



BGA2716

MMIC wideband amplifier

Rev. 3 — 8 September 2011

Product data sheet

1. Product profile

1.1 General description

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband amplifier with internal matching circuit in a 6-pin SOT363 SMD plastic package.

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

1.2 Features and benefits

- Internally matched to 50 Ω
- Wide frequency range (3.2 GHz at 3 dB bandwidth)
- Flat 23 dB gain (± 1 dB up to 2.7 GHz)
- 9 dBm output power at 1 dB compression point
- Good linearity for low current ($IP_{3\text{out}} = 22$ dBm)
- Low second harmonic; -38 dBc at $P_L = -5$ dBm
- Unconditionally stable ($K \geq 1.2$).

1.3 Applications

- LNB IF amplifiers
- Cable systems
- ISM
- General purpose.

1.4 Quick reference data

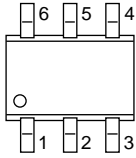
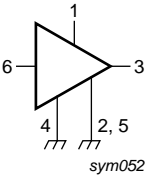
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|----------------------|-------------|-----|------|-----|------|
| V_S | DC supply voltage | | - | 5 | 6 | V |
| I_S | supply current | | - | 15.9 | - | mA |
| $ s_{21} ^2$ | insertion power gain | $f = 1$ GHz | - | 22.9 | - | dB |
| NF | noise figure | $f = 1$ GHz | - | 5.3 | - | dB |
| $P_{L(\text{sat})}$ | saturated load power | $f = 1$ GHz | - | 11.6 | - | dBm |



2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Symbol |
|------|----------------|---|---|
| 1 | V _S |  |  |
| 2, 5 | GND2 | | |
| 3 | RF_OUT | | |
| 4 | GND1 | | |
| 6 | RF_IN | | |
| | | | |

3. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BGA2716 | - | plastic surface mounted package; 6 leads | SOT363 |

4. Marking

Table 4. Marking

| Type number | Marking code |
|-------------|--------------|
| BGA2716 | B7- |

5. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|-------------------------|-------------------------|-----|------|------|
| V _S | DC supply voltage | RF input AC coupled | - | 6 | V |
| I _S | supply current | | - | 30 | mA |
| P _{tot} | total power dissipation | T _{sp} ≤ 90 °C | - | 200 | mW |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| T _j | junction temperature | | - | 150 | °C |
| P _D | maximum drive power | | - | -10 | dBm |

6. Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit |
|----------------|--|--|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | $P_{tot} = 200 \text{ mW};$ $T_{sp} \leq 90 \text{ }^\circ\text{C}$ | 300 | K/W |

7. Characteristics

Table 7. Characteristics

$V_S = 5 \text{ V}; I_S = 15.9 \text{ mA}; T_j = 25 \text{ }^\circ\text{C};$ measured on demo board; unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------|--------------------------------------|---|-----|------|-----|------|
| I_S | supply current | | 13 | 15.9 | 21 | mA |
| $ s_{21} ^2$ | insertion power gain | f = 100 MHz | 21 | 22.1 | 23 | dB |
| | | f = 1 GHz | 22 | 22.9 | 24 | dB |
| | | f = 1.8 GHz | 22 | 23.1 | 25 | dB |
| | | f = 2.2 GHz | 21 | 22.8 | 24 | dB |
| | | f = 2.6 GHz | 20 | 22.1 | 24 | dB |
| | | f = 3 GHz | 19 | 20.8 | 22 | dB |
| $ s_{11} ^2$ | input return losses | f = 1 GHz | 15 | 17 | - | dB |
| | | f = 2.2 GHz | 10 | 12 | - | dB |
| $ s_{22} ^2$ | output return losses | f = 1 GHz | 10 | 12 | - | dB |
| | | f = 2.2 GHz | 9 | 11 | - | dB |
| $ s_{12} ^2$ | isolation | f = 1.6 GHz | 30 | 31 | - | dB |
| | | f = 2.2 GHz | 33 | 35 | - | dB |
| NF | noise figure | f = 1 GHz | - | 5.3 | 5.4 | dB |
| | | f = 2.2 GHz | - | 5.5 | 5.6 | dB |
| B | bandwidth | at $ s_{21} ^2$ -3 dB below flat gain at 1 GHz | 3 | 3.2 | - | GHz |
| K | stability factor | f = 1 GHz | - | 1.4 | - | |
| | | f = 2.2 GHz | - | 1.9 | - | |
| $P_{L(sat)}$ | saturated load power | f = 1 GHz | 10 | 11.6 | - | dBm |
| | | f = 2.2 GHz | 6 | 7.5 | - | dBm |
| $P_{L(1dB)}$ | load power | at 1 dB gain compression; f = 1 GHz | 8 | 8.9 | - | dBm |
| | | at 1 dB gain compression; f = 2.2 GHz | 5 | 6.1 | - | dBm |
| IM2 | second order intermodulation product | at $P_L = -5 \text{ dBm};$ $f_0 = 1 \text{ GHz}$ | 36 | 38 | - | dBc |
| IP3 _{in} | input, third order intercept point | f = 1 GHz | -2 | -0.7 | - | dBm |
| | | f = 2.2 GHz | -8 | -6.9 | - | dBm |
| IP3 _{out} | output, third order intercept point | f = 1 GHz | 21 | 22.2 | - | dBm |
| | | f = 2.2 GHz | 15 | 15.9 | - | dBm |

8. Application information

[Figure 1](#) shows a typical application circuit for the BGA2716 MMIC. The device is internally matched to $50\ \Omega$, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2 and C3 should not be more than 100 pF for applications above 100 MHz. However, when the device is operated below 100 MHz, the capacitor value should be increased.

The nominal value of the RF choke L1 is 100 nH. At the frequencies below 100 MHz this value should be increased. At frequencies above 1 GHz, a lower value can be used to tune the output return loss. For optimal results, a good quality chip inductor or a wire-wound SMD type should be chosen.

Both the RF choke and the 22 nF supply decoupling capacitor C1 should be located as close as possible to the MMIC.

The printed-circuit board (PCB) top ground plane, connected to pins 2, 4 and 5 must be as close as possible to the MMIC, and ideally directly beneath it. When using via holes, use multiple via holes, located as close as possible to the MMIC.

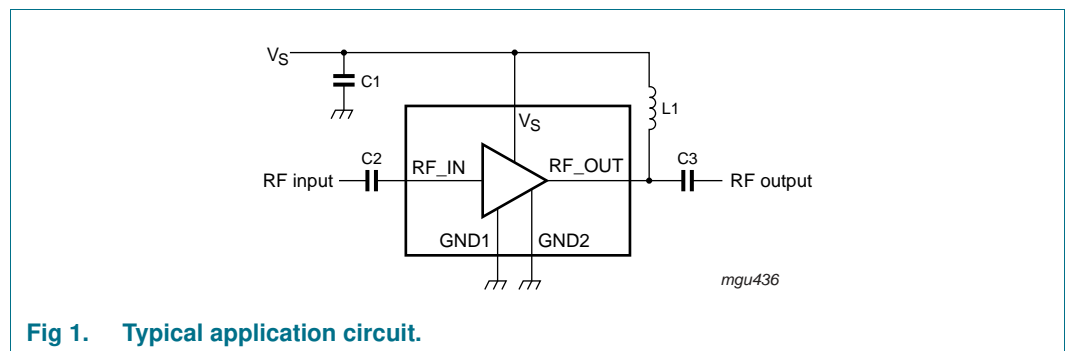
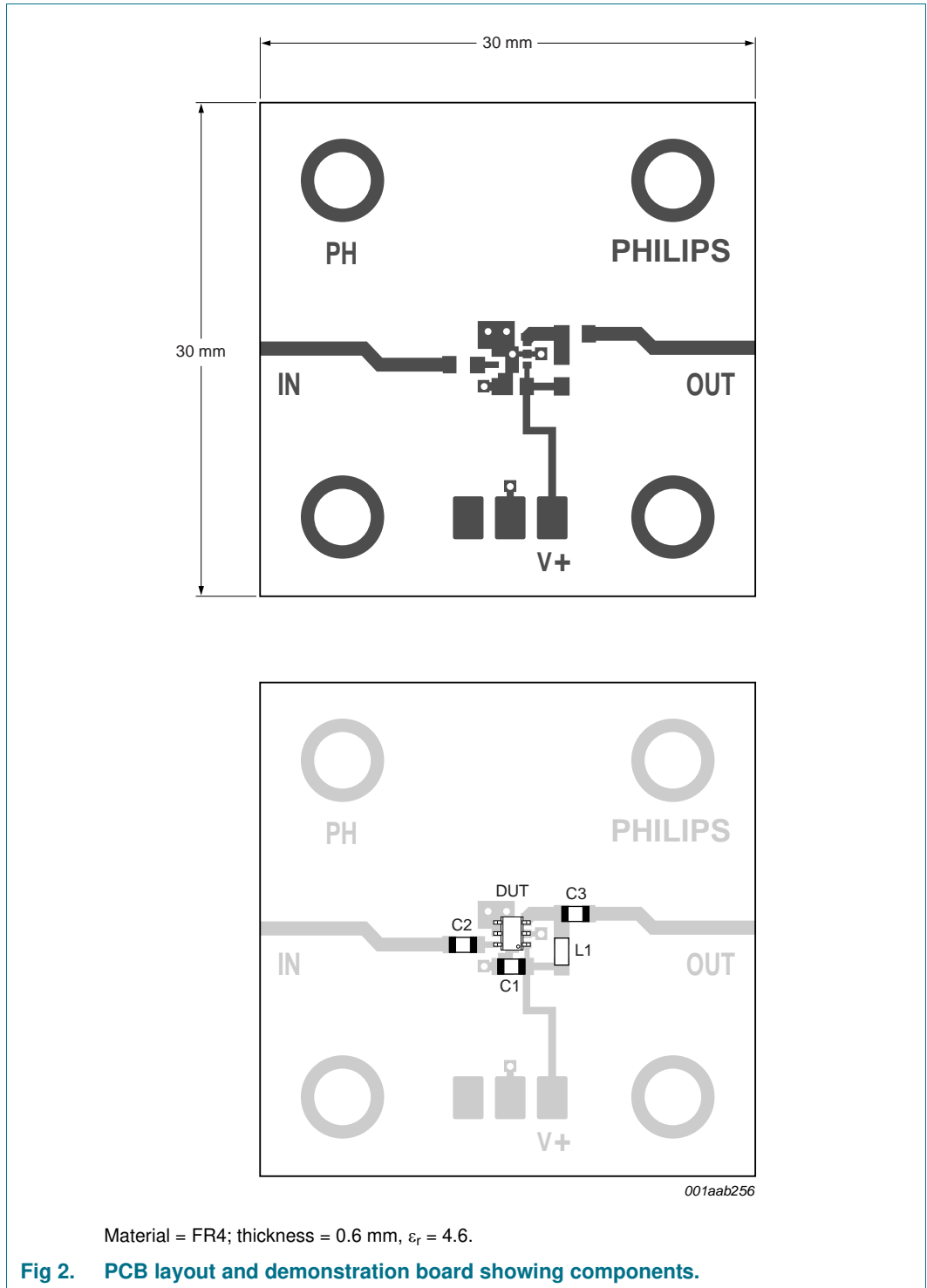


Fig 1. Typical application circuit.

[Figure 2](#) shows the PCB layout, used for the standard demonstration board.

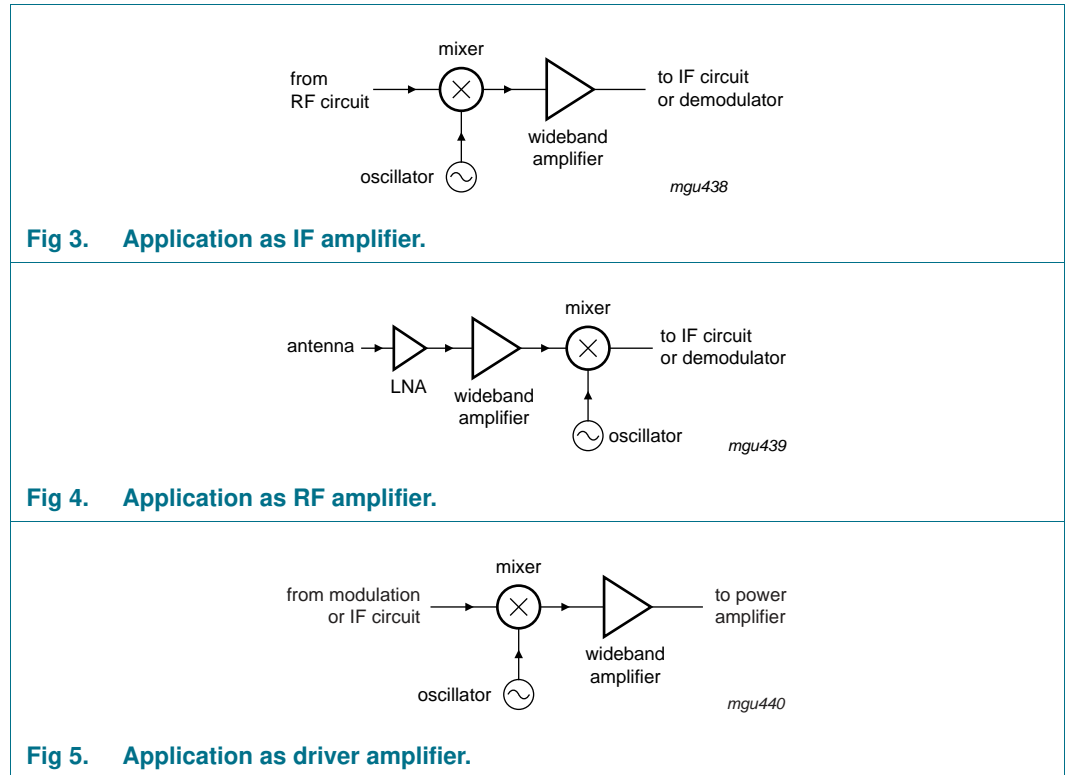


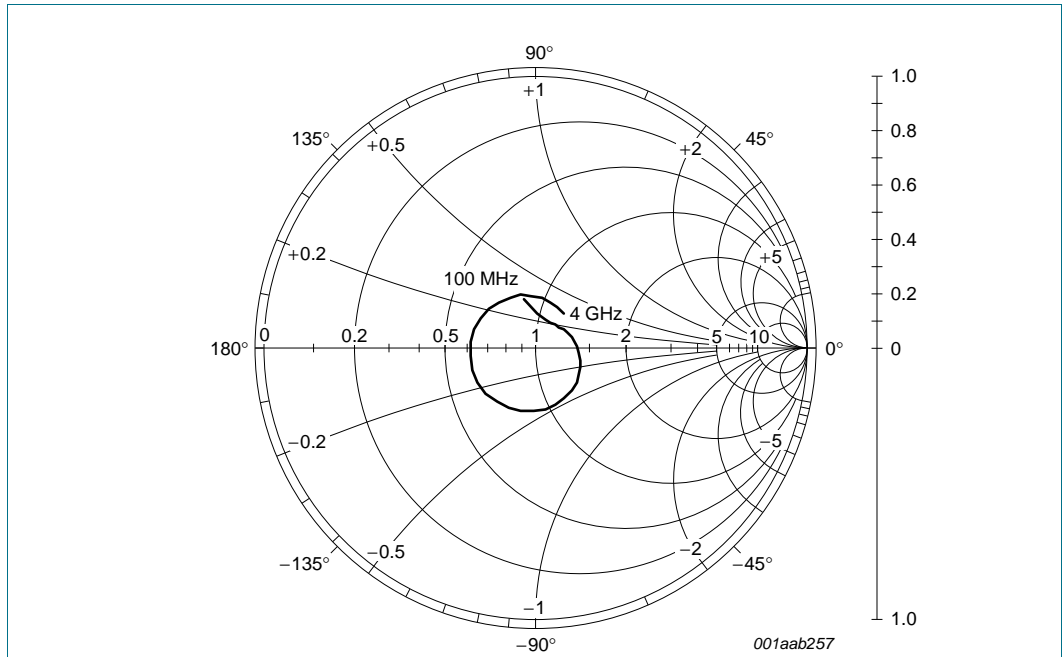
8.1 Application examples

The excellent wideband characteristics of the MMIC make it an ideal building block in IF amplifier such as LNBS (see [Figure 3](#)).

As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution (see [Figure 4](#)).

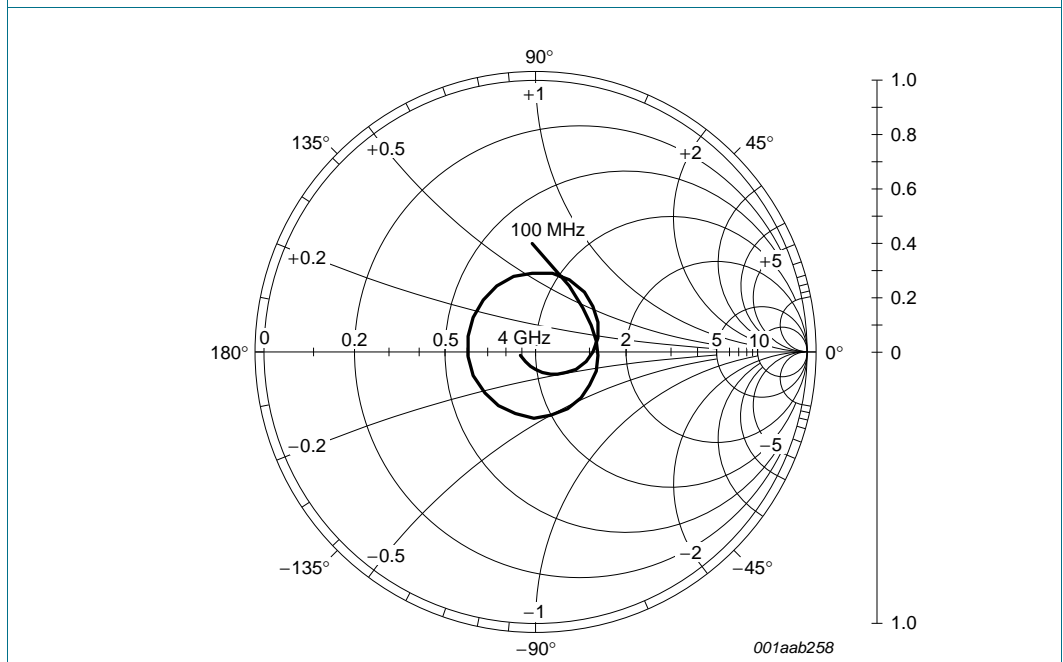
As driver amplifier in the TX path, the good linear performance and matched input/output offer quick design solutions (see [Figure 5](#)).





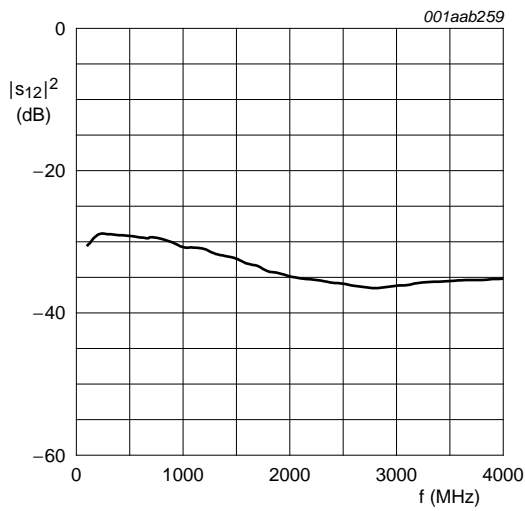
$I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$; $P_D = -35 \text{ dBm}$; $Z_o = 50 \Omega$.

Fig 6. Input reflection coefficient (s_{11}); typical values.



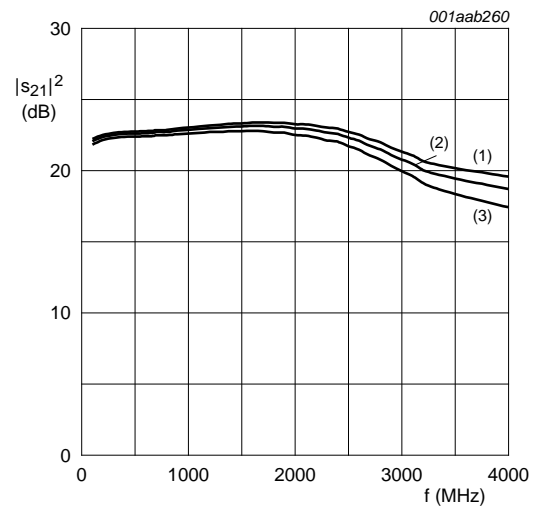
$I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$; $P_D = -35 \text{ dBm}$; $Z_o = 50 \Omega$.

Fig 7. Output reflection coefficient (s_{22}); typical values.



$I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$; $P_D = -35 \text{ dBm}$; $Z_0 = 50 \Omega$.

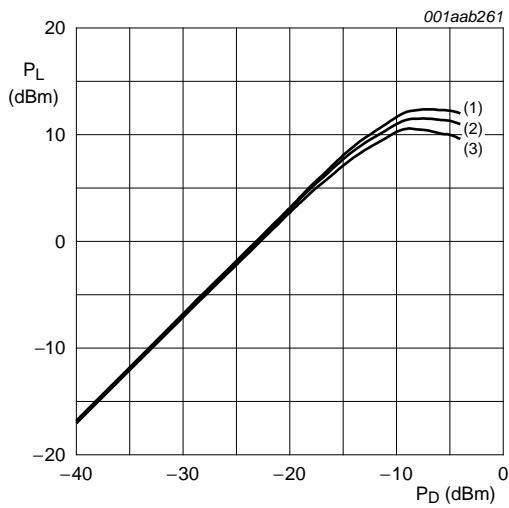
Fig 8. Isolation ($|s_{12}|^2$) as a function of frequency; typical values.



$P_D = -35 \text{ dBm}$; $Z_0 = 50 \Omega$.

- (1) $I_S = 19.5 \text{ mA}$; $V_S = 5.5 \text{ V}$.
- (2) $I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$.
- (3) $I_S = 12.4 \text{ mA}$; $V_S = 4.5 \text{ V}$.

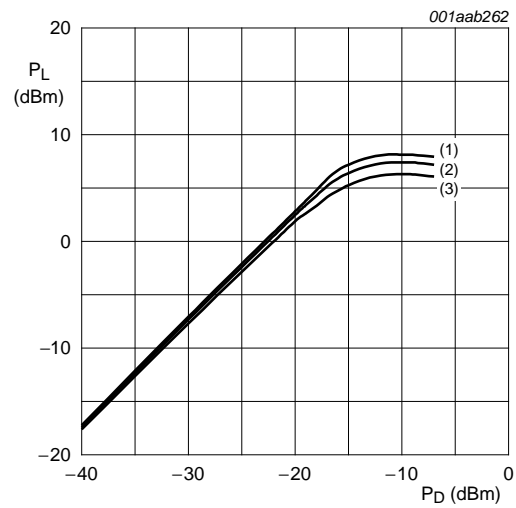
Fig 9. Insertion gain ($|s_{21}|^2$) as a function of frequency; typical values.



$f = 1 \text{ GHz}$; $Z_0 = 50 \Omega$.

- (1) $V_S = 5.5 \text{ V}$.
- (2) $V_S = 5 \text{ V}$.
- (3) $V_S = 4.5 \text{ V}$.

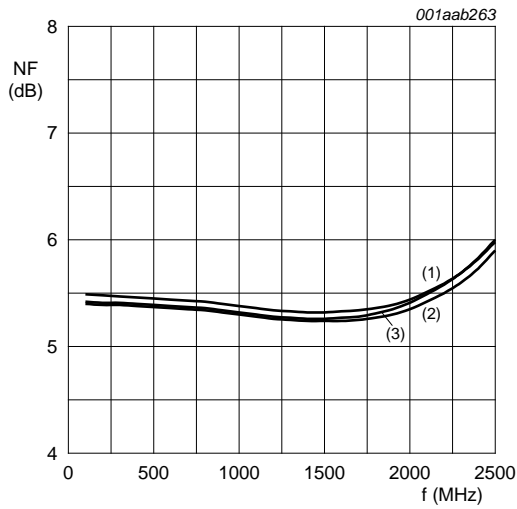
Fig 10. Load power as a function of drive power at 1 GHz; typical values.



$f = 2.2 \text{ GHz}$; $Z_0 = 50 \Omega$.

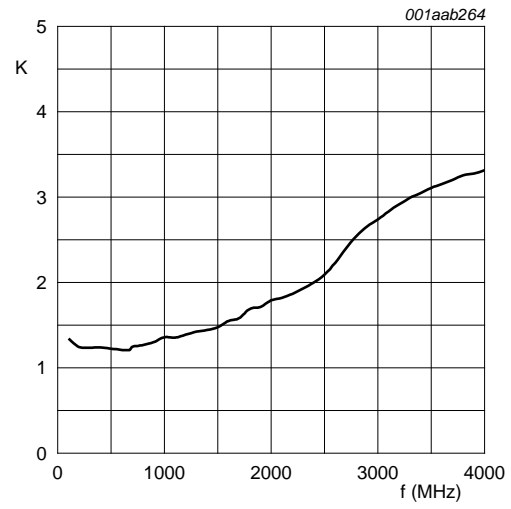
- (1) $V_S = 5.5 \text{ V}$.
- (2) $V_S = 5 \text{ V}$.
- (3) $V_S = 4.5 \text{ V}$.

Fig 11. Load power as a function of drive power at 2.2 GHz; typical values.



- $Z_o = 50 \Omega$.
- (1) $I_S = 19.5 \text{ mA}$; $V_S = 5.5 \text{ V}$.
 - (2) $I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$.
 - (3) $I_S = 12.4 \text{ mA}$; $V_S = 4.5 \text{ V}$.

Fig 12. Noise figure as a function of frequency; typical values.



$I_S = 15.9 \text{ mA}$; $V_S = 5 \text{ V}$; $Z_o = 50 \Omega$.

Fig 13. Stability factor as a function of frequency; typical values.

Table 8. Scattering parameters

$V_S = 5\text{ V}$; $I_S = 15.9\text{ mA}$; $P_D = -35\text{ dBm}$; $Z_o = 50\ \Omega$; $T_{amb} = 25\text{ }^\circ\text{C}$.

| f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K-factor |
|---------|-------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|----------|
| | Magnitude (ratio) | Angle (deg) | Magnitude (ratio) | Angle (deg) | Magnitude (ratio) | Angle (deg) | Magnitude (ratio) | Angle (deg) | |
| 100 | 0.182562 | 102.7794 | 12.69581 | 13.48682 | 0.029472 | 28.74955 | 0.39239 | 91.48628 | 1.3 |
| 200 | 0.123465 | 87.55274 | 13.13419 | -5.272917 | 0.035438 | -2.202361 | 0.267851 | 62.37296 | 1.2 |
| 400 | 0.107855 | 58.58513 | 13.47149 | -31.7377 | 0.035299 | -22.54301 | 0.227252 | 24.6455 | 1.2 |
| 600 | 0.114731 | 40.14071 | 13.57901 | -53.09631 | 0.033167 | -43.06353 | 0.227993 | -3.493572 | 1.3 |
| 800 | 0.130176 | 24.28555 | 13.67457 | -73.60665 | 0.033194 | -59.63503 | 0.234967 | -31.11084 | 1.3 |
| 1000 | 0.144984 | 9.657616 | 13.91705 | -94.01973 | 0.029047 | -76.09972 | 0.239818 | -60.54722 | 1.4 |
| 1200 | 0.160922 | -7.518892 | 14.10949 | -114.55 | 0.028188 | -88.34045 | 0.242141 | -91.56898 | 1.4 |
| 1400 | 0.179351 | -23.35989 | 14.2808 | -135.3117 | 0.025188 | -101.2729 | 0.243087 | -124.5484 | 1.4 |
| 1600 | 0.20199 | -41.01349 | 14.3825 | -156.7041 | 0.022257 | -110.3342 | 0.24499 | -158.6224 | 1.5 |
| 1800 | 0.218268 | -60.71294 | 14.26935 | -178.3843 | 0.019611 | -121.0192 | 0.255598 | 167.5983 | 1.7 |
| 2000 | 0.233965 | -81.48254 | 14.0667 | 160.1504 | 0.018087 | -127.6765 | 0.269829 | 136.117 | 1.8 |
| 2200 | 0.242904 | -103.1109 | 13.83968 | 138.2379 | 0.017203 | -137.8213 | 0.283613 | 106.0987 | 1.9 |
| 2400 | 0.246576 | -125.52 | 13.46447 | 115.7594 | 0.016318 | -138.8717 | 0.29058 | 77.95189 | 2.0 |
| 2600 | 0.249069 | -148.8707 | 12.74638 | 93.38644 | 0.015514 | -147.6622 | 0.281505 | 50.68612 | 2.2 |
| 2800 | 0.243665 | -172.646 | 11.87558 | 71.02792 | 0.014954 | -152.1988 | 0.25135 | 24.40624 | 2.5 |
| 3000 | 0.233266 | 163.9035 | 10.94049 | 50.42722 | 0.015522 | -163.8718 | 0.211425 | -0.674037 | 2.7 |
| 3200 | 0.222055 | 140.7754 | 10.05626 | 30.75908 | 0.016261 | -170.5637 | 0.165534 | -23.9944 | 2.9 |
| 3400 | 0.207486 | 117.0531 | 9.576357 | 11.98315 | 0.016664 | -176.5407 | 0.118726 | -46.28101 | 3.0 |
| 3600 | 0.191654 | 94.64431 | 9.199166 | -7.677643 | 0.016982 | 176.9385 | 0.083354 | -72.36691 | 3.2 |
| 3800 | 0.175783 | 71.9551 | 8.912598 | -27.73098 | 0.017094 | 165.8227 | 0.058549 | -109.9804 | 3.3 |
| 4000 | 0.163768 | 49.89436 | 8.618058 | -48.90874 | 0.017414 | 157.6095 | 0.055225 | -163.7132 | 3.3 |

9. Package outline

Plastic surface-mounted package; 6 leads

SOT363

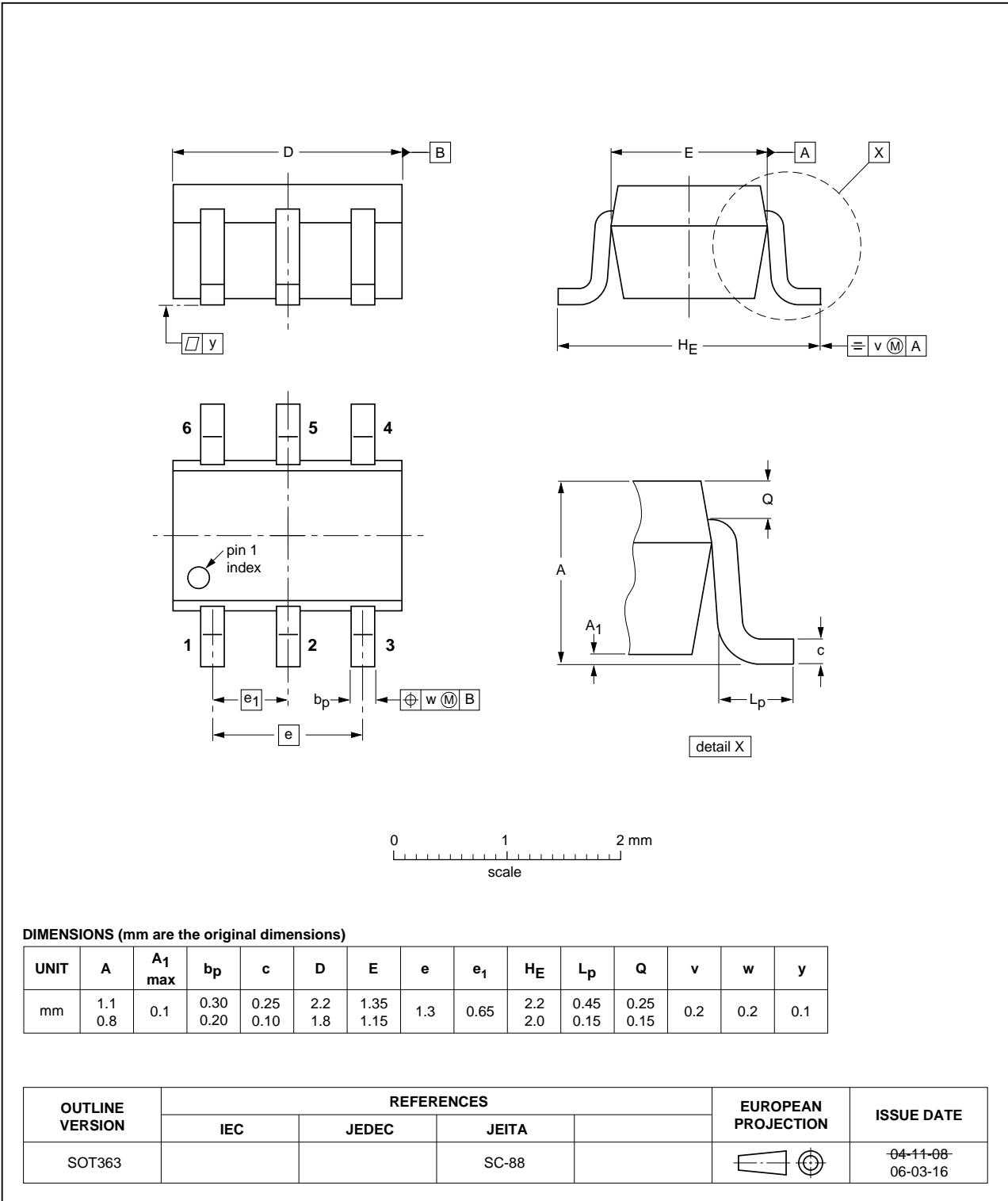


Fig 14. Package outline; SOT363 (SC-88).

10. Revision history

Table 9. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------------------------|--------------|--|---------------|---------------|
| BGA2716 v.3 | 20110908 | Product data sheet | - | BGA2716 v.2 |
| Modifications: | | <ul style="list-style-type: none">• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.• Legal texts have been adapted to the new company name where appropriate.• Package outline drawings have been updated to the latest version. | | |
| BGA2716 v.2 (9397 750 13292) | 20040924 | Product data sheet | - | BGA2716_N v.1 |
| BGA2716_N v.1 (9397 750 12827) | 20040202 | Preliminary data sheet | - | - |

11. Legal information

11.1 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. |
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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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