



## Installation and Operation Manual Ultrasonic Flow Transmitter DU-S

Flow meters on the ultrasonic measuring principle



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### 1. Description of the instrument

The DU-S detects flows and accumulated volumes in pipe systems due to an ultrasonic delay time mode with a time resolution of 45 picoseconds.

Different connection versions are available:

- ½" version in brass or stainless steel, flow maximum about 80 l/min
- 1" version in stainless steel, flow maximum about 180 l/min
- 2" version in stainless steel, flow maximum about 1000 l/min

All versions come with an external thread connection for mounting in existing pipe systems.

Media: Water, oil, emulsion etc. with low gas rate (bubbles)

DU-S must not be used in systems where the max. pressure or max. temperature indicated in our documentation is exceeded.

#### **Advice!**

DU-S may not be used as the only safety-relevant part according to PED 97/23 / EC.

### 2. Menu of DU-S

The user can adapt the device to his application with the help of a menu system. The menu has a simple structure and is easy to use. Pressing button < P > activates the menu. With the button < Arrow up > respectively < Arrow down > one can choose the wanted menu points:

- Output ParmS
- Instrument ParmS
- Math ParmS
- Instrument Test

Again pressing button < P > the menu point marked with < \* > is activated. Using button < Arrow up > respectively < Arrow down > parameters can now be adjusted. By pressing < P > selected data are accepted. All data are stored in a non-volatile memory.

#### **Attention:**

Changing of parameters have to be confirmed by pressing < P > within 5 seconds, otherwise the DU-S changes back to the measuring modus without taking over the parameters.

#### **Advice:**

Parameters critical to the system are protected by a code in order to guarantee the function of the transmitter. This code is available from the manufacturer, if a change of these parameters is necessary.



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#### 2.1. Output parameter < Output Parameters > Menu 1

2.1.1. **Relay 1** – setting switch point of output relay 1

2.1.2. **Relay 2** – setting switch point of output relay 2

If the actual measured flow exceeds/falls below one of the adjusted switch points the related relay is actuated. If the switching point of one or both relays is adjusted to "0", the relay is never actuated.

The relays are SPDT types with a switching capacity of 30VDC / 1A respectively 120VAC / 1A resistive load.

2.1.3. **U-I-F Output** – Selection of current, voltage or frequency output

4-20mA - analog current output 4-20mA, working resistance 0 Ohm to 1000 Ohm 0-10V

- analog voltage output 0-10V, ripple ca. 1 MOhm

Freq.Out - configurable frequency output with Fmax up to 32KHz, ripple ca. 2 KOhm

Electrical connection is made at two pins of the 4-pole supply plug. All output signals are related to the device ground (see 4.1).

If the frequency output is selected, the desired output frequency range  $F_{out-Max}$  from 125Hz  $\leq F_{out} \leq 32KHz$  can be adjusted. The signal shape is rectangular with an amplitude of about 16Vpp at a working voltage of 24VDC and a load of 4.7 KOhm.

2.1.4. **Maximum flow limit - Max Flow Limit**

This parameter determines at which flow the maximum value of the selected output signal (4-20mA, 0-10V,  $F_{out}$ ) is created. This allows to adapt the upper limit of the measuring range to special requirements. If the *Max Flow Limit* is achieved, the selected output delivers its maximum signal.

Advice:

If the Max Flow Limit is passed over, the display shows < Overflow > and the different output signals react as follows:

4-20mA -> 24mA is generated

0-10V -> 12V is generated

Freq.Out ->  $F_{out-Max}$  is shown

If the flow is less than 0, respectively reversed, output signals react as follows:

4-20mA -> 2mA is generated

0-10V -> 0V is generated

Freq.Out -> 0Hz is generated



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#### 2.2 Instrument Parameter < Instrument Params > Menu 2

##### 2.2.1. DU-S Modus, Flow meter - Totaliser - *DU-S Mode*

**Flow** – the device works as flow meter.  
**Totalise** – the device works as totaliser.

The added value of the totaliser is maintained in case of power failure to the DU-S. Power outages can be indicated by the *Bat Check* function (see 2.2.5.)

**Advice:**

The totaliser is always working even when the DU-S device is not in the *Totalize* mode. In device mode *Totalize*, the totaliser can be reset to zero by pressing button < Arrow up >.

##### 2.2.2. Flow-Units *Select Flow Unit*

Available Flow Units::

**L/Sec** - Litres per second  
**L/Min** - Litres per minute  
**L/H** - Litres per hour  
**M<sup>3</sup>/Min** - Cubic meters per minute  
**M<sup>3</sup>/H** - Cubic meters per hour  
**Gal/Sec** - Gallons per second  
**Gal/Min** - Gallons per minute  
**Gal/H** - Gallons per hour  
**%** - Percentage of **Max Flow Limit**  
**m/sec** - Flow speed in meters per second

**Advice:**

If the DU-S device is in measuring mode, the actual speed of flow is displayed when you press < Arrow up >. Pressing < Arrow down > indicates the speed of sound in the media in m/sec.

##### 2.2.3. Flow direction - *Reverse Flow*

**Reverse Flow** negates the prefix of flow indication.

If, after installing the DU-S device in a piping system, a negative flow rate is displayed, this can be reversed with the **Reverse flow** function!



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### 2.2.4. Leak flow volume cut off - **Low Flow Cut-Off**

If the absolute value of the flow rate is less than or equal the **Max Flow Limit** \* **Low\_Flow\_Cut\_Off**, the calculated flow value is drawn to 0. Low flow cut-off can be adjusted between the limits of 0% to 10% of the **Max Flow Limit**.  
To obtain a clearly defined point 0, at least 1% ( to 2 %) adjustment should be set.

### 2.2.5. Checking supply voltage failure - **BatCheck**

If **BatCheck** is activated, a possible power failure is registered. If power comes back a sound alert is generated and the message < Pwr.Supply fail > appears. It is necessary to press < P > and < Arrow up > at the same time to get back to the standard measuring mode.  
This function is recommended to use when the totaliser is in operation and thus informs the user that due to the power failure the totaliser level is not correct as the flow passing the DU-S device during power failure was not counted.

### 2.2.6. Parameter protection – **PIN code**

The **PIN code** protects the parameters of the device. Unauthorized change is thus prevented. If the **PIN code** is activated the DU-S device requires the 4-digit PIN code if a parameter needs to be changed. This is in effect until the PIN code query is de-activated.

#### **Advice:**

It is recommended to leave a note of the PIN code at a save location. If the PIN code is lost the user must request a Master PIN code from the manufacturer.

### 2.2.7. Interface RS-232 or RS-485 - **COM interface**

For selection of following interface standards: RS-232 or RS-485.

Following options are available:

DU-S with RS-232

DU-S with RS-485, Half Duplex

#### **Advice:**

If the RS-485 interface is selected, the DU-S device demands the input of a valid bus address.

### 2.2.8. Restore of Factory Settings - **Restore Factory Settings**

The DU-S device is reset to the condition at the state of delivery. All parameters are at the default setting of the manufacturer (software adjustment).



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#### 2.3. Mathematical Parameters < Math.Parms > Menu 3

##### 2.3.1. Characteristic diagram K-Factor - *K-Factor*

This function is used for adaption of the characteristic diagram according to formula:

$$Q_{korr} = Q_{ist} * K$$

Q<sub>ist</sub> - measured flow  
Q<sub>korr</sub> - corrected flow  
K - absolute term (multiplicative constant)

This function is used when flow conditions have changed in regard to the original calibration.

**Advice:**

This function is protected by a separate Code (KO\_Code). If the Code is needed please ask the manufacturer.

##### 2.3.2. Characteristic diagram dynamical offset - *Dynamical Offset*

This function is used for adaption of the characteristic diagram according to formula:

$$Q_{korr} = Q_{ist} + DynOffset * (Q_{ist} / Q_{maxPhys})$$

with: Q<sub>ist</sub> - measured flow  
Q<sub>korr</sub> - corrected flow  
Q<sub>maxPhys</sub> - maximum flow in pipe at v=5m/sec  
DynOffset - absolute term (additive)

**Advice:**

This function is protected by a separate Code (KO\_Code). If the Code is needed please ask the manufacturer.

##### 2.3.3. *Integration Time*

The DU-S device needs approx. 80ms for one flow measurement. It calculates the indicated flow rate out of a minimum of 10 to a maximum of 100 measurements. This means an adjustment range of the *Integration Time* of 0,8sec to 8sec. The average value is formed after the method of the exponential moving average.



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##### 2.3.4. Zero point adjustment - *Auto Zero Instrument*

This function is for automatic 0-point determination of the device. It is assumed that the pipe section of the DU-S unit is filled completely with medium, free of bubbles and movement.

**It is necessary to perform this function for each new device!**

## 2.4. Instrument Test Function < Instr. Test > Menu 4

##### 2.4.1. Indication of supply voltage - *Supply Voltage*

The device works like a Voltmeter and indicates the actual supply voltage. Press button < P > to finish the measurement.

##### **Advice!**

The allowed voltage is: 24VDC +/-15%, maximum ripple 100mV

If low-grade power supply units are used, restricted function of the DU-S device respectively an inaccurate measurement can occur. To operate inductive loads with the same power supply as the DU-S unit are not allowed!

##### 2.4.2. 4-20mA offset of analog output - *4-20mA Offset*

This function is set for special applications and protected by the code of the manufacturer.

##### 2.4.3. 4-20mA K-value of current output - *4-20mA K-Value*

This function is set for special applications and protected by the code of the manufacturer.

##### 2.4.4. 0-10V K-value of voltage output - *0-10V K-Value*

This function is set for special applications and protected by the code of the manufacturer.

##### 2.4.5. Flow test function - *Flow Test*

This function simulates flow rates between zero and the *Max Flow Limit* for demonstration and test purposes during configuration of the plant. This way the display, the relay contacts as well as 4-20 mA, 0-10V, Fout and the interface can be controlled. Here, the DU-S unit works without pipe connection and medium.

##### 2.4.6. Relay Test Function - *Relay Test*

The relay test function operates the switching point relays alternately (relays on/off).





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### 3. Error messages

#### **Error 1: Echo Bad**

Very turbulent flow, no measurement is possible.

#### **Error 2: No Fluid**

No medium in measuring pipe, no measurement is possible.

If there is 0 flow indication while there is flow, flow direction has to be changed in the program.  
Please refer to point 2.2.3.

### 4. Connection plug arrangement

Please first open the plug to get access to the connection pins

#### 4.1. Power supply, current- voltage - freq.out output, 4-pole plug

Pin 1: 4-20mA / 0-10V / Freq.Out

Pin 2: GND

Pin 3: GND

Pin 4: +24VDC +/-15%

#### 4.2. Relay output, 6-pole plug

Pin 1: Relay 2, normally open contact

Pin 2: Relay 2, middle contact

Pin 3: Relay 2, normally closed contact

Pin 4: Relay 1, normally open contact

Pin 5: Relay 1, middle contact

Pin 6: Relay 1, normally closed contact

#### 4.3. Interface, RS232 / RS485 RS-232, Option

Pin 1: TxD

Pin 2: RxD

Pin 3: GND

RS-485 Half Duplex, Option

Pin 1: A

Pin 2: B

Pin 3: GND



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#### 5. Technical data

Connection sizes	½", 1" and 2" external thread
Material pipe section	Brass (½" Version), stainless steel 1.4571 (1" and 2" Version)
Material sensors	Stainless steel 1.4571
Housing	Die-cast aluminium
Measuring range	0,1-6 m/s, possibility to choose different measurement units.
Measuring function	Flow speed, flow quantity and totalizer
Display	2x16 digits, illuminated
Power supply	24V DC ± 15%
Power consumption	200 mA maximum
Relays	30VDC/1A 2x SPDT
Signal output	4-20mA, 0-10V, frequency (adjustable maximum 32 kHz)
Interface	RS 232, RS 485 (with optional interface cable only)
Measuring principle	Ultra sonic transit-time difference method
Media	Acoustic conductive fluids, gas solid contents ≤ 10 volume %
Operation	3 buttons at the front side
Orientation	Optional (housing is rotatable)
Accuracy	±2% v. M.E. at norm conditions
Operation temperature	-10° - 60° C
Operation temperature (medium)	-20° - 100° C (higher on request)
Pressure loss	No cross-section reduction
Maximum pressure	25 bar
Protection class	IP 65
Measurement deviations	Better than +/- 2 % of the measuring range end value

As an option, the configuration software US is available. It allows easy programming of the device and reading of output values. System software: Windows TM XP.