XM1001-BD

Image Reject Mixer
12.0-40.0 GHz

Features

- Fundamental Image Reject Mixer
- 8.0 dB Conversion Loss
- 20.0 dB Image Rejection
- +25.0 dBm Input Third Order Intercept (IIP3)
- 100% On-Wafer RF Testing
- 100% Visual Inspection to MIL-STD-883 Method 2010
- RoHS* Compliant and 260°C Reflow Compatible

Description

M/A-COM Tech’s 12.0-40.0 GHz GaAs MMIC fundamental image reject mixer can be used as an up- or down-converter. The device has a conversion loss of 8.0 dB with a 20.0 dB image rejection across the band. I and Q mixer outputs are provided and an external 90 degree hybrid is required to select the desired sideband. This MMIC uses M/A-COM Tech’s GaAs PHEMT device model technology, and is based upon electron beam lithography to ensure high repeatability and uniformity. The chip has surface passivation to protect and provide a rugged part with backside via holes and gold metallization to allow either a conductive epoxy or eutectic solder die attach process. This device is well suited for Millimeter-wave Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>XM1001-BD-000V</td>
<td>“V” - vacuum release gel paks</td>
</tr>
<tr>
<td>XM1001-BD-EV1</td>
<td>evaluation module</td>
</tr>
</tbody>
</table>

Chip Device Layout

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Bias Voltage (Vg)</td>
<td>+0.3 VDC</td>
</tr>
<tr>
<td>Input Power (RF Pin)</td>
<td>+20.0 dBm</td>
</tr>
<tr>
<td>Input Power (IF Pin)</td>
<td>+20.0 dBm</td>
</tr>
<tr>
<td>Storage Temperature (Tstg)</td>
<td>-65 °C to +165 °C</td>
</tr>
<tr>
<td>Operating Temperature (Ta)</td>
<td>-55 °C to +125 °C</td>
</tr>
</tbody>
</table>
## Electrical Specifications: 12-40 GHz (Upper Side Band) ( Ambient Temperature T = 25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (RF) Lower Side Band</td>
<td>GHz</td>
<td>12.0</td>
<td>-</td>
<td>38.0</td>
</tr>
<tr>
<td>Frequency Range (LO)</td>
<td>GHz</td>
<td>8.0</td>
<td>-</td>
<td>42.0</td>
</tr>
<tr>
<td>Frequency Range (IF)</td>
<td>GHz</td>
<td>DC</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>RF Return Loss (S11)</td>
<td>dB</td>
<td>-</td>
<td>10.0</td>
<td>-</td>
</tr>
<tr>
<td>IF Return Loss (S22)</td>
<td>dB</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
</tr>
<tr>
<td>LO Return Loss (S33)</td>
<td>dB</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
</tr>
<tr>
<td>Conversion Loss (S21)</td>
<td>dB</td>
<td>-</td>
<td>8.0</td>
<td>-</td>
</tr>
<tr>
<td>LO Input Drive (P_{LO})</td>
<td>dBm</td>
<td>-</td>
<td>+12.0</td>
<td>-</td>
</tr>
<tr>
<td>Image Rejection</td>
<td>dBc</td>
<td>-</td>
<td>20.0</td>
<td>-</td>
</tr>
<tr>
<td>Isolation LO/RF</td>
<td>dB</td>
<td>-</td>
<td>16.0</td>
<td>-</td>
</tr>
<tr>
<td>Isolation LO/IF</td>
<td>dB</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
</tr>
<tr>
<td>Isolation RF/IF</td>
<td>dB</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
</tr>
<tr>
<td>Input Third Order Intercept (IIP3)</td>
<td>dBm</td>
<td>-</td>
<td>+25.0</td>
<td>-</td>
</tr>
<tr>
<td>Gate Bias Voltage (Vg1)</td>
<td>VDC</td>
<td>-2.0</td>
<td>-0.5</td>
<td>+0.1</td>
</tr>
</tbody>
</table>
XM1001-BD

Image Reject Mixer
12.0-40.0 GHz

Typical Performance Curves

XM1001-BD Vg=0.5 VDC, USB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~4840 Devices

XM1001-BD Vg=0.5 VDC, LSB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~4840 Devices

XM1001-BD Vg=0.5 VDC, USB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~4840 Devices

XM1001-BD Vg=0.5 VDC, LSB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~4840 Devices

For further information and support please visit:
https://www.macom.com/support
XM1001-BD

Image Reject Mixer
12.0-40.0 GHz

Typical Performance Curves (cont.)

XM1001-BD Vg=0.5 VDC, USB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~140 Devices

XM1001-BD Vg=0.5 VDC, LSB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~140 Devices

XM1001-BD Vg=0.5 VDC, USB/LSB
LO=+12.0 dBm, IF=2.0 GHz, RF=20.0 dBm, ~130 Devices
XM1001-BD

Image Reject Mixer
12.0–40.0 GHz

Typical Performance Curves (cont.)

(Vg=-0.5V, PRF=10dBm IF=2GHz): USB PLO=+12dBm
Image Rejection (dBc) & Conversion Gain (dB) vs. LO freq (GHz) & RF freq (GHz)

(USB, Vg=-0.5V, PRF=-10dBm, IF=2GHz): 1 device and different powers
Image Rejection (dBc) & Conversion Gain (dB) vs. LO freq (GHz) & RF freq (GHz)

(LSB, Vg=-0.5V, PRF=10dBm, IF=2GHz): 1 device and different powers
Image Rejection (dBc) & Conversion Gain (dB) vs. LO freq (GHz) & RF freq (GHz)

USB Conversion Gain/Image Rejection vs Frequency and for different Vg bias (-2.1V to 0.1V with 0.2V steps) PLO=+12dBm

I.S.B Conversion Gain vs Frequency and for different Vg bias (-2.1V to 0.1V with 0.2V steps) PLO=+12dBm

Visit www.macom.com for additional data sheets and product information.
Typical Performance Curves (cont.)

XM1001-BD (Vgs=0.5V, IF=2GHz, USB, PLO=+6dBm): IP1 & OP1 (dBm) vs. RF & LO freq (GHz)

XM1001-BD (Vgs=0.5V, IF=2GHz, LSB, PLO=+6dBm): IP1 & OP1 (dBm) vs. RF & LO freq (GHz)

XM1001-BD (Vgs=0.5V, IF=2GHz, USB, PLO=+12dBm): IP1 & OP1 (dBm) vs. RF & LO freq (GHz)

XM1001-BD (Vgs=0.5V, IF=2GHz, LSB, PLO=+12dBm): IP1 & OP1 (dBm) vs. RF & LO freq (GHz)
XM1001-BD

ImageReject Mixer
12.0-40.0 GHz

Typical Performance Curves (cont.)

XM1001-BD (Vgs=-0.5V, IF=2GHz, USB, LO=-15dBm):
IP1 & OP1 (dBm) vs. RF & LO freq (GHz)

XM1001-BD (Vgs=3.5V, IF=2GHz, LSB, LO=15dBm):
IP1 & OP1 (dBm) vs. RF & LO freq (GHz)

XM1001-BD (Vgs=3.5V, IF=2GHz, LO=12dBm, IF1-IF2=100MHz, USB, Down Conversion):
IM3 avg vs RF freq (GHz), IP3 vs RF freq (GHz)

XM1001-BD (Vgs=3.5V, IF=2GHz, LSB, LO=15dBm, IF1-IF2=100MHz, LSB, Down Conversion):
IM3 avg vs RF freq (GHz)

For further information and support please visit: https://www.macom.com/support
Image Reject Mixer
12.0-40.0 GHz

Mechanical Drawing

(Bias Arrangement)

(Note: Engineering designator is 20IRRFM0374)

Units: millimeters (inches) Bond pad dimensions are shown to center of bond pad.

Thickness: 0.110 +/- 0.010 (0.0043 +/- 0.0004). Backside is ground. Bond Pad/Backside Metallization: Gold.

All Bond Pads are 0.100 x 0.100 (0.004 x 0.004).

Bond pad centers are approximately 0.109 (0.004) from the edge of the chip.

Dicing tolerance: +/- 0.006 ( +/- 0.0002). Approximate weight: 1.592 mg.

Bond Pad #1 (RF) Bond Pad #3 (Vg) Bond Pad #5 (IF2)
Bond Pad #2 (IF1) Bond Pad #4 (LO)

Bypass Capacitors - See App Note [2]
**App Note [1] Biasing** - As shown in the bonding diagram, the pHEMT mixer devices are operated using a separate gate voltage Vg1. Set Vg1=-0.5V for optimum conversion loss performance.

**App Note [2] Bias Arrangement** - Each DC pad (Vg1) needs to have DC bypass capacitance (~100-200 pF) as close to the device as possible. Additional DC bypass capacitance (~0.01 uF) is also recommended.

**App Note [3] USB/LSB Selection**

### For Upper Side Band Operation (USB)

With IF1 and IF2 connected to the direct port (0º) and coupled port (90º) respectively as shown in the diagram, the USB signal will reside on the isolated port. The input port must be loaded with 50 ohms.

### For Lower Side Band Operation (LSB)

With IF1 and IF2 connected to the direct port (0º) and coupled port (90º) respectively as shown in the diagram, the LSB signal will reside on the input port. The isolated port must be loaded with 50 ohms.

**Note:** The coupled port can be used as an alternative input but the port location of the Coupled and Direct ports reverse.

An alternate method of Selection of USB or LSB:

### USB

[Diagram of USB connection]

### LSB

[Diagram of LSB connection]
Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these class 2 devices.
Image Reject Mixer
12.0-40.0 GHz

M/A-COM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with M/A-COM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM’s Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppels or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.