Cascadable Silicon Bipolar MMIC Amplifier

Technical Data

MSA-0500

Features

- **Cascadable 50 Ω Gain Block**
- **High Output Power:** +23 dBm Typical $P_{1\,dB}$ at 1.0 GHz
- **Low Distortion:** 33 dBm Typical IP_3 at 1.0 GHz
- **8.5 dB Typical Gain at 1.0 GHz**

Description

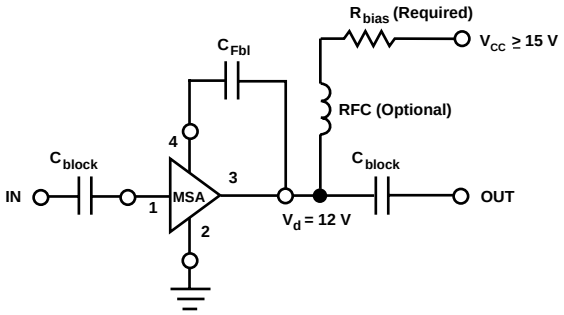
The MSA-0500 is a high performance, medium power silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) chip. This MMIC is designed for use as a general purpose 50 Ω gain block. Typical applications include narrow and broad band IF and RF amplifiers in industrial and military systems.

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.

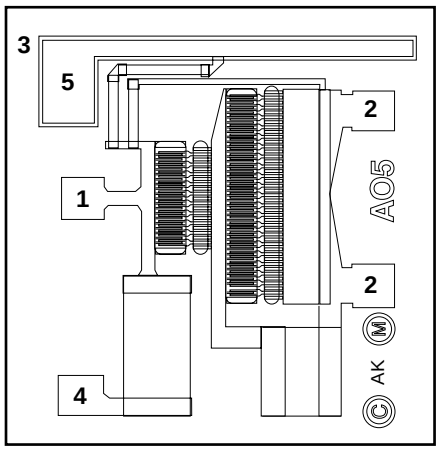
The recommended assembly procedure is gold-eutectic die attach at 400°C and either wedge or ball bonding using 0.7 mil gold wire.

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 capacitor.[1]

Typical Biasing Configuration



Chip Outline[1]



Note:

1. See Application Note, AN-S009: "Silicon MMIC Chip Use" for additional information.

MSA-0500 Absolute Maximum Ratings

Parameter	Absolute Maximum[1]
Device Current	225 mA
Power Dissipation[2,3]	3.0 W
RF Input Power	+25 dBm
Junction Temperature	200°C
Storage Temperature	–65 to 200°C

Thermal Resistance[2,4]:
$\theta_{jc} = 20°C/W$

Notes:
1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{Mounting\ Surface}$ (T_{MS}) = 25°C.
3. Derate at 50 mW/°C for T_{MS} > 140 °C.
4. The small spot size of this technique results in a higher, though more accurate determination of θ_{jc} than do alternate methods.

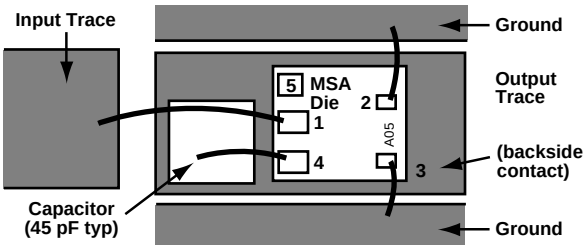
Electrical Specifications[1], T_A = 25°C

Unless otherwise noted, performance is for a MSA-0500 used with an external 45 pF capacitor. See bonding diagram.

Symbol	Parameters and Test Conditions[2]: I_d = 165 mA, Z_O = 50 Ω		Units	Min.	Typ.	Max.
$P_{1\ dB}$	Output Power at 1 dB Gain Compression	f = 1.0 GHz	dBm		23.0	
G_P	Power Gain ($\|S_{21}\|^2$)	f = 0.1 GHz	dB		9.0	
ΔG_P	Gain Flatness	f = 0.1 to 2.0 GHz	dB		± 0.75	
$f_{3\ dB}$	3 dB Bandwidth[3]		GHz		2.8	
VSWR	Input VSWR	f = 0.1 to 2.0 GHz			2.0:1	
	Output VSWR	f = 0.1 to 2.0 GHz			2.5:1	
IP_3	Third Order Intercept Point	f = 1.0 GHz	dBm		33.0	
NF	50 Ω Noise Figure	f = 1.0 GHz	dB		6.5	
t_D	Group Delay	f = 1.0 GHz	psec		125	
V_d	Device Voltage		V	10.5	12.0	13.5
dV/dT	Device Voltage Temperature Coefficient		mV/°C		–16.0	

Notes:
1. The recommended operating current range for this device is 80 to 200 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.
3. Referenced from 0.1 GHz gain (G_p).

Bonding Diagram



Numbers refer to pin contacts listed on the Chip Outline.

Part Number Ordering Information

Part Number	Devices Per Tray
MSA-0500-GP4	100

MSA-0500 Typical Scattering Parameters[1,2] (T_A = 25°C, I_d = 165 mA)

Freq. GHz	S_{11}		S_{21}			S_{12}			S_{22}		k
	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	Mag	Ang	
0.001	.68	–8	15.6	6.05	176	–26.2	.149	25	.79	–7	0.92
0.005	.57	–38	14.6	5.37	186	–19.3	.108	38	.67	–35	0.56
0.010	.43	–65	12.8	4.38	158	–15.7	.165	30	.50	–61	0.64
0.050	.16	–111	9.8	3.08	164	–14.2	.194	10	.19	–101	1.06
0.100	.12	–134	9.3	2.90	169	–14.0	.200	4	.13	–117	1.11
0.200	.12	–141	9.1	2.86	168	–13.9	.202	4	.12	–125	1.13
0.400	.13	–133	9.1	2.84	162	–13.8	.204	4	.17	–116	1.10
0.600	.16	–124	9.1	2.84	155	–13.7	.207	4	.22	–109	1.05
0.800	.21	–118	9.0	2.83	148	–13.6	.210	5	.28	–108	0.99
1.00	.25	–115	9.0	2.83	139	–13.4	.213	6	.34	–106	0.91
1.50	.36	–113	8.8	2.75	118	–12.7	.232	9	.44	–107	0.72
2.00	.45	–120	8.2	2.58	96	–11.6	.262	12	.66	–111	0.39
2.50	.51	–125	7.3	2.32	83	–11.0	.281	17	.58	–109	0.43
3.00	.52	–134	6.0	2.00	66	–10.5	.297	18	.58	–109	.46
3.50	.51	–144	4.8	1.75	52	–9.6	.329	20	.58	–106	0.49
4.00	.46	–157	3.7	1.53	39	–9.2	.347	21	.54	–104	0.60

Notes:

1. S-parameters are de-embedded from 200 mil BeO package measured data using the package model found in the DEVICE MODELS section.
2. S-parameter data assumes an external 45 pF capacitor. Low frequency performance can be extended using a larger valued capacitor.

Typical Performance, T_A = 25°C

(unless otherwise noted)

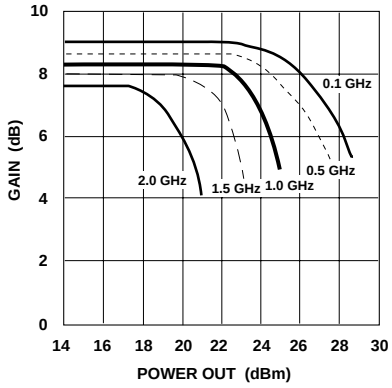


Figure 1. Typical Gain vs. Power Out, T_A = 25°C, I_d = 165 mA.

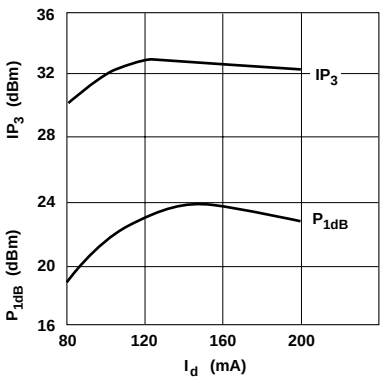


Figure 2. Output Power @ 1 dB Gain Compression, Third Order Intercept Point, f = 1.0 GHz.

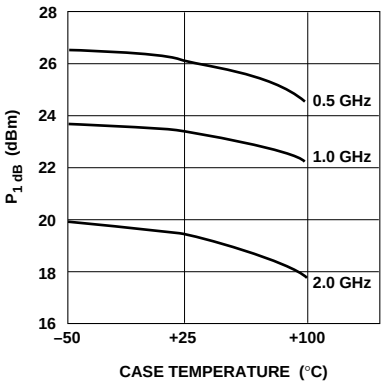


Figure 3. Output Power @ 1 dB Gain Compression vs. Temperature, I_d = 165 mA.

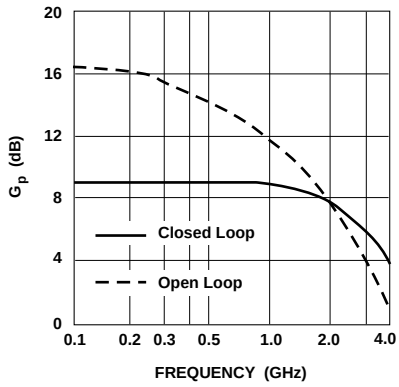
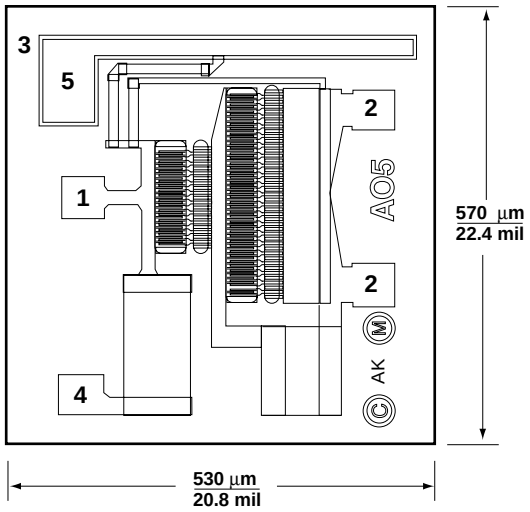


Figure 4. Gain vs. Frequency.

MSA-0500 Chip Dimensions[1]



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.
Note 1: Output contact is made by die attaching the backside of the die.