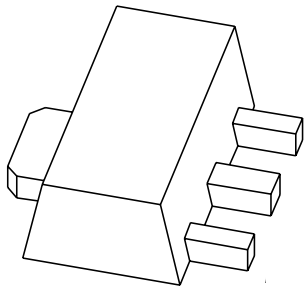


# DATA SHEET



## **BGA6489**

MMIC wideband medium power  
amplifier

Product specification

2003 Sep 18

# MMIC wideband medium power amplifier

# BGA6489

## FEATURES

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

## 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.

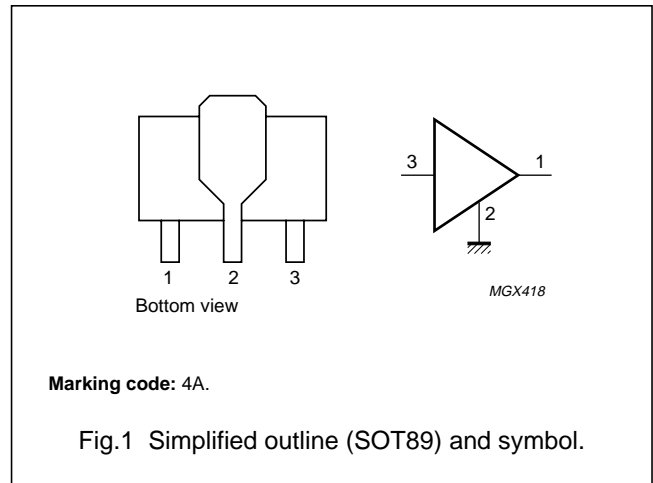
## DESCRIPTION

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband medium power amplifier with internal matching circuit in a 4-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.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | RF out/bias |
| 2   | GND         |
| 3   | RF in       |



## QUICK REFERENCE DATA

| SYMBOL               | PARAMETER                      | CONDITIONS  | TYP. | UNIT |
|----------------------|--------------------------------|---|------|------|
| $V_S$                | DC supply voltage              | $I_S = 74 \text{ mA}$   | 5.1  | V    |
| $I_S$                | DC supply current              | $V_S = 8 \text{ V}; R_1 = 39 \text{ } \Omega; T_j = 25 \text{ } ^\circ\text{C}$ | 78   | mA   |
| $ s_{21} ^2$         | insertion power gain           | $f = 1.95 \text{ GHz}$  | 16   | dB   |
| NF                   | noise figure                   | $f = 1.95 \text{ GHz}$  | 3.3  | dB   |
| $P_{L \text{ 1 dB}}$ | load power at 1 dB compression | $f = 850 \text{ MHz}$   | 20   | dBm  |
|                      |                                | $f = 1.95 \text{ GHz}$  | 17   | dBm  |

## CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

## MMIC wideband medium power amplifier

BGA6489

**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    |
| $I_S$     | DC supply current              |                                  | –    | 150  | mA   |
| $P_{tot}$ | total power dissipation        | $T_s \leq 70\text{ °C}$ ; note 1 | –    | 800  | mW   |
| $T_{stg}$ | storage temperature            |                                  | –65  | +150 | °C   |
| $T_j$     | operating junction temperature |                                  | –    | 150  | °C   |
| $P_D$     | maximum drive power            |                                  | –    | 15   | dBm  |

**Note**

- $T_s$  is the temperature at the soldering point of pin 2.

**THERMAL CHARACTERISTICS**

| SYMBOL        | PARAMETER  | CONDITIONS                       | VALUE | UNIT |
|---------------|--|----------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to solder point | $T_s \leq 70\text{ °C}$ ; note 1 | 100   | K/W  |

**Note**

- $T_s$  is the temperature at the soldering point of pin 2.

**STATIC CHARACTERISTICS** $T_j = 25\text{ °C}$ ;  $V_S = 8\text{ V}$ ;  $R_1 = 39\ \Omega$ ; unless otherwise specified.

| SYMBOL | PARAMETER      | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------|----------------|------------|------|------|------|------|
| $I_S$  | supply current |            | 70   | 78   | 86   | mA   |

## MMIC wideband medium power amplifier

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**CHARACTERISTICS**

$V_S = 8\text{ V}$ ;  $I_S = 74\text{ mA}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ;  $IP3_{(\text{out})}$  tone spacing = 1 MHz;  $P_L = 0\text{ dBm}$  per tone (see Fig.2);  $R_1 = 39\ \Omega$ ;  $Z_L = Z_S = 50\ \Omega$ ; unless otherwise specified.

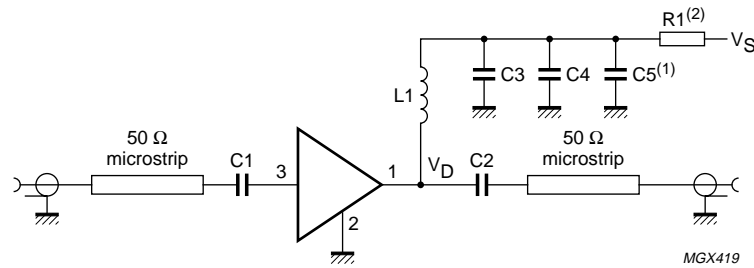
| SYMBOL               | PARAMETER              | CONDITIONS                             | TYP. | UNIT |
|----------------------|------------------------|--|------|------|
| $ s_{21} ^2$         | insertion power gain   | f = 850 MHz                            | 20   | dB   |
|                      |                        | f = 1.95 GHz                           | 16   | dB   |
|                      |                        | f = 2.5 GHz                            | 15   | dB   |
| $R_{L\text{ IN}}$    | return losses input    | f = 850 MHz                            | 14   | dB   |
|                      |                        | f = 1.95 GHz                           | 16   | dB   |
|                      |                        | f = 2.5 GHz                            | 19   | dB   |
| $R_{L\text{ OUT}}$   | return losses output   | f = 850 MHz                            | 16   | dB   |
|                      |                        | f = 1.95 GHz                           | 12   | dB   |
|                      |                        | f = 2.5 GHz                            | 10   | dB   |
| NF                   | noise figure           | f = 850 MHz                            | 3.1  | dB   |
|                      |                        | f = 1.95 GHz                           | 3.3  | dB   |
|                      |                        | f = 2.5 GHz                            | 3.4  | dB   |
| K                    | stability factor       | f = 850 MHz                            | 1.2  | –    |
|                      |                        | f = 2.5 GHz                            | 1.3  | –    |
| $P_{L\ 1\text{ dB}}$ | load power             | at 1 dB gain compression; f = 850 MHz  | 20   | dBm  |
|                      |                        | at 1 dB gain compression; f = 1.95 GHz | 17   | dBm  |
| $IP3_{(\text{in})}$  | input intercept point  | f = 850 MHz                            | 13   | dBm  |
|                      |                        | f = 2.5 GHz                            | 12   | dBm  |
| $IP3_{(\text{out})}$ | output intercept point | f = 850 MHz                            | 33   | dBm  |
|                      |                        | f = 2.5 GHz                            | 27   | dBm  |

MMIC wideband medium power amplifier

BGA6489

APPLICATION INFORMATION

Figure 2 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 the tables below. Capacitors C1 and C2 are used in conjunction with L1 and C3 to fine tune the input and output impedance. For optimum supply decoupling, a 1 μF capacitor (C5) can be added. 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.



- (1) Optional capacitor for optimum supply decoupling.
- (2) R1 values at operating supply voltage:  
 VS = 6 V; R1 = 15 Ω.  
 VS = 9 V; R1 = 51 Ω.  
 VS = 11.5 V; R1 = 82 Ω.

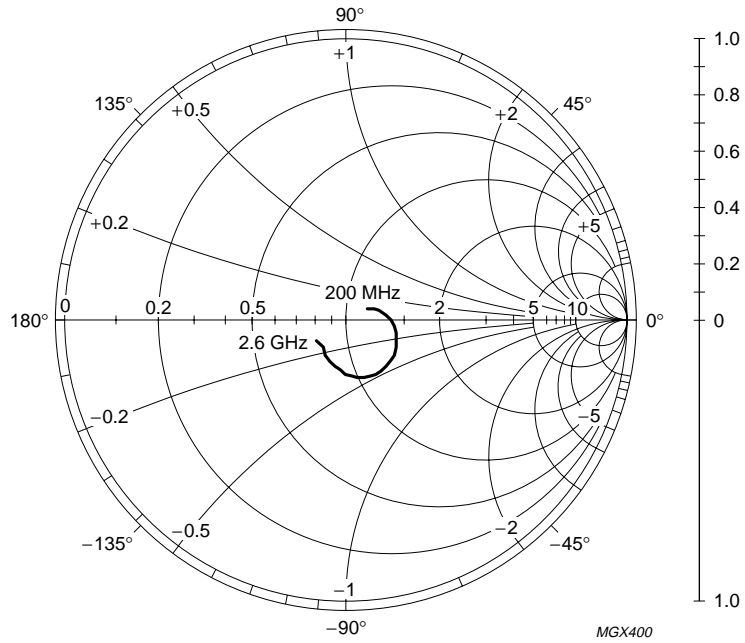
Fig.2 Typical application circuit.

Table 1 Component descriptions (see Fig.2)

| COMPONENT     | DESCRIPTION                        | DIMENSIONS | 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       | 1 nF                         | 1 nF    | 1 nF     | 1 nF     | 1 nF     |
| C4            | multilayer ceramic chip capacitor  | 0603       | 100 pF                       | 68 pF   | 22 pF    | 22 pF    | 15 pF    |
| C5 (optional) | 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; VS = 9 V       | —          | —                            | —       | —        | —        | —        |

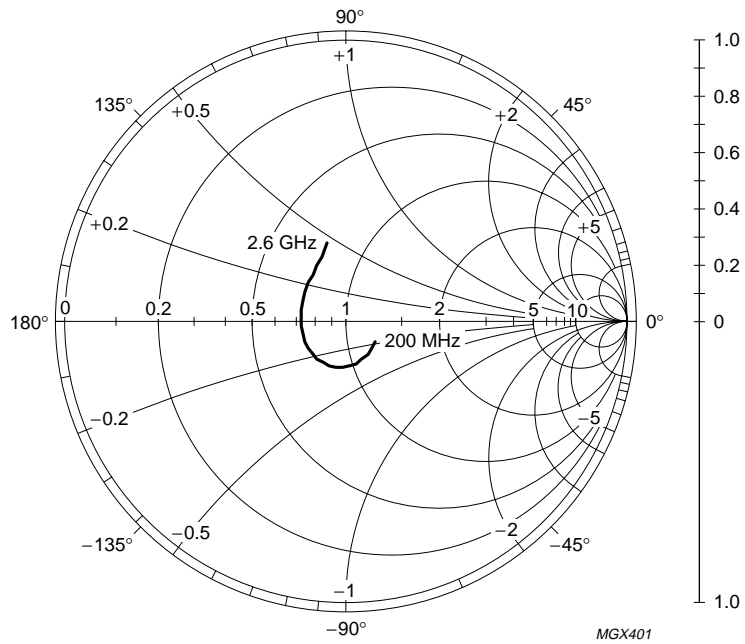
MMIC wideband medium power amplifier

BGA6489



$I_S = 74 \text{ mA}$ ;  $V_S = 8 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.3 Input reflection coefficient ( $s_{11}$ ); typical values.

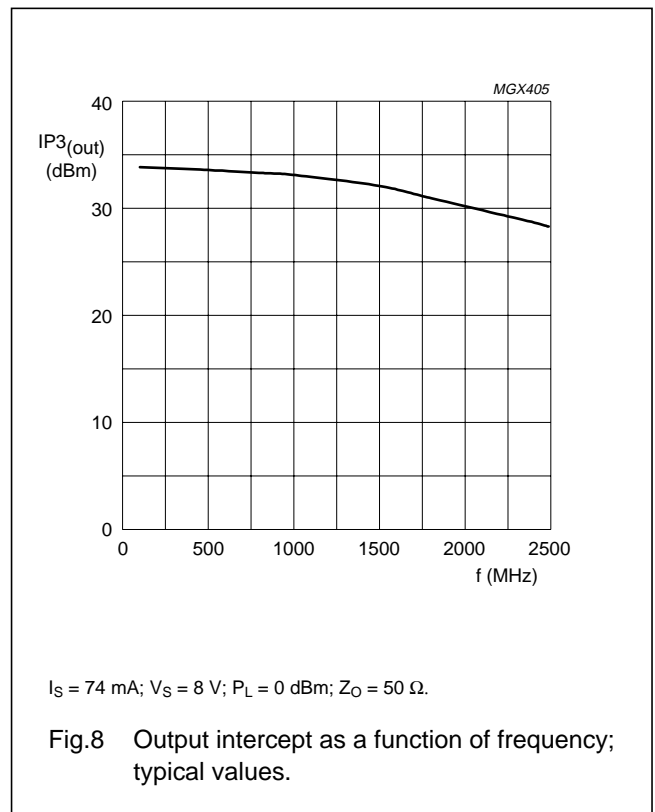
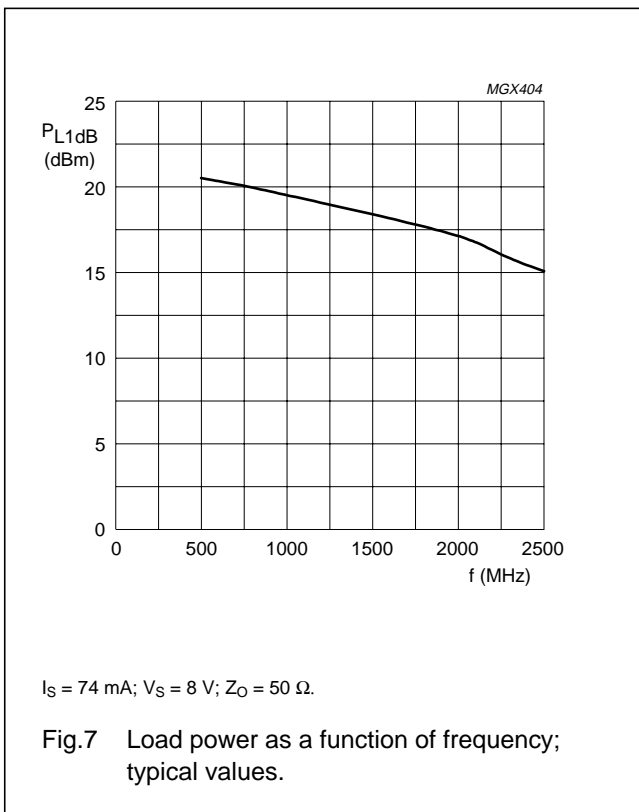
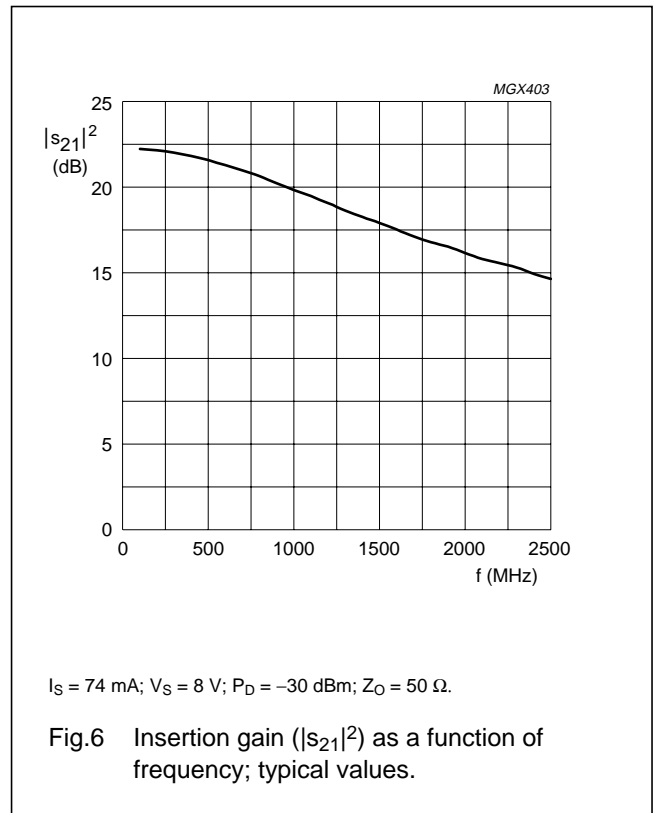
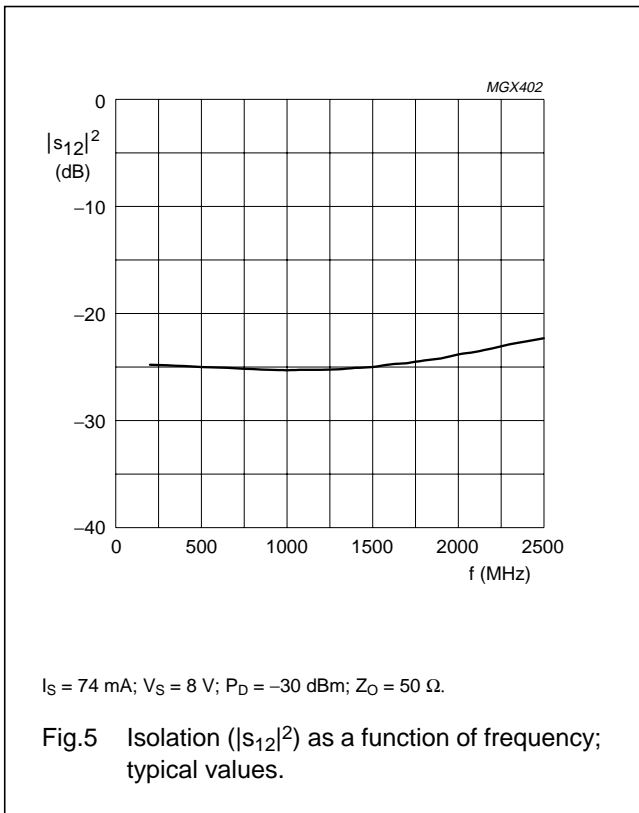


$I_S = 74 \text{ mA}$ ;  $V_S = 8 \text{ V}$ ;  $P_D = -30 \text{ dBm}$ ;  $Z_O = 50 \Omega$ .

Fig.4 Output reflection coefficient ( $s_{22}$ ); typical values.

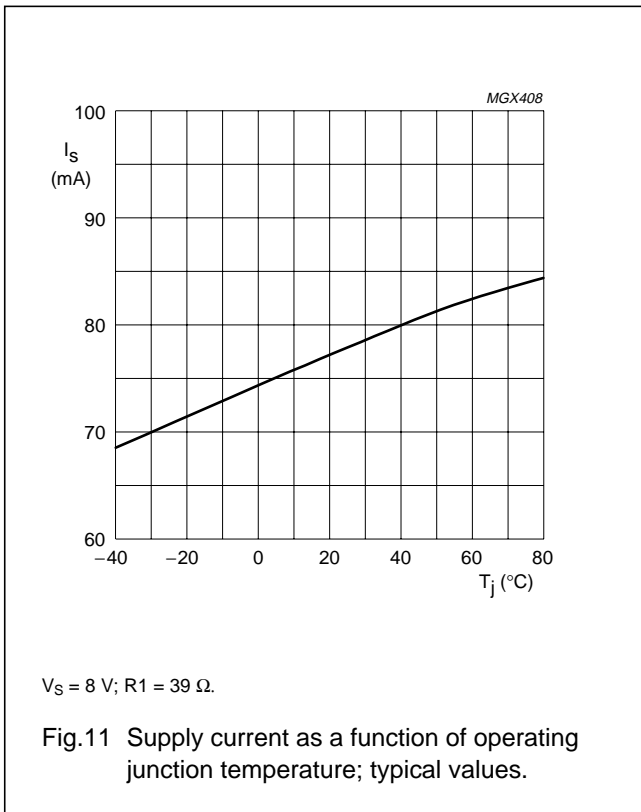
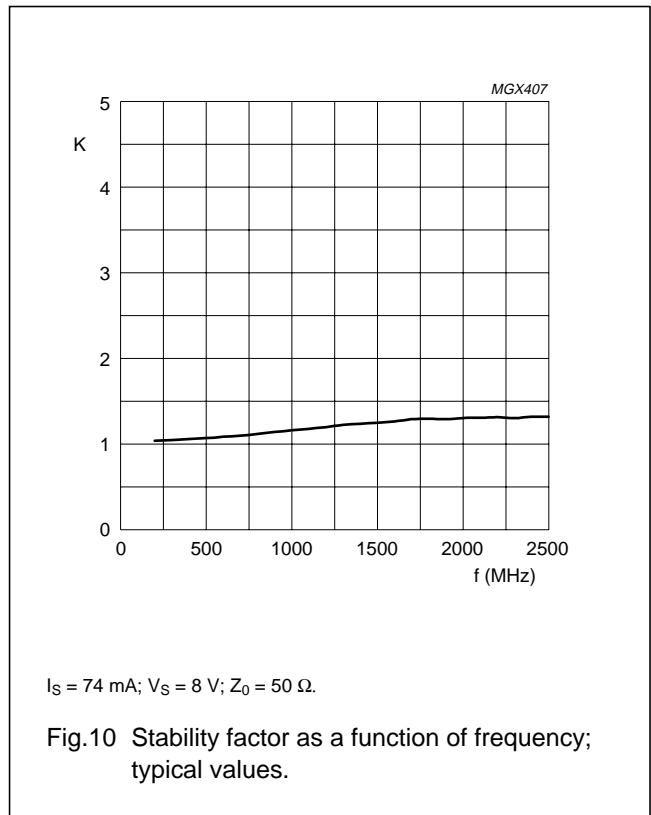
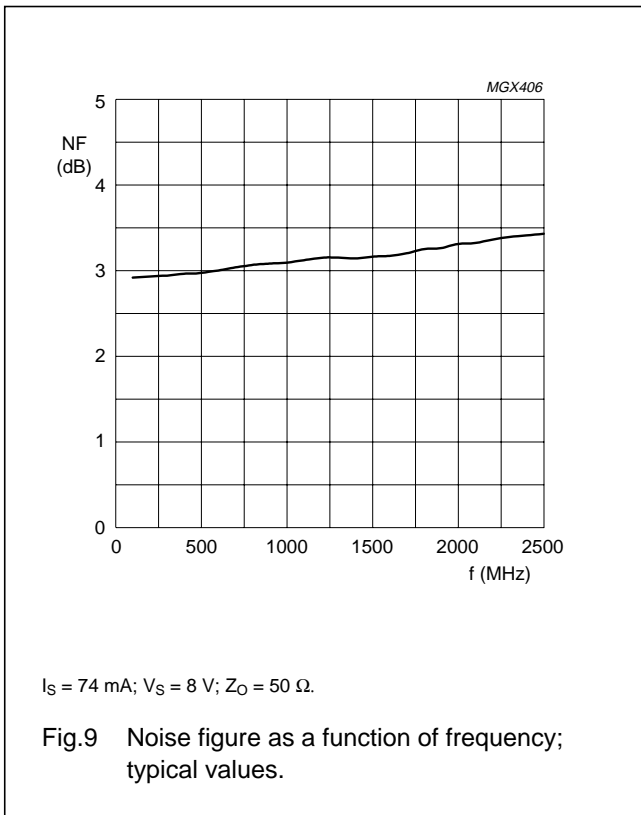
MMIC wideband medium power amplifier

BGA6489



MMIC wideband medium power amplifier

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## MMIC wideband medium power amplifier

BGAG489

## Scattering parameters

 $V_S = 8\text{ V}$ ;  $I_S = 74\text{ mA}$ ;  $P_D = -30\text{ dBm}$ ;  $Z_O = 50\ \Omega$ ;  $T_{\text{amb}} = 25\text{ }^\circ\text{C}$ 

| f (MHz) | S <sub>11</sub>   |             | S <sub>21</sub>   |             | S <sub>12</sub>   |             | S <sub>22</sub>   |             | K-FACTOR |
|---------|-------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|----------|
|         | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) |          |
| 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              | 117.62      | 1.3      |
| 2600    | 0.13              | -129.80     | 5.30              | 36.66       | 0.08              | 14.68       | 0.24              | 110.35      | 1.3      |
| 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      |

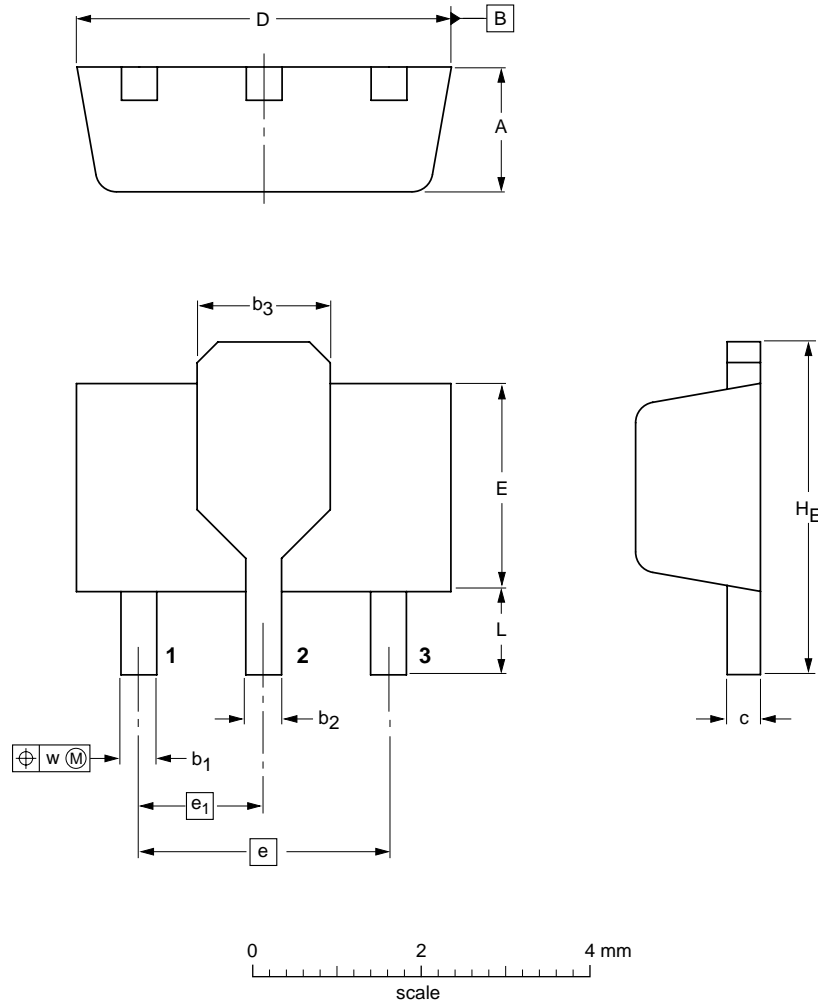
MMIC wideband medium power amplifier

BGA6489

PACKAGE OUTLINE

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

SOT89



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b <sub>1</sub> | b <sub>2</sub> | b <sub>3</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | L min. | w    |
|------|------------|----------------|----------------|----------------|--------------|------------|------------|-----|----------------|----------------|--------|------|
| mm   | 1.6<br>1.4 | 0.48<br>0.35   | 0.53<br>0.40   | 1.8<br>1.4     | 0.44<br>0.37 | 4.6<br>4.4 | 2.6<br>2.4 | 3.0 | 1.5            | 4.25<br>3.75   | 0.8    | 0.13 |

| OUTLINE VERSION | REFERENCES |        |       |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | EIAJ  |  |                     |                      |
| SOT89           |            | TO-243 | SC-62 |  |                     | 97-02-28<br>99-09-13 |

## MMIC wideband medium power amplifier

BGA6489

## DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)(3)</sup> | DEFINITION   |
|-------|----------------------------------|----------------------------------|--|
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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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