

# BGS8L4UK

SiGe:C Low Noise Amplifier MMIC with bypass switch for LTE

Rev. 1 — 1 December 2015

Product data sheet

## 1. Product profile

### 1.1 General description

The BGS8L4UK is a Low Noise Amplifier (LNA) with bypass switch for LTE receiver applications, available in a Wafer Level Chip-Scale Package (WLCSP). The BGS8L4UK requires one external matching inductor.

The BGS8L4UK delivers system-optimized gain for both primary and diversity applications where sensitivity improvement is required. The high linearity of this low noise device ensures the required receive sensitivity independent of cellular transmit power level in Frequency Division Duplex (FDD) systems. When receive signal strength is sufficient, the BGS8L4UK can be switched off to operate in bypass mode at a 1  $\mu$ A current, to lower power consumption. The BGS8L4UK requires only one external matching inductor.

The BGS8L4UK is optimized for 720 MHz to 960 MHz.

### 1.2 Features and benefits

- Operating frequency from 720 MHz to 960 MHz
- Noise figure (NF) = 0.8 dB
- Gain 17.3 dB
- High input 1 dB compression point of  $-5.0$  dBm
- Bypass switch insertion loss of  $-1.8$  dB
- IP<sub>3i</sub> of 1.0 dBm
- Supply voltage 1.5 V to 3.1 V
- Integrated supply decoupling capacitor
- Optimized performance at a supply current of 4.4 mA
- Bypass mode current consumption < 1  $\mu$ A
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor
- Input and Output AC coupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Extremely small Wafer Level Chip-Scale Package (WLCSP)  
6 bumps; 0.69 mm  $\times$  0.44 mm  $\times$  0.29 mm; 0.25 mm / 0.26 mm bump pitch
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level of 1



### 1.3 Applications

- LNA for LTE reception in smart phones, feature phones, tablet PCs and RF front-end modules.

### 1.4 Quick reference data

**Table 1. Quick reference data**

$f = 882\text{ MHz}$ ;  $V_{CC} = 2.8\text{ V}$ ;  $V_{I(CTRL)} \geq 0.8\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; input matched to  $50\ \Omega$  using a  $8.2\text{ nH}$  Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

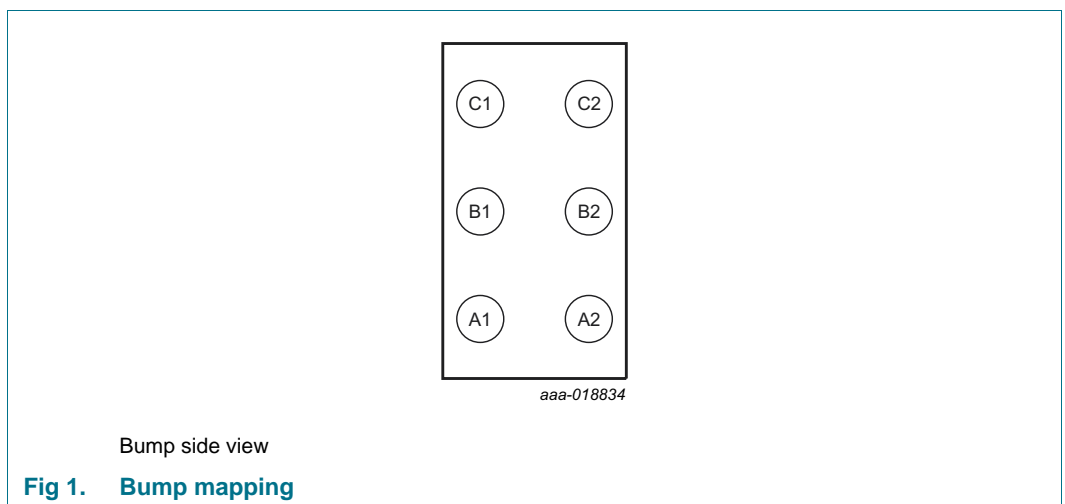
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		1.5	-	3.1	V
$I_{CC}$	supply current	in gain mode	-	4.4	-	mA
		in bypass mode; $0.1\text{ V} \leq V_{I(CTRL)} \leq 0.3\text{ V}$	-	-	1	$\mu\text{A}$
$G_p$	power gain	in gain mode <a href="#">[1]</a>	-	17.3	-	dB
		in bypass mode <a href="#">[1]</a>	-	-1.8	-	dB
NF	noise figure	<a href="#">[1][2]</a>	-	0.8	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	<a href="#">[1]</a>	-	-5.0	-	dBm
$IP3_i$	input third-order intercept point	<a href="#">[1]</a>	-	1.0	-	dBm

[1] E\_UTRA operating band 5 (869 MHz to 894 MHz).

[2] PCB losses are subtracted.

## 2. Pinning information

### 2.1 Pinning



## 2.2 Pin description

Table 2. Ball description

Symbol	Pad	Description
GND	A1	ground
V <sub>CC</sub>	B1	supply voltage
RF_OUT	C1	RF out
CTRL	A2	gain control, switch between gain and bypass mode
RF_IN	B2	RF in
GND_RF	C2	ground RF

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGS8L4UK	WLCSP6	wafer level chip-scale package; 6 bumps; 0.69 × 0.44 × 0.29 mm	SOT1445-1

## 4. Marking

Table 4. Marking codes

Type number	Marking code
BGS8L4UK	single character, indicating assembly month. <sup>[1]</sup>

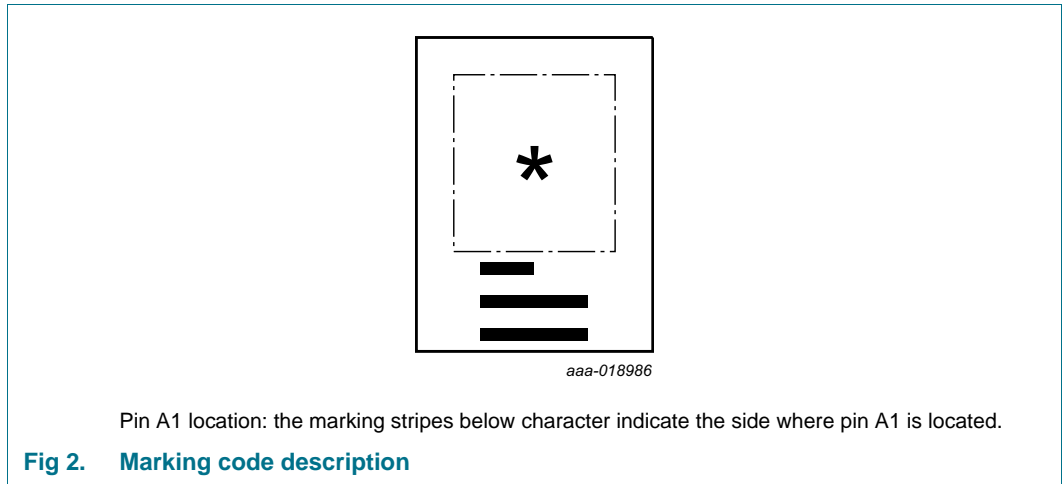
[1] Month code see [Table 5](#).

Table 5. Calendar marking month code

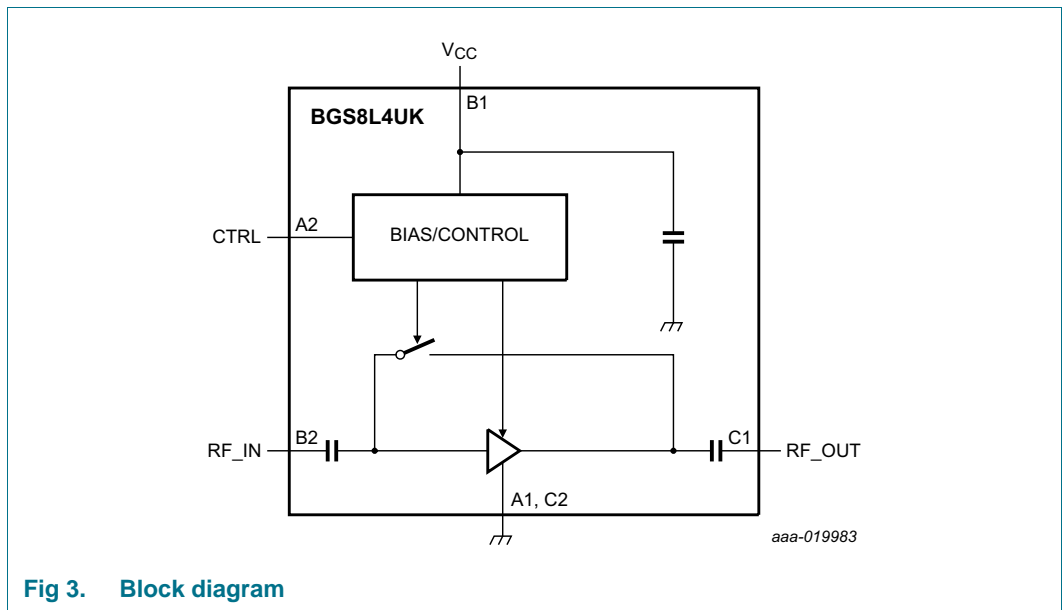
Asterisk (\*) is replaced by character in table, see [Figure 2](#).

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
2015	A	B	C	D	E	F	G	H	I	J	K	L
2016	M	N	O	P	Q	R	S	T	U	V	W	X
2017	Y	Z	b	d	f	h	3	4	5	6	7	8

[1] Rotates every 3 years.



### 5. Block diagram



### 6. Limiting values

**Table 6. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134). Absolute Maximum Ratings are given as Limiting Values of stress conditions during operation, that must not be exceeded under the worst probable conditions.

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		[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][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

**Table 6. Limiting values ...continued**

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

Absolute Maximum Ratings are given as Limiting Values of stress conditions during operation, that must not be exceeded under the worst probable conditions.

Symbol	Parameter	Conditions	Min	Max	Unit
$P_{\text{tot}}$	total power dissipation	$T_{\text{sp}} \leq 130 \text{ }^\circ\text{C}$	-	55	mW
$T_{\text{stg}}$	storage temperature		-65	+150	$^\circ\text{C}$
$T_{\text{j}}$	junction temperature		-	150	$^\circ\text{C}$
$V_{\text{ESD}}$	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001	-	$\pm 2$	kV
		Charged Device Model (CDM) According to JEDEC standard JESD22-C101C	-	$\pm 1$	kV

[1] Stressed with pulses of 200 ms in duration.

[2] Warning: due to internal ESD diode protection, the applied DC voltage shall not exceed  $V_{\text{CC}} + 0.6 \text{ V}$  and shall not exceed 5.0 V in order to avoid excess current.

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

## 7. Recommended operating conditions

**Table 7. Operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{\text{CC}}$	supply voltage		1.5	-	3.1	V
$T_{\text{amb}}$	ambient temperature		-40	+25	+85	$^\circ\text{C}$
$V_{\text{I(CTRL)}}$	input voltage on pin CTRL	OFF state	-	-	0.25	V
		ON state	0.8	-	-	V

## 8. Thermal characteristics

**Table 8. Thermal characteristics**

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

## 9. Characteristics

**Table 9. Characteristics**

$720 \text{ MHz} \leq f \leq 960 \text{ MHz}$ ;  $V_{\text{CC}} = 1.8 \text{ V}$ ;  $V_{\text{I(CTRL)}} \geq 0.8 \text{ V}$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ; input matched to  $50 \text{ } \Omega$  using a  $8.2 \text{ nH}$  Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Gain mode</b>						
$I_{\text{CC}}$	supply current	$V_{\text{I(CTRL)}} \geq 0.8 \text{ V}$	-	4.2	-	mA
$G_{\text{p}}$	power gain	$f = 740 \text{ MHz}$	[1]	16	-	dB
		$f = 882 \text{ MHz}$	[2]	17	-	dB
		$f = 943 \text{ MHz}$	[3]	17	-	dB

**Table 9. Characteristics ...continued**

720 MHz ≤ f ≤ 960 MHz; V<sub>CC</sub> = 1.8 V; V<sub>I(CTRL)</sub> ≥ 0.8 V; T<sub>amb</sub> = 25 °C; input matched to 50 Ω using a 8.2 nH Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
RL <sub>in</sub>	input return loss	f = 740 MHz	[1]	-	7	-	dB
		f = 882 MHz	[2]	-	10	-	dB
		f = 943 MHz	[3]	-	11	-	dB
RL <sub>out</sub>	output return loss	f = 740 MHz	[1]	-	8	-	dB
		f = 882 MHz	[2]	-	15	-	dB
		f = 943 MHz	[3]	-	15	-	dB
ISL	isolation	f = 740 MHz	[1]	-	25	-	dB
		f = 882 MHz	[2]	-	25	-	dB
		f = 943 MHz	[3]	-	25	-	dB
NF	noise figure	f = 740 MHz	[1][4]	-	0.8	-	dB
		f = 882 MHz	[2][4]	-	0.8	-	dB
		f = 943 MHz	[3][4]	-	0.85	-	dB
P <sub>I(1dB)</sub>	input power at 1 dB gain compression	f = 740 MHz	[1]	-	-8.5	-	dBm
		f = 882 MHz	[2]	-	-9.5	-	dBm
		f = 943 MHz	[3]	-	-9.5	-	dBm
IP3 <sub>i</sub>	input third-order intercept point	f = 740 MHz	[1]	-	-0.5	-	dBm
		f = 882 MHz	[2]	-	0.5	-	dBm
		f = 943 MHz	[3]	-	0.5	-	dBm
t <sub>on</sub>	turn-on time	time from V <sub>I(CTRL)</sub> ON, to 90 % of the gain	-	-	4	μs	
t <sub>off</sub>	turn-off time	time from V <sub>I(CTRL)</sub> OFF, to 10 % of the gain	-	-	1	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 = 740 MHz	[1]	-	-1.7	-	dB
		f = 882 MHz	[2]	-	-1.9	-	dB
		f = 943 MHz	[3]	-	-2.1	-	dB
RL <sub>in</sub>	input return loss	f = 740 MHz	[1]	-	15.3	-	dB
		f = 882 MHz	[2]	-	11.8	-	dB
		f = 943 MHz	[3]	-	10.8	-	dB
RL <sub>out</sub>	output return loss	f = 740 MHz	[1]	-	13.5	-	dB
		f = 882 MHz	[2]	-	12	-	dB
		f = 943 MHz	[3]	-	11.5	-	dB

[1] E\_UMTS operating band 17 (734 MHz to 746 MHz).

[2] E\_UMTS operating band 5 (869 MHz to 894 MHz).

[3] E\_UMTS operating band 8 (925 MHz to 960 MHz).

[4] PCB losses are subtracted

**Table 10. Characteristics**

720 MHz ≤ f ≤ 960 MHz; V<sub>CC</sub> = 2.8 V; V<sub>I(CTRL)</sub> ≥ 0.8 V; T<sub>amb</sub> = 25 °C; input matched to 50 Ω using a 8.2 nH Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Gain mode</b>						
I <sub>CC</sub>	supply current	V <sub>I(CTRL)</sub> ≥ 0.8 V	-	4.4	-	mA
G <sub>p</sub>	power gain	f = 740 MHz <a href="#">[1]</a>	-	16.1	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	17.3	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	17.3	-	dB
RL <sub>in</sub>	input return loss	f = 740 MHz <a href="#">[1]</a>	-	7.5	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	10.5	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	11.0	-	dB
RL <sub>out</sub>	output return loss	f = 740 MHz <a href="#">[1]</a>	-	8	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	15	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	15	-	dB
ISL	isolation	f = 740 MHz <a href="#">[1]</a>	-	25	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	25	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	25	-	dB
NF	noise figure	f = 740 MHz <a href="#">[1]</a> <a href="#">[4]</a>	-	0.80	-	dB
		f = 882 MHz <a href="#">[2]</a> <a href="#">[4]</a>	-	0.80	-	dB
		f = 943 MHz <a href="#">[3]</a> <a href="#">[4]</a>	-	0.80	-	dB
P <sub>i(1dB)</sub>	input power at 1 dB gain compression	f = 740 MHz <a href="#">[1]</a>	-	-4.5	-	dBm
		f = 882 MHz <a href="#">[2]</a>	-	-5.0	-	dBm
		f = 943 MHz <a href="#">[3]</a>	-	-5.0	-	dBm
IP <sub>3i</sub>	input third-order intercept point	f = 740 MHz <a href="#">[1]</a>	-	-1.0	-	dBm
		f = 882 MHz <a href="#">[2]</a>	-	1.0	-	dBm
		f = 943 MHz <a href="#">[3]</a>	-	0.5	-	dBm
t <sub>on</sub>	turn-on time	time from V <sub>I(CTRL)</sub> ON, to 90 % of the gain	-	-	4	μs
t <sub>off</sub>	turn-off time	time from V <sub>I(CTRL)</sub> OFF, to 10 % of the gain	-	-	1	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 = 740 MHz <a href="#">[1]</a>	-	-1.5	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	-1.8	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	-1.9	-	dB
RL <sub>in</sub>	input return loss	f = 740 MHz <a href="#">[1]</a>	-	15.0	-	dB
		f = 882 MHz <a href="#">[2]</a>	-	12.0	-	dB
		f = 943 MHz <a href="#">[3]</a>	-	11.0	-	dB

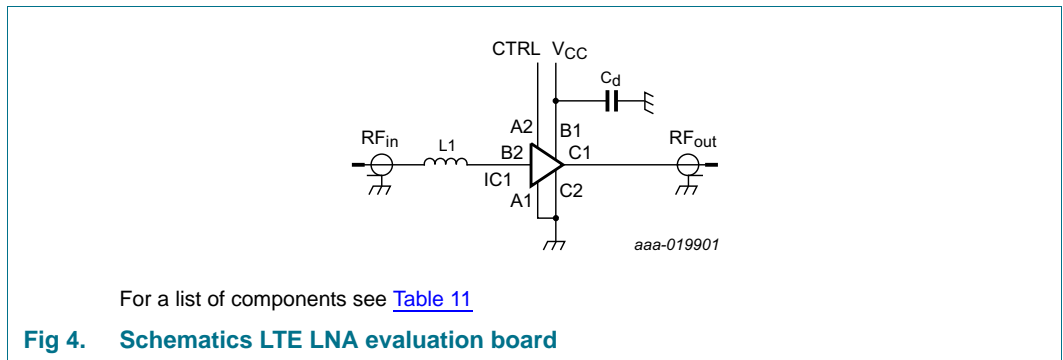
**Table 10. Characteristics ...continued**

720 MHz ≤ f ≤ 960 MHz; V<sub>CC</sub> = 2.8 V; V<sub>I(CTRL)</sub> ≥ 0.8 V; T<sub>amb</sub> = 25 °C; input matched to 50 Ω using a 8.2 nH Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
RL <sub>out</sub>	output return loss	f = 740 MHz	[1]	-	12.5	-	dB
		f = 882 MHz	[2]	-	11	-	dB
		f = 943 MHz	[3]	-	10.0	-	dB

- [1] E\_UTRA operating band 17 (734 MHz to 746 MHz).
- [2] E\_UTRA operating band 5 (869 MHz to 894 MHz).
- [3] E\_UTRA operating band 8 (925 MHz to 960 MHz).
- [4] PCB losses are subtracted

## 10. Application information



**Table 11. List of components**

Component	Description	Value	Remark
Cd	decoupling capacitor	1 μF	to suppress power supply noise
IC1	BGS8L4UK	-	NXP Semiconductors N.V.
L1	high-quality matching inductor	8.2 nH	Murata LQW15A



11. Package outline

WLCSP6: wafer level chip-scale package; 6 bumps; 0.69 x 0.44 x 0.29 mm

SOT1445-1

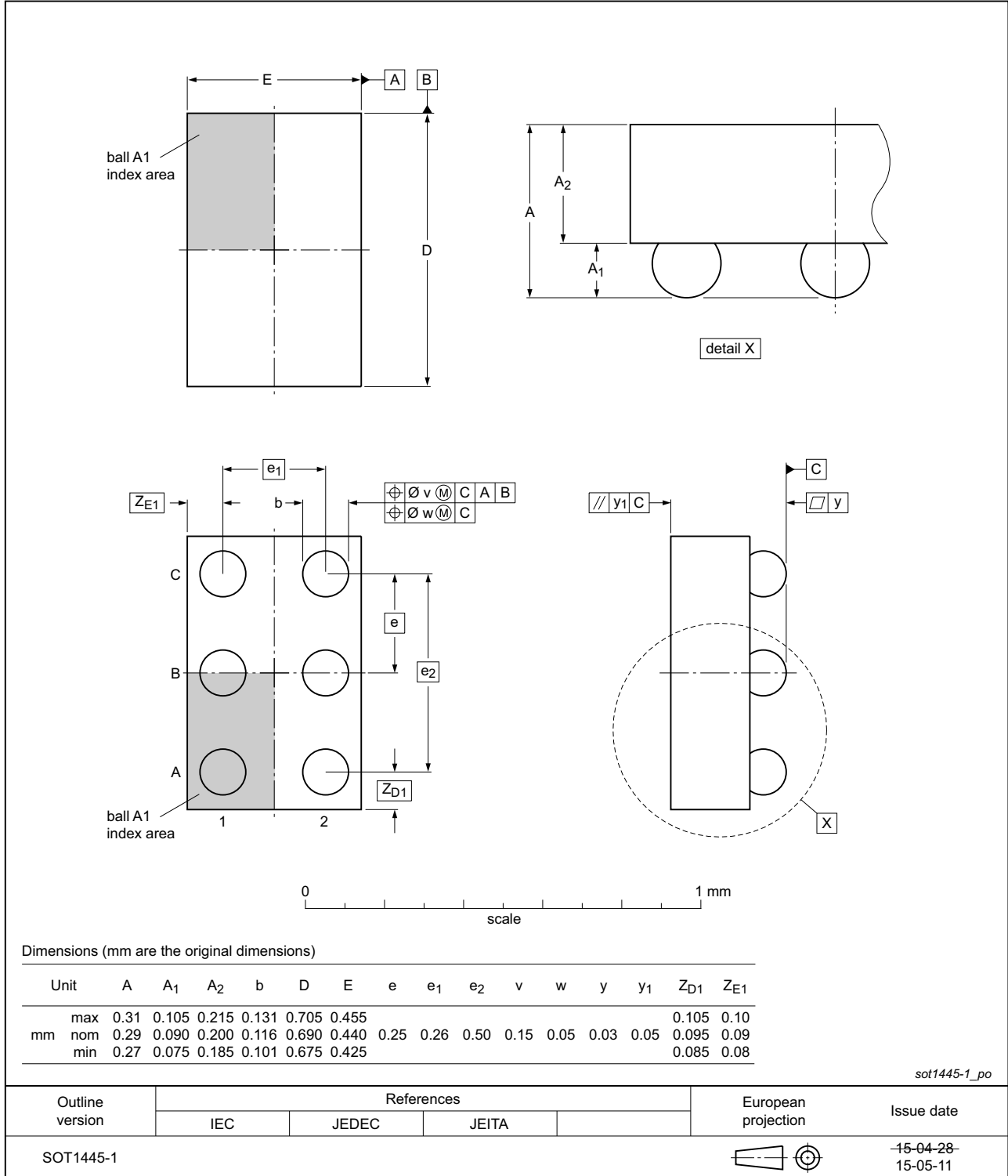


Fig 5. Package outline SOT1445-1 (WLCSP6)

## 12. 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.

## 13. Mounting

This WLCSP is only to be used in an overmolded module (using MUF)

## 14. Abbreviations

Table 12. Abbreviations

Acronym	Description
ESD	ElectroStatic Discharge
HBM	Human Body Model
LNA	Low Noise Amplifier
LTE	Long Term Evolution
MMIC	Monolithic Microwave Integrated Circuit
MUF	Molded UnderFill
PCB	Printed-Circuit Board
SiGe:C	Silicon Germanium Carbon

## 15. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGS8L4UK v.1	20151201	Product data sheet	-	-

## 16. Legal information

### 16.1 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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- [2] The term 'short data sheet' is explained in section "Definitions".
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For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

## 18. Contents

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