



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 μ 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 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 | $f = 1575\text{ MHz}$ | | | | |
| | | $V_{CC} = 1.8\text{ V}$ | - | -7 | - | dBm |
| | | $V_{CC} = 2.85\text{ V}$ | - | -4 | - | dBm |
| $IP3_i$ | 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 | 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 50Ω 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 |

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 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] $f_1 = 1713\text{ MHz}$; $f_2 = 1851\text{ MHz}$; $P_i = -20\text{ dBm}$ 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 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 | 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 | $f = 1575\text{ MHz}$ | - | -4 | - | dBm |
| $IP3_i$ | input third-order intercept point | $f = 1575\text{ MHz}$ | [2] | 7 | - | dBm |
| t_{on} | turn-on time | | [3] | - | 2 | μs |
| t_{off} | turn-off time | | [3] | - | 1 | μs |
| 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 |
|----------------------------|-------|
| ≤ 0.3 | OFF |
| ≥ 0.9 | ON |

8. Application information

8.1 GNSS LNA

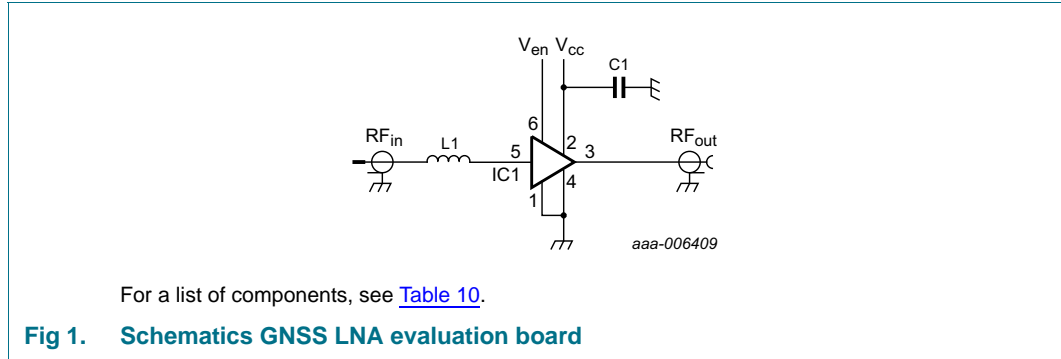


Table 10. List of components

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

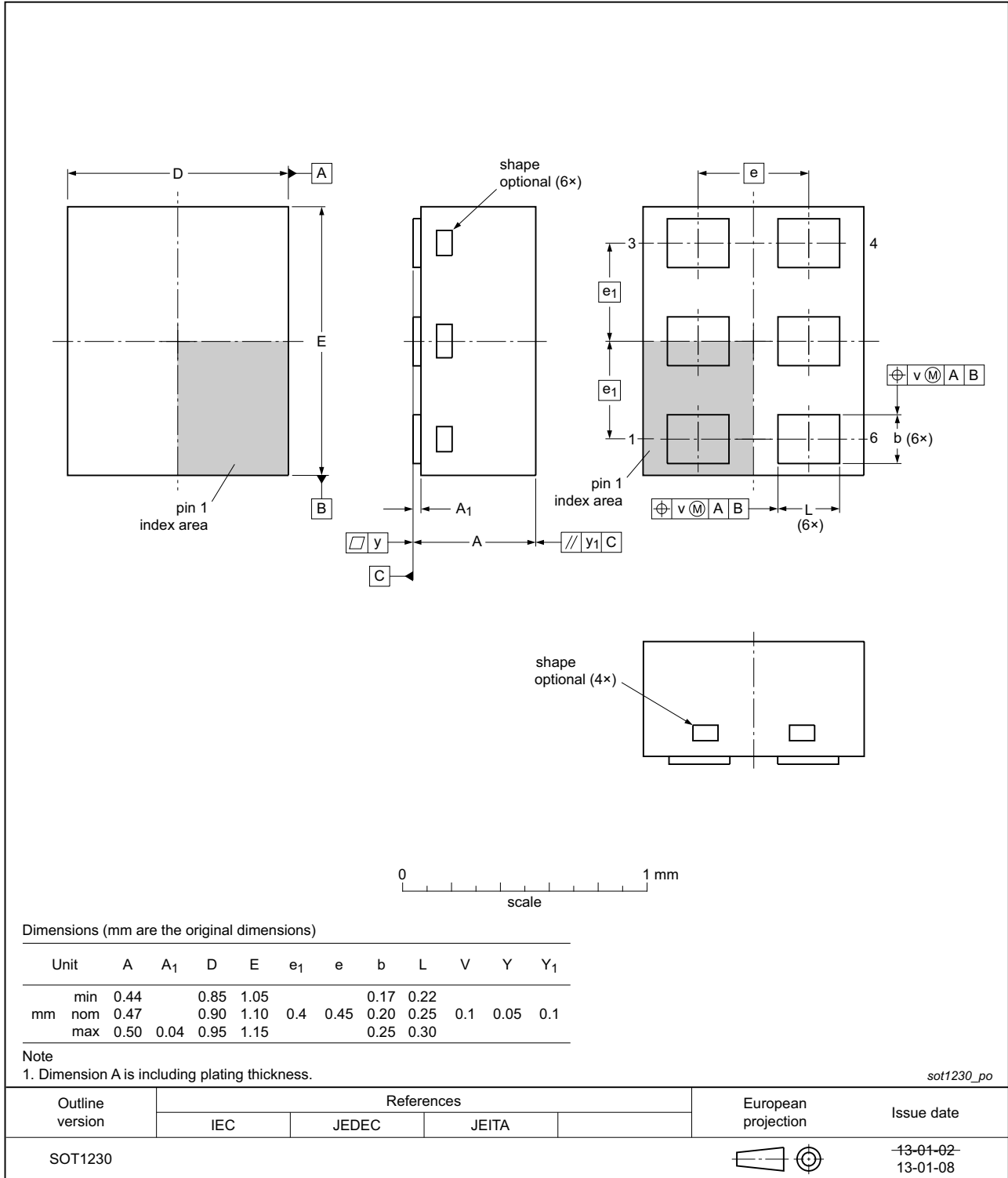


Fig 2. Package outline SOT1230 (XSON6)

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

13. Legal information

13.1 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. |
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[2] The term 'short data sheet' is explained in section "Definitions".

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15. Contents

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

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