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

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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

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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
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Rev. V1

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)

USB Conversion Gain/Image Rejection vs Frequency and for different Vg bias (-2.1V to 0.1V with 0.2V steps) PL0=+12dBm

(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)

LSB Conversion Gain vs Frequency and for different Vg bias (-2.1V to 0.1V with 0.2V steps) PL0=+12dBm

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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)
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Typical Performance Curves (cont.)

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

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

XM1001-BD (Vg=0.5V, I=2GHz, LO=12dBm, IF=12GHz, USB, Down Conversion):
IM3 (dBm) vs. RF freq (GHz)

XM1001-BD (Vg=3.5V, I=2GHz, LSB, IF=12GHz, LO=15dBm, Down Conversion):
IM3 (dBm) vs. RF freq (GHz)

XM1001-BD (Vg=0.5V, I=2GHz, LO=-12dBm, IF1=2GHz, LO2=100MHz, USB, Down Conversion):
OP3 (dBm) vs. RF freq (GHz)

XM1001-BD (Vg=3.5V, I=2GHz, LSB, IF1=2GHz, LO2=100MHz, LSB, Down Conversion):
OP3 (dBm) vs. RF freq (GHz)

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Mechanical Drawing

Bias Arrangement

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 \( V_{g1} \). Set \( V_{g1} = -0.5 \text{V} \) for optimum conversion loss performance.

App Note [2] Bias Arrangement - Each DC pad \( (V_{g1}) \) 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 \( (0^\circ) \) and coupled port \( (90^\circ) \) 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 \( (0^\circ) \) and coupled port \( (90^\circ) \) 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:
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.
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