

**TN1211.01**  
**SX1211 Low Power ISM Transceiver**  
**Evaluation Kit User Guide**

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## 1 GENERAL INTRODUCTION

### 1.1 INTRODUCTION

This document has been written with the courtesy of Ylynx [www.y-lynx.com](http://www.y-lynx.com) referred as official Semtech Partner. This first chapter contains general information that will be useful to know before using the SX1211 Starter Kit environment.

### 1.2 HIGHLIGHTS

The information you will gain from this chapter:

- About this Guide
- Recommended Reading
- Troubleshooting
- The Y-Lynx and SEMTECH Internet Web Site
- Customer Support

### 1.3 ABOUT THIS GUIDE

This document describes how to use the SX1211 Starter Kit to develop and test RF application based on the SEMTECH SX1211 RF module. The manual layout is as follows:

**Chapter 2: Overview and Installation** - What SX1211SK is and how it can help you, how to install the hardware and the software.

**Chapter 3: SX1211SK - Tutorial** - A tutorial on using the Starter Kit with a SX1211 RF Module.

**Chapter 4: Functional Overview** - A description of each application mode embedded in the kit.

**Chapter 5: Test and Evolution** - A description of the basic features to evaluate the SX1211

**Chapter 6: Advanced Features** - A description of specific SX1211's functionalities.

#### 1.3.1 Conventions Used in this Guide

This manual uses the following documentation conventions:

Description	Represents	Examples
Underlined, Italic text with right arrow	A menu selection from the menu bar	File > Save
Bold characters	A window or dialog button to click	OK, Cancel, Next, Back
Characters in angle brackets <>	A key on the keyboard	<Tab>, <Enter>
Italic characters	Referenced documentations	<i>SX1211 Datasheet</i>

**Table 1: Documentation Conventions**

#### 1.3.2 Documentation Updates

Since the Starter Kit and other tools are constantly evolving to meet customer needs, some PC-GUI environment dialogs and/or tool descriptions may differ from those in this document.

### 1.4 RECOMMENDED READING

This user's guide describes how to use the SX1211 Starter Kit. Other useful documents can be found on [www.y-lynx.com](http://www.y-lynx.com) or [www.semtech.com/products](http://www.semtech.com/products) :

SX1211 Product Datasheet  
SM1211 Product Brief  
SEMTECH Application notes  
Y-Lynx Application note

## 2 OVERVIEW AND INSTALLATION

**ADVANCED COMMS & SENSING****2.1 INTRODUCTION**

This chapter gives you an overview of the SX1211SK and then explains how to install the system hardware and software.

**2.2 HIGHLIGHTS**

The items discussed in this chapter include:

- What the SX1211SK is
- How SX1211SK helps you
- SX1211SK - Kit Components
- Installing SX1211SK Hardware
- Installing SX1211SK "Graphical User Interface" software

**2.3 WHAT THE SX1211SK IS**

The SX1211 Starter Kit is an environment for the SEMTECH SX1211 transceiver. The SX1211SK allows the demonstration of a two way communication between two radio boards, to perform practical "demonstration", "range" and "site survey" testing but also to evaluate the RF transceiver.

SX1211SK performs basic functions such as modulation schemes selection (FSK / OOK), configuration in transmitter, receiver or sleep mode, plus features such as frequency deviation selection, filter bandwidth and output power management.

This document covers the basic setup and operation for the SX1211SK environment.

**2.4 HOW THE STARTER KIT HELPS YOU**

SX1211SK allows you to:

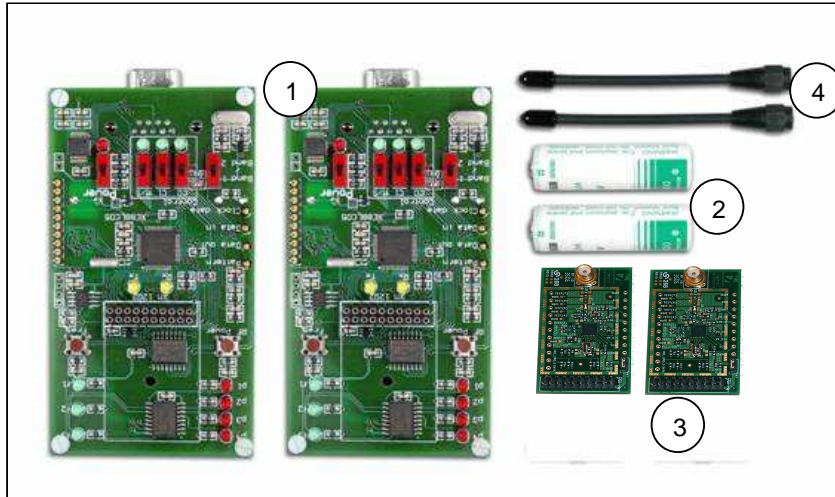
- Demonstrate a two way communication - Ping Pong Demo with a default configuration
- Change the settings of the Ping Pong Demo
- Configure internal registers of SX1211 transceiver for Evaluation purpose.
- Transmit and receive a data stream

**2.5 SX1211SK KIT COMPONENTS**

The components of the SX1211 Starter Kit are shown in Figure 2.1.

- 1) 2 x Processor Board
- 2) 2 x batteries
- 3) 2 x SX1211 - SEMTECH RF Module
- 4) 2 x antennas

A Serial Cable to connect the Processor Board to a PC and the CD-ROM with SX1211SK software and on line documentation are also included in the kit.



**Figure 2.1: SX1211SK Components**

**2.6 INSTALLING SX1211 SK - HARDWARE**

Follow the steps in this section to install the SX1211 Starter Kit

**Warning**

The main board should not be placed in ON position

**Step 1:**

Install the AA size battery(s) while observing the polarity indicated on the PCB. The processor board uses an AA size 3.6-volt Lithium battery.

**Step 2:**

Connect the SX1211 RF module to the processor board

**Note**

That step 1 and 2 are the only steps required to perform a Ping Pong demo with the default settings.

**Step 3:**

Connect the RS232 interface cable between the PC serial port connector and the Processor RS232 socket.

Additional set-up procedure may be required depending on the user objective.

**2.7 SX1211SK – “GRAPHICAL USER INTERFACE” SOFTWARE****Install**

To install the SX1211 SK software perform the steps given by “Installshield™” (please note that these steps are general guidelines and procedures may vary depending on individual user PC WINDOWS™ configuration and WINDOWS™ OS software).

**Run**

- a) Click on **‘Start’** button on the MENU bar on the desktop window.
- b) On the pop-up window, click on the **‘Program’** ICON
- c) Locate and click on the SX1211SK on the sub menu bar that is displayed.

The Graphic User Interface software screen follows standard WINDOWS™ Conventions. The PC GUI provides an interactive user interface for selecting and modifying SX1211 parameters. A brief description of the screen layout and usage of the GUI interface can be found in the particular “SX1211 – Test and Evaluation” section.

**Uninstall**

If it is necessary or desired to completely UNINSTALL the PC GUI software it can be removed easily by performing the following steps:

- a) Click the **‘Start’** button the PC’s desktop screen
- b) On the pop-up window, click on the **‘Settings’** button
- c) Locate and click on the **‘Control Panel’** button
- d) Within the Control Panel window, locate and double-click on the **‘Add/Remove Programs’** ICON.
- e) Locate and select the SX1211SK ICON and follow the removal procedures.

### 3 SX1211SK - TUTORIAL

#### 3.1 INTRODUCTION

After installing the SX1211SK hardware and software, you are ready to start using the kit.

#### 3.2 HIGHLIGHTS

- Reviewing Hardware
- System Description
- Default Ping Pong Test Overview
- Ping Pong Test Procedure

#### 3.3 REVIEWING HARDWARE

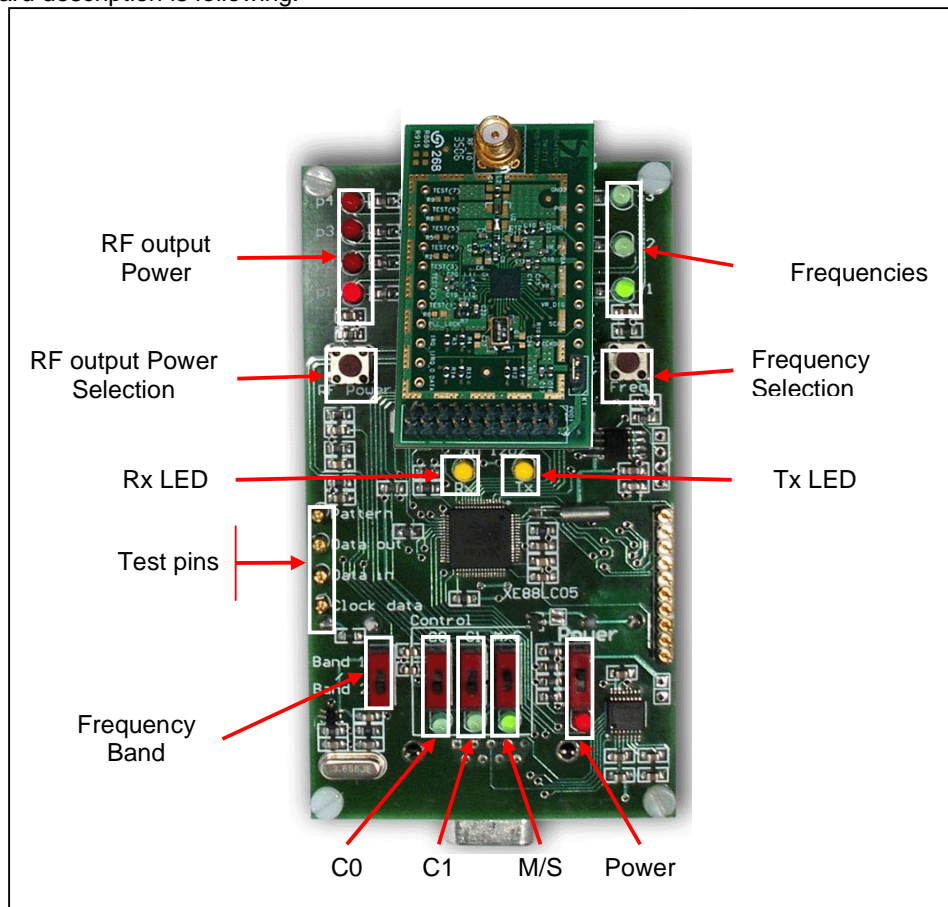
The hardware set-up for this tutorial is described below:

- Verify that the power supply is turned off at this time
- Each SX1211 RF module is connected to the application board (processor board)
- Each antenna is connected to the SX1211 RF module
- Boards are not connected to the PC

#### 3.4 SYSTEM DESCRIPTION

One objective of this Starter Kit is to demonstrate a two way communication between two radio modules, but also to evaluate the SEMTECH transceiver SX1211. In order to have a high flexibility, the Starter Kit board has been developed in order to support all the SX1211 RF modules and so few buttons have been added to the board (see Figure 3.1).

The Board description is following:



**Figure 3.1: Board Overview**

**ADVANCED COMMS & SENSING****Brief narrative of LEDs and push buttons**

Power	: Switch on or switch off the power supply
Frequency band band	: Switch to select the frequency band according to the SX1211 frequency band
RF Output Power	: LEDs which indicate the transmitted output power: 10, 7, 4, 1, -2, -5dBm
RF power Selection	: Push button used to select the desired output power value
Frequencies	: LEDs which indicate the frequency used.
Frequency Selection	: Push button used to select a frequency with the manual mode
Tx LED	: LED which indicates an RF transmission
Rx LED	: LED which indicates that a message has been received correctly

**Control buttons**

C0 / C1	: Configuration Switch buttons
M/S	: Switch button to select between Master and Slaves

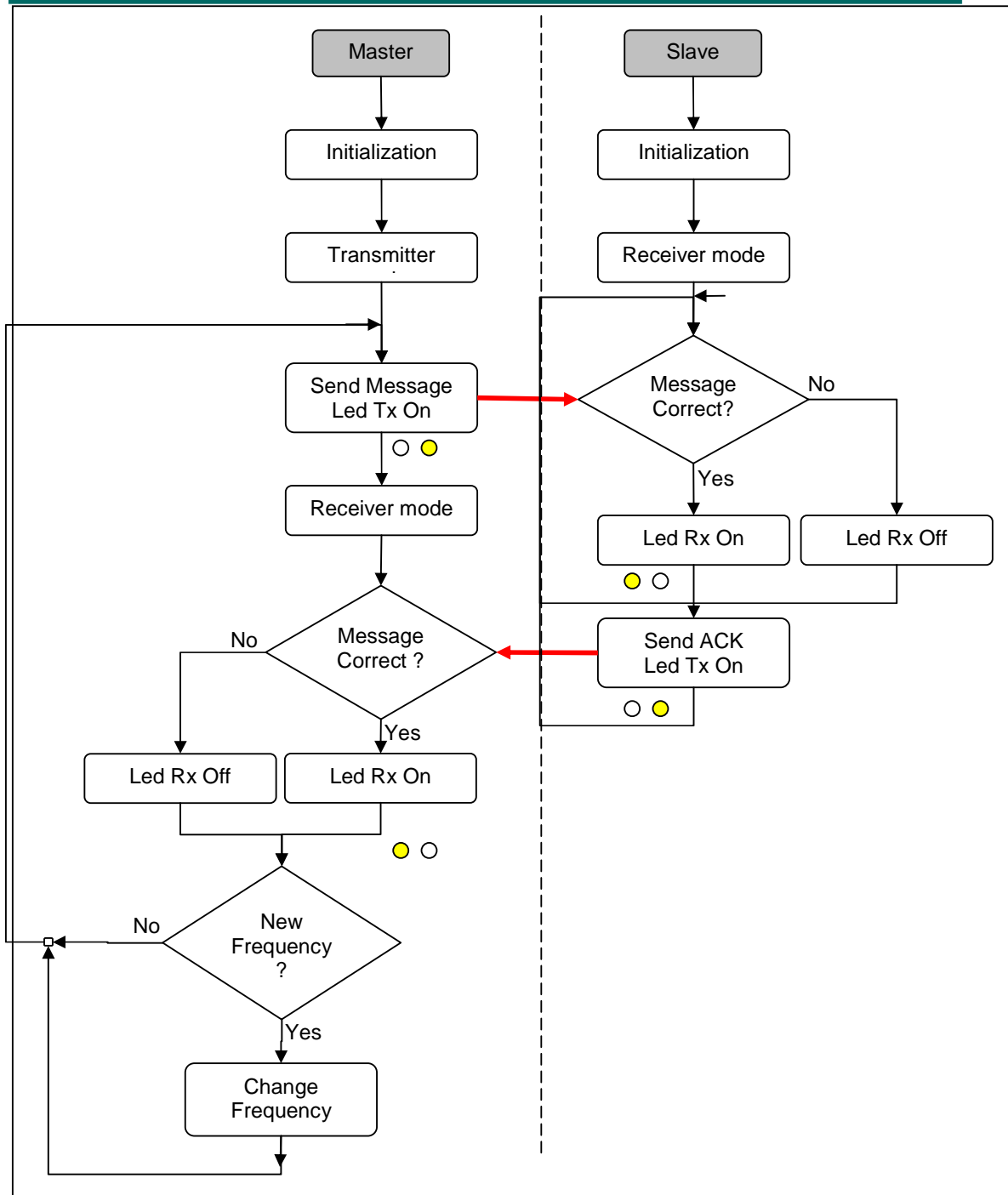
**3.5 DEFAULT PING PONG TEST OVERVIEW**

The first Ping Pong demonstration allows RF communication between two points to be achieved. The communication is made between a board operating as Master and a board operating as a Slave. In addition two operating modes are available: Automatic and Manual.

With the Automatic mode, the Master sends a message to the Slave every 125ms and changes transmission frequency after 1s (Auto-jump). When the Master receives an acknowledge message from the Slave or when the Slave receives a message from the Master, the Rx yellow LED lights up (Communication OK).

The Manual mode is the same as Automatic mode. The main difference is the selection of the frequency. In this case a user selects the frequency by pushing on the "Frequency Selection" button.



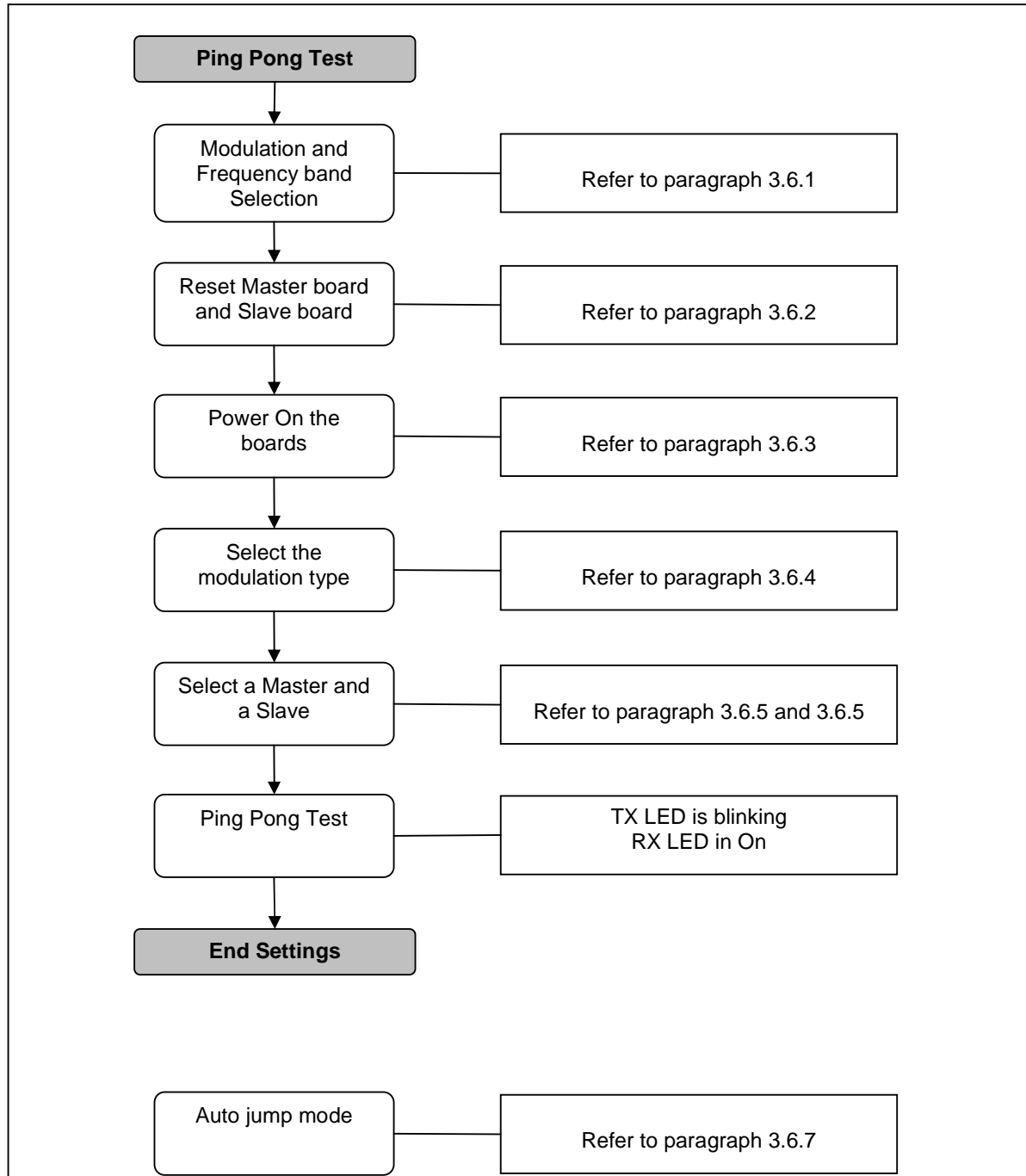


**Figure 3.2: Ping. Pong Test Flowchart overview**

Note: The user can change the frequency of the receiver (Slave) at anytime by pushing on the "Frequency Selection" button.

### 3.6 PING-PONG TEST PROCEDURE

The Ping Pong Settings flowchart is shown Figure 3.3. At the end of this process the Ping Pong test will start automatically.



**Figure 3.3: Ping-Pong Settings flowchart**

**ADVANCED COMMS & SENSING****3.6.1 Frequency band selection**

1 – Set the Band 1/ Band 2 according to the frequency band of your RF modules.

Band 1= 915MHz

Band 2= 950MHz / 868MHz

**Warning**

Before starting the setting of the Ping-Pong demo, please verify that all the push buttons are in down position and all the LEDs are off.

**3.6.2 Reset the boards**

- 1) Set the configuration buttons C0 and C1 to 1 (up position, the both green LEDs will switch On at the power-up). This action will reset the EEPROM where the latest configuration is saved.
- 2) Switch on the power supply via the button POWER (up position). The red LED lights up.
- 3) Wait until the LED p1 and f1 light up.
- 4) Switch off the power supply, down position of POWER button.
- 5) Switch C0 and C1 to the down position

**3.6.3 Switch On the boards**

- 1) Switch all the buttons (C0, C1 and M/S) in down position,
- 2) Switch on the power supply, the red LED light on.
- 3) Verify that p1 LED and f1 LED are switched On

**3.6.4 Modulation type**

Set the Modulation type.

C1 = 1 (ON) OOK Modulation

C1 = 0 (OFF) FSK Modulation

**3.6.5 Slave Mode**

The Slave mode is selected if M/S is set in down position, the green LED is Off.

**3.6.6 Master Mode**

Push up the M/S button to select the Master mode on one unit only. The green LED below the push button switches ON.

**Warning**

The push buttons are only used to change a state and not to select a state. The state information is displayed by the green LEDs

**Manual Mode:** The manual mode is selected if the green LED corresponding to C0 is OFF. The user can choose the frequency by pressing on Frequency Selection button (**Freq**) and the output power via RF Power Selection button (**RF Power**).

**Autojump Mode:** Push up the button C0 on the Master board (the green LED switches ON) to select the Automatic Mode. C1 is still down. The board is now in automatic mode; the user can not change the frequency manually but can still modify the output power.

### 3.6.7 Configuration Switch buttons

C0	C1	M/S	Description
0	0	0	FSK without auto-jump - Slave
0	0	1	FSK without auto-jump - Master
0	1	0	OOK without auto-jump - Slave
0	1	1	OOK without auto-jump - Master
1	0	0	FSK with auto-jump - Slave
1	0	1	FSK with auto-jump - Master
1	1	0	OOK with auto-jump - Slave
1	1	1	OOK without auto-jump - Master
1	1	1	Reset at the power-up

### 3.6.8 Ping Pong Test

Ping-Pong has automatically started after the Automatic Frequency Control. At this stage the user observes that the Tx yellow LED blinks (Ping). The Rx yellow LED comes on when the received message is correct (Pong).

A reliable two way radio link has been established between two modules. Each module, upon receipt a valid radio frame will immediately "echo back", keeping the Ping-Pong test sequence continually active. This indicates the desired state of 100% two-way communications reliability.

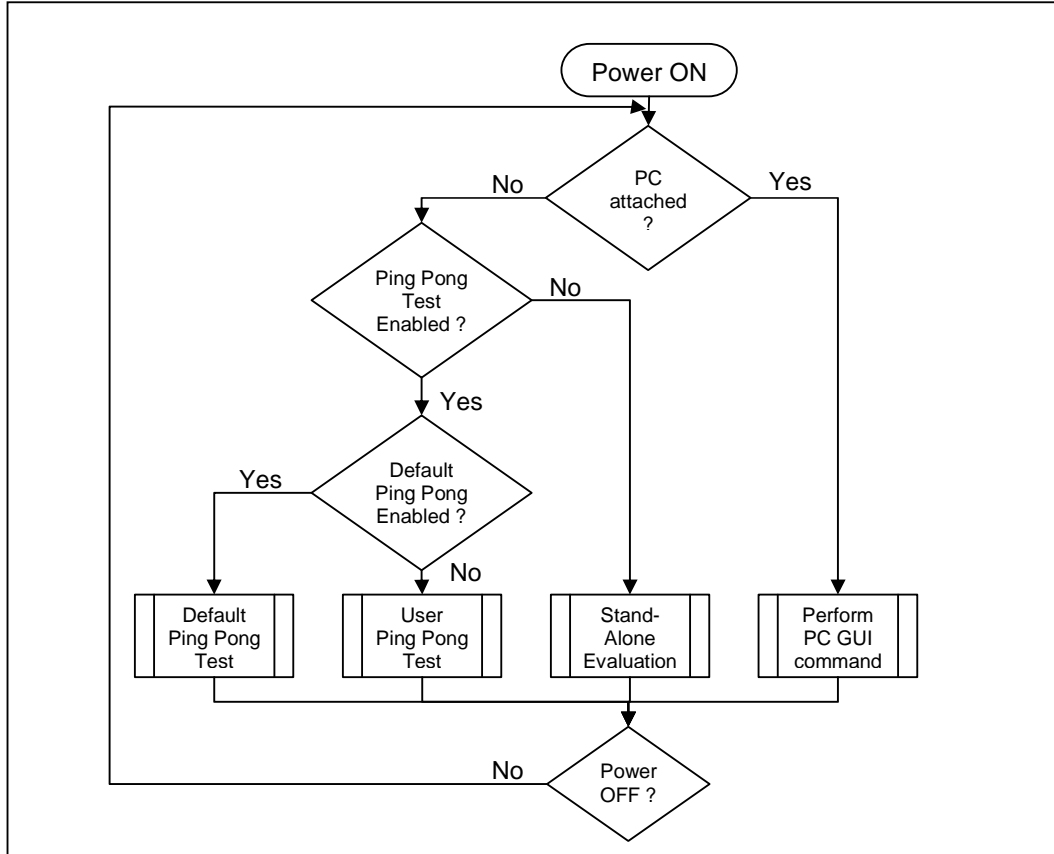
## 4 FUNCTIONAL OVERVIEW

### 4.1 INTRODUCTION

After using the Ping Pong Demo, you are ready to start using the kit.

### 4.2 HIGHLIGHTS

- SX1211SK - Functional flow chart
- Default Ping Pong Test
- User Ping Pong Test
- Stand Alone Evaluation Mode
- PC – GUI command

**4.3 SX1211SK – FUNCTIONAL FLOW CHART**


**Figure 4.1: “Embedded software” general flow chart**

**Brief explanation of Figure 4.1**

- If the PC is attached to the processor board, the embedded microcontroller software will monitor the RS232 port for a valid user request from the PC GUI software. Acceptance and execution of a request is indicated by the “blinking” of both yellow LEDs Rx and Tx together.
- If the PC is not attached, the SX1211SK will assume “SX1211 Evaluation” mode if the user has disabled the Ping-Pong Test, otherwise the “embedded software” will check if the user has defined a “User Ping-Pong Test” if not the microcontroller will assume the “Default Ping-Pong Test”.

**4.4 DEFAULT PING-PONG TEST**
**4.4.1 Purpose**

The Ping-Pong Test provides the user a means to demonstrate practical two-way radio communications between two processor boards with SX1211 RF modules attached. The Ping Pong mode can be a valuable test facility when conducting on-site and range tests.

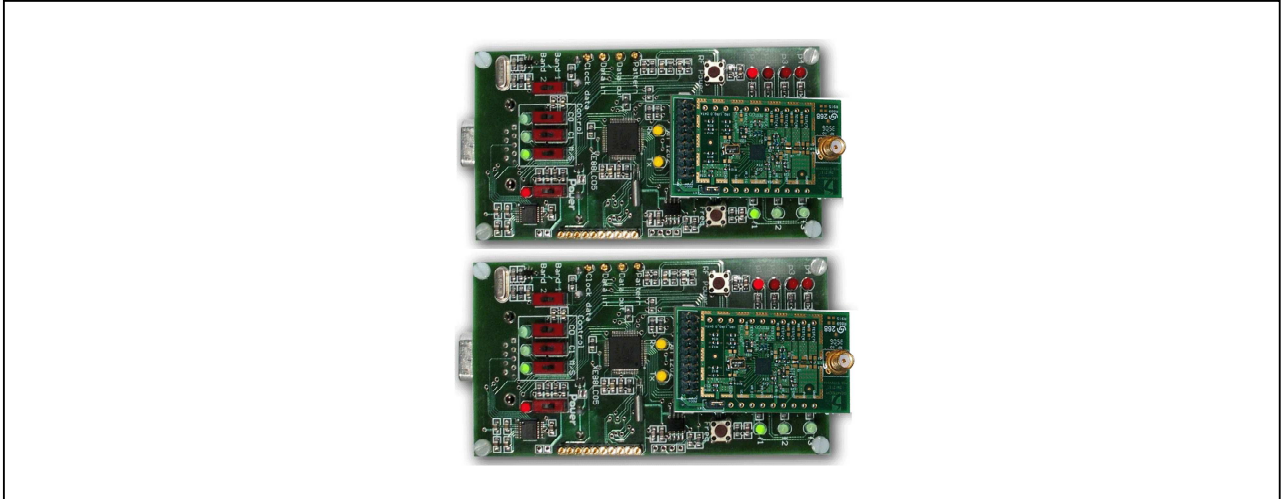
A Default Ping Pong Test program is embedded within a SEMTECH RISC microcontroller chip (XE88LC05) on the board. The Ping Pong Test (*Default* or *User*) is automatically started after the power up if no PC is attached to the board’s RS232 connector and if the option has not been disabled from the PC-GUI Software.

**ADVANCED COMMS & SENSING**

In addition the RESET of the board will not affect the parameters of the default Ping Pong demo.

**4.4.2 Equipment required**

- Two SX1211 radio modules
- Two antennas
- Two processor boards



**Figure 4.2 Ping-Pong test Hardware set up**

While the Ping-Pong Test is in progress:

- Tx Yellow Led switched ON indicates a radio message is being sent
- Rx Yellow Led switched ON indicates a valid radio message is being received

**4.4.3 Default Ping-Pong Test enabling**

To enable the default Ping Pong test the user needs to click on the “Default Ping-Pong” button on the PC-GUI interface before disconnecting the RS232 cable from the board.

**4.4.4 Read back the configuration**

To read the Default Ping Pong configuration saved in the Microcontroller memory, the user needs to click on “SX1211 Eval” to have access to the control buttons. Click on “Get Config”, **do not click on “Load Config”**. The Graphic Interface will display the Default Ping Pong configuration which has been saved into the microcontroller.

**4.5 USER PING-PONG TEST****4.5.1 Purpose**

The “User Ping Pong Test” allows the user to achieve a Ping Pong Test with their own settings. The User configuration will be saved in an EEPROM, but will be lost after the RESET function. This mode allows the user to modify all the parameters of the SX1211 (Frequency deviation, Local Oscillator f1, f2, f3, Pattern, etc). The only restriction is the data rate, which must be lower than 38.4kbps for a Ping-Pong Test.

**4.5.2 User Ping-Pong Test Enabling**

To modify the Ping-Pong settings, the user needs to click on the “SX1211 Eval” button before starting the parameter modifications. The next step is to send the new configuration to the microcontroller by clicking on “Send Config”. To save this configuration into the memory (EEPROM), the user needs to click on the “Save Config” button. The RESET operation will erase all the user parameters. To start the User Ping Pong test the user needs to click on the “User Ping-Pong” button on the PC-GUI interface before disconnecting the RS232 cable from the board.

The three predefined frequencies (f1, f2 and f3) can also be modified by clicking on “Ping Pong” on the tool bar menu

#### **4.5.3 Read Back the Configuration**

The SX1211SK allows the user to read back the latest configuration saved in the EEPROM. To display the registers contents, the user needs to click on “SX1211 Eval” to have access to the control buttons. Click on “Load Configuration” to load the latest configuration into the SX1211 transceiver followed by “Get Config”. The Graphic Interface will display the latest configuration which has been saved into the memory.

### **4.6 STAND ALONE EVALUATION**

#### **4.6.1 Purpose**

This operating mode allows the user to disable the Ping-Pong Test. In this condition, the user will be able to apply external data to the *Data in* pin and data received to the *Data out*, *Clock out* and *pattern*. The SX1211 configuration will be set via the graphic interface.

#### **4.6.2 Stand Alone Evaluation enabling**

To have access to this mode the user needs to click on “SX1211 Eval” button placed on the PC GUI interface. When all the bits have been set correctly, the configuration will be set to the microcontroller by clicking on “Send Config” and saved in the EEPROM by clicking on “Save Config”. The user can then disconnect the board from the RS232 cable.

#### **4.6.3 Read back the configuration**

As for the “User Ping Pong” function, the SX1211SK allows the user to read back the latest configuration saved in the EEPROM. To display the registers contains, the user needs to click on “SX1211 Eval” to have access to the control buttons. Click on “Load Configuration” to load the latest configuration into the SX1211 transceiver followed by “Get Config”. The Graphic Interface will display the latest configuration which has been saved into the memory.

### **4.7 PC-GUI COMMAND**

#### **4.7.1 Purpose**

This mode allows the user to evaluate the SX1211 performances by connecting a spectrum analyzer or a FM generator but also to define new parameters for the Ping-Pong Test and for the Stand Alone Evaluation. All the bits of each register are accessible, to set a bit the user needs to click on corresponding LEDs or to use the predefined values available from the MENU Bar. In this mode the board needs to be connected to the PC through the serial cable.

#### **4.7.2 PC-GUI Command Enabling**

To have access to all the registers, the user needs to select “SX1211 Eval” on the “App State” window from the PC-GUI screen.

## **5 TEST AND EVALUATION**

### **5.1 INTRODUCTION**

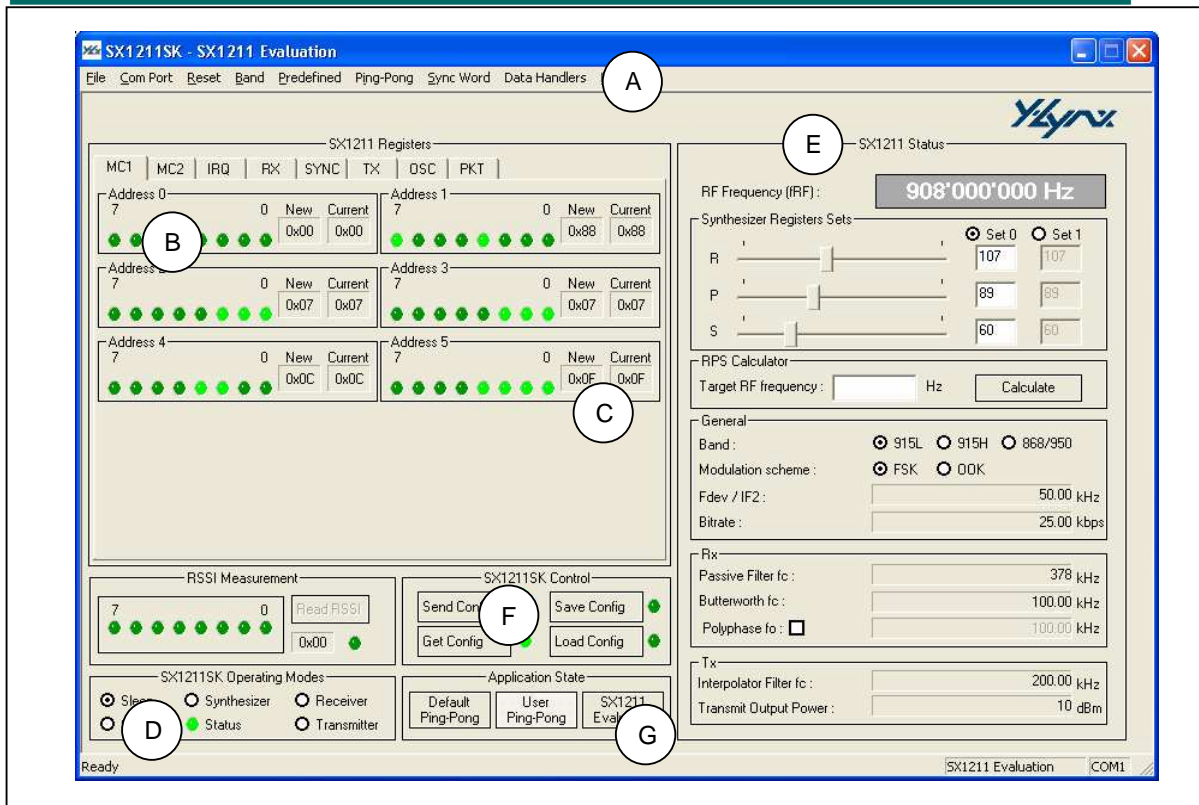
After installing the SX1211SK hardware and software, you are ready to start using the kit.

### **5.2 HIGHLIGHTS**

- SX1211SK – Basic PC-GUI Screen Layouts
- PC-GUI Screen Areas
- Menu Bar and Sub-Menu Options
- Ping Pong Mode modifications

### **5.3 SX1211SK – BASIC PC-GUI SCREEN LAYOUTS**

The SX1211SK PC-GUI consists of a single fixed screen. The screen is presented to easily allow the user to manipulate the SX1211 radio module at the binary level. The PC-GUI screen is divided into seven primary areas as shown in the diagram below.



**Figure 5.1: Screen Layouts**

Note: The actual PC-GUI presentation may differ as new features and updates are added to PC-GUI software.

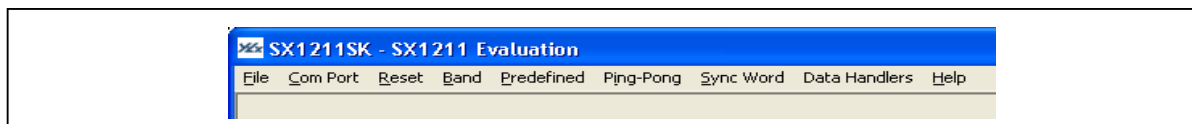
A brief description is:

- (A) Main Menu Bar with pre-defined configuration information
- (B) SX1211 Registers presentation and set-up window
- (C) Real time display window of register values (New and Current value)
- (D) SX1211 Operating Mode and set-up window
- (E) SX1211 Status display
- (F) SX1211SK Control window
- (G) Selection of the Application

## 5.4 SX1211SK PC-GUI SCREEN AREAS

### 5.4.1 Menu Bar

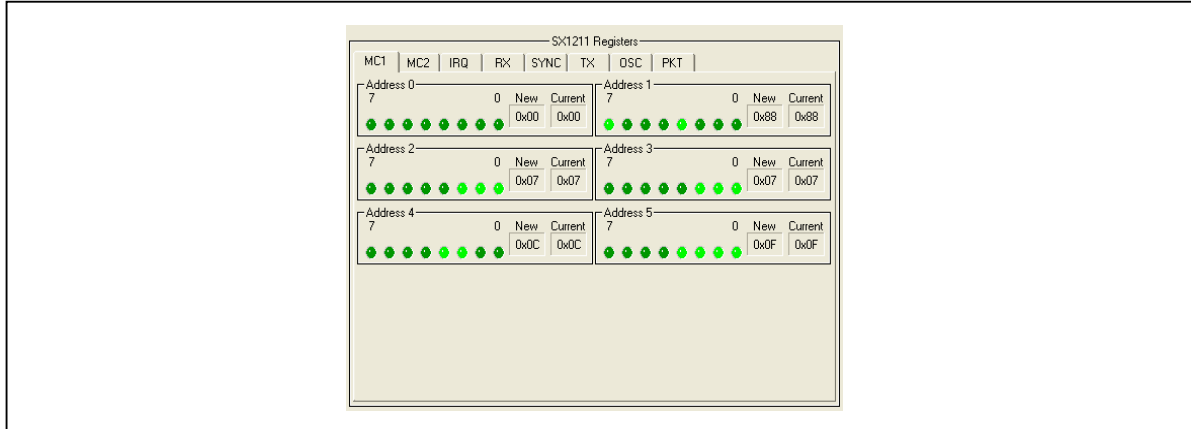
The MENU Bar allows the user to select the Com\_Port that the board is attached to. Reset registers, Band, Pre-Defined SX1211 Settings, Ping Pong, Sync Word, Data Handler and Help are included in the menu.



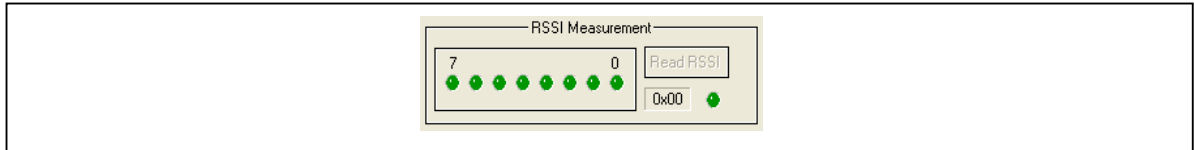


**ADVANCED COMMS & SENSING**
**5.4.2 Binary Registers**

The user can select a register by clicking on the register's name tab and can select individual bit settings for a particular SX1211 register. The new settings of the register occur only when *Send Config* button is clicked.

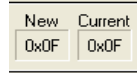

**RSSI Measurement**

The RSSI measurement button is available only if the RSSI is enabled and then the PC-GUI displays the result of the measurement. The RSSI output is available in two formats, in binary and in Hexadecimal.



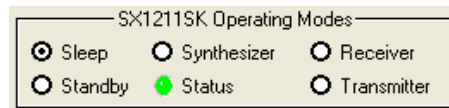
### 5.4.3 Register Status

Two Register status windows are displayed, the Current status and the New status. The current status corresponds to the actual SX1211 programming. This configuration can be read from the transceiver by clicking on *Get Config* and then the status window will be automatically updated. The New Status window is updated in real time (display in red) and based on the user interaction with the PC-GUI screen data. In addition, the new configuration is transferred to the SX1211 by clicking on *Send config* button, at the same time the Current status window is updated with the value of this new configuration.



### 5.4.4 Select Mode and Operating Mode

Operating Mode is used to select the mode or state that the SX1211 will assume. The selection will be transmitted automatically to the attached board, the operating mode Status LED switches on (green) if the selection has been transmitted to the board correctly, red if not.



### 5.4.5 SX1211 Status display

A Narrative window is provided for informing the user about the primary SX1211 configuration currently set-up. This window is updated in real-time when the user sets and clears various parameters on the PC-GUI screen.

#### Synthesizer Registers Sets:

The “start-up” local oscillator frequency of the SX1211 RF module, when the frequency offset is zero, will vary from device to device due to external components tolerance (i.e. Crystal). The RF Frequency can be adjusted thanks to the RPS slide-bars or directly by entering the value in the text window.

In addition, the SX1211 offers the possibility to set two RF frequencies defined by **Set 0** and **Set 1**

#### RPS Calculator

A text window (Target RF frequency) allows entering the Local frequency through the keyboard. Click on **Calculate** button, to update the synthesizer registers

#### General

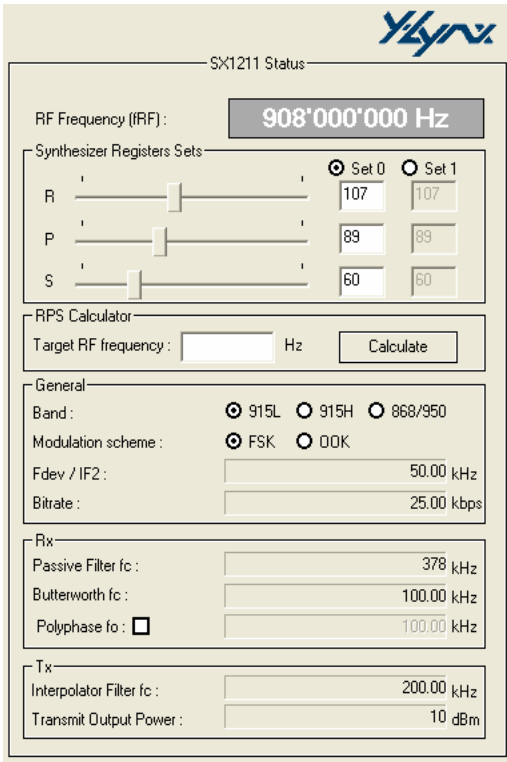
The General window displays the main parameters of the SX1211 to establish radio communication.

#### Rx

The RX window displays the information used by the receiver. To modify one of these parameters, use the SX1211 Registers window. The user has only the possibility to enable the polyphase filter when the FSK modulation has been enabled. If the OOK modulation has been selected, the polyphase filter is automatically enabled.

#### Tx

The Tx window displays the information used by the transmitter and set in the SX1211 Registers window.



**SX1211 Status**

RF Frequency (IRF): **908'000'000 Hz**

Synthesizer Registers Sets: ☒ Set 0 ☐ Set 1

R	<input type="text" value="107"/>	<input type="text" value="107"/>
P	<input type="text" value="89"/>	<input type="text" value="89"/>
S	<input type="text" value="60"/>	<input type="text" value="60"/>

RPS Calculator

Target RF frequency:  Hz

General

Band: ☒ 915L ☐ 915H ☐ 868/950

Modulation scheme: ☒ FSK ☐ OOK

Fdev / IF2:  kHz

Bitrate:  kbps

Rx

Passive Filter fc:  kHz

Butterworth fc:  kHz

Polyphase fc: ☐  kHz

Tx

Interpolator Filter fc:  kHz

Transmit Output Power:  dBm

#### 5.4.6 SX1211SK Control Window

The Graphic Interface offers different modes to control the RF module. The communication with the attached board is validated if the corresponding LED turns bright green. If the LED is red, the communication cannot be established or the operation is not allowed (the **SX1211 Eval** mode has not been selected).

##### Send Config

This operation sends all the registers to the microcontroller in order to program the SX1211 with the new configuration.

##### Get config

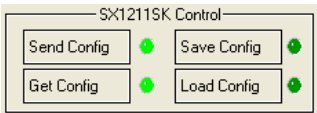
By clicking on this button, the user will be able to read the values of the SX1211 registers. This operation is very useful to find out what the previous programmed configuration was in the transceiver.

##### Save Config

This operation will save the configuration into an EEPROM placed on the preprocessor board. In this case the user will be able to read back the latest configuration after clicking on the "Load Config".

##### Load Config

This operation is used to load the configuration which has been saved in the EEPROM, onto the SX1211. The user will be able to read back the latest configuration by clicking on after on "Get Config".



**SX1211SK Control**

Send Config	<input checked="" type="radio"/>	Save Config	<input checked="" type="radio"/>
Get Config	<input checked="" type="radio"/>	Load Config	<input checked="" type="radio"/>

It is also possible to save a configuration in a file (extension .sk) using the FILE menu. The file can be loaded afterwards using the FILE in the menu. Semtech provides example of most configurations.

#### 5.4.7 Application Selection Window

The SX1211SK combined with the PC-GUI interface provides three different applications. To enable them, the user needs to click on the corresponding button.

##### Default Ping Pong in FSK Mode

By clicking on this buttons the user will have access to a range test with pre-defined parameters.

- Frequency 1 = 908.000 MHz or 868.000 MHz
- Frequency 2 = 909.000 MHz or 869.000 MHz
- Frequency 3 = 910.000 MHz or 870.000 MHz
- Data rate = 25 kbps
- Frequency deviation = 50 kHz
- Rx filter fc = 100kHz
- Passive filter = 378kHz
- Polyphase filter = Off
- Interpolartor filter fc = 196kHz

##### Default Ping Pong in OOK Mode

By clicking on this buttons the user will have access to a range test with pre-defined parameters.

- Frequency 1 = 908.000 MHz or 868.000 MHz
- Frequency 2 = 909.000 MHz or 869.000 MHz
- Frequency 3 = 910.000 MHz or 870.000 MHz
- Data rate = 2 kbps
- Frequency deviation = 50 kHz
- Rx filter fc = 100kHz
- Passive filter = 378kHz
- Interpolartor filter fc = 196kHz

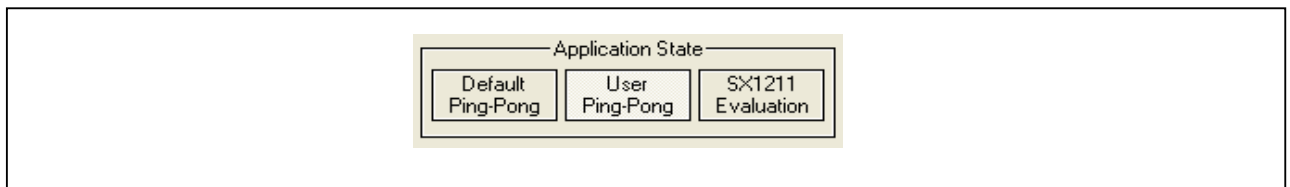
##### User Ping Pong

This mode is used by the user to achieve a Ping Pong test with their own parameters in order to be closer to the final application test. Before switching on this mode the user needs to define or modify parameters, in this case the **SX1211 Evaluation** needs to be selected. At the end of the modification, the user will enable the “**User Ping-Pong**” feature and disconnect the board from the RS232 cable. At this time, the user will be able to achieve the field range test with their own parameters.

##### SX1211 Eval

This mode allows the user to evaluate the SX1211 performances but also to program other parameters for the User Ping-Pong test. For more information about SX1211 registers, please refer to the SEMTECH SX1211 Datasheet.

When the board is connected to the PC, the user can evaluate the performance of the SX1211 transceiver by connecting a spectrum analyzer or an FM generator.



## 5.5 SX1211SK MENU BAR AND SUB-MENU OPTION

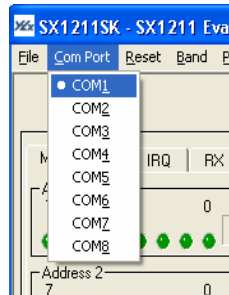


### Note

The actual PC-GUI presentation may differ from the illustrations as new features and updates are added to the software

### 5.5.1 Com Port

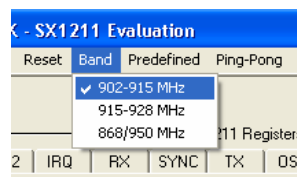
The Com Port sub-menu will allow the user to specify the PC serial RS232 communication port to use when attaching the board.



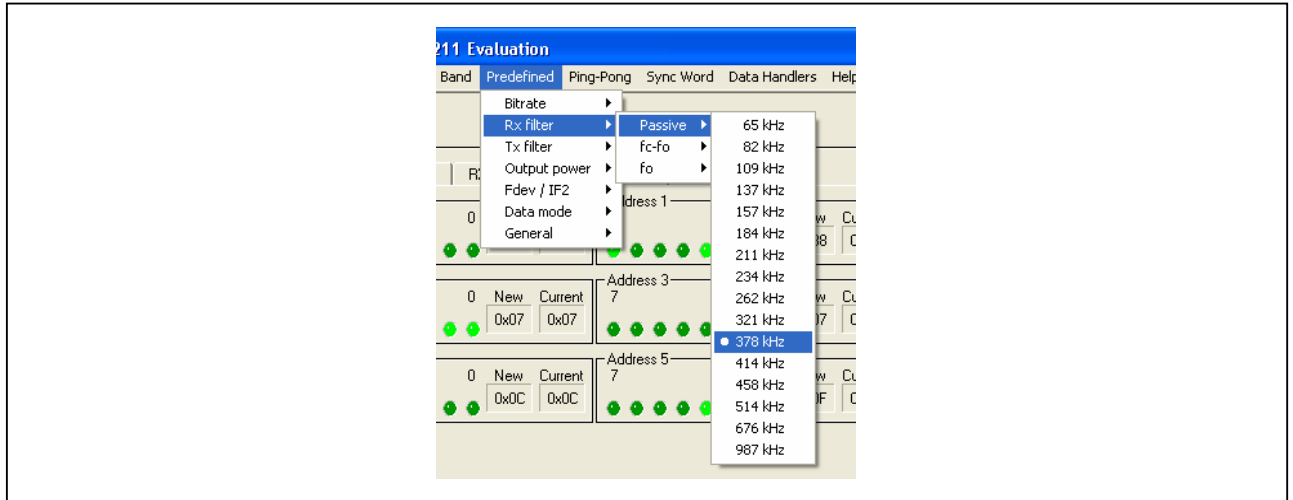
### 5.5.2 Band

The SX1211 Band set sub-menus will allow the user to select the operating radio spectrum or the band that the SX1211 RF module being tested is designed for.

Note: The 915MHz band is subdivided in two bands, 902-915MHz and 915-928MHz but can be address with the same hardware (RF module).



### 5.5.3 Pre-defined



#### Data Rate

The Data rate sub-menu will allow the user to set a pre-defined receive data rate (see SX1211 Datasheet, MCPParam, Address 3, bit [6.. 0])

#### RX Filter

The SX1211 RX Filter menu is divided in three sub-menu that allows the user to select the Passive filter (see SX1211 Datasheet, RXParam, Address 16, bit [7.. 4]), the "fc-fo filter" to set the Butterworth filter (RXParam, Address 16, bit [3.. 0]), and "fo filter" to set the the Polyphase filter (RXParam, Address 17, bit [7.. 4])

#### TX Filter

The user can also configured the Interpolator filter used by the transmitter (TXParam, Address 26, bit [7.. 4])

#### Output Power

The output power sub-menu will allow the user to set the desired SX1211 transmit output power level from -2dBm up to +10dBm (see SX1211 Datasheet, TXParam, Address 26, bit[3..1])

#### Frequency Deviation / Low Intermediate Frequency

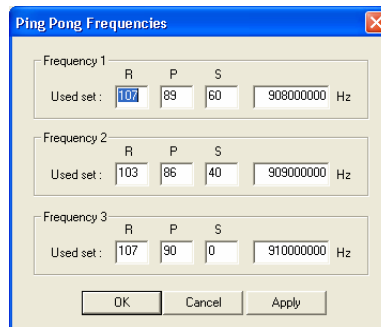
The frequency deviation / Low IF sub-menu allows the user to set a pre-defined "Transmit" frequency deviation (see SX1211, MCPParam, Address 2, bit [7.. 0])

#### General

The General sub-menu will allow the user to set selected parameters (Bit Sync and Buffered mode). The Bit Synchronizer is enabled by default.

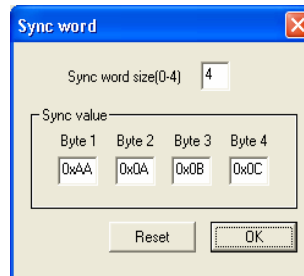
### 5.5.4 Ping - Pong

By default the Ping Pong mode is activated when no PC is connected to the board. If the user wants to alter the Ping Pong, each board needs to be connected temporarily to the PC and the **SX1211 Evaluation** Application needs to be selected. In addition the user can also change the three frequencies used in the Ping Pong demo. Upon completion of desired settings, the user needs to select "User Ping Pong" before removing the PC connection to the board. By clicking on "OK" the new frequencies will be automatically transferred to the SX1211, **do not click on "Send configuration"**



### 5.5.5 Sync Word

As for the Ping-Pong frequencies, the user can alter the Synchronisation Word used during the radio communication. The process is similar as described in the above and must be done on both starter kits.



## 6 ADVANCE FEATURES

### 6.1 INTRODUCTION

The SX1211 Starter Kit is also a development environment. For that, Advanced Features have been built into this development tool. A general description of these features is provided here.

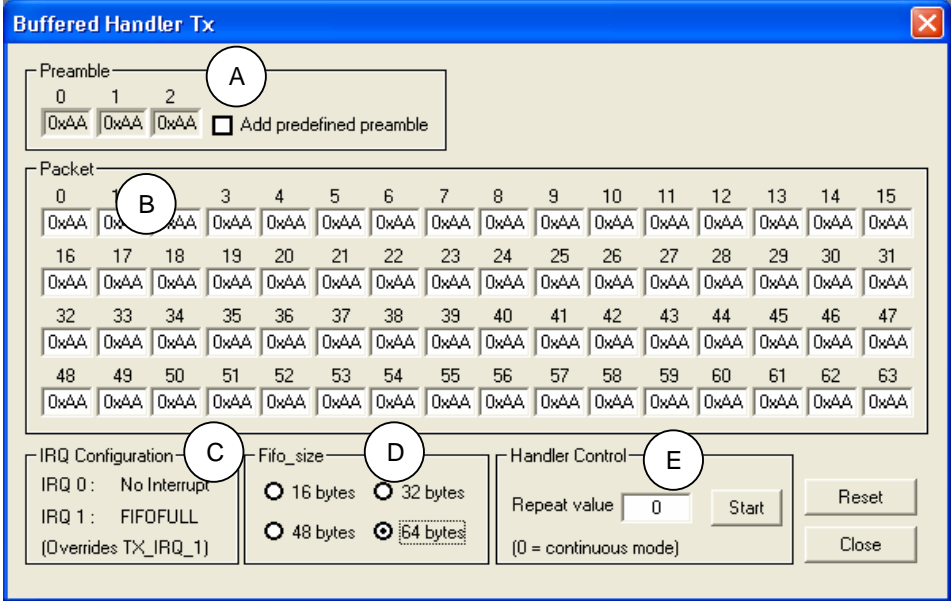
### 6.2 HIGHLIGHTS

The items discussed in this chapter include:

- Buffered Handler Tx
- Buffered Handler Rx
- Packet Handler Tx
- Packet Handler Rx

### 6.3 BUFFERED HANDLER TX

The GUI interface for the SX1211SK offers the advantage to program a pattern generator (Transmitter FIFO Handler). This mode is available only if the SX1211 RF module has been set in transmitter mode with the Buffered mode enabled (MCPParam, Address 1, bit 5).



The screenshot shows the 'Buffered Handler Tx' GUI. It includes a 'Preamble' section with three input fields (0, 1, 2) and an 'Add predefined preamble' checkbox. A large 'Packet' table with 64 columns (0-63) is present, each containing '0xAA'. Below the packet table is the 'IRQ Configuration' section with radio buttons for 'No Interrupt' and 'FIFOFULL'. The 'Fifo\_size' section has radio buttons for 16, 32, 48, and 64 bytes. The 'Handler Control' section includes a 'Repeat value' input field, a 'Start' button, and a 'Reset' button. A 'Close' button is at the bottom right.

A: Pattern Preamble: Three preamble bytes can be added at the beginning of the message. It will be used to lock the Bit Synchronizer at the receiver.

B: Pattern Content: The content of the packets can be modified by the user.

C: IRQ Configuration, display interrupts status.

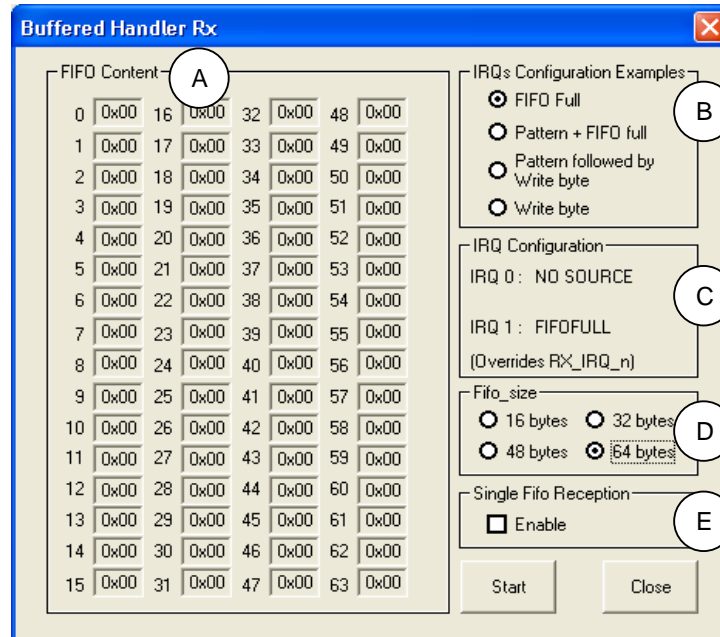
D: Fifo\_size: The size of the packet can be selected from 16 bytes to 64 bytes.

E: Handler Control: The number of transmissions can be programmed. If a "0" is set, the pattern content and the Pattern Preamble, if enabled, are sent continuously.

#### 6.4 BUFFERED HANLDER RX

The SX1211 FIFO used in receiver mode can be displayed by the GUI interface. The Receiver FIFO is accessible only if the SX1211SK is in receiver mode and if the Buffered mode has been selected. The interrupt configuration (IRQ0 and IRQ1) will affect the way to fill the FIFO. For more information about the SX1211 interrupts, please refer to the SEMTECH Datasheet SX1211.





A: FIFO Content, display the bytes received by the SX1211 RF module. The latest byte received is store in byte 0, as it is a FIFO (First In First Out).

B: IRQs Configuration Examples shows four ways to fill the FIFO.

1. FIFO Full, the FIFO is displayed only when 16 bytes are received
2. Pattern + FIFO Full, the FIFO is filled only after the pattern detection and after the reception of 16 bytes. The pattern will not be stored in the FIFO's registers.
3. Pattern followed by Write Byte, the FIFO registers are filled after each byte received and only after the pattern detection. As Pattern and Write bytes are using the same interrupt IRQ0, the IRQ configuration register will be modified during the RF communication.
4. Write byte, the FIFO register is filled after each byte received.

C: IRQ Configuration, display the interrupt status accordingly with the selection.

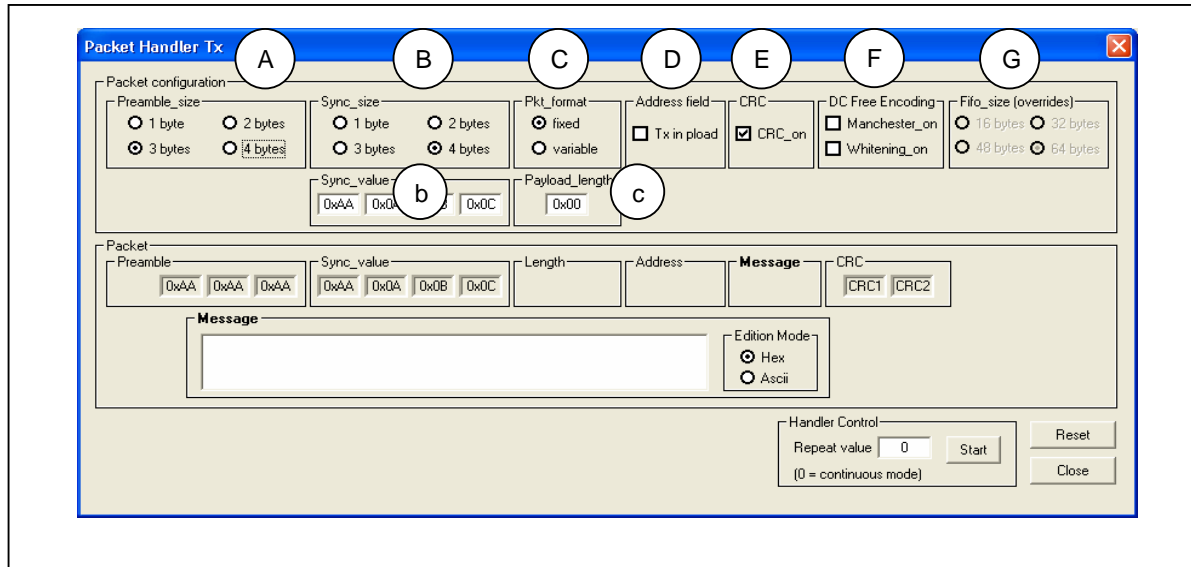
D: Fifo\_size: The size of the packet can be selected from 16 bytes to 64 bytes.

E: Single Fifo Reception: the fill of the FIFO will be stop after receiving the latest byte (16<sup>th</sup>, 32<sup>nd</sup>, 48<sup>th</sup> or 64<sup>th</sup>).

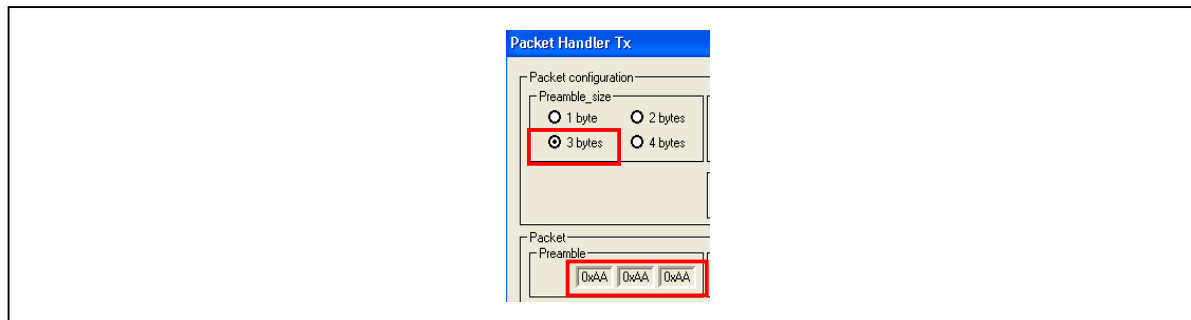
## 6.5 PACKET HANDLER TX

The Semtech transceiver SX1211 embeds a packet handling mode, useful to reduce the software complexity and microcontroller tasks. For more information, please refer to SX1211 Datasheet.

The SX1211 Starter Kit from Y-Lynx, allows the user to play with the packet handler in transmitter as well as in receiver.



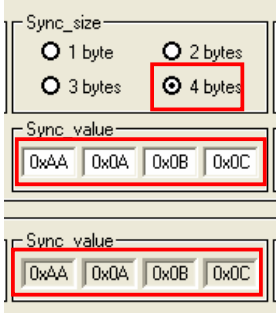
A: Preamble size: Used to set the length of the preamble from 1 byte to 4 bytes.



**ADVANCED COMMS & SENSING**

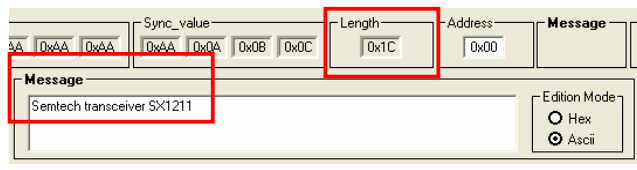
B: Sync size: Used to set the length of the synchronisation word, from 1 byte to 4 bytes.

b : The value can be modified in the Sync-value window.

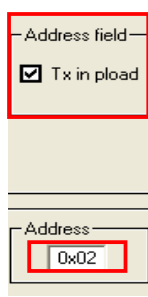


C: Pkt\_format: Used to program the packet format. When the Fixed packet is enabled, the payload length is manually entered. If the selected format is “variable”, the length of the payload is automatically calculated and displayed in the Length window accordingly with the message.

c : Payload length: Length of the payload must be entered manually if the Fixed option is selected for the Pkt-Format.



D: Address Field: If enabled the transmitter address is added manually by the user in the payload.



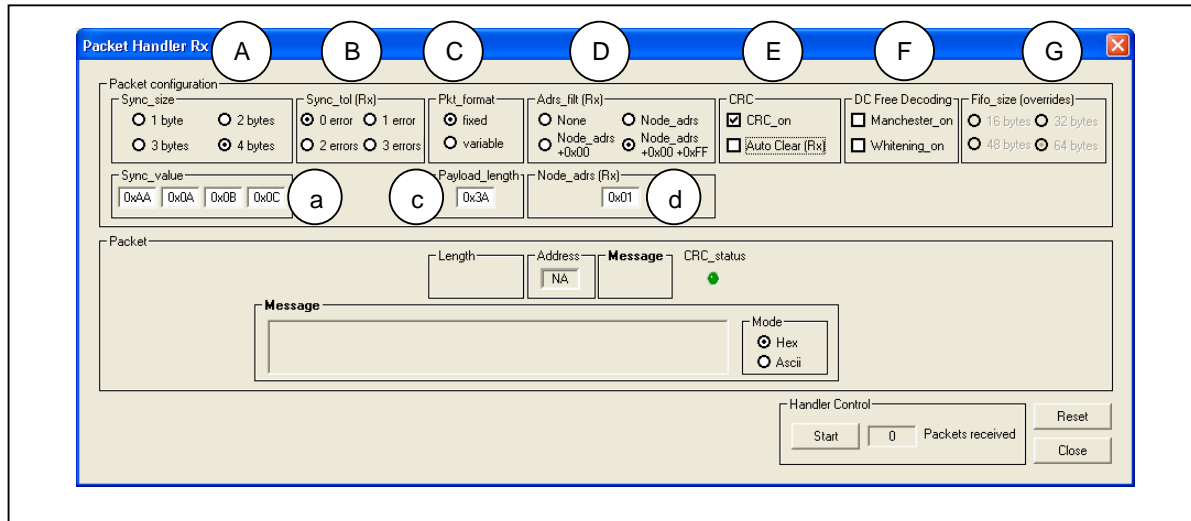
E: CRC: The CRC is used for checking the integrity of the message. The two byte CRC checksum is calculated on the payload part of the packet and appended to the end of the message.

F: DC Free Encoding: Two methods of encoding are available with the SX1211, the Manchester encoding and the Withering encoding. For more information, please refer to the Semtech SX1211 Datasheet.

G: Fifo\_size: The Fifo-size can not be modified and is hard-coded to 64bytes.

## 6.6 PACKET HANDLER RX

The Packet Handler Rx window is displays below.



A: Sync size: Uses to set the length of the synchronisation word, from 1 byte to 4 bytes.

a : The value can be modified in the Sync-value window.

B: Sync-tol: Uses to set the tolerance on the reception. Number of errors accepted

C: Pkt\_format: Uses to program the packet format. If the selected format is “variable”, the length of the payload entered in the window is the maximum length of the message. If the message received is longer than the programmed payload length, the message is discarded.

c : Payload length: Length of the payload must be entered manually for the Fixed and Variable option.

D: Adrs\_filt: Address filtering adds another level of filtering above Sync-word.

Three address filtering options are implemented:

- Node\_adrs: Received address filed is compared with Node\_adrs register (d), if they match the packet is accepted and processed else it is discarded.
- Node\_adrs +0x00: Received address filed is compared with Node\_adrs register (d) and the constant 0x00. If any of the two matches, the received packet is accepted and processed, else it is discarded.
- Node\_adrs +0x00 +0xFF: Received address filed is compared with Node\_adrs register (d) and constants 0x00 and 0xFF. If any of the three matches, the received packet is accepted and processed, else it is discarded.

d : Node\_adrs register, uses to compare with the received address.

E: CRC: The CRC is used for checking the integrity of the message. The status is display thanks to a LED on the screen called CRC\_status.

F: DC Free Encoding: Two methods of en coding are available with the SX1211, the Manchester encoding and the Withering encoding. For more information, please refer to the Semtech SX1211 Datasheet.

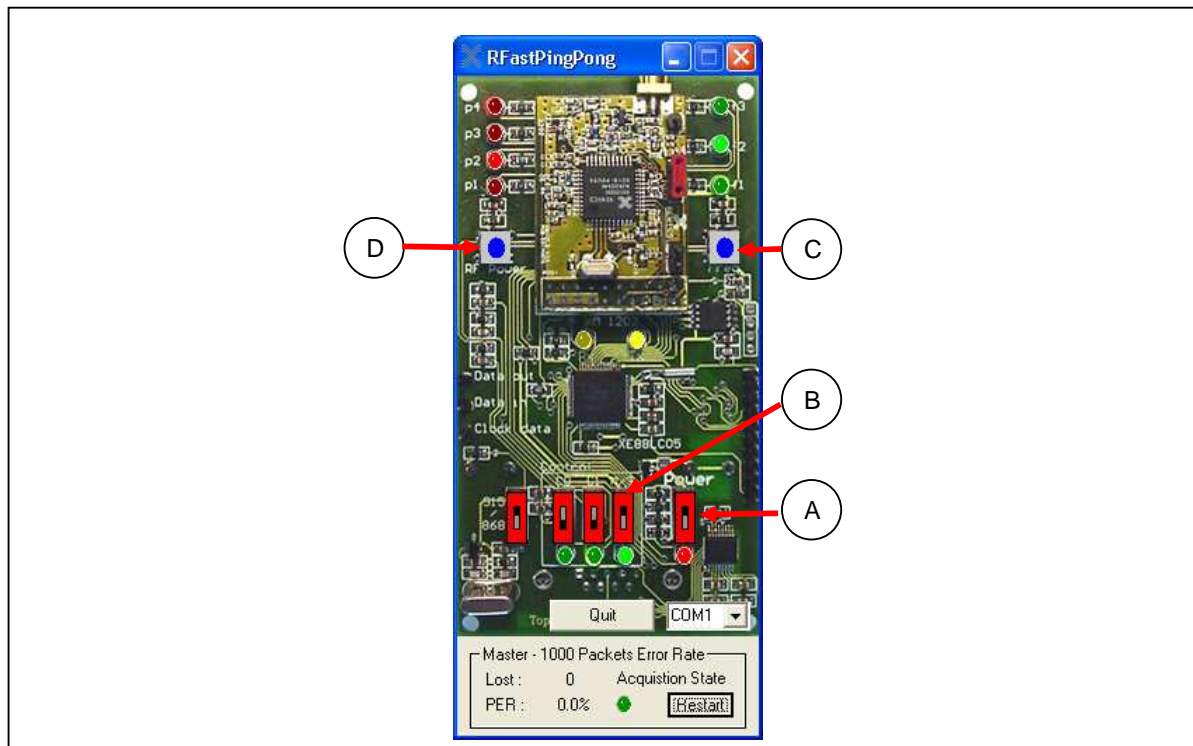
G: Fifo\_size: The Fifo-size can not be modified and is hard-coded to 64bytes.

## 6.7 PING – PONG TEST AND COMMUNICATION QUALITY

Another Ping Pong test is embedded with the SX1211 Starter Kit and allows evaluating the communication quality in term of Packet Error Rate during the data transfer.

These second ping pong test is established between a starter kit board connected to a PC and set as Master and a slave in stand-alone or connected to a PC and set as Slave.

To activate the communication quality window, click on Default ping pong mode to launch “RFast Ping Pong”. On the picture of the board, click on button ON/OFF (A) following by MS in On position (B). An additional window appears. The frequency and the output power can also be modified by clicking on the two push buttons (C) and (D).



The additional window displays:

- the number of packet lost
- the ratio of packet send/packet lost (Packet error Rate) on the last 1'000 packets sent
- the Acquisition State switches on when the first 1000 packets has been sent.

## 7 TROUBLESHOOTING

### 7.1 INTRODUCTION

This section describes some common problems associated with using SX1211 Starter Kit and steps to follow to solve those problems.

### 7.2 HIGHLIGHTS

This section discusses the following:

- Communications cannot be established with the Starter Kit
- Data Handler menu not enabled

**7.3 COMMON PROBLEMS**
**Communication cannot be established with the SX1211SK**

**Check the serial port**

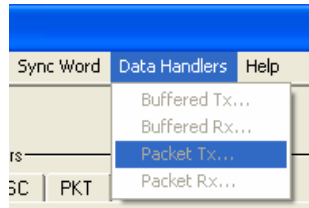
- Verify that the SX1211SK is connected to the selected serial port. By default the COM1 is selected. If the RS232 is connected to another com port, click on OK and select the right com port in menu tool bar. The selected com port is displayed on the down-right corner of the screen.

**Check the power supply**

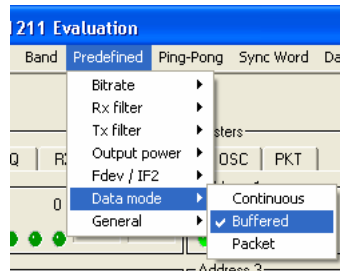
- Verify that the SX1211SK is powered (the LED power indicator is ON)
- Verify that the SX1211 RF module is well powered. If the SX1211SK is battery operated, a jumper must be placed on module (default configuration)
- Verify that the voltage of the battery or of the external source is between 2.4V and 3.6V.

**Data Handler menu not enabled**

An error message is displayed at the bottom right of the screen.



- Data Handler function is available only if the SX1211SK is set in transmitter mode and if the Buffered mode / Packet mode is enabled for the Buffered Handler Tx / Packet Handler Tx. To activate one of these modes, click on Predefined>Data mode>...



**END OF DOCUMENT**



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