User Manual

EE074
Temperature Probe
with Modbus RTU

YOUR PARTNER IN SENSOR TECHNOLOGY E+E

ELEKTRONIK®
Ges.m.b.H.

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The document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.

EMC note USA (FCC):

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.

EMC note Canada (ICES-003):

CAN ICES-3 (A) / NMB-3 (A)

CONTENTS

1   General

This user manual serves for ensuring 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. The user manual may not be used for the purposes of competition without the written consent of E+E Elektronik® and may not be forwarded to third parties. Copies may be made for internal purposes. All information, technical data and diagrams included in these instructions are based on the information available at the time of writing.

Please find this document and further product information on our website at www.epluse.com/EE074.

1.1   Explanation of Symbols

This symbol indicates safety information.
It is essential that all safety information is strictly observed. Failure to comply with this information can lead to personal injuries or damage to property. E+E Elektronik® assumes no liability if this happens.

This symbol indicates instructions.
The instructions shall be observed in order to reach optimal performance of the device.

1.1.1   General Safety Instructions

- Avoid any unnecessary mechanical stress and inappropriate use.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.
- Use the EE074 only as intended and observe all technical specifications.
- Do not use EE074 in explosive atmosphere or for measurement of aggressive gases.
- Do not apply the nominal voltage to the RS485 data lines.

1.1.2   Mounting, Start-up and Operation

The EE074 Modbus RTU temperature probe has been produced under state of the art manufacturing conditions, has been thoroughly tested and has left the factory fulfilling all safety criteria. The manufacturer has taken all precautions to ensure safe operation of the device. The user must ensure that the device is set up and installed in a manner that does not have a negative effect on its safe use. The user is responsible for observing all applicable safety guidelines, local and international, with respect to safe installation and operation on the device. This user manual contains information and warnings that must be observed by the user in order to ensure safe operation.

- Mounting, start-up, operation and maintenance of the device may be performed by qualified staff only. Such staff must be authorized by the plant operator to carry out the mentioned activities.
- The qualified staff must have read and understood this user manual and must follow the instructions contained within.
- All process and electrical connections shall be thoroughly checked by authorized staff before putting the device into operation.
- Do not install or start-up a device supposed to be faulty. Make sure that such devices are not accidentally used by marking them clearly as faulty.
- A faulty device may only be investigated and possibly repaired by qualified, trained and authorized staff. If the fault cannot be fixed, the device shall be removed from the process.
- Service operations other than described in this user manual may only be performed by the manufacturer.

Disclamer
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 damages incurred due to failure to comply with the applicable regulations, operating instructions or the operating conditions. Consequential damages are excluded from the liability

1.2 Environmental Aspects

Products from E+E Elektronik® are developed and manufactured observing of all relevant requirements with respect to environment protection. Please observe local regulations for the device disposal.

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.
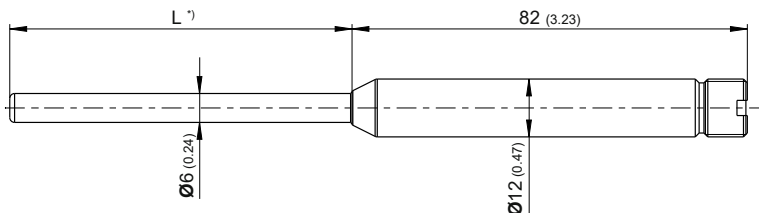
2 Scope of Supply

- EE074 – Modbus RTU Temperature Probe
- Test report according to DIN EN 10204-3.1
- Quick user guide

3 Product Description

3.1 Dimensions

The following figure shows the probe dimensions in mm (inch)

*)	L in mm	L in Inch
	70	2.81
	155	6.16
	305	12.07

3.2 Connectivity

Important note:
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.
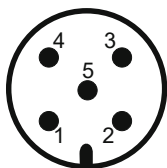
M12 device plug
front view

Pin number	Function	Wire colors for accessories: - Coupling 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	Not connected	gray

4   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 EE074 may be for instance fixed onto a wall with
the mounting clip HA010211 (not included in the scope of supply, see
data sheet "Accessories"), or freely hang from the ceiling on the
connection cable.

4.2   Duct Mount

The probe can be installed also into a duct using the plastics flange
HA401101 (not included in the scope of supply, see data sheet
"Accessories").

4.3   Immersion Well Mount

The probe can be installed into a pressured liquid system using an
ISO or NPT ½" immersion well HA400101-04 or HA4000211-14
(not included in the scope of supply, see data sheet "Accessories").

Please note: For a good thermal connection between the probe and the
immersion well, the use of a thermal paste is recommended.

The EE074 can be used up to 15 bar (218 psi) with an E+E brass immersion well and with an E+E
stainless steel immersion well up to 25 bar (363 psi).
Please observe following maximum flow speed limitations for the E+E immersion wells:

Length (L)	50 mm (1.97")	100 mm (3.94")	135 mm (5.31")	285 mm (11.22")
Brass	26 m/s (5118 ft/min)	12 m/s (2362 ft/min)	6 m/s (1181 ft/min)	1 m/s (197 ft/min)
Stainless steel	29 m/s (5118 ft/min)	15 m/s (2953 ft/min)	9 m/s (1771 ft/min)	2 m/s (394 ft/min)

4.4   Recommendations for Accurate Temperature Measurement

Air Temperature Measurement

In air, best accuracy is achieved with an air flow of min. 0.2 m/s surrounding the sample.

In case the EE074 probe is not entirely located in the environment to be monitored, large temperature
differences along the probe will lead to temperature gradients. These will have an influence on the
accuracy. Therefore, it is of paramount importance to minimize the temperature gradients. The biggest
part of the probe shall be located in the target environment and the rest shall be thermally well insula-
ted.

Air and Liquids Temperature Measurement down to -70 °C (-94 °F)

The front part of the 305 mm (12.07″) probe may be immersed up to 100 mm in a medium with a
temperature of down to -70 °C (-94 °F). The temperature of the other parts, especially those containing
the electronics, shall not fall below -40 °C (-40 °F). The insulation design depends on the measurement
task. In good thermal conductors like in liquids or dry block calibrators, the insulation can be smaller in
order to achieve a good measurement accuracy. In contrast, for media with low thermal conductivity like
air, the insulation must cover at least 200 mm (7.87″) of the remaining probe.

5 Modbus RTU Interface

5.1 Modbus Setup

	Factory settings	User selectable values (via PCS10)
Baud rate	9600	9600, 19200, 38400, 57600, 76800, 115200
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Slave address	233	1...247

Device address, baud rate, parity and stop bits can be set via:
1. PCS10 Product Configuration Software and the Modbus configuration adapter HA011018.
   The PCS10 can be downloaded free of charge from www.epluse.com/PCS10.
2. Modbus protocol in the register adddresses 0x00 and 0x01 with function code 0x06.
   See Modbus Application Note AN0103 (available at www.epluse.com/EE074)

The serial number as ASCII-code is located in the register addresses 0x00...0x07 (16 bits per address). The firmware version is located in the register address 0x08 (bits 15...8 = major release; bits 7...0 = minor release). The sensor name is located in register address 0x09. The beforementioned registers can be read out with function code 0x03 or 0x04.

INTEGER 16 bit		
Parameter	**Register number[1] [DEC]**	**Protocol address[2] [HEX]**
Write register: function code 0x06		
Slave-ID Modbus address	0001	0x00
Modbus protocol settings[3]	0002	0x01

1) Register number starts from 1.
2) Protocol address starts from 0.
3) For Modbus protocol settings see Application Note Modbus AN0103 (available on www.epluse.com/EE074).

INFO (read register):		
Parameter	**Register number[1] [DEC]**	**Protocol address[2] [HEX]**
Read only register: function code 0x03 / 0x04		
Serial number (as ASCII)	0001	0x00
Firmware version	0009	0x08
Sensor Name	0010	0x09

1) Register number starts from 1.
2) Protocol address starts from 0.

5.2 Modbus Register Map

The measured data is saved as a 32 bit floating point values (data type FLOAT) and as 16 bit signed integer values (data type INTEGER)

FLOAT 32 bit			
Parameter	**Unit**	**Register number[1] [DEC]**	**Protocol address[2] [HEX]**
Read register: function code 0x03 / 0x04			
Temperature T	° C	1003	0x3EA
Temperature T	° F	1005	0x3EC
Temperature T	K	1009	0x3F0

INTEGER 16 bit				
Parameter	**Unit**	**Scale[3]**	**Register number[1] [DEC]**	**Protocol address[2] [HEX]**
Read register: function code 0x03 / 0x04				
Temperature T	° C	100	4002	0xFA1
Temperature T	° F	50	4003	0xFA2
Temperature T	K	50	4005	0xFA4

1) Register number starts from 1.
2) Protocol address starts from 0.
3) Examples: For scale 100, the reading of 2550 means a value of 25.5. For scale 50, the reading of 13500 means a value of 270.

5.3   Modbus RTU Example

Example of MODBUS RTU command for reading the temperature (FLOAT value) T = 26,953624 °C from the register 0x3EA

Device EE074; slave ID 233 [0xE9]

	Modbus ID address	Function code	Starting address Hi	Starting address Lo	No. of register Hi	No. of register Lo	CRC	
Request [Hex]:	E9	03	03	EA	00	02	F2	93

	Modbus ID address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
Response [Hex]:	E9	03	04	A1	06	41	D7	21	CE

Decoding of floating point values:

Floating point values are stored according IEEE754 standard. The byte pairs 1, 2 and 3, 4 are inverted as follows:

MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM
Byte 3	Byte 4	Byte 1	Byte 2

Example:

Response [Hex]				Value in decimal
Byte 1 (Register 2 - Hi)	*Byte 2 (Register 2 – Lo)*	*Byte 3 (Register 1 - Hi)*	*Byte 4 (Register 1 - Lo)*	
41	D7	A1	06	26.953624

i

Please note: For obtaining the correct value, both registers have to be read within the same reading cycle. The measured value can change between two Modbus requests, therefore, exponent and mantissa may get inconsistent.

For more details, please see the Modbus Application Note available at https://www.epluse.com/EE074 and chapter 6.3 of the Modbus reference document http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf.

6   Maintenance and Service

EE074 does not require any special maintenance, nevertheless for high accurate measurements especially over wide 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 below.

6.1   Cleaning

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.

6.2   Repairs

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

6.3　Configuration Interface

The EE074 is ready to use and does not require any configuration by the user. The user can change the factory setup by using the Modbus configuration adapter (order code HA011018) and the PCS10 Product Configuration Software.

One can change the digital communication settings and perform a measurement adjustment in the form of an offset or as a 2-point adjustment.

PCS10 PRODUCT CONFIGURATION SOFTWARE
1. Download the PCS10 Product Configuration Software from www.epluse.com/PCS10 and install it on the PC.
2. Connect the E+E device to the PC using the appropriate configuration cable.
3. Start the PCS10 software.
4. Follow the instructions on thePCS10 opening page for scanning the ports and identifying the connected device.
5. Click on the desired setup or adjustment mode from the main PCS10 menu on the left and follow the online instructions of the PCS10.
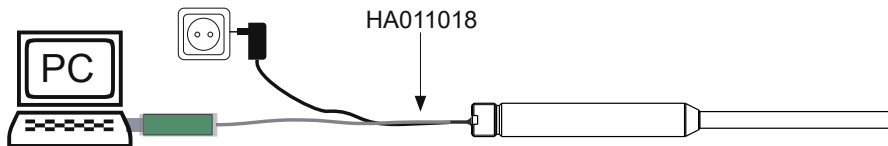
6.4　Temperature Adjustment and Calibration

6.4.1　Definitions

Adjustment: The specimen is brought in line with the reference.
Calibration: The specimen is compared with a reference and its deviation from the reference is documented.

Depending on the application and the requirements of certain industries, there might arise the need for periodical temperature calibration or adjustment

6.4.2　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.

6.4.3　Calibration and Adjustment by the User

Depending on the level of accuracy required, the temperature reference can be:
• Liquid bath calibrator
• Dry block calibrator
• Climate chamber
• Handheld device (e.g. Omniport30), please see www.epluse.com/omniport30
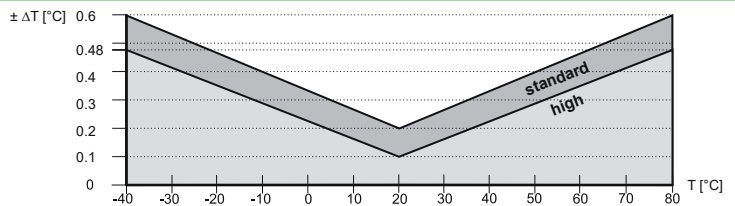
7   Technical Data

Measurand

Temperature sensor	Pt1000 Class A
Accuracy[1] incl. hysteresis, non-linearity, temperature dependency of electronics and repeatability	
Resolution	0.01 °C
Response time t_{63}	75 s in air @ 3.0 m/s 21 s in liquid
Measuring interval	1 s

General

Digital interface		RS485 (EE074 = 1 unit load)
Protocol		Modbus RTU
Default settings		Baud rate 9 600[2], parity even, 1 stop bit, Modbus address 233
Power supply class III ⬦		10 - 28 V DC
Current consumption, typ.		3 mA
Enclosure material		Stainless steel 1.4404 / AISI 316 L
Protection rating[3] IP68 (electrical connection IP67)		
Connector		M12x1, 5 poles, stainless steel
Electromagnetic compatibility		EN 61326-1 EN 61326-2-3 Industrial Environment FCC Part15 Class A ICES-003 Class A
Working range	electronics	-40…80 °C (-40... 176 °F) / 0…100 % RH
	probe (70 & 155 mm)	-40…80 °C (-40... 176 °F) / 0…100 % RH
	probe (305 mm)	-70…105 °C (-94... 221 °F) / 0…100 % RH
Storage conditions		-40…80 °C (-40... 176 °F) / 0…90 % RH

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Immersion well

Material	Brass nickel-plated Stainless steel (tube: 1.4571 / 316Ti, mounting thread: 1.4404 / 316L)
Pressure rating	15 bar (218 psi), brass 25 bar (363 psi), stainless steel

3) Traceable to intern. standards, administrated by NIST, PTB, BEV,... The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor k=2 (2-times standard deviation). The accuracy was calculated in accordance with EA-4/02 and with regard to GUM (Guide to the Expression of Uncertainty in Measurement). The accuracy is defined at a 24 V DC supply, 9600 Baud rate, without termination resistor and a polling interval of ≥ 1 second. For the accurate measurement in air, please observe the installation note in the product manual.
2) Supported baud rates 9 600, 19 200, 38 400, 57 600, 76 800 and 115 200;
   more details about communication setting: See User Guide and Modbus Application Note at www.epluse.com/EE074
3) The IP67 protection rating applies when plugged into an appropiate M12x1 female connector.

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