GAS- AND STEAM-
FLOW COMPUTER

DigiFlow 515

Softwareversion: 2.0 and up

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Note.
The information in this document can be changed without previous announcement.

These instructions do not claim to cover all details or variations in equipment, nor to provide for every possible contingency that may arise during installation, operation or maintenance.
Should further information be desired or should particular problems arise that are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local INTRA Sales Office.
The contents of this instructions manual shall not become become part of or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of INTRA. The warranty contained in the contract between the parties is the sole warranty of INTRA. Any statements contained herein do not create new warranties or modify the existing warranty.

Directory of the symbols used in this handbook

Symbol	Description	SI unit	US-unit
A	Normalized Signal between 0 and 1 (0 ≡ 4 mA and 1 ≡ 20 mA	–	–
d	specific Gravity. Ratio of the density of a gas to the density of air	–	–
f	Frequency	Hz	Hz
h_v, h_r	specific Enthalpy at Flow Conditions	kJ/kg	kJ/kg
h_0	specific Enthalpy at Reference Conditions	kJ/kg	
k_F	k-factor (pulses/unit) for a frequency flowmeter.	n/m^3	n/m^3
No	Timebase Constant with which the flowrate is displayed: 1 for units/s, 60 for units/min., 3600 for units/h, 86,400 for units/d.	–	–
p	Pressure at Flow Conditions.	kPa_{abs}	psi_a
p_b	Pressure at Reference Conditions.	kPa_{abs}	psi_a
p_{krit}	Critical Pressure of Gas.	kPa_{abs}	psi_a
Q_E	Energy Value of Steam.	MJ/TU	BTU/TU
Q_M	Mass Flowrate.	kg/TU	lbs/TU
Q_{Vb}	Corrected Volume Flowrate.	m^3/TU	ft^3/TU
S_M	Span of Mass	kg/TU	lbs/TU
S_V	Span of Volume.	m^3/TU	ft^3/TU
S_{Vb}	Span of Volume at Reference Conditions.	m^3/TU	ft^3/TU
T	Temperature at Flow Conditions.	K	K
T_b	Temperature at Reference Conditions.	K	K
T_{krit}	Critical Temperature of Gas.	K	K
z_f	Compressibility at Flow Conditions	–	–
z_b	Compressibility at Reference Conditions	–	–
ρ	Density at Flow Conditions.	kg/m^3	kg/m^3
$ρ_b$	Density at Reference Conditions.	kg/m^3	kg/m^3
υ	Specific Weight of Steam at Flow Conditions.	dm^3/kg	dm^3/kg
$υ_b$	Specific Weight of Steam at Reference Conditions.	dm^3/kg	dm^3/kg

* TU = Time Unit (d, h, min, s)

Remark:

Are a temperature of 0°C and a pressure of 101,325 kPa_{abs} as normalized conditions programmed, the volume unit will so be added with the prefix „N" in the display, to point to this „NORM"-state. If a temperature of 15°C and a pressure of 101,325kPa_{abs} are defined as normalized conditions, then the volume unit will be prefixed by an „s", to point to this „standard-conditions, which are often used at US-Units.

1 Introduction

The **DigiFlow 515** combines compensation for gas and vapors to the following equations:

1. *Ideal Gas:* Temperature and pressure correction, compressibility correction not required.
2. *General Gas:* Temperature and pressure correction with compressibility correction calculated using the Redlich-Kwong[1] state equation. This equation is suitable for gases with known properties. Information about common industrial gases are provided in the operating manual.
3. *Natural Gas:* Compressibility is calculated using the AGA-NX-19-mod equation for natural gases of low gross caloric value.
4. *Steam Flow Computer*: Based on the IFC 1967.Mass flow correction of the flowing steam using pressure and temperature.
5. *Energy*: The heat quantity is calculated based on enthalpy and mass flow.
6. *Energy Balance: .* Assuming a mass balance in upstream-and downstream pipe, an energy balance of the loop is calculated.

Inputs from various of flowmeters are accepted. Examples of these sensors are (**VORTEX**)**,** turbine, orifice plate, averaging pitot tubes like (**ITABAR**-Flow sensor), wedges and target flowmeters.

To increase the measured flowrange of an **ITABAR**-Flow sensor, it is possible to use two differential pressure transmitters whose ranges overlap with automatic crossover in the computer.

The device include a scaleable Pulse Output an two scaleable Alarm Relay Outputs.

Optionally this computer includes:

- Up to 3 Analog Outputs 0/4 – 20mA.
- RS485 – Interface.
- Control Relays for an Sensor–Purge–Unit.

A unique feature available with the serial interface is the ability to print flowrates and totals at programmable time intervals. This enables the instrument to function as a data logger when used in conjunction with a printer, or other storage device.

[1] Redlich & Kwong,, „An equation of State“, Chem Rev., vol. 44, p233, 1949

2 Ordering details

Code	Option or Feature
515	**Gas- and Steam Flow Computer, Type: DigiFlow 515**

Code	**Housing**
S	Panel mounting IP54 (Standard)
T	Panel mounting with lockable transparent door IP55

Code	**Power Supply**
2	230 V AC mains (Standard)
1	115 V AC mains
4	24 V AC/DC

Code	**Analog Output**
X	No Analog Output
1	One Analog Output
2	Two Analog Outputs
3	Three Analog Outputs

Code	**Communication Port**
2	RS232 - Serial Interface (Standard)
4	RS485 - Multipoint Serial Interface

Code	**Sensor-Purge-Unit**
S	Without Relay Output
L	With Relay Output for Sensor Purge Unit

3 Technical data

General:

Display:	Backlighted, alphanumeric LC–Display, 2 rows, 16 cols. Each char is 0.276" high.
Keyboard:	Sealed membrane keyboard with four keys.
Transmitter supply:	18 V / 100 mA; via keyboard adjustable, isolated.
Power:	115/230 V AC; 50/60 Hz internally switchable. Optionally 24-28 V AC/DC Power consumption 10 W @ 230 V AC without Options.
Operating Temperature:	32 – 131 °F
Housing:	Enclosure: glass–fiber reinforced synthetic material; Front: aluminum keyboard membrane.
Face:	Watertight to IP 54 (NEMA 4X equal)
Dimensions:	5.7" W × 2.8" H × 5.1" D
Panel cutout:	5.4" W × 2.6" H

Programming and Configuration:

Handheld:	There is no handheld terminal required. All necessary constants and parameters are programmed using the keypad.
Language:	German, English or French selectable.

Frequency Input:

Frequency Range:	0.25 - 10 kHz Input 1. 0.25 - 500 Hz Input 2.
Input Circuits:	Most AC, logic and proximity switches accepted. 0.5 – 50 V_{pp}.
Non–Linear Correction:	Up to 12 points for curve fit.

Analog Input 4 – 20 mA:

Inputs:	2 for flow (split range), 1 for pressure, and 1 for temperature, for flow correction, or 2 for flow (split range) and 2 for pressure for energy–balance.
Input Impedance:	120 Ω.
Circuit:	All inputs are isolated, no common ground.

RTD Input:

Range:	-310 to +1472°F.
RTD Type:	Pt100 according to DIN 43760.
Non–Linear Correction:	The non–linearity of the RTD is internally compensated.

Pressure Input:

Type:	Absolute or gauge.
Span:	The pressure at 4mA and 20mA are programmable. Linear interpolation for all other points.
Atmospheric pressure:	If a gauge pressure sensor is used, the atmospheric pressure must be entered.

Pulse Output:

Pulse Width:	Adjustable between 10 ms and 90 ms.
Duty Cycle:	≥ 1 : 1.
Logic:	Open Collector, Active Low.
Current sinking:	max. 100 mA.
Pulse generation:	The pulse count is proportional to the counter difference in selectable units of 10 (1, 10, 100, ...100000).

External Keyboard:

Function:	One input controls the display and one input resets the total-counters.
Circuit:	An input voltage higher than +18 V is detected.

Communication Port:

Type:	An RS232 interface is provided. Optionally there is a RS485 multipoint communication interface for up to 32 instruments connected to a common bus.
Baud Rate:	300 – 9600 Baud.
Data Bits:	7 or 8 selectable.
Parity:	None, even or odd.
Stop Bits:	1 or 2 selectable.
Data logging:	Output in intervals up to 9999 min or by key stroke.

Relay Output:

Function:	High– and Low–flow rate alarms based on the flow rate, mass, corrected volume, or energy.
Form:	Normally open. (SPST)
Max. Voltage	250 V AC
Max. Current	6 A AC

Options:

Analog Outputs:

Function:	Selectable: Output current proportional to standard display or of other Parameter See Table on Page 35. Setpoints at 4 mA and 20 mA, linear interpolation between.
Output Span:	0 – 20 mA or 4 –20 mA selectable.
Resolution:	12 Bit
Max. Load:	500 Ω internally powered. 800 Ω externally 24 V powered.
Powering:	If there is no external supply >15V the output will be internal powered automatically.

Control of a Sensor–Purge–Unit:

Function:	Two relays control the solenoid activated valves of a Sensor Purge Unit. During the purging time and an additional selectable time after purging, the flow input is maintened.
Time between purging:	10 minutes to 31 days 23 hours 50 minutes.
Purge Duration:	1 to 999 s
Time Constant:	1 to 99 s

4 Algorithms

Ideal Gas:

Display:	Corrected Volume (m^3 or SCF), Mass (kg or lbs)
Temperature Range:	-273 °C (-460 °F) to +1,000 °C (1,832 °F)
Pressure Range:	0 kPa_{abs} (0 psia) to 100,000 kPa_{abs} (14,514 psia)

General Gas:

Gases:	Handles most gases where critical temperature, critical pressure and specific gravity are known.
Compressibility:	Calculation using the Redlich–Kwong equation.
Ranges:	Same as Ideal Gas.

Natural Gas:

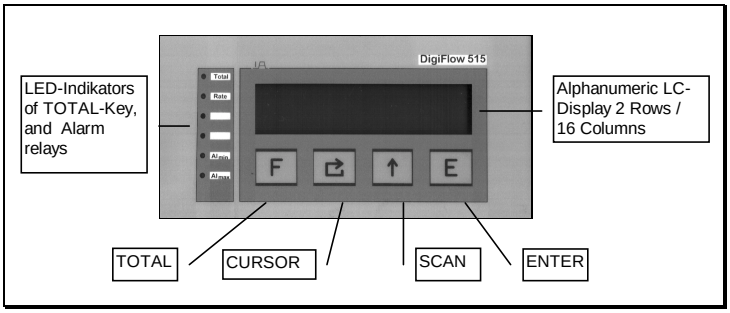
Gases:	Natural Gases with a gross caloric value of 31.8 MJ/m^3 to 38.8 MJ/m^3, specific gravity of 0.554 to 0.75, density at reference conditions of 0.716 kg/m^3 to 0.970 kg/m^3, and a CO_2– and N_2– molar fraction of 15% each.
Compressibility:	Uses the AGA–NX–19–mod equation.
Temperature Range:	-40 °C (-40 °F) to 115,6 °C (240 °F).
Pressure Range:	101.325 kPa_{abs} (14.7 psia) to 13,790 kPa_{abs} (2,001 psia).

Steam:

Calculation:	Uses 1967 IFC Formulation (ASME) equations to calculate specific weight and enthalpy of steam.
Steam Type:	Liquid Water, saturated and superheated steam.
Temperature Range:	0.01 °C (32.02 °F) to 800 °C (1,472 °F).
Pressure Range:	0 kPa_{abs} (0 psia) to 100,000 kPa_{abs} (14,514 psia).
Saturated steam:	Either the temperature or pressure input required (not both).

5 Operation

5.1 Front view



5.2 General

The DigiFlow 515 work with a CMOS microprocessor that processes all measurements and takes all controlling functions.

All operation parameters and rake constant are programmable and get in a nonvolatile memory filed which keeps the information after energy loss for at least 40 years.

About the alphanumeric display can information about the parameters and measuring units necessarily be called.

During the parameter setting can be selected, whether the flow rate is reported as volume or mass when at gas calculator or as mass or energy when at steaming calculator.

The following data can be fetched in the display by means of the SCAN key during the ongoing measuring: (also see ` key description ' page 21)

Gas flow:
- Corrected volume (m^3 or SCF)
- Mass (kg or lbs)
- Temperature and pressure (°C or °F resp. kPa or psi)
- Compressibility factors [except ideal gas]
- Date and time

Steaming flow:
- Mass (kg or lbs)
- Energy (MJ or BTU)
- Temperature and pressure in upstream path (°C or °F resp. kPa or psi)
- Specific Weight and Enthalpy in upstream path (dm^3/kg or kJ/kg)
- Temperature and pressure in downstream path (°C or °F resp. kPa or psi) [only when energy balance]
- Specific Weight and Enthalpy in downstream path (dm^3/kg or kJ/kg) [only when energy balance]
- Date and time

By means of the TOTAL-key the display changed of the present flow rate and the accumulated flow. If on a higher level display is switched back to main level.

A higher display level is also exited without any key actuation after about 60 seconds.

If the accumulated flow is displayed, the sum counters can be deleted about the CURSOR-key. This function can be inhibited at the configuration.

By simultaneous pressure the TOTAL-key and the SCAN key the calculator is switched into the parametrising and configuration mode. Herein all necessary inputs are made for the special application. The keys partly get another function for this menu level. By means of the SCAN-key is scrolled through the sub-menus of a menu level. The ENTER-key then serves the subroutine-call to the selected menu item. At the input of numerical values about the CURSOR-key an input place is selected which is represented by the flashing cursor. This place then can be adjusted to the desired value by means of the SCAN-key. this can be set to the value ‘0’ by pressing the TOTAL–key.

6 Application

6.1 The DigiFlow 515 as gas compensation calculator.

Flow equations for gases

This chapter is only of meaning for flow measurings at gases. If the flow medium is steam, you can change for chapter 5.2 on page 16 at once.

The flow calculator **DigiFlow 515** process the input signals of a wide range of flowmeters by the equations defined below.

Mass flow and corrected volume are shown and processed in SI units. For explanation about the following abbreviations see listing at the beginning of the operating instruction.

2 formulas form the basis for all other equations:

① Specific Gravity $d = \dfrac{\text{Molecular Weight of Gas}}{\text{Molecular Weight of Air}}$

$$d = \frac{\text{Molecular Weight of Gas}}{28.9625} \qquad [1]$$

② Density of a gas ρ_0 , at Reference Conditions:

$$\text{in SI-Units: } \rho_0 = \frac{3.4834 \cdot d \cdot p_b}{z_b \cdot T_b} \qquad \left[\text{kg}/\text{m}^3\right] \qquad [2]$$

The conditions all calculations are being based (‘NORM“-conditions), will be entered by the user. Most times these will be set to:

- Temperature 0 °C (273.15 K) and Pressure 101.325 kPa_{abs}

A: Volumetric Flowmeters With Frequency Output.

(e.g. VORTEX, turbine or PDF with Pulse Output).

$$Q_{Vb} = \frac{N_0 \cdot f}{k_F} \cdot \frac{p}{p_b} \cdot \frac{T_b}{T} \cdot \frac{z_b}{z_f} \qquad [4]$$

$$Q_M = \rho \cdot Q_{Vb} \qquad [5]$$

B: Volumetric Flowmeters with 4–20mA Output.

(e.g. VORTEX, turbine or PDF with Analog output)

$$Q_{Vb} = S_V \cdot \frac{p}{p_b} \cdot \frac{T_b}{T} \cdot \frac{z_b}{z} \cdot A \qquad [6]$$

$$Q_M = \rho_0 \cdot Q_{Vb} \qquad [5]$$

C: Differential Pressure Flowmeters With 4–20mA Output And a Square Law Relationship.

(e.g. Orifice Plates, ITABAR-Probes, Pitot Tubes, etc.)

$$Q_{Vb} = S_{Vb} \cdot \sqrt{\frac{p}{p_b}} \cdot \sqrt{\frac{T_b}{T}} \cdot \sqrt{\frac{z_b}{z}} \cdot \sqrt{A} \qquad [7]$$

$$Q_M = \rho_b \cdot Q_{Vb} \qquad [5]$$

D: Differential Pressure Flowmeters With 4–20mA Output And a Linear Flow Relationship.

(e.g. D.P. transmitter with integrated square root extractor.)

$$Q_{Vb} = S_{Vb} \cdot \sqrt{\frac{p}{p_b}} \cdot \sqrt{\frac{T_b}{T}} \cdot \sqrt{\frac{z_b}{z}} \cdot A \qquad [8]$$

$$Q_M = \rho_b \cdot Q_{Vb} \qquad [5]$$

Pressure and temperature signal are still square rooted, the flow signal are not. This is because the output from the D.P. transmitter isn't truly volumetric, but will be affected by a change in density of the gas being measured.

E: Dual Differential Pressure Flowmeters With 4–20mA Output.

To increase the range over which flow can measured, two D.P. transmitters with different spans can be connected across a common D.P. device (e.g. Orifice Plate or ITABAR-Probe). Depending on the Output of the transmitter, equations 5 and 6 or 7 and 8 are used. Separate scaling must be programmed for each transmitter.

Transmitter #2 is selected when signal from Transmitter #1 is higher than 19mA.

Example No. 1:

With an orifice plate the flow shall be measured in the range of 0-2,000 m^3/h, what to a Measuring range relationship of 10:1 corresponds. The two transmitters are spanned as follows:

Transmitter 1: **0 600m^3/h**

Transmitter 2: **0 2,000m^3/h**

In range up to 600m^3/h Transmitter 1 is used, at flow rates above 600m^3/h transmitter 2 is used. Since D.P. transmitters are accurate over a 3:1 range, then the system will provide reliable readings between 200 and 2000 m^3/h, which is a 10:1 range.

6.1.1 Parameter setting of the flow calculator:

For the correct function of the flow calculator the following parameters must be entered:

- k_F k–factor of flow measuring instruments with frequency output
- S_{Vb} /S_V Span (for analog flowmeters)
- T_b Reference temperature
- p_b Reference pressure
- d Specific gravity of the gas

The flow calculator gets the signals for flow, pressure and temperature. In dependence of the chosen gas equation the compressibility factor is taken into account and the density calculates.

Which parameters are to be entered, can be looked up in chapters 5.4.

6.1.1.1 Programming the Span as Mass

It is possible to enter the measuring range of the flow measuring instrument as mass flow. The computer will then calculate the span as:

$$S_{Vb} = \frac{S_M}{\rho_b} \qquad [9]$$

Example No. 2:

A flowmeter produced a mass flow of 1,000kg/h. Temperature of 30°C, pressure of 220kPa and specific Gravity of 1.52.

Using equation [2] gets:

$$\rho = \frac{3.4834 \cdot 1.52 \cdot 220}{1 \cdot (30 + 273.15)}$$

$$\rho = 3.84 \, {}^{kg}\!/_{m^3} \qquad \text{(assuming: } z_b = 1\text{)}$$

Therefore from equation [9] the span will be: S_{Vb} = 260 m^3/h.

If the span is programmed as mass S_M = 1,000kg/h at reference conditions of 30°C and 220kPa, then the display of mass flow and volume flow referenced to these conditions.

Example No. 3:

Shall the volume flow from above example calculated into „standard“ conditions, then the setable values are 15°C and 101.325kPa_{abs}.

Then the span will be: S_{Vb} = 537.2 sm^3/h.

6.1.2 Application for Ideals Gases

If the influence of the compressibility on gases can be ignored, then the factors Zb and Zf in the equations 1 to 8 will be set to "1".

The computings become substantially simpler with these approximations. These approximations are applicable for:

- Gases of 1. Gas range (also at higher pressures)
- Gases of 2. Gas range up to 20bar

Example No. 4:

A VORTEX is used to measure oxygen in a pipe at 25°C and 200kPa_{abs}. The VORTEX produces 9,500 Pulses/m^3 and the flowrange is 100 to 1,000m^3/h.

Determine the flow parameters which need to be programed into the instrument for it to display the flowrate and total flow as both mass and corrected volume to standard conditions.

From the table, the molecular weight of oxygen is: 31.9988mol/g

From equation (1):

$$d = \frac{31.9988 \, {}^{g}\!/_{mol}}{28.9625 \, {}^{g}\!/_{mol}} = 1.105$$

According to ISO 5024, Standard Conditions are 15°C at 101.325kPa. Hence the following values are programmed into the instument:

Scaling Factor (k-Factor):	**9,500 Pulses/m^3**
Specific Gravity d:	**1.105**
Base Temperature:	**15°C**
Base Pressure:	**101.325 kPa**
Time Base:	**hours**

Other parameters can be programmed as required.

The instrument will now display the corrected volume and mass flowrates of the gas.

Example No. 5:

The same vortex meter installation, as detailed in Example 4, has a 4–20mA output. The instrument produce at 0m^3/h a current of 4mA and at 1,000m^3/h a current of 20mA.

Determine the parameters necessary for the Configuration.

If the calculator gets a linear 4–20mA signal, then the following parameters are to program:

Span:	**1,000 m^3/h**
Specific Gravity:	**1.105**
Base Temperature:	**15 °C**
Base Pressure:	**101.325 kPa**
Time Base:	**hours**

6.1.3 Application for General Gases

For general Gases the compressibility is calculated using the Redlich-Kwong-equation. Therefor it is necessary to know the critical temperature and the criticial pressure of the gas. From these parameters, the compressibility factors z_b and z_f are calculated for a gas..

Datas of common gases are listen in Appendix B **Properties of Some Gases:**

Equations 1 to 9 are used to calculate the corrected volume and mass.

Example No. 6:

A flow of Hydrogen via an orfice plate shall be calculated under consideration of the compressibility. Which constants are required?

T_k:	**-239.9°C**
p_k:	**1,296.9kPa**
d:	**0.0696**

6.1.4 Natural Gas

For natural gas of low caloric value the compressibility factor is calculated using the AGA-NX-19-mod equation. These factors are used with equations 4 to 8.

To calculate this compressibility factor following paramerters are to be entered in consideration of their limitations.

Specific Gravity d	**0.554 to 0.75**
mol% CO_2	**0 - 15%**
mol% N_2	**0 - 15%**

Temperature and pressure must be within following ranges:

Temperature:	**-40 bis 115°C**
Pressure:	**0 bis 137.9 bar_{abs}**

6.2 The DigiFlow 515 for the steaming quantity measuring

The **DigiFlow 515** incorporates equations to calculate flows of water , satirized steam and superheated steam over the following range:

Pressure:	**0kPa$_{abs}$ bis 100,000kPa$_{abs}$ (0 psia to 14,513.8 psia)**
Temperature:	**0.01°C bis 800°C (32.02°F bis 1,472°F)**

When measuring saturized steam, ist is possible to renounce of either the pressure input, or the temperature input, since, on the saturation curve, there is a corresponding pressure for every temperature and vice versa. For superheated steam and water, it is necessary to use both inputs.

Both the mass flow and enthalpy (heat content) are calcuated internally based on the 1967 IFC (ASME) Formulations. The equations use the pressure and temperature input values to calculate:

the specific Volume of steam: ν in dm^3/kg and

the specific Enthalpy: h in kJ/kg

A: Volumetric Flowmeter with Frequency Output

(e.g. VORTEX, Turbine etc.)

Mass Flow / SI–Units:
$$Q_{M(SI)} = 1000 \cdot \frac{N_0 \cdot f}{k_F} \cdot \frac{1}{\upsilon} \quad [11]$$

Mass Flow / US–Units:
$$Q_{M(US)} = 62.425 \cdot \frac{f}{k_F} \cdot \frac{1}{\upsilon} \quad [12]$$

Note: when using US–Units k–factor must be entered in Pulses/ft^3.

Energy / SI–Units:
$$Q_{E(SI)} = \frac{Q_{M(SI)} \cdot h}{1000} \quad [13]$$

Energy / US–Units:
$$Q_{E(US)} = 0.45359 \cdot \frac{Q_{M(US)} \cdot h}{1000} \quad [14]$$

B: Volumetric Flowmeter With 4-20mA Output

(e.g. VORTEX, Turbine with Analog Output etc.)

Mass Flow / SI–Units: $$Q_{M(SI)} = 1000 \cdot \frac{S_V}{\upsilon} \cdot A$$ [15]

Mass Flow / US–Units: $$Q_{M(US)} = 62,447 \cdot \frac{S_V}{\upsilon} \cdot A$$ [16]

Energy: Use equations 13 and 14

C: Differential Pressure Flowmeter with 4-20mA Output And A Square Law Relationship.

(e.g. Orifice Plates, ITABAR–Probe, Pitot Tubes, etc.)

Mass: $$Q_M = S_M \cdot \sqrt{\frac{\upsilon_b}{\upsilon}} \cdot \sqrt{A}$$ [17]

Energy: Use equations 13 and 14

D: Differential Pressure Flowmeter with linear 4-20mA Output

(e.g. Transmitter With Internal Square Root circuit)

Mass: $$Q_M = S_M \cdot \sqrt{\frac{\upsilon_b}{\upsilon}} \cdot A$$ [18]

Energy: Use equations 13 and 14

E: Differenzdruckmessung mit 2 Eingangssignalen

To increase the range over which flow can measured, two D.P. transmitters with different spans can be connected across a common D.P. device (e.g. Orifice Plate or ITABAR-Probe). Depending on the Output of the transmitter, equations 5 and 6 or 7 and 8 are used. Separate scaling must be programmed for each transmitter.

Transmitter #2 is selected when signal from Transmitter #1 is higher than 19mA.

6.3 The DigiFlow 515 as heat consumption calculator

If the **DigiFlow 515** is uded as heat consumption calculator, it will be presumed a mass continuity in a closed loop, that means the quantity of the pouring out medium is the same as streaming in. Therefore ,in this case, the factor 'h' (enthalpy) will be replaced by the factor 'Δh', the diffence of both enthalpies. Both pressure and temperature in this case are investigated in the downstream loop. Therefor it is completely same which state the medium takes in the downstream loop. If the calculator is used in this mode, the temperature exclusively by means of the Pt100–direct inputs be investigated, since the analog temperature input in this case becomes the pressure input of the downstrem loop.

.

6.3.1 Programming The Flow Computer

So that the flow calculating machine can determine the exact flow according to equations 11 to 18, a number of parameters have to be entered:

k_F	**k-Factor (Flow Meters with Frequency Output)**
S_M	**Span (for Analog Outputs)**
υ_b	**Base specific weight at which the span is determined.**

The calculator will be measure the flow input A (normalized between 0 and 1), the temperature and the pressure to calculate the specific weight, and enthalpy.

Example No. 7:

A VORTEX (k-Factor 68.32 Pulses/ft^3) is used at saturized steam. The flow output shall be in lbs/hour.

What are the parameters to be programmed?

The calculator should be programmed for steam measurement at a frequency meter. Cause steam is saturated, it is only necessary to use either the pressure input or the temperature input. Becaus of cost the temperature sensor is used. Then the following parameters are to be entered.

Units:	**US**
k-Factor:	**68.32**
Time Base:	**hours**

Example No. 8:

A differential pressure transmitter across an orifice plate outputs 20mA at a flow of 10,000kg/h. Design pressure is 1,300kPa_{abs} and a specific weight of 216.5dm^3/kg. The flowrate is required in kg/h and the caloric value in MJ/h. What are the parameters to be programmed?

From the steam table we read a temperature of 350°C at 1,300kPa_{abs} and a specific weight of 216.5dm^3/kg. Steam is in superheated state. Following parameters are to be entered for steam flow measuring with analog input and square root relationship.

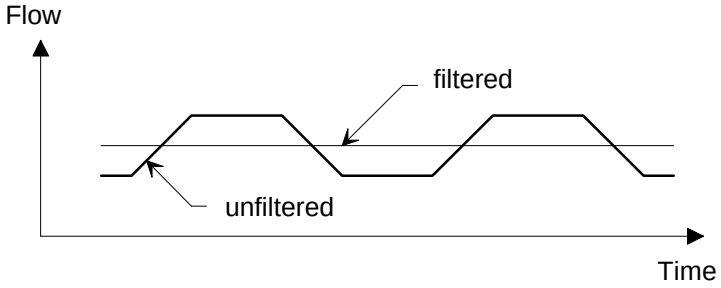
Units:	**SI**
Span:	**10,000**
Base Temperature:	**350°C**
Base Pressure:	**1300kPa**
Time Base:	**hours**
Type of Steam:	**superheated**

6.4 Filtering of The Flow Input

Reading the instantaneous measurand correctly often is impossible because of the frequency fluctuations or output current fluctuations of the flow measuring instrument created by the pulsating flow.

Therefore the flow calculator is provided with a digital filter which average out these fluctuations of the flow signal and facilitates through this a more precisely reading of the measured values.

The following diagram shows an input signal pulsating and the effect of the filter on this signal.



As guideline to the degree of filteringto be used, the following table shows the response to a step change in input.

The value AF is the entered filter constand.

The times, after the value reported on the display 90 or 99% of the at the ending worth reaches, is indicated in seconds. For the value AF = 1 therefor no filtering is executed.

AF	**90%**	**99%**
1	0	0
2	1	2
4	2	4
6	3	6
10	5	11
15	8	17
20	11	22
25	14	28
35	20	40
45	25	51
60	34	69
75	43	86
90	52	103
99	57	113

Table 1: Response time in seconds on a volatile modification of the input signal

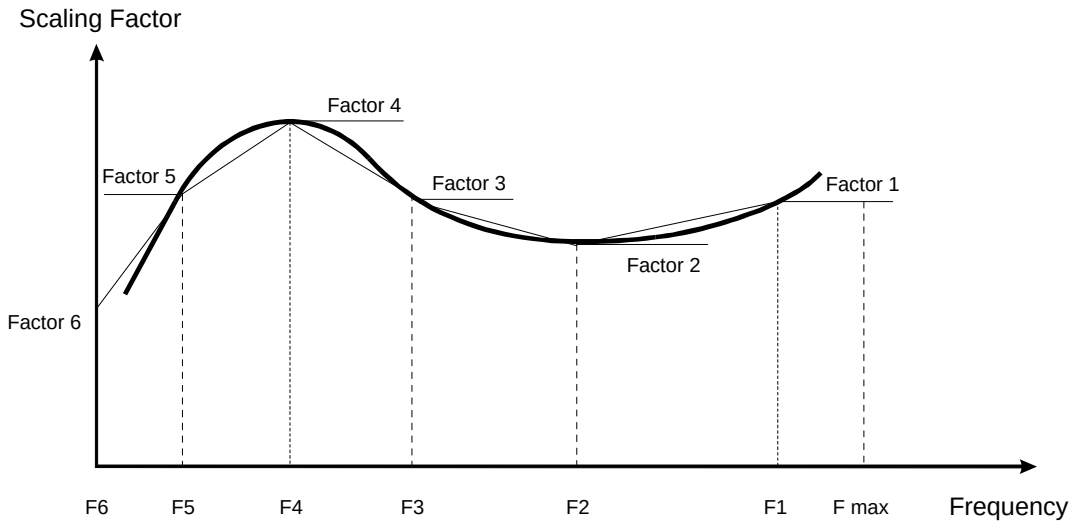
6.5 Correction of The Nonlinearity

6.5.1 Correction for the frequency input

Known nonlinearities of a flow measuring instrument can be corrected.

12 frequencies and scale factors are available to this. Data on the flowmeter non-linearity can usually be supplied by the flowmeter manufacturer in the form of a Calibration Certificate, and is the result of individual tests on flowmeter over a range of flowrates. The certifikate will list a number of flowrates or frequencies with the measured k-factor at each flowrate.

The following diagram shows an example for the different scaling factors at various frequencies of an arbitrary flow measuring instrument. The broad black turn stands for the current scaling factor of the set, and the narrow line is for the approximation in the flow calculator.



The curve between the single dots was won by linear interpolation, except for factor 1 which maintains a constant value between Frequency 1 and the maximum input frequency.

During Calibration, the user have to enter a frequency and the corresponding k-factor for each of maximimum 12 points.

If a frequency with 0Hz is entered, the program doesn't expect any further correction data. If all 12 correction points are used, the 12th frequency is set on 0Hz automatically.

6.5.2 Linearization for the analog input

Is only a flow signal to the flow calculator connected, a linearization can be programmed for this to compensate for deviations of flow signal and actual flow. Up to 12 Dots can be entered, between worth be interpolated linearly. The correction is done at the standardized device signal (0 1) , so that measure begin and measure end are not affected. Programming of corrections points start with ‘1’, if a ‘0’ is entered no further inputs are accepted.

The flow correction is defined as:

$$Q = \mathrm{Span} \cdot A_C$$

Note:
The sqare root relationship for conventional differential pressure flow devices is handled separately and not by the liearity correction described in this section.

7 Programming and parameter setting

7.1 Key description

The keys on the front panel of the set have the following functions:

Pict.	Name	Function at normal operation	Function at parameter setting
	TOTAL	Change between sums and instant value display.	Presets at digit input the actual digit to '0'.
	CURSOR	Resets if displayed and allowed the sum counters.	Positions the cursor at number input on position right.
	SCAN	Change between display levels according to description on p.9.	Increase at number input the digit by '1', else next parameter at same level.
	ENTER	Without function.	Take number, resp. jump into selected menulevel.

7.2 Configuration of a set

Both the required results entered and the input signal can be subjected to a check with the help of the flow chart to the parameter setting.

By pressing simultaneaously the TOTAL– and the SCAN–key the configuration mode is entered. Then the user defined password must be confirmed after input with the ENTER-key. This password is at the new set: '**0000**'.

If moving step by step through the levels, always a description of the actual parameter is shown for clarification.

To leave this configuration mode, the menu must stepped until the item '**Leave**'. Then the ENTER–key must be pressed.

7.3 Input of a number

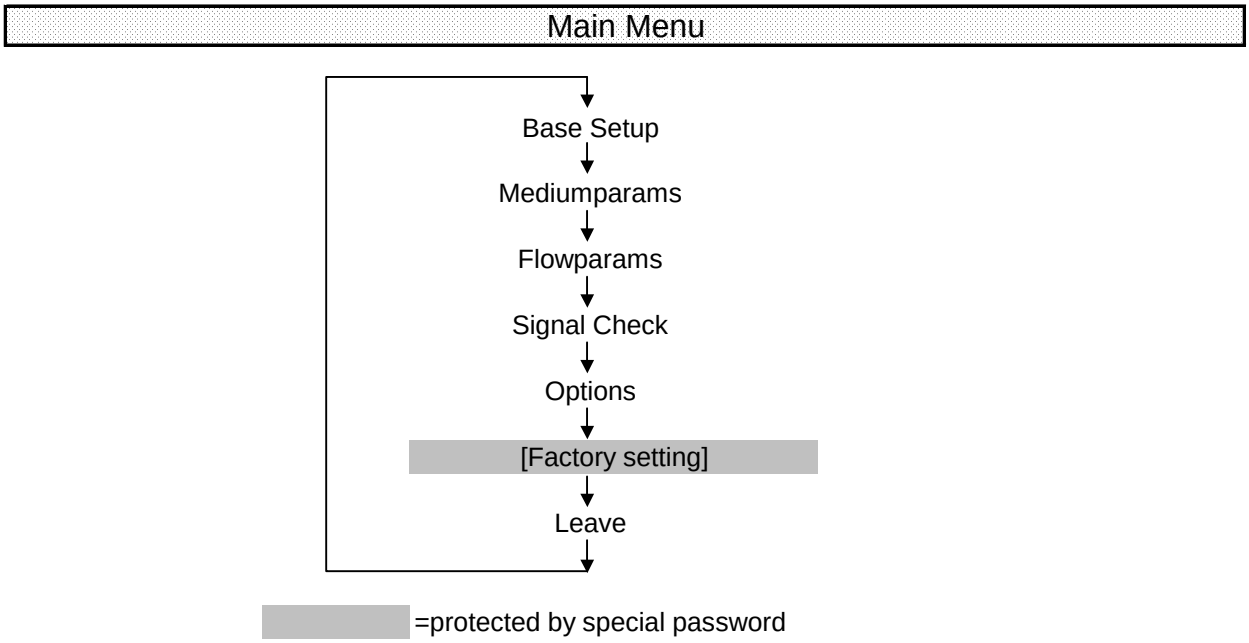
If the input parameter is a number, so the input procedes as follows.

By means of the CURSOR-key is jumped the desired place. This place then is changed with the help of the SCAN-key. The cursor lies under the sign, this so is changed. The cursor lies under the decimal dot, this so is moved cyclicly by actuation of the SCAN-key around a place to the right. Lies the cursor under a number, this can rapidly with the help of the TOTAL-key with the value ` 0 ' be covered.

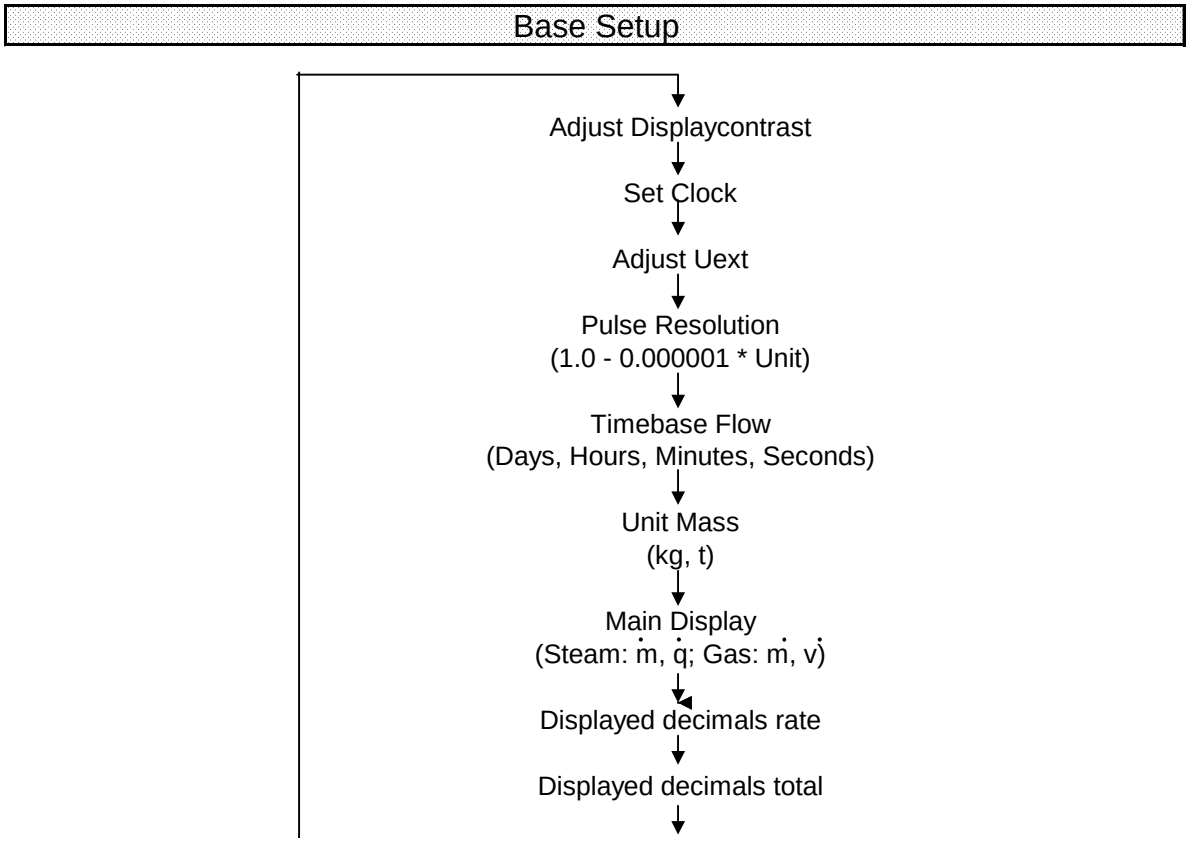
By pressing the ENTER–key, the number input will be finished.

8 Menu tables

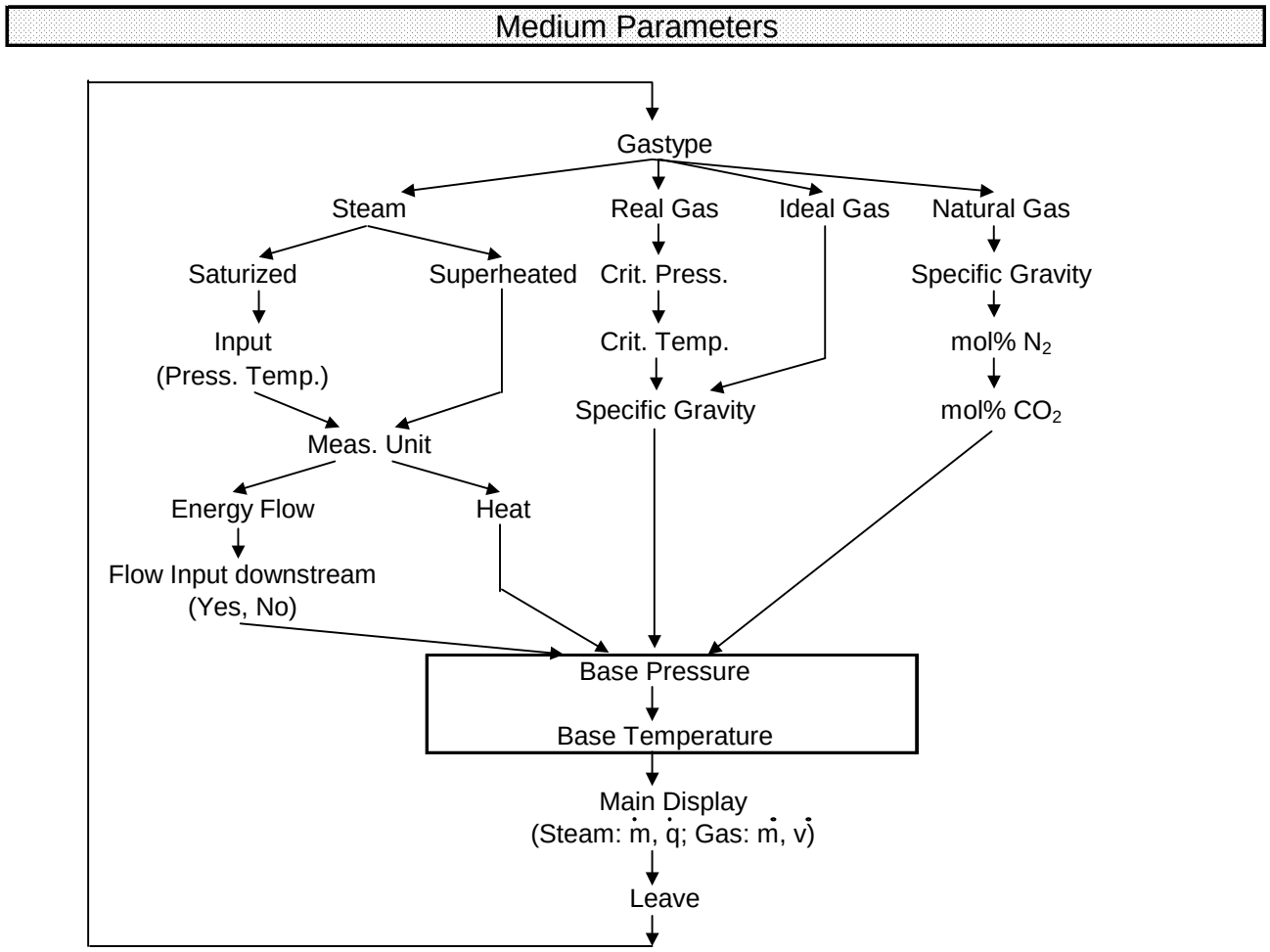
8.1



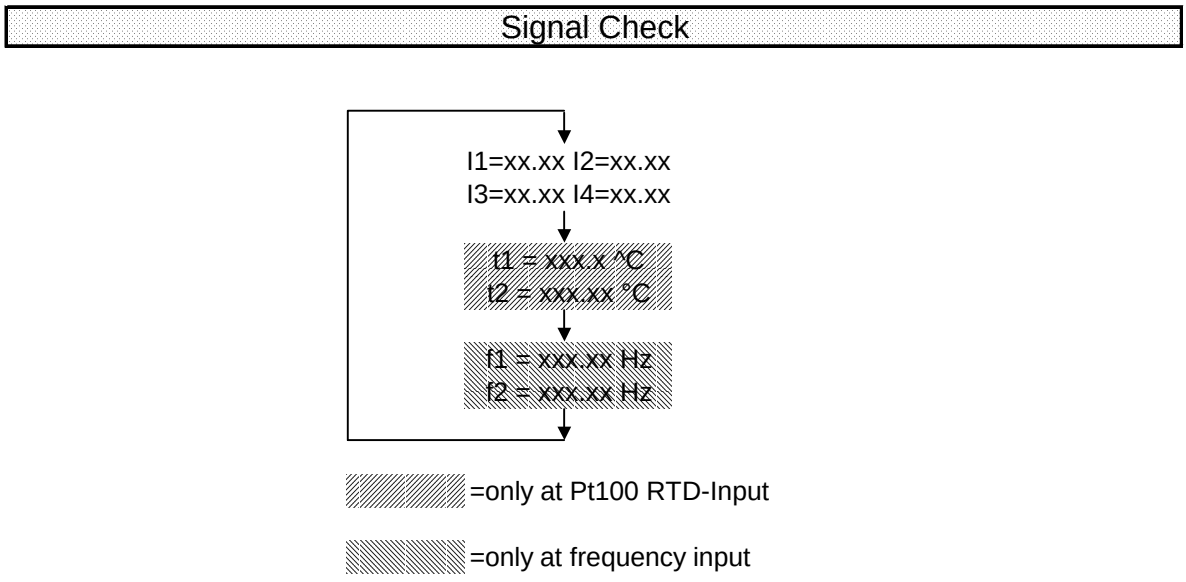
8.2



8.3

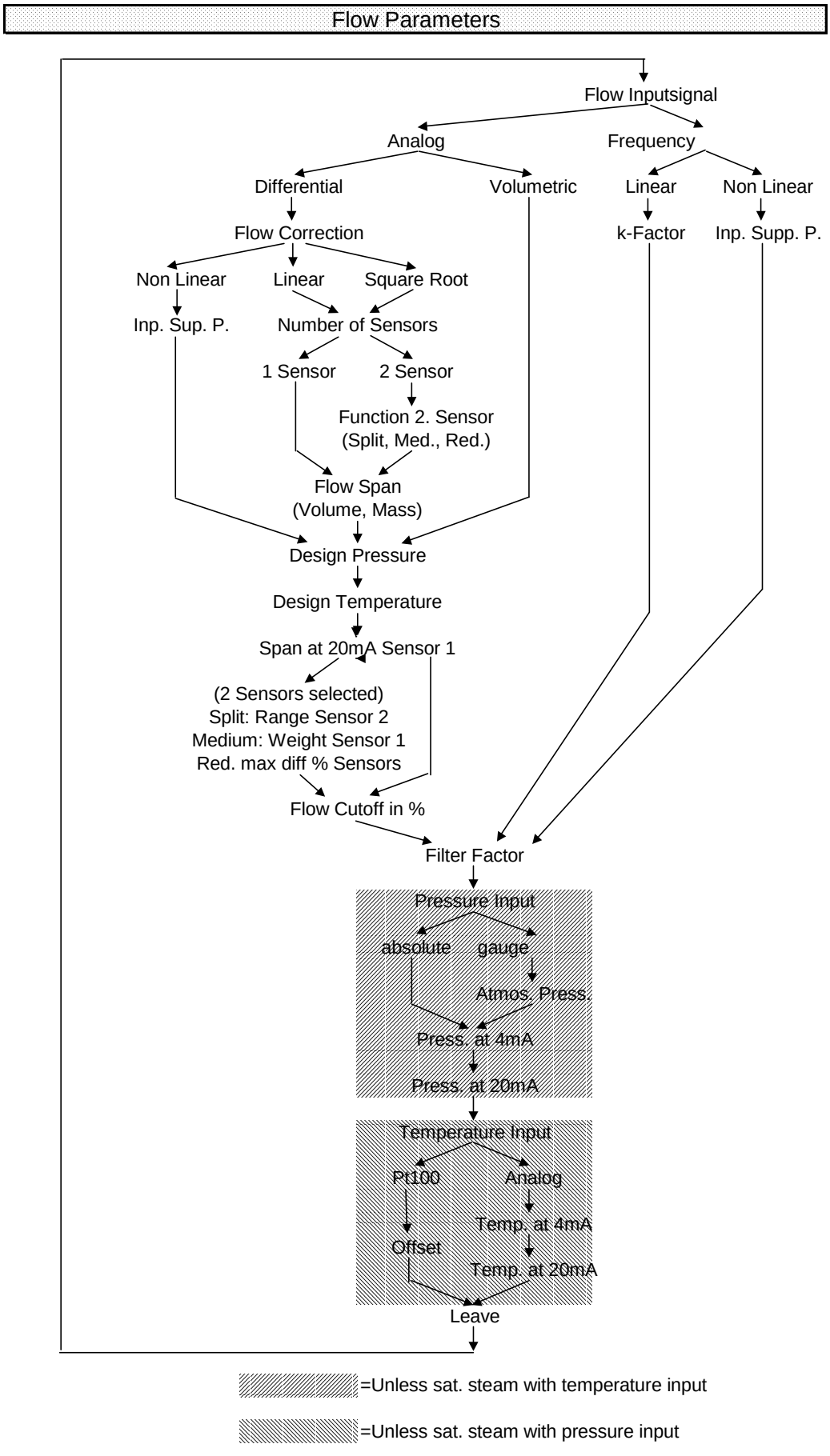


8.4

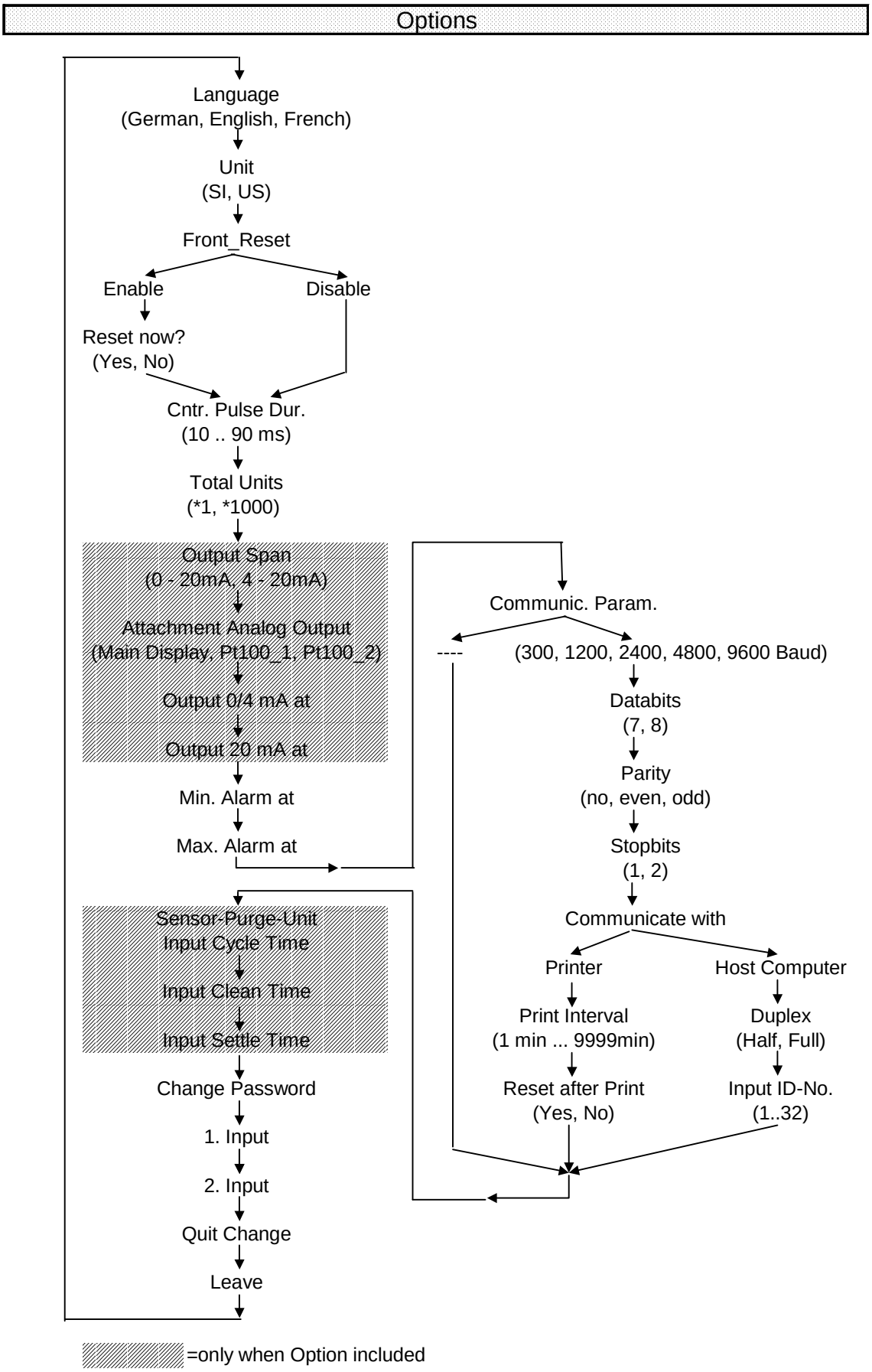


(Remark: This submenu is placed only for set technical reasons in this place. In truth it follows the flow parameter menu).

8.5


Flow Parameters
Flow Inputsignal
Analog
Frequency
Differential
Volumetric
Linear
Non Linear
Flow Correction
k-Factor
Inp. Supp. P.
Non Linear
Linear
Square Root
Inp. Sup. P.
Number of Sensors
1 Sensor
2 Sensor
Function 2. Sensor
(Split, Med., Red.)
Flow Span
(Volume, Mass)
Design Pressure
Design Temperature
Span at 20mA Sensor 1
(2 Sensors selected)
Split: Range Sensor 2
Medium: Weight Sensor 1
Red. max diff % Sensors
Flow Cutoff in %
Filter Factor
Pressure Input
absolute
gauge
Atmos. Press.
Press. at 4mA
Press. at 20mA
Temperature Input
Pt100
Analog
Temp. at 4mA
Offset
Temp. at 20mA
Leave
=Unless sat. steam with temperature input
=Unless sat. steam with pressure input

8.6


Options
Language
(German, English, French)
Unit
(SI, US)
Front_Reset
Enable
Disable
Reset now?
(Yes, No)
Cntr. Pulse Dur.
(10 .. 90 ms)
Total Units
(*1, *1000)
Output Span
(0 - 20mA, 4 - 20mA)
Attachment Analog Output
(Main Display, Pt100_1, Pt100_2)
Output 0/4 mA at
Output 20 mA at
Min. Alarm at
Max. Alarm at
Sensor-Purge-Unit
Input Cycle Time
Input Clean Time
Input Settle Time
Change Password
1. Input
2. Input
Quit Change
Leave
Communic. Param.

(300, 1200, 2400, 4800, 9600 Baud)
Databits
(7, 8)
Parity
(no, even, odd)
Stopbits
(1, 2)
Communicate with
Printer
Host Computer
Print Interval
(1 min ... 9999min)
Reset after Print
(Yes, No)
Duplex
(Half, Full)
Input ID-No.
(1..32)
=only when Option included

9 Input circuits

The **DigiFlow 515** have an adjustable supply voltage for transmitters. This voltage can be adjusted in a range of approx. 17.5 -- 19.5V during configuration. A maximum output current of 100mA is allowed.

Of the rear side is a DIP switch accessibly. If the flow signal is a frequency signal, the signal type must here be defined.

If the input signal is an analog signal, the DIP switch doesn't have any function.

9.1 Frequency signal

The DigiFlow 515 has an input signal-conditioning board, which can process most frequency signals of pressure transmitters. By means of the DIP-Switch the correct flow signal will be selected.

The position of the DIP switches is in the following table in dependence of the input signal listed:

Input signal		Terminal		DIP - switch position			
		+	-	1 CH_1	2 CH_1	1 CH_2	2 CH_2
A	active impulse output with large amplitude (12 ... 30 V)	13	17	off	on	off	on
B	passive impulse output (open collector, Reed switch, ...)	13	17	on	on	on	on
C	active impulse output with small amplitude (CMOS, TTL, ...)	13	17	off	off	off	off

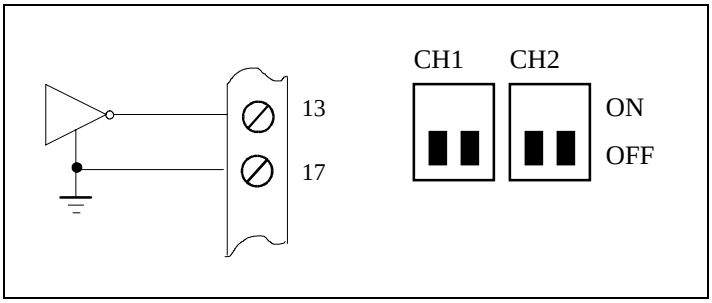
The position of the DIP switch #2 is for passive signaling transmitters for channel 1 as same as for channel 2 without meaning.

General data:

max. input voltage: $35V_{SS}$

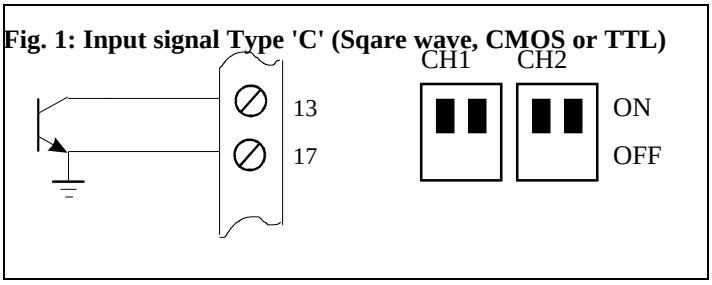
input impedance: A 30kΩ

C 10kΩ



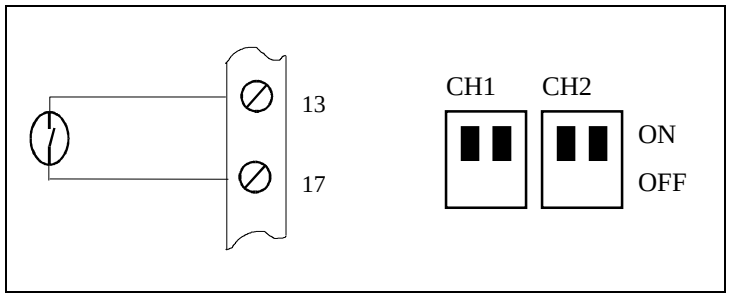
e.g.: VORTEX, pre amplifier, magnetic inductive flow meters

Fig. 1: Input signal Type 'C' (Sqare wave, CMOS or TTL)



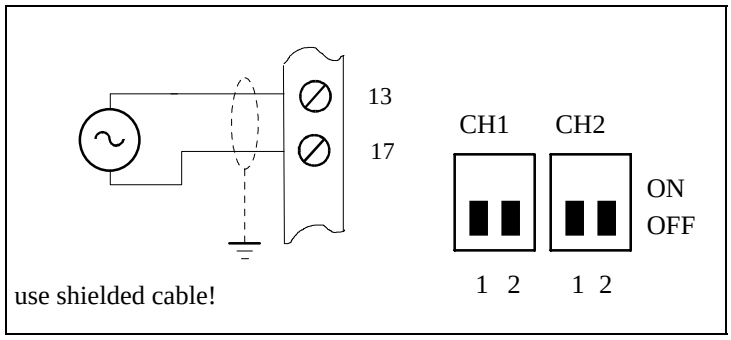
e.g.: Hall effect-sensors

Fig. 2: Input signal Type 'B' Open Collector



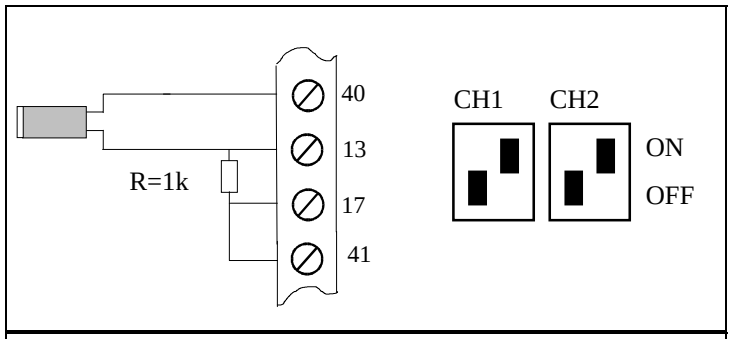
e.g..: PDM *) with reed switch

Fig. 3: Input signal Type 'B' (reed switch)



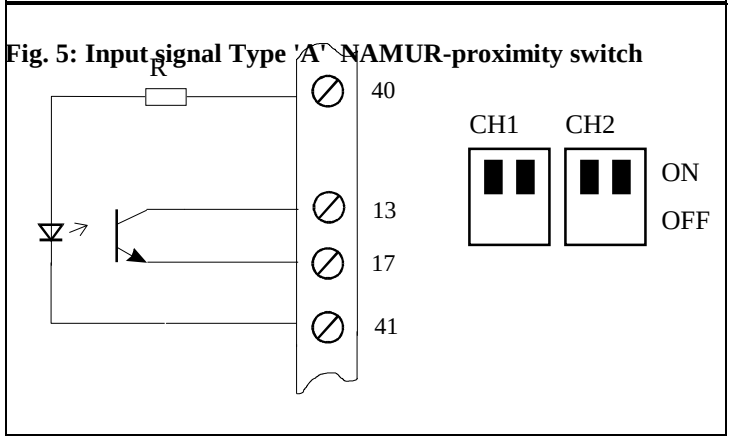
e.g.: mV signal of turbine flow meter

Fig. 4: Input signal Type 'C' coil or tacho generator



e.g.: PDF with proximity switch output

Fig. 5: Input signal Type 'A' NAMUR-proximity switch



e.g.: opto-sensors, pre amplifier

Fig. 6: Input signal Type 'B' opto-sensor

9.2 Analog inputs

The flow calculator ***DigiFlow 515*** can be operated with temperature input of Pt100 RTD or with 4-20mA temperature analog current input.

9.2.1 Input of Pt100 RTD

A possibility to measure temperature very exactly offers the four wire Pt100 RTD measurement. (use shielded wire).

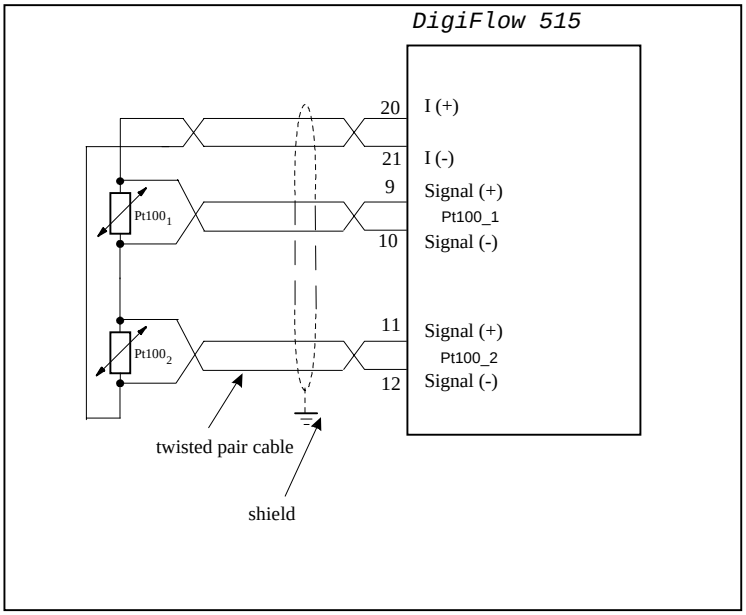


Fig. 7: Connection of the Pt100 RTD

Care must be take that the positive pole of current source connected to positive pole of the signal wires. PTD himselfs has no polarity.

9.2.2 Analog 4-20mA input

Each 4-20mA input has a load of 120Ω. When the computer is AC powerd, there is sufficient current from DC supply output to power up to 4 transmitters. If more loops are to be powered, an external supply source is required.

Shielding: When shielding the input signals, the shield should be connected to earth only at one end.

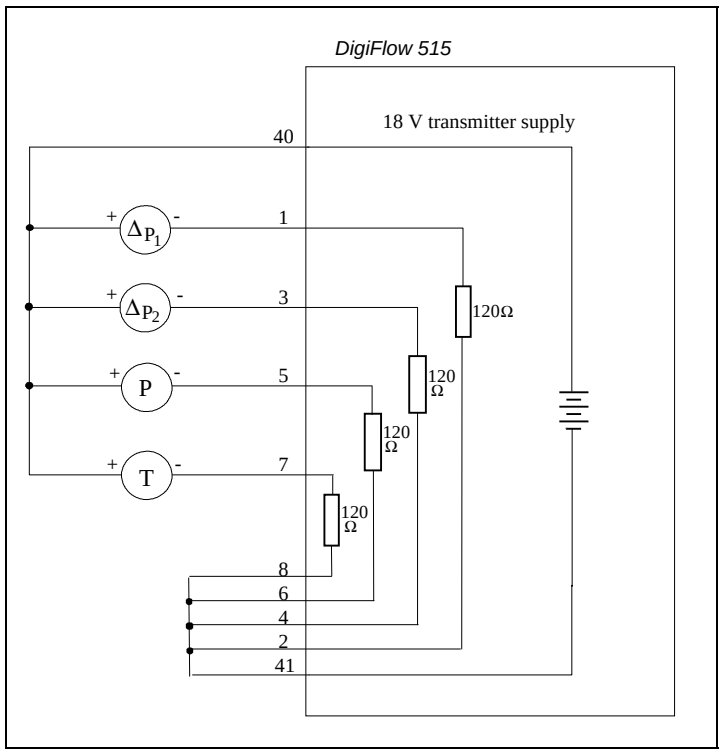


Fig. 8: Internal tranmitter supply

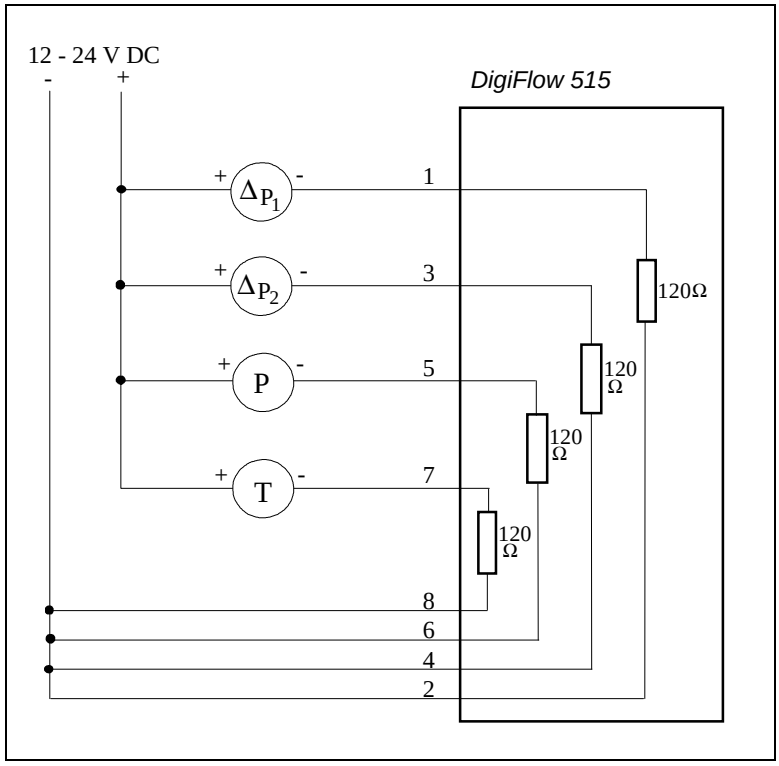


Fig. 9: External transmitter supply

Two transmitters for differential pressure as well as respectively one transmitter for pressure and for temperature are connected as displayed in Fig. 8 or Fig. 9. Is only one D.P. transmitter user, it will be connected on terminals 1 and 2.

9.3 Remote switched functions

The ***DigiFlow 515*** has the ability to reset the sums and to switch the display, by remote keys.

The connection of that keys are displayed in Fig. 10.

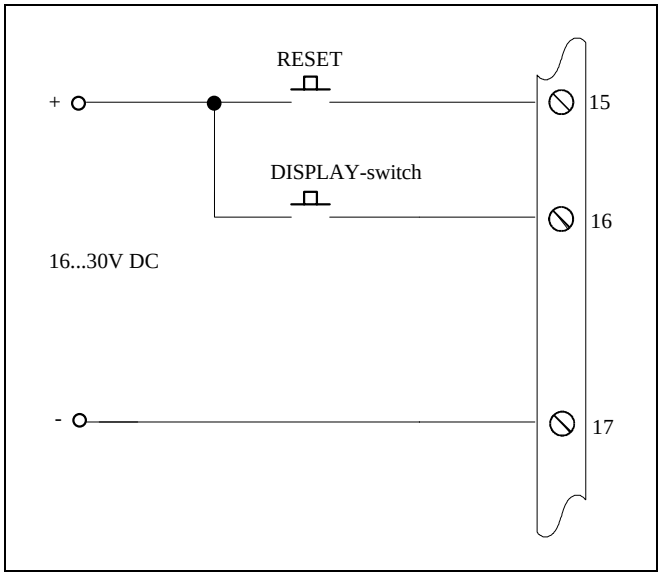


Fig. 10: Connection of external keys

10 Output circuits

10.1 Digital output

An output pulse can be taken from the terminal strip at the rear side to operate of external counters. At every increase of a selectable decade of the sum counter a pulse count corresponding to this increase gets generated.

If the total value was chosen e.g. with a resolution of 0.01kg, an impuls so is distributed with every increase at 0.01kg.

This pulse is genarated at a transistor with open collector output. Pulse width is 10 - 90ms (selectable).

The maximum switch current is 100mA.

When connecting a counter to the pulse output, it may be necessary to use an external pull-up-restistor. A restistance of 5 to 10kΩ connected to terminal 40, are most times sufficient.

Make sure that this output isn't usually suitable for a further flow indicator as input signal because of the not periodical pulse signal, please

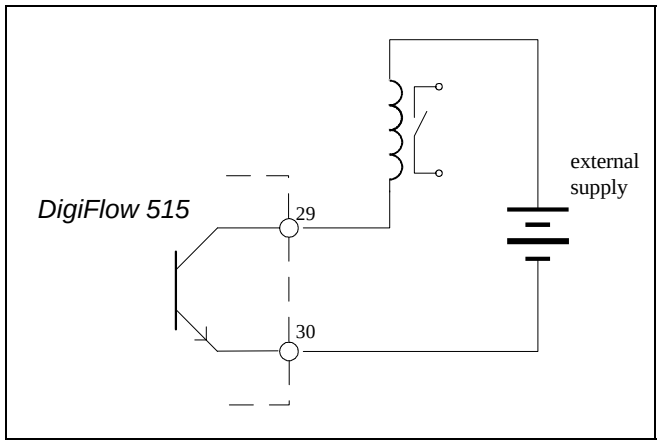


Fig. 11: Drive of external relay or counter

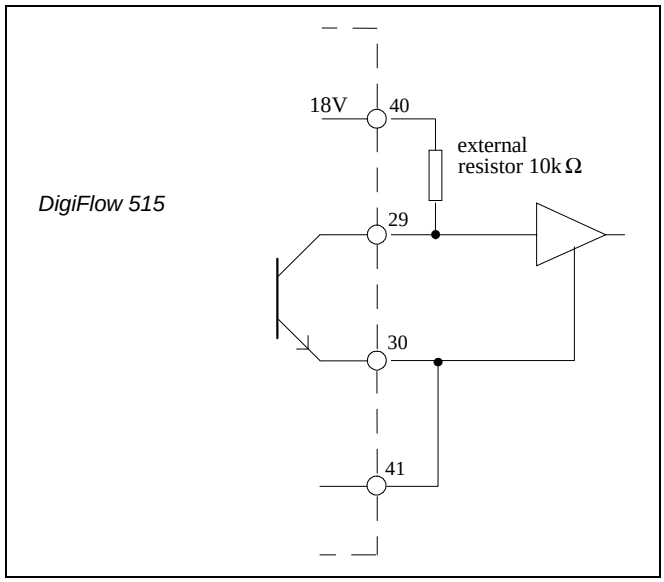


Fig. 12: Drive of a logical input as e.g. PLC or electronic counter

10.2 Relay output

The calculator is equipped with two relays (SPST) per default. These are preset during configuration to energisw when the default flowrate exceeds ($Alarm_{max}$) or drops below ($Alarm_{min}$) the preset value. It has to be taken into account, that the oriented alarm worth lie within the valid measuring range.

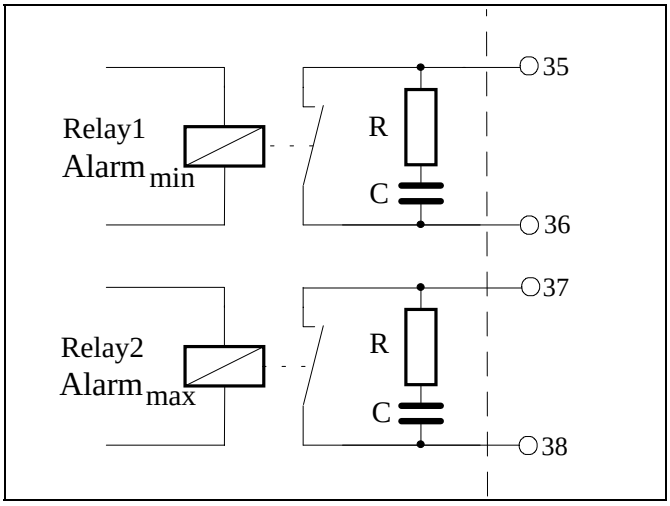


Fig. 13: Circuit diagram relay output

10.3 RS232 or RS485 interface

With this option either a serial RS 232 interface or a RS 485 interface with galvanic isolation is provided. The interface can be used for data transmission with peripheral equipments or other computers. A standard ticket form is in the flow computer integrated. You find further information as well as the software protocol description in the instructions for the RS-232/485 interface.

10.3.1 Hardware

The following drawing gives a survey of the interfaces wiring. The connection is connected via the terminal strip for both types at the rear side of the set.

Intervals for data output can be programmed between 1 and 9999min during configuration.

The RS 232 interface is mostly used for the communications with printers or for point to point connections over short distances.

on the other hand the RS 485 interface is used mainly for communications on large distances (to 1.2km) or for multipoint connections.

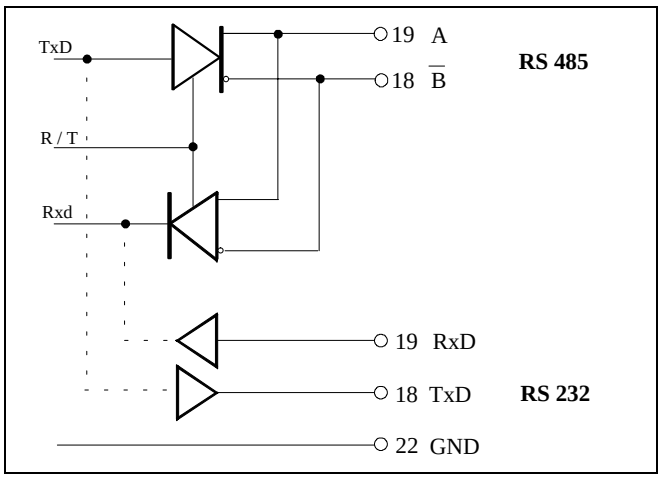


Fig. 14: Circuit communication interface

10.3.2 Communication Protocol

The ***DigiFlow 515*** has a build in real time clock. This enables the time and date to be set and printed on tickets.

Make sure you that the clock keeps its setting at loss of the energy only for about 5 days. After then the clock may need to be set.

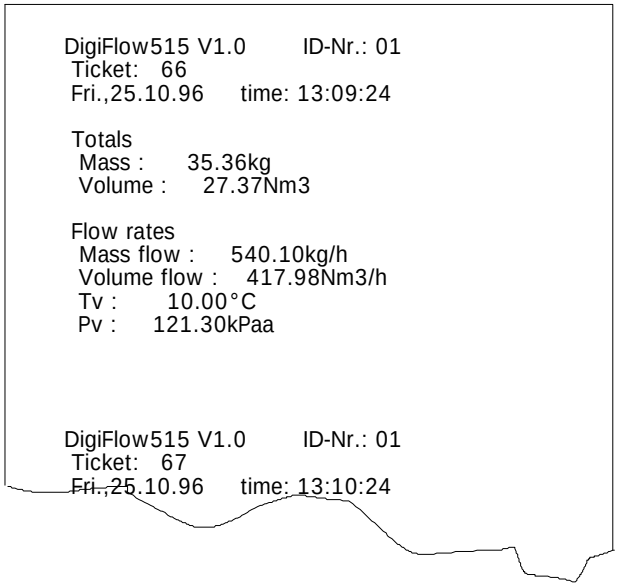
The baud rate can be adjusted at the configuration. The user must worry for this, that the settings agree of computers and ***DigiFlow 515*** so that the communications can take place.

10.3.3 Printers Protocol

A ticket can alternatively be created after actuation of the RESET–key, or after defined intervals (see key lock). At interval wise expression a reset of the sum counters can simultaneously be done.

If the RESET operation is triggered, first the ticket is created and after this the total values are reset internally.

The communications with printers take place without handshake lines. At this is presupposed that the printer buffer correspondingly is large enough and cannot (also at print intervals) overflow. A ticket looks as follows:



10.3.4 Host–Communication

To communicate via a host computer, the following commands are implemented::

ID	When unit active, answer with ID-Code.
IDXX	Activate Unit XX.
S?	Request totals.
R?	Request rates.
T?	Request temperature inputs.
P?	Request pressure inputs.
SR	Reset totals

10.3.5 Network communications

During the network communications several sets are connected about a twisted pair cable and mentioned about addresses. Up to 32 instruments can be connected to a common bus using the RS485 interface. Every set gets its own address about which it can be mentioned by the control computers, e.g. process control computers or PLC. The Host distributes an address and activates the corresponding set with it. The data interchange is controlled between control computer and instrument about the software protocol.

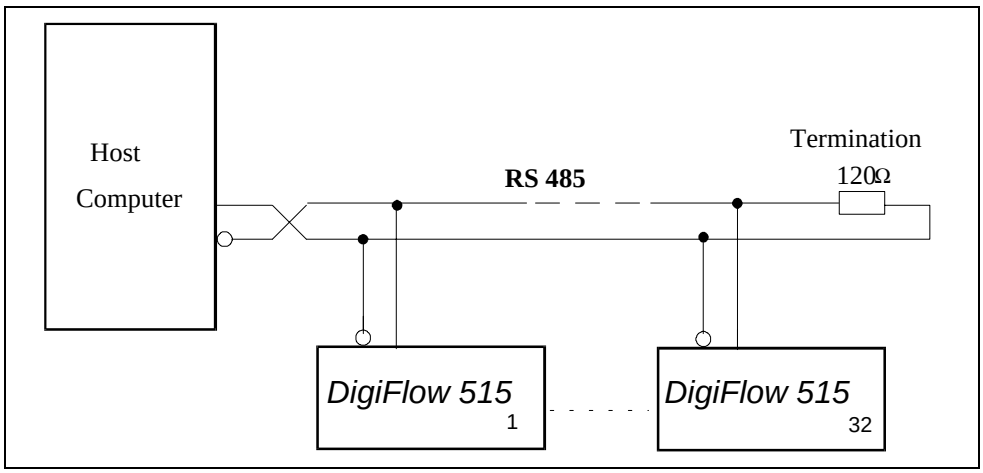


Fig. 15: Wiring of the network

11 Options

11.1 Analog output

The 0/4-20mA output option provides an scaled analog output to one of the listed parameters below:

Computer function:	**Selectable parameter:**
Gas flow correction	Volume flow, mass flow, temperature, pressure, (Kompressibilitly factor z_f of natural gas)
Steam flow correction	Mass flow, energy flow, temperature, pressure
Steam flow correction with energy balance	Mass flow total, up- or downstream, energy flow total, up- or downstream, temperature up- or downstream, pressure up- or downstream, specific volume in up- or downstream, specific enthalpy in up- or downstream

All output signal are isolated from power source an signal inputs, to ensure minimum interference an high reliability.

A block diagram of the output circuit is represented followingly, the various methods of connection have to be found on the following sides.

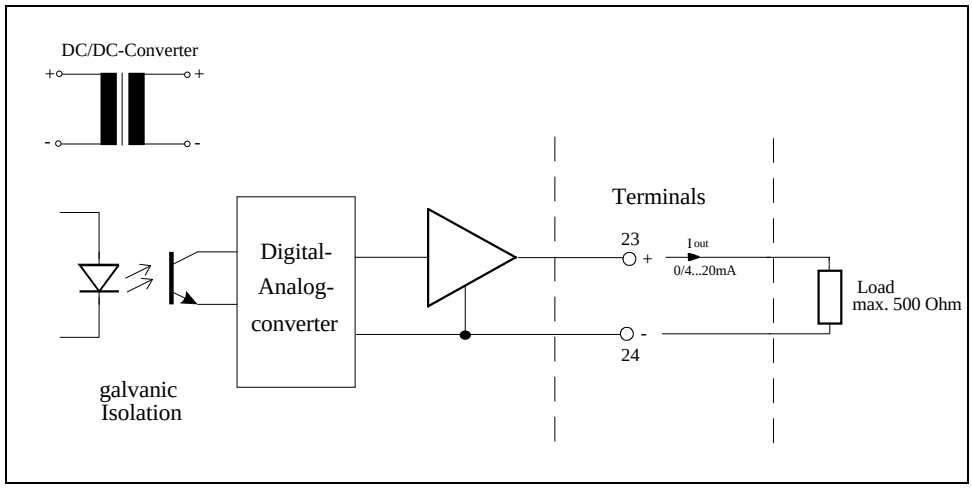


Fig. 16: Analog output circuit

Maximum load in output loop will be 500Ω.

The parameters for the analogous output are programmed at the configuration of the computer and serve:

Definition of corresponding min. value to 4 or 0mA output

Definition of corresponding max. value to 20mA output

Selection of output span 0–20mA — 4–20mA

Since the output range can be chosen freely, the computer can be used also for the amplification of the input signal e.g.. At the use of a writer can so instead of the illustration of the complete measuring range of e.g. 0-200kg/min be represented a part extended of 100kg/min (corresponds 4mA) to 120kg/min (corresponds 20mA)

For flow rates or displayed values outside the maximum or minimum values, an output signal of 20 or 0/4mA is issued.

The output signal is after approx. 0.8sec in agreement with the display udated. Between these update the output remains constantly.

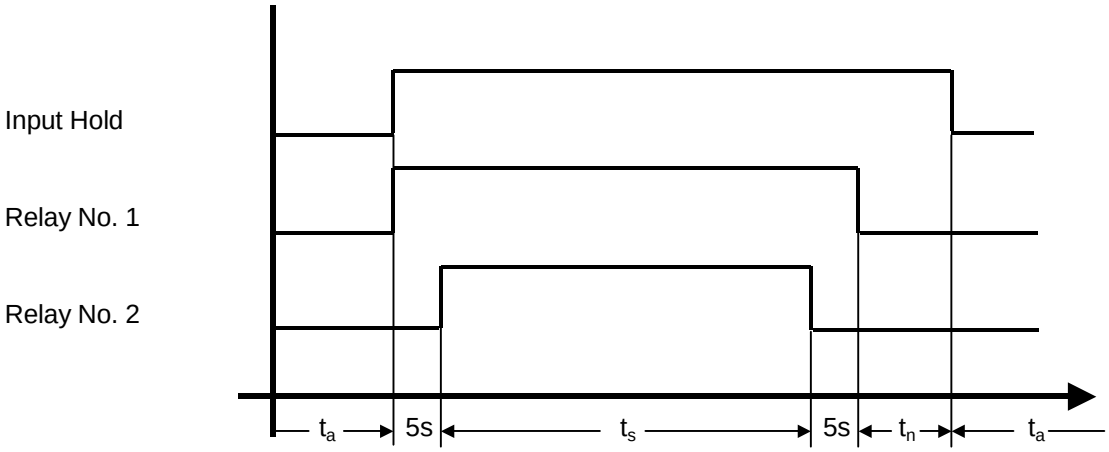
11.2 Control of a Sensor–Purge–Unit

The ***DigiFlow 515*** takes about this option the time control of the solenoid valves of a Sensor–Purge–Unit. This serves the freeing of the drillings of the ITABAR-open flow probes, which slowly lean on themselves in a polluted medium, by means of compressed air. Most times the D.P.-transmitter must be uncoupled from sensor before. This happens about solenoid valve blocks. During the flush the transmitter works not and no flow signal therefore is created, the quantity determination wouldn't be correct there. The flow signal therefore is held in the computer during the flush on the last value before the flush. The summation is therefore roughly correct furthermore.

During the parameter setting of the flow computer shall feed in three times.

- 1. Purging time distance $\mathbf{t_a}$: Time between two purgings. Setable from 10min to 31d:23h:50min. This time starts after starting up the calculator or after reconfiguration.
- 2. Purging time $\mathbf{t_s}$: Time of purging the probe. Setable from 1s to 999s.
- 3. Hold on time $\mathbf{t_n}$: Time lasting the measurement held still is although the transmitter is coupled again. This serves, that a stable difference pressure signal can be build up again. Setable from 0s to 99s

11.2.1 Time diagram Sensor–Purge–Unit



11.2.2 Functional description:

If the time between purging $\mathbf{t_a}$ has passed puts relays #1 on and the measurement of the flow input is held. Relay #2 becomes excited after 5s. Both relays remain excited for the purging time $\mathbf{t_s}$ now. After sequence of operations relay #2 releases and after another 5ses relays #1 also. For the duration of the settle time $\mathbf{t_n}$ however the measurement furthermore is in the calculator held. The current flow signal gets weighted first after this again.

12 Installation

12.1 General

The standard version of the calculating machine is supplied as panel mounting set (144 X 77 mm 5.7" X 3.03"). The cutoff in this panel must be 137mm wide (5.4") and 67 mm (2.6") high. The depth is 130 mm (5.1").The set ist fastened with the supplied mounting clamps.

The feeding of transmitter is carried out via a voltage supply output. This output delivers a voltage of about 18V, which can be set by an parameter at configuration. The maximum output current is 100mA.

The flow computer will be supplied by either 24V DC or 115/230V AC. The built-in mains transformer worries for a complete galvanic isolation between main power and the signal input- and output circles.

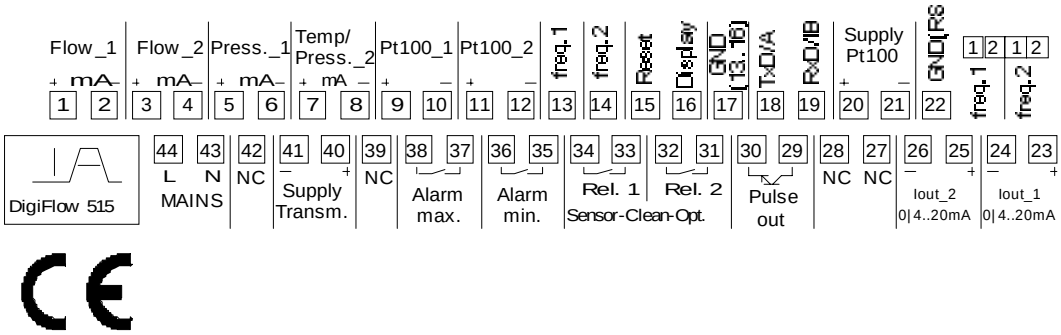
If the transmitter is in larger distance installed by the flow computer, in each case shielded cables should for the inputs and outputs, also in regard on EMC strength be used.

Make sure that the shielding may be grounded only at an end.

suppression filters:

If inductive loads are switched with the relay output, it may be necessary to provide a filtering module under circumstances

12.2 Rear View



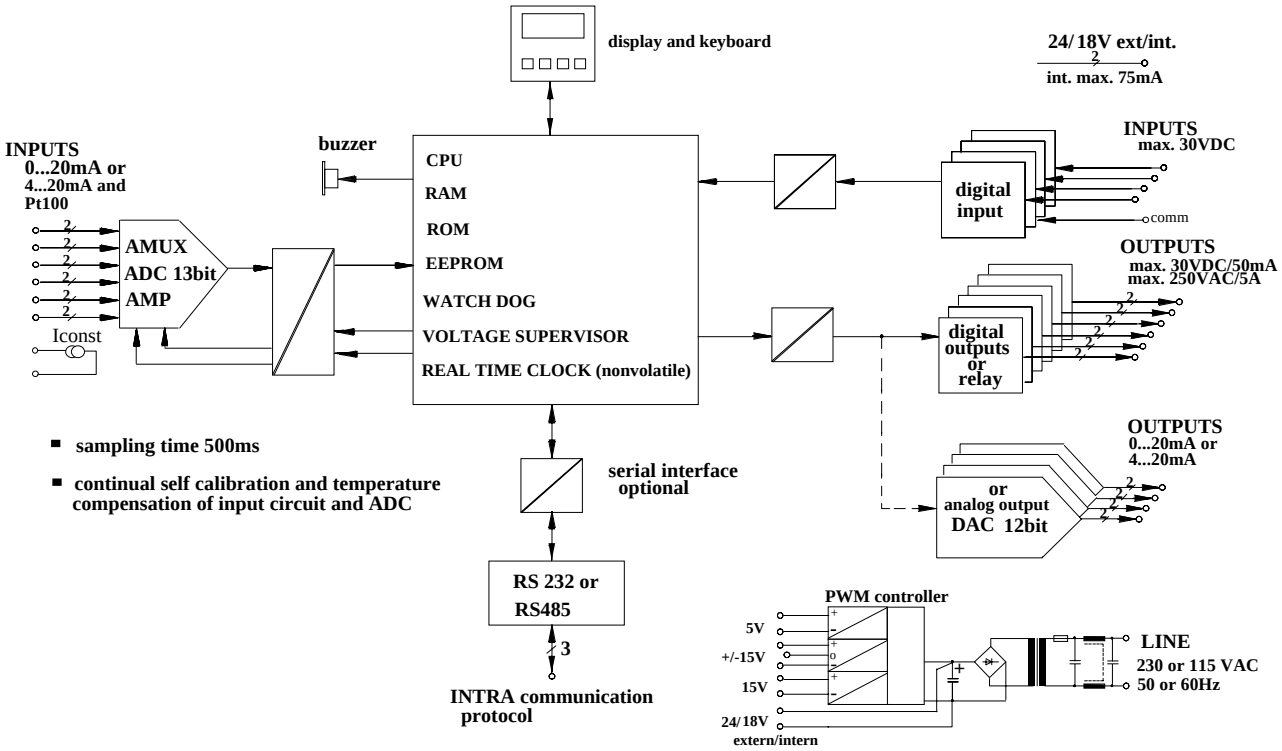
Attention! At an early series is the letterings for RxD and TxD mixes imprint up in this.

12.3 Wiring Designations

clamp	Function
1	Flow input no. 1 positive pole
2	Flow input no. 1 negative pole
3	Flow input no. 2 positive pole
4	Flow input no. 2 negative pole
5	Pressure input no. 1 positive pole
6	Pressure input no. 1 negative pole
7	Temperature input/Pressure input no. 2 positive pole
8	Temperature input/Pressure input no. 2 negative pole
9	Pt100 no. 1 positive pole
10	Pt100 no. 1 negative pole
11	Pt100 no. 2 positive pole

clamp	Function
12	Pt100 no. 2 negative pole
13	Frequency input no. 1 positive pole
14	Frequency input no. 2 positive pole
15	External sums reset, positive pole
16	External display switchover, positive pole
17	GND for clamps 13 - 16
18	RS 232 TxD / RS 485 B
19	RS 232 RxD / RS 486 A
20	Feeding of Pt100 positive pole
21	Feeding of Pt100 negative pole
22	GND RS 232 / RS 485
23	Analog output no. 1 positive pole (option)
24	Analog output no. 1 negative pole (option)
25	Analog output no. 2, positive pole (option)
26	Analog output no. 2, negative pole (option)
27	Analog output no. 3 positive pole (option)
28	Analog output no. 3 negative pole (option)
29	Pulse output (PNP, collector)
30	Pulse output (PNP-emitter)
31	Relays flush no. 2 (option)
32	Relays flush no. 2 (option)
33	Relays flush no. 1 (option)
34	Relays flush no. 1 (option)
35	Relays alarm minimum
36	Relays alarm minimum
37	Relays alarm maximum
38	Relays alarm maximum
39	NC
40	Transmitter feed+18V, positive pole
41	Transmitter feed +18V, negative pole
42	NC
43	Mains N / (optional 24V negative pole)
44	Mains L / (optional 24V positive pole)

13 Block Diagram



14 Appendix A Error descriptions

In case of errors the display of the **DigiFlow 515** toggles between normal display and error display in Frequency of 1 s. The beeper sounds alternately.

The beeper can be stopped by pressing the ENTER-key during on change to error display. The beeper is then quiet until a new error condition occures.

All errors are not stored and releases when the error conditions ends.

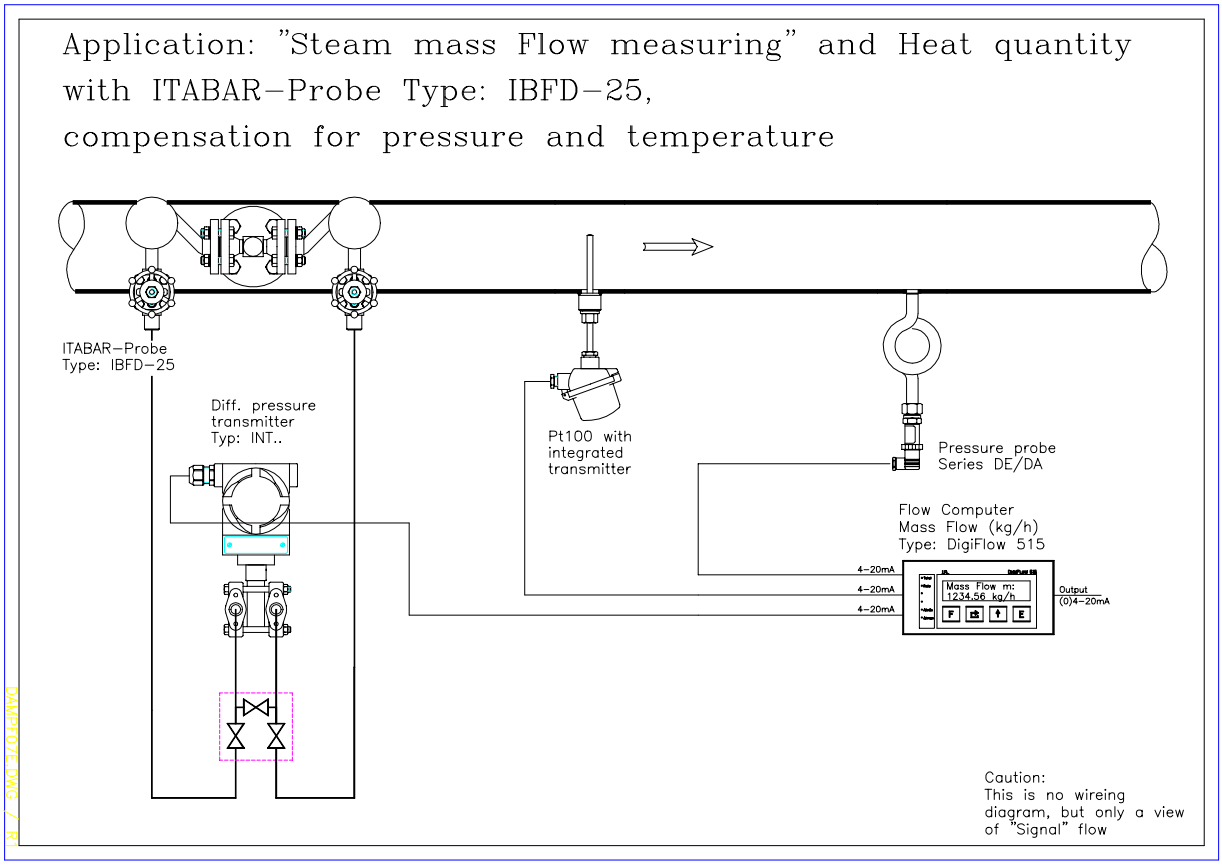
The meaning of these errors are:

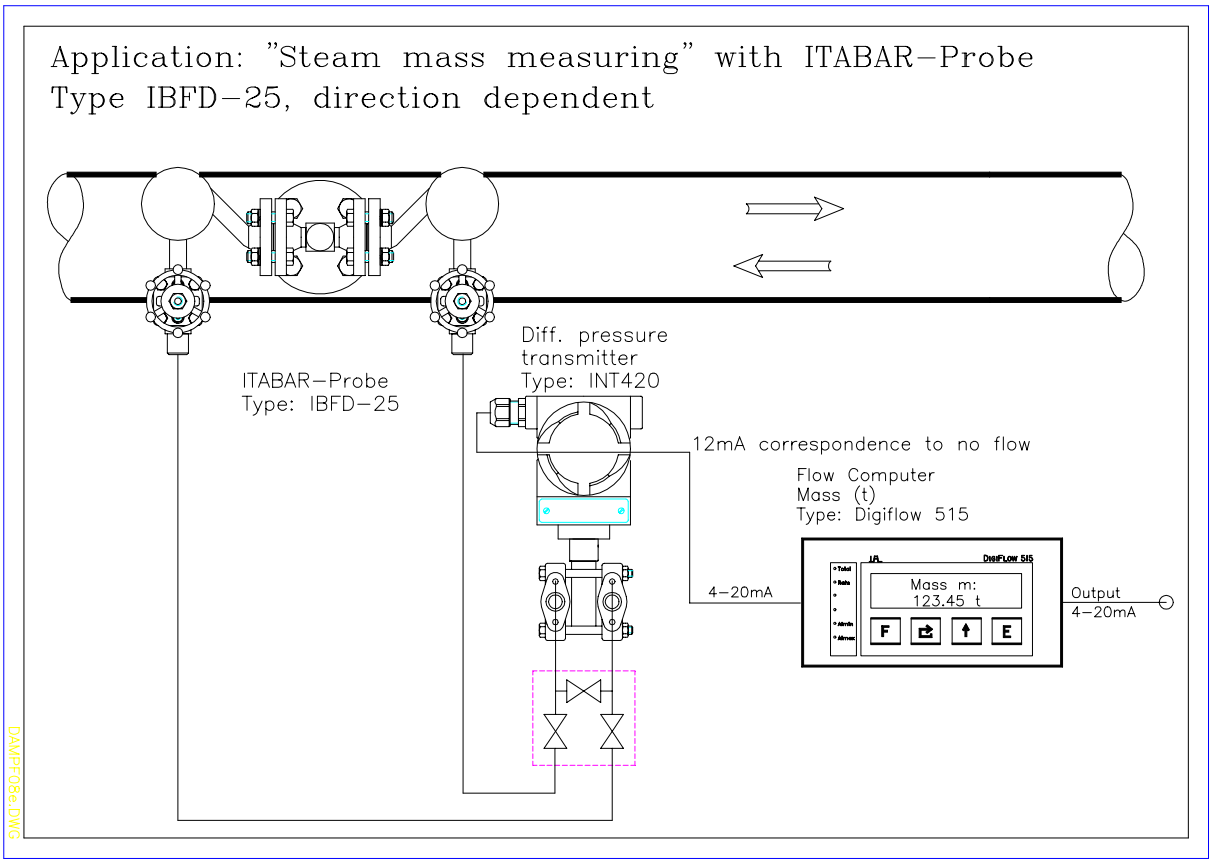
Analog #1	I_{in} < 3.6mA or I_{in} > 22mA.
Analog #2	Same as Analog #1, but only when this input is used..
Analog #3	Same as Analog #1, but only when this input is used.
Analog #4	Same as Analog #1, but only when this input is used.
Pt100 #1	R_{pt100} < 20 Ohms or R_{pt100} > 390 Ohms, but only when input is used.
Pt100 #2	Same as Pt100 #1
Redundanz	When selected 2 redundant analog flow inputs, the allowed maximum difference exeeded.
Bel. sat. line.	Can only occur on Steam-Computers, and when during factory setting the calculation of water is disabled in the forward path. The calculator then calculates on the saturation line, determined by temperature input.. (This shall inhibit the enormous massflow output, when in errorous case water as flow medium is determined, when by tolerances of the sensors the tempature or pressure is below the saturation line.)

15 Appendix B Properties of Some Gases:

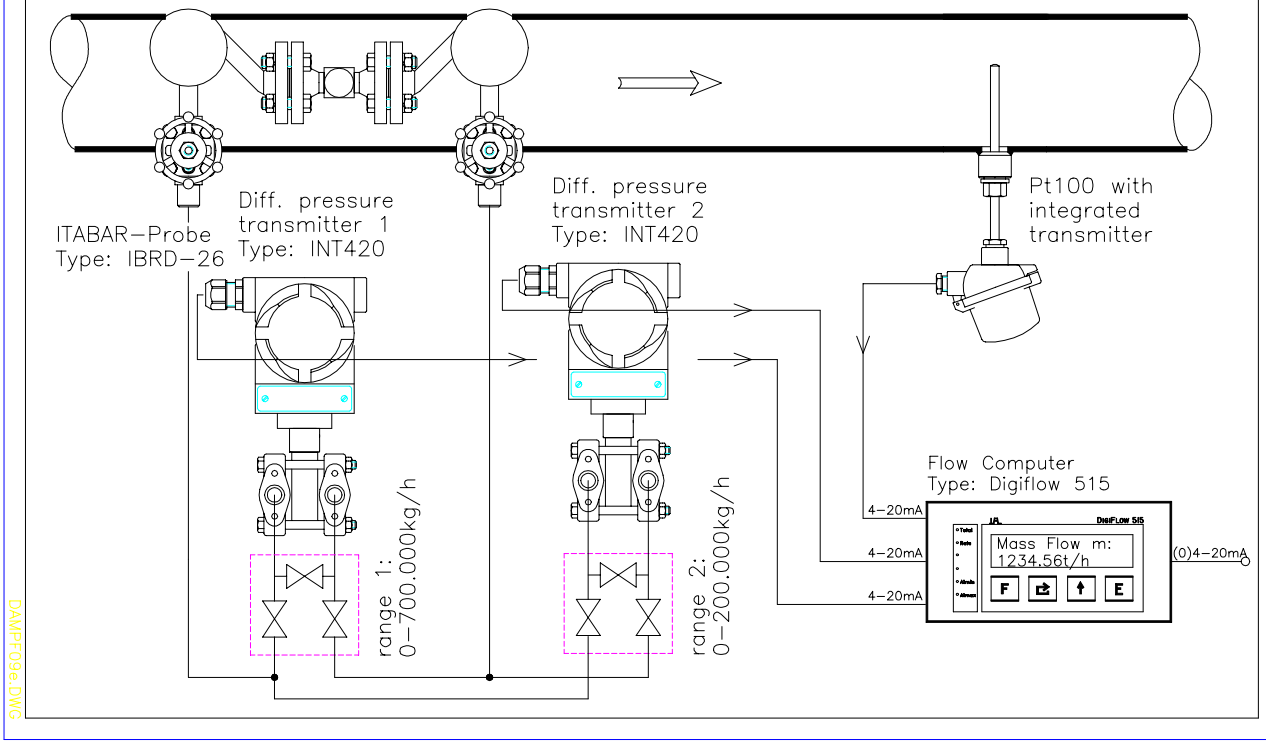
Gas	Formular Symbols	Specific Gravity	Crit. Temp. [°C]	Crit. Temp. [°F]	Crit. Press. [kPa]	Crit. Press. [psia]
Acetylene	C_2H_2	0.899	+35.17	95.3	6140	890.6
Air	- - -	1.000	-140.40	-220.8	3769	546.7
Ammonia	NH_3	0.588	-168.00	-270.4	11277	1637.7
Argon	C_2H_6	1.3793	122.30	-188.2	4873	706.9
Butane	C_4H_{10}	2.0054	153.00	307.4	3648	529.1
Carbon Dioxide	CO_2	1.5196	+31.60	87.9	7376	1069.9
Carbon Monoxide	CO	0.9671	-140.30	-229.5	3496	507.0
Chlorine	Cl_2	2.4482	+143.80	290.9	7701	1116.9
Ethane	C_2H_6	1.0382	+32.28	90.1	4884	708.4
Ethylene	C_2H_4	0.9686	+9.28	48.7	5036	730.4
Helium	He_2	0.1381	-267.90	-450.2	228.99	33.21
Helium-4		0.1382	-267.90	-450.3	226.8	32.9
Hydrogen	H_2	0.0696	-239.90	-399.9	1296.9	188.1
Hydrogen Chloride	HCl	1.1898	+51.44	124.6	8313	1205.7
Hydrogen Sulfide	H_2SO_4	1.1767	+100.10	212.1	8751	1269.2
Methane	CH_4	0.5539	-82.56	-116.6	4600	667.2
Neon	Ne_2	0.6969	-228.80	-379.8	2756	399.7
Nitrogen	N_2	0.9672	-146.90	-232.5	3394	492.3
Nitrous Oxide	NO_2	1.5199	+36.50	97.7	7265	1053.7
Oxygen	O_2	1.1048	-118.60	-181.4	5046	731.9
Propane	C_3H_8	1.5226	+96.67	206.0	4246	615.8
Propylene	CH_2	1.4529	+91.83	197.3	4620	670.1
Sulfur -Dioxide	SO_2	2.2119	+157.70	315.8	7883	1143.4
Xenon	Xe_2	4.5334	+16.56	61.8	5836	846.5

16 **Appendix C** Applications (Examples)

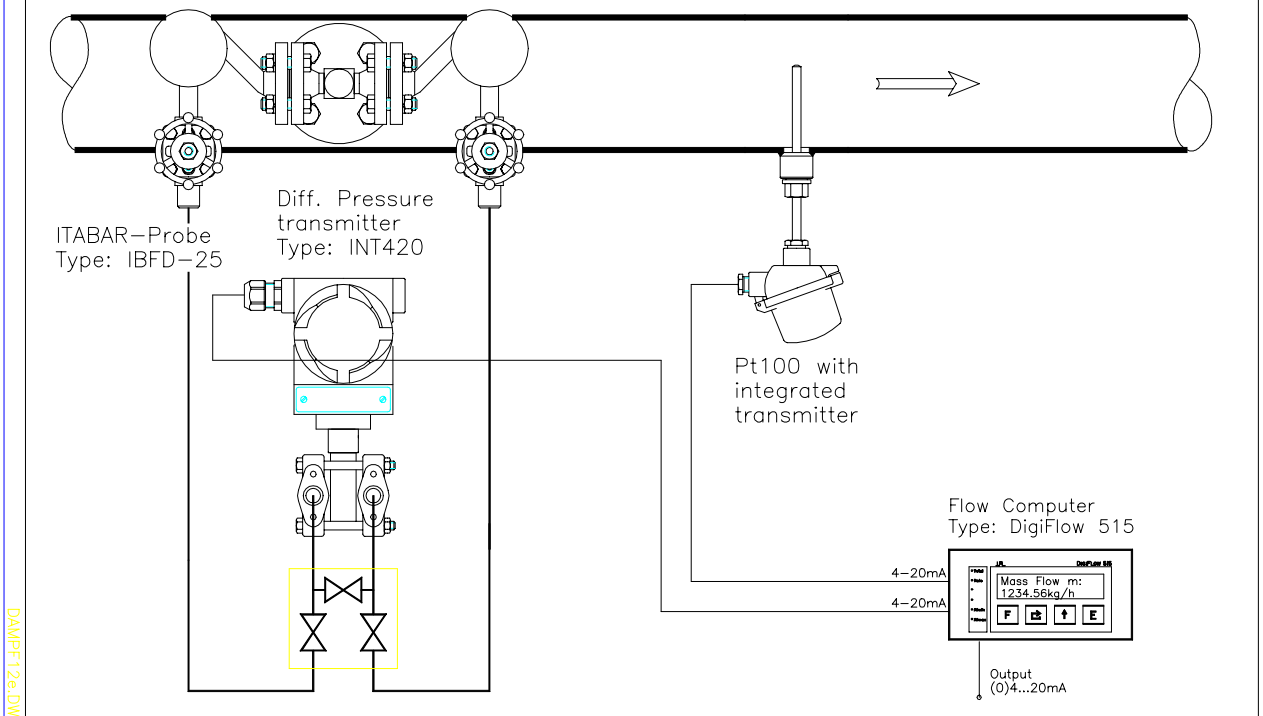




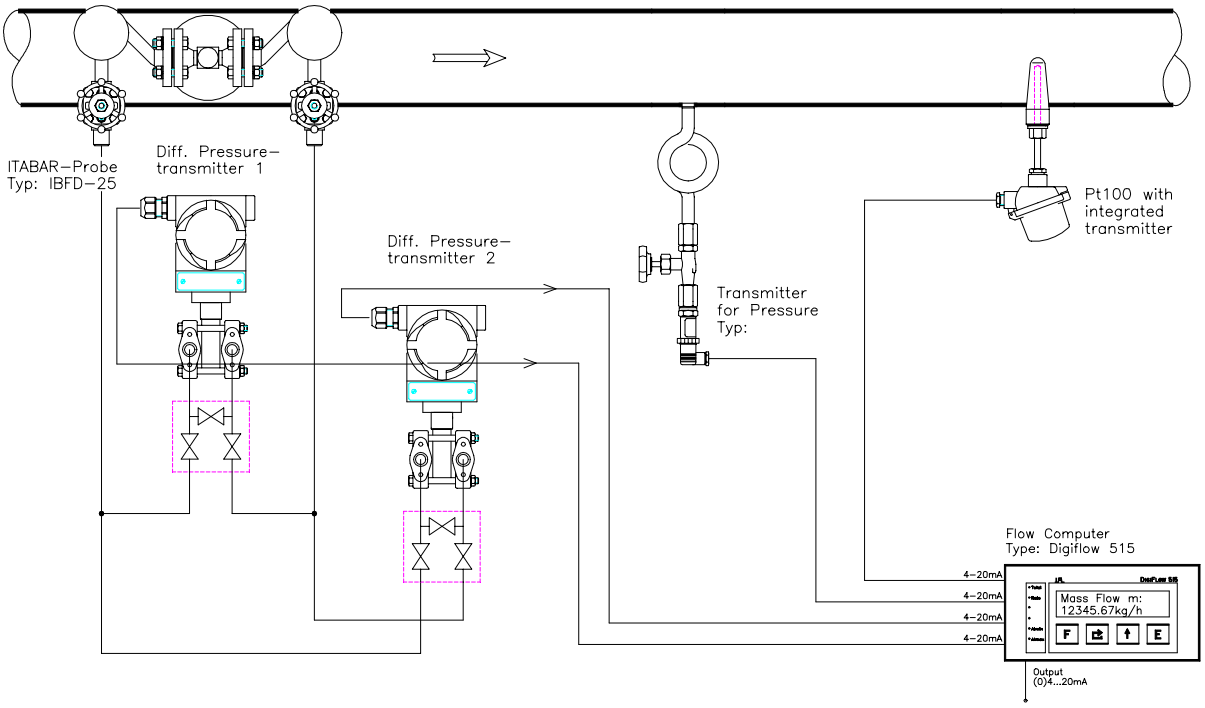
Application: "Steam mass measuring" with range splitting and compensation for temperature



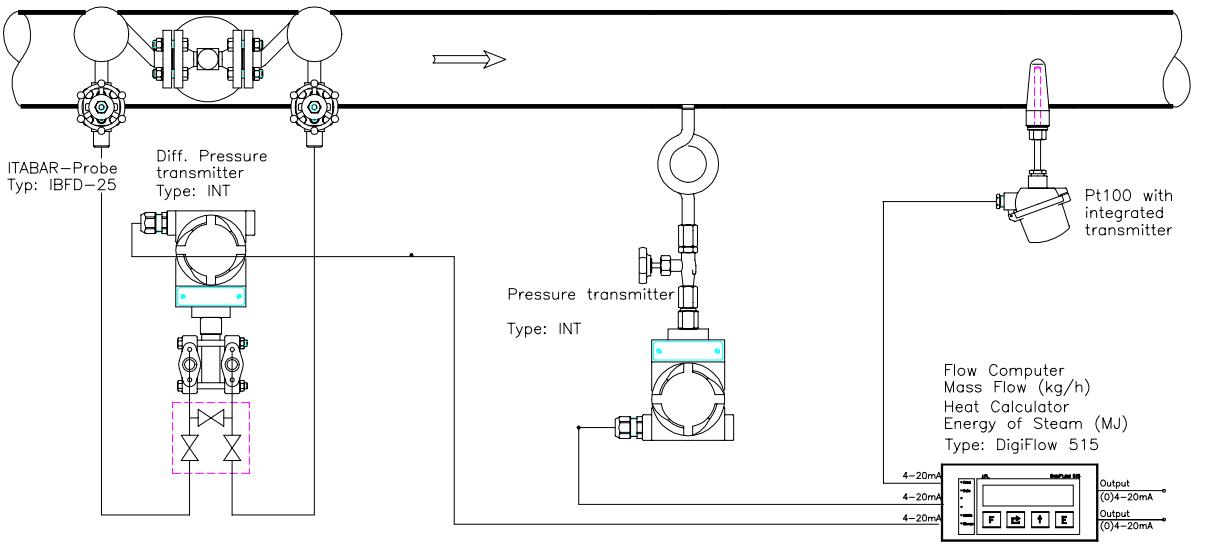
Application: "Quantity of saturized steam" with ITABAR-probe Type: IBFD–25, compensation for temperature



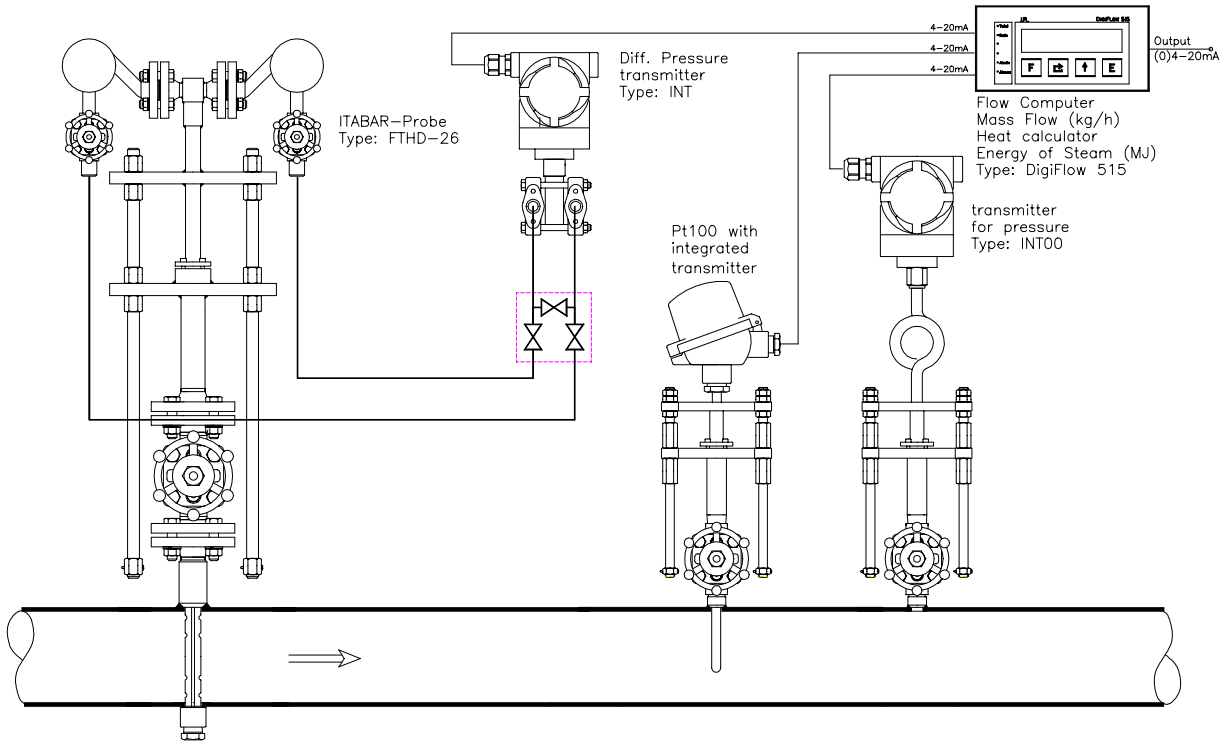
Application: "Quantity of steam" with ITABAR-Probe, range splitting, compensation for pressure and temperature



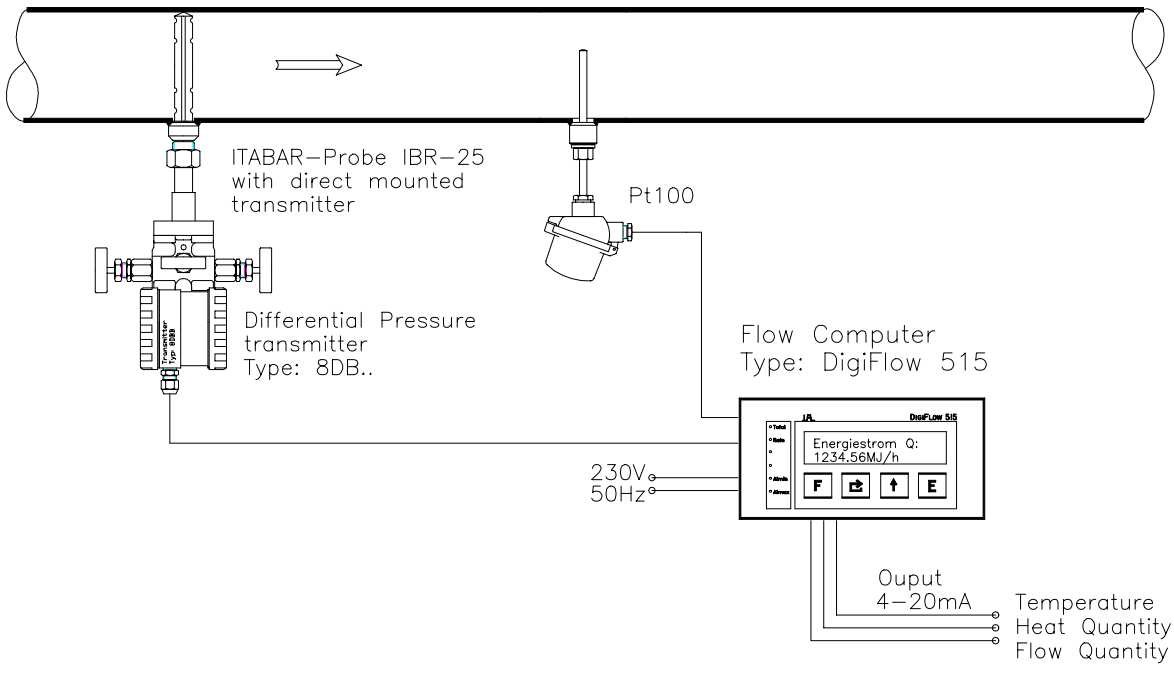
Application: "Mass Flow of steam and Energy of Steam" with ITABAR-Probe IBFD-25, compensation for pressure and temp.

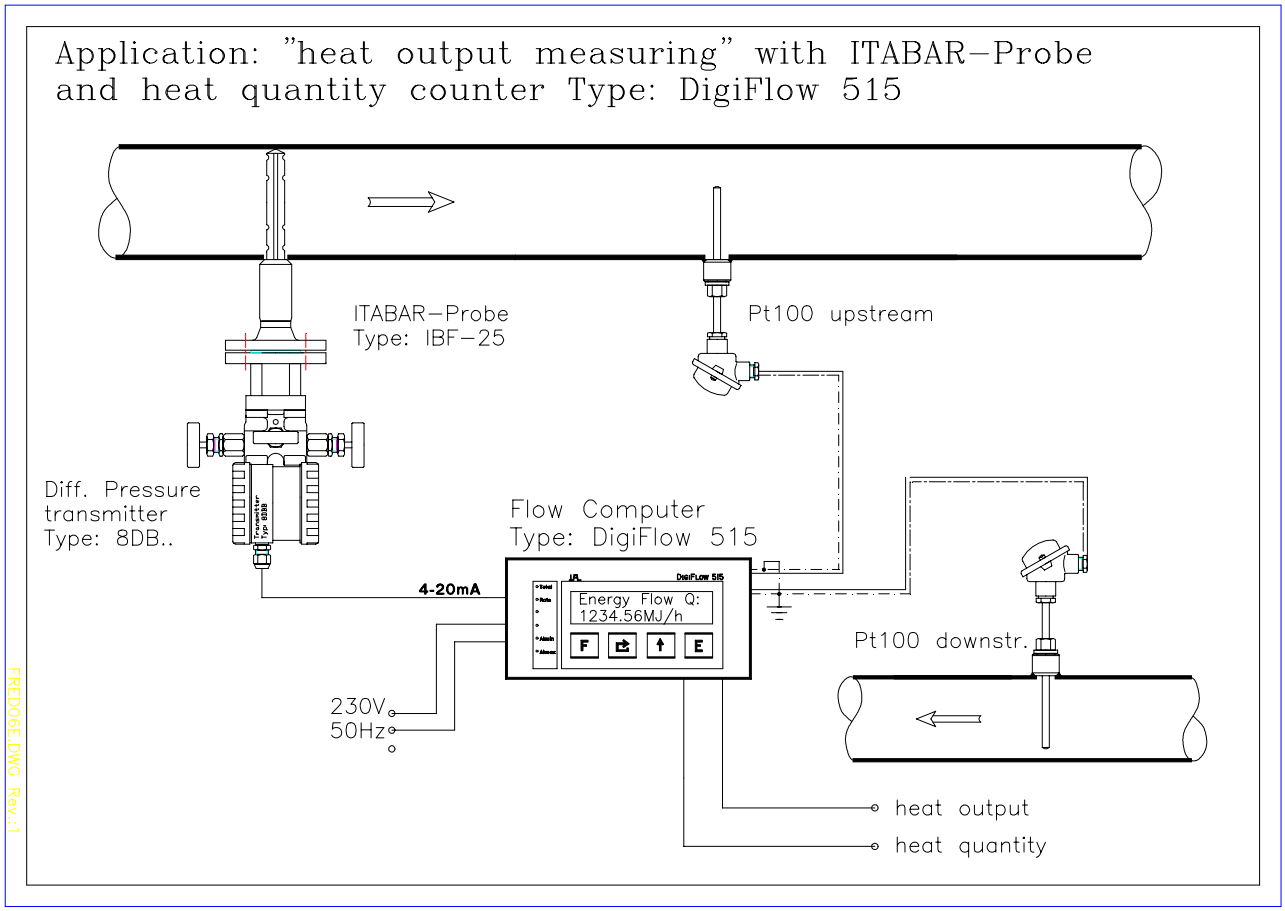


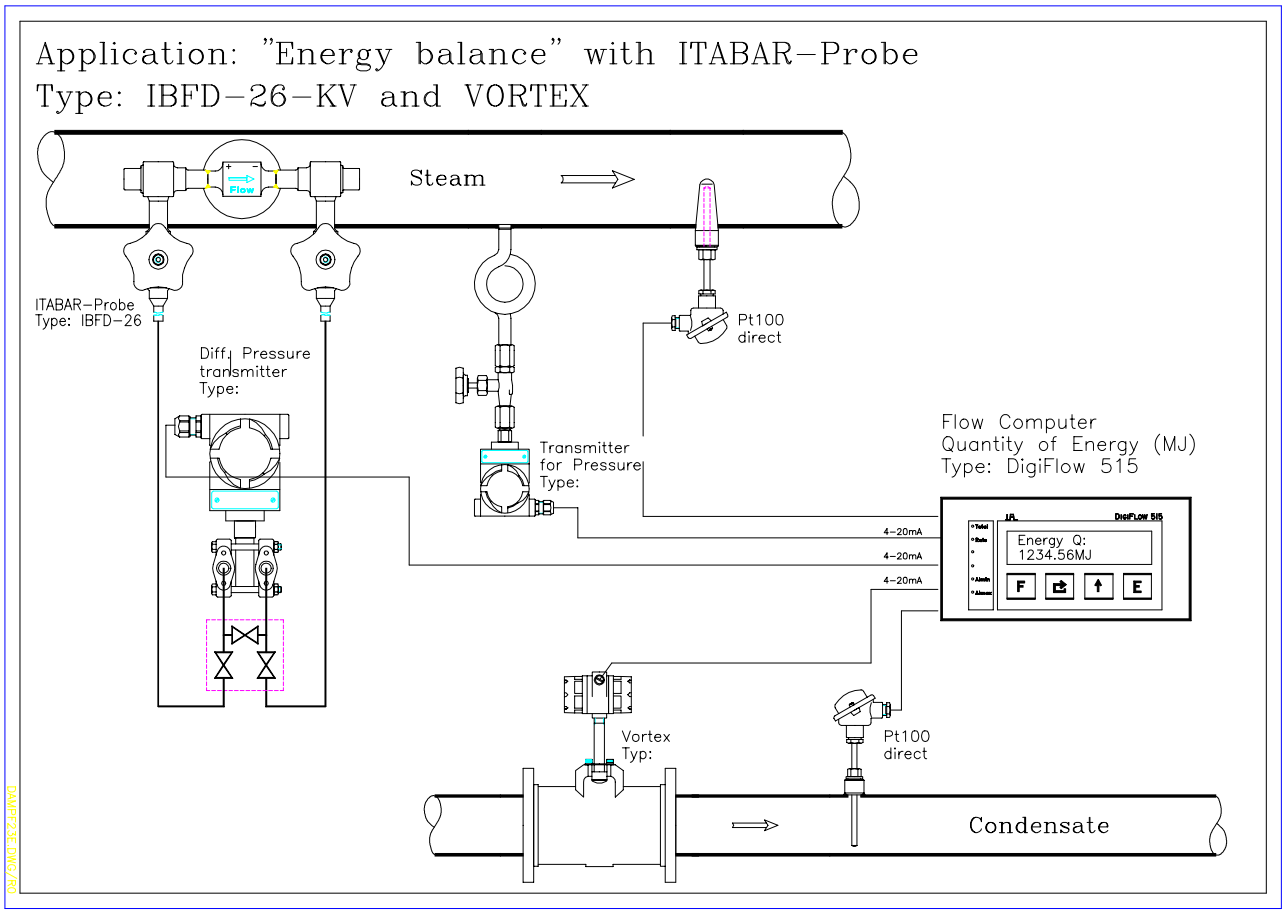
Application: "Steam mass measuring and Steam-Energy" with ITABAR-Probe FTHD-26, compensation for pressure and temp.

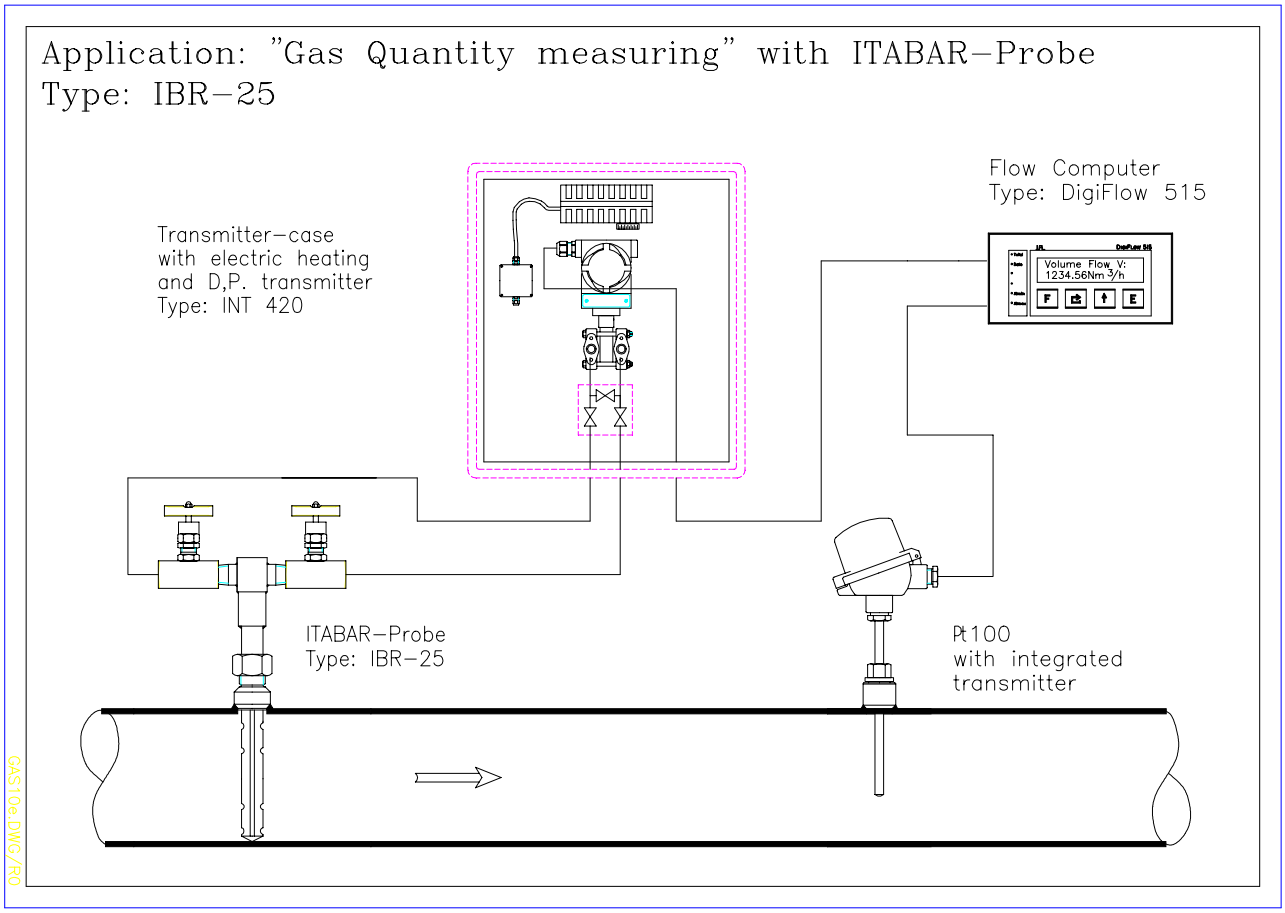


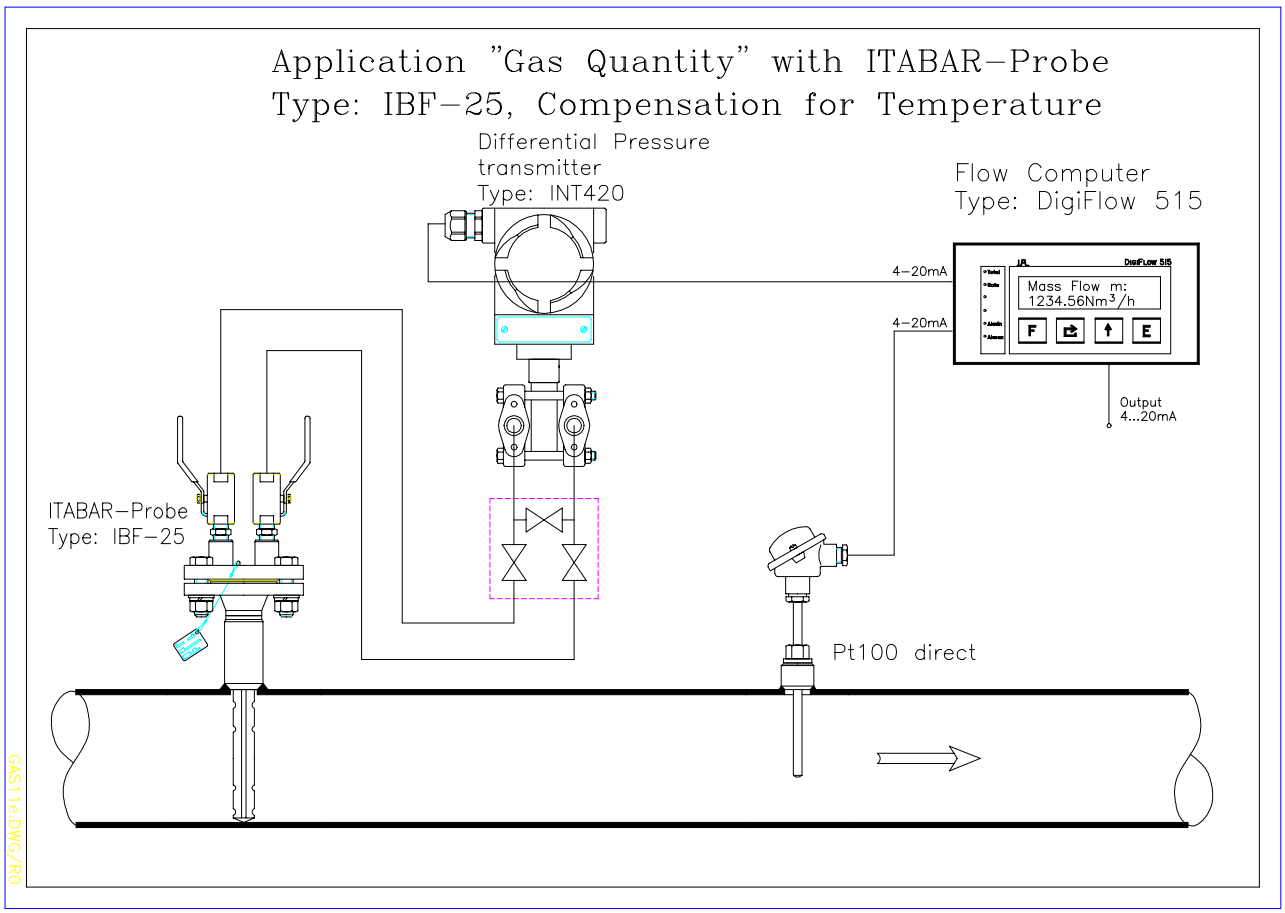
Application: "Energy of condensate" with ITABAR-Probe: Type: IBR-25




Application: "heat output measuring" with ITABAR-Probe
and heat quantity counter Type: DigiFlow 515
ITABAR-Probe
Type: IBF-25
Pt100 upstream
Diff. Pressure
transmitter
Type: 8DB..
Flow Computer
Type: DigiFlow 515
4-20mA
Energy Flow Q:
1234.56MJ/h
F
E
Pt100 downstr.
230V
50Hz
heat output
heat quantity


Application: "Energy balance" with ITABAR-Probe
Type: IBFD-26-KV and VORTEX
Steam
Flow
ITABAR-Probe
Type: IBFD-26
Diff. Pressure
transmitter
Type:
Pt100
direct
Transmitter
for Pressure
Type:
Flow Computer
Quantity of Energy (MJ)
Type: DigiFlow 515
4-20mA
4-20mA
4-20mA
Energy Q:
1234.56MJ
F
E
Vortex
Typ:
Pt100
direct
Condensate


Application: "Gas Quantity measuring" with ITABAR-Probe
Type: IBR-25
Transmitter-case
with electric heating
and D,P. transmitter
Type: INT 420
Flow Computer
Type: DigiFlow 515
Volume Flow V:
1234.56Nm³/h
ITABAR-Probe
Type: IBR-25
Pt100
with integrated
transmitter
GAS10e.DWG/R0


Application "Gas Quantity" with ITABAR-Probe
Type: IBF-25, Compensation for Temperature
Differential Pressure
transmitter
Type: INT420
Flow Computer
Type: DigiFlow 515
4-20mA
4-20mA
Mass Flow m:
1234.56Nm³/h
Output
4...20mA
ITABAR-Probe
Type: IBF-25
Pt100 direct
GAS11e.DWG/R0