DC-2.5 GHz InGaP HBT Matched Gain Block Amplifier

May 2006 - Rev 23-May-06

CGB7289-SC
RoHS

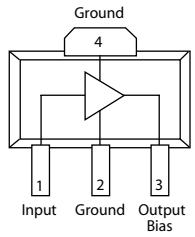
Features

- 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
- Low Cost: SOT-89 Package
- 100% DC On-Wafer Testing
- ESD Protection on All Die: >2000V HBM
- Low Thermal Resistance: <35°C/Watt
- Low Volt Supply: 5V, Active Bias

Applications

- PA Driver Amp, IF Amp, LO Buffer Amp
- Cellular, PCS, GSM, UMTS, 3G
- Wireless Data and SATCOM
- Transmit and Receive Functions
- CATV

Functional Block Diagram (SOT-89)



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
EDS (HBM)	2000 V

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

Description

The CGB7289-SC 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.

This MMIC amplifier is 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.

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-SC an ideal transmit and receive solution when used in applications including cellular, PCS and 3G services operating from 0.8 to 2.2 GHz.

Electrical Characteristics (5V, Active Bias)

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

		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	13.5	14.5	15.5	12.3	13.3	14.3	dB
	-40 to +85	19.7	21.0	22.3	13.2	14.5	15.8	12.0	13.3	14.6	dB
Output P1dB	+25	22.1	23.1		22.8	23.8		22.7	23.7		dBm
	-40 to +85	21.8	23.1		22.5	23.8		22.4	23.7		dBm
Output IP3	+25	37.0	38.5		39.0	40.5		39.5	41.0		dBm
	-40 to +85	36.5	38.5		38.5	40.5		39.0	41.0		dBm
Noise Figure	+25		4.0	4.8		4.9	5.7		5.5	6.3	dB
	-40 to +85		4.0	5.2		4.9	6.2		5.5	6.7	dB
Operating Current	+25	105	115	125	105	115	125	105	115	125	mA
	-40 to +85	100	115	130	100	115	130	100	115	130	mA
Input Return Loss	+25	12	18		11	16		11	15		dB
	-40 to +85	11	18		10	16		10	15		dB
Output Return Loss	+25	5.5	7.5		11.0	16.0		10.0	13.0		dB
	-40 to +85	5.0	7.5		10.0	16.0		9.5	13.0		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. Test Conditions in Mimix eval board, Vs = 5 V, Id = 115 mA Typ., Zs = Zl = 50Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 11 dBm.
2. Values reflect performance in recommended application circuit.

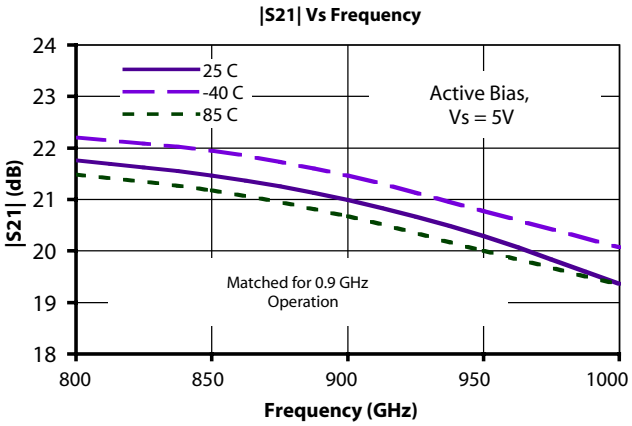
Electrical Characteristics (8V, Active Bias)

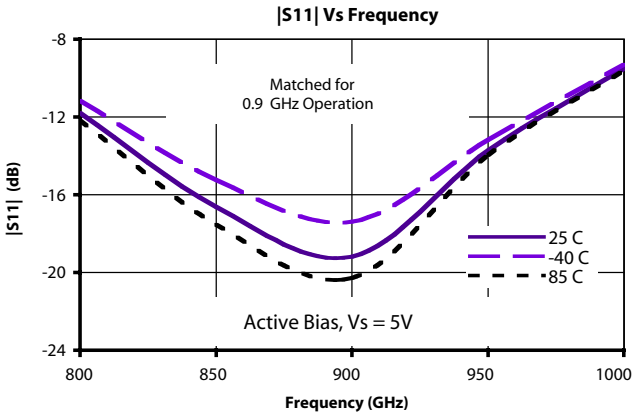
Unless otherwise specified, the following specifications are guaranteed at room temperature in a Mimix test fixture.

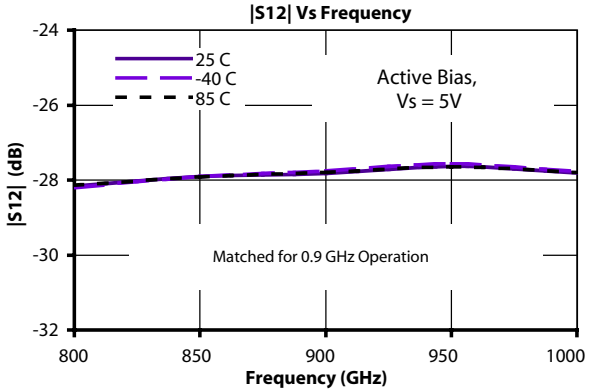
		900 MHz			1960 MHz			2140 MH			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25	20.0	21.0	22.0	13.7	14.7	15.7	12.5	13.5	14.5	dB
	-40 to +85	19.7	21.0	22.3	13.4	14.7	16.0	12.2	13.5	14.8	dB
Output P1dB	+25	22.3	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	+25		16.5			17.5					dBm
IS-95, 9 Forward Channels	-40 to +85		16.5			17.5					dBm

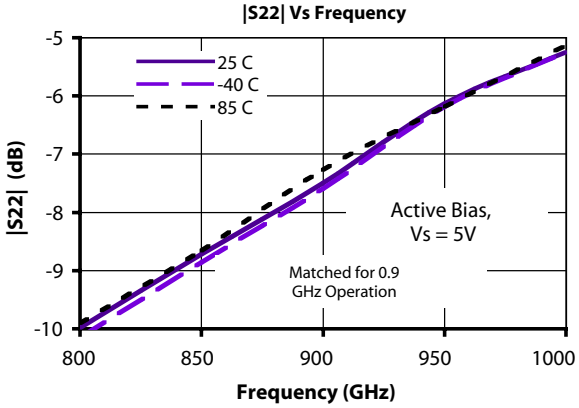
Notes: 1. Test Conditions in Mimix eval board, Vs = 8 V, Id = 120 mA Typ., Rbias = 27 Ω, Zs = Zl = 50 Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 11 dBm.
2. Values reflect performance in recommended application circuit.

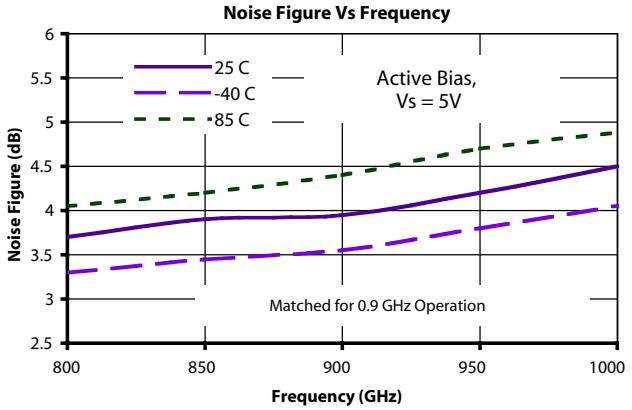
Typical S-Parameter and Noise Performance: 900 MHz, 5V (Matched for 0.9 GHz Operation)











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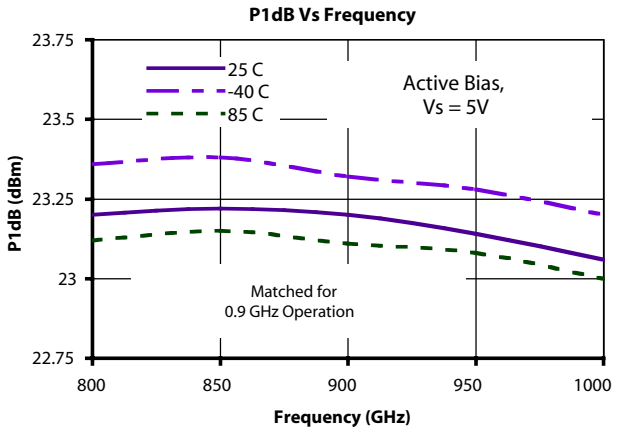
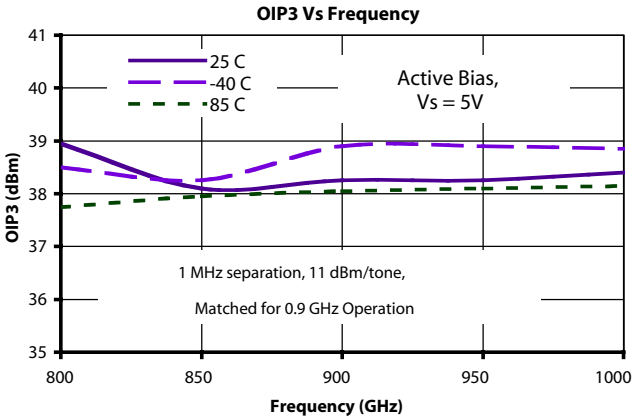
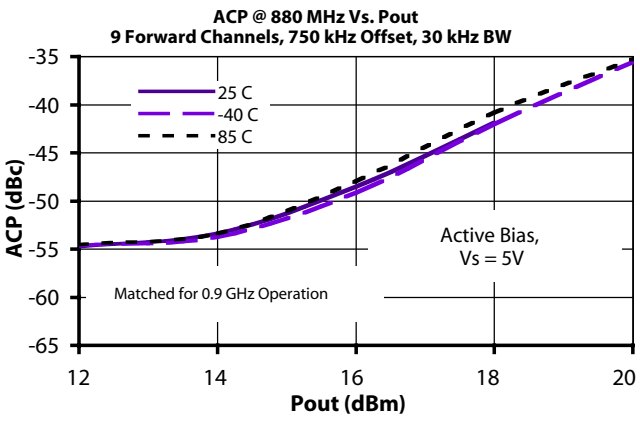
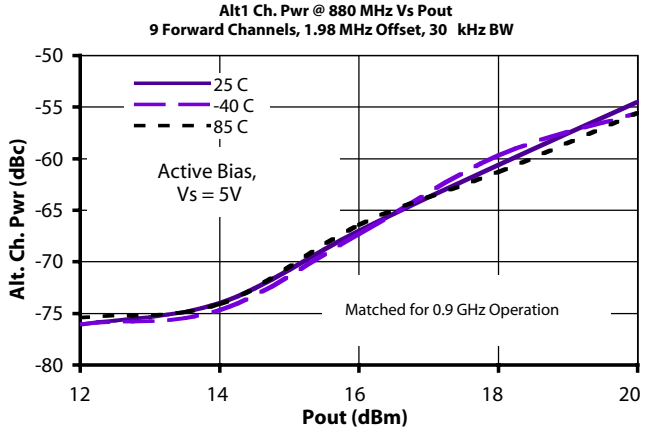
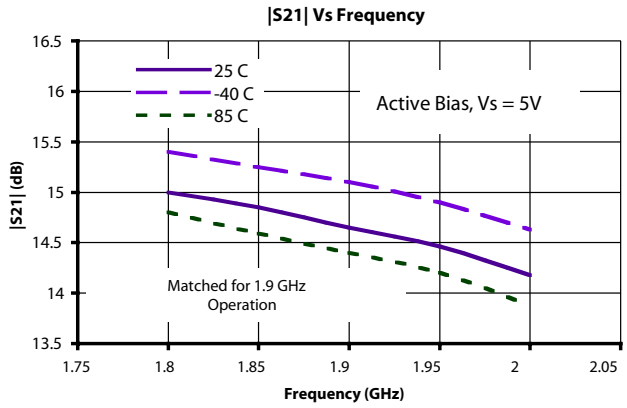


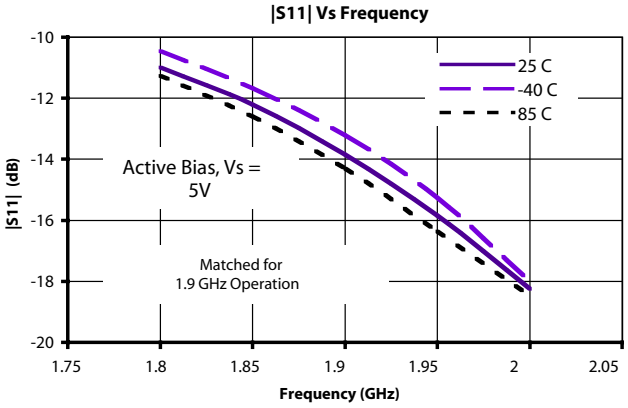


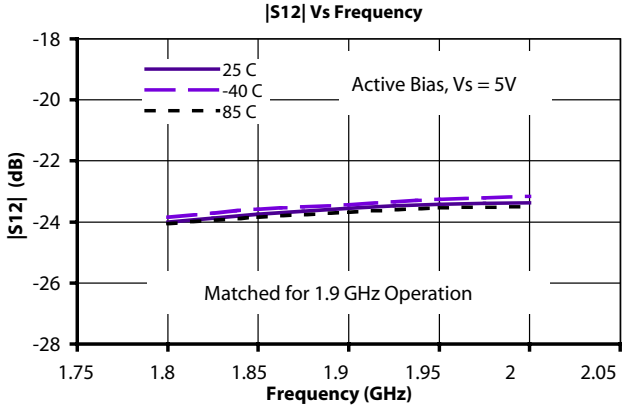


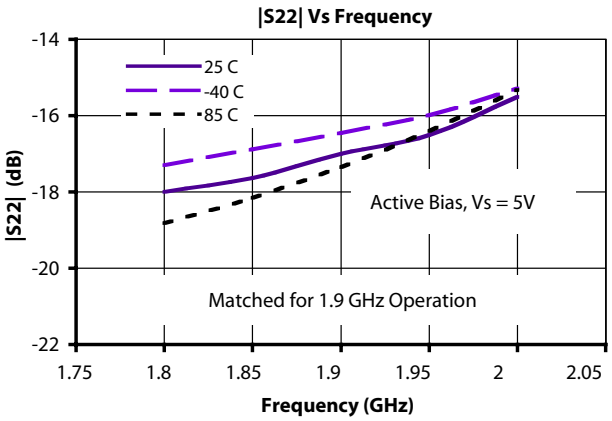


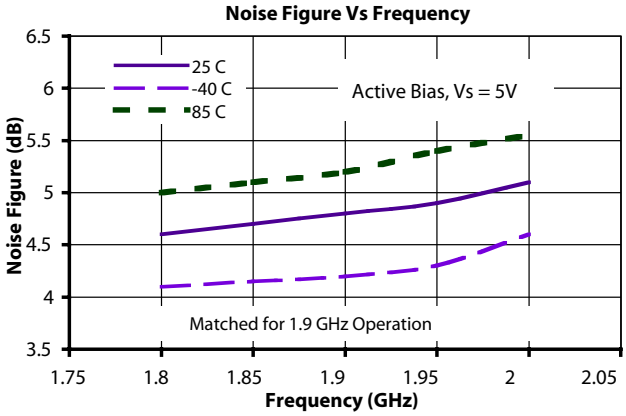
Typical S-Parameter and Noise Performance: 1960 MHz, 5V (Matched for 1.9 GHz Operation)



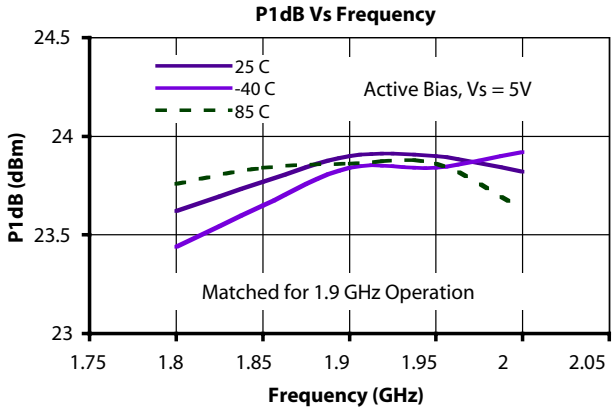


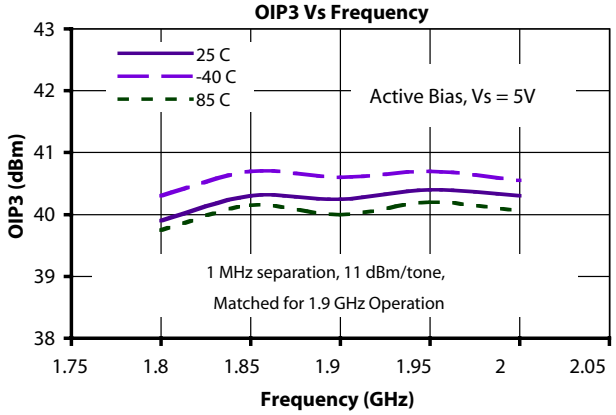


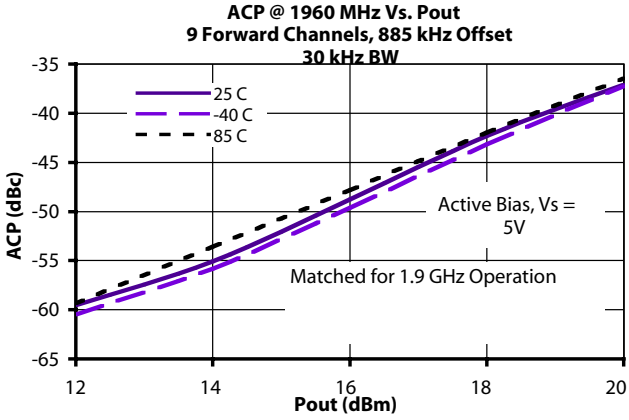


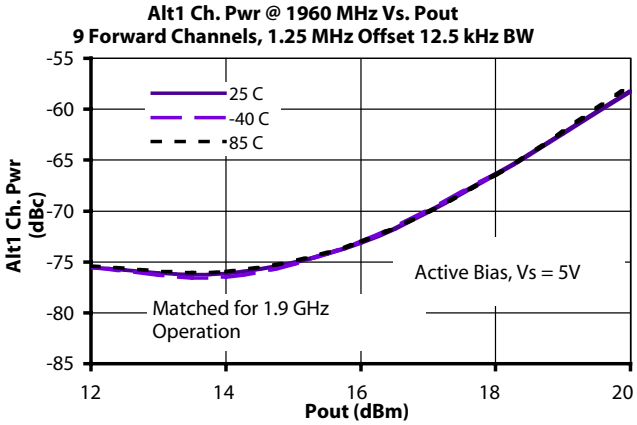


Typical S-Parameter and Noise Performance: 1960 MHz, 5V (Matched for 1.9 GHz Operation)

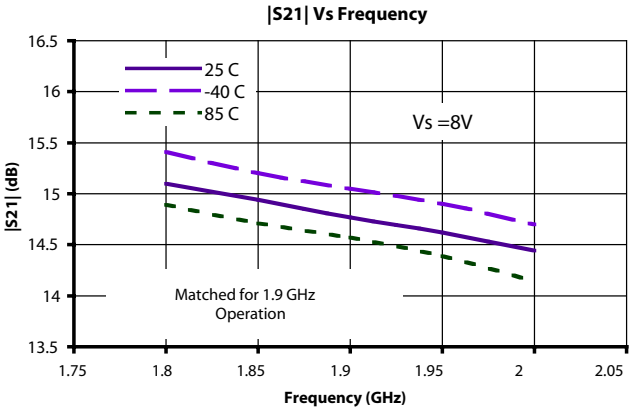


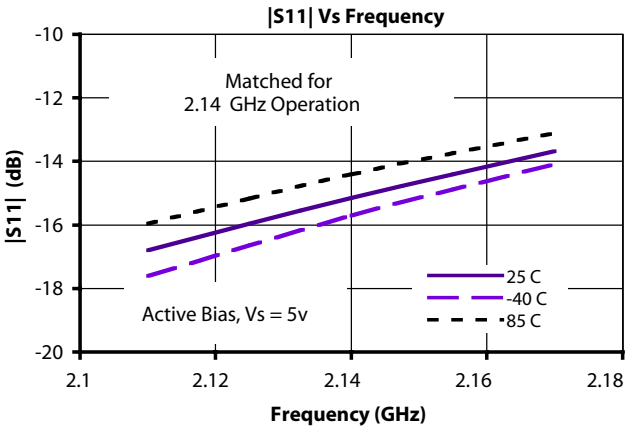


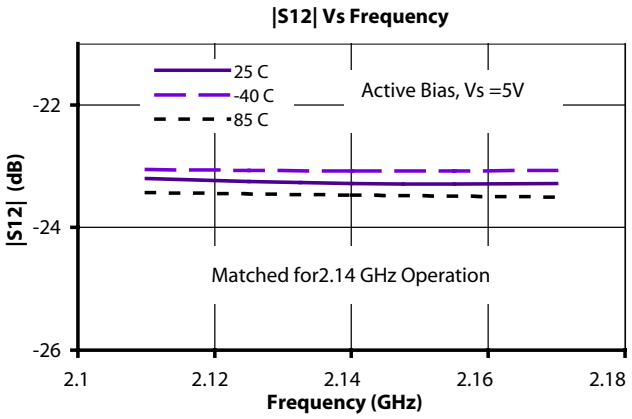


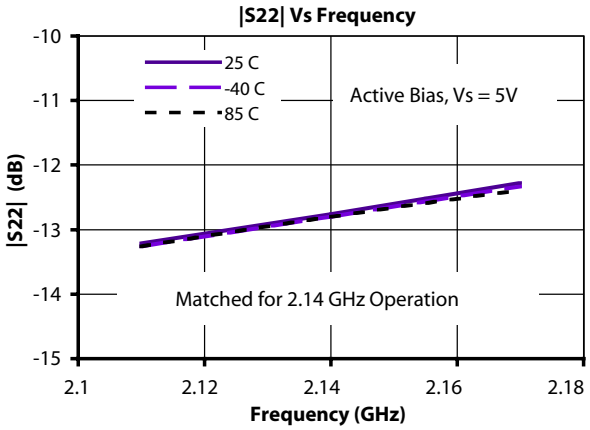


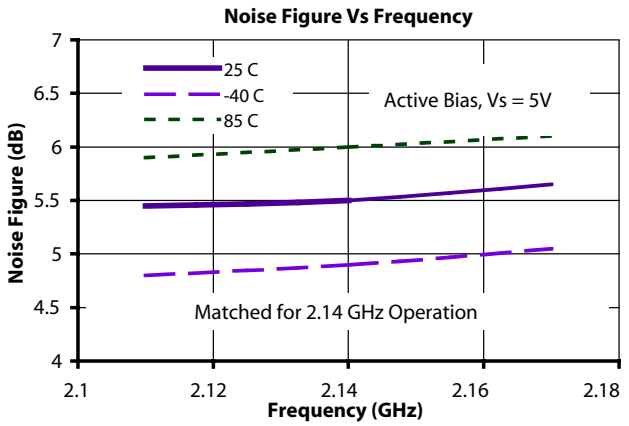
Typical S-Parameter and Noise Performance: 2140 MHz, 5V (Matched for 2.14 GHz Operation)



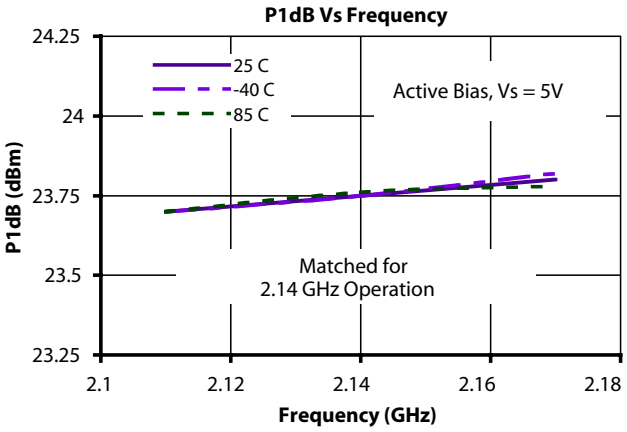


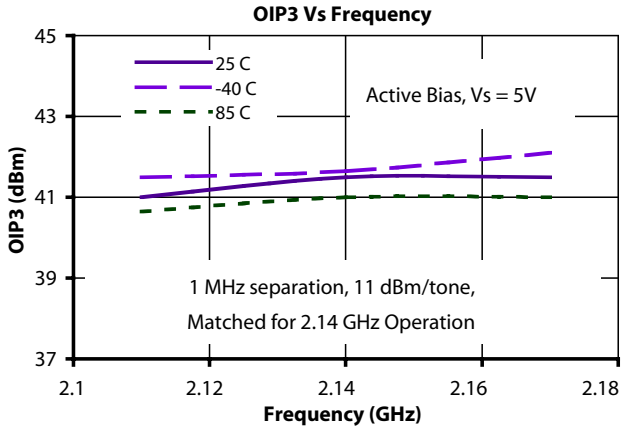




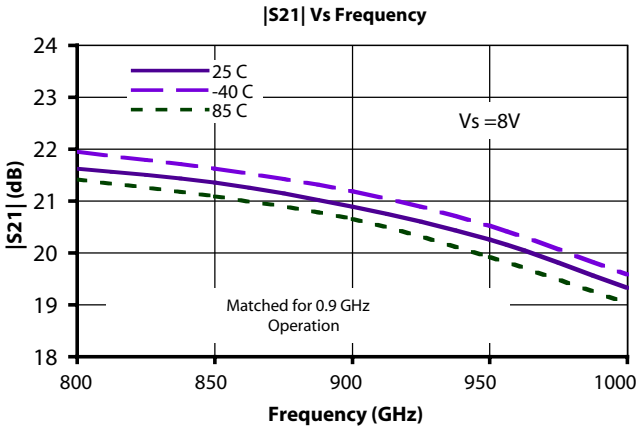


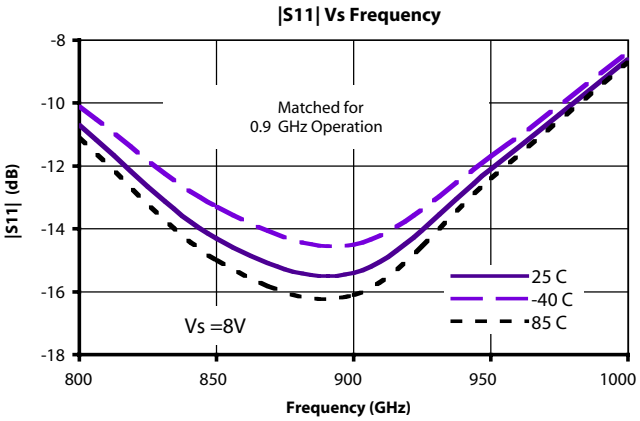
Typical S-Parameter and Noise Performance: 2140 MHz, 5V (Matched for 2.14 GHz Operation)

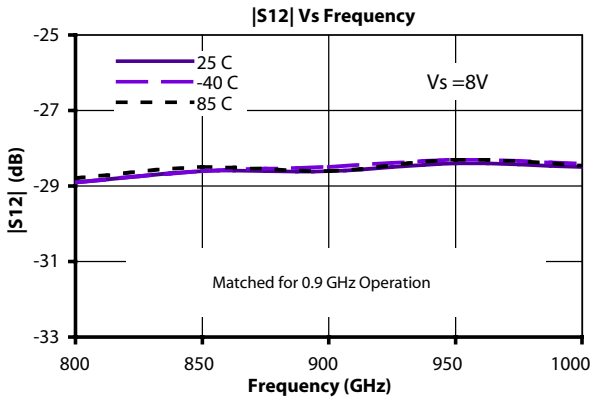


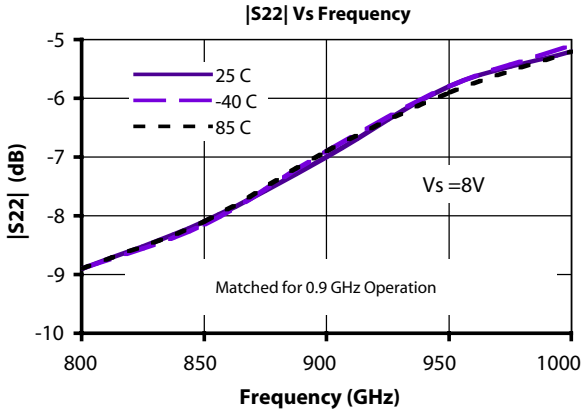


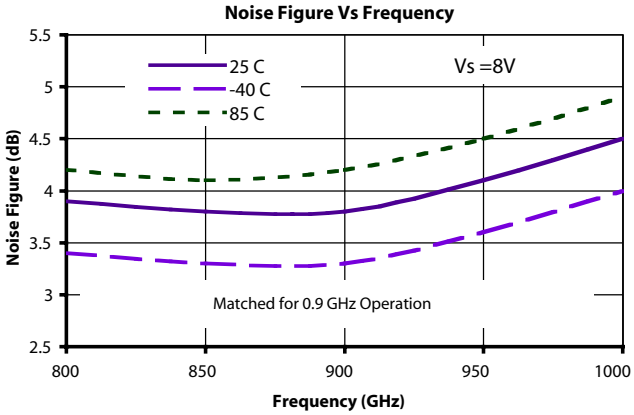
Typical S-Parameter and Noise Performance: 900 MHz, 8V (Matched for 0.9 GHz Operation)



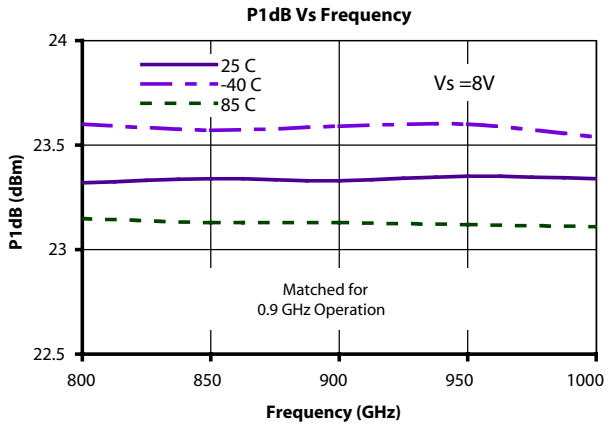


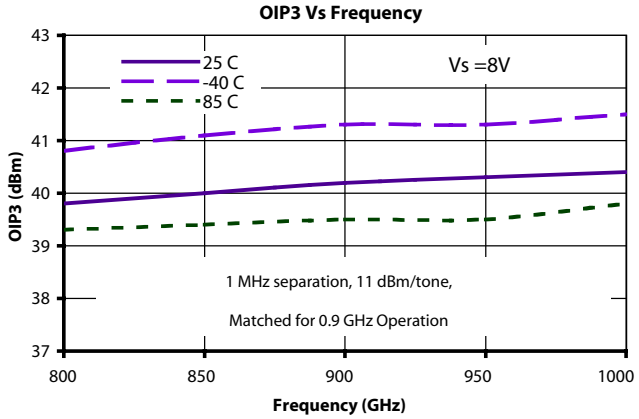


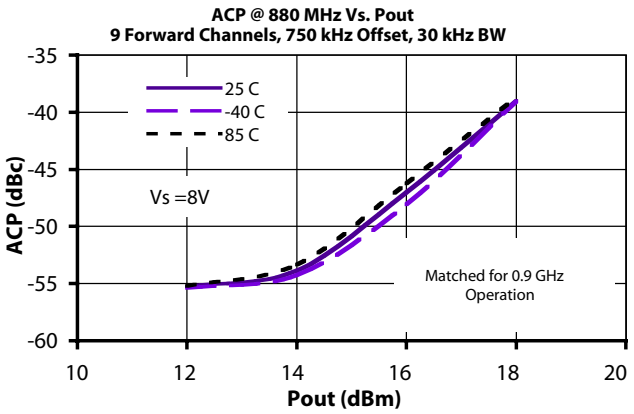


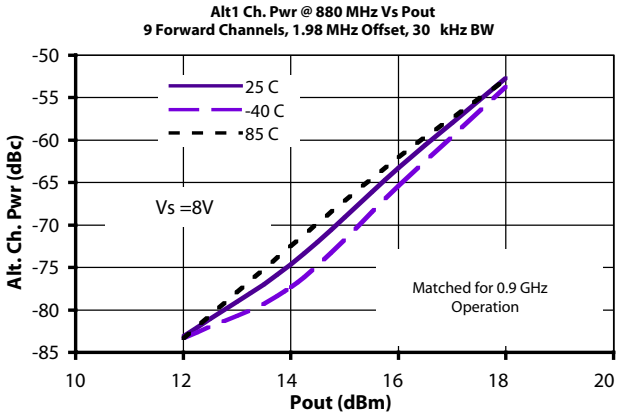


Typical S-Parameter and Noise Performance: 900 MHz, 8V (Matched for 0.9 GHz Operation)

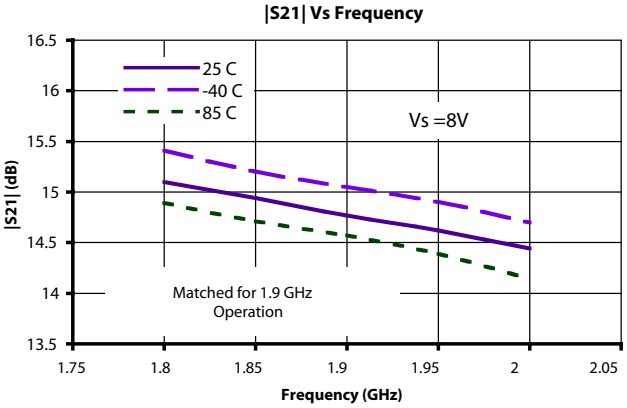


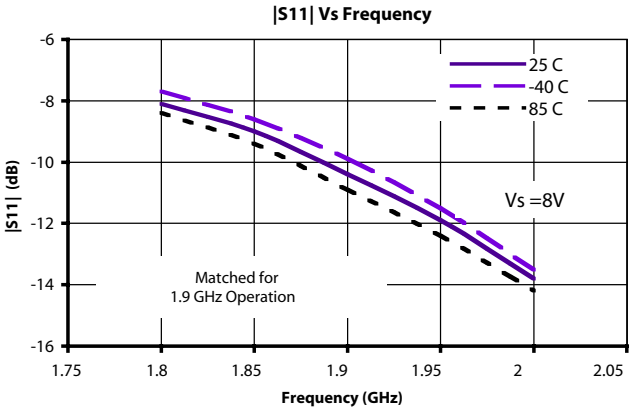


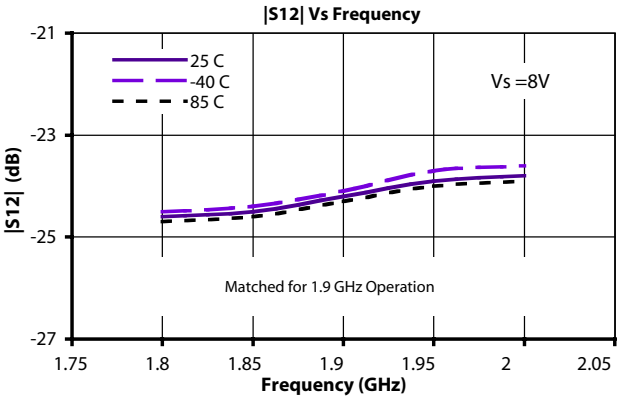


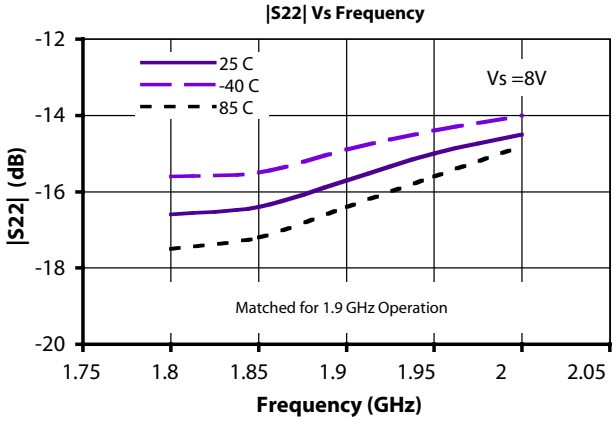


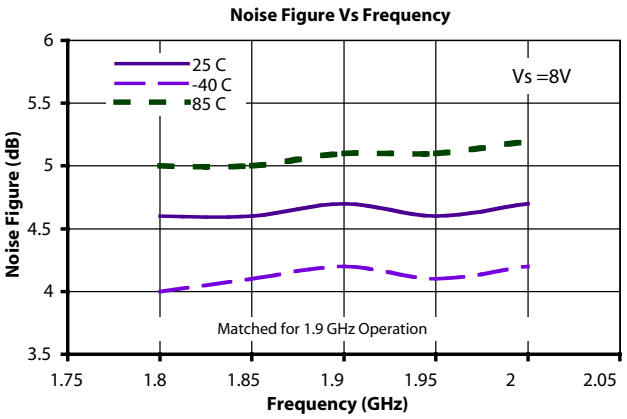
Typical S-Parameter and Noise Performance: 1960 MHz, 8V (Matched for 1.9 GHz Operation)



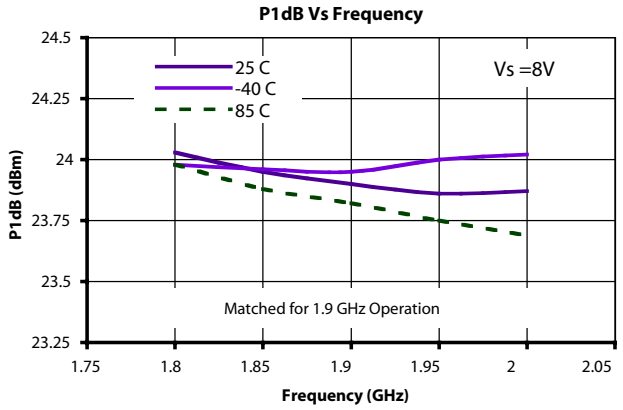


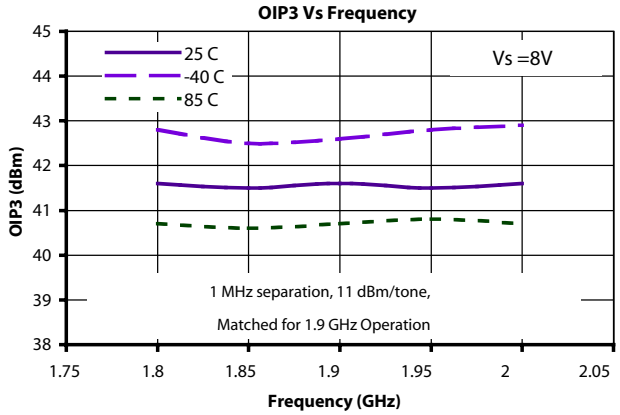


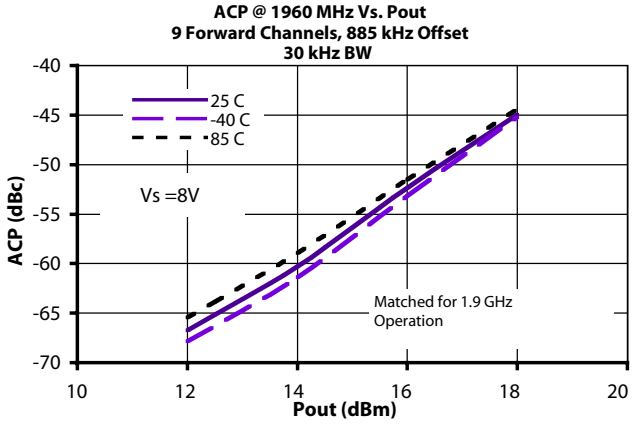


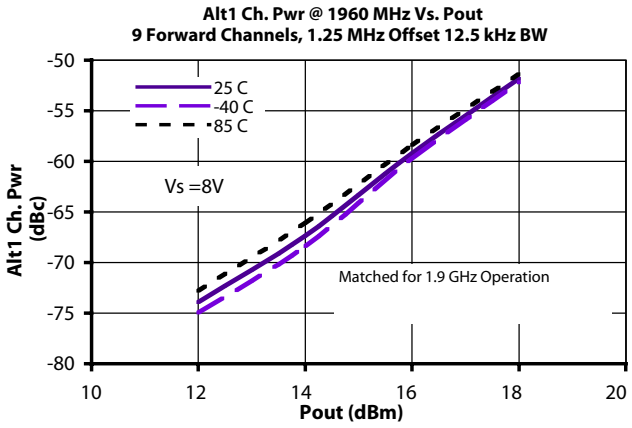


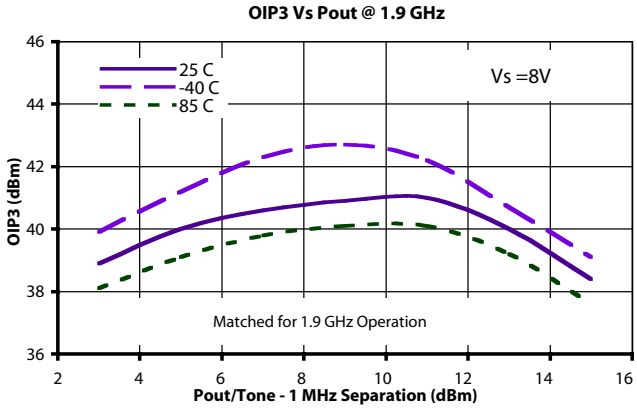
Typical S-Parameter and Noise Performance: 1960 MHz, 8V (Matched for 1.9 GHz Operation)



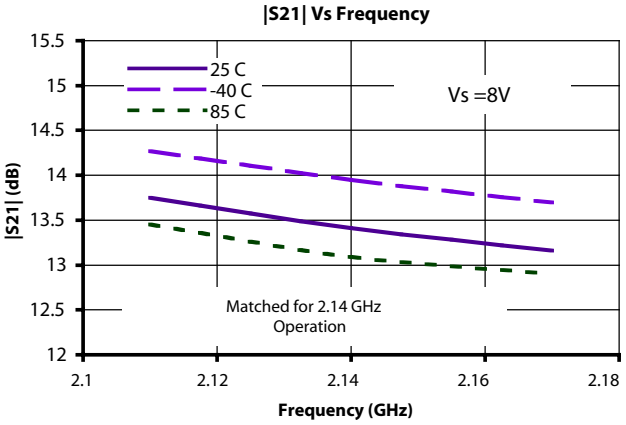


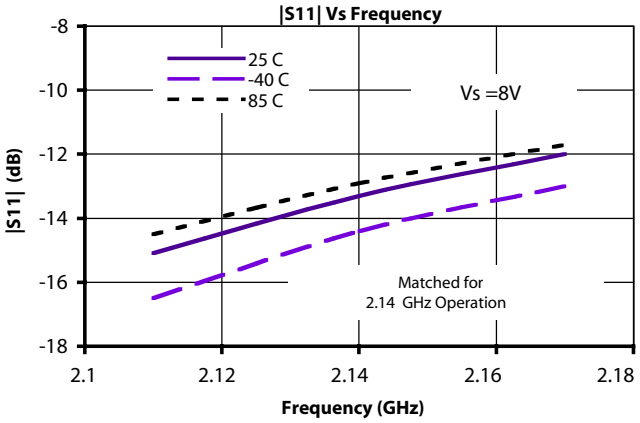


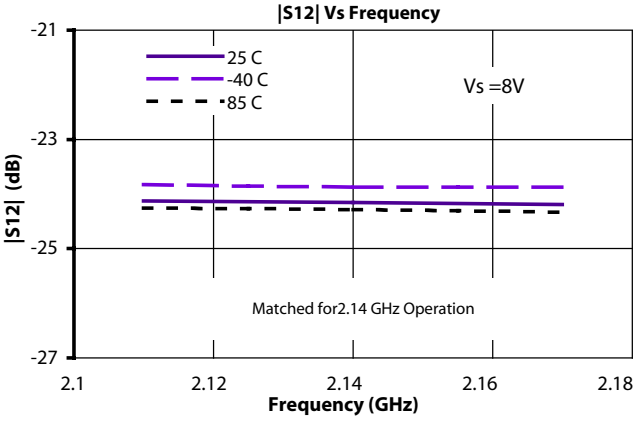


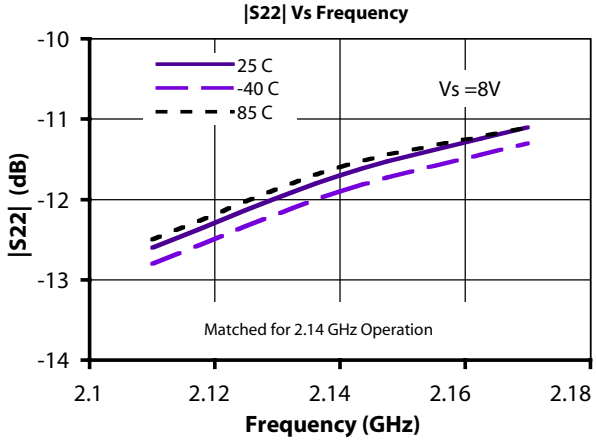


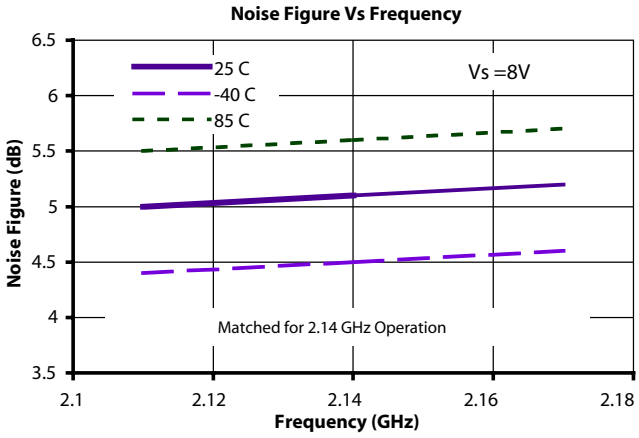
Typical S-Parameter and Noise Performance: 2140 MHz, 8V (Matched for 2.14 GHz Operation)



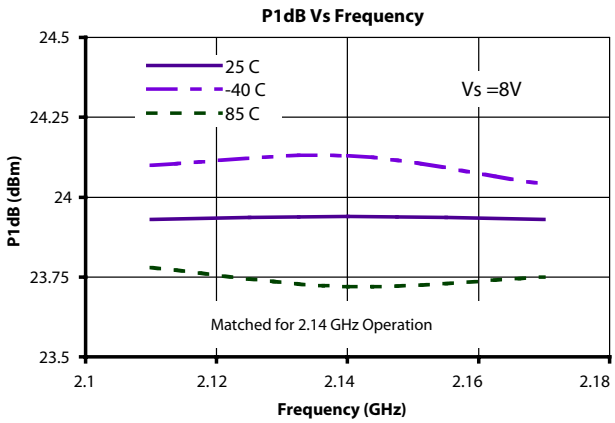


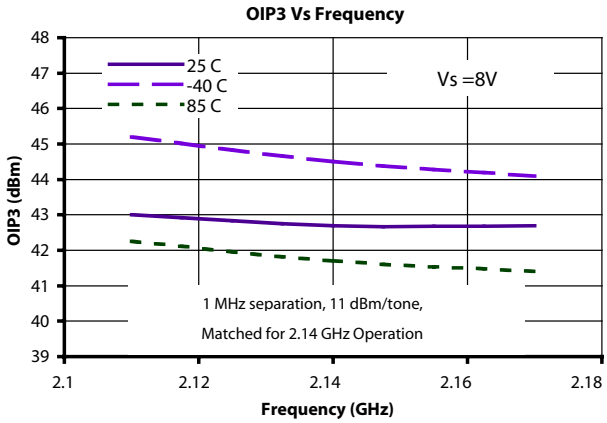






Typical S-Parameter and Noise Performance: 2140 MHz, 8V (Matched for 2.14 GHz Operation)





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 on-line at: www.mimixbroadband.com

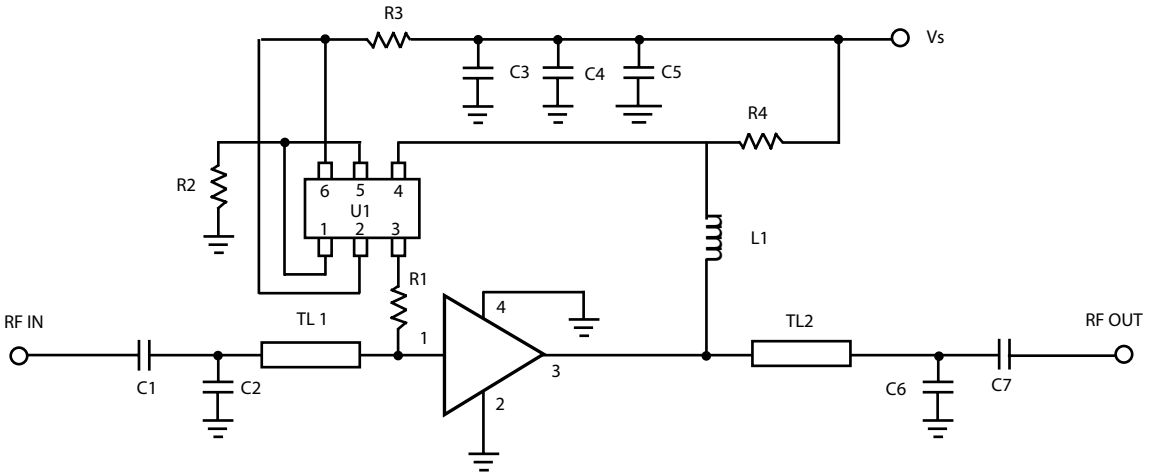
Typical Scattering Parameters (Vd = +4.76V, Icc = 118 mA, T = 23°C, device in a 50 ohm system)

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 on-line at: www.mimixbroadband.com

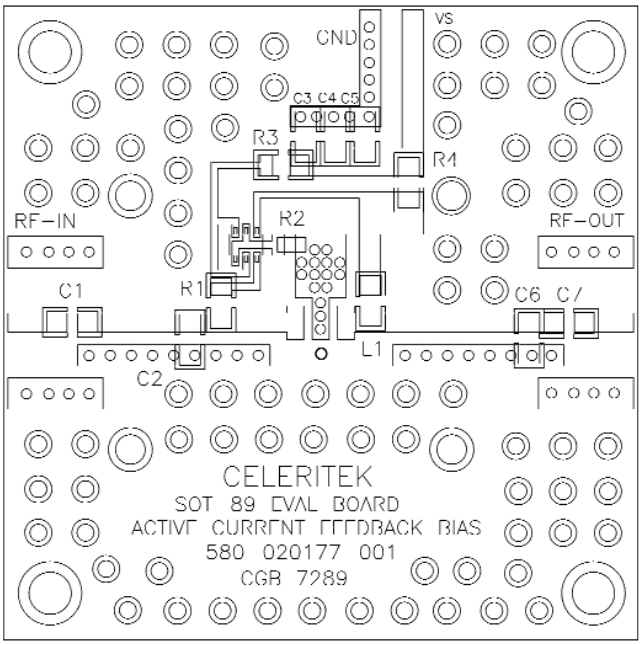
Application Circuit - Active Bias, V Supply = 5V

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



Ref Designator	850 MHz Value	1950 MHz Value	2140 MHz Value	Description / Size
C1, C7	100 pf	68 pf	68 pf	PHYC 0805 NPO
C2	5.6 pF	DNP	DNP	PHYC 0805 NPO 5%
C3	0.1 µF	0.1 µF	0.1 µF	VITR 0.1µF 0604 X7R
C4	1000 pF	1000 pF	1000 pF	PHYC 0805 NPO
C5	68 pF	22 pF	22 pF	PHYC 0805 NPO
C6	DNP	1.2 pF	0.5 pF	PHYC 0603 NPO
L1	33 nH	22 nH	22 nH	TOKO 0603 10%
R1	750 Ω	750 Ω	750 Ω	KOA 0805 5% 1/8W
R2	1.8K Ω	1.8K Ω	1.8K Ω	KOA 0603 1% 1/16W
R3	220 Ω	220 Ω	220 Ω	KOA 0805 1% 1/8W
R4	4.3 Ω	4.3 Ω	4.3 Ω	KOA 0805 1% 1/8W
U1	UMZ1N	UMZ1N	UMZ1N	KOA 0805 1% 1/8W
TL1	13 deg	N/A	N/A	
TL2	N/A	45 deg	49 deg	

Active Bias Evaluation Board Layout



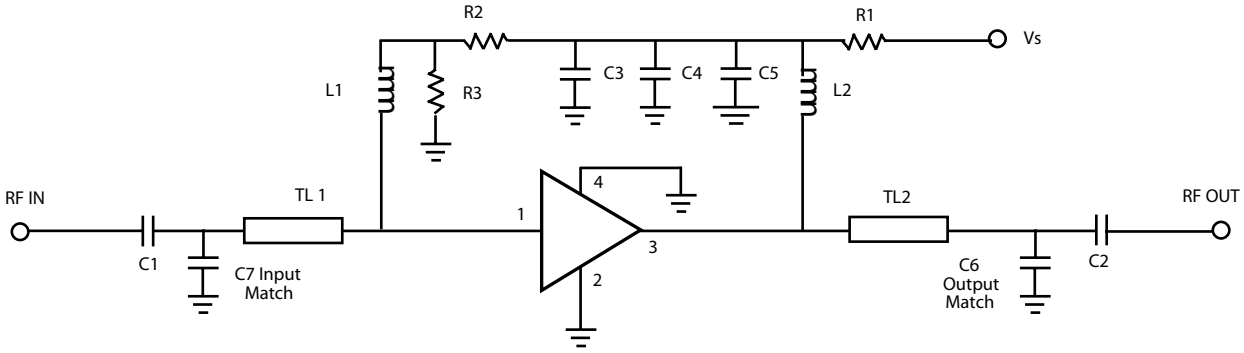
Application Circuit - Passive Bias, V Supply = 8V

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

Recommended Bias Resistor Values for ID = 120 mA					
Supply Voltage (V)	7V	8V	9V	10V	12V
Rbias (R1 Description: 1206 1/4W 1%)	18Ω	27Ω	—	—	—
Rbias (R1 Description: 1210 1/2W 1%)	—	—	36Ω	43Ω	62Ω

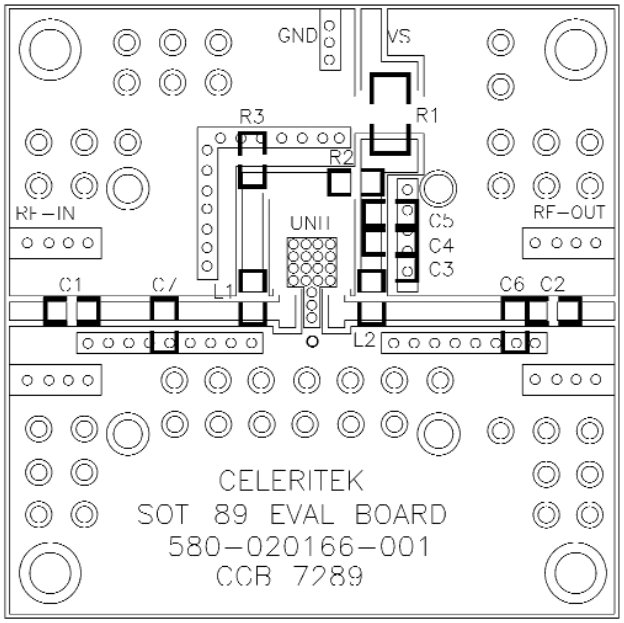
Note: Rbias provides DC bias stability over temperature.

Application Schematic

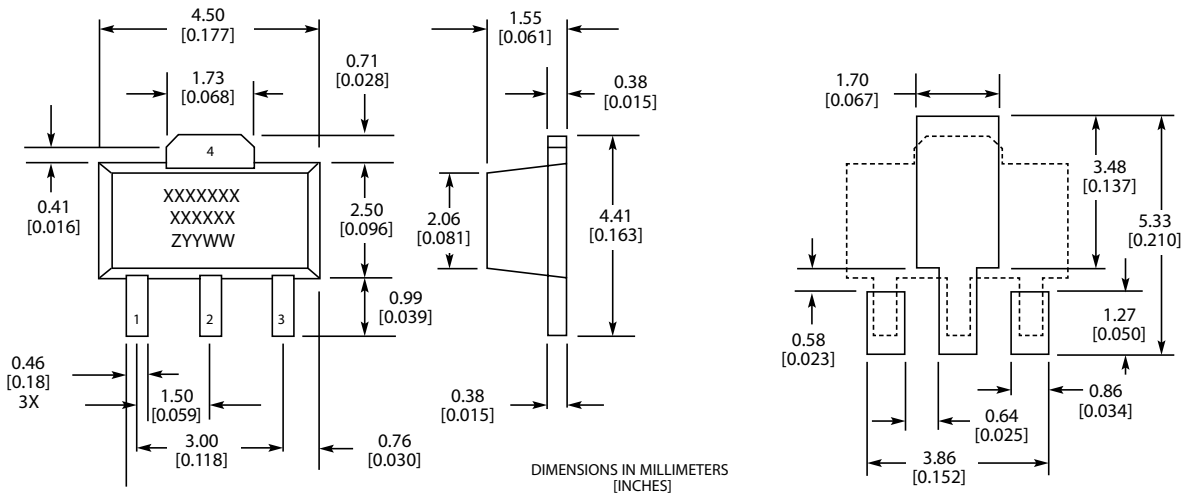


Ref Designator	850 MHz Value	1950 MHz Value	2140 MHz Value	Description / Size
C1, C2	1000 pf	1000 pf	1000 pf	PHYC 0805 NPO
C3	DNP	DNP	DNP	—
C4	DNP	DNP	DNP	—
C5	1 µF	1 µF	1 µF	0805 X7R
C6	DNP	1.2 pF	0.5 pF	PHYC 0603 NPO
C7	5.6 fH	DNP	DNP	PHYC 0805 NPO 5%
L1	33 nH	22 nH	22 nH	Coilcraft 0603 10%
L2	33 nH	22 nH	22 nH	Coilcraft 0603 10%
R1	27Ω	27Ω	27Ω	KOA 2010 5% 3/4W
R2	391Ω	391Ω	391Ω	KOA 0805 1% 1/8W
R3	182Ω	182Ω	182Ω	KOA 0805 1% 1/8W
EL1	13 deg	N/A	N/A	
EL2	N/A	45 deg	49 deg	

Passive Bias Evaluation Board Layout



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.

Ordering Information

Part Number for Ordering	Description
CGB7289-BD	Bare die in GelPak
CGB7289-SC-0G00	Matte Tin plated RoHS compliant SOT-89 surface mount package in bulk quantity
CGB7289-SC-0G0T	Matte Tin plated RoHS compliant SOT-89 surface mount package in tape and reel
CGB7289-SP-0G00	Matte Tin plated RoHS compliant SOT-86 surface mount package in bulk quantity
CGB7289-SP-0G0T	Matte Tin plated RoHS compliant SOT-86 surface mount package in tape and reel
PB-CGB7289-SC-0000	Evaluation Board for SOT-89 packaged device with SMA connectors
PB-CGB7289-SP-0000	Evaluation Board for SOT-86 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