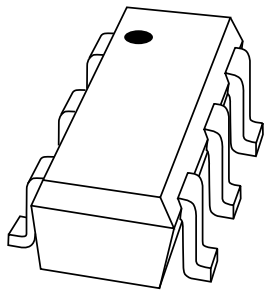


DATA SHEET



BGA2709 MMIC wideband amplifier

Product specification
Supersedes data of 2002 Feb 05

2002 Aug 06



MMIC wideband amplifier

BGA2709

FEATURES

- Internally matched to 50 Ω
- Very wide frequency range (3.6 GHz at 3 dB bandwidth)
- Flat 23 dB gain (DC to 2.6 GHz at 1 dB flatness)
- 12.5 dBm saturated output power at 1 GHz
- High linearity (22 dBm OIP3 at 1 GHz)
- Unconditionally stable ($K > 1.2$).

APPLICATIONS

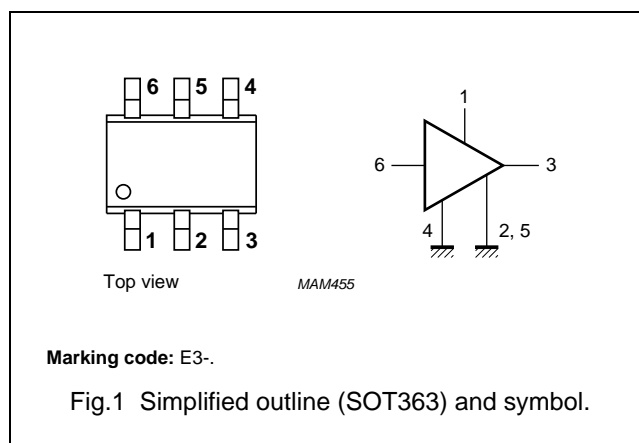
- Cable systems
- LNB IF amplifiers
- General purpose
- ISM.

DESCRIPTION

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

PINNING

| PIN | DESCRIPTION |
|------|----------------|
| 1 | V _S |
| 2, 5 | GND2 |
| 3 | RF out |
| 4 | GND1 |
| 6 | RF in |



QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|--------------------------------|----------------------|------------|------|------|------|
| V _S | DC supply voltage | | 5 | 6 | V |
| I _S | DC supply current | | 23.5 | – | mA |
| S ₂₁ ² | insertion power gain | f = 1 GHz | 22.7 | – | dB |
| NF | noise figure | f = 1 GHz | 4 | – | dB |
| P _{L(sat)} | saturated load power | f = 1 GHz | 12.5 | – | dBm |

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 | | – | 35 | mA |
| P _{tot} | total power dissipation | T _s ≤ 90 °C | – | 200 | mW |
| T _{stg} | storage temperature | | –65 | +150 | °C |
| T _j | operating junction temperature | | – | 150 | °C |
| P _D | maximum drive power | | – | 10 | dBm |

CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling.

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THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------|--|---|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to solder point | $P_{tot} = 200\text{ mW}$; $T_s \leq 90\text{ }^\circ\text{C}$ | 300 | K/W |

CHARACTERISTICS

$V_S = 5\text{ V}$; $I_S = 23.5\text{ mA}$; $T_j = 25\text{ }^\circ\text{C}$ unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|----------------------|------------------------|--|------|------|------|------|
| I_S | supply current | | 19 | 23.5 | 32 | mA |
| $ S_{21} ^2$ | insertion power gain | $f = 100\text{ MHz}$ | 21 | 22.2 | 23 | dB |
| | | $f = 1\text{ GHz}$ | 21 | 22.7 | 24 | dB |
| | | $f = 1.8\text{ GHz}$ | 22 | 23.0 | 24 | dB |
| | | $f = 2.2\text{ GHz}$ | 21 | 23.0 | 24 | dB |
| | | $f = 2.6\text{ GHz}$ | 20 | 22.1 | 23 | dB |
| | | $f = 3\text{ GHz}$ | 18 | 21.1 | 22 | dB |
| $R_{L\ IN}$ | return losses input | $f = 1\text{ GHz}$ | 9 | 11 | – | dB |
| | | $f = 2.2\text{ GHz}$ | 9 | 11 | – | dB |
| $R_{L\ OUT}$ | return losses output | $f = 1\text{ GHz}$ | 17 | 20 | – | dB |
| | | $f = 2.2\text{ GHz}$ | 20 | 24 | – | dB |
| $ S_{12} ^2$ | isolation | $f = 1.6\text{ GHz}$ | 31 | 33 | – | dB |
| | | $f = 2.2\text{ GHz}$ | 34 | 36 | – | dB |
| NF | noise figure | $f = 1\text{ GHz}$ | – | 4.0 | 4.4 | dB |
| | | $f = 2.2\text{ GHz}$ | – | 4.4 | 4.9 | dB |
| BW | bandwidth | at $ S_{21} ^2 - 3\text{ dB}$ below flat gain at 1 GHz | 3.1 | 3.6 | – | GHz |
| K | stability factor | $f = 1\text{ GHz}$ | 1.3 | 1.7 | – | – |
| | | $f = 2\text{ GHz}$ | 1.8 | 2.2 | – | – |
| $P_{L(sat)}$ | saturated load power | $f = 1\text{ GHz}$ | 11 | 12.5 | – | dBm |
| | | $f = 2.2\text{ GHz}$ | 5 | 7.5 | – | dBm |
| $P_{L\ 1\text{ dB}}$ | load power | at 1 dB gain compression; $f = 1\text{ GHz}$ | 7 | 8.3 | – | dBm |
| | | at 1 dB gain compression; $f = 2.2\text{ GHz}$ | 3 | 5.4 | – | dBm |
| IP3 _(in) | input intercept point | $f = 1\text{ GHz}$ | –3 | –1 | – | dBm |
| | | $f = 2.2\text{ GHz}$ | –7 | –9 | – | dBm |
| IP3 _(out) | output intercept point | $f = 1\text{ GHz}$ | 20 | 22 | – | dBm |
| | | $f = 2.2\text{ GHz}$ | 12 | 14 | – | dBm |

MMIC wideband amplifier

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APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2709 MMIC. The device is internally matched to 50 Ω, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2, C3 should be not 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 frequencies below 100 MHz this value should be increased to 220 nH. At frequencies above 1 GHz a much lower value must be used (e.g. 10 nH) to improve return losses. For optimal results, a good quality chip inductor such as the TDK MLG 1608 (0603), or a wire-wound SMD type should be chosen.

Both the RF choke, L1 and the 22 nF supply decoupling capacitor, C1 should be located as closely as possible to the MMIC.

Separate paths must be used for the ground planes of the ground pins GND1, GND2, and these paths must be as short as possible. When using vias, use multiple vias per pin in order to limit ground path inductance.

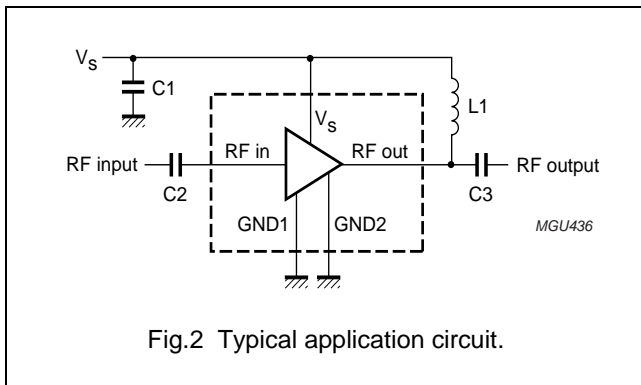


Fig.2 Typical application circuit.

Figure 3 shows two cascaded MMICs. This configuration doubles overall gain while preserving broadband characteristics. Supply decoupling and grounding conditions for each MMIC are the same as those for the circuit of Fig.2.

The excellent wideband characteristics of the MMIC make it an ideal building block in IF amplifier applications such as LBNs (see Fig.4).

As a buffer amplifier between an LNA and a mixer in a receiver circuit, the MMIC offers an easy matching, low noise solution (see Fig.5).

In Fig.6 the MMIC is used as a driver to the power amplifier in part of a transmitter circuit. Good linear performance and matched input and output offer quick design solutions in such applications.

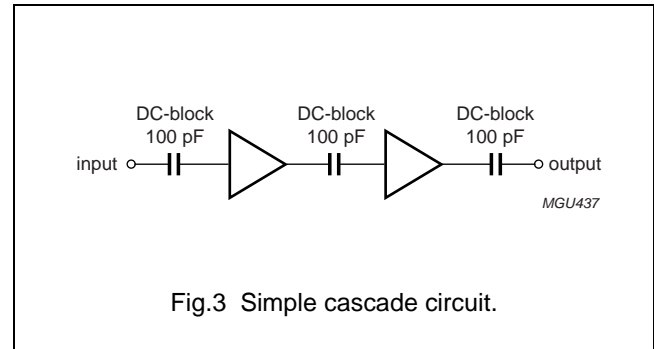


Fig.3 Simple cascade circuit.

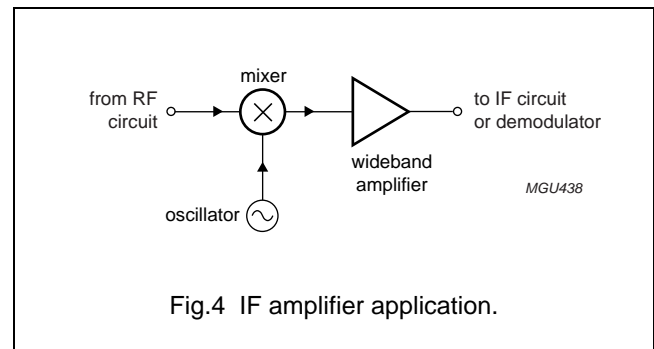


Fig.4 IF amplifier application.

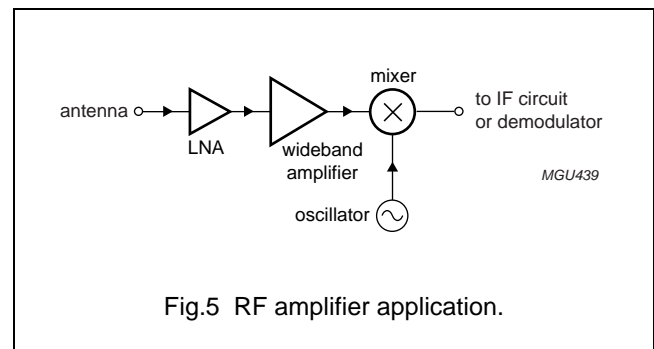


Fig.5 RF amplifier application.

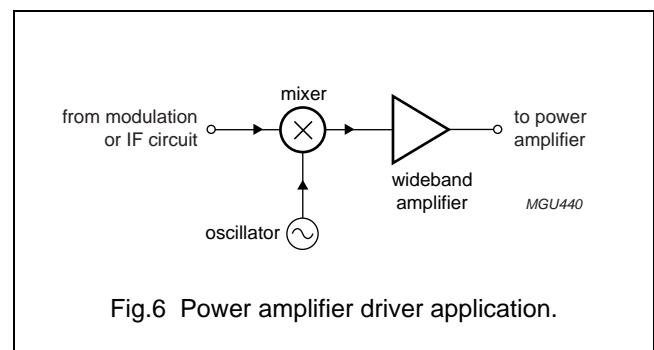
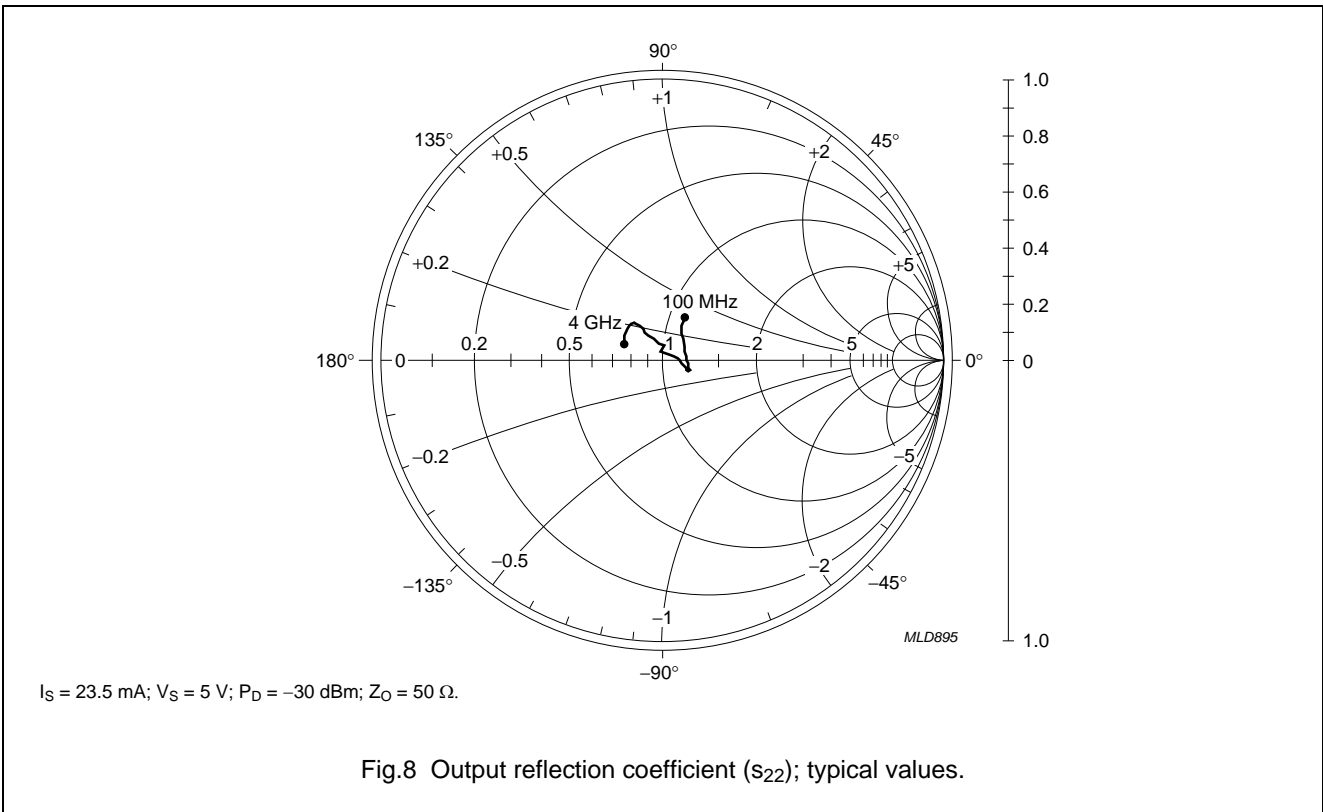
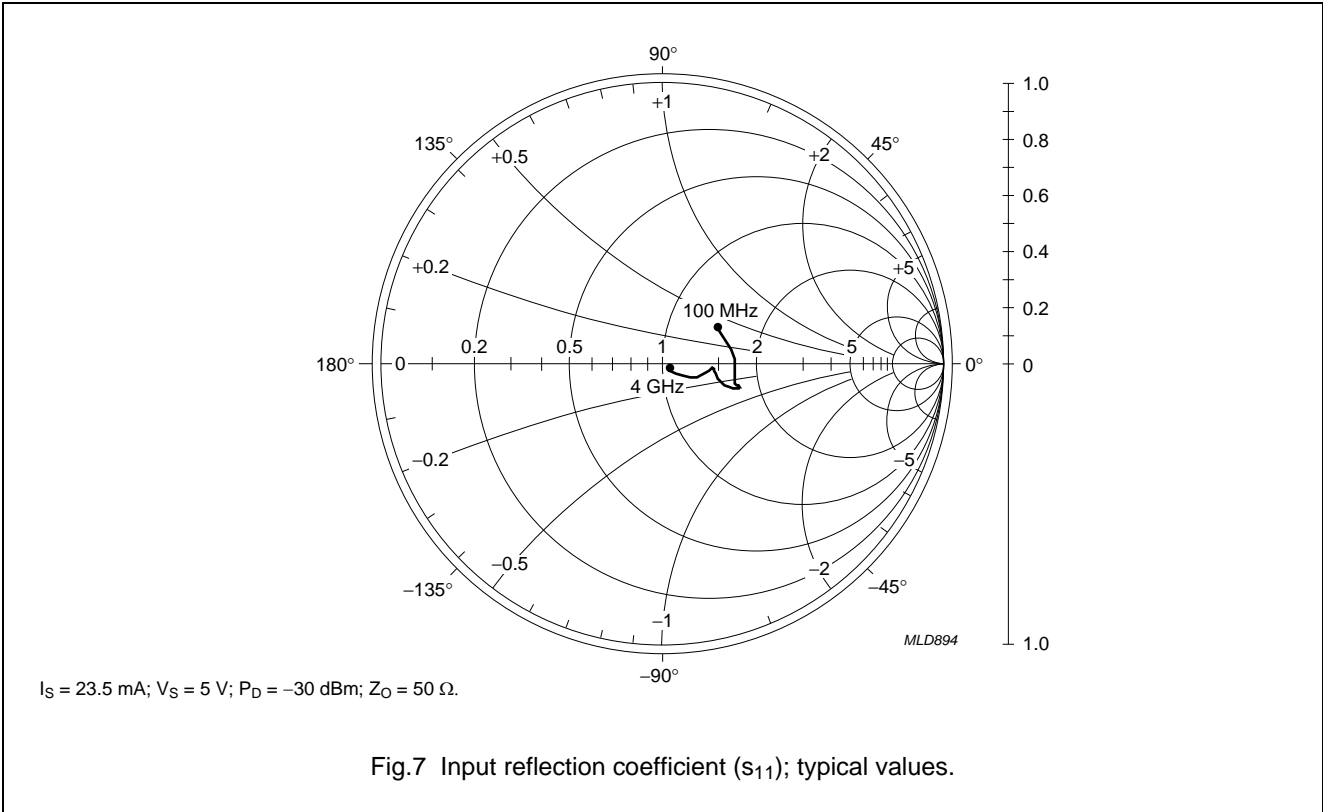


Fig.6 Power amplifier driver application.

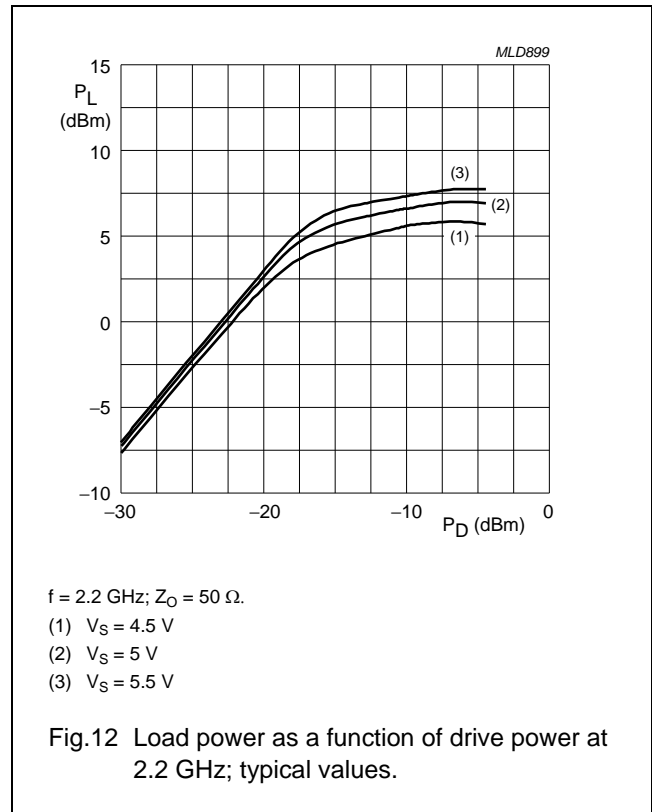
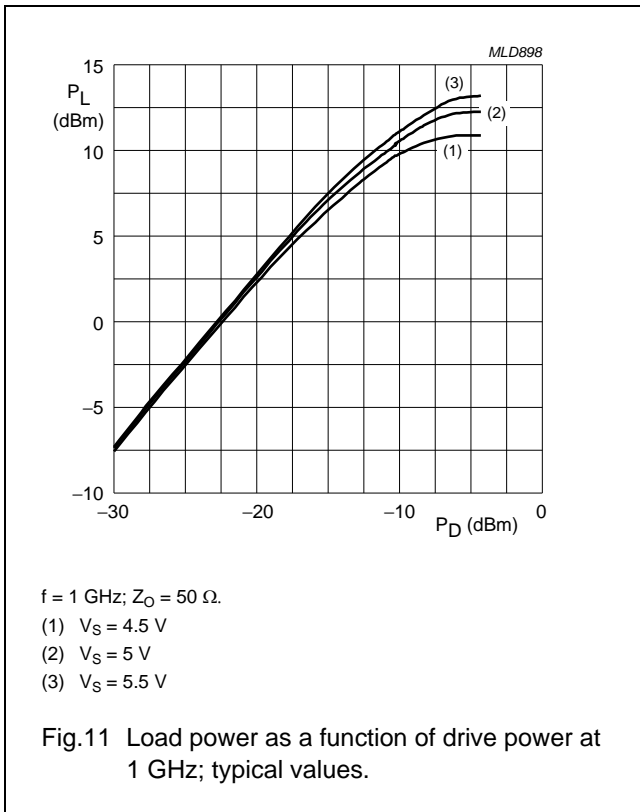
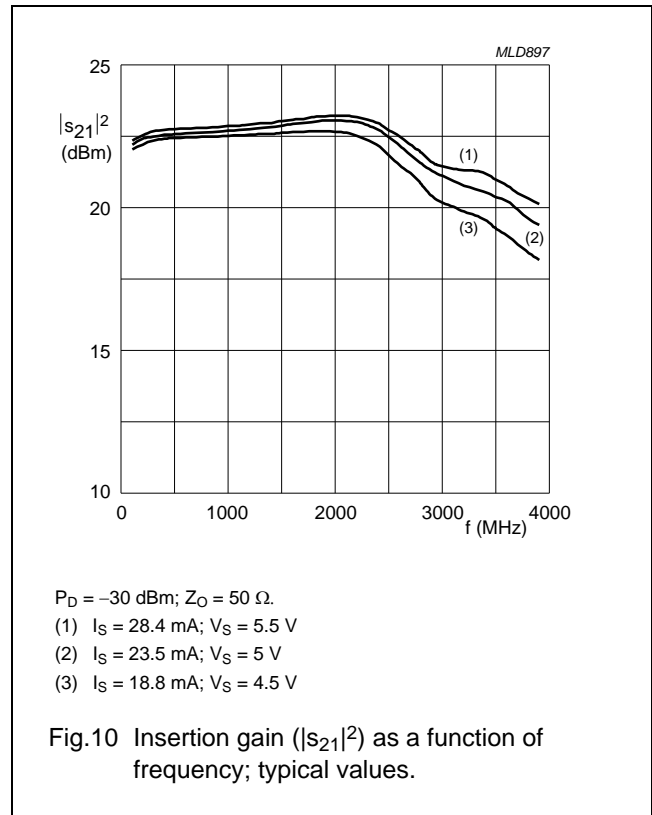
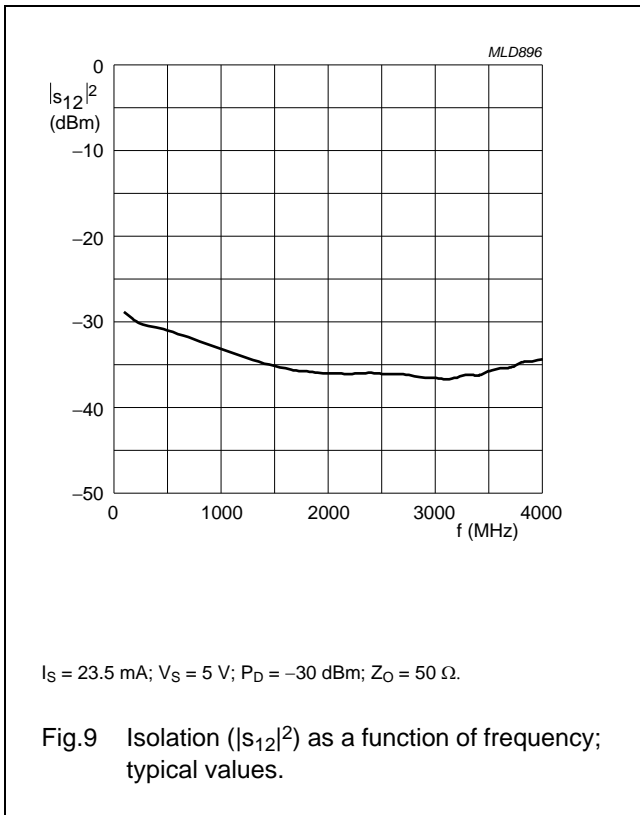
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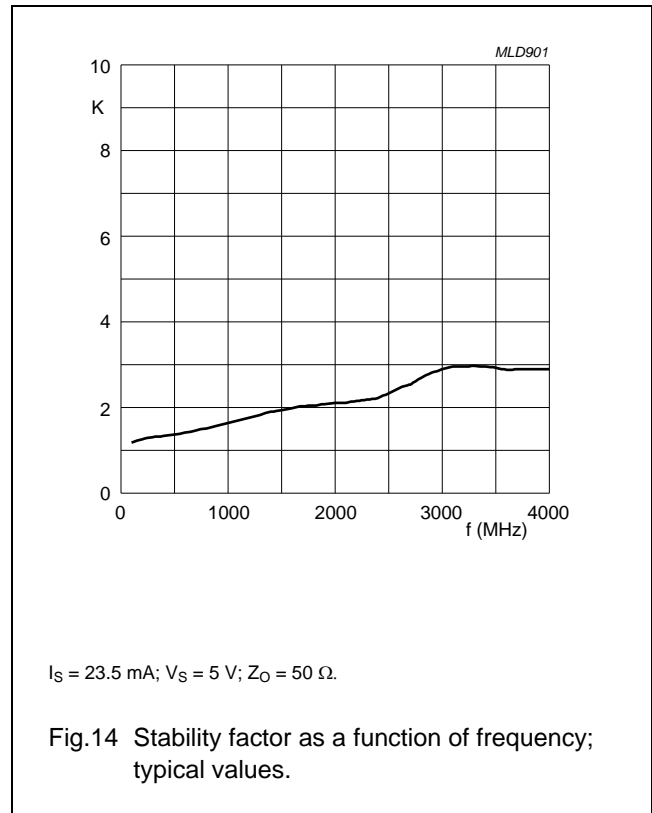
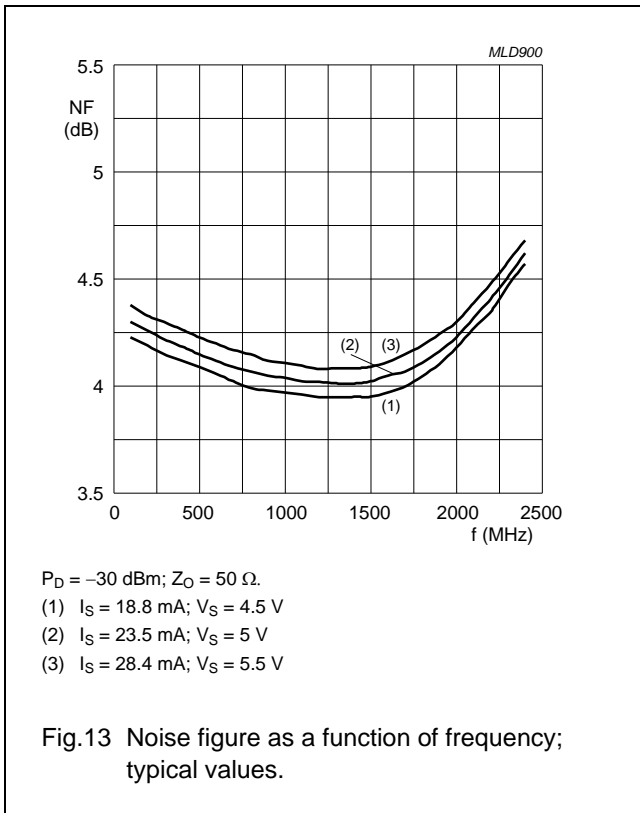
MMIC wideband amplifier

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MMIC wideband amplifier

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MMIC wideband amplifier

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Table 1 Scattering parameters: $I_S = 23.5$ mA; $V_S = 5$ V; $P_D = -30$ dBm; $Z_O = 50$ Ω ; $T_{amb} = 25$ $^{\circ}$ 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 | 0.23362 | 32.281 | 12.90523 | 21.565 | 0.036496 | 16.408 | 0.16296 | 61.578 | 1.2 |
| 200 | 0.25252 | 11.824 | 13.22858 | 4.852 | 0.032314 | 5.728 | 0.13501 | 60.573 | 1.3 |
| 400 | 0.25838 | -2.149 | 13.43580 | -10.31 | 0.029604 | -5.865 | 0.10353 | 41.717 | 1.3 |
| 600 | 0.25990 | -8.784 | 13.51088 | -21.14 | 0.027122 | -11.45 | 0.085075 | 16.95 | 1.4 |
| 800 | 0.26278 | -12.76 | 13.56715 | -30.93 | 0.024611 | -15.08 | 0.088892 | -1.879 | 1.5 |
| 1000 | 0.26695 | -14.88 | 13.65916 | -40.37 | 0.022107 | -16.33 | 0.09716 | -13.36 | 1.7 |
| 1200 | 0.27404 | -16.30 | 13.74736 | -49.83 | 0.019986 | -15.67 | 0.10279 | -20.25 | 1.8 |
| 1400 | 0.27921 | -16.51 | 13.85661 | -59.47 | 0.018217 | -13.42 | 0.10385 | -23.24 | 1.9 |
| 1600 | 0.28486 | -16.78 | 14.03414 | -69.50 | 0.017049 | -9.927 | 0.099148 | -24.08 | 2.0 |
| 1800 | 0.28749 | -17.25 | 14.16012 | -80.23 | 0.016409 | -5.968 | 0.089633 | -20.58 | 2.1 |
| 2000 | 0.28601 | -17.76 | 14.23586 | -91.65 | 0.015912 | -2.04 | 0.076785 | -14.48 | 2.1 |
| 2200 | 0.27487 | -18.98 | 14.14430 | -103.9 | 0.015829 | 1.077 | 0.062455 | -4.507 | 2.2 |
| 2400 | 0.25176 | -19.94 | 13.70546 | -117.0 | 0.016054 | 3.361 | 0.044552 | 11.808 | 2.2 |
| 2600 | 0.21405 | -17.09 | 12.75365 | -129.7 | 0.015801 | 3.145 | 0.023668 | 98.126 | 2.5 |
| 2800 | 0.19288 | -11.85 | 11.96153 | -138.7 | 0.015406 | 7.602 | 0.057779 | 104.35 | 2.7 |
| 3000 | 0.18347 | -6.228 | 11.33015 | -147.6 | 0.015049 | 11.411 | 0.094848 | 119.98 | 2.9 |
| 3200 | 0.17459 | -6.327 | 10.94943 | -156.3 | 0.015098 | 15.52 | 0.12948 | 123.28 | 3.0 |
| 3400 | 0.15344 | -14.14 | 10.65459 | -167.3 | 0.015529 | 20.649 | 0.15325 | 126.56 | 3.0 |
| 3600 | 0.10799 | -26.12 | 10.28106 | -179.1 | 0.017107 | 23.92 | 0.16627 | 131.67 | 2.8 |
| 3800 | 0.05984 | -39.66 | 9.56897 | 170.0 | 0.018529 | 23.226 | 0.16317 | 140.54 | 2.8 |
| 4000 | 0.025953 | -28.87 | 8.97718 | 157.3 | 0.019276 | 18.403 | 0.14602 | 157.03 | 2.9 |

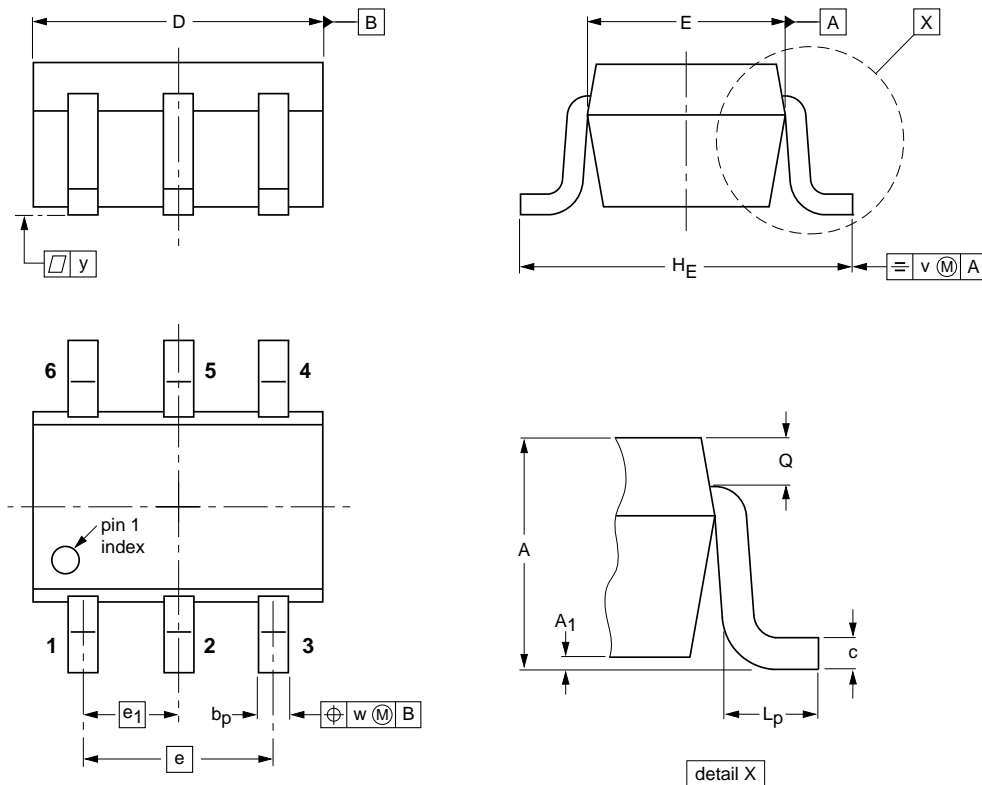
MMIC wideband amplifier

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PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads

SOT363



DIMENSIONS (mm are the original dimensions)

| UNIT | A | A ₁ max | b _p | c | D | E | e | e ₁ | H _E | L _p | Q | v | w | y |
|------|------------|-----------------------|----------------|--------------|------------|--------------|-----|----------------|----------------|----------------|--------------|-----|-----|-----|
| mm | 1.1 0.8 | 0.1 | 0.30 0.20 | 0.25 0.10 | 2.2 1.8 | 1.35 1.15 | 1.3 | 0.65 | 2.2 2.0 | 0.45 0.15 | 0.25 0.15 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|-------|-------|--|------------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT363 | | | SC-88 | | | 04-11-08 06-03-16 |

MMIC wideband amplifier

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DATA SHEET STATUS

| DOCUMENT STATUS ⁽¹⁾ | PRODUCT STATUS ⁽²⁾ | DEFINITION |
|--------------------------------|-------------------------------|---|
| Objective data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary data sheet | Qualification | This document contains data from the preliminary specification. |
| Product data sheet | Production | This document contains the product specification. |

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