Content

Air flow

The Right Flow Sensor For Any Measuring Task

For measuring the flow velocity, typically, three methods are used, which are particularly different from each other with regard to their measuring range and the operating temperature:

- Pitot tubes
- Rotating vanes
- Thermoanemometer probes

Pitot Tubes

The air velocity is determined by the dynamic pressure and the static pressure. Pitot tubes are robust and are available in special steel or nickel-plated brass. They connect to ALMEMO® devices by silicone hoses and a differential pressure module.

Advantage:
suitable for high flow velocities and harsh operating conditions, high ambient temperatures possible, easy to clean

Disadvantage:
strongly directional, low flow velocities are not measurable, temperature-dependent, limited accuracy, sensitive to turbulent flows

Rotating Vanes

The flow velocity is determined through a frequency measurement. Our rotating vanes are sensitive transducers with diamond bearings that are very precisely adjusted. This ensures high accuracy.

Advantage:
high accuracy at medium flow velocities and medium ambient temperatures, insensitive to turbulent flows

Disadvantage:
sensitive sensor technology, sensitive to mechanical stress, directional

Thermoanemometers

Thermistors and hot wire anemometers are highly sensitive sensors. The measuring element is continuously heated up. A control circuit keeps the temperature of the element, which has cooled down by the air flow, on a constant value. The control current is proportional to the flow velocity.

Advantage:
even very small air speeds can be measured (e.g. draught measurements), direction-independent measurements are also possible

Disadvantage:
sensitive sensor technology, sensitive to mechanical stress and contamination, sensitive to turbulent flows, high current consumption, limited ambient temperature.

Correction Factors for Exact Measurements of the Air Speed

Air Temperature	940 mbar	960 mbar	980 mbar	1000 mbar	1020 mbar	1040 mbar
–30°C	0.942	0.932	0.922	0.913	0.904	0.895
–20°C	0.961	0.951	0.941	0.932	0.923	0.914
–10°C	0.980	0.970	0.960	0.950	0.941	0.931
0°C	0.998	0.988	0.978	0.968	0.958	0.949
10°C	1.016	1.005	0.995	0.985	0.975	0.966
20°C	1.035	1.024	1.013	1.003	0.993	0.983
30°C	1.051	1.040	1.029	1.019	1.009	0.999
40°C	1.069	1.057	1.047	1.036	1.026	1.016
50°C	1.085	1.074	1.063	1.052	1.042	1.031
60°C	1.102	1.09	1.079	1.068	1.057	1.047
70°C	1.118	1.106	1.095	1.084	1.073	1.063
80°C	1.135	1.123	1.111	1.100	1.089	1.078
90°C	1.151	1.139	1.127	1.116	1.105	1.094
100°C	1.167	1.154	1.142	1.131	1.120	1.109
150°C	1.242	1.229	1.216	1.204	1.192	1.180
200°C	1.314	1.300	1.287	1.274	1.261	1.249
250°C	1.381	1.367	1.353	1.339	1.326	1.313
300°C	1.446	1.431	1.416	1.402	1.388	1.375
400°C	1.567	1.55	1.534	1.519	1.504	1.489
500°C	1.68	1.663	1.646	1.629	1.613	1.597
600°C	1.784	1.766	1.748	1.73	1.713	1.696
700°C	1.884	1.865	1.846	1.827	1.809	1.791

The true air velocity depends on the air temperature and the barometric air pressure. Therefore, the measured value must be corrected according to the above table to obtain exact measurements of the air speed.

Example:

Measured air velocity 50m/s, air temperature 80°C, atmospheric pressure 960mbar. The measured value must be multiplied with the correction value 1.123. The air velocity is, therefore, 56.1m/s.

Air Speed For Selected Dynamic Pressures (Prandtl Pitot Tube, T = 22°C)

Dynamic Pressure [Pa]	Dyn. Press. [mm h.o.water]	Air Speed [m/s]
1	0.1	1.29
2	0.2	1.83
3	0.3	2.24
4	0.41	2.59
5	0.51	2.89
10	1.02	4.09
20	2.04	5.78
30	3.06	7.08
40	4.08	8.18
50	5.1	9.14
100	10.2	12.93

Digital vane anemometer FVAD 15 for air, with ALMEMO® D6 plug

Technical data and functions, FVAD 15 series

- Measuring air flow velocity
- The vane anemometer is in practice unaffected by environmental variables such as pressure, temperature, density, or humidity.
- The design is compact - especially suitable for mobile measuring operations - heating, ventilating, air-conditioning.
- The probe head has an aero-dynamically optimized shape and protected bearings.
- On those variants with a snap-on head the probe head can be exchanged quickly and easily, e.g. for servicing.
- ALMEMO® D6 plug with high-resolution frequency measurement
- One measuring channel is programmed (at our factory). Flow velocity (m/s, v).

General features, ALMEMO® D6 sensors
see page 01.08

Technical data FVAD15 series

Operative range	-20 to +140 °C
Maximum resolution	0.01 m/s
Nominal temperature	+22 °C ±2 K
Connecting cables	Fitted cable, 1.5 meters, with LEMO® plug
ALMEMO® adapter cable	LEMO® coupling cable, 0.2 meters with ALMEMO® D6 plug
ALMEMO® D6 plug	
Frequency measurement	resolution 0.01 Hz
Refresh rate	0.5 seconds for all channels
Averaging period	2 seconds
Supply voltage	6 to 13 VDC
Current consumption	4.5 mA

Accessories	Order no.
Extension set Ø 15 mm, 4 x 255 mm	ZV9915VR3
Telescopic extension Ø 15 to 24 mm, 330 / 1010 mm	ZV9915TV

DAkkS / DKD or factory calibration KV90xx air flow for digital sensor (see chapter „Calibration certificates“)

Digital vane anemometer FVAD 15 S120/S140 with snap-on head, mini

Accessories	Order no.
Spare snap-on head, mini, 20 m/s	ZV9915S120
Spare snap-on head, mini, 40 m/s	ZV9915S140

Technical data

Accuracy	±1 % of final value ±1.5 % of measured value
Probe head	Ø 22 mm, length 28 mm Replaceable snap-on head
Insert opening	from 35 mm
Sensor shaft	Ø 15 mm
Sensor length	175 mm including probe head

Standard delivery	Order no.
Digital vane anemometer with snap-on head, fitted cable, adapter cable with ALMEMO® D6 plug	
Measuring range 0.4 to 20 m/s	**FVAD15S120**
Measuring range 0.5 to 40 m/s	**FVAD15S140**

Digital vane anemometer FVAD 15 S220/S240 with snap-on head, micro

Technical data

Accuracy	±1 % of final value ±3 % of measured value
Probe head	Ø 11 mm, length 15 mm Replaceable snap-on head
Insert opening	from 16 mm
Sensor shaft	Ø 15 mm
Sensor length	165 mm including probe head

Accessories	Order no.
Spare snap-on head, micro, 20 m/s	ZV9915S220
Spare snap-on head, micro, 40 m/s	ZV9915S240

Standard delivery

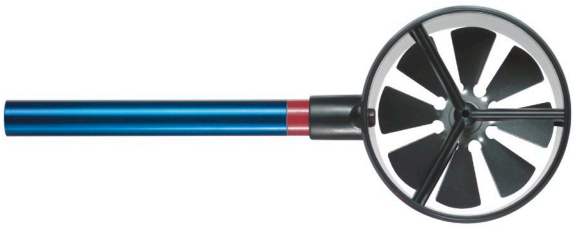
Order no.

Digital vane anemometer with snap-on head fitted cable, adapter cable with ALMEMO® D6 plug

Measuring range 0.6 to 20 m/s — **FVAD15S220**

Measuring range 0.7 to 40 m/s — **FVAD15S240**

Digital vane anemometer FVAD 15 SMA1 with snap-on head, macro



Technical data

Accuracy	±1 % of final value ±1.5 % of measured value
Probe head	Ø 85 mm, length 80 mm Replaceable snap-on head
Insert opening	from 119 mm
Sensor shaft	Ø 15 mm
Sensor length	235 mm including probe head

Accessories	Order no.
Spare snap-on head, macro, 20 m/s	ZV9915SMA1
Carry-case	ZB9605TK

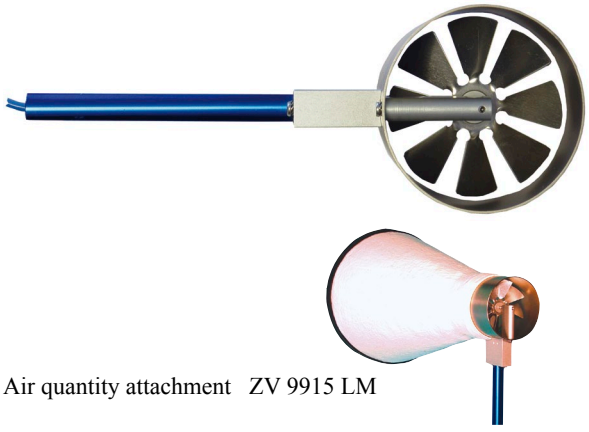
Standard delivery

Order no.

Digital vane anemometer with snap-on head fitted cable, adapter cable with ALMEMO® D6 plug

Measuring range 0.2 to 20 m/s — **FVAD15SMA1**

Digital vane anemometer FVAD 15 MA1 with brass probe head, macro attachment for measuring air quantity



Air quantity attachment ZV 9915 LM

Technical data

Accuracy	±0.5 % of final value ±1.5 % of measured value
Probe head	Ø 80 mm, length 70 mm fitted brass probe head
Insert opening	from 108 mm
Sensor shaft	Ø 15 mm
Sensor length	225 mm including probe head

Accessories	Order no.
Carry-case for rotating vane	ZB9605TK
Air quantity attachment (plug-in) Ø 200 mm (up to approx. 275 m³/h)	ZV9915LM

Standard delivery

Order no.

Digital vane anemometer with fitted brass probe head fitted cable adapter cable with ALMEMO® D6 plug

Measuring range 0.2 to 20 m/s — **FVAD15MA1**

Differential pressure and Pitot tube measurement Measuring connector FDA 602 S1K / S6K

Measuring connector FDA602S1K / S6K

- Pressure measuring connector in compact design for flow measurement with Pitot tubes
- Fitting for connecting hose between Pitot tube and pressure measuring connector
- Pressure measuring connector can be plugged directly onto the measuring instrument.

Technical data

Overload capacity	Maximum three times final value
Max. common mode pressure	700 mbar
Accuracy (zero-pt adjusted)	±0.5% of final value in range 0 to positive final value
Nominal temperature	25 °C
Temperature drift	< ±1.5 % of final value
Compensated temp. range	0 to +70 °C

Operating range	-10 to +60 °C, 10 to 90% RH, non-condensing
Dimensions	74 x 20 x 8.8 mm
Hose terminals	Ø 5 mm, 12 mm long
Sensor material	aluminum, nylon, silicone, silica gel, brass

! Advisory note when used in conjunction with ALMEMO® 2890, 5690, 5790, 8590, 8690:
The new ALMEMO® pressure measuring connector is very slightly higher (8.8 mm). As a result adjacent input sockets on the ALMEMO® device may be partly covered. However, the 1st input socket can always be used without restriction. Or, alternatively, the ALMEMO® pressure measuring connector can be plugged in at any input socket using connecting cable ZA9060AK1.

! On ALMEMO® devices to obtain precise measured results in m/s the wind tunnel temperature can be entered in the -50 to +700 °C range for compensation purposes.

Accessories

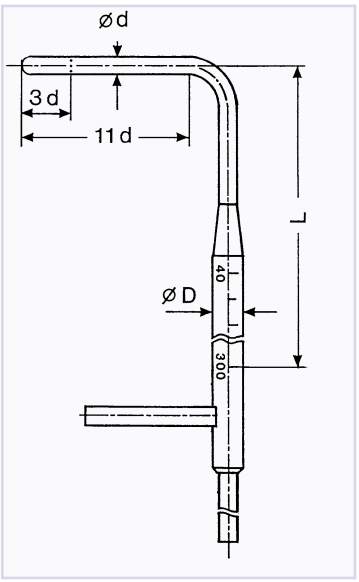
	Order no.
new ALMEMO® pressure measuring connector for barometric pressure 700 to 1100 mbar, without pressure terminal sleeve Technical data see page 11.12	**FDAD12SA**
including programming for automatic atmospheric pressure compensation (comment *P)	**OA9000PK**
(variant with pressure terminal sleeve, see page 10.10)	
Connecting cable, 0.2 meters	**ZA9060AK1**
Extension cable, 2 meters	**ZA9060VK2**
1 set of silicone hoses black / colorless, 2 meters	**ZB2295S**
Silicone hose, black, per meter	**ZB2295SSL**
Silicone hose, colorless, per meter	**ZB2295SFL**

Variants (including manufacturer's test certificate)

	Order no.
(including one set of silicone hoses, 2 meters) Measuring ranges ±1250 Pa, Differential pressure (1 to 40 m/s), Measured variables: m/s, Pa, Measuring connector, independent of position	**FDA602S1K**
Measuring ranges ±6800 Pa Differential pressure (2 to 90 m/s) Measured variables m/s, Pa, Measuring connector, independent of position	**FDA602S6K**

DAkkS / DKD or factory calibration KV90xx, air flow, and KD90xx, pressure, for sensor or measuring chain (sensor + device)
(see chapter „Calibration certificates")

Pitot Tubes for Differential Pressure Sensors FDA602



- Prandtl Pitot tubes with hemispheric head.
- For measuring the dynamic pressure, the tip of the Pitot tube has an opening of 0.3d.
- For measuring the static pressure, a total of 12 holes with 0.1d Ø have been arranged at a distance of 3d.

! Mit ALMEMO® devices that have an option for entering factors can also be used to perform wind velocity measurements with cylindrical probes, according to VDEH. The cylindrical Pitot tubes have a probe-related coefficient of 1.7. By entering a factor of 0.767 in the range m/s this coefficient will be considered during the measurement.

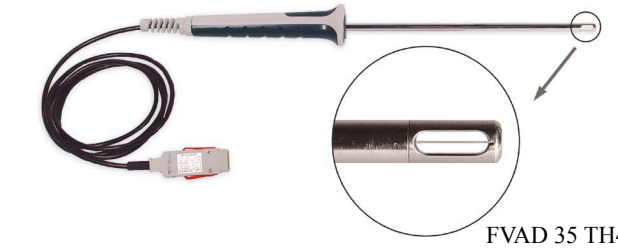
Option	Order no.
Movable screw connection for brass Pitot tubes with shaft diameter x (6; 8; 10; 20mm)	ZB9912KMx
for steel Pitot tubes with shaft diameter x (6; 8; 10; 20mm)	ZB9912KVx

Types and Technical Data:

Head Diameter (d)	Shaft Diameter (D)	Length	Tmax	Permiss. Dust	Material	Order no.
3 mm	6 mm	300 mm	150°C	none	Nickel-plated brass	**FD991233MS**
3 mm	6 mm	300 mm	300°C	none	Chrome-nickel steel	**FD991233VA**
5 mm	8 mm	400 mm	350°C	none	Nickel-plated brass	**FD991254MS**
5 mm	8 mm	400 mm	500°C	none	Chrome-nickel steel	**FD991254VA**
5 mm	8 mm	600 mm	350°C	none	Nickel-plated brass	**FD991256MS**
5 mm	8 mm	600 mm	500°C	none	Chrome-nickel steel	**FD991256VA**
8 mm	8 mm	400 mm	350°C	low	Nickel-plated brass	**FD991284MS**
8 mm	8 mm	400 mm	500°C	low	Chrome-nickel steel	**FD991284VA**
8 mm	8 mm	800 mm	350°C	low	Nickel-plated brass	**FD991288MS**
8 mm	8 mm	800 mm	600°C	low	Chrome-nickel steel	**FD991288VA**
10 mm	10 mm	800 mm	350°C	some	Nickel-plated brass	**FD991296MS**
10 mm	10 mm	800 mm	600°C	some	Chrome-nickel steel	**FD991296VA***
10 mm	10 mm	1000 mm	350°C	some	Nickel-plated brass	**FD991297MS**
10 mm	10 mm	1000 mm	600°C	some	Chrome-nickel steel	**FD991297VA***
10 mm	20 mm	1500 mm	350°C	some	Nickel-plated brass	**FD991298MS**
10 mm	20 mm	1500 mm	600°C	some	Chrome-nickel steel	**FD991298VA***
20 mm	20 mm	2000 mm	350°C	more	Nickel-plated brass	**FD991299MS**
20 mm	20 mm	2000 mm	600°C	more	Chrome-nickel steel	**FD991299VA***

*) all VA Pitot tubes can be operated up to 700°C for a short period

Digital thermoanemometer FVAD 35 THx with ALMEMO® D6 plug with integrated atmospheric pressure sensor, for automatic pressure compensation



FVAD 35 TH4 / TH5

FVAD 35 TH4Kx / TH5Kx

- *new:* Automatic atmospheric pressure compensation is provided for pressure-dependent flow velocity by means of a digital atmospheric pressure sensor integrated in the ALMEMO® D6 plug itself.
- Digital thermoanemometer with A/D converter in the grip or integrated in the cable
- The probe tube has a small diameter, only 6 mm.
- All relevant measurable variables can be measured using just one sensor.
- Three measuring channels are programmed (at our factory): Temperature (°C, t), Flow velocity (m/s, v), Atmospheric pressure (mbar, AP, p)

General features and accessories, ALMEMO® D6 sensors: see page 01.08

DAkkS / DKD or factory calibration KV90xx air flow for digital sensor (see chapter „Calibration certificates“)

Technical data

Digital thermoanemometer (Sensor including A/D converter)

Flow	
Measuring range	
FVAD 35 TH4 / TH4Kx	0.08 to 2 m/s
FVAD 35 TH5 / TH5Kx	0.2 to 20 m/s
Resolution	
FVAD 35 TH4 / TH4Kx	0.001 m/s
FVAD 35 TH5 / TH5Kx	0.01 m/s
Response time	<1.5 seconds
Accuracy	
FVAD 35 TH4 / TH4Kx	± (0.04 m/s +1% of meas. val.)
FVAD 35 TH5 / TH5Kx	± (0.2 m/s +2% of meas. val.)
Nominal conditions	22 °C ±2 K, 45 % RH ±10 % RH 1013 mbar
Temperature compensation	0 to +50 °C
Influence of temperature	
FVAD 35 TH4 / TH4Kx	±0.5 % of measured value /°C at 0.3 to 2 m/s
FVAD 35 TH5 / TH5Kx	±0.3% of measured value /°C at 0.3 to 20 m/s
Incidental flow	bidirectional
Angle dependence	<3% of measured value with deviation <15°
Pressure range	Ambient pressure
Pressure compensation	automatic in range 700 to 1100mbar

Temperature	
Measuring range	-20 to +70 °C
Resolution	0.1 °C
Accuracy	±0.7 °C at 0 to 50 °C and >0.5 m/s
Response time T_{90}	typical 10 seconds
Digital atmospheric 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	0.5 seconds for all 3 channels
Supply voltage	6 to 13 VDC
Current consumption	40 mA
Dimensions	
Probe diameter	6 mm
Flow aperture	approx. 10 x 3 mm
FVAD 35 TH4 / TH5	
Probe with grip, probe lengths 210 mm (plus grip) ALMEMO® cable 1.5 meters	
FVAD 35 TH4Kx / TH5Kx	
Probe with detached electronics unit integrated in the cable, Probe lengths THxK1, 80 mm / THxK2, 300 mm Probe cable 5 meters to the electronics ALMEMO® cable 1.5 m	

Accessories (for FVAD 35 THxK1 / K2 only)

	Order no.
Clamped screw connection with thread adapter for telescopic extension / extension set (maximum 80 °C)	ZV9915KV
Telescope extension Ø 15 to 24 mm 330 / 1010 mm	ZV9915TV
Extension set Ø 15 mm 4 x 255 mm	ZV9915VR3

Variants (including works certificate)

Digital thermoanemometer, fitted cable with ALMEMO® D6 plug and integrated digital atmospheric pressure sensor

	Order no.
Sensor 2 m/s, length = 210 mm, (with grip)	**FVAD35TH4**
Sensor 2 m/s, length = 80 mm, (detached electronics unit)	**FVAD35TH4K1**
Sensor 2 m/s, length = 300 mm, (detached electronics unit)	**FVAD35TH4K2**
Sensor 20 m/s, length = 210 mm, (with grip)	**FVAD35TH5**
Sensor 20 m/s, length = 80 mm, (detached electronics unit)	**FVAD35TH5K1**
Sensor 20 m/s, length = 300 mm, (detached electronics unit)	**FVAD35TH5K2**

Other designs are available on request

High-temperature thermoanemometer MT8635THx
Operative range -40 to +120 °C, up to 40 m/s
Probe with detached electronics unit integrated in the cable

Thermoelectric Flow Sensor FV A605 TA

- Probe tube with heated miniature thermistor for flow measurement and precision NTC resistance for automatic compensation.
- Evaluation electronics are located in a separate sensor transmitter module.
- High accuracy as a result of integrated temperature compensation and individual calibration in wind tunnel, with laser Doppler anemometer as reference system.
- Response time only 2s for smoothing the measured value indicated, optionally without smoothing with 100ms response time.
- Suitable for measuring small flow velocities in gaseous substances, particularly for control systems and monitoring.
- Typical applications include comfort index measurements, HEVAC applications, environmental technology, clean room technology and process measuring and control technology.

Technical Data

Electronics Box with Sensor	
Measuring range:	
FV A605 TA1(O)	0.01 to 1m/s
FV A605 TA5(O)	0.15 to 5m/s
Resolution:	
FV A605 TA1(O)	0.001m/s
FV A605 TA5(O)	0.01m/s
Accuracy:	
FV A605 TA1(O)	±1.0% of final value and ±1.5% of meas. value
FV A605 TA5(O)	±0.5% of final value and ±1.5% of meas. value
Nominal conditions:	22°C, 960hPa
Automatic temperature compensation:	effective in range 0 to 40°C
Temperature influence:	±0.5% of fin. value/°C
Sensor	
Head size:	Ø 8mm
Shaft:	Ø 15mm
Operative range:	0 to 40°C
Angle of attack:	
FV A605 TA1/TA5	±30°
FV A605 TA1O/TA5O	±180°
Inlet opening:	
FV A605 TAx:	9mm
FV A605 TAxO:	protecting cage 110mm
Sensor length:	
FV A605 TAx:	300mm
FV A605 TAxO	310mm
Sensor cable length:	1.5m
Storage temperature:	–30 to +90°C
General Technical Specifications	
Measurement medium:	dry air or inert gases
Response time:	
FVA605TAxD	smoothened, 1 τ = 2s
FVA605TAxU	not smoothened, 1 τ = 100ms
Power supply:	through ALMEMO® device (approx. 7… 12V)
Current consumption:	approx. 70mA
Output signal:	0 … 1V, linearised, load resistance min. 10kohms
Housing:	
Dimensions:	100 x 60 x 35mm (L x W x H)
Protection system:	IP 40 (aluminium housing)
Weight:	approx. 250g
Operating temperature:	0 to 40°C
Storage temperature:	–30 to 90°C
Air humidity:	0 … 90% r.H., non-condensing
Adjusting reference:	laser Doppler wind tunnel, adjustment at 22°C/approx. 960hPa, (certificate according to SN EN 45001)

Types (incl. clamping holder and ALMEMO® connecting cable 1.5m long)

	Order no.
Unidirectional (sensitive in one direction) with protected measuring tip	
Measuring range up to 1m/s, smoothened	**FVA605TA1D**
Measuring range up to 5m/s, smoothened	**FVA605TA5D**
Measuring range up to 1m/s, not smoothened	**FVA605TA1U**
Measuring range up to 5m/s, not smoothened	**FVA605TA5U**
Omnidirectional (direction-independent, symmetrical ball tip)with protecting cage (Ø110mm) including carry-case	
Measuring range up to 1m/s, smoothened	**FVA605TA1OD**
Measuring range up to 5m/s, smoothened	**FVA605TA5OD**
Measuring range up to 1m/s, not smoothened	**FVA605TA1OU**
Measuring range up to 5m/s, not smoothened	**FVA605TA5OU**

DAkkS / DKD or factory calibration KV90xx, air flow, for sensor or measuring chain (sensor + device) (see chapter „Calibration certificates“)