UM10453

2-Tone Test BGU7005 and BGU7007 GPS LNA

Rev. 2 — 15 October 2012 **User manual**

Document information

Info	Content
Keywords	LNA, GPS, BGU7005, BGU7007 Linearity Measurements
Abstract	This document describes 2-Tone Linearity Measurements with the BGU7005 and BGU7007 GPS low noise amplifier evaluation board.

Revision history

Rev	Date	Description
v1	20110311	First release
v2	20121015	Updated version

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1. Introduction

NXP Semiconductors BGU7005 and BGU7007 are low-noise amplifiers for GPS receiver applications in a plastic, leadless 6 pin, extremely thin small outline SOT886 package. The typical gain is 16.5 dB for the BGU7005 and 18.5 dB for the BGU7007. Both types have a noise figure of 0.9 dB (incl. board losses) or 0.85 dB (board losses subtracted). They have a superior linearity performance to suppress interference and noise from co-habitation cellular transmitters, while retaining sensitivity. The GPS LNA evaluation boards (EVB's) are designed to evaluate the performance of the BGU7005 and BGU7007 applied as a GPS LNA (Fig 1).

The application diagram, board layout, bill of materials, and typical results of the EVB's are given in separate application notes about the BGU7005 and BGU7007.

This document shows examples of the linearity performance to suppress interference from co-habitation (cellular) transmitters with a 2-Tone test.

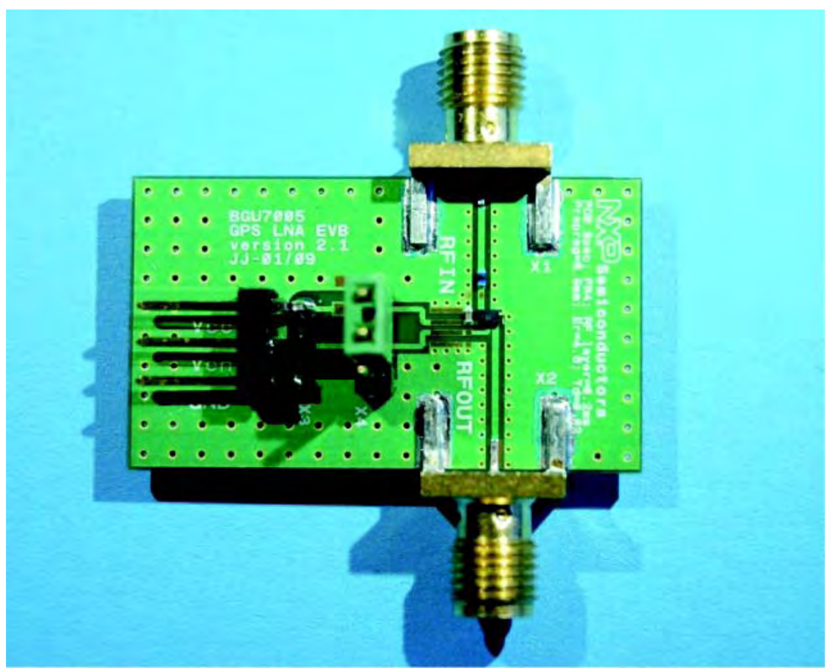

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Fig 1. BGU7005 GPS LNA evaluation board (Same board is used for the BGU7007).

Note 1: Including PCB losses.

The BGU7005 and BGU7007 GPS LNA evaluation boards simplify the evaluation of the BGU7005 and BGU7007 GPS LNA's for the GPS applications. The evaluation boards enable testing of the device performance and require no additional support circuitry. The boards are fully assembled with the BGU7005 or BGU7007, including the input series inductor as well as a decoupling capacitor to optimize the performance. The boards are supplied with two SMA connectors for input and output connection to RF test equipment. The BGU7005 and BGU7007 can operate from a 1.5 V to 2.85 V single supply and consumes about 5 mA.

1.1 Application Circuit

The circuit diagram and EVB-layout of the evaluation board are shown below. With jumper JU1 the enable pin can be controlled to either to V_{cc} or GND.

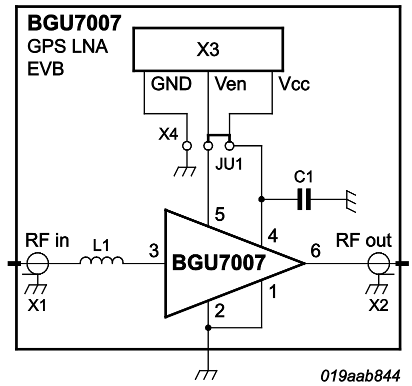


Fig 2. Circuit diagram of the BGU7005 (and BGU7007) evaluation board

1.2 Board layout

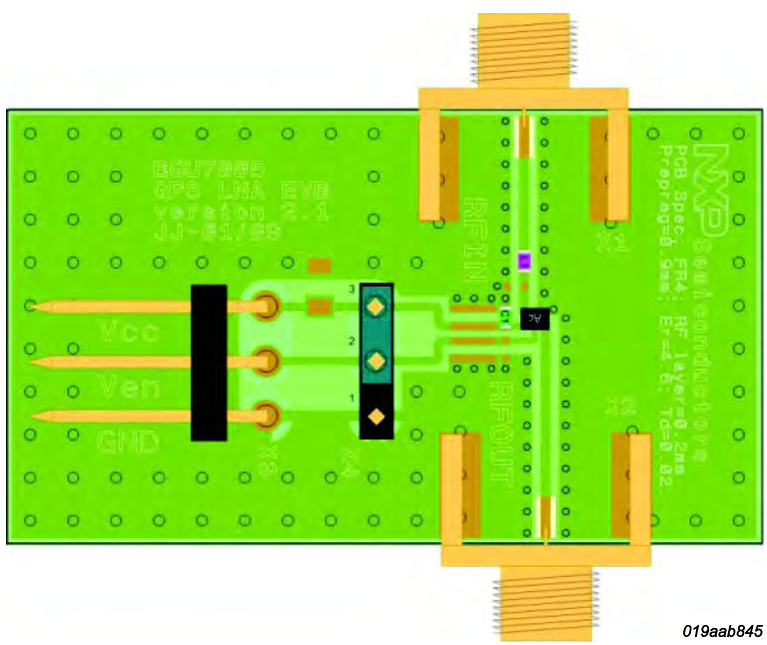


Fig 3. Printed circuit board lay-out of the BGU7005 (and BGU7007) GPS LNA evaluation board

2. Out-of-Band Second- and Third-Order Intercept Points

At the average power levels of –130 dBm that have to be received by a GPS receiver, the system will not have in-band intermodulation problems caused by the GPS-signal itself. Strong out-of-band cell phone TX jammers however can cause linearity problems, and result in third-order intermodulation products in the GPS frequency band.

The Out-of-Band Second- and Third-Order Intercept Points (IIP2 and IIP3) are measured by a two-tone measurement where the carriers have been chosen is such a way that one of the following conditions is met:

1. Second-Order distortion: $f_{spur} = f_1 + f_2$ ~1575 MHz
2. Third Order Distortion: $f_{spur} = 2f_1 - f_2$ ~1575 MHz

With f_{spur} is around the center of the GPS band (~1575 MHz).

Figure 4 gives an overview of the frequency-spectrum caused by second- and third order intermodulation in a 2-Tone test.

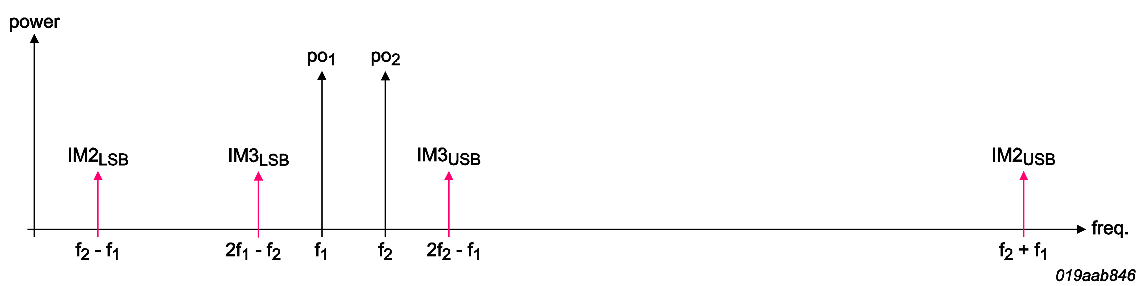


Fig 4. O-IIP3 at V_{cc} = 1.5 V, 1.8V and 2.85 V

Several cases can be found for which one of the above conditions is valid. In this document 5 test cases will be discussed in more detail. Table 1 gives the five cases. The f_{spur}-component which falls inside the GPS-band is high-lighted.

Table 1. Test cases Out-of-Band Input Second- and Third-Order Intercept Point

Test case	Signal Type f_1	Signal Type f_2	$IM2_{LSB}$-Comp.	$IM3_{LSB}$-Comp	Input Tone-1	Input Tone-2	$IM3_{USB}$-Comp.	$IM2_{USB}$-Comp.
			f_2-f_1	$2f_1$-f_2	f_1	f_2	$2f_2$-f_1	f_2+f_1
			[MHz]	[MHz]	[MHz]	[MHz]	[MHz]	[MHz]
1	UMTS FDD	GSM1800	138	**1575.42**	1713.42	1851.42	1989.42	3564.84
2	LTE	LTE	0.6	786.8	787.4	788	788.6	**1575.4**
3	GSM900	BT/WLAN	**1575.4**	-750.8	824.6	2400	3975.4	3224.6
4	GSM1800	WLAN	3425	**|-1575|**	1850	5275	8700	7125
5	GPS	GPS	1	**1574**	1575	1576	1577	3151

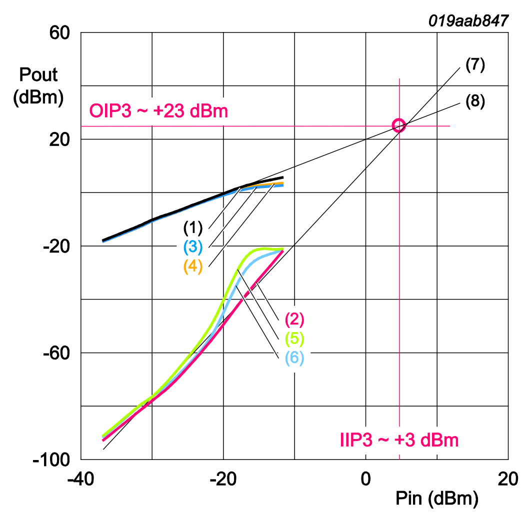
The two carriers in the Table 1 (f_1 and f_2) can be seen as two TX jammers (for example in UMTS FDD and GSM1800 cell phone systems). One of the third-order products ($2f_1$-f_2) generated in the LNA due to amplifier third order non-linearity's can fall at the desired 1575.42 MHz frequency as follows:

$2f_1$-f_2=2(1713.42 MHz)-1851.42 MHz=1575.42 MHz (test-case 1).

This third-order product can influence the sensitivity of the GPS receiver drastically. So this third-order intermodulation product needs to be as low as possible, meaning the out-of-band intercept point must be as high as possible.

As an example Fig 5 shows the In- and Output-IP3 of the BGU7007 at different supply voltages (typical values). The results of all test-cases will be discussed later.

In Fig 5 the Pin-Pout-curve and third-order spur ($IM3_{LSB}$) and their trend lines are given. The point where both dashed trend lines meet gives the in- and output IP3.



(1) Pout@2.85V

(2) IM3(2f1-f2)@2.85V

(3) Pout@1.5V

(4) Pout@1.8V

(5) IM3(2f1-f2)@1.5V

(6) IM3(2f1-f2)@1.8V

(7) Linear (Pout@2.85V)

(8) Linear (IM3(2f1-f2)@2.85V)

BGU7007 GPS LNA EVB#166, 2-Tone test, f_1 =1713.42 MHz, f_2 =1851.42 MHz, f_spur =1575.42 MHz

Fig 5. O-IIP3 at V_{cc} = 1.5 V, 1.8 V and 2.85 V

The formula's to calculate the IP2 and IP3 are taken from literature and given below:

Formula's IP2:

f_1:	$OIP2_{LSB} = po_1 + po_2 - IM2_{LSB}$	[dBm]	(1)
f_2:	$OIP2_{USB} = po_2 + po_1 - IM2_{USB}$	[dBm]	(2)
	$IIP_2 = OIP2_{LSB} - Gp_1$	[dBm]	(3)
	$IIP_2 = OIP2_{USB} - Gp_2$	[dBm]	(4)

With Gp_1 = power gain = $po_1 - pi_1$	[dB]	(5)
Gp_2 = power gain = $po_2 - pi_2$	[dB]	(6)

Formula's IP3:

f_1:	$OIP3_{LSB} = po_1 + (po_2 - IM3_{LSB})/2$	[dBm]	(7)
f_2:	$OIP3_{USB} = po_2 + (po_1 - IM3_{USB})/2$	[dBm]	(8)
	$IIP3_{LSB} = OIP3_{USB} - Gp_1$	[dBm]	(9)
	$IIP3_{USB} = OIP3_{LSB} - Gp_2$	[dBm]	(10)

Note: The in- and output powers in the formula's are for in- and output-levels of the DUT. Therefore the cable losses and RF-Combiner losses have to be measured. These losses can be used to correct the measured power levels.

3. Required Equipment

In order to measure the evaluation board the following is necessary:

- DC Power Supply up to 30 mA at 1.5 V to 2.85 V;
- Two RF signal generators capable of generating an RF signal at the jammer frequencies f_1 and f_2 listed in Table 1;
- An RF spectrum analyzer that covers at least the operating frequency of 1575 MHz as well as a few of the harmonics, so up to 6 GHz should be sufficient;
- Amp meter to measure the supply current (optional);
- RF-Combiner;
- Proper RF cables.

The table below gives an overview of the equipment used for the 2 Tone test. It can be used as an example which equipment to use.

Table 2. Equipment used for 2-Tone test

Equipment	Type	Settings	
RF-Generator f_1	R&S SMA 100A (9 kHz…6 GHz)	-	
RF-Generator f_2	R&S SMR20 (10 MHz…20 GHz)	-	
Power Splitter/Combiner	Agilent 11667B (DC-26.5 GHz)	-	
Spectrum Analyzer	HP8595E	Res. BW:	10 kHz
		Video BW:	10 kHz (AUTO)
		Video AVG:	ON (100x)
		Pref:	-20 dBm
		Att.:	10 dB
		Fcenter	Fmeas
		Fspan:	100 kHz
		Tweep:	Auto

4. Connections and setup

The BGU7005 and BGU7007 GPS LNA evaluation boards are fully assembled and tested. Figure 6 gives an overview of the 2-Tone test setup. Please follow the steps below for a step-by-step guide to operate the evaluation board and testing the device functions.

1. Measure the cable- and RF-Combiner losses at the frequencies which are used during the evaluation to (see Table 1). These losses are used to correct the measured power levels.
2. Connect the DC power supply to the V_{cc}, and GND terminals. Set the power supply to the desired supply voltage, between 1.5 V and 2.85 V, but never exceed 3.1 V as it might damage the BGU7007.
3. Jumper JU1 is connected between the V_{cc} terminal of the evaluation board and the V_{en} pin of the BGU7005 or BGU7007.

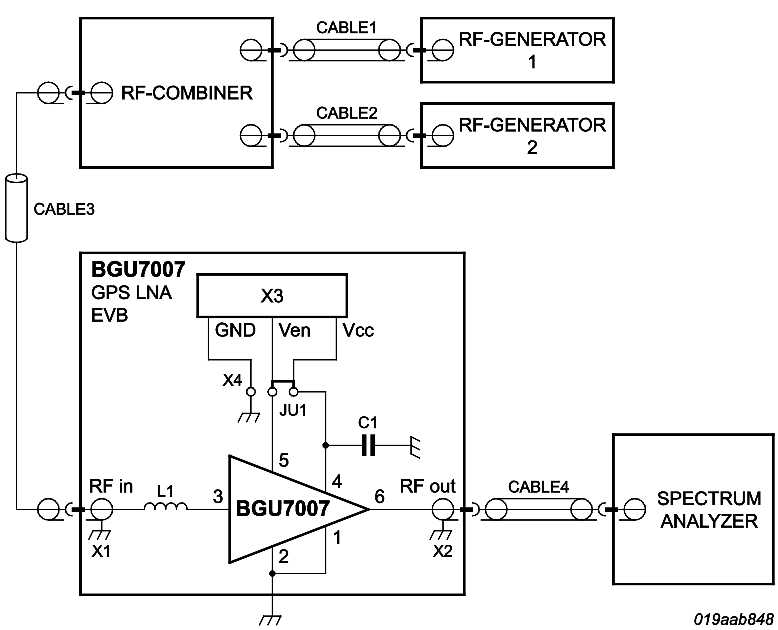


Fig 6. 2-Tone Test Setup

4. Connect the RF signal generators via the RF-combiner to the RF input and the spectrum analyzer to the RF output of the evaluation board (See Fig 6). Do not turn on the RF output of the Signal generators yet, set it to -30 dBm output power at f1 and f2 (see Table 1), set the spectrum analyzer at f_{spur} (~1575 MHz, see Table 1) center frequency and a reference level of -20 dBm.
5. Turn on the DC power supply and it should read approximately 5 mA.
6. Enable the RF output of the generators; the spectrum analyzer displays a tone of around –95 dBm at f_{spur} (~1575 MHz, see Table 1).

7. Increase the RF output-level of the Signal generators of f1 and f2 from -30 dBm to approx. -5 dBm and check the spectrum analyzer level at f_{spur} (~1575 MHz, see Table 1).

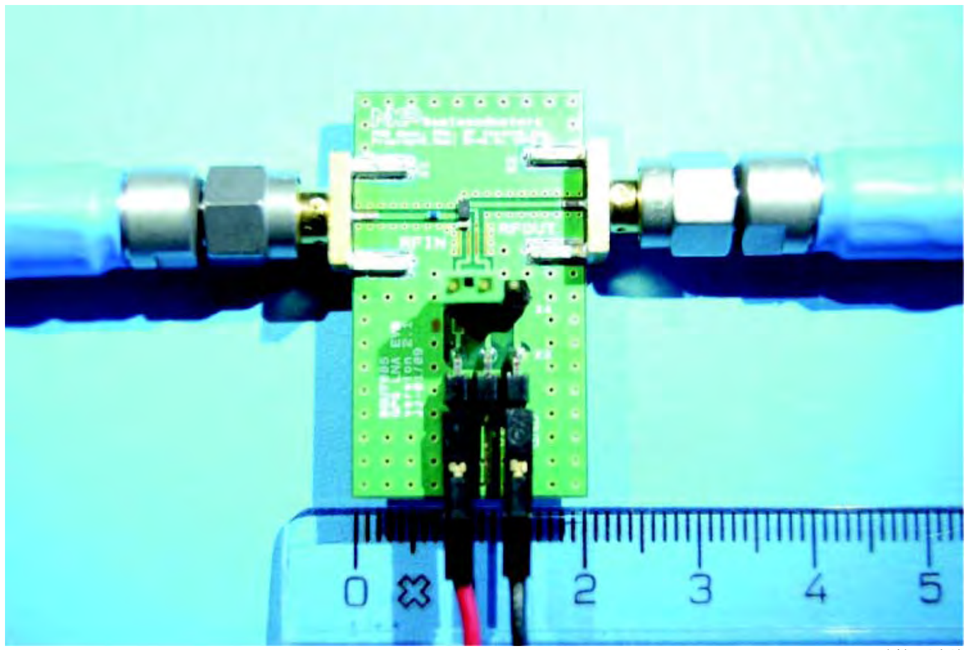


Fig 7. BGU7005 (and BGU7007) evaluation board including its connections

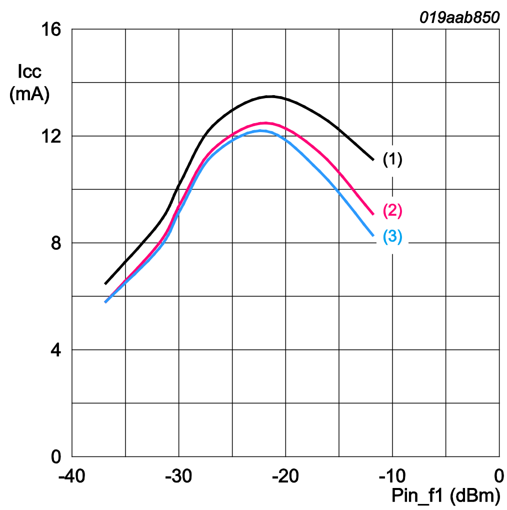
5. Typical Evaluation Board results

5.1 Test-Case 1

Generators: f_1 = 1713.42 MHz, f_2 = 1851.42 MHz

Spectrum Analyzer: Third Order Product f_{spur} = 1575.42 MHz

The figures below give the measured results of the 2-Tone test for BGU7007 and BGU7005 EVB's:



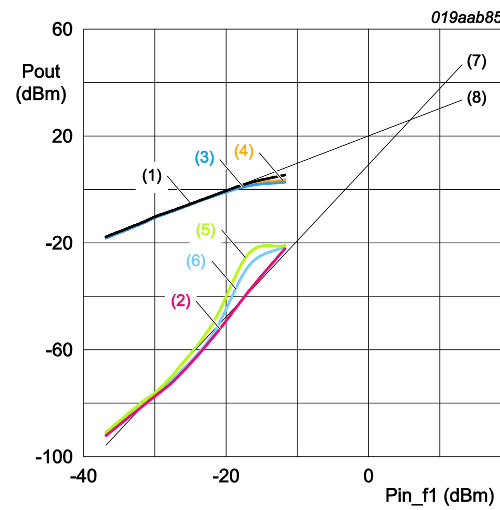
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7007 GPS LNA EVB#166, Icc = f(Pin), 2-Tone test, f_1=1713.42 MHz, f_2=1851.42 MHz, f_spur=1575.42 MHz

Fig 8. Tone Test Results Test-Case 1, BGU7007



(1) Pout_f_1@2.85V

(2) IM3($2f_1$-f_2)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM3($2f_1$-f_2)@1.5V

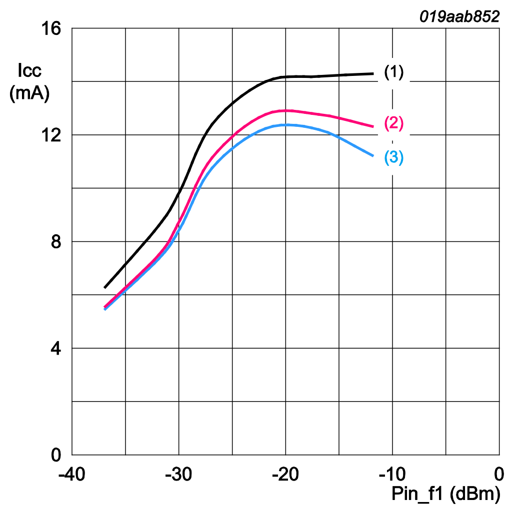
(6) IM3($2f_1$-f_2)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM3($2f_1$-f_2)@2.85V)

BGU7007 GPS LNA EVB#166, 2-Tone test, f_1=1713.42 MHz, f_2=1851.42 MHz, f_spur=1575.42 MHz

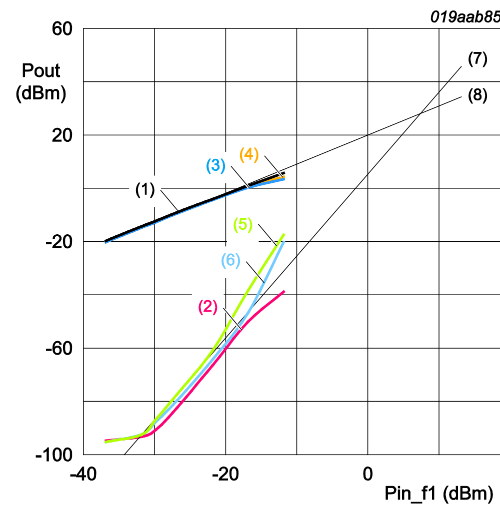
Fig 9. 2-Tone Test Results Test-Case 1, BGU7007



(1) Vcc = 2.85 V
(2) Vcc = 1.8 V
(3) Vcc = 1.5 V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=1713.42 MHz, f_2=1851.42 MHz, f_spur=1575.42 MHz

Fig 10. Tone Test Results Test-Case 1, BGU7005



(1) Pout_f_1@2.85V
(2) IM3($2f_1$-f_2)@2.85V
(3) Pout_f_1@1.5V
(4) Pout_f_1@1.8V
(5) IM3($2f_1$-f_2)@1.5V
(6) IM3($2f_1$-f_2)@1.8V
(7) Linear (Pout_f_1@2.85V)
(8) Linear (IM3($2f_1$-f_2)@2.85V)

BGU7005 GPS LNA EVB#60, 2-Tone test, f_1=1713.42 MHz, f_2=1851.42 MHz, f_spur=1575.42 MHz

Fig 11. 2-Tone Test Results Test-Case 1, BGU7005

Table 3. Results Test case 1: Third Order Intercept Points, Temp = 25 °C.

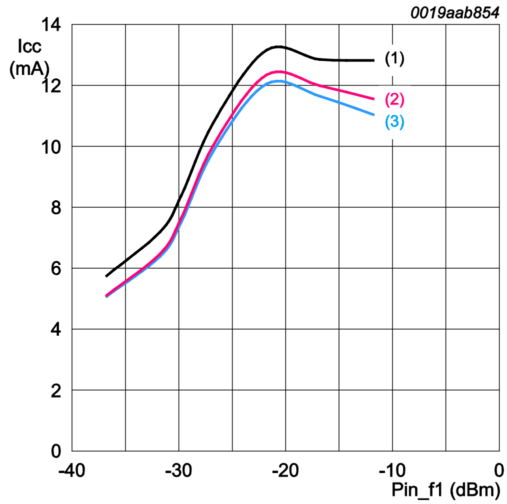
				DUT	DUT	DUT	DUT	DUT	DUT
		Vsup	Isup	Pin_f_1	Pout_f_1	Gp_DUT_f_1	IM3_($2f_1$-f_2)	OIP3_($2f_1$-f_2)	IIP3_($2f_1$-f_2)
Type	EVB#	[V]	[mA]	[dBm]	[dBm]	[dB]	[dBm]	[dBm]	[dBm]
BGU7007	166	1.5	9.26	-29.84	-10.41	19.43	-75.90	21.59	2.16
BGU7007	166	1.8	9.5	-29.84	-10.30	19.54	-75.80	21.70	2.16
BGU7007	166	2.85	10.3	-29.84	-10.10	19.74	-77.30	22.75	3.01
BGU7005	60	1.5	8.5	-29.84	-12.90	16.94	-86.70	23.30	6.36
BGU7005	60	1.8	8.8	-29.84	-12.70	17.14	-87.60	24.00	6.86
BGU7005	60	2.85	9.9	-29.84	-12.40	17.44	-90.50	25.95	8.51

5.2 Test-Case 2

Generators: f_1 = 787.4 MHz, f_2 = 788 MHz

Spectrum Analyzer: Second Order Product f_{spur} = 1575.4 MHz

The figures below give the measured results of the 2-Tone test for BGU7007 and BGU7005 EVB's:



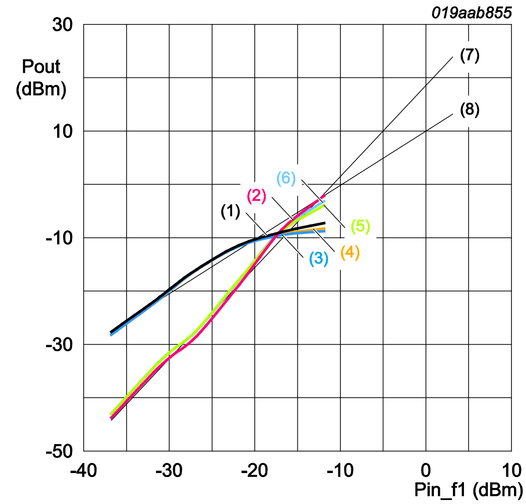
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7007 GPS LNA EVB#166, Icc = f(Pin), 2-Tone test, f_1=787.4 MHz, f_2=788 MHz, f_spur=1575.4 MHz

Fig 12. Tone Test Results Test-Case 2, BGU7007



(1) Pout_f_1@2.85V

(2) IM2(f_2+f_1)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM2(f_2+f_1)@1.5V

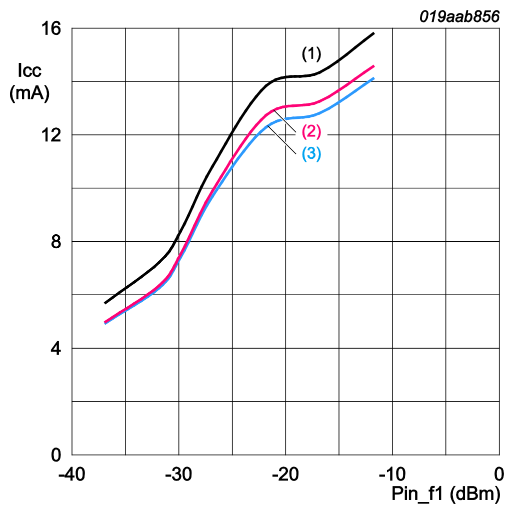
(6) IM2(f_2+f_1)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM2(f_2+f_1)@2.85V

BGU7007 GPS LNA EVB#166, 2-Tone test, f_1=787.4 MHz, f_2=788 MHz, f_spur=1575.4 MHz

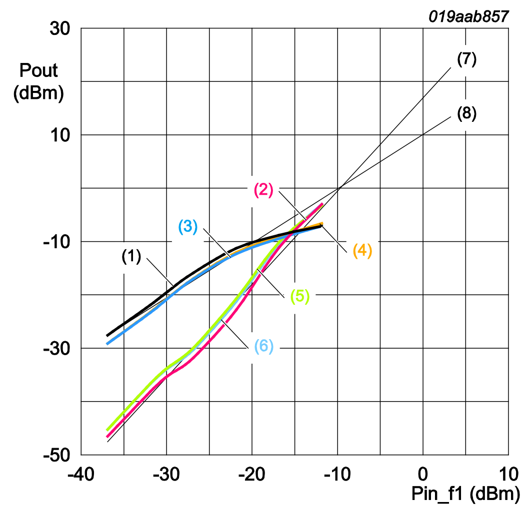
Fig 13. 2-Tone Test Results Test-Case 2, BGU7007



(1) Vcc = 2.85 V
(2) Vcc = 1.8 V
(3) Vcc = 1.5 V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=787.4 MHz, f_2=788 MHz, f_spur=1575.4 MHz

Fig 14. Tone Test Results Test-Case 2, BGU7005



(1) Pout_f_1@2.85V
(2) IM2(f_2+f_1)@2.85V
(3) Pout_f_1@1.5V
(4) Pout_f_1@1.8V
(5) IM2(f_2+f_1)@1.5V
(6) IM2(f_2+f_1)@1.8V
(7) Linear (Pout_f_1@2.85V)
(8) Linear (IM2(f_2+f_1))@2.85V

BGU7005 GPS LNA EVB#60, 2-Tone test, f_1=787.4 MHz, f_2=788 MHz, f_spur=1575.4 MHz

Fig 15. 2-Tone Test Results Test-Case 2, BGU7005

Table 4. Results Test case 2: Second Order Intercept Points, Temp = 25 °C.

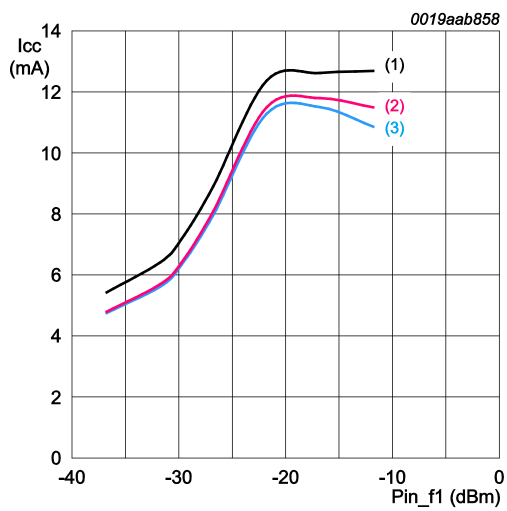
				DUT	DUT	DUT	DUT	DUT	DUT
		Vsup	Isup	Pin_f_1	Pout_f_1	Gp_DUT_f_1	IM2_(f_2+f_1)	OIP2_(f_2+f_1)	IIP2_(f_2+f_1)
Type	EVB#	[V]	[mA]	[dBm]	[dBm]	[dB]	[dBm]	[dBm]	[dBm]
BGU7007	166	1.5	7.5	-29.84	-19.80	10.04	-31.25	-8.35	-18.39
BGU7007	166	1.8	7.65	-29.84	-19.80	10.04	-31.36	-8.24	-18.28
BGU7007	166	2.85	8.37	-29.84	-19.45	10.39	-32.45	-6.45	-16.84
BGU7005	60	1.5	7.39	-29.84	-20.65	9.19	-33.65	-7.65	-16.84
BGU7005	60	1.8	7.52	-29.84	-20.60	9.24	-33.84	-7.36	-16.60
BGU7005	60	2.85	8.36	-29.84	-20.30	9.54	-35.10	-5.50	-15.04

5.3 Test-Case 3

Generators: f_1 = 824.6 MHz, f_2 = 2400 MHz

Spectrum Analyzer: Second Order Product f_{spur} = 1575.4 MHz

The figures below give the measured results of the 2-Tone test for BGU7007 and BGU7005 EVB's:



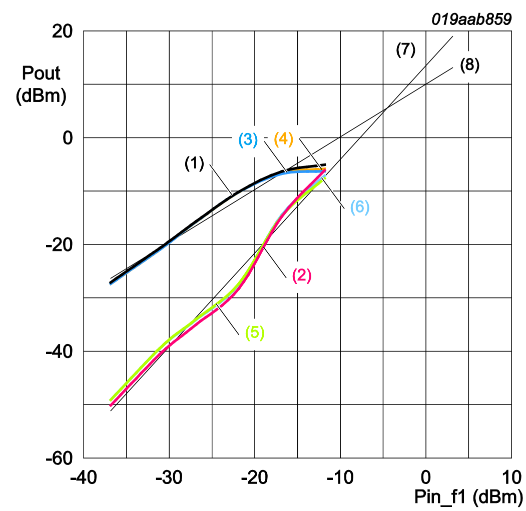
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7007 GPS LNA EVB#168, Icc = f(Pin), 2-Tone test, f_1=824.6 MHz, f_2=2400 MHz, f_spur=1575.4 MHz

Fig 16. Tone Test Results Test-Case 3, BGU7007



(1) Pout_f_1@2.85V

(2) IM2(f_2-f_1)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM2(f_2-f_1)@1.5V

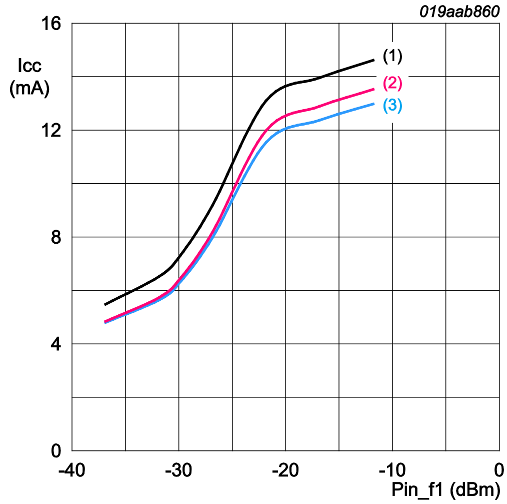
(6) IM2(f_2-f_1)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM2(f_2-f_1)@2.85V

BGU7007 GPS LNA EVB#166, 2-Tone test, f_1=824.6 MHz, f_2=2400 MHz, f_spur=1575.4 MHz

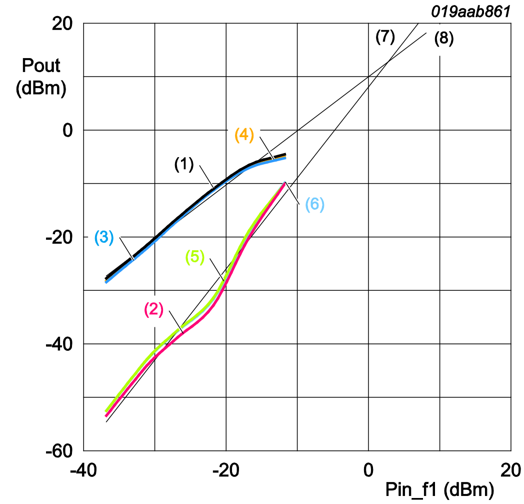
Fig 17. 2-Tone Test Results Test-Case 3, BGU7007



(1) Vcc = 2.85 V
(2) Vcc = 1.8 V
(3) Vcc = 1.5 V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=824.6 MHz, f_2=2400 MHz, f_spur=1575.4 MHz

Fig 18. Tone Test Results Test-Case 3, BGU7005



(1) Pout_f_1@2.85V
(2) IM2(f_2-f_1)@2.85V
(3) Pout_f_1@1.5V
(4) Pout_f_1@1.8V
(5) IM2(f_2-f_1)@1.5V
(6) IM2(f_2-f_1)@1.8V
(7) Linear (Pout_f_1@2.85V)
(8) Linear (IM2(f_2-f_1)@2.85V

BGU7005 GPS LNA EVB#60, 2-Tone test, f_1=824.6 MHz, f_2=2400 MHz, f_spur=1575.4 MHz

Fig 19. 2-Tone Test Results Test-Case 3, BGU7005

Table 5. Results Test case 3: Second Order Intercept Points, Temp = 25 °C.

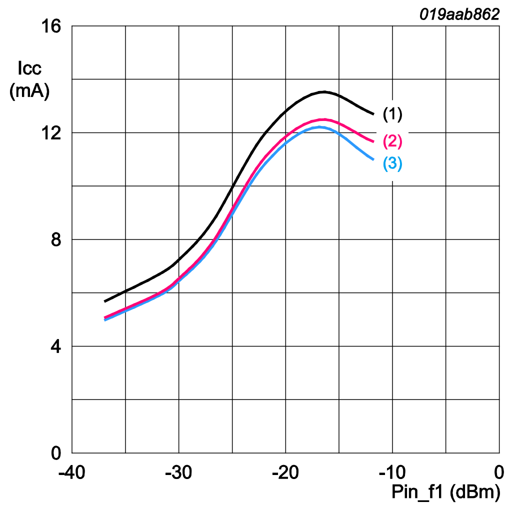
				DUT	DUT	DUT	DUT	DUT	DUT
		Vsup	Isup	Pin_f_1	Pout_f_1	Gp_DUT_f_1	IM2_(f_2-f_1)	OIP2_(f_2-f_1)	IIP2_(f_2-f_1)
Type	EVB#	[V]	[mA]	[dBm]	[dBm]	[dB]	[dBm]	[dBm]	[dBm]
BGU7007	166	1.5	6.64	-29.84	-19.50	10.34	-37.45	1.28	-9.06
BGU7007	166	1.8	6.75	-29.84	-19.45	10.39	-37.52	1.56	-8.83
BGU7007	166	2.85	7.48	-29.84	-19.11	10.73	-38.71	3.38	-7.35
BGU7005	60	1.5	6.33	-29.84	-20.60	9.24	-41.10	1.20	-8.04
BGU7005	60	1.8	6.48	-29.84	-20.50	9.34	-41.16	1.46	-7.88
BGU7005	60	2.85	7.34	-29.84	-20.10	9.74	-42.40	3.50	-6.24

5.4 Test-Case 4

Generators: f_1 = 1575 MHz, f_2 = 1576 MHz

Spectrum Analyzer: Third Order Product f_{spur} = 1574 MHz

The figures below give the measured results of the 2-Tone test for BGU7007 and BGU7005 EVB's:



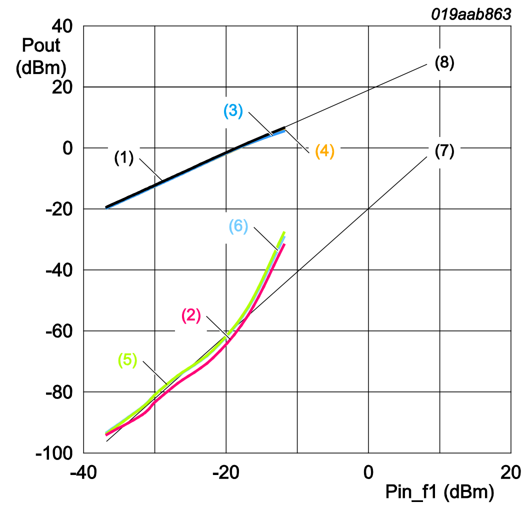
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7007 GPS LNA EVB#166, Icc = f(Pin), 2-Tone test, f_1=1850 MHz, f_2=5275 MHz, f_spur=1575.4 MHz

Fig 20. Tone Test Results Test-Case 4, BGU7007



(1) Pout_f_1@2.85V

(2) IM3($2f_1$-f_2)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM3($2f_1$-f_2)@1.5V

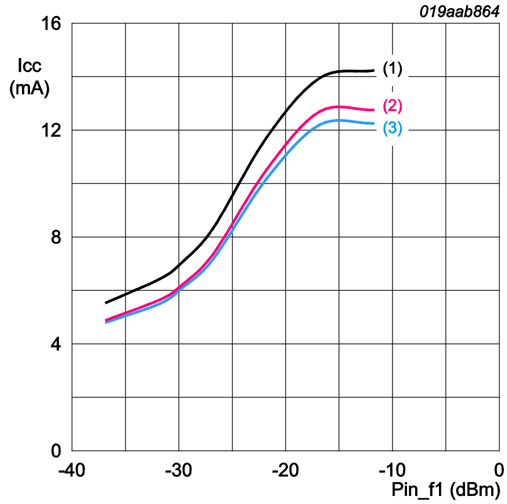
(6) IM3($2f_1$-f_2)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM3($2f_1$-f_2)@2.85V

BGU7007 GPS LNA EVB#166, 2-Tone test, f_1=1850 MHz, f_2=5275 MHz, f_spur=1575.4 MHz

Fig 21. 2-Tone Test Results Test-Case 4, BGU7007



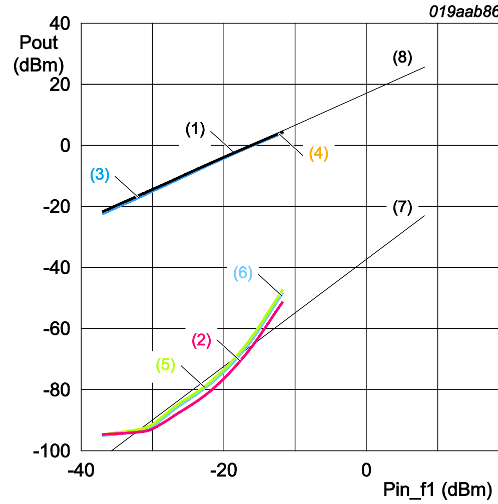
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=1850 MHz, f_2=5275 MHz, f_spur=1575.4 MHz

Fig 22. Tone Test Results Test-Case 4, BGU7005



(1) Pout_f_1@2.85V

(2) IM3($2f_1$-f_2)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM3($2f_1$-f_2)@1.5V

(6) IM3($2f_1$-f_2)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM3($2f_1$-f_2)@2.85V

BGU7005 GPS LNA EVB#60, 2-Tone test, f_1=1850 MHz, f_2=5275 MHz, f_spur=1575.4 MHz

Fig 23. 2-Tone Test Results Test-Case 4, BGU7005

Table 6. Results Test case 4: Third Order Intercept Points, Temp = 25 °C.

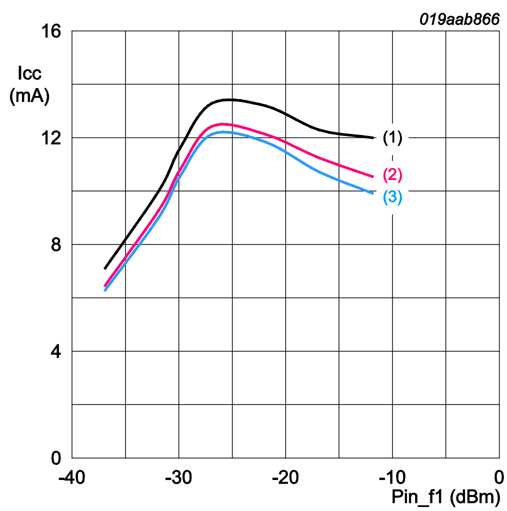
				DUT	DUT	DUT	DUT	DUT	DUT
		Vsup	Isup	Pin_f_1	Pout_f_1	Gp_DUT_f_1	IM3_($2f_1$-f_2)	OIP3_($2f_1$-f_2)	IIP3_($2f_1$-f_2)
Type	EVB#	[V]	[mA]	[dBm]	[dBm]	[dB]	[dBm]	[dBm]	[dBm]
BGU7007	166	1.5	6.5	-29.85	-12.40	17.45	-80.50	8.02	-9.44
BGU7007	166	1.8	6.6	-29.85	-12.30	17.55	-80.70	8.25	-9.30
BGU7007	166	2.85	7.3	-29.85	-12.10	17.75	-83.00	9.60	-8.15
BGU7005	60	1.5	6.05	-29.85	-14.84	15.01	-91.30	9.71	-5.30
BGU7005	60	1.8	6.18	-29.85	-14.68	15.17	-91.80	10.07	-5.10
BGU7005	60	2.85	7	-29.85	-14.29	15.56	-92.80	10.96	-4.60

5.5 Test-Case 5

Generators: f_1 = 1575 MHz, f_2 = 1576 MHz

Spectrum Analyzer: Third Order Product f_{spur} = 1574 MHz

The figures below give the measured results of the 2-Tone test for BGU7007 and BGU7005 EVB's:



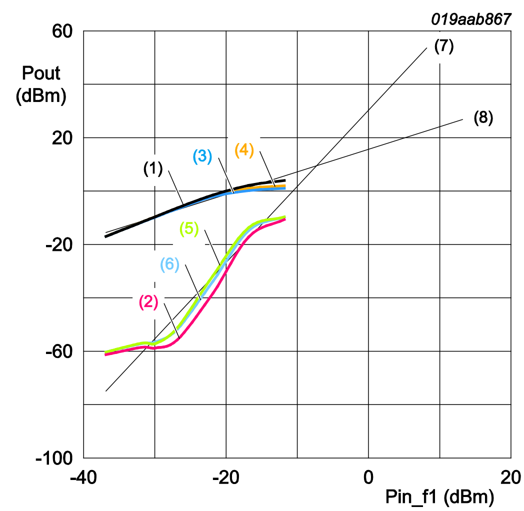
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7007 GPS LNA EVB#166, Icc = f(Pin), 2-Tone test, f_1=1575 MHz, f_2=1576 MHz, f_spur=1574 MHz

Fig 24. Tone Test Results Test-Case 5, BGU7007



(1) Pout_f_1@2.85V

(2) IM3($2f_1$-f_2)@2.85V

(3) Pout_f_1@1.5V

(4) Pout_f_1@1.8V

(5) IM3($2f_1$-f_2)@1.5V

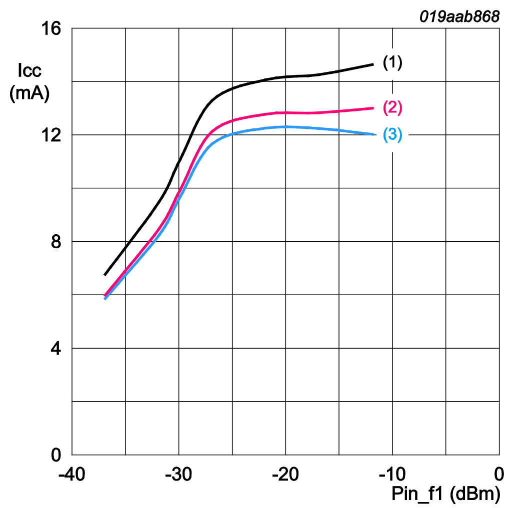
(6) IM3($2f_1$-f_2)@1.8V

(7) Linear (Pout_f_1@2.85V)

(8) Linear (IM3($2f_1$-f_2)@2.85V

BGU7007 GPS LNA EVB#166, Icc = f(Pin), 2-Tone test, f_1=1575 MHz, f_2=1576 MHz, f_spur=1574 MHz

Fig 25. 2-Tone Test Results Test-Case 5, BGU7007



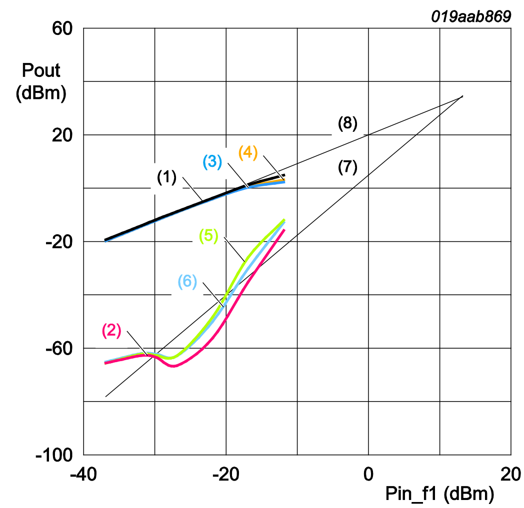
(1) Vcc = 2.85 V

(2) Vcc = 1.8 V

(3) Vcc = 1.5 V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=1575 MHz, f_2=1576 MHz, f_spur=1574 MHz

Fig 26. Tone Test Results Test-Case 5, BGU7005



(4) Pout_f_1@2.85V

(5) IM3($2f_1$-f_2)@2.85V

(6) Pout_f_1@1.5V

(7) Pout_f_1@1.8V

(8) IM3($2f_1$-f_2)@1.5V

(9) IM3($2f_1$-f_2)@1.8V

(10) Linear (Pout_f_1@2.85V)

(11) Linear (IM3($2f_1$-f_2)@2.85V

BGU7005 GPS LNA EVB#60, Icc = f(Pin), 2-Tone test, f_1=1575 MHz, f_2=1576 MHz, f_spur=1574 MHz

Fig 27. 2-Tone Test Results Test-Case 5, BGU7005

Table 7. Results Test case 5: Third Order Intercept Points, Temp = 25 °C.

				DUT	DUT	DUT	DUT	DUT	DUT
		Vsup	Isup	Pin_f_1	Pout_f_1	Gp_DUT_f_1	IM3_($2f_1$-f_2)	OIP3_($2f_1$-f_2)	IIP3_($2f_1$-f_2)
Type	EVB#	[V]	[mA]	[dBm]	[dBm]	[dB]	[dBm]	[dBm]	[dBm]
BGU7007	166	1.5	10.52	-29.84	-9.81	20.03	-57.24	13.80	-6.23
BGU7007	166	1.8	10.77	-29.84	-9.72	20.12	-56.60	13.61	-6.52
BGU7007	166	2.85	11.6	-29.84	-9.65	20.19	-58.90	14.85	-5.34
BGU7005	60	1.5	9.64	-29.84	-12.30	17.54	-62.50	12.70	-4.84
BGU7005	60	1.8	9.9	-29.84	-12.05	17.79	-62.00	12.80	-4.99
BGU7005	60	2.85	11.05	-29.84	-11.85	17.99	-63.50	13.85	-4.14

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