



BGU8053

Low noise high linearity amplifier

Rev. 2 — 30 December 2013

Product data sheet

1. Product profile

1.1 General description

The BGU8053 is a low noise high linearity amplifier for wireless infrastructure applications, equipped with fast shutdown to support TDD systems. The LNA has a high input and output return loss and is designed to operate between 2 GHz and 4 GHz. It is housed in a 2 mm × 2 mm × 0.75 mm 8-terminal plastic thin small outline package. The LNA is ESD protected on all terminals.

1.2 Features and benefits

- Low noise performance: $NF = 0.56$ dB
- High linearity performance: $IP3O = 36$ dBm
- High input return loss > 12 dB
- High output return loss > 20 dB
- Unconditionally stable up to 20 GHz
- Programmable bias current (via resistor)
- Small 8-terminal leadless package 2 mm × 2 mm × 0.75 mm
- ESD protection on all terminals
- Moisture sensitivity level 1
- Fast shutdown to support TDD systems
- +5 V single supply

1.3 Applications

- Wireless infrastructure
- Low noise and high linearity applications
- LTE, W-CDMA, CDMA, GSM
- General purpose wireless applications
- TDD or FDD systems
- Suitable for small cells



1.4 Quick reference data

Table 1. Quick reference data

$f = 2500$ MHz; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; input and output 50Ω ; $R_{bias} = 5.1$ k Ω ; unless otherwise specified. All RF parameters are measured in an application board as shown in [Figure 15](#) with components listed in [Table 9](#) optimized for $f = 2500$ MHz.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{CC}	supply current	on state	36	48	60	mA
		off state	-	2.8	-	mA
G _{ass}	associated gain	on state	17	18.5	20	dB
		off state	-	-23.5	-	dB
NF	noise figure		[1]	0.56	0.75	dB
P _{L(1dB)}	output power at 1 dB gain compression		-	18	-	dBm
IP3 _O	output third-order intercept point	2-tone; tone spacing = 1 MHz; P _i = -15 dBm per tone	32	36	-	dBm

[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded.

2. Pinning information

2.1 Pinning

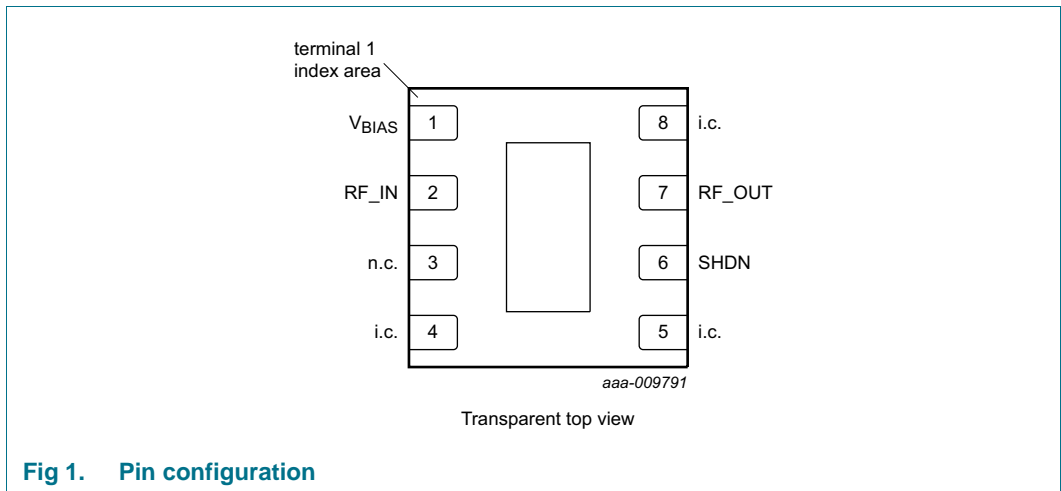


Fig 1. Pin configuration

2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
V _{BIAS}	1	bias voltage
RF_IN	2	RF input
n.c.	3	not connected
i.c.	4, 5, 8	internally connected. Can be grounded or left open in the application
SHDN	6	shutdown
RF_OUT	7	RF output
GND	exposed die pad	ground

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BGU8053	HWSO8	plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 × 2 × 0.75 mm	SOT1327-1

4. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-	6	V
$V_{ctrl(sd)}$	shutdown control voltage		-	3	V
I_{CC}	supply current		-	85	mA
$P_{i(RF)CW}$	continuous waveform RF input power		-	20	dBm
T_{stg}	storage temperature		-40	+150	°C
T_j	junction temperature		-	150	°C
P	power dissipation	$T_{case} \leq 125 \text{ °C}$	[1]	510	mW
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001-2010	-	0.9	kV
		Charged Device Model (CDM); According JEDEC standard 22-C101B	-	2	kV

[1] Case is ground solder pad.

5. Recommended operating conditions

Table 5. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.75	5	5.25	V
Z_0	characteristic impedance		-	50	-	Ω
T_{case}	case temperature		-40	-	+85	°C

6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-case)}$	thermal resistance from junction to case		[1][2] 50	K/W

[1] Case is ground solder pad.

[2] Thermal resistance measured using infrared measurement technique, device mounted on application board and placed in still air.

7. Characteristics

Table 7. Characteristics

$f = 2500 \text{ MHz}$; $V_{CC} = 5 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$; input and output $50 \text{ } \Omega$; $R_{bias} = 5.1 \text{ k}\Omega$; unless otherwise specified. All RF parameters are measured in an application board as shown in [Figure 15](#) with components listed in [Table 9](#) optimized for $f = 2500 \text{ MHz}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	on state	36	48	60	mA
		off state	-	2.8	-	mA
G_{ass}	associated gain	on state	17	18.5	20	dB
		off state	-	-23.5	-	dB
NF	noise figure		[1]	0.56	0.75	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	18	-	dBm
$IP3_O$	output third-order intercept point	2-tone; tone spacing = 1 MHz; $P_i = -15 \text{ dBm}$ per tone	32	36	-	dBm
		2-tone; tone spacing = 1 MHz; $P_i = -15 \text{ dBm}$ per tone	[2]	30	34	-
RL_{in}	input return loss	on state	-	12.2	-	dB
		off state	-	6.3	-	dB
RL_{out}	output return loss		-	28.0	-	dB
ISL	isolation		-	22.0	-	dB
$t_{s(pon)}$	power-on settling time	$P_i = -20 \text{ dBm}$; SHDN (pin 6) from HIGH to LOW	[2]	1.4	-	μs
$t_{s(poff)}$	power-off settling time	$P_i = -20 \text{ dBm}$; SHDN (pin 6) from LOW to HIGH	[2]	0.4	-	μs
K	Rollett stability factor	both on state and off state up to $f = 20 \text{ GHz}$	1	-	-	
$R_{pd(SHDN)}$	pull-down resistance on pin SHDN		-	30	-	$\text{k}\Omega$

[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded.

[2] For TDD systems where fast switching is required, it is recommended to change C1 and C2 to 100 pF.

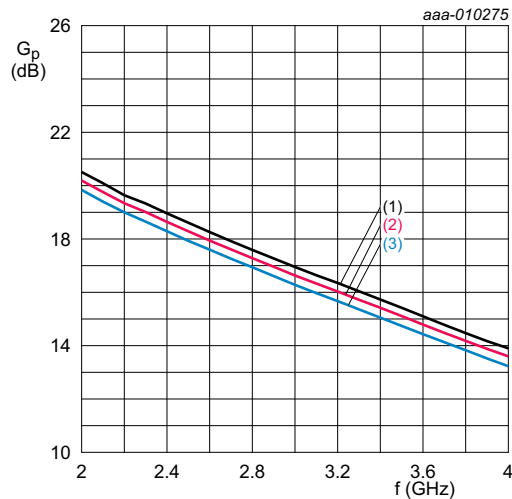
Table 8. Shutdown control

$V_{CC} = 5 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$; input and output $50 \text{ } \Omega$; $R_{bias} = 5.1 \text{ k}\Omega$; unless otherwise specified. All RF parameters are measured in an application board as shown in [Figure 15](#) with components listed in [Table 9](#) optimized for $f = 2500 \text{ MHz}$.

State	$V_{ctrl(sd)}$ [1] (V)
on state	≤ 0.6
off state	≥ 1.2

[1] Voltage on pin 6 (SHDN).

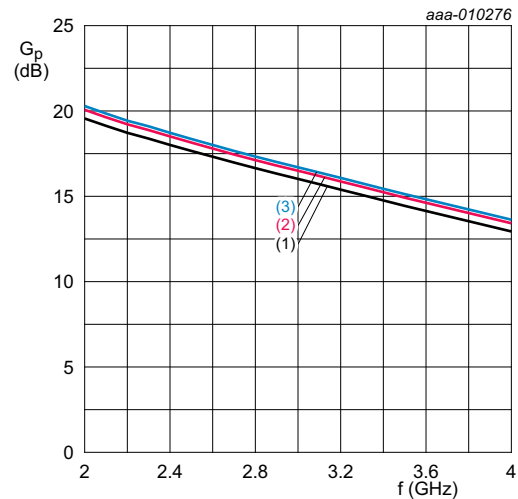
7.1 Graphs



$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}$.

- (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
- (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
- (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

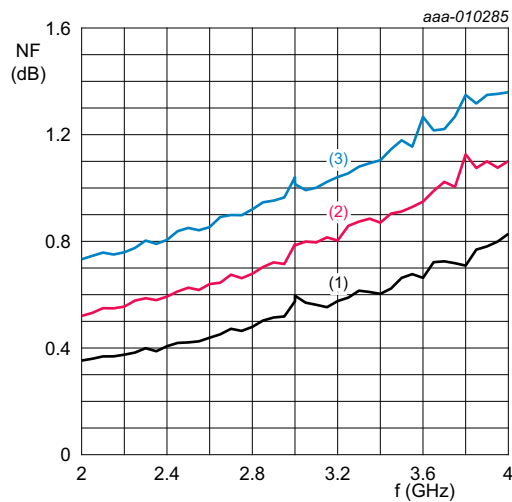
Fig 2. Power gain as a function of frequency; typical values



$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$.

- (1) $I_{CC} = 30\text{ mA}$
- (2) $I_{CC} = 45\text{ mA}$
- (3) $I_{CC} = 60\text{ mA}$

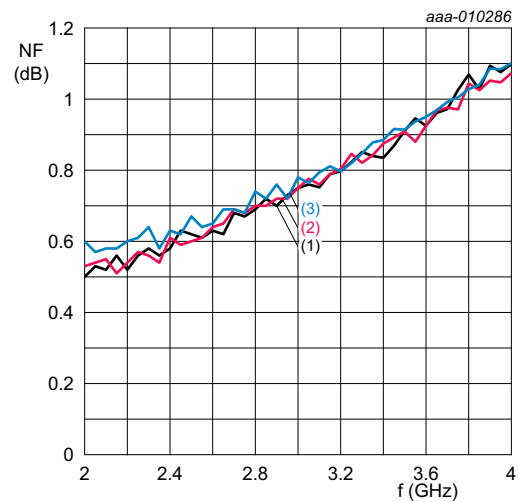
Fig 3. Power gain as a function of frequency; typical values



$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}$.

- (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
- (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
- (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

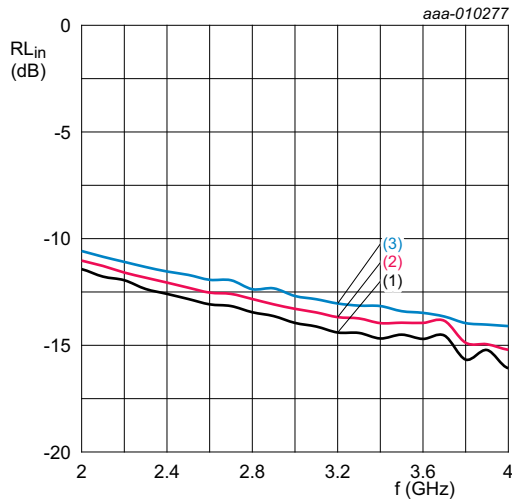
Fig 4. Noise figure as a function of frequency; typical values



$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$.

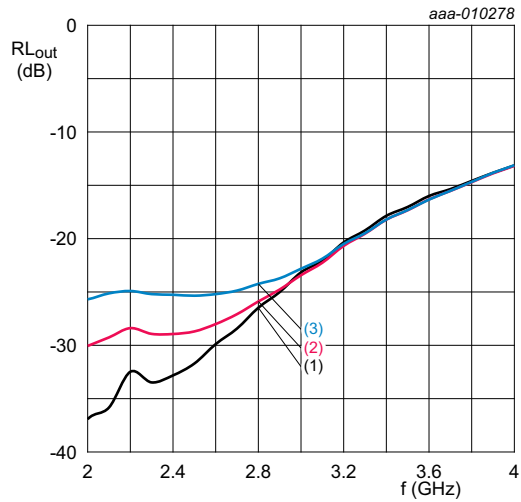
- (1) $I_{CC} = 30\text{ mA}$
- (2) $I_{CC} = 45\text{ mA}$
- (3) $I_{CC} = 60\text{ mA}$

Fig 5. Noise figure as a function of frequency; typical values



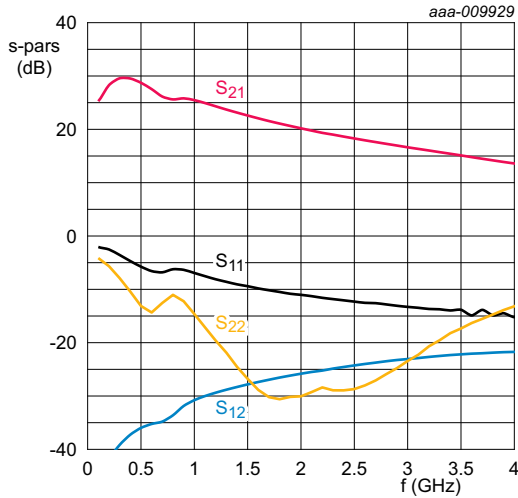
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

Fig 6. Input return loss as a function of frequency; typical values



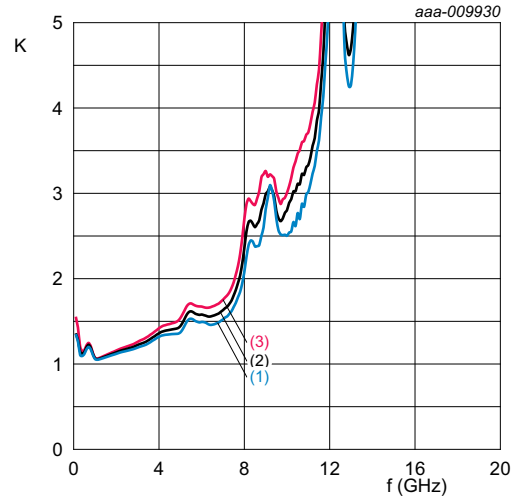
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

Fig 7. Output return loss as a function of frequency; typical values



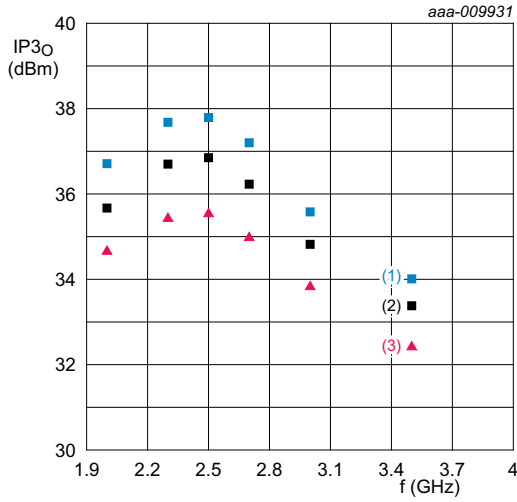
$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}; I_{CC} = 48\text{ mA}.$

Fig 8. Wideband S-parameters as function of frequency; typical values



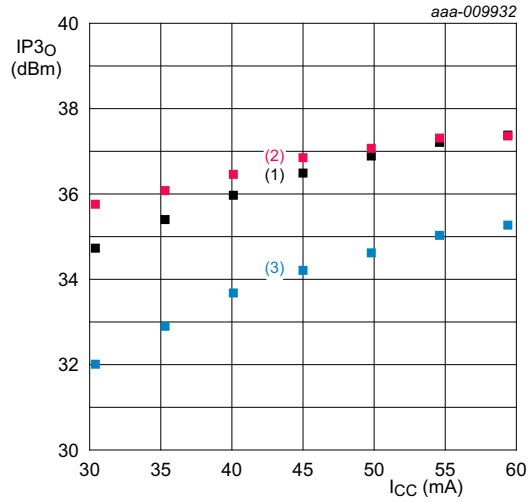
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

Fig 9. Rollet stability factor as a function of frequency; typical values



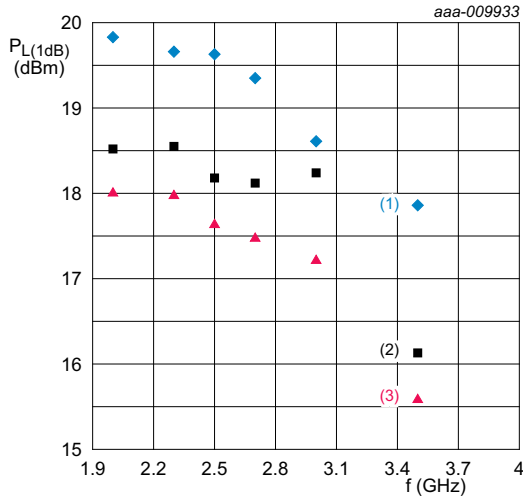
$V_{CC} = 5\text{ V}$; $P_i = -15\text{ dBm}$ per tone; $I_{CC} = 48\text{ mA}$.
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = +25\text{ }^\circ\text{C}$
 (3) $T_{amb} = +85\text{ }^\circ\text{C}$

Fig 10. Output third-order intercept point as a function of frequency; typical values



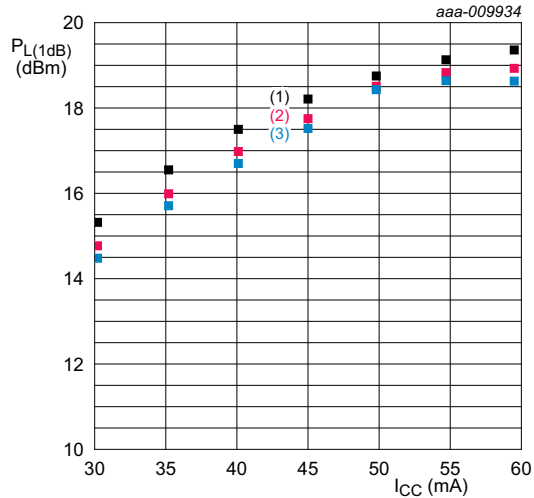
$V_{CC} = 5\text{ V}$; $P_i = -15\text{ dBm}$ per tone; $T_{amb} = 25\text{ }^\circ\text{C}$.
 (1) $f = 2000\text{ MHz}$
 (2) $f = 2500\text{ MHz}$
 (3) $f = 3000\text{ MHz}$

Fig 11. Output third-order intercept point as a function of supply current; typical values



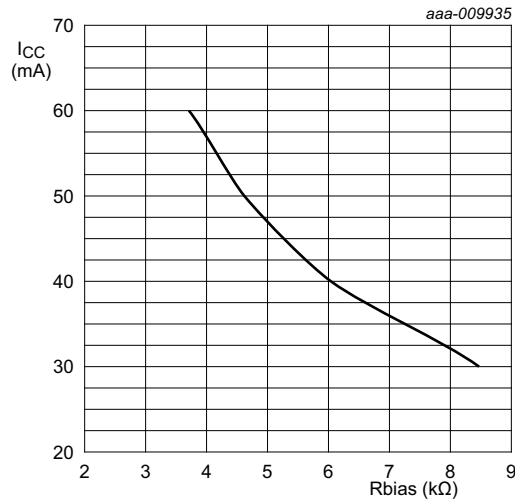
$V_{CC} = 5\text{ V}$; $I_{CC} = 48\text{ mA}$.
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = +25\text{ }^\circ\text{C}$
 (3) $T_{amb} = +85\text{ }^\circ\text{C}$

Fig 12. Output power at 1 dB gain compression as a function of frequency; typical values



$V_{CC} = 5\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$.
 (1) $f = 2000\text{ MHz}$
 (2) $f = 2500\text{ MHz}$
 (3) $f = 3000\text{ MHz}$

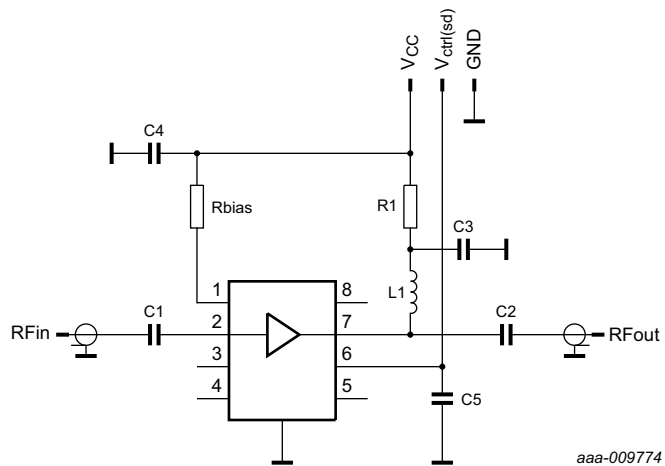
Fig 13. Output power at 1 dB gain compression as a function of supply current; typical values



V_{CC} = 5 V.

Fig 14. Supply current as a function of R_{bias}; typical values

8. Application information



See [Table 9](#) for a list of components.

Fig 15. Schematic of application board

Table 9. List of components

See [Figure 15](#) for schematics.

Component	Description	Value	Remarks
C1, C2	capacitor	100 nF	
		100 pF	recommended for TDD systems
C3, C5	capacitor	10 pF	
C4	capacitor	10 nF	

Table 9. List of components ...continued
See [Figure 15](#) for schematics.

Component	Description	Value	Remarks
L1	inductor	15 nH	
R1	resistor	10 Ω	
Rbias	resistor	5.1 kΩ	

Table 10. Typical performance BGU8053 application board

All RF parameters are measured at the application board as shown in [Figure 15](#) with the components as listed in [Table 9](#) while optimized for: $f = 2500$ MHz; $V_{CC} = 5$ V; $I_{CC} = 48$ mA and $T_{amb} = 25$ °C.

Symbol	Parameter	f (MHz)								
		2000	2300	2500	2700	3000	3400	3500	3800	
G _{ass}	associated gain	20.2	19.0	18.3	17.6	16.6	15.4	15.1	14.2	
RL _{in}	input return loss	11.0	11.8	12.3	12.6	13.3	14.0	13.8	14.9	
RL _{out}	output return loss	30.1	28.9	28.7	27.1	23.4	18.2	17.3	14.7	
P _{L(1dB)}	output power at 1 dB gain compression	18.5	18.6	18.2	18.1	18.2	16.4	16.1	14.4	
IP3 _O	output third-order intercept point	[1]	35.7	36.7	36.8	36.2	34.8	36.2	33.4	33.0
		[1][2]	34.9	35.9	34.5	36.0	32.1	35.3	31.7	31.6
NF	noise figure	[3]	0.52	0.59	0.63	0.68	0.79	0.81	0.83	0.96

[1] 2-Tone; tone spacing = 1 MHz; P₁ = -15 dBm per tone.

[2] For TDD systems C1 and C2 have to be 100 pF.

[3] Connector and board losses not de-embedded.

10. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDMA	Code Division Multiple Access
ESD	ElectroStatic Discharge
FDD	Frequency-Division Duplexing
GSM	Global System for Mobile Communication
LNA	Low Noise Amplifier
LTE	Long Term Evolution
RF	Radio Frequency
TDD	Time-Division Duplexing
W-CDMA	Wideband Code Division Multiple Access

11. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGU8053 v.2	20131230	Product data sheet	-	BGU8053 v.1
Modifications:	<ul style="list-style-type: none"> Table 4 on page 3: The maximum value for $V_{ctrl(sd)}$ has been corrected to 3 V. 			
BGU8053 v.1	20131127	Product data sheet	-	-

12. Legal information

12.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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