

SX1276 Development Kit

USER GUIDE



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1 Preamble

This document describes how to use the SX1276 Evaluation kit. This document describes especially the SX1276 Eiger platform and the SX1276SKA User Interface. We strongly recommend for the user to read thoroughly the datasheet of the SX1276 prior to start working on the device. Most of this document assumes a general knowledge on the SX1276 and modern RF communications.

2 Introduction

The SX1276 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 SX1276 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 SX1276 is intended for applications over a wide frequency range and it is covering all available sub-1GHz frequency bands (168MHz, 434MHz, 470MHz, 868MHz and 902MHz). Coupled with a link budget in excess of 135 dB in FSK in excess of 155 dB in LoRa, the SX1276 really offers the possibility of two modems in one single package. The SX1276 complies with both ETSI and FCC regulatory requirements and is available in a 5x5 mm QFN 28 lead free package.

The SX1276 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 SX1276. On the other hand, the SX1276SKA 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 SX1276 Eiger module and how to perform PER test in LoRa and FSK; the second part of this document present the SX1276 SKA and how it can be used to test every single aspect of the radio.





3 Getting Started

3.1 Evaluation Kit Contents

The SX1276DVK1 Development Kit consists of:

- 2 x SX1276RF1 modules
- 2 x Eiger platforms
- 2 x dipole antennas for LF frequency band
- 2 x dipole antennas for HF frequency band
- 2 x Mini-USB cables
- 2 x Touch Screen Styluses
- Disclaimer Note



Figure 1: SX1276 Development Kit

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3.2 Ordering information

Each of part of the SX1276 Evaluation kit can be ordered as a single entity or in a whole package. When ordering, please refer to the following parts numbers:

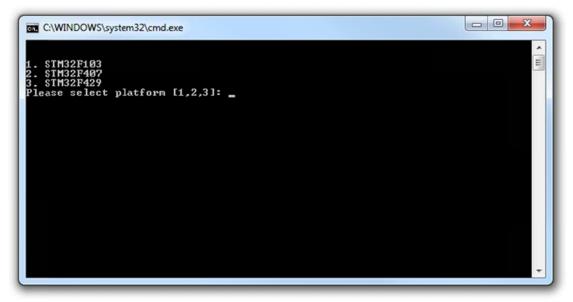
SX1276DVK1IAS	SX1276 Development Kit - 169/868MHz version with TCXO
SX1276DVK1JAS	SX1276 Development Kit - 433/868MHz version with XTAL
SX1276DVK1KAS	SX1276 Development Kit - 490/915MHz version with XTAL
SX1276RF1IAS	SX1276 Evaluation Module - 169/868MHz version with TCXO + Antennas
SX1276RF1JAS	SX1276 Evaluation Module - 433/868MHz version with XTAL + Antennas
SX1276RF1KAS	SX1276 Evaluation Module - 490/915MHz version with XTAL + Antennas

For more information on each of the options available, please, contact your local Semtech representative. The SX1276SKA evaluation software, the firmware, drivers and all SX1276 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:





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. To finish, the STM32F429 is easily identifiable thanks to the size of its MCU.



STM32F103 Module



STM32F407 Module



STM32F429 Module



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 3. STM32F429 Please select platform [1,2,3]: 3	* III
!!! 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: STM32F429ZI (0) Car Gimmirg PLink Driver (0)	
Configuring RLink Driver OK Connecting to RLink ??? Error 304: Unable to open USB com with RLink. Please check RLink connection and driver installation.	
error er	
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.

- 0 -X C:\WINDOWS\system32\cmd.exe STM32F103 STM32F407 STM32F429 1:2: 3. STM32F429 Please select platform [1,2,3]: 3 !!! 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: STM32F429ZI... (0) Configuring RLink Driver... OK Connecting to RLink... OK Connecting to target... OK Silicon Revision Id: 0x10036419. Option bytes: RDP=0xAA, USER=0xEF, WRP=0xFFFF3FFF Measured Target Voltage : 2.9V. ок (2) Erasing Option Bytes and Flash... OK (20) Programming file sx12xxEiger.hex to Flash... OK (27) Starting program execution... OK (28) 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.

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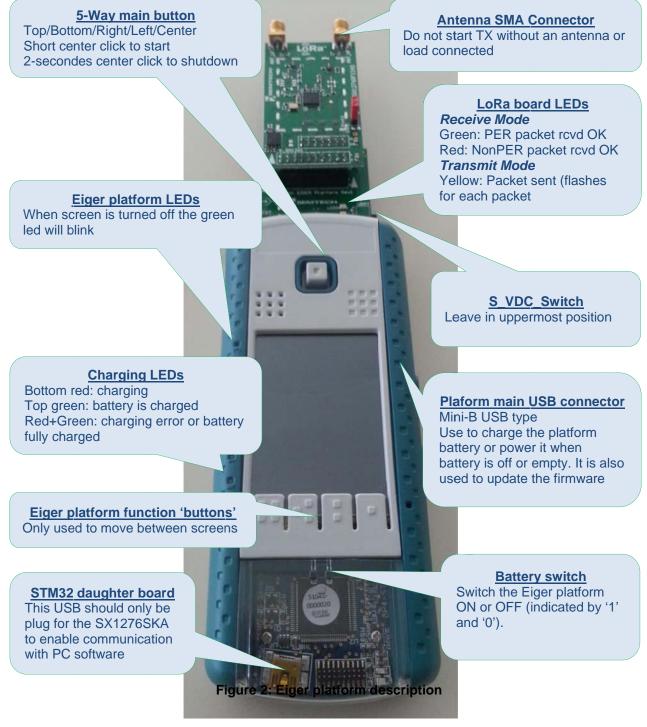




4 Eiger Platform Presentation

4.1 Platform Description

The Eiger platform is intended to enable a quick and easy range test of the sx1276 module. Here most of the modem parameters are pre-configured and the user only needs to set some RF parameters.



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4.2 SX1276 Module Hardware

The SX1276DVK is a USB based evaluation software designed to allow simple and easy evaluation of the suitability of the SX1276 for a given application. There are three evaluation module developed around the SX1276 and each module is targeted to specific RF Bands.

4.2.1 SX1276RF1IAS

The SX1276RF1IAS is targeted to the 169MHz and 868MHz frequency bands.

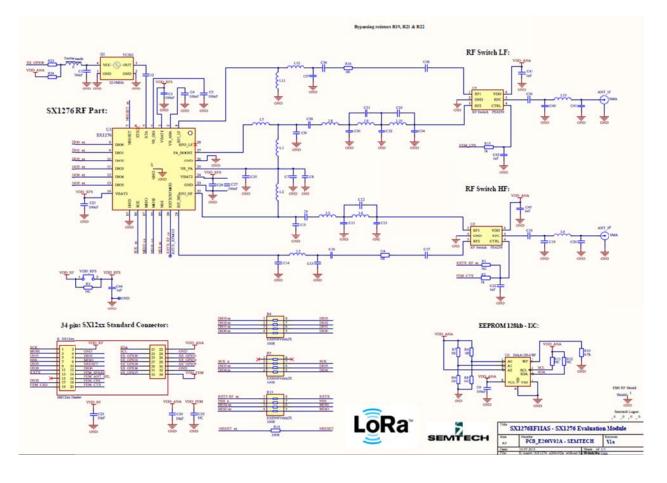


Figure 3: SX1276RF1IAS Module Schematic



4.2.2 SX1276RF1JAS

The SX1276RF1JAS is targeted to the 433MHz and 868MHz frequency bands.

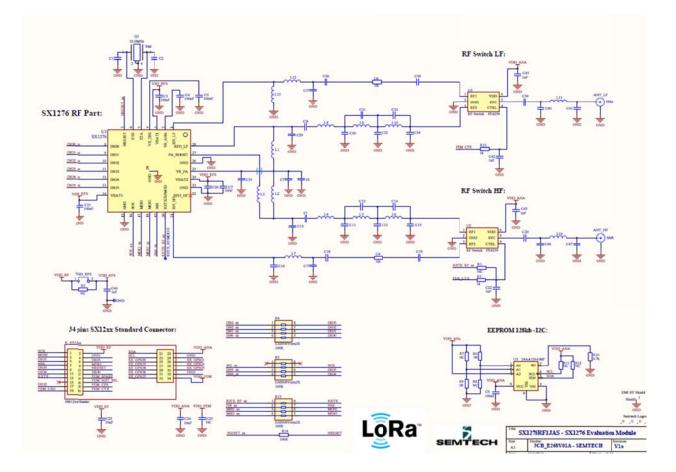


Figure 4: SX1276RF1JAS Module Schematic



4.2.3 SX1276RF1KAS

The SX1276RF1KAS is targeted to the 490MHz and 915MHz frequency bands.

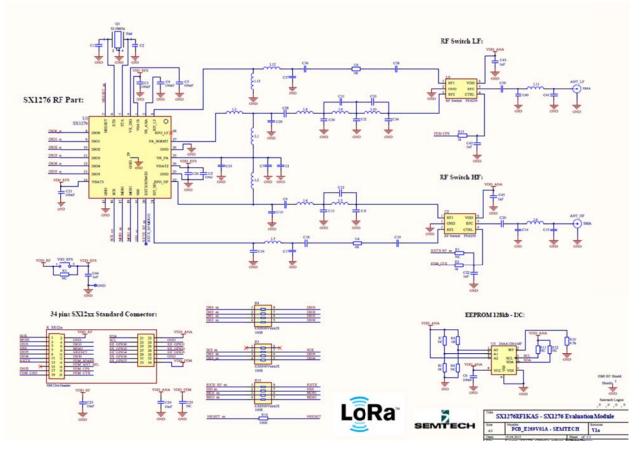


Figure 5: SX1276RF1KAS Module Schematic



4.2.4 Module Antenna

The SX1276RF1 modules are fitted with 2 RF antenna SMA connectors. Each antenna connection has been specifically designed to offer the best RF matching to a specific frequency band.

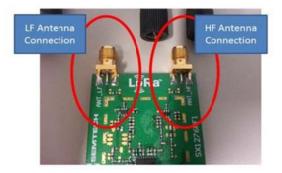


Figure 6: LF and HF Antenna Connection

Five antennas types could be delivered with kits. The antennas can be identified through their color dedicated or shape, to a specific frequency band (LF=169, 433 or 490MHz, HF=868 and 915 MHz). Antenna types and part numbers are subject to be changed.

Do not connect both antenna types at the same time on the module.



Figure 7: Frequency Band Targeted Antenna



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 me 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.

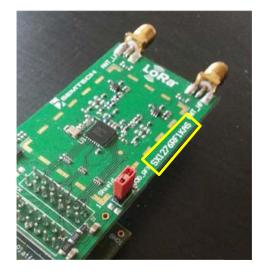
The PER demo operates in FSK or in LoRa modes so that the advantages and drawbacks of each modulation can been seen easily.

5.2 Using the Eiger platform

When booting up, the Eiger application will detect the hardware module connected to configure the RF parameters dedicated to each modules. Each hardware module is fitted with an EEPROM which is programmed at manufacturing. However, if for any reasons, the EEPROM cannot be read or has not be programmed, the following window is shown.

In case of doubt, the exact part number of the hardware module connected is written on the right side of the module.

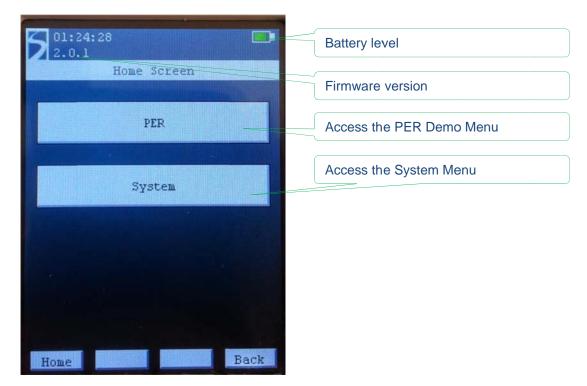




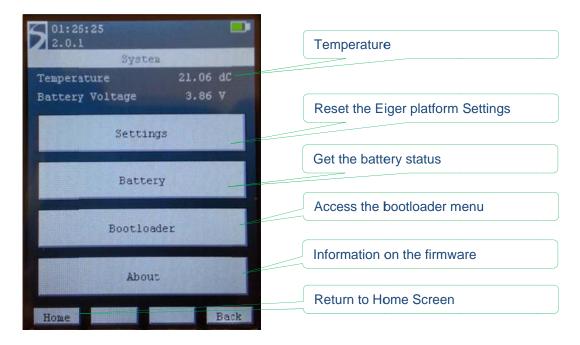
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When the module is successfully detected, the home screen is the first window displayed on the control touch screen.

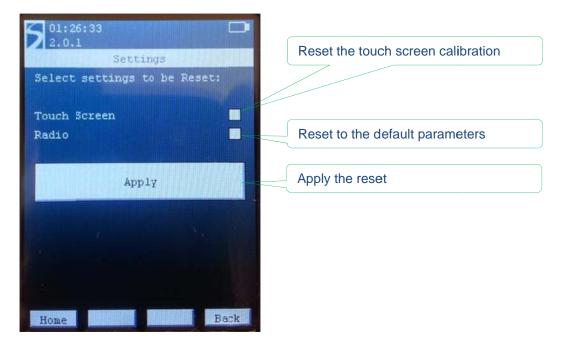


5.2.1 System Window



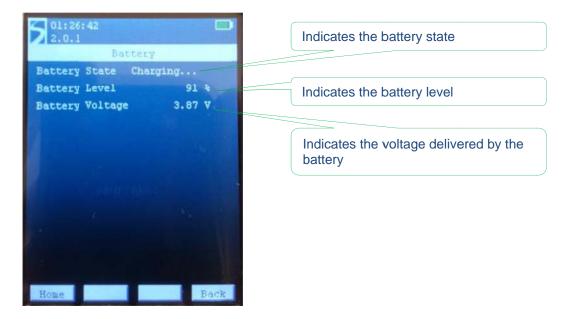


In case of miss-operation or to simply reset the Eiger module into a known state, it is possible the reset the touch screen parameters or to reset the device parameters to their default parameters.



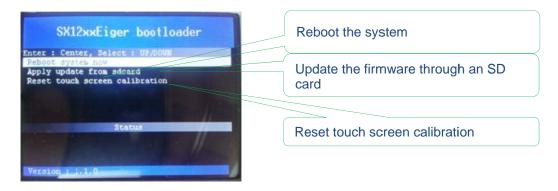
Once a box is ticked, "clicking" on the Apply button will reset the selected parameters. The ticked box will then go un-ticked.

5.2.1.2 Battery

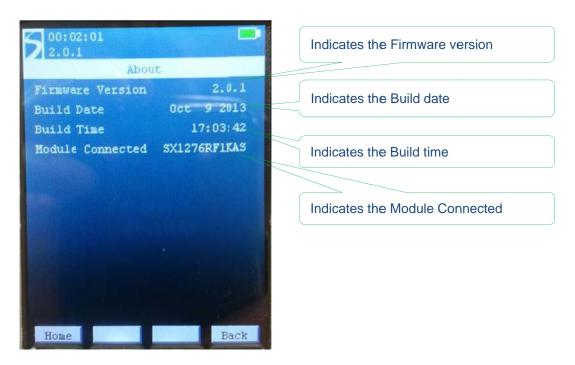




5.2.1.3 Bootloader



5.2.1.4 About



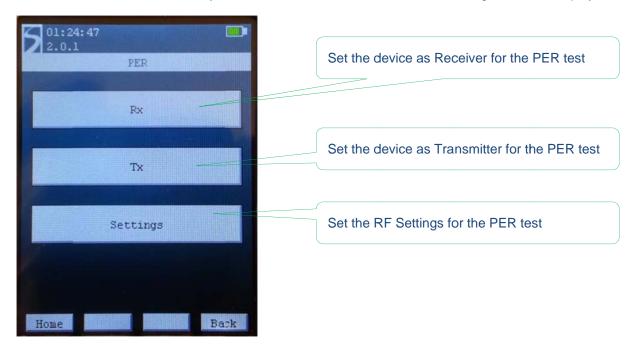


5.2.2 PER Demo Window

When entering the PER Demo Windows, the EEPROM on the module type is read so that the module connected can be used. If the EEPROM is faulty, not present or damaged, the following windows is displayed.



If the module is detected correctly, the PER demo is accessed and the following window is displayed.

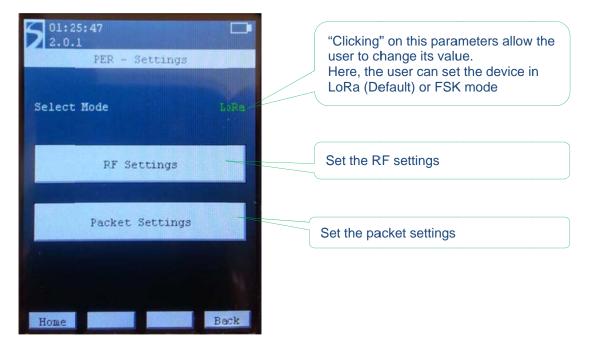


The PER Demo menu is the core of the Eiger platform testing. The menu is divided in three main areas, Tx, Rx and Settings. The PER Settings menu allows the user to set several parameters of the Radio for Tx and Rx.

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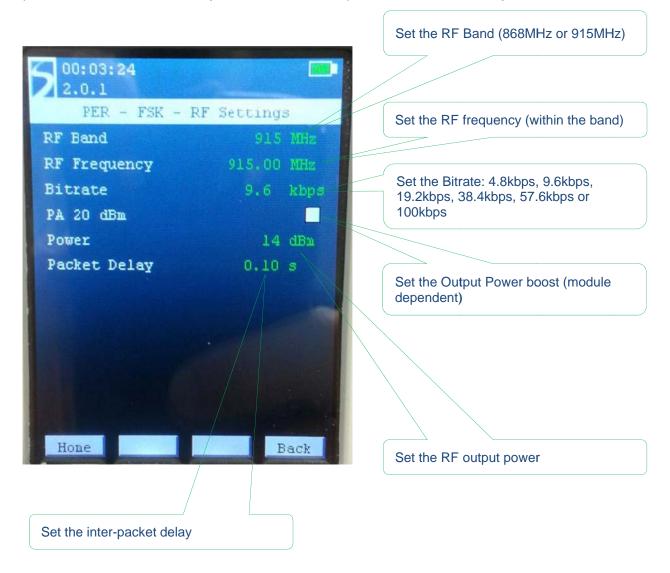
A text in green indicates that the value can be changed. For example, on the first window of the PER Setting screen, you will see:





5.2.2.1 PER Settings Menu running in FSK mode

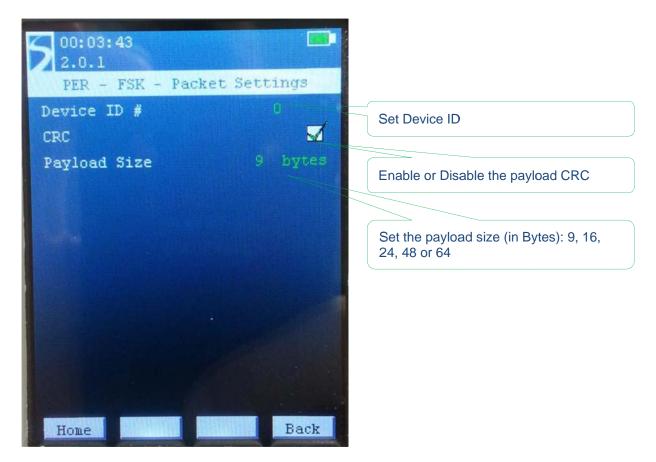
For a given modulation, there is only a limited set of parameters that can be set by the user. Most of the parameters are set automatically in the software to keep the interface user friendly.



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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.

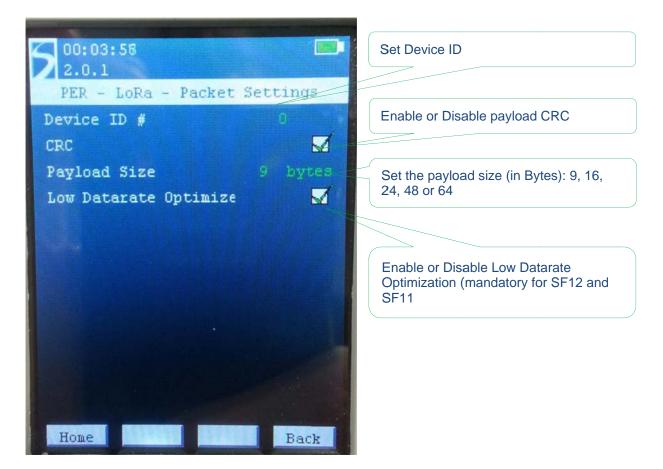


5.2.2.3 PER Settings Menu running in LoRa mode





5.2.2.4 PER Packet Settings Menu running in LoRa mode



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

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

00:04:37 2.0.1 PER - LoRa	- Tx Mode
Power	14 diam
RF Frequency	915.00 MHz
Spreading Factor	SF12
Error Coding	4/6
Bandwidth	125.0 kHz
Payload Size	9 bytes
Packet #	12
Home	Reset Back

PER Tx window in FSK mode:

5 00:05:00 2.0.1 PER - FSK	- Tx Mode		lation parameters
Power RF Frequency Bitrate Payload Size	14 dBn 915.00 MHz 9.6 kbps 9 bytes		lation parameters
Packet #	46	Number o	of packet sent
Home	Reset Back	Reset the	counter

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5.2.2.6 PER RX Mode

PER Rx window in Lora mode:



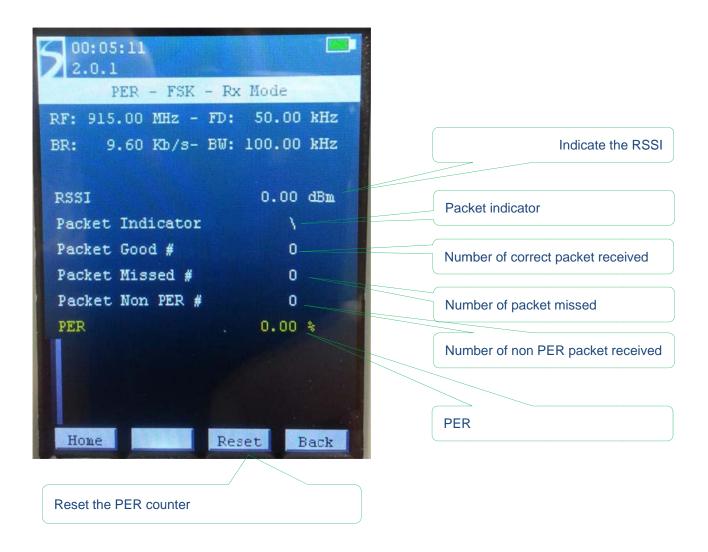
In LoRa mode, when sub-noise reception is occurring (SNR < 0), the displayed RSSI value is extrapolated using the SNR indicator. When the SNR > 0, the actual SNR is not computed and the value is clamped.



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PER Rx window in FSK mode:



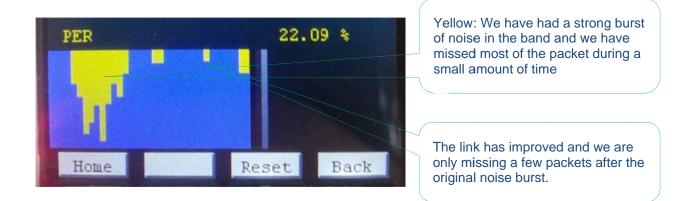


5.2.3 PER Rx Bar-graph

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 in 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

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





6 SX1276SKA Software Description

The SX1276SKA 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 SX1276.

6.1 SX1276SKA Quick start Guide

It is recommended that this user guide is read in conjunction with the SX1276 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 SX1276 User Interface software: Start > All Programs > SX1276SKA > SX1276SKA
- 3. The SX1276SKA 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 SX1276SKA shows the default configuration of the SX1276 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.

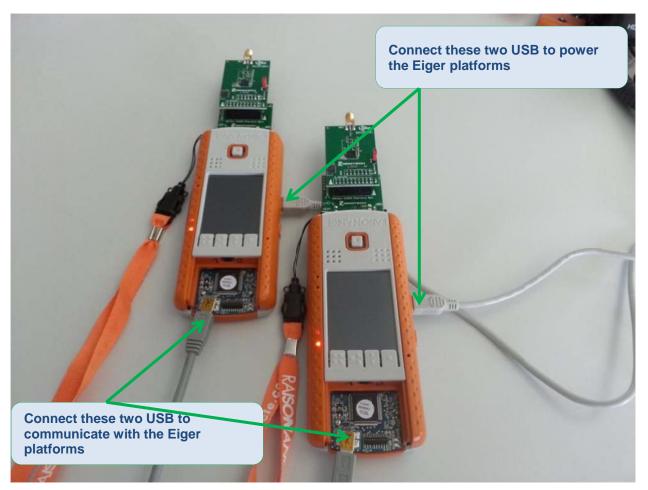


Figure 8: Connect both USB ports to use the SX1276SKA

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The SX1276SKA 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.

💱 SX1276 Starter Kit A	
File Action Tools Help	
Monitor: ON OFF	
→ Opens Registers window	Irq flags ModeReady
→ Refresh all registers value	 RxReady TxReady
Set Radio in LoRa or FSK	PIILock
Connect or disconnect to the module	Rssi
Save Radio configuration	TimeoutPreamble
Load Radio Configuration	SyncAddressMatch
	 FifoFull FifoEmpty FifoLevel FifoCverrun PacketSent
SX1276SKA Version Eiger Module Firmware Version	 PayloadReady CrcOk LowFat
	Lowcar
SX1276 Chipset Version Radio config file currently loaded	Operating mode Sleep Standby Synth. Tx Transmitter Synth. Rx Receiver
- Version: 1.0.Beta5 Firmware Version: 2.0.B1 Chip version: 1.1 Config File: -	Connection status: 🧉

Figure 9: SX1276 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 SX1276SKA 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 SX1276SKA configuration files (.cfg). This is implemented through a standard Windows file dialog box. The default file name is the last configuration file saved.



For reference purposes, it is possible to display the register map of the device. This can help the user to refer to the datasheet register when testing the device.

Register	Addr	Value	Register	Addr	Value	Register	Addr	Value	Register	Addr	Value
RegFilo	0x00	0x00	RegRxTineout1	0x20	0x00	RegDioMapping1	0x40	0x00	RegTest60	0x60	0x00
RegOpMode	0x01	0x01	RegRxTineout2	0x21	0x00	RegDioMapping2	0x41	0x00	RegAgeRef	0x61	Ox1C
RegBitrateMsb	0x02	Ox1A	RegRxTineout3	0x22	0x20	RegVersion	0x42	0x11	RegAgcThresh1	0x62	0x0E
RegBitrateLsb	0x03	0x09	RegRxDeay	0x23	0x00	RegTest43	0x43	0x00	RegAgeThresh2	0x63	0x5B
RegFdevMsb	0x04	0x00	RegOsc	0x24	0x05	RegPliHop	0x44	0x20	RegAgcThresh3	0x64	0xCC
RegFdevLsb	0x05	0x52	RegPreanbleMsb	0x25	0x00	RegTest45	0x45	0x00	RegTest65	0x65	0x0E
RegFrfMsb	0x06	0xE4	RegPreanbleLsb	0x26	0x03	RegTest46	0x46	0x00	RegTest66	0x66	Ox41
RegFrfMid	0x07	0xC0	RegSyncConfig	0x27	0x93	RegTest47	0x47	0x00	RegTest67	0x67	0x50
RegFrfLsb	0x08	0x00	RegSync/alue1	0x28	0x55	RegTest48	0x48	0x00	RegTest68	0x68	0x00
RegPaConfig	0x09	0x0F	RegSync/alue2	0x29	0x55	RegTest49	0x49	0x00	RegTest69	0x69	0x00
RegPaRamp	0x0A	0x19	RegSync/alue3	0x2A	0x55	RegTest4A	0x4A	0x00	RegTest6A	0x6A	0x00
RegOcp	0x0B	0x2B	RegSync/alue4	0x2B	0x55	RegTaxo	0x4B	Ox09	RegTest68	0x6B	0x00
RegLna	0x0C	0x20	RegSync/alue5	0x2C	0x55	RegTest4C	0x4C	0x00	RegTest6C	0x6C	0xA0
RegRxConfig	0x0D	0x00	RegSync/alue6	0x2D	0x55	RegPaDac	0x4D	0x84	RegTest6D	0x6D	0x00
RegRssiConfig	0x0E	0x02	RegSync/alue7	0x2E	0x55	RegTest4E	0x4E	Ox00	RegTest6E	0x6E	0x0F
RegRssiCollision	0x0F	0x0A	RegSync/alue8	0x2F	0x55	RegTest4F	0x4F	0x00	RegTest6F	0x6F	0x0B
RegRssiThresh	0x10	OxFF	RegPackstConfig1	0x30	0x90	RegTest50	0x50	0x00	RegPll	0x70	0xD0
RegRssiValue	0x11	0x00	RegPackstConfig2	0x31	0x00	RegTest51	0x51	0x00	RegTest71	0x71	0x00
RegRxBw	0x12	0x15	RegPayleadLength	0x32	0x01	RegTest52	0x52	0x00	RegTest72	0x72	0x14
RegAfcBw	0x13	0x0B	RegNodeAdrs	0x33	0x00	RegTest53	0x53	0x00	RegTest73	0x73	0x00
RegOokPeak	0x14	0x28	RegBroalcastAdrs	0x34	0x00	RegTest54	0x54	0x00	RegTest74	0x74	0x00
RegOokFix	0x15	0x0C	RegFifoTuresh	0x35	0x0F	RegTest55	0x55	0x00	RegTest75	0x75	0x00
RegOokAvg	0x16	0x12	RegSeqConfig1	0x36	0x00	RegTest56	0x56	0x00	RegTest76	0x76	0x00
RegRes17	0x17	0x47	RegSeqConfig2	0x37	0x00	RegTest57	0x57	0x00	RegTest77	0x77	0x00
RegRes18	0x18	0x32	RegTimeResol	0x38	0x00	RegTest58	0x58	0x00	RegTest78	0x78	0x00
RegRes 19	0x19	0x3E	RegTime1Coef	0x39	0xF5	RegTest59	0x59	Ox00	RegTest79	0x79	0x00
RegAfcFei	0x1A	0x00	RegTime2Coef	0x3A	0x20	RegTest5A	0x5A	0x00	RegTest7A	0x7A	0x00
RegAfcMsb	0x1B	0x00	RegImageCal	0x3B	0x82	RegFormerTemp	0x5B	0x00	RegTest7B	0x7B	0x00
RegAlcLsb	0x1C	0x00	RegTemp	0x3C	OxF6	RegTest5C	0x5C	0x07	RegTest7C	0x7C	0x00
RegFeiMsb	0x1D	0x00	RegLowBat	0x3D	0x02	RegBitrateFrac	0x5D	Ox00	RegTest7D	0x7D	0x00
RegFeiLsb	0x1E	0x00	RegirqFligs1	0x3E	0x80	RegTest5E	0x5E	0x00	RegTest7E	0x7E	0x00
RegPreambleDetect	0x1F	0x40	RegIrgFlags2	0x3F	0x40	RegTest5F	0x5F	0x00	RegTest7F	0x7F	0x00

Figure 10: Register table

For advance user only, it is also possible to read or write the register directly by pressing the <CTRL>+<ALT>+<T> keys of the PC keyboard simultaneously.

Registers			
	Address	Data	
	0x01	0x81	
	Write	Read	
		(Communication of the local of	

This window allows the user to write to and read from the contents of individual configuration register addresses. Note that address and data are entered in hexadecimal format.



6.2 LoRa Mode

6.2.1 LoRa Menu

By default, when the application is launched, the SX1276SKA is configured in LoRa.

🔋 SX1276 Starter Kit A	
File Action Help	
Refresh all registers value Direct access to sub menu Opens Registers window Indicates the Modem IRQ and Modem status	Ing flags RxTimeout RxDone PayloadCrcError ValidHeader TxDone CadDone FhssChangeChannel CadDetected Moden status Modem clear Header info valid Rx on going Signal synchronized Signal detected
Indicates the Modem operating Mode	Operating mode Sleep Standby Synth. Rx Synth. Tx Rx Tx continuous Rx Single CAD
Version: 1.0.Beta5 Firmware Version: 2.0.81 Chip rersion: 1.1 Config File: -	Connection status: 🌘



6.2.2 LoRa Common Window

General RF frequency:	915000'000	🗢 Hz	D Frequency: D input selection:	32'000'000	÷ Hz	Ita flags RxTimeout RxDone PayloadCrcError ValidHeader 5
Tx settings		PA0 -> "ransmits on PA1 -> "ransmits on				 Valdheader TxDone CadDone FhusChangeChannel CadDetected
PA ramp	40	• µs PL	L bandwidth:	300'000	Hz	Modem status
Maximum output power:	10.8	🚖 dBm 🖉 Ov	verload current protection:	ON OFF		Modem clear
Output power:	10.8	dBm Ov	verload currenttrimming:	100	mA	Header info valid
+20 dBm on pin PA_BOOS1 Rx settings	T: ON OFF					 Rx on going Signal synchronized Signal detected
		AGC auto: 3 LNA boost:	 ON OFF ON OFF 			Operating mode 6
DIO mapping			4			 Sleep Standby Synth. Rx Synth. Tx
DIO5	DIO4	DO3	DI02	DIO1	DIOO	© Rx © Tx continuou
ModeReady -	CadDetected 👻	CadDone 👻	RhssChangeChannel •	RxTimeout -	RxDone •	Rx Single CAD

Figure 11: SX1276SKA Boot-up windows

- 1: Set the default basic parameters for the Radio.
- 2: Set the parameters related to the transmission of the data such as output power.
- 3: Set the parameters related to the reception of the data such as AGC or LNA boost settings.
- 4: Set the mapping for the device IO pins. The Status of the IO is then displayed over time in the section 5 of the window.
- 5: This section indicates the modem and DIOs status
- 6: Set the operating mode of the device.



6.2.3 LoRa Parameters Window

	Help dem: LoR	a FSK I	Reset 🛛 🖻	Reg Monitor:	ON OFF 🛛 🔞					
Settings Spreading factor: Coding rate: Bandwidh: Rx timeout: Low datarate optimize:	SF7 4/5 125 1.047552	© OFF	▼ ▼ kHz	Preamble length: Implict header: Payload length: Payload CRC:	12 ON OFF 11 ON OFF	🕏 bytes	IRQ mask Rt timeout: Rt done: Payload CRC error: Valid header: Tx done: CAD done: FHSS change channel CAD detected:	NC () NC ()	 OFF OFF OFF OFF OFF OFF OFF OFF 	Ing fags RxTimeout RxDone PayloadCrCError ValidHeader TxDone CadDone FhssChangeChannel CadDetected Modem status
Rx header info — Packet status —	2	Received header	count	PLL timeout R	x payload CRC	Rx payload coding rate	Number of bytes received	0.011		 Modem clear Header info valid Rx on going Signal synchronized Signal detected
	cha	hopping annel	Received v packet co			cket Received RSSI (d	Bm] value [dBm]			Operating mode
Mc336ge		XADECIM/	EF A	3	ASCII	-	Start Log		Tx 💿 Rx	 Sleep Synth. Rx Synth. Tx Rx Tx continuou Rx Single CAD

Figure 12: LoRa Radio parameters window

- 1: Set the Radio settings for the LoRa modulation
- 2: Details status of the reception
- 3: Set the payload to be transmitted control the emission or reception of the radio
- 4: Enable or disable the IRQ related to the LoRa modulation



6.3 FSK Mode

6.3.1 FSK Menu

The FSK menu is organized around several windows allowing the user to set the radio step by step. The detail of each window is described from section 5.2.1.1 onward.

Some information are however global to the FSK radio operation and are thus displayed on every window as shown on figure 9.

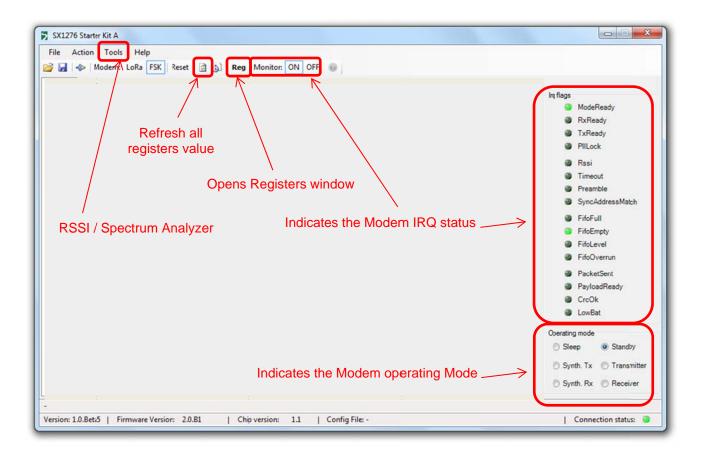


Figure 13: FSK window structure

In FSK mode, it is possible to perform a quantitative spectrum analysis but reading the RSSI value across a range of Frequency. It is also possible to have a qualitative measurement of the RSSI as it is detected by the chipsets. This tool is especially useful when a more expensive spectrum analyzer is not at hand reach.

When Monitor is set to ON, the GUI will constantly scan the status of the FSK IRQ register and displays the status on the right hand side of the GUI. Setting Monitor to OFF disables this features.



6.3.2 Common window

ommon Transmitter Receiver	IRQ & Map Packet Handlei Sequencer Temperature General RF frequency: 915'000'000 + Hz Fast hopping: O N OFF Bitrate: \$799 + bps Fdev: +/- 5'005 +	Ing flags ModeReady RxReady TxReady FilLock Rssi Timeout
	Modulation Modulation: FSK OOK Modulation shapng: OFF Gaussian filter, BT = 1.0 Caussian filter, BT = 0.5 Gaussian filter, BT = 0.3	 Preamble SyncAddressMatch FifoFull FifoEmpty FifoLevel FifoOverrun
	Oscillators XO Frequency: 3 XO input selection: Calibrate RC oscillator calibration: Calibrate Battery management Low battery detextor: ON OFF Low battery threshold trim: 1.835 V	PacketSent PayloaReady CrcOk CrcOk LowBat Operating mode Sleep Standby Synth. Tx Transmitte Synth. Rx Receiver

Figure 14: FSK Common window

The Common window allows the user to set the common Tx/Rx parameters for the modulation. Parameters such as the modulation type (FSK or OOK), Frequency, Bitrate, frequency deviation or the oscillator details can be entered in this window.

When Frequency Hopping is used, the control bit "Fast Hoping" need to be set so that the internal PLL can optimize to jump from one frequency to the next in the smallest amount of time.

It is also in this window that the Gaussian Filter parameter is set for the transmission. A general description would be:

- 1: Set the general parameters for the modulation
- 2: Set the modulation Type and the Gaussian filter parameter (Tx Only)
- 3: Set the oscillators parameters



6.3.3 Transmitter window

ammon Transmitter Receiver	IRQ & Map Packet Handler Sequencer Power Amplifier PA) -> Transmits PAI -> Transmits	on pin RFO	1	Ing flags ModeReady RxReady TxReady PILock Rssi Timeout
	PA ramp:	40	Ψ μ5	Preamble SyncAddressMatch
	Output power Maximum output power: 2 Output power:	10.8	dBm	 FifoFull FifoEmpty FifoLevel
	+20 dBm on pin P4_BOOST: Overload current protection 3	© ON @ 0		 FifoOverrun PacketSent PayloadReady CrcOk
	Trimming: PLL bandwidth	100	🔁 mA	LowBat Operating mode
	PLL:	300'000	Hz	Steep Standby Synth. Tx Transmitte Synth. Rx Receiver

Figure 15: FSK Transmitter window

As indicated through its name, the transmitter window groups the configuration parameters related to the transmission:

- 1: This field allows the user to select the radio output pin. Depending of the SX1276 module version, it may or may not be possible to select the RFO pin as output.
- 2: Set the output power of the radio. The maximum output power is 20dBm.
- 3: Overload current protection
- 4: PLL Bandwidth



6.3.4 Receiver window

ommon Transmitter	200 M C & L		Packet H	andler Sec										
Bandwidth Rx filter bandwidth: AFC filter bandwidth:	10'417 50'000		Hz A	FC FC auto: FC auto clea	, <mark>5</mark>	-	OFFOFF		Demodulator Bit synchronizer:	8 () ON	OFF		irq flags ModeR RxRea	dy
AGC AGC: 2	St	art		FC: El:	Clear Read	0		Hz Hz	OOK Threshold type: Peak threshold ste	Peak] dB	TxRead PIILock	<u> </u>
AGC aulo: Reference Level:	© ON 28	1000	dD.	ISSI ffset.	6	0	\$	dB	Fixed threshold:	12	*	dB	 Rssi Timeou Preamb 	
Threshold step 1: Threshold step 2:	14 5	2	HB	moothing: hreshdd:	U	8 -127.5	-	dBm	Peak threshold dec Avg threshold cuto		p ▼ ↓			dressMatch
Threshold step 3: Threshold step 4:	11	-	dB	alue: Ix startup cor	trol		.0	dBm	Avg offset: Timeout RSSI:	0.000	×		 FifoEm FifoLev FifoOv 	el
Threshold step 5: Preamble detection — Detection: Size: 3	12 ON 3	-	R	estart Rx on ollision three Rx		10	(Orr	7 dB	9 Preamble: Signal sync:	0.000	×	ms ms ms	 Packet Payloa CrcOk 	Sent
Error tolerance:	0	No. of Lot		k trigger:		None	*		Inter packet Rx de	ay: 0.000		ms	LowBat Operating mode	
Lna settings 4		erence 103	Thresh -89		Thresho -84	ld 2	Threshold -73	3	Threshold 4	Threshold 5 -49	-> Pin	[dBm]		Standby
LNA boost: 🔘 ON	OFF	G Gain @		G2 ©		G3 ©		G4	G5		G6 ©		 Synth. Tx Synth. Rx 	

Figure 16: FSK Receiver window

This window allows the user to set the parameters for the packet reception:

- 1: Set the reception bandwidth filter and set the AFC reception bandwidth filter Please, note that the AFC bandwidth filter is disregarded if AFC Auto is set to OFF
- 2: Enable or disable the AGC and set the step threshold (I am not sure what it does actually)
- 3: Enable or disable the preamble detector and set the preamble detector parameters. Please, note that the preamble detector must be enabled if the reception is triggered on preamble detection.
- 4: Enable or disable the LNA boost
- 5: Enable or disable the AFC and read the FEI
- 6: Control the RSSI detection. If the reception is triggered on the RSSI detection, these parameters allow controlling the level of RSSI triggering the reception and smoothing the peak detector to avoid false detection in case of random peak in the frequency band.
- 7: These parameters control the events that trig a reception and the behavior of the receiver in case of collision
- 8: Enable or Disable the bit synchronizer and configure the OOK demodulator
- 9: Set internal timing between events



6.3.5 IRQ and Map window

7 → Modem: LoRa FSK Resources IRQ & Macommon Transmitter Receiver, IRQ & Macommon Transmitter	P Packet Handler Sequencer		ing flags
	Device status Bit Synchroxizer: Data mode: Operating mode:	ON Continuous Standby	 TxReady PIILock Rssi Timeout
	DIO settings Preamble IFQ: 2	ON OFF	 Timeout Preamble SyncAddressMatch
	DIO mapping DIO5: DIO4:	CikOut •	 FifoFull FifoEmpty FifoLevel FifoQverrun
	DIO3: 3 DIO2: DIO1:	· •	 PacketSent PayloadReady CrcOk
	DIO0: Clock out	- •	LowBat Operating mode
	Frequency: 4	1000000 V Hz	 Sleep ● Standby Synth. Tx ● Transmitt Synth. Rx ● Receiver

Figure 17: FSK IRQ and Map window

The IRQ and Mapping window is used to set and control the IRQs in the device:

- 1: Indicates the current status of the device
- 2: Enable or disable the preamble detection IRQ (when starting on RSSI detection)
- 3: Configures the IRQ and how they are mapped with the DIOs of the device.
- 4: Disable or Enable and set the clock out of the device



6.3.6 Packet Handler window

	ceiver IRQ & Map Pac	ket Handler	Sequencer Temp				ing flags
Data mode: Preanble size: Auto restart Rx mode: Preanble polarity:	Continuous 3 ON, wait for PL © 0xAA		bytes	Address based filt Node address: Broadcast address DC-free:	OFF Manchester		ModeReady RxReady TxReady PllLock
Sync word: FIFO fill condition: Sync word size: Sync word value: Packet format: Payload length:	1 ● ON ● O ● Sync addre 4 ÷ 55-55-55-55 ● Variable (1 ÷		bytes bytes	CRC calculation: CRC auto clear: CRC polynom: Tx start condition: FIFO Threshold: IO Home: IO Home Power fro Beacon:	ON OFF OFF OFF IBM OFF IBM CCITT FifbLevel FifoNotEn 15 OF ON OFF ON OFF ON OFF	ıpty	 Rssi Timeout Preamble SyncAddressMatch FifoFull FifoEmpty FifoLevel FifoOverrun PacketSent
^{'acket} 2					Device status		PayloadReady CrcOk
Preamble 55-55-55	Sync 55-55-55	Length	Node Address	Message	CRC Bit Synchronizer: 33-63 Data mode:	ON Continuous	LowBat
Message 3	HEXADECIMAL			ASCII	Operating mode: Control 4 Start L	Standby	Operating mode Sleep Standby Synth. Tx Transmitte

Figure 18: FSK Packet Handler window

The packet handler is the main interface windows to control the transmission or reception of packets once the radio has been setup. Whether in transmission or reception, this window allow the user to defined the packet to be transmitted or to be received

- 1: This field allows the user to define the packet structure.
- 2: Once the packet structure has been defined, this view allows the user that all each field of the packet structure is set correctly.
- 3: Enter the payload to be transmitted or display the payload received.
- 4: Control the packet handler transmission or reception.



6.3.7 Sequencer window

mmon Transmitter Receiver RQ & Map Packet Handle Sequencer Temperature	
Sequencer: Start Stop Idle mode: Standby • Transition from start: To LowPowerSelectik ▼ Low power selection: Sequencer OFF ▼ Transition from idle: To Tx Transition from transmit: To LowPowerSelectik ▼ Transition from transmit: To LowPowerSelectik ▼ Transition from receive: Unused Unused ▼ Transition from packet received: To Sequencer OFF ▼ Timer 1 resolution Timer 1 coefficient OFF ys X Z45 = OFF µs Timer 2 resolution Timer 2 coefficient ps OFF ys X 32 = OFF µs	Irq flage ModeReady RxReady TxReady PilLock Rssi Timeout Preamble SyncAddressMatch FridFull FridFull FridFull FridEwel FridEvel FridOverrun PacketSent PayloadReady CrcOk LowBat Operating mode Seep Standby Synth. Tx Transmit Synth. Rx Receiver

Figure 19: FSK Sequencer window

The sequencer window allows the user to setup the internal state machine of the device and control how the device will react following an event. For more information on the FSK internal state machine, please, refer to the datasheet.



6.3.8 Temperature window

Common Transmitter Recei	iver IRQ & Map Packet H	landler Sequencer Tem	150 –	- 30	Ing flags ModeReady RxReady
IQ calibration Auto: Calibration: Calibration status: Temperature delta (Actual - Former): Temperature Monitor: Measuring: Threshold: Change higher than thresho		- °C		- 10 - 70 - 60 - 20 - 20 - 40 - 30 - 30 - 70 - 70 - 70 - 70 - 70 - 70 - 70 - 7	 TxReady PILock Rssi Timeout Preamble SyncAddressMatch FifoFull FifoEmpty FifoLevel FifoOverrun PacketSent PayloadReady CrcOk LowBat
					Operaing mode Sleep Standby Synth. Tx Transmitte Synth. Rx Receiver

Figure 20: FSK Temperature window

The SX1276 is fitted with an internal temperature sensor. Note that user is prompted to calibrate the SX1276 temperature sensor by clicking on the Calibrate button to access the temperature calibration dialog box. If auto calibration is set, a new calibration will be performed at every temperature change that exceeds the threshold. Threshold value could be set to 5, 10, 15 and 20°C.



7 How to...

7.1 ... perform a simple transmission / reception in LoRa

Performing a simple Transmission – Reception in LoRa is fairly straight forward. First, the user needs to set the RF transmission parameters:

File Action Help							Set the frequency
Midem LoR	a FSK Reset 🛛	Reg Moniton O	N OFF I III I				
ommon LoRa						111 Marca	
General						ing flags	
RF frequency:	915'000'000	Hz Hz	XD Frequency: XD input selection	321000000 TCXD Crys	6 Hz	RxTimeout RxDone PayloadCrcEmor ValidHeader	
Tx settings		PAD -> Transmits o PAD -> Transmits o				TxDore CadDore PresChargeCharrel CadDected	
PA ramp:	40	* µs	PLL bandwidth:	300'000	+ Hz	Noder status	
Maximum output sower:	10.8	dim (Overload current instection	ON OOFF		Modern clear	
Output power:	10.8		Overload current rimming:	100	ê mA	Modern clear Header info valid	
+20 dBm on pin FA_BOOST	O ON OFF	All and a second s				B Rx on going	
Pa settings						Signal synchronized	
		AGC auto UNA boost	 ON OFF ON OFF 			Signal detected Openting mode Standay	
DIO mapping						🔿 Synth Rx 🔿 Synth. Tx	
0105	DIO4	DIO3	DIO?	DIO1	DIOO	Px O Tx continuous	
0100	adDetected .	CadDone	 ResChangeCrannel • 	PrTmont .	RxDone •	O Fx Single O C40	

Second, the user needs to set the LoRa modulation parameters:

SX1276 Starter	KA A									
File Action	Help bdem: LoRa FSK R									Set the Spreading Factor
	odemi Loka PSK K	eter []	Leg Montor	ON ON IN	·)					Oct the opreading radio
Common LoRa Settings						IPO mask			iqfag	
Spreading factor	1972.117	•	Preamble length		🔄 symbols	Rx timeout Rx done:	-	OFF OFF	 RxTimeout RxDone 	Set the Coding Rate
Coding rate:	4/5			0N #1		Payload CRC error	0.000480	· OFF	PayloadCrcError	
Bandwidth:	8-00		Payload length		bytes	Valid header	10.000	. 0FF	ValidHeader TxDone	
Ra timeout: Low datarate optimize:	0.409600	1	Payload CRC	0 ON	Dee	Tx done: CAD done: FHSS change chame		OFF OFF	CadDoxe PhisOlangeDarnel CadDetected Moder status	Set the Bandwidth
						CAD detected	O ON	OFF	Modem clear	
Rx header info	Received header of	valid P	L timeout F	Rx payload CRC	fx peyload ioding rate	Number of bytes received			Header info valid Px on going	Optimize transmission
Packet status	0		9	0	1.	0			Signal synchronized Signal detected	for Low Datarate OFF
	Current hopping channel	Received vali packet count			(db) Received ((db) RSSI (d	packet Current RSB Em] value (dBn)			Operating mode	(mandatory for SF11 and
	0	0	0		+155	0 -155.0				SF12 with BW=125KHz)
Message	HEXADECIMA			ASCI	- (e)	Λ		fx 🔹 Rx	Sivep Standby Synth, Rx Synth, Tx Ri Tx continuous	ST 12 WIIT DW-125K12)
								\sum	O Ru Single O CAD	
Version: 1.0.Beta1	Firmware Version		Chip vers	ion: -	Config File -				Connection status	Set the Payload
	Clicl	k "Sta	art" to	start	Transm	nitting			Set the De	vice in Transmitter Mode

It is important to notice that the device mode of operation is standby between packets, this is why the Operating mode is left in "Standby".



On the Reception side, the principle is exactly the same. We first need to set the basic radio parameters:

SX1276 Starter Kit A							Set the frequency
File Action Help							
Modem: Los	Ra FSK Reset	Reg Monitor: Of	I OFF I				
Common LoRa							
General RF frequency:	915'000'000	0 Hz	C) Frequency (O) input selector:	32000000 © TCXD @ Crrt	0 Hz	ls fage RxTimeout RxDone PayloadCreEmor ValidHeader	
Tx settings		 PA0 -> Transmits or PA1 -> Transmits or 				TsDore CadDore PhisChargeCharnel CadDetected	
PA ramp:	40	• µ •	LL bendwidth:	300'000	0 Hz	Nodem status	
Maximum output power.	10.8	dBm (iverfood current protection:	ON OFF		Modern clear	
Output power:	10.8	🗄 dBm 🛛 🕻	Verload curret trimming:	100	4m 19	Header info valid	
+20 dBm on pin PA_BOOST:	O ON @ OFF					Rx on going	
Pix settings		AGC auto: INA boost	 ON OFF OI OFF 			Sgnal synchronized Sgnal detected Coerating mode Steps Standby	
DIO mapping						🔿 Synth, Rx 🔿 Synth, Tx	
DI05	DI04	DIO3	002	DI01	DIOO	🔿 Rx 🛛 💮 Tx continuous	
ModeReady . C	CadDetected •	CadDone •	RechangOrannel •	ParTimeout *	RxDone •	🔿 Rx Single 🙁 CAD	

Then we need to set the device in reception after setting the Lora modulation parameters.

SX1276 Starter8	Kit A									
File Action										Set the Spreading Factor
do Me	dem: LoRa	FSK Reset 📑	Reg Monib	ON OFF	0					7
ommon LoRa										
Settings						IRQ mask			ing flags	
Spreading factor:	SF10	•	Preamble leng	tr 12	ayrrd	Rx simeout	© ON	OFF	RxTimeout RxDone	
Coding rate:	4/5	•	implicit header	0 ON #	OFF	Rx done:	© ON	* OFF	PayloadCrcErrox	Set the Coding Rate
Bandwidth:	250	* 1944	Perioad length	32	tyter	Payload CRC erro	C ON	OFF	ValidHeader	g i tato
Rx timeout	0.409600	101 +	Payload CRC	O ON		Valid header	(D ON	OFF	TxDone	
Low datarate		- Advert				Tx done:	O ON	OFF	CadDone	Set the Bandwidth
optimize	O ON O	OFF.				CAD doce	O ON	· OFF	FhssChargeCharnel	Set the bandwidth
						FHSS change cha	MO O Jan	· OFF	CadDetected	
						CAD detected	© ON	· OFF	Nodes status	
tx header info					-				Hodem clear	
		eceived valid	PLL timeout	Rx payload CR	Rx payload coding rate	Number of byses			Header info valid	Enable the payload CRC
	-	header count			coding rate	received	_		Rx on going	
acket status		0	9					_	 Signal synchronized Signal detected 	check
acket status	Current hop	ping Received	valid Rx data	Au Pres	ed sacket Recei	ved packet Current R			· operation	
	channe	packet o		est S	R (6) RS	Si [dBm] value [dB	m		Operating mode	
	0	0	0		0	155.0 -155.0				
Message				/24		Packet Control	-		O Sleep Standby	Optimize transmission for
enion: 10.8eta5		/esion: •	Chip ve	ASI	La Contra File -	Ra packeta	log 🚇 🔿 T.		Synth. Rx Synth. Tx Rx Tx continuous Rx Single C4D	Low datarate OFF (mandatory for SF11 and SF12)
CI	lick "S	Start" to	o start	Receiv	/ing			Set	the Device in R	eceiver

At this stage, the transmission – reception should be complete and the user should see the LEDs blinking on the Eiger platforms.



7.2 ... perform a simple transmission / reception in FSK

First, you need to set the RF parameters for the transmission:

SK1276 Starter Kit A		Contra and and	Set the frequency. 915,000,000 Hz
File Action Tool Help	Sk. Revel (3) Revel (3) (5) Revel (3) (5) Revel (3)	Inform Notified	Set the frequency: 915,000,000 Hz Set the bitrate: 19,200 bps Set the Frequency deviation: 50,000 Hz
version 18,8450 (Fernare V	XO Frequency: 12200000 (b) Ire XO input deficition: 170.0 0 Cymel RC sociliary statution: Cellinetre: Battery statution: Cellinetre: Lan battery detactor: 0 Kit @ OFF Lan battery detactor: 100.0 Integration: 100.0	Coche Controle Controle Controle Controle Controle Singer 48 Strendey Singer 56 S Transvister Singer 56 S Pacesver 1 Connection status:	

In the transmitter, receiver and IRQ windows, all the parameters can be left at their default values and then we simply need to set our packet structure.

le Action Tools H	inter .						Set the preamble size: 5
	a FSK Reset () (a) (A	es Maxter Of	017.1 (0)				
	er IRG⤅ Packet Handler						
Data mode. Preamble size: Auto restant Ro mode Preamble activity	Pader •	bytes				In Tape ModeReady Reflectly Troffeedy Phane	Set the preamble polarity: 0x55
Sync word NEO till condition: Sync word waxe Sync word value	ON © OFF Sync address © Ale 4 0 35-05-05-05	(72)	CRC saturation CRC suts clear CRC polynom Ta start condition	ON O OFF OFF		Rasi Torenut Peartire SyncAddresMatch	Set the Sync Word size: 4
Packet turnat: Payload length	Veriable O Fixed 1 00 0x01	- 4,40	FFO Threaded 10 Home 10 Home Power fra Season	0 ON # 011 0 ON # 011 0 ON # 011 19 15		Fale Fale	Set the Sync Word: 0x69- 0x81
whet				Deice status		@ PaylonTrady	
Preamble 55-55-55	Sync Length 15-55-55-55 00	h NodeAddress		CRC Bit lynchroniger 33-63 Dati mode	ON Packet	B CreCk B Londiet	Set the packet length: variable
Message	IEXADECIMAL		ASCII	Operating mode Coend	Standty	Openating mode	
				* Stat	Log Falfillo	O Synth Ta: O Transmitter O Synth Fa: O Reasiver	Set the payload: 0xA1-0xA2



At this stage the radio is fully configured on the transmitter side. We can now set the device in Transmitter mode so that packets are ready to be sent from the device.

SX1276 Starter Kit A				
	Help ofa FSK Reset (1) (3) Reg Monitor (OFF @		
Common Trananitier Reco	aiver IRQ & Map Facket Harder Separater Te	espendure .		
Data mode: Preemble size: Auto restant Rx mode: Preemble planty: Sync word: FVFO 68 candidan: Sync word size: Sync word size: Sync word size: Packet format: Packet format:	Packet ··· 3 (2) (3) 0FF •·· •·· •·· (3) (3) (3) •·· (3) (3) (3) (3) •·· (3) (3) (3) (3) (3) •·· (3) (3) (3) (3) (3) (4)	Dradcast bötess: 2 0.00 DC-tex 0.07 € MacAsasar 5 Mitaning DC-tex 0.01 € 0.01 € 5 Mitaning DC-tex 0.01 € 0.01 € 0.01 € DC-tex 0.01 € 0.01 € 0.01 €	Haften Madebady Pollendy Trillendy Plandy Plandy Pland Pland Preside Preside Preside Presidend Plandte Presidend Plandte Pl	Tx Packets: Indicates the number of packets sent
Packet Preamble 55-55-55	Sync Length Node Addres	an Message CRC 51 Synchronizer ON 33-53 Data mole Packet	Payladfeaty GCA GCA	Set the Device in Transmitter Mode
Nessage	HEXADECIMAL	ASCH Caveling note Standay ASCH Start Lag FAITHO	Opening notif -> Sire +> Sanday -> Sireh. Fix: -> Trenentife -> Sanda, Fix: -> Fix: -	A small control window appears allowing the user to set the number of packets to be sent. Setting the value to '0' will make the device transmitting indefinitely.

To start sending packets, simply click on the "Start" button.

SX1276 Starter Kit A						
File Action Tools P			less in the			
	Ra FSK Reset 📋 💩 Reg					
onmon Trananitian Recen	tver IRQ⤅ Packet Harder 5	lequencer Temp				to fep
Data mode:	Packet •		Address based fi	tering	OFF Node Node or Broadcast	ModeReady
Preamble size:	0 (Q)	01568	Node address:		0x00	Notice the green LED indicating when
Auto restart Rx mode	OFF.		Broadcast address		0x00	@ Taffeedy
Preamble polarity:	0x44 © 0x55		DC-bee.		OFF C Marchester C Whitering	• *** a packet is sent
Sync word:	I ON COFF		CRC calculation	6 I I	ON OFF	@ Resi
FIFO fill condition	· Sync address · Always		CRC auto clear:		ON COFF	Timesut
Sync word size:	4 0	bytes	CRC polynom:		BIEM · CCITT	Prestie
Sync word value.	55-55-55-55		Tx start condition		Frickevel · FricketEmpty	SyncAddressMetch
Packet format:	Variable O Fixed		FIFO Threshold		5 [0]	FAF#
Payload length:	1 (0 0x01	bytes	IO Hone:		O ON OFF	FhEngty
			10 Home Power I	inne.	O ON COFF	Thirst Thirst
			Beacon.		DON OFF	Proce "Start" to start conding packate
					Take of Statements of	Press Start to start seriulity packets
Facilit	And Annual	Node Address		-	Device status	© Crock
Preamble 55-55-55	Sync Length 55-55-55 00	NAME PRODUCED	Message	CRC 33-63	Bit Synchronizer: ON Data mode Packat	Lowber
Mesage			-		Operating mode Standay	Operating mode
	HEXADECIMAL		ASCII		Central	O See Sandy
					Start Lag Failife	
						Press "Stop" to stop sending packets
				17		Stet Rx O Reserver

The device is now sending packet. You can also see the Yellow LED flashing on the Eiger modules to indicate that the device is currently transmitting.



We must now configure the receiver side. Open a new window of the SX1276SKA and configure the radio as done for the transmitter side. The process is identical:

File Action Took Help		Set the frequency: 915,000,000 Hz
Image: Second Secon	Notari White White<	Set the bitrate: 19,200 bps Set the Frequency deviation: 50,000 Hz

In the receiver, it is necessary to set some parameters to configure the receiver.





To finish, the user must simply set the packet handler parameters as in Tx:

SX1276 Starter Kit A					Set the preamble size: 5
File Action Tools H		Marriella.			
🥶 🖬 💠 Modem Lef	la FSK Reset [] () Reg Monton (IN OFF I I			
Coreon Toronition People	er IRG⤅ Packet Handler Seauncer To	nuesture.			Set the preamble polarity: 0x55
Data mode:	Pathat .	Address based libering	OF Node Node or Broadcast	ing face	
Prepride side:	3 (0) byter	Node address	0	NoteFeat/ BrPeat/	
Auto-restart Rx mode	0##	Broadcast address	10 [1] Delli	G Taffaady	
Preantile polarity:	0x44. © 0x55	DC-free	. OF C Marchester C Vititaring	@ PEack	Set the Sync Word size: 4
Sync word	ON COFF	CRC calculation:	* ON () OFF	G Fast	
FIFO NI condition	· Sunc address () Alugue	CRC and Gen	1 ON () OFF	@ Timesal	
Sure word size		CRC polynom:	O BH . COTT	@ Prearitie	
Sync word value.	55-55-55-55	Ty start condition.	C FALevel . Fitchedingty	SyncAddressMatch	Set the Sync Word: 0x69- 0x81
Pachat format:	· Variable · O Fixed	FIFO Truestold	18 (4)	@ FaiFut	Set the Sync Word. 0x03- 0x01
Psyload length	1 0 0.01 bott	ID Home:	O ON . OFF	FileEngty	
		O Hone Power Barriel	O ON . OFF	FALerel FALerel FALerel	
		Beacon:	O ON . OFF	0.4400.000	Set the packet length: variable
				PacketSert PacketSert PacketSert	Set the packet length. Valiable
Packet			Dvice statue	CoOk	
Preamble 55-55-55	Sync Langth Node Addres	Manage CRC 23-6		· Lovellar	
Hemaja			Oprating mode Standby	Operating mode	Press "Start" to start receiving packets
	HEXADECIMAL	ASCII	Cresi	C Care & Smith	Fless Start to start receiving packets
		(A)	Start Lag. Fal FiFO		
	Λ			O Synth. Tx: O Transmitter	
		(T)		O Synth. Rx : O Receiver	Set the Device in Receiver Mode
Version: 1.0.Beta3 Freme	are Venion - Orig venion	- Config File -		Connection status: @	
				,	
				$\langle \rangle$	
/					<
/					
/		ia diant			
The rec	ceived payload	is displa	ayed here	Number of pa	acket received



7.3 ... perform Continuous transmission and Reception in LoRa

It is possible to set the SX1276 in Continuous Tx mode to perform a spectral evaluation of the LoRa modulation. In this mode, the SX1276 will be going through the FiFo and send whatever data are present in the RAM.

mmon LoRa ettings preeding factor oding rate: andwidth: a timeout: ow datarate planize:	4/5 125 0 10240	0 	• • kHz	Preamble len Implicit head Payload leng Payload CRC	r: © ON	tytes	IRQ mask Rx timeout: Payload CRC error: Valid header: Tx done: CAD done: FHSS change channel CAD deexted:		OFF OFF OFF OFF OFF OFF OFF OFF OFF OF	Ing fags R RTimeout R RDone PayloadOrcError VididHeader TuDone CasDone PaysonargeChannel CasDone RaschangeChannel Modem status	
header info		Receiv	ed valid r count	PLL timeout	Rx payload CRC	Rx payload coding rate	Number of bytes received			 Modern clear Header info valid Rx on going 	
			0	0	9		0			 Signal synchronized Signal detected 	
iket status 🦟		nt hopping hannel	Received	d velid Rx dat	abuffer Receive	ed sacket Receive R 161 RSSI	d packet Current RSSI IdBm) value IdBm)	1		Dperating mode	Oat the device in
	T	0	0		0	0 -15	55.0 -115.0				Set the device in
ныре	н	EXADECI	UAL.	A. C.	ASC		Packet Control Start Log	Ø 0	Tx ⊙ Rx	Steep Standby Synth, Rx Synth, Tx Rx Tx continuous Rx Single CAD	continuous TX mode

It is also possible to set the device in Continuous Rx mode. In this mode, the device is continuously receiving the packet sent from the transmitter.

mon LoRa ettinga preading factor: oding rate: andwidth: x timeout ow datarate ptimize:	SF7 Presmble length: 12 œ symbols S5 Implicit header: O N O F 125 Wbr: Psyload length: 12 © symbols 0 100400 © s Psyload CRC: © ON ⊙/F © ON © OF						Rx 1 Rx d Payl Valid Tx d CAD FHS	IRQ mask Rx timeout ○ ON ● OFF Psyload CRC error: ○ ON ● OFF Valid header: ○ ON ● OFF Tx done: ○ ON ● OFF CAD done ○ ON ● OFF CAD detected ○ ON ● OFF			Ing Ray Partimetut Partimetut ParticeSCeEntre Valid-Header TuDone CaSDone FhosChangeChannel CaSDenected Woden status Modem status
header info		Receive	ed valid r count	PLL timeout	Rx payload CRC	Rx payload coding rate		r of bytes reived			Header info valid Px on going
			0			- · · · ·		0			 Signal synchronized Signal detected
vet status -	Current	hopping	Received packet of			Jacket Received	packet dBm]	Current RSSI value (dBm)			Operating mode
		0	0	0	0	-15	5.0	-155.0	1		
inage	HE	KADECIN	(AL		ASCI		Packet (Sta		0	Tx ⊕ Rx	Set the device in continuous RX mod

Downloaded from Arrow.com.



7.4 ... Log the Transmitted or Received packets

The SX1276SKA has a logging facility which allows the user to get the exact time stamps at which a packet has been sent or received and with all the information related to this packet.

Common LoRa												
Settinga								IRQ m		020200	10,000	In flage ReTimeout
Spreading factor:	SF7		•	Preamble leng	et: 12		symbols			O ON	OFF OFF	RxDone
Coding rate:	4/5		•	Implicit heade	0.0	O ON OFF	t.	Rx do				PayloadCrcError
Bendwidth:	125		 kHz 	Payload lengt	32		Dytes		ed CRC error:	() ON	· OFF	ValidHeader
Rx timeout:	0.102400		. 5	Payload CRC:	0.01	N OF	t¢.		header	O ON	OFF	TxDone
Low datarate	O ON @ OFF								ne:	O ON	OFF	CadOone
optimize	0.01							CAD 6	ione:	O ON	OFF	FhssChargeCharnel CadDetected
								FHSS	change channel	O ON	OFF	Nodem status
								CAD	Setected	O ON	OFF	
Rx header info -												 Modem clear Header info valid
		Received header of		PLL timeout	Rx paylor	ad CRC	Rx payload coding rate	Number of receiption				 Rx on going
		0	-					0	1			Signal synchronized
Packet status -	-	-							_			Signal detected
	Curren	nt hopping hannel	Received packet or			Received p SNR (d			CurrentRSSI value (88m)			Overating mode
		0	0			0	-15		-155.0	-		
Message	1.1.1	×	1			10.15		Packet Co		_		() Sleep 💌 Standby
	HE	EXADECIMA	L			ASCII		Start	Log	0 01	x e Rx	🔿 Synth Rx 🔿 Synth. Tx
							A	Rx packets	1		0	© Rx 💮 Tx continuous
							4	or paceta				O Rx Single O CAD
ersion: 1.0.Beta5	Firms	ware Version:		Chip ve	rsion:	• 1	Cooling File -					Connection status: @

Depending if you are in FSK mode or in LoRa mode, a different pop-up window will appear:



In FSK mode, the packet logger allows to the user to only log a limited amount of packet (indicated by the value "Max Samples"). Then, when the packets are being transmitted or received, the number of desired packets will be logged in the file selected.



In LoRa mode, the packet logger is enabled or disabled. Once enabled, all transmitted or received packets will be logged in the selected file until the packet logger is disabled.

When enabling the packet logger, it is possible to start a complete new log in a new file or to append an existing file.

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7.5 ... perform a CW or PN9 Tx test on the SX1276

The SX1276 does not have a dedicated CW or PN9 Tx test mode implemented. However, it is possible to perform this test manually by setting the device in Tx continuous mode, and feed PN9/15 data stream to the DATA pin (DIO2/DATA), from a signal generator.

7.6 ... check the frequency accuracy of the SX1276 module

There is a very simple way to get the frequency error of the sx1276 modules. The core idea is to set the device in FSK and to set the frequency deviation to 0. In this case, the device will only emit a signal at the center frequency. The difference between the measured value and the set value gives you the frequency error.



8 Troubleshooting

Each Eiger platform, radio module or software kit has been thoroughly tested before to be released for customer evaluation. The section below highlights some of the common issues faced by users and how it can be fixed.

8.1 The Eiger platform indicates very high PER even in short range

There are several reasons which can have a dramatic influence over the performance of the platform. One of the common reasons is that the frequency selected is in the GSM or in another already used frequency band. If the frequency you have selected is already used by another RF system, the communication will obviously be affected. We therefore recommend to the user to check the RF band usage in his location before to start any PER testing.

8.2 The communication range in Lora is very poor

There are two aspects which can limit the LoRa performances: the emission power and the antenna. Please, make sure that we are using enough power to reach the distance you want to achieve. The Eiger platform can output up to 20dBm signals. The other aspect is the antenna, please, make sure the antenna you are using is designed to operate at the frequency region you are transmitting in.

8.3 The SX1276SKA do not detect the device through the USB

This issue is usually caused by a wrong connection of the USB The step below should fix the issue.

- 1- Make sure the Eiger Platform is powered down (Battery switch set to 0) and is not connected to the PC through the USB.
- 2- Reconnect the side USB to the PC, the red LED on the left side should light up
- 3- Connect the bottom USB to the PC.
- 4- Power the device up (Battery switch set to 1)
- 5- Press the five-way central push button until the screen light up.
- 6- Launch the SX1276SKA on the PC

8.4 The Eiger platform does not seem to work anymore

The battery is probably empty and you should connect the device through the side USB to a computer for a few hours, time for the battery to charge.

8.5 The Eiger platform touch screen is not accurate

This is probably due to a miss-calibration of the touch screen. In this situation, the user should reset the touch screen calibration and perform an accurate calibration using the stylus provided.



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