# MSA-9970
Cascadable Silicon Bipolar MMIC Amplifier

## Data Sheet

### Description

The MSA-9970 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a hermetic high reliability package. This MMIC is designed with high open loop gain and is intended to be used with external resistive and reactive feedback elements to create a variety of special purpose gain blocks.

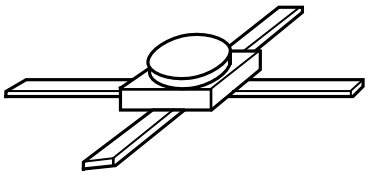
Applications include very broadband, minimum ripple amplifiers with extended low frequency performance possible through the use of a high valued external feedback blocking capacitor; extremely well matched (–20 dB return loss) amplifiers; and negative gain slope amplifiers for flattening MMIC cascades.

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

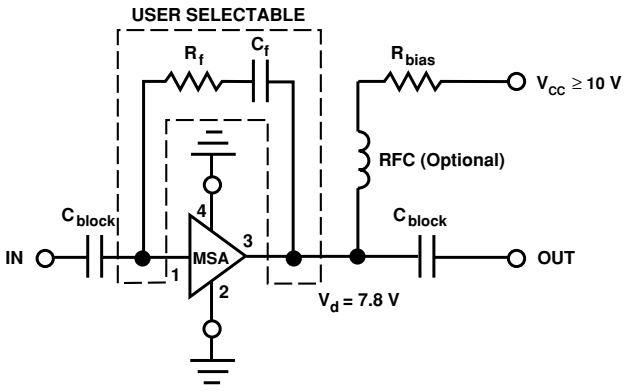
### Features

- Open Loop Feedback Amplifier
- Performance Flexibility with User Selected External Feedback for:
  Broadband Minimum Ripple Amplifiers
  Low Return Loss Amplifiers
  Negative Gain Slope Amplifiers
- Usable Gain to 6.0 GHz
- 16.0 dB Typical Open Loop Gain at 1.0 GHz
- 14.5 dBm Typical $P_{1\,dB}$ at 1.0 GHz
- Hermetic Gold-ceramic Microstrip Package

### 70 mil Package



### Typical Biasing Configuration



## MSA-9970 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°C to 200°C |

**Thermal Resistance[2,4]:**

$\theta_{jc} = 150°C/W$

Notes:
1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{CASE} = 25°C$.
3. Derate at 6.7 mW/°C for $T_C > 88°C$.
4. The small spot size of this technique results in a higher, though more accurate determination of $\theta_{jc}$ than do alternate methods.

## Electrical Specifications[1], $T_A = 25°C$

| Symbol | Parameters and Test Conditions: $I_d = 35$ mA, $Z_O = 50\ \Omega$ | | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $G_P$ | Power Gain[2] ($\|S_{21}\|^2$) | f = 0.1 GHz | dB | | 17.5 | |
| | | f = 1.0 GHz | | 14.5 | 16.0 | 17.5 |
| | | f = 4.0 GHz | | 8.0 | 9.0 | 10.0 |
| $P_{1\,dB}$ | Output Power at 1 dB Gain Compression[2] | f = 1.0 GHz | dBm | | 14.5 | |
| $IP_3$ | Third Order Intercept Point[2] | f = 1.0 GHz | dBm | | 25.0 | |
| $V_d$ | Device Voltage | | V | 7.0 | 7.8 | 8.6 |
| dV/dT | Device Voltage Temperature Coefficient | | mV/°C | | –16.0 | |

Notes:
1. 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.
2. Open loop value. Adding external feedback will alter device performance.

## MSA-9970 Typical Scattering Parameters ($Z_0 = 50\ \Omega$, $T_A = 25°C$, $I_d = 35$ mA)

| Freq. | $S_{11}$ | | | $S_{21}$ | | | $S_{12}$ | | $S_{22}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang | k |
| 0.02 | .89 | −1 | 17.5 | 7.51 | 179 | −37.2 | .014 | 4 | .93 | −1 | 1.01 |
| 0.05 | .90 | −3 | 17.5 | 7.47 | 177 | −35.6 | .017 | 34 | .92 | −3 | .83 |
| 0.1 | .90 | −6 | 17.4 | 7.45 | 174 | −33.2 | .022 | 43 | .93 | −6 | .70 |
| 0.2 | .89 | −12 | 17.4 | 7.43 | 168 | −29.6 | .033 | 61 | .93 | −13 | .39 |
| 0.4 | .87 | −24 | 17.2 | 7.27 | 156 | −24.4 | .061 | 63 | .91 | −27 | .24 |
| 0.6 | .85 | −36 | 17.0 | 7.06 | 145 | −20.8 | .091 | 58 | .90 | −40 | .21 |
| 0.8 | .82 | −47 | 16.6 | 6.78 | 134 | −18.8 | .115 | 52 | .87 | −53 | .21 |
| 1.0 | .79 | −59 | 16.2 | 6.49 | 124 | −17.0 | .141 | 44 | .84 | −66 | .24 |
| 1.5 | .72 | −86 | 15.3 | 5.79 | 100 | −14.6 | .186 | 29 | .74 | −96 | .28 |
| 2.0 | .65 | −113 | 14.2 | 5.10 | 77 | −13.4 | .215 | 16 | .64 | −123 | .34 |
| 2.5 | .59 | −133 | 13.0 | 4.45 | 61 | −12.9 | .227 | 7 | .57 | −143 | .39 |
| 3.0 | .54 | −155 | 11.6 | 3.79 | 42 | −12.5 | .236 | −3 | .51 | −163 | .46 |
| 3.5 | .53 | −174 | 10.3 | 3.28 | 26 | −12.4 | .239 | −14 | .45 | 178 | .53 |
| 4.0 | .52 | 168 | 9.2 | 2.87 | 10 | −12.5 | .238 | −22 | .39 | 164 | .59 |
| 4.5 | .53 | 152 | 8.0 | 2.51 | −4 | −12.6 | .234 | −30 | .34 | 155 | .66 |
| 5.0 | .55 | 140 | 6.9 | 2.21 | −17 | −12.8 | .228 | −37 | .31 | 153 | .72 |
| 5.5 | .55 | 130 | 5.8 | 1.94 | −31 | −13.2 | .220 | −44 | .30 | 154 | .80 |
| 6.0 | .55 | 121 | 4.6 | 1.70 | −43 | −13.6 | .209 | −48 | .32 | 157 | .88 |
| 6.5 | .56 | 114 | 3.5 | 1.50 | −53 | −13.8 | .203 | −54 | .37 | 158 | .94 |
| 7.0 | .56 | 107 | 2.6 | 1.34 | −63 | −14.0 | .201 | −59 | .42 | 157 | .97 |

## Typical Performance, $T_A = 25°C$

(unless otherwise noted)

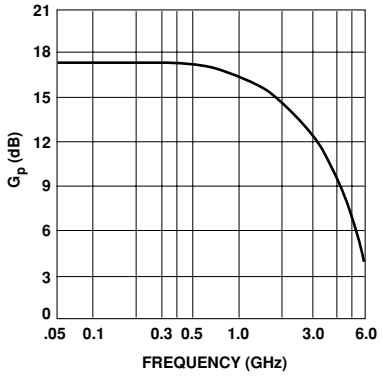



**Figure 1. Open Loop Power Gain vs. Frequency, $I_d = 35$ mA.**

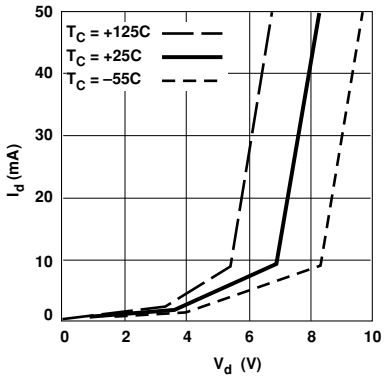



**Figure 2. Device Current vs. Voltage.**

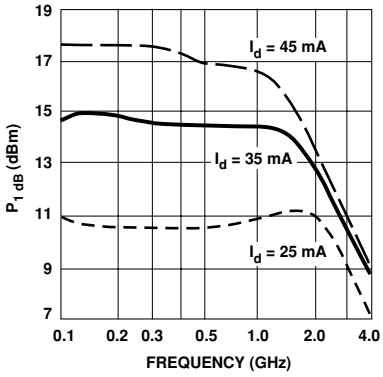



**Figure 3. Open Loop Output Power at 1 dB Gain Compression vs. Frequency.**

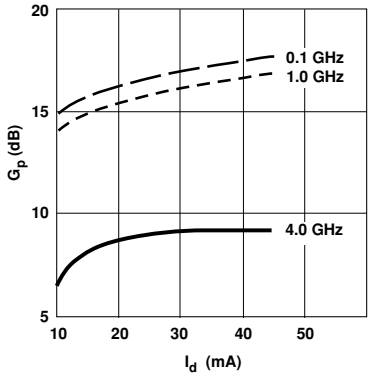



**Figure 4. Open Loop Power Gain vs. Current.**

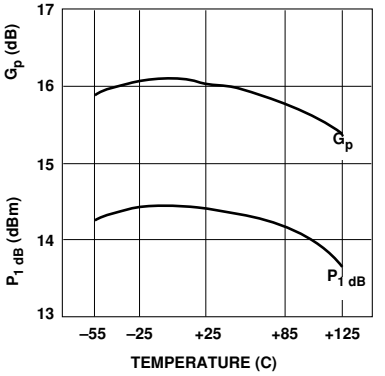
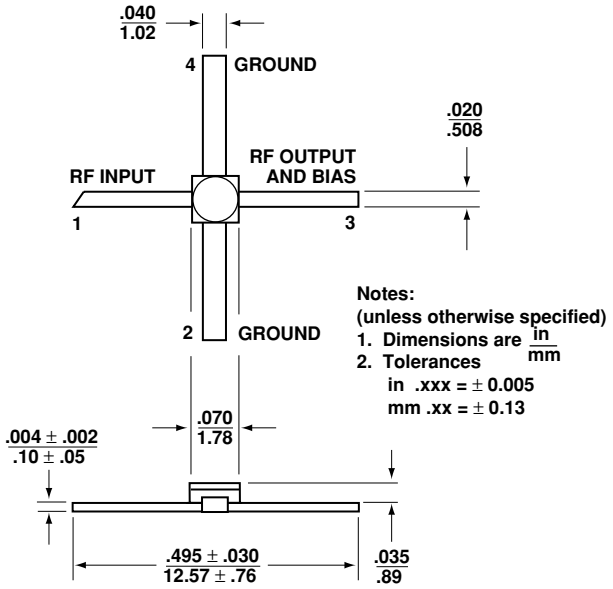



**Figure 5. Open Loop Output Power at 1 dB Gain Compression and Open Loop Power Gain vs. Case Temperature, f = 1.0 GHz, $I_d = 35$ mA.**

## Ordering Information

| Part Numbers | No. of Devices | Comments |
|---|---|---|
| MSA-9970 | 100 | Bulk |

## 70 mil Package Dimensions




For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**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