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# Wireless M-Bus Range Extender

AN032 - Quick Start Guide

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## Revision History

Version	Date	Comments
0.5	November 2020	Created
1.0	November 2020	Reviewed
1.1	January 2021	Added further chapters
1.2	February 2021	Updated the information of Filter Group ID for WMBus receives Events with local output in WS Configurator V1_2_16
1.3	October 2021	Revised due to new WS Config version and new firmware version

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# General Information

## Aim of this Document

A typical use case for the Range Extender is forwarding of Wireless M-Bus messages from a configurable group of sensor / meter devices. The Range Extender offers a flexible way to define hourly, daily, weekly or monthly reception windows for sampling of WM-Bus messages and a large data memory for temporary buffering. Even large WM-Bus messages with maximum payload size can be forwarded within LoRaWAN<sup>®</sup> radio packets by means of an integrated segmentation & reassembly protocol. This Application Note describes how to configure the wireless M-Bus Range Extender with the Configuration Tool via the serial interface.

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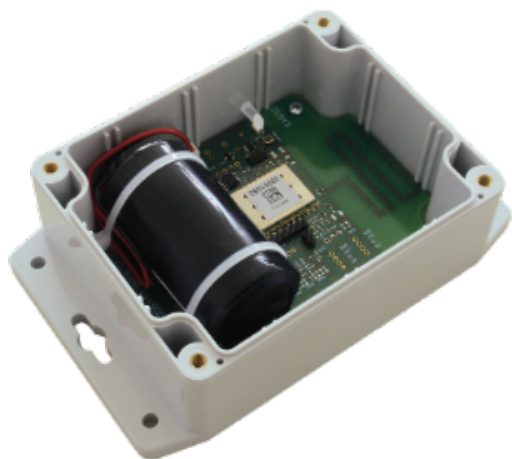
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## Hardware Set Up

Remove the four screws, open the housing of the Range Extender and remove the plastic foam that protects the battery.



## Power Supply

Default power source is one non-rechargeable 3.6V LTC (Lithium-Thionylchlorid, Li-SOCl<sub>2</sub>) battery cell. It is equipped with a cable and the 2-pin connector JST PHR-2. Power for the Range Extender is supplied via the 2-pin connector JST B2B-PH-K-S. Connect the cable of the battery with the 2-pin connector. The yellow LED flasjhes twice.

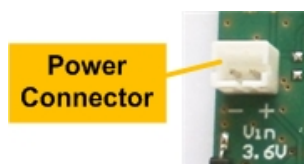


Figure: Power Connector

### Battery Notes



Battery cells with a nominal voltage of more than 3.6V are not allowed.

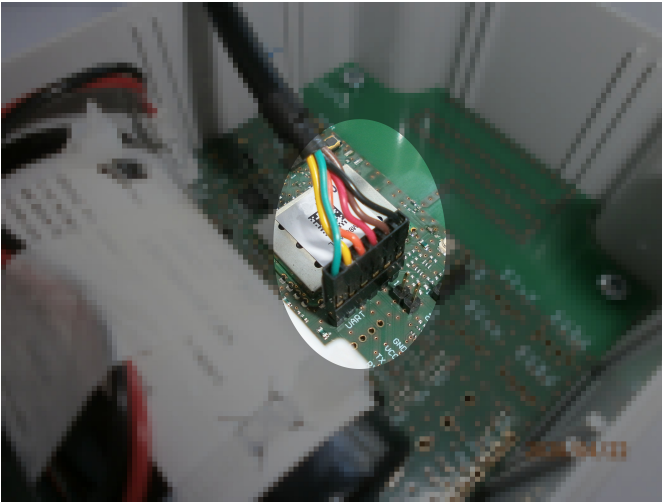
Do not recharge the battery cell.

Do not disassemble, or heat the battery cell above 100 °C.

Dispose the battery cell only in designated areas for recycling old batteries.

## Serial Connection

Connect the configuration cable [TTL-232R-3V3](#) to the **Serial Configuration Interface** of the Wireless M-Bus Range Extender.



Connect the other side of the cable to your laptop/PC and start the configuration tool "WS Configurator".

## Software Update

Check the firmware version (build date and build count) with the current version on our [webpages](#).

The screenshot displays the WS Configurator web interface. At the top, there is a navigation bar with the IMS T logo and a dropdown menu set to 'auto\_COM6'. The main content area is divided into three primary sections:

- Firmware information:** Contains three input fields: 'Build count' (118), 'Build date' (06.11.2020), and 'Firmware version' (1.0).
- Device information:** Contains two input fields: 'Product ID' (00002117) and 'Product type' (Wireless M-Bus Range Extender). Below these is a 'Documentation' section with a 'PRODUCT-WEBPAGE' button and a red play button icon.
- Device status:** This section is further divided into:
  - System time:** 'System time' (09:31:17 16.09.2021) and 'Last change of system time' (09:28:02 16.09.2021).
  - WMBus statistics:** 'WMBus packages received' (0), 'WMBus packages saved' (0), and 'WMBus packets sent' (0). A 'RESET' button is located below these fields.
  - Reset Counter:** A field showing the value '2'.
  - Device states:** A grid of checkboxes: 'LoRaWAN activated' (unchecked), 'LoRaWAN configuration available' (checked), 'OTAA pending' (unchecked), 'Network time synchronized' (unchecked), and 'System time synchronized' (unchecked).
  - Device errors:** A grid of checkboxes: 'Filter list empty' (checked with a red icon), 'Memory full' (unchecked), 'Calendar list empty' (checked with a red icon), and 'CRC memory error' (unchecked).

If a newer version of the firmware is available, you can update the Range Extender using the WS-Configurator. Click on the question mark in the upper right corner of the WS-Configurator GUI and follow the instructions.

## Wireless M-Bus Reception and Local Output

The Wireless M-Bus Range Extender requires an initial configuration before usage. This configuration can be done by means of a PC-Tool **WS Configurator** which is connected via serial interface to the device. The configuration of the devices can be done on different ways and sequences. Therefore the following configuration sequences should only be seen as an example.

A first useful step is to check the wireless M-Bus reception. Therefore we configure a 5-minute alternating reception window of S- and C/T-mode with no special wireless M-Bus packet filter. For testing the received wireless M-Bus packets are output locally. If you know the operation mode (S- or C/T-mode) of your wireless M-Bus meters you can also use only one reception window (S- or C/T-mode reception). In any case configure the event(s) as repeating event(s) e.g. 10 minutes. Then the integrated Duplicate Filter is re-initialized with each reception window again. The following steps explain how to proceed.

## Reset the WM-Bus Counters

Connect the Range Extender with the configuration cable to your PC/Laptop. Start the WS-Configurator. On the starting GUI you can see some device information.

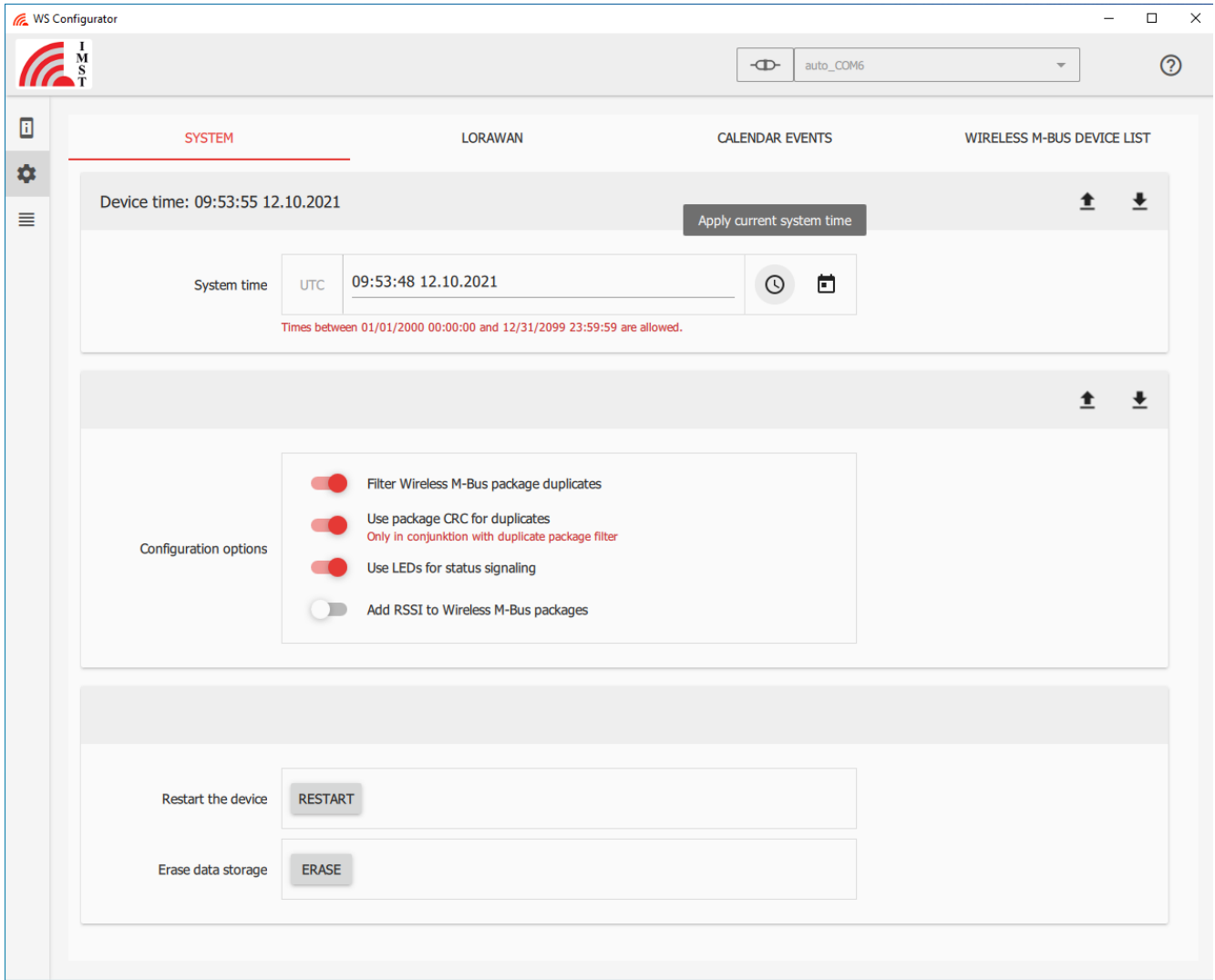
The screenshot displays the WS Configurator interface. At the top, there is a header with the IMS logo and a dropdown menu set to 'auto\_COM6'. The main content is divided into several sections:

- Firmware information:** Build count (141), Build date (07.10.2021), Firmware version (1.1).
- Device information:** Product ID (00002117), Product type (Wireless M-Bus Range Extender), and a Documentation button labeled 'PRODUCT-WEBPAGE' with a play icon.
- Device status:** System time (09:28:19 16.09.2021), Last change of system time (09:28:02 16.09.2021), WMBus packages received (0), WMBus packages saved (0), WMBus packets sent (0), Reset Counter (4), and Battery voltage (mV) (3310). A 'RESET' button is located below these fields.
- Device states:** LoRaWAN activated (checkbox), Network time synchronized (checkbox), LoRaWAN configuration available (checkbox with green checkmark), System time synchronized (checkbox), and OTAA pending (checkbox).
- Device errors:** Filter list empty (checkbox with red checkmark), Calendar list empty (checkbox with red checkmark), Memory full (checkbox), and CRC memory error (checkbox).

For the first step only the WM-Bus packet counters (received, saved, sent) are of interest. RESET the corresponding counters by clicking the RESET button.

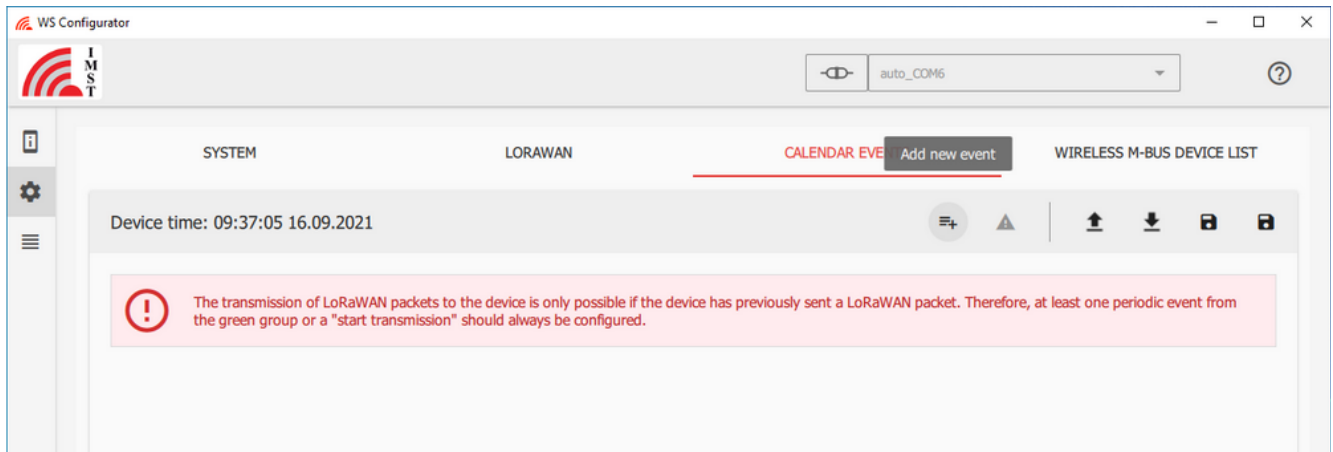
## Set Date and Time

Then under Configuration and System synchronize the Date/Time of the Range Extender with your PC/Laptop. Write this setting into the Range Extender.

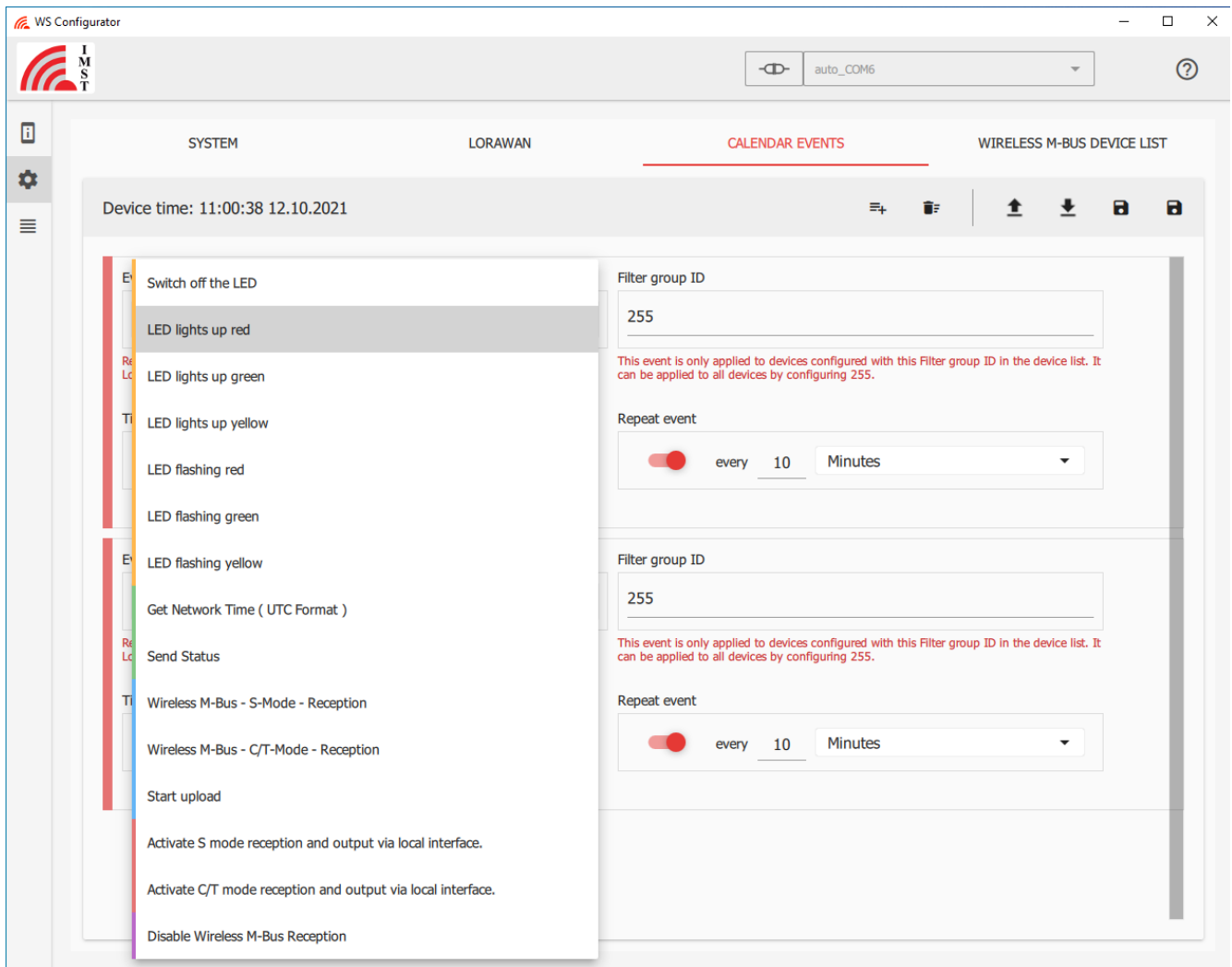


## Set Calendar Events

To be able to receive wireless M-Bus packets at least one reception window within the Calendar must be configured. Therefore choose Calendar Events under the Configuration Menu.



The different events are marked by different colors.



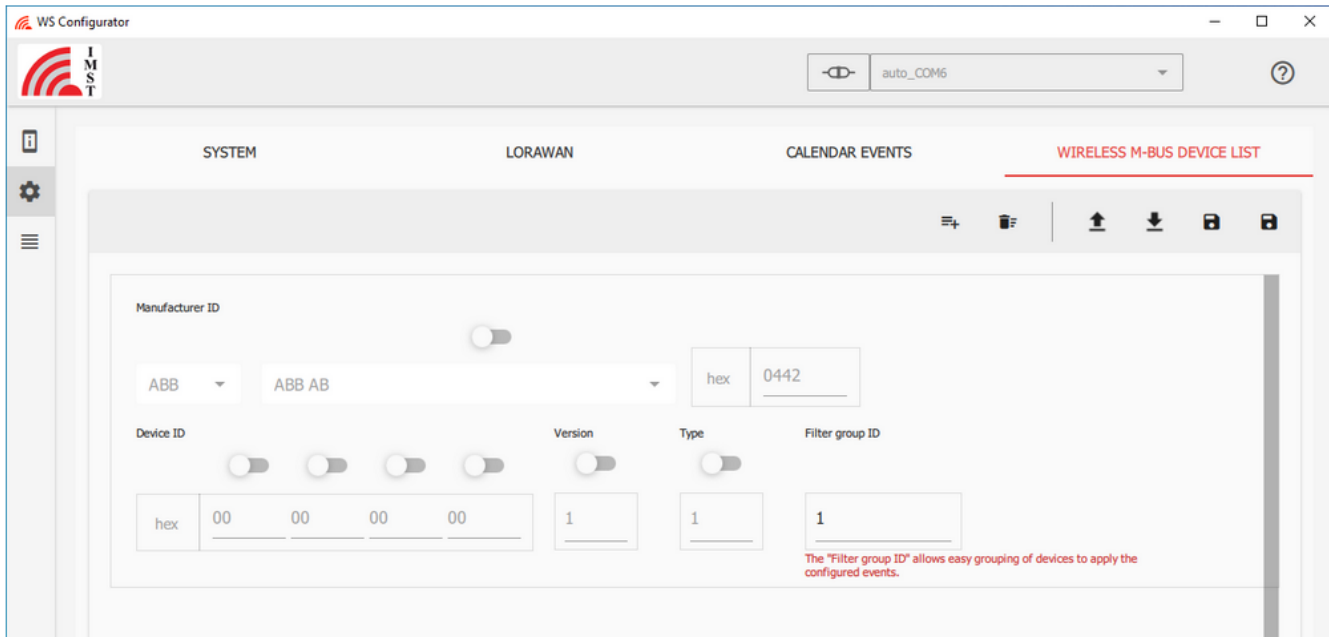
- Orange: LEDs control events
- Green: System events Time and Status
- Blue: Wireless M-Bus receives modes with LoRa start upload events
- Red: Wireless M-Bus receives modes with local output, Those wireless M-Bus packets are not stored within the data memory.
- Violet: Disable wireless M-Bus reception event

## Device Filter

For proper operation at least one "Filter group ID" must be configured. Due to the fact that we don't want to filter now, configured the "Filter group ID" 1 without any special setting. All slide switched are off.

You can load the corresponding file from the Examples\Device List\FILTER\_empty.whbi and write it into the device.

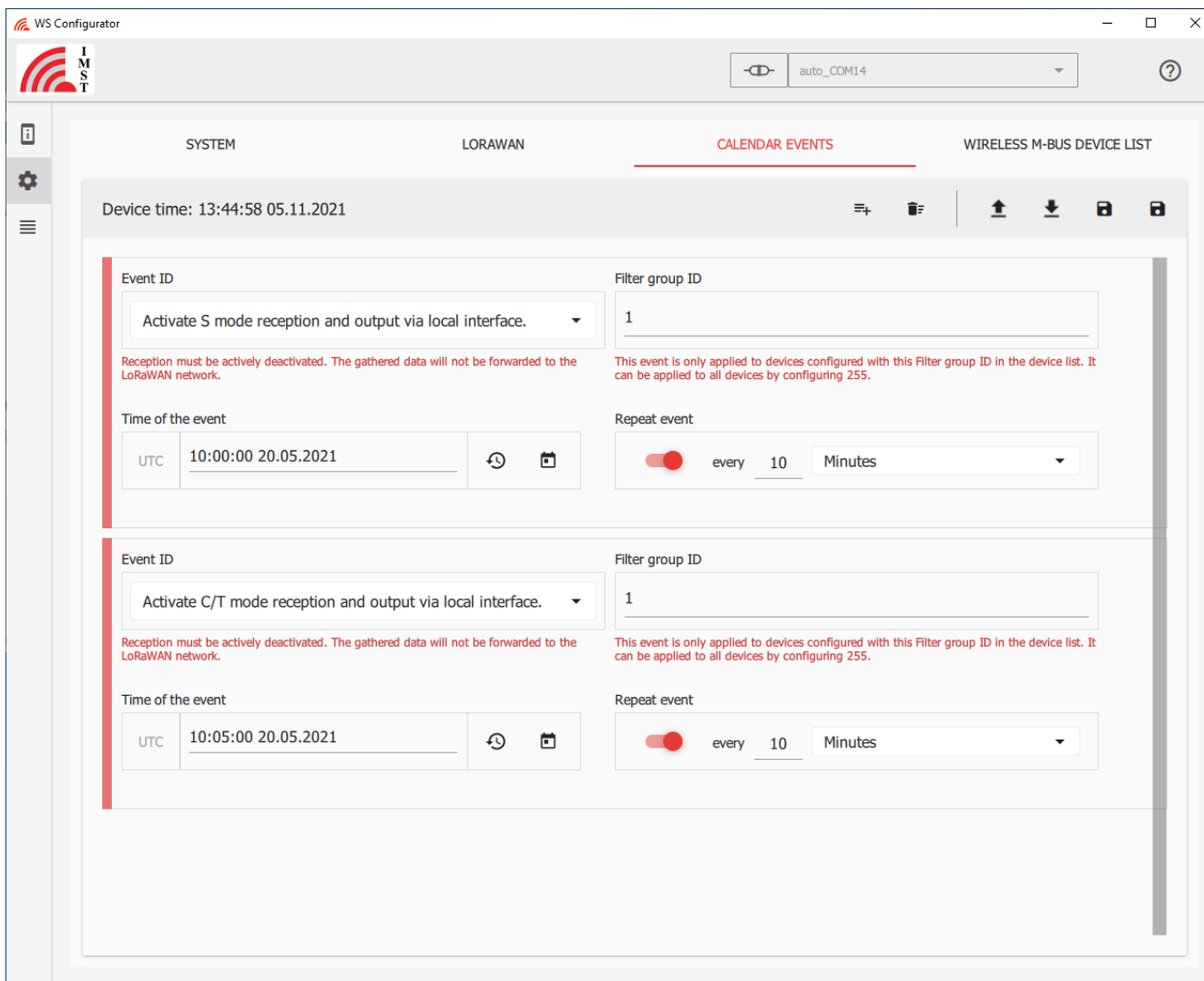




Add and configure the following two events. We are using two events C/T- and S-mode to be able to receive packet from both wireless M-Bus operating modes. Configure the following events.

Due to the fact that there are currently no wireless M-Bus filters specified you can use the default value of the Filter Group ID of 1. That means all specified wireless M-Bus filters will be applied.

The following example can be found within the zip file under the Examples\Calendar directory (Rex\_ExLoRa\_C-T3m\_upload\_rep30m\_Status\_2\_in\_30m\_Time1d.evbi). Load this file and write it into the device.



On 08:10:00 a clock a wireless M-Bus reception window in S-mode is started. The received packets are directly output via the serial interface to your PC/Laptop and are therefore not stored in the internal data memory. On 08:15:00 the wireless M-Bus C/T-mode reception window is started which automatically stops the S-mode reception window. Both events are configured by a repetition of 10 minutes. Therefore 5-minute alternating reception windows of S- and C/T-mode are created. The received packets are sent to the WS-Configurator via the serial connection. Due to their repetitive nature, the events can also be started in the past. Write this setting into the Range Extender or load the corresponding calendar file.

You can see the received wireless M-Bus packets under the Message Menu

WS Configurator

auto\_COM6

WIRELESS M-BUS MESSAGES

Device time: 10:06:25 12.10.2021

Timestamp	RSSI	Manufacturer ID hex	Device ID hex	Version	Type	Payload hex
10:06:12 12.10.2021	-37	0cae	77665544	1	2	7a 6a 00 00 00 2f 2f 84 00 00 68 01 0f 00
10:06:06 12.10.2021	-45	0cae	77665544	1	2	7a 08 00 00 00 2f 2f 84 00 00 20 03 00 00
10:06:06 12.10.2021	-38	0cae	66554433	1	2	7a 6a 00 00 00 2f 2f 84 00 00 68 01 0f 00
10:06:00 12.10.2021	-45	0cae	66554433	1	2	7a 08 00 00 00 2f 2f 84 00 00 20 03 00 00
10:06:00 12.10.2021	-38	25b3 IMS	55443322	1	2	7a 6a 00 00 00 2f 2f 84 00 00 68 01 0f 00
10:05:54 12.10.2021	-45	25b3 IMS	55443322	1	2	7a 08 00 00 00 2f 2f 84 00 00 20 03 00 00
10:05:54 12.10.2021	-37	25b3 IMS	44332211	1	2	7a 6a 00 00 00 2f 2f 84 00 00 68 01 0f 00

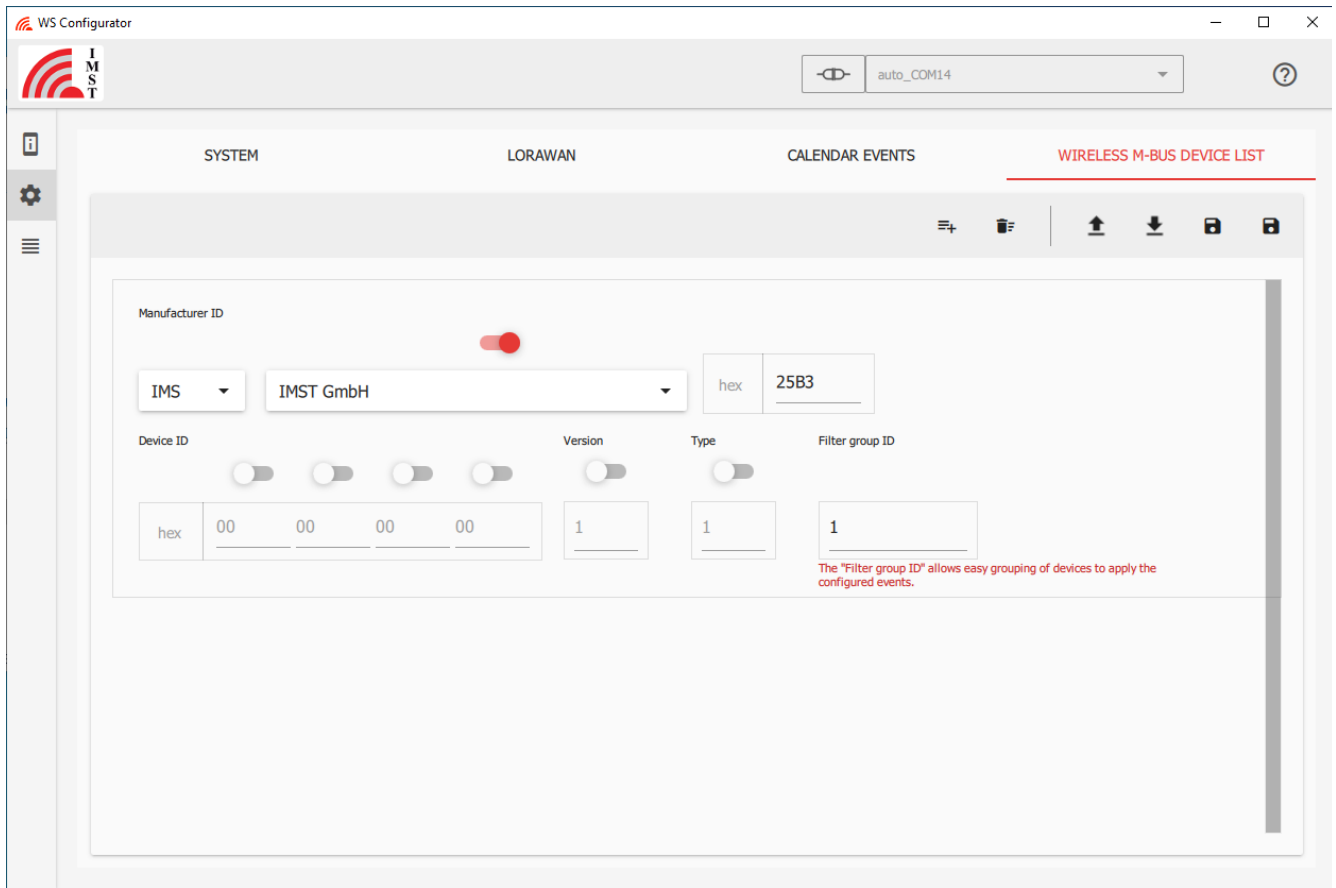
Your wireless M-Bus device should be listed here. You can see the reception Timestamp, the Manufacturer ID, the Device ID, the Version and Type, and the Payload which is normally encrypted. In this example Wireless M-Bus devices with manufacturer ID 0CAE and 25B3 are received.

## Wireless M-Bus Device Filter

In normal operation, the Range Extender receives wireless M-Bus packets, stores them and then transmits them using LoRa radio technology. In order to use the Range Extender as efficiently as possible, unwanted wireless M-Bus packets should neither be temporarily stored nor subsequently transmitted via LoRa. Therefore there is the possibility of various wireless M-Bus package filters. The configuration of a wireless M-Bus packet filter is described below using an example.

A simple reduction in the number of packets can be achieved by configuring manufacturer filters. Assume you only want to receive devices with manufacturer ID 0CAE (see above) a corresponding filter must be configured. Under Configuration "Wireless M-BUS Device Whitelist" configure e.g. the manufacturer ID 25B3. You can assign a Filter Group ID to this filter. E.g. assign the Filter Group ID 1. (You can define several filters and assign them all to one Filter Group ID, or you use for each filter a single Filter Group ID.) Due to the fact that the receive window within the calendar has specified the Filter Group ID 255 all filters are applied.

You can load this file from the directory Examples\Device List\FILTER\_IMST.whbi and write this configuration into the device.



Now only the wireless M-Bus packets from devices with manufacturer ID 25B3 are received. All others are discarded.

WS Configurator

auto\_COM14

### WIRELESS M-BUS MESSAGES

Device time: 14:09:11 05.11.2021

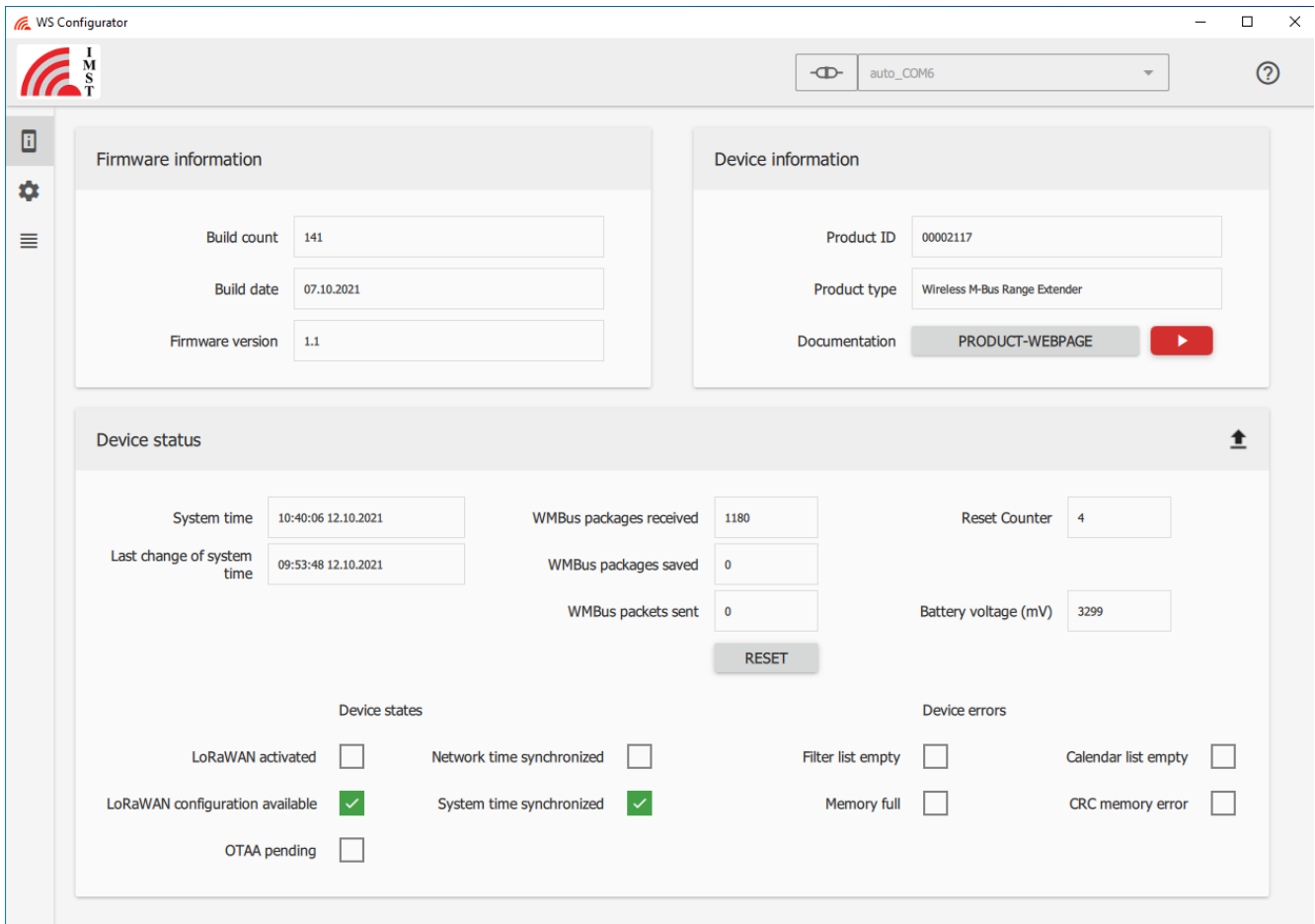
Timestamp	RSSI	Manufacturer ID hex	Device ID hex	Version	Type	Payload hex
14:09:02 05.11.2021	-28	25b3 IMS	55443322	1	2	7a 58 00 00 00 2f 2f 84 00 00 60 ee 10 00
14:08:56 05.11.2021	-28	25b3 IMS	44332211	1	2	7a 58 00 00 00 2f 2f 84 00 00 60 ee 10 00
14:07:50 05.11.2021	-28	25b3 IMS	55443322	1	2	7a 57 00 00 00 2f 2f 84 00 00 fc ed 10 00
14:07:44 05.11.2021	-28	25b3 IMS	44332211	1	2	7a 57 00 00 00 2f 2f 84 00 00 fc ed 10 00
14:06:38 05.11.2021	-28	25b3 IMS	55443322	1	2	7a 56 00 00 00 2f 2f 84 00 00 98 ed 10 00
14:06:32 05.11.2021	-28	25b3 IMS	44332211	1	2	7a 56 00 00 00 2f 2f 84 00 00 98 ed 10 00
14:05:33 05.11.2021	-28	25b3	55443322	1	2	7a 55 00 00 00 2f 2f 84 00 00 34 ed 10 00

# Wireless M-Bus Reception and Transmission via LoRaWAN

In this chapter we provide examples on how to configure WM-Bus device filters, WM-Bus reception windows, calendar events for uploading the WM-Bus data and some calendar event for the system.

## Device- and Status-Information

Start the "WS Configurator" tool and open the serial com port (right upper corner). On the first page the WS Configurator tool provides Firmware-, Device-Information and the Device Status. For further information, please refer to the WS Configurator Manual.



Under the Configuration item



the following four sections of device configuration are shown.

- SYSTEM
- LORAWAN
- CALENDAR EVENTS
- WIRELESS M-BUS DEVICE WHITELIST

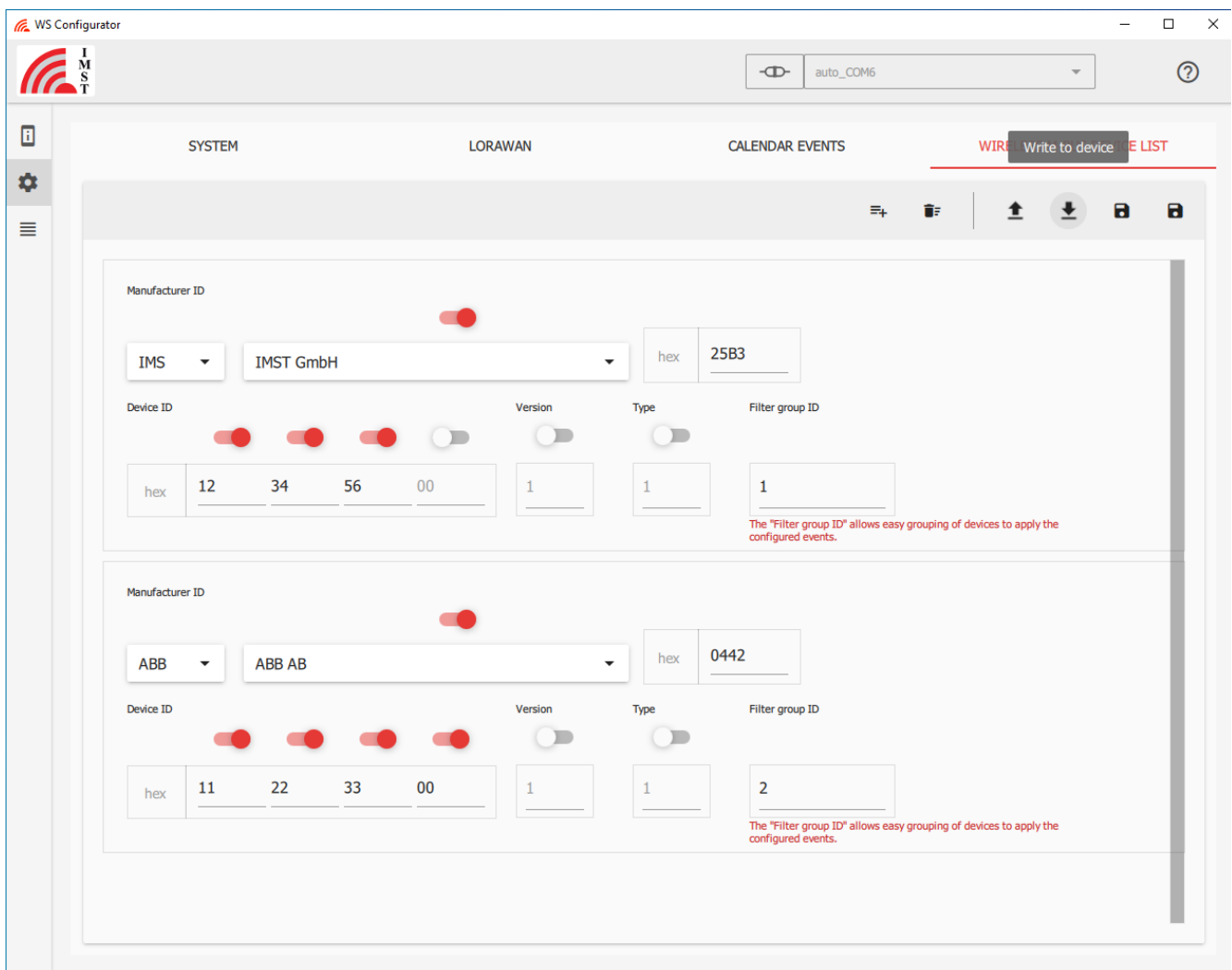
Starting with the last point, Wireless M-Bus Device Whitelist.

## Wireless M-Bus Device List (Filter Group ID)

The Range Extender is able to receive Wireless M-Bus packets in different M-Bus operation modes from all wireless M-Bus devices. In practice it is usually not necessary to receive all wireless M-Bus devices in the immediate surrounding of the Range Extender. Therefore an intelligent filtering of the wireless M-Bus traffic makes sense. Up to 32 different filters can be configured. Each filter setting can be assigned its own number, the *Filter Group ID*. Different wireless M-Bus filter settings can have the same Filter Group ID. E.g. you can configure two different filters, one for manufacturer X and one for manufacturer Y. Both can be assigned to the same Filter Group ID. If this Filter Group ID is assigned to a wireless M-Bus receive window then only the wireless M-Bus packets from both manufacturers are received. All other wireless M-Bus packets are discarded.

Only wireless M-Bus packets that pass the configured filters are stored within the internal data memory and then forwarded via the LoRaWAN network. The filter settings have impact on the amount of data to be stored within the internal memory and forwarded via the LoRaWAN network and therefore influence also the power consumption and life time of the device. You can read the corresponding config file from the directory Examples\Device List\FILTER\_IMST\_ABB.whbi

Write this configuration into the device.



In this example two filter settings are configured.

- The first one with the "Filter Group ID" 1 is a filter that receives all wireless M-Bus devices from the manufacturer IMST (ID: 25B3) with the wireless M-Bus Device ID between 0x12345600 to 0x123456FF.
- The second filter example with the "Filter Group ID" 2 is a filter that receives all wireless M-Bus devices from manufacturer ABB (ID: 0442) with wireless M-Bus Device IDs between 0x11223300 and 0x112233FF.

Write this setting into the Range Extender. Now you have specified two filters for the wireless M-Bus reception.



## Calendar Events

Within the integrated calendar function the Range Extender can schedule different events, like wireless M-Bus receive (S- and C/T-mode) windows or events like "Get Network Time" and "Send Status". The two events "Get Network Time" and "Send Status" should be executed regularly.

### Example 1

One useful event is to request the network time from the LoRaWAN network operator regularly. This is needed to stay synchronized over long term. Therefore it is recommended to schedule this command regularly e.g. once per week. Additionally within this example we specify a wireless M-Bus reception window event and a LoRaWAN upload event. You can read the corresponding config file from the directory Examples\Calendar\ExLoRa\_C-T5m\_upload\_rep4h\_Time1w.evbi

Write this configuration into the device.

The screenshot shows the WS Configurator interface with the 'CALENDAR EVENTS' tab selected. The device time is 22:36:12 on 12.09.2021. Three events are listed:

- Event 1 (Green border):** "Get Network Time (UTC Format)". Description: "This event will be prioritized and may interrupt a WM-Bus receive window." Time: UTC 23:30:00 on 20.05.2021. Repeat: every 1 Week.
- Event 2 (Blue border):** "Wireless M-Bus - C/T-Mode - Reception". Description: "Activate C/T mode reception and save data in flash memory. Reception must be actively deactivated." Filter group ID: 1. Time: UTC 10:50:00 on 20.05.2021. Repeat: every 4 Hours.
- Event 3 (Blue border):** "Start upload". Description: "Deactivates the reception of wireless M-Bus messages and starts sending the recorded data via LoRaWAN." Time: UTC 10:55:00 on 20.05.2021. Repeat: every 4 Hours.

- The first event specified is the "Get Network Time" event (marked with green color), see picture above. It is repeated once per week at 23:30:00 starting from the 20th of May 2021. That means the device synchronizes itself once per week with the time from the LoRaWAN network.
- The second event is a Wireless M-Bus receive window for C/T mode (marked with blue color). It is repeated every 4 hours starting from 10:50:00 of 20th of May 2021. The wireless M-Bus "Filter Group ID" 1 is assigned to this reception window, see above. All

wireless M-Bus packets passing this filter are stored within the internal data memory.

- The wireless M-Bus C/T receive window is terminated by the third event, the "Start upload" event (marked with blue color). The "Start upload" event automatically stops a wireless M-Bus reception event and starts uploading the content of the internal data memory via the LoRaWAN network. This is repeated also every 4 hours starting from 10:55:00 of 20th of May 2021.

That means beside the "Get Network Time" requested every week, the Range Extender receives in C/T-mode every 4 hour for 5 minutes wireless M-Bus devices from manufacturer IMST with Device IDs between 0x12345600 and 0x123456FF, stores those packets within the internal data memory, and then uploads those packets via the LoRaWAN network subsequently.

## Example 2

Due to the fact that there is also a "Disable Wireless M-Bus Reception" event and the internal data memory it is also possible to configure different windows of wireless M-Bus reception over the day/week and use only one "Start upload" event. So the following configuration is also a possible one. The corresponding configuration can be found in Examples\Calendar\Rex\_ExLoRa\_C-T5m\_disable\_rep6h\_upload2d\_Time1w.evbi

Load the file and write it into the device.

The screenshot shows the WS Configurator interface with the 'CALENDAR EVENTS' tab selected. The device time is 22:45:50 on 12.09.2021. The interface displays three event configurations:

- Event 1 (Blue border):** Event ID: Wireless M-Bus - C/T-Mode - Reception. Filter group ID: 2. Time of the event: 10:50:00 UTC on 20.05.2021. Repeat event: every 6 Hours.
- Event 2 (Violet border):** Event ID: Disable Wireless M-Bus Reception. Time of the event: 10:55:00 UTC on 20.05.2021. Repeat event: every 6 Hours.
- Event 3 (Blue border):** Event ID: Start upload. Time of the event: 00:00:00 UTC on 20.05.2021. Repeat event: every 2 Days.

- The first event that should be configured is the "Get Network Time" event (not shown in the picture above).
- The second event is a wireless M-Bus receive window in C/T-mode (marked with blue color). It is started at 10:50:00 on the 20th of May 2021 and is repeated every 6 hours. The "Filter Group ID" 2 is assigned to this reception window. All wireless M-Bus packets received and passed the filter are stored within the internal data memory.
- The reception window for C/T-mode is terminated by the "Disable Wireless M-Bus Reception" event (marked with violet color). It is started at 10:55:00 on the 20th of May 2021 (5 minutes later) and is repeated also every 6 hours.
- The third event is the "Start upload" event (marked with blue color). It uploads the content of the internal data memory via the LoRaWAN network. It is started at 00:00:00 on the 20th of May 2021 and repeated every second day.

That means beside the "Get Network Time" requested every week, the Range Extender receives in C/T-mode every 6 hour for 5 minutes wireless M-Bus devices from manufacturer ABB with M-Bus Device IDs between 0x11223300 and 0x112233FF, save those packets within

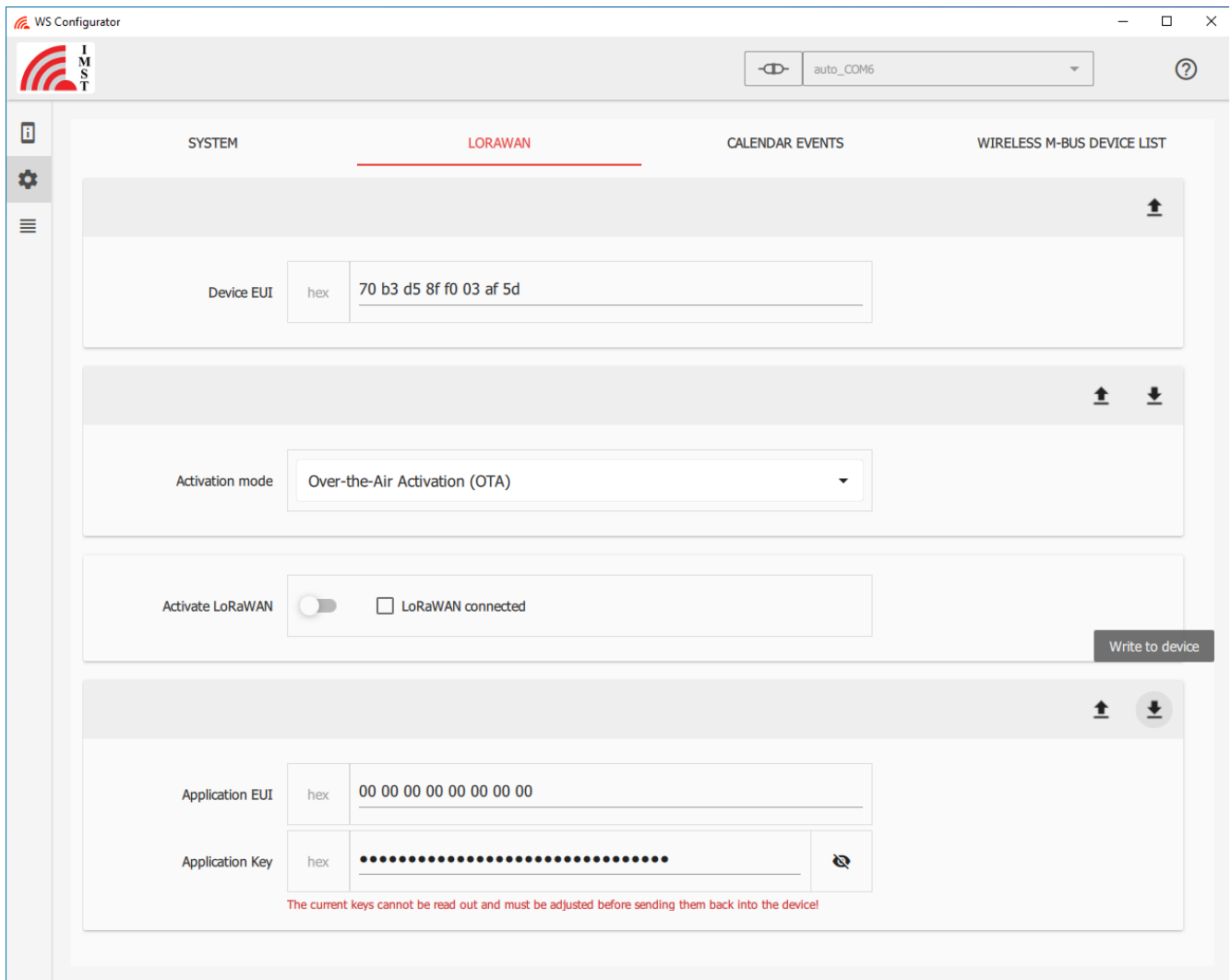
the internal data memory and then uploads those packets via the LoRaWAN network every second day at 00:00:00.

Write this setting into the Range Extender.

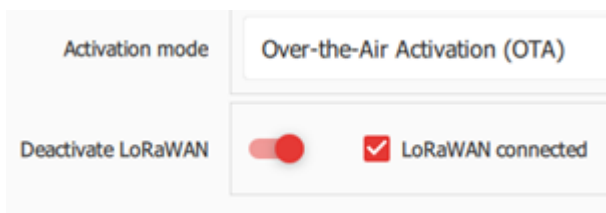
## LoRaWAN

Within the LoRaWAN section the LoRaWAN credentials can be configured. Both, ABP (from firmware version v1.1 ABP should only be used for test purpose) and OTAA are supported by the Range Extender. We recommend using the OTAA process for joining the LoRaWAN network. You normally get the LoRaWAN credentials from your LoRaWAN network operator when you create an application and add a device. Therefore generate the corresponding "Application EUI" and "Application Key" and write both into the Range Extender. The Application key can only be written into the device. A read out of this key is not possible due to security reasons. So, it is recommended to document the LoRaWAN credentials separately.

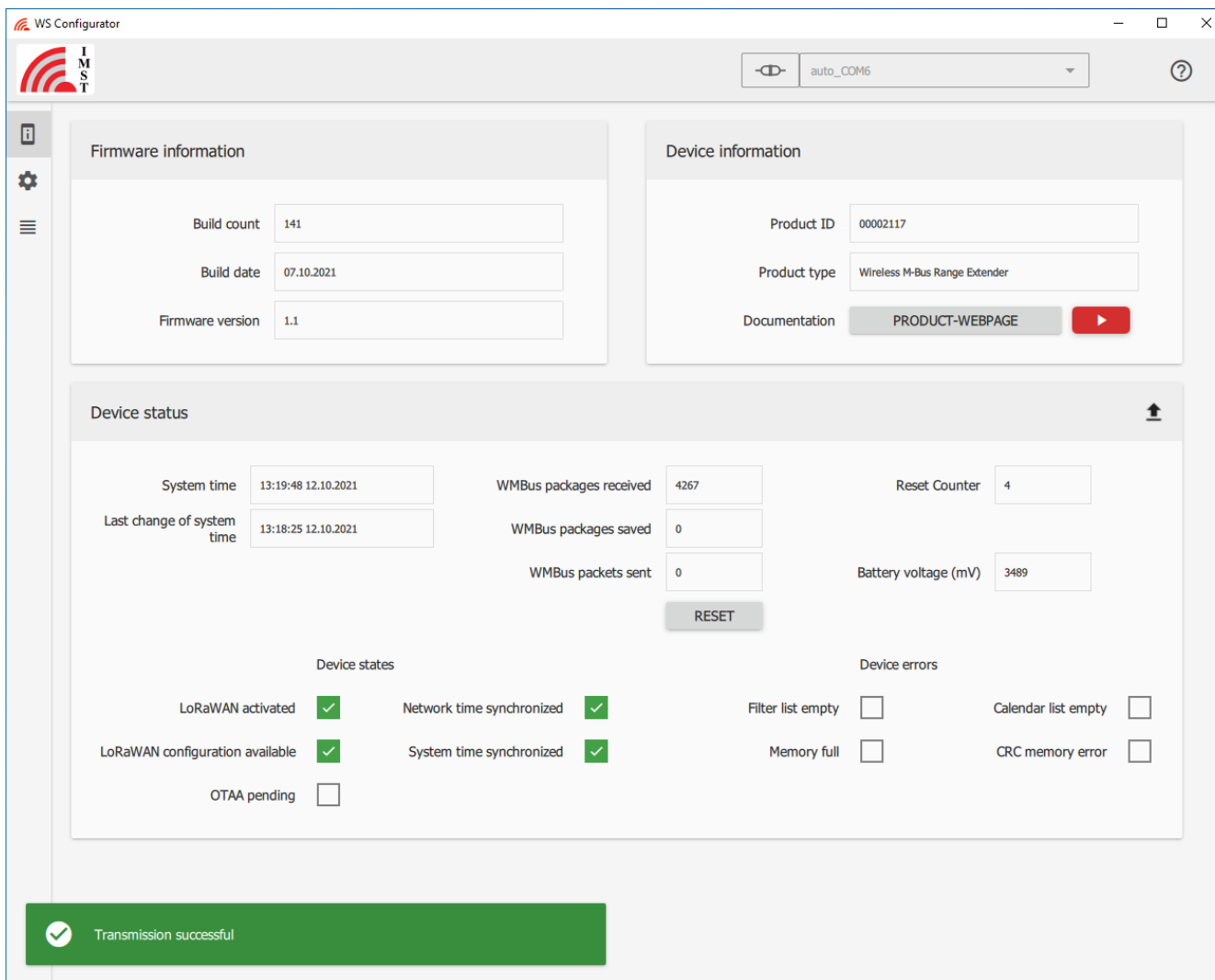
### Activation by WS Configurator



After the corresponding parameters (Activation mode and Application EUI and Key) have been written into the device the LoRaWAN stack can be activated by switching the "Activate LoRaWAN" button.

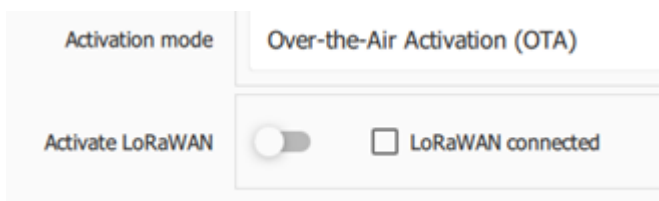


If the Join process is successful the corresponding parameter within the device status are marked green.



## Activation by Reed Switch

Another possibility to activate the LoRaWAN stack is the Reed Switch of the Range Extender. With an external magnet the internal Reed Switch can be triggered and the LoRaWAN is then activated. This enables an activation of the device after installation within the field. To use this way of activation the "Activate LoRaWAN" button should not be switched on after the keys have been written to the device.



You can close the WS-Configurator tool instead, disconnect the configuration cable and screw the housing cover. The Range Extender is now in deep sleep mode. After installation in the field the RangeExtender can be started with a magnet impuls on the reed contact, see User Manual - Chapter Installation.

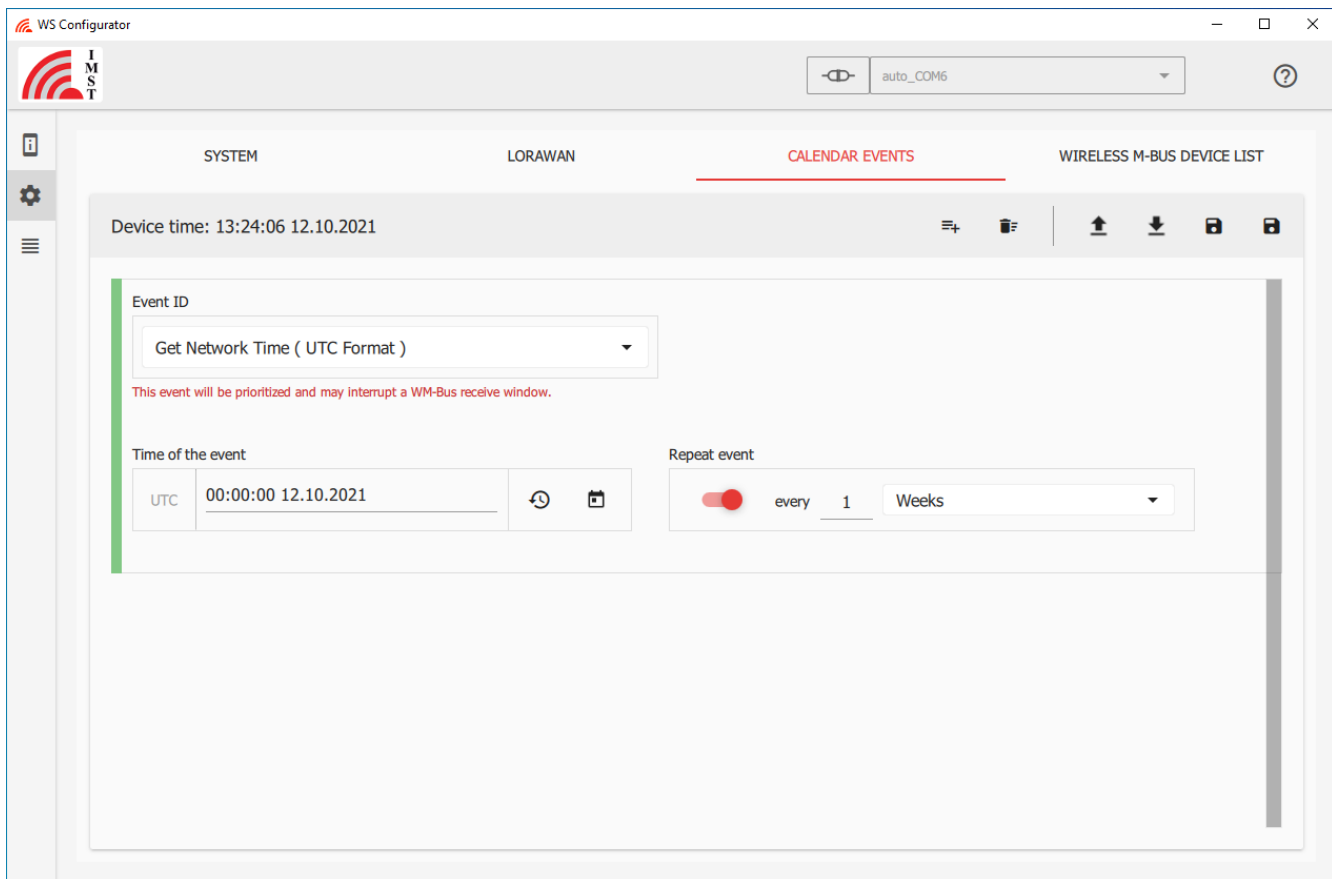
For firmware V0.9 it is recommended to perform a reset whenever the LoRaWAN® settings have been updated!  
Do not forget to synchronize the embedded RTC of the Range Extender with the PC time afterwards!

# System Time

Due to the fact that the Range Extender includes calendar functionality the device should be synchronized periodically. Therefore the "Get Network Time" should be executed regularly.

## Synchronization via LoRaWAN

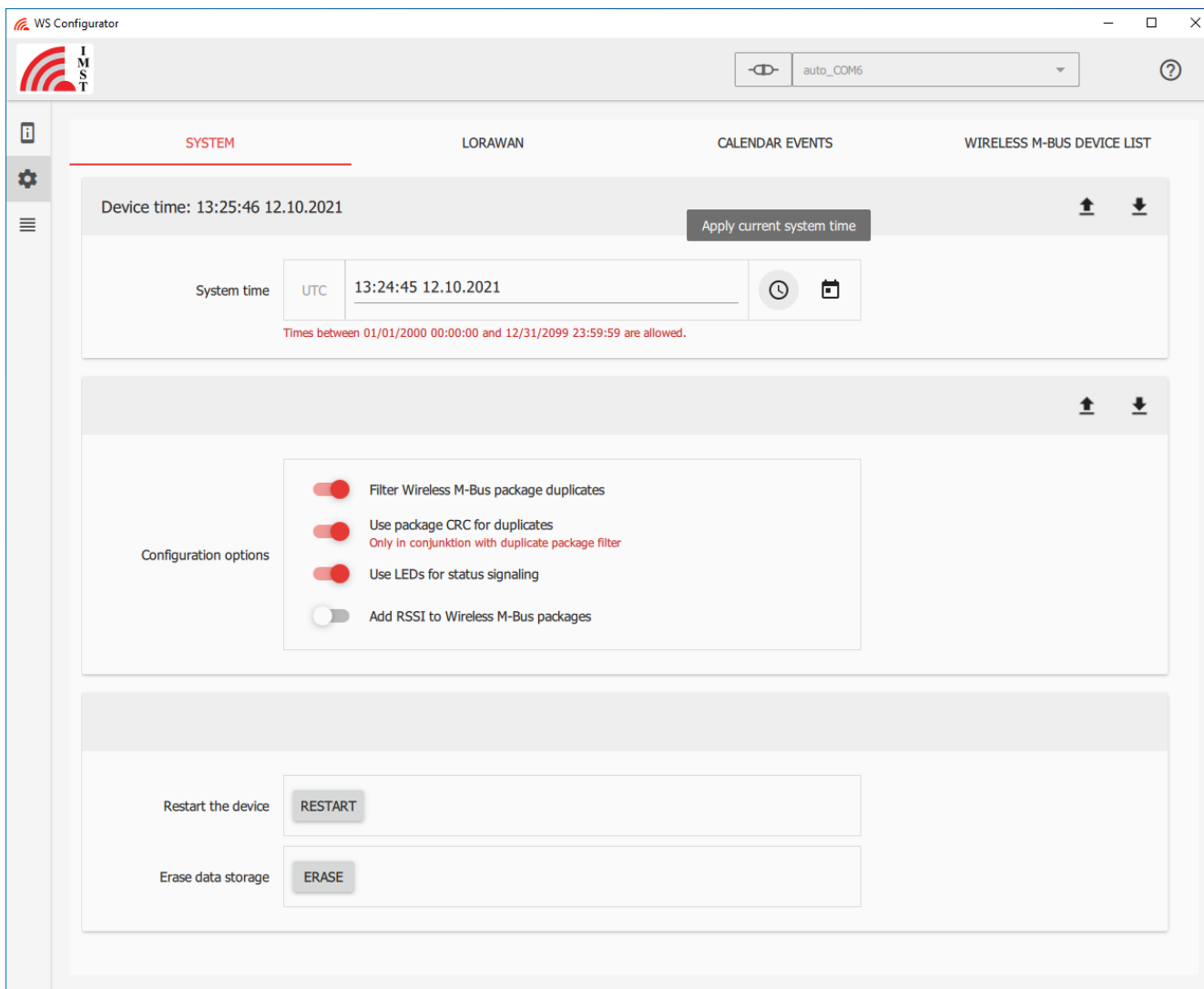
This is normally done after start up. Further synchronization must be configured as a periodically calendar event.



Get the Network Time from your LoRaWAN network operator once a week starting from 12.10.2021 00:00:00 a clock.

## Synchronization with your PC/Laptop

The synchronization with your PC/Laptop is also possible. Don't forget to write the time into the Range Extender.



## Set Date and Time Manually

Date and Time can also be set manually. Don't forget to write the time into the Range Extender.



