

# Cascadable Silicon Bipolar MMIC Amplifier

## Technical Data

### MSA-0200

#### Features

- **Cascadable 50 Ω Gain Block**
- **3 dB Bandwidth:**  
DC to 2.8 GHz
- **12.0 dB Typical Gain at 1.0 GHz**
- **Unconditionally Stable**  
( $k > 1$ )

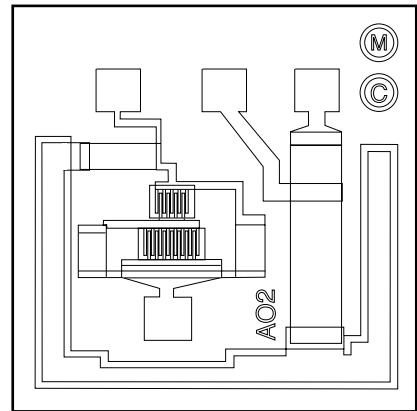
#### Description

The MSA-0200 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) chip. 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, industrial and military 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.

The recommended assembly procedure is gold-eutectic die attach at 400°C and either wedge or ball bonding using 0.7 mil gold wire.<sup>[1]</sup> See APPLICATIONS section, "Chip Use".

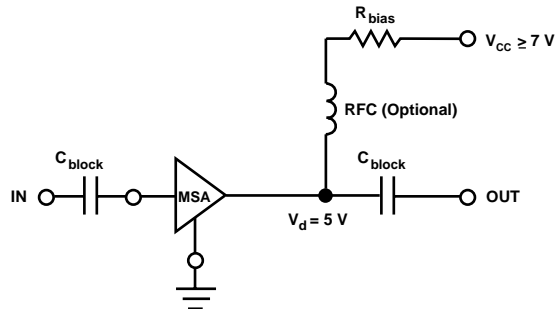
#### Chip Outline<sup>[1]</sup>



#### Note:

1. This chip contains additional biasing options. The performance specified applies only to the bias option whose bond pads are indicated on the chip outline. Refer to the APPLICATIONS section "Silicon MMIC Chip Use" for additional information.

#### Typical Biasing Configuration



## Absolute Maximum Ratings

Parameter	Absolute Maximum <sup>[1]</sup>
Device Current	60 mA
Power Dissipation <sup>[2,3]</sup>	325 mW
RF Input Power	+13 dBm
Junction Temperature	200°C
Storage Temperature	-65 to 200°C

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

$$\theta_{jc} = 35^{\circ}\text{C/W}$$

### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{Mounting Surface}} (T_{\text{MS}}) = 25^{\circ}\text{C}$ .
3. Derate at 28.6 mW/°C for  $T_{\text{MS}} > 189^{\circ}\text{C}$ .
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.

## MSA-0200 Electrical Specifications<sup>[1]</sup>, $T_A = 25^{\circ}\text{C}$

Symbol	Parameters and Test Conditions <sup>[2]:</sup> $I_d = 25 \text{ mA}$ , $Z_o = 50 \Omega$	Units	Min.	Typ.	Max.
$G_P$	Power Gain ( $ S_{21} ^2$ )	dB		12.5	
$\Delta G_P$	Gain Flatness	dB		$\pm 0.6$	
$f_{3 \text{ dB}}$	3 dB Bandwidth	GHz		2.8	
VSWR	Input VSWR			1.4:1	
	Output VSWR			1.4:1	
NF	50 $\Omega$ Noise Figure	dB		6.5	
$P_{1 \text{ dB}}$	Output Power at 1 dB Gain Compression	dBm		4.5	
$IP_3$	Third Order Intercept Point	dBm		17.0	
$t_D$	Group Delay	psec		125	
$V_d$	Device Voltage	V	4.5	5.0	5.5
$dV/dT$	Device Voltage Temperature Coefficient	mV/°C		-8.0	

### Notes:

1. The recommended operating current range for this device is 18 to 40 mA. Typical performance as a function of current is on the following page.
2. RF performance of the chip is determined by packaging and testing 10 devices per wafer in a dual ground configuration.

## Part Number Ordering Information

Part Number	Devices Per Tray
MSA-0200-GP4	100

### MSA-0200 Typical Scattering Parameters<sup>[1]</sup> ( $Z_0 = 50 \Omega$ , $T_A = 25^\circ\text{C}$ , $I_d = 25 \text{ mA}$ )

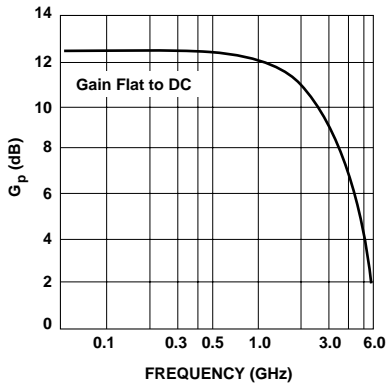
Freq. GHz	$S_{11}$		$S_{21}$			$S_{12}$			$S_{22}$	
	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	Mag	Ang
0.1	.11	179	12.6	4.27	177	-18.4	.120	1	.11	-7
0.2	.11	174	12.6	4.26	172	-18.6	.117	4	.11	-12
0.4	.10	170	12.5	4.24	165	-18.4	.120	5	.12	-25
0.6	.09	166	12.5	4.22	158	-18.2	.123	7	.13	-38
0.8	.08	162	12.4	4.17	152	-18.2	.123	10	.13	-47
1.0	.06	161	12.3	4.13	144	-18.0	.126	13	.14	-55
1.5	.02	-170	12.0	3.99	126	-17.3	.137	17	.15	-72
2.0	.05	-105	11.5	3.74	109	-16.4	.152	20	.15	-89
2.5	.10	-103	10.8	3.46	97	-15.8	.163	25	.13	-91
3.0	.17	-124	9.8	3.10	83	-15.3	.172	26	.11	-100
3.5	.22	-137	8.7	2.71	68	-14.7	.184	22	.13	-94
4.0	.26	-144	7.4	2.35	55	-14.3	.192	22	.16	-85
5.0	.29	-165	5.1	1.80	35	-13.8	.203	17	.22	-76
6.0	.33	-162	3.3	1.46	20	-13.5	.211	14	.23	-82

**Note:**

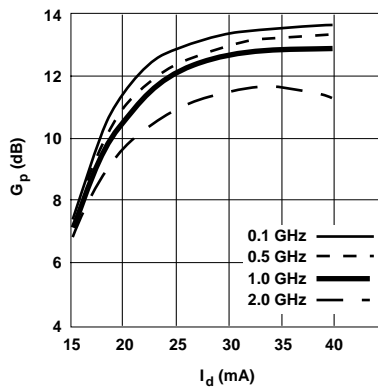
- S-parameters are de-embedded from 70 mil package measured data using the package model found in the DEVICE MODELS section.

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

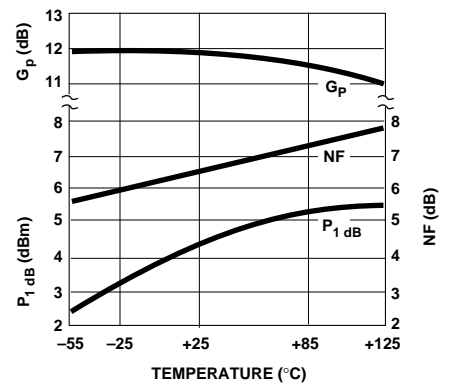
(unless otherwise noted)



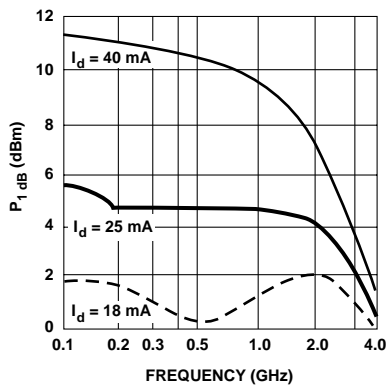
**Figure 1. Typical Power Gain vs. Frequency,  $T_A = 25^\circ\text{C}$ ,  $I_d = 25 \text{ mA}$ .**



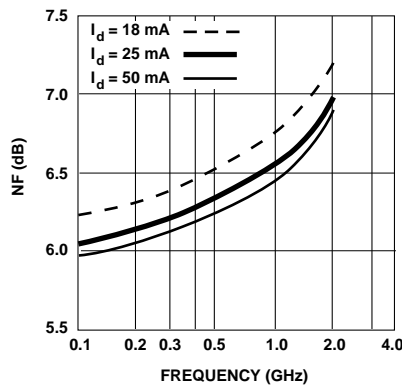
**Figure 2. Power Gain vs. Current.**



**Figure 3. Output Power at 1 dB Gain Compression, NF and Power Gain vs. Mounting Surface Temperature,  $f = 1.0 \text{ GHz}$ ,  $I_d = 25 \text{ mA}$ .**

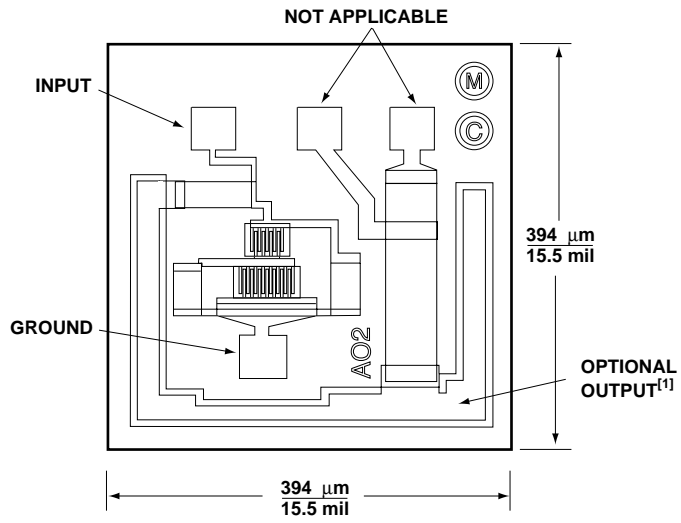


**Figure 4. Output Power at 1 dB Gain Compression vs. Frequency.**



**Figure 5. Noise Figure vs. Frequency.**

## MSA-0200 Chip Dimensions



Unless otherwise specified, tolerances are  $\pm 13 \mu\text{m}/\pm 0.5 \text{ mils}$ . Chip thickness is  $114 \mu\text{m}/4.5 \text{ mil}$ . Bond pads are  $41 \mu\text{m}/1.6 \text{ mil}$  typical on each side. Note 1: Output contact is made by die attaching the backside of the die.