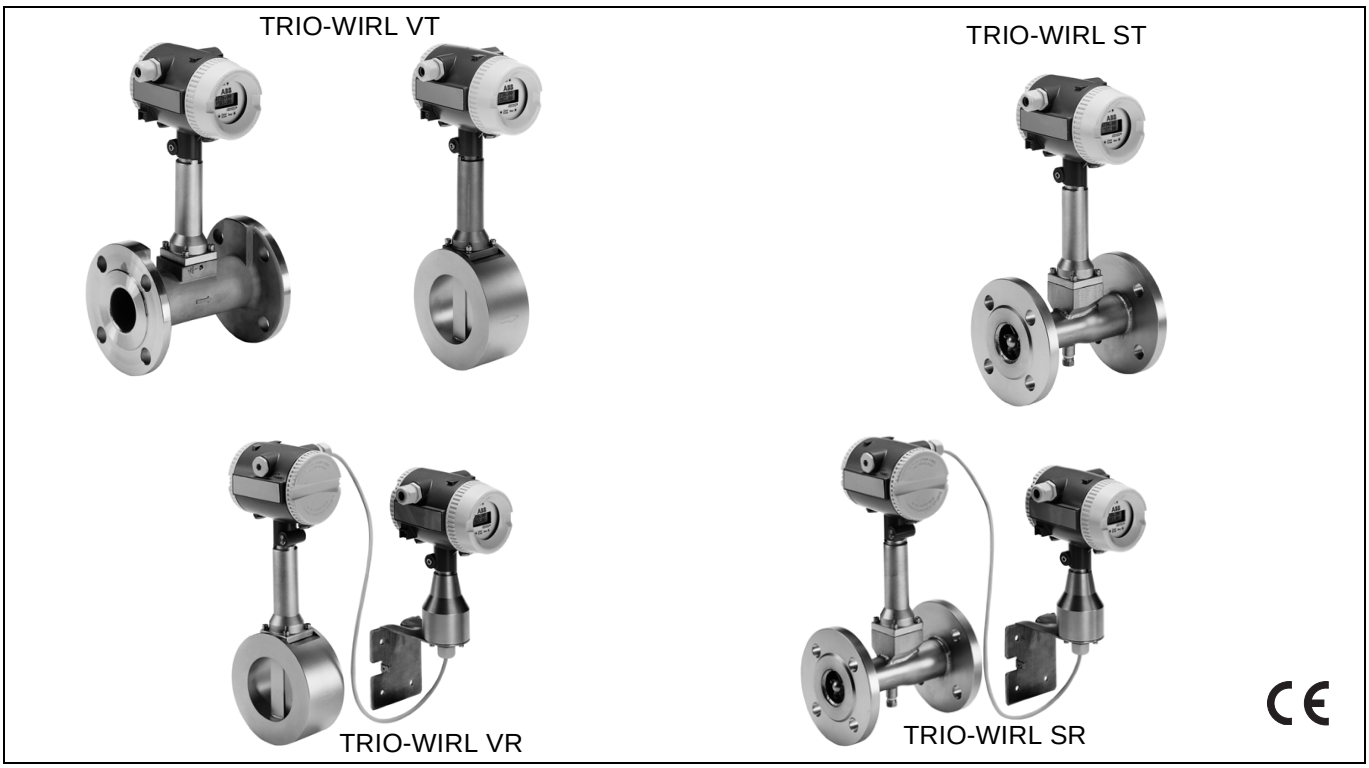
TRIO-WIRL V **Vortex Flowmeter**
Models VT4000 / VR4000

TRIO-WIRL S **Swirl Flowmeter**
Models ST4000 / SR4000

Instruction Bulletin D184B097U02 Rev. 0 / 12.99



ABB

You have purchased a high quality, modern instrument from ABB Automation Products.
We appreciate your purchase and the confidence you have expressed in us.

This Instruction Bulletin contains information relating to the assembly and installation of the instrument and the specifications for this instrument design. ABB Automation Products reserves the right to make hardware and software improvements without prior notice. Any questions which may arise that are not specifically answered by these instructions should be referred to our main plant in Göttingen, Germany Tel. 49-551/905-0 or to the Service personnel assigned to your account.

Introductory Safety Notes

Regulated Usage

These flowmeters are 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 user assumes all risk for such usage.

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

Assembly, Start-Up and Service Personnel

Please read this Instruction Bulletin and the safety notes before attempting installation, start-up or service.

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

Assure that the interconnections are in accordance with the Interconnection Diagrams, Ground the flowmeter system

Observe the warning notes designated in this document by the symbol: 

Hazardous Material Information

In view of the Disposal Law of 27 Aug. 86 (AbfG. 11 Special Wastes) the owner of special wastes is responsible for its care and the employer also has, according to the Hazardous Material Law of 01 Oct. 86 (GefStoffV, 17 General Protection Responsibility), a 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, bases, solvents, etc.)

b) The flowmeter primaries must be flushed so that the hazardous materials are neutralized. There are cavities in the primaries between the metering tube and the housing. Therefore after metering hazardous materials the cavities are to be neutralized (see Hazardous Material Law -GefStoffV).

c) For service and repairs **written confirmation** is required that the measures listed in a) and b) have been carried out.

d) Any costs incurred to remove the hazardous materials during a repair will be billed to the owner of the equipment

EG-Konformitätserklärung
EC-Certificate of Compliance

Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our

TRIO-WIRL Durchflußmesser
TRIO-WIRL Flowmeter

Modell VT41.; ST41.; VR41.; SR41.
Model VT41.; ST41.; VR41.; SR41.

mit den grundlegenden Sicherheits- und Gesundheitsanforderungen gem. der Richtlinie 94/9/EG des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.
are in compliance with the Essential Health and Safety Requirements with refer to the council directives 94/9/EC of the European Community. The safety and installation requirements of the product documentation must be observed.

Die TRIO-WIRL Durchflußmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.
The TRIO-WIRL flowmeters are utilized to meter the flowrate of gases, steam or liquids.

EG-Baumusterprüfbescheinigung: *EC-Type Examination Certificate:*	TÜV 99 ATEX 1465
Benannte Stelle: *Notified Body:*	TÜV Hannover/Sachsen-Anhalt e.V., Kennummer 0032
Geräte-Kennzeichnung: *Apparatus code:*	II 2G EEx ib IIC T4
Sicherheitstechnische Daten: *Safety values:*	siehe EG-Baumusterprüfbescheinigung TÜV 99 ATEX 1465 *refer to EC-Type Examination Certificate TÜV 99 ATEX 1465*
Angewandte Normen: *Standards:*	EN 50 014: 1997 EN 50 020: 1994

Göttingen, 23. September 1999

Unterschrift / *Signature*

BZ-13-8010, Rev.0, E22268

Inhalt **Seite**

Inhalt **Seite**

0. Introduction

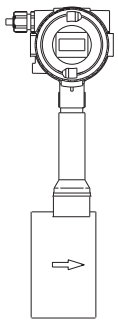
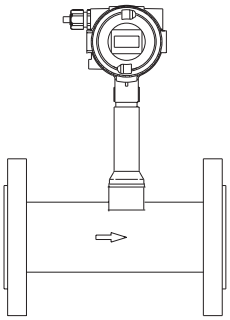
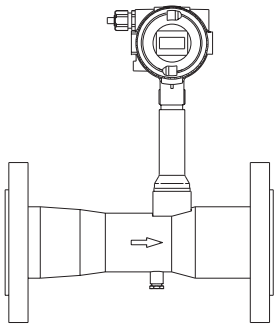
The descriptions of the flowmeters are divided into 3 main sections:

The **first section** (Chapters 1 & 2) describes the operating principles, assembly and installation of the Swirl Flowmeter **TRIO-WIRL S** flowmeter primaries.

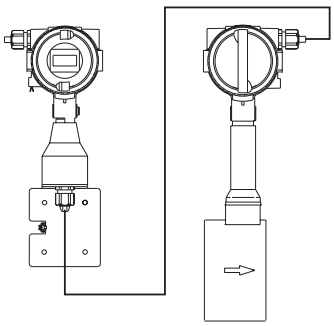
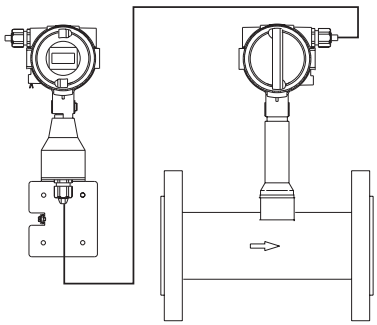
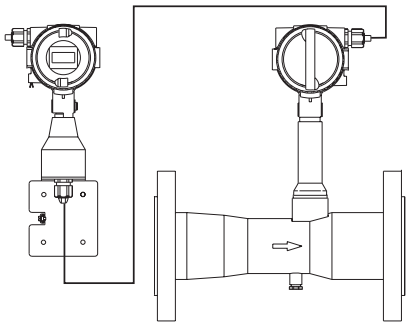
The **second section** (Chapters 3 & 4) describes the operating principles, assembly and installation of the Vortex Flowmeters **TRIO-WIRL V** flowmeter primaries.

The **third section** (Chapters 5 – 11) describes the electrical interconnections (Standard and Ex-Designs) and the start-up procedures for the **TRIO-WIRL** converter. There are two converter designs available:

a) Compact Design: Converter mounted directly on the flowmeter primary

		
Vortex Flowmeter **TRIO-WIRL VT** Wafer Design	Vortex Flowmeter **TRIO-WIRL VT** Flanged Design	Swirl Flowmeter **TRIO-WIRL ST** Flanged Design

b) Remote Mounted Design: **The converter can be mounted up to 10m remote from the flowmeter primary. The cable is permanently attached to the converter. It can be shortened if required.**

		
Vortex Flowmeter **TRIO-WIRL VR** Wafer Design	Vortex Flowmeter **TRIO-WIRL VR** Flanged Design	Swirl Flowmeter **TRIO-WIRL SR** Flanged Design

I. Swirl Flowmeter Primary TRIO-WIRL S

1. Functionality

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

There are no moving parts in the SFM making it maintenance and wear free.

Principle of Operation

The inlet guide body causes the axially entering flow to rotate. In the center of this rotation a vortex core is formed, which due to the backflow is forced into a spiral shaped secondary rotation (see Fig. 1 and Fig. 2).

The frequency of the secondary rotation is proportional to the flowrate and is linear over a wide flow range for optimized internal geometries.
This frequency is detected by a Piezo sensor.

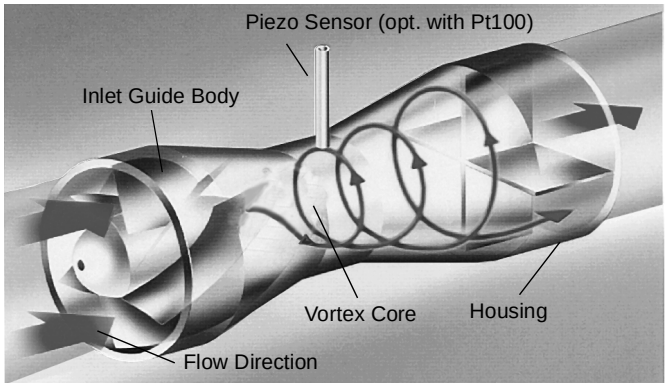


Fig. 1 Measurement Principle TRIO-WIRL S

The flowrate proportional frequency signal generated in the flowmeter primary is processed in the converter into scaled frequency and current output (4 - 20 mA) signals.

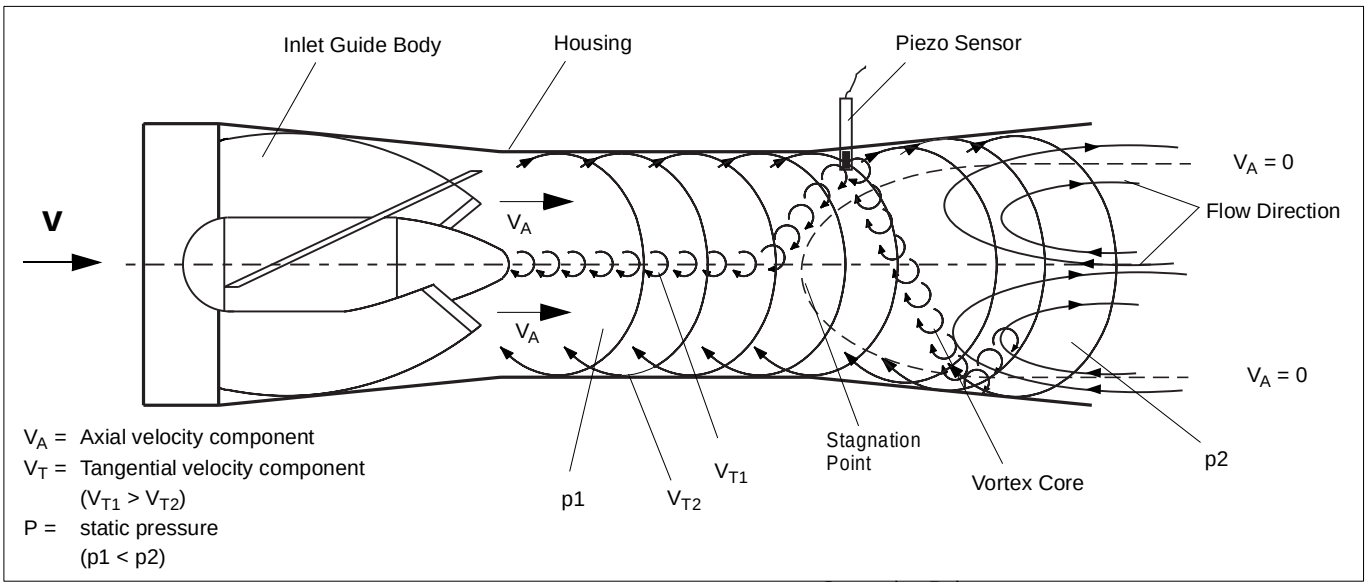


Fig. 2 Swirl Flowmeter Principle of Operation

2. Assembly and Installation Flowmeter Primary

2.1 Inspection

Prior to installing the SFM check for mechanical damage to the flowmeter due to possible mishandling during shipment. All claims for damage are to be made promptly to the shipper.

2.2 Installation of the Flowmeter Meter Primary in the Pipeline

2.2.1 Installation Requirements

The SFM can be installed at any arbitrary location in the pipeline. Care should be exercised to assure that

- the ambient requirements are not exceeded (see Specification Sheet TRIO-WIRL D184S035U02).
- the recommended in- and outlet straight sections are provided (Fig. 3).
- **the flow direction corresponds to the direction indicated by the arrow on the flowmeter primary.**
- the required minimum distance for removing the converter and exchanging sensors is provided (see Specification Sheet TRIO-WIRL D184S035U02).
- mechanical vibrations are to be eliminated, using supports if required.
- **the inside diameters of the flowmeter primary and the pipeline are the same** (see Specification Sheet D184S035U02).
- pressure fluctuations at zero flowrate in long pipelines should be eliminated by installing intermediate gate valves.
- flow pulsations resulting from piston pump or compressor operation should be reduced by using appropriate dampeners.
- when metering liquids the flowmeter primary is always completely filled with fluid and cannot drain.
- for high fluid temperatures the flowmeter primary is installed so that the electronic assembly is mounted at the side or bottom of the flowmeter (Fig. 4).

2.2.2 Recommended In- and Outlet Sections

Due to the measurement principles of the Swirl Flowmeter it can be installed with very minimal in- and outlet straight section lengths. Fig. 3 shows the recommended lengths for the in- and outlet straight sections for various installation conditions. No in- and outlet straight sections are required when single or double elbows are installed up- or downstream from the flowmeter primary when the radius of the radius is greater than 1.8 x D. No additional in- and outlet straight sections are required downstream from reducers per DIN 28545 (α /2=8°).

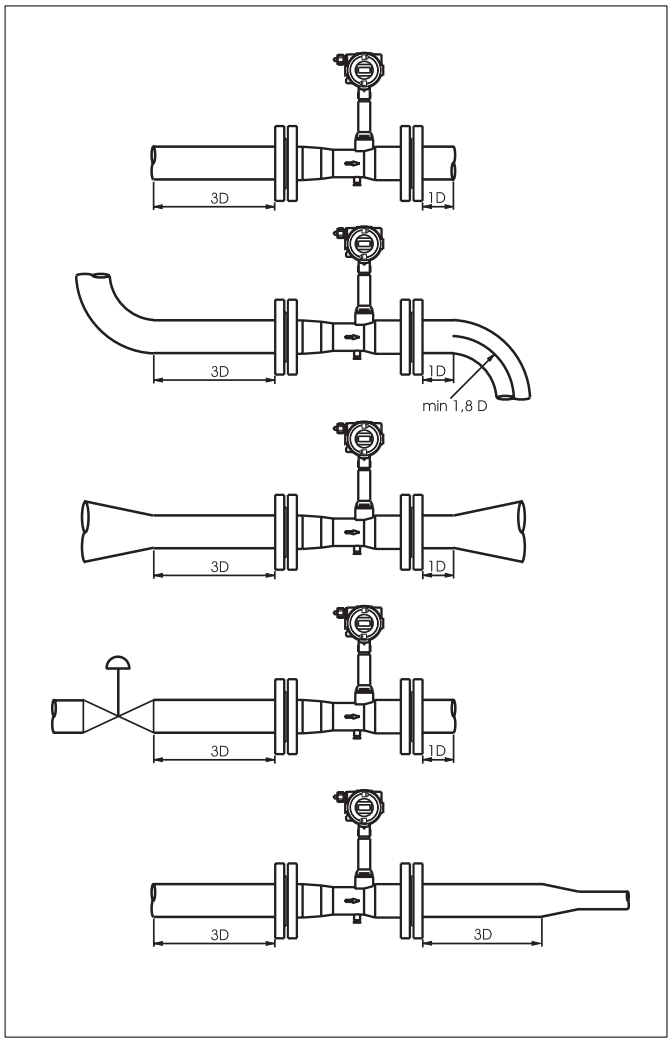


Fig. 3 Recommended In- and Outlet Straight Sections

2.2.3 Flowmeter Primary Installations for High Fluid Temperatures > 150 °C

Note:

The interrelationship between the fluid and ambient temperatures must be considered (Fig. 5).

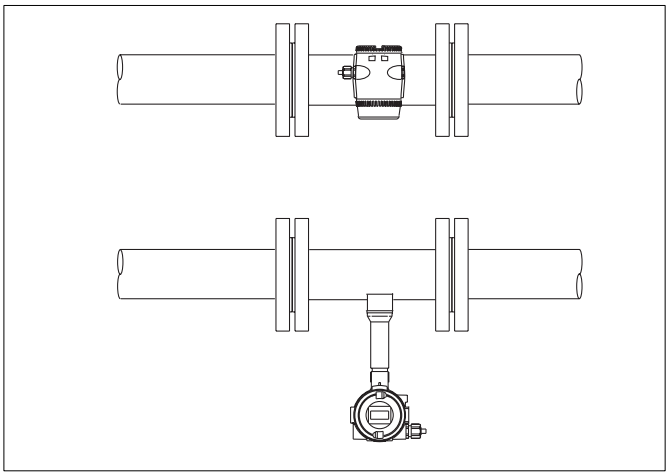


Fig. 4 Installations for High Fluid Temperatures >150 °C

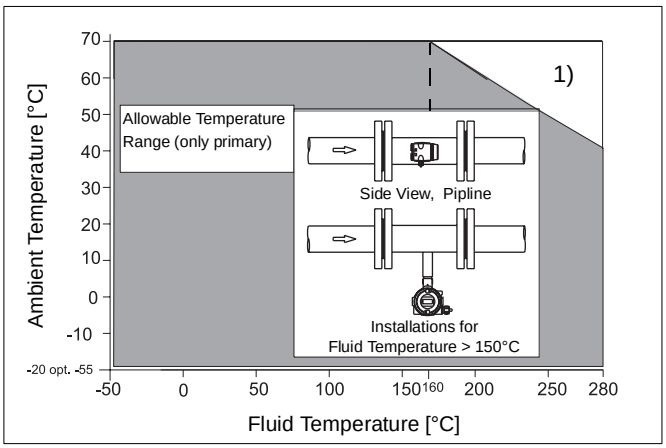


Fig. 5 Ambient – Fluid Temperature Relationship

1) Cables suitable for T=110°C can be used for the supply power terminals 31, 32 and the contact output terminals 41, 42 without any reduction in the temperature range specifications. Cables suitable only for temperatures T=80°C reduce the temperature range of the flowmeter as shown in Fig. 5.

2.2.4 Insulating the SFM

The flowmeter primary can be insulated to a max. thickness of 100 mm (see Fig. 6).

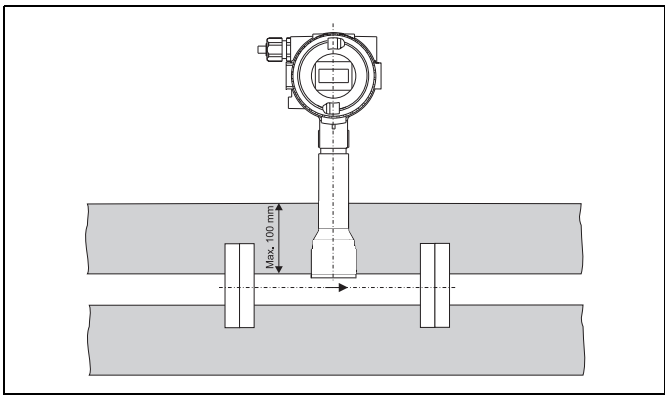


Fig. 6 Pipeline Insulation

2.2.5 Control Valve Installation

Control valves should be installed downstream from the flowmeter (see Fig. 7)

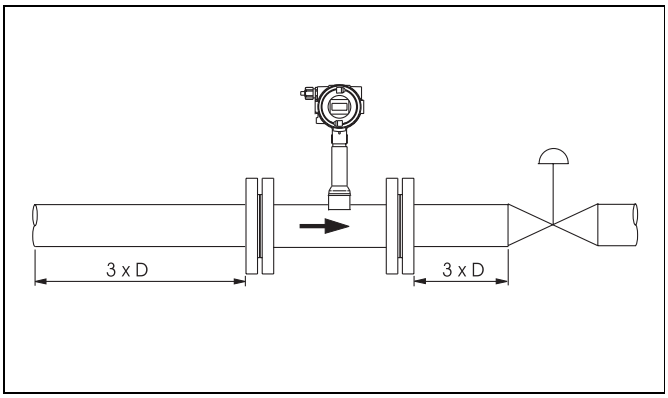


Fig. 7 Control Valve Installation

2.3 Temperature Measurement

An option is available for the SFM for direct Pt100 temperature measurements. These temperature measurements can be used to monitor the fluid temperature or for the measurement of saturated steam in mass units.
For additional applications see Section III.

II. Vortex Flowmeter Primary TRIO-WIRL V

3. Functionality

The flowrate of gases, steam and liquids can be metered the the Vortex Flowmeter (VFM) over a wide flow range independent of the properties of the fluid being metered.

Principle of Operation
The operation of the Vortex Flowmeter (VFM) is based on the Karman Vortex Street principle. Vortices are formed alternately on both of its sides as a fluid flows around the shedder body. The flow causes these vortices to be shed forming a vortex street (Karman Vortex Street)
(Fig. 8).

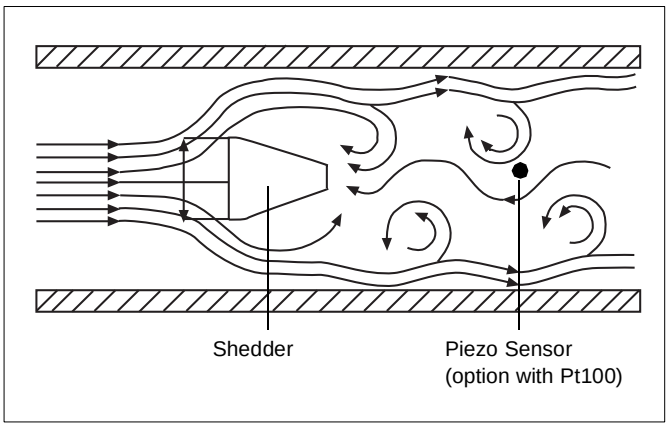


Fig. 8 Karman Vortex Street

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

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

St, the Strouhal Number, a dimensionless number, defines the quality of the vortex flowrate measurements.

By appropriate design of the shedder body, **St** is constant over a wide Reynolds Number range (Fig. 9).

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

ν = kinematic viscosity
v = flow velocity
D = inside diameter of the meter tube

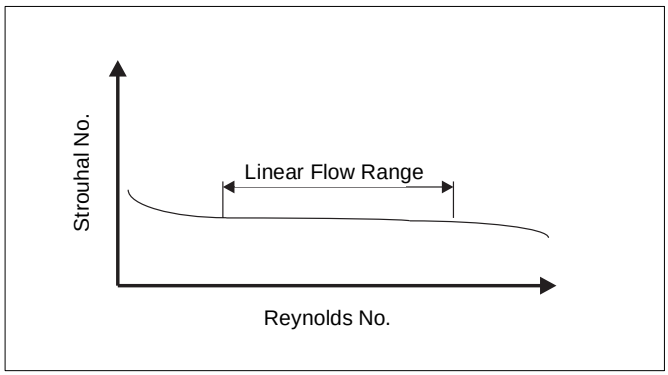


Fig. 9 Strouhal No. / Reynolds No. Relationship

As a result, the vortex shedding frequency to be evaluated, is a function only of the flow velocity and is independent of the fluid density and viscosity.

The local pressure changes resulting from the vortex shedding are detected by a Piezo sensor and converted into electrical impulses corresponding to the vortex shedding frequency. The flowrate proportional frequency signal generated in the flowmeter primary is processed in the converter into scaled frequency and current (4-20 mA) output signals.

4. Assembly and Installation

4.1 Inspection

Prior to installing the VFM check for mechanical damage to the flowmeter due to possible mishandling during shipment. All claims for damage are to be made promptly to the shipper.

4.2 Installation of the Flowmeter Meter Primary in the Pipeline

4.2.1 Installation Requirements

The VFM can be installed at any arbitrary location in the pipeline. Care should be exercised to assure that

- the ambient requirements are not exceeded (see Specification Sheet TRIO-WIRL D184S035U02).
- the recommended in- and outlet straight sections are provided (Fig. 8).
- the flow direction corresponds to the direction indicated by the arrow on the flowmeter primary.
- the required minimum distance for removing the converter and exchanging sensors is provided (see Specification Sheet TRIO-WIRL D184S035U02).
- mechanical vibrations are to be eliminated, using supports if required.
- the inside diameters of the flowmeter primary and the pipeline are the same (see Specification Sheet D184S035U02).
- pressure fluctuations at zero flowrate in long pipelines should be eliminated by installing intermediate gate valves.
- flow pulsations resulting from piston pump or compressor operation should be reduced by using appropriate dampeners.
- when metering liquids the flowmeter primary is always completely filled with fluid and cannot drain.
- for high fluid temperatures the flowmeter primary should be installed so that the electronic assembly is mounted at the side or bottom of the flowmeter (Fig. 11).

4.2.2 Recommended In- and Outlet Sections

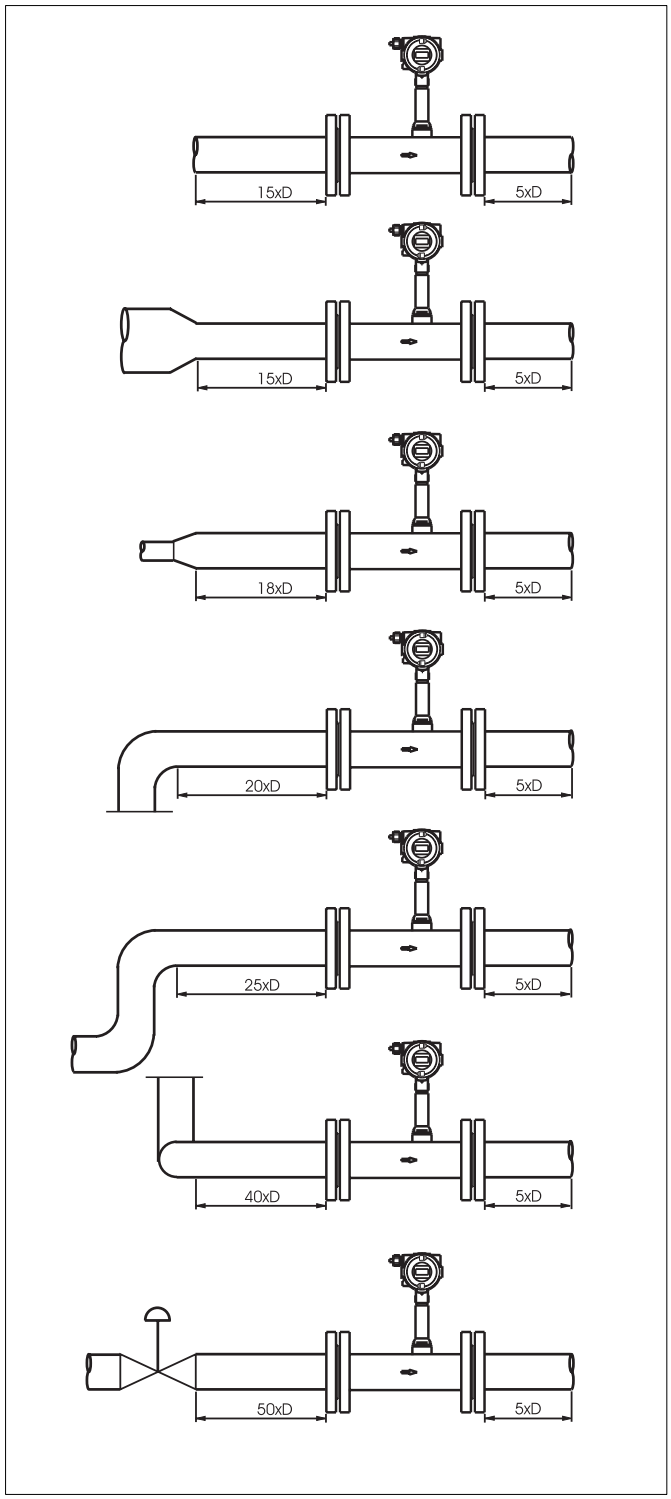


Fig. 10 Recommended In- and Outlet Straight Sections

4.2.3 Flowmeter Primary Installation for High Fluid Temperatures > 150 °C

Note:

The interrelationship between the fluid and ambient temperatures must be considered (Fig. 12).

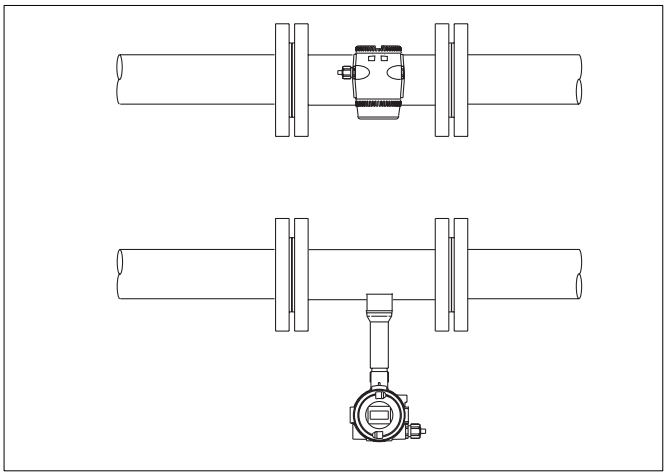


Fig. 11 Installations for High Fluid Temperatures >150 °

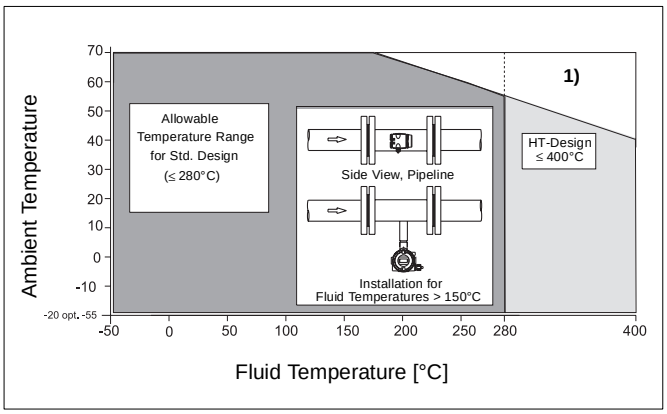


Fig. 12 Ambient – Fluid Temperature Relationship

[1)] Cables suitable for T=110°C can be used for the supply power terminals 31, 32 and the contact output 41, 42 without any reduction in the temperature range specifications. Cables suitable only for temperatures T=80°C reduce the temperature range of the flowmeter as shown in Fig. 12.

4.2.4 Insulating the VFM

The flowmeter primary can be insulated to a max. thickness of 100 mm (Fig. 13).

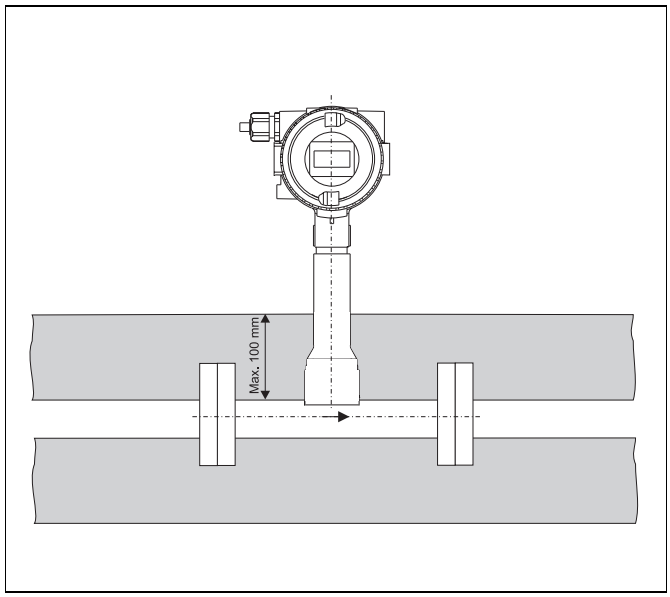


Fig. 13 Pipeline Insulation

4.2.5 Control Valve Installation

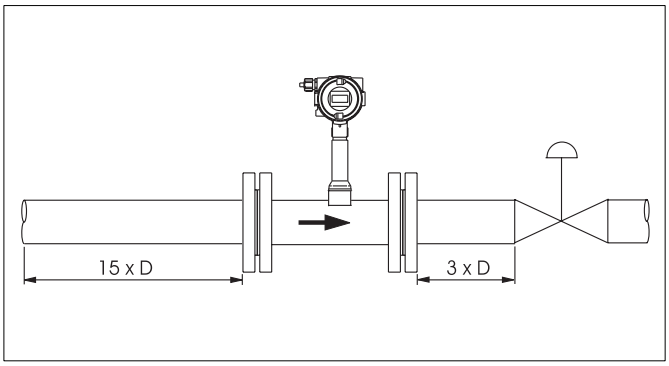


Fig. 14 Control Valve Installation

4.2.6 Centering the Wafer Design

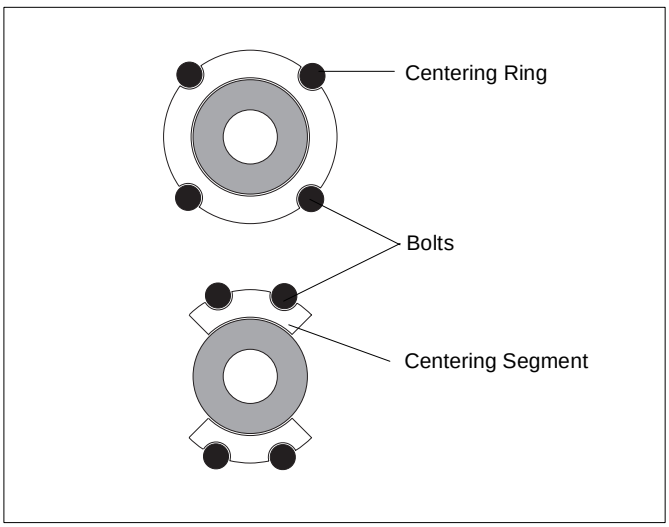


Fig. 15 Wafer Design Centering with Ring or Segment

The outside diameter of the flowmeter primary and the bolts are utilized to center the Wafer Design flowmeters in the pipeline. Dependent on the pressure rating of the flowmeter primary, sleeves to be placed over the bolts or centering rings are included with the shipment.

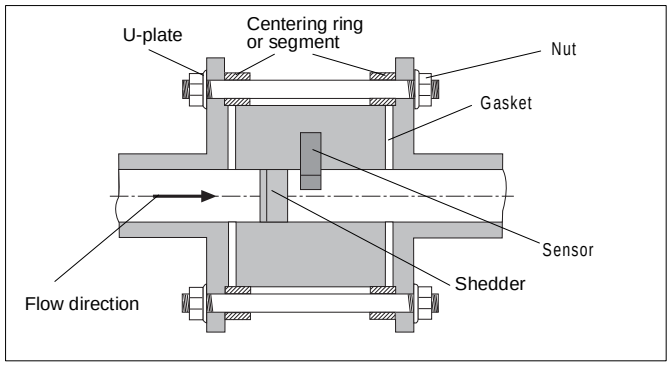


Fig. 16 Assembly of wafer design

4.3 Temperature Measurement

An option is available for the VFM for direct Pt100 temperature measurements. These temperature measurements can be used to monitor the fluid temperature or for the measurement of saturated steam in mass units.

III. Converter TRIO-WIRL

5. Electrical Interconnections

The flow metering system TRIO-WIRL is designed as a 2-wire instrument, i.e. the supply power and the current output signal (4-20 mA) both use the same pair of connection leads.

Any one of the following functions can be assigned to the separate contact output:: Pulse output, min. or max. alarm (temperature or flowrate) or system alarm.

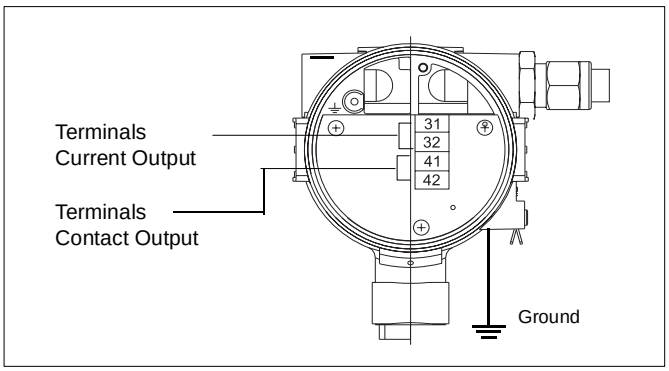


Fig. 17 Connection Box TRIO-WIRL

5.1 Converter Positioning

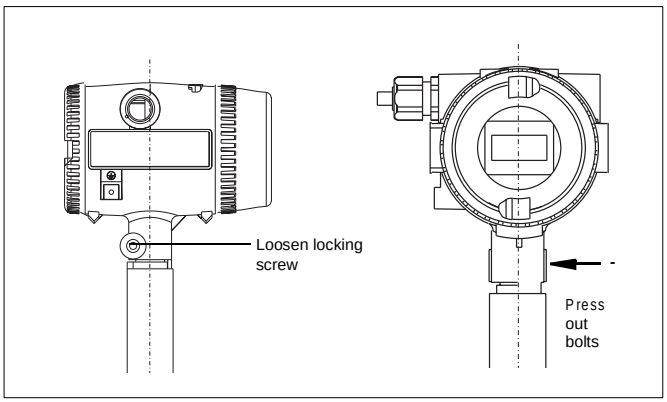


Fig. 18 Rotating the Converter Housing

It is possible during the installation to position the converter housing for optimal readability. A simple mechanical block prevents the housing from being rotated more than 330°. This protects the cable which is connected to the flowmeter primary.

1. Loosen the locking screw on the converter housing with a 4 mm hex wrench.
2. Press out the bolt.
3. Rotate the converter housing in the desired direction.
4. Reinsert the bolt.
5. Tighten the locking screw.

5.2 Supply Power Interconnection Examples

a) Supply Power from a Central Power Supply

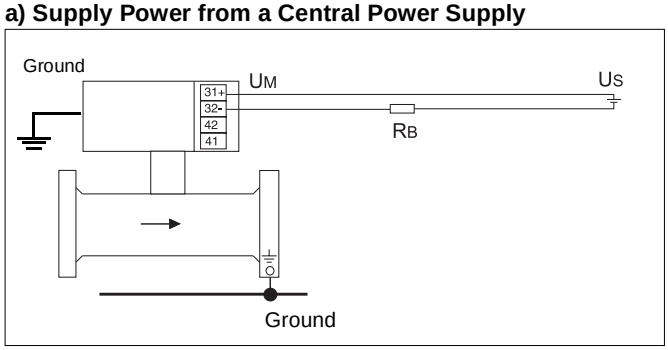


Fig. 19 Central Power Supply

b) Voltage Supply from Transmitter Power Supply

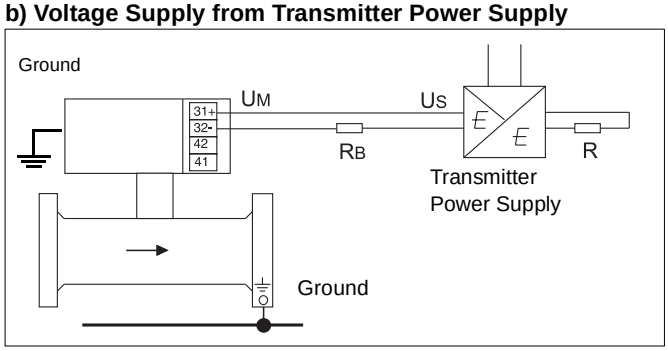


Fig. 20 Transmitter Power Supply

U_M = Supply voltage TRIO-WIRL = min. 14 V DC
U_S = Supply voltage, 14 - 46 V DC
R_B = Max. allow. load for Transmitter Power Supply (e.g. indicator, recorder, cable resistor, etc.)
R = Max. allow. load for the output circuit is determined by the Transmitter Power Supply (e.g. indicator, recorder, etc.)

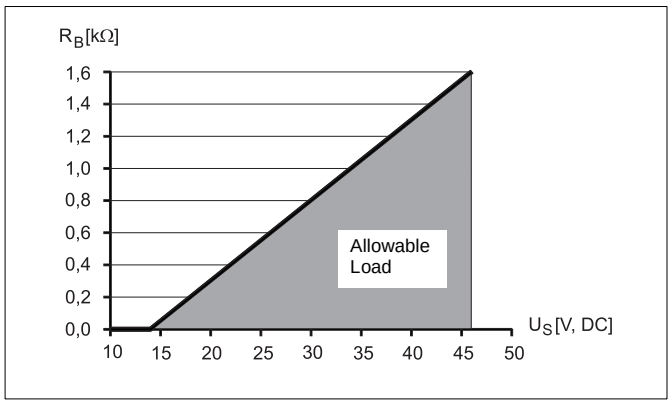


Fig. 21 Load Diagram

5.3 Contact Output Interconnection Examples

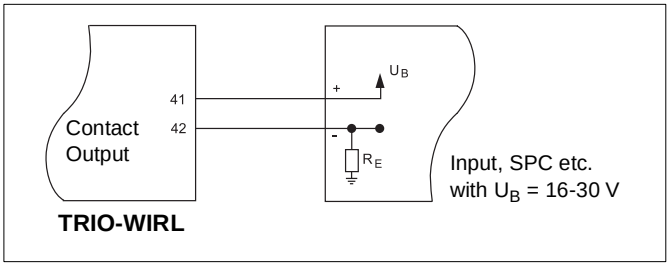


Fig. 22 Contact Output Interconnection Example

The value of the resistance R_E is a function of the supply power U_B and the selected signal current I_B.

$$R_E = \frac{U_B}{I_B}$$

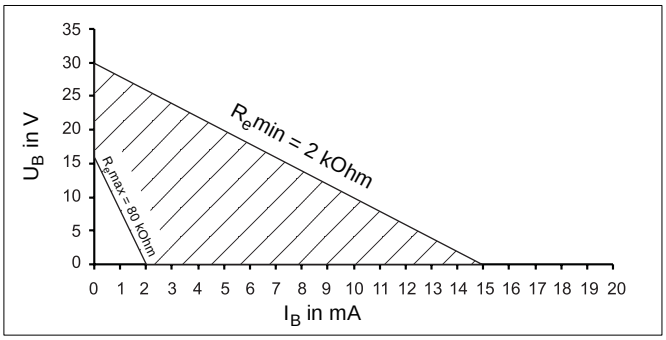


Fig. 23 Relationship R_E at the Contact Output as a Function of the Voltage and Current

6. Communication, HART®-Protocol

The HART-Protocol provides for digital communication between a process control system/PC, handheld terminal and the TRIO-WIRL. All parameters, such as meter location specific data, can be transmitted from the converter to the process control system or PC. In the reverse direction it is possible to reconfigure the converter.

The digital communication utilizes an ac signal superimposed on the current output (4-20 mA) which does not affect any other instruments connected to the output.

Transmission Mode

FSK-Modulation on the 4-20 mA current output per Bell 202 Standard. Max. signal amplitude 1.2 mA_{PP}.
Logic 1: 1200 Hz
Logic 0: 2200 Hz
The WINDOWS software program SMART VISION ® is used for the HART-Communication. Detailed information will be provided upon request.

Load, Current Output

Min. 250 Ω, max. 750 Ω
max. cable length
1500 m AWG 24 twisted and shielded

Baudrate

1200 Baud

Current Output During an Alarm Condition

High = 21-26 mA (programmable)
For operation using the HART-Protocol see the separate Instruction Bulletin.

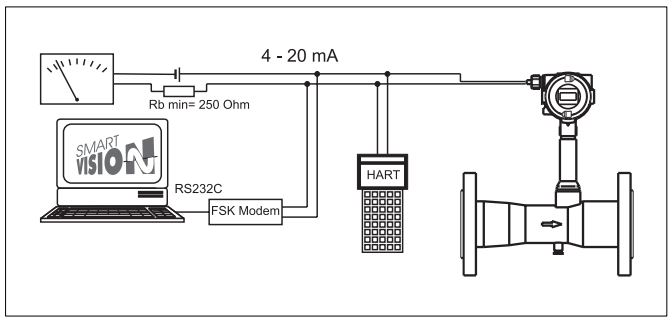


Fig. 24 HART-Communication

7. TRIO-WIRL VR/SR

The TRIO WIRL VR/SR (Fig. 27) is based on the VT/ST technology and includes all the options available in the VT/ST models. The converter is mounted remotely from the flowmeter primary when it is installed in a location difficult to access. This design also offers advantages when the ambient conditions at the flowmeter primary are extreme. The maximum distance between the converter and the flowmeter primary is 10 m. A special cable is utilized to interconnect the flowmeter primary and the converter (permanently attached to the converter)

.

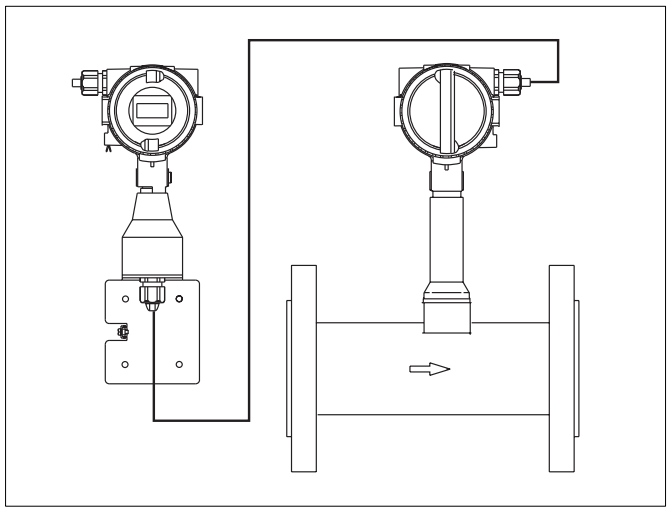


Fig. 25 TRIO-WIRL VR/SR

After the installation has been completed, the cable can be cut to the length required to reach he flowmeter primary. Because the signals between the flowmeter primary and converter are not amplified all connections must be made with care and the leads positioned in the connection box so that they are not affected by vibrations.

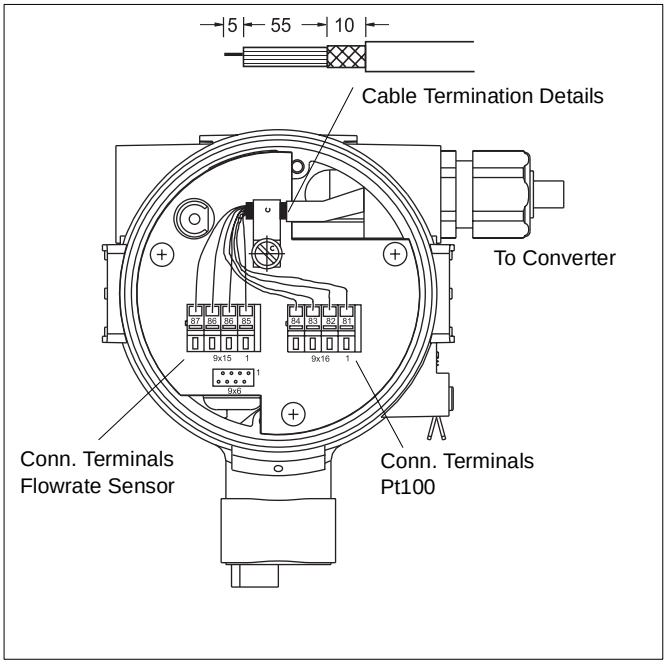


Fig. 26 Connection Box TRIO-WIRL VR/SR Flowmeter Primary

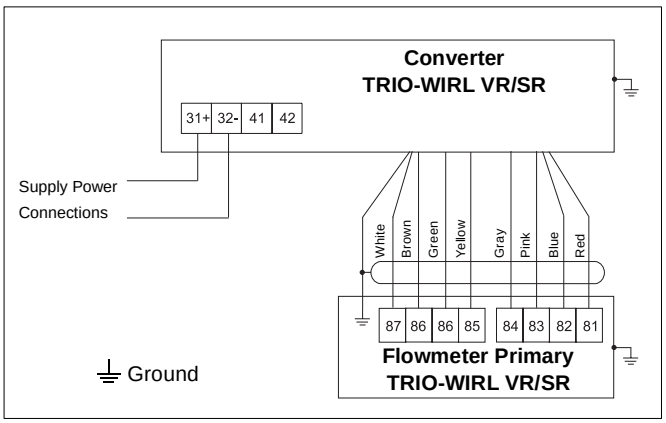
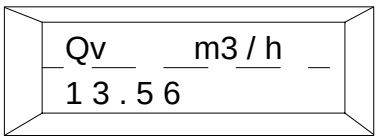


Fig. 27 Interconnections between Converter and Flowmeter Primary

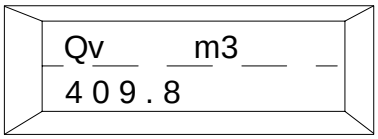
8. Date Entry/Operation and Configuration

8.1 LC-Display

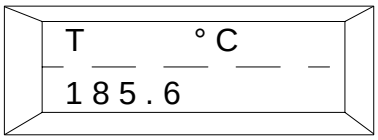
After the power is turned on the instrument automatically executes a number of self test routines. After they have been concluded the Standard–Process–Display (process information) appears.
The values which are to be displayed can be user configured



Actual flowrate in direct reading engineering units



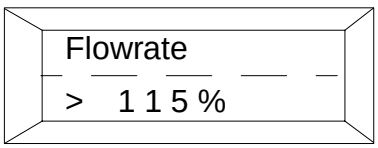
Totalized actual flow



Fluid temperature

in the Multiplex-Mode it is possible to display additional information. The display alternates every 10 s.

An error message is displayed during an error condition:



This message is displayed alternately in clear text and with its error code number. The clear text message is displayed only for the error with the highest priority while all the active errors are indicated by their error code numbers.

No.	Error	Priority
0	Steam calculations	0
1	-	
2	Front end	0
3	Flowrate > 115 %	2
4	Temperature	0
5	Data base	0
6	Totalizer defective	1
7	Qv > 115 % Rangemax	2

Current output is always set to 22.4 mA during an error condition.

Warning:
For error codes 3 and 7 the output current is always set to 22.4 mA. Error 7 must be reset by pressing a key or interrupting the power to the converter.

8.2 Data Entry

The data can be entered using either the 3 buttons, DATA, STEP and C/CE on the converter or with the Magnetic Stick when the housing cover is closed.

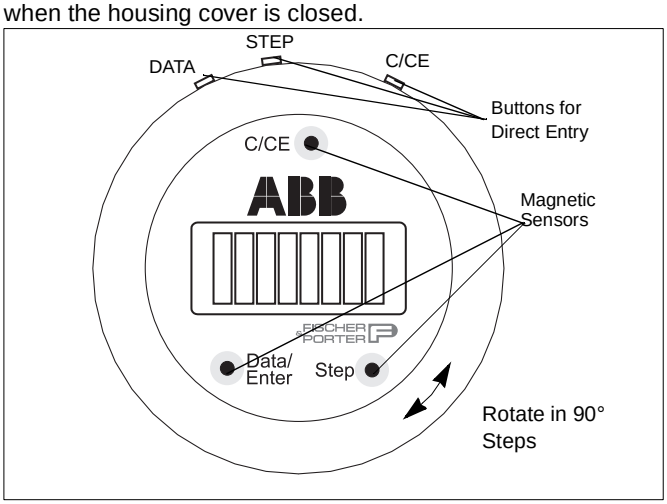


Fig. 28 Converter Keypad and Display

The converter remains on-line during data entry, i.e., the current and pulse outputs continue to indicate the actual instantaneous flowrate values. The individual buttons are described below:

C/CE — The C/CE-key is used to toggle back and forth between the operating mode and the menu display.

STEP ↑ — The STEP-key is one of two arrow keys. **STEP is used to scroll forward through the menu.** All desired parameters can be accessed.

DATA ↓ — The DATA-key is one of two arrow keys. **DATA is used to scroll backward through the menu.** All desired parameters can be accessed.

ENTER — The ENTER function requires that both arrow keys, STEP and DATA, be pressed simultaneously. ENTER is utilized to access the values in the parameter to be changed and to accept the new values or selections.
The ENTER function is only active for approx. 10 Sec. If no entries are made during this 10 Sec. time interval the old value is redisplayed on the converter. If an additional 10 seconds elapses without any action, the standard process display reappears.

ENTER Function for Magnetic Stick Operation

The ENTER function is initiated when the DATA/ENTER sensor is activated for more than 3 seconds. The display blinks to indicate that the function is active.

8.2.1 Data Entry for Converters without a Display

In this design version the converter is operated and configured from a separately ordered Operator Unit 55BE1000 (for ordering information see Specification Sheet TRIO-WIRL) or by using the HART-Protocol.

After the converter cover has been removed, the cable included with the Operator Unit can be plugged into its socket. The keypad layout is similar to that described in Section 8.2 .

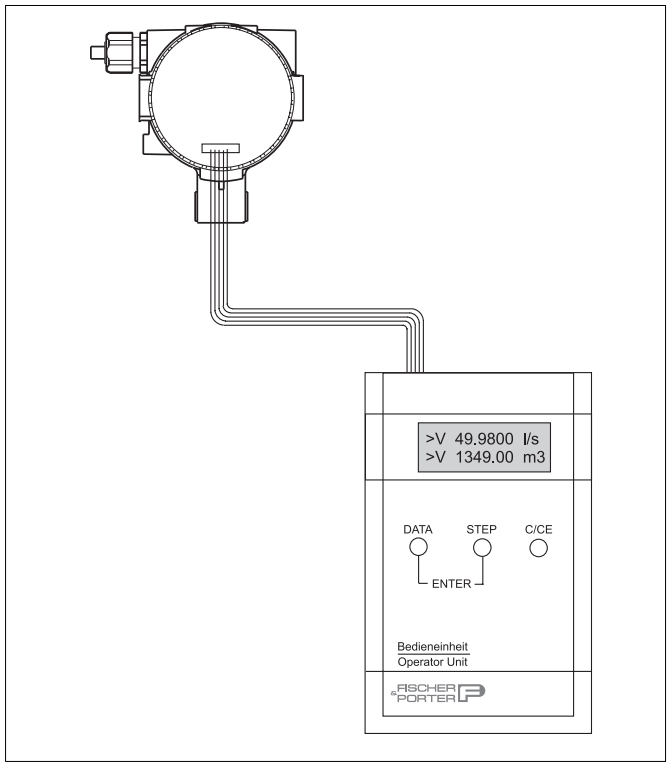


Fig. 29 Data Entry for Converters without a Display

Warning:
When the converter housing is opened the EMC-Protection is voided.

Note:
During data entry the values entered are checked for plausibility and if necessary, rejected with an appropriate message in the display.

8.3 Menu Structure TRIO-WIRL

The menu structure is subdivided in 3 user levels:

1st Level: Standard Menu
The standard menu provides a quick means for configuring the instrument. All user specific menu entries required for operating the instrument can be set in this menu.

2nd Level: Specialist
In contrast to the standard menu the **complete** set of user specific parameters are accessible in this menu.

3rd Level: Service
The Service-Menu is only accessible to ABB Automation Products Customer Service personnel.

8.3.1 Configuring Gases, Steam or Liquids

The selections for the available operating modes, the required parameters and the additional menus displayed are listed in the following table.

Operating Mode[1)]	Fluid	Measurement Method	Equations	Correction Parameters	Additional Menus Displayed
Liquid Qv	Liquid	Volume flowrate	—	—	—
Liquid[2)] Qm(D,T)	Liquid	Mass flowrate	$Qm = Qv \cdot \rho(T)$ $\rho(T) = \rho_0 \cdot (1 + (T_{oper} - T_0) \cdot \beta 2)$	Ref. density ρ_0; Ref. temp. T_0 Operating temp. T_{oper} Density Expansion Coefficient ß2	Units density Operating density Operating temperature Units Qm
Liquid[2)] Qm (V, T)	Liquid	Mass flowrate	$Qm = Qn \cdot \rho_0$ $Qn = \frac{Qv}{(1 + (T_{oper} - T_0) \cdot \beta 1)}$	Volume Expansion Coefficient [%/K] ß1 Ref. temp. T_0 Operating temp. T_{oper} Ref. density ρ_0	Units Density Operating density Operating temperature Vol._Exp_coef Units Qm (Temperature is measured)
Gas Qv	Gas	Volume flowrate at operating conditions	—	—	—
Gas Normal[2)] Qn (pT)	Gas	Normal flowrate 1.013 bar / 0°C 0 - 1.013 bar / 20°C	$Qn = Qv \cdot \frac{Pbtr}{1,013bar} \cdot \frac{273K}{273K + T_{oper}}$	Operating press. P_{oper} abs Operating temp. T_{oper}	Operating pressure Units Pressure
Gas Std[2)] Qs (pT)	Gas	Standard flowrate 14. 7psia / 60°F	$Qs = Qv \cdot \frac{Pbtr}{14,7psia} \cdot \frac{60°F}{60°F + T_{oper}}$	Operating press. P_{oper} abs Operating temp. T_{oper}	—
Gas Normal Qn (Kmpf)	Gas	Normal flowrate 1.013 bar / 0°C	$Qn = Qv \cdot Normal\ factor$ $Normal\ factor = \frac{\rho_{oper}}{\rho_0}$	Normal factor as a constant (Compressibility Factor)	Normal factor
Gas Mass[2)] Qm (pT)	Gas	Mass flowrate Normal conditions 1.013 bar / 0°C or 1.013 bar /20°C	$Qm = \rho_0 \cdot Qn$ $Qn = Qv \cdot \frac{Pbtr}{1,013bar} \cdot \frac{273K}{273K + T_{oper}}$	Operating press. P_{oper} abs Normal density ρ_0 Operating temp. T_{oper}	Units Density Normal density Normal conditions Operating temperature Press_ Poper_abs Units Qm (Temperature is measured)
Gas Mass Qm (D)	Gas	Mass flowrate	$Qm = Qv \cdot \rho_{oper}$	Constant operating density ρ_{oper}	Units Density Operating density Units Qm
Sat. Steam[2)] Qm	Saturated steam	Mass flowrate	$Qm = Qv \cdot \rho_{oper}(T_{oper})$ Corrections using Saturated Steam Tables	Operating temp. T_{oper}	Units Qm
Sat. Steam Qv	Saturated steam	Volume flowrate at operating conditions	—	—	—

Qm = Mass flowrate [kg/h]
Qv = Actual volume flowrate [m^3/h
Qn = Normal flowrate [m^3/h]
P_{oper} = Operating pressure
ß1 = Volume Expansion Coefficient
ß2 = Density Expansion Coefficient
ρ_0 = Normal density
ρ_{oper} = Operating density

[1)] The possible measurement methods are a function of the type of flowmeter calibration.

[2)] These measurement methods can only be selected when a temperature measurement is integrated in the flowmeter.

8.3.2 Data Entry in „Condensed Form“

Note:
The program protection must be turned off before data can be entered.

Action	Use Keys=	Display Information	
Turn off Program Protection	-	Qv % / 10.5	Standard-Display
1) Enter programming mode	C/CE	An arbitrary parameter is displayed	
2) Find parameter “Prog. Protection”	STEP or DATA	*Prog. / Protect.*	
3) Access „Prog. Protection“	ENTER	on	
4) Turn off Program Protection	ENTER	off	

Direct Numeric Entry
Example: Set Qmax value

Action	Keys =	Display Information
1) Find Parameter “Qmax”	STEP or DATA	Qmax
2) Check “Qmax” setting	ENTER	5.000 / l/s
3) Change Parameter “Qmax”	ENTER	0 / l/s
4) Enter the desired number series		4 . 5 2 5 / l/s
	4xDATA	
	STEP	
	10xDATA (decimal point)	
	STEP	
	5xDATA	
	STEP	
	2xDATA	
	STEP	
	5xDATA	
4) *The C/CE key clears the entry		
5) Accept new Qmax value	ENTER	4.525 / l/s

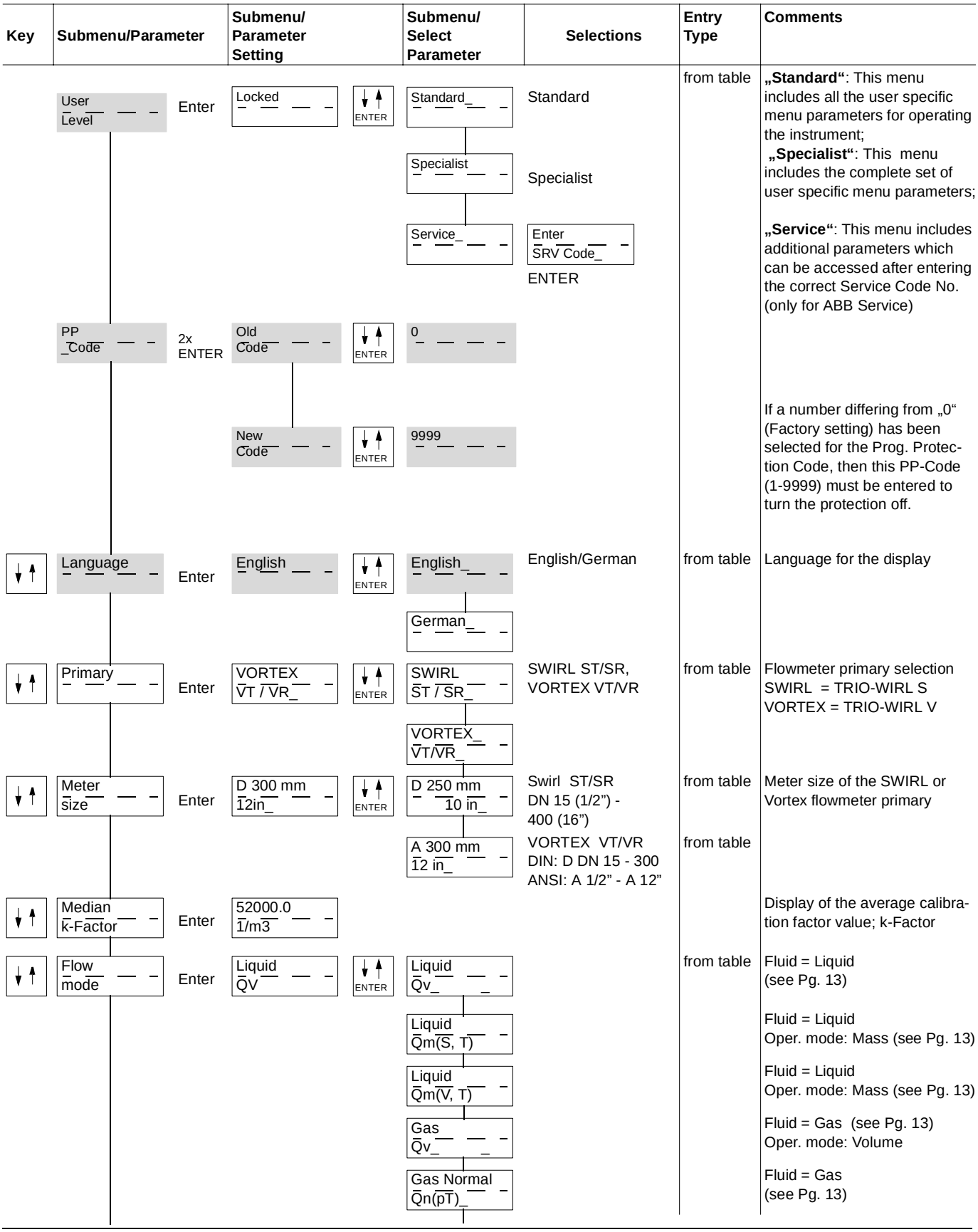
Entry from a Table
Example: Set meter size

Action	Keys =	Display Information
1) Select parameter „Meter size“	STEP or DATA	Meter / size
2) Check „Meter Size“	ENTER	15 mm / 1/2 in
3) Change parameter „Meter Size“	ENTER	15 mm / 1/2 in
4) Select „Meter Size“ from table.	STEP or DATA	50 mm / 2 in
5) Accept new Meter Size	ENTER	Meter / Size

Exit from Qmax or Meter Size Find Program Protection	STEP or DATA	*Prog. / Protection*	
Access parameter setting	ENTER	off	
Turn program protection on again	ENTER	on	
Return to Standard Display/ Process Information	C/CE	Qv % / 10.5	Standard Display

8.4 Parameter Overview and Data Entry

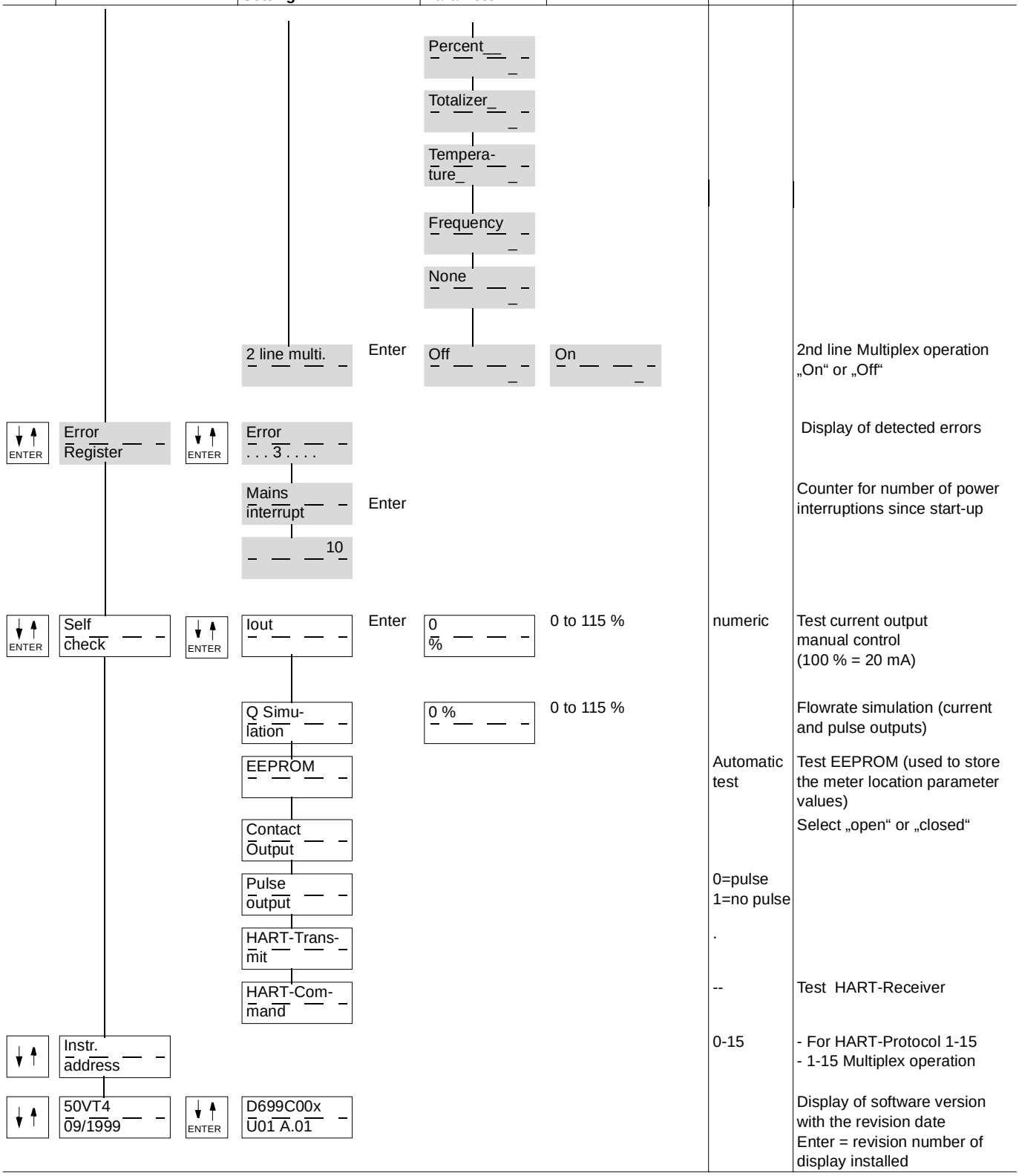
The menus shaded in gray are included in the **Standard Level.**



Key	Submenu/Parameter		Submenu/ Parameter Setting		Submenu/ Select Parameter	Selections	Entry Type	Comments
					Gas Std Qs(pT)			Standard flowrate: Gas Explanation see Page 13
					Gas Normal Qn(KmpF)			Normal flowrate: Gas Explanation see Page 13
					Gas Mass Qm(pT)			Mass flowrate: Gas Explanation see Page 13
					Gas Mass Qm(D)			Mass flowrate: Gas Explanation see Page 13
					S- Steam Qm			Mass flowrate: Sat. steam Explanation see Page 13
					S- Steam Qv			Actual flowrate: Sat. steam
↓↑	Unit density	Enter	kg/l_	ENTER	kg/m3_	g/l, g/cm³, g/l, kg/l, kg/l, kg/m³, lb/ft³, lb/ugl, g/ml_,	from table	**Menu displayed for selection** Liquid Qm (S,T), Liquid Qm (V,T), Gas Mass Qm (pT), Gas Mass Qm(D)
↓↑	Referenc density	Enter	1.000 kg/l_	ENTER	0 kg/l_	0.001 - 1000.000	from table	**Menu displayed for selection** Liquid Qm (S,T), Liquid Qm (V,T), Gas Mass Qm(D)
↓↑	Normal density	Enter	0.001 kg/l kg/l_	ENTER	0 kg/l_	0.000 - 0.100	from table	**Menu displayed for selection** Gas Mass Qm (pT)
↓↑	Compres-sibility	Enter	1.000	ENTER	0	0.001 - 1000.000	numeric	**Menu displayed for selection** Gas Normal Qn(Kmpf) Normal factor = $\rho_{oper} : \rho_0$ see Table on Page 13
↓↑	Normal condi.	Enter	1.0133 bara 0 °C	ENTER	1.0133 bara 20 °C			**Menu displayed for selection** Gas Mass Qm(pT) Gas Norm Qn (pT)

Key	Submenu/Parameter		Submenu/ Parameter Setting		Submenu/ Select Parameter	Selections	Entry Type	Comments
↓↑	Unit Temp	Enter	°C	↓↑ ENTER	F	°C, F,K	from table	
↓↑	Referenc Temp.	Enter	20.0 °C			-200.0 - 500.0		**Menu displayed for selection** 2, 3, 7 see Legends Pg. 19
↓↑	Pressure Popr abs	Enter	1.0 bar					**Menu displayed for selection** Gas Mass Qm(pT)
↓↑	Vol.ext-ension	Enter	1.00 %./K					**Menu displayed for selection** Liquid Qm(V,T)
↓↑	Unit Qvol	Enter	m3/h	↓↑ ENTER	m3/d	Qvol and Qm function of „Operating Mode“! l/s, l/m, l/h, m^3/s, m^3/m, m^3/h, m^3/d ft^3/s, ft^3/m, ft^3/h, ft^3/d, usgps, usgpm, usgph, usmgd, igps, igpm, igph, igpd, bbl/s, bbl/s, bbl/h, bbl/d		Selection of volume units for Qv, Qn and Qs
↓↑	Unit Qm	Enter	kg/s	↓↑ ENTER	kg/h	kg/s, g/h, kg/s, kg/m, kg/h, kg/d, t/m, t/h, t/d, lb/s, lb/m, lb/h, lb/d	from table	**Menu displayed for selection** 2, 3, 7, 8, 9 see Legends Pg. 19
↓↑	QmaxDN operating	Enter	84.000 m3/h	↓↑ ENTER				Display of max. flowrate for the selected meter size
↓↑	Qmax	Enter	84.000 m3/h	↓↑ ENTER	0 m3/d	0.15-1.15 x $Range_{max}$ numeric Operating mode	numeric	$Range_{max}$: End value for the selected flowrate mode (=20 mA)
↓↑	Qmin operating	Enter	1.000 m3/h	↓↑ ENTER	0 m3/h	0-10 % $Range_{max}$ volume	numeric	Low flow cutoff value - cannot be changed!
↓↑	Totalizer	↓↑ ENTER	Qv m3 l0.00	Enter				Display of totalizer value based on operating mode Qv, Qn, Qm
			Over-flow		10			Display of number of overflows; max. 65.535 1 overflow = 10,000,000
			Units Totalizer	Enter	m3	m^3, ft^3, usgal, igal, igl, bbl, l, g, kg, t, lb	from table	Selection of the totalizer units as a function of the selected operating mode Volume or mass flowrate
				↓↑ ENTER	ft3			
			Totalizer reset	Enter	Reset -> Enter			
↓↑	Damping	Enter	50.0 s	↓↑ ENTER	0 s	0.2 - 100 s	from table	Current output damping Response time 1 τ (=63 %) for step flowrate changes
↓↑	Hardware Config.	Enter	I/HART	↓↑ ENTER	I/HART		from table	**Contact Output Configuration:** Current, HART-Protocol.
					I/HART/ Pulse_Bin			Current, HART-Protocol Contact output: Pulse
					I/HART/ Q_Alarm			Current, HART-Protocol Contact output: flowrate alarm closes at alarm

Key	Submenu/Parameter	Submenu/ Parameter Setting	Submenu/ Select Parameter	Selections	Entry Type	Comments
			I/HART/ T_Alarm_			Current, HART-Protocol, Contact output: Temperature alarm closes at alarm
			I/HART/ S-Alarm_			Current, HART-Protocol, Contact output: System alarm closes at alarm
		Note: Min.and **Max. Q_Alarm** menus only displayed when I/HART/Q_Alarm is selected.				
↓↑	Min. Q_Alarm	Enter → 10.000 %	ENTER → 0 %	0 - 100 % of Qmax	numeric	Min-Alarm flowrate 0 % = turned off
↓↑	Max. Q_Alarm	Enter → 80.000 %	ENTER → 0 %	0 - 100 % of Qmax	numeric	Max-Alarm flowrate 100 % = turned off
		Note: Min.and **Max. T_Alarm** menus only displayed when I/HART/T_Alarm is selected.			numeric	
↓↑	Min. T_Alarm	Enter → 50 °C	ENTER → 0 °C	-60 °C to 410 °C	numeric	Min Alarm temperature -60 °C = turned off
↓↑	Max. T_Alarm	Enter → 180.000 °C	ENTER → 0 °C	-60 °C to 410 °C	numeric	Max Alarm temperature 410 °C = turned off
↓↑	Iout at alarm	Enter → 22.4 mA	ENTER → 0 mA	21-26 mA	numeric	Current output value for Alarm programmable
↓↑	Pulse factor	Enter → 100.000 1/m3	ENTER → 5 1/m3	0.001 - 1000 Pulses/unit	numeric	For internal and external flow totalizers
		Note: Pulse width menu only displayed when I/HART/Pulse_Bin is selected.				Selection of units for output
↓↑	Pulse width	Enter → 10 ms	ENTER → 0 ms	1 - 256 ms	numeric	Max. 50 % on/off. Warning is displayed if too high a value is entered.
↓↑	Display	Enter → Main Display	ENTER → Q oper.-mode			
			Qv Operate_ Percent_ Totalizer_ Tempera-ture_ Frequency_ None_	Qv operate Normal, standard Qm Mass Percent Totalizer Temperature Frequency	from table	Selections for the main display
	↓↑ Multipl. Display		ENTER → Q Oper. mode Qv Operate_		from table	Selection of the value to be multiplexed in the display



Legends for Liquids, Gases and Steam Calculations:

1) Liquid QV = Volume flowrate
2) Liquid Qm(S,T) = Mass flowrate
3) Liquid Qm(V,T) = Mass flowrate
4) Gas Qv = Actual flowrate
5) Gas Norm Qn(pT) = Normal flowrate
6) Gas Norm Qn(Kmpf) = Normal flowrate
7) Gas Mass Qm(pt) = Mass flowrate
8) Gas MassQm(D) = Mass flowrate
9) S-Steam Qm = Saturated steam mass flowrate
10) S-Steam Qv = Saturated steam volume flowrate

9. Configuring Converter at Start-Up

The measurement system has been configured by ABB Automation Products prior to shipment based on the information included with the Order. All the required values have been entered. Because the instruments can be installed universally, i.e., for liquids or gases, it is recommended that the following parameter settings be checked at start-up:

Software:

Parameter	Action
1. Meter size	Select Meter Size. The displayed value must be identical to the size listed on the Instr. Tag
2. Operating mode	
3. k-Factor	Select k-Factor. The displayed value must be identical to the value listed on the Instr. Tag.

4. Which flowrate units are to be used for the display indications and for the totalizer values?

Mass Units		Volume Units	
Parameter	**Action**	**Parameter**	**Action**
Operating mode Mass	select	Operating mode Volume, Normal Standard, Actual	select from table
Density units Qm	from table	Units Qv/Qn/Qs/ l/min	select from table
Operating density	enter	Normal factor (only for Qs, Qn)	enter value
Units Qm kg/s	from table		

5. Enter the desired flow range in the units selected above in the parameter **Qmax Operating Mode**.
   Entry range: 0.15 to 1.15 x $Range_{max}$ actual.
6. Check the low flow cutoff value in the parameter **Qmin Actual**
   Entry range: 0 to 0.1 x $Range_{max}$.
7. Select the units for the internal and external totalizers in the parameter **Units Totalizer.**
8. The response time of the converter can be set in the parameter **Damping**. Default setting is 3 sec.
9. Select submenu **Display** and select desired values, e.g.
   For main display select percent
   For multiplex display select totalizer values
   The measurement system is ready for operation.

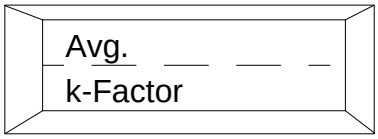
10. Additional Configuration Information

10.1 Meter Size

This parameter is used to define the flowmeter size of the installed flowmeter since the same converter can be used for all flowmeter sizes.

The meter size is set at the factory for the flowmeter primary assigned to the converter (see Instrument Tag).

Calibration K-Factor



The average k-Factor value displayed must be identical to the value listed on the Instrument Tag.

Each flowmeter is calibrated on a test stand at 5 flowrate values. The calibration factors are entered in the converter and recorded on a calibration report. An average calibration factor value is calculated and listed on the Instrument Tag.

Typical calibration factor values and the signal frequencies for liquids and gases are listed in the following table. These values are approximate guidelines only.:

Vortex Flowmeter TRIO-WIRL V

Meter Size Inch	DN	Typ. k-Factor max [1/m³]	Liquid f_{max} at Q_{vmax} [Hz]	Gas f_{max} at Q_{vmax} [Hz]
1/2	15	22500	400	1620
1	25	48000	240	1990
1-1/2	40	14500	190	1520
2	50	7500	150	1030
3	80	2100	102	700
4	100	960	72	500
6	150	290	50	360
8	200	132	32	240
10	250	66	14	120
12	300	39	10	70

Swirl Flowmeter TRIO-WIRL S

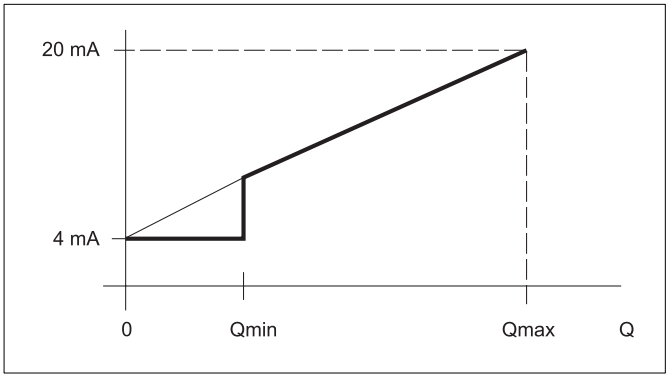
Meter Size Inch	DN	Typ. k-Factor max [1/m³]	Liquid f_{max} at Q_{vmax} [Hz]	Gas f_{max} at Q_{vmax} [Hz]
1/2	15	440000	185	1900
3/4	20	165000	100	1200
1	25	86000	135	1200
1-1/4	32	33000	107	1200
1-1/2	40	24000	110	1330
2	50	11100	90	1100
3	80	2900	78	690
4	100	1620	77	700
6	150	460	40	470
8	200	194	23	270
12	300	54	16	92
16	400	upon request	13	80

The converter calculates the actual flowrate using the following equations:

$$Q = \frac{f}{k}$$

Q= Actual flowrate at operating conditions [m^3/s]
f = Frequency [1/s]
k = Calibration k-Factor [$1/m^3$]

10.2 Current Output



The measurement value output characteristic for the current output is shown in the curve: Above the Qmin (operating mode) value the curve is a straight line whose value at 4 mA is Q = 0 and whose value at 20 mA is the value of Q_{max} (operating mode). The current output for flowrates less than the low flow cutoff value Q_{min} is set 4 mA equivalent to Q = 0.

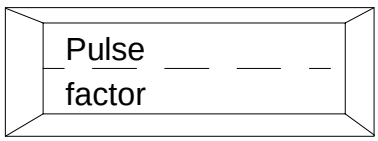
10.3 Hardware Configuration

The function assigned to the contact output (terminals 41, 42) is selected in this submenu. The menus „Pulse width“, „Min and Max Q_Alarm“ or „Min and Max T_Alarm“ are displayed based on the selection of the output function. „

Selections	Contact Output Function	Menus Displayed
I/HART	None	None
I/HART/Pulse_Bin	Pulse output	Pulse width
I/HART/Q_Alarm_	Flow alarm	Min. and Max. Q_Alarm
I/HART/T_Alarm_	Temperature alarm	Min. and Max. T_Alarm
I/HART/S_Alarm_	System alarm	None

10.4 Submenu Pulse Output

This menu is used to configure the scaled pulse output to the user requirements.

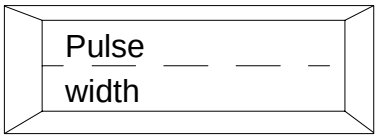


0.001 - 100

The pulse factor is the number of pulses per selected flow unit.

10.4.1 Submenu Pulse Width

! If the pulse output function is to be assigned to the contact output it is necessary that the parameter “I/HART/ Pulse_Bin“ be selected in the menu „Hardware Config“. Otherwise this menu is hidden.



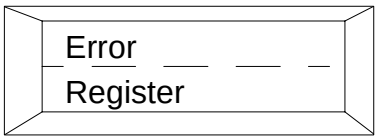
1 - 256 ms

The pulse width (length of the pulses) for the scaled pulse output can be set between 1 and 256 ms.

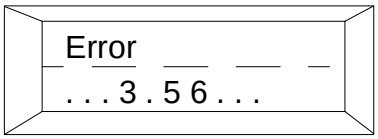
The program monitors the relationship of the pulse width to the period of the max. pulse frequency (at 115 % flowrate). If an on/off ratio ≥ 50 % results, a warning is displayed and the old value is retained.

10.5 Submenu Error Register

This menu contains the error register and the supply power interruption counter.



10.5.1 Error Register



Submenu Error Register
Display of the error register contents

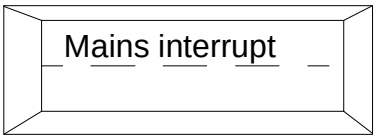
All errors detected are permanently stored in the error register, whether they occurred momentarily or for a long time period.

Every number in the error register display represents a specific error type
Display: ..... = OK or ... 3.56... = Error codes

The error register can be cleared by pressing the “ENTER“ key.

Error No.	Error	Priority
0	Steam calculations	0
1	-	-
2	Front End	0
3	Flowrate > 115 %	2
4	Temperature	0
5	Data Base	0
6	Totalizer defective	1
7	Qv > 115 % Qmax	2

10.5.2 Mains Interrupt



The converter counts the number of times the supply power was turned off or interrupted. This number can be displayed in this parameter. The mains interrupt counter can be reset with the command “Reset Error”. This parameter is located in the Service level and requires entry of the Service Code number for access.

10.6 Normal Factor (see Section 8.3.1)

$$\frac{Q_N}{Q_V} = \frac{(1{,}013\,\text{bar} + p)}{1{,}013\,\text{bar}} \times \frac{273}{(273 + T)}$$

Since the mass flowrate at both conditions is equal the following equation is also applicable:

$$\frac{Q_N}{Q_V} = \frac{\rho_V}{\rho_N}$$

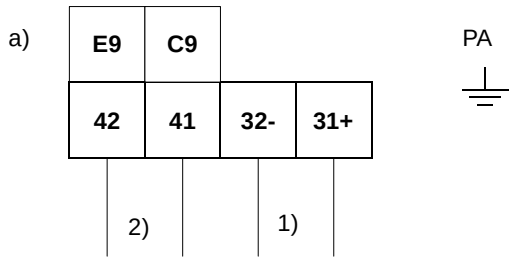
Q_N = Normal flowrate at normal conditions
Q_V = Actual flowrate at operating conditions
p = Pressure at operating conditions
T = Temperature at operating conditions [°C]
ρV = Density at operating conditions
ρN = Density at normal conditions

11. Specifications Ex-Design

EC-Type Examination Certificate TÜV 99 ATEX 1465

Markings:  II 2G EEx ib IIC T4

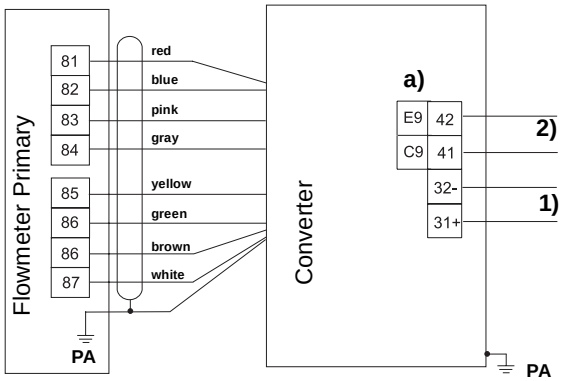
11.1 Interconnection Diagram VT41/ST41



1) Supply power, standard 14-28 V DC, terminals 31/32
2) Contact output, terminals 42/41 (optional)
a) Function E9/C9:
The scaled pulse output (passive) optocoupler, is configured as a NAMUR contact (per DIN 19234).
The internal resistance is approx. 1000 Ω, the resistance of the open contact > 10 k Ω.
Pulse width selectable between 1 ms and 256 ms but limited to max. 50 % of the period.
Max. frequency fmax = 100 Hz.

Fig. 30 Interconnection Diagram VT41 /ST41

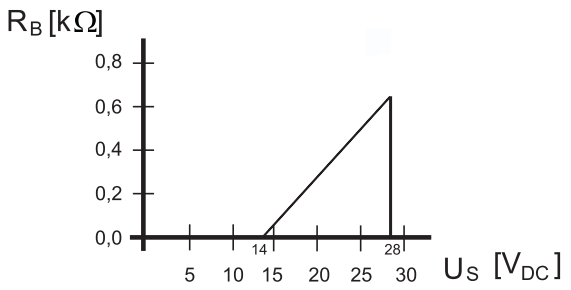
11.2 Interconnection Diagram VR/SR



1) Supply power, standard 14-28 V DC, terminals 31/32
2) Contact output, terminals 42/41
a) Function E9/C9:
The scaled pulse output (passive) optocoupler, is configured as a NAMUR contact (per DIN 19234).
The internal resistance is approx. 1000 Ω, the resistance of the open contact > 10 k Ω.
Pulse width selectable between 1 ms and 256 ms but limited to max. 50 % of the period.
Max. frequency fmax = 100 Hz.

Fig. 31 Interconnection Diagram VR41 /SR41

11.3 Terminals 31/32 Supply Power or Supply Circuit



The minimum voltage U_S of 14 V is based on a load of 0 Ω

U_S= Supply voltage
R_B= Maximum allow. load in the supply circuit
e.g. Indicator, Recorder or resistor

11.4 Ex-Approval Specifications

Ambient temperature -55 °C to 70 °C

VT41/ST41 VR41/SR41	
Supply circuit Terminals 31, 32 U_M= 60 V	II 2G EEx ib IIC T4 Ui = 28 V Ii = 110 mA Pi = 770 mW Effective int. capacitance: 12.8 nF Effective int. capacitance to ground: 24 nF Effective int. inductance: 0.27 mH
Contact output Terminals 41, 42 U_M= 60 V	Ui = 15 V Ii = 30 mA Pi = 115 mW Effective int. capacitance: 11.6 nF Effective int. capacitance to ground: 19.6 nF Effective int. inductance: 0.137 mH
Recommended Transmitter Power Supplies	
Hartmann & Braun (ABB)	TZN 128-Ex, Contrans I V 17151-62
Digitable	CS3/420, CS5/420
MTL	MTL 3046B
Pepperl+Fuchs	KHD3-IST/Ex1, KFD2-STC1-Ex, KSD2-CI-S-Ex
Recommended NAMUR Switch Amplifiers	
Hartmann & Braun (ABB)	V17131-51 ... 53, V17131-54...56
Digitable	ci 1/941, ci 1/942
Apparatebau Hundsbach	AH TS920, AH 90 924
Pepperl + Fuchs	Various types
VR41./SR41	
Piezo-Sensor Terminals 85, 86, 86, 87 PT100-circuit Terminals 81, 82, 83, 84	U_0 = 7.2 V I_0 = 965 mA

11.5 Electrical Interconnections for the Ex-Design

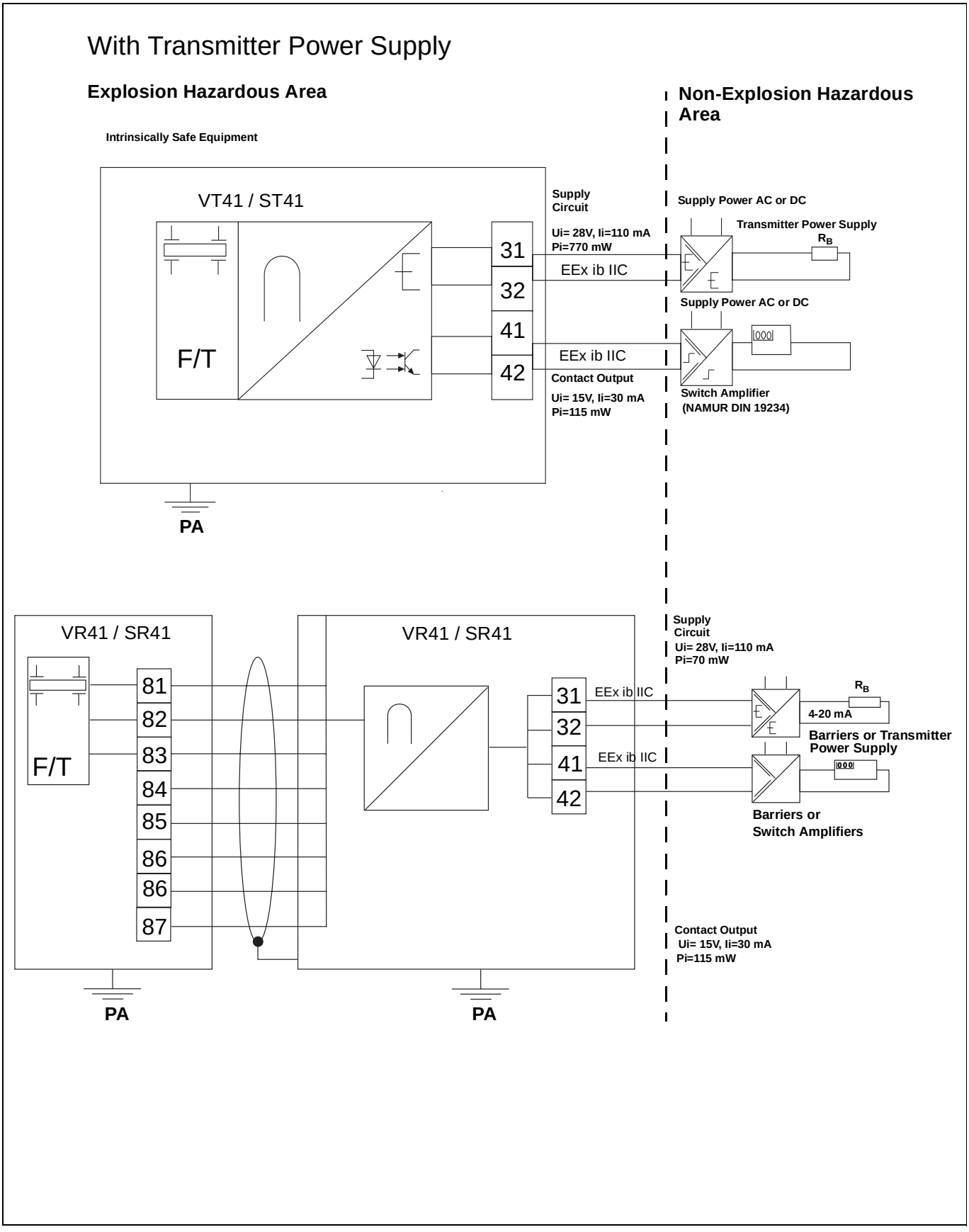


Fig. 32 Interconnection Example

11.6 Fluid Temperatures

Cables suitable for T=110°C can be used for the supply power terminals 31, 32 and the contact output 41, 42 without any reduction in the temperature range specifications. Cables suitable only for temperatures T=80°C, which may be the cause if cable shorting occurs, reduce the temperature range of the flowmeter as shown in the following table.

Ambient Temperature [°C]	Max. Allow. Temperature of the Connection Cables to Terminals 31, 32, 41, 42 [°C]	Max. Allow. Fluid Temperature [°C]
-55 to 70	110	280 / 400[1)]
-55 to 70	80	160
-55 to 60	80	240
-55 to 55	80	280
55 to 50	80	320[1)]
-55 to 40	80	400[1)]

1) Fluid temperatures >280°C
only HiTemp Design TRIO-WIRL V

11.7 Insulating the Flowmeter Primary

The flowmeter primary can be insulated to a max. thickness of 100 mm (Fig. 33).

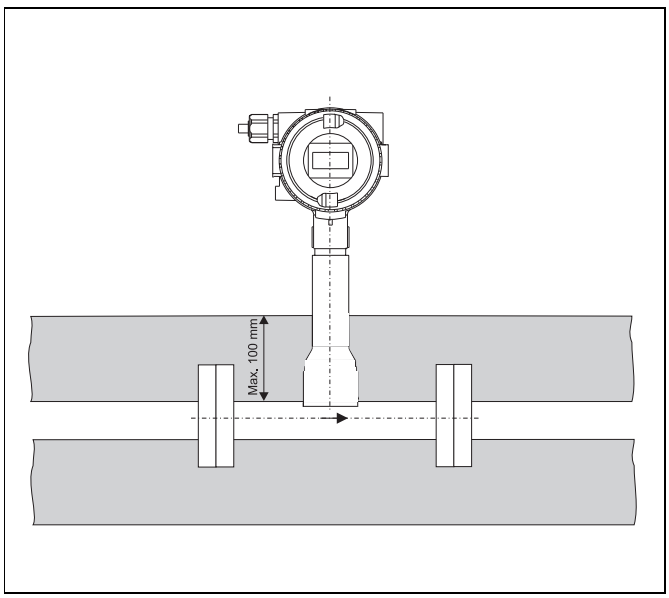


Fig. 33 Pipeline Insulation

12. EC-Type Examination Certificate

Translated from German Original

TÜV
CERT

(1) **EC-Type Examination Certificate**

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

(3) **TÜV 99 ATEX 1465**

(4) Equipment: Flowmeter TRIO-WIRL Types VT41.; ST41.; VR41.; SR41.

(5) Manufacturer: ABB Automation Products GmbH

(6) Address: D-37079 Göttingen, Dransfelder Straße 2, Germany

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

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

The examination and test results are recorded in the confidential Report No. 99/PX19790.

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

EN 50 014:1997 **EN 50 020:1994**

(10) If the symbol "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:

Ex II 2 G EEx ib IIC T4

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV CERT-Zertifizierungsstelle
Am TÜV 1
D-30519 Hannover, Germany

Hannover, 08.09.1999

Head of the
Certification Body

Translated from German Original

(13) **SCHEDULE**

(14) **EC-Type Examination Certificate No. TÜV 99 ATEX 1465**

(15) Description of the Equipment

The flowmeter TRIO-WIRL Types VT41.; ST41.; VR41.; SR41. are utilized to meter the flowrate or the actual volume flow of steam, gases or liquids.

The allowable temperature range is –55°C to +70°C.

Electrical Specifications

Supply Power Circuit (Terminals 31, 32)	Ignition Class Intrinsically Safe EEx ib IIC Only for connection to a certified Intrinsically Safe circuit with the following maximum values: U_i = 28 V I_i = 110 mA P_i = 770 mW	
	Effective internal capacitance	C_i = 12.8 nF
	Effective internal capacitance to PA	C_i = 24 nF
	Effective internal inductance	L_i = 0.27 mH
Contact Output (Terminals 41, 42)	Ignition Class Intrinsically Safe EEx ib IIC Only for connection to a certified Intrinsically Safe circuit with the following maximum values: U_i = 15 V I_i = 30 mA P_i = 115 mW	
	Effective internal capacitance	C_i = 11.6 nF
	Effective internal capacitance to PA	C_i = 19.6 nF
	Effective internal inductance	L_i = 0.137 mH

Types VR41. and SR41.

Sensor Circuit Piezo Sensor (Terminals 85, 86, 87) and PT100 Circuit (Terminals 81, 82, 83, 84)	Ignition Class Intrinsically Safe EEx ib IIC Maximum values: U_o = 7.2 V I_o = 965 mA	

Translated from German Original

Schedule to EC-Type Examination Certificate No. TÜV 99 ATEX 1465

Types VT41. and ST41.

In these types the sensor circuits are internally Intrinsically Safe circuits.

(16) Test documentation are listed in Test Report No.: 99/PX19790.

(17) Special Conditions

None

(18) Basic Safety and Health requirements

None additionally

13. EC-Certificate of Compliance

EG-Konformitätserklärung
EC-Certificate of Compliance

Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our

TRIO-WIRL Durchflußmesser
TRIO-WIRL Flowmeter

Modell VT41.; ST41.; VR41.; SR41.
Model VT41.; ST41.; VR41.; SR41.

mit den grundlegenden Sicherheits- und Gesundheitsanforderungen gem. der Richtlinie 94/9/EG des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.
are in compliance with the Essential Health and Safety Requirements with refer to the council directives 94/9/EC of the European Community. The safety and installation requirements of the product documentation must be observed.

Die TRIO-WIRL Durchflußmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.
The TRIO-WIRL Flowmeters are utilized to meter the flowrate of gases, steam or liquids.

EG-Baumusterprüfbescheinigung: *EC-Type Examination Certificate:*	TÜV 99 ATEX 1465
Benannte Stelle: *Notified Body:*	TÜV Hannover/Sachsen-Anhalt e.V., Kennummer 0032
Geräte-Kennzeichnung: *Apparatus code:*	II 2G EEx ib IIC T4
Sicherheitstechnische Daten: *Safety values:*	siehe EG-Baumusterprüfbescheinigung TÜV 99 ATEX 1465 *refer to EC-Type Examination Certificate TÜV 99 ATEX 1465*
Angewandte Normen: *Standards:*	EN 50 014: 1997 EN 50 020: 1994

Göttingen, 23. September 1999

Unterschrift / *Signature*

BZ-13-8010, Rev.0, E22268

14. Parameter Settings Overview

Meter location: . . . . . TAG No.:. . . . . .

Flowmeter Primary type: . . . . . Converter type:. . . . . .

Order No.: . . . . . Instrument No.:. . . . . Supply voltage:. . . . . .

Fluid temperature: . . . . . .

Parameter		Setting Range
Language	. . . . .	English, German
Flowmeter Primary		TRIO-WIRL S (Swirl-Flowmeter)
		TRIO-WIRL V (Vortex-Flowmeter)
Meter Size	. . . . .	1/2” - 12” or 16” / DN 15 - 300 or DN400 (only TRIO-WIRL)
Average k-Factor	. . . . .	l/m^3
Operating Mode	. . . . .	Gas Qv, Gas Normal Qn, Gas Standard Qs, Saturated steam Qm, Saturated steam Qv, steam QM, Steam Qv, Liquid Qv, Liquid Qm
Q_{max}	. . . . .	0.15 $Range_{max}$ - 1 $Range_{max}$
Min. flowrate (Q_{min})	. . . . .	0 - 10 % of $Range_{max}$
Damping	. . . . .	1 - 100 s
Density Units	. . . . .	g/ml, g/cm^3, kg/m^3 etc.
Units Q_{vol}	. . . . .	l/s, l/min, l/h, m^3/s, m^3/min, m^3/h etc.
Units Qm	. . . . .	g/min, lb/s, kg/min, t/min, t/d etc.
Density Setting	. . . . .	0.001 - 1000
Normal Factor	. . . . .	0.001 - 1000
Totalizer Units	. . . . .	l, m^3, iga, gal, bbl, g, kg, t, lb
Hardware	. . . . .	I/HART/; IHART/Pulse_Bin;
Contact Output Function	. . . . .	I/HART/Q_Alarm; I/HART/T_Alarm; I/HART/S_Alarm
Max. Alarm	. . . . .	% for flowrate; °C for temperature
Min. Alarm	. . . . .	% for flowrate; °C for temperature
Pulse Factor	. . . . .	0.001 - 1000 pulse/unit
Pulse Width	. . . . .	1 - 256 ms
Display	. . . . .	Qv actual, Qv Normal, Qv Standard, Qm Mass, Percent, Totalizer
Multiplex Display	. . . . .	Temperature, frequency

ABB Automation Products GmbH
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