BGU7045

1 GHz wideband low-noise amplifier with bypass

Rev. 3 — 11 April 2018 Product data sheet

1 Product profile

1.1 General description

The BGU7045 MMIC is a 3.3 V wideband amplifier with bypass mode. It is designed specifically for high linearity, low-noise applications over a frequency range of 40 MHz to 1 GHz. It is especially suited for Set-Top Box applications.

The LNA is housed in a 6-pin SOT363 plastic SMD package.

1.2 Features and benefits

- Voltage supply of 3.3 V
- Internally biased
- Programmable between G_p = 14 dB and bypass
- Flat gain between 40 MHz and 1 GHz
- Noise figure of 2.8 dB
- High linearity with an $IP3_O$ of 29 dBm
- 75 Ω input and output impedance
- Power-down during bypass mode
- Bypass mode current consumption < 5 mA
- ESD protection > 2 kV Human Body Model (HBM) and >1.5 kV Charged Device Model (CDM) on all pins

1.3 Applications

- Terrestrial and cable Set-Top Boxes (STB)
- Silicon and "Can" tuners
- Personal Video Recorders (PVR) and Digital Video Recorders (DVR)
- Home networking and in-house signal distribution

1.4 Quick reference data

Table 1. Quick reference data

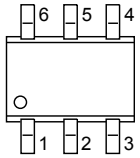
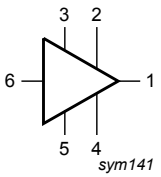
T_{amb} = 25 °C; typical values at V_{CC} = 3.3 V; Z_S = Z_L = 75 Ω; R_{bias} = 18 Ω; 40 MHz ≤ f_1 ≤ 1000 MHz.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		3.1	3.3	3.5	V
$I_{CC(tot)}$	total supply current	G_p = 14 dB mode	[1]	30	34	38	mA
		bypass mode	[1]	-	3	-	mA
T_{amb}	ambient temperature			−40	-	+85	°C
NF	noise figure	G_p = 14 dB mode	[1]	-	2.8	-	dB
		bypass mode	[1]	-	2.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	G_p = 14 dB mode; 1 GHz	[1]	-	13	-	dBm
$IP3_O$	output third-order intercept point	G_p = 14 dB mode	[1][2]	-	29	-	dBm

[1] Mode depends on setting of V_{CTRL}; see Table 8.
[2] The fundamental frequency (f_1) is 1000 MHz. The intermodulation product (IM3) is 2 x f_2 - f_1, where f_2 = f_1 ± 1 MHz. Input power P_i = -10 dBm.

2 Pinning information

Table 2. Pinning

Pin	Description		Simplified outline	Graphic symbol
1	RF_OUT			
2	V_{CC}			
3	n.c.			
4	CTRL			
5	GND			
6	RF_IN			

3 Ordering information

Table 3. Ordering information

Type number	Package Name	Description	Version
BGU7045	-	plastic surface-mounted package; 6 leads	SOT363

4 Marking

Table 4. Marking code

Type number	Marking code	Description
BGU7045	LK*	* = p: made in Hong Kong
		* = W: made in China
		* = t: made in Malaysia

5 Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		−0.6	3.5	V
V_{CTRL}	voltage on CTRL pin		[1]	0	V_{CC}	V
$I_{CC(tot)}$	total supply current			-	60	mA
P_{tot}	total power dissipation	$T_{sp} \leq 100$ °C	[2]	-	250	mW
P_i	input power	single tone		-	20	dBm
T_{stg}	storage temperature			−65	+150	°C
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			−40	+85	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM); according to JEDEC standard 22-A114E		2	-	kV
		Charged Device Model (CDM); according to JEDEC standard 22-C101B		1.5	-	kV

[1] V_{CTRL} must not exceed V_{CC}; I_{CTRL} must be limited to 5 mA (maximum).
[2] T_{sp} is the temperature at the solder point of the ground lead.

Remark: V_{CTRL} must not exceed V_{CC}; I_{CTRL} must be limited to a maximum of 5 mA.

6 Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[1]	130	K/W

[1] Determined by final element method simulation with device mounted on application board and in still air.

7 Characteristics

Table 7. Characteristics

T_{amb} = 25 °C; typical values at V_{CC} = 3.3 V; Z_S = Z_L = 75 Ω; R_{bias} = 18 Ω; 40 MHz ≤ f_1 ≤ 1000 MHz.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		3.1	3.3	3.5	V
$I_{CC(tot)}$	total supply current	G_p = 14 dB mode	[1]	30	34	38	mA
		bypass mode	[1]	-	3	-	mA
$\|s_{21}\|^2$	insertion power gain	G_p = 14 dB mode	[1]	-	14	-	dB
		bypass mode	[1]	-	−2	-	dB
SL_{sl}	slope straight line	G_p = 14 dB mode		-	−1	-	dB
FL	flatness of frequency response	G_p = 14 dB mode		-	0.2	-	dB
NF	noise figure	G_p = 14 dB mode	[1]	-	2.8	-	dB
		bypass mode	[1]	-	2.5	-	dB
RL_{in}	input return loss	G_p = 14 dB mode	[1]	-	20	-	dB
		bypass mode	[1]	-	9	-	dB
RL_{out}	output return loss	G_p = 14 dB mode	[1]	-	12	-	dB
		bypass mode	[1]	-	10	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	G_p = 14 dB mode; 1 GHz	[1]	-	13	-	dBm
$IP3_O$	output third-order intercept point	G_p = 14 dB mode	[1][2]	-	29	-	dBm
		bypass mode	[1][2]	-	27	-	dBm

[1] Mode depends on setting of V_{CTRL}; see Table 8.
[2] The fundamental frequency (f_1) is 1000 MHz. The intermodulation product (IM3) is 2 × f_2 - f_1, where f_2 = f_1 ± 1 MHz. Input power P_i = -10 dBm.

Table 8. Gain selection (pin CTRL)

-10 °C ≤ T_{amb} ≤ +70 °C; recommended power-up condition: V_{CTRL} = logic 0 or < 0.7 V.

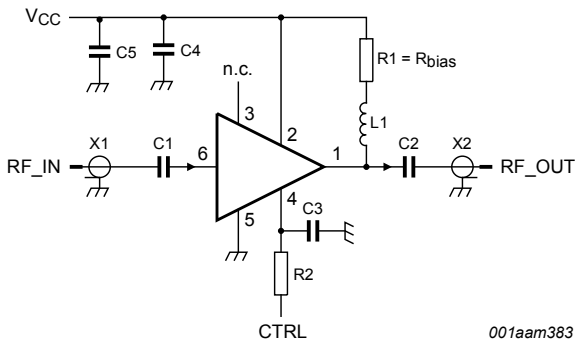
V_{CTRL} (V)	Mode
≤ 0.7	bypass
≥ 1.5	G_p = 14 dB

Remark: V_{CTRL} must not exceed V_{CC}; I_{CTRL} must be limited to a maximum of 5 mA.

8 Application information

- Application notes are available on the NXP website.
- Section 8.1 describes the application circuit used for characterisation and datasheet.
- Section 8.2 describes the recommended application circuit.

8.1 Application circuit



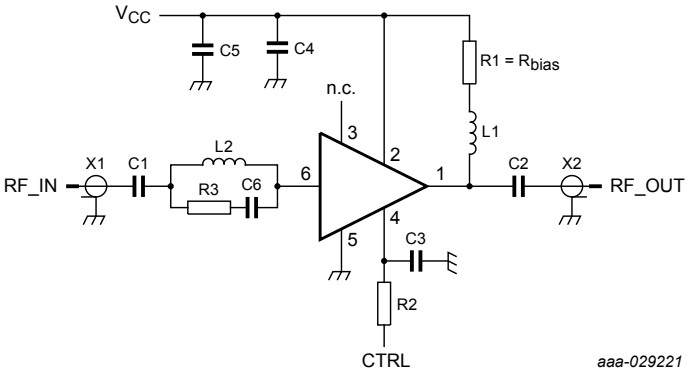
Components are listed in Table 9.

Figure 1. BGU7045 application circuit

All control and supply lines must be decoupled properly. The decoupling capacitors must be placed as close to the device as possible.

8.2 Recommended application circuit

Recommended application circuit to compensate capacitive load influence at RF input.

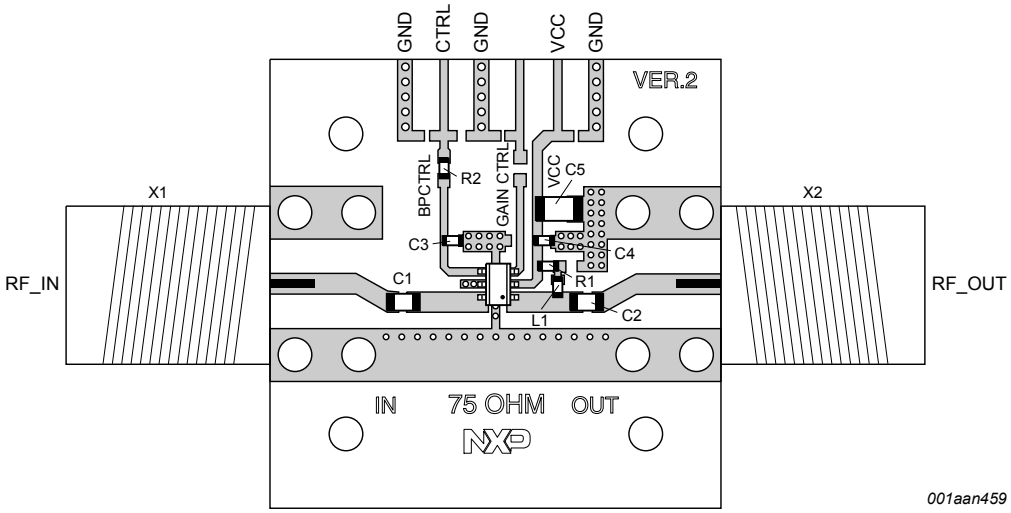


components are listed in Table 10

Figure 2. BGU7045 recommended application circuit.

(Values can be changed depending on the PCB routing) Keep the components (L2, R3, C6) next to the BGU7045 RF input pin.

8.3 Application circuit board layout



PCB material = FR4.
PCB thickness = 1.6 mm.
PCB size = 30 mm x 30 mm.
ε_r = 4.5; thickness of copper layer = 35 µm.
Components are listed in Table 9.

Figure 3. BGU7045 application circuit board layout.

Table 9. List of components

See Figure 1 and Figure 3 .

Component	Description	Value		Remarks	Function
C1, C2	capacitor	10 nF			DC blocking
C3, C4	capacitor	10 nF			decoupling
C5	capacitor	10 µF			decoupling
L1	chip ferrite bead	1.5 kΩ	[1]	Murata BLM18HE152SN1DF	RF choke
R1	resistor	18 Ω	[1]	R_{bias}	bias setting
R2	resistor	1.8 kΩ			current limiting
X1, X2	connector	75 Ω		F-connector, edge mount PCB reflow type, Bomar 861V509ER6	input/output

[1] L1 and R1 must have a power rating of 0.1 W or higher.

Table 10. List of components for recommended application circuit

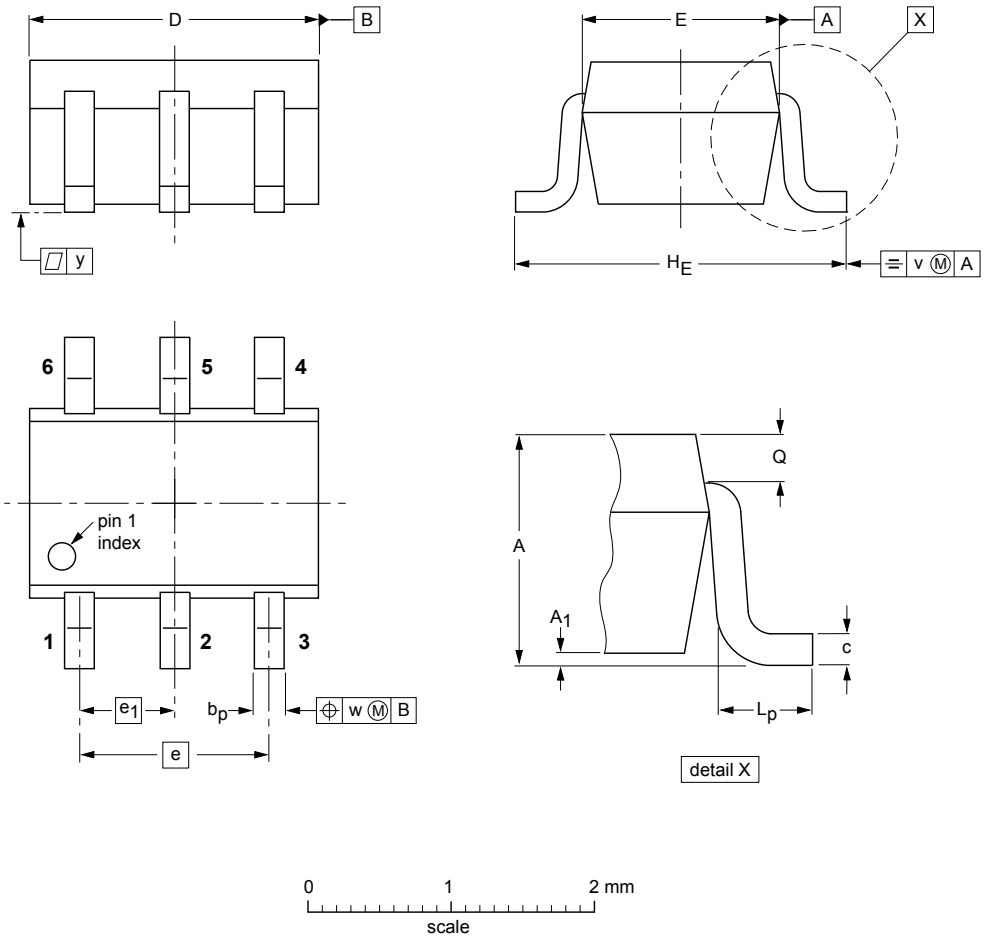
See Figure 2 .

Component	Description	Value		Remarks	Function
C1, C2	capacitor	10 nF			DC blocking
C3, C4	capacitor	10 nF			decoupling
C5	capacitor	10 µF			decoupling
C6	capacitor	0.5 pF		Murata GRM1555C1HR50BA01	value depends on layout
L1	chip ferrite bead	1.5 kΩ	[1]	Murata BLM18HE152SN1DF	RF choke
L2	inductor	2.7 nH		Murata LQG11A2N7	value depends on layout
R1	resistor	18 Ω	[1]	R_{bias}	bias setting
R2	resistor	1.8 kΩ			current limiting
R3	resistor	47 Ω			
X1, X2	connector	75 Ω		F-connector, edge mount PCB reflow type, Bomar 861V509ER6	input/output

[1] L1 and R1 must have a power rating of 0.1 W or higher.

9 Package outline

Plastic surface-mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Figure 4. Package outline SOT363

10 Abbreviations

Table 11. Abbreviations

Acronym	Description
AC	Alternating Current
DC	Direct Current
ESD	ElectroStatic Discharge
LNA	Low-Noise Amplifier
MMIC	Monolithic Microwave Integrated Circuit
PCB	Printed-Circuit Board
RF	Radio Frequency
SMD	Surface-Mounted Device

11 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGU7045 v.3	20180411	product data sheet	-	BGU7045 v.2
Modification	added recommended application circuit with components table			
BGU7045 v.2	20140526	product data sheet	-	BGU7045 v.1
Modifications:	• Table 6 on page 3: The information in this table has been updated.			
BGU7045 v.1	20120203	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.

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