

BGU7045

1 GHz wideband low-noise amplifier with bypass

Rev. 3 — 11 April 2018

Product data sheet

1 Product profile

1.1 General description

The BGU7045 MMIC is a 3.3 V wideband amplifier with bypass mode. It is designed specifically for high linearity, low-noise applications over a frequency range of 40 MHz to 1 GHz. It is especially suited for Set-Top Box applications.

The LNA is housed in a 6-pin SOT363 plastic SMD package.

1.2 Features and benefits

- Voltage supply of 3.3 V
- Internally biased
- Programmable between $G_p = 14$ dB and bypass
- Flat gain between 40 MHz and 1 GHz
- Noise figure of 2.8 dB
- High linearity with an $IP3_O$ of 29 dBm
- 75 Ω input and output impedance
- Power-down during bypass mode
- Bypass mode current consumption < 5 mA
- ESD protection > 2 kV Human Body Model (HBM) and >1.5 kV Charged Device Model (CDM) on all pins

1.3 Applications

- Terrestrial and cable Set-Top Boxes (STB)
- Silicon and "Can" tuners
- Personal Video Recorders (PVR) and Digital Video Recorders (DVR)
- Home networking and in-house signal distribution



1.4 Quick reference data

Table 1. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$; typical values at $V_{CC} = 3.3\text{ V}$; $Z_S = Z_L = 75\text{ }\Omega$; $R_{bias} = 18\text{ }\Omega$; $40\text{ MHz} \leq f_1 \leq 1000\text{ MHz}$.

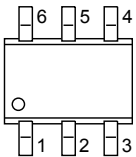
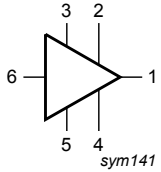
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------|---------------------------------------|---|----------|-----|-----|--------------------|
| V_{CC} | supply voltage | RF input AC coupled | 3.1 | 3.3 | 3.5 | V |
| $I_{CC(tot)}$ | total supply current | $G_p = 14\text{ dB mode}$ | [1] 30 | 34 | 38 | mA |
| | | bypass mode | [1] - | 3 | - | mA |
| T_{amb} | ambient temperature | | -40 | - | +85 | $^{\circ}\text{C}$ |
| NF | noise figure | $G_p = 14\text{ dB mode}$ | [1] - | 2.8 | - | dB |
| | | bypass mode | [1] - | 2.5 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $G_p = 14\text{ dB mode}; 1\text{ GHz}$ | [1] - | 13 | - | dBm |
| IP3O | output third-order intercept point | $G_p = 14\text{ dB mode}$ | [1][2] - | 29 | - | dBm |

[1] Mode depends on setting of V_{CTRL} ; see Table 8.

[2] The fundamental frequency (f_1) is 1000 MHz. The intermodulation product (IM3) is $2 \times f_2 - f_1$, where $f_2 = f_1 \pm 1\text{ MHz}$. Input power $P_1 = -10\text{ dBm}$.

2 Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|-------------|---|---|
| 1 | RF_OUT |  |  |
| 2 | V_{CC} | | |
| 3 | n.c. | | |
| 4 | CTRL | | |
| 5 | GND | | |
| 6 | RF_IN | | |

3 Ordering information

Table 3. Ordering information

| Type number | Package Name | Description | Version |
|-------------|--------------|--|---------|
| BGU7045 | - | plastic surface-mounted package; 6 leads | SOT363 |

4 Marking

Table 4. Marking code

| Type number | Marking code | Description |
|-------------|--------------|--------------------------|
| BGU7045 | LK* | * = p: made in Hong Kong |
| | | * = W: made in China |
| | | * = t: made in Malaysia |

5 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 | RF input AC coupled | -0.6 | 3.5 | V |
| V_{CTRL} | voltage on CTRL pin | | [1] 0 | V_{CC} | V |
| $I_{CC(tot)}$ | total supply current | | - | 60 | mA |
| P_{tot} | total power dissipation | $T_{sp} \leq 100\text{ °C}$ | [2] - | 250 | mW |
| P_i | input power | single tone | - | 20 | dBm |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_j | junction temperature | | - | 150 | °C |
| T_{amb} | ambient temperature | | -40 | +85 | °C |
| V_{ESD} | electrostatic discharge voltage | Human Body Model (HBM); according to JEDEC standard 22-A114E | 2 | - | kV |
| | | Charged Device Model (CDM); according to JEDEC standard 22-C101B | 1.5 | - | kV |

[1] V_{CTRL} must not exceed V_{CC} ; I_{CTRL} must be limited to 5 mA (maximum).

[2] T_{sp} is the temperature at the solder point of the ground lead.

Remark: V_{CTRL} must not exceed V_{CC} ; I_{CTRL} must be limited to a maximum of 5 mA.

6 Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit |
|----------------|--|------------|---------|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [1] 130 | K/W |

[1] Determined by final element method simulation with device mounted on application board and in still air.

7 Characteristics

Table 7. Characteristics
 $T_{amb} = 25\text{ }^{\circ}\text{C}$; typical values at $V_{CC} = 3.3\text{ V}$; $Z_S = Z_L = 75\text{ }\Omega$; $R_{bias} = 18\text{ }\Omega$; $40\text{ MHz} \leq f_1 \leq 1000\text{ MHz}$.

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|------------------|---------------------------------------|---|--------|-----|-----|-----|------|
| V_{CC} | supply voltage | RF input AC coupled | | 3.1 | 3.3 | 3.5 | V |
| $I_{CC(tot)}$ | total supply current | $G_p = 14\text{ dB mode}$ | [1] | 30 | 34 | 38 | mA |
| | | bypass mode | [1] | - | 3 | - | mA |
| $ S_{21} ^2$ | insertion power gain | $G_p = 14\text{ dB mode}$ | [1] | - | 14 | - | dB |
| | | bypass mode | [1] | - | -2 | - | dB |
| SL_{sl} | slope straight line | $G_p = 14\text{ dB mode}$ | | - | -1 | - | dB |
| FL | flatness of frequency response | $G_p = 14\text{ dB mode}$ | | - | 0.2 | - | dB |
| NF | noise figure | $G_p = 14\text{ dB mode}$ | [1] | - | 2.8 | - | dB |
| | | bypass mode | [1] | - | 2.5 | - | dB |
| RL_{in} | input return loss | $G_p = 14\text{ dB mode}$ | [1] | - | 20 | - | dB |
| | | bypass mode | [1] | - | 9 | - | dB |
| RL_{out} | output return loss | $G_p = 14\text{ dB mode}$ | [1] | - | 12 | - | dB |
| | | bypass mode | [1] | - | 10 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $G_p = 14\text{ dB mode}; 1\text{ GHz}$ | [1] | - | 13 | - | dBm |
| IP3 _O | output third-order intercept point | $G_p = 14\text{ dB mode}$ | [1][2] | - | 29 | - | dBm |
| | | bypass mode | [1][2] | - | 27 | - | dBm |

[1] Mode depends on setting of V_{CTRL} ; see [Table 8](#).

[2] The fundamental frequency (f_1) is 1000 MHz. The intermodulation product (IM3) is $2 \times f_2 - f_1$, where $f_2 = f_1 \pm 1\text{ MHz}$. Input power $P_1 = -10\text{ dBm}$.

Table 8. Gain selection (pin CTRL)
 $-10\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$; recommended power-up condition: $V_{CTRL} = \text{logic 0 or } < 0.7\text{ V}$.

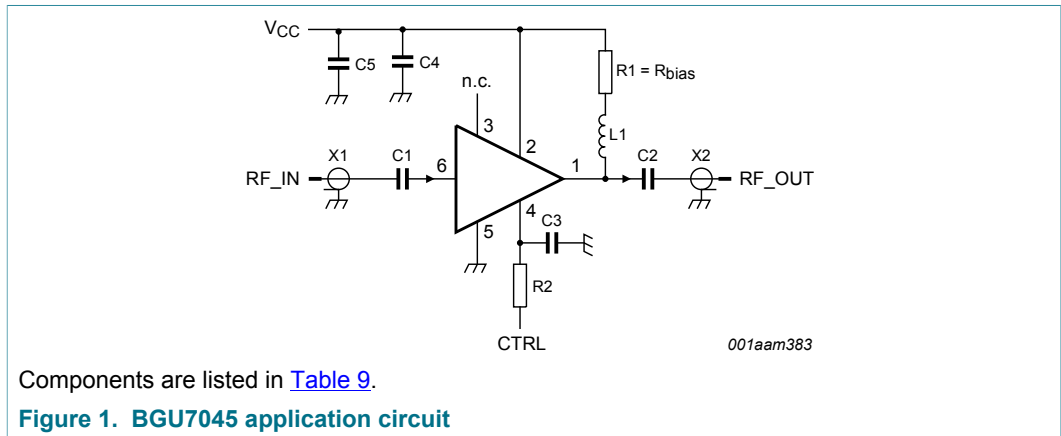
| V_{CTRL} (V) | Mode |
|----------------|----------------------|
| ≤ 0.7 | bypass |
| ≥ 1.5 | $G_p = 14\text{ dB}$ |

Remark: V_{CTRL} must not exceed V_{CC} ; I_{CTRL} must be limited to a maximum of 5 mA.

8 Application information

- Application notes are available on the NXP website.
- Section 8.1 describes the application circuit used for characterisation and datasheet.
- Section 8.2 describes the recommended application circuit.

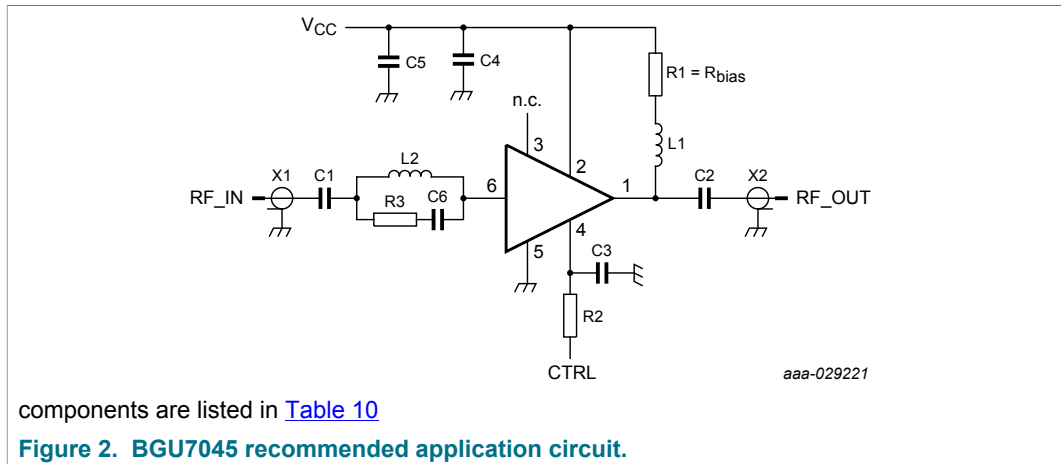
8.1 Application circuit



All control and supply lines must be decoupled properly. The decoupling capacitors must be placed as close to the device as possible.

8.2 Recommended application circuit

Recommended application circuit to compensate capacitive load influence at RF input.



(Values can be changed depending on the PCB routing) Keep the components (L2, R3, C6) next to the BGU7045 RF input pin.

8.3 Application circuit board layout

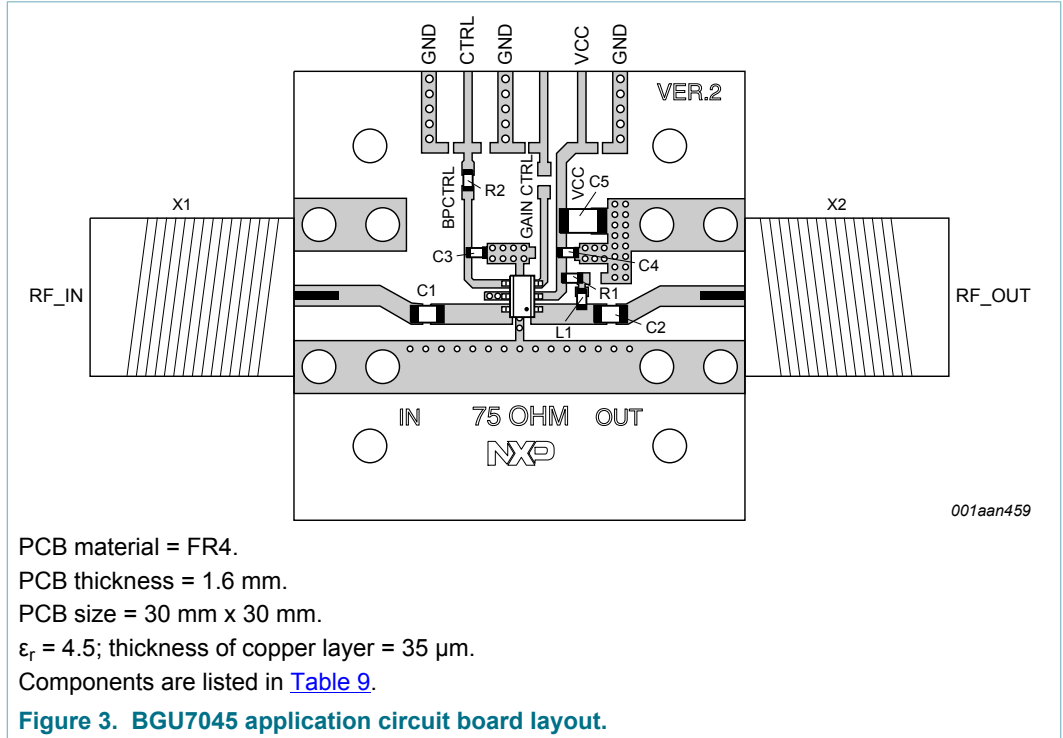


Table 9. List of components

See [Figure 1](#) and [Figure 3](#).

| Component | Description | Value | Remarks | Function |
|-----------|-------------------|------------------|---|------------------|
| C1, C2 | capacitor | 10 nF | | DC blocking |
| C3, C4 | capacitor | 10 nF | | decoupling |
| C5 | capacitor | 10 μF | | decoupling |
| L1 | chip ferrite bead | 1.5 k Ω | ^[1] Murata BLM18HE152SN1DF | RF choke |
| R1 | resistor | 18 Ω | ^[1] R_{bias} | bias setting |
| R2 | resistor | 1.8 k Ω | | current limiting |
| X1, X2 | connector | 75 Ω | F-connector, edge mount PCB reflow type, Bomar 861V509ER6 | input/output |

[1] L1 and R1 must have a power rating of 0.1 W or higher.

Table 10. List of components for recommended application circuitSee [Figure 2](#).

| Component | Description | Value | Remarks | Function |
|-----------|-------------------|----------------|---|-------------------------|
| C1, C2 | capacitor | 10 nF | | DC blocking |
| C3, C4 | capacitor | 10 nF | | decoupling |
| C5 | capacitor | 10 μ F | | decoupling |
| C6 | capacitor | 0.5 pF | Murata GRM1555C1HR50BA01 | value depends on layout |
| L1 | chip ferrite bead | 1.5 k Ω | ^[1] Murata BLM18HE152SN1DF | RF choke |
| L2 | inductor | 2.7 nH | Murata LQG11A2N7 | value depends on layout |
| R1 | resistor | 18 Ω | ^[1] R _{bias} | bias setting |
| R2 | resistor | 1.8 k Ω | | current limiting |
| R3 | resistor | 47 Ω | | |
| X1, X2 | connector | 75 Ω | F-connector, edge mount PCB reflow type, Bomar 861V509ER6 | input/output |

[1] L1 and R1 must have a power rating of 0.1 W or higher.

9 Package outline

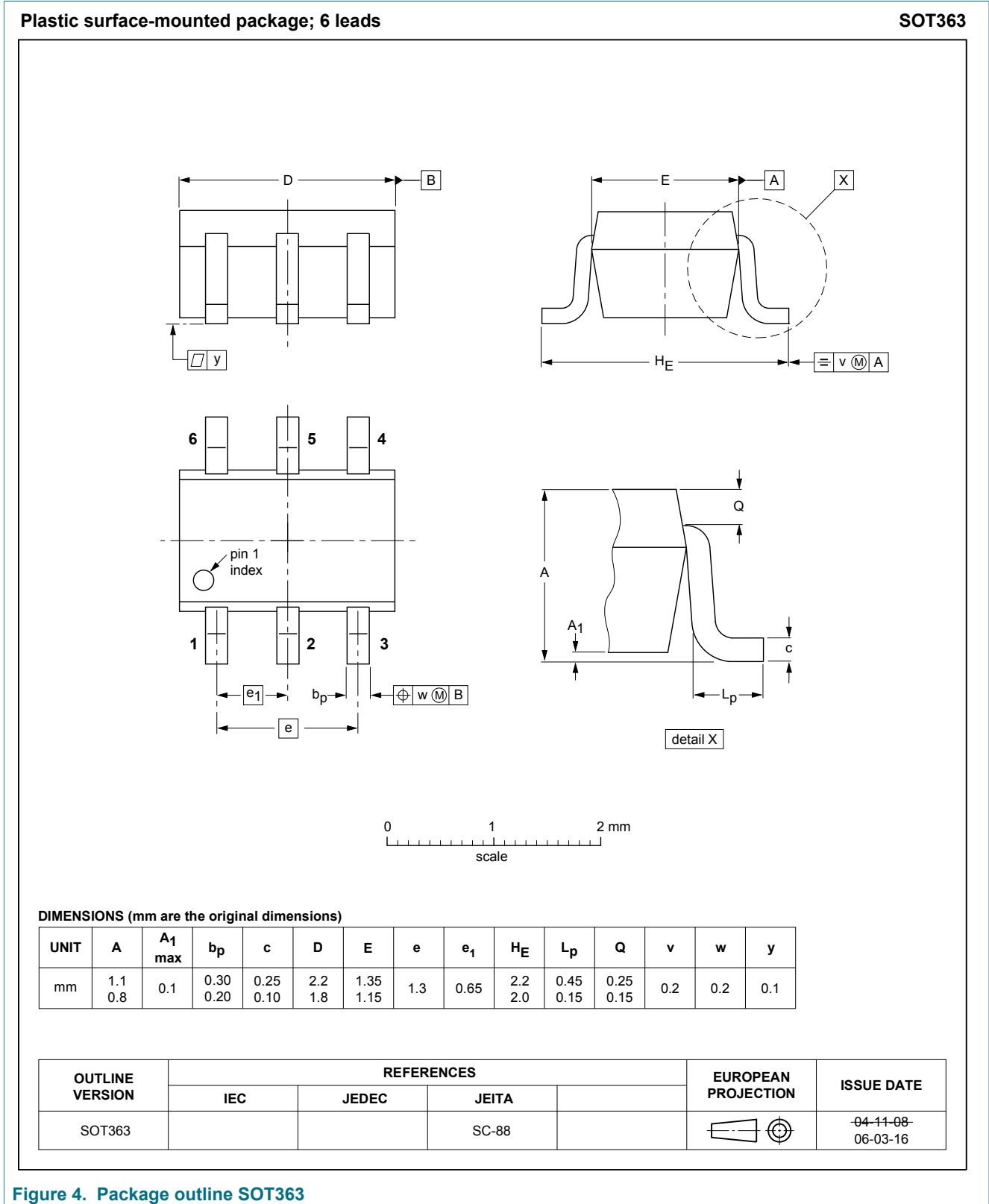


Figure 4. Package outline SOT363

10 Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| AC | Alternating Current |
| DC | Direct Current |
| ESD | ElectroStatic Discharge |
| LNA | Low-Noise Amplifier |
| MMIC | Monolithic Microwave Integrated Circuit |
| PCB | Printed-Circuit Board |
| RF | Radio Frequency |
| SMD | Surface-Mounted Device |

11 Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|-------------|
| BGU7045 v.3 | 20180411 | product data sheet | - | BGU7045 v.2 |
| Modification | added recommended application circuit with components table | | | |
| BGU7045 v.2 | 20140526 | product data sheet | - | BGU7045 v.1 |
| Modifications: | <ul style="list-style-type: none"> Table 6 on page 3: The information in this table has been updated. | | | |
| BGU7045 v.1 | 20120203 | product data sheet | - | - |

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. |
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