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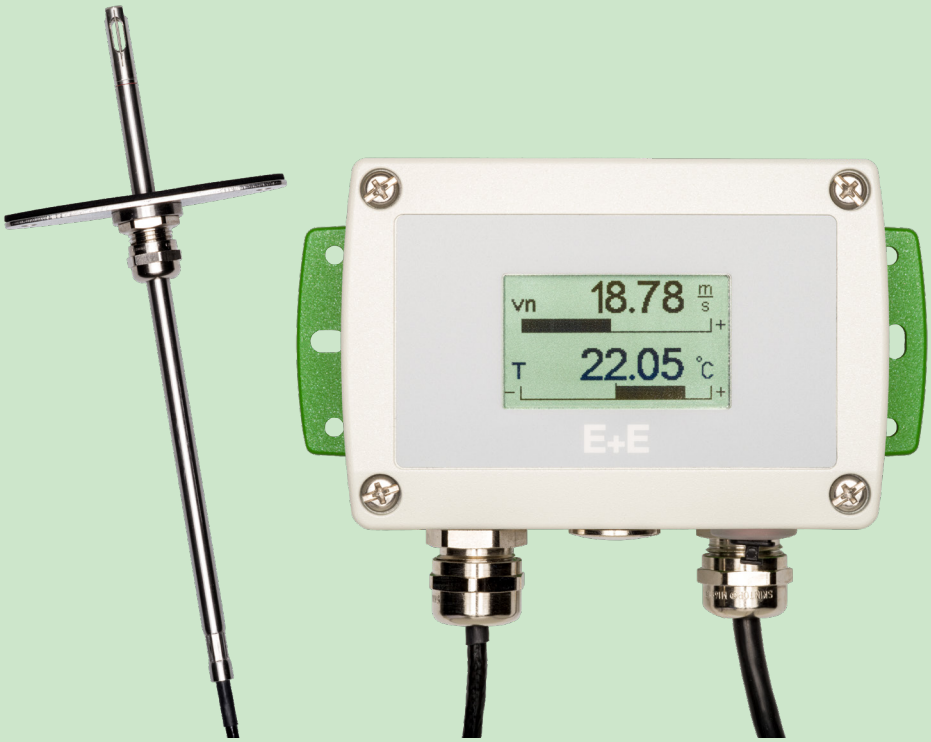
User Manual AVS701

Highly Accurate Air / Gas Velocity Sensor for Industrial Applications



Modbus

www.jlcinternational.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/avs701.

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.

- The AVS701 enclosure, the sensing probe and the sensing module shall not be exposed to unnecessary mechanical stress.
- Do not apply the supply voltage to the RS485 data lines.
- The AVS701 electronics are sensitive to electrostatic discharge (ESD), appropriate protective measures shall be taken when touching it.
- For sensor cleaning please observe the “Cleaning Instructions” at www.epluse.com.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.
- The device is designed for the operation with class III supply (EU) and class 2 supply (NA).
- The power supply must be switched off before opening the enclosure.
- Use the AVS701 only as intended and observe all technical specifications.

1.2.2 Intended Use

The device is intended for measuring velocity, temperature and volume flow of air or gases in industrial applications where pressure-compensated standardised or non-standardised measured values are desired.

Measurement can be performed in air or other non-explosive and non-aggressive gases, selectable at the time of order or via PCS10 Product Configuration Software. Medium velocity and temperature ranges are up to 0...40 m/s (0...8 000 ft/min) and -40...+140 °C (-40...+284 °F), respectively. Depending on the type ordered, the gas pressure can be up to 10 bar (145 psi).

⚠ WARNING

Non-compliance with the product documentation may cause safety risk 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 AVS701 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 AVS701 may only be operated under the conditions described in this user manual and within the specification included in chapter 10 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 AVS701 air velocity sensor 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 way that does not impair its safe use. The user is responsible for observing all applicable local and international safety guidelines for safe installation and operation of the device. This user manual contains information and warnings that must be observed by the user 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 putting the device into operation.
- 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 ESD Protection

The sensing elements and the electronics board are ESD (electrostatic discharge) sensitive components of the device and must be handled as such. Failure to do so may damage the device by electrostatic discharge when touching exposed sensitive components.

2 Scope of Supply

	Included in all versions	Option
AVS701 sensor	✓	
Quick Guide	✓	
Inspection certificate acc. to DIN EN 10204-3.1	✓	
Stainless steel mounting flange		Types T2 and T3
Probe alignment tool		Types T3 and T26
Clamp fitting		Type T26
Protection cap	✓	

3 Product Description

3.1 General

The AVS701 provides highly accurate high-performance air / gas velocity, temperature and volume flow measurement in industrial applications. Measurement can be performed in air, non-explosive atmosphere and non-aggressive gas. The velocity range is 0...40 m/s (0...8 000 ft/min), the temperature range is -40...+140 °C (-40...+284 °F). With type T26, the medium's pressure can be up to 10 bar (145 psi).

Product Variants

Three different AVS701 types provide a broad range of options for measurement tasks:

Probe Type	Description
T2	Duct mount
T3	Remote probe
T26	Remote probe, pressure-tight, 10 bar

Tab. 1 Probe types

A gas library is included for adaptation to measurement in various gases (for other gases, please contact your E+E sales partner):

Gas #	Description
1	Air
2	Nitrogen
3	CO_2
7	Argon

Tab. 2 AVS701 gas library entries

INFO

The gas type can be selected via the order code and changed later using the configuration software.

Quantities and Units

Parameter		Standard	With Optional Probe[1)]	Measurement Units
Air velocity	v	✓		m/s, ft/min
Air velocity standardised	vn	✓		m/s, ft/min
Volume flow	V'	✓		m^3/h, l/s, m^3/s, m^3/min, ft^3/min
Volume flow standardised	V'n	✓		m^3/h, m^3/min, SLPM, l/s, SCFM, m^3/s
Temperature	T	✓		°C, °F, K
Relative humidity	RH		✓	%RH
Pressure	p		✓	mbar, bar, psi

1) Connected to sensor control port

Tab. 3 AVS701 scope of measured quantities and measurement units

PLEASE NOTE

Reference conditions are required to calculate the standardised quantities vn and V'n.

By factory default, these reference conditions are 23 °C (73 °F) and 1 013.25 mbar (14.7 psi). The values are changeable via PCS10 Product Configuration Software.

Low Flow Suppression

This feature helps to detect machinery or plant standstill which is possibly caused by failure. In such a case, small airflow caused by temperature gradients or thermal convection would lead to undesirable output other than zero. The low flow suppression feature is defined by a cut-off value and the hysteresis. If the air velocity falls below the cut-off value, the device output will be 0. For air velocity higher than the cut-off value + hysteresis, the actual value will be indicated at the outputs.

INFO

The low flow suppression feature is enabled by factory default.

Materials

All AVS701 probe types and their sensing heads are made of stainless steel for protection against possible damage in rough industrial environments.
The sensing element material is made of ceramic with a proprietary polymer-based coating.
The robust enclosure of the evaluation unit is available in either polycarbonate or die-cast aluminium.

Supply

The AVS701 shall be supplied with 24 V DC +/- 20 % via M12 connector or cable gland and direct wiring to the internal terminals , depending on the electrical connection option ordered.

3.2 Product Design

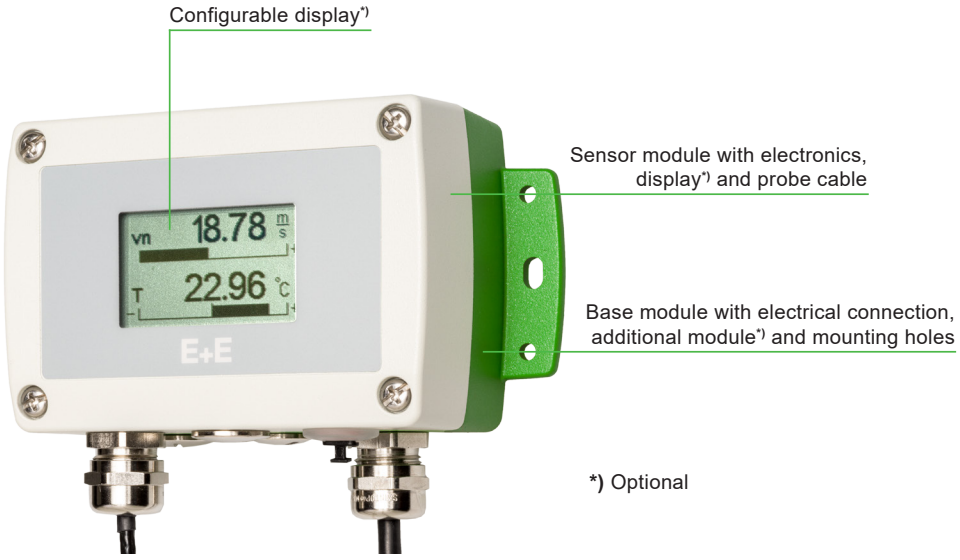


Fig. 1 AVS701 perspective view

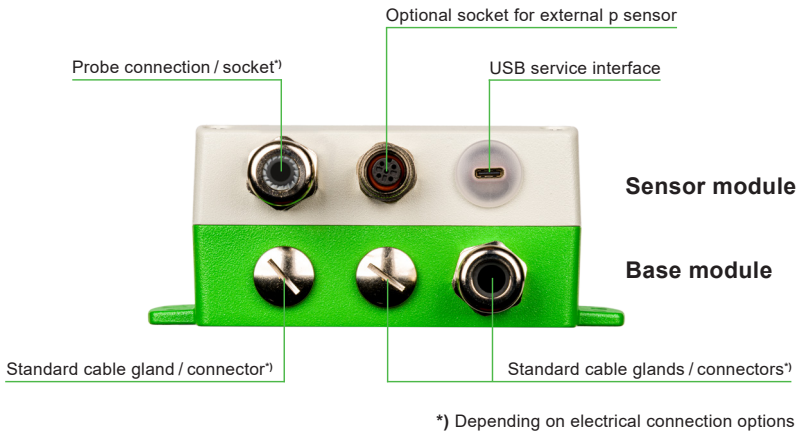


Fig. 2 AVS701 connector-side view

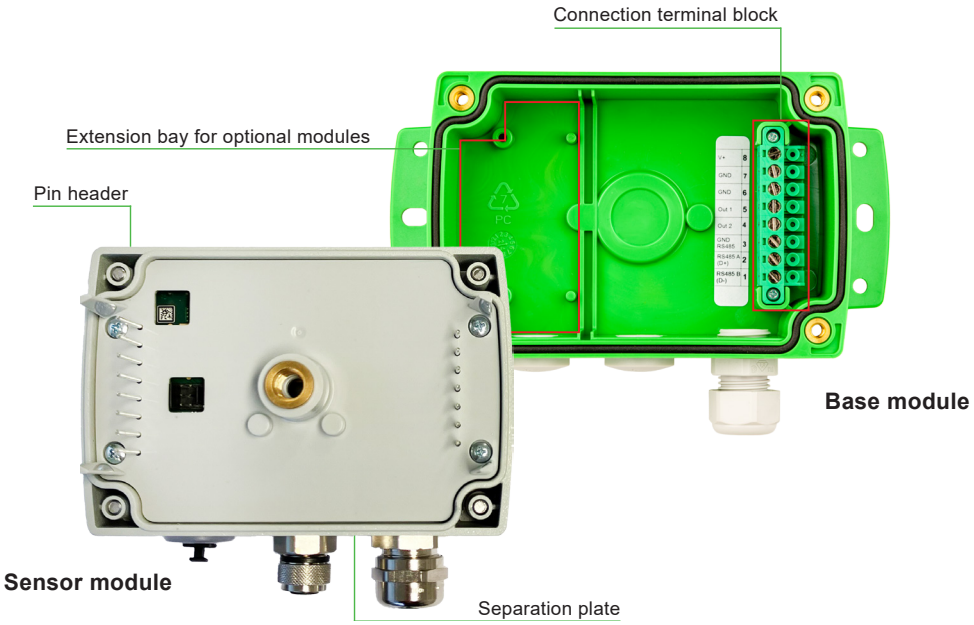
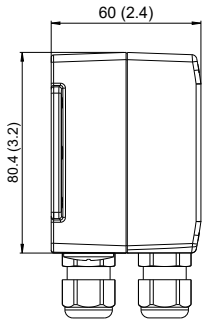


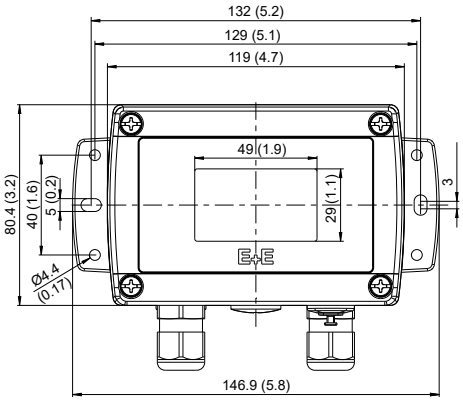
Fig. 3 AVS701 modular polycarbonate enclosure inside view

3.3 Dimensions

Values in mm (inch)

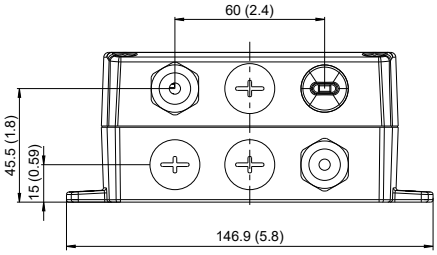
Enclosure





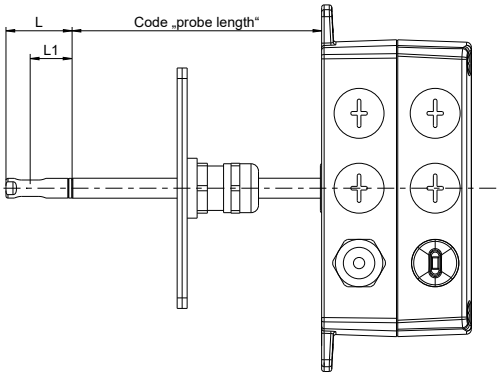
Enclosure

Connector side view



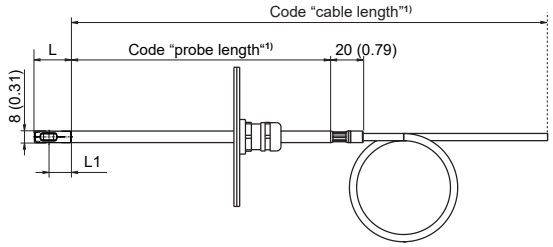
Type T2 Probe

Duct mount



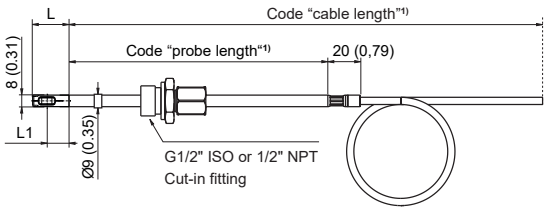
Type T3 Probe

Remote probe



Type T26 Probe

Remote probe, pressure-tight up to
10 bar (150 psi) with cut-in fitting

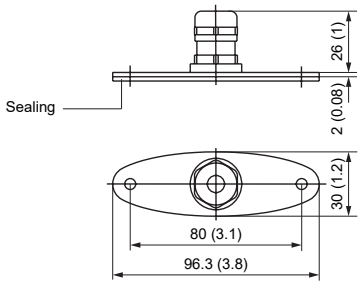


1) Refer to ordering guide

Sensing head	L	L1
Stainless steel	26.5 (1.04)	16.8 (0.66)

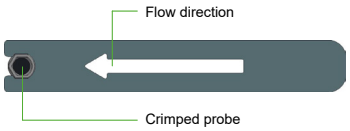
Mounting flange

Within scope of supply for types T2 and T3



Probe alignment tool

Poka-yoke inspired, only one direction possible
Within scope of supply for types T3 and T26



3.4 Outputs

The measured data is available on two analogue outputs and on the digital RS485 interface with Modbus RTU protocol. The freely scalable analogue outputs both are either current (0 – 20 mA) or voltage (0 – 10 V). Configuration can be selected at the time of order and can be changed in the field via PCS10 Product Configuration Software on the configuration interface.

It is possible to “deselect” the analogue outputs when ordering. In this case, they are still active (voltage) but unconfigured. Configuration may be carried out via PCS10.

Two potential-free switching outputs are available optionally. Please refer to chapter 3.6.3 Switching / Pulse Outputs).

Optionally, an LC display with up to three lines is available. For details, please refer to chapter 3.6.2 Display.

Output	Please refer to chapter
Two freely selectable and scalable outputs for vn, v, T, V'n, V'	6.2 Analogue Outputs
Digital interface RS485 with Modbus RTU protocol	6.3 RS485 Digital Interface
Optional: Switching / Pulse Outputs	3.6.3 Switching / Pulse Outputs
Optional: LC display with up to three lines	3.6.2 Display

Tab. 4 Interface overview

Output Filter Time Constant (Attenuation)

A filter can be activated for stable and smoothed measured values. The filter is realised as a low-pass filter with an adjustable time constant t_{90} (response time). If there is a jump at the input (100 %), a level of 90 % will present at the output after t_{90} has elapsed. Via PCS10, the time constant can be set in the range 0.1...35 s in nine steps. Tab. 5 shows the possible values.

Step	t_{90} [s]	Remark
1	0.1	Fast response time
2	0.2	
3	0.3	
4	0.7	
5	1.7	Factory setting
6	3.5	
7	7.0	
8	17.5	
9	35.0	Slow response time

Tab. 5 Selectable response time t_{90}

3.5 Configuration Interface

The AVS701 is ready to use and does not require any further configuration. The factory setup of AVS701 corresponds to the specified order code. Please refer to the datasheet at www.epluse.com/avs701.

The AVS701 features a USB configuration interface for configuration, adjustment and firmware update via PCS10 (please refer to chapter 6 Setup and Configuration). The USB interface also serves as a power supply for this purpose (not for permanent supply).

If needed, the factory setup can be changed via

- Free PCS10 Product Configuration Software.
  Please refer to chapter 6.1 PCS10 Product Configuration Software.
- Modbus RTU protocol (if the RS485 option is selected).
  Please refer to chapter 6.3 RS485 Digital Interface.

PLEASE NOTE

- The full scope of configuration is available with the PCS10.
- Configuration with the Modbus RTU protocol only refers to the Modbus communication settings.

The illuminated USB socket indicates the device status:

LED	Description
Green - flashing	Measured values within preconfigured range, probe OK
Orange - flashing	Measured values out of min./max. thresholds or measured values outside of working range
Red - flashing	Hardware error or measurement failure

Tab. 6 Status indication via LED

3.6 Optional Features

3.6.1 Sensor Control Port - Interface for External Sensor

The sensor control port (SCP) is an RS485 interface with Modbus RTU protocol for connecting an optional external probe. The AVS701 provides an M12 5-pole socket for connection.

AVS701 indicates the pressure-compensated air velocity at all outputs. The p value needed for this purpose can be supplied by an optional pressure probe. E+E Elektronik offers a pre-adjusted pressure probe as an accessory. Alternatively, the p value can be a predefined value which can be set via PCS10 Product Configuration Software. The currently valid p value may be read via Modbus RTU, be indicated at the outputs (analogue or digital) and/or on the optional display.

PLEASE NOTE

If there is no external p probe present or the p probe is disconnected or if there is a communication error between the p probe and the evaluation unit, the optional display indicates an “error 2”. Please refer to chapter 7.1 Self Diagnosis and Error Messages.

In this case, the predefined p value takes effect for pressure compensation and output. There is always a valid p value available.

For more information on the p probe, please refer to chapter 9 Spare Parts / Accessories and to chapter 13 Annex.

It is also possible to get the humidity value from the gas, provided that an E+E humidity probe with the original Modbus address of EE072 (234_{DEC}, 0xEA) and with its default communication settings is connected to the SCP.

The RH value may be read via Modbus RTU, be indicated at one of the analogue outputs and/or on the optional display.

INFO

Please refer to chapter 6.3.3 Modbus Register Map or the registers containing the v and RH values.

3.6.2 Display

The optional display provides a clear presentation of the measured values in up to three lines. With one or two measurands, the readings can also be displayed as a linear gauge below the numerical values. Please refer to Fig. 4 below for a visual reference of various configuration options.

The following can be customised to meet specific requirements:

- Number of measurands
- Linear gauge limits
- Display contrast
- Backlight on/off and brightness
- Display orientation

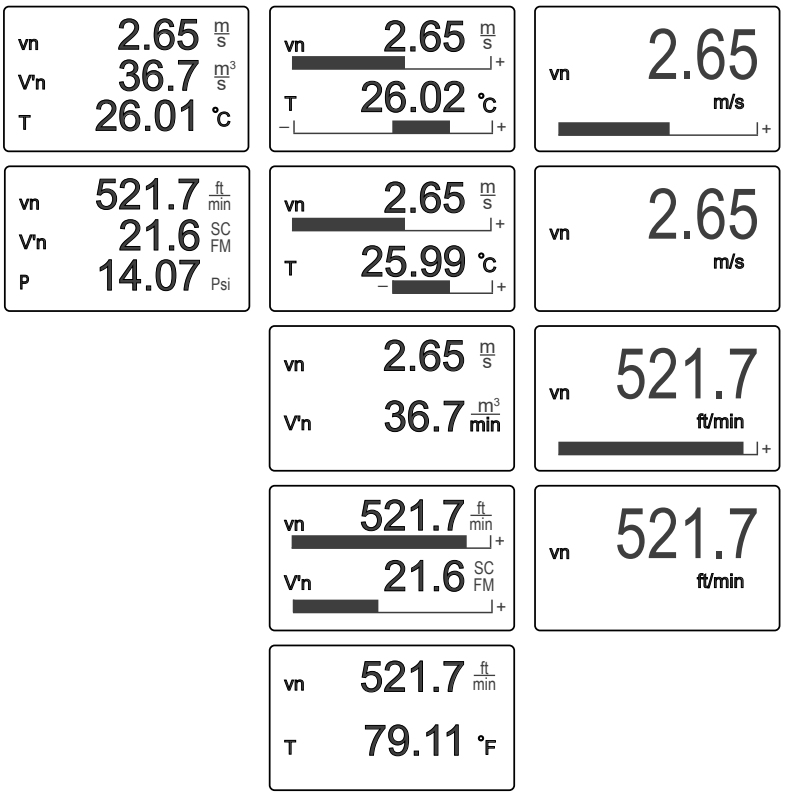


Fig. 4 Display configuration examples

PLEASE NOTE

If the measured values are outside the predefined ranges, an “error 2” will be displayed.

Measurands to be displayed can be preselected via ordering code. Use the PCS10 Product Configuration Software to customise the display later, as required.

3.6.3 Switching / Pulse Outputs

This option includes two freely configurable switching outputs for alarm or control purposes. Various operation modes are available including switch hysteresis, switch window and error indication. The error modes can be configured independently from each other. The measurands at the outputs as well as switching points, hysteresis, normal state (NO /NC) and the pulse ratio can be set via PCS10 Product Configuration Software.

The contacts are led out from the enclosure via a cable gland.

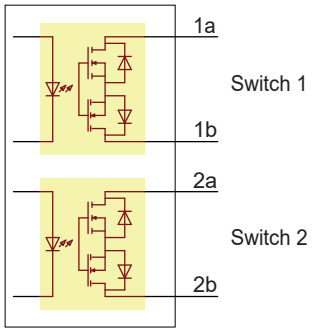


Fig. 5 Electrical scheme of switching output

Switch Hysteresis Mode

The switching behavior is determined by entering a switching point and an associated hysteresis value.

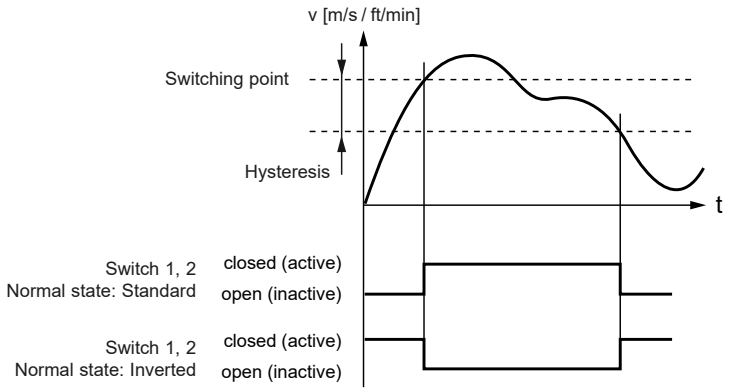


Fig. 6 Example hysteresis mode on both switching outputs

Switch Window Mode

The switching behavior is determined by entering two switching points and two associated hysteresis values.

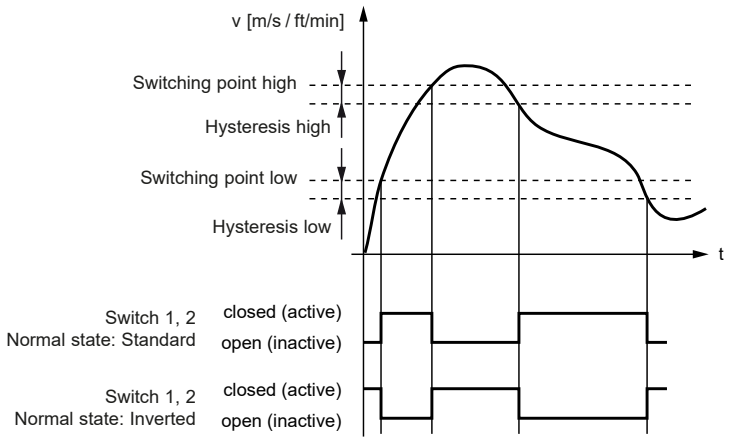


Fig. 7 Example window mode on both switching outputs

Error Indication Mode

When error indication mode is selected, various errors will trigger the alarm output.

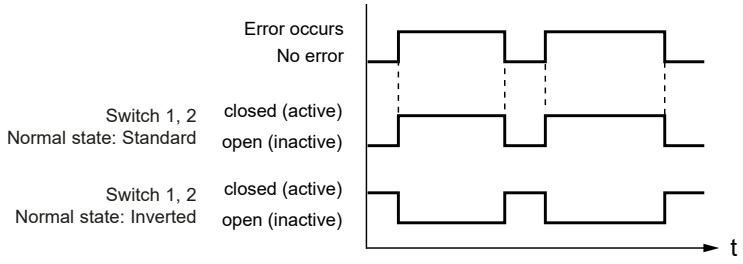


Fig. 8 Example of error mode on both switching outputs

PLEASE NOTE

An alarm output in this operation mode is used for error indication only (no combination with switching points possible).

Electrical Connection and Switch Load

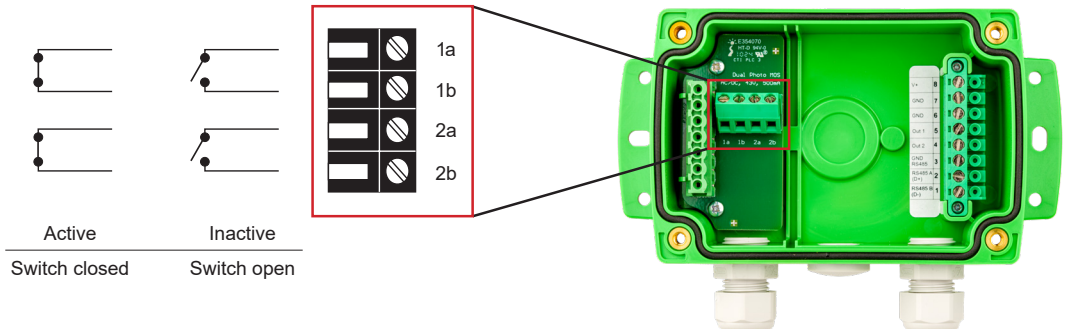


Fig. 9 Switching output module (option AM10)

Switch Load	
Max. switch load	24 V DC, 1 A

Tab. 7 Maximum switch load

WARNING

The metal enclosure must be grounded during operation. National regulations for installation must be observed!

WARNING

No overcurrent and short circuit protection. Both relays shall be connected to either high oder low voltage.

4 Mounting and Installation

4.1 General Information on Mounting AVS701 Sensing Probes

For best measuring accuracy, the sensing element must be accurately aligned with the direction of the flow. For probe alignment, please refer to chapter 4.5 Probe Alignment to the Flow. For probe positioning, please refer to chapter 4.6 Probe Positioning in Ducts.

It is possible to operate the probe in both flow directions. However, if the flow is against the default direction, the specified accuracy will no longer apply to the measurement.

4.2 Wall-mounting with Screws (Types T3, T26)

Mounting with Screws

- Drill the mounting holes according to the corresponding mounting pattern below.
- Mount the base module of the enclosure with 4 screws (screw diameter < 4.2 mm (0.2"), not included in the scope of supply).

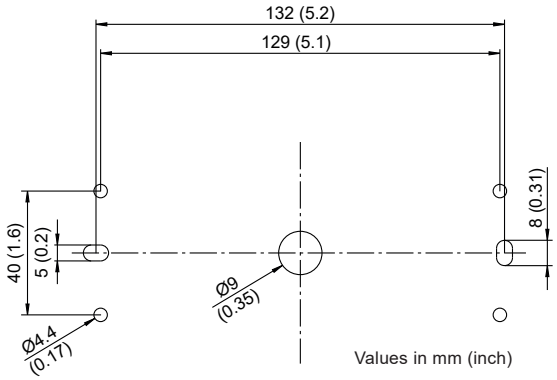


Fig. 10 Drilling pattern of enclosure

EE75 Retrofit		New Designs	
○	○	○	○
○	○		

Tab. 8 Drilling pattern recommendation

4.3 Duct Mount (Type T2)

For probe mounting, use the stainless steel mounting flange or screw the sensor directly to the duct.

PLEASE NOTE

For an accurate measurement, please observe the correct immersion depth. Please refer to chapter 4.6 Probe Positioning in Ducts.

The stainless steel mounting flange is not appropriate for pressure-tight mounting. For pressure-tight requirements use AVS701-T26.

4.4 Remote Sensing Probe (Types T3, T26)

4.4.1 Installation at Normal Pressure (Type T3)

For mounting the probe into a duct use the stainless steel mounting flange. The immersion depth is adjustable.

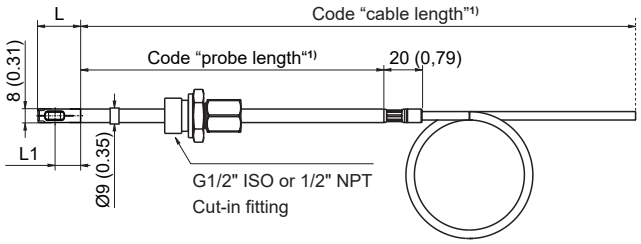
PLEASE NOTE

For an accurate measurement, please observe the correct immersion depth. Please refer to chapter 4.6 Probe Positioning in Ducts.

The stainless steel mounting flange is not appropriate for pressure-tight mounting. For pressure-tight requirements use AVS701-T26.

4.4.2 Pressure-Tight Installation (Type T26)

For pressure-tight installation up to 10 bar (145 psi), the remote sensing probe type T26 comes with a pressure-tight feedthrough within the scope of supply.



⚠ WARNING

General safety instructions for pressure-tight installation

- The installation, commissioning and operation of the AVS701-T26 must be carried out by qualified staff. Special attention must be paid to the correct installation of the probe into the process, as incorrect installation can result in the probe being suddenly expelled due to pressure.
- Bending over the sensing probe should be avoided under any circumstances. Ensure that the probe’s surface is not damaged during installation. Damage to the probe surface may result in compromised seals, potentially leading to leakage and pressure loss.

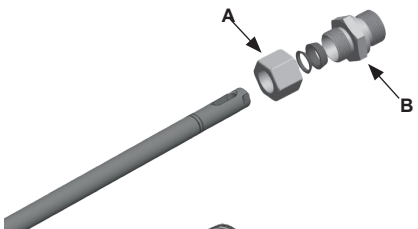
The probe is rated with leakage rate B according to EN12266-1.

⚠ CAUTION

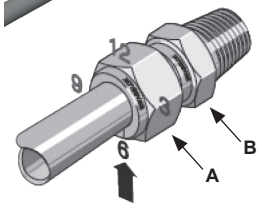
Safety instructions for pressure-tight feedthrough:

- Do not assemble the probe and tighten the feedthrough if the plant is under pressure.
- The plant must not be vented by releasing the nut (A).
- Use appropriate seal on the conical probe threads.
- Never rotate the screw connection body (B), instead, hold the screw connection body (B) securely and turn the nut (A).
- Avoid unnecessary disassembly of pipe screw connections.

Installation Instructions

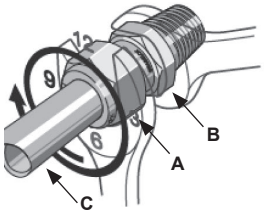


- Tighten the nut (A) finger-tight.
- Mark the nut (A) at 6 o‘clock position.
- Hold the screw connection body (B) tight and tighten the nut (A) with 1 ¼ turns till 9 o’clock position.



Assembly with high pressure applications and applications with a high security factor:

- Tighten the nut (A) until the probe (C) can no longer be turned by hand and moved axially in the feedthrough.
- Mark the nut (A) at 6 o’clock position.
- Hold the screw connection body (B) tigh



Re-mounting:

- Slide the measurement probe with clamping ring into the fitting as far as it goes.
- Tighten the nut finger-tight, then tighten by approx. a ¼ turn using a spanner.

4.5 Probe Alignment to the Flow

The AVS701 sensing heads are asymmetric and have a 2D barcode printed on top.

Fig. 11 Asymmetric AVS701 probe head

PLEASE NOTE

For correct and accurate measurement, the sensing element of the AVS701 must be aligned exactly in the direction of the flow in which factory adjustment took place.

The angular deviation must be kept to a minimum.

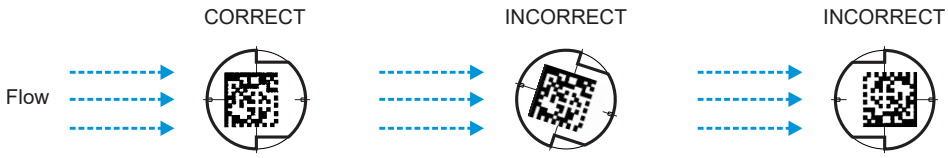


Fig. 12 Correct flow alignment

The AVS701 with remote probe comes with a tool which is inspired by the Japanese concept of Poka-Yoke for preventing and detecting mistakes and errors. This key is designed to fit onto the probe's "arrow crimping" at the cable side. It allows to fine-rotate the probe and shows the flow direction.

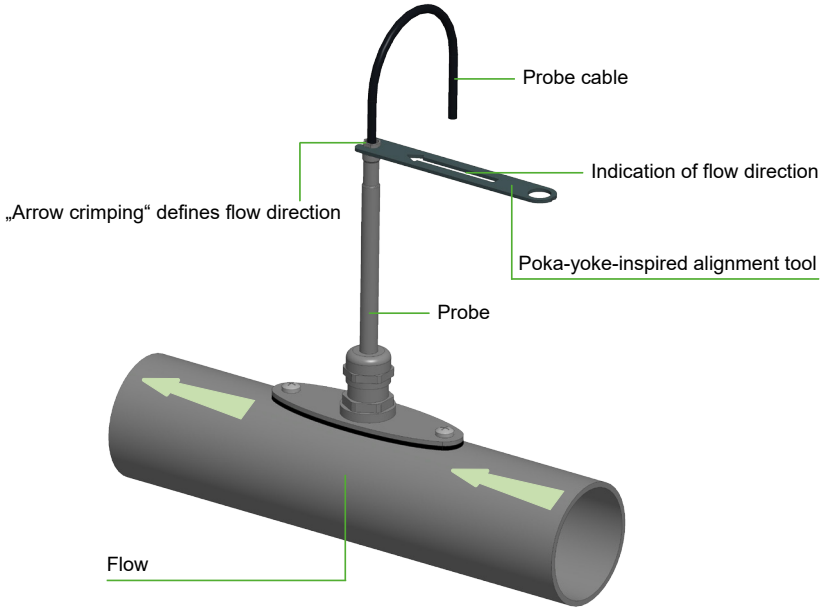


Fig. 13 AVS701 Poka-Yoke-inspired probe alignment tool

The AVS701 duct mount version shall be installed as depicted in Fig. 14.

PLEASE NOTE

The sensing head is asymmetric. A correct measurement is achieved only if the air / gas flow enters the sensing element from the right side.

When viewing the enclosure from the top and the cable glands / connectors pointing towards the viewer, the flow shall be from right to left.

The direction of gas flow is also indicated on the side of the enclosure.

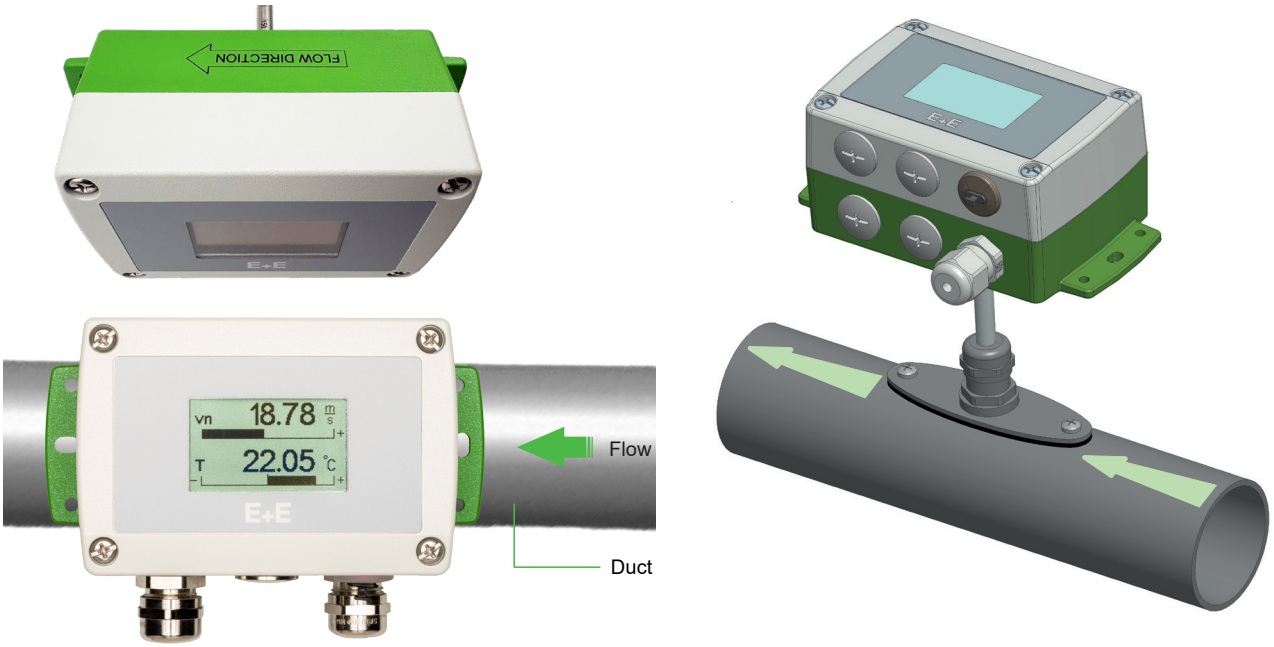


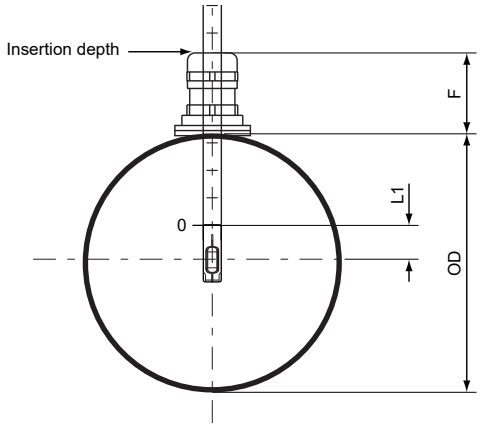
Fig. 14 AVS701 duct mount version installed on a duct

4.6 Probe Positioning in Ducts

NOTICE

In order to achieve optimal measurement accuracy, particularly for calibration purposes, it is recommended that the sensing head be positioned as close as possible to the centre of the duct (50 % of the duct diameter). In any case, the immersion depth must be 30...50 % of the duct diameter.

Please note that the scale on the probe tube for the immersion depth refers to the base of the sensing head.



Insertion depth = $\frac{OD}{2}$ + F - L1

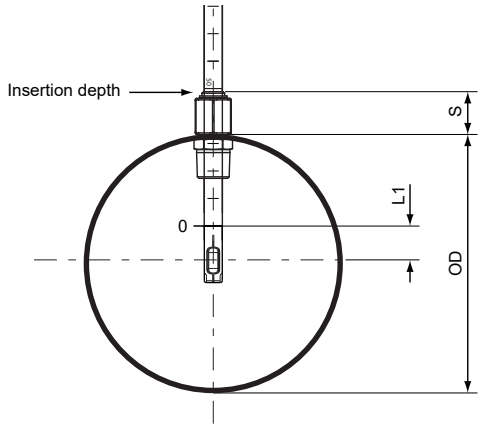
OD .... Outside diameter

F ..... Flange height 28 mm (1.1 inch)

L1 ..... Length from tube to sensing head centre

Sensing head	L1
Stainless steel	16.8 (0.66)

Fig. 15 Correct sensing head position in the duct using a mounting flange



Insertion depth = $\frac{OD}{2}$ + S - L1

OD .... Outside diameter

S ..... Sliding fitting part 18.5 mm (0.73 inch)

L1 ..... Length from tube to sensing head centre

Sensing head	L1
Stainless steel	16.8 (0.66)

Fig. 16 Correct sensing head position in the duct using a sliding fitting

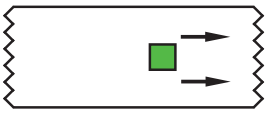
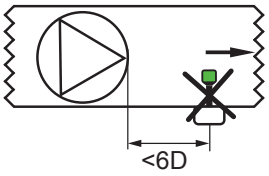
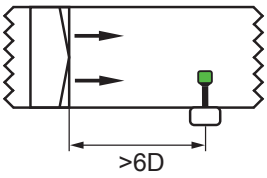
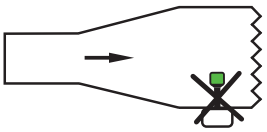
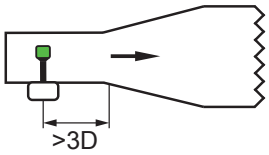
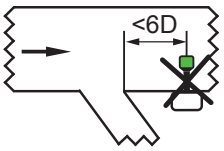
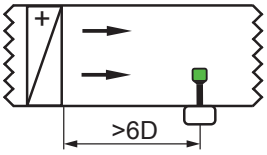
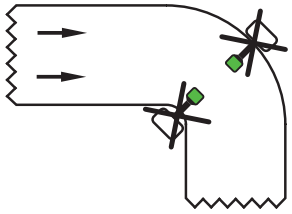
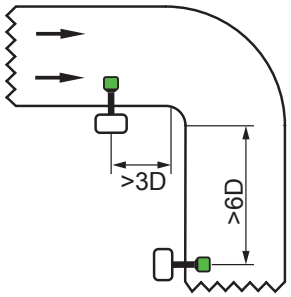
4.7 Mounting Location in Duct Systems

For accurate measurement results, it is essential to position the sensing probe at a location with a homogenous profile without turbulences. Turbulences are irregular flows that occur after obstructions like fans, bends, junctions or section changes in the duct (diffusers / confusers). The probe shall be placed at a certain minimum distance from these obstructions in order to measure in a flow as uniform as possible. The minimum length of the settling zone (straight duct section without obstructions whatsoever) between the probe and the source of turbulence depends on the diameter D of the duct.

For rectangular ducts with dimensions a · b, an equivalent diameter D_{gl} can be defined:

$$D_{gl} = \frac{2 \cdot a \cdot b}{a + b}$$

The following table supplies guidelines for correct installation of air velocity transducers with respect to location and to minimum recommended settling zones.

Not recommended	Recommended	Remark
		Install the probe in the middle of the duct.
		The preferred position of the probe is after a filter.
		Place the probe in front of the diffusers at a position with high air velocity.
		Place the probe at a position with regular (non-turbulent) flow. Turbulence appears after fans as well as after bends, junctions, air heater, air cooler, filters, flaps or diameter changes in the duct.
		

Tab. 9 Recommended mounting locations

5 Electrical Connection

NOTICE

The electrical installation of the AVS701 must be carried out by qualified staff. Observe all applicable national and international requirements for the installation of electrical devices as well as for power supply according to EN 61140, class III (EU) and class 2 supply (North America).

⚠ WARNING

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

Cables must not be under voltage during electrical installation and connection or disconnection, especially at terminal connections on circuit boards. 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.

PLEASE NOTE

Supply, ground, OUT and RS485 A & B are internally connected.

5.1 Electrical Connection and Wiring Overview

Up to 32 AVS701 sensors with Modbus RTU interface can be connected in an RS485 bus system (1 unit load).

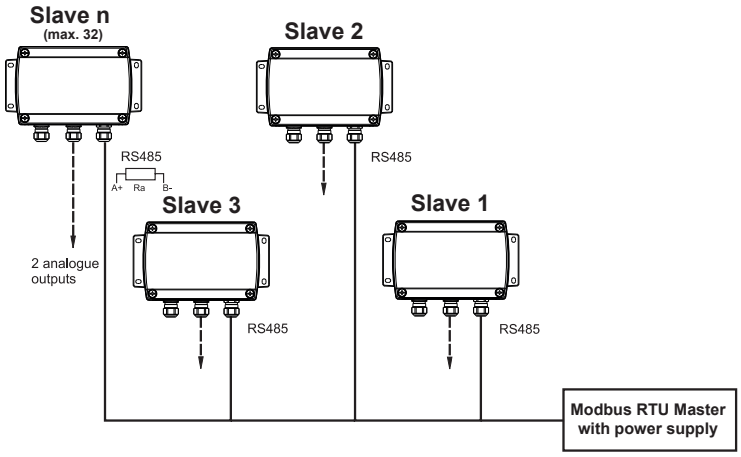


Fig. 17 2-wire RS485 bus

PLEASE NOTE

Both ends of the bus shall be terminated with a resistor R_a = 120 Ω.
9 600 Baud (9 600 8E1), max. 1 200 m (4 000 ft) with twisted pair cable, AWG26.

5.2 With Cable Glands

For cabling via the cable glands and direct electrical connection within the enclosure, the screw terminal assignment in the enclosure's base module is as shown in Fig. 18.

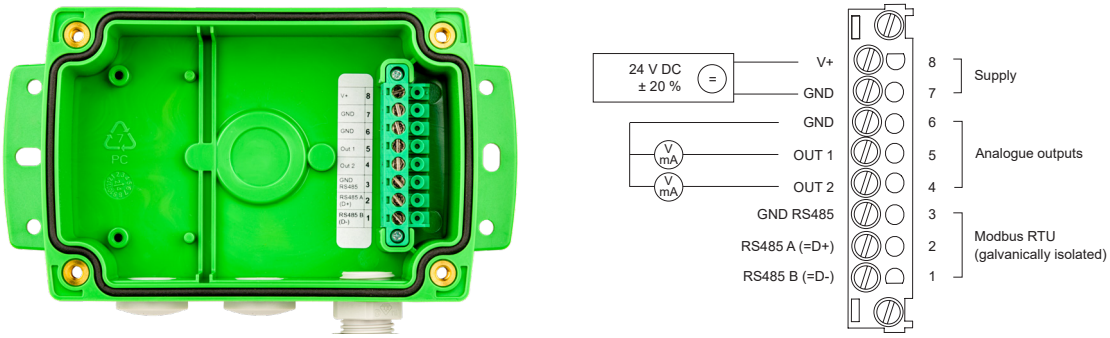
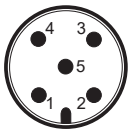


Fig. 18 Pin assignment on screw terminals for electrical connection via cable glands

5.3 Plug Options

Plug for supply and analogue output ❶

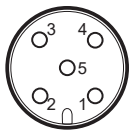


Front view on device

Pin	Assignment
1	V+
2	OUT1
3	GND (Supply)
4	OUT2
5	GND (OUT)

E4

Socket for RS485 connection ❷

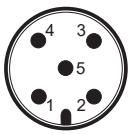


Front view on device

Pin	Assignment
1	Not assigned
2	RS485 B (D-)
3	Not assigned
4	RS485 A (D+)
5	RS485 GND

E6

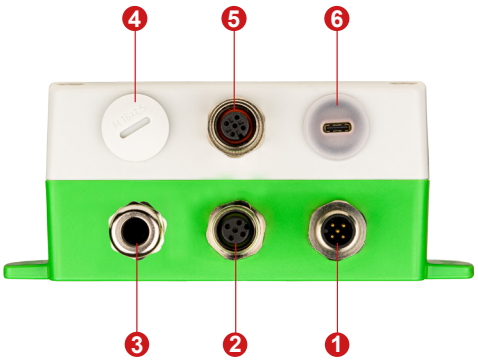
Plug for RS485 connection ❶



Front view on device

Pin	Assignment
1	V+
2	RS485 B (D-)
3	GND
4	RS485 A (D+)
5	n.c.

E9



No.	Part
❶	M12 plug or cable gland
❷	M12 socket or closed
❸	Cable gland or closed
❹	Probe connection, closed for duct mount type
❺	Optional M12 socket (sensor control port) or closed
❻	USB service interface with dust protector

Tab. 10 Overview of AVS701 connection options

6 Setup and Configuration

The AVS701 is ready to use and does not require any further configuration. The factory setup of AVS701 corresponds to the specified order code. Please refer to the data sheet at www.epluse.com/avs701. If needed, the factory setup can be changed. This chapter describes the configuration possibilites with the PCS10 Product Configuration Software and via the digital RS485 interface with Modbus RTU.

6.1 PCS10 Product Configuration Software

The PCS10 provides a convenient graphical user interface to the AVS701 for changing the factory setup via PCS10 and USB cable. The AVS701 is powered via the USB interface then, no additional power supply shall be applied.

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 for adjustments and changes in 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 AVS701 to the PC using the USB cable. Refer to Fig. 19 and Fig. 20 below.
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. Follow the online instructions of the PCS10 which are displayed when clicking the “Tutorial” button.
6. Upload changes to the sensor by pressing the “Sync” button.

Fig. 19 USB service interface

Fig. 20 Plugged USB cable and LED indication

6.2 Analogue Outputs

Measurands, output type and range and scaling are freely selectable. All settings and modifications can be performed using the PCS10 Product Configuration Software.

The analogue outputs are both either current or voltage outputs. If one output is changed from current to voltage or vice versa, the second output will automatically change to match. The scaling will also automatically change if it is out of physical range (i.e. 20 mA will be changed to 10 V instead of 20 V).

PLEASE NOTE

Check output scale after changing between voltage and current output.

Error indication

The analogue outputs feature an error indication function according to NAMUR NE43. In the case of an error, the output signal will freeze at 21 mA or 11 V respectively.

PLEASE NOTE

The error indication is enabled by default.

6.3 RS485 Digital Interface

6.3.1 Modbus RTU Setup

	Factory settings	User 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
Modbus address	47 (0x2F)	1...247

Tab. 11 Modbus RTU protocol settings

PLEASE NOTE

- The recommended settings for multiple devices in a Modbus RTU network are 9 600, 8, even, 1.
- The AVS701 represents 1 unit load on an RS485 network.

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

- PCS10 Product Configuration Software via USB cable
  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/avs701).

The serial number as ASCII-code is located in read-only registers 1 – 8 (0x00 – 0x07, 16 bits per register).
The firmware version is located in register 9 (0x08) (bit 15...8 = major release; bit 7...0 = minor release).
The sensor name is located in registers 10 – 17 (16 bits per register).

NOTICE

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.

NOTICE

To obtain the correct floating point values, it is necessary to read both registers within the same reading cycle. The measured value can change between two Modbus requests, which 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 the MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, available at the Modbus Organisation's Technical Resources site https://www.modbus.org/modbus-specifications.

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
Device status	602	259	1

1) Register number starts from 1.
2) Protocol address starts from 0.
3) Number of registers.
4) For Modbus protocol settings see Application Note Modbus AN0103 (available on www.epluse.com/avs701).

Tab. 12 AVS701 registers for device setup

To calculate the operating v value, the working pressure is available either as a pre-specified value or as an instantaneous value from an external pressure probe.

The operating v value is calculated using a p-value from the corresponding Modbus register.

PLEASE NOTE

If an external probe is employed with the AVS701, its measured values are written to the p or RH registers, depending on the probe type. Please refer to the Modbus map in Tab. 16.

If there is no p probe connected or if there is a transmission error, the predefined value will be available in the p register. The register is factory-set with the value of 1 013.25 mbar (14.7 psi) which may be adapted via PCS10 Product Configuration Software. For calculating the normalised v value, there is alwas a valid p value available. Please refer to Tab. 13.

Pressure value origin	Priority	Value
External p probe	1	Current p value
Pre-specified	2	▪ Factory setting: 1 013.25 mbar (14.7 psi) ▪ Customer setting: changeable via PCS10

Tab. 13 Pressure value options

6.3.2 Gas Library

The AVS701 can measure in different gases for which the appropriate parameters are stored in a library. The gas-specific parameters are maintained by E+E Elektronik Ges.m.b.H. and the latest ones are imported during production. The gas type is set and the corresponding parameters are activated.

Application parameter (FLOAT32)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]
Read and write register: Read function code 0x03 or 0x04 / Write function code: 0x06		
Gas type	5501	157C

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

Tab. 14 AVS701 register for gas type

Gas # [Register content]	Gas parameters	Properties
0 [00 00]	Air	Persistent
1 [00 01]	Custom gas 1	Gas type determined upon order and changeable via PCS10 and Modbus command
2 [00 02]	Custom gas 2	
3 [00 03]	Custom gas 3	
4 [00 04]	Custom gas 4	
5 [00 05]	Custom gas 5	

Tab. 15 AVS701 gas library

6.3.3 Modbus Register Map

The measured 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	Register number[1] [DEC]	Register address[2] [HEX]
Read register: function code 0x03 / 0x04			
Temperature T	°C	1003	3EA
	°F	1005	3EC
	°K	1009	3F0
Relative humidity RH[3]	%	1021	3FC
Air velocity v	m/s	1041	410
	ft/min	1043	412
Air velocity standardised vn	m/s	1045	414
	ft/min	1047	416
Volume flow V'	m^3/h	1055	41E
	l/s	1057	420
	m^3/s	1059	422
	m^3/min	1179	49A
	ft^3/min	1181	49C
Volume flow standardised V'n	m^3/h	1167	48E
	m^3/min	1169	490
	SLPM	1171	492
	l/s	1173	494
	SCFM	1175	496
	m^3/s	1177	498
Pressure p[4]	mbar	1201	4B0
	psi	1203	4B2
	bar	1209	4B8

INT16

Parameter	Unit	Factor	Register number[1] [DEC]	Register address[2] [HEX]
Read register: function code 0x03 / 0x04				
Temperature	°C	100	4002	FA1
	°F	50	4003	FA2
	°K	50	4005	FA4
Relative humidity RH[3]	%	100	4011	FAA
Air velocity v	m/s	100	4021	FB4
	ft/min	1	4022	FB5
Air velocity standardised vn	m/s	100	4023	FB6
	ft/min	0.1	4024	FB7
Volume flow V’	m^3/h	1	4028	FFB
	l/s	1	4029	FBC
	m^3/s	1000	4030	FBD
	m^3/min	100	4090	FF9
	ft^3/min	1	4091	FFA
Volume flow standardised V’n	m^3/h	10	4084	FF3
	m^3/min	100	4085	FF4
	SLPM	0.1	4086	FF5
	l/s	10	4087	FF6
	SCFM	1	4088	FF7
	m^3/s	1000	4089	FF8
Pressure p[4]	mbar	10	4101	1004
	psi	100	4102	1005
	bar	100	4105	1008

1) Register number starts from 1.
2) Register address starts from 0.
3) Valid RH value only available if external RH probe (EE072) is connected.
4) p value from p probe, if connected. Otherwise, a pre-specified value is written to the register; Factory setting: 1 013.25 mbar (14.7 psi), changeable via PSC10

Tab. 16 AVS701 FLOAT32 and INT16 measured data registers

6.3.4 Freely Configurable Custom Modbus Map

It is possible to map measured value / status registers arbitrarily to a block of up to 20 registers provided for this purpose. This means that registers of interest can be mapped to a range of consecutive registers, so that important values can be queried with a single command in one block.

The custom map can be configured via:

- PCS10 Product Configuration Software and USB-C cable.
  The PCS10 can be downloaded free of charge from www.epluse.com/pcs10.
- Modbus protocol commands.

The register block for the configuration of the customisable Modbus map consists of the registers 6001 (0x1770) to 6010 (0x1779). For the blockwise query of the measured values behind Modbus registers 3001 (0xBB8) to 3020 (0xBCB), the firmware accesses this configuration area and thus gets the information about which measured value/status registers are to be output. A maximum of 10 user-defined registers can be mapped. The table below shows an example:

Registers ...		**... with these assigned measurands ...**			**... map to registers ...**		**... mirrored from source registers**	
Dec	**Hex**	**Meas.**	**Unit**	**Type**	**Dec**	**Hex**	**Dec**	**Hex**
Function code 0x10					*Function code 0x03/0x04*			
6001	1770	T	°C	FLOAT32	3001	BB8	1003	3EA
				FLOAT32	3002	BB9	1004	3EB
6002	1771	T	°F	FLOAT32	3003	BBA	1005	3EC
				FLOAT32	3004	BBB	1006	3ED
6003	1772	vn	m/s	FLOAT32	3005	BBC	1045	414
				FLOAT32	3006	BBD	1046	415
6004	1773	vn	ft/min	FLOAT32	3007	BBE	1047	416
				FLOAT32	3008	BBF	1048	417
6005	1774	V'n	m^3/s	FLOAT32	3009	BC0	1059	498
				FLOAT32	3010	BC1	1060	499
6006	1775	V'n	SCFM	FLOAT32	3011	BC2	1181	496
				FLOAT32	3012	BC3	1182	497
6007	1776	p	bar	FLOAT32	3013	BC4	1161	488
				FLOAT32	3014	BC5	1162	489
6008	1777	p	psi	FLOAT32	3015	BC6	1209	4B8
				FLOAT32	3016	BC7	1210	4B9
6009	1778				3017	BC8	65536	FFFF
					3018	BC9	65536	FFFF
6010	1779				3019	BCA	65536	FFFF
					3020	BCB	65536	FFFF

Tab. 17 Custom Modbus map example

6.3.5 Device Status Indication

The AVS701 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	Display communication faulty	Return the unit to the E+E Customer Service
Bit 1	Temperature below T working range	Observe the lower working range limit
Bit 2	Temperature above T working range	Observe the upper working range limit
Bit 3	T measuring value invalid (NaN)	Return the unit to the E+E Customer Service
Bit 4	Gas velocity below vn working range	Observe the lower working range limit
Bit 5	Gas velocity above vn working range	Observe the upper working range limit
Bit 6	v measuring value invalid (NaN)	Return the unit to the E+E Customer Service
Bit 7	Measuring signal processing faulty	Optically check sensing element and measurement setup. If error persists, return the unit to the E+E Customer Service
Bit 8	Power supply insufficient	Check wiring and power source
Bit 9	v sensing element broken	Return the unit to the E+E Customer Service
Bit 10		
Bit 11	External humidity probe faulty	Check external probe and wiring
Bit 12	External pressure probe faulty	Check external probe and wiring
Bit 13	-	
Bit 14	-	
Bit 15	-	

Tab. 18 Device status indication

6.4 Modbus RTU Examples

The AVS701's Modbus address is 47 [0x2F].

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/avs701)

Read the standardised air velocity (FLOAT32) vn = 2.4122192859649658203125 m/s from register address 1045 (0x414) with function code 0x03:

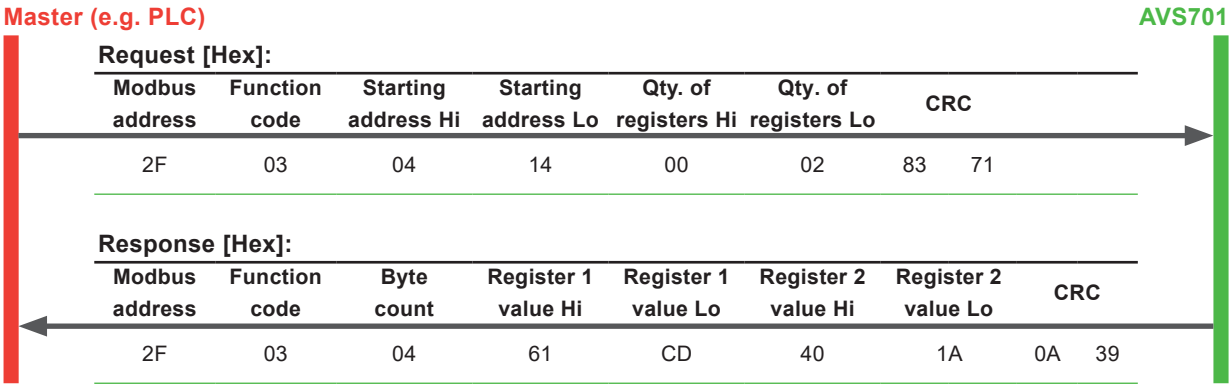


Fig. 21 Example temperature query

NOTICE

To obtain the correct floating point values, both registers have to be read within the same read cycle. The measured value can change between two Modbus requests, which 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 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]
61	CD	40	1A
MMMM MMMM	MMMM MMMM	SEEE EEEE	EMMM MMMM

Tab. 19 Modbus response

IEEE754

Register 2 Hi [3]	Register 2 Lo [4]	Register 1 Hi [1]	Register 1 Lo [2]
40	1A	61	CD
0100 0001	1100 1101	0110 1101	1111 1011
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Decimal value [m/s]: 2.412219285964965820312 5			

Tab. 20 Data representation according to IEEE754

Read the gas type from register address 5501 (0x157C) with function code 0x03:

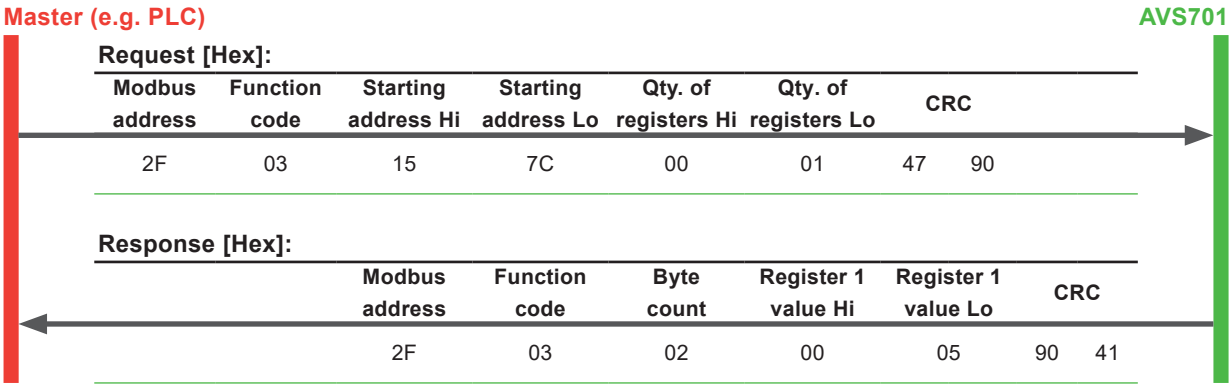


Fig. 22 Example gas type query

The query results in gas no. 5.

Change the gas type to no. 4:

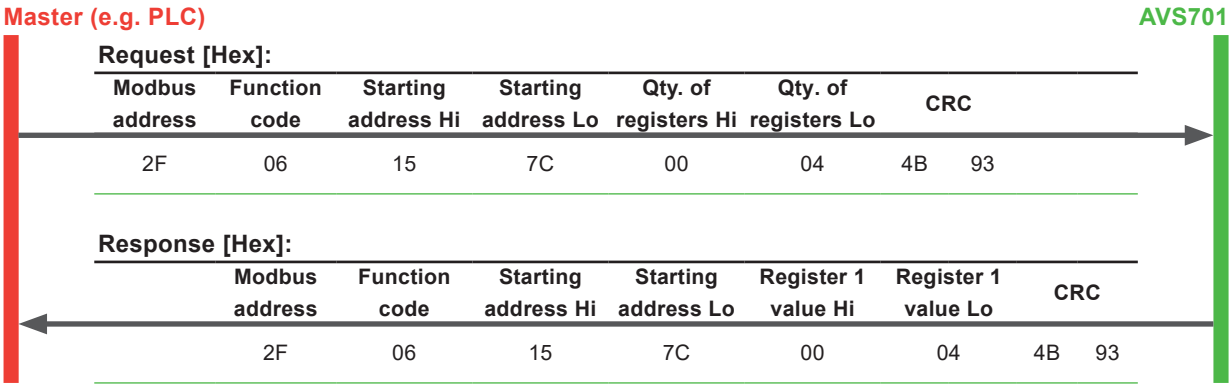


Fig. 23 Example gas type change

7 Maintenance and Service

AVS701 does not require any special maintenance, however for high accuracy measurements it is recommended to calibrate the probe periodically. Contamination on the sensing head and the sensing element may lead to incorrect measurement values. Therefore, the sensing head must be checked regularly for contamination. If needed, the enclosure and the sensing head may be cleaned as described in chapter 7.2 Cleaning and the device may be re-adjusted as described in chapter 8 vn / T Calibration and Adjustment.

7.1 Self Diagnosis and Error Messages

7.1.1 Error Messages on the Display

Error Description	Error Code (Display)	Recommended Action
Air velocity measurement failure	error 2	See note below. If error persists, return the faulty unit to E+E for service
Temperature measurement failure		
Air velocity sensing element polluted	error 4	Return the faulty unit to E+E for service
Hardware error		

Tab. 21 Overview of error codes

PLEASE NOTE

An error 2 also occurs when the probe is unconnected from the sensor. As soon as the probe is plugged again, the sensor will return to normal operation again.

7.1.2 Status and Error Messages via LED

The AVS701 features an optical status indication via its illuminated socket. The integrated LEDs clearly display the operating status in colour. Please refer to Tab. 22 for an explanation.

Fig. 24 Backlit USB-C socket in different states

LED colour	Description
Green flashing	Normal operation, measured values within preconfigured range, probe OK
Yellow flashing	Measured values out of min./max. thresholds or measured values outside of measuring range or Modbus probe is missing (error 2)
Red flashing	Failure, return sensor to your E+E service

Tab. 22 Explanation of the LED colors

7.1.3 Error Messages in PCS10

The PCS10 information section includes error messages from AVS701, if there are any errors present. The following table shows the error codes and their meaning. Please note that this table directly corresponds to Tab. 18 in chapter 6.3.5 Device Status Indication.

Error code	Description	Recommended action
6.x	SDADC communication failure	Service recommended, check the possibilities with an E+E service representative
7.x	Temperature measurement failure	1. Check the actual temperature and the T output scaling of the ordered sensor, check the wiring 2. Service recommended, check the possibilities with an E+E service representative
9.x	Humidity measurement failure	1. Check the humidity probe and its wiring 2. Service recommended, check the possibilities with an E+E service representative
12.x	Air velocity measurement failure	1. Check the air velocity sensing element 2. Service recommended, check the possibilities with an E+E service representative
14.x	Pressure measurement failure or sensor control port communication failure	1. Check the humidity probe and its wiring 2. Service recommended, check the possibilities with an E+E service representative
17.x	Air velocity measurement incorrect	1. Check the actual air velocity and the vn output scaling of the ordered sensor, check the wiring 2. Service recommended, check the possibilities with an E+E service representative
21.x	Display communication error	Service recommended, check the possibilities with an E+E service representative
32.x	Power supply via USB not sufficient	1. Check USB wiring and power supply of feeding device

Tab. 23 PCS10 error messages for AVS701

7.1.4 Error Indication on the Analogue Output (NAMUR)

The AVS701 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-nena.html).

Output signal	NAMUR signal level
0 – 10 V	11 V
0 – 20 mA / 4 – 20 mA	21 mA

Tab. 24 NAMUR error indication

NAMUR error indication is enabled by factory default. With the PCS10 Product Configuration Software, the feature can be disabled and the threshold levels can be customised.

7.2 Cleaning

The AVS701 has been optimised with regard to the materials used (probe and sensing head made of stainless steel 1.4404) to provide the best possible resistance to sterilisation processes and corrosive cleaning agents.

Approved cleaning methods are

- H_2O_2 sterilisation with 6 % concentrated H_2O_2 surface cleaning agents
- Isopropyl alcohol
- Water

PLEASE NOTE

Inappropriate cleaning agents may deposit on the sensing element, resulting in incorrect measured values or permanent damage to the sensing element.

For any other than the approved methods, the protection cap included must be mounted prior to cleaning.

Cleaning of the sensing head / probe body

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

NOTICE

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

If cleaning with compressed air is not successful, the sensing head can be carefully cleaned using water, isopropyl alcohol or H_2O_2 sterilization (6 % concentration) by repeated immersion and drying.

Cleaning with water:

1. Remove the power supply from the device
2. Flush with the selected detergent
3. Dry in the air
4. Reapply power to the device

NOTICE

- Do not touch the sensing element with your fingers or other tools at any time!
- Do not shake, knock or tap the wet sensing 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 sensing head!

7.3 Repairs

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

7.4 Transportation

Whenever AVS701 needs to be returned to E+E Elektronik GmbH for calibration, adjustment or repairs purposes, contamination and any mechanical stress during transport have to be avoided by appropriate packaging. Please use the protection cap included in the scope of the supply (see chapter 2 Scope of Supply) to protect the sensing head.

CAUTION

Returned sensors must at no time pose a risk to the health of our employees.

If the product has been in contact with contaminating substances (toxic, hazardous, explosive, radioactive, etc.), the sensor must be decontaminated before return.

8 vn /T Calibration and Adjustment

The AVS701 can be calibrated /adjusted with the help of the PCS10. For this purpose, the sensor needs to be connected to a PC via a USB-C cable.

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 results comparable to the E+E factory setting, please observe the following instructions:

- The adjustment should be done in a wind tunnel with homogeneous, low turbulent flow profile.
- Insert the probe into the duct so that the sensing head is in its centre.
- The fixtures should be mounted outside the flow channel and should not protrude into the air flow.
- EURAMET Calibration Guidelines No. 24 and 25 shall be considered.

8.1 Selection of the Appropriate Adjustment Method

The AVS701 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.

8.1.1 General Information on 1-Point vn/T Adjustment

The selected adjustment point should be as close as possible to the working point (or 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).

8.1.2 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: AVS701 - 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).

8.2 Adjustment with PCS10

Please follow the instructions from the PCS10 Product Configuration Software.

8.3 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 17025 or accredited calibration please see www.eplusecal.com.

For information on the E+E capabilities in ISO 9001 calibration please see www.epluse.com/iso9001cal.

9 Spare Parts / Accessories

For further information please refer to the Accessories datasheet.

Description	Code
E+E Product Configuration Software (Free download: www.epluse.com/pcs10)	**PCS10**
Modbus pressure probe 0…10 bar abs.	**HA600001**
Connection cable, unshielded, 5 poles, M12x1 plug ←→ socket	
2 m (6.6 ft)	**HA010813**
5 m (16.4 ft)	**HA010814**
10 m (32.8 ft)	**HA010815**

10 Technical Data

Measurands

Air Velocity Standardised (vn)

Measuring range	0...2 m/s (0...400 ft/min) 0...15 m/s (0...3 000 ft/min) 0...40 m/s (0...8 000 ft/min)	
Accuracy in air at 23 °C (73 °F) and 1 013 mbar (14.7 psi), including non-linearity, hysteresis and repeatability **0.06...2 m/s (12...400 ft/min)** **0.15…15 m/s (30…3 000 ft/min)** **0.20…40 m/s (40…8 000 ft/min)**	 ±0.03 m/s (6 ft/min) ±(0.10 m/s (20 ft/min) + 1 % of mv) ±(0.20 m/s (40 ft/min) + 1 % of mv)	 mv = measured value
Uncertainty of factory calibration	±1 % of mv, min. 0.015 m/s (3 ft/min)	mv = measured value
Dependency of inflow angle (α)	<3 % for α < ±10°	
Influence of the reverse flow, typ.	<2 % of mv	mv = measured value
Response time t_{90}, typ.	0.1...35 s (Factory setting: 1.7 s; configurable via PCS10 in 9 steps)	
Temperature dependency of electronics, typ.	±0.01 % of mv/K deviating from 25 °C (77 °F)	mv = measured value
Temperature dependency of probe, typ.	±0.1 % of mv/K deviating from 25 °C (77 °F)	mv = measured value
Warm-up time	<5 s	

Temperature (T)

Measuring range **Remote probe** **Duct version**	 -40...+140 °C (-40...+284 °F) -40...+80 °C (-40…+176 °F)	
Accuracy in air at 23 °C (73 °F) at air flows ≥0.45 m/s (886 ft/min)	±0.5 °C (±0.9 °F)	
Temperature dependency of electronics, typ.	±0.005 % of mv/K deviating from 23 °C (73 °F)	mv = measured value
Temperature dependency of probe, typ.	±0.1 % of mv/K deviating from 23 °C (73 °F)	mv = measured value
Response time t_{90}, typ.	≤10 s	

Outputs

Analogue

Two freely selectable and scalable outputs for vn, T, V'n	0 – 10 V 0 – 20 mA / 4 – 20 mA (3-wire)	-1 mA < I_L < 1 mA R_L ≤ 350 Ω	I_L = load current R_L = load resistance
Accuracy @23 °C (68 °F)	±0.05 % FS		FS = full scale (20 mA, 10 V)
Temperature dependency[1)]	±0.005 % FS / °C		FS = full scale (20 mA, 10 V)
NAMUR Factory settings	11 V or 21 mA		

1) Deviating from 23 °C (68 °F), defined at 12 mA or 5 V, respectively

Digital

Digital interface	RS485 (AVS701 = 1 unit load)
Protocol	Modbus RTU
Factory settings	9 600 Baud, 8 data bits, parity even, 1 stop bit, Modbus address 47
Supported Baud rates	9 600, 19 200, 38 400, 57 600, 76 800 and 115 200

Switching Outputs (Optional)

2 switching outputs	Potential-free (Opto-MOS)
Switching capacity	Max. 24 V DC, 1 A

General

Power supply class III USA & Canada: Class 2 supply necessary	24 V DC ±20 %
Current consumption **Typ.** **With Display**	<100 mA <160 mA
Electrical connection	M12x1 plug or via M16 cable gland to internal terminals
Temperature working range	
Probe and sensing element	-45…+160 °C (-40…+320 °F)[1)]
Probe cable	-40…+180 °C (-40…+356 °F)
Enclosure	-40…+60 °C (-40…+140 °F)
Enclosure with display	-30…+60 °C (-22…+140°F)
Pressure working range	
T2, T3	700...1 300 mbar (10.2...18.9 psi)
T26	Pressure-tight 0.05...10 bar (0.73...145 psi)
Humidity working range	0…99 %RH, non-condensing
Storage conditions	-20...+70 °C (-4…+158 °F) 0...95 %RH, non-condensing
Protection rating	IP65 / NEMA 4X
Material	
Probe incl. head	Stainless steel 1.4404
Probe cable jacket	PTFE (Polytetrafluoroethylene)
Sensing element	Ceramics with polymer finish
Enclosure	Die-cast aluminium AlSi9Cu3 or PC (Polycarbonate)
Electromagnetic compatibility	EN 61326-1 EN 61326-2-3 Industrial Environment FCC Part15 Class B ICES-003 Class B
Configuration und adjustment	PCS10 via USB
Conformity	CE UKCA

1) Without power supply

Accuracy of E+E 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 air velocity and temperature sensor is multipoint factory adjusted and calibrated in a highly stable wind tunnel. 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}.....the uncertainty of the factory calibration
$u_{accuracy}$...the 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 designated laboratory (NMI) responsible for maintaining the National Standard for air velocity in Austria, E+E Elektronik represents the highest level in calibration. For further details, please refer to www.eplusecal.com.

11 Conformity

11.1 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/avs701 for the Declarations of Conformity.

11.2 Electromagnetic Compatibility

EMC for industrial environment.
The sensor is a group 1 device and corresponds to class B.

11.3 FCC Part 15 Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the installation manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

11.4 ICES-003 Compliance Statement

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

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

12 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.

Evaluation Unit

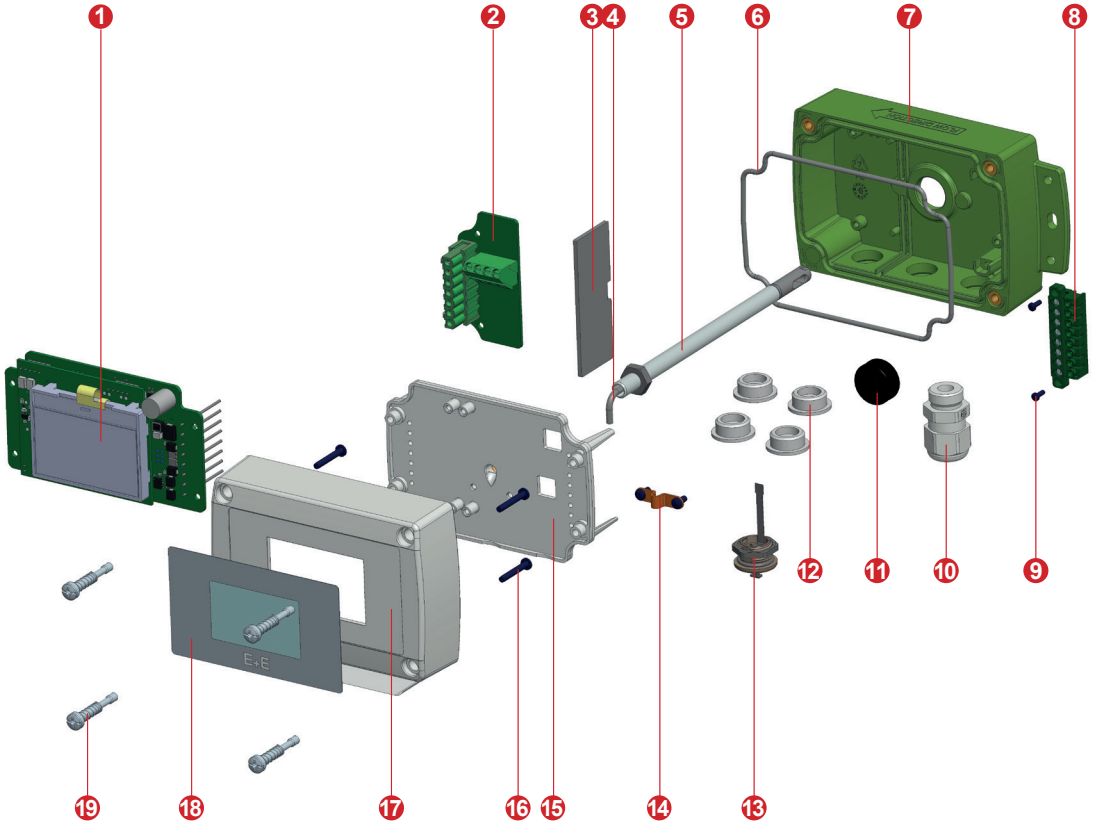


Fig. 25 Evaluation unit (duct mount version)

No.	Part	Material	Recycling Type
1	Display with electronics board	Various materials	Electrical and Electronics waste
2	Terminal block on electronics board	Various materials	Electrical and Electronics waste
3	Extension bay separator	Polycarbonate	Plastics waste
4	Probe cable	Various materials	Electrical and Electronics waste
5	Probe	Various materials	Electrical and Electronics waste
6	Rubber seal	Neoprene	Plastics waste
7	Base module enclosure part	Polycarbonate or die-cast aluminium	Plastics or metal waste
8	Terminal block	Various materials	Electrical and Electronics waste
9	Screws	Steel	Metal waste
10	Cable gland(s)	Polyamide or nickel-plated brass	Plastics or metal waste
11	Grommit	Neoprene	Plastics waste
12	Dummy plugs	Plastic	Plastics waste
13	Illuminated USB socket	Various materials	Electrical and Electronics waste
14	Strain relief	Various materials	Electrical and Electronics waste
15	Separation plate	FR4	Plastics waste
16	Screws	Steel	Metal waste
17	Sensor module enclosure part	Polycarbonate or die-cast aluminium	Plastics or metal waste
18	Protective foil	Plastic	Plastics waste
19	Screws	Stainless steel	Metal waste

Tab. 25 Recycling of the parts of the AVS701 evaluation unit (duct mount version)

Remote Probe

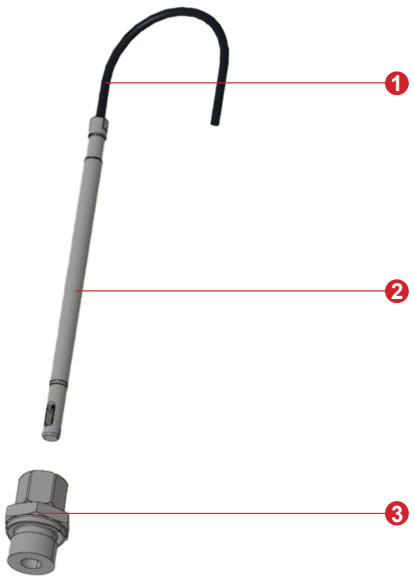


Fig. 26 Probe

No.	Part	Material	Recycling Type
1	Probe cable	Various materials	Electrical and Electronics waste
2	Probe	Various materials	Electrical and Electronics waste
3	Sliding fitting	Stainless steel	Metal waste

Tab. 26 Recycling of AVS701 probes

Probe Alignment Tool

Fig. 27 Probe alignment tool

No.	Part	Material	Recycling Type
1	Tool	Stainless steel	Metal waste

Tab. 27 Recycling of the probe alignment tool

Clamp Fitting

Fig. 28 Clamp fitting

No.	Part	Material	Recycling Type
1	Clamp fitting	Stainless steel	Metal waste

Tab. 28 Recycling of the probe alignment tool

Flange

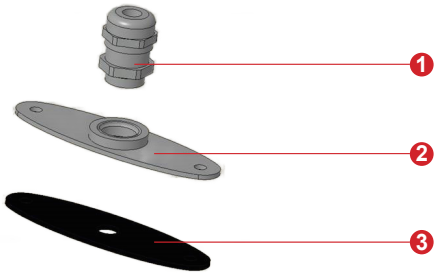


Fig. 29 Stainless steel mounting flange

No.	Part	Material	Recycling Type
1	Gland	Stainless steel	Metal waste
2	Floor	Various materials	Metal waste
3	Gasket	Foam rubber	Plastics waste

Tab. 29 Recycling of the stainless steel mounting flange (AVS701 types T2 and T3)

Protection Cap

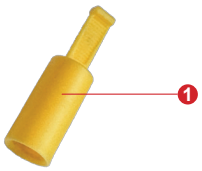


Fig. 30 Protection cap

No.	Part	Material	Recycling Type
1	Protection cap	Plastic	Plastics waste

Tab. 30 Recycling of the protection cap

13 Annex: External Pressure Probe (Accessory)

This annex provides concise information on the external pressure probe mentioned in the accessories.

The external stainless steel pressure probe has a measuring range of 0...10 bar absolute. The probe features an RS485 interface with Modbus RTU protocol for measured value transmission towards the evaluation unit. A G1/4" DIN 3852 fitting provides perfect mechanical connection to the process. The probe has excellent thermal behaviour and long term stability as well as a reset function.

FLOAT32

Parameter	Unit	Register number[1] [DEC]	Register address[2] [HEX]
Read register: function code 0x04			
Pressure p[3]	bar	777	308

1) Register number starts from 1.
2) Register address starts from 0.
3) Floating point value is stored according to IEEE754. Please refer to chapter 6.4 Modbus RTU Examples.

Tab. 31 External pressure probe Modbus map

Measurand

Pressure (p)

Measuring range	0...10 bar (1...145 psi) absolute
Accuracy incl. hysteresis, non-linearity and repeatability	±0.5 % FS FS = full scale
Temperature dependency, typ.	<0.02 % from FS / 10 K
Response time t_{90}	500 ms
Long-term stability	<0.1 % from FS/year
Overload limits **Overpressure** **Burst pressure**	 40 bar (580 psi) 50 bar (725 psi)

Output

Digital

Digital interface **Protocol** **Factory settings** **Supported Baud rates**	RS485 Modbus RTU 9 600 Baud, 8 data bits, parity even, 1 stop bit, Modbus address 1 9 600, 19 200, 38 400, 57 600 and 76 800

General

Power supply class III ⧫ USA & Canada: Class 2 supply necessary, max. voltage 30 V DC	24 V DC ±20 %
Current consumption, max.	10 mA
Temperature range **Medium** **Electronics** **Storage**	 -25…+125 °C (-13...+257 °F) -25…+85 °C (-13...+185 °F) -40…+100 °C (-40...+212°F)
Material **Enclosure / pressure port** **Diaphragm** **Seals**	 Stainless steel 1.4404 (316 L) Stainless steel 1.4404 (316 L) FKM
Protection rating	IP67
Electromagnetic compatibility	Emission and immunity according to EN 61326 2014/30/EU
Shock and vibration	Tested acc. to EN 60068-2-6 and EN 60068-2-27
Conformity	CE

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