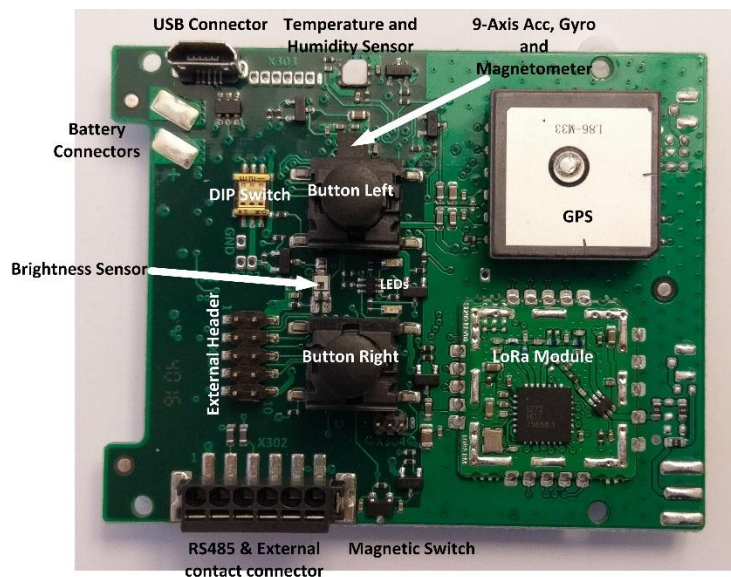




LPN MS-3 SW Specification / V05



History

| REVNr | Author | Description |
|-------|---------------|---|
| REV00 | 2016-11-22-Ra | Generate file |
| REV01 | 2017-01-19-Ra | Added Chapter 2 and 3 (SW REV > = 0.32) |
| REV02 | 2017-03-17-Ra | Document revised, extended Chapter 2 and 3 (SW Rev > = 0.44) |
| REV03 | 2017-03-21-Ra | Chapters feature added CFG, LED, bootloader (SW Rev > = 0.55) |
| REV03 | 2017-12-18-Zs | Formatting of the document changed |
| REV04 | 2017-12-22-Ra | Features from HWREV02 and SWREV 00.86 added |
| REV05 | 2018-05-31-Ra | Payload types added |

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1 Features

The MS-3

2 Function of the onboard DIP Switch

2.1 HWREV01

Following modes or options can be set with DIP switches:

| DIP-switch No. [0...X] | Function/Meaning | Remarks |
|------------------------|------------------|--|
| 1 | Default off | LoRaWAN TxConfirmed uplinks OFF or ON |
| 2 | Default off | LoRaWAN device activation OFF= APB (ActivationByPersonalization); ON=OTAA (OverTheAir) |
| 3 | Default off | LoRaWAN class OFF A (battery operation); ON = C |

2.2 HWREV02

Following modes or options can be set with DIP switches:

| DIP-switch No. [0...X] | Function/Meaning | Remarks |
|------------------------|------------------|---|
| 1 | Default off | LoRaWAN TxConfirmed uplinks OFF or ON |
| 2 | Default off | LoRaWAN Duty Cycle Control OFF or ON |
| 3 | Default off | LoRaWAN class OFF A (battery operation); ON = C |

3 Function of the LEDs

Two status LEDs (blue and orange) can be found in the MS3. The flashing of the LEDs varies depending on the device status or event.

The table below shows the different LED flashing modes:

| LED | Blink duration | Meaning |
|--------|----------------------|--|
| Blue | 250 ms (short pulse) | MS3 (LoRa module + remaining peripherals) was initialized (done after a reset or power-up) |
| | | LoRa message has been sent (uplink), done during operation |
| Orange | 250 ms (short pulse) | A LoRa message was received (downlink) |
| | Ca. 1s (pulse) | GPS – module has been initialized (takes place after a reset or power-up) |

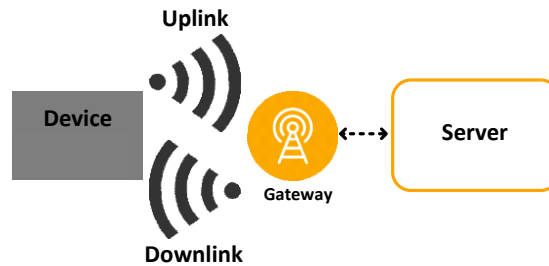
4 Function of the Buttons

| Button | Function/Meaning | Remarks |
|---------------------|---|--|
| Left + Right | At Power Up | If both buttons are pressed when powering up the device (device was totally off), the device switches to the bootloader mode. |
| Left + Right | During Power Up (only orange LED is on) | If both buttons are pressed during power up (device is already on, 1 second orange LED pulse at power up is active), the CFG.TXT file is reset to its default internal values. |
| Left | During operation | A push initiates a measurement and transmit a LoRa message Changes in the CFG.txt file will be applied only after a reset! A reset can be generated with the left button. If the left button is pressed for more than 3 seconds, the MS3 will restart. |
| Right | During operation | A push initiates a measurement and transmit a LoRa message |

Reset:

During operation, the device can be reset by pressing the left button for more than 3 seconds.

5 LoRa Up- and Downlink



5.1 LoRa uplink payload structure on port 3

The sensor data is approximately every 15 minutes (default value, can be customized in the **CFG.txt file**) or sent (**uplink, port 3**) press (left or right). Only the sensor data are measured by the enabled peripherals. All other data are initialized with invalid content and so sent.

The payload structure (uplink) of the MS3 is as follows:

| Byte No. [0...X] | Function | Comment |
|------------------|---|---|
| 0 | Status | Which periphery is on? 0 RS485 GPS ACC MAG MIC BIRGHT TEMP / HUM |
| 1 | Ext. Contact buttons (TXONEVENT), magnetics, MIC? | Actual state of different components: TXONEVENT MAG EXT. CON BOOSTER EXT_SUPPLY DIP3 DIP2 DIP1 |
| 2 | Battery voltage | 0.. 255 (1V + value * 10mV), range 1 to 3.55 volts (unsigned) |
| 3 | Brightness | 0.. 255 * (10Lux), (unsigned) |
| 4 | Humidity | 10% → 0 ... 100 (unsigned) |
| 5-6 | Temperature | 34.5 → + 345, 12.3 → 123, (signed) |
| 7-8 | Accelerometer X | 12.222 g → 12222 (signed), (initial value is 0x7FFF) |
| 9-10 | Accelerometer Y | 12.222 g → 12222 (signed), (initial value is 0x7FFF) |
| 11-12 | Accelerometer Z | 12.222 g → 12222 (signed), (initial value is 0x7FFF) |
| 13-14 | Gyro X | 1150.4 dps → 11504 (signed), (initial value is 0x7FFF) |
| 15-16 | Gyro Y | 1150.4 dps → 11504 (signed), (initial value is 0x7FFF) |
| 17-18 | Gyro Z | 1150.2 dps → 11504 (signed), (initial value is 0x7FFF) |
| 19-20 | Magnetometer X | 12.232gauss → 12232 (signed), (initial value is 0x7FFF) |
| 21-22 | Magnetometer Y | 12.232gauss → 12232 (signed), (initial value is 0x7FFF) |
| 23-24 | Magnetometer Z | 12.232gauss → 12232 (signed), (initial value is 0x7FFF) |
| 25-28 | GPS latitude | 89.999999 N → + 89999999 (signed) where + is N (initial value is 0x7FFFFFFF) |
| 29-32 | GPS longitude | 179.999999 E → + 179999999 (signed) where + is S (initial value is 0x7FFFFFFF) |
| 33-34 | GPS EPE | Estimated position error in meters, 12523 → 125.23 (unsigned), (initial value is 0) |

5.1.1 LoRa uplink payload Example

Below an example of one payload

13 00 bc 00 1f 0100 ff5f fecc 03b1 0024 fff2 000d ffc3 0163 0017 7fffffff 7fffffff 0000

This in the correct byte order:

| Byte No. [0...X] | Function | Example payload value |
|------------------|---|--|
| 0 | Status | 0x13 = 0b 0001 0011 Which periphery is on? 0 RS485 GPS ACC MAG MIC BIRGHT TEMP / HUM |
| 1 | Ext. Contact buttons (TXONEVENT), magnetics, MIC? | 0x00 Actual state of different components: TXONEVENT MAG EXT. CON BOOSTER EXT_SUPPLY DIP3 DIP2 DIP1 |
| 2 | Battery voltage | 0xbc = 188 = 1V + 188*0.01V = 2.88V 0.. 255 (1V + value * 10mV), range 1 to 3.55 volts, (unsigned) |
| 3 | Brightness | 0x00 -> 0 Lux 0.. 255 * (10Lux), (unsigned) |
| 4 | Humidity | 0x1f = 31 -> 31% 10% -> 0 ... 100, (unsigned) |
| 5-6 | Temperature | 0x01 00 = 256 = 25.6 Grad 34.5 ° -> + 345, 12.3° -> 123, (signed) |
| 7-8 | Accelerometer X | 0xff 5f = -161 = -0.161 g 12.222 g -> 12222 (signed), (initial value is 0x7FFF) |
| 9-10 | Accelerometer Y | 0x fe cc = -308 = -0.308 g 12.222 g -> 12222 (signed), (initial value is 0x7FFF) |
| 11-12 | Accelerometer Z | 0x03 b1 = 945 = 0.945g 12.222 g -> 12222 (signed), (initial value is 0x7FFF) |
| 13-14 | Gyro X | 0x00 24 = 36 = 3.6 dps 1150.4 dps -> 11504 (signed), (initial value is 0x7FFF) |
| 15-16 | Gyro Y | 0xff f2 = -14 = -1.4 dps 1150.4 dps -> 11504 (signed), (initial value is 0x7FFF) |
| 17-18 | Gyro Z | 0x00 0d = 13 = 1.3 dps 1150.2 dps -> 11504 (signed), (initial value is 0x7FFF) |
| 19-20 | Magnetometer X | 0xff c3 = -61 = -0.061 Gauss 12.232 Gauss -> 12232 (signed), (initial value is 0x7FFF) |
| 21-22 | Magnetometer Y | 0x01 63 = 355 = 0.355 Gauss 12.232 Gauss -> 12232 (signed), (initial value is 0x7FFF) |
| 23-24 | Magnetometer Z | 0x00 17 = 23 = 0.023 Gauss 12.232 Gauss -> 12232 (signed), (initial value is 0x7FFF) |
| 25-28 | GPS latitude | 0x7f ff ff ff [GPS OFF] 89.999999 N -> + 89999999 (signed) where + is N (initial value is 0x7FFFFFFF) |
| 29-32 | GPS longitude | 0x7f ff ff ff [GPS OFF] 179.999999 E -> + 179999999 (signed) where + is S (initial value is 0x7FFFFFFF) |
| 33-34 | GPS EPE | 0x00 00 [GPS OFF] Estimated position error in meters, 12523 -> 125.23 (unsigned), (initial value is 0) |

5.2 LoRa downlink Payload structure on port 2

The peripherals can be switched on or be switched off using downlink messages (**downlink, port 2**).

The payload structure of downlink news is defined as follows:

| Byte No. [0...X] | Function/meaning | Re marks |
|------------------|-----------------------------------|---|
| 0 | Status SET | Turn peripherals on or off (to turn a periphery off set 0 at the periphery's position in the byte) 0 RS485 GPS ACC MAG MIC BIRGHT TEMP / HUM |
| 1-2 | Send interval [minutes, unsigned] | Send interval can be set between 0 and 1440 minutes (one day) Example: 0x00 0F for 15 minutes |

The peripheral settings will not take effect until the next uplink on.

6 Function of the CFG.txt File

When you plug in a USB cable to the MS3, a new drive (MS3) is visible on the computer. The CFG is on this drive. TXT file to find. Thus, the LoRa - and the peripheral settings can be configured.

The CFG.txt file looks like this:

```
App.vers.:00.87

SendInterval=0015 (0000..9999 minutes, 0000 for no interval)

LoRa Config (LoRaMac version 430):
PrivateNetwork=0 (0: Public Network, 1: Private Network)
ADR=1 (0: ADR OFF, 1: ADR ON)
OTAA=0 (0: ABP, 1: OTAA)

OTAA (OverTheAirActivation):
DevEUI=70B3D5FFFE0E90C7
AppEUI=70B3D5FFFE297010
AppKey=AB89EFCDD2301674554761032DCFE98BA

ABP (ActivationByPersonalization):
DevAddr=015e0125
NetwSesKey=42899E7D12DC1DD8AFOA507E2E7E6021
AppSesKey=BF0BE2A7ECCB199007224691CA7852E7

BroadcastAddr=0x00000000
BroadcastNetwSesKey=2223456789ABCDEEEDCBA9876543222
BroadcastAppSesKey=DDDCBA9876543211123456789ABCDDD

LoRaMAC Datarate (0..5; DR_0..DR_5; SF12..SF7):
MinDatarate=0
MaxDatarate=5
DefDatarate=0
Rx2DefDatarate=0

ENABLE/DISABLE Peripherals (0: DISABLE, 1: ENABLE)
GpsON=0
AccON=1
TempHumON=1
BrightON=1 (TempHumOn must be enabled for a valid measurement)
MagON=0
(These 2 peripherals are yet to be implemented)
MicON=0
RS485ON=0
```

- A send interval of 15 minutes is configured by default. This can be adjusted using the variable **SendInterval**.
- The activation type can be configured with the variable **OTAA**. ABP is configured by default.
- Public Networking and ADR are set by default (see variables **ADR** and **PrivateNetwork**).
- Messages can also be sent by push of a button (left or right button).

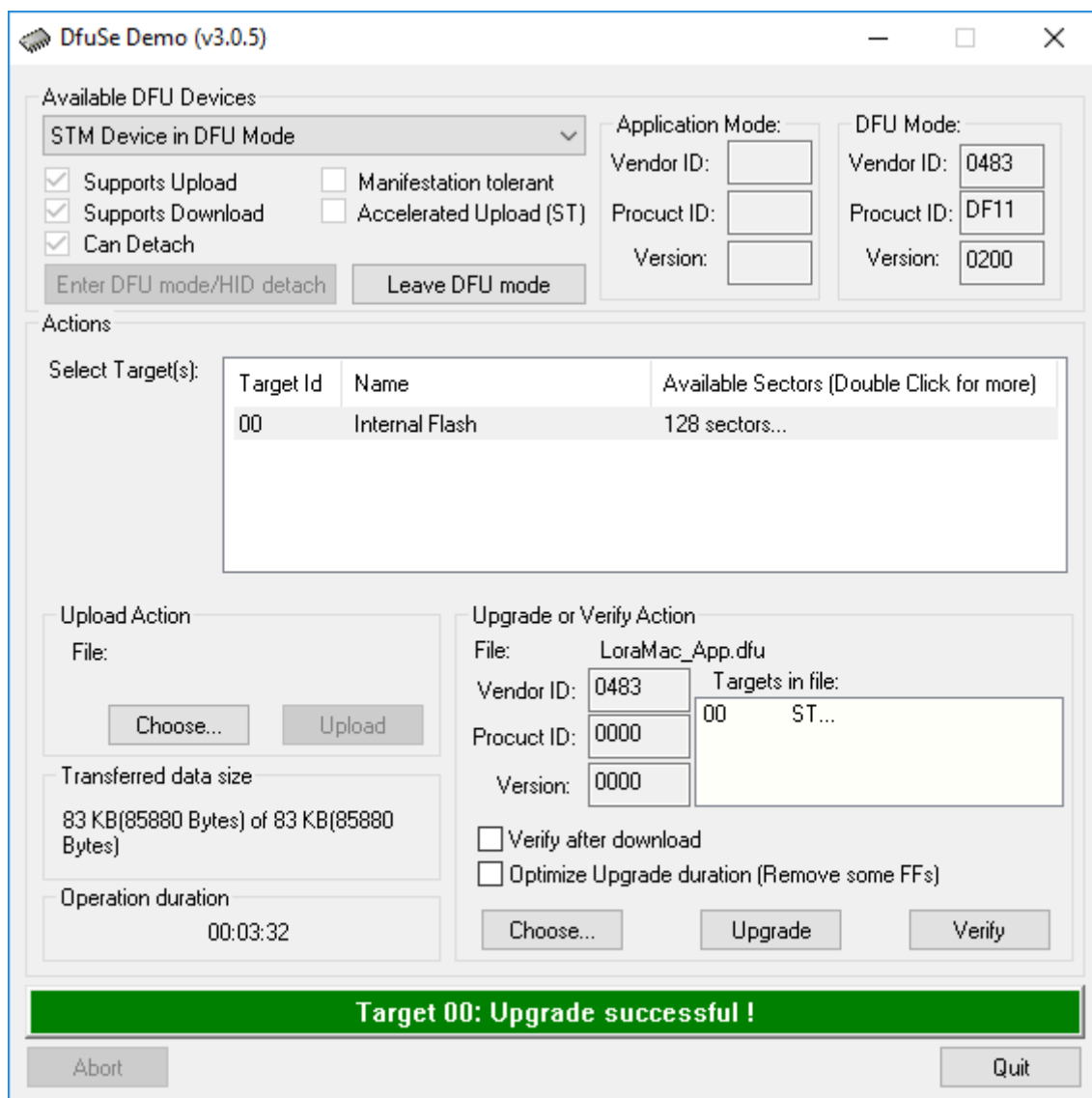
IMPORTANT

- If both buttons are pressed during power up (device is already on, 1 second orange LED pulse at power up is active), the CFG.TXT file is reset to its default internal values.
- Changes in the CFG.txt file only applied **after a reset!** A reset can be generated with the left button. If the left button is pressed for more than 3 seconds, the MS3 will restart.

7 SW Update over the USB Bootloader

MS 3 boards which have a bootloader that can be updated via USB DFU.

1. DFU tool «DFuSe demo» start (link → <http://www.st.com/en/development-tools/stsw-stm32080.html>).
2. means "Choose..." under **upgrade or verify action** (bottom right) the current DFU file download.
3. **both press and hold buttons when you restart (power-up)**, to enter the bootloader mode.
4. the LEDs should Flash now delayed all 500 ms.
5. insert the USB cable.
6. now the MS3 should appear under "available DFU devices".
7. press "Upgrade" and any messages, ignore and continue. Lasts 3 minutes and 32 seconds.
8. after the update, disconnect the USB cable and restart the device.



Important: After you install the DFU tool, see the UM0412.pdf. At the first update to the driver path (C:\Program files (x 86) \STMicroelectronics\Software\DfuSe v3.0.5\Bin\Driver\) be manually searched.