AN11171

BGU7063 evaluation board application note

Rev. 1 — 7 January 2013 **Application note**

Document information

Info	Content
Keywords	BGU7063, LNA-VGA, $IP3_i$, NF, PCB, $P_{i(1dB)}$, dynamic range.
Abstract	This application note describes the evaluation board (EVB) design and typical performance of the BGU7063. The BGU7063 is a fully integrated analog-controlled variable gain amplifier module. This EVB is supplied with all necessary connectors in order to enable ease of evaluation.
Ordering info	Board number: OM7937, BGU7063 12NC: 9340 668 53598
Contact information	For more information, please visit: http://www.nxp.com

Revision history

Rev	Date	Description
v.1	20130107	First publication

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1. Introduction

This application note gives a description of the BGU7063 evaluation board.

This enables ease of evaluation; it provides the EVB circuit schematic, the bill of materials (BOM), PCB material information and artwork. It also provides a list of equipment for a typical evaluation set up, as well as typical test results of the BGU7063.

This fully supplied EVB can be ordered from the NXP website www.nxp.com

2. Product description

NXP semiconductors' BGU7063 is a fully integrated analog-controlled variable gain amplifier module. Its low noise and high linearity performance makes it ideal for sensitive receivers in cellular base station applications. The BGU7063 is operating in the 1920MHz to 1980MHz frequency range and has a gain control range of 35 dB. At maximum gain the noise figure is 0.9 dB. The gain is analog-controlled having maximum gain at 0 V and minimum gain at 3.3 V. The LNA can be bypassed extending the dynamic range. The BGU7063 is internally matched to 50 Ohm, meaning no external matching is required, enabling ease of use. It is housed in a 16 pins 8x8x1.3mm leadless HLQFN16R package SOT1301. The BGU7063 can operate from 4.75V to 5.25 single supply and consumes about 230mA in high gain mode (LNA active) and about 190mA in the low gain mode (LNA bypassed)

BGU7063 is one of a series of LNA-VGA products for the different frequency bands intended for cellular base stations and its related applications.

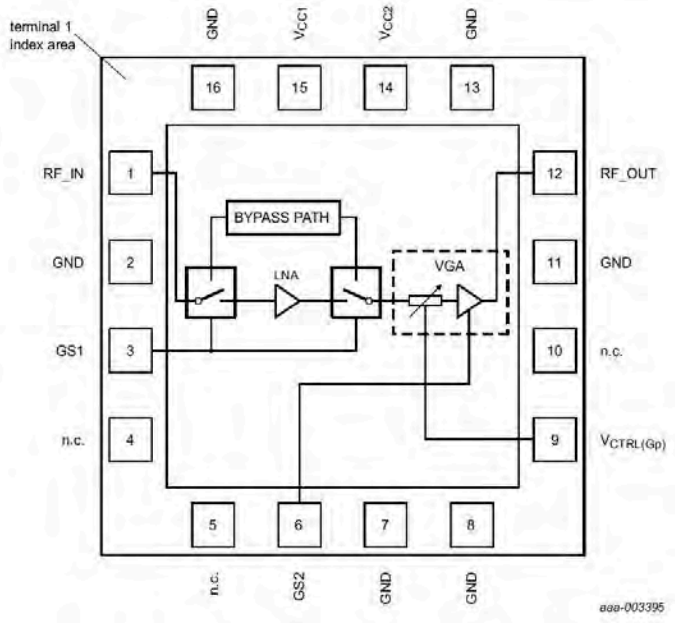

Fig 1. Pin description.

3. BGU7063 Evaluation board

The BGU7063 evaluation board, (see Fig 2) is fabricated on a 1mm thick 3 layer PCB that uses 0.5mm R4003C for the RF performance and 0.5mm Fr4 for the mechanical strength of the PCB. The board is fully assembled with the BGU7063, including the external components. The board is supplied with two SMA connectors for input and output connection to the RF test equipment.

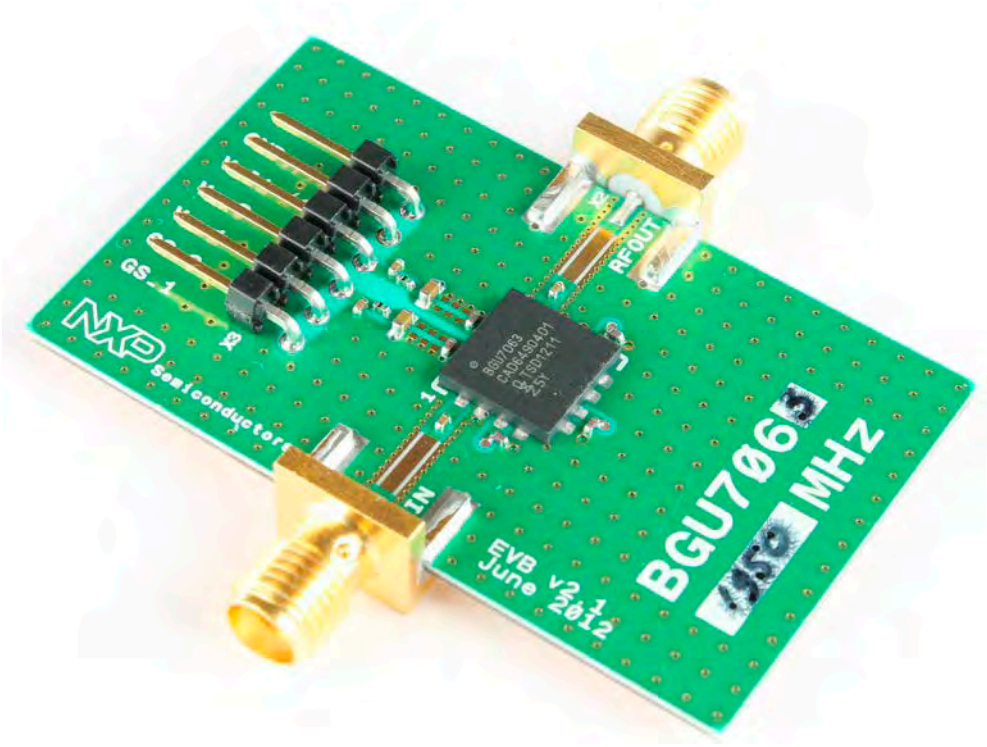

Fig 2. Evaluation Board

3.1 Application circuit

The circuit diagram of the evaluation board is shown in Fig 3

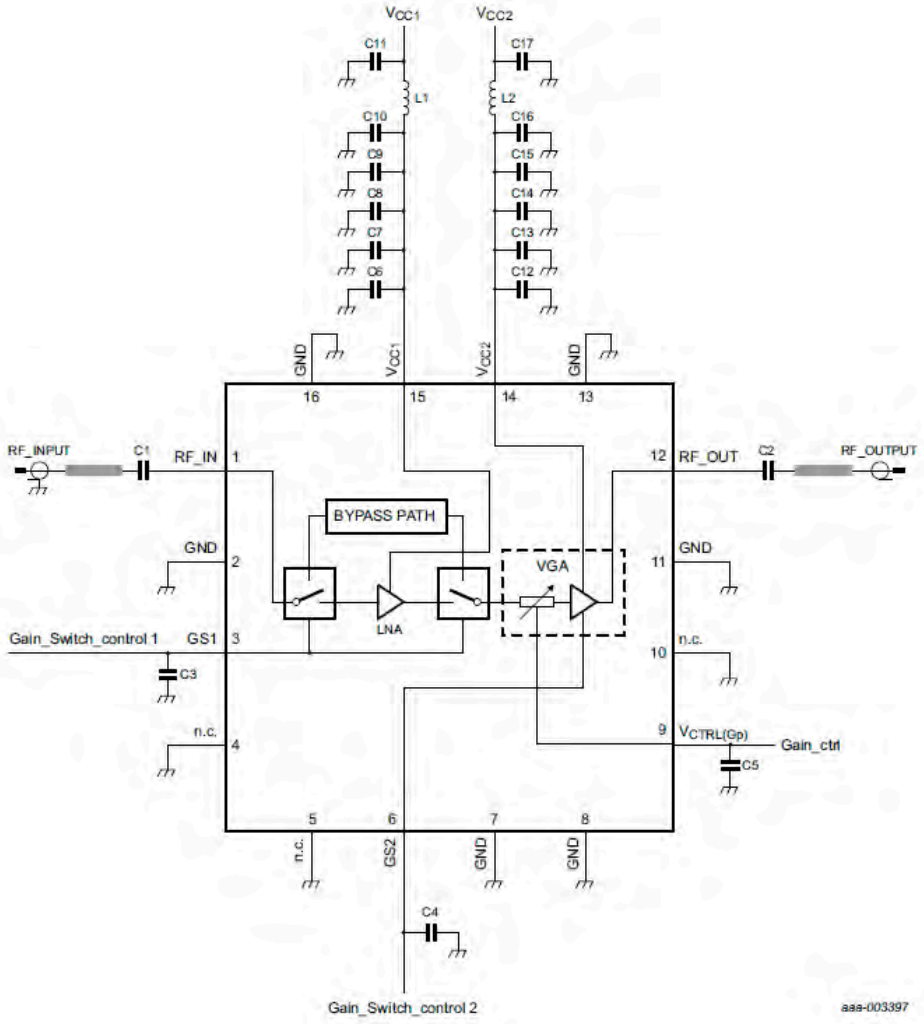

Fig 3. Circuit diagram of the evaluation board.

Since the BGU7063 is fully integrated the evaluation board only needs two AC coupling capacitors on the RF input and RF output, as well as bias decoupling circuits on Vcc1 and Vcc2, GS1, GS2, $V_{CTRL(GP)}$.

3.2 Decoupling structure.

Applying the BGU7063 in e.g. wireless base station BST, ask for careful Vcc decoupling in order to get the optimal and stable performance of the product especially on NF.

If the LNA_VGA module is supplied via supply rail that supplies more components, lack of decoupling can degrade the performance.

3.3 PCB Layout information

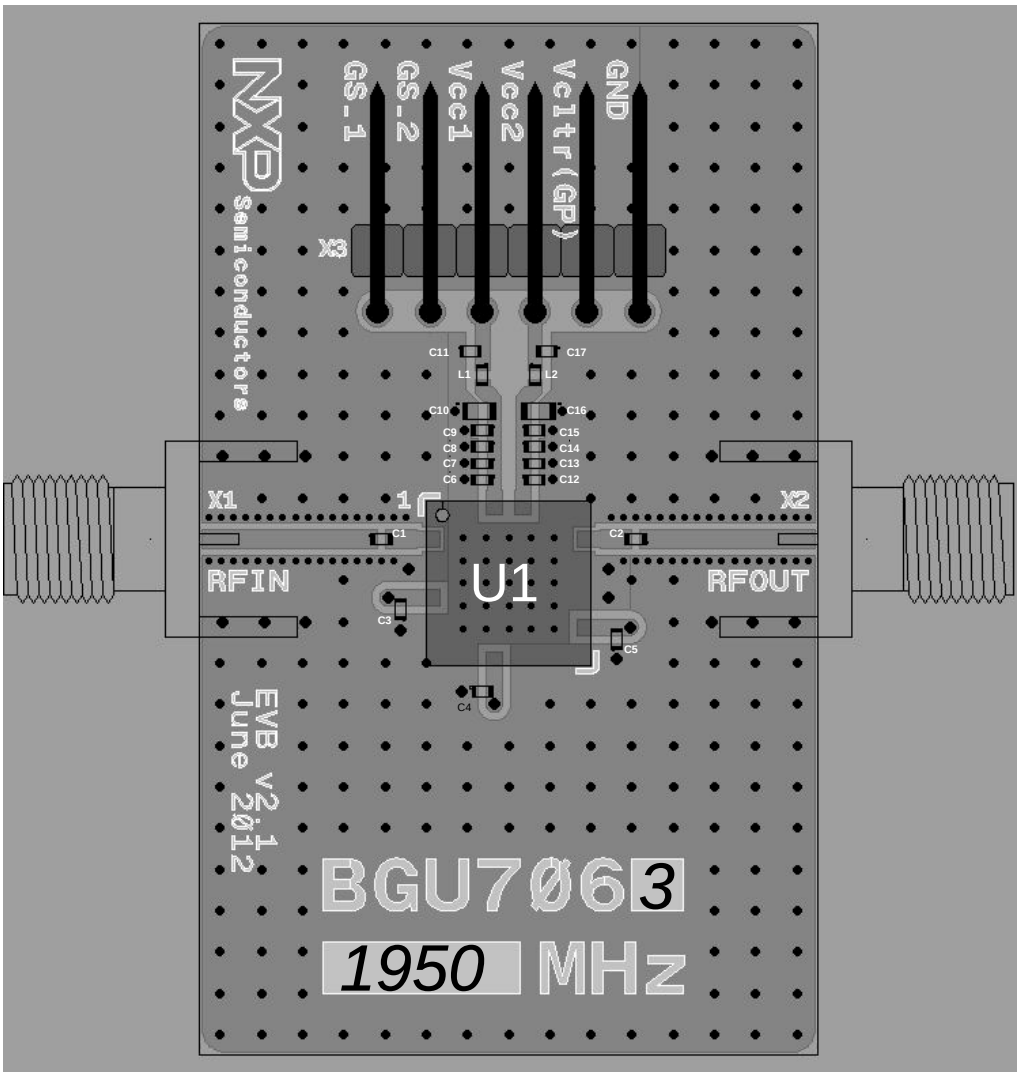

Fig 4. BGU7063 evaluation board component placement

Table 1. BOM of the BGU7063 evaluation board

Table description (optional)

Designator	Description	Footprint	Value	Supplier Name/type	
U1	BGU7063	8x8x1.3mm 16 pins		HLQFN16R	
PCB		20x30mm		BGU706x EVB v2.1 June 2012	
C1,C2	Capacitor	0402	1nF	Murata GRM1555	AC coupling
C3-C5	Capacitor	0402	100pF	Murata GRM1555	Decoupling
C6,C12	Capacitor	0402	100pF	Murata GRM1555	Decoupling
C11,C17	Capacitor	0402	100nF	Murata GRM1555	Decoupling
C7-C10, C13-C16	-	-	-	-	Not assembled
L1,L2	Inductor	0402	10nH	Murata LQG15	Decoupling
X1,X2	SMA RF connector	-	-	Johnson, End launch SMA 142-0701-841	
X3	DC header	-	-	Molex, PCB header, right angle, 1 row 6 way 90121-0766	

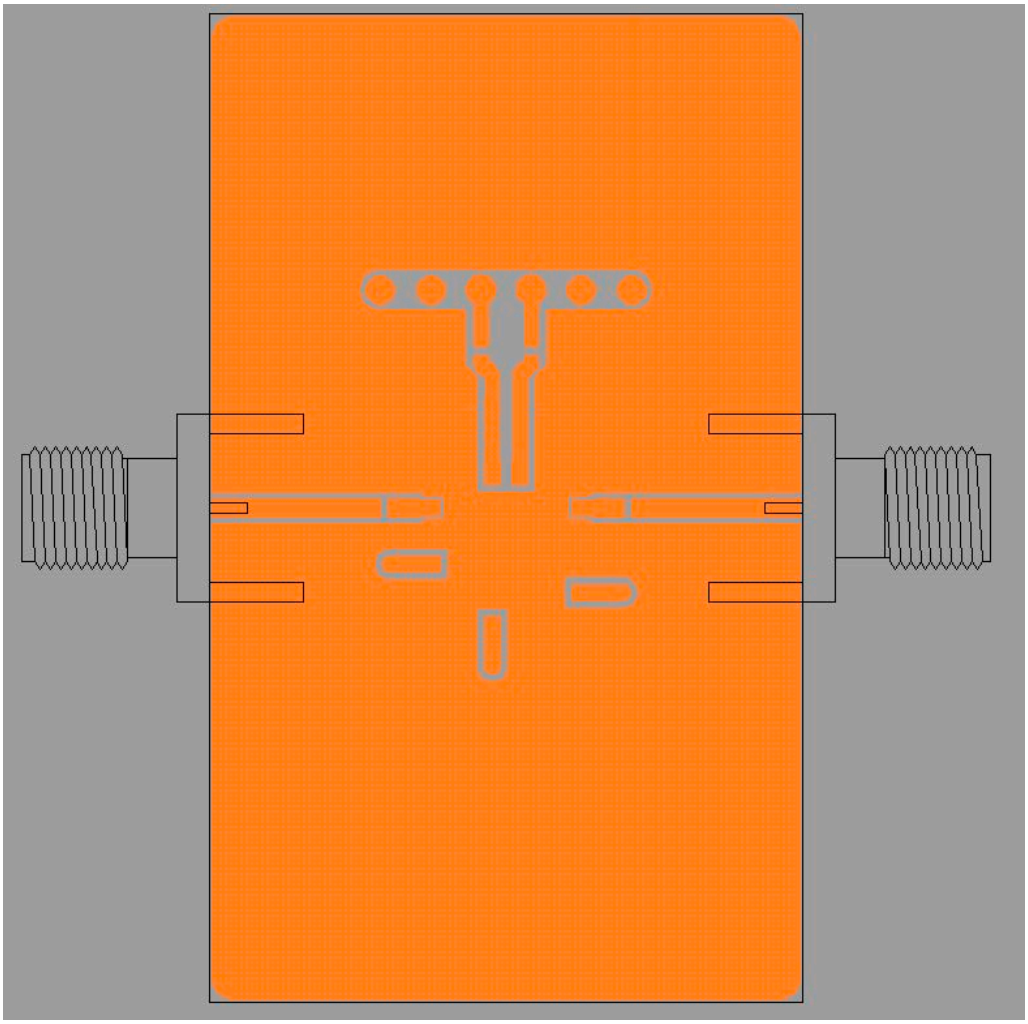

Fig 5. BGU706x Evaluation board Top layer PCB layout

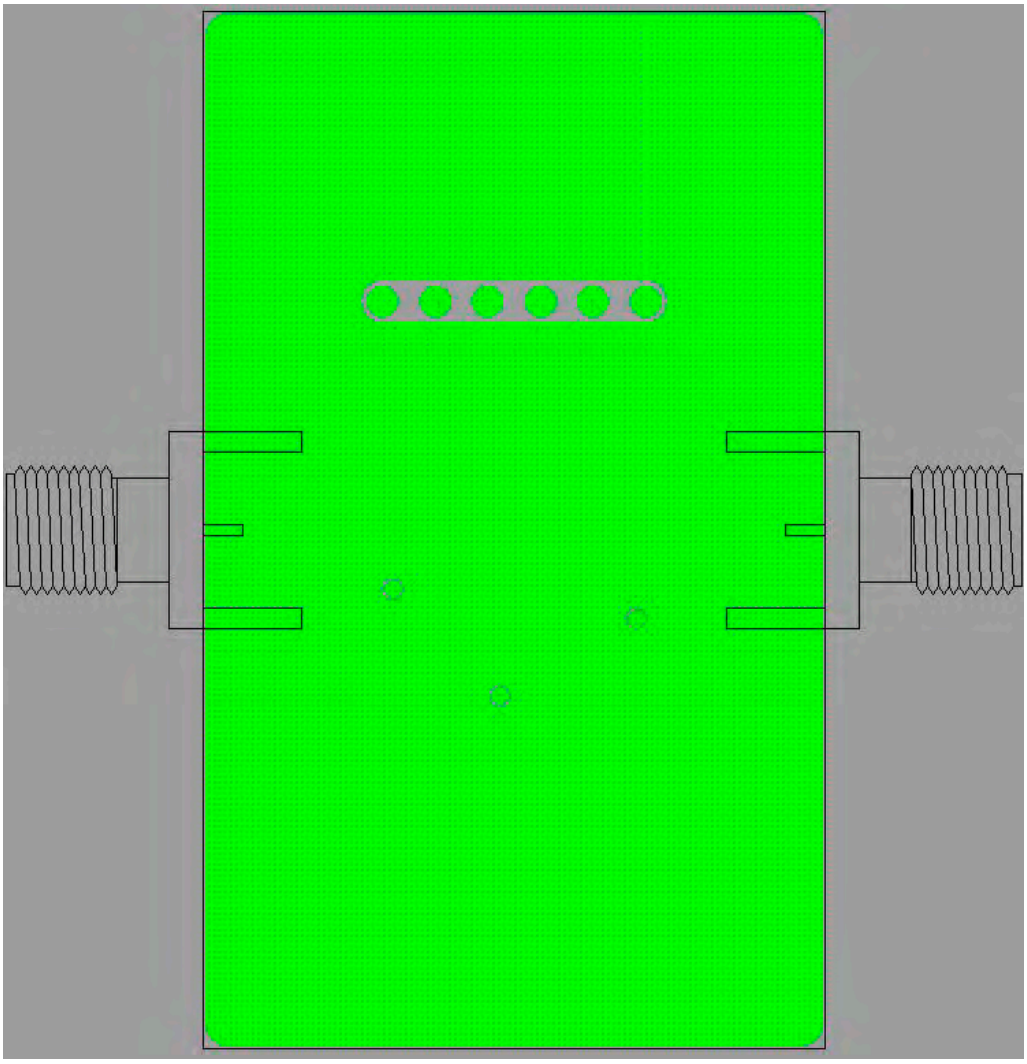

Fig 6. BGU706x Evaluation board inner layer PCB layout

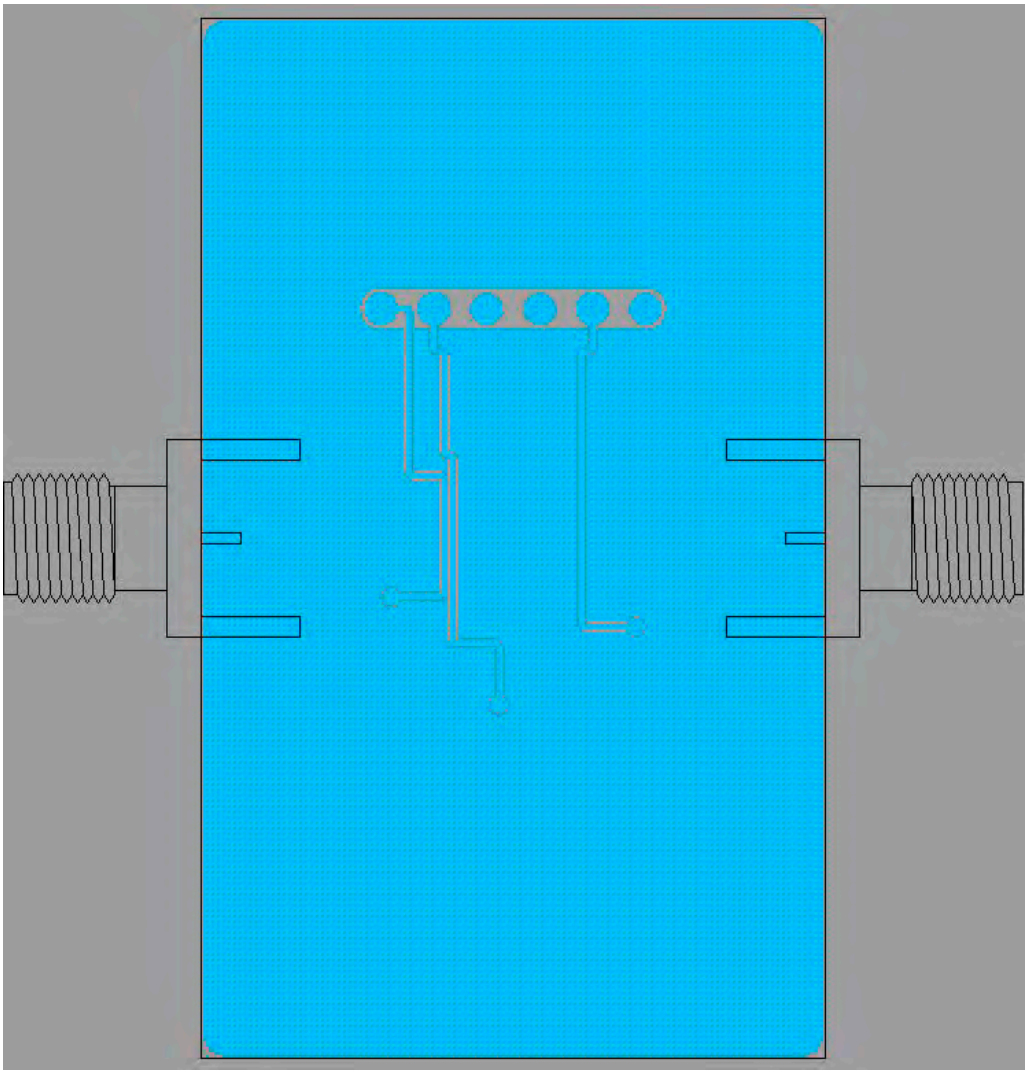

Fig 7. BGU706x Evaluation board bottom layer PCB layout

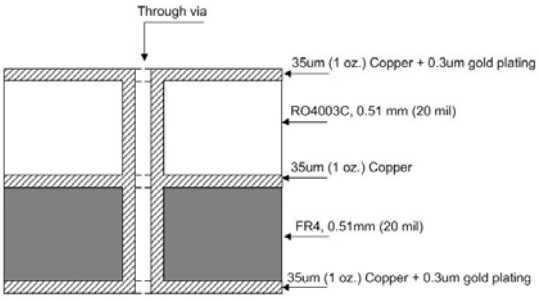

Fig 8. BGU706x Evaluation board stack up

3.4 Recommended footprint

A good PCB layout is an essential part of an RF circuit design. The BGU7063 evaluation board can serve as a guideline for laying out a board using the BGU7063. Both RF input and RF output lines are controlled impedance lines. Vcc1 and Vcc2 are decoupled by a Π filter decoupling. The recommended footprint for reflow soldering can be found in Fig 9 as well as via this link sot1301-1_fr.pdf.

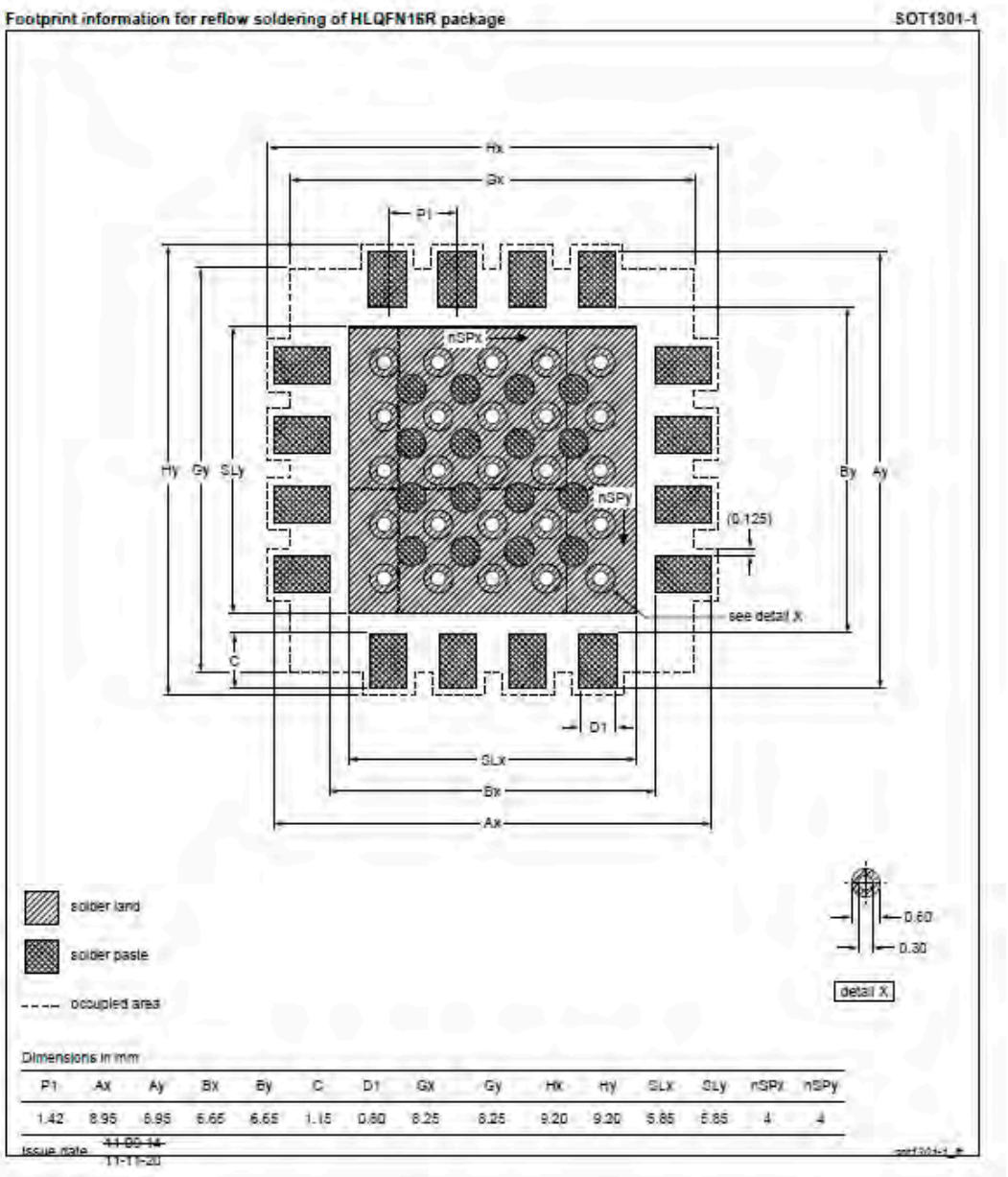

Fig 9. Recommended footprint specification for the HLQFV16R

4. Test Setup

4.1 S_Parameter,1dB compression, IIP3, measurement setup

The BGU7063 EVB is fully assembled and tested.

Fig 10 Shows the measurements setup that is used to evaluate the BGU7063 EVB for S_parameters Gain, IRL ORL Reverse Isolation), 1dB gain compression as well as IIP3. It is intended as a guide only, substitutions are possible. The 10dB attenuator in the output path is recommended in order to avoid overdriving the analyzers receiver port when measuring 1 dB gain compression. Especially in the high gain mode of the BGU7063, this is needed.

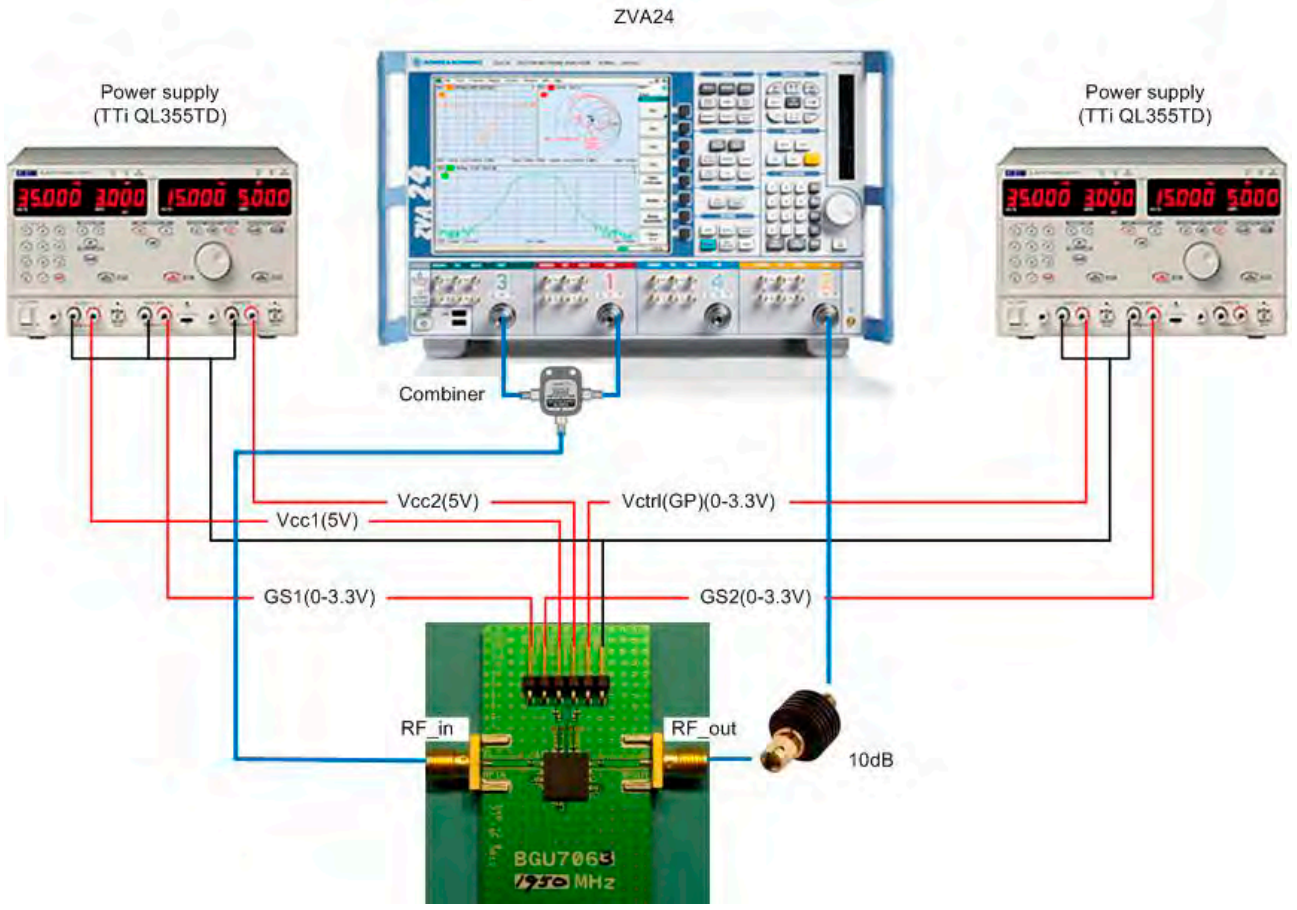

Fig 10. S_parameter, 1dB compression and IP3 measurement setup.

4.2 Noise figure measurement setup

In Fig 11 the noise figure measurement set-up is shown, this is also intended as a guide only, substitutions can be made. For the High gain mode of the BGU7063 it is recommended to use a 5dB ENR noise source, for the Low gain a 15 dB ENR noise source recommended. To achieve to lowest possible setup noise figure an external pre

amplifier might be necessary, but since this will make the total gain in the highest gain setting of the BGU7063 to high a 6dB attenuator is needed to avoid overdriving the input of the spectrum analyzer.

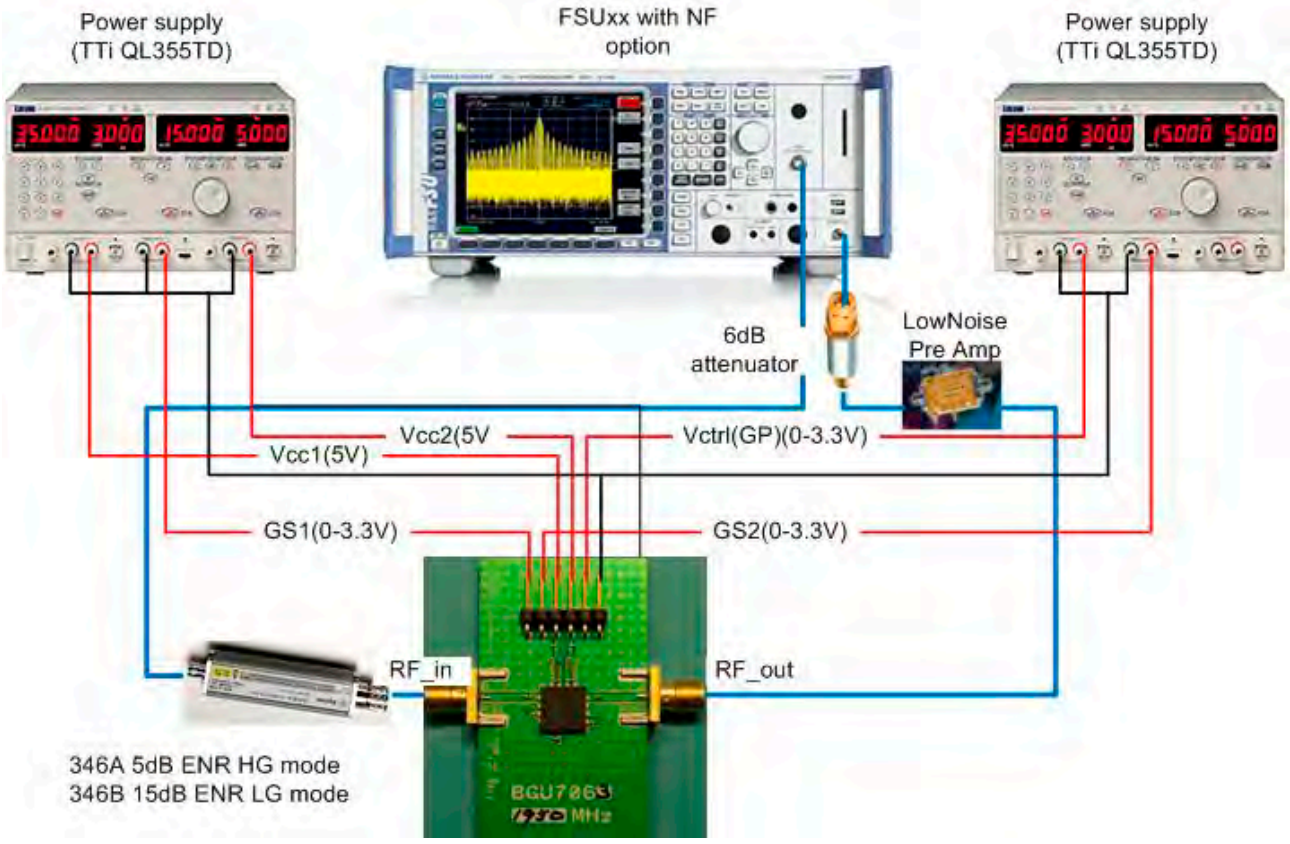

Fig 11. Noise figure test setup

5. Typical operating performance.

A detailed overview of the performance of the BGU7063 can be found in de Datasheet.

In Table 2 and Table 3 the typical performance at 1950MHz in High- and Low-gain is given.

Table 2. Typical performance high gain mode

GS1=LOW; GS2=HIGH; Vcc1=5V; Vcc2=5V; f=1950MHz; Tamb=25°C; input and output 50Ω; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC(tot)}$	total supply current		200	230	265	mA
$G_{p(min)}$	minimum power gain	$V_{ctrl(Gp)}$ = 3.3 V		12.5		dB
$G_{p(max)}$	maximum power gain	$V_{ctrl(Gp)}$ = 0 V		37.5		dB
$G_{p(flat)}$	power gain flatness	1920 MHz≤ f ≤1980 MHz 18 dB≤ G_{p}≤ 35 dB		0.2		dB
NF	noise figure	$V_{ctrl(Gp)}$ = 0 V(maximum power gain)		0.9		dB
		G_p = 35 dB		1.05		dB
		G_p = 18 dB		6.40		dB
$IP3_I$	input third-order intercept point	2-tone; tone-spacing = 1.0 MHz				
		G_p = 35 dB		0.9		dBm
		G_p = 30 dB		3.4		dBm
		G_p = 29 dB		3.8		dBm
		G_p = 18 dB		5.4		dBm
$P_{i(1dB)}$	input power at 1 dB gain compression	G_p = 35 dB		0.9		dBm
		G_p = 30 dB		3.4		dBm
		G_p = 29 dB		3.8		dBm
		G_p = 18 dB		5.4		dBm
RL_{in}	input return loss	$V_{ctrl(Gp)}$ = 0 V(maximum power gain)		35		dB
		G_p = 35 dB		31		dB
RL_{out}	output return loss	$V_{ctrl(Gp)}$ = 0 V (maximum power gain)		15		dB
K	Rollett stability factor	0 GHz≤ f ≤ 12.75 GHz	1	-		

Table 3. Typical performance low gain mode

GS1=HIGH; GS2=LOW; Vcc1=5V; Vcc2=5V; f=1950MHz; Tamb=25°C; input and output 50Ω; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC(tot)}$	total supply current		165	190	215	mA
$G_{p(min)}$	minimum power gain	$V_{ctrl(Gp)}$ = 3.3 V		-6.6		dB
$G_{p(max)}$	maximum power gain	$V_{ctrl(Gp)}$ = 0 V		18.6		dB
$G_{p(flat)}$	power gain flatness	1920 MHz≤ f ≤1980 MHz 3 dB≤ G_{p}≤ 17 dB		0.2		dB
NF	noise figure	$V_{ctrl(Gp)}$ = 0 V(maximum power gain)				dB
		G_p = 17 dB		11.3		dB
		G_p = 3 dB		22.0		dB
$IP3_I$	input third-order intercept point	2-tone; tone-spacing = 1.0 MHz				
		G_p = 17 dB		20		dBm
		G_p = 12 dB		24		dBm
		G_p = 11 dB		25		dBm
		G_p = 3 dB		28		dBm
$P_{i(1dB)}$	input power at 1 dB gain compression	G_p = 17 dB		6.0		dBm
		G_p = 12 dB		10.0		dBm
		G_p = 11 dB		10.5		dBm
		G_p = 3 dB		10.5		dBm
RL_{in}	input return loss	$V_{ctrl(Gp)}$ = 0 V(maximum power gain)		30		dB
		G_p = 17 dB		25		dB
RL_{out}	output return loss	$V_{ctrl(Gp)}$ = 0 V (maximum power gain)		18		dB
K	Rollett stability factor	0 GHz≤ f ≤ 12.75 GHz	1			

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7. List of figures

8. List of tables

9. Contents

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