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LMS7002EVB Quick Start Manual

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1

Introduction

The Lime Development System is a comprehensive hardware and software combination that allows users to evolve and refine a wireless sub-system. It can be combined with a baseband processor such as an FPGA or DSP processor to develop a comprehensive wireless solution.

The EVB7 module is a high-speed wireless communication module, based on the LMS7002M fully programmable RF transceiver. It is designed to support 2G, 3G, 4G/LTE radio systems with both time-division duplex (TDD) and frequency-division duplex (FDD) applications, M2M and software defined radios. The wireless communication module covers the frequency range of 100 kHz to 3.8 GHz, including licensed and unlicensed bands. The channel bandwidth is programmable from less than 100 kHz to 108 MHz through a combination of analog and digital filtering via the easy-to-use GUI software.

The EVB7 provides system designers with the ability to connect the board to any type of baseband, FPGA or CPU and allow them to implement their ideas for various wireless communication applications.

This document describes how to make a quick start with the LMS7002M using the EVB7 module. Section 2 begins by listing the contents of the Quick Start kit. Section 3 gives a general description of the evaluation board features. Section 4 describes the procedure for obtaining and installing the LMS7002M control software “Control LMS7002M” for both Windows and Linux platforms. Section 5 describes how to connect and use the EVB and LMS7002M control software “Control LMS7002M” for the Quick Start example configurations. Section 6 describes in detail the EVB connectors and hardware options. Section 7 describes in detail how to use the LMS7002M control software “Control LMS7002M”. Section 8.1 describes calibration procedures. Appendix 1 details the recommended test and measurement equipment, and how to set up the test equipment to work with EVB7 and the LMS7002M.

2

Development System Content

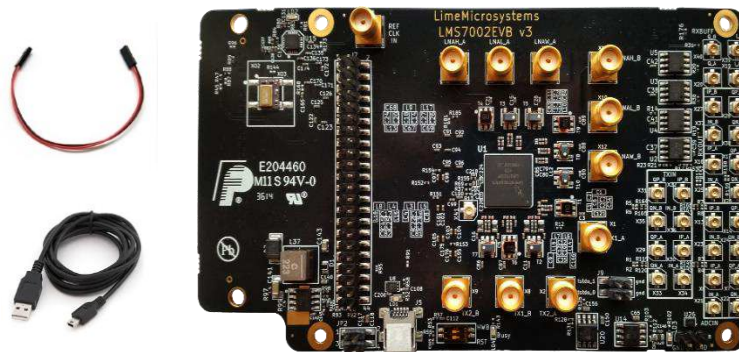


Figure 1 Development System Content

Complete development kit content consists of:

- Hardware
 - 1 – LMS7002EVB v3 board
 - 1 - Power supply cable that connects the EVB7 board to any lab power supply unit
 - 1 - USB-A to Micro-USB-B cable
 - USB stick with software
- Software:
 - LMS7002M GUI “Control_LMS7002M”
 - Windows drivers
- Documentation:
 - Quick Starter Manual
 - LMS7002M datasheet
 - Complete PCB database
 - Register map document
 - Generator waveforms

3

Overview of the Development Board

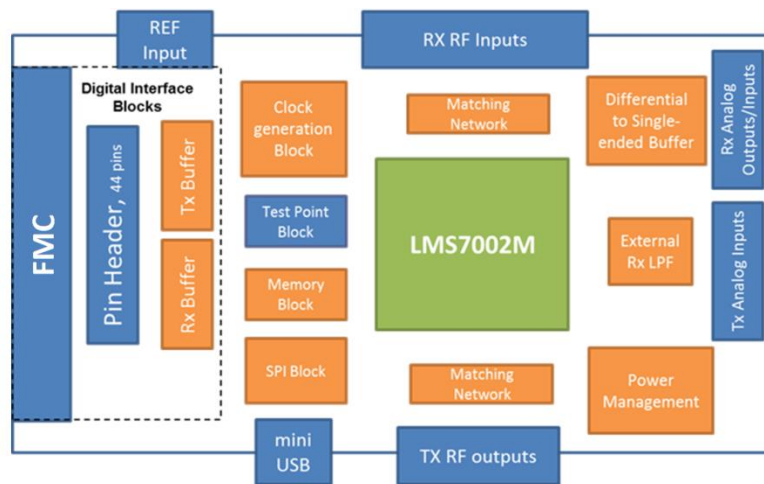


Figure 2 Board block diagram

A photograph of the development board is shown in *Figure 1*. A block diagram of the board is shown in *Figure 2*. The connections are shown in blue, the LMS7002M chip is shown in green, and the other parts are shown in orange. The core of the board is the LMS7002M transceiver chip, which has multiple RF, analogue and digital interfaces.

The evaluation board includes RF matching networks for the LMS7002M. These matching networks include wideband transformers to allow operation over the entire frequency range. However, the matching networks have been optimized for operation over selected frequency

bands and offer the best performance in these bands. Connectors are provided for 4 RF transmitter outputs and 6 RF receiver inputs. Further details of the matching networks are provided in section 6.3.5.

The evaluation board includes connectors for the baseband analogue differential receiver outputs and differential transmitter inputs. Additionally, on board high speed differential to single ended converters allow the EVB7 receivers to indirectly drive 50R test equipment such as spectrum analysers for baseband testing.

The evaluation board includes a clock generation block, which by default, is a standalone 30.72 MHz low phase noise TXCO. TXCOs at other frequencies can also be fitted and three different footprints are supported. The EVB7 can be easily modified to operate with external clock sources. It can also be synchronized to the standard 10 MHz reference of measurement equipment via an on board PLL. Details of the required changes on EVB7 are given in section 6.3.1 and 6.3.2.

EVB7 includes two kinds of digital I/O, one for control only, and two for data and control.

The USB interface is used to control the LMS7002M SPI via the LMS7002M control software. The USB port is converted to SPI by an on board microcontroller.

The FMC connector or the 44 pin header can be used for the buffered digital interface and can be connected to compatible platforms such as the Lime “Stream” board. The Lime “Stream” board also provides connections to general purpose lab equipment such as pattern generators and logic analysers. A pin list for the digital interface can be found in section 6.2. The logic level for the digital interface can be set by modifying EVB7 and is described in section 6.3.4. Additionally these connectors can be used to control the SPI but require the board modifications described in 6.3.3.

A 7th order LC filter can be selected between the analogue output of the LMS7002M and its digital inputs by using the LMS7002M control software. This allows additional filtering at 100 kHz (IF BW) for 2G applications.

The board includes memory to work with the LMS7002M internal microcontroller. This is intended to provide calibration support for the LMS7002M and is currently under development. The memory is programmed via the LMS7002M control software and the USB/SPI interface.

Test points are provided for various test signals including the LMS7002M internal peak and RSSI detectors as well as various PLL test signals.

More detailed information on the connectors for the evaluation board can be found in section 6.1. Information about PCB options supported is in section 6.3.

4

Installing the LMS7002M Control Software

4.1 Introduction to installing the software

To operate the EVB7 board, the LMS7002M Control Software, “LMS7002M Control” has to be downloaded from <http://www.limemicro.com> and installed. The software consists of three parts.

- The main LMS7002M control Software, which provides a GUI to control the chip.
- The USB driver “USB to LMS7002M”, which provides an interface between the PC and the EVB7 SPI microcontroller.
- The EVB7 microcontroller firmware, which is preinstalled on the board prior to shipping.

Section 4.1 describes the how to download the software from the Lime Microsystems web page.

Sections 4.2, 4.3 and 4.4 describe the set up for the Windows Operating System. Section 4.2 describes the installing of the “USB to LMS7002M” driver. Section 4.3 describes the Windows OS set up. Section 4.4 describes how to identify which USB port is being used.

Section 4.5 describes installing the USB driver in a typical Linux distribution. Section 4.6 describes how to start the “LMS7002M Control Software”.

Section 4.7 describes how to connect the EVB7 with the “LMS7002M Control Software” via the USB interface.

A simple demonstration of the “LMS7002M Control Software” is given in section 5. A detailed description of the “LMS7002M Control Software” is given in section 7.

4.2 Downloading the Software

To get started with the EVB7 board control software, download the latest version from www.limemicro.com.

4.3 Windows USB Setup

The steps to setup “Control LMS7002M” software are as follows (please note that these steps may vary based on the specific version of Windows software being used and you may need to be logged in as Administrator to accomplish them):

1. Connect EVB7 board to your PC via the USB cable.
2. Go to **Control Panel > System > Device Manager**
3. Locate **USB to LMS7002M** under **Other devices** and press right click to select **Properties** (*Figure 3*)

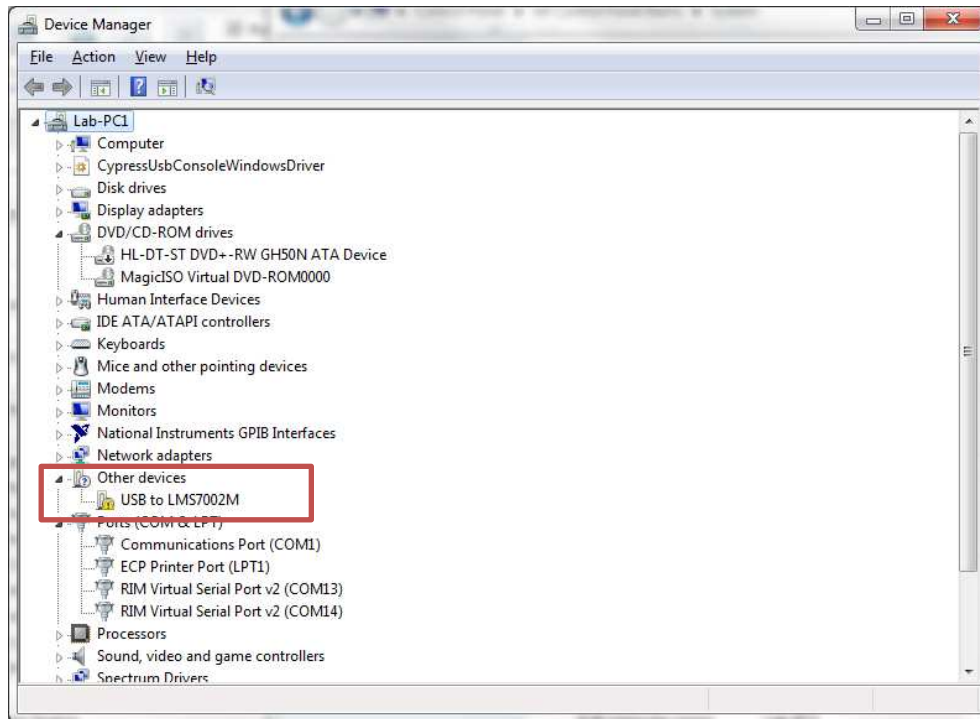


Figure 3 Device Manager content

4. When a new window pops-up press Update driver (*Figure 4*)



Figure 4 Device properties

5. Select **Browse my computer for driver software**, locate the driver provided with EVB7 board and press **Next** (Figure 5)

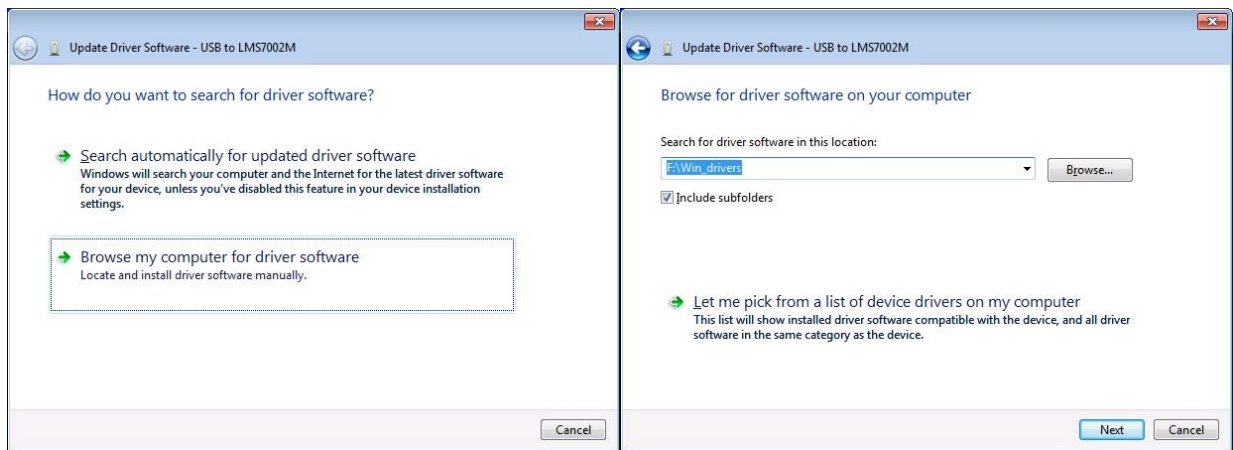


Figure 5 Update Driver Wizard.

6. If the **Windows Security** window appears, select **Install this driver software anyway** (Figure 6)



Figure 6 Hardware wizard. Install driver manually

Windows should proceed to install drivers at this stage. Generally, once the above steps have been taken for the EVB7, these steps do not need to be repeated.

IMPORTANT:

Before running the control software, unplug then plug your device back into your computer.

4.4 Determining Serial Port

After driver installation, Windows will assign to your EVB7 board a serial port. To check your board serial port number, please follow these steps:

1. Go to **Control Panel > System > Device Manager**
2. Locate **USB Virtual Serial Port** under **Ports (COM & LPT)**

Note that in this system example it has enumerated as COM2 (*Figure 7*).

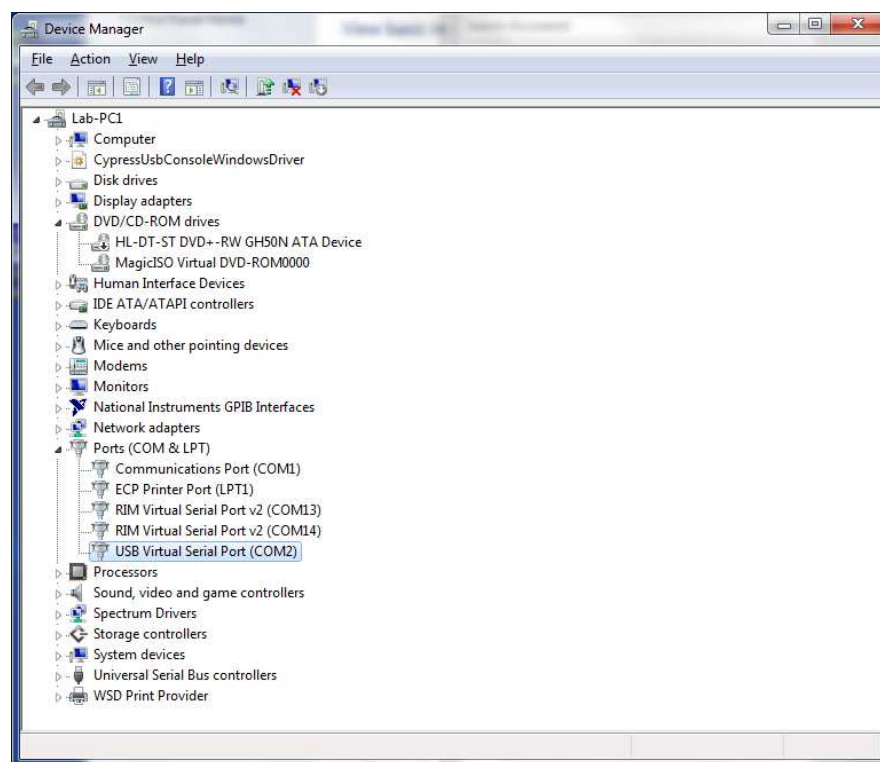


Figure 7 Check for new communication port

4.5 Linux Setup

For Linux users, there is no need to install USB drivers, as the system will assign drivers automatically once the EVB7 board is connected to PC.

To determine port number the easiest is via the command line and type command:

```
$ setserial -g /dev/ttyS[0123]
```

4.6 Starting Control LMS7002M Software

Apply +5V to the board and start “Control LMS7002M” software. The application must be run under administrator privileges. To do that, right click on the “Control LMS7002M” icon and select **Run as an Administrator**. This will provide administrator privileges, which are required for EVB7 board communication via USB.

4.7 Connecting

Once the Windows driver is installed and the control software has been launched, click on **Options>Connection Settings**. The **Connection Setting** windows will pop-up (*Figure 8*).

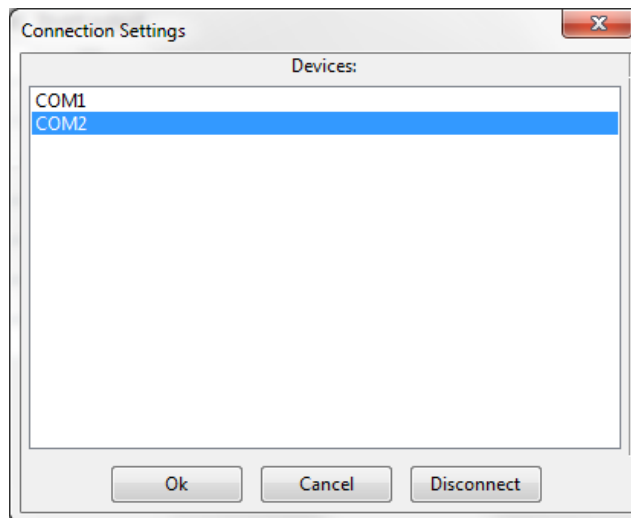


Figure 8 GUI communication settings.

Select the dedicated USB port number of the EVB board. In this case, it is COM2, and press OK.

The GUI device name and firmware version will appear in the bottom (*Figure 9*), once connection with the board is established.

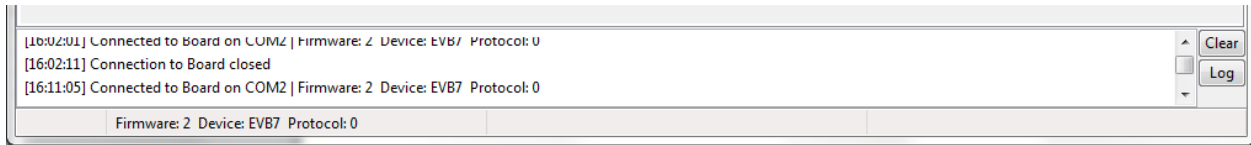


Figure 9 GUI detected device and firmware version

5

Getting started with the EVB

5.1 Introduction to using the EVB7

The EVB7 allows powerful demonstrations of the LMS7002M transceiver. In this quick start guide, we demonstrate the board operating with analogue inputs and outputs. The Lime “Stream” board is used to demonstrate the board operating with digital inputs and outputs.

Section 5.2 describes the set up of the transmitter, with section 5.2.1 describing how to set up the SXT (TX PLL) and section 5.2.2 describing how to set up the TX analogue baseband and RF tabs of the LMS7002M Control software. Section 5.4 describes the set up of the transceiver for basic tests, with section 5.4.1 describing how to set up the SXR (RX PLL) and section 5.4.2 and 5.4.3 describing how to set up the RX analogue baseband and RF tabs of the LMS7002M Control software.

The analogue quick start demonstration assumes the user has all the equipment listed in Appendix 8.2. Users with less equipment can use the set up of Section 5.6.

5.2 Transmitter Setup and Basic Testing

To test the Tx path, the Keysight (formerly Agilnet) MXG N5182A generator is used as an external baseband source. This is connected to the Tx path via the analog inputs and generates a WCDMA modulation signal at socket X1 (TX1_A) as shown in *Figure 10*. To generator settings are described in section 8.3 (Appendix A).

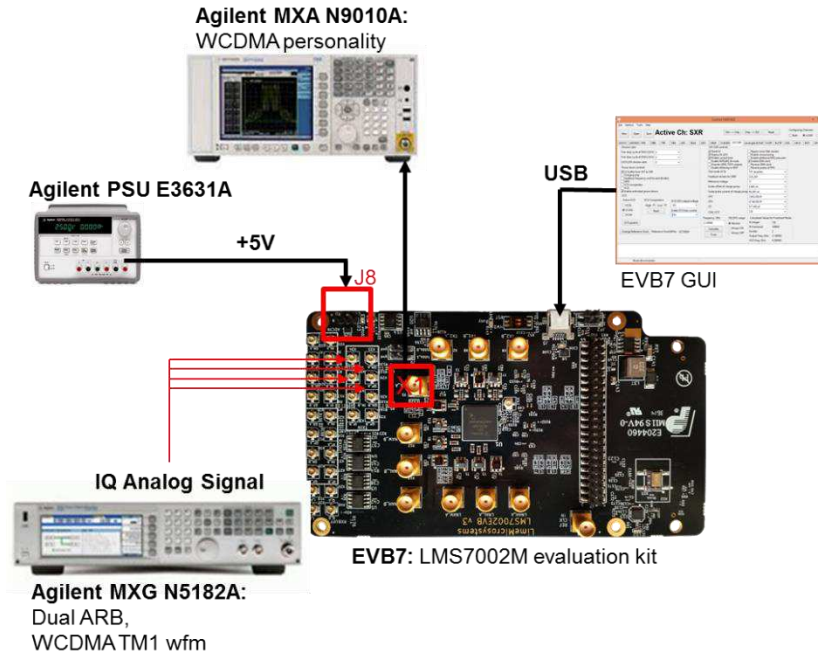


Figure 10 Tx Test Setup

5.2.1. SXT/SXR tab setup

After power up, connect the GUI to the board and select the **SXT/SXR** tab. To configure the Tx LO to 2140 MHz, do the following:

1. Select the **B/SXT** in the configuration channels window to control TxPLL
2. Enable Tx PLL **VCO** (Deselect).
3. Type the wanted frequency in **Frequency, GHz** box. In this case, 2140 MHz.
4. Press **Calculate** followed by **Tune**.

See *Figure 11* below to check selections.

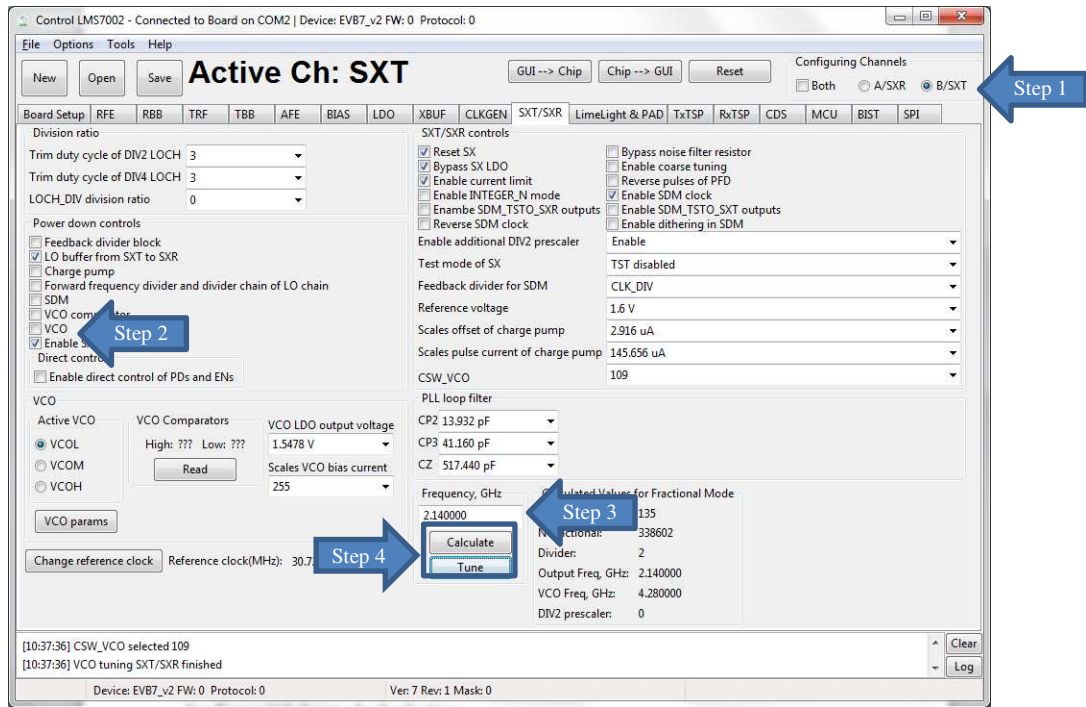


Figure 11 SXT register setup procedure

5.2.2. TRF tab setup

The TRF tab controls the TX RF gain and output path. By default the Tx RF gain is set to maximum (**TXPAD gain control** set to '0') and **TXFE output selection** set to **Band 1** (to X1 on EVB7 board) as the output path. For this test, we are not going to change these settings.

5.2.3. TBB tab setup

In the **TBB** tab the baseband gain and filter bandwidth are controlled. Follow the instructions below set up TBB:

1. Select the **A/SXR** to control channel A.
2. **Enabled Tx IQ analog input path to current amplifier.**
3. Set **Frontend gain** to your wanted.
4. Configure the base band filter settings. By default, high band filter (**LPFH_TBB**) is power on.

See *Figure 12* below to check selections.

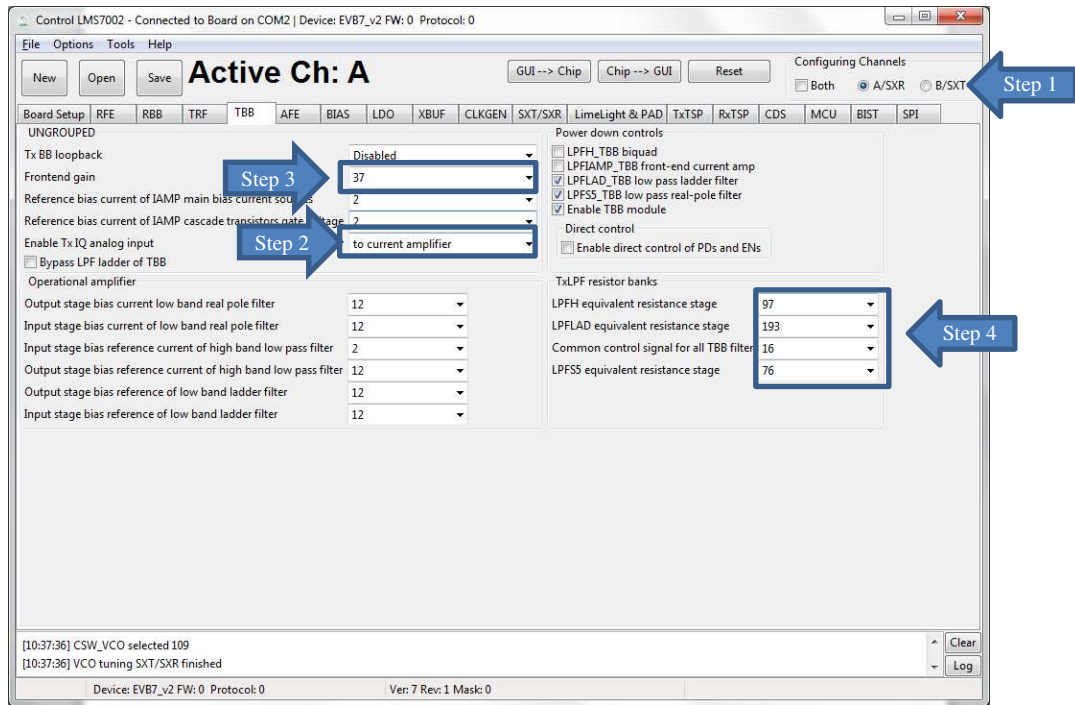


Figure 12 TBB register setup procedure

Note: the register preset file for Tx test ‘TX_2140_MHz_demo_setup.ini’ is supplied with design kit. You can load it by clicking menu button **Open**>> locate and select the file in `../LMS7GUI` folder/ ‘TX_2140_MHz_demo_setup.ini’ >> select **Open**, followed by **GUI--> Chip** button. The select **SXT/SXR** tab and retune synthesizer.

5.3 Testing the TX Output

When the transmitter is configured as shown in section 5.2, the TX1_A output (socket X1) can be connected to a spectrum analyzer (SA). With the SA you can now observe the results of this basic operational test (Figure 13). The test is looking at the DC offset from the un-programmed data DAC as LO leakage and the example shown below is measuring a value of -26.8dBm.

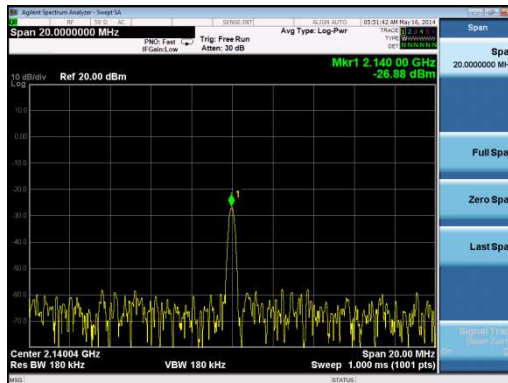


Figure 13 Basic TX testing using DC offset resulting in LO leakage

When the baseband is enabled, the WCDMA modulation can be tested and the results of *Figure 14* can be obtained with the MXG Spectrum Analyser.

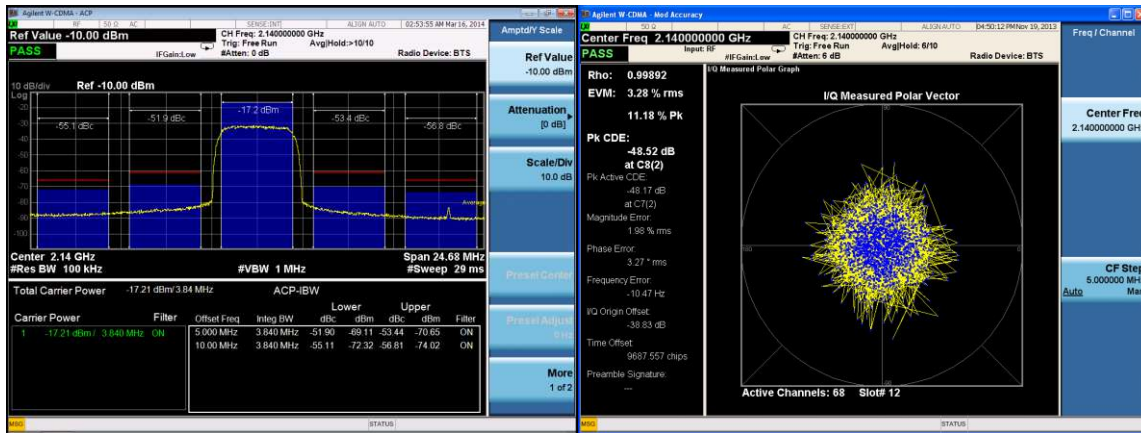


Figure 14 Basic TX testing using WCDMA modulation

5.3.1. TX Basic Operation Checks

To check the basic TX frequency and gain control, conduct some tests changing frequencies and gain settings. The following tests are recommended:

TRF – TXPAD gain change setting from 0 to 31 and observe results. LO should vary by approx. 1 dB steps, 31dB range.

Change frequency from 2.14 GHz to 2.11 GHz and press ‘Calculate’/’Tune’ (CAP value should change), check the Spectrum Analyzer.

Change frequency from 2.11 GHz to 2.17 GHz and press ‘Calculate’/’Tune’ (CAP value should change), check the Spectrum Analyzer.

5.4 Receiver Setup and Basic Testing

The test bench for the receiver is shown in *Figure 15*. Basic functionality checks on the receiver side are achieved by using the Analog output from connector X20.

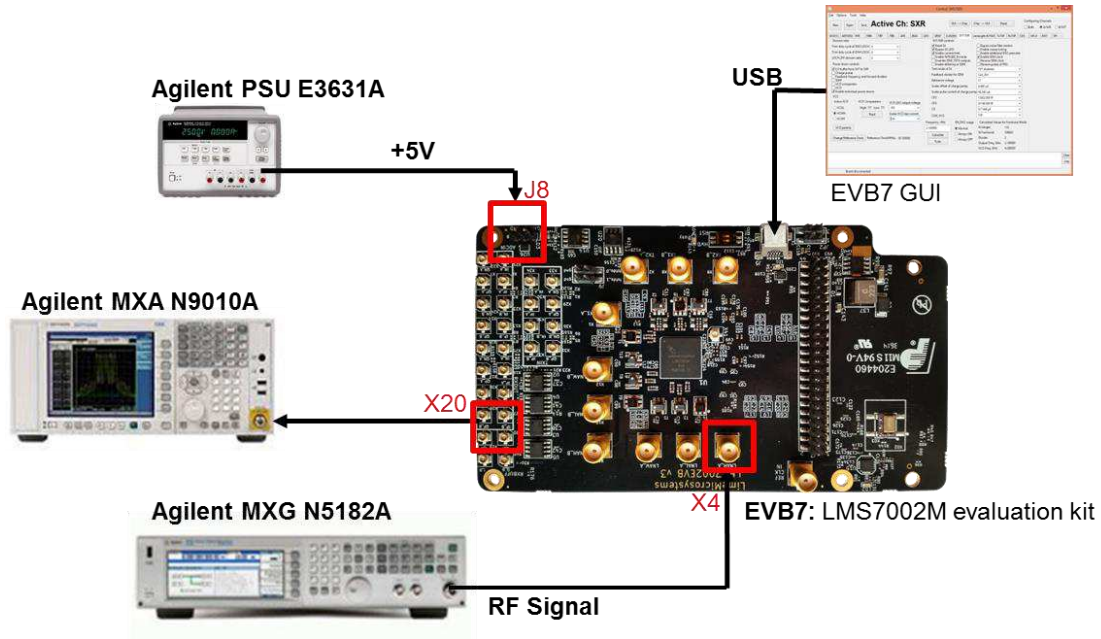


Figure 15 Rx Test Setup

5.4.1. SXT/SXR tab setup

Select the **SXT/SXR** tab. To configure the Rx LO to 1950 MHz, do the following:

1. Select the **A/SXR** in the configuration channels window to control RxPLL
2. Enable Rx PLL **VCO** (Deselect).
3. Type the wanted frequency in **Frequency, GHz** box. In this case, 1950 MHz.
4. Press **Calculate** followed by **Tune**.

See *Figure 16* below to check selections.

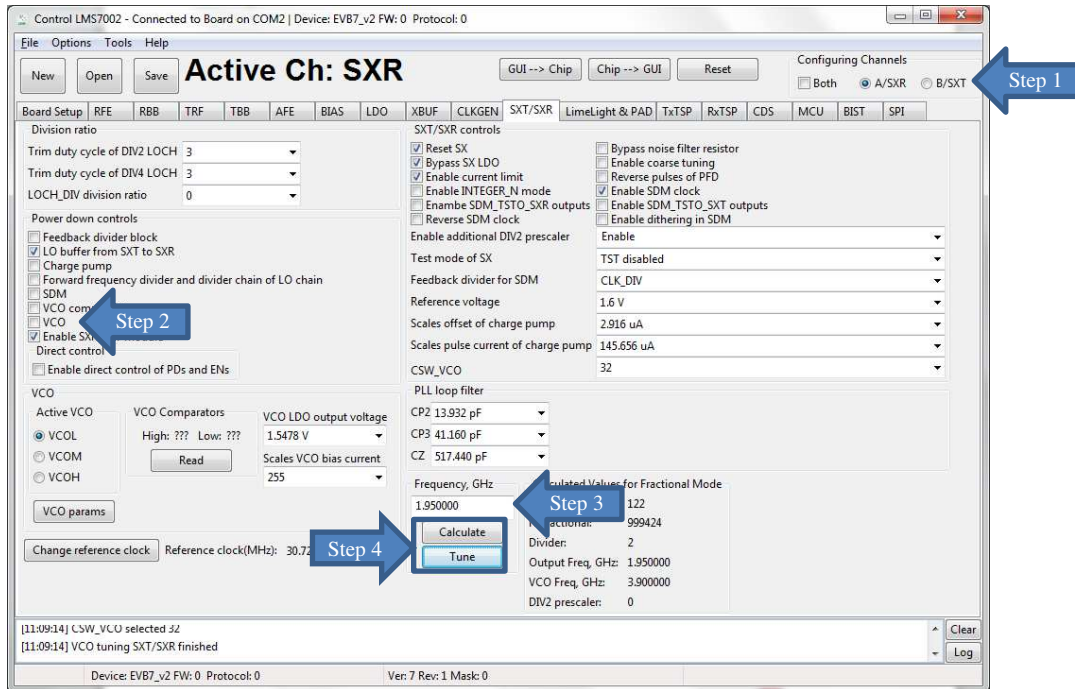


Figure 16 SXR register setup procedure

5.4.2. RFE tab setup

Select the RFE tab to configure the receiver RF front–end. Follow the configuration steps below:

1. Enable **LNA_RFE**, **RXFE mixer LO buffer** and **RFFE Quadrature LO generator**.
2. Select **Active path to the RXFE**. Select **LNAH** for this test. The LNAH is a default setting.
3. The **LNA** and **TIA** gain are preset to maximum.

See Figure 17 below to check selections.

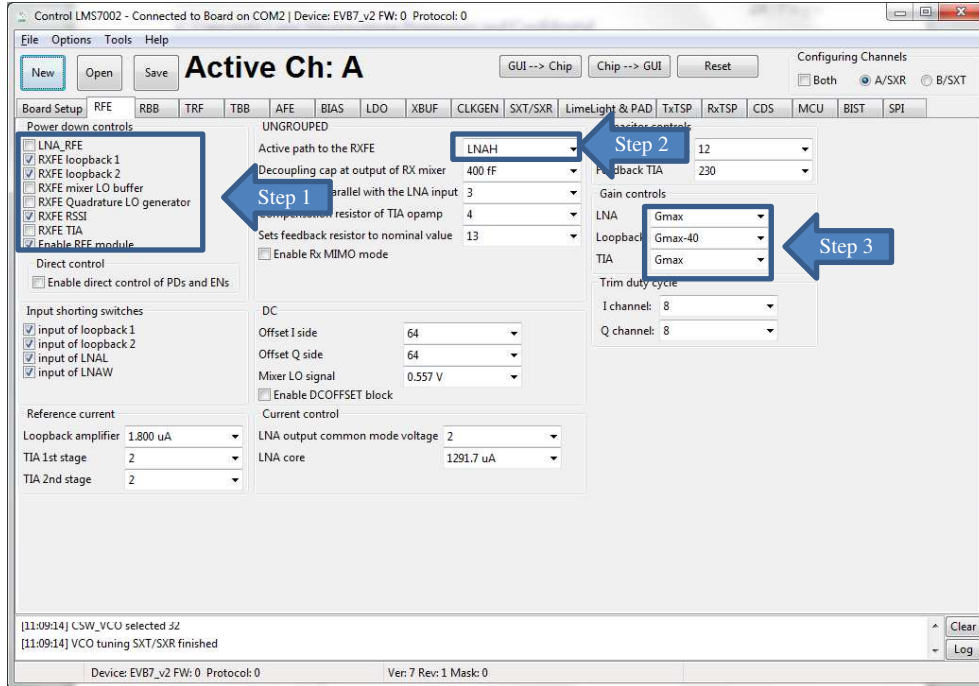


Figure 17 SXR register setup procedure

5.4.3. RBB tab setup

Select the TBB tab to configure the PGA gain and baseband filter bandwidths. Follow the configuration steps below:

1. Select PGA output to **output pads**. This selection enables receiver analog outputs.
2. Set **PGA gain** to 19 dB.
3. Configure filter bandwidth. By default the LPFL is selected.

See Figure 18 below to check selections.