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User Manual EE072

Humidity and Temperature Probe with Digital Interface

CANopen

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/ee072.

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 unnecessary mechanical stress and inappropriate use.
- Do not apply the supply voltage to the RS485 data lines.
- The EE072 electronics are sensitive to electrostatic discharge (ESD). Take appropriate protective measures when touching it.
- Use the EE072 only as intended and observe all technical specifications.

1.2.2 Intended Use

The EE072 is intended for highly accurate humidity (RH) and temperature (T) measurement in demanding process applications. The measured values and the calculated parameters are availabe on Modbus RTU or CANopen.

⚠ 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 EE072 in explosive atmosphere or for measurement in aggressive gases.
- This device is not appropriate for safety, emergency stop or other critical applications where device malfunction or failure could cause injury to human beings.
- The device may not be manipulated with tools other than specifically described in this manual.

NOTICE

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

- The EE072 may only be operated under the conditions described in this user manual and within the specification included in chapter 8 Technical Data.
- Any unauthorised product modifications will invalidate all warranty claims. Modifications may only be carried out with express authorisation of E+E Elektronik Ges.m.b.H.!
- The sensor must be operated with the filter cap on at all times. Do not touch the sensing element inside the sensing head.
- While replacing the filter cap, take very good care not to touch or rub the sensing elements.

1.2.3 Mounting, Start-up and Operation

The EE072 humidity and temperature probe 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.

1.3 Environmental Aspects

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.

1.4 ESD Protection

The sensing elements and the electronics board are ESD (electrostatic discharge) sensitive components of the device and must be handled as such. Otherwise, the device may be damaged by electrostatic discharge when touching exposed sensitive components.

2 Scope of Supply

- EE072 – Humidity and Temperature Probe with Digital Interface
- Inspection certificate according to DIN EN 10204-3.1
- Quick guide (for Modbus version only)

3 Product Description

3.1 General

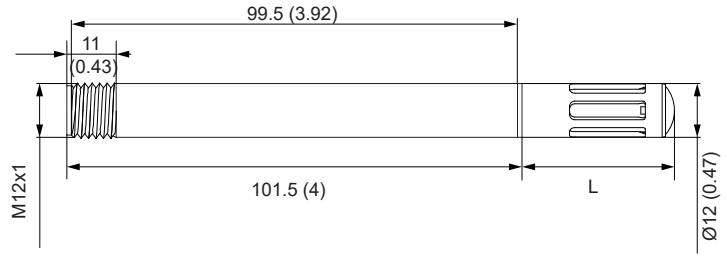
The EE072 is a robust probe for relative humidity and temperature measurement. Its IP65 rating and the E+E proprietary protective sensor coating make it ideal for highest requirements. This is also underlined by the wide humidity and temperature working ranges of 0...100 %RH and -40...80 °C. The EE072 is typically implemented in demanding process and climate control applications like in agriculture, life stock, food, pharma or clean rooms. A wide choice of filter caps allow for versatile options in challenging industrial applications. Installation is simplified by various mounting options which are supported by E+E accessories.

The EE072 is available with two different interface versions, either with CANopen/CAN or with Modbus RTU over RS485. The M12x1 connector links the probe to the digital infrastructure.

3.2 Dimensions

Values in mm (inch)

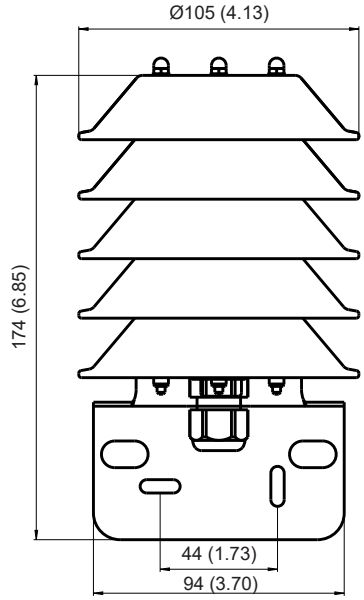
Probe

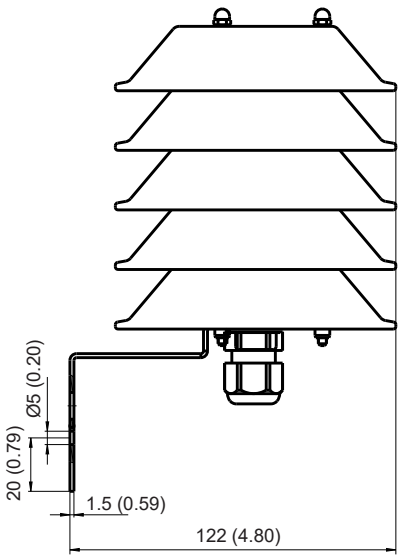


L = filter cap length	mm (inch)
Membrane	34 (1.34)
Stainless steel	31 (1.22)

Radiation shield

(needs to be ordered separately)





3.3 Electrical Connection

⚠ WARNING

Incorrect installation, wiring or power supply may cause overheating and result in personal injury or property damage.

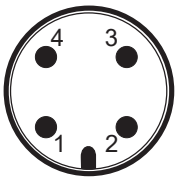
For correct cabling, always observe the presented wiring diagram for the product version used.

The manufacturer cannot be held responsible for personal injury or damage to property caused by incorrect handling, installation, wiring, power supply or maintenance of the device.

The relations of electrical potential between a bus system and an EE072 humidity/temperature sensor are characterised by the following properties:

- The bus connection is not electrically isolated from the supply connection
- The individual EE072 node is not electrically isolated from the supply voltage
- Each EE072 humidity/temperature sensor can be supplied separately

3.3.1 Modbus RTU Version

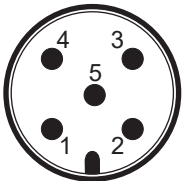


Connection plug for power supply and RS485
(Front view)

Pin	Assignment	Wire colors for accessories: Flange socket HA010705 Sensor connection cable H010819/820/821
1	Supply voltage	Brown
2	RS485 B (D-)	White
3	GND	Blue
4	RS485 A (D+)	Black

Tab. 1 Connection to the Modbus RTU version

3.3.2 CANopen Version



Connection plug for power supply and CAN
(Front view)

Pin	Assignment	Wire colors according to ISO 11898
1	CAN_SHLD	Not in use
2	CAN_V+	Brown
3	CAN_GND	White
4	CAN_H	Green
5	CAN_L	Yellow

Tab. 2 Connection to the EE072 CANopen version, in accordance with CiA-303-1

NOTICE

To ensure stable CANopen communication, the supply voltage must exceed the lower limit of 10 V DC within two seconds of switching on.

PLEASE NOTE

The EE072 triggers an alarm message if the supply voltage is outside the supply limits. The lowest detectable voltage is 9 V and the highest is 35 V.

3.4 Specification of the CAN Lines

The cables used for connecting the CAN bus nodes must comply with ISO 11898. Therefore, the lines must have the following characteristics:

Parameter	Bus system overall length <300 m	Bus system overall length <1 000 m
Cable type	LIYCY 2x2x0.5 mm^2 twisted pair with shielding	CYPIMF 2x2x0.5 mm2 twisted pair with shielding
Line resistance	≤40 Ω/km	≤40 Ω/km
Line capacitance	≤130 nF/km	≤60 nF/km
Connection	Pair 1 (white / brown): CAN_GND and CAN_V+ Pair 2 (green / yellow): CAN_H and CAN_L	

Tab. 3 CAN cable specification

- Only use cables that have an additional pair of wires for CAN_GND.
- Trouble-free operation of the CAN bus is only possible with correctly connected CAN_GND.
- Connect the bus termination resistors. A 120 Ω terminating resistor must be connected at each physical end of the bus system (main trunk).

4 Mounting and Installation

4.1 Wall and Ceiling Mount

Best measurement performance is achieved when the entire probe is located inside the environment to be monitored.

In such a case, the EE072 can be fixed to a wall using the HA010211 mounting clip (not included in the supply; see the “Accessories” datasheet) or hung freely from the ceiling using the connection cable.

Fig. 1 Optional wall and ceiling mount (ordering code HA010211)

4.2 Duct Mount

The probe can also be installed in ducts using plastic (HA010202) or stainless steel (HA010201) flanges. These are not included in the scope of supply (see the “Accessories” datasheet).

Fig. 2 Optional plastic flange (ordering code HA010202)

Fig. 3 Optional stainless steel flange (ordering code HA010201)

4.3 Recommendations for Accurate Humidity and Temperature Measurement

- Should the EE072 probe not be fully located within the designated monitoring environment, significant temperature variations along the probe may result in the formation of temperature gradients. These will have an impact on the accuracy of the results. Therefore, it is of paramount importance to minimise the temperature gradients. The primary section of the probe shall be situated within the target environment, with the remainder featuring effective thermal insulation.
- For outdoor applications, the EE072 model should be fitted with a radiation shield (HA010502) which provides protection from rain, snow and ice. This also causes a natural ventilation which largely prevents overheating of the probe in the sun and thus a distortion of the measured values.
- To ensure the highest possible accuracy when measuring humidity and calculating parameters (e.g. wet bulb temperature, dew point and others), it is recommended to set the barometric pressure at the operating point using the PCS10 product configuration software (see 5 Setup and Adjustment), via the Modbus protocol (see 5.2.1 Modbus RTU Setup (Modbus RTU Protocol Settings)) or via the CANopen protocol (see Chapter 5.6 CANopen). The factory setting is 1013.25 mbar.
- The best accuracy is achieved at a velocity of the air surrounding the probe of at least 0.2 m/s. The accuracy may decrease depending on the installation position, flow direction and flow velocity. The following table provides a brief overview. Please note that vertical positioning with the sensor element facing upwards is the most sensitive in terms of accuracy. Due to the possible self-heating of the sensor electronics, the specified air flow velocity is decisive.

Medium flow direction	Probe direction	
		
←	> 0.2 m/s	> 0.2 m/s
→	Polycarbonate > 0.2 m/s Stainless steel > 2 m/s	> 0.2 m/s
↑	> 0.2 m/s	Polycarbonate > 0.2 m/s Stainless steel > 2 m/s
↓	> 0.2 m/s	> 0.2 m/s

Tab. 4 Mounting position, air velocity and accuracy

5 Setup and Adjustment

The EE072 is ready to use and does not require any further configuration. The factory setup of the EE072 corresponds to the specified order code. Please refer to the datasheet at www.epluse.com/ee072.

With PCS10, it is possible to change the digital communication settings and to perform a RH and T adjustment in the form of an offset or as a 2-point adjustment. For the purpose of pressure compensation, the barometric air pressure at the operating site may be set.

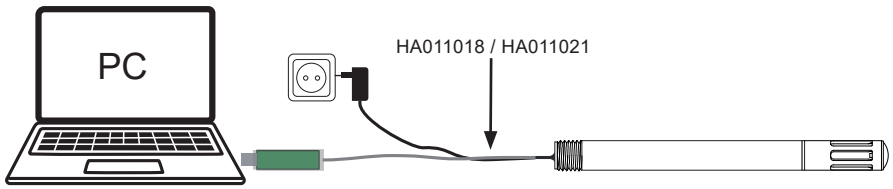


Fig. 4 EE072 connected to a PC running PCS10

5.1 PCS10 Product Configuration Software

The PCS10 provides a convenient graphical user interface to the EE072 for changing the factory setup via PCS10 and Modbus configuration adapter HA011018 / CAN configuration adapter HA011021.

NOTICE

Data integrity might not be provided during firmware download.

Ensure that the device is only powered by the USB interface during firmware update, otherwise the update may fail.

To use the software to change the settings, please proceed as follows:

1. Download the PCS10 Product Configuration Software from www.epluse.com/pcs10 and install it on the PC.
2. Connect the EE072 to the PC using the appropriate 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

5.2.1 Modbus RTU Setup (Modbus RTU Protocol Settings)

	Factory settings	Selectable values (via PCS10)
Baud rate	9600	9 600, 19 200, 38 400, 57 600, 76 800, 115 200
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Modbus address	234	1...247

Tab. 5 Modbus RTU protocol settings

PLEASE NOTE

- The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1.
- The EE072 represents 1 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 EE-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/ee072).

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 the MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, chapter 6:
www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf

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

Air pressure

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Read and write register: function code 0x03 / 0x10			
Air pressure[5]	5001	0x1388	2

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/ee072).
5) Ambient pressure in mbar, with 2 decimal digits (e.g. 1008.25), (Default value 1013.25 mbar).

Tab. 6 EE072 registers for device setup

5.3 Modbus Register Map

The measurement data are 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			
Temperature T	°C	1003	3EA
	°F	1005	3EC
	K	1009	3F0
Relative humidity RH, Uw	%	1021	3FC
Water vapour partial pressure e	mbar	1101	44C
	psi	1103	44E
Dew point temperature Td	°C	1105	450
	°F	1107	452
	K	1147	47A
Wet bulb temperature Tw	°C	1109	454
	°F	1111	456
	K	1145	478
Absolute humidity dv	g/m^3,	1113	458
	gr/ft^3	1115	45A
Mixing ratio r	g/kg	1121	460
	gr/lb	1123	462
Specific enthalpy h	kJ/kg	1125	464
	ft lbf/lb	1127	466
	BTU/lb	1129	468
Frost point temperature Tf	°C	1131	46A
	°F	1133	46C
	K	1149	47C
Ice bulb temperature Ti	°C	1237	4D4
	°F	1239	4D6
	K	1241	4D8

1) The choice of measurement units (metric or non-metric) must be made according to the ordering guide, see EE072 datasheet.
It is not possible to switch from metric to non-metric or vice versa with the PCS10.
2) Register number (decimal) starts from 1.
3) Register address (hexadecimal) starts from 0.

INT16

Parameter	Unit[1)]	Scale[4)]	Register number[2)] [DEC]	Register address[3)] [HEX]
Read register: function code 0x03 / 0x04				
Temperature T	°C	100	4002	FA1
	°F	50	4003	FA2
	K	50	4005	FA4
Relative humidity RH, Uw	%	100	4011	FAA
Water vapour partial pressure e	mbar	10	4051	FD2
	psi	1 000	4052	FD3
Dew point temperature Td	°C	100	4053	FD4
	°F	100	4054	FD5
	K	100	4074	FE9
Wet bulb temperature Tw	°C	100	4055	FD6
	°F	100	4056	FD7
	K	100	4073	FE8
Absolute humidity dv	g/m^3,	10	4057	FD8
	gr/ft^3	10	4058	FD9
Mixing ratio r	g/kg	10	4061	FDC
	gr/lb	10	4062	FDD
Specific enthalpy h	kJ/kg	1	4063	FDE
	ft lbf/lb	1	4064	FDF
	BTU/lb	1	4065	FE0
Frost point temperature Tf	°C	100	4066	FE1
	°F	100	4067	FE2
	K	100	4075	FEA
Ice bulb temperature Ti	°C	100	4119	1016
	°F	100	4120	1017
	K	50	4121	1018

1) The choice of measurement units (metric or non-metric) must be made according to the ordering guide, see EE072 datasheet.
It is not possible to switch from metric to non-metric or vice versa with the PCS10.
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. 7 EE072 FLOAT32 and INT16 measured data registers

5.4 Device Status Indication

The EE072 features a status register that contains all status and error information. The status information can be read from Modbus register 602 (0x259). Errors are displayed in bit-coded form. If an event is present, the corresponding bit is set to 1.

If a critical error occurs, all Modbus values are set to NaN (according to IEEE754 for data type FLOAT32) or to 0x8000 (INT16).

Measured values out of range are limited by the corresponding limit value.

Error Bits	Description	Recommended action
Bit 0	Sensor not adjusted	Return the unit to the E+E Customer Service
Bit 1	ADC value incorrect	Return the unit to the E+E Customer Service
Bit 2	Temperature below minimum limit	Observe the lower working range limit
Bit 3	Temperature above maximum limit	Observe the upper working range limit
Bit 4	Temperature value = infinite	Return the unit to the E+E Customer Service
Bit 5	Capacity faulty	Return the unit to the E+E Customer Service
Bit 6	Humidity below minimum limit	Observe the lower working range limit
Bit 7	Humidity above maximum limit	Observe the upper working range limit
Bit 8	Humidity value = infinite	Return the unit to the E+E Customer Service

Tab. 8 Device status indication

5.5 Modbus RTU Example

The ABC123's Modbus address is 234 [0xEA].

Please refer to

- MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, chapter 6: www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf
- E+E Application Note Modbus AN0103 (available at www.epluse.com/ee072).

Read the temperature (FLOAT32) T = 26.953624 °C from register address 0x3EA:

Master (e.g. PLC) → **EE072**

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
EA	03	03	EA	00	02	F2	A0

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	
EA	03	04	A1	06	41	D7	12	CE

Tab. 9 Example temperature query

NOTICE

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

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 (numbers taken from the T reading Modbus request/response example above):

Modbus response [Hex]			
Byte 3 (Register 1 - Hi)	Byte 4 (Register 1 - Lo)	Byte 1 (Register 2 - Hi)	Byte 2 (Register 2 - Lo)
A1	06	41	D7
MMMM MMMM	MMMM MMMM	SEEE EEEE	EMMM MMMM

Tab. 10 Modbus response

IEEE754			
Byte 1	Byte 2	Byte 3	Byte 4
41	D7	A1	06
0100 0001	1101 0111	1010 0001	0000 0110
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Decimal value: 26.953624			

Tab. 11 Data representation according to IEEE754

5.6 CANopen

5.6.1 Setup

	Factory settings	**Selectable parameters**	**Configurable via**
Baud rate	125 kBit/s	125 kBit/s, 250 kBit/s, 500 kBit/s, 800 kBit/s, 1MBit/s	PCS10 or LSS
Node ID	64	1...127	PCS10 or LSS
TPDO 1	T in [°C], Uw in [%]	T, Uw, e, Td, Tw, dv, r, h, Tf, Ti	CAN SDO
TPDO 2	Td in [°C],Tw in [°C]	T, Uw, e, Td, Tw, dv, r, h, Tf, Ti	CAN SDO
TPDO 3	r in [g/kg], h in [kJ/kg]	T, Uw, e, Td, Tw, dv, r, h, Tf, Ti	CAN SDO
TPDO 4	Tf in [°C], Ti in [°C]	T, Uw, e, Td, Tw, dv, r, h, Tf, Ti	CAN SDO
TPDO data type	REAL32	REAL32, INTEGER16	CAN SDO

Abbreviations: TPDO Transceive Process Data Object
PCS10 E+E Product Configuration Software (see chapter 5.1 PCS10 Product Configuration Software)
LSS Layer Setting Services (see chapter 5.6.4 Layer Setting Services (LSS))
CAN SDO Service Data Object

Tab. 12 CANopen default settings

Parameter	**Symbol**	**Condition**	**Unit**
Temperature	T		[°C, °F, K]
Relative humidity	RH, Uw		[%]
Water vapour partial pressure	e		[mbar, psi]
Dew point temperature	Td		[°C, °F, K]
Wet bulb temperature	Tw	Tw ≥ 0 °C	[°C, °F, K]
Absolute humidity	dv		[g/m³]
Mixing ratio	r		[g/kg]
Specific enthalpy	h		[kJ/kg]
Frost point temperature	Tf	Tf ≤ 0 °C	[°C, °F, K]
Ice bulb temperature	Ti	Ti ≤ 0 °C	[°C, °F, K]

Tab. 13 Selectable parameters

5.6.2 Function Overview

The EE072 humidity/temperature probes have a standardised CANopen interface according to CiA DS-301 and a device profile according to CiA DSP-404. All measured values and parameters are accessible via the object directory (OD). The individual configuration can be saved in the internal permanent memory (EEPROM).

The following CANopen functions are available:

- Transceive Process Data Objects (TPDO1 - 4) in four possible operating modes
  - Individual query via Remote Transmit Request (RTR)
  - Cyclic transmission by interval time
  - Event-controlled transmission on measurand change
  - Synchronised transmission after receipt of a SYNC telegram
- Service Data Object (standard SDO)
- Error messages via Emergency Object (EMCY) with support
  - The general error register (Error Register)
  - The manufacturer-specific status register (Manufacturer Status)
  - The error list (Pre-defined Error Field)
  - Supply range alarm
- Monitoring mechanisms Heartbeat and Nodeguarding/Lifeguarding
- Save and restore function for all parameters (Store and Load Parameter Field)
- Setting the Node ID and the baud rate via LSS
- In addition to the CiA DS-301 functionality, there are further manufacturer or profile specific features
  - Setting of pressure compensation parameter (object 2205h - default value 1013.25 mbar)
  - Supply voltage monitoring
  - Read calibration date (factory and customer)

5.6.3 Electronic Datasheet (EDS)

An electronic data sheet (EDS) is available for the EE072 CANopen (download free of charge at www.epluse.com/ee072) .

It contains a complete description of the object dictionary and facilitates a convenient integration into a CANopen engineering software.

5.6.4 Layer Setting Services (LSS)

In order to use the LSS functionality, LSS data is required which clearly identifies the sensor. This is the Identity Object (Index 1018_h).

Designation	Object	Sub-Index	Value for EE072
Vendor ID	1018_h	01_h	$000004C8_h$
Product code	1018_h	02_h	$0x00_h$
Revision number	1018_h	03_h	$0x00_h$
CANopen serial number	1018_h	04_h	device specific (LLS – 04h: 0x….)

Tab. 14 LLS data

The sensor specific identifier (LLS – 04h) is printed on each EE072.

Example of sensor labeling including LSS data:

EE072 TT2
CANopen / LSS - 04h: 0x20220503
Supply: 10-28 V DC

6 Maintenance and Service

THe EE072 does not require any special maintenance, nevertheless for high accurate measurements especially over wide RH and T ranges it is recommended to calibrate the probe every 12 months. If needed, the enclosure may be cleaned and the device may be re-adjusted as described in the following chapters below.

6.1 Calibration and Adjustment

The EE072 can be calibrated / adjusted with the help of the PCS10. For this purpose, the probe needs to be connected to a PC via the Modbus configuration adapter HA011018 / CAN configuration adapter HA011021.

Definitions

- **Calibration** documents the accuracy of a measurement device. The device under test (specimen) is compared with the reference and the deviations are documented in a calibration certificate. During the calibration, the specimen is not changed or improved in any way.
- **Adjustment** improves the measurement accuracy of a device. The specimen is compared with the reference and brought in line with it. An adjustment can be followed by a calibration which documents the accuracy of the adjusted specimen.

6.2 RH and T Calibration and Adjustment

Humidity 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 and ww.epluse.com/iso9001cal.

Calibration and adjustment by the user

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 Meter (e.g. Omniport 40), please refer to www.epluse.com/omniport40.
- Humidity Calibration Kit (e.g. E+E Humidity Standards), please refer to www.epluse.com/ee072.

6.3 Filter Cap Exchange

In a dusty, polluted environment it might be necessary to replace the filter cap once in a while. In most cases, a clogged filter shows visible contamination or dirt. Longer response time of the measurement also indicates a clogged filter cap. In such cases, replace the filter by a new, original one, see chapter 6.7 Spare Parts.

Procedure:

1. Turn the filter cap counter-clockwise to remove it.
2. Install the new filter cap finger-tight by turning it clockwise.

NOTICE

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

While replacing the filter cap, take very good care not to touch or rub the sensing elements.

6.4 Protection During Site Cleaning Operations

NOTICE

- Protect the sensing head with the optional HA010783 protection cap for 12 mm (0.47") probe when cleaning or sterilising the site.
- If the probe is removed from the site, it is recomendet to fit the protection caps for the M12 cable socket (HA010781) and the M12 cable plug (HA010782).

Fig. 5 HA010783 Protection cap for Ø12 mm (0.47") probe

Fig. 6 HA010781 Protection cap M12 socket

Fig. 7 HA010782 Protection cap M12 plug

6.5 Cleaning the Sensing Head and Filter Cap Replacement

In case of dusty, oily and polluted environment

- Use a damp soft cloth to remove deposits of dust or dirt from the exterior of the probe. Do not use any solvents or abrasive cleaning agents.
- The filter cap shall be replaced once in a while with an E+E original one (see). A polluted filter cap causes longer response time of the device.
- If needed, the sensing element of the humidity probe can be cleaned by the user (see cleaning instruction - www.epluse.com/cleaning-instructions).

6.6 Repairs

PLEASE NOTE

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

6.7 Spare Parts

Description	Code
Filter caps for probes with Ø 12 mm	**Please refer to the datasheet "Accessories"**

7 Accessories

For further information please refer to the Accessories datasheet.

Description	Code
E+E Product Configuration Software (Free download: www.epluse.com/pcs10)	**PCS10**
Protection cap for M12 socket	**HA010781**
Protection cap for M12 plug	**HA010782**
Protection cap for Ø12 mm (0.47") probe, RAL6018	**HA010783**
Stainless steel mounting flange Ø12 mm (0.47")	**HA010201**
Plastic mounting flange, Ø12 mm (0.47"), RAL7035	**HA010202**
Y-style splitter, M12x1, 1 plug ←→ 2 sockets, 5 poles	**HA030204**
Wall mounting clip, Ø12 mm (0.47")	**HA010211**
Radiation shield with clamp ring M20x1.5, for probes with Ø12 mm (0.47")	**HA010502**
Drip water protection	**HA010503**

Accessories Modbus	Code
Connector, M12x1 socket, 4 poles, for self assembly	**HA010707**
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**

Accessories CAN	Code
Connector, M12x1 socket, 5 poles, for self assembly	**HA010708**
CAN configuration adapter for EE072 (CAN version)	**HA011021**
Connection cable for EE072 (CAN version) with 120 Ω termination, M12x1 plug ←→ socket, 1.8 m (5.9 ft)	**HA010850**

8 Technical Data

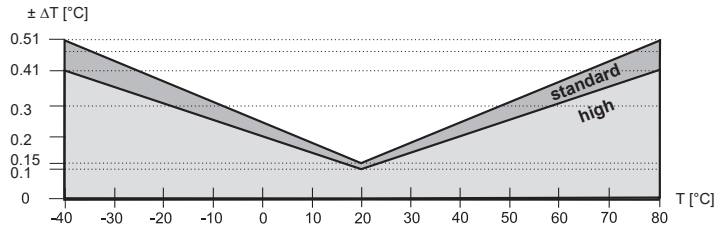
Measurands

Relative Humidity (RH)

Measuring range	0...100 %RH
Accuracy[1)] incl. hysteresis, non-linearity and repeatability **RH ≤ 90 % -15...+40 °C (5...+104 °F)** **RH > 90 % -15...+40 °C (5...+104 °F)** **40...+80 °C (-40...+176 °F)**	 ±(0.95 + 0.0013 % *mv) %RH ±1.8 %RH ±(1.15 + 0.013 % *mv) %RH mv = measured value
Factory calibration uncertainty[2)] **0...90 %RH** **> 90 %RH**	±(0.7 + 0.003 % *mv) %RH ±1 %RH
Response time t_{90}, typ. @20 °C (68 °F)	≤15 s with stainless steel grid filter
Measuring interval	1 s
Resolution	0.01 %RH

1) Defined against E+E calibration reference.
For Modbus, the accuracy is defined at a 24 V DC supply, baud rate 9 600, without termination resistor, a polling interval ≥1 s and a flow velocity >0.2 m/s. For CANopen, the accuracy is defined at a flow velocity >0.2 m/s.
2) Defined at 23 °C (73.4 °F) with a coverage factor k=2, corresponding to a confidence level of 95 %.

Temperature (T)

Measuring range	-40...+80 °C (-40...+176 °F)
Accuracy[1)]	
Factory calibration uncertainty[2)]	±0.1 °C (±0.18 °F)
Measuring interval	1 s
Resolution	0.01 °C (32.02 °F)

1) Defined against E+E calibration reference.
For Modbus, the accuracy is defined at a 24 V DC supply, baud rate 9 600, without termination resistor, a polling interval ≥1 s and a flow velocity >0.2 m/s (39 ft/min). For CANopen, the accuracy is defined at a flow velocity >0.2 m/s (39 ft/min).
2) Defined at 23 °C (73.4 °F) with a coverage factor k=2, corresponding to a confidence level of 95 %.

Outputs

Digital

Digital interface	RS485 (EE072 = 1 unit load)
Protocol **Factory settings**[1)] **Supported Baud rates** **Measured data types**	Modbus RTU 9 600 Baud, parity even, 1 stop bit, Modbus address 234 9 600, 19 200, 38 400, 57 600, 76 800 and 115 200 FLOAT32 und INT16
Protocol / Profile **Connector** **Factory settings**[2)] **Supported Baud rates**	CANopen / device profile CiA 404 M12x1, 5 poles, pin assignment according to CiA 303-1 Data rate 125 kBit/s, node ID 64 125 kBit/s, 250 kBit/s, 500 kBit/s, 800 kBit/s, 1 MBit/s

1) For more details about communication setting see User Manual and Modbus Application Note at www.epluse.com/ee072.
2) For further information on the configuration see User Manual and the EDS file (Electronic Data Sheet).

General

Power supply class III USA & Canada: Class 2 supply necessary	10 - 28 V DC
Current consumption, typ.	3 mA (RS485, without termination resistor) 8 mA (CAN)
Storage conditions	-40...+80 °C (-40...+176 °F) 0...95 %RH, non-condensing
Enclosure **Material** **Protection rating**	 Polycarbonate RAL 7035 Stainless steel 1.4404 / AISI 316 IP65 (when plugged into an appropiate M12x1 socket)
Electromagnetic compatibility	EN 61326-1:2013 EN 61326-2-3:2013 Industrial environment FCC Part15 Class A ICES-003 Class A
Conformity	CE UKCA
Configuration and adjustment	PCS10 Product Configuration Software Free download from www.epluse.com/pcs10

Accuracy of E+E Humidity and Temperature Sensors

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 RH and T sensor is multi-point factory adjusted and calibrated in a highly stable RH / T reactor. Using a high-precision dew point mirror as reference, 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:

$$U_{total} = k \bullet \sqrt{\left(\frac{U_{cal}}{2}\right)^2 + \left(\frac{u_{accuracy}}{\sqrt{3}}\right)^2}$$

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.

As National Metrological Institute (NMI) / Designated Institute (DI) responsible for maintaining National Standards in Austria, E+E Elektronik represents the highest level in calibration. For further details, please refer to www.eplusecal.com.

As accredited laboratory, E+E Elektronik represents the highest level in calibration. For further details, please refer to www.eplusecal.com.

9 Conformity

9.1 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/ee072 for the Declarations of Conformity.

9.2 Electromagnetic Compatibility

EMC for industrial environment.
The probe 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.

9.3 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.

9.4 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.

Company Headquarters &
Production Site

E+E Elektronik Ges.m.b.H.
Langwiesen 7
4209 Engerwitzdorf | Austria
T +43 7235 605-0
F +43 7235 605-8
info@epluse.com
www.epluse.com

Subsidiaries

E+E Sensor Technology (Shanghai) Co., Ltd.
T +86 21 6117 6129
info@epluse.cn

E+E Elektronik France SARL
T +33 4 74 72 35 82
info.fr@epluse.com

E+E Elektronik Deutschland GmbH
T +49 6171 69411-0
info.de@epluse.com

E+E Elektronik India Private Limited
T +91 990 440 5400
info.in@epluse.com

E+E Elektronik Italia S.r.l.
T +39 02 2707 86 36
info.it@epluse.com

E+E Elektronik Korea Ltd.
T +82 31 732 6050
info.kr@epluse.com

E+E Elektronik Corporation
T +1 847 490 0520
info.us@epluse.com

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