



# BGU8103

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

Rev. 3 — 18 January 2017

Product data sheet

## 1. General description

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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

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- 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  $< 1$   $\mu$ 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**

$f = 1575 \text{ MHz}$ ;  $V_{CC} = 1.8 \text{ V}$ ;  $V_{I(ENABLE)} \geq 0.8 \text{ V}$ ;  $P_i < -40 \text{ dBm}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ; input matched to  $50 \Omega$  using a  $12 \text{ nH}$  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	$P_i < -40 \text{ dBm}$	0.8	1.2	1.6	mA	
$G_p$	power gain	no jammer	14.5	17.5	20.0	dB	
NF	noise figure	$P_i = -40 \text{ dBm}$ ; 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]  $f_1 = 1713 \text{ MHz}$ ;  $f_2 = 1851 \text{ MHz}$ ;  $P_i = -20 \text{ dBm}$  at  $f_1$ ;  $P_i = -65 \text{ dBm}$  at  $f_2$ .

### 5. Ordering information

**Table 2. Ordering information**

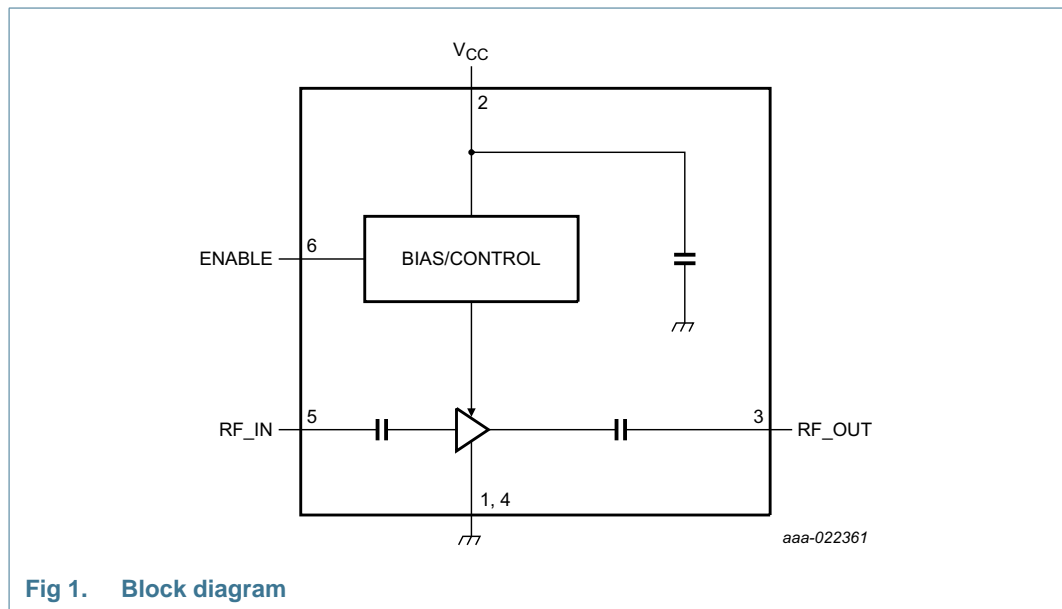
Type number	Package		Version
	Name	Description	
BGU8103	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body $1.1 \times 0.7 \times 0.37 \text{ mm}$	SOT1232

### 6. Marking

**Table 3. Marking codes**

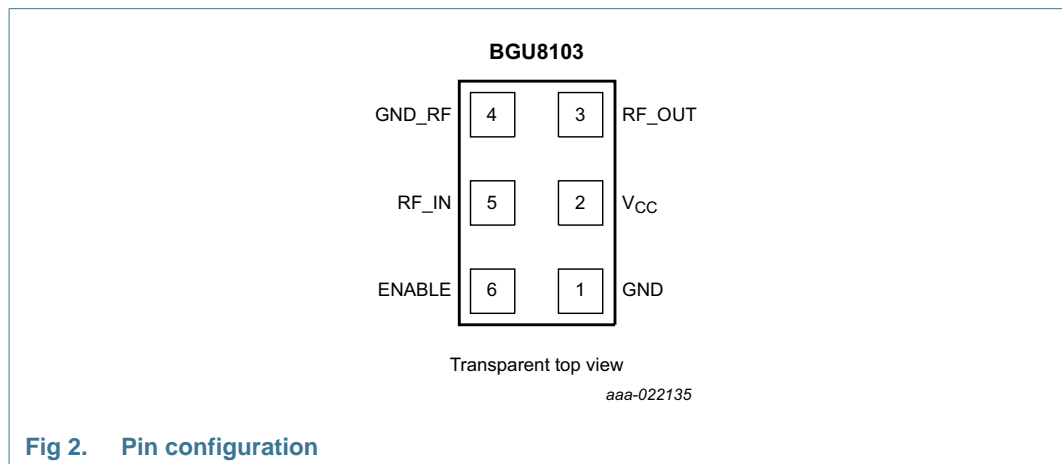
Type number	Marking code
BGU8103	G

## 7. Block diagram



## 8. Pinning information

### 8.1 Pinning



### 8.2 Pin description

**Table 4. Pin description**

Symbol	Pin	Description
GND	1	ground
V <sub>CC</sub>	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 <sub>CC</sub>	supply voltage	RF input AC coupled [1]	-0.5	+5.0	V
V <sub>I(ENABLE)</sub>	input voltage on pin ENABLE	V <sub>I(ENABLE)</sub> < V <sub>CC</sub> + 0.6 V [1][2]	-0.5	+5.0	V
V <sub>I(RF_IN)</sub>	input voltage on pin RF_IN	DC; V <sub>I(RF_IN)</sub> < V <sub>CC</sub> + 0.6 V [1][2][3]	-0.5	+5.0	V
V <sub>I(RF_OUT)</sub>	input voltage on pin RF_OUT	DC; V <sub>I(RF_OUT)</sub> < V <sub>CC</sub> + 0.6 V [1][2][3]	-0.5	+5.0	V
P <sub>i</sub>	input power	[1]	-	10	dBm
P <sub>tot</sub>	total power dissipation	T <sub>sp</sub> ≤ 130 °C	-	55	mW
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
V <sub>ESD</sub>	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<sub>CC</sub> + 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 <sub>CC</sub>	supply voltage		1.5	-	3.1	V
T <sub>amb</sub>	ambient temperature		-40	+25	+85	°C
V <sub>I(ENABLE)</sub>	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  $V_{CC} = 1.8\text{ V}$**

$f = 1575\text{ MHz}$ ;  $V_{CC} = 1.8\text{ V}$ ;  $V_{I(ENABLE)} \geq 0.8\text{ V}$ ;  $P_i < -40\text{ dBm}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; input matched to  $50\ \Omega$  using a  $12\text{ nH}$  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	$\mu\text{A}$
$G_p$	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 <a href="#">[1][2]</a>	-	0.8	1.4	dB
		$P_i = -40\text{ dBm}$ ; no jammer <a href="#">[2][3]</a>	-	0.9	1.5	dB
		$P_{jam} = -20\text{ dBm}$ ; $f_{jam} = 850\text{ MHz}$ <a href="#">[3]</a>	-	1.1	-	dB
		$P_{jam} = -20\text{ dBm}$ ; $f_{jam} = 1850\text{ MHz}$ <a href="#">[3]</a>	-	1.4	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	<a href="#">[2]</a>	-19	-16	-	dBm
$IP3_i$	input third-order intercept point	<a href="#">[2][4]</a>	-11	-8	-	dBm
IMD3	third-order intermodulation distortion	output referred <a href="#">[4]</a>	-	-72	-	dBm
$t_{on}$	turn-on time	time from $V_{I(ENABLE)}$ ON to 90 % of the gain	-	-	2	$\mu\text{s}$
$t_{off}$	turn-off time	time from $V_{I(ENABLE)}$ OFF to 10 % of the gain	-	-	1	$\mu\text{s}$

[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  $12\text{ nH}$  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	$\mu\text{A}$
$G_p$	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 <a href="#">[1][2]</a>	-	1.0	1.4	dB
		$P_i = -40\text{ dBm}$ ; no jammer <a href="#">[2][3]</a>	-	1.1	1.5	dB
		$P_{jam} = -20\text{ dBm}$ ; $f_{jam} = 850\text{ MHz}$ <a href="#">[3]</a>	-	1.1	-	dB
		$P_{jam} = -20\text{ dBm}$ ; $f_{jam} = 1850\text{ MHz}$ <a href="#">[3]</a>	-	1.4	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		<a href="#">[2]</a> -16	-13	-	dBm
$IP3_i$	input third-order intercept point		<a href="#">[2][4]</a> -10	-7	-	dBm
IMD3	third-order intermodulation distortion	output referred <a href="#">[4]</a>	-	-72	-	dBm
$t_{on}$	turn-on time	time from $V_{I(ENABLE)}$ ON to 90 % of the gain	-	-	2	$\mu\text{s}$
$t_{off}$	turn-off time	time from $V_{I(ENABLE)}$ OFF to 10 % of the gain	-	-	1	$\mu\text{s}$

[1] PCB losses are subtracted.

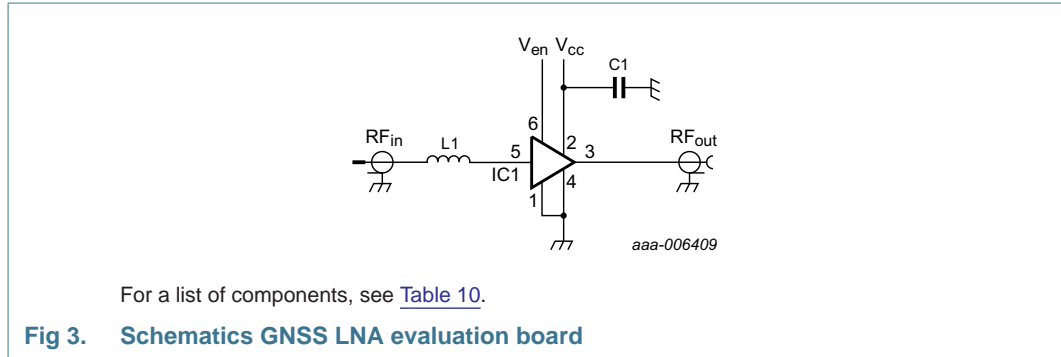
[2] Guaranteed by device design; not tested in production.

[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

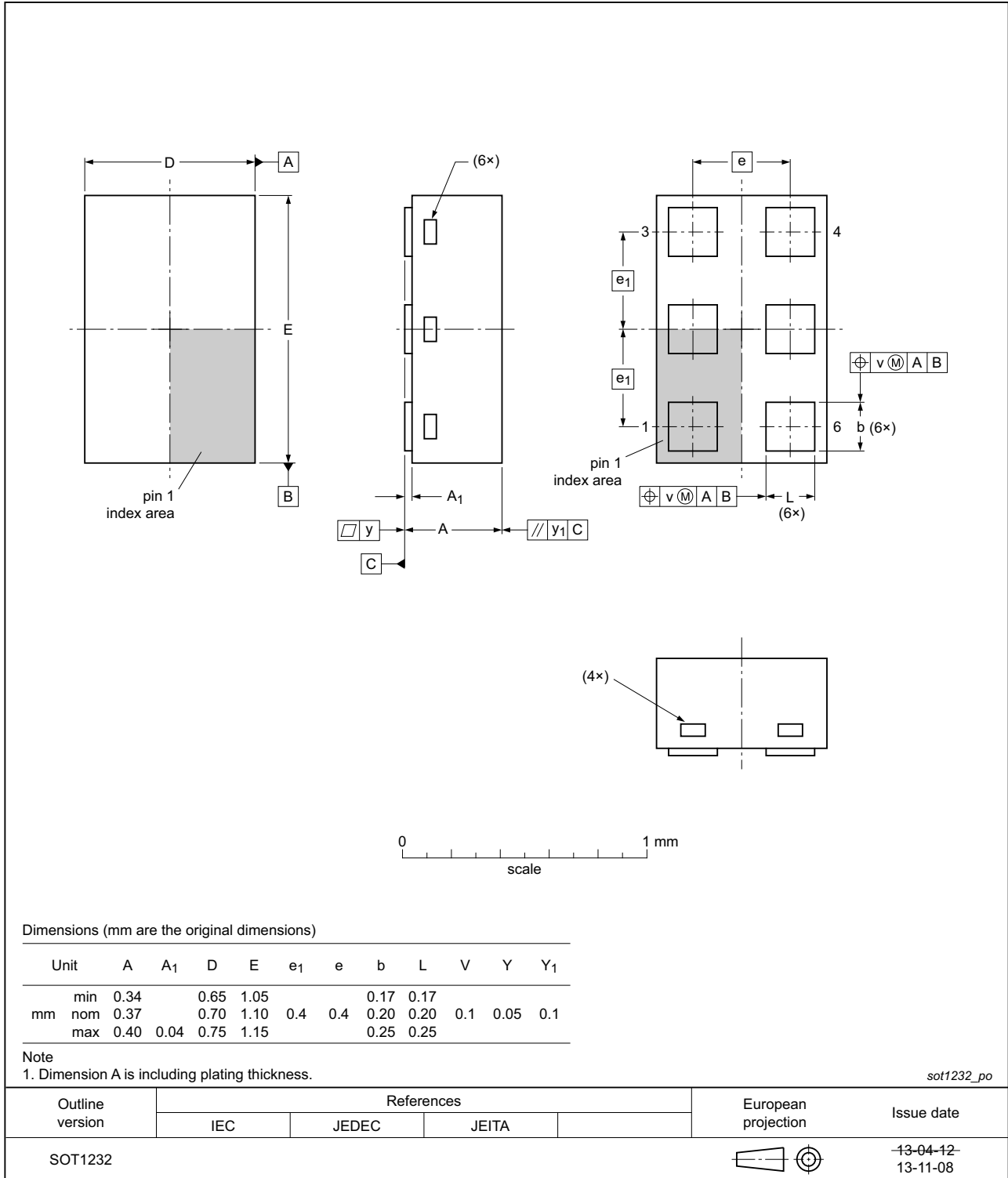


Fig 4. Package outline SOT1232 (XSON6)



### 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"> <li><a href="#">Section 1</a>: added GPS1301M according to our new naming convention</li> </ul>			
BGU8103 v.2	20160325	Product data sheet	-	BGU8103 v.1
Modifications:	<ul style="list-style-type: none"> <li>Data sheet status changed from Preliminary data sheet to Product data sheet</li> </ul>			
BGU8103 v.1	20151221	Preliminary data sheet	-	-

## 18. Legal information

### 18.1 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.
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".

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## 19. Contact information

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## 20. Contents

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