Vane wheel measuring tube FA(R) Di for use in gaseous and liquid media

Drawing 42

Drawing 42

Drawing 42

Measured variables
- flow rate [l/min, m³/h] in air/ gases and water/liquids
- conversion to standard flow rate by measuring or entering working pressure and temperature parameters

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

Measuring range
- gases / gas mixtures / air ±4 l/min ... ±10,000 m³/h
- water/liquids ±0.6 ... ±590 l/min

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

Design
- Measuring tube with flanged connection and integrated transducer UFA in connection housing

Examples of application
- flow measurement e.g. of air, exhaust gases, process gases
- in processes with varying and/or unknown gas compositions
- for use in category 1 (zone 0 and 20); transducer housing approved for category 2 (zone 1 and 21)
- no external isolation/supply unit necessary
- flow monitoring in pharmaceutical plants
- monitoring of leaks, for example on large ball valves
- monitoring of inerting processes
- use up to 370 °C
- measurement of flammable liquids and gases
- measuring in non-conducting liquids, for example such as ultra pure water in the semiconductor industry or in refrigerants
- tank venting/tank sucking/purge air
- biogas in laboratory facilities
- measurement in overheated steam
- synthesis gas in laboratory facilities
- hydrogen measurements

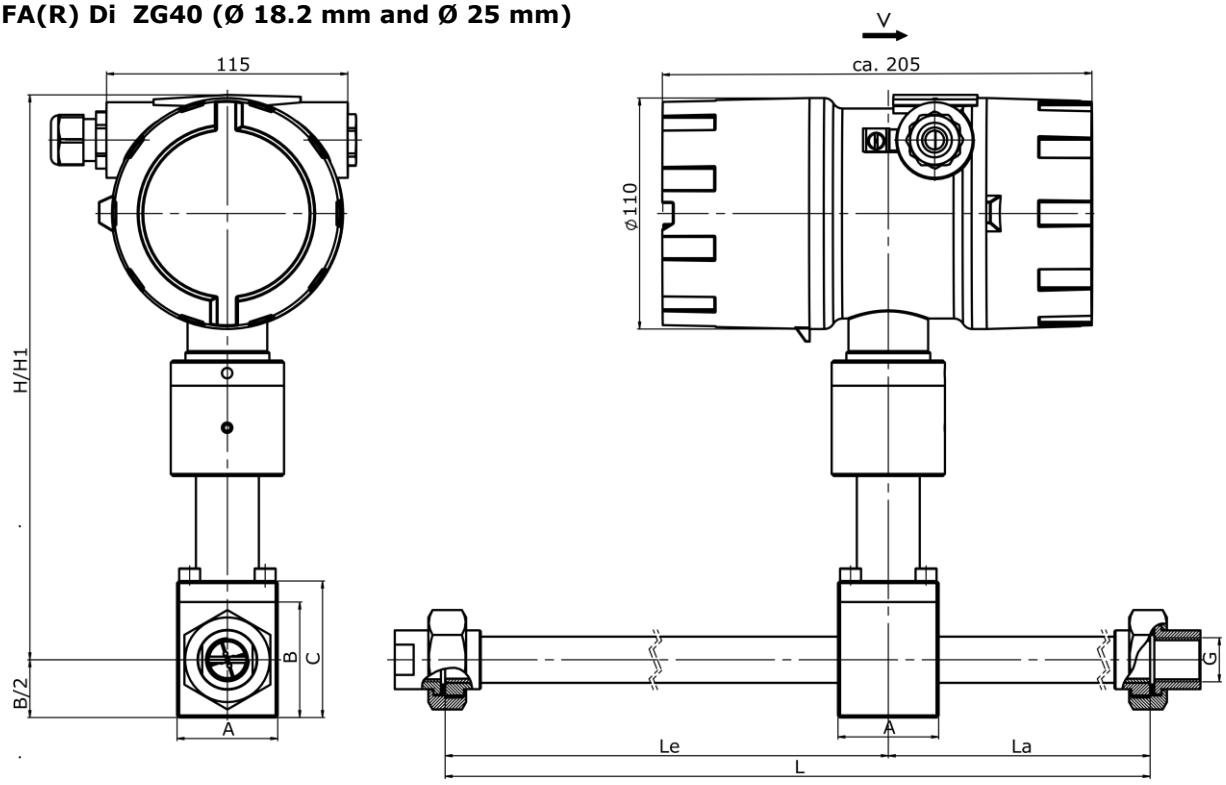
Examples of application (cont`d)
- separation processes, e.g. of CO2, or in the production of polysilicon
- Applications with bidirectional measurement requirements

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
- universal application spectrum
- optional with ± directional sensing
- easy adjustment of parameters with HART® interface
- marginal pressure loss

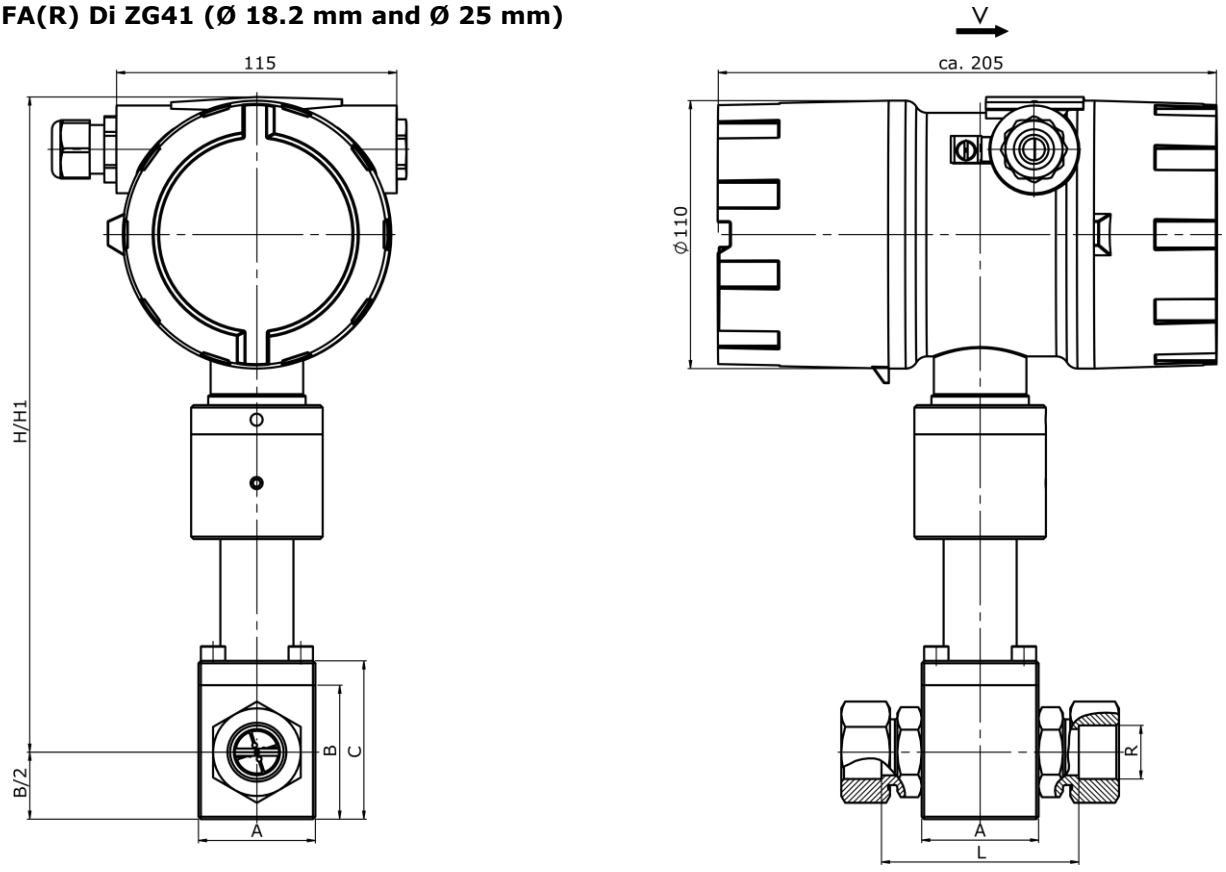
Humidity in the sample gas
- relative gas humidity of less than 100 % has no impact on the measurement uncertainty

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

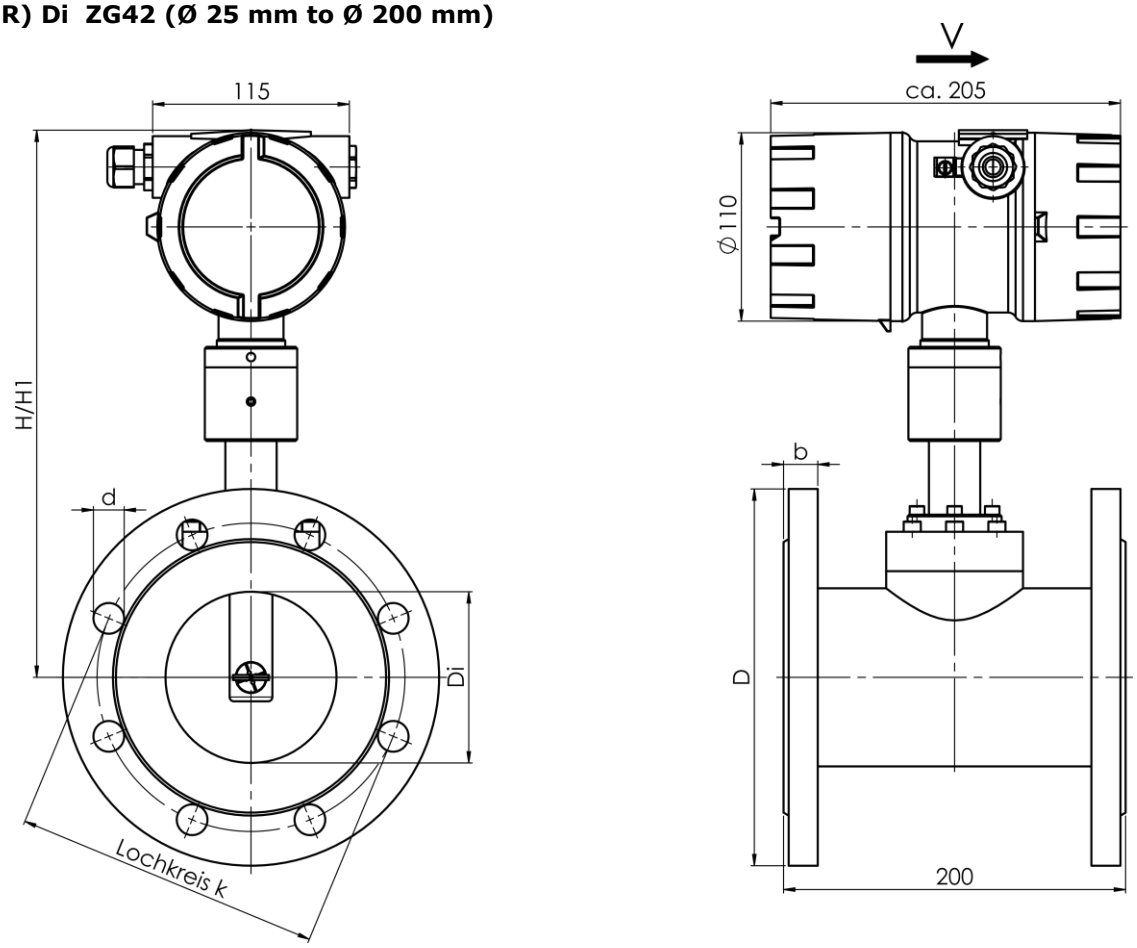
FA(R) Di ZG40 (Ø 18.2 mm and Ø 25 mm)



FA(R) Di ZG41 (Ø 18.2 mm and Ø 25 mm)



FA(R) Di ZG42 (Ø 25 mm to Ø 200 mm)



Basic-types (I) without direction sensing	
Type	**Article No.**
Measuring tube inside diameter 18.2 mm	
FA Di 18,2 GFE /p10/ZG40 Ex-d	B018/400
FA Di 18,2 GFE /p10/ZG41 Ex-d	B018/410
Measuring tube inside diameter 25 mm	
FA Di 25 GFE /p10/ZG40 Ex-d	B018/420
FA Di 25 GFE /p10/ZG41 Ex-d	B018/430
FA Di 25 GFE /p10/ZG42 Ex-d	B018/440
Measuring tube inside diameter 40 mm	
FA Di 40 GFE /p10/ZG42 Ex-d	B018/450
Measuring tube inside diameter 50 mm	
FA Di 50 GFE /p10/ZG42 Ex-d	B018/460
Measuring tube inside diameter 80 mm	
FA Di 80 GFE /p10/ZG42 Ex-d	B018/470
Measuring tube inside diameter 100 mm	
FA Di 100 GFE /p10/ZG42 Ex-d	B018/480

Basic-types (I) without direction sensing (cont'd)	
Type	**Article No.**
Measuring tube inside diameter 150 mm	
FA Di 150 GFE /p5/ZG42 Ex-d	B018/490
Measuring tube inside diameter 200 mm	
FA Di 200 GFE /p5/ZG42 Ex-d	B018/495
Optional:	
Design TT (Low Temperature) ambient temperature -40 … +60 °C	EX-TT

Basic-types (II) with direction sensing	
Type	**Article No.**
Measuring tube inside diameter 18,2 mm	
FAR Di 18,2 GFE /p5/ZG40 Ex-d	B018/500
FAR Di 18,2 GFE /p5/ZG41 Ex-d	B018/510
Measuring tube inside diameter 25 mm	
FAR Di 25 GFE /p5/ZG40 Ex-d	B018/520
FAR Di 25 GFE /p5/ZG41 Ex-d	B018/530
FAR Di 25 GFE /p5/ZG42 Ex-d	B018/540
Measuring tube inside diameter 40 mm	
FAR Di 40 GFE /p5/ZG42 Ex-d	B018/550
Measuring tube inside diameter 50 mm	
FAR Di 50 GFE /p5/ZG42 Ex-d	B018/560
Measuring tube inside diameter 80 mm	
FAR Di 80 GFE /p5/ZG42 Ex-d	B018/570
Measuring tube inside diameter 100 mm	
FAR Di 100 GFE /p5/ZG42 Ex-d	B018/580
Measuring tube inside diameter 150 mm	
FAR Di 150 GFE /p5/ZG42 Ex-d	B018/590
Measuring tube inside diameter 200 mm	
FAR Di 200 GFE /p5/ZG42 Ex-d	B018/595
*** For measuring tubes with direction sensing, the inlet and outlet sections on both sides must be the same length as the inlet section. Medium temperature max. 260 °C.**	
Optional:	
Design TT (Low Temperature) ambient temperature -40 … +60 °C	EX-TT

Model designation / order code (examples)							
FA Di	18.2	GF ... E		p10	ZG40	Ex-d	
FA Di	25	GF ... E		p10	ZG41	Ex-d	
FAR Di	80	GF ... E		P5	ZG42	Ex-d	
(1)	(2)	(3) ... (4)		(5)	(6)	(7)	

(1) Sensor type	
Description	**Design**
FA Di ...	vane wheel measuring tube without direction sensing
FAR Di ...	vane wheel measuring tube with ± direction sensing

(2) Measuring tube inside diameter		
... 18,2 ...	tube inside diameter	18.2 mm
... 25 ...	tube inside diameter	25 mm
... 40 ...	tube inside diameter	40 mm
... 50 ...	tube inside diameter	50 mm
... 80 ...	tube inside diameter	80 mm
... 100 ...	tube inside diameter	100 mm
... 150 ...	tube inside diameter	150 mm
... 200 ...	tube inside diameter	200 mm

(3) Medium *	
... GF ...	air/gases or gas mixtures

* Most sensors up to 260 °C can also be used in liquids. However, the appropriate vane wheel article and water calibration must be selected for this purpose. (see page 8-10)

Protection	
Tranducer housing	IP68
Measuring tube with integrated vane wheel	IP68

(4) Sensor material / materials in contact with the medium *			
Design	**Material measuring tube**	**Material vane wheel**	**others**
... E ... stainless steel	stainless steel 1.4404/AISI316L 1.4305, 1.4571	stainless steel 1.xy	PVDF, vespel, ceramics Al_2O_3

* Not all mentioned materials are used in every sensor. Materials may differ for individual sensors. Detailed information about a desired sensor on request!

(5) Permissible temperature of the medium* / ambient temperature* / sealing material		
sealing material **	**permissible temperature of the medium**	**Article No.**
't_{max} +100 °C'		
PTFE, FKM (standard)	-20 ... +100 °C	B018/901
PTFE	-40 ... +100 °C	B018/902
Graphite, FKM	-20 ... +100 °C	B018/903
't_{max} +260 °C'		
Graphite	-40 ... +260 °C	B018/911
PTFE	-40 ... +260 °C	B018/912
't_{max} +370 °C'		
Graphite	-40 ... +370 °C	B018/921

* When used in hazardous areas, the media and ambient temperature are limited according to the valid operating instructions

** other materials on request!

Ambient temperature	-20 ... +60 °C

(6) Max. working pressure *	
... p5 ...	up to 5 bar / 0.5 MPa overpressure
... p10 ...	up to10 bar / 1 MPa overpressure
* others on request!	

(7) Designs (see page 2 and 3)		
Drawing No.	**Tube inside diameter**	**Sensor connection**
… ZG40 …	Ø 18.2 and 25 mm	tube fitting Ø 18.2 mm: G 1/2" (customer side outside thread) Ø 25 mm: G 1" (customer side outside thread)
… ZG41 …	Ø 18.2 and 25 mm	cutting ring fittings on both sides Ø 18.2 mm: for pipes 22 x 2 mm Ø 25 mm: for pipes 30 x 2.5 mm
… ZG42 …	Ø 25, 40, 50, 80, 100, 150, 200 mm	flange connection, DIN EN 1092-1 form B1
* special designs on request!		

(7) Design (I) ZG40 and ZG41 / Dimensions / Weight

Type	ZG No.	Tube inside-Ø Di [mm]	Temp max. [°C]	H Height [mm]	H1 Height [mm]	L Length [mm]	LE Inlet [mm]	LA Outlet [mm]
FA Di	ZG40	18.2	100	269.5	-	550	365	185
FA Di	ZG40	18.2	260/370	-	329.5	550	365	185
FAR Di	ZG40	18.2	100	269.5	-	730	365	365
FAR Di	ZG40	18.2	260	-	329.5	730	365	365
FA Di	ZG40	25	100	274.5	-	750	500	250
FA Di	ZG40	25	260/370	-	334.5	750	500	250
FAR Di	ZG40	25	100	274.5	-	1000	500	500
FAR Di	ZG40	25	260	-	334.5	1000	500	500
FA Di	ZG41	18.2	100	269.5	-	81	-	-
FA Di	ZG41	18.2	260/370	-	329.5	81	-	-
FAR Di	ZG41	18.2	100	269.5	-	81	-	-
FAR Di	ZG41	18.2	260	-	329.5	81	-	-
FA Di	ZG41	25	100	274.5	-	101	-	-
FA Di	ZG41	25	260/370	-	334.5	101	-	-
FAR Di	ZG41	25	100	274.5	-	101	-	-
FAR Di	ZG41	25	260	-	334.5	101	-	-

(7) Design (I) ZG40 and ZG41 / Dimensions / Weight (cont'd)

Type	ZG No.	Tube inside-Ø Di [mm]	Temp max. [°C]	Body length A [mm]	Body height B [mm]	Body height 2 C [mm]	Inside thread sensor G	Weight [kg]
FA Di	ZG40	18.2	100	48	55	65	G 1/2"	TBD
FA Di	ZG40	18.2	260/370	48	55	65	G 1/2"	TBD
FAR Di	ZG40	18.2	100	48	55	65	G 1/2"	TBD
FAR Di	ZG40	18.2	260	48	55	65	G 1/2"	TBD
FA Di	ZG40	25	100	58	65	75	G 1"	TBD
FA Di	ZG40	25	260/370	58	65	75	G 1"	TBD
FAR Di	ZG40	25	100	58	65	75	G 1"	TBD
FAR Di	ZG40	25	260	58	65	75	G 1"	TBD
FA Di	ZG41	18.2	100	48	55	65	G 1/2"	TBD
FA Di	ZG41	18.2	260/370	48	55	65	G 1/2"	TBD
FAR Di	ZG41	18.2	100	48	55	65	G 1/2"	TBD
FAR Di	ZG41	18.2	260	48	55	65	G 1/2"	TBD
FA Di	ZG41	25	100	58	65	75	G 1"	TBD
FA Di	ZG41	25	260/370	58	65	75	G 1"	TBD
FAR Di	ZG41	25	100	58	65	75	G 1"	TBD
FAR Di	ZG41	25	260	58	65	75	G 1"	TBD

(7) Design (II) ZG42 / Dimensions / Weight

ZG No.	Tube inside Ø Di [mm]	Temp. max. ** [°C]	Flange outside Ø D [mm]	Flange thickness b [mm]	Bolt circle Ø k [mm]	Hole Ø d [mm]	Hole quantity	Height H [mm]	Height H1 [mm]	Weight [kg]
ZG42	25	100	115	18	85	14	4	274.5	-	8
ZG42	25	260/370	115	18	85	14	4	-	334.5	8.2
ZG42	40	100	150	18	110	18	4	302	-	TBD
ZG42	40	260/370	150	18	110	18	4	-	362	TBD
ZG42	50	100	165	18	125	18	4	302	-	TBD
ZG42	50	260/370	165	18	125	18	4	-	362	TBD
ZG42	80	100	200	20	160	18	8	310	-	TBD
ZG42	80	260/370	200	20	160	18	8	-	370	TBD
ZG42	100	100	220	20	180	18	8	320	-	14
ZG42	100	260/370	220	20	180	18	8	-	380	14.2
ZG42	150	100	285	22	240	22	8	345	-	TBD
ZG42	150	260/370	285	22	240	22	8	-	405	TBD
ZG42	200	100	340	24	295	22	12	370	-	TBD
ZG42	200	260/370	340	24	295	22	12	-	430	TBD

** FAR Di sensors only up to 260 °C

(8) ATEX protection

for gas	: ⟨Ex⟩ II 1/2 G Ex ia/db e [ia] IIC T6 Ga/Gb
for dust	: ⟨Ex⟩ II 1/2 D Ex ia/tb IIIC TX Da/Db
sensor	: Category 1 (zone 0 or 20)
transducer housing	: Category 2 (zone 1 or 21)

Measuring ranges for measurements in gaseous media (with a density of approx. 1.2 kg/m³), vane wheel types and calibration possibilities

Vane wheel type	Measuring range air/gases	Vane wheel Article No.	Calibration possibilities	
			Article No. for ISO calibration	Article No. for DAkkS calibration
Measuring tubes with tube inside Ø 18.2 mm				
mn20	4 ... 200 l/min	V_DI182_MN20	CQ-100 ISO	CQ-100 DAKKS
mn40	5 ... 400 l/min	V_DI182_MN40	CQ-100 ISO	CQ-100 DAKKS
mn80	0.8 ... 50 m³/h	V_DI182_MN80	CQ-100 ISO	CQ-100 DAKKS
mn120	1.2 ... 75 m³/h	V_DI182_MN120	CQ-100 ISO	CQ-100 DAKKS
Measuring tubes with tube inside Ø 25 mm				
mn20	0.5 ... 25 m³/h	V_DI25_MN20	CQ-100 ISO	CQ-100 DAKKS
mn40	0.6 ... 50 m³/h	V_DI25_MN40	CQ-100 ISO	CQ-100 DAKKS
mn80	1.4 ... 100 m³/h	V_DI25_MN80	CQ-100 ISO	CQ-100 DAKKS
mn120	2.0 ... 160 m³/h	V_DI25_MN120	CQ-1600 ISO	CQ-1600 DAKKS
Measuring tubes with tube inside Ø 40 mm				
mn20	2 ... 90 m³/h	V_DI40_MN20	CQ-100 ISO	CQ-100 DAKKS
mn40	3 ... 170 m³/h	V_DI40_MN40	CQ-1600 ISO	CQ-1600 DAKKS
mn80	4 ... 350 m³/h	V_DI40_MN80	CQ-1600 ISO	CQ-1600 DAKKS
mn120	6 ... 520 m³/h	V_DI40_MN120	CQ-1600 ISO	CQ-1600 DAKKS
Measuring tubes with tube inside Ø 50 mm				
mn20	3 ... 100 m³/h	V_DI50_MN20	CQ-100 ISO	CQ-100 DAKKS
mn40	4 ... 210 m³/h	V_DI50_MN40	CQ-1600 ISO	CQ-1600 DAKKS
mn80	6 ... 400 m³/h	V_DI50_MN80	CQ-1600 ISO	CQ-1600 DAKKS
mn120	8 ... 600 m³/h	V_DI50_MN120	CQ-1600 ISO	CQ-1600 DAKKS

Measuring ranges for measurements in gaseous media (with a density of approx. 1.2 kg/m³), vane wheel types and calibration possibilities (cont'd)

Vane wheel type	Measuring range air/gases	Vane wheel Article No.	Calibration possibilities	
			Article No. for ISO calibration	Article No. for DAkkS calibration
Measuring tubes with tube inside Ø 80 mm				
mn20	7 ... 250 m³/h	V_DI80_MN20	CQ-1600 ISO	CQ-1600 DAKKS
mn40	10 ... 550 m³/h	V_DI80_MN40	CQ-1600 ISO	CQ-1600 DAKKS
mn80	15 ... 1100 m³/h	V_DI80_MN80	CQ-1600 ISO	CQ-1600 DAKKS
mn120	21 ... 1700 m³/h	V_DI80_MN120	CQ-5500 ISO	CQ-5500 DAKKS
Measuring tubes with tube inside Ø 100 mm				
mn20	10 ... 430 m³/h	V_DI100_MN20	CQ-1600 ISO	CQ-1600 DAKKS
mn40	16 ... 850 m³/h	V_DI100_MN40	CQ-1600 ISO	CQ-1600 DAKKS
mn80	25 ... 1700 m³/h	V_DI100_MN80	CQ-5500 ISO	CQ-5500 DAKKS
mn120	32 ... 2800 m³/h	V_DI100_MN120	CQ-5500 ISO	CQ-5500 DAKKS
Measuring tubes with tube inside Ø 150 mm				
mn20	20 ... 1000 m³/h	V_DI150_MN20	CQ-1600 ISO	CQ-1600 DAKKS
mn40	30 ... 1900 m³/h	V_DI150_MN40	CQ-5500 ISO	CQ-5500 DAKKS
mn80	50 ... 4000 m³/h	V_DI150_MN80	CQ-5500 ISO	CQ-5500 DAKKS
mn120	80 ... 6000 m³/h	V_DI150_MN120	CQ-10000 ISO	CQ-10000 DAKKS
Measuring tubes with tube inside Ø 200 mm				
mn20	35 ... 1700 m³/h	V_DI200_MN20	CQ-5500 ISO	CQ-5500 DAKKS
mn40	50 ... 3500 m³/h	V_DI200_MN40	CQ-5500 ISO	CQ-5500 DAKKS
mn80	80 ... 6500 m³/h	V_DI200_MN80	CQ-10000 ISO	CQ-10000 DAKKS
mn120	120 ... 10000 m³/h	V_DI200_MN120	CQ-10000 ISO	CQ-10000 DAKKS

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

Linearisation of characteristics (ISO)	all types	< 1.5 % of measured value + 0.5 % of terminal value ***
Linearisation of characteristics (DAkkS)	all types	Up to < 0.9 % of measured value + 0.25 % of terminal value (up to 40 m/s) ***
Repeatability		±(0.05 % of measured 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 calibration documents 'U325 and U183'.

*** on request, in the calibration range of the respective accredited test bench

Calibration certificate	
ISO calibration certificate calibration medium air, 6 calibration values in the measuring range	already included in ISO calibration
DAkkS calibration certificate calibration medium air, 6 selectable calibration values in the measuring range	already included in DAkkS calibration

Measuring ranges for measurements in liquids, vane wheel types and calibration (takes place in water)

Vane wheel type	Measuring range liquid/water	Vane wheel article No.	ISO calibration
Measuring tubes with tube inside Ø 18,2 mm			
mn20	0.6 ... 70 l/min	V_DI182_MN20	CQ-WVP
mn40	0.8 ... 100 l/min	V_DI182_MN40	CQ-WVP
mn80	1.0 ... 100 l/min	V_DI182_MN80	CQ-WVP
Measuring tubes with tube inside Ø 25 mm			
mn20	1.2 ... 100 l/min	V_DI25_MN20	CQ-WVP
mn40	1.5 ... 130 l/min	V_DI25_MN40	CQ-WVP
mn80	1.8 ... 150 l/min	V_DI25_MN80	CQ-WVP
Measuring tubes with tube inside Ø 40 mm			
mn20	3 ... 250 l/min	V_DI40_MN20	CQ-WVP
mn40	4 ... 330 l/min	V_DI40_MN40	CQ-WVP
mn80	5 ... 400 l/min	V_DI40_MN80	CQ-WVP
Measuring tubes with tube inside Ø 50 mm			
mn20	5 ... 470 l/min	V_DI50_MN20	CQ-WVP
mn40	6 ... 530 l/min	V_DI50_MN40	CQ-WVP
mn80	7 ... 590 l/min	V_DI50_MN80	CQ-WVP

Measurment uncertainty / repeatability in water*		
Linearisation of characteristics	all types	< 1 % of measured value + 0.5 % of terminal value **
Repeatability		±(0.05 % of measured 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 calibration documents 'U325 and U183'

* for water and liquids with a viscosity of up to approx. 0.0002 m²/s (200 cSt)
** on request, in the calibration range of the respective test bench

Calibration / adjustment in sensors with direction indication

FAR Di probes are adjusted for both oncoming flow directions. The subsequent calibration is, as a rule, based on the '+'-oncoming flow direction which is marked with a dot on the sensor body. An additional calibration based on the '-'-oncoming flow direction is generally possible.

Smallest measurable values, density influence

The smallest measurable value for measurements in air/gases specified in our documents results from a measuring medium density $\rho \cong 1.204$ kg/m³. The smallest measurable value $\dot{V}_0$ is also increased/decreased negligibly even with a considerably different medium density from 1.204 kg/m³ and follows in good approximation the relation:

$$\dot{V}_{0,real} = \dot{V}_{0,specif.} \bullet \sqrt{1.204\ kg/m^3 / \rho_{real}}$$

The characteristic is displaced by the difference

$$\dot{V}_{0,specif.} - \dot{V}_{0,\,real} = \Delta\dot{V}$$

Readout of measured values is too great by the amount $\Delta\dot{V}$ when measuring in gases of a density of ρ_{real} greater than 1.204 kg/m³, and too small by the amount $\Delta\dot{V}$ when measuring in gases of a density ρ_{real} less than 1.204 kg/m³. $\Delta\dot{V}$ is to be added to or subtracted from the respective output value.

Ex-d transducer housing	
Dimensions	outside diameter/length/height: approx. 110/205/182 mm
Material	aluminium cast alloy max. 0.5 % Mg, coated
Protection	IP68, IEC 529 and EN 60 529
Connection	glands for shielded cables with outside diameter 5 ... 9 mm; contacting of overall screen on the ground terminal in the housing; via "Ex-e" screw terminals for wires with cross-section 0.14 – 1.5 mm²
Alignment	rotatable by approx. 350 ° and lockable
Setup	dual chamber system consisting of: 1) electronics in Ex-d protection (flameproof enclosure) 2) connections in Ex-e protection (increased safety) with terminal block and cable glands

Electromagnetic Compatibility (EMC)

according to EN 61 000-6-2 and EN 61 000-6-4 / IEC77

Installation position
any

Transducer UFA integrated in the connection housing	
Analog output flow / resistance	for FA DI and FAR Di*: 4 ... 20 mA = 0 … x m³/h (or m/s), for FAR Di also 4 … 12 … 20 mA = -x … 0 … +x m³/h (or m/s) end value x adjustable / resistance max. 500 Ohm * only if digital output is parameterised as flow direction output
Ouput 'limit value' or 'quantity pulses' or '±flow direction'	potential-free relay contact (normally-open), max. 300 mA / 27 VDC pulse duration 0.5 s
Communication port	HART® via modem adapter for PC connection and UCOM PC software UCOM (see Accessories)
	output signals are electrically isolated from the power supply
Self-monitoring	parameter settings, sensor interface; in the case of error: analog output < 3.6 mA
Power supply	24 V DC (20 ... 27 V DC)
Power consumption	less than 5 W
Setting parameters (selection depending on parameter set)	analog output, time constant, profile factor, tube inside diameter, limit value or quantity pulse (rating adjustable) or ±flow direction, switchover actual/standard flow with parameters 'working pressure' and 'working temperature'

Accessories (optional)		
	Description	**Article No.**
LCD display	1st row: 'instantaneous value': flow rate or flow velocity 2nd row: 'counter' or 'error code' 2 x 16-digit, character height 5.5 mm, working temperature range -20 ... +60 °C display rotatable in 90 °-stages on removing the Ex-d housing window cover	A010/520
HART® modem adapter	for changing setting parameters, for PC-USB connection	A010/101
PC software UCOM	for configuring the transducer via RS232	A010/052

Ex-d transducer housing
with optional LCD display

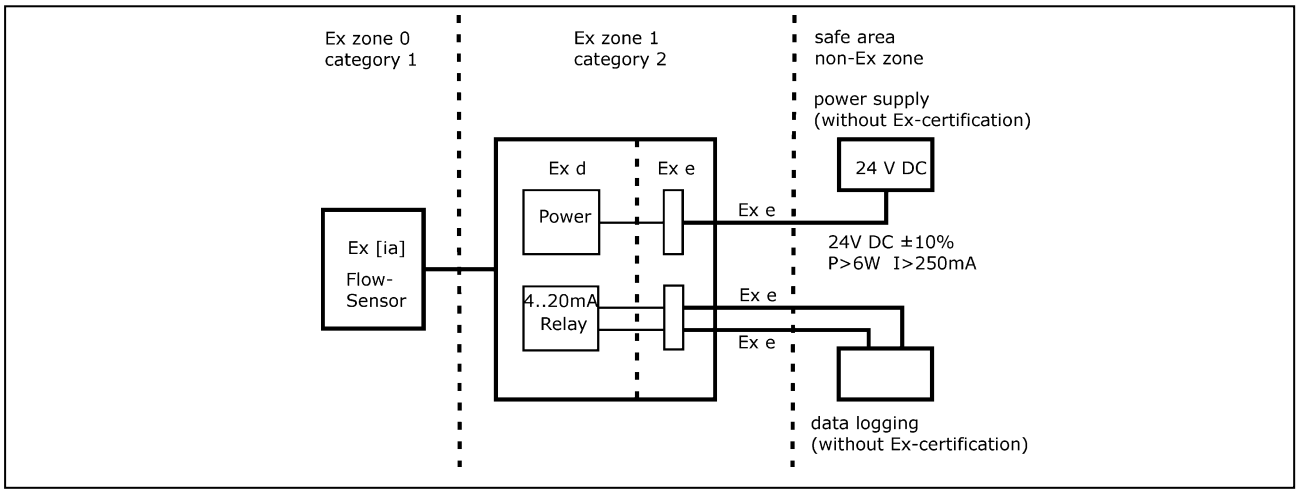


Diagram of Ex-Zones

® Registered trademark:
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Subject to change