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# Cascadable Silicon Bipolar MMIC Amplifier

## Technical Data

**MSA-1110**

### Features

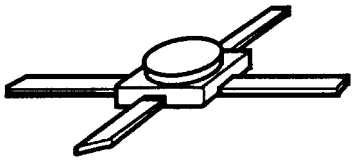
- **High Dynamic Range Cascadable 50 Ω or 75 Ω Gain Block**
- **3 dB Bandwidth:** 50 MHz to 1.6 GHz
- **17.5 dBm Typical $P_{1\ dB}$ at 0.5 GHz**
- **12 dB Typical 50 Ω Gain at 0.5 GHz**
- **3.5 dB Typical Noise Figure at 0.5 GHz**
- **Hermetic Gold-ceramic Microstrip Package**

### Description

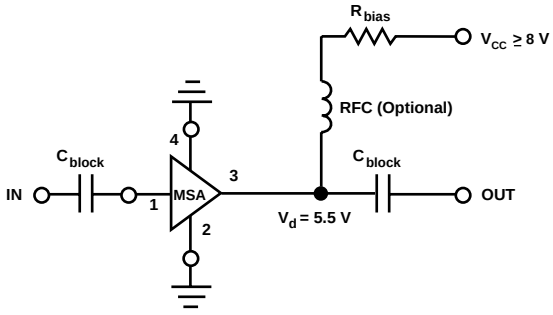
The MSA-1110 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a hermetic high reliability package. This MMIC is designed for high dynamic range in either 50 or 75 Ω systems by combining low noise figure with high $IP_3$. Typical applications include narrow and broadband linear amplifiers in industrial and military systems.

The MSA-series is fabricated using Agilent'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.

### 100 mil Package



### Typical Biasing Configuration



## MSA-1110 Absolute Maximum Ratings

| Parameter | Absolute Maximum[1] |
|---|---|
| Device Current | 90 mA |
| Power Dissipation[2,3] | 560 mW |
| RF Input Power | +13 dBm |
| Junction Temperature | 200°C |
| Storage Temperature | –65 to 200°C |

**Thermal Resistance[2,4]:**
$\theta_{jc}$ = 135°C/W

**Notes:**
1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{CASE}$ = 25°C.
3. Derate at 7.4 mW/°C for $T_C$ > 124°C.
4. The small spot size of this technique results in a higher, though more accurate determination of $\theta_{jc}$ than do alternate methods. See MEASUREMENTS section "Thermal Resistance" for more information.

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

| Symbol | Parameters and Test Conditions: $I_d$ = 60 mA, $Z_O$ = 50 Ω | | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $G_P$ | Power Gain ($\|S_{21}\|^2$) | f = 0.1 GHz | dB | 11.5 | 12.5 | 13.5 |
| $\Delta G_P$ | Gain Flatness | f = 0.1 to 1.0 GHz | dB | | ±0.7 | ±1.0 |
| $f_{3\ dB}$ | 3 dB Bandwidth[2] | | GHz | | 1.6 | |
| VSWR | Input VSWR | f = 0.1 to 1.0 GHz | | | 1.7:1 | |
| | Output VSWR | f = 0.1 to 1.0 GHz | | | 1.9:1 | |
| NF | 50 Ω Noise Figure | f = 0.5 GHz | dB | | 3.5 | 4.5 |
| $P_{1\ dB}$ | Output Power at 1 dB Gain Compression | f = 0.5 GHz | dBm | 16.0 | 17.5 | |
| $IP_3$ | Third Order Intercept Point | f = 0.5 GHz | dBm | | 30.0 | |
| $t_D$ | Group Delay | f = 0.5 GHz | psec | | 160 | |
| $V_d$ | Device Voltage | | V | 4.5 | 5.5 | 6.5 |
| dV/dT | Device Voltage Temperature Coefficient | | mV/°C | | –8.0 | |

**Notes:**
1. The recommended operating current range for this device is 40 to 75 mA. Typical performance as a function of current is on the following page.
2. Referenced from 50 MHz gain ($G_P$).

## MSA-1110 Typical Scattering Parameters ($Z_O$ = 50 Ω, $T_A$ = 25°C, $I_d$ = 60 mA)

| Freq. GHz | $S_{11}$ | | $S_{21}$ | | | $S_{12}$ | | | $S_{22}$ | | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang | |
| .0005 | .83 | –7 | 19.5 | 9.44 | 176 | –31.9 | .025 | 39 | .84 | –7 | 0.77 |
| .005 | .54 | –50 | 16.8 | 6.92 | 158 | –18.7 | .116 | 34 | .55 | –50 | 0.60 |
| .025 | .15 | –78 | 13.0 | 4.47 | 167 | –16.6 | .148 | 9 | .15 | –79 | 1.03 |
| .050 | .10 | –64 | 12.6 | 4.26 | 171 | –16.5 | .149 | 5 | .10 | –67 | 1.08 |
| .100 | .08 | –63 | 12.5 | 4.23 | 171 | –16.5 | .150 | 4 | .08 | –66 | 1.09 |
| .200 | .09 | –74 | 12.4 | 4.17 | 166 | –16.4 | .152 | 4 | .09 | –78 | 1.09 |
| .300 | .11 | –85 | 12.3 | 4.10 | 160 | –16.2 | .154 | 5 | .12 | –89 | 1.07 |
| .400 | .13 | –94 | 12.3 | 4.10 | 154 | –16.1 | .157 | 6 | .15 | –98 | 1.05 |
| .500 | .16 | –102 | 12.1 | 4.04 | 148 | –15.9 | .161 | 7 | .18 | –106 | 1.02 |
| .600 | .18 | –108 | 12.0 | 3.98 | 143 | –15.6 | .165 | 8 | .20 | –113 | 1.00 |
| .700 | .21 | –114 | 11.8 | 3.89 | 137 | –15.4 | .169 | 8 | .23 | –120 | 0.97 |
| .800 | .23 | –120 | 11.6 | 3.80 | 131 | –15.2 | .173 | 8 | .25 | –126 | 0.95 |
| .900 | .25 | –126 | 11.4 | 3.71 | 126 | –15.0 | .178 | 8 | .28 | –132 | 0.92 |
| 1.000 | .27 | –131 | 11.1 | 3.60 | 120 | –14.8 | .182 | 8 | .30 | –137 | 0.91 |
| 1.500 | .36 | –153 | 9.8 | 3.10 | 96 | –13.8 | .203 | 4 | .37 | –160 | 0.83 |
| 2.000 | .42 | –171 | 8.4 | 2.64 | 74 | –13.3 | .217 | 1 | .40 | –178 | 0.82 |
| 2.500 | .47 | 177 | 7.2 | 2.29 | 59 | –12.5 | .236 | –2 | .41 | 172 | 0.80 |
| 3.000 | .47 | 159 | 5.9 | 1.97 | 43 | –13.2 | .220 | –10 | .38 | 157 | 0.95 |

A model for this device is available in the DEVICE MODELS section.

## Typical Performance, $T_A$ = 25°C, $Z_O$ = 50 Ω

(unless otherwise noted)

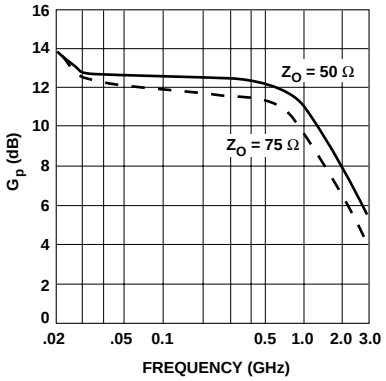



**Figure 1. Typical Power Gain vs. Frequency, $I_d$ = 60 mA.**

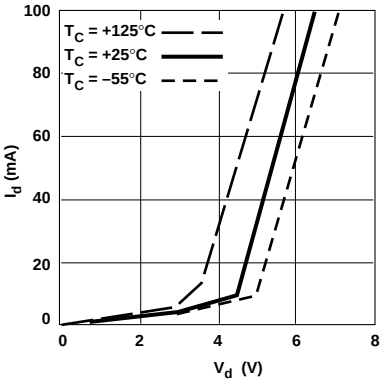



**Figure 2. Device Current vs. Voltage.**

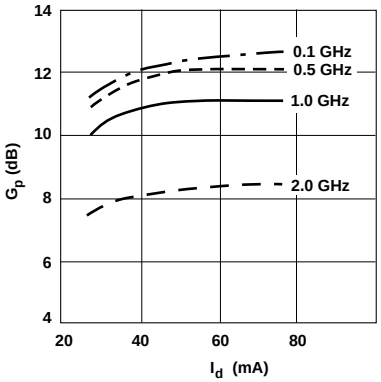



**Figure 3. Power Gain vs. Current.**

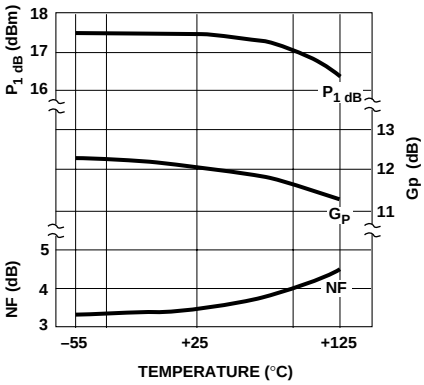



**Figure 4. Output Power at 1 dB Gain Compression, Noise Figure and Power Gain vs. Case Temperature, f = 0.5 GHz, $I_d$ = 60 mA.**

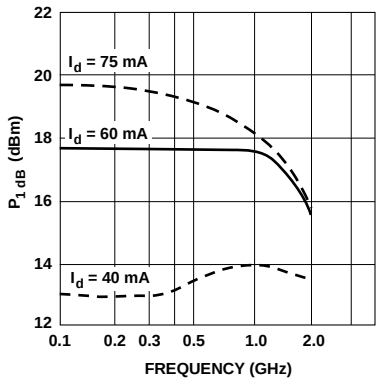



**Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.**

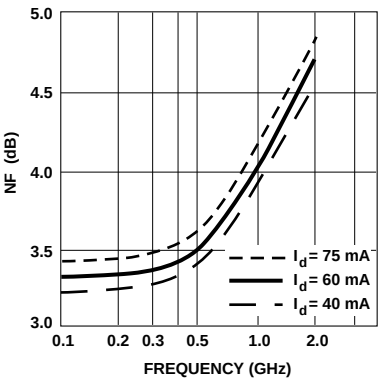



**Figure 6. Noise Figure vs. Frequency.**

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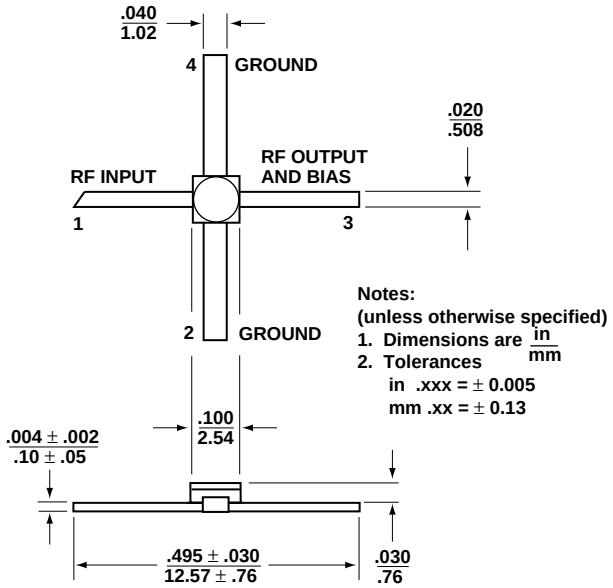
## 100 mil Package Dimensions

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Data subject to change.

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