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#### 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

#### **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<sup>®</sup> devices by silicone hoses and a differential pressure module.

#### **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.

#### 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. to their measuring range and the operating temperature:

#### Advantage:

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

#### Advantage:

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

# Advantage:

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

### • Pitot tubes

- Rotating vanes
- Thermoanemometer probes

#### **Disadvantage:**

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

#### Disadvantage:

sensitive sensor technology, sensitive to mechanical stress, directional

#### **Disadvantage:**

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

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

#### **Correction Factors for Exact Measurements of the Air Speed**

temperature and the barometric air pressure. Therefore, the measured value must be corrected according to the above table

speed.

**Example:** 

Measured air velocity 50m/s, air tempera-

The true air velocity depends on the air to obtain exact measurements of the air ture 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 Technical data FVAD15 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<sup>®</sup> 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

Operative range	-20 to +140 °C
Maximum resolution	0.01 m/s
Nominal temperature	+22 °C ±2 K
Connecting cables	Fitted cable, 1.8 meters, with LEMO <sup>®</sup> plug
ALMEMO <sup>®</sup> adapter cable	LEMO <sup>®</sup> coupling cable, 0.2 meters with ALMEMO <sup>®</sup> D6 plug
ALMEMO <sup>®</sup> 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 Telescopic extension Ø 15 to 24 mm 330 / 1010 mm	ZV9915VR3 ZV9915TV
recession of 15 to 24 min, 5507 for thin	2,799131,4

DAkkS or factory calibration KV90xx air flow for digital sensor (see chapter "Calibration certificates"). DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

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



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

	Technical data		
		Accuracy	$\pm 1$ % of final value $\pm 3$ % of measured value
		Probe head	Ø 11 mm, length 15 mm Replaceable snap-on head
		Insert opening	from 16 mm
Accessories	Order no.	Sensor shaft	Ø 15 mm
Spare snap-on head, micro, 20 m/s	ZV9915S220	Sensor length	165 mm including probe head
Spare snap-on head, micro, 40 m/s	ZV9915S240		

#### Standard delivery

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

Measuring range 0.6 to 20 m/s

Measuring range 0.7 to 40 m/s

Order no.

Air flow

FVAD15S220 FVAD15S240

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



Accessories Spare snap-on head, macro, 20 m/s Carry-case

Order no. ZV9915SMA1 ZB9605TK

Technical data

Accuracy

	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

 $\pm 1$  % of final value  $\pm 1.5$  %

#### Standard delivery

Digital vane anemometer with snap-on head fitted cable, adapter cable with ALMEMO® D6 plug Measuring range 0.2 to 20 m/s

#### Order no.

FVAD15SMA1

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

	Technical data			
	Accuracy	$\pm 0.5$ % of fin of measured	$\pm 0.5$ % of final value $\pm 1.5$ % of measured value	
	Probe head	Ø 80 mm, ler fitted brass p	ngth 70 mm robe head	
	Insert opening	from 108 mm	1	
	Sensor shaft	Ø 15 mm		
	Sensor length	225 mm incl	uding probe head	
	Accessories		Order no.	
	Carry-case for rotating	vane	ZB9605TK	
V 9915 LM	Air quantity attachmen Ø 200 mm (up to appro	t (plug-in) ox. 275 m <sup>3</sup> /h)	ZV9915LM	
у			Order no.	
ometer with fitted brass probe hea ALMEMO® D6 plug	ad fitted cable			
nge 0.2 to 20 m/s			FVAD15MA1	

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



Measuring connector FDA602S1K / S6K

#### **Technical data**

- 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.

Overload capacity	Maximum three times final value	_ Operating range	-10 to +60 °C, 10 to 90% RH,
Max. common mode pressure	700 mbar		non-condensing
Accuracy (zero-pt adjusted)	$\pm 0.5\%$ of final value	Dimensions	74 x 20 x 8.8 mm
	in range 0 to positive final value	Hose terminals	Ø 5 mm, 12 mm long
Nominal temperature	25 °C	Sensor material	aluminum, nylon, silicone,
Temperature drift	$<\pm1.5$ % of final value		silica gel, brass
Compensated temp. range	0 to +70 °C		

Advisory note when used in conjunction with ALMEMO<sup>®</sup> 2890, 5690, 5790, 8590, 8690, 500, 809: The new ALMEMO<sup>®</sup> pressure measuring connector is very slightly higher (8.8 mm). As a result adjacent input sockets on the ALMEMO<sup>®</sup> device may be partly covered. However, the 1st input socket can always be used without restriction. Or, alternatively, the ALMEMO<sup>®</sup> pressure measuring connector can be plugged in at any input socket using connecting cable ZA9060AK1.

On ALMEMO<sup>®</sup> 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.

FDA602S6K

Accessories	Order no.
ALMEMO <sup>®</sup> 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
	Gruer no
(including one set of silicone hoses, 2 meters)	
Measuring ranges $\pm 1250$ Pa, Differential pressure (1 to 40 m/s), Measured variables: m/s, Pa, Measuring connector, independent of position	FDA602S1F

Measuring connector, independent of position Measuring ranges ±6800 Pa Differential pressure (2 to 90 m/s) Measured variables m/s, Pa,

Measuring connector, independent of position

DAkkS or factory calibration KV90xx, air flow, and KD90xx, pressure, for sensor or measuring chain (sensor + device) (see chapter "Calibration certificates"). DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.



- 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<sup>®</sup> 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

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## 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*

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

Order no.

FVAD35TH4

FVAD35TH5

FVAD35TH4K1

FVAD35TH4K2

FVAD35TH5K1

FVAD35TH5K2

#### Digital thermoanemometer FVAD 35 THx with ALMEMO<sup>®</sup> D6 plug with integrated atmospheric pressure sensor, for automatic pressure compensation



FVAD 35 TH4Kx / TH5Kx

#### Technical data

Digital the nomoton (Conson including 1/D convertor) • 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 or factory calibration KV90xx air flow for digital sensor (see chapter "Calibration certificates"). DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

Digital thermoanemometer (S	ensor including A/D converter)		
Flow		Temperature	
Measuring range		Measuring range	-20 to +70 °C
FVAD 35 TH4 / TH4Kx	0.08 to 2 m/s	Resolution	0.1 °C
FVAD 35 TH5 / TH5Kx	0.2 to 20 m/s	Accuracy	$\pm 0.7$ °C at 0 to 50 °C and >0.5 m/s
Resolution		Response time T <sub>90</sub>	typical 10 seconds
FVAD 35 TH4 / TH4Kx	0.001 m/s	Digital atmospheric pressure sensor	
FVAD 35 TH5 / TH5Kx	0.01 m/s	(integrated in ALMEMO <sup>®</sup> D6 plug)	
Response time	<1.5 seconds	Measuring range	700 to 1100 mbar
Accuracy		Accuracy	±2.5 mbar (at 23 °C ±5 K)
FVAD 35 TH4 / TH4Kx	$\pm$ (0.04 m/s +1% of meas. val.)	ALMEMO <sup>®</sup> D6 plug	
FVAD 35 TH5 / TH5Kx	$\pm$ (0.2 m/s +2% of meas. val.)	Refresh rate	0.5 seconds for all 3 channels
Nominal conditions	22 °C $\pm$ 2 K, 45 % RH $\pm$ 10 % RH	Supply voltage	6 to 13 VDC
	1013 mbar	Current consumption	40 mA
Temperature compensation	0 to +50 °C	Dimensions	
Influence of temperature		Probe diameter	6 mm
FVAD 35 TH4 / TH4Kx	$\pm 0.5$ % of measured value /°C	Flow aperture	approx. 10 x 3 mm
	at 0.3 to 2 m/s	FVAD 35 TH4 / TH5	
FVAD 35 TH5 / TH5Kx	$\pm 0.3\%$ of measured value /°C	Probe with grip, probe lengths 210 mm	
	at 0.3 to 20 m/s	(plus grip) ALMEMO <sup>®</sup> cable 1.5 meters	
Incidental flow	bidirectional	FVAD 35 TH4Kx / TH5Kx	
Angle dependence	<3% of measured value	Probe with detached electronics unit integrated in the	
-	with deviation <15°	cable, Probe lengths THxK1, 80 mm / THxK2, 300 mm	
Pressure range	Ambient pressure	Probe cable 5 meters to the electronics	
Pressure compensation	automatic in range 700 to 1100mbar	ALMEMO <sup>®</sup> cable 1.5 m	
Accessories (for FVAD	35 THxK1 / K2 only)		Order no.

#### Clamped screw connection with thread adapter for telescopic extension ŽV9915KV / extension set (maximum 80 °C) Telescope extension Ø 15 to 24 mm 330 / 1010 mm ZV9915TV ZV9915VR3 Extension set Ø 15 mm 4 x 255 mm

# **Variants** (including works certificate)

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

Sensor 2 m/s, length = 210 mm, (with grip) Sensor 2 m/s, length = 80 mm, (detached electronics unit) Sensor 2 m/s, length = 300 mm, (detached electronics unit) Sensor 20 m/s, length = 210 mm, (with grip) Sensor 20 m/s, length = 80 mm, (detached electronics unit) Sensor 20 m/s, length = 300 mm, (detached electronics unit)

#### 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





- · 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.

Measuring range: FV A605 TA1(O)	0.01 to $1m/s$	FV A605 TAx: FV A605 TAxO	300mm 310mm	
FV A605 TA5(O)	0.15 to 5m/s	Sensor cable length:	1.5m	
Resolution:		Storage temperature:	-30 to +90°C	
FV A605 TA1(O)	0.001m/s	General Technical Specifi	al Technical Specifications	
FV A605 TA5(O)	0.01m/s	— Measurement medium:	dry air or inert gases	
Accuracy: FV A605 TA1(O)	$\pm 1.0\%$ of final value and $\pm 1.5\%$ of meas. value $\pm 0.5\%$ of final value and $\pm 1.5\%$ of meas. value	Response time: FVA605TAxD FVA605TAxU	smoothened, $1 \tau = 2s$ not smoothened, $1 \tau = 100ms$	
F V A005 TA5(0)		Power supply:	through ALMEMO <sup>®</sup> device	
Nominal conditions:	22°C, 960hPa			
Automatic temperature compensation:	effective in range 0 to 40°C	Output signal:	0 1V, linearised,	
Temperature influence:	±0.5% of fin. value/°C		load resistance min. 10kohms	
Sensor		Housing:	100 (0.25 (I.W. II)	
Head size:	Ø 8mm	Dimensions: Protection system:	$100 \times 60 \times 35 \text{mm} (L \times W \times H)$ IP 40 (aluminium housing)	
Shaft:	Ø 15mm	Weight:	approx. 250g	
Operative range:	0 to 40°C	Operating temperature:	0 to 40°C	
Angle of attack:		Storage temperature:	-30 to 90°C	
FV A605 TA1/TA5	±30°	Air humidity:	0 90% r.H., non-condensing	
Inlet opening: FV A605 TAX: FV A605 TAX:	9mm	— Adjusting reference:	laser Doppler wind tunnel, adjustment at 22°C/approx. 960hPa, (certificate according to SN EN 45001)	
FV A003 TAXU:	protecting cage 110mm			

Sensor length:

<b>Types</b> (incl. clamping holder and ALMEMO <sup>®</sup> 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		
Measuring range up to 1m/s, not smoothened	FVA605TA1OU	

**Electronics Box with Sensor** 

**Technical Data** 

Measuring range up to 5m/s, not smoothened

DAkkS or factory calibration KV90xx, air flow, for sensor or measuring chain (sensor + device) (see chapter ,,Calibration certificates"). DAkkS calibration meets all the requirements regarding test resources laid down in DIN EN ISO/IEC 17025.

FVA605TA5OU