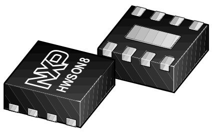


# BGU8051

## Low noise high linearity amplifier

Rev. 3 — 29 September 2014 Product data sheet

## 1. Product profile

### 1.1 General description

The BGU8051 is a low noise high linearity amplifier for wireless infrastructure applications, equipped with fast shutdown to support TDD systems. The LNA has a high input and output return loss and is designed to operate between 0.3 GHz and 1.5 GHz. It is housed in a 2 mm × 2 mm × 0.75 mm 8-terminal plastic thin small outline package. The LNA is ESD protected on all terminals.

### 1.2 Features and benefits

- Low noise performance: NF = 0.43 dB
- High linearity performance: $IP3_O$ = 39 dBm
- High input return loss > 15 dB
- High output return loss > 20 dB
- Unconditionally stable
- Programmable bias current (via resistor)
- Small 8-terminal leadless package 2 mm × 2 mm × 0.75 mm
- ESD protection on all terminals
- Moisture sensitivity level 1
- Fast shutdown to support TDD systems
- +5 V single supply

### 1.3 Applications

- Wireless infrastructure
- Low noise and high linearity applications
- LTE, W-CDMA, CDMA, GSM
- General purpose wireless applications
- TDD or FDD systems
- Suitable for small cells

### 1.4 Quick reference data

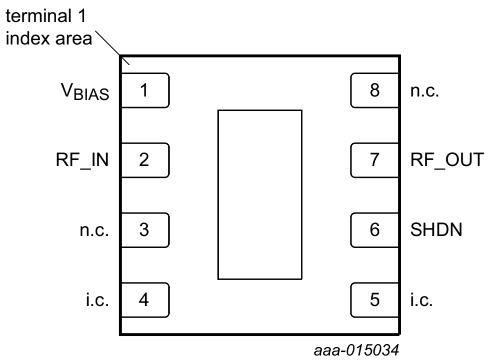
**Table 1. Quick reference data**

*f = 900 MHz; $V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; input and output 50 Ω; Rbias = 5.1 kΩ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 15 with components listed in Table 9 optimized for f = 900 MHz.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CC}$ | supply current | on state | 36 | 48 | 60 | mA |
| | | off state | - | 2.8 | - | mA |
| $G_{ass}$ | associated gain | on state | 17 | 18.3 | 20 | dB |
| | | off state | - | −21 | - | dB |
| NF | noise figure | | - | 0.43 | 0.63 | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 19 | - | dBm |
| $IP3_O$ | output third-order intercept point | 2-tone; tone spacing = 1 MHz; $P_i$ = −15 dBm per tone | 35 | 39 | - | dBm |

## 2. Pinning information

### 2.1 Pinning




Transparent top view

**Fig 1. Pin configuration**

### 2.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| $V_{BIAS}$ | 1 | bias voltage |
| RF_IN | 2 | RF input |
| n.c. | 3, 8 | not connected |
| i.c. | 4, 5 | internally connected. Can be grounded or left open in the application |
| SHDN | 6 | shutdown |
| RF_OUT | 7 | RF output |
| GND | exposed die pad | ground |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## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BGU8051 | HWSON8 | plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 × 2 × 0.75 mm | SOT1327-1 |

## 4. Limiting values

**Table 4. Limiting values**

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | - | 6 | V |
| $V_{ctrl(sd)}$ | shutdown control voltage | | - | 3 | V |
| $I_{CC}$ | supply current | | - | 85 | mA |
| $P_{i(RF)CW}$ | continuous waveform RF input power | | - | 20 | dBm |
| $T_{stg}$ | storage temperature | | –40 | +150 | °C |
| $T_j$ | junction temperature | | - | 150 | °C |
| P | power dissipation | $T_{case} \leq 125$ °C [1] | - | 510 | mW |
| $V_{ESD}$ | electrostatic discharge voltage | Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001-2010 | - | 0.9 | kV |
| | | Charged Device Model (CDM); According JEDEC standard 22-C101B | - | 2 | kV |

[1] Case is ground solder pad.

## 5. Recommended operating conditions

**Table 5. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 4.75 | 5 | 5.25 | V |
| $Z_0$ | characteristic impedance | | - | 50 | - | Ω |
| $T_{case}$ | case temperature | | –40 | - | +85 | °C |

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-case)}$ | thermal resistance from junction to case | [1][2] | 50 | K/W |

[1] Case is ground solder pad.

[2] Thermal resistance measured using infrared measurement technique, device mounted on application board and placed in still air.



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## 7. Characteristics

**Table 7. Characteristics**

*f = 900 MHz; $V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; input and output 50 Ω; Rbias = 5.1 kΩ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 15 with components listed in Table 9 optimized for f = 900 MHz.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | supply current | on state | | 36 | 48 | 60 | mA |
| | | off state | | - | 2.8 | - | mA |
| $G_{ass}$ | associated gain | on state | | 17 | 18.3 | 20 | dB |
| | | off state | | - | −21 | - | dB |
| NF | noise figure | | | - | 0.43 | 0.63 | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | - | 19 | - | dBm |
| $IP3_O$ | output third-order intercept point | 2-tone; tone spacing = 1 MHz; $P_i$ = −15 dBm per tone | | 35 | 39 | - | dBm |
| | | 2-tone; tone spacing = 1 MHz; $P_i$ = −15 dBm per tone | [1] | 33 | 37 | - | dBm |
| $RL_{in}$ | input return loss | on state | | - | 15.9 | - | dB |
| | | off state | | - | 12.5 | - | dB |
| $RL_{out}$ | output return loss | | | - | 29 | - | dB |
| ISL | isolation | | | - | 21 | - | dB |
| $t_{s(pon)}$ | power-on settling time | $P_i$ = −20 dBm; SHDN (pin 6) from HIGH to LOW | [1] | - | 1.4 | - | µs |
| $t_{s(poff)}$ | power-off settling time | $P_i$ = −20 dBm; SHDN (pin 6) from LOW to HIGH | [1] | - | 0.4 | - | µs |
| K | Rollett stability factor | both on state and off state up to f = 20 GHz | | 1 | - | - | |
| $R_{pd(SHDN)}$ | pull-down resistance on pin SHDN | | | - | 10 | - | kΩ |

[1] For applications where fast switching is required, it is recommended to change C1 and C2 to 100 pF.

**Table 8. Shutdown control**

*$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; input and output 50 Ω; Rbias = 5.1 kΩ; unless otherwise specified. All RF parameters are measured in an application board as shown in Figure 15 with components listed in Table 9 optimized for f = 900 MHz.*

| State | $V_{ctrl(sd)}$ [1] |
|---|---|
| | (V) |
| on state | ≤ 0.6 |
| off state | ≥ 1.2 |

[1] Voltage on pin 6 (SHDN).


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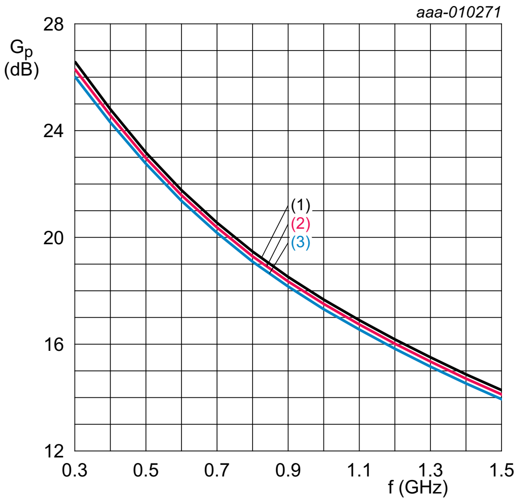
### 7.1 Graphs



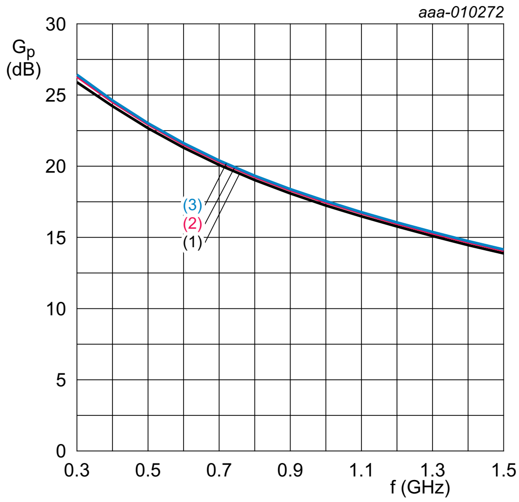

$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 2. Power gain as a function of frequency; typical values**



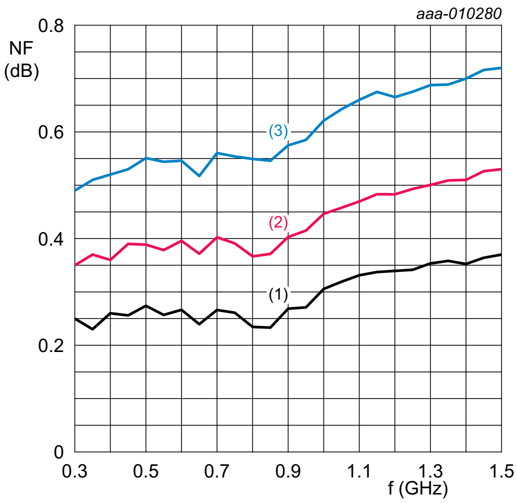

$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C.

(1) $I_{CC}$ = 30 mA

(2) $I_{CC}$ = 45 mA

(3) $I_{CC}$ = 60 mA

**Fig 3. Power gain as a function of frequency; typical values**



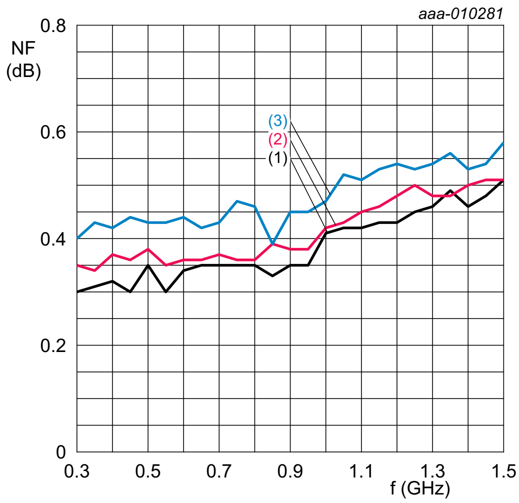

$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 4. Noise figure as a function of frequency; typical values**




$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C.

(1) $I_{CC}$ = 30 mA

(2) $I_{CC}$ = 45 mA

(3) $I_{CC}$ = 60 mA

**Fig 5. Noise figure as a function of frequency; typical values**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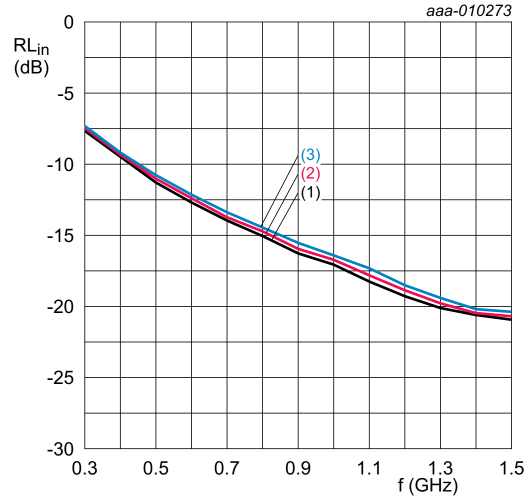


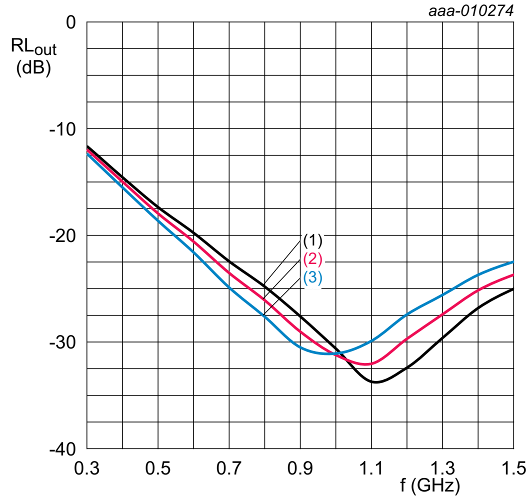

$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 6. Input return loss as a function of frequency; typical values**



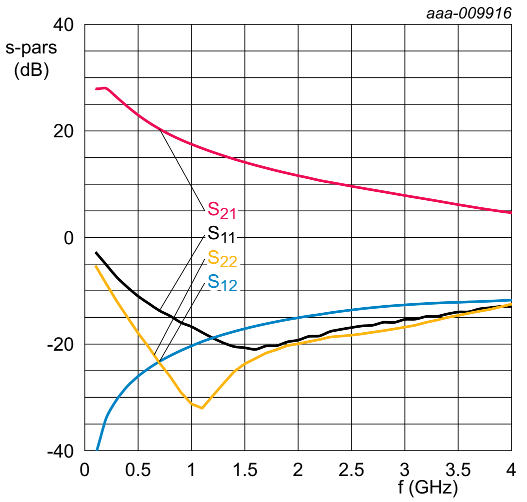

$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

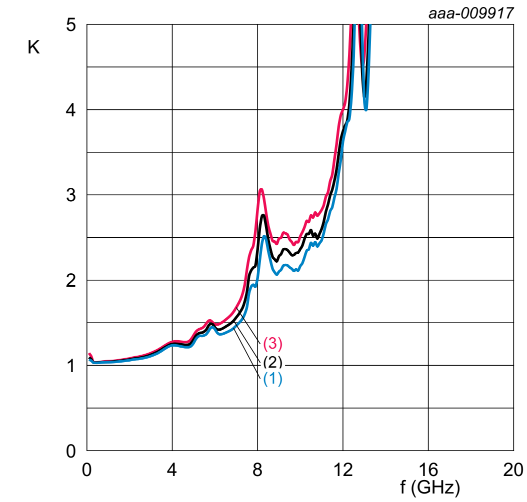
(3) $T_{amb}$ = +85 °C

**Fig 7. Output return loss as a function of frequency; typical values**




$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; $I_{CC}$ = 48 mA.

**Fig 8. Wideband S-parameters as function of frequency; typical values**




$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 9. Rollet stability factor as a function of frequency; typical values**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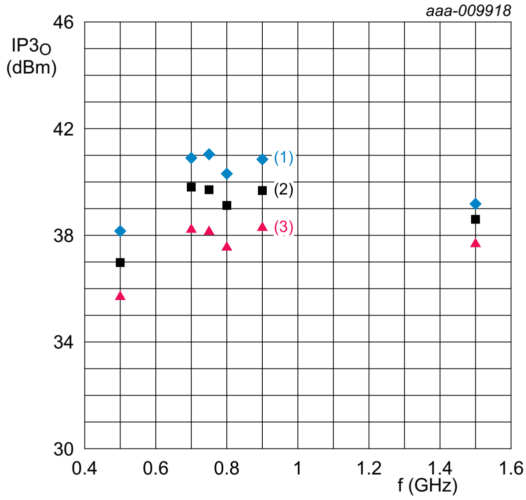


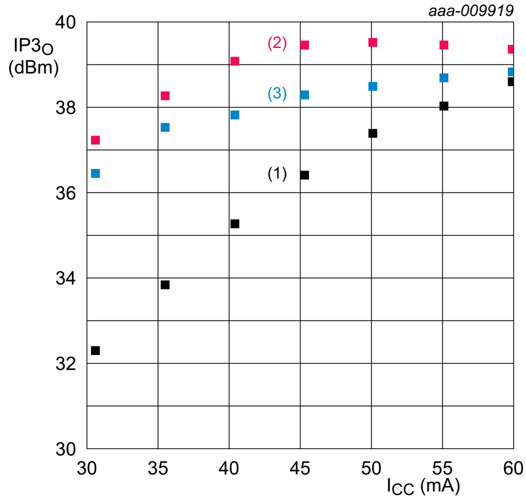

$V_{CC}$ = 5 V; $P_i$ = −15 dBm per tone; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 10. Output third-order intercept point as a function of frequency; typical values**



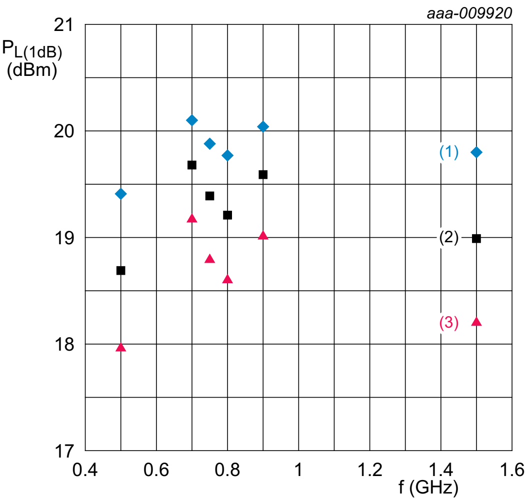

$V_{CC}$ = 5 V; $P_i$ = −15 dBm per tone; $T_{amb}$ = 25 °C.

(1) f = 500 MHz

(2) f = 900 MHz

(3) f = 1500 MHz

**Fig 11. Output third-order intercept point as a function of supply current; typical values**



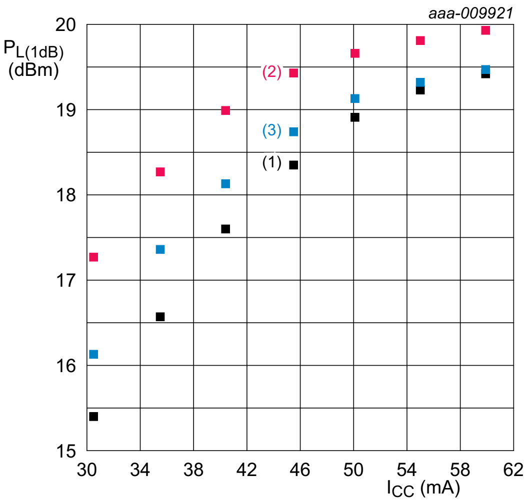

$V_{CC}$ = 5 V; $I_{CC}$ = 48 mA.

(1) $T_{amb}$ = −40 °C

(2) $T_{amb}$ = +25 °C

(3) $T_{amb}$ = +85 °C

**Fig 12. Output power at 1 dB gain compression as a function of frequency; typical values**




$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C.

(1) f = 500 MHz

(2) f = 900 MHz

(3) f = 1500 MHz

**Fig 13. Output power at 1 dB gain compression as a function of supply current; typical values**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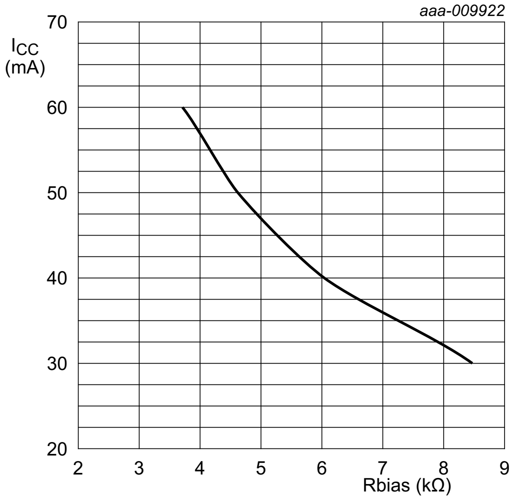
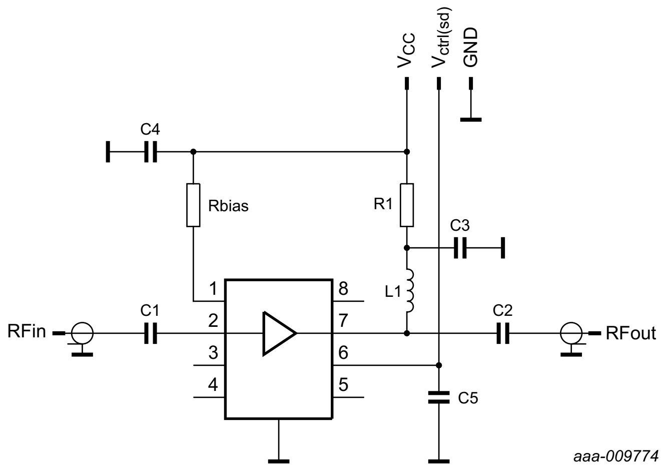



$V_{CC}$ = 5 V.

**Fig 14. Supply current as a function of Rbias; typical values**

# 8. Application information




See Table 9 for a list of components.

**Fig 15. Schematic of application board**

**Table 9. List of components**

*See Figure 15 for schematics.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C1, C2 | capacitor | 100 nF | |
| | | 100 pF | recommended for TDD systems |
| C3, C5 | capacitor | 10 pF | |
| C4 | capacitor | 10 nF | |


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**Table 9. List of components** *…continued*

*See Figure 15 for schematics.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| L1 | inductor | 33 nH | |
| R1 | resistor | 10 Ω | |
| Rbias | resistor | 5.1 kΩ | |

**Table 10. Typical performance BGU8051 application board**

*All RF parameters are measured at the application board as shown in Figure 15 with the components as listed in Table 9 while optimized for: f = 900 MHz; $V_{CC}$ = 5 V; $I_{CC}$ = 48 mA and $T_{amb}$ = 25 °C, unless otherwise specified.*

| Symbol | Parameter | Conditions | | f (MHz) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 400 | 500 | 700 | 750 | 800 | 900 | 1500 |
| $G_{ass}$ | associated gain | | | 24.6 | 23.0 | 20.4 | 19.8 | 19.3 | 18.3 | 14.1 |
| $RL_{in}$ | input return loss | | | 9.3 | 11.0 | 13.7 | 14.2 | 14.7 | 15.9 | 20.7 |
| $RL_{out}$ | output return loss | | | 15.0 | 18.0 | 23.5 | 24.8 | 26.1 | 29.0 | 23.7 |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | 18.0 | 18.7 | 19.7 | 19.4 | 19.2 | 19.6 | 19.0 |
| $IP3_O$ | output third-order intercept point | $P_i$ = –15 dBm per tone | [1] | | | | | | | |
| | | C1 = C2 = 100 nF | [1] | - | - | - | 39.7 | 39.1 | 39.7 | 38.6 |
| | | C1 = C2 = 100 pF | [1][2] | - | - | - | 37.9 | 35.1 | 37.8 | 36.6 |
| | | $P_i$ = –25 dBm per tone | [1] | | | | | | | |
| | | C1 = C2 = 100 nF | [1] | 36.7 | 38.5 | 39.8 | - | - | - | - |
| | | C1 = C2 = 100 pF | [1][2] | 35.6 | 36.4 | 37.0 | - | - | - | - |
| NF | noise figure | | [3] | 0.41 | 0.39 | 0.40 | 0.39 | 0.37 | 0.40 | 0.53 |

[1] 2-Tone; tone spacing = 1 MHz.

[2] For TDD systems C1 and C2 have to be 100 pF.

[3] Connector and board losses not de-embedded.



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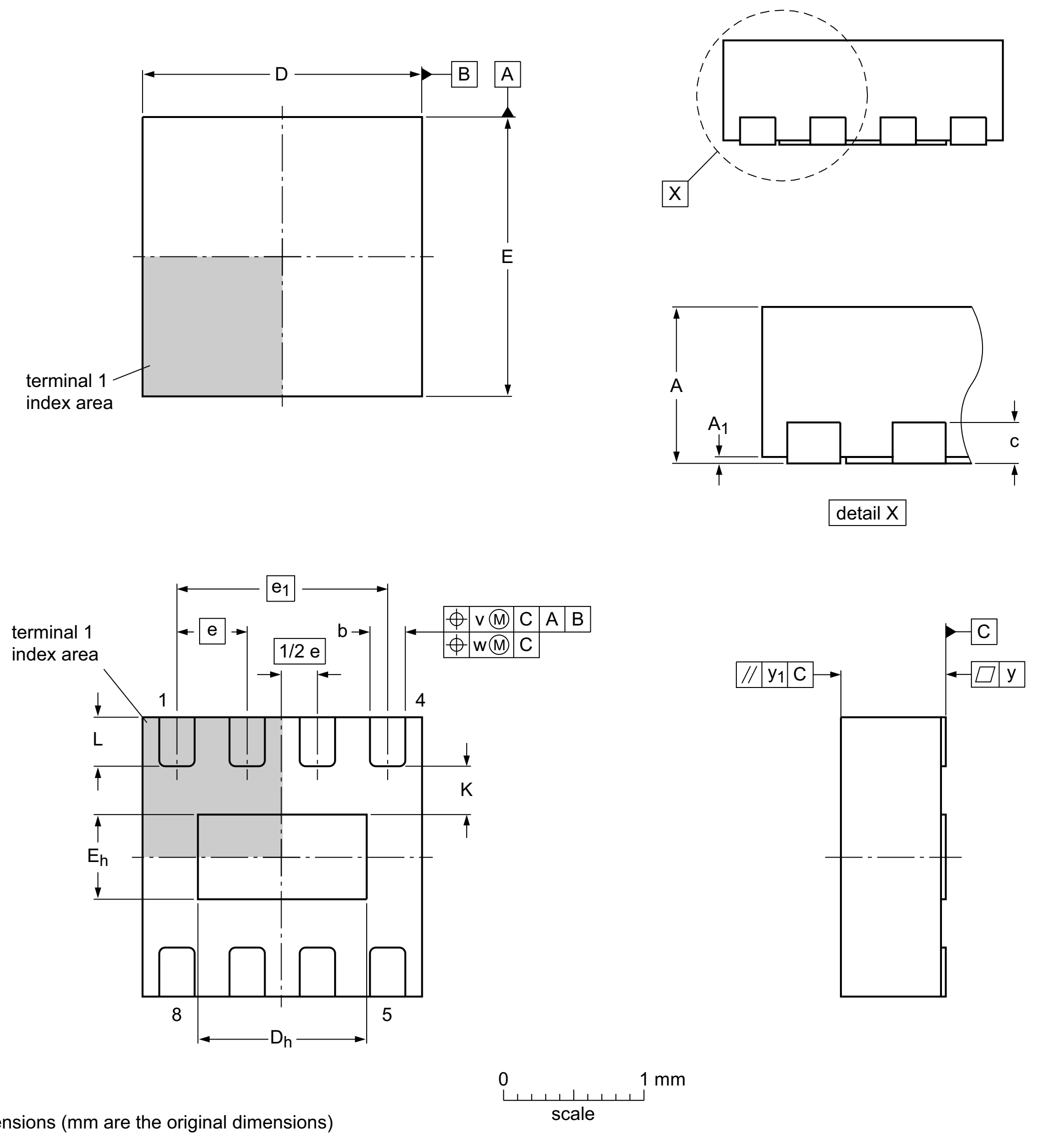
# 9. Package outline

**HWSON8: plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body 2 x 2 x 0.75 mm** **SOT1327-1**




Dimensions (mm are the original dimensions)

| Unit | | A | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | K | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.80 | 0.05 | 0.30 | | 2.05 | 1.25 | 2.05 | 0.65 | | | | 0.40 | | | | |
| mm | nom | 0.75 | 0.03 | 0.25 | 0.2 | 2.00 | 1.20 | 2.00 | 0.60 | 0.5 | 1.5 | | 0.35 | 0.1 | 0.05 | 0.05 | 0.1 |
| | min | 0.70 | 0.00 | 0.20 | | 1.95 | 1.15 | 1.95 | 0.55 | | | 0.35 | 0.30 | | | | |

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1327-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1327-1 | | MO-229 | | | | ~~12-04-11~~ 12-04-15 |

**Fig 16. Package outline SOT1327-1 (HWSON8)**



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## 10. Abbreviations

**Table 11. Abbreviations**

| Acronym | Description |
|---|---|
| CDMA | Code Division Multiple Access |
| ESD | ElectroStatic Discharge |
| FDD | Frequency-Division Duplexing |
| GSM | Global System for Mobile Communication |
| HBM | Human Body Model |
| LNA | Low Noise Amplifier |
| LTE | Long Term Evolution |
| TDD | Time-Division Duplexing |
| W-CDMA | Wideband Code Division Multiple Access |

## 11. Revision history

**Table 12. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BGU8051 v.3 | 20140929 | Product data sheet | - | BGU8051 v.2 |
| Modifications: | • Figure 1 on page 2: figure has been corrected | | | |
| BGU8051 v.2 | 20131230 | Product data sheet | - | BGU8051 v.1 |
| BGU8051 v.1 | 20131127 | Product data sheet | - | - |


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# 12. Legal information

## 12.1 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. |
| 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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