



User Manual

EE680

**Air Velocity and Temperature Sensor
for Laminar Flow**

YOUR PARTNER IN SENSOR TECHNOLOGY



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Ges.m.b.H.

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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)

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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/EE680.

Disclaimer

The manufacturer or his authorized agent can be 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 damages incurred due to failure to comply with the applicable regulations, operating instructions or the specified operating conditions. Consequential damages are excluded from the liability.

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.

1.2 Safety Instructions

1.2.1 General Safety Instructions

- The probe shall not be exposed to unnecessary mechanical stress.
- The sensing element is sensitive to electrostatic discharge (ESD), avoid touching the sensing element whenever possible, appropriate protective measures should be taken when touching it.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.
- Use the EE680 only as intended and observe all technical specifications.
- Do not use EE680 in explosive atmosphere or for measurement of aggressive gases.
- Do not apply the nominal voltage to the RS485 data lines.
- This device is not appropriate for safety, emergency stop or other critical applications where device malfunction or failure could cause injury to human beings.

1.2.2 Intended Use

The EE680 is intended for monitoring laminar flows fulfilling highest requirements for the use in GMP Grade A and B or ISO class 5 clean rooms and above. It measures the standardized air velocity (v_n) and the temperature (T) highly accurate. Its GMP-compliant design makes it the ideal solution for branches like microelectronics, pharmaceutical industry and other life science fields. The EE680 is not designed for outdoor applications. It is suitable for use in clean gases (air) free from oils, residue-forming substances or abrasive particles.

The use of the EE680 in any other way than described in this manual bears a safety risk for people and the entire measurement installation and is therefore not allowed.

The manufacturer cannot be hold responsible for damages as a result of incorrect handling, installation, and maintenance of the equipment.

In order to avoid damage to the instrument or health hazards, the measuring equipment must never be manipulated with tools that are not specifically described in this manual.

The sensor may only be utilized in accordance with the conditions defined in the technical data. Otherwise, measurement inaccuracies will occur and equipment failures cannot be ruled out.

The steps recommended by the manufacturer for installation, inspections and maintenance work must be observed and carried out for the safety of the user and for the functionality of the equipment.

Unauthorized product modification leads to loss of all warranty claims. This may be accomplished only with an explicit permission of E+E Elektronik!

1.2.3 Mounting, Start-up and Operation

The EE680 air velocity and temperature sensor for laminar flow 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 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 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.
- 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.

1.3 Environmental Aspects



Products from E+E Elektronik are developed and manufactured in compliance with all relevant environmental protection requirements. 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

- EE680 – Air Velocity and Temperature Sensor for Laminar Flow (with protection cap)
- EE680 stainless steel mounting flange
- Inspection certificate according to DIN EN 10204-3.1
- Quick guide

3 Product Description

3.1 General

The EE680 probe is optimized for highly accurate and reliable standardized air velocity (v_n) and temperature (T) measurement in GMP Grade A and B or ISO class 5 clean rooms and above. Its GMP compliant design makes it the ideal probe for laminar flow monitoring in clean rooms with the highest requirements. The probe is suitable for air velocity measurement down to 0.1 m/s (20 ft/min).

The EE680 is available as straight and angled version with various probe lengths. All variants provide an optical status indication - see chapter 5.4.

The probe employs an E+E thin-film sensing element with excellent accuracy, long term stability and low angular dependency. The E+E proprietary coating protects the sensing element against H₂O₂ sterilization processes and corrosive cleaning agents.

The air velocity and temperature measured data is available as current or voltage analogue output or on the RS485 interface with Modbus RTU protocol. The analogue output and other settings can be configured with the PCS10.

3.2 Dimensions

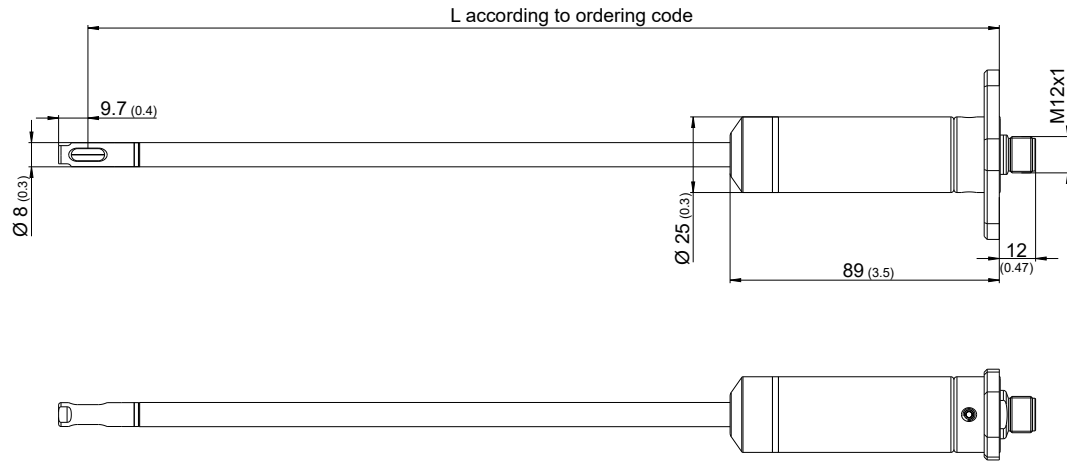


Fig. 1 EE680 straight probe, dimensions in mm (inch)

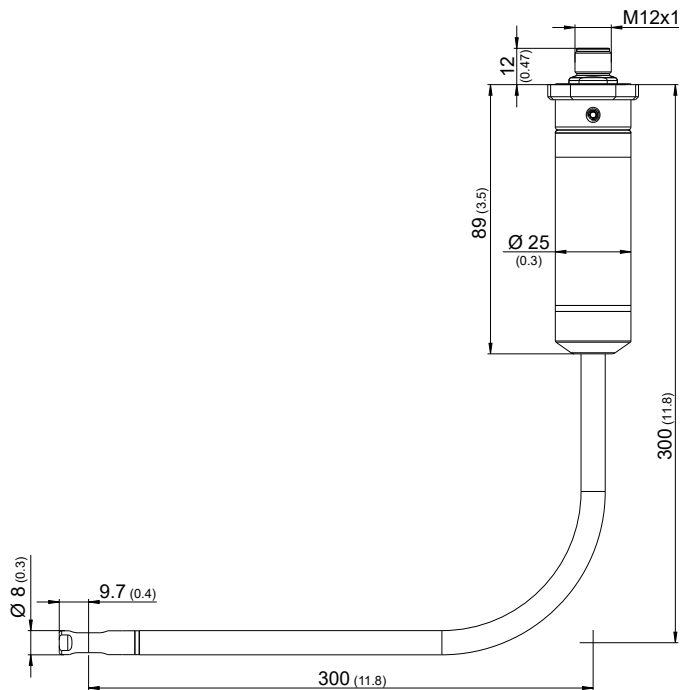


Fig. 2 EE680 angled probe, dimensions in mm (inch)

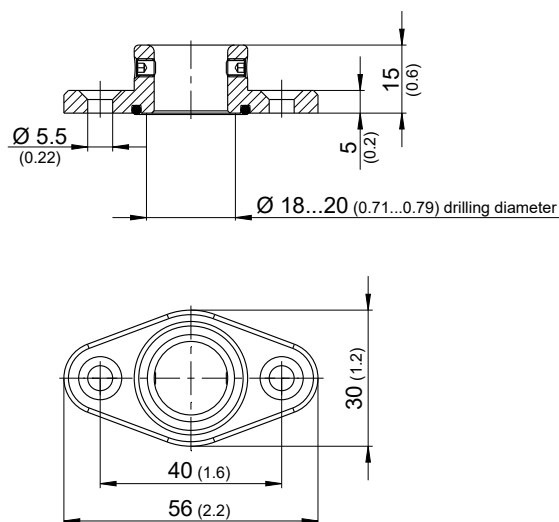


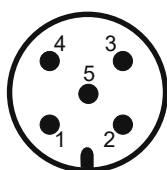
Fig. 3 Mounting flange for EE680, dimensions in mm (inch)

3.3 Electrical Connection



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: - Flange coupling HA010705 - Connection cable HA010819/820/821
1	Supply voltage 24 V DC +/- 20% (Class III) ⚡	brown
2	Analogue out 2 or RS485 (D-), Data	white
3	GND	blue
4	Analogue out 1 or RS485 (D+), Clock	black
5	Configuration pin	gray

Tab. 1 EE680 pin assignment



Please note:

In order to comply with the EMC Directive 2004/108/EC a shielded connection cable must be used.

3.4 Hardware Selection between Analogue Output and RS485 Interface with Modbus RTU

	Default: analogue	Default: Modbus RTU
Pin 5 open (=HIGH)	10 s timeout ¹⁾ , then analogue output	Modbus RTU
Pin 5 GND (=LOW)	Analogue	Analogue

1) For configuration purposes, during the first 10 seconds after power on the EE680 awaits connection with the PCS10 Product Configuration Software.

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

The “default output” of the EE680 can be analogue or Modbus RTU. The “default output” of a new EE680 corresponds to the ordered type number, refer to the EE680 datasheet. In case the user altered the factory setup, the “default output” corresponds to the latest settings uploaded to the EE680 by means of the PCS10 Product Configuration Software (refer to the tutorial function of PCS10).

4 Probe Mounting

The EE680 can be mounted on walls, ceilings or inside safety workbenches. Fig. 4 and Fig. 5 show the principal probe mounting alternatives, depending on the probe type.

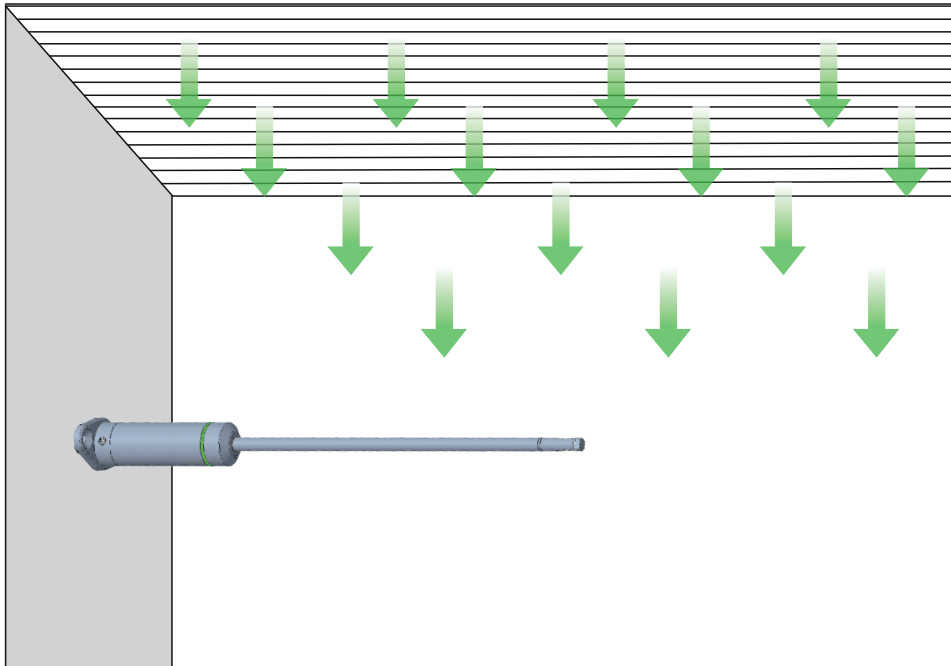


Fig. 4 EE680 mounting on a wall

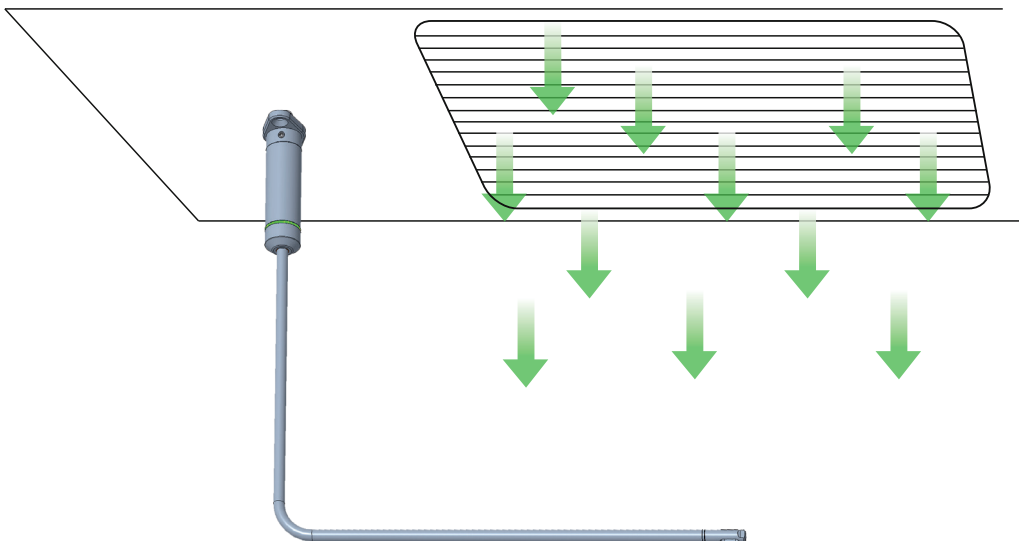


Fig. 5 EE680 mounting on a ceiling

The stainless steel mounting flange allows for the probe to be mounted on a wall or inside a safety workbench.

After fastening the flange, feed the connection cable through the flange for connecting it with the sensor. For convenient handling, the cable should extend 5 cm (2 in) from the flange and there should be enough space for it behind the flange. Connect the sensor with the M12 connector. Insert the sensor into the flange and adjust the sensor position for parallelism of the sensing element and the air flow. Finally, fasten the sensor with the imbus screw in the flange.

For facilitating sheet metal wall mounting, there is a mounting set available as accessory (HA011601) consisting of counter plate, sealing and screws. See Fig. 7.

In case of site cleaning, remove the sensor and protect the electrical connection with the help of the sealing plug which is available as accessory (HA011602). See Fig. 8

Remove the sensor protection cap before commissioning.



Flow direction

For best measuring accuracy the sensing element of the EE680 must be aligned exactly in the direction of the laminar flow in which factory adjustment took place.

An arrow symbol on the sensor tip indicates factory adjustment direction. The arrow on the sensor probe should be pointing exactly in the direction of the laminar air flow.

The angular deviation must be kept to a minimum.

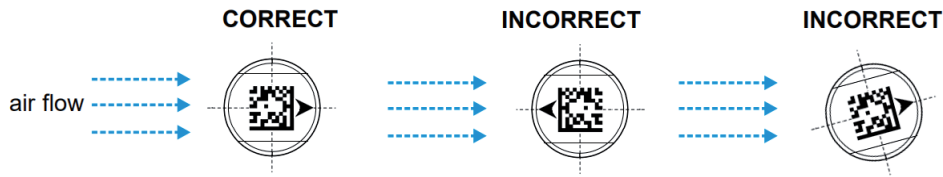


Fig. 6 Correct laminar flow alignment



Fig. 7 EE680 mounting flange and mounting set (HA011601)



Fig. 8 EE680 mounting flange and sealing plug (HA011602)

5 Setup and Configuration

The EE680 is ready to use and does not require any configuration by the user. The EE680 factory setup corresponds to the type number ordered. Please refer to the data sheet at www.epluse.com/EE680. The user can change the factory setup with the help of the PCS10 Product Configuration Software and the Modbus configuration adapter (order code HA011018).

Besides the measurand selection of the analogue and digital outputs and their scaling, the digital interface settings may be changed. The RH and T measurement is offset and 2-point adjustable. It is possible to enable or disable the optical status indication and the NAMUR error indication (factory setting: disabled). Temperature and barometric pressure reference values for standardized air velocity calculation can be set.



Please note: The EE680 may not be connected to any additional power supply when using the Modbus configuration adapter HA011018.

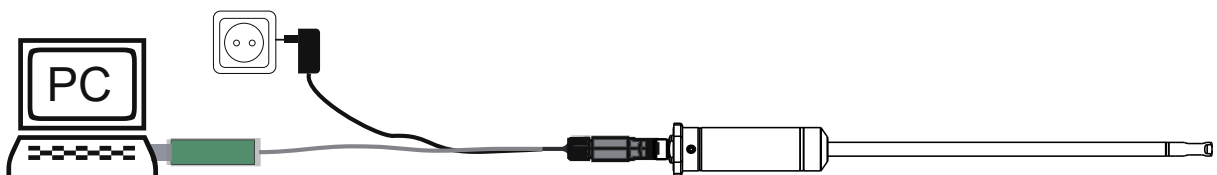


Fig. 9 EE680 configuration and adjustment

5.1 PCS10 Product Configuration Software

For performing adjustment or changes in EE680 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 EE680 to the PC using the Modbus configuration adapter.
3. Start the PCS10 software.
4. Follow the instructions on the PCS10 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. Refer to the tutorial available throughout PCS10.

5.2 Digital Interface RS485 with Modbus RTU Protocol

Item	Factory settings	Selectable values (via PCS10)
Baud rate	9 600	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
Slave address	68	1...247

Tab. 3 Digital interface default settings

The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1. The EE680 represents 1 unit load on an RS485 network.

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

1. PCS10 Product Configuration Software, the Modbus configuration adapter HA011018.
The PCS10 can be downloaded free of charge from www.epluse.com/PCS10
2. Modbus protocol in the register 60001 (0x00) and 60002 (0x01).
See Modbus Application Note AN0103 (available at www.epluse.com/EE680)

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.



Please note: When reading the serial number or the sensor name, it is always necessary to read all 8 registers, even if the desired information requires less.



Please note: For obtaining the correct floating point values, 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.

Communication settings (INTEGER 16 bit)		
Parameter	Register number ¹⁾ [DEC]	Protocol address ²⁾ [HEX]
Write register: function code 0x06		
Slave ID (Modbus address)	1	0x00
Modbus protocol settings ³⁾	2	0x01
Device information (INTEGER 16 bit)		
Parameter	Register number ¹⁾ [DEC]	Protocol address ²⁾ [HEX]
Read register: function code 0x03 / 0x04		
Serial number (as ASCII)	1	0x00
Firmware version	9	0x08
Sensor Name	10	0x09

1) Register number starts from 1.

2) Protocol address starts from 0.

3) For Modbus protocol settings see Application Note Modbus AN0103 (available at www.epluse.com/EE680).

5.3 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 name	Unit	Register number ¹⁾ [Dec]	Register address ²⁾ [HEX]
<i>Read register: function code 0x03 / 0x04</i>			
Air velocity vn ³⁾	m/s	1045	0x414
	ft/min	1047	0x416
Temperature T	°C	1003	0x3EA
	°F	1005	0x3EC

INTEGER 16 bit:				
Parameter	Unit	Scale ⁴⁾	Register number ¹⁾ [Dec]	Register address ²⁾ [HEX]
<i>Read register: function code 0x03 / 0x04</i>				
Air velocity vn ³⁾	m/s	100	4023	0xFB6
	ft/min	0.1	4024	0xFB7
Temperature T	°C	100	4002	0xFA1
	°F	50	4003	0xFA2

1) Register number starts from 1

2) Register address starts from 0

3) Standardized air velocity vn at standard conditions (factory setup): Tn = 23 °C (73 °F), pn = 1013.25 hPa (14.7 psi), configurable via PCS10

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.

5.4 LED Ring for Optical Status Indication

The status of the laminar flow and of the probe is indicated by the LED ring embedded in the probe body. The user can set the behaviour of the optical status indication and choose from the following options:

- Enable / disable optical status indication

If enabled, two status indication modes are selectable :

- Error indication: shows the probe status.
- Laminar flow state: additionally indicates whether the measured flow is within or beyond the predefined, user configurable range

The table below summarizes the meaning of LED indication:

Colour	Flow Status	Probe Status
None	Faulty power supply. Optical status indication disabled.	
GREEN	Measured value within range	Normal, failure-free operation
YELLOW FLASHING	Measured value out of range	
RED FLASHING	Failure, return sensor to E+E for investigation	

Tab. 4 Meaning of LED ring indication

On delivery, the EE680 monitors the flow using the factory preset values according to Tab. 5.

	Low threshold	High threshold
Standardized air velocity vn	0 m/s (0 ft/min)	2 m/s (394 ft/min)
Temperature T	0 °C (32 °F)	50 °C (122 °F)

Tab. 5 Factory default values for laminar flow monitoring

6 vn / T Adjustment and Calibration

The EE680 can be calibrated / adjusted with the help of the PCS10. For this purpose, the probe needs to be connected to a PC via a Modbus configuration adapter.

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.



Please note: To achieve comparable results to the E+E factory setting, please observe the following instructions:

- a) The adjustment should be done in a wind tunnel with homogeneous, low turbulent flow profile.
- b) Insert the probe 10 cm (4") deep into the flow channel.
- c) The fixtures should be mounted outside the flow channel and should not rise into the air stream

6.1 Selecting the Appropriate Adjustment Method

The EE680 can be adjusted in 2 different ways:

■ 1-point vn/T adjustment:

Quick and easy option for obtaining precise measuring results at a specific working point. 1-point adjustment should only be used for very limited working ranges.

■ 2-point vn/T adjustment:

With 2-point adjustment, precise measuring results can be obtained over the entire vn/T measuring range. The more complicated 2-point adjustment procedure is preferable to 1 point adjustment, if higher precision or a wider working range is required.

6.1.1 General Information on 1-Point vn/T Adjustment:

If possible the selected adjustment point should be similar to the working point (of the limited working range) of the sensor.

Example: Working range vn 0...2 m/s (0...400 ft/min) → adjustment point at 1.0 m/s (200 ft/min); working range T 18...22°C (64.4...71.6°F) → adjustment point at 20°C (68°F).

6.1.2 General Information on 2-Point vn/T Adjustment:

With 2-point adjustment, vn/T adjustment is performed at 2 different adjustment points.

To ensure the smallest possible deviation in measuring results over the entire measuring range, the two adjustment points should be selected as follows:

- The low adjustment point should be in the lower third of the measuring range. Adjustment shall be performed using the "Low" point in the drop-down.
- The high adjustment point should be in the upper third of the measuring range. Adjustment shall be performed using the "High" point in the drop-down.
- There is also an "Auto" option for adjustment point selection. This option means that the smaller value will automatically be taken as the low adjustment point and the bigger value as the high one.

Example: EE680 - measuring range = 0...2 m/s (0...400 ft/min).

Low adjustment point (V-CAL LOW) should be around 0.4 m/s (0...0.7 m/s) / 79 ft/min (0...138 ft/min).

High adjustment point (V-CAL HIGH) should be around 1.8 m/s (1.4...2 m/s) / 354 ft/min (276...400 ft/min).

6.2 Adjustment with PCS10

Please follow the instructions from the PCS10 Product Configuration Software.

6.3 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.

7 Maintenance and Service

EE680 does not require any special maintenance, nevertheless for highly accurate measurements it is recommended to calibrate the probe every 6-12 months. Contamination on the sensor element and the sensor head may lead to false measurement values. The sensor head must therefore be checked regularly for contamination. If needed, the enclosure and the sensing head may be cleaned as described below and the device may be re-adjusted as described in chapter 6.

7.1 Cleaning

The EE680 was optimized in means of used materials (probe and sensor head made of stainless steel 1.4404) for best resistance against H₂O₂ sterilization processes and corrosive cleaning agents.

Approved cleaning methods are: H₂O₂ sterilization, 6 % concentrated H₂O₂ surface cleaning agents, isopropyl alcohol.



- Inappropriate cleaning agents can deposit on the sensor element and thus lead to incorrect measurements results, or permanently damage the sensor element.
- Prior to cleaning measures for any other than the approved methods the protection cap included in the scope of the supply (see chapter 2) must be used.

Cleaning of the sensor head/probe body

If the sensor head or especially the sensing element is dusty or dirty, it may be carefully cleaned with oil-free compressed air.



Do not apply any hard pressure shocks on the sensing element.

If cleaning with compressed air is not successful the sensor head can be carefully cleaned using isopropyl alcohol by repeated immersion and drying.



- Do not touch the sensing element with your fingers at any time!
- Do not shake, knock or tap the wet sensor head!
- Any mechanical contact with the sensing element incorporated in the sensing head will cause irreversible damage to the sensor and needs to be avoided at any time!
- Do not use any cleaning objects (e.g. brushes) to clean the sensor head!

7.2 Transportation

Whenever EE680 is needed to be returned for calibration, adjustment or repairs to E+E Elektronik GmbH, contamination and any mechanical stresses during transport have to be avoided by appropriate packaging measures. Please use the protection cap included in the scope of the supply (see chapter 2).



If the product was in contact with contaminating (poisonous, hazardous, explosive, ...) substances, decontamination of the sensor must be ensured before returning. Returned sensors must not be harmful to the health of our employees at any time.

7.3 Repairs

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

7.4 Error Indication on the Analogue Output (NAMUR)

The EE680 features an error indication on its analogue outputs according to the NAMUR NE 043 recommendations (Standardization of the Signal Level for the Failure Information of Digital Transmitters, Edition 2003-02-03, see www.namur.net/en/recommendations-and-worksheets/current-nea.html). The feature is enabled by factory default and can be disabled with the PCS10 Product Configuration Software.

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

Tab. 6 NAMUR error indication

8 Accessories

Please also refer to the “Accessories“ data sheet.

Modbus configuration adapter	HA011018
E+E Product Configuration Software (free download: www.epluse.com/PCS10)	PCS10
Protection cap M12 female connector	HA010781
Protection cap M12 male connector	HA010782
Connection cable M12 - flying leads (1.5 m (4.9 ft) / 5 m (16.4 ft) / 10 m (32.8 ft))	HA010819/20/21
T-coupler M12 - M12	HA030204
M12 cable connector for self assembly	HA010708
Mounting set EE680	HA011601
M12 sealing plug stainless steel	HA011602

9 Technical Data

Measurands

Air Velocity¹⁾

Measuring range	0...2 m/s (0...400 ft/min)	
Accuracy ²⁾ <i>in air at 23 °C (73 °F) and 1 013 hPa (14.7 psi)</i>	0.1...2 m/s (20...400 ft/min): ± (0.5 % of mv + 0.05 m/s) mv = measured value	
Dependence of inflow angle (α) of inflow direction	< 3 % for α < ±10° < 3 %	
Response time t ₉₀ , typ.	< 1.5...40 s (Factory setting: 1.5 s, configurable via PCS10)	



Temperature

Measuring range	-20...70 °C (-4...158 °F)	
Accuracy ³⁾ , typ. <i>in air at 23 °C (73 °F)</i>	±0.5 °C (±0.9 °F)	

Outputs

Analogue	0 - 5 V / 0 - 10 V	-1 mA < I _L < 1 mA
	0 - 20 mA / 4 - 20 mA (3-wire)	Load resistance ≤ 350 Ω
Digital interface	RS485 (EE680 = 1 unit load)	
Protocol	Modbus RTU	
Default settings	Baud rate 9600, parity even, 1 stop bit, Modbus address 68	

General

Power supply class III 	24 V DC ±20 %	
Current consumption, typ.	< 30 mA	
Electrical connection	M12x1, 5 poles, stainless steel 1.4404	
Protection rating	IP65	
Enclosure material	Stainless steel 1.4404	
Pressure range	700...1 300 hPa (10.2...18.9 psi)	
Electromagnetic compatibility	EN 61326-1 EN 61326-2-3 Industrial Environment FCC Part15 Class A ICES-003 Class A	
Storage conditions	-20...70 °C (-40...158 °F) 0...95 % RH, non-condensing	
Configuration and adjustment	PCS10 Product Configuration Software (free download) and configuration adapter	

1) Standardized air velocity v_n at standard conditions (factory setup): T_n = 23 °C (73 °F), p_n = 1 013.25 hPa (14.7 psi), configurable via EE-PCS

2) 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)

3) At air flows ≥ 0.45 m/s



HEADQUARTERS

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