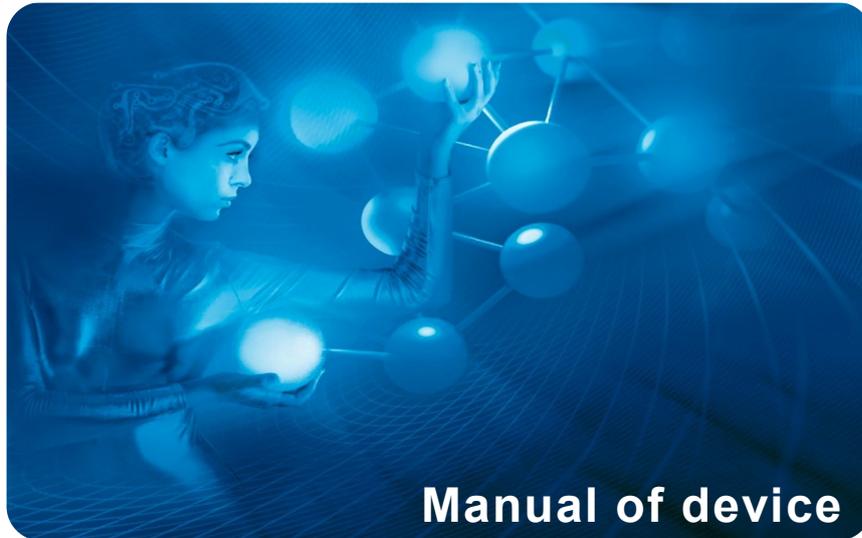




MEASURING SOLUTIONS

**Manual of device**

## **APT-GSM-UT-2**

Measurement-transmission device

### **1. INTRODUCTION**

APT-GSM-UT-2 is a data transmission module designed for: recording of water meter readings, detection and alarming of events, and transmission of relevant data to a telemetry server: either cyclically via an integrated GSM GPRS module in automatic mode, or by manual request of a user via NFC.

APT-GSM-UT-2 features 4 pulse inputs for a maximum of two water meters or a maximum of four alarm devices which feature pulse outputs (like door opening sensors, for example).

APT-GSM-UT-2 can record water forward flow, water reverse flow, and balanced pulses.



APT-GSM-UT-2 can also detect and record **events**, including **minimum flow**, **maximum flow**, **reverse flow**, **leak**, and **unchanged measurement**, and relay **event** notifications via **SMS**, record each **event's details** in internal memory, or transmit the required data to its telemetry server as triggered by a predefined event.

An embedded **NFC module** enables forced data transmission output to the telemetry server and basic configuration with mobile devices with a dedicated **configuration app** installed.

APT-GSM-UT-2 features an **RTC** (real time clock) which can be synchronised with a telemetry server or a mobile terminal/device.

The power supply of APT-GSM-UT-2 uses interchangeable **batteries** which enable installation in locations remote to the grid.

The housing has a high **protection rating** of IP67, for safe installation in water meter vaults or similar locations.

## 2. OPERATING INSTRUCTIONS

### 2.1 GENERAL

Read and understand this Operating Manual before connecting, powering on and operating this device. Thorough understanding of its safety precautions and instructions provided herein is critical.

The manufacturer recommends **periodic maintenance inspections** to prevent corrosion to the wiring, especially at connections.

APT-GSM-UT-2 features no user-serviceable components. Do not attempt to open the housing of the device once it has been installed by qualified personnel. Should the device malfunction or fail, its servicing shall only be carried out by authorized and trained personnel.

### 2.2 SAFETY PRECAUTIONS

#### 2.2.1 TRANSPORT

The device shall be protected against damage in transport. The device shall be secured against shifting or movement in transport.

#### 2.2.2 PRECAUTIONS FOR LITHIUM-ION BATTERIES

The device is delivered with a **lithium-ion battery**. This is a hazardous battery type.

Handling **lithium-ion batteries**:

- ▶ Keep dry.
- ▶ Prevent heating to over 100°C and do not discard into fire.
- ▶ Do not short the battery poles.
- ▶ Do not open or otherwise tamper with the battery.
- ▶ Do not recharge.
- ▶ Keep out of reach of children.

## 2.3. INSTALLATION GUIDELINES

Install and connect the APT-GSM-UT-2 modules strictly as instructed in this manual. Operate the device according to its intended use and the applicable safety regulations and guidelines.

Do not install the device in metal enclosures/cabinets or in any location the enclosure/sheltering of which will significantly reduce access to the GSM service. Install the device in the location with the **best GSM service**. Test the GSM service signal level in the conditions as close as reasonably possible to the actual intended operating conditions, e.g. by closing all doors and windows in the room for the duration of the test.

It is recommended to fasten the device with **Ø8, 60 mm** long bolts/screws. Do not use quick-setting plugs.

Connect the wiring of the device to the water meter or alarm device wiring with **3M Scotchlok UR2 connectors**. Seal the connectors against ingress of moisture.

The SIM card and the battery pack shall only be replaced by a manufacturer's authorized service centre or authorised and qualified personnel.

**CAUTION! The manufacturer will not guarantee the ingress protection rating if the SIM card and/or the battery pack is replaced not by a manufacturer's authorized service centre or authorised and qualified personnel. Failure to comply will void the warranty.**

When installing/removing the SIM card and/or the battery pack, undo and retighten the housing bolts with a **1.2 Nm torque wrench**.

Change the batteries at low ambient humidity. **Replace the batteries** only when the device is at ambient temperature (ca. 20°C).

The housing contains factory-added **desiccant balls**. Change the desiccant balls at every replacement of the battery and/or the SIM card.

## 2.4. PERMITTED OPERATING ENVIRONMENT

This device has an **ingress protection rating of IP67**. The manufacturer guarantees 3 days of full ingress protection of the device submerged in water.

Do not install this device in any **explosive atmosphere**.

Included in the device delivery is 4 **telecommunication cables**. The minimum bending radius of cables is 4d, where d is the outer diameter of a cable.

The cable and wiring are rated for operation between -15°C to 70°C, whereas the installation temperature shall be between -15°C to 50°C. The wiring shall be sealed against humidity, especially at interconnections. If replacement is necessary, the maximum replacement length shall not exceed **10 m**.

## 2.5. WARRANTY

The device is covered by 24 months of warranty, excluding the battery pack, which is covered by 12 months of warranty.

**CAUTION! All warranty claims shall be considered valid if the claimed parts have been used as intended and all applicable technical requirements and instructions have been followed.**



### 3. Technical specification of APT-GSM-UT-2

Housing	
Dimensions (L x W x H)	120 mm x 104 mm x 63 mm
Weight incl. battery	< 0,5 kg
Fastening	Ø8 60 mm long fasteners (4 pcs.)
Ingress protection rating	IP 67
Operating environment	
Operating temperature	-15°C ÷ 55°C
Installation requirements	Location away from direct exposure to sunlight is recommended
Power supply and pulse inputs	
Battery	3,6 V, Li-ion
Device operating time (configuration-dependent)*	5 yeras max
Pulse inputs	4
Pulse signal type	Dry (reed switch) Transistor key (OC, OD)
Minimum pulse duration	1 ms
Max. pulse frequency	16 Hz
Voltage levels of logical states	$V_{LO}: 0 \div 0,5 V$ $V_{HI}: 2 \div 15 V$
Wiring	
Wire size	2 x 0,14 mm
Wire lenght	4 x 1.55 m
Device and modem specifications	
Device model	5.68.1.4.1.01
Data protocol format	TCP/IP
Frequency range	850 MHz ÷ 900 MHz 1800 MHz ÷ 1900 MHz
GPRS multichannel transmission class	12
Minimum transmission frequency	1/h
Maximum transmission frequency	1/month
SIM card compatible voltage	3 V / 1,8 V
SIM card format	Mini SIM

Recorded data format	
Memory type	RAM
Maximum sample count to write	250
Maximum count of recorded water meter indications	25
Minimum write period	every 10 sek.
Maximum write period	every 24 h

#### 4. Technical specifications of APT-GSM-UT-2



A part of the device is its enclosure, which features 4 **mounting openings** in the cover and PCB installation slots.



The device delivery also features 4 suspension holders for the device housing and 4 pcs. of **mounting bolts**.



## 5. FUNCTIONALITY

### 5.1. DEVICE FUNCTIONS

#### 5.1.1. PULSE INPUTS

The device features 4 **pulse inputs** which can be wired to water meters and alarm devices. Each pulse can be configured for the device to:

- ▶ record water usage, which is then used to and generate events;
- ▶ record events which depend on the functionality of each water meter or its module;
- ▶ record events from alarm devices which feature pulse outputs.

APT-GSM-UT-2 is capable of totalling input pulses. Each pulse is assigned a pulse **weight** (see 7.3.7) which is then converted into **volume** by the **peripheral system, Metis 2** (see 5.1.2).

#### 5.1.2. APT-GSM-UT-2 PERIPHERAL SUPPORT SYSTEM

APT-GSM-UT-2 is supported by a **peripheral system** which comprises the following:

- ▶ The **configuration app** installed on a mobile terminal **provides basic configuration of the device**, forcing data transmission to a **telemetry server**, **restoring default configuration** of the device, and reading configuration and diagnostic data from the device.
- ▶ **Metis 2** enables full configuration of the device, its data management, overview of measurement data and events from water meters and events from other devices connected to APT-GSM-UT-2. A major component of the APT-GSM-UT-2 system is its **telemetry server**.

#### 5.1.3. EVENT SIGNALLING

The device enables recording of internal **events** detected during self-diagnosis and **events** of external devices connected to the pulse inputs of the device. Each **pulse input** can be configured to record **events** from a water meter or an alarm device.

APT-GSM-UT-2 is capable of recording two **event** types:

##### Device internal events

- ▶ low battery level
- ▶ battery replacement
- ▶ device reset
- ▶ sample buffer overflow
- ▶ event log overflow
- ▶ data buffer overflow
- ▶ text message limit exceeded
- ▶ housing breached
- ▶ supply disconnection

### External device events

- ▶ przepływ maksymalny
- ▶ maximum flow
- ▶ minimum flow
- ▶ reverse flow
- ▶ measurement unchanged
- ▶ leak
- ▶ other events the connected water meter or its module can generate
- ▶ events generated by the connected alarm devices

#### 5.1.4. BUFOR SAMPLE BUFFER AND PROPER WATER METER SELECTION TEST

The **sample buffer** is a data structure location which stores readings (**samples**). The **sample buffer** capacity is **250** readings. The **sample buffer operation** can only be assigned to one water meter, connected to the **measurement inputs** which count **pulses forward**.

The **sampling period** is a time interval between each two successive writes of water meter reading increments by the **sample buffer** function. The sampling period can be set at 10 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 2 h, 4 h, 6 h, 8 h, 12 h, or 24 h.

The data stored in the sample buffer can be used to analyse water usage and flow rates and diagnose if **the connected water meter is a correct one for the application**.

\* Currently not implemented in the software from Apator Telemetry sp. z o.o.

#### 5.1.5. INSTANTANEOUS AND SAVED READINGS

The device can transmit **instantaneous readings** and **saved readings**. **Instantaneous readings** relate to current usage. **Saved readings** are written and stored in the device memory. There can be a maximum of 25 **saved readings** from a single water meter. The **water meter reading memorisation period** is a time interval between each two successive writes of water meter readings and can be set at: 1 h, 2 h, 3 h, 4 h, 6 h, 12 h, and 24 h.

#### 5.1.6. INSTANTANEOUS AND SAVED READINGS

The device can be configured with one of two recording options, i.e. water meter reading writes to the **sample buffer** (see 5.1.4). These include: **continuous logging** and **one-time logging**:

##### ▶ Continuous logging

When the **sample buffer** is full in 80%, a forced data transmission is sent to the telemetry server which issues a command to read the sample buffer. Next, the telemetry server clears the **sample buffer** to make space for further data logging.

If the data connection with the telemetry server fails somehow or the **sample buffer** fails to clear, the device will continue to log **samples** up to 100% of the **sample buffer** storage capacity. When this happens, the **sample buffer** stops logging the data, and the device generates the **sample buffer overflow** event. The device configuration can be optionally set to log event details, force data transmission, or send an SMS text message.



▶ **One-time logging**

When the sample buffer is 100% full, data logging stops automatically. When this happens, the **sample buffer** stops logging the data, and the device generates the **sample buffer overflow** event. If the user configured the device to do so, it **logs the event details** (see 7.3.9), forces data transmission, or sends an SMS text message (which is configuration-dependent).

**This functionality can be enabled if a measurement pulse input is configured as a pulse forward input.**

### 5.1.7. SAMPLE BUFFER AND PROPER WATER METER SELECTION TEST

The device features an RTC (real time clock) supported by battery power. The RTC can be synchronised with the **telemetry server** or a **mobile terminal/device**. When commissioning the device for the first time, the RTC should be set at UTC+0, while **Metis 2** will provide conversion to the local time.

### 5.1.8. SAMPLE BUFFER AND PROPER WATER METER SELECTION TEST

The device can delete specific data each time **RTC is synchronised**. **RTC synchronisation** is carried out when the out-of-sync exceeds the **measurement/sampling period** (for metering value writing) in the **sample buffer** (see 5.1.4) and the **saved readings history**.

The **sampling period** is a time interval between two successive writes of water meter reading **details** (see 7.3.9).

Each time there is an **RTC synchronization**, the device compares the time and date saved last before the sync to the date and time saved during the sync.

If the latter value is equal to or higher than the **sampling period**, the **sample buffer** is automatically cleared.

If the value is equal to or higher than the **water meter reading memorisation period** (see 5.1.5), the **readings history** of the connected water meter **measurement inputs** is cleared automatically.

When the **RTC synchronisation** is finished, the date and time settings are changed to that of the synced telemetry server or mobile terminal.

### 5.1.9. DATA TRANSMISSION

Measurement data and alarm events are transmitted via GSM network as GPRS data packets to a specified **telemetry server**. **Data transmission** can be handled according to one of 3 scenarios:

1. **Data transmission** follows a predefined schedule. The **data transmission period** can be set at: 1 h, 2 h, 4 h, 6 h, 8 h, 12 h, 24 h, 2 days, 3 days, 4 days, 5 days, 6 days, 7 days, 10 days, or 1 month.
2. When configuring the device, events can be specified which force instant **data transmission** to the telemetry server.

There are also events which force data transmission irrespective of user settings: RAM clearing reset, **event log overflow**, **sample buffer** 80% full (if continuous logging is enabled, see 5.1.6), test data transmission, and device software update enabled.

3. **Data transmission** can also be forced via NFC by a mobile device with the **configuration app** installed.

#### 5.1.10. NFC (NEAR FIELD COMMUNICATION)

**Data transmission** can be forced to the telemetry server, and the **device can be configured** with mobile devices that feature **NFC (near field communication)**. Each NFC connection can be made with a proper **access code** input to the device (this does not apply to the first configuration).

The **access code** is written to the device by the manufacturer, and the user should change it when logging in for the first time. The access code is 4 digits long between 0000 and 9999.

#### 5.1.11. WAREHOUSE MODE

Between the release from production and the **first configuration**, the device is in **warehouse mode**. In warehouse mode, all device functions are disabled for maximum battery power efficiency. The warehouse mode can be switched off via **NFC** with a mobile terminal with the **configuration app** installed.

The device can always be reverted to **warehouse mode** later. This is done by transmitting a command via **NFC**. When leaving **warehouse mode**, the **measurement input readings history** is deleted, while the configuration settings remain unchanged.

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#### 5.1.12. BATTERY REPLACEMENT MODE\*

The device can be switched to **battery replacement mode**. In this mode, all **data transmission** and NFC capabilities are disabled.

**Housing breached** and **supply disconnection** events are not logged while in this mode. The **open housing** sensor is inactive for 5 minutes after reconnecting the battery, so the housing top cover must remain closed, otherwise a **housing breached** event is generated.

When the battery change procedure begins by entering this mode, the following data is automatically deleted:

- ▶ transmission count
- ▶ failed data transmission count
- ▶ NFC-forced data transmission count
- ▶ modem on count

The battery data in the device memory (the current battery voltage) is set properly immediately when connecting a new battery. The **battery replacement** event is logged at the same time, and the device reverts to its normal operating mode.

**Important!** The device leaves the **battery replacement mode** after **10 minutes**. The device is reset with the following data lost:

- ▶ modem on count
- ▶ event information
- ▶ measurement input readings history
- ▶ sample buffer

\* The SIM card and the battery pack shall only be replaced by a manufacturer's authorized service centre or authorised and qualified personnel. The manufacturer will not guarantee the ingress protection rating if the SIM card and/or the battery pack is replaced not by a manufacturer's authorized service centre or authorised and qualified personnel.



### 5.1.13. DEVICE SOFTWARE UPDATE MODE

The **device software update mode** can be **forced via NFC by the configuration app and managed by an external system**. During this mode, the device does not generate **events**, collect **samples** or enables NFC. Hence, any pulse count generated in the meantime can be unreliable. The update does not change the **device configuration** settings.

### 5.1.14. CONNECTION TEST

The connection with the **telemetry server** can be tested by issuing a command from a **mobile device** via NFC. The command starts the connection test during which the following are performed:

1. Modem initialization.
2. SIM card status check.
3. GSM service check.
4. GSM login.
5. Internet connection enabled.
6. User-specified **telemetry server** connection enabled.

## 5.2. EVENT TYPES

There are three **event** types:

- ▶ related to APT-GSM-UT-2: **low battery voltage, battery replacement, sample buffer overflow, event log overflow, data buffer overflow, housing breached, device reset, supply disconnection, text message limit exceeded**
- ▶ related related to external metering devices (water meters): **maximum flow, minimum flow, leak, measurement unchanged, reverse flow**
- ▶ related to external devices (other than water meters): the logged events depend on the type of connected device which generates them; e.g. a door opening sensor can generate **door open** events.

During the **event configuration**, the user can specify which event notifications are to be transmitted. The device can send a **text message** (see 5.3) each time an event occurs, log the event details, and transmit the event details to Metis 2 (see 5.4).

## 5.2. SMS TEXT MESSAGES

Additional details of each generated **event** (see Table 2) can be transmitted in **SMS text messages**.

**SMS text message** configuration specifics:

- ▶ you can define which events trigger **text message** transmission (provided that the recipient **phone numbers** are set in the device configuration);
- ▶ **phone numbers** and the **server address** can be edited with the mobile configuration app;
- ▶ the device can send event text messages to a maximum of three telephone numbers, and a monthly **text message** limit is set in the device configuration that applies to all three phone numbers;

- ▶ you can **disable** the **text message transmission**, and event details will only be transmitted via GPRS if event detail logging is configured.

Each received **text message** includes the location of **event**, event type, and additional event details according to the actual configuration parameters. Table 2 specifies the event information transmitted in text messages.

Table 2. Text message contents

<b>Text body</b>	<b>Description - Significance</b>
<b>Address</b>	Device location specified in its configuration settings
<b>SN UT</b>	The serial number of APT-GSM-UT-2
<b>UP</b>	The connected device number the text message contents relate to
<b>Alarm</b>	Event type
<b>Date</b>	Event logging date

## 5.4. EVENT TYPE

You can define which **events** force instantaneous data transmission to the telemetry server, i.e. outside the configured **data transmission period**.

Detailed below are the events handled by exception and depending on the event type:

- ▶ data transmission cannot be forced with the **battery replacement** event;
- ▶ the **device reset** event details cannot be logged;
- ▶ the details of the events: **supply disconnection**, **text message limit exceeded**, and **battery replacement** can be logged in an **external system (Metis 2)**



## 6. EVENT TYPES

The **basic device configuration** and uploading the **default configuration** can be done with **NFC-enabled mobile devices**. The access to the device settings is possible only with mobile devices that have been configured with proper permissions in prior (this does not apply to the first configuration). This provides appropriate protection of the device against unauthorised modification of the **configuration** settings.

### 6.1. NFC-BASED ACCESS AUTHORISATION

The device memory stores the following data:

1. **Access code**

**Access code** is required to force NFC data transmission. The standard **access code** is written to the device by the manufacturer, and the user should change it when logging in for the first time (the access code value range is 0000 to 9999).

**Entering an invalid access code three times in succession will disable device communication for 1 h.**

2. **Mobile device ID**

To configure the device or terminate data transmission, the session is opened by entering the **mobile device ID**, which is a specific **authorization code**. The first configuration of the device is done by entering any NFC key which is automatically saved in APT-GSM-UT-2. The successive **mobile device IDs** are transmitted to the device from **the external system (Metis 2)**.

**The device can store up to 16 unique NFC keys.**

## 7. CONFIGURING THE DEVICE AND WATER METER PULSE INPUTS

It is recommended to set a reasonably short **data transmission period** for the telemetry server communication during the first configuration, which is due to the following:

1. The device is fully configured with the **external system (Metis 2)** according to the application-specific installation report. All data transmitted by the device prior to the configuration will only be converted after the configuration.
2. Events will only be logged once the device configuration has been set in the external system and uploaded to the device. No **event** in prior of this will be restored.
3. The device configuration and its modifications are transmitted during the first connection session of the **telemetry server**.
4. Until the configuration settings are uploaded to APT-GSM-UT-2, the device will record pulses according to its default configuration. The **default configuration** is designed to be temporary only to enable writing the pulse count; it does not support the restoring of events.
5. Until the device is configured with Metis 2, the system only stores the last 93 readings. If the device configuration is not complete, the readings will not be saved in **Metis 2**.

### 7.1. CONFIGURING THE DEVICE AND WATER METER PULSE INPUTS

The device is by default (prior to its first configuration) in **warehouse mode**. The warehouse mode can be switched off via **NFC** with a mobile terminal with the **configuration app** installed.

The device must be configured before attempting to configure the **pulse inputs** for the first time.

**Step 1:** If this is the first configuration of this device, perform the **basic device configuration**.

The **basic device configuration** includes the parameters which the user must set to enable communication with the **external system**. If the basic device configuration is missing, incomplete or invalid, the device will not work properly in the external system or fail to meet the user's performance specifications.

The **basic device configuration** parameters include:

- ▶ access code
- ▶ SIM card PIN code
- ▶ APN name
- ▶ APN user name
- ▶ APN password
- ▶ connection time limit
- ▶ network address and port number of the programming server
- ▶ network addresses and port numbers of the telemetry servers
- ▶ data transmission frequency with the north bias
- ▶ device date & time

**Step 2:** End by running the **connection diagnostics** with the configuration app.

**Step 3:** If the diagnostics session result is positive, it is recommended to force data transmission to the telemetry server.

**Step 4:** If the data transmission to the server was successful, you can connect/disconnect water meters and/or event devices.



## 7.2. CONNECTING WATER METERS AND EVENT DEVICES

**Connect devices with extreme care and caution. Fill out the installation report carefully: its data will be the configuration inputs for the device in the external system. Any invalid parameter will result in malfunctions of the device and restricted intended use.**

APT-GSM-UT-2 features 4 **pulse inputs**. The device can be connected to a maximum of 2 water meters or a maximum of 4 alarm devices (which are event devices and not water meters). The device supports water meter with **pulse outputs** or suitable **pulse output modules**. Note that the total number of connected **pulse outputs** must be equal to or less than the **pulse inputs** of APT-GSM-UT-2. The connection method will depend on the type and design of the devices connected to APT-GSM-UT-2.

### 7.2.1. CONNECTING WATER METERS

A water meter may feature 1, 2, 3 or 4 **pulse outputs** and, respectively, it can be connected to 1, 2, 3 or 4 **pulse inputs** of APT-GSM-UT-2. Before wiring the inputs and the outputs, read the Operating Manual of the water meter and specify the input type in the installation report. This is required for a proper connection and configuration of APT-GSM-UT-2

A water meter can feature 2 output types (see 7.3.3):

- ▶ **Measurement type**
- ▶ **Event type**

If the water meter has a **measurement output**, verify how it counts pulses: **forward** pulses, **reverse** pulses, or **balanced** pulses.

Connect the water meter outputs to the inputs on APT-GSM-UT-2. Do this with the **wiring** included and preinstalled with the device. Each wire is colour-coded with bands and numbered. Having connected the wiring, specify in the installation report the water meter **output types** connected to the **wiring** of APT-GSM-UT-2.

You can connect the water meter to APT-GSM-UT-2 with any numbering sequence of the inputs. However, remember to specify it precisely in the installation report.

If the water meter features more than 2 **pulse outputs**, only 2 can be enabled as **measurement outputs**. The remaining ones can be left unused or connected as **event outputs**.

### 7.2.2. CONNECTING EVENT DEVICES

Connect the event devices as required for the water meter connections (see 7.2.1). Specify the connected event device type (its intended use) and the input to which it is connected in the installation report.

## 7.3. PULSE INPUT CONFIGURATION

### 7.3.1. DEFAULT INPUT SETTINGS

The device is preconfigured with **default input settings** (see Section 7).

Each water meter replacement, disconnection or input connection change may trigger reversal to the **default settings** of the **pulse inputs** affected by these modifications. The **configuration settings** can be restored with the **configuration app** directly after these modifications.

### 7.3.2. WATER METER HANDLING CONFIGURATION

The **measurement pulse input configuration settings** include these actions:

- ▶ Define the **water meter connection scenario**: see details in 7.3.3., 7.3.4., 7.3.5., and 7.3.6.
- ▶ Define the **pulse weight** and **start volume**: see details in 7.3.7.
- ▶ Define the **event thresholds**: see details in 7.3.8.
- ▶ **Configure the events**: see details in 7.3.11.
- ▶ Optional **sample buffering**: see details in 7.3.10.
- ▶ **Water meter event handling**: see details in 7.3.9.; **definitions of events**, see details in 7.3.11., 7.3.12., and 7.3.13.

It is recommended to input the device configuration settings in the **external system** as soon as possible to enable the full functionality of the device. Until the **pulse input configuration** is set, a part of the reading data can be lost, and **events** generated by the connected alarm (event) devices will not be logged. With the device configuration set in the **external system**, all prior events which have arrived at the **pulse inputs** will not be restored and displayed.

### 7.3.3. WATER METER CONNECTIVITY OPTIONS

Two possible scenarios exist for the connection of water meters to APT-GSM-UT-2:

- ▶ **measurement input scenario**: the inputs provide the water meter output data, i.e. **forward pulses**, **reverse pulses** and **balanced outputs**;
- ▶ **event input scenario**: the inputs provide the state (High or Low, depending on the configuration) which notifies that a specific **event** has occurred.

### 7.3.4. WATER METER CONNECTED TO ONE MEASUREMENT INPUT

If a water meter is connected to one measurement input only, the input can be configured only as a **pulse forward** counting input or a **balanced pulse** counting input (the balanced pulse count is the difference between the **forward pulse count** and the **reverse pulse count**).

**Important!** If one of the measurement pulse inputs is defined as a **pulse forward** counting input, the **reverse pulse** count functionality and **reverse flow** event generation will not be enabled.

**Important!** If one of the measurement pulse inputs is defined as a **balanced pulse** counting input, the following events will not be notified: **measurement unchanged**, **minimum flow**, **maximum flow**, **reverse flow**, **leak**, and **forward pulse** count and **reverse pulse** count will not be enabled. The **sample buffering** functionality will be disabled.



### 7.3.5. WATER METER CONNECTED TO TWO MEASUREMENT INPUTS

If a water meter is connected to two **pulse inputs** which are both **measurement inputs**, APT-GSM-UT-2 can have them configured to count:

- ▶ pulses forward
- ▶ pulses reverse

If a water meter has more than two **pulse outputs**, a maximum of two can be configured as **measurement outputs**. The third and other inputs cannot be configured as a **balanced pulse** counting inputs, **pulse forward** counting inputs or **pulse reverse** counting inputs. They can only be used as event inputs or left free.

**Important!** A water meter can only be connected to one APT-GSM-UT-2 at the same time.

### 7.3.6. CONNECTING MORE THAN ONE WATER METERS

The second water meter is connected to APT-GSM-UT-2 in exactly the same way as one water meter. See details in 7.2.1. Note that the total number of connected **pulse outputs** of the two connected water meters must be equal to or less than the **pulse inputs** of APT-GSM-UT-2.

### 7.3.7. PULSE WEIGHT AND VOLUME

Configure each **measurement output** of the water meter by defining the **pulse weight** (dm<sup>3</sup>/p) and the **start volume** (m<sup>3</sup>).

**Pulse weight:** it is the water volume per one pulse.

The **pulse weight** must correspond to the water meter or its module. The device stores the pulse weight in dm<sup>3</sup>/pulse. Convert the units as required to maintain data conformity.

**Start volume:** the water meter reading at the moment of connection to the device.

### 7.3.8. WATER METER OUTPUT EVENT THRESHOLDS

APT-GSM-UT-2 can log 5 types of **events** related to the flow values send by the **measurement outputs** of the connected water meter(s). The types include:

- ▶ **leak:** non-zero volume flow rate in a defined period; the event is generated when this flow is continuous for a user-defined period of time
- ▶ **maximum flow:** an event generated when the device detects a volume flow rate above the maximum user-defined value
- ▶ **minimum flow:** an event generated when the device detects a volume flow rate below the minimum user-defined value
- ▶ **measurement unchanged:** the volume flow rate is zero or a water usage pulse count, defined by the user, is detected in a period of time
- ▶ **reverse flow:** an event generated by a specific water volume flowing back through the water meter

These **events** are generated when the data processed by APTGSM-UT-2 meets specific event thresholds. The events are handled when specific **event thresholds** have been defined. **Event thresholds** are values considered by the event detection functionality of the device running during data processing. The event thresholds are explained in Table 3.

Table 3. Water meter event thresholds and limits

Event name	User threshold
<b>Measurement unchanged</b>	The maximum limit per day
	Maximum limit volume over a preset number of days
	Stop day count
<b>Minimum flow</b>	The minimum flow threshold
	Minimum flow volume
	Starting flow*
<b>Maximum flow</b>	The maximum flow threshold
	Maximum flow duration
<b>Reverse flow</b>	Reverse flow logging threshold
	Reverse volume threshold
<b>Leak</b>	Starting flow*
	Leak duration

\*This threshold is shared by two events: minimum flow and leak

The **thresholds** for each of the flows explained above are set and stored in **the external system (Metis 2)**.

The **minimum flow**, **maximum flow** and **measurement unchanged** event thresholds shall be determined according to the Product Sheets of the connected water meters.

### 7.3.9. EVENT HANDLING

Each **event** shall have its event handling defined. Event handling specifies the method of logging and notification of detected events. Depending on the event type, the **logged details** may include:

Common to all **events**:

- ▶ event origin
- ▶ event code
- ▶ first instance date
- ▶ last instance date
- ▶ last instance end date
- ▶ number of instances

You can choose from 3 notification methods for each instance of an **event**:

1. An event instance triggers a **text message transmission**. This method is feasible if **phone numbers** of text message recipients are specified in the device configuration settings. See the configuration app manual on how to add phone numbers to the configuration.
2. An event is **saved to the event log**. Each event instance will have the event saved in the device memory and the event information is transmitted to the **external system** during the next connection session of the **telemetry server** (which is forced as scheduled). The device may store up to 8 events.
3. An event **forces data transmission**. As soon as an event instance is detected, the device opens a connection session with the **telemetry server**, and the event details are sent to and saved in the **external system**.

You may use any method or choose not to use any.



Detailed below are device internal events, which are handled differently than explained above:

- ▶ **battery replacement**: data transmission cannot be forced by this event
- ▶ **supply disconnection, text message limit exceeded** and **battery replacement**: these events are always saved in the **event log**
- ▶ the device never logs the details of **device reset** and **event log overflow** events
- ▶ the device never transmits any text messages for these events: **battery replacement, sample buffer overflow, device configuration change, supply disconnection, and text message limit exceeded**

### 7.3.10. SAMPLE BUFFER CONFIGURATION

Sample buffering can only be assigned to one device which is a water meter. The **sampling period** is a time interval between two successive writes of water meter reading details (see 7.3.9).

The **sample buffer** is a data structure location which stores readings (the **samples**) and has a capacity of 250 readings for one of the specified water meters. When the sample buffer is 80% or 100% full (depending on the configured **logging** option, see 5.1.6), the device opens a connection to the **telemetry server** and uploads all the data from the sample buffer. Next, the **sample buffer** is cleared of all data and starts logging again.

Specify the sampling period when configuring the measurement inputs. Choose one from the following: 10 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 2 h, 4 h, 6 h, 8 h, 12 h, or 24 h.

You can choose from two logging options: **continuous logging** or **one-time logging** (see 5.1.6). The reading values stored in the sample buffer can be used to analyse water usage and flow rates and diagnose if the connected water meter is the **correct one for the application**.

**Important!** A relatively short **data transmission period**, especially with **continuous logging** enabled, will reduce the battery life. Each connection to the telemetry server will consume a defined amount of energy. The battery life is estimated for a single data transmission to the **telemetry server** per day.

**Important!** **Sample buffering** works only with a **measurement input** configured for **pulse forward counting**.

**Important!** When the **sample buffer** is full, it stops logging further readings. The data remains saved in the device until the next connection session of the **telemetry server**. Hence, the **sample buffer overflow** event should immediately force data transmission to the telemetry server. This clears the sample buffer of all data to enable logging readings again. A different configuration would be a risk of partial data loss.

**Sample buffering** is optional.

### 7.3.11. EVENT INPUT FROM A WATER METER

If one or more water meter outputs are defined as event outputs, it requires a proper configuration. Define the **input state** which is an event instance and the **signal slope** which triggers an event instance. See the parameter descriptions in section 8, "Configuration of event pulse inputs".

**Important!** If the water meter features one pulses forward counting measurement output and the other output is configured as an event output, do not assign the following system events to the latter: **leak, maximum flow, minimum flow, and measurement unchanged**. APT-GSM-UT-2 will generate these events according to its processing algorithms.

### 7.3.12. EVENT INPUT FROM A WATER METER

APT-GSM-UT-2 external events are not related to the device:

- ▶ **external device events:** generated by the water meter or its module according to the **pulse input** status assigned to the event
- ▶ **measurement unchanged, minimum flow, maximum flow, reverse flow, leak:** the events are generated by the processing algorithms of APT-GSM-UT-2
- ▶ **external events:** generated according to the **pulse input** status assigned to the event. The events are generated by external devices other than water meters or their modules and connected with pulse input wiring to APT-GSM-UT-2

### 7.3.13. INTERNAL EVENTS

Internal **events** are generated by specific operating states of APT-GSM-UT-2. The types include:

- ▶ low battery voltage
- ▶ housing breached: this event has no instance as long as the device is in **warehouse mode** and for 5 minutes after leaving the mode
- ▶ sample buffer overflow
- ▶ device configuration change
- ▶ event log overflow: the event is not stored in the **event log**
- ▶ device reset: the event is not stored in the **event log**
- ▶ data buffer overflow
- ▶ text message limit exceeded
- ▶ supply disconnection: this event has no instance as long as the device is in **warehouse**
- ▶ battery replacement



## 8. Configuration of event pulse inputs

APT-GSM-UT-2 can be connected to alarm (event generating) devices. This requires a proper configuration of the device with a defined input signal **slope** which triggers an **event**, or a defined **input state**.

**Input state:** each input can be 1 or 0. The input state is defined by assigning either bit value. The input state determines when an event instance is present.

**Rising slope edge:** the bit value changes from 0 to 1.

**Trailing slope edge:** the bit value changes from 1 to 0.

Three options exist to define an event instance, and each involves an algorithm-based analysis of the input status bit values:

1. An event instance begins when the device detects the defined **slope**. The event instance ends when the slope direction becomes opposite. One of two options can be set in the configuration:

- ▶ event instance starts when the device detects a **rising slope edge**
- ▶ event instance starts when the device detects a **trailing slope edge**

You can define when the device should log the event instance: when there is a **rising slope edge** or a **trailing slope edge**.

Example:

A configuration setting is made where a **rising slope edge** is an event instance and the input state is bit 1 (alternatively, an event instance for a **trailing slope edge** means that the input state is bit 0). Here, a detected rising slope edge generates an event instance; a detected trailing edge ends the event instance.

The system logs:

- ▶ date and time of the last event instance start and end
- ▶ date and time of the first event instance

Vice versa, when a trailing slope edge means that there is an event instance, the input state is bit 1.

2. An event instance is generated when any slope edge is detected. Both **leading** and **trailing** slope edges mean an event instance (with the input state for the leading and trailing edges is bit 1).

The system logs:

- ▶ date and time of the first event instance
- ▶ date and time of the last event instance start and end (here, the values are the same)

3. If you do not define the **slope edges** which generate event instances, you can use the third option of assigning an **input state** value. If the assigned input state value is bit 1, a **rising slope edge** will generate an event instance, and the event instance will end when a **trailing slope edge** is detected next. If the assigned input state value is bit 0, a **trailing slope edge** will generate an event instance, and the event instance will end when a **rising slope edge** is detected next.

Just as in item 1, the system logs:

- ▶ date and time of the first event instance
- ▶ date and time of the last event instance start and end

To identify the event instances, you need to define the event type (i.e. its name do designate what the specific event is). It can be one of the supported **system events** (which apply to most of devices and include: leak detection, shut-off valve failure, etc.), or defined and set by the user in the system.

**Important!** If more than one inputs are configured as event inputs for devices other than water meters (to handle external events), the event specified for one of the event inputs cannot be duplicated on other event inputs. Otherwise, the device will repeatedly store identical event details from different external devices.

**Event handling**, or how the device notifies about event instances and logs the instances, is identical to the water meter event handling. See details in 7.3.9.

## 9. OPERATING THE DEVICE

### 9.1. SIM CARD INSTALLATION

The device is delivered with a preinstalled **SIM card**. SIM card replacement procedure:

**Step 1:** Remove the top cover from the device housing by removing 4 plugs in the corners and 4 screws from the top cover.



**Step 2:** Open the SIM card slot.





**Step 3:** Insert the SIM card.

**Step 4:** Close the SIM card slot.

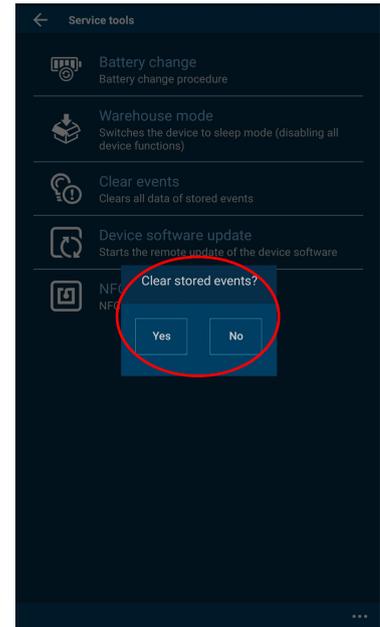
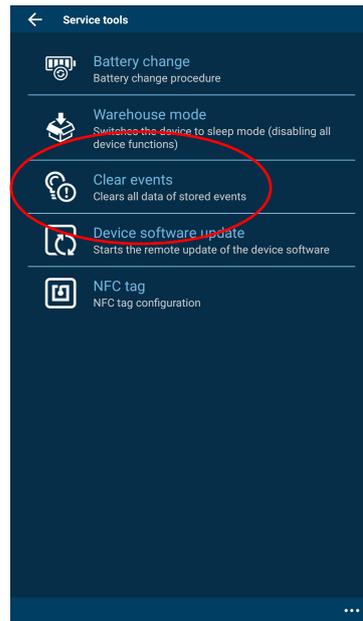
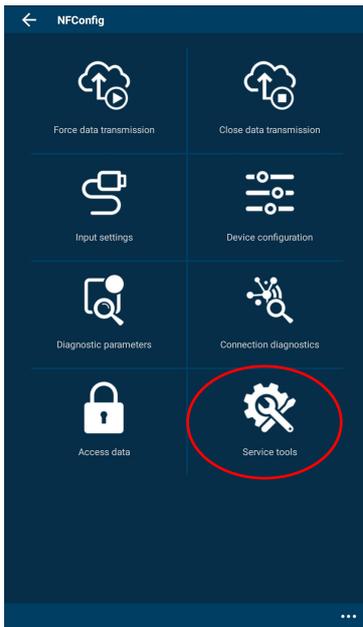
**Step 5:** Place the top cover back on.

**Step 6:** Retighten the 4 screws.

**Step 7:** Reinstall the plugs.

**Step 8:** Delete generated events in NFCofing app.

[Service tools —> Delete events —> Yes]



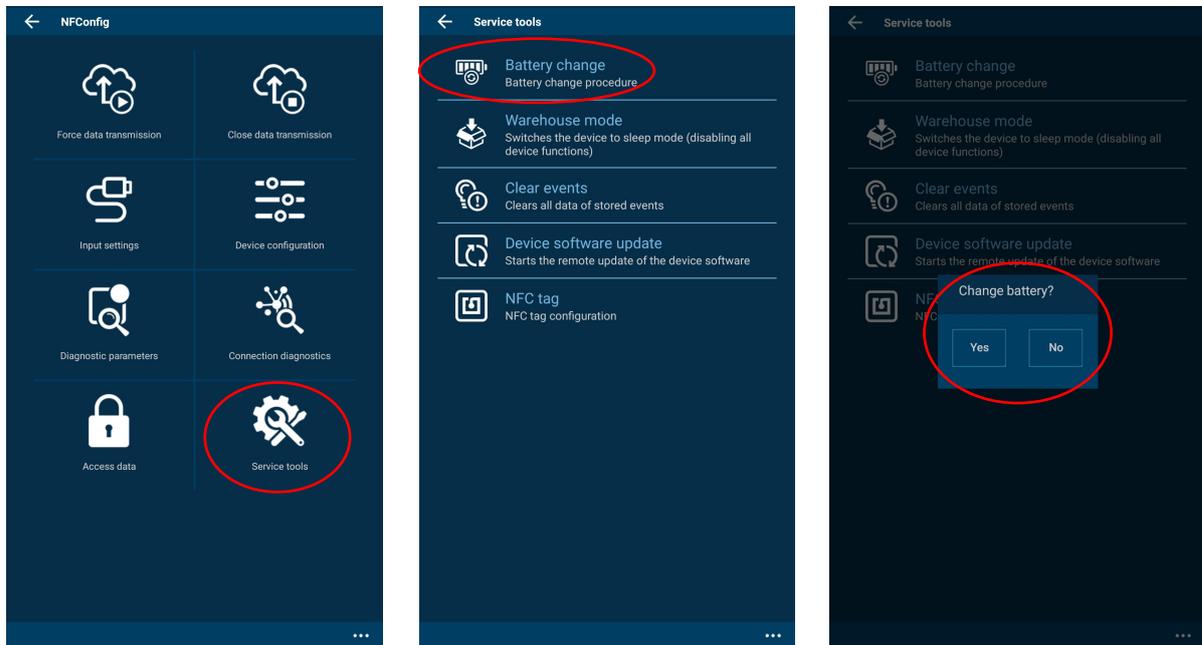
## 9.2. BATTERY REPLACEMENT

The device can be switched to **battery replacement mode**. When the battery replacement procedure is initiated, specific data is automatically deleted. See details in 5.1.12.

Replace the battery at around 20°C of ambient temperature and not above 50% RH.  
Battery replacement procedure:

**Step 1:** Start the battery replacement mode with the app on the mobile device.

[Service tools —> Battery replacement —> Yes]

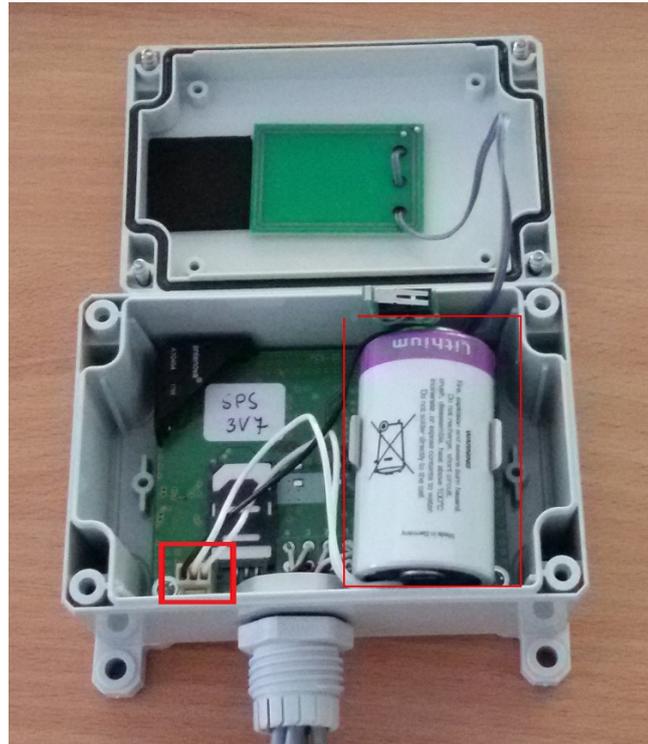


**Step 2:** Remove the top cover from the device housing by removing 4 plugs in the corners and 4 screws from the top cover.

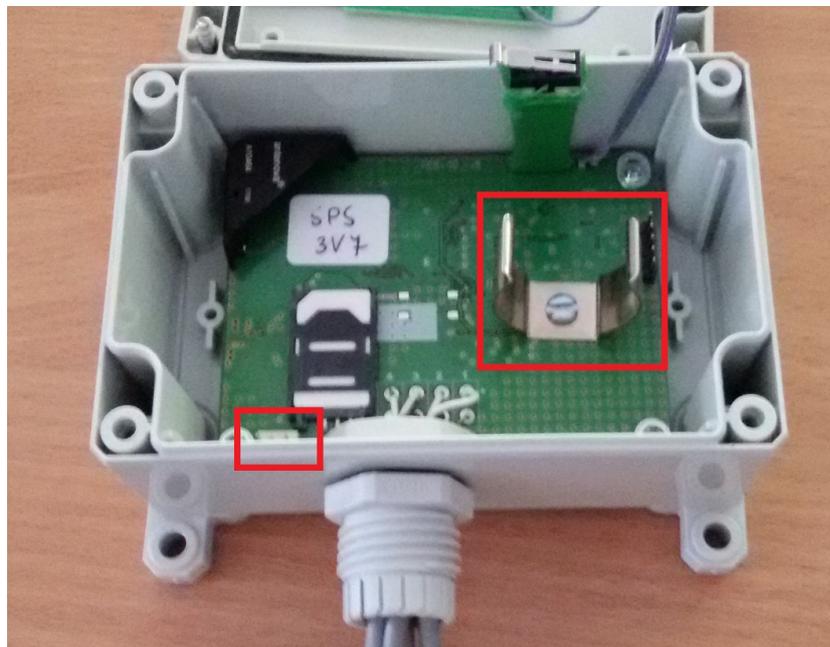




**Step 3:** Disconnect the battery lead.



**Step 4:** Remove the battery from the holder.



**Step 5:** Insert a new battery in the holder.

**Step 6:** Reattach the battery lead.

**Step 7:** Retighten the 4 screws.

**Step 8:** Reinstall the plugs.

### 9.3. MEASUREMENT DEVICE REPLACEMENT

Water meter replacement procedure:

**Step 1:** Before removing the measuring device (the water meter), force data transmission from APT-GSM-UT-2 to the **telemetry server**.

**Step 2:** Next, remove the water meter.

**Step 3:** With the water meter disconnected, upload the **default configuration** for the APT-GSM-UT-2 inputs from which the water meter was disconnected. The **default configuration** is designed to be temporary only to enable writing the pulse count; it does not support the restoring of events.

**Step 4:** Next, proceed with connecting a new water meter to APT-GSMUT-2.

**Step 5:** With the connection complete, force data transmission to the **telemetry server**.

The remainder of the device configuration will be set in the external system. When complete, it will be uploaded to the device during the next **telemetry server** connection session. Only then will the parameters will be converted according to the final configuration and ready for display in the **external system (Metis 2)**. It is necessary to provide the completed installation report.

The installation report must specify the following data to properly configure the device in **Metis 2**:

Device removal:

- ▶ Removal date
- ▶ Removed device serial number(s)
- ▶ Final volume: the water meter reading at the moment of disconnection from the device



Device installation:

- ▶ Installation date
- ▶ Installed device serial number(s)
- ▶ Start volume: the water meter reading at the moment of connection to the device
- ▶ Designation of APT-GSM-UT-2 inputs connected to the water meter (see also 7.2.1)

Important! See separate manuals for a detailed procedure of connection and replacement of measurement and event devices.

#### 9.4. Removal and replacement of other devices

If an external device must be replaced, first force data transmission from APT-GSM-UT-2 to the **telemetry server**.

With the replacement complete, force data transmission to the **telemetry server** again

## 10. ENVIRONMENTAL PROTECTION

### 10.1. PACKAGING WASTE DISPOSAL

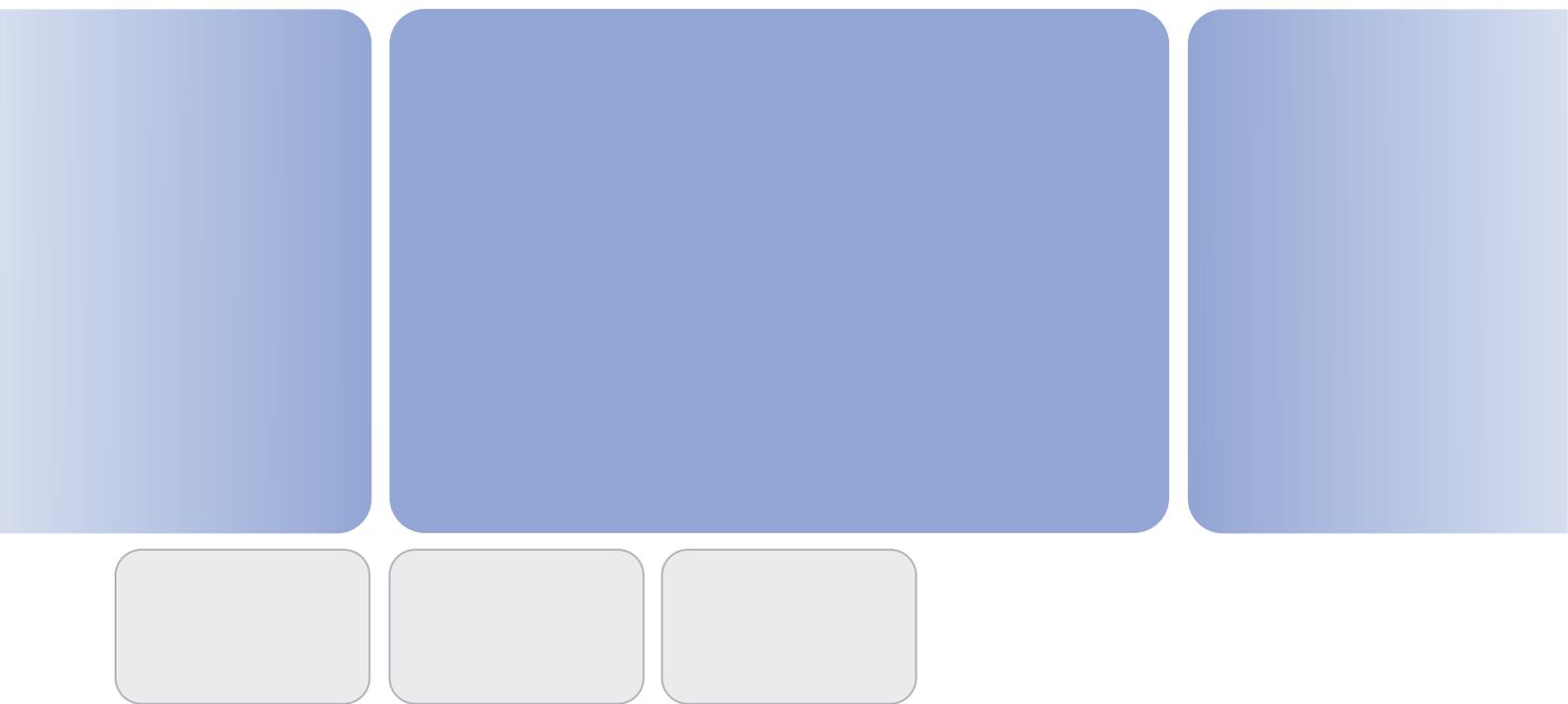
Do not discard any packaging in which the devices are delivered to household waste bins. The user shall separate the packaging materials by type and dispose of them in selective waste management bins.

### 10.2. DISPOSAL OF WASTE BATTERIES

Never dispose of waste batteries and the device upon its end of life in household waste bins. Batteries and other device components contain or may contain hazardous or environmentally harmful substances and must be recycled as hazardous waste. To prevent release of hazardous waste to the environment, a nationwide system of WEEE (waste electrical and electronic equipment) collection, recovery and processing system is operated. Return waste batteries and devices to an authorized WEEE collection point.

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