37.0-40.0 GHz GaAs Transmitter
SMT, 7x7 mm

April 2011 - Rev 25-Apr-11

Features
- Sub-harmonic, Image Reject Transmitter
- Integrated Mixer, LO Doubler/Buffer & Output Amplifier
- +17.0 dBm Output Third Order Intercept (OIP3)
- +2.0 dBm LO Drive Level
- 2.0 dB Conversion Gain
- 7x7mm SMT Package
- 100% RF and DC Testing

General Description
Mimix Broadband’s 36.0-42.0 GHz GaAs transmitter has a +17.0 dBm output third order intercept across the band. This device is a balanced, resistive pHEMT mixer followed by a distributed output amplifier and includes an integrated LO doubler and LO buffer amplifier. The use of integrated LO doubler and LO buffer amplifier makes the provision of the LO easier than for fundamental mixers at these frequencies. I and Q mixer inputs are provided and an external 90 degree hybrid is required. The device comes in a 7x7mm SMT package that is RoHS compliant. This device is well suited for Millimeter-wave Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

Absolute Maximum Ratings
- Supply Voltage (Vd) +6.0 VDC
- Supply Current (Id) 350 mA
- Gate Bias Voltage (Vg) +0.3 VDC
- Input Power (Pin) +0.0 dBm
- Storage Temperature (Tstg) -65 to +165 deg C
- Operating Temperature (Ta) -55 to MTTF Table1
- Channel Temperature (Tch) MTTF Table1
- ESD - Human Body Model Class 1A
- ESD - Machine Body Model Class M1
- Moisture Sensitivity Level MSL3

(1) Channel temperature affects a device’s MTTF. It is recommended to keep channel temperature as low as possible for maximum life

Electrical Characteristics (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) Upper Side Band</td>
<td>GHz</td>
<td>37.0</td>
<td>-</td>
<td>40.0</td>
</tr>
<tr>
<td>Frequency Range (LO)</td>
<td>GHz</td>
<td>16.0</td>
<td>-</td>
<td>26.0</td>
</tr>
<tr>
<td>Frequency Range (IF)</td>
<td>GHz</td>
<td>DC</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>Output Return Loss RF (S22)</td>
<td>dB</td>
<td>-</td>
<td>10.0</td>
<td>-</td>
</tr>
<tr>
<td>Small Signal Conversion Gain IF/RF (S21)</td>
<td>dB</td>
<td>0.0</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>LO Input Drive (Plo)</td>
<td>dBm</td>
<td>+2.0</td>
<td>4.0</td>
<td>-</td>
</tr>
<tr>
<td>Leakage @ RF Port LOx1</td>
<td>dBm</td>
<td>-</td>
<td>-25.0</td>
<td>-</td>
</tr>
<tr>
<td>Leakage @ RF Port LOx2</td>
<td>dBm</td>
<td>-</td>
<td>-15.0</td>
<td>-12.0</td>
</tr>
<tr>
<td>Input Third Order Intercept (IIP3)</td>
<td>dBm</td>
<td>10.0</td>
<td>13.0</td>
<td>-</td>
</tr>
<tr>
<td>Attenuation Range</td>
<td>dB</td>
<td>25.0</td>
<td>28.0</td>
<td>-</td>
</tr>
<tr>
<td>Drain Bias Voltage (Vd)</td>
<td>VDC</td>
<td>-</td>
<td>+4.0</td>
<td>-</td>
</tr>
<tr>
<td>Gate Bias Voltage (Vg1)</td>
<td>VDC</td>
<td>-</td>
<td>-0.3</td>
<td>-</td>
</tr>
<tr>
<td>Gate Bias Voltage (Vg2) Mixer, Doubler</td>
<td>VDC</td>
<td>-</td>
<td>-0.5</td>
<td>-</td>
</tr>
<tr>
<td>Dynamic Range Control (Vc)</td>
<td>VDC</td>
<td>-2.0</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>Supply Current (Id) (Vd=4.0V)</td>
<td>mA</td>
<td>-</td>
<td>240</td>
<td>-</td>
</tr>
<tr>
<td>Supply Current (Ic)</td>
<td>mA</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
</tr>
</tbody>
</table>
Transmitter Measurements

**XU1006-QB, USB Conv. Gain (dB) and Image Rejection (dBc)**

- Gain (dB) and IR (dBc)
- RF USB (GHz) [IF = 2 GHz]

**XU1006-QB, 1xLO to RF Leakage (dBm), P_LO=+2dBm**

- LO (GHz)
- RF to Leakage (dBm)

**XU1006-QB, 2xLO to RF Leakage (dBm), P_LO=+2dBm**

- LO (GHz)
- RF to Leakage (dBm)

**RFout-2xLO (dBc) vs. LO Freq**

- LO Freq (GHz)
- RFout-2xLO (dBc)

**XU1006-QB, Output IP3 (dBm)**

- RF (GHz)
- OIP3 (dBm)
Transmitter Measurements (cont.)

XU1006-QB, Input IP3 (dBm)

RF (GHz) vs. IP3 (dBm)

USB Conversion Gain Vs Control Voltage (Vc), 38GHz

Vg2=-0.5V, Vd=4V, Id=240mA, P_LO=+4dBm

Conversion Gain (dB)

Vc (V)

USB IIP3 for XU1006-QB

Vg2=-0.5V, Vd=4V, Id=240mA, P_LO=+4dBm, P_IF/tone=-5dBm, IF=10 MHz

Frequency (GHz) vs. IIP3 (dBm)
Transmitter Measurements (cont.)

(x2)LO Leakage for XU1006-QB
Vg2=-0.5V, Vd=4V, Id=240mA, P_LO=+4dBm, P_IF=-10dBm, IF_Frequency=2 GHz

USB Conversion Gain (dB) and IR (dBc) for XU1006-QB
Vg2=-0.8V, Vd=4V, Id=240mA, P_LO=+4dBm, P_IF= 10dBm, IF_Frequency=2 GHz
Physical Dimensions

QB - MSL, Gross Leak Test Compliant

RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS

NOTES:
1. DIMENSIONS ARE IN MM.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Nominal Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>IF1 Input</td>
<td>2.0</td>
<td>mA</td>
</tr>
<tr>
<td>8</td>
<td>IF2 Input</td>
<td>2.0</td>
<td>mA</td>
</tr>
<tr>
<td>9</td>
<td>IF2 Input</td>
<td>2.0</td>
<td>mA</td>
</tr>
</tbody>
</table>

Functional Schematic

Package Pin-out Table

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Pin Function</th>
<th>Nominal Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>RF Out</td>
<td>RF Out</td>
<td>-2.0 to 0.0</td>
<td>Volts</td>
</tr>
<tr>
<td>7</td>
<td>VC</td>
<td>Gain Control</td>
<td>-0.4</td>
<td>Volts</td>
</tr>
<tr>
<td>9</td>
<td>VG2</td>
<td>Mixer, Doubler</td>
<td>-0.5</td>
<td>Volts</td>
</tr>
<tr>
<td>18</td>
<td>LO IN</td>
<td>LO Input</td>
<td>+2.0</td>
<td>dBm</td>
</tr>
<tr>
<td>25</td>
<td>IF1 Input</td>
<td>IF1 Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>VD1</td>
<td>Drain Bias</td>
<td>+4.0</td>
<td>Volts</td>
</tr>
<tr>
<td>All other pins</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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SMT, 7x7 mm

Recommended Layout

Environmental
MSL - Gross Test Leak Compliant
App Note [1] Biasing - App Note [1] Biasing - The device is operated by biasing VD=4.0V with ID=240mA. Additionally, a mixer and doubler bias are also required with VG2 = -0.5V. Adjusting VG2 above or below this value can adversely affect conversion gain, image rejection and intercept point performance. The VC bias pin controls an integrated attenuator where VC=-1.3 V provides the minimum attenuation and VC = 0.0 V provides the maximum attenuation (approximately 25 dB).

It is recommended to use active biasing to keep the currents constant as the RF power and temperature vary; this gives the most reproducible results. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is VG1 = -0.4V. Typically the gate is protected with Silicon diodes to limit the applied voltage. Also, make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

Typical Application

Mimix Broadband MMIC-based 37.0-40.0 GHz Transmitter Block Diagram

(Changing LO and IF frequencies as required allows design to operate as high as 42 GHz)
App Note [3] USB Selection

For Upper Side Band operation (USB):
With IF1 and IF2 connected to the direct port (0°) and coupled port (-90°) respectively as shown in the diagram, the USB signal will reside on the input port. The isolated port must be loaded with 50 ohms.

An alternate method of Selection of USB:

Factory Automation and Identification

<table>
<thead>
<tr>
<th>Mimix Designator</th>
<th>Package Type</th>
<th>Number of Leads Offered</th>
<th>W Tape Width</th>
<th>P₁ Component Pitch</th>
<th>P₂ Hole Pitch</th>
<th>Reel Diameter</th>
<th>Units per Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>-QB</td>
<td>QFN (7x7mm)</td>
<td>28</td>
<td>16mm</td>
<td>12mm</td>
<td>4mm</td>
<td>329mm (13in)</td>
<td>1000</td>
</tr>
</tbody>
</table>

Tape and Reel Packaging per the following conditions:

- Tape Width: 16 mm
- Tape Pitch (part to part): 12 mm
- Component Orientation: Parts are to be oriented with the PIN 1 closest to the tape's round sprocket holes on the tape's trailing edge.
- Reel Diameter: 329 mm (13 inch)

Note: Tape and reel packaging is ordered with a -000T suffix. Package is available in 500 unit reels through designated sales channels. Minimum order quantities should be discussed with your local sales representative.

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Handling and Assembly Information

CAUTION! - Mimix Broadband MMIC Products contain gallium arsenide (GaAs) which can be hazardous to the human body and the environment. For safety, observe the following procedures:

- Do not ingest.
- Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.
- Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.

Life Support Policy - Mimix Broadband's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of Mimix Broadband. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user; (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Package Attachment - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Vacuum tools or other suitable pick and place equipment may be used to pick and place this part. Care should be taken to ensure that there are no voids or gaps in the solder connection so that good RF, DC and ground connections are maintained. Voids or gaps can eventually lead not only to RF performance degradation, but reduced reliability and life of the product due to thermal stress.

Typical Reflow Profiles

<table>
<thead>
<tr>
<th>Reflow Profile</th>
<th>SnPb</th>
<th>Pb Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp Up Rate</td>
<td>3-4 ºC/sec</td>
<td>3-4 ºC/sec</td>
</tr>
<tr>
<td>Activation Time and Temperature</td>
<td>60-120 sec @ 140-160 ºC</td>
<td>60-180 sec @ 170-200 ºC</td>
</tr>
<tr>
<td>Time Above Melting Point</td>
<td>60-150 sec</td>
<td>60-150 sec</td>
</tr>
<tr>
<td>Max Peak Temperature</td>
<td>240 ºC</td>
<td>265 ºC</td>
</tr>
<tr>
<td>Time Within 5 ºC of Peak</td>
<td>10-20 sec</td>
<td>10-20 sec</td>
</tr>
<tr>
<td>Ramp Down Rate</td>
<td>4-6 ºC/sec</td>
<td>4-6 ºC/sec</td>
</tr>
</tbody>
</table>

Mimix Lead-Free RoHS Compliant Program - Mimix has an active program in place to meet customer and governmental requirements for eliminating lead (Pb) and other environmentally hazardous materials from our products. All Mimix RoHS compliant components are form, fit and functional replacements for their non-RoHS equivalents. Lead plating of our RoHS compliant parts is 100% matte tin (Sn) over copper alloy and is backwards compatible with current standard SnPb low-temperature reflow processes as well as higher temperature (260ºC reflow) “Pb Free” processes.

Ordering Information

Part Number for Ordering | Description
-------------------------|---------------------------------|
XU1006-QB-0N00           | Ni/Au plated RoHS compliant 7x7 28L surface mount package in bulk quantity
XU1006-QB -0N0T          | Ni/Au plated RoHS compliant 7x7 28L surface mount package in tape and reel
XU1006-QB -EV1           | XU1006-QB evaluation board