Content

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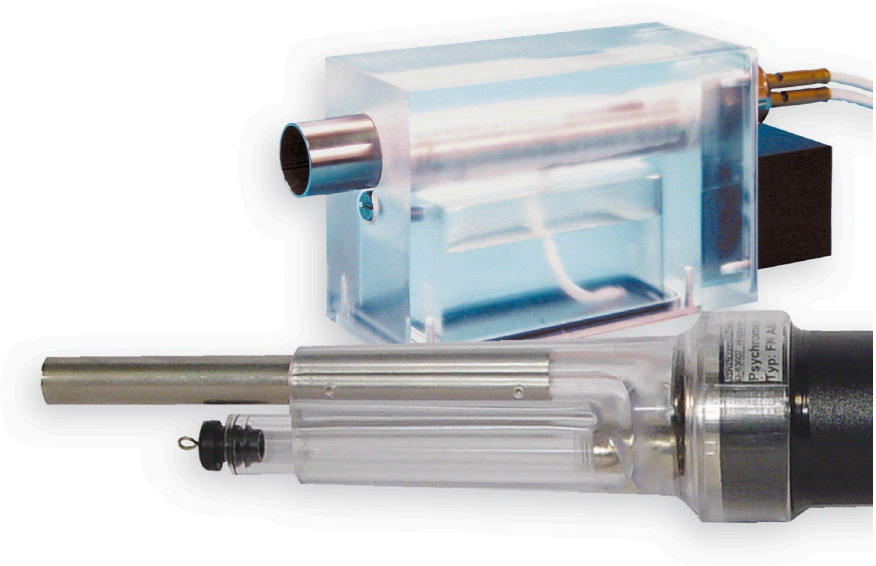
clark™ solutions
valves, pumps and instrumentation

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 ALMEMO® 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 parametersMaterialparametern

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 condensate 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.

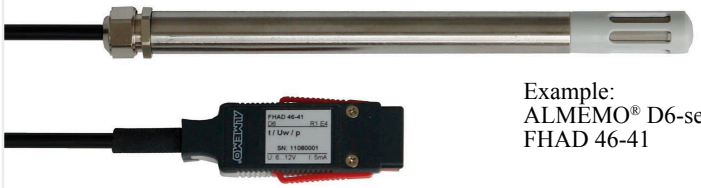
Advantage:
- high accuracy, reliability and reproducibility
- independent from atmospheric pressure
- wide measuring range
- suitable for temperatures below 0°C

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

Other designs are available on request

Sensor with PTFE filter cap FHAD 46-3
Water-proof sensor, Sensor plug connection IP67

DAkkS / DKD or factory calibration KH9xxx temperature, humidity for digital sensor (see chapter „Calibration certificates“)

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
Mechanical design	
Sensor tube	Stainless steel, diameter 12 mm Length (see variants)
Filter cap	Metal-mesh filter, SK7
Screw-fit cable gland	Splash-protected

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	**FHAD4641**
Sensor length 160 mm, Connecting cable, length 5 meters	**FHAD4641L05**
Sensor length 160 mm, Connecting cable, length 10 meters	**FHAD4641L10**
Sensor length 270 mm, Connecting cable, length 2 meters	**FHAD4642**
Sensor length 270 mm, Connecting cable, length 5 meters	**FHAD4642L05**
Sensor length 270 mm, Connecting cable, length 10 meters	**FHAD4642L10**
Sensor length 530 mm, Connecting cable, length 2 meters	**FHAD4643**
Sensor length 530 mm, Connecting cable, length 5 meters	**FHAD4643L05**
Sensor length 530 mm, Connecting cable, length 10 meters	**FHAD4643L10**
Replacement sensor element, digital, adjusted, plug-in	**FH0D46**

Protective caps

Dimensions :
length approx. 33 mm, diameter 12 mm

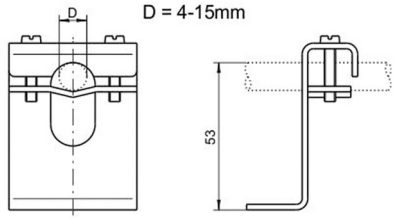
SK7 SK6 SK8

	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

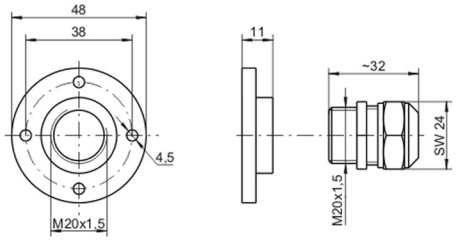
* Observe application range

Accessories

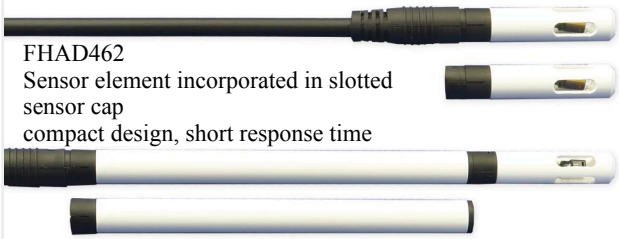
Brackets for wall mounting, distance from wall approx. 40 mm
ZB9600W



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
Mechanical design	
Sensor cap	Ø 8 mm, length 36 mm
Plug connection	Ø approx. 9 mm, IP40
Extension tube	Ø 8 mm, length 97 mm

General description and common technical data see FHAD 46x

Variants including manufacturer's test certificate

	Order no.
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**
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
Mechanical design	
Sensor element (dimensions over all)	approx. 6 x 14 x 3 mm
Plug connection	Width approx. 7 mm

Variants including manufacturer's test certificate

	Order no.
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**
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)

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 ±3 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 +200 °C * Please observe operative range ! (depending on sensor type)
Accuracy at +23 °C	±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 0 to +65 °C)

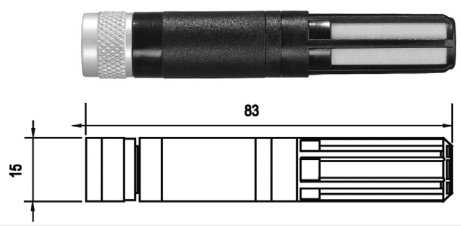
ALMEMO® D6 plug

Refresh rate	1 second for all four channels
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 / DKD or factory calibration KH9xxx temperature, humidity for digital sensor (see chapter „Calibration certificates“)

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		

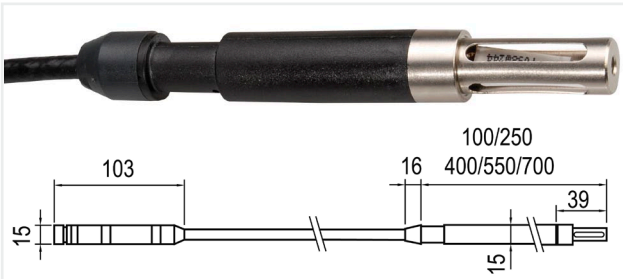
Accessorie	Order no.
Brackets for wall mounting (see page 08.05)	**ZB9600W**

Variants Including factory test certificate and polyethylene filter	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 +200 °C*
Automatic atmospheric pressure compensation. Digital sensor with ALMEMO® D6 plug



Sensor plug, high-temperature cable, sensor

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

Technical data

Operative range	-100 to +200 °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

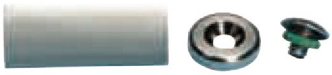
	Order no.
Assembly screw fittings for 15 mm sensor Brass, nickel-plated Thread M20x1.5 Viton® seal, up to +200 °C	**ZB9636KV**
Mounting flange Steel, nickel-plated Diameter 80 mm	**ZB9636F**

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 (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**

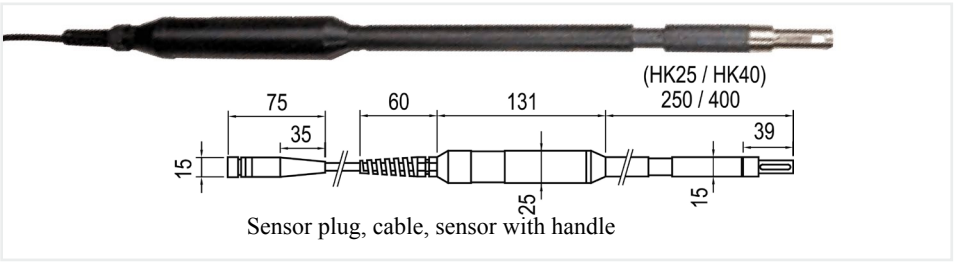
Other designs are available on request

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



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 08.07)

Technical data

Operative range	-100 to +150 / +200 °C* (see variants)
Operative range of the electronics in the grip	-40 to +85 °C
Sensor materials	Shaft PPS (polyphenylene sulfide)
Grip	POM (polyoxymethylene)
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.

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
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 °C, 0 to +70 ±0.1 °C +70 to +100 ±0.6 °C
Reproducibility	0.1 °C
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)

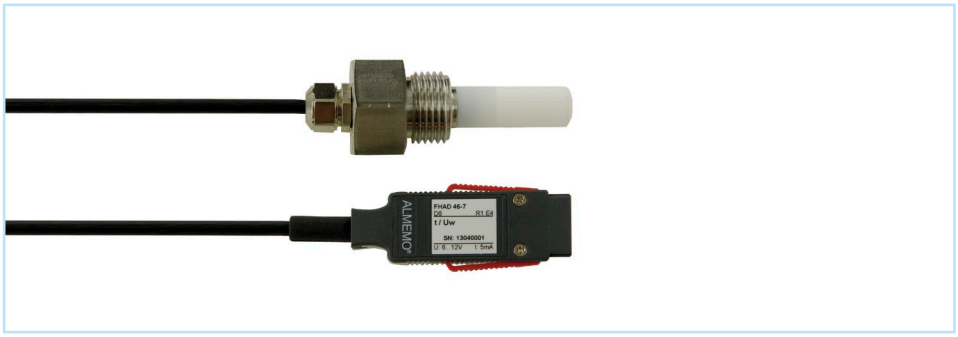
! The sensor can only be operated by plugging DIRECTLY onto an ALMEMO® device.
(NOT with extension cables ZA9060VKx or ZA9090VKCx).
Or, alternatively, the following sensor types can be used. FHAD36RS up to +100 °C (see page 08.08)
FHAD462 or FHAD460 Compact design (see page 08.06)

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 / DKD or factory calibration KH9xxx temperature, humidity for measuring chain (sensor + device) (see chapter „Calibration certificates“)

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 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

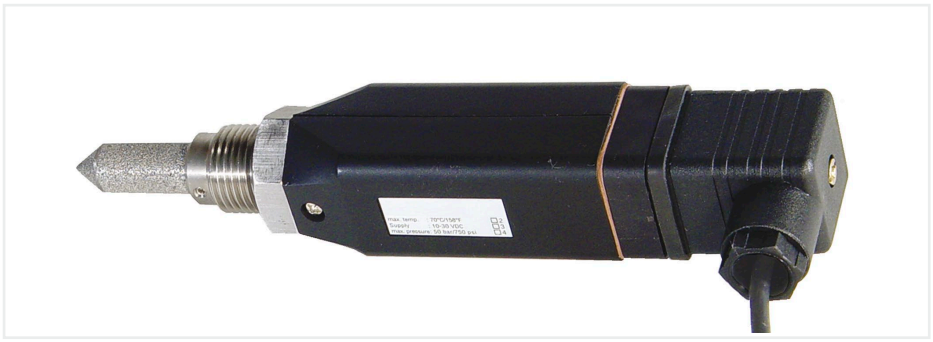
	Order no.
Adapter for compressed air pipes	ZB96467AP
PTFE sinter filter (spare) (see page 08.08)	ZB9600SK6
Stainless-steel sinter filter (see page 08.08)	ZB9600SK8

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	**FHAD467**
Connecting cable, length 5 meters	**FHAD467L05**
Connecting cable, length 10 meters	**FHAD467L10**
Replacement sensor element, digital, adjusted, plug-in	**FH0D46**

DAkkS / DKD or factory calibration KH9xxx, temperature, humidity, for digital sensor (see chapter „Calibration certificates“)

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

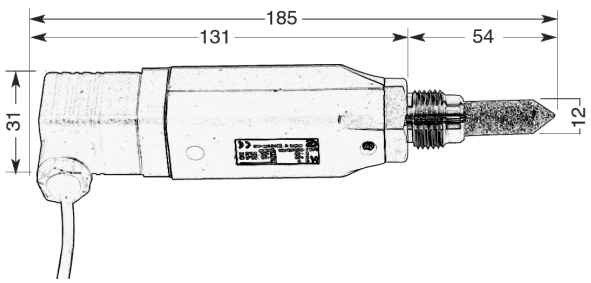
Accessories

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**

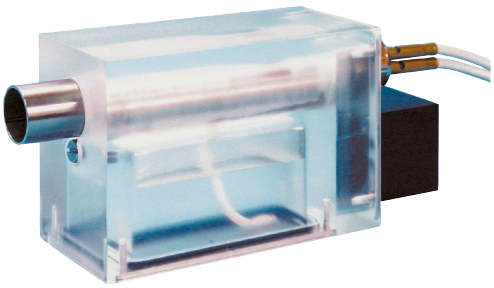


Variants including factory calibration certificate

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 series 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 series

Psychrometer	
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 to +70 °C ± 0.1 K, +70 to +90 °C ± 0.4 K

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)
Measuring range	-50.00 to +125.00 °C
Precision class	AA (see page 01.05)
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 series (see page 08.14)

Technical data

Operating temperature	0 to +60 °C (no ice)
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

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**
DAkkS/DKD or factory calibration KH91xx, temperature, humidity, for digital sensor (see chapter „Calibration certificates“)	

Stationary digital psychrometer FNAD 46-3

Version optimized for long-term measuring operations

General description and common technical data
FNAD 46 series (see page 08.14)

Technical data

Operating temperature	0 to +90 °C (no ice)
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

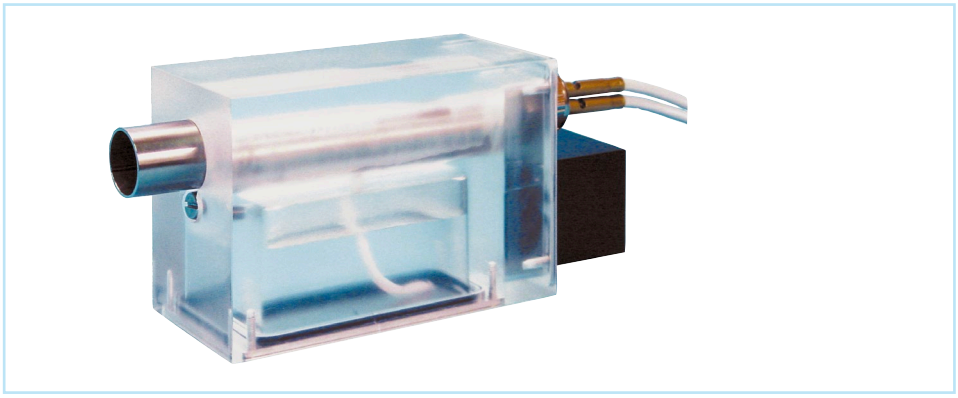
Accessories

	Order no.
Extension 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/DKD or factory calibration KH91xx, temperature, humidity, for digital sensor (see chapter „Calibration certificates“)	

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 — Order no.

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**

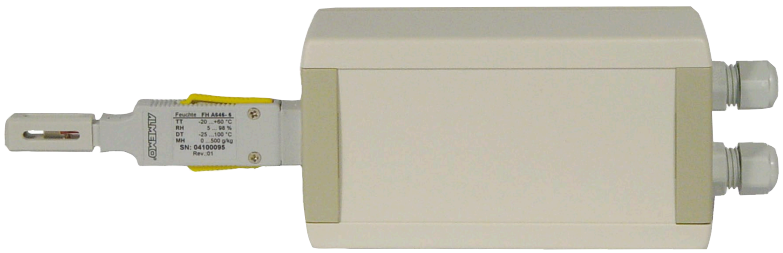
Spare wicks (2 pieces) **ZB98462ED**
Extension cable for mains units,
3-pin bayonet coupling, length 5 meters **ZB5090VK05**

Variants — Order no.

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

DAkkS/DKD or factory calibration KH91xx, temperature, humidity, for sensor or measuring chain (sensor + device)
(see chapter „Calibration certificates“)

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

Option

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

Humidity sensor including manufacturer's test certificate

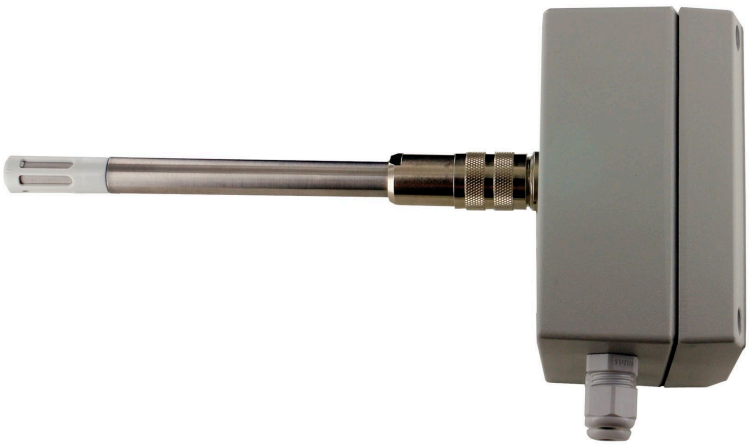
	Order no.
Plug-in sensor, –20 to +60 °C	**FHA6466**
Stainless steel tube, with 1.5-meter cable, –20 to +80 °C	**FHA646E1C**
Miniature sensor, with 2-meter cable, -30 to +100 °C	**FHA646R**

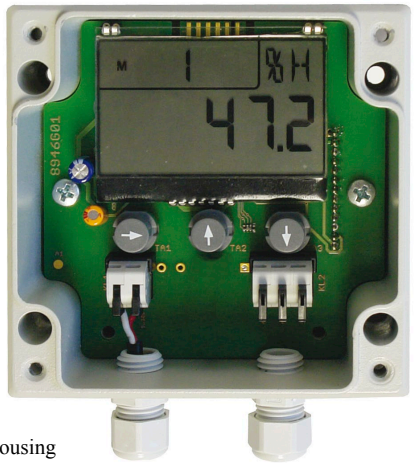
Advisory note
Dewpoint sensor FHA646DTC1 and digital ALMEMO® D6 sensors cannot be connected.

Variants including manufacturer's test certificate

	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/DKD or factory calibration KH9xxx, temperature, humidity, for measuring chain (sensor + transmitter) (see chapter „Calibration certificates“)	

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





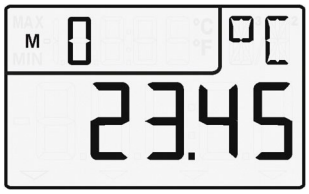
Transmitter
with open housing

- 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 DKD 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

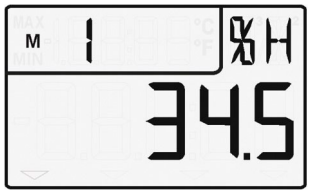
Technical data

Operative range	Sensor -20 to +80 °C, 5 to 98 % RH Electronics -10 to +60 °C, IP65
Humidity sensor	
Measuring range	0 to 100 % RH
Sensor	CMOSens® technology
Fixed measuring period / output period	approx. 3 seconds
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	
Sensor	CMOSens® technology
Fixed measuring period / output period	approx. 3 seconds
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)
Outputs	
Double analog output	Digital-to-analog converter (DAC) electr. isol. 0 to 10 V, load >100 kilohms 0 to 20 mA, load <500 ohms
Output type	0 to 10 V, 0 to 20 / 4 to 20 mA, selectable
Resolution	16 bit
Accuracy	0.1 % of final value
Temperature drift	10 ppm / K
Time constant	100 µs
Connection	Cable, via screwless clamp connector, with cable bushing Cable diameter 2 to 5 mm Limit value relays available on request
Standard equipment	
Display, internal	2-row LCD 7 segments 4 1/2 and 5 characters 2 digits 16 segments
Operation, internal	3 keys
Power supply	
DC voltage	9 to 30 VDC
Current consumption	30 mA + 1.2·IOut
Connection	Cable, via screwless clamp connector, with cable bushing Cable diameter 2 to 5 mm
Mechanical design	
Sensor tube	Stainless steel, diameter 12 mm
Protective cap	SK7, metal-mesh filter
Housing	Die-cast aluminum, closed cover
Dimensions	100 x 100 x 60 mm (LxWxH)
Protective class	IP65 (with sensor tube or connecting cable plugged in)

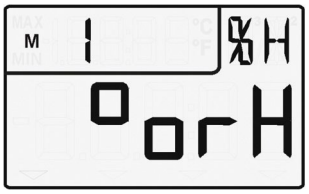
Display of measured values and programming (housing open)



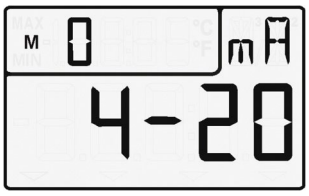
Measured value display, channel M0, temperature



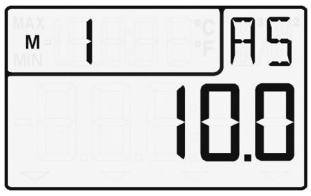
Measured value display, channel M1, humidity variable, e.g. relative humidity



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)	
Mains plug, 230 VAC, 12 VDC, 2.5 A	**ZB1012NA9**

	Order no.
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 / DKD or factory calibration KH9xxx, temperature, humidity, for digital sensor (see chapter „Calibration certificates“)