DC-8.0 GHz InGaP HBT Packaged Matched Gain Block Amplifier

April 2007 - Rev 19-Apr-07

CGB7014-SC
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
- SOT-89 Package
- 100% DC On-Wafer Testing
- ESD Protection on All Die: >1000V HBM
- Low Thermal Resistance: <80°C/Watt

Description

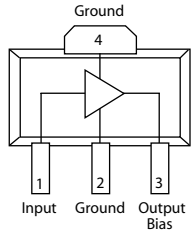
The CGB7014-SC is a Darlington Configured, high dynamic range, utility gain block amplifier. Designed for applications operating within the DC to 8.0 GHz frequency range, Mimix's broadband, cascadable, gain block amplifiers are ideal solutions for transmit, receive and IF applications.

These MMIC amplifiers are available in an industry standard SOT-89 package. 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.

Functional Block Diagram (SOT-89)



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
EDS (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

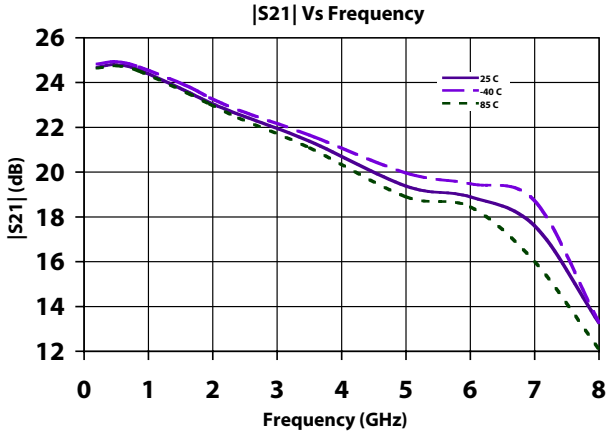
Electrical Characteristics

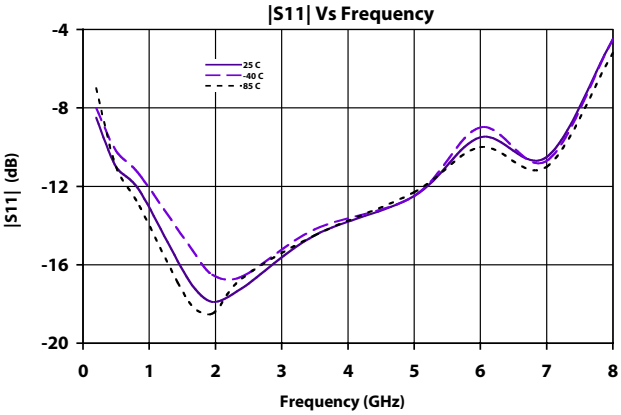
Unless otherwise specified, the following specifications are guaranteed at room temperature in a Mimix test fixture.

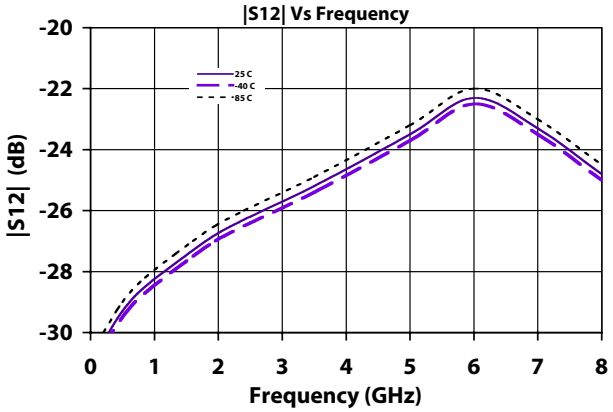
		850 MHz			1950 MHz			2400 MHz			3500 MHz			6000 MHz			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25	23.5	24.5	25.5	22.0	23.0	24.0	21.5	22.5	23.5		21.5			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 IS-95, 9 Forward Channels	+25		13.5			13.5											dBm
	-40 to +85		13.5			13.5											dBm

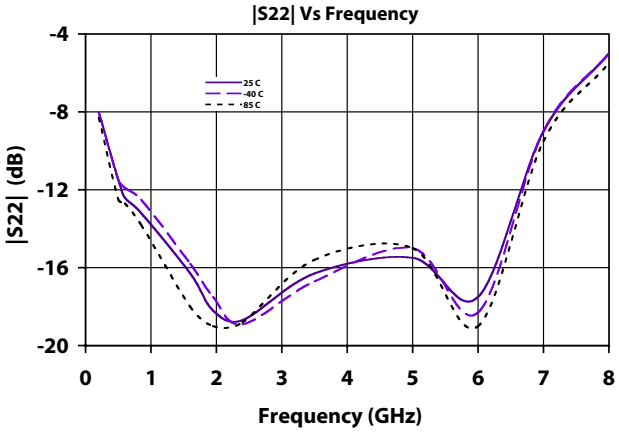
Notes: 1. Test Conditions in Mimix eval board, Vs = 8 V, Id = 80 mA Typ., Rbias = 39 Ω, Zs = Zl = 50 Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 6 dBm.
2. Values reflect performance in recommended application circuit.

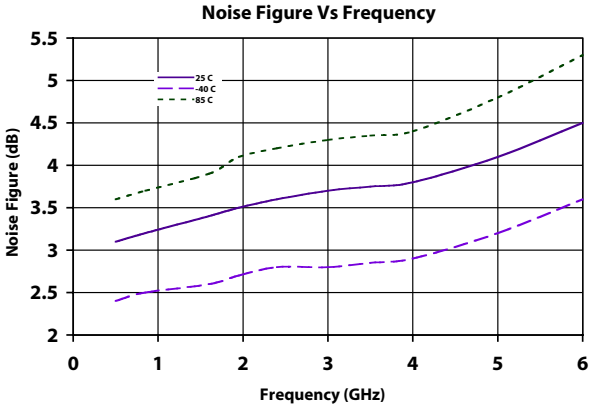
Typical S-Parameter and Noise Performance



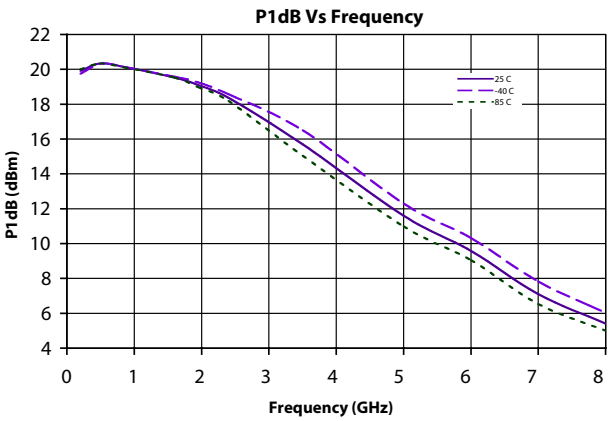


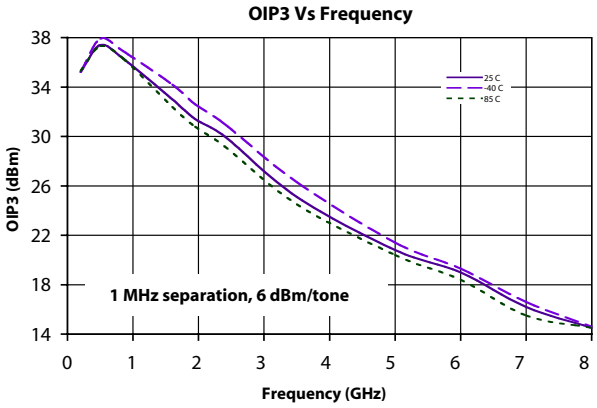




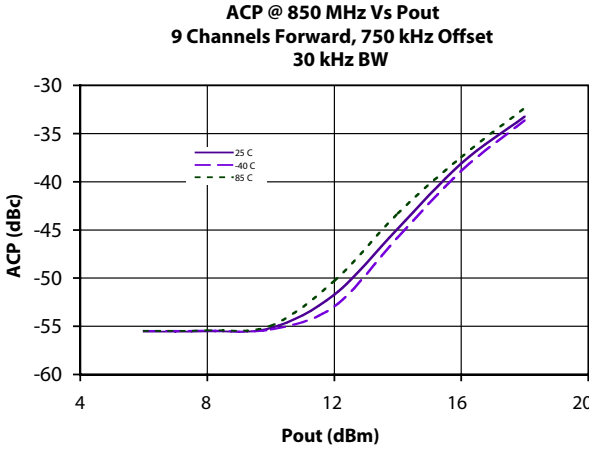


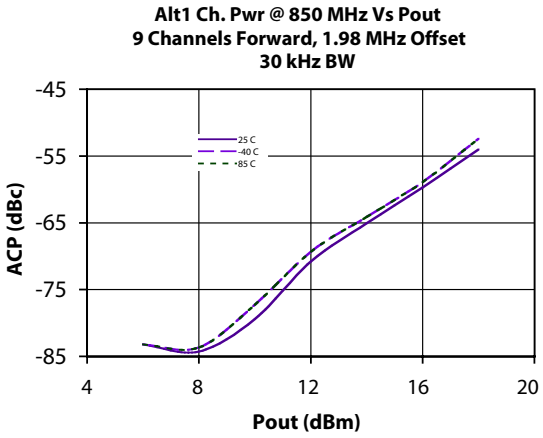
Typical Power and Linearity Performance

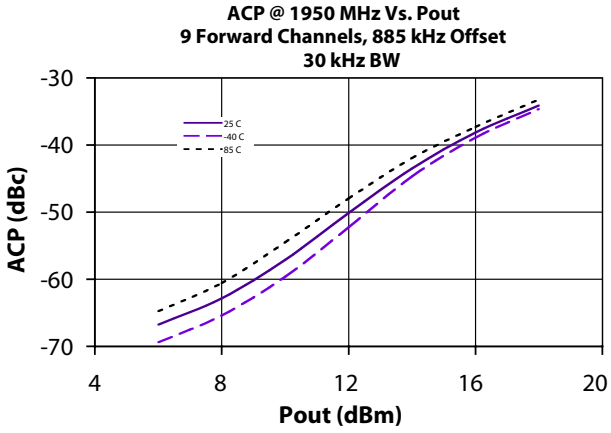


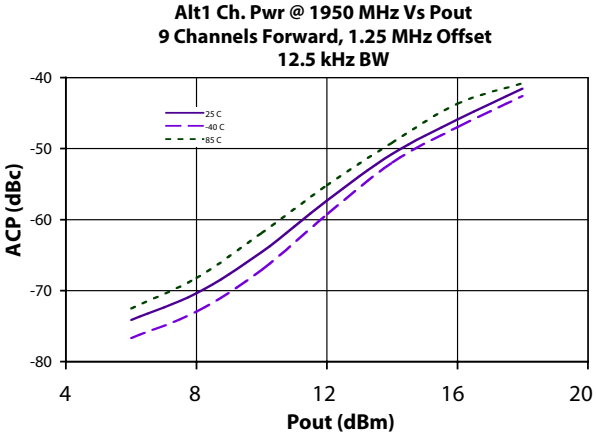


Linearity Performance - Base Station ACP – IS-95









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

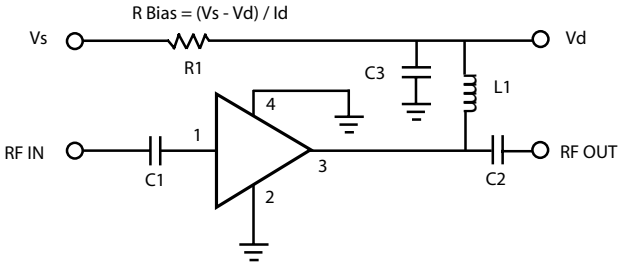
S-Parameter Data Files are available online at: www.mimixbroadband.com

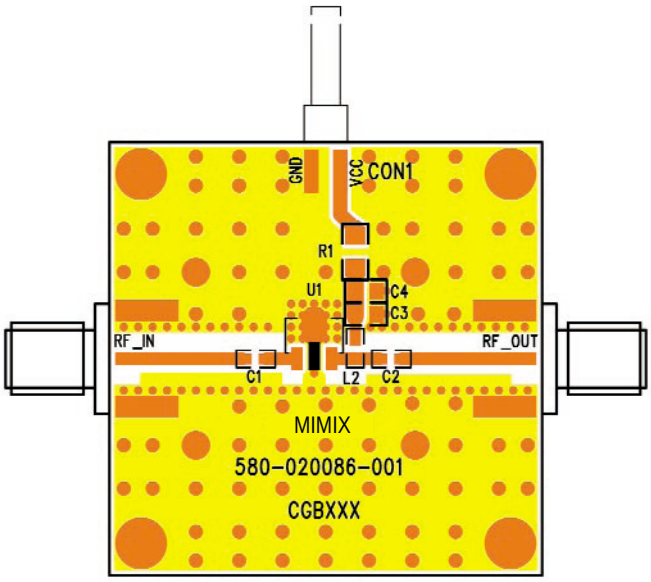
Application Circuit

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

Recommended Bias Resistor Values for ID = 80 mA				
Supply Voltage (V)	7V	8V	10V	12V
Rbias (R1 Description: 1206 1/4W 1%)	25Ω	39Ω	—	—
Rbias (R1 Description: 1210 1/2W 1%)	—	—	64Ω	89Ω

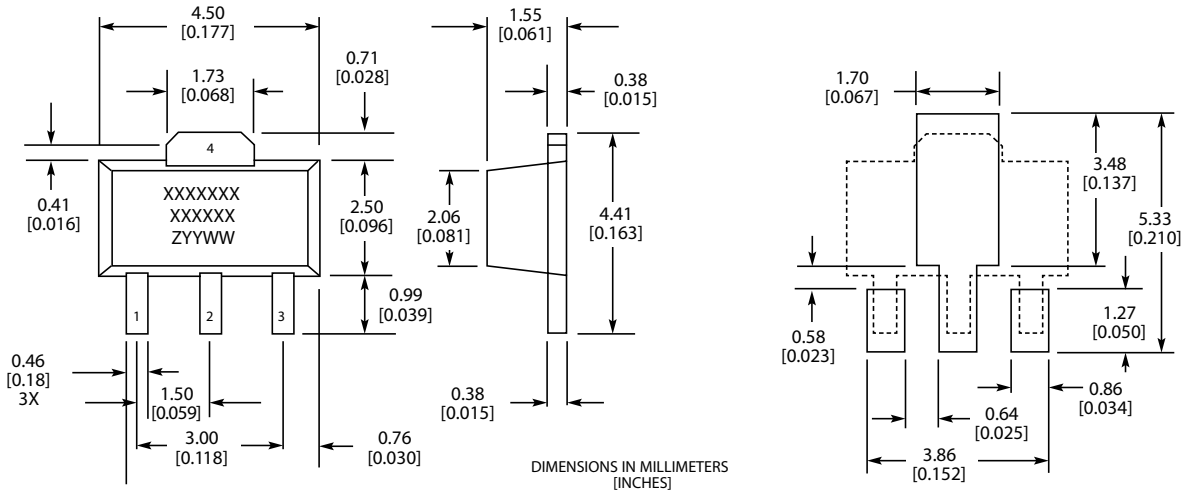
Note: Rbias provides DC bias stability over temperature.





Ref Designator	Value	Description	Size
C1, C2	1000 pF	MCH185A101JK	0805
C3	1.0 µF	VITR 1.0 µF 25V CER CAP 0805 X7R 10%	0805
L1	56 nH	Coilcraft 0603 CS 10%	0603
R1		RBias = (Vs - Vd) / Id	1206 / 1210
C4		DNP (Do Not Place)	N/A

Physical Dimensions - SC Package (SOT-89)



DIMENSIONS IN MILLIMETERS
[INCHES]

MARKINGS:
XXXXXXX = MIMIX MODEL NO.
XXXXXX = WAFER LOT NO.
ZYYWW = DATE CODE (YR/WEEK)
FIRST LETTER COUNTRY OF ORIGIN IF OTHER THAT USA

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.

Package Attachment - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Care should be taken not to apply heavy pressure to the top 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 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.

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 (260°C reflow) "Pb Free" processes.

Ordering Information

Part Number for Ordering	Description
CGB7014-SC-0G00	Matte Tin plated RoHS compliant SOT-89 surface mount package in bulk quantity
CGB7014-SC-0G0T	Matte Tin plated RoHS compliant SOT-89 surface mount package in tape and reel
PB-CGB7014-SC-0000	Evaluation Board for SOT-89 packaged device with SMA connectors

We also offer the plastic packages with SnPb (Tin-Lead) or NiPdAu plating. Please contact your regional sales manager for more information regarding different plating types