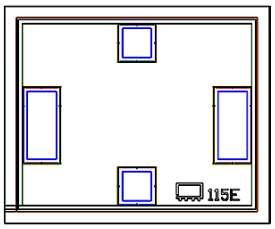
5 Volt, High Gain

Monolithic Amplifier Die

GVA-84-D+

50Ω DC to 7 GHz



+RoHS Compliant
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

Product Features

- High Gain, 24 dB typ. at 100 MHz
- High Pout, P1dB 20.5 dBm typ. at 100 MHz
- High IP3, 37 dBm typ. at 100 MHz
- Ruggedized design
- Fixed 5V operation
- Transient protected, US patent 6,943,629

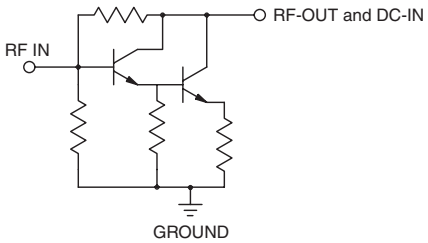
Typical Applications

- Base station infrastructure
- Portable Wireless
- CATV & DBS
- MMDS & Wireless LAN
- LTE

General Description

GVA-84-D+ (RoHS compliant) is a wideband high gain amplifier die offering high dynamic range. It uses patented Transient Protected Darlington configuration and is fabricated using InGaP HBT technology.

Simplified Schematic and Pad description



Pad	Description
RF IN	RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	RF output and bias pad. DC voltage is present on this pad; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection.
GND	Connections to ground. Use via holes as shown in “Suggested Layout for PCB Design” to reduce ground path inductance for best performance.

Note: 1. Bond Pad material - Gold
2. Bottom of Die - Gold plated

Electrical Specifications[1] at 25°C and 5V, unless noted

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range[2]		DC		7	GHz
Gain	0.1		24.1		dB
	1.0		21.7		
	2.0		18.4		
	3.0		16.0		
	4.0		14.6		
	6.0		12.5		
	7.0		10.5		
Magnitude of Gain Variation versus Temperature[3] (values are negative)	0.1		0.0004		dB/°C
	1.0		0.0021		
	2.0		0.0032		
	3.0		0.0044		
	4.0		0.0058		
	6.0		0.0131		
	7.0		0.0175		
Input Return Loss	0.1		22.9		dB
	1.0		20.6		
	2.0		18.5		
	3.0		18.1		
	4.0		19.1		
	6.0		17.9		
	7.0		11.9		
Output Return Loss	0.1		23.3		dB
	1.0		10.7		
	2.0		7.7		
	3.0		7.1		
	4.0		7.0		
	6.0		6.3		
	7.0		5.6		
Reverse Isolation	2.0		26.5		dB
Output Power @1 dB compression	0.1		20.4		dBm
	1.0		20.5		
	2.0		20.6		
	3.0		21.0		
	4.0		19.9		
	6.0		17.0		
	7.0		15.6		
Saturated Output Power (at 3dB compression)	0.1		21.7		dBm
	1.0		22.3		
	2.0		22.3		
	3.0		22.2		
	4.0		21.0		
	6.0		18.9		
	7.0		17.2		
Output IP3	0.1		36.7		dBm
	1.0		35.8		
	2.0		36.6		
	3.0		35.8		
	4.0		34.9		
	6.0		33.0		
	7.0		32.0		
Noise Figure	0.1		5.5		dB
	1.0		5.6		
	2.0		5.5		
	3.0		5.5		
	4.0		5.6		
	6.0		6.2		
	7.0		6.8		
Group Delay	2.0		94		psec
Device Operating Voltage		4.8	5.0	5.2	V
Device Operating Current		85	108	130	mA
Device Current Variation vs. Temperature			61.8		µA/°C
Device Current Variation vs Voltage			0.058		mA/mV
Thermal Resistance, junction-to-ground lead			64		°C/W

1. Measured on Mini-Circuits characterization test board. Die packaged in SOT-89 Package and soldered on test board TB-313.
2. Guaranteed specification DC-7 GHz. Low frequency cut off determined by external coupling capacitors and external bias choke.
3. (Gain at 85°C - Gain at -45°C)/130

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature (ground lead)	-45°C to 85°C
Operating Current at 5V	160mA
Power Dissipation	1W
Input Power	13 dBm
DC Voltage at RF-OUT and DC-IN pad	5.8V

Note:
Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.

Characterization Test Circuit

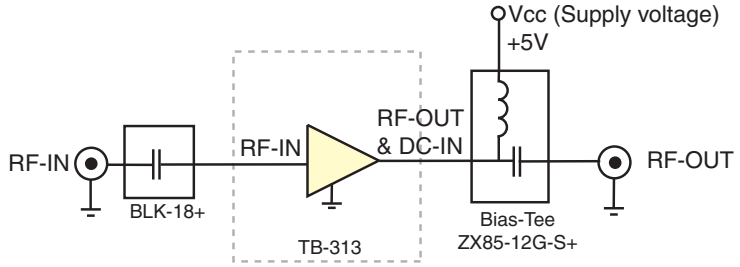


Fig 1. Block Diagram of Test Circuit used for characterization. (Measured on Mini-Circuits characterization test board. Die packaged in SOT-89 Package and soldered on test board TB-313).
Gain, Output power at 1dB compression (P1 dB) and output IP3 (OIP3) are measured using R&S Network Analyzer ZVA-24.
Noise Figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.

Die Layout

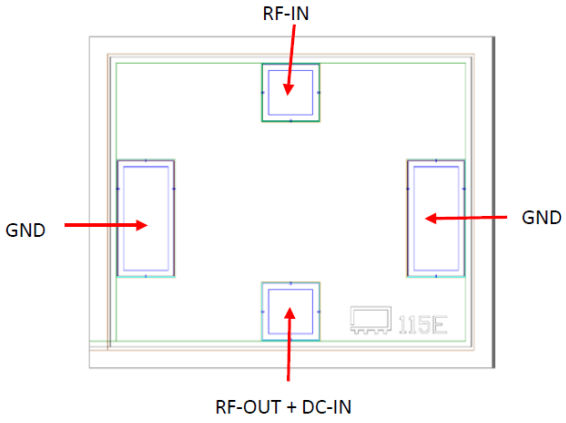


Fig 2. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

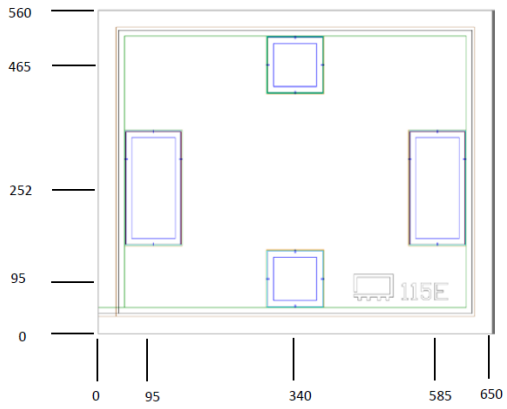


Fig 3. Bonding Pad Positions

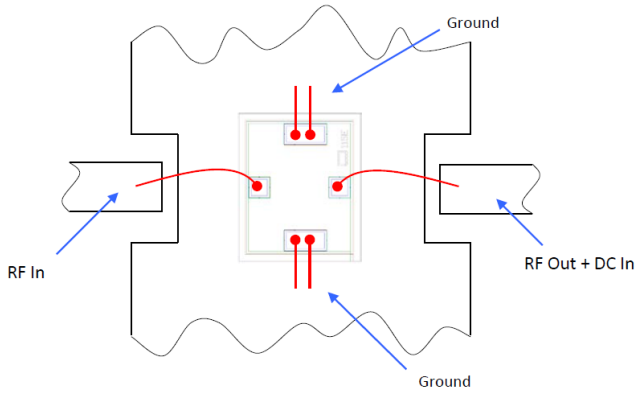
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	560
Die Length, µm	680
Bond Pad Size (RF In, RF Out+DC In, µm	100 x 100
Bond Pad Size (Ground pad), µm	100 x 200

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC Gallium Arsenide (GaAs) amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static worksta tion. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach
   The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
Ground	0.25	0.15
RF In, RF Out + DC In	1.20	0.15

Additional Detailed Technical Information

additional information is available on our dash board.

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50,100 KGD*	GVA-84-DG+
	Medium†, Partial wafer: KGD*<2540	GVA-84-DP+
	Large†, Full Wafer	GVA-84-DF+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

ESD Rating**

Human Body Model (HBM): Class 1C (1000 to <2000V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard SOT-89 package.

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

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MMIC Amplifier Die GVA-84-D+

Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions or to view GRAPHS.

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5.00V, Id=106mA @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	FREQ	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(MHz)	(dB)
50	24.18	31.36	21.65	24.37	1.34	0.43	36.98	20.73	50	5.53
100	24.11	31.36	21.72	23.67	1.35	0.43	36.83	20.77	100	5.65
200	23.98	31.07	21.79	20.65	1.33	0.44	36.80	20.73	200	5.65
400	23.62	30.73	21.59	16.17	1.32	0.44	36.48	20.89	400	5.77
600	23.07	30.40	21.19	13.38	1.31	0.43	36.05	20.71	600	5.70
800	22.44	29.97	20.64	11.57	1.31	0.42	36.17	20.74	800	5.78
1000	21.77	29.47	20.14	10.29	1.30	0.42	36.37	20.77	1000	5.73
1200	21.08	28.90	19.70	9.36	1.28	0.41	36.34	20.59	1200	5.71
1400	20.41	28.38	19.28	8.68	1.27	0.41	36.37	20.60	1400	5.73
1600	19.75	27.89	18.96	8.17	1.27	0.40	36.90	20.76	1600	5.75
1800	19.12	27.33	18.76	7.80	1.26	0.40	37.15	20.73	1800	5.69
2000	18.57	26.79	18.60	7.50	1.24	0.39	37.30	20.88	2000	5.67
2200	18.02	26.31	18.65	7.36	1.24	0.39	37.15	21.00	2200	5.66
2400	17.54	26.01	18.62	7.23	1.24	0.38	36.78	21.02	2400	5.63
2600	17.10	25.53	18.65	7.15	1.23	0.37	36.47	21.08	2600	5.59
2800	16.70	25.04	18.75	7.12	1.22	0.37	36.63	21.24	2800	5.59
3000	16.34	24.75	18.76	7.05	1.22	0.37	36.53	21.18	3000	5.70
3200	15.99	24.48	18.96	7.09	1.22	0.36	36.27	21.06	3200	5.62
3400	15.73	24.11	18.90	7.08	1.21	0.36	36.28	20.92	3400	5.70
3600	15.45	23.78	18.89	7.04	1.20	0.36	36.25	20.85	3600	5.64
3800	15.20	23.55	19.03	7.07	1.20	0.36	35.37	20.59	3800	5.77
4000	14.97	23.32	19.18	7.09	1.21	0.36	34.81	20.24	4000	5.82
4200	14.73	23.13	19.27	7.05	1.21	0.36	34.94	20.08	4200	6.09
4400	14.51	23.02	19.34	7.00	1.22	0.36	35.34	19.97	4400	5.93
4600	14.33	22.84	19.13	6.90	1.22	0.36	35.00	19.83	4600	5.93
4800	14.08	22.74	18.84	6.76	1.23	0.36	34.78	19.38	4800	5.84
5000	13.90	22.80	18.86	6.72	1.26	0.36	34.75	19.02	5000	6.04
5200	13.68	22.78	18.20	6.56	1.27	0.36	34.44	18.79	5200	6.18
5400	13.44	22.73	17.65	6.38	1.28	0.36	34.15	18.55	5400	6.30
5600	13.21	22.78	17.20	6.22	1.31	0.36	33.77	18.36	5600	6.26
5800	12.94	22.83	16.26	6.07	1.34	0.35	34.05	18.10	5800	6.18
6000	12.67	23.02	15.66	5.98	1.38	0.35	33.34	17.40	6000	6.33
6400	11.97	23.14	14.33	5.76	1.48	0.35	33.17	15.49	7000	6.78
6600	11.53	23.32	13.52	5.73	1.56	0.34	32.42	15.67	7500	6.99
6800	11.02	23.67	12.54	5.57	1.67	0.33	32.08	15.69	8000	7.42
7000	10.48	23.58	11.89	5.56	1.74	0.34	32.01	15.58	8500	8.07
7500	8.76	23.41	10.29	5.65	2.01	0.33	31.65	13.94	9500	9.06
8000	6.90	23.07	8.76	5.63	2.26	0.33	30.50	13.46	10000	9.32

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 4.75V, Id=92mA @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	FREQ	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(MHz)	(dB)
50	24.01	30.66	23.55	22.45	1.29	0.46	34.47	19.75	50	5.39
100	23.94	30.94	23.43	21.88	1.33	0.44	34.28	19.78	100	5.51
200	23.80	30.69	23.32	19.66	1.31	0.45	34.34	19.73	200	5.51
400	23.46	30.71	22.93	15.79	1.33	0.43	34.14	19.80	400	5.62
600	22.92	30.33	22.08	13.18	1.32	0.42	33.91	19.66	600	5.55
800	22.29	29.85	21.27	11.43	1.30	0.42	34.24	19.66	800	5.68
1000	21.63	29.23	20.55	10.18	1.28	0.42	34.53	19.73	1000	5.60
1200	20.95	28.76	19.94	9.27	1.28	0.41	34.53	19.48	1200	5.58
1400	20.28	28.20	19.36	8.60	1.26	0.40	34.58	19.56	1400	5.61
1600	19.62	27.69	18.97	8.09	1.25	0.40	35.22	19.70	1600	5.63
1800	19.00	27.16	18.65	7.72	1.24	0.39	35.57	19.73	1800	5.56
2000	18.44	26.64	18.45	7.42	1.23	0.39	35.77	19.89	2000	5.51
2200	17.90	26.30	18.43	7.27	1.24	0.38	35.66	20.05	2200	5.52
2400	17.42	25.79	18.40	7.15	1.22	0.38	35.51	20.12	2400	5.45
2600	16.99	25.40	18.40	7.07	1.22	0.37	35.22	20.11	2600	5.46
2800	16.59	24.99	18.43	7.05	1.21	0.37	35.17	20.27	2800	5.45
3000	16.22	24.68	18.40	6.96	1.21	0.36	35.20	20.37	3000	5.53
3200	15.88	24.38	18.59	7.01	1.22	0.36	35.12	20.21	3200	5.49
3400	15.61	24.05	18.51	6.99	1.21	0.36	35.11	20.12	3400	5.58
3600	15.33	23.74	18.52	6.97	1.20	0.36	35.04	20.09	3600	5.48
3800	15.08	23.55	18.64	7.01	1.21	0.35	34.06	19.85	3800	5.63
4000	14.86	23.24	18.79	7.02	1.20	0.36	33.57	19.51	4000	5.64
4200	14.61	23.10	18.89	7.00	1.21	0.35	33.60	19.39	4200	5.91
4400	14.39	22.97	18.98	6.97	1.22	0.35	33.88	19.25	4400	5.74
4600	14.21	22.80	18.77	6.87	1.22	0.36	33.46	19.13	4600	5.78
4800	13.96	22.70	18.53	6.74	1.23	0.36	33.49	18.70	4800	5.69
5000	13.76	22.78	18.54	6.71	1.27	0.35	33.31	18.39	5000	5.87
5200	13.54	22.73	17.94	6.57	1.28	0.35	32.92	18.15	5200	6.01
5400	13.29	22.70	17.42	6.38	1.30	0.35	32.74	17.86	5400	6.11
5600	13.05	22.72	16.99	6.24	1.32	0.35	32.27	17.71	5600	6.08
5800	12.78	22.84	16.09	6.11	1.36	0.35	32.08	17.43	5800	6.01
6000	12.50	23.03	15.54	6.02	1.41	0.34	32.02	16.81	6000	6.14
6200	12.13	23.16	14.74	5.88	1.46	0.34	32.17	15.01	6500	6.15
6400	11.80	23.12	14.23	5.83	1.50	0.34	31.48	14.85	7000	6.57
6600	11.34	23.32	13.43	5.79	1.59	0.33	31.17	15.02	7500	6.79
6800	10.84	23.67	12.50	5.64	1.71	0.33	30.63	15.09	8000	7.19
7000	10.31	23.56	11.85	5.63	1.77	0.33	30.70	15.01	8500	7.84
7500	8.59	23.39	10.27	5.74	2.05	0.33	30.21	13.37	9500	8.88
8000	6.74	23.06	8.75	5.72	2.31	0.33	29.19	13.00	10000	8.98

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

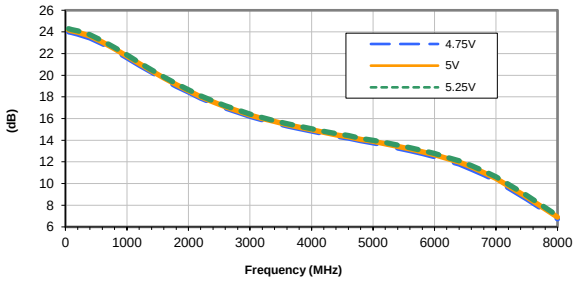
TEST CONDITIONS: Vd = 5.25V, Id=121mA @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	FREQ	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(MHz)	(dB)
50	24.30	31.09	20.87	26.72	1.31	0.45	39.25	21.50	50	5.65
100	24.23	30.81	20.63	25.17	1.28	0.47	39.11	21.55	100	5.77
200	24.09	31.45	20.75	21.34	1.36	0.43	38.96	21.53	200	5.78
400	23.74	31.14	20.72	16.43	1.35	0.43	38.46	21.65	400	5.88
600	23.18	30.63	20.46	13.52	1.33	0.43	37.68	21.51	600	5.83
800	22.55	30.13	20.16	11.67	1.32	0.42	37.47	21.52	800	5.92
1000	21.87	29.60	19.81	10.38	1.30	0.42	37.58	21.52	1000	5.87
1200	21.18	29.05	19.48	9.43	1.29	0.41	37.44	21.41	1200	5.86
1400	20.50	28.51	19.17	8.76	1.28	0.41	37.34	21.40	1400	5.88
1600	19.83	27.90	18.93	8.25	1.27	0.41	37.72	21.52	1600	5.88
1800	19.22	27.46	18.78	7.88	1.27	0.40	37.83	21.48	1800	5.82
2000	18.66	26.99	18.68	7.58	1.26	0.39	38.02	21.61	2000	5.77
2200	18.11	26.45	18.75	7.42	1.25	0.39	37.65	21.73	2200	5.80
2400	17.63	26.03	18.77	7.31	1.25	0.38	37.36	21.74	2400	5.75
2600	17.19	25.59	18.82	7.22	1.24	0.38	36.99	21.77	2600	5.73
2800	16.79	25.21	18.92	7.18	1.23	0.37	37.21	21.90	2800	5.75
3000	16.42	24.80	18.96	7.12	1.22	0.37	37.11	21.88	3000	5.83
3200	16.08	24.53	19.18	7.15	1.23	0.36	36.82	21.67	3200	5.77
3400	15.81	24.14	19.12	7.14	1.21	0.37	36.72	21.44	3400	5.86
3600	15.53	23.86	19.17	7.10	1.21	0.36	36.74	21.18	3600	5.78
3800	15.28	23.64	19.31	7.12	1.21	0.36	36.04	20.90	3800	5.91
4000	15.05	23.40	19.44	7.13	1.21	0.36	35.41	20.53	4000	5.96
4200	14.82	23.18	19.53	7.10	1.21	0.36	35.26	20.39	4200	6.26
4400	14.60	23.09	19.60	7.05	1.23	0.36	35.66	20.25	4400	6.08
4600	14.43	22.92	19.34	6.95	1.22	0.36	35.67	20.11	4600	6.09
4800	14.18	22.79	19.07	6.78	1.23	0.37	35.31	19.62	4800	6.00
5000	14.00	22.79	19.05	6.74	1.25	0.36	35.36	19.26	5000	6.20
5200	13.78	22.74	18.38	6.58	1.26	0.36	35.18	19.03	5200	6.36
5400	13.54	22.80	17.78	6.38	1.28	0.36	35.06	18.81	5400	6.48
5600	13.31	22.77	17.31	6.22	1.30	0.36	34.40	18.59	5600	6.44
5800	13.05	22.90	16.37	6.05	1.33	0.36	34.73	18.31	5800	6.38
6000	12.79	23.08	15.76	5.96	1.38	0.35	34.37	17.62	6000	6.52
6200	12.42	23.17	14.91	5.78	1.42	0.35	34.52	16.09	6500	6.53
6400	12.11	23.15	14.38	5.70	1.46	0.35	34.25	15.90	7000	6.99
6600	11.66	23.35	13.56	5.67	1.54	0.34	33.24	16.18	7500	7.21
6800	11.15	23.67	12.57	5.52	1.65	0.34	33.37	16.18	8000	7.64
7000	10.62	23.60	11.90	5.49	1.72	0.34	33.32	15.98	8500	8.28
7500	8.91	23.46	10.30	5.60	1.99	0.34	33.18	14.14	9500	9.34
8000	7.03	23.08	8.76	5.57	2.23	0.34	31.20	13.73	10000	9.56

Typical Performance Curves

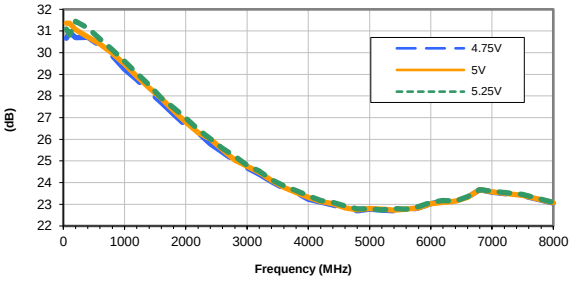
GAIN vs. FREQUENCY & DEVICE VOLTAGE

INPUT POWER = -25dBm,, Temperature = +25°C



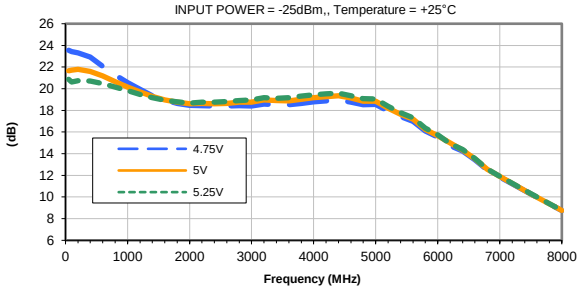
ISOLATION vs. FREQUENCY & DEVICE VOLTAGE

INPUT POWER = -25dBm,, Temperature = +25°C



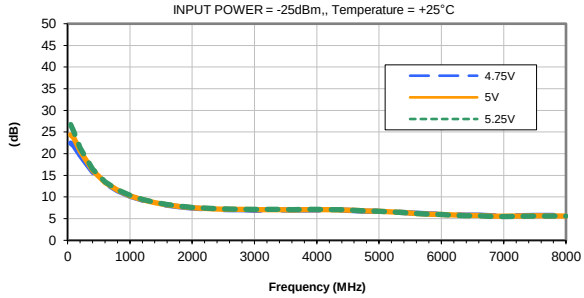
INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE

INPUT POWER = -25dBm,, Temperature = +25°C



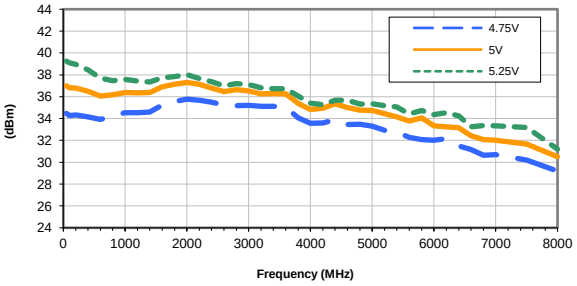
OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE

INPUT POWER = -25dBm,, Temperature = +25°C



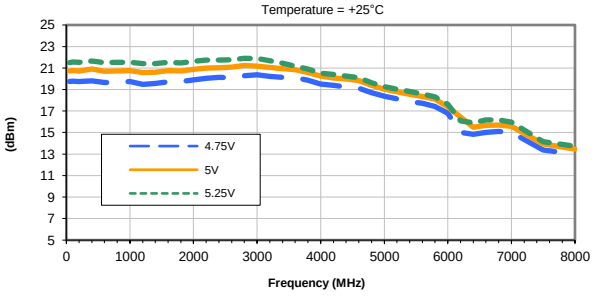
OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE

INPUT POWER = -25dBm,, Temperature = +25°C



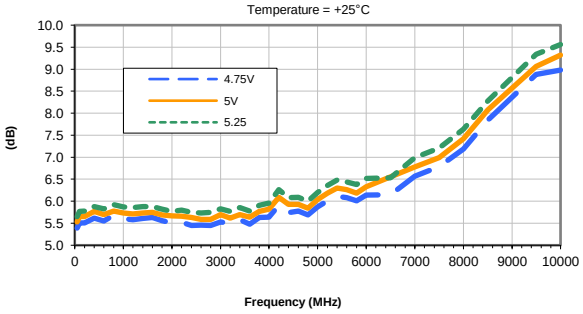
P1dB vs. FREQUENCY & DEVICE VOLTAGE

Temperature = +25°C



NOISE FIGURE vs. FREQUENCY & DEVICE VOLTAGE

Temperature = +25°C



Mini-Circuits

Environmental Specifications ENV80

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment (Die)	-65° to 150°C	Individual Model Data Sheet
Storage Environment(Packaging)	-40° to 70°C and 40 to 60% humidity (In Factory Shipped Package)	