

Lora final delivery report

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| 1.0.0 |  |  |  |  |
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**Related documents**

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Contents

[1. Scope 5](#_Toc125885197)

[2. Glossary 6](#_Toc125885198)

[3. Chapter 7](#_Toc125885199)

[3.1. Sub Chapter Section 7](#_Toc125885200)

[3.2. Chapter 7](#_Toc125885201)

[3.3. Table 8](#_Toc125885202)

List of Figures:

Figure 1-Satellite 8

List of Tables:

[Table 1-Table Example 9](#_Toc125885171)

# Scope

# Glossary

Each document shall include a table of glossary terms:

|  |  |
| --- | --- |
| Acronyms | |
| Term | Definition |
| SF | Spreading Factor |
| BW | Band Width |
| PER | Packet error rate |
| AFC | Automatic Frequency Control |

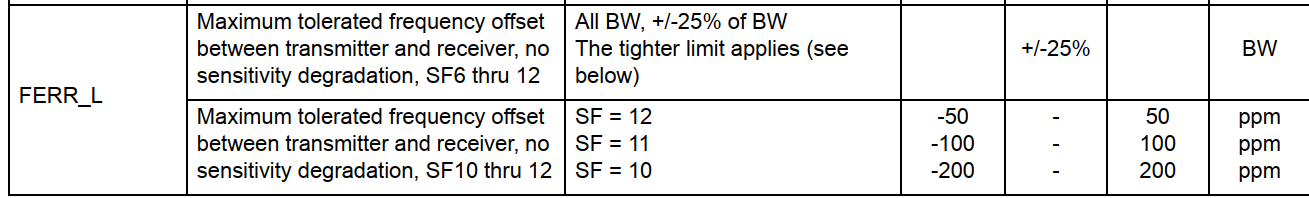
# Development History

# Lab Evaluation

## Tests portfolio

At the core of test portfolio lies the signal bandwidth and the encoding spreading factor.

|  |  |
| --- | --- |
| Demand | remark |
| BW - 125,500,500 [KHz] |  |
| SR – 8,10,11 |  |
| Message length - short(16), long(64) |  |
| Fc - 2.2,2.25,2.3[GHz] |  |
| AFC – on ,off |  |
| Low Data Rate Optimizer – on, off |  |
| Dopler |  |
| BW-err - 25% |  |
| Packet format – explicit, implicit |  |



## Packet structure:

preamble, explicit\implicit header, crc, low\_data\_rate\_optimizer, sync\_word

## Setup

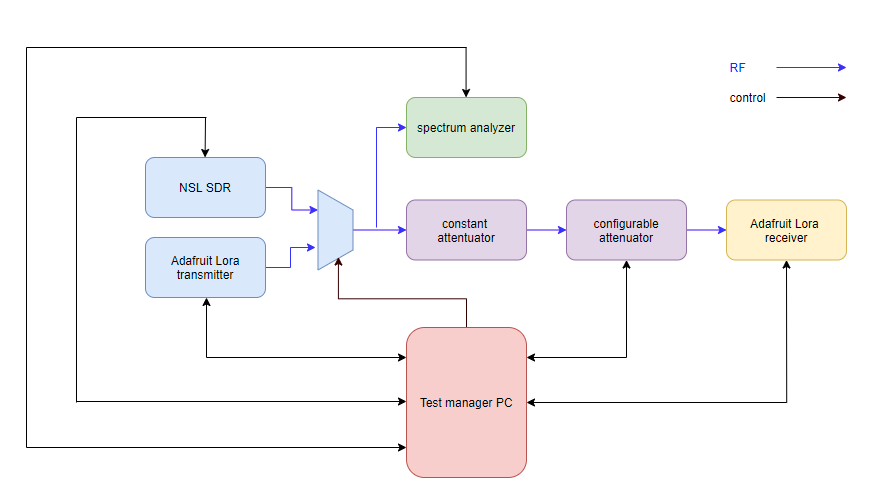


Figure 1: Lab setup

### RF path

RF signal can be generated from two sources:

* NSL SDR which is the DUT
* Adafruit Lora transmitter serves as a reference source for evaluating the DUT performance.

Signal is attenuated by two consecutive stages:

* A constant, TBD attenuator
* A mini circuits RCDAT-6000-90 configurable attenuator:
  1. resolution of 0.25dB
  2. Dynamic range of 0-90dB



Then it is applied to the Adafruit Lora M0 RFM95 LoRa Radio receiver:

* Based on Semtec SX1276 Lora transceiver.
* Embeds an Arduino controller.

A close-up of a circuit board

Description automatically generated

Remark:

The same board is used as a reference transmitter.

In parallel, pre-attenuated signal is injected into a spectrum analyzer for power measurements.

### Control path

The setup is managed by a single, test manager PC whose tasks are:

* Manage all controllable devices.
* Run the tests.

Control is done via serial (UART) or LAN connections.

## Test flow

Main principles lead for the test flow design were:

* For each tested configuration, gain receiving sensitivity at various PER levels, as many as possible.
* Maintain a reasonable testing duration.

Elaborating the term “reasonable testing duration” one must consider that, for maintaining a certain PER level, the total number of received packets should be larger by at least one order. For example, for measuring a true PER of 1e-3 at least 1e4 packets should be received. Considering that the packet rate is around 1 packet/sec, we get to more than 3 hours for a single iteration!

Thus, the following steps were taken:

* Limit the PER scale to 1e-3.
* For reaching test working point use:
  + Accumulated knowledge on system behavior from previous stages
  + Use relatively large (coarse) attenuation steps in the search stage.

A diagram of a workflow

Description automatically generated

Figure 2: Test flow main state machine

The test flow is handled by a principle state machine, described briefly herein:

### Init

* Creating symbols files (currently done off line, see TBD)
* Verify connection with all controllable devices.
* Get the attenuation level such that no bad frames are detected for the least evaluated robust mode, SF = 8. This level, , is the base line for all tests.

The algorithm for finding :

A diagram of a flowchart

Description automatically generated

Figure 3: Finding base attenuation level

Parameters used for this stage are:

* = 1 dB
* = 10 sec
* = 3 dB

Remark:

The search for the base attenuation level is performed once per HW setup and saved. Later runs uses the saved

### Config test

* Spreading factor and band width parameters are configured.
* An adequate pre-defined symbols file is determined.

### Find working point

A diagram of a flowchart

Description automatically generated

Figure 4: Finding working point

Parameters used for this stage are:

* = 1 dB
* = 10 sec
* = 3 dB

### Measure

A diagram of a process

Description automatically generated

Figure 5: Measurement process

Parameters used for this stage are:

* = 0.25 dB
* = 30 min

## Logging

For each test, a dedicated logger file should be maintained, for which the contents (per test state) are described:

### Config test

The test configuration should be printed at the top of the logger file.

### Find working point

* If process succeeded:

### “Find working point” succeeded with Wp = ….

* If process failed:

### “Find working point failed due to….”

### Measure

|  |  |  |  |
| --- | --- | --- | --- |
| L | N\_good | N\_bad | PER |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

* “L\_wp = [L\_wp]”

“L\_wp = Null”

# Space Evaluation

# Summary