User Manual

DGT_ULTRA

Software version: Rev. A01
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Thank you for purchasing the **DGT_ULTRA**. This is an ultrasonic water volume meter developed and manufactured in Brazil by **DIGITROL**. We have prepared this manual to provide specific product information to those responsible for the installation, operation, and maintenance of the meter.

GENERAL INFORMATION

Before installing the **DGT_ULTRA**, read this manual carefully and follow all recommendations contained herein.

After reading this manual, keep it in a safe and accessible place for future reference.

If there are any doubts regarding installation or if the meter is not functioning properly, please contact **DIGITROL** technical support.

Never attempt to open the meter to repair it, as this will void the warranty and render it unsuitable for billing purposes.

WARRANTY

DIGITROL guarantees for a period of 12 months from the date of delivery to the customer (warranty period) that the **DGT_ULTRA**, installed under normal conditions of use, is free from manufacturing defects

During the warranty period, **DIGITROL**'s obligation and liability shall be limited, at its sole discretion, to replacement, repair, or refund of the purchase price of any defective product proven not to comply with the product specifications and returned by the customer to the factory or a service center designated by **DIGITROL** within the warranty period. The meter must be sent accompanied by a written failure report. Shipping costs to the service center must be paid by the customer.

DIGITROL shall not be responsible for, and will have no obligation under, warranty for any non-conformity of the products caused, in whole or in part, as a result of misuse, abuse, tampering or modification of the product and/or by accidents, failures or negligence, incorrect installation, by any act of vandalism or by any causes external to it, including, but not limited to, environmental conditions.

Replacement or repair as provided above shall constitute fulfillment of all **DIGITROL** obligations regarding product quality and performance.

Under no circumstances shall **DIGITROL** be liable for any direct, indirect, incidental, special, or punitive damages, including loss of profits or business, even if advised of the possibility of such damages. The customer is solely responsible for the selection, use, efficiency, and suitability of the product.

MINIMUM CONDITIONS FOR OPERATION

For proper operation of the **DGT_ULTRA** in field installations, the following conditions must be satisfied:

- Measured fluid must be water;
- Meter must be completely filled with water;
- Suspended solids must be less than 5%;
- Outlet pressure must be greater than 0.03 MPa (0.3 bar) to prevent cavitation;
- Water temperature must be between 0.1 °C to 50 °C; and
- It is not recommended to expose the liquid crystal display to continuous sunlight.

ULTRASONIC MEASUREMENT PRINCIPLE

In general terms, ultrasonic measurement is obtained from the difference in transit time between two acoustic signals traveling through water in opposite directions.

The volumetric flow rate (Q) of water is calculated using the following equation:

$$Q = v \cdot A$$

where v is the average velocity in the flow cross-section and A is the cross-sectional area of measurement.

The average velocity in the flow cross-section is determined from the upstream (t_{up}) and downstream (t_{dn}) signal transit times.

$$t_{up} = \frac{L}{v_{som} - v \cdot \cos(\theta)}$$

$$t_{dn} = \frac{L}{v_{som} + v \cdot \cos(\theta)}$$

where L is the distance between the upstream and downstream ultrasonic sensors, v_{som} is the speed of sound in water and θ is the angle between the flow direction and the ultrasonic signal path.

Since L it is calculated based on the diameter of measuring section (D), we have the following relationship:

$$L = \frac{D}{\text{sen}(\theta)}$$

Thus, since the speed of sound is much greater than the flow speed ($v \ll v_{som}$), we can rewrite water flow rate as follows:

$$Q = K\left[\frac{\pi \cdot D^3}{4 \cdot sen(2\theta)}\right]\frac{t_{up} - t_{dn}}{t_{up} \cdot t_{dn}}$$

where K is the correction factor of velocity profile as a function of the Reynolds number.

Finally, as water flow is dynamic over time, totalized volume (V) measured by meter up to the instant tf is the sum of instantaneous volumes (V_i) calculated in small time intervals (Δt) and multiplied by the average flow rate in that interval (Q_i):

$$V = \sum_{i=0}^{tf} Vi = \sum_{i=0}^{tf} Q_i \cdot \Delta t$$

MAIN FEATURES

Ultrasonic technology: DGT_ULTRA is a water volume meter with ultrasonic measurement technology, with no moving parts and no metrological degradation over its useful life.

Accuracy in measured volumes: DGT_ULTRA has high accuracy (accuracy class 1, according to Inmetro Ordinance No. 155:2022 and OIML R49:2013).

High rangeability: DGT_ULTRA has high rangeability (Q3/Q1 ratio) which allows totalization of water volume even at low flow rates.

Bidirectional measurement: DGT_ULTRA measures totalized volume in forward flow, in reverse flow and also the net volume (difference between the volumes of forward and reverse flow).

No straight pipes required: DGT_ULTRA has a unique internal geometry and built-in signal processing that allows meter to be mounted without upstream and downstream straight pipes.

Battery Powered: DGT_ULTRA is internally powered by a non-replaceable Lithium battery that provides a 15-years lifetime.

Data storage: DGT_ULTRA has internal data storage of totalized volumes in forward and reverse direction, maximum and minimum flow rates, average and maximum electronic temperatures, average water temperature during the period in which there was flow, in addition to audit records and alarms.

Alarms: DGT_ULTRA has 8 types of alarms to identify anomalies in water consumption and meter operating conditions.

User interface: DGT_ULTRA allows four types of user interface: display, NFC communication, signal output (pulse or/and current) and radio communication (when present in equipment).

Temperature measurement: DGT_ULTRA allows the measurement temperature of water and internal electronics of the meter.

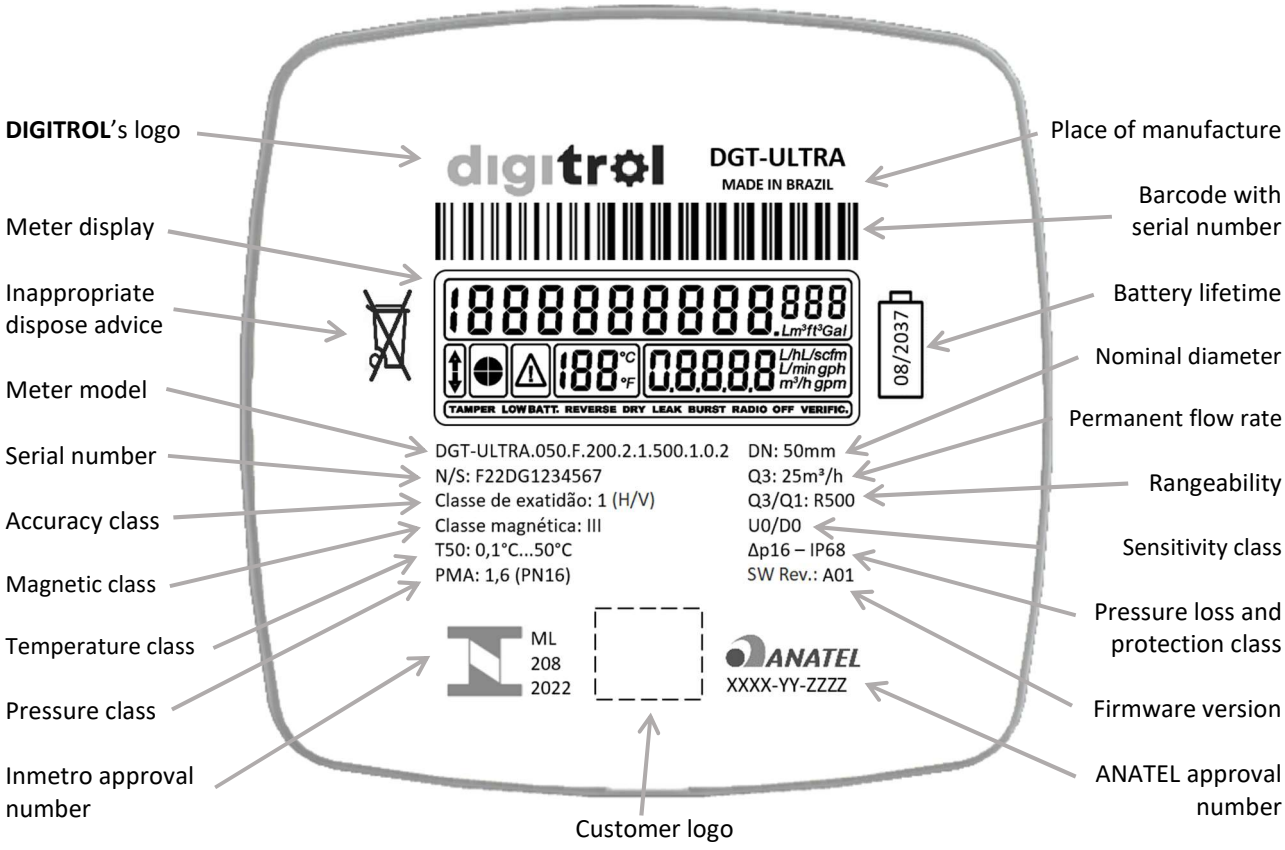
Internal clock (RTC): DGT_ULTRA has an internal clock that allows to accurately determine the moment of a given event occurs.

TECHNICAL DATA

Accuracy class:	Class 1 or 2
Rangeability (Q3/Q1):	up to 500 (class 1) or up to 800 (class 2)
Flow sensitivity profile class:	U0 (upstream) and D0 (downstream)
Pressure class:	1.0 (PN10) or 1.6 (PN16)
Pressure loss class:	Δp16 (0.16 bar @ Q3)
Protection class:	IP68
Temperature class:	T50 (0.1°C to 50°C)
Ambient temperature:	-10°C to +55°C
Installation environment classification:	Class B (fixed meters installed in buildings) Class O (fixed meters installed without shelter - outdoors)
Electromagnetic environmental class:	E1 (residential and commercial) E2 (industrial)
Magnetic class:	I, II or III
Reverse flow measurement:	Meter has the functionality to measure reverse flow in accordance with Inmetro Ordinance No. 155:2022 and OIML R49:2013

METER DIAL DETAILS

The figure below identifies the information that is displayed on meter dial.



FLOW RATE TABLE

Table 1 shows meter's operating flow rates for accuracy class 1 and rangeability 500 as a function of meter's nominal diameter. In accuracy class 1, the maximum permissible error in the upper measurement range (Q2 ≤ Q ≤ Q4) is a maximum of ±1% and for the lower measurement range (Q1 ≤ Q < Q2) it is a maximum of ±3%.

Table 1 – Metrological characteristics of DGT_ULTRA family for accuracy class 1 and rangeability 500.

DN [mm]	Low flow cut-off [L/h]	Q1 [L/h]	Q2 [L/h]	Q3 [m³/h]	Q4[m³/h]	High flow cut-off [m³/h]
50	12.5	50	80	25	31.25	37.5
	20	80	128	40	50	60
65	20	80	128	40	50	60
80	31.5	126	201.6	63	78.75	94.5
100	50	200	320	100	125	150
125	80	320	512	160	200	240
150	125	500	800	250	312.5	375
200	200	800	1 280	400	500	600
250	315	1 260	2 016	630	787.5	945
300	500	2 000	3 200	1 000	1 250	1 500
400	800	3 200	5 120	1 600	2 000	2 400
500	1 250	5 000	8 000	2 500	3 125	3 750
600	2 000	8 000	12 800	4 000	5 000	6 000

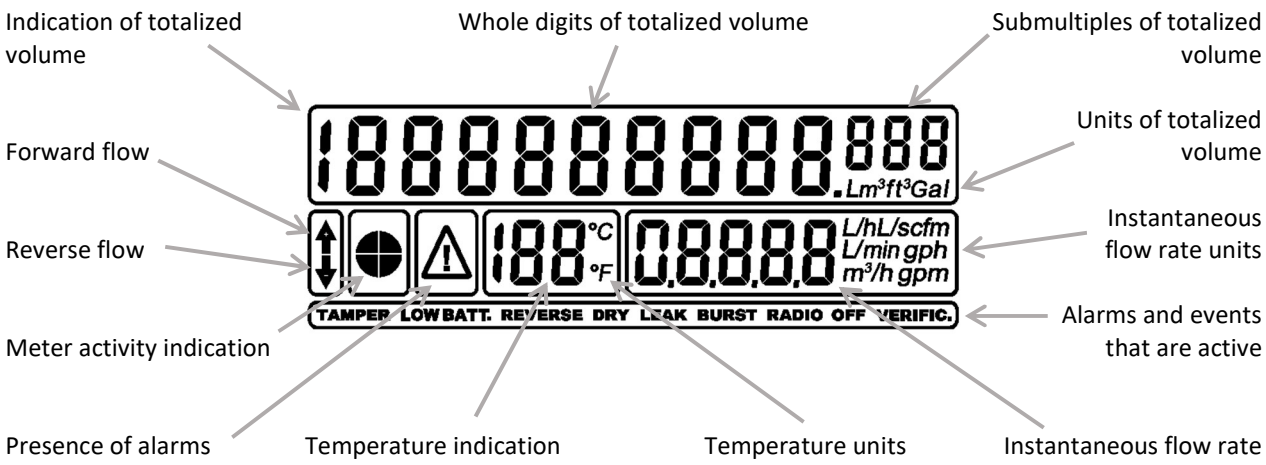
Table 2 shows the operational flow rates of meter for accuracy class 2 and rangeability 800 as a function of nominal diameter of meter. In accuracy class 2, the maximum permissible error in the upper measurement range (Q2 ≤ Q ≤ Q4) is a maximum of ±2% and for the lower measurement range (Q1 ≤ Q < Q2) it is a maximum of ±5%.

Table 2 – Metrological characteristics of DGT_ULTRA family for accuracy class 2 and rangeability 800.

DN [mm]	Low flow cut-off [L/h]	Q1 [L/h]	Q2 [L/h]	Q3 [m³/h]	Q4[m³/h]	High flow cut-off [m³/h]
50	12.5	31.25	50	25	31.25	37.5
	20	50	80	40	50	60
65	20	50	80	40	50	60
80	31.5	78.75	126	63	78.75	94.5
100	50	125	200	100	125	150
125	80	200	320	160	200	240
150	125	312.5	500	250	312.5	375
200	200	500	800	400	500	600
250	315	787.5	1 260.0	630	787.5	945
300	500	1 250	2 000.0	1 000	1 250	1 500
400	800	2 000	3 200	1 600	2 000	2 400
500	1 250	3 125	5 000	2 500	3 125	3 750
600	2 000	5 000	8 000	4 000	5 000	6 000

METER DISPLAY DETAILS

The figure below identifies the information that is presented on meter display.



Totalized volume: DGT_ULTRA has a total of 12½ digits to indicate totalized volume, with 9½ digits intended to indicate totalized volume in units of m³, *L, ft³ or Gal,* and 3 digits intended to indicate the submultiples of totalized volume.

Instantaneous flow rate: DGT_ULTRA has a total of 4½ digits intended to indicate the instantaneous flow rate in metric system units (m³*/h, L/s, L/min* and *L/h)* or in the imperial system (gpm*, gph* and *cfm)*.

Temperature measurement: DGT_ULTRA has 2½ digits for displaying water temperature in *°C* or *°F* units. The temperature measurement is calculated using the transit times of sound signal in the upstream (t_{up}) and downstream (t_{dn}) directions and water density.

Flow direction: DGT_ULTRA displays the flow direction indication by means of an arrow with the symbol "+" (forward flow) and an arrow with the symbol "-" (reverse flow). If there is no water flow, all the arrows will remain off.

Meter activity indication: DGT_ULTRA displays meter activity indication by means of symbols (◐, ●, ◔ and ◕) that flash alternately indicating that meter is active.

Alarms and events: if one of **DGT_ULTRA** alarms or events is active, excluding RADIO OFF and VERIFIC., the exclamation mark (⚠) will appear on equipment display until the alarm ends. Tampering (TAMPER) or battery level (LOW BATT.) alarms are irreversible.

MODES OF OPERATION

DGT_ULTRA operates in four different operating modes, as shown below:

Normal operation: in this operating mode, the measurement cycle, display update and activity indication (◔ and ◕) will alternate at a frequency of 0.25Hz (every 4 seconds).

Inactive mode: After production, meter is placed in inactive mode and the activity indication (◐ and ●) will alternate with a frequency of 0.25Hz. When water passes through meter, it will automatically switch to normal operating mode. In inactive mode, the ultrasonic sensors are in battery saving mode and the radio (when present in equipment) is turned off.

Verification mode: in this operating mode, the measurement cycle, display update and activity indication (◔ and ◕) will alternate at a frequency of 2Hz. Meter will remain in this mode for 8 hours without interruption and then automatically return to normal operating mode.

Error mode: if an irreversible error is detected, the activity indicator (◐ and ●) will alternate at a frequency of 0.5 Hz and Err message will be shown on the display. In this mode, the signal outputs are deactivated, but the information on totalized volumes in the forward and reverse flows is preserved.

INTERNAL DATA STORAGE

DGT_ULTRA has seven types of records that are stored internally, as shown below:

Indelible logs: these are records that undergo metrological control and must be stored and cannot be altered or deleted: electronics initialization, meter data, calibration parameters, metrological sealing and totalized volumes in forward and reverse flow.

Audit log: records firmware integrity checks; peripheral and display tests; switching to verification mode (CHECK); radio, display and signal output parameters; and radio power-on or power-off (RADIO OFF). At least the last 5 years of records are stored with their respective time-stamp (*dd/mm/yy hh:mm:ss*) and user ID.

Alarms: stores the existence of following alarms: TAMPER, LOW BATT., REVERSE, DRY, LEAK, BURST, air bubbles detection and flow rate above the high flow cut-off. The last 1000 alarms are stored in circular memory with the start and end timestamps (*dd/mm/yy hh:mm:ss*).

Consumption profile: record at the beginning of each hour of following information: time-stamp (*dd/mm/yy hh:00:00*); volume consumed in forward flow divided into 10 programmed flow rates (between Q1 and Q4); volume consumed in forward flow and the amount of time in which the flow was between low flow cut-off and Q1; volume consumed in forward flow and the amount of time in which the flow was between Q4 and high flow cut-off ; and average water temperature. The last 2160 records (90 days) are stored in circular memory.

Hourly record: records at the beginning of each hour of following information: time stamp (*dd/mm/yy hh:00:00*); totalized volumes in forward and reverse flow; amount of time that there was water flow in forward flow; minimum and maximum flow rates in forward flow and the time at which these flows occurred in the last hour; average temperatures of water and electronics; and maximum temperature of electronics. The last 2160 records (90 days) are stored in circular memory.

Daily log: records at the beginning of each hour of following information: time stamp (*dd/mm/yy 00:00:00*); totalized volumes in forward and reverse flow; amount of time that there was water flow in forward flow; minimum and maximum flow rates in forward flow and the time at which these flows occurred on the last day; average temperatures of water and electronics; and maximum temperature of electronics. The last 730 records (2 years) are stored in circular memory.

Monthly record: record at the beginning of each hour of following information: time-stamp (*01/mm/yy 00:00:00*); totalized volumes in forward and reverse flow; amount of time that there was water flow in forward flow; minimum and maximum flow rates in forward flow and the time at which these flows occurred in the last month; average temperatures of water and electronics; and maximum temperature of electronics. The last 180 records (15 years) are stored in circular memory.

AUDIT RECORD

DGT_ULTRA has audit logs that allow you to store meter operating conditions and tests performed, where the event is stored with its respective time stamp (dd/mm/yy hh:mm:ss) and user identifier. Each of these events is described in detail below.

Firmware integrity check: this check aims to identify any type of change (intentional or involuntary) to meter's firmware.

Peripheral and display test: performs tests on peripherals connected to the microcontroller (measurement module, signal output, radio output, power module and display).

Signal, radio and display parameters: stores a record whenever there is a change in the signal, radio and display parameters.

CHECK: This event indicates that meter is in check mode, where the volume unit is automatically changed to L if the volume unit was in the metric system, or to Gal if the volume unit was in the imperial system.

RADIO OFF: This event indicates that radio communication is turned off. The radio is automatically turned on when the first liter of water passes through meter. Radio communication is optional and is not present on all models.

ALARMS

DGT_ULTRA has 8 types of alarms that allow you to identify anomalies in water consumption and meter operating conditions. Each of these alarms is described in detail below.

TAMPER: this alarm is activated when there is an attempt to commit fraud by opening meter improperly. After this alarm is activated, meter is no longer valid for billing and the alarm indication will remain permanently active.

LOW BATT.: this alarm is activated when the battery charge level reaches a critical level or when the battery expiration date is reached. After the alarm is activated, there will be a limit of at least 6 months before meter must be replaced.

REVERSE: this alarm is activated when water flows through meter in the opposite direction. When this alarm is active, reverse flow volume totalizer is incremented, while forward flow totalizer increment is suspended.

DRY: this alarm indicates that meter is not fully filled with water. When this alarm is active, nothing will be measured.

LEAK: this alarm indicates that there has been an uninterrupted flow of water over the last 24 hours. This alarm can be activated regardless of flow direction. Selection options range from >1x Q1 to >500x Q1.

BURST: this alarm indicates that water flow has exceeded a pre-established flow rate for more than 15 uninterrupted minutes. This alarm is activated regardless of flow direction. The selection options range from: >1% of Q3 to >125% of Q3.

BUBBLE: this alarm detects when there are air bubbles in water flow. If the amount of water bubbles is significant, nothing will be measured.

HI-FLOW: this alarm indicates that water has passed through meter with a flow rate higher than the high flow cut-off value. In this case, nothing will be measured and the message HI.FLO will be shown on the display.

USER INTERFACES

DGT_ULTRA has four types of user interface, as shown below:

Display: information is displayed on totalized volume in forward flow, the instantaneous flow rate, water temperature, the flow direction, whether there are meter activity and the presence of alarms.

NFC communication: enables the acquisition of information from stored internal records, changing meter's operating mode, configuring the frequency of radio communication (when present in equipment), configuring signal output parameters (when the signal output is present) and performing functional tests (metrological verification, firmware integrity and display test).

Signal output (optional): unidirectional data communication using pulse output (solid state relay - SSR type, normally closed) or 4-20mA current output (passive). Pulse output is realized with a 4-way connector and current output is realized with a 2-way connector.

Radio communication (optional): unidirectional communication of previously configured data. Communication uses SigFox, LoRaWAN (end device) or NB-IoT network with encrypted data (AES128 encryption with private key).

NFC COMMUNICATION

All meters in **DGT_ULTRA family** have the NFC communication interface. This communication interface is used for configuration, downloading stored data and executing commands by meter.

It consists of a dynamic passive NFC tag connected to **DGT_ULTRA** microcontroller. This means that the microcontroller can write to the tag 's memory and this content will be read when a compatible RFID reader or a smartphone with NFC technology approaches it. Likewise, everything that the reader writes to the tag will be made available to the microcontroller.

SIGNAL OUTPUT

DGT_ULTRA also has as an optional user interface, dual pulse output (solid state relay type - SSR, normally closed) and/or 4-20mA current output (passive), as described below.

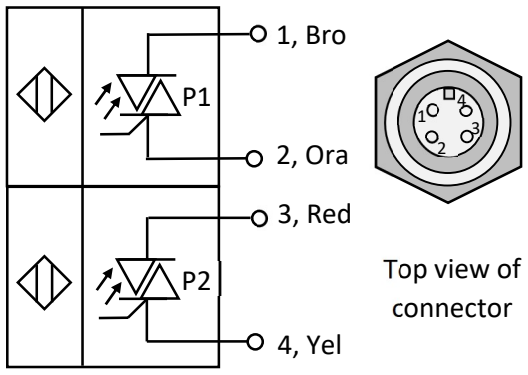
ATTENTION:

In installations located in open or remote areas with a high incidence of lightning strikes, the use of additional protection systems on the signal outputs is recommended, such as lightning protection systems (LPS) and/or surge protection devices (SPDs).

Additionally, the operation of frequency inverters near the meter can cause electromagnetic interference, inducing noise in the pulse and current outputs. This condition can result in incorrect measurements or anomalous operational behavior. In this case, good electrical installation practices should be adopted, including segregation between power and signal cables, use of shielded cables, and proper grounding of the system.

PULSE OUTPUT:

Each of the two outputs can be configured as pulses in forward flow, pulses in reverse flow, pulses in either flow direction or status alarms for the following events: high flow, low flow, attempted tampering (TAMPER), low battery (LOW BATT.), reverse flow (REVERSE), meter not fully filled with water (DRY), small leak (LEAK) and large leak (BURST). Additionally, the alarm activation flow rate (high flow, low flow, small leak and large leak), the tolerance time before alarm activation and the alarm dwell time can be configured.



Top view of connector

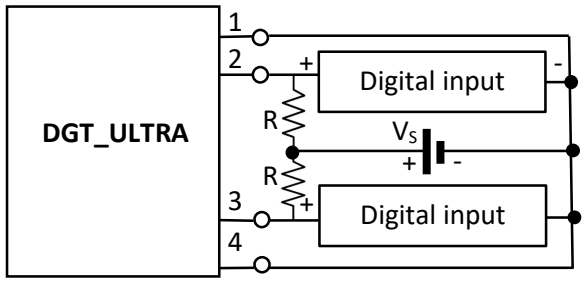
Internal electrical diagram

P1: Pulse output A (pins 1 and 2, brown and orange cable)
P2: pulse output B (pins 3 and 4, red and yellow cable)

Maximum frequency = 50Hz

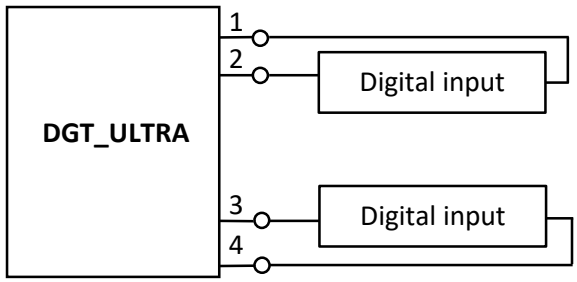
R_{ON} = 30Ω (zero logic level)
R_{OFF} > 10MΩ (logic level one)

Suggested connection with external *pull-up*:



Power supply: $7V_{DC} \leq V_S \leq 28V_{DC}$
For external *pull-up*: 1k Ω ≤ R ≤ 100kΩ

Suggested connection with internal *pull-up*:



Resolution of each pulse output (configurable from 0.5 to 20 000 L/pulse), pulse width (configurable from 10ms to 500ms) and output type are configured independently using the NFC communication interface.

If the output is configured as a pulse output (forward flow, reverse flow or any flow direction) and the frequency or pulse width limits are exceeded, the message HI FrEQ will be showed on equipment display and the output will have a logic level of zero (contact closed).

The table below shows the maximum pulse output flow rate as a function of resolution and pulse width, where 10ms is the minimum pulse width value and 500ms is the maximum pulse width value.

Pulse output resolution		Maximum pulse output flow rate			
		10ms pulse width		500ms pulse width	
[L/pulse]	[pulse/L]	[m³/h]	[L/s]	[m³/h]	[L/s]
0.1	10	18	5	0.36	0.1
0.2	5	36	10	0.72	0.2
0.5	2	90	25	1.8	0.5
1	1	180	50	3.6	1
2	0.5	360	100	7.2	2
5	0.2	900	250	18	5
10	0.1	1 800	500	36	10
20	0.05	3 600	1 000	72	20
50	0.02	9 000	2 500	180	50
100	0.01	18 000	5 000	360	100
200	0.005	36 000	10 000	720	200
500	0.002	90 000	25 000	1 800	500
1 000	0.001	180 000	50 000	3 600	1 000
2 000	0.0005	360 000	100 000	7 200	2 000
5 000	0.0002	900 000	250 000	18 000	5 000
10 000	0.0001	1 800 000	500 000	36 000	10 000
20 000	0.00005	3 600 000	1 000 000	72 000	20 000

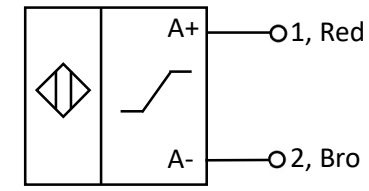
DGT_ULTRA meter also allows the pulse outputs to be configured for high flow, low flow, LEAK (small leak) or BURST (large leak) alarms:

- High flow rate: this alarm will be activated if the flow rate exceeds the value set in the configuration program. If this type of alarm is selected, meter is factory configured with the flow rate value Q4.
- Low flow rate: this alarm will be activated if the flow rate is lower than the value set in the configuration program. If this type of alarm is selected, meter is factory configured with the flow rate value Q1.
- LEAK: This alarm will be activated if the flow rate exceeds the set flow rate value for more than 24 continuous hours. Flow rate selection options range from >1x Q1 to >500x Q1. If this type of alarm is selected, meter is factory configured with a flow rate value of >1x Q1.
- BURST: This alarm will be activated if the flow rate exceeds the set flow rate value for more than 15 continuous minutes. Flow rate selection options range from >1% of Q3 to >125% of Q3. If this type of alarm is selected, meter is factory configured with a flow rate value of >100% of Q3.

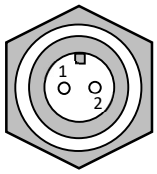
When pulse outputs are related to alarms, it is possible to configure the tolerance time before the alarm is activated and the time the alarm remains on. Meter is factory configured with t = 0s. If it is necessary to configure the output type, pulse resolution or times related to the output, do so using the configuration program.

CURRENT OUTPUT:

The current output is proportional to meter flow rate. The zero (4mA) and span (20mA) values of current output are independently set in the range of -Q4 to +Q4.



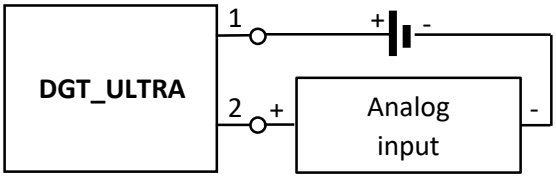
Internal electrical diagram



Top view of connector

A+: positive current output
A-: negative current output

Connection with current loop:



Current loop voltage: ($9V_{DC} \leq VCC \leq 28V_{DC}$)

Meter comes with the following factory current output configuration (if enabled):

- 4mA (zero) = 0m³/h
- 20mA (span) = flow rate value Q4

If it is necessary to change the parameters, do so through the configuration program using the NFC communication interface.

RADIO COMMUNICATION

DGT_ULTRA has as an optional user interface unidirectional radio communication using four standards: SigFox, LoRaWAN, NB-IoT or SigFox + LoRaWAN.

In radio communication, the following information can be selected to be sent: time during which meter recorded flow within the transmission period, totalized volume in forward flow, totalized volume in reverse flow, meter time, maximum flow with time, minimum flow with time, average water temperature, average electronics temperature and active alarms. The frequency of radio communication can be selected in intervals of 1, 2, 3, 4, 6, 12 or 24 hours, and the transmitted events always being those from the beginning of each hour (*hh:00:00*).

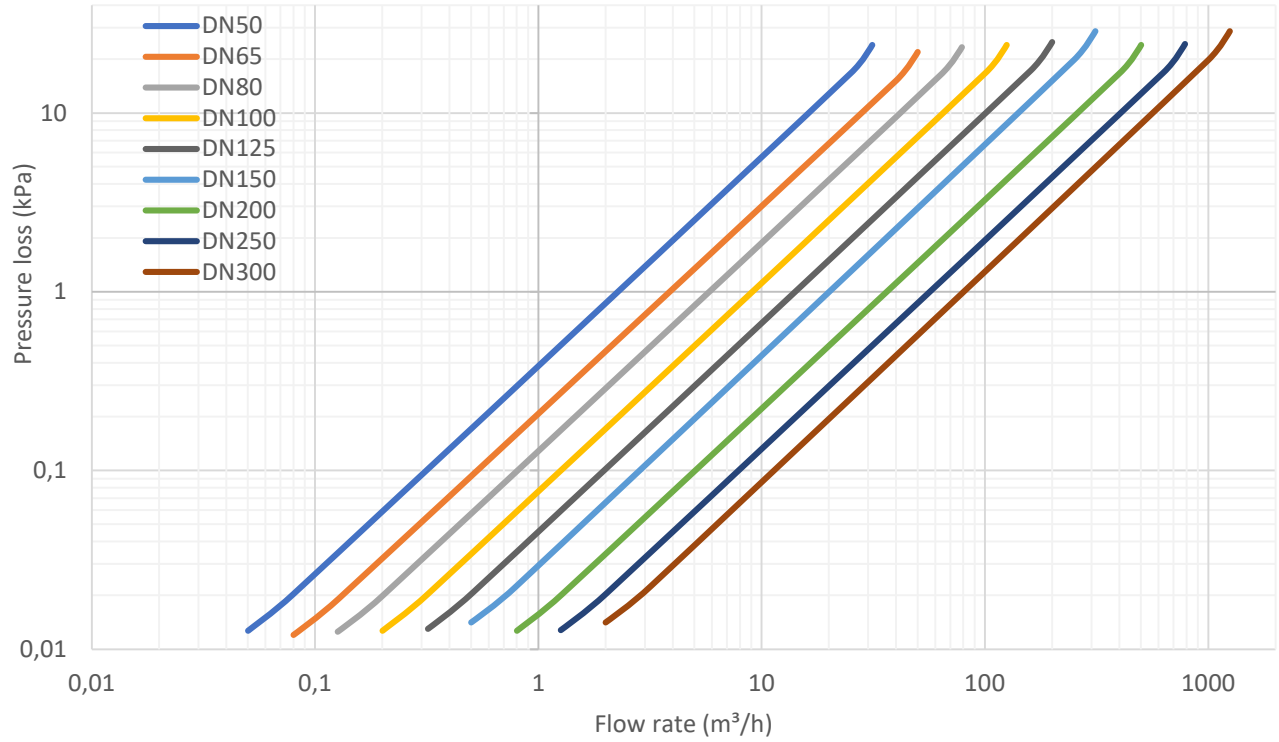
It is important to note that battery life depends on the amount of information and the frequency of transmission. In meters with radio communication, meter battery is made up of two cells $3.6V_{DC}$.

Data communication is encrypted using the AES-128 algorithm, with a cryptographic key generated at the time of authentication on the network. The authentication key is registered via meter's NFC communication interface, which is also encrypted and requires user authentication for use.

The information to be sent, as well as the frequency of radio communication, are configured using the NFC communication interface.

LOSS OF PRESSURE

DGT_ULTRA presents the following pressure loss curve as a function of nominal diameter of meter.



METER INSTALLATION

Before installing the **DGT_ULTRA**, ensure that the location is clean, with the correct fitting dimensions or even a mounting joint, with new and high-quality sealing gaskets (never reuse sealing gaskets as they may cause unwanted leaks) and with the counter flanges aligned.

When positioning the **DGT_ULTRA** at the installation site, ensure that the water flow direction is aligned with the measurement direction indicated on the meter. Although the equipment is capable of measuring in reverse flow, the installation must respect the indicated direction to guarantee the correct increment of the volume totalizer values. Additionally, verify that the counter flanges used have the same pressure class specified for the meter.

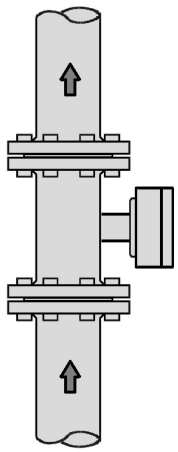
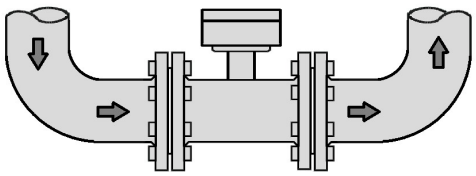
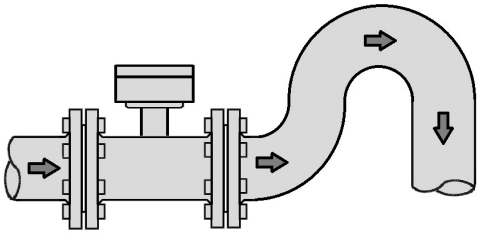
It is not possible to change the position of the **DGT_ULTRA** dial, so choose the position that makes it easiest to read. If the dial is facing upwards, make sure the cover protecting the display remains closed when not in use, preventing sunlight from damaging the meter's display.

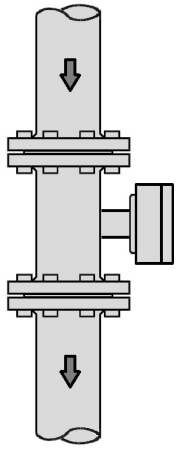
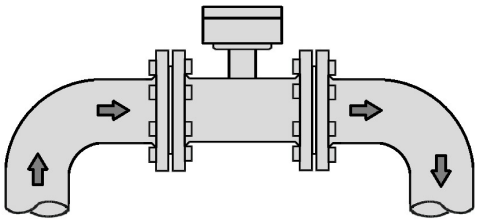
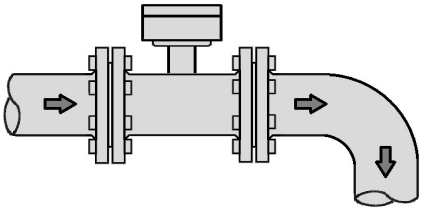
To attach **DGT_ULTRA** to pipe counter flanges, always use the correct number of appropriate screws or studs (these items are not supplied with the meter). Always secure all screws/studs to prevent leaks or the risk of the fasteners breaking due to internal pipe pressure. When tightening the screws that secure the **DGT_ULTRA** to the pipe counter flanges, ensure that the correct torque is used.

If there is a leak, do not attempt to fix it by applying more torque to the screws. Restart the process and check that the gasket is correctly positioned.

INSTALLATION CONDITIONS

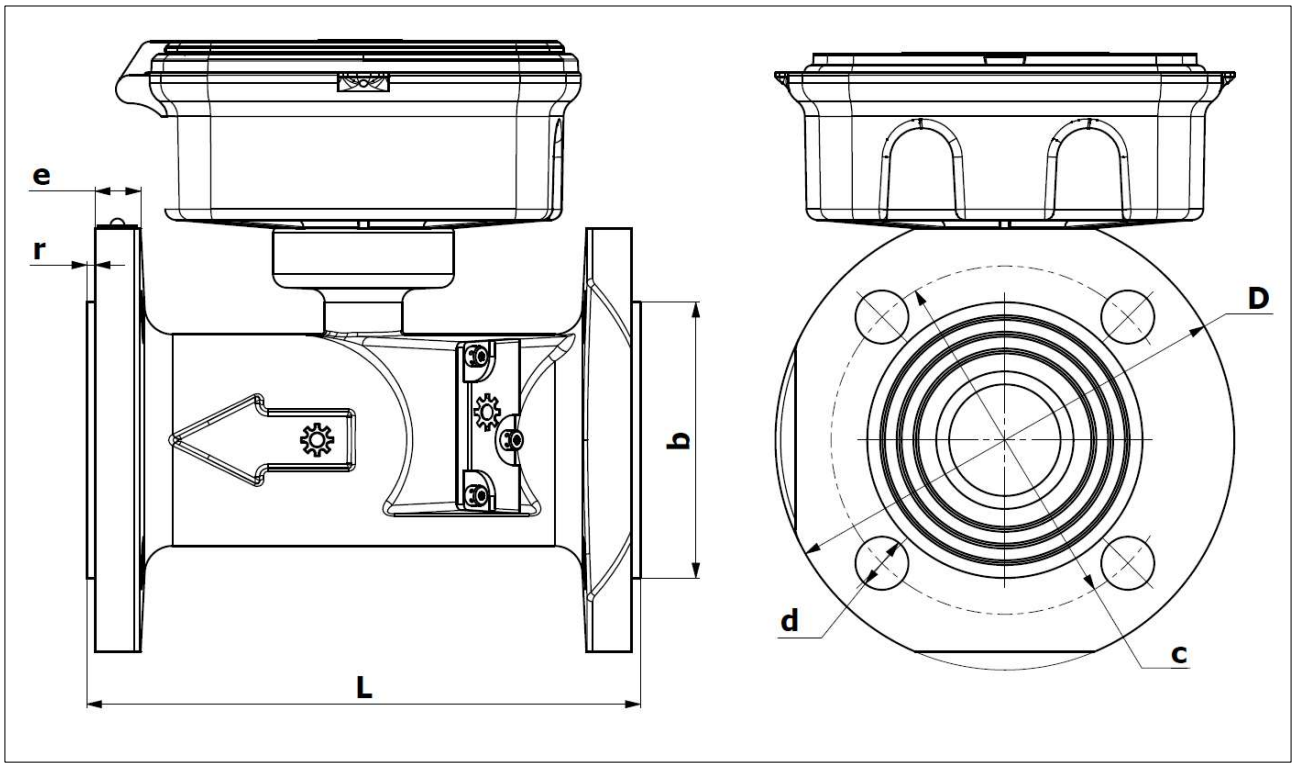
Due to its unique internal geometry and built-in signal processing, **DGT_ULTRA** can be installed without the need for straight upstream and downstream sections. However, some conditions must be met.

Recommended installation conditions:		
	 	• Installation below waterline • Installation in the upstream flow • Fully filled pipes • Rigid and well-fitted pipes • Flow velocities of up to 6 m/s • Use with clean water 

Installation conditions not recommended:		
	 	• Installation at the highest point of the pipeline • Installation in downflow • Partially filled pipes • Pipes with severe vibrations • Locations with air in the piping • Close to pump suction to avoid cavitation 

METER DIMENSIONS

The main dimensions of **DGT_ULTRA** are shown in the figure below and in the following tables:



Pressure class PN10 - NBR 7675 / DIN EN 1092-1								
DN [mm]	Weight [kg]	L [mm]	D [mm]	C [mm]	e [mm]	d [mm]	b [mm]	r [mm]
50	9.8 11.3	**200** **270**	165	125	19	4x19	99	3
65	11.9 14.4	200 300	185	145	19	4x19	118	3
80	14.5 15.1 16.6 18.3	200 **225** **300** 350	200	160	19	4x19**	132	3
100	18.6 22.9 23.4	**250** 350 **360**	220	180	19	8x19	156	3
125	24.5 29.4 29.9	250 350 360	250	210	19	8x19	184	3
150	31.2 38.0	**300** 450	285	240	19	8x23	211	3
200	47.8	350	340	295	20	8x23	266	3
250	63.0	450	400	350	22	12x23	319	3
300	82.6	500	455	400	24.5	12x23	370	4
400	1125 116.0	500 600	565	515	24.5	16x28	480	4
500	148.3 158.9	500 800	670	620	26.5	20x28	582	4
600	199.5	750	780	725	30	20x31	682	5

* Values in bold correspond to preferred lengths.

** As NBR 7675 does not make this clear, it has been agreed that the PN10 version has 4 holes.

Pressure class PN16 - NBR 7675 / DIN EN 1092-1								
DN [mm]	Weight [kg]	L [mm]	D [mm]	C [mm]	e [mm]	D [mm]	b [mm]	r [mm]
50	9.8 11.3	**200** **270**	165	125	19	4x19	99	3
65	11.9 14.4	200 300	185	145	19	4x19	118	3
80	14.5 15.1 16.6 18.3	200 **225** **300** 350	200	160	19	8x19**	132	3
100	18.6 22.9 23.4	**250** 350 **360**	220	180	19	8x19	156	3
125	24.5 29.4 29.9	250 350 360	250	210	19	8x19	184	3
150	31.2 38.0	**300** 450	285	240	19	8x23	211	3
200	47.8	350	340	295	20	12x23	266	3
250	63.0	450	400	355	22	12x28	319	3
300	82.6	500	455	410	24.5	12x28	370	4
400	116.5 120.0	500 600	580	525	28	16x31	480	4
500	164.1 174.7	500 800	715	650	31.5	20x34	609	4
600	223.9	750	840	770	36	20x37	720	5

* Values in bold correspond to preferred lengths.
** As NBR 7675 does not make this clear, it has been agreed that the PN16 version has 8 holes.

Pressure class # 150lbs - ASME B16.5								
DN [pol]	Weight [kg]	L [mm]	D [mm]	C [mm]	e [mm]	d [pol]	b [mm]	r [mm]
2	9.5 11.0	**200** **270**	150	120.7	19.1	4x $^{3}/_{4}$”	92.1	2
2 $^{1}/_{2}$	11.9 14.4	200 300	180	139.7	22.3	4x $^{3}/_{4}$”	104.8	2
3	13.5 14.9 16.6 18.3	200 **225** **300** 350	190	152.4	23.9	4x $^{3}/_{4}$”	127.0	2
4	20.5 23.4 24.8	**250** 350 **360**	230	190.5	23.9	8x $^{3}/_{4}$”	157.2	2
5	24.5 29.4 29.9	250 350 360	255	215.9	23.9	8x $^{7}/_{8}$”	185.7	2
6	32.5 39.8	**300** 450	280	241.3	25.4	8x $^{7}/_{8}$”	215.9	2
8	49.8	350	345	298.5	28.6	8x $^{7}/_{8}$”	269.9	2
10	65.0	450	405	362.0	30.2	12x 1”	323.8	2
12	85.0	500	485	431.8	31.8	12x 1”	381.0	2
16	119.3 122.8	500 600	595	539.8	36.6	16x 1$^{1}/_{8}$”	469.9	2
20	155.4 166.0	500 800	700	635.0	42.9	20x 1$^{1}/_{4}$”	584.2	2
24	209.9	750	815	749.3	47.7	20x 1⅜”	692.2	2

* Values in bold correspond to preferred lengths.

Pressure class # 300lbs - ASME B16.5								
DN [pol]	Weight [kg]	L [mm]	D [mm]	C [mm]	e [mm]	D [pol]	b [mm]	r [mm]
2	10.2 11.7	**200** **270**	165	127.0	22.3	8x $^{3}/_{4}$”	92.1	2
2 $^{1}/_{2}$	12.8 15.5	200 300	190	149.2	25.4	8x $^{7}/_{8}$”	104.8	2
3	14.5 15.9 18.6 19.8	200 **225** **300** 350	210	168.3	28.6	8x $^{7}/_{8}$”	127.0	2
4	21.8 25.4 25.5	**250** 350 **360**	255	200.0	31.8	8x $^{7}/_{8}$”	157.2	2
5	26.5 31.3 32.4	250 350 360	280	235.0	35.0	8x $^{7}/_{8}$”	185.7	2
6	33.5 40.1	**300** 450	320	269.9	36.6	12x $^{7}/_{8}$”	215.9	2
8	51.7	350	380	330.2	41.3	12x 1”	269.9	2
10	68.5	450	445	387.4	47.7	16x 1$^{1}/_{8}$”	323.8	2
12	88.5	500	520	450.8	50.8	16x 1$^{1}/_{4}$”	381.0	2
16	133.1 136.7	500 600	650	571.5	57.2	20x 1⅜”	469.9	2
20	180.0 190.6	500 800	775	685.8	63.5	24x 1⅜”	584.2	2
24	249.8	750	915	812.8	69.9	24x 1⅝”	692.2	2

* Values in bold correspond to preferred lengths.

MODEL CODING

Different models of **DGT_ULTRA** are presented in the table below:

DGT-ULTRA:	AAA	B	CCC	D	E	FFF	G	H	I
Nominal diameter – DN:									
50mm / 2”	050								
65mm / 2½”	065								
80mm / 3”	080								
100mm / 4”	100								
125mm / 5”	125								
150mm / 6”	150								
200mm / 8”	200								
250mm / 10”	250								
300mm / 12”	300								
400mm / 16”	400								
500mm / 20”	500								
600mm / 24”	600								
Permanent flow rate – Q3:									
25m³/h		F							
40m³/h		G							
63m³/h		J							
100m³/h		K							
160m³/h		W							
250m³/h		L							
400m³/h		M							
630m³/h		N							
1000m³/h		P							
1600 m³/h		Q							
2500 m³/h		R							
4000 m³/h		S							
Length – L:									
200mm			200						
225mm			225						
250mm			250						
270mm			270						
300mm			300						
350mm			350						
360mm			360						
450mm			450						
500mm			500						
600mm			600						
750mm			750						
800mm			800						
Pressure Class:									
PN10				1					
PN16				2					
# 150lbs				3					
# 300lbs				4					

Continue in next page…

DGT-ULTRA:	AAA	B	CCC	D	E	FFF	G	H	I
Accuracy class:									
Class 1					1				
Class 2					2				
Rangeability (Q3/Q1):									
R400						400			
R500						500			
R630 (class 2 only)						630			
R800 (class 2 only)						800			
Signal output:									
No signal output							0		
Pulse output							1		
Current output							2		
Pulse + current outputs							3		
Modbus							4		
Radio communication:									
No radio communication								0	
LoRaWAN								1	
SigFox								2	
NB-IoT								3	
Battery:									
1x D cell (3.6VDC / 17Ah)									1
2x D cells (3.6VDC / 34Ah)									2

CONFIGURATION CODING

Different **DGT_ULTRA** configurations are presented in the table below:

CONFIG:	A	B	C	D	E	FF	GG
Totalizer unit:							
Totalized volume in m^3	1						
Totalized volume in L	2						
Totalized volume in ft^3	3						
Totalized volume in Gal	4						
Flow rate unit:							
Flow rate in m^3/h		1					
Flow rate in L/h		2					
Flow rate in L/min		3					
Flow rate in L/s		4					
Flow rate in cfm		5					
Flow rate in gpm		6					
Flow rate in gph		7					
Temperature unit:							
Temperature in °C			1				
Temperature in °F			2				
Totalizer submultiples:							
No submultiples				0			
0.0				1			
0.00				2			
0.000				3			
Display on the totalizer:							
Net volume (forward - reverse)					0		
Volume in forward flow					1		
Volume in reverse flow					2		
Pulse output A:							
Disabled						00	
Pulse in forward flow						PD	
Pulse in reverse flow						PR	
Pulse in any direction of flow						FX	
High flow rate						FH	
Low flow rate						FL	
TAMPER						A1	
LOW BATTERY						A2	
REVERSE						A3	
DRY						A4	
LEAK						A5	
BURST						A6	
Presence of bubbles						A7	
High flow cut-off						A8	
Pulse output B:							
Disabled							00
Pulse in forward flow							PD
Pulse in reverse flow							PR
Pulse in any direction of flow							FX
High flow rate							FH
Low flow rate							FL
TAMPER							A1
LOW BATTERY							A2
REVERSE							A3
DRY							A4
LEAK							A5
BURST							A6
Presence of bubbles							A7
High flow cut-off							A8

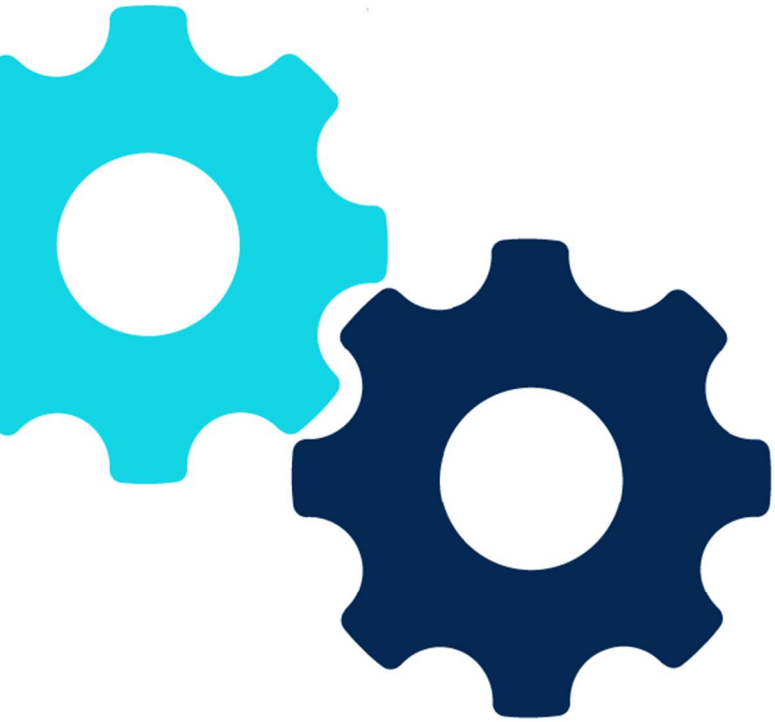
REGULATORY REFERENCE

- Inmetro Ordinance No. 155, of March 30, 2022 – Consolidated Metrological Technical Regulation for meters for consumption of cold drinking water and hot water.
- ABNT NBR 16043, of February 2, 2021 – Meters for cold drinking water and hot water. Part 1: Technical and metrological requirements; Part 2: Test methods; Part 3: Non-metrological requirements not covered by ABNT NBR 16043-1; Part 4: Installation requirements.
- ABNT NBR 8194, December 18, 2019 – Drinking water meters - Standardization.
- ABNT NBR 15538, of July 12, 2023 – Drinking water meters — Tests for performance evaluation.
- ABNT NBR 7675, dated September 29, 2022 – Ductile iron pipes and fittings and accessories for water supply and distribution systems - Requirements.
- ABNT NBR IEC 60529, July 24, 2017 – Degrees of protection provided by enclosure (IP Codes).
- Annex XX of Ordinance GM/MS No. 888, of May 4, 2021 – Procedures for controlling and monitoring the quality of water for human consumption and its potability standard.
- ASME B16.5, 2021 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard.
- DIN EN 1092-1, 2018 – Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges.

TERMS AND DEFINITIONS

- **Minimum flow rate – Q1**: lowest flow rate at which water meter is required to operate within the maximum permissible errors (MPE).
- **Transition flow rate – Q2**: flow rate that occurs between the permanent flow rate and the minimum flow rate, dividing the flow range into two fields (upper field and lower field), each characterized by its own maximum permissible errors (MPE). Q2 = 1.6 x Q1.
- **Permanent flow rate – Q3**: highest flow rate, within normal operating conditions, with which a water meter is required to operate within maximum permissible errors (MPE).
- **Overload flow rate – Q4**: the highest flow rate at which a water meter is required to operate for a short period of time, within its maximum permissible errors (MPE), while maintaining its metrological performance when subsequently operated within its nominal operating conditions. Q4 = 1.25 x Q3.
- **Rangeability – R**: Ratio between the permanent flow rate (Q3) and the minimum flow rate (Q1). R = Q3/Q1.
- **Minimum admissible temperature – mAT**: minimum temperature that a water meter can permanently withstand, within its operating conditions, without deterioration of its metrological performance.
- **Maximum allowable temperature – MAT**: maximum temperature that a water meter can permanently withstand, within its operating conditions, without deterioration of its metrological performance.
- **Error**: value of measured quantity minus the value of reference quantity. The indicated volume is considered the measured value of quantity and the drained volume the reference value of quantity. The difference between the drained and indicated volumes is referred to as the indication error.
- **Upper flow rate zone (Q2 ≤ Q ≤ Q4)**: flow rate range where the maximum permissible errors (MPE) are ± 1% for meters with metrological class 1 and ± 2% for meters with metrological class 2, for water temperatures between 0.1°C and 30°C.
- **Lower flow rate zone (Q1 ≤ Q < Q2:** flow rate range where the maximum permissible errors (MPE) are ± 3% for meters with metrological class 1 and ± 5 % for meters with metrological class 2, for water temperatures between 0.1°C and 30°C.

NOTES



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