



# BGS8M2

SiGe:C low-noise amplifier MMIC with bypass switch for LTE

Rev. 5 — 20 August 2018

Product data sheet

## 1 General description

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The BGS8M2 is, also known as the LTE3001M, a Low-Noise Amplifier (LNA) with bypass switch for LTE receiver applications, available in a small plastic 6-pin extremely thin leadless package. The BGS8M2 requires one external matching inductor.

The BGS8M2 delivers system-optimized gain for both primary and diversity applications where sensitivity improvement is required. The high linearity of these low noise devices ensures the required receive sensitivity independent of cellular transmit power level in FDD (Frequency Division Duplex) systems. When receive signal strength is sufficient, the BGS8M2 can be switched off to operate in bypass mode at a 1  $\mu$ A current, to lower power consumption.

The BGS8M2 is optimized for 1805 MHz to 2200 MHz.

## 2 Features and benefits

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- Operating frequency from 1805 MHz to 2200 MHz
- Noise figure = 0.85 dB
- Gain 14.4 dB
- High input 1 dB compression point of -3.5 dBm
- Bypass switch insertion loss of 2.2 dB
- High in band IP<sub>3i</sub> of 3.5 dBm
- Supply voltage 1.5 V to 3.1 V
- Self-shielding package concept
- Integrated supply decoupling capacitor
- Optimized performance at a supply current of 5.8 mA
- Power-down mode current consumption < 1  $\mu$ A
- Integrated temperature stabilized bias for easy design
- Require only one input matching inductor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Available in 6-pins leadless package 1.1 mm x 0.7 mm x 0.37 mm; 0.4 mm pitch: SOT1232
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level 1



### 3 Applications

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- LNA for LTE reception in smart phones
- Feature phones
- Tablet PCs
- RF front-end modules

## 4 Quick reference data

**Table 1. Quick reference data**

1805 MHz ≤ f ≤ 2200 MHz, V<sub>CC</sub> = 2.8 V, V<sub>I(CTRL)</sub> ≥ 0.8 V and T<sub>amb</sub> = 25 °C. Input matched to 50 Ω using a 3.9 nH inductor in series. Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.5	-	3.1	V
I <sub>CC</sub>	supply current	in gain mode	3.8	5.8	7.8	mA
		in bypass mode; V <sub>I(CTRL)</sub> < 0.3 V	-	-	1	μA
G <sub>p</sub>	power gain	in gain mode; f = 1960 MHz	[1] [2] 12.4	14.4	16.4	dB
		in bypass mode; f = 1960 MHz	[1] [2] -4.0	-2.2	-0.7	dB
NF	noise figure	in gain mode; f = 1960 MHz	[1] [3] [2] -	0.85	1.4	dB
P <sub>I(1dB)</sub>	input power at 1 dB gain compression	in gain mode; f = 1960 MHz	[1] [2] -7.5	-3.5	-	dBm
IP <sub>3i</sub>	input third-order intercept point	in gain mode; f = 1960 MHz	[1] [2] -1.5	3.5	-	dBm

[1] E-UTRA operating band 2 (1930 MHz to 1990 MHz).

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

[3] PCB losses are subtracted.

## 5 Ordering information

**Table 2. Ordering information**

Type number	Package		Version
	Name	Description	
BGS8M2	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm	SOT1232
OM17006	EVB	BGS8M2 evaluation board	-

## 6 Marking

**Table 3. Marking codes**

Type number	Marking code
BGS8M2	N

## 7 Block diagram

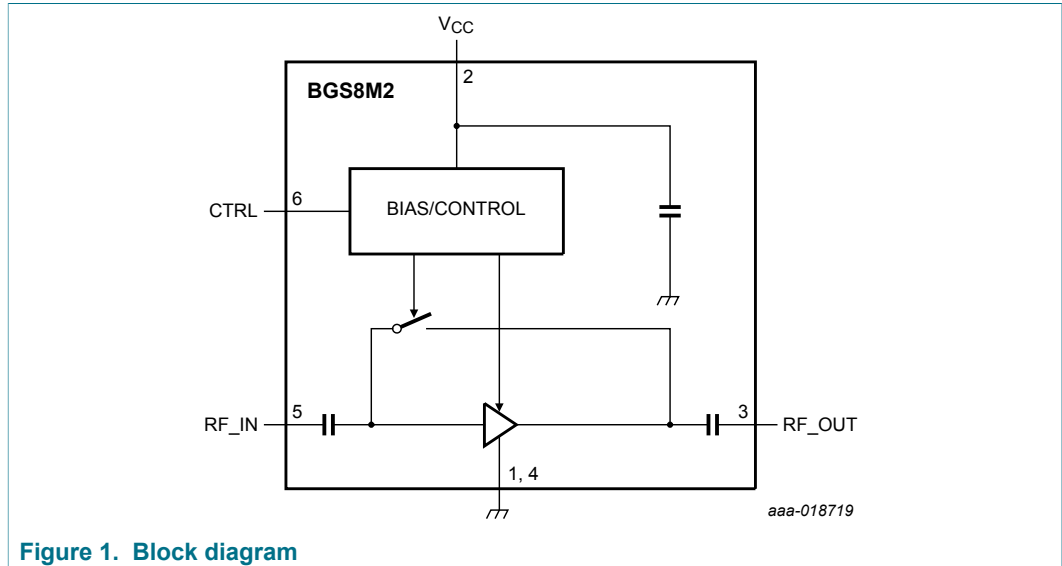


Figure 1. Block diagram

## 8 Pinning information

### 8.1 Pinning

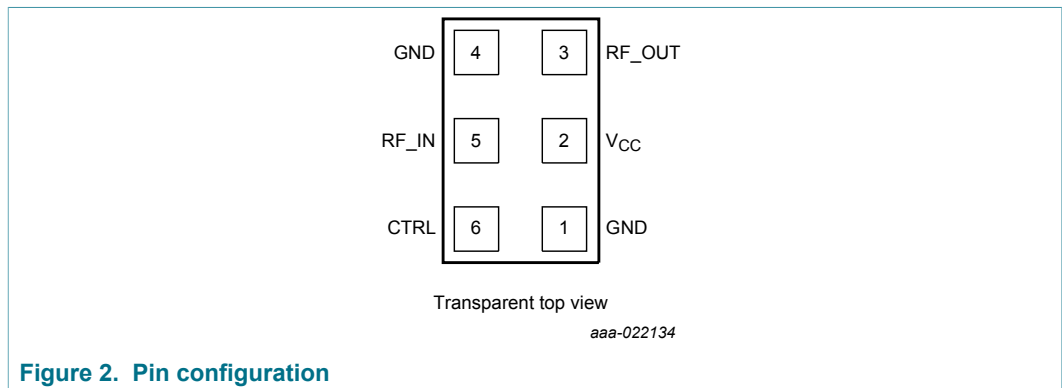


Figure 2. Pin configuration

### 8.2 Pin description

Table 4. Pinning

Symbol	Pin	Description
GND	1	ground
V <sub>CC</sub>	2	supply voltage
RF_OUT	3	RF out
GND_RF	4	ground RF
RF_IN	5	RF in
CTRL	6	gain control, switch between gain and bypass mode

## 9 Limiting values

**Table 5. Limiting values**

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

See legal section: "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(CTRL)</sub>	input voltage on pin CTRL	V <sub>I(CTRL)</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]	-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]	-	26	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 ANSI/ESDA/JEDEC standard JS-001		-	±2	kV
		Charged Device Model (CDM) according to JEDEC standard JESD22-C101C		-	±1	kV

[1] Stresses with pulses of 1 s in duration. V<sub>CC</sub> connected to a power supply of 2.8 V with 500 mA current limit.

[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(CTRL)</sub>	input voltage on pin CTRL	bypass mode	-	-	0.3	V
		ON state	0.8	-	V <sub>CC</sub>	V

## 11 Thermal characteristics

**Table 7. Thermal characteristics**

Symbol	Parameter	Conditions		Typ	Unit
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point			225	K/W

## 12 Characteristics

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

$1805 \text{ MHz} \leq f \leq 2200 \text{ MHz}$ ,  $V_{CC} = 1.8 \text{ V}$ ,  $V_{I(CTRL)} \geq 0.8 \text{ V}$  and  $T_{amb} = 25 \text{ }^\circ\text{C}$ . Input matched to  $50 \text{ } \Omega$  using a  $3.9 \text{ nH}$  inductor in series. Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$\Delta\phi$	phase variation	between gain mode and bypass mode					
		f = 1843 MHz		-	-	-	deg
		f = 1960 MHz	[1]	-5.0	-	+5.0	deg
		f = 2140 MHz		-	-	-	deg
<b>Gain mode</b>							
$I_{CC}$	supply current		3.6	5.6	7.6	mA	
$G_p$	power gain	f = 1843 MHz	[1][2]	12.3	14.3	16.3	dB
		f = 1960 MHz	[3]	12.0	14.0	16.0	dB
		f = 2140 MHz	[1][3]	11.2	13.2	15.2	dB
$RL_{in}$	input return loss	f = 1843 MHz	[2]	-	5.5	-	dB
		f = 1960 MHz	[4]	-	6.0	-	dB
		f = 2140 MHz	[3]	-	7.0	-	dB
$RL_{out}$	output return loss	f = 1843 MHz	[2]	-	11.0	-	dB
		f = 1960 MHz	[4]	-	11.0	-	dB
		f = 2140 MHz	[3]	-	11.0	-	dB
ISL	isolation	f = 1843 MHz	[2]	-	23.0	-	dB
		f = 1960 MHz	[4]	-	23.0	-	dB
		f = 2140 MHz	[3]	-	23.0	-	dB
NF	noise figure	f = 1843 MHz	[1][2][5]	-	0.80	1.4	dB
		f = 1960 MHz	[1][4][5]	-	0.85	1.4	dB
		f = 2140 MHz	[1][3][5]	-	0.95	1.5	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	f = 1843 MHz	[1][2]	-12.0	-8.0	-	dBm
		f = 1960 MHz	[1][3]	-11.0	-7.0	-	dBm
		f = 2140 MHz	[1][5]	-10.0	-6.0	-	dBm
IP3 <sub>i</sub>	input third-order intercept point	f = 1843 MHz	[1][2]	-3.0	+2.0	-	dBm
		f = 1960 MHz	[1][4]	-2.5	+2.5	-	dBm
		f = 2140 MHz	[1]	-2.0	+3.0	-	dBm
K	Rollett stability factor		1	-	-	-	
$t_{on}$	turn-on time	time from $V_{I(CTRL)}$ ON to 90 % of the gain	-	-	1.7	$\mu\text{s}$	
$t_{off}$	turn-off time	time from $V_{I(CTRL)}$ OFF to 10 % of the gain	-	-	0.6	$\mu\text{s}$	

SiGe:C low-noise amplifier MMIC with bypass switch for LTE

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Bypass mode</b>							
I <sub>CC</sub>	supply current	V <sub>I(CTRL)</sub> < 0.3 V		-	-	1	μA
G <sub>p</sub>	power gain	f = 1843 MHz	[1][2]	-3.6	-2.1	-0.6	dB
		f = 1960 MHz	[1][4]	-4.0	-2.2	-0.7	dB
		f = 2140 MHz	[1][3]	-4.0	-2.5	-1.0	dB
RL <sub>in</sub>	input return loss	f = 1843 MHz	[2]	-	12.0	-	dB
		f = 1960 MHz	[4]	-	11.0	-	dB
		f = 2140 MHz	[3]	-	10.0	-	dB
RL <sub>out</sub>	output return loss	f = 1843 MHz	[2]	-	10.0	-	dB
		f = 1960 MHz	[4]	-	9.5	-	dB
		f = 2140 MHz	[3]	-	9.0	-	dB

- [1] Guaranteed by device design; not tested in production.
- [2] E-UTRA operating band 3 (1805 MHz to 1880 MHz).
- [3] E-UTRA operating band 1 (2110 MHz to 2170 MHz).
- [4] E-UTRA operating band 2 (1930 MHz to 1990 MHz).
- [5] PCB losses are subtracted.

**Table 9. Characteristics at V<sub>CC</sub> = 2.8 V**

1805 MHz ≤ f ≤ 2200 MHz, V<sub>CC</sub> = 2.8 V, V<sub>I(CTRL)</sub> ≥ 0.8 V and T<sub>amb</sub> = 25 °C. Input matched to 50 Ω using a 3.9 nH inductor in series. Unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit	
Δφ	phase variation	between gain mode and bypass mode						
		f = 1843 MHz		-	-	-	deg	
		f = 1960 MHz	[1]	-5.0	-	+5.0	deg	
		f = 2140 MHz		-	-	-	deg	
<b>Gain mode</b>								
I <sub>CC</sub>	supply current			3.8	5.8	7.8	mA	
G <sub>p</sub>	power gain	f = 1843 MHz	[1][2]	12.5	14.5	16.5	dB	
		f = 1960 MHz	[3]	12.4	14.4	16.4	dB	
		f = 2140 MHz	[1][4]	11.7	13.7	15.7	dB	
RL <sub>in</sub>	input return loss	f = 1843 MHz	[2]	-	5.5	-	dB	
		f = 1960 MHz	[3]	-	6.5	-	dB	
		f = 2140 MHz	[4]	-	7.5	-	dB	
RL <sub>out</sub>	output return loss	f = 1843 MHz	[2]	-	12.0	-	dB	
		f = 1960 MHz	[3]	-	12.0	-	dB	
		f = 2140 MHz	[4]	-	11.0	-	dB	
ISL	isolation	f = 1843 MHz	[2]	-	25.0	-	dB	
		f = 1960 MHz	[3]	-	24.0	-	dB	
		f = 2140 MHz	[4]	-	23.0	-	dB	

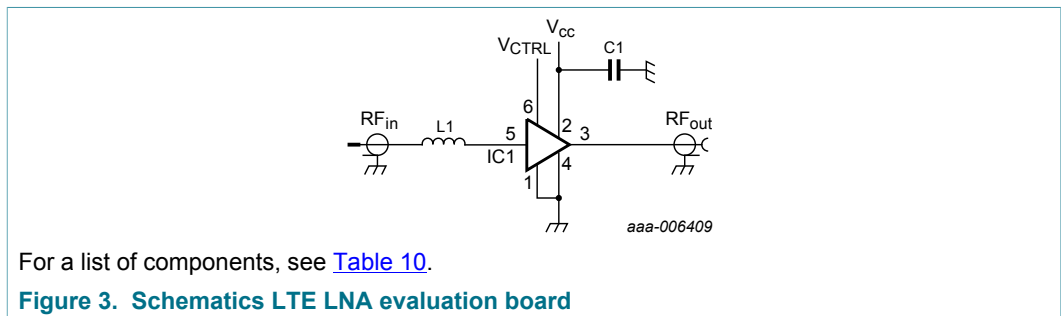


Symbol	Parameter	Conditions		Min	Typ	Max	Unit
NF	noise figure	f = 1843 MHz	[1][2][5]	-	0.80	1.4	dB
		f = 1960 MHz	[1][3][5]	-	0.85	1.4	dB
		f = 2140 MHz	[1][4][5]	-	0.95	1.5	dB
P <sub>i(1dB)</sub>	input power at 1 dB gain compression	f = 1843 MHz	[1][2]	-7.5	-3.5	-	dBm
		f = 1960 MHz	[1][3]	-7.5	-3.5	-	dBm
		f = 2140 MHz	[1][4]	-6.5	-2.5	-	dBm
IP <sub>3i</sub>	input third-order intercept point	f = 1843 MHz	[1][2]	-2.5	+2.5	-	dBm
		f = 1960 MHz	[1][3]	-1.5	+3.5	-	dBm
		f = 2140 MHz	[1][4]	-1.0	+4.0	-	dBm
K	Rollett stability factor			1	-	-	
t <sub>on</sub>	turn-on time	time from V <sub>I(CTRL)</sub> ON to 90 % of the gain		-	-	1.3	μs
t <sub>off</sub>	turn-off time	time from V <sub>I(CTRL)</sub> OFF to 10 % of the gain		-	-	0.3	μs
<b>Bypass mode</b>							
I <sub>CC</sub>	supply current	V <sub>I(CTRL)</sub> < 0.3 V		-	-	1	μA
G <sub>p</sub>	power gain	f = 1843 MHz	[1][2]	-3.6	-2.1	-0.6	dB
		f = 1960 MHz	[3]	-4.0	-2.2	-0.7	dB
		f = 2140 MHz	[1][4]	-4.0	-2.5	-1.0	dB
RL <sub>in</sub>	input return loss	f = 1843 MHz	[2]	-	12	-	dB
		f = 1960 MHz	[3]	-	11	-	dB
		f = 2140 MHz	[4]	-	10	-	dB
RL <sub>out</sub>	output return loss	f = 1843 MHz	[2]	-	10	-	dB
		f = 1960 MHz	[3]	-	10	-	dB
		f = 2140 MHz	[4]	-	9	-	dB

[1] Guaranteed by device design; not tested in production.  
 [2] E-UTRA operating band 3 (1805 MHz to 1880 MHz).  
 [3] E-UTRA operating band 2 (1930 MHz to 1990 MHz).  
 [4] E-UTRA operating band 1 (2110 MHz to 2170 MHz).  
 [5] PCB losses are subtracted.

## 13 Application information

### 13.1 LTE LNA



**Table 10. List of components**

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

Component	Description	Value	Remarks
C1	decoupling capacitor	1 $\mu$ F	to suppress power supply noise
IC1	BGS8M2	-	NXP Semiconductors
L1	high-quality matching inductor	3.9 nH	Murata LQW15A

14 Package outline

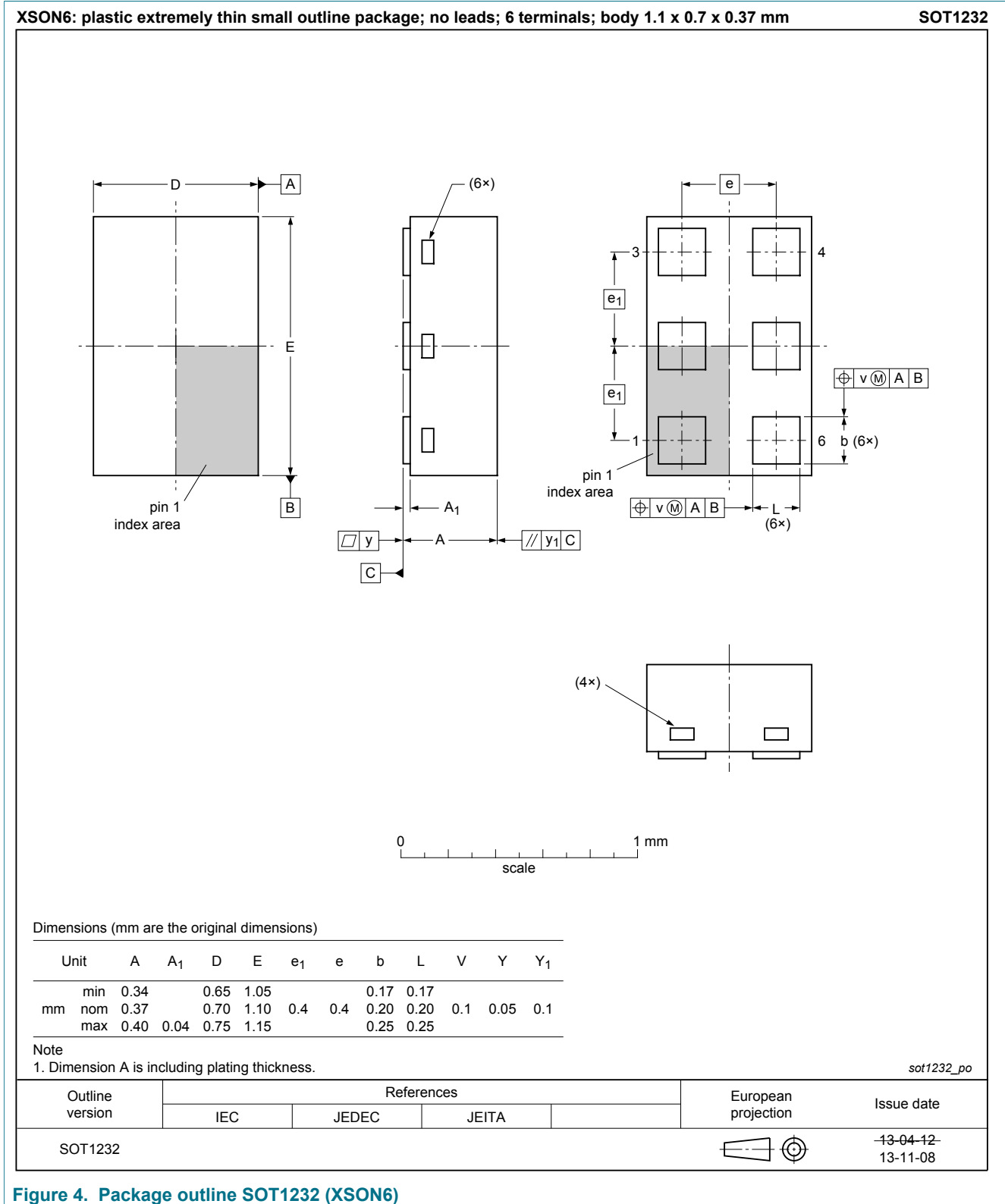



Figure 4. Package outline SOT1232 (XSON6)

## 15 Handling information

CAUTION	
	<p>This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices. Such precautions are described in the <i>ANSI/ESD S20.20</i>, <i>IEC/ST 61340-5</i>, <i>JESD625-A</i>, or equivalent standards.</p>

## 16 Abbreviations

Table 11. Abbreviations

Acronym	Description
ESD	ElectroStatic Discharge
HBM	Human Body Model
LTE	Long-Term Evolution
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
BGS8M2 v.5	20180820	product data sheet	-	BGS8M2 v.4
Modification:	changed from company confidential to public			
BGS8M2 v.4	20180612	product data sheet	-	BGS8M2 v.3.1
Modifications:	changed $V_{I(CTRL)}$ Max ON state value to $V_{CC}$ at recommended operating conditions			
BGS8M2 v.3.1	20180517	product data sheet	-	BGS8M2 v.3
Modifications:	inserted the standard ESD picture at handling information			
BGS8M2 v.3	20170117	product data sheet	-	BGS8M2 v.2
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Section 1</a>: added LTE3001M according to our new naming convention</li> </ul>			
BGS8M2 v.2	20160329	product data sheet	-	BGS8M2 v.1
Modifications:	<ul style="list-style-type: none"> <li>• added phase variation <a href="#">Table 8 on page 5</a> and <a href="#">Table 9 on page 6</a></li> </ul>			
BGS8M2 v.1	20151222	Product 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.

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