Content

Air humidity

The Right Humidity Sensor for Any Measuring Task

For humidity measurements various methods are used that differ from each other mainly with regard to their accuracy and their suitability for long term measurements and the substance used for the measurement:

• Capacitive Air Humidity Measurement,
• Psychrometric Air Humidity Measurement,
• Hygrometric Air Humidity Measurement,
• Dielectric Measurement of Moisture in Materials,
• Measurement of the Moisture in Materials According to the Principle of Conductivity,
• Dew Point Determination with CCC Dew Point Probes,
• Dew Point Determination with Dew Point Mirrors.

Capacitive Air Humidity Measurement

Capacitive sensors contain a glass substrate with a moisture sensitive polymer layer between two metal layers. By absorption of water, corresponding to the relative humidity, the dielectric constant and, as a result, the capacity of the thin-film capacitor are changing. The measuring signal is directly proportional to the relative humidity and does not depend on the atmospheric pressure.

Advantage:
• maintenance-free measurement over longer periods,
• can withstand temperatures below 0°C
• atm. pressure-independent, works when pressure is applied
• flexible use of the sensor

Disadvantage:
• limited long term stability
• sensitive to dewing and certain aggressive substances

Psychrometric Air Humidity Measurement

Psychrometers are precision devices containing a dry and a moistened temperature sensor. As a result of the evaporation the humidity sensor cools down, with a wind velocity of a minimum of 2m/s being required for the cool down process. The humidity values are calculated from the temperature difference (psychrometric difference). The calculation formulae for AL-MEMO® devices correspond to those used by the German Weather Authority related to 1013mbar. Differences regarding to the atmospheric pressure can be corrected to achieve precise measurements.

Advantage:
• no ageing of the sensor - exception: contamination of the wick
• high accuracy
• high quality regarding the measuring technology
• usable without problems up to 100% r.H. in all substances

Disadvantage:
• long term measurement limited by the required water reserve and wick maintenance
• difficult to use with temperatures below 0°C and with low humidities
• depending on the atmospheric pressure

Dew Point Determination with Dew Point Mirrors

An optically monitored mirror is mounted on a cascaded Peltier element. The sensor unit is also connected to a control circuit that regulates the operating current of the cooling element so that a defined condensate is established. The dew point temperature will be directly measured within the sensor and can be output in a format, which allows for an evaluation.

Advantage:
• high accuracy, reliability and reproducibility
• independent from atmospheric pressure
• wide measuring range
• suitable for temperatures below 0°C

Disadvantage:
• high sophisticated measuring method
• high current consumption
• risk of contamination

Small Glossary for Humidity/Moisture Measurement Variables

Absolute Humidity	The absolute humidity indicates the weight of the water vapour contained in one m³ of a mixture of air and water vapour.
Enthalpy	The enthalpy indicates how much heat is stored within the humid air. This value is important for calculating the cooling and heating performance, e.g. when checking heat exchangers.
Mixture Ratio	The absolute humidity related to 1kg dry air.
Relative Humidity	The relative humidity indicates the percentage of air, which is saturated with water vapour, i.e. how much percent of the maximum possible amount of water vapour is currently contained in the air. Owing to the dependence on temperature the relat. humidity can only ever be indicated for one specific temperature.
Saturation Vap. Pressure	Air can only ever contain a certain maximum amount of water vapour. This is called the saturation vapour pressure, specified as g water vapour per kg of humid air. The saturation vapour pressure strongly depends on the air temperature. At low temperatures it will be low and at high temperatures it will be high. Therefore, warm air can accept large amounts of vapour pressure and cold air only small amounts.
Dew Point	The dew point is the temperature where the relative humidity equals 100%. If the dew point is not reached the water vapour will start condensing.
Water Vap. Partial Press.	The total pressure in the room determined by the water vapour.

new

ALMEMO® measuring system for calibrating climatic chambers as per guideline DAkkS-DKD-R 5-7
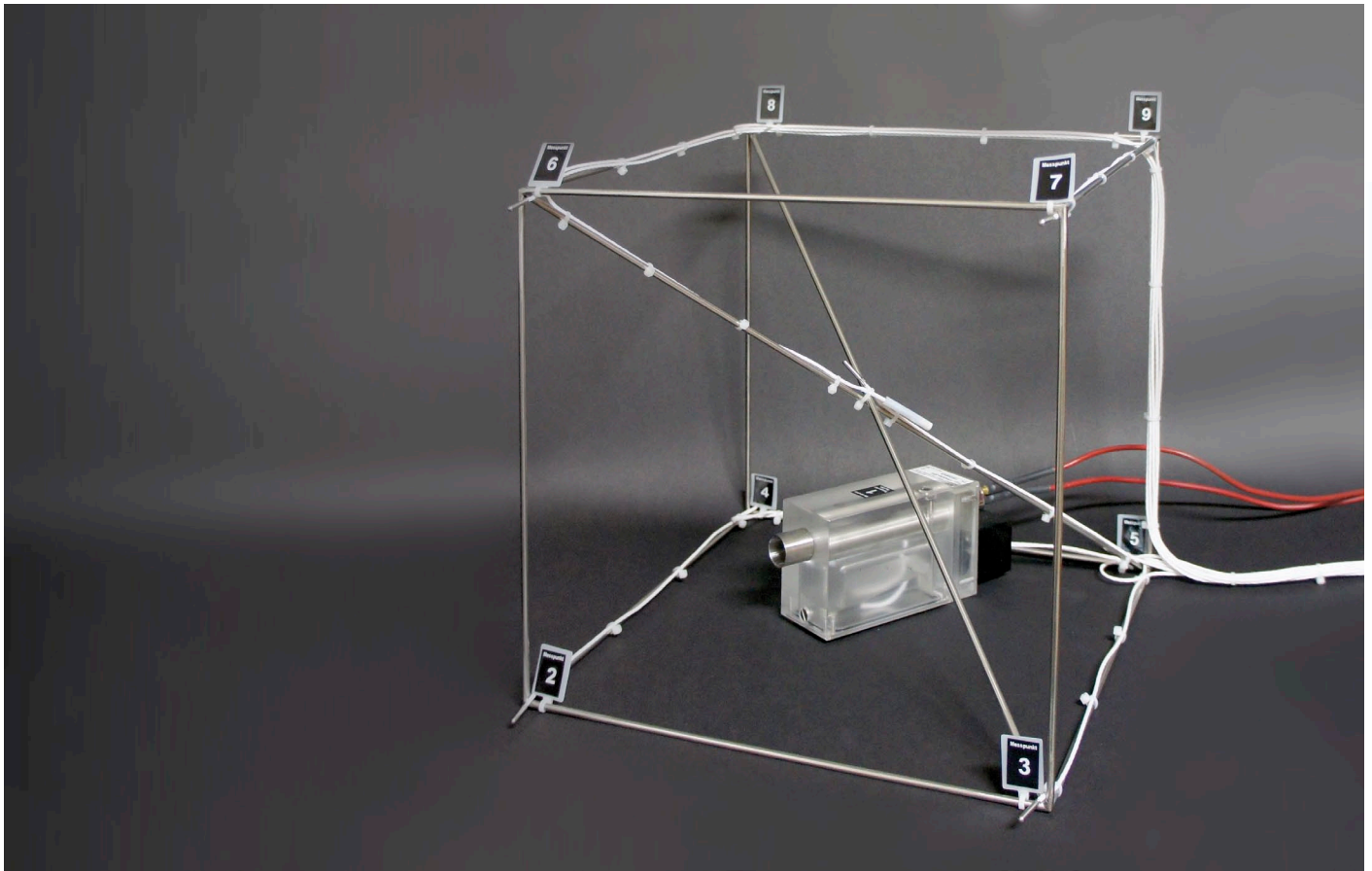
- Guideline DAkkS-DKD-R 5-7 lays down minimum requirements for the calibration procedure and for the determination of measurement uncertainties when calibrating climatic chambers.

- This guideline describes inter alia the objectives, procedures, and methods of calibration, and the uncertainty components involved.
- The full text of this guideline is availab-

le as a PDF document on the home page of the Deutsche Akkreditierungsstelle GmbH (www.dakks.de > Dokumente > Kalibrierlaboratorien) and can be downloaded free-of-charge.

Calibration of relative atmospheric humidity at nine points in the climatic chamber using precision measuring instrument ALMEMO® 710

The ALMEMO® measuring system, comprising precision measuring instrument ALMEMO® 710, one humidity sensor, and eight temperature sensors, can be used to acquire all relevant measurable variables prevalent in the climatic chamber. The relative atmospheric humidity at the nine points in the climatic chamber is calculated in the ALMEMO® 710 itself. Climatic chambers can thus be calibrated in full and on site quickly and easily.

Humidity is calculated in the ALMEMO® 710 on the basis of formulae as per Dr.

Sonntag and the enhancement factor as per W. Bögel (correction factor $Fw(t,p)$) for real mixed gas systems). This substantially widens the measuring range and improves the accuracy of humidity variable calculations.

All values, both measured and calculated, are shown in a clear and easy-to-understand way on the ALMEMO® 710's large touch display. The ALMEMO® 710 also operates as a data logger. Measuring series can be saved either to the internal memory (capacity for over 400,000

measured values) or via the ALMEMO® memory connector to an SD card (capacity for several millions of measured values).

WinControl can be used to display and document values e.g. as a line graphic - either online those measured values actually being acquired during a measuring operation or offline after a measuring operation those measured values previously saved. It also provides various evaluation and statistical functions.

Calibrating climatic chambers

8 x Pt100 temperature sensors (FPA40ST0050S01KL0050)

1x Humidity sensor
(psychrometer FPA8363)

Measuring
locations 1 to 9

Measuring locations 1 to 9 represent the positioning of the
ALMEMO® sensors within the measuring space of a climatic chamber

Measuring chamber
(climatic chamber volume)

Useful volume as spanned by the
measuring locations (calibrated space)
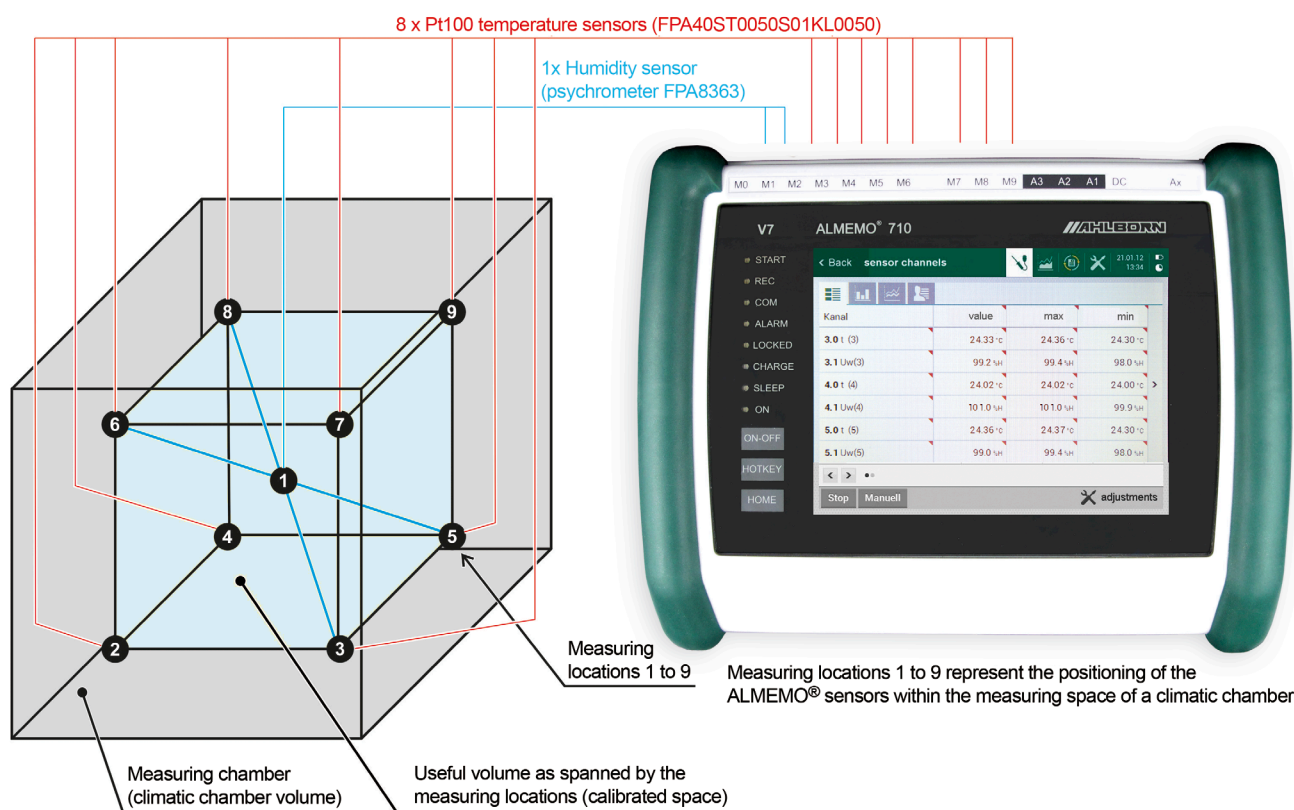
The ALMEMO® measuring system comprises:

Precision measuring instrument ALMEMO® 710

10 inputs for any ALMEMO® sensors,
atmospheric pressure sensor integrated in the measuring instrument
(with DAkkS calibration certificate).

Precision measuring instrument ALMEMO® 710 including USB cable, mains unit, instrument case, and configuration software ALMEMO® Control	**MA710**
DAkkS calibration certificate for atm. pressure sensor five points in range 700 to 1100 mbar	**KD9213D**

Precision measuring instrument ALMEMO® 500

Data acquisition system, Tablet control via app.
20 measuring inputs for any ALMEMO® sensors (expandable).

Data logger ALMEMO® 500 CPU card including interfaces and web service. 4GB SD memory card. 2 active measuring circuit cards MA10 featuring 20 input sockets for all ALMEMO® sensors (standard, DIGI, D6, D7). Mains adapter Control unit with preinstalled app.In desktop housing TG6, 9 free slots	**MA500CPUA20TG6B**
Digital atm. pressure sensor, built in the ALMEMO® D6 connector	**FDAD12SA**
DAkkS calibration certificate for atm. pressure sensor five points in range 700 to 1100 mbar	**KD9213D**

08.04

Calibrating climatic chambers

Pt100 psychrometer with DAkkS calibration certificate

Operative range 0 (not ice) to 90 °C, 10 to 100 % RH
The psychrometer is positioned at the center of the useful volume. From the measured values - dry temperature (t) and wet temperature (t_w) - and atmospheric pressure (p) (atmospheric pressure sensor integrated in the ALMEMO® 710) we can calculate the relative humidity (U_w) at the center and the dewpoint (t_d).
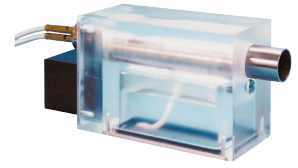
Pt100 psychrometer FPA836-3 including mains unit, water bottle, one pair of wicks	**FPA8363**
DAkks calibration certificate for atmospheric humidity Two climate points at 25°C, 30%RH and 25°C, 75%RH (other points available on request)	**KH9146D**
Case for psychrometer and accessories	**ZB2490TK2**

Eight Pt100 temperature sensors with DAkkS calibration certificate

for operation in the climatic chamber stainless steel protective tube with PFA cable. Operative range -100 to +250 °C, Protective class IP68
The eight temperature sensors are positioned at the corners of the cuboid spanning the useful volume. From the eight measured values for temperature (t) and the humidity variables from the psychrometer we can calculate the relative humidity values (U_w) at the corners of the cuboid

Eight Pt100 temperature sensors, diameter 4mm, for operation in the climatic chamber, IP68, Cable length = 5 meters	8 x **FPA40ST0050S01KL0050**
DAkks calibration certificate for temperature, three points at 0, 50, 100 °C (other points available on request)	
for 1st sensor	1 x **KT9021D**
for 2nd to 8th sensor	7 x **KT9021D2**
Multi-point adjustment for eight sensors (in certificate, sensor deviation virtually reduced to zero)	8 x **KA9001DW**
Programming for eight Pt100 temperature sensors for calculating humidity using ALMEMO® 710 including labeling of the sensor connector	**OA9000PRKS**
Wire cube, VA wire Ø4 mm. edge length 300 mm, vertices welded. Including spiral hoses to fix the sensor cables.	**ZB1002Q01**

Note: Two temperature sensors with different surfaces (e.g. stainless steel and PTEE) to determine the radiation effects on air temperature measurement operations. In case the two temperatures are measured simultaneously (additionally) with the 8 temperatures of the vertices, an ALMEMO® 500 measuring instrument (20 inputs) is needed; alternatively an ALMEMO® 710 measuring instrument (10 inputs) plus an additional measuring instrument e.g. ALMEMO® 2590-2A (2 inputs) can be used.

cover for Pt100 temperature sensor, diameter 4mm, PTFE, large emissivity factor for determining the radiation effect on air temperature measurement	**ZT9000TS41**

Measuring software WinControl

WinControl software, for measured value processing and documentation for any number of channels (i.a. arithmetic channels, statistic channels)	**SW5600WC2**
Assistant for the calibration of climate cabinets	**SW5600WCZM13**

Calibrating climatic chambers

Assignment of measuring points, ALMEMO® 710 (example)

Sensor position	Measuring point	Variable	Note
Spatial center	0.0	t_w (wet temperature)	measuring channel -psychrometer
	1.0	t (dry temperature)	measuring channel -psychrometer
	1.1	U_w (humidity)	arithmetic channel (psychrometer)
	1.2	t_d (dewpoint)	arithmetic channel (psychrometer)
	1.3	p (atmospheric pressure)	device-internal atmospheric pressure sensor
Corner 1	2.0	t (temperature Pt100)	measuring channel (Pt100)
	2.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 2	3.0	t (temperature Pt100)	measuring channel (Pt100)
	3.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 3	4.0	t (temperature Pt100)	measuring channel (Pt100)
	4.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 4	5.0	t (temperature Pt100)	measuring channel (Pt100)
	5.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 5	6.0	t (temperature Pt100)	measuring channel (Pt100)
	6.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 6	7.0	t (temperature Pt100)	measuring channel (Pt100)
	7.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 7	8.0	t (temperature Pt100)	measuring channel (Pt100)
	8.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)
Corner 8	9.0	t (temperature Pt100)	measuring channel (Pt100)
	9.1	U_w (humidity)	arithm. channel (humidity from Pt100 and psychrometer)

Guideline DAkkS-DKD-R 5-7   The following section includes extracts from the guideline.

Guideline DAkkS-DKD-R 5-7 Calibration of climatic chambers
(...)
4 Objectives of calibration
The calibration of a climatic chamber determines any deviation between the values displayed by the chamber indicators and the climatological variables, air temperature and relative humidity, measured in those parts of the chamber volume provided for use or at individual points in the chamber volume. (...)
The objectives of calibration are thus the following :
Calibration of the indicators for temperature and relative humidity by comparison with values for air temperature and atmospheric humidity measured in the useful space using reference equipment (also specifying any such deviation and the necessary corrections.   (...)
6 Calibration methods
(...)
(A) Calibration refers to the useful volume as spanned by the measuring locations in the unloaded climatic chamber. (...)
(B) Calibration refers to the useful volume as spanned by the measuring locations in the unloaded climatic chamber. The climatic chamber can be loaded in line with the user's typical application or by filling at least 40 percent of the useful volume with test pieces.
(...)
7 Calibration procedures
*7.1 Arrangement of measuring locations*
(...) For chamber volumes of up to 2000 liters the requirements regarding the number and spatial positioning of the measuring points are as per DIN EN 60068, 3-5; i.e. the measuring locations are the corner points and the spatial center of the cuboid spanning the useful volume. (...)
The calibration result is only valid for that volume spanned by the measuring points. (...)
7.6 Humidity calibration
For the purpose of calibrating relative humidity in a climatic chamber subject to air circulation the absolute humidity and dewpoint Td or frost point Tf can be determined in the center of the useful volume and the spatial distribution of relative humidity can be calculated on the basis of the measured air temperature distribution. (...)

Miniature multi-sensor module for measuring temperature, humidity, and pressure with integrated EEPROM FH0D 46-C
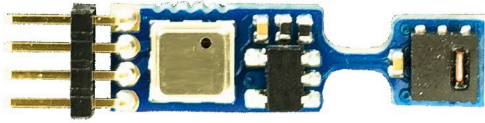
Our new plug-in digital multi-sensor module - with its miniature design and extremely low energy consumption - combines the measurable variables - temperature, atmospheric humidity, and atmospheric pressure. It takes a complete reading of all these ambient parameters and can thus accurately determine all humidity-related and pressure-dependent variables, e.g. the frequently needed mixture ratio (r).

It communicates its findings via an I²C interface; the user can selectively access individual sensor variables and data saved to the integrated EEPROM.

Before leaving our factory the sensor module is adjusted and assigned an electronic identification code that can be read out on

receipt of the appropriate command. The integrated EEPROM can be used to save the user's own adjustment data, fine tuning, or electronic ID data (ID number, comments text, etc.). Since the saved parameters are retained in the EEPROM, a multi-sensor module can only be exchanged or replaced with modules that are identically calibrated and have all the same data.

The module is specially designed with very good thermal isolation to withstand temperature influence / thermal conduction and thus ensure that all variables are measured precisely. This system - unlike analog measured value processing - virtually excludes the risk of varying line lengths or disturbance factors adversely affecting the accuracy of measured results.

Technical data

Temperature range	-40 to +85 °C
Accuracy	+5 to +60 °C, typical ±0.2 K
	+5 to +60 °C, maximum 0.4 K
	-20 to +85 °C, maximum 0.7 K
Reproducibility	typical ±0.1 K
Humidity range	5.0 to 98.0 % RH
Accuracy	10 to 90 % RH, maximum ±2 % RH at 23 °C ±5 K
	5 to 98 % RH, maximum ±4 % RH at 23 °C ±5 K
Hysteresis	typical ±1 % RH
Pressure range	300 to 1100 mbar
Accuracy	700 to 1100 mbar, ±2.5 mbar at 23 °C ±5 K
Internal memory	two-wire serial EEPROM 4 kbit (512 x 8 bit)

I²C interface	
Data rate	0 to 400 kHz
Sampling rate	2/sec at highest resolution
Electrical data	
Power supply	2.1 to 3.6 V, typical 3.3 V
Current consumption	during measuring typical 310 µA
	in standby typical 0.35 µA
Energy consumption	during measuring typical 1.02 mW
	in standby typical 1.16 µW
Connection	male strip connector, 4-pin, spacing 1.27 mm see pin assignment

lead-free, halogen-free, and RoHS-compliant
(restriction of hazardous substances)

Pin assignment

1 SDA
2 VCC
3 GND
4 SCL

Dimensions

22,8
5,2
2,4
5,7
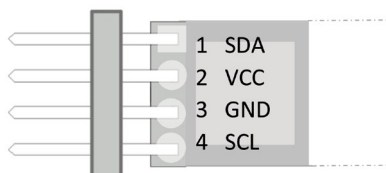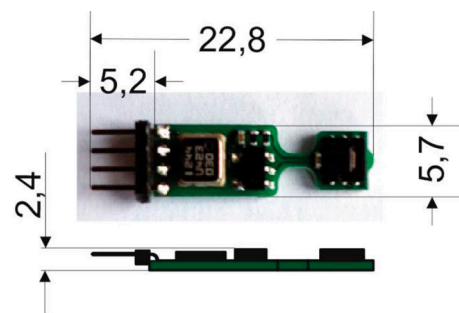
Variants

Miniature multi-sensor module for, humidity, temperature, and pressure with integrated EEPROM	Order no.
packaging unit 1 piece	FH0D46C
packaging unit 10 pieces	FH0D46CVE0010
packaging unit 100 pieces	FH0D46CVE0100

Air humidity

Digital sensor for temperature, humidity, and atmospheric pressure FHAD 46-Cx
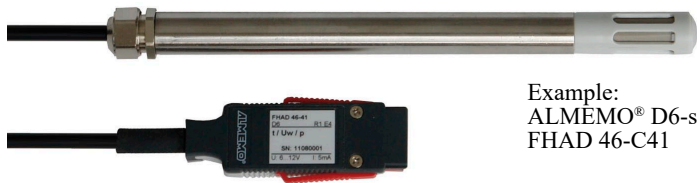
Example:
ALMEMO® D6-sensor
FHAD 46-C41

Digital sensor for temperature, humidity, and atmospheric pressure FHAD46-Cx, with ALMEMO® D6 plug
new: atmospheric pressure sensor integrated in the multi-sensor module, for automatic atmospheric pressure compensation

Common technical features FHAD 46-Cx

- All sensors in 1 multi-sensor module: capacitive digital sensor for humidity and temperature, digital atmospheric pressure sensor. Additional EEPROM data storage medium in the sensor module.
- The sensor module is thoroughly adjusted. All sensor characteristic and adjustment data are stored on the data storage medium of the sensor module itself. In the process of readjusting the individual sensors the adjustment values are directly saved on the data storage medium of the sensor module.
- *new:* Every sensor module has an unique serial number saved on the humidity sensor. The serial number is either displayed in the sensor menu of the measuring instrument or in the ALMEMO® Control software. Hence, calibrated sensor modules can clearly be assigned to the calibration certificate.
- Replacement sensor modules are inexpensive: The sensor module is pluggable and can simply be exchanged on-site. Full accuracy without any adjustment, especially with calibrated sensors. The ALMEMO® connecting cable and the ALMEMO® measuring instrument have no influence on the calibration.
- new: The atmospheric pressure is measured directly at the measuring point in the sensor tip. Hence, the atmospheric pressure dependent humidity variables are automatically pressure compensated.

- All relevant ambient parameters are measured with just one sensor.
- Humidity calculation on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor fw(t,p) for real mixed gas systems) This substantially widens the measuring range and improves the accuracy of humidity variable calculations.
- *new:* Humidity variable : Absolute humidity in g/m³
- The humidity variables are calculated from the three primary measuring channels (real measurable variables). temperature, relative humidity, atmospheric pressure
- Freely selectable measurable variables
  Four measuring channels are programmed (at our factory). temperature (°C, T, t), relative humidity (%H, RH, Uw), dewpoint (°C, DT, td), atmospheric pressure (mbar, AP, p)
  Other humidity variables can also be selected.
  mixture (g/kg, MH, r), absolute humidity (g/m³, AH, dv), vapor pressure (mbar, VP, e), enthalpy (kJ/kg, En, h)
  The configuration is performed on the ALMEMO® V7 measuring instrument or directly on the PC using the USB adapter cable ZA1919AKUV (see chapter "ALMEMO® Network technology").

Common technical data FHAD 46-Cx

Digital temperature / humidity sensor (including A/D converter)	
Operative range	depending on sensor type
Humidity	
Measuring range	0 to 98 % RH
Sensor	CMOSens® technology
Accuracy	±2.0 % RH in range 10 to 90 % RH
	±4.0 % RH in range 5 to 98 % RH
	at nominal temperature
Hysteresis	typical ±1 % RH
Nominal temperature	+23 °C ±5 K
Sensor operating pressure	Atmospheric pressure
Response time T_{63}	typical 8 seconds at +25 °C, 1 m/s (without filter)
Temperature	
Sensor	CMOSens® technology

Accuracy	typical ±0.2 K at 5 to 60 °C
	maximum ±0.4 K at 5 to 60 °C
	maximum ±0.7 K at -20 to +80 °C
Reproducibility	typical ±0.1 K
Response time T_{63}	typical 20 seconds (without filter)
ALMEMO® connecting cable	
PVC; Length (see variants) with ALMEMO® D6 plug	
Digital atm. pressure sensor (integrated in the multi-sensor module)	
Measuring range	700 to 1100 mbar
Accuracy	±2.5 mbar (at 23 °C ±5 K)
ALMEMO® D6 plug	
Refresh rate	1 seconds for all four channels
Supply voltage	6 to 13 VDC
Current consumption	3 mA

DAkkS or factory calibration KH9xxx temperature, humidity for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

Digital sensor for temperature, humidity, and atm. pressure FHAD 46-C4AG
in protective all-weather housing cable length up to 100 meters with ALMEMO® D6 plug

Technical data and variants
(see chapter „Meteorology")

Air humidity

Digital sensor for temperature, humidity, and atm. pressure FHAD 46-C4x
Version in stainless steel, with filter cap with ALMEMO® D6 plug

General description
and common technical data FHAD 46 Cx

Technical features

- Four measuring channels are programmed (at our factory).
  - temperature (°C, T, t),
  - relative humidity (%H, RH, Uw),
  - dewpoint (°C, DT, td),
  - atmospheric pressure (mbar, AP, p)

Technical data

Operative range	-20...+80 °C / 5...98 % RH	Filter cap	Metal-mesh filter, SK7
Mechanical design		Screw-fit cable gland	Splash-protected
Sensor tube	Stainless steel, diameter 12 mm		
	Length (see variants)		

Variants including manufacturer's test certificate

Order no.

Digital sensor for temperature, humidity, and atmospheric pressure, filter cap, stainless steel tube,
with fitted cable and ALMEMO® D6 plug.

	Order no.
Sensor length 160 mm, Connecting cable, length 2 meters	**FHAD46C41**
Sensor length 160 mm, Connecting cable, length 5 meters	**FHAD46C41L05**
Sensor length 160 mm, Connecting cable, length 10 meters	**FHAD46C41L10**
Sensor length 270 mm, Connecting cable, length 2 meters	**FHAD46C42**
Sensor length 270 mm, Connecting cable, length 5 meters	**FHAD46C42L05**
Sensor length 270 mm, Connecting cable, length 10 meters	**FHAD46C42L10**
Sensor length 530 mm, Connecting cable, length 2 meters	**FHAD46C43**
Sensor length 530 mm, Connecting cable, length 5 meters	**FHAD46C43L05**
Sensor length 530 mm, Connecting cable, length 10 meters	**FHAD46C43L10**
Replacement multi-sensor module, digital, adjusted, plug-in	**FH0D46C**

Protective caps

SK7   SK6   SK8

Dimensions :
length approx. 33 mm, diameter 12 mm

	Designation	Pore size	max. temp.*	Typical Application	Order no.
SK7	Metal-mesh filter in PC-housing	100 μm	120°C	Universal, for medium, contamination, also high humidity	ZB9600SK7
SK6	PTFE-Sinterfilter	50 μm	180°C	High chemical resistance	ZB9600SK6
SK8	Stainless steel sinter filter	10 μm	180°C	For severe mechanical stress, heavy contamination, strong air flow	ZB9600SK8

* Observe application range

Accessories

Brackets for wall mounting, distance from wall
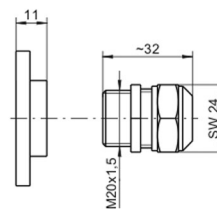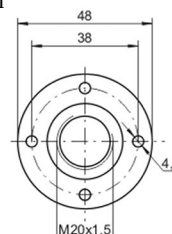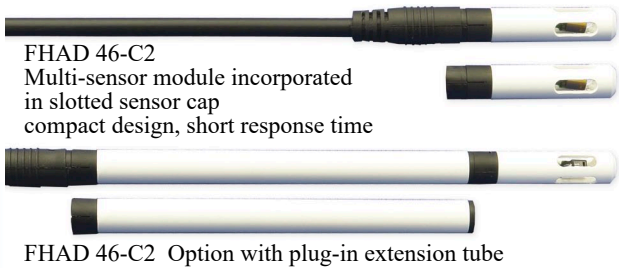approx. 40 mm
ZB9600W
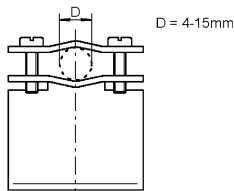
Movable brass screw connection
with plastic sealing ring
ZB9600KV20
Connecting flange for screw
connection,
hole circle 38 mm Ø
ZB9600F20

Air humidity

Digital sensor for temperature, humidity, and atmospheric pressure FHAD 46-C2
Version in plastic, with slotted sensor cap with ALMEMO® D6 plug

FHAD 46-C2
Multi-sensor module incorporated
in slotted sensor cap
compact design, short response time

FHAD 46-C2 Option with plug-in extension tube

FHAD 46-C2L00

- Four measuring channels are programmed (at our factory).   Dewpoint (°C, DT, td)
  Temperature (°C, T, t), Relative humidity (%H, RH, Uw)   Atmospheric pressure (mbar, AP, p).

Technical data

Operative range	-20 to +60 °C / 5 to 98 % RH	Extension tube	Ø 8 mm, length 97 mm
Mechanical design			
Sensor cap	Ø 8 mm, length 36 mm	General description and common technical data see FHAD 46-Cx	
Plug connection	Ø approx. 9 mm, IP40		

Variants including manufacturer's test certificate		**Order no.**
Digital sensor for temperature, atmospheric humidity, and atmospheric pressure, with multi-sensor module in slotted sensor cap, plug connector, including ALMEMO® connecting cable with coupling and ALMEMO® D6 plug.	Cable stub approx. : 80 mm (incl. multi-sensor module)	**FHAD46C2L00**
	Spare sensor element for FHAD462, digital, enclosed in slotted sensor cover, adjusted	**FH0D46C2**
Connecting cable, length 2 meters **FHAD46C2**	Extension tube, Ø 8 mm, length 97 mm,	
Connecting cable, length 5 meters **FHAD46C2L05**	plug-in, for FHAD 46-C2	**ZB0D462VR**
Connecting cable, length 10 meters **FHAD46C2L10**		

Digital sensor for temperature, humidity, and atm. pressure FHAD 46-C0
## Uncovered multi-sensor module with ALMEMO® D6 plug

FHAD 46-C0
Uncovered multi-sensor module
most compact design, short response time

- Four measuring channels are programmed (at our factory).   Dewpoint (°C, DT, td),
  Temperature (°C, T, t), Relative humidity (%H, RH, Uw)   Atmospheric pressure (mbar, AP, p).

Technical data

Operative range	-20 to +80 °C / 5 to 98 % RH	Multi-sensor module (dimensions over all) approx. 6 x 14 x 3 mm	
Mechanical design		Plug connection	Width approx. 7 mm

Variants including manufacturer's test certificate		**Order no.**
Digital sensor for temperature, humidity, and atmospheric pressure, with uncovered multi-sensor module, plug connector, including ALMEMO® connecting cable with coupling and ALMEMO® D6 plug.	Connecting cable, length 10 meters	**FHAD46C0L10**
	Replacement multi-sensor module, digital, adjusted, plug-in	**FH0D46C**
Connecting cable, length 2 meters **FHAD46C0**		
Connecting cable, length 5 meters **FHAD46C0L05**		

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 Rx
Wide operating temperature range Automatic atmospheric pressure compensation
Digital sensor with ALMEMO® D6 plug
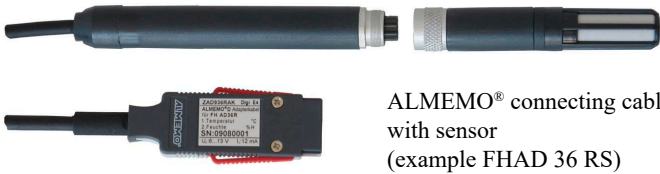
ALMEMO® connecting cable
with sensor
(example FHAD 36 RS)

**General features,
ALMEMO® D6 sensors**
see page 01.08
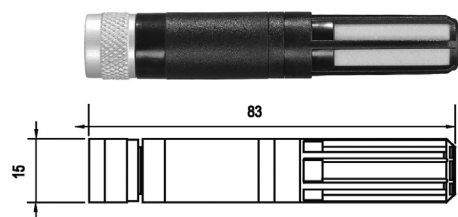
Common technical features FHAD 36 Rx

- Digital capacitive humidity sensor with integrated signal processor, designed to meet the highest accuracy requirements in humidity measurement
- Unique correction and adjustment process All sensor characteristics and adjustment data are saved in the humidity sensor itself.
- A digital atmospheric pressure sensor integrated in the ALMEMO® D6 plug itself provides automatic pressure compensation for all pressure-dependent humidity variables.
- Humidity calculation on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor fw(t,p) for real mixed gas systems) This substantially widens the measuring range and improves the accuracy of humidity variable calculations.
- Humidity variable, Absolute humidity in g/m³

- All relevant ambient parameters are measured with just one sensor.
- The humidity variables are calculated from the three primary measuring channels (real measurable variables). temperature, relative humidity, atmospheric pressure
- Freely selectable measurable variables
- Four measuring channels are programmed (at our factory). temperature (°C, T, t), relative humidity (%H, RH, Uw), dewpoint (°C, DT, td), atmospheric pressure (mbar, AP, p) Other humidity variables can also be selected: mixture (g/kg, MH, r), absolute humidity (g/m³, AH, dv), vapor pressure (mbar, VP, e), enthalpy (kJ/kg, En, h)
- This device can be configured directly on a PC using USB adapter cable ZA 1919 AKUV. (see chapter „Networking").

Common technical data FHAD 36 Rx

Digital temperature / humidity sensor (including A/D converter)

Operative range	depending on sensor type

Humidity

Sensor	capacitive
Measuring range	0 to 100 % RH
Adjusted	at +23 °C and 10%, 35%, 80% RH
Accuracy	±1.3 % RH (at +23°C ±5 K)
Reproducibility	0.3 % RH
Response time T_{63}	<15 seconds at typical 1 m/s (without filter)

Temperature

Sensor	Pt100 class A
Measuring range	-100 to +170 °C
	Please observe operative range ! (depending on sensor type)
Accuracy at +23 °C ±5 K	±0.2 K
Reproducibility	0.05 °C

Sensor connector on the sensor / sensor cable

Plug connector (Materials : anticorodal aluminum, anodized) IP65	

Operative range of the electronics

in the connecting cable (coupling) -40 to +90 °C	
in the grip (of hand-held sensors) -40 to +85 °C	

ALMEMO® connecting cable

Coupling (length = 100 mm) with cable, length = 2 or 5 meters (Materials : TPU, -40 to +90 °C) with ALMEMO® D6 plug	

Digital atm. pressure sensor (integrated in ALMEMO® D6 plug)

Measuring range	700 to 1100 mbar
Accuracy	±2.5 mbar (at 23 °C ±5 K)

ALMEMO® D6 plug

Refresh rate	1 second for all four channels
Supply voltage	6 to 13 VDC
Current consumption	12 mA

DAkkS or factory calibration KH9xxx temperature, humidity for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 RS
Automatic atmospheric pressure compensation. Digital sensor with ALMEMO® D6 plug

83

15

General description and common technical data
FHAD 36 Rx (see page 08.11)

Technical data

Operative range	-50 to +100 °C	Filter	Polyethylene
Sensor materials	Polycarbonate		

Accessorie	Order no.
Brackets for wall mounting (see page 08.05)	**ZB9600W**

Variants Including factory test certificate and polyethylene filter **Order no.**

High-precision digital temperature / humidity sensor, with plug connector, including ALMEMO® connecting cable with coupling
and ALMEMO® D6 plug, and integrated digital atmospheric pressure sensor

Connecting cable, length 2 meters	**FHAD36RS**
Same as above Connecting cable, length 5 meters	**FHAD36RSL05**

Filters

Variants **Order no.**

|	
Polycarbonate filter cartridge with a filter insert made from polyethylene for standard applications good response time and good protection against fine particulates	**ZB9636PE**
Polycarbonate filter cartridge with a filter insert made from stainless-steel wire fabric quickest response time not suitable for environments that are bioactive or contaminated with fine particulates (risk of congestion)	**ZB9636WM**
Polycarbonate filter cartridge with a filter insert made from PTFE (polytetrafluoroethylene) good protection against fine particulates and salt (maritime environment) slower response time	**ZB9636TF**
POM (polyoxymethylene) filter cartridge with a filter insert made from PTFE water-proof very good protection against fine particulates slow response time	**ZB9636FD2**

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 RIC
Industrial-standard design for high temperatures up to +170 °C
Automatic atmospheric pressure compensation. Digital sensor with ALMEMO® D6 plug

103
100/250
400/550/700
16
39
15
15
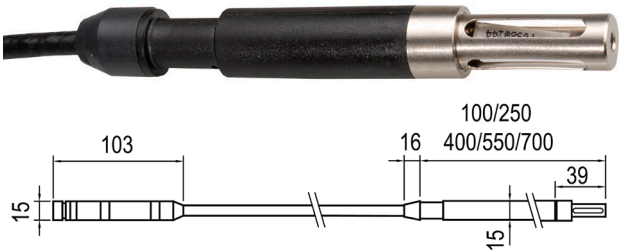
Sensor plug, high-temperature cable, sensor

General description
and common technical data
FHAD 36 Rx (see page 08.11)

Technical data

Operative range	-100 to +170 °C *
Sensor length	100 mm
(Other lengths 250 / 400 / 550 / 700 mm are available on request.)	
Sensor materials	PPS (polyphenylene sulfide)

Filter cartridge	Brass, nickel-plated
Filter	Stainless-steel wire fabric filter
Response time T_{63}	<10 seconds at typical 1 m/s, without filter

* Persistent use in the high-temperature range (>170 °C) may incur
a loss in accuracy and / or damage to the measuring cell.

Accessories   Order no.

Assembly screw fittings for 15 mm sensor Brass, nickel-plated
Thread M20x1.5 Viton® seal, up to +200 °C   **ZB9636KV**

Mounting flange Steel, nickel-plated Diameter 80 mm   **ZB9636F**

Variants Including factory test certificate and stainless-steel wire fabric filter   Order no.

High-precision digital temperature / humidity sensor, industry-standard, with high-temperature
sensor cable and plug connector, including ALMEMO® connecting cable with coupling and ALMEMO® D6 plug
Integrated digital atmospheric pressure sensor

Sensor cable, length = 2 meters, Connecting cable, length 2 meters	**FHAD36RIC102**
Same as above Sensor cable, length = 5 meters, Connecting cable, length 2 meters	**FHAD36RIC105**
Same as above Sensor cable, length = 2 meters, Connecting cable, length 5 meters	**FHAD36RIC102L05**
Same as above Sensor cable, length = 5 meters, Connecting cable, length 5 meters	**FHAD36RIC105L05**

Filter

for sensors with filter cartridge
for FHAD 36 RIC and FHAD 36 RHK

Variants   Order no.

| Stainless-steel wire fabric filter quickest response time	
not suitable for environments that are bioactive or contaminated with fine particulates (risk of congestion)	**ZB9636M15**
Stainless-steel sinter filter best protection in environments heavily contaminated with particulates	
good response time for low humidities (not to be used for high humidities)	**ZB9636S15**
PTFE filter good protection against fine particulates and salt (maritime environment) slower response time	**ZB9636T15**

Other designs are available on request

Industry-standard humidity sensor FHAD 36 RIM
in stainless steel Diameter 15 mm, -100 to +170 °C

Screw-fit humidity sensor FHAD 36 RIE, up to 100 bar,
stainless steel Thread G 1/2-inch, -50 to +170 °C

Air humidity

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 RHK
Hand-held sensor for temperatures up to +170 °C
Automatic atmospheric pressure compensation, Digital sensor with ALMEMO® D6 plug

(HK25 / HK40)
250 / 400

75   60   131   35   39   15   25   15

Sensor plug, cable, sensor with handle
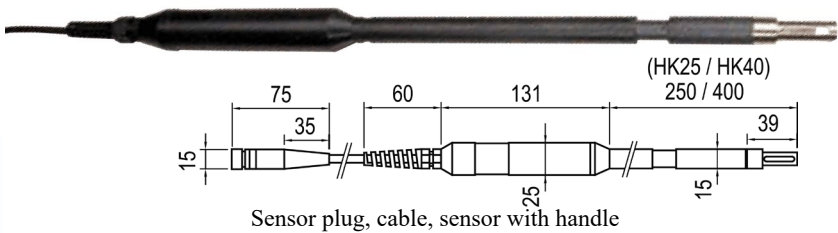
For on-site test measurements,
not for stationary installation

General description and
common technical data FHAD 36 Rx
(see page 08.11)

Technical data

Operative range	-100 to +150 / +170 °C (see variants)	Filter cartridge	Brass, nickel-plated
Operative range of the electronics in the grip -40 to +85 °C		Filter	Stainless-steel wire fabric filter
Sensor materials	Shaft PPS (polyphenylene sulfide)	Response time T_{63}	<10 seconds at typical 1 m/s, without filter
Grip	POM (polyoxymethylene)		

Variants Including factory test certificate and stainless-steel wire fabric filter   **Order no.**

High-precision digital temperature / humidity sensor
Handle with 2-meter sensor cable and plug connector, including ALMEMO® connecting cable, length 0.3 meters,
with coupling and ALMEMO® D6 plug Integrated digital atmospheric pressure sensor

Operative range up to +150 °C Sensor length 250 mm	**FHAD36RHK25**
Operative range up to +170 °C Sensor length 400 mm	**FHAD36RHK40**

Other designs are available on request

Humidity probe with pointed tip, Diameter 10 mm
for taking meas. in loose bulk materials, -40 to +85 °C

Humidity probe with flat blade 18 x 4 mm
for taking meas. in paper or textile stacks, -40 to +85 °C

Capacitive humidity sensor FHA 646 R, miniature sensor

- Compact sensor, extremely small dimensions
- Wide operating temperature range
- Particularly suitable for measuring operations between PCBs,

inside cases, in walls, ceilings, and insulation layers used in the construction industry, and for the protection of listed historic monuments

Technical data

Operative range	-30 to +100 °C, 5 to 98 % RH
Humidity measuring circuit	
Measuring range	0 to 100 % RH
Sensor	capacitive
Accuracy	±2 % RH in the range <90 % RH at nominal temperature
Reproducibility	<1% RH at nominal temperature
Nominal temperature	+25 ±3 °C
Response time T63	approx. 10 seconds at 1 m/s

Temperature measuring circuit	
Sensor	NTC type N
Accuracy	-20 to 0 ±0.4 K, 0 to +70 ±0.2 K
	+70 to +100 ±0.6 K
Reproducibility	0.1 K
Mechanical design	
Sensor tube	nickel-plated, 50 mm long, 5 mm Ø
Protective cap	None
Cable	High-temperature cable (up to +100 °C), 2 meters long, with ALMEMO® plug (no other lengths available)

> **!** The sensor can only be operated by plugging DIRECTLY onto an ALMEMO® device.
> (NOT with extension cables ZA9060VKx or ZA9090VKCx).
> Or, alternatively, the following sensor types can be used. FHAD36RS up to +100 °C (see page 08.08)
> FHAD462 or FHAD460 Compact design (see page 08.06)

Accessories	Order no.
PTFE filter, inside diameter 5 mm suitable for protection against dust, not water-proof	**ZB9646SKR**
Clamped screw connection with thread adapter for telescopic extension / extension set (maximum 80 °C)	**ZV9915KV**
Telescopic extension Ø 15 to 24 mm, 330 / 1010 mm	**ZV9915TV**
Extension set Ø 15 mm, 4 x 255 mm	**ZV9915VR3**

| Variants	Order no.
Miniature sensor for temperature / humidity, with fitted high-temperature cable, length 2 meters, with ALMEMO® plug	**FHA646R**

DAkkS or factory calibration KH9xxx temperature, humidity for measuring chain (sensor + device) (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

Digital sensor for measuring temperature and humidity FHAD 46-C7,
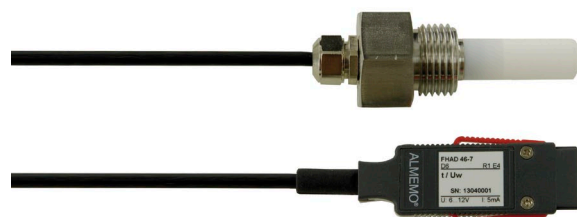
Pressure-sealed variant up to 16 bar, with ALMEMO® D6 plug

- Compact sensor made from stainless steel
- Screw thread, for pressure pipes
- Option - adapter for compressed air pipes
- Capacitive digital sensor for humidity and temperature. Additionally EEPROM data storage medium in the multi-sensor module.
- The sensor module is thoroughly adjusted. All sensor characteristic and adjustment data are stored on the data storage medium of the sensor module itself. In the process of readjusting the individual sensors, the adjustment values are directly saved on the data storage medium of the sensor module.
- *new:* Every sensor module has an unique serial number saved on the humidity sensor. The serial number is either displayed in the sensor menu of the measuring instrument or in the ALMEMO® Control software. Hence, calibrated sensor modules can clearly be assigned to the calibration certificate.
- Replacement sensor modules are inexpensive: The sensor module is pluggable and can simply be exchanged on-site. Full accuracy without any adjustment, especially with calibrated sensors. The ALMEMO® connecting cable and the ALMEMO® measuring instrument have no influence on the calibration.
- The humidity variables are calculated from the two primary measuring channels (real measurable variables): temperature, relative humidity
- Three measuring channels are programmed: temperature (°C, T, t), relative humidity (%H, RH, Uw), dewpoint (°C, DT, td) One further humidity variable can also be selected: mixture (g/kg, MH, r), absolute humidity (g/m³, AH, dv), vapor pressure (mbar, VP, e), enthalpy (kJ/kg, En, h) The configuration of the channels and the input of the system pressure for the automatic pressure compensation of the pressure dependent humidity variables is performed on the ALMEMO® V7 measuring instrument or directly on the PC using the USB adapter cable ZA1919AKUV (see chapter "ALMEMO® Network technology").

Technical data

Operative range	-20 to +80 °C, 5 to 98 % RH
Digital temperature / humidity sensor (including A/D converter)	
Humidity	
Measuring range	0 to 98 % RH
Sensor	CMOSens® technology
Accuracy	±2.0 % RH in range 10 to 90 % RH
	±4.0 % RH in range 5 to to 98 % RH
	at nominal temperature
Hysteresis	typical ±1 % RH
Nominal temperature	+23 °C ±5 K
Sensor operating pressure	up to 16 bar
Temperature	
Sensor	CMOSens® technology
Accuracy	typical ±0.2 K at 5 to 60 °C
	maximum ±0.4 K at 5 to 60 °C
	maximum ±0.7 K at -20 to +80 °C
Reproducibility	typical ±0.1 K

ALMEMO® connecting cable	
PVC Length (see variants) with ALMEMO® D6 plug	
ALMEMO® D6 plug	
Refresh time	1 second for all four channels
Supply voltage	6 to 13 VDC
Current consumption	3 mA
Mechanical design	
Sensor	Stainless steel, diameter 12 mm
	Overall length approx. 77 mm
Filter cap	PTFE sinter filter SK6
Process connection	Male thread G 1/2-inch
	Fitted length 48 mm, Width across flats 27
Screw-fit cable gland	Splash-protected

Adapter for compressed air pipes

Accessories

	Order no.
Adapter for compressed air pipes	ZB96467AP
PTFE sinter filter (spare) (see page 08.09)	ZB9600SK6
Stainless-steel sinter filter (see page 08.09)	ZB9600SK8

Variants

	Order no.
Digitaler sensor for temperature and humidity, filter cap PTFE, pressure-sealed variant, with fitted cable and ALMEMO® D6 plug, manufacturer's test certificate	
Connecting cable, length 2 meters	**FHAD46C7**
Connecting cable, length 5 meters	**FHAD46C7L05**
Connecting cable, length 10 meters	**FHAD46C7L10**
Replacement sensor element, digital, adjusted, plug-in	**FH0D46C**

DAkkS or factory calibration KH9xxx, temperature, humidity, for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

ALMEMO® dewpoint sensor FHA 646 DTC1, dewpoint transmitter MT 8716 DTC1

- Especially suitable for monitoring pressurized systems
- Digital transfer of measured values to the ALMEMO® display device (avoids risk of inaccuracy on connecting lines or display section itself)
- High-level accuracy sustained down to -80 °C

- Quick response time
- Displayed variables temperature, relative humidity, dewpoint
- Process connection for high pressures (option, up to 350 bar).

Technical data

Measuring range	-80 to +20°C dewpoint temperature (DT)
Measuring accuracy	± 0.5 °C from -10 to +20 °C DT
	typical ±2 °C DT at -40 °C DT
Measuring channels (FHA646DTC1 only)	
temperature	-20.0 to +70.0 °C
Relative humidity	0 to 98.0 % RH
Dewpoint	-80.0 to +20.0 °C (DT)
Operating temperature	-20 to +70 °C
Process connection	Screw thread G 1/2-inch, stainless steel
Protective cap	Sintered stainless steel filter
Pressure range	-1 to +50 bar standard
Storage temperature	-40 to +80 °C

FHA 646 DTC1

Output	ALMEMO® digital
Power supply	via ALMEMO® plug, approx. 5 mA
Connection	Cable, 1.5 meters, with ALMEMO® plug

MT 8716 DTC1

Output	4 to 20 mA / -80 to +20 °C (DT), 2 wires
Power supply	10 to 30 VDC, load <500 ohms
Connection	Transmitter connector

Housing

Material	Polycarbonate
Protective class	IP65

Accessories   Order no.

Screw-on measuring chamber for connecting a dewpoint transmitter to compressed air pipes via a ball valve up to maximum 16 bar including perforated protective cap   **ZB9646DTCK**
Advantage high-speed measuring without waiting for installation.

Option

Dewpoint sensor for process pressure up to 350 bar   **OA9646DTCP**
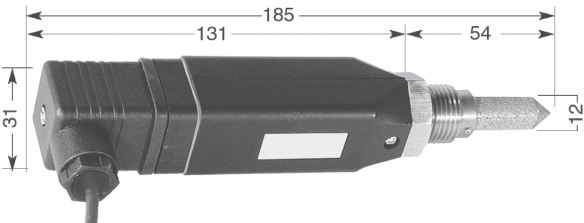
Variants including factory calibration certificate	Order no.
ALMEMO® dewpoint sensor with connecting cable, 1.5 meters long, and ALMEMO® plug	**FHA646DTC1**
Dewpoint transmitter with current output, including connector	**MT8716DTC1**
Factory calibration KH93xx, dewpoint, for digital sensor (see chapter „Calibration certificates")	

Digital psychrometers, FNAD 46 and FNAD 46-3 with ALMEMO® D6 plug
with integrated atmospheric pressure sensor, for automatic pressure compensation
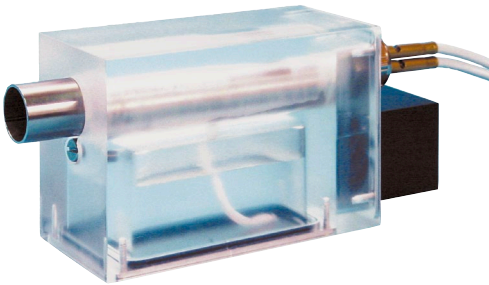
**General features,
ALMEMO® D6 sensors**
see page 01.08

- *new:* A digital atmospheric pressure sensor integrated in the ALMEMO® D6 plug itself provides automatic pressure compensation for all pressure-dependent humidity variables.
- *new:* Humidity calculation on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor fw(t,p) for real mixed gas systems) This substantially widens the measuring range and improves the accuracy of humidity variable calculations.
- *new:* Humidity variable Absolute humidity in g/m³
- High-precision NTC sensors for dry temperature and wet temperature
- Temperatures are measured using a 24-bit A/D converter incorporated in the ALMEMO® D6 plug.
- The humidity variables are calculated from the three primary measuring channels (real measurable variables): Dry temperature, wet temperature, atmospheric pressure
- Freely selectable measurable variables
Four measuring channels are programmed (at our factory): dry temperature (°C, TT, t), wet temperature (°C, HT, tw), relative humidity (%H, RH, Uw), atmospheric pressure (mbar, AP, p)
- Other humidity variables can also be selected: dewpoint (°C, DT, td), mixture (g/kg, MH, r), absolute humidity (g/m³, AH, dv), vapor pressure (mbar, VP, e), enthalpy (kJ/kg, En, h)
This device can be configured directly on a PC using USB adapter cable ZA 1919 AKUV. (see chapter „Networking").

Technical data, FNAD 46 and FNAD 46-3

Digital atmospheric pressure sensor (integrated in ALMEMO® D6 plug)	
Measuring range	700 to 1100 mbar
Accuracy	±2.5 mbar (at 23 °C ±5 K)
A/D converter incorporated in ALMEMO® D6 plug	
Inputs	2 NTC sensors (clamped connection in plug)
Resolution	0.01 K

|	
Linearization	error-free computing method according to Galway Steinhart (no approximations)
Accuracy	±0.05 K
Nominal temperature	23 °C ±2 K
Temperature drift:	0,004 %/K (40 ppm)
Calculated humidity variables	Analytic equation (not an approximation)
Refresh rate	0.4 seconds for all four channels

Hand-held digital psychrometer FNAD 46

For test measurements

General description and common technical data
FNAD 46 (see page 08.18)

Technical data

Operating temperature	0 to +60 °C (no ice)
Humidity measuring range	10 to 100% RH
Measuring system Accuracy	psychrometric ±1 % RH under nominal conditions
Nominal conditions	+25 °C ±3 K, 1013 mbar, 50 % RH
Temperature sensors Accuracy	2 x NTC type N ±0,2 K at 0 to 60 °C
Ventilator power supply	via ALMEMO® D6 plug
Housing	Plastic
Dimensions	Ø 50 mm, length 245 mm
Weight	approx. 300 g
Sensor connector	Built-in plug
ALMEMO® connecting cable	coupling, 1.5 meters, PVC cable with ALMEMO® D6 plug
Supply voltage	9 to 13 VDC
Current consumption	20 mA

Stationary digital psychrometer FNAD 46-3
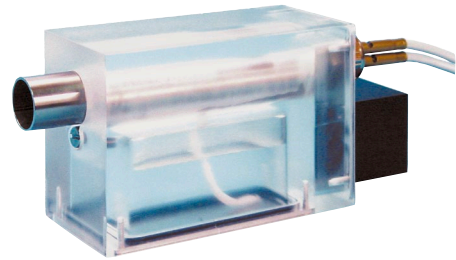
Version optimized for long-term measuring operations
Automatic humidification of the wick after filling the water
tank.

General description and common technical data
FNAD 46-3 (see page 08.18)

Technical data

Operating temperature	0 to +90 °C (no ice)
Humidity measuring range	10 to 100% RH
Measuring system Accuracy	psychrometric ±1 % RH under nominal conditions
Nominal conditions	+25 °C ±3 K, 1013 mbar, 50 % RH
Temperature sensors Accuracy	2 x NTC type N ±0,2 K at 0 to 70 °C, ±0,4 K at 70 to 90 °C
Ventilator power supply	12 VDC via mains unit, cable approx. 1.5 meters (included in delivery)
Housing	Plastic PMMA
Dimensions	175 x 50 x 75 mm (LxWxH)
Weight	approx. 890 g
ALMEMO® connecting cable	Cable, FEP / silicone, 5 meters with ALMEMO® D6 plug
Supply voltage	6 to 13 VDC
Current consumption	4 mA

Accessories	Order no.
Extension pipe, 200 mm long	**ZB9846VR**
Plastic suction hose, 300 mm long	**ZB9846PS**
Spare wicks (2 pieces)	**ZB9846ED**

Accessories	Order no.
Extension cable for mains units, 3-pin bayonet coupling, length 5 meters	**ZB5090VK05**
Spare wicks (2 pieces)	**ZB98462ED**

| Variants	Order no.
Hand-held digital psychrometer with NTC sensor Hand-held psychrometer, connecting cable with ALMEMO® D6 plug, integrated digital atmospheric pressure sensor, water bottle, two wicks	**FNAD46**

Variants	Order no.
Digital psychrometer with NTC sensor Psychrometer, fitted cable, with ALMEMO® D6 plug, integrated digital atmospheric pressure sensor, mains unit, water bottle, two wicks, carry case	**FNAD463**

DAkkS or factory calibration KH91xx, temperature, humidity, for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

Air humidity

Psychrometer FPA 836-3
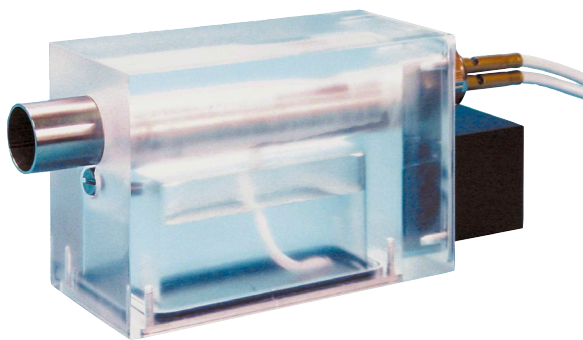
- Optimized for long-term measuring operations
- Especially suitable for high temperatures

Recommended for measuring instrument ALMEMO® 710

ALMEMO® 710

When measuring atmospheric humidity the combination of precision measuring instrument ALMEMO® 710 and Pt100 psychrometer FPA 836-3 ensures a substantially higher level of accuracy and a wider measuring range. The measuring instrument incorporates a digital atmospheric pressure sensor for compensation purposes.

On the ALMEMO® 710 atmospheric humidity is calculated on the basis of formulae as per Dr. Sonntag and enhancement factor as per W. Bögel (correction factor fw(t, p) for real mixed gas systems). Variables are calculated from the three primary measuring channels (real measurable variables) - dry temperature (°C, TD, t), wet temperature (°C, TW, tw), and atmospheric pressure (mbar, AP, p). Humidity variables can be selected: relative humidity (%H, RH, Uw), dewpoint (°C, DT, td), mixture (g/kg, MH, r), absolute humidity(g/m3, AH, dv), vapor pressure (mbar, VP, e), enthalpy (kJ/kg, En, h)

For ALMEMO® 710's general description and technical data see Chapter „ALMEMO® universal measuring instruments"

Recommendations for calibration laboratories and quality assurance

ALMEMO®¹ 1036-2

Reference measuring instrument ALMEMO® 1036-2 is ideally suited for use in calibration laboratories and quality assurance procedures. When measuring atmospheric humidity the combination of reference measuring instrument ALMEMO® 1036-2 and precision psychrometer FPA-836-3P3 ensures very high levels of resolution, precision, and linearity. Resolution parameters: temperature Pt100 0.001 K, relative humidity 0.01%, dewpoint 0.01K The measuring instrument incorporates a digital atmospheric pressure sensor for compensation purposes. These devices are offered in a set including the sensor and a DAkkS calibration certificate.

For general description and technical data see Chapter „ALMEMO® reference measuring instruments".

Recommendations for measuring operations using other ALMEMO® devices

Digital NTC psychrometer FNAD 46-3 with integrated atmospheric pressure sensor and new humidity calculation procedure
For general description and technical data see Catalog, page 08.14.

Psychrometer FPA 836-3

Technical data

Atmospheric humidity

Operating temperature	0 to 90 °C
Measuring range	approx. 10 to 100 % RH
Measuring system	psychrometric
Accuracy	±1 % RH under nominal conditions using ALMEMO® 710 (new humidity calculation procedure)
Nominal conditions	+25 ±3 °C, 1013 mbar, 50% RH

Temperature

Sensor	2 x Pt100 ilm resistor
Accuracy	class B, ALMEMO® adjusted
Ventilator power supply	12 VDC via mains unit, cable approx. 1.5 meters (included in delivery)

Mechanical design

Housing	Plastic PMMA (polymethyl methacrylate, acrylic)
Dimensions	175 x 50 x 75 mm (LxWxH)
Weight	approx. 890 g
Cable	FEP / silicone, 5 meters with ALMEMO® plug 2 cables, 2 plugsr

Accessories   Order no.

Automatic compensation of pressure-dependent variables affecting atmospheric humidity
Psychometric measurable variables depend on the ambient atmospheric pressure, . ALMEMO® plug-in pressure probe FDAD12SA measures the barometric atmospheric pressure. The ALMEMO® measuring instrument thus compensates pressure-dependent humidity variables.

ALMEMO® plug-in pressure probe for barometric pressure 700 to 1100 mbar, without pressure connection sleeve
(For version with pressure connection sleeve and technical data, see Catalog, page 10.10).   **FDAD12SA**
Option with programming for automatic atmospheric pressure compensation (designation *P)   **OA9000PK**
Spare wicks (2 pieces)   **ZB98462ED**
Extension cable for mains units, 3-pin bayonet coupling, length 5 meters   **ZB5090VK05**

Variants   Order no.

(including mains plug, water bottle, two wicks)
Psychrometer with 2 x Pt100 sensors, including connecting cable (two ALMEMO® plugs)   **FPA8363**

DAkkS or factory calibration KH9xxx, temperature, humidity, for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

Air humidity

Digital temperature / humidity transmitter MH8D46 with double analog output V or mA

Transmitter
with open housing

- Digital sensor element
  All key sensor characteristics, settings, and adjustment data are saved in the sensor element itself.
- Plug-in sensor element
  Spare elements are inexpensive; a replacement can be fitted on site quickly and easily by virtually anyone; it will be fully accurate straight away needing no special adjustment.
- Digital transfer of measured values from the sensor element to the transmitter
- Factory or DAkkS calibration is erformed on the sensor element alone. Fully accurate - irrespective of connecting cable and transmitter

- Four climate variables can be measured: Double analog output for temperature and one humidity variable relative humidity / dewpoint / mixture ratio
- Limit value relays available on request
- The transmitters can be configured via the internal display and the keypad.
- The analog output type (10 V or 20 mA) can be selected (via the keypad); the analog output range can be programmed.
- Display of measured value, channel, units, humidity range, analog start, analog end, and analog type
- The sensor tube can be connected either directly by plugging onto the transmitter itself or via a connecting cable.
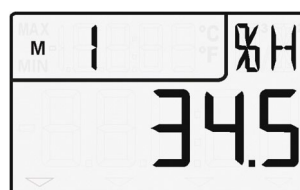- Suitable for conduit mounting or wall mounting

Technical data

Operative range	Sensor -20 to +80 °C, 5 to 98 % RH	Output type	0 to 10 V, 0 to 20 / 4 to 20 mA, selectable
	Electronics -10 to +60 °C, IP65	Resolution	16 bit
		Accuracy	0.1 % of final value
Humidity sensor		Temperature drift	10 ppm / K
Measuring range	0 to 100 % RH	Time constant	100 µs
Sensor	CMOSens® technology	Connection	Cable, via screwless clamp connector,
Fixed measuring period / output period approx. 3 seconds			with cable bushing
Accuracy	±1.8 % RH in range 20 to 90 % RH		Cable diameter 2 to 5 mm
	±2.3 % RH in range 10 to < 20 % RH		Limit value relays available on request
	at nominal temperature		
Hysteresis	typical ±1 % RH	Standard equipment	
Nominal temperature	+25 °C	Display, internal	2-row LCD 7 segments
Sensor operating pressure	Atmospheric pressure		4 1/2 and 5 characters 2 digits
Response time T_{63}	typical 8 seconds at +25 °C, 1 m/s		16 segments
	(without filter)	Operation, internal	3 keys
Temperature sensor		Power supply	
Sensor	CMOSens® technology	DC voltage	9 to 30 VDC
Fixed measuring period / output period approx. 3 seconds		Current consumption	30 mA + 1.2·IOut
Accuracy	±0.3 K at +25 °C	Connection	Cable, via screwless clamp connector,
	±0.4 K at +10 to +40 °C		with cable bushing
	±1.3 K at -20 to +80 °C		Cable diameter 2 to 5 mm
Reproducibility	typical ±0.1 K	Mechanical design	
Response time T_{63}	typical 20 seconds (without filter)	Sensor tube	Stainless steel, diameter 12 mm
Outputs		Protective cap	SK7, metal-mesh filter
Double analog output	Digital-to-analog converter (DAC) electr. isol.	Housing	Die-cast aluminum, closed cover
	0 to 10 V, load >100 kilohms	Dimensions	100 x 100 x 60 mm (LxWxH)
	0 to 20 mA, load <500 ohms	Protective class	IP65 (with sensor tube or connecting cable plugged in)

Display of measured values and programming (housing open)
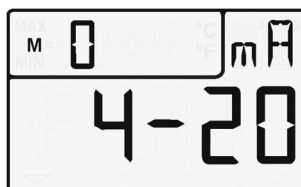
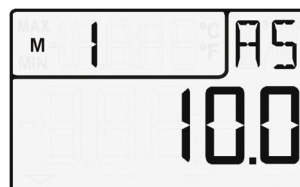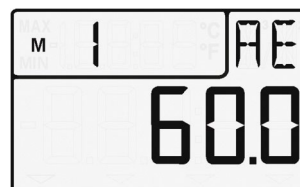|		
Measured value display, channel M0, temperature	Measured value display, channel M1, humidity variable, e.g. relative humidity	Selecting the humidity variable, e.g. relative humidity, % RH
Selecting the analog output type, e.g. 4 to 20 mA	Programming the analog start	Programming the analog end
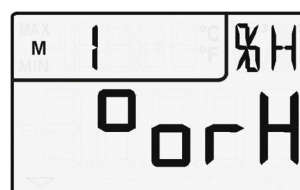
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Accessories

	Order no.		Order no.
Angle bracket for wall mounting	**ZB8D00W**	Connecting cable between sensor tube and transmitter	
Rubber gasket (mat) for mounting the housing directly on a conduit wall (immersion depth = sensor length + approx. 42 mm plug length)	**ZB8D00GD**	Length = 2 meters	**ZH9D46VK02**
		Same as above Length = 5 meters	**ZH9D46VK05**
		Same as above Length = 10 meters	**ZH9D46VK10**
Movable brass screw with plastic sealing ring (see page 08.05)	**ZB9600KV20**	Spare sensor, complete Sensor element inside sensor tube including protective cap SK7	
Connecting flange for screw connection, pitch circle diameter 38 mm (see page 08.05)	**ZB9600F20**	Sensor length = 125 mm	**FH9D461K1**
		Same as above Sensor length = 265 mm	**FH9D461K2**
Protective caps (see page 08.05)		Same as above Sensor length = 525 mm	**FH9D461K3**
Mains plug, 100 to 240 VAC, 12 VDC, 2 A	**ZB1012NA10**	Replacement sensor element, digital, adjusted, plug-in	**FH0D46**

Variants including manufacturer's test certificate | | Order no.

Digital transmitter for temperature and humidity

	Order no.
with double analog output, 10 V or 20 mA (selectable via keypad), internal display, 3 keys, aluminum housing, IP65, with plug-in digital sensor, sensor length = 125 mm	**MH8D461K1**
Same as above Sensor length = 265 mm	**MH8D461K2**
Same as above Sensor length = 525 mm	**MH8D461K3**

DAkkS or factory calibration KH9xxx, temperature, humidity, for digital sensor (see chapter „Calibration certificates").
DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.