BGA231L7

LNA for Global Positioning Systems

Application Note AN250

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2012-02-20

RF and Protection Devices

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Application Note AN250

Revision History: 2012-02-20

Previous Revision: Rev. 1.1, 2011-02-11

Page	Subjects (major changes since last revision)
Page 7	Measurements added for supply voltage of 1.8 V

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1 Introduction

The BGA231L7 is a low cost and easy-to-use SiGe LNA (Low Noise Amplifier). It features high gain, ultra low noise figure, high linearity and an outstanding ESD performance of 2 kV HBM at all pins.

BGA231L7's integrated biasing circuit makes powering of the device an easy task, offering a constant bias point over a wide range of supply voltages and temperatures. The LNA can be switched on and off using a standard digital logic level as the control current into PON pin is only 5 µA in on-state and even lower at off-state.

BGA231L7's output is already matched to 50 Ohm and its input is pre-matched requiring only one coil for impedance matching. The bypass capacitor at VCC (Pin-6) can be chosen above 1nF in order to provide a proper ground for low frequency signals.

This application note demonstrates the performance of the device on a low cost 0.2 mm FR4 material using standard 0201 size SMT components

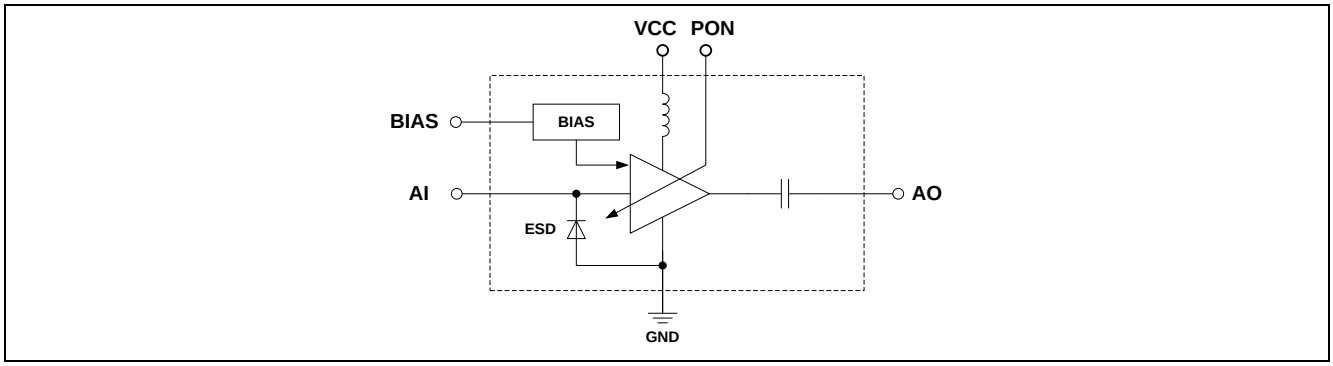

Figure 1 Block diagram

Figure 2 shows the location of BGA231L7's gain circles and noise circles at device level. This means that losses of external passives and losses of a PCB are not included.

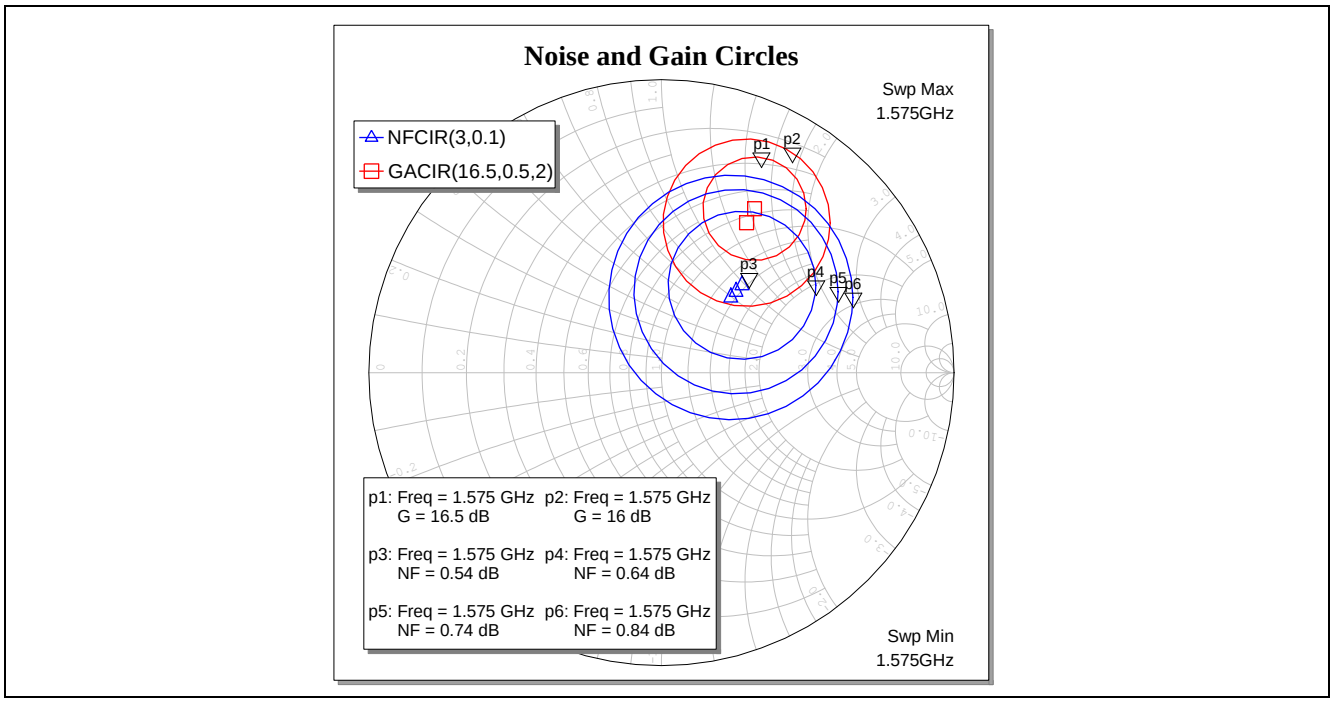

Figure 2 Device level noise circles (blue) and gain circles (red) at 1575 MHz

2 Application Circuit

2.1 Schematic Diagram

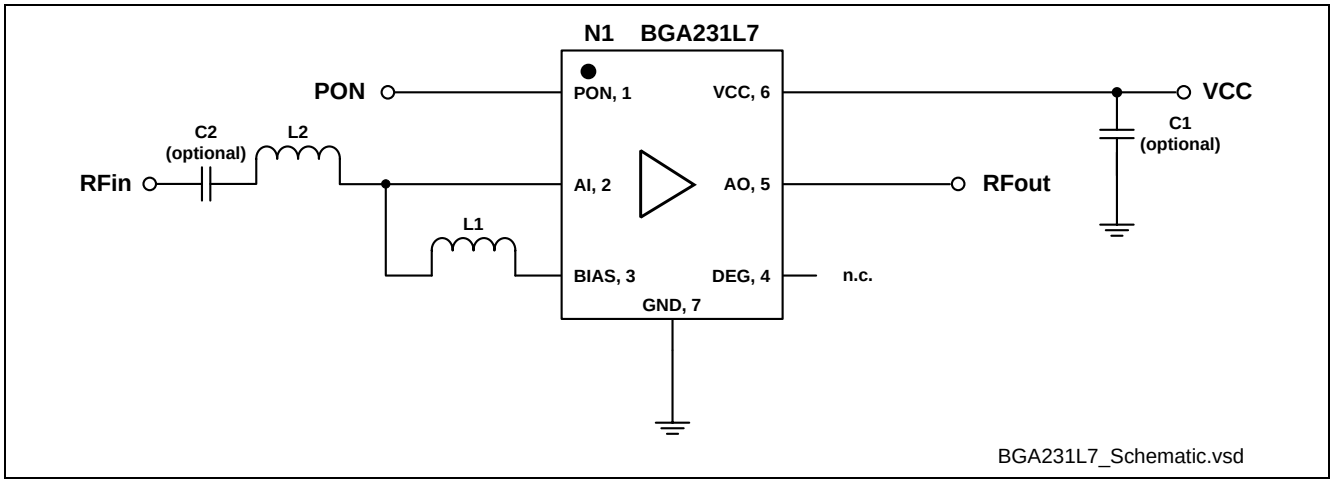

Figure 3 BGA231L7 application circuit

Table 1 Bill-of-Materials

Symbol	Value	Unit	Package	Manufacturer	Comment
C1	100	nF	0201	Various	RF bypass for low frequencies
C2	33	pF	0201	Various	DC block, optional, self resonance frequency @ 1.575 GHz
L1	39	nH	0201	Murata LQP03T	Bias feed, RF choke, self resonance frequency @ 1.575 GHz
L2	6.8	nH	0201	Murata LQP03T	Input matching / noise matching
Q1	BGA231L7		TSLP-7-1	Infineon	SiGe LNA

3 Typical Measurement Results

Table 2 and Table 3 show typical measurement results of the application circuit shown in Figure 3. The values given in this table include losses of the board and the SMA connectors if not otherwise stated.

Table 2 Electrical Characteristics (at room temperature)

Vcc = Vpon = 1.8 V

Parameter	Symbol	Value		Unit	Comment/Test Condition
DC Voltage	Vcc	1.8		V	
DC Current	Icc	4.3		mA	
Frequency Range	Freq	1575	1609	MHz	
Gain	G	15.8	15.7	dB	
Noise Figure	NF	0.85	0.83	dB	Incl. board and connector losses
		0.70	0.68	dB	Losses de-embedded
Input Return Loss	RLin	8.8	9.0	dB	
Output Return Loss	RLout	17.2	19.9	dB	
Reverse Isolation	IRev	22.7	22.5	dB	
Input P1dB	IP1dB	-7.5	-7.3	dBm	
Input IP3	IIP3	-1.3	-0.8	dBm	f_1 = 1575 MHz, f_2 = 1576 MHz, -30 dBm per tone
Out-of-Band IIP2	OoB_IP2	2.5		dBm	f_1 = 2400 MHz, -50 dBm f_2 = 824.6 MHz, -20 dBm
Out-of-Band IIP3	OoB_IP3	5.0		dBm	f_1 = 1850 MHz, -50 dBm f_2 = 1712.7 MHz, -20 dBm
Stability	k	> 1.2		--	

Table 3 Electrical Characteristics (at room temperature)

Vcc = Vpon = 2.85 V

Parameter	Symbol	Value		Unit	Comment/Test Condition
DC Voltage	Vcc	2.85		V	
DC Current	Icc	4.4		mA	
Frequency Range	Freq	1575	1609	MHz	
Gain	G	15.9	15.8	dB	
Noise Figure	NF	0.85	0.84	dB	Incl. board and connector losses
		0.70	0.69	dB	Losses de-embedded
Input Return Loss	RLin	9.3	9.5	dB	
Output Return Loss	RLout	16.6	20.3	dB	
Reverse Isolation	IRev	23.1	22.9	dB	
Input P1dB	IP1dB	-4.7	-4.5	dBm	
Input IP3	IIP3	-1	-0.5	dBm	f_1 = 1575 MHz, f_2 = 1576 MHz, -30 dBm per tone
Out-of-Band IIP2	OoB_IP2	2		dBm	f_1 = 2400 MHz, -50 dBm f_2 = 824.6 MHz, -20 dBm
Out-of-Band IIP3	OoB_IP3	4.5		dBm	f_1 = 1850 MHz, -50 dBm f_2 = 1712.7 MHz, -20 dBm
Stability	k	> 1.2		--	

4 Measured Graphs

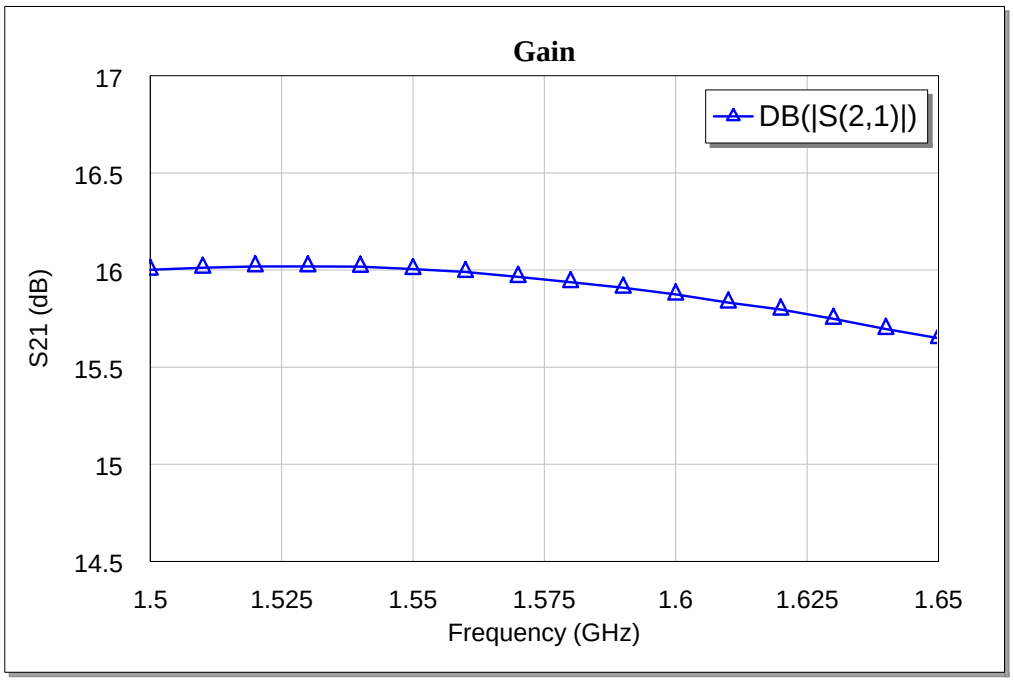

Figure 4 Gain

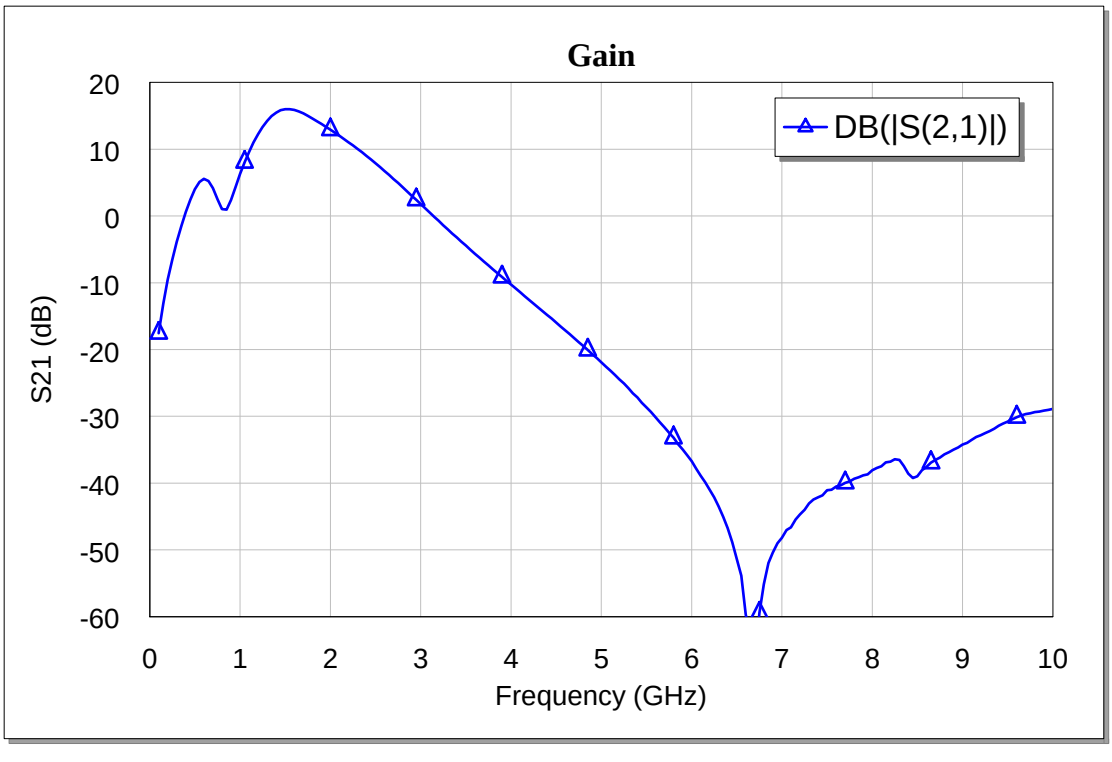

Figure 5 Wideband Gain

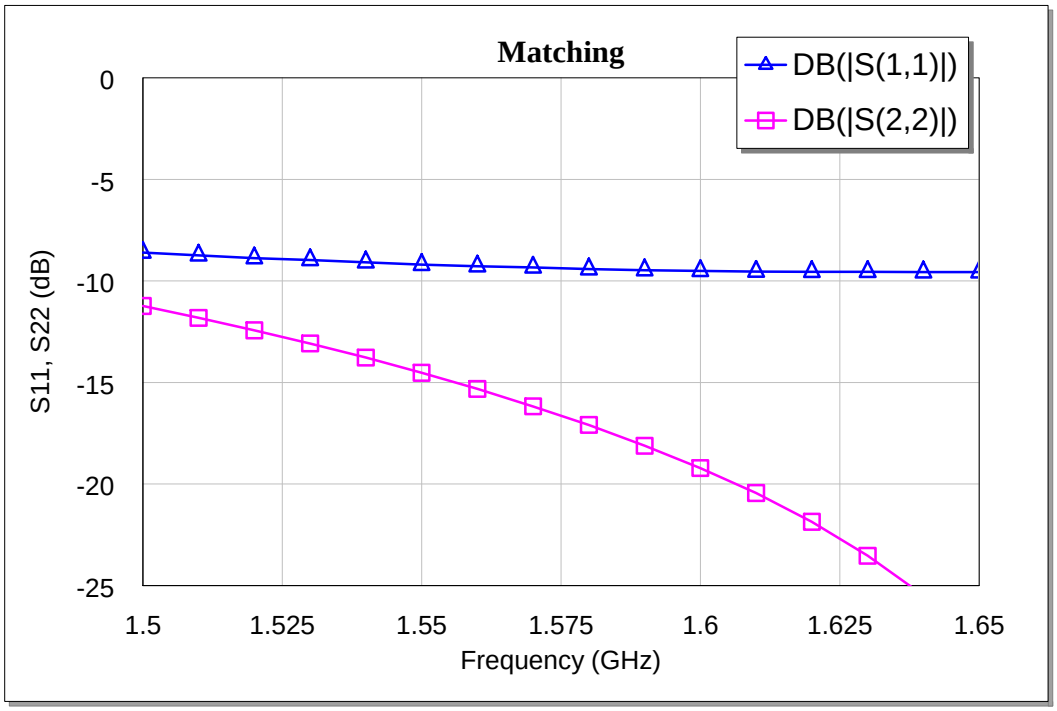

Figure 6 Matching

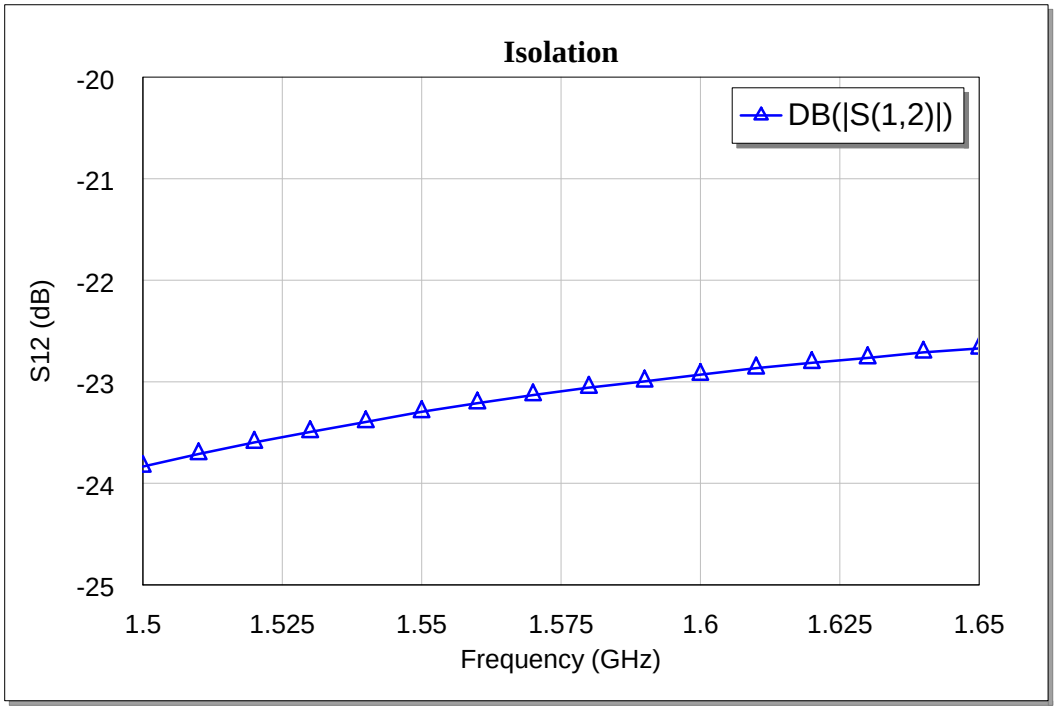

Figure 7 Isolation

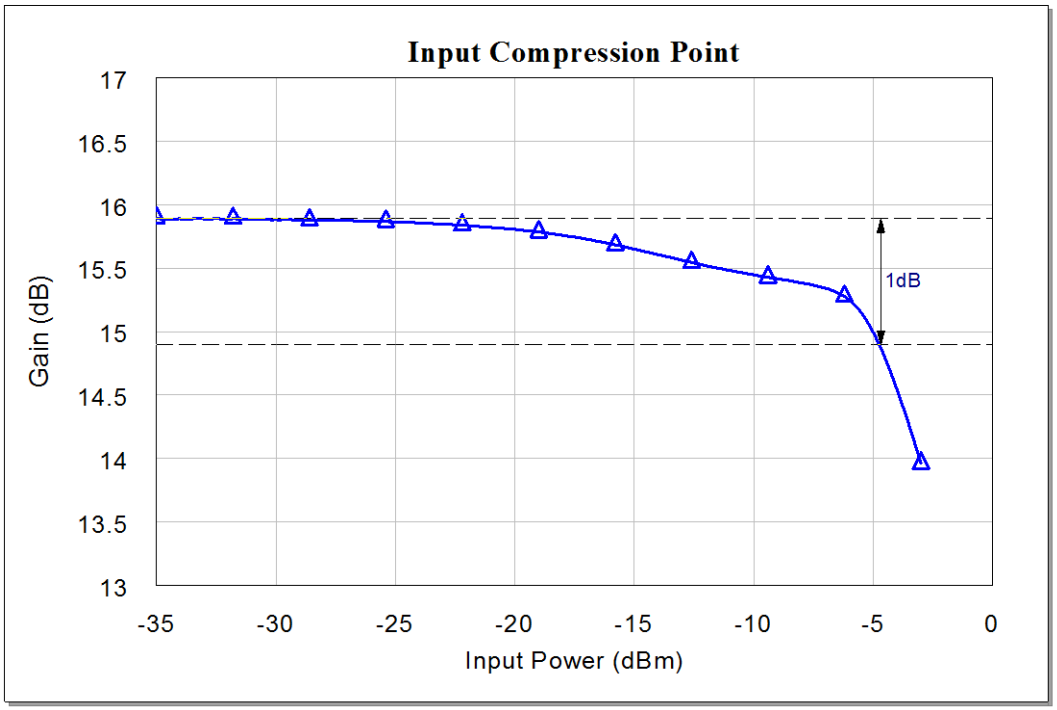

Figure 8 Input 1 dB compression point

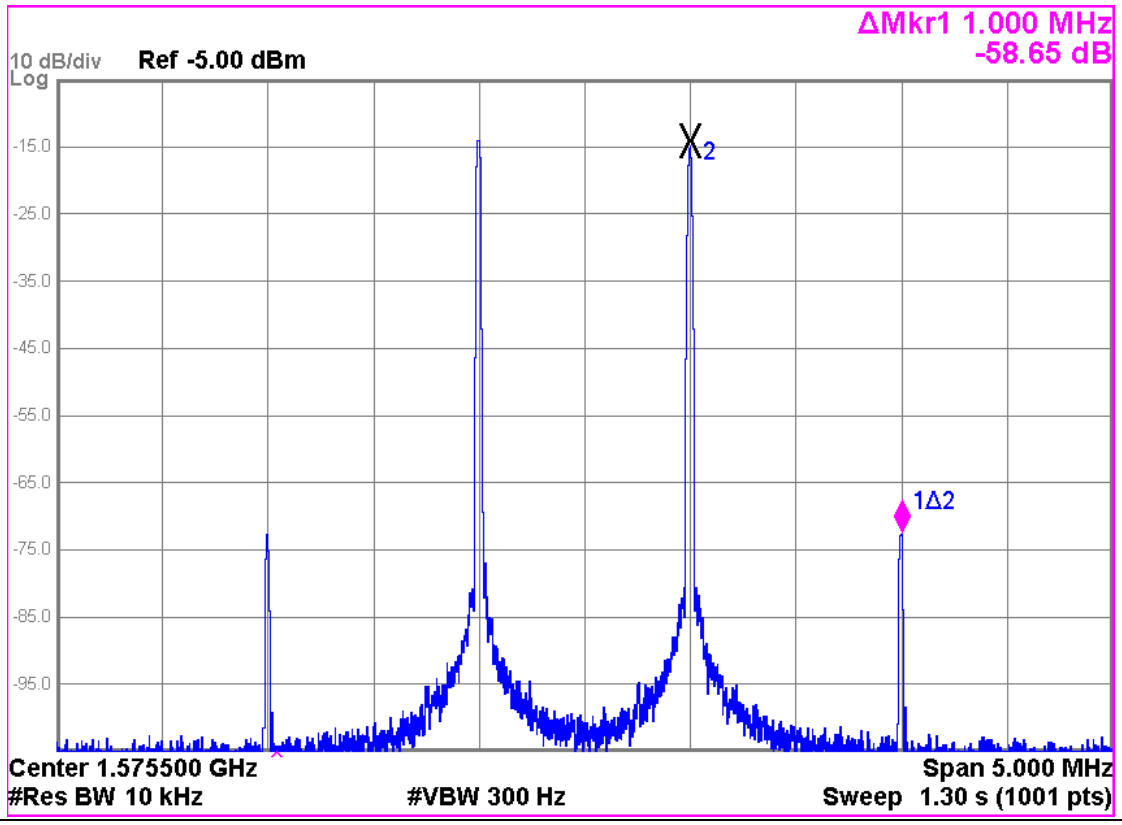

Figure 9 IP3 measurement

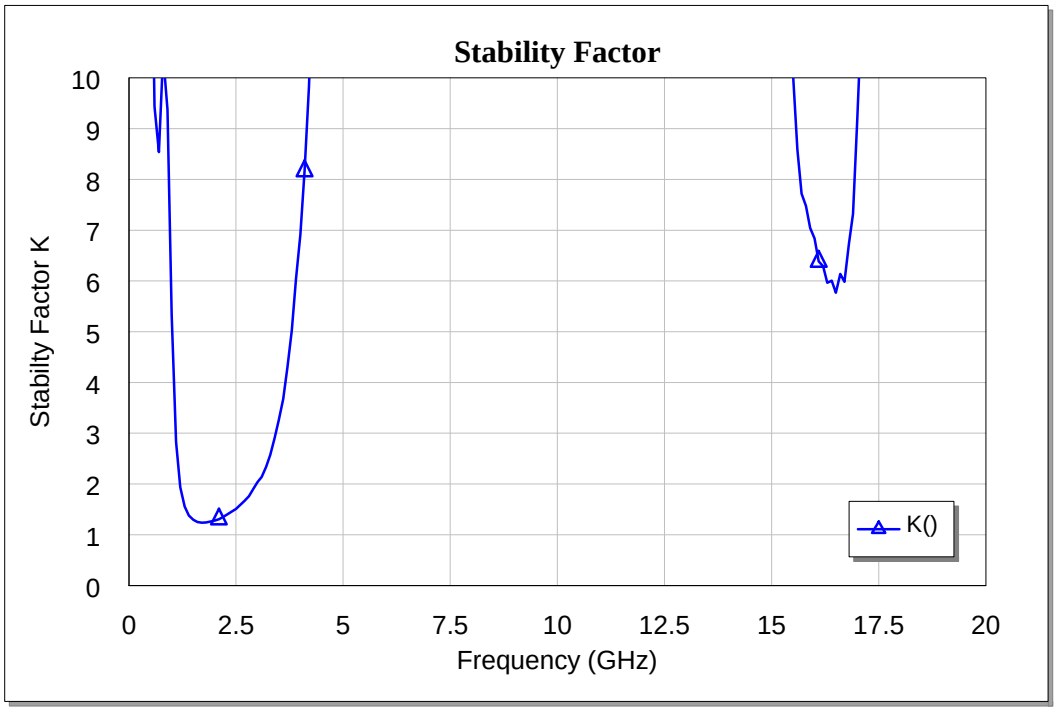

Figure 10 Stability factor

5 Evaluation Board

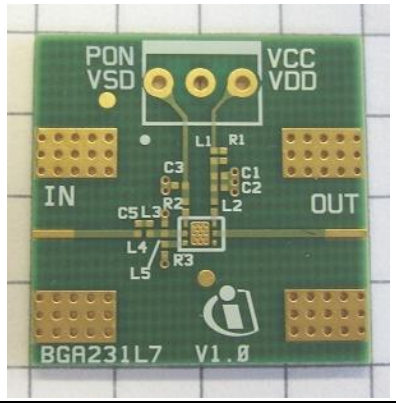

Figure 11 Unpopulated board. Size: 20 mm x 20 mm.

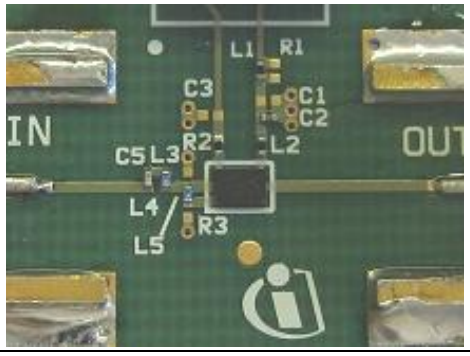

Figure 12 Assembled board

Note: There are three 0 Ω jumpers at positions L1, L2 and R2 in Figure 12. These are not required for a new design with BGA231L7 but make it possible to place a pin-compatible competitor's part on the same PCB. This competitor's device requires additional coils, resistors and capacitors.

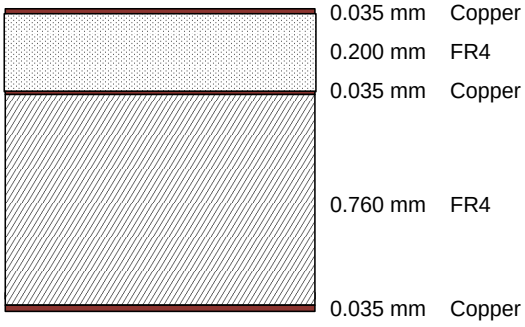

Figure 13 PCB layer stack

6 Author

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