



# BGU6009/N2

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

Rev. 4 — 18 January 2017

Product data sheet

## 1. Product profile

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### 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  $< 2$   $\mu$ 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).

- 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**

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

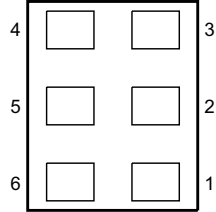
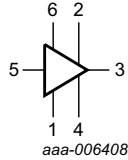
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	1.5	1.8	3.1	V
$I_{CC}$	supply current		-	5.1	-	mA
$G_p$	power gain	no jammer	-	17	-	dB
NF	noise figure	no jammer <a href="#">[1]</a>	-	0.9	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	$f = 1575\text{ MHz}$				
		$V_{CC} = 1.8\text{ V}$	-	-7	-	dBm
		$V_{CC} = 2.85\text{ V}$	-	-4	-	dBm
IP3 <sub>i</sub>	input third-order intercept point	$f = 1575\text{ MHz}$				
		$V_{CC} = 1.8\text{ V}$ <a href="#">[2]</a>	-	5	-	dBm
		$V_{CC} = 2.85\text{ V}$ <a href="#">[2]</a>	-	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	W

## 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  $50 \Omega$  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 <sub>i</sub>	input third-order intercept point	$f = 1575$ 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]  $f_1 = 1713\text{ MHz}$ ;  $f_2 = 1851\text{ MHz}$ ;  $P_i = -20\text{ dBm}$  at  $f_1$ ;  $P_i = -65\text{ dBm}$  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]  $f_1 = 1713\text{ MHz}$ ;  $f_2 = 1851\text{ MHz}$ ;  $P_i = -20\text{ dBm}$  at  $f_1$ ;  $P_i = -65\text{ dBm}$  at  $f_2$ .
- [3] Within 10 % of the final gain.

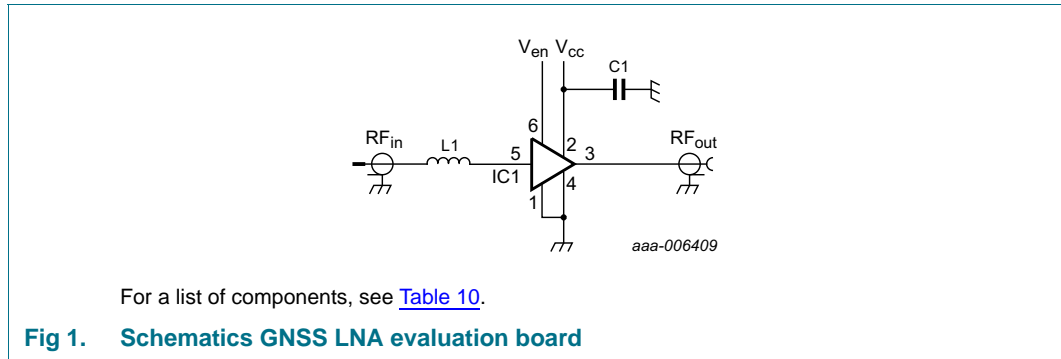
**Table 9. ENABLE (pin 6)**

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

$V_{I(ENABLE)}\text{ (V)}$	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 Semiconductors
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

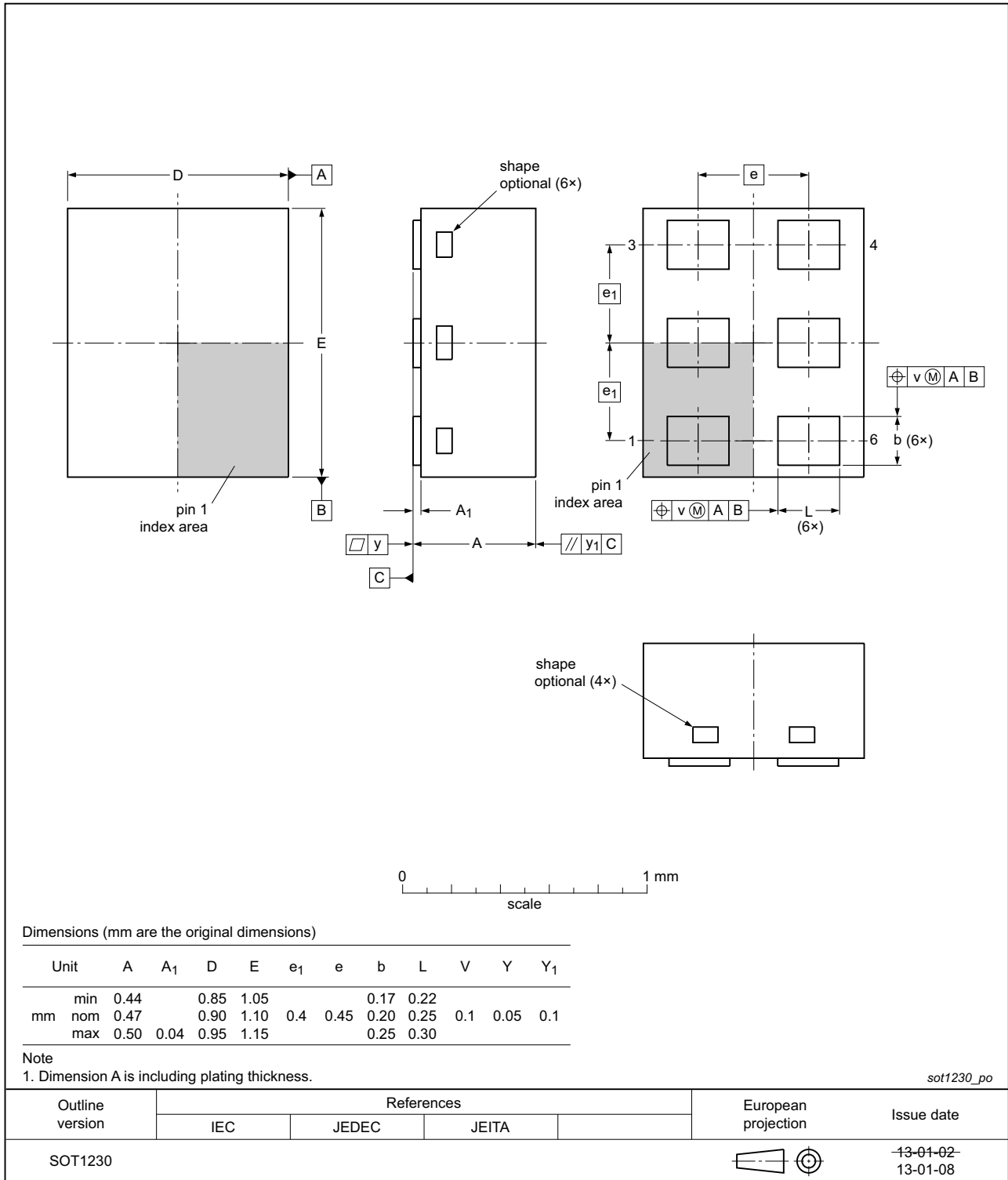


Fig 2. Package outline SOT1230 (XSON6)

## 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
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:	<ul style="list-style-type: none"> <li>• <a href="#">Section 1</a>: added GPS1002M according to our new naming convention</li> </ul>			
BGU6009_N2 v.3	20160315	Product data sheet	-	BGU6009_N2 v.2
Modifications:	<ul style="list-style-type: none"> <li>• Marking code F changed into W</li> </ul>			
BGU6009_N2 v.2	20141106	Product data sheet	-	BGU6009_N2 v.1
Modifications:	<ul style="list-style-type: none"> <li>• Table 1 on page 2: The value of the inductor has been corrected.</li> </ul>			
BGU6009_N2 v.1	20141001	Product data sheet	-	-

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### 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.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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Date of release: 18 January 2017

Document identifier: BGU6009\_N2