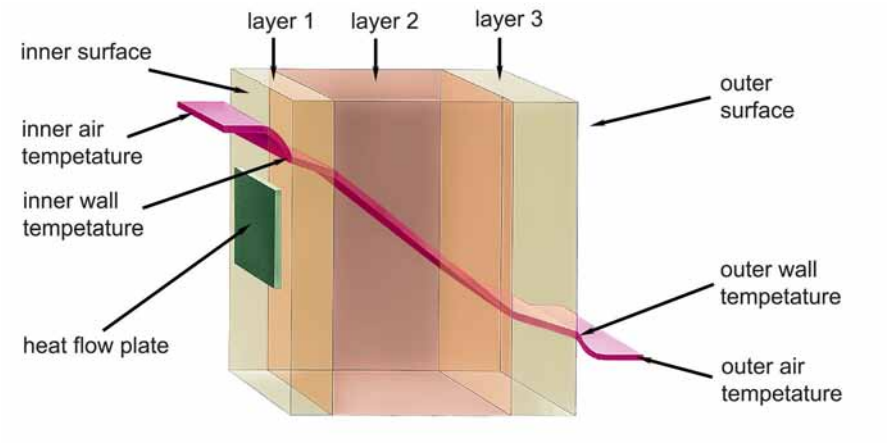
BUILDING PHYSICS

new!

Measuring thermal transmittance (U) and heat flow

The heat transfer characteristics of any structural element depend on the thermal conductivity of the materials used, on the thickness of its various component layers, on its structural geometry (e.g. flat or cylindrically curved walls, etc.), and on the ambient conditions at the structure's surfaces inside and outside.

Presentation of the temperature behavior



The thermal transmittance coefficient (U value) of a structural element describes the quantity of heat that passes through it from one side to the other (no matter how many layers) per second and per square meter surface at a constant difference in ambient temperature inside / outside of 1°K. This thermal transmittance coefficient (U) thus also includes the surface heat transfer coefficients, i.e. the thermal energy transferred at the boundary surfaces, interior air - structure - exterior air. The thermal transmittance coefficient (U) is measured in watts per square meter and degree Kelvin (W/m^2K) and is internationally defined in standard ISO 6946.

A structure's thermal transmittance coefficient (U) is the reciprocal of its total thermal resistance coefficient (R); R is the sum of the thermal transmission resistances between the structure's various contiguous layers and also the surface heat transfer resistances between the structure and the ambient media on either side (e.g. air).

Total thermal resistance (R) = thermal transmission resistances through the material + surface heat transfer resistances, inside and out

The thermal transmittance coefficient (U value) is an important rating in civil engineering and the construction industry where it is used to define a building's transmission heat loss through its various structural elements. Transmission heat loss is the term used to describe the energy-saving qualities of a building's shell (i.e. the thermal insulation of its roof, outside walls, windows, and floors). In Germany each residential structure is assigned a permissible maximum U value (depending on its external surface area and its internal volume); this is based on the most recently amended version of the Energieeinsparverordnung (EnEV) (German energy-saving legislation).

Measuring the equilibrium moisture content

A material's equilibrium moisture content is that level of relative humidity prevailing in the ambient atmosphere at which the material neither gains nor loses moisture.

All construction materials may - to a greater or lesser degree - attract water vapor from or emit water vapor to the ambient air. They are hygroscopic; i.e. they attempt to establish an equilibrium in terms of moisture content with respect to the ambient air. The construction material and the ambient air, depending on their respective temperatures, establish an interactive balance between the adsorption of and the emission of water vapor from / to one another. Each material thus has, depending on temperature and on atmospheric humidity, a certain moisture content level (measured in water as a percentage of overall weight).

In the state of equilibrium the relationship between the water content and the equilibrium humidity of a material can be displayed graphically as a curve, the so called moisture sorption isotherm. The sorption isotherm for the material in question indicates per atmospheric humidity value the corresponding water content value at a given constant temperature. If the composition or quality of the material changes then its sorption behavior - and thus its sorption isotherm - also changes. Given the great complexity of sorption processes these isotherms cannot be determined by calculation; they have to be recorded experimentally.

ALMEMO® Measuring system for Measuring thermal transmittance (U) and heat flow

The thermal transmittance coefficient (U value) is an important rating in civil engineering and the construction industry where it is used to define a building's transmission heat loss through its various structural elements. It is now possible, with the ALMEMO® measuring system, to measure and record all the physical parameters for the component parts of existing buildings (e.g. walls, etc.) in order to calculate their U value and other relevant thermal energy coefficients.

Measuring principle:

The measuring principle involved in quantifying heat loss at partition elements, e.g. walls, heating systems, etc., is based on the method which uses a heat flow plate (sensor) fitted on the surface of the structural element and thus incorporated directly in the heat flow. Using the known thermal characteristics of the heat flow plate and the thermo-electrically measured temperature gradient inside the heat flow plate the ALMEMO® measuring system can thus measure the heat flow density q in W/m².

The ALMEMO® measuring system can also be used to measure the surface temperatures on either side the structural element and the respective air temperatures immediately inside and outside; based on these results it is then possible to calculate all the relevant thermal coefficients.

The temperatures and heat flow density data on which these calculations are based are acquired cyclically as average values. Any influence that the structure's own thermal capacity may have on these calculations (e.g. time shifts between temperature and heat flow, affecting calculation of the U value) will, given a sufficiently long measuring period, become negligible and the calculated average value will certainly be very close to the structure's actual U value.

Operative range:

To ensure a stable and meaningful U value calculation it is possible to stipulate that measuring operations only be performed subject to certain specified conditions.

- The temperature difference between interior and exterior ambient air must be sufficiently large (typically 20 K, e.g. inside temperature 20°C and outside temperature 0°C).
- Any fluctuations in these temperatures (e.g. day / night) must throughout the measuring period be as small as possible.
- The measured values must be acquired and recorded on-site over a sufficiently long period (e.g. one whole day or even several days) and the parameters must be calculated on the basis of average values.

Ordering information

ALMEMO® measuring system - with 2 temperature sensors and 1 heat flow plate - for determining the U value - with straightforward calculation in the ALMEMO® measuring instrument:

ALMEMO® data logger 2590-4S, 4 inputs	Order no. MA25904S
Mains unit	Order no. ZA1312NA8
ALMEMO® data cable, RS232 interface, electrically isolated	Order no. ZA1909DK5
Outside air temperature Thermo-wire sensor, with glass-fiber insulation, 5 meters long	Order no. FTA3900L05
Inside air temperature Thermo-wire sensor, with glass-fiber insulation, 1.5 meters long	Order no. FTA3900
Programming for inside sensor Differential channel and average value	Order no. OA9000PRUT
Heat flow plate, including installation materials see page 14.04	
e.g. type 118, approx. 120 x 120 mm, cable 2 meters	Order no. FQA018C
Programming for heat flow plate Average value and U-value channel	Order no. OA9000PRUQ

ALMEMO® measuring system - with 4 temperature sensors and 1 heat flow plate - for determining the U value - using WinControl software (possible both online and offline)

ALMEMO® data logger 2690-8, 5 inputs, including mains unit and data cable, RS232 interface	Order no. MA26908AKS
Outside air temperature Thermo-wire sensor, with glass-fiber insulation, 5 meters long	Order no. FTA3900L05
Outside surface temperature Thermo-wire sensor, with glass-fiber insulation, 5 meters long	Order no. FTA3900L05
Inside air temperature Thermo-wire sensor, with glass-fiber insulation, 1.5 meters long	Order no. FTA3900
Inside surface temperature Thermo-wire sensor, with glass-fiber insulation, 1.5 meters long	Order no. FTA3900
Heat flow plate, including installation materials see page 14.04	
e.g. type 118, approx. 120 x 120 mm, cable 2 meters	Order no. FQA018C
WinControl software for 20 measuring points, 1 device	Order no. SW5600WC1
Additional module - U-value wizard	Order no. SW5600WCZM4
Hardlock USB dongle	Order no. SW5600HL

Accessories

Heat-conducting paste, 20 ml	Order no. ZB9000WP
Carry case, large	Order no. ZB2590TK2

HEAT FLOW

Heat Flow PLates FQ 90 xxx

Technical Features:

- For determining the heat flow density up to max. 150°C.
- Application-oriented designs, consisting of a meander of opposing thermocouples that are embedded in a substrate.
- In case of thick substrates no lateral circulation of the heat flow because of sufficient meander shell zone.
- Software for k value measurement, see page 06.07.

Each heat flow plate has been assigned a calibration value, which corresponds to the heat flow density in W/m² when the plate provides an output of 1mV. The calibration value will be stored as factory-setting in the ALMEMO® connector so that ALMEMO® devices will immediately indicate the current heat flow density in W/m².

Types including connecting cable, 2 meters, with ALMEMO® connector and manufacturer's test certificate

Model	Application	
117	for even surfaces, e.g. casement sections	**Order no. FQA017C**
118	for universal applications, e.g. solar-electric systems and insulating plates	**Order no. FQA018C**
119	especially for constructional industry, brickwork insulating plates, old buildings	**Order no. FQA019C**
120	small heat flow plate, e.g. for medicine, veterinary medicine, small components etc.	**Order no. FQA020C**
117 SI	flexible heat flow plate, suitable for even surfaces, e.g. casement sections	**Order no. FQA017CSI**
118 SI	flexible heat flow plate, suitable for even surfaces, e.g. solar-electric systems and insulating plates	**Order no. FQA018CSI**
150-1	flexible heat flow plate, particularly suitable for high temperatures e.g. for brickwork, insulated boilers and pipes	**Order no. FQA0801H**
150-2	particularly suitable for high temperatures, especially for the construction industry, masoned walls and insulating plates	**Order no. FQA0802H**

Technical Data:

Type	Dimensions (mm)	Meander Size (mm)	Substrate	Temperature Stability	Calibr. Val. approx. (W/m² ≈ 1 mV)	Accuracy of Calibr. Value
117	100 x 30 x 1.5	80 x 20	epoxy resin	80°C	< 50	5% at 25°C
118	120 x 120 x 1.5	90 x 90	epoxy resin	80°C	< 15	5% at 25°C
119	250 x 250 x 1.5	180 x 180	epoxy resin	80°C	< 8	5% at 25°C
120	33 Ø x 1.5	20 Ø	epoxy resin	80°C	< 150	6% at 25°C
117SI	100 x 30 x 3	80 x 20	silicone	80°C	< 50	5% at 25°C
118SI	120 x 120 x 3	90 x 90	silicone	80°C	< 15	5% at 25°C
150-1	180 x 100 x 0.6	170 x 90	PTFE	150°C	< 80	5% at 25°C
150-2	500 x 500 x 0.6	490 x 490	PTFE	150°C	< 10	5% at 25°C

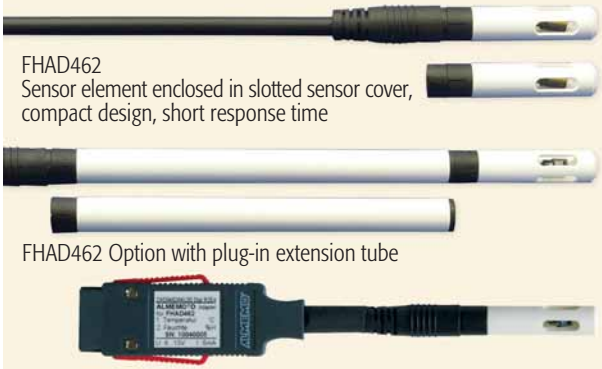
Accessories:

Heat-conducting paste	Order no. ZB9000WP
Scotch tape for room temperature	Order no. ZQ9017KB
Self-adhesive film 24 x 100cm for room temperature	Order no. ZQ9017KF

Capacitive ALMEMO® D humidity sensor, FHAD 46

FHAD460
Uncovered sensor element: smallest design, short response time

FHAD460 with option W Sensor terminals protected against damp



FHAD462
Sensor element enclosed in slotted sensor cover, compact design, short response time

FHAD462 Option with plug-in extension tube

New FHAD462L00

- Digital sensor element. All key sensor characteristics and settings data is stored in the sensor element itself.
- Plug-in sensor element. Spare elements are inexpensive; a replacement can be inserted quickly and easily on site by virtually anyone; it will be fully accurate and need no prior adjustment.
- Digital transfer of measured values from the sensor element to the ALMEMO® measuring instrument: All risk of error involved in digital-to-analog conversion in the sensor and analog-to-digital conversion in the measuring instrument (as is the case with analog output signals) is excluded.
- ALMEMO® connecting cable with digital ALMEMO® D measuring module Cable extensions up to 100 meters and various connection methods see page 09.08.
- Four climate variables can be displayed, temperature, relative humidity, dew point, and mixture ratio.
- Factory or DKD calibration is performed on the sensor element alone. Fully accurate - irrespective of connecting cable and ALMEMO® measuring instrument
- Operation in sleep mode only possible with devices with sleep delay function (only ALMEMO® 2590-2/3S/4S, 2690-8, 2890-9, 5690, 8590-9, 8690-9A, update may be possible)

Technical data

Field of application	
FHAD460:	-20 to +80 °C; 5 to 98 % RH
FHAD462:	-20 to +60 °C; 5 to 98 % RH
Humidity measuring circuit	
Measuring range	0 to 100 % RH
Sensor	CMOSens® technology
Measuring duration / output period	approx. 3 seconds
Accuracy	±1.8% RH in range 20 to 80% RH at nominal temperature
Hysteresis	±1 % RH
Nominal temperature	25 °C ±2 K
Sensor operating press.	Atmospheric pressure
Response time T63	Typical 10 seconds at 25 °C, 1 m/s
Temperature measuring circuit	
Sensor	CMOSens® technology
Measuring duration / output period	approx. 3 seconds
Accuracy	±0.3 K at 25 °C, ±1 K (±1.2 K) in range -20 to +60 (or +80) °C
Reproducibility	±0.1 K
Response time T63	Typical 10 seconds
Mechanical design	
Dimensions FHAD460: Sensor chip (dimensions over all) approx. 6 x 14 x 3 mm Connection width approx. 7 mm *New* Option W Sensor terminals protected against damp with silicone and shrink-fit sleeve (sensor element cannot be plugged in) Width approx. 8 mm FHAD462: Sensor cover Ø 8 mm, length 36 mm Plug connection Ø approx. 9 mm Extension tube Ø 8 mm, length 97 mm	
Cable	PVC, with ALMEMO D connector (for various lengths, see version data)
New Option OAD946AP	Atmospheric pressure sensor integrated in ALMEMO® connector
Measuring range	700 to 1100 mbar Technical data as for FDAD12SA see page 11.12

Accessories

ALMEMO® extension cable, 2 meters — Order no. ZA9060VK2
ALMEMO® extension cable, 4 meters — Order no. ZA9060VK4
ALMEMO®-D extension cable, USB data cable, RS422 coupling, see page 09.08

Versions including manufacturer's test certificate

ALMEMO® D humidity sensor with plug-in, digital sensor element, without protective cover, including ALMEMO® D connecting cable, length = 2 meters	**Order no. FHAD460**
Same, with ALMEMO® D connecting cable, length = 5 meters	**Order no. FHAD460L05**
Same, with ALMEMO® D connecting cable, length = 10 meters	**Order no. FHAD460L10**
Spare sensor element for FHAD460, digital, adjusted	**Order no. FH0D46**
New Option W Sensor terminals protected against damp (sensor element cannot be plugged in)	**Order no. OAD9460W**
ALMEMO® D humidity sensor with plug-in, digital sensor element, enclosed in slotted sensor cover, including ALMEMO® D connecting cable, length = 2 meters	**Order no. FHAD462**
Same, with ALMEMO® D connecting cable, length = 5 meters	**Order no. FHAD462L05**
Same, with ALMEMO® D connecting cable, length = 10 meters	**Order no. FHAD462L10**
New Same, with total length (incl. sensor element) approx. : 80 mm	**Order no. ZAD9460AKL00**
Extension tube, Ø 8 mm, length 97 mm, plug-in, for FHAD462	**Order no. ZB0D462VR**
Spare sensor element for FHAD462, digital, enclosed in slotted sensor cover, adjusted	**Order no. FH0D462**

MOISTURE

Moisture Sensor FHA 696 MF

- Moisture sensor for determination of the moisture content in mineral construction materials, wood and cardboard.
- Indirect measurement of the moisture through the determination of the dielectric constant.
- Capacity measurement through a high frequency electromagnetic field, which penetrates the material in a non-destructive way.

Accessories:

Test block for min. construct. materials Order no. ZB9696PE05
Test block for wood, paper, cardboard Order no. ZB9696PE30

Types:

Moisture sensor **Order no. FHA696MF**

Technical Data:

Measuring method:	capacitive
Resolution:	0.1%
Measuring range (moisture):	0 to 50% moisture
Measuring range (material):	mineral construction materials 0 to 20%, woods 0 to 50%, paper and cardboard 0 to 20%
Housing:	plastic handle with integrated electronics 40mm Ø, 130mm long
Terminal block:	aluminium/plastic 20 x 25 x 70mm
Measuring comb:	stainless spring steel 0.5mm, 70 x 35mm
Weight:	260g
Nominal temperature:	15 to 25°C
Operative range:	0 to +60°C
Storage temperature:	–20 to +80°C
Signal output:	0 to 2V
Power supply:	+8 to +12V
Current consumption	approx. 7mA

Wood moisture probe FHA 636 MF
Hand-held probe for mobile test measurements

- Moisture sensor for determination of the moisture content in wood.
- Indirect moisture measurement according to the principle of conductivity.
- Determination of the moisture content in the material through the dependence of the electrical resistance on the moisture.

Accessories:

PTFE-insulated measuring tip - helps avoid measuring errors in the event of surface moisture, 1 piece
(2 pieces are needed per probe.) Order no. ZB9636MFST

Types:

Wood moisture probe **Order no. FHA636MF**

Technical Data:

Measuring method:	principle of conductivity
Measuring range:	7 to 30 % moisture in wood
Housing:	plastic handle 40mm Ø, 130mm long
Measuring tips:	stainless steel, uninsulated 3mm Ø, 50mm long
Weight:	260g
Reproducibility:	± 1%
Nominal temperature:	23°C ±2°C
Operating temperature:	0 to +60°C
Storage temperature:	–20 to +80°C
Signal output:	0 to 2V
Power supply:	7.5 to +12V
Current consumption	max. 10mA

new!

Wood moisture probe for long-term measuring FHA 636 MF10

- Wood moisture probe for long-term measuring
- Switched measuring current (intermittent mode) prevents salinization or dehydration of the material.
- For long-term monitoring of wooden parts of buildings (e.g. roof structures with laminated beams)

☞ Operation with the device in SLEEP mode is not possible.

Variants

Wood moisture probe for long-term measuring
including measuring tips, ALMEMO® connecting cable

Order no. FHA636MF10

Technical data

Measuring method	Principle of conductivity Intermittent mode for long-term measuring Every 120 minutes the measuring current is activated very briefly and a new measured value is acquired; during the pauses the measuring current remains OFF.
Measuring range	5 to 50 % moisture in wood
Housing	Metal case 65 x 60 x 35 mm (LxWxH) with cable bushings
Measuring cable	Permanently fitted, 2 sensor lines, PTFE insulated Length = 0.1 meters ^ (= maximum possible length) with cable lugs in circular form, diameter 4 mm
Measuring tips	2 stainless-steel hanger bolts M4 Total length = 60 mm including 4 stainless-steel nuts 2 stainless-steel locking washers
Clearance	2.5 cm at right angles to the grain
Operating temperature	0 to +60 °C
Voltage supply	via ALMEMO® connector
Connecting cable	PVC Length = 5 meters with ALMEMO® connector

DEW POINT, WATER DETECTION

Dew Point Detector FHA 9461

- Dew detector for determination of dew conditions.
- Consisting of one temperature sensor and an integrated sensor chip with CCC dew point sensor.
- Particularly suitable in building physics for control measurements and stationary installation.
- The dew point detector does not provide a measuring signal but a step function: dewed (100%) / no dew (0%).

Types:

Sensor and electronics integrated in ALMEMO® connector, mounted on heat conducting plate made of aluminium — **Order no. FHA9461**

Technical Data:

Principle of measurement:	CCC sensor
Operative range:	0°C to +70°C (no ice formation, no saliferous atmosphere)
Settling time:	final value after 2 to 60 seconds
Temperature sensor:	NTC type N (10k at 25°C), accuracy: ±0.1°C (within operative range)
Signal output:	scaled voltage approx. 0 to 1V
Current consumption:	approx. 3mA
Heat flow plate:	aluminium, 40 x 40mm
Storage temperature:	–10°C to +70°C

Water Detection Probe FHA 936 WD

- Water detection probe for instant detection of uncombined water.
- Particularly suitable for construction applications, especially in locations that are difficult to check visually, e.g. at sealing joints, under cement floors etc.
- Indirect moisture measurement according to the principle of conductivity.
- Probe with two collets for easy electrode replacements.
- Electrodes in three different designs for matching any required application.

Types:

Water detection probe — **Order no. FHA936WD**

Technical Data:

Measuring method:	detection of water
Meas. values:	<10% no water >10% water
Housing:	plastic handle 40mm Ø, 130mm long
Electrodes:	stainless steel
Electrode types:	uninsulated with rounded tip: 200mm long, 3mm Ø uninsulated with sharp-edged tip: 50mm long, 3mm Ø spring steel strap: 200mm long, 6mm wide, 0.5mm high
Weight:	260g
Nominal temperature:	23°C ±2°C
Operating temperature:	0 to +60°C
Storage temperature:	–20 to +80°C
Signal output:	ALMEMO® (approx. 0 to 2V)
Power supply:	7.5 to 15V
Current consumption	max. 10mA

MOISTURE

new!

Sensor for measuring the moisture in materials FHA 696 GF1
For determining the moisture content in granulated materials such as wood chips, wood pellets, and sawdust

- The sensor operates on the principle of an open plate capacitor. The moisture contained in a material can be measured in terms of that material's dielectric constants.
- Moisture content can be determined in a matter of seconds - in wood chips or wood pellets, and sawdust, in grain and cereals, and other granulated materials.
- The characteristics of the materials to be measured can be specified on a highly customized basis; a wide variety of granulates, e.g. various cereal types, can thus be measured

Technical data

Measuring principle	capacitive
Measuring range	0 to 99.9 % water content as a weight percentage H_2O
Resolution	0.1%
Measuring radius / penetration depth	approx. 10 cm around the sensor
Temp. range of material	+5 to +40 °C
Operating temp. range	+5 to +40 °C
Storage temp. range	-20 to +70 °C
Signal output	ALMEMO® (voltage)
Power supply	5 V from ALMEMO® measuring instrument
Current consumption	approx. 5 mA
Dimensions	
Sensor head	Ø = 22 mm, length = 200 mm Rounded tip
Extensions	3 pieces, screw-on Ø = 18 mm, length = 300 mm
End piece	Plastic Ø = 22 mm, length = 30 mm
Cable terminal	Mountable male connector on sensor head
Cable	PVC Length = 2 meters with ALMEMO® connector The cable is led through the extension tubes and end piece.

Option :

Determining characteristics for special customer-specific materials

1. We need a sample of approx. 10 liters of your granulate (e.g. wood, cereal, plastic). This sample should be sealed in an air-tight package, e.g. shrink-wrapped in plastic film.
2. We use various dried samples to determine the characteristics of your particular material.
3. We then program these characteristics in the ALMEMO® connector for the moisture content probe..

Pro rata processing costs per material sample, net (service) Order no. OA9696GFK

Advisory note:
If the material cannot absorb water (not hygroscopic), it will not be possible to measure its moisture content.
In this case the processing fee we charge will be reduced.

Variants

Sensor for measuring moisture in granulated wood chips and pellets comprising :
Sensor head, 3 screw-on extensions, end piece connecting cable, 2 meters, with ALMEMO® connector programmed for wood chips (also programmable for wood pellets; if required, please indicate) including carry case **Order no. FHA696GF1**

Test block for FHA696GF for wood chips and wood pellets **Order no. ZB9696PE22**

MOISTURE IN THE SOIL

new!

Tensiometer ZB 9602 TMxxx

- Measurement of soil moisture through the identification of suction pressure. The suction pressure is the force with which water is being held in the soil or is available for absorption. This is the force that must be produced by the plant roots in order for water to be absorbed.
- The porous, clay tip of the tensiometer transfers water from within to the drier outer surroundings by means of capillarity, thereby, creating a sub-pressure within the sealed tensiometer tube. This sub-pressure is a measure of the moisture level and can be determined as a value or used directly to activate an electrical switch. The customary unit of measurement is hPa.
- However, a tensiometer also functions in dry air as long as evaporation can take place over the porous, clay chamber. Therefore, moisture levels can be measured even in coarse-grained or very loose substrate.
- Suction pressure measurements are largely independent of the salt concentration of the substrate or soil.

Typical Suction Pressure at Peat Substrates

30 - 40 hPa	very moist
50 – 120 hPa	moist
150 – 200 hPa	dried
>200 hPa	dry

Typical Suction Pressure at Open fields
(intermediate grade soil)

< 50 hPa	saturated
100 – 150 hPa	wet to moist
>200 hPa	start drying
200 – 500 hPa	Irrigation

Moisture tension meter, electronics

Measuring range	0 to 1000 hPa
Output	0 to 10 V
Power supply	12 V via ALMEMO® device

Electronics to be screwed onto the moisture tension meter with ALMEMO® connecting cable, 7 meters long
Order no. FDA602TM1

Moisture tension meter, spare electronics
like FDA602TM1 but without ALMEMO® connecting cable
Order no. FD9602TM1

Spare ALMEMO® connecting cable, 7 meters long
Order no. ZA9602AKTM1

Technical Data:

Measurement:	Measurement of soil moisture through the identification of suction pressure.
Measure range:	
Tensiometer:	0 ... 900 hPa
Electronic:	0 ... 1000 hPa

Insertion Tensiometer L2 Order no. ZB9602TML2

Ceramic cell	Cylindrical, with tip, Ø 20 x 65 mm
Overall length	approx. 340 mm
Insertion depth	typical 250 mm

Insertion Tensiometer LV Order no. ZB9602TMLV

Ceramic cell	Cylindrical, with tip, Ø 15 x 40 mm
Overall length	approx. 210 mm
Insertion depth	typical 120 mm

Insertion Tensiometer LKV2 Order no. ZB9602TMKV2

Ceramic cell	Cylindrical, with tip, Ø 15 x 40 mm
Overall length	approx. 160 mm
Insertion depth	typical 70 mm

Surface Tensiometer FO Order no. ZB9602TMFO

Sensor completely porous for measuring in thin layers of substrate.

Dimensions:	65 mm, Ø 70 mm
Sink deep:	approx. 30 - 60 mm

Surface Tensiometer FV Order no. ZB9602TMFV

Standard model for use on capillary matting, for moist to moderately moist cultivation or for general measurement on moist surfaces.

Dimensions:	65 mm, Ø 70 mm