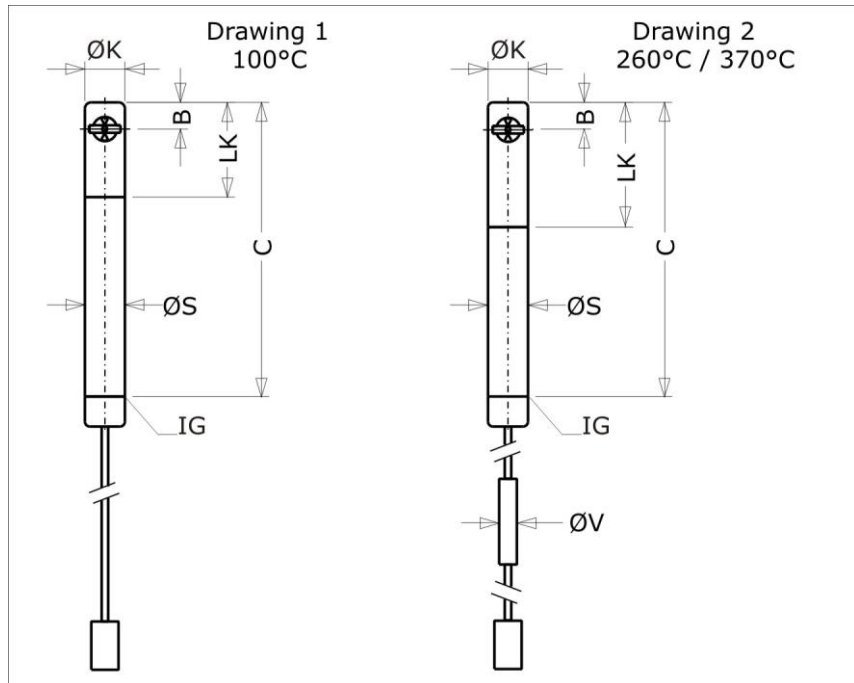


Flow and flow rate measurement with vane wheel flow sensor FA as 16 mm cylinder probe at working temperatures of $-40 \dots 370 \text{ }^\circ\text{C}$ for connection to a fixed or portable evaluation unit



Measurable variables

- flow velocity v [m/s] and
- flow rate [m³/h] in air/gases and water/liquids
- conversion to standard velocity/standard flow rate (measuring in air/gases) by entering working pressure and temperature parameters

Measuring range

- 0.6 ... 120 m/s gases
- 0.06 ... 10 m/s liquids

Medium

- air, clean gases and gas mixtures
- water, liquids

Functional principle

- vane wheel flow sensor
- sensing the vane rotation; non-contact by means of inductive proximity switch

Design

- insertion probe with fixed cable, extendable

Examples of application

- flow measurement e.g. of air, exhaust gas, process gas
- in processes with varying and/or unknown gas compositions
- flow monitoring in pharmaceutical installations
- monitoring neutralisation processes
- measurement of flammable liquids
- measuring in surface waters
- measuring in non-conducting liquids such as ultra pure water, for example in the semiconductor industry

Advantages

- accurate measured values even in varying and/or unknown gas compositions
- turndown ratio approx. 1 : 100

- no distortion of values due to thermal radiation
- optional application in category 2 (zone 1)
- small insertion opening
- universal application spectrum
- extendable
- small pressure loss

Connection possibilities

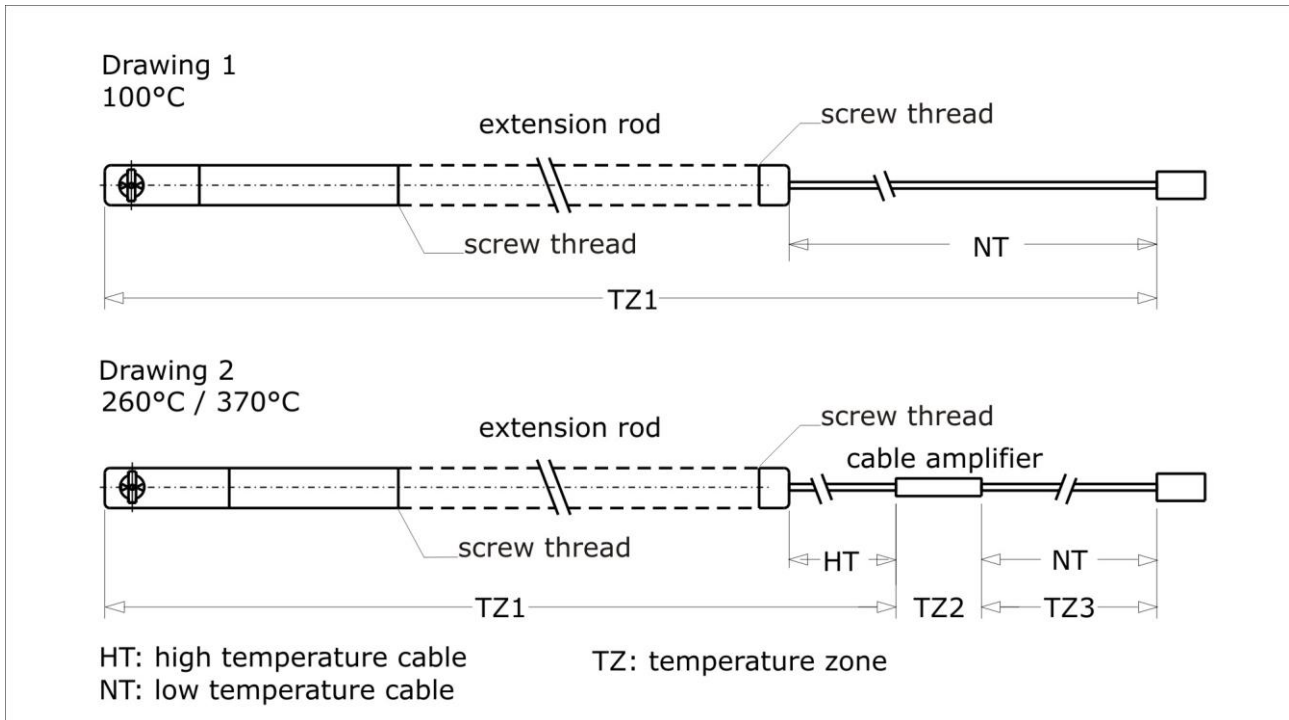
- portable and fixed evaluation units with sensor input v/FA , v/FAR or $v/FA-Ex$, $v/FAR-Ex$

Humidity in the sample gas

- relative gas humidity of less than 100 % has no impact on the measurement uncertainty

Particles in the medium

- can cause restriction in the fatigue strength of the vane wheel set



Model designation for ZS16 (example)

ZS16	GF	E	100	P6	2m	ZG1
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Basic types

'aluminium'	vane wheel types	cable length	article no.
ZS16GFA/100/p3/ 2m /ZG1	mc20A, mc40A, mc80A, mc120A	2.0 m	B005/200
ZS16GFA/100/p3/ 3.5m /ZG1	mc20A, mc40A, mc80A, mc120A	3.5 m	B005/201
ZS16GFA/100/p3/ 5m /ZG1	mc20A, mc40A, mc80A, mc120A	5.0 m	B005/202
'stainless steel'			
ZS16GFE/100/p6/ 2m /ZG1	mc20T, mc40T, mc80T	2.0 m	B005/210
ZS16GFE/100/p6/ 4m /ZG1	mc20T, mc40T, mc80T	4.0 m	B005/211
ZS16GFE/100/p6/ 6m /ZG1	mc20T, mc40T, mc80T	6.0 m	B005/212
ZS16GFE/260/p6/ 2m /ZG2	mc20T, mc40T, mc80T	HT 2 m*	B005/220
ZS16GFE/260/p6/ 4m /ZG2	mc20T, mc40T, mc80T	HT 4 m*	B005/221
ZS16GFE/260/p6/ 6m /ZG2	mc20T, mc40T, mc80T	HT 6 m*	B005/222
ZS16GE/370/p6/ 2m /ZG2	mc20T, mc40T, mc80T	HT 2 m*	B005/230
ZS16GE/370/p6/ 4m /ZG2	mc20T, mc40T, mc80T	HT 4 m*	B005/231
ZS16GE/370/p6/ 6m /ZG2	mc20T, mc40T, mc80T	HT 6 m*	B005/232

* HT : length of high temperature cable plus length of low temperature cable (s. page 4, point 6)

Basic types (cont.)			
'titanium'	vane wheel types	cable length	article no.
ZS16GFT/100/p6/ 2m /ZG1	mc20T, mc40T, mc80T	2.0 m	B005/240
ZS16GFT/100/p6/ 4m /ZG1	mc20T, mc40T, mc80T	4.0 m	B005/241
ZS16GFT/100/p6/ 6m /ZG1	mc20T, mc40T, mc80T	6.0 m	B005/242
ZS16GFT/260/p6/ 2m /ZG2	mc20T, mc40T, mc80T	HT 2 m*	B005/250
ZS16GFT/260/p6/ 4m /ZG2	mc20T, mc40T, mc80T	HT 4 m*	B005/251
ZS16GFT/260/p6/ 6m /ZG2	mc20T, mc40T, mc80T	HT 6 m*	B005/252

* HT : length of high temperature cable plus length of low temperature cable (s. page 4, point 6)

(1) Sensor type / probe diameter
Vane wheel flow sensor ZS16 with probe Ø 16 mm

(2) Medium	
... GF ...	air / gases and water / liquids
... G ...	air / gases (probes '370 °C')

(3) Materials in contact with the medium	
Design	Material
... A ... aluminium	AlCuMgPb, PSU, FKM seal
... E ... stainless steel	stainless steel 1.4404 / AISI 316L, titanium 3.7035 (grade 2), ceramics Al ₂ O ₃ 99.9 %, 100 °C: pure graphite seal, FKM 260 °C: pure graphite seal, PTFE 370 °C: pure graphite seal
... T ... titanium	titanium 3.7035 (grade 2), ceramics Al ₂ O ₃ 99.9 %, 100 °C: pure graphite seal, FKM 260 °C: pure graphite seal, PTFE

(4) Permissible temperature of the medium / ambient temperature				
Design	Temperature of the medium	Ambient temperature (see Drawings, Page 2)		
		TZ1	TZ2	TZ3
... 100 ...	-20 ... +100 °C (c)	-20 ... +100 °C	-	-
... 260 ...	-40 ... +260 °C (c) -40 ... +300 °C (s)	-40 ... +260 °C	-40 ... +125 °C	-40 ... +125 °C
... 370 ...	-40 ... +370 °C (c) -40 ... +400 °C (s)	-40 ... +400 °C	-40 ... +125 °C	-40 ... +125 °C

(c) continuous; (s) short-time = max. 2 minutes

(5) Max. working pressure

... p3 ...	up to 3 bar / 0.3 MPa overpressure
... p6 ...	up to 6 bar / 0.6 MPa overpressure

Ingress protection cable outlet

sensor design 100 °C and 260 °C	IP68
sensor design 370 °C	IP50

(6) Cable length

Design	Description
sensor design up to 100 °C *	
... 2m ...	2 m fixed cable
... 3.5m ...	3.5 m fixed cable
... 4m ...	4 m fixed cable
... 5m ...	5 m fixed cable
... 6m ...	6 m fixed cable
sensor design up to 260 °C and 370 °C *	
... 2m ...	2 m fixed high temperature cable in front of cable amplifier + 1.5 m low temperature cable (max. +125 °C) behind cable amplifier
... 4m ...	4 m fixed high temperature cable in front of cable amplifier + 1.5 m low temperature cable (max. +125 °C) behind cable amplifier
... 6m ...	6 m fixed high temperature cable in front of cable amplifier + 1.5 m low temperature cable (max. +125 °C) behind cable amplifier

* special cable lengths on request

(7) Design / dimensions

'aluminium', for max. 100 °C, as in Drawing 1 (Page 1)								
dimensions	Ø K	16 mm	Ø S	16 mm	B	10.65 mm	LK	53 mm
	C	163 mm	IG	M14x1.5				
'stainless steel' or 'titanium', for max. 100 °C, as in Drawing 1 (Page 1)								
dimensions	Ø K	16 mm	Ø S	16 mm	B	11 mm	LK	65 mm
	C	163 mm	IG	M14x1.5				
'stainless steel' or 'titanium', for max. 260 °C or 370 °C, as in Drawing 2 (Page 1)								
dimensions	Ø K	16 mm	Ø S	16 mm	B	11 mm	LK	65 mm
	C	163 mm	IG	M14x1.5	Ø V	9.5 mm		

Option 'Ex-protection'

		Ex-protection category 3G and 3D (zone 2 and 22)	Ex-protection * category 2G (zone 1)
sensor	article no.	article no.	article no.
		FAEX2E	FAEX1
ZS16GFA/100/p3/2m/ZG1	B005/200	X	X
ZS16GFA/100/p3/3.5m/ZG1	B005/201	X	X
ZS16GFA/100/p3/6m/ZG1	B005/202	X	X
ZS16GFE/100/p6/2m/ZG1	B005/210	X	X
ZS16GFE/100/p6/4m/ZG1	B005/211	X	X
ZS16GFE/100/p6/6m/ZG1	B005/212	X	X
ZS16GFE/260/p6/2m/ZG2	B005/220	X	X
ZS16GFE/260/p6/4m/ZG2	B005/221	X	X
ZS16GFE/260/p6/6m/ZG2	B005/222	X	X
ZS16GE/370/p6/2m/ZG2	B005/230	X	X
ZS16GE/370/p6/4m/ZG2	B005/231	X	X
ZS16GE/370/p6/6m/ZG2	B005/232	X	X
ZS16GFT/100/p6/2m/ZG1	B005/240	X	X
ZS16GFT/100/p6/4m/ZG1	B005/241	X	X
ZS16GFT/100/p6/6m/ZG1	B005/242	X	X
ZS16GFT/260/p6/2m/ZG2	B005/250	X	X
ZS16GFT/260/p6/4m/ZG2	B005/251	X	X
ZS16GFT/260/p6/6m/ZG2	B005/252	X	X

* only in conjunction with ATEX-conform, portable or fixed evaluation units with v/FA-Ex or v/FAR-Ex input, or isolation-/supply unit

Measuring ranges (with an air/gas density of approx. 1.2 kg/m³) / vane wheel type

measuring range air/gases	measuring range water/liquids*	vane wheel type	article no.
with 'aluminium' probes up to 100 °C			
0.6 ... 20 m/s	0.06 ... 7.5 m/s	mc 20 A	V_MC20GFA
0.6 ... 40 m/s	0.06 ... 10 m/s	mc 40 A	V_MC40GFA
1.2 ... 80 m/s	0.08 ... 10 m/s	mc 80 A	V_MC80GFA
1.4 ... 120 m/s	0.10 ... 10 m/s	mc 120 A	V_MC120GFA
with 'stainless steel' and 'titanium' probes up to 100 °C and 260 °C			
0.8 ... 20 m/s	0.08 ... 7.5 m/s	mc 20 T	V_MC20GFT
1.0 ... 40 m/s	0.10 ... 10 m/s	mc 40 T	V_MC40GFT
1.6 ... 80 m/s	0.10 ... 10 m/s	mc 80 T	V_MC80GFT
with 'stainless steel' probes up to 370 °C			
0.8 ... 20 m/s		mc 20 T	V_MC20GT
1.0 ... 40 m/s		mc 40 T	V_MC40GT
1.6 ... 80 m/s		mc 80 T	V_MC80GT

* precondition: no cavitation!

Measurement uncertainty / repeatability with a gas density of approx. 1.2 kg/m³ or with water*

Linearisation of characteristics (standard)	all types	< 1.0 % of measured value + 0.5 % of terminal value
Linearisation of characteristics (DAkkS)	all types	< 0.9 % of measured value + 0.25 % of terminal value
Frequency response characteristics ** (interchangeability is guaranteed)	all types	< 2 % of terminal value (in gas up to 40 m/s)
Repeatability		±(0.05 % of terminal value + 0.02 m/s)

The lowest measurement uncertainties in the field are attained with calibrations as close as possible to the operating conditions. For this, the measurement results obtained can be implemented as characteristic in the evaluation unit.

Information and details on the measurement uncertainties according to the calibrated measurement standards can be found in the document 'U183 and U325 Calibration'

* for water and liquids with a viscosity of up to approx. 0.0002 m²/s (200 cSt) < 2 % FS applies with linearisation of characteristics < 1.0 % of measured value + 0.5 % of terminal value

** if the evaluation electronics do not support linearisation of characteristics

Optional

ISO or DAkkS Calibration certificate v/FA* calibration medium air, 6 calibration values in the measuring range	article no.: KLB
--	------------------

* An engraved dot on the sensor head indicates the upstream side during calibration. Details of additional calibration values or customised calibrations can be found in document 'U183 Calibration' or are available on request

Sensor output

v/FA

Evaluation unit for signal evaluation

- with input **v/FA** or **v/FAR**

v/FA-Ex
with option 'Ex' for
category 2G (zone 1)

- with intrinsically safe **v/FA-Ex** or **v/FAR-Ex** input
- with **v/FA** or **v/FAR** input connected in series with an
isolation/supply unit ATEX

Smallest measurable value, density influence

The smallest measurable value for measurements in air/gases specified in our documents results from a measuring medium density $\rho \cong 1.204 \text{ kg/m}^3$. The smallest measurable value v_0 is also increased / decreased negligibly even with a considerably different medium density from 1.204 kg/m^3 and follows in good approximation the relation:

$$v_{0,real} = v_{0,specif} * \sqrt{1.204 \text{ kg/m}^3 / \rho_{real}}$$

The characteristic is displaced by the difference

$$v_{0,specif} - v_{0,real} = \Delta v.$$

Readout of measured values is too great by the amount Δv when measuring in gases of a density of ρ_{real} greater than 1.204 kg/m^3 , and too small by the amount Δv when measuring in gases of a density of ρ_{real} less than 1.204 kg/m^3 . Δv is to be added to or subtracted from the respective output value.

Evaluation unit connection

for unit with 8-pin screw-type connector

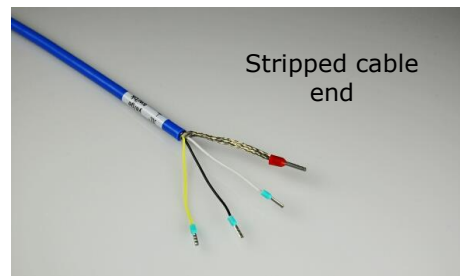
		article no.
plug 680-8*	type of protection IP40	A099/055
plug 423-8*	type of protection IP67	A099/056
plug LEMO.0-4	with extension rods VS16 ... incl. LEMO.0-4 / 680-8 adapter cable	A099/053

for unit with connecting terminals

stripped cable end	marked strands with end sleeves	A099/110
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* with extension rods VS16 ... please use article no. A099/053 or A099/110

Connection possibilities



Extension rods

	material	length	outside diameter	article no.
VS16A-350	aluminium FKM O-Ring	350 mm	16 mm	B099/000
VS16E-350	stainless steel FKM O-Ring	350 mm	16 mm	B099/001

Other accessories

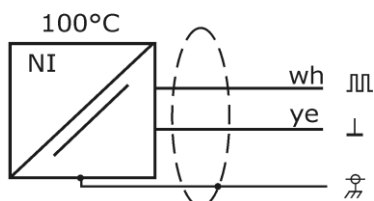
	article no.
direction indicator RZ16	B099/950

Profile factors depending on inside diameter (see also 'Measuring ranges', Page 5)

Measuring tube inside diameter Di [mm]	Profile factor PF* [-]	Measuring tube inside diameter Di [mm]	Profile factor PF* [-]
40	0.914	100	0.994
50	0.933	120	1.004
60	0.950	170	1.008
70	0.964	180	1.008
80	0.976	220	1.008
90	0.987	...	1.009

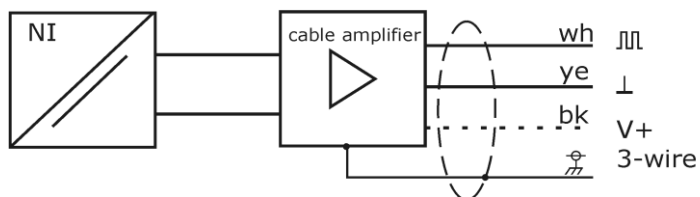
* These profile factors are only accurate with centric sensor positioning, turbulent, non-rotational inlet flow and sufficiently dimensioned input and output sections (see Operating Instructions). The profile factor describes the ratio of average flow velocity in the measurement cross section area and the flow velocity measured from the sensor. The above mentioned operating conditions apply.

Wiring Diagram 100 °C Sensors



Wiring Diagram 260 °C or 370 °C Sensors

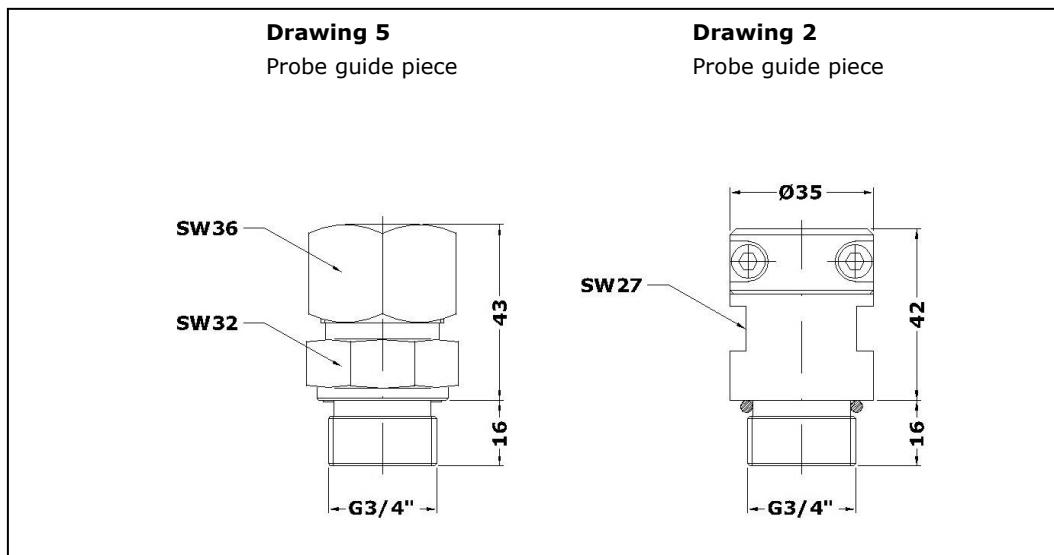
260°C / 370°C



**Extendable vane wheel flow sensor
ZS16 with connection cable**

probe guide pieces *		
designation	description	articles no.
SFB 16 E-45 / G 3/4" according drawing 5 (see below)	connection: outside thread G 3/4" max. pressure: 2 bar / 200 kPa temperature: -40 ... +240 °C materials: stainless steel, FKM, PTFE fixation: clamping bush length: 45 mm	B004/520
SFB 16 E-45 / 3/4" NPT according drawing 5 (see below)	connection: outside thread 3/4" NPT max. pressure: 2 bar / 200 kPa temperature: -20 ... +240 °C materials: stainless steel, PTFE fixation: clamping bush length: 45 mm	B004/521
SFB 16 E-45 / G 3/4" according drawing 5 (see below)	connection: outside thread G 3/4" max. pressure: 2 bar / 200 kPa temperature: -40 ... +370 °C materials: stainless steel, graphite fixation: clamping bush length: 45 mm	B004/525
SFK 16 E-42 / G 3/4" according drawing 2 (see below)	connection: outside thread G 3/4" max. pressure: 16 bar / 1.6 MPa temperature: -20 ... +240 °C materials: stainless steel, FKM, fixation: clamping yoke length: 42 mm	B004/221

* Probe guide pieces enable a process connection via threaded sleeve. They are moveable and rotatable on the probe shaft. Other probe guide pieces on request.



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Subject to alteration