ULTRASONIC FLOWMETER
SONIX 10D

INSTRUCTION FOR ASSEMBLY AND OPERATING

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Contents

 Act. 13.08.2010

GENERAL INFORMATIONS ON SAFETY

Introduction

- Assembly and operating of the flowmeter is not allowed without reading, understanding and following the informations in this manual
- Sevice of the flowmeter performs SONIX only
- For power supply of the flowmeter use 1-phase mains with protective earth
- Do not use the flowmeter with removed cover
- The recommendations and warnings contained in this manual and placed on the flowmeter should be followed

Symbols

The symbols used in this manual or placed on the flowmeter have the following meaning:

Attention: Risk of electrical shock

PROTECTIVE EARTH TERMINAL

Attention: Identify conditions that could result in injury or loss of life and also could result in flowmeter damage. In each case the explanation is in this manual.

Disclaimer

- Using the flowmeter in a way or in conditions incompatible with this manual may result in flowmeter damage, loss of warranty or reducing protection provided by the flowmeter
- SONIX reserves the right to change the product in order to increase its utility values or adjust it to current regulations. Such changes may not be taken into account in the current version of the manual. SONIX is not responsible for consequences it imply.
- The purchaser is responsible for the selection of suitable flowmeter
- Warranty is given in accordance with terms specified in Guarantee Certificate

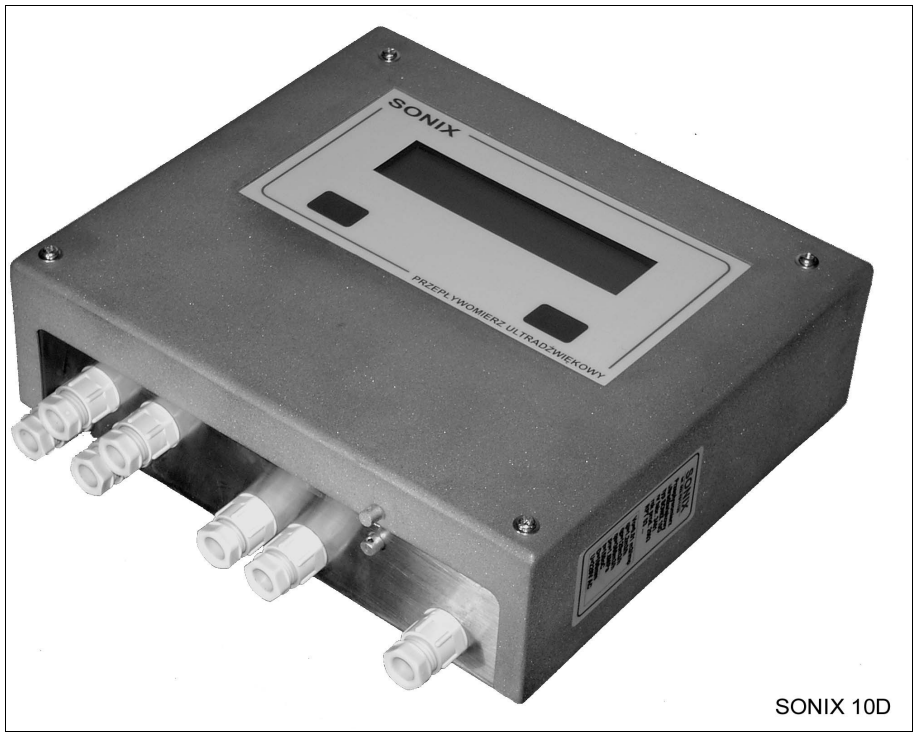
INTRODUCTION

Component parts

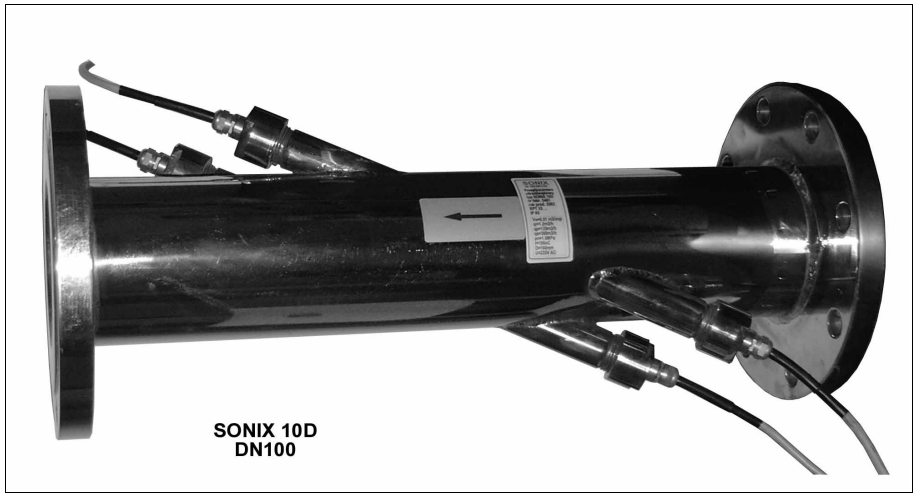
The SONIX 10D flowmeter consists of a flow sensor and a measuring transducer connected together with probes cables. The flow sensor is available in three versions:

1. An U-shaped section ended with flanges or a screw thread (DN15...40)
2. A section ended with flanges (DN50...200)
3. An existing section of a pipeline (DN250...2000)

Additional equipment:
- Flow simulator SONIX S5I
- Probes exchangeable under pressure for versions 2 and 3 (from DN250)



SONIX 10D


SONIX 10D
DN100

List of supplied elements

The following elements constitute the flowmeter set:
- a measuring transducer
- a flow sensor with two or four ultrasound probes including cables
- Instructions for Assembly and Operating and a Guarantee Certificate
- Calibration certificate for the flowmeters calibrated in the SONIX company flow stand

Purpose

Measurement of flow intensity and summing the volume of flowing liquids in closed, fully filled pipelines.
Flow transducer for a heat meter.
Cold water meter.
Universal flowmeter for industrial usage

Basic technical data

	Flow transducer for heat meter	Cold water meter	Flow meter not requiring verification
Authentication type	-	Decision No ZT 295/2006	-
Mark of authentication type	-	PLT 06268	-
Diameter range of pipelines (mm)	50 ÷ 600	50 ÷ 300	15 ÷ 2000
Liquid speed range (m/s)	0,038 ÷ 5	0,038 ÷ 4	0 ÷ 15
Liquid temperature range (°C)	0 ÷ 130	0 ÷ 30	0 ÷ 150 temporarily to 180
Ambient temperature of the measuring transducer	+5 ÷ +55	+5 ÷ +55	+5 ÷ +55
Liquid reaction (pH)	3 ÷ 11	3 ÷ 11	3 ÷ 11
Working pressure (MPa)	0,03 ÷ 2,5	0,03 ÷ 2,5	0,03 ÷ 2,5 (4)
Basic measurement error (% w.m.)	σ=±0.5	σ=±0.5	σ=±0.5
Method of calibration or verification	Calibration in the flow stand of the SONIX company.	Verification on the flow stand in the verification premises	Calibration in the flow stand of the SONIX company. Flowmeters assembled on an existing pipeline- theoretically calibrated in accordance with the Polish PN/M-42370 Norm

ASSEMBLY

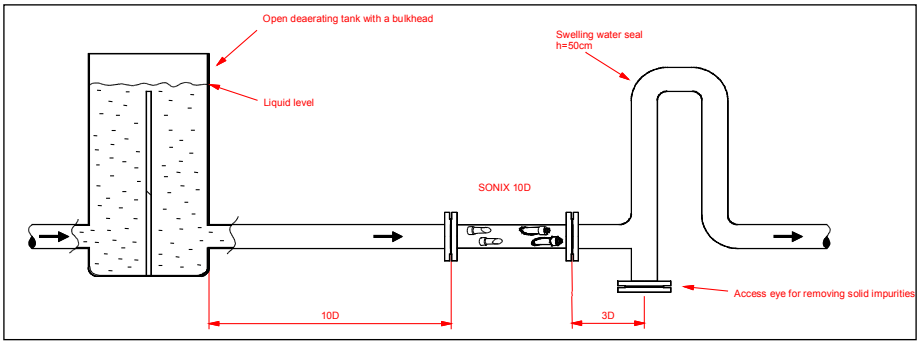
Mechanical assembly of the flow sensor

The choice of location and manner of the assembly of the flow sensor decides on the metrological properties of the device.
The following conditions must be met in order to provide correct measurement:
1. Lack of aeration of the liquid
2. 100% filling of the pipeline
3. Small attenuation of the ultrasound wave
3. Stabilized and symmetrical profile of liquid speed

The U-shaped sensor must be assembled horizontally or at the 45° angle max. The assembly position of the remaining type of sensor depends on the choice of the user. The probes must be located in the horizontal surface i.e. at both sides of the pipeline and not below and above it. The acceptable deviation from the level equals 25°.

Measurement example of sewage flow in a gravitational pipeline

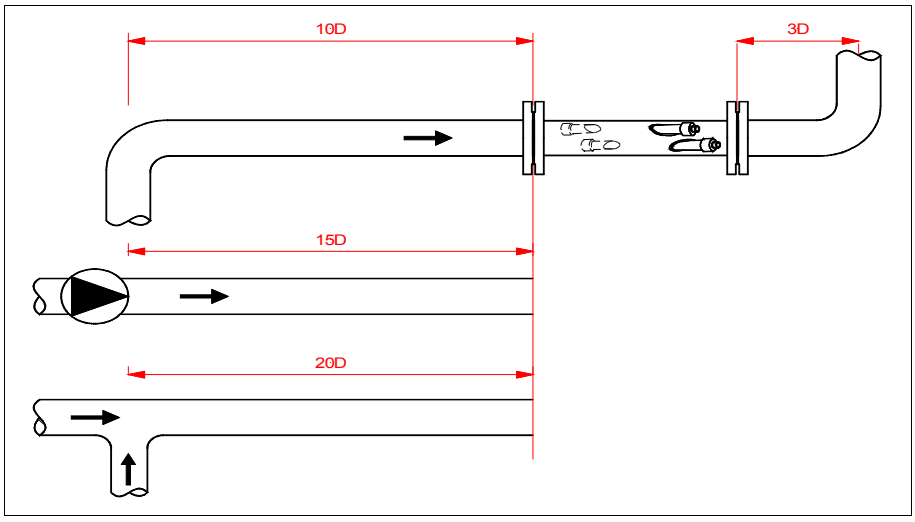
The elements of the measuring system shown on the following figure provide the conditions necessary for the correct measurement:
- Deaeration of the inflowing sewage
- 100% filling of the pipeline
- Lack of accumulating deposit in the flow sensor
- Symmetrical profile of liquid speed



Length of straight sections of the pipeline

In the majority of cases, straight sections of the following lengths are sufficient:
- Inlet: 10D
- Outlet: 3D

Two- or more surface spatial configurations of the pipeline, the pump, not entirely closed valves, side inlets etc. require appropriate elongation of the straight sections before and behind the measuring spot. The U-shaped flow sensor does not require straight sections.



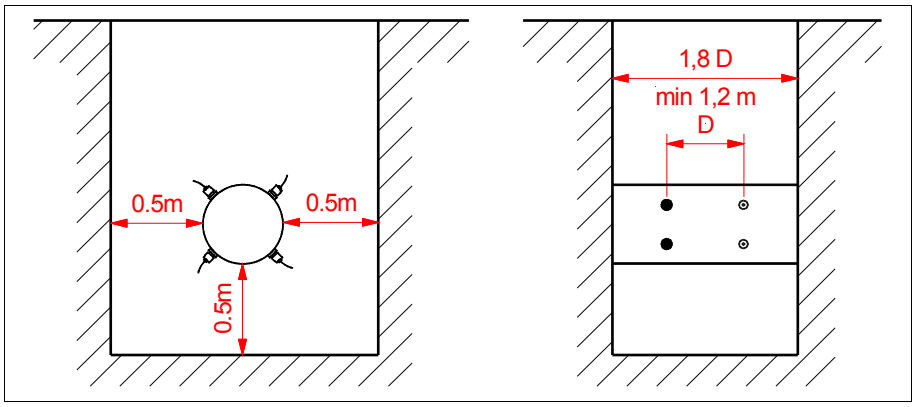
Recommendations for the flow sensor assembly

- Choose the longest available straight section of the pipeline. Install the sensor with probes on the 3/4 of its length starting from the inflow.
- Make sure that in the selected spot the liquid will not be aerated and air or solid impurities will not accumulate there.
- The inside diameter of the pipeline and the sensor should be the same.
- Install the sensor in such a way so the arrow on it is on top and shows the flow direction.
- The probes should be located horizontally on both sides of the pipeline (never vertically).
- The seals of the flange connections cannot protrude into the inside of the pipeline (protruding seals can cause the increase of measurement error from ± 5 to even ± 40%)
- Do not hit the flow sensor with a hammer or other devices. It may damage the probes.
- The factory numbers of the measuring transducer and the sensor must be identical.
- Place the measuring transducer in a place appropriate for readings from the display and accessible for servicing team.
- Run the signal and supply cables in separate, own channels and attach them to the terminal strip of the flowmeter in accordance with the markings and colours.
- The length of the cable between the PE terminal of the flowmeter and the grounding vertical should not exceed a few metres.

The producer's supervision over the assembly and start-up (refers to assembly on an existing pipeline DN250...DN2000)

The following activities make up the assembly and the start-up of the flowmeter:
- Tracing points on the pipeline
- Making 4 holes of approx. 25mm diameter in the wall of the pipeline (acetylene cutting in a steel pipeline, drilling in a cast iron one)
- Electrical welding of attaching sleeves to the steel pipeline or screwing them to a cast iron one
- Assembly of ultrasound probes
- Assembly of the measuring transducer
- Connecting the measuring transducer to the ultrasound probes with transmission cables
- Start-up of the flowmeter
- Setting to zero in the case of stopped flow

Space for the assembly of ultrasound probes

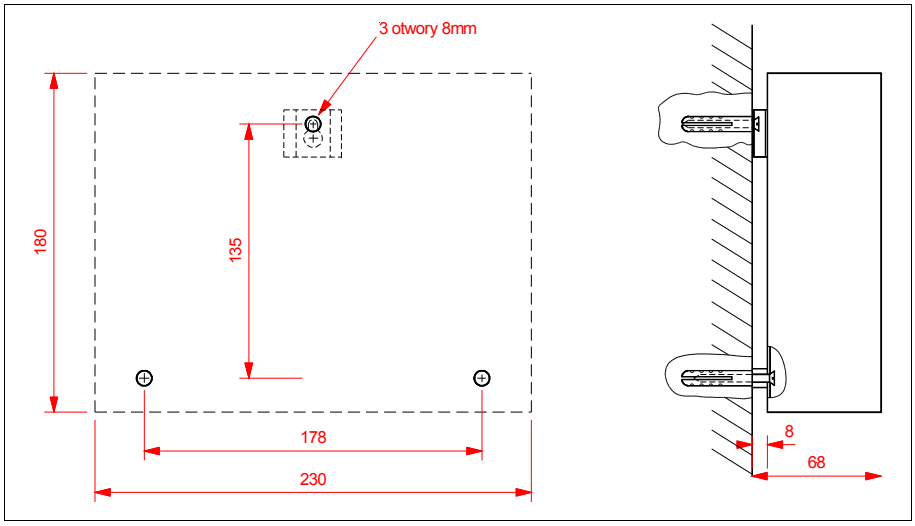


User's preparation for assembly

- Choice of the measuring spot on the pipeline and choice of measuring transducer location. The standard length of probes cables is 4 x 5m. In case of doubts, it is recommended to consult a SONIX representative.
- Preparation of the pipeline for assembly:
  - cleaning the surface of the pipeline from rust, insolation etc on the whole of its surface on the length of 1.8D
  - emptying the pipeline for welding and probe assembly. The tentative emptying time equals approx. 2 hours for a steel pipeline and approx. 6 hours for a cast iron one.
  - filling the pipeline in order to start-up the flow meter. After the filling, it is recommended to stop the flow for approx. 10 min in order to set the flowmeter to zero.
- Acetylene cutting of the holes of approx. 25mm diameters and electrical welding for a steel pipeline.
- Preparation of possible bushings, tubes, ducts etc. for probes cables: four cables of the approx. 6mm diameter.
- Arrangement of the 230V AC supply and signal cables connected to the measuring transducer.

Assembly of the measuring transducer

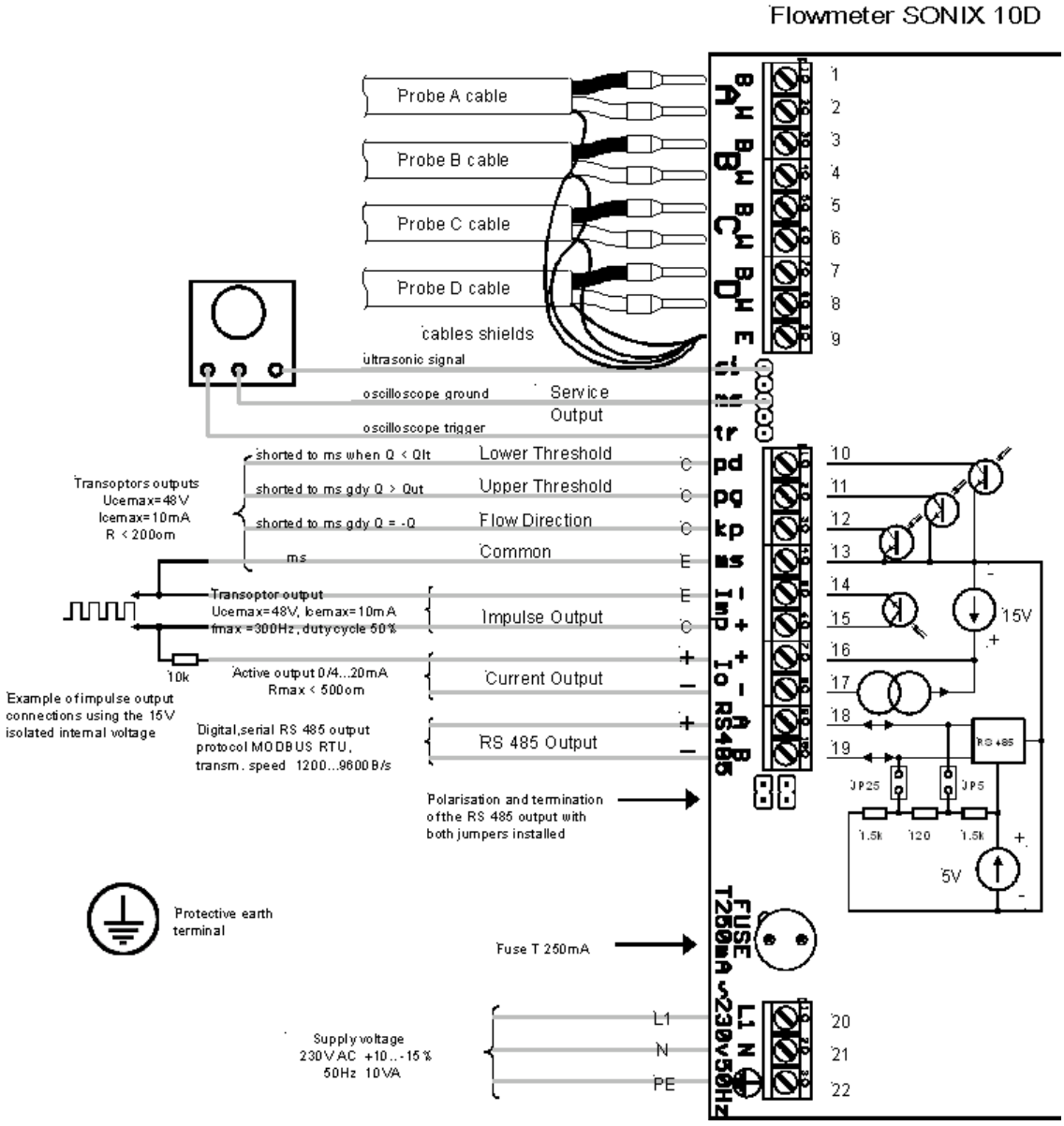
Protection category of the measuring transducer: IP54 It is acceptable to assembly the device in the open air in a heated protective cabinet. Due to temperature range of +5..+55 C during the summer months, the cabinet should be located in the shadow.



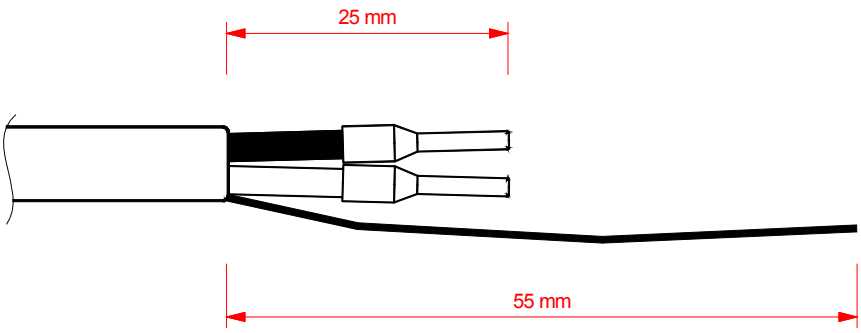
Power supply conection

- Protective earth conductor up to 2.5mm^2 (13 AWG) has to be connected to terminal ⏚ of the flowmeter
- Permanent connection to themains 230V AC +10..-15% 50Hz 10VA
- The power supply should have applied a reliable limiters decreasing surge to a level which does not couse a danger
- Protective earth cable lenght should not exceed a few meters
- It is forbidden connecting to protective earth terminal any other cable than protective earth conductor
- Power supply cable should have a diameter 5..6mm and its cable gland should be assembled properly

Electrical connections



Probe's cable correct ending

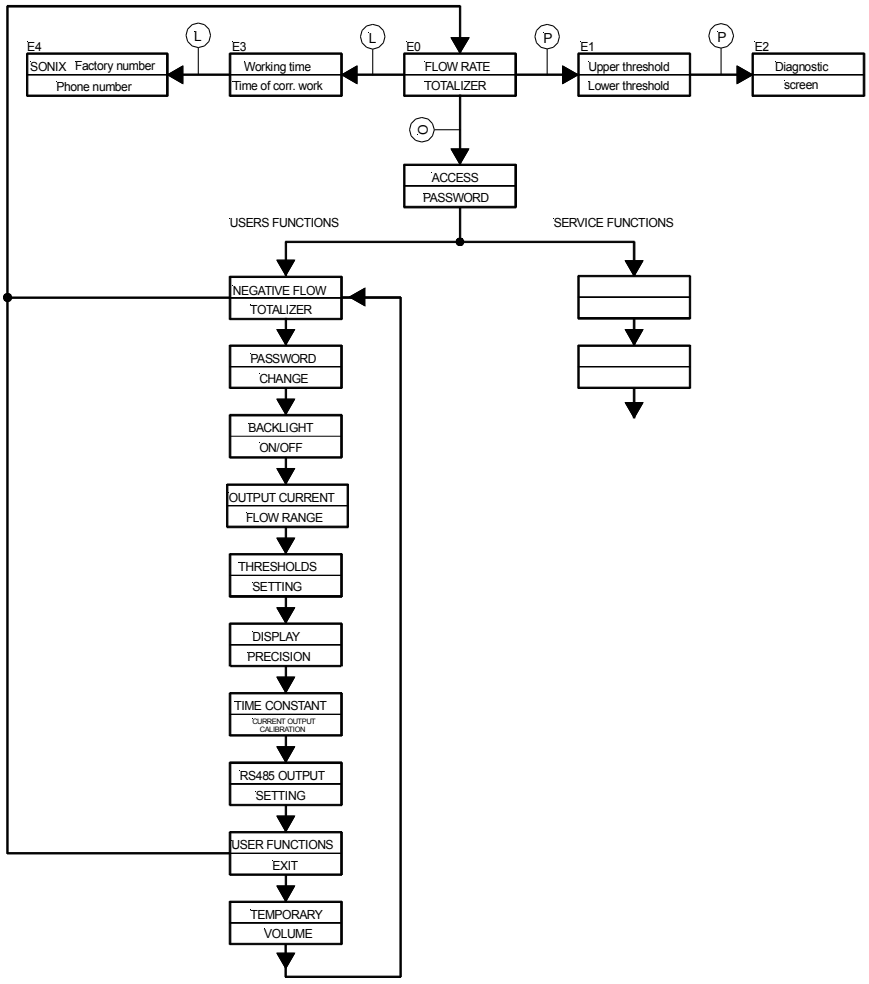


OPERATING

General Information

The user communicates with the device via the LCD 2x16 characters display using two push buttons for choice of functions or parameters. The principle of operating is as follows:
-The left one 'L': choice of function or digit
-The right one 'P': change of function or value
-Left and right one at the same time 'O': acceptance the change
The menu consists of 5 basic main screens and several screens of user's and servicing functions.

Descriptions of the menu



E0
Flow
Volume

The current flow in m^3/h (or t/h) and the counted total volume in m^3(or t).
For positive flow counts the basic volume counter.
For negative flow counts a separate negative volume counter available in the user's functions.
Power failure does not cause deletion of volume counters data or the loss of other data and parameters.
It is possible for the user to program the number (0...3) of displayed decimals.

E1
Upper threshold
Lower threshold

Threshold programming is available in the user's functions.
On E1 screen are only displyed the programmed flow thresholds above and below which a short circuit of appropriate transistors in transoptor outputs takes place.

E2
Diagnostic screen

Upper line, from left:
-Flow speed in m/s
-Type and value of enhancing adjustment: r-manual adjusting, a-automatic adjusting
-Mode of work: 0 – lack of liquid
1– two path measurement, work only on the AB path
2– two path measurement, work only on the CD path
3– two path measurement, work on both paths
4– one path measurement - AB
5– one path measurement - CD
- the percentage of interferences marking the ratio of the number of incorrect flow measurements to all measurements done within a unit of time. Values below 25% are satisfactory. Values between 25...50% show excessive electrical interferences or liquid aeration. Values above 50% are treated as group I errors requiring servicing.

Diagnostic messages are displayed in the lower line:
'Measurement OK'
'Empty pipe' – empty pipeline or disconnected probes
'Low signal AB' – decreasing of the signal from the AB pair of probes
'Low signal CD' – decreasing of the signal from the CD pair of probes CD
'Out of I range' – flow exceeding the current range of flowmeter
'Out of v range' – too high liquid speed
'Disturbances' – more than 50% of interfered measurements
'Wrong parameter' – incorrect parameter value programmed
'AB trans. trouble' – damage of one or both probes of the AB pair
'CD trans. trouble' – damage of one or both probes of the CD pair
'Main trouble' – damage of the digital part of the flowmeter
'Temperature?' – lack of temperature record (in the case of tone display)

E3
Working time
Time of correct work

Working time means the number of hours the supply of the meter was on.
Time of correct work means the number of hours without signaling errors of group I or II.

E4
SONIX

Logo of the SONIX company. Factory number of the flowmeter. Phone number of SONIX's service.

User's functions

Using the user's functions does not influence flow measurement and volume counting done at the same time by the flowmeter. The impulse output remains free from interference as well.

Negative volume

Negative flow total volume counter.

Password change

5 digit access password to user's functions. Default password: 11111

Starting the backlight

The LCD display is illuminated for 15s after pressing any push button.

Change of current and range

Change of output current: 0-20mA or 4-20mA
Programming of range flow in m^3/h or t/h.
Programming the characteristics of the current output:
+ the output works symmetrically for the negative and positive flows
- the output work only for the positive flow

Setting the thresholds

Programming of the lower and upper flow threshold in m^3/h or t/h.

Change of display precision

Programming from 0 to 3 decimals for temporary flow and the totalized volume.

Change of the constant of time, calibration of the current output

Change of the measurement's time constant: 0...9 corresponds to approx. 0.5...30s. Forcing the 0, 4, 10, 15 or 20mA current in order to achieve a calibration of the device connected to the current output of the flowmeter.

Parameters of the RS485 output

Programming parity control: Odd, Even, None, address of the device: 01_H...FF_H and transmission speed: 1200B/s...9600B/s.

Exiting user's functions

Exiting user's functions is done by pressing both push buttons.

Temporary volume

The function allows dosing the liquid. The temporary liquid counter is set to zero and initiated with the left push button and stopped with the right one. The counter may also be operated by the RS485 series link (see Protocol of series transmission).

Servicing

Service of the flowmeter is performed only by the SONIX servicing team.

ERRORS

General information

Operating flowmeters errors are divided into two groups:

I. Errors causing incorrect measurement and requiring immediate servicing. The occurrence of such error is signaled by periodical blanking of the display every 0.3s. All outputs return to non-active states. Volume counting and the counter of correct work are blocked. The description of the error is displayed on the diagnostic screen.

II. Errors of lesser importance which do not significant influence on the accuracy of measurement but require servicing within a few weeks or months. The occurrence of such error is signaled by periodical blanking of the display every 4s. All functions and outputs remain active. The description of the error is displayed in the diagnostic screen.

Diagnostic messages

Measurement OK - the measurements are done correctly.
Errors:
Group I – errors of high importance (blanking of the display every 0.3s)
-damage of the measuring transducer
-damage of the probes or cables except for damage of one pair of probes in two-path work. When this occurs the flowmeter then switches over to the functioning pair of probes and an error of group II is signaled
-too high speed of the liquid
-pipeline not fully filled
-too many interferences
-programming of an incorrect value of a parameter
Group II – errors of lesser importance (blanking of the display every 2s)
-low ultrasound signal
-flow outside the current range
-damage of one pair of probes in two-path work
-lack of temperature records by the RS485 link when tones are the programmed unit. Cubic meters then remains the unit and an error is signaled.

THE SERIES RS485 OUTPUT

Protocol description

The MODBUS RTU protocol of series transmission is compliant with the current specification available at www.modbus.org Transmission speeds: 1200, 2400, 4800 or 9600 B/s. Addresses of the devices: 1 ...255. Character format:

- -1 start bit
- -8 data bits
- -1 parity control bit (programmable: Odd, Even, None)
- -1 stop bit (or 2 stop bits when programmed to None).

Two functions are available:
03 or 04 – reading of the content of the flowmeter's register group
06 – recording data in the flowmeter register

Examples of frames for the device of the 02_H address

1. Reading of 2 registers beginning from register no 10 of the following content:
   register no 10: $057F_H$ register no 11: $9D1A_H$
   Order: 02,03,00,09,00,02,14,3A
   Response: 02,03,04,05,7F,9D,1A,11,7C
2. Setting to zero and starting the temporary volume counter:
   Order: 02,06,00,1E,00,01,28,3F
   Response: 02,06,00,1E,00,01,28,3F
3. Stopping the temporary volume counter:
   Order: 02,06,00,1E,00,00,E9,FF
   Response: 02,06,00,1E,00,00,E9,FF
4. Record of the 94°C temperature in register no 32:
   Order: 02,06,00,1F,00,5E,39,C7
   Response: 02,06,00,1F,00,5E,39,C7

Electrical connections

The applied isolated interface is compliant with the EIA RS-485 standard. The transmission line must be connected in accordance with labels on the printed plate: R_A – higher potential, R_B – lower potential. In the case of severe electrical interferences or if the length of the cables exceed 300m, paired twisted 120Ω cable cat.4 wave resistance should be used.
If the flowmeter is located at the end of a transmission line exceeding 300m, line termination should be initiated by attaching the 2 jumpers (next to the fuse on the printed plate). Simultaneously with the termination, the line is also polarized with the approx 2.5V voltage. (see electrical connections of the flowmeter). The flowmeter is supplied with jumpers attached.

Unit change volume/mass

The SONIX 10D flowmeter enables readings of temporary values of the flow and the content of counters in mass units (t/h, t and kg). In order to achieve this, one should:

1. Program the desired option in the servicing functions (done by the SONIX servicing team)
2. Record in register no. 32 the current temperature value in the char. Format via the RS485 interface. Available temperature range: 1 ...255°C

Remarks:

- -Temperature records must be done not less frequently than every 100s. If this is not done, the device will return to displaying in volume units and signals an error. The content of the volume counters will not be deleted.
- -The change over into mass units does not apply to the impulse output of the flowmeter.

List of registers

Register no	Variable type	Name of the variable	
1	float	LO	Flow m3/h (t/h)
2		HI	
3	long int	HI	Positive volume m3(t)
4		LO	
5	int		Positive volume l(kg)
6	float	LO	
7		HI	Liquid speed m/s
8	bit		errors 1... 16
9			reserved
10			reserved
11	long int	HI	
12		LO	Working time s
13	long int	HI	Time of correct work s
14		LO	
15	long int	HI	Temporary volume l(kg)
16		LO	
17	long int	HI	Negative volume m3(t)
18		LO	
19	int		Negative volume l(kg)
20	float	LO	
21		HI	5 min average of the flow
22	float	LO	
23		HI	Hour average of the flow m3(t)
24			Reserved
25			Reserved
26			Reserved
27			Reserved
28			Reserved
29			Reserved
30			Reserved
31	bit		Op. with temp. vol. counter
32	char		Temperature oC

Remarks:
16 bit registers, char, int, long int – variable without a sign
Register no 8 (errors), 1 in a given position means:
15 - reserved
14 - reserved
13 - reserved
12 - reserved
11 - reserved
10 - lack of temperature record to register no 32
9 - low signal from the CD pair of probes
8 - outside the range of acceptable liquid speed
7- damage of the digital part of the flowmeter
6 - the flow exceeds the programmed current range value
5 - excessive number of electrical interferences or aeration of the liquid
4 - damage of a probe in the CD pair
3 - damage of a probe in the AB pair
2 - incorrect value of a parameter programmed
1 - lack of liquid in the pipeline, damaged probe cables, damage of the analogue part of the flowmeter
0 - low signal from the AB pair of probes

DECLARATION OF CONFORMITY

The manufacturer:
SONIX® Industrial Electronic Devices
ul. Leopolda Lisa-Kuli 12, 05-270 Marki

declares that the following described product:
Ultrasonic Flowmeter type SONIX10D
is compliant with the requirements of the European Counsil directives no 73/23/ECC, 89/336/ECC, 97/23/EC
and is compliant with the principal requirements contained in the following norms:
PN-EN 61000-4-2:1999; PN-EN 61000-4-3:2002; PN-EN 61000-4-4:1999; PN-EN 61000-4-5:1998; PN-EN 61000-4-8:1998; PN-EN 61000-4-11:1997; PN-EN 55022:2000; PN-EN 1434-1:1997; PN-EN 1434-4:2001; PN-EN 60068-2-2; PN-EN 60068-2-1; PN-EN 1708-1:2002; PN-EN 1779:2002; PN-EN1289:2000; PN-EN 1011-1; IEC 68-2-30: Test Db,variant 1; PN-M-42370
Compliance with the principal requirements was confirmed by accredited laboratories and offices:
Polskie Centrum Badań i Certyfikacji S.A. [Polish Centre for Testing and Certification] , ul. Kłobucka 23A, 02-699Warsaw, Poland
Przemysłowy Instytut Elektroniki [Institute of Industrial Electronics], ul. Długa 44/50, 00-241 Warsaw, Poland
Główny Urząd Miar Jednostka Certyfikująca [Central Office of Measures, Certificating Unit], ul.Elektoralna 2, 00-950 Warsaw, Poland

Warszawa, 13.08.2010

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Krzysztof Kolodziej

Managing Director

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GUARANTEE CERTIFICATE

1. The producer guarantees good quality of the product and its meeting the parameters defined in the Instruction for Assembly and Operating.
2. The guarantee period covers 72 months from the date of sales.
3. The free of charge guarantee repair shall be done within 48 hours from delivering the product to the producer's.
4. The producer undertakes to perform post-guarantee repairs within the dates specified in point 3.
5. The guarantee shall not remain valid in the case of:
   - mechanical damage to the product
   - interferences to the inside of the product except for the cases defined in the Instruction for Assembly and Operating
   - operation incompliant with the Instruction for Assembly and Operating
6. The guarantee does not cover complaints relating to incorrect working caused by external factors or by damage of the product (e.g. the probes' surface covering with deposit, presence of air in the pipeline, exceeding the allowed temperature limit for the ultrasound probes etc.).

Name of the product: ULTRASOUND FLOWMETER, type: SONIX 10D

Purchasing company:.....

Factory numbers:

The SONIX 10D Flowmeter.....

Date of sale:.....