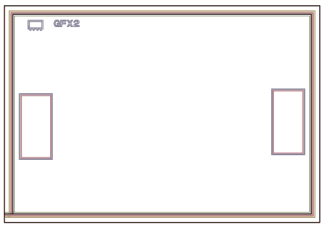
Low Noise, Wideband, High IP3

Monolithic Amplifier Die PMA3-83LNW-D+

50Ω 0.4 to 8 GHz



The Big Deal

- Flat gain over wideband, 0.4 to 8 GHz
- Low noise figure, 1.2 dB
- High IP3, up to +37 dBm

Product Overview

The PMA3-83LNW-D+ is a PHEMT based wideband, low noise MMIC amplifier die with a unique combination of low noise, high IP3, and flat gain over wideband making it ideal for sensitive, high-dynamic-range receiver applications. This design operates on a single 5V or 6V supply, is well matched for 50Ω.

Key Features

Feature	Advantages
Low noise, 1.2 dB at 2 GHz	Enables lower system noise figure performance.
High IP3 • +37 dBm at 2 GHz • +29 dBm at 8 GHz	Combination of low noise and high IP3 makes this MMIC amplifier ideal for use in low noise receiver front end (RFE) as it gives the user advantages of sensitivity and two-tone IM performance at both ends of the dynamic range.
Low operating voltage, 5V/6V.	Achieves high IP3 using low voltage.
Wide bandwidth with flat gain • ±0.6 dB over 0.4 to 7 GHz • ±1.5 dB over 0.4 to 8 GHz	Enables a single amplifier to be used in many wideband applications including defense, instrumentation and more.
Unpackaged die	Enables user to integrate it directly into hybrids.

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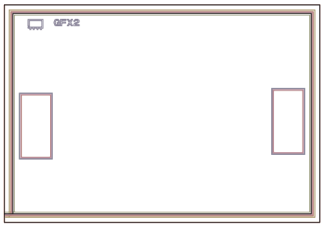


Product Features

- Low Noise figure, 1.2 dB at 2 GHz
- High IP3, 31 dBm typ. at 2 GHz
- High Pout, P1dB 21.7 dBm typ. at 2 GHz and 6V
- Excellent Gain flatness, ±0.6 dB over 0.4 to 7 GHz and 6V

Typical Applications

- WiFi
- WLAN
- UMTS
- LTE
- WiMAX
- S-band Radar
- C-band Satcom

+RoHS Compliant

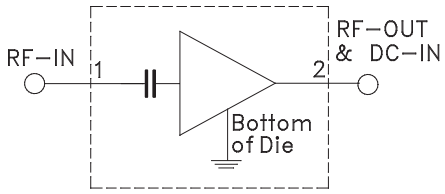
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

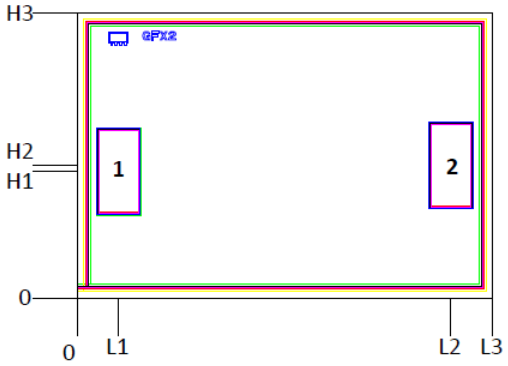
The PMA3-83LNW-D+ is a PHEMT based wideband, low noise MMIC amplifier die with a unique combination of low noise, high IP3, and flat gain over wideband making it ideal for sensitive, high-dynamic-range receiver applications. This design operates on a single 5V or 6V supply, is well matched for 50Ω.

Simplified Schematic and Pad description



Pad#	Function
1	RF-IN
2	RF-OUT AND DC-IN
Bottom of Die	GND

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	H1	H2	H3	Thickness	Die size	Pad size 1	Pad size 2
97	865	962	292	306	660	100	660X962	101X201	101X201

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

Parameter	Condition (GHz)	V_{DD}=6.0			V_{DD}=5.0			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Frequency Range		0.4		8.0	0.4		8.0	GHz
Noise Figure	0.4		2.0			2.0		dB
	2.0		1.2			1.2		
	4.0		1.3			1.4		
	5.0		1.5			1.6		
	8.0		2.2			2.2		
Gain	0.4		22.0			21.1		dB
	2.0		22.6			21.7		
	4.0		21.8			21.0		
	5.0		21.3			20.6		
	8.0		19.0			18.6		
Input Return Loss	0.4		10			10		dB
	2.0		17			18		
	4.0		12			11		
	5.0		11			10		
	8.0		7			7		
Output Return Loss	0.4		22			22		dB
	2.0		14			16		
	4.0		24			24		
	5.0		19			18		
	8.0		10			9		
Output Power at 1dB Compression	0.4		18.8			16.2		dBm
	2.0		21.7			20.5		
	4.0		20.4			18.9		
	5.0		20.2			18.8		
	8.0		18.1			17.3		
Output IP3	0.4		32.2			28.7		dBm
	2.0		37.0			31.1		
	4.0		34.5			30.1		
	5.0		32.0			28.6		
	8.0		29.0			26.8		
Device Operating Voltage (V_{DD})		5.75	6	6.25	4.75	5	5.25	V
Device Operating Current (I_{DD})			75	94		58		mA
Device Current Variation vs. Temperature[2]			-190			-143		µA/°C
Device Current Variation vs. Voltage			0.017			0.017		mA/mV
Thermal Resistance, junction-to-ground lead			47			47		°C/W

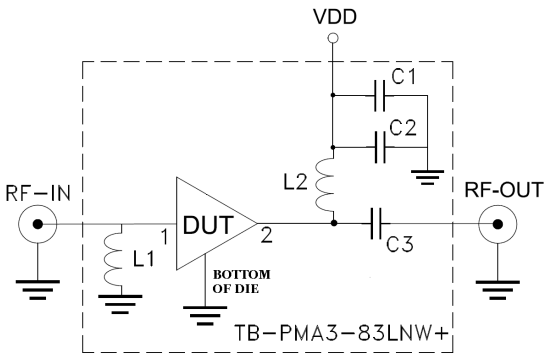
1. Measured on Mini-Circuits Characterization test board. Die is packaged in 3X3 mm, 12-lead MCL package and soldered on TB-PMA3-83LNW+. See Characterization Test Circuit (Fig. 1)
2. (Current at 105°C - Current at -45°C)/130

Absolute Maximum Ratings[3]

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 105°C
Junction Temperature	150°C
Total Power Dissipation	0.95 W
Input Power (CW), Vd=5,6V	+19 dBm (5 minutes max) +9 dBm (continuous, 0.4-0.5 GHz) +16 dBm (continuous, 0.5-8 GHz)
DC Voltage	7 V

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

Characterization Test Circuit

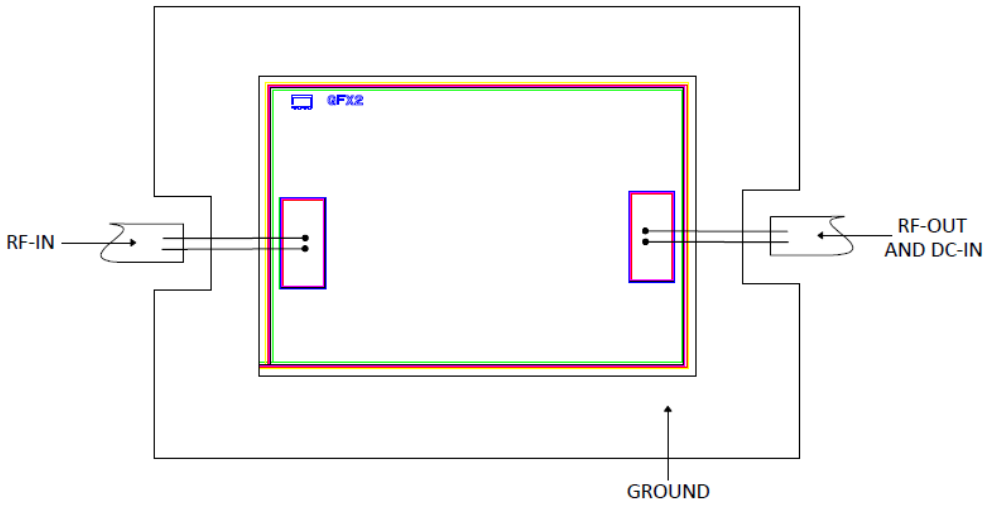


Component	Size	Value	Part Number	Manufacturer
L1	0402	18nH	LQP15MN18NJ02D	Murata
L2	0402	39nH	0402CS-39NXGLW	Coilcraft
C1	0402	0.01uF	GRM155R71E103KA01D	Murata
C2	0402	10pF	GJM1555C1H100JB01D	Murata
C3	0402	100pF	GRM1555C1H101JA01D	Murata

Fig 1. Application and Characterization Circuit
Note: This block diagram is used for characterization. (Die is packaged in 3x3mm, 12-lead MCLP package and soldered on Mini-Circuits Characterization test board TB-PMA3-83LNW+) Gain, Return loss, Output power at 1dB compression (P1dB), output IP3 (OIP3) and 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 PHEMT amplifier dice are susceptible to electrostatic and mechanical damage. Dice are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. 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.

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*	PMA3-83LNW-DG+
	Medium†, Partial wafer: KGD*<1911	PMA3-83LNW-DP+
	Large†, Full Wafer	PMA3-83LNW-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 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard MCLP 3x3 mm, 12-lead 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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Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions

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 = 57mA @ Temperature = +25°C

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)
200	16.55	32.15	2.44	5.75	1.30	1.04	26.00	13.07	3.70
400	21.10	27.25	9.51	21.83	1.14	0.87	28.76	15.84	2.03
600	21.83	26.38	17.20	18.28	1.10	0.67	29.60	18.21	1.72
800	21.98	26.16	24.75	14.88	1.09	0.59	30.64	19.71	1.40
1000	22.01	26.09	27.10	13.84	1.09	0.56	30.09	20.42	1.37
1200	21.99	26.06	24.12	13.54	1.09	0.55	32.06	20.45	1.30
1400	21.96	26.08	21.59	13.59	1.09	0.56	31.62	20.42	1.30
1600	21.90	26.13	19.63	13.92	1.09	0.58	31.65	20.36	1.18
1800	21.83	26.16	18.39	14.47	1.09	0.60	30.40	20.32	1.27
2000	21.78	26.17	17.23	15.12	1.10	0.62	30.19	20.37	1.27
2200	21.73	26.21	16.13	15.88	1.10	0.64	30.64	19.97	1.34
2400	21.65	26.27	15.32	16.66	1.10	0.66	30.85	20.02	1.27
2600	21.55	26.34	14.59	17.82	1.11	0.69	30.59	20.00	1.30
2800	21.45	26.43	14.03	19.11	1.12	0.72	30.45	19.58	1.35
3000	21.36	26.49	13.40	20.66	1.12	0.74	29.91	19.54	1.42
3200	21.31	26.52	12.78	21.84	1.12	0.76	29.92	19.08	1.41
3400	21.25	26.54	12.25	22.39	1.12	0.77	28.34	18.51	1.45
3600	21.18	26.60	11.85	22.24	1.12	0.79	28.28	18.71	1.38
3800	21.10	26.66	11.45	21.68	1.12	0.81	29.87	19.06	1.45
4000	21.01	26.73	11.15	20.70	1.12	0.83	29.04	18.64	1.39
4200	20.92	26.80	10.89	19.62	1.12	0.84	28.01	18.49	1.48
4400	20.82	26.86	10.69	18.49	1.12	0.85	28.49	18.41	1.48
4600	20.74	26.96	10.46	17.42	1.13	0.86	27.65	18.22	1.52
4800	20.64	27.00	10.31	16.47	1.13	0.87	28.35	18.41	1.44
5000	20.56	27.07	10.16	15.68	1.13	0.88	28.45	18.79	1.59
5200	20.46	27.16	10.04	14.96	1.14	0.88	26.76	19.04	1.48
5400	20.37	27.21	9.92	14.38	1.14	0.89	28.22	19.29	1.54
5600	20.29	27.27	9.81	13.76	1.14	0.89	28.56	18.72	1.57
5800	20.21	27.36	9.70	13.17	1.14	0.90	27.55	18.72	1.57
6000	20.11	27.41	9.58	12.67	1.15	0.90	28.64	18.79	1.63
6200	20.02	27.53	9.44	12.14	1.15	0.91	27.83	18.80	1.65
6400	19.90	27.60	9.25	11.63	1.15	0.92	27.59	18.12	1.84
6600	19.72	27.75	9.01	11.19	1.15	0.93	26.75	17.98	1.79
6800	19.48	27.92	8.55	11.48	1.17	0.97	26.40	17.99	1.79
7000	19.52	27.85	8.41	11.20	1.15	0.97	27.66	18.04	1.80
7200	19.39	27.92	8.14	10.74	1.14	0.97	27.62	17.83	1.94
7400	19.23	28.00	7.79	10.34	1.13	0.99	26.58	17.61	1.96
7600	19.03	28.13	7.39	10.01	1.13	1.01	25.87	17.36	1.96
7800	18.80	28.26	7.00	9.70	1.12	1.03	26.44	17.51	2.02
8000	18.54	28.35	6.58	9.40	1.11	1.05	26.52	17.27	2.11
8200	18.24	28.50	6.14	9.12	1.11	1.07	26.20	16.71	2.19
8400	17.89	28.63	5.70	8.89	1.10	1.10	25.58	16.79	2.26
8600	17.50	28.81	5.31	8.65	1.11	1.13	25.84	16.93	2.36
8800	17.05	28.99	4.89	8.49	1.11	1.15	25.73	16.40	2.50
9000	16.54	29.19	4.54	8.39	1.14	1.18	24.52	15.86	2.67
10000	13.02	30.79	3.31	6.33	1.40	1.17	22.03	14.82	3.82

Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL 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 = 53mA @ Temperature = +25°C

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)
200	16.17	31.90	2.39	5.70	1.31	1.03	24.86	12.24	3.56
400	20.76	26.99	9.22	21.48	1.14	0.87	27.33	15.13	1.89
600	21.51	26.08	16.66	19.59	1.10	0.67	27.92	17.65	1.62
800	21.67	25.86	24.80	15.73	1.09	0.60	29.08	19.30	1.29
1000	21.71	25.78	30.42	14.57	1.09	0.57	29.01	20.03	1.19
1200	21.70	25.75	25.86	14.24	1.09	0.56	29.87	20.06	1.21
1400	21.66	25.77	22.36	14.28	1.09	0.57	29.64	20.16	1.17
1600	21.60	25.81	19.94	14.64	1.09	0.59	29.68	19.98	1.03
1800	21.53	25.85	18.45	15.22	1.09	0.61	29.07	19.95	1.17
2000	21.49	25.87	17.13	15.92	1.10	0.63	28.43	20.11	1.19
2200	21.43	25.92	15.95	16.77	1.10	0.65	28.89	19.60	1.18
2400	21.35	25.97	15.08	17.61	1.10	0.67	29.31	19.78	1.23
2600	21.25	26.05	14.31	18.89	1.11	0.70	29.02	19.77	1.24
2800	21.15	26.14	13.73	20.30	1.12	0.73	28.66	19.22	1.27
3000	21.06	26.20	13.08	21.92	1.12	0.75	28.67	19.18	1.30
3200	21.01	26.25	12.46	22.98	1.12	0.77	28.57	18.71	1.29
3400	20.95	26.30	11.94	23.11	1.12	0.79	27.42	18.28	1.37
3600	20.88	26.35	11.54	22.47	1.11	0.80	27.43	18.21	1.27
3800	20.80	26.39	11.15	21.51	1.11	0.82	28.61	18.71	1.32
4000	20.72	26.47	10.84	20.30	1.11	0.83	27.76	18.28	1.28
4200	20.62	26.52	10.59	19.12	1.11	0.84	26.78	18.00	1.34
4400	20.54	26.64	10.39	17.96	1.12	0.86	27.29	17.80	1.33
4600	20.45	26.71	10.16	16.89	1.12	0.87	26.58	17.60	1.42
4800	20.36	26.76	10.02	15.95	1.12	0.87	26.84	17.94	1.40
5000	20.28	26.85	9.88	15.19	1.13	0.88	27.15	18.34	1.47
5200	20.19	26.91	9.77	14.50	1.13	0.89	25.76	18.60	1.39
5400	20.10	26.99	9.65	13.94	1.13	0.89	26.85	18.87	1.49
5600	20.03	27.04	9.54	13.36	1.13	0.90	27.46	18.30	1.45
5800	19.95	27.14	9.44	12.80	1.14	0.90	26.12	18.32	1.43
6000	19.86	27.20	9.33	12.32	1.14	0.91	27.33	18.40	1.55
6200	19.77	27.32	9.20	11.82	1.14	0.91	27.06	18.53	1.61
6400	19.65	27.40	9.02	11.33	1.14	0.92	26.26	17.74	1.71
6600	19.48	27.58	8.78	10.92	1.15	0.94	25.67	17.60	1.71
6800	19.25	27.73	8.34	11.23	1.16	0.97	25.23	17.74	1.76
7000	19.30	27.64	8.22	10.96	1.14	0.97	26.16	17.69	1.71
7200	19.17	27.72	7.96	10.51	1.13	0.98	26.80	17.60	1.85
7400	19.01	27.83	7.62	10.13	1.13	0.99	25.95	17.39	1.83
7600	18.81	27.96	7.23	9.82	1.12	1.01	24.83	17.02	1.90
7800	18.59	28.04	6.86	9.52	1.11	1.03	25.48	17.31	1.94
8000	18.34	28.20	6.45	9.24	1.10	1.05	25.51	16.95	2.07
8200	18.04	28.31	6.02	8.97	1.09	1.08	25.45	16.52	2.11
8400	17.69	28.51	5.60	8.76	1.10	1.10	24.79	16.49	2.17
8600	17.31	28.66	5.22	8.53	1.10	1.13	24.90	16.63	2.30
8800	16.86	28.85	4.80	8.37	1.10	1.15	25.14	16.10	2.39
9000	16.35	29.09	4.47	8.28	1.13	1.18	23.92	15.44	2.59
10000	12.83	30.70	3.27	6.25	1.39	1.17	21.44	14.11	3.77

Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL 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 = 61mA @ Temperature = +25°C

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)
200	16.86	32.40	2.46	5.77	1.30	1.04	26.99	13.70	3.74
400	21.41	27.49	9.64	21.80	1.13	0.86	30.32	16.46	2.01
600	22.11	26.65	17.42	17.62	1.10	0.66	30.94	18.93	1.71
800	22.26	26.44	24.61	14.45	1.09	0.58	32.12	20.14	1.40
1000	22.29	26.37	25.99	13.45	1.09	0.55	31.15	20.71	1.34
1200	22.27	26.34	23.36	13.17	1.08	0.55	32.66	20.74	1.29
1400	22.23	26.36	21.18	13.23	1.09	0.56	33.78	20.83	1.32
1600	22.17	26.37	19.42	13.55	1.09	0.57	33.15	20.65	1.21
1800	22.10	26.41	18.27	14.08	1.09	0.59	31.38	20.60	1.29
2000	22.05	26.46	17.19	14.71	1.10	0.61	31.95	20.65	1.24
2200	22.00	26.48	16.14	15.46	1.10	0.63	32.36	20.25	1.37
2400	21.91	26.54	15.35	16.21	1.10	0.66	31.01	20.30	1.34
2600	21.81	26.60	14.65	17.30	1.11	0.69	31.56	20.28	1.32
2800	21.70	26.67	14.12	18.57	1.12	0.71	32.40	19.98	1.36
3000	21.62	26.73	13.48	20.04	1.12	0.74	31.15	19.83	1.43
3200	21.57	26.73	12.88	21.28	1.12	0.75	32.00	19.48	1.38
3400	21.50	26.77	12.35	21.97	1.12	0.77	29.73	18.92	1.55
3600	21.42	26.81	11.94	22.05	1.12	0.79	30.31	19.12	1.43
3800	21.34	26.88	11.55	21.70	1.12	0.81	31.42	19.46	1.44
4000	21.25	26.95	11.24	20.88	1.12	0.82	30.68	19.04	1.39
4200	21.15	27.00	10.98	19.89	1.12	0.84	30.06	18.90	1.47
4400	21.05	27.07	10.79	18.79	1.13	0.85	29.70	18.82	1.47
4600	20.96	27.15	10.55	17.73	1.13	0.86	29.13	18.62	1.48
4800	20.86	27.20	10.40	16.76	1.13	0.87	29.65	18.80	1.43
5000	20.77	27.29	10.26	15.94	1.14	0.88	29.65	19.04	1.55
5200	20.67	27.34	10.14	15.21	1.14	0.88	28.21	19.28	1.44
5400	20.57	27.42	10.01	14.60	1.14	0.89	29.53	19.53	1.57
5600	20.49	27.49	9.90	13.98	1.15	0.89	30.11	18.96	1.55
5800	20.40	27.57	9.79	13.37	1.15	0.90	28.67	18.84	1.57
6000	20.30	27.62	9.68	12.84	1.15	0.91	29.21	19.01	1.61
6200	20.20	27.69	9.53	12.31	1.15	0.91	29.15	19.02	1.68
6400	20.07	27.81	9.34	11.77	1.15	0.92	28.43	18.34	1.84
6600	19.89	27.96	9.09	11.31	1.16	0.93	28.06	18.19	1.78
6800	19.64	28.10	8.62	11.59	1.18	0.97	27.11	18.19	1.83
7000	19.68	28.01	8.47	11.32	1.15	0.97	28.38	18.12	1.75
7200	19.54	28.07	8.20	10.84	1.15	0.98	28.26	18.03	1.92
7400	19.37	28.17	7.84	10.43	1.14	0.99	28.10	17.80	1.91
7600	19.16	28.29	7.44	10.09	1.14	1.01	26.59	17.54	1.96
7800	18.93	28.37	7.05	9.77	1.13	1.03	27.18	17.69	2.05
8000	18.66	28.49	6.63	9.46	1.12	1.05	27.11	17.45	2.12
8200	18.36	28.63	6.18	9.18	1.11	1.08	26.95	17.00	2.17
8400	18.00	28.75	5.74	8.95	1.11	1.10	26.46	16.96	2.22
8600	17.61	28.92	5.35	8.71	1.11	1.13	26.57	17.09	2.35
8800	17.16	29.08	4.92	8.54	1.11	1.16	26.55	16.57	2.51
9000	16.64	29.28	4.57	8.44	1.14	1.18	25.26	16.04	2.61
10000	13.12	30.82	3.33	6.38	1.40	1.18	22.82	14.98	3.83

Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL 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 = 6.00V, Id = 74mA @ Temperature = +25°C

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)
200	17.56	32.85	2.54	5.84	1.28	1.04	29.39	15.74	3.73
400	22.06	28.04	10.15	21.30	1.13	0.85	33.36	18.61	2.05
600	22.72	27.26	18.19	15.99	1.10	0.65	34.15	20.63	1.71
800	22.85	27.06	23.26	13.36	1.09	0.57	36.70	21.50	1.39
1000	22.86	26.99	22.76	12.51	1.08	0.54	36.80	21.78	1.36
1200	22.84	26.97	21.13	12.27	1.08	0.54	39.74	21.91	1.34
1400	22.79	26.98	19.78	12.33	1.08	0.54	39.96	21.88	1.28
1600	22.72	27.01	18.68	12.59	1.09	0.56	40.63	21.70	1.20
1800	22.66	27.03	17.82	13.05	1.09	0.58	36.48	21.63	1.28
2000	22.60	27.04	17.01	13.57	1.09	0.60	38.48	21.68	1.21
2200	22.54	27.06	16.23	14.24	1.10	0.62	37.24	21.29	1.34
2400	22.46	27.11	15.56	14.94	1.10	0.64	45.85	21.33	1.36
2600	22.36	27.15	14.98	15.96	1.11	0.67	35.84	21.31	1.32
2800	22.25	27.24	14.51	17.16	1.12	0.70	40.59	21.01	1.37
3000	22.16	27.25	13.95	18.54	1.12	0.72	38.01	20.88	1.36
3200	22.10	27.26	13.33	19.84	1.12	0.74	39.17	20.52	1.41
3400	22.03	27.30	12.83	20.69	1.12	0.76	34.02	20.23	1.49
3600	21.95	27.34	12.41	21.29	1.12	0.78	37.29	20.55	1.40
3800	21.86	27.38	12.03	21.49	1.12	0.80	36.60	20.49	1.42
4000	21.76	27.44	11.73	21.25	1.13	0.81	35.73	20.20	1.40
4200	21.66	27.50	11.46	20.53	1.13	0.83	35.80	20.19	1.45
4400	21.55	27.56	11.29	19.62	1.14	0.84	37.92	20.09	1.44
4600	21.45	27.58	11.04	18.61	1.14	0.85	35.20	19.88	1.48
4800	21.34	27.64	10.87	17.69	1.14	0.86	34.99	20.03	1.48
5000	21.24	27.72	10.72	16.85	1.15	0.87	35.67	19.99	1.58
5200	21.13	27.78	10.56	16.06	1.15	0.88	32.79	20.23	1.46
5400	21.02	27.83	10.42	15.36	1.16	0.88	36.91	20.33	1.57
5600	20.93	27.92	10.27	14.67	1.16	0.89	34.97	19.75	1.54
5800	20.83	27.97	10.14	14.03	1.17	0.90	32.60	19.61	1.58
6000	20.72	28.01	10.02	13.48	1.17	0.90	36.82	19.76	1.70
6200	20.60	28.07	9.86	12.90	1.17	0.91	34.67	19.75	1.67
6400	20.47	28.17	9.64	12.35	1.17	0.92	33.00	19.07	1.80
6600	20.26	28.33	9.37	11.91	1.19	0.94	31.66	18.90	1.80
6800	20.07	28.39	8.90	12.30	1.19	0.97	31.48	18.77	1.80
7000	20.06	28.35	8.74	11.85	1.17	0.97	32.35	18.79	1.79
7200	19.91	28.43	8.44	11.33	1.17	0.98	32.04	18.58	1.93
7400	19.72	28.49	8.07	10.92	1.16	0.99	31.18	18.33	1.91
7600	19.50	28.58	7.63	10.56	1.16	1.01	29.53	17.94	1.93
7800	19.26	28.69	7.21	10.20	1.15	1.03	30.02	18.07	2.00
8000	18.98	28.78	6.78	9.90	1.14	1.06	29.97	17.83	2.13
8200	18.67	28.88	6.31	9.59	1.13	1.08	29.49	17.36	2.19
8400	18.31	29.00	5.86	9.34	1.13	1.11	28.79	17.30	2.22
8600	17.91	29.13	5.45	9.09	1.13	1.13	28.79	17.43	2.43
8800	17.46	29.28	5.03	8.88	1.13	1.16	28.50	17.05	2.53
9000	16.93	29.48	4.66	8.81	1.16	1.19	26.97	16.37	2.65
10000	13.47	30.87	3.39	6.67	1.39	1.19	24.26	15.15	3.91

Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL 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 = 5.75V, Id = 70mA @ Temperature = +25°C

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)
200	17.35	32.73	2.52	5.79	1.29	1.04	28.77	14.96	3.75
400	21.87	27.87	9.99	21.54	1.13	0.85	31.22	18.08	1.99
600	22.54	27.08	17.97	16.46	1.10	0.65	32.01	20.25	1.71
800	22.68	26.87	23.76	13.66	1.09	0.57	35.96	21.15	1.37
1000	22.70	26.81	23.62	12.77	1.08	0.54	34.44	21.56	1.36
1200	22.68	26.78	21.75	12.52	1.08	0.54	35.88	21.57	1.26
1400	22.63	26.78	20.23	12.57	1.08	0.55	37.28	21.66	1.29
1600	22.57	26.82	18.92	12.88	1.09	0.56	35.83	21.48	1.21
1800	22.50	26.83	18.04	13.38	1.09	0.58	33.88	21.42	1.27
2000	22.45	26.83	17.14	13.96	1.09	0.60	34.45	21.47	1.20
2200	22.39	26.88	16.23	14.65	1.10	0.62	35.21	20.96	1.22
2400	22.31	26.94	15.52	15.35	1.10	0.65	35.26	21.13	1.25
2600	22.21	26.99	14.88	16.37	1.11	0.68	34.20	21.10	1.29
2800	22.10	27.03	14.39	17.55	1.12	0.70	33.31	20.69	1.33
3000	22.01	27.10	13.80	18.92	1.12	0.73	32.99	20.67	1.39
3200	21.95	27.15	13.20	20.18	1.12	0.75	34.08	20.31	1.37
3400	21.88	27.16	12.68	21.03	1.12	0.76	31.94	19.90	1.45
3600	21.80	27.20	12.27	21.50	1.12	0.78	31.57	20.23	1.41
3800	21.71	27.22	11.86	21.59	1.12	0.80	33.07	20.18	1.44
4000	21.62	27.29	11.56	21.18	1.12	0.82	32.75	19.88	1.37
4200	21.52	27.31	11.30	20.39	1.12	0.83	30.83	19.87	1.42
4400	21.41	27.42	11.09	19.42	1.13	0.84	31.54	19.78	1.46
4600	21.32	27.47	10.85	18.37	1.13	0.85	31.40	19.45	1.54
4800	21.21	27.54	10.71	17.39	1.14	0.86	30.95	19.61	1.51
5000	21.11	27.58	10.55	16.54	1.14	0.87	31.10	19.70	1.56
5200	21.01	27.65	10.43	15.78	1.15	0.88	29.79	19.94	1.47
5400	20.91	27.71	10.30	15.14	1.15	0.89	31.11	20.05	1.53
5600	20.81	27.79	10.18	14.47	1.16	0.89	31.36	19.48	1.55
5800	20.72	27.87	10.06	13.82	1.16	0.90	29.96	19.46	1.55
6000	20.60	27.88	9.94	13.26	1.16	0.90	31.09	19.51	1.62
6200	20.50	27.97	9.78	12.68	1.16	0.91	30.64	19.51	1.69
6400	20.36	28.07	9.58	12.11	1.16	0.92	29.34	18.82	1.83
6600	20.17	28.21	9.33	11.62	1.17	0.93	29.03	18.66	1.76
6800	19.92	28.37	8.82	11.89	1.19	0.97	28.72	18.65	1.85
7000	19.94	28.26	8.66	11.60	1.17	0.97	29.54	18.68	1.84
7200	19.80	28.32	8.38	11.09	1.16	0.97	29.88	18.47	1.93
7400	19.62	28.43	8.01	10.66	1.16	0.99	28.66	18.23	1.94
7600	19.40	28.51	7.59	10.29	1.15	1.01	27.85	17.85	1.99
7800	19.16	28.58	7.19	9.96	1.14	1.03	28.65	18.00	2.03
8000	18.89	28.69	6.75	9.63	1.13	1.05	27.93	17.75	2.17
8200	18.58	28.83	6.30	9.33	1.12	1.08	28.03	17.29	2.18
8400	18.22	28.94	5.84	9.09	1.12	1.10	27.54	17.24	2.28
8600	17.82	29.08	5.44	8.84	1.12	1.13	27.63	17.37	2.38
8800	17.37	29.24	5.00	8.67	1.12	1.16	27.69	16.98	2.52
9000	16.85	29.43	4.65	8.57	1.15	1.18	26.59	16.31	2.64
10000	13.33	30.92	3.38	6.48	1.40	1.18	23.58	15.10	3.80

Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL package

Typical Performance Data

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

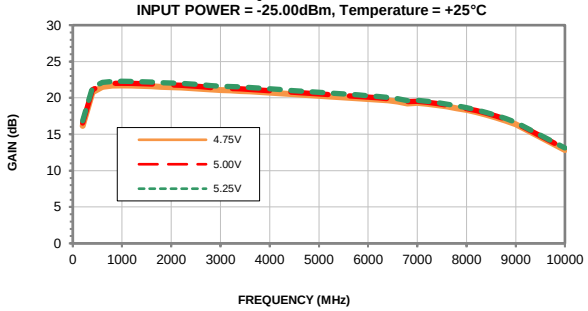
TEST CONDITIONS: Vd = 6.25V, Id = 79mA @ Temperature = +25°C

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)
200	17.76	33.14	2.53	5.79	1.29	1.03	30.29	16.25	3.75
400	22.28	28.27	10.11	21.16	1.13	0.85	33.90	19.12	2.02
600	22.94	27.42	18.12	16.05	1.09	0.65	32.69	21.11	1.72
800	23.07	27.25	23.49	13.36	1.08	0.57	36.21	21.85	1.39
1000	23.09	27.17	23.03	12.51	1.08	0.54	34.43	22.12	1.34
1200	23.06	27.15	21.31	12.25	1.08	0.53	37.99	22.13	1.31
1400	23.01	27.14	19.92	12.32	1.08	0.54	40.42	22.21	1.30
1600	22.95	27.19	18.70	12.62	1.09	0.56	38.69	22.03	1.15
1800	22.87	27.22	17.87	13.12	1.09	0.58	41.07	21.96	1.25
2000	22.82	27.22	17.01	13.68	1.09	0.60	35.15	22.01	1.20
2200	22.75	27.21	16.14	14.35	1.09	0.62	37.24	21.61	1.37
2400	22.67	27.26	15.46	15.05	1.10	0.64	38.82	21.66	1.28
2600	22.56	27.32	14.85	16.06	1.11	0.67	36.80	21.63	1.27
2800	22.44	27.39	14.37	17.21	1.12	0.70	36.90	21.33	1.41
3000	22.35	27.44	13.78	18.56	1.12	0.72	37.21	21.31	1.34
3200	22.29	27.46	13.19	19.86	1.12	0.74	35.33	20.84	1.39
3400	22.21	27.48	12.68	20.79	1.12	0.76	34.34	20.55	1.48
3600	22.12	27.49	12.28	21.40	1.12	0.78	34.03	20.87	1.39
3800	22.02	27.56	11.88	21.66	1.12	0.80	36.73	20.91	1.42
4000	21.92	27.58	11.56	21.44	1.12	0.81	33.66	20.51	1.37
4200	21.81	27.66	11.31	20.71	1.13	0.83	32.40	20.50	1.44
4400	21.70	27.69	11.11	19.79	1.13	0.84	33.60	20.40	1.45
4600	21.59	27.78	10.87	18.73	1.14	0.86	32.47	20.18	1.51
4800	21.48	27.82	10.72	17.72	1.14	0.86	32.00	20.32	1.43
5000	21.37	27.88	10.58	16.86	1.15	0.87	32.52	20.39	1.56
5200	21.26	27.94	10.46	16.05	1.15	0.88	31.36	20.62	1.42
5400	21.15	28.00	10.32	15.39	1.16	0.89	31.99	20.59	1.52
5600	21.05	28.07	10.21	14.68	1.16	0.89	32.58	20.13	1.53
5800	20.94	28.13	10.08	14.01	1.17	0.90	31.56	19.87	1.54
6000	20.82	28.14	9.96	13.43	1.17	0.91	31.84	20.01	1.60
6200	20.70	28.24	9.81	12.83	1.17	0.91	31.96	20.00	1.67
6400	20.56	28.32	9.60	12.23	1.17	0.92	31.48	19.31	1.79
6600	20.36	28.45	9.34	11.73	1.18	0.94	30.61	19.13	1.78
6800	20.09	28.60	8.84	11.99	1.20	0.97	29.54	18.99	1.76
7000	20.11	28.48	8.67	11.70	1.17	0.97	30.84	18.89	1.85
7200	19.96	28.53	8.39	11.17	1.17	0.98	31.19	18.78	1.91
7400	19.77	28.60	8.02	10.72	1.16	0.99	29.88	18.53	1.91
7600	19.54	28.69	7.59	10.34	1.15	1.01	29.04	18.13	1.94
7800	19.29	28.74	7.20	10.00	1.14	1.03	29.77	18.26	2.06
8000	19.02	28.84	6.76	9.67	1.13	1.05	29.36	18.01	2.12
8200	18.69	28.95	6.31	9.37	1.12	1.08	29.23	17.54	2.18
8400	18.33	29.07	5.85	9.13	1.12	1.11	28.40	17.48	2.29
8600	17.92	29.17	5.45	8.87	1.12	1.13	28.41	17.59	2.37
8800	17.46	29.33	5.02	8.71	1.12	1.16	28.65	17.09	2.48
9000	16.94	29.52	4.66	8.62	1.15	1.19	27.48	16.53	2.59
10000	13.41	30.95	3.40	6.55	1.40	1.19	24.88	15.30	3.82

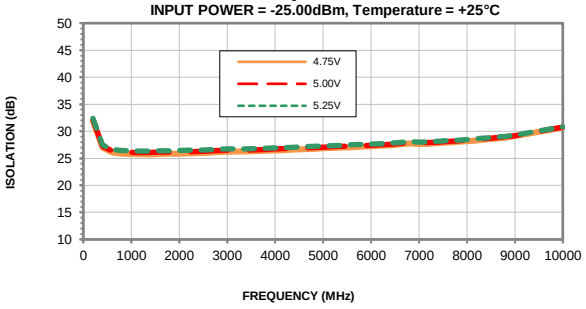
Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL package

Typical Performance Curves

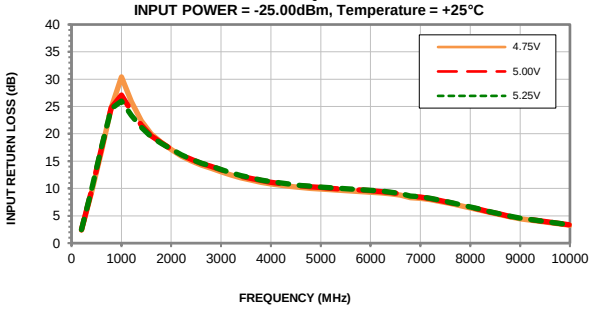
GAIN vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



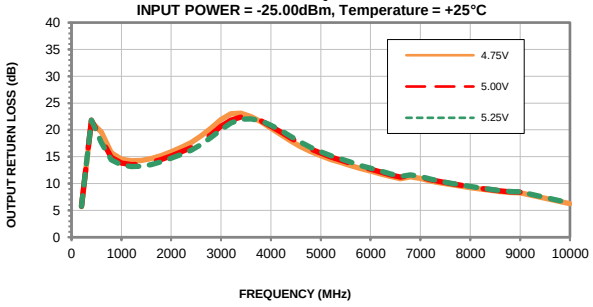
ISOLATION vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



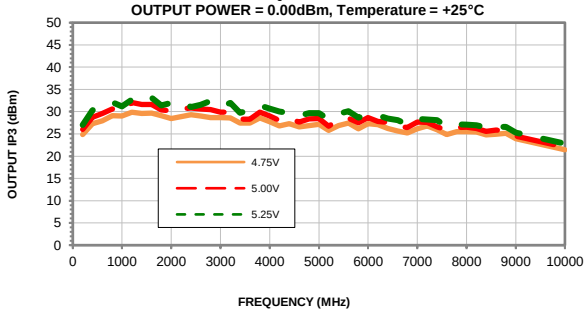
INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



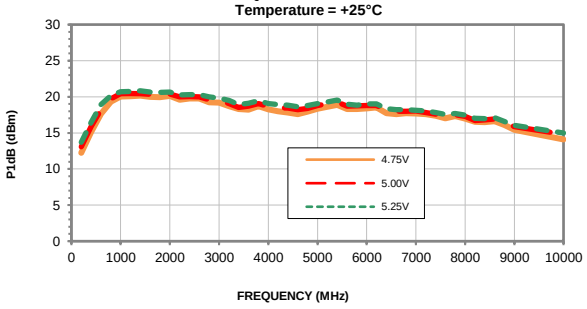
OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



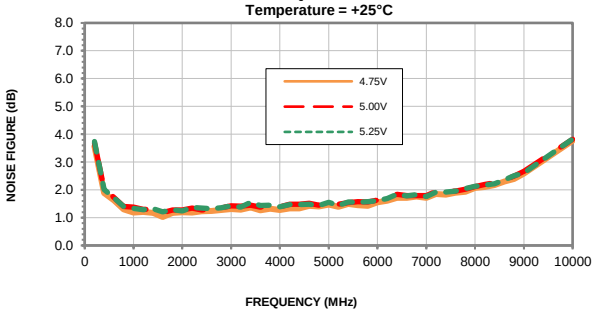
OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = 0.00dBm, Temperature = +25°C



P1dB vs. FREQUENCY & DEVICE VOLTAGE
Temperature = +25°C



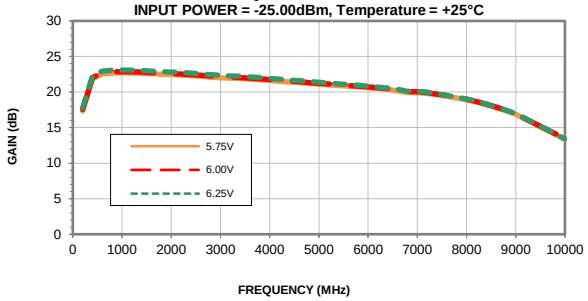
NOISE FIGURE vs. FREQUENCY & DEVICE VOLTAGE
Temperature = +25°C



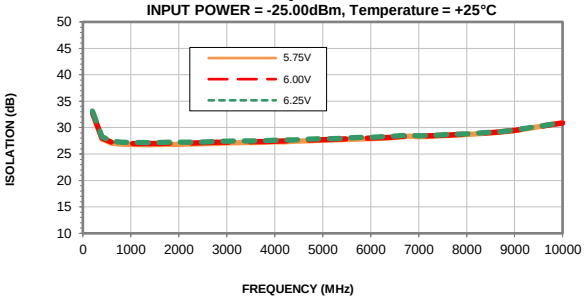
Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL package

Typical Performance Curves

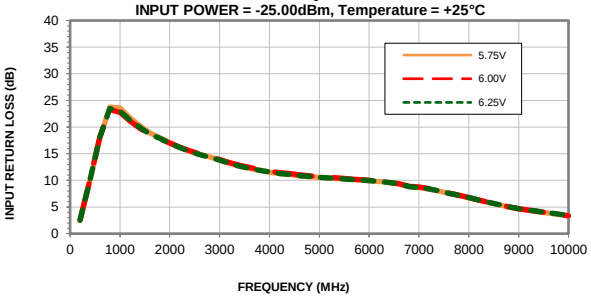
GAIN vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



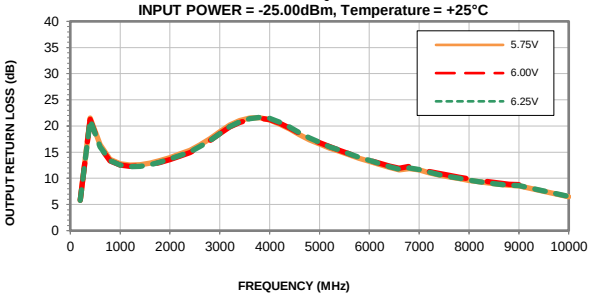
ISOLATION vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



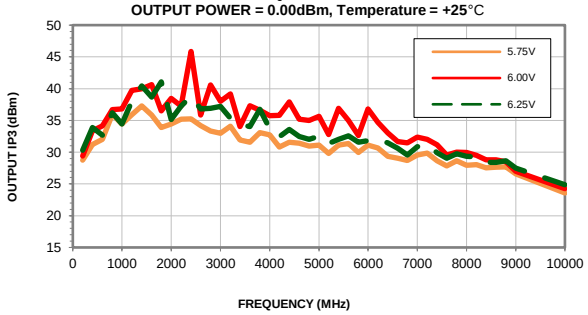
INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



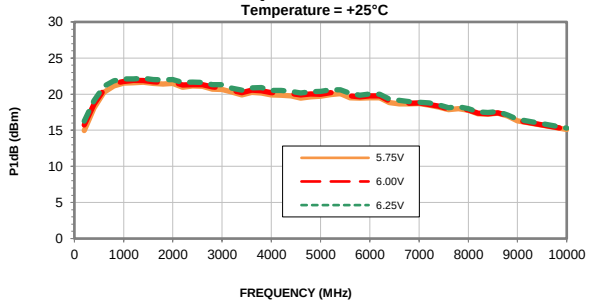
OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



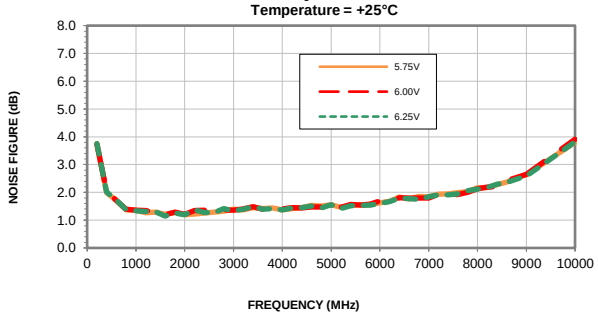
OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = 0.00dBm, Temperature = +25°C



P1dB vs. FREQUENCY & DEVICE VOLTAGE
Temperature = +25°C



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



Note: Test data of Die packaged in industry standard 3x3MM 12-lead MCL 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 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)	