

Parameter	Unit[1)]	Scale[4)]	Register number[2)] [DEC]	Register address[3)] [HEX]
Read register: function code 0x03 / 0x04				
CO_2 (average)	ppm	1	4031	FBE
CO_2 (raw)	ppm	1	4032	FBF
Pressure*	mbar	10	4101	1004
Pressure*	psi	100	4102	1005
Relative humidity**	%	100	4011	FAA
Temperature**	°C	100	4002	FA1
Temperature**	°F	50	4003	FA2
Temperature**	K	50	4005	FA4
Dew point temperature***	°C	100	4053	FD4
Dew point temperature***	°F	100	4054	FD5
Dew point temperature***	K	100	4074	FE9

* Available for version M13.
** Only available with the M13 version if the probe is not heated (default setting).
*** Always available for the M13 version: Activating or deactivating the probe heating has no effect on the Td measurement.

1) The choice of measurement units (metric or non-metric) must be done according to the ordering guide, refer to EE872 datasheet. Switching from metric to non-metric or vice versa by using the PCS10 is not possible.
2) Register number (decimal) starts from 1
3) Register address (hexadecimal) starts from 0
4) Examples: For scale 100, the reading of 2550 means a value of 25.5. For scale 50, the reading of 2550 means a value of 51.

Tab. 5 EE872 FLOAT32 and INT16 measured data registers

5.4 Modbus RTU Example

The EE872's Modbus address is 237 [0xED].

Please refer to

- Chapter 6 of MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, available at https://www.modbus.org/.
- E+E Application Note Modbus AN0103 (available at www.epluse.com/ee872)

Read the CO_2 level (FLOAT32) from register address 0x424 (CO_2 = 1288.34375 ppm):

Master (e.g. PLC) **EE872**

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
ED	03	04	24	00	02	93	9C

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
ED	03	04	0B	00	44	A1	27	61

Tab. 6 Example temperature query

Decoding of floating point values:

Floating point values are stored according to IEEE754. The byte pairs [1], [2] and [3], [4] are transformed as follows (register contents taken from the T reading Modbus request/response example above):

Modbus response [Hex]

Register 1 Hi [1]	Register 1 Lo [2]	Register 2 Hi [3]	Register 2 Lo [4]
0B	00	44	A1
MMMM MMMM	MMMM MMMM	SEEE EEEE	EMMM MMMM

Tab. 7 Modbus response

IEEE754

Register 2 Hi [3]	Register 2 Lo [4]	Register 1 Hi [1]	Register 1 Lo [2]
44	A1	0B	00
0100 0100	1010 0001	0000 1011	0000 0000
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Decimal value: 1288.34375			

Tab. 8 Data representation according to IEEE754

5.5 Error Indication on the Analogue Output (NAMUR)

The EE872 features an analogue output error indication in accordance with the NAMUR NE 043 recommendations (Standardisation of the Signal Level for the Failure Information of Digital Transmitters, Edition 2003-02-03, see www.namur.net/en/recommendations-and-worksheets/current-nena.html).
The feature is disabled by factory default and can be enabled with the PCS10 Product Configuration Software, as described above.

Output signal	NAMUR signal level
0 - 5 V	5.5 V
0 - 10 V	11 V
4 - 20 mA	21 mA
0 - 20 mA	21 mA

Tab. 9 Error indication according to NAMUR NE 043

6 Maintenance and Service

The sensing module and the filter cap can be easily replaced on the EE872.

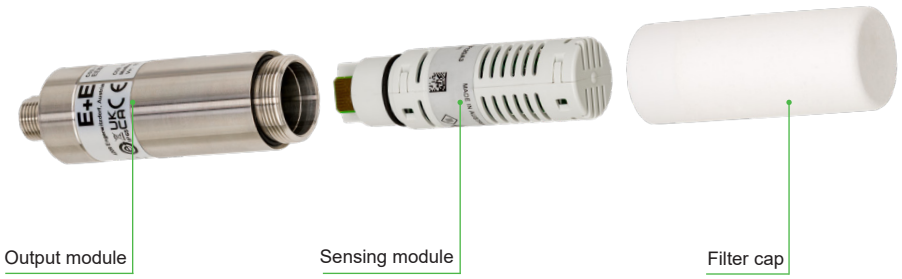


Fig. 4 EE872 modular construction

PLEASE NOTE

Extreme working conditions such as highly polluted, aggressive and chemically contaminated environment may require periodical maintenance of the device. Maintenance is facilitated by the modular design. Replacing the sensing module under the above conditions is a standard maintenance operation, as the sensing module is a wearing part. Any possible measurement drift or failure of the sensing module due to harsh working conditions is excluded from any warranty claims.

6.1 Sensing Module Replacement of the EE872S

If needed, the EE872 sensing module can be replaced by a new one. For the appropriate order code, please refer to chapter 7 Spare Parts.

Procedure:

1. Power off the EE872.
2. Remove the filter cap by turning it counter-clockwise.
3. Remove the sensing module by pulling it straight out of the output module.
4. Plug the new EE872S sensing module into the output module.
5. Screw the filter cap finger-tight onto the probe.

PLEASE NOTE

A replacement EE872S sensing module must have the same CO_2 measuring range as the original EE872 probe! If the measuring ranges of the replacement module and the original EE872 probe differ, the analogue output will remains at 4 mA, 0 V or displays a NAMUR error, while the CO_2 measured value transmitted via the RS485 interface is 0 ppm.

6.2 Filter Cap Exchange

In dusty or polluted environments, it may be necessary to replace the filter cap periodically. In most cases, a clogged filter shows visible contamination or dirt. An increased response time of the CO_2 measurement is another indication of a clogged filter cap. If any of this signs occur, replace the filter cap with a new original one; refer to the “Accessories” datasheet.

NOTICE

Keep the membrane filter clean and grease-free to prevent clogging, avoid touching it if possible. Failure to comply may result in blockages, reduced performance or inaccurate results.

Procedure:

1. Remove the filter cap by turning it counter-clockwise.
2. Install the new filter cap, tightening it finger-tight by turning it clockwise.

6.3 EE872 Calibration or Adjustment with Reference CO_2 Gas

The EE872 can be calibrated and adjusted using the PCS10. For this purpose, the probe must be connected to a PC via a Modbus configuration adapter.

Definitions

- Calibration verifies the accuracy of a measurement device. The device under test (the specimen) is compared with the reference, and any deviations are recorded in a calibration certificate. During calibration, the specimen is not altered or improved in any way.
- Adjustment improves the measurement accuracy of a device. The specimen is compared with a reference and then aligned with it. An adjustment may be followed by a calibration, which documents the accuracy of the specimen after adjustment.

To calibrate or adjust the EE872 with a reference CO_2 gas, use the HA010785 calibration adapter (not included in the scope of supply, refer to the “Accessories” datasheet available at www.epluse.com/ee872).

Fig. 5 Calibration adapter HA010785 (with rubber caps mounted as protective caps)

Procedure:

1. Remove the filter cap and install the calibration adapter onto the probe.
2. Connect the calibration gas to one of the two connection nipples. The gas introduced into the calibration adapter must be able to escape unhindered through the second nipple.
3. Set the flow rate to 0.1...1.0 l/min and consider a stabilisation time of 10 minutes.

PLEASE NOTE

- For best accuracy of the calibration procedure, the temperature difference between the reference gas and the probe should be kept as small as possible.
- Adjustment and calibration shall be performed with the factory settings enabled for both sensing-module heating and pressure compensation.

6.4 EE872 Protection Measures During Construction-Site Cleaning

The calibration adapter (HA010785) can also be used as a protection cap, for example, if the device remains installed at the measuring site during cleaning operations. For this purpose, seal both nipples with the rubber caps provided.

If the probe is removed from its location, it is recommended to attach the protection cap for the M12 cable socket (HA010781) and the protection cap for the EE872 M12 plug of (HA010782).

6.5 CO_2, RH and T Calibration and Adjustment

Depending on the application and the requirements of certain industries, there might arise the need for periodical humidity calibration (comparison with a reference) or adjustment (bringing the device in line with a reference).

Calibration and adjustment at E+E Elektronik

Calibration and/or adjustment can be performed in the E+E Elektronik calibration laboratory. For information on the E+E capabilities in ISO or accredited calibration please see www.eplusecal.com.

Calibration and adjustment by the user

Perform offset and 2-point adjustment via PCS10 Product Configuration Software (see below). Depending on the level of accuracy required, the humidity reference can be:

- Humidity Calibrator (e.g. Humor 20), please refer to www.epluse.com/humor20.
- Hand-held Device (e.g. Omniport40), please refer to www.epluse.com/omniport40.

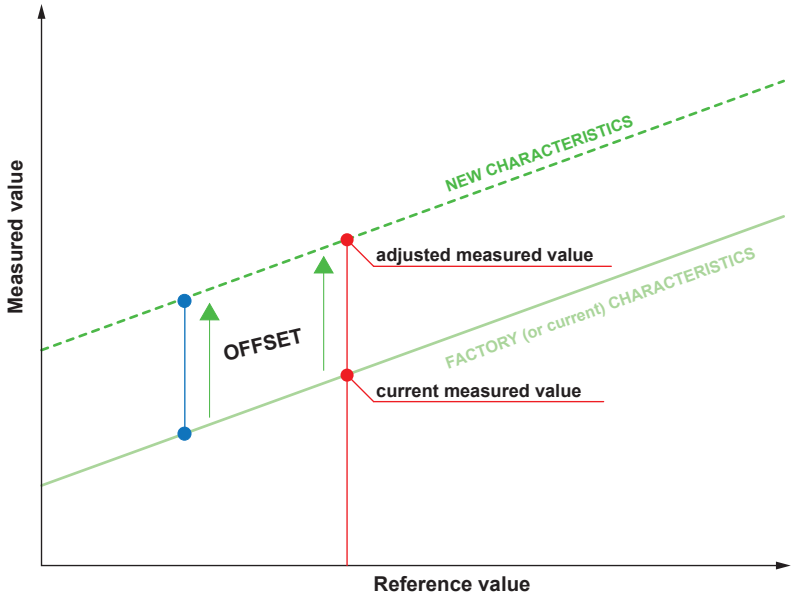


Fig. 6 1-point adjustment (offset)

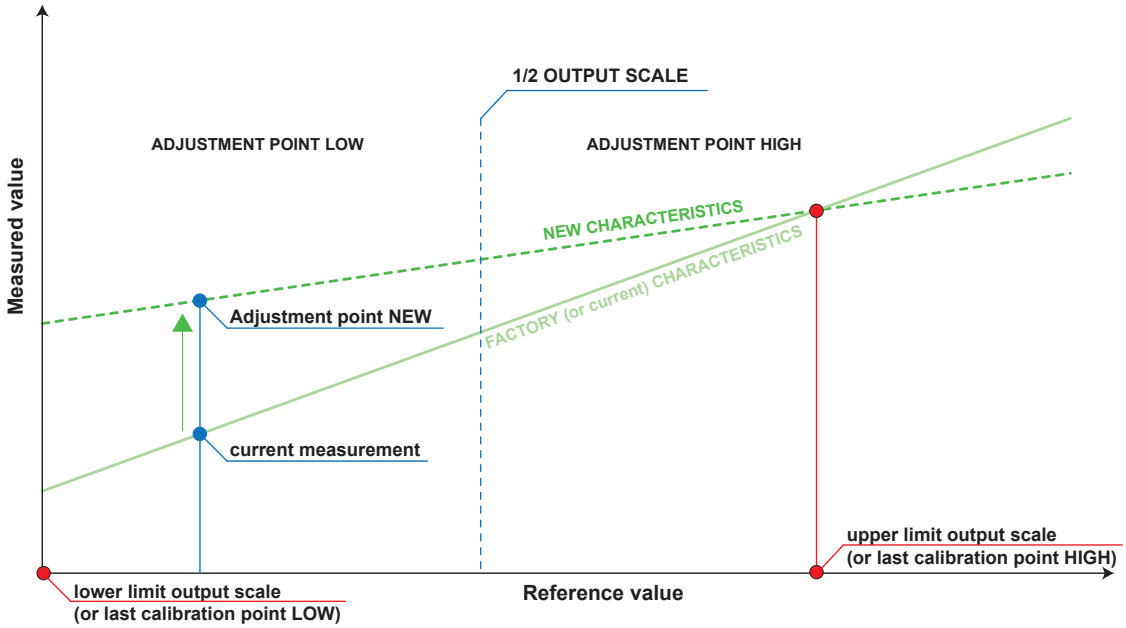


Fig. 7 2-point adjustment

6.6 Repairs

PLEASE NOTE

Repairs may only be carried out by the manufacturer. The attempt of unauthorised repair excludes any warranty claims.

7 Spare Parts

Description		Code
PTFE filter cap		HA010123
Catalytic filter cap for H_2O_2 sterilizsation		HA010124
PTFE (Polytetrafluoroethylene) membrane filter cap[1)]		HA010135
Replacement sensing module		EE872S-
Model	CO2 (default: heated)	M10
	CO2 + T + RH + p (default: not heated)	M13
CO2 range[2)]	0...2 000 ppm	HV1
	0...5 000 ppm	HV2
	0...1 % (10 000 ppm)	HV3
	0...3 % (30 000 ppm)	HV5
	0...5 % (50 000 ppm)	HV6

1) For M10 version only; increased response time; increased self-heating.
2) The CO_2 range of the EE872S must be the same as of the original EE872 probe.

8 Accessories

For further information please refer to the Accessories datasheet.

Description	Code
PCS10 Product Configuration Software (Free download from www.epluse.com/pcs10)	**PCS10**
Stainless steel mounting flange, Ø25 mm (0.98")	**HA010226**
Wall mounting clip, Ø25 mm (0.98")	**HA010227**
Radiation shield	**HA010510**
Flange socket, M12x1 ↔ 50 mm (1.97") stranded wire, 5 poles, M16x1 screw-in thread	**HA010705**
Modbus configuration adapter, M12 4 poles ↔ USB	**HA011018**
Sensor connection cable, shielded, 5 poles, M12x1 socket ↔ wire ferrules **1.5 m (4.9 ft)** **5 m (16.4 ft)** **10 m (32.8 ft)**	 **HA010819** **HA010820** **HA010821**
Y-style splitter, M12x1, 1 plug ↔ 2 sockets, 5 poles	**HA030204**
Connector, M12x1 socket, 5 poles, for self assembly	**HA010708**
Protection cap / calibration adapter	**HA010785**
Protection cap for M12 socket	**HA010781**
Protection cap for M12 plug	**HA010782**

9 Technical Data

Measurands

CO_2

Measurement principle	Dual wavelength non-dispersive infrared technology (NDIR)		
Measuring range	0...2 000 ppm / 5 000 ppm / 10 000 ppm / 3 % / 5 %		
Accuracy[1)] @ 25 °C (77 °F) and 1 013 mbar (14.7 psi) **0...2 000 ppm** **0...5 000 ppm** **0...10 000 ppm** **0...3 %** **0...5 %**	 <±(40 ppm + 1.8 % of mv) <±(40 ppm + 2.2 % of mv) <±(70 ppm + 2.5 % of mv) <±(450 ppm + 1.8 % of mv) <±(750 ppm + 1.8 % of mv)		 mv = measured value
Factory calibration uncertainty[1)] @ 25 °C (73 °F) **0...2 000 / 5 000 / 10 000 ppm** **0...3 % / 0...5 %**	 ±2.6 % of mv, min ±20 ppm ±0.38 % of mv, min ±60 ppm		 mv = measured value
Temperature dependency in the range of -20...+45 °C (-4...+113 °F) **0...2 000 / 5 000 / 10 000 ppm** **0...3 % / 0...5 %**	 ±(1 + mv / 1 000) ppm/°C -0.3 % of mv/°C	 ±0.556*(1 + mv / 1 000) ppm/°F -0.167 % mv/°F	 mv = measured value
Residual pressure dependency[2)] in the range of -20...+45 °C (-4...+113 °F), related to 1 013 mbar (14.7 psi)	0.014 % of mv/mbar	0.965 % of mv/psi	mv = measured value
Long-term stability, typ. @ 0 ppm CO_2	±20 ppm/year		
Response time t_{63}, typ.[3)]	90 s[4)]		
Measuring interval	15 s (user adjustable from 15 s to 1 h)		

1) Defined with a coverage factor k=2, corresponding to a confidence level of 95 %.
2) Pressure dependency of a sensor without pressure correction: 0.14 % of mv/mbar.
3) With data averaging algorithm for smooth output signal. Faster response time available on request.
4) With PTFE standard filter cap.

Relative Humidity (RH)

Measuring range **Heating enabled** **Heating disabled**	 0...100 %RH 0…95 %RH (non-condensing)
Accuracy[1)] @ 25 °C (77 °F) **20...80 %RH** **0...95 %RH**	 ±3 %RH ±5 %RH

1) With 24 V DC supply, air flow min. 0.3 m/s, probe horizontal or with sensing head downwards, excl. hysteresis

Pressure (p)

Measuring range	700…1 100 mbar (10.15...15.95 psi)
Accuracy, typ. @ 25 °C (77 °F)	±2 mbar (±0.03 psi)
Temperature dependency in the range of 0...60 °C (32...140 °F)	±0.016 mbar/K (0.00013 psi/°F)

Temperature (T)

Measuring range	-40...+60 °C (-40...+140 °F)
Accuracy, typ.[1)] in the range of 5...60 °C (41...140 °F)	±0.5 °C (±0.9 °F)

1) With 24 V DC supply, air flow min. 0.3 m/s, probe horizontal or with sensing head downwards, excl. hysteresis.

Calculated quantities		Unit
Dew point temperature	Td	°C
		°F
		K

Outputs

Analogue

CO_2	0 – 5 V / 0 – 10 V I_L = load current 0 – 20 mA / 4 – 20 mA (3-wire) R_L = load resistance	0 < I_L < 1 mA R_L ≤ 500 Ω

Digital

Digital interface	RS485 (EE872 = 1/10 unit load)
Protocol **Factory settings**[1)] **Supported Baud rates** **Measured data types**	Modbus RTU Baud rate acc. to order code, parity even, 1 stop bit, Modbus address 237 9 600, 19 200 and 38 400 FLOAT32 and INT16

1) More details about communication setting and the Modbus map: See User Manual and Modbus Application Note at www.epluse.com/ee872.

General

Power supply class III USA & Canada: Class 2 supply necessary, max. voltage 30 V DC **Current output** **RS485 interface and voltage output**	 15 – 35 V DC 12 – 30 V DC
Average current consumption @ 24 V DC/AC and 15 s measurement interval **20 mA current output** **RS485 interface and voltage output**	 37 mA 17 mA
Peak current, max.	200 mA
Electrical connection	M12x1 5 poles, stainless steel 1.4404
Filter	PTFE (Polytetrafluoroethylene), UL94 V-0 approved
Storage conditions	-40...+60 °C (-40...+140 °F) 700...1 100 mbar (10.15...15.95 psi) 0...95 %RH, non-condensing
Enclosure material	Stainless steel 1.4404 PET (Polyethyleneterephthalate), UL94HB approved
Protection rating probe body	IP65
Electromagnetic compatibility	EN 61326-1 EN 61326-2-3 Industrial environment FCC Part15 Class A ICES-003 Class A
Conformity	CE UKCA

The measurement accuracy depends both on the performance of the measuring instrument and on the correct installation in the application.

For best accuracy, every E+E CO_2 sensor is multi-point factory adjusted and calibrated in a highly stable reactor. The overall uncertainty of the factory calibration U_{cal} is minimal.

The total measurement uncertainty U_{total} for E+E sensors is calculated in accordance with EA-4/02 (European Accreditation, Evaluation of the Measurement Uncertainty in Calibration) and with GUM (Guide to the Expression of Uncertainty in Measurement) as follows:

$$U_{total} = k \sqrt{\left(\frac{U_{cal}}{2}\right)^2 + \left(\frac{U_{accuray}}{2}\right)^2}$$

U_{total} .....total accuracy incl. factory calibration
U_{cal}.....uncertainty of the factory calibration
$u_{accuracy}$...accuracy of the measurement device
k.....coverage factor k=2, corresponding to a confidence level of 95 %.

For external calibrations, U_{total} is to be used as the evaluation criterion. The calculation does not include effects due to long-term drift or chemical exposure.

10 Conformity

10.1 Declarations of Conformity

E+E Elektronik Ges.m.b.H. hereby declares that the product complies with the respective regulations listed below:

CE European directives and standards.

and

UKCA UK statutory instruments and designated standards.

Please refer to the product page at www.epluse.com/ee872 for the Declarations of Conformity.

10.2 Electromagnetic Compatibility

EMC for industrial environment.
The sensor is a group 1 device and corresponds to Class A.

⚠ WARNING

This device is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

10.3 FCC Part 15 Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

10.4 ICES-003 Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

11 Recycling of the Device

PLEASE NOTE

Products from E+E Elektronik Ges.m.b.H. are developed and manufactured in compliance with relevant environmental protection requirements. Please observe local regulations for the disposal of the device.

For disposal, the individual components of the device must be separated according to local recycling regulations. The electronics shall be disposed of correctly as electronics waste.

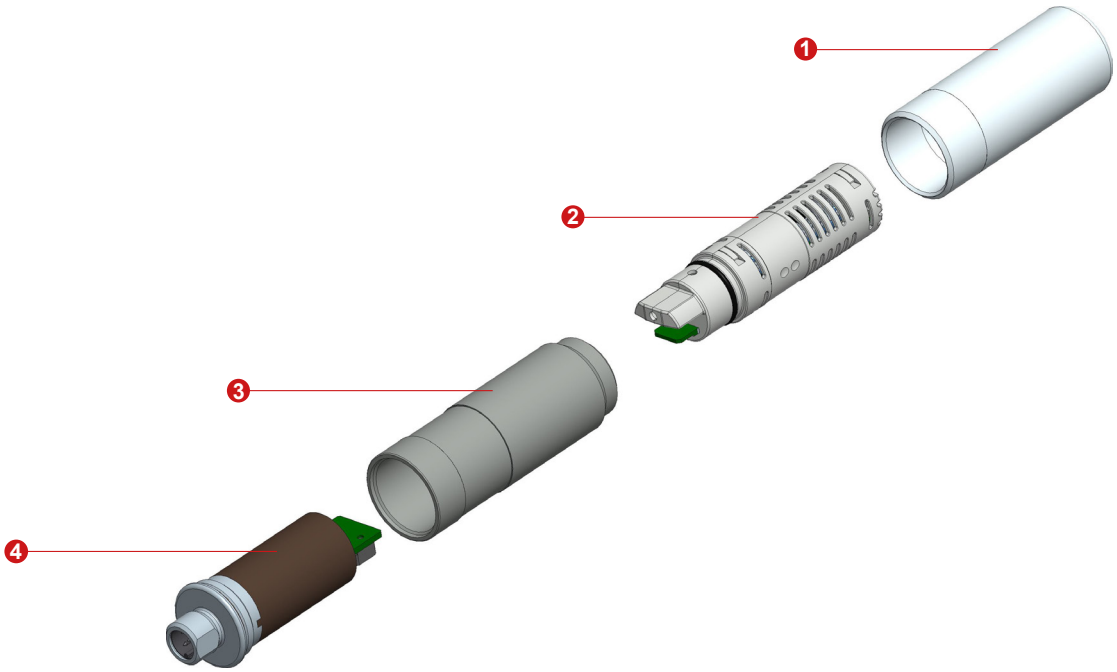


Fig. 8 Probe

No.	Part	Material	Recycling Type
1	Filter cap	Plastics	Plastics waste
2	Sensing module	Various materials	Electrical and electronics waste
3	Enclosure	Stainless steel or plastic	Metal waste or plastics waste
4	Output module with M12 connector	Various materials	Electrical and electronics waste

Tab. 10 Recycling of the parts of the EE872 Probe

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