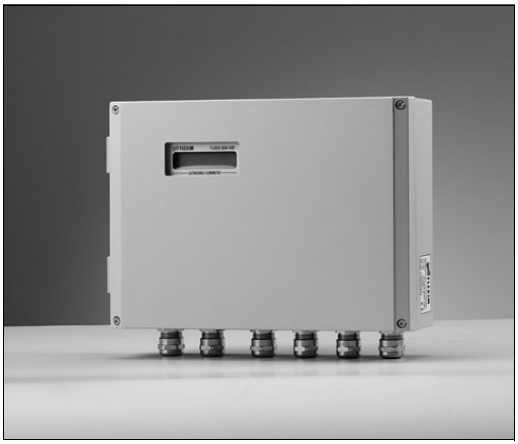
User Manual

UMFLUXUS_G7V4-0-2EN

Ultrasonic Flowmeter for Gas

FLUXUS G704
FLUXUS G704 A2



FLUXUS G709

Firmware V5.xx

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User manual for
FLUXUS G70x
UMFLUXUS_G7V4-0-2EN, 2011-03-16
Firmware V5.xx

Die Sprache, in der die Anzeigen auf dem Messumformer erscheinen, kann eingestellt werden (siehe Abschnitt 9.4).

The transmitter can be operated in the language of your choice (see section 9.4).

Il est possible de sélectionner la langue utilisée par le transmetteur à l'écran (voir section 9.4).

El caudalímetro puede ser manejado en el idioma de su elección (ver sec-- ción 9.4).

Table of Contents

Annex

1 Introduction

1.1 Regarding this Manual

This manual has been written for the personnel operating the ultrasonic flowmeter FLUXUS. It contains important information about the instrument, how to handle it correctly, and how to avoid damages.

Make sure you have read and understood this manual before using the instrument.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Read the safety Instructions carefully. Make sure you have read and understood this manual before using the instrument.

All reasonable effort has been made to ensure the correctness of the content of this user manual. However, If you find any erroneous information, please inform us. We will be grateful for any suggestions and comments regarding the concept and your experience working with the instrument.

This will ensure that we can further develop our products for the benefit of our customers and in the interest of technological progress. If you have any suggestions about improving the documentation and particularly this user manual, please let us know so that we can consider your comments for future reprints.

1.2 Safety Instructions

The user manual contains instructions that are marked as follows:

Note!	This text contains important information about the use of the flowmeter.

Attention!	This text contains important instructions which should be observed to avoid damage or destruction of the flowmeter. Proceed with special caution!

	This texts denotes instructions according to directive 94/9/EC.

Observe these safety instructions!

1.3 Warranty

The FLUXUS flowmeter is guaranteed for the term and to the conditions specified in the sales contract provided the equipment has been used for the purpose for which it has been designed and operated according to the instructions given in this User Manual. Misuse of the FLUXUS will immediately revoke any warranty given or implied.

This includes:

- replacement of a component of FLUXUS with a component that was not approved by FLEXIM
- unsuitable or insufficient maintenance
- repair of FLUXUS by unauthorized personnel

FLEXIM assumes no responsibility for injury to the customer or third persons proximately caused by the material owing to defects in the product which were not predictable or for any indirect damages.

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear.

If any problem appears which can not be solved with the help of this manual (see chapter 19), contact our sales office giving a precise description of the problem. Specify the type, serial number and firmware version of the flowmeter.

2 Handling

2.1 First Inspection

The flowmeter has already been tested thoroughly at the factory. At delivery, proceed to a visual control to make sure that no damage has occurred during transportation.

Check that the specifications of the flowmeter delivered correspond to the specifications given on the purchase order.

The type and the serial number of the transmitter are shown on the nameplate. The transducer type is printed on the transducers.

2.2 General Precautions

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

FLUXUS is a precision measuring instrument and must be handled with care. To obtain good measurement results and not damage the instrument, it is important that great attention is paid to the instructions given in this user manual, particularly to the following points:

- Protect the transmitter from shocks.
- The housing may only be opened by authorized personnel. The degree of protection of the transmitter FLUXUS G704 A2 and FLUXUS G704 will only be ensured if the front plate is tightly screwed to the housing.
- Keep the transducers clean. Manipulate the transducer cables with caution. Avoid excessive cable bend.
- Make sure to work under correct ambient and operating temperatures. The ambient temperature must be within the operating temperature range of the transmitter and the transducers (see annex B, section Technical Data).
- Observe the degree of protection (see annex B, section Technical Data).

2.3 Cleaning

- Clean the transmitter with a soft cloth. Do not use detergents.
- Remove traces of the coupling compound from the transducers with a soft paper towel.

3 Transmitter

3.1 Measurement principle

The flow of the medium is measured by ultrasonic signals using the transit time difference method.

Ultrasonic signals are emitted by a transducer installed on one side of the pipe, reflected on the opposite side and finally received by a second transducer. The signals are emitted alternatively in and against the flow direction.

As the medium in which the signals propagate is flowing, their transit time in flow direction is shorter than against the flow direction.

The transit time difference Δt is measured, allowing to determine the average flow velocity on the propagation path of the ultrasonic signals. A flow profile correction is then performed to obtain the area average of the flow velocity, which is proportional to the volumetric flow rate.

The received ultrasonic signals are tested for their usefulness for the measurement and the plausibility of the measured values is evaluated. The complete measuring procedure is controlled by the integrated microprocessors. Disturbance signals are eliminated.

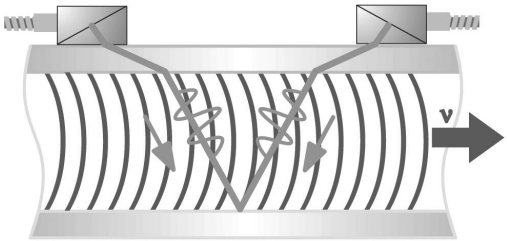


Fig. 3.1: Path of the ultrasonic signal

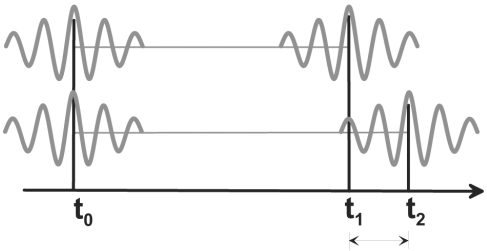


Fig. 3.2: Transit time difference Δt

3.2 Serial number

The type and the serial number are shown on the nameplate of the transmitter. When contacting FLEXIM, always have both numbers and the number of the firmware version at hand (see section 15.6).

3.3 Description of the Transmitter

Attention! The degree of protection of the transmitter will only be ensured if the cable glands are firmly tightened and the housing is tightly screwed.

3.3.1 Design of FLUXUS G704 A2 and FLUXUS G704

The front plate has to be removed to access the command panel.

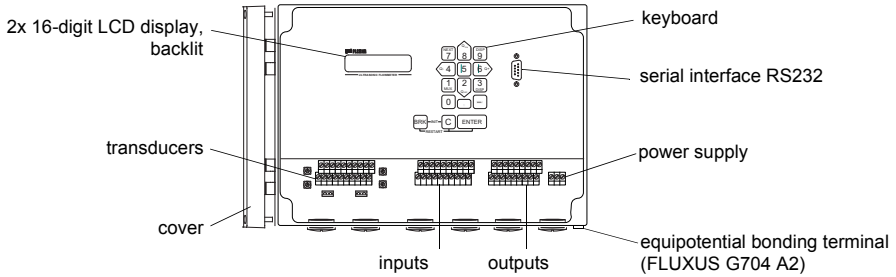


Fig. 3.3: Command panel of FLUXUS G704 A2 and FLUXUS G704

3.3.2 Design of FLUXUS G709

The transmitter is designed as a 19 " module (42 HP, 3 U).

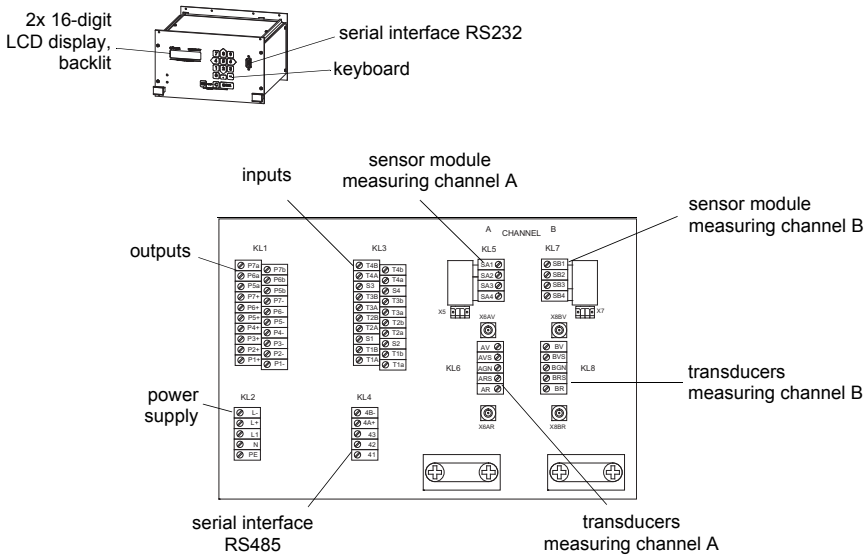


Fig. 3.4: Command panel and terminal board of FLUXUS G709

3.4 Keyboard

The keyboard consists of three function keys ENTER, BRK and C and ten numerical keys.

Several keys have double functions. They can be used for entering data and for navigating through scroll lists.

The arrow-shaped keys 4, 6, 8 and 2 are used as cursor keys in the selection mode and for entering digits and letters in the input mode.

Table 3.1: General functions

ENTER	confirmation of selection or of entered value
BRK + C + ENTER	RESET: Press these three keys simultaneously to correct a malfunction. The reset has the same effect as restarting the transmitter. Stored data are not affected.
BRK	interruption of the measurement and selection of the main menu Be careful not to stop a current measurement by inadvertently pressing key BRK!

Table 3.2: Navigation

BRK	selection of the main menu
4 6	scroll to the left/right through a scroll list
8 2	scroll upwards/downwards through a scroll list
ENTER	confirmation of the selected menu item

Table 3.3: Input of digits

0 ... 9	input of the digit shown on the key
−	sign for the input of negative values
LIGHT ■	decimal marker
C	Delete values. After the value has been deleted, the previous value will be displayed.
ENTER	confirmation of input

Table 3.4: Input of text

4 6	positioning of the cursor
9	changing the currently selected character to an "A"
3	changing the currently selected character to a "Z"
5	changing between small and capital letters
8 2	selection of the precedent/next ASCII character
0	deleting the character and inserting a blank
7 ... 1	Automatic scrolling up or down through the limited ASCII character set. The character changes every second. The scrolling is stopped by pressing any other key.
ENTER	finishing editing

Table 3.5: Cold start

BRK + C	INIT (cold start): Most parameters and settings are reset to the factory default values. Stored data is not affected. Keep the two keys pressed while switching the transmitter on until the main menu is displayed. A cold start during operation is executed as follows: • Press the keys BRK, C and ENTER simultaneously. A RESET is executed. • Release key ENTER only. Keep the keys BRK and C pressed until the main menu is displayed.

4 Selection of the Measuring Point

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The correct selection of the measuring point is crucial for achieving reliable measurement results and a high measurement accuracy.

A measurement on a pipe is possible if

- the ultrasound propagates with a sufficiently high amplitude (see section 4.1)
- the flow profile is fully developed (see section 4.2)
- the influence of noise is sufficiently low (see section 4.3)

The correct selection of the measuring point and thus, the correct transducer positioning guarantees that the sound signal will be received under optimum conditions and evaluated correctly.

Due to the variety of applications and the different factors that influence the measurement, there is no standard solution for the transducer positioning. The correct position of the transducers is influenced by the following factors:

- diameter, material, lining, wall thickness and form of the pipe
- medium

Avoid measuring points in the vicinity of deformations and defects of the pipe and in the vicinity of welds.

Avoid locations with deposit formation in the pipe.

The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point.

The ambient temperature at the location must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

4.1 Acoustic Penetration

The pipe must be acoustically penetrable at the measuring point. The acoustic penetration is reached when pipe and medium do not attenuate the sound signal so strongly that it is completely absorbed before reaching the second transducer.

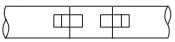
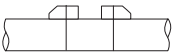
The attenuation in the pipe and in the medium depends on:

- kinematic viscosity of the medium
- proportion of liquid and solids in the medium
- deposits on the inner pipe wall
- pipe material

The following requirements must be met at the measuring point:

- no material deposits in the pipe
- no accumulation of liquid (condensate), e.g. before orifice plates or at pipe sections located at lower levels

Table 4.1: Recommended mounting position

horizontal pipe Select a measuring point where the transducers can be mounted on the side of the pipe, allowing the sound waves to propagate in the pipe horizontally. Thus, solid or liquid deposits on the bottom of the pipe will not influence the propagation of the signal. correct :  disadvantageous: 

4.2 Undisturbed Flow Profile

Some flow elements (elbows, slide valves, valves, control valves, pumps, reducers, diffusers, etc.) distort the flow profile in their vicinity. The axisymmetrical flow profile needed for correct measurement is no longer given. A careful selection of the measuring point helps to reduce the impact of disturbance sources.

It is most important that the measuring point is chosen at a sufficient distance from any disturbance sources. Only then it can be assumed that the flow profile in the pipe is fully developed. However, measuring results can be obtained even if the recommended distance to disturbance sources can not be observed for practical reasons.

Recommended straight inlet and outlet pipe lengths for different types of flow disturbance sources are shown in the examples in Table 4.2.

Table 4.2: Recommended distance from disturbance sources
D = nominal pipe diameter at the measuring point, l = recommended distance

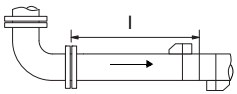
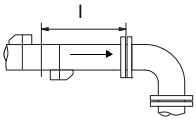
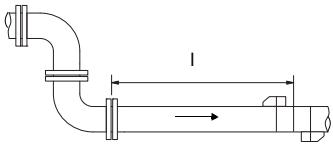
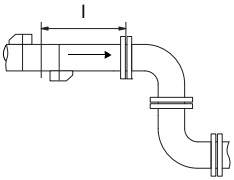
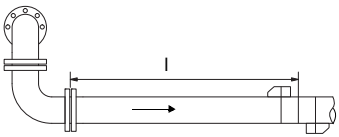
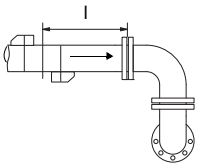
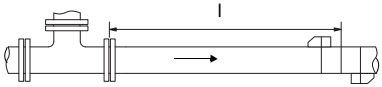
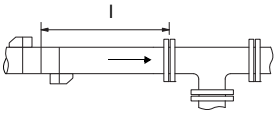
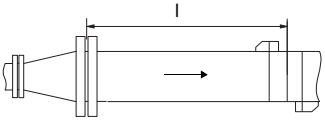
disturbance source: 90° elbow supply line: l ≥ 20 D    return line: l ≥ 10 D 
disturbance source: 2x 90° elbows on same level supply line: l ≥ 50 D    return line: l ≥ 10 D 
disturbance source: 2x 90° elbows on different level supply line: l ≥ 80 D    return line: l ≥ 10 D 
disturbance source: T piece supply line: l ≥ 100 D    return line: l ≥ 20 D 

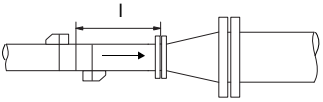
Table 4.2: Recommended distance from disturbance sources
D = nominal pipe diameter at the measuring point, l = recommended distance

disturbance source: diffuser

supply line: l ≥ 60 D

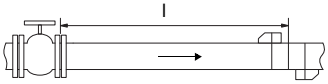


return line: l ≥ 10 D

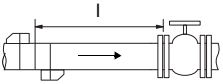


disturbance source: valve

supply line: l ≥ 80 D

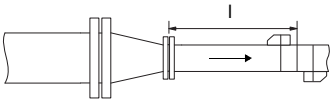


return line: l ≥ 20 D

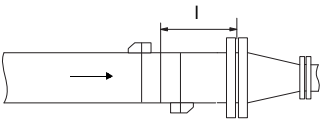


disturbance source: reducer

supply line: l ≥ 20 D

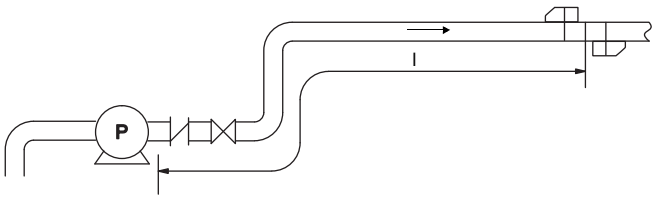


return line: l ≥ 10 D



disturbance source: compressor

supply line: l ≥ 100 D



4.3 Influence of Noise

The ultrasonic waves do not only propagate in the medium but also in the pipe wall (see Fig. 4.1). They are reflected at flanges.

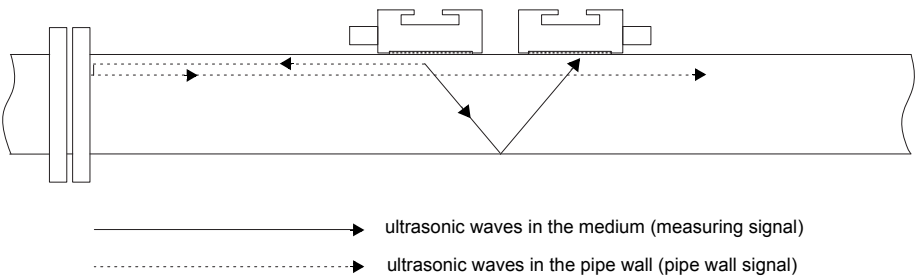


Fig. 4.1: Propagation of ultrasonic waves

The reflected pipe wall signals can disturb the measurement, especially if:

- the measuring point is close to the reflection point
- the pipe wall signals and measuring signals are received by the transducer at the same time

Table 4.3: Measuring points to be avoided

measuring point directly at the reflection point (l_S < 3 D):

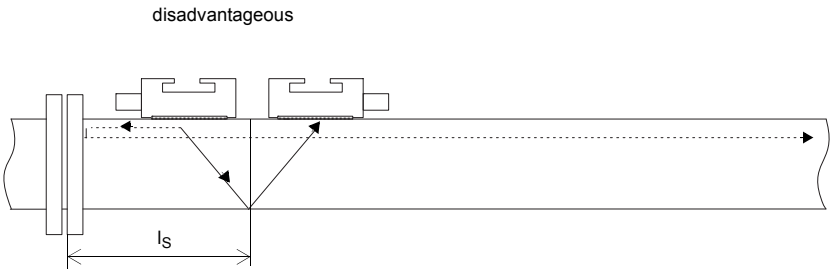
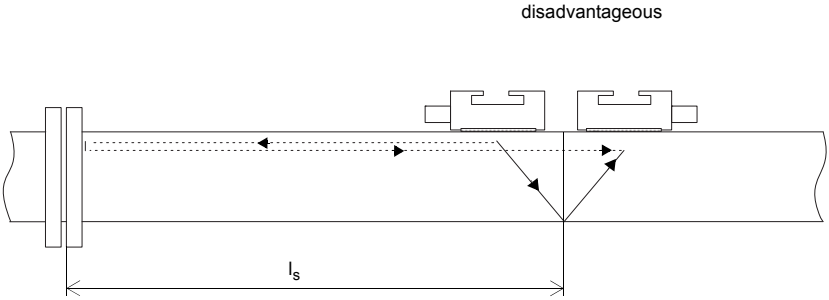


Table 4.3: Measuring points to be avoided

Measuring point at a distance of l_S ± 2 D from the reflection point

Pipe wall signal and measuring signal are received by the transducer at the same time.



$$l_s = \frac{n}{2} \cdot \frac{c_P}{c_F} \cdot D$$

l_S - distance to the reflection point
D - outer pipe diameter
c_F - sound velocity in the medium
c_P - sound velocity in the pipe
n - number of sound paths

example:

medium: natural gas
pipe material: stainless steel
c_P: 3000 m/s
c_F: 400 m/s
number of sound paths: 2
l_S = 7.5 D

The area (7.5 ± 2) D is disadvantageous for the transducer installation.

4.4 Selection of the Measuring Point Taking into Account the Flow Profile and the Influence of Noise

- Select an area on the pipe where the flow profile is fully developed (see section 4.2).
- In this area, select the measuring point in such way that the influence of noise can be neglected (see 4.3).

example: medium: natural gas
pipe material: stainless steel
length of pipe segment 1: 20 D
length of pipe segment 2: 20 D
number of sound paths: 2

- area with developed flow profile:

disturbance source: 90° elbow
recommended area for the measuring point: l ≥ 20 D (complete pipe segment 2) (see Table 4.2)

- area with low influence of noise:

reflection point: flange
recommended area for the measuring point: l ≥ 3 D and outside of l = (7.5 ± 2) D on pipe segment 2 (see Table 4.2)

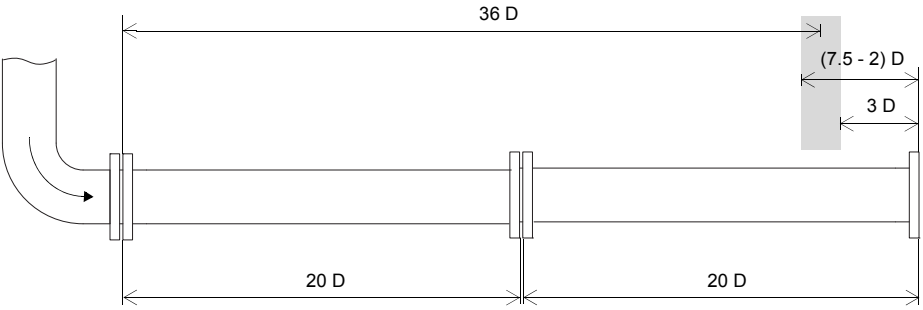


Fig. 4.2: Area for the measuring point with a favorable flow profile and low influence of noise

In consideration of the flow profile and the influence of noise, the measuring point can be selected in the area 3...(7.5 - 2) D on the right side of pipe segment 2 (with max. distance from the elbow). In the example, a distance of 36 D from the elbow was selected.

It is not always possible to meet both requirements at the same time. In these cases, the measuring point has to be selected in such way that the influence of noise is min. and the measuring point is as far from the disturbances of the flow profile as possible.

example: medium: natural gas
pipe material: stainless steel
length of pipe segment 1: 20 D
length of pipe segment 2: 5 D
number of sound paths: 2

- area with developed flow profile:

disturbance source: 90°-Krümmer
recommended area for the measuring point: l ≥ 20 D (complete pipe segment 2) (see Table 4.2)

- area with low influence of noise:

reflection point: flange
recommended area for the measuring point: l ≥ 3 D and outside of l = (7.5 ± 2) D on pipe segment 1 (see Table 4.2)

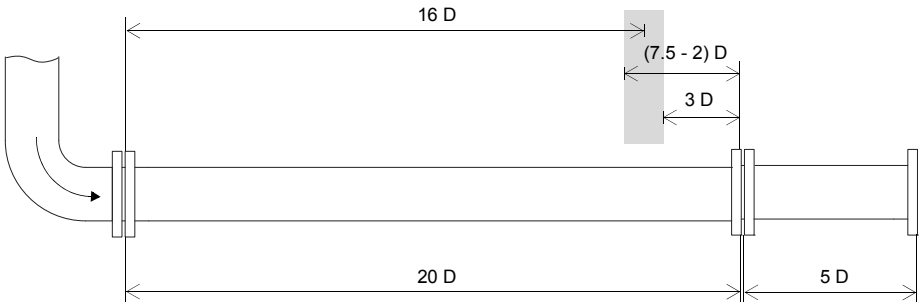


Fig. 4.3: Area for the measuring point with low influence of noise and not fully developed flow profile

In the example, there is no area where both demands are met at the same time. The measuring point has to be selected as far as possible from the elbow, at a point where the influence of noise can be neglected: 3...(7.5 - 2) D on the right side of pipe segment 1. In the example, a distance of 16 D from the elbow was selected.

5 Installation of FLUXUS G704

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

5.1 Location

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point. The ambient temperature must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The degree of protection of the transmitter will only be ensured if the cable glands are firmly tightened and the housings are tightly screwed.

5.2 Wall Installation

- Remove the front cover of the housing.
- At the chosen location, drill 4 holes in the wall (see Fig. 5.1).

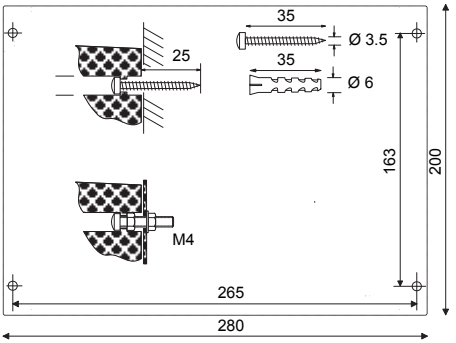


Fig. 5.1: Wall installation (dimensions in mm)

- Insert the dowels into the holes.
- Fix the housing to the wall with screws.

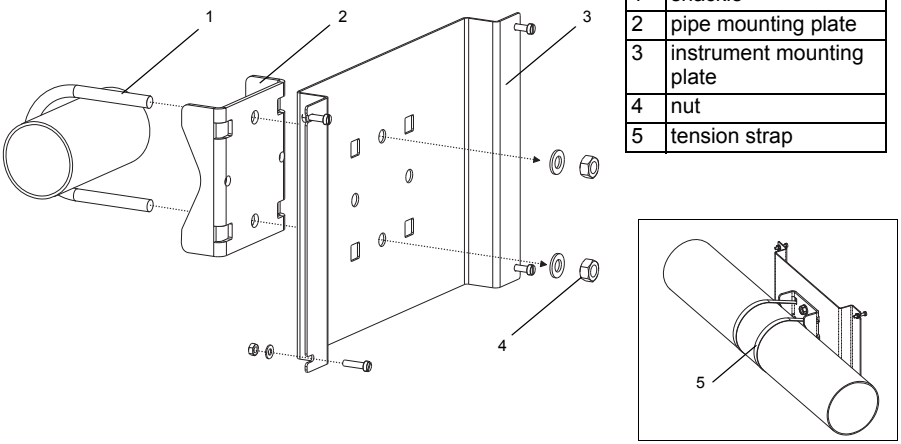
5.3 Pipe Installation

Installation on a 2 " pipe

- Fix the pipe mounting plate (2) to the pipe (see Fig. 5.2).
- Fix the instrument mounting plate (3) to the pipe mounting plate (2) with the nuts (4).
- Fix the bottom side of the housing to the instrument mounting plate (3).

Installation on a 2 " pipe:

The mounting kit is fixed to the pipe with tension straps (5) instead of the shackle (see Fig. 5.2). Push the tension straps through the holes of the instrument mounting plate (3).



1	shackle
2	pipe mounting plate
3	instrument mounting plate
4	nut
5	tension strap

Fig. 5.2: Pipe installation set

5.4 Connection of the Transducers - Connection System TS

Note!	If transducers are replaced or added, the sensor module must also be replaced or added (see section 5.10).

It is recommended to run the cables from the measuring point to the transmitter before connecting the transducers to avoid load on the connectors.

Overview

5.4.1 Transducers - Direct Connection

For the connection of the transducers (ATEX Zone 1) see section 5.4.3.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.3).
- Insert the transducer cable with the SMB connectors in the housing.

- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the transmitter (see Fig. 5.3 and Table 5.1).

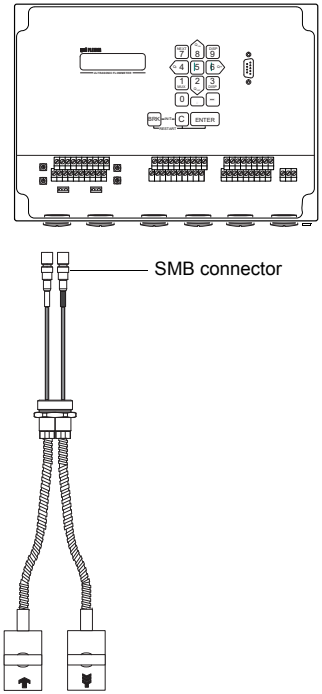


Fig. 5.3: Transducers - direct connection

Table 5.1: Terminal assignment

terminal	connection
X_AV	SMB connector (brown cable, marked white)
X_AR	SMB connector (brown cable, marked black)

5.4.2 Transducers - Connection via Junction Box

For the connection of the transducers (ATEX Zone 1) see section 5.4.4.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Remove the left blind plug for the connection of the transducers (see Fig. 5.4).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut and the compression part.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the extension cable in the housing

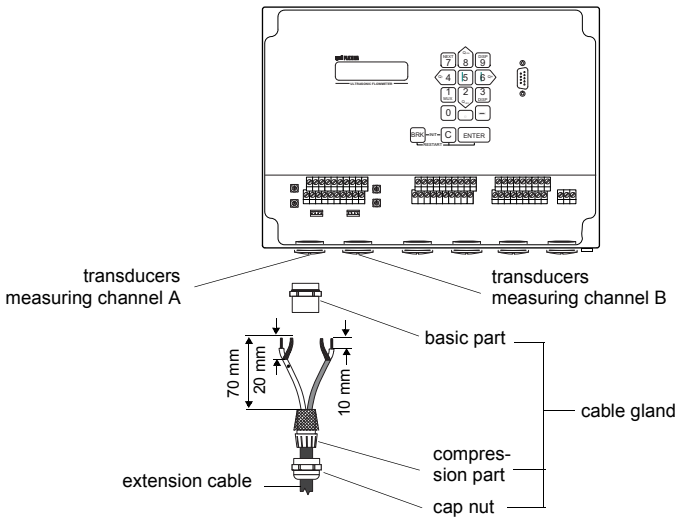


Fig. 5.4: Transducers - connection via junction box to the transmitter

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.4 and Table 5.2).

Table 5.2: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 5.5 or Fig. 5.6).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back (see Fig. 5.5 or Fig. 5.6.
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 5.7 or Fig. 5.8).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 5.7 or Fig. 5.8).
- Connect the leads to the terminals of the junction box (see Fig. 5.7 or Fig. 5.8 and Table 5.3).

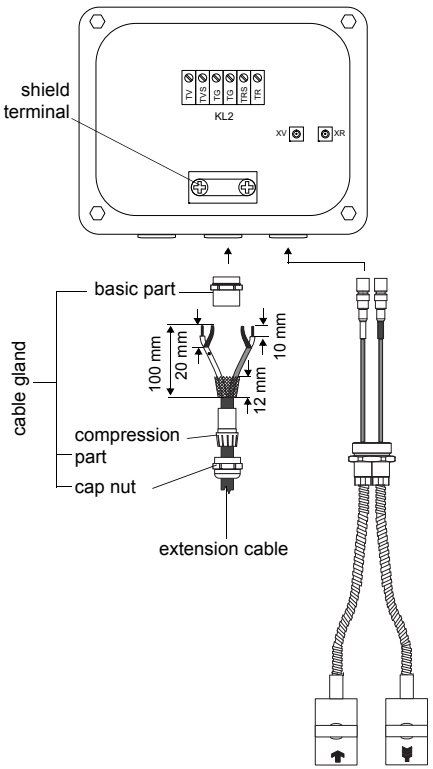


Fig. 5.5: Connection to junction box JB02, JB03

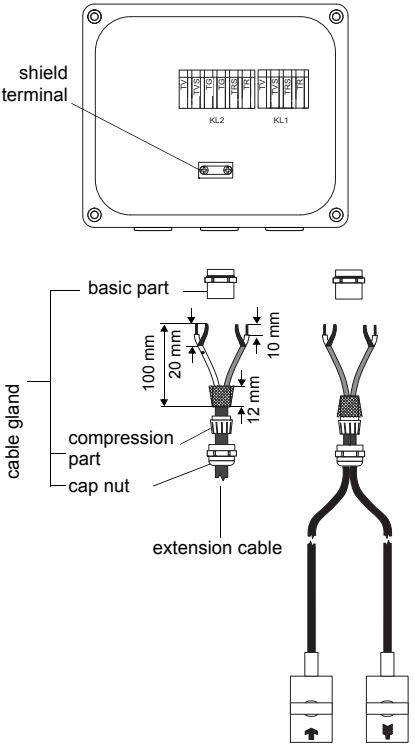


Fig. 5.6: Connection to junction box JBP2, JBP3

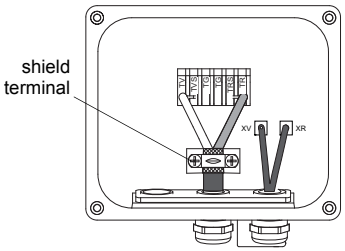


Fig. 5.7: Junction box JB02, JB03

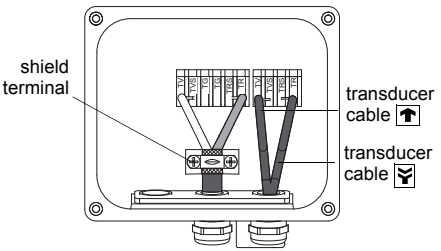


Fig. 5.8: Junction box JBP2, JBP3

Table 5.3: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box JB02, JB03

- Remove the blind plug from the junction box (see Fig. 5.7).
- Insert the transducer cable with the SMB connectors in the housing.
- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the junction box (see Fig. 5.7 and Table 5.4).

Table 5.4: Terminal assignment

terminal	connection
XV	SMB connector (brown cable, marked white)
XR	SMB connector (brown cable, marked black)

Connection of the Transducer Cable to the Junction Box JBP2, JBP3

- Remove the blind plug from the junction box (see Fig. 5.8).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 5.8 and Table 5.5).

Table 5.5: Terminal assignment (KL1)

terminal	connection
TV	transducer ↑ (core)
TVS	transducer ↑ (internal shield)
TRS	transducer ↓ (internal shield)
TR	transducer ↓ (core)

5.4.3 Transducers (ATEX Zone 1) - Direct Connection

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.9).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the two transducer cables through the cap nut and the compression part.

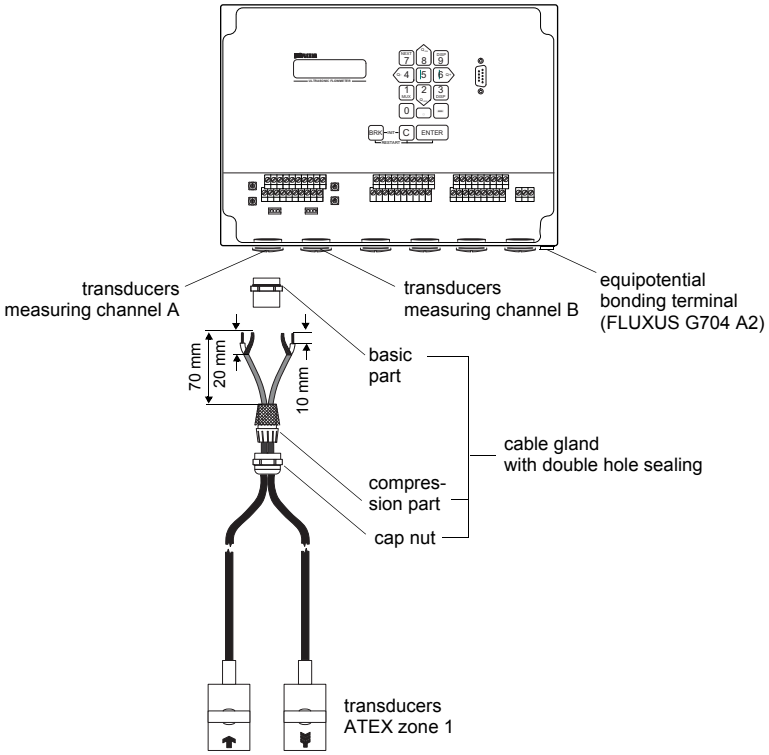


Fig. 5.9: Transducers (ATEX zone 1) - direct connection

Table 5.6: Terminal assignment

terminal	connection
AV	transducer ↑ (core)
AVS	transducer ↑ (internal shield)
ARS	transducer ↓ (internal shield)
AR	transducer ↓ (core)

- Prepare the transducer cables with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the transducer cable in the housing.

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.9 and Table 5.6).

5.4.4 Transducers (ATEX Zone 1) - Connection via Junction Box

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Remove the left blind plug for the connection of the transducers (see Fig. 5.10).
- Open the cable gland of the extension cable. The compression part remains in the cap nut
- Insert the extension cable in the cap nut and the compression part.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the extension cable in the housing.

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

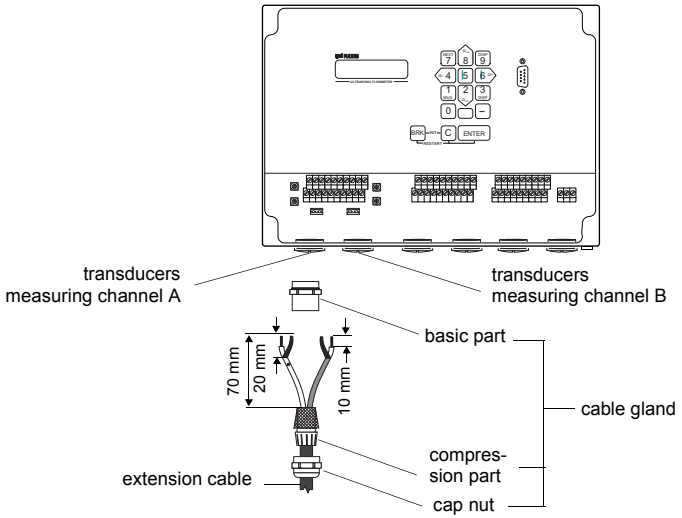


Fig. 5.10: Transducers (ATEX zone 1) - connection via junction box, connection of the extension cable to the transmitter

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.10 and Table 5.7).

Table 5.7: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 5.11).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.

- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back.
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 5.12).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 5.12).
- Connect the leads to the terminals of the junction box (see Fig. 5.12 and Table 5.8)

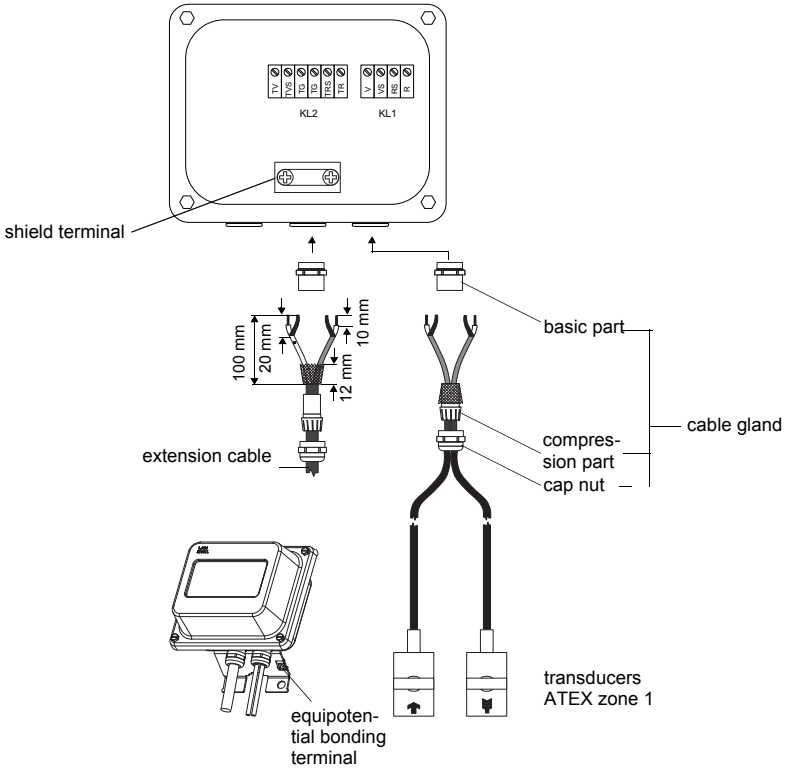


Fig. 5.11: Transducers (ATEX zone 1) - connection via junction box, connection of extension cable and transducer cable to the junction box

Table 5.8: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box

- Remove the blind plug from the junction box (see Fig. 5.11).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 5.12 and Table 5.9)

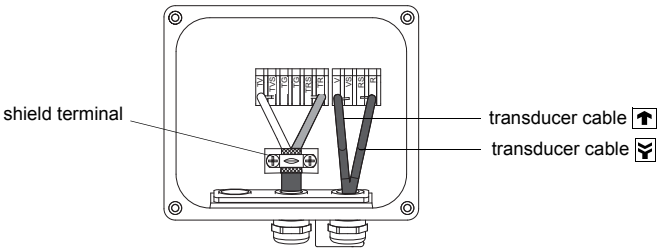


Fig. 5.12: Terminals for the connection of the extension cable and the transducer cable (ATEX zone 1).

Table 5.9: Terminal assignment

terminal	connection
V	transducer ↑ (core)
VS	transducer ↑ (internal shield)
RS	transducer ↓ (internal shield)
R	transducer ↓ (core)

5.5 Connection of the Transducers - Connection System AS

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.13).
- Insert the extension cable with the AMP-Quick and SMB connectors in the housing.
- Fix the extension cable to the housing by tightening the cable gland.
- Connect the AMP-Quick und SMB connectors to the sockets of the transmitter (see Fig. 5.13 and Table 5.10).

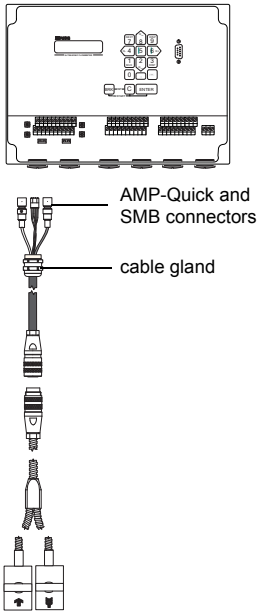


Fig. 5.13: Transducers - direct connection

Table 5.10: Terminal assignment

terminal	connection
X_AV	SMB connector (white or marked cable)
X_AR	SMB connector (brown cable)
X1	AMP-Quick connector

5.6 Connection of the Power Supply

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	According to IEC 61010-1:2001, a switch has to be provided near the instrument in the building installation, easily accessible for the user and marked as a disconnection device for the instrument. If FLUXUS G704 A2 is used in explosive atmosphere, the switch should be installed outside the explosive atmosphere. If this is not possible, the switch should be installed in the least hazardous area.

Attention!	The degree of protection of the transmitter will only be guaranteed if the power cable fits firmly and tightly in the cable gland.

- Remove the right blind plug for the connection of the power supply (see Fig. 5.14).
- Prepare the power cable with an M20 cable gland.
- Push the power cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 5.15).
- Insert the power cable into the housing (see Fig. 5.14).
- Screw the gasket ring side of the basic part in the housing of the transmitter.

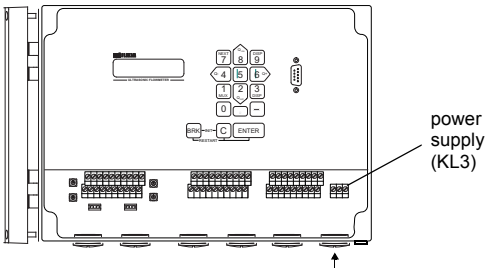


Fig. 5.14: Connection of the power supply

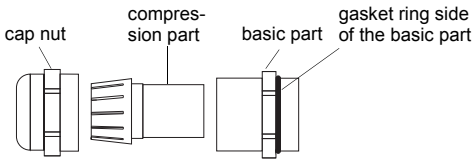


Fig. 5.15: Cable gland

- Fix the cable gland by screwing the cap nut on the basic part of the cable gland (see Fig. 5.15).
- Connect the leads to the terminals of terminal strip KL3 (see Fig. 5.14 and Table 5.11).

Table 5.11: Terminal assignment (power supply)

terminal	connection AC	connection DC
PE	earth	earth
N(-)	neutral	- DC
L(+)	phase 100...240 V AC, 50/60 Hz	+ DC
fuse	1 A, time-lag	1.6 A, time-lag

5.7 Connection of the Outputs

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

```
I1 active loop
Klemmen:P1+,P1-
```

Configure the outputs (see chapter 18). The terminals to be used for the connection of the output are displayed at the end of the configuration dialog (here: P1+ and P1- for the active current loop).

- Remove the second blind plug from the right for the connection of the outputs (see Fig. 5.16).
- Prepare the output cable with an M20 cable gland.
- Push the output cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 5.15).
- Insert the output cable into the housing.
- Screw the gasket ring side of the basic part in the housing of the transmitter.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminal of terminal strip KL4 as displayed (see Fig. 5.16 and Table 5.12).
- Close the transmitter: Screw the front plate to the housing.

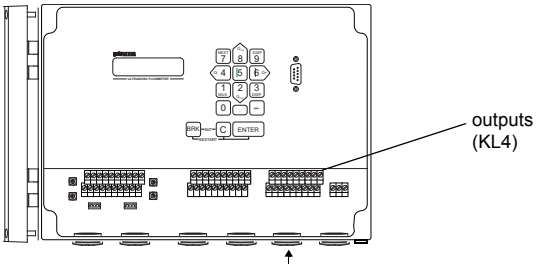
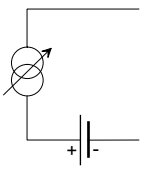
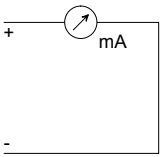
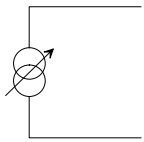
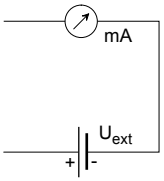
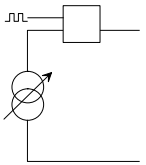
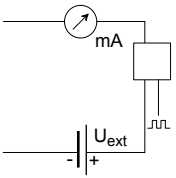
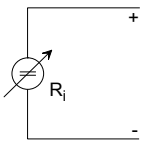
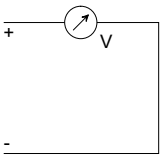
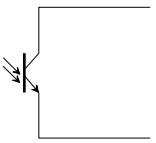
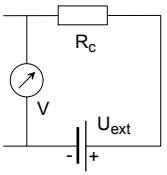


Fig. 5.16: Connection of the Outputs

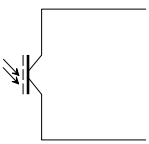
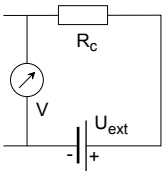
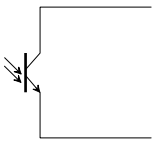
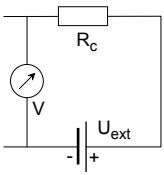
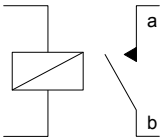
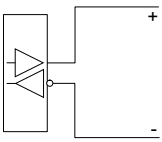
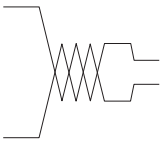
Table 5.12: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
active current loop		Px+ Px-		R_{ext} < 500 Ω
passive current loop		Px+ Px-		U_{ext} = 4...24 V U_{ext} > 0.021 A · R_{ext} [Ω] + 4 V example: U_{ext} = 12 V: R_{ext} = 0...380 Ω
HART (passive)		Px+ Px-		U_{ext} = 10...24 V
voltage output		Px+ Px-		R_i = 500 Ω R_{ext} > 2 MΩ If R_{ext} is lower, the accuracy is lower than specified.
frequency output		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

Table 5.12: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
binary output (optorelay)		Px+ Px-		U_{ext} ≤ 26 V I_c ≤ 100 mA
binary output (open collector)		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA
binary output (Reed relay)		Px+/Pxa Px-/Pxb		U_{max} = 48 V I_{max} = 0.25 A
RS485		A+ B- 101 (shield)		120 Ω termination resistor

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

5.8 Connection of the Inputs

5.8.1 Connection of a Temperature Input

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see chapter 8).

For the assignment and the activation of the temperature inputs see chapter 17.

Table 5.13: Terminal assignment of the transmitter

terminal	connection with extension cable	connection without extension cable
Txa	red	red
TxA	gray	red/blue
Txb	blue	white/blue
TxB	white	white
Sx	Pt100/Pt1000 shield	Pt100/Pt1000 shield

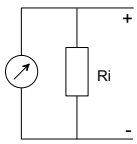
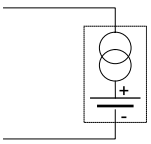
x = 1...4

5.8.2 Connection of a Current Input

Passive Current Input

An active current source or a passive current source with an external power supply can be connected to a passive current input.

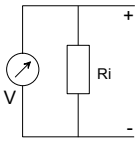
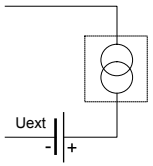
Table 5.14: Connection of an active current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		TxA TxB		max. permanent overcurrent: 100 mA

Attention!	The terminals Txa and Txb must not be connected.

If the polarity of the current source is inversed, only the sign of the measured current will change.

Table 5.15: Connection of a passive current source

input	transmitter		external circuit	note
	internal circuit	connection		
passive current input		TxA Txb		short circuit current: max. 100 mA

Attention!	The terminals Txa and TxB must not be connected.

An external voltage source U_{ext} is necessary. It must provide a current of min. 20 mA and

- supply sufficient power for the energy requirements of the passive current source and
- cover the voltage drop at the input resistor (1 V at 20 mA) and
- cover all other voltage drops (e.g. cable resistance) in the circuit

example: A passive current source (e.g. a pressure sensor) is to be connected to a passive current input.

Technical data of the pressure sensor:

U_S = 11...30 V DC
I_a = 4...20 mA ($I_{a\ max}$ = 22 mA)

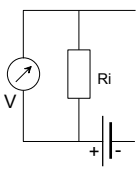
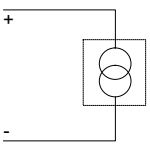
U_{ext} required for the operation of the passive pressure sensor is:

$$U_{ext\ min} = U_{S\ min} + I_{a\ max} \cdot R_i + I_{a\ max} \cdot R_c$$
$$= 11\ V + 22\ mA \cdot 50\ \Omega + 20\ mA \cdot 2\ \Omega$$
$$= 12.14\ V$$
$$U_{ext\ max} = U_{S\ max}$$
$$= 30\ V$$

U_S - operating voltage of the pressure sensor
I_a - output current
R_i - input resistance
R_c - cable resistance

Active Current Input

Table 5.16: Connection of a passive current source

input	transmitter		external circuit	note
	internal circuit	connection		
active current input		TxA Txb		max. permanent overcurrent: 100 mA

At full load (20 mA), a voltage of 22.9 V DC is available for the supply of the passive current source.

Attention!	An active current source must not be connected to an active current input!

Attention!	The terminals Txa and TxB must not be connected.

Attention!	Observe the correct polarity to avoid damage of the current source. A permanent short circuit can lead to the destruction of the active current input.

5.9 Connection of the Serial Interface

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The RS232 interface is located on the front plate of the transmitter (see Fig. 5.17). In order to connect the RS232 interface, the housing must be opened.

The transmitter can also be equipped with an RS485 interface (optional). It is connected as follows (see Fig. 5.17 and Table 5.17):

Table 5.17: Connection of the RS485 interface

terminal	connection
A+	A+
B-	B-
101	shield (optional)

For further information on the data transmission see chapter 13.

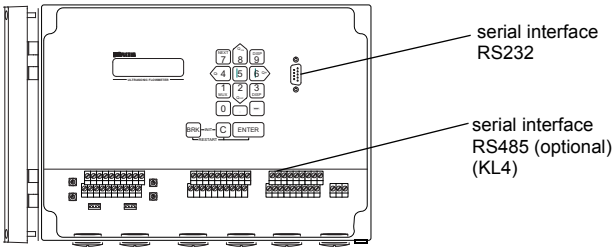


Fig. 5.17: Connection of the serial interface

5.10 Connection of the Sensor Module (SENSPROM)

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The sensor module contains important transducer data for the operation of the transmitter with the transducers. It is connected to the corresponding terminals of the transmitter.

If transducers are replaced or added, the sensor module must also be replaced or added.

Note!	The serial numbers of the sensor module and the transducer must be identical. A wrong or incorrectly connected sensor module will lead to incorrect measured values or to a measurement failure.

- Stop the measurement.
- Insert the sensor module in the lower row of terminal strip KL1 (see Fig. 5.18). The slots SA1...SA4 are assigned to the transducers of measuring channel A, the slots SB1...SB4 are assigned to the transducers of measuring channel B.
- Edit the program branch `Parameter` once completely. Press ENTER until the main menu is displayed
- The measurement can be restarted afterwards.

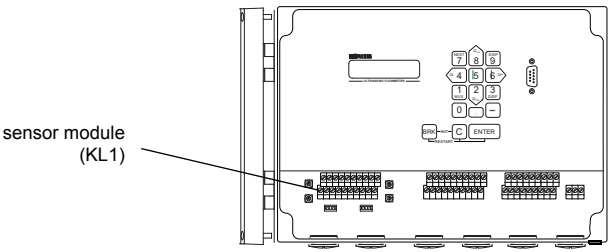


Fig. 5.18: Connection of the sensor module (SENSPROM)

6 Installation of FLUXUS G709

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

6.1 Location

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point. The ambient temperature must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

6.2 Connection of the Transducers - Connection System TS

Note!	If transducers are replaced or added, the sensor module must also be replaced or added (see section 6.8).

It is recommended to run the cables from the measuring point to the transmitter before connecting the transducers to avoid load on the connectors.

Overview

6.2.1 Transducers - Connection via Junction Box

For the connection of the transducers (ATEX Zone 1) see section 6.2.2.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Prepare the extension cable. Cut the external shield and brush it back.
- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.1).

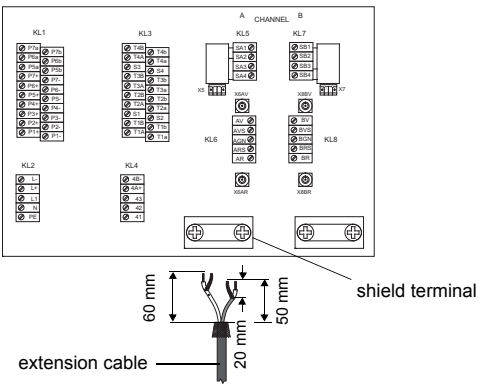


Fig. 6.1: Transducers - connection via junction box to the transmitter

- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.1).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the leads to the terminals of the transmitter (see Fig. 6.1 and Table 6.1).

Table 6.1: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 6.2 or Fig. 6.3).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back (see Fig. 6.2 or Fig. 6.3.
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 6.4 or Fig. 6.5).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 6.4 or Fig. 6.5).
- Connect the leads to the terminals of the junction box (see Fig. 6.4 or Fig. 6.5 and Table 6.2) .

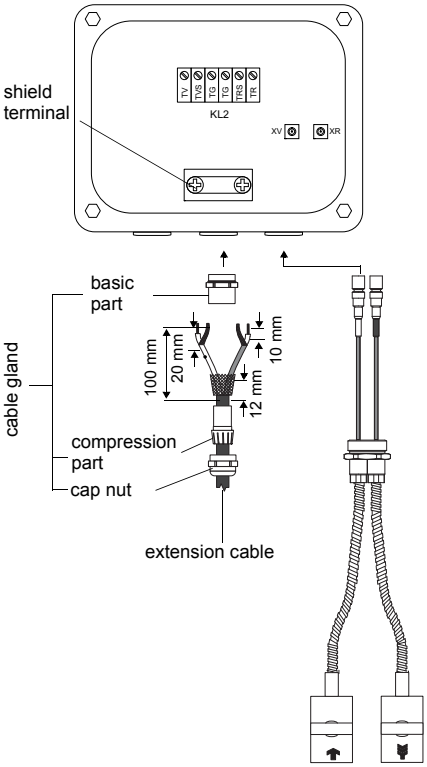


Fig. 6.2: Connection to junction box JB02, JB03

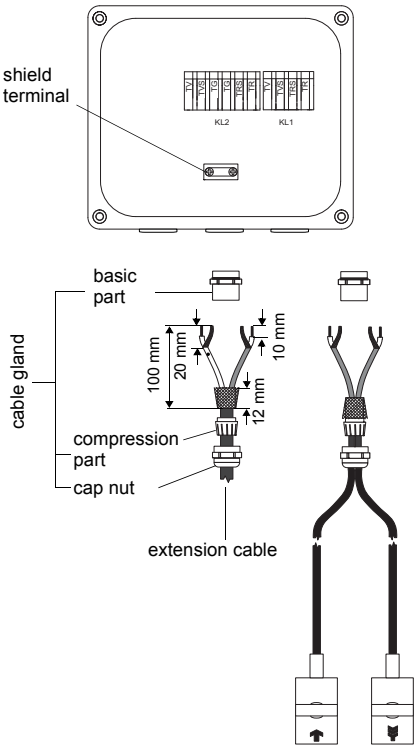


Fig. 6.3: Connection to junction box JBP2, JBP3

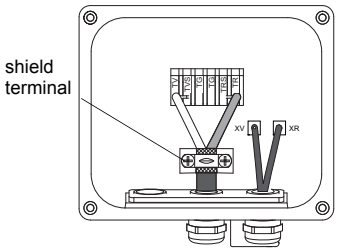


Fig. 6.4: Junction box JB02, JB03

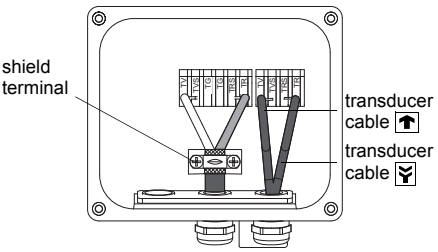


Fig. 6.5: Junction box JBP2, JBP3

Table 6.2: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box JB02, JB03

- Remove the blind plug from the junction box (see Fig. 6.4).
- Insert the transducer cable with the SMB connectors in the housing.
- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the junction box (see Fig. 6.4 and Table 6.3).

Table 6.3: Terminal assignment

terminal	connection
XV	SMB connector (brown cable, marked white)
XR	SMB connector (brown cable, marked black)

Connection of the Transducer Cable to the Junction Box JBP2, JBP3

- Remove the blind plug from the junction box (see Fig. 6.5).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 6.5 and Table 6.4).

Table 6.4: Terminal assignment (KL1)

terminal	connection
TV	transducer ↑ (core)
TVS	transducer ↑ (internal shield)
TRS	transducer ↓ (internal shield)
TR	transducer ↓ (core)

6.2.2 Transducers (ATEX Zone 1) - Connection via Junction Box

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Prepare the extension cable. Cut the external shield and brush it back.
- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.6).
- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.6).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the leads to the terminals of the transmitter (see Fig. 6.6 and Table 6.5).

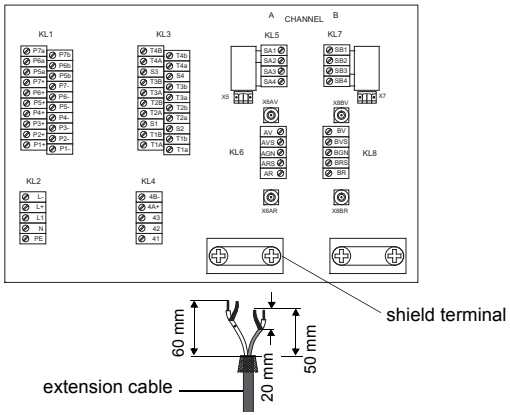


Fig. 6.6: Transducers (ATEX zone 1) - connection via junction box, connection of the extension cable to the transmitter

Table 6.5: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 6.7).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back.

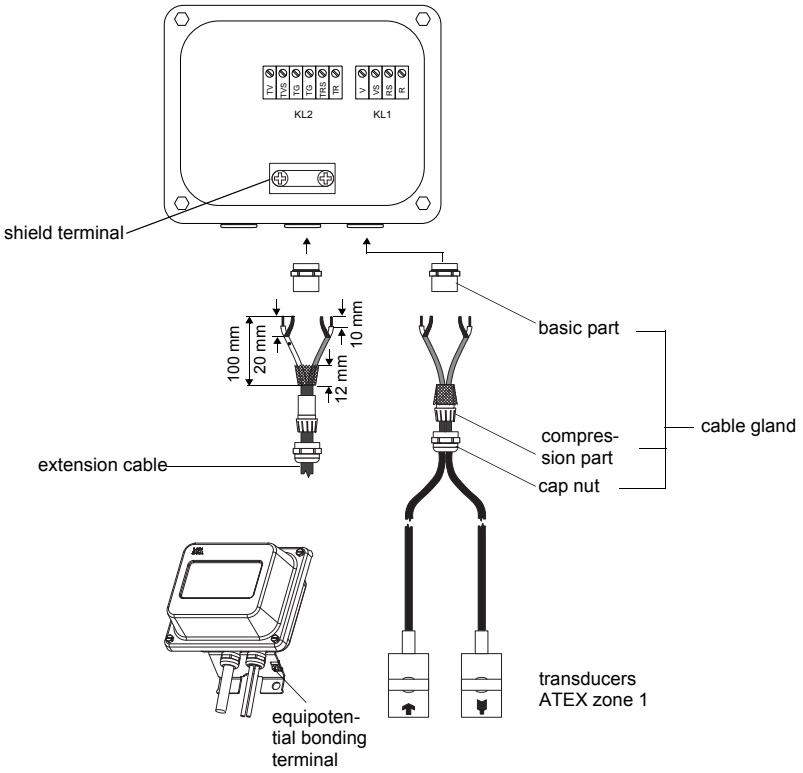


Fig. 6.7: Transducers (ATEX zone 1) - connection via junction box, connection of extension cable and transducer cable to the junction box

- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box(see Fig. 6.8).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 6.8).
- Connect the leads to the terminals of the junction box (see Fig. 6.8 and Table 6.6).

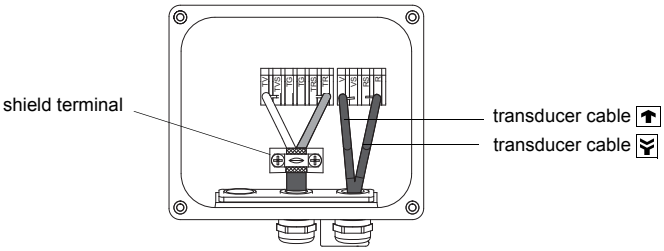


Fig. 6.8: Terminals for the connection of the extension cable and the transducer cable (ATEX zone 1)

Table 6.6: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box

- Remove the blind plug from the junction box (see Fig. 6.7).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.

• Connect the leads to the terminals of the junction box (see Fig. 6.8 and Table 6.7).

Table 6.7: Terminal assignment

terminal	connection
V	transducer ↑ (core)
VS	transducer ↑ (internal shield)
RS	transducer ↓ (internal shield)
R	transducer ↓ (core)

6.3 Connection of the Transducers - Connection System AS

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

• Open the cable gland of the extension cable (see Fig. 6.9).

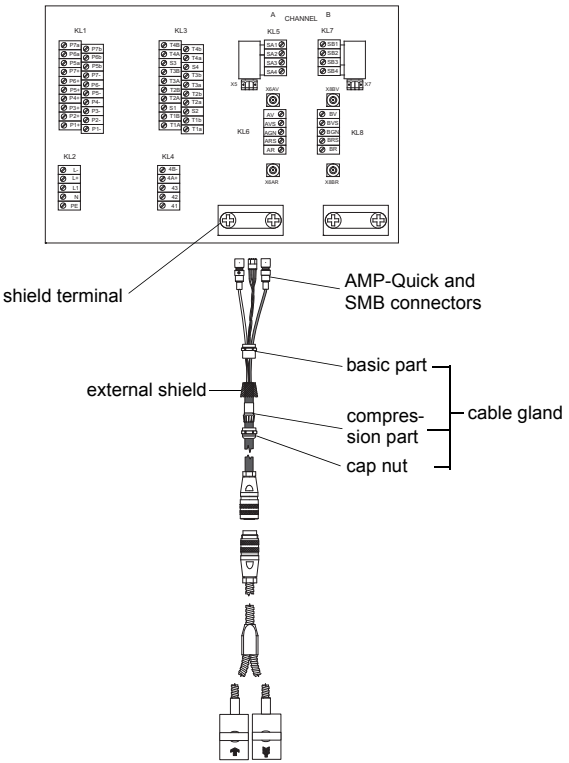


Fig. 6.9: Transducers - direct connection

- Push the basic part of the cable gland towards the AMP-Quick and SMB connectors, the cap nut and the compression part in the other direction.

Note!	Cap nut, compression part and basic part of the cable gland remain on the cable.

- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.9).
- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.9).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the AMP-Quick and SMB connectors to the sockets of the transmitter (see Fig. 6.9 and Table 6.8).

Table 6.8: Terminal assignment

terminal		connection
measuring channel A	measuring channel B	
X6AV	X8BV	SMB connector (white or marked cable)
X6AR	X8BR	SMB connector (brown cable)
X5	X7	AMP-Quick connector

6.4 Connection of the Power Supply

Attention!	According to IEC 61010-1:2001, a switch has to be provided near the instrument in the building installation, easily accessible for the user and marked as a disconnection device for the instrument.

- Connect the leads to the terminals of the power supply (see Fig. 6.10 and Table 6.9).

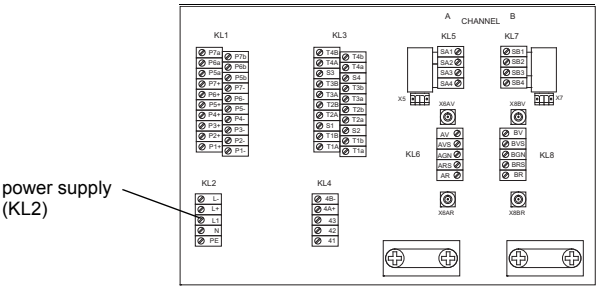


Fig. 6.10: Connection of the power supply

Table 6.9: Terminal assignment (power supply)

terminal	connection AC
PE	earth
N	neutral
L1	Phase 100...240 V AC, 50/60 Hz
fuse	1 A, time-lag

terminal	connection DC
PE	earth
L-	- DC
L+	+ DC
fuse	1.6 A, time-lag

6.5 Connection of the Outputs

```
I1 active loop
Klemmen:P1+,P1-
```

Configure the outputs (see chapter 18). The terminals to be used for the connection of the output are displayed at the end of the configuration dialog (here: P1+ and P1- for the active current loop).

- Connect the leads to the terminals of the outputs as displayed on the transmitter (see Fig. 6.11 and Table 6.10).

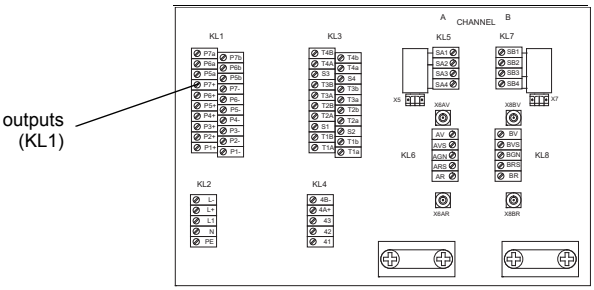
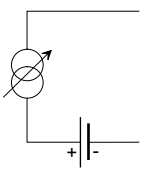
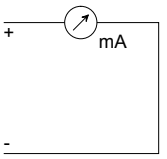


Fig. 6.11: Connection of the Outputs

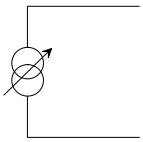
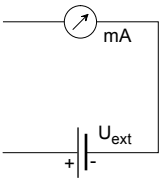
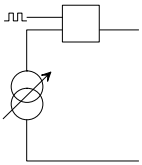
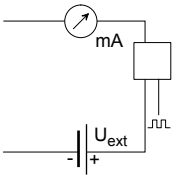
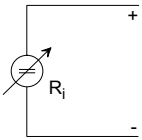
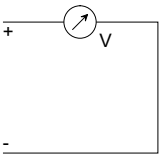
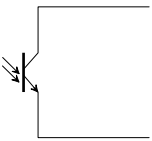
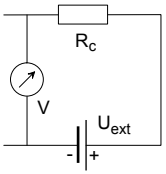
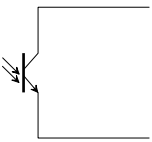
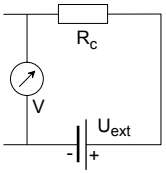
Table 6.10: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
active current loop		Px+ Px-		R_{ext} < 500 Ω

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

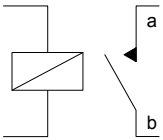
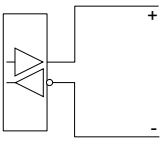
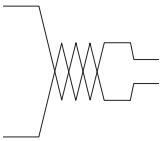
Table 6.10: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
passive current loop		Px+ Px-		U_{ext} = 4...24 V $U_{ext} > 0.021\ A \cdot R_{ext}$ [Ω] + 4 V example: U_{ext} = 12 V: R_{ext} = 0...380 Ω
HART (passive)		Px+ Px-		U_{ext} = 10...24 V
voltage output		Px+ Px-		R_i = 500 Ω R_{ext} > 2 MΩ If R_{ext} is lower, the accuracy is lower than specified.
frequency output		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA
binary output (open collector)		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

Table 6.10: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
binary output (Reed relay)		Px+/Pxa Px-/Pxb		U_{max} = 48 V I_{max} = 0.25 A
RS485		4A+ 4B- 43 (shield)		120 Ω termination resistor

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

6.6 Connection of the Inputs

6.6.1 Connection of a Temperature Input

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see chapter 8).

For the assignment and the activation of the temperature inputs see chapter 17.

Table 6.11: Terminal assignment of the transmitter

terminal	connection with extension cable	connection without extension cable
Txa	red	red
TxA	gray	red/blue
Txb	blue	white/blue
TxB	white	white
Sx	Pt100/Pt1000 shield	Pt100/Pt1000 shield

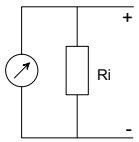
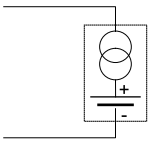
x = 1...4

6.6.2 Connection of a Current Input

Passive Current Input

An active current source or a passive current source with an external power supply can be connected to a passive current input.

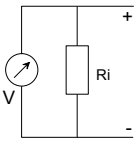
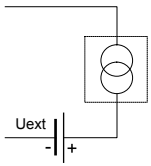
Table 6.12: Connection of an active current source

input	transmitter internal circuits	connection	external circuits	note
passive current input		TxA TxB		max. permanent over-current: 100 mA

Attention!	The terminals Txa and Txb must not be connected.

If the polarity of the current source is inversed, only the sign of the measured current will change.

Table 6.13: Connection of a passive current source

input	transmitter internal circuits	connection	external circuits	note
passive current input		TxA Txb		short circuit current: max. 100 mA

Attention!	The terminals Txa and TxB must not be connected.

An external voltage source U_{ext} is necessary. It must provide a current of min. 20 mA and

- supply sufficient power for the energy requirements of the passive current source and
- cover the voltage drop at the input resistor (1 V at 20 mA) and
- cover all other voltage drops (e.g. cable resistance) in the circuit

example: A passive current source (e.g. a pressure sensor) is to be connected to a passive current input.

Technical data of the pressure sensor:

U_S = 11...30 V DC
I_a = 4...20 mA ($I_{a\ max}$ = 22 mA)

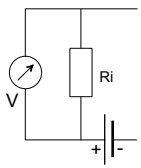
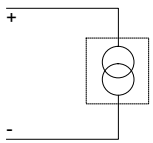
U_{ext} required for the operation of the passive pressure sensor is:

$$U_{ext\ min} = U_{S\ min} + I_{a\ max} \cdot R_i + I_{a\ max} \cdot R_c$$
$$= 11\ V + 22\ mA \cdot 50\ \Omega + 20\ mA \cdot 2\ \Omega$$
$$= 12.14\ V$$
$$U_{ext\ max} = U_{S\ max}$$
$$= 30\ V$$

U_S - operating voltage of the pressure sensor
I_a - output current
R_i - input resistance
R_c - cable resistance

Active Current Input

Table 6.14: Connection of a passive current source

input	transmitter internal circuits	connection	external circuits	note
active current input		TxA Txb		max. permanent over-current: 100 mA

At full load (20 mA), a voltage of 13.9 V DC is available for the supply of the passive current source.

Attention!	An active current source must not be connected to an active current input!

Attention!	The terminals Txa and TxB must not be connected.

Attention!	Observe the correct polarity to avoid damage of the current source. A permanent short circuit can lead to the destruction of the active current input.

6.7 Connection of the Serial Interface

The RS232 interface is located on the front plate of the transmitter (see Fig. 3.4).

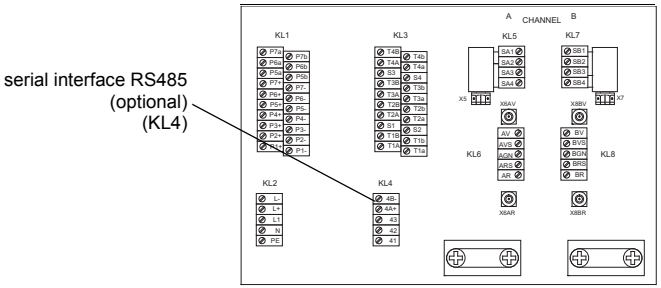


Fig. 6.12: Connection of the serial interface

The transmitter can also be equipped with an RS485 interface (optional). It is connected as follows (see Fig. 3.4 and Table 6.15):

Table 6.15: Terminal assignment

terminal	connection
4A+	RS485 A+
4B-	RS485 B-
43	RS485 (shield)

For further information on the data transmission see chapter 13.

6.8 Connection of the Sensor Module (SENSPROM)

The sensor module contains important transducer data for the operation of the transmitter with the transducers. It is connected to the corresponding terminals of the transmitter.

If transducers are replaced or added, the sensor module must also be replaced or added.

Note!	The serial numbers of the sensor module and the transducer must be identical. A wrong or incorrectly connected sensor module will lead to incorrect measured values or to a measurement failure.

- Disconnect the power supply from the transmitter.
- If the transducer cable has a 4-pole connector, connect it with socket X5 (terminal strip KL5) or X7 (terminal strip KL7) (see Fig. 6.13).
- Alternatively, connect the sensor module to the terminals of terminal strip KL5 or KL7 (see Fig. 6.13).

Attention!	The sensor module and the connector must not be connected at the same time.

- If the length of pre-assembled cables is reduced, it is not necessary to use the 4-pole connector. The data cables can be be connected directly to the terminals of terminal strip KL5 or KL7 (see Fig. 6.13 and Table 6.16).

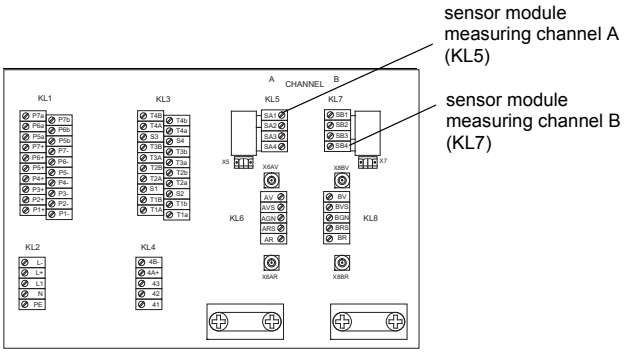


Fig. 6.13: Connection of the sensor module (SENSPROM)

Table 6.16: Terminals for the connection of the sensor module

terminal	connection
SA1	gray
SA2	
SA3	brown
SA4	green

7 Mounting the Transducers

- Before you start this chapter, read and follow the instruction in chapter 10.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The transducers will be fixed to the pipe by means of the supplied transducer mounting fixture.

- Mount the damping mats (see section 10.6).
- Use coupling foil (only if damping mats are not installed) or apply a bead of acoustic coupling compound along the center line onto the contact surface of the transducers.
- Observe that there must be no air pockets between the transducer contact surface, the damping mat and the pipe wall.
- Make sure that the transducer mounting fixture applies the necessary pressure on the transducers.

The transducers are mounted in such way that the engravings on the transducers form an arrow (see Fig. 7.1). The transducer cables show then in opposite directions.

For the determination of the flow direction with the help of the arrow see section 10.9.

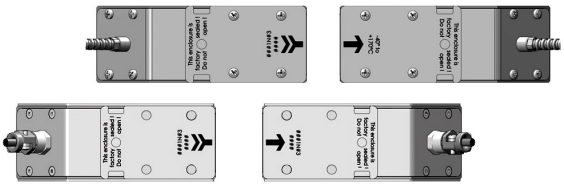


Fig. 7.1: Correct positioning of the transducers

Select the installation instructions that correspond to the supplied transducer mounting fixture.

- Variofix L: see section 7.1
- Variofix C: see section 7.2

7.1 Mounting with Variofix L

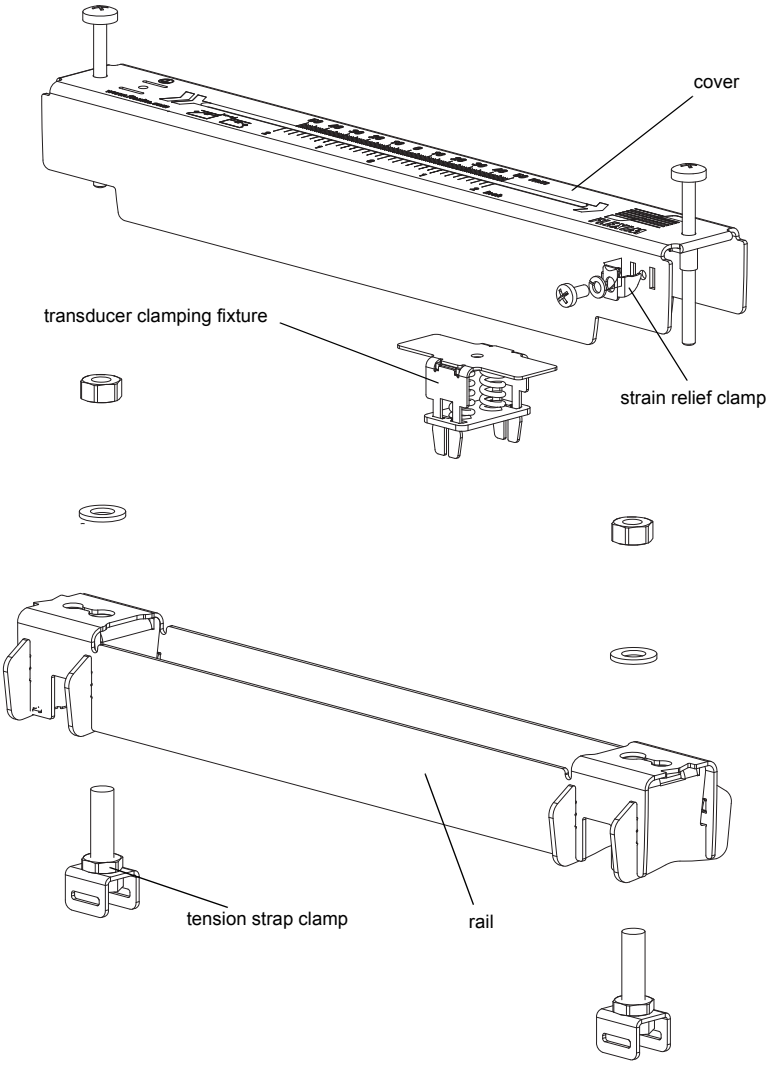


Fig. 7.2: Design of Variofix L

7.1.1 Mounting the Clasps

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.1.1
- for quick release clasp see section 7.1.1.2
- for ratchet clasp see section 7.1.1.3

7.1.1.1 Band Clamp Clasp

The clasp is fixed to the tension strap (see Fig. 7.3).

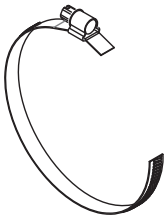


Fig. 7.3: Band clamp clasp with tension strap

7.1.1.2 Quick Release Clasp

The clasp is fixed to the tension strap (see Fig. 7.4).

Cut the tension straps to length (pipe circumference + 120 mm).

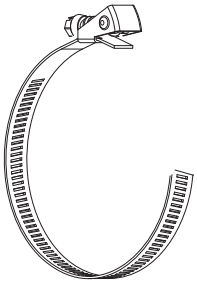


Fig. 7.4: Quick release clasp with tension strap

7.1.1.3 Ratchet clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap through the parts (1) and (2) of the clasp (see Fig. 7.5 a).
- Bend the tension strap.
- Insert the tension strap in part (1) of the ratchet clasp (see Fig. 7.5 b).
- Tighten the tension strap.
- Repeat the steps for the second tension strap.

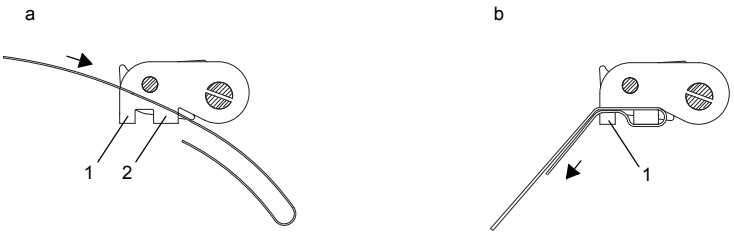


Fig. 7.5: Ratchet clasp with tension strap

7.1.2 Mounting the Tension Strap Clamp

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.2.1
- for quick release clasp see section 7.1.2.2
- for ratchet clasp see 7.1.2.3

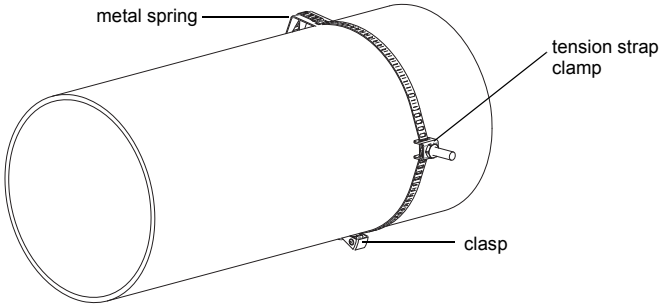


Fig. 7.6: Tension strap with tension strap clamp and metal spring on the pipe

7.1.2.1 Band Clamp Clasp

- Insert the tension strap in the tension strap clamp (see Fig. 7.7).
- Position the clasp and the tension strap clamp on the pipe (see Fig. 7.6). On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.7).
- Tighten the tension strap.
- Tighten the screw of the clasp.

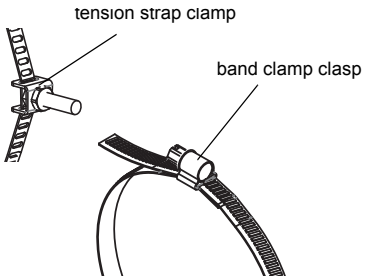


Fig. 7.7: Tension strap with band clamp clasp and tension strap clamp

7.1.2.2 Quick Release Clasp

- Insert the tension strap in the tension strap clamp and the metal spring (see Fig. 7.8).
- Position the clasp, the metal spring and the tension strap clamp on the pipe (see Fig. 7.6):
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring on the opposite side of the tension strap clamp.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.8).
- Tighten the tension strap.
- Tighten the screw of the clasp.

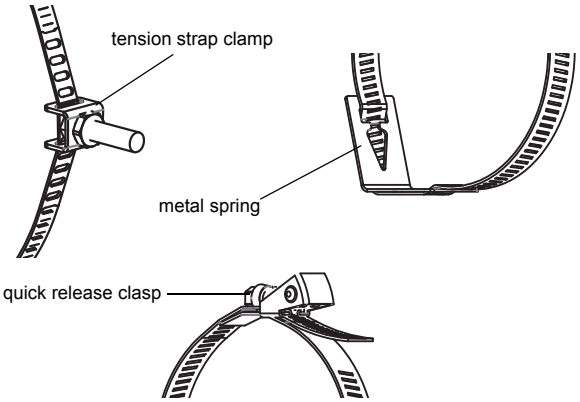


Fig. 7.8: Tension strap with quick release clasp, metal spring and tension strap clamp

7.1.2.3 Ratchet Clasp

- Insert the tension strap in the tension strap clamp and the metal spring (see Fig. 7.9). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Position the clasp, the metal spring (if necessary) and the tension strap clamp on the pipe (see Fig. 7.6).
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring on the opposite side of the tension strap clamp.

- Place the tension strap around the pipe and insert it in part (3) of the clasp (see Fig. 7.10).
- Tighten the tension strap.
- Cut off the protruding tension strap (see Fig. 7.11).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the clasp.

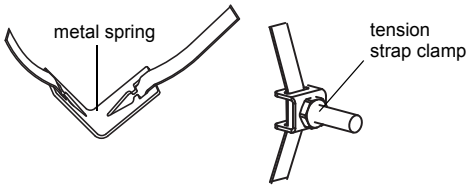


Fig. 7.9: Tension strap with tension strap clamp and metal spring

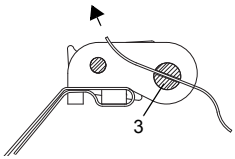


Fig. 7.10: Ratchet Clasp with tension strap

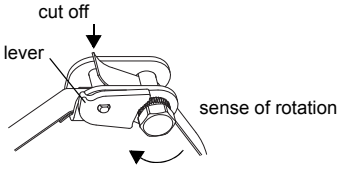


Fig. 7.11: Ratchet clasp with tension strap

7.1.3 Mounting the Rail

- Place the second tension strap clamp in the rail. Observe the orientation of the tension strap clamp (see Fig. 7.12).
- Tighten the nut of the tension strap clamp slightly.
- Screw the rail to the tension strap clamp that is fixed to the pipe (see Fig. 7.13).
- Tighten the nut of the tension strap clamp.

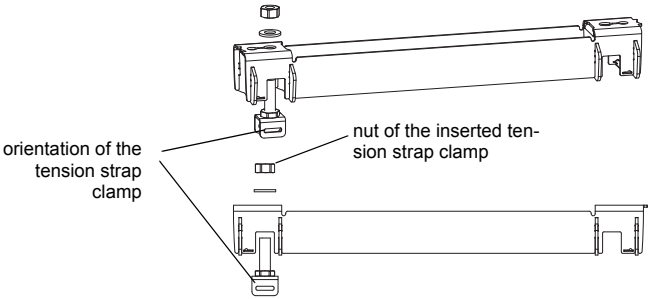


Fig. 7.12: Rail Variofix L

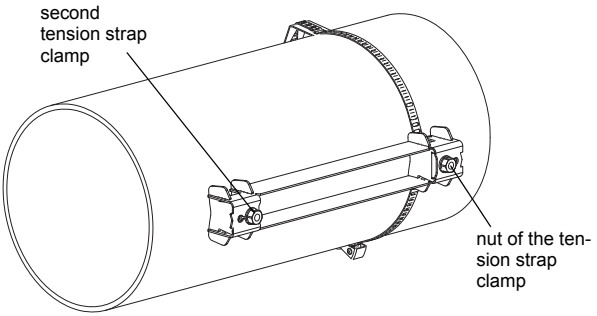


Fig. 7.13: Rail, one side mounted on the pipe

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.3.1
- for quick release clasp see section 7.1.3.2
- for ratchet clasp see section 7.1.3.3

7.1.3.1 Band Clamp Clasp

- Insert the tension strap in the second tension strap clamp (see Fig. 7.15).
- Position the clasp and the tension strap clamp on the pipe:
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.14).
- Tighten the tension strap.
- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

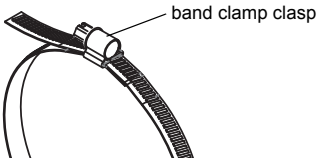


Fig. 7.14: Tension strap with band clamp clasp

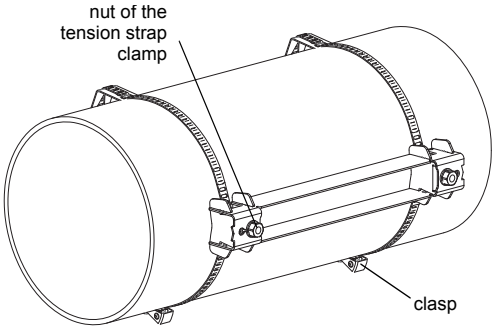


Fig. 7.15: Rail on the pipe

7.1.3.2 Quick Release Clasp

- Insert the tension strap in the second tension strap clamp and the metal spring (see Fig. 7.15 and Fig. 7.16).
- Position the clasp, the metal spring and the tension strap clamp on the pipe. Mount the metal spring on the opposite side of the tension strap clamp.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.16).
- Tighten the tension strap.
- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

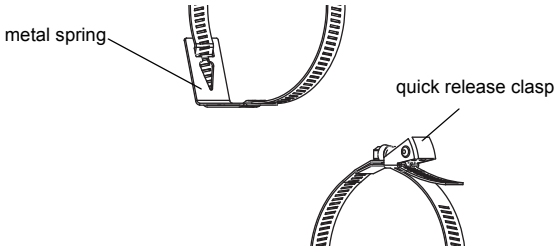


Fig. 7.16: Tension strap with quick release clasp and metal spring

7.1.3.3 Ratchet Clasp

- Insert the tension strap in the second tension strap clamp and the metal spring (see Fig. 7.15 and Fig. 7.17). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Position the clasp, the metal spring (if necessary) and the tension strap clamp on the pipe. Mount the metal spring on the opposite side of the tension strap clamp, if necessary.

- Place the tension strap around the pipe and insert it in part (3) of the clasp (see Fig. 7.18).
- Tighten the tension strap.

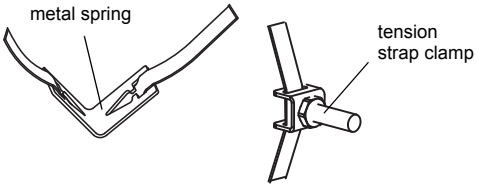


Fig. 7.17: Tension strap with the metal spring and the tension strap clamp

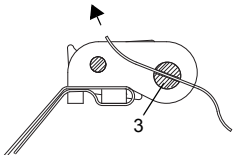


Fig. 7.18: Ratchet Clasp with tension strap

- Cut off the protruding tension strap (see Fig. 7.19).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

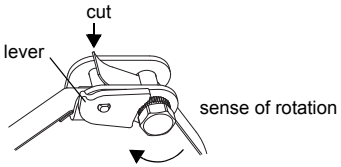


Fig. 7.19: Ratchet clasp with tension strap

Note!	To release the screw and the tension strap press the lever down (see Fig. 7.19).

7.1.4 Mounting the Transducers in the Cover

- Press the transducers firmly on the transducer clamping fixture in the cover until the transducers are firmly fixed in the cover. The transducer cables show in opposite directions (see Fig. 7.20).

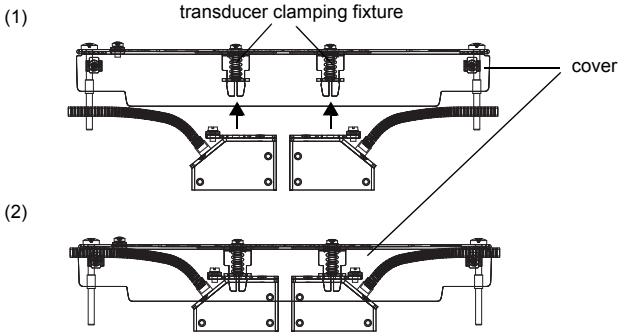


Fig. 7.20: Transducers in the cover

- Adjust the transducer distance recommended by the transmitter (see Fig. 7.21).
- Fix the transducer cables with the strain relief clamp to protect them from mechanical strain (see Fig. 7.21).
- Put coupling pads (or some coupling compound for a short-term installation) on the contact surface of the transducers. The coupling pads can be fixed to the contact surface with some coupling compound.

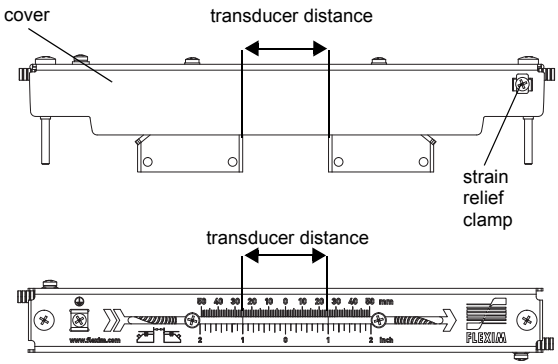


Fig. 7.21: Adjusting the transducer distance

Note!	If coupling pads are used: If the signal is not sufficient for a measurement, use the coupling compound instead of the coupling pads.

- Put the cover with the transducers on the rail.
- Correct the transducer distance, if necessary (see section 10.7.1 and section 10.7.2).

Note!	Observe that the coupling pads must remain on the contact surface of the transducers.

- Tighten the screws of the cover (see Fig. 7.22).

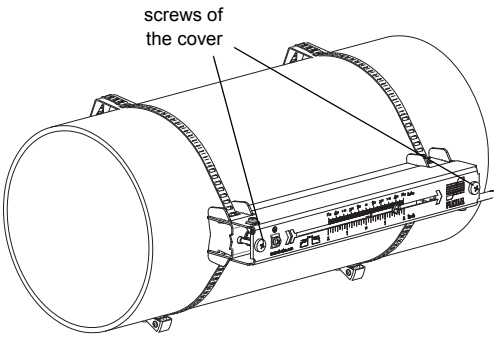


Fig. 7.22: Transducers with Variofix L on the pipe

7.2 Mounting with Variofix C

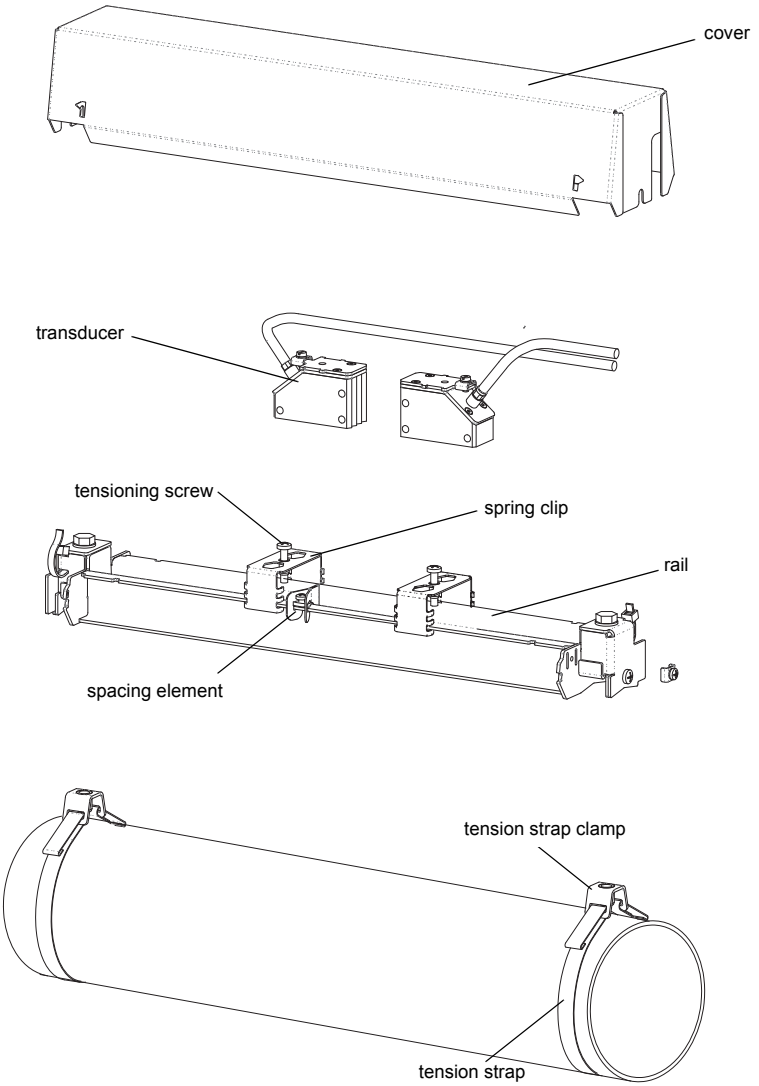


Fig. 7.23: Design of Variofix C with transducers (installation without clasp)

7.2.1 Installation of the Rail

Select the installation instructions that correspond to the supplied clasp:

- for the installation of the rail without a clasp see section 7.2.1.1
- for the installation of the rail with a ratchet clasp see section 7.2.1.2

7.2.1.1 Installation of the Rail Without a Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap in one of the slots of the tension strap clamp and bend it (see Fig. 7.24).
- If necessary, insert the long end of the tension strap in the metal spring (see Fig. 7.25). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Place the tension strap around the pipe (see Fig. 7.26).
- Position the metal spring (if mounted) and the tension strap clamp:
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring (if necessary) on the opposite side of the tension strap clamp.
- Insert the long end of the tension strap in the second slot of the tension strap clamp (see Fig. 7.26 a).
- Tighten the tension strap and bend it.

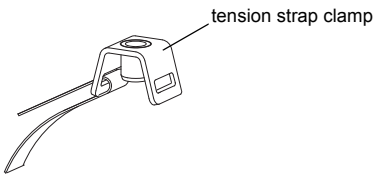


Fig. 7.24: Tension strap with tension strap clamp

- Bend both ends of the tension strap (see Fig. 7.26 b).
- Repeat the steps for the second tension strap.

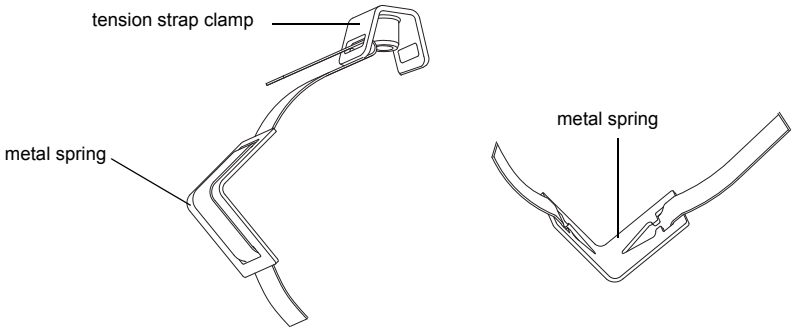


Fig. 7.25: Tension strap with the metal spring and the tension strap clamp

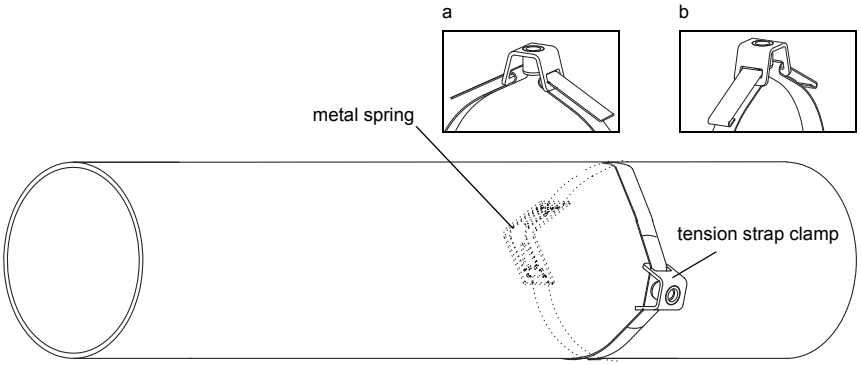


Fig. 7.26: Tension strap with the metal spring and the tension strap clamp on the pipe

- Put the rail on the tension strap clamps (see Fig. 7.27).
- Fix the rail to the tension strap clamps with the screws.
- Tighten the screws.

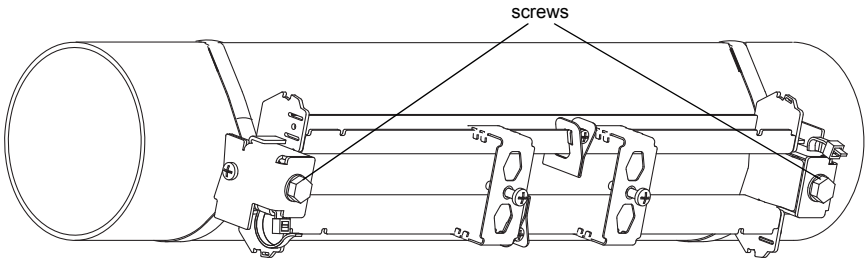


Fig. 7.27: Rail on the pipe

7.2.1.2 Installation of the Rail with the Ratchet Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap through parts (1) and (2) of the ratchet clasp (see Fig. 7.28 a).
- Bend the tension strap.
- Insert the tension strap in part (1) of the ratchet clasp (see Fig. 7.28 b).
- Tighten the tension strap.

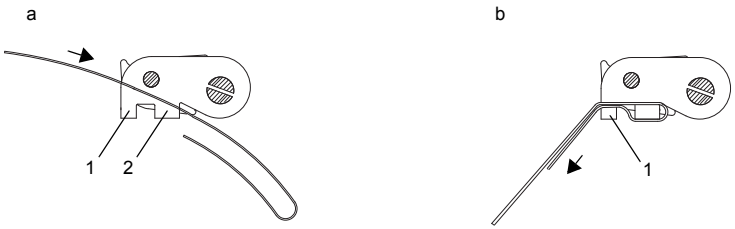


Fig. 7.28: Ratchet clasp with tension strap

- Insert the long end of the tension strap in the tension strap clamp and the metal spring (see Fig. 7.29). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Place the tension strap around the pipe (see Fig. 7.30).
- Position the metal spring (if mounted), the ratchet clasp and the tension strap clamp:
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring (if necessary) on the opposite side of the tension strap clamp.
- Insert the long end of the tension strap in part (3) of the ratchet clasp (see Fig. 7.31).
- Tighten the tension strap.

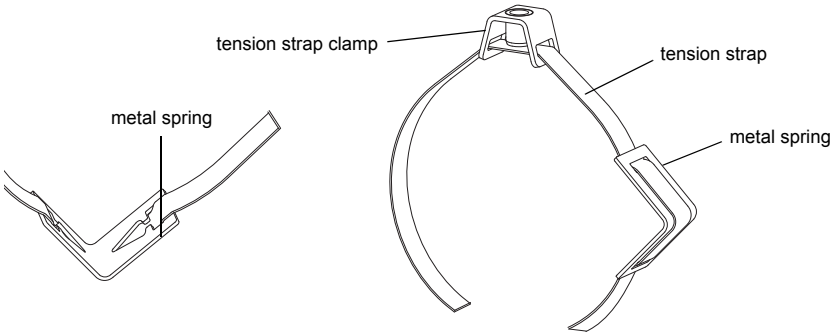


Fig. 7.29: Tension strap with the metal spring and the tension strap clamp

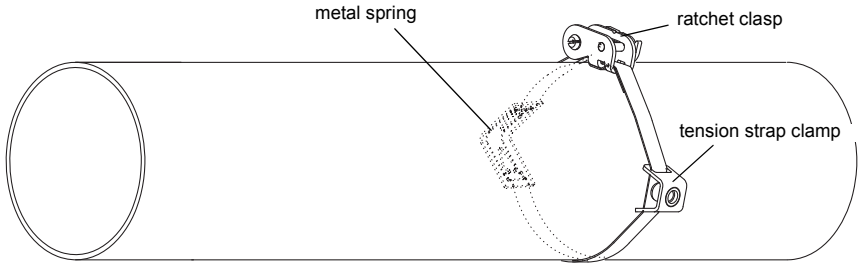


Fig. 7.30: Tension strap with the metal spring, the ratchet clasp and the tension strap clamp on the pipe

- Cut off the protruding tension strap (see Fig. 7.32).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the ratchet clasp.
- Repeat the steps for the second tension strap.

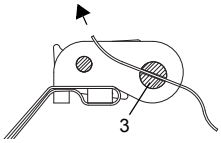


Fig. 7.31: Ratchet Clasp with tension strap

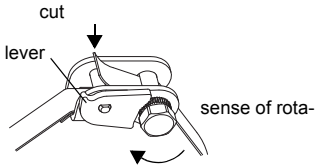


Fig. 7.32: Ratchet Clasp with tension strap

Note!	To release the screw and the tension strap press the lever down (see Fig. 7.32).

- Put the rail on the tension strap clamps (see Fig. 7.33).
- Fix the rail to the tension strap clamps with the screws.
- Tighten the screws.

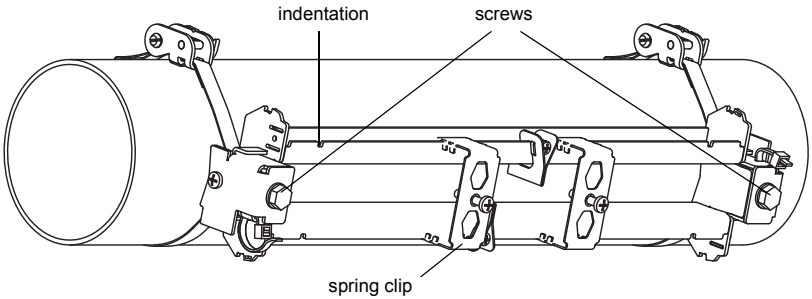


Fig. 7.33: Rail on the pipe

Note!	The spring clip can be removed from the rail or put on the rail over the indentations (see Fig. 7.33).

7.2.2 Mounting the Transducers

- Put coupling pads (or some coupling compound for a short-term installation) on the contact surface of the transducers. The coupling pads can be fixed to the contact surface of the transducers with some coupling compound.

Note!	If coupling pads are used: If the signal is not sufficient for a measurement, use the coupling compound instead of the coupling pads.

- Position the transducers on the rail in such way that the engravings on the transducers form an arrow. The transducer cables show in opposite directions (see Fig. 7.34).
- Adjust the transducer distance recommended by the transmitter (see section 10.7).

Note!	Observe that the coupling pads must remain on the contact surface of the transducers.

- Slide the spring clips on the transducers (see Fig. 7.35).
- Fix the transducers by tightening the tensioning screws slightly. The end of the screw must be rotated into the hole on the transducer (see Fig. 7.34).
- Correct the transducer distance, if necessary (see section 10.7.1 and section 10.7.2).
- Tighten the tensioning screw.
- Fix the spacing element on the rail to mark the transducer position (see Fig. 7.34).
- Fix the transducer cables with the cable tie to protect them from mechanical strain (see Fig. 7.35).
- Put the cover on the rail (see Fig. 7.36).
- Tighten the screws on both sides of the cover.

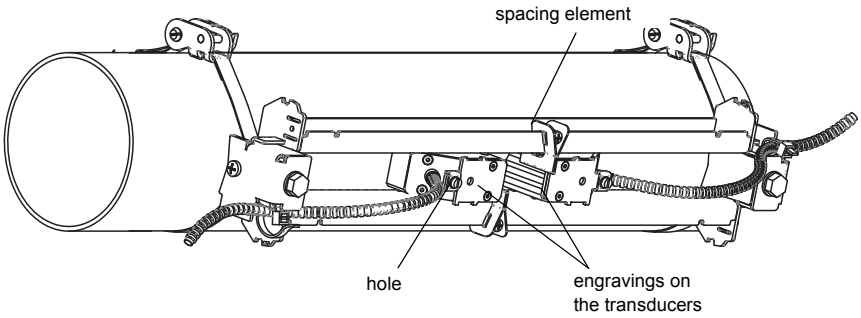


Fig. 7.34: Transducers in the rail (spring clip not shown)

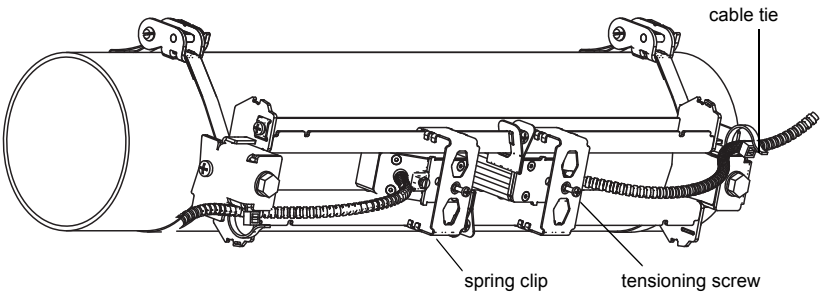


Fig. 7.35: Transducers in the rail

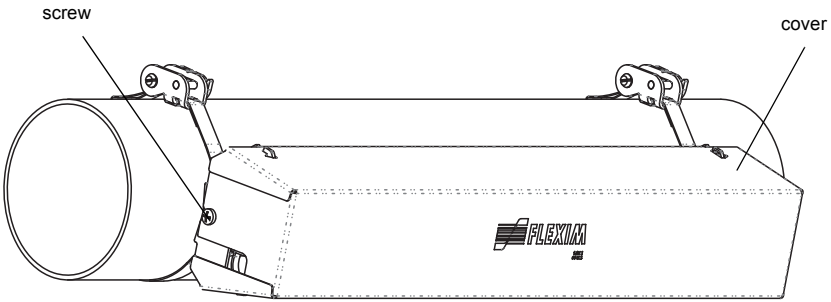


Fig. 7.36: Variofix C with transducers on the pipe

8 Installation of the Temperature Probes (Optional)

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

8.1 Mounting the Temperature Probes

- Remove rust, insulation material and loose paint to get a good thermal contact.
- Clean the pipe.

Temperature Probe Pt100 (Response Time 8 s)

- Fix the protection plate and the isolation foam to the temperature probe (see Fig. 8.1 and Fig. 8.2).
- Apply a film of thermal conductivity paste (not supplied by FLEXIM) on the contact surface of the temperature probe.
- Take the spring end of the ball chain and insert the last ball in one of the slots on the top of the temperature probe.

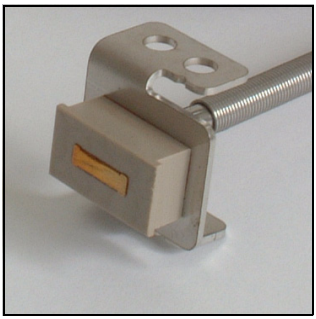


Fig. 8.1: Temperature probe

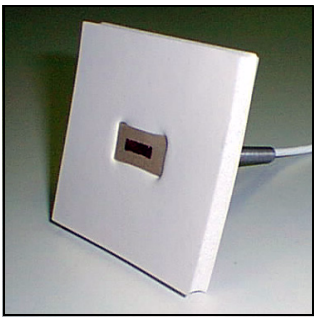


Fig. 8.2: Temperature probe with protection plate and isolation foam

- Place the chain around the pipe. Tighten the chain and insert it in the other slot of the temperature probe (see Fig. 8.3).

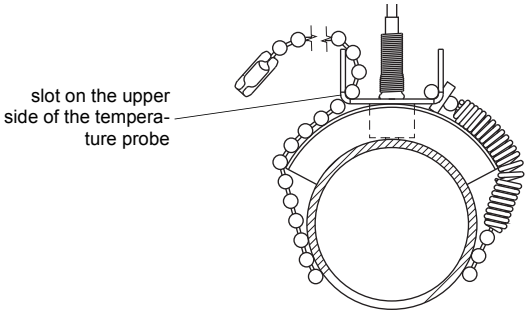


Fig. 8.3: Mounted temperature probe

8.2 Connection of the Temperature Probes

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

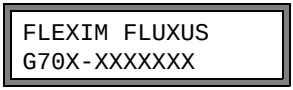
- Connect the temperature probes to temperature inputs of the transmitter.

Table 8.1: Terminal stripKL2 of the transmitter

terminal	connection of the temperature probe	connection of the extension cable
T1a...T4a	red	red
T1A...T4A	red/blue	gray
T1b...T4b	white/blue	blue
T1B...T4B	white	white
S1...S4	shield	shield

9 Start-up

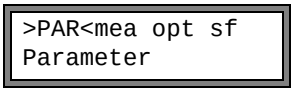
9.1 Switching on



As soon as the transmitter is connected to the power supply, the display indicates which transducer has been detected at which channel.

Afterwards, the serial number of the transmitter is displayed for a short time.

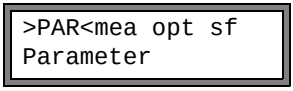
Data can not be entered while the serial number is displayed.



After the initialization, the main menu is displayed in the selected language. The language of the display can be set (see section 9.4).

9.2 Displays

9.2.1 Main menu



The main menu contains the following program branches:

- `par` (Parameter)
- `mea` (Measuring)
- `opt` (Output Options)
- `sf` (Special Function)

The selected program branch is displayed in capital letters between arrows. The complete designation of the selected program branch is displayed in the lower line.

Select a program branch by pressing key 4 and 6. Press ENTER.

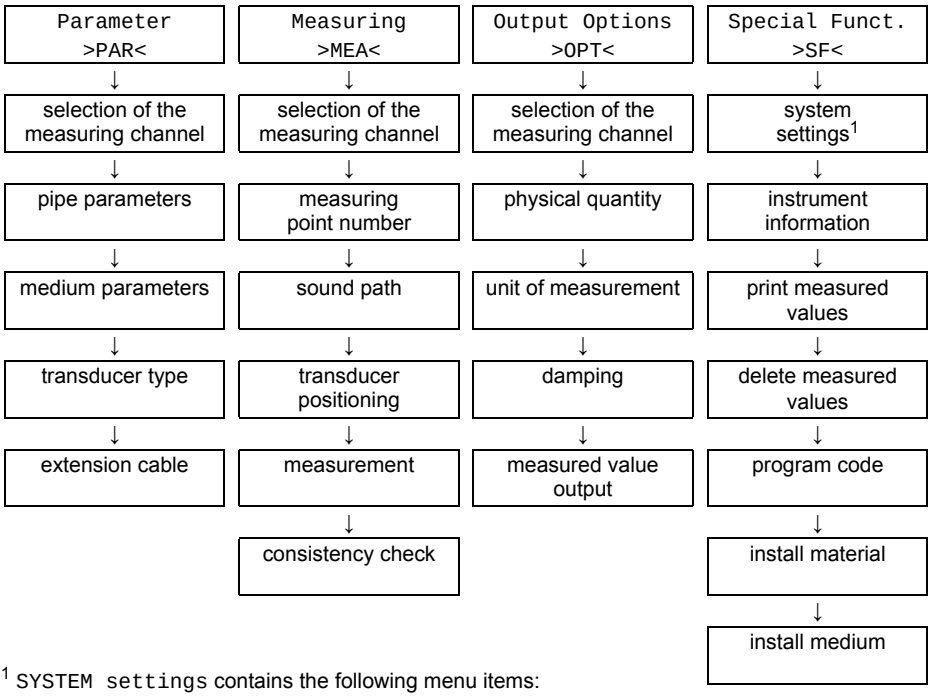
Note!	By pressing key BRK, the measurement will be stopped and the main menu selected.

Note!	In this user manual, all program entries and keys are indicated with typewriter characters (`Parameter`). The menu items are separated from the main menu by a backslash "\".

9.2.2 Overview of the Program Branches

- **Program branch `Parameter`**
  input of the pipe and medium parameters
- **Program branch `Measuring`**
  processing of the steps for the measurement
- **Program branch `Output Options`**
  setting of the physical quantity, the unit of measurement and the parameters for the measured value output
- **Program branch `Special Funct.`**
  contains all functions that are not directly related to the measurement

For an overview of the program branches see figure below. For a detailed overview of the menu structure see annex A.



[1] `SYSTEM settings` contains the following menu items:

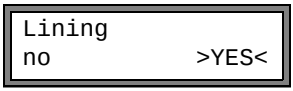
- `Dialogs/Menus`
- `Proc. inputs`
- `Measuring`
- `Gas-Measuring`
- `Proc. outputs`
- `Storing`
- `serial transmis.`
- `Miscellaneous`
- `Set Clock`
- `Libraries`

9.2.3 Navigation

A vertical arrow ⇳ will be displayed if the menu item contains a scroll list. The current list item will be displayed in the lower line.

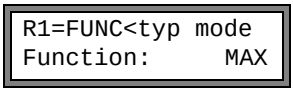
Use key 8 and 2 to select a list item in the lower line. Press ENTER.

Some menu items contain a horizontal scroll list in the lower line. The selected list item is displayed in capital letters between arrows.



Press key 4 and 6 to scroll through the lower line and select a list item. Press ENTER.

Some menu items contain a horizontal scroll list in the upper line. The selected list item is displayed in capital letters between arrows. The current value of the list item is displayed in the lower line.



Press key 4 and 6 to scroll through the upper line and select a list item.

Press key 8 and 2 to scroll through the lower line and select a value for the selected list item.

Press ENTER.

9.3 HotCodes

A HotCode is a key sequence used to activate certain settings:

- language selection (see section 9.4)
- activating the SuperUser mode (see section 16)
- activating the FastFood mode (see section 12.6)
- manual input of the lower limit for the inner pipe diameter (see section 12.8)

A HotCode can be entered in the main menu after pressing key C. The HotCode will not be displayed during the input.

9.4 Language Selection

The transmitter can be operated in the languages listed below. The language can be selected with the following HotCodes:

Table 9.1: Language HotCodes

909031	Dutch
909033	French
909034	Spanish
909044	English
909049	German

Depending on the technical data of the transmitter, some of the languages might not be implemented.

When the last digit has been entered, the main menu will be displayed in the selected language.

The selected language remains activated when the transmitter is switched off and on again. After a cold start, the default language set by the manufacturer is activated.

9.5 Operation State Indication (G709)

The operation state is indicated by 2 LEDs .

Table 9.2: Operation State Indication (LED SIGNAL)

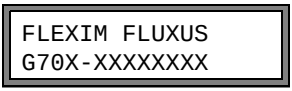
LED off	transmitter offline
LED lights green	signal quality of the measuring channel sufficient for a measurement
LED lights red	signal quality of the measuring channel not sufficient for a measurement

Table 9.3: Operation state indication (LED READY)

LED off	no measurement
LED lights yellow	measurement
LED flashes yellow	before a HotCode can be entered, key C must be pressed

9.6 Interruption of the Power Supply

As soon as the measurement begins, all current measuring parameters will be stored in a non-volatile cold start resistant EPROM. The operation of the transmitter will be interrupted if the power supply fails. All input data remain stored.



After the return of the power supply, the serial number is displayed for a few seconds.

The interrupted measurement is continued. All selected output options are still active. The measurement will not be continued after the return of the power supply if a cold start has been performed.

10 Basic Measurement

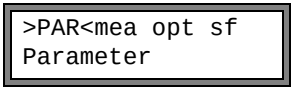
Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The pipe and medium parameters are entered for the selected measuring point (see chapter 4). The parameter ranges are limited by the technical characteristics of the transducers and of the transmitter.

Note!	During the parameter input, the transducers must be connected to the transmitter.

Note!	The parameters will only be stored when the program branch `Parameter` has been edited in its entirety.

10.1 Input of the Pipe Parameters

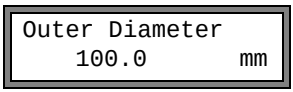


Select the program branch `Parameter`. Press ENTER.

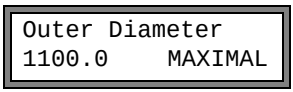
Select the channel for which the parameters are to be entered. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

10.1.1 Outer Pipe Diameter/Pipe Circumference



Enter the outer pipe diameter. Press ENTER.



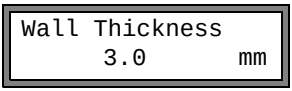
An error message will be displayed if the entered parameter is outside of the range. The limit will be displayed.

example: upper limit 1100 mm for the connected transducers and for a pipe wall thickness of 50 mm.

It is possible to enter the pipe circumference instead of the outer pipe diameter (see section 15.2.1).

If the input of the pipe circumference has been activated and `0` (zero) is entered for the `Outer Diameter`, the menu item `Pipe Circumfer.` will be displayed. If the pipe circumference is not to be entered, press key BRK to return to the main menu and start the parameter input again.

10.1.2 Pipe Wall Thickness

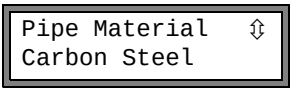


Enter the pipe wall thickness. Press ENTER.

Note!	The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed. It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 12.8).

10.1.3 Pipe Material

The pipe material must be selected to be able to determine the sound velocity. The sound velocity for the materials in the scroll list are stored in the transmitter.

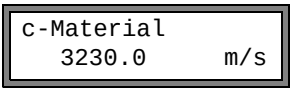


Select the pipe material.

If the medium is not in the scroll list, select `Other Material`. Press ENTER.

It can be specified which materials will be displayed in the scroll list (see section 14.5).

When the pipe material has been selected, the corresponding sound velocity is set automatically. If `Other Material` has been selected, the sound velocity must be entered.

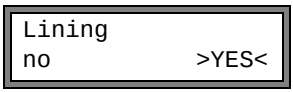


Enter the sound velocity of the pipe material. Press ENTER.

Note!	Enter the sound velocity of the material (i.e. longitudinal or transversal velocity) which is nearer to 2500 m/s.

For the sound velocity of some materials see annex C, Table C.1.

10.1.4 Pipe Lining



If the pipe has an inner lining, select `yes`. Press ENTER.

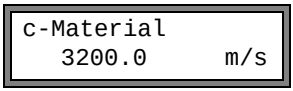
If `no` is selected, the next parameter will be displayed (see section 10.1.5).

Select the lining material.

If the material is not in the scroll list, select `Other Material`. Press ENTER.

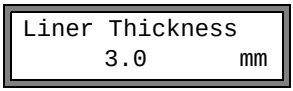
It can be specified which materials will be displayed in the scroll list (see chapter 10.1.5).

If `Other Material` is selected, the sound velocity must be entered.



Enter the sound velocity of the lining material. Press ENTER.

For the sound velocity of some materials see annex C, Table C.1.



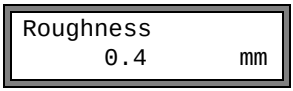
Enter the thickness of the liner. Press ENTER.

Note!	The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness - 2x liner thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed. It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 12.8).

10.1.5 Pipe Roughness

The flow profile of the medium is influenced by the roughness of the inner pipe wall. The roughness will be used for the calculation of the profile correction factor. As, in most cases, the pipe roughness can not be exactly determined, it has to be estimated.

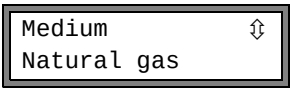
For the roughness of some materials see annex C, Table C.2.



Enter the roughness of the selected pipe or liner material.

Change the value according to the condition of the inner pipe wall. Press ENTER.

10.2 Input of the Medium Parameters



Select the medium from the scroll list.

If the medium is not in the scroll list, select `Other Medium`. Press ENTER.

It is possible to specify which media will be displayed in the scroll list (see section 14.5).

For the programmed parameters of common media see annex C, Table C.3.

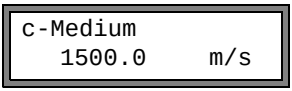
If a medium is selected from the scroll list, the menu item for the input of the medium temperature is displayed directly (see section 10.2.5).

If `Other Material` is selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas, as the parameters depend on the composition of the natural gas), the medium parameters must be entered first.

- min. and max. sound velocity
- kinematic viscosity
- density
- gas compressibility factor

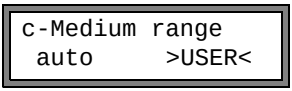
10.2.1 Sound Velocity

The sound velocity of the medium is used for the calculation of the transducer distance at the beginning of the measurement. However, the sound velocity does affect the measuring result directly. Often, the exact value of the sound velocity for a medium is unknown. Therefore, a range of possible values for the sound velocity must be entered.



Enter the average sound velocity of the medium. Press ENTER.

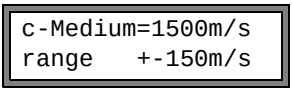
This display will only be indicated if `Other Medium` has been selected.



Select `auto` or `user`. Press ENTER.

`auto`: The area around the average sound velocity is defined by the transmitter.

`user`: The area around the average sound velocity must be entered.

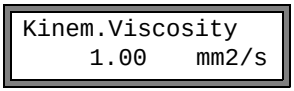


Enter the area around the average sound velocity of the medium. Press ENTER.

This display will only be indicated if `user` has been selected.

10.2.2 Kinematic Viscosity

The kinematic viscosity affects the flow profile of the medium. The entered value and other parameters are used for the profile correction.

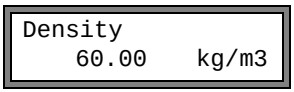


Enter the kinematic viscosity of the medium. Press ENTER.

This display will only be indicated if `Other Medium` has been selectedor no data set for the selected medium is stored in the transmitter (e.g. natural gas)

10.2.3 Density

The density is used to calculate the mass flow rate (product of the volumetric flow rate and the density).

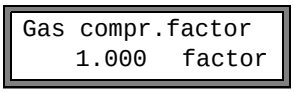


Enter the operating density of the medium. Press ENTER.

This display will only be indicated if `Other Medium` has been selectedor no data set for the selected medium is stored in the transmitter (e.g. natural gas).

10.2.4 Gas Compressibility Factor

The gas compressibility factor is necessary for the calculation of the standard volumetric flow rate (see section 11.1.1). Note that the value is selected correspondingly to the operating pressure, the operating temperature and the composition of the gas.



Enter the gas compressibility factor. Press ENTER.

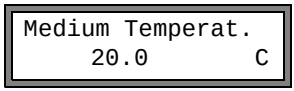
This display will only be indicated if `Other Medium` has been selected or no data set for the selected medium is stored in the transmitter (e.g. natural gas).

10.2.5 Medium Temperature

The medium temperature is used for the interpolation of the sound velocity and for the calculation of the recommended transducer distance and for the interpolation of the gas compressibility factor at the beginning of the measurement.

During the measurement, the medium temperature is used for the interpolation of the density and the viscosity of the medium.

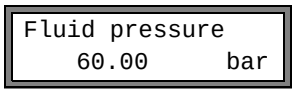
The value entered here will be used for the calculations if the medium temperature is not measured and fed to an input of the transmitter.



Enter the medium temperature. The value must be within the operating temperature range of the transducers. Press ENTER.

10.2.6 Medium Pressure

The medium pressure is used for the interpolation of the sound velocity and of the gas compressibility factor .



Enter the medium pressure. Press ENTER.

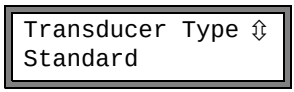
This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated OR if Gas-Measuring is deactivated and Special Funct.\SYSTEM settings\Dialogs/Menus\Fluid pressure is activated.

10.3 Other Parameters

10.3.1 Transducer Parameters

If transducers are detected on a measuring channel, the parameter input finished. Press ENTER. The main menu will be displayed.

If no or special transducers are connected, the transducer parameters have to be entered.

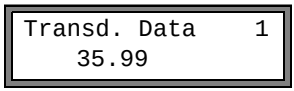


Select Standard to use the standard transducer parameters stored in the transmitter.

Select Special Version to enter the transducer parameters. The transducer parameters must be provided by the transducer manufacturer.

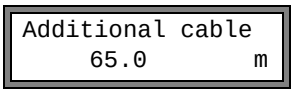
Press ENTER.

Note!	If standard transducer parameters are used, FLEXIM can not guarantee for the precision of the measured values. A measurement might even be impossible.



If Special Version has been selected, enter the 6 transducer parameters specified by the manufacturer. Press ENTER after each input.

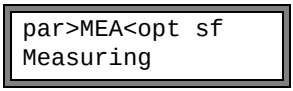
10.3.2 Extension Cable



If the transducer cable must be extended, enter the additional cable length (e.g. between the junction box and the transmitter). Press ENTER.

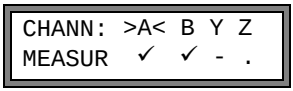
10.4 Selection of the Channels

The channels on which will be measured can be activated individually.



Select program branch `Measuring`. Press ENTER.

If this error message is displayed, the parameters are not complete. Enter the missing parameters in the program branch `Parameter`.



The channels for the measurement can be activated and deactivated.

✓: the channel is active

–: the channel is not active

•: the channel can not be activated

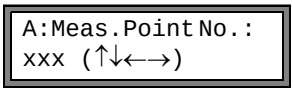
This display will not be indicated if the transmitter has only one measuring channel.

Note!	A channel can not be activated if the parameters are not valid, e.g. if the parameters in the program branch `Parameter` of the channel are not complete.

- Select a channel with key 4 and 6.
- Press key 8 to activate or deactivate the selected channel. Press ENTER.

A deactivated channel will be ignored during the measurement. Its parameters will remain unchanged.

If the data logger or the serial interface is activated, the measuring point number must be entered:



Enter the measuring point number. Press ENTER.

If arrows are displayed in the lower line on the right, ASCII text can be entered. If no arrows are displayed, only digits, point and hyphen can be entered.

10.5 Defining the Number of Sound Paths

The number of transits of the ultrasonic waves through the medium depends on the placement of the transducers on the pipe.

If the number of transits is odd (diagonal mode), the transducers will be mounted on opposite sides of the pipe.

If the number of transits is even (reflection mode), the transducers will be mounted on the same side of the pipe.A higher number of transits means increased accuracy of the measurement. However, the increased transit distance results in a higher attenuation of the signal.

The reflections on the opposite pipe wall and deposits on the inner pipe wall cause additional amplitude losses of the sound signal.

If the signal is attenuated strongly, e.g. by the medium, the pipe, deposits, etc., the number of sound paths must be set to 1 if necessary.

Note!	Exact positioning of the transducers is easier for an even number of transit paths (reflection mode) than for an odd number (diagonal mode).

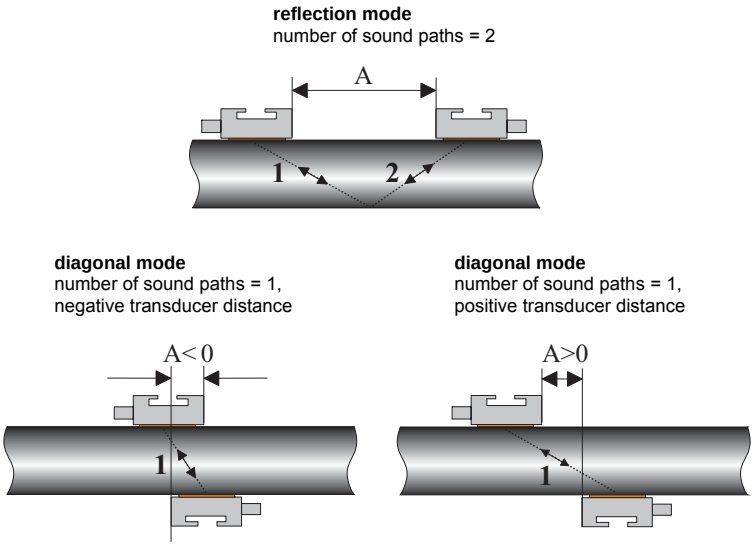


Fig. 10.1: Sound path and transducer distance (A)

```
A: Sound Path
        2       NUM
```

A value for the number of sound paths corresponding to the connected transducers and the entered parameters will be recommended. Change the value if necessary. Press ENTER.

10.6 Installation of the Damping Mats

The damping mats are installed before the mounting of the transducers. The damping mats reduce propagation of acoustic noise in the pipe wall.

- Select the measuring point according to the recommendations in chapter 4.
- Clean the pipe at the selected measuring point:
  - If present, the paint layer must be smoothed by grinding. The paint does not need to be removed completely.
  - Grind off the rust or loose paint.
  - Remove grease or dust. Clean the pipe surface with soap sud.
- Select the type and the size of the damping mat (see annex B, sectionTechnical Data).
- Select the installation instructions that correspond to the supplied damping mat (see section 10.6.1 or 10.6.2).

10.6.1 Installation of Self-Adhesive Damping Mats

Observe the operating temperature of the damping mat (see annex B, section Technical Data).

Attention!	Wear protective gloves and protective goggles when mounting the damping mats. In case of contact with the eyes: • rinse immediately with plenty of water and • see an eye specialist. In case of contact with the skin: • wash the skin immediately with plenty of water.

- Cut the damping mat to size, if necessary (see annex B, section Technical Data).
- Remove a part of the protective foil and fold it (see Fig. 10.2).
- Fix the part of the damping mat without protective foil to the pipe.

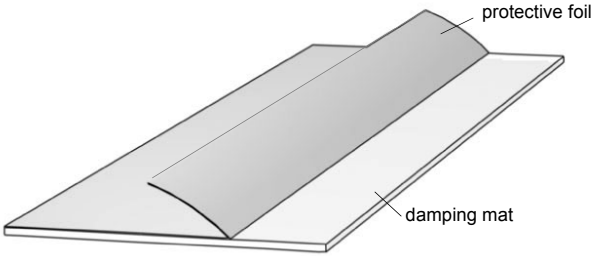


Fig. 10.2: Protective foil folded

- Fix the damping mat to the pipe: remove the protective foil bit by bit from the damping mat and attach the damping mat to the pipe at the same time.

Note!	Air pockets must be avoided.

Improvement of adhesion and removal of air pockets:

- Press the roll in the middle of the damping mat along the pipe axis (see 1 in Fig. 10.3).
- Press the roll from the middle to the sides (see 2 in Fig. 10.3).
- Open the remaining air pockets with a knife.
- Remove the steps for the installation of the damping mat on the opposite side of the pipe in case of a measurement in the diagonal mode (see Fig. 10.4).

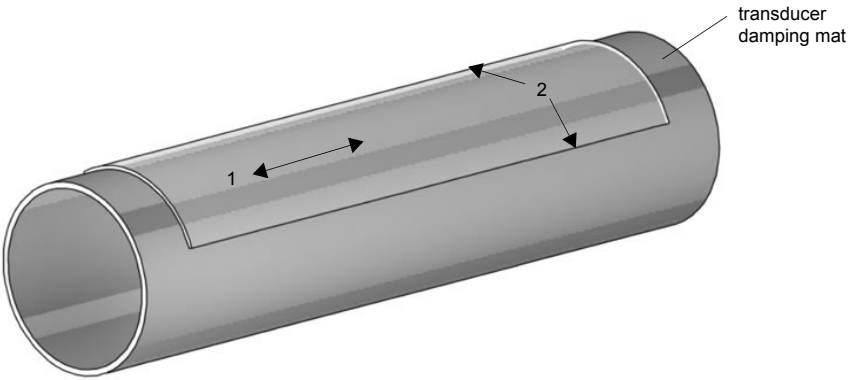


Fig. 10.3: Installation of the damping mat (reflection mode)

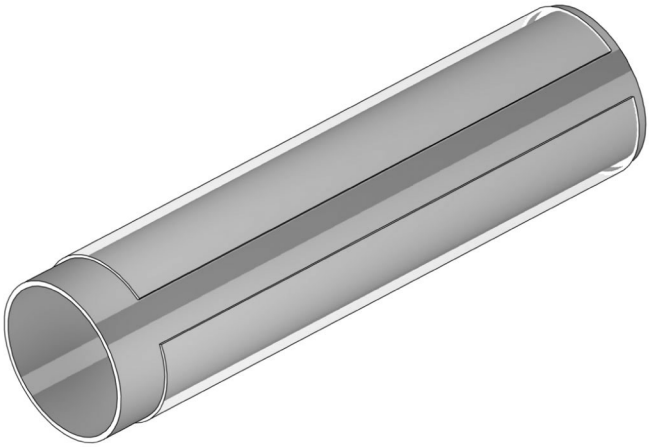


Fig. 10.4: Installation of the damping mat (diagonal mode)

Note!	The damping mat adheres strongly to the pipe. Later alignment is not possible. The damping mat has to be positioned correctly immediately.

Note!	The damping mat can not be reused after removal.

- Depending on the transducer type, another layer of the damping mat is necessary (see annex B, Technical Data). Repeat the steps for the installation of the damping mat.
- Mount the transducers onto the damping mat. Select the installation instructions that correspond to the supplied transducer mounting fixture (see section 10.7).
- If the measuring point is close to a reflection point (e.g. flange), a damping mat must be installed there, if necessary (see Fig. 10.5). Damping mats will be mounted on the complete circumference of the pipe. Repeat the steps for the installation of the damping mats.

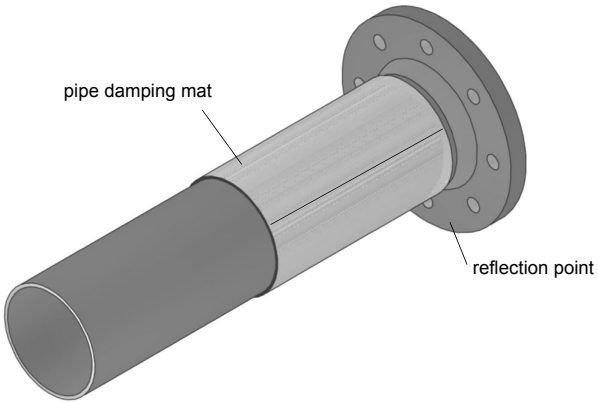


Fig. 10.5: Installation of the damping mat to the reflection point

10.6.2 Installation of non Self-Adhesive Damping Mats

Observe the operating temperature of the damping mat (see annex B, section Technical Data).

The non self-adhesive damping mats can be reused. They are not suitable for permanent use.

A water-based ultrasound gel is used for coupling. The ultrasound gel can dry up and is then no longer effective.

- Cut the damping mat to size, if necessary (see annex B, section Technical Data).
- Apply a bead of the ultrasound gel on the inner side of the damping mat along the center line.

- Spread the ultrasound gel evenly on the surface of the damping mat by means of a spattle (see Fig. 10.6).
- Position the damping mat on the pipe (see Fig. 10.3).
- Remove air pockets by means of the supplied roller.
- Repeat the steps for the installation of the damping mat on the opposite side of the pipe in case of a measurement on the diagonal mode (see Fig. 10.4).

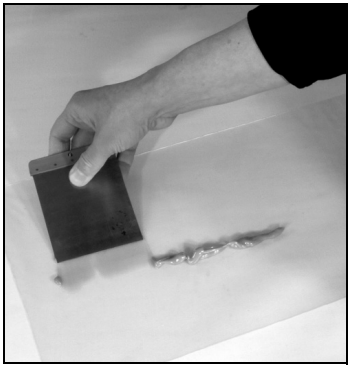


Fig. 10.6: Application of ultrasound gel to the damping mat

Mount the transducers onto the damping mat. Select the installation instructions that correspond to the supplied transducer mounting fixture (see section 10.7).

If the measuring point is close to a reflection point (e.g. flange), damping mats must be installed there, if necessary (see Fig. 10.5). The damping mats are mounted on the complete circumference of the pipe. Repeat the steps for the installation of the damping mats.

10.7 Transducer Distance

```
Transd. Distance
A:54 mm Reflec
```

A value for the transducer distance is recommended. Fix the transducers (see chapter 7). Adjust the transducer distance.

Press ENTER.

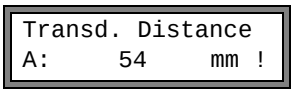
`A` - measuring channel
`Reflec` - reflection mode
`Diagon` - diagonal mode

The transducer distance displayed here is the distance between the inner edges of the transducers.

In case of a measurement in diagonal mode on very small pipes, a negative transducer distance is possible (see Fig. 10.1).

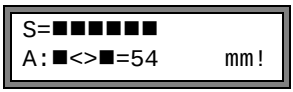
Note!	The accuracy of the recommended transducer distance depends on the accuracy of the entered pipe and medium parameters.

10.7.1 Fine Adjustment of the Transducer Distance



If the displayed transducer distance is adjusted, press ENTER.

The measuring for the positioning of the transducers is started.



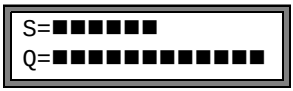
The amplitude of the received signal is displayed by the bar graph S=.

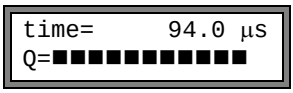
If the LED of the measuring channel lights green, the signal is sufficient for a measurement (FLUXUS G709).

If the LED of the measuring channel lights red, the signal is not sufficient for a measurement (FLUXUS G709).

Shift a transducer slightly in the range of the recommended transducer distance

- FLUXUS G704: until the bar graph reaches its max. length (max. 6 squares)
- FLUXUS G709: until the LED of the measuring channel lights green.





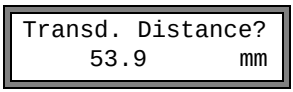
The following can be displayed in the upper line with key 9 DISP and in the lower line with key 3 DISP:

- transducer distance
- C (signal-to-noise ratio)

  If min. one box is displayed, the signal is sufficient for the measurement. Three or more boxes are optimal for a measurement.
- bar graph Q= (signal quality), must have max. length
- transit time time in µs
- bar graph S= (signal amplitude)

If the signal is not sufficient for measurement, Q= UNDEF will be displayed.

In case of large deviations, check if the entered parameters are correct or repeat the measurement at a different point on the pipe.



After the precise positioning of the transducers, the recommended transducer distance is displayed again.

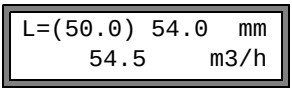
Enter the actual (precise) transducer distance. Press ENTER.

Repeat the steps for all channels on which will be measured. The measurement will be started automatically afterwards.

10.7.2 Consistency Check

If a wide range for the sound velocity has been entered in the program branch `Parameter` or the exact parameters of the medium are not known, a consistency check is recommended.

The transducer distance can be displayed during measurement by scrolling with key [DISP 9].



The optimum transducer distance (here: 50.0 mm) is displayed in the upper line in parentheses, followed by the entered transducer distance (here: 54.0 mm). The latter value must correspond to the adjusted transducer distance. Press ENTER to optimize the transducer distance.

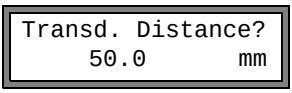
The optimum transducer distance is calculated on the basis of the measured sound velocity. It is therefore a better approximation than the first recommended value which had been calculated on the basis of the sound velocity range entered in the program branch `Parameter`.

If the difference between the optimum and the entered transducer distance is less than specified in Table 10.1, the measurement is consistent and the measured values are valid. The measurement can be continued.

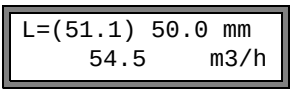
If the difference is greater, adjust the transducer distance to the displayed optimum value. Afterwards, check the signal quality and the signal amplitude bar graph (see section 10.7.1). Press ENTER.

Table 10.1: Standard values for signal optimization

transducer frequency (third character of the technical type)	**difference between the optimum and the entered transducer distance [mm]**	
	shear wave transducer	**lamb wave transducer**
G	20	-50...+100
H	-	-35...+60
K	15	-25...+40
M	10	-10...+20
P	8	-6...+10
Q	6	-3...+5
S	3	-



Enter the new adjusted transducer distance. Press ENTER.



Scroll with key [DISP 9] again until the transducer distance is displayed and check the difference between the optimum and the entered transducer distance. Repeat the steps if necessary.

Note!	Never change the transducer distance during the measurement without restarting the consistency check.

Repeat the steps for all channels on which a measurement is being made.

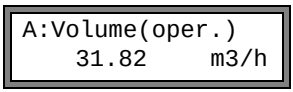
10.7.3 Value of the Sound Velocity

The sound velocity of the medium can be displayed during the measurement by pressing key [3 DISP].

If an approximate range for the sound velocity has been entered in the program branch `Parameter` and the transducer distance has been optimized afterwards as described in section 10.7.2, it is recommended to write down the sound velocity for the next measurement. By doing this, it will not be necessary to repeat the fine adjustment.

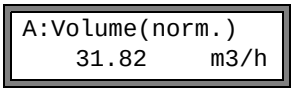
Also write down the medium temperature because the sound velocity depends on the temperature. The value can be entered in the program branch `Parameter` or a user defined medium can be created for this sound velocity (see section 14.2 and 14.3).

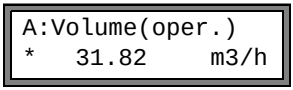
10.8 Start of the Measurement



The measured values are displayed in the lower line. Press ENTER to return to the fine adjustment of the transducer distance (see section 10.7.1).

If the standard volumetric flow rate is selected as the physical quantity during the gas measurement, the operating volumetric flow rate can also be displayed.





Press key to display the operating volumetric flow rate.

The character * indicates that the displayed value (here: operating volumetric flow rate) is not the selected physical quantity (here: standard volumetric flow rate).

If more than one measuring channel is available/activated, the transmitter works with an integrated measuring point multiplexer providing simultaneous measurement on the different measuring channels.

The flow is measured on one measuring channel for approx. 1 s, then the multiplexer switches to the next activated channel.

The time necessary for the measurement depends on the measuring conditions. E.g. if the measuring signal can not be detected immediately, the measurement might be > 1 s.

The outputs and the serial interface continuously receive the measured values of the corresponding channel. The results are displayed according to the actually selected output options. The default unit of measurement of the volumetric flow rate is m^3/h. For the selection of the values to be displayed and for the setting of the output options see chapter 11. For further measuring functions see chapter 12.

10.9 Detection of the Flow Direction

The flow direction in the pipe can be detected with the help of the displayed volumetric flow rate in conjunction with the arrow on the transducers:

- The medium flows in the direction of the arrow if the displayed volumetric flow rate is positive (e.g. 54.5 m^3/h).
- The medium flows against the direction of the arrow if the displayed volumetric flow rate is negative (e.g. -54.5 m^3/h).

10.10 Stopping the Measurement

The measurement will be interrupted by pressing key BRK if it is not protected by a program code (see section 12.9).

Note!	Be careful not to stop a current measurement by inadvertently pressing key BRK!

11 Displaying the Measured Values

The physical quantity is set in the program branch `Output Options` (see section 11.1).

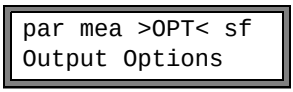
During the measurement, the designation of the physical quantity is displayed in the upper line, the measured value in the lower line. The display can be adapted (see section 11.3).

11.1 Selection of the Physical Quantity and of the Unit of Measurement

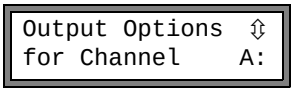
The following physical quantities can be measured:

- **sound velocity**
- **flow velocity**: is calculated on the basis of the measured transit time difference
- **operating volumetric flow rate**: is calculated by multiplying the flow velocity by the cross-section of the pipe
- **standard volumetric flow rate**: is calculated on the basis of the operating volumetric flow rate (see section 11.1.1)
- **mass flow rate**: is calculated by multiplying the volumetric flow rate by the operating density of the medium

The physical quantity is selected as follows:

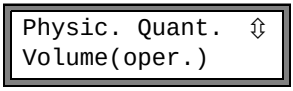


Select the program branch `Output Options`. Press ENTER.

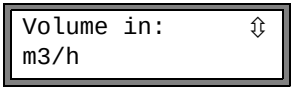


Select the channel for which the physical quantity is to be entered. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel.



Select the physical quantity in the scroll list. Press ENTER.



For the selected physical quantity (except for the sound velocity), a scroll list with the available units of measurement is displayed. The previously selected unit of measurement is displayed first.

Select the unit of measurement of the selected physical quantity. Press ENTER.

Press BRK to return to the main menu. The further menu items of the program branch `Output Options` are for the activation of the measured value output.

Note!	If the physical quantity or the unit of measurement is changed, the settings of the outputs will have to be checked (see chapter 18).

11.1.1 Measurement of the Standard Volumetric Flow Rate

If the medium is a gas, the standard volumetric flow rate can be selected as the physical quantity in addition to the operating volumetric flow rate. The standard volumetric flow rate is calculated as follows:

$$V_N = V * p/p_N * T_N/T * 1/K$$

V_N - standard volumetric flow rate
V - operating volumetric flow rate
p_N - standard pressure (absolute value)
p - operating pressure (absolute value)
T_N - standard temperature in K
T - operating temperature in K
K - gas compressibility factor

Standard pressure p_N and standard temperature T_N are set in `Special Funct.\SYSTEM settings\Gas-Measuring\Normal pressure` and `Normal temper.`.

If the operating pressure p and the operating temperature T are measured and fed to the transmitter, they will be used for the calculation of the standard volumetric flow rate. Otherwise, they will be set in `Parameter\Fluid pressure` and `Medium Temperat.`.

The gas compressibility factor K is stored in the medium data set. If `Other Medium` is selected or if there is no data set for the selected medium, the compressibility factor will be set in `Parameter\Gas compr.factor`. Note that the value is to be selected correspondingly to the operating pressure, the operating temperature and the composition of the gas.

11.2 Toggling between the channels

If more than one channel is available/activated, the display for the measured values can be adapted as follows:

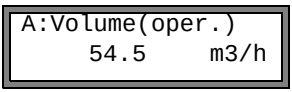
- AutoMux mode
  - all channels
  - only calculation channels
- HumanMux mode

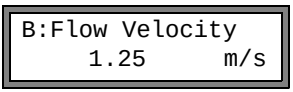
Key [1 MUX] toggles between the modes.

11.2.1 AutoMux Mode

In the AutoMux mode, the display and the measuring process are synchronized. The channel on which a measurement is being made is displayed in the upper line on the left.

The measured values are displayed as configured in the program branch `Output Options` (see section 11.1). When the multiplexer switches to the next channel, the display is updated.





The AutoMux mode is the default display mode. It is activated automatically after a cold start.

All Channels

The measured values of all channels (measuring and calculation channels) are displayed. The next active channel is displayed after min. 1.5 s.

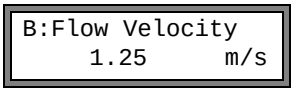
Only Calculation Channels

Only the measured values of the calculation channels are displayed. The next active calculation channel is displayed after min. 1.5 s.

This mode can only be activated if at least 2 calculation channels are active.

11.2.2 HumanMux Mode

In the HumanMux mode, the measured values of one channel are displayed. The measurement on the other channels is continued, but not displayed.



The selected channel is displayed left in the upper line.

Press key [NEXT 7] to display the next activated channel. The measured values of the selected channel will be displayed as configured in the program branch `Output Options` (see section 11.1).

11.3 Adjustment of the Display

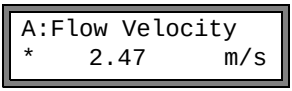
During the measurement, the display can be adapted as to display two measured values simultaneously (one in each line of the display). This does not affect totalizing, storing of measured values, measured value output, etc.

The following information can be displayed in the upper line:

- designation of the physical quantity
- totalizer values, if activated
- temperatures assigned to the channel and their difference if the temperature is measured
- date and time at which the data logger will be full
- measuring mode
- transducer distance
- alarm state indication if it is activated (see section 18.7.5) and if alarm outputs are activated (see section 18.6).

The following information can be displayed in the lower line:

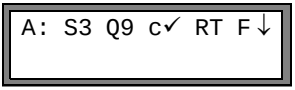
- flow velocity
- sound velocity
- mass flow rate
- volumetric flow rate
- Press key [DISP 9] during the measurement to change the display in the upper line, press key [3 DISP] to change the display in the lower line.



The character * indicates that the displayed value (here: flow velocity) is not the selected physical quantity.

11.4 Status Line

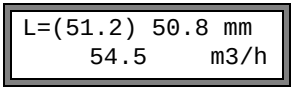
Important data on the ongoing measurement are displayed in the status line. The quality and precision of the ongoing measurement can be estimated.



Press key [DISP 9] during the measurement to scroll through the upper line to the status line.

	value	explanation
S		**signal amplitude**
	0	< 5 %
	…	…
	9	≥ 90 %
		Values ≥3 are sufficient for the measurement.
Q		**signal quality**
	0	< 5 %
	…	…
	9	≥ 90 %
c		**sound velocity** comparison of the measured and the expected sound velocity of the medium. The expected sound velocity is calculated on the basis of the medium parameters (medium selected in the program branch `Parameter`, temperature dependency, pressure dependency).
	√	ok, is equal to the expected value
	↑	> 20 % of the expected value
	↓	< 20 % of the expected value
	?	unknown, can not be measured
R		**flow profile** information about the flow profile based on the Reynolds number
	T	fully turbulent flow profile
	L	fully laminar flow profile
	↕	the flow is in the transition range between laminar and turbulent flow
	?	unknown, can not be calculated
F		**flow velocity** comparison of the measured flow velocity with the flow limits of the system
	√	ok, the flow velocity is not in the critical range
	↑	the flow velocity is higher than the current limit
	↓	the flow velocity is lower than the current cut-off flow (even if it is not set to zero)
	0	the flow velocity is in the offset range of the measuring method
	?	unknown, can not be measured

11.5 Transducer distance



By pressing key [DISP 9] during the measurement, it is possible to scroll to the display of the transducer distance.

The optimum transducer distance (here: 51.2 mm) is displayed in parentheses in the upper line, followed by the entered transducer distance (here: 50.8 mm).

The optimum transducer distance might change during the measurement (e.g. due to temperature fluctuations).

A deviation from the optimum transducer distance (here: -0.4 mm) is compensated internally.

Note!	Never change the transducer distance during the measurement!

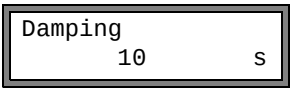
12 Advanced Measuring Functions

12.1 Damping Factor

Each displayed measured value is a floating average of all measured values of the last x seconds, with x being the damping factor. A damping factor of 1 s means that the measured values are not averaged because the measuring rate is approx. 1/s. The default value of 10 s is appropriate for normal flow conditions.

Strongly fluctuating values caused by high flow dynamics require a higher damping factor.

Select the program branch `Output Options`. Press ENTER until the menu item `Damping` is displayed.



Enter the damping factor. Press ENTER.

Press BRK to return to the main menu.

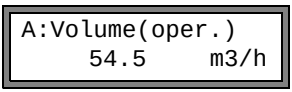
12.2 Totalizers

total volume or total mass of the medium at the measuring point can be determined.

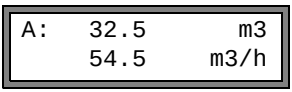
There are two totalizers, one for the positive flow direction, one for the negative flow direction.

The unit of measurement used for totalizing corresponds to the volume or mass unit selected for the physical quantity.

The value of a totalizer consists of max. 11 digits, including max. 4 decimal places. For the adjustment of the number of decimal places see section 16.6.



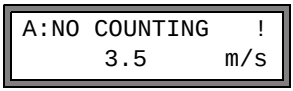
To activate the totalizers, press key 8 during the measurement (see Table 12.1).



The value of the totalizer will be displayed in the upper line (here: the volume which has passed through the pipe at the measuring point in the positive flow direction after the activation of the totalizers).

Table 12.1: Keys for display of the totalizers

activation	press key 8 once during the measurement
deactivation	press key 2 three times during the measurement
display of the totalizer for the positive flow direction	press key 6 during the measurement
display of the totalizer for the negative flow direction	press key 4 during the measurement
reset of the totalizers to zero	press key 8 three times during measurement



This error message will be displayed if the totalizers of a measuring channel used for measuring the flow velocity are to be activated. The flow velocity can not be totalized.

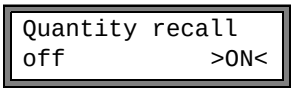
Note!	The totalizers can only be activated for the measuring channel whose measured values are displayed at the moment.

Note!	The pressing of a key will only influence the totalizers if the totalizer is displayed in the upper line.

12.2.1 Storing the Values of the Totalizers

When the Measurement Is Stopped

The behavior of the totalizers when the measurement is stopped or after a RESET of the transmitter is set in `Special Funct.\SYSTEM settings`\Measuring\`Quantity recall`.



If `on` is selected, the values of the totalizers will be stored and used for the next measurement.

If `off` is selected, the totalizers will be reset to zero.

Selection of the Totalizers for Storing

It is possible to store only the value of the totalizer that is currently displayed or one value for each flow direction. Select `Special Funct.\SYSTEM settings\Storing\Quantity Storage`.

If one is selected, only the value of the totalizer that is currently displayed will be stored.

If both is selected, the values of the totalizers totalizer for both flow directions will be stored.

Press ENTER.

12.2.2 Overflow of the Totalizers

The overflow behavior of the totalizers can be set:

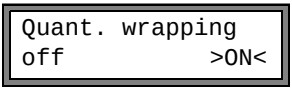
Without overflow:

- The value of the totalizer increases to the internal limit of 10^{38}.
- if necessary, the values will be displayed as exponential numbers (±1.00000E10). The totalizer can only be reset to zero manually.

With overflow:

- The totalizer will be reset to zero automatically when ±9999999999 is reached.

Select Special Funct.\SYSTEM settings\Measuring\Quant. wrapping.



Select on to work with overflow. Select off to work without overflow. Press ENTER.

Independently of the setting, the totalizers can be reset to zero manually.

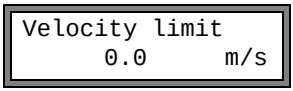
Note!	The overflow of a totalizer influences all output channels, e.g. data logger, online output. The output of the sum of both totalizers (the throughput ΣQ) via an output will not be valid after the first overflow (wrapping) of one of the corresponding totalizers. To signalize the overflow of a totalizer, an alarm output with the switching condition QUANT. and the type HOLD must be activated.

12.3 Upper Limit of the Flow Velocity

Single outliers caused by heavily disturbed surroundings can appear among the measured values of the flow velocity. If the outliers are not ignored, they will affect all derived physical quantities, which will then be unsuitable for the integration (e.g. pulse outputs).

It is possible to ignore all measured flow velocities higher than a upper limit. These measured values will be marked as outliers.

The upper limit of the flow velocity is set in `Special Funct.\SYSTEM settings\Measuring\Velocity limit`.



Enter 0 (zero) to switch off the checking for outliers.

Enter a limit > 0 to switch on the checking for outliers. The measured flow velocity will then be compared to the entered upper limit.

Press ENTER.

If the flow velocity is higher than the upper limit,

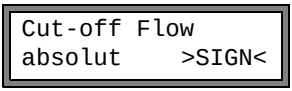
- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red (FLUXUS G709)
- "!" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed)

Note!	If the upper limit is too low, a measurement might be impossible because most of the measured values will be marked as "invalid".

12.4 Cut-Off Flow

The cut-off flow is a lower limit for the flow velocity. All measured flow velocities that are lower than the limit and their derived values are set to zero.

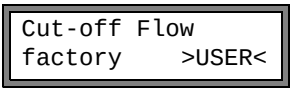
The cut-off flow can depend on the flow direction or not. The cut-off flow is set in `Special Funct.\SYSTEM settings\Measuring\Cut-off Flow`.



Select `sign` to define a cut-off flow in dependence on the flow direction. Two independent limits are set for the positive and negative flow directions.

Select `absolut` to define a cut-off flow independently of the flow direction. A limit is set for the absolute value of the flow velocity.

Press ENTER.

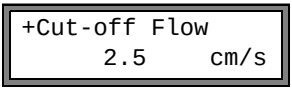


Select `factory` to use the default limit of 2.5 cm/s (0.025 m/s) for the cut-off flow.

Select `user` to enter the cut-off flow.

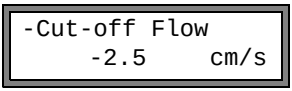
Press ENTER.

If `Cut-off Flow\sign` and `user` have been selected, two values will have to be entered:



Enter the cut-off flow. Press ENTER.

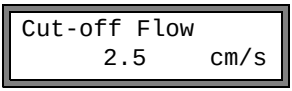
All positive values of the flow velocity that are lower than this limit will be set to zero.



Enter the cut-off flow. Press ENTER.

All negative values of the flow velocity greater than this limit will be set to zero.

If `Cut-off Flow\absolut` and `user` is selected, only one value will have to be entered:



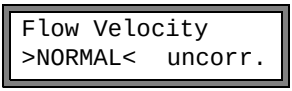
Enter the cut-off flow. Press ENTER.

The absolute values of all flow velocity values that are lower than this limit will be set to zero.

12.5 Uncorrected Flow Velocity

For special applications, the uncorrected flow velocity might be of interest.

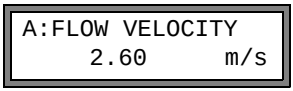
The profile correction for the flow velocity is activated in Special Funct.`\SYSTEM settings\Measuring\Flow Velocity`.



Select `normal` to display and output the flow velocity with profile correction.

Select `uncorr.` to display the flow velocity without profile correction. Press ENTER.

If `uncorr.` is selected, it has to be confirmed each time the program branch `Measuring` is selected if the profile correction is to be used.



If no is selected, the profile correction will be switched off.

All physical quantities will be calculated with the uncorrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

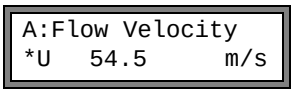
Press ENTER.

If yes is selected, the uncorrected flow velocity will only be used if the flow velocity is selected as the physical quantity in the program branch Output Options.

All other physical quantities (volumetric flow rate, mass flow rate, etc.) will be determined with the corrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

Press ENTER.



In both cases, the corrected flow velocity can also be displayed.

Scroll with key 3 DISP until the flow velocity is displayed. The uncorrected flow velocity is marked with U.

Uncorrected flow velocities transmitted to a PC are marked with uncorr..

12.6 Measurement of Transient Processes (FastFood Mode)

The FastFood mode enables the measurement of flows with high dynamics.

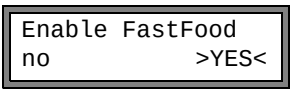
A continuous adaptation to changing measuring conditions which takes place in the normal measuring mode is only partially realized in the FastFood mode.

- The sound velocity of the medium is not measured. Instead, the sound velocity stored in the internal database is used, taking into account the medium temperature entered in the program branch Parameter (or the measured temperature if the medium temperature is measured).
- A change of measuring channel is not possible.
- The inputs and outputs can still be used.
- The measured values are stored as usual.

The FastFood mode has to be enabled and activated.

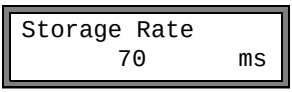
12.6.1 Enabling/Disabling the FastFood Mode

Press key C. Enter HotCode 007022 has been switched on.



Select yes to enable the FastFood Mode, no to disable it.

12.6.2 Storage Rate of the FastFood Mode

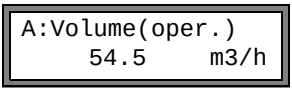


If the FastFood mode is enabled, a Storage Rate in ms will have to be entered in the program branch Output Options.

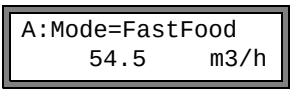
Press ENTER.

12.6.3 Activation/Deactivation of the FastFood Mode

If the FastFood mode is enabled and a measurement is started, the normal measuring mode will still be running (i.e. multi-channel measurement with permanent adaptation to the measuring conditions). If the data logger is activated, the measured values will not be stored.



Press key [0] to activate/deactivate the FastFood mode for the measuring channel currently displayed.



Scroll with key [DISP 9] in the upper line until the activated measuring mode A:Mode=FastFood or A:Mode=TransTime is displayed.

If the data logger is activated, a new data set will be created and storing of measured values will be started. If the FastFood mode is deactivated or if the measurement is interrupted, the storing will be stopped.

Note!	The values of the current measuring data set will be deleted if the FastFood mode is deactivated and activated again without interrupting the measurement. The values of the current measuring data set will be kept if the measurement is interrupted before the FastFood mode is activated again. A new measuring data set is created when the next measurement is started.

12.7 Calculation Channels

Note!	Calculation channels are only available if the transmitter has more than one measuring channel.

In addition to the ultrasonic measuring channels, the transmitter has two virtual calculation channels Y and Z. The measured values of the measuring channels A and B can be used for calculations by the calculation channels.

The result of the calculation is the measured value of the selected calculation channel. This measured value is equivalent to the measured values of a measuring channel. All operations with the measured values of a measuring channel (totalizing, online output, storing, outputs, etc.) can also be done with the values of a calculation channel.

12.7.1 Characteristics of the Calculation Channels

In the program branch `Parameter`, the measuring channels to be used for the calculation and the calculation function have to be entered.

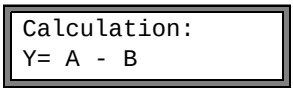
A calculation channel can not be attenuated. The damping factor has to be set separately for each of the two measuring channels.

Two cut-off flow values for each calculation channel can be defined. The cut-off flow is not based on the flow velocity as for measuring channels. Instead, it is defined in the unit of measurement of the physical quantity selected for the calculation channel. During the measurement, the calculated values are compared to the cut-off flow values and set to zero if necessary.

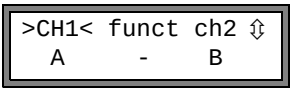
A calculation channel provides valid measured values if at least one measuring channel provides valid measured values.

12.7.2 Parameterization of a Calculation Channel

Select a calculation channel (Y or Z) in the program branch `Parameter`. Press ENTER.



The current calculation function is displayed. Press ENTER to edit the function.



Three scroll lists are displayed in the upper line:

- selection of the first measuring channel (`ch1`)
- selection of the calculation function (`funct`)
- selecton of the second measuring channel (`ch2`)

Select a scroll list with key 4 or 6.

The list items are displayed in the lower line.

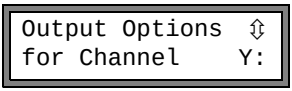
Scroll with key 8 and 2 through the scroll list. All measuring channels and their absolute values can be used as input channels for the calculation.

The following calculation functions are available:

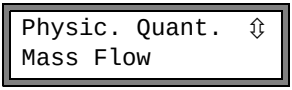
- `-: Y = ch1 - ch2`
- `+: Y = ch1 + ch2`
- `(+)/2: Y = (ch1 + ch2)/2`
- `|-|: Y = |ch1 - ch2|`

Press ENTER.

12.7.3 Output Options for a Calculation Channel



Select a calculation channel in the program branch `Output Options`. Press ENTER.



Select the physical quantity to be calculated. Press ENTER.

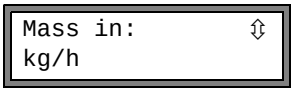
Make sure that the physical quantity selected for the calculation channel can be calculated from the physical quantities of the selected measuring channels. Possible combinations are shown in Table 12.2.

Table 12.2: Physical quantity of the calculation channel

physical quantity of the calculation channel	possible physical quantity of the first measuring channel (CH1)				possible physical quantity of the second measuring channel (CH2)			
	flow velocity	volumetric flow rate	mass flow rate		flow velocity	volumetric flow rate	mass flow rate	
flow velocity	x	x	x		x	x	x	
volumetric flow rate		x	x			x	x	
mass flow rate		x	x			x	x	

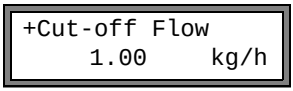
example: The difference of the volume flow rates of the channels A and B is to be calculated.

The physical quantity of channel A and B can be the volumetric flow rate or the mass flow rate, but not the flow velocity. The physical quantities of the two measuring channels do not need to be identical (channel A = mass flow rate, channel B = volumetric flow rate).

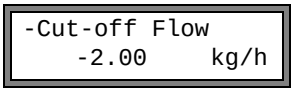


Select the unit of measurement. Press ENTER.

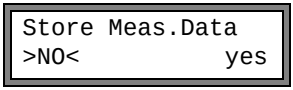
Two cut-off flow values for each calculation channel can be defined. They are defined in the unit of measurement of the physical quantity selected for the calculation channel.



All positive calculated values that are lower than the limit will be set to 0.

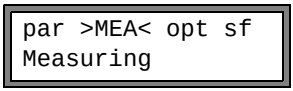


All negative calculated values that are greater than the limit will be set to 0.

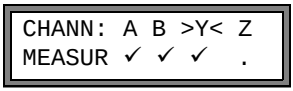


The data logger can be activated/deactivated. Press ENTER.

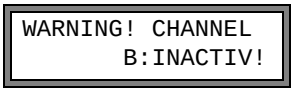
12.7.4 Measuring with Calculation Channels



Select program branch `Measuring`. Press ENTER.

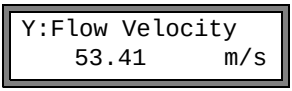


Activate the necessary channels. Calculation channels are activated or deactivated in the same way as the measuring channels. Press ENTER.



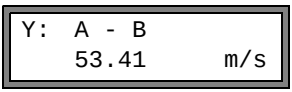
If a measuring channel that is needed for an activated calculation channel has not been activated, a warning will be displayed. Press ENTER.

Position the transducers for all activated measuring channels. The measurement will be started automatically.



If a calculation channel is activated, the HumanMux mode (see section 11.2.2) will be selected at the beginning of the measurement and the values of the calculation channel will be displayed.

If the AutoMux mode is selected, the measured values of the measuring channels, but not the measured values of the calculation channels, will be displayed alternately.



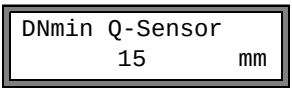
Press key DIGIT 9 to display the calculation function.

Press key NEXT 7 to display the measured values of the different channels.

12.8 Change of the Limit for the Inner Pipe Diameter

It is possible to change the lower limit of the inner pipe diameter for a given transducer type.

Press key C.Enter HotCode 071001.



Enter the lower limit of the inner pipe diameter of the displayed transducer type. Press ENTER to select the next transducer type.

Note!	If a transducer is used below its recommended inner pipe diameter, a measurement might be impossible.

12.9 Program Code

An ongoing measurement can be protected from an inadvertent intervention by a program code.

If a program code has been defined, it will be requested when there is an intervention in the measurement (a command or key BRK).

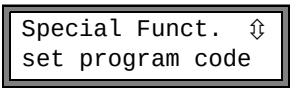
If a program code is active, the message `Program code active` will be displayed for a few seconds when a key is pressed.

To execute a command, it is sufficient to enter the first three digits of the program code (= access code).

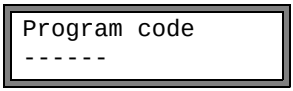
To stop an ongoing measurement, the complete program code has to be entered (= break code).

The input of a program code is interrupted with key C.

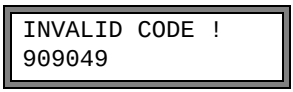
Note!	Do not forget the program code!



Select `Special Funct.\set program code`.



Enter a program code with max. 6 digits. Press ENTER.



An error message will be displayed if a reserved number has been entered (e.g. a HotCode for language selection).

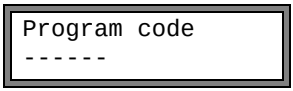
A program code will remain valid as long as:

- no other valid program code is entered or
- the program code is not deactivated.

12.9.1 Intervention in the Measurement

To stop a measurement when it is protected by a program code, press key C and enter the program code. If the entered program code is correct, the measurement will be interrupted and the main menu will be selected.

Deactivation of the Program Code



Select `Special Funct.\set program code`.

The program code is deleted by entering "`------`". Press ENTER.

If the character "`-`" is entered less than six times, this character sequence will be used as the new program code.

13 Storing and Output of Measured Values

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Storing

The following data can be stored:

- date
- time
- measuring point number
- pipe parameters
- medium parameters
- transducer parameters
- sound path (reflection or diagonal mode)
- transducer distance
- damping factor
- storage rate
- physical quantity
- unit of measurement
- measured values
- totalizer values

In order to store the measured data, the data logger must be activated (see section 13.1.1).

The available data logger memory can be displayed (see section 13.5).

The storing of each measured value will be signaled acoustically. This signal can be deactivated (see section 13.4.6).

Online Output

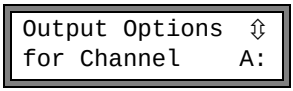
During the measurement, the measured values will be transmitted directly to a PC (see section 13.2.3).

Offline Output

The measured values will be stored in the transmitter and later transmitted to a PC (see section 13.2.4).

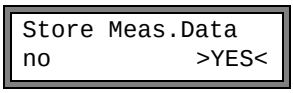
13.1 Data Logger

13.1.1 Activation/Deactivation of the Data Logger



Select in the program branch `Output Options` the channel for which the data logger is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.



Press ENTER until the menu item `Store Meas.Data` is displayed.

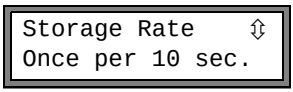
Select `yes` to activate the data logger. Press ENTER.

13.1.2 Setting the Storage Rate

The storage rate is the frequency at which the measured values are output or stored. The storage rate will be set separately for each measuring channel.

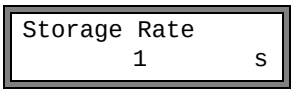
If the storage rate is not set, the storage rate previously selected will be used.

The storage interval should be at least equal to the number of activated measuring channels, e.g. the storage interval of a channel should be min 2 s if 2 measuring channels are activated.



Select a storage rate or `EXTRA`. Press ENTER.

This display will only be indicated if `Store Meas.Data` and/or `Serial Output` are activated.



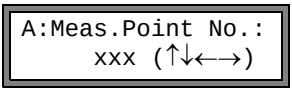
If `EXTRA` has been selected, enter the storage rate. Press ENTER.

13.1.3 Measuring Point Number

At the beginning of the measurement, the measuring point must be identified by

- an ASCII text (e.g. MS.PK20!)
- digits, including point, hyphen (e.g. 18.05-06).

The input mode is set in the program branch `Special Funct.` (see section 15.2.3).

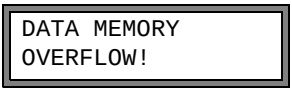


Enter the measuring point number. Press ENTER.

If arrows are displayed, ASCII text can be entered. If no arrows are displayed, only digits, point and hyphen can be entered.

The measuring point number and the parameters will be stored together with the measured values.

13.1.4 Measurement



If `Output Options\Store Meas.Data` has been activated and `Special Funct.\SYSTEM settings\ Ringbuffer` is deactivated, this error message will be displayed as soon as the data logger is full. Press ENTER.

If no other measured value output has been activated, the measurement will be stopped.

If another measured value output has been activated, the measurement will be continued. Only the storing of the measured values will be stopped. The error message will be displayed periodically.

13.2 Output of the Measured Values

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The measured values can be output via the serial interface. For the connection of the serial interface to the transmitter see section .

13.2.1 RS232 Interface

In order to connect the RS232 interface, the housing must be opened.

- output of the measured values in ASCII format
- transmission of the stored measured values by means of the program FluxData in binary format

13.2.2 RS485 Interface (Optional)

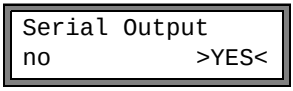
- output of the measured values in ASCII format
- transmission of the measured values via a bus protocol (transmitter as Modbus slave)

Note!	It is recommended to use the RS485 interface for the online output. The RS232 interface should only be used if the transmitter does not have an RS485 interface.

13.2.3 Online Output

The measured values are transmitted via the serial interface to a PC directly during the measurement. If the data logger is activated, the measured values will also be stored.

- Select the program branch `Output Options`. Press ENTER.
- Select the channel for which the online output is to be activated. Press ENTER until the menu item `Serial Output` is displayed.



Select `yes` to activate the online output. Press ENTER.

- Set the storage rate (see section 13.1.2).

The measuring point number will be requested when the measurement is started (see section 13.1.3).

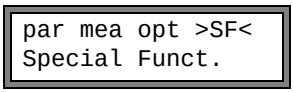
13.2.4 Offline Output

The measured values will be transmitted from the data logger of the transmitter via the serial interface:

- to a PC by means of the program FluxData or
- to a terminal program in ASCII format

Offline Output by Means of the Program FluxData

Settings in the transmitter:



Press BRK to select the main menu.

Further settings in the transmitter are not necessary.

settings in the program FluxData:

- Start the program FluxData on the PC.
- In the program FluxData, open the menu "Options" and select "Serial interface". Select the Default protocol and the serial port of the PC that the transmitter is connected to (e.g. COM1 in Fig. 13.1). Click on OK.

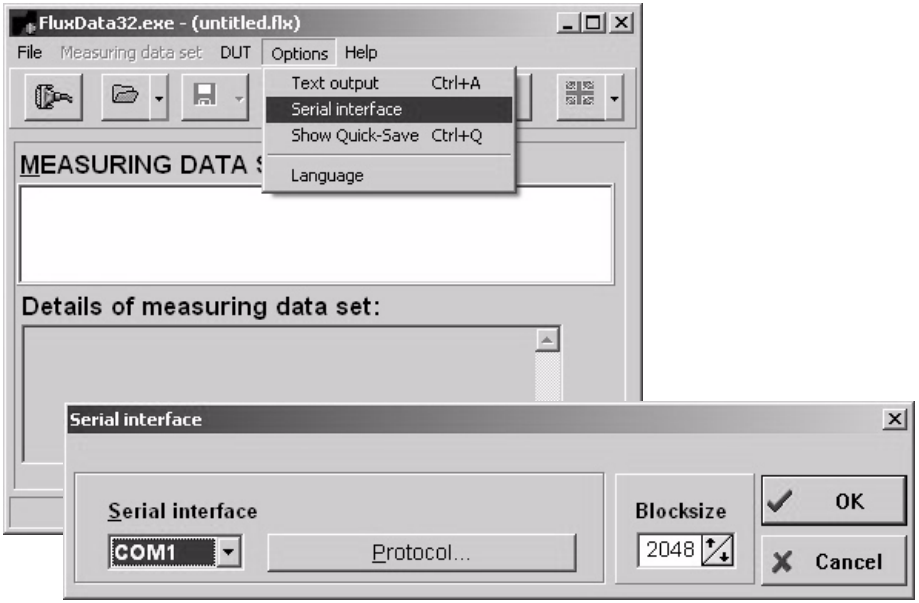


Fig. 13.1: Selection of the serial interface

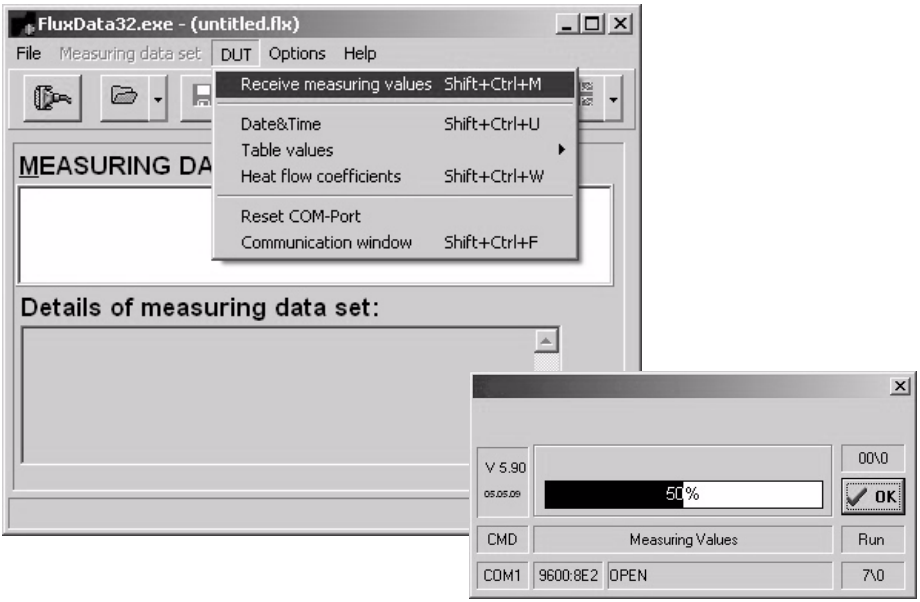


Fig. 13.2: Receive measured values

- In the program FluxData, open the menu "DUT" and select "Receive Measuring values" (see Fig. 13.2). The received measuring data sets will be displayed (see Fig. 13.3).

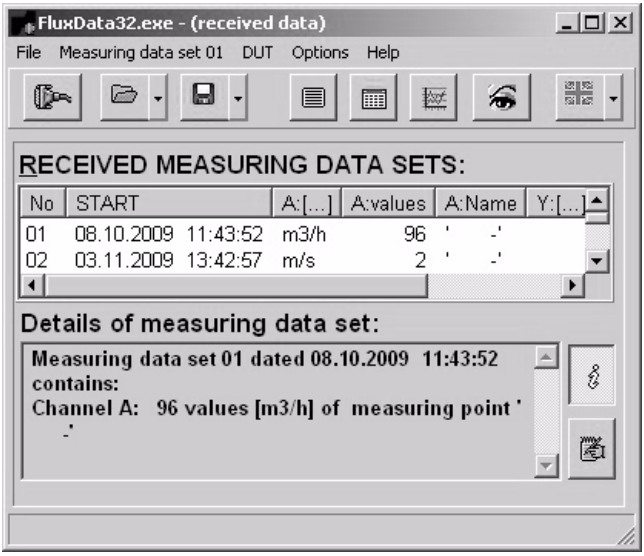


Fig. 13.3: Display of the received measuring data sets

Offline Output to a Terminal Program

```
Special Funct.  ⇳
Print Meas.Val.
```

Select `Special Funct.\Print Meas.Val.`. Press ENTER.

```
NO VALUES       !
Print Meas.Val.
```

This error message will be displayed if no measured values are stored. Press ENTER.

Connect the transmitter to a PC with a serial interface. Press ENTER to transmit the stored measured values.

```
Send Header    01
.................
```

The display indicates that the measured values are being transmitted.

```
SERIAL ERROR    !
Print Meas.Val.
```

This error message will be displayed if an error has occurred during the serial transmission. Press ENTER. Check the connections and make sure that the PC is ready to receive data.

```
■■■■■■
.................
```

The progress of the data transfer is displayed by a bar graph.

13.2.5 Data Format

The header is transmitted at the beginning of the measurement. The first 4 lines contain general information about the transmitter and the measurement. The following lines contain the configuration parameters that are output for each channel in a data block.

example:

```
\DEVICE            : G70X-XXXXXXXX
\MODE              : ONLINE
\CHAN              : 1 (A:)
DATE               : 2011-01-09
TIME               : 19:56:52
Par.Record
Meas.Point No.:    : A:F5050
Pipe
 Outer Diameter    : 60.3 mm
 Wall Thickness    : 5.5 mm
 Roughness         : 0.1 mm
 Pipe Material     : Carbon Steel
 Lining            : WITHOUT LINING
Medium             : Natural gas
 Medium Temperat.  : 38 C
 Fluid pressure    : 60.00 bar
Transducer Type    : xxx
Sound Path         : 3 NUM
Transd. Distance   : -15.6 mm
Damping            : 20 s
Full-Scale Val.    : 4.50 m3/h
Physic. Quant.     : Volume(oper.)
Unit Of Measure    : [m3/h]/[m3]
```

The line \DATA will be transmitted next, followed once by the column titles (see Table 13.1) for the corresponding channel. The measured values are transmitted afterwards.

example:

```
\DATA
A:;\*MEASURE;      Q_POS;        Q_NEG;
B:;\*MEASURE;      Q_POS;        Q_NEG;
```

In every storage interval, one data line per activated measuring channel is transmitted. The line "???" will be transmitted if there are no measured values available for the storage interval.

example: With a storage interval of 1 s, 10 lines "???" will be transmitted if the measurement has been restarted after a 10 s interruption for the positioning of the transducers.

The following data columns can be transmitted:

Table 13.1: Format of the serial output

column title	column format	contents
*MEASURE	###000000.00	the physical quantity selected in `Output Options`
Q_POS	+00000000.00	totalizer value for the positive flow direction
Q_NEG	-00000000.00	totalizer value for the negative flow direction
FQ_POS		value of the totalizer for the positive flow direction (if the heat flow has been selected as the physical quantity)
FQ_NEG		the value of the totalizer for the negative flow direction (if the heat flow has been selected as the physical quantity)
T1	###000.0	temperature `T1` (= supply temperature if the heat flow has been selected as the physical quantity)
T2	###000.0	temperature `T2` (= return temperature if the heat flow has been selected as the physical quantity)
...		designation for other inputs
SSPEED		sound velocity of the medium
KNZ		concentration in mass percent
AMP		signal amplitude

Online Output

Columns will be created for all quantities that appear during the measurement. The columns Q_POS and Q_NEG will remain empty if the totalizers are deactivated.

As the totalizers can not be activated for the physical quantity flow velocity, these columns will not be created.

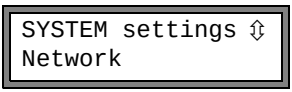
Offline Output

During the offline output, columns will only be created if at least one measured value is stored in the data set. The columns Q_POS and Q_NEG will not be created if the totalizers are deactivated.

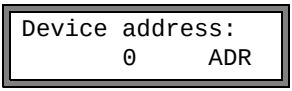
Transmission Parameters

- the transmitter sends CRLF-terminated ASCII
- max. line length: 255 digits
- RS232: 9600 bits/s, 8 data bits, even parity, 2 stop bits, protocol (RTS/CTS)
- RS485: 9600 bits/s, 8 data bits, even parity, 1 stop bit

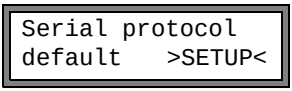
The settings for the RS485 interface can be changed in the program branch `Special Funct.\SYSTEM settings\Network`. These displays will not be indicated if the transmitter does not have an RS485 interface.



Select `Special Funct.\SYSTEM settings\Network` to change the settings of the transmission parameters.



Press ENTER to confirm the instrument address in the network.



Select `default` to display the default transmission parameters.

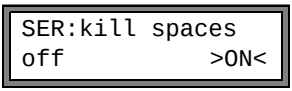
Select `setup` to change the transmission parameters. Press ENTER.

Set the transmission parameters in the 3 scroll lists. Press ENTER.

- `baud`: baud rate
- `parity`parity:
- `st`: number of stop bits

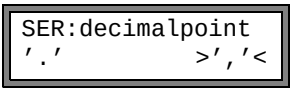
13.2.6 Settings of the Serial Output

Some formatting settings for the serial output can be set in `Special Funct.\SYSTEM settings\serial transmis.`

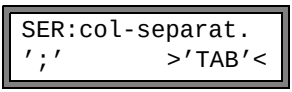


Select on if the space characters are not to be transmitted. Press ENTER.

The file size will be considerably smaller (shorter transmission time).

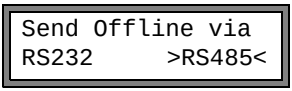


Select the decimal marker to be used for floating-point numbers (point or comma). Press ENTER.



Select the character to be used to separate columns (semicolon or tabulator). Press ENTER.

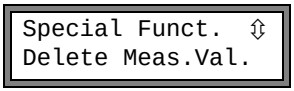
This setting depends on the PC program used.



Select the serial interface for the offline output.

This display will only be indicated if the transmitter has an RS485 interface.

13.3 Deleting the Measured Values



Select `Special Funct.\Delete Meas.Val.`. Press ENTER.

Select `yes` or `no`. Press ENTER.

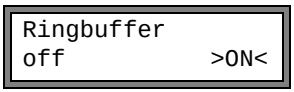
13.4 Settings for the Data Logger

Select `Special Funct.\SYSTEM settings\Storing`. The following menu items are available:

- ring buffer
- storage mode
- storing of the totalizer values
- storing of the signal amplitude
- storing of the sound velocity
- storing of the concentration
- acoustic signal during the storing

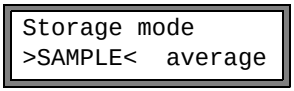
13.4.1 Ring Buffer

The setting of `Ringbuffer` affects the storing of measured values as soon as the data logger is full:



Select the behavior of the ring buffer. Press ENTER. If `on` has been selected, the available data logger memory will be halved. The oldest measured values will be overwritten. If `off` has been selected, the storing of measured values will be stopped.

13.4.2 Storage Mode



Select the storage mode. Press ENTER.

If `sample` has been selected, the displayed measured value will be used for storing and online output. If `average` is selected, the average of all values measured during a storage interval will be used for storing and online output.

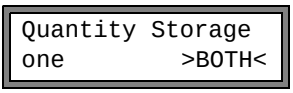
Note!	The storage mode does not affect the continuously working interfaces (e.g. current output, voltage output). If `average` has been selected, all primary physical quantities will be averaged, i.e. also the measured temperatures if the corresponding measuring channel is activated.

Note!	If no average could be calculated over the complete storage interval while `average` was activated, the value will be marked as invalid. The ASCII file will contain "???" instead of invalid average values and the corresponding physical quantity and "?UNDEF" instead of invalid temperatures. There will be no indication as to how many currently measured values a valid average consists of.

13.4.3 Storing of the Totalizers

It is possible to store only the value of the currently displayed totalizer or one value for each flow direction.

Select `Special Funct.\SYSTEM settings\Storing\Quantity Storage`.



Select `one` to store only the displayed totalizer.

Select `both` to store the totalizers of both flow directions.

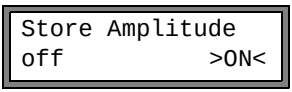
Press ENTER.

Note!	The totalizers will only be stored if they are activated and the data logger is activated. The storing of a totalizer reduces the total number of measured values to be stored by approx. two thirds.

example: In the program branch `Special Funct.`, It is displayed that 10 000 additional measured values can be stored. If the totalizers are activated and only one totalizer is being stored, 3 333 data fields will be available for storing. If both totalizers are stored, 2 000 data fields will be available for storing.

13.4.4 Storing of the Signal Amplitude

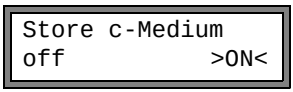
Select `Special Funct.\SYSTEM settings\Storing\Store Amplitude`.



If `on` is selected and the data logger is activated, the amplitude of the measured signal will be stored together with the measured values. Press ENTER.

13.4.5 Storing the Sound Velocity of the Medium

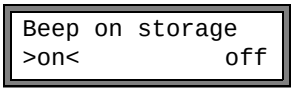
Select `Special Funct.\SYSTEM settings\Storing\Store c-Medium`.



If on is selected and the data logger is activated, the sound velocity of the medium will be stored together with the measured values. Press ENTER.

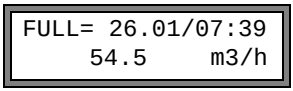
13.4.6 Acoustic Signal

Per default, an acoustic signal will be emitted every time a measured value is stored or transmitted to a PC or printer. The signal can be deactivated in `Special Funct.\SYSTEM settings\Storing\Beep on storage`.



Select `off` to deactivate the acoustic signal, `on` to activate it. Press ENTER.

13.5 Available Data Logger Memory

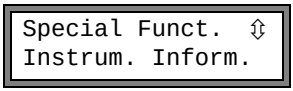


The time on which the memory will be full can be displayed during the measurement.

Scroll through the displays of the upper line with key DISP 9 during the measurement.

Max. 100 measuring data sets can be stored. The number of measuring data sets depends on the total number of measured values stored in the previous measuring data sets.

If the data logger is empty and a measurement is started with one physical quantity on one measuring channel without storing the totalizer, approx. 100 000 measured values can be stored. The available data logger memory can be displayed:



Select `Special Funct.\Instrum. Inform.`. Press ENTER.

The type and the serial number of the transmitter will be displayed in the upper line.

The available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored). Press key BRK twice to return to the main menu.

14 Libraries

The internal material database of the transmitter contains parameters for pipe and lining materials as well as for media. It can be extended with user defined materials or media. User defined materials and media will always be displayed in the scroll lists of the program branch `Parameter`.

User defined materials and media can be stored in an integrated coefficient memory (user area). The coefficient memory has to be partitioned first (see section 14.1).

The properties of user defined materials or media can be entered as follows:

- as constants without the extended library (see section 14.2)
- as constants or temperature and pressure dependent functions by means of the extended library (see section 14.3)

The material and media scroll lists displayed in the program branch `Parameter` can be arranged (see section 14.5). Shorter scroll lists make working more efficient.

14.1 Partitioning of the Coefficient Memory

The coefficient memory can be divided into parts for the following material data:

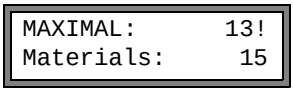
- material properties:
  - transversal and longitudinal sound velocity
  - typical roughness
- medium properties:
  - min. and max. sound velocity
  - kinematic viscosity
  - density
  - gas compressibility factor

For the max. number of data sets for each category of these material data see Table 14.1.

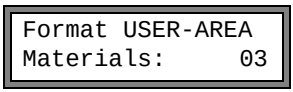
Table 14.1: Capacity of the coefficient memory

	max. number of data sets	occupancy of the coefficient memory in %
materials	13	97
media	13	97

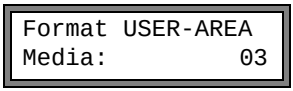
Select `Special Funct.\SYSTEM settings\ Libraries\Format USER-AREA`. Press ENTER.



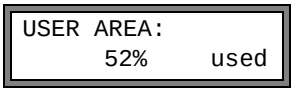
This error message will be displayed if the entered number of data sets for a category of material data exceeds the capacity of the coefficient memory.



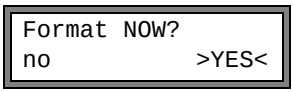
Enter the number of the user defined materials. Press ENTER.



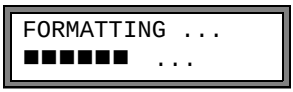
Enter the number of the user defined media. Press ENTER.



The occupancy of the coefficient memory is displayed for a few seconds.



Select yes to start the partitioning. Press ENTER.



The coefficient memory will partitioned accordingly. This procedure takes a few seconds.

After the partitioning, Format USER-AREA is displayed again.

14.1.1 Data Retention during Formatting of the Coefficient Memory

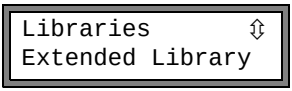
When the coefficient memory is repartitioned, max. 8 data sets of each type can be retained.

example 1: The number of user defined materials is reduced from 5 to 3. The data sets #01 to #03 are retained. . The data sets #04 and #05 are deleted.

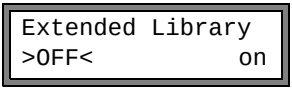
example 2: The number of user defined materials is increased from 5 to 6. All 5 data sets are kept.

14.2 Input of Material/Medium Properties without the Extended Library

To enter the material/medium properties as constants, the extended library must be deactivated.



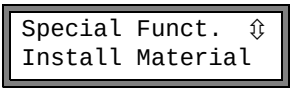
Select `Special Funct.\SYSTEM settings\Libraries\Extended Library`. Press ENTER.



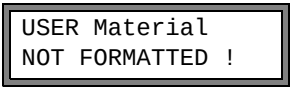
Select `off` to deactivate the extended library. Press ENTER.

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, displays for a medium will only be shown and described in case of differences.

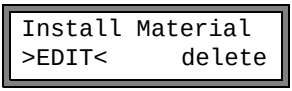


Select `Special Funct.\Install Material` or Install Medium. Press ENTER.

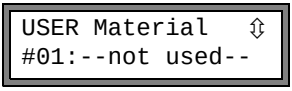


This error message will be displayed if the coefficient memory does not contain an area for user defined materials/media.

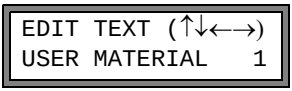
Partition the coefficient memory accordingly (see section 14.1).



Select `edit`. Press ENTER.



Select a user defined material/medium. Press ENTER.

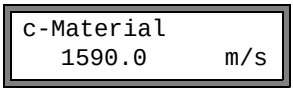


Change the designation of the material/medium.

The default name for a user defined material/medium is `USER MATERIAL N` or `USER Medium N` with `N` being an integer.

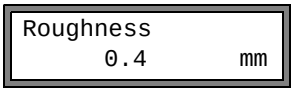
Note!	95 ASCII characters (letters, capital letters, numbers, special characters [!? " + - ( ) > < % * etc.]) are available for the designation of materials/media. A designation can have max. 16 characters. The input of text is described in section 3.4.

Material Properties



Enter the sound velocity of the material. Press ENTER.

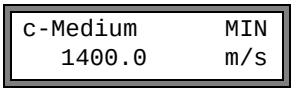
For the sound velocity of some materials see annex C, Table C.1.



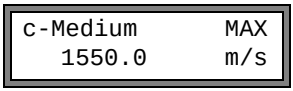
Enter the roughness of the material. Press ENTER.

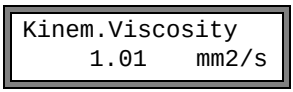
For the typical roughness of some materials see annex C, Table C.2.

Medium Properties



Enter the min. and max. sound velocity of the medium. Press ENTER.





Enter the kinematic viscosity of the medium. Press ENTER.

Enter the density of the medium. Press ENTER.

14.3 Extended Library

14.3.1 Introduction

If the extended library is activated, it is possible to enter material and medium properties as a function of the temperature or of the pressure. These data can be entered into the transmitter directly or by means of the program FluxKoef.

Table 14.2: Material and medium properties that can be stored

property	property is necessary for
material property	
transversal sound velocity	flow measurement
longitudinal sound velocity	flow measurement
type of sound wave	flow measurement
typical roughness	profile correction of the flow velocity
medium property	
sound velocity	start of measurement
viscosity	profile correction of the flow velocity
density	calculation of mass flow rate
gas compressibility factor	standard volumetric flow rate

Enter only the properties needed for the measuring task.

The dependency of the material/medium properties from the temperature and pressure can be described

- as constants
- as linear function
- with polynomials of grade 1 to 4
- with customized interpolation functions

In most cases, constants or a linear function are sufficient.

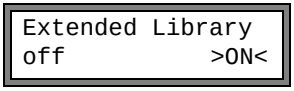
If e.g. the temperature fluctuations at the measuring point are low compared to the temperature dependency of the material properties, the linearization or the complete neglect of the temperature dependency will not result in a considerable additional measuring error.

If, however, the process conditions fluctuate strongly and the medium properties depend strongly on the temperature (e.g. viscosity of a hydraulic oil), polynomials or customized interpolation functions should be used. Contact FLEXIM to find the best solution for the measuring task.

Customized Interpolation Functions

Some dependencies are only approximated insufficiently by polynomials. A number of customized interpolation functions `Basics: Y=F(X,Z)` are available to interpolate multidimensional dependencies y = f(T, p). Contact FLEXIM for more information.

14.3.2 Activation of the Extended Library



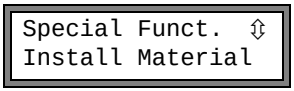
Select `Special Funct.\SYSTEM settings\ Libraries\Extended Library`. Press ENTER.

Select `on` to activate the extended library. Press ENTER.

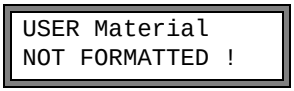
14.3.3 Input of Material/Medium Properties

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, the displays for a medium will only be shown and described in case of differences.

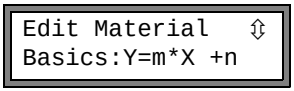


Select `Special Funct.\Install Material` or `Install Medium`. Press ENTER.



An error message will be displayed if the coefficient memory does not contain an area for user defined materials/ media.

Partition the coefficient memory accordingly (see section 14.1).



Select the function for the temperature or pressure dependency of the material/medium properties:

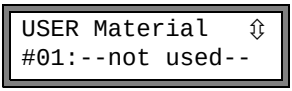
`Y=const.`: constants

`Y=M*X+N`: linear function of the temperature

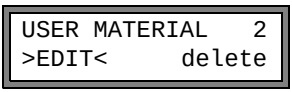
`Y=Polynom`: $y = k_0 + k_1 \cdot x + k_2 \cdot x^2 + k_3 \cdot x^3 + k_4 \cdot x^4$

`Y=F(X,Z)`: customized interpolation function (only for experienced users or after consultation with FLEXIM)

`go back`: return to the precedent menu item

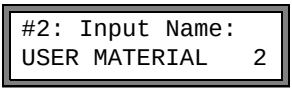


Select a user defined material/medium.



Select `edit` to edit the material/medium properties or `delete` to delete the material/medium and to return to the scroll list `Edit Material` or `Edit Medium`.

This display will only be indicated if an already existing material/medium has been selected.



Enter the designation of the material/medium. Press ENTER.

The default name for a user defined material/medium is `USER MATERIAL N` or `USER Medium N` with `N` being an integer.

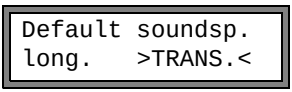
Material Properties

Enter the material's:

- transversal sound velocity
- longitudinal sound velocity

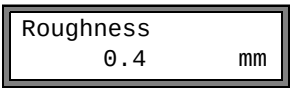
1...5 values depending on the selected function must be entered. Press ENTER after each input.

If an already defined material is edited, for each property there will be a request whether it is to be edited. Select `yes` or `no`. Press ENTER. Change the values, if necessary.

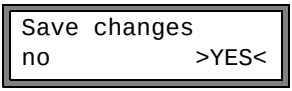


Select the type of sound wave to be used for the flow measurement. Press ENTER.

For most materials, a transversal sound wave must be selected.



Enter the typical roughness of the material. Press ENTER.



Select `yes` to store the entered properties or `no` to quit the menu item without storing. Press ENTER.

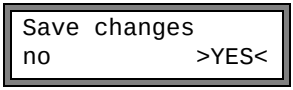
Medium Properties

Enter the medium's:

- longitudinal sound velocity
- kinematic viscosity
- density
- gas compressibility factor

Depending on the selected function, 1...5 values must be entered. Press ENTER after each input.

If an already defined medium is edited, for each property of some of the functions there will be a request whether it is to be edited. Select `yes` or `no`. Press ENTER. Change the values, if necessary.



Select `yes` to store the entered properties, `no` to quit the menu item without storing. Press ENTER.

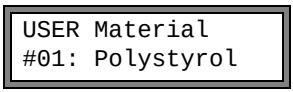
14.4 Deleting a User Defined Material/Medium

To delete a user defined material/medium, proceed as follows:

Select `Special Funct.\Install Material` or `Install Medium`. Press ENTER.

If the extended library is activated, press ENTER until the request for deleting is displayed.

Select `delete`. Press ENTER.



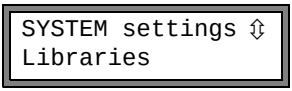
Select the material/medium to be deleted. Press ENTER.

Select `yes` or `no`. Press ENTER.

14.5 Arrangement of the Material/Medium Scroll List

The materials and media to be displayed in the program branch `Parameter` are arranged in the material scroll list and in the medium scroll list.

Note!	User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`.



Select `Special Funct.\SYSTEM settings\Libraries`. Press ENTER.

Select `Material list` to edit the material scroll list or `Medium list` to edit the medium scroll list.

Select `go back` to return to `SYSTEM settings`. Press ENTER.

Select `factory` if all materials/media of the internal database are to be displayed in the scroll list. An already existing scroll list will not be deleted but only deactivated.

Select `user` to activate the user defined scroll list. Press ENTER.

If `user` has been selected, the material or medium scroll list can be edited (see section 14.5.1...14.5.3).

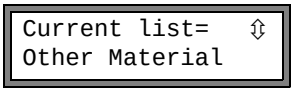
Select `End of Edit` to stop editing. Press ENTER.

Select `yes` to store all changes of the scroll list or `no` to quit the menu item without storing. Press ENTER.

Note!	If the material/medium scroll list is quit by pressing key BRK before storing, all changes will be lost.

14.5.1 Displaying a Scroll List

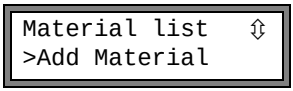
Select `Show list`. Press ENTER to display the scroll list as in the program branch `Parameter`.



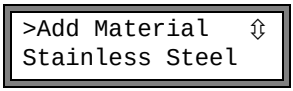
The current scroll list is displayed in the lower line.

Press ENTER to return to the scroll list `Material list` or `Medium list`.

14.5.2 Adding a Material/Medium to the Scroll List



Select `Add Material` or `Add Medium` to add a material/medium to the scroll list. Press ENTER.

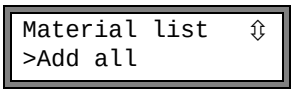


All materials/media that are not contained in the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be added to the scroll list.

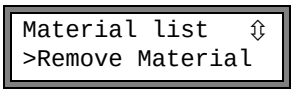
Note!	The materials/media are displayed in the order in which they have been added.

14.5.3 Adding all Materials/Media to the Scroll List

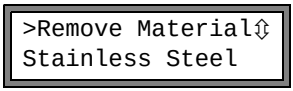


Select `Add all` to add all materials/media of the database to the current scroll list. Press ENTER.

14.5.4 Removing a Material/Medium from the Scroll List



Select `Remove Material` or `Remove Medium` to remove a material/medium from the scroll list. Press ENTER.

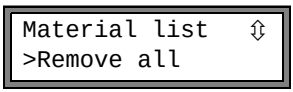


All materials/media of the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be removed from the scroll list.

Note!	User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`. They can not be removed.

14.5.5 Removing all Materials/Media from the Scroll List



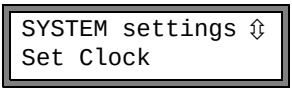
Select `Remove all` to remove all materials/media from the scroll list. Press ENTER. User defined materials/media will not be removed.

15 Settings

15.1 Time and Date

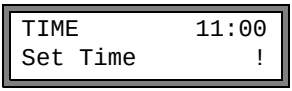
The transmitter has a battery-powered clock. Measured values are automatically stored with the date and time.

15.1.1 Time



Select Special Funct.\SYSTEM settings\Set Clock. Press ENTER.

The current time is displayed. Select ok to confirm the time or new to set the time. Press ENTER.



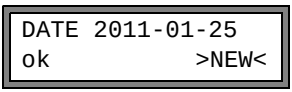
Select the digit to be edited with key 4 and 6.

Edit the selected digit with key 8 and 2. Press ENTER.

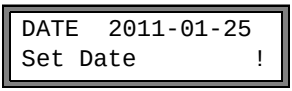
The new time is displayed. Select ok to confirm the time or new to set the time again. Press ENTER.

15.1.2 Date

After the time has been set, DATE is displayed.

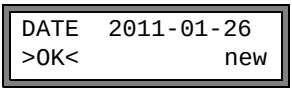


Select ok to confirm the date or new to set the date. Press ENTER.



Select the digit to be edited with key 4 and 6.

Edit the selected digit with key 8 and 2. Press ENTER.



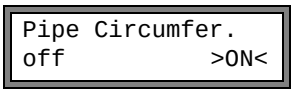
The new date is displayed. Select ok to confirm the date or new to set the date again. Press ENTER.

15.2 Dialogs and Menus

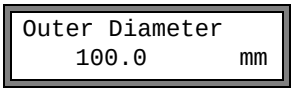
Select `Special Funct.\SYSTEM settings\Dialogs/Menus`. Press ENTER.

Note!	The settings of the menu item `Dialogs/Menus` will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.

15.2.1 Pipe circumference

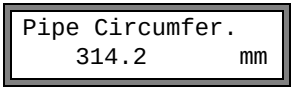


Select on if the pipe circumference is to be entered instead of the pipe diameter in the program branch `Parameter`. Press ENTER.



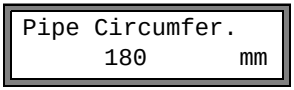
If on has been selected for `Pipe Circumfer.`, the outer pipe diameter will nevertheless be requested in the program branch `Parameter`.

To select the menu item `Pipe Circumfer.`, enter `0` (zero). Press ENTER.

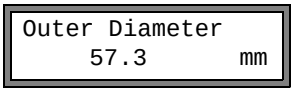


The value displayed in `Pipe Circumfer.` is calculated on the basis of the last displayed value of the outer pipe diameter.

example: 100 mm * π = 314.2 mm



Enter the pipe circumference. The limits for the pipe circumference are calculated on the basis of the limits for the outer pipe diameter.



During the next scroll through the program branch `Parameter`, the outer pipe diameter that corresponds to the entered pipe circumference will be displayed.

example: 180 mm : π = 57.3 mm

Note!	The pipe circumference is only edited temporarily. When the transmitter switches back to the display of the pipe circumference (internal recalculation), slight rounding errors may occur.

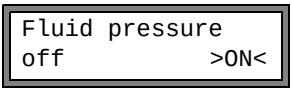
example: entered pipe circumference: 100 mm
displayed outer pipe diameter: 31.8 mm

When the transmitter switches back to the display of the pipe circumference, 99.9 mm will be displayed.

15.2.2 Medium Pressure

The dependency of the properties of a medium on the pressure can be taken into account.

This display will only be indicated if `Special Funct.\SYSTEM settings\Measuring\Gas-Measuring` is deactivated. If `Gas-Measuring` is activated, the medium pressure will always be requested in the program branch `Parameter`..

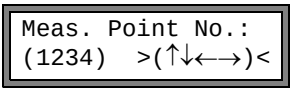


If `on` has been selected, the medium pressure will be requested in the program branch `Parameter`.

If `off` has been selected, 1 bar will be used for all calculations.

Note!	For documentation purposes, it is useful to enter the medium pressure, even if the transmitter contains no pressure-dependent characteristic curves.

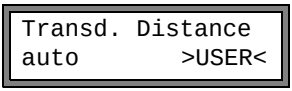
15.2.3 Measuring Point Number



Select `1234` if the measuring point is to be identified only by numbers, point and dash.

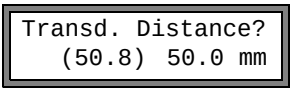
Select ↑↓←→ if the measuring point is to be identified by the ASCII editor.

15.2.4 Transducer Distance

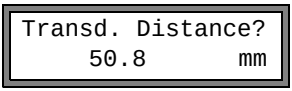


recommended setting: `user`

- `user` will be selected if the measuring point is always the same.
- `auto` can be selected if the measuring point changes often.



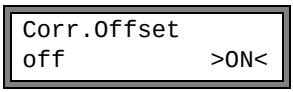
In the program branch `Measuring`, the recommended transducer distance will be displayed in parentheses, followed by the entered transducer distance if the recommended and the entered transducer distance are not identical.



During transducer positioning in the program branch `Measuring`

- only the entered transducer distance will be displayed if `Transd. Distance = user` has been selected and the recommended and the entered transducer distances are identical
- only the recommended transducer distance will be displayed if `Transd. Distance = auto` has been selected.

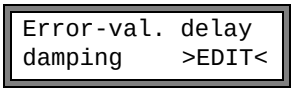
15.2.5 Temperature Correction



Select on to enable the input of a temperature correction for each temperature input (see section 17.5).

15.2.6 Error Value Delay

The error value delay is the time after which an error value will be sent to an output if no valid measured values are available.



Select edit to enter an error value delay. Select damping if the damping factor is to be used as the error value delay.

For further information on the behavior of missing measured values see section 18.1.2 and 18.2.

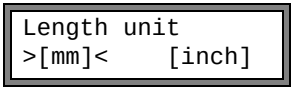
15.2.7 Alarm State Indication

Select on to display the alarm state during the measurement.

Fur further information on the alarm outputs see section 18.6.

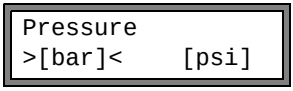
15.2.8 Preferred Units

It is possible to set the preferred units for the length, temperature and pressure:



Select mm or inch as the preferred unit for the length. Press ENTER.

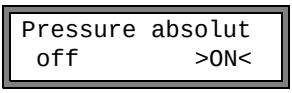
Select °C or °F as the preferred unit for the temperature. Press ENTER.



Select bar or psi as the preferred unit for the pressure. Press ENTER.

15.2.9 Setting for the Medium Pressure

It is possible to set whether the absolute or the relative pressure will be used:

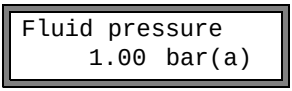


Select on or off. Press ENTER.

If on has been selected, the absolute pressure p_a will be displayed/input/output.

If off has been selected, the relative pressure p_g will be displayed/input/output.

$p_g = p_a - 1.01$ bar



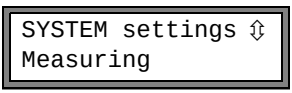
The pressure and its unit of measurement will e.g. be displayed in the program branch Parameter. It will be followed by the selected pressure, indicated in parentheses.

a - absolute pressure
g - relative pressure

Note!	The standard pressure in Special Funct.\SYSTEM settings\Gas-Measuring\Normal pressure is entered as the absolute pressure.

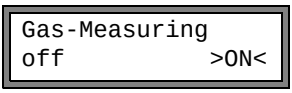
Note!	All changes will be stored now at the end of the dialog.

15.3 Measurement Settings

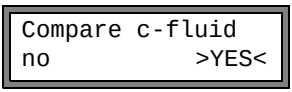


Select Special Funct.\SYSTEM settings\Measuring. Press ENTER.

Note!	The settings of the menu item Measuring will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.



Select on to activate the gas measurement, off to deactivate it. Press ENTER.

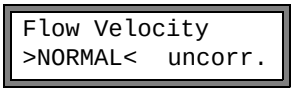


Select yes if the measured sound velocity is to be compared to the theoretical or expected value. The difference

$\Delta c = c_{mea} - c_{stored}$

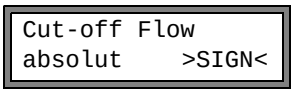
between the two sound velocities will be displayed during the measurement. c_{stored} is the sound velocity stored in the database.

Press key [DISP 9] during the measurement to scroll to the display of Δc.

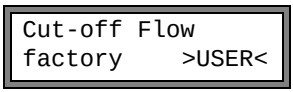


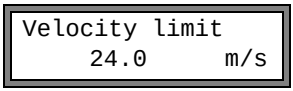
Select `normal` to display and output the profile corrected flow values, `uncorr.` to display and output the flow values without flow profile correction. Press ENTER.

Fur further information see section 12.5.



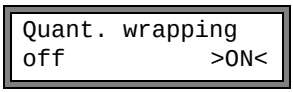
A lower limit for the flow velocity can be entered (see section 12.4).



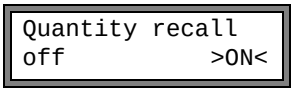


An upper limit for the flow velocity can be entered (see section 12.3).

Enter `0` (zero) to deactivate the flow velocity check.

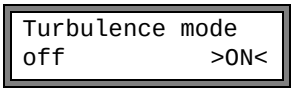


Select the overflow behavior of the totalizers (see section 12.2.2).



Select `on` to keep the previous totalizer values after a restart of the measurement.

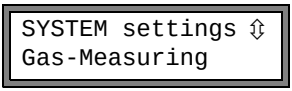
Select `off` to reset the totalizers to zero after a restart of the measurement.



The activation of the turbulence mode can improve the signal quality if the flow is highly turbulent (e.g. in the vicinity of an elbow or valve). An SNR value of min. 6 dB is required during the measurement.

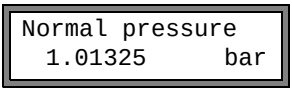
Note!	All changes will be stored now at the end of the dialog.

15.4 Settings of the Standard Conditions for the Gas Measurement

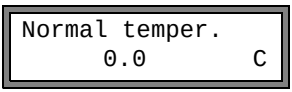


Select `Special Funct.\SYSTEM settings\Gas-Measuring`. Press ENTER.

This display will only be indicated if the gas measuring has been activated in `Special Funct.\SYSTEM settings\Measuring`.

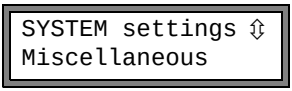


Enter the pressure for the local standard conditions.



Enter the temperature for the local standard conditions.

15.5 Setting the Contrast



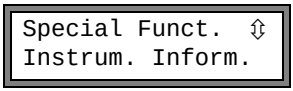
Select `Special Funct.\SYSTEM settings\ Miscellaneous` to set the contrast of the display of the transmitter. Press ENTER.

The contrast of the display is adjusted with the following keys:

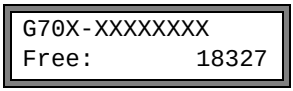
- **6** to increase the contrast
- **4** to decrease the contrast
- **2** = min. contrast
- **5** = medium contrast
- **8** = max. contrast

Note!	After a cold start, the display will be reset to medium contrast.

15.6 Instrument Information



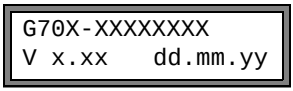
Select `Special Funct.\Instrum. Inform.` to display information about the transmitter. Press ENTER.



The type and the serial number of the transmitter will be displayed in the upper line.

The available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored).

Press ENTER.



The type and the serial number of the transmitter will be displayed in the upper line.

The firmware version of the transmitter with date is displayed in the lower line.

Press ENTER.

16 SuperUser-Mode

The SuperUser mode offers the possibility of an advanced analysis of the signal and the measured values as well as the definition of additional parameters adapted to the measuring point, in order to achieve better measuring values or during experimental work. Features of the SuperUser mode are:

- Defaults will not be observed.
- There are no plausibility checks when parameters are being entered.
- There is no check whether the entered parameters are within the limits determined by the laws of physics and technical data.
- The cut-off flow is not active.
- A value for the number of sound paths must be entered.
- Some menu items that are not visible in the normal the normal mode are displayed.

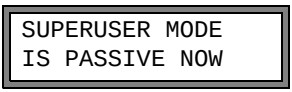
Attention!	The SuperUser mode is intended for experienced users with advanced application knowledge. The parameters can affect the normal measuring mode and lead to wrong measuring values or to a failure of the measurement when a new measuring point is set up.

16.1 Activation/Deactivation

Press key C. Enter HotCode 071049 .

It is displayed that the SuperUser mode is activated. Press ENTER. The main menu will be displayed.

Press key C. Enter HotCode 071049 again to deactivate the SuperUser mode.

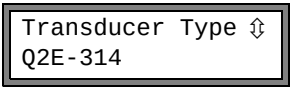


It is displayed that the SuperUser mode is deactivated. Press ENTER. The main menu will be displayed.

16.2 Transducer Parameters

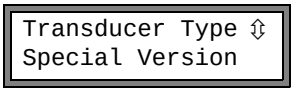
Attention!	Some of the defined parameters are still active after the deactivation of the SuperUser mode.

In the SuperUser mode, the menu item `Transducer Type` will be displayed at the end of the parameter input, even if the transducers are detected by the transmitter.

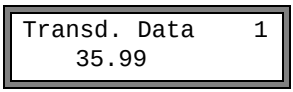


Press ENTER.

or



Select `Special Version` to enter the transducer parameters. Press ENTER.

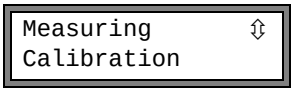


If `Special Version` has been selected, the transducer parameters must be entered.

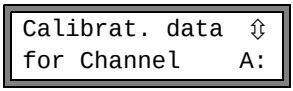
The transducer parameters must be provided by the transducer manufacturer. Press ENTER after each input.

16.3 Defining the Flow Parameters

In the SuperUser mode, it is possible to define some flow parameters (profile bounds, correction of the flow velocity) for the specific application or measuring point.

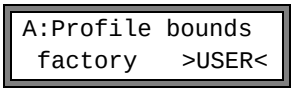


Select `Special Funct.\SYSTEM settings\Measuring\Calibration`. Press ENTER.



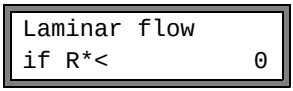
Select the measuring channel for which the flow parameters are to be defined. Press ENTER.

16.3.1 Profile Bounds



Select `user` if the profile bounds are to be defined. If `factory` is selected, the default profile bounds will be used and the menu item `Calibration` will be displayed (see section 16.3.2).

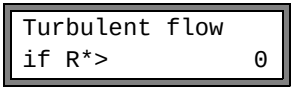
Press ENTER.



Enter the max. Reynolds number at which the flow is laminar. The entered number will be rounded to the hundreds. Enter `0` (zero) to use the default value.

range: 0...25 500
default: 1 000

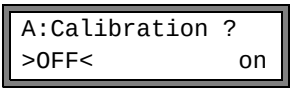
Press ENTER.



Enter the min. Reynolds number at which the flow is turbulent. The entered number will be rounded to the hundreds. Enter `0` (zero) to use the default value.

range: 0...25 500
default: 3 000

Press ENTER.



A request is displayed if an additional correction of the flow velocity is to be defined. Select `on` to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.

For the definition of the correction of the flow velocity see section 16.3.2.

example: profile bound for the laminar flow: 1 500
profile bound for the turbulent flow: 2 500

At Reynolds numbers < 1 500, the flow during the measurement is regarded as laminar for the calculation of the physical quantity. At Reynolds numbers > 2 500, the flow is regarded as turbulent. The range 1 500...2 500 is the transition range between laminar and turbulent flow.

Attention!	The defined profile bounds are still active after the deactivation of the SuperUser mode.

16.3.2 Correction of the Flow Velocity

After the profile bounds have been defined (see section 16.3.1), it is possible to define a correction of the flow velocity.

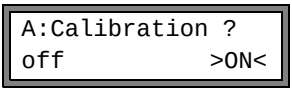
$v_{cor} = m \cdot v + n$

with

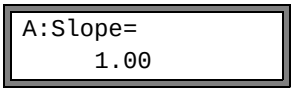
v - measured flow velocity
m - slope, range: -2.000...+2.000
n - offset, range: -12.7...+12.7 cm/s
v_{cor} - corrected flow velocity

All quantities derived from the flow velocity will be calculated with the corrected flow velocity. The correction data will be transmitted to the PC or printer during the online or offline output.

Note!	During the measurement, it will not be displayed that the correction of the flow velocity is active.



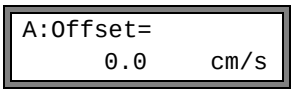
Select `on` to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.



If on has been selected, enter the slope. If 0.0 is entered, the correction will be deactivated.

range: -2.000...+2.000

Press ENTER.



Enter the offset. Enter 0 (zero) to work without an offset.

range: -12.7...+12.7 cm/s

Press ENTER.

example 1: Slope: 1.1
Offset: -10.0 cm/s = -0.1 m/s

If a flow velocity v = 5 m/s is measured, before the calculation of the derived quantities, it will be corrected as follows:

$v_{cor} = 1.1 \cdot 5 \text{ m/s} - 0.1 \text{ m/s} = 5.4 \text{ m/s}$

example 2: Slope: -1.0
Offset: 0.0

Only the sign of the measured values is changed.

Note!	The correction data will only be stored when a measurement is started. If the transmitter is switched off without starting a measurement, the entered correction data will be lost.

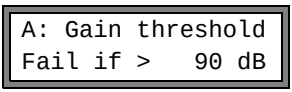
Attention!	The correction of the flow velocity is still active after the deactivation of the SuperUser mode.

16.4 Limit of the Signal Amplification

In order to prevent disturbing and/or pipe wall signals (e.g. if the pipe has run empty) from being interpreted as useful signals, it is possible to define a max. signal amplification. If the signal amplification is greater than the max. signal amplification,

- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red
- a hash symbol "**#**" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed).

Select `Special Funct./SYSTEM settings/Measuring/Miscellaneous`. Press ENTER until the menu item `Gain threshold` is displayed.



Enter for each measuring channel the max. signal amplification. Enter `0` (zero) if no limit of the signal amplification is to be used.

range: 0...255

Press ENTER.

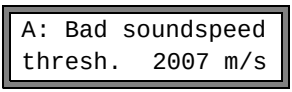
Attention!	The limit of the signal amplification is still active after the deactivation of the SuperUser mode.

16.5 Upper Limit of the Sound Velocity

When the plausibility of the signal is evaluated, it will be checked if the sound velocity is within a defined range. The upper limit used for the evaluation is the greater of the following values:

- fixed upper value, default: 1 848 m/s
- value of the sound velocity curve of the medium at the operating point plus offset, default offset: 300 m/s

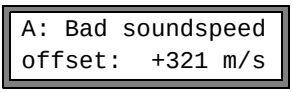
In the SuperUser mode, the values can be defined for media that are not contained in the data set of the transmitter. Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Bad soundspeed` is displayed.



Enter for each measuring channel the fixed upper level of the sound velocity. Enter `0` (zero) to use the default value.

range: 0...3 000 m/s
default: 1 848 m/s

Press ENTER.



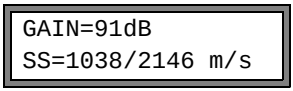
Enter for each measuring channel the offset. Enter `0` (zero) to use the default value.

rangeich: 0...900 m/s
default: 300 m/s

Press ENTER.

example: fixed upper value of the sound velocity `thresh.`: 2 007 m/s
`offset:` 600 m/s
value of the sound velocity curve at the operating point: 1 546 m/s

As 1 546 m/s + 600 m/s = 2 146 m/s is greater than the fixed upper value 2 007, this value will be used as the upper limit of the sound velocity when the plausibility of the signal is evaluated.



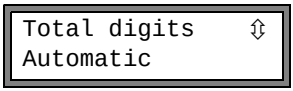
It is possible to display the valid range for the sound velocity (SS=) in the lower line during the measurement. The second value (here: 2 146 m/s) is the upper limit at the operating point.

Attention!	The defined upper limit of the sound velocity is still active after the deactivation of the SuperUser mode.

16.6 Number of Decimal Places of the Totalizers

The values of the totalizers can be displayed with up to 11 places, e.g. 74890046.03. In the SuperUser mode, it is possible to define the number of decimal places.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Total digits` is displayed.



Select one of the following list items.

`Automatic`: dynamic adjustment
`Fixed to x digit`: x decimal places (range: 0...4)

Press ENTER.

Total digits = Automatic

The number of decimal places will be adjusted dynamically. Low values will first be displayed with 3 decimal places. With greater values, the number of decimal places will be reduced.

max. value	display
$< 10^6$	±0.00 ... ±999999.999
$< 10^7$	±1000000.00 ... ±9999999.99
$< 10^8$	±10000000.0 ... ±99999999.9
$< 10^{10}$	±1000000000 ... ±9999999999

Total digits = Fixed to x digit

The number of decimal points is constant. The max value of the totalizer is reduced with each additional decimal place.

decimal places	max. value	max. display
0	$< 10^{10}$	±9999999999
1	$< 10^8$	±99999999.9
2	$< 10^7$	±9999999.99
3	$< 10^6$	±999999.999
4	$< 10^5$	±99999.9999

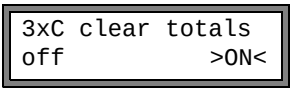
Note!	The number of decimal places and the max. value defined here only affect the display of the totalizers.

For setting the behavior of the totalizers when the max. value is reached see section 12.2.2.

16.7 Manual Reset of the Totalizers

If the manual reset of the totalizers is activated, the totalizers can be reset to zero during the measurement by pressing key C three times, even if a program code is activated.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `3xC clear totals` is displayed.



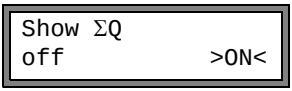
Select `on` to activate the manual reset of the totalizers, `off` to deactivate it. Press ENTER.

Note!	The manual reset of the totalizers is still active after the deactivation of the SuperUser mode.

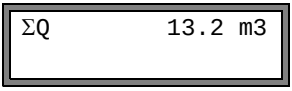
16.8 Display of the Sum of the Totalizers

The sum of the totalizers for the two flow directions can be displayed in the upper line during the measurement.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Show ΣQ` is displayed.



Select `on` to activate the display of the sum of the totalizers, `off` to deactivate it. Press ENTER.



If the display of the sum of the totalizers is activated, the sum `ΣQ` can be displayed in the upper line during the measurement.

16.9 Display During the Measurement

In the SuperUser mode, the following information can be displayed during the measurement besides the normal information (see section 11.3):

- absolute transit time of the measuring signal
- sound velocity
- Reynolds number
- variance of the measuring signal
- range of the sound velocity
- signal amplification

17 Inputs

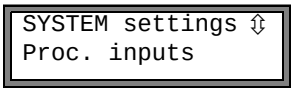
External transducers can be connected to the inputs (optional) to measure the following physical quantities:

- temperature
- density
- pressure
- kinematic viscosity
- dynamic viscosity

The values of the current, voltage, and temperature inputs can be used by all measuring channels.

An input must be assigned to a measuring channel (see section 17.1 and 17.3) and activated (see section 17.4) before it can be used for the measurement and for the storing of measured values.

Note!	If a new input module has been installed, the transmitter must be restarted (RESET) in order for the new inputs to be identified.



Select `Special Funct.\SYSTEM settings\Proc. inputs`.

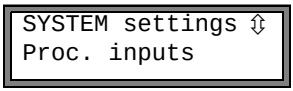
Depending on the configuration of the transmitter, one or several of the following list items will be displayed:

Table 17.1: List items for `Proc. inputs`

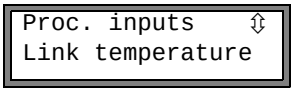
list item	function
`Link temperature`	assigning of the temperature inputs to the measuring channels
`Link other inp.`	assigning of other inputs to the measuring channels
`PT100/PT1000`	selection of a temperature probe
`...go back`	return to the precedent menu item

17.1 Assigning the Temperature Inputs to the Measuring Channels

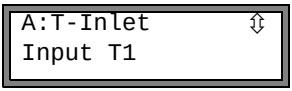
17.1.1 Assignment of the Temperature Inputs



Select `Special Funct.\SYSTEM settings\ Proc. inputs`. Press ENTER.



Select the list item `Link temperature`.



Select the temperature input to be assigned to measuring channel A as the supply temperature.

Select the list item `Fixed input val.` if the temperature is to be entered manually before the measurement.

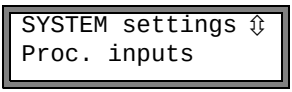
Select the list item `No measuring` if no supply temperature is to be assigned to measuring channel A.

Press ENTER.

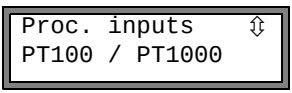
Select the list items for `T-Fluid/Outle`, `T(3)` and `T(4)` of measuring channel A and the other activated channels accordingly. Press ENTER after each input.

Note!	The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel must be finished to store the changes.

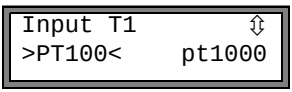
17.2 Selection of the Temperature Probe



Select `Special Funct.\SYSTEM settings\Proc. inputs`. Press ENTER.



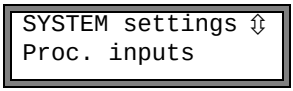
Select the list item `PT100/PT1000`.



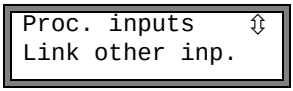
Select the temperature probe.

If necessary, select the temperature probe for `Input T2...T4` accordingly.

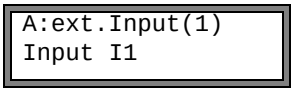
17.3 Assignment of Other Inputs to the Measuring Channels



Select `Special Funct.\SYSTEM settings\Proc. inputs`. Press ENTER.



Select the list item `Link other inp.`.



Select the first input to be assigned to measuring channel A. Only the installed inputs are displayed in the scroll list.

Select the list item `No measuring` if no input is to be assigned to measuring channel A.

Press ENTER.

Select the list items for `ext.Input(2)...(4)` of measuring channel A and the other activated channels accordingly.

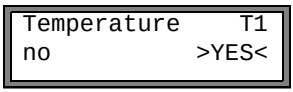
Note!	The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel has to be finished to store the changes.

17.4 Activation of the Inputs

The activation of the inputs in program branch `Output Options` will only be displayed if the transmitter has inputs of the corresponding type and they have been assigned to a measuring channel.

17.4.1 Activation of the Temperature Inputs

Temperature inputs must be activated if the measured temperatures are to be displayed, stored and/or output or if the measured temperature is to be used for the interpolation of the viscosity and the density of the medium.



Select in the program branch `Output Options` the channel for which a temperature input has to be activated.

The temperature inputs assigned to the channel will be displayed one after another. Select `yes` for the temperature inputs that are to be activated.

Note!	The total number of measured values that can be stored will be reduced if a temperature input is activated.

17.4.2 Activation of Other Inputs

Attention!	Observe the correct polarity to avoid damaging the current source. A permanent short circuit can lead to the destruction of the current input.

Inputs must be activated if the measured values are to be displayed, stored and/or output together with the other measured values.

In the program branch `Output Options`, select the channel for which an input is to be activated.

The inputs assigned to the channel will be displayed one after another. Select `yes` for the inputs that are to be activated.

Note!	The total number of measured values that can be stored will be reduced if an input is activated.

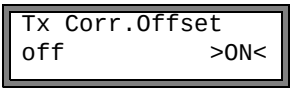
17.5 Temperature Correction

A temperature correction value (offset) can be set for each temperature input. If a correction value has been defined, it will be added automatically to the measured temperature. This function is useful if e.g.:

- the characteristic curves of the two temperature probes differ considerably from each other.
- a known and constant temperature gradient exists between the measured temperature and the actual temperature.

17.5.1 Activation/Deactivation of the Temperature Correction

The temperature correction can be activated/deactivated in program branch `Special Funct.\SYSTEM settings\Dialogs/Menus`.

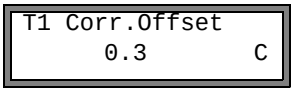


Select `on` to activate the temperature correction, `off` to deactivate it.

Note!	If `off` is selected, the temperature correction will be deactivated for all inputs. However, the entered correction values for each temperature input will be stored and displayed again when the temperature correction is activated again.

17.5.2 Input of the Temperature Correction

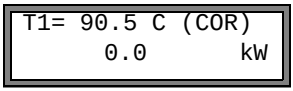
During the flow transducer positioning, the correction values will be requested for each input which has been activated and where the temperature can be measured.



Enter the offset for the temperature input.

Press ENTER.

Note!	Only measured temperatures can be corrected. In order to adjust the zero point, the same reference temperature is measured with the two temperature probes. The difference between the two measured temperatures is entered as the offset for one of the temperature inputs. The difference can also be distributed between the offsets of the two channels. The display of the temperature difference T1-T2 does not indicate if one or both temperatures are constant or if the values have been corrected.



During the measurement, a corrected temperature value is marked by `cor`.

18 Outputs

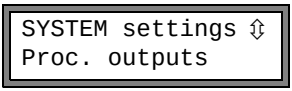
If the transmitter is equipped with outputs, they have to be installed and activated before they can be used:

- assign a measuring channel (source channel) to the output (if the transmitter has more than one measuring channel)
- assign the physical quantity (source item) to be transmitted to the output by the source channel, and the properties of the signal
- define the behavior of the output in case no valid measured values are available
- activate of the installed output in the program branch `Output Options`

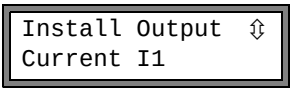
18.1 Installation of an Output

All outputs are installed in `Special Funct.\SYSTEM settings\Proc. outputs`.

Note!	The configuration of an output will be stored at the end of the dialog. If the dialog is quit by pressing key BRK, the changes will not be stored.

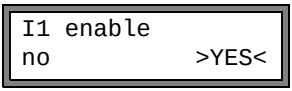


Select `Special Funct.\SYSTEM settings\Proc. outputs`. Press ENTER.

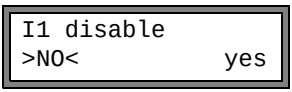


Select the output to be installed. Press ENTER.

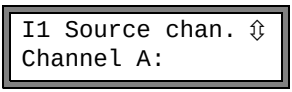
The scroll list contains all available outputs. A tick ✓ after a list item indicates that this output has already been installed.



This display will be indicated if the output has not been installed yet. Select `yes`. Press ENTER.

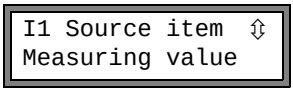


If the output has already been installed, select `no` to reconfigure it or `yes` to uninstall the output and to return to the previous menu item to select another output. Press ENTER.



Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel or only one measuring channel is active.



Select the physical quantity (source item) to be transmitted from the source channel to the output.

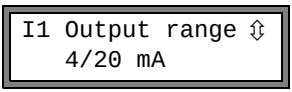
If a binary output is configured, only the list items `Limit` and `Impuls` will be displayed.

The source items and their scroll lists are shown in Table 18.1.

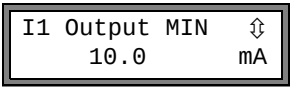
Table 18.1: Configuration of the outputs

source item	list item	output
`Measuring value`	`actual measure`	physical quantity selected in the program branch `Output Options`
	`Flow`	flow, independently of the physical quantity selected in the program branch `Output Options`
`Quantity`	`Q+`	totalizer for the positive flow direction
	`* actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	`* Flow`	flow totalizer
	`Q-`	totalizer for the negative flow direction
	`* actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	`* Flow`	flow totalizer
	`ΣQ`	sum of the totalizers (positive and negative flow direction)
	`* actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	`* Flow`	flow totalizer
`Limit`	`R1`	limit message (alarm output R1)
	`R2`	limit message (alarm output R2)
	`R3`	limit message (alarm output R3)
`Temperature`		Is only available if a temperature input has been assigned to the channel.
	`T-Inlet (T1)`	supply temperature
	`T-Outlet (T2)`	return temperature
	`T(3)=EINGANG T3`	further temperature input
	`T(4)=INPUT T4`	further temperature input
	`TV(=T1)-TR(=T2)`	difference between supply and return temperature
	`TV(=T1)-T3`	difference between supply temperature and T(3)
	`TR(=T2)-T3`	difference between return temperature and T(3)
	`TV(=T1)-T4`	difference between supply temperature and T(4)
	`TR(=T2)-T4`	difference between return temperature and T(4)
	`T3-T4`	difference between T(3) and T(4)
`Impuls`	`from abs(x)`	pulse without sign consideration
	`from x > 0`	pulse for positive measured values
	`from x < 0`	pulse for negative measured values
`Miscellaneous`	`c-Medium`	sound velocity of the medium
	`Signal`	signal amplitude of a measuring channel

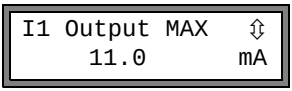
18.1.1 Output Range

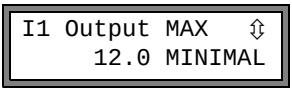


When configuring an analog output, the output range will be defined now. Select a list item or `other range...` to enter the output range manually.



If `other range...` has been selected, enter the values `Output MIN` and `Output MAX`. Press ENTER after each input.





This error message will be displayed if the output range is not min. 10 % of the max. output range. The next possible value will be displayed. Repeat the input.

example: $I_{MAX} - I_{MIN} \geq 2$ mA for a 4…20 mA current output

18.1.2 Error Output

In the following dialog, an error value can be defined which is to be output if the source item can not be measured e.g. if there are solids in the medium.

Table 18.2: Error output

error value	result
`Minimum`	output of the lower limit of the output range
`Hold last value`	output of the last measured value
`Maximum`	output of the upper limit of the output range
`Other value...`	The value must be entered manually. It must be within the limits of the output.

example: source item: volumetric flow rate
output: current output
output range: 4…20 mA
error value delay t_d (see section 18.2): > 0

The volumetric flow rate can not be measured during the time interval t_0...t_1 (see Fig. 18.1). The error value will be output.

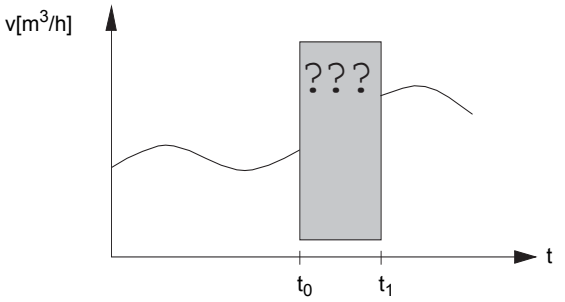


Fig. 18.1: Error output

Table 18.3: Examples for the error output

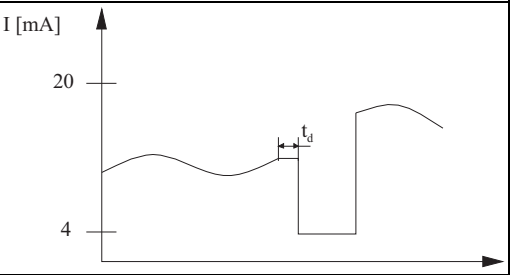
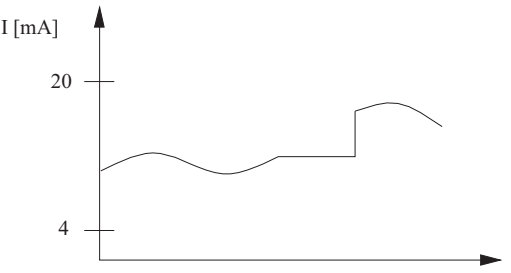
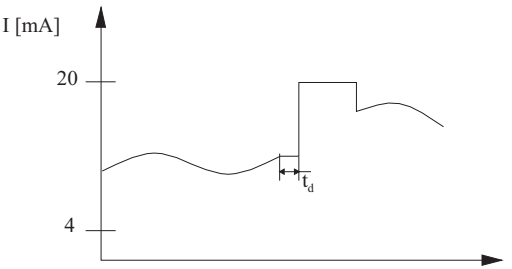
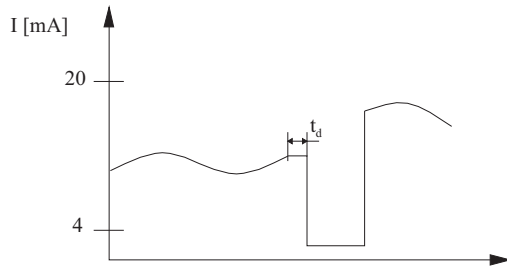
list item for the error output	output signal
Error-value ⇳ Minimum (4.0mA)	
Error-value ⇳ Hold last value	

Table 18.3: Examples for the error output

list item for the error output	output signal
Error-value ⇳ Maximum (20.0mA)	
Error-value ⇳ Other value... error output = 2 mA	

Error-value ⇳
Minimum (4.0mA)

Select a list item for the error output. Press ENTER.

Error-value
3.5 mA

If `Other value` has been selected, enter an error value. It has to be within the limits of the output.

Press ENTER.

Note!	The settings will be stored now at the end of the dialog.

I1 active loop
Terminal:P1+,P1-

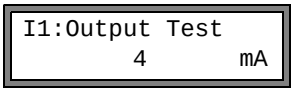
The terminals for the connection of the output are displayed (here: `P1+` and `P1-` for the active current loop).

Press ENTER.

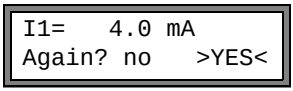
18.1.3 Function Test

The function of the installed output can now be tested. Connect a multimeter to the installed output.

Test of the Analog Outputs



The current output is tested in the display. Enter a test value. It has to be within the output range. Press ENTER.

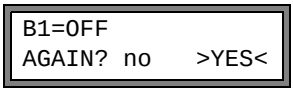


If the multimeter displays the entered value, the output functions correctly.

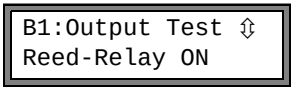
Select `yes` to repeat the test, `no` to return to `SYSTEM settings`. Press ENTER.

Test of the Binary Outputs

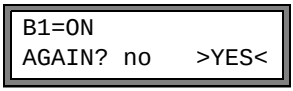
Select `Reed-Relay OFF` or `Open collect OFF` in the scroll list `Output Test` to test the de-energized state of the output. Press ENTER. Measure the resistance at the output. The value has to be high ohmic.



Select `yes`. Press ENTER.



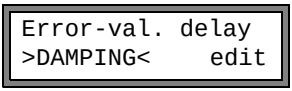
Select `Reed-Relay ON` or `Open collect. ON` in the scroll list `Output Test` to test the energized state of the output. Press ENTER. Measure the resistance at the output. The value has to be low ohmic.



Select `yes` to repeat the test, `no` to return to `SYSTEM settings`. Press ENTER.

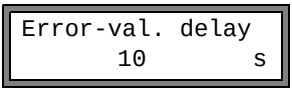
18.2 Error Value Delay

The error value delay is the time interval after which the error value will be transmitted to the output in case no valid measured values are available. The error value delay can be entered in the program branch `Output Options` if this menu item has been previously activated in the program branch `Special Funct.`. If the error value delay is not entered, the damping factor will be used.



Select `Special Funct.\SYSTEM settings\Dialogs/Menus\Error-val. delay`.

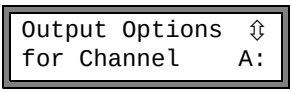
Select `Damping` if the damping factor is to be used as the error value delay. Select `edit` to activate the menu item Error-val. delay in the program branch `Output Options`.



From now on, the error value delay can be entered in the program branch `Output Options`.

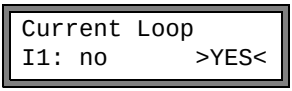
18.3 Activation of an Analog Output

Note!	An output can only be activated in the program branch `Output Options` if it has been previously installed.



In the program branch `Output Options`, select the channel for which an output is to be activated. Press ENTER.

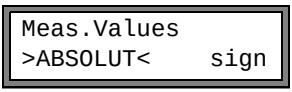
This display will not be indicated, if the transmitter has only one measuring channel.



Press ENTER until `Current Loop` is displayed. Select `yes` to activate the output. Press ENTER.

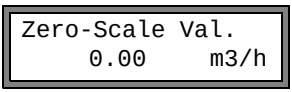
18.3.1 Measuring Range of the Analog Outputs

After an analog output has been activated in the program branch `Output Options`, the measuring range of the source item must be entered.



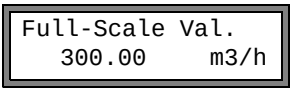
Select `sign` if the sign of the measured values is to be considered for the output.

Select `absolut` if the sign is not to be considered.



Enter the lowest expected measured value. The unit of measurement of the source item will be displayed.

`Zero-Scale Val.` is the measured value that corresponds to the lower limit of the output range as defined in section 18.1.1.



Enter the highest expected measured value.

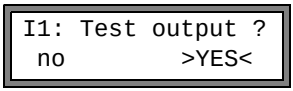
`Full-Scale Val.` is the measured value tha corresponds to the upper limit of the output range as defined in section 18.1.1.

example: output: current output
output range: 4…20 mA
Zero-Scale Val.: 0 m^3/h
Full-Scale Val.: 300 m^3/h

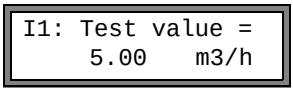
volumetric flow rate = 0 m^3/h, corresponds to 4 mA
volumetric flow rate = 300 m^3/h, corresponds to 20 mA

18.3.2 Function Test

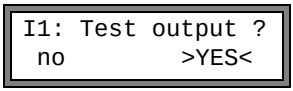
The function of the installed output can now be tested. Connect a multimeter to the installed output.



Select yes to activate the output. Press ENTER.



Enter a test value. The value must be indicated on the connected multimeter. Press ENTER.

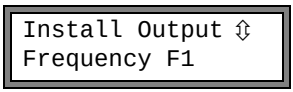


Select yes to repeat the test. Press ENTER.

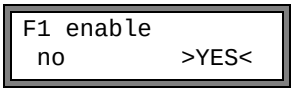
18.4 Configuration of a Frequency Output as a Pulse Output

A frequency output sends a signal with a frequency that depends on the volume flow rate. The frequency output can be configured in such way that the source item can be totalized by using each period of the output signal as the increment.

Installation of a frequency output (optional):

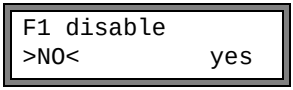


Select Frequency F1 in Special Funct.\SYSTEM settings\Proc. outputs. Press ENTER.

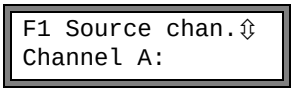


Select yes if the output has not been installed. Press ENTER.

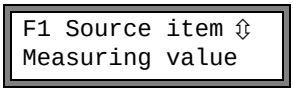
or



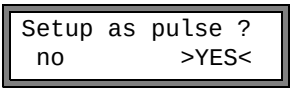
Select no if the output has already been installed. Press ENTER.



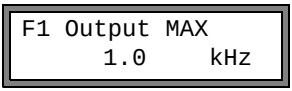
Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER.



Select in the scroll list Measuring value (but not Impuls!). Press ENTER.



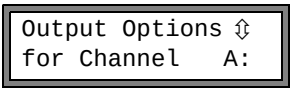
If Measuring value has been selected and the source item can be totalized, a request will be indicated whether the frequency output is to be configured as a pulse output. Select yes. Press ENTER.



Enter the upper limit of the frequency. Press ENTER.

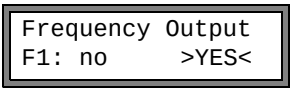
The lower limit of the frequency and the error value will be set automatically to 0.5 Hz.

Activation of the output:

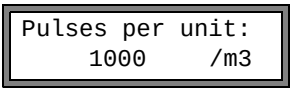


In the program branch Output Options, select the channel for which the input is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

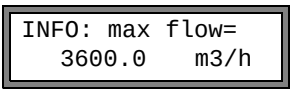


Select yes to activate the output. Press ENTER.



Enter the number of pulses that is to be assigned to the unit of measurement of the totalizer. Press ENTER.

Example: 1000 pulses correspond to 1 m^3 of the totalized medium.

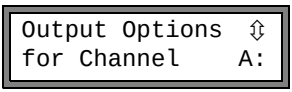


The max. flow depending on the upper limit of the frequency and pulse value is indicated. Press ENTER.

18.5 Activation of a Binary Output as a Pulse Output

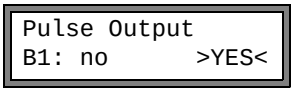
A pulse output is an integrating output which emits a pulse when the volume or the mass of the medium which has passed the measuring point reaches a given value (Pulse Value). The integrated quantity is the selected physical quantity. Integration is restarted as soon as a pulse is emitted.

Note!	The menu item Pulse Output will only be indicated in the program branch Output Options if a pulse output has been installed.

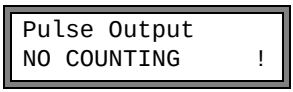


Select in the program branch Output Options the channel for which a pulse output is be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

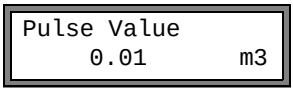


Select yes to activate the output. Press ENTER.



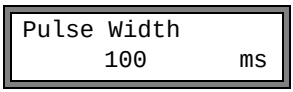
This error message will be displayed if the flow velocity has been selected as the physical quantity.

The use of the pulse output is not possible in this case because integrating the flow velocity does not result in a reasonable value.



Enter the pulse value. The unit of measurement will be displayed according to the current physical quantity.

When the totalized physical quantity reaches the pulse value, a pulse will be emitted.



Enter the pulse width.

The range of possible pulse widths depends on the specification of the instrument (e.g. counter, PLC) that is to be connected to the output.

The max. flow that the pulse output can work with will be displayed now. This value is calculated on the basis of the entered pulse value and pulse width.

If the flow exceeds this value, the pulse output will not function properly. In this case, the pulse value and the pulse width must be adapted to the flow conditions. Press ENTER.

18.6 Activation of a Binary Output as an Alarm Output

Note!	The menu item Alarm Output will only be displayed in the program branch Output Options if an alarm output has been installed.

Max. 3 alarm outputs R1, R2, R3 per channel operating independently of each other can be configured. The alarm outputs can be used to output information on the current measurement or to start and stop pumps, motors, etc.

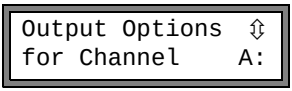
18.6.1 Alarm Properties

The switching condition, the holding behavior and the switching function of an alarm output can be defined.

Table 18.4: Alarm properties

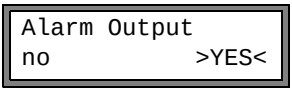
alarm property	setting	description
func (switching condition)	MAX	The alarm will switch if the measured value exceeds the upper limit.
	MIN	The alarm will switch if the measured value falls below the lower limit.
	+→- -→+	The alarm will switch if the flow direction changes (sign change of measured value).
	QUANT.	The alarm will switch if totalizing is activated and the totalizer reaches the limit.
	ERROR	The alarm will switch if a measurement is not possible.
	OFF	The alarm is switched off.
typ (holding behaviour)	NON-HOLD	If the switching condition is not true anymore, the alarm will return to the idle state after approx. 1 s.
	HOLD	The alarm remains activated even if the switching condition is not true anymore.
mode (switching function)	NO Cont.	The alarm is energized if the switching condition is true and de-energized if idle.
	NC Cont.	The alarm is de-energized if the switching condition is true and energized if idle.

Note!	If no measurement is made, all alarms will be de-energized, independently of the programmed switching function.

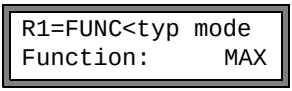


Select in the program branch Output Options the channel for which an alarm output is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.



Select yes to activate the alarm output. Press ENTER.



Three scroll lists will be displayed:

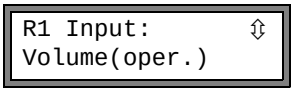
- func: switching condition
- typ: holding behaviour
- mode: switching function

Press key 4 and 6 to select a scroll list in the upper line. Press key 8 and 2 to select a list item in the lower line.

Press ENTER to store the settings.

18.6.2 Setting the Limits

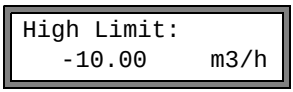
If the switching condition MAX or MIN has been selected in the scroll list func, the limit of the output will have to be defined:



Select in the scroll list Input the physical quantity to be used for the comparison. The following list items are available:

- selected physical quantity
- signal amplitude
- sound velocity of the medium

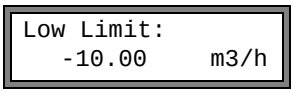
Press ENTER.



switching condition: MAX

Enter the upper limit. Press ENTER.

The alarm will switch if the measured value exceeds the limit.



switching condition: MIN

Enter the lower limit. Press ENTER.

The alarm will switch if the measured value falls below the limit.

example 1: High Limit:: -10 m^3/h

volumetric flow rate = -9.9 m^3/h
the limit is exceeded, the alarm switches

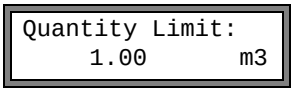
volumetric flow rate = -11 m^3/h
the limit is not exceeded, the alarm does not switch

example 2: Low Limit:: -10 m^3/h

volumetric flow rate = -11 m^3/h
the measured value is below the limit, the alarm switches

volumetric flow rate = -9.9 m^3/h
the measured value is not below the limit, the alarm does not switch

If the switching condition QUANT. has been selected in the scroll list func, the limit of the output will have to be defined:



switching condition: QUANT.

Enter the limit of the totalizer. Press ENTER.

The alarm will switch if the measured value reaches the limit.

A positive limit will be compared to the totalizer value for the positive flow direction.

A negative limit will be compared to the totalizer value for the negative flow direction.

The comparison will also take place if the totalizer of the other flow direction is displayed.

Note!	The unit of measurement of the limit corresponds to the unit of measurement of the selected physical quantity. If the unit of measurement of the physical quantity is changed, the limit has to be converted and entered again.

example 1: physical quantity: volumetric flow rate in m^3/h
`Quantity Limit:`: 1 m^3

example 2: physical quantity. volumetric flow rate in m^3/h
`Low Limit:`:60 m^3/h

The unit of measurement of the physical quantity is changed to m^3/min. The new limit to be entered is 1 m^3/min.

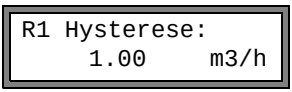
18.6.3 Defining the Hysteresis

A hysteresis can be defined for the alarm output R1 to prevent a constant triggering of the alarm due to small fluctuations of the measured values around the limit.

The hysteresis is a symmetrical range around the limit. The alarm will be activated if the measured values exceed the upper limit and deactivated if the measured values fall below the lower limit.

example: `High Limit:`: 30 m^3/h
`Hysterese`: 1 m^3/h

The alarm will be triggered at values > 30.5 m^3/h and deactivated at values < 29.5 m^3/h.



switching condition: `MIN` or `MAX`

Enter the value for `Hysterese`.

or

Enter 0 (zero) to work without a hysteresis.

Press ENTER.

18.7 Behavior of the Alarm Outputs

18.7.1 Apparent Switching Delay

Measured values and totalizer values will be displayed rounded to two decimal places. The limits, however, will be compared to the non-rounded measured values. This might cause an apparent switching delay when the measured value changes marginally (less than two decimal places). In this case, the switching accuracy of the output is greater than the accuracy of the display.

18.7.2 Reset and Initialization of the Alarms

After a cold start, all alarm outputs will be initialized as follows:

Table 18.5: Alarm state after a cold start

func	OFF
typ	NON-HOLD
mode	NO Cont.
Limit	0.00

Press key C three times during the measurement to set all alarm outputs to the idle state. Alarm outputs whose switching condition is still met will be activated again after 1 s. This function is used to reset alarm outputs of the type HOLD if the switching condition is not met anymore.

By pressing key BRK, the measurement will be stopped and the main menu selected. All alarm outputs will be de-energized, independently of the programmed idle state.

18.7.3 Alarm Outputs during Transducer Positioning

At the beginning of the transducer positioning (bar graph display), all alarm outputs switch back to the programmed idle state.

If the bar graph is selected during measurement, all alarm outputs will switch back to the programmed idle state.

An alarm output of the type HOLD that has been activated during the previous measurement will remain in the idle state after the transducer positioning if the switching condition is not met anymore.

Switching of the alarms into the idle state will not be displayed.

18.7.4 Alarm Outputs during Measurement

An alarm output with switching condition MAX or MIN will be updated max. once per second to avoid humming (i.e. fluctuation of the measured values around the value of the switching condition).

An alarm output of the type NON-HOLD will be activated if the switching condition is met. It will be deactivated if the switching condition is not met anymore. The alarm will remain activated min. 1 s even if the switching condition is met for a shorter period of time.

Alarm outputs with the switching condition QUANT. will be activated if the limit is reached.

Alarm outputs with the switching condition ERROR will only be activated after several unsuccessful measuring attempts. Therefore, typical short-term disturbances of the measurement (e.g. switching on of a pump) will not activate the alarm.

Alarm outputs with the switching condition +→- -→+ and of the type NON-HOLD will be activated with each change of the flow direction for approx. 1 s (see Fig. 18.2).

Alarm outputs with the switching condition +→- -→+ and of the type HOLD will be active after the first change of the flow direction. They can be switched back by pressing key C three times (see Fig. 18.2).

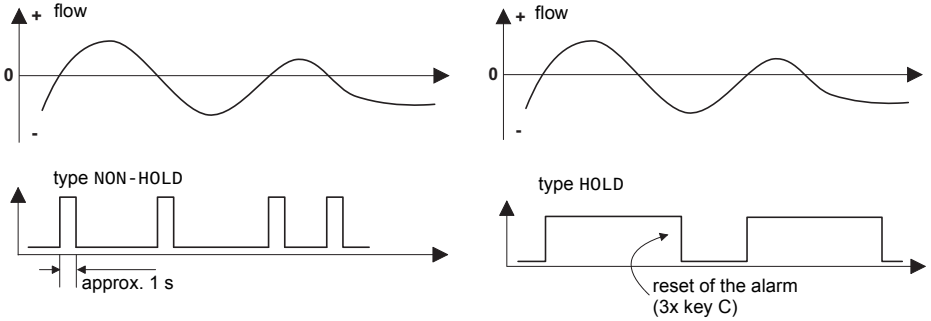


Fig. 18.2: Behavior of a relay when the flow direction changes

If there is an internal adaptation to changing measuring conditions, e.g. to a considerable rise of the medium temperature, the alarm will not switch. Alarm outputs with the switching condition OFF will be set automatically to the switching function NO Cont..

18.7.5 Alarm State Indication

Note!	There is no visual or acoustic indication of alarm output switching.

The alarm state can be displayed during the measurement. This function is activated in Special Funct.\SYSTEM settings\Dialogs/Menus.

Select the menu item SHOW RELAIS STAT. Select on to activate the alarm state indication.

Scroll during the measurement with key [DISP 9] until the alarm state is displayed in the upper line.

RX = ☐ ☐ ☐ ☐, with ☐ being a pictogram as shown in Table 18.6.

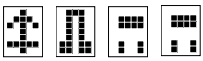
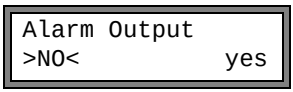
example: R1 = 

Table 18.6: Pictograms for the alarm state indication

	no.		func (switching condition)	typ (holding behavior)	mode (switching condition)	current state
R		=				
	1		OFF	NON-HOLD	NO Cont.	closed
	2		MAX	HOLD	NC Cont.	open
	3		MIN			
			+→- -→+			
			QUANT.			
			ERROR			

18.8 Deactivating the Outputs

If the programmed outputs are no longer required, they can be deactivated. The configuration of a deactivated output is stored and will be available if the output is activated again.



Select no in `Output Options\Alarm Output` to deactivate an output. Press ENTER.

19 Troubleshooting

If any problem appears which can not be solved with the help of this manual, contact our sales office and give a precise description of the problem. Specify the type, the serial number and the firmware version of the transmitter.

Calibration

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear. The transmitter has been calibrated at the factory and, usually, a re-calibration of the transmitter will not be necessary. A re-calibration is recommended if

- the contact surface of the transducers shows visible wear or
- the transducers were used for a prolonged period of time at a high temperature (several months >130 °C for normal transducers or > 200 °C for high temperature transducers).

The transmitter has to be sent to FLEXIM for recalibration under reference conditions.

The display does not work at all or fails regularly

Make sure that the correct voltage is available at the terminals. The voltage is indicated on the metal plate below the outer right terminal. If the power supply is ok, the transducers or an internal component of the transmitter are defective. The transducers and the transmitter have to be sent to FLEXIM for repair.

The message SYSTEM ERROR is displayed

Press key BRK to return to the main menu.

If this message is displayed repeatedly, write down the number in the lower line. Track down the situations when the error is displayed. Contact FLEXIM.

The transmitter does not react when key BRK is pressed during the measurement

A program code has been defined. Press key C and enter the program code.

The backlight of the display does not work, but all other functions are available.

The backlight is defective. This problem does not affect the other functions of the display. Send the transmitter to FLEXIM for repair.

Date and time are wrong, the measured values are deleted when the transmitter is switched off

The data backup battery has to be replaced. Send the transmitter to FLEXIM.

An output does not work

Make sure that the outputs are configured correctly. Check the function of the output as described in section 18.1.3. If the output is defective, contact FLEXIM.

A measurement is impossible or the measured values substantially differ from the expected values

see section 19.1.

The values of the totalizer are wrong

see section 19.6.

19.1 Problems with the Measurement

A measurement is impossible because no signal is received. A question mark is displayed in the lower line on the right

- Check if the entered parameters are correct, especially the outer pipe diameter, the pipe wall thickness and the sound velocity of the medium. (Typical errors: The circumference or the radius was entered instead of the diameter. The inner pipe diameter was entered instead of the outer pipe diameter.)
- Make sure that the recommended transducer distance was adjusted when mounting the transducers.
- Make sure that an appropriate measuring point has been selected (see section 19.2).
- Try to establish better acoustic contact between the pipe and the transducers (see section 19.3).
- Enter a lower value for the number of sound paths. The signal attenuation might be too high due to a high medium viscosity or deposits on the inner pipe wall (see section 19.4).

The measuring signal is received but no measured values can be obtained

- An exclamation mark "!" in the lower line on the right indicates that the defined upper limit of the flow velocity is exceeded and, therefore, the measured values are marked as invalid. The limit must be adapted to the measuring conditions or the check must be deactivated (see section 12.3).
- If no exclamation mark "!" is displayed, a measurement at the selected measuring point is not possible.

Loss of signal during the measurement

- If the pipe had been pressureless: Was there no measuring signal afterwards? Contact FLEXIM.
- Wait briefly until acoustic contact is reestablished. The measurement can be interrupted by a temporarily higher proportion of liquid and solids in the medium.

The measured values substantially differ from the expected values

- Wrong measured values are often caused by wrong parameters. Make sure that the entered parameters are correct for the measuring point.
- If the parameters are correct, see section 19.5 for the description of typical situations in which wrong measured values are obtained.

19.2 Selection of the Measuring Point

- Make sure that the recommended min. distance to any disturbance source is observed (see chapter 4, Table 4.2).
- Avoid measuring points with deposit formation in the pipe.
- Avoid measuring points in the vicinity of deformations and defects on the pipe and in the vicinity of welds.
- Measure the temperature at the measuring point and make sure that the transducers are suitable for this temperature.
- Make sure that the outer pipe diameter is within the measuring range of the transducers.
- When measuring on a horizontal pipe, the transducers must be mounted on the side of the pipes.
-

Note!	If the temperature fluctuates at the measuring point, it is especially important that the inner hooks of the clasp engage in the tension strip. Otherwise, the contact pressure of the transducers will be insufficient at low temperatures.

Note!	If the temperature fluctuates widely, it is recommended to use FLEXIM clasps with springs to fix the transducers. Contact FLEXIM.

19.3 Maximum Acoustic Contact

Observe the instructions in section 10.7.

19.4 Application Specific Problems

The entered sound velocity of the medium is wrong

The entered sound velocity is used to calculate the transducer distance and is therefore very important for the transducer positioning. The sound velocities stored in the transmitter only serve as orientation.

The entered pipe roughness is not appropriate

Check the entered value. The state of the pipe should be taken into account.

Measurements on porous pipe materials (e.g. concrete or cast iron) are only possible under certain conditions

Contact FLEXIM.

The pipe liner may cause problems during the measurement if it is not firmly attached to the inner pipe wall or consists of an acoustically absorbing material

Try measuring on a liner free section of the pipe.

A higher proportion of droplets or solids in the medium scatter and absorb the ultrasonic signal and therefore attenuate the measuring signal

A measurements is impossible if the value is ≥ 10 %. If the proportion is high, but < 10 %, a measurement is only possible under certain conditions.

19.5 Large Deviations of the Measured Values

The entered sound velocity of the medium is wrong

A wrong sound velocity can result in the ultrasonic signal that is reflected directly on the pipe wall being mistaken for the measuring signal that has passed through the medium. The flow calculated on the basis of the wrong signal by the transmitter is very small or fluctuates around zero.

The defined upper limit of the flow velocity is too low

All measured flow velocities that are greater than the upper limit will be ignored and marked as invalid. All quantities derived from the flow velocity will also be marked as invalid. If several correct measured values are ignored, the totalizer values will be too low.

The entered cut-off flow is too high

All flow velocities below the cut-off flow are set to zero. All derived quantities are also set to zero. The cut-off flow (default: 2.5 cm/s) has to be set to a low value in order to be able to measure at low flow velocities.

The entered pipe roughness is not appropriate

The flow velocity to be measured is outside the measuring range of the transmitter

The measuring point is not appropriate

Select another measuring point to check whether the results are better. Because pipes are never rotationally symmetric, the flow profile is affected. Change the transducer position according to the pipe deformation.

The operating volumetric flow rate meets the expectations, but the standard volumetric flow rate deviates strongly

The parameters for the measurement of the standard volumetric flow rate have not been entered correctly (see section 15.4).

19.6 Problems with the Totalizers

The values of the totalizer are too high

See `Special Function\SYSTEM settings\Measuring\Quantity recall`. If this menu item is activated, the values of the totalizer will be stored. The totalizer will continue with this value at the start of the next measurement.

The values of the totalizer are too low

One of the totalizers has reached the upper limit and has to be reset to zero manually.

The sum of the totalizers is not correct

See `Special Function\SYSTEM settings\Measuring\Quant. wrapping`. The sum of both totalizers (throughput) transmitted via an output is not valid after the overflow (wrapping) of one of the totalizers.

A Menu Structure

	cold start resistant
Program Branch `Parameter`	

`>PAR< mea opt sf`
`Parameter`
 	
main menu: selection of the program branch `Parameter`	

`Parameter ⇳`
`for Channel A:`
 	
selection of a measuring channel (A, B) or of a calculation channel (Y, Z)
This display will not be indicated if the transmitter has only one measuring channel.	

When a measuring channel is selected (A, B)	

`Outer Diameter`
`100.0 mm`
 	
input of the outer pipe diameter	

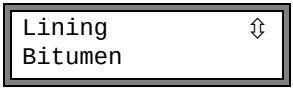
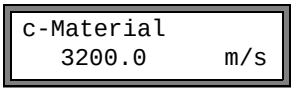
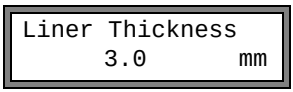
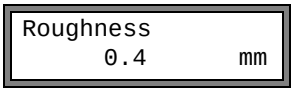
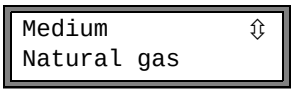
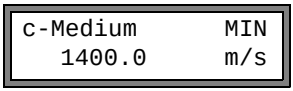
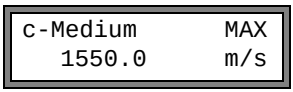
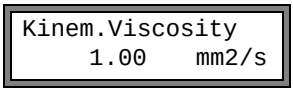
`Pipe Circumfer.`
`314.2 mm`
 	
input of the pipe circumference
This display will only be indicated if `Special Funct.\SYSTEM settings\Dialogs/ Menus\Pipe Circumfer.` is activated and `Outer Diameter` = `0` has been entered.	

`Wall Thickness`
`3.0 mm`
 	
input of the pipe wall thickness
range: depends on the connected transducers
default: 3 mm	

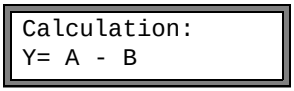
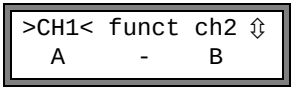
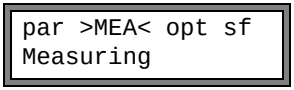
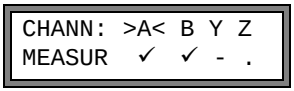
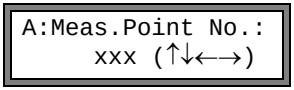
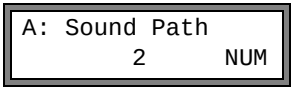
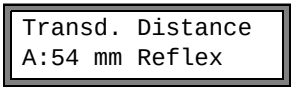
`Pipe Material ⇳`
`Carbon Steel`
 	
selection of the pipe material	

`c-Material`
`3230.0 m/s`
 	
input of the sound velocity of the pipe material
range: 600...6553.5 m/s
This display will only be indicated if `Other Material` has been selected.	

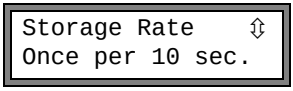
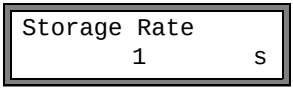
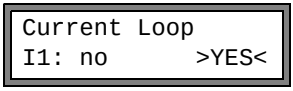
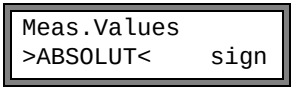
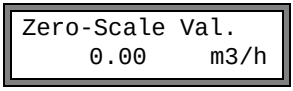
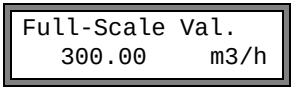
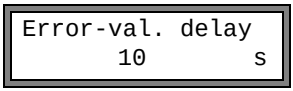
`Lining`
`no >YES<`
 	
selection whether the pipe is lined	

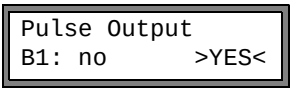
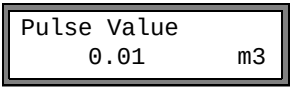
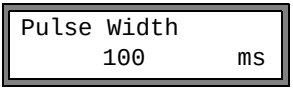
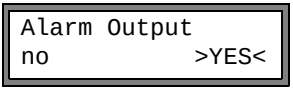
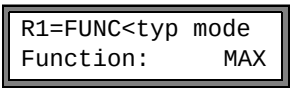
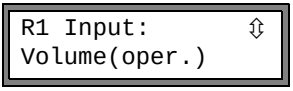
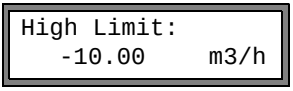
		cold start resistant
	selection of the lining material This display will only be indicated if `Lining` = `yes` has been selected.	
	input of the sound velocity of the lining material range: 600...6553.5 m/s This display will only be indicated if `Other Material` has been selected.	
	input of the liner thickness default: 3 mm	
	input of the roughness of the inner pipe wall range: 0...5 mm default: 0.1 mm (for steel as pipe material)	
	selection of the medium	
	input of the min. sound velocity of the medium range: 200...3500 m/s This display will only be indicated if `Other Medium` has been selected.	
	input of the max. sound velocity of the medium This display will only be indicated if `Other Medium` has been selected.	
	input of the kinematic viscosity of the medium range: 0.01...30 000 mm^2/s This display will only be indicated if `Other Medium` or `Natural gas` has been selected.	

		cold start resistant
Density 60.00 kg/m3	input of the operating density of the medium range: 0.1...20 000 kg/m^3 if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated or 0.01...20 g/cm^3, if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is deactivated This display will only be indicated if Other Medium or Natural gas has been selected.	
Gas compr.factor 1.000 factor	input of the gas compressibility factor range: 0.001...2 This display will only be indicated if Other Medium or Natural gas has been selected.	
Medium Temperat. 20.0 C	input of the medium temperature default: 20 °C	
Fluid pressure 60.00 bar	input of the medium pressure range: 1...600 bar This display will only be indicated if Special Funct.\SYSTEM settings\Measuring\Gas-Measuring is activated or if Gas-Measuring is deactivated and Special Funct.\SYSTEM settings\Dialogs/Menus\Fluid pressure is activated.	
Transducer Type ⇳ Standard	selection of the transducer type This display will only be indicated if no or special transducers are connected.	
Additional cable 65.0 m	input of the length of an extension cable	

	cold start resistant
When a calculation channel is selected (Y, Z) Calculation channels will only be available if the transmitter has more than one measuring channel.	
 display of the current calculation function	
 selection of the calculation function	
Program Branch `Measuring`	
 main menu: selection of the program branch `Measuring`	
 activation of the channels This display will not be indicated if the transmitter has only one measuring channel.	
 input of the measuring point number This display will only be indicated if `Output Options\Store Meas.Data` and/or `Serial Output` are activated.	
 activating/deactivating the flow profile correction This display will only be indicated if `Special Funct.\SYSTEM settings\Measuring\ Flow Velocity` = `uncorr.` has been selected.	
 input of the number of sound paths	
 display of the transducer distance to be adjusted between the inner edges of the transducers	

	cold start resistant
Program Branch `Output Options`	
`par mea >OPT< sf` `Output Options` — main menu: selection of the program branch `Output Options`	
`Output Options ⇳` `for Channel A:` — selection of the channel whose output options are to be defined	
`Physic. Quant. ⇳` `Volume(oper.)` — selection of the physical quantity	
`Volume in: ⇳` `m3/h` — selection of the unit of measurement for the physical quantity	
`Temperature T1` `no >YES<` — activation of a temperature input This display will only be indicated if the temperature input T1 has been assigned to the channel in `Special Funct.\SYSTEM settings\ Proc. inputs\Link temperature`.	
`INPUT I1` `no >YES<` — activation of a current input for an external temperature measurement This display will only be indicated if the input I1 has been assigned to the channel in `Special Funct.\SYSTEM settings\ Proc. inputs\Link other inp.`.	
`Damping` `10 s` — input of the duration over which a floating average of the measured values has to be determined range: 1...100 s	
`Store Meas.Data` `no >YES<` — activation of the data logger	
`Serial Output` `no >YES<` — activation of the measured value output to a PC or a printer via the serial interface	

		cold start resistant
	selection of the storage rate for storing measured values in the data logger This display will only be indicated if `Output Options\Store Meas.Data` and/or `Serial Output` are activated.	
	Input of the storage rate if `Storage Rate` = EXTRA has been selected range: 1...43 200 s (= 12 h)	
Current Loop		
	activation of a current output This display will only be indicated if the current output has been installed in `Special Funct.\SYSTEM settings\Proc. outputs`.	
	selection whether the sign of the measured values is to be considered for the output This display will only be indicated if `Current Loop` is activated.	
	input of the lowest/highest measured value to be expected for the current output The values are assigned to the lower/upper limit of the output range.	
	These displays will only be indicated if `Current Loop` is activated.	
	input of the error value delay, i.e. of the time interval after which the value entered for the error output will be transmitted to the output if no valid measured values are available This display will only be indicated if `Special Funct.\SYSTEM settings\Dialogs/Menus\Error-val. delay` = `EDIT` has been selected.	

	cold start resistant
Pulse Output	
	Activation of a Pulse Output This display will only be indicated if a pulse output has been installed in `Special Funct.\SYSTEM settings\Dialogs/ Menus\Proc. outputs`.
	input of the pulse value (value of the totalizer at which a pulse will be emitted) This display will only be indicated if `Pulse Output` is activated.
	input of the pulse width range: 1 or 80...1000 ms This display will only be indicated if `Pulse Output` is activated.
Alarm Output	
	activation of an alarm output This display will only be indicated if an alarm output has been installed in `Special Funct.\SYSTEM settings\Proc. outputs`.
	Selection of the switching condition (`func`), the holding behavior (`typ`) and the switching function (`mode`) of the alarm output. This display will only be indicated if `Alarm Output` is activated.
	selection of the physical quantity to be monitored This display will only be indicated for R1 if `Alarm Output` is activated.
	input of the upper limit of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `MAX` has been selected as the switching condition.

		cold start resistant
Low Limit: -10.00 m3/h	input of the lower limit of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `MIN` has been selected as the switching condition.	
Quantity Limit: 1.00 m3	input of the limit for the totalizer of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `QUANT.` has been selected as the switching condition.	
R1 Hysterese: 1.00 m3/h	input of the hysteresis for the lower or upper limit This display will only be indicated if `Alarm Output` has been activated and `MIN` or `MAX` has been selected as the switching condition.	
Program Branch `Special Funct.`		
par mea opt >SF< Special Funct.	main menu: selection of the program branch `Special Funct.`	
`SYSTEM settings`		
Special Funct. ⇳ SYSTEM settings	selection of `Special Funct.\SYSTEM settings`	
`SYSTEM settings\Set Clock`		
SYSTEM settings ⇳ Set Clock	selection of the displays for the input of the date and the time	
`SYSTEM settings\Libraries`		
SYSTEM settings ⇳ Libraries	selection of the displays for the management of the material and medium scroll lists	

	cold start resistant

SYSTEM settings\Libraries\Material list

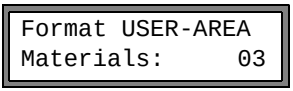
selection of the displays for the arrangement of the material scroll list (pipe and lining materials)

SYSTEM settings\Libraries\Medium list

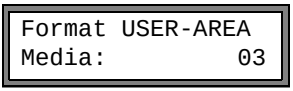
selection of the displays for the arrangement of the medium scroll list

SYSTEM settings\Libraries\Format USER-AREA

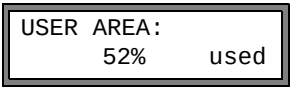
selection of the displays for the partitioning of the coefficient memory for the storing of user defined material and medium properties



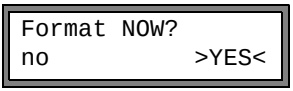
input of the number of user defined materials



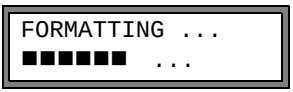
input of the number of user defined media



display of the occupancy of the coefficient memory

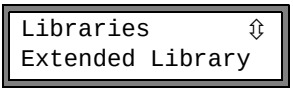


confirmation of the selected partition



the coefficient memory is being partitioned

SYSTEM settings\Libraries\Extended Library



selection of the displays for the activation of the extended library

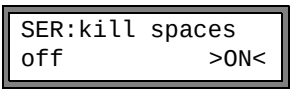
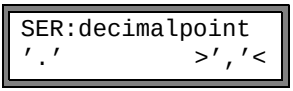
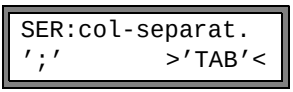
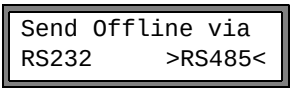
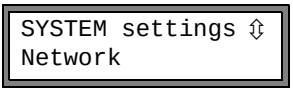
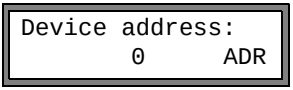
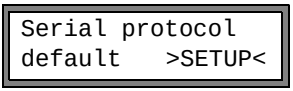
		cold start resistant
Extended Library off >ON<	activation of the extended library	
SYSTEM settings\Dialogs/Menus		
SYSTEM settings ⇳ Dialogs/Menus	selection of the displays for the activation/deactivation or setting of the menu items in the other program branches	
Pipe Circumfer. off >ON<	activation of the menu item for the input of the pipe circumference in the program branch Parameter	x
Fluid pressure off >ON<	activation of the menu item for the input of the medium pressure in the program branch Parameter This display will only be indicated if SYSTEM settings\Measuring\Gas-Measuring is deactivated.	
Meas.Point No.: (1234) >(↑↓←→)<	selection of the input mode for the measuring point number in the program branch Measuring: (1234): digits, point, hyphen (↑↓←→): ASCII editor	
Transd. Distance auto >USER<	setting for the display for the input of the transducer distance in the program branch Measuring: • user: only the entered transducer distance will be displayed if the recommended and the entered transducer distances are identical • auto: only the recommended transducer distance will be displayed recommended setting: user	
Tx Corr.Offset off >ON<	activation of the menu item for the input of a correction value (offset) for each temperature input in the program branch Measuring	

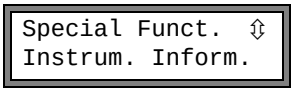
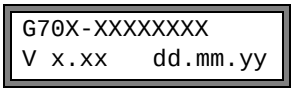
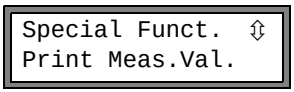
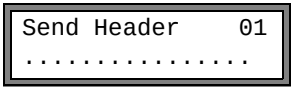
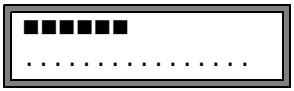
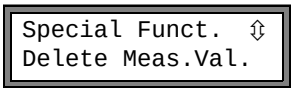
		cold start resistant
Error-val. delay damping >EDIT<	selection of the error value delay • damping: The damping factor will be used. • edit: The menu item for the input of the error value delay in the program branch Output Options will be activated.	x
SHOW RELAIS STAT off >ON<	activation of the display of the alarm state during the measurement	x
SYSTEM settings\Proc. inputs		
SYSTEM settings ⇳ Proc. inputs	selection of the displays for the setting of the inputs of the transmitter	
Proc. inputs ⇳ Link temperature	assignment of temperature inputs and other inputs to the measuring channels	
SYSTEM settings\Measuring		
SYSTEM settings ⇳ Measuring	selection of the displays for the settings of the measurement	
Gas-Measuring off >ON<	activation of the gas measurement default: on	
Compare c-fluid no >YES<	activation of the display for the difference between the measured and the expected sound velocity of a selected reference medium during the measurement	
Flow Velocity normal >UNCORR.<	selection whether the flow velocity is displayed and transmitted with or without profile correction	x

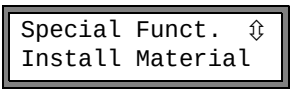
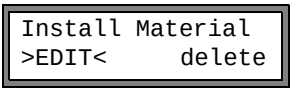
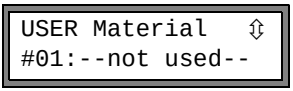
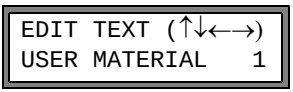
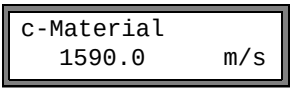
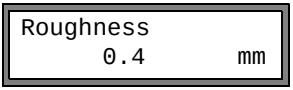
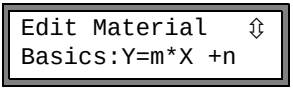
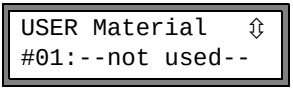
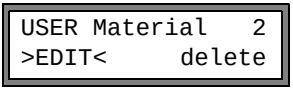
		cold start resistant
Cut-off Flow absolut >SIGN<	selection of the input of a lower limit for the flow velocity: • `absolut`: independent of the flow direction • `sign`: dependent on the flow direction	x
Cut-off Flow factory >USER<	activation of the input of a lower limit of the flow velocity: • `factory`: the default limit of 2.5 cm/s will be used • `user`: input of a limit	
+Cut-off Flow 2.5 cm/s	input of the cut-off flow for positive measured values range: 0...12.7 cm/s (0.127 m/s), default: 2.5 cm/s (0.025 m/s) This display will only be indicated if `Cut-off Flow` = `sign` and `Cut-off Flow` = `user` has been selected.	
-Cut-off Flow -2.5 cm/s	Input of the cut-off flow for negative measured values range: -12.7...0 cm/s default: -2.5 cm/s This display will only be indicated if `Cut-off Flow` = `sign` und `Cut-off Flow` = `user` has been selected.	
Cut-off Flow 2.5 cm/s	Input of the cut-off flow for the absolute value of the measured values range: 0...12.7 cm/s default: 2.5 cm/s This display will only be indicated if `Cut-off Flow` = `absolut` und `Cut-off Flow` = `user` has been selected.	

		cold start resistant
Velocity limit 0.0 m/s	input of an upper limit of the flow velocity range: 0.1...25.5 m/s All measured values that are greater than the limit will be marked as outliers. Input of 0 (zero) switches off the detection for outliers.	x
Quant. wrapping off >ON<	activation of the overflow of the totalizers	x
Quantity recall off >ON<	activation of the taking-over of the totalizer values after a restart of the measurement	x
SYSTEM settings\Gas-Measuring		
SYSTEM settings ⇳ Gas-Measuring	selection of the displays for the input of the standard conditions for the gas measurement This display will only be indicated if `Special Funct.\SYSTEM settings\Measuring\Gas-Measuring` is activated.	
Normal pressure 1.01325 bar	input of the pressure for the local standard conditions range: 0.70001...1.30000 bar	
Normal temper. 0.0 C	input of the temperature for the local standard conditions range: -20.0...+90.0 °C	
SYSTEM settings\Proc. outputs		
SYSTEM settings ⇳ Proc. outputs	selection of the displays for the setting of the outputs of the transmitter	
Install Output ⇳ Current I1	selection of the output to be installed	

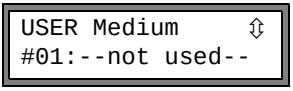
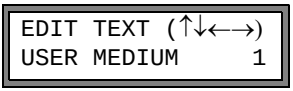
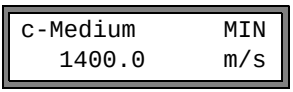
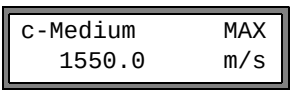
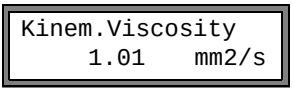
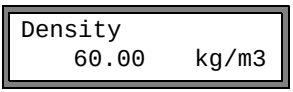
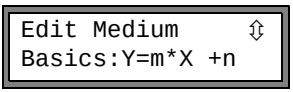
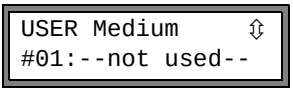
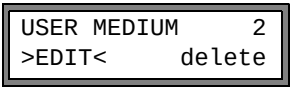
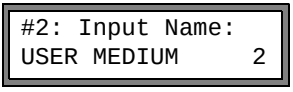
		cold start resistant
SYSTEM settings\Storing		
SYSTEM settings ⇳ Storing	selection of the displays for the storing of measured values in the data logger	
Ringbuffer off >ON<	setting of the overflow behavior of the data logger	x
Storage mode sample >AVERAGE<	selection of the sample mode • `sample`: storing and online output of the displayed measured value • `average`: storing and online output of the average of all measured values of a storage interval	x
Quantity Storage one >BOTH<	setting of the storing behavior of the totalizers • `one`: the value of the totalizer that is currently displayed will be stored • `both`: one value for each flow direction will be stored	x
Store Amplitude off >ON<	activation of the storing of the signal amplitude The value will only be stored if the data logger is activated.	x
Store c-Medium off >ON<	activation of the storing of the sound velocity of the medium The value will only be stored if the data logger is activated.	x
Beep on storage >ON< off	activation of an acoustic signal every time a measured value is stored or transmitted	x
SYSTEM settings\Serial transmis.		
SYSTEM settings ⇳ serial transmis.	selection of the displays for the formatting of the serial transmission of measured values	

		cold start resistant
	activation of the serial transmission with/without blanks	
	selection of the decimal marker for floating point numbers	
	selection of the character for column separation	
	selection of the serial interface default: RS232 This display will only be indicated if the transmitter has an RS485 interface.	
SYSTEM settings\Network		
	change of the settings of the transmission parameters	
	input of the instrument address	
	confirmation or change of the transmission parameters	
	change of the baud rate, parity or number of stop bits	
SYSTEM settings\Miscellaneous		
	selection of the display for the setting of the contrast	
	setting of the contrast of the display	

	cold start resistant
Instrum. Inform.	
 selection of the displays for information about the transmitter	
 display of the type, serial number and available data logger capacity	
 display of the type, serial number and firmware version with the date (dd - day, mm - month, yy - year)	
Print Meas.Val.	
 selection of the displays for the transmission of stored measured values to a PC	
 start of the transmission of measured values This display will only be indicated if the data logger contains measured values and the transmitter is connected to a PC via a serial cable.	
 display of the data transmission progress	
Delete Meas.Val.	
 selection of the displays for the deleting of stored measured values	
 confirmation for the deleting of measured values This display will only be indicated if measured values are stored in the data logger.	

	cold start resistant
Install Material	
 selection of the displays for the input of the pipe and lining materials	
Install Material with Special Funct.\SYSTEM settings\ Libraries\Extended Library = off	
 selection whether a user defined material is to be edited or deleted	
 selection of a user defined material	
 input of a designation for the selected material	
 input of the sound velocity of the material range: 600...6553.5 m/s	
 input of the roughness of the material	
Install Material with Special Funct.\SYSTEM settings\ Libraries\Extended Library = on	
 selection of the function for the temperature and pressure dependency of the material properties	
 selection of a user defined material	
 selection whether the user defined material is to be edited or deleted This display will only be indicated if the selected material already exists.	

		cold start resistant
`#2: Input Name:` `USER MATERIAL 2`	input of a designation for the selected material	
`T-SOUNDSP.` `1500.0 m/s`	input of the constants for the transversal sound velocity of the material The number of constants depends on the function selected above.	
`L-SOUNDSP.` `1500.0 m/s`	input of the constants for the longitudinal sound velocity of the material The number of constants depends on the function selected above.	
`Default soundsp.` `long. >TRANS.<`	selection of the sound wave type for the flow measurement	
`Roughness` `0.4 mm`	input of the roughness of the material	
`Save changes` `no >YES<`	confirmation that the changes are to be stored This display will only be indicated if a new material has been entered or the properties of an existing material have been changed.	
`Install Medium`		
`Special Funct. ⇳` `Install Medium`	selection of the displays for the input of media	
`Install Medium with Special Funct.\SYSTEM settings\ Libraries\Extended Library = off`		
`Install Medium` `>EDIT< delete`	selection whether a user defined medium is to be edited or deleted	

	cold start resistant
 selection of a user defined medium	
 input of a designation for the selected medium	
 input of the min. sound velocity of the medium range: 800...3500 m/s	
 input of the max. sound velocity of the medium	
 input of the kinematic viscosity of the medium range: 0.01...30 000.00 mm^2/s	
 input of the operating density of the medium	
Install Medium with Special Funct.\SYSTEM settings\ Libraries\Extended Library = on	
 selection of the function for the temperature and pressure dependency of the medium properties	
 selection of a user defined medium	
 selection whether the user defined medium is to be edited or deleted This display will only be indicated if the selected medium already exists.	
 input of a designation for the selected medium	

		cold start resistant
SOUNDSPEED 1500.0 m/s	input of the constants for the longitudinal sound velocity of the medium The number of constants depends on the function selected above.	
VISCOSITY 1.0 mm2/s	input of the kinematic viscosity of the medium	
DENSITY 1.0 g/cm3	input of the operating density of the medium	
GASFACTOR 0.0	input of the gas compressibility factor	
Save changes no >YES<	confirmation that the changes are to be stored This display will only be indicated if a new medium has been entered or the properties of an existing medium have been changed.	
After the input of HotCode 071001		
DNmin Q-Sensor 15 mm	input of the lower limit of the inner pipe diameter for the displayed transducer type range: 3...63 mm	x

B Technical Data

Flow Transmitter

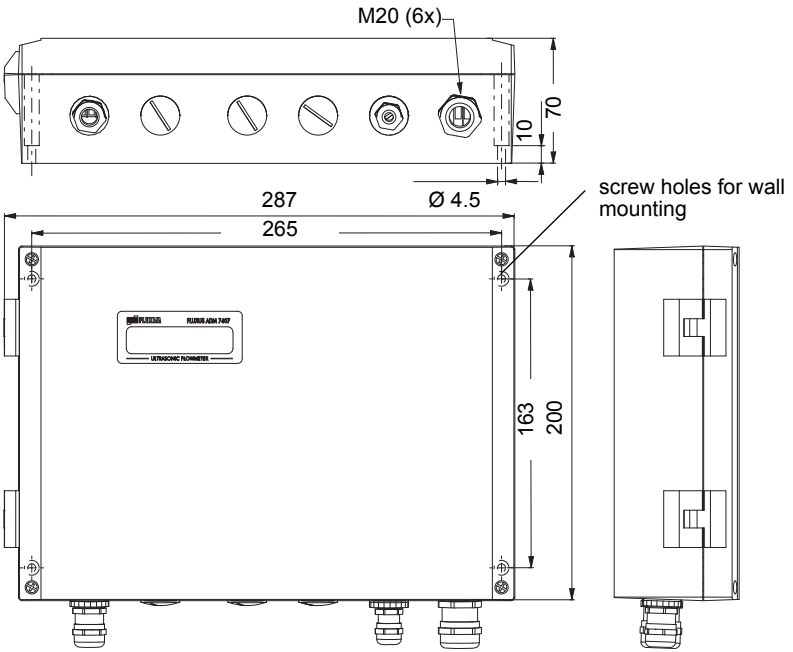
FLUXUS	G704	G704 A2	G709
design	standard field device	field device for ATEX zone 2	19 " module
measurement			
measuring principle	transit time difference correlation principle		
flow velocity	0.01...35 m/s, pipe diameter dependent		
repeatability	0.15 % of reading ±0.01 m/s		
medium	gases with a ratio of the characteristic acoustic impedances of pipe wall and gas < 3000, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane		
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5M-1985		
accuracy			
- volumetric flow rate	± 1...3 % of reading ±0.01 m/s depending on application ± 0.5 % of reading ±0.01 m/s with field calibration		
flow transmitter			
power supply	100...240 V/50...60 Hz or 20...32 V DC		
power consumption	< 15 W		
number of flow measuring channels	1, optional: 2		
signal damping	0...100 s, adjustable		
measuring cycle (1 channel)	100...1000 Hz		
response time	1 s (1 channel), optional: 70 ms		
housing material	aluminum, powder coated		aluminum
degree of protection according to EN 60529	IP 65	IP 65	IP 20
dimensions	see dimensional drawing		42HP x 3U (without back panel) see dimensional drawing
weight	2.8 kg		1.7 kg
fixation	wall mounting, optional: 2 " pipe mounting		19 " rack mounting
operating temperature	-20...+60 °C		
display	2 x 16 characters, dot matrix, backlit		
menu language	English, German, French, Dutch, Spanish		
explosion protection			
ATEX zone	-	2	-
ATEX marking	-	CE Ex II3G Ex nA II T4 T_a -20...+60 °C II3D Ex tD A22 IP65 T100 °C	-

FLUXUS	G704	G704 A2	G709
measuring functions			
physical quantities	operational volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity		
totalizers	volume, mass		
calculation functions	average, difference, sum		
diagnostic functions	sound velocity, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times		
data logger			
loggable values	all physical quantities, totalized values and diagnostic values		
capacity	> 100 000 measured values		
communication			
interface	- process integration: optional: RS485 (Modbus, sender) or HART - diagnosis: RS232		
serial data kit (optional)			
software (all Windows™ versions)	- FluxData: download of measured data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoef: creating medium data sets		
cable	RS232		
adapter	RS232 - USB		
outputs (optional)			
	The outputs are galvanically isolated from the transmitter.		
number	on request		
	current output		
current output - range - accuracy - active output - passive output	 0/4...20 mA 0.1 % of reading ±15 µA R_{ext} < 500 Ω U_{ext} = 4...24 V, dependent on R_{ext}, R_{ext} < 1 kΩ		
current output I1 in HART mode - range - passive output	 4...20 mA U_{ext} = 10...24 V		
	voltage output		
range accuracy internal resistance	0...1 V or 0...10 V 0...1 V: 0.1 % of reading ±1 mV 0...10 V: 0.1 % of reading ±10 mV R_i = 500 Ω		
	frequency output		
range open collector	0...1 kHz or 0...5 kHz 24 V/4 mA		
	binary output		
Reed relay open collector optorelay	- - 26 V/100 mA		48 V/0.25 A 24 V/4 mA -
binary output as alarm output - functions	 limit, change of flow direction or error		
binary output as pulse output - pulse value - pulse width	 0.01...1000 units 1...1000 ms		 0.01...1000 units 80...1000 ms

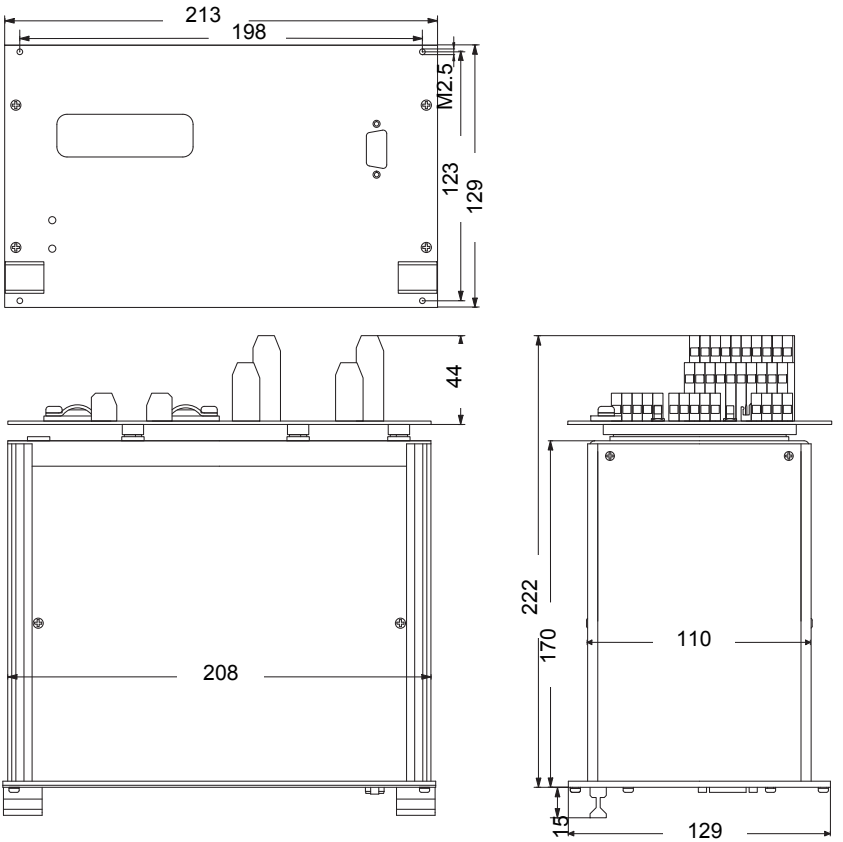
FLUXUS	G704	G704 A2	G709
inputs (optional)			
	The inputs are galvanically isolated from the transmitter.		
number	max. 4, on request		
	temperature input		
designation	Pt100/Pt1000		
connection	4-wire		
range	-150...+560 °C		
resolution	0.01 K		
accuracy	±0.01 % of reading ±0.03 K		
	current input		
accuracy	0.1 % of reading ±10 µA		
active input	U_i = 24 V, R_i = 50 Ω, P_i < 0.5 W, not short circuit proof		
- range	0...20 mA		
passive input	R_i = 50 Ω, P_i < 0.3 W		
- range	-20...+20 mA		
	voltage input		
range	0...1 V		
accuracy	0.1 % of reading ±1 mV		
internal resistance	R_i = 1 MΩ		

Dimensions

FLUXUS G704

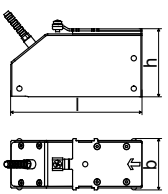
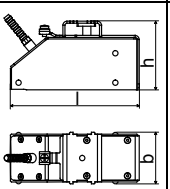
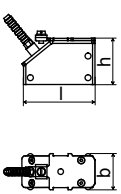
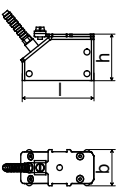


FLUXUS G709



in mm

Shear Wave Transducers (zone 1)

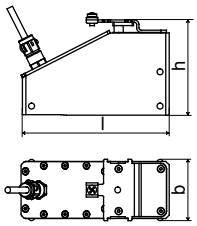
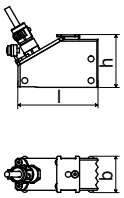
technical type		GDG1N81	GDK1N81	GDM2N81	GDP2N81
order code		GSG-NA1TS GSG-NA1TS/OS GSG-NI1TS GSG-NI1TS/OS	GSK-NA1TS GSK-NA1TS/OS GSK-NI1TS GSK-NI1TS/OS	GSM-NA1TS GSM-NA1TS/OS GSM-NI1TS GSM-NI1TS/OS	GSP-NA1TS GSP-NA1TS/OS GSP-NI1TS GSP-NI1TS/OS
transducer frequency	MHz	0.2	0.5	1	2
medium pressure[1]					
min. extended	bar	metal pipe: 20	metal pipe: 20	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]					
min. extended	mm	250	70	30	15
min. recommended	mm	380	80	40	20
max. recommended	mm	810	500	80	40
max. extended	mm	1100	720	120	60
pipe wall thickness					
min.	mm	14	5	2.5	1.5
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 65	IP 65	IP 65	IP 65
transducer cable					
type		1699	1699	1699	1699
length	m	5	5	4	4
dimensions					
length l	mm	129.5	126.5	62.5	62.5
width b	mm	51	51	32	32
height h	mm	67	67.5	40.5	40.5
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+130	+130	+130	+130
temperature compensation		x	x	x	x

technical type			GDG1N81	GDK1N81	GDM2N81	GDP2N81
explosion protection						
ATEX / IEC Ex	transducer ATEX		GSG-NA1TS GSG-NA1TS/OS	GSK-NA1TS GSK-NA1TS/OS	GSM-NA1TS GSM-NA1TS/OS	GSP-NA1TS GSP-NA1TS/OS
	transducer IEC Ex		GSG-NI1TS GSG-NI1TS/OS	GSK-NI1TS GSK-NI1TS/OS	GSM-NI1TS GSM-NI1TS/OS	GSP-NI1TS GSP-NI1TS/OS
	zone		1	1	1	1
	explosion protection temperature					
	min. max.	°C °C	-55 +180	-55 +180	-55 +180	-55 +180
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (zone 1, IP 68)

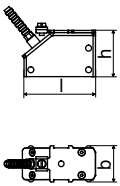
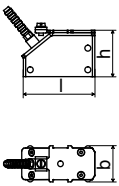
technical type		GDG1LI1	GDK1LI1	GDM2LI1	GDP2LI1
order code		**GSG-NA1TS/ IP68 GSG-NI1TS/IP68**	**GSK-NA1TS/ IP68 GSK-NI1TS/IP68**	**GSM-NA1TS/ IP68 GSM-NI1TS/ IP68**	**GSP-NA1TS/ IP68 GSP-NI1TS/IP68**
transducer frequency	MHz	0.2	0.5	1	2
medium pressure[1]					
min. extended	bar	metal pipe: 20	metal pipe: 20	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]					
min. extended	mm	250	70	30	15
min. recommended	mm	380	80	40	20
max. recommended	mm	810	500	80	40
max. extended	mm	1100	720	120	60
pipe wall thickness					
min.	mm	14	5	2.5	1.5
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 68	IP 68	IP 68	IP 68
transducer cable					
type		2550	2550	2550	2550
length	m	12	12	12	12
dimensions					
length l	mm	128.5	128.5	70	70
width b	mm	54	54	32	32
height h	mm	83.5	83.5	46	46
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+100	+100	+100	+100
temperature compensation		x	x	x	x

technical type			GDG1LI1	GDK1LI1	GDM2LI1	GDP2LI1
explosion protection						
ATEX/IECEx	transducer ATEX		GSG-NA1TS/ IP68	GSK-NA1TS/ IP68	GSM-NA1TS/ IP68	GSP-NA1TS/ IP68
	transducer IEC Ex		GSG-NI1TS/IP68	GSK-NI1TS/IP68	GSM-NI1TS/ IP68	GSP-NI1TS/IP68
	zone		1	1	1	1
	explosion protection temperature					
	min. max.	°C °C	-55 +180	-55 +180	-55 +180	-55 +180
	marking		CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX
	certification ATEX		IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (zone 1, extended temperature range)

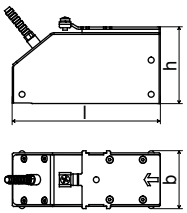
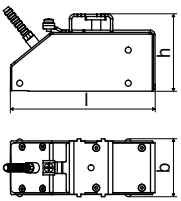
technical type		GDM2E85	GDP2E85
order code		**GSM-EA1TS** **GSM-EA1TS/OS** **GSM-EI1TS** **GSM-EI1TS/OS**	**GSP-EA1TS** **GSP-EA1TS/OS** **GSP-EI1TS** **GSP-EI1TS/OS**
transducer frequency	MHz	1	2
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
pipe wall thickness			
min.	mm	2.5	1.5
max.	mm	-	-
material			
housing		PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PI	PI
degree of protection according to EN 60529		IP 56	IP 56
transducer cable			
type		6111	6111
length	m	4	4
dimensions			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+200	+200
temperature compensation		x	x

technical type			GDM2E85	GDP2E85
explosion protection				
ATEX/IEC Ex	transducer ATEX		GSM-EA1TS GSM-EA1TS/OS	GSP-EA1TS GSP-EA1TS/OS
	transducer IEC Ex		GSM-EI1TS GSM-EI1TS/OS	GSP-EI1TS GSP-EI1TS/OS
	zone		1/2 (gas/dust)	1/2 (gas/dust)
	explosion protection temperature			
	min. max.	°C °C	-45 +225	-45 +225
	marking		CE 0637 Ex II2G II3D Ex eq II T6...T2 Ex tD A22 IP56 TX	CE 0637 Ex II2G II3D Ex eq II T6...T2 Ex tD A22 IP56 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (ATEX zone 2, FM or without explosion protection)

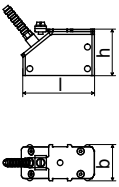
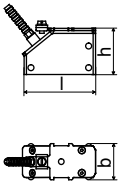
technical type		GDG1N52	GDK1N52
order code		**GSG-NA2TS** **GSG-NA2TS/OS** **GSG-NF2TS** **GSG-NF2TS/OS** **GSG-NNNTS** **GSG-NNNTS/OS**	**GSK-NA2TS** **GSK-NA2TS/OS** **GSK-NF2TS** **GSK-NF2TS/OS** **GSK-NNNTS** **GSK-NNNTS/OS**
transducer frequency	MHz	0.2	0.5
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	250	70
min. recommended	mm	380	80
max. recommended	mm	810	500
max. extended	mm	1100	720
pipe wall thickness			
min.	mm	14	5
max.	mm	-	-
material			
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK
degree of protection according to EN 60529		IP 67	IP 67
transducer cable			
type		1699	1699
length	m	5	5
dimensions			
length l	mm	129.5	126.5
width b	mm	51	51
height h	mm	67	67.5
dimensional drawing			
operating temperature			
min.	°C	-40	-40
max.	°C	+130	+130
temperature compensation		x	x

technical type			GDG1N52	GDK1N52
explosion protection				
ATEX	transducer		GSG-NA2TS GSG-NA2TS/OS	GSK-NA2TS GSK-NA2TS/OS
	zone		2	2
	explosion protection temperature			
	min. max.	°C °C	-55 +190	-55 +190
	marking		CE Ex II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX
	certification		-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		GSG-NF2TS GSG-NF2TS/OS	GSK-NF2TS GSK-NF2TS/OS
	explosion protection temperature			
	min. max.	°C °C	-40 +125	-40 +125
	marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (ATEX zone 2, FM or without explosion protection)

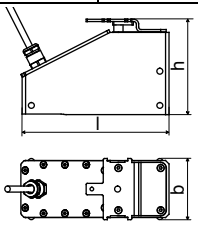
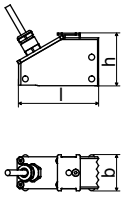
technical type		GDM2N52	GDP2N52
order code		**GSM-NA2TS** **GSM-NA2TS/OS** **GSM-NF2TS** **GSM-NF2TS/OS** **GSM-NNNTS** **GSM-NNNTS/OS**	**GSP-NA2TS** **GSP-NA2TS/OS** **GSP-NF2TS** **GSP-NF2TS/OS** **GSP-NNNTS** **GSP-NNNTS/OS**
transducer frequency	MHz	1	2
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
pipe wall thickness			
min.	mm	2.5	1.5
max.	mm	-	-
material			
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK
degree of protection according to EN 60529		IP 67	IP 65
transducer cable			
type		1699	1699
length	m	4	4
dimensions			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
operating temperature			
min.	°C	-40	-40
max.	°C	+130	+130
temperature compensation		x	x

technical type			GDM2N52	GDP2N52
explosion protection				
ATEX	transducer		GSM-NA2TS GSM-NA2TS/OS	GSP-NA2TS GSP-NA2TS/OS
	zone		2	2
	explosion protection temperature			
	min. max.	°C °C	-55 +190	-55 +190
	marking		CE Ex II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX
	certification		-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		GSM-NF2TS GSM-NF2TS/OS	GSP-NF2TS GSP-NF2TS/OS
	explosion protection temperature			
	min. max.	°C °C	-55 +190	-55 +190
	marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (ATEX zone 2 or without explosion protection, IP 68)

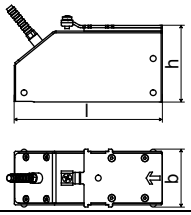
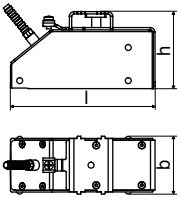
technical type		GDG1LI8	GDK1LI8	GDM2LI8	GDP2LI8
order code		**GSG-NA2TS/ IP68 GSG-NNNTS/ IP68**	**GSK-NA2TS/ IP68 GSK-NNNTS/ IP68**	**GSM-NA2TS/ IP68 GSM-NNNTS/ IP68**	**GSP-NA2TS/ IP68 GSP-NNNTS/ IP68**
transducer frequency	MHz	0.2	0.5	1	2
medium pressure[1]					
min. extended	bar	metal pipe: 20	metal pipe: 20	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]					
min. extended	mm	250	70	30	15
min. recommended	mm	380	80	40	20
max. recommended	mm	810	500	80	40
max. extended	mm	1100	720	120	60
pipe wall thickness					
min.	mm	14	5	2.5	1.5
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 68	IP 68	IP 68	IP 68
transducer cable					
type		2550	2550	2550	2550
length	m	12	12	12	12
dimensions					
length l	mm	128.5	128.5	70	70
width b	mm	54	54	32	32
height h	mm	83.5	83.5	46	46
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+100	+100	+100	+100
temperature compensation		x	x	x	x

technical type			GDG1LI8	GDK1LI8	GDM2LI8	GDP2LI8
explosion protection						
ATEX	transducer		GSG-NA2TS/ IP68	GSK-NA2TS/ IP68	GSM-NA2TS/ IP68	GSP-NA2TS/ IP68
	zone		2	2	2	2
	explosion protection temperature					
	min. max.	°C °C	-40 +90	-40 +90	-40 +90	-40 +90
	marking		CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3GEx nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX
	certification		-	-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

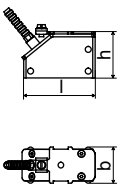
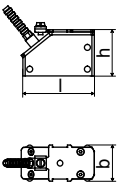
Shear Wave Transducers (connection system AS, without explosion protection)

technical type		GDG1NZ7	GDK1NZ7
order code		**GSG-NNNAS**	**GSK-NNNAS**
transducer frequency	MHz	0.2	0.5
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	250	70
min. recommended	mm	380	80
max. recommended	mm	810	500
max. extended	mm	1100	720
pipe wall thickness			
min.	mm	14	5
max.	mm	-	-
material			
housing		PEEK with stainless steel cap 304 (1.4301)	PEEK with stainless steel cap 304 (1.4301)
contact surface		PEEK	PEEK
degree of protection according to EN 60529		IP 67	IP 67
transducer cable			
type		1699	1699
length	m	5	5
dimensions			
length l	mm	129.5	126.5
width b	mm	51	51
height h	mm	67	67.5
dimensional drawing			
operating temperature			
min.	°C	-40	-40
max.	°C	+130	+130
temperature compensation		x	x

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

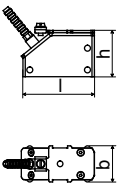
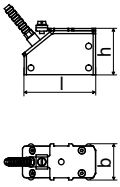
Shear Wave Transducers (connection system AS, without explosion protection)

technical type		GDM2NZ7	GDP2NZ7
order code		**GSM-NNNAS**	**GSP-NNNAS**
transducer frequency	MHz	1	2
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
pipe wall thickness			
min.	mm	2.5	1.5
max.	mm	-	-
material			
housing		PEEK with stainless steel cap 304 (1.4301)	PEEK with stainless steel cap 304 (1.4301)
contact surface		PEEK	PEEK
degree of protection according to EN 60529		IP 67	IP 67
transducer cable			
type		1699	1699
length	m	4	4
dimensions			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
operating temperature			
min.	°C	-40	-40
max.	°C	+130	+130
temperature compensation		x	x

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Shear Wave Transducers (extended temperature range, ATEX zone 2, FM or without explosion protection)

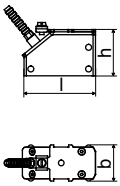
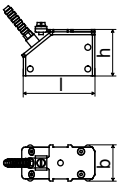
technical type		GDM2E52	GDP2E52
order code		**GSM-EA2TS** **GSM-EA2TS/OS** **GSM-EF2TS** **GSM-EF2TS/OS** **GSM-ENNTS** **GSM-ENNTS/OS**	**GSP-EA2TS** **GSP-EA2TS/OS** **GSP-EF2TS** **GSP-EF2TS/OS** **GSP-ENNTS** **GSP-ENNTS/OS**
transducer frequency	MHz	1	2
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
pipe wall thickness			
min.	mm	2.5	1.5
max.	mm	-	-
material			
housing		PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PI	PI
degree of protection according to EN 60529		IP 56	IP 56
transducer cable			
type		6111	6111
length	m	4	4
dimensions			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+200	+200
temperature compensation		x	x

technical type			GDM2E52	GDP2E52
explosion protection				
ATEX	transducer		GSM-EA2TS GSM-EA2TS/OS	GSP-EA2TS GSP-EA2TS/OS
	zone		2	2
	explosion protection temperature			
	min.	°C	-45	-45
	max.	°C	+235	+235
	marking		CE Ex II3G Ex nA II T6...T2 Ta -45...+235 °C II3D Ex tD A22 IP56 TX	CE Ex II3G Ex nA II T6...T2 Ta -45...+235 °C II3D Ex tD A22 IP56 TX
	certification		-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		GSM-EF2TS GSM-EF2TS/OS	GSP-EF2TS GSP-EF2TS/OS
	explosion protection temperature			
	min.	°C	-45	-45
	max.	°C	+235	+235
	marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

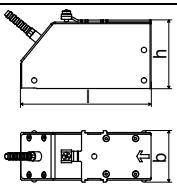
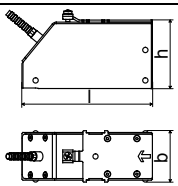
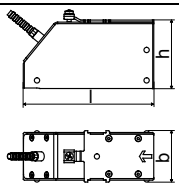
Shear Wave Transducers (extended temperature range, without explosion protection, connection system AS)

technical type		GDM2EZ7	GDP2EZ7
order code		**GSM-ENNAS**	**GSP-ENNAS**
transducer frequency	MHz	1	2
medium pressure[1]			
min. extended	bar	metal pipe: 20	metal pipe: 20
min.	bar	metal pipe: 30 plastic pipe: 1	metal pipe: 30 plastic pipe: 1
inner pipe diameter d[2]			
min. extended	mm	30	15
min. recommended	mm	40	20
max. recommended	mm	80	40
max. extended	mm	120	60
pipe wall thickness			
min.	mm	2.5	1.5
max.	mm	-	-
material			
housing contact surface		PI with stainless steel cap 304 (1.4301) PI	PI with stainless steel cap 304 (1.4301) PI
degree of protection according to EN 60529		IP 65	IP 65
transducer cable			
type		6111	6111
length	m	4	4
dimensions			
length l	mm	62.5	62.5
width b	mm	32	32
height h	mm	40.5	40.5
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+200	+200
temperature compensation		x	x

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] shear wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

Lamb Wave Transducers (zone 1)

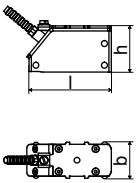
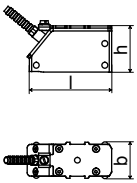
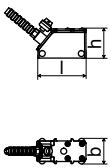
technical type		GRG1N83	GRH1N83	GRK1N83
order code		**GLG-NA1TS** **GLG-NA1TS/OS** **GLG-NI1TS** **GLG-NI1TS/OS**	**GLH-NA1TS** **GLH-NA1TS/OS** **GLH-NI1TS** **GLH-NI1TS/OS**	**GLK-NA1TS** **GLK-NA1TS/OS** **GLK-NI1TS** **GLK-NI1TS/OS**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

technical type			GRG1N83	GRH1N83	GRK1N83
explosion protection					
ATEX / IEC Ex	transducer ATEX		GLG-NA1TS GLG-NA1TS/OS	GLH-NA1TS GLH-NA1TS/OS	GLK-NA1TS GLK-NA1TS/OS
	transducer IEC Ex		GLG-NI1TS GLG-NI1TS/OS	GLH-NI1TS GLH-NI1TS/OS	GLK-NI1TS GLK-NI1TS/OS
	zone		1	1	1
	explosion protection temperature				
	min. max.	°C °C	-55 +140	-55 +140	-55 +140
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (zone 1)

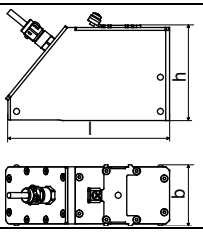
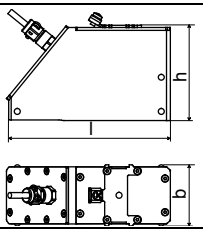
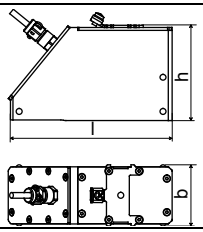
technical type		GRM1N83	GRP1N83	GRQ1N83
order code		**GLM-NA1TS** **GLM-NA1TS/OS** **GLM-NI1TS** **GLM-NI1TS/OS**	**GLP-NA1TS** **GLP-NA1TS/OS** **GLP-NI1TS** **GLP-NI1TS/OS**	**GLQ-NA1TS** **GLQ-NA1TS/OS** **GLQ-NI1TS** **GLQ-NI1TS/OS**
transducer frequency	MHz	1	2	4
medium pressure[1]				
min. extended	bar	-	-	-
min.	bar	metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1	metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1	metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	90	50	22
max. extended	mm	150	70	35
pipe wall thickness				
min.	mm	2	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

technical type			GRM1N83	GRP1N83	GRQ1N83
explosion protection					
ATEX/IECEx	transducer ATEX		GLM-NA1TS GLM-NA1TS/OS	GLP-NA1TS GLP-NA1TS/OS	GLQ-NA1TS GLQ-NA1TS/OS
	transducer IEC Ex		GLM-NI1TS GLM-NI1TS/OS	GLP-NI1TS GLP-NI1TS/OS	GLQ-NI1TS GLQ-NI1TS/OS
	zone		1	1	1
	explosion protection temperature				
	min. max.	°C °C	-55 +140	-55 +140	-55 +140
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
remark					on request

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (zone 1, IP 68)

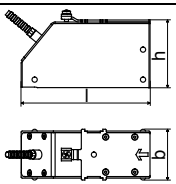
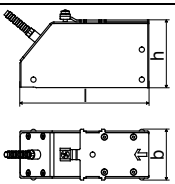
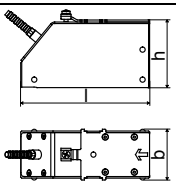
technical type		GRG1LI3	GRH1LI3	GRK1LI3
order code		**GLG-NA1TS/IP68**	**GLH-NA1TS/IP68**	**GLK-NA1TS/IP68**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing		PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 68	IP 68	IP 68
transducer cable				
type		2550	2550	2550
length	m	12	12	12
dimensions				
length l	mm	143.5	143.5	143.5
width b	mm	54	54	54
height h	mm	83.5	83.5	83.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+100	+100	+100
temperature compensation		x	x	x

technical type			GRG1LI3	GRH1LI3	GRK1LI3
explosion protection					
ATEX	transducer		GLG-NA1TS/IP68	GLH-NA1TS/IP68	GLK-NA1TS/IP68
	zone		1	1	1
	explosion protection temperature				
	min. max.	°C °C	-55 +140	-55 +140	-55 +140
	marking		CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX
	certification		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (ATEX zone 2, FM or without explosion protection)

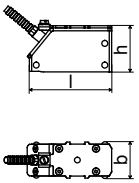
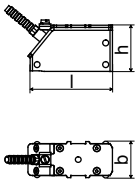
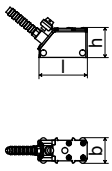
technical type		GRG1N52	GRH1N52	GRK1N52
order code		**GLG-NA2TS GLG-NA2TS/OS GLG-NF2TS GLG-NF2TS/OS GLG-NNNTS GLG-NNNTS/OS**	**GLH-NA2TS GLH-NA2TS/OS GLH-NF2TS GLH-NF2TS/OS GLH-NNNTS GLH-NNNTS/OS**	**GLK-NA2TS GLK-NA2TS/OS GLK-NF2TS GLK-NF2TS/OS GLK-NNNTS GLK-NNNTS/OS**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended min.	bar bar	metal pipe: 10 metal pipe: 15 plastic pipe: 1	metal pipe: 10 metal pipe: 15 plastic pipe: 1	metal pipe: 10 (d > 120 mm), 5 (d < 120 mm) metal pipe: 15 (d > 120 mm), 10 (d < 120 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing contact surface		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU
degree of protection according to EN 60529		IP 67	IP 67	IP 67
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

technical type			GRG1N52	GRH1N52	GRK1N52
explosion protection					
ATEX	transducer		GLG-NA2TS GLG-NA2TS/OS	GLH-NA2TS GLH-NA2TS/OS	GLK-NA2TS GLK-NA2TS/OS
	zone		2	2	2
	explosion protection temperature				
	min. max.	°C °C	-55 +150	-55 +150	-55 +150
	marking		CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX
	certification		-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		GLG-NF2TS GLG-NF2TS/OS	GLH-NF2TS GLH-NF2TS/OS	GLK-NF2TS GLK-NF2TS/OS
	explosion protection temperature				
	min. max.	°C °C	-40 +165	-40 +165	-40 +165
	marking		FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive	non incendive

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (ATEX zone 2, FM or without explosion protection)

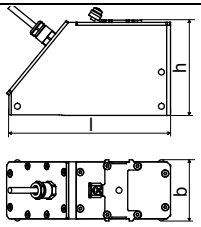
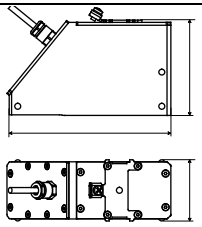
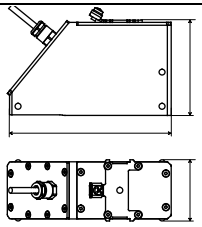
technical type		GRM1N52	GRP1N52	GRQ1N52
order code		**GLM-NA2TS GLM-NA2TS/OS GLM-NF2TS GLM-NF2TS/OS GLM-NNNTS GLM-NNNTS/OS**	**GLP-NA2TS GLP-NA2TS/OS GLP-NF2TS GLP-NF2TS/OS GLP-NNNTS GLP-NNNTS/OS**	**GLQ-NA2TS GLQ-NA2TS/OS GLQ-NF2TS GLQ-NF2TS/OS GLQ-NNNTS GLQ-NNNTS/OS**
transducer frequency	MHz	1	2	4
medium pressure[1]				
min. extended min.	bar bar	- metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1	- metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1	- metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	90	50	22
max. extended	mm	150	70	35
pipe wall thickness				
min.	mm	2	1	0.5
max.	mm	5	3	1
material				
housing contact surface		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404) PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

technical type			GRM1N52	GRP1N52	GRQ1N52
explosion protection					
ATEX	transducer		GLM-NA2TS GLM-NA2TS/OS	GLP-NA2TS GLP-NA2TS/OS	GLQ-NA2TS GLQ-NA2TS/OS
	zone		2	2	2
	explosion protection temperature				
	min. max.	°C °C	-55 +150	-55 +150	-55 +150
	marking		CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	CE Ex II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX
	certification		-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		GLM-NF2TS GLM-NF2TS/OS	GLP-NF2TS GLP-NF2TS/OS	GLQ-NF2TS GLQ-NF2TS/OS
	explosion protection temperature				
	min. max.	°C °C	-55 +165	-55 +165	-55 +165
	marking		FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	FM APPROVED NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive	non incendive
remark					on request

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (ATEX zone 2 or without explosion protection, IP 68)

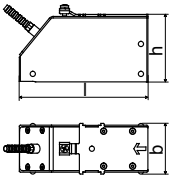
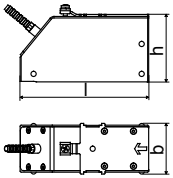
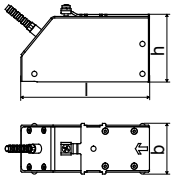
technical type		GRG1LI8	GRH1LI8	GRK1LI8
order code		**GLG-NA2TS/IP68** **GLG-NNNTS/IP68**	**GLH-NA2TS/IP68** **GLH-NNNTS/IP68**	**GLK-NA2TS/IP68** **GLK-NNNTS/IP68**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing		PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 68	IP 68	IP 68
transducer cable				
type		2550	2550	2550
length	m	12	12	12
dimensions				
length l	mm	143.5	143.5	143.5
width b	mm	54	54	54
height h	mm	83.5	83.5	83.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+100	+100	+100
temperature compensation		x	x	x

technical type			GRG1LI8	GRH1LI8	GRK1LI8
explosion protection					
ATEX	transducer		GLG-NA2TS/IP68	GLH-NA2TS/IP68	GLK-NA2TS/IP68
	zone		2	2	2
	explosion protection temperature				
	min. max.	°C °C	-40 +90	-40 +90	-40 +90
	marking		CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX
	certification		-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

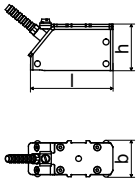
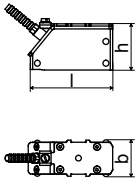
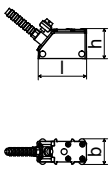
Lamb Wave Transducers (without explosion protection, connection system AS)

technical type		GRG1NC3	GRH1NC3	GRK1NC3
order code		**GLG-NNNAS**	**GLH-NNNAS**	**GLK-NNNAS**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	metal pipe: 15 plastic pipe: 1	metal pipe: 15 plastic pipe: 1	metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (without explosion protection, connection system AS)

technical type		GRM1NC3	GRP1NC3	GRQ1NC3
order code		**GLM-NNNAS**	**GLP-NNNAS**	**GLQ-NNNAS**
transducer frequency	MHz	1	2	4
medium pressure[1]				
min. extended	bar	-	-	-
min.	bar	metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1	metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1	metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1
inner pipe diameter d[2]				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	90	50	22
max. extended	mm	150	70	35
pipe wall thickness				
min.	mm	2	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x
remark				on request

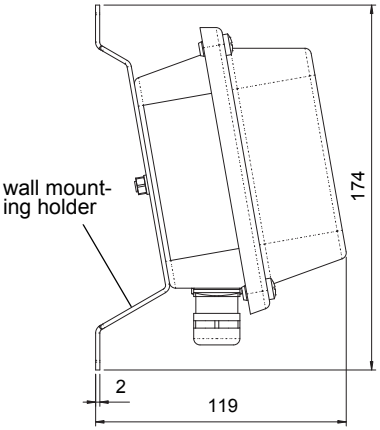
[1] depending on application, typical absolute value for natural gas, nitrogen, compressed air

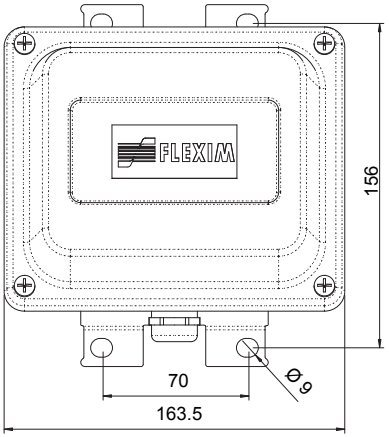
[2] Lamb wave transducers:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocityof 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Junction Box

technical type		JB01S4E3M	JB02	JB03	JBP2	JBP3
dimensions		see dimensional drawing	see dimensional drawing	see dimensional drawing	see dimensional drawing	see dimensional drawing
fixation		wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting
material						
housing gasket		stainless steel 316L (1.4404) silicone	stainless steel 304 (1.4301) option OS: 316L (1.4404) silicone	stainless steel 304 (1.4301) option OS: 316L (1.4404) silicone	stainless steel 316L (1.4404) silicone	stainless steel 316L (1.4404) silicone
degree of protection according to EN 60529		IP 67	IP 67	IP 67	IP 67	IP 67
cable gland		M20	M20	M20	M20	M20
operating temperature						
min. max.	°C °C	-40 +80	-40 +80	-40 +80	-40 +80	-40 +80
explosion protection						
ATEX / IEC Ex zone		1	2	-	2	-
marking		CE 0637 Ⓔx II2G Ⓔx II2D Ex e mb II (T6)...T4 Ta -40...+(70)80 °C Ex tD A21 IP67 T 100 °C	CE Ⓔx I3G Ex nA II T6...T4 T_a -40...+80 °C II3D Ex tD A22 IP67 T 100 °C	-	CE Ⓔx II3G Ex nA II T6...T4 T_a -40...+80 °C II3D Ex tD A22 IP67 T 100 °C	-
certification ATEX		IBExU06ATEX1161	-	-	-	-
certification IEC Ex		IECEx IBE08.0006	-	-	-	-
type of protection		junction box: increased safety decoupled network: encapsulation	non sparking, protection by enclosure	-	non sparking, protection by enclosure	-

Dimensions



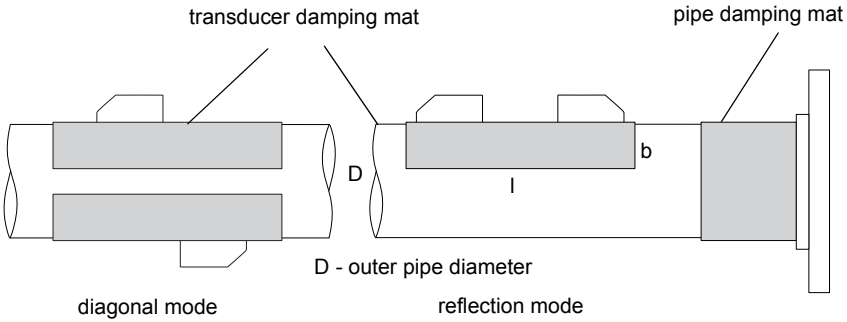


Damping Mats (Optional)

Damping mats will be used for the gas measurement to reduce noise influences on the measurement.

Transducer damping mats will be installed below the transducers.

Pipe damping mats will be installed at reflection points, e.g. flange, welding.



Selection of Damping Mats

type	description	outer pipe diameter mm	dimensions l x b x h mm	transducer frequency G	H	K	M	P	temperature °C	remark
transducer damping mat										
C	self-adhesive, for stationary installation	< 80	450 x 115 x 0.5	-	-	-	x	x	-25...+60	
		≥ 80	900 x 230 x 0.5	-	-	x	x	-		
			900 x 230 x 1.3	x	x	-	-	-		
pipe damping mat										
B	self-adhesive, for stationary installation		l x 100 x 0.9	x	x	x	x	x	-35...+50	l - see table below

Pipe Damping Mat Type A: Number of Pieces Depending on the Outer Pipe Diameter

Pipe Damping Mat Type B: Length l Depending on Transducer Frequency and Outer Pipe Diameter

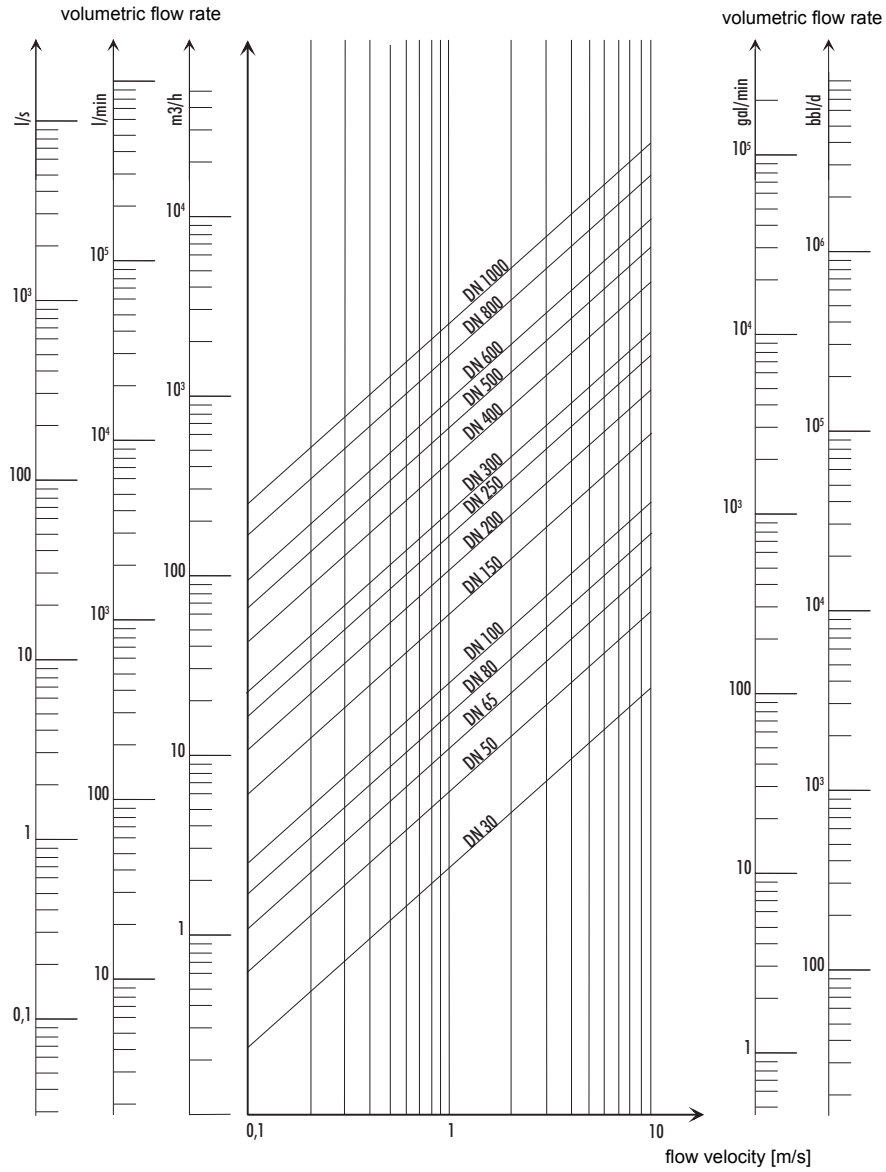
outer pipe diameter mm	transducer frequency G, H	K, M, P
100	2 m	1 m
200	6 m	3 m
300	12 m	6 m
500	32 m	16 m
1000	126 m	63 m

Units of Measurement

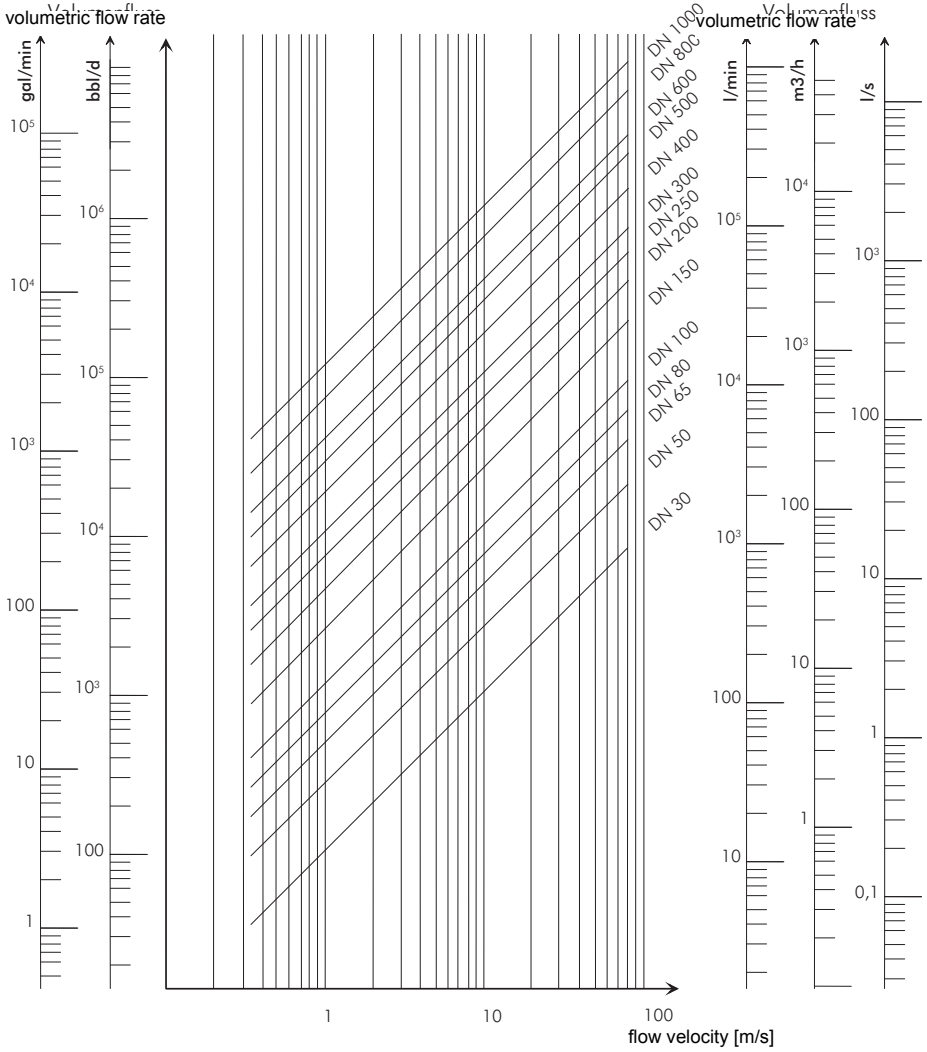
standard/ operating volumetric flow rate	flow velocity	mass flow rate	totalizers		sound velocity
			volume	mass	
m^3/d	m/s	kg/h	m^3	g	m/s
m^3/h	cm/s	kg/min	l	kg	
m^3/min	inch/s	g/s	gal	t	
m^3/s	fps	t/d			
ml/min		t/h			
l/h		lb/d			
l/min		lb/h			
l/s		lb/min			
hl/h		lb/s			
hl/min					
hl/s					
Ml/d					
bbl/d					
bbl/h					
bbl/m					
USgpd					
USgph					
USgpm					
USgps					
MGD					
CFD					
CFH					
CFM					
CFS					

1 US gallon = 3.78 l
1 barrel = 42 US gallons = 158.76 l

Flow Nomogram (metrical)



Flow Nomogram (imperial)



C Reference

The following tables provide assistance for the user. The accuracy of the data depends on the composition, the temperature and the manufacturing process of the material. FLEXIM does not assume liability for any inaccuracies.

Table C.1: Sound Velocity of Selected Pipe and Lining Materials at 20 °C

The values of some of these materials are stored in the internal database of the transmitter. Column c_{flow} shows the sound velocity (longitudinal or transversal) used for the flow measurement.

material	c_{trans} [m/s]	c_{long} [m/s]	c_{flow}	material	c_{trans} [m/s]	c_{long} [m/s]	c_{flow}
aluminum	3 100	6 300	trans	platinum	1 670		trans
asbestos cement	2 200		trans	polyethylene	925		trans
lead	700	2 200	trans	polystyrene	1 150		trans
bitumen	2 500		trans	PP	2 600		trans
brass	2 100	4 300	trans	PVC		2 395	long
carbon steel	3 230	5 800	trans	PVC (hard)	948		trans
copper	2 260	4 700	trans	PVDF	760	2 050	long
Cu-Ni-Fe	2 510		trans	quartz glass	3 515		trans
ductile iron	2 650		trans	rubber	1 900	2 400	trans
glass	3 400	4 700	trans	silver	1 590		trans
grey cast iron	2 650	4 600	trans	Sintimid		2 472	long
PE		1 950	long	stainless steel	3 230	5 790	trans
Perspex	1 250	2 730	long	Teka PEEK		2 537	long
PFA		1 185	long	Tekason		2 230	long
plastics	1 120	2 000	long	titanium	3 067	5 955	trans

The sound velocity depends on the composition and the manufacturing process of the material.

The sound velocity of alloys and cast materials fluctuates strongly. The values only serve as an orientation.

Table C.2: Typical Roughnesses of Pipes

The values are based on experience and measurements.

material	absolute roughness [mm]
drawn pipes of non-ferrous metal, glass, plastics and light metal	0…0.0015
drawn steel pipes	0.01…0.05
fine-planed, polished surface	max. 0.01
planed surface	0.01…0.04
rough-planed surface	0.05…0.1
welded steel pipes, new	0.05…0.1
after long use, cleaned	0.15…0.2
moderately rusted, slightly encrusted	max. 0.4
heavily encrusted	max. 3
cast iron pipes:	
bitumen lining	> 0.12
new, without lining	0.25…1
rusted	1…1.5
encrusted	1.5…3

Table C.3: Typical Properties of Selected Media at 20 °C and 1 bar

medium	sound velocity [m/s]	kinematic viscosity [mm^2/s]	density [g/cm^3]
acetone	1 190	0.4	0.7300
ammonia (NH_3)	1 386	0.2	0.6130
gasoline	1 295	0.7	0.8800
beer	1 482	1.0	0.9980
BP Transcal LT	1 365	20.1	0.8760
BP Transcal N	1 365	94.3	0.8760
diesel	1 210	7.1	0.8260
natural gas	424	0.0	0.0000
ethanol	1 402	1.5	0.7950
hydrofluoric acid 50 %	1 221	1.0	0.9980
hydrofluoric acid 80 %	777	1.0	0.9980
glycol	1 665	18.6	1.1100
20 % glycol/H_2O	1 655	1.7	1.0280
30 % glycol/H_2O	1 672	2.2	1.0440
40 % glycol/H_2O	1 688	3.3	1.0600
50 % glycol/H_2O	1 705	4.1	1.0750
ISO VG 100	1 487	314.2	0.8690
ISO VG 150	1 487	539.0	0.8690
ISO VG 22	1 487	50.2	0.8690
ISO VG 220	1 487	811.1	0.8690
ISO VG 32	1 487	78.0	0.8690
ISO VG 46	1 487	126.7	0.8730
ISO VG 68	1 487	201.8	0.8750
methanol	1 119	0.7	0.7930
milk	1 482	5.0	1.0000
Mobiltherm 594	1 365	7.5	0.8730
Mobiltherm 603	1 365	55.2	0.8590
NaOH 10 %	1 762	2.5	1.1140
NaOH 20 %	2 061	4.5	1.2230
paraffin 248	1 468	195.1	0.8450
R134 Freon	522	0.2	1.2400
R22 Freon	558	0.1	1.2130
crude oil, light	1 163	14.0	0.8130
crude oil, heavy	1 370	639.5	0.9220
sulphuric acid 30 %	1 526	1.4	1.1770
sulphuric acid 80 %	1 538	13.0	1.7950
sulphuric acid 96 %	1 366	11.5	1.8350
juice	1 482	1.0	0.9980
hydrochloric acid 25 %	1 504	1.0	1.1180
hydrochloric acid 37 %	1 511	1.0	1.1880
sea water	1 522	1.0	1.0240
Shell Thermina B	1 365	89.3	0.8630
silicone oil	1 019	14 746.6	0.9660
SKYDROL 500-B4	1 387	21.9	1.0570
SKYDROL 500-LD4	1 387	21.9	1.0570
Water	1 482	1.0	0.9990

Table C.4: Properties of Methane

medium temperature [°C]	medium pressure [bar]	density [kg/m^3]	sound velocity [m/s]	kinematic viscosity [mm^2/s]	compressibility factor (AGA8-DC92) K
0	40	31.177	415.43	0.358693909	0.9062727
10		29.683	425.18	0.38628171	0.9182674
20		28.354	434.39	0.414403611	0.928556
30		27.159	443.13	0.44309437	0.9374469
40		26.076	451.46	0.472426753	0.9451792
50		25.09	459.43	0.502271821	0.9519414
60		24.186	467.08	0.532704871	0.9578844
70		23.353	474.44	0.563696313	0.9631301
80		22.583	481.54	0.595270779	0.9677784
0	80	68.928	411.41	0.184177693	0.819764
10		64.534	422.6	0.19880993	0.8446627
20		60.824	433.08	0.213649217	0.8656106
30		57.632	442.93	0.228709745	0.883441
40		54.841	452.23	0.24399628	0.8987615
50		52.372	461.06	0.259547086	0.9120284
60		50.164	469.47	0.275336895	0.9235928
70		48.174	477.51	0.291402001	0.9337303
80		46.367	485.22	0.307718852	0.9426606
0	120	111.81	429.84	0.134809051	0.7579655
10		103.24	438.35	0.144178613	0.7919381
20		96.221	447.12	0.153874934	0.8207028
30		90.346	455.84	0.163836805	0.8452495
40		85.332	464.39	0.174014438	0.8663576
50		80.984	472.7	0.184419145	0.8846352
60		77.166	480.75	0.195021123	0.90056
70		73.775	488.53	0.205828533	0.9145109
80		70.737	496.07	0.216831361	0.9267913

Table C.5: Chemical Resistance of Autotex

Autotex (keyboard) is resistant according to DIN 42115, part 2 against the following chemicals for a contact time of more than 24 h without visible changes:

- ethanol
- cyclohexanol
- diacetone alcohol
- glycol
- isopropanol
- glycerine
- methanol
- triacetin
- Dowandol DRM/PM
- acetone
- methyl-ethyl-ketone
- Dioxan
- cyclohexanone
- MIBK
- isophorone
- ammonia < 40 %
- soda lye < 40 %
- potassium hydroxide < 30 %
- alcalicarbonate
- bichromate
- potassium hexacyanoferrates
- acetonitrile
- sodium bisulfate
- formaldehyde 37…42 %
- acetaldehyde
- aliphatic hydrocarbons
- Toluol
- Xylol
- diluent (white spirit)
- formic acid < 50 %
- acetic acid < 50 %
- phosphoric acid < 30 %
- hydrochloric acid < 36 %
- nitric acid < 10 %
- trichloroacetic acid < 50 %
- sulphuric acid < 10 %
- drilling emulsion
- diesel oil
- varnish
- paraffin oil
- castor oil
- silicone oil
- turpentine oil substitute
- Dccon
- plane fuel
- gasoline
- Water
- saltwater
- 1,1,1-trichlorethane
- ethyl acetate
- diethyl ether
- N-butyl acetate
- amyl acetate
- butylcellosolve
- ether
- chlornatron < 20 %
- hydrogen peroxide < 25 %
- potash soft soap
- detergent
- tensides
- softener
- iron chloride ($FeCl_2$)
- iron chloride ($FeCl_3$)
- dibutyl phthalate
- dioctyl phthalate
- sodium carbonate

Autotex is resistant according to DIN 42115, part 2 to acetic acid for a contact time <1 h without visible damage.

Autotex is not resistant to following chemicals:

- concentrated mineral acids
- concentrated alkaline solutions
- high pressure steam > 100 °C
- benzyl alcohol
- methylene chloride

D Certificates

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the ultrasonic flowmeters

FLUXUS G704 A2, FLUXUS ADM 7407 A2

to which this declaration relates are in conformity with the following EC directives:

EMC Directive 2004/108/EC for Electromagnetic Compatibility

Low Voltage Directive 2006/95/EC for Electrical Safety

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres according to annex VIII

The ultrasonic flowmeters are in conformity with the following European Standards:

Class	Standard	Description
EMC Directive	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements - General requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques - Electrostatic discharge immunity test
	EN 61000-4-3:2003	Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
	EN 61000-4-4:2005	Testing and measurement techniques - Electrical fast transient/burst immunity test
	EN 61000-4-5:2007	Testing and measurement techniques - Surge immunity test
	EN 61000-4-6:2002	Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
	EN 61000-4-11:2005	Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
- Emission	EN 61326-1:2007	Electrical equipment Class A
Low Voltage Directive	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
- Isolation		Pollution degree 2
		Overvoltage category 2
		Safety class 1

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The ultrasonic flowmeters have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T4 Ta -20...+60°C

⟨Ex⟩ II3D Ex tD A22 IP65 T 100°C

The installation, operating and safety instructions have to be observed!

Berlin, 2009-09-23

Dipl.-Ing. Jens Hilpert
Managing Director

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CE

FLEXIM

Declaration of conformity

We

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the ultrasonic flowmeters

FLUXUS ADM 7207, FLUXUS ADM 7407, FLUXUS ADM 7807,
FLUXUS ADM 7907, FLUXUS G704, FLUXUS G709

to which this declaration relates are in conformity with the EC directives

EMC Directive 2004/108/EC for Electromagnetic Compatibility
Low Voltage Directive 2006/95/EC for Electrical Safety.

The ultrasonic flowmeters are in conformity with the following European Standards:

Class	Standard	Description
EMC Directive	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques; Electrostatic Discharge Immunity
	EN 61000-4-3:2003	Testing and measurement techniques; RF Field Immunity
	EN 61000-4-4:2005	Testing and measurement techniques; Electrical Fast Transient / Burst Immunity
	EN 61000-4-5:2007	Testing and measurement techniques; Surge Immunity Test
	EN 61000-4-6:2002	Testing and measurement techniques; RF Conducted Immunity
	EN 61000-4-11:2005	Testing and measurement techniques; AC Mains Voltage Dips and Interruption Immunity
- Emission	EN 61326-1:2007	Electrical equipment Class A
Low Voltage Directive	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control and laboratory use
- Isolation		Pollution degree 2
		Overvoltage category 2
		Safety class 1

The installation, operating and safety instructions have to be observed!

Berlin, 03/02/2009

i.A. Andreas

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the junction box

JB01SaE3b

is in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The junction box mentioned above is in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2004	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-7:2003	Electrical apparatus for explosive gas atmospheres - Increased safety "e"
	EN 60079-18:2004	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection encapsulation "m" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	Junction box JB01SaE3b	IBExU06ATEX1161

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the junction box includes the following:

CE 0637 Ex II2G II2D

Ex e mb II (T6)...T4 Ta -40...+(70)80 °C

Ex tD A21 IP67 T 100 °C

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the junction boxes

JB02, JBT2 and JBP2

conform to the requirements for use in explosive atmosphere
according to annex VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The junction boxes mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The junction boxes have to be marked as follows:

Ex II3G Ex nA II T6...T4 Ta -40...+80 °C

Ex II3D Ex tD A22 IP67 T 100 °C

The installation, operating and safety instructions have to be observed!

Berlin, 2009-09-23

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1N31, **K1N41, **G1N31, **G1N41, **K1N33, **K1N43, **G1N33, **G1N43, **H1N33, **H1N43, **M2N41, **P2N41, **M1N43, **P1N43, **M2E45, **P2E45**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1N31, **K1N41, **G1N31, **G1N41, **K1N33, **K1N43, **G1N33, **G1N43, **H1N33, **H1N43, **M2N41, **P2N41, **M1N43, **P1N43, **M2E45, **P2E45	IBExU04ATEX1011 X

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FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex

II2G Ex q II T6...T3 or T2

II2D Ex tD A21 IP65 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1N71, **K1N81, **G1N71, **G1N81, **K1N73, **K1N83, **G1N73, **G1N83, **H1N73, **H1N83, **M2N81, **P2N81, **Q2N81, **M1N83, **P1N83, **Q1N83**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-7:2007	Explosive atmospheres - Equipment protection by increased safety "e"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1N71, **K1N81, **G1N71, **G1N81, **K1N73, **K1N83, **G1N73, **G1N83, **H1N73, **H1N83, **M2N81, **P2N81, **Q2N81, **M1N83, **P1N83, **Q1N83	IBExU07ATEX1168 X

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex II2G II2D
Ex eq II T6...T3
Ex tD A21 IP65 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1LI1, **G1LI1, **M2LI1, **P2LI1, **K1LI3, **H1LI3, **G1LI3**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1LI1, **G1LI1, **M2LI1, **P2LI1, **K1LI3, **H1LI3, **G1LI3	IBExU07ATEX1168 X

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

Test conditions for IP 68:	3 months at 2 bar (20 m) at 20 °C

The marking of the transducers includes the following:

CE 0637 Ex II2G II2D
Ex q II T6...T3
Ex tD A21 IP68 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****M2E85, **P2E85, **Q2E85**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-7:2007	Explosive atmospheres - Equipment protection by increased safety "e"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**M2E85, **P2E85, **Q2E85	IBExU07ATEX1168 X

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex II2G II3D

Ex eq II T6...T2

Ex tD A22 IP56 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

GDM1N52, GDP1N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T4 Ta -20°C...130°C

⟨Ex⟩ II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 23/04/2008

Dipl.-Ing. Jens Hilpert
Managing Director

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

***DG1N52, *DK1N52, *DM2N52, *DP2N52, *DQ2N52**

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T3 Ta -55...+190 °C

⟨Ex⟩ II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 2009-11-20

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

****M2E52, **P2E52, **Q2E52**

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

The operating and safety instructions have to be observed!

Berlin, 2009-06-25

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

**K1LI8, *RH1LI8, **G1LI8, **M2LI8, **P2LI8

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T5 Ta -40...+90 °C

⟨Ex⟩ II3D Ex tD A22 IP68 TX

The operating and safety instructions have to be observed!

Berlin, 11/03/2009

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

GRK1N52, GRH1N52, GRG1N52, GRM1N52, GRP1N52, GRQ1N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T3 Ta -55...+150 °C

⟨Ex⟩ II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 17/10/2008

Dipl.-Ing. Jens Hilpert
Managing Director

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

CRK1N52, CTK1N52, CRH1N52, CTH1N52, CRG1N52, CTG1N52, CRM1N52, CTM1N52, CRP1N52, CRQ1N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T3 Ta -55...+150 °C

⟨Ex⟩ II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 17/10/2008

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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