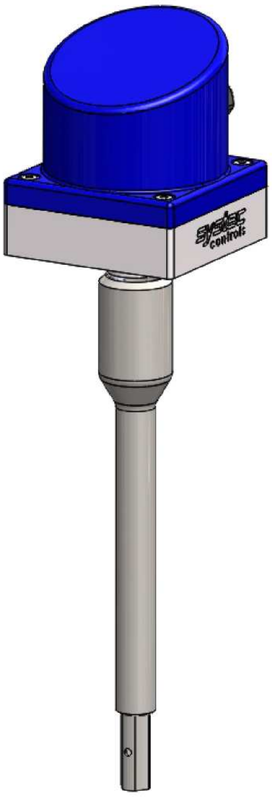
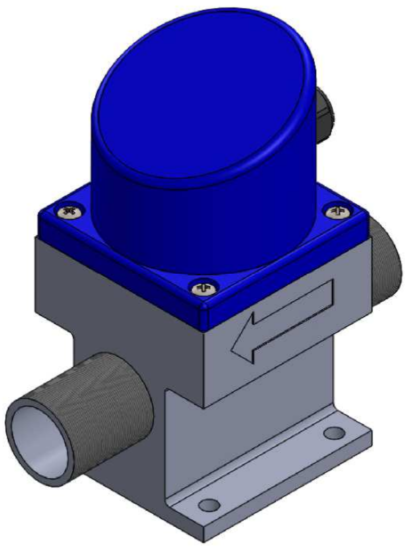
detaflowC

Operating Instructions

deltaflowC





Probe

Venturi

systec Controls GmbH
Lindberghstrasse 4, 82178 Puchheim, Germany
Telefon +49 89 - 80906-0, Fax +49 89 - 80906-200
eMail: info@systec-controls.de
http://www.systec-controls.de

Contents

1 Description

1.1 Introduction

The deltaflowC is used in the industrial sector, to measure the mass flow of air and other non-explosive and non-corrosive gases in pipes and ducts.

There are two different versions *(see Fig. 1 deltaflowC versions*

- **deltaflowC insertion probe** for installation in pipes by means of a weld end flange
- **deltaflowC venturi** with a contoured measuring tube with flange connections

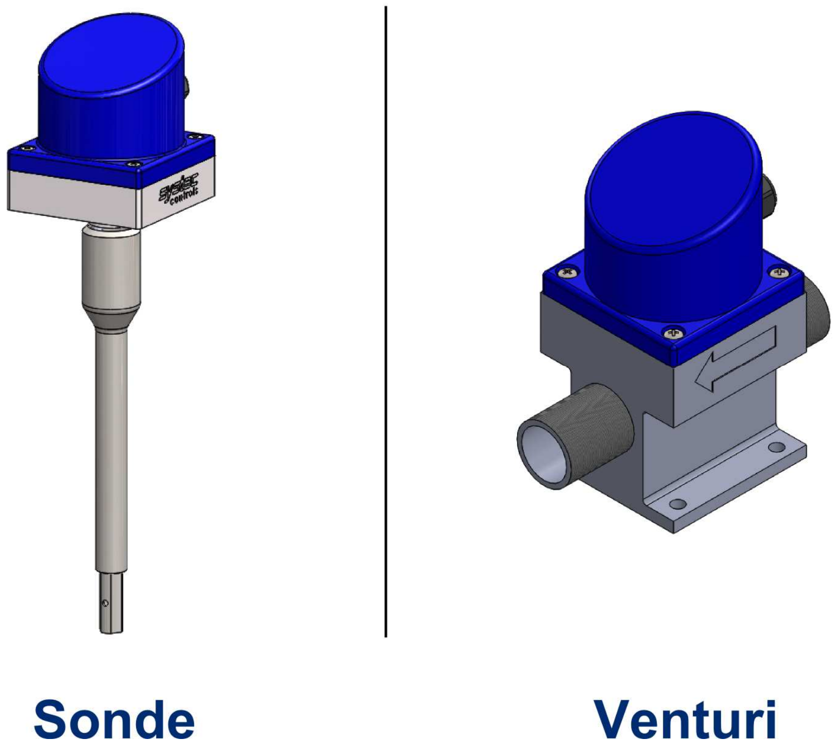


Fig. 1 deltaflowC versions

Both have the same measurement electronics in common, which can indicate the mass flow value, absolute pressure and/or temperature as 4-20mA current signal and 0-10V voltage signal.
In order to cover a very wide range of applications, there are 4 adjustable measuring ranges and 4 different signal filters. The power supply is nominally 24V, but can be anywhere within the range of 18 to 36V.

There are two versions in terms of the absolute pressure range:

- **LP** = Low pressure with a pressure range of 0 (vacuum) to 4.5 bar, abs
- **HP** = High pressure with a pressure range of 0 (vacuum) to 14 bar, abs

1.2 Measurement principle

The measurement principle of the deltaflowC insertion probe and deltaflowC venturi is based on dynamic pressure measurement technology, as is also described in DIN EN ISO 5167-1 to 4.

The **deltaflowC insertion probe** has two apertures in its measuring profile. The flow of medium creates a pressure difference between the aperture facing the direction of flow and the aperture facing away from the direction of flow, depending on the local speed of flow. The magnitude of the differential pressure is a measure of the local flow speed.

The **deltaflowC venturi** works on the venturi measurement principle, but is a compact version similar to a venturi nozzle. The medium accelerates from the inlet cross-section to a smaller throat cross-section. The static medium pressures at the inlet and throat cross-sections are fed to the sensors by apertures on the side. The pressure difference between the two apertures is a measure of the flow speed.

In both versions, the medium density is determined by the integrated pressure and temperature sensors and the type of gas. Knowing the pipe diameter at the deltaflowC insertion probe or the inlet and throat cross-sections in the case of the deltaflowC venturi, the electronics can then calculate the mass flow.

1.3 Highlights

- By measuring temperature, absolute pressure and differential pressure using the compact sensors and microprocessor-based flow computer, the deltaflowC offers a compact and cost-effective solution for a wide range of different flow measurement applications.

- The deltaflowC compensates for the effects of pressure and temperature on the flow measurement with integrated pressure and temperature sensors.

- The mass flow value and/or alternative medium pressure and medium temperature can be displayed directly in the form of current or voltage signals.

- In comparison to other measurement processes, such as thermo anemometers, the deltaflowC is characterised by the absence of sensitivity to condensate and dust deposits.

- The deltaflowC works practically maintenance-free and can be used for large flow, temperature and pressure ranges.

- In addition, with just one installed length, the deltaflowC insertion probe fits almost all pipes and channels (“one size fits all“). This makes it possible to supply the deltaflowC on short delivery times and is well-suited to being kept in stock by customers.

- The deltaflowC venturi is especially suitable for low flow rates and for measuring pulsating flows.

1.4 Applications

Typical applications are the measurement of compressed air, HVAC applications (heating, ventilating and air conditioning), combustion air regulation, process air, etc.

OEM / private label versions are available on request (Contact see Section 7).

2 Layout

The **deltaflowC Designer** program for laying out the deltaflowC insertion probe and venturi is on the enclosed CD. The program can also be downloaded from the systec Controls website (www.systec-controls.de). Each time the software is started, the current version is checked via the systec Controls server. If an update is available, the software is automatically updated.

Based on the differential/dynamic pressure measurement principle, the greatest accuracy for dynamic pressures is obtained with high flow rates. If setting the measurement range results in "Very Low", the dynamic pressure is possibly very low and possibly too low to still be measured accurately enough.
Qmin describes that limit. *(See Fig. 2).* In cases where the flow is in this range, it is recommended to contact systec Controls to check the design and optimisation.

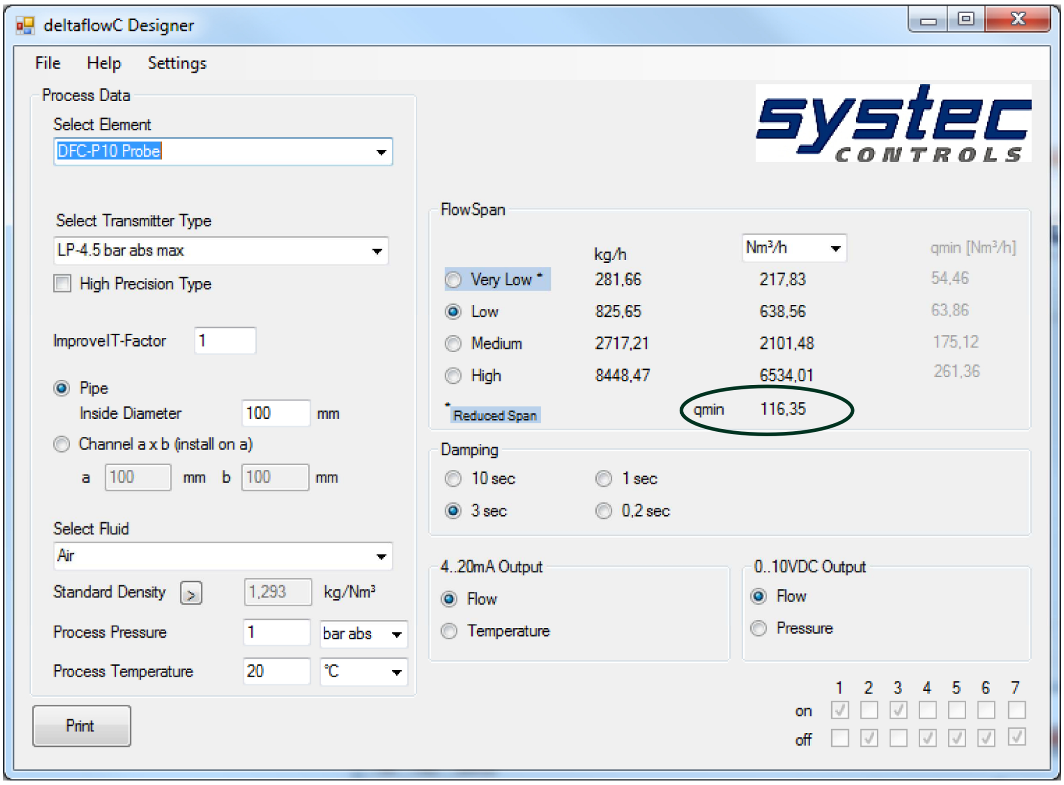


Fig. 2 Qmin layout

To design the layout, first select the probe or venturi type (Select Element):
deltaflowC HP for **14bar** pressure range and **deltaflowC LP** for **4.5bar** pressure range. *(See point 1in Fig. 3 Selection of type)*

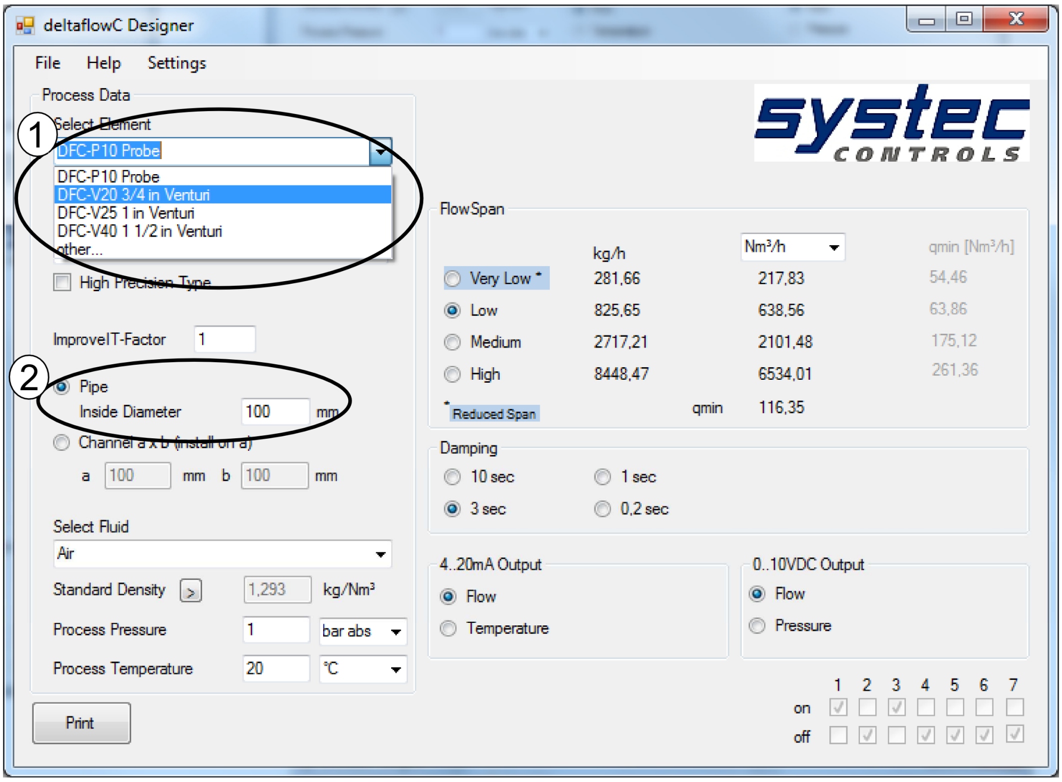


Fig. 3 Selection of type

Then enter the pipe inside diameter. *(See Point 2, Fig. 3 Selection of type)*

systec Controls GmbH
Lindberghstrasse 4, 82178 Puchheim, Germany
Telefon +49 89 – 80906-0, Fax +49 89 – 80906-200
eMail: info@systec-controls.de
http://www.systec-controls.de

Then select the process medium. *(See Fig. 4 Selection of medium)* If this is not available as one of the options, then select the option "other gas" and then enter the standard density of the medium in the field "Standard Density":

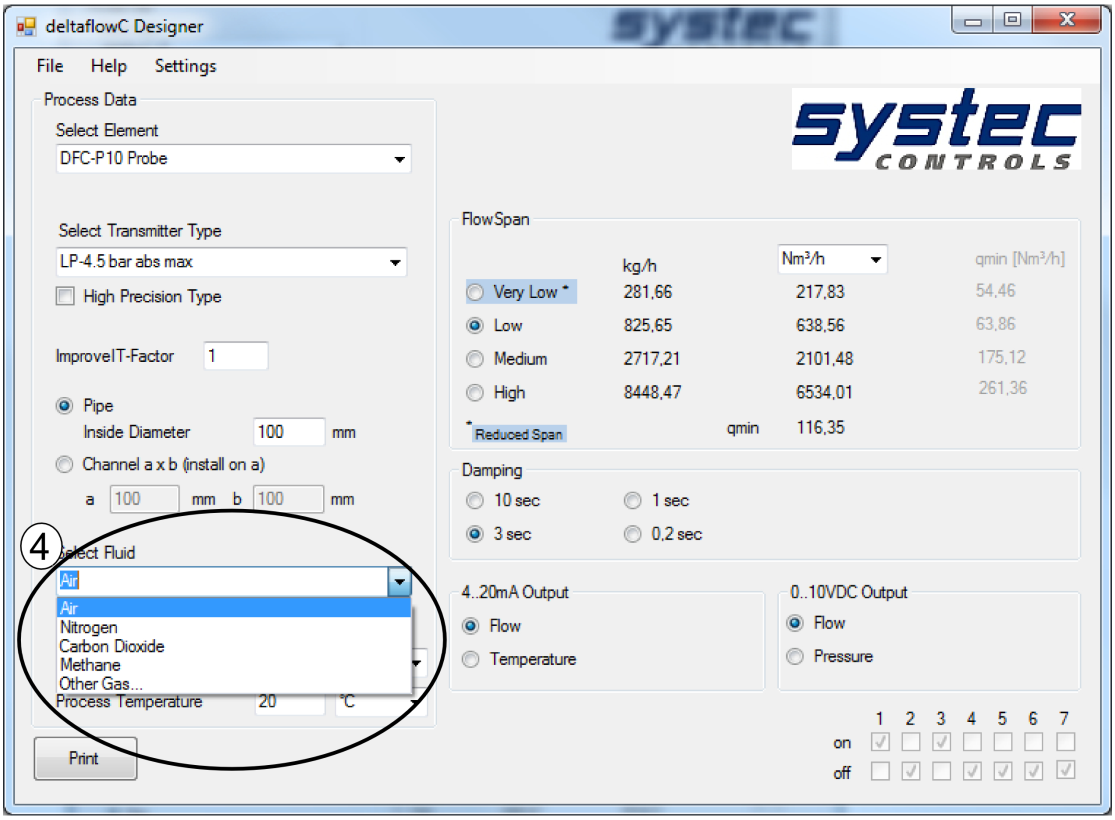


Fig. 4 Selection of medium

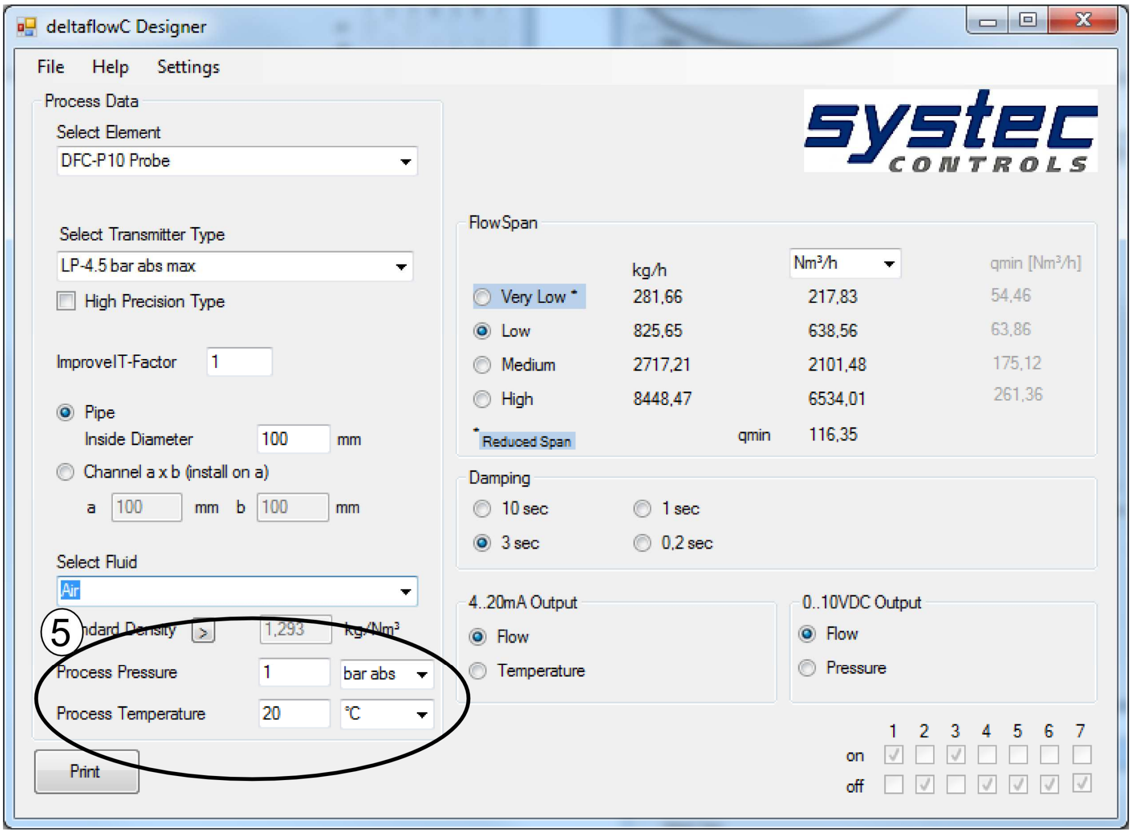


Fig. 5 Pressure and temperature

Then enter the typical operating pressure and the normal operating temperature in the fields ”Process Pressure“ and ”Process Temperature“. *See Fig. 5 Pressure and temperature*

The “ImproveIT-Factor” is an option to take special flow situations such as pipe bends before a measuring point or too short an inlet or outlet section into account in the layout. Should such a requirement arise, then it should be discussed with systec Controls. Factor 1 is to be entered as the default.

Measurement range final values which define the mass flow output for the current and/or the voltage output are available in the top right in the “Flow Span“ field.

In “Damping“, select the damping from Section 3.3.2 for the output of the current and voltage signals. The damping factor is set at 3 s as default. More information about damping will be given in the following sections.

Whether the current output signal of the flow (Flow) or the medium temperature (Temperature) is to be displayed is defined below the damping setting. The same applies for the current output. It is possible here to choose between flow (Flow) or medium pressure (Pressure).

After selecting all parameters and the ”Flow Span“, Very Low, Low, Medium and High, the software automatically calculates the required setting of the DIP switch for the deltaflowC electronics. This switch setting is displayed at the right hand bottom corner.

3 Installation

3.1 Installation

In order to utilise the quality of the deltaflowC optimally, it is very important to install the deltaflowC correctly and to select the correct parameters. However good the measurement, incorrect installation cannot do the quality justice. We will be happy to carefully examine your installation conditions and let you know what the optimum mounting choice is.

Fig. 6 Recommended inlet conditions, shows the optimum conditions for installing the probe. The same inlet conditions also apply to the venturi.

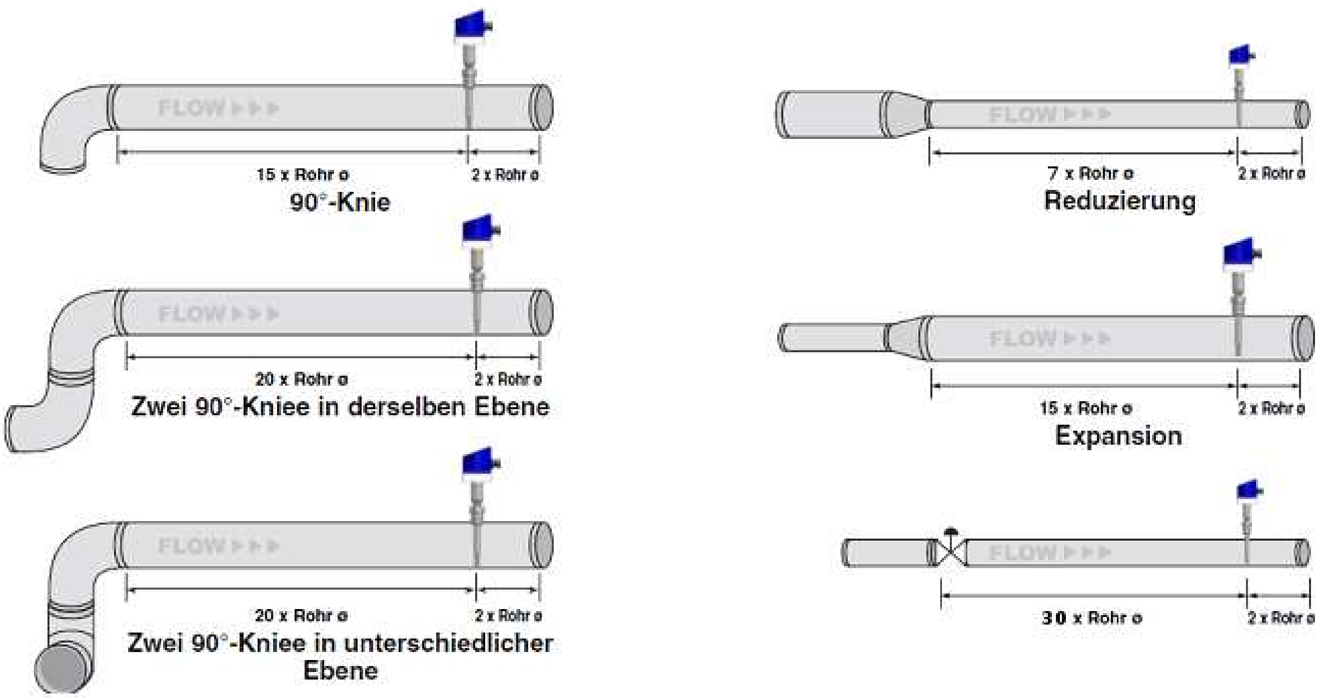


Fig. 6 Recommended inlet conditions, also apply to venturi

Knie	bend
Rohr	pipe
Zwei 90° -Knie in der selben ebene	Two 90° bends in the same plane
Zwei 90° -Knie in unterschiedliche ebene	Two 90° bends in different planes
Reduzierung	Reduction
Expansion	Expansion
Rohr	pipe

3.1.1 deltaflowC insertion probe

The deltaflowC insertion probe must be installed so that in case of condensing gases, the condensate can drain off by gravity in the measurement profile through the differential pressure apertures. Ideally, the probe should be installed vertically with the blue cover uppermost- and the measurement profile located **underneath**. *(See Fig. 7 Probe* installation*)*

Fig. 7 Probe installation

The probe is supplied with a protective cover on the measurement profile end. This must be removed before installing.

The deltaflowC insertion probe is supplied with an 18mm weld end cutting ring-threaded connection for steel pipes or stainless pipes.

Note: When ordering, please indicate the model code of the material required

The measuring pipe is drilled to accept the probe and the cutting ring threaded connection is welded on properly. Take care that no weld metal interferes with the insertion of the probe and that the insertion probe is not damaged by forcing the insertion. The probe should not be subjected to any mechanical stresses such as hitting it with a hammer or the like.

The probe must ***always*** be inserted up to the ***stop*** - either, in the case of small pipes, until it touches the opposite pipe wall or until it touches the finger-tightened nut (over the cutting ring). The probe should be aligned so that the flow direction arrow on the probe housing is in the direction of the flow in the pipe. Small angle differences of less than +/-5° are not critical. The insertion probe can now be fixed in this position by tightening the cutting ring fitting.

Warning: Once the clamping ring has been pressed home on the probe shaft, the position of the clamping ring can no longer be altered.

Note
Only the clamping rings and nuts supplied by systec Controls should be used. No warranty will be given for any other type of installation. In general, typical hydraulic clamping rings do not fit exactly, cause leaks and therefore measurement errors.

The following table lists the recommended weld filler materials.

Material Piping	Material Nozzles	TIG	Rod electrode	Autogenic
Carbon steel (St. 35.8)	Carbon steel (St. 35.8)	DMO-IG	FoxEV50	BW XII
Carbon steel (St. 35.8)	Stainless steel (1.4571)	A7-A-IG	FoxA7-A-IG	
Stainless steel (1.4571)	Stainless steel (1.4571)	SAS4-IG	FoxSAS4-IG	

The material required for butt-welded nozzles can be found in the order confirmation.

A drilled hole, 21.5 (+/-0.5) mm, is required for butt-welding the cutting ring nozzle.
The following drawings show the installation graphically.

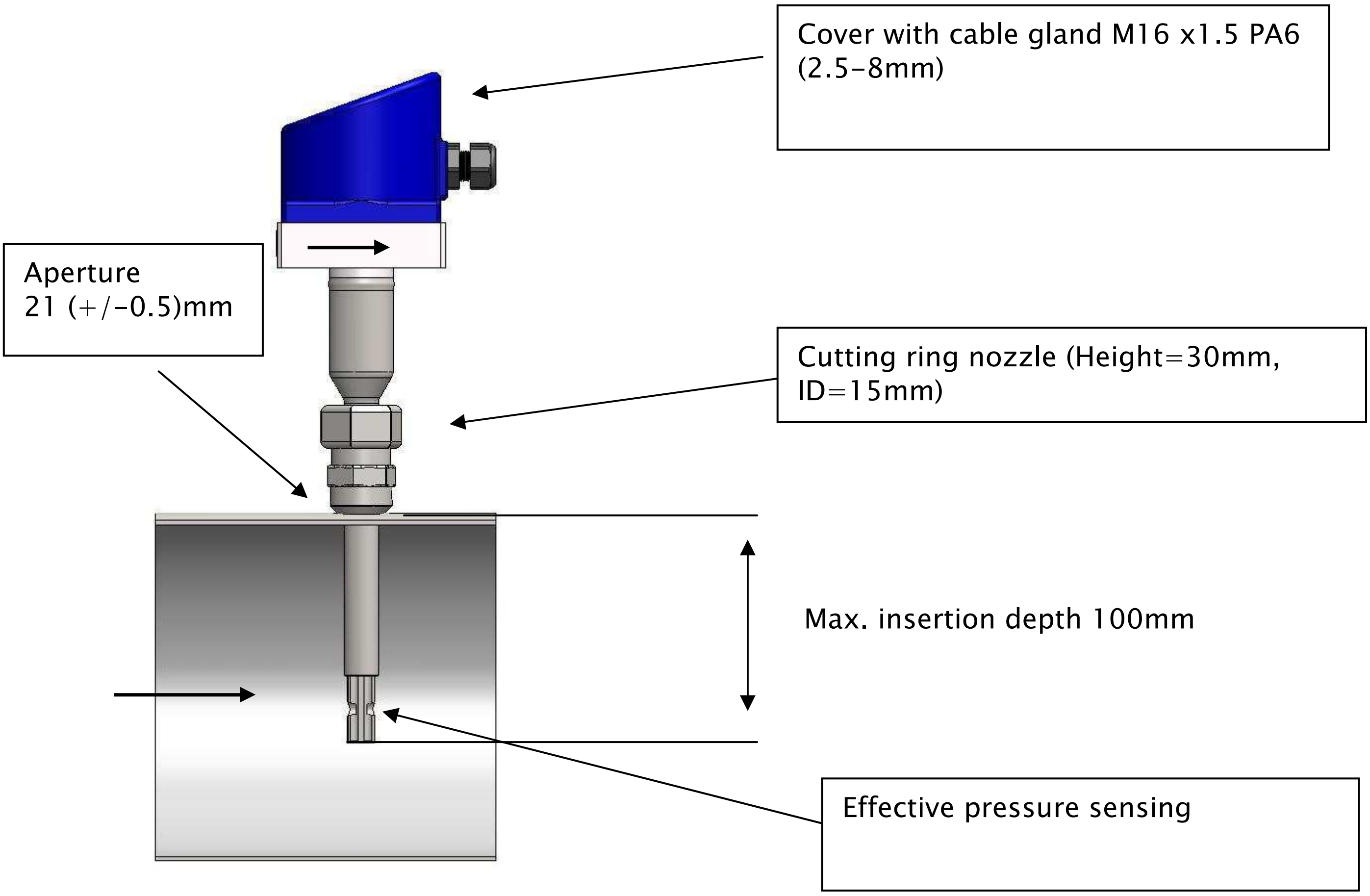
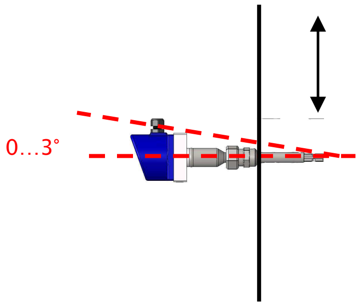
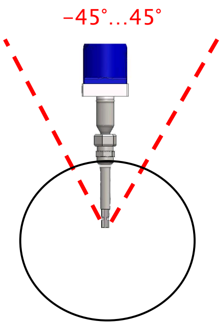
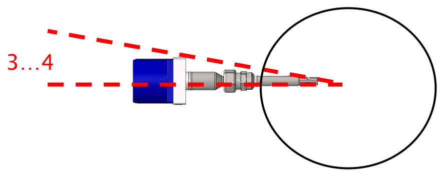


Fig. 8 Example: deltaflowC line DN300

Fig. 9 Example deltaflowC line DN40

systec Controls GmbH
Lindberghstrasse 4, 82178 Puchheim, Germany
Telefon +49 89 - 80906-0, Fax +49 89 - 80906-200
eMail: info@systec-controls.de
http://www.systec-controls.de

Installation situation	Illustration	Description
Vertical line		The probe is installed horizontally or with a slight downward inclination towards the probe tip to ensure free drain-off of condensate.
Horizontal line, **<u>preferred installation position</u>**		The probe is installed vertically from above or below at an angle of max. +/- 30° to ensure free drain-off of condensate.
Horizontal line, alternative installation position		The probe is installed horizontally or with a slight downward inclination towards the probe tip to ensure free drain-off of condensate.

3.1.2 deltaflowC venturi

In the case of possible condensing gases, the deltaflowC-Venturi should be mounted to ensure that the condensate can drain off through the differential pressure apertures by gravity. Ideally the measurement electronics should be located on top.

The flange connection to both pipe flanges is by means of screw connections and use of suitable gaskets according to the required standards.

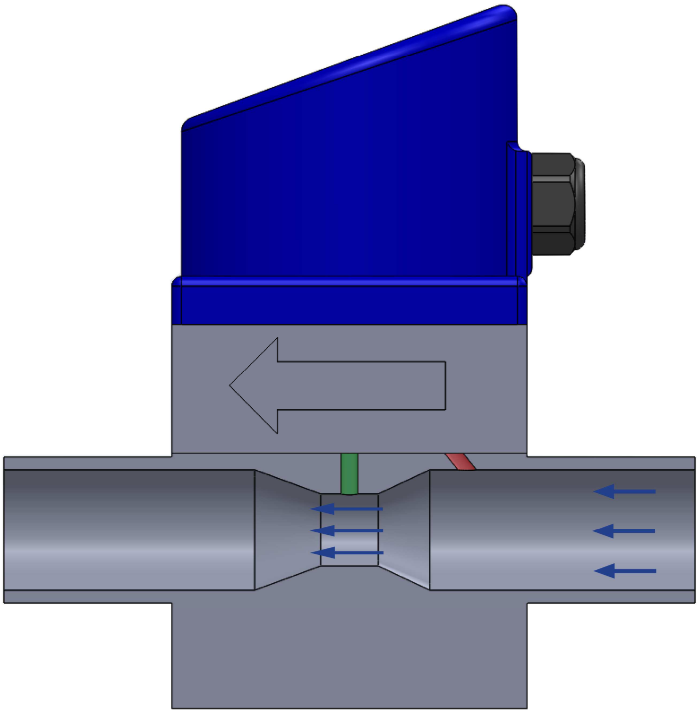


Fig. 10 Venturi sketch

Fig. 10 Venturi shows the venturi principle. The flow is increased through the reduced pipe cross-section. This creates a differential pressure between the effective pressure apertures. This is analysed by the deltaflowC electronics.

The male thread means that the venturi can easily be inserted between two pipe ends. Care must be taken that possible condensate can drain off by gravity. This is ensured by locating the electronics above the venturi body where possible.

3.2 Electrical connections

The deltaflowC is supplied complete with a protective metal cap. First the 4 fastening screws must be unscrewed and the cap removed.
Fig. 11 Connection diagram shows the layout of the probe after removing the protective metal cap.

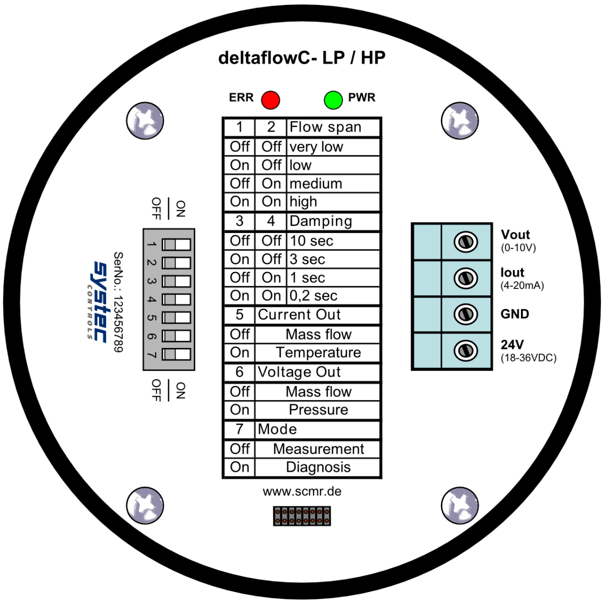


Fig. 11 Connection diagram

The cable with the power supply and signal lines is fed in through the screw connection on the side of the cap. The cable wires should be connected properly with wire end ferrules (max. cros-section 1.5 mm²) according to the following coding.

Vout 0..10VDC	Analogue output with 0..10VDC (flow or pressure)
Iout 4..20mA	Current output with 4—20mA (flow or temperature)
GND	Earth (“Ground“)
24V	Supply voltage 24V; extended range: 18..36VDC; 80mA max.

Before the protective cap is refitted and fastened, the setting switch (”DIP“ switch) must be set (See Section 3.3).

To ensure waterproof protection, care must be taken that the O-ring for sealing the cap (it is around the measurement electronics) is properly seated and that the cable gland for sealing the cable is properly tightened.

3.3 Commissioning

The parameters for the deltaflowC are set with the use of the “DIP“ switch. The setting parameters are: measurement range, damping, signal output and diagnosis function.
The DIP switch settings are briefly summarised as a setting aid on the sensor electronics label.

The **deltaflowC-Designer** is also needed for commissioning. It can be ordered at www.systec-controls.de

The DeltaflowC-Designer software displays the right switch setting, depending on the selection of the parameters. *(See Fig. 12* DIP switch*).* When installing, the DIP switches are to be set in the same way.

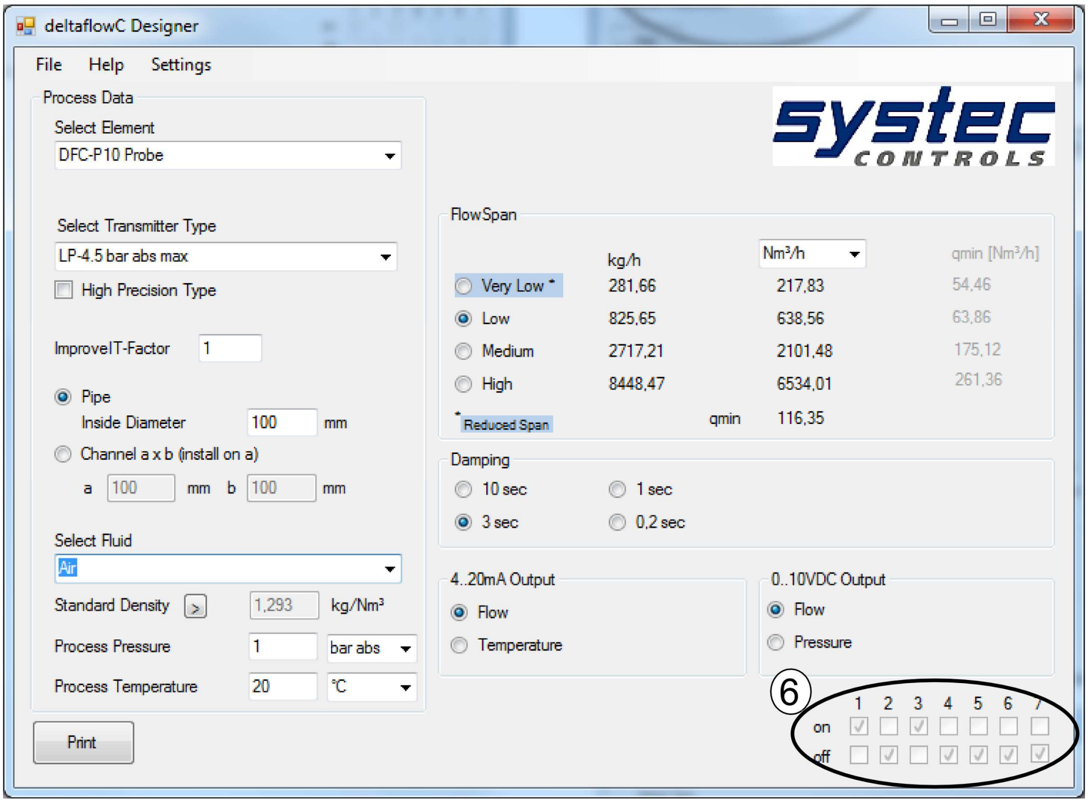


Fig. 12 DIP switch

3.3.1 DIP switch – measurement range

The measurement range is set with switches 1 and 2.

1	2	Setting
OFF	OFF	Very Low
ON	OFF	Low
OFF	ON	Medium
ON	ON	High

The exact ranges can be calculated using the layout software supplied with the unit. (See Section 2).

3.3.2 DIP switch – Damping

The damping is set with DIP switches 3 and 4.

3	4	Setting
OFF	OFF	10 sec
ON	OFF	3 sec
OFF	ON	1 sec
ON	ON	0.2 sec

Note
Damping displays a time of t90. In the case of a rapid change in value, 90% of the change in value is shown in the set damping time at the signal output.

In the software in the measurement computer, the damping for pulsating flows with rapid changes in flow is optimised at 0.2sec and 1sec. If greater value filtering is required, this must be made in the following external control system. If necessary, this adaptation is possible by altering the software. In this case, please contact systec Controls.

For flows with slow flow changes (<1Hz), in other words stationary flow, the damping can be optimised at 3sec and 10sec. In the case of flows with oscillations of absolute pressure and slow flow changes both these dampings can also be used.
Setting the damping is uncritical in the cases when the median mass flow from one damping to the other does not change, or only changes slightly.

Pulsating flows and pressure oscillations generally require a greater volume in order to be measuredaccurately. In such cases, please contact systec Controls (see Section 7 for contact information).

3.3.3 DIP switch – selection of the output

Both the analogue outputs work independently of each other and can, in addition to flow, also show output pressure or temperature. These settings can be set using DIP switches 5 and 6.

5	6	Setting
OFF		4..20mA as flow
ON		4..20mA as temperature -50..250°C
	OFF	0..10VDC as flow
	ON	0..10VDC as pressure 0..10 bara

3.3.4 DIP switch – operating mode

DIP- switch 7 is normally set to “OFF“. With this setting, the flow computer is in measurement mode.
The diagnosis mode is activated with the “ON” setting. Further information can be found in Section 4.

4 Diagnosis mode

Fig.13 Control board shows the control board again.

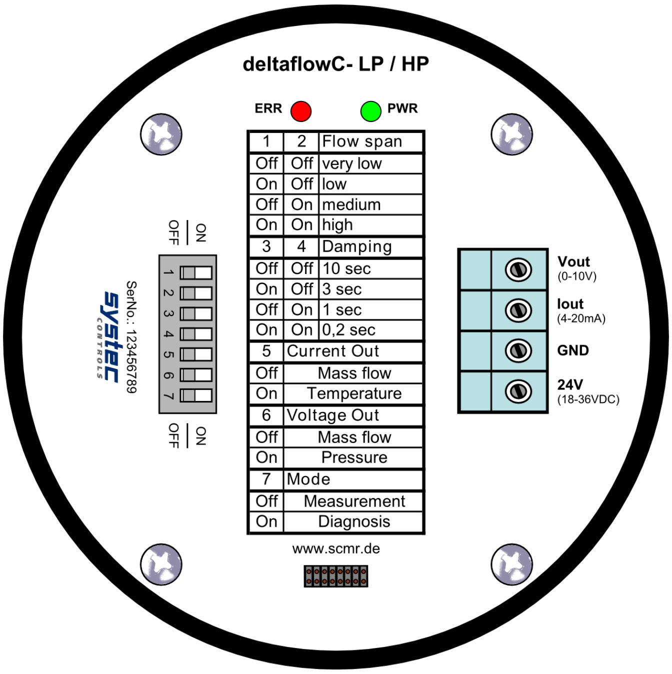


Fig.13 Control board

The diagnosis mode is activated when the DIP switch 7 is set to "ON". The flashing red ERR LED indicates this. The green PWR LED is in the off mode. In the diagnosis mode, both of the analogue outputs are changed so that no flow, pressure or temperature is outputted.
If DIP switch 7 is set to "OFF", the diagnosis mode is deactivated again, the red LED goes out and the green LED lights up, provided there is no error. The sensor is then back to normal operating mode.

The table below shows the individual diagnosis functions each allocated a DIP switch from 1 to 6.

DIP switch	Description of functions
1	Test signals: 4mA and 2V for current and voltage output
2	Test signals: 20mA und 10V for current and voltage output
3	Zero point reference of the differential pressure sensor
4	reserved
5	reserved
6	reserved

To carry out the diagnosis functions, the diagnosis mode must be activated by setting DIP-7 = "ON" with the relevant DIP switch being switched back and forth once.

Both cases:

OFF->ON->**OFF**
or
ON->OFF->**ON**

The diagnosis function is successfully carried out when this is signalled by the green PWR LED flashing three times.

If the sensor, when the medium ceases to flow, shows a current value of >4mA or a voltage of >0V or the measurement in the case of low flow rates shows too low values, this could be caused by a drift of the differential pressure sensor. To correct this, a zero point reference using function 3 should be carried out.

5 Signal Evaluation

The deltaflowC outputs a current and a voltage signal in parallel independently of each other. The combination possibilities can be found in Section 3.3.3.

5.1 Flow

The flow from the process can be calculated from the current- (4-20mA) and the voltage signal (0-10V) of the deltaflowC. The flow is defined as:

$$q_m = FS \cdot a$$ equation 5.1

The constant FS (Flow Span) is the measurement range final value, which is displayed in the “”Flow Span” field, having entered all required parameters (see Section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

The variable is the value of the output signal in %. The output value for the current output is defined as:

$$a = \frac{(I_{out}[mA] - 4mA)}{16mA}$$ equation 5.2

The output value for the voltage output is defined as:

$$a = \frac{U_{out}[V]}{10V}$$ equation 5.3

There are two diagnosis functions to test the display values of the systems connected to the deltaflowC:

1. Output of 4mA and 2V
2. Output of 20mA and 10V.

These functions are described in Section 4.

5.2 Temperature of medium

The temperature of the medium can be outputted by the current output using the appropriate setting of the DIP switch (see Section 3.3.3.). The conversion in temperature is defined by:

$$T[°C] = -40°C + \frac{I_{out} - 4mA}{16mA} \cdot 540°C \qquad \text{equation 5.4}$$

5.3 Pressure of medium

The pressure of the medium can be outputted by the voltage output using the appropriate setting of the DIP switch (see Section 3.3.3). The conversion into pressure is defined as follows:

For deltaflowC-HP (14bar measurement range) as

$$p[bar] = \frac{U_{out}[V]}{10V} \cdot 14bar \qquad \text{equation 5.5}$$

For deltaflowC-LP (4.5bar measurement range) as

$$p[bar] = \frac{U_{out}[V]}{10V} \cdot 4.5bar \qquad \text{equation 5.6}$$

6 Order codes

The deltaflowC can be ordered in two accuracy grades, a standard accuracy and a calibrated high accuracy type. The high accuracy type has undergone a special calibration procedure and is supplied with a calibration certificate.

Standard Type:

4% of measurement value above 10% of the measurement range of the medium.

High Accuracy Type:

The measurement accuracy of the deltaflowC is 2% of measurement value above 15% of the measurement range of the medium and 4% above 7% of the range of the medium.

	Type	Version	Accuracy	Comment
DFC				deltaflowC Mass flow meter
	P10C			Probe insertion depth 100mm; weld end cutting ring carbon steel
	P10S			Probe insertion depth100mm; weld end cutting ring 1.4571
	V20			Venturi connection: 3/4" male thread PN16
	V25			Venturi connection: 1" male thread PN16
	V40			Venturi connection: 1.5" male thread PN16
		LP		Low pressure; 0 – 4.5 bar abs
		HP		High pressure; 0 – 14 bar abs
			DS	Standard 4% of measurement value from 10% of the measurement range
			DH	High accuracy type; calibration (3 point) including calibration record; 2% of measurement value from 15% of the measurement range

7 Contact

systec Controls Meß- und Regeltechnik GmbH
Lindberghstraße 4
D-82178 Puchheim, Germany
www.systec-controls.de

Telephone: +49-(0)89-80 90 6 - 0
Fax: +49-(0)89-80 90 6 - 200
info@systec-controls.de

Please have the following process data available so that we can assist you in the best possible way:

Pipe data:

- ☐ Pipe diameter *(inside or outside)*
- ☐ Pipe material *(steel or stainless)*

Process data:

- ☐ Designation of medium and/or density
- ☐ Temperature range
- ☐ Absolute pressure or process pressure
- ☐ Expected flow