

Features

- **Broadband, Minimum Ripple Cascadable 50 Ω Gain Block**
- **8.0 ± 0.2 dB Typical Gain Flatness from 0.1 to 4.0 GHz**
- **3 dB Bandwidth: 0.1 to 6.0 GHz**
- **Low VSWR: ≤ 1.5:1 from 0.1 to 4.0 GHz**
- **11.5 dBm Typical P_{1dB} at 1.0 GHz**

Description

The MSA is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) chip. This MODAMP™ MMIC is designed for very wide bandwidth industrial and military applications that require flat gain and low VSWR.

The MODAMP MSA-series is fabricated using a 10 GHz f_T , 25 GHz f_{MAX} , silicon bipolar MMIC process which utilizes nitride self-alignment, ion implantation and gold metallization to achieve excellent uniformity, performance and reliability. The use of an external bias resistor for temperature and current stability also allows bias flexibility.

The recommended assembly procedure is gold-eutectic die attach at 400°C and either wedge or ball bonding using 0.7 mil gold wire.

This chip is intended to be used with an external blocking capacitor completing the shunt feedback path (closed loop). Data sheet characterization is given for a 45 pF capacitor. Low frequency performance can be extended by using a larger valued capacitor¹.

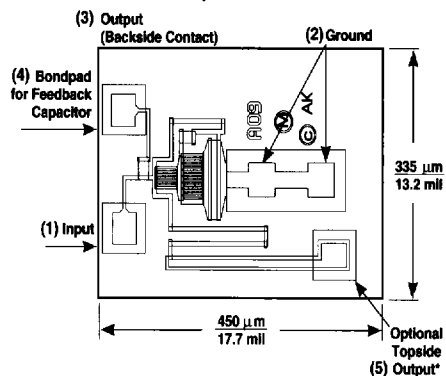
Electrical Specifications², T_A = 25°C

Unless otherwise noted, performance is for a MSA-0900 used with an external 45 pF capacitor. See bonding diagram.

| Symbol | Parameters and Test Conditions ³ : I _d = 35 mA, Z ₀ = 50 Ω | Units | Min. | Typ. | Max. |
|-------------------|---|-------|------|-------|------|
| G _p | Power Gain (S ₂₁ ²) f = 0.1 GHz | dB | | 8.0 | |
| ΔG _p | Gain Flatness ⁴ f = 0.1 to 4.0 GHz | dB | | ±0.2 | |
| f _{3 dB} | 3 dB Bandwidth ^{4,5} | GHz | | 6.0 | |
| VSWR | Input VSWR f = 0.1 to 4.0 GHz | | | 1.4:1 | |
| | Output VSWR f = 0.1 to 4.0 GHz | | | 1.5:1 | |
| P _{1 dB} | Output Power @ 1 dB Gain Compression f = 1.0 GHz | dBm | | 11.5 | |
| | f = 4.0 GHz | | | 6.5 | |
| NF | 50 Ω Noise Figure f = 1.0 GHz | dB | | 6.0 | |
| | f = 4.0 GHz | | | 6.5 | |
| IP ₃ | Third Order Intercept Point f = 1.0 GHz | dBm | | 23.0 | |
| t _D | Group Delay f = 1.0 GHz | psec | | 60 | |
| V _d | Device Voltage | V | 7.0 | 7.8 | 8.6 |
| dV/dT | Device Voltage Temperature Coefficient | mV/°C | | -16.0 | |

- Notes:**
1. See Application Note, AN-S009: MODAMP™ Silicon MMIC Chip Use for additional information.
 2. The recommended operating current range for this device is 25 to 45 mA. Typical performance as a function of current is on the following page.
 3. RF performance of the chip is determined by packaging and testing 10 devices per wafer.
 4. The value is the expected achievable performance for the MSA-0900 used with an external 45 pF capacitor mounted in a 100 mil stripline package.
 5. Referenced from 0.1 GHz gain (G_p).

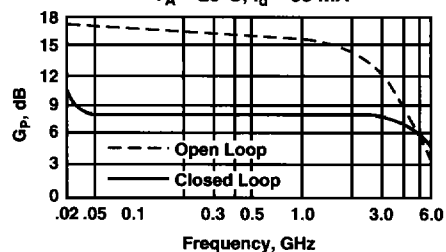
Chip Outline¹



Unless otherwise specified, tolerances are ±13 μm/±0.5 mils.
Chip thickness is 114 μm/4.5 mil Bond Pads are 41 μm/1.6 mil typical on each side.

*Output contact is normally made by die attaching the backside of the die.

Typical Power Gain vs. Frequency T_A = 25°C, I_d = 35 mA



MSA-0900 MODAMP™ Cascadable Silicon Bipolar Monolithic Microwave Integrated Circuit Amplifiers

Absolute Maximum Ratings

| Parameter | Absolute Maximum ¹ |
|-----------------------------------|-------------------------------|
| Device Current | 80 mA |
| Power Dissipation ^{2, 3} | 750 mW |
| RF Input Power | +13 dBm |
| Junction Temperature | 200°C |
| Storage Temperature | -65 to 200°C |

Thermal Resistance^{2, 4}: $\theta_{jc} = 70^\circ\text{C/W}$

Notes:

- Permanent damage may occur if any of these limits are exceeded.
- $T_{\text{MOUNTING SURFACE}} = 25^\circ\text{C}$.
- Derate at $14 \text{ mW}/^\circ\text{C}$ for $T_{\text{MOUNTING SURFACE}} > 148^\circ\text{C}$.
- The small spot size of the technique used results in a higher, though more accurate, determination of θ_{jc} than do alternate methods.

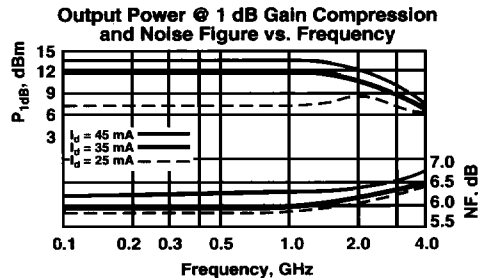
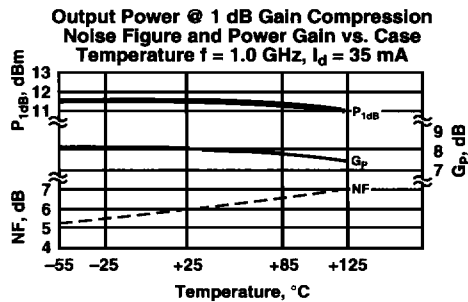
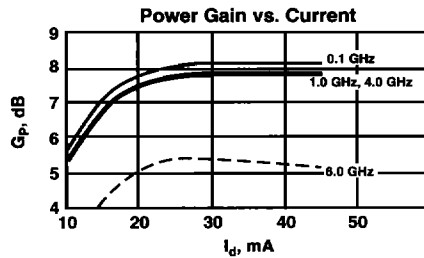
Part Number Ordering Information

| Part Number | Devices Per Tray |
|--------------|------------------|
| MSA-0900-GP2 | 10 |
| MSA-0900-GP4 | 100 |
| MSA-0900-GP6 | Up to 300 |

Typical Performance, $T_A = 25^\circ\text{C}$

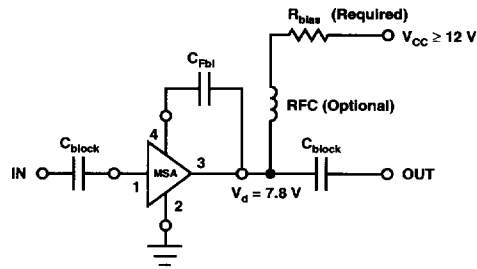
(Unless otherwise noted)

Note: Unless otherwise noted, performance is for a MSA-0900 used with an external 45 pF capacitor mounted in a 100 mil stripline package. See bonding diagram.

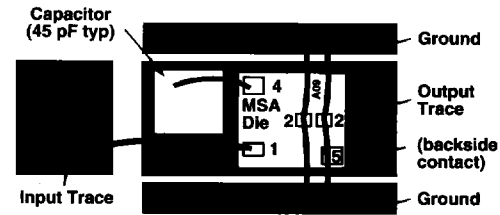


MSA-0900 MODAMP™ Cascadable Silicon Bipolar Monolithic Microwave Integrated Circuit Amplifiers

Typical Biasing Configuration



Bonding Diagram



Numbers refer to pin contacts listed on the Chip Outline.

Typical Scattering Parameters^{5,6}: $Z_0 = 50 \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | | k |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|------|------|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang | |
| 0.02 | .32 | -107 | 10.8 | 3.48 | 151 | -13.9 | .203 | 17 | .32 | -106 | 0.83 |
| 0.05 | .22 | -143 | 8.6 | 2.70 | 164 | -13.6 | .209 | 6 | .22 | -142 | 1.09 |
| 0.1 | .11 | -144 | 8.2 | 2.57 | 171 | -13.3 | .215 | 3 | .11 | -142 | 1.16 |
| 0.2 | .10 | -160 | 8.1 | 2.54 | 172 | -13.5 | .211 | 1 | .11 | -158 | 1.19 |
| 0.4 | .10 | -171 | 8.1 | 2.54 | 175 | -13.4 | .215 | 2 | .10 | -166 | 1.18 |
| 0.6 | .09 | -170 | 8.1 | 2.55 | 166 | -13.3 | .216 | 1 | .10 | -166 | 1.18 |
| 0.8 | .08 | -171 | 8.2 | 2.57 | 162 | -13.3 | .216 | 1 | .11 | -166 | 1.17 |
| 1.0 | .08 | -170 | 8.3 | 2.59 | 158 | -13.1 | .220 | 1 | .11 | -167 | 1.15 |
| 1.5 | .07 | -166 | 8.6 | 2.68 | 147 | -13.1 | .221 | 1 | .14 | -172 | 1.12 |
| 2.0 | .07 | -138 | 8.9 | 2.80 | 136 | -12.6 | .234 | 1 | .15 | -172 | 1.07 |
| 2.5 | .08 | -131 | 9.3 | 2.92 | 126 | -12.6 | .236 | 1 | .18 | 179 | 1.04 |
| 3.0 | .12 | -119 | 9.6 | 3.01 | 112 | -12.0 | .250 | 1 | .21 | 171 | 0.99 |
| 3.5 | .17 | -125 | 9.6 | 3.02 | 95 | -11.8 | .256 | -1 | .22 | 157 | 0.97 |
| 4.0 | .22 | -132 | 9.1 | 2.86 | 78 | -11.5 | .265 | -3 | .19 | 144 | 0.96 |
| 4.5 | .27 | -140 | 8.4 | 2.64 | 63 | -11.5 | .265 | -5 | .16 | 138 | 0.97 |
| 5.0 | .32 | -149 | 7.5 | 2.36 | 50 | -11.4 | .268 | -6 | .12 | 138 | 1.00 |
| 5.5 | .34 | -154 | 6.4 | 2.09 | 38 | -11.3 | .272 | -6 | .10 | 162 | 1.02 |
| 6.0 | .36 | -158 | 5.3 | 1.84 | 29 | -11.3 | .272 | -6 | .10 | -166 | 1.07 |
| 6.5 | .38 | -158 | 4.2 | 1.62 | 22 | -11.4 | .271 | -6 | .16 | -151 | 1.12 |
| 7.0 | .39 | -157 | 3.2 | 1.45 | 15 | -11.5 | .267 | -6 | .23 | -147 | 1.17 |

Notes: 5. S-parameters are de-embedded from 100 mil BeO package measured data using the package model found in the DEVICE MODELS section.
6. S-parameter data assumes an external 45 pF capacitor. Low frequency performance can be extended using a larger valued capacitor.