Low Power Network

Field Measurement Guide

August 2019

NOTICE

Versions

Version	Date	Author	Details
1	28/08/19	Swisscom	Initial version

Reference documents

Item	Documents	Author
01	Swisscom LPN Portal Developer Guide	Swisscom

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1. General Information

The LoRaWAN Field Test Device by ADEUNIS RF is a ready to use system which provides connection to the Swisscom LPN using the LoRaWAN V1.0 protocol. It allows to analyze the quality of the nationwide Swisscom LPN.

Equipped with a large LCD screen, you can instantly review all operating parameters of the network (Uplink, Downlink, Spreading Factor, Packet Error Rate ...).

With built-in rechargeable battery, this demonstrator allows for many hours of use and can be recharged with any type of micro USB charger.

Once the Field Test Device is switched on, a Join procedure is automatically triggered. As soon as the Join request has been accepted the device broadcasts a radio frame every two minutes or when Button 1 is pressed.

1.1. Further notice

The Field Test Device is used to measure the strength of the downlink signal (from the gateway to the device), which will then display on the LCD. The signal of the opposite direction (uplink, device to gateway) is not shown and needs to be looked up in the Wireless Logger of the CMP LPN portal.

LoRa is a wireless radio technology, which means that the signal quality can have a big variance. Other parameters (position, height over floor, distance from the wall, orientation, door open / closed) can have a significant impact. Therefore, multiple (at least 5) measurements should be done for the same place to gain a representative view of the coverage situation.

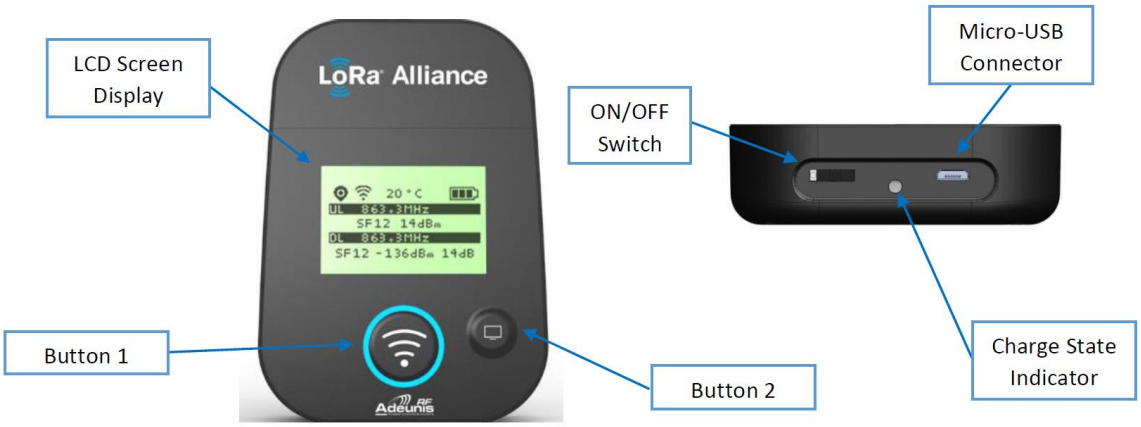
1.2. LPN Support

Further technical questions regarding coverage analysis and interpretation can be asked to Support.LPN@swisscom.com

There is also the possibility of using a tool for checking an address dataset against the LPN coverage model, or downloading the coverage overlay for Google Earth:
https://www.swisscom.ch/de/business/enterprise/angebot/iot/lpn.html

2. Field Test Device (FTD) Details

Performance	Consumption	General information
Power : up to 25mW Radiated RF power : 14dBm Sensitivity : -137dBm Modulation : LoRa™	Battery : 2000mAh Autonomy: approx. 10 hours	Dimensions : 180x72x21mm Weight : 150g Operating temperature : -20°C /+75°C Certified EN300-220 V2012



> ON/OFF Switch
To switch the device on and off. Switching on triggers a Join Request.

> Button 1
This button is used to take a measurement. The Field Test Device sends a confirmed uplink and waits for the answer of the network server. Then the signal strength will display on the screen.

> Button 2
This button is used to switch on the light of the screen and to navigate between the different menus of the Field Test Device.

2.1. Status Icons

Item	Icon	Description
GPS Status	No Icon	GPS is deactivated
		GPS is not synchronized
		GPS is synchronized
		Number of satellites GPS is tracking
		Indicates positioning accuracy
RF Status	No Icon	Product is idle
		Device is trying to join the Swisscom LPN
		Manual transmission has been triggered
		Periodic transmission has been triggered
Temperature	20°C	Temperature in °C
Battery Status		Battery level indicator

2.2. Charging the Field Test Device

The product contains a rechargeable battery. Upon connecting it to a computer via a micro-USB cable, it will automatically begin charging; even if the ON/OFF switch is on the OFF position (this behavior is similar to the one of mobile phones). The product can still be used while it's charging. During the charging process, the charge state indicator is steady red. When charging is completed, the charge state indicator becomes steady green. If the battery is completely discharged, it will need 6 hours of charging time to get back to full charge.

As long as the device is provisioned on the Swisscom LPN Portal it is forbidden to access the firmware of the device. Swisscom is not liable for any failure or misbehavior of the device after manipulation or reconfiguration of the firmware through the micro USB port.

3. How to measure

If you have to measure only outside, do only the 1st step. Otherwise, please follow step 1 and 2.

3.1. Outdoors

Once arrived on site, outside of the building, stand still and hold the FTD in your hand with the antenna pointing the sky. Switch on the FTD using the switch and wait that the device join the network. Once joined, press the button to do a measurement. Wait that an answer comes and read the result. Take an average of 5 measurements and write the results (based on chapter 3) indicating the date and the time as well.

If your application will be outdoors, place the FTD where you'd place your applicative device and retake 5 measurements.

Switch off the Field Test Device.

3.2. Indoors

First of all, if the outdoor measurement gave no results, it highly won't produce any result inside.

Place the Field Test Device (antenna pointing up) at the exact same place where you would place your applicative device.

Once in place, switch on the FTD using the switch. Take an average of 5 measurements and write the result (based on chapter 3) indicating the date and the time as well.

If there is no result (or if the device did not manage to join the network), it probably means that there is no coverage at this place. Take notes of the environment (wall, window, machines,...).

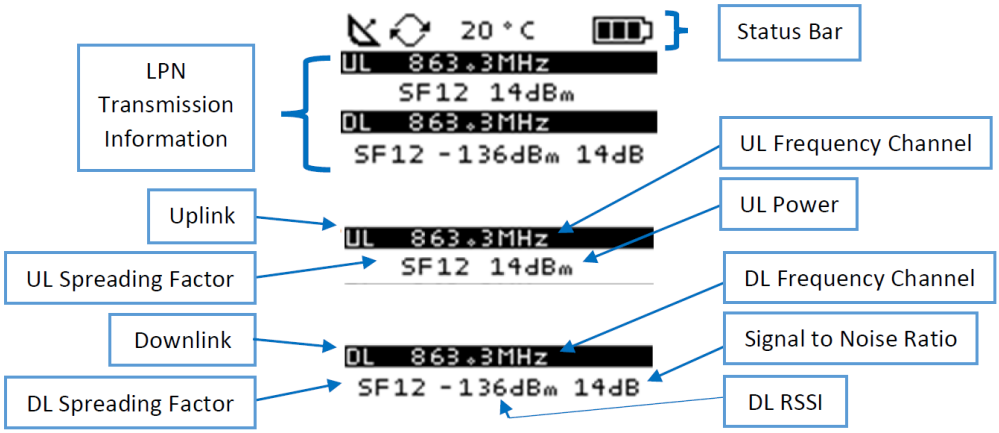
Switch off the Field Test Device

Attention: The procedure of switching on and off the device is important, as the FTD has an adaptive data rate algorithm (ADR) activated by default. If you leave it switched on after a good reception, it will change its spreading factor (SF) and adapt to this good coverage. Once in a bad reception situation, it will need time to re-adapt and might show no coverage in a place that would have coverage. Therefore always switch on and off the device between two different measurements.

4. How to read the results

4.1. The screen

The screen is split into a status bar and two parts in the LPN Transmission Information: Uplink (upper part) and Downlink (lower part).



4.2. Interpretation

The upper part shows details on the uplink sent. On the picture above, the uplink (UL) was sent over the frequency 863.3 MHz on SF12 with a transmission power of 14dBm.

Note: when you switch on the device, it tries to join the network by doing a JoinReq (JR). If the device does not manage to reach the network (could be a coverage issue then), the lower part will stay empty.

The lower part shows details on the downlink (DL) received. On the picture above, the downlink used frequency 863.3 MHz on SF12 with a RRSI value of -136dBm and a signal-to-noise (SNR) of 14dB.

Note: The Signal to Noise Ration (SNR value, number on the right) shows sometimes 255dB. This is an overflow bug and the measurement should be redone.

When reading the result, you should take care of the SNR value. Indeed, this value (14 dB on the picture above) could affect the interpretation of the result. The SNR, which represent the ratio of signal relative to the noise level, could either be positive or negative:

When positive, you can ignore it. Then the signal strength is equal to the RSSI value – middle number (-136 dBm on the picture above).

When it is negative, you should add the value of SNR to the RSSI to get an approximation of the real estimated signal power (ESP).

5. Examples

The following table shows some values for illustration:

RSSI	SNR	ESP
-80 dBm	7 dB	-80 dBm
-80 dBm	-7 dB	-87 dBm
-95 dBm	-3 dB	-98 dBm
-120 dBm	2 dB	-120 dBm
-112 dBm	-10 dB	-122 dBm

The Estimated Signal Power (ESP) can be used to interpret the signal quality:

ESP	Coverage quality
-140 dBm	This is the technical limit of LoRaWAN. A good device might still operate on SF12, but a high packet loss has to be expected
-130 dBm	This is the practical limit for LoRaWAN deployments. A good device on SF12 will operate without significant packet loss.
-120 dBm	More battery efficiency: With this coverage, a good device can operate on SF9-SF10
-100 dBm	Fairly good coverage: Most devices can operate on SF7 with lowered transmission power. There is still margin for the signal to enter a building.
-80 dBm	This signal strength can be reached only very close to to a gateway.

Remark: The exact equation to calculate ESP from RSSI and SNR is the following:

ESP = RSSI - 10*LOG(1+10^(-SNR/10))

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