

**Low Cost MMIC Mixer**  
**800 - 1000 MHz**

**MD54-0005**  
**V4**

**Features**

- Input Power @ 1 dB Compression: +15 dBm
- High LO to RF Isolation: 35 dB
- LO Drive Level: +3 to +8 dBm
- DC - 200 MHz 3 dB IF Bandwidth
- Does not require DC bias
- Ultra-Miniature SOT-25 Plastic Package

**Description**

M/A-COM's MD54-0005 is a passive mixer that achieves the performance of a double balanced diode mixer in an ultra-miniature SOT-25 package. The MD54-0005 is ideally suited for use where high level RF signals and very wide dynamic range are required. Typical applications include frequency up/down conversion, modulation, and demodulation in receivers and transmitters for basestation and portable systems.

The MD54-0005 employs GaAs FETs as mixing elements to achieve a very wide dynamic range in a low cost plastic pack-age. The mixer operates with LO drive levels of +3 dBm to +8 dBm. The LO port may be externally tuned for operation in various frequency bands.

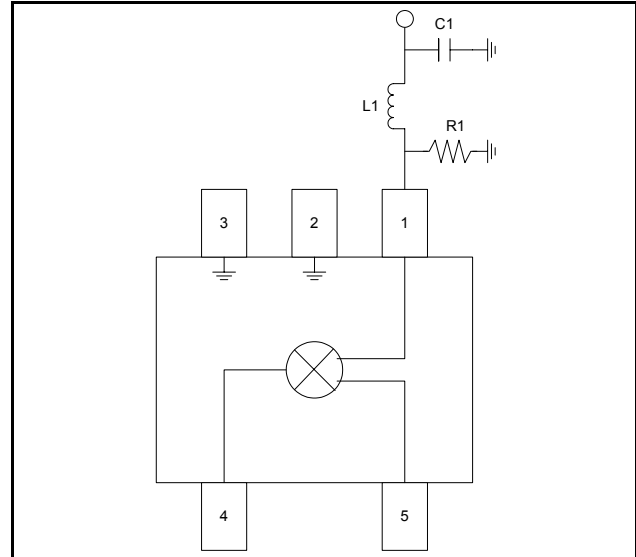
M/A-COM's GaAs IC is fabricated using a mature 0.5 micron gate length GaAs MESFET process. The process features full passivation for increased performance and reliability.

**Ordering Information**

Part Number	Package
MD54-0005	Bulk Packaging
MD54-0005TR	1000 piece reel
MD594-0005SMB	Designers Kit

Note: Reference Application Note M513 for reel size information.

**Functional Schematic**



**Pin Configuration**

Pin No.	Function	Pin No.	Function
1	LO	4	RF
2	GND	5	IF
3	GND		

**External Circuitry Parts List <sup>1</sup>**

Ref. Designation	LO = 840 MHz	LO = 900 MHz
R1	820 Ohms	820 Ohms
L1	22 nH	18 nH
C1	3.3 pF	4 pF

1. All off-chip components are low-cost surface mount components obtainable from multiple sources. (.060 in x .030 in or x .050 in)

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**Electrical Specifications: RF=900 MHz (-10 dBm), LO=840 MHz (+5 dBm), IF=60 MHz, TA = 25°C**

Parameter	Test Conditions	Units	Min	Typ	Max
Conversion Loss	—	dB	—	8.0	9.0
Isolation	LO to RF	dB	25	35	—
	LO to IF	dB	—	25	—
	RF to IF	dB	—	20	—
VSWR	RF Port	Ratio	—	2.0:1	—
	LO Port <sup>2</sup>	Ratio	—	2.0:1	—
	IF Port	Ratio	—	2.0:1	—
Input 1 dB Compression	RF Freq. = 900 MHz, LO = +5 dBm	dBm	—	15	—
Two-Tone IM Ratio <sup>3</sup>	Two tones at -10 dBm each, Tone spacing 100 kHz, IF = 60 MHz	dBc	—	55	—

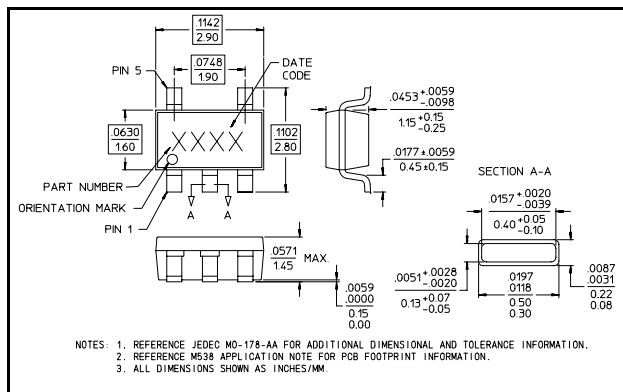
2. With external LO Port matching. See functional block diagram.  
3. IMR vs. RF Drive can be calculated by the formula:  $IMR = 40 - 1.5 \cdot P_{IN}$

**Absolute Maximum Ratings <sup>4</sup>**

Parameter	Absolute Maximum
RF Input Power <sup>5</sup>	+27 dBm
Low Drive Power <sup>5</sup>	+27 dBm
Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.  
5. Ambient Temperature (TA) = +25°C.

**SOT-25 Plastic Package**



**Spurious Table**

Harmonic of LO		Harmonic of RF				
		0x	1x	2x	3x	4x
4x	23.0	36.5	53.8	63.8	68.6	
	10.6	39.9	56.1	58.3	58.8	
3x	34.1	21.6	53.9	53.4	67.3	
	21.3	21.8	57.6	59.3	57.2	
2x	17.7	44.0	51.6	65.2	66.2	
	6.6	44.8	55.5	58.4	56.3	
1x	14.3	0	57.0	63.7	67.0	
	4.0	0	57.6	56.3	56.9	
0x	X	13.9	50.2	59.1	67.2	
	X	13.4	53.1	56.5	57.1	
	<b>0x</b>	<b>1x</b>	<b>2x</b>	<b>3x</b>	<b>4x</b>	

The spurious table shows the spurious signals resulting from the mixing of the RF and LO input signals, assuming down conversion. Mixing products are indicated relative to the IF. The lower frequency mixing term is shown for two different RF input levels. The top number is for an RF input power of 0 dBm, the lower number is for -10 dBm.

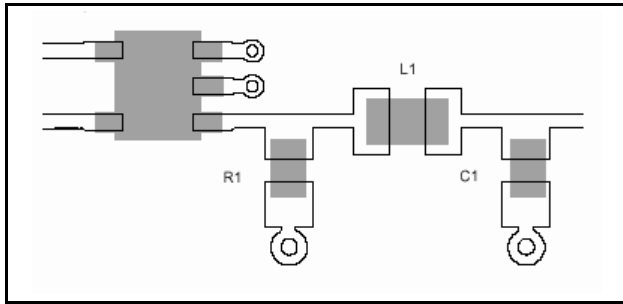
$|nF_{RF} - mF_{LO}|$ , RF = 0 dBm  
 $|nF_{RF} - mF_{LO}|$ , RF = -10 dBm  
 RF Frequency = 900 MHz  
 LO Frequency = 840 MHz

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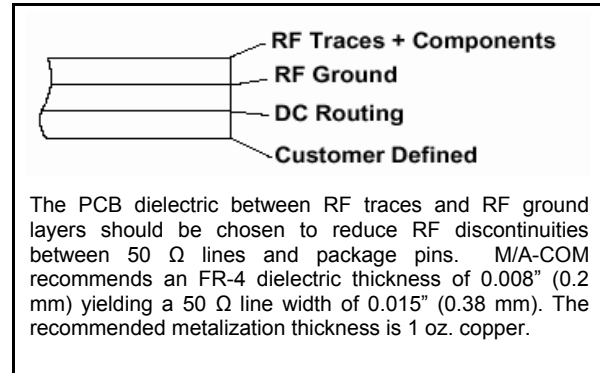
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**Recommended PCB Configuration**

**Layout View**



**Cross Section View**



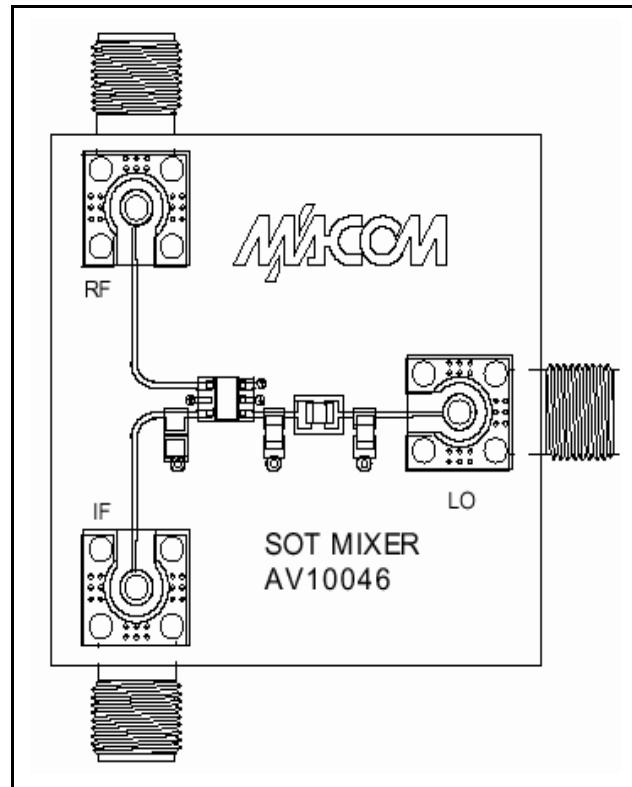
**Designer’s Kit MD54-005SMB**

The MD54-0005SMB Designer’s Kit allows for immediate evaluation of M/A-COM’s MD54-0005. The evaluation board consists of an MD54-0005, recommended external surface mount circuitry, and RF connectors, all mounted to a multi-layer FR-4 PCB. Other items included in the Designer’s Kit are a floppy disk (with typical performance data and a DXF file of the recommended PCB layout) and any additional Application Notes. The MD54-0005SMB evaluation PCB and block diagram are illustrated below with all functional ports labeled.

**Evaluation PCB & RF Connector Losses**

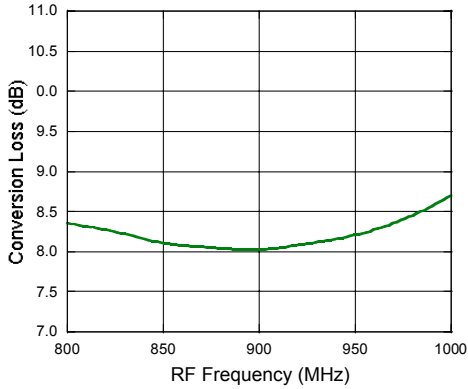
Port Reference	Approximate RF Loss
RF Port	0.10 dB @ 900 MHz
LO Port	0.10 dB @ 900 MHz
IF Port	0.05 dB @ 60 MHz

**Mixer PCB**

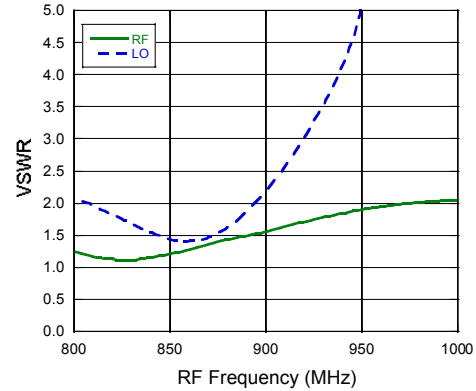


**Typical Performance Curves** <sup>5,6</sup>

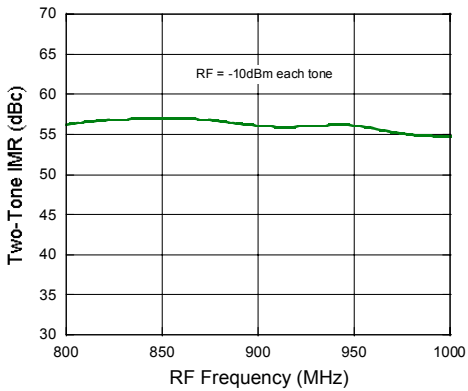
**Conversion Loss vs. Frequency**



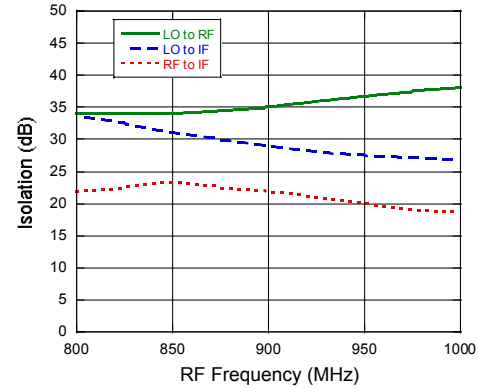
**VSWR vs. Frequency**



**Two-Tone IMR vs. Frequency**



**Isolation vs. Frequency**



5. Test Conditions for Down Converter Application: RF=900 MHz (-10 dBm), IF=60 MHz, LO=840 MHz (+5 dBm), LO Port match shown herein.  
 6. Test Conditions for Up Converter Application: LO=840 MHz (+5 dBm), IF=60 MHz (-10 dBm), RF=900 MHz, LO Port match shown herein.