

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 μ 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_{3i} 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 μ 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 nH Murata LQW15 type inductor connected in series; see [Figure 4](#) unless otherwise specified.

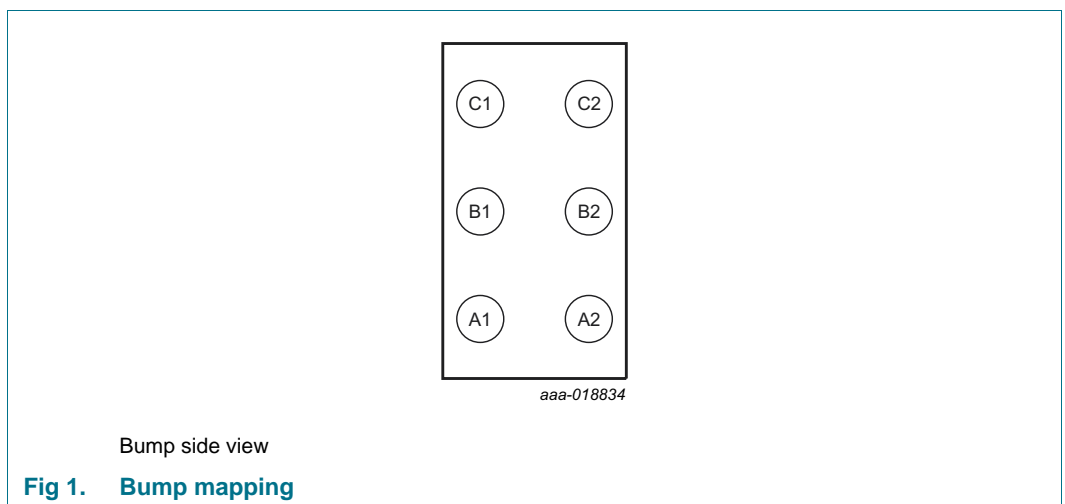
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|--------------------------------------|---|-----|------|-----|---------------|
| V_{CC} | supply voltage | | 1.5 | - | 3.1 | V |
| I_{CC} | supply current | in gain mode | - | 4.4 | - | mA |
| | | in bypass mode; $0.1\text{ V} \leq V_{I(CTRL)} \leq 0.3\text{ V}$ | - | - | 1 | μA |
| G_p | power gain | in gain mode [1] | - | 17.3 | - | dB |
| | | in bypass mode [1] | - | -1.8 | - | dB |
| NF | noise figure | [1][2] | - | 0.8 | - | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | [1] | - | -5.0 | - | dBm |
| $IP3_i$ | input third-order intercept point | [1] | - | 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 _{CC} | 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. ^[1] |

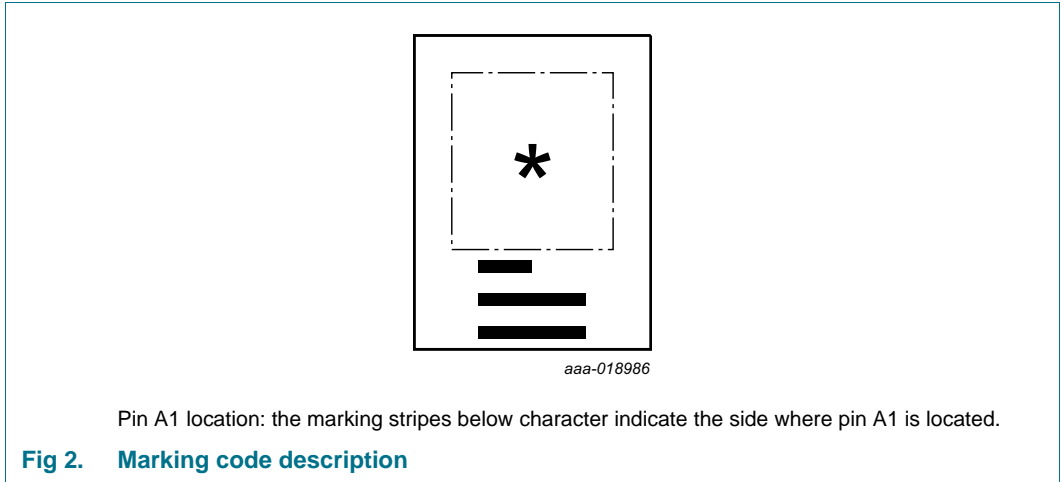
[1] Month code see [Table 5](#).

Table 5. Calendar marking month code

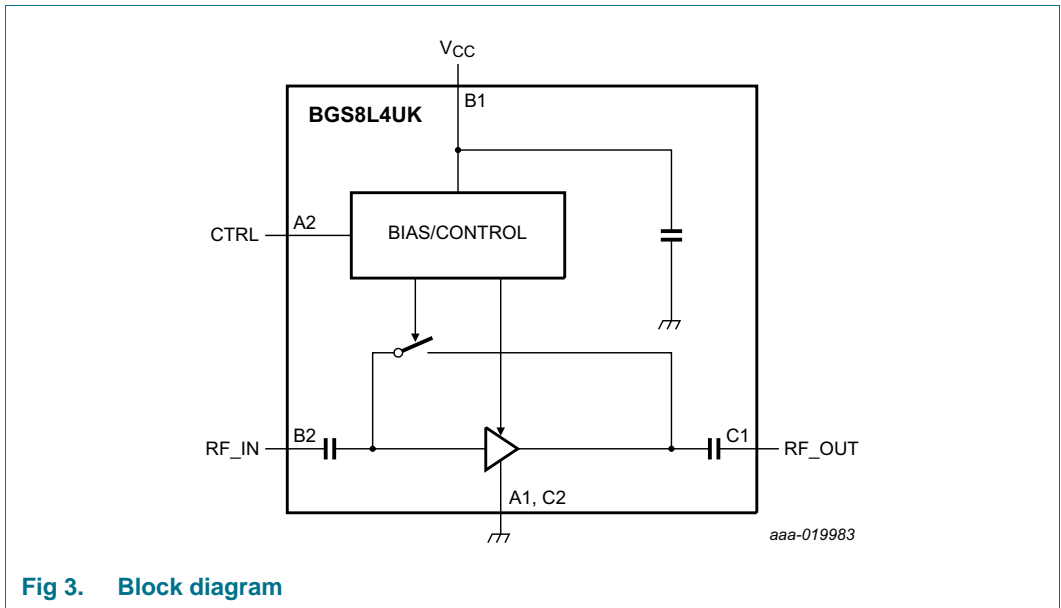
Asterisk (*) is replaced by character in table, see [Figure 2](#).

| 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 _{CC} | supply voltage | | [1] -0.5 | +5.0 | V |
| V _{I(CTRL)} | input voltage on pin CTRL | V _{I(CTRL)} < 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 |

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_{tot} | total power dissipation | $T_{sp} \leq 130\text{ °C}$ | - | 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 ANSI/ESDA/JEDEC standard JS-001 | - | ±2 | kV |
| | | Charged Device Model (CDM) According to JEDEC standard JESD22-C101C | - | ±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 $V_{CC} + 0.6\text{ V}$ 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_{CC} | supply voltage | | 1.5 | - | 3.1 | V |
| T_{amb} | ambient temperature | | -40 | +25 | +85 | °C |
| $V_{I(CTRL)}$ | 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 |
|----------------|--|------------|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | 225 | K/W |

9. Characteristics

Table 9. Characteristics

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|----------------|---------------------------------|-----|-----|-----|------|
| Gain mode | | | | | | |
| I_{CC} | supply current | $V_{I(CTRL)} \geq 0.8\text{ V}$ | - | 4.2 | - | mA |
| G_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_{CC} = 1.8 V; V_{I(CTRL)} ≥ 0.8 V; T_{amb} = 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 _{in} | input return loss | f = 740 MHz | [1] | - | 7 | - | dB |
| | | f = 882 MHz | [2] | - | 10 | - | dB |
| | | f = 943 MHz | [3] | - | 11 | - | dB |
| RL _{out} | 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 _{I(1dB)} | 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 _i | 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 _{on} | turn-on time | time from V _{I(CTRL)} ON, to 90 % of the gain | - | - | 4 | μs | |
| t _{off} | turn-off time | time from V _{I(CTRL)} OFF, to 10 % of the gain | - | - | 1 | μs | |
| Bypass mode | | | | | | | |
| I _{CC} | supply current | V _{I(CTRL)} < 0.3 V | - | - | 1 | μA | |
| G _p | power gain | f = 740 MHz | [1] | - | -1.7 | - | dB |
| | | f = 882 MHz | [2] | - | -1.9 | - | dB |
| | | f = 943 MHz | [3] | - | -2.1 | - | dB |
| RL _{in} | 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 _{out} | 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_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

Table 10. Characteristics

720 MHz ≤ f ≤ 960 MHz; V_{CC} = 2.8 V; V_{I(CTRL)} ≥ 0.8 V; T_{amb} = 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 |
|---------------------|--------------------------------------|---|-----|------|-----|------|
| Gain mode | | | | | | |
| I _{CC} | supply current | V _{I(CTRL)} ≥ 0.8 V | - | 4.4 | - | mA |
| G _p | power gain | f = 740 MHz [1] | - | 16.1 | - | dB |
| | | f = 882 MHz [2] | - | 17.3 | - | dB |
| | | f = 943 MHz [3] | - | 17.3 | - | dB |
| RL _{in} | input return loss | f = 740 MHz [1] | - | 7.5 | - | dB |
| | | f = 882 MHz [2] | - | 10.5 | - | dB |
| | | f = 943 MHz [3] | - | 11.0 | - | dB |
| RL _{out} | 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] | - | 0.80 | - | dB |
| | | f = 882 MHz [2] [4] | - | 0.80 | - | dB |
| | | f = 943 MHz [3] [4] | - | 0.80 | - | dB |
| P _{i(1dB)} | input power at 1 dB gain compression | f = 740 MHz [1] | - | -4.5 | - | dBm |
| | | f = 882 MHz [2] | - | -5.0 | - | dBm |
| | | f = 943 MHz [3] | - | -5.0 | - | dBm |
| IP _{3i} | input third-order intercept point | f = 740 MHz [1] | - | -1.0 | - | dBm |
| | | f = 882 MHz [2] | - | 1.0 | - | dBm |
| | | f = 943 MHz [3] | - | 0.5 | - | dBm |
| t _{on} | turn-on time | time from V _{I(CTRL)} ON, to 90 % of the gain | - | - | 4 | μs |
| t _{off} | turn-off time | time from V _{I(CTRL)} OFF, to 10 % of the gain | - | - | 1 | μs |
| Bypass mode | | | | | | |
| I _{CC} | supply current | V _{I(CTRL)} < 0.3 V | - | - | 1 | μA |
| G _p | power gain | f = 740 MHz [1] | - | -1.5 | - | dB |
| | | f = 882 MHz [2] | - | -1.8 | - | dB |
| | | f = 943 MHz [3] | - | -1.9 | - | dB |
| RL _{in} | input return loss | f = 740 MHz [1] | - | 15.0 | - | dB |
| | | f = 882 MHz [2] | - | 12.0 | - | dB |
| | | f = 943 MHz [3] | - | 11.0 | - | dB |

Table 10. Characteristics ...continued

720 MHz ≤ f ≤ 960 MHz; V_{CC} = 2.8 V; V_{I(CTRL)} ≥ 0.8 V; T_{amb} = 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 _{out} | 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

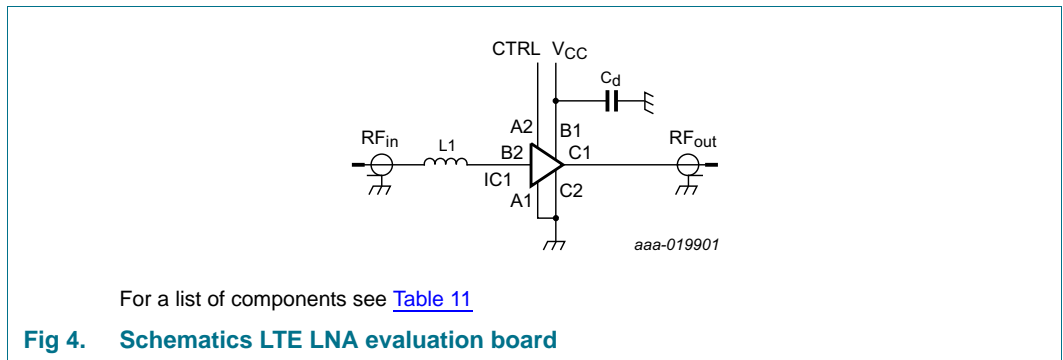


Table 11. List of components

| 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

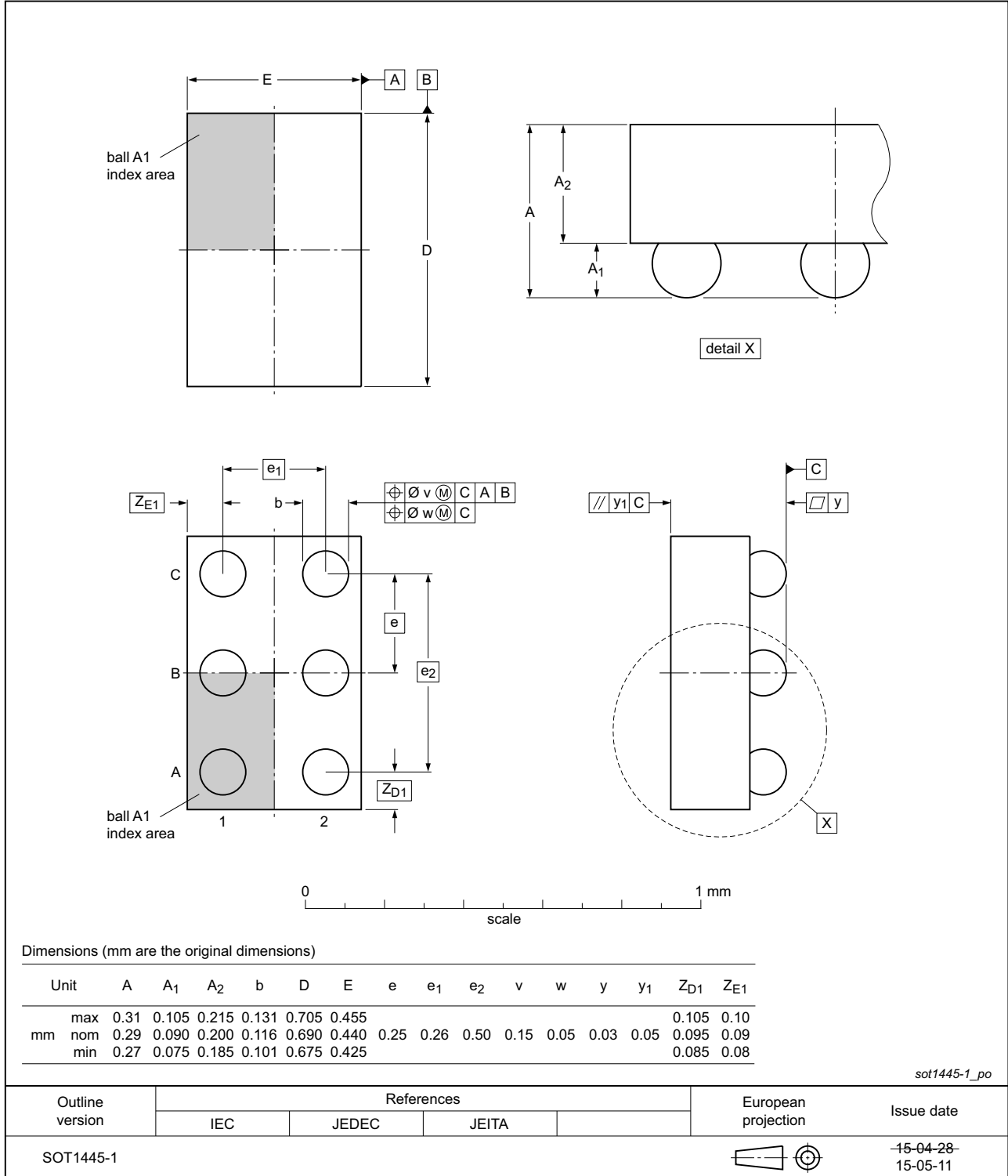


Fig 5. Package outline SOT1445-1 (WLCSP6)

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 ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
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[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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17. Contact information

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

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