AN1502 -BLP25RFE001
Quick Start OM3999
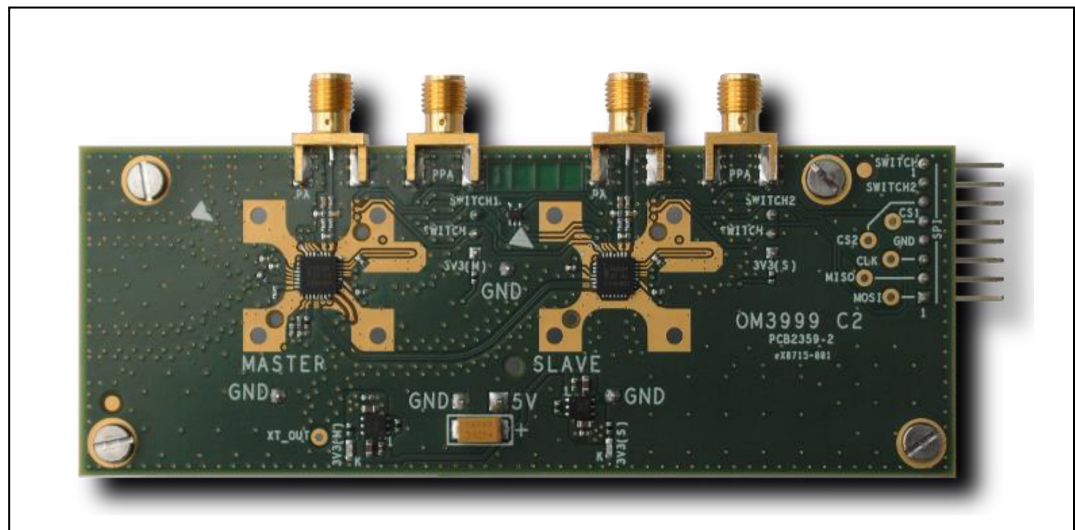
Rev. 1.4 — 22 March 2018

AMPLEON

Application note

Document information

Info	Content
Keywords	RF energy, RF heating, OM3999, BLP25RFE001, Volcano
Abstract	This document helps the user to set up the OM3999 board and software to evaluate his/her application

Revision history

Rev	Date	Description
1.0	2015 01 09	Creation
1.1	2015 02 02	Add back-side picture of the board
1.2	2015 03 31	Update with the latest demo board version OM3999-C2
1.3	2016 02 04	Minor correction (supply,…)
1.4	2018 03 22	Update formatting

Contact information

For more information, please visit: http://www.ampleon.com

For sales office addresses, please visit: http://www.ampleon.com/sales

BLP25RFE001-03

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1. Introduction

The OM3999 system board is a demonstration/evaluation board. It includes the software *OM3999_DUAL_1.2 RELEASE 0* used to control the two circuits BLP25RFE001 in order to evaluate the functionality.

It targets two main markets:

RF cooking

RF lighting

1.1 Features

Features of the BLP25RFE001:

- Support from 2400 MHz to 2483.5 MHz, from 902 MHz to 928 MHz and from 433 MHz to 434.8 MHz ISM bands

- Single 3.3 V supply voltage

- SPI-bus interface up to 20 MHz

- Fully integrated LC-VCO operating in the range from 6.6 GHz to 10 GHz and used with a $\Sigma\Delta$ PLL to generate the frequency

- Very fast tuning and hopping time PLL

- High frequency daisy chaining allowing coherent excitation of multiple RF amplifier chains

- 360° phase shifter with 1.4° steps

- Medium Power Amplifier (MPA) delivering an output up to +27 dBm

- Low Power Amplifier (PPA) delivering an output up to +7 dBm

- Integrated 20 dB gain control

- Integrated RF switch allowing PWM control

- Temperature sensor indicates the junction temperature of the die

- RoHS compliant

1.2 Evaluation board variants

The OM3999 board comes in several variants. Currently:

- OM3999 2.4GHz: the Medium Power Amplifier (MPA) and Low Power Amplifier (PPA) impedance matching are tuned for the frequency band 2400-2483.5 MHz

- OM3999 915MHz: the Medium Power Amplifier (MPA) and Low Power Amplifier (PPA) impedance matching are tuned for the frequency band 902-928 MHz

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2. System Application Board

2.1 Overview

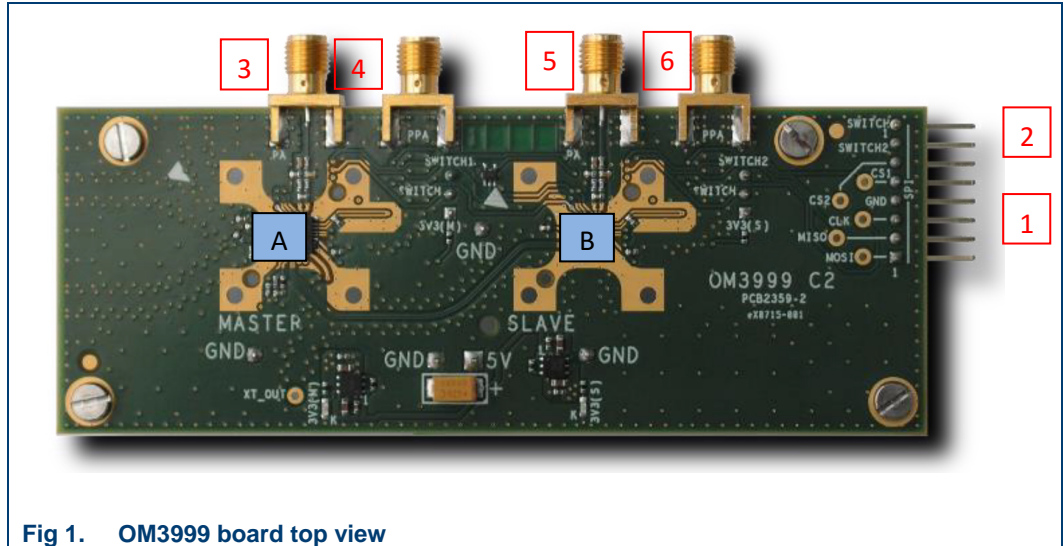Below is a picture of the front-side of the OM3999-C2 board:

Fig 1.   OM3999 board top view

The hardware picture depicted above show the main external connections that are required to make the board up and running. These include:

- A: BLP25RFE001 master
- B: BLP25RFE001 slave

- 1: SPI connector, 6 terminals
- 2: SWITCH pins for master and slave (optional, usage depends bottom jumpers)
- 3: RF medium power output (MPA) of the master (SMA connector)
    Load impedance MUST be 50Ω
- 4: RF low power output (PPA) of the master (SMA connector)
    Load impedance MUST be 50Ω
- 5: RF medium power output (MPA) of the slave (SMA connector)
    Load impedance MUST be 50Ω
- 6: RF low power output (PPA) of the master (SMA connector)
    Load impedance MUST be 50Ω

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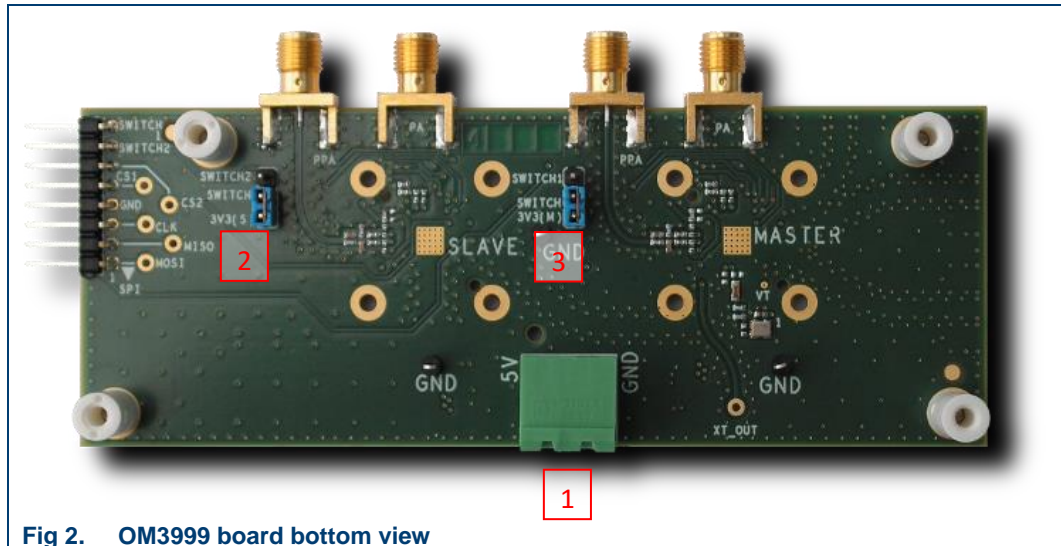Below is a picture of the back-side of the OM3999 board:

Fig 2.   OM3999 board bottom view

- 1: power supply connector +5V

   Master and slave ICs, 2 terminals: voltage, ground
- 2: jumper to the SWITCH pin of the master device (enabled or external)
- 3: jumper to force the SWITCH pin of the slave device

2.2 Getting started

2.2.1 Power supply connection

The power supply (labels 5V) must be plugged with 5.0V external power supply.The BLP25RFE001 Master and Slave ICs are then supplied through 2 independent on-board 3.3V regulators. See Fig 7 Board Schematic

2.2.2 SPI connection

The SPI connection is the only way to control the two circuits.

The evaluation software OM3999 only supports a USB FTDI cable to complete the conversion USB-to-SPI. The FTDI USB 2.0 reference cable to be used is *C232HM-DDHSL-0.*

It can be found here: http://www.ftdichip.com/Products/Cables/USBMPSSE.htm

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Fig 3.   FTDI MPSSE cable (C232HM-DDHSL-0)

Note: with an embedded platform, the FTDI USB cable is not needed and the SPI connector can be connected directly.

In the OM3999 evaluation software, the FTDI driver is integrated with a default mapping. Please follow strictly the following mapping to connect the FTDI cable to the OM3999 board:

Board AMPLEON - OM3999		Cable FTDI - C232HM MPSSE		
Pin #	Name	Pin #	Name	Color
1	MOSI	3	TDI	Yellow
2	MISO	4	TDO	Green
3	CLK	2	TCK	Orange
4	GND	10	GND	Black
5	CS1	6	GPIOL0	Grey
6	CS2	7	GPIOL1	Purple

Fig 4. FTDI MPSSE cable connections (C232HM-DDHSL-0)
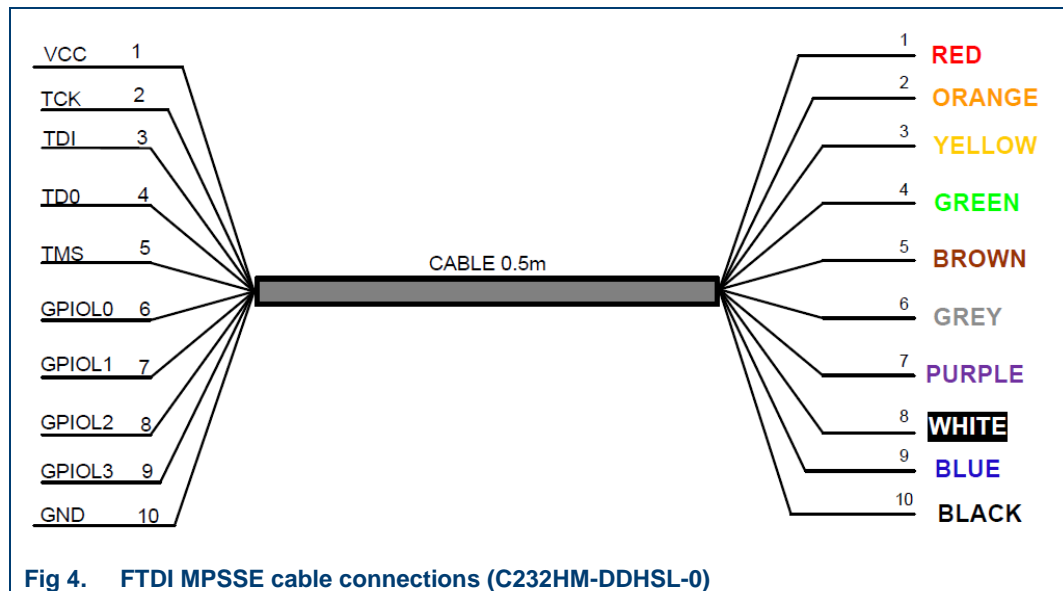
2.2.3 RF outputs

The RF outputs are the 50Ω SMA-type connectors. These outputs are of 2 types depending on the desired power level: medium power amplifier for up to 27 dBm, or pre-power amplifier for up to 7 dBm.

The RF outputs can be connected to external power amplifiers, a spectrum analyzer or a power meter.

2.2.3.1 Medium power (27 dBm)

These outputs are the outputs of power amplifiers which can basically deliver up to 27 dBm.

Beware that the power amplifiers are sensitive to output impedance mismatching. When used with external equipment, **it is important to add fixed connectorized attenuators** of at least 6dB, in case the device is enabled without being properly loaded. This will avoid the PA to be severely damaged.

2.2.3.2 Low power (7 dBm)

These outputs are the outputs of the pre power amplifiers which can basically deliver up to 7 dBm.

2.2.4 Switching

The pin SWITCH is useful to enable/disable the RF outputs. By default, the board is configured in always ON state with the SWITCH pin pulled high.

This can be easily changed in case a burst operation is needed, thanks to the available jumpers J7 (Master) and J8 (Slave).

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3. Application diagram

Different applications can be addressed with the BLP25RFE001 ICs. Among the most common ones, the cooking application gathers several BLP25RFE001 used as signal generators and power amplifier drivers.

A single device BLP25RFE001 is used to generate the signal frequency, the local oscillator being propagated in a daisy chain through LOout and LOin pins as shown on the next figure.

The phase shift between all paths can be fixed at initialization, allowing afterwards to minutely control the phase shift applied selectively on all paths.
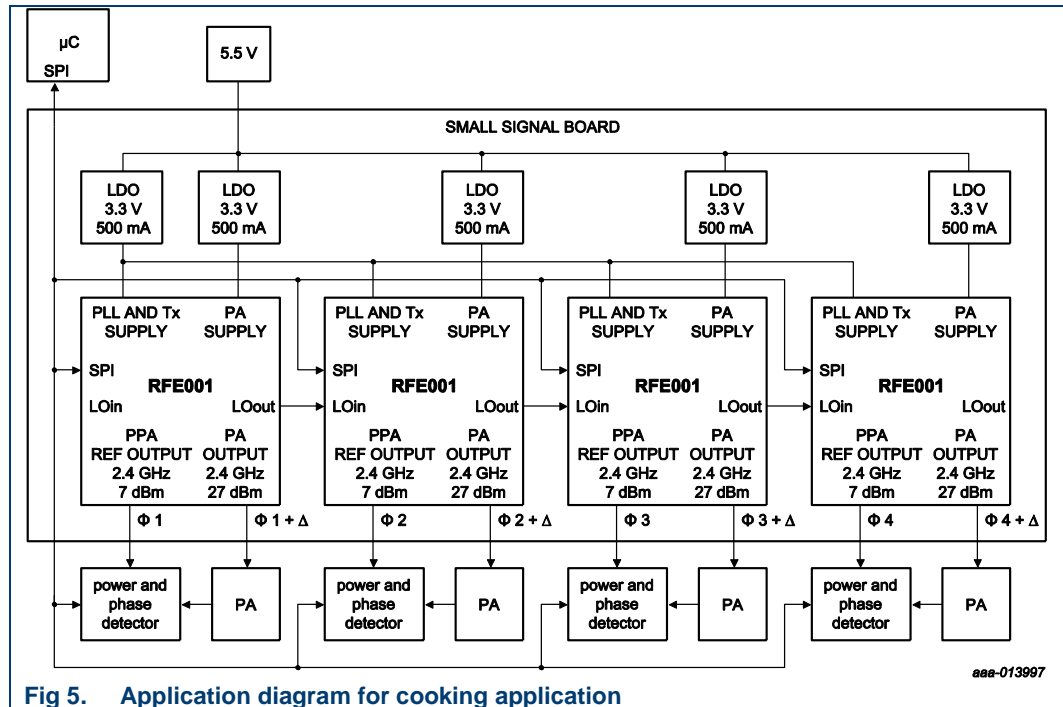
Fig 5.   Application diagram for cooking application

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Another typical application is for lighting, when the BLP25RFE001 serves as a power amplifier driver for a single plasma lamp.
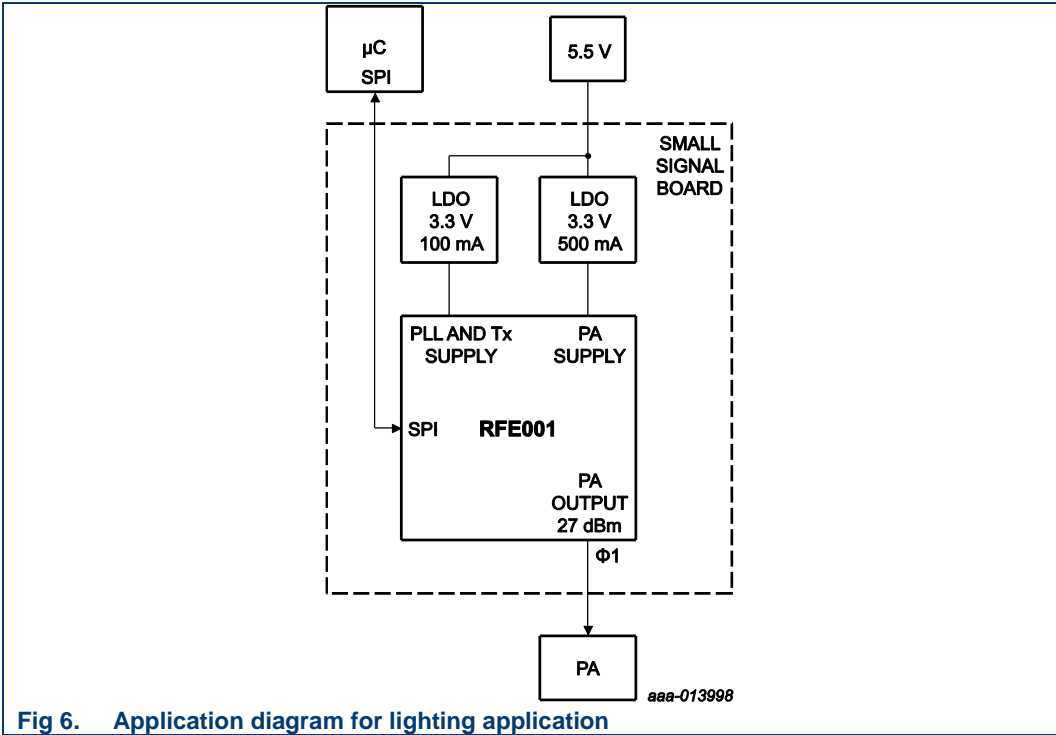
Fig 6. **Application diagram for lighting application**

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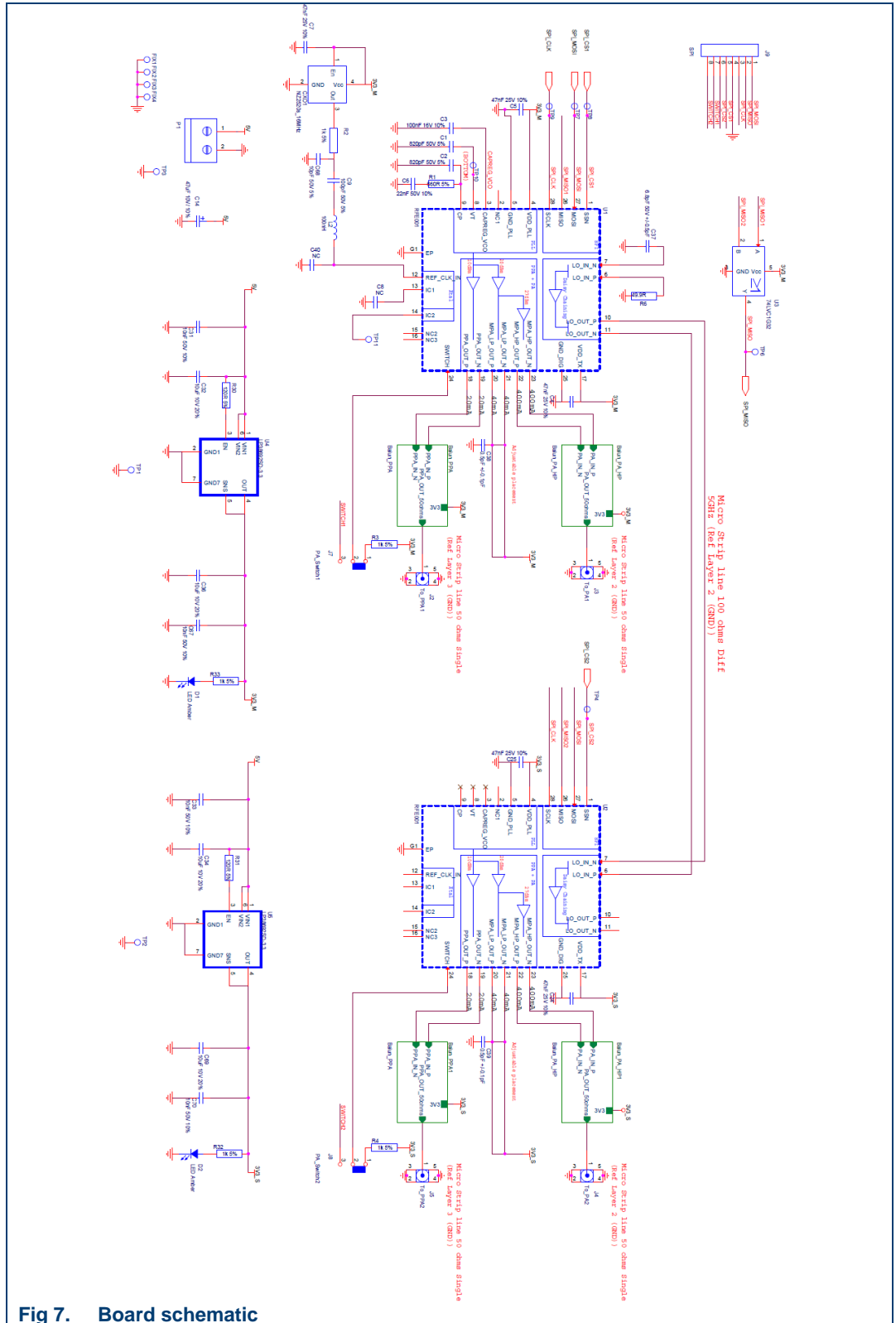
3.1 Schematic

Fig 7.   Board schematic

4. Software and drivers

Before using the OM3999 reference board, it is needed to install the control software on the computer. This section describes the procedure on how to do it.

If it is the first time that an AMPLEON evaluation SW is used on the computer the NXPE dependencies must also be installed in order for the SW to drive the SPI bus or the USB as described later in this document.

4.1 Evaluation software installation

Double-click on the *OM3999 DUAL 1.2 RELEASE 0 Software Setup.exe* executable file to install the software.

Notes:

- On Windows XP and Windows 7, you must have administrator privileges to do so. Follow the instructions to finally install the drivers.

- In case a AMPLEON SW is being installed for the first time on a computer, the dependencies needed to run Microsoft .Net Frameworks must also be installed. While running *OM3999 DUAL 1.2 RELEASE 0 Software Setup,* a pop-up window may appear requesting to allow the download of the dependencies from AMPLEON Internet site. If the Internet connection fails, the installation must be done manually by running the appropriate set-up file that can be provided by AMPLEON upon request.

- The FTDI USB driver must be installed the first time the SW is installed on a PC.

- On a computer the AMPLEON SW must be installed by each user

The Register for ActiveX automation is not required in case the GUI is used only for manual testing, and not controlled by other programs like VBA automatic test programs for instance.

4.2 OM3999 Evaluation Software

4.2.1 Execution

After succeeding the installation, launch the evaluation software OM3999 to get the following Graphical User Interface (GUI):
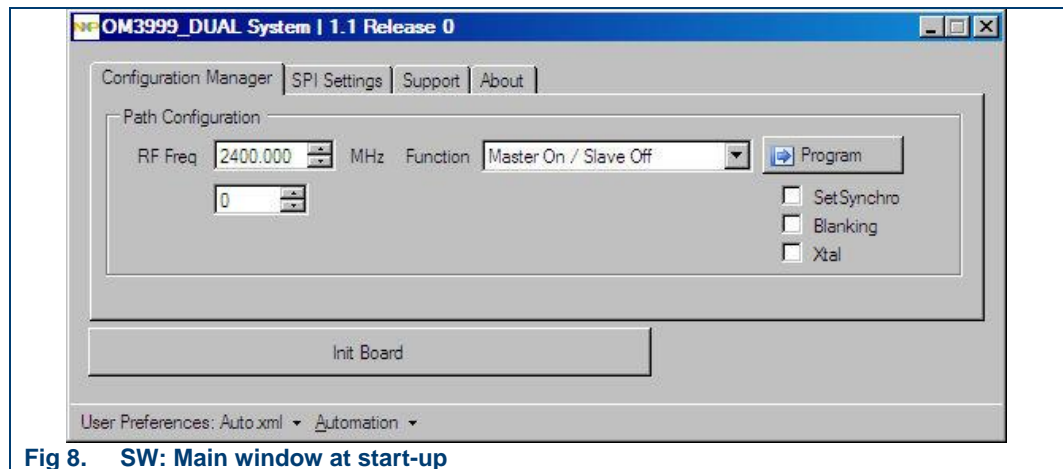
Fig 8.   SW: Main window at start-up

Prior to program any device, it is mandatory to configure the SPI interface if not already done. The SPI configuration will be saved and restored at each execution.

4.2.2 SPI configuration

By default, the FTDI USB interface is selected to make use of the integrated FTDI USB driver. At that time, it is the only supported interface.

Before initializing the board, be sure to define the FTDI USB interface:

- Select the tab **SPI Settings** and click on **SPI Properties:**
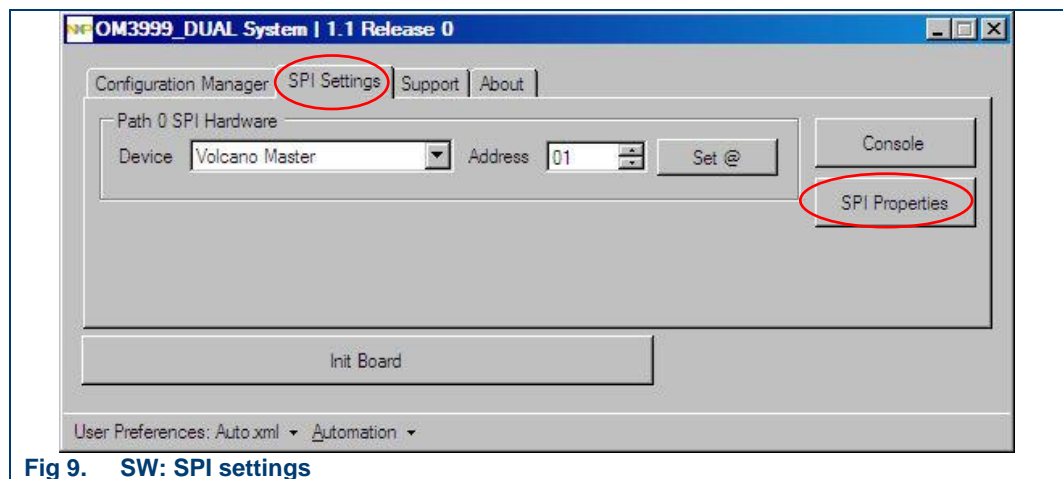
Fig 9.   SW: SPI settings

Make sure that the appropriate interface is selected based on the interface used on the board: E.g. if the CH341 USB is used then:

1. Select "CH341 USB" in the drop down menu
2. "Scan Devices" to get the ID of the device and then click "Set Device"

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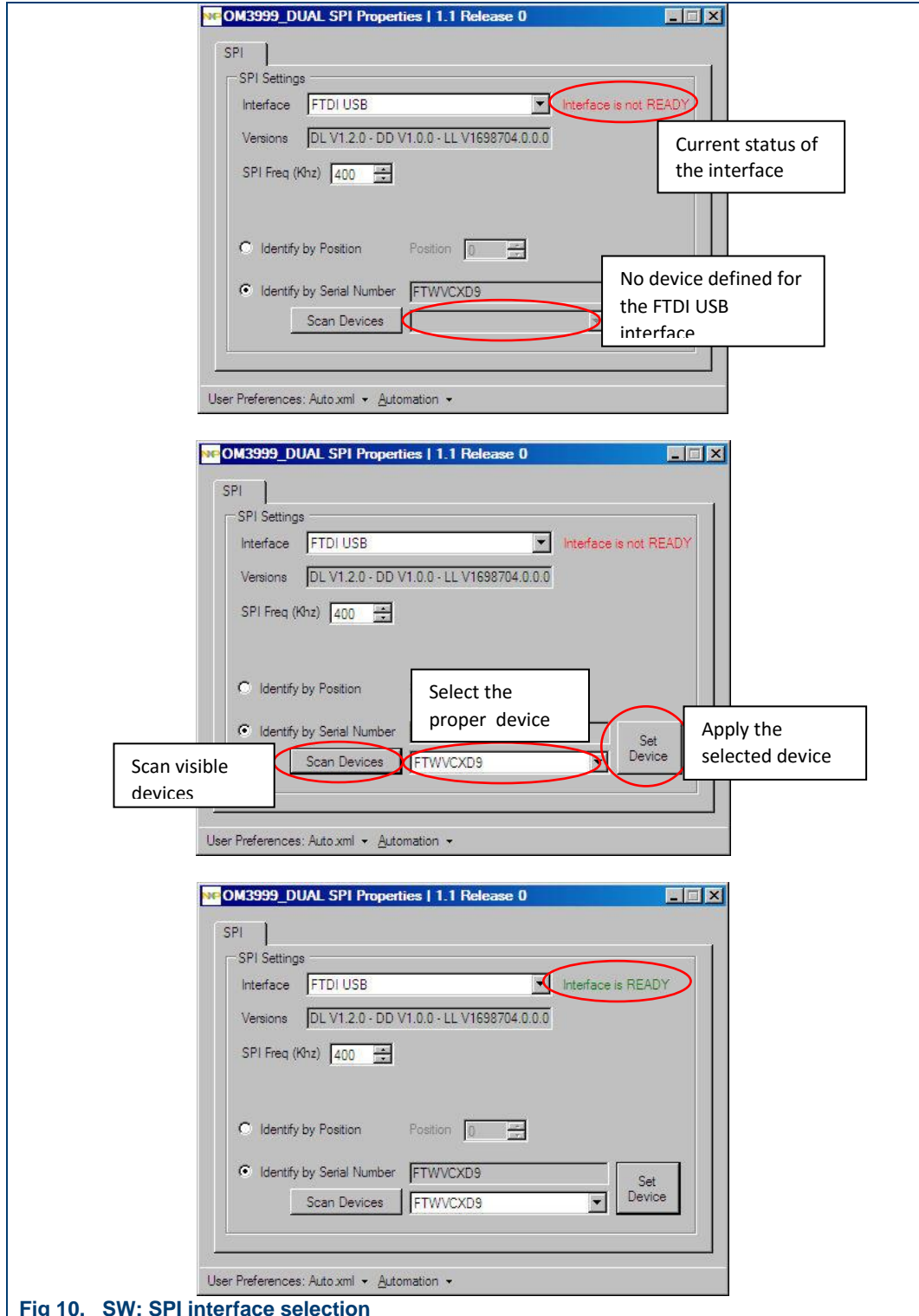
Fig 10.   SW: SPI interface selection

4.2.3   Initialization

To control the OM3999 evaluation board, the initialization procedure must be launched.
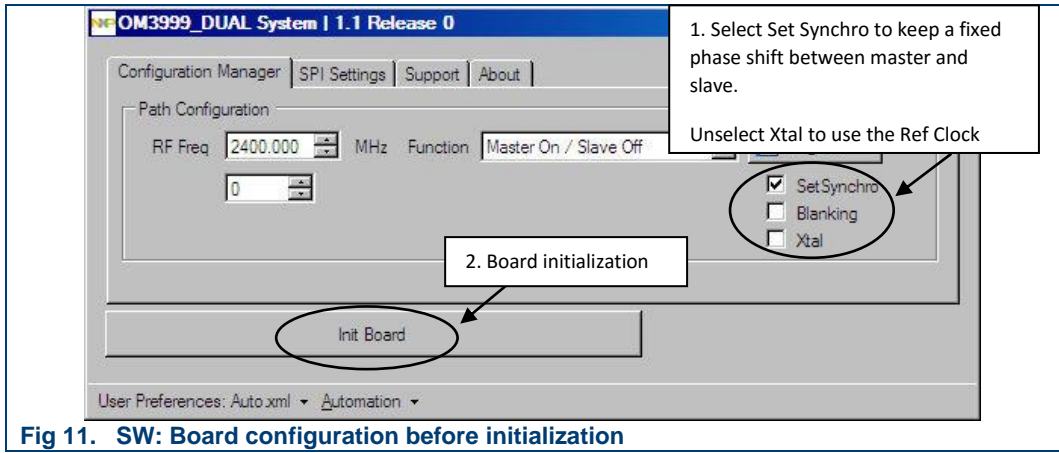
Fig 11.   SW: Board configuration before initialization

Then click on "**Init Board**" to initialize the ICs (BLP25RFE001 master and slave). The message "**Init Board: Succeeded**" will be displayed.
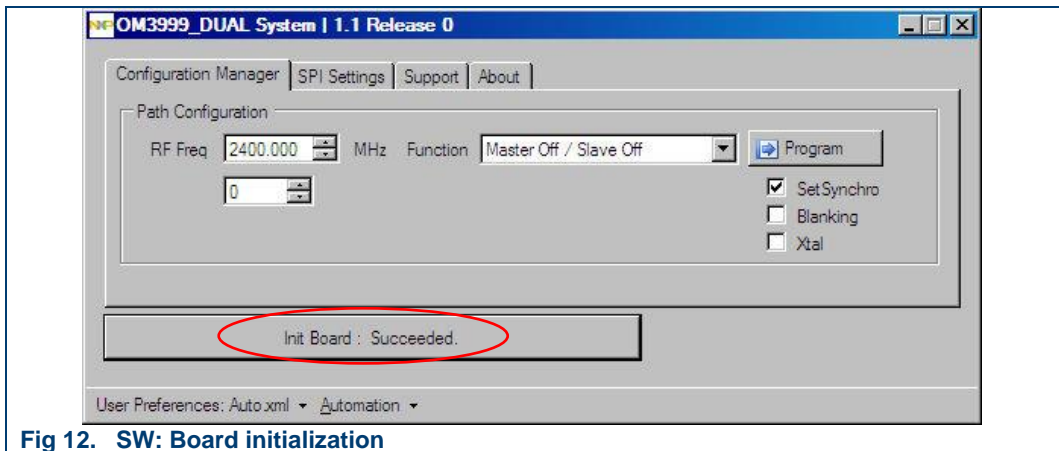

Fig 12.   SW: Board initialization

In case of failure, ensure the power supply is properly applied, and check the SPI connection and configuration.

4.2.4   Device configuration

In the main system window, a control box allows to enable the master only or both the master and the slave simultaneously. This is achieved once the board is initialized.
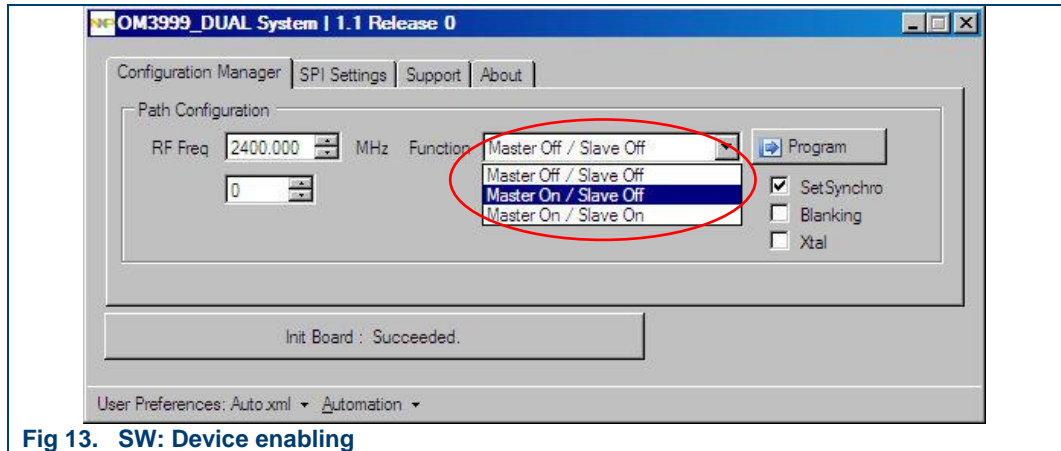
Fig 13.   SW: Device enabling

The frequency programming is achieved in two steps: first enter the frequency, then click on "Program" to program it through the SPI interface.
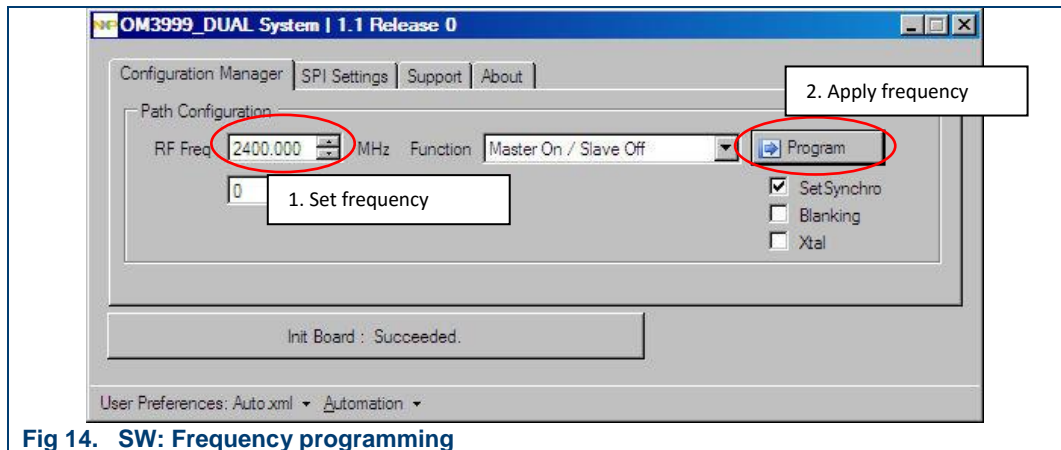
Fig 14.   SW: Frequency programming

Switch now to the device window (0 for master, 1 for slave) to change other parameters. Basically only the output power level is of interest in a typical application.
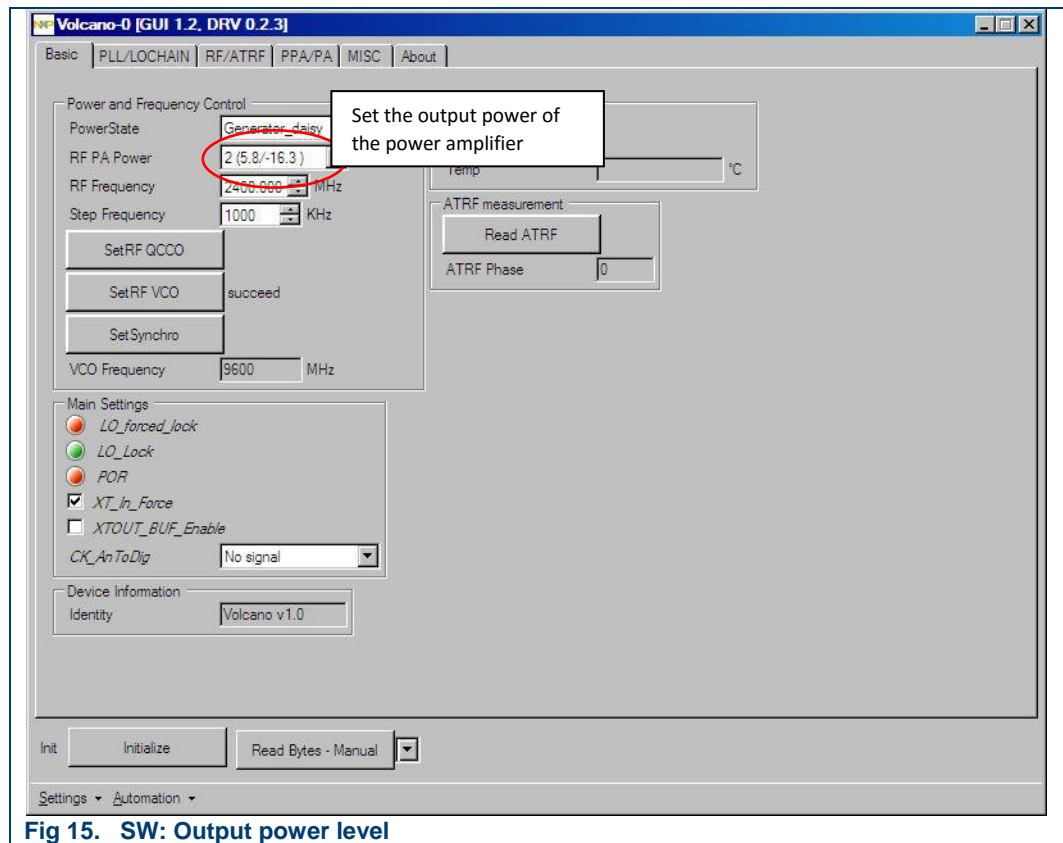
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Fig 15.   SW: Output power level

To get 27dBm, a value of 42 is usually selected. When changed, the value is directly applied.

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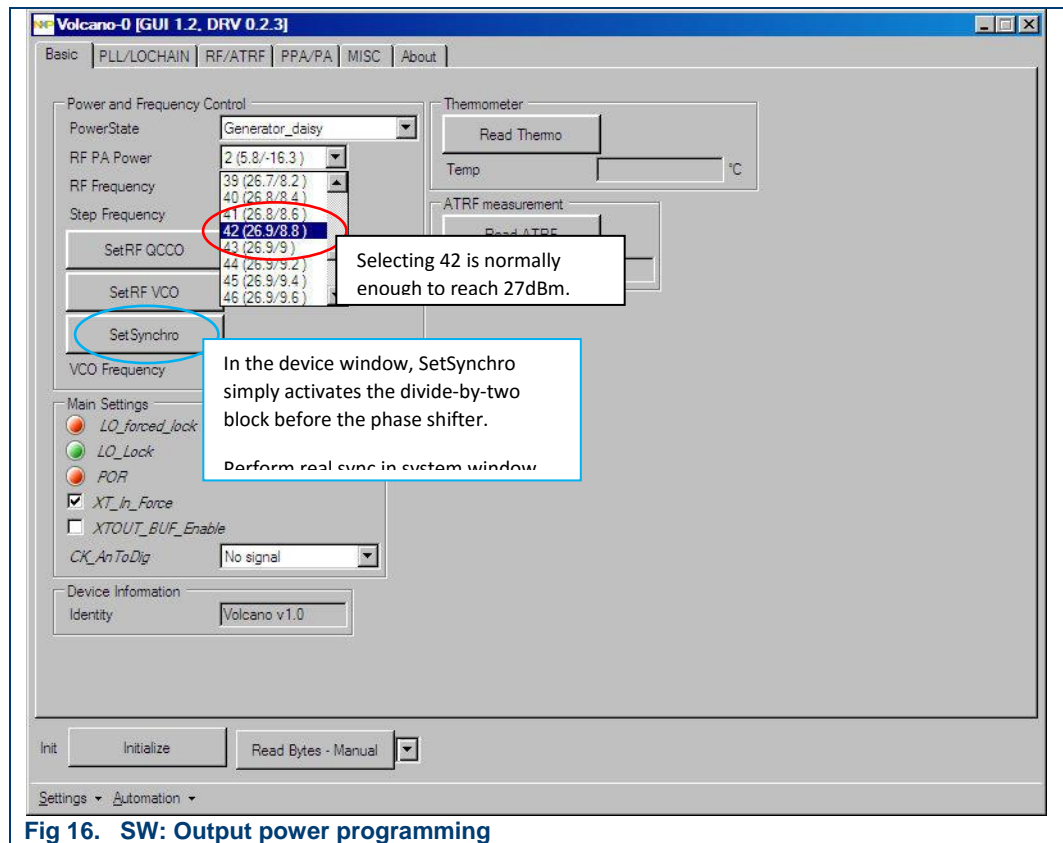
Fig 16. SW: Output power programming

4.3 Quick Results

4.3.1 Power spectrum at 2.4GHz

The next curve depicts the output signal spectrum on the master device, for a 2.4GHz selected frequency, at 27dBm output power level.

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Fig 17. SW: Spectrum at 2.4GHz
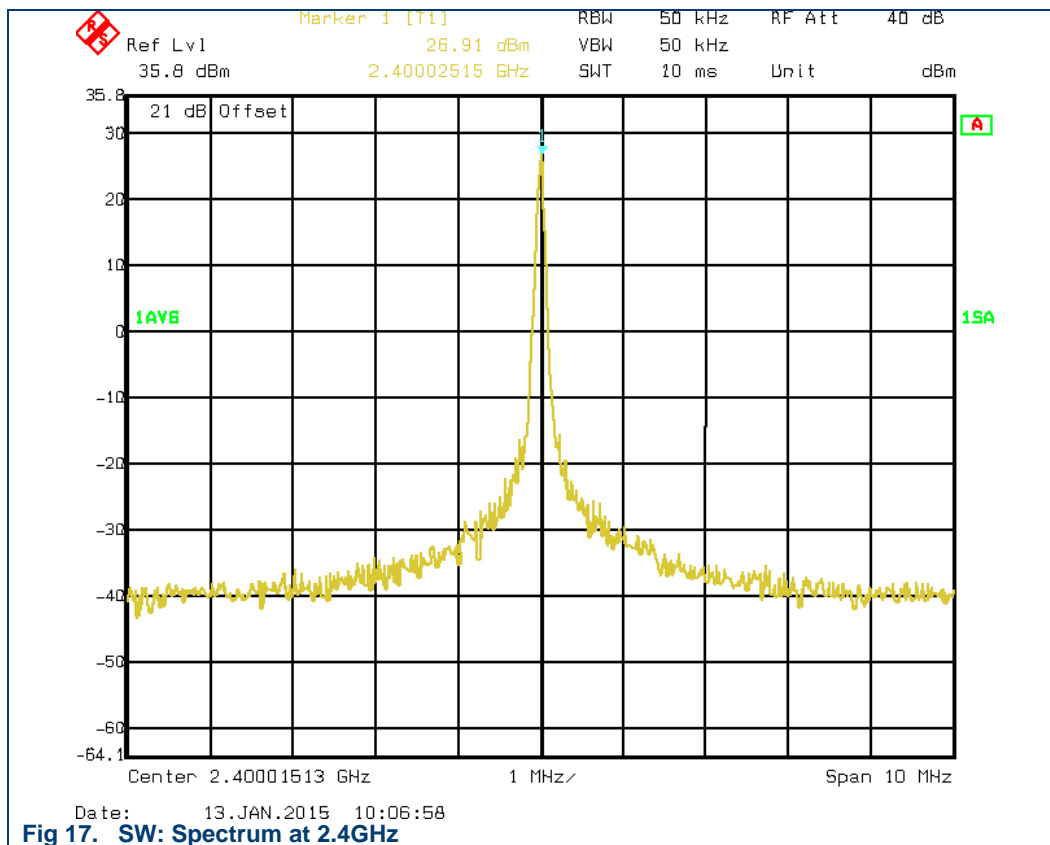
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6. List of figures

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