



FDL400

Flow Data Logger



UNDATEC Flow Measurement Solutions

Frank Stark - Wiesenstrasse 23 - D-75248 Oelbronn-Duerrn / Germany - Telefon +49 (0) 7237-7804
Email: undatec@web.de

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Errors, mistranslation and technical improvement may change these data !

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Email: undatec@web.de

1. EC - Declaration of Conformity

Name of Manufacturer: UNDATEC Flow Measurement Solutions
Wiesenstraße 23
75248 Oelbronn-Duerrn - Germany



Product Name: FDL400 Flow Data Logger

Product Type: Flow measurement for water and wastewater

The designated product is in conformity with the following European Council Directives for harmonization of the laws of Member States.

The conformity of the designated product with the provisions of the Directive evidenced by full compliance with the following harmonized European standards.

2014/30 / EU EMC - Directive

DIN EN 61000-6-2: 2006 + Corrigendum 1: 2011-06
DIN EN 61000-6-4: 2011-09



2014/34 / EU ATEX - Directive

II 2G Ex ib IIB T4

EN 60079-0: 2012 + A11: 2013
EN 60079-11: 2012

With the application of CE - marking we confirm the successful EMC – test
Report No.: 15024C20

Affixing CE marking: 2014

Location: Oelbronn-Duerrn Date: 29/01/2014 Signature / Technical Manager:

Frank Stark

This declaration certifies compliance with the indicated directives but contains no assurance of properties in the sense of the product liability law.
The safety instructions of the supplied product documentation must be observed.

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2. Safety instructions

Safe operation is only ensured if the notes and warnings will be noted in this manual.

Important! Seal, seals and labels

Opening or removing seals or labels, eg etc. with serial numbers, will result in immediate loss of warranty claims result.

Determination and proper use

The manufacturer is not liable for damages resulting from improper use.

Compare and information before operating the conformity of the supply voltage match the specifications on the nameplate.

If it becomes that a safe operation is no longer possible (eg visible damage), put the appliance out of service immediately and secure it against unintentional starting.

Improper or unauthorized use, dangers may arise from the device, which is why we refer to consistent observance of safety notes.

Mounting, commissioning and operating personnel

Mounting, electrical installation, commissioning and maintenance of the device must be carried out only by trained specialist personnel authorized by the plant operator.

Technical personnel must have read and understood this manual, and follow their statements.

The device may only be operated by persons who are authorized and trained by the facility operator. The instructions in this manual must be followed.

Make sure that the device is in accordance with the electrical terminals connected correctly.

Repairs

Repairs should only be performed by trained service personnel.

Please contact in this case to the company Dömges.Detectronic UG.

Technical progress

The manufacturer reserves the right to modify technical data without special announcements on the basis of development of technical progress. About the activities and possible extensions of this manual can be supplied by the company Dömges Detectronic UG.

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3. Description

This manual is valid for the following device version

- Hardware from 2.0 and after

- Firmware from 2.1 and after

The Flow Data Logger FDL400 suitable for flow measurement in partially filled channels or pipes.

The evaluation is performed according to the flow formula $Q = VA$.

A combined measuring sensor, mounted on the bottom or the wall of a channel detects the flow speed V in m / s according to the Doppler principle. About a sound beam that shines against the flow direction in the medium, the speed data is collected and further processed in the processor.

The integrated pressure sensor is used to detect the level in m ; above this value each perfused segment surface is again in the processor through a pre-programmed channel cross section calculated in m^2 .

With the two multiplicands will calculated the sum Q in l / s .

The programming of all necessary parameters can made via 16 buttons on the front-panel keyboard. The clear 4 lines display the individual values appear

- **Velocity**
- **Level**
- **Flow**
- **Totalizer**

The measuring sensor is powered from the FDL400 device with the necessary voltage. The two values for flow rate and liquid level are directly on the sensor 4-20 mA signal is available. This allows the device to be mounted further away from the location on your channel. Without any further installation work is usually sufficient to cable extension of the probe.

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4. FDL400 – Flow Data Logger

4.1 Technical Data

The transmitter are housed in an aluminum case and is suitable for wall mounting or DIN rail mounting.

The device with connected sensor required after turning a certain time to reach operating temperature (warm-up time). This is about 10-15 minutes.

Power supply : 24V DC +/-20%

current consumption : 120mA – 220mA (depending of outputs - and sensor currents).

Fuse : The device is protected against reverse polarity.

To hedge serve soldered fuses.

(A blown fuse must not be repaired by the customer, since this is special parts for ATEX-approved devices.)

Protection class : IP30

Dimension : 197 x 153 x 37,5mm (B x H x T)

Temperatur range : 0 – 50°C

Display : LCD 4 lines x 20 character for

- Velocity
- Level
- Flow
- Totalizer

Outputs : 3 x analog 0(4) – 20 mA (+/- 3%) / Burden 100Ω - 900Ω

freely configurable for flow standards, flow extra amount, velocity and level.

4 x digital , opto-coupled, p-type transistor outputs (PNP) -

12 - 30V / 50mA, short circuit protected.

1 x permanently programmed as an alarm .

3 x freely configurable for flow standards, flow extra amount, impulse, velocity and the level.

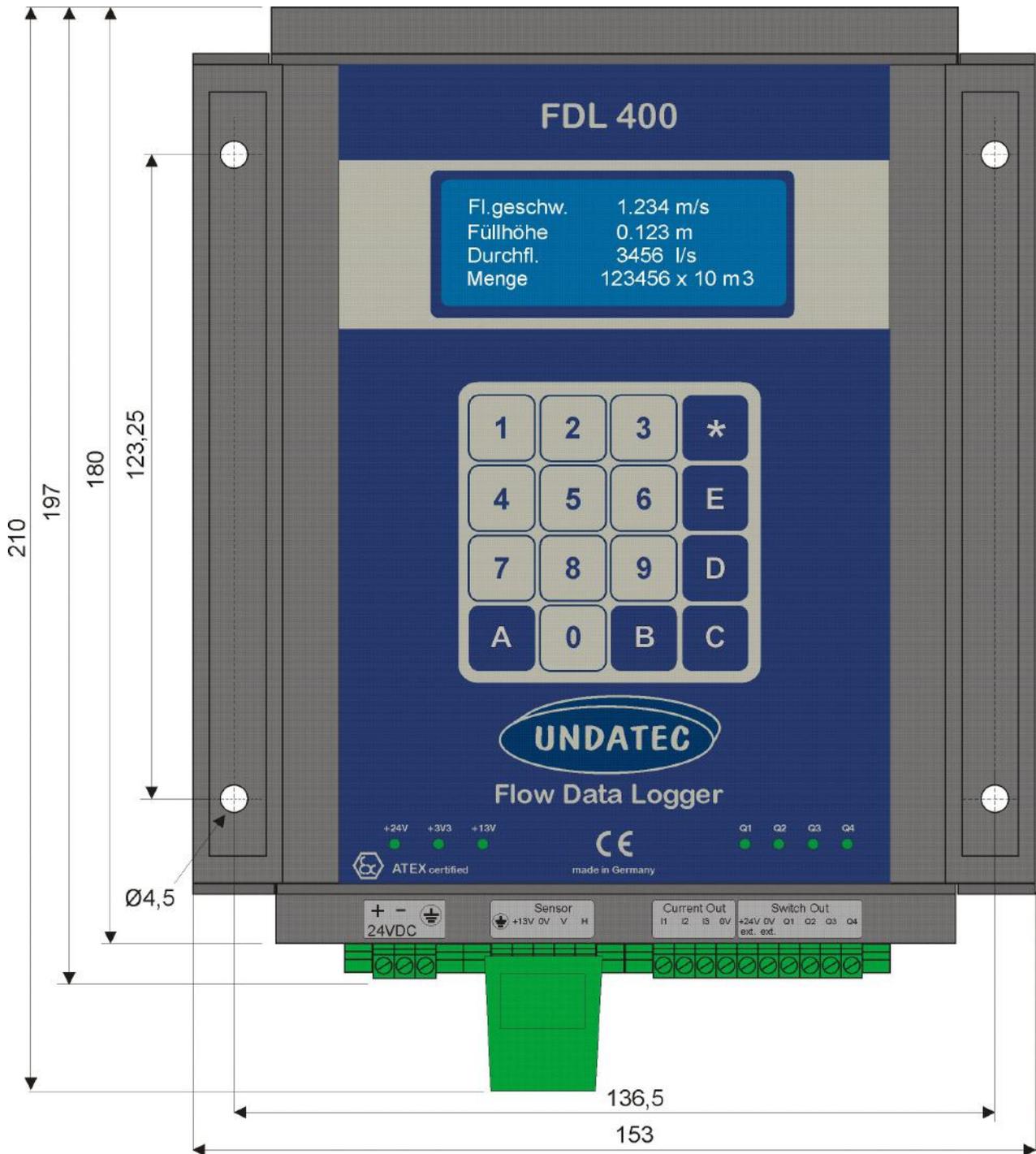
All outputs are individually switchable (on or off).

Note : During the installation, make sure that there is enough space above and below the device for cable laying and available operation. We recommend a minimum of 100mm.

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Frank Stark - Wiesenstrasse 23 - D-75248 Oelbronn-Duerrn / Germany - Telefon +49 (0) 7237-7804
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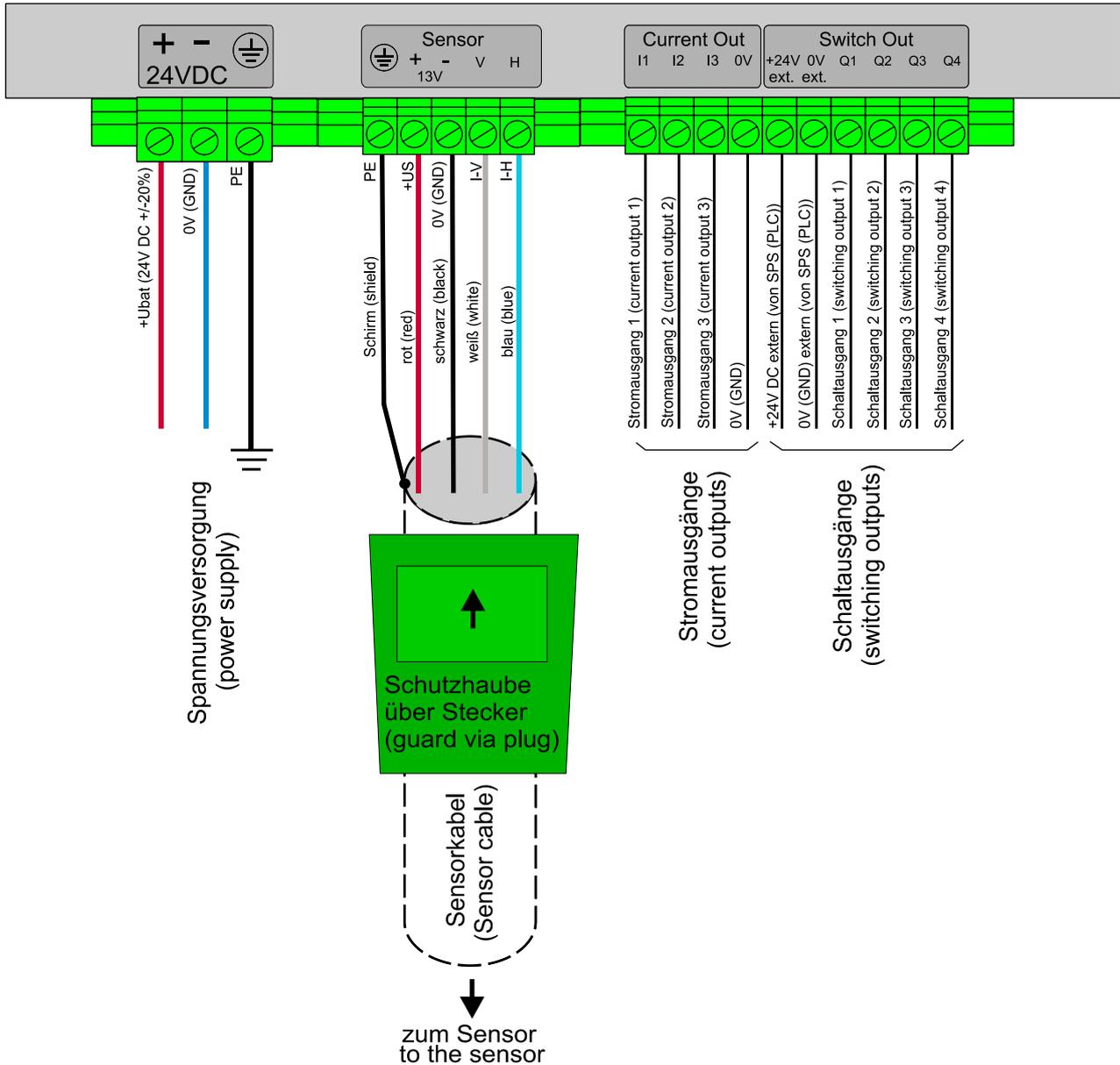
4.2 Dimension



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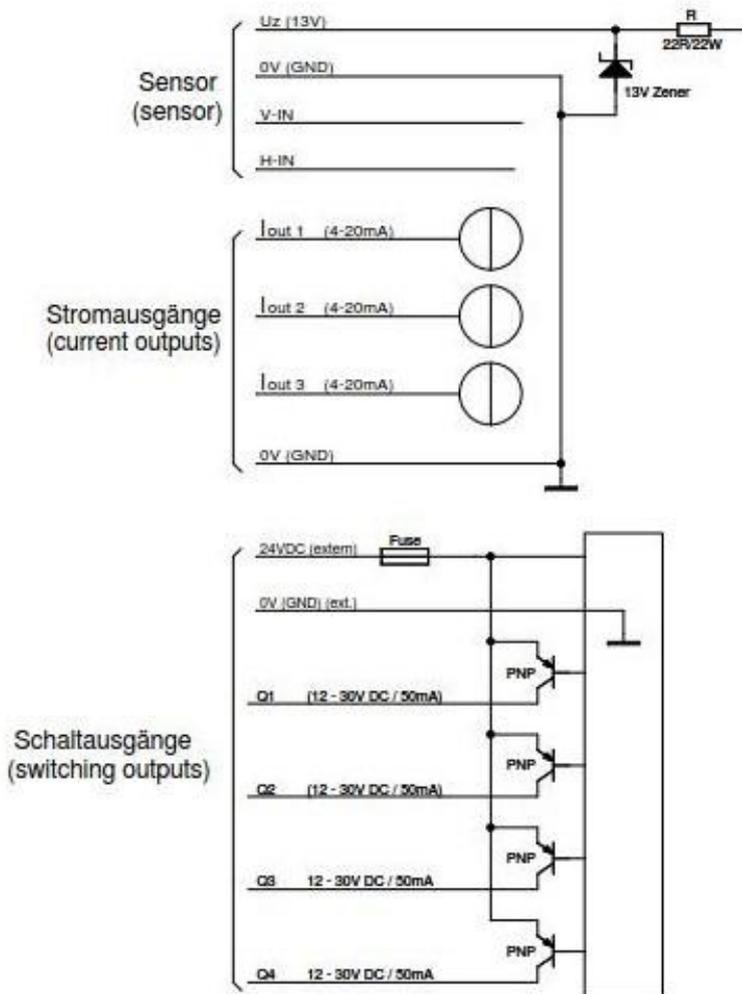
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 Email: undatec@web.de

4.3 Pin Assignment



Attention !
In ATEX relevant applications never do operate the sensor without the safety guard via plug !

4.4 Connection Diagram



The current outputs are not isolated from the power supply.

The switching outputs are electrically isolated by optocouplers from the device power supply and therefore require a separate power supply. This can, for example, come from a connected controller (PLC) or from another source.

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5. FDL400 Programming

After switching on the device is displayed on the display device identification , hardware version, software version, and copyright.

Example:

```
FDL400  
H – Version 2.0  
S – Version 2.3  
copyright UNDATEC
```

After a few seconds the display will jump to the measurement menu.

The display shows velocity, level, flow and totalizer.

Example:

```
Velocity 0.00 m/s  
Level 0.000 m  
Flow 0000.0 l/s  
Total 000000 x 1 m3
```

Function buttons

Button „B“ = Break (Interrupting the measuring program for inputting parameters)

Button „E“ = Enter

Button „F“ = Correction

Button „A“ = Abort

Button „C“ = no function

Button „D“ = special function

Functions (Button „B“ generated entry into the function menu. Here, the desired function will be selected by entering the corresponding function number)

The functions are designed so that they are self-explanatory based on previous selection.

Function 1: Entering of channel shape and associated parameters. It can be a pre-programmed channel shape (Circle, rectangle, trapezoid, triangle or special) are selected.
If special channel shapes are available, they are read in via memory card (SD card).

Function 2: Enter the maximum values for V, H and Q.
(Maximum values refer to the 0/4 - 20mA current outputs. Maximum value is the value at which for the selected output the current of 20mA has the full scale).

Function 3: Entering the limit values for V, H and Q.
(Limits refer to the switch outputs 1,2 and 3. Switch output 4 is for a different Application allocates.
Value is the value at which the selected switching output switches).

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- Function 4:** Input of V and H - offset. An offset can be positive or negative. Since there is no "-" button is available, is a selection of "pos" or "neg" a switchover using the "F" key is provided. The function under the 4 (V or H - offset) value entered is in the calculation of V or H taken into account.
- Function 5:** Input to determine the pulse output (selectable from 1 to 999 l / sec or 1-999 m³ / sec. and the totalizer (potency 0-3 - means quantity counter counts 0 = m³, 1 = 10m³, 2 = 100m³, 3 = 1000m³)
- Note :** The pulse output is limited to a maximum of 1 pulse per second. That is, a plurality of pulses per second are not possible. The pulse output has to be, if necessary, one or more numbers, or a potency be selected higher. The pulse length is about 250ms.
- Function 6:** Assignment of the analog outputs (current outputs). Here is the assignment of the issued Parameters (V, H, Q) is set to the current outputs.
- Function 7:** Assignment of the switching outputs. Here, the assignment of the parameter to be output (V, H, Q) to the Switching outputs set.
- Function 8:** Selection of the totalizer for the display and switching output. Possible are Totalizer and totalizer per day. Totalizer means the constantly counter, totalizer per day (daily amount) means a resettable counter, this accumulated the amount as long until it is reset.
- Function 10:** Calibration factor for velocity (V) - software-based amplification of the V - value 0.001-9.999
- Function 11:** Calibration factor for level (H) - software-based amplification of the H - value 0.001-9.999
- Function 12:** Set date and time (This function is important for the correct time - date allocation of stored data)
If the device is de-energized longer time, is it necessary to control the time and date via the function 99 to checked and corrected if necessary. It is important for data storage.
- Function 13:** Language (german/english)
- Function 14:** Simulation.
In the simulation, the chosen "Function 1" channel is used as a basis for calculation. With the input of a certain filling level and a specific velocity can be a corresponding flow are simulated.
The flow is displayed according to the calculation. The pulse output turns real according to the calculated flow.
A jumping out from the simulation requires a new selection button "B" then "Function 14" with followed by selection on simulation "off"!
- Function 20:** Storage of measurement data - storage rate normal, adjustable 1-999 sec, 1-999 min..
- Function 21:** Storage of measurement data – storage rate quick, adjustment like storage rate normal.
- Function 22:** Level trigger for quick storage. Example: rain events can increase the level in channels. From an adjustable level is to be saved faster. Level trigger is the adjustable fill height for quick storage.
- Function 40:** Select the boot loader. Is needed for firmware updates.
- Function 41:** Setting the display brightness

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Function 50: Saving the system configuration (system.cfg) on the SD card. **Necessary before a firmware update.**

Function 51: Write back of the on SD card stored system configuration (system.cfg). **Necessary after a firmware update.**

Function 52: This function allows the existing hardware and software version and thus the revision level are displayed.

Function 53: This function is used to generate a user-defined password to protect a unauthorized entry of parameters.
That is, when selecting the parameters input by "B" will prompt you to Entering a four-digit password (in the delivery of 0000).
In the parameter input is now on the function: 53 the creation of a customer password possible.
Here is a unique password generated, so this password is in the future Selection of the parameters input by "B" valid.

Function 66: In this function, the values of the factory generated calibration value of the analog current and / or voltage outputs can be displayed.

Function 80: Reset of Totalizer (select Totalizer or Totalizer per day).

Function 90: Automatic zeroing V and H (currently at the V and H – input pending value is called as zero).

Function 91: Automatic zeroing V (currently on the V - input pending value is set as zero).

Function 92: Automatic zeroing H (currently on the H - input pending value is set as zero).

All three functions (90, 91 and 92) set for the selected parameter the currently measured input value as zero (for display and calculation).

Function 93: Zeroing to 4mA, zero for V and H are set exactly 4mA.

Function 94: Zeroing to 4mA, zero for H are set exactly 4mA.

Function 95: Zeroing to 4mA, zero for V are set exactly 4mA.

All three functions (93, 94 and 95) for the selected parameter set 4 mA as zero (for display and calculation).

This function can also be used to correct an erroneous zero point adjustment function with 90,91 or 92.

Function 98: Correction of the V - curve (depending on the filling level). Height-dependent V-correction in 5 steps with entering the height cutoff point and the addition in %.

Function 99: Displaying Date and Time

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The unit has 4 switching outputs.

The switching **output Q4** is switched on so-called security mode. This can be output as alarm conditions such as power failure or sensor failure. The output is switched on correctly-working device, ie, it is in tension. In the case of a not powered or not properly operating unit of output is switched off, ie, he is de-energized (alarm state).

In the case of a disconnected or defective sensor, the output also turns off.

Sinks the analog input under about half of its nominal zero value of 4 mA (about 2mA), so turn off the output and thus signals an alarm. The message on display shows !! Alarm !! - Cable break ".

Accouterment

1. In the first moment of the keyboard operation, the backlight of the display will automatically turn on. During device operation, the display is then illuminated, so a pleasant operation is possible. About 10 minutes after the last operation of the keyboard, the display backlight will turn off automatically. This is for a low power consumption, on the other hand to avoid unnecessary heating devices and thereby also the increasing of life.

2. Measurement data are stored on an SD card (Secure Digital Memory Card). This is on top of the unit under an openable flap. The presence and correct operation is indicated by lighting an LED to the side of SD card. The saving of measuring data is visible by the flashing of this LED. Measurement will stored on a daily basis. That is, for every day a new log file is created. Each log file has the name of the log day, eg, 20140908 for the day 2014/09/08. These are text files that can be opened, edited and archived with any standard spreadsheet software (Excel, LibreOffice etc.)

3. The device can also be operated without an SD card. However, it can then not be stored measurement data.

4. The unit has a mini-USB (AB). This is also on top of the device under the opening flap. An Update of the operating software is with the bootloader on this interface possible.

5. In the device software under "Function 1" four types of channels selectable (circle, rectangle, trapezoid and V-shape).

In cases other than those pre-programmed channel shapes it is necessary to provide a sketch of the channel shape with dimensions available.

The customer then receives an SD card on which this channel is programmed.

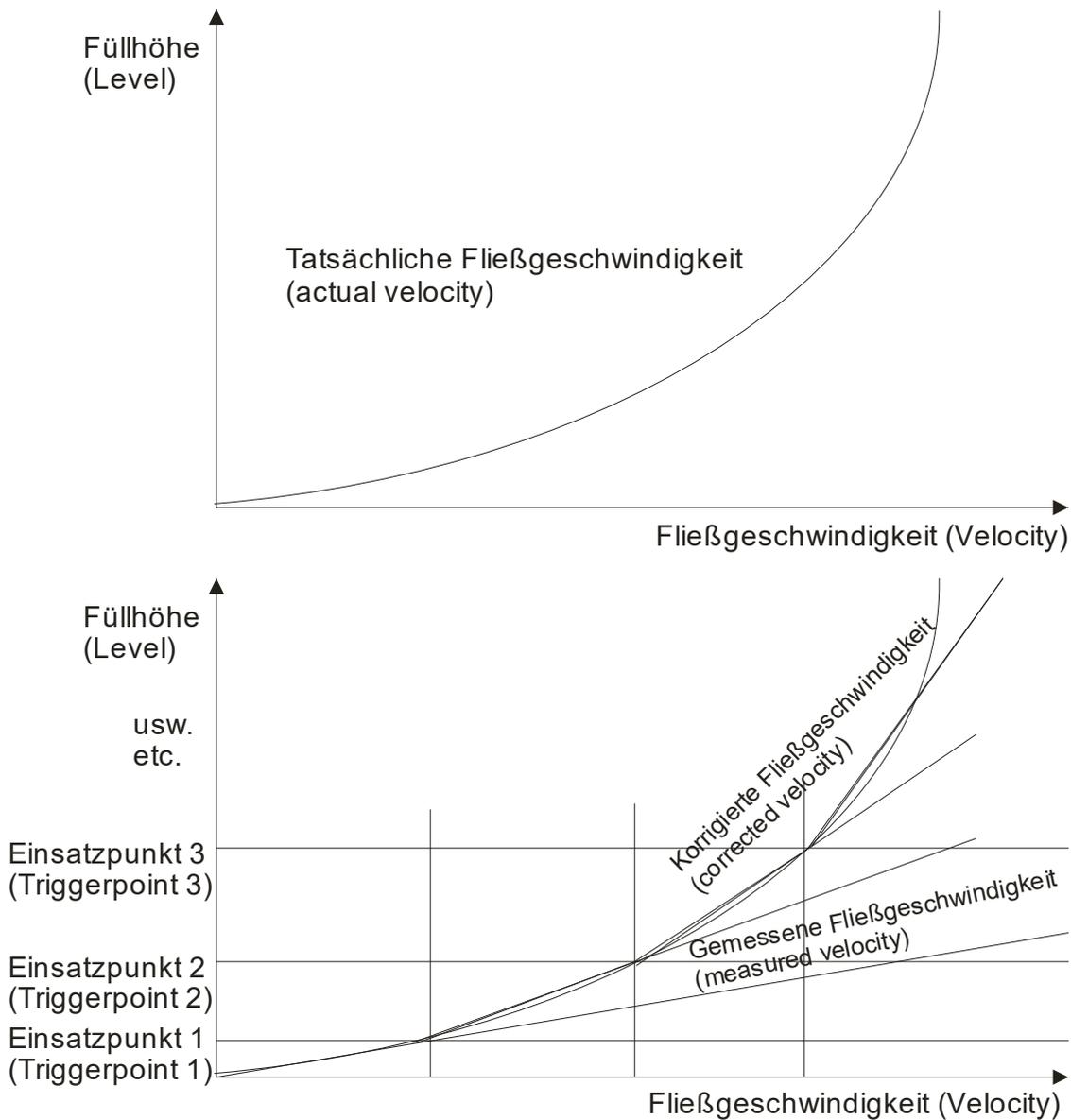
The customer can then select "Function 1" its specialty channel with the additional choice of whether the channel should be included in the instrument software or should only be read from the SD card.

After taking over in the device software, the SD card can be removed from the device when no data needs to be stored.

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Diagram and explanation of „Function 98“



The "Function 98" is useful for large channels or filling levels. Since the flow rate distribution is non-linear in a channel, but is similar to a hyperbola, it may be necessary to calculate a logarithmic curve at high flow levels from low flow levels relatively linear flow rate curve. This is necessary because of the velocity measuring sensor is able to measure up to a filling level of about 400mm safely. An increasing velocity at higher filling levels can not be measured and then calculated with the "Function 98".

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6. Top panel (openable flap) with SD card and USB connection



Figure shows open flap on top of the device with SD - card and USB - connection. The USB interface is necessary for update the firmware to be made. This requires a connection to a USB cable to a PC. The following figure shows the necessary cable.



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6.1 Reading data from the SD - card and processing in a spreadsheet program

To read the data must be taken the SD - card from the device and plugged into the appropriate card slot of a PC.

In the period in which the SD - card is not present in the device, no data is stored.

These memory idle time can be circumvented by inserting of another SD - card.

The measurement data are stored according to a preselected time step in a so-called log file (eg 20150320.log = data from 03.20.2015).

For every day a new log file is created automatically. The log file of the day begins at midnight and ends at midnight course again.

The saved data format is a text file that corresponds to the Excel format and can be practically applied and processed in any spreadsheet program.

As separator is a space.

Example:

FDL400 - Logfile

Date	Time	V(m/s)	H(m)	Q(l/s)	M(m3)	
2015.03.15	14:42:13	0.02	m/s	12 mm	0000.0 l/s	30 m3
2015.03.15	14:42:43	1.44	m/s	50 mm	0030.1 l/s	30 m3
2015.03.15	14:43:13	0.57	m/s	67 mm	0018.8 l/s	31 m3
2015.03.15	14:43:43	0.53	m/s	69 mm	0017.5 l/s	32 m3
2015.03.15	14:44:13	0.51	m/s	66 mm	0016.8 l/s	32 m3
2015.03.15	14:44:43	0.49	m/s	65 mm	0015.4 l/s	33 m3
2015.03.15	14:45:13	0.49	m/s	65 mm	0015.4 l/s	33 m3
2015.03.15	14:45:43	0.50	m/s	65 mm	0015.4 l/s	33 m3
2015.03.15	14:46:13	0.52	m/s	64 mm	0016.0 l/s	34 m3
2015.03.15	14:46:43	0.48	m/s	64 mm	0015.1 l/s	34 m3
2015.03.15	14:47:13	0.49	m/s	63 mm	0014.8 l/s	35 m3
2015.03.15	14:47:43	0.50	m/s	64 mm	0015.4 l/s	35 m3
2015.03.15	14:48:13	0.48	m/s	62 mm	0014.4 l/s	36 m3
2015.03.15	14:48:43	0.48	m/s	65 mm	0014.8 l/s	36 m3
2015.03.15	14:49:13	0.46	m/s	63 mm	0013.5 l/s	37 m3
2015.03.15	14:49:43	0.51	m/s	62 mm	0014.9 l/s	37 m3
2015.03.15	14:50:13	0.51	m/s	62 mm	0014.7 l/s	37 m3
2015.03.15	14:50:43	0.50	m/s	62 mm	0014.0 l/s	38 m3

With the most spreadsheet programs, it is possible to design curves, graphs, and statistical analysis.

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7. Mounting instructions

Conversion of the unit of wall mounting on DIN rail mounting



On delivery the unit for wall mounting is provided.

Using the supplied bracket, the unit can be mounted in the control cabinet using a DIN rail.

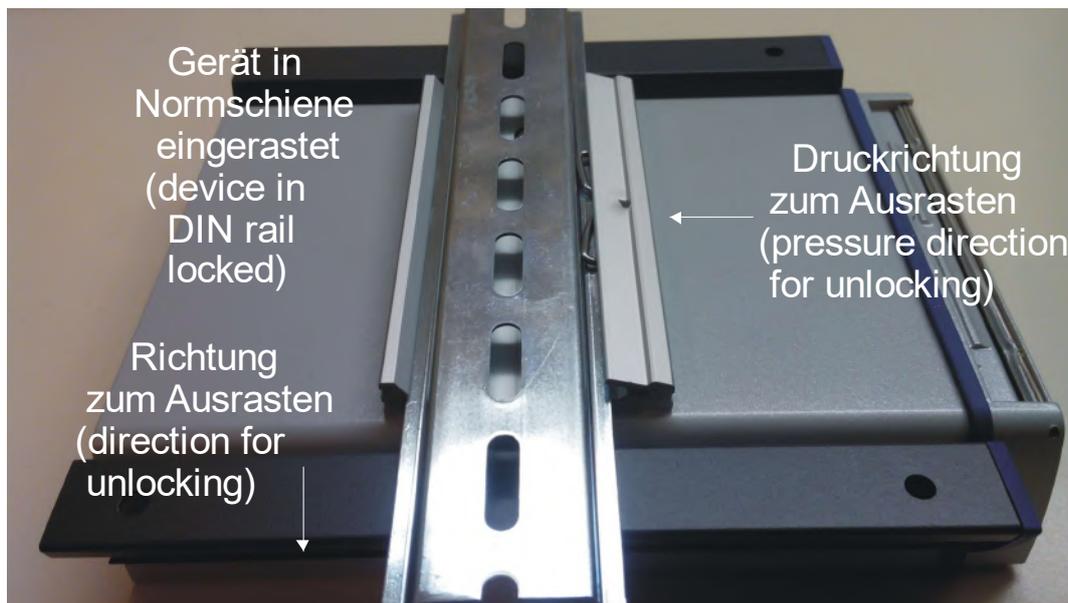
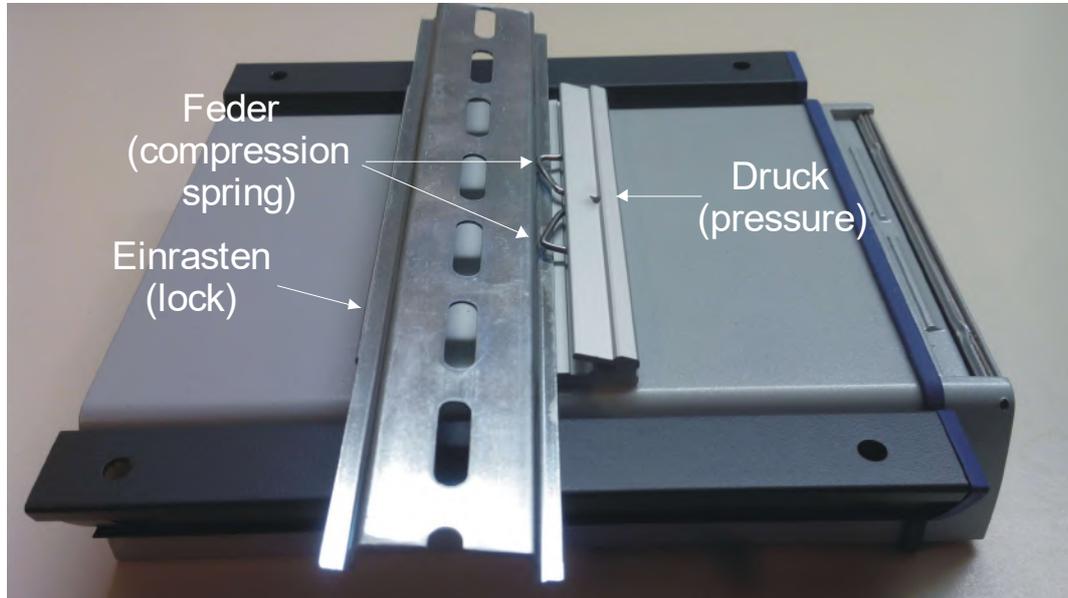
For this purpose, the 3 pcs. Screws with the rosettes on the back of the unit must be loosened.

With the screws the bracket must be mounted on the rear panel, the rosettes are not necessary for this (see photo).

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Mount the unit on a DIN rail



The bracket for mounting on a standard rail has a spring. The insertion of the device onto the DIN rail is done as shown in the photo. To engage the rail, the device is so compressed the spring down. This can now be folded down in the DIN rail in the unit. To disassemble the device, it is also compressed down and allow the spring, then it can be taken out again.

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8. Type Examination Certificate

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[1] **EC-TYPE EXAMINATION CERTIFICATE**

according to Directive 94/9/EC, Annex III

(Translation)



[2] Equipment and Protective Systems intended for use in Potentially Explosive Atmospheres, **Directive 94/9/EC**

[3] EC-Type Examination Certificate Number: **IBExU14ATEX1280 X**

[4] Equipment: **Measuring device**
Type FDL400

[5] Manufacturer: **Dömges Detectronic UG**

[6] Address: **Hainzhöhe 8**
83707 Bad Wiessee
Germany

[7] The design of the equipment mentioned in [4] and any acceptable variation thereto is specified in the schedule to this EC-Type Examination Certificate.

[8] IBExU Institut für Sicherheitstechnik GmbH, NOTIFIED BODY number 0637 in accordance with article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that the equipment mentioned in [4] has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The test results are recorded in the test report IB-14-3-220 of 10 June 2015.

[9] Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-0:2012+A11:2013 and EN 60079-11:2012.

[10] If the sign „X“ is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in [17] in the schedule to this EC-Type Examination Certificate.

[11] This EC-Type Examination Certificate relates only to the design and construction of the specified equipment. If applicable, further requirements of this Directive apply to the manufacture and supply of this equipment.

[12] The marking of the equipment mentioned in [4] shall include the following:

 **II (2)G [Ex ib] IIB**

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7 - 09599 Freiberg, Germany
☎ +49 (0) 3731 3805-0 - 📠 +49 (0) 3731 23650

Authorised for certifications
- Explosion protection -

By order

(Dr. Wagner)



Freiberg, 10 June 2015

Certificates without signature and seal are not valid. Certificates may only be duplicated completely and unchanged. In case of dispute, the German text shall prevail.

Annex

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IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[13] **Annex**

[14] **to the EC-TYPE EXAMINATION CERTIFICATE IBExU14ATEX1280 X**

[15] **Description of the equipment**

The measuring device type FDL400 is an associated apparatus for the connection of intrinsically safe flowmeters in hazardous areas where apparatus of category 2G are required. The circuit board is installed in a standard rail enclosure and has connecting terminals and a special bushing for the sensor connection.

Ambient temperature range -20 °C up to +60 °C

Electrical data

Supply circuit	$U_N = 24 \text{ V DC } \pm 20 \%$
Terminal X1: +24V, GND	$U_m = 265 \text{ V AC/375 V DC}$
Terminal No. 3 [PE]	Equipotential bonding

Supply circuit (+US, GND)	in type of protection intrinsic safety Ex ib IIB
	$U_O = 13.7 \text{ V}$
	$I_O = 346 \text{ mA}$
	$P_O = 1.59 \text{ W}$
	$R = 53 \Omega$
	trapezoidal characteristic
Maximum external capacitance	$C_O = 2.4 \mu\text{F}$
Maximum external inductance	$L_O = 500 \mu\text{H}$

Signal circuit (V-I, H-I)	in type of protection intrinsic safety Ex ib IIB
	$U_O = 16 \text{ V}$
	$I_O = 66 \text{ mA}$
	$P_O = 0.26 \text{ W}$
	linear characteristic
Maximum external capacitance	$C_O = 2.4 \mu\text{F}$
Maximum external inductance	$L_O = 500 \mu\text{H}$

The circuits are potentially bonded with each other.

[16] **Test report**

The proof of the explosion protection is explained in detail in the Test Report IB-14-3-220. The test documents are part of the test report and are listed there.

Summary of the test results:

The measuring device fulfils the requirements of the type of protection intrinsic safety on an associated apparatus for group II and category 2G.

[17] **Special conditions for safe use**

The associated apparatus measuring device type FDL400 has to be installed outside the hazardous area. At the installation, the device must be connected to the equipotential bonding lengthwise of the conductor track of the supply and data circuit within and outside the hazardous area (see EN 60079-14, sec. 16.2.2/16.2.3).

[18] **Essential Health and Safety Requirements**

Confirmed by compliance with standards (see [9]).

By order



(Dr. Wagner)

Freiberg, 10 June 2015