



# BGU6009/N2

Low Noise Amplifier MMIC for GPS, GLONASS, Galileo and Compass

Rev. 1 — 1 October 2014

Product data sheet

## 1. Product profile

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### 1.1 General description

The BGU6009/N2 is 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 (NF) = 0.9 dB
- Gain 17 dB
- High input 1 dB compression point  $P_{i(1dB)}$  of -4 dBm
- High out of band  $IP_{3i}$  of 7 dBm
- Supply voltage 1.5 V to 3.1 V
- Power-down mode current consumption < 2  $\mu$ A
- 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  $\times$  0.9 mm  $\times$  0.47 mm; 0.4 mm pitch: SOT1230

### 1.3 Applications

- LNA for GPS, GLONASS, Galileo and Compass (BeiDou) in smart phones, feature phones, tablet PCs, Personal Navigation Devices, Digital Still Cameras, Digital Video Cameras, RF Front End modules, complete GPS chipset modules and theft protection (laptop, ATM).



1.4 Quick reference data

Table 1. Quick reference data

$f = 1559 \text{ MHz to } 1610 \text{ MHz}$ ;  $V_{CC} = 1.8 \text{ V}$ ;  $V_{I(ENABLE)} \geq 0.9 \text{ V}$ ;  $P_i < -40 \text{ dBm}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ; input matched to  $50 \text{ } \Omega$  using a  $5.6 \text{ nH}$  inductor; unless otherwise specified.

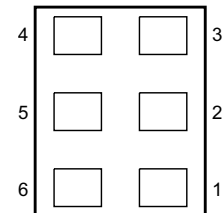
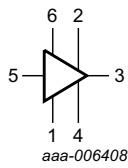
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	-	1.8	-	V
$I_{CC}$	supply current		-	5.1	-	mA
$G_p$	power gain	no jammer	-	17	-	dB
NF	noise figure	no jammer [1]	-	0.9	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	$f = 1575 \text{ MHz}$				
		$V_{CC} = 1.8 \text{ V}$	-	-7	-	dBm
		$V_{CC} = 2.85 \text{ V}$	-	-4	-	dBm
IP3 <sub>i</sub>	input third-order intercept point	$f = 1575 \text{ MHz}$				
		$V_{CC} = 1.8 \text{ V}$ [2]	-	5	-	dBm
		$V_{CC} = 2.85 \text{ V}$ [2]	-	7	-	dBm

[1] PCB losses are subtracted.

[2]  $f_1 = 1713 \text{ MHz}$ ;  $f_2 = 1851 \text{ MHz}$ ;  $P_1 = -20 \text{ dBm}$  at  $f_1$ ;  $P_1 = -65 \text{ dBm}$  at  $f_2$ .

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	GND	 <p>Transparent top view</p>	 <p>aaa-006408</p>
2	$V_{CC}$		
3	RF_OUT		
4	GND_RF		
5	RF_IN		
6	ENABLE		

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BGU6009/N2	XSON6	plastic very thin small outline package; no leads; 6 terminals; body $1.1 \times 0.9 \times 0.47 \text{ mm}$	SOT1230

4. Marking

Table 4. Marking codes

Type number	Marking code
BGU6009/N2	F

## 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	$V_{I(ENABLE)} < V_{CC} + 0.6$ [1]	-0.5	+5.0	V
$V_{I(RF\_IN)}$	input voltage on pin RF_IN	DC; $V_{I(RF\_IN)} < V_{CC} + 0.6$ [1][2]	-0.5	+5.0	V
$V_{I(RF\_OUT)}$	input voltage on pin RF_OUT	DC; $V_{I(RF\_OUT)} < V_{CC} + 0.6$ [1][2]	-0.5	+5.0	V
$P_i$	input power		-	10	dBm
$P_{tot}$	total power dissipation	$T_{sp} \leq 130\text{ °C}$ [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  $V_{CC} + 0.6$  and shall not exceed 5.0 V in order 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 the emitter lead.

## 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  $V_{CC} = 1.8\text{ V}$**

$f = 1559\text{ MHz to }1610\text{ MHz}$ ;  $V_{CC} = 1.8\text{ V}$ ;  $V_{I(ENABLE)} \geq 0.9\text{ V}$ ;  $P_i < -40\text{ dBm}$ ;  $T_{amb} = 25\text{ °C}$ ; input matched to  $50\ \Omega$  using a  $6.8\text{ nH}$  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	$V_{I(ENABLE)} \geq 0.9\text{ V}$	-	5.1	-	mA
		$V_{I(ENABLE)} \leq 0.3\text{ V}$	-	-	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	$f = 1575\text{ MHz}$	-	-7	-	dBm
IP <sub>3i</sub>	input third-order intercept point	$f = 1575\text{ MHz}$ [2]	-	5	-	dBm

**Table 7. Characteristics at  $V_{CC} = 1.8\text{ V}$  ...continued**

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

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

[1] PCB losses are subtracted.

[2]  $f_1 = 1713\text{ MHz}$ ;  $f_2 = 1851\text{ MHz}$ ;  $P_1 = -20\text{ dBm}$  at  $f_1$ ;  $P_1 = -65\text{ dBm}$  at  $f_2$ .

[3] Within 10 % of the final gain.

**Table 8. Characteristics at  $V_{CC} = 2.85\text{ V}$**

$f = 1559\text{ MHz to }1610\text{ MHz}$ ;  $V_{CC} = 2.85\text{ V}$ ;  $V_{I(ENABLE)} \geq 0.9\text{ V}$ ;  $P_i < -40\text{ dBm}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; input matched to  $50\ \Omega$  using a  $6.8\text{ nH}$  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	$V_{I(ENABLE)} \geq 0.9\text{ V}$	-	5.5	-	mA
		$V_{I(ENABLE)} \leq 0.3\text{ V}$	-	-	2	$\mu\text{A}$
$G_p$	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	$f = 1575\text{ MHz}$	-	-4	-	dBm
$IP3_i$	input third-order intercept point	$f = 1575\text{ MHz}$ [2]	-	7	-	dBm
$t_{on}$	turn-on time	[3]	-	-	2	$\mu\text{s}$
$t_{off}$	turn-off time	[3]	-	-	1	$\mu\text{s}$
K	Rollett stability factor		1	-	-	

[1] PCB losses are subtracted.

[2]  $f_1 = 1713\text{ MHz}$ ;  $f_2 = 1851\text{ MHz}$ ;  $P_1 = -20\text{ dBm}$  at  $f_1$ ;  $P_1 = -65\text{ dBm}$  at  $f_2$ .

[3] Within 10 % of the final gain.

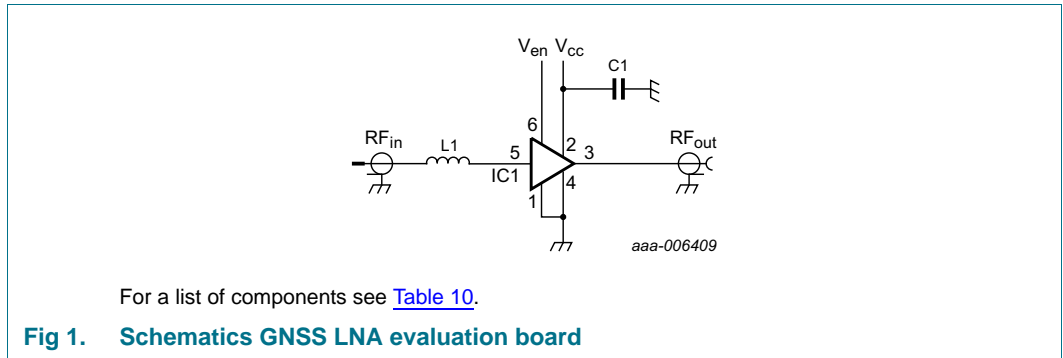
**Table 9. ENABLE (pin 5)**

$-40\text{ }^\circ\text{C} \leq T_{amb} \leq +85\text{ }^\circ\text{C}$ ;  $1.5\text{ V} \leq V_{CC} \leq 3.1\text{ V}$

$V_{I(ENABLE)}\text{ (V)}$	State
$\leq 0.3$	OFF
$\geq 0.9$	ON

## 8. Application information

### 8.1 GNSS LNA



**Table 10. List of components**

For schematics see [Figure 1](#).

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

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

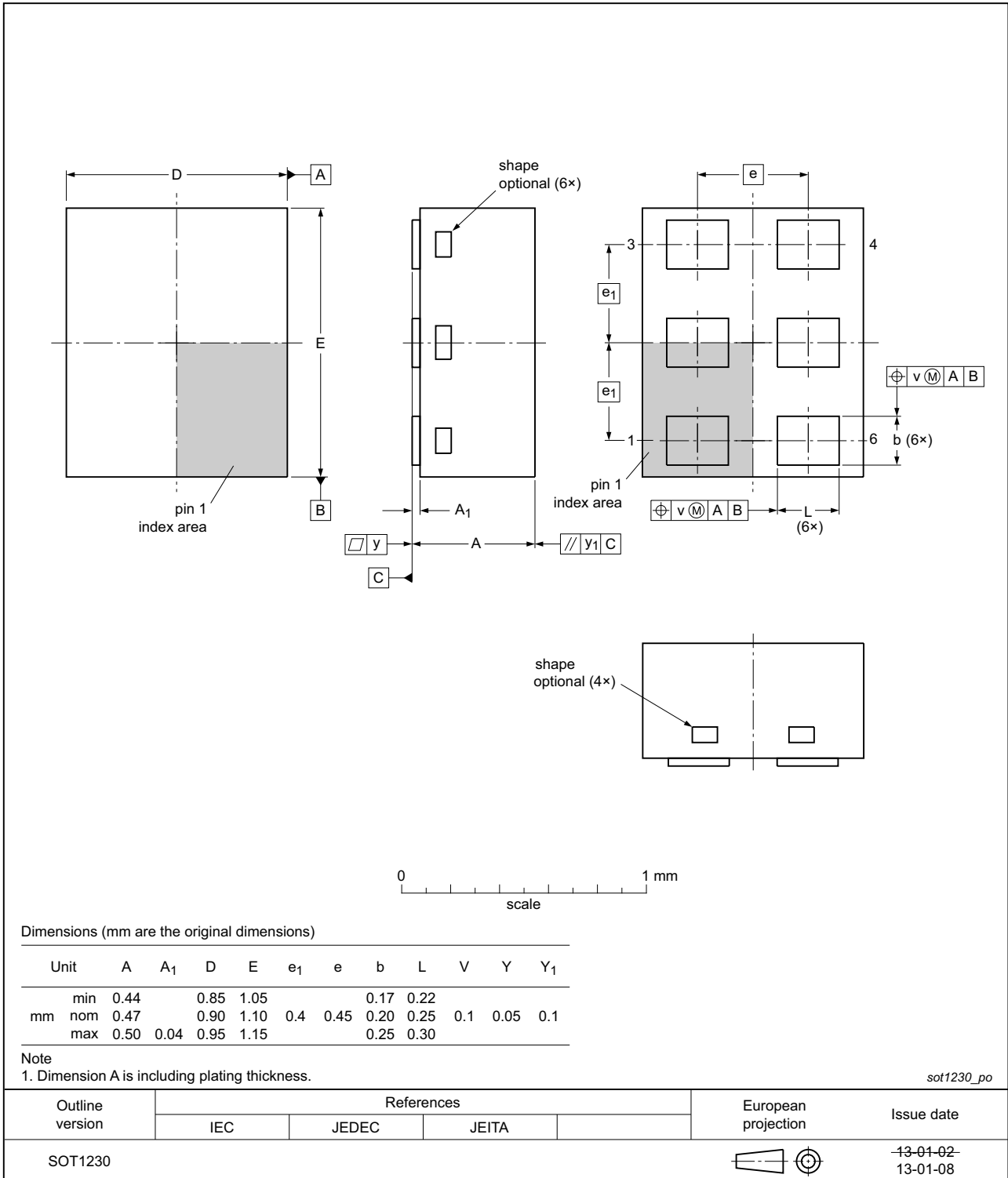


Fig 2. Package outline SOT1230 (XSON6)

## 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
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.1	20141001	Product data sheet	-	-

## 13. Legal information

### 13.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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## 15. Contents

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<b>1</b>	<b>Product profile</b> . . . . .	<b>1</b>
1.1	General description . . . . .	1
1.2	Features and benefits . . . . .	1
1.3	Applications . . . . .	1
1.4	Quick reference data . . . . .	2
<b>2</b>	<b>Pinning information</b> . . . . .	<b>2</b>
<b>3</b>	<b>Ordering information</b> . . . . .	<b>2</b>
<b>4</b>	<b>Marking</b> . . . . .	<b>2</b>
<b>5</b>	<b>Limiting values</b> . . . . .	<b>3</b>
<b>6</b>	<b>Thermal characteristics</b> . . . . .	<b>3</b>
<b>7</b>	<b>Characteristics</b> . . . . .	<b>3</b>
<b>8</b>	<b>Application information</b> . . . . .	<b>5</b>
8.1	GNSS LNA . . . . .	5
<b>9</b>	<b>Package outline</b> . . . . .	<b>6</b>
<b>10</b>	<b>Handling information</b> . . . . .	<b>7</b>
<b>11</b>	<b>Abbreviations</b> . . . . .	<b>7</b>
<b>12</b>	<b>Revision history</b> . . . . .	<b>7</b>
<b>13</b>	<b>Legal information</b> . . . . .	<b>8</b>
13.1	Data sheet status . . . . .	8
13.2	Definitions . . . . .	8
13.3	Disclaimers . . . . .	8
13.4	Trademarks . . . . .	9
<b>14</b>	<b>Contact information</b> . . . . .	<b>9</b>
<b>15</b>	<b>Contents</b> . . . . .	<b>10</b>

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