HEWLETT PACKARD

Cascadable Silicon Bipolar MMIC Amplifier

Technical Data

MSA-1000

Features

- **High Output Power:** +27 dBm Typical P_{1dB} at 1.0 GHz
- **Low Distortion:** 37 dBm Typical IP_3 at 1.0 GHz
- **8.5 dB Typical Gain at 1.0 GHz**
- **Impedance Matched to 25 Ω for Push-Pull Configurations**

Description

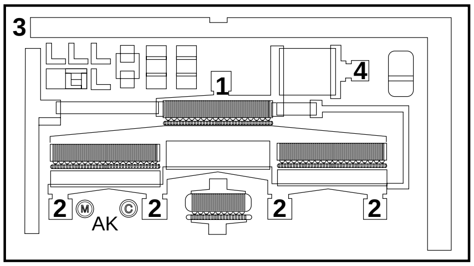
The MSA-1000 is a high performance, medium power silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) chip. This MMIC is designed for use in a push-pull configuration in a 25 Ω system. The MSA-1000 can also be used as single-ended amplifier in a 50 Ω system with slightly reduced performance. Typical applications include narrow and broadband 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.

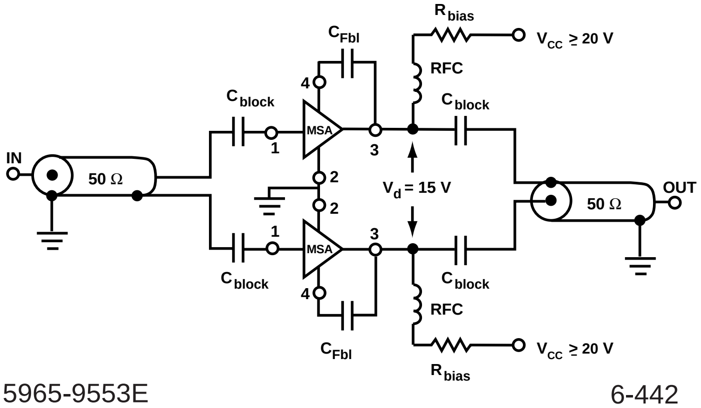
This chip is intended to be used with an external blocking capacitor completing the shunt feedback path (closed loop). Data sheet characterization is given for a 80 pF capacitor. Low frequency performance can be extended by using a larger valued capacitor.[1]

Chip Outline[1]



Note:
1. Refer to the APPLICATIONS section "Silicon MMIC Chip Use" for additional information.

Typical Push-Pull Biasing Configuration



MSA-1000 Absolute Maximum Ratings

Parameter	Absolute Maximum[1]
Device Current	425 mA
Power Dissipation[2,3]	7.0 W
RF Input Power	+25 dBm
Junction Temperature	200°C
Storage Temperature	–65 to 200°C

Thermal Resistance[2,4]:
θ_{jc} = 10°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 100 mW/°C for $T_{Mounting\ Surface}$ > 130°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

Symbol	Parameters and Test Conditions[2]: I_d = 325 mA, Z_O = 25 Ω		Units	Min.	Typ.	Max.
G_P	Power Gain ($\|S_{21}\|^2$)	f = 1.0 GHz	dB		8.5	
ΔG_P	Gain Flatness	f = 0.1 to 2.0 GHz	dB		± 0.6	
$f_{3\ dB}$	3 dB Bandwidth[3]		GHz		2.6	
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	
NF	25 Ω Noise Figure	f = 1.0 GHz	dB		7.0	
$P_{1\ dB}$	Output Power at 1 dB Gain Compression	f = 1.0 GHz	dBm		27.0	
IP_3	Third Order Intercept Point	f = 1.0 GHz	dBm		37.0	
t_D	Group Delay	f = 1.0 GHz	psec		175	
V_d	Device Voltage		V	13.5	15.0	16.5
dV/dT	Device Voltage Temperature Coefficient		mV/°C		–18.0	

Notes:
1. The recommended operating current range for this device is 150 to 400 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.
3. Referenced from 0.1 GHz gain (G_P).

Part Number Ordering Information

Part Number	Devices Per Tray
MSA-1000-GP4	100

MSA-1000 Typical Scattering Parameters[1,2] ($Z = 50\ \Omega$, $T_A = 25°C$, $I_d = 325$ mA)

Freq. GHz	S_{11}		S_{21}			S_{12}			S_{22}		
	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	Mag	Ang	k
0.001	.41	–121	15.5	5.95	149	–17.7	.130	22	.43	–99	0.68
0.005	.52	–167	8.7	2.73	156	–15.7	.164	6	.48	–161	1.02
0.010	.54	–174	7.7	2.41	166	–15.6	.166	3	.46	–171	1.12
0.050	.54	–179	7.3	2.31	174	–15.7	.165	1	.46	–178	1.17
0.100	.55	179	7.2	2.30	173	–15.7	.165	–1	.46	–179	1.17
0.200	.55	178	7.2	2.30	168	–15.7	.165	–1	.47	177	1.16
0.400	.54	176	7.2	2.29	157	–15.7	.165	–3	.48	176	1.16
0.600	.52	174	7.2	2.30	146	–15.8	.163	–4	.48	174	1.16
0.800	.51	174	7.2	2.29	134	–15.8	.161	–5	.48	173	1.15
1.000	.50	172	7.2	2.29	121	–15.9	.160	–5	.49	172	1.12
1.200	.48	173	7.2	2.28	108	–16.0	.158	–6	.49	172	1.10
1.400	.47	175	7.1	2.26	96	–16.2	.155	–7	.50	174	1.05
1.600	.46	178	6.8	2.20	83	–16.3	.153	–7	.51	175	1.00
1.800	.46	179	6.4	2.09	62	–16.5	.150	–8	.53	176	0.94
2.000	.48	–177	6.0	1.99	56	–16.6	.148	–10	.65	–179	0.68
2.500	.56	–170	4.4	1.65	35	–17.0	.141	–1	.54	178	.91
3.000	.61	–171	2.7	1.36	12	–16.7	.147	1	.69	–176	.52

Notes:

1. S-parameters are de-embedded from 100 mil BeO package measured data using the package model found in the DEVICE MODELS section.
2. S-parameter data assumes an external 80 pF capacitor. Low frequency performance can be extended using a larger valued capacitor.

Typical Performance, $T_A = 25°C$

(unless otherwise noted)

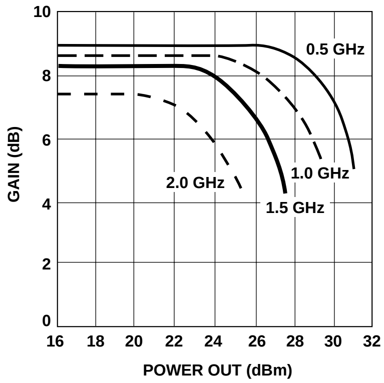


Figure 1. Typical Gain vs. Power Out, $Z_O = 25\ \Omega$, $I_d = 325$ mA.

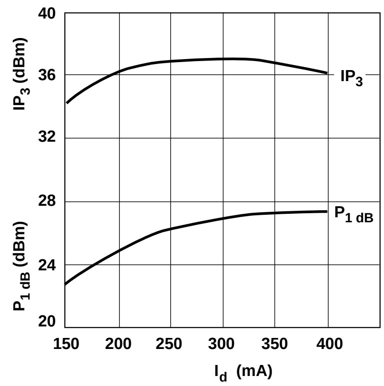


Figure 2. Output Power at 1 dB Gain Compression, Third Order Intercept Point vs. Current, $Z_O = 25\ \Omega$, f=1.0GHz.

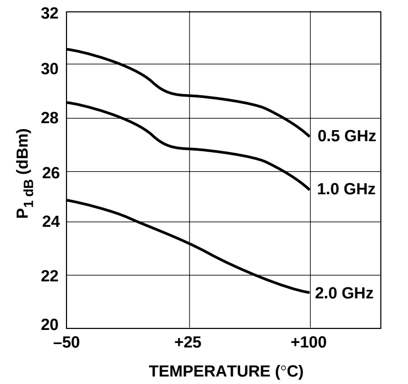


Figure 3. Output Power at 1 dB Gain Compression vs. Case Temperature, $Z_O = 25\ \Omega$, $I_d = 325$ mA.

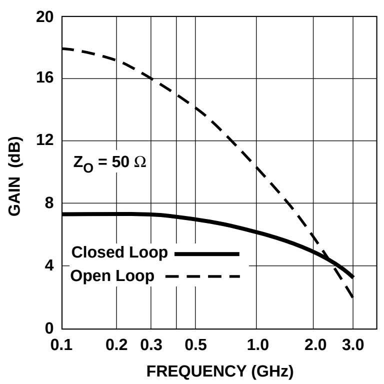
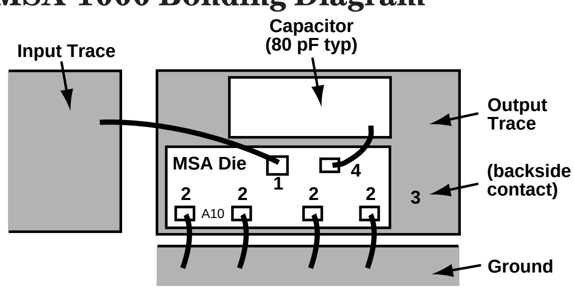


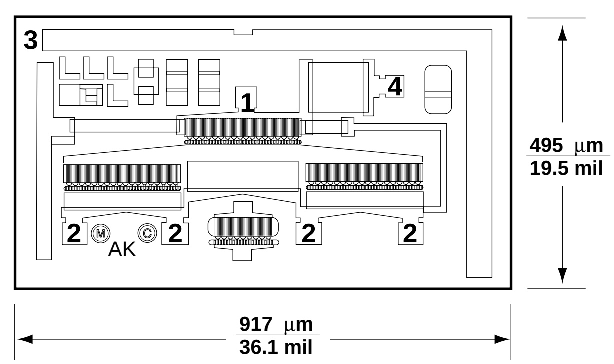
Figure 4. Gain vs. Frequency, $I_d = 325$ mA.

MSA-1000 Bonding Diagram



Numbers refer to pin contacts listed on the Chip Outline.

MSA-1000 Chip Dimensions



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.