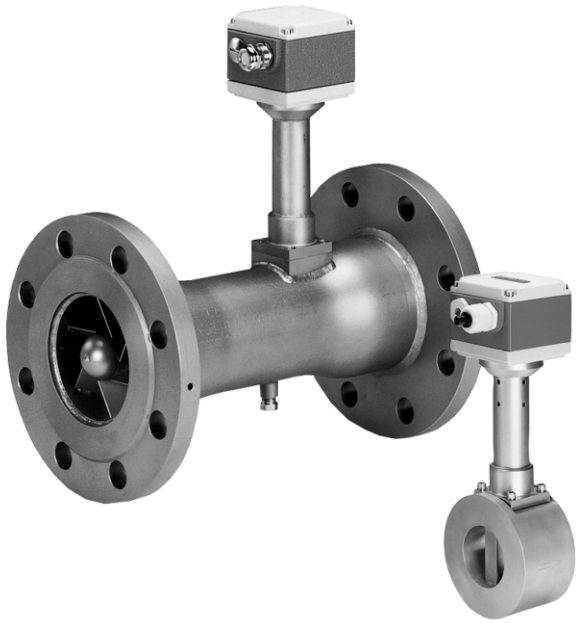
VORTEX-VM
SWIRL-SM

Vortex Flowmeter
Vortex-VM 10VM1000
Swirl Flowmeter
Swirl-SM 10SM1000

Converter 50VM1000
EPROM Part Number: D699B095U01
Valid for Software Versions A.5x

Instruction Bulletin

D184B096U02 Rev. 1 / 01.2000



You have purchased a high quality, modern instrument from Abb Automation Products. We thank you for your purchase and the confidence you have shown in us.

The information contained in this Instruction Bulletin includes instructions for the assembly, installation and testing of the instrument, ABB Automation Products reserves the right to make hardware and software refinements which may not be reflected in this bulletin without prior notice. Any questions which may arise that are not specifically answered by these instructions should be directed to ABB Automation Products at out main plant in Göttingen, Germany. Address, telephone and fax numbers may be found on the back cover.

"This converter satisfies the interference resistance specifications in the NAMUR-Recommendation "EMC-Guidelines for Manufacturers and Users of Electrical Instuments and Systems"
Part 1, 5/93 and EMC-Guideline 89/336/EWG

Introductory Safety Notes for the Flowmeter System

Specified Usage

The flowmeter is to be installed only in the specified applications.

Every usage which exceeds the specifications is considered to be non-specified. Any damages resulting therefrom are not the responsibility of the manufacturer.
The risk is borne by the user alone.

The application specifications include the installation, start-up and service requirements specified by the manufacturer.

Installation, Start-Up and Operating Personnel

Please read this Instruction Manual for the flowmeter primary and converter as well as the safety notes before attempting installation, start-up, operation or maintenance.

Only qualified personnel should have access to the instrument.
The personnel should be familiar with the warnings and operating requirements contained in this Instruction Manual.

Assure that the connections are in accordance with the Interconnection Diagrams. Ground the flowmeter system.

Observe the warning notes in this document indicated by the symbol: !

Hazardous Material Information

In view of the requirements of the Disposal Ordinance of 27.08.86 (AbfG. §11 Special Wastes) which states that the possessor of the special waste is responsible for its care and the employer, according to the Hazardous Waste Ordinance of 01.10.86 (GefStoffV, §17 General Protection Responsibility) also has the responsibility to protect his employees, we must make note that

a) all flowmeter primaries and/or flowmeter converters which are returned to ABB Automation Products for repair are to be free of any hazardous materials (acids, base, solutions, etc.).

b) the flowmeter primaries must be flushed so that the hazardous materials are neutralized.

c) for service and repair, written confirmation is required that the measures listed in a) and b) above have been carried out.

d) any costs which may arise for the decontamination of hazardous materials during repair will be invoiced to the owner of the equipment.

EG-Konformitätserklärung
EC-Certificate of Compliance

CE

Hiermit bestätigen wir die Übereinstimmung der aufgeführten Geräte mit den Richtlinien des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

Herewith we confirm that the listed instruments are in compliance with the council directives of the European Community. The safety and installation requirements of the product documentation must be observed.

Modell: *Model:*	50VM1.. 10VM... 10SM...
Richtlinie: *Directive:*	EMV Richtlinie 89/336/EWG * EMC directive 89/336/EEC *
Europäische Norm: *European Standard:*	EN 50081-1, 3/93 * EN 50082-2, 2/96 *
Richtlinie: *Directive:*	Niederspannungsrichtlinie 73/23/EWG * Low voltage directive 73/23/EEC *
Europäische Norm: *European Standard:*	EN 61010-1, 3/94 *

* einschließlich Nachträge
including alterations

Göttingen, 09. Februar 1998

Unterschrift / Signature

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ABB Automation Products GmbH
Postanschrift:
37070 Göttingen
Besucheranschrift:
Dransfelder Straße 2
37079 Göttingen
Telefon +49 (0) 551 905-0
Telefax +49 (0) 551 905 777
http://www.abb.de/automation

Sitz der Gesellschaft:
Göttingen
Registergericht:
Göttingen
Handelsregister:
HRB 423
USt-IdNr.: DE 115 300 097

Bankverbindung:
Commerzbank AG Göttingen
Konto: 6 124 002
BLZ: 260 400 30
Swift COBA DE FF 260

Geschäftsführung:
Uwe Alwardt (Vorsitz)
Andreas Beaucamp
Burkhard Block

FISCHER PORTER

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I. Flowmeter Primary SWIRL-SM

1. Functional Description

The flowrate of gases, steam and liquids can be metered with the Swirl Flowmeter (SFM) over wide flow ranges independent of the fluid characteristics.

The SFM contains no moving parts and is therefore wear and maintenance free.

Metering Principle

The inlet guide body forces the axially entering fluid flow stream to rotate. A vortex core forms in the center of this rotation, in which a secondary rotation is generated by to the backflow (Fig. I-1 & Fig. I-3).

The frequency of the secondary rotation is proportional to the flowrate and is linear over a wide flow range when the internal geometry of the flowmeter has been optimized. This frequency is measured with a Piezo sensor.

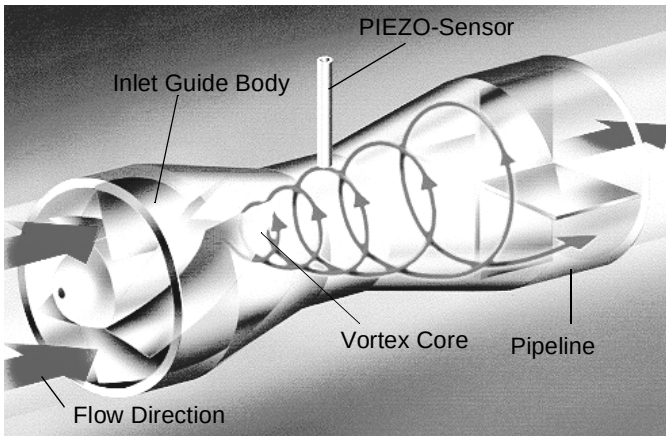


Fig. I-1 Vortex Formation in the Flowmeter Primary

The flowrate proportional frequency signal from the flowmeter primary is transformed in the converter into usable frequency (scaled) or current output (4-20 mA) signals.

For gas and steam measurements it is possible to incorporate a pressure and temperature compensation. An additional pressure and temperature input is available in the converter. As a result, the converter output signals can be based on either normal flowrate Q_n (normal conditions: pressure =1013 mbar; temperature = 0°C) or mass flowrate Q_m (Fig. I-2).

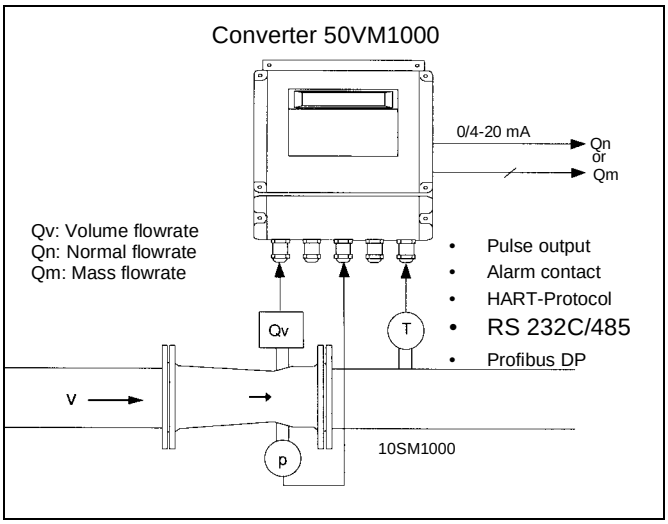


Fig. I-2 Gas or Steam Metering with Pressure and Temperature Compensation

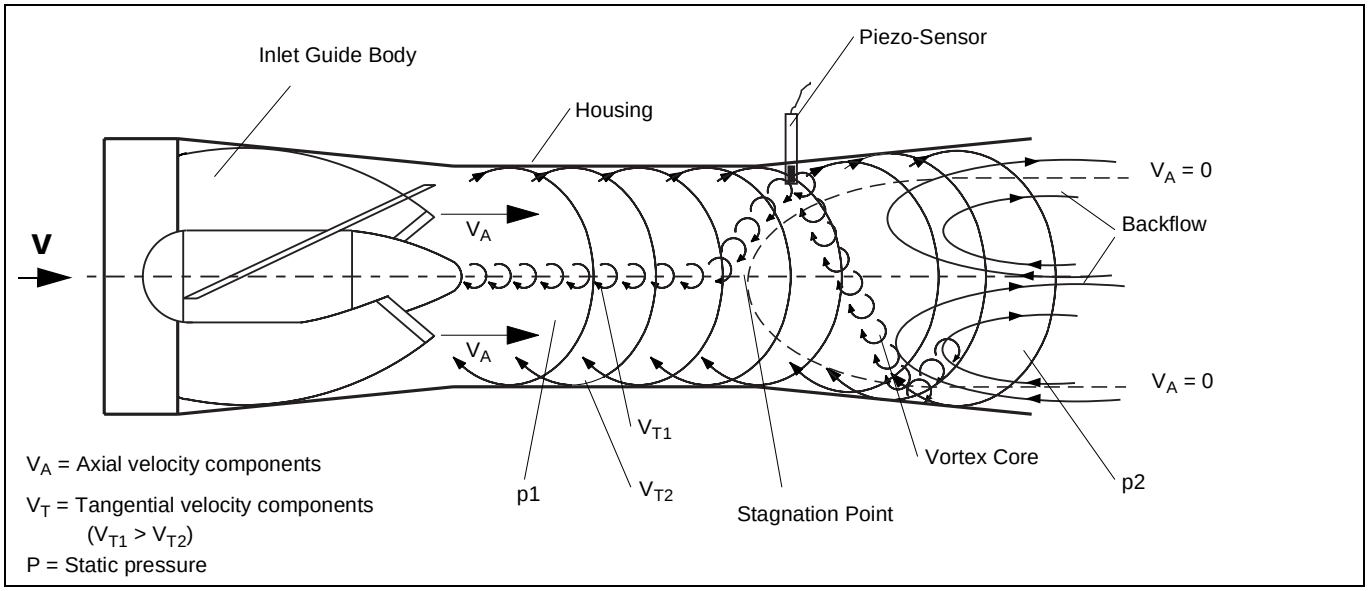


Fig. I-3 Metering Principle Swirl Flowmeter

2. Assembly and Installation

2.1 Inspection

Before installing the Swirl-SM flowmeter check for mechanical damage due to improper handling during shipment. All claims for damages are to made promptly to the shipper prior to installation.

2.2 Installation of the Flowmeter Primary in the Pipeline

2.2.1 Installation Requirements

The Swirl-SM can be installed at any arbitrary location in the pipeline. Care should be exercised to assure that:

- the ambient specifications are not exceeded (see Specification SWIRL-SM);
- the recommended lengths of the in- and outlet straight sections are maintained (Fig. I-4);
- the flow direction corresponds to the direction indicated by the arrow on the flowmeter primary;
- the required distance for removing the preamplifier and to exchange the sensors is available (see Specification SWIRL-SM);
- mechanical vibrations are avoided through use of supports as required;
- the inside diameter of the flowmeter primary and the pipeline are the same;
- pressure fluctuations in long pipelines at zero flow are eliminated by installing intermediate shutoff valves;
- pulsating flow produced by piston pumps or compressors is minimized by utilizing pulsation dampeners;
- when metering liquids the flowmeter is always completely filled with fluid and will not drain;
- when metering at high temperatures, the flowmeter primary is installed so that the electronic section is positioned at the side and oriented downward (Fig. I-5).

2.2.2 Recommended In- and Outlet Sections

Based on its metering principle the Swirl Flowmeter in essence does not require any straight in- or outlet sections.
Fig. I-4 shows the recommended in- and outlet sections for various installation conditions. Additional in- and outlet sections are not required for single and double elbows installed up- or downstream from the flowmeter, when their radius is greater than 1.8 x D, nor are additional in- and outlet sections required when the flowmeter is installed downstream from a flanged reducer per DIN 28545 (α /2=8°).

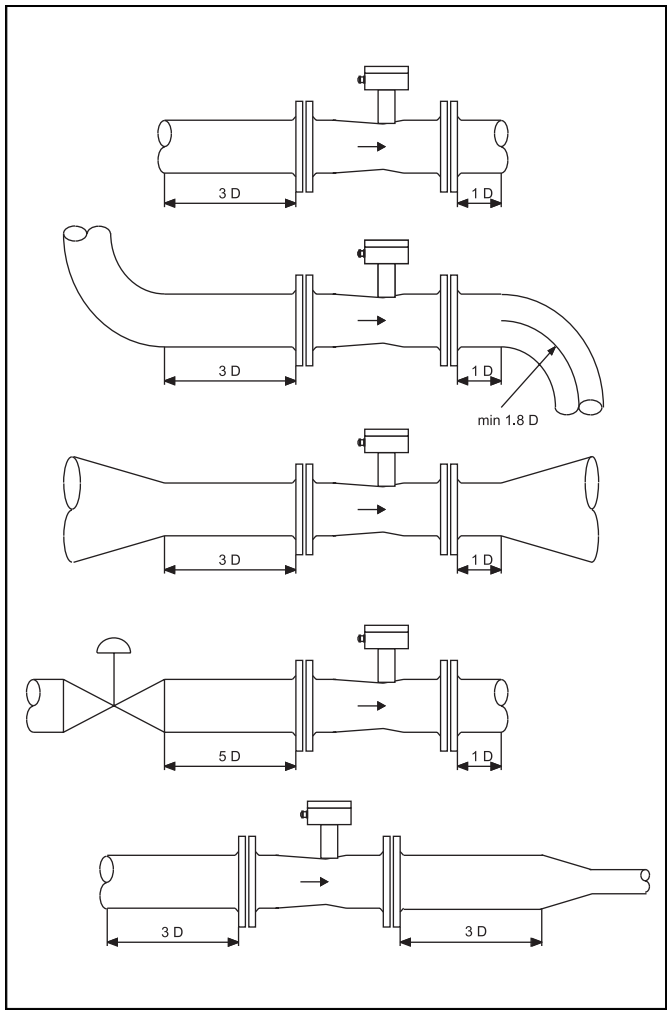


Fig. I-4 In- and Outlet Straight Sections

2.2.3 High Fluid Temperature Installations > 150°C

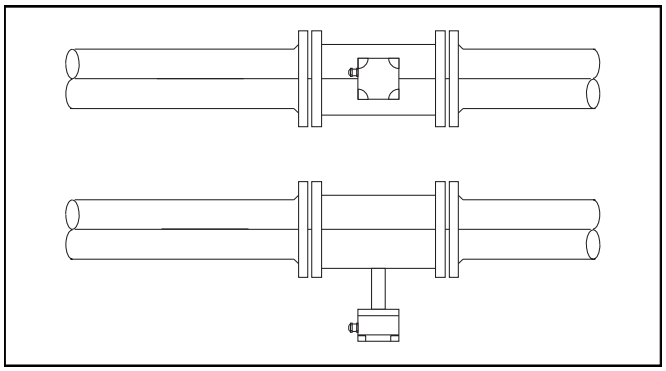


Fig. I-5 High Fluid Temperature Installations > 150 °C

2.3 Pressure and Temperature Measurements

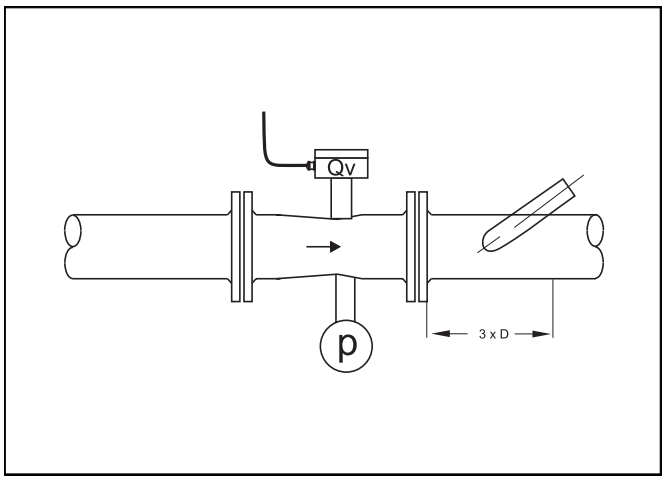


Fig. I-6 Pressure and Temperature Compensation Installation

The pressure should be measured at the pressure tap provided on the flowmeter. If the pressure is measured downstream from the flowmeter, large errors may occur which are a function of the flowrate and the flowmeter size.

2.4 Electrical Connections - Flowmeter Primary

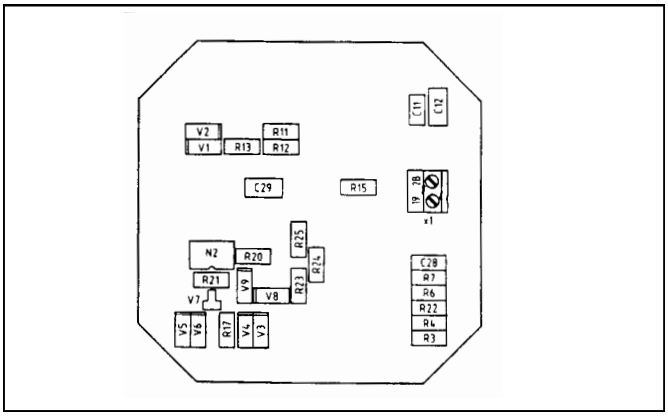


Fig. I-7 Sensor/Preamplifier Connection Board

The signal cable provides the supply power for the preamplifier.

The Piezo-Sensor has been connected at the factory to terminals 19, 2B on the bottom side of the preamplifier board (Fig. I-7).

The connections of the signal cable included with the shipment are made as shown to terminals 12, 2A, 3 on the top side of the preamplifier board (Fig. I-8).

The cable shield is to be connected only at the converter (see Fig. III-1).

Signal cable: a 3 conductor shielded cable, max. cable length between the flowmeter primary and the converter 800 m, or 200 Ω cable resistance, cable capacitance: 100 pF (10 m are included with the shipment). The cable may be shortened.

3. Start-Up

3.1 Checks

Prior to starting up the flowmeter, i.e. turning the supply power on, check that the installation requirements defined in 2.2.1 have been observed.

3.2 Preamplifier Settings

The preamplifier is common for all designs and sizes and is to be matched to the flowmeter using the DIP-Switches on the Sensor/Preamplifier connection board.

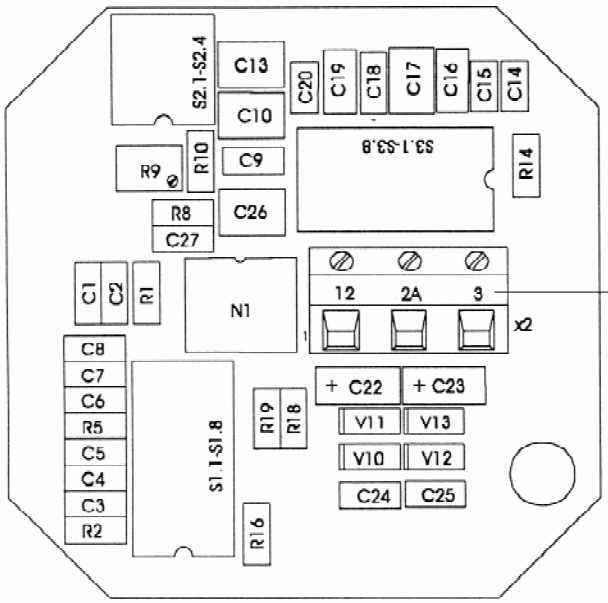
These settings have usually been made at the factory based the order information.

However, if all the necessary information was not available or if changes were made, then the DIP-Switches should be set in accordance with Fig. I-8.

An additional diagram with the actual switch settings may be found in the cover of the preamplifier housing.

! Note

For reasons of operational safety the switch settings should be checked prior to start-up.



Note:
The DIP-Switch numbers listed in the table must be set to “ON”

Meter Size		Fluid Gas			Fluid Liquid		
DN	Inch	S1._	S2._	S3._	S1._	S2._	s3._
15	1/2	1,2,5,6	1	1	4,8	4	6,8
20	3/4	1,2,5,6	1	1	4,8	1-3	1-7
25	1	1,2,5,6	1	1	4,8	4	5,8
32	1-1/4	1,2,5,7	1	2	4,8	4	6,8
40	1-1/2	1,3,5,7	1	2	4,8	4	6,8
50	2	1,3,5,7	1	2	4,8	4	6,8
80	3	1,3,5,7	2	3	3,4,7,8	4	5,6,8
100	4	1,3,5,7	2	3	3,4,7,8	1-4	5,7,8
150	6	3,7	3	4,8	3,4,7,8	1-4	1-8
200	8	4,8	3	4,8	2,3,4,6,7,8	1-4	1-8
300	12	2-4, 6-8	3	6	2,3,4,6,7,8	1-4	1-8
400	16	2-4, 6-8	3	6	2,3,4,6,7,8	1-4	1-8

Fig. I-8 Connection Board Preamplifier, Flowmeter Primary 10SM1000

II. Flowmeter Primary VORTEX-VM

1. Principle of Operation

The operation of the VORTEX-VM is based on the Karman Vortex Street. As the flow passes by an obstructing body vortices are alternately formed on either side..
The flow causes these vortices to shed forming a vortex street (Karman Vortex Street) (Fig.II-1).

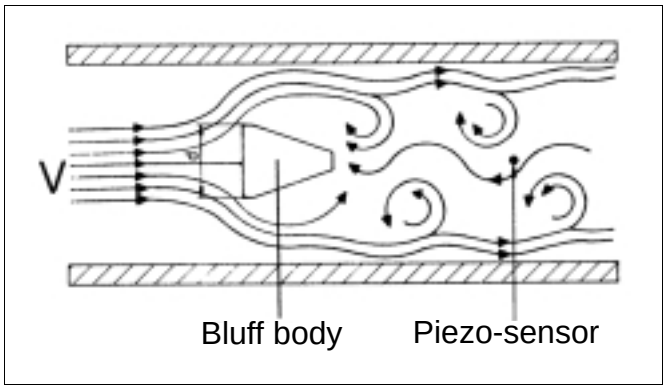


Fig. II-1 Karman Vortex Street

The frequency **f** of the vortex shedding is proportional to the flow velocity **v** and inversely proportional to the width of the shedding body **d**:

$$f = St \cdot \frac{v}{d}$$

St, known as the Strouhal Number, is a dimensionless number, which defines the quality of the vortex flow metering.

By suitably designing the shedder body the **St** number is constant over a wide Reynolds Number **Re** range (Fig. II-2).

$$R_e = \frac{v \cdot D}{\nu}$$

ν = Kinematic viscosity

D = Meter tube diameter

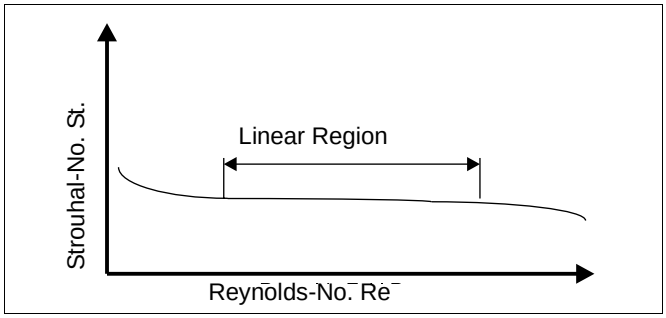


Fig. II-2 Strouhal Number as a Function of the Reynolds Number

The vortex shedding frequency to be measured is a function only of the flow velocity and independent of the fluid density and viscosity.

The local pressure changes which occur as the vortices are shed are detected by a Piezo sensor and converted into electrical impulses corresponding to the shedding frequency. The converter transforms these signals into usable frequency (scaled) and current signals.

For gas or steam measurements it is possible to incorporate a pressure and temperature compensation. An additional pressure and temperature input is available in the converter. As a result, the converter output signals can be based on either normal flowrate Q_n (normal conditions: pressure =1013 mbar; temperature = 0°C) or mass flowrate Q_m (with a density input).

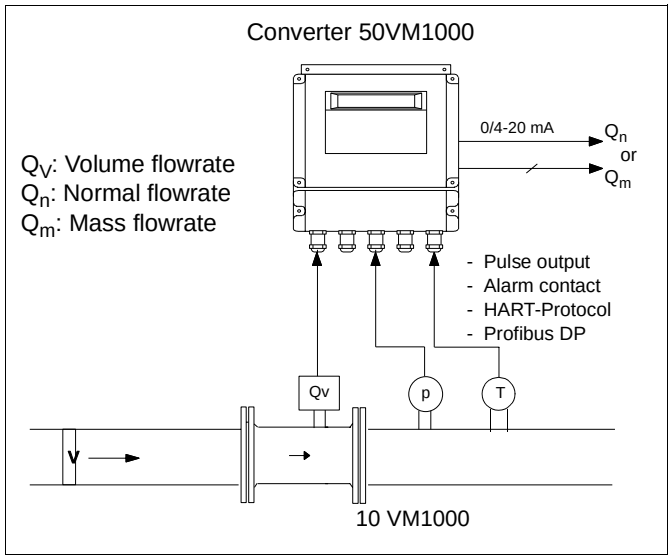


Fig. II-3 Gas or Steam Metering with Pressure and Temperature Compensation.

2. Assembly and Installation

2.1 Inspection

Before installing the Vortex-VM flowmeter check for mechanical damage due to improper handling during shipment. All claims for damages are to made promptly to the shipper prior to installation.

2.2 Installation of the Flowmeter Primary in the Pipeline

2.2.1 Installation Requirements

The Vortex-VM can be installed at any arbitrary location in the pipeline. Care should be exercised to assure that:

- the ambient specifications are not exceeded (see Specification VORTEX-VM);
- the recommended lengths of the in- and outlet straight sections are maintained (Fig. II-4);
- the flow direction corresponds to the direction indicated by the arrow on the flowmeter primary;
- the required distance for removing the preamplifier and to exchange the sensors is available;
- mechanical vibrations are avoided through use of supports as required;
- the inside diameter of the flowmeter primary and the pipeline are the same;
- pressure fluctuations in long pipelines at zero flow are eliminated by installing intermediate shutoff valves;
- pulsating flow produced by piston pumps or compressors is minimized by utilizing pulsation dampeners;
- when metering liquids the flowmeter is always completely filled with fluid and will not drain;
- when metering at high temperatures, the flowmeter primary is installed so that the electronic section is positioned at the side and oriented downward (Fig. II-5).

2.2.2 Recommended In- and Outlet Sections

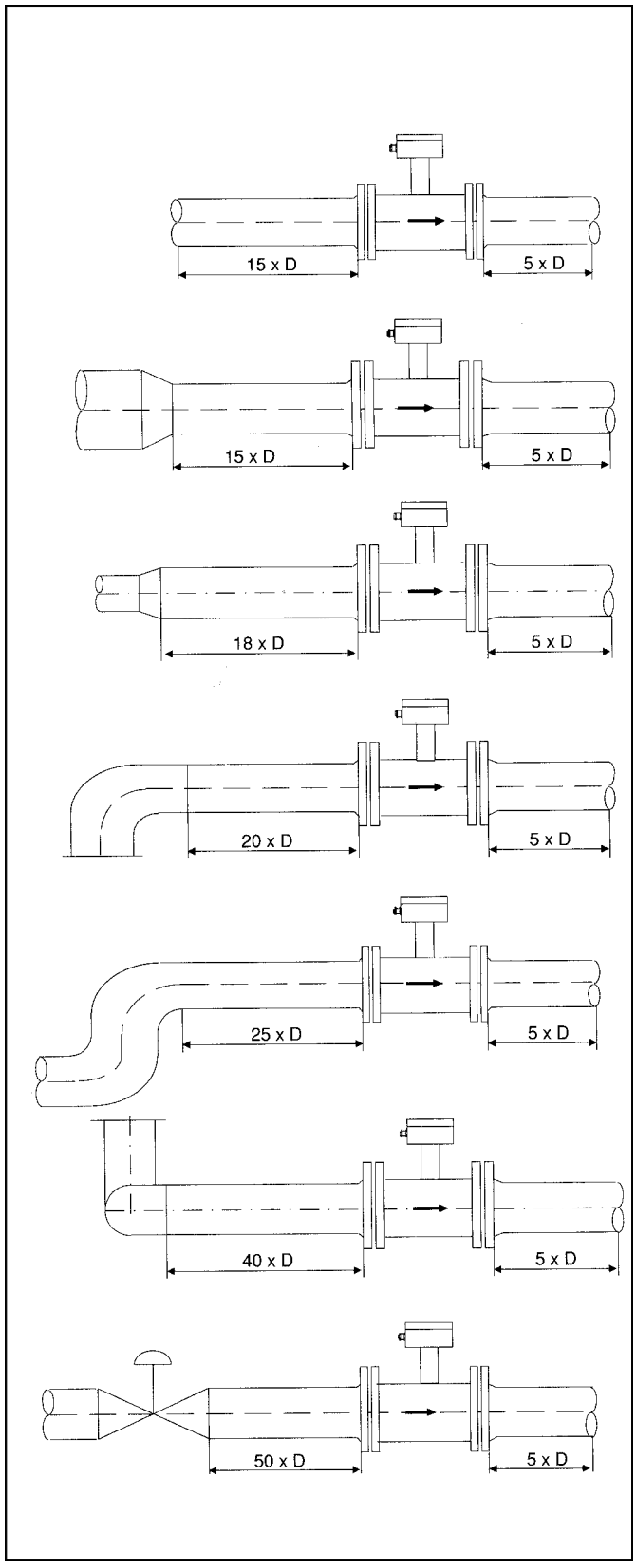


Fig. II-4 Recommended In- and Outlet Sections

2.2.3 High Fluid Temperature Installations > 150°C

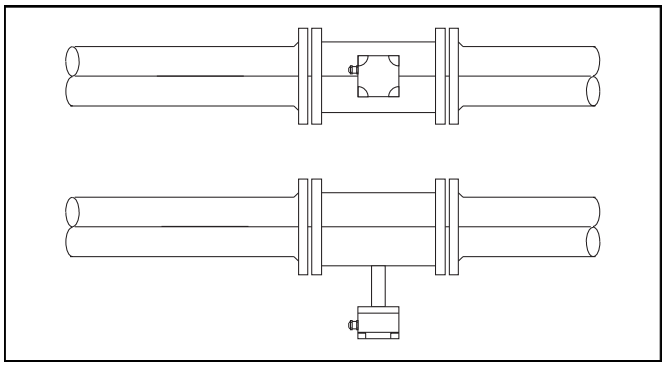


Fig. II-5

2.2.4 Installation of Flow Control Devices

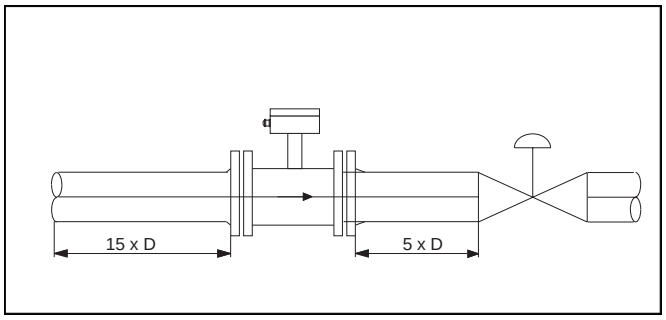


Fig. II-6 Installation of Flow Control Devices

2.2.5 Centering the Wafer Design Flowmeters

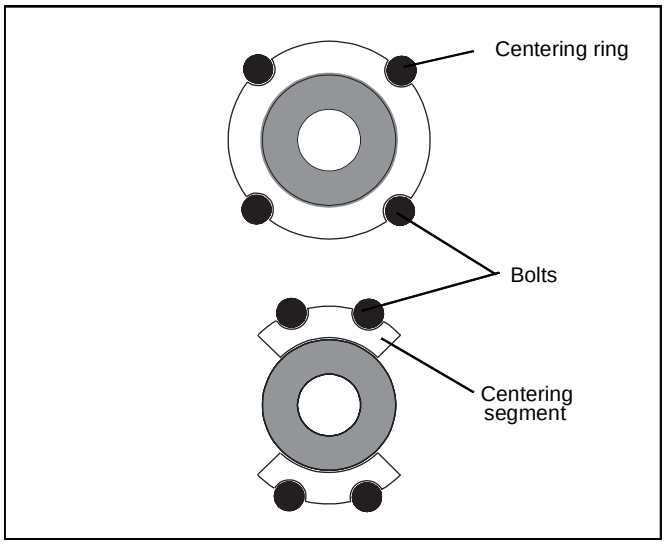


Fig. II-7 Centering the Wafer Design Flowmeters Using Ring or Segment

The wafer design flowmeters are centered utilizing the outside diameter of the flowmeter primary body in conjunction with the mounting bolts. Centering rings or sleeves for the mounting bolts, whose dimensions are a function of the pressure rating, are included with the shipment.

2.2.6 Pressure and Temperature Measurements

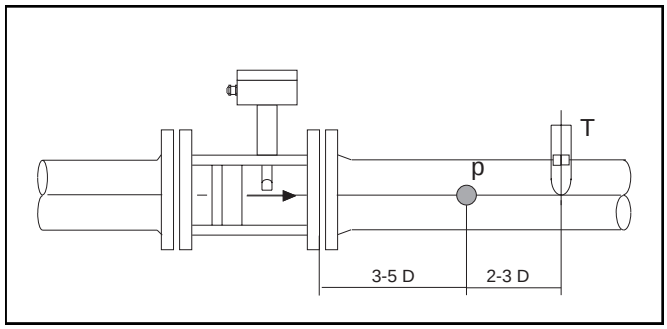


Fig. II-8 Pressure and Temperature Measurement Locations

2.3 Electrical Connections - Flowmeter Primary

The signal cable provides the supply power for the preamplifier.

The Piezo-Sensor has been connected at the factory to terminals 19, 2B on the bottom side of the preamplifier board (Fig. II-9).

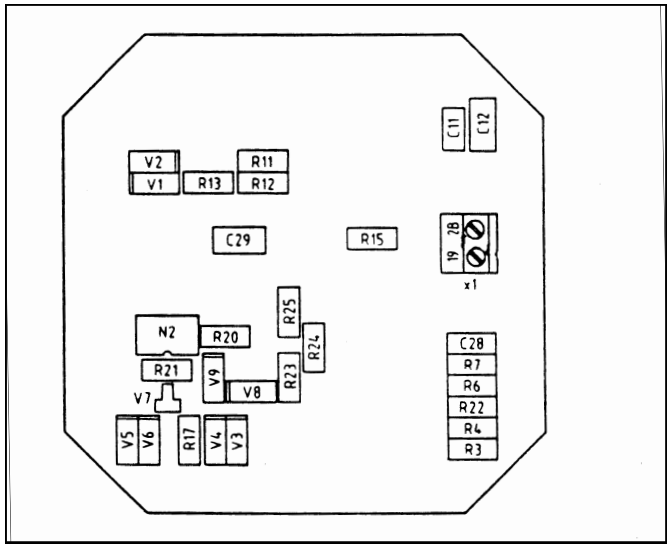


Fig. II-9 Sensor Connections, Preamplifier Board

The connections of the signal cable included with the shipment are made as shown to terminals 12, 2A, 3 on the top side of the preamplifier board (Fig. II-10).
The cable shield is to be connected only at the converter (see Fig. III-1).
Signal cable: a 3 conductor shielded cable, max. cable length between the flowmeter primary and the converter 800 m, or 200 Ω cable resistance, cable capacitance: 160 pF (10 m are included with the shipment). The cable may be shortened.

3. Start-Up

3.1 Checks

Prior to starting up the flowmeter, i.e. turning the supply power on, check that the installation requirements defined in 2.2.1 have been observed.

3.2 Preamplifier Settings

The preamplifier is common for all designs and sizes and is to be matched to the flowmeter using the DIP-Switches on the Sensor/Preamplifier connection board.

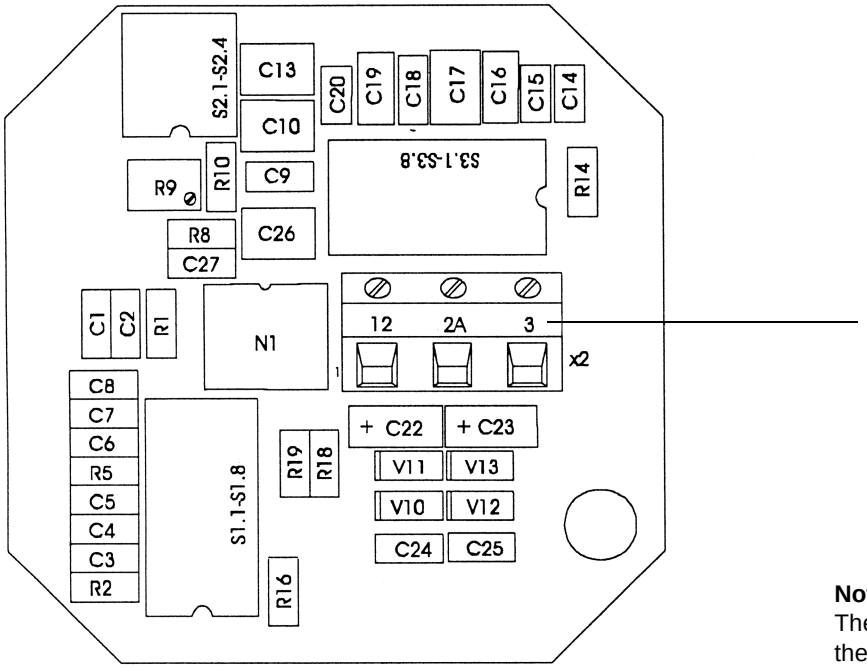
These settings have usually been made at the factory based the order information.

However, if all the necessary information was not available or if changes were made, then the DIP-Switches should be set in accordance with Fig. II-10.

An additional diagram with the actual switch settings may be found in the cover of the preamplifier housing.

! Note:

For reasons of operational safety the switch settings should be checked prior to start-up.



Note:
The DIP-Switch numbers listed in the table must be set to “ON”

Meter Size DN	Meter Size Inch	Fluid Gas DIN/ANSII			Liquid DIN			Liquid ANSI		
		S1._	S2._	S3._	S1._	S2._	S3._	S1._	S2._	S3._
15	1/2	1,2,5,6	1	1	4,8	1-3	3	4,8	1-3	3
25	1	1,3,5,7	1	2	4,8	4	4,8	4,8	4	3,8
40	1-1/2	1,3,5,7	1	2	4,8	4	5,8	4,8	4	3,4,8
50	2	1,3,5,7	2	2	4,8	4	6,8	4,8	4	2,4,5,8
80	3	1,3,5,7	2	3	3,4,7,8	4	7,8	3,4,7,8	4	4,6,8
100	4	1,3,5,7	2	3	3,4,7,8	4	7,8	3,4,7,8	4	3,4,6,8
150	6	3,7	3	4	3,4,7,8	4	5,6,7,8	3,4,7,8	4	6,7,8
200	8	3,7	3	4,8	2-4, 6-8	1-4	1-8	2-4, 6-8	1-4	1-8
250	10	1-8	3	4	2-4, 6-8	1-4	1-8	2-4, 6-8	1-4	1-8
300	12	1-8	3	4	3,4,7,8	1-4	1-8	2-4, 6-8	1-4	1-8

Fig. II-10 Connection Board Preamplifier, Flowmeter Primary 10VM1000

III. Converter Model 50VM1000

1. Assembly and Installation

1.1 Inspection

Before installing the VORTEX-VM, SWIRL-SM, the converter should be checked for damage, possibly due to improper handling during shipment. All claims for damages are to made promptly to the shipper prior to installation.

1.2 Installation Requirements

The mounting location for the converter 50VM1000 must be essentially vibration free. The specified temperature limits of -20 °C and +60 °C are to be observed. The distance to the flowmeter primary may not exceed 800 m.

It is usually possible to adapt the flow range and K-Factor when a converter is exchanged. The converter can incorporate a number of different options. Therefore it is important to coordinate the flowmeter primaries to their corresponding converters (in accordance with the order). The coordination can be made using the designations A1 (flowmeter primary) matched with B1 (converter) or A2 with B2 etc. which are listed on the Instrument Tags.

1.3 Electrical Connections

1.3.1 Supply Power Connections

The line connections are made in accordance with the specifications on the Instrument Tag at terminals "L" (phase) and "N" (neutral) or L1 und L2 over a main fuse and a main switch. The cross section of the cable and the main fuse utilized must be compatible (VDE 0100).

The housing is grounded using the protection ground connection PE/E.

1.3.2 Signal Cable Connections

The signal cable connections are made at the converter to terminals 3, 2A, 12 in accord with the Interconnection Diagram (Fig. III-1).

1.3.3 Pressure and Temperature Measurement Connections

1) The pressure converter in a 2-Wire design, 4-20 mA, can be connected to the terminals P+, PA (supply power from converter) or in the 4-Wire design, 0/4-20 mA, can be coonnected to terminals P-, 3 (external supply power). The pressure signal to the converter can also be connected to the analog input (0/4-20 mA) at terminals 15, 3. (Fig. III-4)

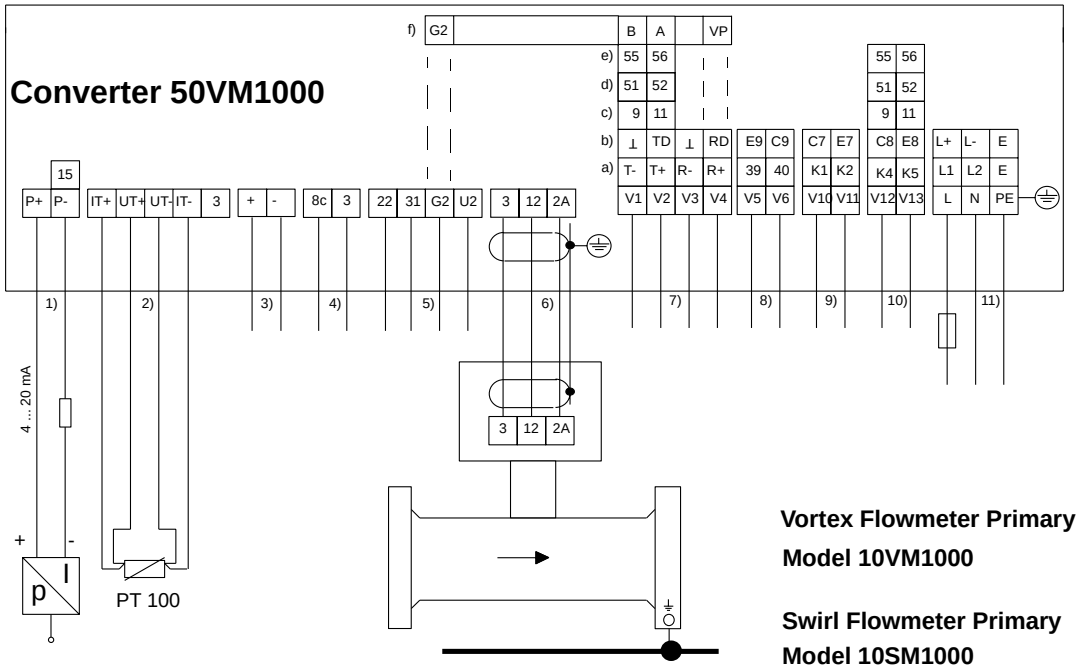
2) The temperature measurement utilizing a PT 100 can be connected in a 2-, 3- or 4-Wire design.
   Termnals: UT+, UT- for signal input
   IT+, IT- for supply current.

The maximum accuracy can be achieved using the 4-Wire design.

The max. cable length is 800 m.

(See also Specifications SWIRL-SM or VORTEX-VM).

1.4 Interconnection Diagram, Flowmeter Primary VORTEX 10VM100 and SWIRL 10SM1000, Converter 50VM1000 (Field Mount Housing and 19”-Insert)



1) Pressure input (current input)
Pressure sensor 0/4-20 mA; P+=30V (idle)*

2) Temperature input
Pt100-Resistance, IP=1 mA, UP=19.5-247 mV
for -200 °C to +400 °C

3) Current output
Selectable, load ≤ 750 or 1500 Ω at 0/4-20 mA
or 0/2-10 mA

4) Measurement frequency, test output (field mount hsg., +5 V TTL; 19”-optocoupler)

5) 22/U2: External zero return, passive over optocoupler) galvanically isolated.
31/U2: External totalizer reset, passive over optocoupler galvanically isolated.

6) Signal cable (shield connected only at converter)

7) Data links or scaled pulse output
- a) Serial data link RS 485
- b) Serial data link RS 232 C / V 24
- c) Scaled pulse output, active 24 V DC, Load ≥ 150 Ω (standard for 19”)
- d) Scaled pulse output, passive, Relay contact (closes) ≤ 3 W, ≤ 250 mA, ≤ 28 V DC
- e) Scaled pulse output, optocoupler, 5V < U_{CE} < 25 V, 5 mA < I_{CE} < 30 mA
- f) Profibus DP, terminals V1, V2, V4, G2

When using the serial data link RS 232 C a shielded data cable is recommended, for the RS485 or Profibus DP a shielded data cable with individually twisted pairs is recommended.

8) Alarm contact, opens at alarm
- a) Alarm contact, relay, opens at alarm, ≤ 3 W, ≤ 250 mA, ≤ 28 V DC
- b) Alarm output, optocoupler, U_{CE} ≤ 25 V, I_{CE} ≤ 7.5 mA

9) Max-Alarm
- a) Alarm contact, relay, opens at alarm, ≤ 3 W, ≤ 250 mA, ≤ 28 V DC**
- b) Alarm output, optocoupler, UCE ≤ 25 V I ≤ 7.5 mA

10) Pulse output or Min-Alarm **
- a) Alarm contact, relay, opens at alarm, ≤ 3 W, ≤ 250 mA, ≤ 28 V DC.
- b) Alarm output, optocoupler, U_{CE} ≤ 25 V, I_{CE} ≤ 7.5 mA
- c) Scaled pulse output, active 24 V DC load ≤ 150 Ω
- d) Scaled pulse output, passive, relay contact (closes) ≤ 3 W, ≤ 250 mA, ≤ 28 V DC.
- e) Scaled pulse output, optocoupler, 5 V < U_{CE} < 25 V; 5 mA < I_{CE} < 30 mA

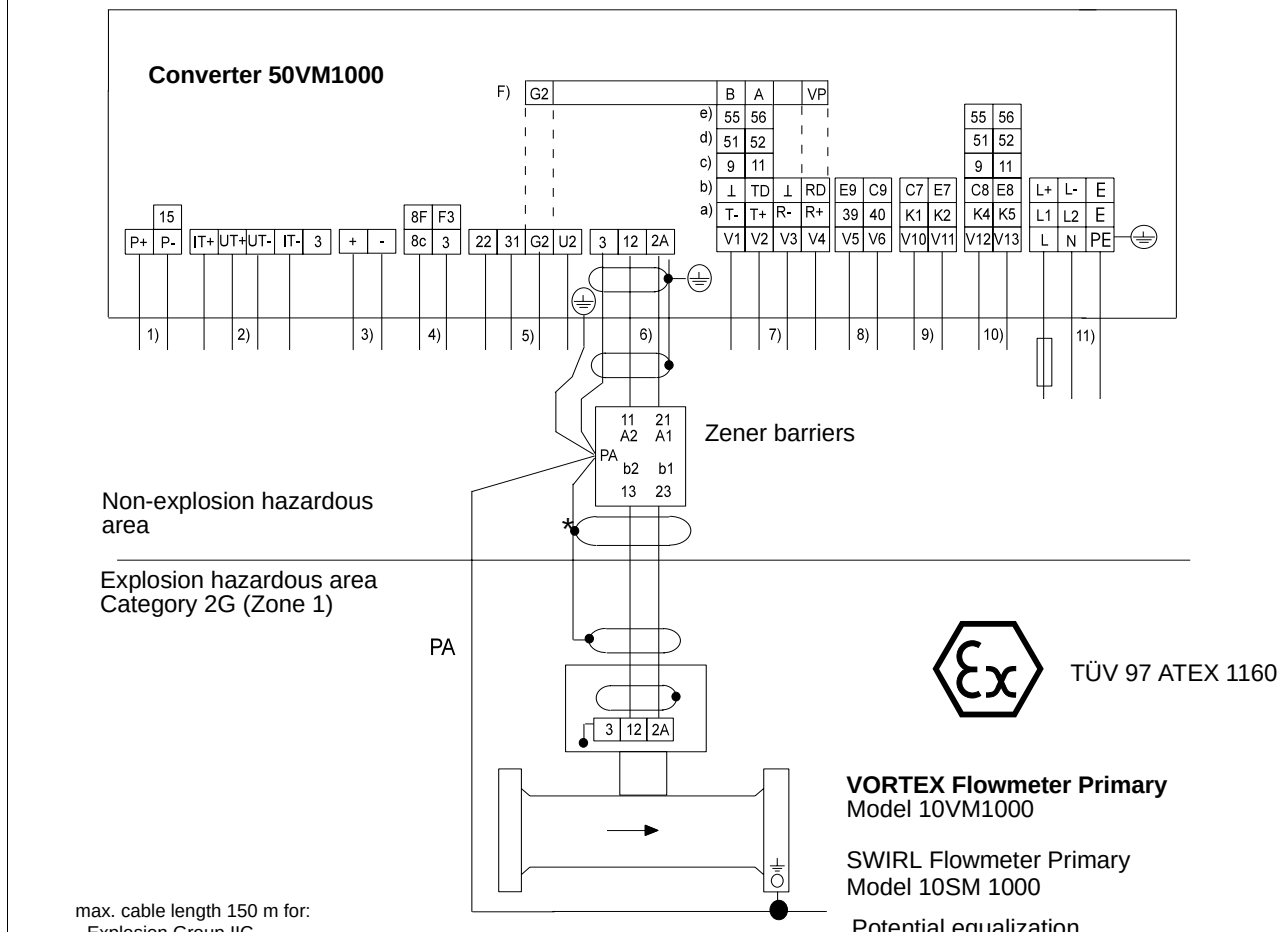
11) Supply power, see Instrument Tag
- a) AC voltage 50/60 Hz
- b) Low voltage 50/60 Hz
- c) DC voltage

* $R_B\ [\Omega] = \frac{26V - U_M[V]}{0{,}02A}$

** Only available with field mount housing

Fig. III-1 Interconnection Diagram, Flowmeter Primaries 10VM1000/10SM1000-50VM1000

1.5 Interconnection Diagram, Flowmeter Primaries Vortex 10VM1000 and SWIRL 10SM1000, Converter 50VM1000 under Ex-Conditions



max. cable length 150 m for:
- Explosion Group IIC
- Signal cable 1D173D1030
- Zener barriers ABB GHG 1149430V3001 C-Rail
- Zener barriers ABB GHG 1149430R3001 19" Design

Interconnection Diagram Safety Barriers on 19 "- Card *
Design F, Edge card connector extended PA pins

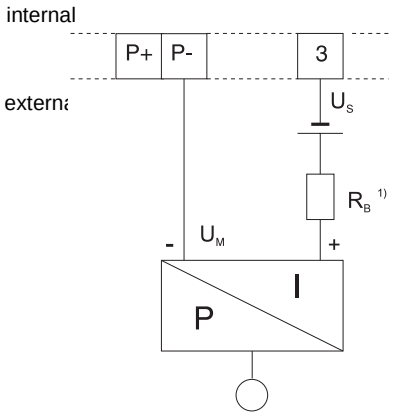
	A1	A2	b1	b2	PE
19"-Card with 1 Module Part No. 55SB132A2 Interconn. Diag. Module A	d4	z14	z28	z22	d16
19"-Card with 2 Modules Part No. 55SB133A2 Interconn. Diag. Module B	d2	z12	d26	d22	z16
19"-Card with 3 Modules Part No. 55SB134A2 Interconn. Diag. Module C	z2	d12	d30	z20	d18
19"-Card with 4 Modules Part No. 55SB135A2 Interconn. Diag. Module D	z4	d14	z32	d20	z18

* One 19" Card can include up to 4 modules.

Fig. III-2 Interconnection Diagram Flowmeter Primaries10VM1000/10SM1000 Converter 50VM1000 under Ex-Conditions
Connection designations see Page III-2 or II-4 and III-5

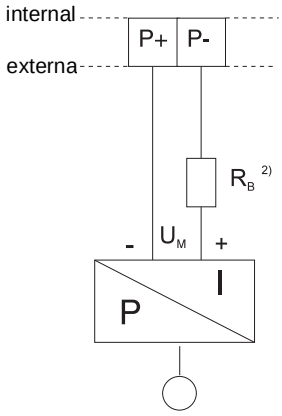
1.6 Interconnection Examples - Inputs

Pressure Transmitter, External Supply



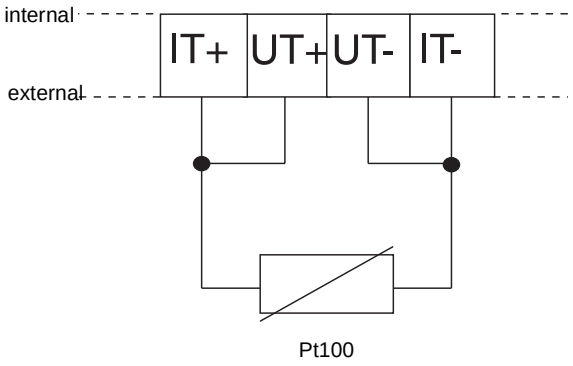
1) $R_B\ [\Omega] \leq \frac{U_S[V] - U_M[V]}{0{,}02A} - 200\Omega$

Pressure Transmitter, Internal Supply

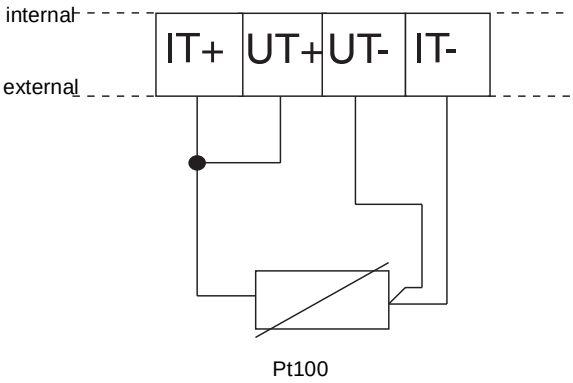


2) $R_B\ [\Omega] \leq \frac{26V - U_M[V]}{0{,}02A}$

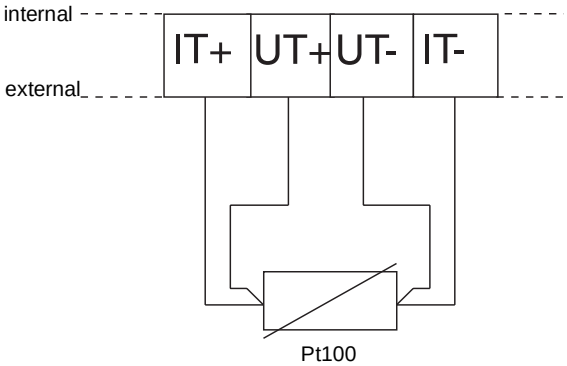
Pt100, 2-Wire Connection



Pt100, 3-Wire Connection



Pt100, 4-Wire Connection



External Totalizer Reset and Zero Return

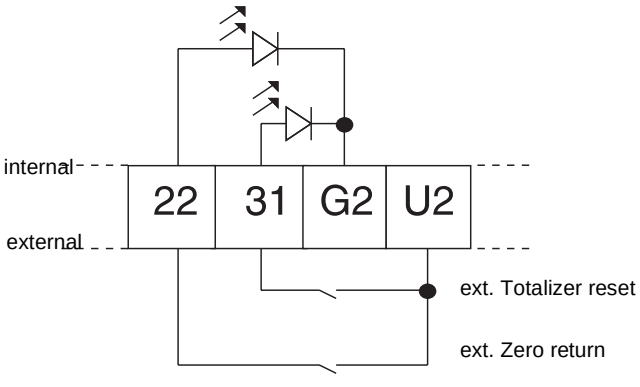
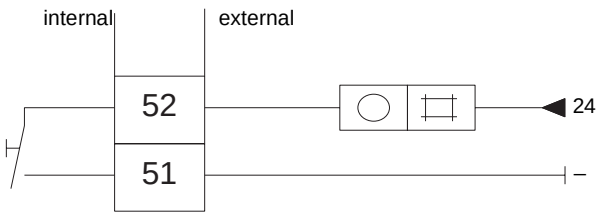


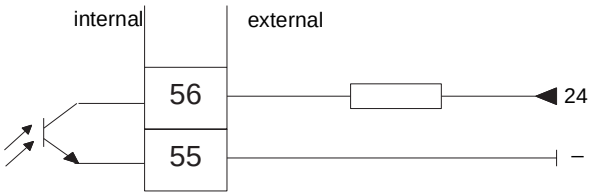
Fig.III-3 Interconnection Examples, Input Connections

1.7 Interconnection Examples - Outputs

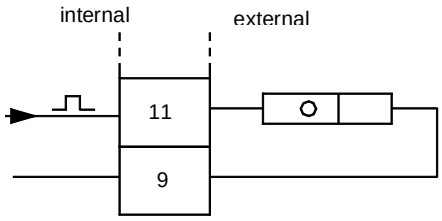
Scaled pulse output passive, relay



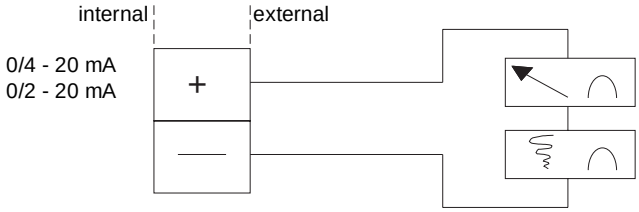
Scaled pulse output passive, optocoupler



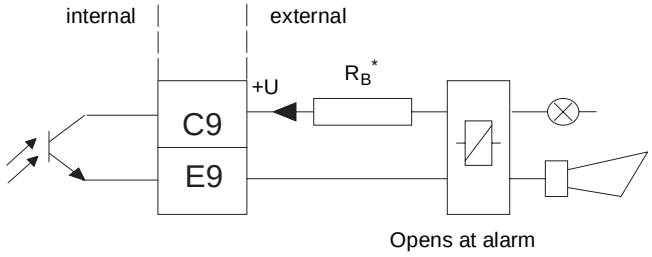
Scaled pulse output active



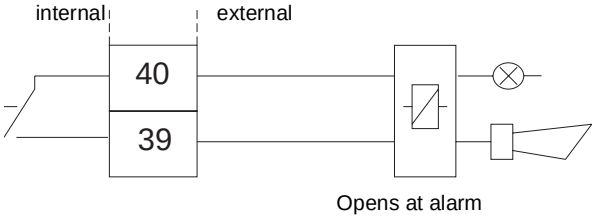
Current output



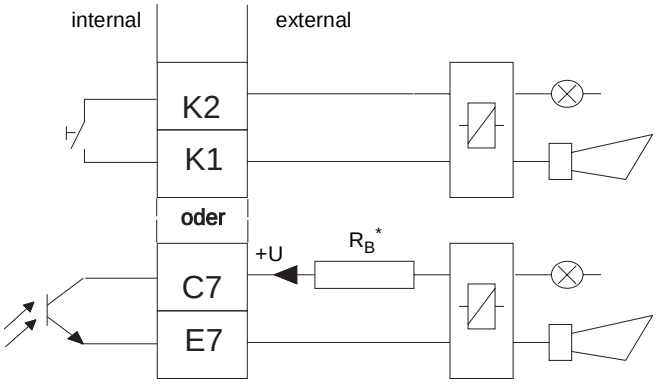
Alarm output optocoupler



Alarm output relay



Max. flow alarm



$$* R_B[\Omega] \geq \frac{U_{CE}[V]}{I_{CE}[A]}$$

Fig.III-4 Interconnection Examples - Output Connections

2. Date Entry / Operation and Programming

2.1 LC-Display Indications

After the converter power is turned on and the self check routine has been completed the standard display appears. The values indicated in the display can be user configured (see Par. 2.4) (it is practical to display the instantaneous flowrate and the 8 digit toalizer values).

When the flowrate and the totalizer values are displayed the basis for these values is clearly indicated by the first two characters in the line:

Qv = Volume flowrate
Qn = Standard flowrate (normal conditions: 1013 mbar, 0 °C)
Qm = Mass flowrate

Qv	25.4 m3/h
Qn	1545 m3/h

It is possible to exit from the standard display to the menus by pressing the direct access keys (see Par. 3).

Submenu
Display

The individual main menus and submenus can be selected using the arrow keys. The display of the term Submenu indicates that additional menus are included in this submenu!

Display 1. Line
Qv Operate

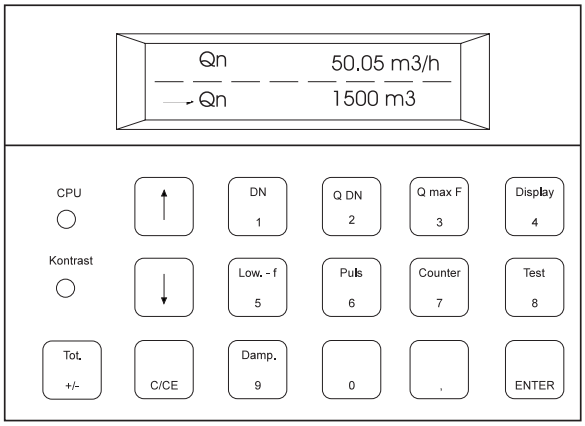
If an error condition is detected an error message is displayed in the first line.

Error - 2	
Qv	1545 m3

Preamplifier	
Qv	1545 m3

The display of this message alternates between the clear text description of the error condition and its corrsponding error number. Only the error with the highest priority is displayed in clear text, while durring the alternate display mode the error numbers for all detected errors are displayed.

2.2 Keypad and Functions 19”-Design



↑ Parameter selection
Arrow key, scroll up

↓ Parameter selection
Arrow key, scroll down

DN 1 Double function key
1. Direct access key, Meter size
2. Number 1 (used for numeric entries)

Q DN 2 Double function key
1. Direct access key Qmax of the meter size
2. Number 2 (used for numeric entries)

Q max F 3 Double function key
1. Flow range setting Range max.
2. Number 3 (used for numeric entries)

Display 4 Double function key
1. Direct access key Display
2. Number 4 (used for numeric entries)

Low. - f 5 Double function key
1. Direct access key Low flow cutoff (Range min.)
2. Number 5 (used for numeric entries)

Puls 6 Double function key
1. Direct access key Pulse factor
2. Number 6 (used for numeric entries)

Counter 7 Double function key
1. Direct access key Submenu totalizer
2. Number 7 (used for numeric entries

Test 8 Double function key
1. Direct access key Submenu self check
2. Number 8 (used for numeric entries)

Damp. 9 Double function key
1. Direct access key Damping
2. Number 9 (used for numeric entries

0 Double function key
1. Direct access key “Load data from ext. EPROM
(after exchanging converter module, upload all meter location parameters into new converter)
2. Number 0 (used for numeric entries)

, Double function key
1. Direct access key “Store data in ext. EPROM
(during start-up, store all meter location parameters)
2. Period

ENTER Use ENTER to access the parameter to be changed and to accept the new parameter value

C/CE Return to the process information display;
Erase erroneously entered data

+/- Double function key
1. Key for sign - (minus) when entering negative values

Kontrast ◯ A small screwdriver can be used to adjust the contrast to the local conditions.

CPU ◯ Control Processing Unit
When the CPU (processor) is defective the diode blinks.
In such a situation, contact the Bailey-Fischer & Porter Service Department

2.3 Data Entry

2.3.1 Data Entry Information

Data is entered using the 16 key foil keypad. The desired parameter or function can be selected by either pressing the direct access keys (Meter size, Qmax of the meter size, Qmax, Pulse factor, Damping and Low flow cutoff) or by using one of the arrow keys.

The name of the parameter is displayed in the first line and its present value, with units, in the second line. A return to the process information (standard display) occurs automatically after approx. 30 seconds or immediately when the C/CE-key is pressed.

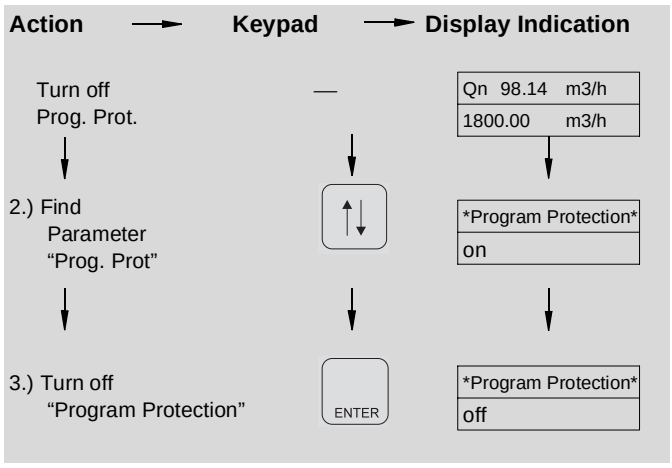
During the programming the converter always remains on-line, i.e., the current and pulse outputs continue to correspond to the current process conditions. Any control devices connected to the converter do not have to switched to “manual” when parameters are viewed or changed. No data is lost in the internal or external pulse totalizers.

Parameter settings can only be changed from the converter when the Program Protection has been turned off.

If an attempt is made to change data in the converter while the Program Protection is turned on, the following message is displayed:

Error
Prog. Prot.

As long as the Program Protection is turned off, parameters can be changed.



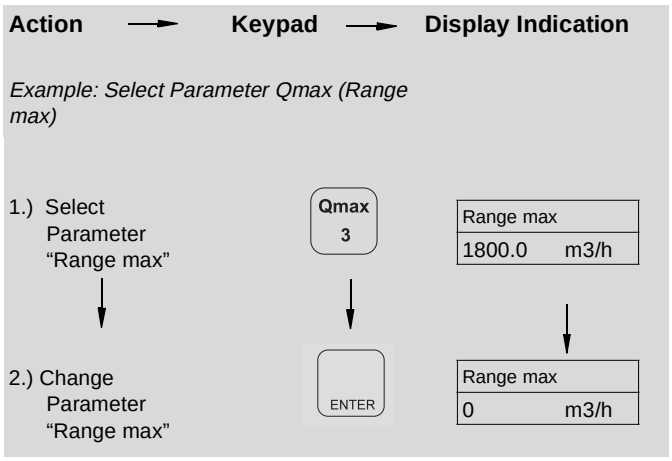
There two types of data entry:

a) direct numerical entries and
b) selections from a predefined table

2.3.2 Direct Numerical Entries

The followinig procedure is used for direct numeric entries:

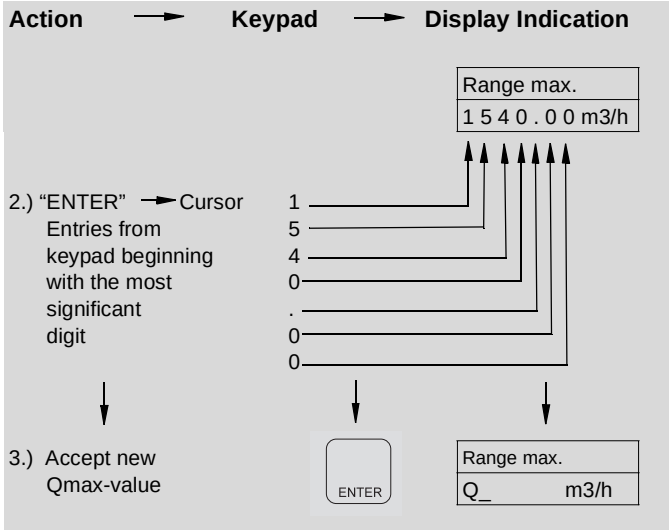
1. Select the desired parameter using either the direct access keys or the arrow keys. The parameter name is display In the first line and its value, with units, is displayed in the second line.



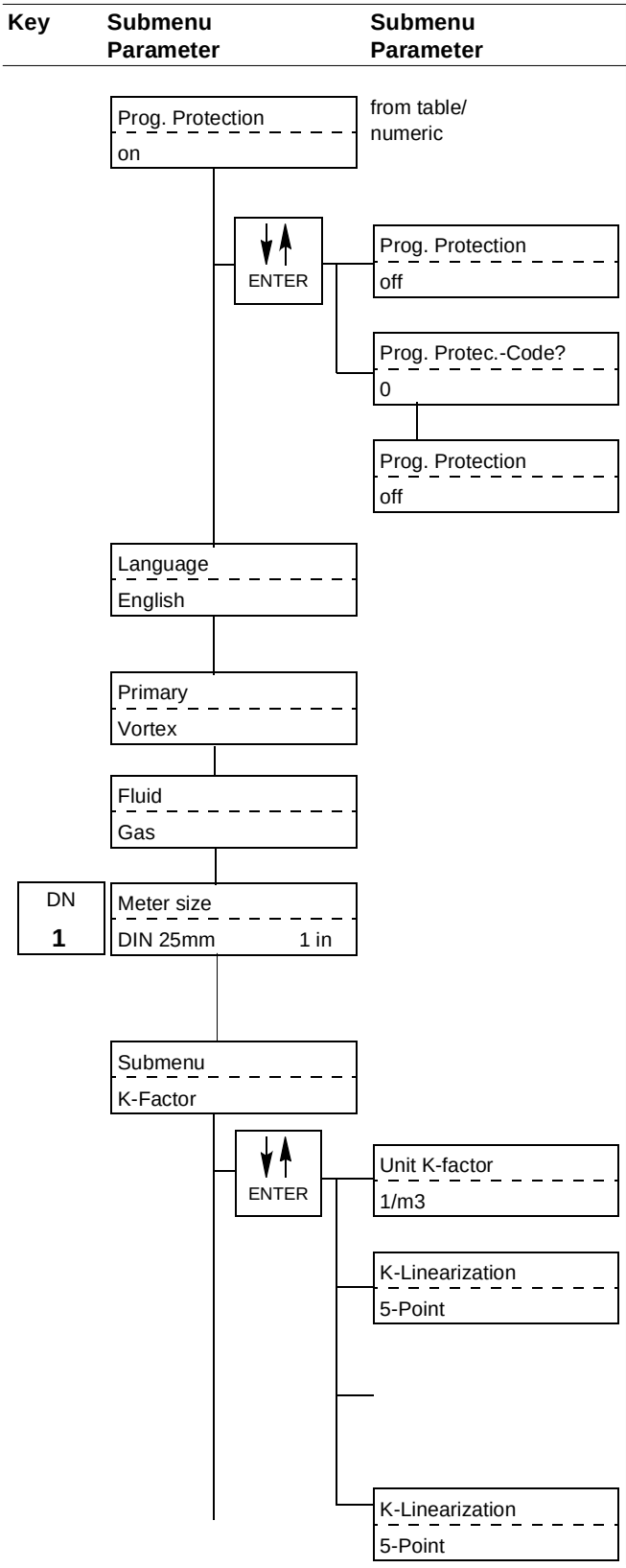
2.) Press the ENTER-key. The text in the second line is erased and a cursor is displayed. The first line does not change. A numeric entry can now made.

3. The data entry begins with the most significant digit. After the entry of the new value is complete, pressing the ENTER-key transfers the value into the converter. The new value is stored and displayed.

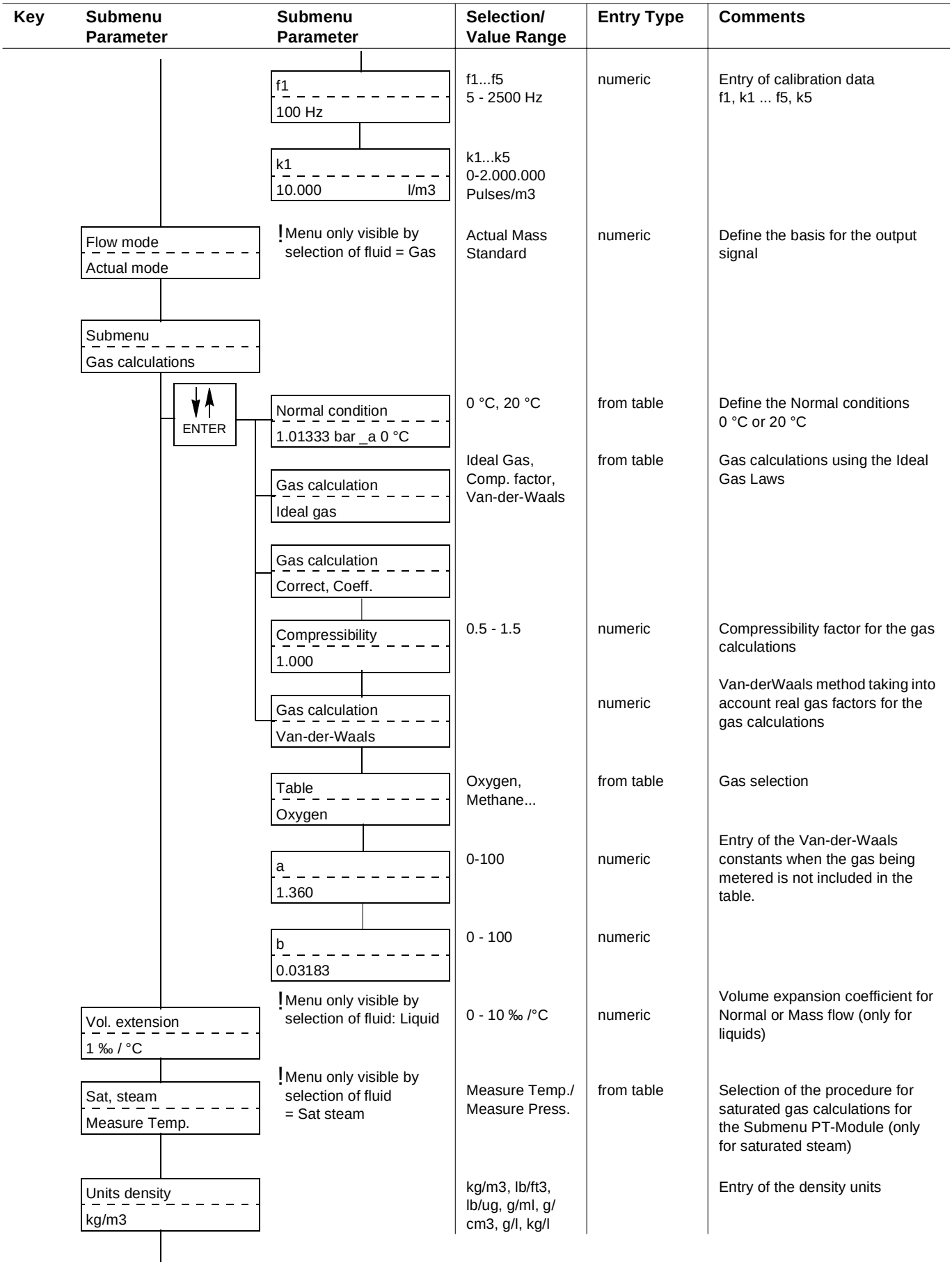
If inadvertanatly an incorrect value was entered, press the C/CE-key before pressing the ENTER-key. The entered value is erased when C/CE-key is presssed and the previous value displayed. To immediately return to the process information (standard display) press the C/CE-key once more. Otherwise the display returns automatically after 20 seconds.



2.4 Parameter Overview and Display Indications Table

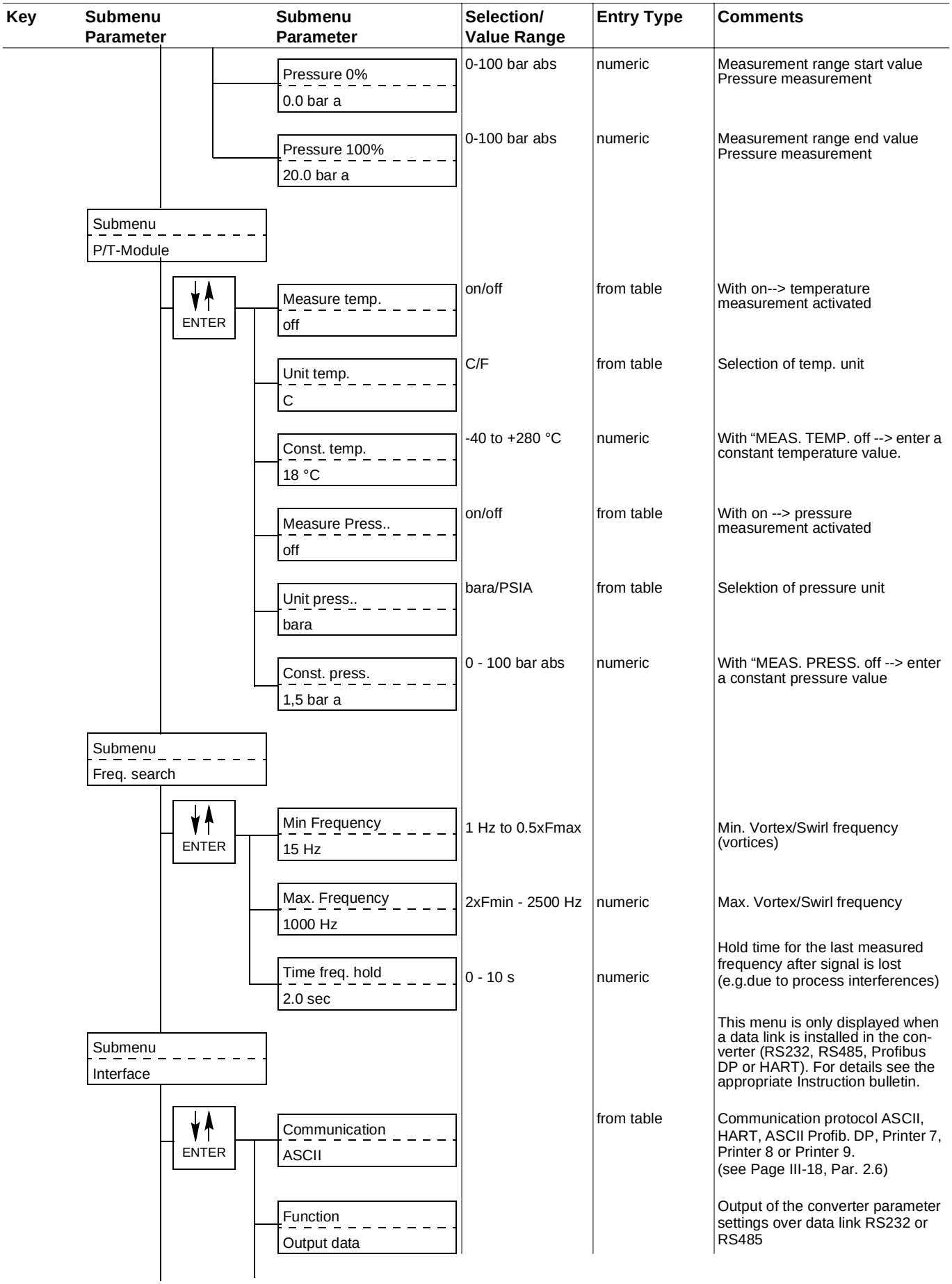


Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
				from table	Data can only be entered after the Prog. Protection has been turned off.
					on/off
					If a value other than "0" (factory setting) has been entered for the Prog. Prot. Code, the Prog. Protection can only be turned off after the correct PP-Code has been entered (1-255). After the Prog. Protection has been turned off values can be changed.
			German, English	from table	Language for display texts
			Vortex, Swirl-meter	from table	Type of flowmeter primary connected to the converter
			Gas/Liquid/ Super heated steam/Sat. steam	from table	Fluid to be metered
			Vortex: DN 15-300 1/2" - 12" Swirl: DN 15-400 1/2" - 16" and type of error (Pie=Piezo, NTC=Thernistor)	from table	Flowmeter primary size and type of sensor (only swirlmeter)
			1/m3, 1/ft3	from table	Entry of a calibration curve
				from table	


Key
Submenu Parameter
Submenu Parameter
Selection/ Value Range
Entry Type
Comments
f1
100 Hz
f1...f5
5 - 2500 Hz
numeric
Entry of calibration data
f1, k1 ... f5, k5
k1
10.000 l/m3
k1...k5
0-2.000.000
Pulses/m3
Flow mode
Actual mode
! Menu only visible by selection of fluid = Gas
Actual Mass
Standard
numeric
Define the basis for the output signal
Submenu
Gas calculations
ENTER
Normal condition
1.01333 bar _a 0 °C
0 °C, 20 °C
from table
Define the Normal conditions
0 °C or 20 °C
Gas calculation
Ideal gas
Ideal Gas,
Comp. factor,
Van-der-Waals
from table
Gas calculations using the Ideal Gas Laws
Gas calculation
Correct, Coeff.
Compressibility
1.000
0.5 - 1.5
numeric
Compressibility factor for the gas calculations
Gas calculation
Van-der-Waals
numeric
Van-derWaals method taking into account real gas factors for the gas calculations
Table
Oxygen
Oxygen,
Methane...
from table
Gas selection
a
1.360
0-100
numeric
Entry of the Van-der-Waals constants when the gas being metered is not included in the table.
b
0.03183
0 - 100
numeric
Vol. extension
1 ‰ / °C
! Menu only visible by selection of fluid: Liquid
0 - 10 ‰ /°C
numeric
Volume expansion coefficient for Normal or Mass flow (only for liquids)
Sat, steam
Measure Temp.
! Menu only visible by selection of fluid = Sat steam
Measure Temp./
Measure Press.
from table
Selection of the procedure for saturated gas calculations for the Submenu PT-Module (only for saturated steam)
Units density
kg/m3
kg/m3, lb/ft3, lb/ug, g/ml, g/ cm3, g/l, kg/l
Entry of the density units

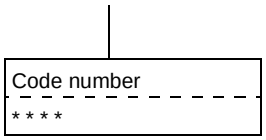
Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
	Normal density 1.28 kg/m3		0-20 kg/m3, kg/dm3	numeric	Entry of the normal density for the gases or liquids
	Unit Qv l/min		l/s, l/m, l/h, m3/ s,m3/m, m3/h, m3/ d,ft3/g, ft3/m, ft3/h, ft3/dug/s, ug/m, ug/h,igl/s, igl/m, igl/h, igl/d,bbl/s, bbl/m, bbl/h,bbl/d	from table	Volume flowrate units
	Units Qm kg/m		kg/s, kg/m, kg/h, kg/d,t/m, t/h, t/d, lb/s, lb/m,lb/h, lb/d, g/s, g/m,g/h	from table	Mass flowrate units
QDN **2**	Meter range max. 10.0 m3/h				Display of the max. volume flowrate for the selected flowmeter size
Qmax F **3**	Range max. 100.0 l/min		0-1.000.000	numeric	Flow range end value for the selected operating mode (=20 mA)
Low-fl **5**	Range min. 10 m3/h		0-10 % RangeMax volume	numeric	Flow range start value
Counter **7**	Submenu Totalizer				
	ENTER	Totalizer Qv 123456.78 m3			Totalizer display based on the operating mode Qv, Qn, Qm
		Overflow 0		from table	Indication of the number of totalizer overflows; max. 65,535 1 overflow = 10,000,000
		Unit totalizer l	l, m3, ft3, ugl, igl, bbl, g, kg, t, lb	from table	Selection of the totalizer units
		Function Totalizer reset		from table	Reset the totalizer and overflow counter
Pulse **6**	Submenu Pulse output				
	ENTER	Pulse factor 1.000 / l	0.0001 - 1000 Pulses/units	numeric	For int. and ext. flow totalization, indication of the pulses per selected unit for the output

Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
		Pulse width 30 ms	0.0016 - 1000 ms	numeric	Width (duration) of the output pulses
Damp **9**	Damping 10.00 s		0.2 - 100 s	numeric	Damping of the current output Response time 1 τ (=63 %) for a step flow change
	Submenu Flow Alarm				
	ENTER	Min. Alarm < > 100 %	0 - 115 %	numeric	Limit value for Min-Alarm
		Max-Alarm > > 10 %s	0 - 115 %	numeric	Limit value for Max-Alarm
Display **4**	Submenu Display		Qv operate on norm, Qm mass		
	ENTER	Display 1. Line Qv	Percent Percent bar Totalizer Pressure	from table	Selection display for 1st Line
		Display 2. Line Qn normal	Press and Temp. Frequenzy	from table	Selection display for 2nd Line
		Multiplex off	on/off	from table	Turn on the multiplex mode for 2nd line
		2. Line Multiplex Press. and Temp.	Multiplexual are Press. and Temp	from table	Selection of multiplexed parameter for line 2
	Submenu Current output				
	ENTER	Current output 4-20 mA	0-20, 4-20, 0-10, 2-10, 0-5 mA	from table	Current output range
		Iout at Alarm 0 %	0/130 %	from table	Current output value at alarm either 0 % or 130%
	Submenu Press. input				
	ENTER	Pressure input 4-20 mA	0-20, 4-20, 0-10, 2-10 mA	from table	Pressure input type


Key
Submenu Parameter
Submenu Parameter
Selection/ Value Range
Entry Type
Comments
Pressure 0%
0.0 bar a
0-100 bar abs
numeric
Measurement range start value Pressure measurement
Pressure 100%
20.0 bar a
0-100 bar abs
numeric
Measurement range end value Pressure measurement
Submenu
P/T-Module
ENTER
Measure temp.
off
on/off
from table
With on--> temperature measurement activated
Unit temp.
C
C/F
from table
Selection of temp. unit
Const. temp.
18 °C
-40 to +280 °C
numeric
With “MEAS. TEMP. off --> enter a constant temperature value.
Measure Press..
off
on/off
from table
With on --> pressure measurement activated
Unit press..
bara
bara/PSIA
from table
Selektion of pressure unit
Const. press.
1,5 bar a
0 - 100 bar abs
numeric
With “MEAS. PRESS. off --> enter a constant pressure value
Submenu
Freq. search
ENTER
Min Frequency
15 Hz
1 Hz to 0.5xFmax
Min. Vortex/Swirl frequency (vortices)
Max. Frequency
1000 Hz
2xFmin - 2500 Hz
numeric
Max. Vortex/Swirl frequency
Time freq. hold
2.0 sec
0 - 10 s
numeric
Hold time for the last measured frequency after signal is lost (e.g.due to process interferences)
Submenu
Interface
This menu is only displayed when a data link is installed in the converter (RS232, RS485, Profibus DP or HART). For details see the appropriate Instruction bulletin.
ENTER
Communication
ASCII
from table
Communication protocol ASCII, HART, ASCII Profib. DP, Printer 7, Printer 8 or Printer 9.
(see Page III-18, Par. 2.6)
Function
Output data
Output of the converter parameter settings over data link RS232 or RS485

Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
		Printer type Standard		from table	Menu only displayed for Communication Printer 7 -9. Selection Standard (standard serial printer), Standard CR LF (standard serial printer, CR and LF sent after each line), Printer 55DE1000 (When BF&P Data Report Printer 55DE1000 is connected)
		Instr. address 0		numeric	Instrument address: 0–99. (Not available for selections Printer- or HART-Protocol). If a number of instruments are connected to a single bus (RS 485), each connected instruments must have a unique address.
		Baudrate 1200 Baud		from table	Baudrate: 110–28800 Baud selectable. For Communication HART always 1200 Baud, for Profibus DP 4800 Baud
		Function Param.-Profibus DP			Only available for Communication Profibus DP. Access to the Profibus relevant parameters (see Data Link Description Profibus DP).
		TAG 126		numeric	Entry of an alphanumeric TAG number with max. 16 characters for meter location identification, including upper and lower case letters or numbers. For Profibus DP it is set to 127.
	Submenu Self Check				
	ENTER	Function Iout			Test Current output Manual process control (100 % = 20 mA)
		Test Iout 25 %	0 - 115 %	numeric	
		Function Fout			Test Pulse output Manual process control
		Test Fout 25 %	0 - 115 %	numeric	
		Function Alarm	on/off	from table	Test Alarm output Manual process control
		Function Max-Alarm	on/off	from table	Test-Max-Alarm Manual process control

Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
		Function Min-Alarm	on/off	from table	Test Min-Alarm
		Function Zero return	on/off		Test ext. zero return; contact, closed --> on opened --> off
		Function Totalizer reset	on/off		Test Ext. Totalizer reset
		Function Display			Test display
		Function Data link	Data link/RAM NVRAM, EPROM, EEPROM, Ext. EEPROM		Test the int. electronic assemblies Message: OK when functioning properly
		Function HART-Transmitter	0,1	from table	Function test HART-Transmitter 0 = 2200 HZ 1 = 1200 Hz
		Function HART-Command			Function test HART-Receiver Display of the received HART-Commands
	Submenu Error register				
	ENTER	Error register . . . 2 3 4. . . 8. .			Display of the detected error conditions (in series) by there error code
		Mains interrupt . . . 2			Display of the number of times power was turned off since start-up
	Store data in ext. EEPROM			from table	Store data in ext. EEPROM on the connection board after a successful start-up
	Load data from ext. EEPROM			from table	Load data from ext. EEPROM on the connection board into the converter module, e.g. after a converter exchange
	50VM1000 04/97 D699B095U01 A.51				Display Revision level; Software

Key	Submenu Parameter	Submenu Parameter	Selection/ Value Range	Entry Type	Comments
					Only for F&P-Service

2.5 Parameter Descriptions

Submenu
Gas calculation

Selection from table

Gas calculation
Ideal gas Correct. Coeff. Van der Waals

This menu is only displated when the fluid selection is "Gas".

The standard the selection is "Ideal gas". The mass flow rute is calculated by the equation:
mass flowrate: Normal density - Normal flowrate

The Normal flowrate is calculated from the volume flowrate at operating conditions using the following equation:

a) For an ideal gas:

$$Q_N = Q_V \cdot \frac{P_O}{P_N} \cdot \frac{T_N}{T_O}$$

b) For a real gas:

$$Q_N = Q_V \cdot \frac{P_O}{P_N} \cdot \frac{T_N}{T_O} \cdot \frac{Z_N}{Z_O}$$

where:

Q_N = Flowrate at Normal conditions
(T_N = 0°C, p_N =1013 mbar)
Q_V = Flowrate at operating conditions (p_O, T_O)
Z_N = Real gas factor at Normal conditions
Z_O = Real gas factor at operating conditions

Using real gas factors reduces the deviations between the behavior of the gas being metered from the behavior of an "Ideal Gas". (For Z_N/Z_O =1 the calculation follows the "Ideal Gas Laws".)

For an Ideal Ga the calculations are made as indicated in a) according the Ideal Gas Laws.

The methods available for the gas calculations, which take into account the real gas factors (at operating and Normal conditions), are the Z-Curve and the "Van der Waals" algorithm.

A constant factor, corresponding to the ratio Z_N/Z_O, can be entered as the compensation factor which defines the deviations from ideal gas behavior.

Correction coefficient
Direct numeric entry

Compressibility
0.85

0.5 -1.5

This menu is only displayed when "Correction Coefficient" has been selected.

The deviations from ideal gas behavior will be taken into account when the user selected factor is entered.

Gas Calculations per Van-der-Waals
Selection from table

Submenu
Van der Waals

This menu is only displayed when "Gas" is selected as the fluid and "Van der Waals" is selected as the gas calculation method. It is used for the calculation of the real gas factors Z_N and Z_O.

It is based on the following algorithm:

$$Z = \left(1 + \frac{P}{R \cdot T}\right) \cdot \left(b - \frac{a}{R \cdot T}\right)$$

where a and b are the "Van der Waals" constants.

Gas Table
Selection from table

Table
Methane
Methane Ethane Propane Oxygen Nitrogen Ammonia - - -

This table contains a listing of gases. When a gas is selected both “Van-der-Waals” constants, a and b, for the selected gas are automatically entered in the following two menus.

If the gas to be metered is not listed in the table, then the menu “- - -” is to be selected and the “Van-der-Waals” constants manually entered in the following two menus.

Van der Waals Constants
Direct numeric entry

a
10.0

0.0 - 100.0

b
0.1

0.0 - 100.0

The two “Van-der-Waals” constants, “a” and “b”, for the gas can be entered in these two menus.

If a gas is selected from the table the values of the two constants can be viewed in these menus.

Density
Direct numeric entry

a) Gas:

Normal Density
1 . 97 Kg/m3

0.0 - 20.0 kg/m3

b) Liquid

Vol. extension
1‰ / °C

p/T-Module

In this menu the converter receives a signal to activate the the p/T-Compensation function is informed which values are to be used for the calculations, data from the pressure and temperature inputs or consatnt values which have been entered by the user.

Note:

When the pressure and temperature inputs are to be utilized, a p/T-Module must be installed in the converter.

Temperature Measurement
Selection from table

Temp. measure
off
on
off

When “on” is selected the temperture input is activated (requires a (p/T-Module).

Constant Temperature
Direct numeric entry

Const. Temp
18.0 °C

-40.0 - +280.0 °C

This submenu is only displayed when “off” has been selected in “Temp. Measure”.

A constant temperature value is to be entered in °C.

Pressure Measurement
Selection from table

Press. measure
off
on
off

When “on” is selected the pressure input is activated (requires a (p/T-Module).

Constant Pressure
Direct numeric entry

Const. press.
1 . 0 bar a

1 - 100

This submenu is only displayed when “off” has been selected in “Press. measure”.

A constant pressure value is be to entered in bar (abs.).

Pressure Input

Press. input
4 - 20 mA

The pressure input is configured in this submenu. The pressure input signal is the current value from the output of the pressure sensor (pressure transmitter) in a two- or four-Wire connection.

Pressure Input Current Range
Selection from table

Press. input
4 - 20mA
0 - 20mA
4 - 20mA
0 - 10mA
2 - 10mA

Defines the range of the current/pressure input. The first number correponds to a 0% signal and the second number to a 100% signal at the pressure input (e.g. for current input type 4-20 mA:
4 mA= 0%, 20 mA=100%).

Pressure Measurement Range
Entry of the pressure measurement limits.

Direct numeric entry

Press. 0%
0 . 0 bar a

0.0 - 100.0

Entry of p_{min} [bar abs.] for 0% current.

Press. 100%
20 . 0 bar a

0.0 - 100.0

Entry of p_{max} [bar abs.] for 100% current.

2.6 Printer Data Reports for Vortex and Swirl

1.) Printer Data Report Format 7 (Printer 7)

This format prints the TAG number (= meter location identifier) and the totalizer value. The date and time are also printed when a clock module is installed in the printer.

The flowrate must be less than Qmin for a print cycle to be initiated, i.e. the flowrate must be less than the low flow cutoff value. After the report has been printed the totalizer is reset. If the flowrate is greater than Qmin, the report is not printed and the totalizer is not reset. Printing of the report can be initiated from the “External Totalizer Reset” terminals 31, U2.

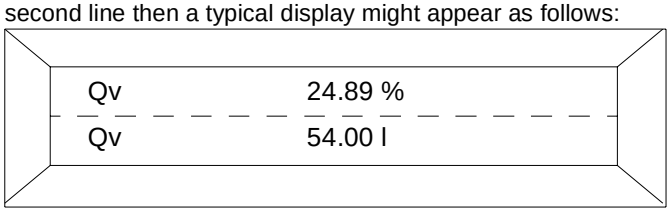
Standard Printer	F&P Data Report Printer	
	19.08.97 14:58´44	Date, Time
Tag No	Tag No	Tag No = Meter location identifier
Qv 3395.00 l	Qv 1385771 l	Qv = Totalizer value

The text “Qv”, “Qn” or “Qm” can be used to identify the basis for the flow values, i.e., if the flow is totalized as a volume, Normal or mass flow.

2.) Printer Data Report Format 8 (Printer 8)

This format prints the values displayed on the converter. They are selected in the submenu “Display”.

For example: if “Percent” (= flowrate in percent of Qmax) has been selected for the first line and “Totalizer” (in liters) for the second line then a typical display might appear as follows:



Printing of the report can be initiated from the “External Totalizer Reset” terminals. The totalizer is not reset. A typical report might have the following format:.

Standard Printer	F&P Data Report Printer	
	19.08.97 14:59´05	Data Report example
Tag No	Tag No	Tag No = Meter location identifier
Qv 24.89 %	Qv 0.00 l/s	Qv = Flowrate in %
Qv 54.00 l	Qv 0.00000 l	Qv = Totalizer value

When the multiplex mode is turned on, the additional value displayed in the second line is also printed (lines 3-5 above can be user configured).

3.) Printer Data Report Format 9 (Printer 9)

This report format can be used for service purposes and prints all the measurement values at one time. Printing of the report can be initiated from the “External Totalizer Reset” terminals. The totalizer is **NOT** reset..

Standard Printer	F&P Data Report Printer	
	19.08.97 14:59´19	Date, Time
Tag No	Tag No	Tag No = Meter location identifier
Qv 6.22 m^3/h Qn 5.80 m^3/h Qm 5.80 kg/h	Qv 0.00 l/s Qn 0.00 l/s Qm 0.00 g/s	Qv = volume flowrate Qn = Normal flowrate Qm = Mass flowrate
Qv 24.89 % Qv 67.00 l	Qv 0.00 % Qv 0.00000	Qv = Percent of Qmax Qv = Totalizer value
T 20.00 °C P 1,01 bara	T -0.8 °C P 5.72 bara	T = Temperature P = Pressure
F 6.22.15 Hz	F 0.00 Hz	F = Frequency of vortices

2.7 Dimensions Converter 50VM1000

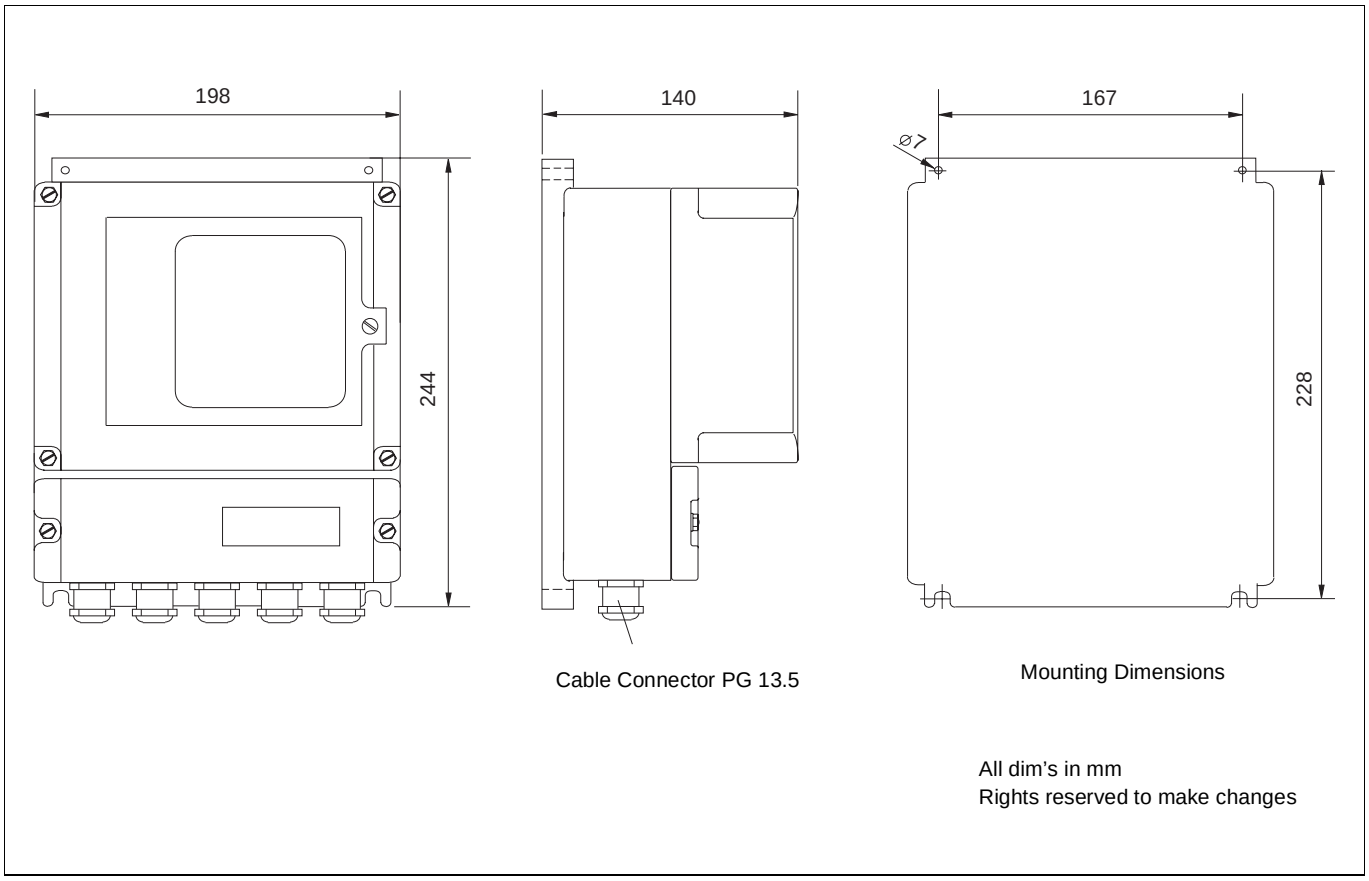


Fig. III-4 Dimensions, Field Mount Housing Converter 50VM1000

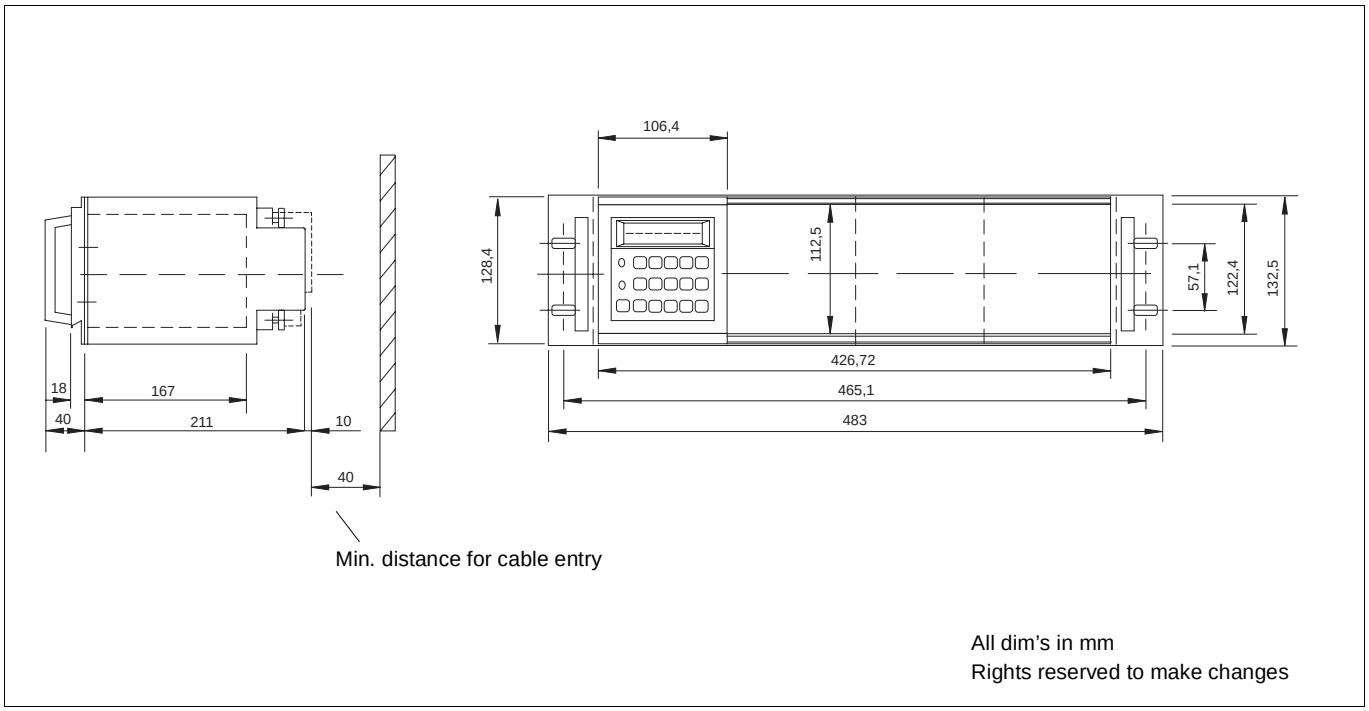


Fig. III-5 Dimensions, 19"-Design Converter 50VM1000

2.8 Specifications 10VM1000/10SM1000

Ex-Protection for the 10VM1000/10SM1000 in conjunction with Zener barriers EC-Type Examination Certificate
TÜV 97 ATEX 1160

Classification: II 2G EEx ib IIC T4

Ambient temperature, standard:
-20 °C to +60 °C

Ambient temperature to -55 °C upon request

Max. Fluid tmperature range:
-55 °C to +280 °C

For fluid temperatures > +150 °C the connection box is to mounted on the side or under the pipeline.

Safety Specifications
valid for the range from -55 °C to +60 °C

Ignition type characteristics EEx ib IIC
Ui = 35.5 V
Ii = 70 mA
Linear curve
Effective internal capacitance: 5 nF
The effective internal inductance is negligible.

Terminals 12/2A
Signal Circuit
Connection of the signal cable between the converter and flowmeter primary. max. Cable length 150 m.

Thermally Insulated pipes.
The insulation of the preamplifier box and the neck must be avoid.

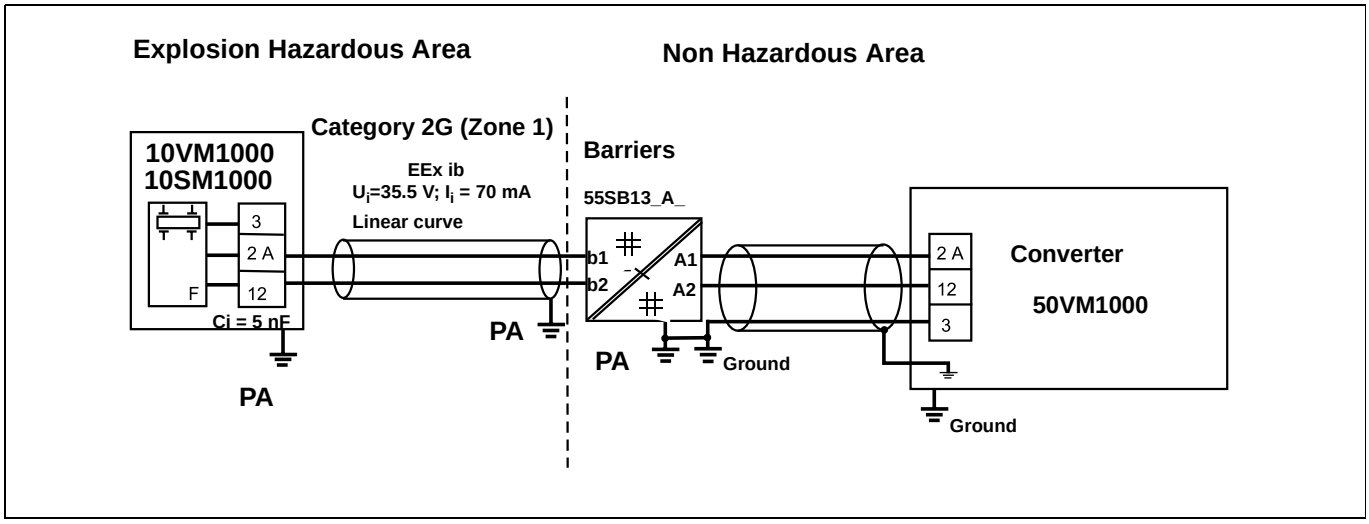


Fig. III-6

	A1	A2	b1	b2	PA
Zener barriers for C-Rail Part No. 55SB131A0	21	11	23	13	PA
19”-Card with 1 module Part No. 55SB132A2 Interconn. Diag. Module A	d4	z14	z28	z22	d16
19-Card with 2 modules Part No. 55SB133A2 Interconn. Diag. Module B	d2	z12	d26	d22	z16
19”-Card with 3 modules Part No. 55SB134A2 Interconn. Diag. Module C	z2	d12	d30	z20	d18
19”-Card with 4 modules Part No. 55SB135A2 Interconn. Diag. Module D	z4	d14	z32	d20	z18

Profibus DP per DIN 19245

Terminals: V1, V2, V4, G2

Terminal	Function	Reference
V1	RxD/TxD-P (B)	Receive/Send-Data-P
V2	RxD/TxD-N (A)	Receive/Send-Data-N
V4	VP	Supply-Voltage-Plus (P5V
G2	DGND (C)	Data-Common-Potential (M5V)

Cable specifications:
- 2 conductor, twisted, shielded, max 1200 m, Cable Type A
- Characteristic impedance: 135 to 165 Ω
- Distributed capacitance : < 30pF/m
- Max. 32 Instruments per Profibus DP Segment
- Loop resistance : 110 Ω/km
- Baudrate : 9.6 to 1500 kbit/s
- Cable connections : Loop conned to terminals
- Length of the tap line : ≤1 m

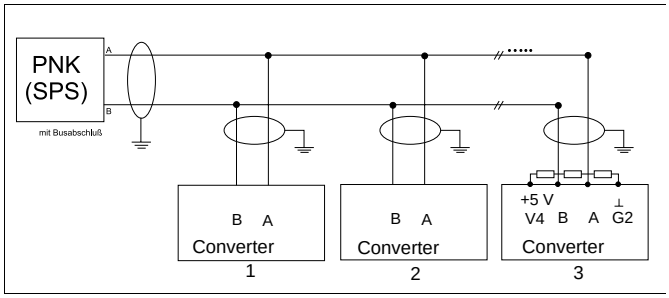


Fig. III-7 Communication using Profibus DP

2.9 Error Messages

Error Message	Clear Text	Cause
0	Steam calculation	Pressure-Temperature below saturation curve
1		
2	Preamplifier	No signal from preamplifier
3*	Flowrate > 115 %	Flowrate is greater than 115 % of the flow range setting
4	Ex. Zero return	Ext. Zero return activated
5	EEPROM	Data in EEPROM corrupted
6	Totalizer defective	Totalizer value is invalid
7	Pressure	No signal from pressure sensor
8	Temperature	No signal from temperature sensor
9*	Qv > 115% RangeMax	Flowrate greater than 115% RangeMax. Error must be acknowledged by pressing a key

2.10 Block Diagram

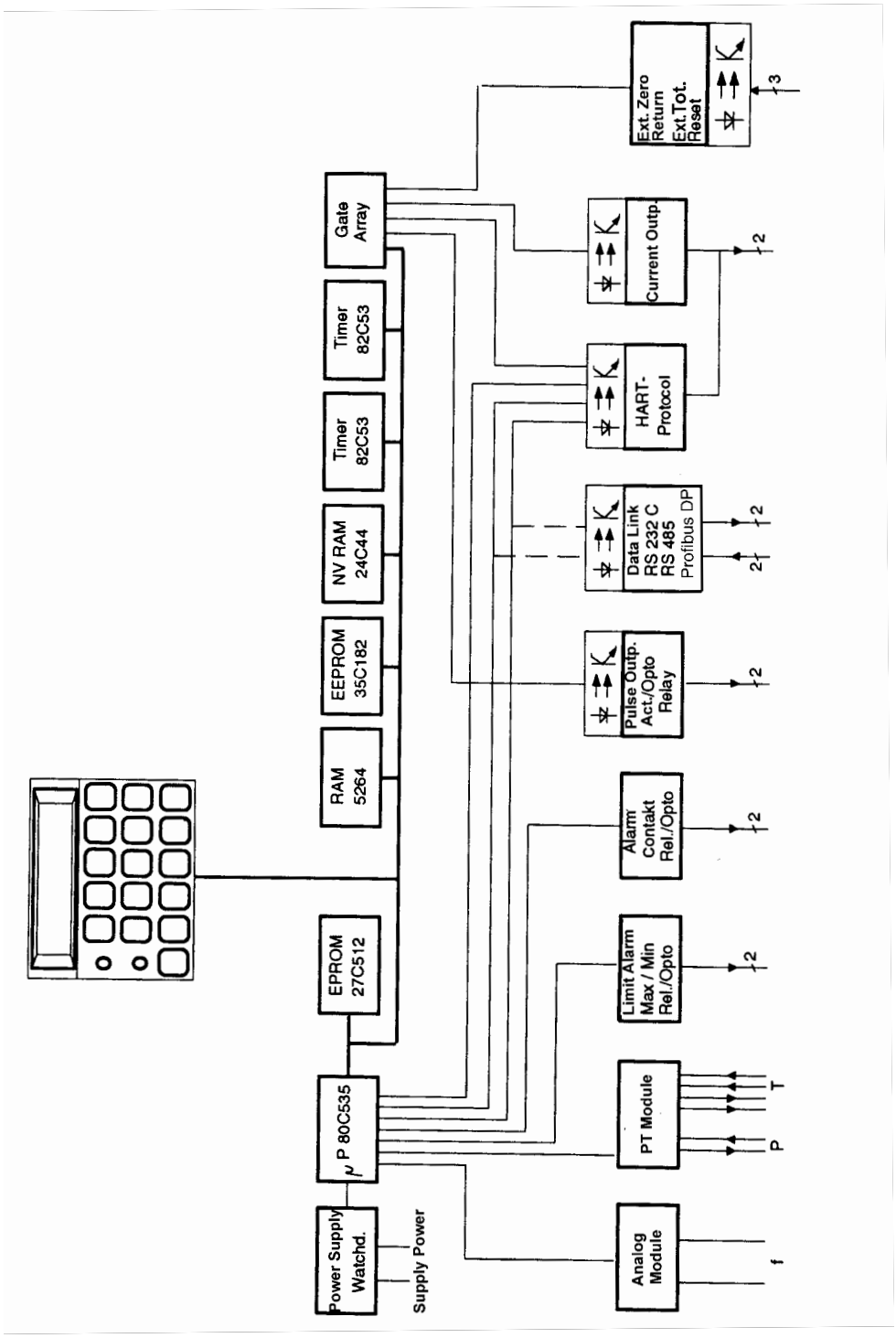
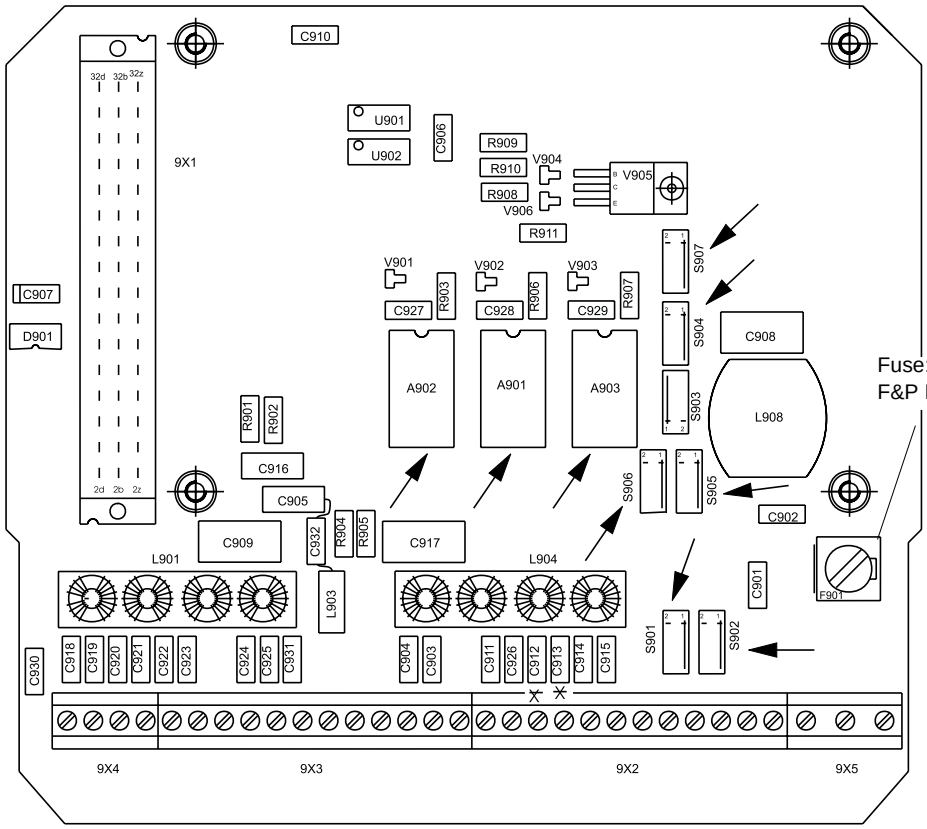


Fig. III-8

2.11 Circuit Boards

2.11.1 Connection Board - Field Mount Housing



	Pulse Output Active	Pulse Output Passive - Opto	Pulse Output Passive - Relay	Min - Alarm Opto	Min - Alarm Relay
Connection Board:					
Socket A903	optocoupler	optocoupler	relay	optocoupler	relay
Switch S904	2	1	1	1	1
Switch S905	2	1	1	1	1
Switch S906	2	1	1	1	1
Switch S903	1 -	1 -	1 ---> closes 2 ---> opens	1 -	1 ---> closes 2 ---> opens
Switch S907	2	1	1	1	1
Digital Board:					
Switch S204	2	2	2	1	1

	Max - Alarm, Opto	Max - Alarm, Relay		General Alarm, Opto	General Alarm, Relay
Connection Board:			**Connection Board:**		
Socket A901	optocoupler	relay	Socket A902	optocoupler	relay
Switch S902	1 -	1 ---> closes 2 ---> opens	Switch S901	1 -	1 ---> closes 2 ---> opens

Fig. III-9

2.11.2 Digital Board

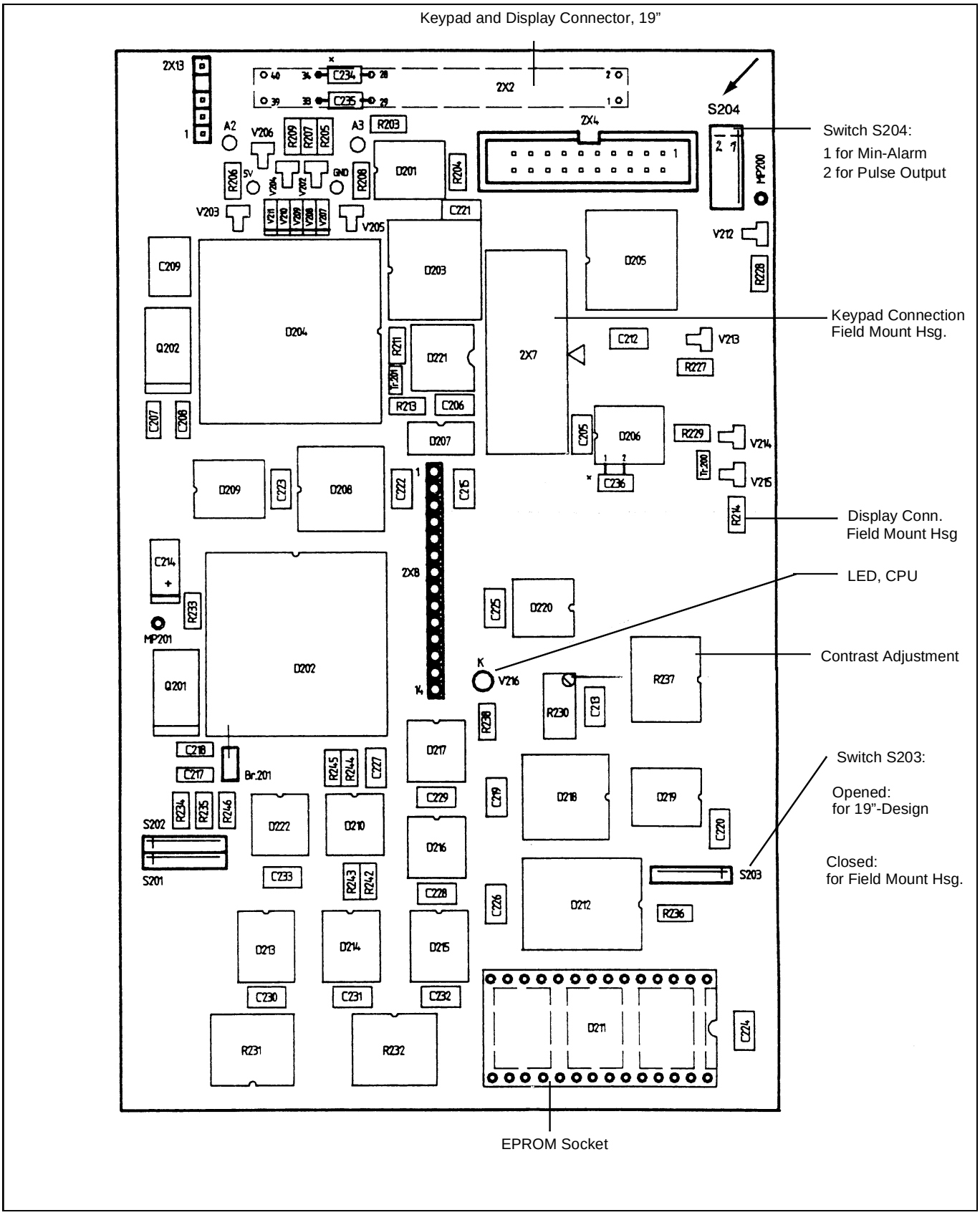
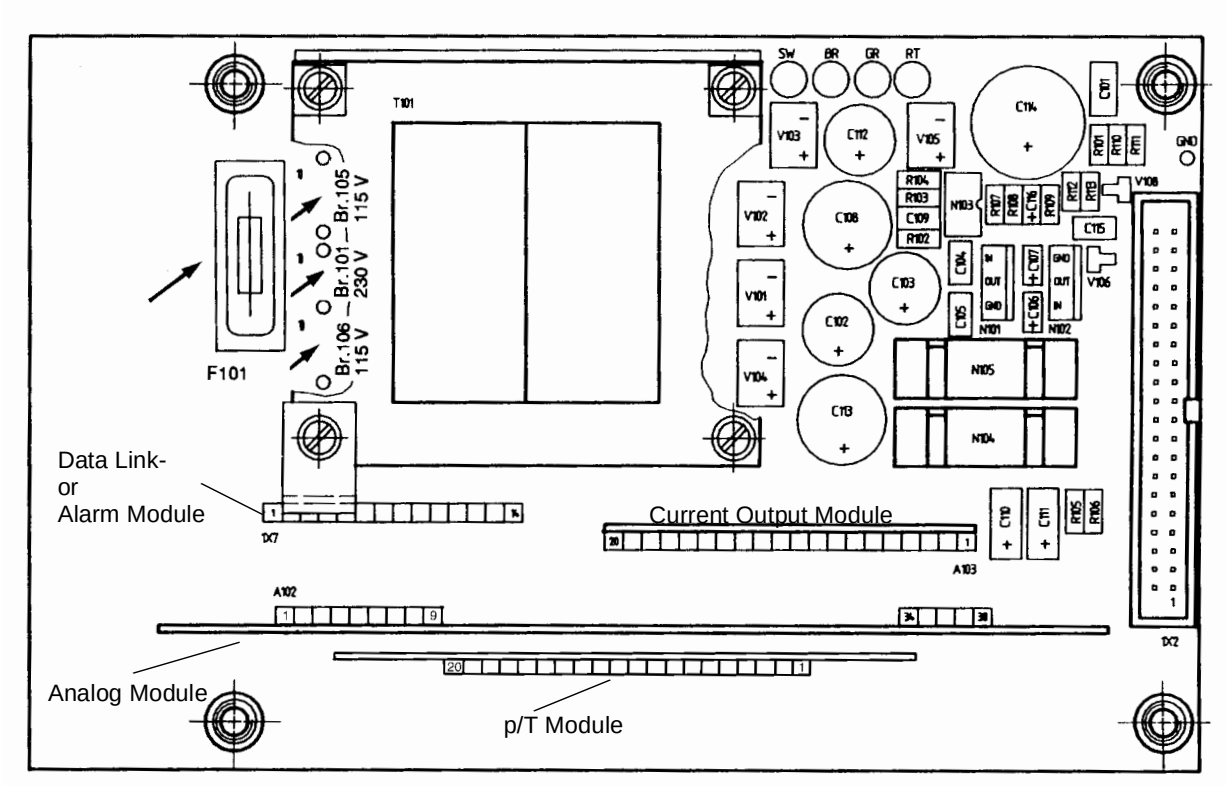


Fig. III-10

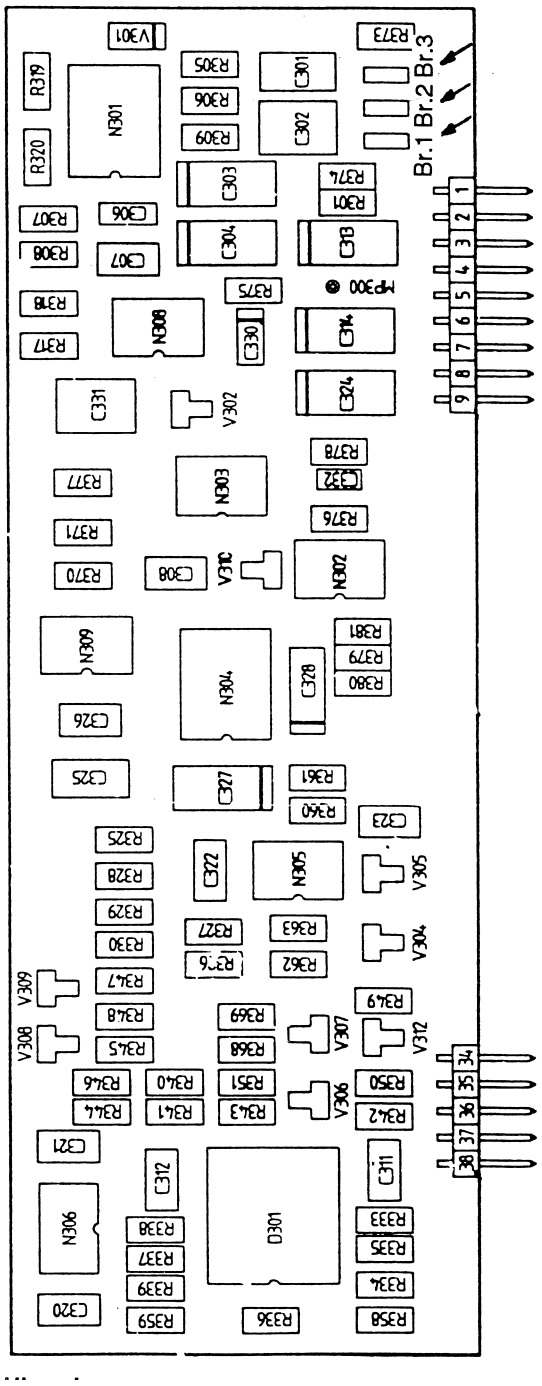
2.11.3 Analog Board



Voltage	Jumpers	F101	Fuse B-F&P Replacement Part No.
230 V AC	101	160 mA	D151B001U09
115 V AC	105 & 106	315 mA	D151B001U01
48 V AC	101	800 mA	D151B001U14
24 V AC	105 & 106	1.6 A	D151B001U18
24 V DC	-	1.6 A	D151B001U18

Fig. III-11

2.11.4 Analog Module



Preamplifier, Flowmeter Primary	**Br. 1**	**Br. 2**	**Br. 3**
Vortex & Swirl after 7/92 (w/o Ex)	opened	closed	closed
Swirl NTC “old”	closed	opened	closed
Swirl, Piezo	closed	opened	opened

Note:

- Vortex: Vortex Flowmeter, Vortex-VM
- Swirl, NTC: Swirl Flowmeter with NTC-Sensor
- Swirl, Piezo: Swirl Flowmeter with Piezo-Sensor

Fig. III-12

Translation: Original German

TÜV CERT

(1) EC-TYPE EXAMINATION CERTIFICATE

(2) Equipment or Protective Systems intended for use in potentially explosive atmospheres - **Directive 94/9/EC.**

(3) EC-Type Examination Certificate Number

TÜV 97 ATEX 1160

(4) Equipment or Protective System: Vortex and Swirl Flowmeters Type 10 ***

(5) Manufacturer: Bailey-Fischer & Porter GmbH

(6) Address: Dransfelderstr. 2
D-37079 Göttingen, Germany

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

(8) The TÜV Hannover/Sachsen-Anhalt e.V., TÜV Certification Body No 0032 in accordance with the Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potential explosive atmospheres given in Annex II of the Directive.

The examination and test results are recorded in confidential report No 125/97/4044.

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

EN 50 014:1994-03 **EN 50 020:1996-04**

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

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

(12) The markings for the equipment or protective system shall include the following:

II 2G EEx ib IIC T4

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV Certification Authority
Am TÜV 1
D-30519 Hannover, Germany

Hannover 1997-03-03

Stürwold

Head of the
Certification Body

(13) APPENDIX

(14) EC-Type Examination Certificate No. TÜV 97 ATEX 1160

(15) Description of the equipment or protective system

The Vortex or Swirl Flowmeter Type 10*** ... is used for measuring the flow of gases, steam and liquids. The metering principle is based on the measurement of the frequency of vortices after a shedder body (Vortex Flowmeter) or the rotational frequency of the fluid after a guide body (Swirl Flowmeter) by piezoelectric sensors.
The following designs have been approved:
-Compact Design: Electronic assembly mounted directly on the flowmeter primary
-Remote Design: Electronic assembly connected to the flowmeter primary with a signal cable and installed in the explosion hazardous area
-External Design: Flowmeter primary installed in the explosion hazardous area and connected to the electronic assembly mounted outside of the explosion hazardous area by a signal cable.

The ambient temperature range is -55°C to 60°C

Electrical data

Compact/Remote Design
10VT*... , 10VR*... , 10ST*... , 10SR*...

Signal circuit (Connection terminals TW+ and TW-): Intrinsically safe ignition class EEx ib IIC only for connection to a certified intrinsically circuit:
U_i = 28 V
I_i = 110 mA
P_i = 770 mW
The effective internal capacitances and inductances are negligibly small

External Design
10VM*... and 10SM*...

Signal circuit (Connection terminals 12 and 2A): Intrinsically safe ignition class EEx ib IIC only for connection to a certified intrinsically circuit:
U_i = 35.5 V
I_i = 70 mA
Linear characteristic
The effective internal capacitance: 5nF
The effective internal inductances is negligibly small

EG-Konformitätserklärung
EC-Certificate of Compliance

CE

Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our

Vortex- und Drall-Durchflußmesser
Vortex and Swirl Flowmeter

Modell 10*...**
Model

- 1 ⇨ **ein Sensor** / *one sensor*
- 2 ⇨ **zwei Sensoren** / *two sensors*
- T ⇨ **Kompakt-Ausführung** / *compact design*
- R ⇨ **Remote-Ausführung** / *remote design*
- M ⇨ **Getrennt-Ausführung** / *external design*
- V ⇨ **Vortex** / *Vortex*
- S ⇨ **Drall** / *Swirl*

mit der Richtlinie 94/9/EG der Europäischen Gemeinschaft.
is in compliance with the council directive 94/9/EEC of the European Community.

Die Vortex- und Drall-Durchflußmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.
The Vortex and Swirl Flowmeter serves for the measurement of gases, steam and fluids.

EG-Baumusterprüfbescheinigung: *EC-Type Examination Certificate:*	TÜV 97 ATEX 1160
Benannte Stelle: *Notified Body:*	TÜV Hannover/Sachsen-Anhalt e.V., Kennummer 0032
Geräte-Kennzeichnung: *Apparatus code:*	Ex II 2G EEx ib IIC T4
Umgebungstemperatur: *Ambient temperature:*	-55°C bis +60°C
Sicherheitstechnische Daten: *Safety values:*	siehe EG-Baumusterprüfbescheinigung TÜV 97 ATEX 1160
Angewandte Normen: *Standards:*	EN 50 014: 1994-03 EN 50 020: 1996-04

Göttingen, 10 März 1997

Unterschrift / Signature

TÜV Hannover/Sachsen-Anhalt e.V.

Appendix EC-Type Examination Certificate No. TÜV 97 ATEX 1160

(16) Test documents consisting of 9 pages and including 9 drawings and 2 Certificates of Compliance are included in the test report.

(17) Special conditions

None

(18) Basic safety and health requirements

No additional

ABB Automation Products GmbH
Fischer & Porter
Dransfelder Str. 2
D-37079 Goettingen
Tel.: +49 (0) 5 51 9 05 - 0
Fax: +49 (0) 5 51 9 05 - 777
http://www.abb.com/automation