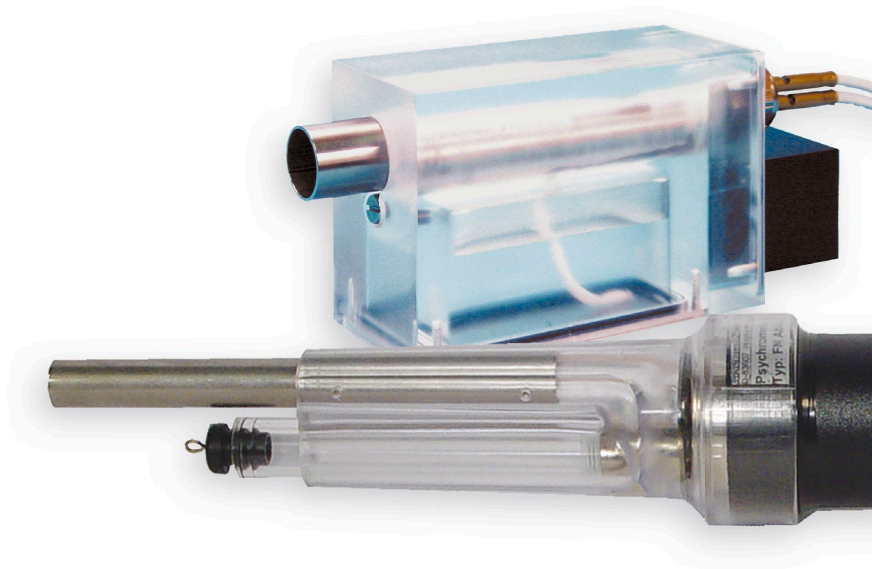


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Air humidity



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

Hygrometric Air Humidity Measurement

Hygrometric sensors are equipped with a measuring strip, which lengthens or tightens depending on the humidity. The measuring strip consists of many single fibers (measuring harp), which are made

from organic or synthetic material.

Advantage:

- simple and low cost measuring technology, also usable for contaminated environments

- easy to clean

Disadvantage:

- limited accuracy
- limited measuring range
- slow measurement

Dielectric Measurement of Moisture in Materials

The measurement of the moisture in materials is performed indirectly via the determination of the dielectric constant. This is performed by using a capacity measurement via a high-frequency electrical field,

which penetrates the material without disturbances.

Advantage:

- simple and fast measuring technology
- non-destructive contact measurement

- long term use is possible

Disadvantage:

- limited accuracy

Measurement of the Moisture in Materials according to the Principle of Conductivity

The measurement of the moisture in materials is performed indirectly via the determination of the electrical resistance, which depends on the moisture content of the material.

Advantage:

- simple and fast measuring technology

Disadvantage:

- limited accuracy
- probe insertions

- only for short term control measurements
- measured values depend on various material parameters

Dew Point Determination with CCC Dew Point Probes

The dew point sensor is equipped with an integrated sensor chip (CCC dew point principle according to Heinze), which is mounted on a cooling element. The sensor unit is also connected to a control circuit that regulates the operating current of the cooling element so that a defined con-

densate is established. The resulting 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

- wide measuring range

Disadvantage:

- high-sophisticated measuring method
- not suitable for quick control measurements
- cannot be used at temperatures below 0°C

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

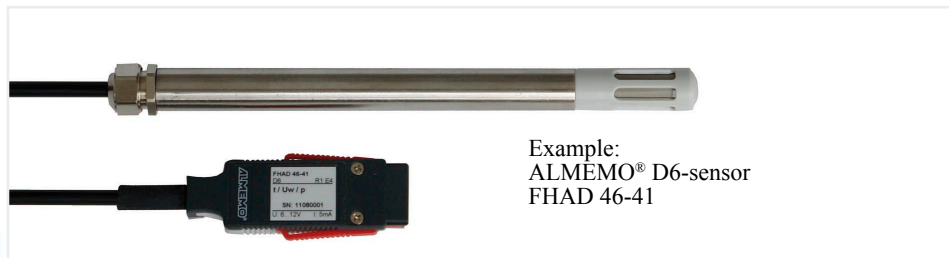
Disadvantage:

- 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 m ³ 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.

Digital sensor for temperature, humidity, and atmospheric pressure FHAD46-x



Example:
ALMEMO® D6-sensor
FHAD 46-41

Digital sensor for temperature, humidity, and atmospheric pressure FHAD46-x, with ALMEMO® D6 plug with integrated atmospheric pressure sensor for automatic pressure compensation

Common technical features FHAD 46x

- Digital capacitive humidity sensor with integrated signal processor
- All sensor characteristics and adjustment data are saved in the humidity sensor element itself.
- Humidity sensor element, plug-in : 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.
- **new:** A digital atmospheric pressure sensor integrated in the ALMEMO® D6 plug itself provides automatic pressure compensation for all pressure-dependent humidity variables.
- All relevant ambient parameters are measured with just one sensor.
- **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
- 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 on a PC using USB adapter cable ZA1919AKUV. (see page 04.05).

Common technical data FHAD 46x

Digital temperature / humidity sensor (including A/D converter)
Operative range depending on sensor type

Humidity

Measuring range	0 to 100 % RH
Sensor	CMOSens® technology
Accuracy	±1.8 % RH in range 10 to 90 % RH at nominal temperature
Hysteresis	typical ±1 % RH
Nominal temperature	+25 °C
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	±0.3 K at +25 °C ±0.4 K at +10 to +40 °C ±1.3 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 ALMEMO® D6 plug)

Measuring range	700 to 1100 mbar
Accuracy	±2.5 mbar (at 0 to +65 °C)

ALMEMO® D6 plug

Refresh rate	2 seconds 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.

Digital sensor for temperature, humidity, and atm. pressure FHAD46-4AG in protective all-weather housing cable length up to 100 meters with ALMEMO® D6 plug



Technical data and variants
(see chapter „Meteorology“)

Digital sensor for temperature, humidity, and atm. pressure FHAD 46-4x

Version in stainless steel, with filter cap with ALMEMO® D6 plug



General description
and common technical data FHAD 46 x

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.

Sensor length 160 mm, Connecting cable, length 2 meters
 Sensor length 160 mm, Connecting cable, length 5 meters
 Sensor length 160 mm, Connecting cable, length 10 meters
 Sensor length 270 mm, Connecting cable, length 2 meters
 Sensor length 270 mm, Connecting cable, length 5 meters
 Sensor length 270 mm, Connecting cable, length 10 meters
 Sensor length 530 mm, Connecting cable, length 2 meters
 Sensor length 530 mm, Connecting cable, length 5 meters
 Sensor length 530 mm, Connecting cable, length 10 meters
 Replacement sensor element, digital, adjusted, plug-in

FHAD4641
FHAD4641L05
FHAD4641L10
FHAD4642
FHAD4642L05
FHAD4642L10
FHAD4643
FHAD4643L05
FHAD4643L10
FH0D46

Protective caps

Dimensions :
length approx. 33 mm, diameter 12 mm

SK7



SK6



SK8



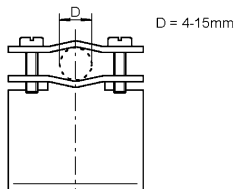
	Designation	Pore size	max. temp.*	Typical Application	Order no.
SK7	Metal-mesh filter in PC-housing	100 µm	120°C	Universal, for medium, contamination, also high humidity	ZB9600SK7
SK6	PTFE-Sinterfilter	50 µm	180°C	High chemical resistance	ZB9600SK6
SK8	Stainless steel sinter filter	10 µm	180°C	For severe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

* Observe application range

Accessories

Brackets for wall mounting, distance from wall approx. 40 mm

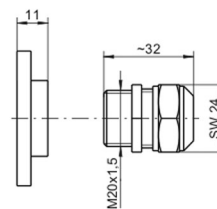
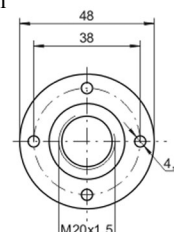
ZB9600W



Movable brass screw connection with plastic sealing ring

ZB9600KV20

Connecting flange for screw connection, hole circle 38 mm Ø
ZB9600F20



Digital sensor for temperature, humidity, and atmospheric pressure FHAD46-2
Version in plastic, with slotted sensor cap with ALMEMO® D6 plug



FHAD462
Sensor element incorporated in slotted sensor cap
compact design, short response time



FHAD462 Option with plug-in extension tube



FHAD462L00

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

Variants including manufacturer's test certificate

Digital sensor for temperature, atmospheric humidity, and atmospheric pressure, with sensor element in slotted sensor cap, plug connector, including ALMEMO® connecting cable with coupling and ALMEMO® D6 plug.

Connecting cable, length 2 meters	FHAD462
Connecting cable, length 5 meters	FHAD462L05
Connecting cable, length 10 meters	FHAD462L10

Order no.

Cable stub approx. : 80 mm (incl. sensor element) **FHAD462L00**

Spare sensor element for FHAD462, digital, enclosed in slotted sensor cover, adjusted **FH0D462**


Extension tube, Ø 8 mm, length 97 mm, plug-in, for FHAD462 **ZB0D462VR**

Other designs are available on request

Sensor with terminal box FHD 462 KL for wall mounting
Terminal box with plug-in digital temperature / humidity sensor, cable lengths up to 100 meters



Digital sensor for temperature, humidity, and atm. pressure FHAD 46-0
Uncovered sensor element with ALMEMO® D6 plug



FHAD460
Uncovered sensor element
most compact design, short response time

- 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 to +80 °C / 5 to 98 % RH	Sensor element (dimensions over all) approx. 6 x 14 x 3 mm
Mechanical design		Plug connection Width approx. 7 mm

Variants including manufacturer's test certificate

Digital sensor for temperature, humidity, and atmospheric pressure, with uncovered sensor element, plug connector, including ALMEMO® connecting cable with coupling and ALMEMO® D6 plug.

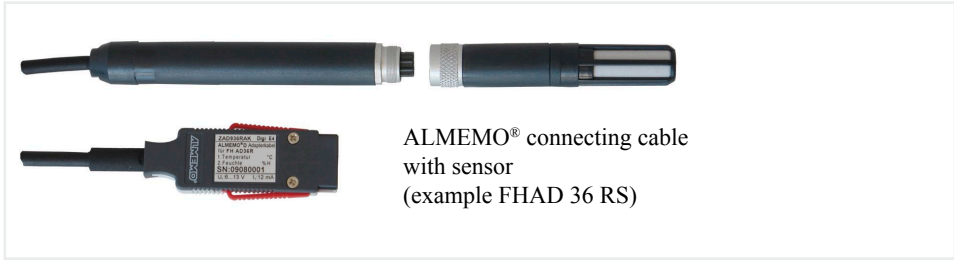
Connecting cable, length 2 meters	FHAD460
Connecting cable, length 5 meters	FHAD460L05

Order no.

Connecting cable, length 10 meters **FHAD460L10**

Replacement sensor element, digital, adjusted, plug-in **FH0D46**

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.
- **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
- 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

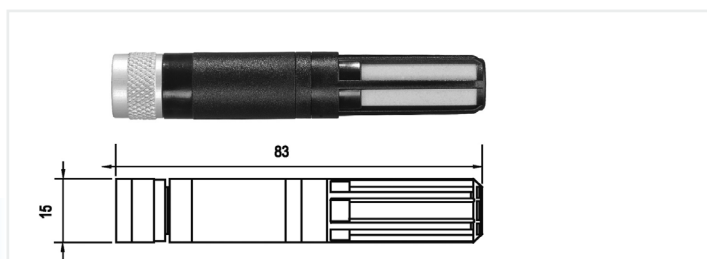
Digital temperature / humidity sensor (including A/D converter)		Sensor connector on the sensor / sensor cable	
Operative range		Plug connector (Materials : anticorodal aluminum, anodized) IP65	
depending on sensor type			
Humidity		Operative range of the electronics	
Sensor	capacitive	in the connecting cable (coupling) -40 to +90 °C	
Measuring range	0 to 100 % RH	in the grip (of hand-held sensors) -40 to +85 °C	
Adjusted	at +23 °C and 10%, 35%, 80% RH		
Accuracy	±1.3 % RH (at +23°C ±5 K)	ALMEMO® connecting cable	
Reproducibility	0.3 % RH	Coupling (length = 100 mm) with cable, length = 2 or 5 meters	
Response time T ₆₃	<15 seconds at typical 1 m/s (without filter)	(Materials : TPU, -40 to +90 °C) with ALMEMO® D6 plug	
Temperature		Digital atm. pressure sensor (integrated in ALMEMO® D6 plug)	
Sensor	Pt100 class A	Measuring range 700 to 1100 mbar	
Measuring range	-100 to +200 °C *	Accuracy ±2.5 mbar (at 0 to +65 °C)	
	Please observe operative range ! (depending on sensor type)	ALMEMO® D6 plug	
Accuracy at +23 °C ±5 K	±0.2 K	Refresh rate 1 second for all four channels	
Reproducibility	0.05 °C	Supply voltage 6 to 13 VDC	
		Current consumption 12 mA	

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

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.

10/2013 • We reserve the right to make technical changes.

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



General description and common technical data
FHAD 36 Rx (see page 08.07)

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

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

Same as above Connecting cable, length 5 meters

Order no.

FHAD36RS

FHAD36RSL05

Filters



Variants

Polycarbonate filter cartridge with a filter insert made from polyethylene for standard applications
good response time and good protection against fine particulates

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)

Polycarbonate filter cartridge with a filter insert made from PTFE (polytetrafluoroethylene)

good protection against fine particulates and salt (maritime environment) slower response time

POM (polyoxymethylene) filter cartridge with a filter insert made from PTFE water-proof

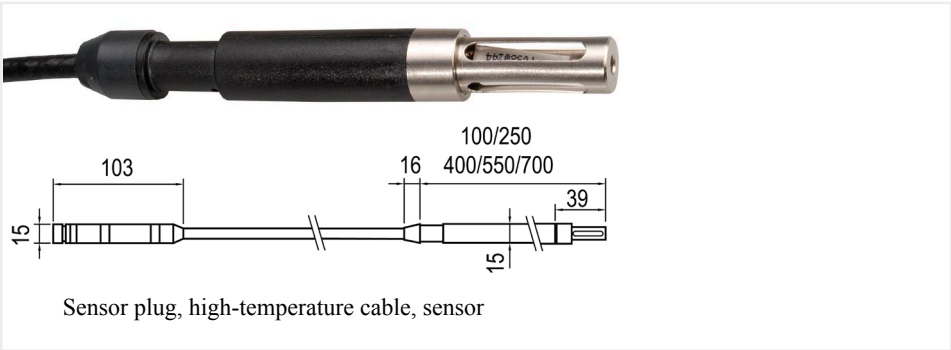
very good protection against fine particulates, slow response time

Order no.

ZB9636PE**ZB9636WM****ZB9636TF**

ZB9636FD2

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 RIC
Industrial-standard design for high temperatures up to +200 °C*
Automatic atmospheric pressure compensation. Digital sensor with ALMEMO® D6 plug



General description
and common technical data
FHAD 36 Rx (see page 08.07)

Technical data

Operative range	-100 to +200 °C	*	Filter cartridge	Brass, nickel-plated
Sensor length	100 mm		Filter	Stainless-steel wire fabric filter
(Other lengths 250 / 400 / 550 / 700 mm are available on request.)			Response time T ₆₃	<10 seconds at typical 1 m/s, without filter
Sensor materials	PPS (polyphenylene sulfide)			

* 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	Mounting flange	Steel, nickel-plated	Diameter 80 mm	ZB9636F
Thread M20x1.5	Viton® seal, up to +200 °C				ZB9636KV



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 (up to 200°C)

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

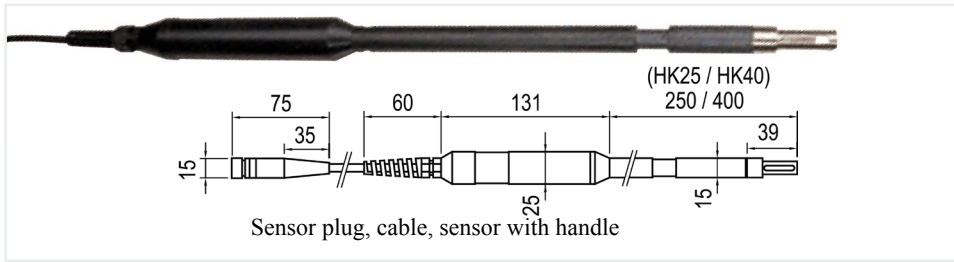
Industry-standard humidity sensor FHAD 36 RIM
in stainless steel Diameter 15 mm, -100 to +200 °C*

Screw-fit humidity sensor FHAD 36 RIE, up to 100 bar,
stainless steel Thread G 1/2-inch, -100 to +200 °C*



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

High-precision sensor for temperature, humidity, atmospheric pressure FHAD 36 RHK
Hand-held sensor for temperatures up to +200 °C*
Automatic atmospheric pressure compensation, Digital sensor with ALMEMO® D6 plug



For on-site test measurements,
not for stationary installation

General description and
common technical data FHAD 36 Rx
(see page 08.07)

Technical data

Operative range	-100 to +150 / +200 °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)		

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

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 +200 °C Sensor length 400 mm	FHAD36RHK40

Other designs are available on request

Miniature cable humidity sensor Diameter 4 mm , -40 to +85 °C	
Humidity probe with pointed tip, Diameter 5 / 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	Temperature measuring circuit	
Humidity measuring circuit		Sensor	NTC type N
Measuring range	0 to 100 % RH	Accuracy	-20 to 0 ±0.4 °C, 0 to +70 ±0.1 °C
Sensor	capacitive		+70 to +100 ±0.6 °C
Accuracy	±2 % RH in the range <90 % RH at nominal temperature	Reproducibility	0.1 °C
Reproducibility	<1% RH at nominal temperature	Mechanical design	
Nominal temperature	+25 ±3 °C	Sensor tube	nickel-plated, 50 mm long, 5 mm Ø
Response time T63	approx. 10 seconds at 1 m/s	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

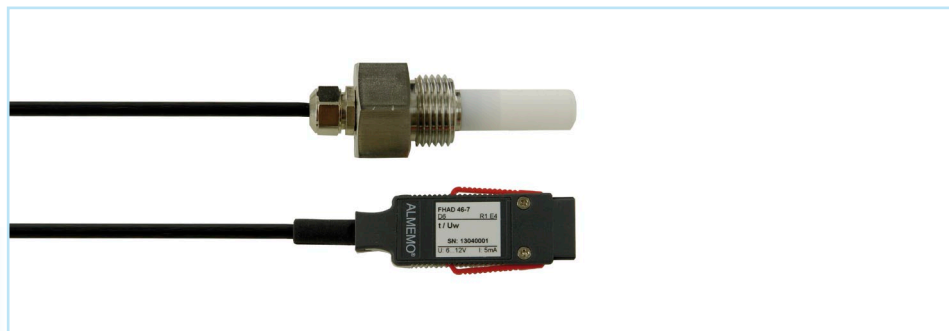
Miniature sensor for temperature / humidity, with fitted high-temperature cable, length 2 meters, with ALMEMO® plug

Order no.

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 46-7,



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
- Digital capacitive humidity sensor with integrated signal processor
- All sensor characteristics and adjustment data are saved in the humidity sensor element itself. Humidity sensor element, plug-in
- 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.
- 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 system pressure needed for automatic pressure compensation of pressure-dependent humidity variables and the channel configuration are entered directly on the PC using USB adapter cable ZA1919AKUV. (see page 04.05).

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 100 % RH
Sensor	CMOSens® technology
Accuracy	±1.8 % RH in range 10 to 90 % RH at nominal temperature
Hysteresis	typical ±1 % RH
Nominal temperature	+25 °C
Sensor operating pressure	up to 16 bar
Temperature	
Sensor	CMOSens® technology
Accuracy	±0.3 K at +25 °C ±0.4 K at +10 to +40 °C ±1.3 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	2 seconds for all four channels
Supply voltage	6 to 13 VDC
Current consumption	12 mA

Mechanical design

Sensor	Stainless steel, diameter 12 mm
Filter cap	Overall length approx. 77 mm
Process connection	PTFE sinter filter SK6
	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

Adapter for compressed air pipes
PTFE sinter filter (spare) (see page 08.08)
Stainless-steel sinter filter (see page 08.08)

Order no.

ZB96467AP
ZB9600SK6
ZB9600SK8

Variants

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
Connecting cable, length 5 meters
Connecting cable, length 10 meters
Replacement sensor element, digital, adjusted, plug-in

Order no.

FHAD467
FHAD467L05
FHAD467L10
FH0D46

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

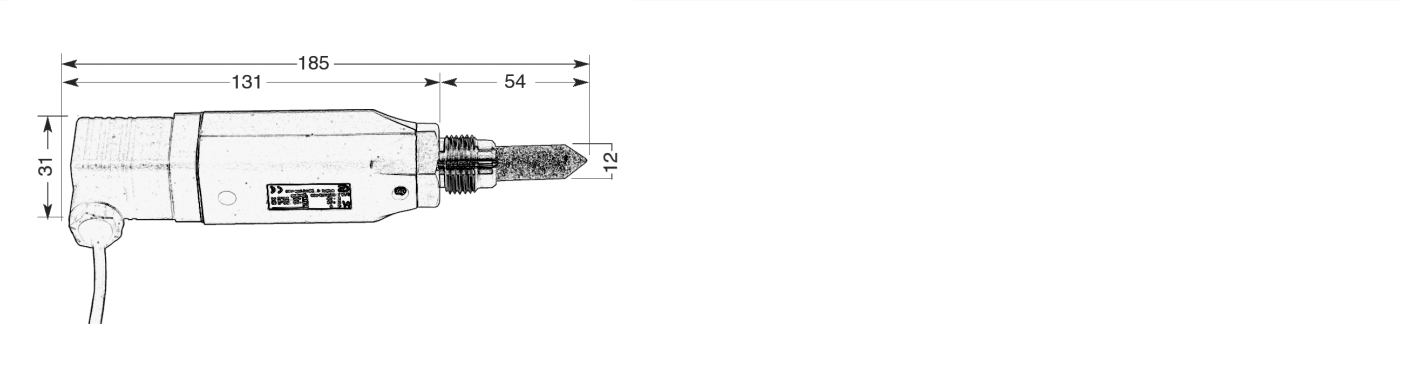
Measuring range	-80 to +20°C dewpoint temperature (DT)	FHA 646 DTC1	
Measuring accuracy	± 0.5 °C from -10 to +20 °C DT typical ±2 °C DT at -40 °C DT	Output	ALMEMO® digital
		Power supply	via ALMEMO® plug, approx. 5 mA
		Connection	Cable, 1.5 meters, with ALMEMO® plug
Measuring channels (FHA646DTC1 only)		MT 8716 DTC1	
temperature	-20.0 to +70.0 °C	Output	4 to 20 mA / -80 to +20 °C (DT), 2 wires
Relative humidity	0 to 98.0 % RH	Power supply	10 to 30 VDC, load <500 ohms
Dewpoint	-80.0 to +20.0 °C (DT)	Connection	Transmitter connector
Operating temperature	-20 to +70 °C	Housing	
Process connection	Screw thread G 1/2-inch, stainless steel	Material	Polycarbonate
Protective cap	Sintered stainless steel filter	Protective class	IP65
Pressure range	-1 to +50 bar standard		
Storage temperature	-40 to +80 °C		

Accessories

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.

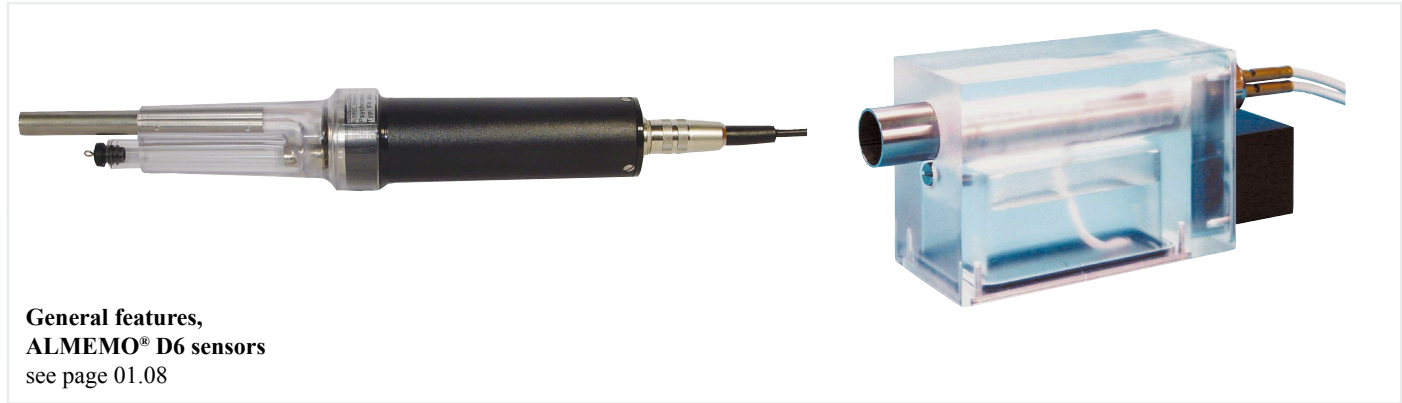
Option

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“ page 05.05).

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 0 to +65 °C)
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 08.14)

Technical data

Operating temperature	0 to +60 °C (no ice)
Humidity measuring range	10 to 100% RH
Measuring system	psychrometric
Accuracy	±1 % RH under nominal conditions
Nominal conditions	+25 °C ±3 K, 1013 mbar, 50 % RH
Temperature sensors	2 x NTC type N
Accuracy	±0,1 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 08.14)

Technical data

Operating temperature	0 to +90 °C (no ice)
Humidity measuring range	10 to 100% RH
Measuring system	psychrometric
Accuracy	±1 % RH under nominal conditions
Nominal conditions	+25 °C ±3 K, 1013 mbar, 50 % RH
Temperature sensors	2 x NTC type N
Accuracy	±0,1 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

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

Accessories**Order no.**

Extension cable for mains units, 3-pin bayonet coupling, length 5 meters	ZB5090VK05
Spare wicks (2 pieces)	ZB98462ED

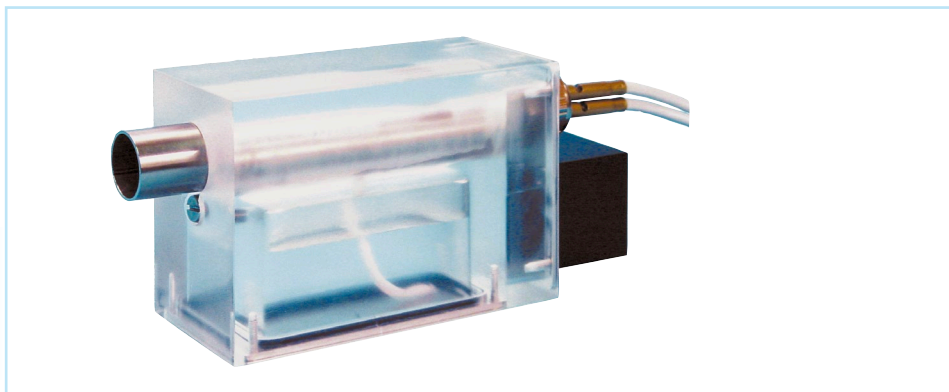
Variants**Order no.**

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 8363



- Optimized version for long-term measuring operations
- Especially suitable for high temperatures
- Operative range 0 to 90 °C, 10 to 100% RH
- Possible variables
dry temperature, relative humidity, dewpoint,
mixture ratio, wet temperature, partial vapor pressure.

Technical data

Humidity

Measuring range	10 to 100% RH
Measuring system	psychrometric
Accuracy	±1 % RH under nominal conditions
Nominal conditions	+25 ±3 °C, 1013 mbar, 50% RH

Temperature

Sensors	2 x Pt100
Accuracy	IEC 751, class B ALMEMO® adjusted

Electrical supply

Operating voltage	12 VDC via mains plug (cable approx. 2 meters)
Current consumption	approx. 40 mA

Mechanical design

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

Accessories

new: ALMEMO® plug-in pressure probe for measuring barometric pressure 700 to 1100 mbar without pressure connection sleeve (version with pressure connection sleeve) (see page 10.10)
Technical data (see page 10.10) **FDAD12SA**
including programming for automatic atmospheric pressure compensation (comment *P) **OA9000PK**

Spare wicks (2 pieces)
Extension cable for mains units,
3-pin bayonet coupling, length 5 meters

Order no.

ZB98462ED

ZB5090VK05

Variants

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

Order no.

FPA8363

DAkkS or factory calibration KH91xx, temperature, humidity, for sensor or 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.

Transmitter in wall-mounted housing MA 8646 for capacitive ALMEMO® humidity sensor FHA 646



Transmitter MA8646-0 with plug-in sensor FHA6466

- Twin analog transmitters for capacitive ALMEMO® humidity sensors (not for dewpoint sensor FHA646DTC1 or digital ALMEMO® D6 sensors)
- Humidity sensor, plug-in, can be exchanged as and when necessary.
- Analog output range can be scaled on the sensor connector.
- For stationary measuring operations, housing suitable for wall-mounting
- Versions available for different supply voltages.

Technical data

Operative range	(see humidity sensor)	Nominal temperature	+23 ±3 °C
Humidity measuring circuit		Option R3	2 x 0/4 to 20 mA (load <500 ohms)
Measuring range	0 to 100 % relative humidity (%RH, HRH, HcRH)	Output range	Standard 0 to 100 % RH, -30 to +70 °C Set to customer-specific needs before leaving our factory or programmed by the user in the sensor connector using ALMEMO® device
Sensor	capacitive	Power supply	
Accuracy	±2 % RH in the range <90 % RH at nominal temperature	Mains	230 V, + 10 to 15 %, 50 to 60 Hz (Option U5 : 110 V)
Reproducibility	1 % at nominal temperature	Option U	10 to 30 VDC, electrically isolated
Nominal temperature	+23 ±3 °C	Option U0	13 to 28 VDC, not electrically isolated
Transmitter, accuracy	±0.5 % RH	Current consumption	approx. 30 mA (no load)
Temperature measuring circuit		Connections	Screw terminals
Measuring range	-50 to +125 °C	Cable bushing to the wall or through grommets at end	
Sensor	NTC type N	Housing	Wall-mounted housing, plastic 123 x 68 x 49 mm
Accuracy	0 to +70 °C ±0.1 K -20 to 0 °C ±0.4 K +70 to +100 °C ±0.6 K	Protective class	IP40
Reproducibility	0.1 K	Ambient conditions	
Transmitter, accuracy	±0.1 K	Operating temperature	-10 to +60 °C
Outputs	2 x 0 to 10 V (load >100 kilohms)	Storage temperature	-30 to +70 °C
Resolution	12 bit (4000 digits)	Ambient humidity	10 to 90 % RH non-condensing
Temperature drift	±0.02 % / K		

Option

Option		Order no.
Analog output, 2 x 0 to 20 mA	OA8646R3	Supply voltage 13 to 28 VDC not electr. isolated OA8646U0
Analog output, 2 x 4 to 20 mA	OA8646R4	Supply voltage 0 to 30 VDC electr. isolated OA8646U
Other analog output range		Supply voltage 110 VAC, 50 - 60 Hz OA8646U5
PLEASE SPECIFY WHEN ORDERING !		
Programming on the humidity sensor connector	OA9000PR	

Humidity sensor including manufacturer's test certificate

Humidity sensor		Order no.
Plug-in sensor, -20 to +60 °C	FHA6466	Advisory note Dewpoint sensor FHA646DTC1 and digital ALMEMO® D6 sensors cannot be connected.
Stainless steel tube, with 1.5-meter cable, -20 to +80 °C	FHA646E1C	
Miniature sensor, with 2-meter cable, -30 to +100 °C	FHA646R	

Variants including manufacturer's test certificate

Variants	Order no.
Temperature / humidity transmitter in wall-mounted housing. Outputs 2 x 0 to 10 V (equivalent to 0 to 100 % RH and -30 to +70 °C). Supply voltage 230 VAC including wall unit, without sensor	MA86460

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



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 performed 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

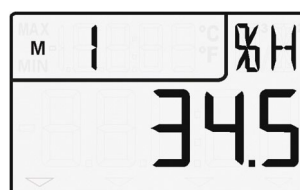
Technical data

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

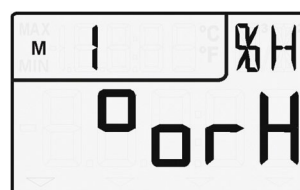
Display of measured values and programming (housing open)



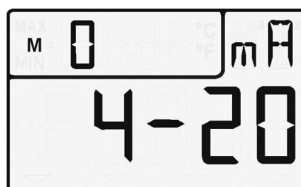
Measured value display, channel M0, temperature



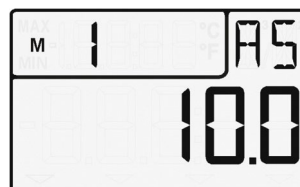
Measured value display, channel M1, humidity variable, e.g. relative humidity



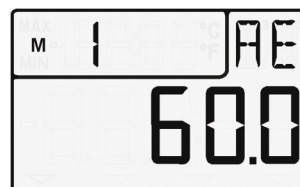
Selecting the humidity variable, e.g. relative humidity, % RH



Selecting the analog output type, e.g. 4 to 20 mA



Programming the analog start



Programming the analog end

Accessories	Order no.
Angle bracket for wall mounting	ZB8D00W
Rubber gasket (mat) for mounting the housing directly on a conduit wall (immersion depth = sensor length + approx. 42 mm plug length)	ZB8D00GD
Movable brass screw with plastic sealing ring (see page 08.05)	ZB9600KV20
Connecting flange for screw connection, pitch circle diameter 38 mm (see page 08.05)	ZB9600F20
Protective caps (see page 08.05)	ZB1012NA9
Mains plug, 230 VAC, 12 VDC, 2.5 A	
Connecting cable between sensor tube and transmitter Length = 2 meters	ZH9D46VK02
Same as above Length = 5 meters	ZH9D46VK05
Same as above Length = 10 meters	ZH9D46VK10
Spare sensor, complete Sensor element inside sensor tube including protective cap SK7 Sensor length = 125 mm	FH9D461K1
Same as above Sensor length = 265 mm	FH9D461K2
Same as above Sensor length = 525 mm	FH9D461K3
Replacement sensor element, digital, adjusted, plug-in	FH0D46

Variants including manufacturer's test certificate	Order no.
Digital transmitter for temperature and humidity 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.

