

**Low Cost MMIC Mixer,  
1400 - 2100 MHz**

**MD54-0006  
V6**

**Features**

- +12 dBm Input Power @ 1 dB Compression
- High Isolation, 28 dB LO to RF
- +3 to +8 dBm LO Drive Level
- DC - 500 MHz 3 dB IF Bandwidth
- Does not require DC bias
- Ultra-Miniature SOT-25 Plastic Package

**Description**

M/A-COM's MD54-0006 is a passive mixer that achieves the performance of a double balanced diode mixer in an ultra-miniature SOT-25 package. The MD54-0006 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 MD54-0006 uses FETs as mixing elements to achieve very wide dynamic range in a low cost plastic package. 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.

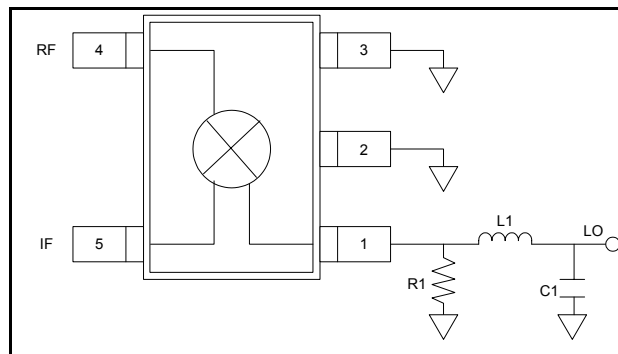
M/A-COM's MD54-0006 is fabricated using a mature 0.5 micron gate length GaAs MESFET process. The process features full passivation for increased performance and reliability. The MD54-0006 is 100% RF tested to ensure performance specification compliance.

**Ordering Information**

Part Number	Package
MD54-0006	Bulk Packaging
MD54-0006TR	1000 piece reel
MD54-0006SMB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

**Functional Block Diagram**



**Pin Configuration**

Pin No.	Pin Name	Description
1	LO Port	LO Input
2	GND	Ground
3	GND	Ground
4	RF Port	RF Input
5	IF Port	IF Output

**External Circuitry Parts List**

LO Frequency			
Part	1500 MHz	1710 MHz	2300 MHz
R1	470 Ohms	470 ohms	820 ohms
L1	6.8 nH	4.7 nH	2.7 nH
C1	3.3 pF	2.2 pF	2.2 pF

1. The external LO matching network allows tuning from 1400 MHz to 2300 MHz. The networks given above are intended to serve as guidelines for matching in different bands.
2. All off-chip components are low-cost surface mount components obtainable from multiple sources (0.060 in. x 0.030 in. or 0.080 in. x 0.050 in.).

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**Electrical Specifications:**

**RF = 1850 MHz (-10 dBm), LO = 1710 MHz (+5 dBm), IF = 140 MHz, T<sub>A</sub> = 25°C**

Parameter	Test Conditions	Units	Min	Typ	Max
Conversion Loss		dB	—	8.0	9.0
Isolation	LO to RF	dB	20	28	—
	LO to IF	dB	—	15	—
	RF to IF	dB	—	15	—
VSWR	RF Port	Ratio	—	2.0:1	—
	LO Port <sup>3</sup>	Ratio	—	2.0:1	—
	IF Port	Ratio	—	2.0:1	—
Input 1 dB Compression	LO = +5 dBm, RF Freq: 1850 MHz	dBm	—	12	—
Two-Tone IM Ratio <sup>4</sup>	Two Tones at -10 dBm each, Tone spacing = 100 KHz, IF = 150 MHz	dBc	—	55	—

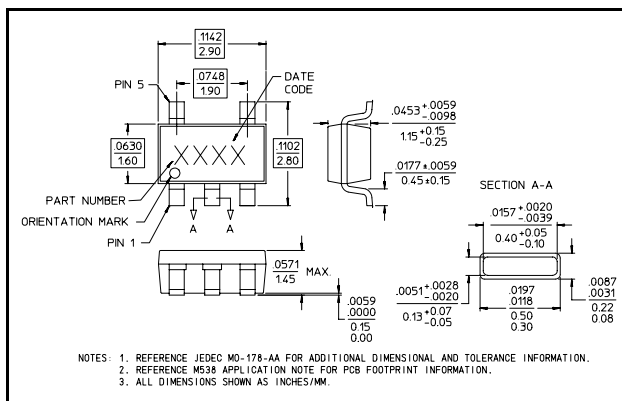
3. With external LO Port matching. See functional diagram herein.  
4. IMR vs. RF drive can be calculated by the formula:  $IMR = 40 - 1.5 \cdot Pin$ .

**Absolute Maximum Ratings<sup>5</sup>**

Parameter	Absolute Maximum
RF Input Power <sup>6</sup>	+27 dBm
LO Drive Power <sup>6</sup>	+27 dBm
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.  
6. Ambient Temperature (T<sub>A</sub>) = +25°C

**SOT-25**



**Spurious Table**

Harmonic of LO	4x	38.3 27.3	41.3 39.9	45.4 52.5	64.7 77.1	57.0 78.7
	3x	21.4 10.5	30.1 30.1	69.0 70.5	43.0 58.8	68.3 76.8
2x	9.0 -0.9	36.1 36.4	36.0 45.8	65.8 75.0	64.3 78.0	
	1x	1.9 -6.0	0 0	44.8 55.5	56.1 75.2	65.0 78.3
0x	X X	8.1 8.3	45.5 54.4	56.8 72.3	72.9 74.3	
	0x	1x	2x	3x	4x	
<b>Harmonic of RF</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.

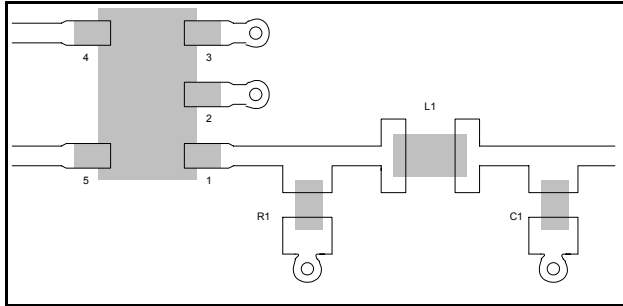
$|nF_{RF} - mF_{LO}|$ , RF = 0 dBm  
 $|nF_{RF} - mF_{LO}|$ , RF = -10 dBm  
RF Frequency = 1850 MHz  
LO Frequency = 1710 MHz

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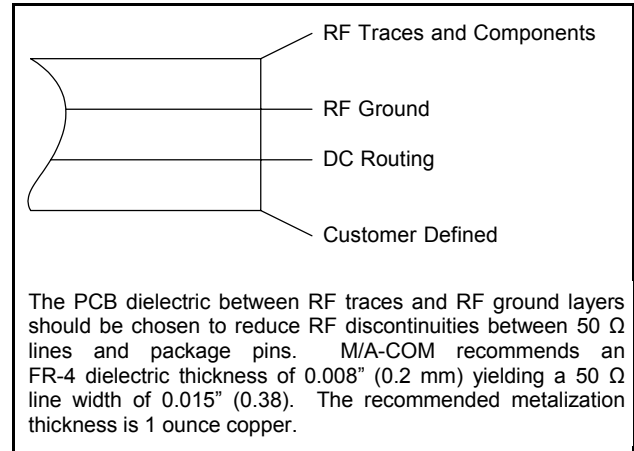
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**Recommended PCB Configuration**

*Layout View*



*Cross Section View*



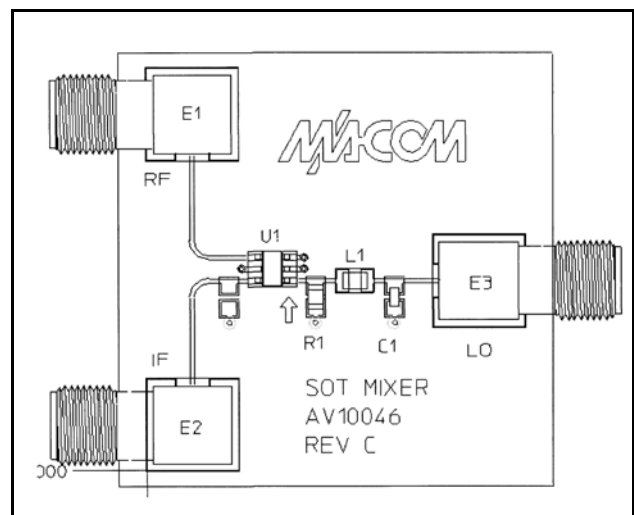
**Designer's Kit MD54-0006SMB**

The MD54-0006SMB Designer's Kit allows for immediate evaluation of M/A-COM's MD54-0006. The Designer's Kit consists of an MD54-0006, and evaluation board, and a floppy disk containing typical performance data and a DXF file of the recommended PCB layout.

Port Reference	Approximate RF Loss
RF Port	0.30 dB @ 1850 MHz
LO Port	0.20 dB @ 1710 MHz
IF Port	0.075 dB @ 140 MHz

**Mixer PCB**

The evaluation board consists of the recommended external surface mount circuitry and RF connectors mounted to a multi-layer PCB. The MD54-0006SMB evaluation PCB is shown below with all functional ports labeled.



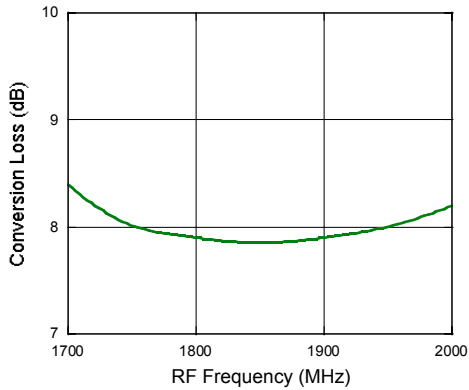
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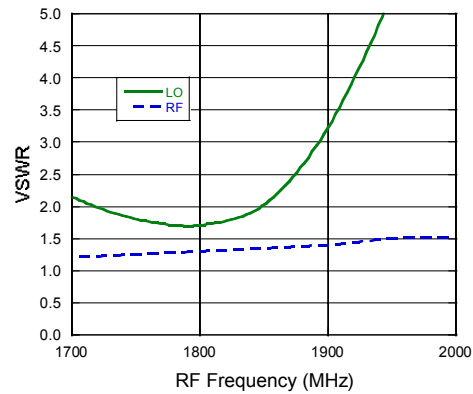
**Typical Performance Curves**

- **Test Conditions for Down Converter Application:** RF = 1850 MHz (-10 dBm), IF = 140 MHz, LO = 1710 MHz (+5 dBm).
- **Test Conditions for Up Converter Application:** LO = 1710 MHz (-5 dBm), IF = 140 MHz (-10 dBm), RF = 1850 MHz.

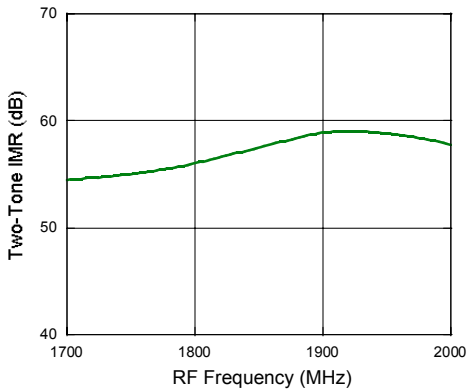
**Conversion Loss (Up/Down) vs. Frequency**



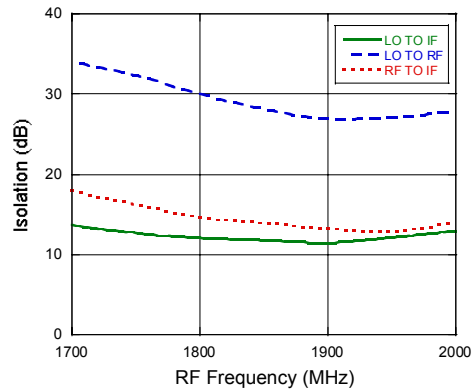
**VSWR vs. Frequency**



**Two-Tone IMR vs. Frequency**



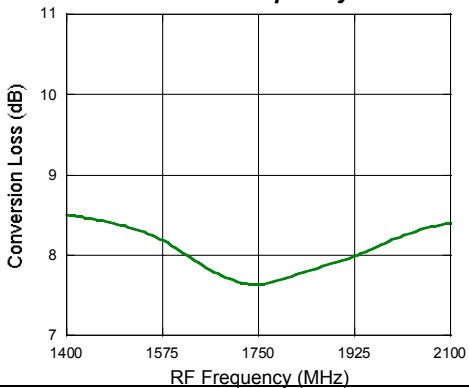
**Isolation vs. Frequency**



**Wide-Band Performance Curves**

- **Test Conditions for Wide-Band Application:** RF = -10 dBm, IF = 140 MHz, LO = +11 dBm, LO Port resistively matched. Lower LO drive operation is available for narrow band performance using external reactive matching. The 3 dB IF bandwidth is 500 MHz. IF frequencies above 200 MHz can be optimized for low conversion loss by using external matching components.

**Conversion Loss vs. Frequency**



**Two-Tone IMR vs. Frequency**

