DC-6.0 GHz InGaP HBT MMIC Matched Gain Block Amplifier

April 2007 - Rev 04-Apr-07

CGB7015-BD
RoHS

Features

- Low Operating Voltage: 5V
- 37.0 dBm Output IP3 @ 850 MHz
- 4.0 dB Noise Figure @ 850 MHz
- 23.0 dB Gain @ 850 MHz
- 21.1 dBm P1dB @ 850 MHz
- Low Performance Variation Over Temperature
- 100% DC On-Wafer Testing
- ESD Protection on All Die: >1000V HBM
- Low Thermal Resistance: <80°C/Watt

Description

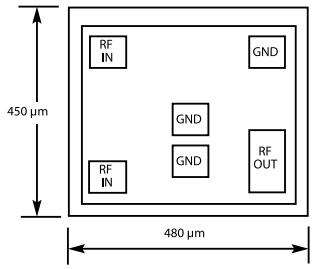
The CGB7015-BD is a Darlington Configured, high dynamic range, utility gain block amplifier. Designed for applications operating within the DC to 6.0 GHz frequency range, Mimix's broadband, cascadable, gain block amplifiers are ideal solutions for transmit, receive and IF applications.

These MMIC amplifiers are available in bare die form. Mimix's InGaP HBT technology and an industry low thermal resistance offers a thermally robust and reliable gain block solution.

The InGaP HBT die have extra pads to enable thorough DC testing. This unique test capability and the inclusion of ESD protection on all die, significantly enhances the quality, reliability and ruggedness of these products.

With a single bypass capacitor, optional RF choke and two DC blocking capacitors, this gain block amplifier offers significant ease of use in a broad range of applications.

Chip Layout



Absolute Maximum Ratings

Max Device Voltage	+6.0 V
Max Device Current	130 mA
Max Device Dissipated Power	0.65 W
RF Input Power	+17 dBm
Storage Temperature	-55°C to 150°C
Junction Temperature	150°C
Operating Temperature	-40°C to +85°C
Thermal Resistance	80° C/W
ESD (HBM)	1000 V

Operation of this device above any of these parameters may cause permanent damage.

Applications

- PA Driver Amp, IF Amp, LO Buffer Amp
- Cellular, PCS, GSM, UMTS
- Wireless Data and SATCOM
- Transmit and Receive Functions
- CATV

Typical Performance

		500 MHz			850 MHz			1950 MHz			2400 MHz			3500 MHz			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25		24.0		22.0	23.0	24.0	18.2	19.2	20.2	17.0	18.0	19.0		15.5		dB
	-40 to +85		24.0		21.7	23.0	24.3	17.9	19.2	20.5	16.7	18.0	19.3		15.5		dB
Output P1dB	+25		21.2		20.1	21.1		19.0	20.0		17.8	18.8			16.2		dBm
	-40 to +85		21.2		19.8	21.1		18.7	20.0		17.5	18.8			16.2		dBm
Output IP3	+25		37.0		35.5	37.0		33.0	34.5		31.5	33.0			30.1		dBm
	-40 to +85		37.0		35.0	37.0		32.0	34.5		30.5	33.0			30.1		dBm
Noise Figure	+25		4.0			4.0	4.8		4.0	4.8		4.1	5.1		4.2		dB
	-40 to +85		4.0			4.0	5.2		4.0	5.2		4.1	5.5		4.2		dB
Operating Current	+25	87	92	97	87	92	97	87	92	97	87	92	97	87	92	97	mA
	-40 to +85	84	92	100	84	92	100	84	92	100	84	92	100	84	92	100	mA
Input Return Loss	+25		14		11	16		17	25		17	25			25		dB
	-40 to +85		14		10	16		16	25		16	25			25		dB
Output Return Loss	+25		14		11	15		14	20		14	20			14		dB
	-40 to +85		14		10	15		13	20		13	20			14		dB
Pout @ -45 dBc, ACP IS-95, 9 Forward Channels	+25					15			15								dBm
	-40 to +85					15			15								dBm

Notes: 1. Performance in Mimix eval board, Vs = 8 V, Id = 92 mA Typ., Rbias = 30 Ω, Zs = Zl = 50 Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 6 dBm.
2. Values reflect performance in recommended application circuit.
3. Only on-wafer DC test is done. Devices are not tested for RF performance.

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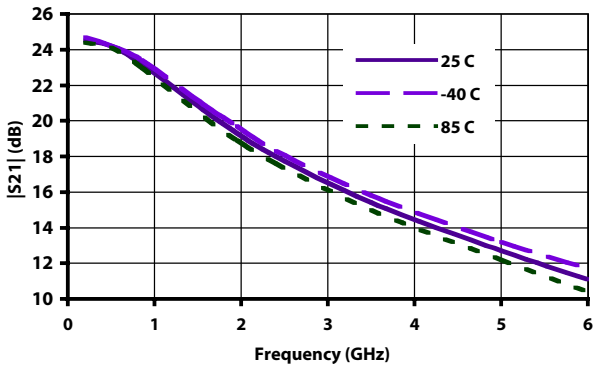
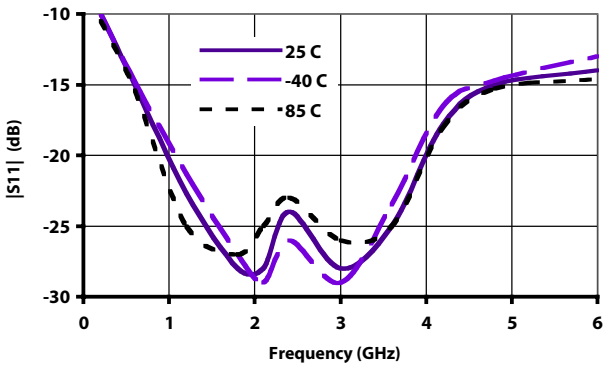
Typical S-Parameter and Noise Performance

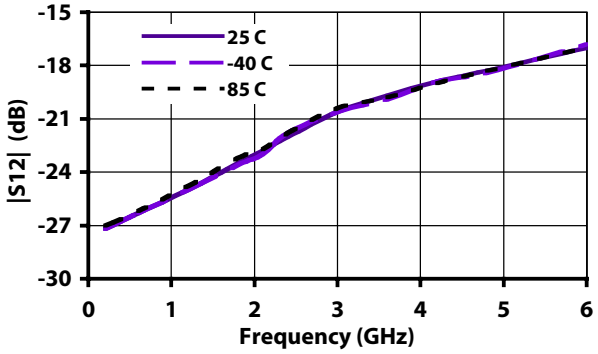
|S21| Vs Frequency



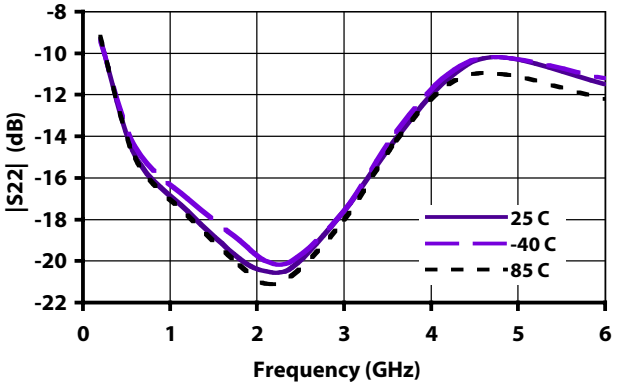
|S11| Vs Frequency



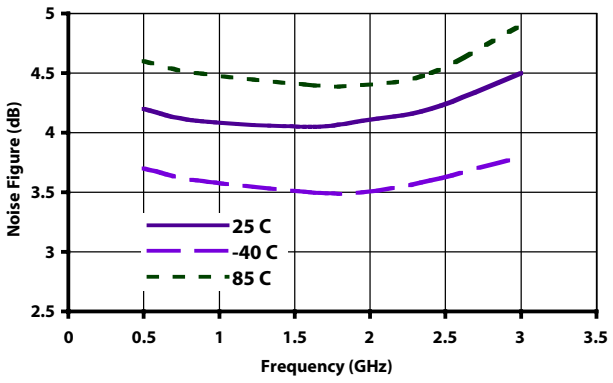
|S12| Vs Frequency



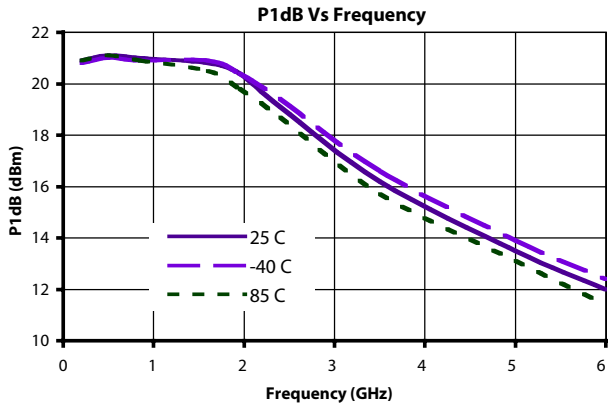
|S22| Vs Frequency

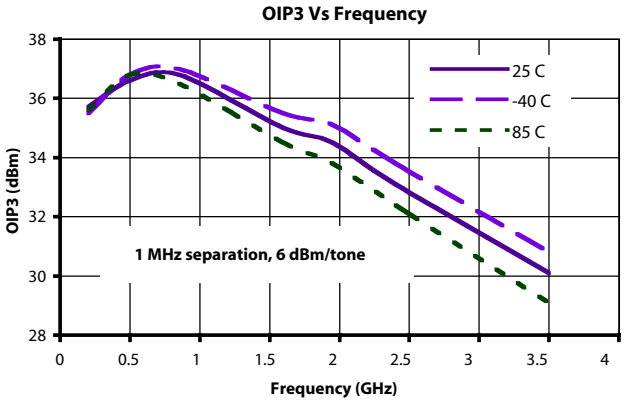


Noise Figure Vs Frequency

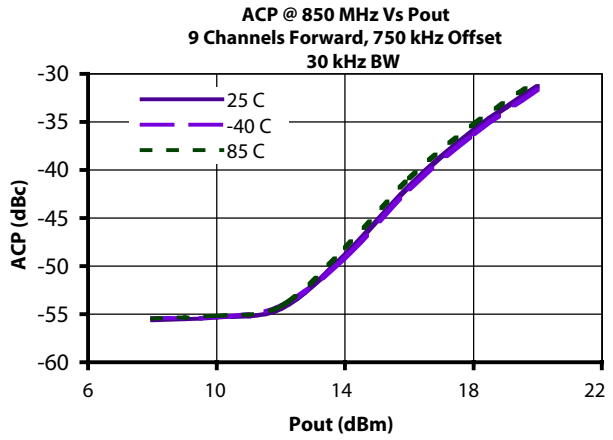


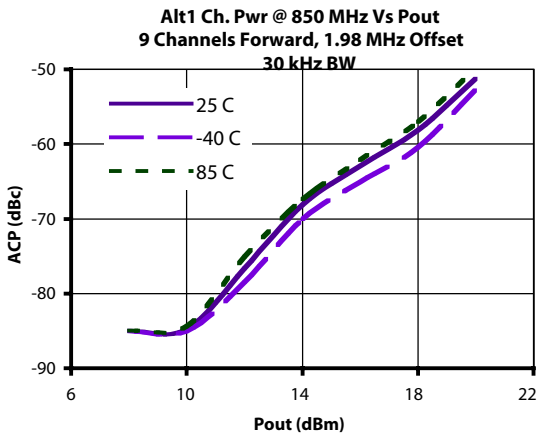
Typical Power and Linearity Performance

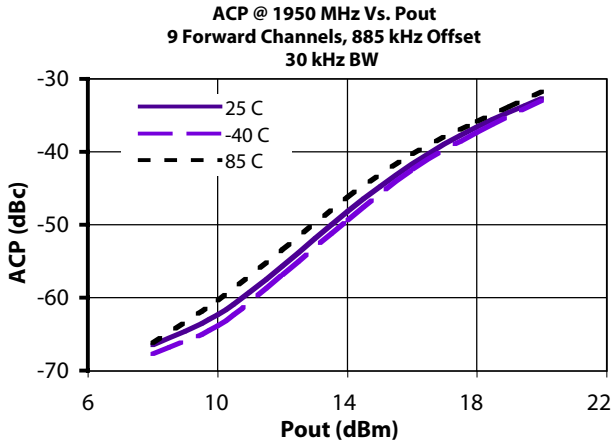


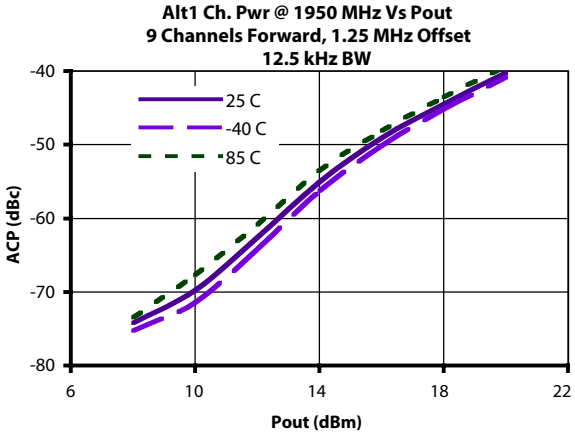


Linearity Performance - Base Station ACP – IS-95









Typical Scattering Parameters (Vd = +4.8V, Icc = 95 mA, T = 23°C, device in a 50 ohm system)

Frequency (MHz)	S_{11} (Mag)	S_{11} (Ang)	S_{21} (Mag)	S_{21} (Ang)	S_{12} (Mag)	S_{12} (Ang)	S_{22} (Mag)	S_{22} (Ang)
100	0.20	174	18.6	172	0.04	1	0.15	179
200	0.19	168	18.3	164	0.04	2	0.15	178
300	0.19	162	18.0	156	0.05	3	0.15	176
400	0.18	157	17.6	148	0.05	4	0.16	175
500	0.17	151	17.1	141	0.05	4	0.16	173
600	0.16	146	16.6	134	0.05	4	0.16	172
700	0.15	142	16.0	127	0.05	5	0.16	170
800	0.14	138	15.5	120	0.05	5	0.16	168
900	0.13	134	14.9	114	0.05	5	0.16	166
1000	0.12	131	14.3	107	0.05	5	0.16	163
1100	0.11	128	13.8	101	0.05	5	0.17	161
1200	0.10	126	13.3	95	0.06	4	0.17	158
1300	0.09	124	12.7	90	0.06	4	0.17	156
1400	0.08	123	12.2	84	0.06	3	0.17	153
1500	0.07	122	11.8	79	0.06	2	0.17	151
1600	0.06	123	11.3	74	0.06	1	0.17	148
1700	0.06	124	10.9	69	0.06	0	0.17	145
1800	0.05	128	10.5	64	0.07	-1	0.17	142
1900	0.04	133	10.1	59	0.07	-2	0.17	140
2000	0.04	139	9.8	54	0.07	-4	0.17	137
2100	0.04	146	9.4	50	0.07	-5	0.17	134
2200	0.04	152	9.1	45	0.07	-7	0.17	131
2300	0.04	158	8.8	40	0.08	-8	0.16	128
2400	0.04	164	8.5	36	0.08	-10	0.16	126
2500	0.04	168	8.3	32	0.08	-12	0.16	123
2600	0.04	170	8.0	27	0.08	-13	0.16	120
2700	0.05	172	7.8	23	0.09	-15	0.16	117
2800	0.05	173	7.5	19	0.09	-17	0.16	114
2900	0.05	172	7.3	15	0.09	-19	0.16	112
3000	0.06	172	7.1	11	0.09	-21	0.16	109
3100	0.06	171	6.9	7	0.09	-23	0.16	106
3200	0.06	169	6.7	3	0.10	-25	0.16	103
3300	0.07	166	6.6	-1	0.10	-27	0.16	100
3400	0.07	163	6.4	-6	0.10	-29	0.17	97
3500	0.07	159	6.3	-9	0.10	-32	0.17	94
3600	0.07	155	6.1	-13	0.11	-34	0.17	91
3700	0.08	151	6.0	-17	0.11	-36	0.17	88
3800	0.08	146	5.8	-21	0.11	-38	0.18	85
3900	0.08	141	5.7	-25	0.11	-41	0.18	82
4000	0.08	136	5.6	-29	0.11	-43	0.18	78
4100	0.08	130	5.4	-33	0.12	-46	0.19	75
4200	0.09	125	5.3	-37	0.12	-48	0.19	72
4300	0.09	118	5.2	-41	0.12	-51	0.20	69
4400	0.09	111	5.1	-45	0.12	-53	0.21	65
4500	0.09	104	5.0	-49	0.12	-56	0.21	62
4600	0.09	98	4.9	-53	0.13	-58	0.22	58
4700	0.10	91	4.8	-57	0.13	-61	0.23	55
4800	0.10	84	4.7	-61	0.13	-64	0.24	51
4900	0.10	76	4.6	-65	0.13	-66	0.24	48
5000	0.11	69	4.5	-69	0.13	-69	0.25	44

Continues Next Page. S-Parameter Data Files are available online at: www.mimixbroadband.com

Typical Scattering Parameters (Vd = +4.8V, Icc = 95 mA, T = 23°C, device in a 50 ohm system)

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)
5100	0.11	61	4.4	-73	0.14	-72	0.26	41
5200	0.12	54	4.3	-77	0.14	-74	0.27	37
5300	0.13	48	4.3	-81	0.14	-77	0.28	34
5400	0.13	41	4.2	-85	0.14	-80	0.30	31
5500	0.14	34	4.1	-89	0.14	-83	0.31	27
5600	0.15	28	4.0	-92	0.14	-86	0.32	23
5700	0.16	22	3.9	-96	0.14	-89	0.33	20
5800	0.17	16	3.9	-101	0.15	-92	0.35	17
5900	0.18	10	3.8	-105	0.15	-94	0.36	13
6000	0.19	5	3.7	-108	0.15	-97	0.37	10
6100	0.21	0	3.6	-113	0.15	-100	0.38	6
6200	0.22	-5	3.5	-117	0.15	-103	0.40	3
6300	0.23	-10	3.5	-121	0.15	-106	0.41	-1
6400	0.24	-15	3.4	-124	0.15	-109	0.43	-4
6500	0.25	-20	3.3	-129	0.15	-112	0.44	-7
6600	0.27	-25	3.2	-132	0.15	-115	0.45	-11
6700	0.28	-29	3.2	-136	0.15	-118	0.47	-14
6800	0.29	-34	3.1	-140	0.15	-121	0.48	-17
6900	0.30	-38	3.0	-144	0.15	-124	0.50	-20
7000	0.32	-42	2.9	-148	0.15	-127	0.51	-24
7100	0.33	-46	2.9	-152	0.15	-130	0.52	-27
7200	0.34	-51	2.8	-156	0.15	-133	0.54	-30
7300	0.35	-54	2.7	-160	0.15	-136	0.55	-33
7400	0.36	-58	2.6	-164	0.15	-139	0.56	-36
7500	0.37	-62	2.6	-168	0.15	-142	0.57	-39
7600	0.38	-66	2.5	-172	0.14	-145	0.58	-42
7700	0.39	-70	2.4	-175	0.14	-148	0.60	-45
7800	0.40	-74	2.4	-179	0.14	-150	0.61	-48
7900	0.41	-77	2.3	177	0.14	-153	0.62	-51
8000	0.42	-81	2.2	174	0.14	-156	0.63	-54
8100	0.42	-85	2.2	170	0.14	-159	0.64	-56
8200	0.43	-88	2.1	166	0.14	-161	0.64	-59
8300	0.44	-91	2.1	163	0.14	-164	0.65	-62
8400	0.44	-95	2.0	159	0.13	-167	0.66	-64
8500	0.44	-98	1.9	155	0.13	-169	0.67	-67
8600	0.45	-102	1.9	152	0.13	-172	0.68	-70
8700	0.45	-105	1.8	148	0.13	-174	0.68	-72
8800	0.45	-108	1.8	145	0.13	-177	0.69	-74
8900	0.45	-111	1.7	141	0.13	-179	0.69	-77
9000	0.45	-114	1.7	138	0.12	178	0.70	-79
9100	0.46	-118	1.6	134	0.12	176	0.70	-82
9200	0.45	-121	1.6	131	0.12	173	0.71	-84
9300	0.45	-124	1.5	128	0.12	171	0.71	-86
9400	0.45	-127	1.5	124	0.12	168	0.72	-88
9500	0.45	-130	1.5	121	0.12	166	0.72	-90
9600	0.44	-133	1.4	117	0.12	164	0.72	-92
9700	0.44	-136	1.4	114	0.11	162	0.73	-95
9800	0.44	-140	1.3	111	0.11	159	0.73	-97
9900	0.43	-143	1.3	107	0.11	157	0.73	-99
10000	0.42	-146	1.3	104	0.11	155	0.74	-101

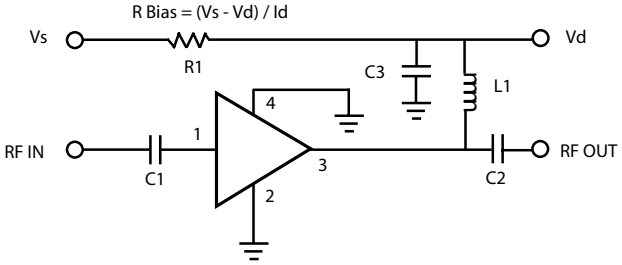
S-Parameter Data Files are available online at: www.mimixbroadband.com

Application Circuit

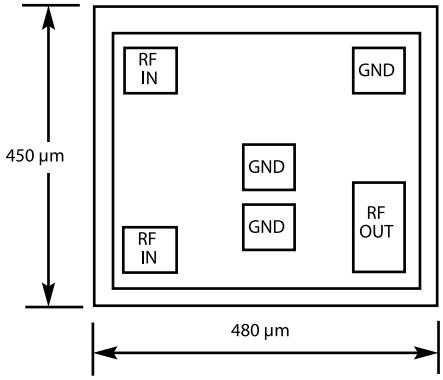
Note: This schematic represents the topology of the application circuit recommended by Mimix.

Recommended Bias Resistor Values for ID = 92 mA				
Supply Voltage (Vs)	7V	8V	10V	12V
Rbias (1/4W)	12 Ω	37Ω	—	—
Rbias (1/2W)	—	—	50Ω	79Ω

Note: Rbias provides DC bias stability over temperature.



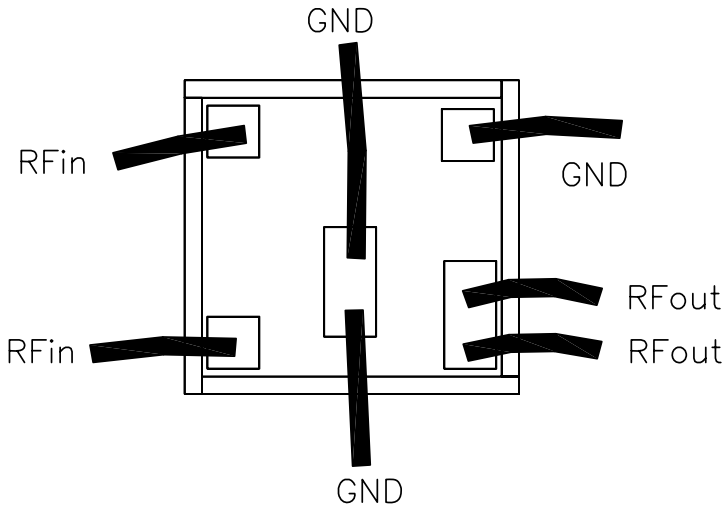
Physical Dimensions



Ref Designator	Value
C1, C2	1000 pF
C3	1.0 µF
L1	56 nH
R 1	R Bias = (Vs - Vd) / Id

Notes:
RF OUT bonding pad is 75 µm x 155 µm.
All other pads are 75 µm x 75 µm.

Bonding Configuration



Caution: ESD Sensitive
Appropriate precautions in handling, packaging and testing devices must be observed.

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 anti-static 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. 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.

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 Gold 0.025 mm (0.001") diameter ball bonds. 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	Description
CGB7015-BD-000V	RoHS compliant die packed in vacuum release gel paks