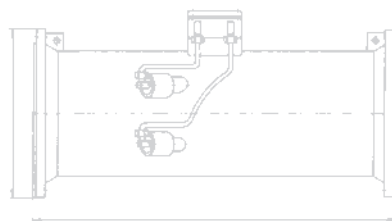
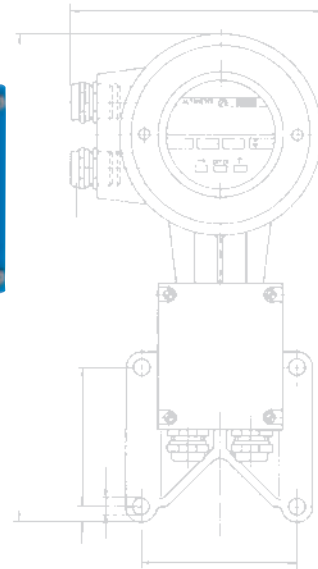
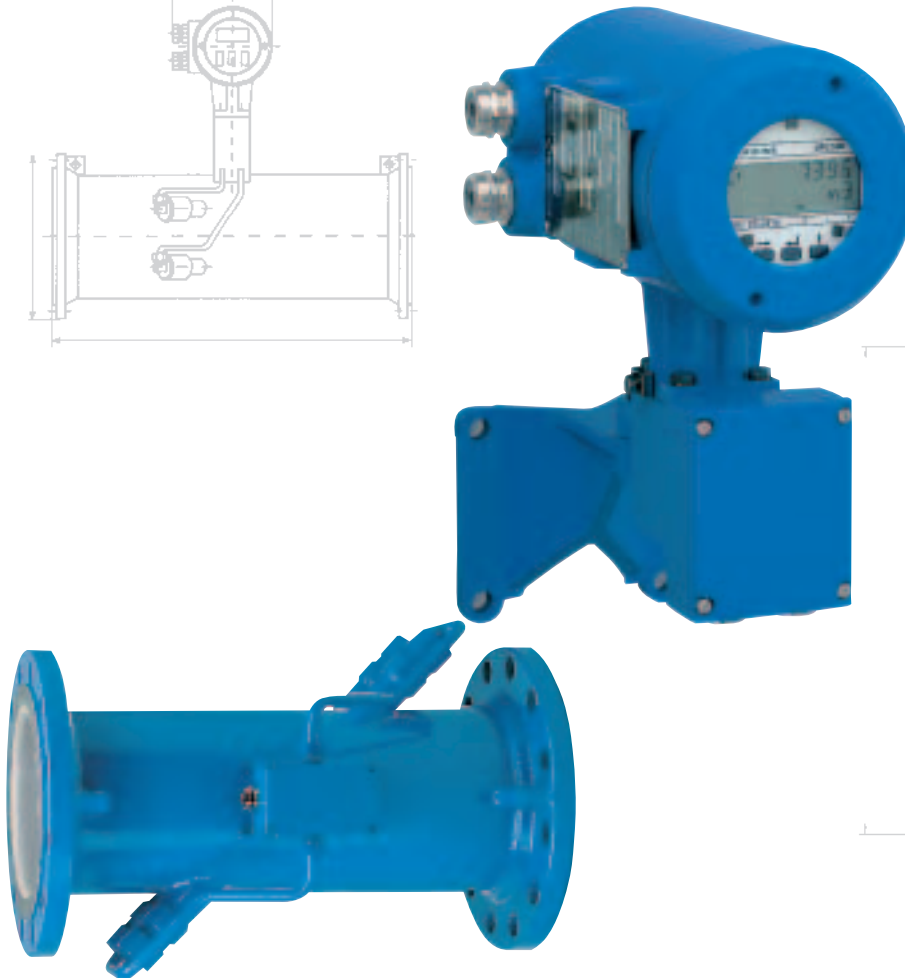
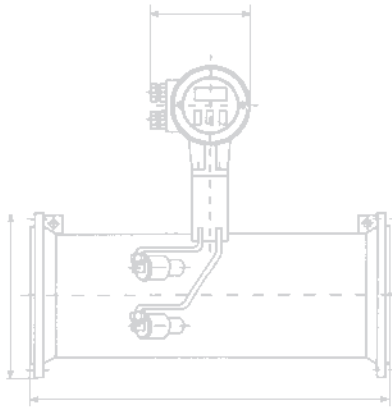


Installation and operating instructions

GFM 700 K **GFM 700 F** **GFM 700 F-EE_x ATEX** **GFM 700 F/HT-EE_x ATEX** Ultrasonic gas flowmeter



Variable area flowmeters

Vortex flowmeters

Flow controllers

Electromagnetic flowmeters

Ultrasonic flowmeters

Mass flowmeters

Level measuring instruments

Communications technology

Engineering systems & solutions

Switches, counters, displays and recorders

Heat metering

Pressure and temperature

General advice on safety

Safety instructions

This product is designed for use in accordance with EN IEC 61010-1 for Installation Category 2 and Pollution Degree 2. Hazardous voltages are present within this product during normal operation. The product is designed for Protection Class I and should never be operated without protective earthing. The product shall also never be operated with covers removed unless equivalent protection of the operator and its environment from accidental contact with hazardous internal voltages is provided. Always follow basic and local safety precautions when using this product to reduce risk of injury from electrical shock, spread of fire or other dangerous situations.

1. Do not install, maintain or operate this flow meter without reading, understanding and following the factory-supplied instructions and manuals, otherwise injury or damage may result.
2. Read these instructions carefully before starting installation. Save these instructions for future reference.
3. Observe all warnings and instructions marked on the product
4. Use only mains supply with protective earthing connected
5. Do not use the product with removed covers under wet conditions
6. Consider handling and lifting instructions to avoid damage
7. Install the product securely and stable
8. Install and connect cabling proper to exclude damage or harmful situations
9. If the product does not operate normally refer to qualified KROHNE service technicians
10. There are no operator serviceable components inside the product

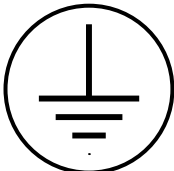
The following symbols may appear in this manual or on the product :



Attention : refer to the manual



DANGER : risk of electrical shock



PROTECTIVE conductor terminal



WARNING

Warning statements identify conditions or practice that could result in injury loss of live



CAUTION

Caution statements identify conditions or practice that could result in damage to the product or other property

Declarations of Conformity / Statement of Compliance

Low Voltage directive

The product complies with the requirements of the Low Voltage Directive 73/23/EEC and is designed in accordance with EN IEC 61010-1 first and second edition. (safety requirements for electrical equipment for measurement, control and laboratory use part 1) Local safety regulations shall be observed in combination with the measures special to this product to avoid dangerous situations

Unpacking and inspection

This product has been thoroughly inspected and tested before shipment and is ready for operation.

After carefully unpacking, inspect for shipping damage before attempting to operate. If any indication of mechanical damage is found contact immediately the responsible transport service and your local KROHNE representative.

A simple operating check of the electronics after unpacking and before permanent installation, is advisable to ascertain whether it has suffered damage during shipment. Confirm for the correct mains voltage printed on the nameplate. If it differs from the ordered product please contact your local KROHNE representative.

After connecting to the mains, check if there is any indication on the display and if the backlight of the display is lighted. If not contact your local KROHNE representative for advice.

Disclaimer

This document contains important information of the product. KROHNE attempts to be as accurate and up-to-date as possible but assumes no responsibility for errors or omissions. Nor does KROHNE make any commitment to update the information contained herein. This manual and all other documents are subject to change without notice. KROHNE will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect, incidental, punitive and consequential damages. This disclaimer does not apply in case KROHNE has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations. Any product purchased from KROHNE is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale. KROHNE reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

CAUTION



There are no operator servicable parts or adjustments within the product enclosure
Refer all servicing to trained service technicians



Source power shall be removed from the product to perform any servicing



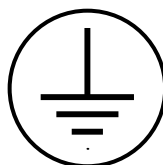
This product is prepared for the nominal AC mains voltage indicated on its tagplate. To reconfigure the product power input for other mains voltages as listed in the chapter Technical data, the product must be modified including the fuses by a trained service technician. After a power input reconfiguration the tagplate needs to be adapted.



This product is a Class 1 device, (earthed which utilizes a proper connection to the protective earthing for protection from electrical shock to ensure operator and its environmental safety.



The protective conductor terminal of the product shall be properly connected to the protective earth wiring of the source power to ensure safety from electrically shock. See instruction manual



Protective earthing conductor terminal.

This symbol indicates the point on the product to which the protective earthing conductor shall be connected. It is positioned near the terminal block, inside the terminal compartment. The diameter of the protective earthing conductor shall be in accordance with the Low Voltage Directive.

Manufacturer

The GFM 700 is developed and manufactured by
KROHNE Altometer
Kerkeplaat 12
3313 LC Dordrecht, The Netherlands

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4	Technical data	7 – 10
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1 GFM 700 Ultrasonic gas flowmeter

First ultrasonic gas flowmeter with two beams

Non-contact ultrasonic gas flow measurement and volume counting, suitable for all gases available meter sizes DN 50-600 and 2"-24".

Wide range of application

The large range of products that can be measured accurately and easily make this a truly universal device. Just a few examples:

Natural gas

- Air
- Methane
- Nitrogen
- Determination of the molecular weight of gases
- Measurement in hazardous locations, Zones 1 and 2

Calibrated on **EN 17025** accredited calibration rigs, calibration accuracy better than 99.97% of the measured value.



2 Size, flow velocity, flowrate

Selection of meter size / nominal pipe size

Flow velocities in m/s or ft/s and the flowrate in m³/h or US Gal / min can be determined for each meter size (DN) using the Tables below.

Example: v in m/s

Nominal pipe size DN 150

Required measuring range 1000 m³/h

For a flow velocity of 1 m/s at DN 150, the table gives a flowrate of 63.617 m³/h.

For 1000 m³/hr, the flow velocity v is thus

$$v = \frac{1000 \text{ m}^3/\text{h} \times 1 \text{ m/s}}{63.617 \text{ m}^3/\text{h}} = 15.72 \text{ m/s}$$

Flowtable for v = 1 m/s

Meter size		Flow
in mm	in inches	m ³ /h
DN 50	2	7.0686
DN 65	2 ½	11.946
DN 80	3	18.096
DN 100	4	28.274
DN 125	5	44.179
DN 150	6	63.617
DN 200	8	113.10
DN 250	10	176.71
DN 300	12	254.47
DN 350	14	346.36
DN 400	16	452.39
DN 500	20	706.86
DN 600	24	1017.9

Precise determination of flow velocities

For range setting, use the flow table below to determine the precise flow velocity for each nominal pipe size.

Example: v in ft/s

Nominal pipe size 6"

Required measuring range 5000 US Gal / min

For a flow velocity of 3.3 ft/s at 6", the table gives a flowrate of 280.11 gal/min.

For 5000 Gal / min, the flow velocity v is thus

$$v = \frac{5000 \text{ US / min} \times 3.3 \text{ ft/s}}{280.11 \text{ US Gal / min}} = 58.91 \text{ ft/s}$$

Flowtable for v = 10 ft/s

Meter size		Flow
in inches	in mm	US Gal/min
2	DN 50	31.13
3	DN 80	79.68
4	DN 100	124.49
5	DN 125	194.52
6	DN 150	280.11
8	DN 200	497.98
10	DN 250	778.05
14	DN 350	1525.0
16	DN 400	1991.9
20	DN 500	3112.8
24	DN 600	4418.8

3 Measuring principle

All KROHNE ultrasonic flowmeters operate using the transit-time differential method.

Transit-time differential measurement is based on a simple physical fact.

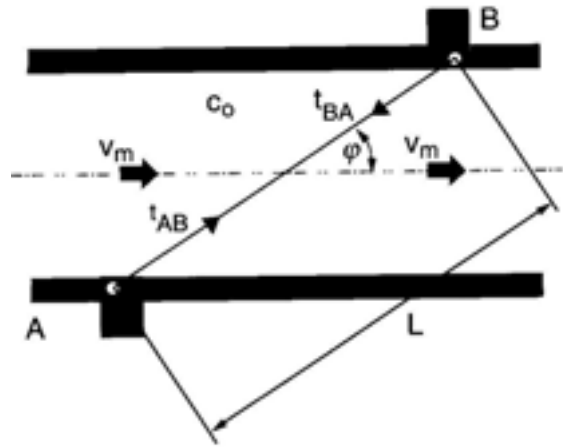
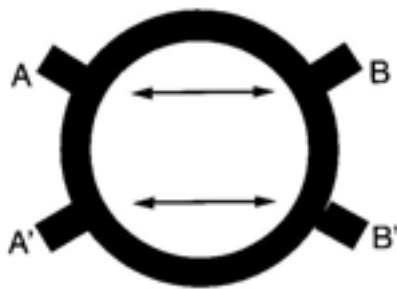
Imagine two canoes crossing a river on the same diagonal line, one with the flow and the other against the flow. The canoe moving with the flow needs much less time to reach the opposite bank.

Ultrasonic waves behave exactly the same way. A sound wave travelling in the direction of flow of the product is propagated at a faster rate than one travelling against the flow ($v_{AB} > v_{BA}$).

Transit times t_{AB} and t_{BA} are measured continuously. The difference ($t_{BA} - t_{AB}$) in time travelled by the two ultrasonic waves is directly proportional to the mean flow velocity (v_m) of the product.

The volumetric flowrate per unit time is the product of the mean flow velocity (v_m) multiplied by the pipe cross-section.

A liquid product is identified by direct measurement of the transit time of ultrasonic waves. Assuming the same path length (L), the transit time in water is shorter than in crude oil, for example.



	Propagation rate of ultrasonic waves . . .	Transit time of ultrasonic waves ...
... in direction of flow of product from sensor A to B	$v_{AB} = c_o + v_m \times \cos\phi$	$t_{AB} = \frac{L}{c_o + v_m \times \cos\phi}$
... counter to direction of flow of product from sensor A to B	$v_{BA} = c_o - v_m \times \cos\phi$	$t_{BA} = \frac{L}{c_o - v_m \times \cos\phi}$
with the given product flow direction	$v_{AB} > v_{BA}$	$t_{AB} < t_{BA}$
mean flow velocity v_m of liquid product	$v_m = GK \times \frac{(t_{BA} - t_{AB})}{(t_{AB} \times t_{BA})}$	

A (A') Sensor A, transmitter and receiver

B (B') Sensor B, transmitter and receiver

c_o Sound velocity in the product

GK A calibration constant

L Length of measuring beam,
distance between sensors A and B

φ Angle between pipe axis and
measuring beam

t_{AB} Transit time of ultrasonic waves
from sensor A to sensor B

t_{BA} Transit time of ultrasonic waves
from sensor B to sensor A

v_{AB} Propagation rate of ultrasonic waves between
sensor A and sensor B

v_{BA} Propagation rate of ultrasonic waves between
sensor B and sensor A

v_m Mean flow velocity of liquid product

4 Technical data

The responsibility as to the suitability, intended use and corrosion-resistance of the materials used in their construction rests solely with the purchaser.

4.1 Versions, full-scale ranges, accuracies

Versions	Primary head (S)	Signal converter (C)
GFM 700 K integral system	GFS 700 K	GFC 700 K
GFM 700 F remote system	GFS 700 F	GFC 700 F
GFM 700 F-EEx (Ex versions (remote system))	GFS 700 F-EEx Approval to ATEX (Ex II 2 G) EEx de IIC T6 oder EEx d IIC T6 DEMKO Nr. 00ATEX2118 X	GFC 700 F - EEx signal converter is installed in non hazardous area
Full-scale ranges (configurable)	Q _{100%} volume flow	v _{100%} flow velocity
Standard	14 – 25000 m ³ /h 60 – 88000 US Gal/min	2 – 25 m/s 6.6 – 80 ft/s
Option	14 – 30000 m ³ /h 60 – 156000 US Gal/min	2 – 30 m/s 6.6 – 100 ft/s
Error limits		
<u>Accuracy</u>		
DN ≥ 80 / ≥ 3"	v < 2 m/s	± 0.04 m/s (± 0.13 ft/s)
	v ≥ 2 m/s	± 2% of measured value
DN ≤ 65 / ≤ 1½"		± 2% of measured value + 0.04 m/s (± 2% of measured value + 0.13 ft/s)
<u>Repeatability</u>		
		± 0.5% of measured value

4.2 GFS 700 Primary head

Diameter	DN 50 – 600 / 2" – 24" (option DN 700 – 1200 / 28" – 48")		
Flange connections	Pressure rating (standard)		
to DIN 2501	DN 50, DN 80:	PN 40	40 bar / 580 psig
	DN 65, DN 100 – 150:	PN 16	16 bar / 230 psig
	DN 200 – 600:	PN 10	10 bar / 150 psig
to ANSI B 16.5	2" – 24": Class 150 lb / RF		19 bar / 275 psig
Special versions	max. 100 bar / 900 lb		
Max. operating data	Gas-Temperature	Operating pressure	
<u>Integral systems</u>		<u>standard</u>	<u>option</u>
Ambient temperature ≤ 40°C / ≤ 104°F	≤ 140°C / 284 °F	≤ 25 bar / 360 psig	≤ 40 bar / 580 psig
Ambient temperature ≤ 60°C / ≤ 140°F	≤ 60°C / 140 °F	≤ 25 bar / 360 psig	≤ 40 bar / 580 psig
<u>Remote systems</u>	≤ 180°C / 356 °F	≤ 25 bar / 360 psig	≤ 40 bar / 580 psig
Hazardous-duty versions	≤ 180°C / 356 °F	≤ 20 bar / 300 psig	–
Max. allowable flow velocity	≤ 25 m/s / ≤ 80 ft/s, optionally ≤ 30 m/s / ≤ 100 ft/s		
Max. allowable meter size (DN) as a function of process product	DN _{max} [mm] = 200 × ρ _{Gas} [kg/m ³] or [inches] = 0.47 × ρ _{Gas} [lb/ft ³] Density ρ _{Gas} in kg/m ³ or in [lb/ft ³]		
Protection category (IEC 529 / EN 60529)	IP 65 equivalent to NEMA 4 and 4X		
Materials			
<u>Measuring tube and flanges</u>			
Standard	DN 50-300	2"-12"	SS 1.4301 (measuring tube) and steel (flanges)
	DN 350-600	14"-24"	steel
Option	DN 50-600	2"-24"	SS 1.4404
	DN 50-600	(only DIN)	SS 1.4571
<u>Ultrasonic sensors</u>	SS 1.4301		
<u>Gaskets</u>	Viton		

4.3 GFC 700 Signal converter

Versions

Integral systems (K)	GFC 700 K signal converter mounted on primary head
Remote systems (F)	GFC 700 F signal converter with wall mount (rotating design) and additional terminal box
Option MP	signal converter equipped with magnet sensors, to set the signal converter by means of hand held bar magnet without opening the housing

Power supply	1. AC Version	AC / DC Version	
	Standard	Option	
1. Rated voltage	115 / 230 V	24 V AC	24 V DC
Tolerance band	+/- 13 %	20 – 27 V AC	18 – 32 V DC
Frequency	48 – 63 Hz	48 – 63 Hz	–
Power consumption (incl. primary head)	Max. 13 VA	approx. 10 VA	approx. 8 W

When connected to functional extra-low voltage (24 V) safety separation (PELV) is essential to VDE 0100 / VDE 0106 and IEC 364 / IEC 536 or equivalent national standards.

Analog Output

Function	<ul style="list-style-type: none"> • continuous flowrate measurement or measurement of sound velocity to determine (composition of) liquid product • all operating data configurable • galvanically isolated • for active and passive mode • useable as internal power supply for the binary outputs 	
Current	for Q = 0%: 0 – 16 mA settings in 1 mA increments for Q = 100%: 4 – 20 mA ($I_{max} = 22$ mA)	
Active mode	load max. 680 Ohm	
Passive mode	external voltage ≤ 18 V DC load ≤ 680 Ohm	
Low-flow cutoff	cutoff "on" value 1 – 19% cutoff "off" value 2 – 20% <table style="display: inline-table; vertical-align: middle;"> <tr> <td style="border-left: 1px solid black; padding-left: 5px;">of $Q_{100\%}$, setting in 1% increments</td> </tr> </table>	of $Q_{100\%}$, setting in 1% increments
of $Q_{100\%}$, setting in 1% increments		
Time constant	0.04 – 3600 s, setting in increments of 1, 0.1 or 0.01 s	
Forward / reverse measurement	direction identified via status output (or pulse output)	
Internal power supply for binary outputs	$U_{int} = 19 - 32$ V DC / $I \leq 50$ mA	

Pulse output

Function	<ul style="list-style-type: none"> – continuous flow counting or measurement of sound velocity to determine (composition of) liquid product – all operating data configurable – galvanically isolated – active and passive mode 	
Pulse rate for Q = 100%	10 – 3600000 pulses/h 0,167 – 60000 pulses/min 0.0028 – 1000 pulses/s (= Hz) <table style="display: inline-table; vertical-align: middle;"> <tr> <td style="border-left: 1px solid black; padding-left: 5px;">optionally in pulse per liter, m³, US gallons or user-defined unit</td> </tr> </table>	optionally in pulse per liter, m ³ , US gallons or user-defined unit
optionally in pulse per liter, m ³ , US gallons or user-defined unit		
Pulse width	automatic: pulse duty cycle 1:1, max. 1000 Pulse/s = max. 1000 Hz variable: 30, 50, 100, 200, 500 ms, ≤ 10 Pulse/s ≤ 10 Hz	
Active mode	connection: electronic totalizer internal voltage: 19 – 32 V DC, from current output $I_{max} < 50$ mA, operation with status output	
Passive mode	connection: electronic or electromechanical totalizer external voltage: $U_{ext} \leq 32$ V DC / ≤ 24 V AC load current: $I_{max} \leq 150$ mA	
Low-flow cutoff	cutoff "on" value: 1 – 19% cutoff "off" value: 2 – 20% <table style="display: inline-table; vertical-align: middle;"> <tr> <td style="border-left: 1px solid black; padding-left: 5px;">of $Q_{100\%}$, setting in 1% increments</td> </tr> </table>	of $Q_{100\%}$, setting in 1% increments
of $Q_{100\%}$, setting in 1% increments		
Time constant	0.04 – 3600 s, setting in increments of 1, 0.1 or 0.01 s	
Forward / reverse measurement	direction identified via status output or current output (status output only available in non-Ex version)	

Local display	3-field LCD
Display function	actual flowrate, measurement of sound velocity to determine (composition of) liquid product, forward, reverse and sum totalizer (7-digit) and status messages; each can be set for continuous or sequential display
Units: actual flowrate	m ³ , liter, US gallons per second, minute or hour, or in user-defined unit, e.g. liter/h or US gallon/day
totalizer	m ³ , liter, US gallons or in user-defined unit, e.g. hecto liter or US million gallon (min. 1 year overflow time)
Language of plain texts	English, French, German, Dutch, other on request
Display 1st line (top)	8-character, 7-segment numeral and sign display, and symbols for key acknowledgement
2nd line (middle)	10-character, 14-segment text display
3rd line (bottom)	5 markers to identify display in measuring mode
Housing	
Material	die-cast aluminium with polyurethane finish
Protection category	IP 67 (IEC 529 / EN 60529) equivalent to NEMA 4 and 4X
Signal cable only for remote systems (F) length up to 10 m / 30 ft (max. 20 m / 60 ft, option)	

4.4 Environmental conditions

In accordance with EN IEC 61010-1 the following environmental conditions have to be observed .

The GFM 700 is designed to operate safe under the following conditions:

- a) suitable for indoor and outdoor use, the housing of the signal converter is usable up to Protection Category IP67
- b) IP 67 is only warranted when using suitable cabling in the cable glands
- c) use up to an altitude of 2000 m above sea level
- d) suitable for an operation ambient temperature range - 40 +60 °C
- e) suitable for an storage temperature range -40 + 80 °C
- f) suitable for use in atmospheres with a relative humidity up to 80%
- g) mains supply voltage fluctuations up to ± 13 % of the nominal voltage range
- h) withstands over voltages up to category II on the main supply voltage (IEC 60364-4-443)
- i) connected to protective earth conductor (Protection Class I)
- j) rated pollution degree 2

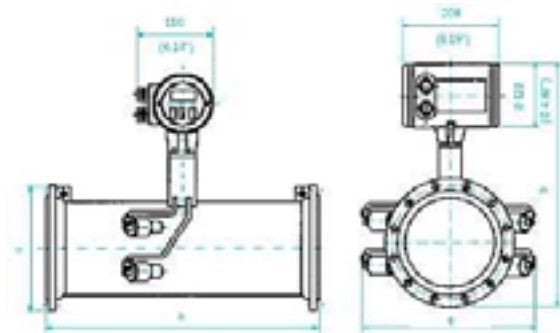
4.5 Dimensions and weights

Flange connections to DIN 2501 / pressure PN, s. Tabelle: dimensions b_{DIN} and c_{DIN} | maximum operation pressure, see Sect. 4.2
to ANSI / class 150 lb/RF: dimensions b_{ANSI} and c_{ANSI}

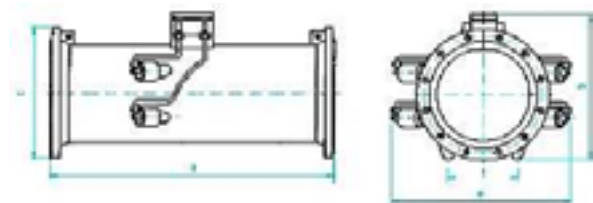
Meter size to ...			Dimensions in mm and (inches)						Weight ** approx. in kg
DIN	ANSI		a	b_{DIN}	b_{ANSI}	c_{DIN}	c_{ANSI}	e	
DN mm	PN	inches							
50	40	2	500 (19.69)	198 (7.80)	198 (7.80)	165 (6.50)	165 (6.50)	370 (14.57)	15 (33)
65	16	2 ½	500 (19.69)	216 (8.50)	212 (8.35)	185 (7.28)	178 (7.01)	380 (14.96)	20 (44)
80	40	3	500 (19.69)	230 (9.06)	235 (9.25)	200 (7.87)	210 (8.27)	390 (15.35)	20 (44)
100	16	4	500 (19.69)	252 (6.66)	257 (10.12)	220 (8.66)	229 (9.02)	410 (16.14)	20 (44)
125	16	5	500 (19.69)	280 (11.02)	282 (11.10)	250 (9.84)	254 (10.00)	430 (16.93)	30 (66)
150	16	6	500(19.69)	312 (12.28)	310 (12.20)	285 (11.22)	280 (11.02)	460 (18.11)	35 (77)
200	10	8	600 (23.62)	365 (14.37)	367 (14.45)	340 (13.39)	343 (13.50)	490 (19.29)	40 (88)
250	10	10	600 (23.62)	419 (16.50)	425 (16.73)	395 (15.55)	407 (16.02)	570 (22.44)	45 (99)
300	10	12	700 (27.56)	470 (18.50)	489 (19.25)	445 (17.52)	483 (19.02)	610 (24.02)	55 (121)
350	10	14	700 (27.56)	515 (20.28)	530 (20.87)	505 (19.88)	534 (21.02)	650 (25.59)	65 (143)
400	10	16	700 (27.56)	571 (22.48)	587 (23.11)	565 (22.24)	597 (23.50)	690 (27.17)	75 (165)
450	10	18	800 (31.50)	621 (24.45)	631 (24.84)	615 (24.21)	635 (25.00)	740 (29.13)	95 (210)
500	10	20	800 (31.50)	674 (26.54)	690 (27.17)	670 (26.38)	699 (27.52)	780 (30.71)	120 (265)
550	10	22	800 (31.50)	755 (29.72)	740 (29.13)	780 (30.71)	750 (29.53)	820 (32.28)	150 (331)
600	10	24	800 (31.50)	780 (30.71)	797 (31.38)	780 (30.71)	813 (32.01)	870 (34.25)	175 (386)

Please note for compact flowmeter: * dimension "b" see Table plus 210 mm
** weight see Table plus approx. 3.0 kg

GFM 700 K Compact flowmeter

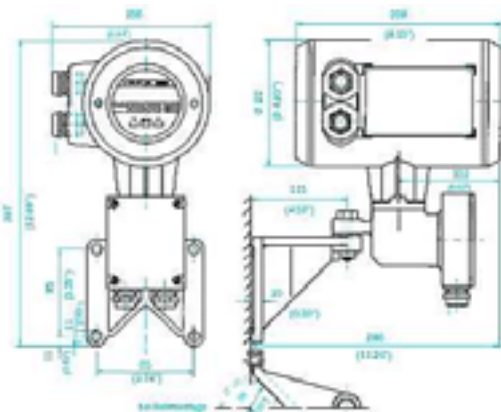


GFS 700 S Primary head



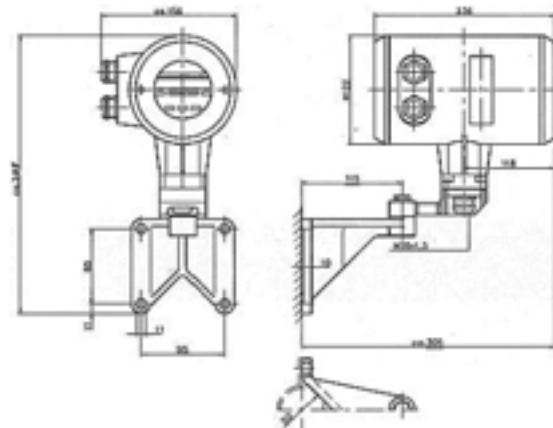
GFC 700 F Signal converter

wall mounting (rotatable)
weight approx. 4.2 kg



GFC 700 F – EEx Signal converter

wall mounting (rotatable)
weight approx. 4.2 kg



5 Installation notes

- Inlet run:**
- downstream of a compressor or nozzle $\geq 40 \times \text{DN}$
 - downstream of a fan $\geq 30 \times \text{DN}$
 - downstream of fully open control valve $\geq 20 \times \text{DN}$
 - downstream of a 90° bend (elbow) $\geq 20 \times \text{DN}$
 - downstream of a reducer ($\alpha/2 < 4^\circ$) no additional inlet run required

Outlet run: $\geq 10 \times \text{DN}$ (DN = meter size)

Installation conditions Select position such that the measuring beam is approximately horizontal.
Fit the mating flanges precisely at right angles to the pipeline.

6.1 Electrical connection

- **Power supply, power consumption and load rating** of outputs, see "Technical data"
- **Current and pulse outputs (I + P) are galvanically isolated** from all input and output circuits.

• Selection of connection diagrams	Standard operation	EEx operation
Current output	2) passive/active	1) active (also standard)
Pulse output	3) passive	4) passive (also standard)
Power supply and connection terminals	5)	6)

<p>1) Current output active Standard and EEx</p> <p>$R_1 \leq 680 \Omega$</p>	<p>2) Current output passive Standard</p> <p>$U_{\text{ext.}} \leq 18 \text{ V DC}$ $R_1 \leq 680 \Omega$</p>	<p>3) Pulse output active Standard</p> <p>$U_{\text{Output}} = 19 \text{ V} - 32 \text{ V}$ $R_1 \geq 650 \Omega$ $I \leq 50 \text{ mA}$ EC electronic totalizer</p>	<p>4) Pulse output passive Standard and EEx</p> <p>$U_{\text{ext.}} \leq 32 \text{ V DC} \leq 24 \text{ V AC}$ $I \leq 150 \text{ mA}$ EC electronic totalizer EMC electromechanical totalizer</p>
<p>5) Power supply connection and all outputs standard</p> <p>binary outputs current output</p> <p>L N L~ L~</p> <p>only internal connection protective conductor terminal</p>		<p>6) Power supply connection and all outputs EEx version</p> <p>binary outputs current output</p> <p>L N L~ L~</p> <p>power supply protective conductor terminal</p>	

6.2 Electrical installation to the mains supply voltage



The GFM 700 is intended for permanent connection to the mains. It is required (for example for service) to mount an external switch or circuitbreaker near the product for disconnection from the mains. It must be reached easily by the operator and marked as the disconnecting device for this product. The switch or circuitbreaker has to be suitable for the application and shall also be in accordance with local (safety) requirements and requirements of the building installation.



The protective conductor clamp terminal size M5, press-fitted, in the terminal compartment (Inear the power connection terminals) shall always be connected to the protective earth conductor of the main supply. Conductors up to 4mm² can be connected.



The diameter of the conductors of the main supply, including the protective earth conductor shall to be in accordance with the general requirements.

7 Operation of the signal converter

7.1 Table of settable functions

Fct.	Text	Description and settings
1.0	OPERATION	Main menu 1.0 Operation
1.1.0	BASIC. PARAM	Submenu 1.1.0 Basis parameters
1.1.1	FULL SCALE	Full-scale range for flowrate $Q_{100\%}$, see Fct. 3.1.1
1.1.2	REV. SCALE	Different range for reverse flow required? See Fct. 3.1.2
1.1.3	REV. VALUE	Full-scale range for reverse flow $Q_{R100\%}$, see Fct. 3.1.3
1.1.4	ZERO SET.	Zero setting, see Fct. 3.1.4
1.2.0	DISPLAY	Submenu 1.2.0 Display
1.2.1	DISP. FLOW	Unit for flowrate display, see Fct. 3.2.1
1.2.2	DISP. TOTAL.	Function of totalizer display, see Fct. 3.2.2
1.2.3	UNIT TOTAL.	Unit for totalizer display required? See Fct. 3.2.3
1.2.4	DISP. SP. S.	Display of sound velocity required? See Fct. 3.2.4
1.2.5	CYCL. DISP.	Cyclic display required? See Fct. 3.2.5
1.3.0	CUR. OUTP. I	Submenu 1.3.0 Current output I
1.3.1	TIMECONST.I	Time constant of current output I, see Fct. 3.3.6
1.3.2	L.F.CUTOFF I	Low-flow cutoff (SMU) for current output required? See Fct. 3.3.7
1.3.3	CUTOFF ON	Cutoff "on" value SMU-I, see Fct. 3.3.8
1.3.4	CUTOFF OFF	Cutoff "off" value SMU-I, see Fct. 3.3.9
1.4.0	FREQ. OUTP.F	Submenu 1.4.0 Frequency output F
1.4.1	PULSRATE or PULSE/UNIT	Pulse rate for 100% flowrate or for sound velocity, see Fct. 3.4.3 or Pulse value for flowrate unit, see Fct. 3.4.3
1.4.2	L.F.CUTOFF F	Low-flow cutoff (SMU) for frequency output required? See Fct. 3.4.3
1.4.3	CUTOFF ON	Cutoff "on" value SMU-F, see Fct. 3.4.7
1.4.4	CUTOFF OFF	Cutoff "off" value SMU-F, see Fct. 3.4.8
2.0	TEST	Main menu 2.0 Test functions
2.1	TEST DISP.	Carry out display test (Sect. 7.1.1) Start with → key, duration approx. 30 Sec. Test interruption with ↓ key.
2.2	TEST I	Test current output I (Sect. 7.1.2) • 0 mA • 4 mA • 20 mA • 2 mA • 10 mA • 22 mA Displayed value present directly at current output. Actual value again present at output after pressing the ↓ key.
2.3	TEST F	Test frequency output F (Sect. 7.1.3) • 1 Hz • 100 Hz • 10 Hz • 1000 Hz Displayed value present directly at current output. Actual value again present at output after pressing the ↓ key.
2.4	PROCESSOR	Test microprocessor (Sect. 7.1.4) Start with ↓ key, duration approx. 2 Sec. End of test: NO ERROR or ERROR displayed.

Fct.	Text	Description and settings
3.0	INSTALL	Main menu 3.0 Installation
3.1.0	BASIS.PARAM.	Submenu 3.1.0 Basisparameters
3.1.1	FULL SCALE	Full-scale range for flowrate $Q_{100\%}$ <u>Unit:</u> select from list under Fct. 3.2.1 <u>Value:</u> $9.5 \cdot 10^{-7}$ - 150.8 m ³ /Sec or 3.9 - 1,987,200 US Gal/min <u>After selecting unit, call numerical value with ↵ key, 1st digit flashes.</u>
3.1.2	REV. SCALE	Different range for reverse flow required? Setting NO or YES
3.1.3	REV. VALUE	Full-scale range for reverse flow (appears only if YES set under Fct. 3.2.1) <u>Unit:</u> select from list under Fct. 3.2.1 <u>Value:</u> $9.5 \cdot 10^{-7}$ - 150.8 m ³ /Sec or 3.9 - 1,987,200 US Gal/min Value must not be larger than that of Fct. 3.1.1! <u>After selecting unit, call numerical value with ↵ key, 1st digit flashes.</u>
3.1.4	ZERO SET	Zero setting • <i>FIXED.VALUE</i> • <i>VALUE.MEASU.</i> (Carry out only at "zero" flow and with completely filled measuring tube). 1) Inquiry: <i>CALIB. NO</i> or <i>YES</i> 2) if YES: calibration (duration approx. 20 Sec) with zero display in <i>PERCENT</i> of $Q_{100\%}$ 3) Inquiry: <i>STORE NO</i> or <i>YES.</i>
3.1.5	METER SIZE	Meter size <u>Unit:</u> <i>mm</i> or <i>inches</i> <u>Value:</u> 25 - 1200 mm or 0.98 - 48 inches <u>After selecting unit, call numerical value with ↵ key, 1st digit flashes.</u>
3.1.6	GK VALUE	Primary head constant GK (see also primary head nameplate). <u>Range:</u> 0.5 - 14
3.1.7	FLOW DIR	Define direction of forward flow, see Sect. 5.4. <u>Setting:</u> + or -, acc. to direction of arrow on primary head.
3.1.8	MIN SP. S.	Minimum sound velocity Minimum value used for $I_{0\%}$ or $F_{0\%}$ (when function <i>SOUND.VELO.</i> selected in 3.3.1 or 3.4.1) <u>Value:</u> 0 to 5000 m/s
3.1.9	MAX SP. S	Maximum sound velocity Maximum value used for $I_{100\%}$ or $F_{100\%}$ (when function <i>SOUND.VELO.</i> selected in 3.3.1 or 3.4.1) <u>Value:</u> 1 - 5000 m/s

Fct.	Text	Description and settings
3.2.0	DISPLAY	Submenu 3.2.0 Display
3.2.1	DISP. FLOW	Unit for flowrate <ul style="list-style-type: none"> • m³/Sec • Liter/Sec • US Gal/Sec • m³/min • Liter/min • US Gal/min • m³/hr • Liter/hr • US Gal/hr • h Liter/hr or US.MGal/DAY (factory set, can be changed as required, see Fct. 3.6.6, 3.6.7+3.6.8 and Sect. 5.14) • PERCENT • NO DISPLAY
3.2.2	DISP. TOTAL	Function of totalizer display <ul style="list-style-type: none"> • + TOTAL. (forward totalizer) • -- TOTAL. (reverse totalizer) • +/- TOTAL. (forward and reverse totalizers, alternating) • SUM TOTAL. (sum of + and -- totalizers) • ALL TOTAL. (alternating, sum, + and --totalizers) • TOTAL. OFF (totalizer switched off)
3.2.3	UNIT TOTAL.	Unit for totalizer display <ul style="list-style-type: none"> • m³ • Liter • US Gal • h Liter or US.Mgal (see Fct. 3.2.1 "hLiter/hr" and "US.Mgal/DAY")
3.2.4	DISP. SP. S	Display of sound velocity (in m/s) required? <u>Setting:</u> NO or YES
3.2.5	CYCL. DISP.	Cyclic display required? <u>Setting:</u> NO or YES
3.2.6	ERROR MSG.	Which error messages to be displayed? <ul style="list-style-type: none"> • NO MESSAGES (no error messages) • US ERROR (only ultrasonic errors) • TOTAL.ERROR (only errors of internal totalizer) • ALL ERRORS (all errors)

Fct.	Text	Description and settings
3.3.0	CUR.OUTP. I	Submenu 3.3.0 Current output I
3.3.1	FUNCTION I	Function, current output I <ul style="list-style-type: none"> • OFF (switched off) • F/R IND. (F/R indication, e.g. for F) • 1 DIR. (1 flow direction) • I<I 0 PCT (Forward / Reverse flow, e.g. in 0 - 20 mA range: F=10 - 20 mA and R=10 - 0 mA) • 2 DIR. (Forward/Reverse flow, F/R-measurement) • SP. SOUND (sound velocity)
3.3.2	RANGE I	Range for current output I, see Sect. 5.7.2 <ul style="list-style-type: none"> • 0 - 20 mA • 4 - 20 mA • OTHER RANGE (see Fct. 3.3.3, 3.3.4 + 3.3.5)
3.3.3	I 0 PCT.	Current for 0% flow ($I_{0\%}$) (appears only if OTHER RANGE set under Fct. 3.3.2). <u>Value:</u> 00 to 16 mA
3.3.4	I 100 PCT.	Current for 100% flow ($I_{100\%}$) of full-scale range (Fct. 3.1.1) (appears only if OTHER RANGE set under Fct. 3.3.2). <u>Value:</u> 04 - 20 mA (value must be at least 4 mA greater than that of Fct. 3.3.4).
3.3.5	I MAX mA	Current limitation (I_{max}) see Fct. 5.7.2 (appears only if OTHER RANGE is set under Fct. 3.3.2) <u>Value:</u> 04 20 mA (value must be at least 4 mA greater than that of Fct. 3.3.4).
3.3.6	TIMECONST. I	Time constant of current output I <u>Value:</u> 0.04 - 3600 Sec
3.3.7	L.F.CUTOFF I	Low flow cutoff (SMU) for current output required? <u>Setting:</u> NO or YES
3.3.8	L.F.CUTOFF ON	Cutoff "on" value for SMU-I (appears only if YES set under Fct. 3.3.7) <u>Value:</u> 01 - 19 PERCENT of $Q_{100\%}$ (Fct. 3.1.1)
3.3.9	L.F.CUTOFF OFF	Cutoff "off" value for SMU-I (appears only if YES set under Fct. 3.3.7) <u>Value:</u> 02 - 20 PERCENT of $Q_{100\%}$ (Fct. 3.1.1), value must be greater than that of Fct. 3.3.8.

Fct.	Text	Description and settings
3.4.0	FREQ. OUTP.F	Submenu 3.4.0 Frequency output F
3.4.1	FUNCTION F	Function, frequency output F <ul style="list-style-type: none"> • OFF (switched off) • F/R IND. (F/R indication, e.g. for I) • 1 DIR. (1 flow direction) • 2 DIR. (forward / reverse flow, F/R measurement) • SP. SOUND (sound velocity)
3.4.2	PULSOUTP	Unit of frequency output F <ul style="list-style-type: none"> • PULSRATE (setting in pulses per unit time) • PULSE/UNIT (setting in pulses per unit volume)
3.4.3	PULSRATE	Pulse rate for 100% flowrate or for sound velocity, see Fct. 3.1.1 or 3.1.8 + 3.1.9 (appears only if PULSRATE set under Fct. 3.4.2) <u>Value:</u> 2.778*10 ⁻³ - 1000 PuLSe/Sec (= Hz) or 0.1667 - 60,000 PuLSe/min or 10 - 3,600,000 PuLSe/hr <u>After selecting unit, call numerical value with ↵ key. 1 digit flashes.</u>
3.4.3	PULSE/UNIT	Pulse value for flowrate unit (appears only if PULSE/UNIT set under Fct. 3.4.2) <u>Unit:</u> PuLSe per m ³ , Liter, US Gal or unit of Fct. 3.6.6, 3.6.7+3.6.8 <u>Value:</u> 0.0001 to 9.9999*10 ⁹ PuLSe (no check, but Q _{100%} *pulse value ≤ 3.600.000 pulses/hr). <u>After selecting unit, call numerical value with ↵ key. 1 digit flashes.</u>
3.4.4	PULSWIDTH	Pulse width for frequenc ≤ 10 Hz <ul style="list-style-type: none"> • 30 mSec • 50 mSec • 100 mSec • 200 mSec • 500 mSec
3.4.5	TIMECONST. F	Time constant of frequency output F <ul style="list-style-type: none"> • 40 mSec • SAME AS I (time constant for F same as for I, see Fct. 3.3.6)
3.4.6	L.F.CUTOFF F	Low-flow cutoff (SMU) for frequency output required? <u>Setting:</u> NO or YES
3.4.7	CUTOFF ON	Cutoff "on" value SMU-F (appears only if YES set under Fct. 3.4.6) <u>Value:</u> 01 - 19 PERCENT of Q _{100%} (Fct. 3.1.1)
3.4.8	CUTOFF OFF	Cutoff "off" value SMU-F (appears only if YES set under Fct. 3.4.6) <u>Value:</u> 02 - 20 PERCENT of Q _{100%} (Fct. 3.1.1),, value must be greater than of Fct. 3.3.8

Fct.	Text	Description and settings
3.5.0	USER DATA	Submenu 3.5.0 User data
3.5.1	LANGUAGE	Language for display texts, see Sect. 5.11 <ul style="list-style-type: none"> • GB/USA (English) • D (german) • F (French) • N (Dutch)
3.5.2	ENTRY.CODE. 1	Entry code 1 for setting level required? See Sect. 5.12 <ul style="list-style-type: none"> • NO = Entry with → key only • YES = Entry with → key and 9-keystroke code Setting of the code under Fct. 3.5.3
3.5.3	CODE 1	Set Code 1, see Sect. 5.12 (appears only if YES set under Fct. 3.6.2) <ul style="list-style-type: none"> • <u>Factory setting:</u> →, →, →, ↓, ↓, ↓, ↑, ↑, ↑ • <u>Different code required:</u> Press any 9-keystroke combination and then press the same combination again. Each keystroke acknowledged by “*”. WRONG CODE appears if 1st and 2nd entries are not equal. Press ↓ + → keys and repeat entries.
3.5.4	LOCATION	Tag name setting (measurement point no.) max. 10 digits. Required only for flowmeters of “HHC” design (operator control via Hand-Held Communicator MIC 500, connected to current output). <u>Factory setting:</u> ALTOMETER <u>Characters assignable to each place:</u> A..Z / a..z / 0..9 / + / - / underscore character = blank character.
3.5.5	OUTP. HOLD	Hold values of outputs during settings? <u>Setting:</u> NO or YES
3.5.6	UNIT TEXT	Text for user-defined unit <u>Factory setting:</u> hLiter/hr or US.MGal/DAY <u>Characters assignable to each place:</u> A..Z / a..z / 0..9 / + / -- / underscore character = blank character. Fraction bar “/” in 7 th place is unalterable.
3.5.7	FACT. QUANT	Conversion factor for quantity F_M $F_M = \text{quantity per } 1 \text{ m}^3!$ <u>Factory setting:</u> 1.00000 E1 (for hecto Liter) or 2.64172 E-4 (for US M.gallons) <u>Value setting:</u> $0.00001 \cdot 10^{-9}$ - $9.99999 \cdot 10^{+9}$
3.5.8	FACT. TIME	Conversion factor for time F_T F_T in seconds! <u>Factory setting:</u> 3.60000 E3 (for hour) or 8.64000 E4 (for day) <u>Value setting:</u> $0.00001 \cdot 10^{-9}$ - $9.99999 \cdot 10^{+9}$

Fct.	Text	Description and settings
3.5.9	<i>TOTAL. RESET</i>	Totalizer reset (+ and -- totalizer together) Inquiry: NO or YES
3.5.10	<i>ENABL. RESET</i>	Enable totalizer reset for RESET/QUIT menu. Inquiry: NO or YES
3.5.11	<i>PLAUSIB ERR.</i>	Error limit in % of measured value for plausibility statement. Measured values that are outside the specified band are not processed. Every measured value outside the specified band will increase an internal counter by "1", until a maximum counter value (see Fct. 3.6.13) has been reached. The corresponding measurement channel will then be made inactive and an indication will be visible on the display. Value setting: 1 - 99 PERCENT Factory setting: 20 PERCENT
3.5.12	<i>WEIGHT P.OK</i>	Weight factor for correct measurements. The internal plausibility counter is increased by the number programmed, when the measured value is correct. The higher the number the faster an inactive channel will become active again. Value setting: 1 - 50 Factory setting: 4
3.5.13	<i>N.ER.PLAU SIB.</i>	Limit value for the counter of incorrectly measurements (see Fct. 3.6.11). When '0' is set, the plausibility function will become inactive. Value setting: 0 - 10,000 Factory setting: 0

7.2 Error messages

Fct.	Text	Description and settings
4.0	PARAM. ERROR	Main menu 4.0 Parameter error
4.1.0	FLOW VELOC.	FLOW VELOCITY “v” incorrect: Ensure condition $0.5 \text{ m/s} \leq v \leq 60 \text{ m/s}$ or $1.5 \text{ ft/s} \leq v \leq 180 \text{ ft/s}$ is met!
4.1.1	FULL SCALE	Full-scale range for flowrate $Q_{100\%}$, see Fct. 3.1.1
4.1.2	METER SIZE	Meter size, see Fct. 3.1.5
4.2.0	F/R FLOW	FULL-SCALE RANGE(S) for forward/reverse flow incorrect: Ensure condition $F \geq R$ is met!
4.2.1	FULL SCALE	Full-scale range for forward flowrate $Q_{F100\%}$, see Fct. 3.1.1
4.2.2	REV. SCALE	Different range for reverse flow required? See Fct. 3.1.2
4.2.3	REV. VALUE	Full-scale range for reverse flow $Q_{R100\%}$, see Fct. 3.1.3
4.3.0	I RANGE	CURRENT OUTPUT I RANGE incorrect: Ensure condition $I_{100\%} - I_0 \geq 4 \text{ mA}$ is met!
4.3.1	I 0 PCT	Current for 0% flow (I_0), see Fct. 3.3.3
4.3.2	I 100 PCT	Current for 100% flow ($I_{100\%}$), see Fct. 3.3.4
4.4.0	I MAXIMUM	CURRENT LIMITATION incorrect: Ensure condition $I_{\max} \geq I_{100\%}$ is met!
4.4.1	I 100 PCT	Current for 100% flow ($I_{100\%}$), see Fct. 3.3.4
4.4.2	I MAX mA	Setting of max. output current (I_{\max}), see Fct. 3.3.5
4.5.0	LFC. I RANG.	LOW-FLOW CUTOFF RANGE I incorrect: Ensure condition cutoff “off”. Cutoff “on” $\geq 1\%$ is met!
4.5.1	L.F. CUTOFF I	Low-flow cutoff (SMU) for current output required? See Fct. 3.3.7
4.5.2	CUTOFF ON	Cutoff “on” value SMU-I, see Fct. 3.3.8
4.5.3	CUTOFF OFF	Cutoff “off” value SMU-I, see Fct. 3.3.9
4.6.0	LFC. F RANG.	LOW-FLOW CUTOFF RANGE F incorrect: Ensure condition cutoff “off”. Cutoff “on” $\geq 1\%$ is met!
4.6.1	L.F. CUTOFF F	Low-flow cutoff (SMU) for frequency output required? See Fct. 3.4.6
4.6.2	CUTOFF ON	Cutoff “on” value SMU-F, see Fct. 3.4.7
4.6.3	CUTOFF OFF	Cutoff “off” value SMU-F, see Fct. 3.4.8

Fct.	Text	Description and settings
4.7.0	F > 1 kHz	OUTPUT FREQUENCY too high: must be less than 1 kHz!
4.7.1	FULL SCALE	Full-scale range for flowrate $Q_{100\%}$, see Fct. 3.1.1
4.7.2	PULSOUTP.	Unit of frequency output F, see Fct. 3.4.2
4.7.3	PULSRATE or PULSE/UNIT	Pulse rate for 100% flowrate or for sound velocity, see Fct. 3.4.3 or Pulse value for flowrate unit, see Fct. 3.4.3
4.8.0	F <> PULSW.	FREQUENCY/PULSE WIDTH ASSIGNMENT is incorrect
4.8.1	PULSOUTP.	Unit of frequency output F, see Fct. 3.4.2
4.8.2	PULSRATE or PULSE/UNIT	Pulse rate for 100% flowrate or for sound velocity, see Fct 3.4.3 or Pulse value for flowrate unit, see Fct. 3.4.3
4.8.3	PULSWIDTH	Pulse width for frequencies ≤ 10 Hz, see Fct. 3.4.4
4.9.0	PULS/T.TIME	Incorrect ASSIGNMENT of UNIT for F and SOUND VELOCITY
4.9.1	FUNCTION F	Function of frequency output F, see Fct. 3.4.1
4.9.2	PULSOUTP.	Unit of frequency output F, see Fct. 3.4.2
4.10.0	LFC. I/T.TIME	LOW-FLOW CUTOFF I incorrect: Ensure low-flow cutoff is "off" when function of current output is sound velocity.
4.10.1	FUNCTION I	Function of current output I, see Fct. 3.3.1
4.10.2	L.F.CUTOFF I	Low-flow cutoff (SMU) for current output required? See Fct. 3.3.7
4.11.0	LFC. F/T.TIME	LOW-FLOW CUTOFF F incorrect: Ensure low-flow cutoff is "off" when function of frequency output is sound velocity.
4.11.1	FUNCTION F	Function of frequency output F, see Fct. 3.4.1
4.11.2	L.F.CUTOFF F	Low-flow cutoff (SMU) for frequency output required? See Fct. 3.4.6
4.12.0	V.S. min>max	MAX. SOUND VELOCITY MUST BE LARGER THAN MIN. SOUND VELOCITY.
4.12.1	MIN SP. S	Minimum sound velocity, sound velocity for $I_{0\%}$ or $F_{0\%}$
4.12.2	MAX SP. S	Maximum sound velocity, sound velocity for $I_{100\%}$ or $F_{100\%}$

8. Addition for the GFM 700 F-EEEx ATEX and GFM 700 HT EEx-ATEX

8.1 Safety instructions

This product is designed for use in accordance with EN IEC 61010-1 for Installation Category 2 and Pollution Degree 2. Hazardous voltages are present within this product during normal operation. The product is designed for Protection Class I and should never be operated without protective earthing. The product shall also never be operated with covers removed unless equivalent protection of the operator and its environment from accidental contact with hazardous internal voltages is provided. Always follow basic and local safety precautions when using this product to reduce risk of injury from electrical shock, spread of fire or other dangerous situations.

WARNING !



No changes may be made to the devices. Unauthorized changes might affect the explosion safety of the devices.



These additional instructions are an extension to the standard Installation and Operating Instructions and only applies for the EEx version of the GFM 700 F gas flowmeter. All technical information described in the standard Installation and Operating Instructions are applicable, when not specifically excluded or replaced by the instructions in these additional instructions.

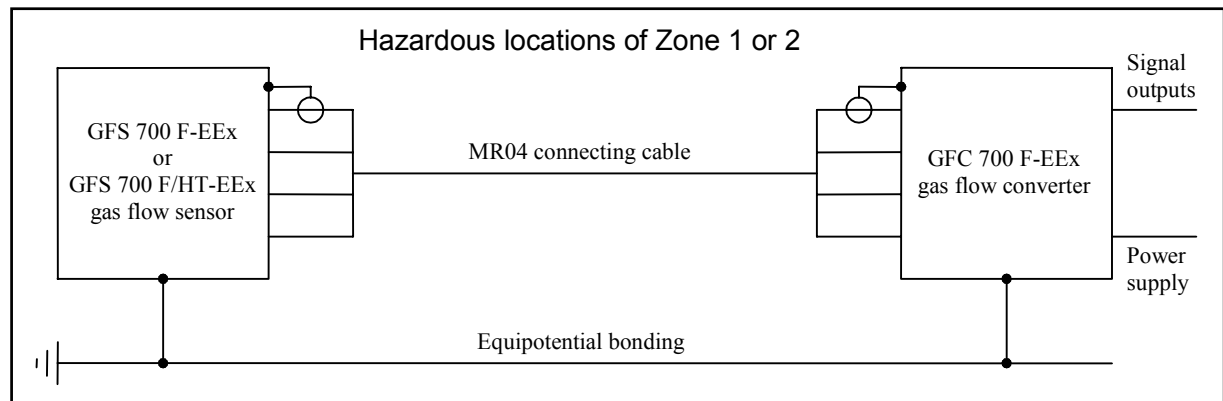
Be sure to follow these instructions !

8.2 SYSTEM COMPONENTS

8.2.1 General information

The Altosonic gas flowmeter system GFM 700 F-EEEx consists of the ultrasonic gas flow sensor GFS 700 F-EEEx or GFS 700 F/HT-EEEx (high-temperature version) in combination with the ultrasonic gas flow converter GFC 700 F-EEEx. Both the sensor and the converter can be installed in a hazardous location of Zone 1 or 2. The schematic block diagram of the gas flowmeter system is given in Figure 1 (see Section 4 **Connection diagram** for details).

Figure 1: Schematic block diagram of the GFM 700 F-EEEx gas flowmeter.



Important



The prescriptions and regulations as well as the electrical data described in the EG certificate of conformity must be obeyed.



Beside the instructions for electrical installations in non-hazardous locations according to the applicable National standard (equivalent to IEC 364, i.e. VDE 0100) especially the regulations in EN 60079-14 "Electrical installations in hazardous locations" or equivalent national standard (e.g. DIN VDE 0165) must be followed.



Installation, establishment, utilization and maintenance are only allowed to be executed by personnel with an education in explosion safety.

8.2.2 Gas flow sensor

There are two types of gas flow sensors, namely the GFS 700 F-EEEx (standard version) and the GFS 700 F/HT-EEEx (high-temperature version). The GFS 700 F/...-EEEx gas flow sensors are in conformance with the European Directive 94/9 EG (ATEX 100a) and approved by KEMA according to the European Standards EN 50xxx under the following number.

KEMA 00 ATEX 2119 X

The GFS 700 F/...-EEEx gas flow sensors have type of protection flameproof enclosure "d" according to EN 50018 (measuring sensors) and increased safety "e" according to EN 50019 (junction box). Both types of gas flow sensors are designed for ambient temperatures (i.e. T_a) in the range of -40°C to $+60^{\circ}\text{C}$. The maximum permissible temperature of the gas(es) to be measured is restricted by the temperature class of the explosive atmosphere that (possibly) surrounds the gas flow sensor, see therefore Table 1 and 2 below.

Temperature class	Maximum gas temperature at $T_a \leq 60^{\circ}\text{C}$
T6	80°C
T5	95°C
T4	130°C
T3	180°C

Table 1: Temperature classification of GFS 700 F-EEEx (standard).

Temperature class	Maximum gas temperature at $T_a \leq 60^{\circ}\text{C}$
T6	80°C
T5	95°C
T4	130°C
T3	195°C
T2	290°C
T1	440°C

Table 2: Temperature classification of GFS 700 F-EEEx (standard).

The GFS 700 F-EEEx gas flow sensor is marked with the code **II 2G EEx de IIC T6...T3**, the high-temperature version GFS 700 F/HT-EEEx bears code **II 2G EEx de IIC T6...T1**. See also the respective Certificate of Conformity in section 5.1 of these additional instructions.

8.2.3 Gas flow converter

The GFC 700 F-EEEx gas flow converter also conforms to the European Directive 94/9 EG (ATEX 100a) and is approved by KEMA in accordance with the European Standards of the EN 50xxx series. The GFC 700 F-EEEx has the following approval number.

KEMA 00 ATEX 2118 X

The GFC 700 F-EEEx ultrasonic gas flow converter has type of protection flameproof enclosure "d" to EN 50018 (electronics compartment and **optional** for terminal compartment) and/or increased safety "e" according to EN 50019 (**standard** for terminal compartment). The flow converter is suitable for ambient temperatures in the range of -40 to $+60^{\circ}\text{C}$ and is marked with temperature classification T6, because a maximum surface temperature of 80°C (85°C minus 5 K safety margin) is not exceeded.

The GFC 700 F-EEEx is marked with code **II 2G EEx d IIC T6** for the terminal compartment in type of protection "d" or with code **II 2G EEx de IIC T6** (terminal compartment in "e"). The Certificate of Conformity is listed in section 5.2 of these additional instructions.

8.3 ELECTRICAL CONNECTION

8.3.1 General

The GFC 700 F-EEEx gas flow converter is always connected to one of two in Section 1.2 (see previous page) described GFS 700 F/...-EEEx ultrasonic gas flow sensors via the factory installed MR04 type connecting cable. Both apparatus must also be incorporated into the equipotential bonding system via respectively the external M5 clamp terminal that is pressed into the connecting flange at the bottom of the signal converter housing (of GFC 700 F-EEEx) and the M8 terminal on the warning plate of the GFS 700 F/...-EEEx gas flow sensor.

8.3.2 Gas flow converter

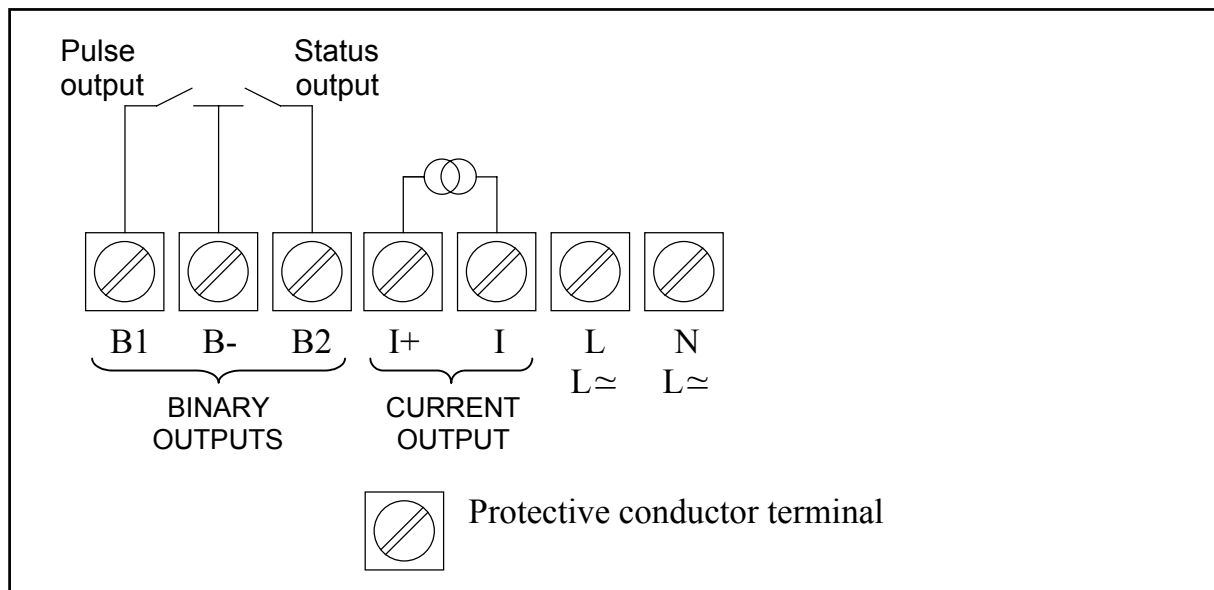
The MR04 connecting cable runs into the flameproof ("EEEx d") electronics compartment through an "EEEx d" approved cable gland. The cable is factory installed and tightly clamped by this gland. The gland **may under no conditions be (re)assembled by the customer**, because it could damage the flameproof properties of the electronics compartment.

The field cables that enter the terminal compartment of the GFC 700 F-EEEx flow converter (power supply, current output and binary outputs) are **non-intrinsically safe**. For connection of measuring devices to the output terminals, the wiring requirements for type of protection of the compartment (standard: increased safety "e", option: flameproof enclosure "d") must be according to the international or national standard (e.g. DIN VDE 0165, section 5.6) involved.

For flameproof conduit systems, the terminal compartment must have type of protection flameproof enclosure "d" according to EN 50018. The conduits must be sealed by "EEEx d" approved (within the ATEX 100a directive) sealing devices (i.e. stopping box) directly at the conduit entrances of the as flameproof enclosure performed terminal compartment.

The arrangement of the terminals in the terminal compartment is shown by Figure 2 below.

Figure 2: Arrangement of terminals.



NOTE:

The status output is not supported by the current software yet, but will be supported by future software versions. The current and pulse output are galvanically insulated from each other as well as from all other in-/output circuits.

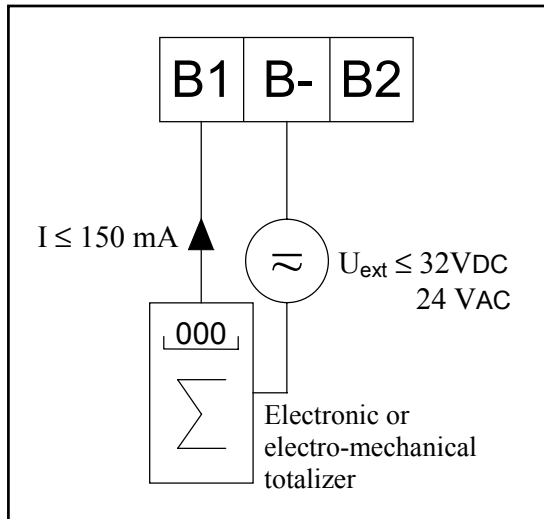


Figure 3: Passive pulse output.

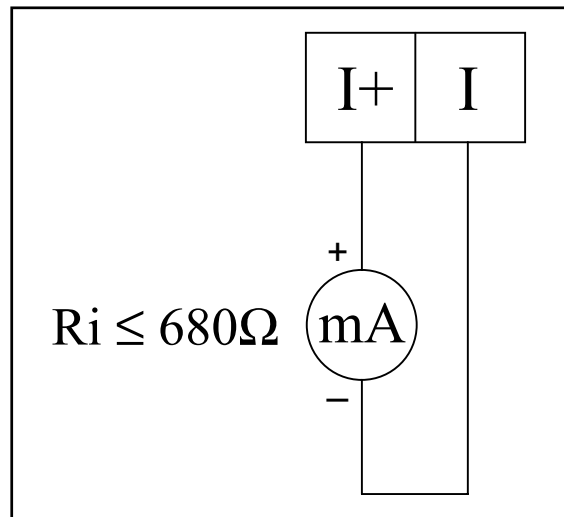


Figure 4: Active current output.

NOTE:

The status output (terminals B1 and B-) can only be configured as passive output, the current output (terminals I+ and I) can only be configured as active output.

See page 6 of the standard Installation and Operating Instructions for the electrical data of the available power supplies (e.g. mains voltages, etc.).

8.3.3 Replacement of electronics unit or power fuse(s)



IMPORTANT !

The following instructions must be followed carefully if the GFC 700 F-EEEx gas flow converter housing has to be opened respectively closed !

Before opening:

- ◆ Make absolutely sure that there is no **explosion hazard !**
- ◆ **Gas-free certificate !**
- ◆ Make sure that all connecting cables are **safely isolated from the power supply !**
- ◆ Allow the prescribed waiting time to elapse before opening the housing:
 - 20 minutes for temperature class T6
 - 11 minutes for temperature class T5

When the instructions above are strictly followed, the cover (includes a glass window) of the electronics compartment may be removed. First unscrew the recessed head screw of the interlocking device by a hollow-head screw wrench **size 3**, until the cover can rotate freely. Unscrew the cover with the special plastic wrench (black) that is supplied with the apparatus.

After opening:

- ◆ The copper grounding strip at the back of the electronics unit **must** be securely screwed to the housing (back-end of electronics compartment) by screw **C** (see Figure 5). The electronics unit is mounted to the back-end of electronics compartment by two screws **B**. Before screws **B** and **C** can be accessed, the display unit must be removed via screws **A**.
- ◆ Before the cover is screwed back into the housing, the screw-thread must be **clean and well-greased with an acid and resin-free grease**, e.g. silicone grease.
- ◆ Screw the cover as tight as possible into the housing by hand, until it cannot be opened by hand anymore. Screw the recessed head screw of the interlocking device tight.

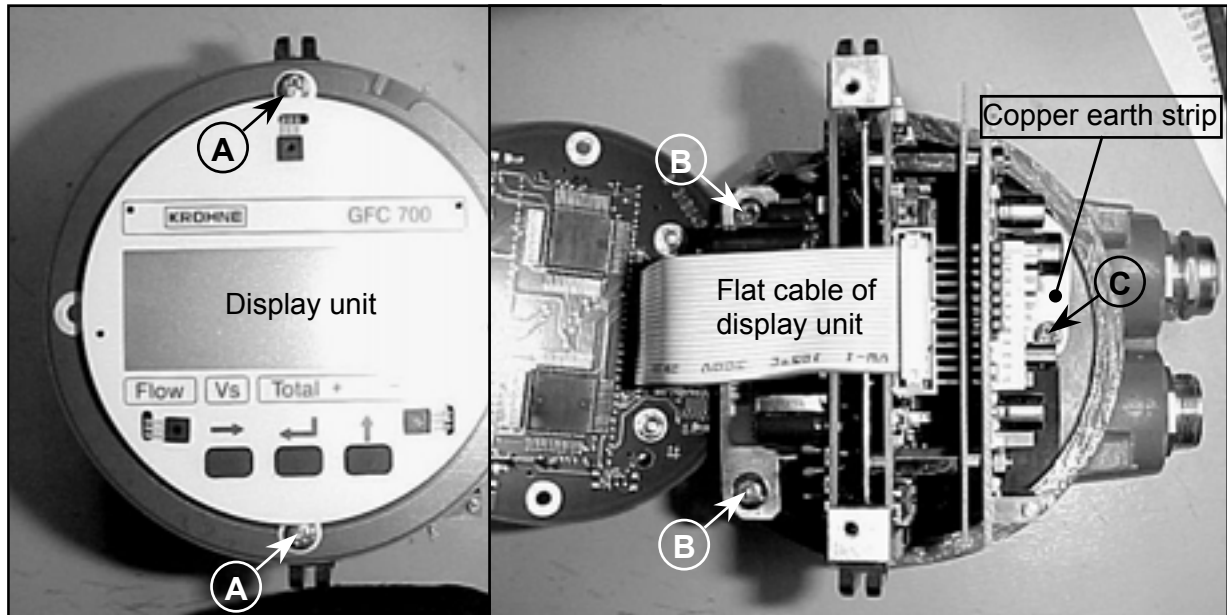


Figure 5: Display unit (left) / Electronics unit after removal of display unit (right).

8.3.4 Replacement of electronics unit

See the standard Installation and Operating Instructions for detailed information about resetting and reprogramming the new electronics unit after replacement. Important customer specific data (like the value of the internal totalizer) should be noted before replacing the electronics unit !

Before commencing work, **note the instructions in Section 2.3 ("Before opening")**.

Then continue as follows:

1. Remove the cover of the electronics compartment.
2. Unscrew the two screws **A** of the display unit and turn display unit carefully aside or remove the unit completely by taking out the flat cable connector.
3. Unscrew the two mounting screws **B** of the electronics unit as well as screw **C**, which fixes the copper earth strip at the back of the housing. A screwdriver with a long shaft (200 mm) can best be used to unscrew **C** (e.g. screwdriver type **Philips No. 2**).
4. Pull the electronics unit carefully out of the converter housing, till the SMB connectors of the coaxial cables can be unplugged easily. Then remove the complete electronics unit.
5. Check the new electronics unit if the voltage setting (only applicable for AC supplies) and power fuse rating are correct. Change the voltage setting (see section 2.3.3) or exchange the fuse if necessary.
6. Carefully insert the electronics unit till the numbered SMB connectors can be connected to the corresponding numbered SMB receptacles on the electronics unit. Then mount the unit completely into the housing and fix the screws. First **C**, then **B** and finally screw the display unit on the electronics via screws **A**, after the flat cable connector is connected.
7. Screw the cover of the electronics compartment back into the housing.

Note the instructions of section 2.3 ("After opening") during reassembling.

IMPORTANT !

Carefully keep the coaxial cables to the side of the housing, while inserting or removing the electronics unit into respectively from the converter housing. This is to prevent damaging of the coaxial cables !

8.3.5 Replacement of power fuse(s)

a) AC versions 115/230 VAC and 100/200 VAC

Before commencing work, **note the instructions in Section 2.3 ("Before opening")**.

Then continue as follows:

1. Remove the cover of the electronics compartment.
2. Unscrew the two screws **A** of the display unit and turn the display unit carefully aside.
3. The fuse-holder in which the power fuse is mounted is accessible now to exchange the defect power fuse **F1** for one with the same rating. The rating depends on the voltage of the mains (**T200mA** for 100/115VAC and **T125mA** for 200/230 VAC setting). See also the yellow sticker on the mains transformer as shown in Figure 6 below.
4. Reassemble in reverse order (points 2 and 1).

Note the instructions of section 2.3 ("After opening") during reassembling.

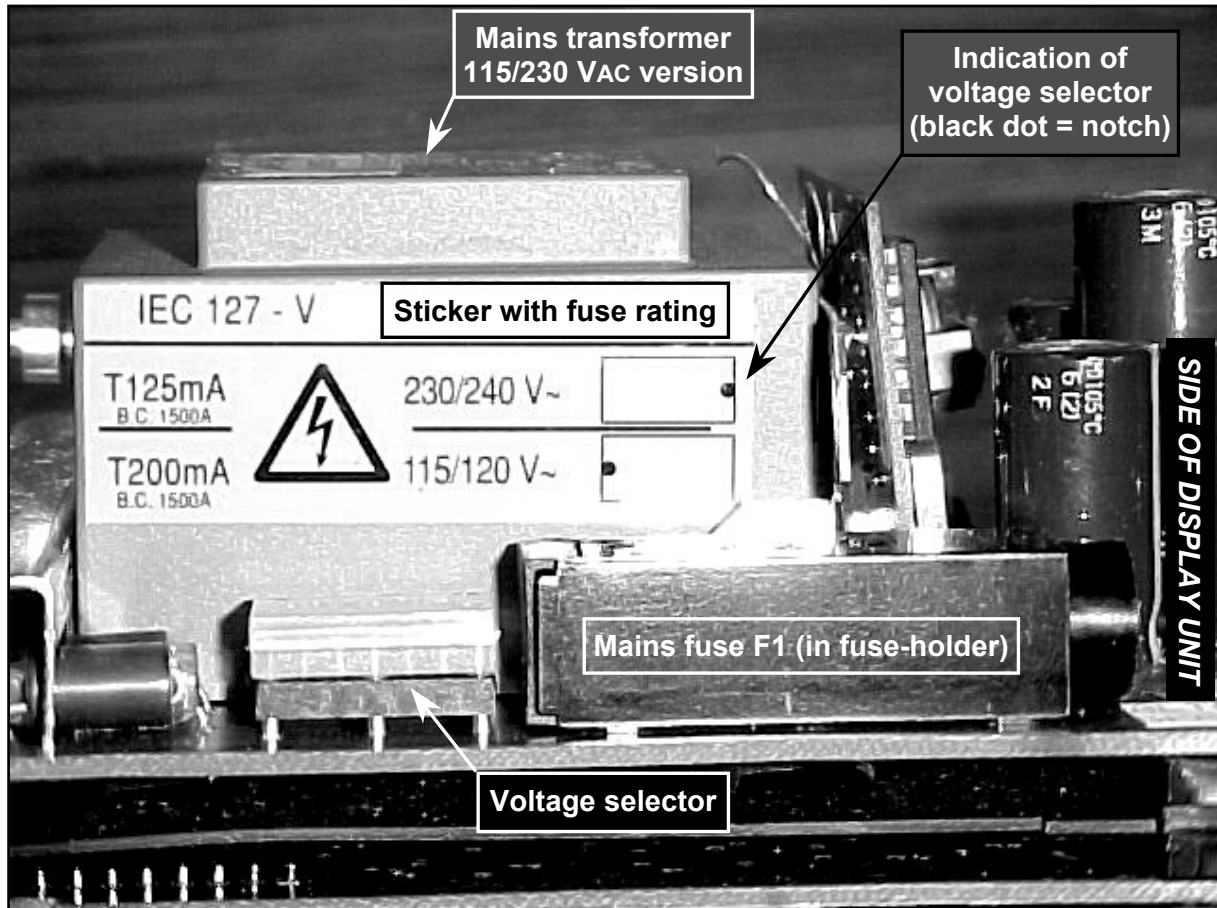


Figure 6: Power supply 115/230 VAC.

b) 24 VAC/DC version

Before commencing work, **note the instructions in Section 2.3 ("Before opening")**.

Then continue as follows:

1. Remove the cover of the electronics compartment.
2. Unscrew the two screws **A** of the display unit and disconnect the display unit via the flat cable connector (see right picture of Figure 5 on the previous page).
3. Unscrew the copper earth strip (screw **C**) with the and the mounting screws **B** of the electronics unit. Pull the unit out until the SMB connectors of the coaxial cables can be disconnected from the electronics. Then take out the complete electronics unit. Be careful with the coaxial cables, so that they do not damage while removing the electronics unit from the flow converter housing. **Continued on the next page !**

4. The power fuses F1 and F2 (see Figure 7 below) can be replaced now. The 24 VAC/DC power supply uses two sub-miniature fuses of **T1.25A** in accordance with IEC 127-3.
5. Reassemble in reverse order (points 3 through 1).

Note the instructions of section 2.3 ("After opening") during reassembling.

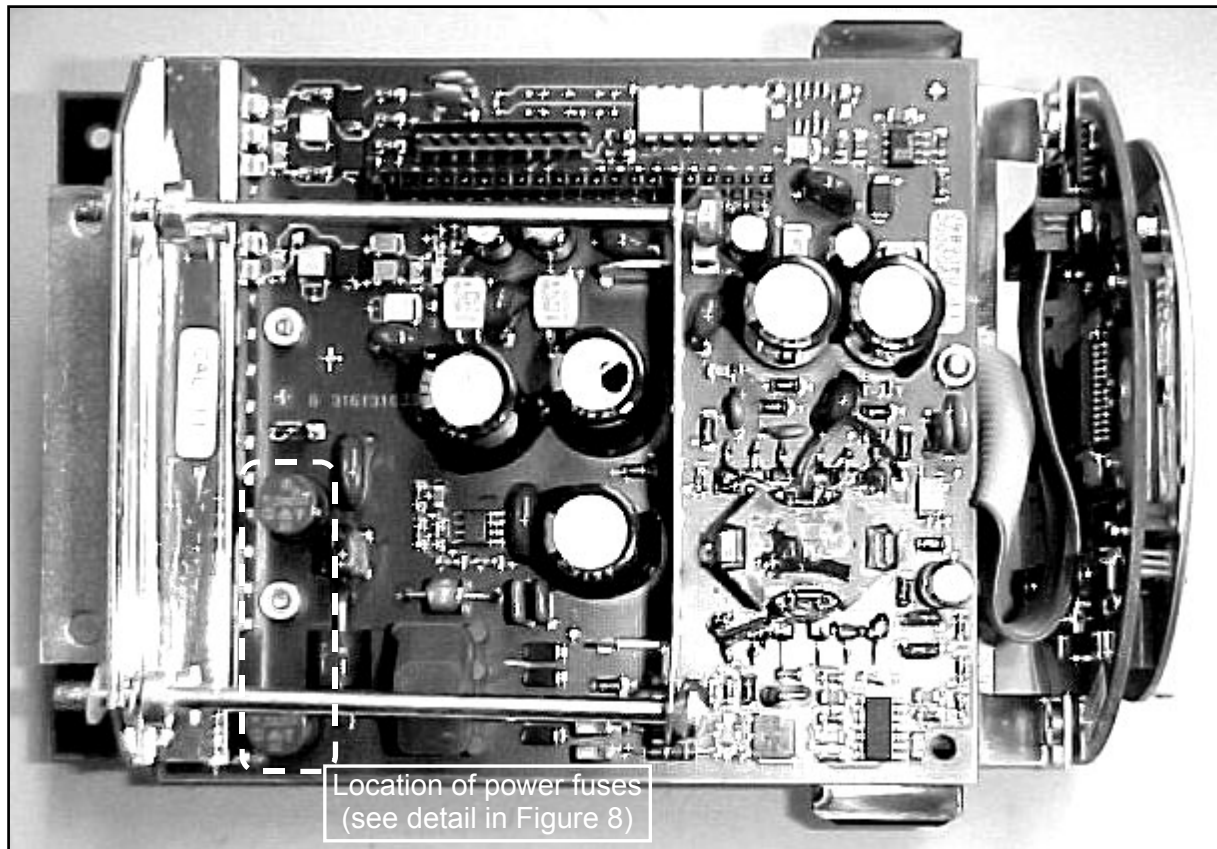


Figure 7: GFC 700 electronics unit with 24 VAC/DC power supply.

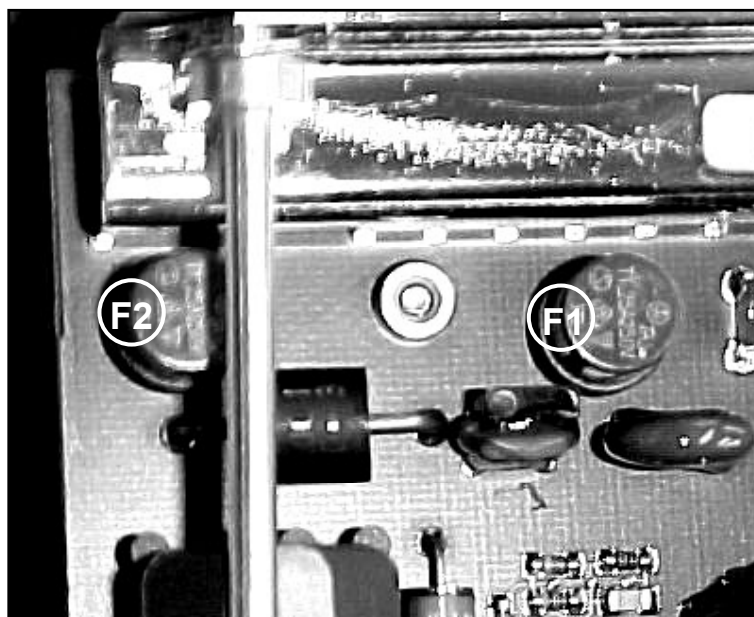


Figure 8: Location of fuses F1, F2 on 24 VAC/DC unit.

8.3.6 Changing power supply voltage (not for 24 VAC/DC version)

Before commencing work, **note the instructions in Section 2.3 ("Before opening")**.

Then continue as follows:

1. Remove the cover of the electronics compartment.
2. Unscrew the two screws **A** of the display unit and turn display unit carefully aside or remove the unit completely by taking out the flat cable connector.
3. Unscrew the two mounting screws **B** of the electronics unit as well as screw **C**, which fixes the copper earth strip at the back of the housing. A screwdriver with a long shaft (200 mm) can best be used to unscrew **C** (e.g. screwdriver type **Philips No. 2**).
4. Pull the electronics unit carefully out of the converter housing, till the SMB connectors of the coaxial cables can be unplugged easily. Then remove the complete electronics unit.
5. The voltage setting of the power supply can be changed by turning the dummy dual-in-line block (i.e. **voltage selector**, see Figure 6 on page 6) over 180° in its socket. The position of the notch on the dummy dual-in-line block indicates the voltage setting. Also see the sticker that is mounted on the mains transformer (see Figure 6).
6. Carefully insert the electronics unit back into the housing until the numbered SMB connectors can be connected to the corresponding numbered SMB receptacles on the electronics unit. Then mount the unit completely into the housing and fix the screws. First **C**, then **B** and finally screw the display unit on the electronics via screws **A**, after the flat cable connector is connected.
7. Screw the cover of the electronics compartment back into the housing.

Note the instructions of section 2.3 ("After opening") during reassembling.



IMPORTANT !

Carefully keep the coaxial cables to the side of the housing, while inserting or removing the electronics unit into respectively from the converter housing. This is to prevent damaging of the coaxial cables !

8.3.7 Gas flow sensor

The gas flow sensor is available in two designs, the GFS 700 F-EEx (standard) for gas temperatures up to a maximum of 180°C and the GFS 700 F/HT-EEx (high-temperature) for higher gas temperatures. Both types are connected to a GFC 700 F-EEx gas flow converter via a MR04 connecting cable (i.e. four RG 179 B/U coaxial cables with additional insulation). Each coaxial cable is marked by a number "1" to "4". The core of each cable is connected to a "EEx e" approved terminal in the terminal box of the flow sensor. The core of the cable with number "1" is connected to the terminal marked with number "21", the screen is connected to the adjoining terminal with number "1". Core number "2" is connected to terminal number "22", etcetera. An equipotential bonding conductor must interconnect the flow sensor to the gas flow converter (see section 2.5 below).

8.3.8 Equipotential bonding system

The equipotential bonding conductor consists of a insulated copper wire with a minimum cross-sectional area of 4 mm² (AWG 10). One side of the wire is connected to the external M5 clamp terminal on the connecting flange at the bottom of the converter housing, the other end is screwed to the M8 bolt/nut terminal on the warning plate of the gas flow sensor. This end of the cable is therefor provided with a eye cable tag.

8.3.9 Maximum length of connecting cable

The maximum length of the connecting MR04 cable between the GFC 700 F-EEx gas flow converter and the GFS 700 F/...-EEx gas flow sensor is standard limited at 10 m (30 ft) due to measurement technical reasons. Longer cables on request, but must be evaluated first.

8.4 CONNECTING CABLES

NOTE:

The below described cables are shown in the connection diagram on the following page.

Cable A:

Quad coaxial cable
Type MR04 (to be supplied by Krohne Altometer)

Technical data:

Test voltage	≥ 500 V
Diameter of strand (core and screen)	≥ 0.1 mm
Distributed capacitance (core/screen)	67 pF/m
Distributed inductance (core/screen)	0.4 μH/m

Cable B:

Power supply cable
Cable parameters must be in accordance with the regulations in the EN 60079-14 "Electrical installations in hazardous locations" or an equivalent national standard (e.g. DIN VDE 0165).

Rated voltage ≥ 500 V

Examples: H07...-, H05...-

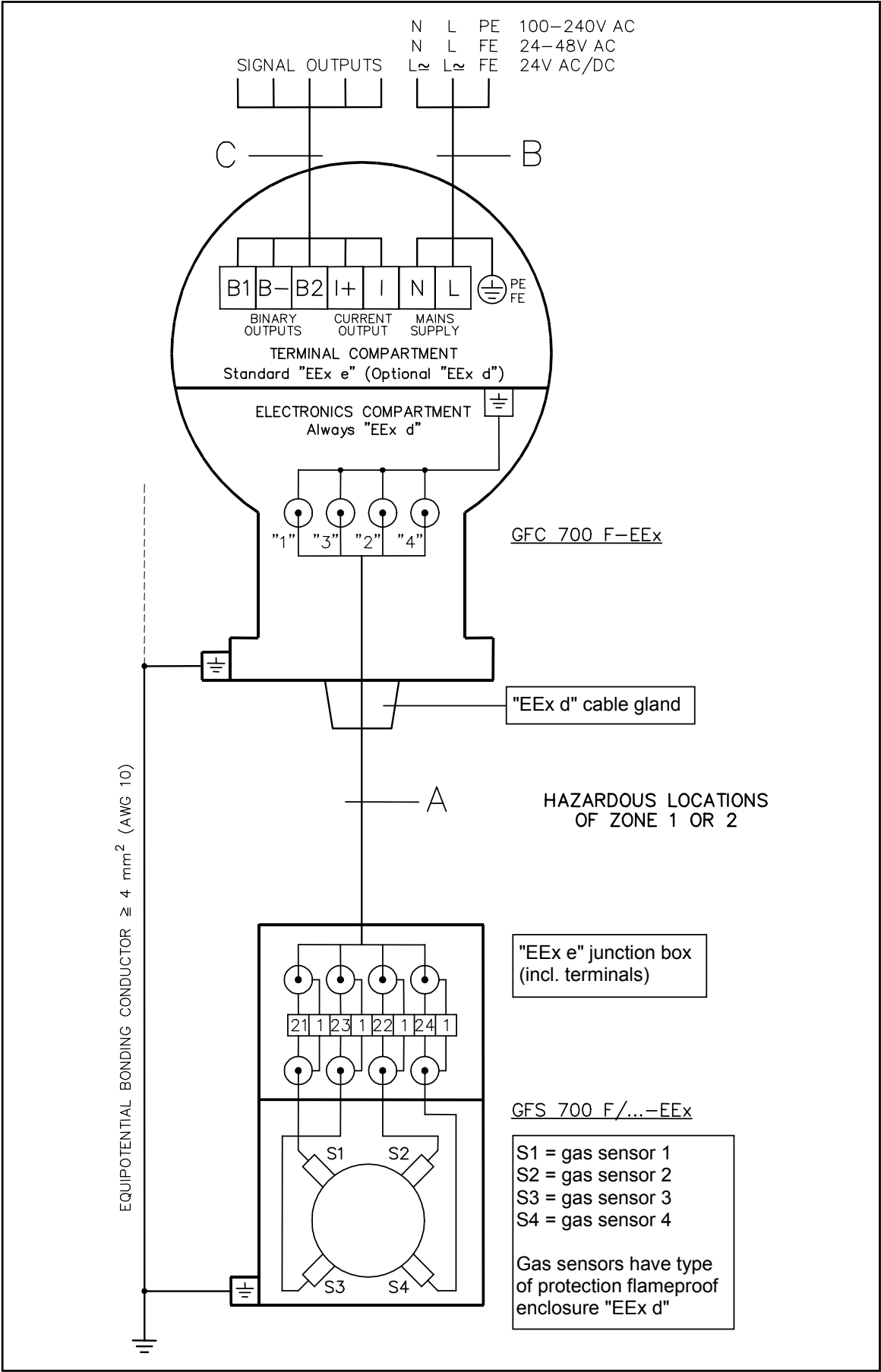
Cable C:

Signal cable for current output and binary outputs (pulse and status output).
Cable parameters must be in accordance with the regulations in the EN 60079-14 "Electrical installations in hazardous locations" or an equivalent national standard (e.g. DIN VDE 0165).

Bonding conductor:

Minimum cross-sectional area 4 mm² (AWG 10)

8.5 CONNECTION DIAGRAM



9 ATEX approvals

9.1 GFC 700 F - EEx Signal converter



(1) **EC-TYPE EXAMINATION CERTIFICATE**

(2) Equipment or protective system intended for use in potentially explosive atmospheres – Directive 94/9/EC

(3) EC-Type Examination Certificate Number: **KEMA 00ATEX2118 X**

(4) Equipment or protective system: **Ultrasonic Gas Flow Converter type GFC 700 F-EEx**

(5) Manufacturer: **Krohne Altometer**

(6) Address: **Kerkpleaats 12, 3313 LC, Dordrecht, The Netherlands**

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) KEMA, notified body number 0344 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report no. 2000240.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50014 : 1997 EN 50018 : 2000 EN 50019 : 2000

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design and construction of the specified equipment or protective system. If applicable, further requirements of this Directive apply to the manufacture and supply of this equipment or protective system.

(12) The marking of the equipment or protective system shall include the following:

 **II 2 G EEx de IIC T6 or EEx d IIC T6**

Arnhem, 12 September 2001
by order of the Board of Directors of N.V. KEMA


C.M. Boschloo
Certification Manager

* This Certificate may only be reproduced in its entirety and without any change



(13)

SCHEDULE

(14)

to EC-Type Examination Certificate KEMA 00ATEX2118 X

(15) **Description**

The Ultrasonic Gas Flow Converter type GFC 700 F-EEx is the remote unit that is to be connected to the remote measuring unit Ultrasonic Gas Flowmeter type GFS 700 F-EEx. The enclosure is constructed in type of explosion protection flameproof enclosure "d", with a terminal compartment either in type of explosion protection flameproof enclosure "d" or increased safety "e". The converter unit supplies power to the GFS 700-EEx unit and processes the electrical measurement signals thereof.

Ambient temperature range $-40\text{ }^{\circ}\text{C}$... $+60\text{ }^{\circ}\text{C}$.

Electrical data

Power supply 100-240 Vac, 48 ... 63 Hz, 13 VA, or
24 Vdc, 8 W

Current output max. 22 mA, $U \leq 18\text{ V}$

Pulse in-/outputs max. 150 mA, $U \leq 36\text{ V}$

Installation instructions

The cable entry devices shall be of a certified ("ATEX" or "E-generation") type EEx d for the terminal compartment in type of protection flameproof enclosure "d" or of a certified type EEx e for the terminal compartment in type of protection increased safety "e", suitable for the conditions of use and correctly installed.

Unused apertures shall be closed with suitable blanking elements.

Routine tests

Routine tests according to Clause 16 of EN 50018 are not required since the type test has been made at a static pressure of four times the reference pressure.

(16) **Report**

KEMA No. 2006240.

(17) **Special condition for safe use**

The unterminated cable from the converter housing is to be connected and terminated in the terminal box of the GFS 700 F-EEx sensor assembly.

The cable between the GFC 700 F-EEX converter housing and the terminal box of the GFS 700 F-EEx sensor assembly, is to be fixed installed in such a way that it is protected against mechanical damage.

(13)

SCHEDULE

(14)

to EC-Type Examination Certificate KEMA 00ATEX2118 X

(15) **Essential Health and Safety Requirements**

Essential Health and Safety Requirements not covered by the standards listed at (9)	
Clause	Subject
1.0.5	Marking
1.0.6 b) and d)	Instructions

These Essential Health and Safety Requirements are examined and positively judged.
The results are laid down in the report listed at (16)

(19) **Test documentation**

1. Component Certificate PTB 98.E.1046 U
Certificate of Conformity L.C.I.E. 92.C6075 X

Signed:

2. Description (6 pages))
)
3. Drawing No. 8.30872.10 rev. A) 06.09.2001
8.30872.09)
33119301)
33119401)
4. Samples

9.2 GFS 700 F - EEx Primary head (flowmeter)



(1) **EC-TYPE EXAMINATION CERTIFICATE**

(2) Equipment or protective system intended for use in potentially explosive atmospheres – Directive 94/9/EC

(3) EC-Type Examination Certificate Number: **KEMA 00ATEX2119 X**

(4) Equipment or protective system: **Ultrasonic Gas Flow Meters type GFS 700 F-EEx and GFS 700 F/HT-EEx**

(5) Manufacturer: **Krohne Altometer**

(6) Address: **Kerkeplaat 12, 3313 LC Dordrecht, The Netherlands**

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) KEMA Quality B.V., notified body number 0344 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report no. 2006242.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50014 : 1997 EN 50018 : 2000 EN 50019 : 2000

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment or protective system in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

(12) The marking of the equipment or protective system shall include the following:

 **II 2 G EEx de IIC T6 ... T1**

Anhem, 22 January 2002
KEMA Quality B.V.



T. Pijper
Certification Manager

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KEMA Quality B.V.
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P.O. Box 5165, 6802 ED Anhem, The Netherlands
Telephone +31 26 3 56 20 08, Telefax +31 26 3 52 58 00

ACCREDITED BY THE
DUTCH COUNCIL FOR
ACCREDITATION



Page 1/3

(13) **SCHEDULE**
 (14) **to EC-Type Examination Certificate KEMA 00ATEX2119 X**

(15) **Description**

The Ultrasonic Gas Flow Meters type GFS 700 F-EEEx and GFS 700 F/HT-EEEx are the measuring units that are to be connected to the remote Ultrasonic Gas Flow Converter type GFC 700 F-EEEx. The Flow Meters consist of measuring sensors in type of explosion protection flameproof enclosure "d", connected to a terminal box in type of explosion protection increased safety "e".

Ambient temperature range -40 °C ... +60 °C.

Temperature class	Max. proces temperature (GFS 700 F-EEEx)	Max. proces temperature (GFS 700 F/HT-EEEx)
T6	80 °C	80 °C
T5	95 °C	95 °C
T4	130 °C	130 °C
T3	180 °C	180 °C
T2	-	290 °C
T1	-	440 °C

Electrical data

Current output $I \leq 22 \text{ mA}$, $U \leq 18 \text{ V}$
 Pulse status in-/outputs $I \leq 150 \text{ mA}$, $U \leq 36 \text{ V}$
 Sensor outputs $U \leq 400 \text{ V}_{\text{peak}}$

Installation instructions

The cable entry device for the connecting cable to the Ultrasonic Gas Flow Converter type GFC 700 F-EEEx, shall be in type of explosion protection increased safety "e", suitable for the conditions of use and correctly installed.

Unused apertures shall be closed with suitable certified blanking elements.

Routine tests

Routine tests according to Clause 16 of EN 50018 shall be carried out using an overpressure of at least 20 bar, during 1 minute.

(16) **Report**

KEMA No. 2006242.

(13) **SCHEDULE**
 (14) **to EC-Type Examination Certificate KEMA 00ATEX2119 X**

(17) **Special conditions for safe use**

The cable between the terminal box of the GFS 700 F-EEEx sensor assembly and the GFC 700 F-EEEx converter, is to be fixed installed in such a way that it is protected against mechanical damage.

(18) **Essential Health and Safety Requirements**

Covered by the standards listed at (9).

(19) **Test documentation**

1. EC-Type Examination Certificate PTB 00ATEX1063
 EC-Type Examination Certificate KEMA 98ATEX1651 U

signed:

2. Description (9 pages) 25.10.2000 / 20.11.2001

3. Drawing No. 8.30872.01, rev. A)
 8.30872.02, rev. A)
 8.30872.03, rev. A)
 8.30872.04, rev. B)
 8.30872.05, rev. D)
 8.30872.06, rev. A)
 8.30872.07, rev. C) 21.11.2001
 8.30872.08, rev. B)
 8.30872.11, rev. D)
 8.30872.13, rev. A)

 8.30872.12, rev. B)
 8.30872.16, rev. A)
 8.30872.17, rev. A)

12.04.2001

4. Samples