DC-2.5 GHz InGaP HBT Matched Gain Block Amplifier

August 2009 - Rev 07-Aug-09

CGB7289-BD
RoHS

Features

- 41.0 dBm Output IP3 @ 2140 MHz
- 21.0 dB Gain @ 900 MHz
- 13.3 dB Gain @ 2140 MHz
- 23.7 dBm P1dB @ 2140 MHz
- Low Performance Variation Over Temperature
- 100% DC On-Wafer Testing
- ESD Protection on All Die: >2000V HBM
- Low Thermal Resistance: <35°C/Watt
- Low Volt Supply: 5V, Active Bias

Description

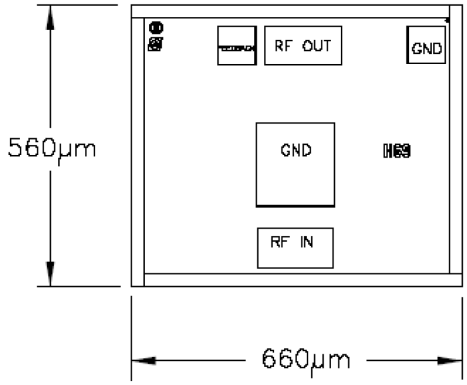
The CGB7289-BD is a single stage, high power, high dynamic range, utility gain block amplifier. Designed for applications operating within the DC to 2.5 GHz frequency range, Mimix's broadband, cascadable, gain block amplifier is an ideal solution for transmit, receive and IF applications.

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.

This gain block amplifier offers significant ease of use in a broad range of applications. The combination of high gain, P1dB and high OIP3 at low current makes the CGB7289-BD an ideal transmit and receive solution when used in applications including cellular, PCS and 3G services operating from 0.8 to 2.2 GHz.

Chip Layout



Absolute Maximum Ratings

Max Device Voltage	+6.0 V
Max Device Current	200 mA
Max Device Dissipated Power	1.2 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	35° C/W
ESD (HBM)	2000 V

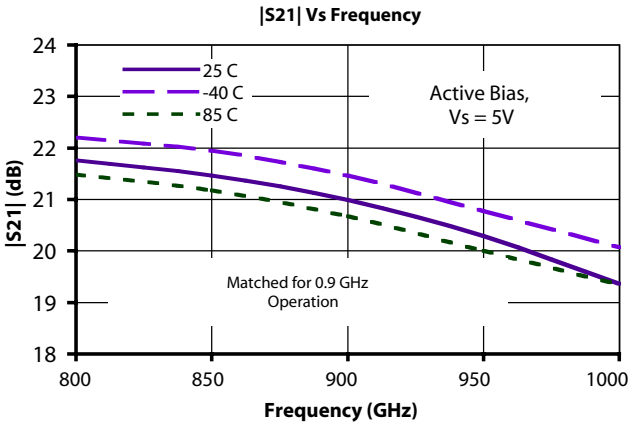
Operation of this device above any of these parameters may cause permanent damage.

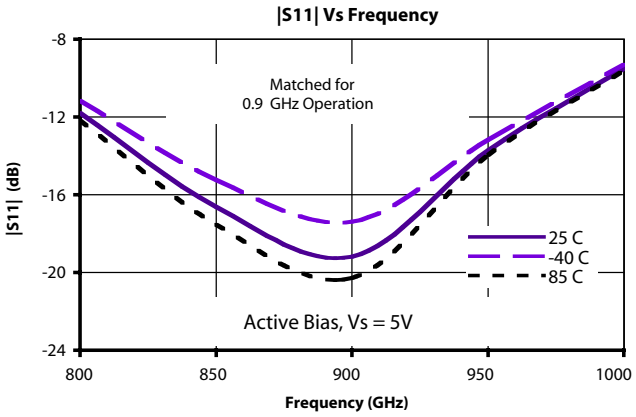
Typical Performance (8V, Passive Bias)

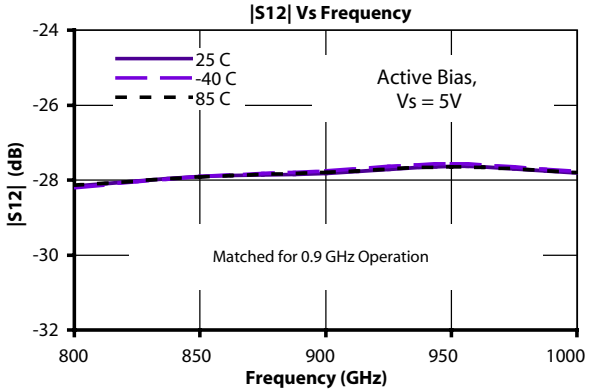
		900 MHz			1960 MHz			2140 MH			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25	20.0	21.0	22.0	13.7	14.7	15.7	12.5	13.5	14.5	dB
	-40 to +85	19.7	21.0	22.3	13.4	14.7	16.0	12.2	13.5	14.8	dB
Output P1dB	+25	22.3	23.3		23.0	24.0		23.0	24.0		dBm
	-40 to +85	22.0	23.3		22.7	24.0		22.7	24.0		dBm
Output IP3	+25	38.5	40.0		40.0	41.5		40.5	42.0		dBm
	-40 to +85	37.5	40.0		39.0	41.5		39.5	42.0		dBm
Noise Figure	+25		3.8	4.8		4.7	5.5		5.3	6.4	dB
	-40 to +85		3.8	5.3		4.7	6.0		5.3	6.5	dB
Operating Current	+25	110	120	130	110	120	130	110	120	130	mA
	-40 to +85	105	120	135	105	120	135	105	120	135	mA
Input Return Loss	+25	11	15		9.0	12		10	13		dB
	-40 to +85	10	15		8.5	12		9	13		dB
Output Return Loss	+25	5.5	7.5		11.0	15.0		9.0	12.0		dB
	-40 to +85	5.0	7.5		10.0	15.0		8.5	12.0		dB
Pout @ -45 dBc, ACP IS-95, 9 Forward Channels	+25		16.5			17.5					dBm
	-40 to +85		16.5			17.5					dBm

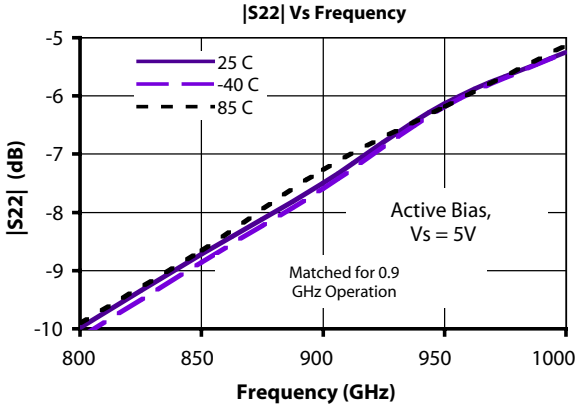
Notes: 1. Performance in Mimix eval board, Vs = 8 V, Id = 120 mA Typ., Rbias = 27 Ω, Zs = Zl = 50 Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 11 dBm.
2. Values reflect performance in recommended application circuit.
3. Only on-wafer DC test is done. Devices are not tested for RF performance.

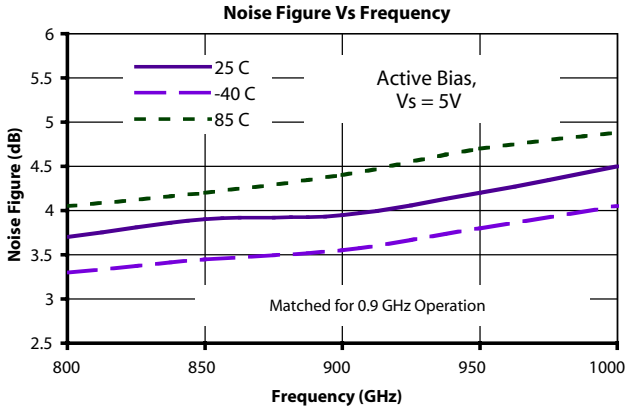
Typical S-Parameter and Noise Performance: 900 MHz, 5V (Matched for 0.9 GHz Operation)



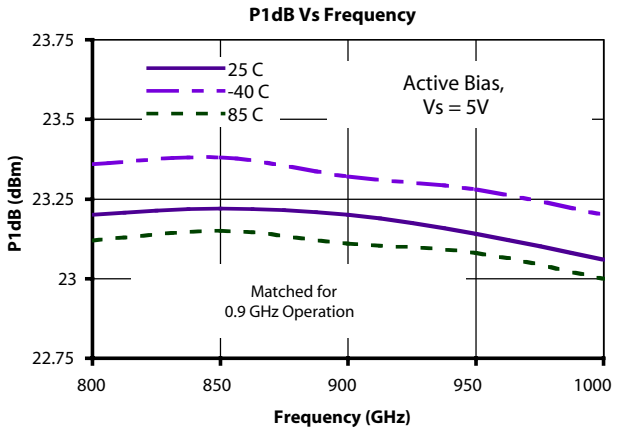


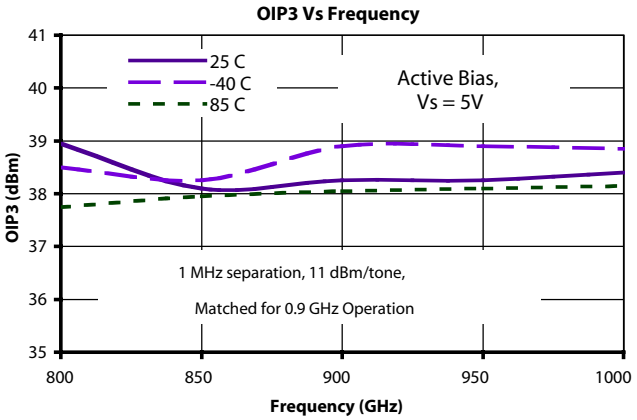


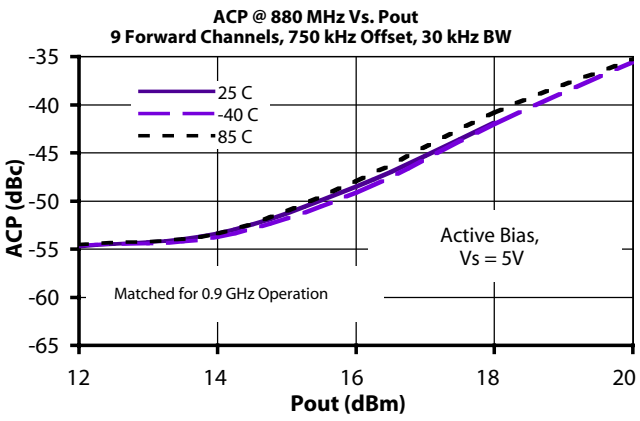


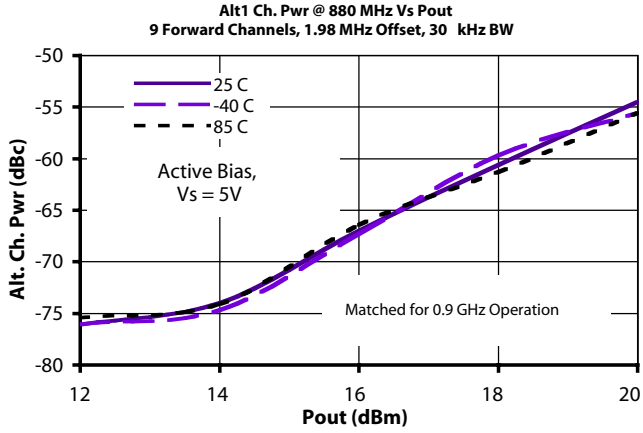


Typical S-Parameter and Noise Performance: 900 MHz, 5V (Matched for 0.9 GHz Operation)

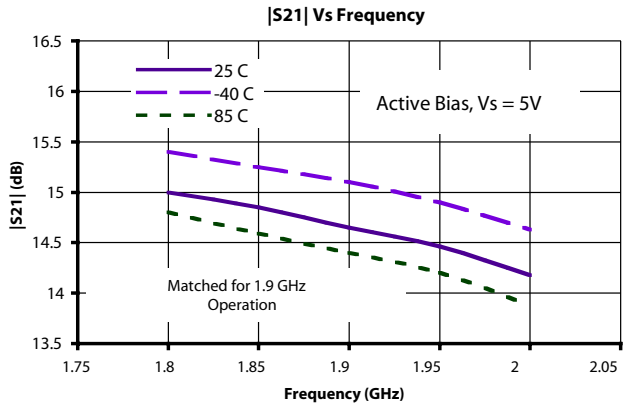


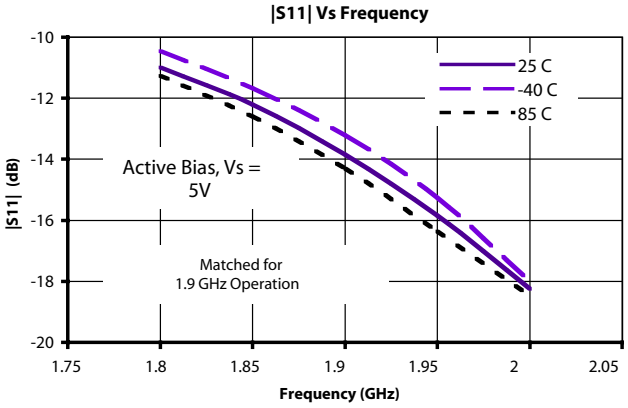


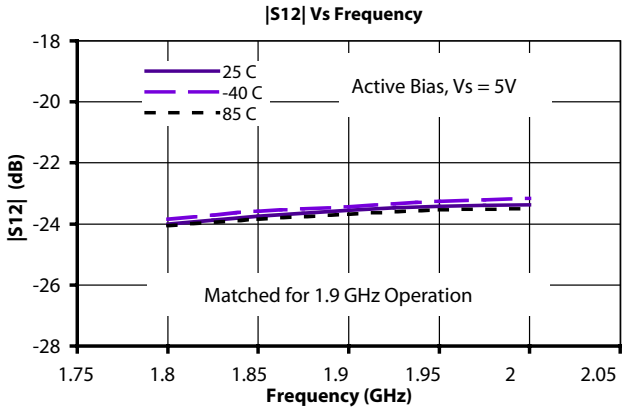


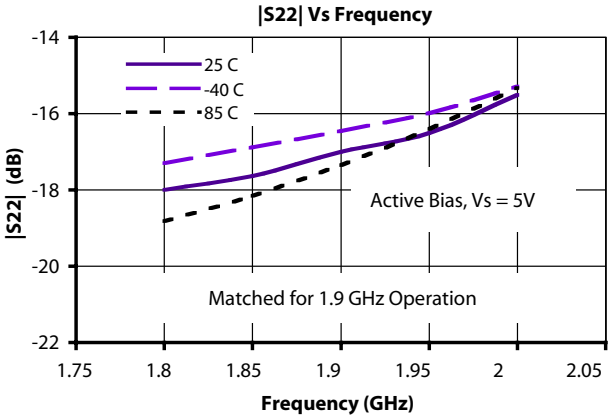


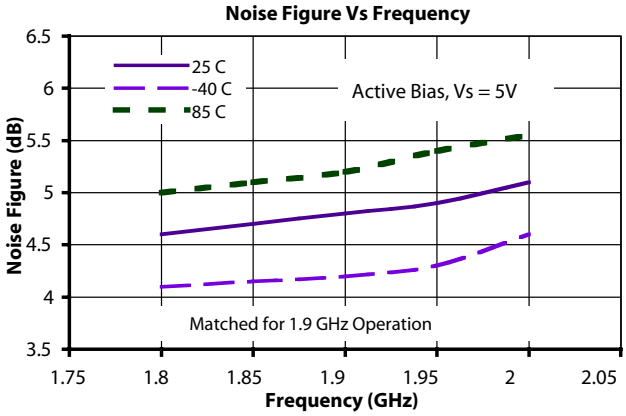
Typical S-Parameter and Noise Performance: 1960 MHz, 5V (Matched for 1.9 GHz Operation)



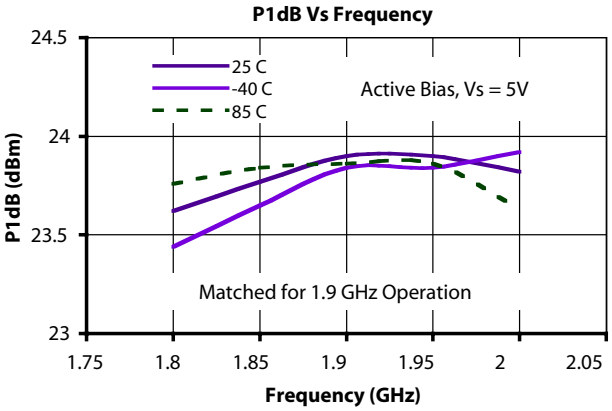


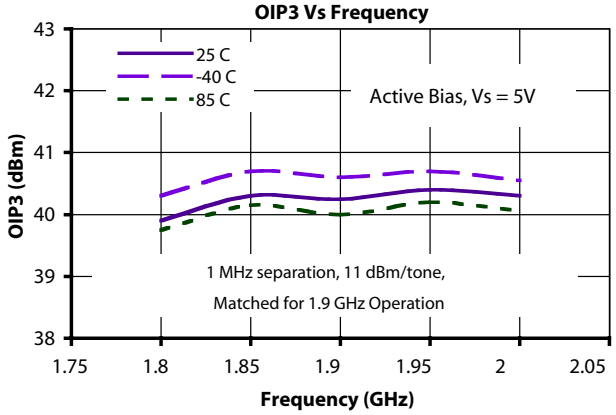


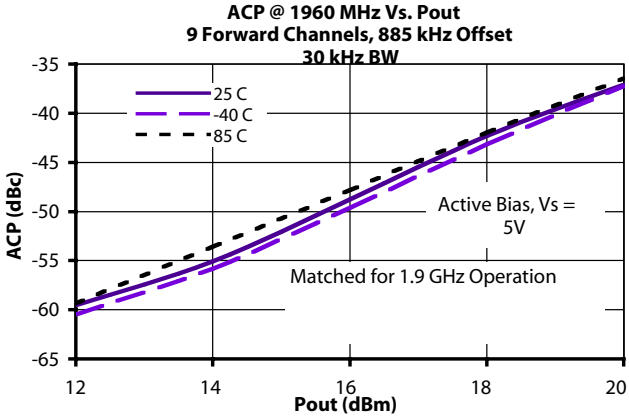


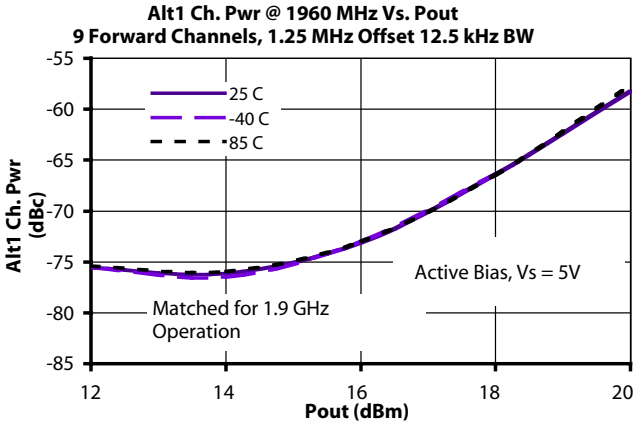


Typical S-Parameter and Noise Performance: 1960 MHz, 5V (Matched for 1.9 GHz Operation)

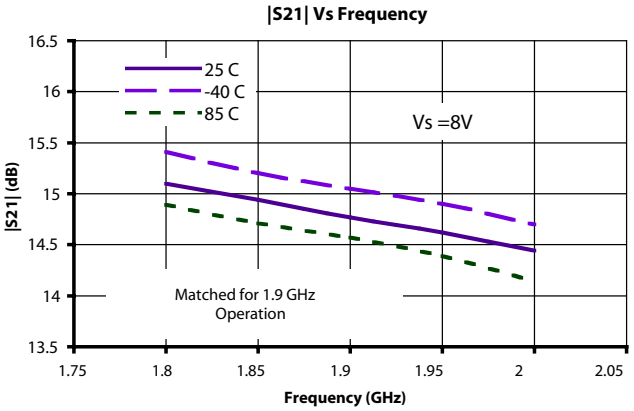


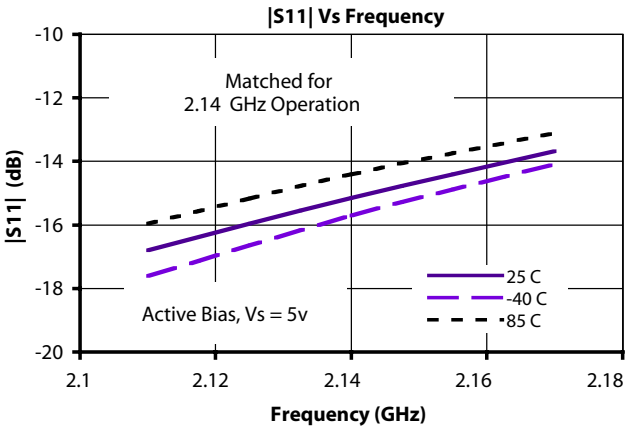


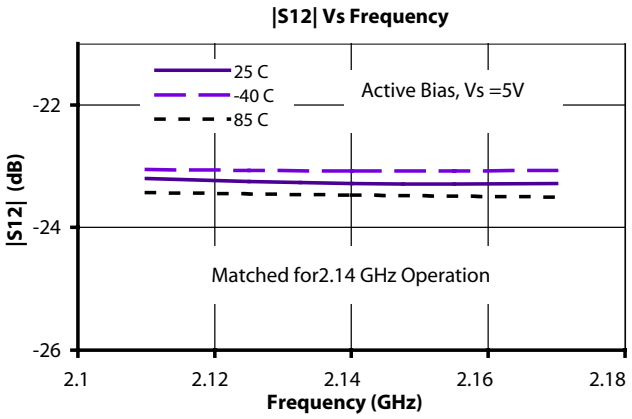


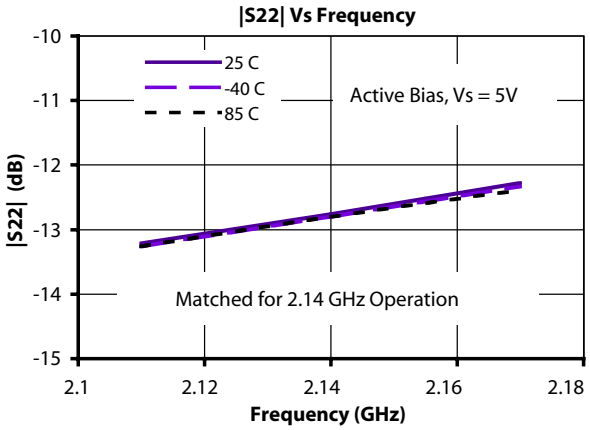


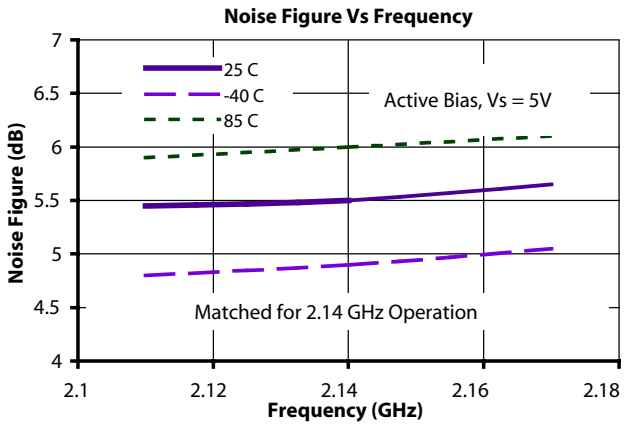
Typical S-Parameter and Noise Performance: 2140 MHz, 5V (Matched for 2.14 GHz Operation)



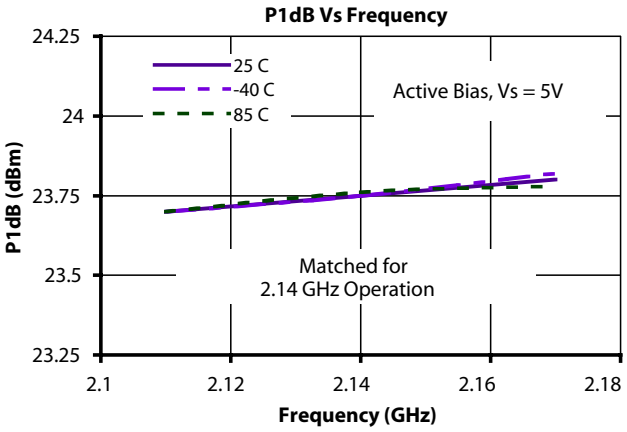


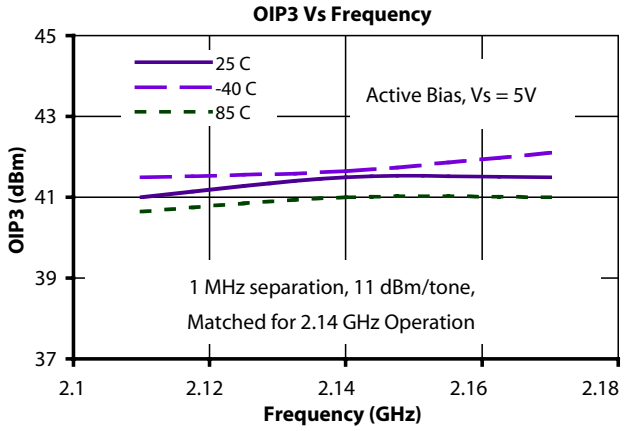




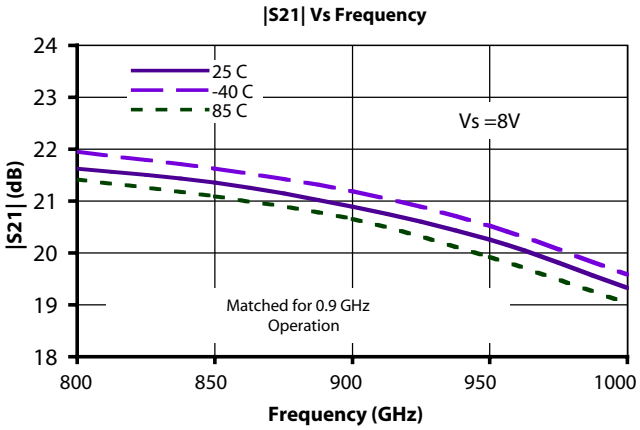


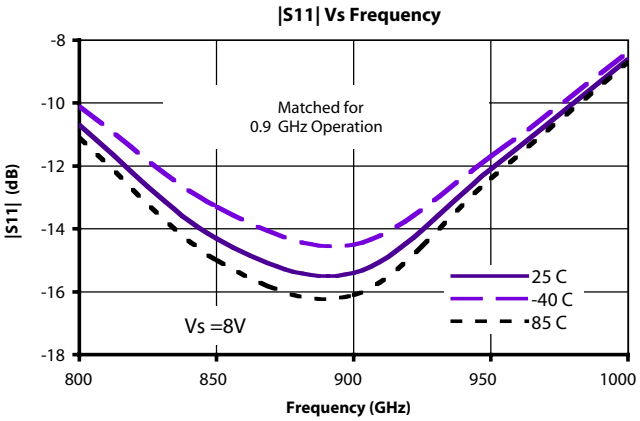
Typical S-Parameter and Noise Performance: 2140 MHz, 5V (Matched for 2.14 GHz Operation)

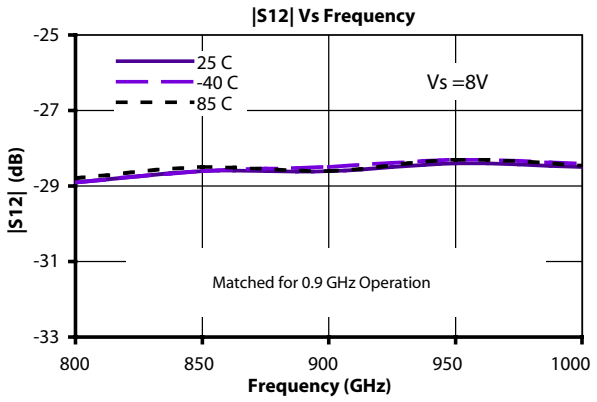


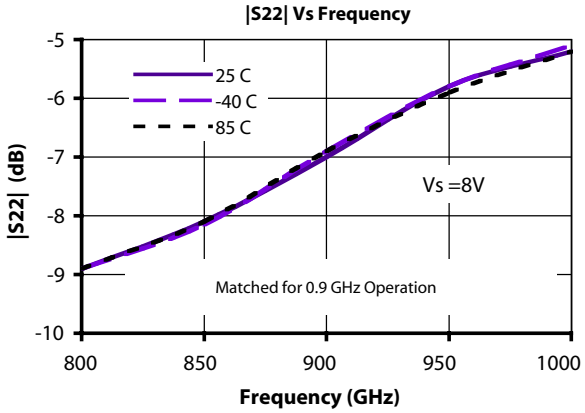


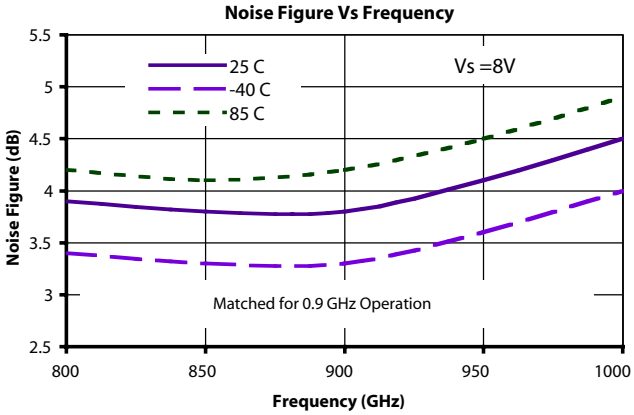
Typical S-Parameter and Noise Performance: 900 MHz, 8V (Matched for 0.9 GHz Operation)



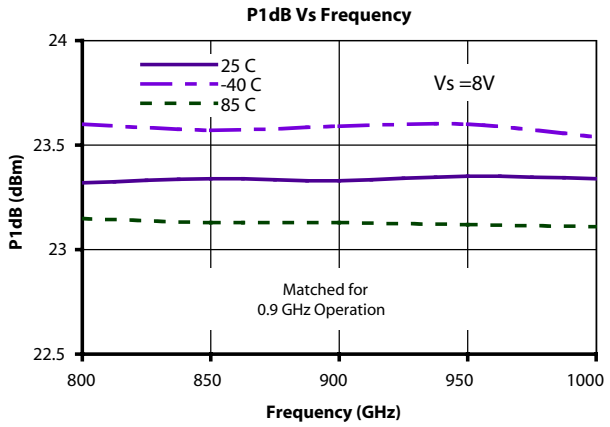


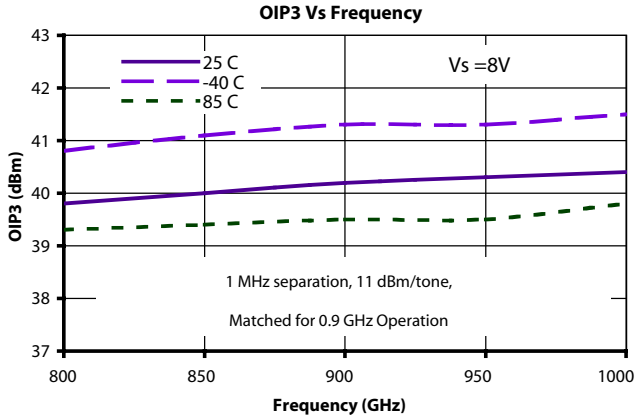


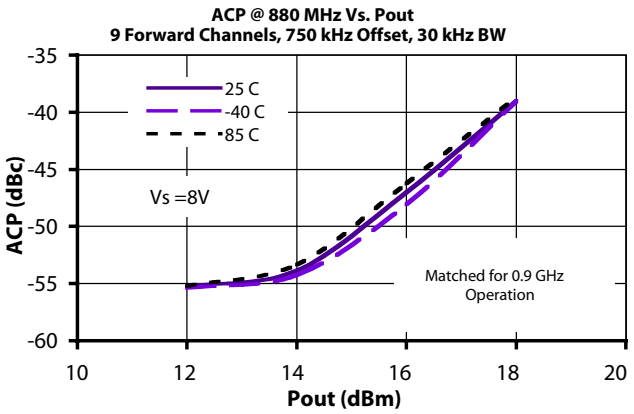


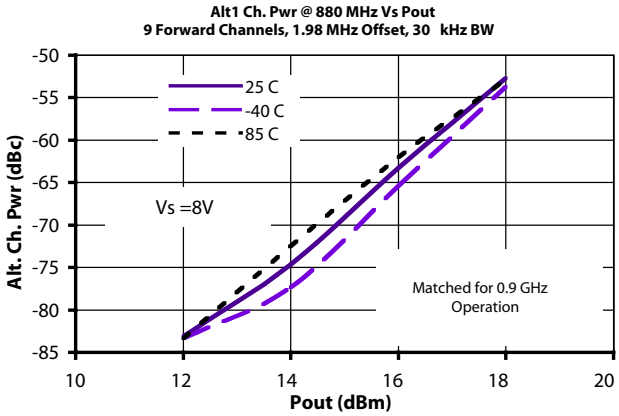


Typical S-Parameter and Noise Performance: 900 MHz, 8V (Matched for 0.9 GHz Operation)

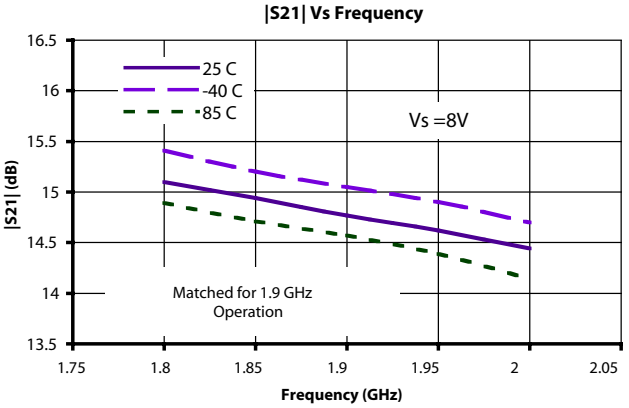


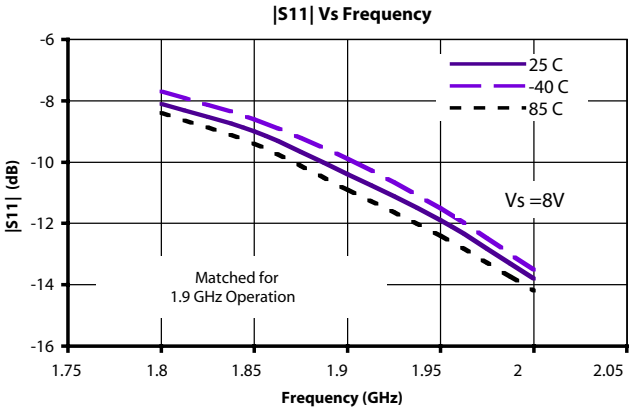


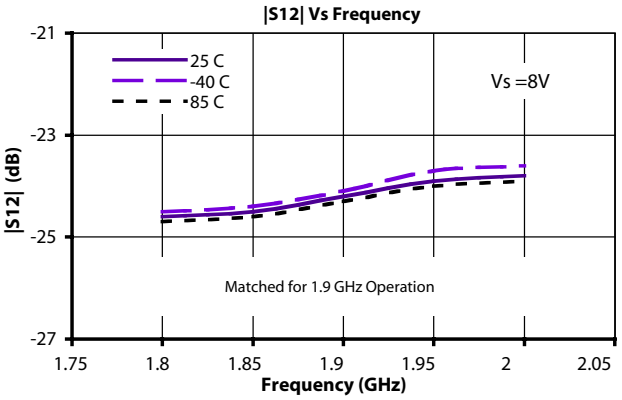


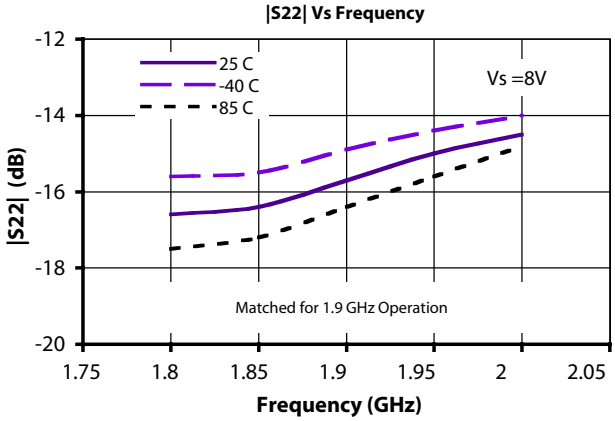


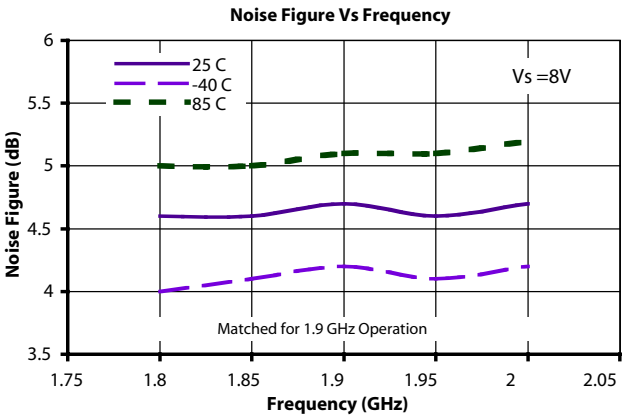
Typical S-Parameter and Noise Performance: 1960 MHz, 8V (Matched for 1.9 GHz Operation)



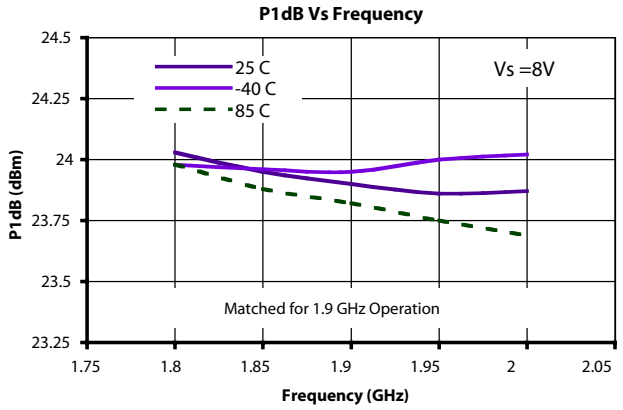


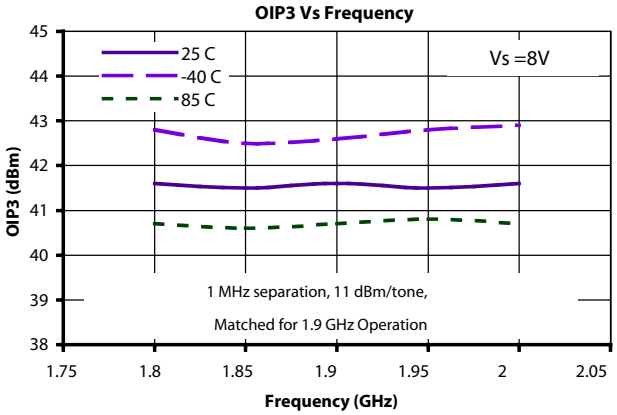


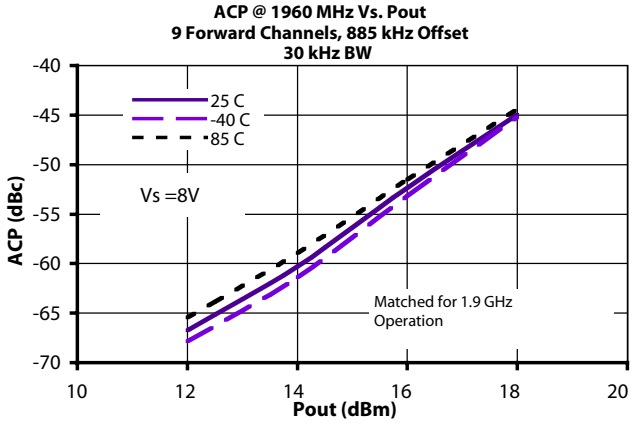


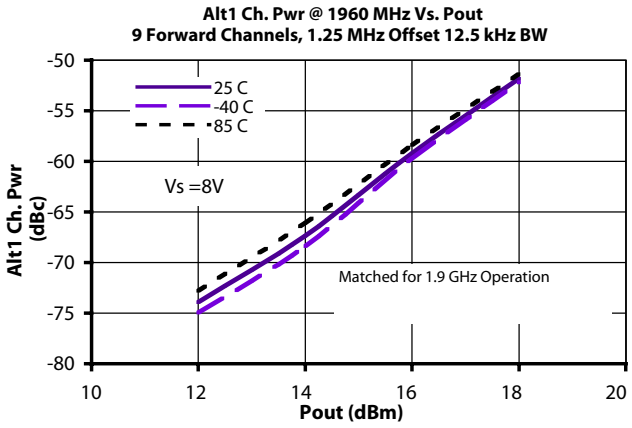


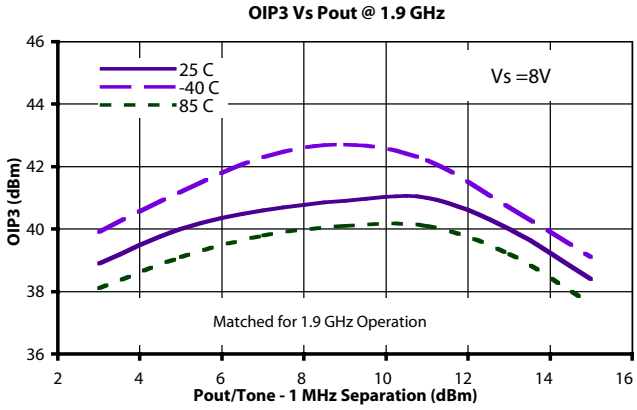
Typical S-Parameter and Noise Performance: 1960 MHz, 8V (Matched for 1.9 GHz Operation)



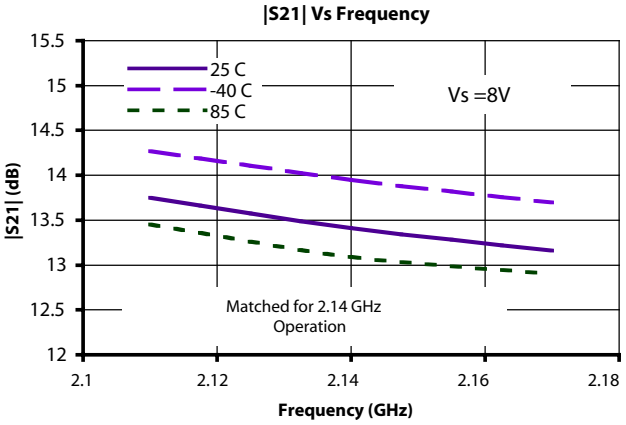


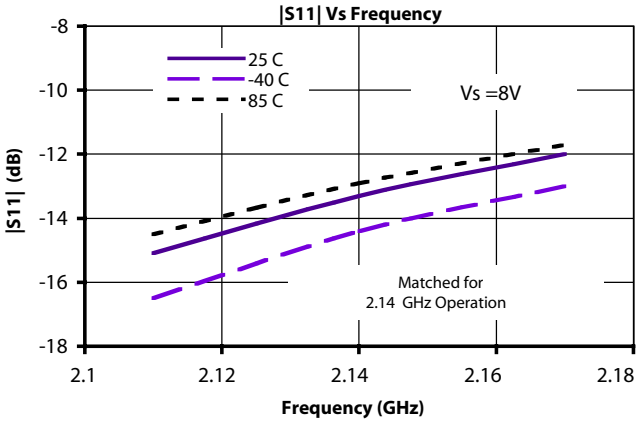


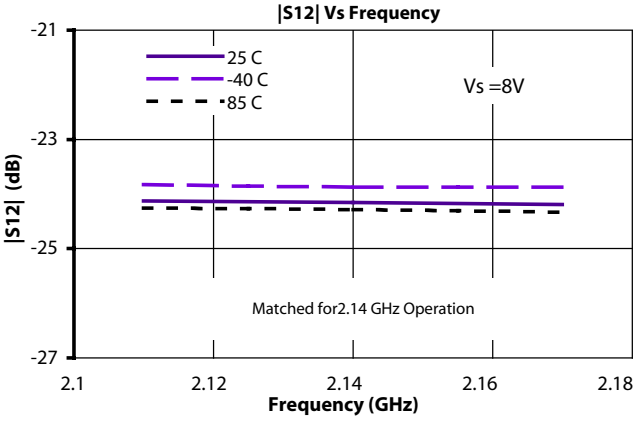


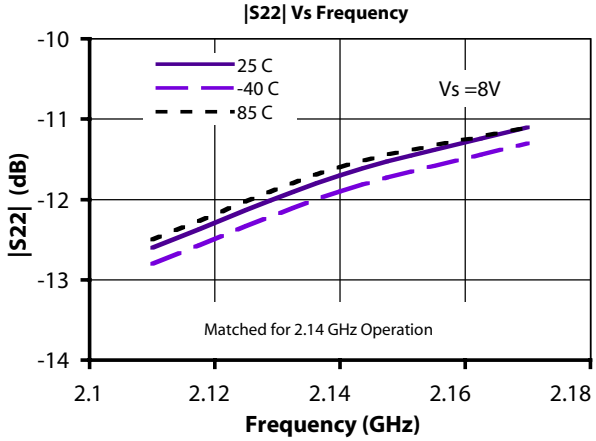


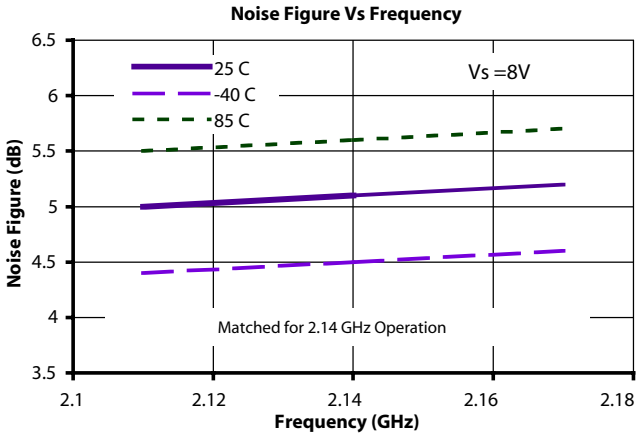
Typical S-Parameter and Noise Performance: 2140 MHz, 8V (Matched for 2.14 GHz Operation)



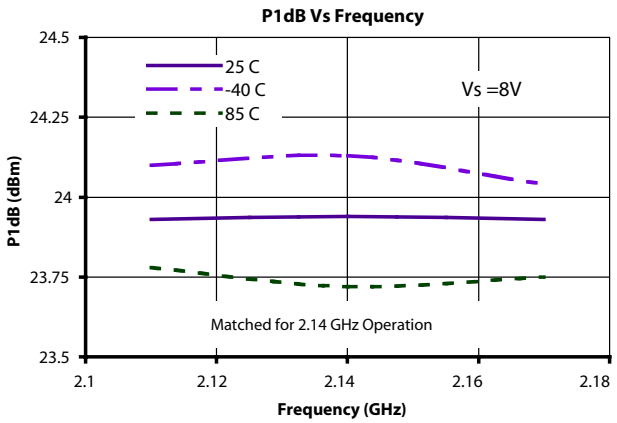


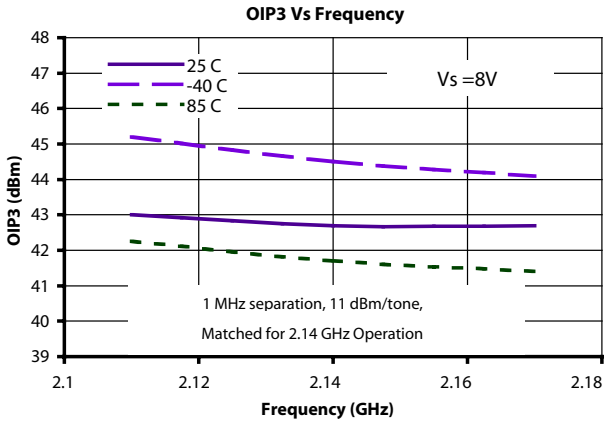






Typical S-Parameter and Noise Performance: 2140 MHz, 8V (Matched for 2.14 GHz Operation)





Typical Scattering Parameters (Vd = +4.76V, Icc = 118 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	0.560	-172.9	25.36	152.4	0.016	11.6	0.202	-113.5
200	0.643	-175.1	21.09	131.1	0.018	12.6	0.323	-135.0
300	0.698	179.5	17.30	115.2	0.019	11.5	0.389	-149.6
400	0.726	173.6	14.41	103.0	0.021	10.0	0.423	-160.4
500	0.737	168.0	12.29	93.0	0.022	9.3	0.439	-168.5
600	0.743	162.6	10.73	84.4	0.024	7.9	0.446	-175.4
700	0.740	157.3	9.56	76.6	0.025	6.1	0.446	178.8
800	0.732	152.2	8.66	69.2	0.027	4.4	0.442	173.7
900	0.721	147.0	7.98	62.1	0.029	2.3	0.434	169.1
1000	0.705	141.8	7.44	55.1	0.031	-0.1	0.423	164.9
1100	0.684	136.5	7.02	48.0	0.033	-2.9	0.409	161.0
1200	0.657	131.0	6.70	40.7	0.036	-6.2	0.391	157.7
1300	0.622	125.4	6.45	33.0	0.039	-10.5	0.369	155.0
1400	0.578	119.6	6.26	24.9	0.043	-15.3	0.345	153.3
1500	0.521	113.9	6.11	16.0	0.047	-21.2	0.318	153.1
1600	0.450	108.6	5.98	6.3	0.051	-28.1	0.292	155.3
1700	0.362	104.9	5.84	-4.5	0.056	-36.2	0.277	160.7
1800	0.262	106.9	5.65	-16.6	0.060	-45.9	0.281	168.5
1900	0.182	126.9	5.37	-29.7	0.063	-57.0	0.314	175.2
2000	0.205	162.7	4.97	-43.8	0.065	-69.2	0.372	177.3
2100	0.322	175.0	4.44	-58.1	0.065	-82.0	0.441	174.7
2200	0.454	172.5	3.83	-72.1	0.063	-94.4	0.503	169.0
2300	0.571	165.3	3.21	-85.1	0.059	-106.3	0.552	161.9
2400	0.664	157.0	2.63	-96.9	0.054	-117.3	0.585	154.5
2500	0.733	148.7	2.12	-107.4	0.049	-127.1	0.605	147.1
2600	0.783	140.9	1.69	-116.6	0.044	-136.3	0.615	140.1
2700	0.819	133.7	1.33	-124.7	0.040	-144.6	0.619	133.6
2800	0.844	126.9	1.04	-131.8	0.036	-152.1	0.618	127.4
2900	0.863	120.6	0.80	-137.9	0.033	-159.6	0.615	121.6
3000	0.879	114.7	0.61	-143.2	0.030	-167.4	0.610	116.0
3100	0.890	109.0	0.45	-147.3	0.027	-174.5	0.604	110.5
3200	0.899	103.5	0.32	-149.9	0.025	178.5	0.598	105.1
3300	0.907	98.1	0.22	-149.4	0.023	171.1	0.591	99.8
3400	0.912	92.9	0.13	-141.9	0.021	163.9	0.584	94.5
3500	0.916	87.7	0.08	-116.1	0.020	156.3	0.578	89.2
3600	0.920	82.7	0.08	-72.4	0.019	147.9	0.571	84.0
3700	0.923	77.7	0.11	-50.8	0.018	139.7	0.564	78.6
3800	0.925	72.8	0.15	-44.8	0.018	132.0	0.559	73.3
3900	0.926	67.8	0.19	-44.3	0.017	124.0	0.553	67.8
4000	0.927	62.8	0.22	-46.2	0.017	115.6	0.548	62.4
4100	0.928	57.9	0.24	-49.3	0.017	107.0	0.544	56.9
4200	0.928	53.0	0.27	-53.0	0.017	99.4	0.541	51.4
4300	0.929	48.1	0.28	-57.0	0.017	91.1	0.539	45.9
4400	0.929	43.1	0.30	-61.3	0.018	84.0	0.537	40.3
4500	0.929	38.2	0.31	-65.8	0.018	76.6	0.536	34.8
4600	0.929	33.3	0.32	-70.4	0.019	69.8	0.536	29.3
4700	0.928	28.5	0.33	-75.1	0.019	62.8	0.537	23.8
4800	0.929	23.6	0.33	-79.8	0.020	56.7	0.539	18.4
4900	0.928	18.7	0.34	-84.6	0.020	50.3	0.541	13.0
5000	0.928	13.9	0.34	-89.4	0.021	44.4	0.544	7.6

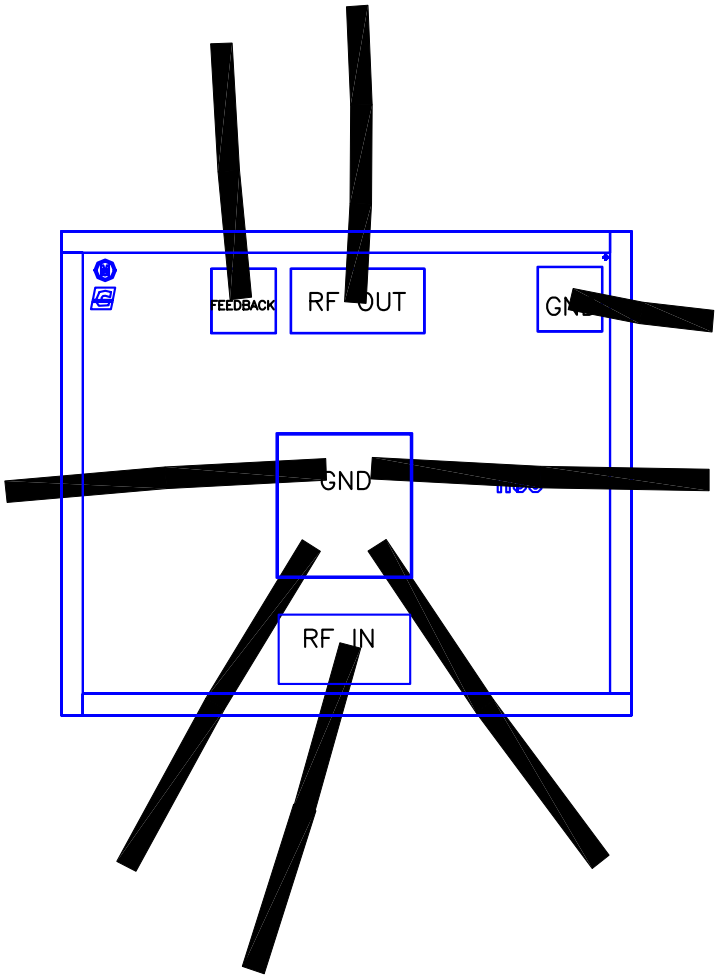
Continues Next Page. S-Parameter Data Files are available online at: www.mimixbroadband.com

Typical Scattering Parameters (Vd = +4.76V, Icc = 118 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	0.928	9.1	0.34	-94.2	0.022	39.0	0.548	2.3
5200	0.927	4.3	0.33	-99.0	0.023	33.6	0.552	-3.0
5300	0.926	-0.5	0.33	-103.9	0.023	28.5	0.557	-8.2
5400	0.925	-5.4	0.33	-108.7	0.024	23.5	0.562	-13.4
5500	0.925	-10.1	0.32	-113.4	0.025	18.9	0.569	-18.4
5600	0.924	-14.9	0.32	-118.3	0.026	14.2	0.575	-23.4
5700	0.922	-19.8	0.31	-123.0	0.026	9.3	0.583	-28.1
5800	0.921	-24.4	0.31	-127.9	0.027	4.9	0.590	-33.0
5900	0.920	-29.1	0.30	-132.5	0.028	0.7	0.598	-37.6
6000	0.918	-33.8	0.29	-137.2	0.028	-3.8	0.606	-42.1
6100	0.916	-38.5	0.28	-141.8	0.029	-8.2	0.614	-46.5
6200	0.915	-43.1	0.27	-146.4	0.029	-11.9	0.622	-50.7
6300	0.913	-47.6	0.26	-150.8	0.030	-16.0	0.631	-54.9
6400	0.912	-52.1	0.25	-155.3	0.031	-19.7	0.639	-58.9
6500	0.910	-56.6	0.24	-159.7	0.031	-23.6	0.647	-62.8
6600	0.908	-60.9	0.23	-164.1	0.031	-27.3	0.656	-66.7
6700	0.906	-65.1	0.23	-168.3	0.032	-31.0	0.664	-70.4
6800	0.904	-69.4	0.22	-172.5	0.032	-34.5	0.671	-74.0
6900	0.901	-73.5	0.21	-176.7	0.032	-38.0	0.678	-77.5
7000	0.899	-77.6	0.20	179.2	0.033	-41.3	0.685	-81.0
7100	0.896	-81.6	0.19	175.3	0.033	-44.7	0.693	-84.4
7200	0.894	-85.5	0.18	171.3	0.034	-48.3	0.699	-87.8
7300	0.892	-89.4	0.17	167.4	0.034	-51.3	0.707	-91.1
7400	0.889	-93.3	0.16	163.5	0.034	-55.1	0.712	-94.3
7500	0.884	-97.1	0.16	159.9	0.034	-58.1	0.719	-97.4
7600	0.882	-100.8	0.15	156.1	0.034	-61.3	0.724	-100.5
7700	0.880	-104.5	0.14	152.3	0.035	-64.5	0.731	-103.5
7800	0.875	-108.1	0.13	149.0	0.035	-67.2	0.737	-106.4
7900	0.873	-111.7	0.13	145.2	0.035	-70.2	0.742	-109.3
8000	0.871	-115.2	0.12	141.7	0.035	-72.8	0.747	-112.0
8100	0.868	-118.7	0.11	138.3	0.035	-75.3	0.752	-114.8
8200	0.866	-122.1	0.11	135.6	0.035	-78.7	0.757	-117.5
8300	0.862	-125.5	0.10	131.9	0.036	-81.1	0.761	-120.1
8400	0.860	-128.7	0.10	128.8	0.035	-84.1	0.765	-122.7
8500	0.857	-132.0	0.09	125.6	0.036	-86.6	0.768	-125.2
8600	0.853	-135.2	0.09	122.6	0.036	-89.5	0.771	-127.8
8700	0.850	-138.3	0.08	119.6	0.036	-92.2	0.775	-130.4
8800	0.847	-141.2	0.08	116.6	0.036	-94.9	0.778	-132.9
8900	0.844	-144.3	0.07	113.9	0.036	-97.7	0.780	-135.3
9000	0.841	-147.2	0.07	111.1	0.037	-100.3	0.783	-137.8
9100	0.836	-150.1	0.06	108.5	0.037	-103.2	0.785	-140.2
9200	0.832	-153.0	0.06	105.8	0.037	-105.8	0.786	-142.7
9300	0.827	-155.9	0.06	103.0	0.037	-108.2	0.788	-145.1
9400	0.823	-158.7	0.05	100.1	0.037	-110.7	0.790	-147.5
9500	0.818	-161.6	0.05	97.9	0.037	-113.4	0.792	-149.9
9600	0.811	-164.3	0.05	95.0	0.037	-115.9	0.793	-152.3
9700	0.806	-167.0	0.04	92.7	0.037	-118.2	0.793	-154.6
9800	0.802	-169.7	0.04	90.3	0.037	-120.3	0.795	-156.9
9900	0.798	-172.3	0.04	88.3	0.037	-122.7	0.795	-159.2
10000	0.793	-174.8	0.03	86.7	0.038	-125.5	0.796	-161.5

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

Bonding Configuration



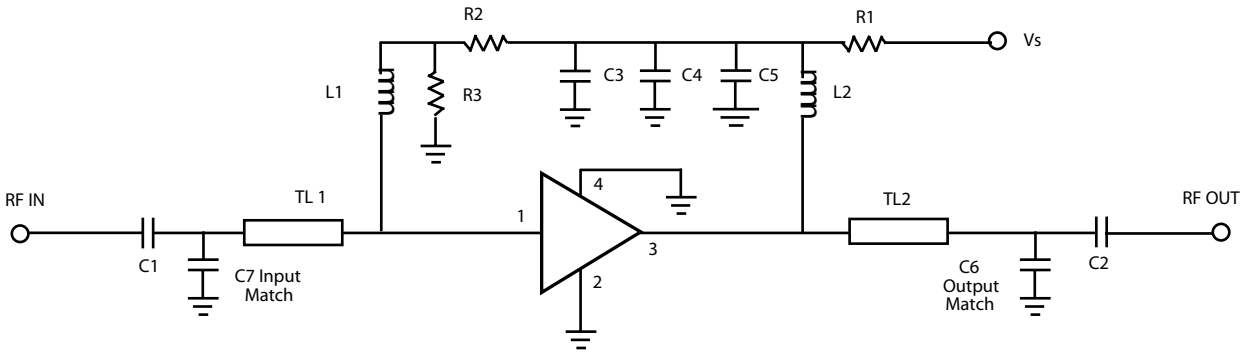
Application Circuit - Passive Bias, V Supply = 8V

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

Recommended Bias Resistor Values for ID = 120 mA					
Supply Voltage (Vs)	7V	8V	9V	10V	12V
Rbias (R1 Description: 1/4W)	18 Ω	27Ω	—	—	—
Rbias (R1 Description: 1/2W)	—	—	36Ω	43Ω	62Ω

Note: Rbias provides DC bias stability over temperature.

Application Schematic



Ref Designator	850 MHz Value	1950 MHz Value	2140 MHz Value
C1, C2	1000 pf	1000 pf	1000 pf
C3	DNP	DNP	DNP
C4	DNP	DNP	DNP
C5	1 µF	1 µF	1 µF
C6	DNP	1.2 pF	0.5 pF
C7	5.6 fH	DNP	DNP
L1	33 nH	22 nH	22 nH
L2	33 nH	22 nH	22 nH
R1	27Ω	27Ω	27Ω
R2	391Ω	391Ω	391Ω
R3	182Ω	182Ω	182Ω
EL1	13 deg	N/A	N/A
EL2	N/A	45 deg	49 deg

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. If eutectic mounting is preferred, then a fluxless gold-tin (AuSn) preform, approximately 0.001 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 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
CGB7289-BD-000V	Where "V" is RoHS compliant die packed in vacuum release gel paks