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UM10480

Variable gain amplifier BGA7210

Rev. 2 — 26 July 2011 User manual

Document information

Info	Content
Keywords	BGA7210, VGA, variable gain amplifier
Abstract	This user manual describes how to evaluate the variable gain amplifier BGA7210 using a customer evaluation kit

Revision history

Rev	Date	Description
v.2	20110726	• Section 1 "Introduction" text altered. • Section 5 "Controlling the customer RF evaluation board" amended to include Section 5.1 "Improving linearity"
v.1	20110520	first version

Contact information

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1. Introduction

The BGA7210 customer evaluation kit enables the user to evaluate the performance of the variable gain amplifier BGA7210.

The BGA7210 performance information is available in the BGA7210 data sheet.

2. Quick start

1. Connect the interface board to the RF evaluation board using the flat cable.
2. Power the RF evaluation board with a 5 V, 1 W power supply.
3. Insert the interface board in a free USB slot.
4. Insert the USB flash drive in another free USB slot.
5. Launch the customer software bga7210_mswin.exe from the USB flash drive.

3. Installation

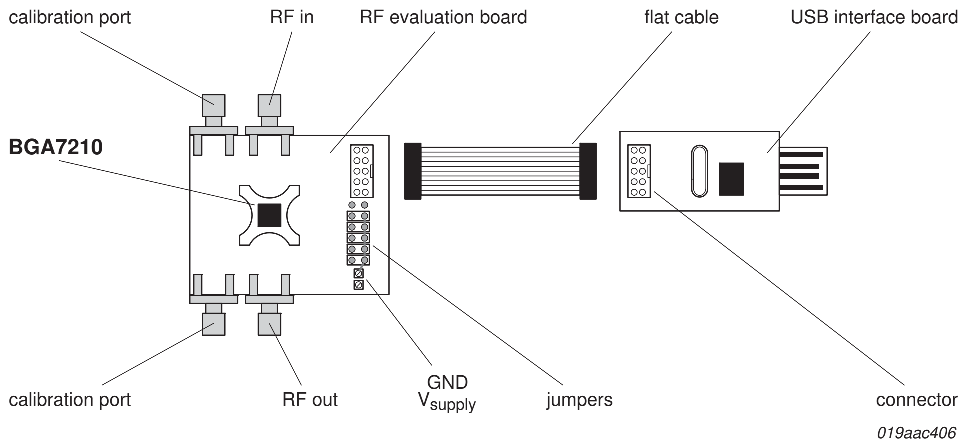

Fig 1. BGA7210 customer evaluation kit parts

Remark: Do not change the jumper settings until you are familiar with the functions. The jumpers are intended for evaluating the current on each supply pin. If configured correctly the VGA can be powered by the USB bus, however RF performance might be compromised. See Section 7 “Jumpers and connectors” on page 10.

4. Customer evaluation kit contents

The evaluation kit contains the following items:

- ESD safe casing
- RF evaluation board
- USB interface board
- Flat cable
- USB flash drive containing:
  - This user manual
  - Customer software bga7210_mswin.exe
  - BGA7210 data sheet

5. Controlling the customer RF evaluation board

5.1 Improving linearity

The RF evaluation board is configured without using a shunt capacitor on the output. Adding a shunt capacitor improves linearity around 2.8 GHz. For other operating frequencies it is recommended not to add a shunt capacitor. Please refer to the Data Sheet for performance information.

Place a shunt capacitor of 0.68 pF at a distance of 5.3 mm from the BGA7210 RF_OUT pin, see Figure 2.

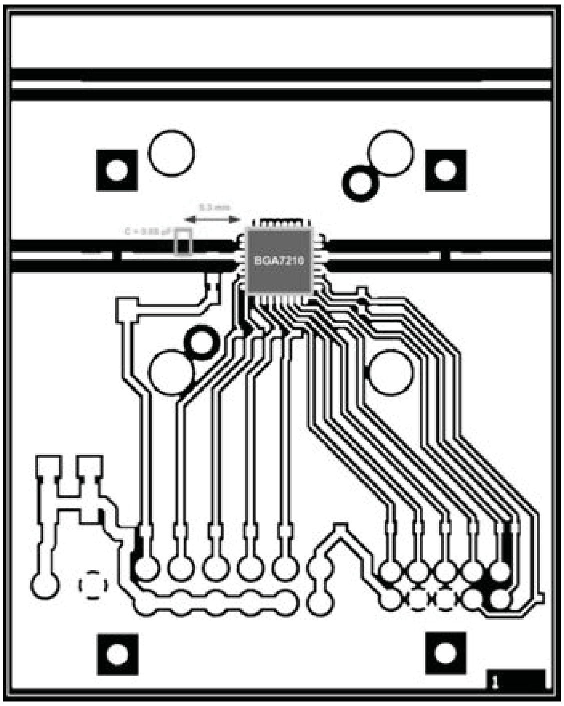

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Fig 2. BGA7210 RF evaluation board PCB layout

5.2 Quick tour

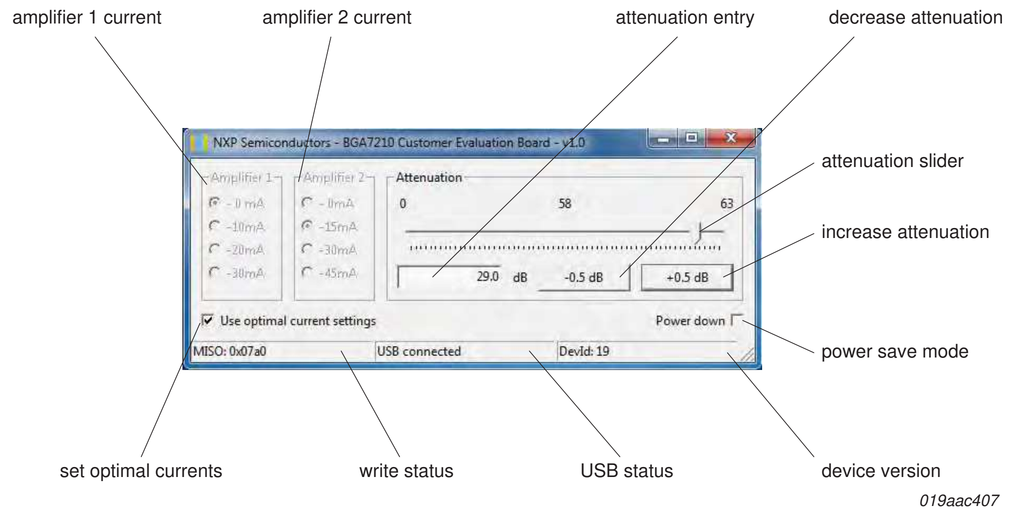

Fig 3. User interface

The customer software offers advanced features for controlling the current and attenuation of the BGA7210. The software also provides a tick box for saving power and a tick box for automatically selecting the optimal current per attenuation setting, yielding maximum linearity.

5.3 Setting current

The current to each amplifier can be set either automatically or manually.

- Automatically: depending on the attenuator setting, each amplifier current setting is selected automatically. This mode optimizes current consumption without compromising linearity
- Manually: each amplifier current can be set manually

5.4 Setting attenuation

There are three methods available for setting attenuation in the range 0 dB to 31.5 dB using:

- the attenuator entry
- attenuation slider
- 0.5 dB step button

5.5 Power save

In Power save mode, the RF blocks are switched off but it is still possible to communicate with the chip.

6. BGA7210 evaluation

Remark: The RF evaluation board output is configured with a shunt capacitor to yield optimal linearity at approximately 2 GHz. It is recommended that the shunt capacitor is removed at other operating frequencies. Please refer to the BGA7210 data sheet for performance information.

6.1 Calibration

The calibration port can be used to determine the PCB losses.

6.2 S-parameters and output compression point

Both S-parameters and the output compression point (P1 dB) are measured with a NetWork Analyzer (NWA); see Figure 4.

The P1 dB is measured by sweeping the input power, and observing where the S21 of the device is compressed by 1 dB compared to the linear gain. In order for this measurement to accurately measure the input power, the input must first be calibrated with a power head. The output power of the device is calculated using equation Equation 1.

$$P_{out}(dBm) = P_{in}(dBm) + s_{21}(dB) \quad (1)$$

The drive power can be optionally enhanced with a driver amplifier. To prevent the output signal driving the NWA receiver into compression, an attenuator can be inserted at the NWA input. Both driver amplifier and attenuator should be included in the calibration path.

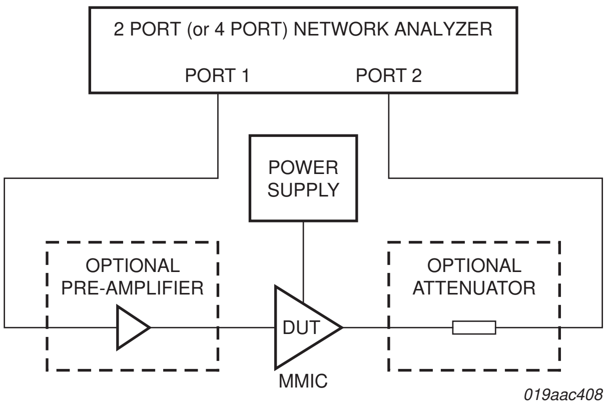

Fig 4. S-parameter and output compression power set-up

In order to maintain small signal conditions for the S-parameter measurements, an input power of –20 dBm is applied.

6.3 Output third-order intercept point

The output intercept point (OIP3) is a figure of merit for linearity; see Figure 5. The set-up is configured to achieve an accurate measurement of the OIP3; see Figure 6. After the signal generators, a Low-Pass Filter (LPF) and isolator is applied, before combining the two signals. This configuration gives best isolation between the generators, hence IMD3 levels of the input signal < –80 dBc can be measured.

Please refer to the BGA7210 data sheet for power level and tone spacing values.

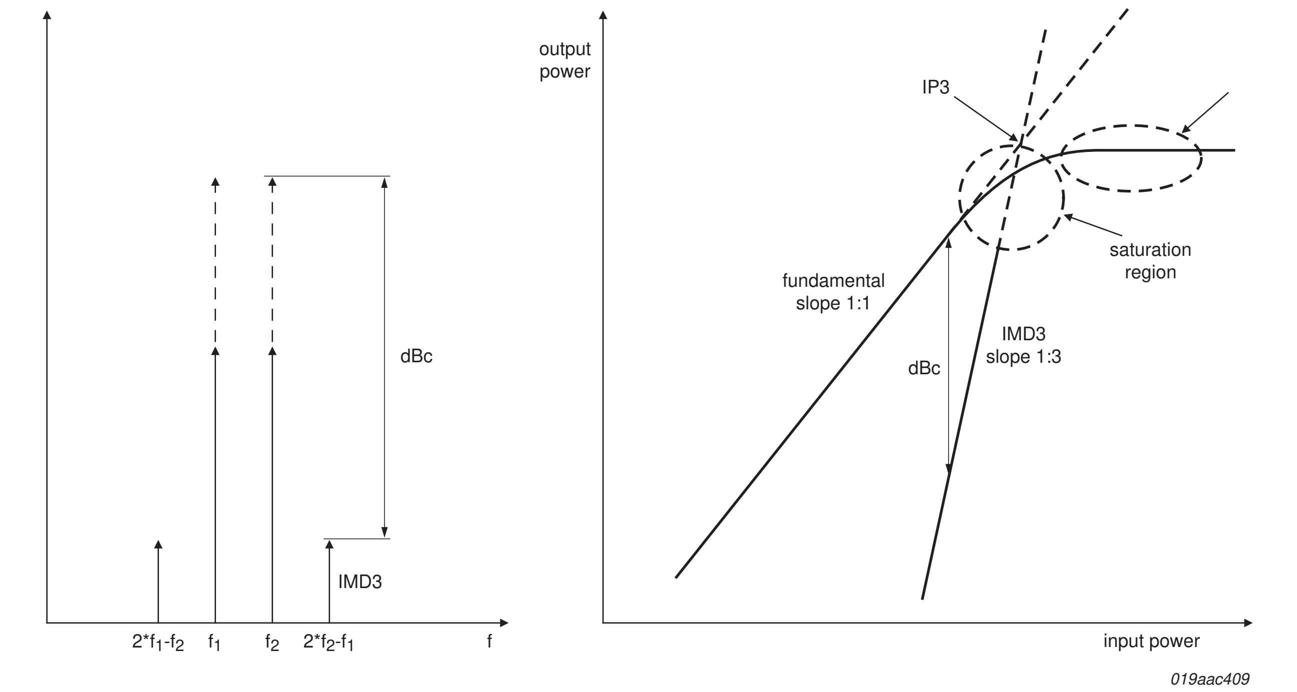

Fig 5. Definition of output intercept point (OIP3)

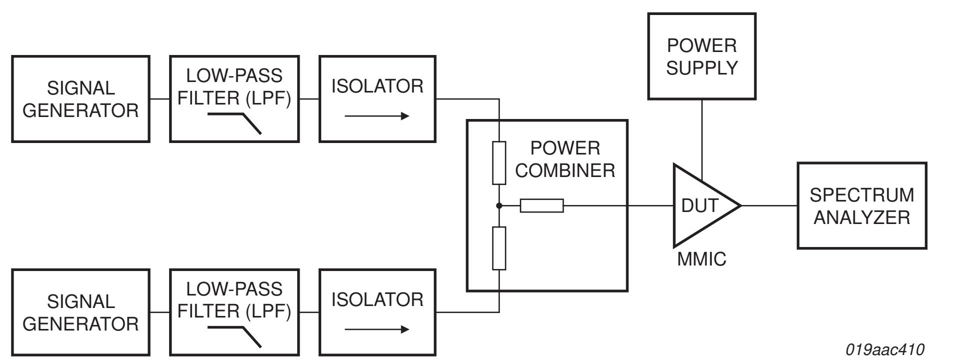

Fig 6. Output intercept point (OIP3) set-up

6.4 Noise

The Noise Figure (NF) is measured using a calibrated noise source with a specified Excess Noise Ratio (ENR), and a spectrum analyzer with a noise measurement option. The system is calibrated with this noise source in order to measure accurate noise figures; see Figure 7.

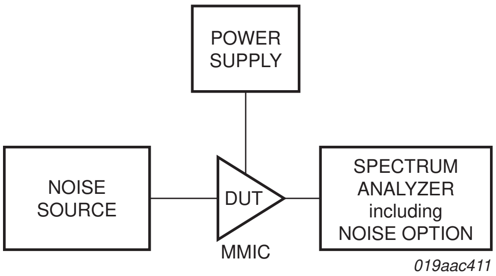

Fig 7. Noise figure measurement set-up

7. Jumpers and connectors

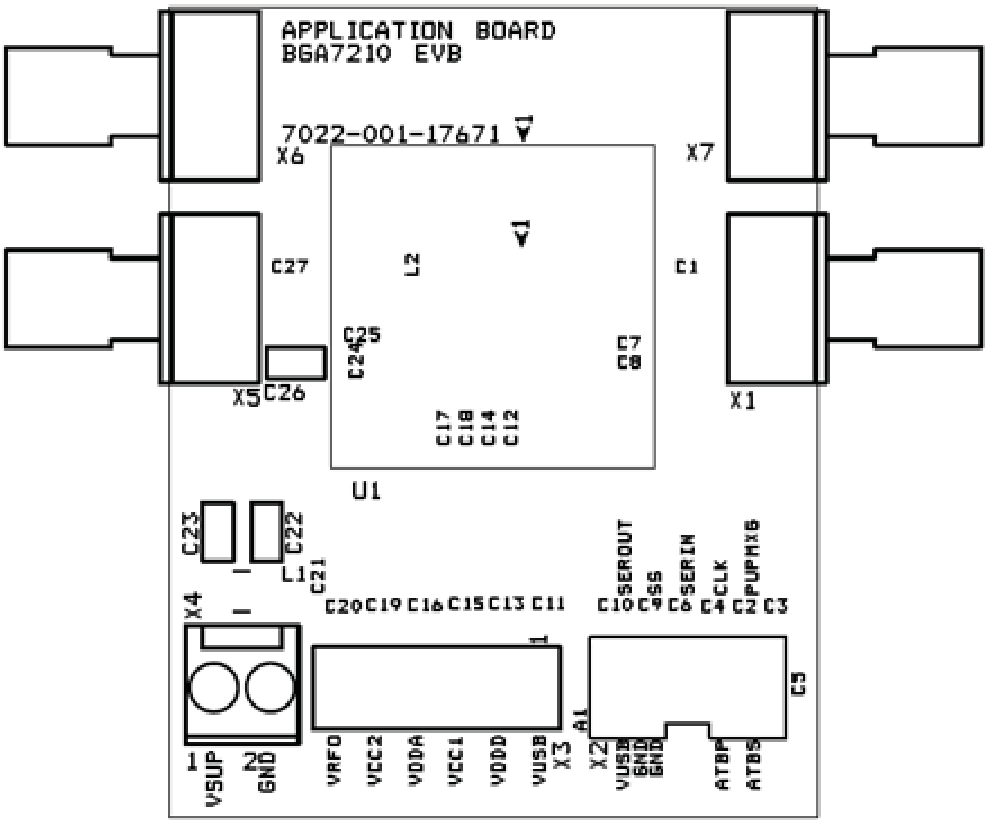

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Fig 8. BGA7210 RF evaluation board jumpers and connectors

Table 1. RF evaluation board components

Component reference	Description
RF connectors	
X6, X7	calibration port for determining PCB losses
X1	RF in
X5	RF out
Control interface	
X2	USB interface board connector
Voltage supply	
X4	external supply voltage 5 V/200 mA
X3	power configuration jumper

The RF evaluation board is powered through connector X4. The X3 jumpers are set as shown in Figure 9.

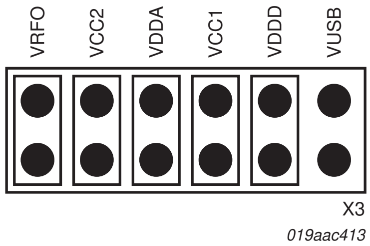

Fig 9. X3 jumper setting using supply voltage on X4

The 5 V provided by the USB port can be used for quick tests. In that case X4 should not be used and jumpers on X3 should be set as shown in Figure 10.

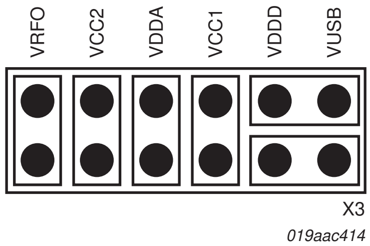

Fig 10. X3 jumper setting using USB supply voltage on X2

8. Abbreviations

Table 2. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
IMD3	Inter-Modulation Distortion (third-order)
MMIC	Monolithic Microwave Integrated Circuit
PCB	Printed-Circuit Board
USB	Universal Serial Bus
VGA	Variable Gain Amplifier

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