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MIOTY® MEK5.0-EVAL - EVALUATION ENDPOINT

USER GUIDE

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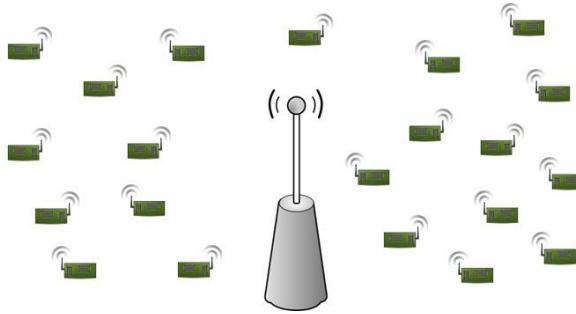
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4 Abstract

The objective of the MIOTY® Waveform is to create a low complexity wide area sensor network. To keep production cost of the sensor nodes low, standard transceiver chips are used. Typically the sensor nodes are supplied by a battery. The network is designed that one receiver is able to receive up to several thousand sensor nodes.



The transmission is typically done in industrial, scientific and medical (ISM) bands or in the short range devices (SRD) bands. Several other systems also use these bands for transmission, therefore an interference free channel can't be guaranteed. The transmit power in these bands is severely limited too.

To achieve a wide area transmission, the data rate has to be reduced. Therefore the interference probability increases vehemently. The Telegram Splitting (TS) Technology invented by Fraunhofer IIS is dealing with the issue of long telegrams and the MIOTY® waveform based on the TS Technology is designed to deal with such interference.

4.1 Transmitter

The MIOTY® MEK5.0-EVAL relies on the TI Launchpad™ Sensor Tag kit LPSTK-CC1352R and includes several integrated environmental and motion sensors, such as a temperature, humidity, light, hall effect and acceleration sensor. It is fully enclosed and battery-operated whilst keeping the current consumption at a minimum, even during the transmission and reception of a MIOTY® telegram.

This document gives you a brief introduction about the MIOTY® MEK5.0-EVAL and guides you through the operation of this device.

5 Transmission of MIOTY®

5.1 Profiles

The Fraunhofer Telegram Splitting based waveform MIOTY® is an ultra-narrowband radio transmission scheme. Therefore, it can be used in virtually any radio band, from a regulatory perspective.

These endpoints supports four different profiles:

- EU0: Transmission in 868.180 MHz band
- EU1: Transmission in 868.080 MHz and 868.180 MHz band
- EU2: Transmission in 866.825 MHz and 867.625 MHz band
- US0: Transmission in 915.600 MHz and 916.400 MHz band

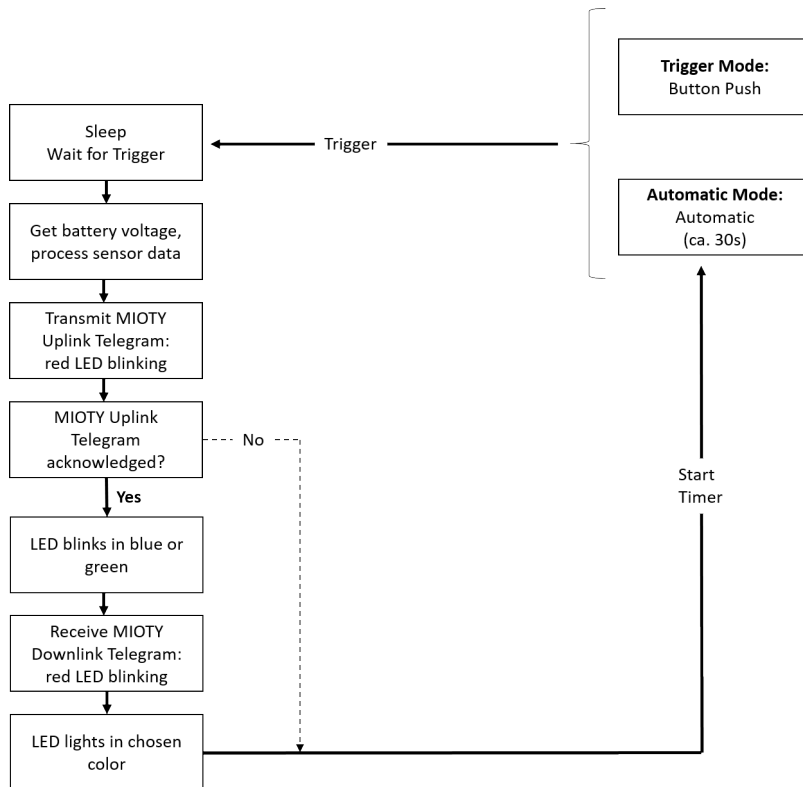
Attention: Due to oscillator tolerances, a transmission at the exact frequency is impossible in practice and frequency offsets should be expected. Regardless of this, the MIOTY® receivers are designed to compensate these tolerances and still achieve the optimal performance.

5.2 Firmware Control Flow

The firmware has two modes of operation. Enable Trigger Mode by placing a jumper across DIO28 and DIO29 before startup. Without a connection between DIO28 and DIO29, the device operates in Automatic Mode.

Jumper for Trigger Mode
operation





5.3 Automatic Mode

In Automatic Mode, a transmission will be executed around 30 seconds after the last package has finished transmission. The integrated on-board sensors are read and the battery level in %, temperature in °C, relative humidity in %, illuminance in lux, magnetic flux in T and the information about possibly detected motion during sleep- time are transmitted by a MIOTY® uplink telegram. During the transmission and reception window, a red blinking LED acts as an indicator for the radio communication process. When the transmission was acknowledged by your M200, the blue LED blinks multiple times. Afterwards it signals the successful reception of a downlink telegram by lighting for five seconds in the color according to the RGB-values that were sent in the downlink.

5.4 Trigger-Mode

In Trigger-Mode, a transmission is executed manually by a trigger event, which is caused by pressing one of the push-buttons. Any further interrupt events are ignored until the MIOTY® transceive event was performed completely. The integrated on-board sensors are read and the battery level in %, temperature in °C, relative humidity in %, illuminance in lux and magnetic flux in mT are transmitted by a MIOTY® uplink telegram. During the transmission and reception window, a red blinking LED signals radio activity. When the transmission was acknowledged by your M200 and BTN-2 triggered the event, the blue LED blinks multiple times. Otherwise, when a transmission triggered by BTN-1 was acknowledged by your M200, the green LED blinks multiple times. Afterwards the LED signals the successful reception of a downlink telegram by lighting for five seconds in the color according to the RGB-values that were sent in the downlink.

6 Device

6.1 Information

The MIOTY® MEK5.0-EVAL is a standalone, small, versatile, low-power transmitter and receiver for the Fraunhofer Telegram Splitting Technology, capable of transmitting the Fraunhofer MIOTY®: It is designed for ease of use to show the various application possibilities of a low-power sensor module combined with the efficient Telegram Splitting Technology for both uplink and downlink purposes.

6.1.1 Connectors

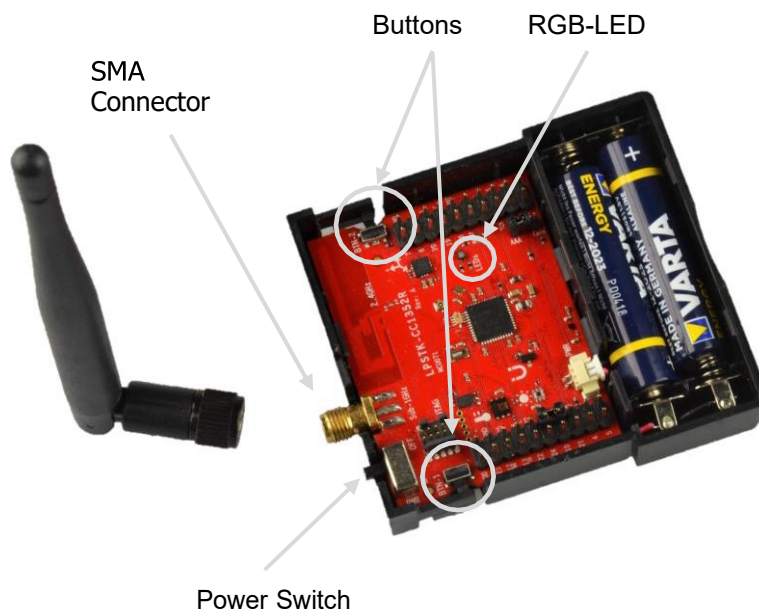
The device has one SMA-Female-Connector that is used to connect the provided Sub-1 GHz SMA antenna. It can also be used to establish a wired connection with any SMA cable.

WARNING! If the device is connected directly to any receiver via cable, you have to ensure, that the receiver supports input powers up to 14 dBm. If not you have to connect additional attenuators to limit the power to a level the receiver supports.

For power supply, two Alkaline AAA-batteries (1.5V each) are recommended. Connecting your device to an XDS110 Launchpad through the provided ARM 10-pin JTAG cable and the 2 wire per for UART provides further debugging, programming and communication possibilities. Refer to <https://www.ti.com/tool/LPSTK-CC1352R> for more information.

6.1.2 Buttons

The MEK5.0-EVAL offers two push buttons for the user to trigger a transmission (BTN-1 and BTN-2).



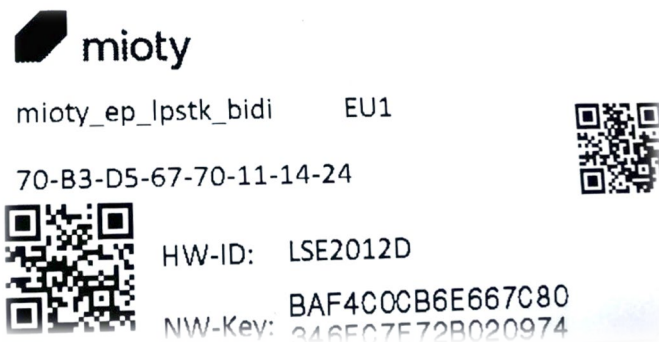
6.1.3 LEDs

There is a RGB-LED on the device.

During boot the red and green LED are turned on and off one by one.

When the device is transmitting or receiving a MIOTY® package, the red indicates the radio activity. The LED is turned off, when the telegram was sent. A successful transmission of the MIOTY® package is signaled by a blue or green blinking LED, depending on the mode of operation.

6.1.4 Label



- Device Name: MIOTY® MEK5.0-EVAL
- EUI64: 64-bit Extended Unique Identifier. The information is also given by the QR code on the right. Required to register the node at the base station
- HW-ID: Hardware Identifier
- NW-Key: 128 bit AES Key that is used to encrypt the data. The information is also given by the QR code on the left. Required to register the node at the base station

7 Uplink- / Downlink-Payload-Formatting

The MIOTY® uplink telegram payload consists of six bytes:

- Battery level in %
- Temperature in °C
- Relative humidity in %
- Illuminance in lux (MSB)
- Illuminance in lux (LSB)
- Magnetic flux in mT

The MIOTY® downlink telegram consists of three bytes in the format $[r,g,b]$, whereas $0 \leq r, g, b \leq 255$

8 Technical Specifications

8.1 Hardware Specification

NAME	VALUE
Electric current Idle-Mode	$\leq 1 \text{ mA @ } 3.3\text{V}$ (Evaluation kit is optimized for usability, an embedded optimized implementation can be as low as $1\mu\text{A}$, dependent on the hardware)
Electric current TX-Mode	$30 \text{ mA @ } 3\text{V}$
RF-TX Output Max. (868 MHz)	14 dBm
Frequency Oscillator Tolerance	10ppm
Input Voltage	$2.5\text{V} - 3.2\text{V}$

Please note:

The transmission power of the MIOTY® M200 base station is reduced compared to available High Performance base stations. The resulting loss of link budget in the downlink has an appreciable impact on the covered range. This reduces the range of the downlink roughly by factor 2. The uplink to the base station has the full link budget and therefore has a higher range.

9 Scope of delivery

A MIOTY® MEK5.0-EVAL is delivered with the following components.

- 1x MIOTY® LPSTK
- Sub-1GHz SMA swivel antenna
- User Guide
- Quick Start Guide

10 Open Source Software

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