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FDT500 Series Ultrasonic Flow Meters



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1. APPLICATION

The battery powered ultrasonic FDT500 series water meter is designed for industrial and commercial applications that require measurements of instantaneous flow rate, pressure (optional) and accumulated flow total. The meter design and parameters meet the requirements of standard EN 14154. The technical capabilities and parameters of the FDT500 water meters make them an ideal solution for not only water consumption measurement but also for water leakage and water-supply network condition monitoring with optional wireless data transfer features.

The standard compact meter version is intended for operation in environments where the meter will not be immersed.

2. MEASUREMENT PRINCIPLE

The meter utilises the "transit-time" impulse measurement method where the flow rate information is derived from the difference between the measured transit times of ultrasonic signals travelling between ultrasonic probes in and against the flow direction of the measured fluid.

3. TECHNICAL DESCRIPTION

3.1. Meter version

Battery-powered ultrasonic water meters of the FDT500 series are manufactured in standard design:

 Single beam, Compact version, display, button, power supply Li-battery 3.6V, T_{max} = 50°C, flanges according to ANSI 150 psi, pulse output with 5 m of cable, current output 4-20mA (-A, optional), material of measured part casting from cast iron, covering by powder colour KOMAXIT, protection IP67, calibration in 3 points, CE mark

3.1.1. Meter sensors

The water meter measuring sensor is designed for operation under conditions typical for conventional mechanical water meters regarding the scope of measured values including the fluid pressure (-PS, optional) (not exceeding 16 bar).

3.1.2. Electronic unit

All water meters work in combination with an electronic unit of a unified design.

The standard electronics unit version includes the following functions:

- Measurement and display of instantaneous flow rate values in one flow direction [m³/h, gal/min];
- Display of the total volume passed through the meter sensor in one flow direction $[m^3, 10^3 \text{ gal}];$
- Flow rate information communicated via a passive insulated pulse output.

Electronic unit with additional functions makes possible/includes:

- Measurement and display of instantaneous flow rate and flow volume data in both flow directions with graphic indication of the actual flow direction on the meter display;
- Measurement and display of instantaneous fluid pressure values (-PS, optional);
- Passive current output 4-20mA (-A, optional) corresponding to the instantaneous flow rate and fluid pressure values (-PS, optional) (only one parameter at a time);
- Fluid flow direction indication via:
 - o binary output for a current loop 4-20mA (in cases of bi-directional flow rate measurement)
- Two-wire power supply to the electronic unit using a current loop 4-20mA;
- Mutually independent measured data storage in periods one minute to one year;
- Measured and stored data reading using optically insulated interface USB or RS232 line;

Available for the electronic unit with additional functions are the associated accessories such as interconnection cables, optical probe or software programs.

Comment: Application of additional electronic unit functions shortens the effective battery life.



3.2. Meter design

Taking into account the meter sensor design, the meter series consists of the following meter types:

Туре	DN	Type of sensor
Water meter	1 1/4" to 8"	Standard
FDT500	(32 to 200)	-PS (Optional)

3.2.1. Dimensional drawing

FDT500



FDT500-R



DN [inch] / [mm]	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
	32	40	50	65	80	100	125	150	200
L [inch] / [mm]	10.24 /	11.81 /	11.81 /	11.81 /	13.8 /	13.8 /	13.8 /	13.8 /	13.8 /
	260	300	300	300	350	350	350	350	350
S [inch] / [mm]	5.51 /	5.71 /	5.91 /	6.10 /	6.3 /	6.5 /	7.09 /	7.48 /	8.07 /
	140	145	150	155	160	165	180	190	205
Weight [lb] / [kg]	15.4 /	17.6 /	22 /	24.3 /	33.1 /	38.6 /	49.6 /	57.3 /	80.5 /
	7	8	10	11	15	17.5	22.5	26	36.5
ø D [inch] / [mm]	4.62 /	5 /	6 /	7 /	7.5 /	9 /	10 /	11 /	13.5 /
for ANSI 150 lb	117.3	127	152.4	177.8	190.5	228.6	254	279.4	342.9



Project design, meter installation and service manual Battery-powered ultrasonic water meters of the FDT500 series

3.2.2. Electronic unit

The electronic circuits and the meter battery are accommodated in an aluminium box with a plastic cap and a lift-off protective cover. The box is further provided with a pressure equaliser preventing air humidity condensation inside the electronic unit box.

The external box surface is painted with a powder paint of hue RAL1017 (saffron yellow).

Located under the protective cover are the meter rating plate, control push-button and a recession to accommodate the optical probe. A window in the plastic cap facilitates view of the meter display showing the measured values and the respective physical units:

- Instantaneous flow rate;
- Total volume passed through the meter in the + direction;
- Instantaneous fluid pressure (-PS, optional);
- Total volume passed through the meter in the direction;
- Check sum.

The displayed quantity can be selected by repeated pressing of the control pushbutton (depress for 1s and leave the pushbutton free for 1s before next depression).

In the case of the standard electronics unit version, only connector X2 (pulse outputs) is installed; the openings for connectors X1 and X3 are sealed. In the case of electronic unit with additional functions, all three connectors (X1, X2 and X3) can be active. When installed, each connector is provided with a water-proof cap sealed with an O-ring.

Connector specifications:

- X1 communication line RS232 (a 4-pole connector);
- X2 two pulse outputs (a 3-pole connector);
- X3 one current and one binary output (a 4-pole connector).

The interconnection of individual outputs is described in Section 6.2., Electric outputs.



Upon a customer's request, supplied with the meter can be the necessary connecting cables meeting the IP68 standards.

Cable specifications:

Connector X1:	a 4-pole plug, 5m cable and a 9-pin Canon connector;
Connector X2:	a 3-pole plug, 5m cable and free wires for connection to the master control system;
Connector X3:	a 4-pole plug, 5m cable and free wires for connection to the master control system.

<u>CAUTION:</u> Prior to putting the meter in operation, make sure that all connectors are tightly screwed on and the openings of unused connected properly sealed. The electronic unit shall not be exposed to direct sunlight.



3.2.3. Ultrasonic sensor

The ultrasonic sensor used with water meters of type designation UC 6.X is embedded in a malleable iron casting.

Each sensor includes two ultrasonic probes (single beam sensor version). The probe bodies are made of stainless steel.

Water meter sensors may also include pressure detectors.

Unless required otherwise, the sensors are provided with flanges meeting the ANSI 150 psi specifications. Other types of flange such as according to standards EN 1092-1, JIS, AS and others may be used on agreement with the sensor manufacturer. The rating plate attached to the sensor body includes information and data in reference to standard EN 14154-1+A1, clause 6.

The sensors are painted with powder epoxy-polyester paint of hue RAL 5017 (blue). The sensors used with water meters UC6.X may also be painted with polyamide RILSAN 7443MAC paint (blue).



UC 6.X

3.2.4. Sensor terminal board (the remote meter design version)

In cases of remote design of the FDT500-R water meters, attached to the sensor body is an aluminium box containing the sensor terminal board.

The water meter is supplied complete with a cable of length 5m meeting the protection class IP68 requirements intended to provide connection between the electronic unit and meter sensor.

The terminal box includes an M12 grommet and a lid with a sealing O-ring.

To ensure meeting the requirements of the specified protection class (IP68), the terminal box interior is sealed with waterproof resin.



4. TECHNICAL PARAMETERS

The symbols and abbreviations used in the following technical specifications comply with the provisions of standard EN 14154-1+A2, part 3, Terms and definitions.

Meter pressure	class	Water meters MAP 16 single beam FDT500 (DN 1 1/4" to 8" /					
Temperature class		Compact version	T50 (water meters FDT500)				
		Remote version	T90 (water meters FDT500-R)				
Flow profile ser	nsitivity class	Single beam sensor	Minimum Upstream and Downstream pipe requirements DN10 and DN5 DN10 with straightener, D5 (for DN 1 1/4" / 32)				
Pressure loss c	lass	ΔP 25 (the highest pressure class 0,25 bar)					
Climatic and me environment	echanical	Class B (static meters installed in a building) – type approved meters Class B, C (static meters installed outside) – non-certified meters					
Accuracy		Referential condition in compliance EN 14154-3+A2 \pm 5% for flow Q1 \leq Q $<$ Q2 \pm 3% for flow Q2 \leq Q \leq Q4 \pm 0,5% FSO for pressure 0 – 16 bar relative					
Electromagneti	c environment	E1, E2 (environment of flats, shops and light industry, industrial environment)					
Measurement cycle period		1 s					
Display unit		Single-line 8-digits LC display					
Power supply		Lithium battery 3,6 V/1	9 Ah, live time min. 8 years in standard version				
Operational ambient		23°F to 131°F / -5°C to	+55°C (protection against direct sunshine)				
Storage temper	ature	14°F to 158°F / -10°C to +70°C (by relative humidity max. 70%)					
Protection		IP67					
Outputs and	Standard	One direction measurement of flow with 1 passive pulse output 1x open collector NPN: U = 3 to 30 V, I = 0.002 to 10 mA, t_{imp} = 30 ms					
Tunctions	Non-standard	Passive current output 4 to 20mA (-A, optional), U = 10 to 24 V (flow or pressure)					
Each passive output must be		Bidirectional measurement of flow with 2 passive pulse outputs $2x$ open collector NPN: U = 3 to 30 V, I = 0.002 to 10 mA, t_{imp} = 30 ms					
powered from individual galvanic insulated		Bidirectional measurement of flow with passive current output 4 to 20mA (-A, optional), $U = 10$ to 24 V with indication of flow direction of flow by static passive output - transistor NMOS-FET: $U = 3$ to 30 V, I = 0,002 to 10 mA					
		Optical interface USB, RS232, RS232+USB driver Measurement of pressure (non for remote version and for temperature over 120°C)					

The value of minimum flow rate at which the meter starts to indicate and measure the flow data (Q_{NEC}) has been set at the manufacturing company at 20 mm/s. Upon the customer's request, this setting can be modified within the range $Q_{NEC} = 0.1$ to 25% Q_4 .



Project design, meter installation and service manual Battery-powered ultrasonic water meters of the FDT500 series

Water meter precision rating in accordance with standard EN 14154 for temperature classes T50 and T90



According to ČSN EN 14154, it holds:

$$\frac{Q_4}{Q_3} = 1.25$$
 $\frac{Q_2}{Q_1} = 1.6$

The flow rate values Q1,Q3 and Q4 related to individual design versions and meter dimensions are shown in Section 4.1.

Meter capabilities and functions:

- Measurements in one or both fluid flow directions (with flow velocity not exceeding 10 m/s);
- Measurements of fluid volumes passed through the meter sensor in both flow directions;
- Measurement of relative pressure of the flowing fluid;
- Storage of data concerning:
 - o flow rate,
 - o fluid volume passed through the meter in one direction (+),
 - o fluid volume passed through the meter in the other direction (-),
 - o pressure,
 - o real time of commencement of failure condition,
 - o real time of termination of failure condition,
 - o diagnosed failure conditions,
 - watch dog (WD) actions;
- Firmware consistency test check sum CRC32 once every 24 hours;
- LC display test consisting of lighting-up all display segments.



4.1 Sensor dimensions and flow-rate ranges

FDT500 (water meter, single beam, compact version) **FDT500-R** (water meter, single beam, remote version)

Nominal diameter DN	[inch]	1 1/4"	1 1/2"	2"	1 1/2"	3"	4"	5"	6"	8"
	[mm]	32	40	50	65	80	100	125	150	200*
Overload flow Q ₄	[GPM]	55.04	88.06	137.6	220.1	346.7	550.3	880.6	1376	2201
	[m ³ /h]	12.5	20	31.25	50	78.75	125	200	312.5	500
Permanent flow Q ₃	[GPM]	44.03	70.45	110.1	176.1	277.4	440.3	704.5	1101	1761
	[m ³ /h]	10	16	25	40	63	100	160	250	400
Minimum flow Q ₁	[GPM]	0.176	0.282	0.440	0.704	0.881	1.396	2.237	3.496	5.592
	[m ³ /h]	0.04	0.064	0.1	0.16	0.200	0.317	0.508	0.794	1.270
Constant of pulse output K_i	[G/imp]	2.6	2.6	6.6	13.2	13.2	26.4	26.4	26.4	66
	[l/imp]	10	10	25	50	50	100	100	100	250
Range of measurement Q ₃ /Q ₁			25	0				315		

* With these dimensions, the data shown on display are one tenth of the actual values (see Section 6.1.)

5. PROJECT DESIGN AND METER INSTALLATION

5.1. Project design of systems including ultrasonic water meters

In project designing and installation of ultrasonic water meters of the FDT500 series, the general rules regarding placement of water meters in piping as outlined in standard ČSN EN 14 154 need be observed.

The following text includes specific requirements concerning the minimum lengths of the straight piping sections at the sensor input and output with respect to various nearby-located flow-disturbing elements and measures to ensure full flooding of the sensor space.

5.1.1. Straight piping sections before and after the sensor

For a single-beam sensor, the minimum straight upstream and downstream pipe requirements are: DN10, DN5.



5.1.2. Elimination of the effect of pumps in the piping

The nearest pump in the piping shall be located at least 20 DN away from the meter sensor. To eliminate the effects of cavitation and gas release from the measured fluid, it is recommended to place the pump at the input side of the sensor. The cavitation effects can also be effectively suppressed by sufficiently high pressure in the piping system.



5.1.3. Piping stacks

The nearest stack in the piping system at the sensor input side shall be at least 20 DN away.





5.1.4. Flooding of the piping cross-section

The meter sensor shall always be fully flooded with the measured fluid (water). In cases where complete flooding of the whole piping system cannot be ensured at all times, the sensor placement shall be such that this condition is always met at the piping section concerned.

Preferred placement of single-beam sensors in the fluid piping



If the meter sensor is placed in a vertical piping section, the flow direction shall be upwards.



Single-beam sensor

It is not recommended to place the meter sensor at the highest piping section or, in cases of the sensor placement in a vertical piping section, with the fluid flow direction downwards, in particular if a discharge opening is anywhere near at the sensor output side. Observance of this rule will prevent measurement errors due to increased air bubble concentration inside the sensor space.

Examples of incorrect sensor placement





WARNING! In cases of external placement, the electronic unit shall be protected against direct sunlight. However, the unit shall not be placed in an enclosed box.

Meter handling rules

When lifting the meter, **never** hold it by any part of the electronic unit, but **always** by the sensor flanges or sensor body.



Meter storage

During storage and transport, the meter shall be protected against excessive mechanical shocks and vibrations. The best protection is provided by the original packaging.

Permitted storage temperature range: -10 to +70°C at relative humidity of the air not exceeding 70%. Long-term exposure of the meter to direct sunlight shall be avoided.

5.1.5. Mechanical connections

The ultrasonic sensor shall be installed in the piping using suitable counter-flanges meeting the requirements of standard ČSN EN 1092-1 (or, upon the customer's request, ANSI, JIS or AS).

During the sensor installation, make sure that:

- The arrow on the sensor body points at the fluid flow direction;
- The inner piping and seal diameters correspond to that of the water meter sensor;
- The sealing elements are properly placed between the flanges;
- The piping supports minimise the mechanical stress acting on the sensor (vibration, tension, bend etc.).

The sensor needs be properly grounded. To ensure that, use the green and yellow earthing conductor of minimum cross section 4mm² to connect the earthing bolt on the sensor flange to the piping flanges and the ground potential at the measurement location.





5.1.6. Electrical connections

The only active connector on FDT500 water meters of standard design is connector X2 - pulse output. The openings provided for connectors X1 and X3 are sealed with metal lids meeting the requirements of protection class IP68. In cases of meter with additional functions all three connectors (X1, X2 and X3) may be installed. Should any of the outputs be unused, the respective connector shall be sealed with a screw-on cover M8x1 meeting the requirements of IP68.

To avoid electromagnetic interference, the connecting cables to the electronic unit shall be laid at least 25cm away from the power cables of any other equipment.





5.1.7. Sealed meters

The FDT500 water meters are supplied with parameters set according to the customer requirements.

To prevent unauthorised interference with the meter setting, important meter parts are provided with stick-on assembly seals located on/at:

Electronic unit

- 2x bolts at the bottom of the electronic unit box
- 1x connection between the electronic unit box and the meter sensor
- 1x connection between the battery lid and the electronic unit box

Sensor

- 1x connection between the meter rating plate and the sensor body
- 2x connection between the ultrasonic probe covers and the sensor body

5.2. Operational start

The meters are supplied calibrated and in a fully operational condition. The correct meter function is indicated by the vertical slash sign flashing with the measuring frequency (1Hz) and the display of the ERR symbol on the LC display. Upon the meter installation in the piping, its flooding and bleeding, the ERR symbol will disappear and the meter will start its normal measuring functions. Use the control pushbutton to check switching between the measured quantities shown on the display.

6. **OPERATION**

6.1. Reading of the measured data from the display

The display can show the values of up to four measured quantities and a check sum. The selection of the desired quantity is done by means of the control pushbutton (depress for 1s and wait for another second). In cases where the meter does not include any additional measuring functions, the display will show zero values for the missing measured quantities.

The correct meter operation is indicated by a vertical slash sigh blinking with the measurement frequency (1Hz).

The need to replace the source battery will be indicated by a lighted battery sign.

In cases of error, the ERR sign will appear on the display (see Section 6.5. below).

With water meters of DN 8" / 200 dimension, the sign \checkmark at the bottom right-hand corner of the display indicates that the real values of instantaneous flow rate and of the total volume passed through the meter sensor are 10 times as great as the respective values shown on the display. The same applies to the stored flow rate and fluid volume data that are 10 times smaller than the actual/real values.

The standard meter version

Single-direction fluid flow measurements with the following data appearing on the meter display:

- Instantaneous flow rate with a + sign indicating the correct fluid flow direction (in agreement with the arrow sign on the meter sensor) and the word FLOW displayed; selectable measurement units [m³/h, l/s, gal/min];
- The total volume passed through the meter sensor with a + sign indicating the correct fluid flow directions; selectable measurement units [m³, 10³ gal].

The meter version including additional functions

Fluid flow measurements in both directions with the following data appearing on the meter display:

- Instantaneous flow rate with + or sign and the word FLOW displayed; selectable measurement units [m³/h, l/s, gal/min];
- The total volume passed through the meter sensor in ether flow direction with + or sign displayed, selectable measurement units [m³, 10³ gal].

Fluid pressure measurements (-PS, optional):

• Fluid pressure value in [bar].



Display test

To test the meter display, keep the control pushbutton depressed for 5s whereby all display segments and signs should light up. Upon releasing the control pushbutton, the display will return to the instantaneous flow rate value display mode.





Measured data processing algorithms

Instantaneous flow rate – single-beam sensor
The data shown on the display as well as those contained in the meter outputs are the product of a statistical processing of the measured data (statistic filter).

The total volume passed through the meter sensor

The fluid volume data are displayed with the precision of three valid digits after the decimal point of the selected measurement unit $[m^3, 10^3 \text{ gal}]$ up to the maximum value 99999.999.

Upon exceeding this limit value, the decimal point will shift to the left so that the maximum total volume indicated on the meter is 999999.99 and, eventually, 9999999.9 [m³, 10³ gal].

Taking into account practical measurement conditions and the meter lifetime, any further increase of the meter measurement range is considered unnecessary.



6.2. Electric outputs

The electric outputs are accessible via connectors X2 and X3.



6.2.1. Pulse outputs

The pulse outputs for both flow directions (+/- FLOW) are connected to the socket of a 3-pole connector (X2). These are passive and insulated outputs.

Each passive output shall be powered from an independent insulated power source.

As optional accessory, the meter manufacturer offers to meters with pulse outputs a 5m cable terminated on one end with a matching 3-pole plug and free wires on the other cable end for interconnection to a master control system.

Interconnection cable for connector X2

Indication	Color of wire	Function
	black	Flow in direction of arrow on
	DIACK	a sensor
	brown	Flow against direction of arrow on
	DIOWII	a sensor
IMP GND	blue	Common wire



The pulse output is insulated by means of an optocoupler with an open-collector NPN transistor:

- External power source voltage Uz = 3V to 30V
- Output current loading 2µA to 10mA

Load resistance value:

$$\mathsf{Rz}\left[\Omega\right] = \frac{\mathsf{Uz}\left[\mathsf{V}\right]}{\mathsf{I}\left[\mathsf{A}\right]}$$

Maximum impulse frequency:1 HzImpulse width:30 ms (fixed)



The maximum impulse frequency imposes a limit on the maximum flow rate. The flow rate ranges for individual sensor dimensions are given in Section 3.3.

In cases of short-term increase of the flow-rate values above the permitted maximum (Q4), an ERR message on the display will indicate this condition and the corresponding information will be recorded in the data archive. The impulse frequency will not increase but the impulses that have not appeared at the outputs will be saved and sent later when the flow rate values drop below the maximum value again. Thus these immediately unsent impulses will not be lost and the master system will receive the correct number of impulses corresponding to the flow volume passed through the measuring point. However, in cases of long-term excess of the maximum flow rate value, the processor memory may overflow whereby some of the impulses will be lost.

Pulse output connection diagram



6.2.2. Current output (-A, optional) associated with flow rate or fluid pressure quantities (-PS, optional)

The current output 4 to 20mA (-A, optional) is connected to the socket of a 4-pole connector (X3). It is a passive and insulated output.

Each passive output shall be powered from an independent insulated power source.

As optional accessory, the meter manufacturer offers to meters with a current output 4 to 20mA (-A, optional) a 5m cable terminated on one end with a matching 4-pole plug and free wires on the other cable end for interconnection to a master control system.

Interconnection cable for connector X3

Indication	Color of wire	Function
+1	brown	Current loop (instantaneous flow or pressure)
- I	blue	Current loop (instantaneous flow or pressure)
+ BIN	black	Binary output for indication of direction of flow
– BIN	white	Binary output for indication of direction of flow



External power source voltage:

Uz = 10V to 24V

The highest possible resistance of the current loop (including the input resistance of the connected signal processing equipment):

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

Example: for power source voltage Uz = 12V the maximum current loop resistance is 250Ω .

Flow rate measurement

In cases where the current output 4 to 20mA (-A, optional) is associated with instantaneous flow rate of the measured fluid, then, upon exceeding the maximum flow-rate value (Q4), the output current signal will no longer grow and the error message (ERR) will appear on the meter display.

Pressure measurement (-PS, optional)

The FDT500 water meters of compact design may use a current loop for indication of instantaneous values of the flowing fluid pressure (-PS, optional). This is one of the additional meter functions that need be preset during the meter manufacture.

The pressure measurement function (-PS, optional) can either be configured independently or in combination with the pulse output feature (see Section 6.2.1.).

The current output 4 to 20mA (-A, optional) corresponds to the relative pressure values of 0 to16 bar (the pressure indicated at empty piping is 0 bar).



Current output 4 to 20mA (-A, optional) connection diagram





6.2.3. Binary flow-direction indication

In cases where the current output 4 to 20mA (-A, optional) is used for the purposes of instantaneous flow rate measurement (see Section 6.2.2. below), the flow direction can be indicated using the binary output.

To process the binary output signals, the electronic unit need be preset for this function during the meter manufacture.

Binary output signals +BIN and - BIN are connected to the socket of connector X3. It is a passive and insulated output.

Each passive output shall be powered from an independent insulated power source.

The binary output function requires external power supply connected to the pulse output IMP1. That is why both connectors X3 and X2 (and the associated signal cables) need be used.

The black conductor of the X2 cable shall be connected to external power source of voltage Uz across resistor $100k\Omega$. The brown and blue conductor of the same cable shall remain unconnected.



If the fluid flow direction is as indicated by the arrow on the sensor body (+FLOW), the binary output will be at the

source voltage level (Uz). In cases of opposite flow direction (-FLOW), the binary output voltage will be 0V.

Binary output parameters (a MOSFET transistor, channel N):

- External power source voltage Uz = 3V to 30V
- Current loading: 2µA to 10mA

Load resistance value:

$$\mathsf{Rz}\left[\Omega\right] = \frac{\mathsf{Uz}\left[\mathsf{V}\right]}{\mathsf{I}\left[\mathsf{A}\right]}$$



6.3. Power source

6.3.1. Battery lifetime and replacement

In cases of standard water meter configuration, the battery lifetime is 8 years. The need for battery replacement will be indicated by the corresponding symbol shown on the meter display. To access the battery compartment, it is necessary to remove the assembly seals at the top and at the bottom of the electronic unit box. Upon the battery removal, the following data will be saved in the meter memory:

- The total volume passed through the meter sensor in either fluid flow direction;
- The meter parameter setting;
- The archived data.

The electronic unit does not include any real-time circuit independent of power supply.

To retain the stored time data during the battery replacement operation, the following procedure should be carried out (with water meters including the data archiving function):

- Prior to battery removal, read out the archived data using the SW ARCHTERM program (sold separately);
- After the battery replacement, use the SW ARCHTERM program (sold separately) again to read the archive setting parameters, whereby the correct time and date will automatically be set;
- Delete the archived data.

Recommended battery type

In consideration of the long lifetime requirement, the recommended battery type is TADIRAN SL 2780/S 3,6 V/19 Ah. In cases of air transport where the permitted lithium content in the battery is < 1 g, a smaller battery SAFT Lithium 3,6 V/3,6 Ah, type designation LSH 14 light, accommodated in a plastic container of size D can also be used. The lifetime of that alternative battery in the water meter of standard configuration is 1 year. This battery can be at any time replaced by recommended battery type with capacity 19Ah.

Battery replacement procedure

To remove the old battery, screw off, using Alien wrench 6, the lid on the battery compartment sealed with an O-ring 33x1.5mm. Lift the front contact (against the forcing spring) and remove the battery.

The new battery shall be inserted into its compartment in the electronic unit with the negative pole at the bottom.

Mind the battery polarity – the incorrect polarity may irreparably damage the electronic unit circuits.

Insert the new battery in its compartment; while pressing the battery down, return the front contact to operating position. The positive battery pole must have a reliable contact with the front spring-loaded contact. Screw on the lid with the sealing O-ring, tighten and attach a stick-on assembly seal onto the contact plane.





6.3.2. Electronic unit powered from current loop

The power to the electronic unit of the FDT water meters of the FDT500 series including additional functions can be supplied directly from a current loop. In that case, a special electronic module shall be inserted into the battery compartment.

This current output 4 to 20mA (-A, optional) function must be preset during the meter manufacture.

Upon selection of the current-loop feeding option, the data archiving and reading functions cannot be used.

Meter operational start in cases of power supply from the current loop

Unlike the battery-powered meter, water meters configured for power supply from the current loop are dispatched in deactivated condition (including the display).

Install the meter sensor into the piping. The display will light up only after the current loop has been connected and energised. The correct meter function is then indicated by the vertical slash blinking with the measurement frequency (1Hz) and the ERR message shown on the LC display. Following the sensor flooding and bleeding, the ERR symbol will disappear and the meter will start its normal measuring functions. Using the control pushbutton, check the function of selecting the desired measured quantity to be shown on the display.

The current output 4 to 20mA (-A, optional) connection (connector X3) is as described in Section 6.2.2.

6.4. Communication interface

The FDT water meters are provided with insulated communication interface RS232 facilitating:

- Reading of all measured quantities:
 - o Instantaneous flow rate + /-
 - Total volume passed through the meter sensor + /-
 - Fluid pressure (-PS, optional) in the sensor
- Flow-meter parameter setting
 - Reading of the archived data, including:
 - o Flow rate
 - Total volume passed through the meter sensor in the given direction (+ or -)
 - o Pressure of the flowing fluid
 - o Real times of any error condition start and termination
 - Descriptions of diagnosed errors
 - Watch dog (WD) actions

Connection to the communication interface RS232 is possible using:

- Optical probe, or
- Cable via connector X1



6.4.1. Communication via optical probe (-OPT, optional)

The optical probe shall be placed in a recession on the electronic unit cover where the exact probe position is secured by an arrest pin and the probe is held on the cover by means of a permanent magnet.



The meter software makes it possible to archive all measured quantities with sampling frequency selectable in the range from 1 minute to 1 year. Apart from the measured data, archived also are error messages (see Section 6.5.) and date and time of their occurrence.

To set the archive parameters and read the archived data (-OPT, optional), the meter user shall have the necessary tools herein referred to as "SVAO 1 set".

The SVAO 1 set includes:

- Optical probe OS 7.0 and a 2m cable terminated with an USB connector
- CD including:
 - Program SW ARCHTERM (sold separately) for setting the archive parameters and reading the archived data (-OPT, optional)
 - o Program SW ARCHTERM manual
 - Controllers for optical probe OS7.0 USB



6.4.2. Communication via RS232 cable

The meter software makes it possible to archive all measured quantities with sampling frequency independently selectable in the range from 1 minute to 1 year. Apart from the measured data, archived also are error messages (see Section 6.5.) and date and time of their occurrence.

The insulated RS232 communication interface is accessible via connector X1.



To set the archive parameters and read the archived data, the meter user shall have the necessary tools herein referred to as "SVAK 1 set".

The SVAK 1 set includes:

- The RS232 communication cable 5 metres long, provided with a plug matching connector X1 on one end and a 9-pin Canon connector on the other end (to be connected to a computer).
- CD including:
 - Program SW ARCHTERM (sold separately) for setting the archive parameters and reading the archived data
 - o Program SW ARCHTERM manual

Should the meter location be difficult to access, additional tools described below are available to ensure higher operator comfort.

Connection to RS232 interface:

• Connecting box meeting the IP68 requirements with a 5m cable terminated with a 9-pin Canon connector

Connection to USB interface:

- Connecting box meeting the IP68 requirements with a 5m cable terminated with a 9-pin Canon connector
- RS232-USB convertor
- CD including:
 - RS232-USB convertor user manual
 - o Controllers for the Windows operation system

At all times when the communication interface is not used, connector X1 shall be tightly closed using a screw-on cover M8x1 in combination with a matching O-ring.



RS232 (USB Driver)



6.5. Identification of errors listed in the archive

Any meter failure will be reported at the meter display by means of the ERR symbol.

The detailed information on failures is stored in the archive in the format Date, Time, EBx or EEx where x is the error number (1 to 4), EB indicates the error condition start and EE the error condition termination.

ERR1 - the sensor is impenetrable for ultrasonic signal

The frequent cause of this error condition is aerated sensor, air bubbles or mechanical particles scattered in the measured fluid, or disregarding the system design rules referred to in Section 5 hereof. In the latter case, check the meter placement for possible nonconformities. **Defects originating from incorrect meter placement in piping cannot be claimed and subject to manufacturer's warranty.**

ERR2 - too great difference between the signal flight times in and against the fluid flow direction

The cause of this error can be aeration of one ultrasonic probe which may be a temporary condition at the time when the piping system is being filled with the fluid. Heavy contamination of the head part of one probe may have a similar effect. The method of correction should be consulted with the meter manufacturer.

ERR3 - error of internal A/D converter

The cause of this error can be strong electromagnetic interference or a meter defect. Check the meter placement and electrical connections in reference to the correct system design rules as referred to in Section 5 hereof.

ERR4 - instantaneous flow rate is higher than overloading flow rate value Q4

The archived data include, apart from the error messages, information on any WD actions. The Watch Dog action consists of the meter restart in cases of discontinuation of the normal meter operation due to extreme external interference or internal hardware malfunction.

Low battery voltage and the need to replace the battery will be indicated by the battery sign lighted on the meter display. Information on the battery voltage can also be obtained via the system communication channel. If the display goes completely out, check the battery voltage. It should higher than 3V. To replace the flat battery, follow the instructions in Section 6.3.1. Should the meter fail to restore its functions with the new battery, send it to the manufacturer for repair.

7. CALIBRATION

Ultrasonic water meters are supplied calibrated in three points according to standard EN 14154-3. To check the meter functions, precision or calibration, use always the test methods specified in or conforming to the requirements of standard EN 14154-3.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

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 RETURN (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.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

- 1. Purchase Order number under which the product was PURCHASED,
- 2. Model and serial number of the product under warranty, and
- 3. Repair instructions and/or specific problems relative to the product.

FOR **<u>NON-WARRANTY</u>** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

- 1. Purchase Order number to cover the COST of the repair,
- 2. Model and serial number of the product, and
- 3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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Wire: Thermocouple, RTD & Thermistor

Calibrators & Ice Point References

Recorders, Controllers & Process Monitors

Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

Transducers & Strain Gages

Load Cells & Pressure Gages

Displacement Transducers

Instrumentation & Accessories

FLOW/LEVEL

Rotameters, Gas Mass Flowmeters & Flow Computers

Air Velocity Indicators

Turbine/Paddlewheel Systems

Totalizers & Batch Controllers

pH/CONDUCTIVITY

PH Electrodes, Testers & Accessories

Benchtop/Laboratory Meters

Controllers, Calibrators, Simulators & Pumps

🗹 Industrial pH & Conductivity Equipment

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Data Acquisition & Engineering Software

Communications-Based Acquisition Systems

Plug-in Cards for Apple, IBM & Compatibles

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Cartridge & Strip Heaters

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Flexible Heaters

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