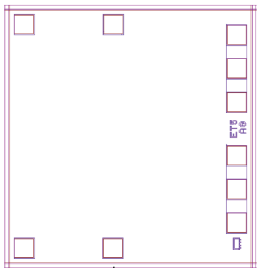
HIGH DIRECTIVITY

Monolithic Amplifier Die MNA-3A-D+

50Ω 0.5 to 2.5 GHz

THE BIG DEAL

- Choice of Supply Voltage, +2.8 V to +5 V
- Internal DC Blocking at RF Input and Output
- High Directivity, 16-25 dB Typ.
- Output Power, +11.6 dBm Typ.



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

SEE ORDERING INFORMATION ON THE LAST PAGE

APPLICATIONS

- Buffer Amplifier
- Cellular Infrastructure
- Communications Satellite
- Defense

PRODUCT OVERVIEW

MNA-3A-D+ is a wideband pHEMT based MMIC amplifier die with high active directivity. MNA-3A-D+ integrates the entire matching network and majority of the bias circuit inside the die, reducing the need for complicated external circuits. This approach makes the MNA-3A-D+ amplifier die extremely straightforward to use. This design operates on a single +2.8 V to +5 V supply, is well matched for 50Ω. MNA series models are available in Die and packaged form.

KEY FEATURES

Features	Advantages
Excellent Active Directivity (Isolation - Gain) 16-25 dB	Ideal for use as a buffer amplifier minimizing interaction of adjacent circuits.
Integrates DC Blocks and RF Choke	Minimizes external components, component count and circuit area.
Single +2.8 V to +5 V Operation	Amplifier can be used at low voltage such as +3 V or standard +5 V. +5 V operation results in higher P1dB and OIP3.
Unpackaged Die	Enables the user to integrate the amplifier directly into hybrids.

REV. C
ECO-024931
MNA-3A-D+
MCL NY
250319

Monolithic Amplifier Die MNA-3A-D+

50Ω 0.5 to 2.5 GHz

ELECTRICAL SPECIFICATIONS[1] AT +25°C

Parameter	Condition (GHz)	V_S=+5 V Min.	V_S=+5 V Typ.	V_S=+5 V Max.	V_S=+2.8 V Typ.	Units
Frequency Range		0.5		2.5	0.5-2.5	GHz
Gain	0.5		12.9		12.0	dB
	0.75		15.5		14.4	
	1.0		16.4		15.2	
	1.5		16.8		15.5	
	2.0		16.5		15.2	
	2.5		15.5		14.2	
Input Return Loss	0.5		4.4		4.7	dB
	0.75		14.1		14.2	
	1.0		24.4		21.5	
	1.5		16.7		17.0	
	2.0		19.4		18.6	
	2.5		14.2		13.8	
Output Return Loss	0.5		15.0		13.9	dB
	0.75		22.3		18.8	
	1.0		30.7		22.4	
	1.5		25.1		22.9	
	2.0		20.2		18.0	
	2.5		18.5		15.0	
Output Power at P1dB	0.5		+11.6		+10.0	dBm
	0.75		+11.6		+10.4	
	1.0		+11.0		+10.0	
	1.5		+10.3		+9.3	
	2.0		+9.5		+8.6	
	2.5		+9.5		+8.4	
Output IP3	0.5		+23.3		+21.0	dBm
	0.75		+24.1		+21.7	
	1.0		+22.9		+21.0	
	1.5		+22.0		+20.2	
	2.0		+21.0		+19.4	
	2.5		+21.0		+19.2	
Noise Figure	0.5		4.5		4.5	dB
	0.75		4.1		4.2	
	1.0		3.9		4.0	
	1.5		3.9		4.0	
	2.0		4.0		4.1	
	2.5		4.1		4.2	
Directivity (Isolation - Gain)	0.5		25.4		25.9	dB
	0.75		19.3		20.0	
	1.0		17.3		18.0	
	1.5		16.3		16.7	
	2.0		16.8		16.7	
	2.5		18.7		17.7	
DC Current			34.3	43.0	32.6	mA
Device Current Variation vs. Temperature[2]			16		6	µA/°C
Device Current Variation vs. Voltage			0.0004[3]		0.0012[4]	mA/mV
Thermal Resitance at +85°C			69.9		69.9	°C/W

1. Measured on Mini-Circuits characterization test board. Die packaged in 3x3 mm 8-Lead QFN-Style Package and soldered on test board TB-186-3A+.
2. (Current at +85°C - Current at -45°C)/130
3. (Current at +5.25 V - Current at +3.9 V)/1.35
4. (Current at +3.9 V - Current at +2.66 V)/1.24

Monolithic Amplifier Die MNA-3A-D+

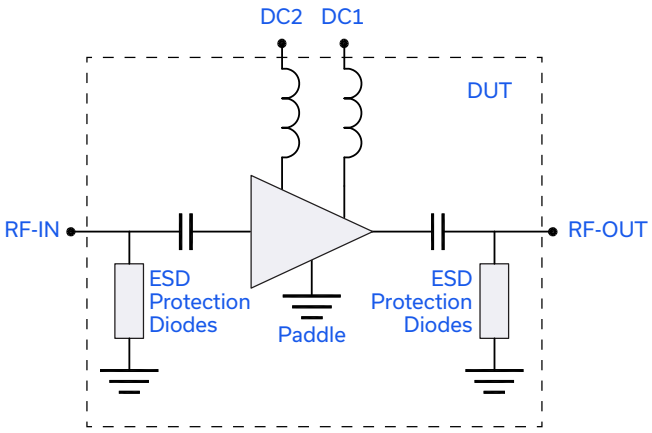
50Ω 0.5 to 2.5 GHz

ABSOLUTE MAXIMUM RATINGS

Parameter	Ratings
Operating Temperature	-40°C to +85°C
DC Voltage	+7 V at DC1 (DC2 connected to DC1 via 33.2Ω) +1 V at RF IN & RF OUT
Power Dissipation	650 mW
Input Power	+6 dBm (continuous operation) +28 dBm (5 minutes max)

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

SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Description
RF-IN	RF input pad.
RF-OUT	RF output pad.
DC1 & DC2	DC Supply pad. Connect DC2 to DC1 via 33.2Ω resistor

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

CHARACTERIZATION CIRCUIT

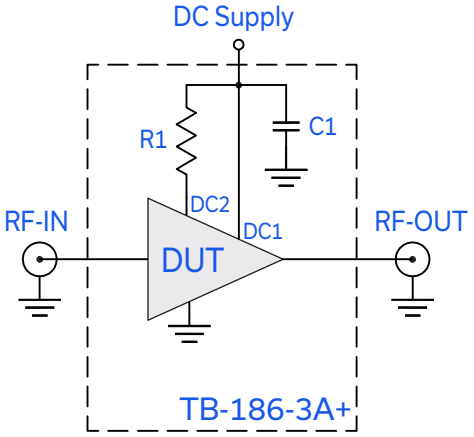


Fig 1. Block Diagram of Test Circuit used for characterization. (Die packaged in 3x3 mm 8-Lead QFN-Style Package and soldered on Mini-Circuits Characterization test board TB-186-3A+) Gain, Return Loss, Output Power at 1 dB Compression (P1dB), Output IP3 (OIP3) and Noise Figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain and Return Loss: P_{IN}= -25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -5 dBm/tone at output.

Component	Size	Value	Units
R1	0805	33.2	Ω
C1	0402	1000	ρ F

RECOMMENDED APPLICATION CIRCUIT

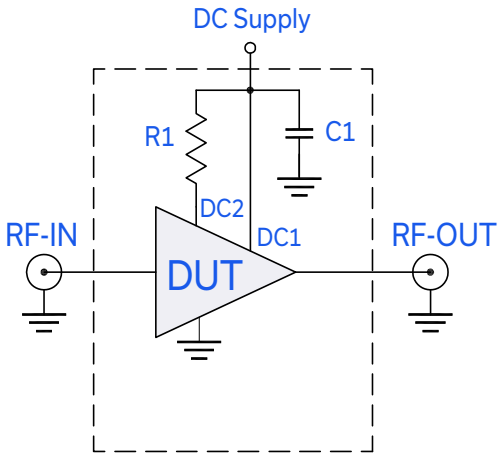


Fig 2. Test Board includes case, connectors, and components soldered to PCB

Component	Value	Units
R1	33.2	Ω
C1	1000	ρ F

Monolithic Amplifier Die MNA-3A-D+

50Ω 0.5 to 2.5 GHz

DIE LAYOUT

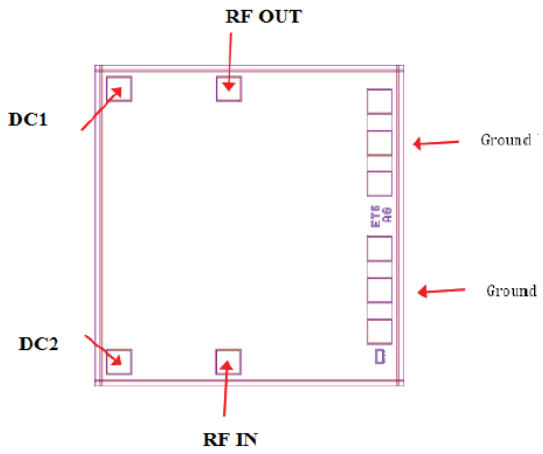


Fig 3. Die Layout

BONDING PAD POSITION

(Dimensions in µm, Typical)

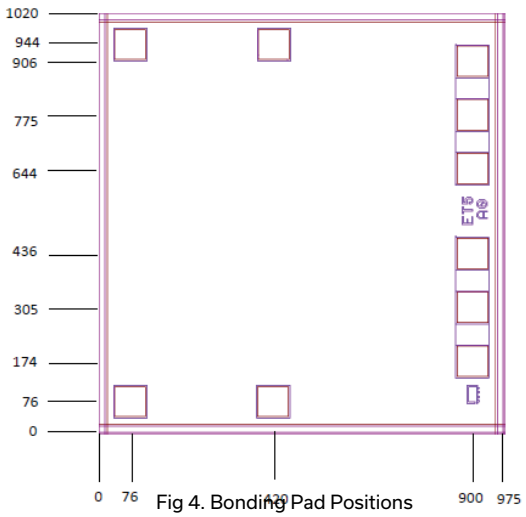
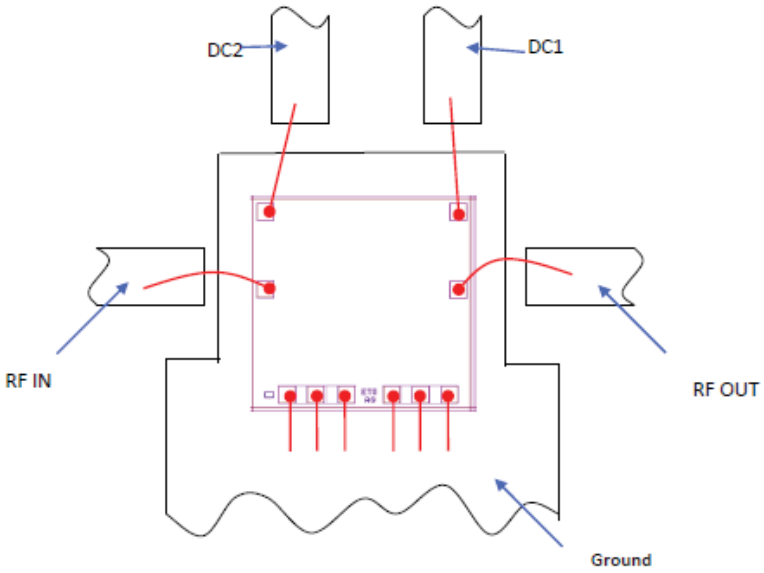


Fig 4. Bonding Pad Positions

CRITICAL DIMENSIONS

Parameter	Values
Die Thickness, µm	100
Die Width, µm	975
Die Length, µm	1020
Bond Pad Size (RF IN, RF OUT, DC1, DC2), µm	80 x 80
Bond Pad Size (Ground), µm	80 x 340

ASSEMBLY DIAGRAM



Note: Ground bond wires are optional.

RECOMMENDED WIRE LENGTH, TYPICAL

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF IN, RF OUT	1.0	0.15
DC1, DC2	0.60	0.15
Ground	0.4	0.15

ASSEMBLY PROCEDURE

1. Storage
   Die should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC PHEMT amplifier Die 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 sufficient 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.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the Die 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 wire length and bond wire height should be kept as short as possible unless specified by the Assembly Drawing to minimize performance degradation due to undesirable series inductance.

Monolithic Amplifier Die MNA-3A-D+

50Ω 0.5 to 2.5 GHz

ADDITIONAL DETAILED TECHNICAL 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* Medium†, Partial wafer: KGD*<1480 Large†, Full Wafer	MNA-3A-DG+ MNA-3A-DP+ MNA-3A-DF+
	†Available upon request contact sales representative Refer to AN-60-067	
Environmental Ratings	ENV-80	

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

ESD RATING**

Human Body Model (HBM): Class 1A (250 V to < 500 V) in accordance with ANSI/ESD STM 5.1 - 2001

**Tested in 3x3 mm 8-Lead QFN-Style Package

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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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 = 34.21mA @ 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)
400	10.60	41.12	3.91	11.89	9.19	1.32	21.84	9.70	4.94
500	12.96	39.11	6.11	15.26	7.38	1.21	23.19	11.73	4.99
600	14.37	37.35	9.09	18.33	6.08	1.11	24.10	11.85	4.27
700	15.24	36.24	12.79	21.27	5.30	1.04	24.11	11.93	4.05
800	15.81	35.39	17.66	24.38	4.71	1.00	23.68	11.68	3.97
900	16.19	34.74	24.37	27.65	4.27	0.99	23.59	11.79	3.88
1000	16.46	34.28	28.54	31.32	3.95	0.98	22.73	11.17	3.87
1100	16.64	33.95	23.53	35.16	3.72	0.99	22.83	11.36	3.93
1200	16.76	33.75	20.37	36.36	3.57	0.99	22.48	11.01	3.88
1300	16.86	33.59	18.65	33.80	3.46	0.99	22.27	10.84	3.89
1400	16.90	33.46	17.66	30.58	3.37	1.00	22.24	10.86	3.90
1500	16.91	33.36	17.13	27.92	3.32	1.00	21.84	10.44	3.87
1600	16.94	33.47	16.92	25.69	3.34	1.00	21.86	10.46	3.92
1700	16.89	33.41	17.45	24.55	3.35	0.99	21.55	10.19	3.88
1800	16.83	33.35	17.96	23.22	3.35	0.99	21.65	10.19	3.90
1900	16.76	33.45	18.81	22.15	3.42	0.99	21.47	10.04	3.88
2000	16.64	33.51	19.73	21.32	3.49	0.98	21.10	9.70	3.94
2100	16.51	33.60	20.55	20.61	3.58	0.98	21.22	9.77	3.91
2200	16.35	33.79	20.56	20.01	3.72	0.98	20.81	9.53	3.90
2300	16.17	33.87	19.61	19.41	3.82	0.98	20.99	9.62	3.94
2400	15.98	33.98	17.39	18.87	3.91	0.99	21.09	9.77	4.04
2500	15.63	34.54	15.51	19.04	4.29	1.00	21.00	9.65	3.99
2600	15.33	35.04	13.83	19.21	4.64	1.02	21.06	9.63	4.18
2700	15.01	35.10	12.25	19.07	4.75	1.03	21.15	9.73	4.20
2800	14.56	35.56	10.63	19.95	5.13	1.07	21.22	9.76	4.33
2900	14.15	35.77	9.43	20.24	5.34	1.09	21.08	9.72	4.38
3000	13.75	36.17	8.40	20.53	5.66	1.13	21.02	9.64	4.42
3100	13.23	36.56	7.42	21.80	6.02	1.17	21.04	9.59	4.58
3200	12.80	37.26	6.67	22.15	6.56	1.20	21.01	9.65	4.59
3300	12.29	37.43	6.01	22.55	6.77	1.24	20.72	9.18	4.72
3400	11.80	37.82	5.39	23.90	7.12	1.28	21.19	9.69	4.90
3600	10.83	38.95	4.45	25.32	8.17	1.35	21.30	9.78	5.22
3800	9.91	39.69	3.77	25.55	8.94	1.41	21.68	10.08	5.53
4000	9.00	40.57	3.28	25.23	10.03	1.46	21.61	10.00	5.95
4200	8.17	41.21	2.84	24.72	10.75	1.51	21.70	10.10	6.40
4400	7.39	39.93	2.56	24.02	9.42	1.55	21.83	10.29	6.87
4600	6.66	39.67	2.38	22.48	9.39	1.57	21.96	10.54	7.26
4800	6.02	40.69	2.18	20.51	10.57	1.59	22.05	10.78	7.65
5000	5.39	35.74	1.98	19.00	5.91	1.62	22.34	11.35	8.06
5200	4.58	37.79	2.02	16.79	8.23	1.60	21.93	10.89	8.63
5400	3.25	42.33	2.00	14.72	15.90	1.58	20.91	10.03	9.12

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 = 3.90V, Id = 33.72mA @ 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)
400	10.40	41.17	3.93	11.77	9.48	1.32	21.34	9.40	4.98
500	12.72	39.10	6.14	14.86	7.58	1.21	22.71	11.42	5.03
600	14.09	37.31	9.07	17.57	6.22	1.11	23.55	11.59	4.30
700	14.92	36.18	12.67	20.12	5.43	1.04	23.57	11.67	4.07
800	15.48	35.31	17.27	22.74	4.83	1.00	23.19	11.44	3.97
900	15.83	34.64	23.05	25.36	4.38	0.99	23.07	11.54	3.95
1000	16.09	34.16	26.96	28.35	4.05	0.98	22.29	10.95	3.90
1100	16.25	33.80	23.67	32.02	3.82	0.99	22.36	11.11	3.94
1200	16.37	33.55	20.79	36.41	3.65	0.99	22.04	10.76	3.91
1300	16.45	33.35	19.08	36.49	3.53	0.99	21.81	10.59	3.91
1400	16.49	33.18	18.10	32.61	3.43	0.99	21.78	10.60	3.90
1500	16.49	33.04	17.56	29.22	3.37	1.00	21.40	10.18	3.91
1600	16.51	33.10	17.30	26.12	3.38	1.00	21.42	10.18	3.96
1700	16.46	32.98	17.79	24.63	3.35	0.99	21.10	9.92	3.94
1800	16.40	32.87	18.26	23.06	3.33	0.99	21.22	9.91	3.96
1900	16.33	32.90	19.04	21.73	3.37	0.99	21.04	9.75	4.01
2000	16.22	32.89	19.85	20.69	3.41	0.98	20.68	9.43	3.94
2100	16.10	32.91	20.59	19.83	3.47	0.98	20.80	9.47	3.96
2200	15.94	33.02	20.51	19.06	3.57	0.98	20.37	9.23	3.92
2300	15.77	33.01	19.62	18.32	3.62	0.98	20.54	9.31	3.97
2400	15.59	33.12	17.49	17.57	3.70	0.98	20.59	9.44	4.04
2500	15.26	33.55	15.66	17.47	4.00	0.99	20.52	9.31	3.99
2600	14.98	33.89	14.02	17.44	4.23	1.00	20.60	9.28	4.23
2700	14.68	33.85	12.42	17.09	4.28	1.02	20.66	9.37	4.23
2800	14.25	34.26	10.81	17.53	4.58	1.05	20.75	9.43	4.31
2900	13.85	34.33	9.58	17.60	4.70	1.08	20.62	9.35	4.43
3000	13.46	34.62	8.56	17.61	4.91	1.11	20.55	9.27	4.42
3100	12.95	34.90	7.54	18.33	5.16	1.15	20.59	9.24	4.58
3200	12.54	35.43	6.78	18.43	5.51	1.18	20.53	9.30	4.61
3300	12.04	35.55	6.11	18.37	5.65	1.22	20.28	8.85	4.77
3400	11.55	35.84	5.48	18.97	5.87	1.26	20.68	9.34	4.90
3600	10.59	36.69	4.53	19.55	6.52	1.33	20.80	9.42	5.22
3800	9.67	37.24	3.84	19.50	7.00	1.39	21.17	9.72	5.62
4000	8.75	37.78	3.34	19.01	7.54	1.44	21.13	9.67	6.03
4200	7.90	38.24	2.88	18.58	7.91	1.49	21.22	9.74	6.44
4400	7.10	37.22	2.61	18.18	7.18	1.52	21.34	9.95	6.88
4600	6.33	36.97	2.43	17.37	7.18	1.54	21.41	10.21	7.34
4800	5.65	37.69	2.22	16.27	7.80	1.56	21.50	10.43	7.69
5000	4.97	34.40	2.04	15.40	5.34	1.58	21.52	10.94	8.13
5200	4.10	35.93	2.09	13.94	7.03	1.56	20.96	10.42	8.67
5400	2.70	39.48	2.11	12.36	12.33	1.53	19.61	9.39	9.18

Typical Performance Data

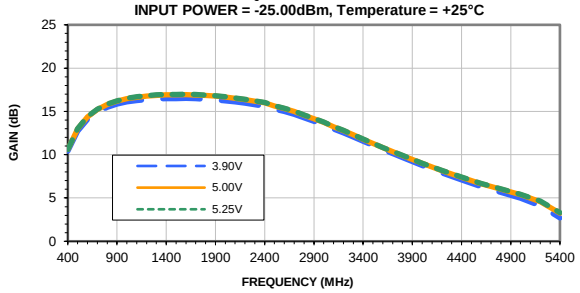
Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5.25V, Id = 34.27mA @ Temperature = +25°C

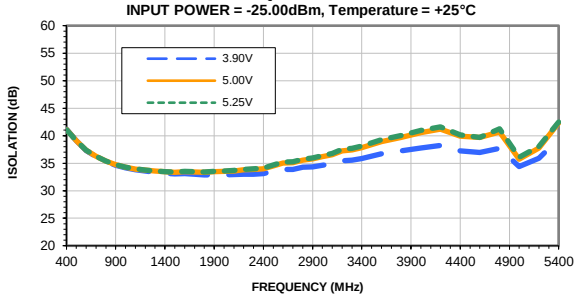
FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
400	10.61	41.09	3.91	11.91	9.14	1.32	21.89	9.75	4.90
500	12.99	39.10	6.11	15.32	7.36	1.21	23.24	11.77	4.92
600	14.40	37.34	9.08	18.44	6.06	1.11	24.18	11.89	4.29
700	15.27	36.24	12.79	21.42	5.28	1.04	24.17	11.96	4.06
800	15.85	35.39	17.71	24.56	4.69	1.00	23.73	11.70	3.94
900	16.23	34.74	24.56	27.79	4.25	0.99	23.64	11.83	3.89
1000	16.50	34.29	28.75	31.14	3.93	0.98	22.79	11.21	3.87
1100	16.68	33.96	23.48	33.85	3.71	0.99	22.88	11.39	3.89
1200	16.81	33.76	20.30	33.91	3.55	0.99	22.53	11.04	3.86
1300	16.91	33.61	18.57	31.93	3.44	0.99	22.31	10.88	3.87
1400	16.95	33.48	17.58	29.45	3.36	1.00	22.28	10.90	3.87
1500	16.96	33.39	17.06	27.19	3.31	1.00	21.89	10.48	3.88
1600	16.99	33.50	16.85	25.26	3.33	1.00	21.91	10.49	3.89
1700	16.94	33.45	17.35	24.24	3.34	0.99	21.60	10.22	3.86
1800	16.89	33.41	17.87	23.02	3.34	0.99	21.69	10.24	3.87
1900	16.81	33.52	18.71	22.04	3.42	0.99	21.52	10.08	3.85
2000	16.70	33.58	19.64	21.27	3.49	0.99	21.14	9.74	3.88
2100	16.57	33.69	20.43	20.61	3.59	0.98	21.28	9.82	3.90
2200	16.40	33.89	20.43	20.06	3.73	0.98	20.87	9.56	3.90
2300	16.21	33.98	19.51	19.49	3.84	0.98	21.05	9.67	3.91
2400	16.03	34.10	17.29	19.03	3.94	0.99	21.14	9.82	3.99
2500	15.67	34.67	15.47	19.24	4.34	1.00	21.06	9.70	3.94
2600	15.37	35.20	13.80	19.46	4.70	1.02	21.10	9.68	4.14
2700	15.04	35.27	12.20	19.37	4.82	1.04	21.22	9.78	4.15
2800	14.59	35.75	10.60	20.35	5.22	1.07	21.30	9.83	4.30
2900	14.17	35.97	9.41	20.72	5.45	1.10	21.14	9.76	4.37
3000	13.77	36.40	8.39	21.08	5.79	1.13	21.06	9.70	4.39
3100	13.25	36.79	7.41	22.48	6.16	1.17	21.11	9.65	4.51
3200	12.81	37.51	6.66	22.87	6.74	1.21	21.09	9.70	4.55
3300	12.30	37.70	6.00	23.40	6.97	1.24	20.76	9.24	4.66
3400	11.80	38.12	5.38	24.93	7.36	1.28	21.26	9.75	4.83
3600	10.84	39.29	4.45	26.44	8.49	1.35	21.39	9.83	5.18
3800	9.92	40.02	3.78	26.67	9.29	1.42	21.76	10.14	5.51
4000	9.02	40.96	3.29	26.48	10.49	1.46	21.70	10.06	5.90
4200	8.18	41.58	2.85	25.95	11.22	1.51	21.78	10.16	6.36
4400	7.42	40.14	2.57	25.14	9.65	1.55	21.87	10.34	6.85
4600	6.67	39.69	2.38	23.37	9.40	1.57	22.00	10.59	7.23
4800	6.05	41.27	2.21	21.11	11.37	1.59	22.12	10.83	7.59
5000	5.43	36.07	1.99	19.35	6.13	1.62	22.45	11.41	7.99
5200	4.64	38.07	2.03	17.09	8.48	1.60	22.05	10.96	8.55
5400	3.31	42.48	2.01	14.99	16.17	1.58	21.04	10.11	9.11

Typical Performance Curves

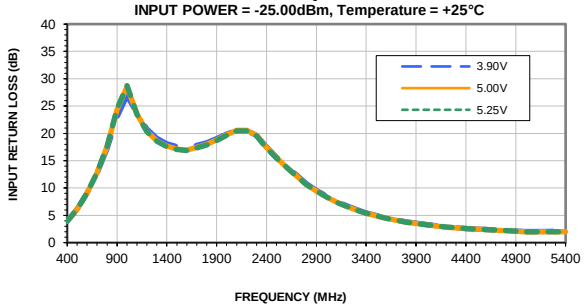
GAIN vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



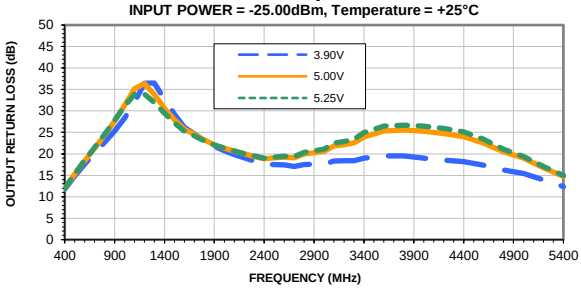
ISOLATION vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



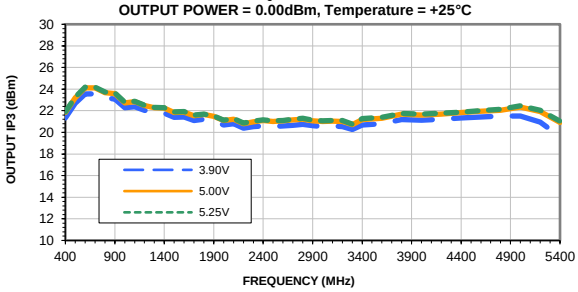
INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



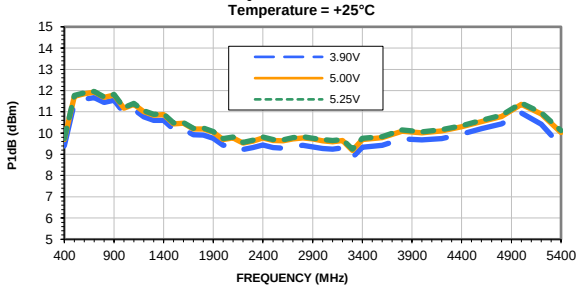
OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



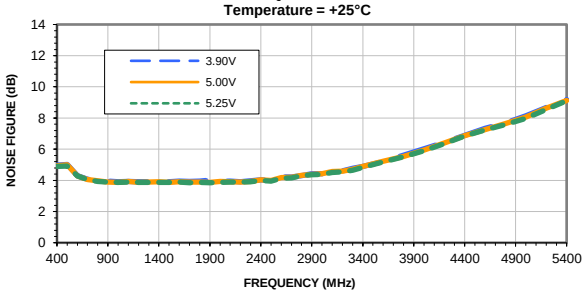
OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = 0.00dBm, Temperature = +25°C



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



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



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)	