



Fluid.iO

SENSING FLUID EXCELLENCE

Mounting- and operating instructions

FDL400

Flow Data Logger



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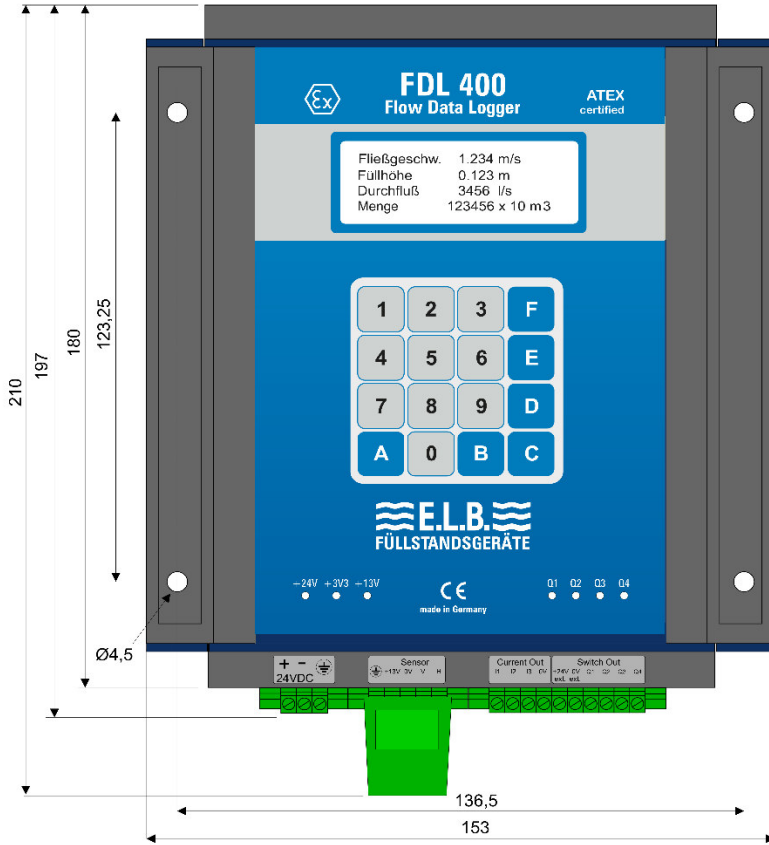


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1. Scope of delivery

- FDL400
- SD-Card
- USB Cable Type B mini
- Clamp for power supply
- Clamp for outputs
- Optional: rail mount adapter

2. General notes

- Read the safety instructions and keep the manual
- Installation, commissioning, electrical connection and repairs may only be carried out by qualified personnel.
- The specified degree of protection is only guaranteed if the device is installed in the correct position and the cables are inserted and screwed in properly.
- Operate the device only at the specified voltage
- Modification and conversion of the device is not permitted and releases Fluid.iO Sensor + Control GmbH & Co. KG from any warranty and liability



Read these assembly instructions carefully before using the device. Follow the instructions. Keep these mounting instructions in a safe place for future reference..

2.1. Safety instructions

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

Seal, seals and labels:

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



CAUTION

- Assembly and electrical connection may only be carried out by qualified personnel.
- Read these operating instructions carefully before commissioning.

- Only operate the device with the voltage and frequency specified on the nameplate.
- Do not make any modifications to the device.
- never operate the device without the electronics cover.

2.2. Determination and proper use

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

Before commissioning, please compare the conformity of the supply voltage with the specifications on the type plate.

If it becomes apparent that safe operation is no longer possible (e.g. in the case of visible damage), please shut down the device immediately and secure it against unintentional operation.

The device may be dangerous if it is used improperly or not as intended. For this reason, we recommend that the safety instructions are strictly observed.

2.3. Commissioning & operating personnel

Assembly, electrical installation, commissioning and maintenance of the device may only be carried out by trained specialist personnel who have been authorized to do so by the system operator.

The qualified personnel must have read and understood these operating instructions and must comply with their statements.

The device may only be operated by persons who have been authorized and instructed by the system operator. The instructions in this operating manual must be followed.

Make sure that the device is correctly connected according to the electrical connections.

2.4. Repairs

Repairs can only be carried out by trained customer service personnel.

In this case, please contact Fluid.iO Sensor + Control GmbH & Co. KG.

2.5. Technological progress

The manufacturer reserves the right to adapt technical data to technical development progress without special announcements. For information on the activities and possible extensions of these operating instructions, please contact Fluid.iO Sensor + Control GmbH & Co. KG.

3. Product description

This manual is valid for devices with the following versions:

- Hardware as of 2.0
- Firmware as of 2.1

The FDL400 "Flow Data Logger 400" measuring device is suitable for flow measurement of water and wastewater in fully or partially filled channels or pipes of various geometries.

The evaluation is carried out according to the flow formula

$$Q = V \times A.$$

Q = liquid flow rate

V = velocity of the liquid

A = area of the pipe or channel

A combined measuring sensor mounted on the channel floor or wall records the flow velocity V in m/s according to the Doppler principle. The velocity data is recorded and processed in the processor via a sound lobe that radiates into the medium against the direction of flow.

The integrated pressure sensor is used to record the filling level in m; this value is in turn used in the processor to calculate the respective flowed-through segment area in m² according to a pre-programmed

channel cross-section. The two multiplicands result in the sum Q in l/s.

Programming of all required parameters is done via the 16-key keypad accessible on the front panel of the device.

The clear 4-fold display shows the individual values

- Velocity
- Level
- Flow
- Totalizer

Measuring sensors are supplied with the necessary voltage by the evaluation electronics.

In addition to its actual measuring function, the FDL400 measuring device also serves as a power supply unit for the sensors intended and approved for this purpose.

The certification issued for this purpose is described in the corresponding EC type examination certificate.

The values for flow velocity and level are available directly at the sensor as 4-20 mA or 0.5-2.5V signal. For sensors with standardized 4-20mA current output, the evaluation electronics can also be mounted at a greater distance from the installation location on the duct. Without any further installation effort, a cable extension of the measuring probe is usually sufficient.

Avoid damage:

Never kink the sensor cable, otherwise the internal air tube for atmospheric pressure compensation of the altitude sensor may be damaged.



Note:

During installation, make sure that there is sufficient space above and below the device for cable routing and operation. We recommend at least 100mm.



The device conforms to the following standards:

- EN IEC 60079-0
- EN 60079-11

- EN 61000-6-2
- EN 61000-6-4

3.1. Technical data

The evaluation electronics are housed in an aluminum enclosure and are suitable for wall mounting or standard rail mounting.

The device with connected sensor requires a warm-up time after switching on to reach the operating temperature. This is about 10-15 minutes.

- Power supply: 24V DC +/- 20%
- Current consumption: 120mA – 220mA (depending of outputs - and sensor currents)
- Fuse: Device protected against polarity reversal
- Protection class: IP30
- Dimensions in mm (LxBxH): 197x153x37,5
- Temperature Range: 0...50°C

Blown Fuse:

A blown fuse must not be repaired by the customer, as these are special specimens for ATEX-approved equipment.



Display LCD 4x20 for

Velocity
Level
Flow
Totalizer

Outputs

- 3x analog 0(4) – 20 mA / Burden 100Ω - 900Ω; freely configurable for flow standards, flow extra amount, velocity and level
- 4x digital, opto-coupled, p-type transistor outputs (PNP); 12 – 30 V / 50 mA, short circuit protected
- 1x permanently programmed as an alarm
- 3x freely configurable for flow standards, flow extra amount, impulse, velocity and level

All outputs are individually switchable (on or off).

3.2. Mounting instructions

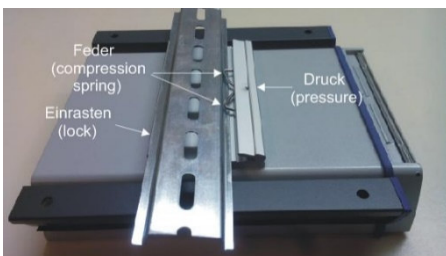
On delivery, the device is intended for wall mounting. By means of the supplied clamp, the device can be mounted on a standard rail when used in the control cabinet.

For this purpose, the 3 screws with the rosettes on the back of the device are loosened.

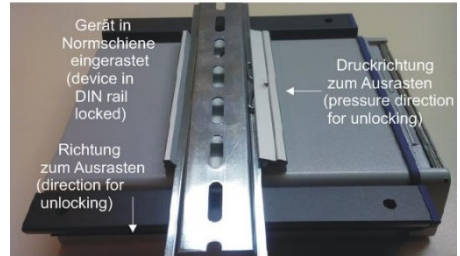
The clamp is fastened to the rear of the device with the loosened screws; the rosettes underneath are no longer to be used for this purpose.



The clamp for mounting on a standard rail has a spring. The device is inserted on the standard rail as shown in the photo. To snap the device onto the rail, it is pressed down and the spring is compressed. This allows the device to be folded downwards into the standard rail.



To dismantle the device, the device is also pressed down and thus the spring compressed, then it can be unfolded again.

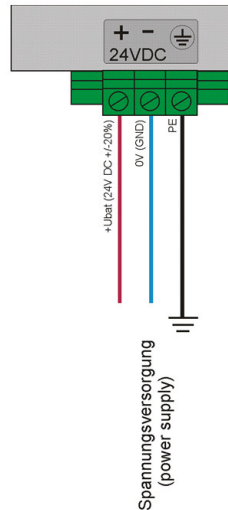


4. Pin Assignment

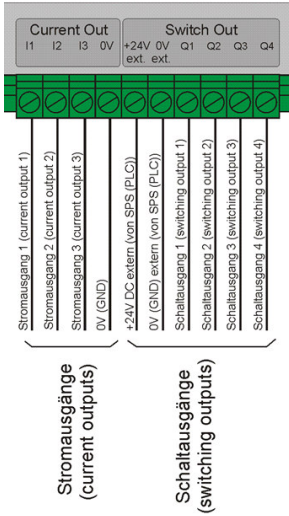
In ATEX relevant applications never do operate the sensor without the safety guard via plug.



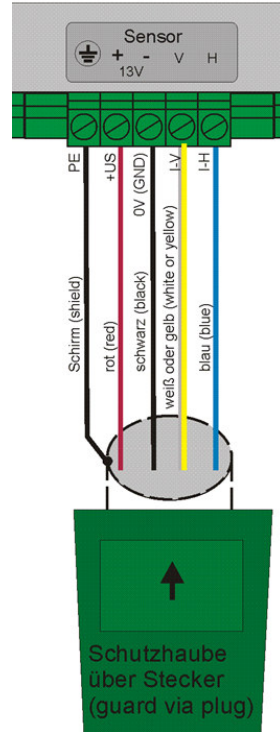
4.1. Power supply



4.2. Outputs



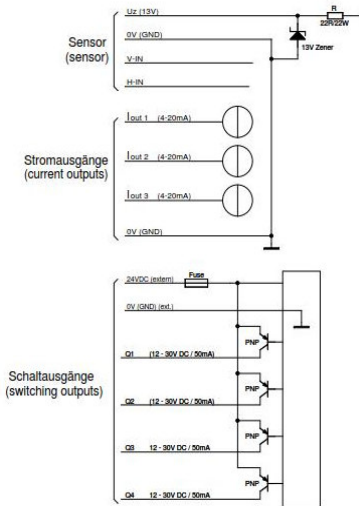
4.3. Sensor



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.



5. FDL400 programming

After switching on the device, the display shows the device identification, hardware version, software version and copyright information.

After approx. 2-3 seconds the display jumps to the measuring menu. Flow velocity, filling level, flow rate and quantity counter are displayed.

Beispiel:

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

5.1. Function keys

Button „B“	Break (Interrupting the measuring program for inputting parameters)
Button „E“	Enter
Button „F“	Correction
Button „A“	Cancel
Button „C“	No function
Button „D“	Data transfer - starts the output of the measurement data to the USB interface.

5.2. Functions

Button "B" creates a jump to the function menu. Here, the desired function can be selected by entering the corresponding function number.

The functions are designed in such a way that they are self-explanatory due to the displayed selection:

Function 1	Input of the channel shape and associated parameters, one of the pre-programmed channel shapes (circle, rectangle, trapezoid, triangle or special) can be selected. If special channel shapes are available, they are read in via memory card (SD card).
Function 2	Input of the maximum values for V, H and Q. (Maximum values refer to the 0/4 - 20mA current outputs. The maximum value is the value at which the selected current output has the full scale of 20mA).
Function 3	Input of limit values for V, H and Q. (Limit values refer to switching outputs 1, 2 and 3. Switching output 4 is reserved for another application. Limit value is the value at which the selected switching output switches).
Function 4	Input of V and H - offset. An offset can be positive or negative. As there is no button "-

	", a changeover "pos" or "neg" is provided with the help of the button "F". The value entered under Function 4 (V or H - Offset) is taken into account when calculating V or H.
Function 5	Input for determining the pulse output (Selectable 1 - 999 l or 1 - 999 m ³ and the quantity counter (Power 0 - 3 - means quantity counter counts 0=m ³ , 1=10m ³ , 2=100m ³ , 3=1000m ³)

The pulse output is limited to a maximum of 1 pulse per second. I.e., several pulses per second are not possible. The pulse output must then be preselected one or more numbers or a power higher if required. The pulse length is about 250ms.



Function 6	Assignment of the analog outputs (current outputs). Here the assignment of the parameters to be output (V, H, Q) to the current outputs is defined.
Function 7	Assignment of the switching outputs. The assignment of the parameters to be output (V, H, Q) to the switching outputs is defined here.
Function 8	Selection of the quantity counter for display and switching output. Quantity and T-quantity are possible. Quantity means the continuously running quantity counter, T-quantity (daily quantity) means a resettable counter which adds up the quantity until it is reset again.
Function 10	Calibration factor for flow velocity (V) - software amplification of the V - value from 0.001 - 9.999
Function 11	Calibration factor for filling level (H) - software amplification of the H value from 0.001 - 9.999

Function 12	Set date and time (correct) (This function is important for the correct time and date assignment of stored data). If the device is without power for a longer period of time, it is necessary to check the time and date via function 99 and to correct it if necessary, because it is important for data storage.
Function 13	Language german or english
Function 14	Simulation During simulation, the channel selected under "Function 1" is used as the basis for calculation. With the input of a certain filling level and a certain flow velocity a corresponding flow can be simulated. The flow is displayed according to the calculation. The pulse output switches real according to the calculated flow. A jump out of the simulation requires a new selection of button "B", then "Function 14" with subsequent selection to simulation "off".
Function 20	Measurement data storage - storage rate normal, adjustable 1-999 sec, 1-999 min.
Function 21	Measurement data storage - storage rate fast, setting like storage rate normal.
Function 22	Fill level trigger for fast storage. Example: Rain events cause the fill level in channels to increase. From an adjustable fill level on, the storage should be faster. Fill level trigger is the adjustable fill level for fast storage.
Function 40	Activate the bootloader. Is required for updates of the firmware.
Function 41	Setting the display brightness
Function 50	Saving the SYSTEM.CFG system configuration (all created parameters) from the internal memory to the SD card. Should

	be performed before updating the firmware.
Function 51	Reading back the SYSTEM.CFG system configuration from the SD card to the internal memory. Should be performed after a firmware update.
Function 52	In this function, the existing hardware and software version and thus the revision level can be displayed.
Function 66	In this function the values for the factory generated calibration of the analog current and/or voltage outputs can be controlled.
Function 80	Resetting the quantity counter (selecting quantity or daily quantity)
Function 90	Automatic zeroing V and H (the value currently present at the V and H input is set as 0 - point).
Function 91	Automatic zeroing V (the value currently present at the V - input is set as 0 - point)
Function 92	Automatic zeroing H (the value currently present at the H - input is set as 0 - point).
Function 93	Zeroing to 4mA, zero point for V and H are set exactly 4mA.
Function 94	Zero point for H is set exactly 4mA.
Function 95	Zero point for V is set exactly 4mA.

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



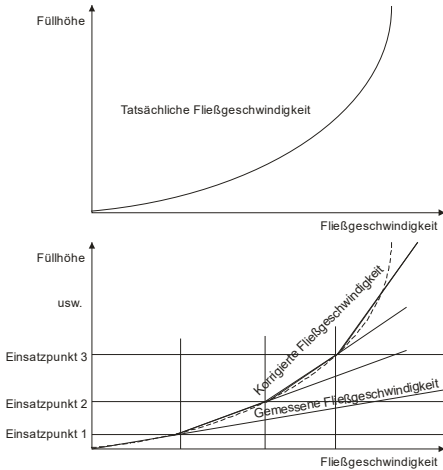
All three functions (93, 94 and 95) set 4mA as zero point for the selected parameter (for display and calculation). This function can also be used to correct an incorrect zero point adjustment under function 90,91 or 92.



Function 98	Correction of the V - curve (filling height dependent). Height-dependent V-correction in 5 steps with input of the height application point and the addition in %.
Function 99	Display date and time

„Function 98“ is useful for large channels or large filling heights. Since the flow velocity distribution in a channel is not linear, but resembles a hyperbola, it may be necessary to calculate a logarithmic curve at higher flow heights from the flow velocity curve, which is still relatively linear at low flow heights. This is necessary because the flow velocity sensor can only measure reliably up to a filling level of about 400mm. An increasing flow velocity at higher filling heights can then no longer be measured and is calculated with "Function 98".





5.3. Further functions

The device has 4 switching outputs.

The output Q4 is switched in the so-called safety mode. This allows states such as voltage failure or sensor error to be output as an alarm. The output is switched on when the device is working correctly, i.e. voltage is present. In case of a switched off or not correctly working device, the output is switched off, i.e., it is de-energized (alarm state).

In case of an unconnected or defective sensor, the output also switches to de-energized.

If an analog input drops below about half of its nominal zero value of 4mA, i.e. about 2mA, this output switches off and thus signals an alarm. The display shows the message "!!! Alarm !!! - Cable break".

6. Special features

6.1. Display

At the moment of keyboard operation, the display illumination turns on automatically. During device operation, the display is then illuminated so that pleasant operation is possible. The display illumination switches off automatically about 10 minutes after the last keyboard operation. This serves on the one hand to keep power consumption low, and on the other hand to avoid unnecessary heating of the device and thus also to extend its service life.

6.2. SD – Card

Measurement data is stored on an SD card (Secure Digital Memory Card). This is located on the top of the device under an openable flap. The presence and correct operation is indicated by a light emitting diode. The saving of measurement data is indicated by the flashing of this LED.

Measurement data are "summarized" by day. I.e., a new log file is created for each day. Each log file has the name of the log day, e.g., 20140908 for the day 08.09.2014.

These are text files that can be opened, edited and archived with any standard spreadsheet software.

The device can also be operated without an SD card. However, no measurement data can then be saved.



6.3. USB - port

The device has a mini-USB interface (AB). This is also located on the top of the device under the openable flap. Via this interface, measurement data can be transferred and updates of the operating software can be loaded..

6.4. Individual channel shapes

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

For all other, not pre-programmed channel shapes, it is necessary to provide a sketch of the channel shape with dimensions.

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

The customer can then select his special channel under "Function 1" with the additional selection of whether the channel is to be transferred to the device software or only read from the SD card.

After transfer to the device software, the SD card can be removed from the device if no measurement data needs to be stored.

6.5. Firmware update



The picture shows the opened cover on the top of the device with SD - card and USB - port.

The firmware can be updated via the USB interface. For this, a connection with a USB cable to a PC is necessary. The following figure shows the necessary cable.



6.6. Reading & processing data

To read out data, the SD card must be removed from the device and inserted into the appropriate card slot of a PC.

No data is saved during the time that the SD card is not present in the device!



CAUTION

This memory idle time can be bypassed by inserting another SD card.

On the SD card, the measurement data are stored according to the preselected time step in a so-called log file.

(e.g. 2050320.log = data from 20.03.2015).

A new log file is created automatically for each day. The log file of a day starts at midnight and ends again at midnight.

The saved data format is a text file (.txt), corresponds to the Excel format and can be transferred and processed practically in every spreadsheet program. A space character serves as separator.

7. Declaration of Conformity



Konformitätserklärung

Declaration of conformity
Déclaration de conformité



Sensor + Control GmbH & Co. KG
An der Hartbrücke 6
D-64625 Bensheim

- erklärt in alleiniger Verantwortung, dass das Produkt : Messgerät
- declare under our sole responsibility that our product : Measuring device
- déclare sous sa seule responsabilité que le produit : Appareil de mesure

FDL400..

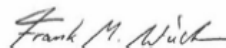
- auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt
- to which this declaration relates is in conformity with the following standards
- auquel se réfère cette déclaration est conforme aux normes

EN IEC 60079-0:2018
EN 60079-11:2012
EN 61000-6-2:2019
EN 61000-6-4:2019

- gemäß den Bestimmungen der Richtlinien
- following the provision of Directives
- conformément aux dispositions des Directives

2014/34/EU
2014/30/EU
2011/65/EU

EU-Baumusterprüfung gemäß Anhang III der Richtlinie durch
IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
D-09599 Freiberg
EU-Baumusterprüfbescheinigungs-Nr.: **IBExU 14 ATEX 1280 X**






Bensheim, 03.01.2023

Frank Wiedmann
Geschäftsführer

Messgerät_FDL_Ex_IBExU

8. Type Examination Certificate (ATEX)

IBExU Institut für Sicherheitstechnik GmbH An-Institut der TU Bergakademie Freiberg	
[1]	EU-TYPE EXAMINATION CERTIFICATE - Translation
	
[2]	Equipment or protective systems intended for use in potentially explosive atmospheres, Directive 2014/34/EU
[3]	EU-type examination certificate number IBExU14ATEX1280 X Issue 1
[4]	Product: Measuring device Type: FDL400
[5]	Manufacturer: E.L.B. Füllstandsgeräte Bundschuh GmbH & Co. KG
[6]	Address: An der Hartbrücke 6 64625 Bensheim GERMANY
[7]	This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
[8]	IBExU Institut für Sicherheitstechnik GmbH, notified body number 0637 in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the essential health and safety requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive. The examination and test results are recorded in the confidential test report IB-22-3-0040/3.
[9]	Compliance with the essential health and safety requirements has been assured by compliance with: EN IEC 60079-0:2018 EN 60079-11:2012 except in respect of those requirements listed at item [18] of the schedule.
[10]	If the sign "X" is placed after the certificate number, it indicates that the product is subject to the specific conditions of use specified in the schedule to this certificate.
[11]	This EU-type examination certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.
[12]	The marking of the product shall include the following:
	Ⓜ II (2)G [Ex ib Gb] IIB
	
	(notified body number 0637)
	Tel: + 49 (0) 37 31 / 38 05 0 Fax: + 49 (0) 37 31 / 38 05 10
	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.
	Freiberg, 2022-05-11
	Page 1/3 IBExU14ATEX1280 X 1
	By order  Dipl.-Ing. (FH) A. Henker
	IBExU Institut für Sicherheitstechnik GmbH Fuchsmühlenweg 7 09599 Freiberg, GERMANY
	FB106100 1

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

[13] **Schedule**

[14] **Certificate number IBExU14ATEX1280 X | Issue 1**

[15] **Description of product**

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.

Technical data:

Environmental conditions

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

Electrical data

Power supply circuit

Terminal X1: +24V, GND:

Rated voltage range	U_N	24 V DC \pm 20 %
Maximum direct voltage	U_m	375 V DC
Maximum effective value of alternating voltage	U_m	265 V AC

Terminal no. 3 (PE):

Potential equalization

**Supply circuit
(+US, GND)**

In type of protection intrinsic safety Ex ib IIB

Maximum output voltage	U_o	13.7 V
Maximum output current	I_o	346 mA
Maximum output power	P_o	1.59 W
Trapezoidal characteristic:	R	53 Ω

**Signal current circuit
(Terminal X2: V-I, H-I)**

In type of protection intrinsically safe Ex ib IIB

Maximum in-/ output voltage	$U_{i/o}$	16 V
Maximum in-/ output current	$I_{i/o}$	66 mA
Maximum output power	P_o	260 mW
Linear characteristic		

The circuits are grounded and are potentially bonded with each other.

Safety instructions

For circuits including inductances and capacitances the following has to be observed:
The values for L_o and C_o , mentioned in the EU-Type Examination Certificate are allowed for:

- distributed inductance and capacitance e.g. as in a cable or
- if the total L_i of the external circuit (excluding the cable) is $< 1\%$ of the L_o value or
- if the total C_i of the external circuit (excluding the cable) is $< 1\%$ of the C_o value.

	supply circuit	signal circuit
	Ex ib IIB	Ex ib IIB
C_o	5.0 μ F	2.75 μ F
L_o	1.2 mH	41 mH

The values of L_o and C_o determined in the EU-Type Examination Certificate shall be reduced to 50 % or taken from the following table if both of the following conditions are met:

- the total L_i of the external circuit (excluding the cable) $\geq 1\%$ of the L_o value and
- the total C_i of the external circuit (excluding the cable) $\geq 1\%$ of the C_o value.

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

The reduced capacitance of the external circuit (including cable) shall not be greater than 1 μF for Groups I, IIA, and IIB and 600 nF for Group IIC.

	supply circuit		signal circuit	
	Ex ib IIB		Ex ib IIB	
C_0	3.1 μF	4.6 μF	1.3 μF	2.5 μF
L_0	500 μH	200 μH	10 mH	500 μH

Variations compared to issue 0 of this certificate:

Variation 1

The EU Type Examination Certificate is transferred to a new manufacturer.

Variation 2

The device meet the requirements of the current standard EN IEC 60079-0:2018.

[16] Test report

The test results are recorded in the confidential test report IB-22-3-0040/3 of 2022-04-27.

The test documents are part of the test report and they are listed there.

Summary of the test results

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

[17] Specific conditions of 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

In addition to the essential health and safety requirements (EHSRs) covered by the standards listed at item [9], the following are considered relevant to this product, and conformity is demonstrated in the test report:

None

[19] Drawings and Documents

The documents are listed in the test report.

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg, GERMANY

By order



Dipl.-Ing.(FH) A. Henker

Freiberg, 2022-05-11