



BGU8103

SiGe:C low-noise amplifier MMIC for GPS, GLONASS, Galileo and COMPASS

Rev. 3 — 18 January 2017

Product data sheet

1. General description

The BGU8103 is, also known as the GPS1301M, an ultra low current and Low-Noise Amplifier (LNA) for GNSS receiver applications. The BGU8103 is available in a small plastic 6-pin extremely thin leadless package. The BGU8103 requires only one external matching inductor.

The BGU8103 adapts itself to the changing environment resulting from co-habitation of different radio systems in modern cellular handsets. It has been designed for ultra low power consumption and optimal performance when jamming signals from co-existing cellular transmitters are present. At low jamming power levels, it delivers 17.5 dB gain at a noise figure of 0.80 dB and a supply current of 1.2 mA. During high jamming power levels, resulting for example from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

2. Features and benefits

- Optimized performance at a low supply current of 1.2 mA
- Covers full GNSS L1 band, from 1559 MHz to 1610 MHz
- Noise figure = 0.80 dB
- Gain 17.5 dB
- Input 1 dB compression point of -16 dBm
- Out of band $IP3_i$ of -8 dBm
- Supply voltage 1.5 V to 3.1 V
- Self-shielding package concept
- Integrated supply decoupling capacitor
- Power-down mode current consumption < 1 μ A
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor
- Integrated DC blocking at both RF input and output
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Available in a 6-pin leadless package 1.1 mm \times 0.7 mm \times 0.37 mm; 0.4 mm pitch: SOT1232
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level 1



3. Applications

- Smart phones
- Feature phones
- Tablets
- Digital still cameras
- Digital video cameras
- RF front-end modules
- Complete GNSS modules
- Personal health applications

4. Quick reference data

Table 1. Quick reference data

$f = 1575 \text{ MHz}$; $V_{CC} = 1.8 \text{ V}$; $V_{I(ENABLE)} \geq 0.8 \text{ V}$; $P_1 < -40 \text{ dBm}$; $T_{amb} = 25 \text{ }^\circ\text{C}$; input matched to $50 \text{ }\Omega$ using a 12 nH inductor; see [Figure 3](#); unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|--------------------------------------|-------------------------------------|--------|------|------|------|
| V_{CC} | supply voltage | RF input AC coupled | 1.5 | - | 3.1 | V |
| I_{CC} | supply current | $P_1 < -40 \text{ dBm}$ | 0.8 | 1.2 | 1.6 | mA |
| G_p | power gain | no jammer | 14.5 | 17.5 | 20.0 | dB |
| NF | noise figure | $P_1 = -40 \text{ dBm}$; no jammer | [1][2] | 0.8 | 1.4 | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | | [2] | -19 | -16 | dBm |
| $IP3_i$ | input third-order intercept point | | [2][3] | -11 | -8 | dBm |

[1] PCB losses are subtracted.

[2] Guaranteed by device design; not tested in production.

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

5. Ordering information

Table 2. Ordering information

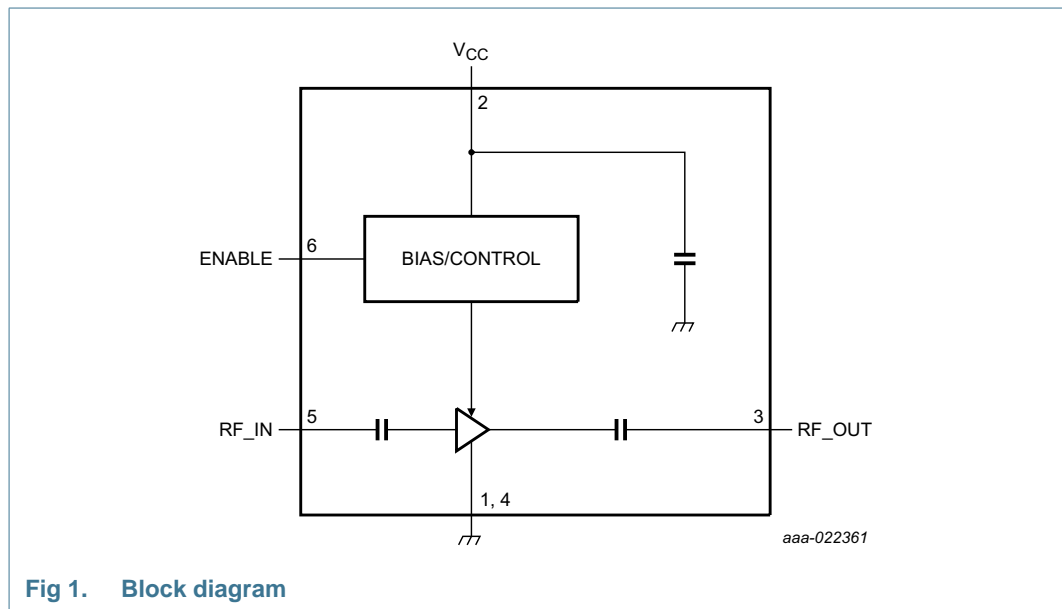
| Type number | Package | | Version |
|-------------|---------|---|---------|
| | Name | Description | |
| BGU8103 | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body $1.1 \times 0.7 \times 0.37 \text{ mm}$ | SOT1232 |

6. Marking

Table 3. Marking codes

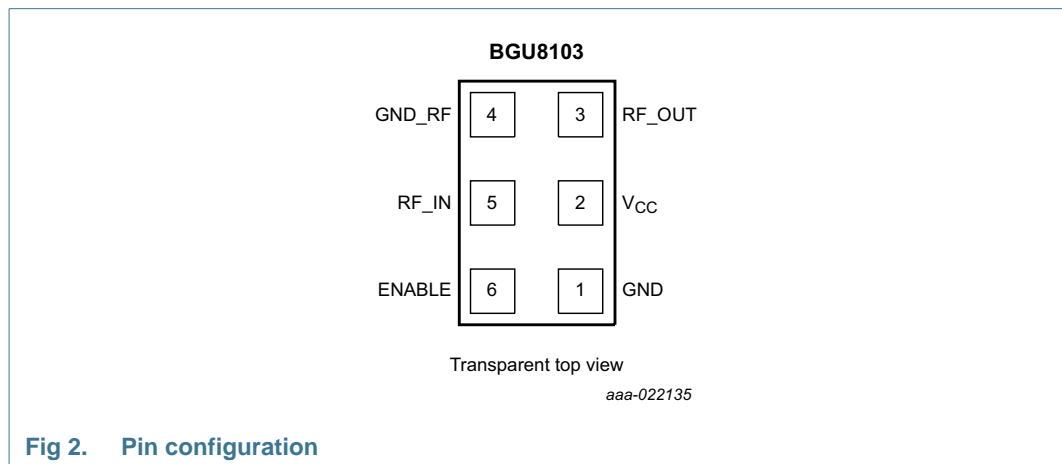
| Type number | Marking code |
|-------------|--------------|
| BGU8103 | G |

7. Block diagram



8. Pinning information

8.1 Pinning



8.2 Pin description

Table 4. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| GND | 1 | ground |
| V _{CC} | 2 | supply voltage |
| RF_OUT | 3 | RF output |
| GND_RF | 4 | ground RF |
| RF_IN | 5 | RF input |
| ENABLE | 6 | enable |

9. Limiting values

Table 5. Limiting values

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

See Section 18.3 "Disclaimers", paragraph "Limiting values".

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|------------------------|---------------------------------|---|-----------|------|------|-----|
| V _{CC} | supply voltage | RF input AC coupled | [1] | -0.5 | +5.0 | V |
| V _{I(ENABLE)} | input voltage on pin ENABLE | V _{I(ENABLE)} < V _{CC} + 0.6 V | [1][2] | -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][3] | -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][3] | -0.5 | +5.0 | V |
| P _i | input power | | [1] | - | 10 | dBm |
| P _{tot} | total power dissipation | T _{sp} ≤ 130 °C | - | - | 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 JEDEC standard JS-001-2010 | - | ±2 | | kV |
| | | Charged Device Model (CDM) according to JEDEC standard JESD22-C101C | - | ±2 | | kV |

[1] Stressed with pulses of 200 ms in duration, with application circuit as in Figure 3.

[2] Warning: Due to internal ESD diode protection, to avoid excess current, the applied DC voltage must not exceed V_{CC} + 0.6 V or 5.0 V.

[3] The RF input and RF output are AC coupled through internal DC blocking capacitors.

10. Recommended operating conditions

Table 6. Operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------------|-----------------------------|------------|-----|-----|-----|------|
| V _{CC} | supply voltage | | 1.5 | - | 3.1 | V |
| T _{amb} | ambient temperature | | -40 | +25 | +85 | °C |
| V _{I(ENABLE)} | input voltage on pin ENABLE | OFF state | - | - | 0.3 | V |
| | | ON state | 0.8 | - | - | V |

11. Thermal characteristics

Table 7. Thermal characteristics

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

12. Characteristics

Table 8. Characteristics at $V_{CC} = 1.8\text{ V}$

$f = 1575\text{ MHz}$; $V_{CC} = 1.8\text{ V}$; $V_{I(ENABLE)} \geq 0.8\text{ V}$; $P_i < -40\text{ dBm}$; $T_{amb} = 25\text{ °C}$; input matched to $50\ \Omega$ using a 12 nH inductor; see [Figure 3](#); unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|--|--|------|------|------|---------------|
| I_{CC} | supply current | $V_{I(ENABLE)} \geq 0.8\text{ V}$ | | | | |
| | | $P_i < -40\text{ dBm}$ | 0.8 | 1.2 | 1.6 | mA |
| | | $P_i = -20\text{ dBm}$ | - | 2.5 | - | mA |
| | | $V_{I(ENABLE)} \leq 0.3\text{ V}$ | - | - | 1 | μA |
| G_p | power gain | no jammer | 14.5 | 17.5 | 20.0 | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 850\text{ MHz}$ | - | 18.5 | - | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 1850\text{ MHz}$ | - | 18.0 | - | dB |
| RL_{in} | input return loss | $P_i < -40\text{ dBm}$ | - | 8 | - | dB |
| | | $P_i = -20\text{ dBm}$ | - | 9 | - | dB |
| RL_{out} | output return loss | $P_i < -40\text{ dBm}$ | - | 11 | - | dB |
| | | $P_i = -20\text{ dBm}$ | - | 11 | - | dB |
| ISL | isolation | | - | 35 | - | dB |
| NF | noise figure | $P_i = -40\text{ dBm}$; no jammer [1][2] | - | 0.8 | 1.4 | dB |
| | | $P_i = -40\text{ dBm}$; no jammer [2][3] | - | 0.9 | 1.5 | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 850\text{ MHz}$ [3] | - | 1.1 | - | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 1850\text{ MHz}$ [3] | - | 1.4 | - | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | [2] | -19 | -16 | - | dBm |
| $IP3_i$ | input third-order intercept point | [2][4] | -11 | -8 | - | dBm |
| IMD3 | third-order intermodulation distortion | output referred [4] | - | -72 | - | dBm |
| t_{on} | turn-on time | time from $V_{I(ENABLE)}$ ON to 90 % of the gain | - | - | 2 | μs |
| t_{off} | turn-off time | time from $V_{I(ENABLE)}$ OFF to 10 % of the gain | - | - | 1 | μs |

[1] PCB losses are subtracted.

[2] Guaranteed by device design; not tested in production.

[3] Including PCB losses.

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

Table 9. Characteristics at $V_{CC} = 2.85\text{ V}$

$f = 1575\text{ MHz}$; $V_{CC} = 2.85\text{ V}$; $V_{I(ENABLE)} \geq 0.8\text{ V}$; $P_i < -40\text{ dBm}$; $T_{amb} = 25\text{ }^\circ\text{C}$; input matched to $50\text{ }\Omega$ using a 12 nH inductor; see [Figure 3](#); unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|--------------|--|--|------------------------|------|------|---------------|-----|
| I_{CC} | supply current | $V_{I(ENABLE)} \geq 0.8\text{ V}$ | | | | | |
| | | $P_i < -40\text{ dBm}$ | 0.8 | 1.2 | 1.6 | mA | |
| | | $P_i = -20\text{ dBm}$ | - | 2.5 | - | mA | |
| | | $V_{I(ENABLE)} \leq 0.3\text{ V}$ | - | - | 1 | μA | |
| G_p | power gain | no jammer | 15.0 | 17.5 | 20.0 | dB | |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 850\text{ MHz}$ | - | 18.5 | - | dB | |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 1850\text{ MHz}$ | - | 18.5 | - | dB | |
| RL_{in} | input return loss | $P_i < -40\text{ dBm}$ | - | 8 | - | dB | |
| | | $P_i = -20\text{ dBm}$ | - | 9 | - | dB | |
| RL_{out} | output return loss | $P_i < -40\text{ dBm}$ | - | 11 | - | dB | |
| | | $P_i = -20\text{ dBm}$ | - | 11 | - | dB | |
| ISL | isolation | | - | 35 | - | dB | |
| NF | noise figure | $P_i = -40\text{ dBm}$; no jammer | [1][2] | - | 1.0 | 1.4 | dB |
| | | $P_i = -40\text{ dBm}$; no jammer | [2][3] | - | 1.1 | 1.5 | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 850\text{ MHz}$ | [3] | - | 1.1 | - | dB |
| | | $P_{jam} = -20\text{ dBm}$; $f_{jam} = 1850\text{ MHz}$ | [3] | - | 1.4 | - | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | | [2] | -16 | -13 | - | dBm |
| $IP3_i$ | input third-order intercept point | | [2][4] | -10 | -7 | - | dBm |
| IMD3 | third-order intermodulation distortion | output referred | [4] | - | -72 | - | dBm |
| t_{on} | turn-on time | time from $V_{I(ENABLE)}$ ON to 90 % of the gain | - | - | 2 | μs | |
| t_{off} | turn-off time | time from $V_{I(ENABLE)}$ OFF to 10 % of the gain | - | - | 1 | μs | |

[1] PCB losses are subtracted.

[2] Guaranteed by device design; not tested in production.

[3] Including PCB losses.

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

13. Application information

13.1 GNSS LNA

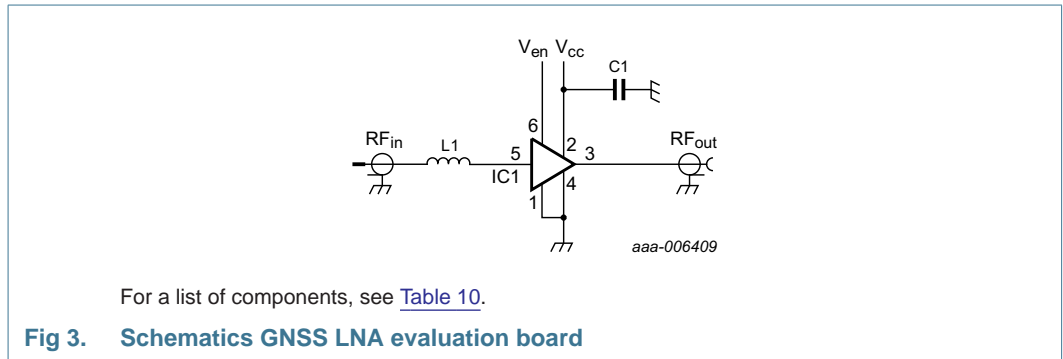


Table 10. List of components

For schematics, see [Figure 3](#).

| Component | Description | Value | Remarks |
|-----------|--------------------------------|-------|--------------------------------|
| C1 | decoupling capacitor | 1 nF | to suppress power supply noise |
| IC1 | BGU8103 | - | NXP Semiconductors |
| L1 | high-quality matching inductor | 12 nH | Murata LQW15A |

14. Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm

SOT1232

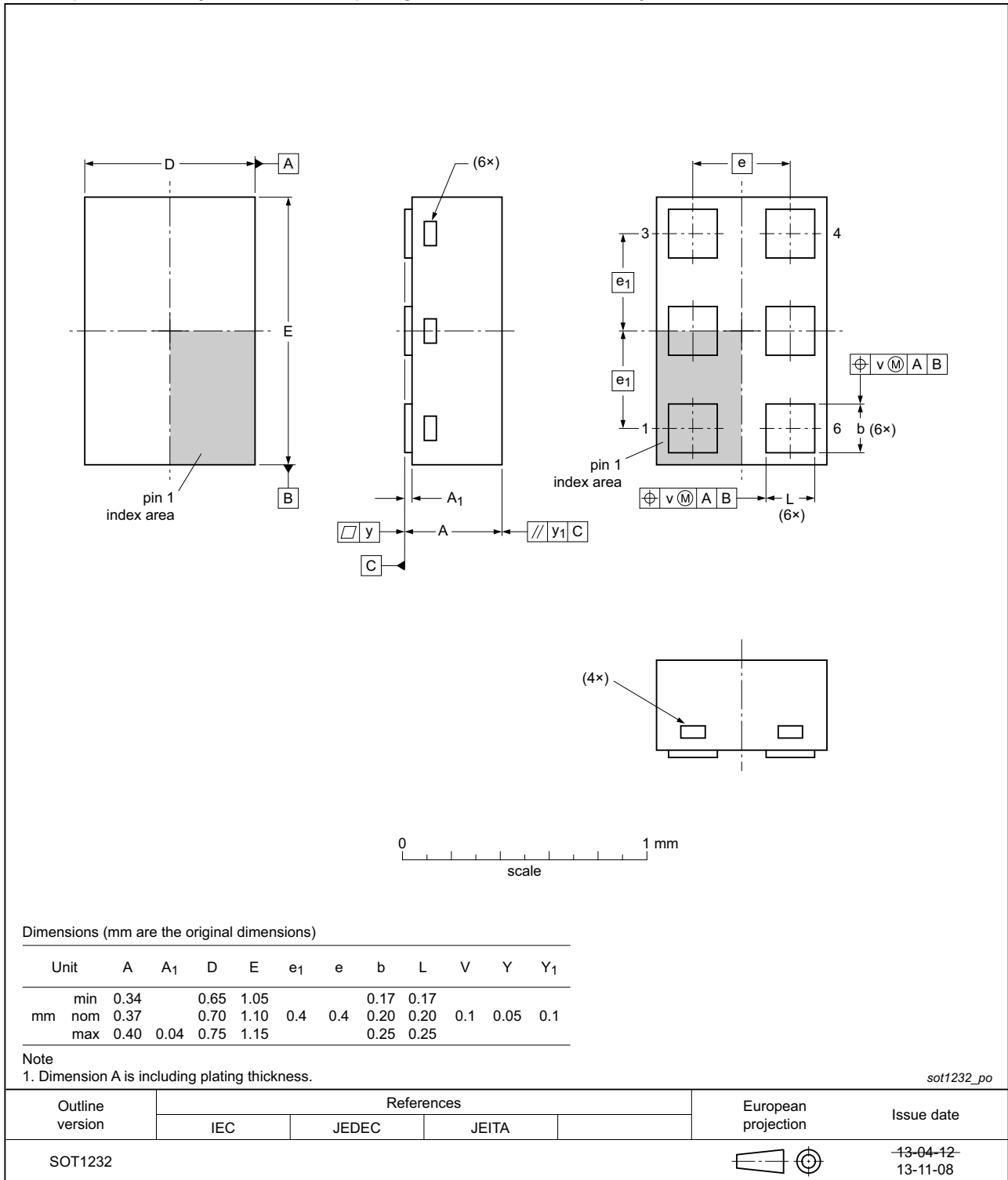


Fig 4. Package outline SOT1232 (XSON6)

15. 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.

16. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| 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 |
| SiGe:C | Silicon Germanium Carbon |

17. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|------------------------|---------------|-------------|
| BGU8103 v.3 | 20170118 | Product data sheet | - | BGU8103 v.2 |
| Modifications: | <ul style="list-style-type: none"> Section 1: added GPS1301M according to our new naming convention | | | |
| BGU8103 v.2 | 20160325 | Product data sheet | - | BGU8103 v.1 |
| Modifications: | <ul style="list-style-type: none"> Data sheet status changed from Preliminary data sheet to Product data sheet | | | |
| BGU8103 v.1 | 20151221 | Preliminary data sheet | - | - |

18. Legal information

18.1 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. |

[1] Please consult the most recently issued document before initiating or completing a design.

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

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

18.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

18.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the

product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

18.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

19. Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

20. Contents

| | | |
|------|--|----|
| 1 | General description | 1 |
| 2 | Features and benefits | 1 |
| 3 | Applications | 2 |
| 4 | Quick reference data | 2 |
| 5 | Ordering information | 2 |
| 6 | Marking | 2 |
| 7 | Block diagram | 3 |
| 8 | Pinning information | 3 |
| 8.1 | Pinning | 3 |
| 8.2 | Pin description | 4 |
| 9 | Limiting values | 4 |
| 10 | Recommended operating conditions | 4 |
| 11 | Thermal characteristics | 5 |
| 12 | Characteristics | 5 |
| 13 | Application information | 7 |
| 13.1 | GNSS LNA | 7 |
| 14 | Package outline | 8 |
| 15 | Handling information | 9 |
| 16 | Abbreviations | 9 |
| 17 | Revision history | 9 |
| 18 | Legal information | 10 |
| 18.1 | Data sheet status | 10 |
| 18.2 | Definitions | 10 |
| 18.3 | Disclaimers | 10 |
| 18.4 | Trademarks | 11 |
| 19 | Contact information | 11 |
| 20 | Contents | 12 |

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© NXP Semiconductors N.V. 2017.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 18 January 2017

Document identifier: BGU8103

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[NXP:](#)

[BGU8103X](#)