3.4 Meteorological Sensors

3.4.1 Atmospheric Pressure Sensor

Barometer and weather are usually understood as being strongly related to each other. The exact measurement of the atmospheric pressure is, for example, very important for the weather forecast and for aviation where it is used as a scale of height. The unit for the atmospheric pressure is millibar (mbar) or hectopascal (hPa).

1mbar = 10^2 N/m² = 10^2 Pa = 1 hPa = 10^3 dyn/cm² = 10.2 Kp/m²
(N = Newton, Pa = Pascal, hPa = hectopascal).

The following relation is applicable for the formerly used units torr and mm mercury column:

1 mbar = 0.750 torr = 0.7500 mm Hg

The physical atmosphere (mean atmospheric pressure on the earth, reduced to sea level) is defined as:

1 atm = 1013 mbar = 760 torr

ALMEMO® Atmospheric pressure measuring connecto

For measuring the barometric pressure the ALMEMO® sensor range provides the piezoelectric pressure measurement connector FDA612SA.

The pressure measuring connector are designed and constructed in such a way that they can be plugged directly onto the measuring instruments.

Meas.variable	Meas. range	Resol.	Dim	Range	Factor	Exp.
Atm. pressure	0 - 1050 mbar	0.1	mb	d2600	-1.0000	3

Technical Data:

Measuring range:	700 to 1050 mbar (total range 0 to 1050 mbar)
Overload capacity:	max. 1.5-fold of fin. val. range
Accuracy:	±0.5% of fin. val.
Nominal temperature:	25°C
Temperature drift:	< ±1% of final value
Compensated temp. range:	0 … +70°C
Operating range:	–10 to +60°C, 10 to 90% r.H. non-condensing
Dimensions:	90 x 20 x 7.6 mm
Hose connection:	Ø 5mm, 12mm long
Sensor material:	aluminium, nylon, silicone, silica gel, brass

3.4.2 Wind Velocity Sensor

The following units are used to indicate the wind velocity:
Meter per second (m/s), kilometer per hour (km/h) or knots with 1 knot equalling 1 nautic mile per hour:

1 m/s	= 3.6 km/h	= 1.9 knots
1 km/h	= 0.54 knots	= 0.28 m/s
1 knots	= 0.52 m/s	= 1.86 km/h

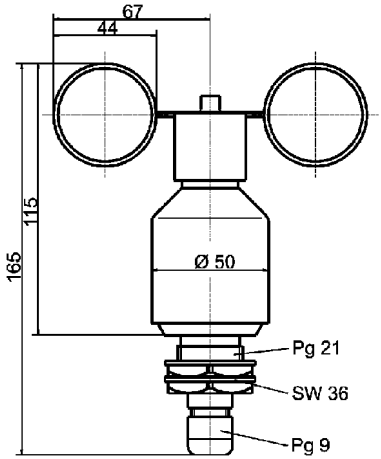
Table m/s to km/h and wind force, wind force designation

m/s	km/h	Wind Force	Designation
0.3 to 1.5	1 to 5	1	light air
1.6 to 3.3	6 to 11	2	light breeze
3.4 to 5.4	12 to 19	3	gentle breeze
5.5 to 7.9	20 to 28	4	moderate breeze
8.0 to 10.7	29 to 38	5	fresh breeze
10.8 to 13.8	39 to 49	6	strong breeze
13.9 to 17.1	50 to 61	7	moderate gale
17.2 to 20.7	62 to 74	8	fresh gale
20.8 to 24.4	75 to 88	9	strong gale
24.5 to 28.4	89 to 102	10	whole gale
28.5 to 32.6	103 to 117	11	storm
more than 32.7	more than 118	12	hurricane

Measuring Principle

A large number of different methods can be used for measuring the wind velocity. In meteorology it is mainly the rotating cup anemometer being used.
It consists of a three or four prong star (cup) that rotates around a vertical shaft. A hemisphere is attached to each prong of the star. These are arranged so that the wind always, simultaneously, encounters one concave and one convex hemisphere. The concave surface provides a significantly higher aerodynamic resistance to the wind than the convex surface. As a result, the wind applies a higher force to the prong of the concave hemisphere than to the prong of the convex hemisphere. Consequently, the star starts to turn and rotate, becoming faster as the wind becomes stronger. The advantage of this measuring principle is that it works independent from the wind direction.
Due to the unavoidable friction effects in the bearings, the wind velocity pick-up will only work from a certain minimum wind velocity and is characterised by a certain 'sluggishness'. In case of a sudden wind gust the cup needs a short acceleration time until it has reached the rotational speed that corresponds to the wind gust. However, it still runs for a certain time when the wind has already decreased. This leads to a smoothing of the wind recording - velocity peaks are smoothed. As the cup adjusts faster with increasing wind velocities than with decreasing wind velocities, the indicated mean value will be higher than the true value.

ALMEMO® Wind Velocity Sensor
For measuring the wind velocity the ALMEMO® range of sensors includes the wind velocity sensor FV A615-2.

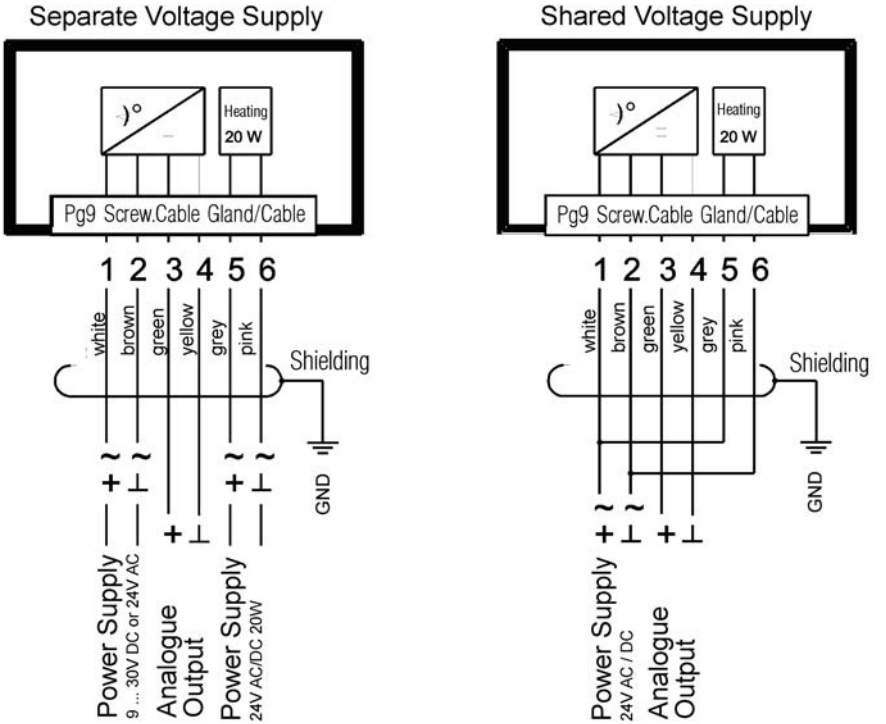


Applications
The wind velocity sensor can be used for measuring the horizontal wind velocity. The measured values are provided as electrical analogue current or voltage signals, e.g. for wind power stations.
All devices are equipped with electronically controlled heating for winter operation to prevent ball bearings and external rotational parts from freezing. The electrical power supply for the heating of the wind velocity sensor must be provided by the customer, e.g. by using an external power supply unit.
If fastening adapters are used (angles, tie-bars) the possible influence caused by turbulences must be considered.

Technical Data

Measuring range	0.5 ... 50m/s
Measuring accuracy	± 0.5m/s or ± 3% of measured value
Resolution	< 0.1m/s
Measuring principle	optoelectronically (slotted disk)
Operating voltage for 0 -10V output	9 - 30 VDC or 24 VAC/DC 13 - 30 VDC
Heating	24 VAC/DC max. 20W
Ambient temperature	-30 ... +70°C
Cable	12m long LiYCY 6 x 0.25mm^2
Installation	e.g. pole tube with holding thread PG21 or drill hole Ø 29mm
Weight	0.75kg

Connection Diagrams



Preparation for Operation

Selection of the place of installation

Generally, instruments for measuring wind data should detect the wind conditions in the widest possible range. The place of installation should be located at a height of 10m above an even, undisturbed area to obtain comparable values when determining the ground wind. An undisturbed area means that the distance between the wind sensor and an obstruction should be, at minimum, ten times the height of the obstruction (see also VDI 3786). If this regulation cannot be met the wind sensor should be installed at a height where local obstructions, if possible, will not influence the measured values (approx. 6-10m higher than the disturbance level). On flat roofs the wind sensor should be mounted in the centre of the roof rather than the edge of the roof to avoid any predominant directions.

Installation

The installation can, for example, be performed on a central pole tube with a holding thread PG 21 or on brackets or similar devices with a Ø 29mm drill hole. Obstructions must be considered that could tamper the air flow and corrupt the measured value. The flexible control line LiYCY is guided through the drilled hole and the wind sensor must be fixed with the hexagon nut (jaw span

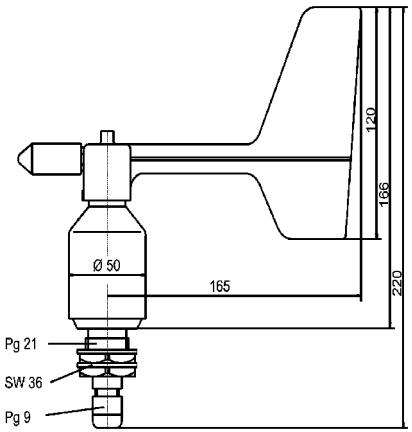
SW36). The electrical connection must be performed according to the connection diagram shown on page 3-4-4.

Note: Storage, installation and operation, when exposed to weather conditions, must only be carried out in a vertical position as otherwise water can penetrate into the device.

Maintenance
If correctly mounted, the device will work maintenance-free. Heavy environmental pollution can lead to clogging of the slit between the rotating and fixed parts of the wind velocity sensor. The slit must always be kept clean.

3.4.3 Wind Direction Sensor

The wind direction is specified either corresponding to the point of the compass or to a scale with a 360 or, sometimes, a 36 graduation.
In meteorological data acquisition the wind-T is usually used to determine the wind direction. For determining the wind direction the ALMEMO® range of sensors includes the wind direction sensor FV A614.



Applications
The wind direction sensor can be used for measuring the horizontal wind direction. The measured values are provided as electrical analogue current or voltage signals, e.g. for wind power stations.
All devices are equipped with electronically controlled heating for winter operation to prevent ball bearings and external rotational parts from freezing. The electrical power supply for the heating of the wind velocity sensor must be provided by the customer, e.g. by using an external power supply unit.
If fastening adapters are used (angles, tie-bars) the possible influence caused by turbulences must be considered.

Technical Data

Measuring range	0 ... 360 °
Measuring accuracy	± 5 °
Resolution	11.25 ° (5 bit Graycode)
Measuring principle	optoelectronically
Operating voltage for 0 -10V output	9 - 30VDC or 24 VAC/DC 13 - 30VDC
Heating	24 VAC/DC max. 20W
Ambient temperature	-30 ... +70°C
Cable	12m long LiYCY 6 x 0.25mm2
Installation	e.g. pole tube with holding thread PG21 or drill hole Ø 29mm
Weight	1.10kg

For connection diagrams please see page 3-4-4

Preparation for Operation

Selection of the place of installation

Generally, instruments for measuring wind data should detect the wind conditions in the widest possible range. The place of installation should be located at a height of 10m above an even, undisturbed area to obtain comparable values when determining the ground wind. An undisturbed area means that the distance between the wind sensor and an obstruction should be, at minimum, ten times the height of the obstruction (see also VDI 3786). If this regulation cannot be met the wind sensor should be installed at a height where local obstructions, if possible, will not influence the measured values (approx. 6-10m higher than the disturbance level). On flat roofs the wind sensor should be mounted in the centre of the roof rather than the edge of the roof to avoid any predominant directions.

Installation

The installation can, for example, be performed on a central pole tube with a holding thread PG 21 or on brackets or similar devices with a Ø 29mm drill hole. (e.g. tie-bar compact, Order No. ZB 9015TC)

The flexible control line LiYCY is guided through the drilled hole and, after it has been aligned to north, the wind sensor must be fixed with the hexagon nut (jaw span SW36). The electrical connection must be performed according to the connection diagram shown on page 3-4-4.

Note: Storage, installation and operation, when exposed to weather conditions, must only be carried out in a vertical position as otherwise water can penetrate into the device.

Alignment to North

The markings on the shaft and at the protective cap must be turned over each other until they are congruent. A compass can be used to determine a land-

mark (tree, building or similar), which is located in the north direction. The wind-T is used to aim at the landmark and, when conforming, the sensor is fiexed with the screw (the north mark must point to the north direction).

Maintenance
If correctly mounted, the device will work maintenance-free. Heavy environmental pollution can lead to clogging of the slit between the rotating and fixed parts of the wind velocity sensor. The slit must always be kept clean.

3.4.4 Rainfall Sensor

The rainfall is specified in mm depth of rainfall or just mm. It is assumed that the fallen rain neither seeps away nor evaporates, but that it forms a sea. Its depth in mm leads to the unit mm depth of rainfall. 1mm equals 1l/m² or 10 m³/ha.

Measuring Principle
To not only measure the amount of rainfall but also to determine the time slope of the rainfall intensity, the rainfall sensor must have a recording unit.

For recording the rainfall, the measuring system is equipped with a tipping scale. At a specified amount of liquid the scale tips and one half of the tipping scale is emptied while the other half is filling. This process is repeated continuously. The content of both halves of the tipping scale is constant. The number of tip processes is a measure for the amount of rainfall. The tipping actions are electronically counted and converted into the amount of rainfall.

ALMEMO® Rainfall Sensor
For rainfall measurements the ALMEMO® sensor range provides the rainfall sensor FR A916 with sieve bar for protection against insects and similar contaminations.

Meas. Variable	Meas. Range	Resol.	Dim	Range	Factor	Exp.
Rainfall amount	0.2 mm/pulse	0.2	mm	PULS	01.02.00	-1

Technical Data

Measuring range:	0.2 mm/pulse, resolution 0.2 mm
Capture cross section:	400 cm2
Operating range:	0 to +50°C, with heating –30 to +50°C
Heating:	24V DC max. 30W
Material:	housing: corrosion-resistant metal, tipping scale: weather-resistant plastic
Dimensions:	280 mm high, 240 mm Ø
Weight:	2.4 kg

3.4.4.1 Precipitation detector

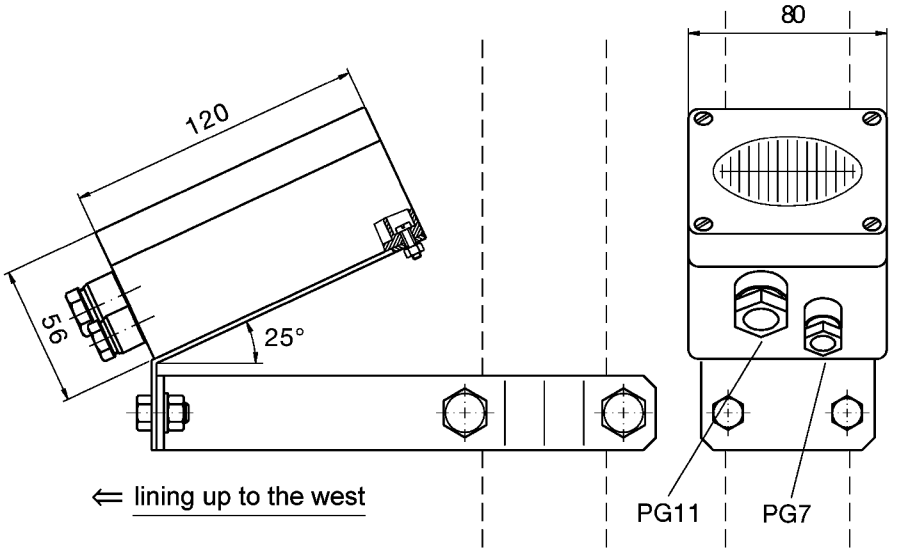
Description

- The sensor reacts to precipitation in the form of either rain or snow within just a few seconds.
- It detects even very slight precipitation.
  - The precipitation detector reacts by switching a relay. It does not provide a continuous measuring signal; it operates with a step function : If it detects precipitation, display in ALMEMO® measuring instrument : 1.0000, if it does not detect precipitation, display in ALMEMO® measuring instrument : 0.0000.
- The precipitation detector is designed for use for example in automatic ventilation or shading systems, or in automatically controlled greenhouses, etc.

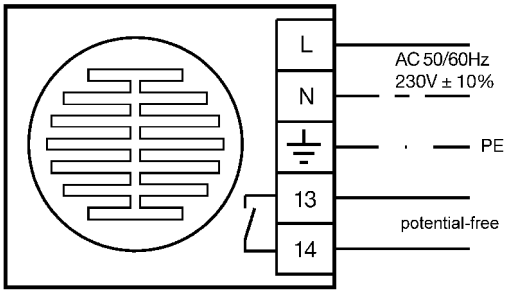
Function

As soon as the response threshold is exceeded, an integrated relay is triggered. This switches the integrated sensor heating system full on. As soon as the sensor surface has sufficiently dried (value dropping back below the limit value plus hysteresis) the automatic reset delay starts to run. This delay is fixed at approx. 5 minutes. In the period from activation of the automatic reset delay until the moment when “rain“ is reported again the sensor heating system operates at approx. 25 percent of full power. This preheating phase helps to prevent “rain” being reported as a result of e.g. mist or dew.

Dimension



Connection



Technical Data

Voltage connection:	230V AC ±10% 6VA (50/60 Hz) optional 24V AC
Power draw:	
Elektronics:	3 VA
Preheating:	1 VA
Total heating:	3 VA
Admissible ambient temperature.:	-30 ... +60 °C
Storage temperature:	-30 ... +70 °C
Relative humidity:	0 ... 100 %
Relay drop-out delay:	5 minutes ± 15%
Test voltage:	
Terminals L or N → Electronics :	1,5kV
Electronics → Relay contacts:	1,5kV
Electromagnetic compatibility:	EN50081-1; EN50082-2; EN61010-1
Relay output:	250V AC, max. 4A, 300VA inductive.
Duty classificationt:	approx. 1 million operations
Housing:	
Material:	polycarbonate, gray
Protection system:	IP65
Mounting system:	Tubular steel pole, diameter approx. 25 to 50 mm
Weight:	approx 0,8 kg (incl. mounting materials)
Connection	
FR8616D:	with connecting terminals
FRA616D:	with ALMEMO® connector and 12 m connection cable

Product overview

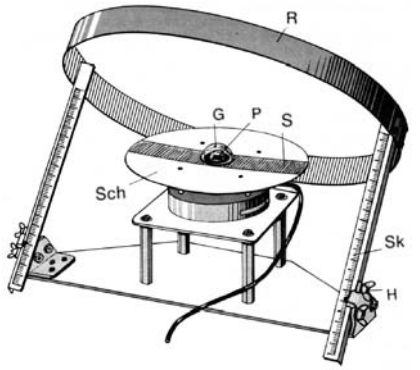
Option: Precipitation detector designed for connection to 24 V AC	Order no. OR8616U6
Precipitation sensor including mounting materials	Order no. FR8616D
Precipitation sensor including mounting materials, ALMEMO® connector, and 12-meter cable	Order no. FRA616D

3.4.5 Global Radiation Pyranometer

The global radiation is the radiation from the upper hemisphere to a horizontal surface in a wave length range of the solar spectrum from 0.3 to 3 µm. It is the sum of the direct solar and the diffuse sky radiation and is specified in Watt per m² (W/m²).

Measuring Principle

The measurement of the intensity of radiation (radiant intensity) is performed indirectly via the temperature difference between black and white areas. By this, an influence from the ambient temperature isavoided. At star pyranometers, 12 circular arranged small copper plates, alternating black and white, are used as radiation-sensitive surfaces. On irradiation the black surfaces heat up more than the white surfaces. This temperature difference is measured using a thermoelectric pile attached to the underside of the surfaces.



Measurement of the Sky Radiation Component

In principle, pyranometers only measure the short-wave radiation as the cover hoods are too opaque for the long-wave spectral range. However, the sky radiation component can also be measured separately by using special constructions. For this purpose, a shade ring (R) is mounted above the device so that the direct sun radiation is kept away from the measuring element. The seasonal variation of the sun elevation is considered by a height adjustment (H) that can be performed by means of a scale (SK)..

Determining the Intensity of the Sun Radiation

If a shaded and a free pyranometer are used together, the difference between their measured values allows for calculating the intensity of the sun radiation.

Measurement of the Short-wave Radiation Balance

A pair of pyranometers, with one device directed upwards and the other device directed downwards, allows for a measurement of the short-wave radiation balance. The radiation detected by the downward-directed sensor surface is just the radiation reflected by the earth. This also allows for calculating the albedo (reflecting ability) of the ground surface.

ALMEMO® Global Radiation Sensor

For measuring the global radiation, the sky radiation and the short-wave radiation the ALMEMO® sensor range provides the star pyranometer, according to Dirmhirn, FL A628-S. The sensor surfaces are shielded from environmental effects by a cut precision glass cupola.

Meas. Variable	Meas. Range	Resol.	Dim	Range	Factor	Exp.
Global radiation	0 - 1500.0 W/m2	0.1	Wm	d26	-	2

Calibration

Each device is supplied with a calibration certificate. The calibration values are stored in the ALMEMO® connector plug and are locked. They must not be modified.

Pyranometers that are used in continuous operation should be calibrated every quarter of a year or at minimum every six months.

Maintenance and Service

If star pyranometers are used in continuous operation, the glass cupola should be cleaned and dried at least once per day. The levelling should be checked daily. It can be easily adjusted by 3 setting screws and an integrated bubble.

For measurements during the winter months, ventilation and heating for the device has been integrated to prevent the glass from becoming covered with moisture (rain, snow, ice). Ice formation must be very carefully removed by using a de-icing spray. The removable dry tank is screwed to the underside of the star pyranometer and contains silica gel crystals as dry substance to avoid condensing effects. The dry substance should always be blue (never pink) and should be replaced or regenerated (by heat-up to approximately 80°C) every two weeks.

The radiation-sensitive surfaces must always be black and white. In case of damages or irregularities to the radiation-sensitive surfaces the device must be inspected in our factory. Scratching of the radiation-sensitive surfaces and the glass cupola must be absolutely avoided.

Technical Data

Measuring range:	0 to 1500 W/m^2, resolution 0.1 W/m^2	
Spectral range:	0.3 to 3 µm	
Output:	approx. 15µV/Wm-2	
Impedance:	approx. 35 ohm	
Operating range:	–40 to +60°C	
Cosine effect:	< 3% of measured value 0 to 80°	
Inclination azimuth effect:	< 3% of measured value	
Temperature influence:	< 1% of meas. value from –20 to +40°C	
Accuracy:	cosine effect + azimuth effect + temp. influence	
Nominal temperature:	22°C ±2°C	
Linearity:	<0.5% in range 0.5 to 1330 W/m2	
Stability:	<1% of meas. range per year at occasional operation	
Settling time:	25 s (t_{95})	
Dimensions:	housing:	160 mm Ø, 75 mm high
	bolt circle:	134 mm Ø
	bore holes:	8 mm Ø
Weight:	1 kg	
Cable length:	3 m with ALMEMO® connector and programmed calibration value	

3.4.6 Temperature/Humidity Sensor in All-Weather Housing

ALMEMO® Temperature/Humidity Sensor
For measuring the temperature and humidity in outdoor areas the ALMEMO® sensor range provides the sensor FH A646 AG.

It includes a 'dew-proof' humidity sensor with a capacitive thin-film sensor (see 3.3.2) and a high-precision NTC sensor and is integrated in all-weather housing.
ALMEMO® devices can, in addition to the relative humidity and temperature, also indicate the dew point temperature and the mixture ratio in g/kg.

Technical Data

Humidity sensor:	capacitive thin-film sensor	
Measuring range:	5 to 98% rH (total range 0 to 100% rH)	
Accuracy:	± 2% at nominal temperature	
Reproducibility:	± 1%	
Nominal temperature:	25°C ±3°C	
Temperature sensor:	NTC type N (10kW at 25 °C)	
Measuring range:	–20 to +80°C	
Accuracy:	–20 to 0°C:	±0.4 °C
	0 to 70°C:	±0.1 °C
	above 70°C:	±0.2 °C
Nominal temperature:	25°C ± 3°C	
Operating range:	–20 to +80°C	
Protective housing:	85 mm Ø, 100 mm high	

3.4.7 Meteo-Multigeber FMA510

Description

The “Meteo Multi” FMA510 is a compact, light-weight multi-sensor system for measuring all important meteorological variables. The system can be freely configured to measure temperature, relative humidity, atmospheric pressure, wind velocity, wind direction, and rainfall.

The device can be fitted in any suitable location quickly and easily using just a single screw. Its quick and easy installation and its very low energy consumption make the “Meteo Multi” ideal for use in weather stations or for any application requiring compact design and low weight. The FMA510 has no moving parts, is virtually maintenance-free, and ensures a long useful life. It is made of materials highly resistant to UV radiation and to corrosion.

Wind measurement

The WINDCAP® sensor can be used to measure both wind velocity and wind direction. This sensor uses ultrasonic measurement to acquire and record the horizontal wind velocity and direction. Three ultrasonic transducers arranged horizontally at equal intervals ensure highly precise wind values measured from all directions without any blind spots or display errors. This wind sensor has no moving parts and is thus virtually maintenance-free.

Rainfall measurement

Rainfall measurement is performed using the RAINCAP® sensor, which actually acquires and records the precipitation of single raindrops. The signals generated in so doing are thus proportional to the volume of the raindrops. The signals generated per raindrop can thus be converted directly to provide the total rainfall quantity.

This measuring method ensures precise rainfall values without the usual losses resulting from overflow, wetting, or evaporation.

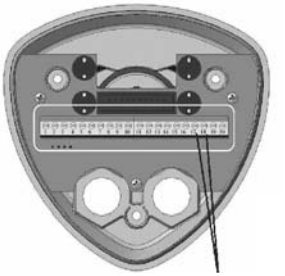
PTU module for pressure, temperature, and humidity

A PTU module uses a series of capacitive measuring methods to acquire and record the values for atmospheric pressure, temperature, and humidity. Atmospheric pressure is measured using a BAROCAP® semiconductor sensor. This sensor ensures low hysteresis, high-level reproducibility, and stability over temperature and time. Temperature is measured using a ceramic THERMOCAP® sensor. Humidity is measured using HUMICAP® technology. The HUMICAP® sensor operates to a high level of precision and ensures long-term stability over time in a wide variety of environments. The PTU module is housed in a special radiation-protected case. This protects the sensors against both dir-

ect and indirect sunlight and rainfall. The plates are made from a plastic material with excellent thermal characteristics and a special UV-stabilized structure. Its white exterior surfaces reflect radiation while its black interior surfaces absorb the accumulated warmth.

Heating (FMA510H only)
To ensure that measured data is available at all times and that such values remain correct even in the event of snowfall the system incorporates heatable wind and rainfall sensors. The operating current circuit and the heating circuit are separate thus ensuring that separate power supplies can be used. The supply voltage for the heating circuit is 12 or 24 V with automatic switchover. (DC or AC voltage - or rectified AC voltage) A thermostat ensures that the heating is only switched on at low ambient temperatures.

Connecting the heating cable
- Undo and remove the long screws underneath the sensor .
- Withdraw the bottom half of the casing.
- Pull the wires out through the cable conduit underneath the sensor.
- Clamp the wires onto terminals 17 (GND) and 18.
- Place the bottom half of the casing back in position and secure by tightening the screws.


terminals 17 und 18

Operating in conjunction with an ALMEMO® device
The “Meteo Multi” incorporates two ALMEMO® connectors suitable for plugging directly onto any ALMEMO® device. The measured values are transferred to the ALMEMO® device in digital form (“DIGI” measuring range).

The functions of this sensor are supported by ALMEMO® devices 2690, 2890, 8590, 8690, and 5690 with effect from version V6 (as of around August 2006, otherwise an update is needed) and with effect from version V5 (the pressure / measuring cycle function only).

To obtain reliable results for the meteorological variables, wind and rainfall, it is absolutely imperative to evaluate measured values over a certain time span. On V5 and V6 devices the average, maximum, and total functions for digital signals (“DIGI” measuring range) are not available as required. The necessary functions are programmed therefore in the ALMEMO® connector . For this purpose the appropriate channels may only be interrogated on a cyclic basis (i.e. not continuously). This problem is solved in different ways for V5 ad V6 devices:

V5 devices: Program the measuring or print cycle e.g. to 10 minutes (at least 5 minutes), conversion rate not continuous. No measuring channel with cyclic averaging must be displayed / selected on the device (i.e. not wind direction, wind velocity, average and maximum values, rainfall quantity, rainfall intensity). The measuring operation / cycle must have been started.

V6 devices: Program the cycle e.g. to 10 minutes (at least 5 minutes); program element flag 4 in each affected measuring channel , thus ensuring that these channels are only interrogated on a cyclic basis (like impulse connectors). The measuring operation / cycle must have been started.

The eight measurable variables involved require two ALMEMO® digital connectors, configured as follows:

Measurable variable	Sensor signal	PIC function = ALMEMO display	Element flag
1. Connector			
1. Wind direction in degrees)	Momentary value	Aver. val. over interrogation cycle	4
2. Wind velocity (m/s)	Momentary value	Aver. val. over interrogation cycle	4
3. Wind velocity (m/s)	Momentary value	Max. value in interrogation cycle	4
4. Atmosph. pressure (mbar)	Momentary value	Momentary value	-
2nd connector			
1. Temperature (°C)	Momentary value	Momentary value	-
2. Humidity (% RH)	Momentary value	Momentary value	-
3. Rainfall quantity (mm)	Momentary value	Total over interrogation cycle	4
4. Rainfall intensity (mm/h)	Momentary value	Max. value in interrogation cycle	4

The average value of the wind direction values is correctly formed on a vectorial basis, i.e. also over and beyond the zero-point.
All channels with cyclic values require a current cycle; otherwise no measured value can be displayed. If WinControl is being used, first switch the device and the sensor on and then start the measuring operation.
Any V5 devices must have been set to the non-continuous conversion rate. This means that channels with momentary values (atmospheric pressure, temperature, humidity) will not display any changes to the measured values within the cycle.

Technical data

Wind direction

Azimuth	0 to 360°, Resolution 1°, Output of average value
Accuracy	±3°

Wind velocity

Range	0.5 to 60 m/s , Resolution 0.1 m/s Output of average value and maximum value
Accuracy	0 to 35 m/s ±0.3 m/s or ±3% (whichever is the larger) 36 to 60 m/s ±5%

Barometric pressure

Range	600 to 1100 mbar , Resolution 0.1 mbar
Accuracy	±0.5 mbar at 0 to 30 °C

	±1 mbar at -52 to +60 °C
Air temperature	
Range	-52 to +60 °C , Resolution 0.1 K
Accuracy	±0.3 K at 20 °C (sensor element)
Relative humidity	
Range	0 to 100 % RH, Resolution 0.1% RH
Accuracy	± 3% RH at 0 to 90 % RH ± 5% RH at 90 to 100 % RH
Rainfall quantity	
Surface area measured	60 cm² , Resolution 0.01 mm Output of total value
Accuracy *	± 5%
Rainfall intensity	
Range	0 to 200 mm/h, Resolution 0.1 mm/h Output of maximum value
Dimensions	
Height	240 mm
Diameter	120 mm
Weight	620 g
Cable	Sensor cable, fixed, 12 meters long with 2 ALMEMO® digital input cables, 0,3 meters
Power supply	6 to 12 V from the ALMEMO® device
Heating (for FMA510H only)	12 VDC maximum 1.1 A or 24 VDC/VAC maximum 0.6 A
Fixing	
Direct	On the side of a traverse or a tubular mast with external diameter 30 mm, internal diameter >= 24 mm
By means of snap-on adapter ZB9510MA27	On a tubular mast with external diameter 27 mm (or 30 mm - without supplied insert)

* Results may be subject, given the variability of rainfall per area, to substantial measuring errors - especially over relatively short periods. The data does not include measuring errors caused by the wind.

Installation

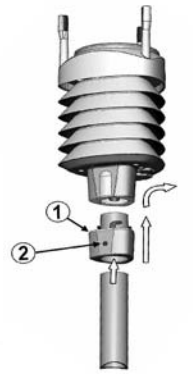
The FMA510 can be fitted either to a vertical mast or to a horizontal bar.
An adapter piece is available as an option; this facilitates installation on a vertical mast. If this adapter is used the task of aligning the sensor towards the north needs to be performed only once. Using this adapter thus helps exclude the risk of misalignment during operation.

The “Meteo” sensor FMA510 must be installed upright in a vertical position.

Fitting to a vertical mast

1. Undo and remove the screw cover and connect the sensor to the mast.
2. Align the sensor so that the arrow points north. (For further details regarding alignment, see below.)
3. Tighten the fastening bolt (3) and place the screw cover back on.

Fitting with the aid of adapter ZB9510MA27



1. Plug the adapter (1) into the sensor; (see Figure).
2. Twist the sensor until it snaps into its locked position.
3. Then fit the adapter onto the mast. Ensure that the fastening bolt (2) is sufficiently loose.
4. Align the sensor so that the arrow points north. (For further details regarding alignment, see below.)
5. Tighten the fastening bolt (2), thus fitting the adapter firmly on the mast.

To remove the sensor from the mast simply twist the sensor until it snaps out of the adapter. As and when the sensor is returned to this position the task of aligning does not need to be repeated.

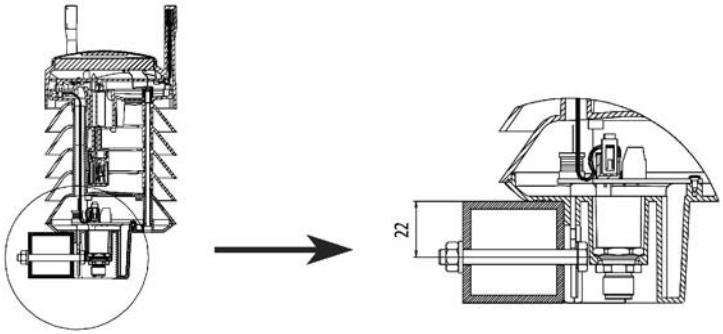
Aligning the sensor to point north when fitted to a vertical mast

Underneath the sensor there is an arrow and the word "North"

1. To be able to twist the sensor the fastening bolt on the sensor or adapter must first be loosened.
2. Using a compass find north and then twist the sensor until the arrow underneath points in exactly this direction.
3. Tighten the fastening bolt again. The sensor is now aligned to north and secured in position.

Fitting to a horizontal bar

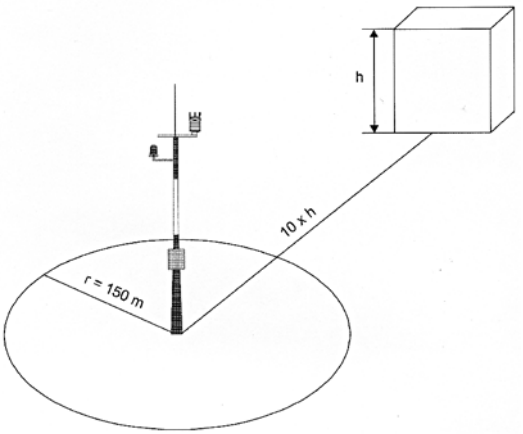
1. Undo and remove the screw cover .
2. Using a compass align the horizontal bar in the north - south direction.
3. The sensor is secured in position on the horizontal bar by means of the fastening bolt (2) and nut (1) (M6); (see Figure on the right).



Choosing the installation site
Installation in a field

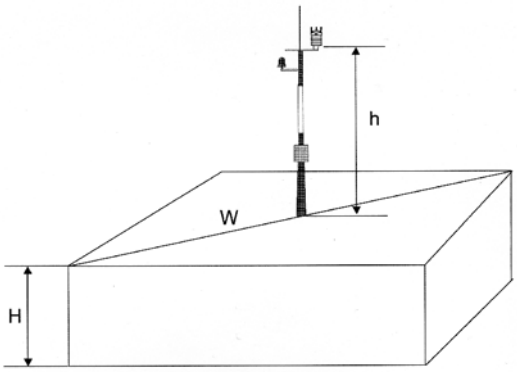
Choosing an appropriate site is very important in obtaining properly representative results; the site should as far as possible reflect the overall weather situation in the environment to be investigated.

There must not be any buildings, trees, etc. in the vicinity of the site likely to cause air turbulence. In general such an object of height (h) will, if the mast is set up at a distance of 10 x (h), have no significant effect on wind measurement; however, the site should always be in a free field with minimum radius (r) of 150 meters; (see Figure).



Installation on top of a building

Mast height (h) should be at least 1.5x building height (H). If building diagonal (W) < building height (H), the mast height (h) should be at least 1.5x building diagonal (W); (see Figure).



CAUTION !

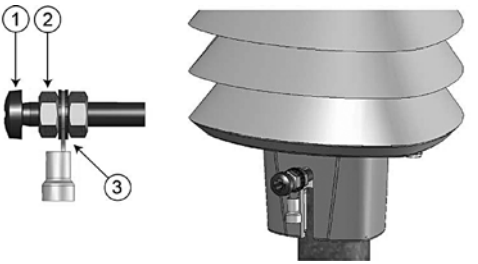
Installation of the weather station in a field or on top of a high building makes it susceptible to being struck

by lightning; this might result in very high voltage which the weather transducer's internal interference suppressor filters would be unable to block.

Warning!
To provide protection for persons and for the device the installation of a lightning conductor is also recommended. The top of this lightning conductor should be at least one meter above the Meteo sensor. Always ensure proper grounding ! All relevant safety stipulations must always be observed.

Grounding
Whether the "Meteo Multi" FMA 510 is fitted to a vertical mast or to a horizontal bar it should always be well grounded.
Ground potential is provided via the locking screw (or the fastening bolts). If the surface of your chosen grounding point has been painted over or is not electrically conductive, a special socket and grounding set is available; (please request as a separate option).

Grounding by means of the special socket and grounding set
If necessary a cable can be laid from the fastening bolt to a suitable grounding point. The installation set comprises 1 fairly long fastening bolt, 2 nuts, 2 washers, and 1 ABIKO ring cable terminal for the ground cable; (see Figure).



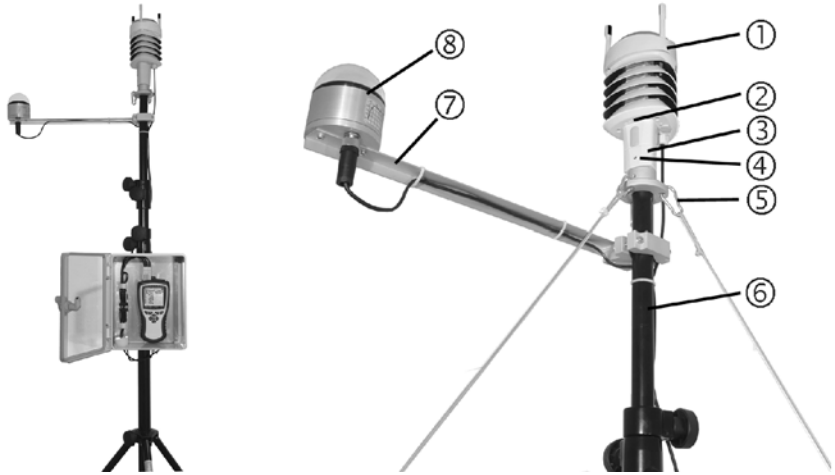
(1) Locking screw
(2) Nut
(3) ABIKO ring cable terminal between 2 washers

The ground cable should have a cross-section of 16 mm² (AWG 5).
(This is not included in delivery.)

Routine servicing and maintenance
Weather sensor FMA510 leaves our factory adjusted and ready-to-use; it is virtually maintenance-free. The only routine maintenance work required is as and when necessary to clean the surface. Leaves and other miscellaneous dirt particles should be removed from the rainfall sensor as and when necessary. The sensor can be cleaned using a soft, fluff-free cloth and a little mild cleaning agent.

Caution!
Extreme care is required when cleaning the wind sensors. These sensors must not under any circumstances be scratched or twisted.

3.4.7.1 Mobile weather station with “Meteo Multi” sensor FMA510



“Meteo -Multi” mobile tripod stand ZB9510ST

(1) “Meteo Multi” FMA510
(2) Arrow pointing north
(3) Fitting adapter (snap-fit)
(4) Fastening bolt
(5) Guy line and snap shackle
(6) Stand ZB9510ST
(7) Cross-piece (holder for probe head)
(8) Radiation probe head FLA613

Assembly and installation site

For further details regarding assembly and the installation site for the “Meteo Multi” sensor see Section 3.4.7, the following points:

- Choosing the installation site (Please note requirements regarding lightning protection and grounding !)
- Fitting with the aid of adapter ZB9510MA27
- Aligning to point north

Before putting into operation ensure that the sensor has snapped properly into its locked position in the adapter and that the fastening bolt on the adapter has been securely tightened.

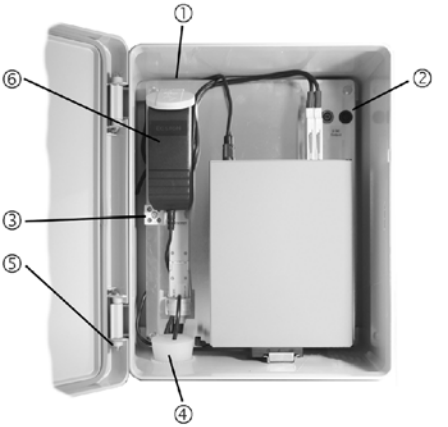
Bolt the radiation probe head (8) (an option) onto the cross-piece (7) and align fitting to point south. If necessary fit the set of guys and anchoring fixtures (3 guy lines) in the form of a star spread at regular intervals of approximately 120 degrees.

Der mitgelieferte Abspannsatz ist ausgelegt für Montage auf Erdboden. Auf hartem Untergrund (Fels, Stein, Beton o.ä.) ist für eine geeignete Bodenverankerung zu sorgen.
Das Stativ ist für mobilen Einsatz vorgesehen, nicht für Dauereinsatz im Freien!

Weather-proof housing ZB9510AG
Installing the device and routing the cables

Almemo® 2690-8

(1) Socket, 230 VAC
(2) Banana sockets, VDC output
(3) Clamp connector, VDC input



Almemo® 8590-9

(4) Cable bushing
(5) On rear of housing
230 VAC connecting cable with safety plug
(6) Mains unit

Power supply:
- 230 VAC supply with mains unit (6): Socket (1) with connecting cable led out and 230 VAC safety plug (5)
- DC voltage supply via external mains unit, 10 to 30 VDC, with electrically isolated ALMEMO supply cable (ZA2690UK or ZB3090EK)
  2 banana sockets, VDC output (2), wired to clamp connector, VDC input (3), for customer's on-site cable, check to ensure correct polarity
- DC voltage supply via external battery or rechargeable battery pack (not included in delivery) 9 to 12 VDC, with ALMEMO supply cable, not electrically isolated (ZA2690EK or ZB5090EK)
  2 banana sockets, VDC output (2), wired to clamp connector, VDC input (3), for customer's on-site cable, check to ensure correct polarity.

Fitting the weather-proof housing on the mobile tripod stand
The weather-proof housing is secured in position by means of 2 clips on the central telescopic element; (see Figure on the right).