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FDT100 Series Ultrasonic Flow Meters



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1. APPLICATION

Battery-powered ultrasonic water meters of the FDT100 SERIES type series are intended for technological measurements of instantaneous flow rate and consumption in water-supply networks, and archiving of the measured data. Measurement of water pressure in piping is also possible. The technical capabilities including high measurement accuracy and long-term stability over a wide range of measured values make it possible to use the meters, apart from the conventional measurements, for monitoring leakage and the general condition of water supply networks. The FDT100 SERIES water meters do not require external power, do not include any moving parts or filters to prevent choking with mechanical impurities and, compared to conventional water meters, have significantly lower hydraulic losses.. Flow meters shall be used in standard non-explosive environments.

Any installation of flow meter must be in conformity with technical conditions mentioned in this manual.

2. MEASUREMENT METHOD

The measurement method used is a single-beam pulse transit-time method based on determination of the time needed for an ultrasonic pulse wave to cross the distance between two probes embedded in piping. Each of the probes functions as the sender and receiver in turns so that the ultrasonic wave travels in turns in and against the water flow direction. This arrangement allows for effective elimination of errors due to asymmetry in the probe locations.

3. TECHNICAL DESCRIPTION

3.1. Meter characteristics

The FDT100 SERIES ultrasonic water meter is an electronic device used to measure the water flow rate in a fully flooded piping. It is manufactured and supplied in two versions: compact and remote. The compact version, designated FDT100 .SERIES, has the electronic unit attached directly onto the flow sensor housing. The remote version, designated FDT100-R .SERIES, has the electronic unit separated from the sensor and connected with it by means of a cable (length 6m). The electronic unit is accommodated in a separate box that can be fitted on a wall.

In the standard configuration, the meter software allows for measuring and display of the instantaneous flow rate and total volume of water passed through the meter since the volume counter was last reset. The meter is provided with a passive pulse output including an optocoupler. The pulse length is 40ms. The meter include passive current output. The meter is supplied suitable for use in drinking-water supply systems.



3.2. Meter design



3.2.1. Compact version – basic dimensions

DN	1¼" (32)	1½" (40)	2" (50)	21⁄2" (65)	3" (80)	4" (100)	5" (125)	6" (150)	8" (200)
L [inch] / [mm]	10.2/260	11.8/300	11.8/300	11.8/300	13.8/350	13.8/350	13.8/350	13.8/350	13.8/350
S [inch] / [mm]	7.5/190	7.8/198	8.2/208	8.9/225	9.3/237	10/253	11/280	12/307	14/352
D [inch] / [mm]	5.5/140	5.9/150	6.5/165	7.3/185	7.9/200	8.7/220	9.8/250	11.2/285	13.4/340
Weight [lb] / [kg]	10/4.5	15/7	22/10	24/11	33/15	39/17.5	50/22.5	57/26	80/36.5

3.2.2. Remote version – basic dimensions





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DN	1¼" (32)	1½" (40)	2" (50)	21⁄2" (65)	3" (80)	4" (100)	5" (125)	6" (150)	8" (200)
L [inch] / [mm]	10.2/260	11.8/300	11.8/300	11.8/300	13.8/350	13.8/350	13.8/350	13.8/350	13.8/350
D [inch] / [mm]	5.5/140	5.9/150	6.5/165	7.3/185	7.9/200	8.7/220	9.8/250	11.2/285	13.4/340
Weight [lb] / [kg]	11/5	16.5/7.5	23/10.5	25/11.5	34/15.5	40/18	51/23	58/26.5	82/37

3.2.3. Ultrasonic sensor unit

The ultrasonic sensor unit comprises a housing made of ductile cast iron (material according to DIN GGG40) with two flanges (according to 150# ANSI B) and two embedded ultrasonic probes. The sensor housing is painted with surface finish of KOMAXIT E 2110 blue powder epoxy paint (RAL 5017). The rating plate attached to the sensor body includes the basic meter specifications including the sensor size (DN), the accuracy class (B) and the rated constant flow rate in gallons per minute (q_P , the figure next to N) – see the picture below.



3.2.4. Electronic unit

The electronic unit and battery are placed in an aluminium box with a plastic lid. The box is provided with a special valve preventing moisture condensation inside the box and up to three grummets for cables of circular cross-section. The surface finish is by paint of orange hue (RAL 1017).

Two M8 grummets are intended for cables of outside diameter 3.5 to 5mm to be connected to the selected output signal terminals. On delivery, these grummets are blinded. The third grummet (M12) is provided only in the case of the remote meter version and is intended for the cable of diameter 6.5 to 8mm connecting the sensor and the remote electronic unit. The connecting cable is supplied attached to the electronic unit with the other end ready to be connected to the sensor terminal board.

The meter display is located under the transparent plastic cover. The push-button on the unit box is used to select the desired display mode: either instantaneous flow rate (in gallons per minute GPM or m^3 /hour), the total fluid volume (in thousands of gallons or m^3) passed through the meter sensor since the volume counter was last reset, or the fluid pressure (in bar). The actual quantity displayed is indicated at the bottom line by the symbol \vee . In the case of a meter failure, the respective error message (E1 through to E5) will be indicated by the same symbol \vee - see the picture below. A recess in the unit box is for an optical probe to be applied onto the recessed surface to read the stored data. Also found under the box lid is the meter rating plate:



Plate including rated parameters in G.10³ a GPM





Plate including rated parameters in m³ and m³/hour



IMPORTANT NOTICE: Prior to operational start, check proper tightening of the grummets and blinding of the unused ones.



3.2.5. Separate sensor unit – terminal board

In the case of the remote version of the FDT100 SERIES water meter, attached to the sensor housing is a terminal board in an aluminium box with a sealed lid. The terminal box is provided with a M12 grommet for a cable of diameter 6.5 to 8mm, a valve preventing moisture condensation inside the box and four spring-loaded WAGO terminals to which the ultrasonic probes signals are brought. Connected to these terminals are the wires of the cable leading to the remote electronic unit.





3.2.6. Meter handling

The arrows indicate incorrect grips on the meter assembly. Do not lift the meter holding it by the electronic unit or the protection tubes – see the figure.





The arrows indicate the correct grips on the meter assembly. To lift the meter, hold it by the flanges or meter body.





4. TECHNICAL SPECIFICATIONS

Rated internal diameter DN		11⁄4"	11⁄2"	2"	21⁄2"	3"	4"	5"	6"	8"	
		(32)	(40)	(50)	(65)	(80)	(100)	(125)	(150)	(200)	
Overloading flow rate g	GPM	52	90	130	220	350	530	880	1,320	1,585	
	m³/h	12	20	30	50	80	120	200	300	360	
Continuous flow rate d	GPM	26	45	65	110	175	265	440	660	1,100	
	m³/h	6	10	15	25	40	60	100	150	250	
Transient flow rate a	GPM	2.1	3.5	13.2	22	35	53	88	132	220	
	m³/h	0.48	0.8	3	5	8	12	20	30	50	
Minimum flow rate days	GPM	0.52	0.9	2	3.3	5.3	7.9	13.2	19.8	33	
	m³/h	0.12	0.2	0.45	0.75	1.2	1.8	3	4.5	7.5	
Pulse output constant k	G/imp	2	5	5	10	10	15	30	30	30	
	l/imp	10	25	25	50	50	100	100	100	100	
Rated pressure PN 16											
Accuracy class		+/- 2% of reading, +/- 5 % below minimum transition rate									
Temperature of measured fluid	1	32 to 122°F (0 to 50°C)									
Ambient temperature		32 to 122°F (0 to 50°C)									
Display unit		single-line 8-character LC display									
Power		Li battery 3.6V/3.6Ah, type LSH 14 light lifetime 1 year from the day of production (standard "transport" battery)									
		Li battery 3.6V/16Ah, type LS 33600, minimum lifetime 6 to 8 years since a date of production (customer supplied)									
Protection class		IP 67									
Pressure loss		less than 0.1 bar at q_p									
Outputs		passive pulse U = 5 to 30V, I_{max} = 10mA, pulse length 40ms									
Optional accessories		passive current output 4 to 20mA, U _{max} = 24V									
		remote meter version, maximum cable length 5m (-R)									



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5. PROJECT DESIGN AND METER INSTALLATION

Compliance with standards ISO 4064-1, ISO 4064-2 and strict observance of the recommendations in this Manual are required in all project-design work regarding application and installation of the FDT100 SERIES ultrasonic water meters in water-supply networks.

5.1. Project design of systems including ultrasonic water meters

In water supply and distribution systems, water meters should be located so as to ensure maximum measurement accuracy. In the case of the FDT100 SERIES meters, the lengths of the required straight piping sections on the input





and output sides are at least 5xDN and 3xDN, respectively. Minimum lengths of straight piping sections

If there is any pump nearby, it should be located on the output side of the meter at the distance of at least 20xDN.



Pump placement

In cases where full flooding of the piping cannot be guaranteed at all times, the meter sensor should be fitted in such piping section where these conditions will always be met.





Meter placement to ensure full flooding

Should the meter need be installed in a vertical piping section, the water flow direction shall be upwards.



Vertical sensor position



To ensure reliable and accurate measurements under all circumstances, the measured fluid shall fill the internal cavity of the sensor at all times. Therefore the sensor should not be placed at the highest piping section or in a vertical piping section where the flow direction is downwards, in particular in cases where a piping outlet to open tanks is anywhere near.



Examples of incorrect sensor placement

There are no limitations regarding sensor position in piping; however, consideration should be given to the ease of reading the display data and access to the optical probe contact point (see the picture below).



The above recommendations regarding the meter/sensor placement and installation apply to both the compact and remote meter versions.



5.2. Meter installation

5.2.1. General recommendations

In the basic arrangement (flow direction from left to right and the sensor installed into a horizontal piping section), the electronic unit is fitted onto the sensor body as shown in the following picture.



In the case of vertical mounting, or the flow direction from right to left, the electronic unit can be rotated with respect to the sensor body by 90 or 180° in both ways; 180° rotation is a limit to avoid straining the connecting wires. The unit can be rotated upon loosening the arresting screw M5 at the unit base using an Alien wrench, size 2.5mm. The 90° positions on the unit base are marked by recesses for the arresting screw.



To prevent signal interference, the meter wiring shall be placed at least 25cm away from any live power cables.



The interconnection between the meter sensor and electronic unit (the remote meter version) is made by a shielded cable with the shielding connected to the earth potential at the sensor terminal board. It is recommended that all output signals (the pulse and current outputs) be connected using shielded cables with the shielding connected to the earth potential on the side of the plant control system. The meter sensor shall also be carefully grounded. To do that, connect the grounding bolt on the sensor flange with the piping flanges using an grounding conductor of cross-section of at least 4mm².

min 4mm²-green and yellow wire insulation



5.2.2. Mechanical fitting

The ultrasonic sensor shall be fitted into the water piping across piping flanges matching the meter flanges ANSI.

5.2.3. Electrical connections

The compact meter version (FDT100 SERIES): the electrical interconnection operation consists of connecting the output signal cables to the respective terminals on terminal board in the electronic unit. The terminal board can be accessed upon removal of the plastic lid at the top of the unit box. The lid is secured in position by means of two M4 screws with hexagonal socket heads for Alien wrench size 2mm.

At the bottom side of the plastic lid there are two slots 8mm wide where a flat tool can be inserted to help lift the lid from the box. It is recommended to insert a screwdriver into one of the slots and slightly pry upwards. The locations of the slots are shown in the picture below. Prior to replacing the lid, apply a thin layer of glycerine or silicon oil on the sealing O-ring.

When replacing the lid, the 3mm hole at the bottom side of the plastic lid should be fitted onto the guide pin of diameter 2.5mm press-fitted at the box bottom.





The remote meter version (FDT100 SERIES): the free end of the signal cable from the electronic unit is to be connected to the respective spring-loaded WAGO terminals at terminal board in the sensor unit assembly. The lid on the terminal box is held in position by means of four M4 screws with hexagonal socket heads for Alien wrench size 3mm.

The output signal cable connections the terminal board are made in the same way as shown above for the case of the compact meter version.





5.2.4. Seals on meters

The water meters used as technological meters shall be provided with clamp-on and stick-on company and assembly seals as shown in the following illustration pictures.

The compact meter version, type FDT100 SERIES





The remote meter version, type FDT100 SERIES





6. OPERATIONAL START

The water meter is delivered calibrated and in a fully operative condition. Once it is fitted into the selected metering point in the piping, bled and filled with the technological fluid, it is ready for operation. The condition of readiness to start is indicated by disappearance of the error messages \checkmark at the bottom of the meter display unit. Using the control pushbutton, check the selection of measurement modes: the instantaneous flow rate, total volume passed and pressure (if applicable).



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7. OPERATION

7.1. Reading the measured quantities from the meter display

The eight-character display unit can show either the instantaneous flow rate in gallons per minute (or m³/hour), the total volume of the fluid passed through the meter sensor since the reading was last reset, in G.10³ (or m³). The reading of instantaneous flow rate has a certain delay as the displayed value is determined as the arithmetic average of the six latest measurements (each taken in 1-second intervals). So calculated values also appear at the meter outputs. The delay becomes noticeable in the cases of rapidly changing (growing or falling) flow rate. Meter errors will be indicated on the display. Due to the limited power capacity of the meter, the various display modes can only be selected in intervals of 1 second or longer. It is therefore recommended that the display mode selection push-button be always depressed for at least one second, and the next selection command be given after another 1 second or longer. Depending on the reading of the total fluid volume passed, the decimal point on the display will move as shown in the following picture.



7.2. Electrical outputs

7.2.1. Pulse output

An pulse output is found on all FDT100 SERIES water meters irrespective of their version or configuration. In includes an optocoupler connected to terminals 7 and 8 (terminal board X1); the permitted current loading is 10mA, the pulse length 40ms. On a customer's request the pulse length can be set at 2ms. If voltage pulses are required, use an external power source of 5 to 25V DC connected in series with a limiting resistor so that the maximum current would not exceed 10mA. The interconnection of external power source and limiting resistor is shown in the picture illustrating the interconnections at the output terminal board (Section 5.2.3 above).

The pulse length can also be modified on site; for 40ms pulses, use jumper J5 to connect terminals J5:2 and J5:3 (X1), for 2ms pulses, connect terminals J5:1 and J5:2 (see the figure below).





7.2.2. Current output

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The current output 4 - 20mA is connected to terminals 5 and 6 at the output terminal board. Upon attaining the output current level of 20mA (corresponding to Qmax), the current will not exceed this value and the error message E4 will appear on the display (see Section 7.5. below). To utilize the output current function, use an external power source of 10 to 24V DC and the interconnection at the output terminal board as described in Section 5.2.3. The maximum permitted resistance (the ohm resistance of the cable + input resistance of the co-operating equipment) of the current output circuit shall be determined using the following formula:

$$\mathsf{R}_{\mathsf{s}}\left[\Omega\right] = \frac{\mathsf{U} \, \mathsf{source}\left[\mathsf{V}\right] - 7}{0.02}$$

7.3. Error identification function

Meter errors shall be identified as E1 through to E5 by symbol ¥ shown at the bottom of the display unit.

Error identification symbols:

- E1 the ultrasonic signal cannot freely propagate in the sensor cavity (due to the presence of air or mechanical particles)
- E2 too great a difference between the signal travel times in and against the fluid flow direction (possibly due to the presence of air at one of the probes, which may be a temporary condition during the operation of filling the piping with fluid, or due to contamination of the face part of one of the probes)
- E3 A/D converter error (e.g. due to strong interference)
- E4 flow rate in excess of q_s
- E5 flat meter battery

Should the display go completely blank, check the battery condition (the voltage should be over 3V). Replace defective battery using the procedure described in Section 7.6. Should the battery replacement fail to restore the correct meter function, send the meter for repair to the manufacturer's service centre.

7.4. Battery life and replacement

Electronic unit is equipped with battery SAFT LITHIUM 3,6V /3,6Ah LSH 14 "light" (size C) containing less than 1g of lithium and is equipped with plastic case capable of using of either C and D size battery. Lifetime of LSH 14 "lite" battery is 1 year since date of production and can be replaced by battery LITHIUM 3.6V / 16Ah LS 33600 (size D) with lifetime up to 8 years, with using of communication functions up to 6 years. Plastic case is not used for D size battery

LSH 14 "light" battery is used as a "transport battery," because it is non-restricted to transport/non-assigned to Class 9 according Lithium battery transport regulation (Ref. TC-LSH 14"light"-09/03-1).

To replace the meter battery, first remove the plastic lid on the electronic unit box held in position by two M4 screws with hexagonal socket heads (use Alien wrench, size 2mm), see Section 5.2.3., then loosen three M3 screws holding the electronic module in the aluminium box and pull the module outside the box. While doing that, make sure you do not damage any metrological or company seals. The electronic module can only be removed as far as probe conductors and output signal cables permit. The battery is located in a holder at the bottom of the unit; pull the battery free and replace it with a new one. Mind the correct polarity as indicated on a plate on the battery holder. Push the electronic module back into the box, tighten the holding bolts, replace the box lid, fix its position with screw and apply assembly seal on one of them.





The electronic module removed from its box

8. CALIBRATION

The standard calibration is done with respect to the pulse output. In that case the measurement error at the current output will be approx. 1% higher than that at the pulse output. If the customer requires calibration for the current output, it can be done and the additional error of about 1% will then appear at the pulse output.

WARRANTY/DISCLAIMER

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETUR (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

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FOR WARRANTY RETURNS, please have the	FOR NON-WARRANTY REPAIRS, consult OMEGA
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contacting OMEGA:	information available BEFORE contacting OMEGA:
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Model and serial number of the product under warranty, and	2. Model and serial number of the product, and

3. Repair instructions and/or specific problems relative to the product.

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