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# **XE1200 – RFast™ - V1.3**

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## **Generic Interface board User's Guide**

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## 1 GENERAL INTRODUCTION

### 1.1 INTRODUCTION

This first chapter contains general information that will be useful to know before using the RFast™ environment.

### 1.2 HIGHLIGHTS

The information you will gain from this chapter:

- About this Guide
- Warranty Registration
- Recommended Reading
- Troubleshooting
- The Semtech Internet Web Site
- Customer Support

### 1.3 ABOUT THIS GUIDE

This document describes how to use RFast as a development tool to develop and debug RF communication on a Semtech target board. The manual Layout is as follows:

- **Quick Start** - How to get up and running quickly using the RFast environment.
- **Chapter 2: Overview and Installation** - What RFast is and how it can help you. Also, how to install RFast Hardware and RFast Software.
- **Chapter 3 : Tutorial XM1201A** - A tutorial on using RFast to develop on a XE1201 RF Module.
- **Chapter 4 : Tutorial XM1202** - A tutorial on using RFast to develop on a XE1202 RF Module.
- **Chapter 5 : Tutorial XM1203** - A tutorial on using RFast to develop on a XE1203 RF Module.
- **Chapter 6 : Tutorial XM1209** - A tutorial on using RFast to develop on a XE1209 RF Module.
- **Chapter 7 : General Set Up** - setting up RFast
- **Chapter 8 : Basic Features** - A description of the basic features of RFast (i.e., Predefined Mode, etc)
- **Chapter 9 : Advanced Features** – A description of advanced features (i.e., load source code).
- **Chapter 10 : Application Examples** – Example of RF communication with the GIB and the Starter Kit.
- **Chapter 11 : Troubleshooting** - How to solve common problem with RFast operation.
- **Chapter 12 : Appendix A** - RFast Electrical Specifications
- **Chapter 13 : Appendix B** – RFast Software Routines.
- **Chapter 14 : Glossary** - A glossary of terms used in this guide.

### 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	<u>File &gt; Save</u>
Bold characters	A window or dialog button to click	<b>OK, Cancel, Next, Back</b>
Characters in angle brackets <>	A key on the keyboard	<Tab>, <Enter>
Italic characters	Referenced documentation	<i>XE1202 Datasheet</i>

**Table 1: Documentation Conventions**

### 1.3.2 Documentation Updates

All documentation evolves and this User's Guide is no exception. Since RFast and other Semtech tools are constantly evolving to meet customer needs, some RFast environment dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site at [www.semtech.com](http://www.semtech.com) to obtain the latest documentation available.

## 1.4 RECOMMENDED READING

This user's guide describes how to use RFast system. Other useful documents are listed below:

- Datasheets (XE12xx)
- Semtech Application Notes (AN12xx)
- Semtech Technical Notes (TN12xx)
- These can be found on our web site [www.semtech.com](http://www.semtech.com)

## 1.5 TROUBLESHOOTING

See Chapter 11 for information on common problems.

## 1.6 THE SEMTECH INTERNET WEB SITE

Semtech provides on line support on the Semtech World Wide Web site. The web site is used by Semtech as a means to make files and information easily available to customers. It is at <http://www.semtech.com>

## 1.7 CUSTOMER SUPPORT

Customers should call their distributor, representative or field application engineer for support. Users of Semtech products can receive assistance through several channels:

- Distributors or Representative, Local Sales Office
- Field Application Engineer (FAE)
- Third party for source code

## 2 OVERVIEW AND INSTALLATION

### 2.1 INTRODUCTION

This chapter gives you an overview of the XE1200 - RFast system and then explains how to install the system hardware and software.

### 2.2 HIGHLIGHTS

The items discussed in this chapter include:

- What RFast is
- XE1200 series and RFast System Components
- How XE1200 - RFast helps you
- XE1200 series and RFast Kit Components
- Installing RFast Hardware
- Applying Power to the System components
- Installing RFast software

### 2.3 WHAT IS RFAST

**RFast** is a complete environment for the Semtech XE1200 transceiver series. The RFast allows you to evaluate RF products, to develop, debug and optimize XE1200 applications. RFast includes RF demo examples for quick application designs. RFast also supports CoolRIDE software and other C development tools.

RFast performs basic functions such as 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 RFast environment.

## 2.4 RFAST SYSTEM COMPONENTS

An RFast system consists of the following items (Figure 1.1)

- Processor Board
- Mini Microcontroller Card (MMC)
- Power Supply
- Serial Cable
- RF Module connector with cable
- Logic probe connector
- Microcontroller port connector



Figure 1.1: RFast System

The Processor Board connects to the PC through a serial port using the provided cable. It contains the hardware necessary to configure a SEMTECH RF module or a custom RF module. The RF module is located at the end of the RF Module's cable.

A Logic Probe connector is also available. It allows one to visualize data from / to the RF module but also to connect an external data source. See Appendix A7 more information on the connector.

## 2.5 HOW RFAST HELPS YOU

RFast allows you to:

- Configure internal registers of XE1200 transceiver series.
- To achieve quick RF demonstration.
- To develop and debug RF protocol.
- To connect your own RF module base on Semtech transceivers.

## 2.6 RFAST KIT COMPONENTS

The components of the RFast kit, plus additional hardware, are shown in Figure 1.2.

1. CD-ROM with RFast software and on line documentation
2. Serial Cable to connect the Processor Board to a PC
3. Processor Board
4. Power Supply block
5. Mini Processor Boards
6. RF Module's Cable



Figure 1.2: RFast Kit Component

## 2.7 INSTALLING RFAST HARDWARE

Follow the steps in this section to install the RFast.



### Warning

Neither the PC nor RFast should have power turned on at this time.

- **Connect the Processor board to the serial port using the serial cable.** Connect one end of the serial cable to the serial connector on the Processor board and connect the other end on the serial port on the PC chassis. Secure both ends with the cable screws. An LED light goes on to indicate that the serial cable is well connected.
- **Attach the power supply.** Make certain that the RFast on/off switch is in the "Off" position before completing this step. Plug the appropriate ends of the power supply outlet into the back of the RFast Processor board.
- **Connect the mini-processor board.** Connect the mini-processor board to the processor board. All the pins of the mini-processor board MUST BE connected to the processor board.
- **Connect the RF Module to the RFast Processor board using the RF module's cable.** Attach the RF Module to the end of the RF Module's cable. Then, plug the cable on the Processor board.
  - If you are using the XE1202 or the XE1203 RF module, uses the 20 pins connector.
  - If you are using the XE1201A or the XE1209 RF module, uses the 10 pins connector.

## 2.8 APPLYING POWER TO THE SYSTEM COMPONENTS

RFast can be run with an internal or external power supply. To prevent damage to any of the subsystems or target application parts, power up (and power down) the system components as specified below.

### 2.8.1 Turning on the System Components

Power up the system components in the sequence described below to prevent damage to any of the subsystem parts or user target application parts. See Section 2.8.2 before using internal Power supply.

**Warning**

Damage to the RFast system and/or target application may occur if these steps are not followed.

- 1) Assemble the RFast system. For instructions on how to assemble the RFast system, see the Installation chapter
- 2) Turn on the PC
- 3) Turn on the Processor board. A red LED switches on to indicate that the Processor board is powered.

**Technical Note**

RFast allows the target to be powered by either the Processor board, the Output power supply connector or via an external source. See Appendix A.3.

### 2.8.2 Turning on the System Components - Internal Power Supply

RFast also supports Internal Power Supply by using accumulators.

**Note:** When accumulators supply power, the lifetime depends on the target current consumption.

Follow these steps when applying Internal Power to the system.

**Warning**

Damage to the RFast system and/or target application may occur if these steps are not followed.

- 1) Assemble the RFast system. For instructions on how to assemble the RFast system, see the Installation chapter
- 2) Turn on the PC and start RFast Software
- 3) Turn on the accumulator button. A red LED switches on to indicate that the Processor board is powered on.

### 2.8.3 Turning Off the System Components

- 1) Remove power from the target application if you are using one of the Output power connectors or external source
- 2) Turn Off the Processor board
- 3) Turn Off the PC

### 2.8.4 Installing RFast Software

To install the RFast software, refer to the installation instruction chapters

The RFast software functions under the following operating systems:

- Windows 95/98
- Windows NT
- Windows 2000

**Warning**

You need to configure your display as following: 1280 by 1024 pixels.

## 3 TUTORIAL - XM1201A

### 3.1 INTRODUCTION

After installing the RFast hardware and RFast software, you may wish to try this tutorial to get you started.

### 3.2 HIGHLIGHTS

This tutorial covers:

- Reviewing the Hardware
- Running RFast software
- Setting Up the Communication port
- Setting Up the Predefined Mode
  - XE88LC05 Programming
  - XE88LC05 Setup Status
  - FPGA Programming
  - FPGA Setup Status
  - Board Status
- XM1201A Configuration in transmitter mode
  - XM1201A Setting in transmitter mode
  - Test in transmitter mode
- XM1201A Configuration in receiver mode
  - XM1201A Settings in receiver mode
  - Test in receiver mode
- Go Forward

### 3.3 REVIEWING THE HARDWARE

The hardware setup for this tutorial is listed below:

- PC Serial Port: Bi-directional mode
- RFast Kit with mini processor board
- Target: XM1201A

### 3.4 RUNNING RFAST SOFTWARE

After installing RFast software, invoke it by executing the file RFast.exe  
For more information on using RFast software, refer to the included file README.log



Figure 2.1

### 3.5 SETTING UP THE COMMUNICATION PORT

Select an available Communication port from dropdown list by clicking on Setting.

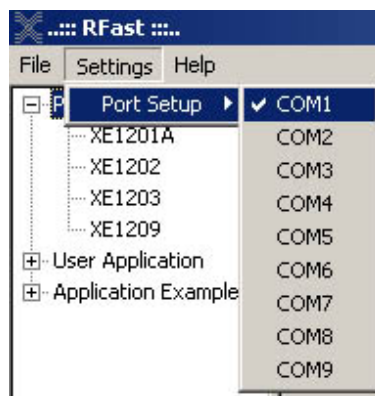


Figure 2.2

If you have any problems configuring the Com port, please refer to Troubleshooting (Chapter 11) chapter.

### 3.6 SETTING UP THE PREDEFINED MODE

Open the XE1201A Predefined Mode dialog (*Predefined Mode>XE1201A*) to set up the RFast processor board. Set up the system by clicking on each option boxes as described below.

**Warning**

Follow these steps only if you are using a mini-processor board for the first time or if you are changing the target. If not click on *Next*

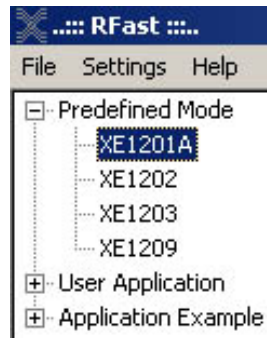


Figure 2.3

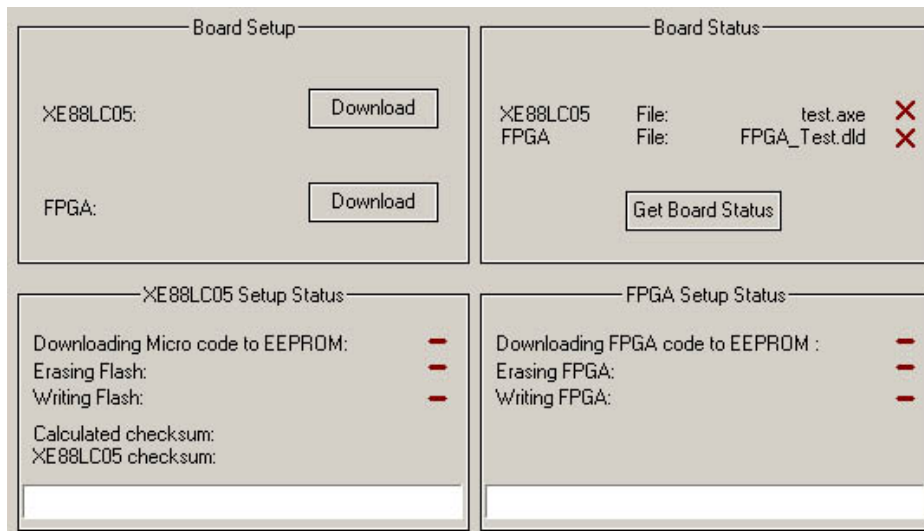


Figure 2.4

### 3.6.1 Mini processor board XE8805/05A Programming

In the *Board Setup* window, Click on **XE8805/05A Download** . This action will automatically download the generic XE1201A driver and program the XE88LC05 microController on the mini-processor board.

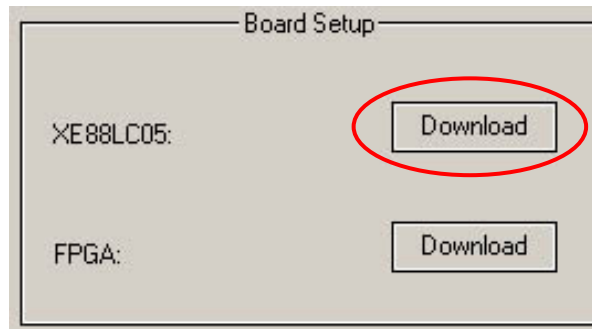
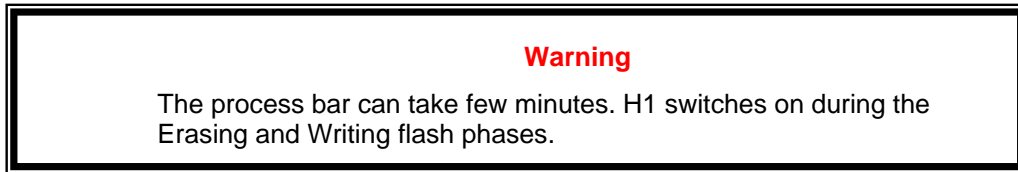


Figure 2.5

### 3.6.2 Mini processor board XE8805/05A Setup Status

The *XE88LC05 Setup Status* displays several indicators. During the programming phase, there are three different indicators; Downloading Micro code to EEPROM followed by Erasing Flash and finally Writing Flash.

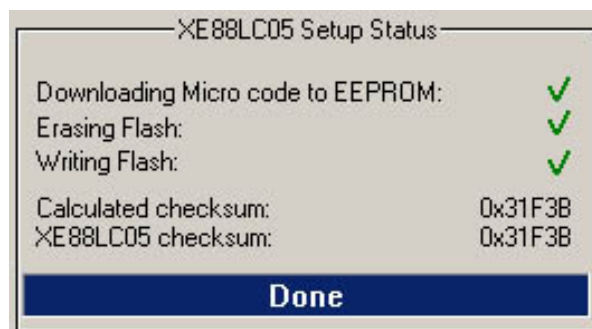


Figure 2.6

The programming status window displays the stage at which the programming procedure is. The stage is complete and correct if the ✓ symbol appears and the programming process has failed if ✗ symbol appears.

The checksum indicates if the programming result is correct. The computer calculates the source code checksum and the XE8805 gives the checksum after the programming sequence. If both are not equal the programming has failed.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 3.6.3 FPGA Programming

In the *Board Setup* window, Click on **FPGA Download**. The RFast architecture allows any microController signals to be connected to any one or more I/Os on the RF module's connector and/or Digital connector. This action will automatically download the XE1201A Crosspoint.

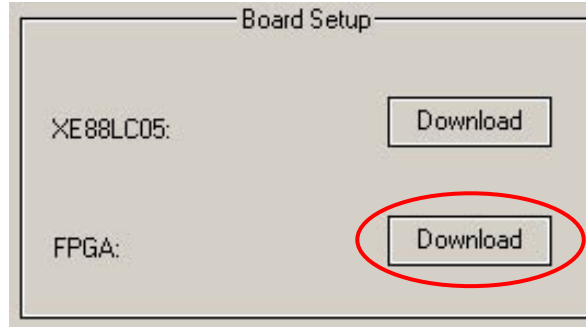


Figure 2.7

### 3.6.4 FPGA Setup Status

The *FPGA Setup Status* window displays a process bar to indicate the stage at which the programming procedure is.

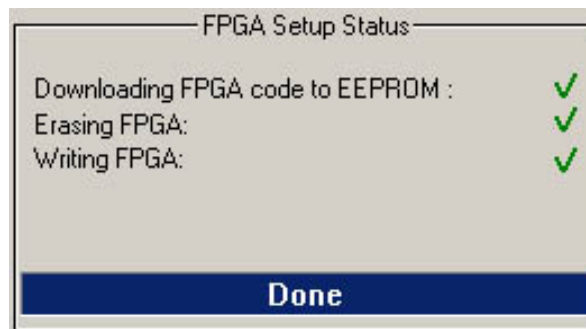




Figure 2.8

The programming stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 3.6.5 Board Status

The *Board Status* window displays the RFast systems' status. The first indicator *XE88LC05* shows the programming result but also the name of the driver (the name of the driver that has been downloaded into the microController). The second indicator *FPGA* shows the programming result of the FPGA and name of the Crosspoint file, which has been downloaded into the FPGA.



Figure 2.9

If everything is OK (the symbol  appears on both Board Status indicators).

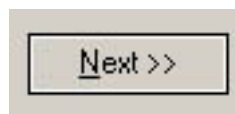


Figure 2.10

Click on **NEXT** to access to XE1201A Configuration window to start RF evaluation.

### 3.7 XM1201A CONFIGURATION IN TRANSMITTER MODE

Now that RFast system has been set and the source code successfully downloaded, you may run the XM1201A driver.

#### 3.7.1 XM1201A Settings in transmitter mode

The goal of this tutorial is to program the XM1201A in transmitter or receiver mode. However, the three internal registers of the transceiver must be set:

Select Modes>Frequency Deviation to configure the frequency deviation of the transceiver. Click on **125kHz**.

To configure data rate select Modes> Data Rate and click on **9600 bits/s**

Select Modes> Transmit power and click on **+5dBm**.

#### Transmitter Mode

To configure the transceiver XM1201A in transmitter mode select Modes> Operating mode and click on **Transmitter**.

You have defined XM1201A configuration, now you will transfer the setting to the device. On the XE1201A Configuration window click on **Send Configuration** and **Set Operating Mode**. If the communication with the RF module is OK indicators switch to green.

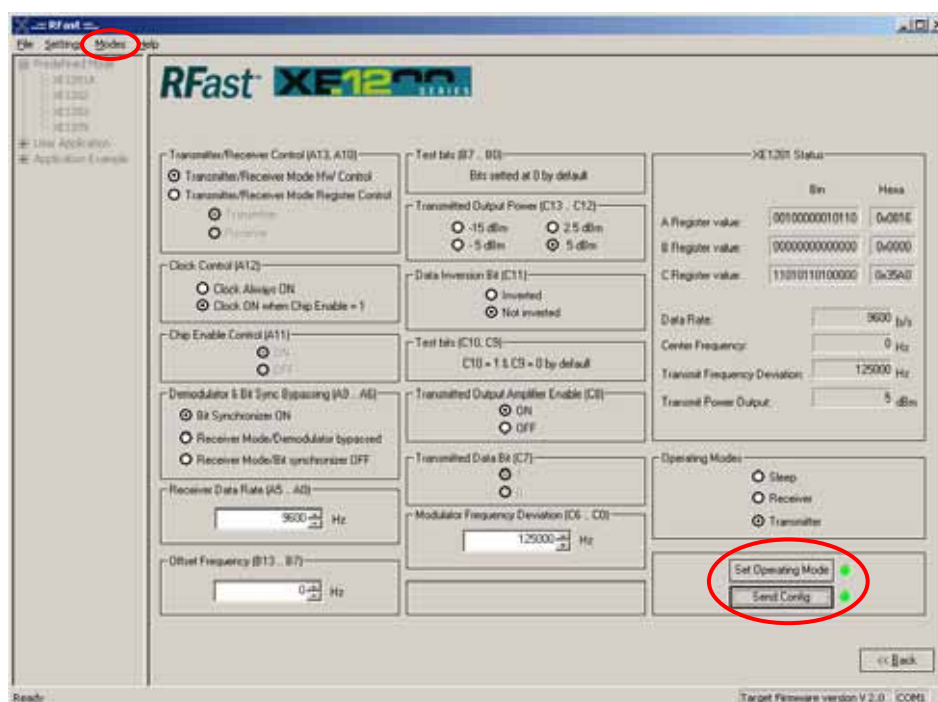


Figure 2.11

#### Technical Note

The XE1201A registers (register A, B and C) are display at the bottom of the XE1201A Configuration window.

### 3.7.2 Test in transmitter mode

Now that the target XM1201A has been programmed in transmitter mode, you can make a test to validate the programming.

By using a spectrum analyser connected directly to an antenna, you can observe an FSK signal at 433.92MHz with 125kHz frequency deviation and +5dBm output power.

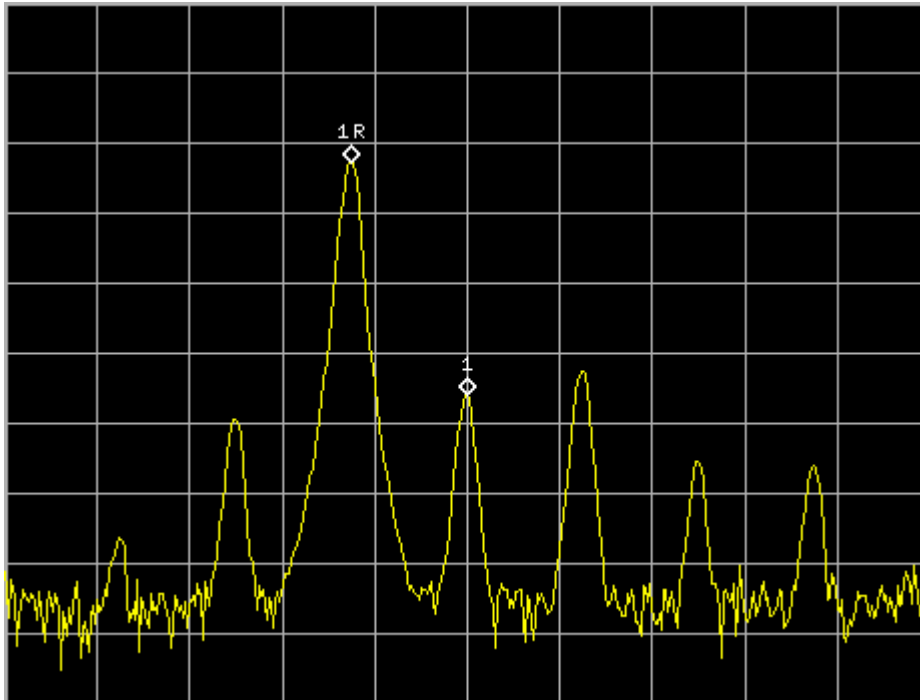


Figure 2.12

#### Technical Note

H2 On and H3 Off indicates the TX mode:

### 3.8 XM1201A CONFIGURATION IN RECEIVER MODE

Now that you have programmed and tested the RF Module in transmitter mode, you can change the operating mode to receiver.

#### 3.8.1 XM1201A Settings in receiver mode

- 1) Select Modes>Frequency Deviation to configure the frequency deviation of the transceiver. Click on **125kHz**.
- 2) To configure data rate select Modes> Data Rate and click on **9600 bits/s**
- 3) Receiver mode: Select Modes>Operating mode and click on **Receiver**. This action will configure the XM1201A in receiver mode with the Bit Synchronizer enable (for more information about the Bit Synchronizer, refer to XE1201A Datasheet).

The RF module has been defined in receiver mode, now you will transfer the setting to the device. On the XE1201A Configuration window click on **Send Configuration** and **Set Operating Mode**. If the communication with the RF Module is OK indicators switch to green.

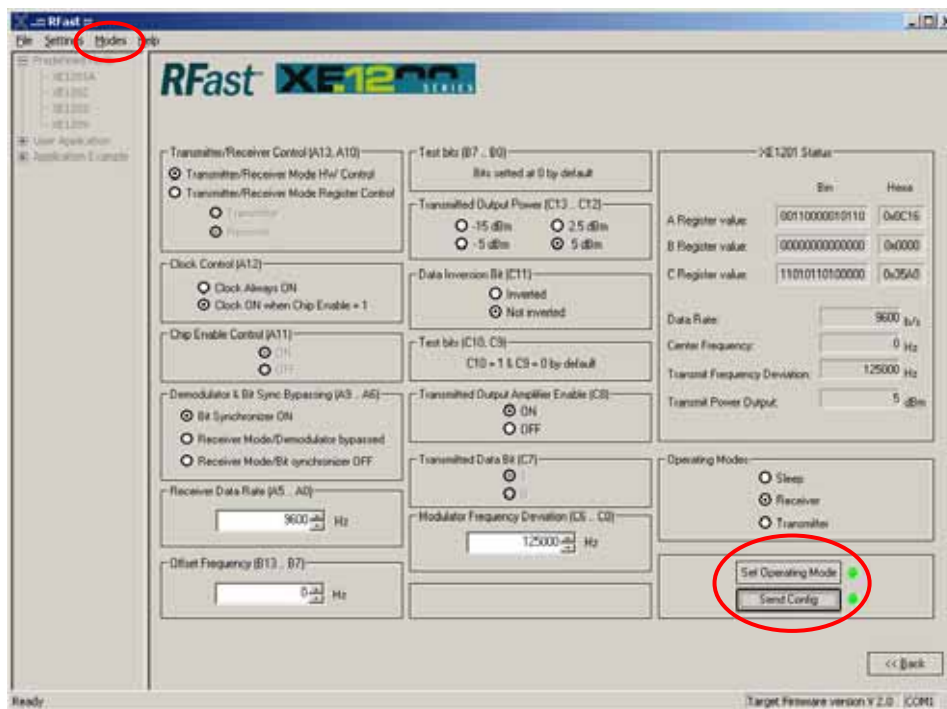


Figure 2.13

### 3.8.2 Test in receiver mode

To test the RF Module in receiver mode, you will observe digital signals. Connect an oscilloscope on pins 1 of the Digital connector to observe a square wave signal at 9.6kHz. This signal is the Clock Data (CLKD signal on the XE1201A).

On pin 2 of the connector K2, a random signal is present. This signal is the Data (RXD on the XE1201A) and corresponds to data received by the RF Module.

#### Technical Note

The signal RXD is random if no RF signal is generated by neither a FM generator nor by another XE1201A module.

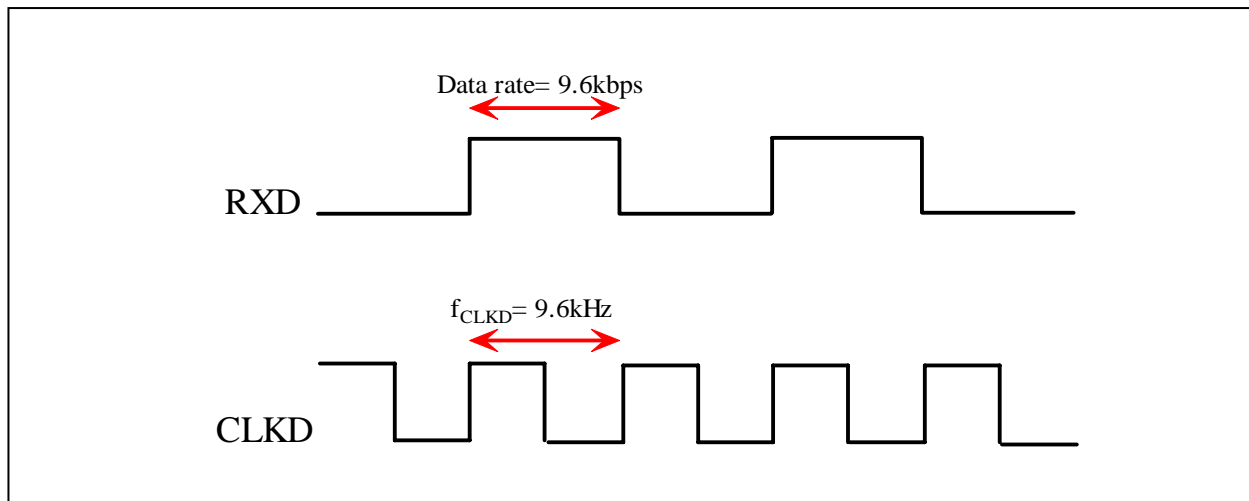


Figure 2.14

### 3.9 GOING FORWARD

You have now completed the XM1201A tutorial on RFast System. The simple examples shown here give you a beginner's knowledge of working with XE1201A devices. For more detailed information on usage for your individual applications, please refer to the Basic (chapter 8) and Advanced (chapter 9) Features chapters.

## 4 TUTORIAL - XM1202

### 4.1 INTRODUCTION

After installing the RFast hardware and RFast software, you may wish to try this tutorial to get you started.

### 4.2 HIGHLIGHTS

This tutorial covers:

- Reviewing the Hardware
- Running RFast software
- Setting Up the Communication port
- Setting Up the Predefined Mode
  - XE88LC05 Programming
  - XE88LC05 Setup Status
  - FPGA Programming
  - FPGA Setup Status
  - Board Status
- XM1202 Configuration in transmitter mode
  - XM1202 Setting in transmitter mode
  - Test in transmitter mode
- XM1202 Configuration in receiver mode
  - XM1202 Settings in receiver mode
  - Test in receiver mode
- Going Forward

### 4.3 REVIEWING THE HARDWARE

The hardware setup for this tutorial is listed below:

- PC Serial Port: Bi-directional mode
- RFast Kit with mini processor board
- Target: XM1202

#### 4.4 RUNNING RFAST SOFTWARE

After installing RFast software, invoke it by executing the file RFast.exe  
For more information on using RFast software, refer to the included file README.log

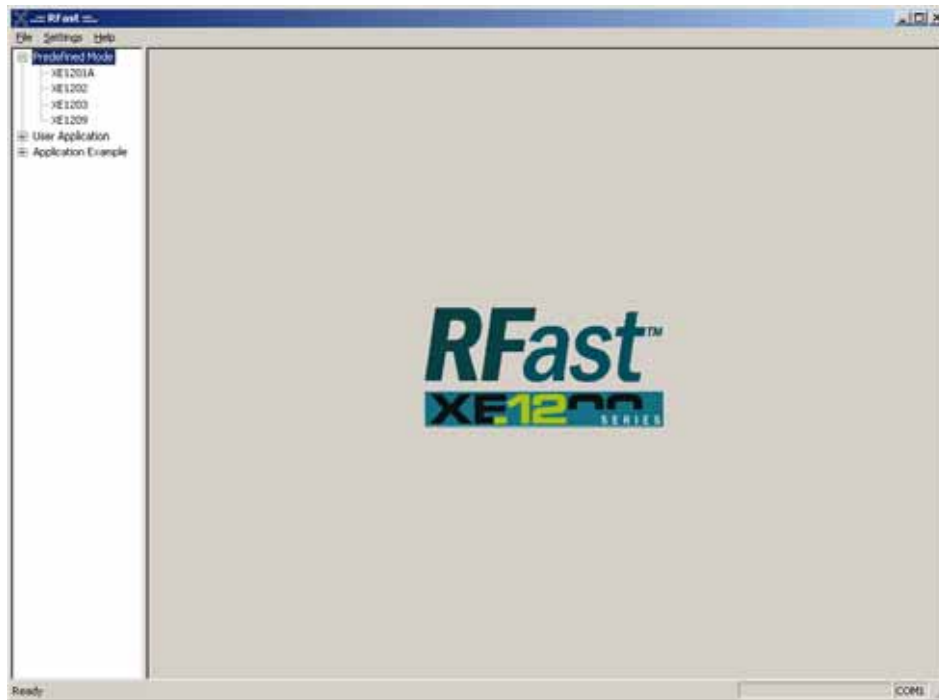


Figure 3.1

#### 4.5 SETTING UP THE COMMUNICATION PORT

Select an available Communication port from dropdown list by clicking on Setting.

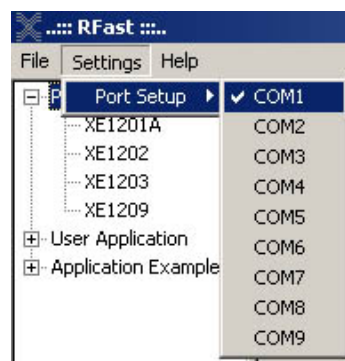


Figure 3.2

If you have any problems configuring the Com port, please refer to Troubleshooting (Chapter 11) chapter.

#### 4.6 SETTING UP THE PREDEFINED MODE

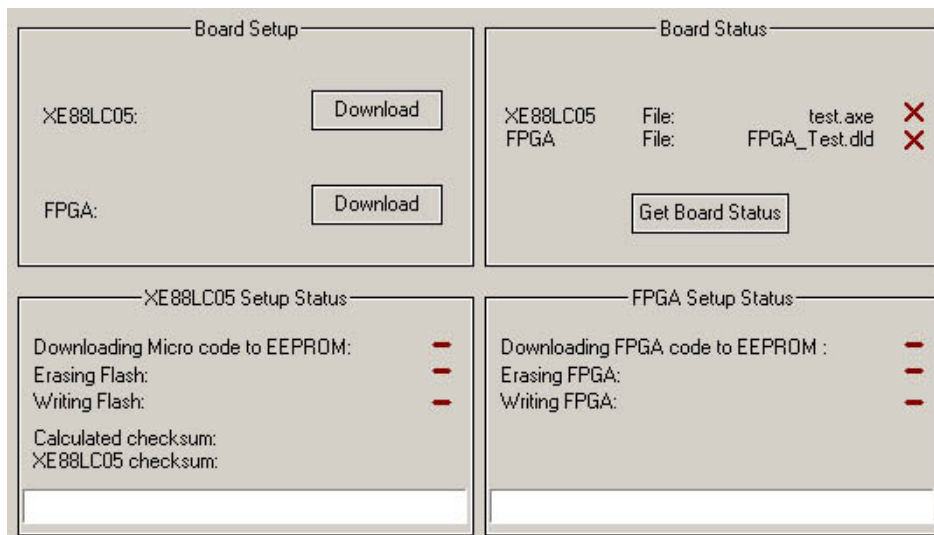
Open the XE1202 Predefined Mode dialog (*Predefined Mode>XE1202*) to set up the RFast processor board. Set up the system by clicking on each option boxes as described below.

**Warning**

Follow these steps only if you are using a mini-processor board for the first time or if you are changing target. If not click on *Next*.



**Figure 3.3**



**Figure 3.4**

#### 4.6.1 XE8805/05A Programming

In the *Board Setup* window, Click on **XE88LC05 Download**. This action will automatically download the generic XM1202 driver and program the XE88LC05 microcontroller on the mini-processor board.

**Warning**

The process bar can take few minutes. H1 switches on during the Erasing and Writing flash phases.

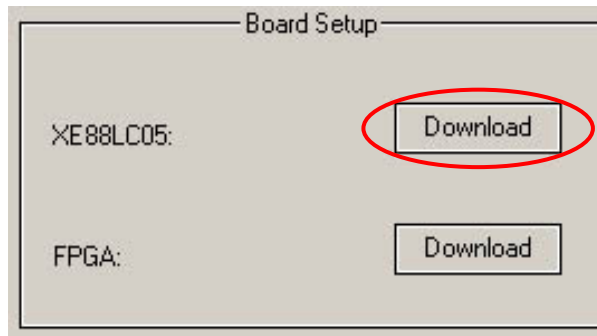


Figure 3.5

#### 4.6.2 XE8805/05A Setup Status

The *XE88LC05 Setup Status* displays several indicators. During the programming phase, there are three different indicators, Downloading Micro Code to EEPROM followed by Erasing Flash and finally Writing Flash.

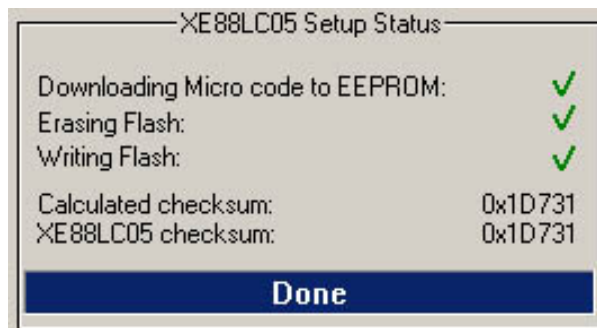


Figure 3.6

The programming status window displays the stage at which the programming procedure is. The stage is complete and correct if the ✓ symbol appears and the programming process has failed if ✗ symbol appears.

The checksum indicates if the programming result is correct. The computer calculates the source code checksum and the XE8805/05A gives the checksum after the programming sequence. If both are not equal the programming has failed.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

#### 4.6.3 FPGA Programming

In the *Board Setup* window, Click on **FPGA Download**. The RFast architecture allows any microcontroller signals to be connected to any one or more I/Os on the RF module's connector and/or Digital connector. This action will automatically download the XM1202 Crosspoint.

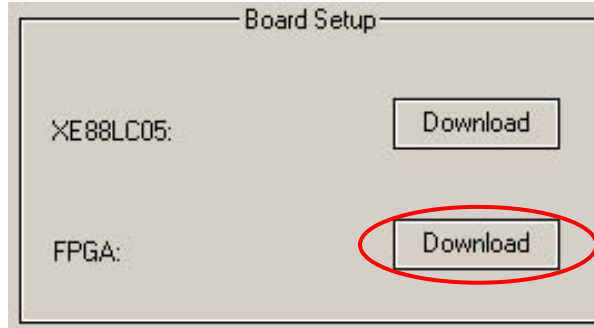


Figure 3.7

#### 4.6.4 FPGA Setup Status

The *FPGA Setup Status* window displays a process bar to indicate the stage at which the programming procedure is.

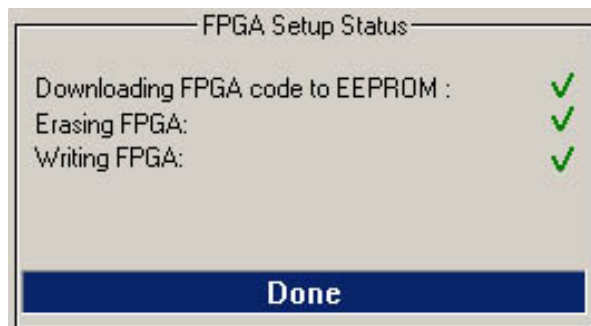




Figure 3.8

The programming stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.


If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

#### 4.6.5 Board Status

The *Board Status* window displays the RFast systems' status. The first indicator *XE88LC05* shows the programming result but also the name of the driver (the name of the driver which has been downloaded into the microController). The second indicator *FPGA* shows the programming result of the FPGA and name of the crosspoint file, which has been downloaded into the FPGA.



Figure 3.9

If everything is OK (the symbol  appears on both Board Status indicators), click on **Next** to access to XE1202 Configuration window to start RF evaluation.

#### 4.7 XM1202 CONFIGURATION IN TRANSMITTER MODE

Now that RFast system has been set and the source code successfully downloaded, you may run the XM1202 driver.

##### 4.7.1 XM1202 Settings in transmitter mode

The goal of this tutorial is to program the XM1202 in transmitter or receiver mode. However, all internal registers of the transceiver must be set:

- 1) Select: Modes>Frequency Band to select the frequency band. Click on **902 - 928MHz** if you are using 915MHz module, click on **868 - 870MHz** if you are using a 868MHz module or click on **433 - 435MHz** if you are using 433MHz module.
- 2) Select Modes>Frequency Deviation to configure the frequency deviation of the transceiver. Click on **20kHz**.
- 3) To configure data rate select Modes> Data Rate and click on **19200 bits/s**
- 4) Select Modes> Transmit power and click on **+0dBm**.

Transmitter Mode

To configure the transceiver module XM1202 in transmitter mode select Modes> Operating mode and click on **Transmitter**.

You have defined the XM1202 configuration, now you will transfer the settings to the device. On the XE1202 Configuration window click on **Send Configuration** and **Set Operating Mode**. If the communication with the RF Module is OK indicators switch to green.

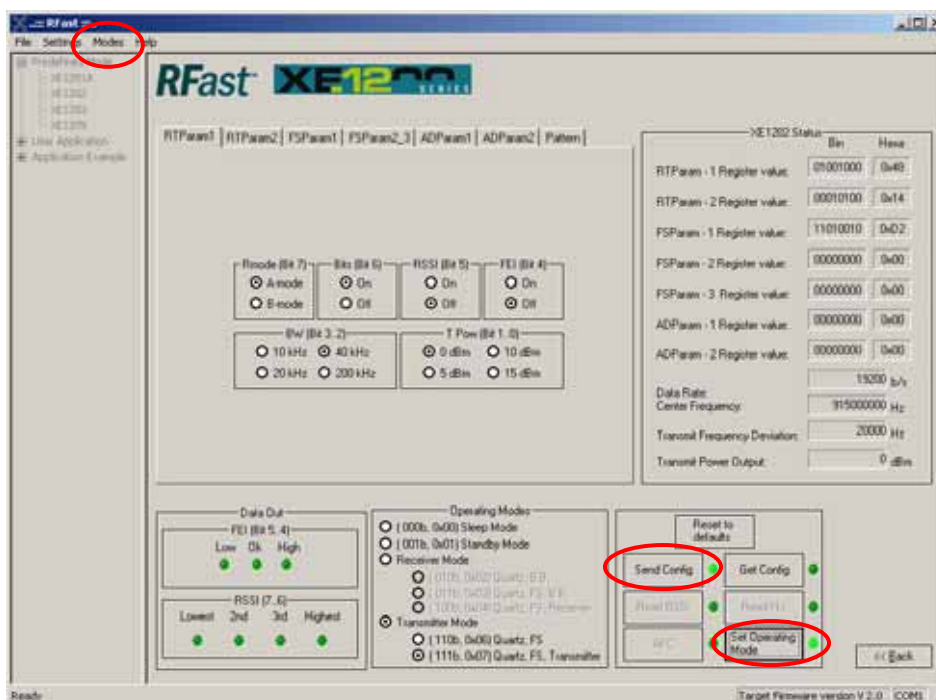


Figure 3.10

#### Technical Note

The XE1202 registers are display at the left of the XE1202 Configuration window.

#### 4.7.2 Test in transmitter mode

Now that the RF Module XM1202 has been programmed in transmitter mode, you can make a test to validate the programming.

By using a spectrum analyzer connected to RFout, you can observe an FSK signal with 20kHz frequency deviation and +0dBm output power.

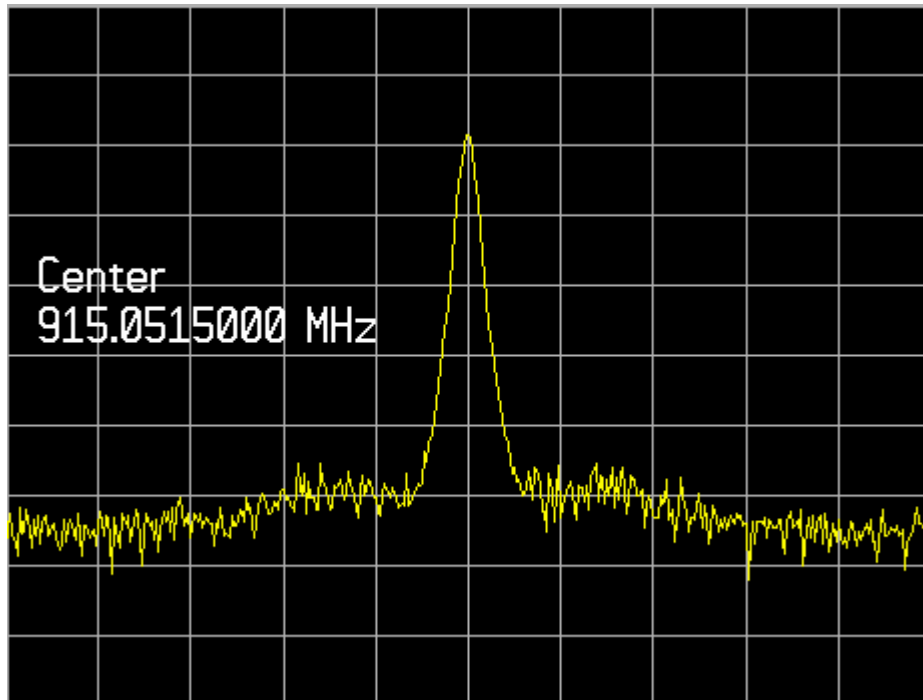


Figure 3.11

In addition, two LEDs (H2 and H3) indicate the status of Mode (0) and Mode(1)  
H2 = Mode (0)  
H3 = Mode(1)

In transmitter mode H2 and H3 are On

#### Technical Note

If the modulation is enabled the bit transmit is "1", use the pin 20 of the Digital connector to connect an external data generator:

#### Warning

If you want more output power than 0dBm, you need to connect the power supply of the module to the output power supply connector of the GIB, in order to obtain enough output current. For more information please refer to Appendix A3 and A5

#### 4.8 XM1202 CONFIGURATION IN RECEIVER MODE

Now that you have programmed and tested the RF Module in transmitter mode, you can change the operating mode to receiver.

##### 4.8.1 XM1202 Settings in receiver mode

1. Select Modes>Frequency Band to configure the band. Click on **902 - 928MHz** if you are using a 915MHz module, click on **868 - 870MHz** if you are using a 868MHz module and click on **433 - 434MHz** if you are using a 433MHz module.
2. Select Modes>Frequency Deviation to configure the frequency deviation of the transceiver. Click on **20kHz**.
3. To configure data rate select Modes> Data Rate and click on **19200 bits/s**
4. Select: Modes> Base Band Filter and click on **40kHz**
5. Receiver mode Select Modes>Operating mode and click on **Receiver**. This action will configure the XM1202 in receiver mode with the Bit Synchronizer enable (for more information about the Bit Synchronizer, refer to XE1202 Datasheet).

**Next**, the RF Module has been defined in receiver mode, now you will transfer the setting to the device. On the XE1202 Configuration window click on **Send Configuration** and **Set Operating Mode**. If the communication with the RF Module is OK indicators switch to green.

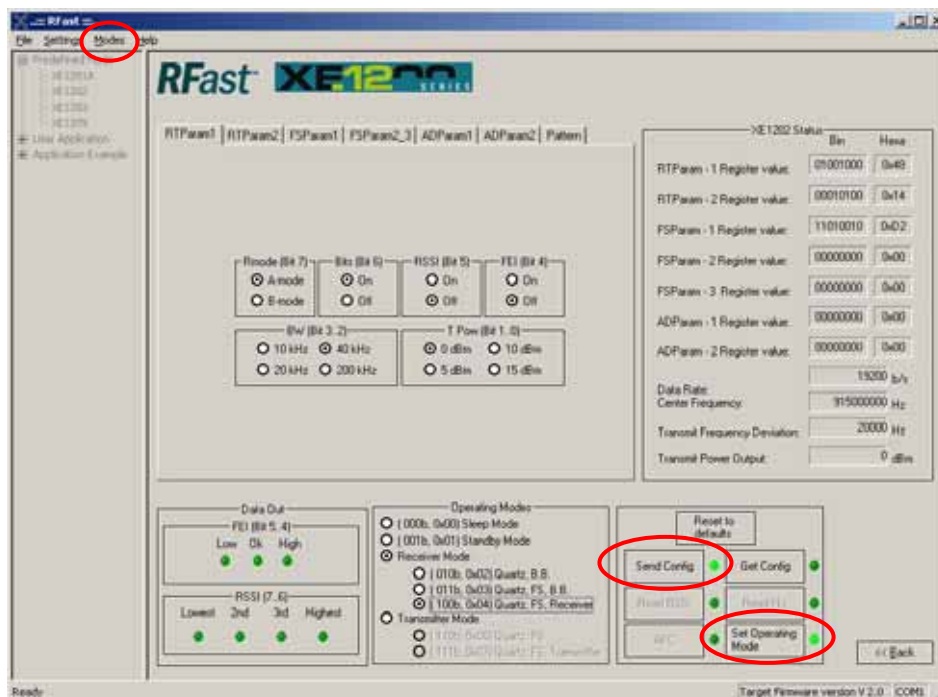


Figure 3.12

#### 4.8.2 Test in receiver mode

To test the RF Module in receiver mode, you will observe digital signals. Connect an oscilloscope to pin 1 of the Digital connector to observe a square wave signal at 19.2kHz. This signal is the Clock Data (DCLK signal on the XE1202).

On pin 2 of the Digital connector, a random signal is present. This signal is called Data (DATAOUT on the XE1202) and corresponds to data received by the RF Module.

#### Technical Note

The signal DATAOUT is random if no RF signal is generated by neither a FM generator nor by another XE1202.

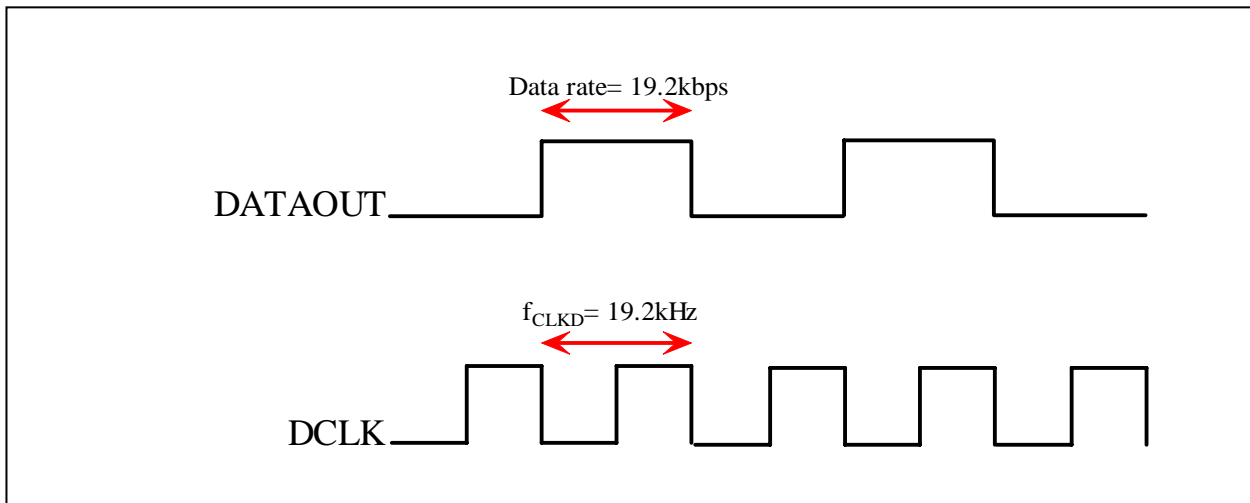


Figure 3.13

In addition, two LEDs (H2 and H3) indicate the status of Mode (0) and Mode(1)

H2 = Mode (0)

H3 = Mode (1)

In transmitter mode H2 is On and H3 is Off

#### Technical Note

If the CLKOUT is enabled, a clock signal is available on pin 4 of the Digital connector at 9.75 down to 1.22MHz (39MHz divided by 4, 8, 16 or 32:

#### Technical Note

The PATTERN signal is also available on pin 3 of the Digital Connector; refer to the XE1202 Datasheet for more information

#### 4.9 GO FORWARD

You have now completed the XM1202 tutorial on RFast System. The simple examples shown here give you a beginner's knowledge of working with XE1202 devices. For more detailed information on usage for your individual applications, please refer to the Basic (chapter 8) and Advanced (chapter 9) Features chapters.

## 5 TUTORIAL - XM1203

### 5.1 INTRODUCTION

After installing the RFast hardware and RFast software, you may wish to try this tutorial to get you started.

### 5.2 HIGHLIGHTS

This tutorial covers:

- Reviewing the Hardware
- Running RFast software
- Setting Up the Communication port
- Setting Up the Predefined Mode
  - XE88LC05 Programming
  - XE88LC05 Setup Status
  - FPGA Programming
  - FPGA Setup Status
  - Board Status
- XM1203 Configuration in transmitter mode
  - XM1203 Setting in transmitter mode
  - Test in transmitter mode
- XM1203 Configuration in receiver mode
  - XM1203 Settings in receiver mode
  - Test in receiver mode
- Going Forward

### 5.3 REVIEWING THE HARDWARE

The hardware setup for this tutorial is listed below:

- PC Serial Port: Bi-directional mode
- RFast Kit with mini processor board
- Target: XM1203

#### 5.4 RUNNING RFAST SOFTWARE

After installing RFast software, invoke it by executing the file RFast.exe  
For more information on using RFast software, refer to the included file README.log

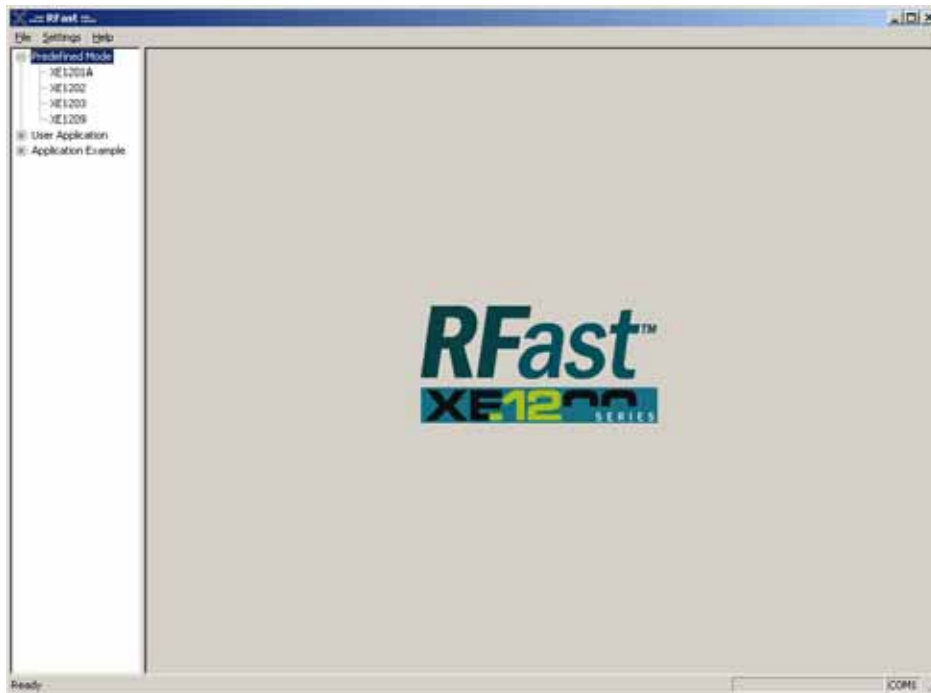


Figure 4.1

#### 5.5 SETTING UP THE COMMUNICATION PORT

Select an available Communication port from dropdown list by clicking on Setting.

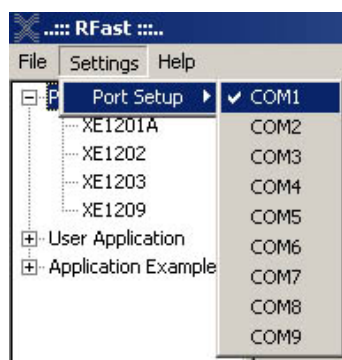


Figure 4.2

If you have any problems configuring the Com port, please refer to Troubleshooting (Chapter 11) chapter.

### 5.6 SETTING UP THE PREDEFINED MODE

Open the XE1203 Predefined Mode dialog (*Predefined Mode>XE1203*) to set up the RFast processor board. Set up the system by clicking on each option boxes as described below.

**Warning**

Follow these steps only if you are using a mini-processor board for the first time or if you are changing target. If not click on *Next*.

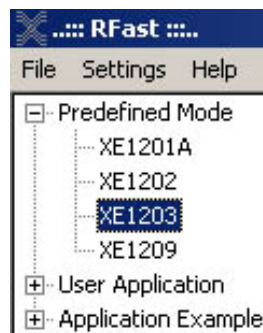


Figure 4.3

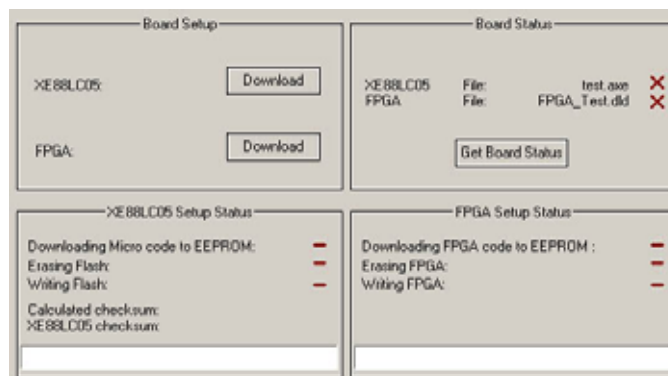


Figure 4.4

### 5.6.1 XE88LC05 Programming

In the *Board Setup* window, Click on **XE88LC05 Download**. This action will automatically download the generic XM1203 driver and program the XE88LC05 microcontroller on the mini-processor board.

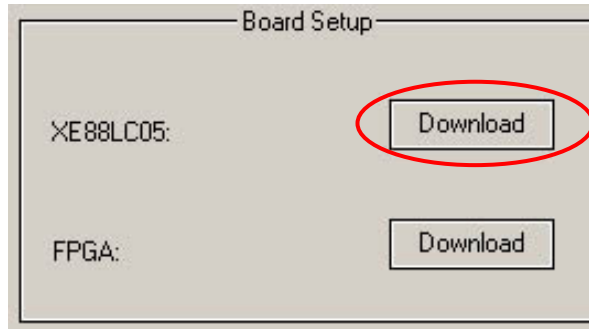
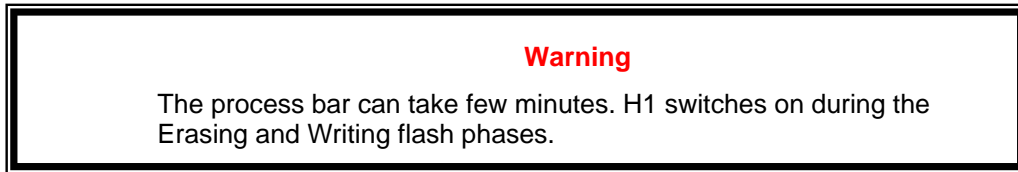


Figure 4.5

### 5.6.2 XE88LC05 Setup Status

The *XE88LC05 Setup Status* displays several indicators. During the programming phase, there are three different indicators, Downloading Micro to EEPROM followed by Erasing Flash and finally Writing Flash.

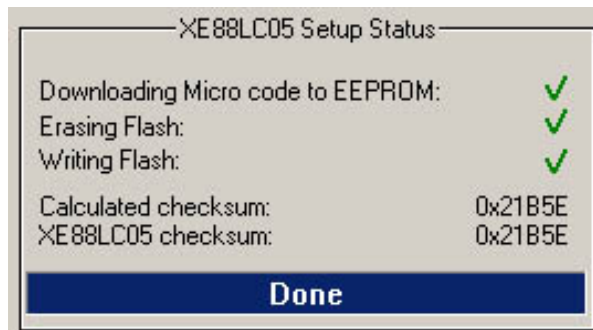


Figure 4.6

The programming status window displays the stage at which the programming procedure is. The stage is complete and correct if the symbol appears and the programming process has failed if symbol appears.

The checksum indicates if the programming result is correct. The computer calculates the source code checksum and the XE88LC05 gives the checksum after the programming sequence. If both are not equal the programming has failed.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 5.6.3 FPGA Programming

In the *Board Setup* window, Click on **FPGA Download**. The RFast architecture allows any microcontroller signals to be connected to any one or more I/Os on the RF module's connector and/or Digital connector. This action will automatically download the XM1203 Crosspoint.

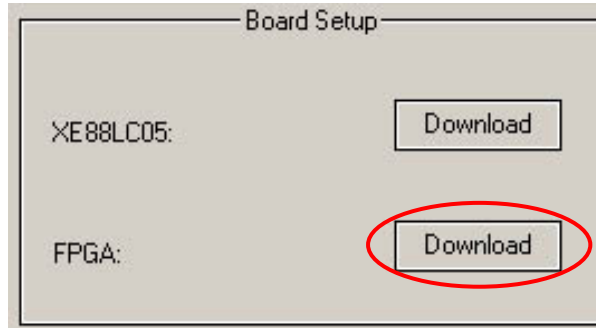


Figure 4.7

### 5.6.4 FPGA Setup Status

The *FPGA Setup Status* window displays a process bar to indicate the stage at which the programming procedure is.

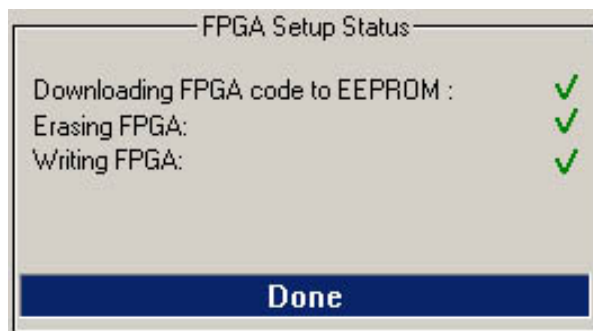




Figure 4.8

The programming stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 5.6.5 Board Status

The *Board Status* window displays the RFast systems' status. The first indicator *XE88LC05* shows the programming result but also the name of the driver (the name of the driver which has been downloaded into the microcontroller). The second indicator *FPGA* shows the programming result of the FPGA and name of the crosspoint file, which has been downloaded into the FPGA.

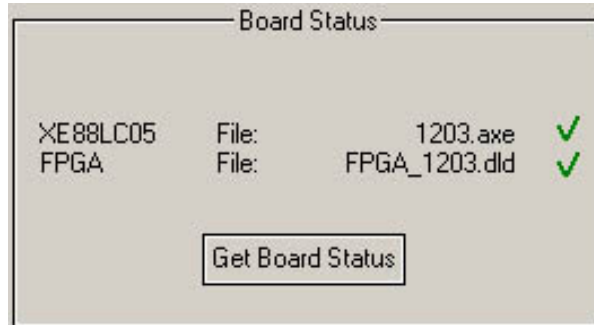



Figure 4.8

If everything is OK (the symbol  appears on both Board Status indicators), click on **Next** to access to XE1203 Configuration window to start RF evaluation.

## 5.7 XM1203 CONFIGURATION IN TRANSMITTER MODE

Now that RFast system has been set and the source code successfully downloaded, you may run the XM1203 driver.

### 5.7.1 XM1203 Settings in transmitter mode

The goal of this tutorial is to program the XM1203 in transmitter or receiver mode. However, all internal registers of the transceiver must be set:

- 1) Select: *Modes>Frequency Band* to select the frequency band. Click on **902 - 928MHz** if you are using 915MHz module, click on **868 - 870MHz** if you are using a 868MHz module or click on **433 - 435MHz** if you are using 433MHz module.
- 2) Select *Modes>Frequency Deviation* to configure the frequency deviation of the transceiver. Click on **40kHz**.
- 3) To configure data rate select *Modes>Data Rate* and click on **19200 bits/s**
- 4) Select *Modes>Transmit power* and click on **+0dBm**.

#### Transmitter Mode

To configure the transceiver module XM1203 in transmitter mode select *Modes> Operating mode>Mode1* and click on **Transmitter**.

You have defined the XM1203 configuration, now you will transfer the settings to the device. On the XE1203 Configuration window, click on **Send Configuration**. If the communication with the RF Module is OK indicators switch to green. The operating mode is automatically sent. To change the operating mode just click on Mode1 or Mode2, the green led switch on to indicate the communication status.

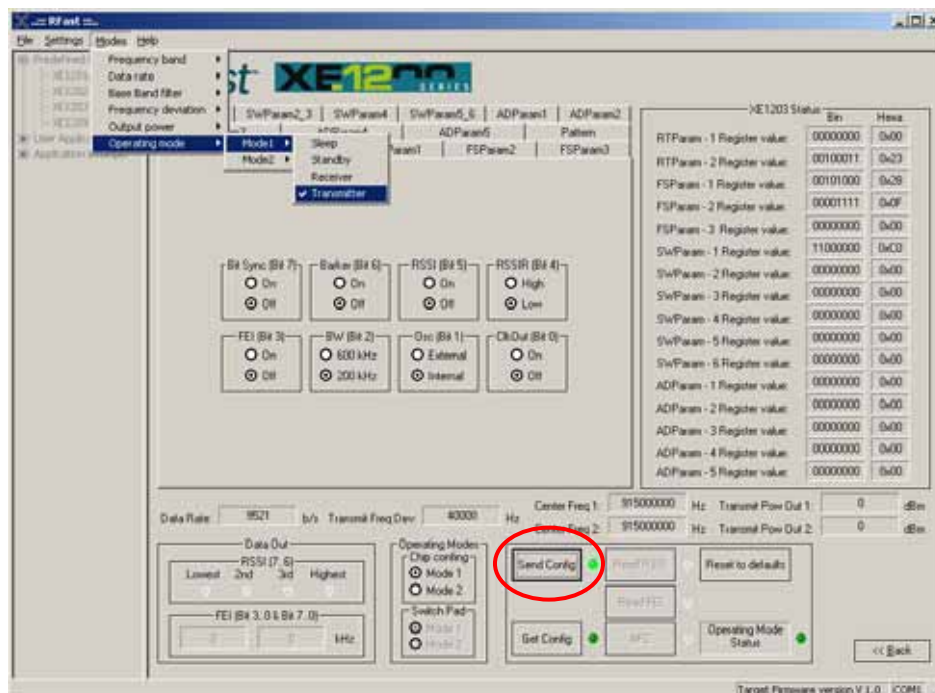


Figure 4.9

#### Technical Note

The XE1203 registers are displayed at the left of the XE1203 Configuration window.

### 5.7.2 Test in transmitter mode

Now that the RF Module XM1203 has been programmed in transmitter mode, you can make a test to validate the programming.

By using a spectrum analyser connected to RFout, you can observe an FSK signal with 40kHz frequency deviation and +0dBm output power.

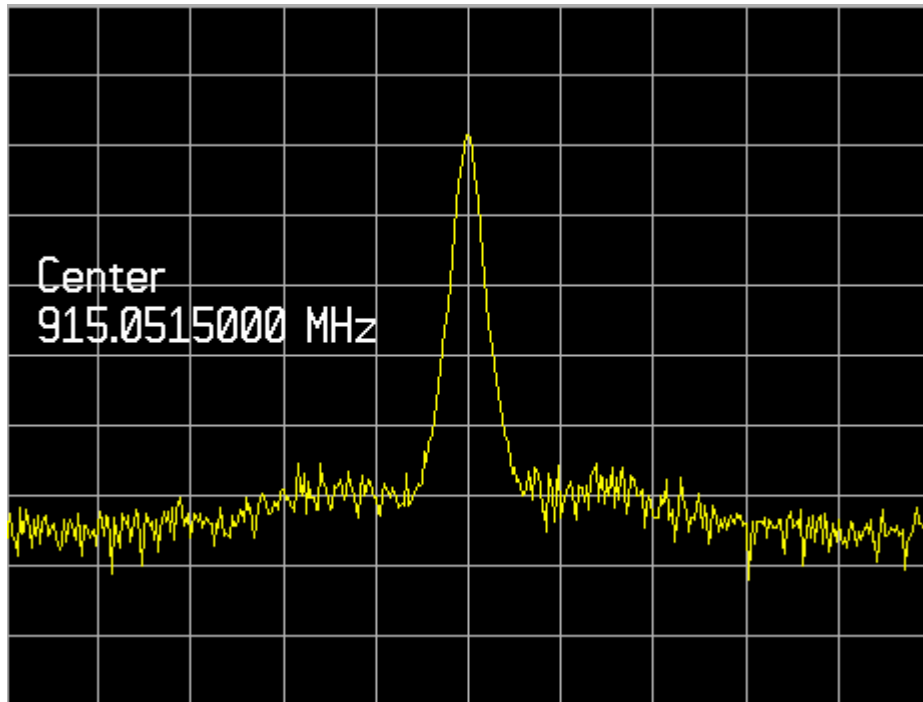


Figure 4.10

In addition, two LEDs (H2 and H3) indicate the status of Mode (0) and Mode (1)

H2 = Mode (0)

H3 = Mode (1)

In transmitter mode H2 and H3 are On

#### Technical Note

If the modulation is enabled the bit transmit is "1", use the pin 20 of the Digital connector to connect an external data generator:

#### Warning

If you want more output power than 0dBm, you need to connect the power supply of the module to the output power supply connector of the GIB, in order to obtain enough output current. For more information please refer to Appendix A3 and A5

## 5.8 XM1203 CONFIGURATION IN RECEIVER MODE

Now that you have programmed and tested the RF Module in transmitter mode, you can change the operating mode to receiver.

### 5.8.1 XM1202 Settings in receiver mode

1. Select *Modes>Frequency Band* to configure the band. Click on **902 - 928MHz** if you are using a 915MHz module, click on **868 - 870MHz** if you are using a 868MHz module and click on **433 - 434MHz** if you are using a 433MHz module.
2. Select *Modes>Frequency Deviation* to configure the frequency deviation of the transceiver. Click on **40kHz**.
3. To configure data rate select *Modes>Data Rate* and click on **19200 bits/s**
4. Select: *Modes>Base Band Filter* and click on **200kHz**
5. Receiver mode Select *Modes>Operating mode>Mode2* and click on **Receiver**. This action will configure the XM1203 in receiver mode with the Bit Synchronizer enable (for more information about the Bit Synchronizer, refer to XE1203 Datasheet).

**Next**, the RF Module has been defined in receiver mode, now you will transfer the setting to the device. On the XE1203 Configuration window, click on **Send Configuration**. If the communication with the RF Module is OK indicators switch to green.

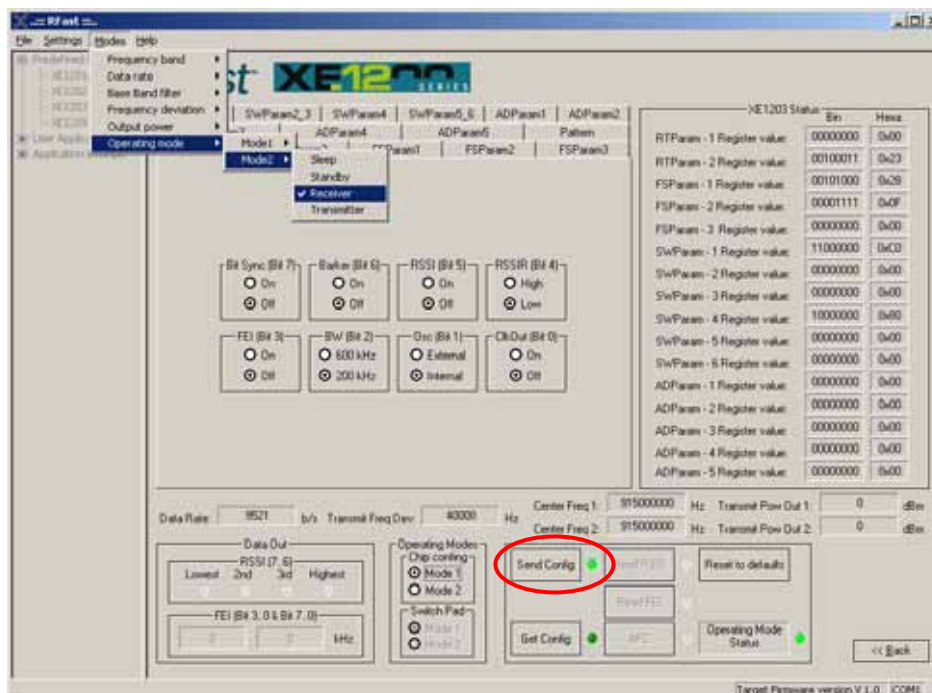


Figure 4.11

### 5.8.2 Test in receiver mode

To test the RF Module in receiver mode, you will observe digital signals. Connect an oscilloscope to pin 1 of the Digital connector to observe a square wave signal at 19.2kHz. This signal is the Clock Data (DCLK signal on the XE1203).

On pin 2 of the Digital connector, a random signal is present. This signal is called DATA (Data Out on the XE1203) and corresponds to data received by the RF Module.

#### Technical Note

The signal DATAOUT is random if no RF signal is generated by neither a FM generator nor by another XE1203.

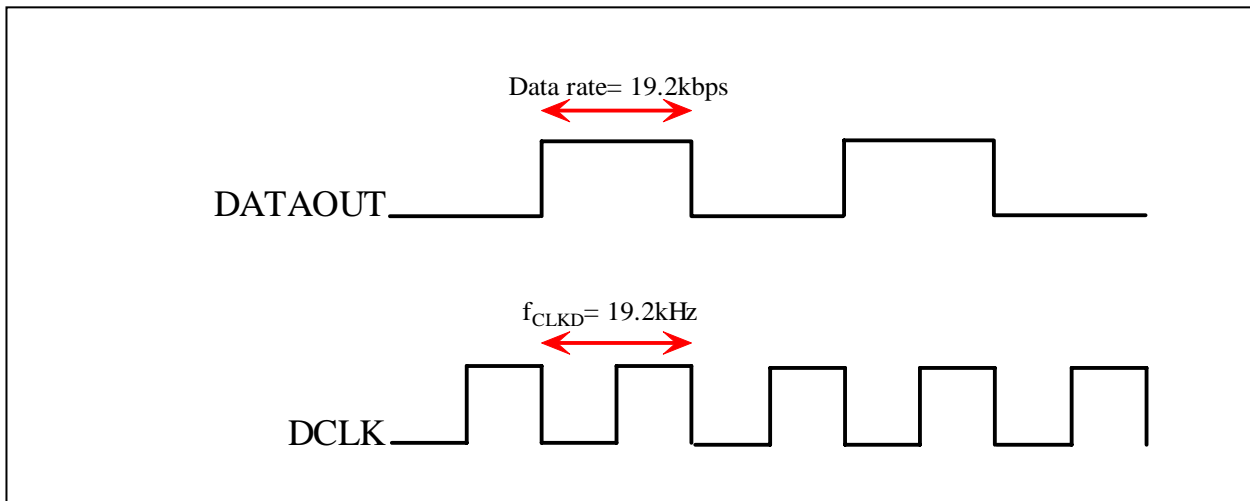


Figure 4.12

In addition, two LEDs (H2 and H3) indicate the status of Mode (0) and Mode (1)

H2 = Mode (0)

H3 = Mode (1)

In transmitter mode H2 is On and H3 is Off

#### Technical Note

If the CLKOUT is enabled, a clock signal is available on pin 4 of the Digital connector at 9.75 down to 1.22MHz (39MHz divided by 4, 8, 16 or 32):

#### Technical Note

The PATTERN signal is also available on pin 3 of the Digital Connector; refer to the XE1203 Datasheet for more information

## 5.9 GO FORWARD

You have now completed the XM1203 tutorial on RFast System. The simple examples shown here give you a beginner's knowledge of working with XE1203 devices. For more detailed information on usage for your individual applications, please refer to the Basic (chapter 8) and Advanced (chapter 9) Features chapters.

## 6 TUTORIAL - XM1209

### 6.1 INTRODUCTION

After installing the RFast hardware and RFast software, you may wish to try this tutorial to get you started.

### 6.2 HIGHLIGHTS

This tutorial covers:

- Reviewing the Hardware
- Running RFast software
- Setting Up the Communication port
- Setting Up the Predefined Mode
  - XE88LC05 Programming
  - XE88LC05 Setup Status
  - FPGA Programming
  - FPGA Setup Status
  - Board Status
- XM1209 Configuration in transmitter mode
  - XM1209 Setting in transmitter mode
  - Test in transmitter mode
- XM1209 Configuration in receiver mode
  - XM1209 Settings in receiver mode
  - Test in receiver mode
- Going Forward

### 6.3 REVIEWING THE HARDWARE

The hardware setup for this tutorial is listed below:

- PC Serial Port: Bi-directional mode
- RFast Kit with mini processor board
- Target: XM1209

#### 6.4 RUNNING RFAST SOFTWARE

After installing RFast software, invoke it by executing the file RFast.exe  
For more information on using RFast software, refer to the included file README.log



Figure 5.1

#### 6.5 SETTING UP THE COMMUNICATION PORT

Select an available Communication port from dropdown list by clicking on Setting.

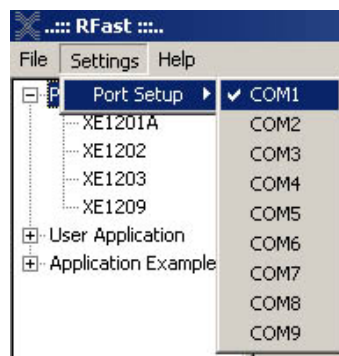


Figure 5.2

If you have any problems configuring the Com port, please refer to Troubleshooting (Chapter 11) chapter.

### 6.6 SETTING UP THE PREDEFINED MODE

Open the XE1209 Predefined Mode dialog (*Predefined Mode>XE1209*) to set up the RFast processor board. Set up the system by clicking on each option boxes as described below.

**Warning**

Follow these steps only if you are using a mini-processor board for the first time or if you are changing target.

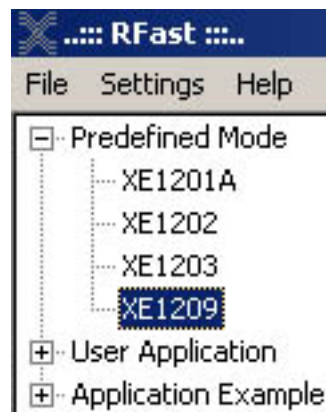


Figure 5.3

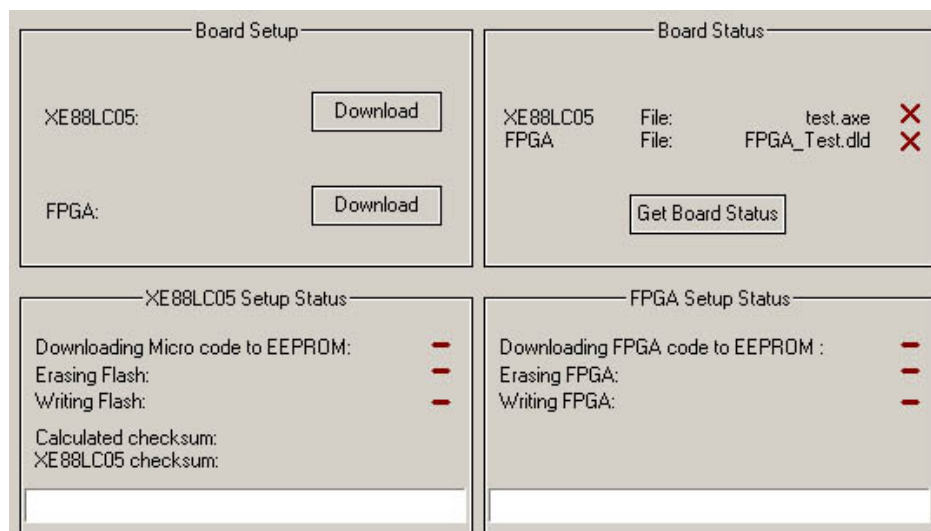


Figure 5.4

### 6.6.1 Mini Processor board XE88LC05 Programming

In the *Board Setup* window, Click on **XE88LC05 Download**. This action will automatically download the generic XM1209 driver and program the XE88LC05 microcontroller on the mini-processor board.

**Warning**

The process bar can take few minutes. H1 switches on during the Erasing and Writing flash phases.

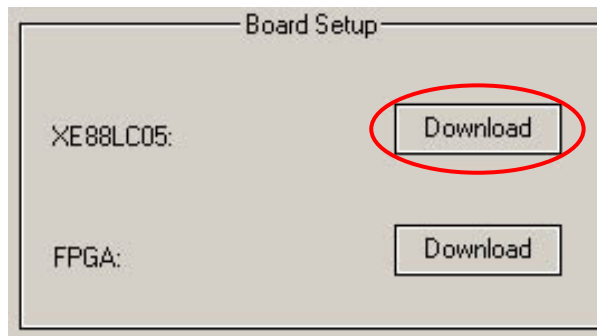


Figure 5.5

### 6.6.2 Mini Processor board XE88LC05 Setup Status

The *XE88LC05 Setup Status* displays several indicators. During the programming phase, there are three different indicators, Downloading Micro code to EEPROM followed by Erasing Flash followed and finally Writing Flash.

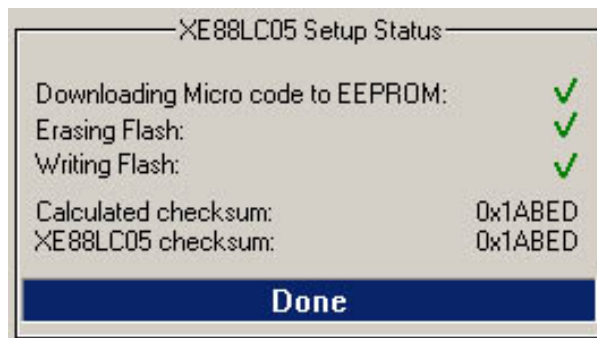


Figure 5.6

The programming status window displays the stage at which the programming procedure is. The stage is complete and correct if the symbol appears and the programming process has failed if symbol appears.

The checksum indicates the programming result is correct. The computer calculates the source code checksum and the XE88LC05 gives the checksum after the programming sequence. If both are not equal the programming has failed.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 6.6.3 FPGA Programming

In the *Board Setup* window, Click on **FPGA Download**. The RFast architecture allows any microcontroller signals to be connected to any one or more I/Os on the RF Module's connectors and/or Digital connector. This action will automatically download the XM1209 Crosspoint.

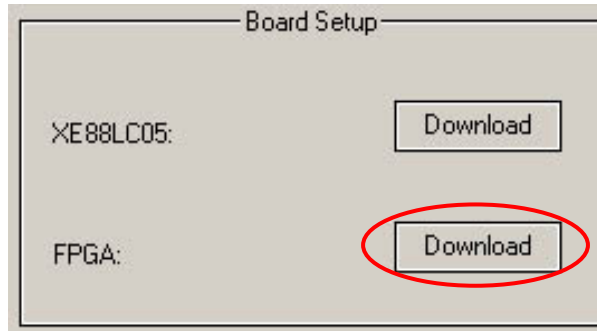


Figure 5.7

### 6.6.4 FPGA Setup Status

The *FPGA Setup Status* window displays a process bar to indicate the stage at which the programming procedure is.

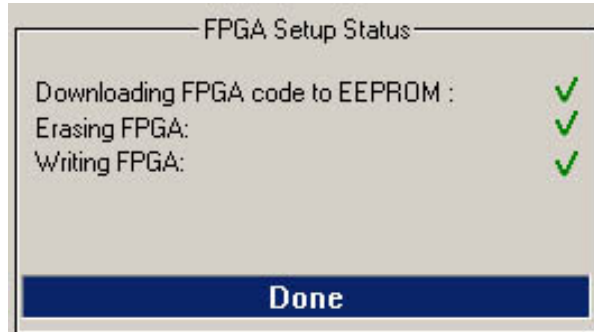




Figure 5.8

The programming stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 6.6.5 Board Status

The *Board Status* window displays the RFast systems' status. The first indicator *XE88LC05* shows the programming result but also the name of the driver (the name of the driver that has been downloaded into the microcontroller). The second indicator *FPGA* shows the programming result of the FPGA and name of the Crosspoint file, which has been downloaded into the FPGA.



Figure 5.9

If everything is OK (the symbol ✓ appears on both Board Status indicators), click on **Next** to access the XE1209 Configuration window to start RF evaluation.

## 6.7 XM1209 CONFIGURATION IN TRANSMITTER MODE

Now that RFast system has been set and the source code successfully downloaded, you may run the XM209 driver

### 6.7.1 XM1209 Settings in transmitter mode

The goal of this tutorial is to program the module XM1209 in transmitter or receiver mode. However, the internal register of the transceiver must be set:

1. Select Modes>Oscillator to configure the oscillator of the transceiver. Click on **Internal**.
2. Select: Modes>Carrier Frequency to select the carrier frequency. Click on **36.86kHz**
3. Select Modes> Transmit power and click on **7.5mA**.

#### Transmitter Mode

To configure the transceiver module XM1209 in transmitter mode select Modes> Operating mode and click on **Transmitter**.

You have defined the XM1209 configuration, now you will transfer the settings to the device. On the XE1209 Configuration window click on **Send Configuration**. If the communication with the RF Module is OK indicators switch to green.

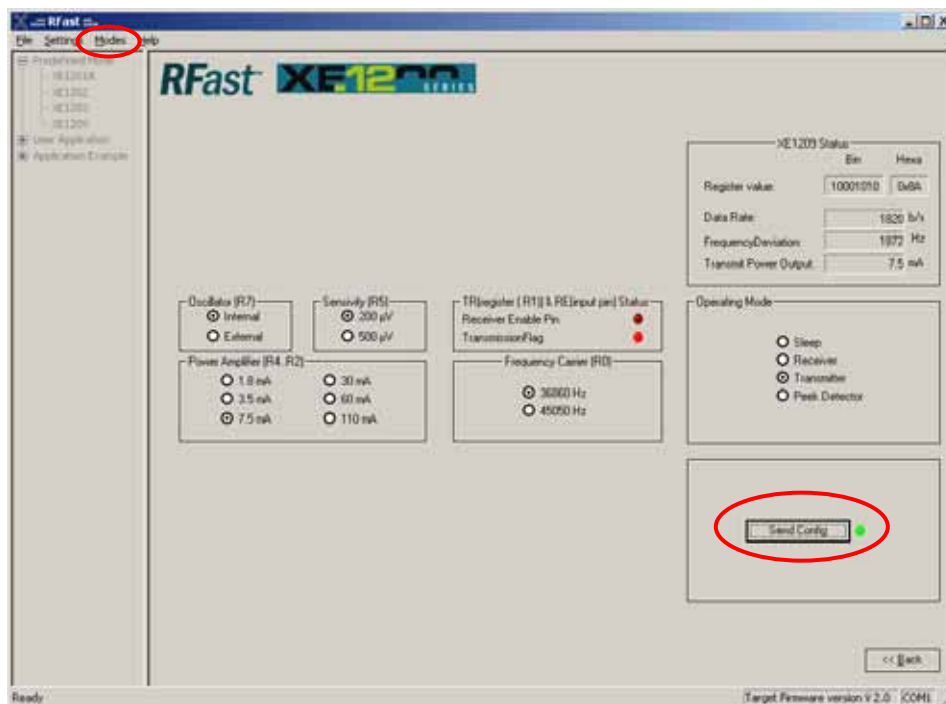


Figure 5.10

#### Technical Note

The XE1209 register is displayed at the left of the XE1209 Configuration window.

### 6.7.2 Test in transmitter mode

Now that the RF Module XM1209 has been programmed in transmitter mode, you can make a test to validate the programming.

The default data, which is transmitted is "1," you can use the pin 20 of the Digital connector to connect an external data generator.

You can connect an oscilloscope to the antenna input to observe the RF signal (PA out)

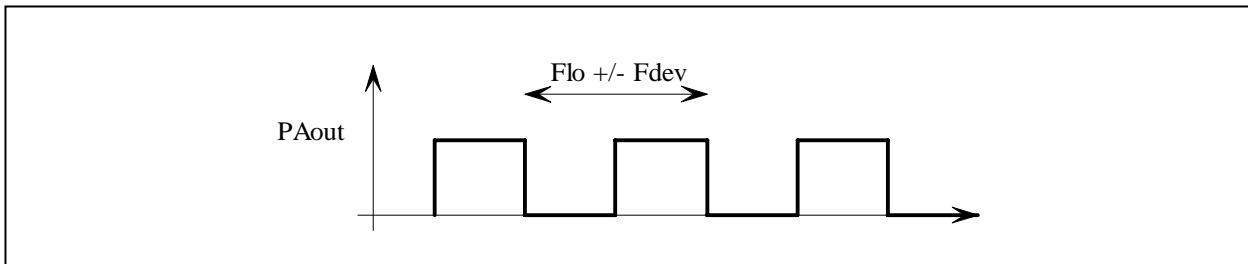


FIGURE 5.11

Connect the antenna before connecting the oscilloscope on Antenna input pin.

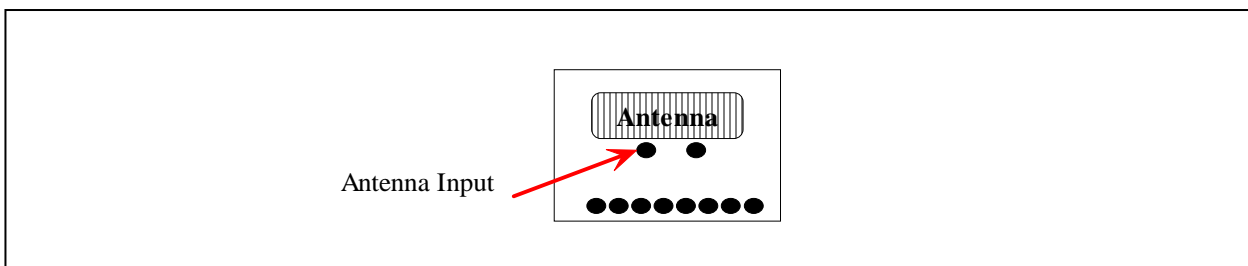


Figure 5.12

## 6.8 XM1209 CONFIGURATION IN RECEIVER MODE

Now that you have programmed and tested the RF Module in transmitter mode, you can change the operating mode to receiver.

### 6.8.1 XM1209 Settings in receiver mode

1. Select Modes>Oscillator to configure the oscillator of the transceiver. Click on **Internal**.
2. Select: Modes>Carrier Frequency to select the carrier frequency. Click on **36.86kHz**
3. Select Modes>Sensitivity and click on **500uV**.

Receiver mode

Select Modes>Operating mode and click on **Receiver**. This action will configure the XM1209 in receiver mode with the Bit Synchronizer enable (for more information about the Bit Synchronizer, refer to XE1209 Datasheet).

**Next**, the RF Module has been defined in receiver mode, now you will transfer the setting to the device. On the XE1209 Configuration window click on **Send Configuration**. If the communication with the RF Module is OK connection status indicators switch to green.

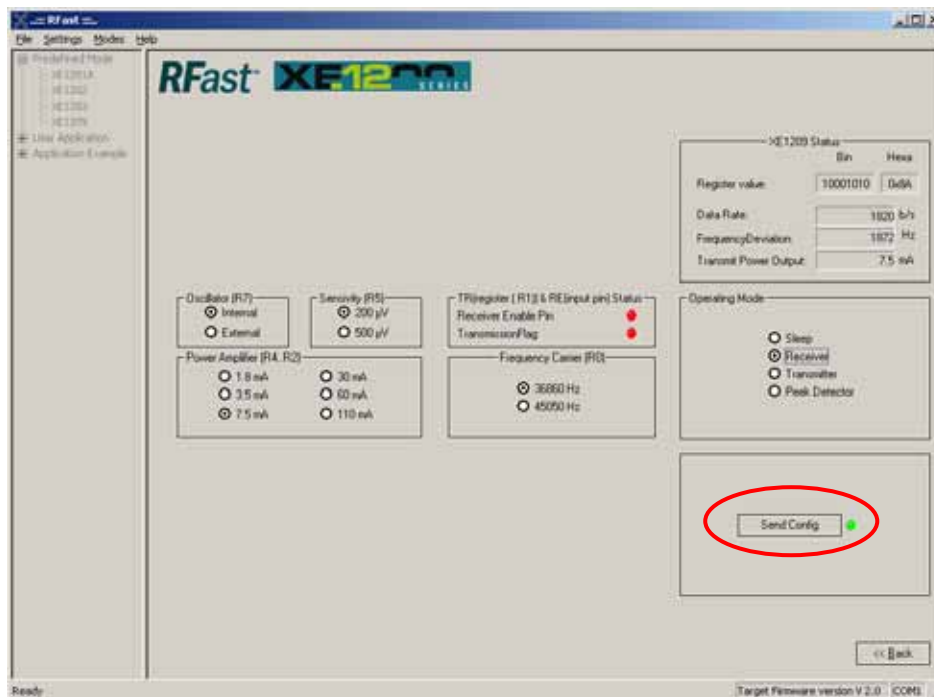


Figure 5.13

In addition, the LED H3 is connected to the RE pin so the LED is on during Receiver mode and Peak Detector mode.

### 6.8.2 Test receiver mode

To test the RF Module in receiver mode, you will observe digital signals. Connect an oscilloscope to pin 1 on the Digital connector to observe a square wave signal at 18.2kHz. This signal is the Clock Data (DCLK signal on the XE1209).

On pin 2 of the Digital connector, a random signal is present. This signal is the Data (DATA on the XE1209) and corresponds to data received by the RF Module.

#### Technical Note

The signal DATA is random if no RF signal is generated by a FM generator neither by another XE1209.

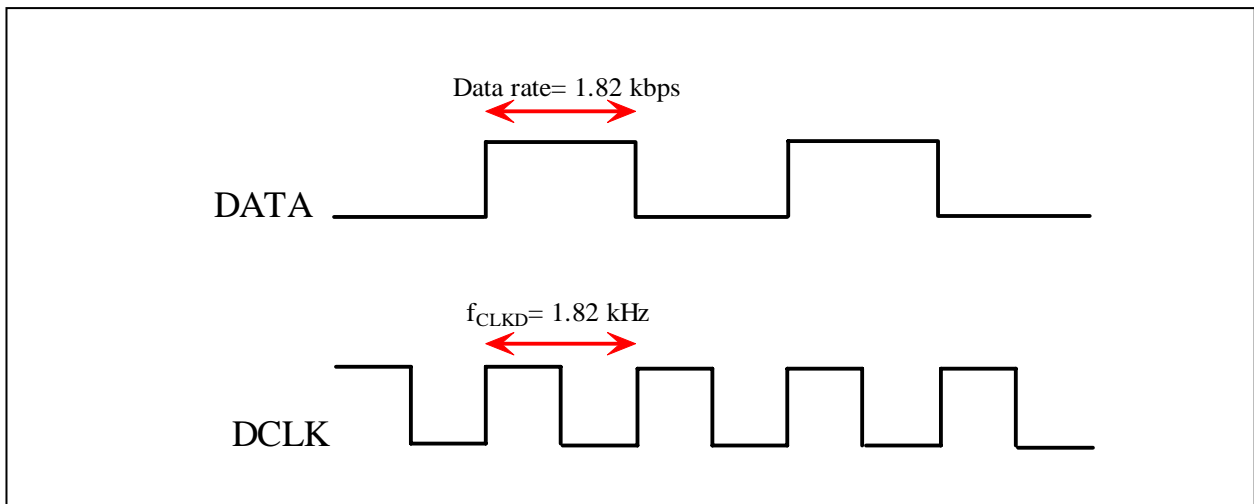


Figure 5.14

### 6.9 GO FORWARD

You have now completed the XM1209 tutorial on RFast System. The simple examples shown here give you a beginner's knowledge of working with XE1209 devices. For more detailed information on usage for your individual applications, please refer to the Basic (chapter 8) and Advanced (chapter 9) Features chapters.

## 7 GENERAL SET UP

### 7.1 INTRODUCTION

After installing and starting up the RFast software, the processor board must be enabled and set up to correctly drive the RF module.

### 7.2 HIGHLIGHTS

The steps needed to get started are:

- Running RFast software
- Setting Up the Communication port
- Selecting the Operating Mode
- Predefined mode
  - Selecting the RF Module
  - XE88LC05 programming
  - XE88LC05 Setup Status
  - FPGA Programming
  - FPGA Setup Status
  - Board Status
- Setting Up the User Application mode
  - Files Selection
  - RS232 Connection
- Setting Up the Application Example mode
  - Setting Up the Ping-Pong Demo
  - Run the Ping-Pong Demo

### 7.3 RUNNING RFAST SOFTWARE

After installing RFast software, invoke it by executing the file RFast.exe  
For more information on using RFast software, refer to the included file README.log

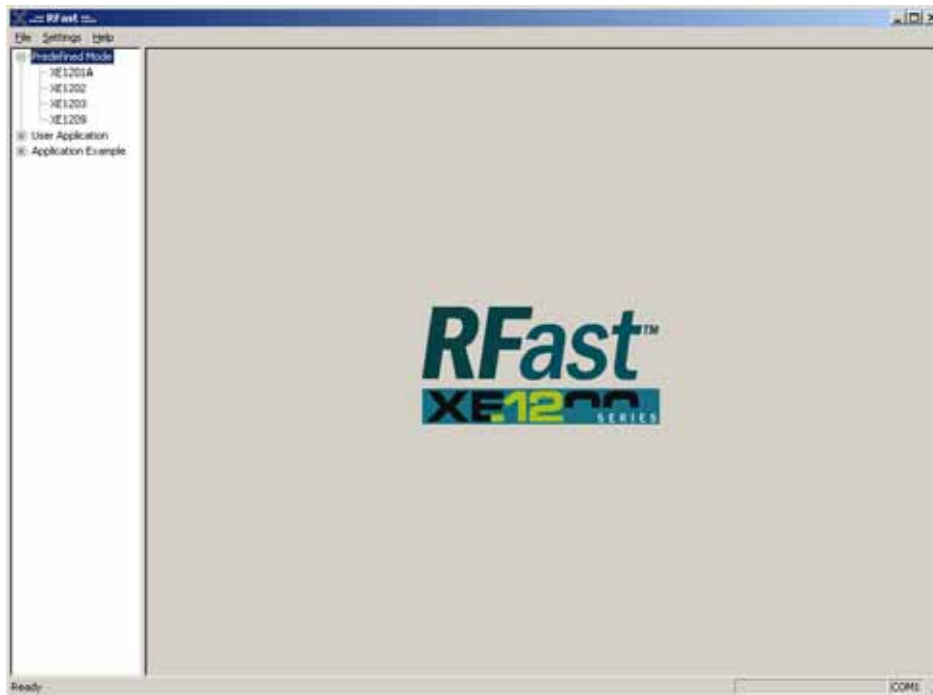


Figure 6.1

### 7.4 SETTING UP THE COMMUNICATION PORT

Select an available Communication port from dropdown list by clicking on Setting.

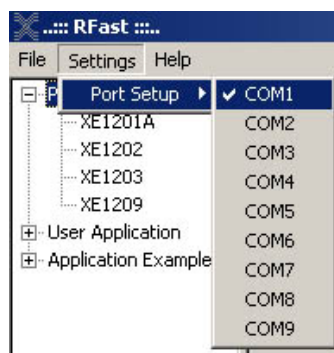


Figure 6.2

If you have any problems configuring the Com port, please refer to the Troubleshooting chapter (Chapter 11).

### 7.5 SETTING UP THE PREDEFINED MODE

Open the Predefined Mode dialog (*Predefined Mode>XE120x*) to set up the RFast processor board. Set up the system by clicking on each option box as described below.

**Warning**

Follow these steps only if you are using a mini-processor board for the first time or if you are changing target.

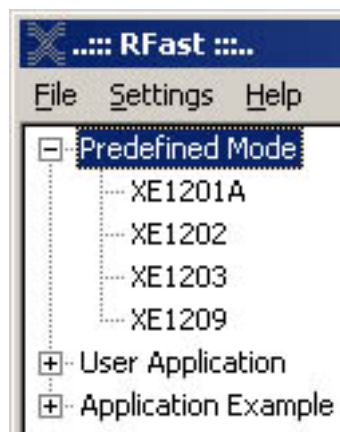


Figure 6.3

#### 7.5.1 Mini processor Board XE88LC05 Programming

In the *Board Setup* window, Click on **XE88LC05 Download** . This action will automatically download the RF module driver and program the XE88LC05 microController on the mini-processor board.

**Warning**

The process can take few minutes. H1 switches on during the Erasing and Writing flash phases.

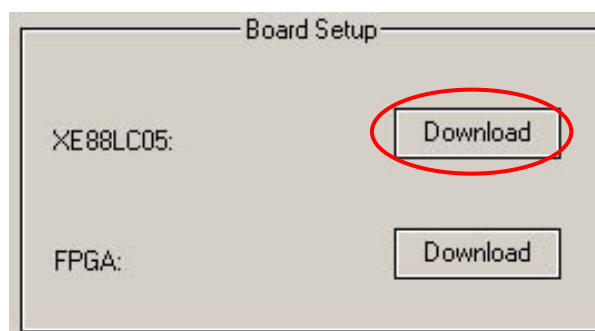


Figure 6.4

### 7.5.2 Mini processor board XE88LC05 Setup Status

The *XE88LC05 Setup Status* displays several indicators. During the programming phase, there are three different indicators, Downloading Micro code to EEPROM followed by Erasing Flash and finally Writing Flash.

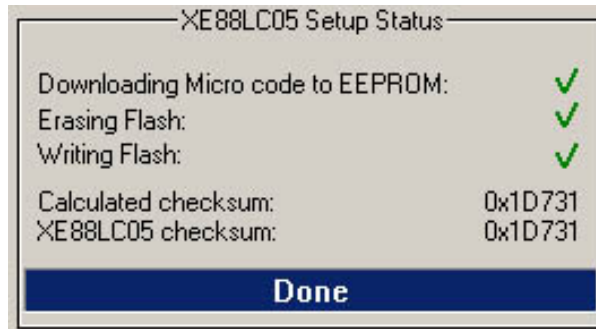




Figure 6.5

The programming status window displays the stage at which the programming procedure is. The stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.

The checksum indicates if the programming result. The computer calculates the source code checksum and the XE88LC05 gives the checksum after the programming sequence. If both are not equal the programming has failed.

If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### FPGA Programming

In the *Board Setup* window, Click on **FPGA Download**. The RFast architecture allows any microcontroller signals to be connected to any one or more I/Os on the target Module's connector and/or digital connector. This action will automatically download the RF Module Crosspoint driver.

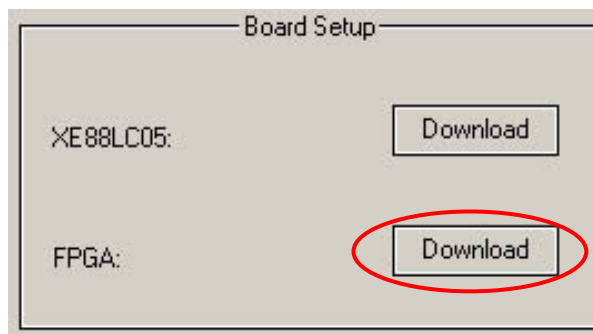


Figure 6.6

### 7.5.3 FPGA Setup Status

The *FPGA Setup Status* window displays a process bar to indicate the stage at which the programming procedure is.

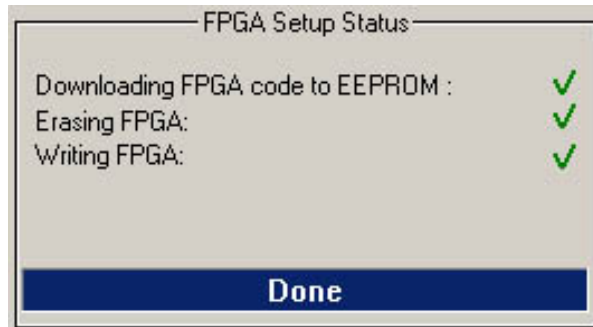




Figure 6.7

The programming stage is complete and correct if the  symbol appears and the programming process has failed if  symbol appears.


If the programming fails, check your communication system and try again or refer to Troubleshooting chapter (Chapter 11).

### 7.5.4 Board Status

The *Board Status* window displays the RFast systems' status. The first indicator *XE88LC05* shows the programming result but also the name of the driver (the name of the driver that has been downloaded into the microcontroller). The second indicator *FPGA* shows the programming result of the FPGA and name of the Crosspoint file, which has been downloaded into the FPGA.



Figure 6.8

If everything is OK (the symbol  appears on both Board Status indicators), click on **Next** to access the RF Module Configuration window to start RF evaluation.

## 7.6 SETTING UP THE USER APPLICATION MODE

The new version of RFast allows the user to download his own microcontroller source code into the XE88LC05 but also to develop to program the FPGA with a custom crosspoint connection via the User Application mode.

Open the User Application dialog (*User Application>GIB - Control*) to set up the RFast processor board. Set up the system by clicking on each option box as described below.



Figure 6.9

### 7.6.1 Files selection

Before to program the microcontroller or the FPGA, the source file needs to be selected.

Click on *XE88LC05 Browse* to select a *.bin* or *.axe* files followed by *Download*.

Click on *FPGA Browse* to select the *.dld* file (for more information about *.dld* file please refer to Advanced Features chapter) followed by *Download*.

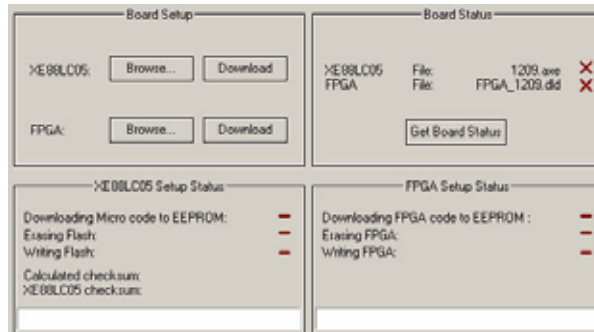


Figure 6.10

Refer to chapter 6.5 for more information about XE88LC05 Board Setup window, FPGA board Setup window and Board Status window. If everything is OK (the symbol  appears on both Board Status indicators).

### 7.6.2 RS232 Connection

RFast offers also the possibility to communicate between the mini-processor board and a base station, for example a PC, via the RS232.

Click on **Next** to connect the RS232 to the second microcontroller placed on the mini processor board, an empty screen appears. In this case a communication is established between the XE88LC05 and a PC (or another system with an RS232 connector).

To go back on the main screen click on *Back* button, the RS232 will automatically be connected to the main processor. Another programming can be done.

## 7.7 SETTING UP THE APPLICATION EXAMPLE MODE

RFast now includes some application examples. The first one, embedded in RFast, is a ping pong demo. This application has been developed for the XE1202SK and XE1203SK, the second XE1200 Development Tools. The microcontroller's source code of the Starter Kit has been re-used in RFast and so both are compatible. In other word, a Ping Pong demo can be achieved between two GIBs or between a GIB and a SK.

Open the application example dialog (Application Example>XE1202>Ping Pong Demo) or (Application Example>XE1203>Ping Pong Demo) to set up the RFast processor board.

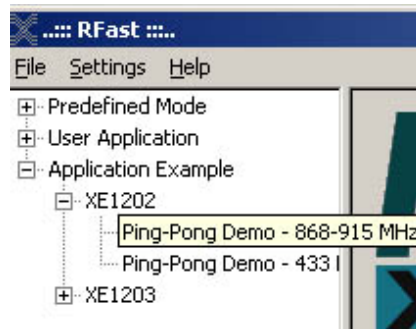


Figure 6.11

Set-up the system by clicking on each option box as described below

### 7.7.1 Setting up the Ping Pong Demo

Before to run the Ping Pong Demo application, the GIB needs to be program.

Click on XE88LC05 Download and verify that the Checksum is correct.

Click on FPGA Download and verify that all the steps have been marked

The Board Status window display the result of the GIB's configuration. Verify that 1202(03)sk.axe has been marked  and also FPGA\_1202(03)SK.dld has been marked .

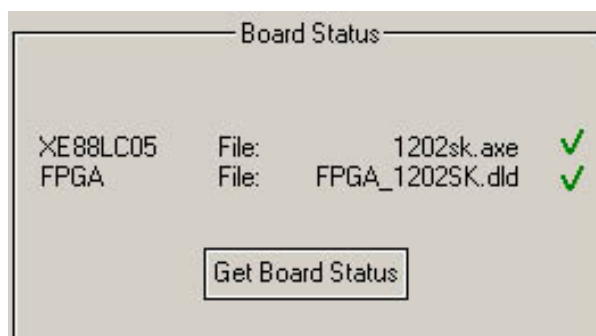


Figure 6.12

### 7.7.2 Run the Ping Pong Demo

To run this application example click on **Next**, to connect the RS232 to the mini processor board. After that a communication can be establish between the RF module and RFast software.

For more information about the Ping Pong Demo and to use it please refer to Chapter 10

## 8 BASIC FEATURES

### 8.1 INTRODUCTION

RFast provides a wide variety of tools to evaluate, develop and debug an application. RFast offers a basic set of tools, including the ability to define, transmit and receive a message, plus additional tools for advanced debugging techniques.

The basic driver's features are built-in to the RFast software. A general description of these features is provided here.

### 8.2 HIGHLIGHTS

RFast basic features include the following:

- Registers selection
- Registers configuration
- Set, Send and Read functions
- Automatic Frequency Control

### 8.3 REGISTERS SELECTION

To select a register click on the register's name tab. This operation will display the bits description and is available only with the XE1202 and XE1203 transceivers.

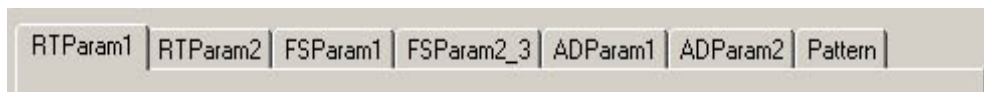


Figure 7.1

### 8.4 REGISTERS CONFIGURATION

To set the RF transceiver registers two methods are possible

- Click on the corresponding small circular buttons to select the desired option. Activation at value 1 visible through a black dot.

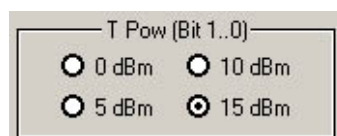


Figure 7.2

- From the menu toolbar: Select *Modes> Transmit power* and click on **+15dBm**

#### Technical Note

The registers are displayed on the left screen of the Configuration window.

### 8.5 SET, SEND AND READ FUNCTIONS

There are four functions to write and read into the RF Module.



Click on [>Set Operating Mode](#)

Sets the operating mode of the RF Module. The transmission is correct if the indicator turns green.



Click on [>Send configuration](#)

Transmits the configuration register to the RF Module. The transmission is correct if the indicator turns green.



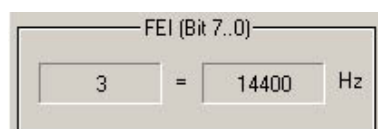
Click on [>FEI>On](#) followed by [>Read FEI Output](#)

This function is available only with the target XM1202. RFast User's Interface provides windows for viewing the FEI output. For more information on the FEI function, please refer to the XE1202 / XE1203 Datasheet.

#### FEI Correlators Output



#### FEI Demodulator Output





**Read RSSI (Receive Signal strength indicator)**

Click on >RSSI>On followed by >Read RSSI Output

This function as the FEI is available only with the RF Module XM1202 and XM1203. A window displays the RSSI output. For more information on the RSSI function, please refer to the XE1202 / XE1203 Datasheet.

RSSI Output



**8.6 AFC – AUTOMATIC FREQUENCY CONTROL**

This function is based on the FEI function and is available only with the XE1202 / XE1203. As described in chapter 8.5, the FEI gives an indication of the difference between the Local Oscillator of the transmitter and the Local Oscillator of the receiver. The AFC consists of an auto-frequency calibration, the Local Oscillator of the receiver will be adjusted to the Local Oscillator of the transmitter.



Click on >FEI> On followed by >AFC

The new value of the Local Oscillator is displayed in the register *FSPParam2\_3*. In addition, it verifies if the frequency is well locked onto the transmitter, the FEI function can be launched and the result needs to be *OK* (see chapter 8.5, *Read FEI*).

For more information about the implementation of the Frequency Error Indicator, please refer to Chapter 13 Appendix B.4.

## 9 ADVANCED FEATURES

### 9.1 INTRODUCTION

The RFast system is also a development environment. For that, Advanced Features have been built into this development tool. RFast allows the user to upload their own driver into the microcontroller as well as modify the I/Os connection.

Specialized features are available in the RFast software. A general description of these features is provided here.

### 9.2 HIGHLIGHTS

RFast advanced features include the following:

- Import external RF driver (microcontroller source code)
- Import external Crosspoint connection (FPGA source code)

### 9.3 IMPORT EXTERNAL RF DRIVER

RFast has a highly flexible and powerful RF driver mechanism. The user can develop their own personal RF driver by using CoolRide, Raisonance Ride or another C Compiler.

For this you need to use the User Application menu, the file needs to have an .axe extension (Resonance extension)

Some microcontroller's I/Os are available for the user and connected to the FPGA. Others are reserved for specific functions, the last are not available for the user.

microcontroller I/Os available for user

Port A	Status	Port B	Status	Port C	Status
PA(0)	Reserved	PB(0)	Reserved	PC(0)	Available
PA(1)	Reserved	PB(1)	Available	PC(1)	Available
PA(2)	Available	PB(2)	Available	PC(2)	Available
PA(3)	Available	PB(3)	Available	PC(3)	Available
PA(4)	Available	PB(4)	Available	PC(4)	Available
PA(5)	Available	PB(5)	Available	PC(5)	Available
PA(6)	Available	PB(6)	UART	PC(6)	Available
PA(7)	Available	PB(7)	UART	PC(7)	Available

#### 9.4 IMPORT EXTERNAL CROSSPOINT CONNECTION

For customers who have developed their own module, The RFast System offers the possibility to change the Crosspoint connection in order to simplify the connection between the RF module and the processor board.

The FPGA used in the RFast System is from Lattice Semiconductor, the ISPGDX160VA. Click on the following address to access to the datasheet:

<http://www.latticesemi.com/lit/docs/datasheets/gdx/ispgdx.pdf>

Free software is available from Lattice Semiconductor to develop the FPGA source code. Click on the following address to download the software:

<http://www.latticesemi.com/account/download.cfm?AMID=295>

#### To import the FGPA source code (with a *.jed* extension):

For this you need to use the User Application menu, the file needs to have a *.dld* extension (Lattice extension).

- With the Lattice software develop your crosspoint file with a *.jed* extension
- Create or edit the *dld* file with an editor as WordPad, a use the name of the new crosspoint file.
  - Example: GDX160V PV Name of your file.jed

For more information about the FPGA, please refer to the Appendix A.6 and A.7

#### 9.5 MICROCONTROLLER PORT (ANALOG CHAIN)

The microcontroller XE88LC05 placed on the mini processor board has two converters, analog and digital. The user has access to these converters through the microcontroller Port Connector. For more information about converters, please refer to Appendix A.8.

## 10 APPLICATION EXAMPLES

### 10.1 INTRODUCTION

The RFast system provides some application examples. This chapter explains how to use these examples.

### 10.2 HIGHLIGHTS

The items discussed in this chapter include:

- XE1202 - XE1203>Ping-Pong Demo
- XE1202>Wireless Xmodem

### 10.3 REVIEWING THE HARDWARE

The hardware setup for this tutorial is listed below:

- PC Serial Port: Bi-directional mode
- RFast Kit with mini processor board
- Target: XM1202 / XM1203
- XE1202SK / XE1203SK Board

### 10.4 XE1202–XE1203>PING PONG DEMO

The first one, embedded in RFast, is a ping pong demo. This application has been developed for the XE1202SK / XE1203SK, the second XE1200 Development Tool. The Starter Kit microcontroller's source code has been re-used in RFast and so both are compatible. In other words, a Ping Pong demo can be set up between two GIBs or between a GIB and a SK.

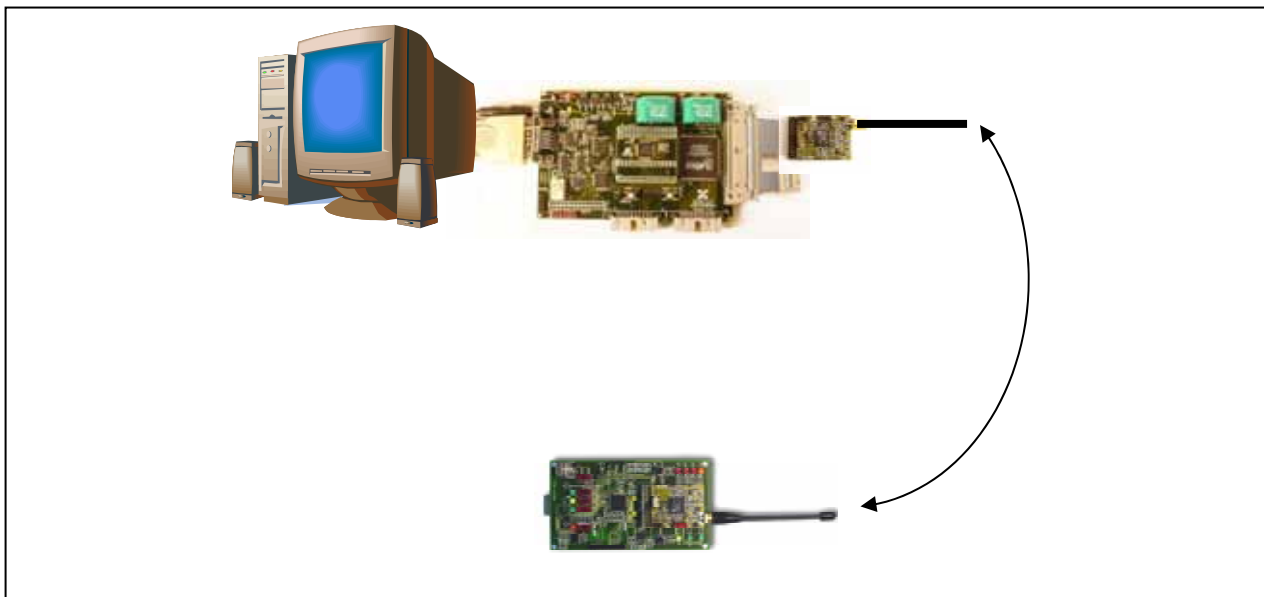


Figure 8.1: Ping Pong Demo Overview

Open the application example dialog (*Application Example>XE1202>Ping Pong Demo*) or (*Application Example>XE1203>Ping Pong Demo*) to set up the RFast processor board.

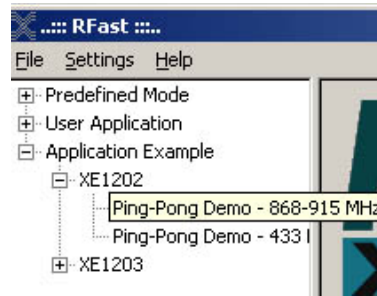



Figure 8.2



Set-up the system by clicking on each option box as described below

#### 10.4.1 Setting up the Ping Pong Demo

Before running the Ping Pong Demo application, the GIB needs to be programmed.

Click on *XE88LC05 Download* and verify that the Checksum is correct.

Click on *FPGA Download* and verify that all the steps have been marked 

The Board Status window displays the result of the GIB's configuration. Verify that 1202sk.axe / 1203sk.axe has been marked  and also FPGA\_1202SK.dld / FPGA\_1203SK.dld has been marked .

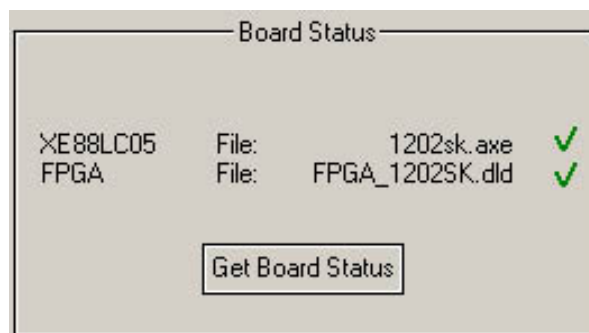


Figure 8.3

#### 10.4.2 Run the Ping Pong Demo

To run this application example click on **Next**, to connect the RS232 to the mini processor board. After that a communication can be established between the RF module and RFast software.

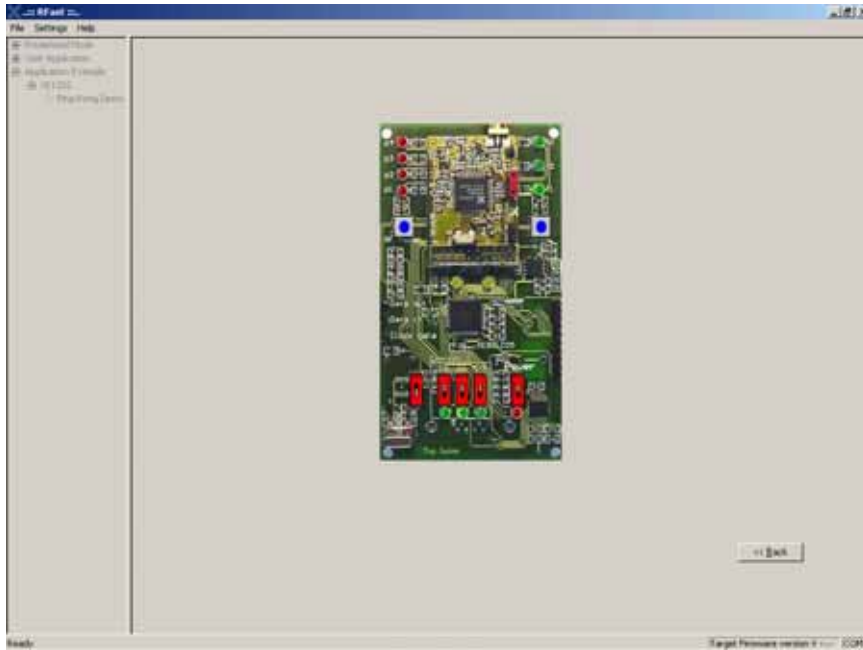
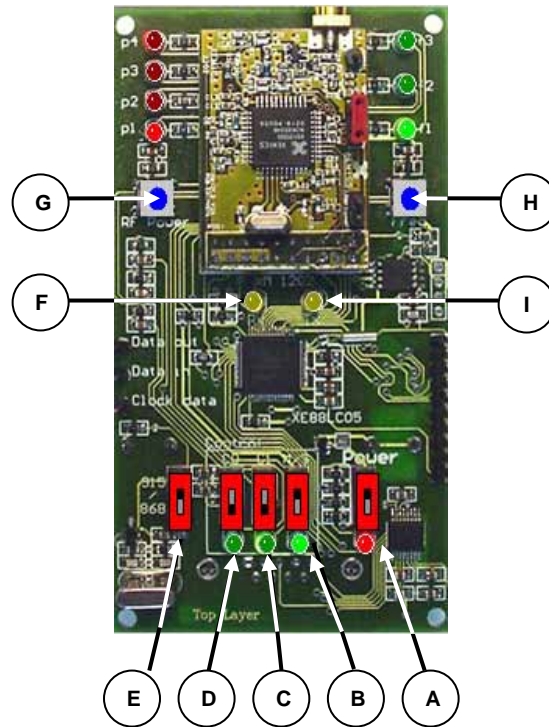


Figure 8.4

### 10.4.3 Start the Ping Pong Demo

The RFast software now emulates a XE1202SK / XE1203SK board (Figure 8.5), for more information on the Starter Kit please refer to **XE1202SK User's Guide / XE1203SK User's Guide**.



**Figure 8.5**

Brief narrative of LEDs and push buttons

- |          |                            |  |
|----------|----------------------------|--|
| <b>A</b> | <i>Power</i>               | : Switch on or switch off the power supply                                 |
| <b>B</b> | <i>M/S</i>                 | : Switch button to select between Master and Slaves                        |
| <b>C</b> | <i>AFC</i>                 | : Switch to launch the Automatic Frequency Control                         |
| <b>D</b> | <i>Manual/Auto</i>         | : Switch to select the operating mode (Manual or Automatic)                |
| <b>E</b> | <i>Frequency band</i>      | : Switch to select the frequency band according to the SEMTECH Module band |
| <b>G</b> | <i>RF power Selection</i>  | : Push button used to select the desired output power value                |
| <b>H</b> | <i>Frequency Selection</i> | : Push button used to select a frequency with the manual mode              |
| <b>F</b> | <i>Rx LED</i>              | : LED which indicates that a message has been received correctly           |
| <b>I</b> | <i>Tx LED</i>              | : LED which indicates the RF transmission                                  |

### Follow these steps to achieve a Ping Pong Demo

1/ Switch on the “virtual power supply”: Click on **A** Button, the red LED will light up.

2/ Band Selection: Click on **E** button to change the band according to your RF module.

- Down position = 868MHz / 433MHz
- Up position = 915MHz

3/ Master / Slave selection accordingly with your Starter Kit board

- Click on **B** button to select the board as Master, the green LED will light up
- The green LED is off in slave mode

4/ Automatic Frequency Control

If there are some communication problems or if the range is not enough, the user must start the Automatic Frequency Control (FEI function of the XE1202 / XE1203) in order to automatically trim the frequencies

On the Master and slave boards *at the same time*:

- 1 - Switch on **C** button (up position, the green LED switches On).
- 2 - p4 LED is turned On
- 4 - Wait around 1 second
- 5 - Switch off **C** button (down position).

#### 10.4.4 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 communication reliably.

The XE1202 Ping Pong Test has been set with the following features:

- Mode B = Linearity
- Data rate = 4.8kbps
- Frequency deviation = 20KHz
- Filter Bandwidth = 40Khz
- ID Frame = 4 bytes
- Message Length = 2 bytes (0x20h – 0x00h: Ping ; 0x31h – 0x00h: Pong)

The XE1203 Ping Pong Test has been set with the following features:

- Data rate = 4.8kbps
- Frequency deviation = 40KHz
- Filter Bandwidth = 200Khz
- ID Frame = 4 bytes
- Message Length = 2 bytes (0x20h – 0x00h: Ping ; 0x31h – 0x00h: Pong)

#### 10.4.5 Back function

To go back to main menu, the *Back* button needs to be activated. For that switch off the virtual starter Kit board by clicking on **A** button. Automatically the *Back* button will be accessible.

### 10.5 XE1202 > WIRELESS XMODEM

The second application example is a file transfer from a PC to another one by using the Xmodem protocol. This application example is an extension of the Ping Pong Demo and uses the same RF protocol. In this condition two files have been added in the XE1202SK project folder, *Xmodem.c* and *Xmodem.h*. This application runs on two GIBs boards.

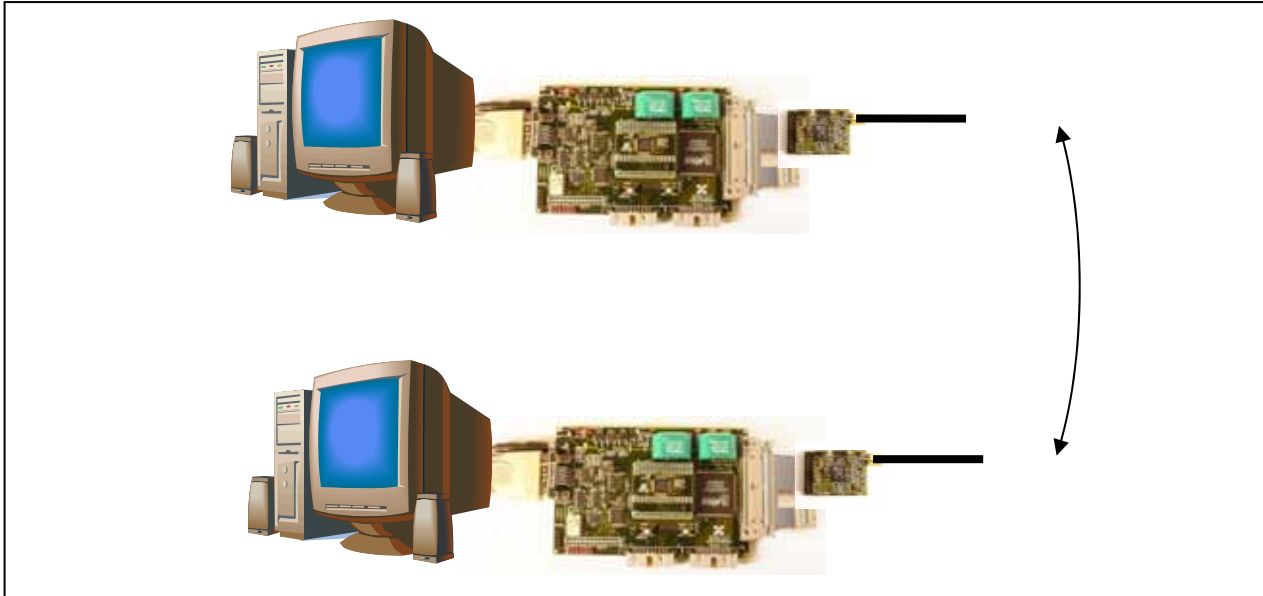


Figure 8.6: Wireless Xmodem Overview

As the Xmodem protocol is installed on all the Windows PC, no graphic interface has been implemented for this example. Open the User Application dialog ( *User Application>GIB Control*) to set up the RFast processor board.



Figure 8.7

Set-up the system by clicking on each option box as described below

### 10.5.1 Setting up the Wireless Xmodem

Before running the Wireless Xmodem application, the GIB needs to be programmed.

Click on XE88LC05 Browse and select *1202sk.axe* following by Download. When the programming sequence is done, verify that the Checksum is correct.

Click on FPGA Browse and select *FPGA\_1202SK.dld* following by Download. When the programming sequence is done, verify that all the steps have been marked

The Board Status window displays the result of the GIB's configuration. Verify that *1202sk.axe* has been marked  and also *FPGA\_1202SK.dld* has been marked .

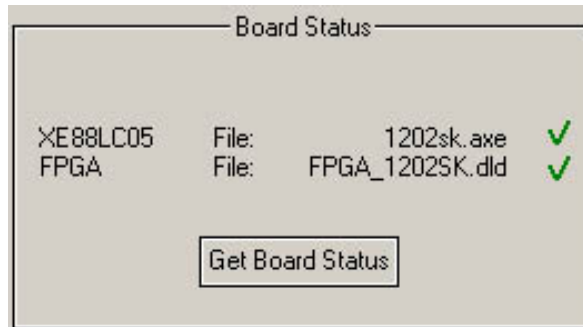


Figure 8.8

### 10.5.2 Run the Xmodem application

To run this application example click on **Next**, to connect the RS232 to the mini processor board. The Xmodem application confirms the RS232 connection, the following window appears (Figure 8.9).



Figure 8.9

### 10.5.3 HyperTerminal set-up

The Xmodem is a protocol available on each Windows platform. To open the HyperTerminal session from windows, click on: Start>Programs>Accessories>Communications>HyperTerminal.exe

**Warning**

Select the same communication port as defined for the GIB (Com 1 by default).

#### Communication properties:

Configure the *Com properties* windows with the following parameters and click on *OK*.

- Bits per second : 57600
- Data bits : 8
- Parity : None
- Stop bits : 1
- Flow control : None

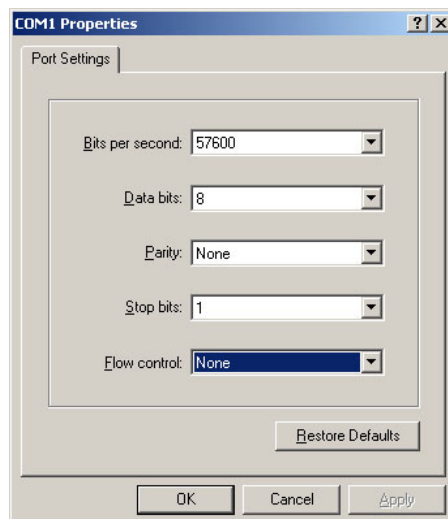


Figure 8.10

### Master / Slave Selection

After the *Com Settings* configured, the GIB board starts to receive data "O". Before transferring a file, a master (the sender) and a slave (the receiver) need to be defined.

- Type "B" + "B": to configure the board as master.
- Type "B" + "b": to configure the board as receiver.

### In Master mode

Every 3 seconds the PC receives a "C" from the GIB, the board is ready to send a file. Select the file by clicking on menu bar: Transfer>Send a file and select your file by clicking on the Browse button.

**Warning**

Verify that the Xmodem protocol has been selected (the Zmodem is selected by default).

### In Slave mode

To receive a file, select from the menu bar: Transfer>Receive a file, verify that the Xmodem protocol has been selected.

#### 10.5.4 Transfer file

The file transfer starts automatically after the set up of the master and slave boards. The Xmodem file window display information regarding the communication.

When the transfer is finished the two GIBs are ready to start another File Transfer.

## 11 TROUBLESHOOTING

### 11.1 INTRODUCTION

This section describes some common problems associated with running RFast systems and steps to follow to solve those problems.

### 11.2 HIGHLIGHTS

This section discusses the following:

- Communications cannot be established with the processor board
- Communications cannot be established with the RF Module
- RF driver can not be loaded into the microcontroller

### 11.3 COMMON PROBLEMS

#### Communication cannot be established with the processor board

*Check the serial port*

- Verify that the LED *RS232 Indicator* is on (see Appendix A.3 and A.10).
- Verify that the Processor board is connected to the selected serial port

*Check processor board power*

- Verify that the LED Power indicator is on (see Appendix A.3 and A.10)
- If the system is battery operated, verify that the voltage is 3.6V.

#### Communication cannot be established with the RF Module

*Check the RF Module connector*

- Verify that the cable is well connected to the Processor board and to the RF Module

*Check the power supply of the kit*

- Verify the power supply voltage is enough to power the RF Module.

#### RF driver can not be loaded into the microcontroller: Checksum Error

*Check the microcontroller*

- Verify that the mini processor board is well connected to the processor board
- If you have programmed the microcontroller more than 10 times, replace the mini processor board with the second mini processor board included in this kit.

## 12 APPENDIX A. RFAST ELECTRICAL SPECIFICATION

### 12.1 A.1 INTRODUCTION

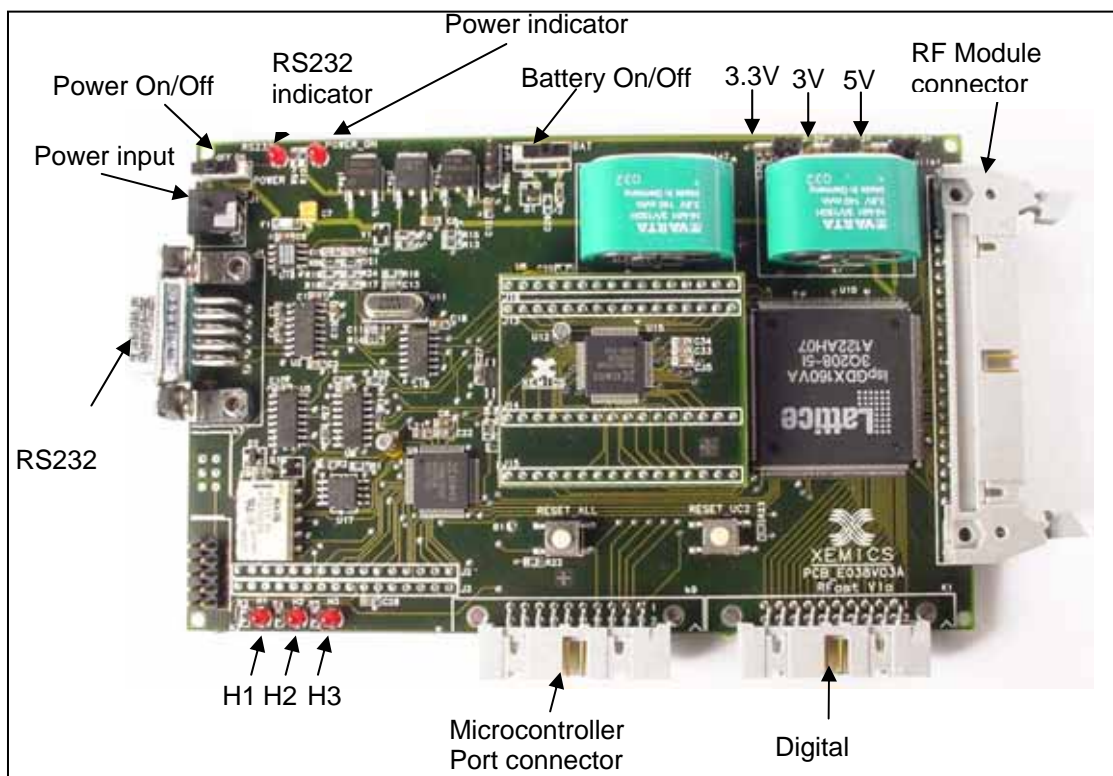
This section describes the hardware electrical specifications of the RFast board. Refer to the datasheets and Application notes for information on RF modules.

### 12.2 A.2 HIGHLIGHTS

This appendix address the following electrical specifications of the RFast systems

- Connectors and lights overview
- Power
- Power output
- RF Module connector
- Digital connector
- microcontroller port connector
- Indicator Lights
- Batteries

### 12.3 A.3 CONNECTOR AND LIGHTS OVERVIEW



**Figure A.1: RFast board**

### 12.4 A.4 POWER

Power to the RFast system is supplied by an external +12V power supply included with the system. The input is located on the back of the processor board, as indicated in Figure A.1. The power On/Off is also located on the back of the processor board.

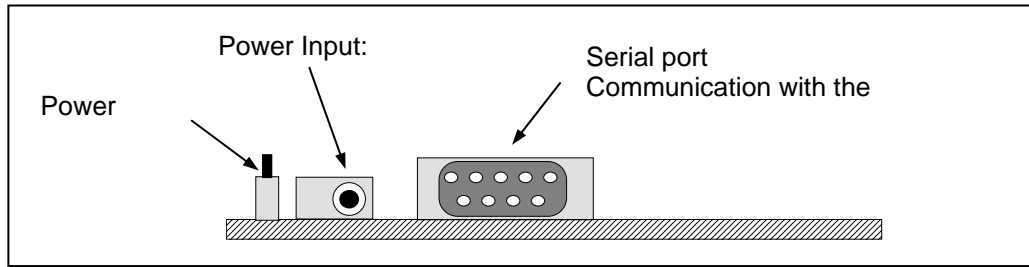


Figure A.2: RFast back panel

### 12.5 A.5 POWER OUTPUTS

Three output powers are available from the RFast processor board. These outputs can be used to power the RF Module or another board.

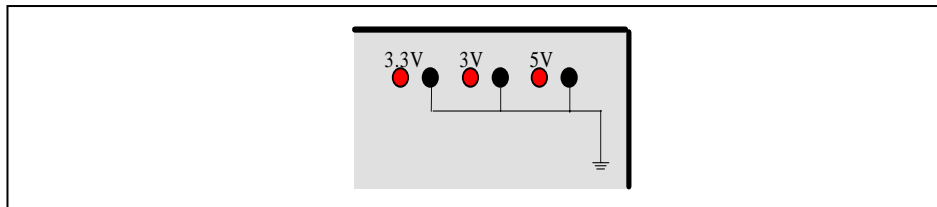


Figure A.3: Power Outputs

### 12.6 A.5 RF MODULE CONNECTOR

To obtain the maximum output power (15dBm) the XM1202 and the XM1203 need to be supply externally. The FPGA can not deliver enough current to the RF Module. Different solutions are possible depending on the module

- With a SEMTECH Evaluation module, for the XM1202 remove the jumper and use the two external pins GND and VDD1 (Left side of the RF module). For the XM1203, use the pin 1 and 2 of the down connector.
- With a LSR Module, use the pin 1 and 2 of the down connector (the module is connected on the GIB via the up connector)
- With the RFC module, remove the jumper and connect the VDD to the external pin.

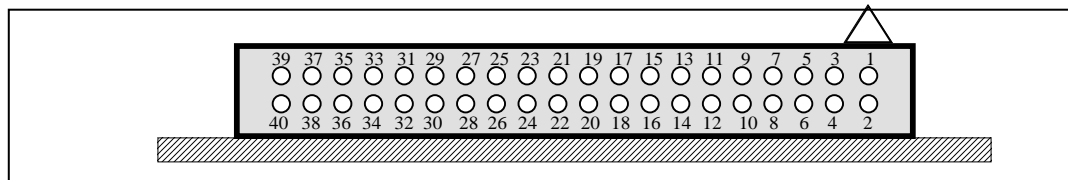
**12.7 A.6 FPGA – RF MODULE CONNECTOR**

Information about the RF Module connector is listed below in table A.1. This table is very useful if you want to program another Crosspoint connection into the FPGA.

**Table A1: RF Module connector**

Pin number	FGPA I/Os	Pin number	FGPA I/Os	Pin number	FGPA I/Os	Pin number	FGPA I/Os
1	A39	11	A29	21	A19	31	A9
2	A38	12	A28	22	A18	32	A8
3	A37	13	A27	23	A17	33	A7
4	A36	14	A26	24	A16	34	A5
5	A35	15	A25	25	A15	35	A4
6	A34	16	A24	26	A14	36	A3
7	A33	17	A23	27	A13	37	A2
8	A32	18	A22	28	A12	38	A1
9	A31	19	A21	29	A11	39	A0
10	A30	20	A20	30	A10	40	NC

Note the FPGA I/O A6 is not connected to the RF Module connector and the pin #40 is not used.



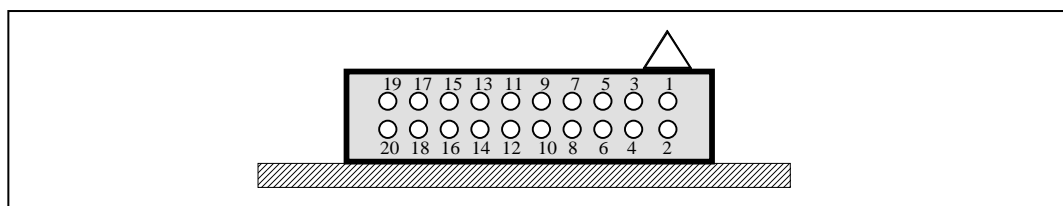
**Figure A.4: RF Module connector, Front view**

**12.8 A.7 DIGITAL CONNECTOR**

Information about the digital connector is listed below in table A.2. This connector can be used as logic probes connector to visualize signals from/to the RF Module.

**Table A2: RF Module connector**

Pin number	FGPA I/Os	Pin number	FGPA I/Os
1	D38	2	D39
3	D36	4	D37
5	D34	6	D35
7	D32	8	D33
9	D30	10	D31
11	D28	12	D29
13	D26	14	D27
15	D24	16	D25
17	D22	18	D23
19	D20	20	D21



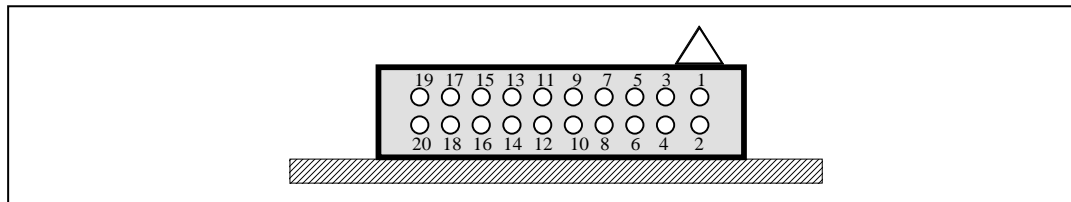
**Figure A.5: Digital connector, Front view**

**12.9 A.8 ANALOG PORT CONNECTOR**

The microcontroller XE88LC05 has two converters, analog and digital. For a higher flexibility, RFast allows the user to access to these converters via a dedicated connector. Information is listed in the table A.3

**Table A3: Analog Microcontroller Port**

Pin number	Analog Pin name	Analog Pin number	Pin number	Analog Pin name	Analog Pin number
1	DAB_AI_m	31	2	DAB_AO_m	29
3	DAB_AO_p	28	4	Ground	NC
5	DAB_R_m	26	6	DAB_out	27
7	DAB_R_p	25	8	DAB_AI_p	30
9	AC_R(1)	45	10	AC_R(0)	46
11	AC_A(1)	43	12	AC_A(0)	44
13	AC_A(3)	41	14	AC_A(2)	42
15	AC_A(5)	39	16	AC_A(4)	40
17	AC_A(7)	37	18	AC_A(6)	38
19	AC_R(3)	35	20	AC_R(2)	36



**Figure A.6: Analog connector, Front view**

**12.10 A.9 MICROCONTROLLER - FPGA**

Information about the digital microcontroller ports connected to FPGA is listed below (Table A4).

**Table A4: Microcontroller – FPGA**

uC Pin number	Pin name	FPGA I/Os	uC Pin number	Pin name	FPGA I/Os	uC Pin number	Pin name	FPGA I/Os
1	PA(0)	NC	17	PB(0)	C15	9	PC(0)	C7
2	PA(1)	NC	18	PB(1)	C16	10	PC(1)	C8
3	PA(2)	NC	19	PB(2)	C17	11	PC(2)	C9
4	PA(3)	C2	20	PB(3)	C18	12	PC(3)	C10
5	PA(4)	C3	21	PB(4)	C19	13	PC(4)	C11
6	PA(5)	C4	22	PB(5)	C20	14	PC(5)	C12
7	PA(6)	C5	23	PB(6)	NC	15	PC(6)	C13
8	PA(7)	C6	24	PB(7)	NC	16	PC(7)	C14

### 12.11 A.10 INDICATORS LIGHTS

Information about indicator lights is given below.

#### Power LED

LED	Condition
On	System is sufficiently powered
Off	No or low power condition

This LED is located on the front panel of the board and is lit when the system is sufficiently powered.

The system may be reset from a fault by turning off the RFast system and then turning it back on. If non-working condition persists, please contact SEMTECH support.

#### RS232 LED

LED	Condition
On	RS232 cable is inserted correctly.
Off	RS232 cable not inserted correctly or completely

This LED will turn on when the RS232 cable is correctly inserted. If this LED stays off, remove and reinsert the cable.

#### H1 LED

LED	Condition
On	The RF Module driver is up loading into the microcontroller.
Off	no up load into the microcontroller.

#### H2 LED

The LED H2 is connected to the pin D15 of the FPGA.

LED	Condition
On	D15 = VDD
Off	D15 = 0V

The LED can be used to visualize the operating mode of the FPGA (transmit or receive)

#### H2 LED

The LED H2 is connected to the pin D16 of the FPGA.

LED	Condition
On	D16 = VDD
Off	D16 = 0V

### 12.12 A.11 BATTERIES SWITCH

RFast has two rechargeable 3.6V / 140mA batteries on board. Information about the batteries is given below:

Switch	Description
On	The board is powered by the batteries, the 12V power supply can be removed
Off	The batteries are charging, do not disconnect the 12V power supply.

## 13 APPENDIX B. RFAST SOFTWARE ROUTINES

### 13.1 B.1 INTRODUCTION

This section describes the some software routines used with RFast. Refer to the datasheets and Application notes for information on RF transceivers and RF modules.

### 13.2 B.2 HIGHLIGHTS

This appendix address the following electrical specifications of the RFast systems

- Source Code Localisation
- XE1202 Frequency Error Indicator Implementation.

### 13.3 B.3 SOURCE CODE LOCALISATION

The source code driver of each slave (XE1201, XE1202 and XE1209) is embedded in RFast software but not visible with the typical installation. To have access to the files, install RFast with the custom option. After the installation, select the following folder C:\Program Files\SEMTECH\RFast\code\_examples (by default). Inside the code\_example folder there are three sub-folders with all the source code necessary to drive the SEMTECH RF transceiver (Figure B.1).

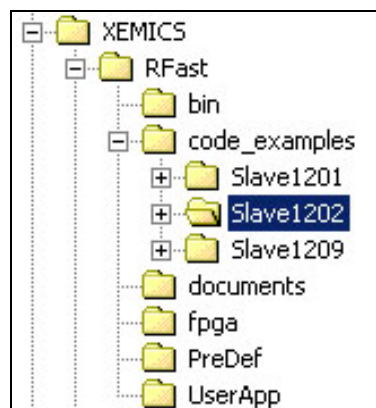
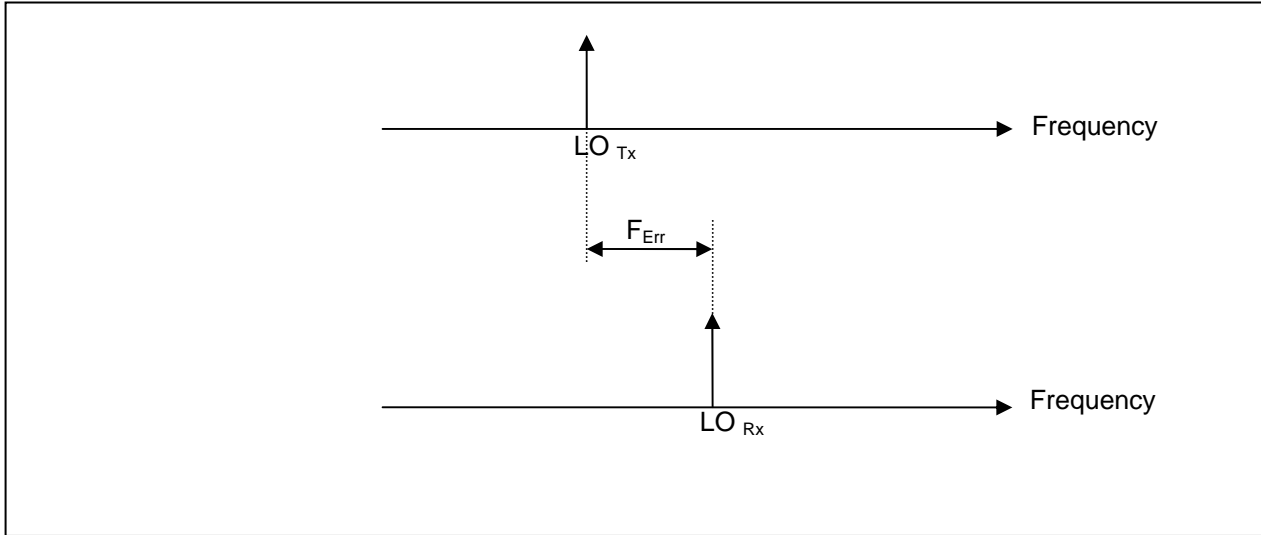


Figure B.1: Files localisation

Most of this source code can be opened with a simple editor like Windows Pad or with a C editor. In addition each file is documented.

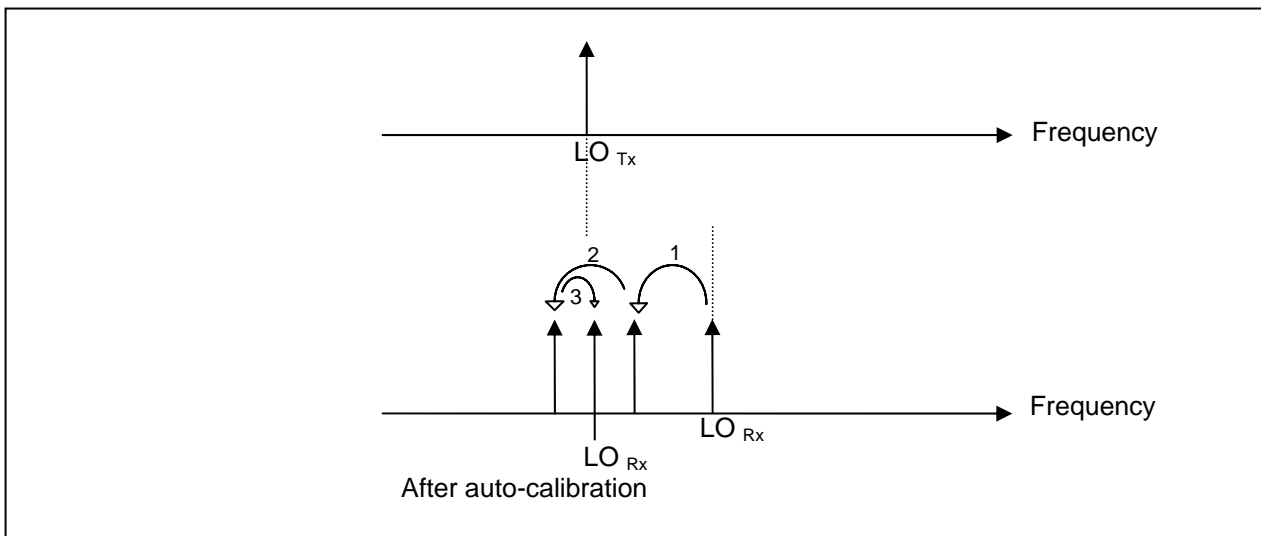
**13.4 B.4 XE1202 FREQUENCY ERROR INDICATOR IMPLEMENTATION**

The XE1202 offers the advantage of giving the information about the difference between the Local Oscillator of the receiver and the Local Oscillator of the transmitter (Figure B.2).



**Figure B.2:**

The **Lock LO Freq** or Automatic Frequency Control consists of an auto frequency calibration, the receiver Local Oscillator adjusts itself on the transmitter Local Oscillator. A software routine has been implemented in the XE88LC05 to calibrate the Local Oscillator. Different solutions can be defined, one of them is the dichotomy process (Figure B.3). The source code of the FEI calibration can be found in *XE1202Driver.c*.



**Figure B.3:**

**FEI Processing**

To launch the FEI and to have a coherent result, the transmitter needs to send a preamble. The receiver will calculate the error based on this RF input signal. In addition, the range of the FEI is between -20kHz and +20kHz around the LO (See example Table B.1).

Bandwidth (kHz)	40		
Deviation (kHz)	20		
Data Rate(kbps)	4.8	9.6	19.2
FEI Range			
High Limit	20	20	20
10	2.8	5.2	6.2
Not defined	2.1	4.4	5.1
0			
Not defined	-1.9	-3.8	-4.5
11	-2.7	-4.6	-5.3
Low Limit	-20	-20	-20

**Table B.1:**

To use the dichotomy process, steps need to be defined; in this example only two steps will be used.

- Step 1 = +/- 5kHz
- Step 2 = +/- 2.5kHz

According to the specification of the FEI and to the step definition, the auto-calibration flowchart is the following (Figure B.4).

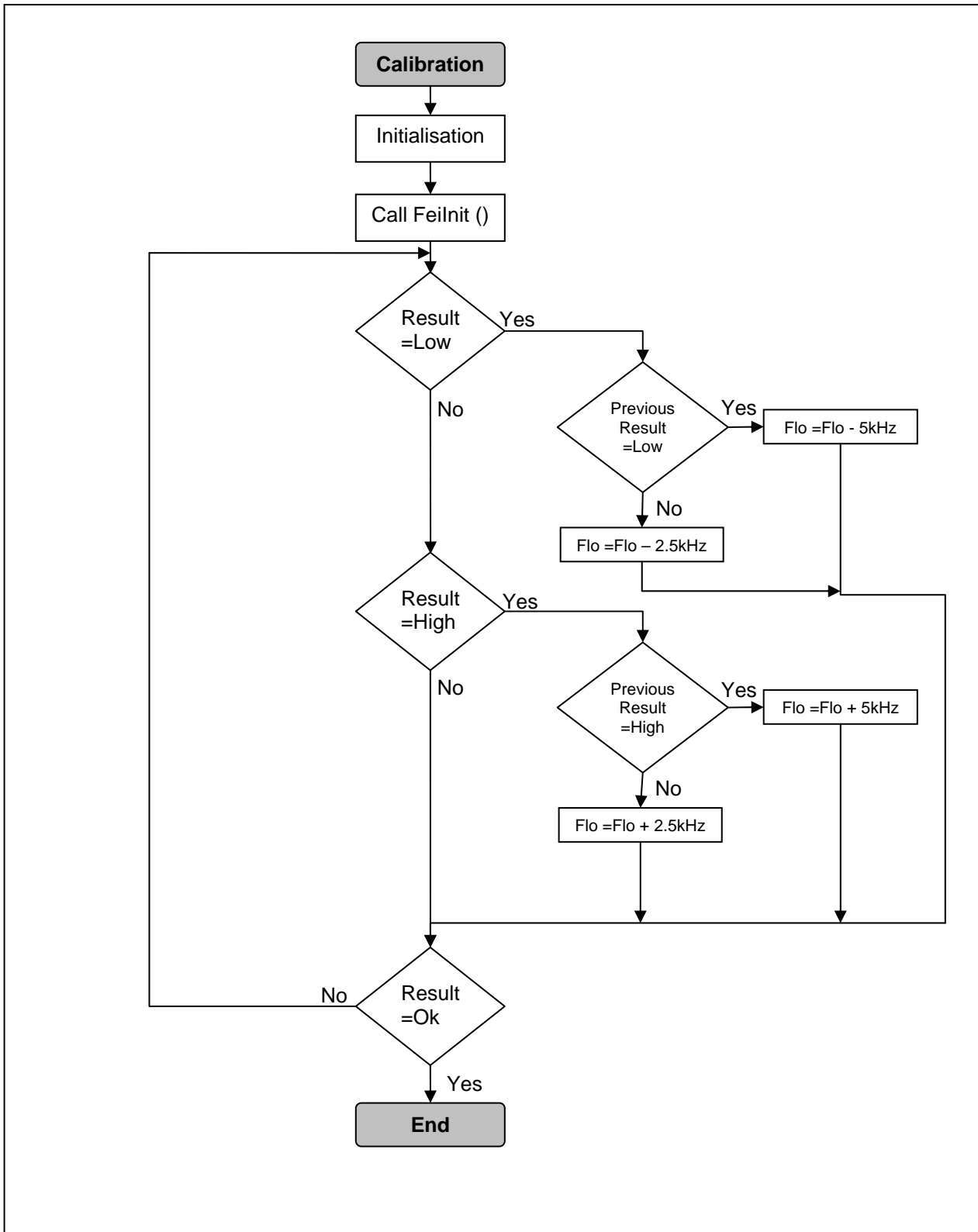


Figure B.4: FEI Calibration Flowchart

## 14 GLOSSARY

### 14.1 INTRODUCTION

To provide a common frame of reference, this glossary defines the terms for several SEMTECH tools.

### 14.2 HIGHLIGHTS

This glossary contains terms and definition for the following tools:

- RFast Systems
- RF Module

### 14.3 TERMS

Prefix	Meanings	Value
n	Nano	$10^{-9}$
μ	Micro-	$10^{-6}$
m	Mili-	$10^{-3}$

#### A7

#### A/D

Analog / Digital

#### AFC

Automatic Frequency Control

#### Application

A set of software and hardware developed by the user.

#### ASCII

American Standard Code for Information Interchange

#### Assembler

A language tool that translate a user's assembly source code (.asm) into machine code.

#### B

#### Block diagram

Pictorial description or representation of a program or algorithm

#### BER

Bit Error Rate

## C

### **Compile**

Process that converts high-level code to machine -executable code.

### **Continuous run**

Execution mode which a trace is sent repeatedly until the user stops it. This function is enabled by clicking the **Continuous run** button

## D

### **DAQ**

See data acquisition

### **Data Acquisition**

DAQ. Process of acquiring data, typically from A/D or digital inputs.

### **DBc/Hz**

DB with respect to carrier level per hertz

### **DDS**

Direct digital Synthesizer

## E

### **EMC**

Electromagnetic compatibility

### **ETSI**

European Telecommunication Standard Institute

## F

### **FCC**

Federal Communication Commission

### **FDMA**

Frequency Division Multiple Access

### **FSK**

Frequency Shift Keying

## H

### **Hex**

Hexadecimal. Base-16 number system.

### **Hz**

Hertz. Cycles per second

## I

### **I and Q**

In phase and quadrature phase

### **I/O**

Input/output. Transfer of data to or from device interfaces.

### **IF**

Intermediate Frequency

### **IC**

Integrated circuit

### **Indicator**

Front panel object that displays output.

### **ISM**

Industrial, scientific and medical

## L

### **LNA**

Low Noise Amplifier

### **LO**

Local Oscillator

## M

### **Menu Bar**

Horizontal bar that lists the names of the main menus of an application. The menu bar appears below the title "**RFast**".

## N

### **NF**

Noise figure

## P

### **PLL**

Phase Lock Loop

## R

### **RF**

Radio Frequency

## S

### **SAW**

Surface Acoustic Wave

**T**

**TDMA**

Time division multiple access

**V**

**VCO**

Voltage Control Oscillator

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