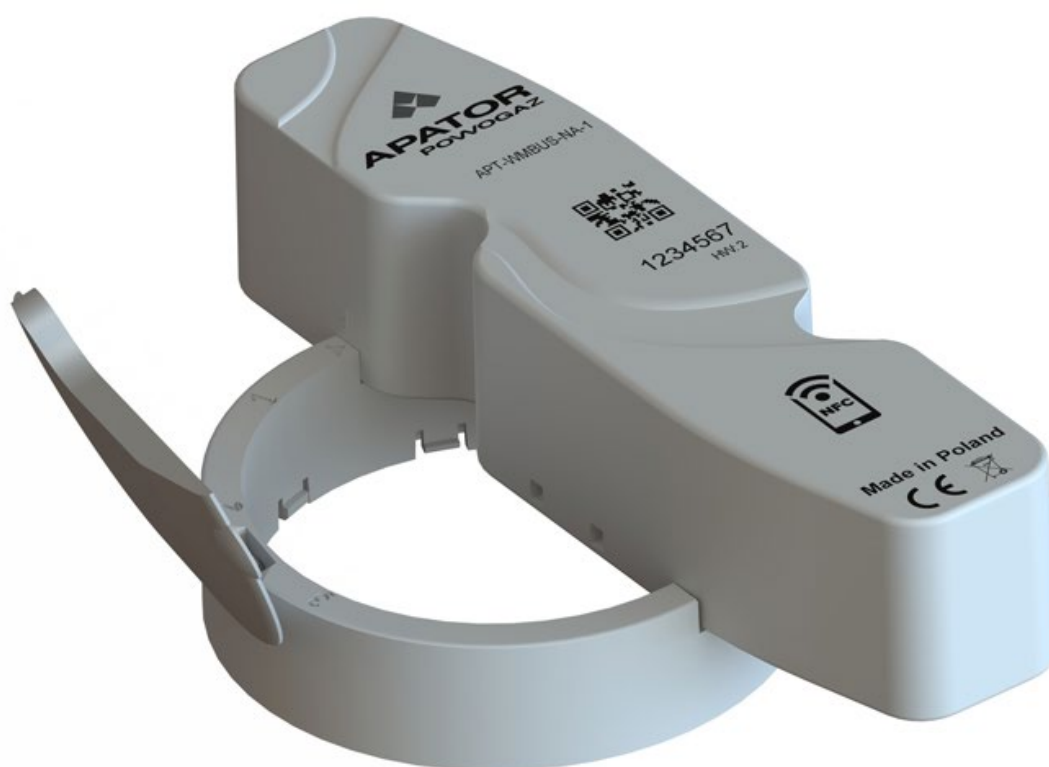


## Operating Manual

# Universal induction module APT-WMBUS-NA-1



ISO 9001

PN-N-18001

ISO 14001

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## 1. Application

The APT-WMBUS-NA-1 is a universal RF (radio frequency) communication module enabling remote reading of water meters made by Apator Powogaz S.A. The APT-WMBUS-NA-1 counts the revolutions of a dedicated inductive pointer of the water meter and outputs data via an ISM 868 MHz RF transmitter interface. The dedicated inductive pointer revolutions are detected with an induction scanning module.

Table 1 Product compatibility chart

| Water meter type / name | Q <sub>3</sub> [m <sup>3</sup> /h] or DN [mm] | Rotation weight [dm <sup>3</sup> /rev.] | Temperature class |
|-------------------------|---|---|-------------------|
| JS Smart C+             | Q <sub>3</sub> 1.6–4                          | 1                                       | T50 / T90         |
| JS Smart +              | Q <sub>3</sub> 1.6–4                          | 1                                       | T50 / T90         |
| JS Master C+            | Q <sub>3</sub> 6.3–16                         | 1                                       | T50               |
| JS Master +             | Q <sub>3</sub> 6.3–16                         | 1                                       | T50 / T130        |
| JS Impero               | Q <sub>3</sub> 50–100                         | 10                                      | T50               |
| MWN Nubis               | DN 40–125                                     | 10                                      | T50 / T130        |
| MWN Nubis               | DN 150–400                                    | 100                                     | T50               |
| MWN Nubis               | DN 150–300                                    | 100                                     | T130              |
| MP                      | DN 40–100                                     | 10                                      | T50 / T130        |
| MK                      | DN 50–100                                     | 10                                      | T50               |
| MK                      | DN 150  | 100                                     | T50               |

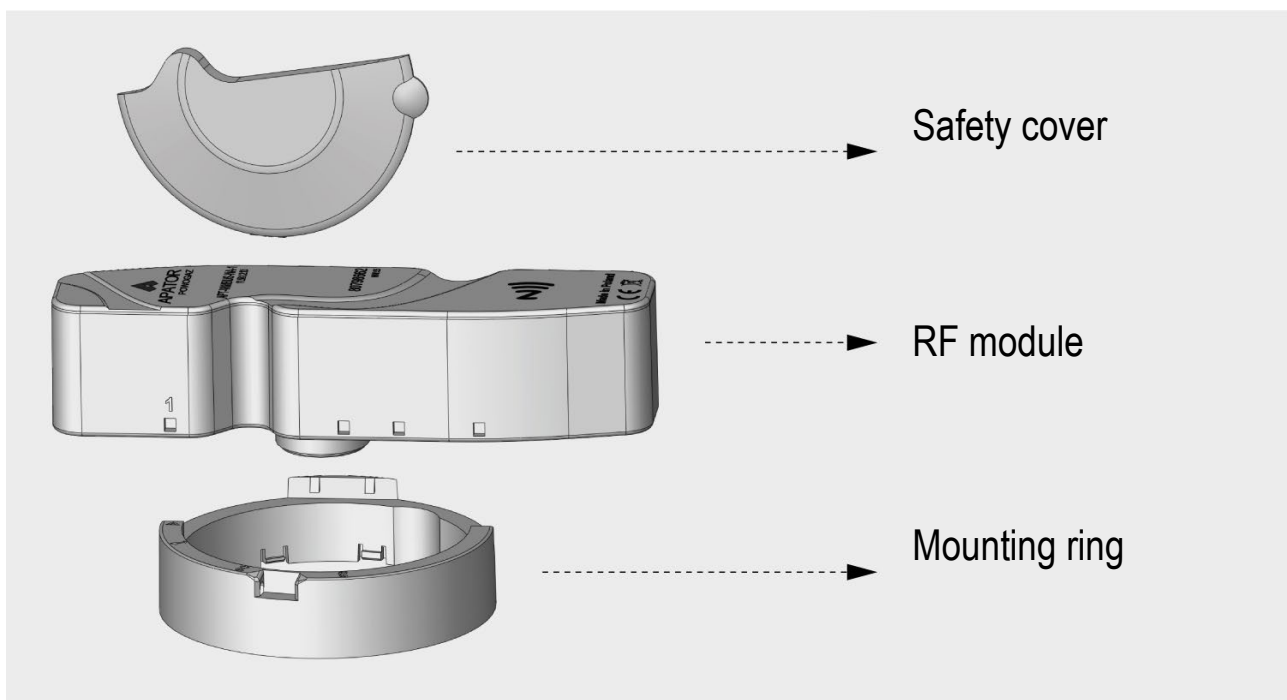
## 2. Overview

The APT-WMBUS-NA-1 universal RF module (Fig. 1) is a separable module comprising an interface ring, the RF (induction) module itself and a safety cover for the water meter counter.

The communication unit is an RF module which comprises electronic components, a battery, and an antenna, which is inside the module's enclosure to ensure an ingress protection rating of IP68 in the standard version. An optional version is available on request with an extended antenna line for installation in deep or flooded water meter vaults and other locations which inhibit RF transmission.

The APT-WMBUS-NA-1 also features an NFC (near-field communication) interface, which is compliant with ISO 15693 and ISO 18000-3 Mode 1. The APT-WMBUS-NA-1 is mounted on a compatible water meter with a mounting ring that secures the module properly at the orientation required (see details further in this Manual).

The APT-WMBUS-NA-1 scans the dedicated inductive pointer of the connected water meter by detecting the revolutions and their sense with an induction circuit. Induction-based detection enables remote transmission of water meter counter indications and metering location events over an ISM 868 MHz RF interface, operating in Wireless M-Bus protocol, providing extensive data analysis and performance diagnostics.



*Fig. 1 Components of the universal induction module*

## 2.1 Dimensions of the module separated and installed on a water meter

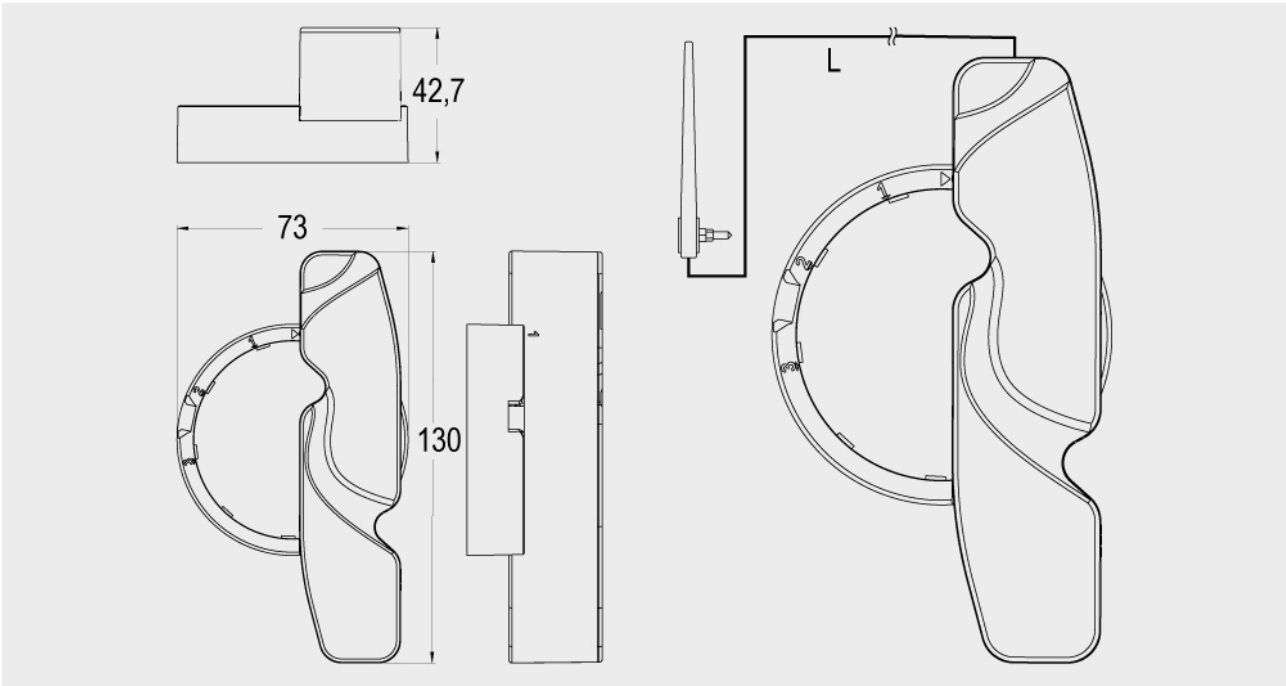


Fig. 2 Module overall dimensions

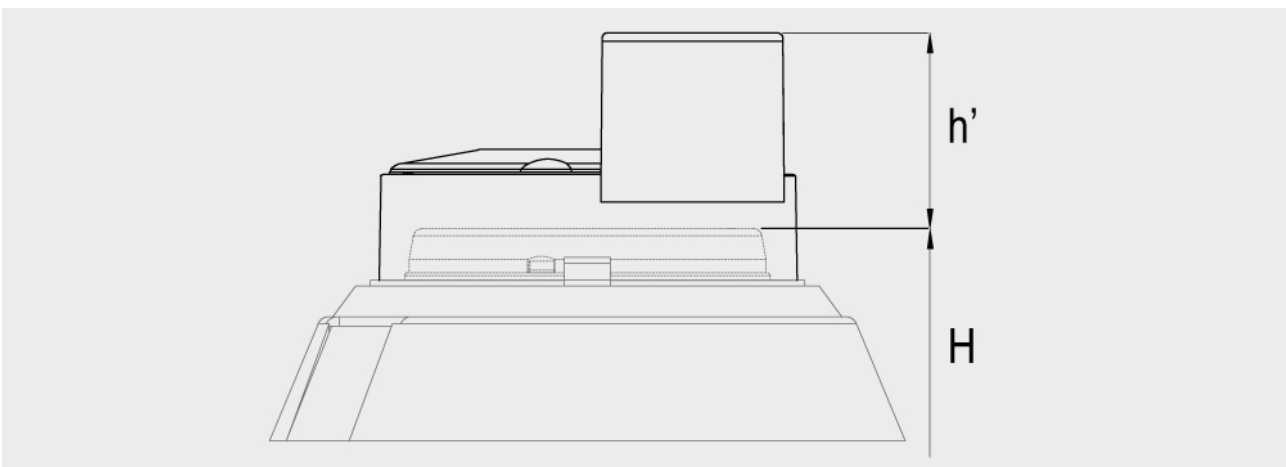


Fig. 3 Water meter height with the module installed

| Water meter type  | Water meter + module height $H + h'$ [mm] |
|---|---|
| Apartment WMs: JS / (T50 or T90; DN15 or DN20)                            | $H^* + 32.2$                              |
| Home WMs: JS / (T50 or T130; DN25 to DN40)                                | $H^* + 35.0$                              |
| Industrial WMs: MWN and MP (T50 or T130), JS, MK; (DN per assigned sizes) | $H^* + 34.8$                              |

\* The  $H$  values are specified in the product data sheets available at [www.apator.com](http://www.apator.com).

## 2.2 Specifications

| Module                                   | APT-WMBUS-NA-1  | APT-WMBUS-NA-1 M                          |
|--|---|---|
| Antenna                                  | Internal (standard version)   | External antenna line<br>L = 3m (L = 5m)* |
| Installation method                      | Interface ring attached to the water meter  |   |
| Pulse counting method                    | Inductive resonance module  |   |
| Power supply                             | 3.6 V A lithium battery   |   |
| Battery life                             | 12 years of operation + 1 years in warehouse mode with a temperature profile:<br>10% of operating time at 10°C, 80% of operating time at 20°C, 10% of operating time at 30°C<br>10% of operating time at 30°C   |   |
|  | 6 years of operation + 1 years in warehouse mode with a temperature profile:<br>100% of operating time at 60°C (for applications with water meter temperature class T90 and T130)   |   |
| Operating temperature                    | -15°C to +60°C  |   |
| Ingress protection rating                | IP 68   |   |
| Transmission type                        | Unidirectional (T1): metered usage (actual reading + 1 historical reading (the last saved one)); event flags<br>Bidirectional (T2): metered usage (actual reading + 12 historical readings); diagnostic data; event details; remote configuration setting |   |
| Transmission interval                    | 10 s from 5:00 to 21:00   |   |
|  | 60 s from 21:00 to 5:00   |   |
| Protocol                                 | Wireless M-Bus **   |   |
| Transmission frequency                   | 868.95 MHz  |   |
| Transmitter power output                 | 20 mW / 50 Ω  |   |
| Transmitter power output level stability | +1 dB / -2 dB   |   |
| Receiver sensitivity                     | -100 dBm  |   |
| Outdoor range                            | 800 m max (depending on the actual surroundings)  |   |
| Weight                                   | <b>0.106 kg</b>   |   |

\*) The APT-WMBUS-NA-1 is available on request with an L = 5 m external antenna line.

\*\*) The protocol has been modified to use Apator's proprietary values in field CI (the application layer is Apator proprietary).

### 3. Installation of the universal induction module on water meters from APATOR POWOGAZ

#### 3.1 Installation prerequisites

Each water meter compatible with the universal induction module features a dedicated inductive pointer (ref. "Ti" or "Ti/IR" as applicable designations). The water meters can still be read with the existing module versions (RF modules, pulse modules and M-Bus modules) which support an optical IR interface.

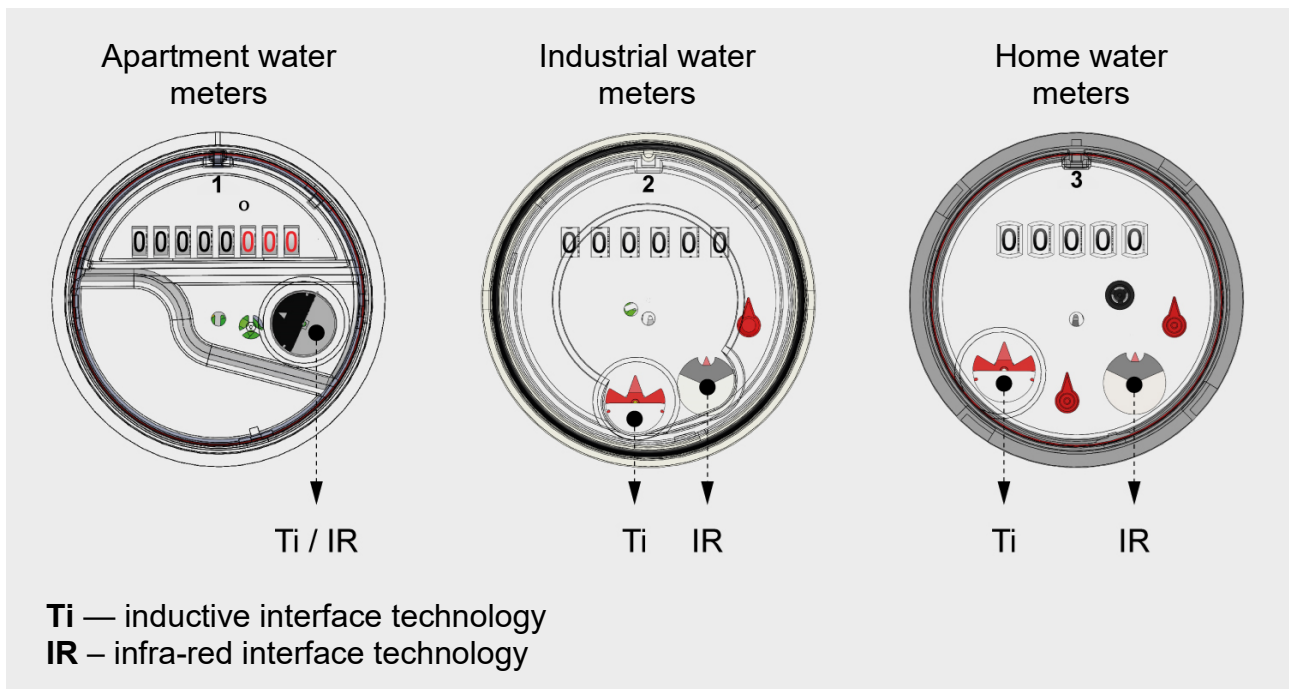


Fig. 4 Compatible data transmission technologies and the locations of inductive pointers



Prepare the water meter for installation:

- Remove the safety cover from the water meter (if installed).
- Remove all fouling from the top of the counter mechanism guard (thoroughly clean the ring recess) and the RF module base which will be directly over the inductive pointer.

Note: Do not use any chemicals, including solvents. Use regular detergents thinned with water.

Keep the universal induction module in warehouse mode until the installation process. If preinstalled on a water meter, handle and ship the modules in warehouse mode.

Exit the warehouse mode of the module already installed on the water meter counter. Alternatively, exit warehouse mode at the installation site; this requires deleting errors (which include Disconnect Alarm). The installation sequence:

- **Mount the mounting ring on the water meter counter assembly, choosing the correct installation orientation.**
- **Mount the module on the mounting ring in the correct installation orientation.**
- **Exit warehouse mode of the module and configure it.**

See details further in this Manual.

- Install the water meter with the mounted universal induction module near water supply systems (steel and/or copper piping, other water meters, RF transmission devices, etc.) and/or electrical wiring respecting the clearances shown in Fig. 5.

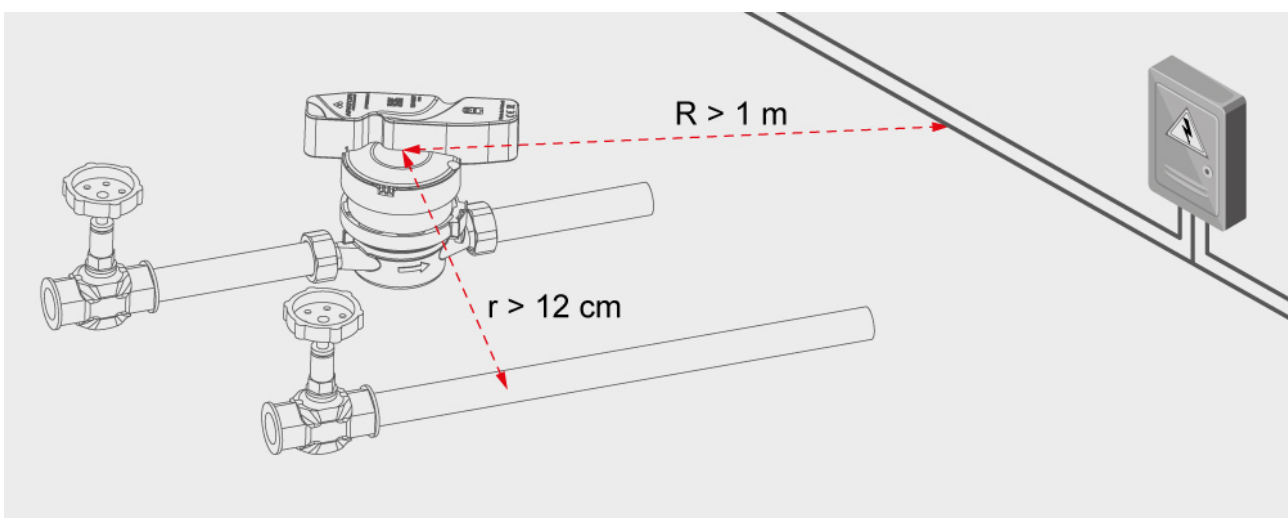


Fig. 5 Recommended minimum installation clearances for the water meter + module assembly near water supply and electrical wiring systems

## 3.2 Installation on apartment water meters: JS Smart+ and JS SmartC+ (DN15 or DN20; T50 or T90)

### 3.2.1 Positioning and securing the mounting ring on the counter assembly

1. Mount the mounting ring with the safety cover on the counter guard. Align the mark “1” on the top edge of the mounting ring with the mark “1” on the counter guard.

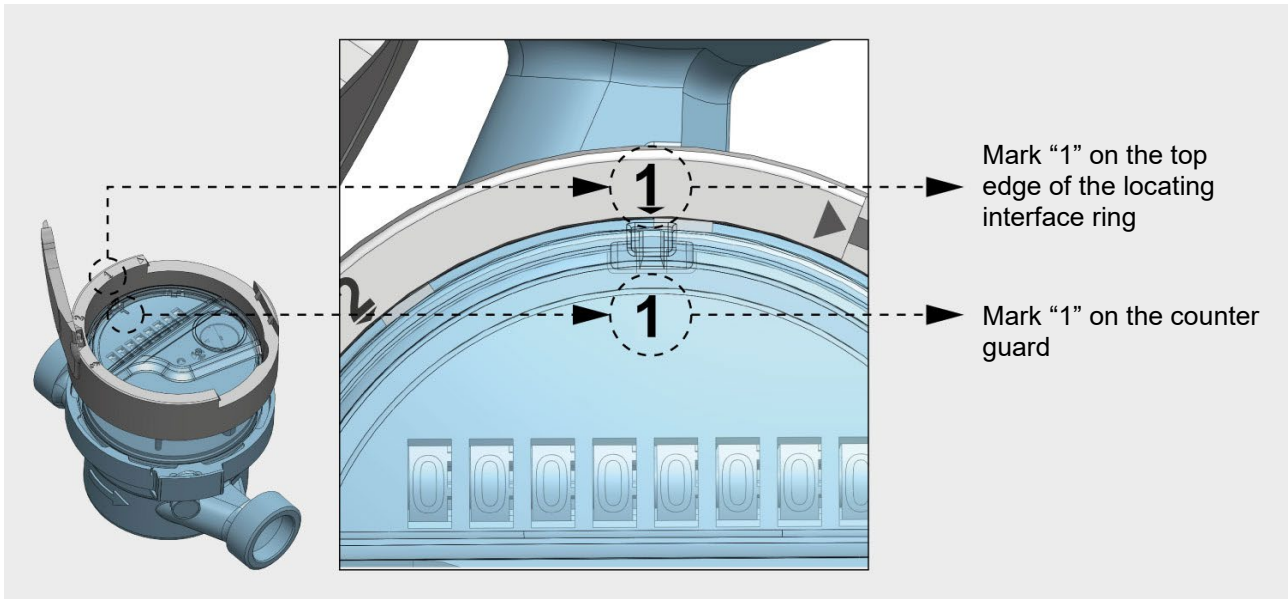


Fig. 6

2. Align the snap tabs of the mounting ring with the respective snap-on detents on the cylindrical section of the counter guard.

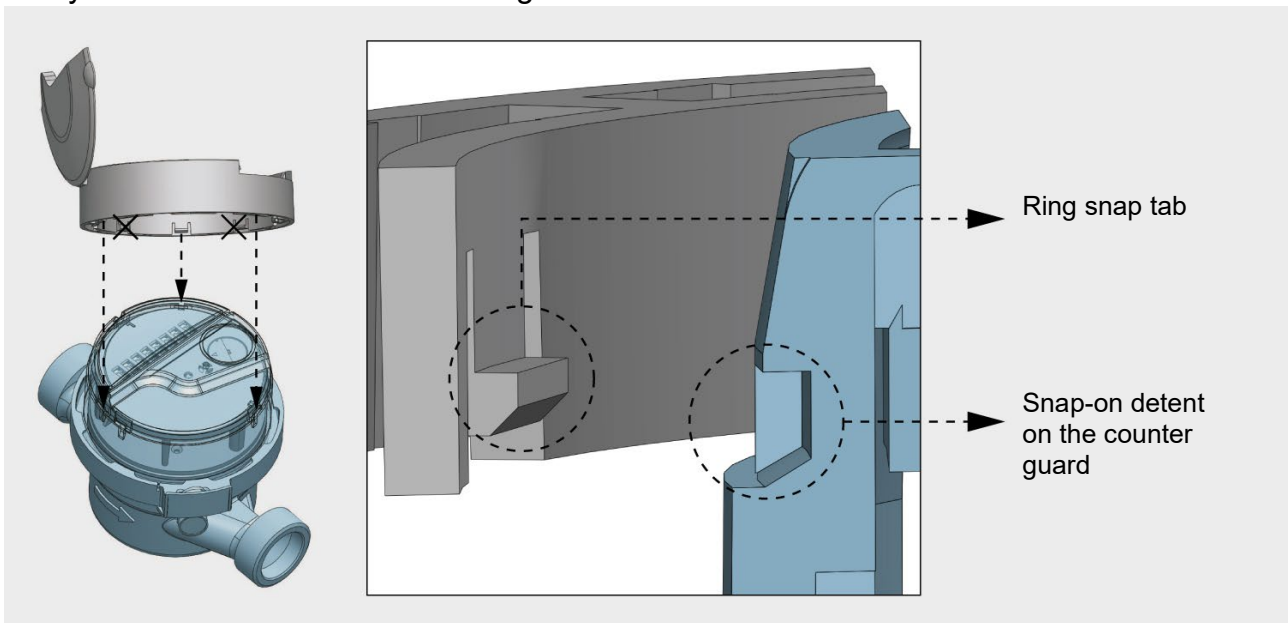


Fig. 7

3. Use both hands to press down the mounting ring firmly on the counter guard until the snap tabs engage the detents with a loud click.

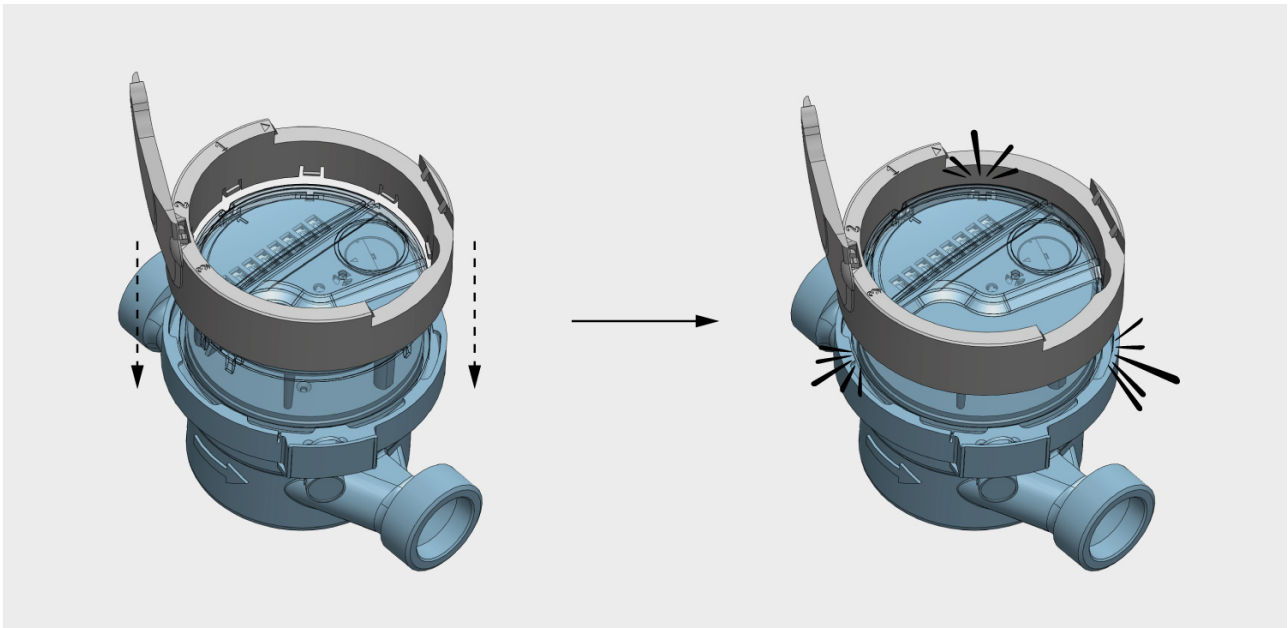


Fig. 8

4. Try to pull away the mounting ring to verify proper fit.

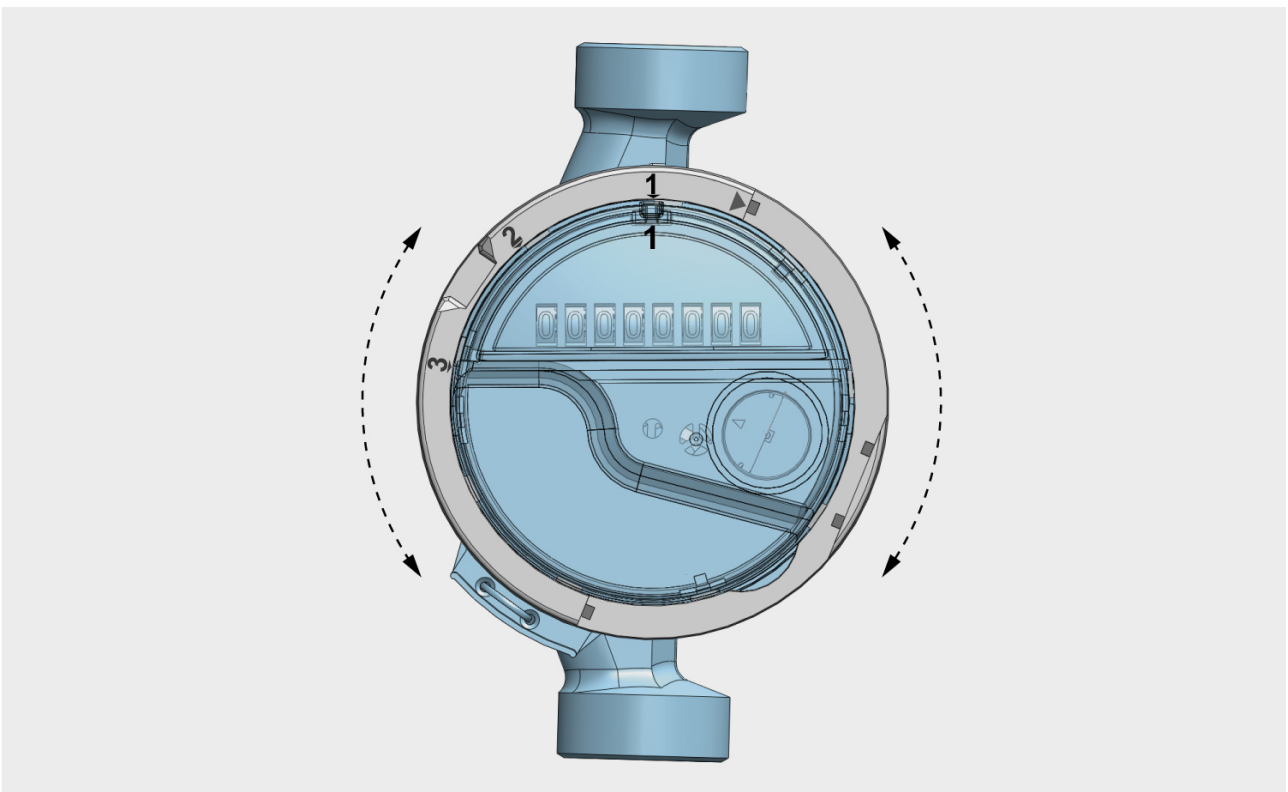


Fig. 9

### 3.2.2 Installing the RF module

1. Position the RF module over the mounting ring secured on the counter guard. Align the mark "1" on the RF module side with the mark "Δ" on the top edge of the mounting ring.

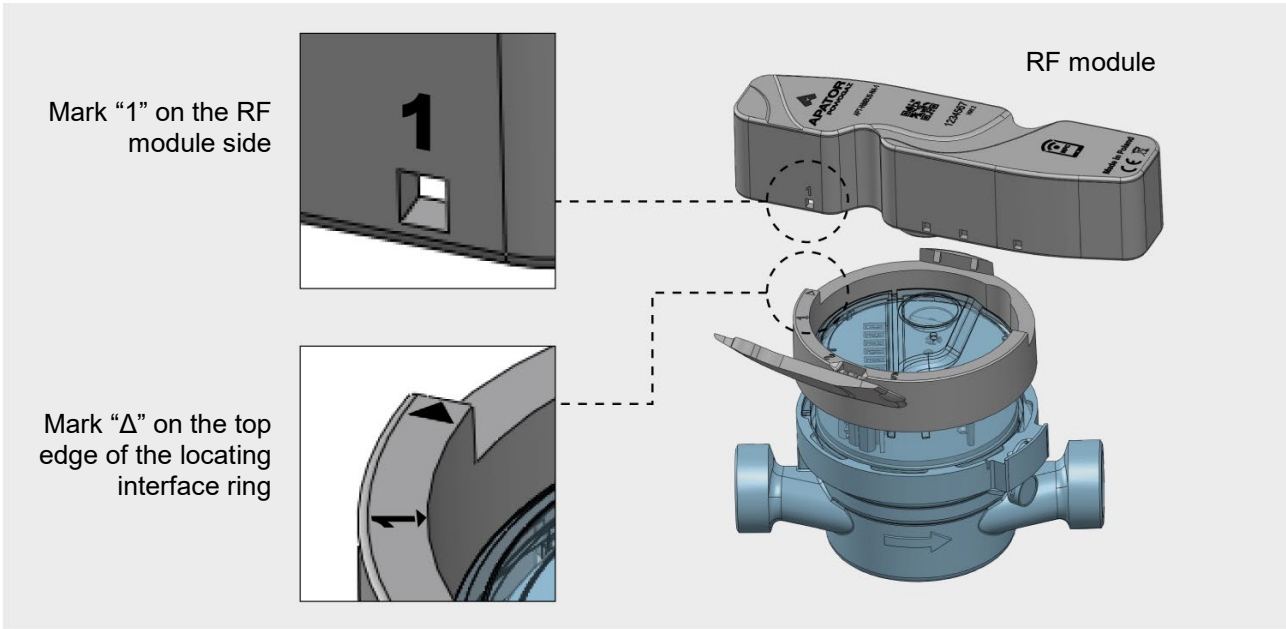


Fig. 10

2. Insert one side of the RF module inside the groove within the mounting ring to engage the two snap-on detents of the RF module over the two respective snap tabs on the mounting ring (A).

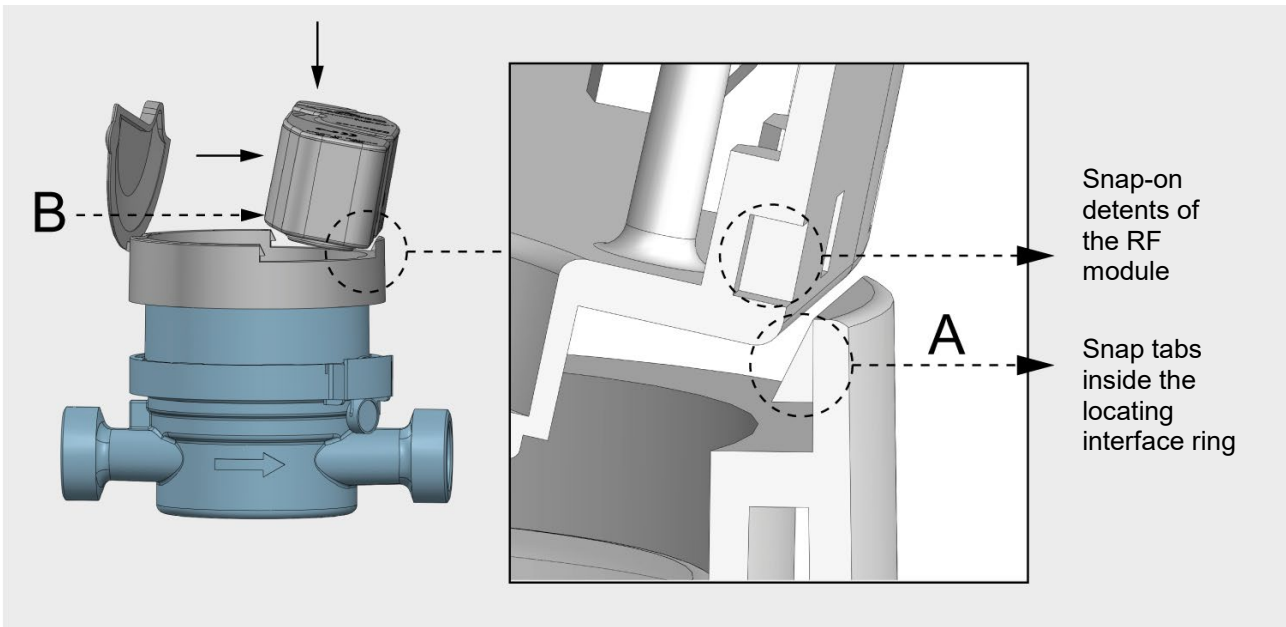


Fig. 11

3. Use both hands to firmly press down the opposite sides of the RF module into the mounting ring and engage the two remaining snap-on detents (**B**) over the two respective snap tabs with a loud click.
4. Try to pull away the RF module to verify proper fit.
5. This completes the installation process.

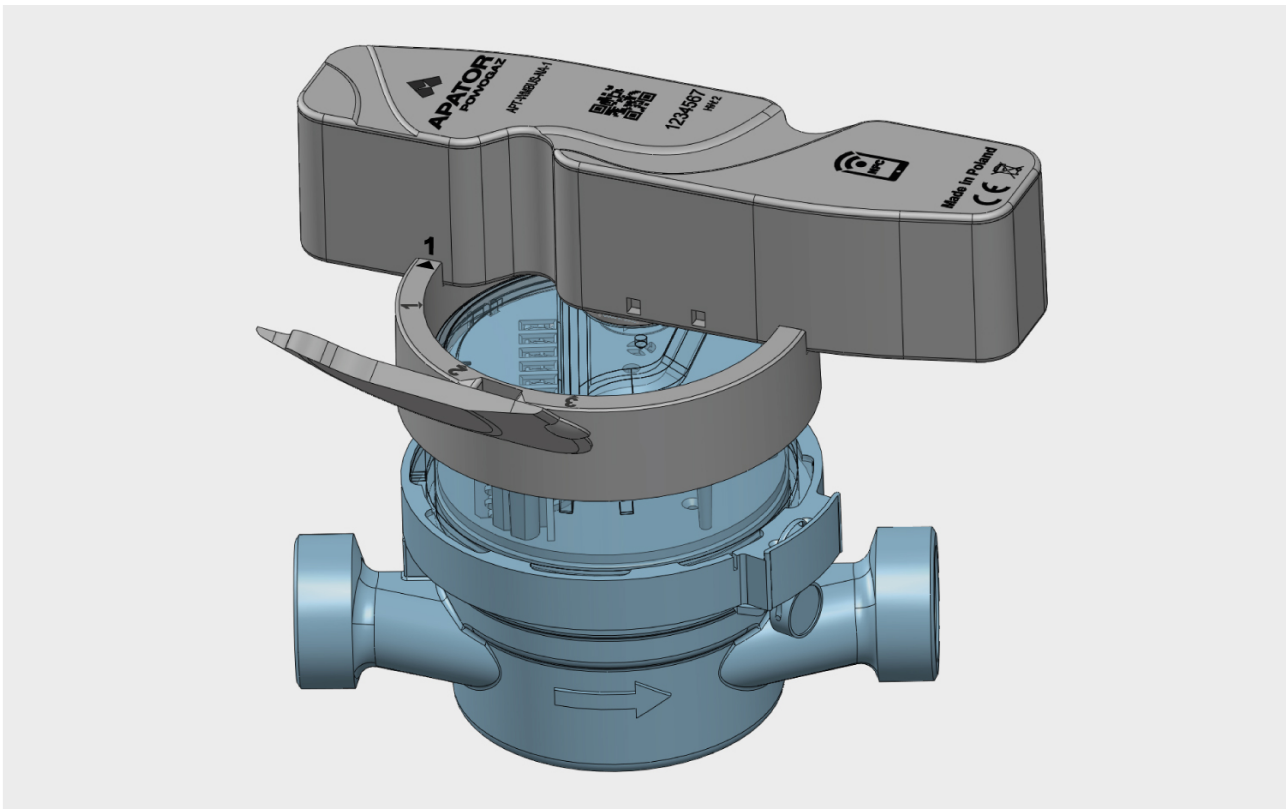


Fig. 12

The universal RF module will operate properly if installed according to the sequence explained above. The separable fastening of the RF module and the mounting ring allow easy replacement of the components as required.

**Note:** The installation sequence and steps of the universal RF module shown above apply to all compatible water meter types. The installation narrative in Sections 3.3 and 3.4 is shown in simplified figures for the remaining water meter types.

### 3.3 Installation on home water meters: JS Master+ and JS MasterC+ (DN25 to DN40; T50 or T130)

#### 3.3.1 Alignment and fastening the mounting ring on the counter guard and proper fitment verification

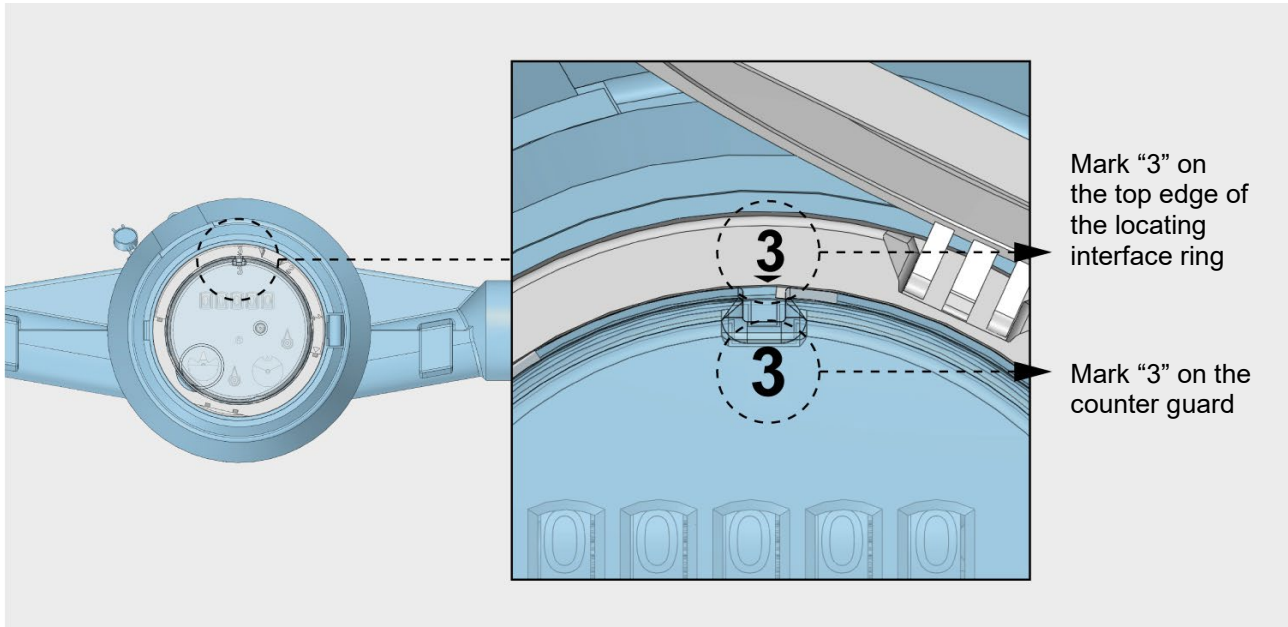


Fig. 13

#### 3.3.2 Fastening the RF module

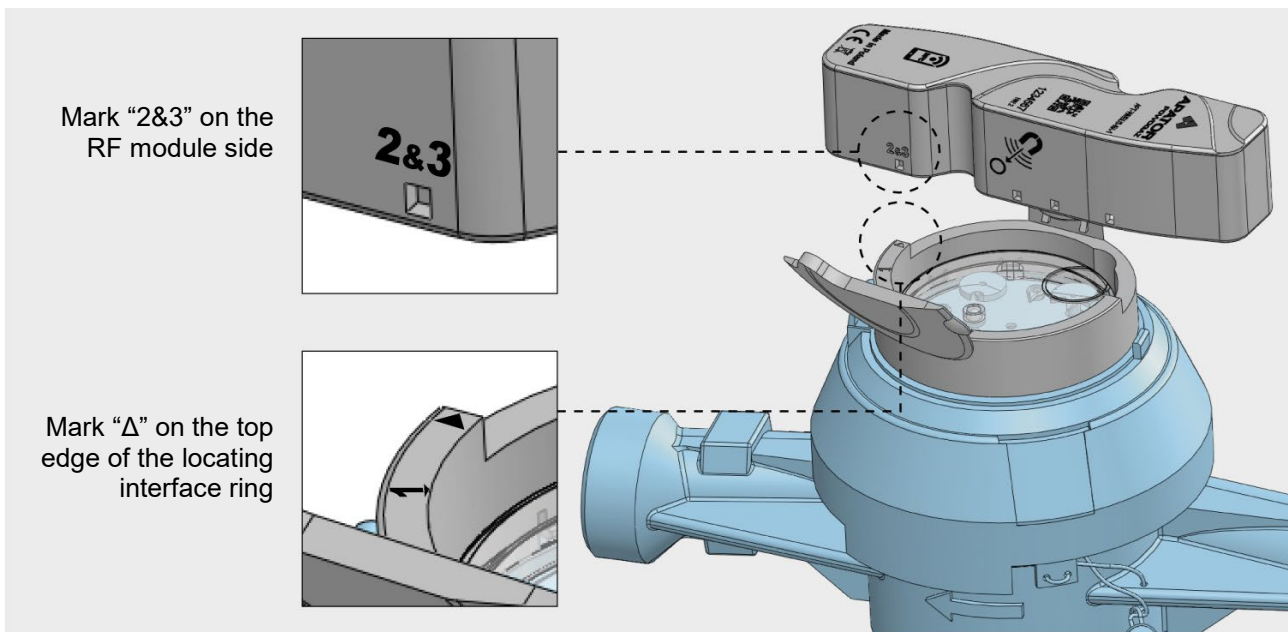


Fig. 14 Aligning the RF module over the mounting ring

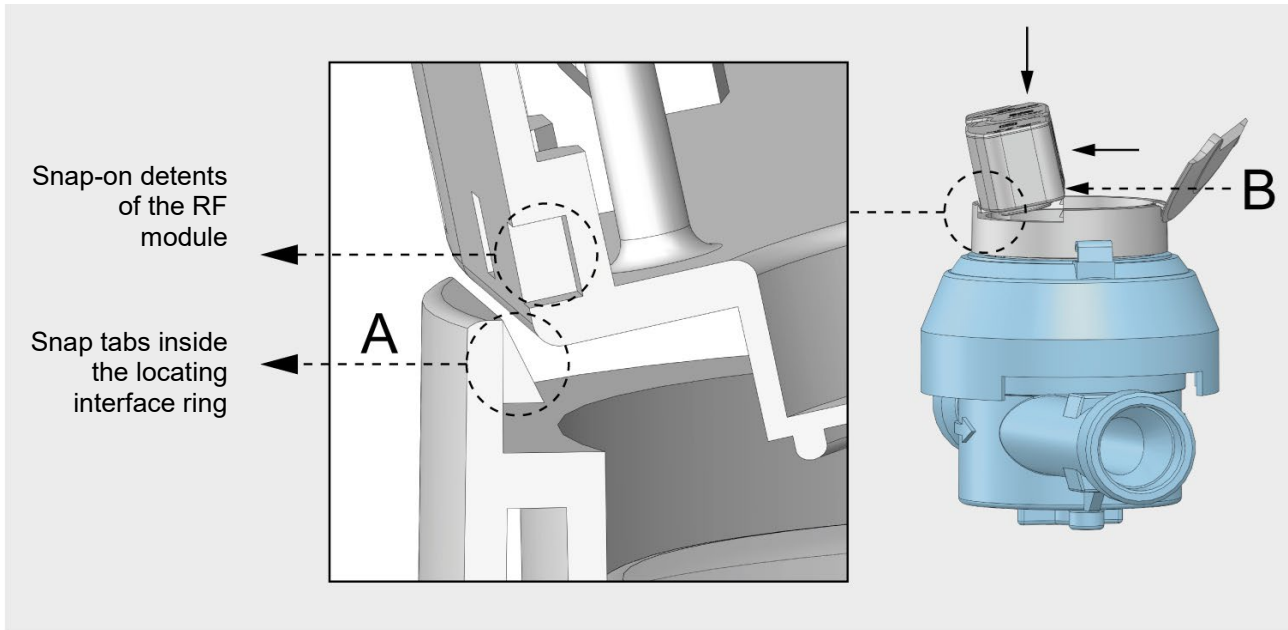


Fig. 15 Fastening the RF module to the mounting ring

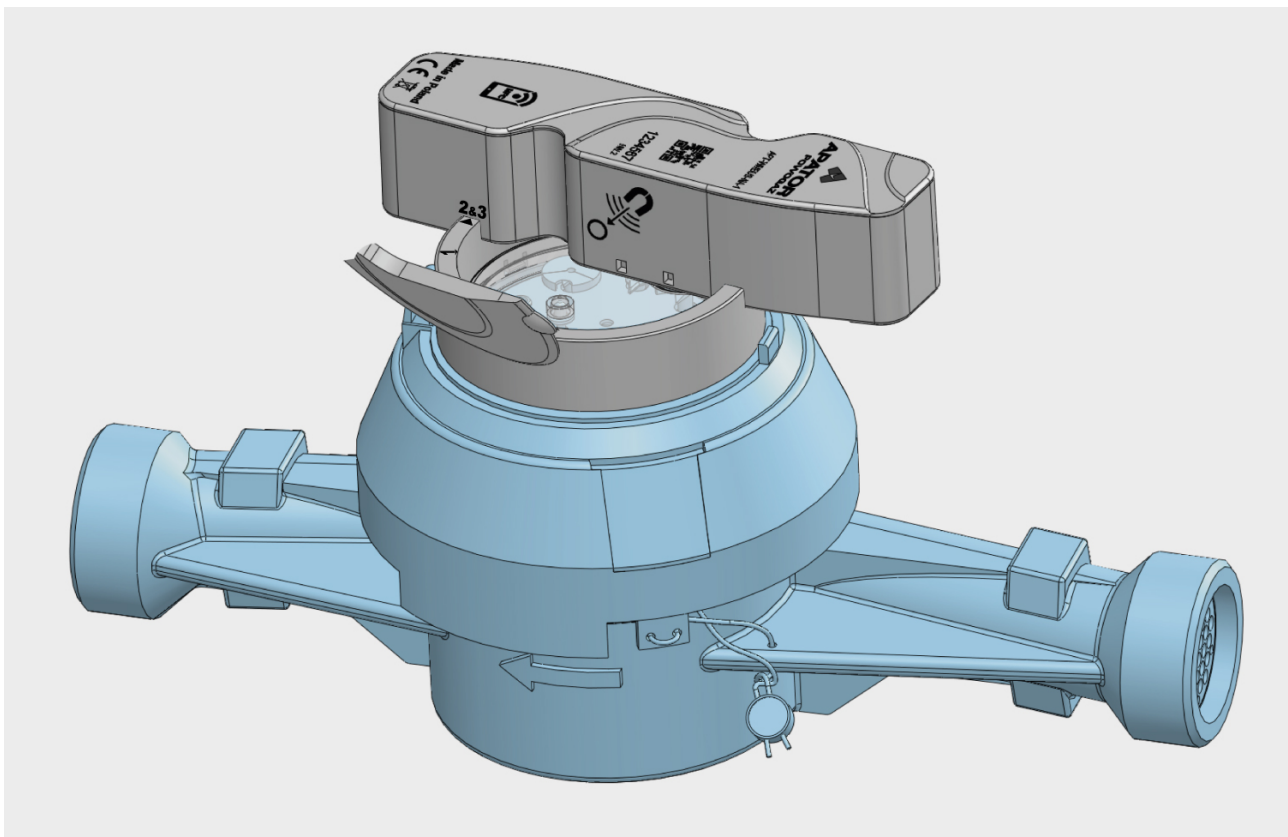


Fig. 16 Overview of the universal RF module mounted on a home water meter

### 3.4 Installation on industrial water meters: MWN and MP (T50 or T130), JS, MK; (DN per assigned sizes)

#### 3.4.1 Fastening the mounting ring on the counter guard

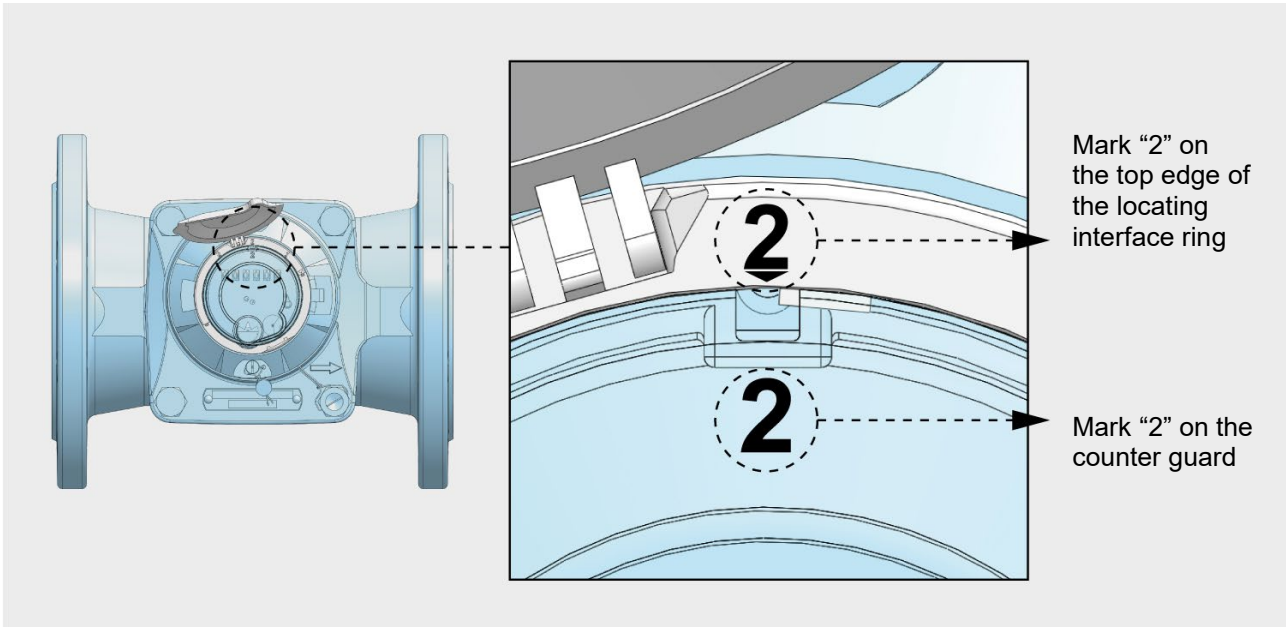


Fig. 17 Fastening the locating intermediate ring on the counter guard

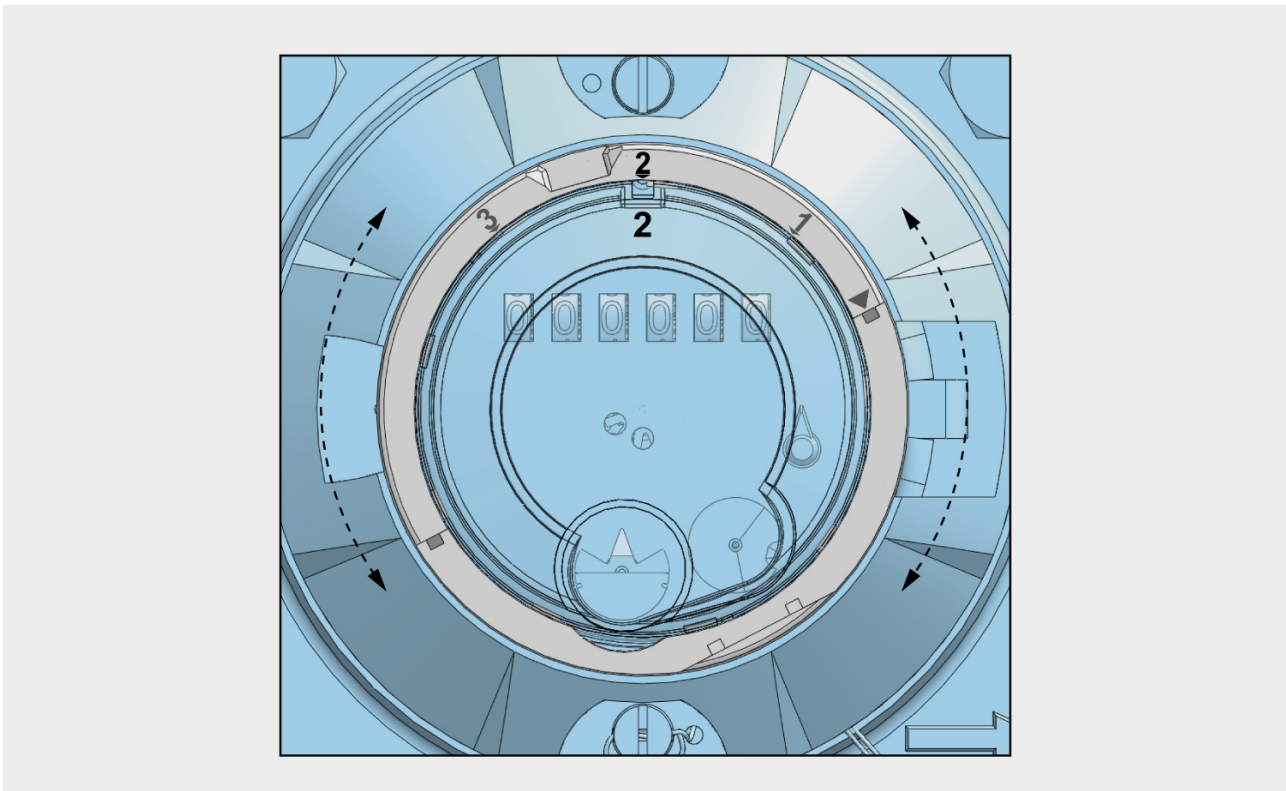


Fig. 18



### 3.4.2 Fastening the RF module

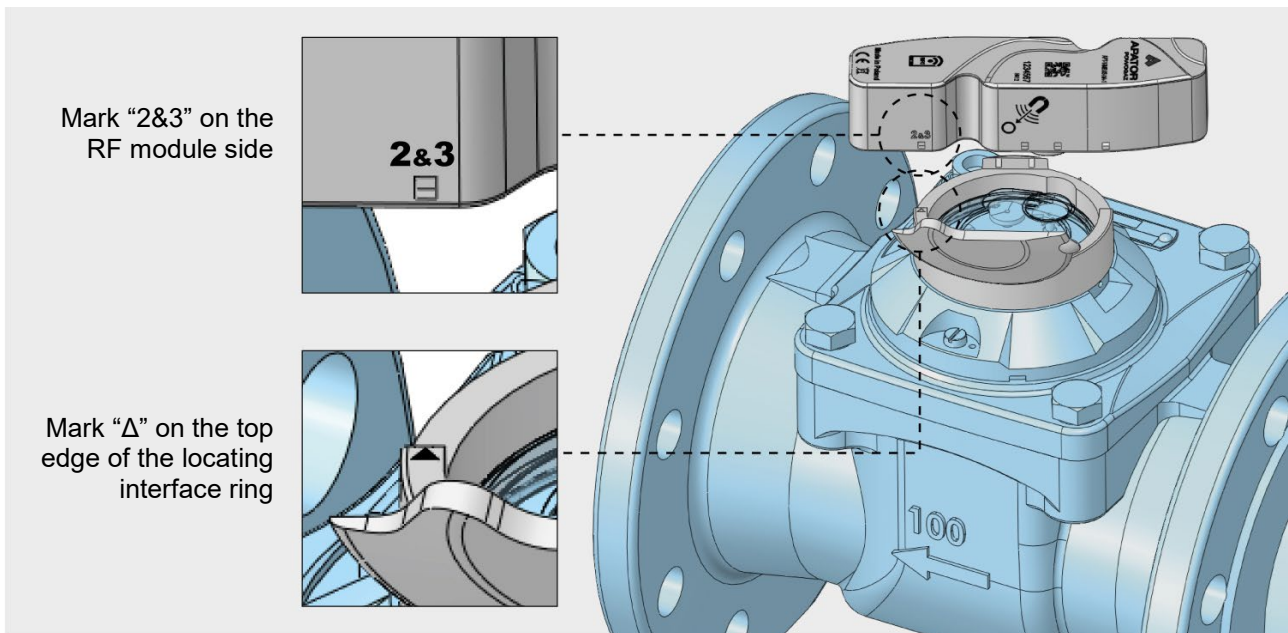


Fig. 19 Aligning the RF module over the mounting ring

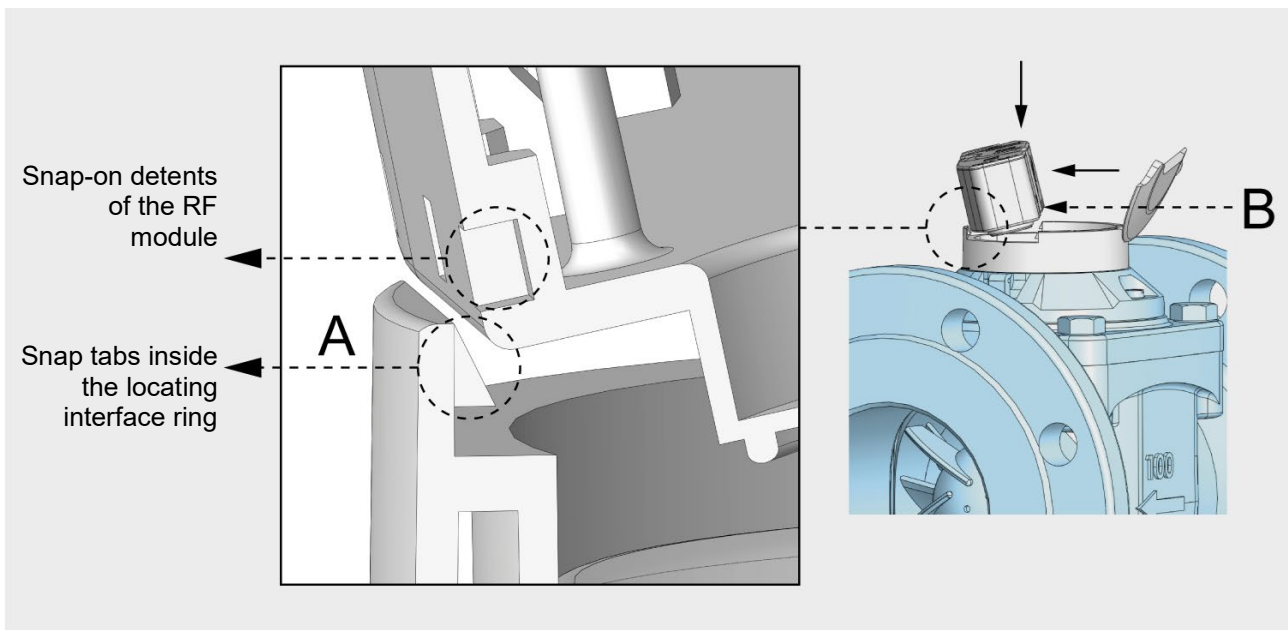
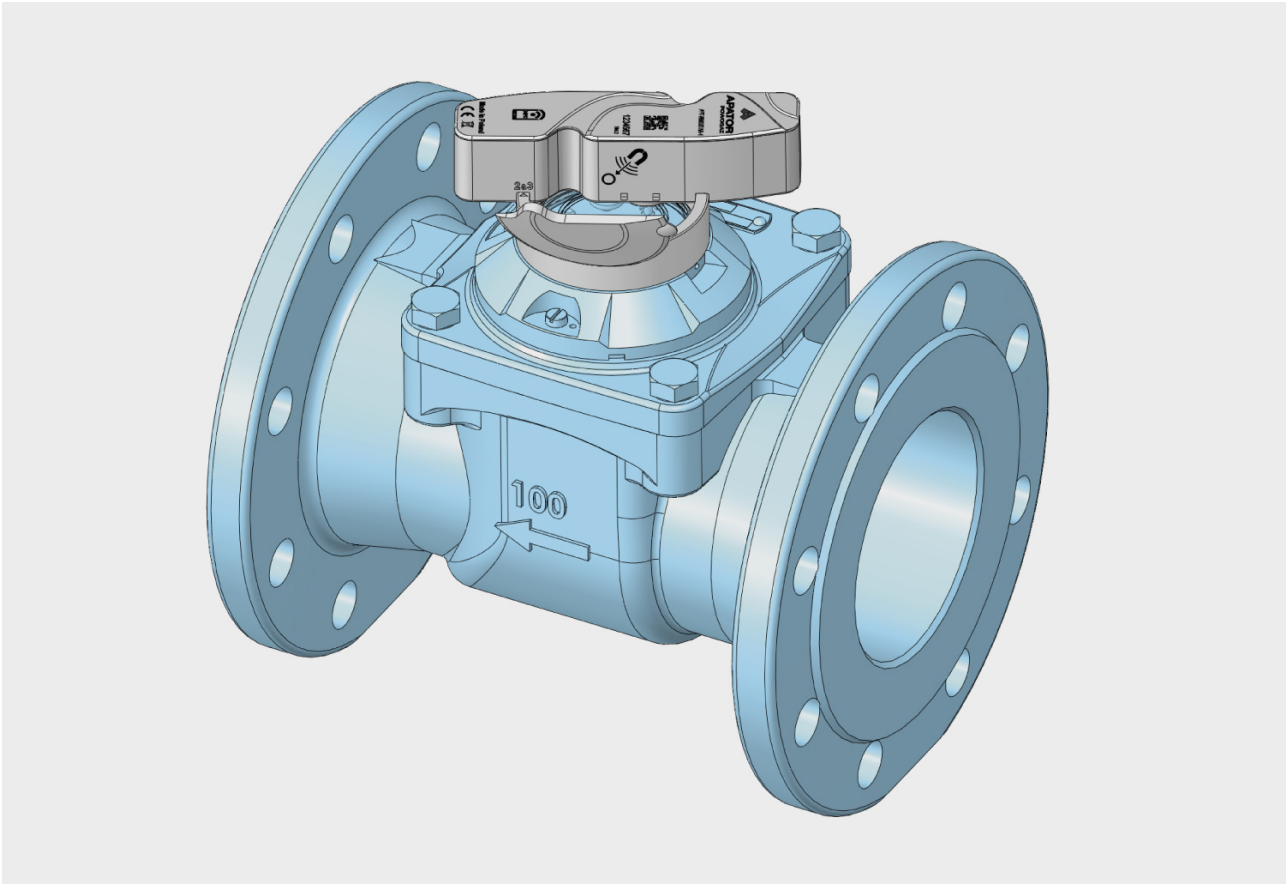


Fig. 20



*Fig. 21 Overview of the universal RF module mounted on an industrial water meter*

### 3.5 Installing an external antenna

1. Install the external antenna according to its version as shown in Fig. 25.
2. The antenna cable must be secured to fixed parts inside the water meter vault (a pipe or a wall feature) with standard fasteners (eye bolts, zip ties, etc.).
3. Never secure the antenna or its components (like the antenna cable) to an access ladder or steps or similar parts which would create a risk of damage.
4. Coil the slack antenna cable length with a diameter above 15 cm and fasten it to a fixed part near the module. Secure the antenna cable against kinks.
5. When installing in a horizontal orientation, keep the antenna cable bending radius above 10 cm.
6. Keep the antenna cable at least 15 cm away of all metal parts.
7. The antenna holder must be fastened less than 1 cm from the antenna tip.

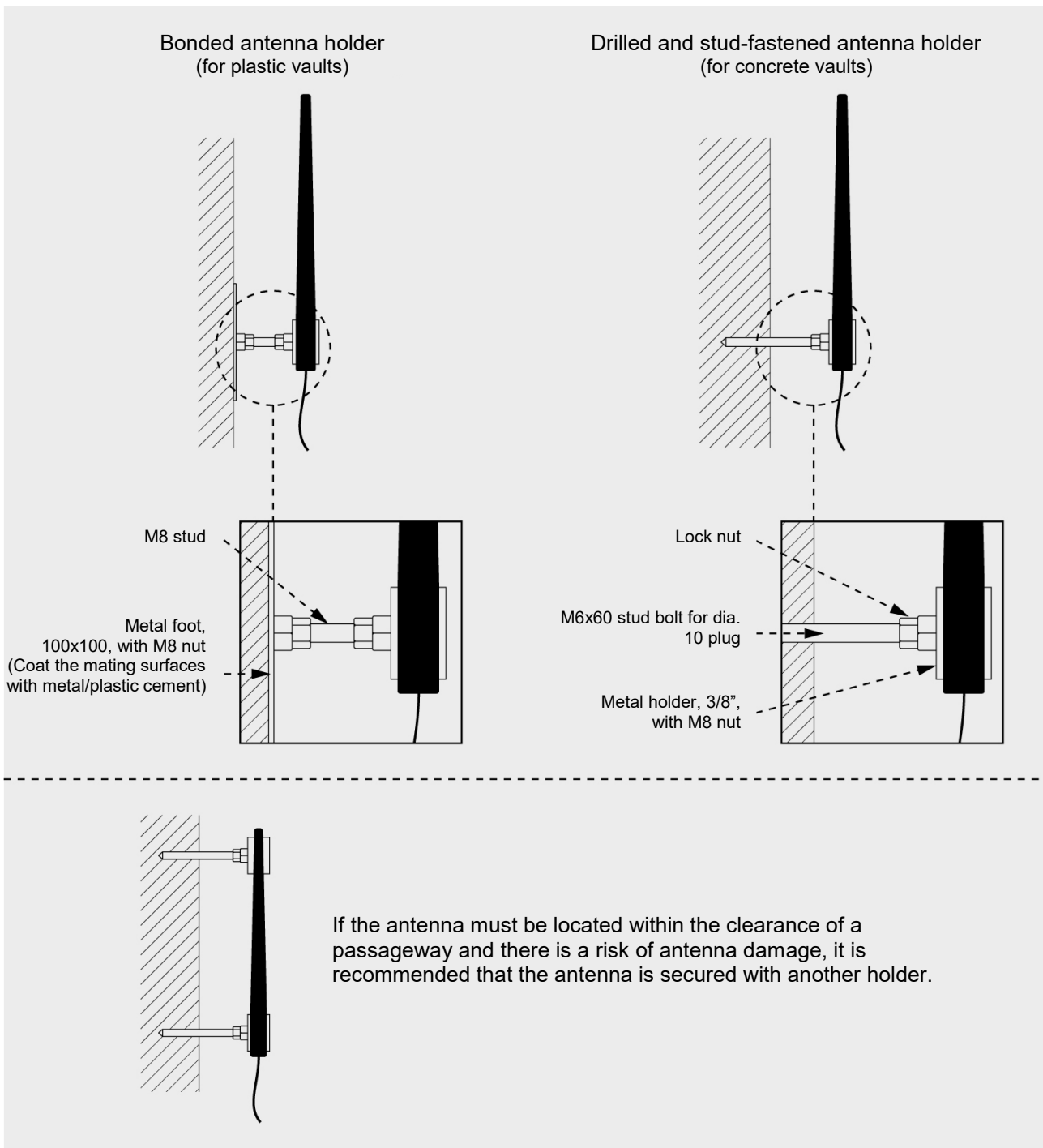


Fig. 22 External antenna installation options

## 4. Operation

### 4.1 Communicating with the module

The universal RF module features an ISM 868 MHz RF interface for unidirectional communication T1 and bidirectional communication T2 modes. The data exchange protocol complies with Wireless M-Bus standards and features a proprietary data frame format. For data communication with the universal RF module, the Inkasoid app version 1.50.1i or later is recommended with the APT-VERTI-1 converter available in the Apator Powogaz S.A. product range for walk-by drive-by collector systems.

The universal RF module also features an NFC (near field communication) interface which is supported by a dedicated mobile app. The NFC interface is used to exit warehouse mode, reading historical data and alarm and event details, and more.

### 4.2 RF interface-based data reading and writing

The universal RF module transmits a spontaneous T1 data frame every 10 seconds between 5:00 and 21:00 and every 60 seconds between 21:00 and 5:00. The data frame contents follow:

- Actual water meter indication and actual device date and time;
- The last historical water meter indication with its save date and time;
- Event flags (see details further in the Manual).

The universal RF module also communicates bidirectionally every third spontaneous data frame in T1 mode and after every data frame in T2 mode, provided that the automatic bidirectional communication is not disabled in the configuration.

In the bidirectional T2 mode communication enables data reading and writing in one of four scenarios: (i) entering or exiting the warehouse mode, (ii) configuration, (iii) deleting or (iv) reading the detailed data of the module.

**Note: All RF data communication with the module is encrypted.**

### 4.3 NFC interface-based communication

The NFC interface enables wireless proximity communication with a mobile device which supports NFC. The NFC interface-based communication enables reading data and exiting the warehouse mode.

Some data exchanged over NFC is not encrypted, which includes:

- Actual water meter indication
- Actual device date and time
- The last 12 historical water meter indications with their save date and time
- Event flags
- Event details
- Device configuration

The following data is encrypted and requires an encryption key for processing:

- Diagnostic data

**Note: When attempting to communicate over NFC under water, make sure that the mobile device is rated at IP68.**

### 4.4 RTC (real time clock)

The universal RF module has a hardware RTC operated by the firmware. Due to variations in the operating conditions and natural ageing, the RTC can go out of sync by 20 minutes a year. It is recommended that the RTC be updated as frequently as required by the user.

### 4.5 Data encryption

The encryption of data exchanged over ISM 868 MHz RF transmission is based on AES-CBC with a static 128-bit encryption key with a dynamic trigger vector. To enable correct data communication with the universal RF module, the software/firmware of the external device must use the encryption key assigned to the same module.

### 4.6 Warehouse mode

Warehouse mode is an energy-saving mode in which all functions of the universal RF module related to metering, event detection, data transmission and listening for messages from external devices are disabled.

Warehouse mode is entered (enabled) with the exit command transmitted over RF to the module.

Warehouse mode can be exited (disabled) in either of two ways:

1. By applying a programming magnet for a minimum 3 seconds at its sensor location shown in Fig. 26 and transmitting the exit command over RF.

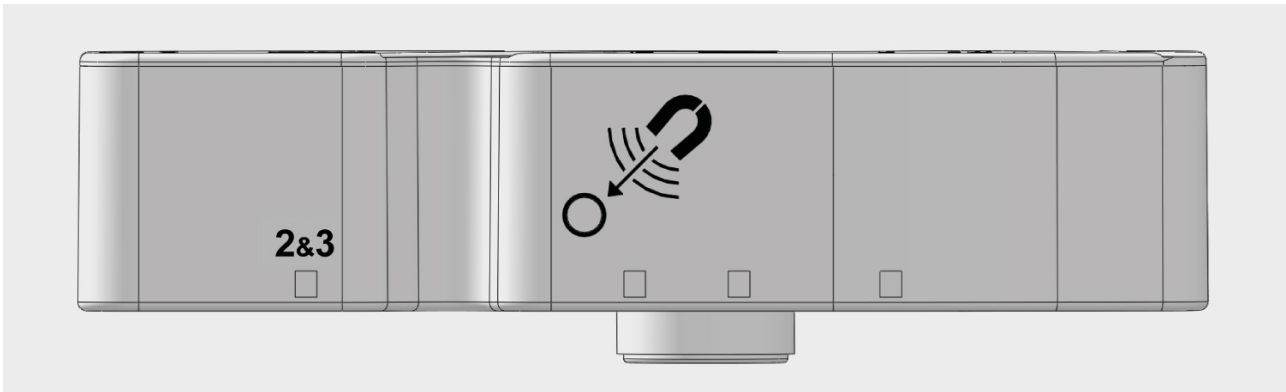


Fig. 23

2. By transmitting the exit command over NFC.

#### 4.7 Reading water meter indications and saved readings

When a programming magnet is applied to its sensor in the universal RF module, the latter enters a temporary exit mode. In this mode, the module transmits messages (data frames) every 10 seconds for 24 hours, if not interrupted earlier. If no command is sent over RF before the temporary exit mode expires, the module will revert to the warehouse mode.

The universal RF module can store up to 12 previous water meter indications, and the storage period is configurable (by choosing between one week, one month, or one year). Each spontaneous data frame (T1 mode) includes the last water meter indication. The full history of readings can be read (and includes 12 historical indications) in T2 mode (bidirectional communication) if triggered by an RF command or over NFC.

**Note: Whenever the storage period or date and time of indication saving is modified or the actual water meter indication changes, the indication history is automatically deleted. If the data is important to the user, it should be read before any modification or change.**

## 4.8 Recording of metering location and module events

The universal RF module can detect the following events at the metering location as related to metered usage and operation of the water meter, and operating events of the module itself:

**Maximum Flow:** the water meter detects a volumetric flow above its specific threshold value for a time which exceeds a specific duration.

**Minimum Flow:** the water meter detects a volumetric flow below its specific threshold value for a time which exceeds a specific duration.

**Leak:** the water meter detects a continuous flow of water which exceeds a specific duration.

**Reverse Flow:** the water meter detects a back flow which exceeds a specific back flow volume.

**Measurement Unchanged:** the water meter detects that the flow is zero or the flow volume increments are extremely small; either event exceeds a specific duration.

**Magnetic Field:** a strong external magnetic field source is detected.

**Disconnected:** the module detected it is removed from the water meter.

**Note: When the module is reinstalled on the water meter, the event must be deleted and the correct actual water meter indication must be saved to the module memory.**

**Low Battery:** the detected battery voltage is too low.

**Battery Usage Threshold Exceeded:** the battery charge is below a threshold configured by the user.

**Out of Operating Temperature:** the device temperature is below  $-15^{\circ}\text{C}$  or above  $+60^{\circ}\text{C}$ .

**Access Error:** the module detected more than 30 failed attempts of RF communication with the module (this event can be caused by invalid encryption keys or improper address or structure of messages).

**Pointer Error:** the metering module has failed.

**Note: This event can be generated by the improper use of the module, e.g. when the module is not installed on a water meter and stored or shipped in the operating mode instead of the warehouse mode.**

**Maximum RPM Exceeded:** the water meter pointer speed has exceeded the maximum limit of correct revolution counting.

**Note: This event can be generated by improper use of the module, e.g. when the module is not installed on a water meter and stored or shipped in operating mode instead of warehouse mode.**

The following table lists all events with their flags and details recorded during an event instance.

| Event                            | Flags   |        | Event details              |                                   |                                 |                |                 |                 |
|----------------------------------|---------|--------|----------------------------|-----------------------------------|---------------------------------|----------------|-----------------|-----------------|
|                                  | Current | Stored | 1st instance date and time | Last instance start date and time | Last instance end date and time | Event duration | Instances count | Other details   |
| Maximum Flow                     | +       | +      | +                          | +                                 | +                               | +              | +               | Peak flow value |
| Minimum Flow                     | +       | +      | +                          | +                                 | +                               | +              | +               | Volume          |
| Leak                             | +       | +      | +                          | +                                 | +                               | +              | +               | Volume          |
| Reverse Flow                     | +       | +      | +                          | +                                 | +                               | -              | +               | Volume          |
| Measurement Unchanged            | +       | +      | +                          | +                                 | +                               | +              | +               | -               |
| Magnetic Field                   | +       | +      | +                          | +                                 | +                               | +              | +               | -               |
| Disconnected                     | +       | +      | +                          | +                                 | +                               | +              | +               | -               |
| Low Battery                      | +       | +      | +                          | +                                 | -                               | +              | -               | -               |
| Battery Usage Threshold Exceeded | +       | +      | +                          | -                                 | -                               | +              | -               | -               |
| Out of Operating Temperature     | +       | +      | +                          | +                                 | +                               | +              | +               | -               |
| Access Error                     | -       | +      | +                          | +                                 | -                               | -              | +               | -               |
| Processor Reset                  | -       | +      | +                          | +                                 | -                               | -              | +               | -               |
| Pointer Error                    | +       | +      | +                          | +                                 | -                               | -              | +               | -               |
| Maximum RPM Exceeded             | +       | +      | +                          | +                                 | +                               | +              | +               | -               |



## 4.9 Disabling event detection

Event detection can be disabled for the events related to metered flow:

Minimum Flow

Maximum Flow

Leak

Reverse Flow

Measurement Unchanged

and for Battery Usage Threshold Exceeded.

## 4.10 Automatic deletion of event details

The universal RF module can periodically and automatically delete the event details from its memory:

- **Periodic deletion:** the user can configure the period after which the module automatically deletes event details. Automatic deletion is executed for each stored event separately and after the predefined period from the last instance of the event. If the details of an event are manually deleted before the period expires, the period countdown until the next automatic deletion is reset.
- Deletion by volume: the user can configure the number of pointer revolutions to be detected by the module until the events are automatically deleted. This function is executed one time once the number of pointer revolutions is configured by the user and reached and deletes event details and flags.

**Note: There are events unaffected by automatic periodic deletion or deletion by volume:**

Low Battery

Processor Reset

Pointer Error

Battery Usage Threshold Exceeded

Maximum RPM Exceeded

## 4.11 Disabling bidirectional communication

The battery life is limited. To extend it, the universal RF module can be configured to disable bidirectional communication after a user-defined credit of bidirectional message count is spent. **The initial credit is 150 bidirectional messages and reduced by 1 with each transmitted bidirectional message. When the credit is reduced to 4, bidirectional communication is automatically disabled. When the credit is less than 150 bidirectional messages, it is increased by 1 every 8 hours until the initial credit is reached. If the credit of bidirectional message count is spent in one month, the**

credit can be increased to 94 bidirectional messages. If there is no bidirectional communication in the next month, the credit is restored to the original count of 150 bidirectional messages.

## 5. Device configuration

Proper operation of the APT-WMBUS-NA-1 in a reading system requires specific configuration settings of the module.

**Note: To ensure uncorrupted and valid data, the module must remain properly mounted on the water meter while being configured, and there must be no actual flow through the water meter when saving the actual water meter indication.**

### 5.1 Automatic calibration of the counter mechanism

The APT-WMBUS-NA-1 is a universal module compatible with the water meter types and counters specified in this Manual.

The procedure:

- Close the stop valves upstream and downstream of the metering location before installing the module on the water meter.
- With the module installed on the water meter, exit warehouse mode.
- With the module in the operating mode, set its configuration parameters and delete events (it is highly recommended to validate the data once the configuration has been set).
- If the configuration is correct, open the stop valves upstream and downstream of the metering location.

### 5.2 RTC sync

The module enables syncing its RTC any time with an RF interface command. The RTC is synced by saving the actual date and time in the module with daylight saving time and UTC time zone offset, as applicable.

**Note: Daylight saving time is enabled in the default configuration. If no daylight saving time is used at your location, disable it in the module configuration. Before each reading or modifying the configuration settings, check the actual date and time of the mobile device you intend to interface with the module, or enable and acknowledge automatic synchronisation with your GSM provider.**

### 5.3 Pointer rotation weight

The module counts the revolutions of the dedicated inductive pointer. Hence, proper operation of the module with a water meter first requires setting the pointer rotation weight

in the module configuration. The pointer rotation weight is the volume of water which passes through the water meter during one full rotation of the inductive pointer. Table 1 lists the pulse weight values for Apator Powogaz water meters.

## 5.4 Initial water meter indication

To properly map the water meter indications, the module configuration must be saved with a properly defined initial indication of the water meter counter. Note the initial counter indication with its maximum resolution. Round the indication to full values of 1, 10, 100 or 1000 litres according to the available pointer rotation weight, see Table 1. (The counter status is saved to the module memory as the number of pointer revolution).

## 5.5 Metering location event thresholds

Event thresholds are parameters which must be saved in the module configuration according to the product data sheet of the water meter for the module to properly detect the instances of:

Maximum Flow  
Minimum Flow  
Reverse Flow  
Measurement Unchanged  
Leak

## 5.6 Water meter serial number

The meter configuration can be saved with the water meter serial number. The stored serial number can be then read in the bidirectional communication T2 mode.

## 5.7 Storage period for historical indications

Define the duration and interval of indication saving according to user's preferences for saving historical indications:

Year: set the month, day of month and time of indication save

Month: set the day of month and time of indication save

Week: set the day of week and time of indication save

**NOTE: It is recommended that 1 month with the day and time of indication save is set as follows: 1st day of month, time 00:01.**

## 5.8 Automatic deletion period of event details

You can set the automatic deletion period for each of the events supported by the functionality:

Maximum and minimum flow

Reverse Flow

Measurement Unchanged

Leak

Disconnected, Magnetic Field, and Access Error

## 6. Regulatory and standard compliance

Radio Equipment Directive (RED) 2014/53/EU

(Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC)

## 7. Operating precautions



The product shall be protected against impact and shock during transport and kept at a temperature between  $-20^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$  (the maximum temperature is allowed for less than 3 days).



Store the product at a temperature between  $+5^{\circ}\text{C}$  and  $35^{\circ}\text{C}$ .



Having installed the product on a water meter, exit the warehouse mode and set the configuration as explained in this Manual.



Operate the product at ambient temperatures and the conditions specified in this Manual.

## 8. Warranty terms and conditions

Apator Powogaz guarantees proper performance of the product for the duration specified in § 2 of the Apator-Powogaz General Warranty Terms & Conditions only if the requirements for transport, storage and operation are followed.

## 9. Environmental protection

Do not dispose of with regular waste. Return the product to a WEEE collection point for disposal. Help protect the natural environment.



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Apator Powogaz S.A. has the right to modify and improve its products without prior notice.