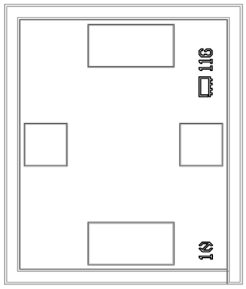
5 Volt, High Gain

Monolithic Amplifier Die

GVA-81-D+

50Ω DC to 6 GHz



The Big Deal

- High Gain, 10 dB Typ.
- High Pout, P1dB 19.5dBm Typ.
- High IP3, 41dBm Typ. at 1GHz
- Transient protected, US patent 6,943,629

Product Overview

GVA-81-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, offering flat gain over a broad frequency range and high IP3. It provides good input and output return loss over a broad frequency range without the need for external matching components. Provided as an unpackaged amplifier die on GaAs, this model allows easy integration directly into the user's hybrids.

Key Features

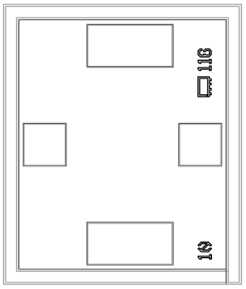
Feature	Advantages
Broadband, 0.1 to 6.0 GHz	Covers the primary wireless communications bands: cellular, PCS, LTE, and WiMAX
Good Gain flatness: • ±0.6 dB over 0.1 to 3 GHz • ± 1.2 dB over 0.1 to 6 GHz	Eliminates the need for gain flattening using external components.
High IP3 versus DC power consumption • +42 dBm typical at 0.1 GHz • +35 dBm typical at 3 GHz	The GVA-81-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and InGaP HBT structure provides enhanced linearity over a broad frequency range, evident in IP3 values typically 15 dB above the P1dB point to 3 GHz. This feature makes this amplifier ideal for use in: • Driver amplifiers for complex waveform up converter paths • Drivers in linearized transmit systems
No External Matching Components Required	GVA-81-D+ provides input and Output return loss of >15 dB up to 6 GHz without the need for external matching components, saving real estate and reducing component count.
Unpackaged die	Enables user to integrate it directly into hybrids.

5 Volt, High Gain

Monolithic Amplifier Die

GVA-81-D+

50Ω DC to 6 GHz



Product Features

- High Gain, 10 dB Typ.
- High Pout, P1dB 19.5dBm Typ.
- High IP3, 41dBm Typ. at 1GHz
- Ruggedized design
- Fixed 5V operation
- Excellent ESD Protection

Typical Applications

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

+RoHS Compliant

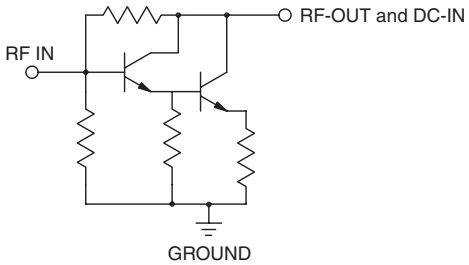
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

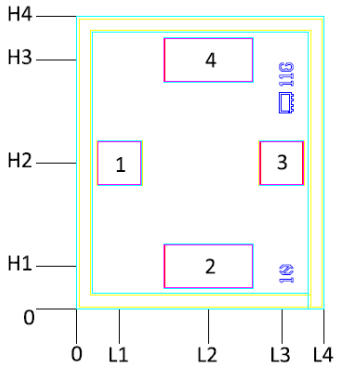
GVA-81-D+ (RoHS compliant) is a wideband high gain amplifier die offering high dynamic range. It uses patented Transient Protected Darlington configuration and is fabricated using InGaP HBT technology, offering flat gain over a broad frequency range and high IP3. It provides good input and output return loss over a broad frequency range without the need for external matching components. Provided as an unpackaged amplifier die on GaAs, this model allows easy integration directly into the user's hybrids.

Simplified Schematic and Pad description



Pad#	Function
1	RF-IN
3	RF-OUT
2,4 and bottom of die	GROUND

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	H1	H2	H3	H4
95	293	455	550	95	324	554	650

Thickness	Die size	Pad size 1 & 3	Pad size 2 & 4
100	550 x 650	95 x 95	195 x 95

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

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range[2]		DC		6	GHz
Gain	0.1		10.5		dB
	1.0		10.5		
	2.0		10.0		
	3.0		9.3		
	4.0		8.7		
	6.0		8.1		
Magnitude of Gain Variation versus Temperature[3] (values are negative)	0.1	—	0.0005	—	dB/°C
	1.0	—	0.0010	—	
	2.0	—	0.0016	—	
	3.0	—	0.0020	—	
	4.0	—	0.0025	—	
	6.0	—	0.0036	—	
Input Return Loss	0.1	—	38.0	—	dB
	1.0	—	27.0	—	
	2.0	—	20.1	—	
	3.0	—	17.4	—	
	4.0	—	16.9	—	
	6.0	—	18.5	—	
Output Return Loss	0.1	—	21.4	—	dB
	1.0	—	20.6	—	
	2.0	—	17.4	—	
	3.0	—	14.5	—	
	4.0	—	13.1	—	
	6.0	—	14.8	—	
Reverse Isolation	2.0		20.8		dB
Output Power @1 dB compression	0.1	—	19.1	—	dBm
	1.0	—	19.1	—	
	2.0	—	19.7	—	
	3.0	—	20.0	—	
	4.0	—	19.4	—	
	6.0	—	17.7	—	
Output IP3	0.1	—	42.0	—	dBm
	1.0	—	41.3	—	
	2.0	—	36.6	—	
	3.0	—	35.0	—	
	4.0	—	33.2	—	
	6.0	—	31.1	—	
Noise Figure	0.1	—	7.3	—	dB
	1.0	—	7.3	—	
	2.0	—	7.4	—	
	3.0	—	7.6	—	
	4.0	—	7.7	—	
	6.0	—	8.3	—	
Group Delay	2.0		98		psec
Device Operating Voltage		4.8	5.0	5.2	V
Device Operating Current		94	103	112	mA
Device Current Variation vs. Temperature			62		µA/°C
Device Current Variation vs Voltage			0.036		mA/mV
Thermal Resistance, junction-to-ground lead			68		°C/W

1. Die is packaged in SOT-89 and soldered on characterization test board TB-313. See Characterization Test Circuit (Fig. 1)
2. Low frequency cut off determined by external coupling capacitors and RF Choke (RFC).
3. (Gain at 85°C, Gain at -45°C)/130

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Operating Current at 5V	160mA
Power Dissipation	0.855W
Input Power	13dBm
DC Voltage on Pin 3	5.9V

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

Characterization Test & Application Circuit

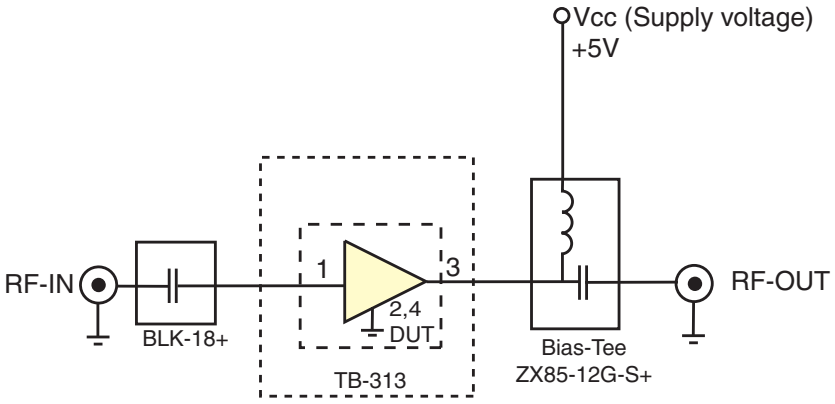
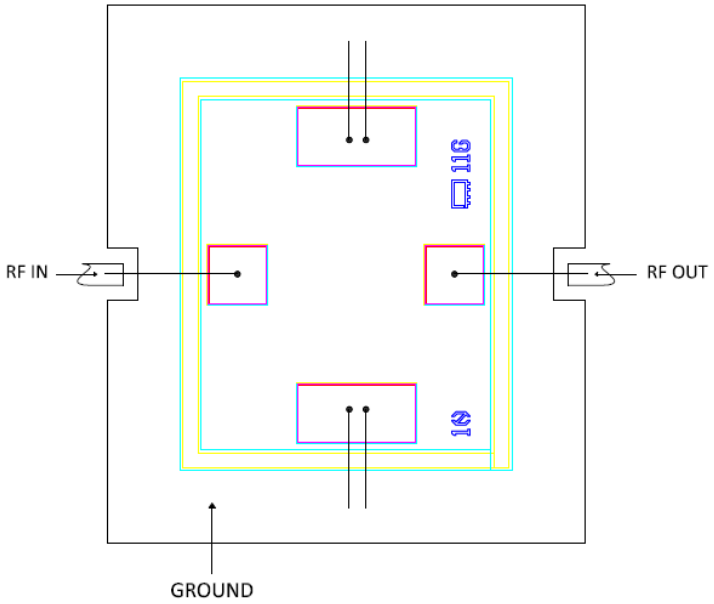


Fig 1. Block Diagram of Test Circuit used for characterization. (Measured on Mini-Circuits characterization test board. Die packaged in SOT-89 Package and soldered on test board TB-313).
Gain, Output power at 1dB compression (P1 dB) and output IP3 (OIP3) are measured using R&S Network Analyzer ZVA-24.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

Assembly Diagram



Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC HBT amplifer dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficent epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. The surface of the chip has exposed air bridges and should not be touched with vacuum collet, tweezers or fingers.
5. 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. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

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-81-DG+
	Medium†, Partial wafer: KGD*<2597	GVA-81-DP+
	Large†, Full Wafer	GVA-81-DF+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV80	

*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 (1000V to <2000V) accordance with ANSI/ESD STM 5.1 - 2001

** Tested in 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.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

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MMIC Amplifier Die GVA-81+

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 = 5.00V, Id=101.48mA @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
100	10.56	20.40	48.28	20.31	1.70	0.89	41.04	19.03	7.25
300	10.40	20.59	38.03	22.53	1.75	0.90	42.23	19.20	7.22
600	10.48	20.45	31.41	21.69	1.72	0.89	42.87	19.34	7.29
900	10.47	20.45	27.44	21.40	1.72	0.90	45.27	19.31	7.30
1000	10.47	20.45	26.33	21.23	1.72	0.90	42.35	19.49	7.31
1200	10.38	20.48	25.26	18.95	1.73	0.90	40.75	19.13	7.37
1400	10.30	20.50	24.05	19.31	1.74	0.90	41.94	19.09	7.42
1600	10.21	20.59	22.63	16.62	1.75	0.90	40.44	19.59	7.46
1800	10.03	20.67	21.42	16.96	1.78	0.91	38.83	18.90	7.45
2000	9.83	20.78	20.13	15.22	1.82	0.91	37.80	19.03	7.42
2200	9.72	20.89	19.41	15.41	1.86	0.92	38.83	19.62	7.44
2400	9.56	20.99	18.28	14.66	1.88	0.92	37.10	18.90	7.47
2600	9.46	20.97	17.19	14.49	1.90	0.93	36.68	19.38	7.53
2800	9.33	21.05	16.60	15.02	1.94	0.94	36.57	19.67	7.50
3000	9.22	21.14	15.95	15.07	1.97	0.94	34.21	19.33	7.48
3200	9.14	21.23	15.75	16.11	2.01	0.95	35.34	19.27	7.56
3400	9.04	21.34	15.64	16.33	2.05	0.96	36.58	19.73	7.62
3600	8.92	21.42	15.63	16.23	2.11	0.96	34.92	19.23	7.65
3800	8.83	21.48	16.23	16.98	2.15	0.96	34.22	19.14	7.69
4000	8.72	21.63	16.21	15.50	2.19	0.96	32.79	18.88	7.72
4200	8.66	21.71	16.97	15.43	2.23	0.95	33.51	19.14	7.75
4400	8.56	21.77	17.89	14.41	2.27	0.94	33.76	19.16	7.81
4600	8.43	21.91	18.45	13.58	2.32	0.94	33.39	18.65	7.82
4800	8.32	22.05	19.99	12.86	2.35	0.92	33.78	19.00	7.85
5000	8.15	22.22	20.89	12.04	2.43	0.91	32.75	18.23	7.90
5200	8.10	22.29	21.35	11.82	2.46	0.91	33.32	18.79	7.93
5400	8.04	22.39	22.64	11.61	2.50	0.91	32.39	18.34	8.00
5600	7.98	22.50	23.16	11.80	2.54	0.91	33.15	18.05	8.08
5800	7.98	22.52	21.78	12.24	2.57	0.92	33.65	18.45	8.15
6000	7.91	22.57	22.47	12.40	2.61	0.92	32.41	18.04	8.19
6200	7.83	22.57	19.99	13.16	2.64	0.94	32.70	17.63	8.24
6400	7.76	22.46	18.31	14.26	2.65	0.95	33.17	18.07	8.33
6600	7.72	22.49	17.10	14.37	2.67	0.96	31.76	17.31	8.45
6800	7.67	22.44	14.63	16.20	2.68	0.99	31.85	17.01	8.52
7000	7.52	22.36	13.54	17.29	2.67	1.00	32.37	17.51	8.62
7200	7.30	22.36	12.44	13.85	2.65	1.00	30.38	16.31	8.73
7400	6.95	22.50	11.09	14.48	2.77	1.03	31.31	16.42	8.84
7600	6.62	22.58	10.46	12.12	2.80	1.02	30.84	16.38	8.94
7800	6.14	22.59	9.54	10.07	2.80	1.01	29.17	15.25	9.12
8000	5.61	22.76	9.08	9.19	2.90	1.00	30.17	15.52	9.27

Note: Test data of die packaged in industry standard SOT-89 Package

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=92.73mA @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
100	10.55	20.39	43.84	20.17	1.70	0.89	39.22	18.27	7.13
300	10.46	20.51	35.07	22.64	1.74	0.90	39.19	18.42	7.09
600	10.47	20.45	31.59	20.79	1.72	0.89	41.14	18.54	7.17
900	10.46	20.47	27.45	20.82	1.71	0.90	41.73	18.54	7.21
1000	10.42	20.41	26.23	20.91	1.71	0.90	42.46	18.70	7.20
1200	10.34	20.45	25.13	19.12	1.73	0.90	40.40	18.38	7.25
1400	10.28	20.46	23.91	18.69	1.74	0.90	38.89	18.35	7.30
1600	10.15	20.53	22.53	16.39	1.75	0.90	40.01	18.80	7.36
1800	9.99	20.62	21.33	16.54	1.78	0.91	37.40	18.19	7.34
2000	9.82	20.74	20.04	15.33	1.81	0.91	38.11	18.30	7.31
2200	9.66	20.80	19.29	15.36	1.85	0.92	37.54	18.78	7.33
2400	9.52	20.91	18.17	14.58	1.88	0.92	35.91	18.19	7.36
2600	9.40	20.93	17.10	14.50	1.89	0.93	35.80	18.59	7.42
2800	9.27	21.00	16.41	15.04	1.93	0.94	36.03	18.87	7.40
3000	9.16	21.07	15.82	14.94	1.97	0.94	33.42	18.61	7.36
3200	9.08	21.16	15.65	15.99	2.00	0.95	34.44	18.51	7.44
3400	8.98	21.24	15.49	16.13	2.04	0.96	36.20	19.02	7.50
3600	8.87	21.31	15.58	16.29	2.08	0.96	34.69	18.54	7.53
3800	8.77	21.35	16.14	16.73	2.13	0.96	33.32	18.72	7.57
4000	8.69	21.52	16.15	15.47	2.17	0.96	32.95	18.74	7.62
4200	8.59	21.59	16.85	15.25	2.21	0.95	32.94	18.49	7.66
4400	8.46	21.65	17.84	14.05	2.24	0.94	33.47	18.54	7.69
4600	8.36	21.80	18.29	13.37	2.29	0.93	32.92	18.03	7.71
4800	8.24	21.94	19.96	12.58	2.35	0.92	33.28	18.41	7.75
5000	8.08	22.08	20.84	11.95	2.41	0.91	31.79	17.66	7.77
5200	8.02	22.18	21.08	12.01	2.44	0.91	33.19	18.23	7.80
5400	7.96	22.25	22.40	11.49	2.49	0.90	31.77	17.81	7.88
5600	7.89	22.35	22.89	11.67	2.52	0.91	32.29	17.51	7.95
5800	7.88	22.38	21.63	12.15	2.54	0.92	32.54	17.90	8.03
6000	7.80	22.41	22.17	12.13	2.59	0.92	32.03	17.55	8.06
6200	7.73	22.42	19.92	13.03	2.63	0.93	32.24	17.10	8.12
6400	7.64	22.35	18.11	14.25	2.64	0.95	32.62	17.57	8.22
6600	7.58	22.33	16.96	14.47	2.66	0.96	31.23	16.82	8.30
6800	7.51	22.28	14.46	15.90	2.68	0.99	31.65	16.51	8.38
7000	7.40	22.24	13.56	17.15	2.67	1.00	31.41	17.03	8.48
7200	7.16	22.24	12.38	13.57	2.64	1.00	30.00	15.84	8.60
7400	6.82	22.38	10.98	14.41	2.76	1.03	30.52	15.92	8.71
7600	6.47	22.48	10.39	12.23	2.81	1.02	30.33	15.91	8.79
7800	6.00	22.53	9.53	10.04	2.80	1.01	28.49	14.78	8.96
8000	5.45	22.63	9.01	9.09	2.89	1.00	29.47	15.04	9.13

Note: Test data of die packaged in industry standard SOT-89 Package

Typical Performance Data

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

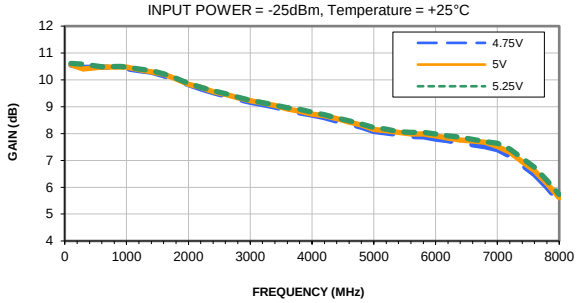
TEST CONDITIONS: Vd = 5.25V, Id=110.31mA @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
100	10.61	20.46	46.87	20.40	1.70	0.89	44.13	19.72	7.36
300	10.58	20.62	36.62	22.90	1.74	0.90	45.37	19.91	7.33
600	10.49	20.49	30.65	21.65	1.72	0.90	44.44	20.06	7.38
900	10.50	20.51	27.65	21.00	1.72	0.90	45.19	20.02	7.41
1000	10.47	20.50	26.29	21.31	1.72	0.90	43.81	20.22	7.41
1200	10.40	20.52	25.19	19.09	1.72	0.90	40.67	19.81	7.47
1400	10.34	20.54	24.20	19.05	1.74	0.90	40.18	19.78	7.54
1600	10.23	20.60	22.71	16.75	1.75	0.90	47.08	20.34	7.59
1800	10.06	20.70	21.46	16.97	1.79	0.91	40.79	19.55	7.59
2000	9.87	20.82	20.27	15.41	1.83	0.91	40.80	19.73	7.53
2200	9.72	20.94	19.39	15.47	1.87	0.92	40.28	20.35	7.54
2400	9.59	21.06	18.36	15.08	1.89	0.92	38.35	19.56	7.59
2600	9.49	21.03	17.24	14.75	1.91	0.93	37.87	20.07	7.65
2800	9.35	21.15	16.67	15.05	1.95	0.94	37.90	20.32	7.64
3000	9.24	21.24	16.10	14.98	1.98	0.94	34.79	19.95	7.61
3200	9.15	21.30	15.82	16.28	2.03	0.95	34.88	19.87	7.68
3400	9.06	21.42	15.62	16.53	2.08	0.96	36.52	20.28	7.74
3600	8.96	21.48	15.72	16.82	2.11	0.96	35.62	19.72	7.77
3800	8.90	21.56	16.30	16.93	2.16	0.96	34.53	19.28	7.80
4000	8.79	21.71	16.30	15.97	2.20	0.96	33.38	18.97	7.86
4200	8.70	21.82	17.01	15.49	2.24	0.95	33.47	19.53	7.89
4400	8.58	21.89	18.00	14.34	2.28	0.94	34.66	19.64	7.94
4600	8.47	22.03	18.50	13.51	2.32	0.94	33.35	19.18	7.95
4800	8.36	22.16	20.17	12.74	2.38	0.92	33.67	19.44	8.01
5000	8.22	22.34	21.00	12.00	2.45	0.91	33.40	18.73	8.04
5200	8.16	22.41	21.35	11.97	2.49	0.91	33.87	19.23	8.08
5400	8.07	22.53	22.59	11.80	2.53	0.91	32.99	18.77	8.14
5600	8.05	22.64	23.24	11.78	2.56	0.91	33.31	18.51	8.20
5800	8.05	22.66	22.02	12.10	2.58	0.92	33.69	18.89	8.31
6000	7.98	22.71	22.62	12.12	2.62	0.92	32.97	18.44	8.32
6200	7.91	22.72	20.12	13.20	2.67	0.94	32.55	18.10	8.38
6400	7.86	22.60	18.39	14.03	2.67	0.95	33.47	18.46	8.48
6600	7.78	22.62	17.12	14.61	2.67	0.96	31.89	17.72	8.57
6800	7.70	22.61	14.74	16.48	2.69	0.99	32.31	17.45	8.68
7000	7.64	22.48	13.61	17.25	2.67	1.00	32.86	17.89	8.79
7200	7.42	22.53	12.49	13.89	2.67	1.00	30.84	16.74	8.89
7400	7.08	22.62	11.08	14.75	2.78	1.03	31.62	16.86	9.01
7600	6.74	22.70	10.46	12.41	2.79	1.02	31.17	16.80	9.09
7800	6.26	22.69	9.62	10.18	2.80	1.01	29.97	15.68	9.25
8000	5.73	22.90	9.08	9.31	2.90	1.01	30.65	15.82	9.41

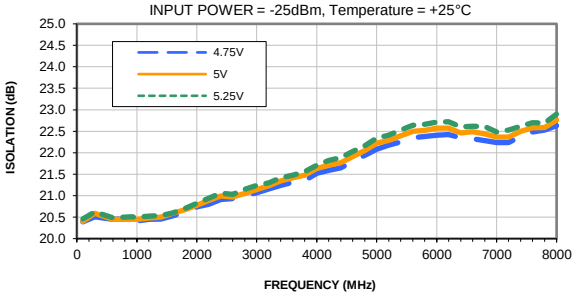
Note: Test data of die packaged in industry standard SOT-89 Package

Typical Performance Curves

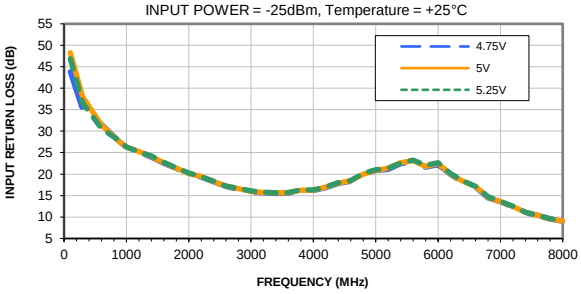
GAIN vs. DEVICE VOLTAGE
INPUT POWER = -25dBm, Temperature = +25°C



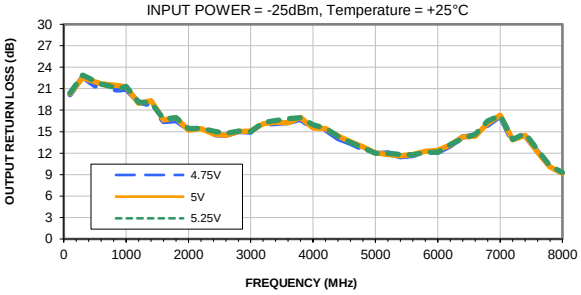
ISOLATION vs. DEVICE VOLTAGE
INPUT POWER = -25dBm, Temperature = +25°C



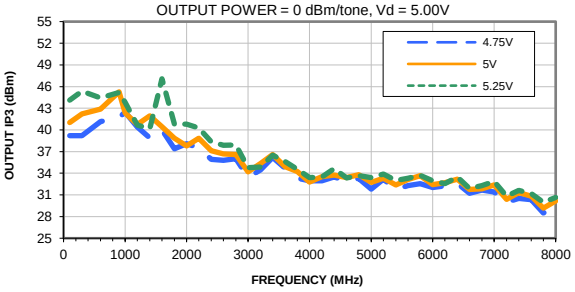
INPUT RETURN LOSS vs. DEVICE VOLTAGE
INPUT POWER = -25dBm, Temperature = +25°C



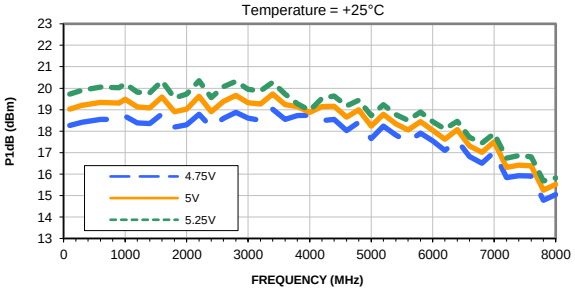
OUTPUT RETURN LOSS vs. DEVICE VOLTAGE
INPUT POWER = -25dBm, Temperature = +25°C



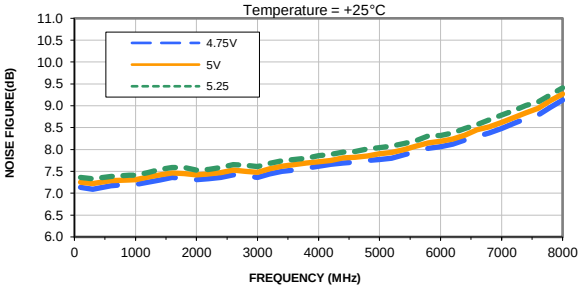
OUTPUT IP3 vs. DEVICE VOLTAGE
OUTPUT POWER = 0 dBm/tone, Vd = 5.00V



P1dB vs. DEVICE VOLTAGE
Temperature = +25°C



NOISE FIGURE vs. DEVICE VOLTAGE
Temperature = +25°C



Note: Test data of die packaged in industry standard SOT-89 Package

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 Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment	20° to 35° C and 40 to 60% humidity (In Factory Shipped Package)	Individual Model Data Sheet