

BGU6009/N2

Low-noise amplifier MMIC for GPS, GLONASS, Galileo and COMPASS

Rev. 4 — 18 January 2017 Product data sheet

1. Product profile

1.1 General description

The BGU6009/N2 is, also known as the GPS1002M, a Low-Noise Amplifier (LNA) for GNSS receiver applications in a plastic leadless 6-pin, very thin small outline SOT1230 package. The BGU6009/N2 requires only one external matching inductor and one external decoupling capacitor.

1.2 Features and benefits

- Covers full GNSS L1 band, from 1559 MHz to 1610 MHz
- Noise figure = 0.9 dB
- Gain 17 dB
- High input 1 dB compression point $P_{i(1dB)}$ of −4 dBm
- High out of band $IP3_i$ of 7 dBm
- Supply voltage 1.5 V to 3.1 V
- Power-down mode current consumption < 2 μA
- Optimized performance at low supply current of 5.1 mA
- Integrated matching for the output
- Requires only one input matching inductor and one supply decoupling capacitor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated temperature stabilized bias for easy design
- Small 6-pin leadless package 1.1 mm × 0.9 mm × 0.47 mm; 0.4 mm pitch: SOT1230

1.3 Applications

LNA for GPS, GLONASS, Gallileo and COMPASS (Beidou).

- Smart phones and feature phones
- Tablet PCs
- Personal Navigation Devices
- Digital Still Cameras
- Digital Video Cameras
- RF front-end modules
- Complete GPS chip set modules and theft protection (laptop, ATM)

1.4 Quick reference data

Table 1. Quick reference data

f = 1559 MHz to 1610 MHz; V_{CC} = 1.8 V; $V_{I(ENABLE)} \geq 0.9$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor; unless otherwise specified.

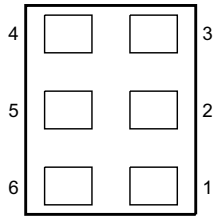
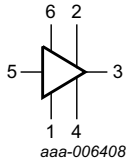
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled	1.5	1.8	3.1	V
I_{CC}	supply current		-	5.1	-	mA
G_p	power gain	no jammer	-	17	-	dB
NF	noise figure	no jammer [1]	-	0.9	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	f = 1575 MHz				
		V_{CC} = 1.8 V	-	–7	-	dBm
		V_{CC} = 2.85 V	-	–4	-	dBm
$IP3_i$	input third-order intercept point	f = 1575 MHz				
		V_{CC} = 1.8 V [2]	-	5	-	dBm
		V_{CC} = 2.85 V [2]	-	7	-	dBm

[1] PCB losses are subtracted.

[2] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = –20 dBm at f_1; P_i = –65 dBm at f_2.

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	GND	 transparent top view	 aaa-006408
2	V_{CC}		
3	RF_OUT		
4	GND_RF		
5	RF_IN		
6	ENABLE		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGU6009/N2	XSON6	plastic very thin small outline package; no leads; 6 terminals; body 1.1 × 0.9 × 0.47 mm	SOT1230

4. Marking

Table 4. Marking codes

Type number	Marking code
BGU6009/N2	W

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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	−0.5	+5.0	V
$V_{I(ENABLE)}$	input voltage on pin ENABLE	$V_{I(ENABLE)} < V_{CC} + 0.6$ V [1]	−0.5	+5.0	V
$V_{I(RF_IN)}$	input voltage on pin RF_IN	DC; $V_{I(RF_IN)} < V_{CC} + 0.6$ V [1][2]	−0.5	+5.0	V
$V_{I(RF_OUT)}$	input voltage on pin RF_OUT	DC; $V_{I(RF_OUT)} < V_{CC} + 0.6$ V [1][2]	−0.5	+5.0	V
P_i	input power		-	10	dBm
P_{tot}	total power dissipation	$T_{sp} \leq 130$ °C [3]	-	55	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		-	150	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM) according to ANSI/ESDA/JEDEC standard JS-001	-	±2.5	kV
		Charged Device Model (CDM) according to JEDEC standard JESD22-C101	-	±1	kV

[1] Warning: due to internal ESD diode protection, the applied DC voltage should not exceed V_{CC} + 0.6 V and shall not exceed 5.0 V to avoid excess current.

[2] The RF input and RF output are AC coupled through internal DC blocking capacitor.

[3] T_{sp} is the temperature at the soldering point of GND_RF (pin 4).

6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		225	K/W

7. Characteristics

Table 7. Characteristics at V_{CC} = 1.8 V

f = 1559 MHz to 1610 MHz; V_{CC} = 1.8 V; $V_{I(ENABLE)} \geq 0.9$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled	-	1.8	-	V
I_{CC}	supply current	$V_{I(ENABLE)} \geq 0.9$ V	-	5.1	-	mA
		$V_{I(ENABLE)} \leq 0.3$ V	-	-	2	µA
G_p	power gain	no jammer	-	17	-	dB
RL_{in}	input return loss		-	12	-	dB
RL_{out}	output return loss		-	11	-	dB
ISL	isolation		-	25	-	dB
NF	noise figure	no jammer [1]	-	0.9	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	f = 1575 MHz	-	−7	-	dBm
$IP3_i$	input third-order intercept point	f = 1575 MHz [2]	-	5	-	dBm

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Table 7. Characteristics at V_{CC} = 1.8 V *…continued*

f = 1559 MHz to 1610 MHz; V_{CC} = 1.8 V; $V_{I(ENABLE)} \geq 0.9$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{on}	turn-on time	[3]	-	-	2	µs
t_{off}	turn-off time	[3]	-	-	1	µs
K	Rollett stability factor		1	-	-	-

[1] PCB losses are subtracted.

[2] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = –20 dBm at f_1; P_i = –65 dBm at f_2.

[3] Within 10 % of the final gain.

Table 8. Characteristics at V_{CC} = 2.85 V

f = 1559 MHz to 1610 MHz; V_{CC} = 2.85 V; $V_{I(ENABLE)} \geq 0.9$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled	-	2.85	-	V
I_{CC}	supply current	$V_{I(ENABLE)} \geq 0.9$ V	-	5.5	-	mA
		$V_{I(ENABLE)} \leq 0.3$ V	-	-	2	µA
G_p	power gain	no jammer	-	17.5	-	dB
RL_{in}	input return loss		-	13	-	dB
RL_{out}	output return loss		-	11	-	dB
ISL	isolation		-	25	-	dB
NF	noise figure	no jammer [1]	-	0.95	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	f = 1575 MHz	-	–4	-	dBm
$IP3_i$	input third-order intercept point	f = 1575 MHz [2]	-	7	-	dBm
t_{on}	turn-on time	[3]	-	-	2	µs
t_{off}	turn-off time	[3]	-	-	1	µs
K	Rollett stability factor		1	-	-	-

[1] PCB losses are subtracted.

[2] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = –20 dBm at f_1; P_i = –65 dBm at f_2.

[3] Within 10 % of the final gain.

Table 9. ENABLE (pin 6)

–40 °C ≤ T_{amb} ≤ +85 °C; 1.5 V ≤ V_{CC} ≤ 3.1 V.

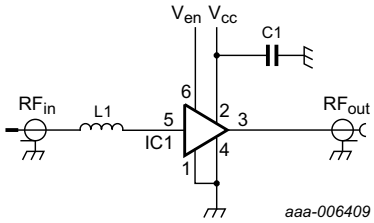
$V_{I(ENABLE)}$ (V)	State
≤ 0.3	OFF
≥ 0.9	ON

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8. Application information

8.1 GNSS LNA



For a list of components, see Table 10.

Fig 1. Schematics GNSS LNA evaluation board

Table 10. List of components

For schematics, see Figure 1.

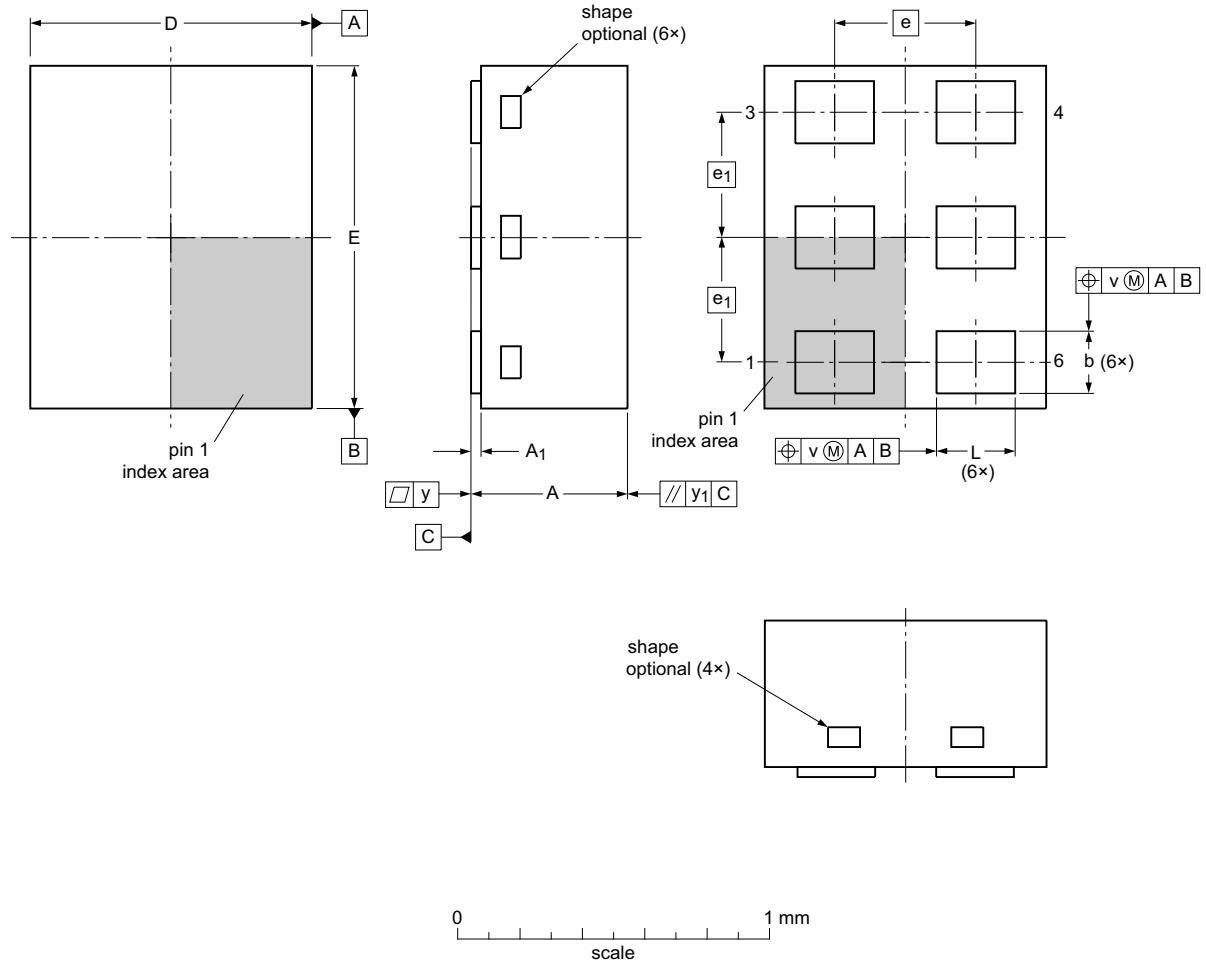
Component	Description	Value	Remarks
C1	decoupling capacitor	1 nF	
IC1	BGU6009/N2	-	NXP Semiconductors
L1	high-quality matching inductor	6.8 nH	Murata LQW15A

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9. Package outline

XSON6: plastic very thin small outline package; no leads; 6 terminals; body 1.1 x 0.9 x 0.47 mm **SOT1230**



Dimensions (mm are the original dimensions)

Unit		A	A_1	D	E	e_1	e	b	L	V	Y	Y_1
mm	min	0.44		0.85	1.05			0.17	0.22			
	nom	0.47		0.90	1.10	0.4	0.45	0.20	0.25	0.1	0.05	0.1
	max	0.50	0.04	0.95	1.15			0.25	0.30			

Note
1. Dimension A is including plating thickness.

sot1230_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1230						~~13-01-02~~ 13-01-08

Fig 2. Package outline SOT1230 (XSON6)

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10. Handling information

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

11. Abbreviations

Table 11. Abbreviations

Acronym	Description
ATM	Automated Teller Machine (cash dispenser)
ESD	ElectroStatic Discharge
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HBM	Human Body Model
LNA	Low-Noise Amplifier
MMIC	Monolithic Microwave Integrated Circuit
PCB	Printed-Circuit Board

12. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGU6009_N2 v.4	20170118	Product data sheet	-	BGU6009_N2 v.3
Modifications:	• Section 1: added GPS1002M according to our new naming convention			
BGU6009_N2 v.3	20160315	Product data sheet	-	BGU6009_N2 v.2
Modifications:	• Marking code F changed into W			
BGU6009_N2 v.2	20141106	Product data sheet	-	BGU6009_N2 v.1
Modifications:	• Table 1 on page 2: The value of the inductor has been corrected.			
BGU6009_N2 v.1	20141001	Product data sheet	-	-

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

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