

# Cascadable Silicon Bipolar MMIC Amplifier

## Technical Data

**MSA-0404**

### Features

- **Cascadable 50 Ω Gain Block**
- **3 dB Bandwidth:**  
DC to 2.5 GHz
- **7.5 dB Typical Gain at  
1.0 GHz**
- **11.5 dBm Typical P<sub>1 dB</sub> at  
1.0 GHz**
- **Unconditionally Stable  
(k>1)**
- **Low Cost Plastic Package**

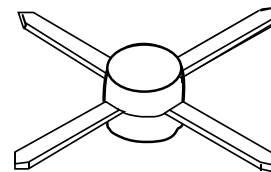
### Description

The MSA-0404 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a low cost

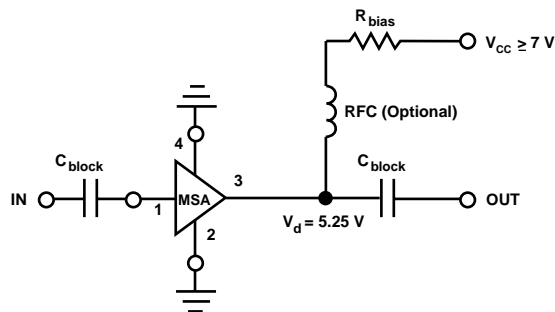
plastic package. This MMIC is designed for use as a general purpose 50 Ω gain block. Typical applications include narrow and broad band IF and RF amplifiers in commercial and industrial applications.

The MSA-series is fabricated using HP'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.

### 04A Plastic Package



### Typical Biasing Configuration



## MSA-0404 Absolute Maximum Ratings

Parameter	Absolute Maximum <sup>[1]</sup>
Device Current	85 mA
Power Dissipation <sup>[2,3]</sup>	500 mW
RF Input Power	+13 dBm
Junction Temperature	150°C
Storage Temperature	-65 to 150°C

### Thermal Resistance<sup>[2,4]</sup>:

$$\theta_{jc} = 85^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{CASE}} = 25^{\circ}\text{C}$ .
3. Derate at 10 mW/°C for  $T_{\text{C}} > 108^{\circ}\text{C}$ .
4. See MEASUREMENTS section "Thermal Resistance" for more information.

## Electrical Specifications<sup>[1]</sup>, $T_{\text{A}} = 25^{\circ}\text{C}$

Symbol	Parameters and Test Conditions: $I_{\text{d}} = 50 \text{ mA}$ , $Z_{\text{o}} = 50 \Omega$	Units	Min.	Typ.	Max.
$G_{\text{P}}$	Power Gain ( $ S_{21} ^2$ ) f = 0.1 GHz f = 0.5 GHz f = 1.0 GHz	dB	7.0	8.3 8.0 7.5	
$\Delta G_{\text{P}}$	Gain Flatness f = 0.1 to 2.0 GHz	dB		± 1.0	
$f_{3 \text{ dB}}$	3 dB Bandwidth	GHz		2.5	
VSWR	Input VSWR f = 0.1 to 2.5 GHz			1.4:1	
	Output VSWR f = 0.1 to 2.5 GHz			1.8:1	
NF	50 $\Omega$ Noise Figure f = 1.0 GHz	dB		7.0	
$P_{1 \text{ dB}}$	Output Power at 1 dB Gain Compression f = 1.0 GHz	dBm		11.5	
$\text{IP}_3$	Third Order Intercept Point f = 1.0 GHz	dBm		24.5	
$t_{\text{D}}$	Group Delay f = 1.0 GHz	psec		150	
$V_{\text{d}}$	Device Voltage	V	4.75	5.25	5.75
dV/dT	Device Voltage Temperature Coefficient	mV/°C		-8.0	

#### Note:

1. The recommended operating current range for this device is 30 to 70 mA. Typical performance as a function of current is on the following page.

### MSA-0404 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ , $T_A = 25^\circ\text{C}$ , $I_d = 50 \text{ mA}$ )

Freq. GHz	S <sub>11</sub>		S <sub>21</sub>			S <sub>12</sub>			S <sub>22</sub>	
	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	Mag	Ang
0.1	.16	175	8.3	2.59	174	-16.2	.156	0	.13	-13
0.2	.16	170	8.2	2.58	168	-16.2	.155	2	.13	-25
0.4	.15	161	8.1	2.54	156	-16.0	.158	4	.14	-47
0.6	.14	152	8.0	2.51	145	-16.0	.158	6	.16	-64
0.8	.12	145	7.8	2.46	133	-15.8	.163	8	.19	-79
1.0	.11	141	7.7	2.41	122	-15.4	.169	9	.21	-91
1.5	.07	141	7.2	2.29	96	-14.6	.186	13	.24	-118
2.0	.09	161	6.6	2.14	71	-13.3	.215	12	.26	-140
2.5	.14	159	5.9	1.98	53	-12.4	.240	13	.28	-157
3.0	.22	148	5.1	1.80	33	-11.7	.260	7	.29	-176
3.5	.30	128	4.3	1.64	13	-10.9	.286	0	.32	167
4.0	.38	109	3.2	1.45	-6	-10.4	.301	-7	.33	153
5.0	.47	91	2.1	1.27	-23	-10.2	.310	-15	.35	137
6.0	.55	75	1.0	1.09	-39	-10.1	.312	-24	.37	120

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

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

(unless otherwise noted)

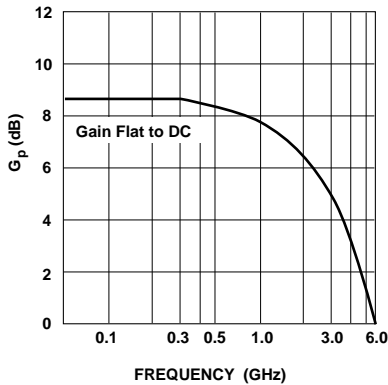


Figure 1. Typical Power Gain vs. Frequency,  $T_A = 25^\circ\text{C}$ ,  $I_d = 50 \text{ mA}$ .

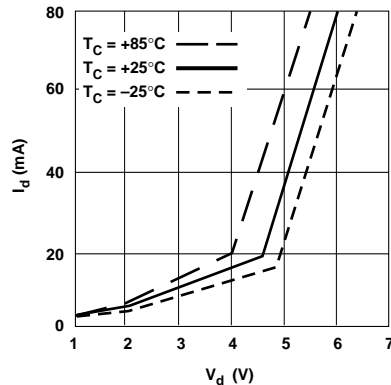


Figure 2. Device Current vs. Voltage.

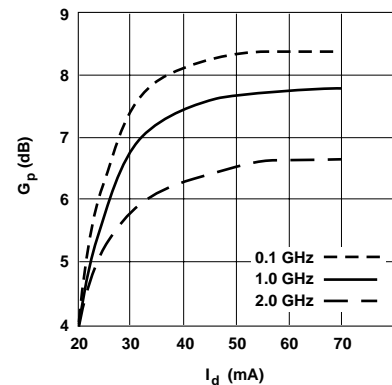


Figure 3. Power Gain vs. Current.

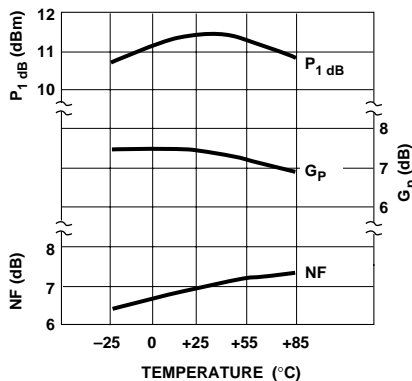


Figure 4. Output Power at 1 dB Gain Compression, NF and Power Gain vs. Case Temperature,  $f = 1.0 \text{ GHz}$ ,  $I_d = 50 \text{ mA}$ .

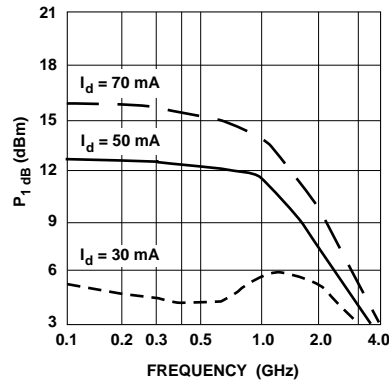


Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.

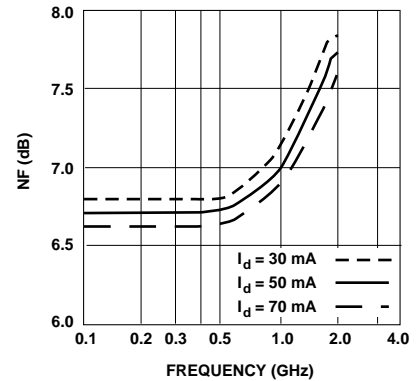


Figure 6. Noise Figure vs. Frequency.

## 04A Plastic Package Dimensions

