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SX1272 Development Kit

USER GUIDE

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1 Preamble

This document describes how to use the SX1272 Evaluation kit. This document describes especially the SX1272 Eiger platform and the SX1272 SKA User Interface. We strongly recommend for the user to read thoroughly the datasheet of the SX1272 prior to start working on the device. Most of this document assumes a general knowledge on the SX1272 and modern RF communications.

2 Introduction

The SX1272 is a single-chip integrated circuit ideally suited for today's high performance ISM band RF applications. Added to the renowned, high-performance and low-cost, FSK / OOK RF transceiver modem, the SX1272 is also equipped with the LoRa proprietary transceiver modem. This advanced feature set, including a state of the art packet engine, greatly simplifies system design whilst the high level of integration reduces the external BOM to a handful of passive decoupling and matching components. It is intended for use as high-performance, long range, half-duplex bi-directional RF links, and where stable and constant RF performances are required over the full operating range of the device down to 1.8V.

The SX1272 is intended for applications over a wide frequency range, including the 868 MHz European and the 902-928 MHz North American ISM bands. Coupled with a link budget in excess of 135 dB in FSK in excess of 155 dB in LoRa, the SX1272 really offers the possibility of two modems in one single package. The SX1272 complies with both ETSI and FCC regulatory requirements and is available in a 5x5 mm QFN 28 lead free package.

The SX1272 Evaluation kit, based around the Eiger platform, allows the user to test every aspect of the radio, both from the system and RF point of view.

On one hand, the Eiger platform is a touch screen portable device which has been design to enable quick and easy testing of the PER performances of the SX1272. On the other hand, the SX1272SKA is a PC based evaluation tool which allows in depth testing of the radio.

This document is therefore divided in two parts: the first part present the SX1272 Eiger module and how to perform PER test in LoRa and FSK; the second part of this document present the SX1272 SKA and how it can be used to test every single aspect of the radio.

3 Getting Started

3.1 Evaluation Kit Contents

The SX1272SKA evaluation kit consists of:

- 2 x Eiger platforms
- 2 x SX1272 modules
- 2 x ½ wave dipole antennas
- 2 x Mini-USB cables
- Insert sheet



Figure 1: SX1272 Development Kit (SX1272DVK1BAS - 868MHz version)

3.2 Ordering information

Each of part of the SX1272 Evaluation kit can be ordered as a single entity or in a whole package. When ordering, please refer to the following parts numbers:

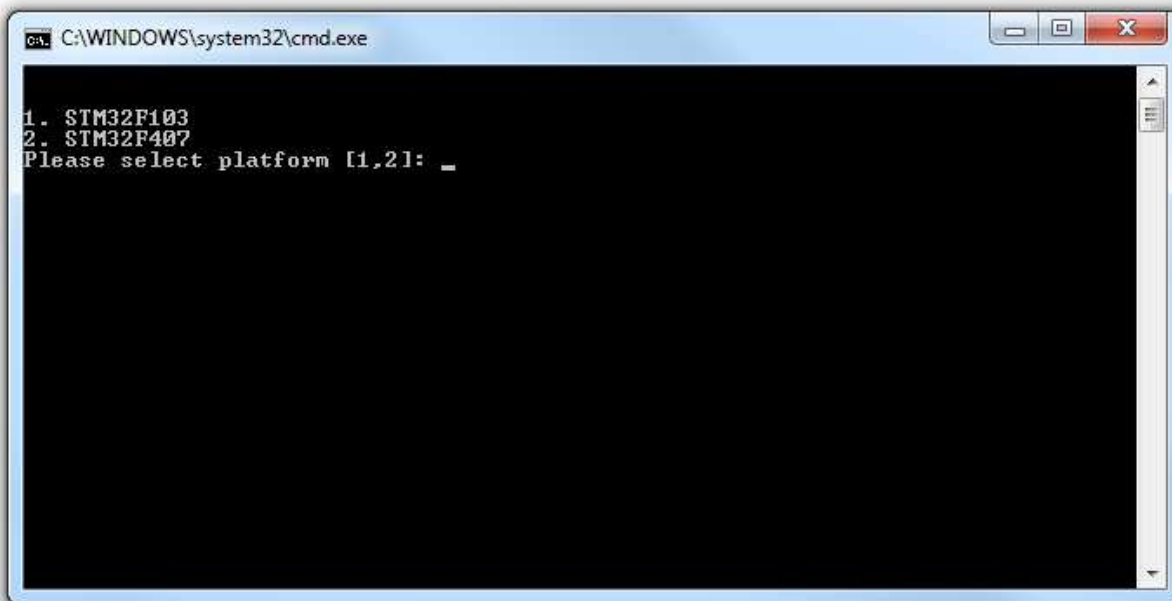
SX1272DVK1BAS	SX1272 Development Kit (868MHz version)
SX1272DVK1CAS	SX1272 Development Kit (915MHz version)
SX1272RF1BAS	SX1272 Evaluation Module (868MHz version + antenna)
SX1272RF1CAS	SX1272 Evaluation Module (915MHz version + antenna)

For more information on each of the options available, please, contact your local Semtech representative. The SX1272SKA evaluation software, the firmware, drivers and all SX1272 related materials are available on the Semtech website: <http://www.semtech.com/wireless-rf/rf-transceivers/>

3.3 Updating the firmware

Updating the Eiger platform firmware is straight forward given that the user follows some simple steps. The first step is to install the Eiger platform drivers on the PC used to update the firmware. These drivers, called RLink USB drivers are located in the folder RLinkDrv given with every version of the firmware. To install the driver, simply launch the file RLinkUSBInstall.exe.

Once the RLink drivers are installed, the firmware upgrade is done through the update.bat file which will upload the correct version of the firmware depending on several options related to the Eiger platform or module being used. When launching the application, the following window opens:



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This window invites the user to select the STM32 daughter board fitted on the Eiger platform. The pictures below should help the user to recognize which daughter board is which. Added to this, the STM32F407 daughter board is equipped with a small camera clearly visible at the back of the module.

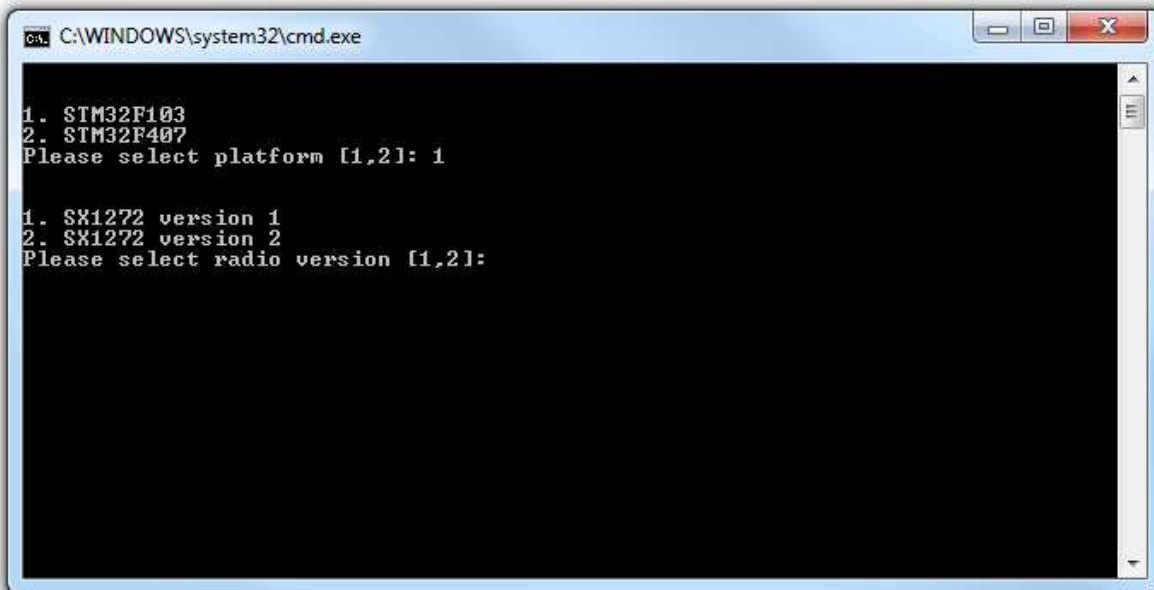


STM32F103 Module

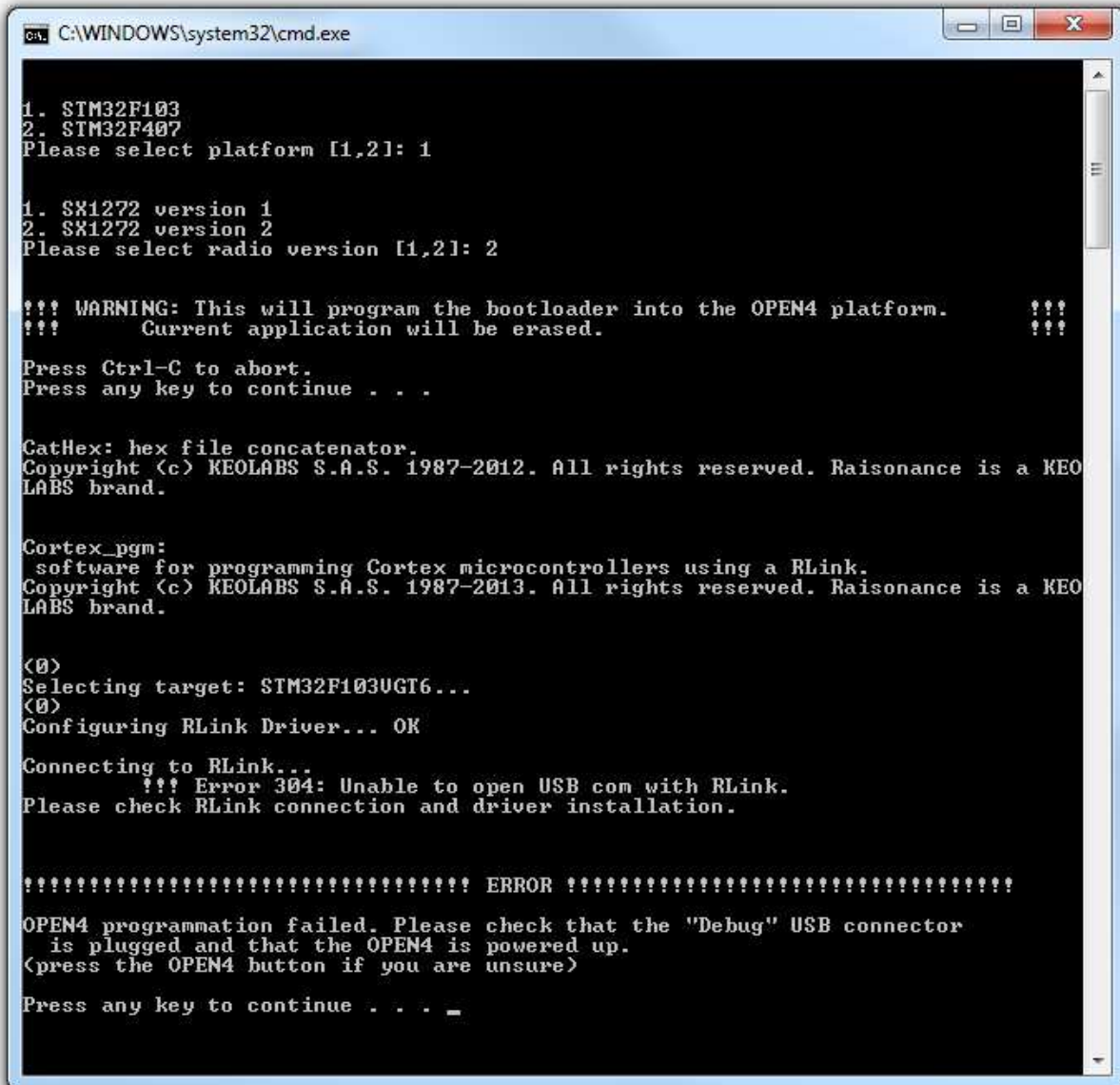


STM32F407 Module

The upgrader then needs to know which version of the SX1272 is used with the Eiger platform. Most users should have the Version 2 of the device. In case of doubt, please contact your Semtech representative.



If the Eiger platform is not powered up, is wrongly connected or if the RLink drivers are not installed, the following message will be displayed on the screen:



```
C:\WINDOWS\system32\cmd.exe

1. STM32F103
2. STM32F407
Please select platform [1,2]: 1

1. SX1272 version 1
2. SX1272 version 2
Please select radio version [1,2]: 2

!!! WARNING: This will program the bootloader into the OPEN4 platform.    !!!
!!!      Current application will be erased.                               !!!

Press Ctrl-C to abort.
Press any key to continue . . .

CatHex: hex file concatenator.
Copyright (c) KEOLABS S.A.S. 1987-2012. All rights reserved. Raisonance is a KEO
LABS brand.

Cortex_pgm:
software for programming Cortex microcontrollers using a RLink.
Copyright (c) KEOLABS S.A.S. 1987-2013. All rights reserved. Raisonance is a KEO
LABS brand.

<0>
Selecting target: STM32F103UGT6...
<0>
Configuring RLink Driver... OK

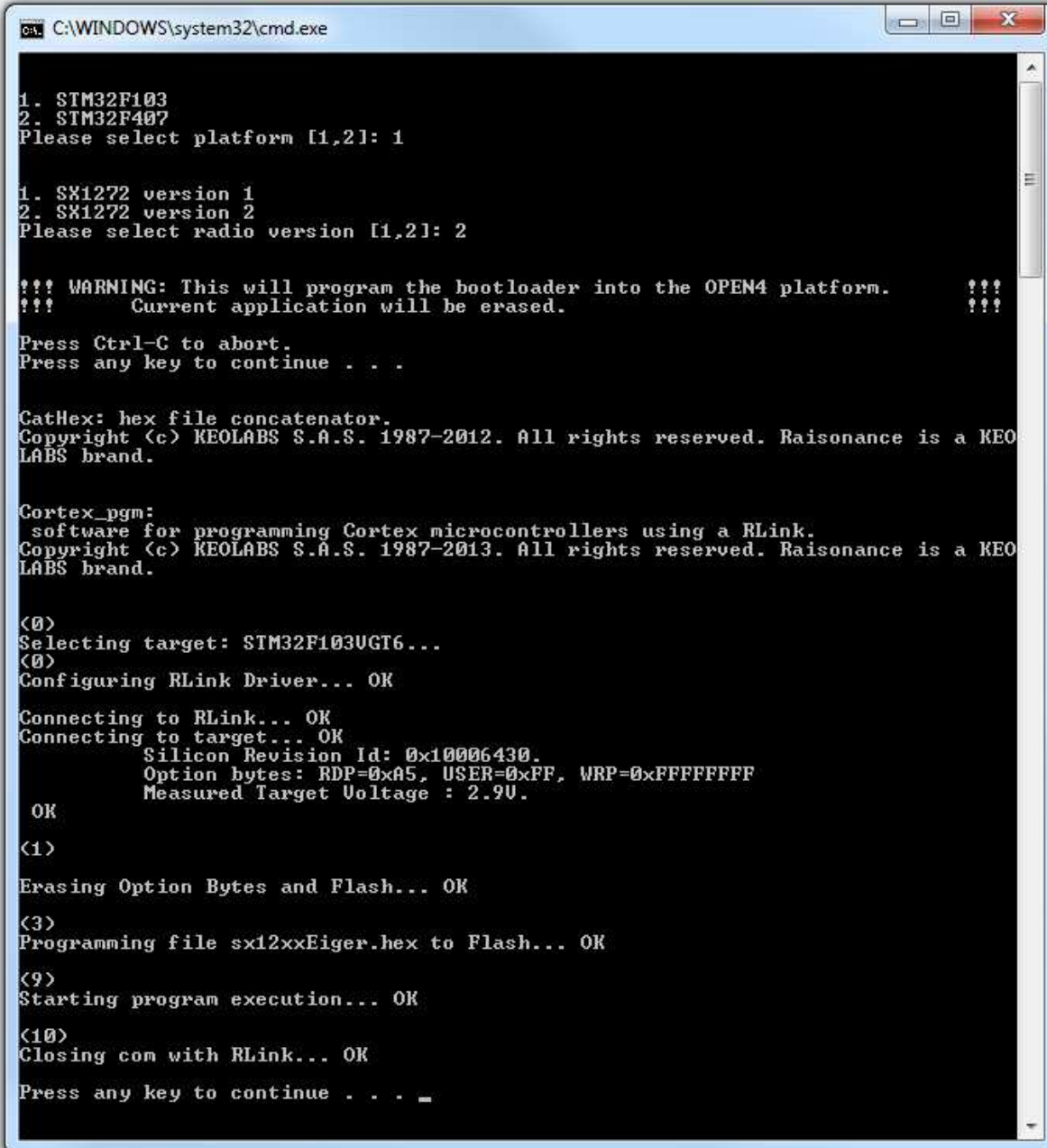
Connecting to RLink...
!!! Error 304: Unable to open USB com with RLink.
Please check RLink connection and driver installation.

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
OPEN4 programmation failed. Please check that the "Debug" USB connector
is plugged and that the OPEN4 is powered up.
<press the OPEN4 button if you are unsure>

Press any key to continue . . . _
```

In this situation, the user need to make sure the device is correctly powered and turned on. Please, refer to section 4.1 of this document for more information.

This is what the full upgrader should look like at the end of the software update.



```
C:\WINDOWS\system32\cmd.exe

1. SIM32F103
2. SIM32F407
Please select platform [1,2]: 1

1. SX1272 version 1
2. SX1272 version 2
Please select radio version [1,2]: 2

!!! WARNING: This will program the bootloader into the OPEN4 platform.    !!!
!!!      Current application will be erased.                               !!!

Press Ctrl-C to abort.
Press any key to continue . . .

CatHex: hex file concatenator.
Copyright (c) KEOLABS S.A.S. 1987-2012. All rights reserved. Raisonance is a KEOLABS brand.

Cortex_pgm:
software for programming Cortex microcontrollers using a RLink.
Copyright (c) KEOLABS S.A.S. 1987-2013. All rights reserved. Raisonance is a KEOLABS brand.

<0>
Selecting target: SIM32F103UGT6...
<0>
Configuring RLink Driver... OK

Connecting to RLink... OK
Connecting to target... OK
      Silicon Revision Id: 0x10006430.
      Option bytes: RDP=0xA5, USER=0xFF, WRP=0xFFFFFFFF
      Measured Target Voltage : 2.90.

OK

<1>
Erasing Option Bytes and Flash... OK

<3>
Programming file sx12xxEiger.hex to Flash... OK

<9>
Starting program execution... OK

<10>
Closing com with RLink... OK

Press any key to continue . . . _
```

Once the software has been upgraded, it is recommended to reset all the internal settings on the Eiger platform. For more information on how to achieve this, please, refer to section 5.2.1.1 of this document.

4 Eiger Platform Presentation

4.1 Platform Description

The Eiger platform is intended to enable a quick and easy range test of the sx1272 module. Here most of the modem parameters are pre-configured and the user only needs to set some RF parameters.

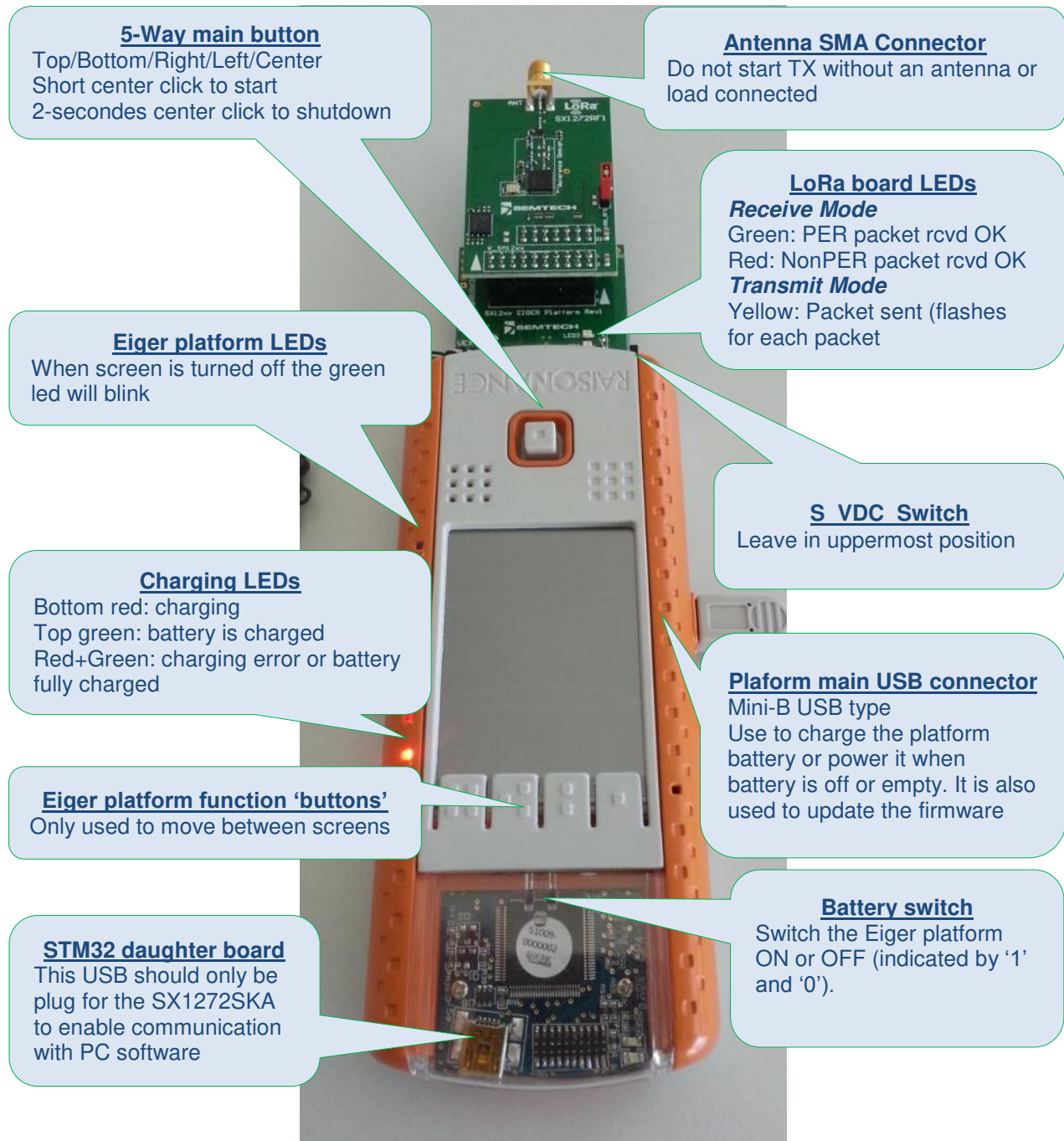


Figure 2: Eiger platform description

4.2 SX1272 Module Hardware

The SX1272SKA is a USB based evaluation software designed to allow simple and easy evaluation of the suitability of the SX1272 for a given application. The low component count reference design implemented in the SX1272RF1xAS reference board is illustrated below in Figure 3.

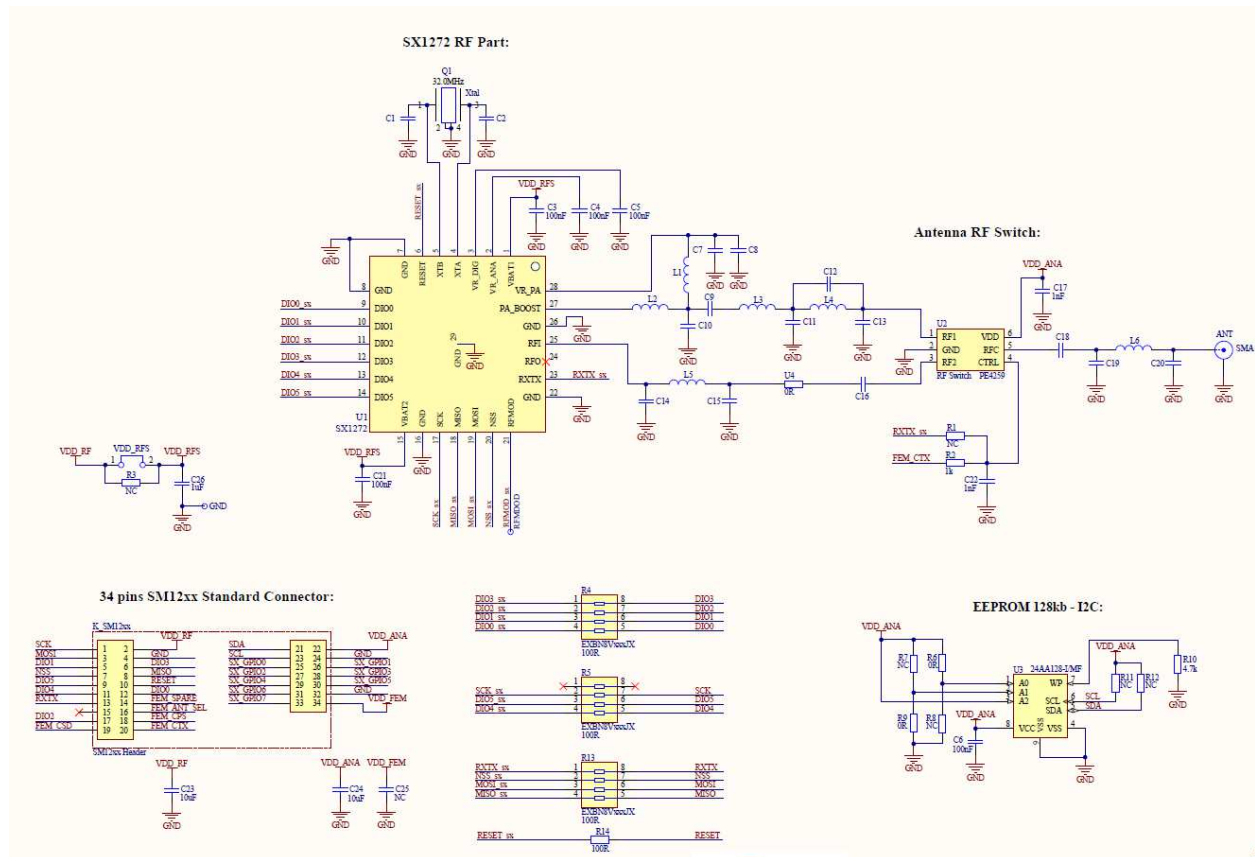


Figure 3: Sx1272 Module Schematic

The circuit has been specifically match to offer the best performances in the 860-930MHz range.

5 Eiger platform for PER Testing

5.1 Menu Description

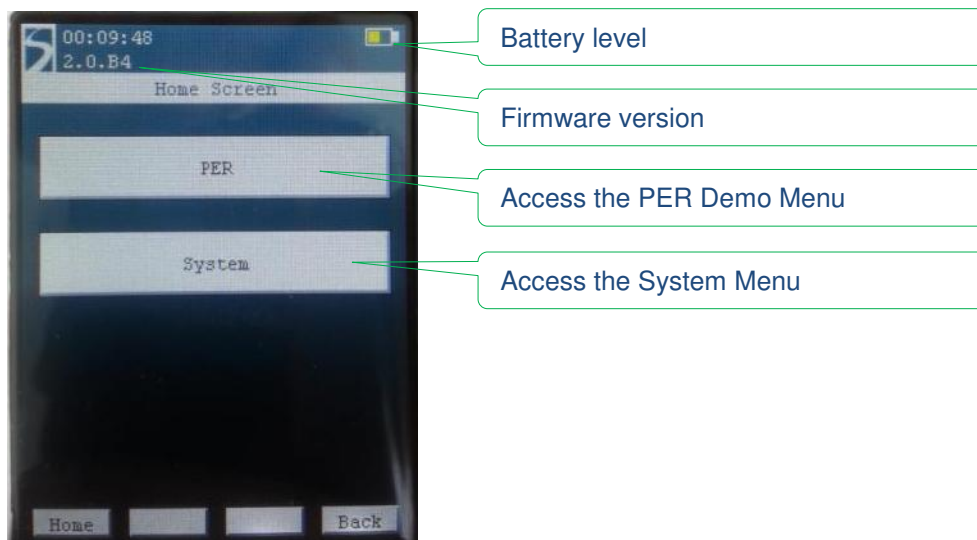
The Eiger menu is organized around the touch screen which allows the user to set on the fly a limited number of parameters. We will here describe each menu window so that the user can quickly start doing PER testing.

The idea behind the PER demo is to set one of the Eiger platform as a transmitter and the other one as a receiver. Then both platforms can be moved away one from the other, in an urban or in an open field environment, to easily capture the PER between the transmitter and the receiver.

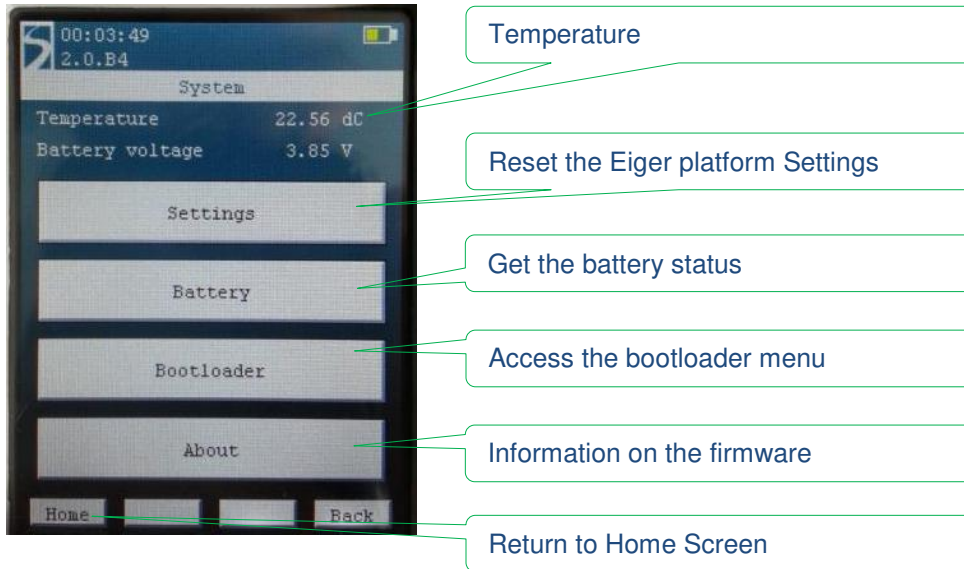
The PER demo operates in FSK or in LoRa modes so that the advantages and drawbacks of each modulation can be seen easily.

5.2 Using the Eiger platform

The home screen is the first window displayed on the control touch screen.

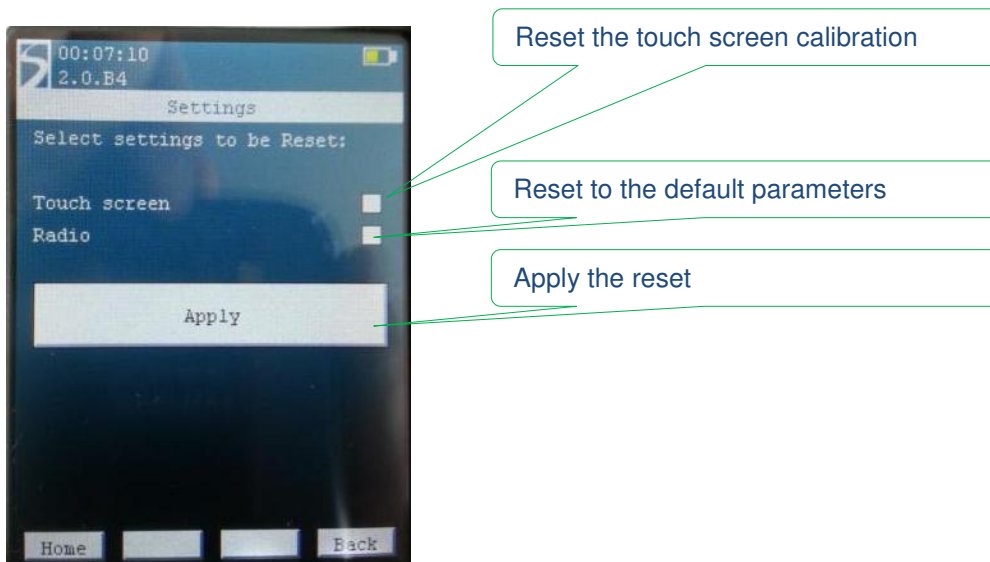


5.2.1 System Window



5.2.1.1 Settings

In case of miss-operation or to simply reset the Eiger module into a known state, it is possible the reset the touch screen parameters or to reset the device parameters to their default parameters.



Once a box is ticked, “clicking” on the Apply button will reset the selected parameters. The ticked box will then go un-ticked.

5.2.1.2 Battery

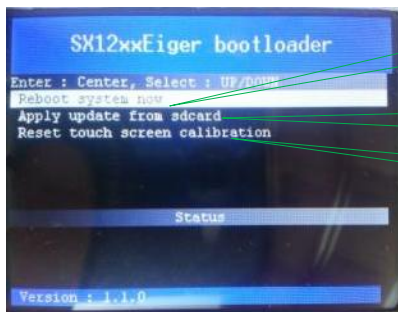


Indicates the battery state

Indicates the battery level

Indicates the voltage delivered by the battery

5.2.1.3 Bootloader

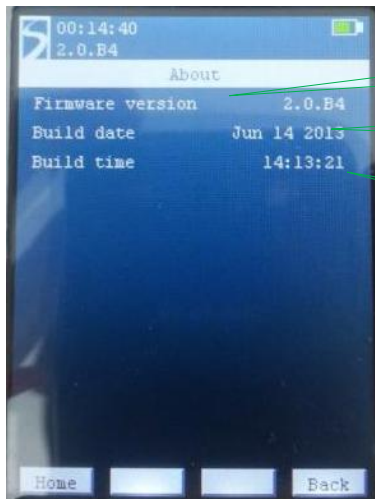


Reboot the system

Update the firmware through an SD card

Reset touch screen calibration

5.2.1.4 About

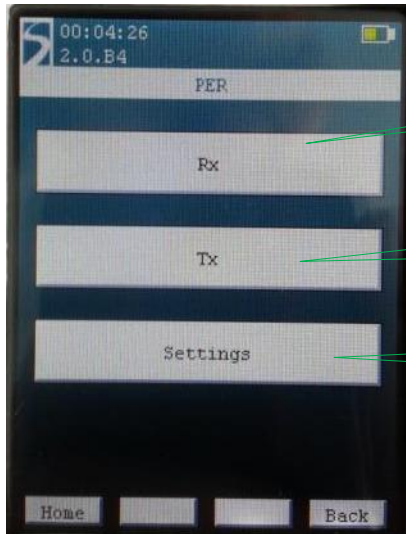


Indicates the Firmware version

Indicates the Build date

Indicates the Build time

5.2.2 PER Demo Window



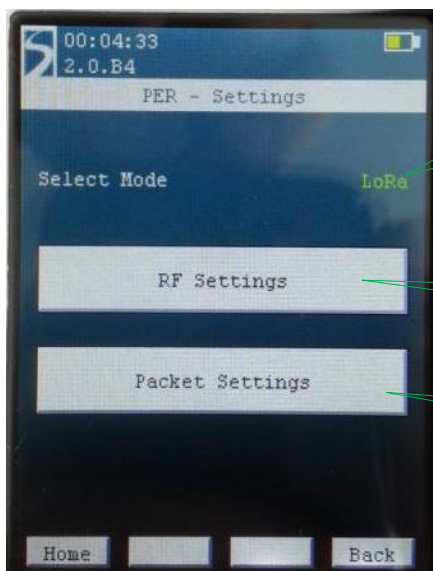
Set the device as Receiver for the PER test

Set the device as Transmitter for the PER test

Set the RF Settings for the PER test

The PER Demo menu is the core of the Eiger platform testing. The menu is divided in three main areas, Tx, Rx and Settings. The PER Settings menu allows the user to set several parameters of the Radio for Tx and Rx.

A text in green indicates that the value can be changed. For example, on the first window of the PER Setting screen, you will see:



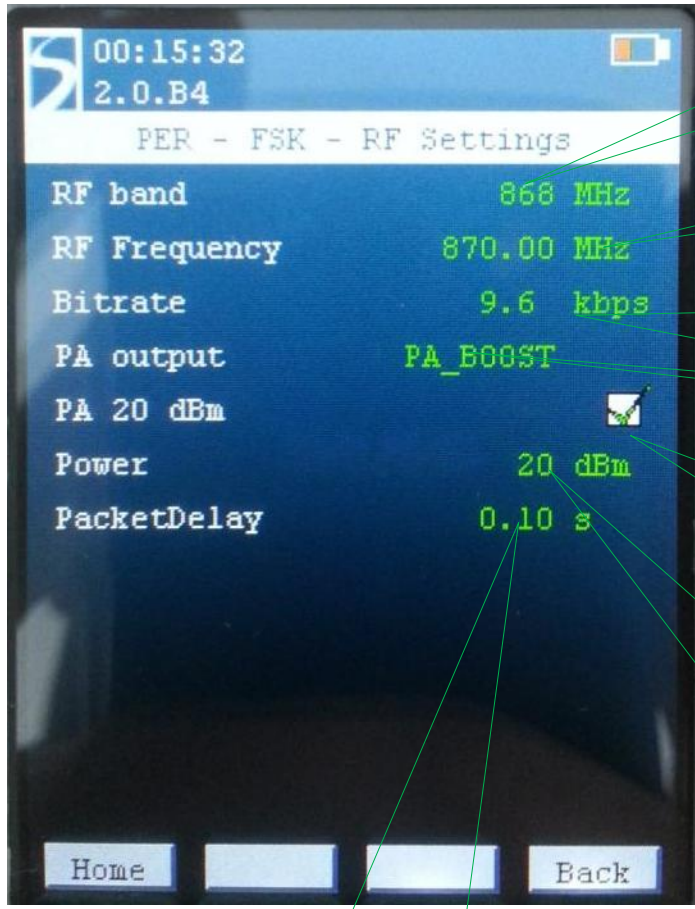
"Clicking" on this parameters allow the user to change its value. Here, the user can set the device in LoRa (Default) or FSK mode

Set the RF settings

Set the packet settings

5.2.2.1 PER Settings Menu running in FSK mode

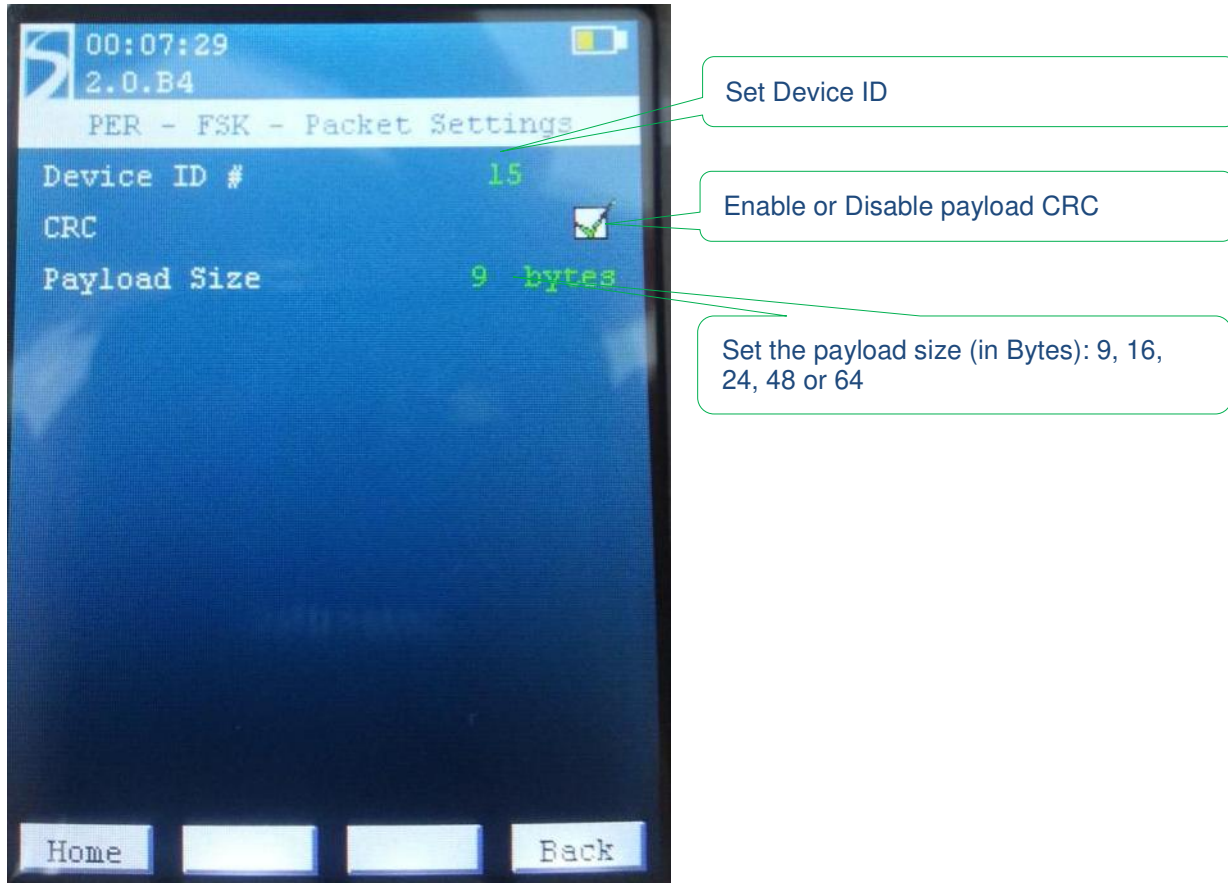
For a given modulation, there is only a limited set of parameters that can be set by the user. Most of the parameters are set automatically in the software to keep the interface user friendly.



00:15:32
2.0.B4
PER - FSK - RF Settings

RF band	868 MHz	Set the RF Band (868MHz or 915MHz)
RF Frequency	870.00 MHz	Set the RF frequency (within the band)
Bitrate	9.6 kbps	Set the Bitrate: 4.8kbps, 9.6kbps, 19.2kbps, 38.4kbps, 57.6kbps or 100kbps
PA output	PA_BOOST	Set the RF output (module dependent)
PA 20 dBm	<input checked="" type="checkbox"/>	Set the Output Power boost
Power	20 dBm	Set the RF output power
PacketDelay	0.10 s	Set the inter-packet delay

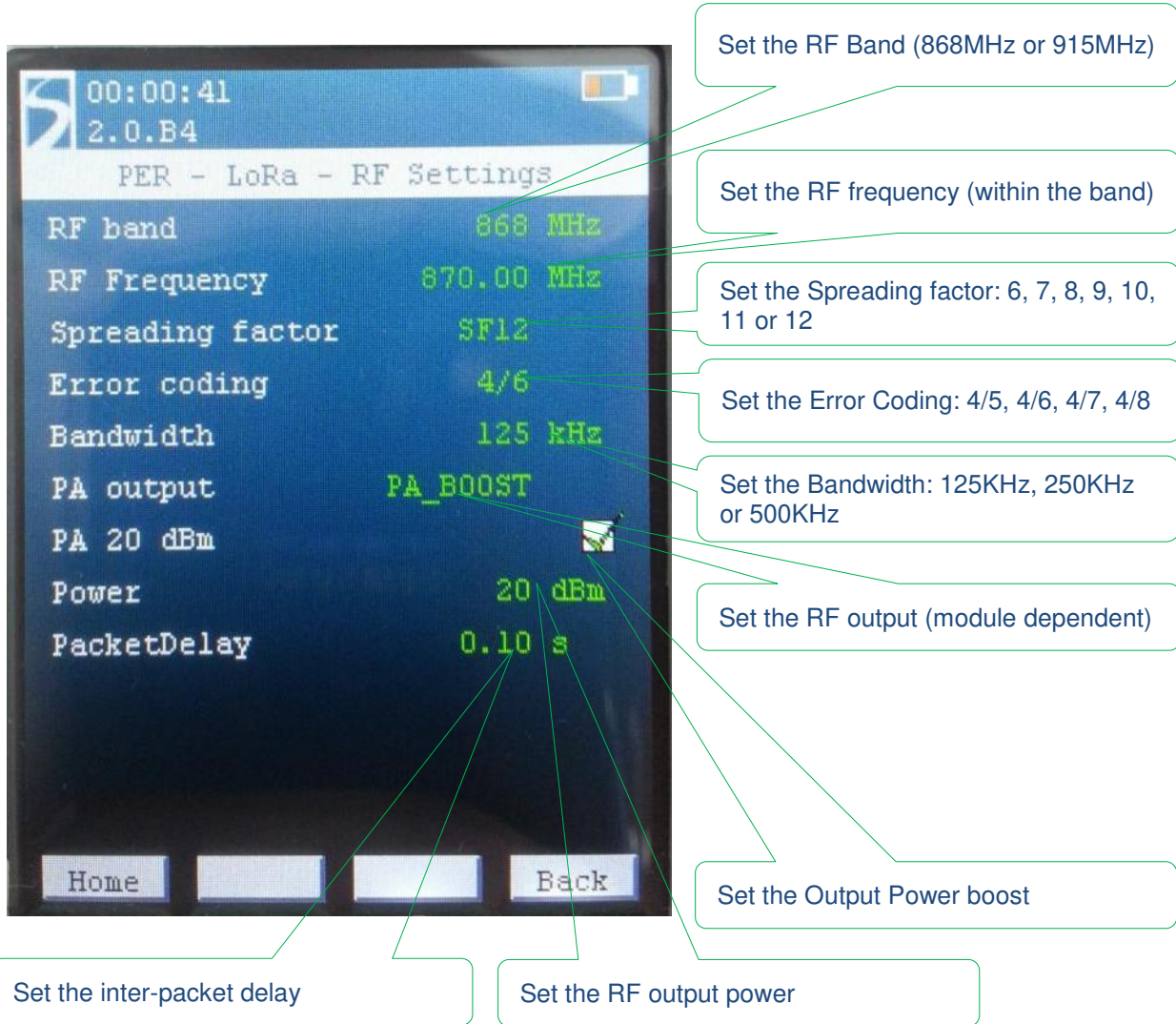
Home [] [] Back

5.2.2.2 PER Packet Settings Menu running in FSK mode


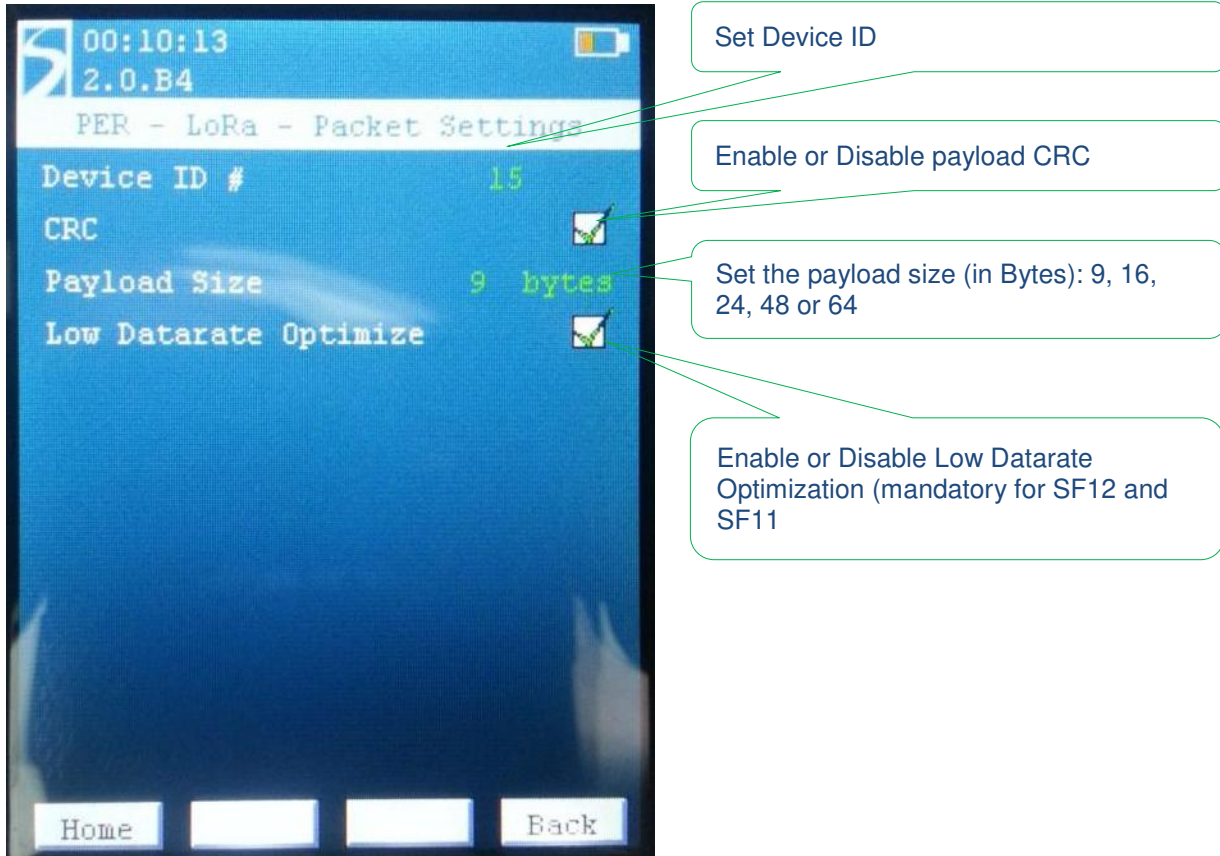
In FSK mode, the payload is built in the following way:

Preamble (8 Bytes)	SyncWord (0x69-0x81-0x7E-0x96)	Payload length (1 Byte)	Payload (Platform ID, 32-bit packet cnt, 'P', 'E', 'R', FCS, 'Padding [xx Bytes]')	CRC (2 Bytes)
-----------------------	-----------------------------------	-------------------------------	---	------------------

The preamble length, the SyncWord and the basic payload structure cannot be changed by the user. However, the payload length is adjustable and the 'Padding' field will increase or decrease depending of the payload size. The CRC can also be enabled or disabled from the packet settings menu. All in all the smallest packet will be 22 bytes long and the longest packet will be 78 bytes long in total.

5.2.2.3 PER Settings Menu running in LoRa mode


Setting	Value	Instruction
RF band	868 MHz	Set the RF Band (868MHz or 915MHz)
RF Frequency	870.00 MHz	Set the RF frequency (within the band)
Spreading factor	SF12	Set the Spreading factor: 6, 7, 8, 9, 10, 11 or 12
Error coding	4/6	Set the Error Coding: 4/5, 4/6, 4/7, 4/8
Bandwidth	125 kHz	Set the Bandwidth: 125KHz, 250KHz or 500KHz
PA output	PA_BOOST	Set the RF output (module dependent)
PA 20 dBm	<input checked="" type="checkbox"/>	Set the Output Power boost
Power	20 dBm	Set the RF output power
PacketDelay	0.10 s	Set the inter-packet delay

5.2.2.4 PER Packet Settings Menu running in LoRa mode


In LoRa mode, the payload is built in the following way:

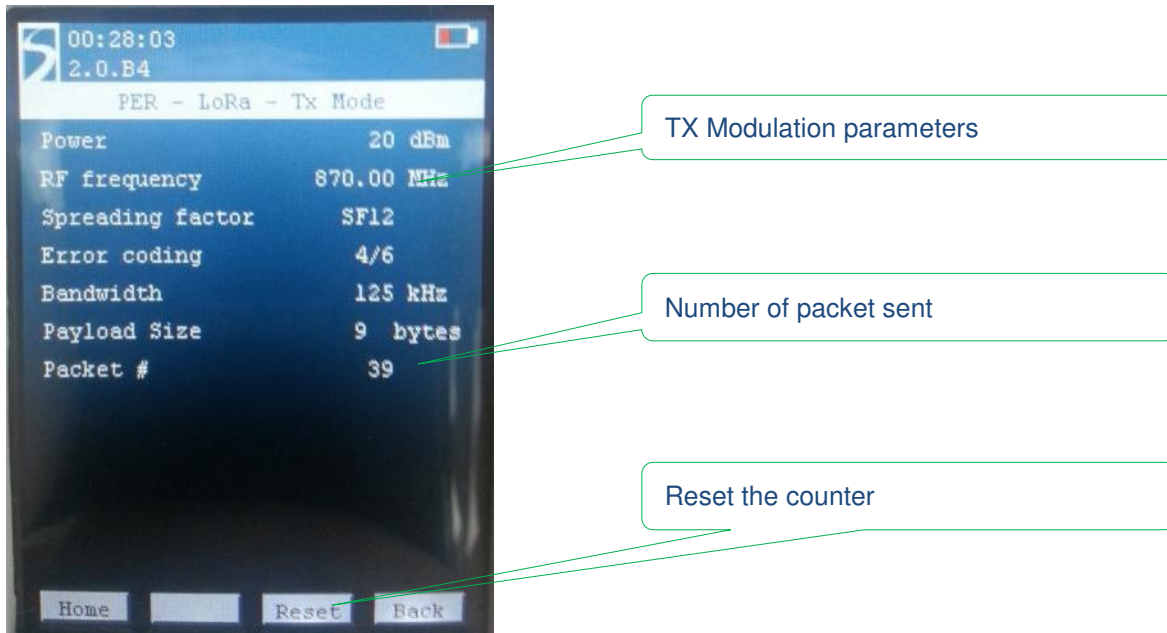
Preamble (8 Symb.)	Header (8 Symb.)	Payload (Platform ID, 32-bit packet cnt, 'P', 'E', 'R', FCS, 'Padding [xx Bytes]')	CRC (2 Bytes)
-----------------------	---------------------	---	------------------

The preamble length, the Header and the basic payload structure cannot be changed by the user. However, the payload length is adjustable and the 'Padding' field will increase or decrease depending of the payload size. The CRC can also be enabled or disabled from the packet settings menu.

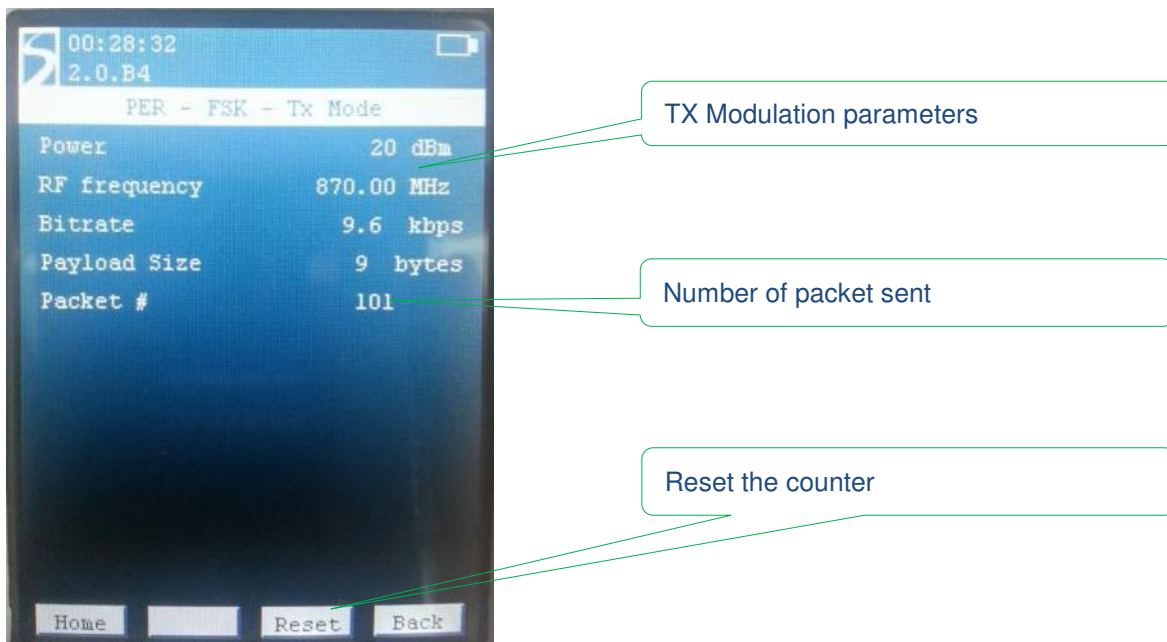
5.2.2.5 PER TX Mode

Once the RF parameters are set, putting the Eiger module in TX mode will initiate the packet transmission. The TX window displays the RF parameters and the number of packet sent since the beginning of the test.

PER Tx window in Lora mode:

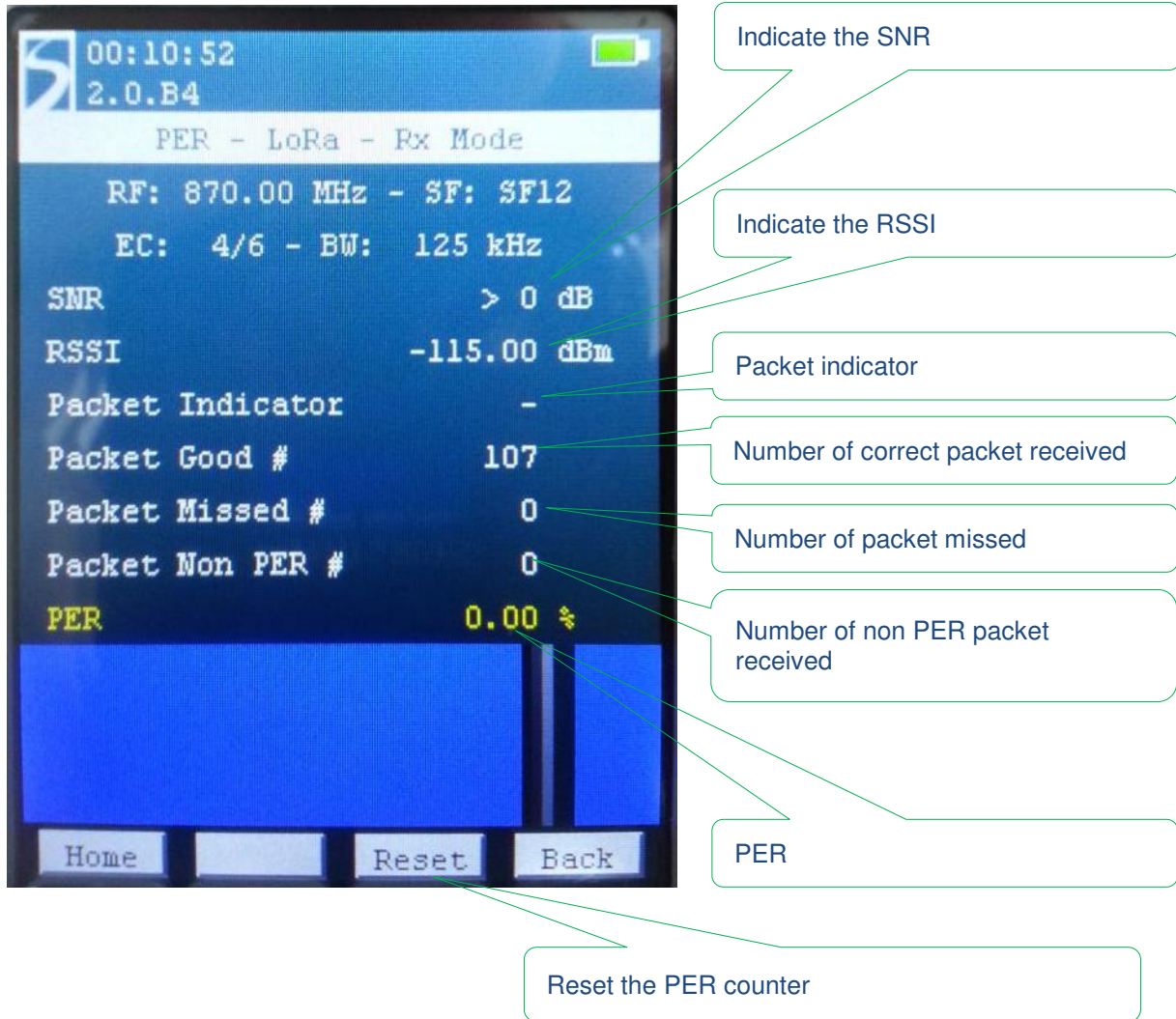


PER Tx window in FSK mode:



5.2.2.6 PER RX Mode

PER Rx window in Lora mode:



The screenshot shows the following data on the screen:

- 00:10:52 (Time)
- 2.0.B4 (Version)
- PER - LoRa - Rx Mode (Title)
- RF: 870.00 MHz - SF: SF12 (Frequency and Spreading Factor)
- EC: 4/6 - BW: 125 kHz (Error Correction and Bandwidth)
- SNR > 0 dB (Signal-to-Noise Ratio)
- RSSI -115.00 dBm (Received Signal Strength Indicator)
- Packet Indicator - (Indicator)
- Packet Good # 107 (Number of correct packets received)
- Packet Missed # 0 (Number of missed packets)
- Packet Non PER # 0 (Number of non-PER packets received)
- PER 0.00 % (Packet Error Rate)

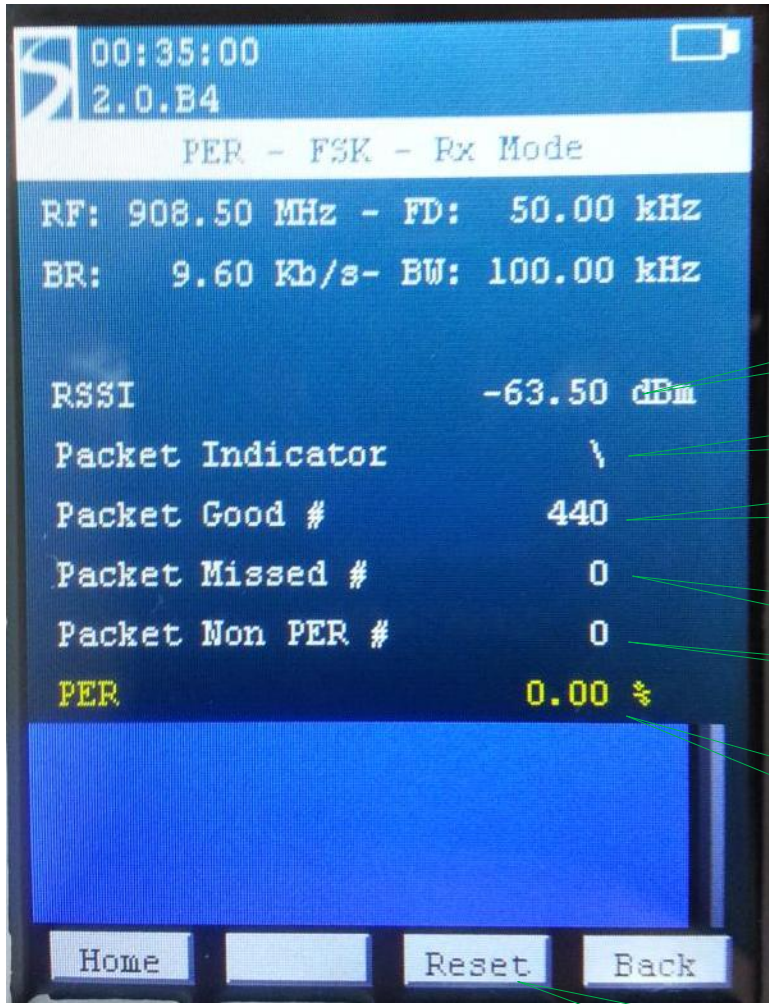
Callouts from the image:

- Indicate the SNR
- Indicate the RSSI
- Packet indicator
- Number of correct packet received
- Number of packet missed
- Number of non PER packet received
- PER
- Reset the PER counter

In LoRa mode, when sub-noise reception is occurring (SNR < 0), the displayed RSSI value is extrapolated using the SNR indicator. When the SNR > 0, the actual SNR is not computed and the value is clamped.

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PER Rx window in FSK mode:



00:35:00
2.0.B4

PER - FSK - Rx Mode

RF: 908.50 MHz - FD: 50.00 kHz
BR: 9.60 Kb/s - BW: 100.00 kHz

RSSI -63.50 dBm

Packet Indicator \

Packet Good # 440

Packet Missed # 0

Packet Non PER # 0

PER 0.00 %

Home Reset Back

Indicate the RSSI

Packet indicator

Number of correct packet received

Number of packet missed

Number of non PER packet received

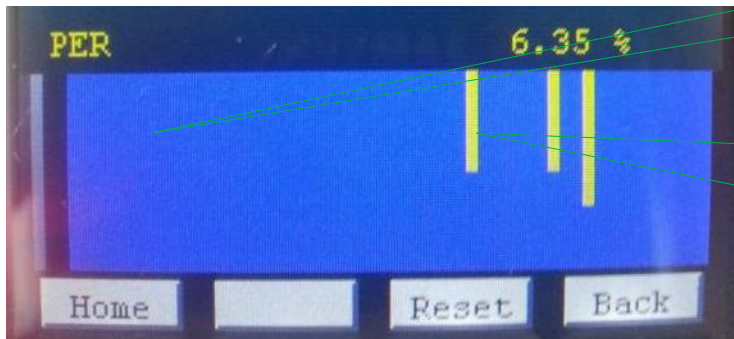
PER

Reset the PER counter

5.2.3 PER Rx Bar-graph

In Rx mode, a bar-graph indicates the distribution of the error over time. This is especially useful to detect the cause of the error, whether a burst of noise in the frequency band or if the device is in the limit of reception range. The examples below highlight what each case looks like:

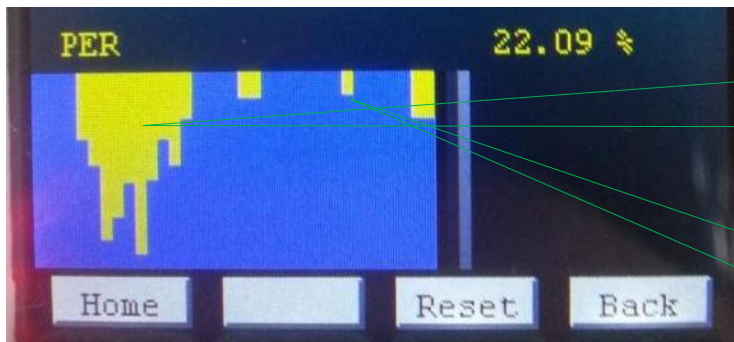
Here, the device is at the limit of the reception range



Blue: the reception is good and we are receiving every packet sent

Yellow: We have some disturbance in the frequency band or we are arriving at the limit range of reception and we start missing packets.

As we can see in the picture below, the device lost many packets in a short amount of time.



Yellow: We have had a strong burst of noise in the band and we have missed most of the packet during a small amount of time

The link has improved and we are only missing a few packets after the original noise burst.

6 SX1272SKA Software Description

The SX1272SKA is organized on a PC software GUI communicating through USB with the Eiger platforms. In this situation, the Eiger platforms are only used as a gateway to communicate with the SX1272.

6.1 SX1272SKA Quick start Guide

It is recommended that this user guide is read in conjunction with the SX1272 datasheet.

1. Plug the Eiger Platform USB ports to the computer (one USB is used to power the platform while the other USB is used for communication).
2. Run the SX1272 User Interface software: Start > All Programs > SX1272SKA > SX1272SKA
3. The SX1272SKA should connect automatically to the User Interface Software. If not, click on the USB connect button, located in the top left hand corner of the window toolbar.
4. Once connected the SX1272SKA shows the default configuration of the SX1272 register settings upon power-up. If the EVK is not connected, the GUI screen is grayed out and an error message is displayed in the bottom left hand corner of the status bar.

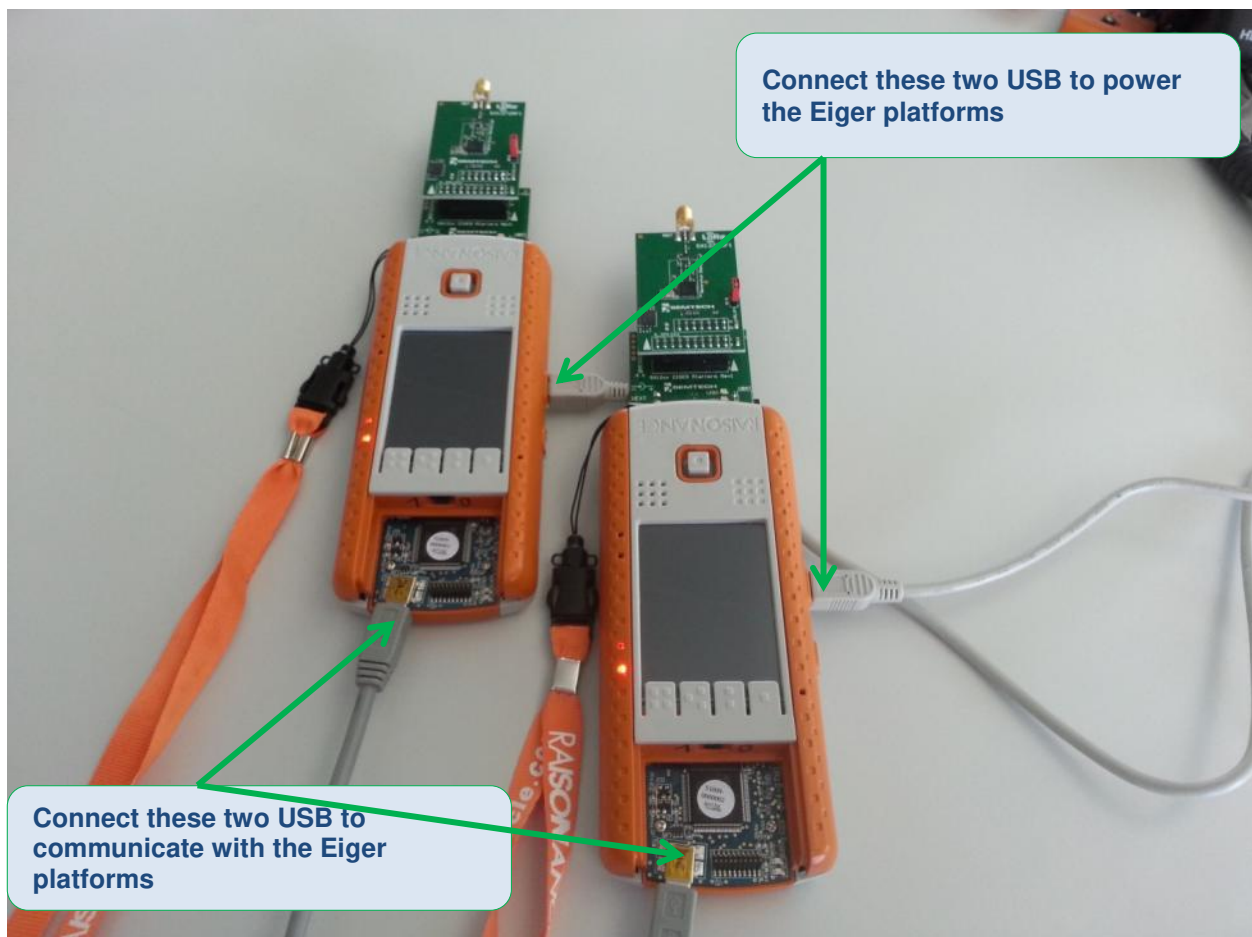


Figure 4: Connect both USB ports to use the SX1272SKA

The SX1272SKA has been developed to test all the capabilities and features of the FSK and LoRa modems present in the device. However, both modems have different control commands and must be operated independently.

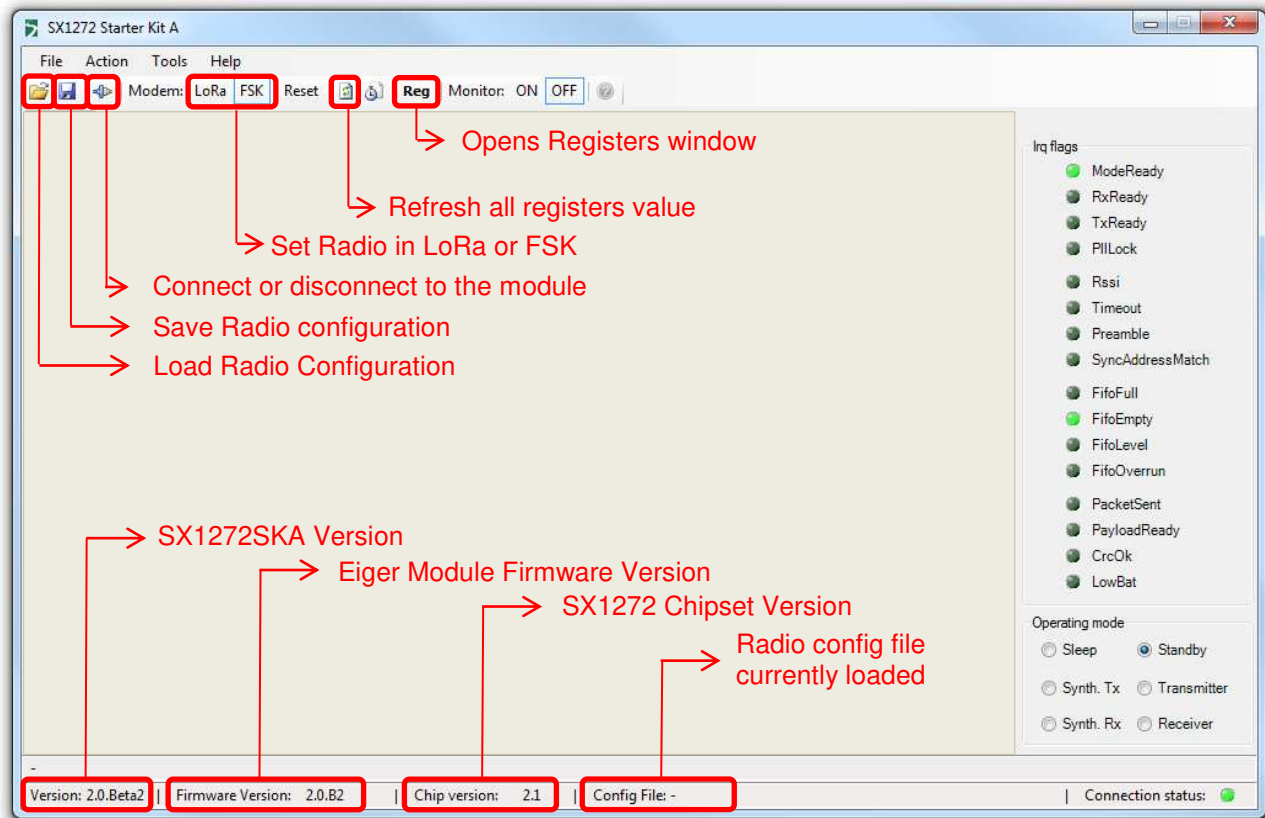


Figure 5: SX1272 window organization

While this approach has limitation on testing the system capability of the device, it allows the user to thoroughly evaluate the device from the radio point of view

This chapter is presenting the various windows and field that controls the radio operations. While some controls can be obvious, some others may need the user to refer to the datasheet to get a full description of the commands.

A load radio configuration is implemented and allows the opening of SX1272SKA configuration files (.cfg). This is implemented through a standard Windows file dialog box and may also be accessed through the short cut buttons of the Window Toolbar.

In the same way, it is possible to save the SX1272SKA configuration files (.cfg). This is implemented through a standard Windows file dialog box. The default file name is the last configuration file saved.