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E1444 TD-1 FW Specs

[Status]

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REV-History

REVNr	Author	Description
REV00	2020-05-13-Ra	Create file.
REV01	2020-07-14-Ra	PL corrections, updates on CFG file. New chapters added
REV02	2020-08-12-Ra	CFG file update, APP version update
REV03	2020-10-12-Ra	CFG file update, APP version update, default params update
V02.00	2023-03-20-Zs	Rename the file

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1 CFG.TXT File

When plugging in a USB cable to the TD-1, a new drive (LPN TD-1) can be seen on the computer. Inside this drive, a CFG.TXT file can be found. All LoRa and device settings can be configured with this file.

Important: Changes in the CFG-File are applied **only after a reset**! Keeping the reed switch active for **more than 3 seconds** will reset the device (only usable in application mode, please reset by extracting USB cable or exiting DFU mode in bootloader mode). **Disconnecting the USB cable while powered up will also reset device**.

```
App.vers.:02.00

LoRaWAN 1.0.3rA EU868 Params (LoRaMac version 444):

PrivateNetwork=0 (0: Public Network, 1: Private Network)

OTAA (OverTheAirActivation):
DevEUI=3834343063378607 (READ ONLY)

App Params:

App Timing Params:
PingRate=15 (Minutes, 15 to 50000)
LongRangeTrigger=1 (Max. 255, 0: OFF)
MidRangeTrigger=0 (Max. 255, 0: OFF)
RejoinTrigger=5760 (Max. 50000, 0: OFF)

App Sensor Params:
GPSFixes=5 (5 to 20)
WIFIDetections=1 (1 to 4)
```

1.1 LoRa settings

With the LoRa settings it is possible to select a network type (**PrivateNetwork** variable). By default, the device is configured for usage on public networks.

The **DevEUI** parameter needed for OTAA is READ ONLY, which means the user can't change it (**Unique ID given by comtac**).

The AppEUI (required for OTAA) is a hardcoded value and valid for all LPN TD-1 devices. The AppKEY (required for OTAA) is generated by the devices themselves and is UNIQUE for every device. Both values can only be retrieved by request.

The LoRaMac's native ADR (Adaptive Data Rate) is turned off for the LPN TD-1 (a special blind ADR algorithm is implemented), all messages are sent unconfirmed.

1.2 Device and sensor settings

With the device and sensor settings, different parameters can be configured. According to these parameters, the device might change its functionality.

At Delivery the device is in DEEP SLEEP (all sensors off). The device can be “turned on” by activating the reed switch. Only after activation, the device starts running and pings are sent every **PingRate** minutes.

Important: Device activation status is kept regardless of HW/SW Reset (Once active, always active). All “Joining” tries are always carried out on SF12.

When running, the user has the possibility to send so called positioning request DLs (DATA see chapter 4.2) on every ping.

There are 4 different kind of pings that can be set:

- NORMAL Ping -> defined by variable **PingRate**, SF7 (lowest priority)
- LONGRANGE Ping -> defined by a multiple of **PingRate** (**LongRangeTrigger**), SF12 (highest priority)
- MIDRANGE Ping -> defined by a multiple of **PingRate** (**MidRangeTrigger**), SF9 (medium priority)
- EVENT Ping -> sent on battery full or connection test events, SF12

Depending on the settings of the variables **LongRangeTrigger** and **MidRangeTrigger**, the data rate used for the pings can vary (SF12 for **LongRangeTrigger**, SF9 for **MidRangeTrigger**).

The LPN TD-1 counts the number of pings it sends, and on every modulo match with one of the range triggers, the data rate is set corresponding to the match. In case both triggers match, the **LongRangeTrigger** has higher priority.

The **RejoinTrigger** is used to carry out a rejoin after a certain number of UL. If **RejoinTrigger** is 0, no automatic rejoins are carried out.

With the variable **GPSFixes**, the minimum number of GPS fixes for a fetch to be valid can be set. The more fixes, the more accurate the position can be (with the drawback, that more energy is needed).

With the variable **WIFIDetections**, the minimum number of WIFI detections for a fetch to be valid can be set. The more WIFIs detected, the more accurate the position can be.

Default parameters:

- PingRate: 15 minutes
- LongRangeTrigger: 1 (All pings sent with SF12)
- MidRangeTrigger: 0 (No ping sent with SF9)
- RejoinTrigger: 5760 (Rejoin trigger done after 5760 ULs, around 2 months)
- GPSFixes: 5
- WIFIDetections: 1

2 REED

The LPN TD-1 integrates a REED switch on the side. Depending on the mode, the REED can be used for different actions.

The table below shows the different actions that can be carried out with the REED depending on the mode.

Runtime description	Button actions	Meaning
At Startup	REED long activation	If REED is kept active at startup and an USB cable is connected to the device, then the device enters BOOTLOADER mode
In DEEP SLEEP mode	REED short activation	If REED was activated for a short time (action shorter than 3 seconds), then the device enters NORMAL mode
	REED long activation	If REED is kept active for a long time (action longer than 3 seconds), then the device resets itself.
In NORMAL mode	REED short activation	If REED was activated for a short time (action shorter than 3 seconds), then the device sends a so-called CONNECTION TEST uplink (see chapter 4.1 for more details).
	REED long activation	If REED is kept active for a long time (action longer than 3 seconds), then the device resets itself.

3 LED

The LPN TD-1 has 1 status LED. Depending on the mode and/or event the LED lights up in different profiles.

The table below shows the different blinking profiles and their meaning.

Runtime description	LED Blinking profiles	Meaning
In BOOTLOADER mode	500 ms toggling	Device is in BOOTLOADER mode
At Startup	1 x 500 ms pulse	Device in DEEP SLEEP mode
	2 x 250ms pulses	Device in NORMAL mode
	ON forever	Startup test failed, ERROR HANDLER reached.
	Battery charging profile	If USB or QI charger detected, the LPN TD-1 runs a long dimmed pulse profile (1 second UP, 1 second DOWN) to signalize that charging has started. Runs on every charger detection (Both at startup and during runtime).
	Battery level profile	Depending on battery charge, the LPN TD-1 runs short dimmed pulse profiles (500ms UP, 500ms DOWN). 3 pulses for high battery level, 2 pulses for medium battery level, 1 pulse for low battery level. Runs on every startup, after having shown the actual device mode.
In NORMAL mode	1 x 200ms pulse	LoRa Tx/Rx OK
	2 x 100ms pulses	LoRa Tx/Rx NOK
	1 x 20ms pulse	When activity on REED detected, and connectivity test started.
	2 x 20ms pulses	When activity on REED detected, and device busy. Connectivity test will be carried out as soon as possible.
	Battery charging profile	Same as at startup

IMPORTANT:

- If the startup test was not passed, the LED remains ON until an automatic restart is carried out (around 30 seconds after fail was detected).
- Only one of the battery profiles is shown at startup. If USB (or QI) charger detected at startup, only the charging profile is shown. If not, only the battery level profile is shown.

4 Payload Version 01

The LPN TD-1 supports 3 different types of uplinks/downlinks:

1) Uplink/Downlink Port 3: Application Data [DATA]
2) Uplink/Downlink Port 100: Configuration + Info Data [CONFIG]
3) Downlink Port 102: Remote Rejoin [REJOIN]

4.1 Uplink Port 3 (DATA)

The device's DATA payload is dynamic. Depending on the data validity, the size of the payload changes. The first 4 Bytes are always sent and build the content of the ping messages.

Byte No. [0...X]	Function	Comment
0	Payload version	Payload Version used by device (0 to 255, UINT8)
1	Status	**In device type 1:** POS STATUS (3 bits) | PING TYPE (3 bits) | BAT FULL | CONNECTION TEST POS STATUS: **0** NONE **1** GPS OK **2** GPS NOK **3** WIFI OK **4** WIFI NOK **5** GPS & WIFI OK **6** GPS & WIFI NOK PING TYPE: **0** NORMAL PING/ANSWER (SF7) **1** MIDRANGE PING/ANSWER (SF9) **2** LONG RANGE PING/ANSWER (SF12) **3** EVENT PING (BAT FULL OR CONNECTION TEST, SF12) BAT FULL: **1** TD-1 Battery full **0** DON'T CARE CONNECTION TEST: **1** Connection test (Reed event) **0** DON'T CARE
2	Battery voltage	Battery voltage in 5 mV steps (UINT8), where 0 equals 3000 mV or less, 254 equals 4270 mV or more (255 for ERROR)
3	Temperature	Temperature in °C (INT8), from -126 to 126°C (127 for ERROR)
4	Payload ID	Application payload ID as defined in chapter 4.1.1
5-X	Payload data	Application payload data corresponding to payload ID
X+1-Y	Payload ID	Next application payload ID
Y+1-Z	Payload data	Next application payload data

(and so on)

4.1.1 Application Payload IDs and Data structure

The following payload IDs and Data types are defined:

Payload ID	Function	Structure	Size in Bytes w/o ID	Size in Bytes w/ ID
01	GPS Data	- 4 Bytes: GPS Latitude (+89999999 → 89.999999 N, INT32 MSB First) - 4 Bytes: GPS Longitude (+89999999 → 89.999999 E, INT32 MSB First) - 1 Byte: GPS Extras * 4 MSBs -> GPS EPE (0 to 15, 1 → 10 to 20 meters, max. 15 → 150 and more meters) * 4 LSBs -> GPS NrOfSats (from 0 to 15)	9	10
02	WIFI Data	- 1 Byte: 0 | 0 | 0 | 0 | NR WIFI DETECTED (4 LSBs) * 4 LSBs -> NR WIFI DETECTED (1 to 4) - 6 Bytes: WIFI MAC (bytewise, MSB first) - 1 Byte: WIFI RSSI (UINT8 * -1) [OPTIONAL, ONLY IF NR WIFI DETECTED >= 2] - 6 Bytes: WIFI MAC (bytewise, MSB first) - 1 Byte: WIFI RSSI (UINT8 * -1) [OPTIONAL, ONLY IF NR WIFI DETECTED >= 3] - 6 Bytes: WIFI MAC (bytewise, MSB first) - 1 Byte: WIFI RSSI (UINT8 * -1) [OPTIONAL, ONLY IF NR WIFI DETECTED = 4] - 6 Bytes: WIFI MAC (bytewise, MSB first) - 1 Byte: WIFI RSSI (UINT8 * -1)	MIN 8, MAX 29	MIN 9, MAX 30

4.2 Downlink Port 3 (DATA)

The payload structure of a DATA downlink is defined as follows:

Byte No. [0...X]	Function	Comment
0	POS GET CMD	1: GPS ONLY 2: WIFI ONLY 3: GPS OR WIFI (IF GPS WAS DETECTED, NO WIFI IS DONE) 4: WIFI OR GPS (IF WIFI WAS DETECTED, NO GPS IS DONE) 5: GPS AND WIFI (DO BOTH)

4.3 Uplink Port 100 (CONFIG)

The CONFIG payload is defined as follows:

Byte No. [0...X]	Function	Comment
0	Payload version	Payload Version used by device (0 to 255, UINT8)
1	Status	0 | 0 | 0 | 0 | 0 | CONFIG SET | CONFIG GET | INIT CONFIG SET: Uplink sent because of a received CONFIG SET downlink CONFIG GET: Uplink sent because of a received CONFIG GET downlink INIT: Uplink sent at mode initialization
2	Battery voltage	Battery voltage in 5 mV steps (UINT8), where 0 equals 3000 mV or less, 254 equals 4270 mV (255 for ERROR)
3	Temperature	Temperature in °C (INT8), from -126 to 126°C (127 for ERROR)
4	App Major Version	0 to 255 (UINT8)
5	App Minor Version	0 to 255 (UINT8)
6-7	Ping Interval	15 to 50000 in minutes (UINT16, MSB first)
8	Long-Range trigger	0 to 240 (UINT8)
9	Mid-Range trigger	0 to 240 (UINT8)
10-11	Rejoin trigger	0 to 50000 (UINT16, MSB first)
12	GPS Fixes	5 to 20 (UINT8)
13	Min. WIFI detections	1 to 4 (UINT8)

4.4 Downlink Port 100 (CONFIG SET)

The payload structure of a CONFIG SET downlink is defined as follows:

Byte No. [0...X]	Function	Comment
0-1	Ping Interval	15 to 50000 in minutes (UINT16, MSB first)
2	Long-Range trigger	0 to 240 (UINT8)
3	Mid-Range trigger	0 to 240 (UINT8)
4-5	Rejoin trigger	0 to 50000 (UINT16, MSB first)
6	GPS Fixes	5 to 20 (UINT8)
7	Min. WIFI detections	1 to 4 (UINT8)

Note that changes in the settings will not take effect until the next uplink (due to Class A, RX only after TX).

4.5 Downlink Port 100 (CONFIG GET)

The payload structure of an CONFIG GET downlink is defined as follows:

Byte No. [0...X]	Function	Comment
0	CONFIG GET	VALUE MUST BE TRUE -> any value != 0

Note that the command will not be carried out until the next uplink (due to Class A, RX only after TX).

4.6 Downlink Port 102 (REJOIN)

The payload structure of a REJOIN downlink is defined as follows:

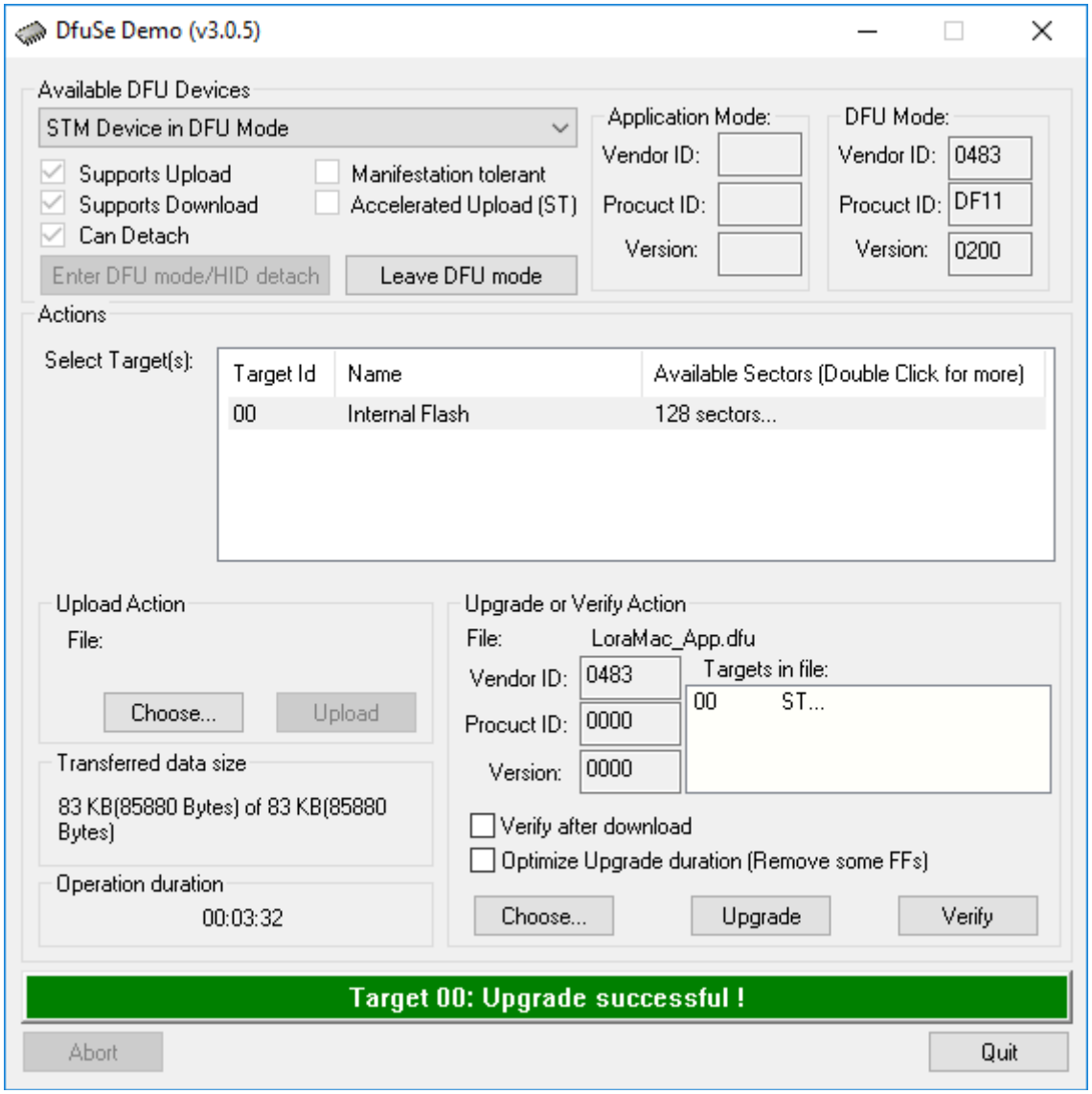
Byte No. [0...X]	Function	Comment
0	REJOIN SET	VALUE MUST BE TRUE -> any value != 0

Note that the command will not be carried out until the next uplink (due to Class A, RX only after TX).

5 SW Update over the USB Bootloader

The LPN TD-1 can be updated via USB DFU Bootloader:

1. DFU tool «DFuSe demo» start (link → http://www.st.com/en/development-tools/stsw-stm32080.html).
2. Select the current DFU file by clicking on "Choose..." under **upgrade or verify action** (bottom right).
3. Activate reed switch at restart (power-up) with the USB Cable connected to go to the bootloader mode.
4. The LED should now toggle every 500 ms.
5. The Device should appear under "available DFU devices".
6. Press "Upgrade" **upgrade or verify action** (bottom right), ignore any messages, and continue. The Update should last around 2 minutes.
7. Once the update is finished press “Leave DFU mode” and disconnect the USB cable.



Important: After installing the DFU tool, check the UM0412.pdf file. The driver path must be searched manually for the first update (C:\Program files (x 86) \STMicroelectronics\Software\DfuSe v3.0.5\Bin\Driver\).