



BGU8053

Low noise high linearity amplifier

Rev. 3 — 18 April 2016

Product data sheet

1. General description

The BGU8053 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 2 GHz and 6 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.

2. Features and benefits

- Low noise performance: $NF = 0.56$ dB
- High linearity performance: $IP3_O = 36$ dBm
- High input return loss > 12 dB
- High output return loss > 20 dB
- Unconditionally stable up to 20 GHz
- 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 shut down to support TDD systems
- 3 V to 5 V single supply

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



4. Quick reference data

Table 1. Quick reference data

$f = 2500\text{ MHz}$; $V_{CC} = 5\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$; input and output $50\ \Omega$; $R_{\text{bias}} = 5.1\text{ k}\Omega$; unless otherwise specified. All RF parameters are measured in an application board as shown in [Figure 16](#) with components listed in [Table 9](#) optimized for $f = 2500\text{ MHz}$.

| 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 | 18.5 | 20 | dB |
| | | off state | - | -23.5 | - | dB |
| NF | noise figure | [1] | - | 0.56 | 0.75 | dB |
| $P_{L(1\text{dB})}$ | output power at 1 dB gain compression | | - | 18 | - | dBm |
| $IP3_O$ | output third-order intercept point | 2-tone; tone spacing = 1 MHz; $P_i = -15\text{ dBm}$ per tone | 32 | 36 | - | dBm |

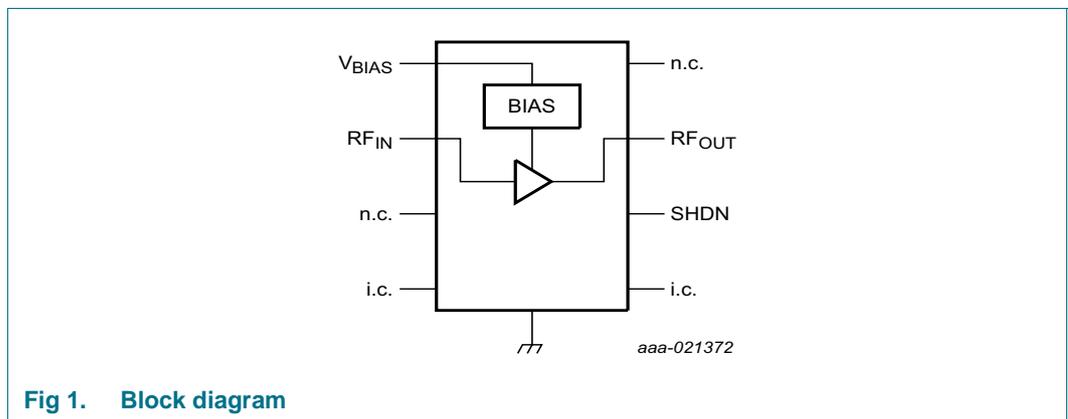
[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded.

5. Ordering information

Table 2. Ordering information

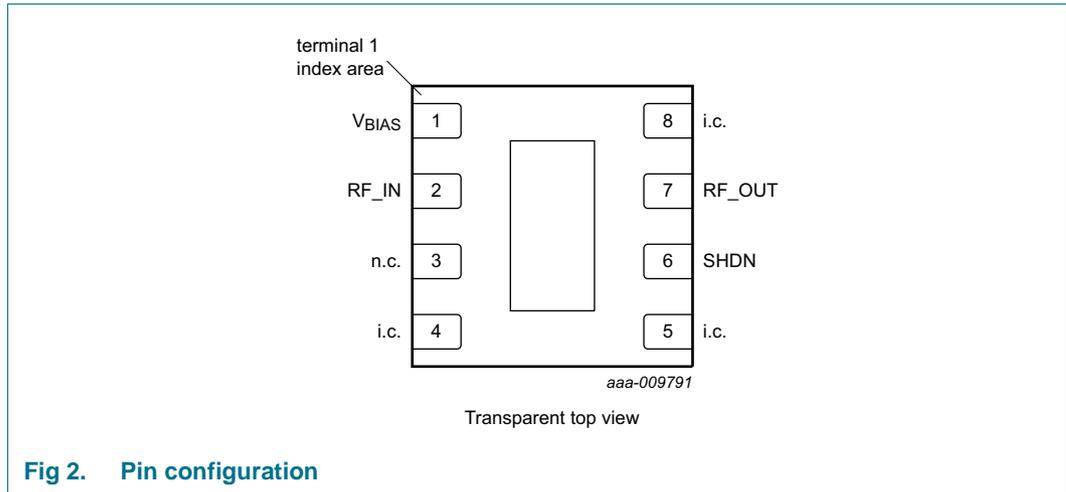
| Type number | Package | | Version |
|-------------|---------|---|-----------|
| | Name | Description | |
| BGU8053 | HWSON8 | plastic thermal enhanced very very thin small outline package; no leads; 8 terminals; body $2 \times 2 \times 0.75\text{ mm}$ | SOT1327-1 |

6. Block diagram



7. Pinning information

7.1 Pinning



7.2 Pin description

Table 3. Pin description

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

8. 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} ≤ 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 to JEDEC standard 22-C101B | - | 2 | kV |

[1] Case is ground solder pad.

9. 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 |

10. 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.

11. Characteristics

Table 7. Characteristics

$f = 1900$ MHz; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; input and output 50Ω ; $R_{bias} = 5.1$ k Ω ; unless otherwise specified. All RF parameters are measured in an application board as shown in [Figure 16](#) with components listed in [Table 9](#) optimized for $f = 1900$ 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 | 18.5 | 20 | dB |
| | | off state | - | -23 | - | dB |
| NF | noise figure | [1] | - | 0.50 | 0.70 | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 18 | - | dBm |
| IP _{3O} | output third-order intercept point | 2-tone; tone spacing = 1 MHz; $P_i = -15$ dBm per tone | 32 | 36 | - | dBm |
| | | 2-tone; tone spacing = 1 MHz; $P_i = -15$ dBm per tone [2] | 30 | 34 | - | dBm |
| RL _{in} | input return loss | on state | - | 14.5 | - | dB |
| | | off state | - | 8.4 | - | dB |
| RL _{out} | output return loss | | - | 23 | - | dB |
| ISL | isolation | | - | 23 | - | dB |
| $t_{s(pon)}$ | power-on settling time | $P_i = -20$ dBm; SHDN (pin 6) from HIGH to LOW [2] | - | 1.4 | - | μ s |
| $t_{s(poff)}$ | power-off settling time | $P_i = -20$ dBm; SHDN (pin 6) from LOW to HIGH [2] | - | 0.4 | - | μ s |
| 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 | | - | 20 | - | k Ω |

[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded.

[2] For TDD systems where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

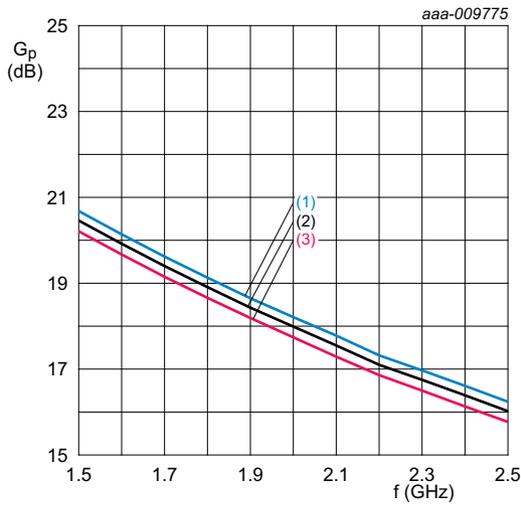
Table 8. Shutdown control

$V_{CC} = 5$ V; $T_{amb} = 25$ °C.

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

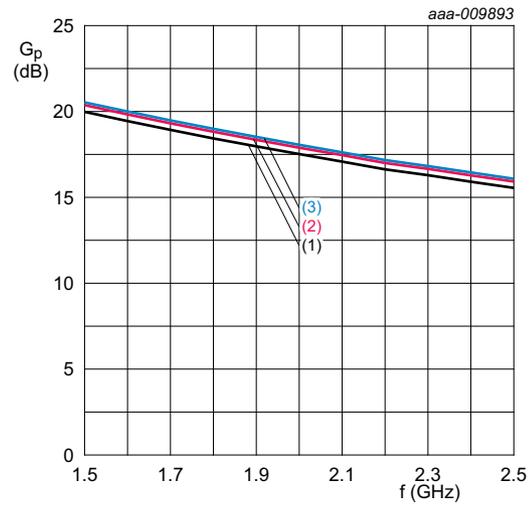
[1] Voltage on pin 6 (SHDN).

11.1 Graphics



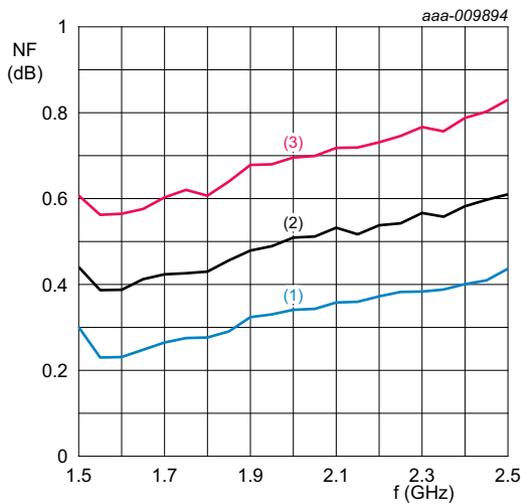
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

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



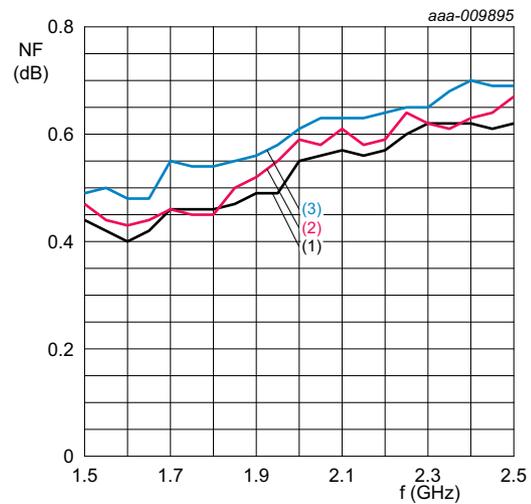
$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $I_{CC} = 30\text{ mA}$
 (2) $I_{CC} = 45\text{ mA}$
 (3) $I_{CC} = 60\text{ mA}$

Fig 4. Power gain as a function of frequency; typical values



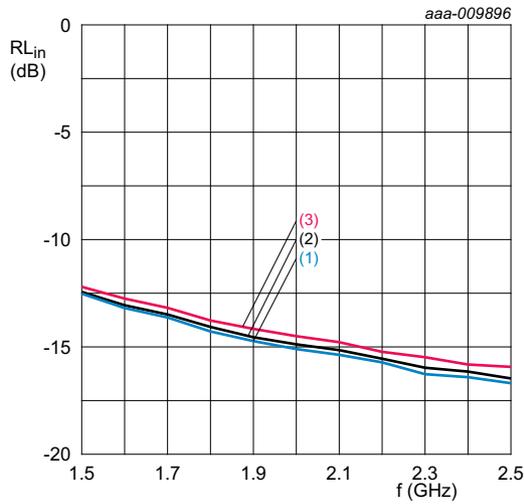
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

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



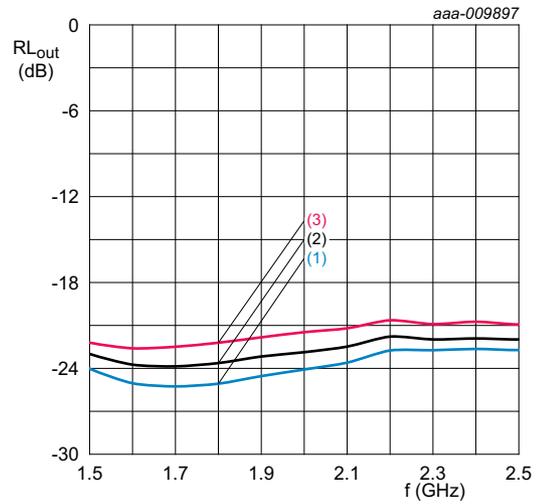
$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $I_{CC} = 30\text{ mA}$
 (2) $I_{CC} = 45\text{ mA}$
 (3) $I_{CC} = 60\text{ mA}$

Fig 6. Noise figure as a function of frequency; typical values



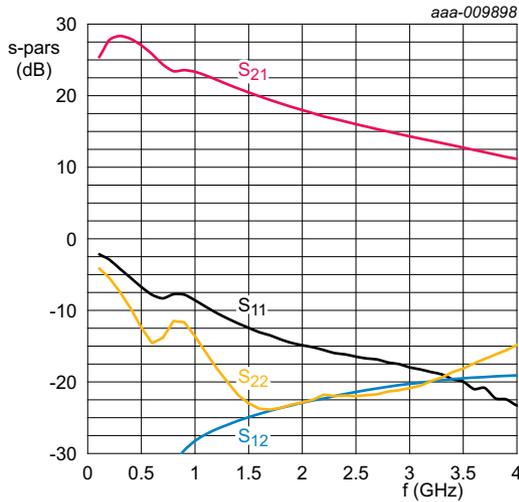
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

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



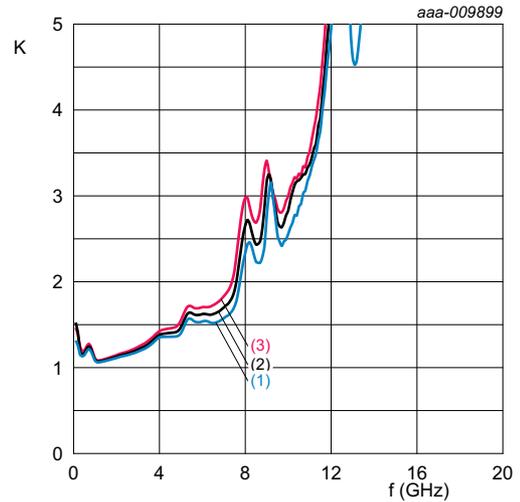
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

Fig 8. Output return loss as a function of frequency; typical values



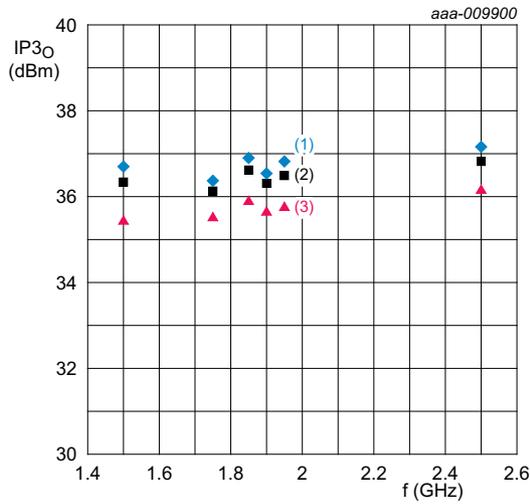
$V_{CC} = 5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}; I_{CC} = 48\text{ mA}.$

Fig 9. Wideband S-parameters as function of frequency; typical values



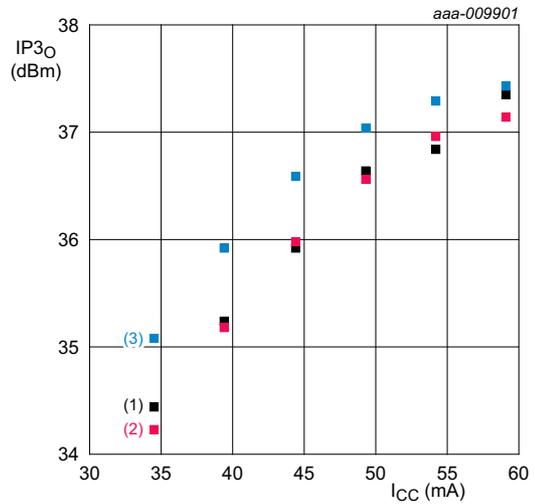
$V_{CC} = 5\text{ V}; I_{CC} = 48\text{ mA}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +85\text{ }^{\circ}\text{C}$

Fig 10. Rollett stability factor as a function of frequency; typical values



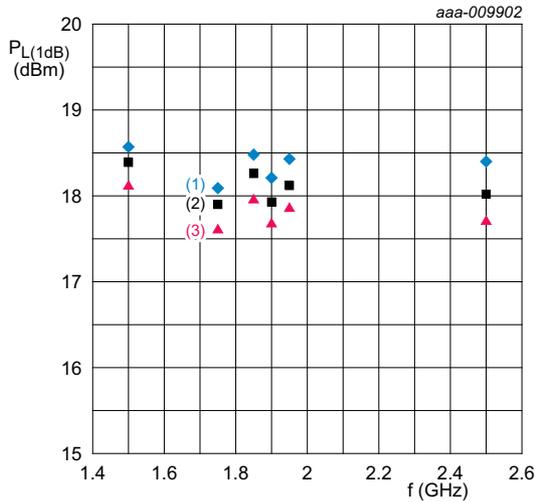
$V_{CC} = 5\text{ V}$; $P_i = -15\text{ dBm}$ per tone; $I_{CC} = 48\text{ mA}$.
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = +25\text{ }^\circ\text{C}$
 (3) $T_{amb} = +85\text{ }^\circ\text{C}$

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



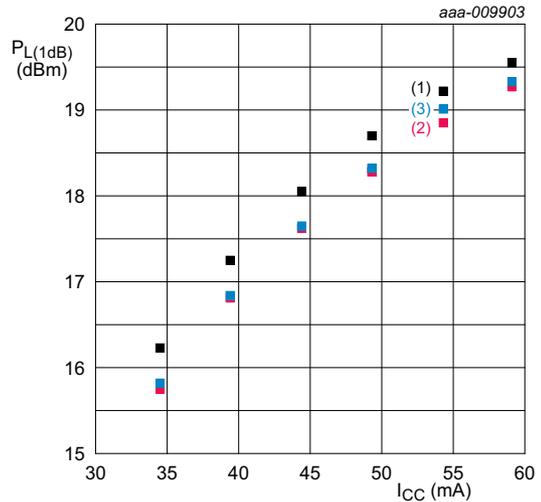
$V_{CC} = 5\text{ V}$; $P_i = -15\text{ dBm}$ per tone; $T_{amb} = 25\text{ }^\circ\text{C}$.
 (1) $f = 1500\text{ MHz}$
 (2) $f = 1900\text{ MHz}$
 (3) $f = 2500\text{ MHz}$

Fig 12. Output third-order intercept point as a function of supply current; typical values



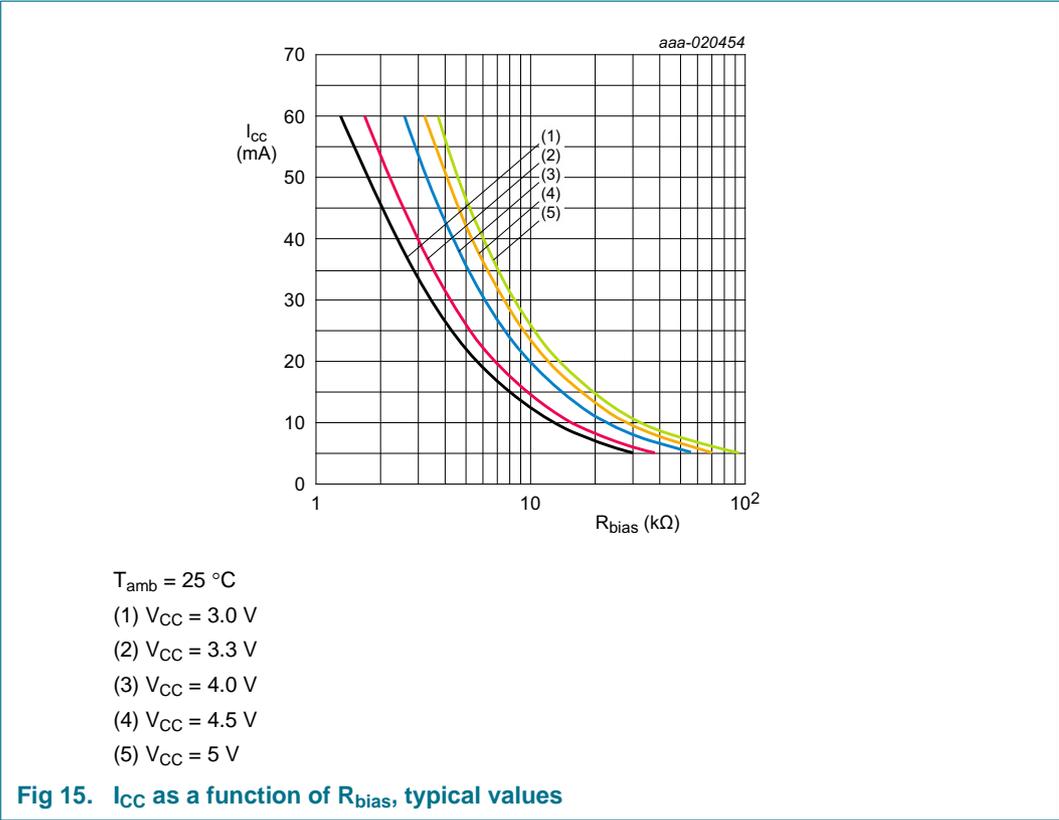
$V_{CC} = 5\text{ V}$; $I_{CC} = 48\text{ mA}$.
 (1) $T_{amb} = -40\text{ }^\circ\text{C}$
 (2) $T_{amb} = +25\text{ }^\circ\text{C}$
 (3) $T_{amb} = +85\text{ }^\circ\text{C}$

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



$V_{CC} = 5\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$.
 (1) $f = 1500\text{ MHz}$
 (2) $f = 1900\text{ MHz}$
 (3) $f = 2500\text{ MHz}$

Fig 14. Output power at 1 dB gain compression as a function of supply current; typical values



12. Application information

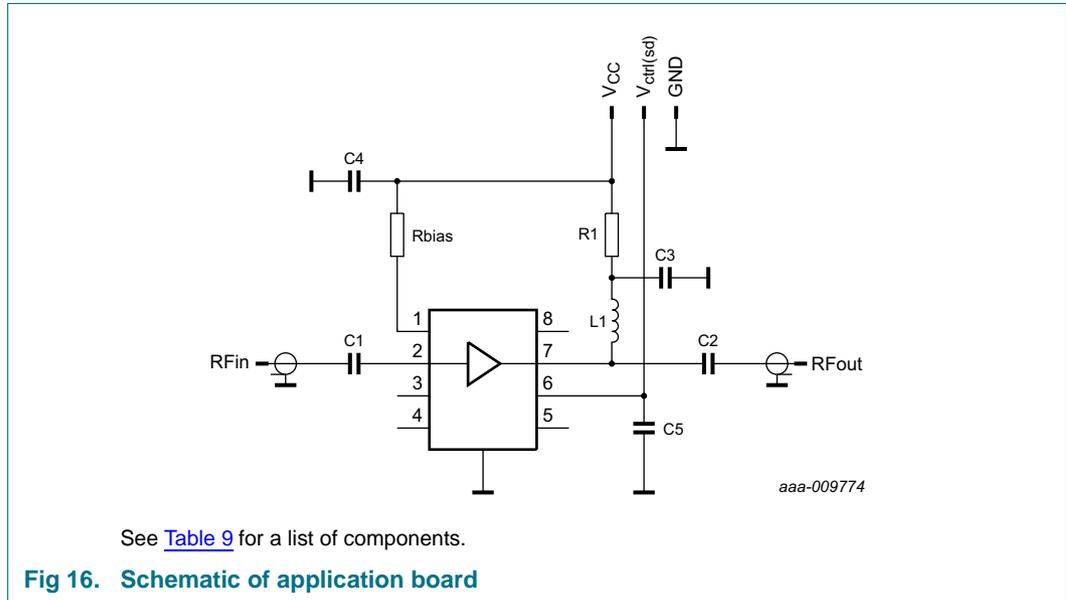


Table 9. List of components

See [Figure 16](#) 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 | |
| L1 | inductor | 15 nH | |
| R1 | resistor | 10 Ω | |
| R _{bias} | resistor | 5.1 kΩ | V _{CC} = 5 V |
| | | 2.3 kΩ | V _{CC} = 3.3 V |

Table 10. Typical performance BGU8053 application board $V_{CC} = 5\text{ V}$

All RF parameters are measured at the application board as shown in [Figure 16](#). With the components as listed in [Table 9](#) while optimized for: $f = 2500\text{ MHz}$, $V_{CC} = 5\text{ V}$, $I_{CC} = 48\text{ mA}$ and $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | Conditions | f (MHz) | | | | | | | |
|---------------------|---------------------------------------|------------|---------|------|------|------|------|------|------|------|
| | | | 2000 | 2300 | 2500 | 2700 | 3000 | 3400 | 3500 | 3800 |
| G | gain | | 20.2 | 19.0 | 18.3 | 17.6 | 16.6 | 15.4 | 15.1 | 14.2 |
| RL _{in} | input return loss | | 11.0 | 11.8 | 12.3 | 12.6 | 13.3 | 14.0 | 13.8 | 14.9 |
| RL _{out} | output return loss | | 30.1 | 28.9 | 28.7 | 27.1 | 23.4 | 18.2 | 17.3 | 14.7 |
| P _{L(1dB)} | output power at 1 dB gain compression | | 18.5 | 18.6 | 18.2 | 18.1 | 18.2 | 16.9 | 16.2 | 14.9 |
| IP _{3O} | output third-order intercept point | [1] | 35.5 | 35.4 | 35.4 | 35.2 | 34.3 | 33.4 | 33.3 | 32.5 |
| | | [1][2] | 34.8 | 36.3 | 36.3 | 36.4 | 35.6 | 32.5 | 33.1 | 31.9 |
| NF | noise figure | [3] | 0.52 | 0.59 | 0.63 | 0.68 | 0.67 | 0.76 | 0.78 | 0.87 |

[1] 2-Tone; tone spacing = 1 MHz, P_o = 5 dBm per tone.

[2] For applications where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

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

Table 11. Typical performance BGU8053 application board $V_{CC} = 3.3\text{ V}$

All RF parameters measured at application board shown in [Figure 16](#). With the components as listed in [Table 9](#) while optimized for 2500 MHz, $V_{CC} = 3.3\text{ V}$, $I_{CC} = 48\text{ mA}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$

| Symbol | Parameter | Conditions | f (MHz) | | | | | | | |
|---------------------|---------------------------------------|------------|---------|------|------|------|------|------|------|------|
| | | | 2000 | 2300 | 2500 | 2700 | 3000 | 3400 | 3500 | 3800 |
| G | gain | | 20.1 | 18.9 | 18.1 | 17.4 | 16.4 | 15.3 | 15.0 | 14.1 |
| RL _{in} | input return loss | | 11.3 | 12.1 | 12.4 | 14.1 | 13.6 | 13.7 | 15.0 | 15.3 |
| RL _{out} | output return loss | | 32.9 | 29.5 | 27.8 | 27.5 | 23.4 | 18.6 | 17.7 | 15.4 |
| P _{L(1dB)} | output power at 1 dB gain compression | | 16.0 | 15.4 | 14.9 | 15.1 | 14.5 | 14.0 | 13.9 | 12.7 |
| IP _{3O} | output third-order intercept point | [1] | 29.2 | 28.8 | 29.0 | 28.1 | 27.1 | 26.0 | 26.3 | 23.4 |
| | | [1][2] | 30.2 | 29.9 | 29.0 | 29.1 | 28.4 | 26.2 | 25.8 | 25.9 |
| NF | noise figure | [3] | 0.55 | 0.58 | 0.60 | 0.63 | 0.69 | 0.78 | 0.80 | 0.89 |

[1] 2-Tone; tone spacing = 1 MHz, P_o = 5 dBm per tone.

[2] For applications where fast switching is required, the value of C1 and C2 should be changed to 100 pF.

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

13. 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

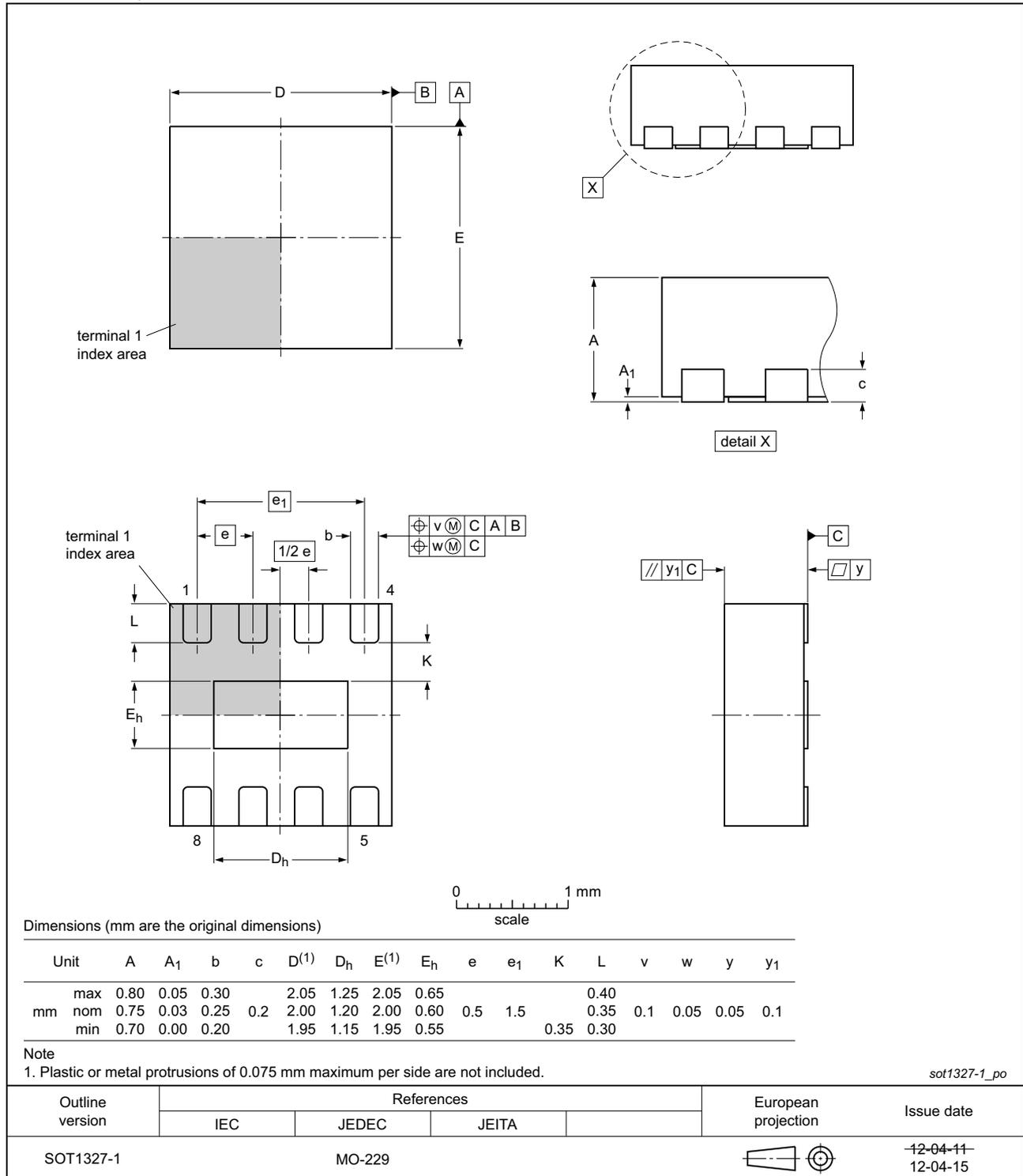


Fig 17. Package outline SOT1327-1 (HWSON8)

14. Abbreviations

Table 12. Abbreviations

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

15. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|--------------------|---------------|-------------|
| BGU8053 v.3 | 20160418 | Product data sheet | - | BGU8053 v.2 |
| Modifications: | <ul style="list-style-type: none"> • 3 V to 5 V single supply added to Section 2 “Features and benefits” • Figure 1 “Block diagram” on page 2 added • An additional curve added to Figure 14 on page 8 • Added remark to R_{bias} in Table 9 on page 10 • Table 11 on page 11 added | | | |
| BGU8053 v.2 | 20131230 | Product data sheet | - | BGU8053 v.1 |
| Modifications: | <ul style="list-style-type: none"> • Table 4 on page 3: The maximum value for $V_{ctrl(sd)}$ has been corrected to 3 V. | | | |
| BGU8053 v.1 | 20131127 | 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. |
| 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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