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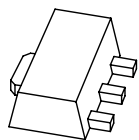
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BGA6489

MMIC wideband medium power amplifier

Rev. 02 — 15 June 2009

Product data sheet

1. Product profile

1.1 General description

The BGA6489 is a silicon Monolithic Microwave Integrated Circuit (MMIC) wideband medium power amplifier with internal matching circuit in a 3-pin SOT89 plastic, low thermal resistance, SMD package.

The BGA6x89 series of medium power gain blocks are resistive feedback Darlington configured amplifiers. Resistive feedback provides large bandwidth with high accuracy.

CAUTION



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

1.2 Features

- Broadband 50 Ω gain block
- 20 dBm output power
- SOT89 package
- Single supply voltage needed

1.3 Applications

- Broadband medium power gain blocks
- Small signal high linearity amplifiers
- Variable gain and high output power in combination with the BGA2031
- Cellular, PCS and CDPD
- IF/RF buffer amplifier
- Wireless data SONET
- Oscillator amplifier, final PA
- Drivers for CATV amplifier

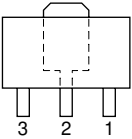
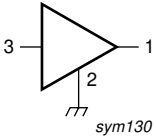
1.4 Quick reference data

Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|-------------------------------------|--|-----|-----|-----|------|
| V_D | DC device voltage | on pin 1; $I_S = 78 \text{ mA}$ | - | 5.1 | - | V |
| I_S | DC supply current | $V_S = 8 \text{ V}$; $R_1 = 39 \Omega$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 78 | - | mA |
| $ S_{21} ^2$ | insertion power gain | $f = 1950 \text{ MHz}$ | - | 16 | - | dB |
| NF | noise figure | $f = 1950 \text{ MHz}$ | - | 3.3 | - | dB |
| P_{L1dB} | load power at 1 dB gain compression | $f = 850 \text{ MHz}$ | - | 20 | - | dBm |
| | | $f = 1950 \text{ MHz}$ | - | 17 | - | dBm |

2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|-------------|--|--|
| 1 | RF_OUT/BIAS |  |  sym130 |
| 2 | GND | | |
| 3 | RF_IN | | |

3. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BGA6489 | SC-62 | plastic surface-mounted package; collector pad for good heat transfer; 3 leads | SOT89 |

4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BGA6489 | 4A |

5. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|-------------------------------|-----|------|------|
| V_D | DC device voltage | on pin 1; RF input AC coupled | - | 6 | V |
| I_S | DC supply current | | - | 150 | mA |
| P_{tot} | total power dissipation | $T_{sp} \leq 70\text{ °C}$ | [1] | 800 | mW |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_j | junction temperature | | - | 150 | °C |
| P_D | maximum drive power | | - | 15 | dBm |

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

6. Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit | |
|----------------|--|----------------------------|-----|------|-----|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | $T_{sp} \leq 70\text{ °C}$ | [1] | 100 | K/W |

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

7. Characteristics

Table 7. Static characteristics

$V_S = 8\text{ V}$; $T_j = 25\text{ °C}$; $R_{bias} = 39\text{ }\Omega$ [1]

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------|-------------------|--------------------------------|-----|-----|-----|------|
| V_D | DC device voltage | on pin 1; $I_S = 78\text{ mA}$ | - | 5.1 | - | V |
| I_S | supply current | | 70 | 78 | 86 | mA |

[1] V_S = DC operating supply voltage applied to R_{bias} ; see [Figure 10](#)

Table 8. Characteristics

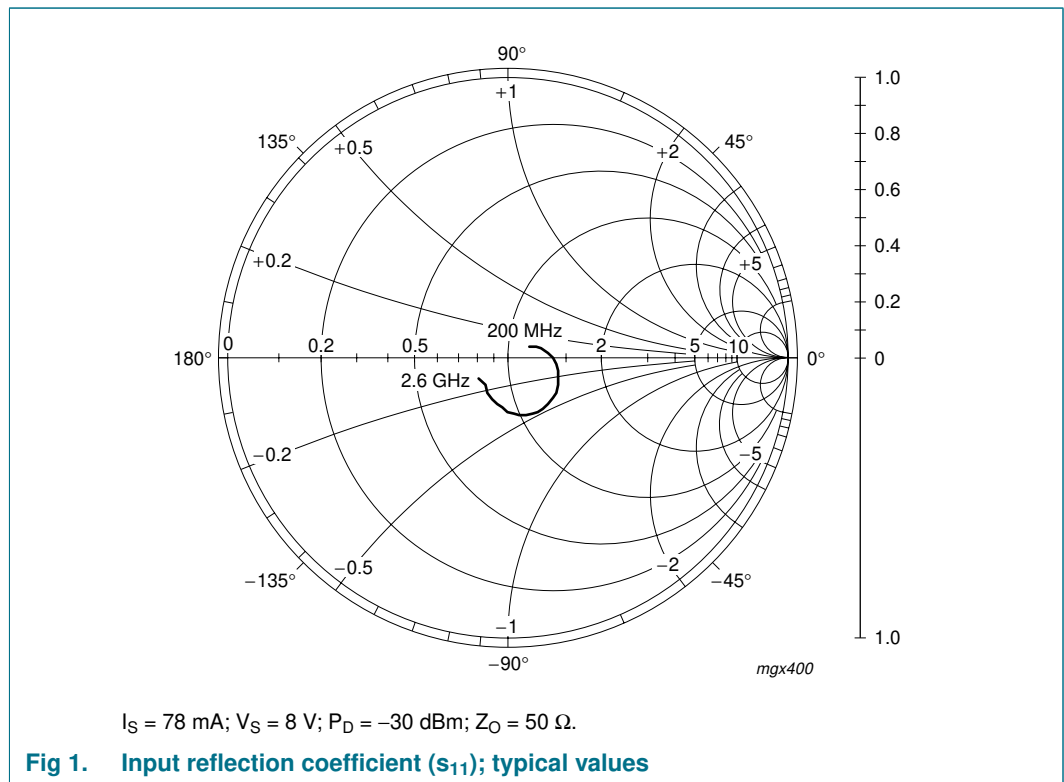
$V_S = 8\text{ V}$; $I_S = 78\text{ mA}$; $T_{amb} = 25\text{ °C}$; $IP3_{(out)}$ tone spacing = 1 MHz; $P_L = 0\text{ dB}$ per tone, $R_{bias} = 39\text{ }\Omega$; $Z_L = Z_S = 50\text{ }\Omega$; unless otherwise specified; see [Figure 10](#).

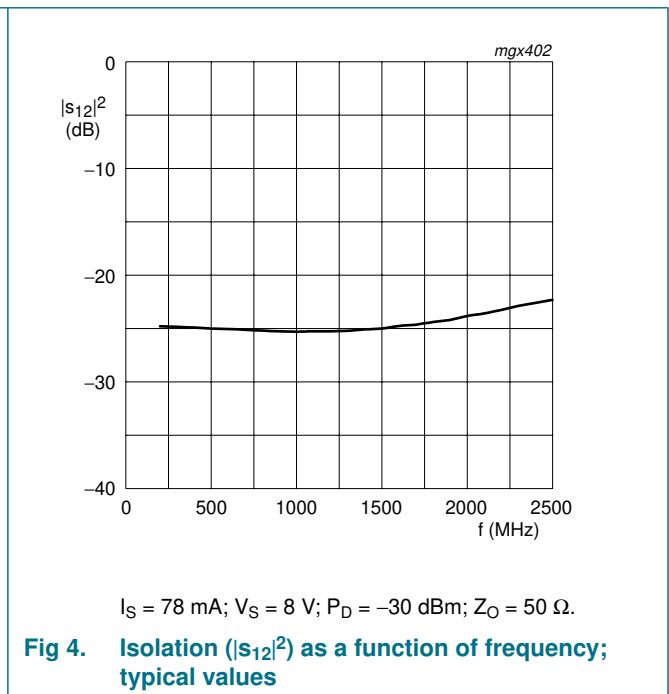
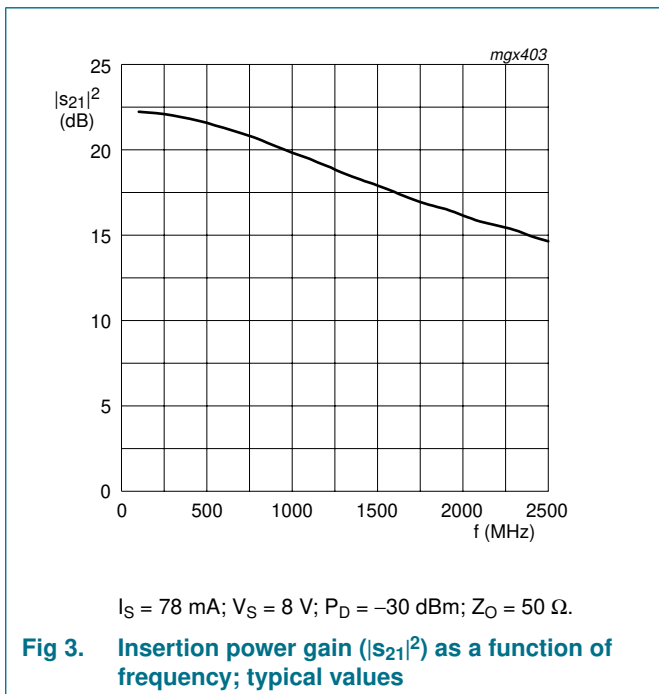
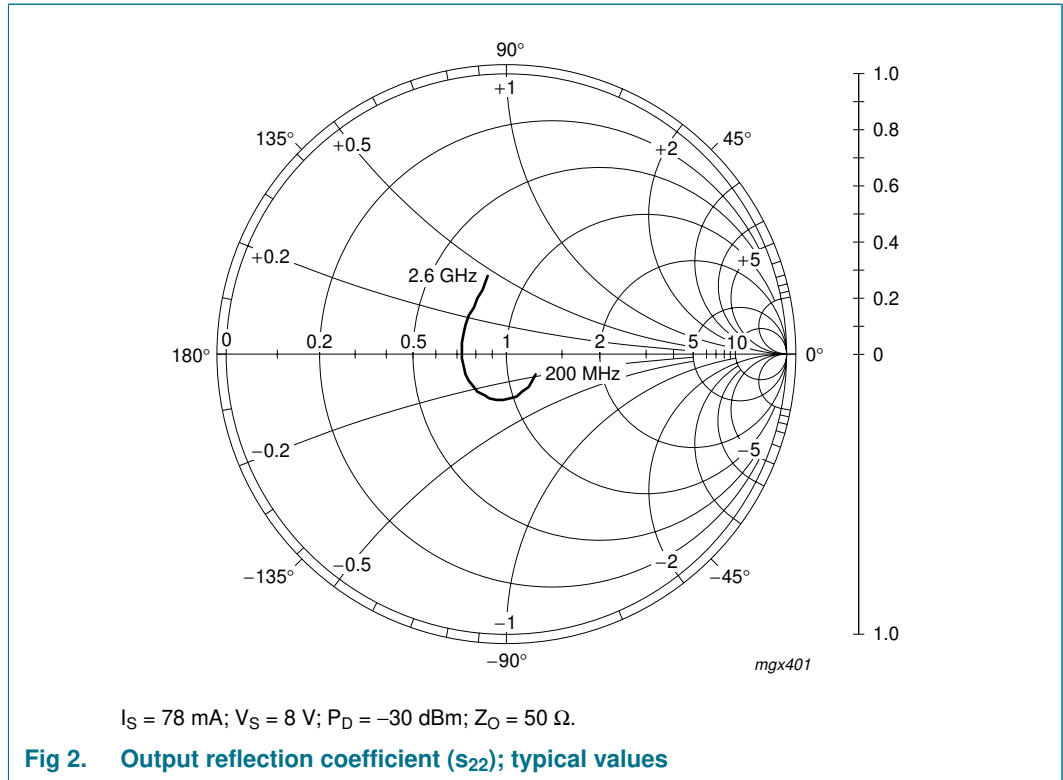
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|----------------------|--------------|-----|-----|-----|------|
| $ S_{21} ^2$ | Insertion power gain | f = 850 MHz | - | 20 | - | dB |
| | | f = 1950 MHz | - | 16 | - | dB |
| | | f = 2500 MHz | - | 15 | - | dB |
| R_{LIN} | return losses input | f = 850 MHz | - | 14 | - | dB |
| | | f = 1950 MHz | - | 16 | - | dB |
| | | f = 2500 MHz | - | 19 | - | dB |
| R_{LOUT} | return losses output | f = 850 MHz | - | 16 | - | dB |
| | | f = 1950 MHz | - | 12 | - | dB |
| | | f = 2500 MHz | - | 10 | - | dB |

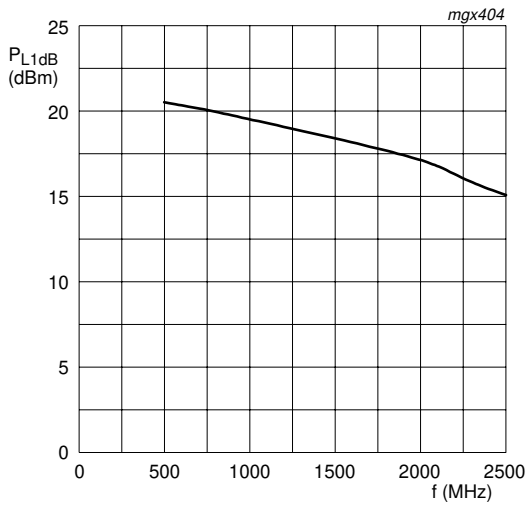
Table 8. Characteristics ...continued

$V_S = 8\text{ V}$; $I_S = 78\text{ mA}$; $T_{amb} = 25^\circ\text{C}$; $IP3_{(out)}$ tone spacing = 1 MHz; $P_L = 0\text{ dB per tone}$, $R_{bias} = 39\ \Omega$; $Z_L = Z_S = 50\ \Omega$; unless otherwise specified; see Figure 10.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------|-------------------------------------|--------------|-----|-----|-----|------|
| NF | noise figure | f = 850 MHz | - | 3.1 | - | dB |
| | | f = 1950 MHz | - | 3.3 | - | dB |
| | | f = 2500 MHz | - | 3.4 | - | dB |
| K | stability factor | f = 850 MHz | - | 1.2 | - | |
| | | f = 2500 MHz | - | 1.3 | - | |
| P_{L1dB} | load power at 1 dB gain compression | f = 850 MHz | - | 20 | - | dBm |
| | | f = 1950 MHz | - | 17 | - | dBm |
| $IP3_{(in)}$ | input intercept point | f = 850 MHz | - | 13 | - | dBm |
| | | f = 2500 MHz | - | 12 | - | dBm |
| $IP3_{(out)}$ | output intercept point | f = 850 MHz | - | 33 | - | dBm |
| | | f = 2500 MHz | - | 27 | - | dBm |

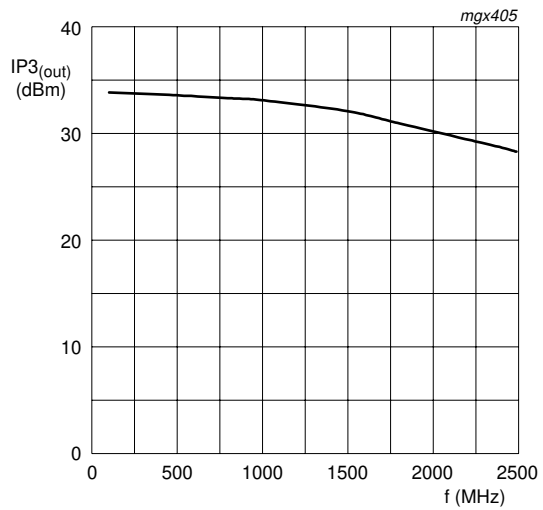






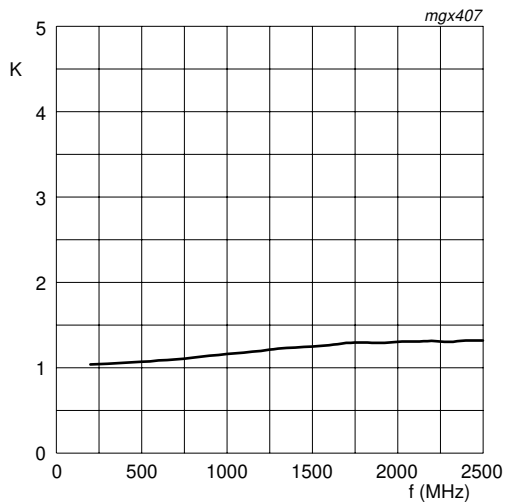
$I_S = 78 \text{ mA}; V_S = 8 \text{ V}; Z_O = 50 \Omega.$

Fig 5. Load power as a function of frequency; typical values



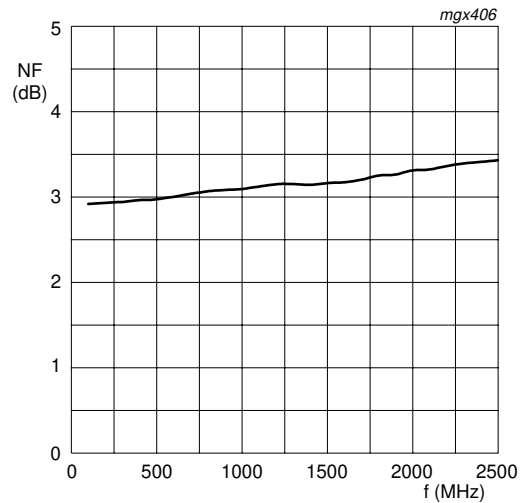
$I_S = 78 \text{ mA}; V_S = 8 \text{ V}; Z_O = 50 \Omega.$

Fig 6. Output intercept as a function of frequency; typical values



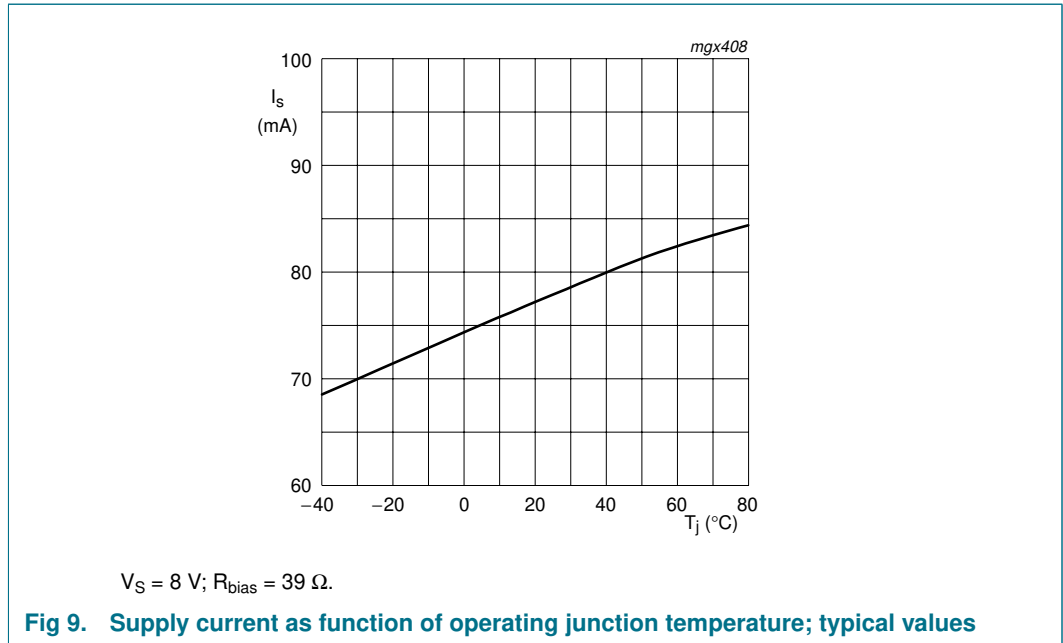
$I_S = 78 \text{ mA}; V_S = 8 \text{ V}; Z_O = 50 \Omega.$

Fig 7. Stability factor as a function of frequency; typical values



$I_S = 78 \text{ mA}; V_S = 8 \text{ V}; Z_O = 50 \Omega.$

Fig 8. Noise figure as a function of frequency; typical values



8. Application information

Figure 10 shows a typical application circuit for the BGA6489 MMIC. The device is internally matched to 50 Ω and therefore does not require any external matching. The value of the input and output DC blocking capacitors C1 and C2 depends on the operating frequency; see Table 9. Capacitors C1 and C2 are used in conjunction with L1 and C3 to fine tune the input and output impedance. Capacitor C4 is a supply decoupling capacitor. A 1 μF capacitor (C5) can be added for optimum supply decoupling. The external components should be placed as close as possible to the MMIC. When using via holes, use multiple via holes per pin in order to limit ground path induction. Resistor R1 is a bias resistor providing DC current stability with temperature.

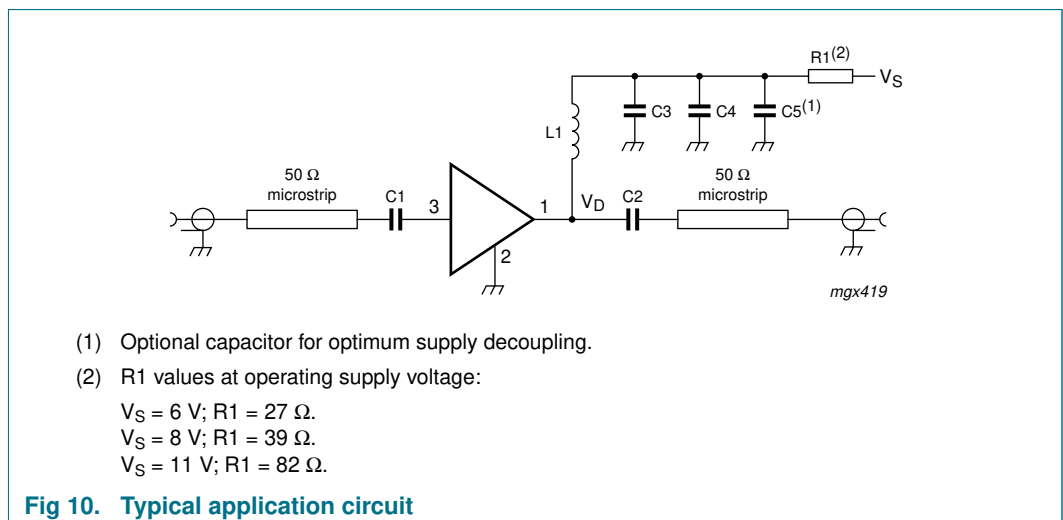


Table 9. List of components

See [Figure 10](#) for circuit.

| Component | Description | Package | Value at operating frequency | | | | |
|-------------------|--|---------|------------------------------|---------|----------|----------|----------|
| | | | 500 MHz | 800 MHz | 1950 MHz | 2400 MHz | 3500 MHz |
| C1, C2 | multilayer ceramic chip capacitor | 0603 | 220 pF | 100 pF | 68 pF | 56 pF | 39 pF |
| C3 | multilayer ceramic chip capacitor | 0603 | 100 pF | 68 pF | 22 pF | 22 pF | 15 pF |
| C4 | multilayer ceramic chip capacitor | 0603 | 1 nF | 1 nF | 1 nF | 1 nF | 1 nF |
| C5 ^[1] | electrolytic or tantalum capacitor | 0603 | 1 μF | 1 μF | 1 μF | 1 μF | 1 μF |
| L1 | SMD inductor | 0603 | 68 nH | 33 nH | 22 nH | 18 nH | 15 nH |
| R1 | SMD resistor 0.5 W; V _S = 8 V | - | 39 Ω | 39 Ω | 39 Ω | 39 Ω | 39 Ω |

[1] Optional.

8.1 Scattering parameters

Table 10. Scattering parameters

I_S = 78 mA; V_S = 8 V; P_D = -30 dBm; Z_O = 50 Ω; T_{amb} = 25 °C

| f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K |
|---------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-----|
| | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | |
| 200 | 0.06 | 28.11 | 12.79 | 164.42 | 0.06 | -0.30 | 0.12 | -22.91 | 1.1 |
| 300 | 0.09 | 27.41 | 12.59 | 156.85 | 0.06 | -0.39 | 0.13 | -35.38 | 1.1 |
| 400 | 0.11 | 21.64 | 12.31 | 149.28 | 0.06 | -0.35 | 0.14 | -46.54 | 1.1 |
| 500 | 0.12 | 15.28 | 11.97 | 141.88 | 0.06 | -0.32 | 0.14 | -57.20 | 1.1 |
| 600 | 0.14 | 8.01 | 11.57 | 134.79 | 0.06 | 0.04 | 0.15 | -61.41 | 1.1 |
| 700 | 0.16 | 0.34 | 11.18 | 127.97 | 0.06 | 0.63 | 0.16 | -76.76 | 1.1 |
| 800 | 0.17 | -7.27 | 10.75 | 121.56 | 0.05 | 1.57 | 0.16 | -85.75 | 1.2 |
| 900 | 0.18 | -14.78 | 10.24 | 115.06 | 0.05 | 1.85 | 0.17 | -94.28 | 1.2 |
| 1000 | 0.19 | -22.18 | 9.80 | 109.18 | 0.05 | 3.16 | 0.17 | -102.4 | 1.2 |
| 1100 | 0.20 | -29.33 | 9.40 | 103.40 | 0.05 | 4.29 | 0.17 | -110.3 | 1.2 |
| 1200 | 0.21 | -36.41 | 8.96 | 98.12 | 0.05 | 5.64 | 0.17 | -118.5 | 1.2 |
| 1300 | 0.21 | -42.47 | 8.53 | 92.76 | 0.05 | 7.03 | 0.17 | -126.7 | 1.2 |
| 1400 | 0.22 | -49.06 | 8.16 | 87.50 | 0.06 | 7.74 | 0.17 | -134.8 | 1.2 |
| 1500 | 0.22 | -55.46 | 7.85 | 82.76 | 0.06 | 9.08 | 0.17 | -143.5 | 1.3 |
| 1600 | 0.22 | -61.20 | 7.51 | 78.52 | 0.06 | 10.76 | 0.16 | -152.7 | 1.3 |
| 1700 | 0.22 | -67.02 | 7.16 | 74.16 | 0.06 | 11.89 | 0.16 | -161.8 | 1.3 |
| 1800 | 0.21 | -73.40 | 6.90 | 69.37 | 0.06 | 12.34 | 0.16 | -171.9 | 1.3 |
| 1900 | 0.21 | -78.99 | 6.69 | 65.14 | 0.06 | 13.16 | 0.16 | 177.4 | 1.3 |
| 2000 | 0.20 | -84.54 | 6.42 | 61.15 | 0.06 | 14.33 | 0.16 | 166.81 | 1.3 |
| 2100 | 0.19 | -91.32 | 6.16 | 56.80 | 0.07 | 14.84 | 0.17 | 156.07 | 1.3 |
| 2200 | 0.18 | -97.58 | 5.99 | 52.55 | 0.07 | 15.05 | 0.17 | 145.29 | 1.3 |
| 2300 | 0.17 | -103.60 | 5.83 | 49.08 | 0.07 | 15.72 | 0.19 | 135.65 | 1.3 |
| 2400 | 0.16 | -111.90 | 5.58 | 45.43 | 0.07 | 15.96 | 0.20 | 126.23 | 1.3 |
| 2500 | 0.14 | -120.80 | 5.39 | 40.67 | 0.08 | 15.27 | 0.22 | 117.16 | 1.3 |
| 2600 | 0.13 | -129.80 | 5.30 | 36.66 | 0.08 | 14.68 | 0.24 | 110.35 | 1.3 |

Table 10. Scattering parameters $I_S = 78 \text{ mA}$; $V_S = 8 \text{ V}$; $P_D = -30 \text{ dBm}$; $Z_O = 50 \Omega$; $T_{amb} = 25^\circ \text{C}$

| f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K |
|---------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-----|
| | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | Magnitude (ratio) | Angle (degree) | |
| 2700 | 0.13 | -143.80 | 5.18 | 33.88 | 0.08 | 15.64 | 0.28 | 104.05 | 1.3 |
| 2800 | 0.12 | -154.47 | 5.08 | 30.28 | 0.08 | 15.56 | 0.31 | 97.10 | 1.3 |
| 2900 | 0.11 | -164.40 | 4.71 | 22.43 | 0.09 | 11.60 | 0.28 | 91.75 | 1.3 |
| 3000 | 0.11 | 178.65 | 4.66 | 18.90 | 0.09 | 11.05 | 0.31 | 84.80 | 1.3 |
| 3100 | 0.12 | 160.01 | 4.45 | 18.63 | 0.10 | 10.63 | 0.33 | 80.37 | 1.3 |

9. Package outline

Plastic surface-mounted package; collector pad for good heat transfer; 3 leads

SOT89

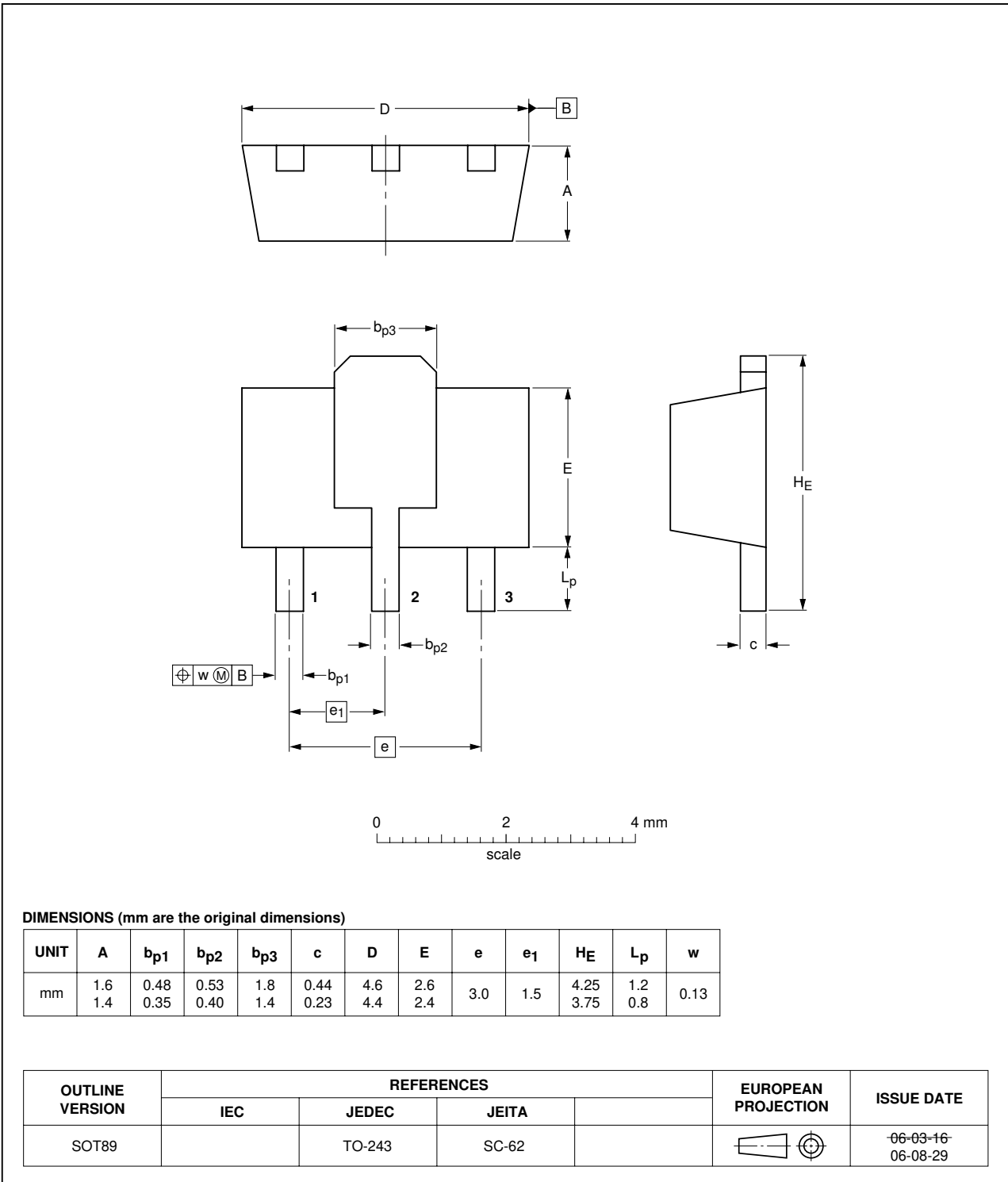


Fig 11. Package outline SOT89 (SC-62)

10. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|--------------------------------|
| CDPD | Cellular Digital Packet Data |
| IF | Intermediate Frequency |
| PCS | Personal Communication Service |
| SMD | Surface Mount Device |
| SONET | Synchronous Optical NETWORK |

11. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|--------------------|---------------|------------|
| BGA6489_2 | 20090615 | Product data sheet | - | BGA6489_1 |
| 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. • Changed I_S from 74 mA to 78 mA throughout. • Table 1: changed symbol V_S to V_D. • Table 5: changed symbol V_S to V_D and added “on pin 1;” to Conditions. • Table 7: added row for V_D DC device voltage. • Section 8: added sentence. • Table 9: added 39 Ω to all value columns for resistor R1. • Table 9: amended values of C3 and C4. | | | |
| BGA6489_1 | 20030918 | 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. |
| 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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14. Contents

1 Product profile 1

1.1 General description 1

1.2 Features 1

1.3 Applications 1

1.4 Quick reference data 2

2 Pinning information 2

3 Ordering information 2

4 Marking 2

5 Limiting values 3

6 Thermal characteristics 3

7 Characteristics 3

8 Application information 7

8.1 Scattering parameters 8

9 Package outline 10

10 Abbreviations 11

11 Revision history 11

12 Legal information 12

12.1 Data sheet status 12

12.2 Definitions 12

12.3 Disclaimers 12

12.4 Trademarks 12

13 Contact information 12

14 Contents 13

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