

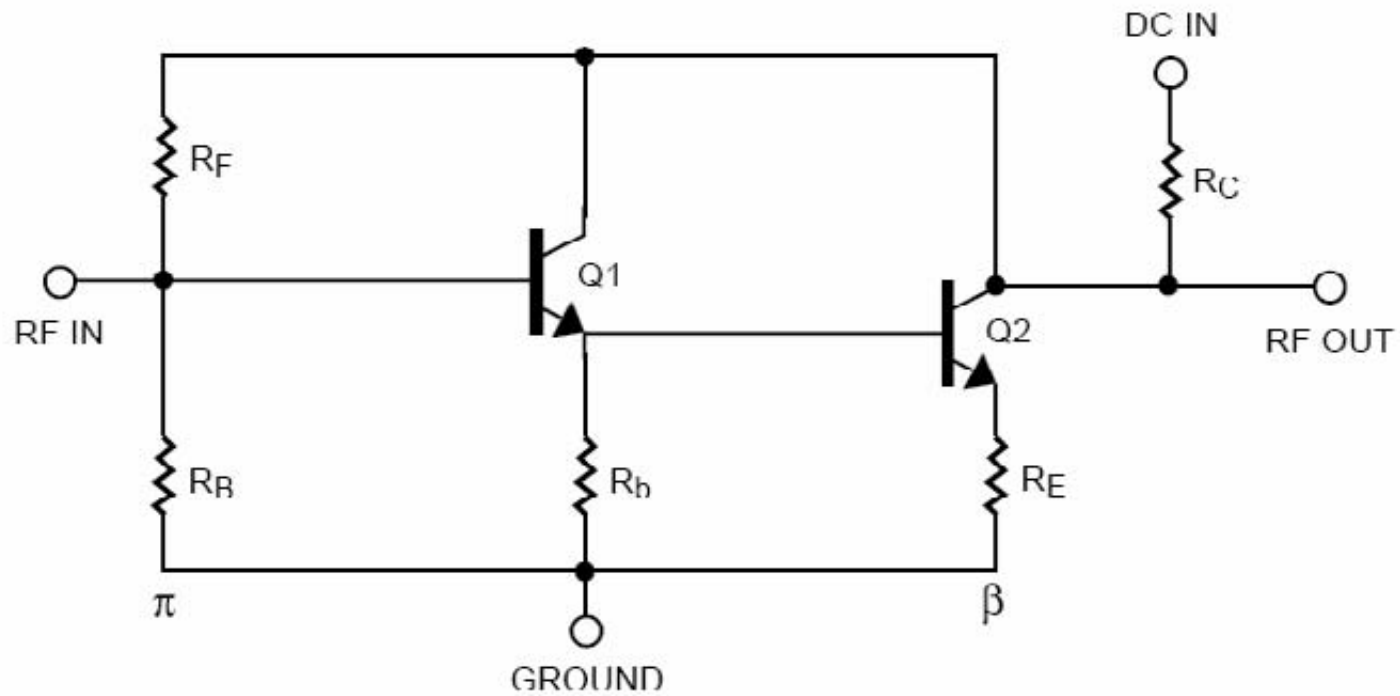
Biasing MSA and MAR/MAV Series Silicon MMICs

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February 1, 2007

MSA and MAR/MAV Series Silicon MMICs



Darlington connected transistor pair

Biasing MSA and MAR/MAV Series Silicon MMICs

MSA-1105

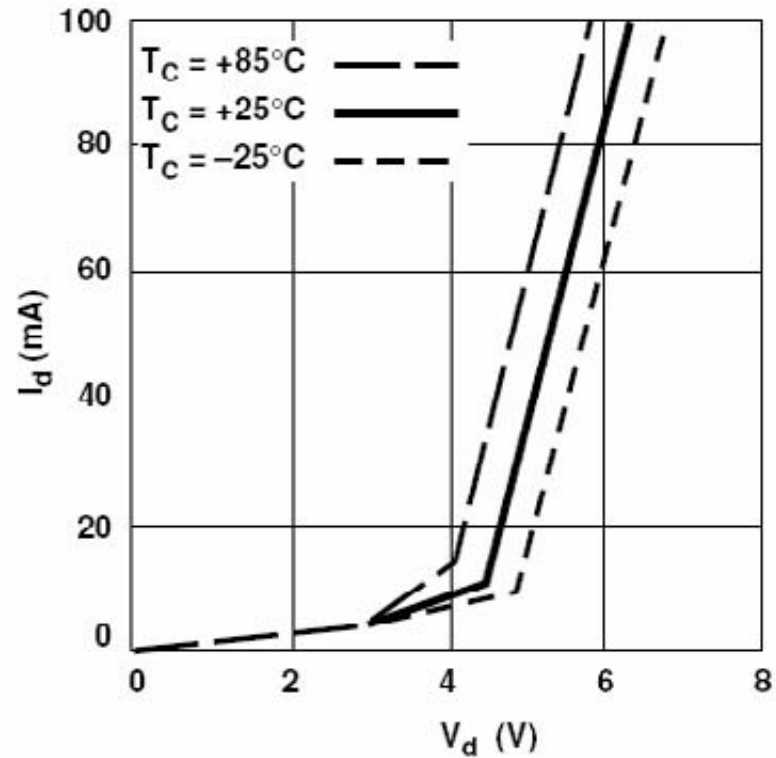
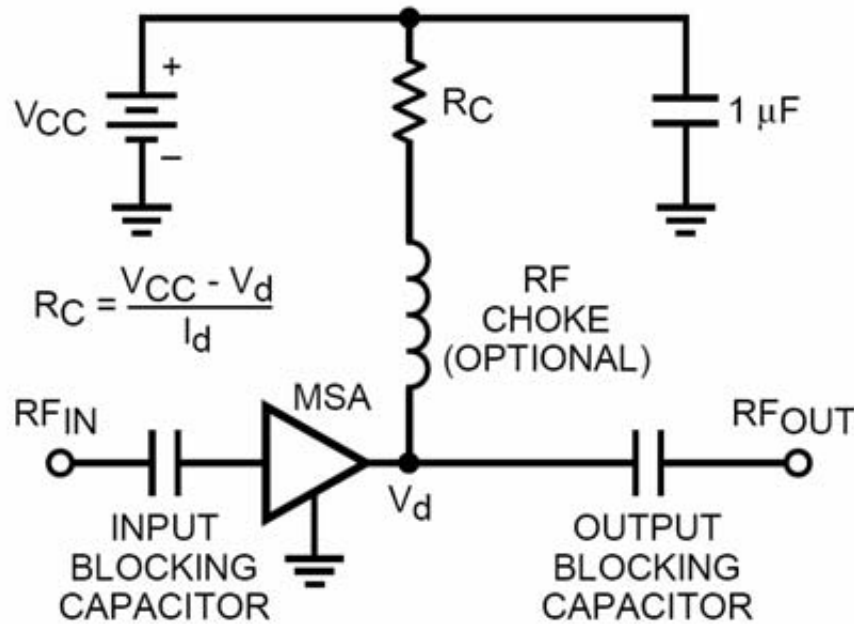


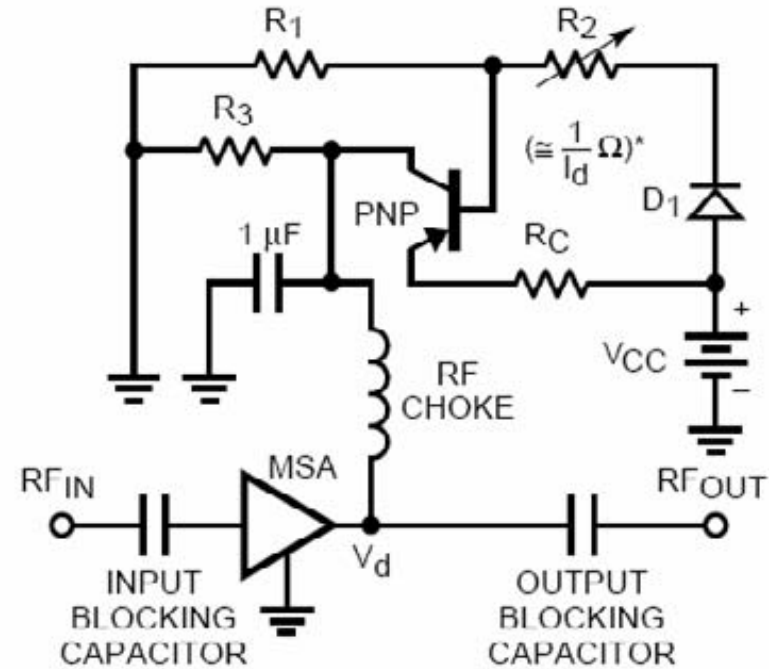
Figure 2. Device Current vs. Voltage.

Two Biasing Techniques for MSA Devices

Passive Biasing



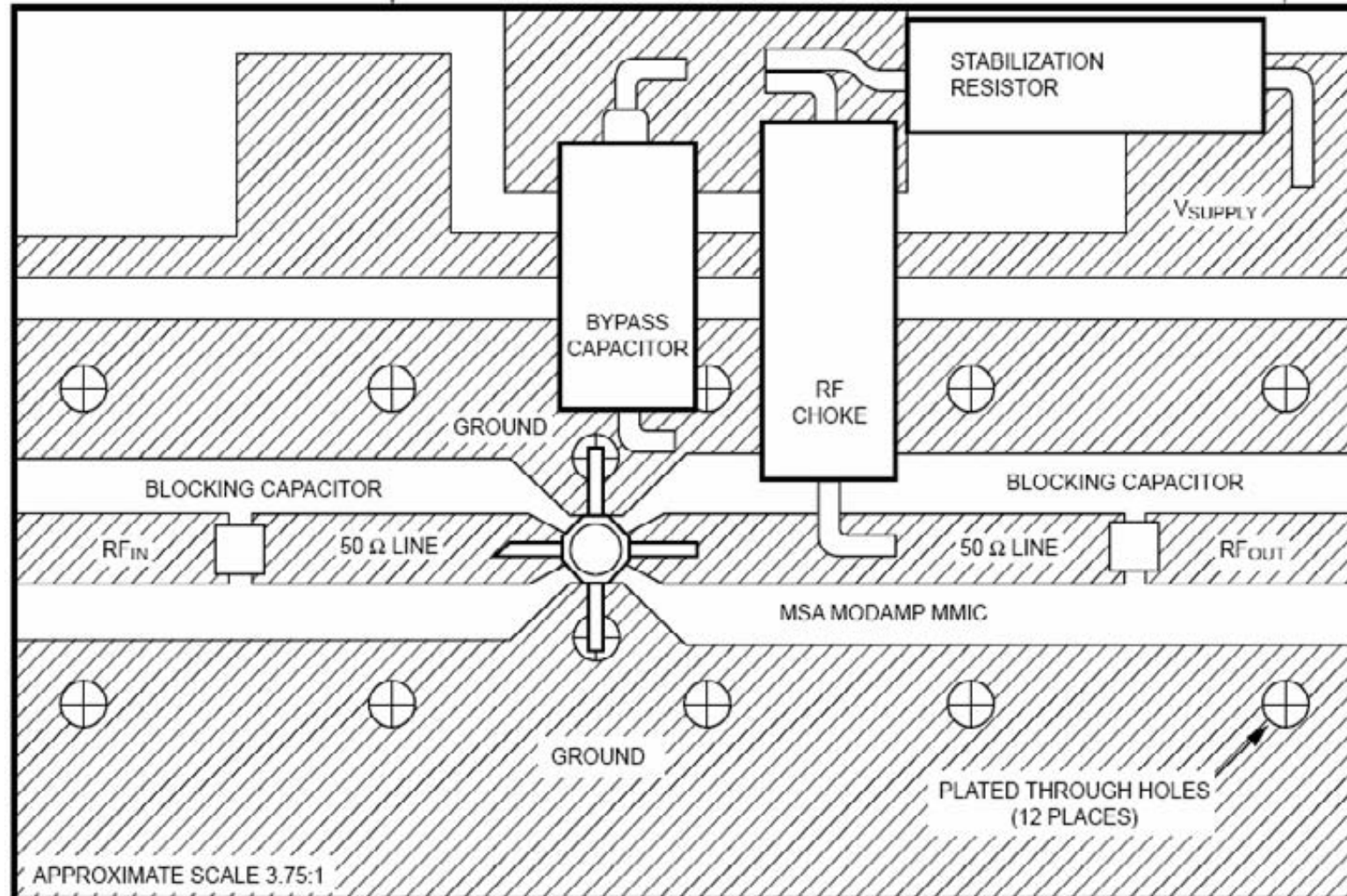
Active Biasing



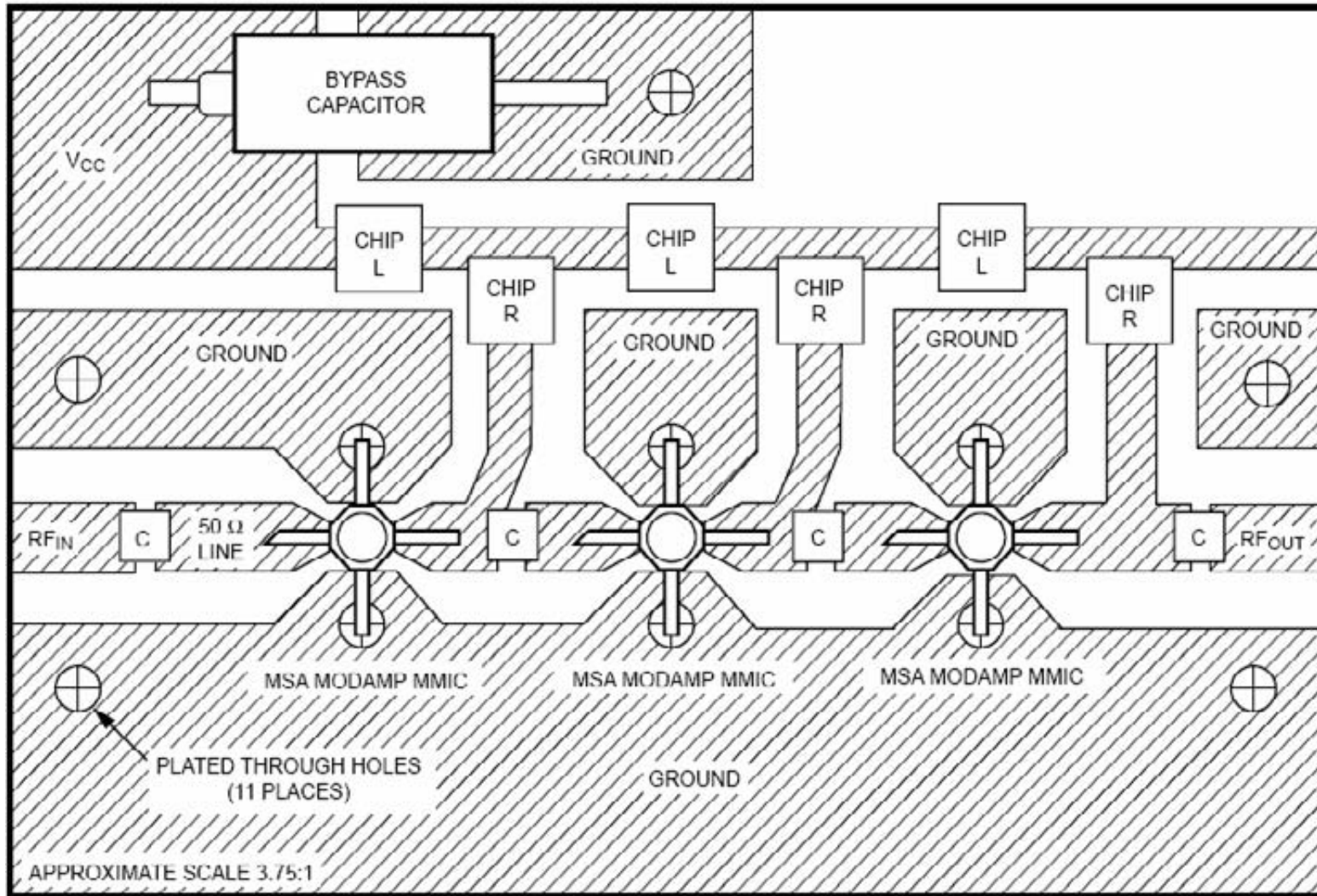
* (ASSUMES A 1 VOLT DROP ACROSS R_C)

$$R = \frac{12 - 5.5}{.059} = 110 \Omega$$

Typical MSA Demo Board



Cascading MSA MMICs



Biasing MSA and MAR/MAV Series Silicon MMICs

AppCAD - [I-Biased Circuit]

File Calculate Select Parameters Options Help

Main Menu [F8]

Current-Biased Circuit

Frequency

Flow

450 MHz

Calculate [F4]

Design Rule (loss per blocking cap)

- 0.01 dB
- 0.1 dB (default)
- 0.25 dB
- 0.5 dB

Note: Click on Cin, Cout to toggle in/out or use Menu Alt-S

$Z_0 = 50 \Omega$
 $C_{in} = 24 \text{ pF}$
 $R_{RFC} = 360 \text{ nH}$
 $R_{bias} = 110 \text{ Ohm}$
 $V_s = 12 \text{ V}$
 $L_b = 1.5 \text{ nH}$
 $C_{out} = 24 \text{ pF}$
 $Z_L = 20 \Omega$

$\theta_{j-c} = 125 \text{ }^\circ\text{C/W}$
 $\delta V_d / \delta T = -0 \text{ mV/}^\circ\text{C}$

$V_d = \begin{cases} 6.6 \text{ V Max} \\ 5.5 \text{ V Typ} \\ 4.4 \text{ V Min} \end{cases}$

$I_d \text{ Design Goal} = 60 \text{ mA}$
 $T_{case} = -25 \text{ }^\circ\text{C} \quad 25 \text{ }^\circ\text{C} \quad 85 \text{ }^\circ\text{C}$

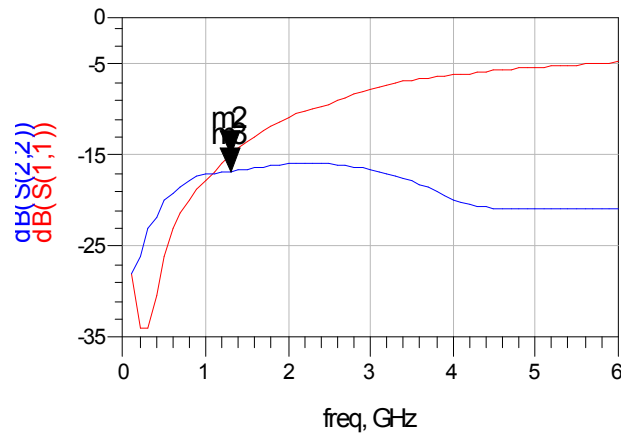
Id and Thermal Analysis:

$T_{case} =$	-25 $^\circ\text{C}$	25 $^\circ\text{C}$	85 $^\circ\text{C}$	
$I_j =$	13.1	65.6	129.1	$^\circ\text{C}$
$P_d =$	305.0	325.0	352.8	mW
$I_d \text{ max} =$	65.5	69.1	73.5	mA
$I_d \text{ typ} =$	55.5	59.1	63.5	mA
$I_d \text{ min} =$	45.5	49.1	53.5	mA

Bias loss = 0.23 dB Pd of Rbias = 593.5 mW

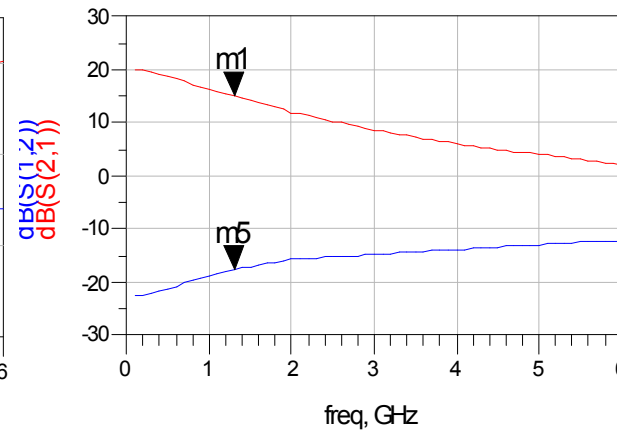
Normal [Click for Web: APPLICATION NOTES - MODELS - DESIGN TIPS - DATA SHEETS - S-PARAMETERS](#)

MSA-0686 with Common Leads Hard Grounded



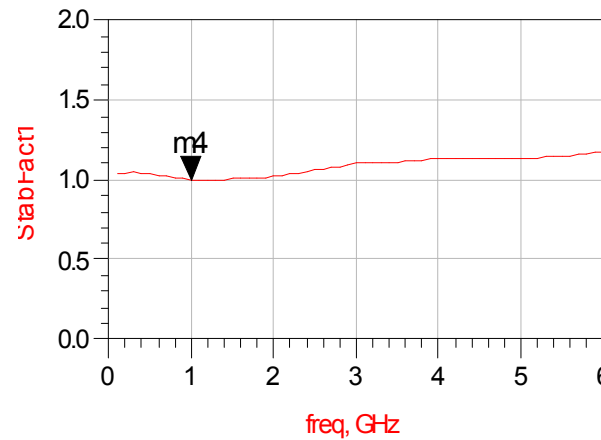
m2
freq=1.300GHz
dB(S(1,1))=-14.992

m3
freq=1.300GHz
dB(S(2,2))=16.713



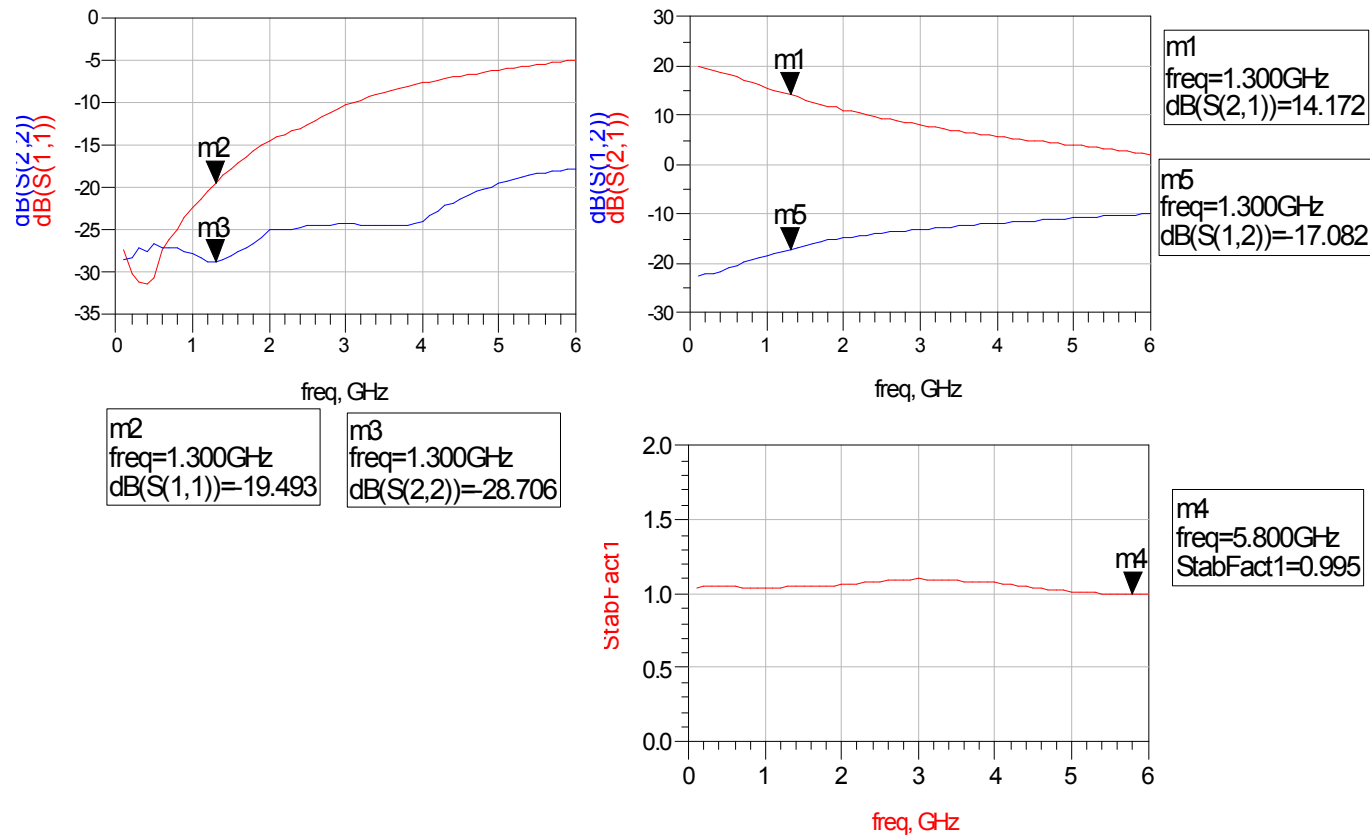
m1
freq=1.300GHz
dB(S(2,1))=15.062

m5
freq=1.300GHz
dB(S(1,2))=-17.721

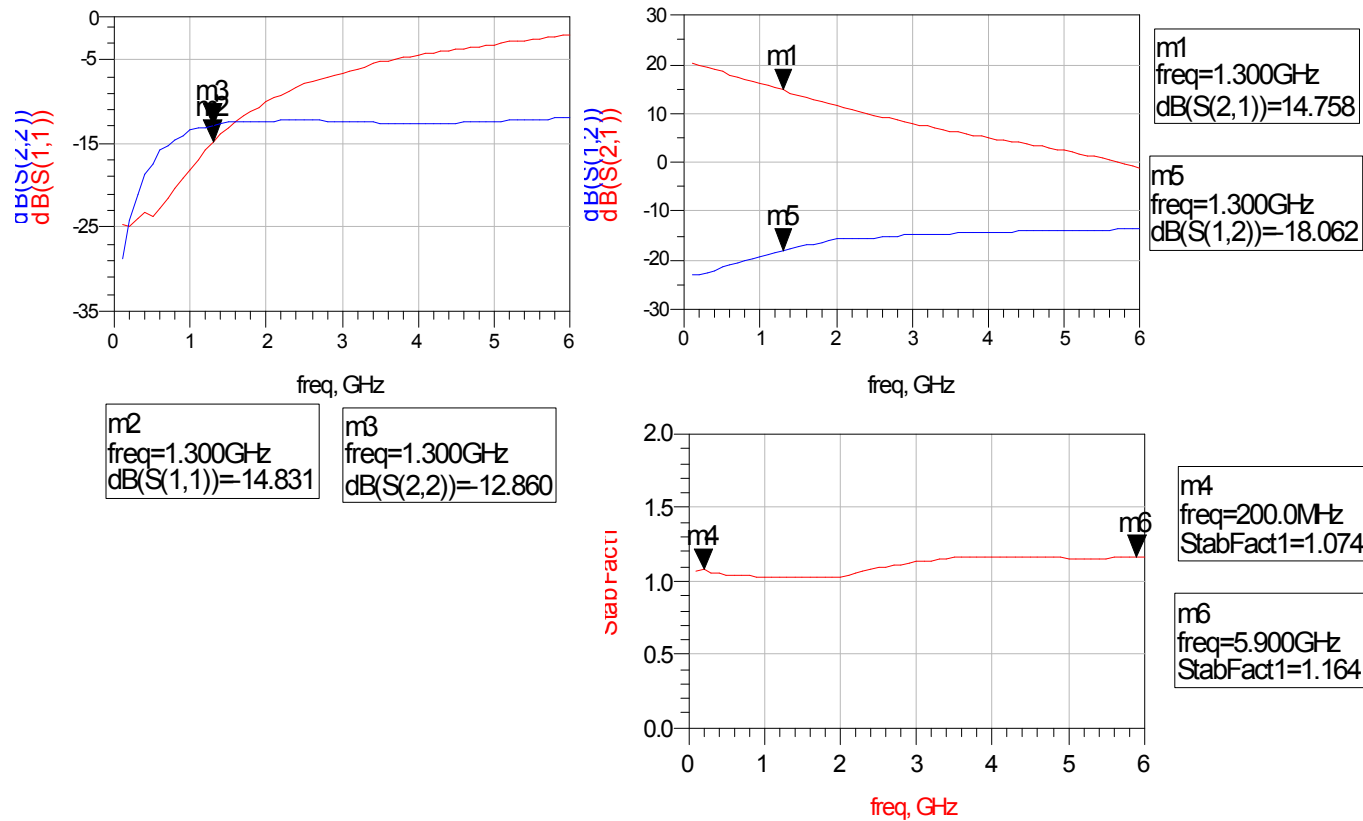


m4
freq=1.000GHz
StabFact1=1.002

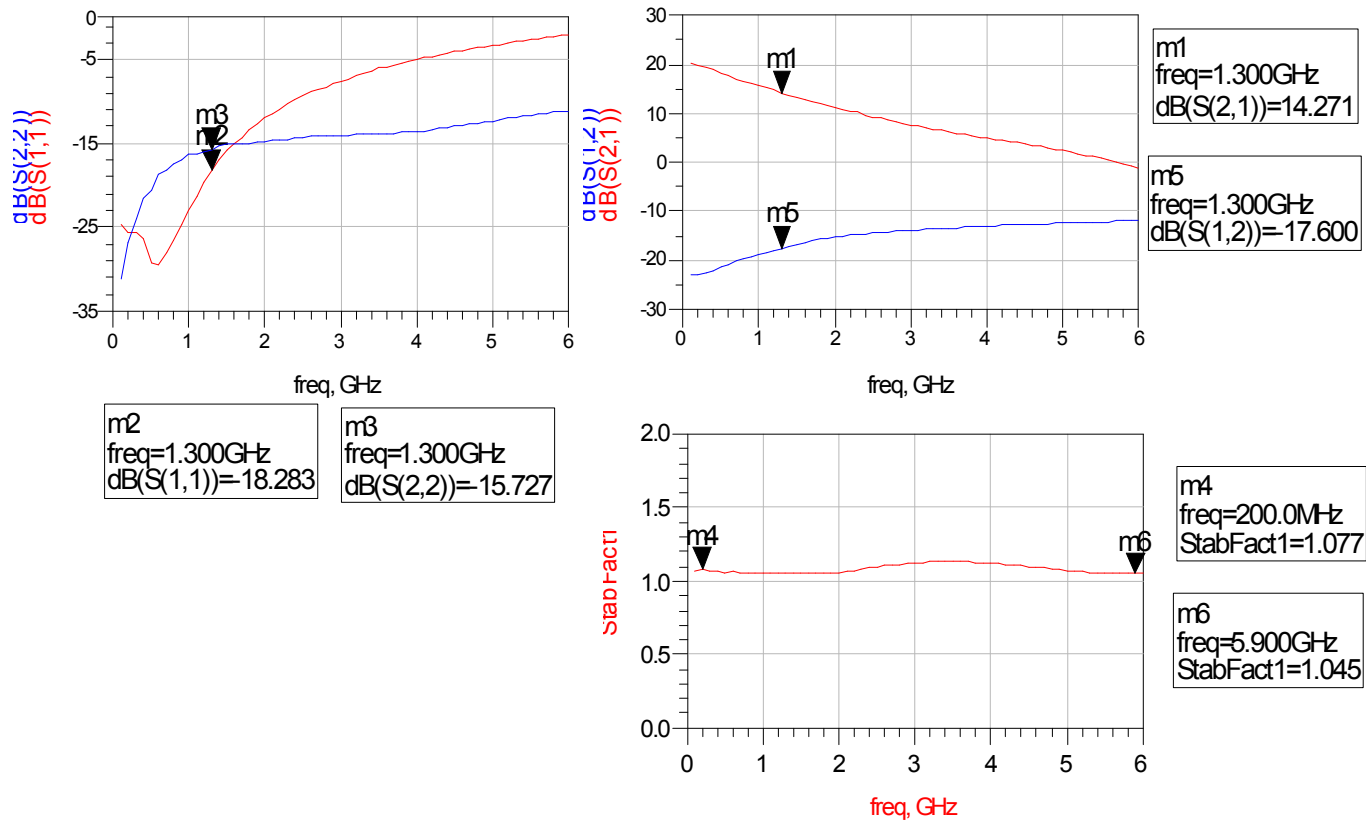
MSA-0686 with .25 nH of Common Lead Inductance



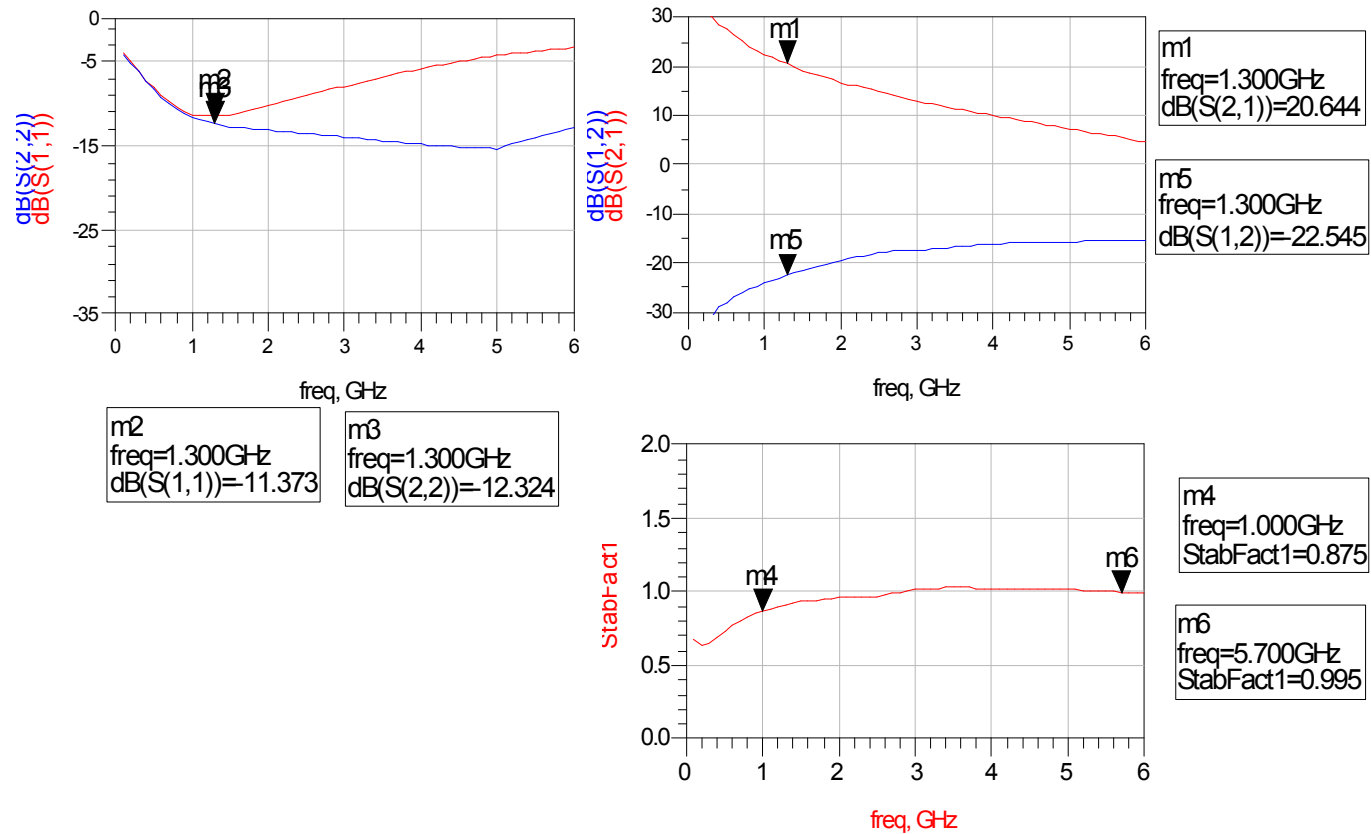
MSA-0686 with 2 PTHs on .031 inch thickness printed circuit board



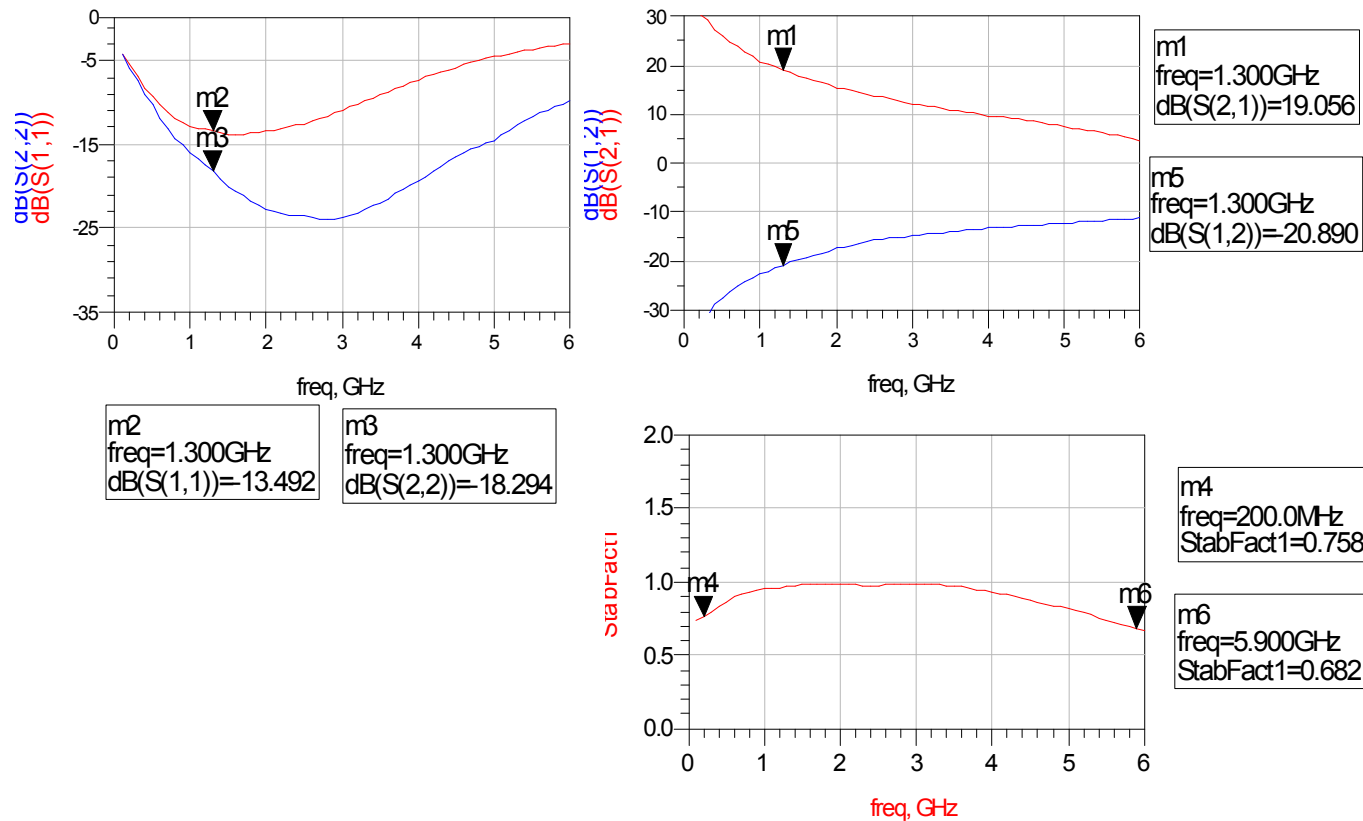
MSA-0686 with 2 PTHs on .062 inch thickness printed circuit board



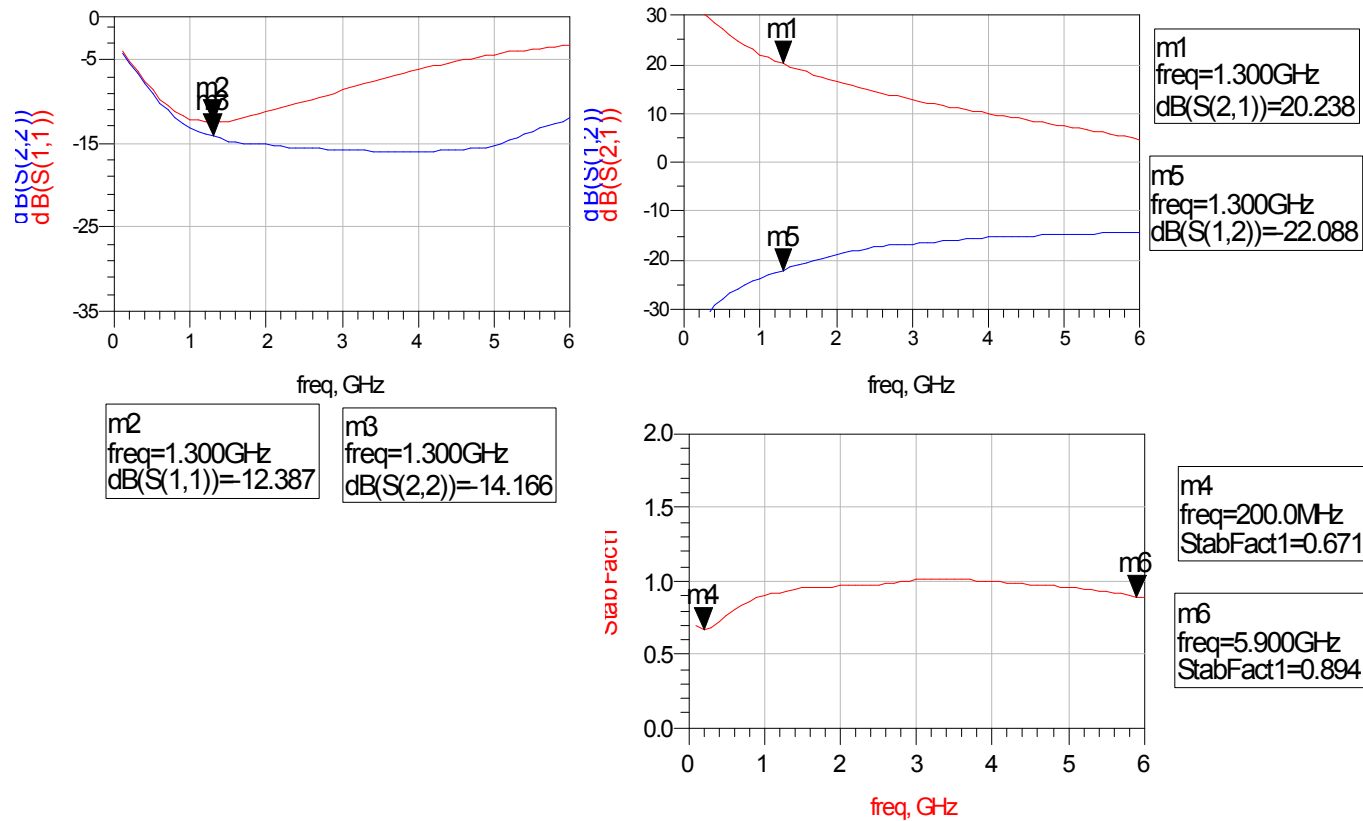
MSA-0886 with Common Leads Hard Grounded



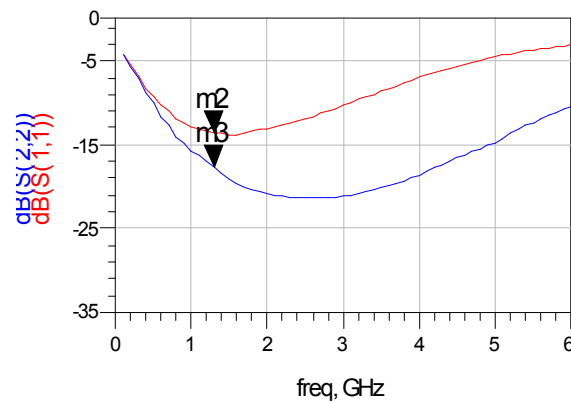
MSA-0886 with .25 nH of Common Lead Inductance



MSA-0886 with 2 PTHs on .031 inch thickness printed circuit board

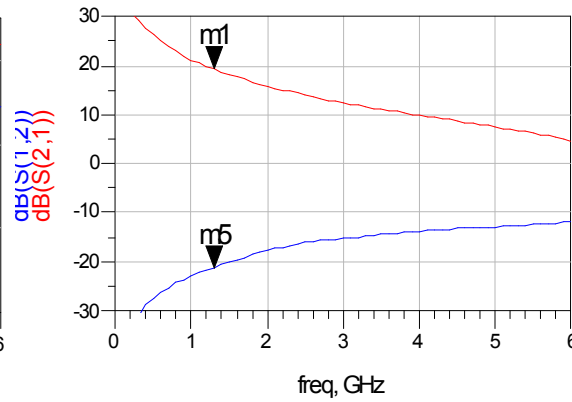


MSA-0886 with 2 PTHs on .062 inch thickness printed circuit board



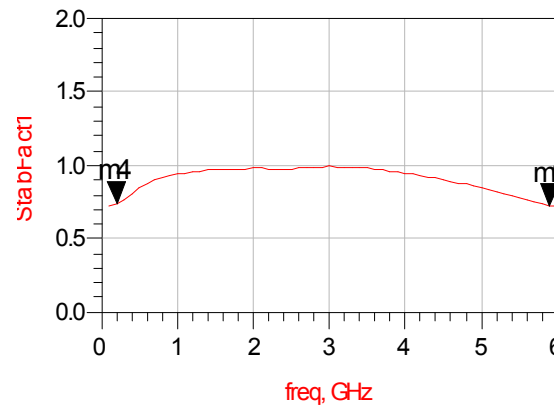
m2
freq=1.300GHz
dB(S(1,1))=-13.525

m3
freq=1.300GHz
dB(S(2,2))=-17.769



m1
freq=1.300GHz
dB(S(2,1))=19.373

m5
freq=1.300GHz
dB(S(1,2))=-21.189



m4
freq=200.0MHz
StabFact1=0.735

m6
freq=5.900GHz
StabFact1=0.729

Related Application Notes and Articles

AN S001 Basic MODAMP MMIC Circuit Techniques – 5967-5924E (11/99)

AN S003 Biasing MSA Series RF Integrated Circuits – 5965-8669E (11/99)

AN S005 Using MSA Series MMIC Amplifiers as Frequency Converters – 5965-7391E (11/99)

Summary

MSAs are current driven devices

Grounding can be important on high gain MMICs – prefer .031 inch thickness PCB material

Series RL combination for biasing MMICs

Use series decoupling elements when biasing 2 or more MMICs in cascade