# BGS8L5

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

Rev. 1 — 2 March 2018 Product data sheet

## 1 General description

The BGS8L5 is a Low-Noise Amplifier (LNA) with bypass switch for LTE receiver applications, available in a small plastic 6-pin thin leadless package.

The BGS8L5 delivers system-optimized gain for 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 BGS8L5 can be switched off to operate in bypass mode at increased $IP3_i$ level. Supply current is 1 µA, to lower power consumption. The BGS8L5 is internally AC coupled and requires only one external matching inductor.

The BGS8L5 is optimized for 617 MHz to 960 MHz.

## 2 Features and benefits

- Operating frequency from 617 MHz to 960 MHz
- Noise figure = 0.8 dB
- Gain 13.7 dB
- High input 1 dB compression point of −4.5 dBm
- High in band $IP3_i$ of −1 dBm
- Bypass switch insertion loss of 2.1 dB
- Supply voltage 1.5 V to 3.1 V
- Integrated RF supply decoupling
- Optimized performance at a supply current of 4.9 mA
- Bypass mode current consumption < 1 µA
- Integrated temperature stabilized bias for easy design.
- Requires only one input matching inductor
- Input and output AC coupled through DC blocking capacitors
- Integrated matching for the output
- ESD protection on all pins
- Low Bill of Materials (BOM)
- 6 pins leadless package: 1.1 mm x 0.7 mm x 0.37 mm: 0.40 mm pitch
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level of 1

# 3 Applications

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

# 4 Quick reference data

**Table 1. Quick reference data**

*f = 882 MHz; $V_{CC}$ = 2.8 V; $V_{I(CTRL)}$ > 0.8 V; $T_{amb}$ = 25 °C. Input matched to 50 Ω using application diagram from Figure 3 and component values as in Table 10. Unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CC}$ | supply current | in gain mode | - | 4.9 | 6.0 | mA |
| | | in bypass mode | - | - | 1 | µA |
| $G_p$ | power gain | in gain mode | - | 13.7 | - | dB |
| | | in bypass mode | - | −2.1 | - | dB |
| NF | noise figure | [1] | - | 0.8 | - | dB |
| $P_{i(1\ dB)}$ | input power at 1 dB gain compression | | - | −4.5 | - | dBm |
| $IP3_i$ | input third-order intercept point | Δf = 1 MHz | - | −1.0 | - | dBm |

[1] PCB losses are subtracted

# 5 Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BGS8L5 | XSON6 | plastic extremely thin small outline package: no leads; 6 terminals; body 1.1. x 0.7 x 0.37 mm | SOT1232 |


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# 6 Marking

**Table 3. Marking code**

| Type number | Marking code |
|---|---|
| BGS8L5 | S |

# 7 Block diagram

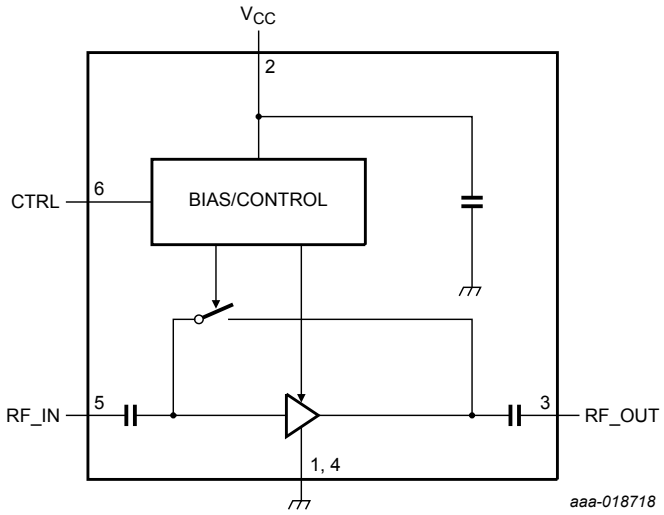


**Figure 1. Block diagram**


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# 8 Pinning information

## 8.1 Pinning

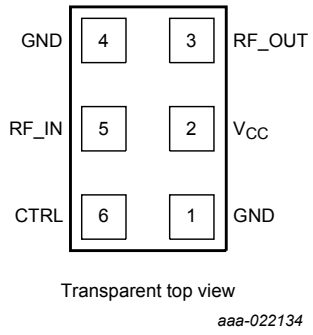


**Figure 2. Pin configuration**

## 8.2 Pin description

**Table 4. Pin description**

| Pin | Symbol | Description |
|---|---|---|
| 1 | GND | RF ground |
| 2 | $V_{CC}$ | supply voltage |
| 3 | RF_OUT | RF output |
| 4 | GND | RF ground |
| 5 | RF_IN | RF input |
| 6 | CTRL | gain control, switch between gain and bypass mode |


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# 9 Limiting values

**Table 5. Limiting values**

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | −0.5 | +5.0 | V |
| $V_{I(CTRL)}$ | input voltage on pin CTRL | $V_{I(CTRL)} < V_{CC} + 0.6$ V | −0.5 | +5.0 | V |
| $V_{I(RF\_IN)}$ | input voltage on pin RF_IN | DC [1] | −0.5 | +0.6 | V |
| $V_{I(RF\_OUT)}$ | input voltage on pin RF_OUT | DC, $V_{I(RF\_OUT)} < V_{CC} + 0.6$ V [1] | −0.5 | +5.0 | V |
| $P_i$ | input power | RF | - | 26 | dBm |
| | | [2] | - | 23 | dBm |
| $T_{stg}$ | 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 [3] | - | ±2 | kV |
| | | Charged Device Model (CDM) according to ANSI/ESDA/JEDEC Standard JS-002 | - | ±1 | kV |

[1] The RF input and output are AC coupled through internal DC Blocking capacitors.
[2] f = 880 MHz, 200 Hrs at $T_{amb}$ = 100 °C
[3] HBM ESD protection level is according to JS-001 Classification 2 (2000 V to < 4000 V)

# 10 Operating conditions

**Table 6. Characteristics**

| 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 | bypass mode | - | - | 0.25 | V |
| | | gain mode | 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 |


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# 12 Characteristics

**Table 8. Characteristics**

*703 MHz ≤ f ≤ 960 MHz; $V_{CC}$ =1.8 V; $T_{amb}$ = 25 °C; input matched 50 Ω using application diagram from Figure 3 and component values as in Table 10. Unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Gain Mode | | | | | | |
| $I_{CC}$ | supply current | $V_{I(CTRL)}$ > 0.8 V | - | 4.7 | 6.0 | mA |
| $G_p$ | power gain | f = 637 MHz | - | 15.5 | - | dB |
| | | f = 740 MHz | - | 14.5 | - | dB |
| | | f = 882 MHz | - | 13.5 | - | dB |
| | | f = 943 MHz | - | 13.0 | - | dB |
| ΔG/ΔT | gain variation with temperature | | - | −0.01 | - | dB/°C |
| NF | noise figure | f = 637 MHz [1] | - | 0.8 | - | dB |
| | | f = 740 MHz [1] | - | 0.8 | - | dB |
| | | f = 882 MHz [1] | - | 0.8 | - | dB |
| | | f = 943 MHz [1] | - | 0.85 | - | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | f = 637 MHz | - | −10 | - | dBm |
| | | f = 740 MHz | - | −9 | - | dBm |
| | | f = 882 MHz | - | −8 | - | dBm |
| | | f = 943 MHz | - | −7 | - | dBm |
| $IP3_i$ | input third-order intercept point | f = 637 MHz, Δf = 1 MHz | - | −3 | - | dBm |
| | | f = 740 MHz, Δf = 1 MHz | - | −2 | - | dBm |
| | | f = 882 MHz, Δf = 1 MHz | - | −1 | - | dBm |
| | | f = 943 MHz, Δf = 1 MHz | - | 0 | - | dBm |
| $RL_{in}$ | input return loss | f = 637 MHz | - | 14 | - | dB |
| | | f = 740 MHz | - | 10 | - | dB |
| | | f = 882 MHz | - | 15 | - | dB |
| | | f = 943 MHz | - | 16 | - | dB |
| $RL_{out}$ | output return loss | f = 637 MHz | - | 9 | - | dB |
| | | f = 740 MHz | - | 10 | - | dB |
| | | f = 882 MHz | - | 9 | - | dB |
| | | f = 943 MHz | - | 9 | - | dB |


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| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| ISL | isolation | f = 637 MHz | - | 23 | - | dB |
| | | f = 740 MHz | - | 23 | - | dB |
| | | f = 882 MHz | - | 23 | - | dB |
| | | f = 943 MHz | - | 23 | - | dB |
| K | Rollett stability factor | | 1 | - | - | |
| $t_{on}$ | 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 | $V_{I(CTRL)}$ < 0.25 V | - | - | 1.0 | µA |
| $G_p$ | power gain | f = 637 MHz | - | −2.0 | - | dB |
| | | f = 740 MHz | - | −2.0 | - | dB |
| | | f = 882 MHz | - | −2.2 | - | dB |
| | | f = 943 MHz | - | −2.5 | - | dB |
| $RL_{in}$ | input return loss | f = 637 MHz | - | 11 | - | dB |
| | | f = 740 MHz | - | 13 | - | dB |
| | | f = 882 MHz | - | 10 | - | dB |
| | | f = 943 MHz | - | 9 | - | dB |
| $RL_{out}$ | output return loss | f = 637 MHz | - | 7 | - | dB |
| | | f = 740 MHz | - | 9 | - | dB |
| | | f = 882 MHz | - | 8 | - | dB |
| | | f = 943 MHz | - | 7 | - | dB |

[1] PCB losses are subtracted.


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### Table 9. Characteristics

*703 MHz ≤ f ≤ 960 MHz; $V_{CC}$ = 2.8 V; $T_{amb}$ = 25 °C; input matched 50 Ω using application diagram from Figure 3 and component values as in Table 10. Unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Gain Mode | | | | | | |
| $I_{CC}$ | supply current | $V_{I(CTRL)}$ > 0.8 V | - | 4.9 | 6.0 | mA |
| $G_p$ | power gain | f = 637 MHz | - | 15.7 | - | dB |
| | | f = 740 MHz | - | 14.7 | - | dB |
| | | f = 882 MHz | - | 13.7 | - | dB |
| | | f = 943 MHz | - | 13.1 | - | dB |
| ΔG/ΔT | gain variation with temperature | | - | -0.01 | - | dB/°C |
| NF | noise figure | f = 637 MHz [1] | - | 0.8 | - | dB |
| | | f = 740 MHz [1] | - | 0.8 | - | dB |
| | | f = 882 MHz [1] | - | 0.8 | - | dB |
| | | f = 943 MHz [1] | - | 0.85 | - | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | f = 637 MHz | - | −5.0 | - | dBm |
| | | f = 740 MHz | - | −4.5 | - | dBm |
| | | f = 882 MHz | - | −4.5 | - | dBm |
| | | f = 943 MHz | - | −4.5 | - | dBm |
| $IP3_i$ | input third-order intercept point | f = 637 MHz, Δf = 1 MHz | - | −3 | - | dBm |
| | | f = 740 MHz, Δf = 1 MHz | - | −2 | - | dBm |
| | | f = 882 MHz, Δf = 1 MHz | - | −1 | - | dBm |
| | | f = 943 MHz, Δf = 1 MHz | - | 0 | - | dBm |
| $RL_{in}$ | input return loss | f = 637 MHz | - | 14 | - | dB |
| | | f = 740 MHz | - | 10 | - | dB |
| | | f = 882 MHz | - | 16 | - | dB |
| | | f = 943 MHz | - | 17 | - | dB |
| $RL_{out}$ | output return loss | f = 637 MHz | - | 9 | - | dB |
| | | f = 740 MHz | - | 10 | - | dB |
| | | f = 882 MHz | - | 9 | - | dB |
| | | f = 943 MHz | - | 9 | - | dB |


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| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| ISL | isolation | f = 637 MHz | - | 23 | - | dB |
| | | f = 740 MHz | - | 23 | - | dB |
| | | f = 882 MHz | - | 23 | - | dB |
| | | f = 943 MHz | - | 23 | - | dB |
| K | Rollett stability factor | | 1 | - | - | - |
| $t_{on}$ | 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 | $V_{I(CTRL)}$ < 0.25 V | - | - | 1.0 | µA |
| $G_p$ | power gain | f = 637 MHz | - | −1.9 | - | dB |
| | | f = 740 MHz | - | −1.8 | - | dB |
| | | f = 882 MHz | - | −2.1 | - | dB |
| | | f = 943 MHz | - | −2.4 | - | dB |
| $RL_{in}$ | input return loss | f = 637 MHz | - | 11 | - | dB |
| | | f = 740 MHz | - | 13 | - | dB |
| | | f = 882 MHz | - | 10 | - | dB |
| | | f = 943 MHz | - | 9 | - | dB |
| $RL_{out}$ | output return loss | f = 637 MHz | - | 7 | - | dB |
| | | f = 740 MHz | - | 9 | - | dB |
| | | f = 882 MHz | - | 8 | - | dB |
| | | f = 943 MHz | - | 7 | - | dB |

[1] PCB losses are subtracted.


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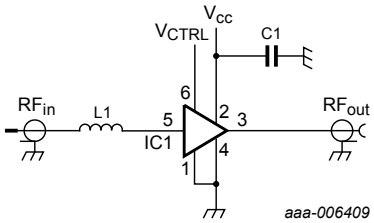
# 13 Application information

## 13.1 LTE LNA




For a list of components, see Table 10. Both ground pins must be connected on PCB.

**Figure 3. Schematics LTE LNA evaluation board**

**Table 10. List of components**

*For schematics, see Figure 3*

| Component | Description | Value | Remarks |
|---|---|---|---|
| $C_1$ | decoupling capacitor | 1 µF | The total capacitance on the $V_{CC}$ node must be at least 1 µF. It must be positioned at a short distance from the $V_{CC}$ pin (preferably within 15 mm). Typically, such capacitance is already present at the output of the $V_{CC}$ voltage regulator. |
| IC1 | BGS8L5 | | NXP |
| L1 | high-quality matching inductor | 15 nH | 617 < f < 652 MHz Murata LQW15A |
| | | 8.7 nH | 703 < f < 960 MHz Murata LQW15A |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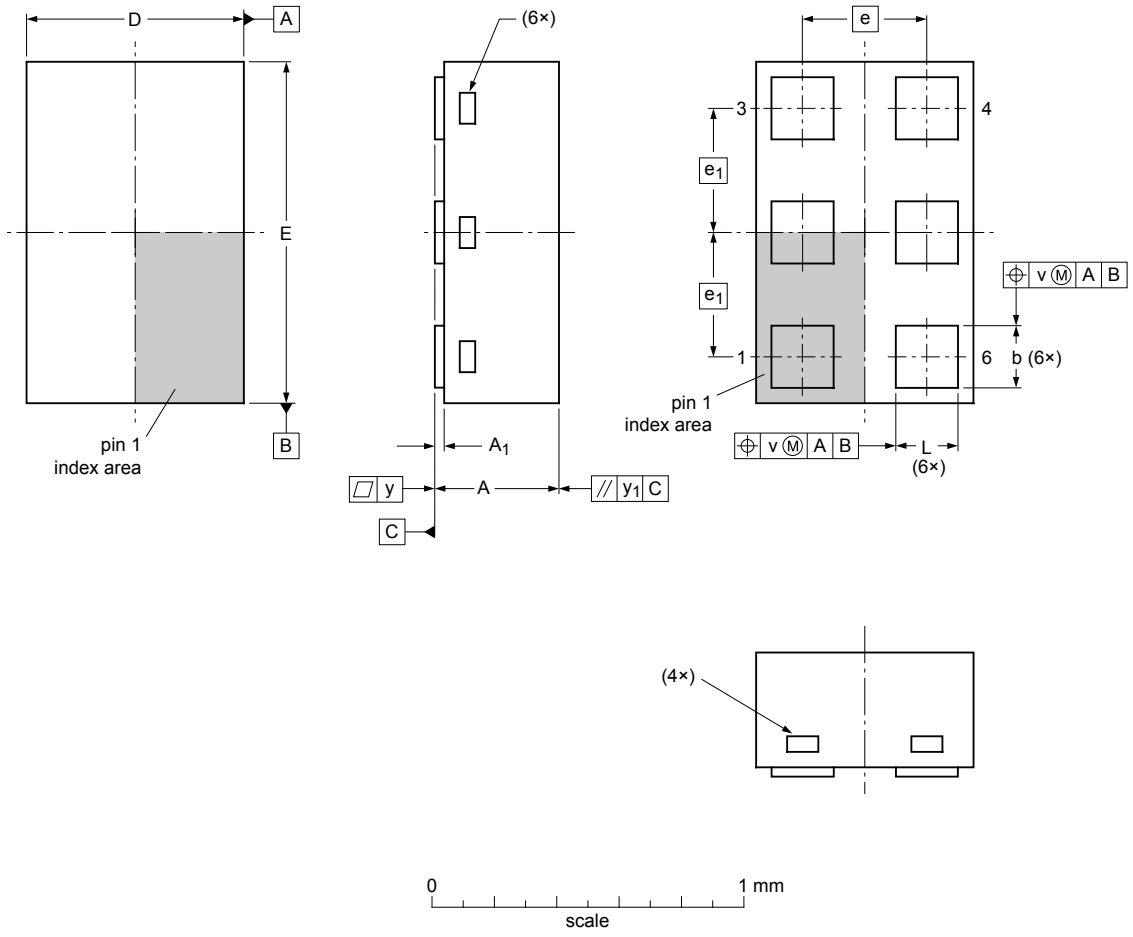
## 14 Package outline

**XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm** **SOT1232**




Dimensions (mm are the original dimensions)

| Unit | | A | $A_1$ | D | E | $e_1$ | e | b | L | V | Y | $Y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | min | 0.34 | | 0.65 | 1.05 | | | 0.17 | 0.17 | | | |
| mm | nom | 0.37 | | 0.70 | 1.10 | 0.4 | 0.4 | 0.20 | 0.20 | 0.1 | 0.05 | 0.1 |
| | max | 0.40 | 0.04 | 0.75 | 1.15 | | | 0.25 | 0.25 | | | |

Note
1. Dimension A is including plating thickness.

*sot1232_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1232 | | | | | | ~~13-04-12~~ 13-11-08 |

**Figure 4. SOT1232**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# 15 Handling information

**Table 11. Caution**

| | |
|---|---|
|  msc896 | 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 12. Abbreviations**

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

# 17 Revision history

**Table 13. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BGS8L5 v.1 | 20180302 | product data sheet | - | - |


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| 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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