DC-8.0 GHz InGaP HBT MMIC Matched Gain Block Amplifier

June 2007 - Rev 15-Jun-07

CGB7014-BD
RoHS

Features

- 18.5 dB Gain @ 6 GHz
- 24.5 dB Gain @ 850 MHz
- 36.0 dBm Output IP3 @ 850 MHz
- 3.5 dB Noise Figure @ 850 MHz
- 20.3 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

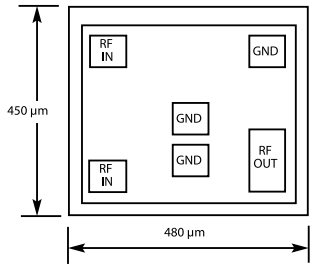
The CGB7014-BD is a Darlington Configured, high dynamic range, utility gain block amplifier. Designed for applications operating within the DC to 8.0 GHz frequency range, Mimix's broadband, cascadable, gain block amplifiers are ideal solutions for transmit, receive and IF applications.

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

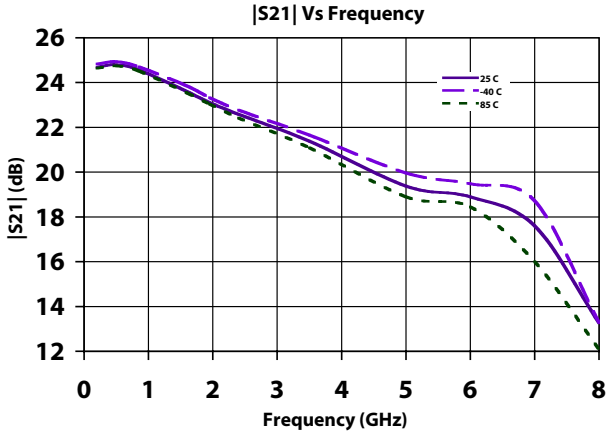
- PA Driver Amp, IF Amp, LO Buffer Amp
- Cellular, PCS, GSM, UMTS
- Wireless Data and SATCOM
- WLAN 802.11a/b/g and WiMAX
- Transmit and Receive Functions
- CATV

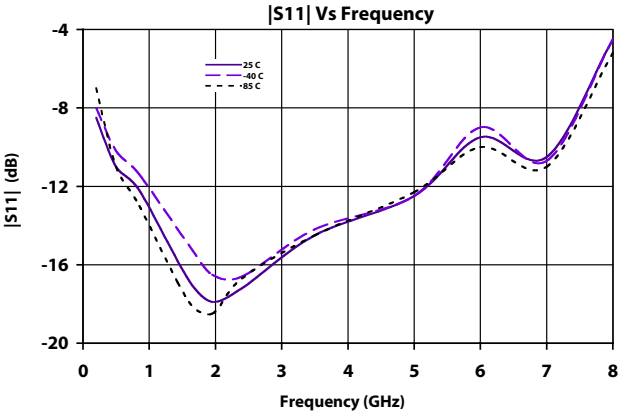
Typical Performance

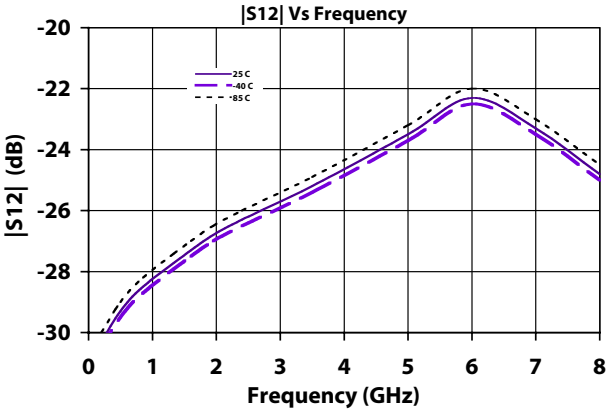
		850 MHz			1950 MHz			2400 MHz			3500 MHz			6000 MHz			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25	23.5	24.5	25.5	22.0	23.0	24.0	21.5	22.5	23.5		21.5			18.5		dB
	-40 to +85	23.2	24.5	25.8	21.7	23.0	24.3	21.2	22.5	23.8		21.5			18.5		dB
Output P1dB	+25	19.3	20.3		18.0	19.0		17.1	18.1			16.0			10.0		dBm
	-40 to +85	19.0	20.3		17.7	19.0		16.8	18.1			16.0			10.0		dBm
Output IP3	+25	34.5	36.0		30.0	31.5		28.5	30.0			27.0			19.0		dBm
	-40 to +85	34.0	36.0		29.0	31.5		27.5	30.0			27.0			19.0		dBm
Noise Figure	+25		3.5	4.3		3.5	4.3		3.6	4.6		3.8			4.5		dB
	-40 to +85		3.5	4.7		3.5	4.7		3.6	5.0		3.8			4.5		dB
Operating Current	+25	76	80	85	76	80	85	76	80	85		80			80		mA
	-40 to +85	72	80	89	72	80	89	72	80	89		80			80		mA
Input Return Loss	+25	9	12		13	19		12	18			14			9		dB
	-40 to +85	8	12		12	19		11	18			14			9		dB
Output Return Loss	+25	9	13		12	17		11	16			17			18		dB
	-40 to +85	8	13		11	17		10	16			17			18		dB
Pout @ -45 dBc, ACP	+25		13.5			13.5											dBm
IS-95, 9 Forward Channels	-40 to +85		13.5			13.5											dBm

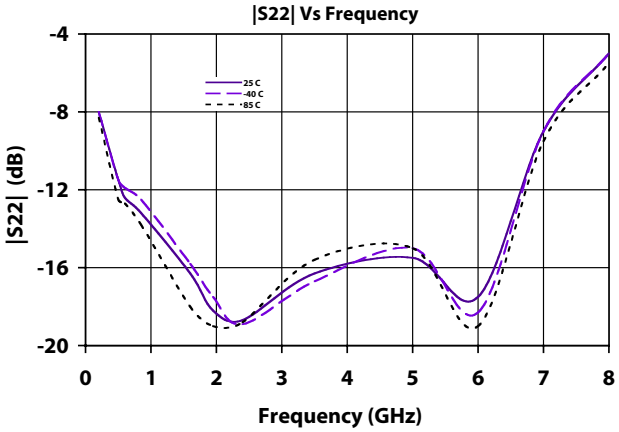
Notes: 1. Performance in Mimix eval board, Vs = 8 V, Id = 80 mA Typ., Rbias = 39 Ω, Zs = Zl = 50 Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 6 dBm.
2. Values reflect performance in recommended application circuit.
3. Only on-wafer DC test is done. Devices are not tested for RF performance.

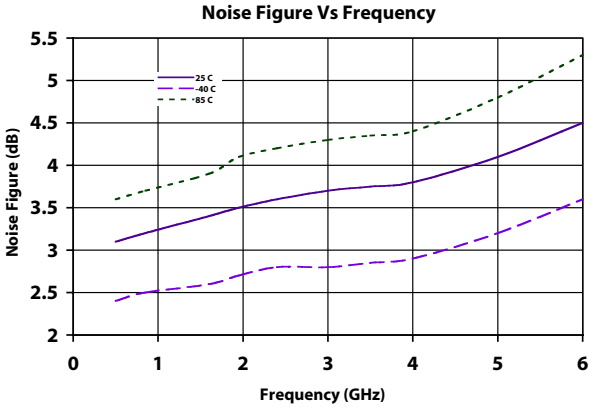
Typical S-Parameter and Noise Performance



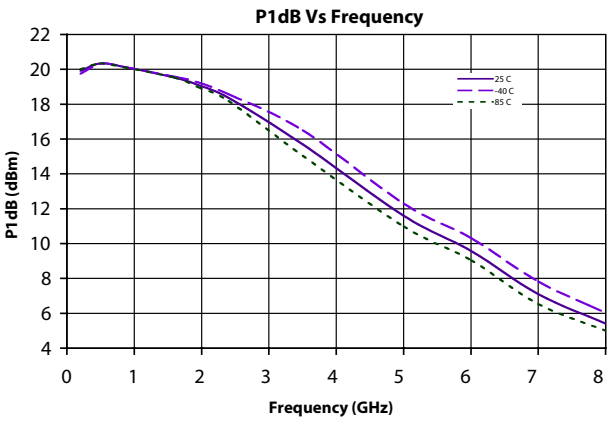


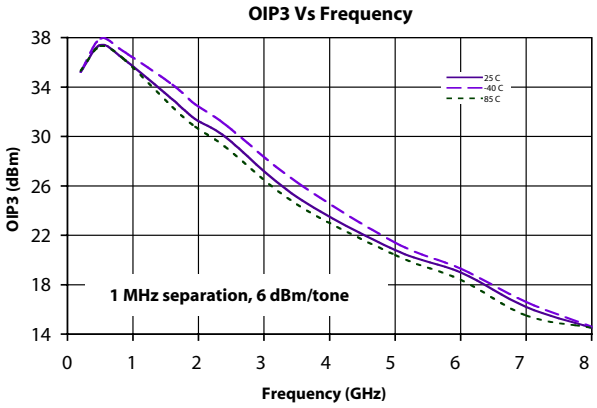




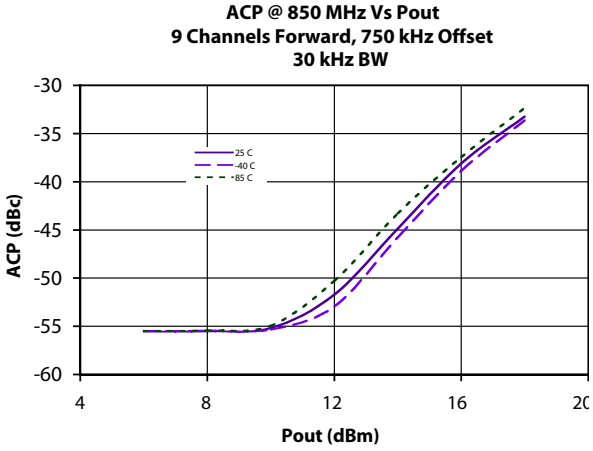


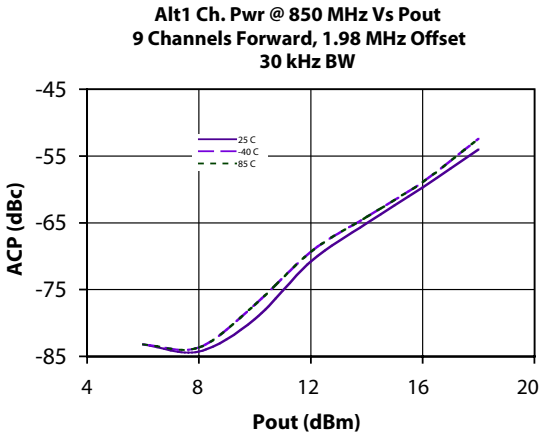
Typical Power and Linearity Performance

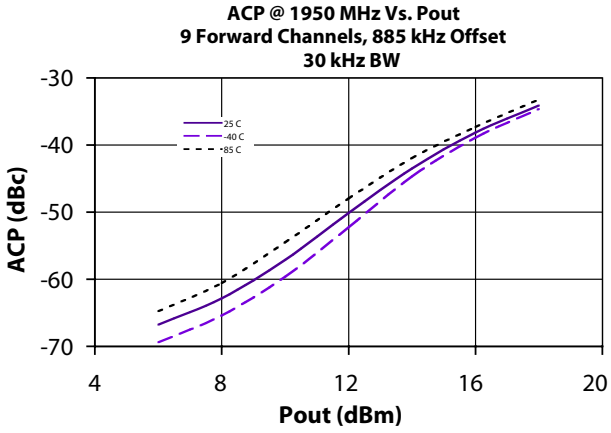


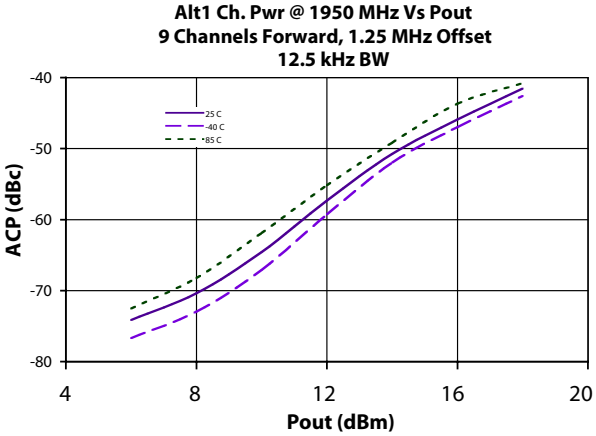


Linearity Performance - Base Station ACP – IS-95









Typical Scattering Parameters (Vd = +4.75V, Icc = 77 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)
100	0.26	179	17.9	175	0.05	-1	0.06	-174
200	0.26	178	17.9	169	0.05	-3	0.06	-164
300	0.25	176	17.8	164	0.05	-4	0.06	-159
400	0.26	174	17.8	159	0.05	-5	0.07	-158
500	0.25	174	17.6	154	0.05	-7	0.08	-154
600	0.25	170	17.5	148	0.05	-8	0.08	-154
700	0.25	169	17.4	143	0.05	-9	0.09	-155
800	0.24	167	17.2	138	0.05	-11	0.09	-152
900	0.24	166	17.1	133	0.05	-12	0.10	-154
1000	0.24	167	16.9	128	0.05	-14	0.11	-152
1100	0.23	163	16.7	122	0.05	-15	0.11	-155
1200	0.23	162	16.7	117	0.05	-16	0.12	-158
1300	0.22	164	16.3	113	0.06	-18	0.13	-156
1400	0.21	161	16.1	107	0.06	-19	0.13	-157
1500	0.21	162	16.0	103	0.06	-21	0.14	-161
1600	0.21	160	15.7	97	0.06	-22	0.14	-162
1700	0.20	160	15.5	93	0.06	-24	0.15	-163
1800	0.19	160	15.3	88	0.06	-25	0.15	-164
1900	0.19	160	15.1	83	0.06	-27	0.16	-167
2000	0.19	162	14.8	78	0.06	-29	0.16	-169
2100	0.18	161	14.6	73	0.06	-30	0.16	-170
2200	0.17	161	14.4	68	0.06	-32	0.16	-172
2300	0.18	163	14.1	64	0.06	-34	0.17	-174
2400	0.17	167	13.8	60	0.06	-35	0.18	-175
2500	0.17	165	13.6	55	0.06	-37	0.17	-176
2600	0.18	166	13.4	51	0.06	-39	0.18	-179
2700	0.18	169	13.1	47	0.06	-41	0.19	-180
2800	0.17	167	13.0	42	0.06	-42	0.18	179
2900	0.18	167	12.9	38	0.06	-44	0.19	176
3000	0.18	167	12.7	33	0.06	-46	0.19	174
3100	0.19	169	12.5	29	0.07	-48	0.20	173
3200	0.18	168	12.3	25	0.07	-50	0.20	172
3300	0.19	165	12.2	21	0.07	-52	0.20	169
3400	0.19	167	12.0	16	0.07	-54	0.21	166
3500	0.19	165	11.9	11	0.07	-56	0.21	166
3600	0.20	164	11.7	8	0.07	-58	0.21	163
3700	0.20	165	11.5	3	0.07	-60	0.22	161
3800	0.20	163	11.4	-1	0.07	-62	0.23	158
3900	0.21	161	11.2	-5	0.07	-64	0.23	155
4000	0.21	159	11.1	-10	0.07	-66	0.23	153
4100	0.22	159	10.9	-14	0.07	-69	0.23	149
4200	0.21	155	10.8	-18	0.08	-71	0.24	148
4300	0.21	151	10.7	-22	0.08	-73	0.24	144
4400	0.22	150	10.6	-26	0.08	-75	0.24	140
4500	0.22	147	10.5	-31	0.08	-78	0.25	137
4600	0.22	143	10.4	-35	0.08	-80	0.24	134
4700	0.22	140	10.2	-39	0.08	-82	0.25	130
4800	0.22	137	10.1	-44	0.08	-85	0.26	127
4900	0.21	132	10.1	-48	0.08	-87	0.26	123
5000	0.21	127	10	-52	0.08	-89	0.25	118

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

Typical Scattering Parameters (Vd = +4.75V, Icc = 77 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	0.21	125	9.8	-57	0.08	-92	0.25	114
5200	0.20	121	9.7	-61	0.09	-95	0.26	111
5300	0.20	115	9.6	-65	0.09	-98	0.27	107
5400	0.20	109	9.6	-70	0.09	-100	0.27	102
5500	0.20	104	9.5	-74	0.09	-103	0.27	96
5600	0.19	97	9.4	-79	0.09	-106	0.27	92
5700	0.20	89	9.3	-83	0.09	-109	0.27	87
5800	0.20	83	9.2	-88	0.09	-113	0.28	80
5900	0.19	73	9.2	-92	0.09	-116	0.29	75
6000	0.20	64	9.1	-97	0.09	-119	0.29	68
6100	0.20	55	9.0	-102	0.10	-122	0.29	62
6200	0.20	46	9.0	-107	0.10	-125	0.30	55
6300	0.20	35	8.9	-112	0.10	-129	0.30	49
6400	0.22	24	8.8	-117	0.10	-132	0.30	42
6500	0.23	18	8.7	-122	0.10	-136	0.31	34
6600	0.24	6	8.6	-127	0.10	-140	0.32	27
6700	0.26	-2	8.5	-132	0.10	-143	0.32	20
6800	0.27	-10	8.3	-137	0.10	-147	0.33	13
6900	0.29	-18	8.2	-143	0.10	-151	0.34	6
7000	0.31	-26	8.0	-148	0.10	-155	0.35	-2
7100	0.34	-34	7.9	-153	0.10	-159	0.36	-9
7200	0.37	-40	7.7	-159	0.10	-163	0.37	-17
7300	0.39	-49	7.5	-164	0.10	-167	0.38	-24
7400	0.42	-55	7.3	-169	0.10	-171	0.39	-31
7500	0.44	-61	7.1	-175	0.10	-175	0.40	-39
7600	0.46	-68	6.9	180	0.10	-179	0.41	-45
7700	0.49	-73	6.7	174	0.10	177	0.42	-52
7800	0.51	-79	6.5	169	0.09	174	0.43	-59
7900	0.53	-84	6.2	164	0.09	170	0.44	-65
8000	0.55	-90	6.0	159	0.09	166	0.45	-71
8100	0.57	-95	5.7	154	0.09	162	0.46	-77
8200	0.60	-99	5.5	149	0.09	159	0.47	-83
8300	0.61	-105	5.3	144	0.08	155	0.48	-89
8400	0.63	-110	5.1	139	0.08	151	0.48	-94
8500	0.64	-114	4.8	134	0.08	148	0.49	-99
8600	0.65	-118	4.6	130	0.08	145	0.50	-104
8700	0.67	-123	4.4	125	0.08	141	0.51	-109
8800	0.68	-127	4.2	121	0.07	138	0.51	-114
8900	0.69	-131	4.0	116	0.07	135	0.51	-118
9000	0.69	-135	3.8	112	0.07	133	0.52	-123
9100	0.70	-139	3.6	108	0.07	130	0.52	-127
9200	0.71	-142	3.5	104	0.07	127	0.52	-131
9300	0.71	-146	3.3	100	0.07	124	0.53	-135
9400	0.72	-150	3.1	95	0.06	121	0.53	-139
9500	0.72	-153	3.0	92	0.06	118	0.53	-142
9600	0.72	-156	2.8	88	0.06	116	0.53	-146
9700	0.72	-160	2.7	84	0.06	113	0.53	-149
9800	0.73	-163	2.6	81	0.06	111	0.54	-152
9900	0.73	-166	2.5	77	0.06	109	0.54	-155
10000	0.73	-169	2.4	73	0.05	107	0.54	-159

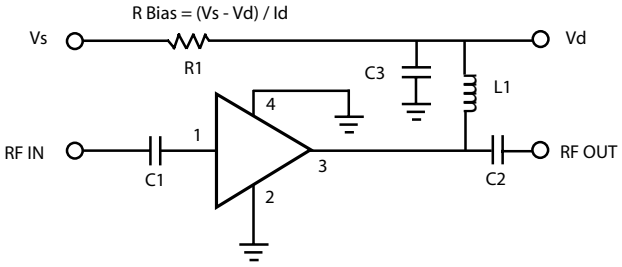
S-Parameter Data Files are available online at: www.mimixbroadband.com

Application Circuit

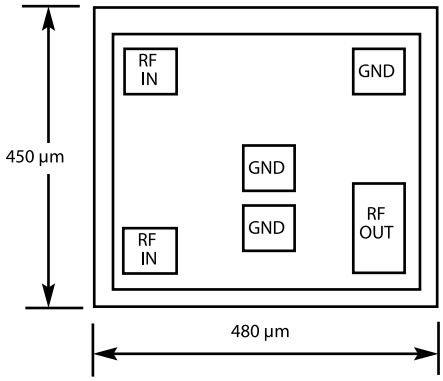
Note: This schematic represents the topology of the application circuit recommended by Mimix.

Recommended Bias Resistor Values for ID = 80 mA				
Supply Voltage (Vs)	7V	8V	10V	12V
Rbias (1/4W)	25 Ω	39Ω	—	—
Rbias (1/2W)	—	—	64Ω	89Ω

Note: Rbias provides DC bias stability over temperature.



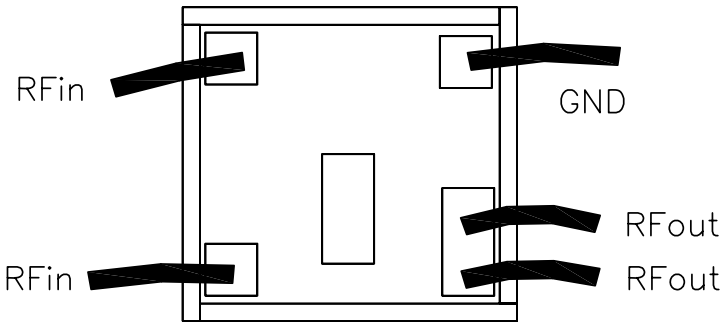
Physical Dimensions - BD (Bare Die)



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

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

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 with backside metallization. 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
CGB7014-BD-000V	RoHS compliant die packed in vacuum release gel paks