17.0-24.0 GHz GaAs MMIC
Surface Mount Power Amplifier

May 2002 - Rev 01-May-02

XP1000P1

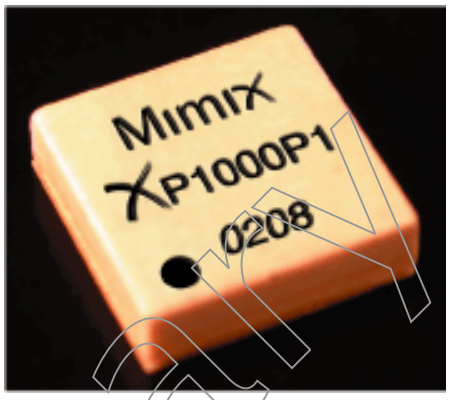
Features

- Surface Mount Leadless Package
- High Linearity Output Amplifier
- Temperature Compensated Output Power Detector
- Excellent Input/Output Match
- 18.0 dB Small Signal Gain
- +36.0 dBm Third Order Intercept (OIP3)
- 100% RF, DC and Output Power Testing

General Description

Mimix Broadband's two stage XP1000 GaAs MMIC power amplifier is supplied in a surface mount leadless chip carrier compatible with high volume surface mount components. This power amplifier is optimized for linear operation with a typical third order intercept point of +36.0 dBm. The device also achieves excellent input/output return loss and includes a temperature compensated output power detector. This packaged MMIC uses Mimix Broadband's 0.15 µm GaAs PHEMT device model technology, and is based upon electron beam lithography to ensure high repeatability and uniformity. This device is well suited for Millimeter-wave Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

Packaged Chip Device



Absolute Maximum Ratings

Supply Voltage (Vd)	+6.0 VDC
Supply Current (Id)	700 mA
Gate Bias Voltage (Vg)	+0.3 VDC
Input Power (Pin)	+9.0 dBm
Storage Temperature (Tstg)	-65 to +165 °C
Operating Temperature (Ta)	-55 to +75 °C [4]

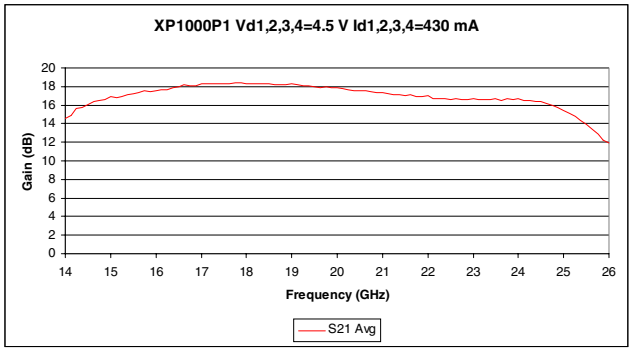
(4) Upper limit assumes ideal thermal transfer on PCB layout.

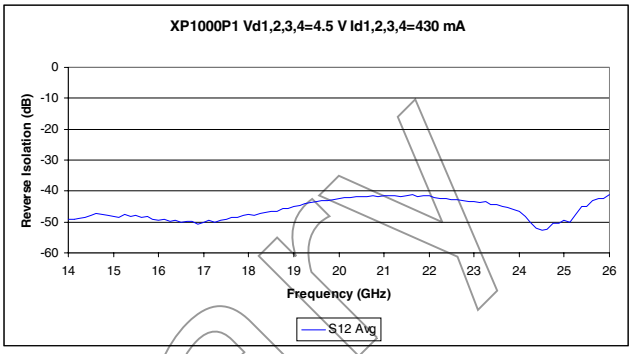
Electrical Characteristics (Ambient Temperature T = 25 °C)

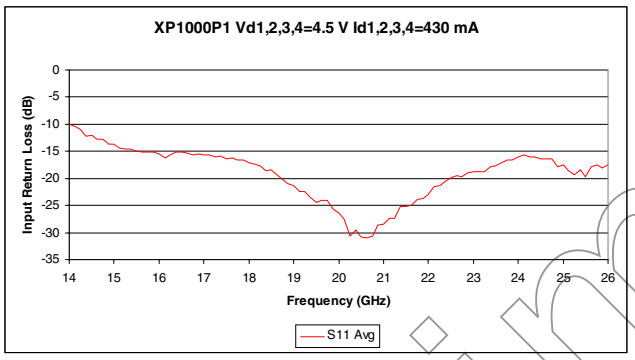
Parameter	Units	Min.	Typ.	Max.
Frequency Range (f)	GHz	17.0	-	24.0
Input Return Loss (S11)	dB	14.0	17.0	-
Output Return Loss (S22)	dB	14.0	17.0	-
Small Signal Gain (S21)	dB	15.0	18.0	20.0
Gain Flatness (ΔS21)	dB	-	+/-2.0	-
Reverse Isolation (S12)	dB	35.0	40.0	-
Output Power for 1 dB Compression (P1dB) [1,2]	dBm	-	+24.0	-
Output Third Order Intercept Point (OIP3) [1,2]	dBm	-	+36.0	-
Drain Bias Voltage (Vd1,2,3,4) (Vd5 [Det], Rd=3-6KΩ)	VDC	-	+5.5	+5.6
Gate Bias Voltage (Vg1,2,3,4)	VDC	-1.0	-0.5	0.0
Supply Current (Id) (Vd=5.5V, Vg=-0.5V Typical)	mA	-	430	650
Detector (diff) Output at 20 dBm [3]	VDC	0.21	0.28	0.35

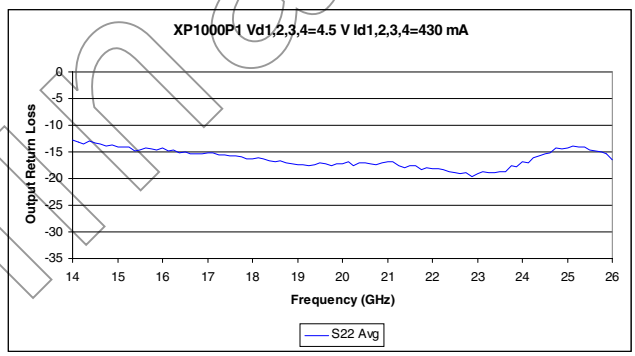
(1) Measured at 16 dBm per tone output carrier level at 22 GHz.
(2) Measured using constant current.
(3) Measured with either Vd5=I.0V, or Vd5=5.5V and Rd=5.6KΩ.

Power Amplifier Measurements

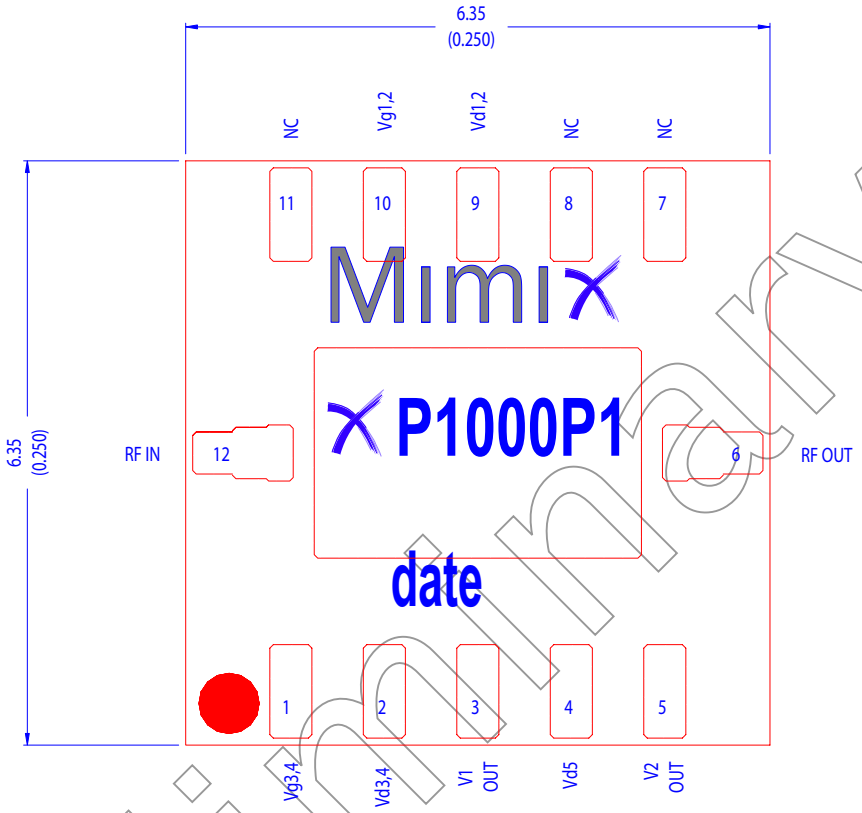








Package Pinout

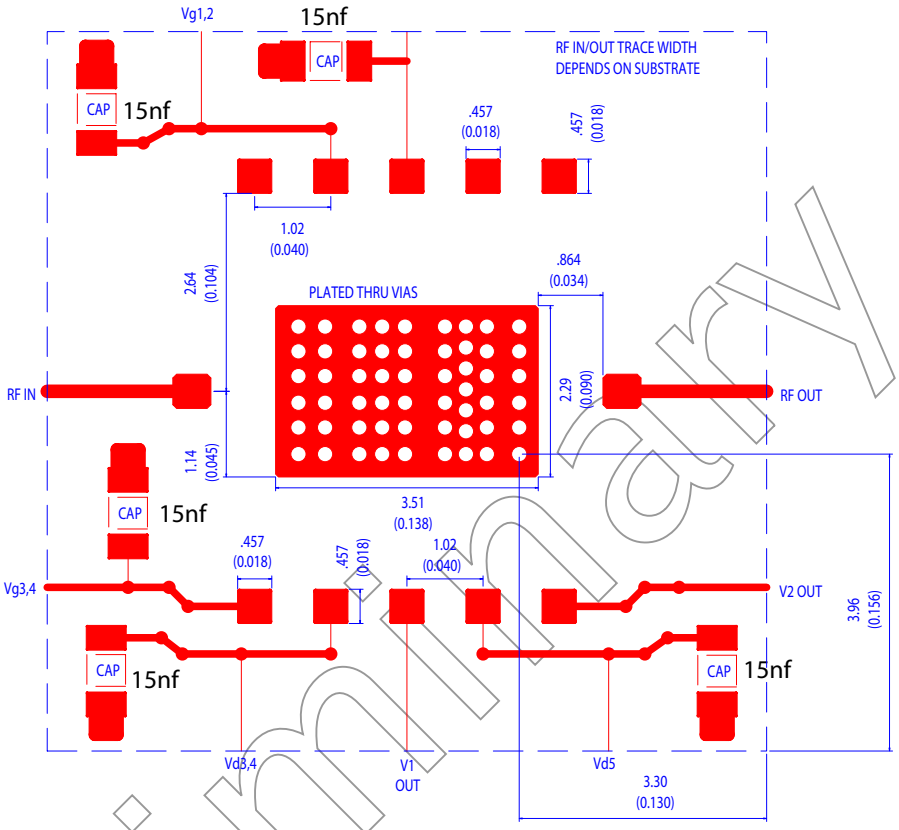


Package Pinout (Top View)

Units: millimeters (inches)
DC Pad Size: 0.040 x 0.018
DC Pad Pitch: 0.040

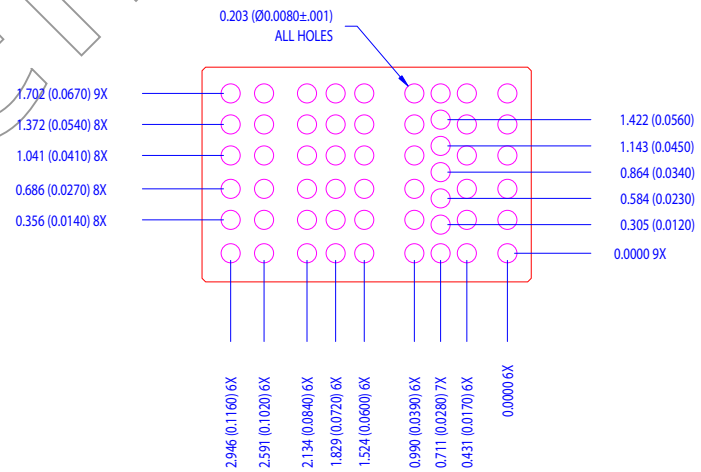
PIN	FUNCTION	PIN	FUNCTION
1	Vg3,4	7	NC
2	Vd3,4	8	NC
3	V1 OUT	9	Vd1,2
4	Vd5	10	Vg1,2
5	V2 OUT	11	NC
6	RF OUT	12	RF IN

Recommended PCB Layout



RECOMMENDED PCB LAYOUT

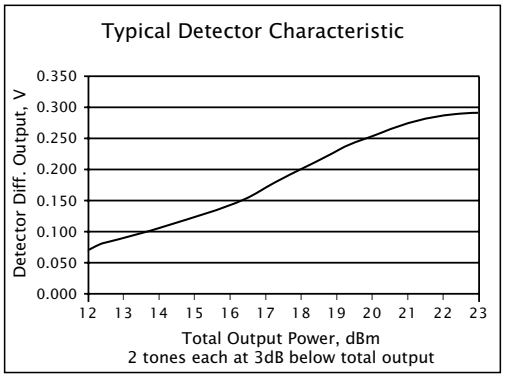
Units: millimeters (inches)

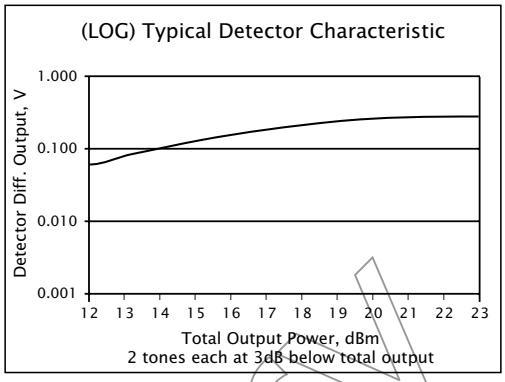


PCB VIA PATTERN

Units: millimeters (inches)

Detector Curves





App Note [1] Biasing - 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 internal pHEMT MMIC is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is -0.5V. 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.

App Note [2] On-board Detector - The output signal of the power amplifier is coupled via a 17dB directional coupler to a detector, which comprises a diode connected to the signal path, and a second diode used to provide a temperature compensation signal. The common bias terminal is Vd5, and is nominally set to forward bias both diodes. The bias is normally provided in 1 of 2 ways. The Vd5 port can be connected directly to a 1V bias, and given the internal series resistance, results in about 1mA of bias current. Alternatively, Vd5 can be tied to the same voltage as Vd1-Vd4 through an external series resistor Rd in the range 3 - 6kΩ.

Material and Layout Notes - Mimix Broadband recommends the use of Rogers RO4003 for PCB layout as shown above. This material closely matches the expansion and performance parameters of the package itself. It is very important to provide plated thru vias as given in the layout above. Vias should be placed as shown in the PCB layout diagram. Vias closest to the RF traces should be located near the edge of the ground pad for the best results. Plated thru via filling should also be guaranteed for proper heat transfer and to provide the lowest thermal resistance possible between the package and PCB carrier or housing. Improper grounding can not only lead to performance degradation but reduced reliability and life of the product due to thermal stress.

Internal DC bypass capacitors (150pf) are included, however, additional external bypass capacitors (15nf) are recommended to prevent oscillations. External capacitors should be located as close to the package as possible to help reduce lead inductance.

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.

ESD - Gallium Arsenide (GaAs) devices are susceptible to electrostatic and mechanical damage. Packaged die are supplied in antistatic containers, which should be opened at an appropriately grounded anti-static workstation.

Package Attachment - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume epoxy or solder installation. The package is constructed of a ceramic loaded teflon base and ceramic lid. Care should be taken not to apply heavy pressure to the lid or base material to avoid package damage. 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/epoxy 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.