

# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

January 2007 - Rev 16-Jan-07

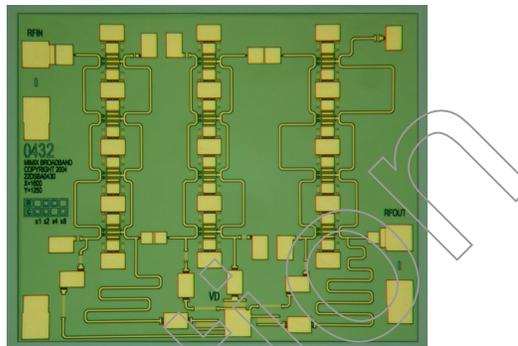
## Features

- ✕ Ultra Wide Band Driver Amplifier
- ✕ Self Bias Architecture
- ✕ 23.0 dB Small Signal Gain
- ✕ 5.0 dB Noise Figure
- ✕ 100% On-Wafer RF, DC and Output Power Testing
- ✕ 100% Visual Inspection to MIL-STD-883 Method 2010

## General Description

Mimix Broadband's 10.0-40.0 GHz GaAs MMIC distributed amplifier has a small signal gain of 23.0 dB with a 5.0 dB noise figure. This MMIC uses Mimix Broadband's 0.15  $\mu\text{m}$  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 microwave, millimeter-wave wideband military and fiber optic applications.

## Chip Device Layout



## Absolute Maximum Ratings

Supply Voltage (Vd)	+6.0 VDC
Supply Current (Id)	270 mA
Input Power (Pin)	+17.0 dBm
Storage Temperature (Tstg)	-65 to +165 °C
Operating Temperature (Ta)	-55 to MTTF Table 1
Channel Temperature (Tch)	MTTF Table 1

(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)

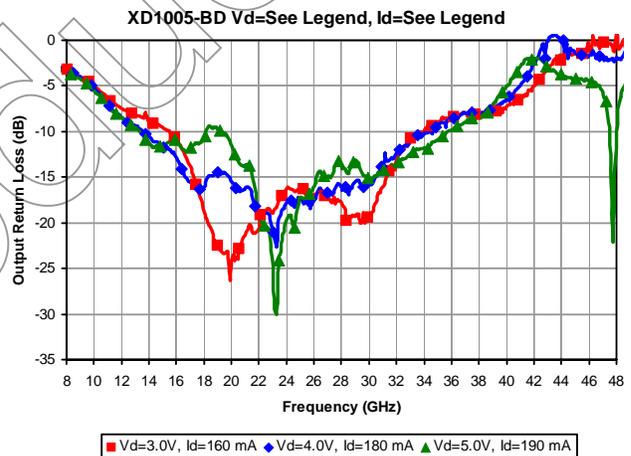
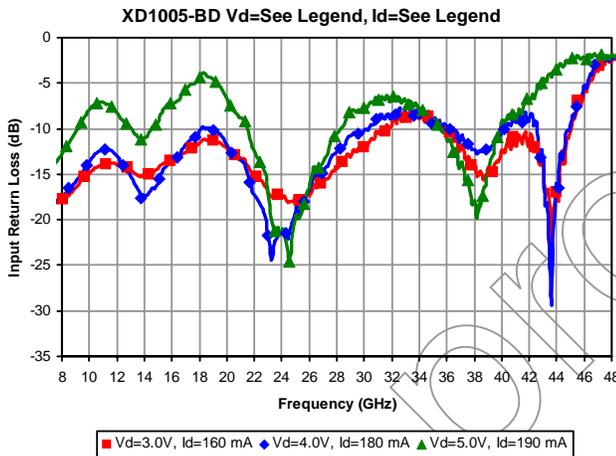
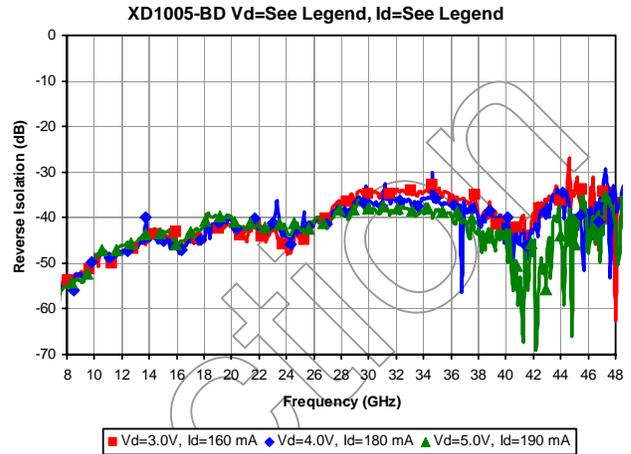
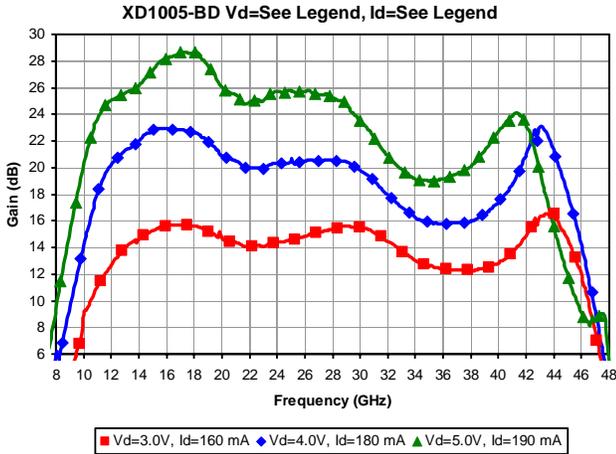
Parameter	Units	Min.	Typ.	Max.
Frequency Range (f)	GHz	10.0	-	40.0
Input Return Loss (S11)	dB	-	7.0	-
Output Return Loss (S22)	dB	-	10.0	-
Small Signal Gain (S21)	dB	-	23.0	-
Gain Flatness ( $\Delta S21$ )	dB	-	+/-5.0	-
Reverse Isolation (S12)	dB	-	35.0	-
Noise Figure (NF)	dB	-	5.0	-
Output Power for 1 dB Compression Point (P1dB) <sup>2</sup>	dBm	-	TBD	-
Drain Bias Voltage (Vd)	VDC	-	+5.0	+5.5
Supply Current (Id) (Vd=5.0V)	mA	-	190	230

(2) Measured using constant current.

# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

January 2007 - Rev 16-Jan-07

## Distributed Amplifier Measurements



# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

January 2007 - Rev 16-Jan-07

## S-Parameters

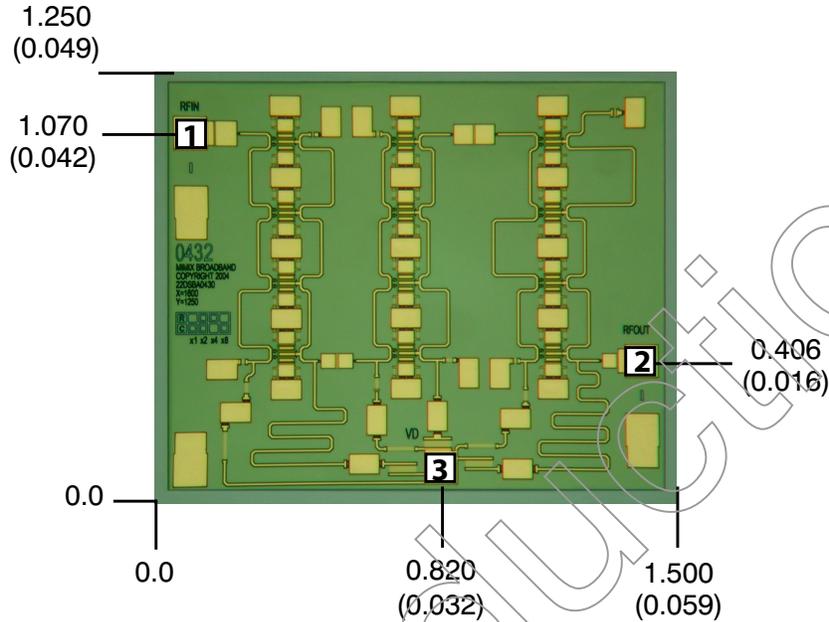
Typical S-Parameter Data for XD1005-BD  
Vd=5.0 V Id=190 mA

Frequency (GHz)	S11 (Mag)	S11 (Ang)	S21 (Mag)	S21 (Ang)	S12 (Mag)	S12 (Ang)	S22 (Mag)	S22 (Ang)
8.0	0.229	-83.96	2.929	-51.89	0.0019	-114.33	0.670	-140.06
9.0	0.310	-88.30	5.960	-92.15	0.0019	-120.63	0.610	-155.98
10.0	0.406	-100.44	10.441	-135.42	0.0035	-124.92	0.525	-168.07
11.0	0.440	-121.85	15.181	174.05	0.0040	-156.95	0.435	-177.18
12.0	0.379	-139.89	17.935	120.94	0.0049	-161.77	0.372	178.85
13.0	0.317	-143.44	19.100	82.07	0.0053	-169.88	0.332	175.41
14.0	0.280	-133.61	20.311	48.64	0.0065	173.66	0.273	173.60
15.0	0.362	-127.07	23.466	11.34	0.0070	159.80	0.262	-179.08
16.0	0.435	-138.34	25.765	-26.27	0.0051	148.04	0.279	173.60
17.0	0.520	-144.03	26.953	-61.57	0.0070	159.39	0.257	179.61
18.0	0.607	-160.43	27.000	-102.19	0.0093	160.45	0.300	-179.24
19.0	0.588	173.99	23.854	-139.22	0.0102	134.55	0.327	158.69
20.0	0.461	155.28	20.012	-167.08	0.0103	116.80	0.264	140.31
22.0	0.234	136.17	17.650	145.59	0.0079	105.99	0.110	127.32
22.0	0.234	136.17	17.650	145.59	0.0079	105.99	0.110	127.32
23.0	0.142	125.24	17.767	121.84	0.0088	113.91	0.053	125.91
24.0	0.089	168.47	19.269	90.92	0.0067	105.04	0.108	-160.48
25.0	0.106	-146.20	19.359	62.94	0.0074	104.90	0.138	-156.23
26.0	0.150	-124.03	19.244	35.51	0.0089	113.90	0.156	-151.63
27.0	0.214	-128.89	18.747	2.26	0.0088	105.69	0.181	-163.96
28.0	0.296	-131.04	18.278	-27.68	0.0107	98.23	0.198	-171.06
29.0	0.393	-140.68	17.353	-59.53	0.0134	103.20	0.220	-172.46
30.0	0.420	-150.70	14.807	-91.79	0.0139	86.31	0.175	-173.03
31.0	0.457	-161.65	12.855	-119.72	0.0135	80.27	0.194	-168.95
32.0	0.458	-172.99	11.054	-143.16	0.0128	72.20	0.208	-165.06
33.0	0.437	-179.67	9.745	-167.65	0.0111	69.61	0.241	-168.28
34.0	0.401	167.51	9.002	171.27	0.0109	65.22	0.260	-174.00
35.0	0.363	161.69	8.918	150.19	0.0118	61.78	0.284	-176.84
36.0	0.268	156.71	9.090	124.67	0.0092	52.31	0.323	174.07
37.0	0.204	156.55	9.480	99.17	0.0095	40.42	0.361	163.77
38.0	0.127	-176.88	10.075	72.86	0.0076	45.83	0.379	151.09
39.0	0.200	-129.17	11.745	38.81	0.0057	41.02	0.452	134.42
40.0	0.352	-131.82	13.740	1.69	0.0072	39.04	0.567	109.82
41.0	0.370	-137.25	15.643	-44.34	0.0023	31.66	0.718	70.75
42.0	0.451	-145.14	13.989	-112.77	0.0056	117.47	0.794	14.99
43.0	0.595	-141.13	9.541	-166.65	0.0037	94.03	0.715	-31.34
44.0	0.675	-147.50	6.009	151.20	0.0065	41.31	0.650	-61.13
45.0	0.775	-160.69	3.840	108.37	0.0051	59.54	0.613	-85.62
46.0	0.778	-167.31	2.831	70.96	0.0041	163.29	0.595	-106.75
47.0	0.774	-178.03	2.641	24.25	0.0088	72.02	0.519	-138.36
48.0	0.808	178.27	1.502	-109.87	0.0058	149.40	0.393	-43.29

# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

January 2007 - Rev 16-Jan-07

## Mechanical Drawing



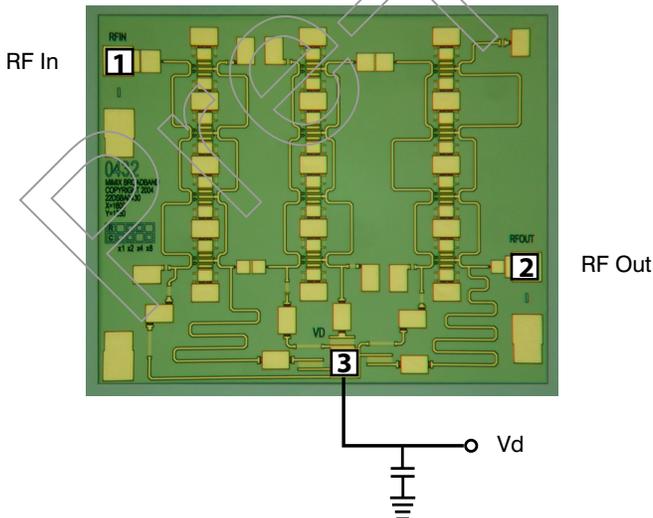
(Note: Engineering designator is 22DSBA0423)

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: +/- 0.005 (+/- 0.0002). Approximate weight: 1.163 mg

Bond Pad #1 (RF In)    Bond Pad #2 (RF Out)    Bond Pad #3 (Vd)

## Bias Arrangement



**Bypass Capacitors** - See App Note [2]

# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

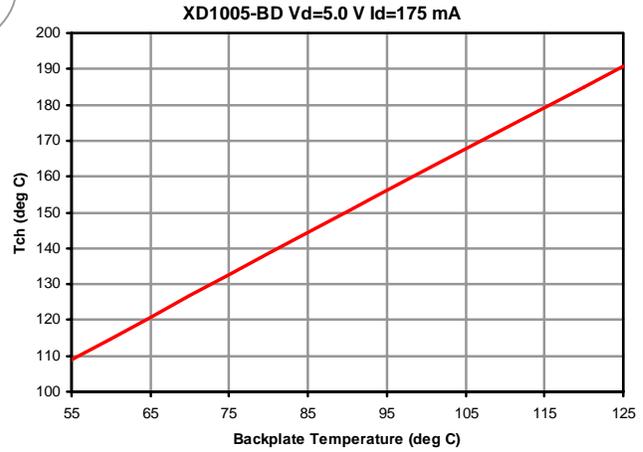
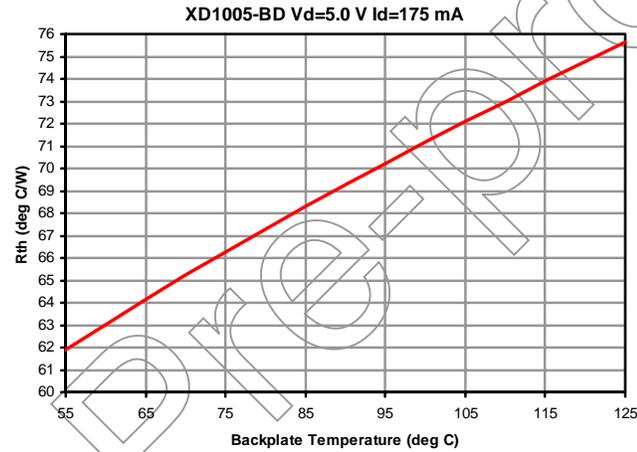
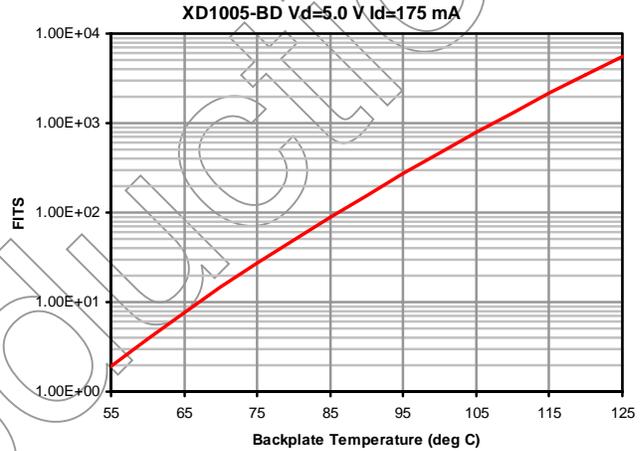
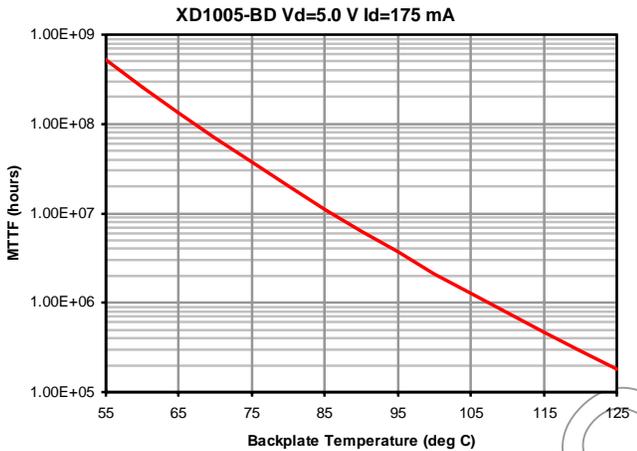
January 2007 - Rev 16-Jan-07

**App Note [1] Biasing** – As shown in the bonding diagram, this device operates using a self-biased architecture and only requires one drain bias. Bias is nominally  $V_d=5V, I_d=190\text{ mA}$ .

**App Note [2] Bias Arrangement** - Each DC pad ( $V_d$ ) needs to have DC bypass capacitance ( $\sim 100\text{-}200\text{ pF}$ ) as close to the device as possible. Additional DC bypass capacitance ( $\sim 0.01\text{ }\mu\text{F}$ ) is also recommended.

## MTTF Graphs

These numbers were calculated based on accelerated life test information and thermal model analysis received from the fabricating foundry.



# 10.0-40.0 GHz GaAs MMIC Distributed Amplifier

January 2007 - Rev 16-Jan-07

## 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. Die are supplied in antistatic containers, which should be opened in cleanroom conditions at an appropriately grounded antistatic workstation. Devices need careful handling using correctly designed collets, vacuum pickups or, with care, sharp tweezers.

**Die Attachment** - GaAs Products from Mimix Broadband are 0.100 mm (0.004") thick and have vias through to the backside to enable grounding to the circuit. Microstrip substrates should be brought as close to the die as possible. The mounting surface should be clean and flat. If using conductive epoxy, recommended epoxies are Tanaka TS3332LD, Die Mat DM6030HK or DM6030HK-Pt cured in a nitrogen atmosphere per manufacturer's cure schedule. Apply epoxy sparingly to avoid getting any on to the top surface of the die. An epoxy fillet should be visible around the total die periphery. For additional information please see the Mimix "Epoxy Specifications for Bare Die" application note. If eutectic mounting is preferred, then a fluxless gold-tin (AuSn) preform, approximately 0.001<sup>2</sup> thick, placed between the die and the attachment surface should be used. A die bonder that utilizes a heated collet and provides scrubbing action to ensure total wetting to prevent void formation in a nitrogen atmosphere is recommended. The gold-tin eutectic (80% Au 20% Sn) has a melting point of approximately 280 °C (Note: Gold Germanium should be avoided). The work station temperature should be 310 °C +/- 10 °C. Exposure to these extreme temperatures should be kept to minimum. The collet should be heated, and the die pre-heated to avoid excessive thermal shock. Avoidance of air bridges and force impact are critical during placement.

**Wire Bonding** - Windows in the surface passivation above the bond pads are provided to allow wire bonding to the die's gold bond pads. The recommended wire bonding procedure uses 0.076 mm x 0.013 mm (0.003" x 0.0005") 99.99% pure gold ribbon with 0.5-2% elongation to minimize RF port bond inductance. Gold 0.025 mm (0.001") diameter wedge or ball bonds are acceptable for DC Bias connections. Aluminum wire should be avoided. Thermo-compression bonding is recommended though thermosonic bonding may be used providing the ultrasonic content of the bond is minimized. Bond force, time and ultrasonics are all critical parameters. Bonds should be made from the bond pads on the die to the package or substrate. All bonds should be as short as possible.

## Part Number for Ordering

XD1005-BD-000V  
XD1005-BD-EV1

## Description

RoHS compliant die packed in vacuum release gel packs  
XD1005-BD evaluation module