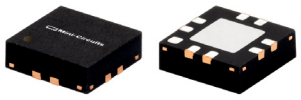
LOW NOISE, HIGH IP3

Monolithic Amplifier PMA-5456-3+

50Ω 0.05 to 6 GHz

THE BIG DEAL

- Ultra Low Noise Figure, 0.8 dB
- High IP3/Low Current, 60mA
- Wideband, up to 6 GHz
- Low Additive Phase Noise
- Suitable for low phase noise applications



Generic photo used for illustration purposes only

CASE STYLE: DQ849

+RoHS Compliant

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

APPLICATIONS

- Cellular
- ISM
- GSM
- WCDMA
- LTE
- WiMAX
- WLAN
- UNII and HIPERLAN

PRODUCT OVERVIEW

PMA-5456-3+ is a high dynamic range, low noise, high IP3, high output power, monolithic amplifier. Manufactured using E-PHEMT* technology enables it to work with a single positive supply voltage. Unconditionally stable over the operating frequency.

KEY FEATURES

Feature	Advantages
Ultra Low Noise, 0.8 dB	Outstanding Noise Figure, measured in a 50 Ohm environment without any external matching
High IP3, 34 dBm	Combining Low Noise and High IP3 makes this MMIC amplifier ideal for Low Noise Receiver Front End (RFE) because it gives the user advantages at both ends of the dynamic range: sensitivity & two-tone spur-free dynamic range
Low Current, 60 mA	At only 60mA, the PMA-5456-3+ is ideal for remote applications with limited available power or densely packed applications where thermal management is critical.
Broad Band	Operating over a broadband the PMA-5456-3+ covers the primary wireless communications bands: Cellular, PCS, LTE, WiMAX
Internally Matched	No external matching elements required to achieve the advertised noise and output power over the full band
MCLP Package	Low Inductance, repeatable transitions, excellent thermal pad
Max Input Power, +20 dBm	Ruggedized design operates up to input powers of +20 dBm without the need of an external limiter
High Reliability	Low, small signal operating current of 60mA nominal maintains junction temperatures typically below 125°C at 85°C ground lead temperature
Low additive phase noise, typically -161 dBc/Hz @10 KHz offset	Ideal for low phase noise synthesizer applications

*Enhancement mode Pseudomorphic High Electron Mobility Transistor.

REV. A
ECO-011027
PMA-5456-3+
TH/RS/CP/AM
211214

ELECTRICAL SPECIFICATIONS[1] AT 25°C, ZO=50Ω (REFER TO CHARACTERIZATION CIRCUIT, SEE FIG. 1)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.05		6.0	GHz
DC Voltage (V_d)			5.0		V
DC Current (I_d)[6]		47	60	80	mA
DC Current (I_{Rbias})			2.4		mA
Noise Figure	0.05 0.5 1.0 2.0 3.0 4.0 5.0 6.0		1.8 0.8 0.8 1.0 1.3 1.6 1.9 2.4	1.3	dB
Additive Phase Noise, 2.0 GHz, 10KHz offset			-160.5		dBc/Hz
Gain	0.05 0.5 1.0 2.0 3.0 4.0 5.0 6.0	12.7	26.0 23.2 19.4 14.4 11.1 9.2 7.3 5.8	15.8	dB
Input Return Loss	0.05-0.5 0.5-6		10.0 7.0		dB
Output Return Loss	0.05-0.1 0.1-6		15.0 20.0		dB
Output IP3	0.05 0.5 1.0 2.0 3.0 4.0 5.0 6.0		31.8 33.0 34.0 36.0 36.4 36.4 37.2 37.2		dBm
Output Power @ 1 dB compression [2]	0.05 0.5 1.0 2.0 3.0 4.0 5.0 6.0		22.0 21.7 21.7 21.6 21.5 21.7 22.0 22.1		dBm
DC Current Variation vs. Temperature [3]			-0.072		mA/°C
Thermal Resistance			128		°C/W

[4] Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.
[5]Measured on Mini-Circuits test board, TB-736+

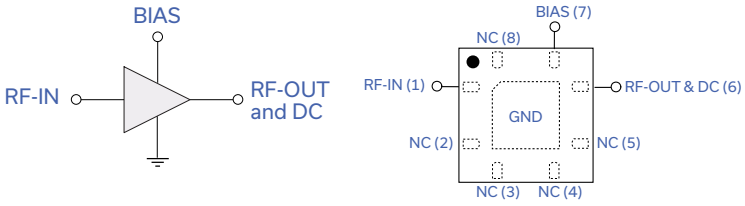
MAXIMUM RATINGS[4]

Parameter	Ratings
Operating Temperature [5]	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Channel Temperature	150°C
DC Voltage (Pad 6)	6V
Power Dissipation	500mW
DC Current (Pad 6)	100mA
Bias Current (Pad 7)	10mA
Input Power[7]	20dBm

(1) Measured on Mini-Circuits Characterization test board TB-502+.
See Characterization Test Circuit (Fig. 1)
(2) P1dB specified with external current limiting of 70mA;
(3) (Current at 85°C - Current at -45°C)/130
(4) Permanent damage may occur if any of these limits are exceeded.
These maximum ratings are not intended for continuous normal operation.
(5) Defined with reference to ground pad temperature.
(6) Specified DC current consumption is under small signal conditions. Current will increase with input RF Power. To maintain maximum current consumption, external DC current limiting circuits are required on Vd line.
(7) Maximum input power is specified based upon external Vd current limiting of 80 mA. Maximum input power will degrade without external current limiting.

Monolithic Amplifier PMA-5456-3+

SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Pad Number	Description (See Application Circuit, Fig. 3)
RF-IN	1	RF input pad
RF-OUT & DC	6	RF output pad (connected to RF-OUT via blocking external cap C2, and Supply voltage Vs via RF Choke L1)
BIAS	7	Bias pad (connected to Vs via Rbias)
GND	paddle in center of bottom	Connected to ground
NOT USED	2,3,4,5,8	No internal connection; recommended use: per PCB Layout PL-299

CHARACTERIZATION TEST CIRCUIT

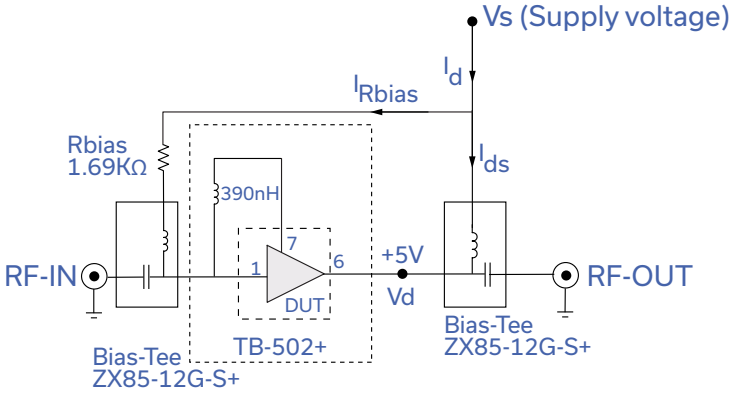


Fig 1. Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization Test Board TB-502+) Gain, Output power at 1dB compression (P1dB), Output IP3 (OIP3) and Noise Figure measured using Agilent's N5242A PNA-X Microwave network analyzer.

Conditions:
1. Gain: Pin=-25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 5 dBm/tone at output.
3. Vs adjusted for 5V at device (Vd), compensating loss of bias tee.

RECOMMENDED APPLICATION CIRCUIT

(refer to evaluation board for PCB Layout and component values)

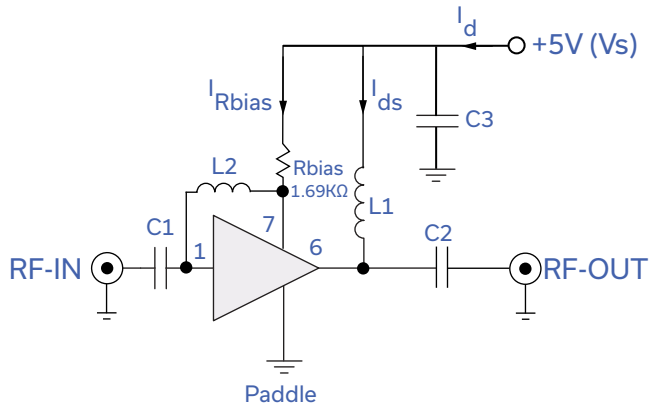


Fig 3. Recommended Application Circuit
Note: Resistance of L1, 0.1-0.2Ω typically

Typical Current (Id) as a function of Rbias
(Vd = 5V)

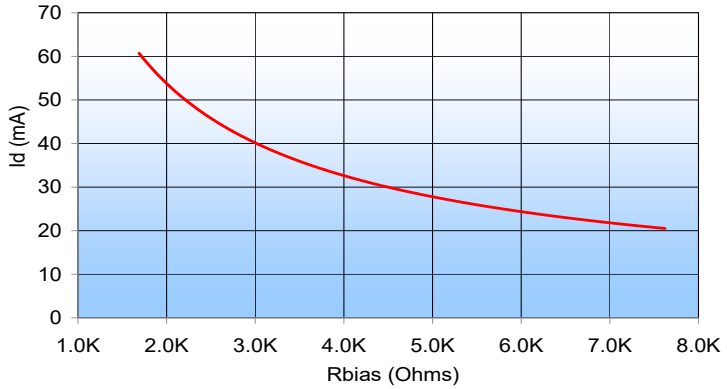
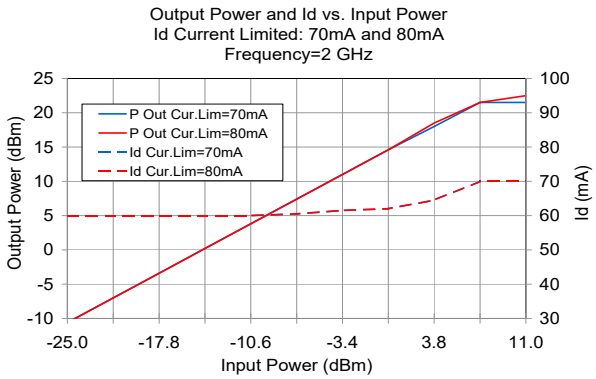


Fig 4. Id varies as a function of Rbias. The Id current range is defined based upon the specific Rbias value noted in the Application Circuit (Fig 3). Rbias may be adjusted to optimize Id for a customers' application. RF performance will vary accordingly.



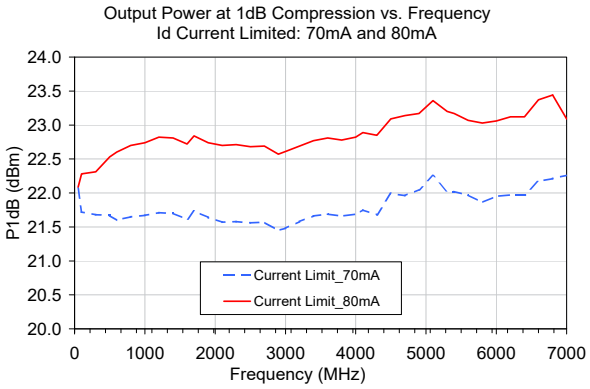
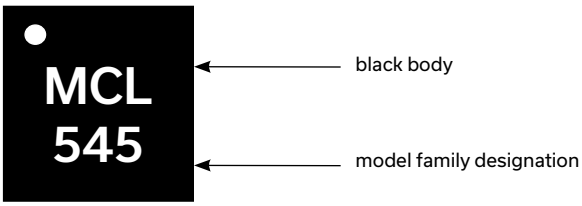


Fig 2. Output Power and Id vs. Input Power and Frequency.
Performance measured on Mini-Circuits Characterization test board TB-502+. See Characterization Test Circuit (Fig. 1)
Measurements performed with current (Id) limited as noted.

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS CLICK HERE

Performance Data	Data Table graphs, s-parameter data set (.zip file)
Case Style	DQ849 Plastic package, exposed paddle, lead finish: tin-silver over nickel
Tape & Reel **Standard quantities available on reel**	F104 7" reels with 20, 50, 100, 200, 500, 1K, or 2K devices.
Suggested Layout for PCB Design	PL-299
Evaluation Board	TB-501-6+ (50-5000 MHz)
Environmental Ratings	ENV08T1

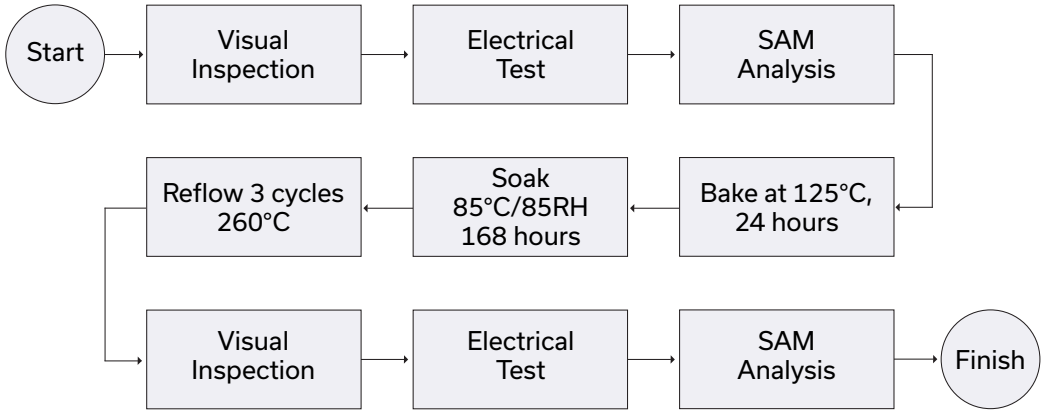
ESD RATING

Human Body Model (HBM): Class 1A (250V to <500V) in accordance with ANSI/ESD STM 5.1 - 2001
Machine Model (MM): Class M1 (<100V) in accordance with ANSI/ESD STM5.2-1999; passes 40V

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

MSL TEST FLOW CHART



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.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

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 = 5V, Rbias=1.69K ohms, Id=56 mA @ Temperature = 25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output (1)		Noise Figure
								Current Limit 70mA	Current Limit 80mA	
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)		(dB)
50	25.79	31.07	11.20	11.94	1.08	0.70	32.90	22.07	22.09	1.30
100	25.66	30.48	11.18	17.34	1.07	0.74	32.54	21.72	22.28	1.15
300	24.55	29.58	9.72	25.32	1.06	0.81	32.71	21.68	22.31	0.62
500	23.00	28.53	8.40	27.70	1.06	0.88	32.74	21.67	22.53	0.59
600	22.20	28.00	7.95	28.36	1.06	0.91	33.18	21.60	22.60	0.67
800	20.66	26.94	7.31	28.91	1.07	0.96	33.70	21.65	22.70	0.69
1000	19.27	25.94	6.93	28.76	1.09	0.99	33.72	21.67	22.74	0.75
1200	18.02	24.95	6.61	28.02	1.10	1.01	34.71	21.71	22.82	0.86
1400	16.92	24.00	6.44	27.54	1.10	1.02	34.52	21.70	22.81	0.86
1600	15.91	23.22	6.26	26.60	1.11	1.04	34.69	21.61	22.72	0.94
1700	15.44	22.77	6.18	26.74	1.11	1.04	34.68	21.73	22.84	0.95
1900	14.62	22.01	6.18	26.51	1.11	1.04	35.20	21.64	22.74	0.88
2100	13.85	21.27	6.09	26.07	1.11	1.05	35.38	21.57	22.70	0.92
2300	13.17	20.58	6.10	26.44	1.11	1.05	35.25	21.58	22.71	1.03
2500	12.47	20.07	6.37	28.04	1.14	1.04	35.51	21.56	22.68	1.09
2700	11.75	19.49	6.00	25.12	1.13	1.07	35.48	21.57	22.69	1.30
2900	11.37	18.80	6.21	26.76	1.12	1.04	35.79	21.45	22.57	1.28
3000	11.11	18.54	6.32	27.32	1.13	1.04	35.64	21.48	22.61	1.17
3200	10.63	18.01	6.39	27.59	1.13	1.03	35.94	21.58	22.69	1.20
3400	10.19	17.52	6.62	28.95	1.13	1.02	35.91	21.66	22.77	1.17
3600	9.78	17.01	6.82	28.89	1.13	1.01	36.02	21.69	22.81	1.24
3800	9.39	16.55	6.94	28.83	1.13	1.00	35.99	21.66	22.78	1.32
4000	9.03	16.14	7.21	28.16	1.14	0.99	35.85	21.69	22.82	1.29
4100	8.81	15.95	7.25	27.11	1.15	0.99	36.21	21.75	22.89	1.61
4300	8.37	15.60	7.39	25.73	1.16	0.98	35.45	21.68	22.85	1.47
4500	8.04	15.17	7.60	24.85	1.16	0.97	35.40	21.99	23.09	1.36
4700	7.57	14.91	7.88	23.39	1.20	0.96	35.87	21.96	23.14	1.74
4900	7.35	14.52	7.34	23.33	1.16	0.97	36.49	22.05	23.17	1.72
5100	7.14	14.12	7.16	22.69	1.14	0.97	36.44	22.25	23.36	1.72
5300	6.86	13.81	6.97	21.88	1.13	0.97	36.53	22.02	23.20	1.82
5400	6.72	13.66	6.89	21.25	1.13	0.97	36.31	22.02	23.17	1.80
5600	6.43	13.38	6.74	20.05	1.13	0.97	36.58	21.97	23.07	1.97
5800	6.14	13.14	6.56	18.99	1.12	0.97	36.60	21.86	23.03	1.96
6000	5.86	12.88	6.30	18.17	1.12	0.98	36.52	21.95	23.06	2.13
6200	5.57	12.68	6.03	17.23	1.11	0.98	36.44	21.97	23.12	1.98
6400	5.29	12.49	5.82	16.62	1.11	0.99	36.55	21.97	23.12	2.20
6600	4.98	12.33	5.63	15.74	1.11	0.99	36.59	22.17	23.37	2.34
6800	4.63	12.23	5.46	15.11	1.12	1.00	36.58	22.21	23.44	2.67
7000	4.14	12.24	5.82	14.29	1.19	0.99	36.54	22.26	23.09	2.81

(1) Current is externally limited during P1dB measurements. Unit is capable of higher output power if current is not limited.

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 = 5V, Rbias=1.69K ohms, Id=59 mA @ Temperature = -45degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dB)
50	26.05	30.43	12.87	11.92	1.01	0.65	31.75	0.96
100	25.73	30.19	13.25	17.08	1.06	0.70	32.40	0.99
300	24.62	29.52	11.07	23.30	1.08	0.76	33.13	0.61
500	23.15	28.70	9.21	24.48	1.09	0.84	33.46	0.46
600	22.39	28.15	8.60	24.54	1.10	0.86	33.85	0.50
800	20.90	27.04	7.79	24.67	1.10	0.91	34.21	0.51
1000	19.54	25.99	7.27	24.17	1.11	0.94	34.14	0.44
1200	18.31	24.99	6.90	23.81	1.11	0.96	35.10	0.67
1400	17.23	24.00	6.65	23.40	1.11	0.98	34.95	0.65
1600	16.23	23.15	6.45	23.01	1.11	0.99	34.99	0.74
1700	15.78	22.68	6.35	23.24	1.10	1.00	35.05	0.77
1900	14.96	21.88	6.28	22.76	1.10	1.00	35.64	0.64
2100	14.20	21.15	6.18	23.08	1.10	1.00	35.64	0.69
2300	13.53	20.45	6.19	22.87	1.09	1.00	35.79	0.62
2500	12.82	19.90	6.46	24.15	1.12	1.00	35.72	0.77
2700	12.00	19.44	6.06	22.91	1.12	1.04	35.89	1.14
2900	11.75	18.57	6.25	24.12	1.09	1.00	35.92	0.92
3000	11.50	18.31	6.34	24.11	1.09	0.99	35.72	0.81
3200	11.02	17.77	6.49	25.35	1.09	0.99	36.09	0.86
3400	10.59	17.24	6.66	25.62	1.10	0.98	36.09	0.81
3600	10.18	16.77	6.89	27.11	1.10	0.97	36.22	0.90
3800	9.80	16.31	6.97	26.83	1.10	0.96	36.28	1.05
4000	9.45	15.83	7.30	27.96	1.10	0.94	36.19	0.88
4100	9.22	15.65	7.30	26.97	1.10	0.94	36.27	0.93
4300	8.80	15.32	7.39	24.77	1.11	0.94	35.86	1.04
4500	8.46	14.90	7.58	24.50	1.12	0.93	35.52	0.86
4700	8.02	14.62	7.79	22.10	1.14	0.92	36.09	1.19
4900	7.66	14.31	7.42	21.68	1.14	0.93	36.27	1.39
5100	7.53	13.88	7.13	20.95	1.10	0.92	36.30	1.25
5300	7.25	13.56	6.88	20.61	1.09	0.93	36.62	1.09
5400	7.09	13.42	6.75	19.33	1.09	0.92	36.51	1.27
5600	6.82	13.15	6.69	19.01	1.09	0.92	36.53	0.88
5800	6.52	12.89	6.46	17.66	1.09	0.92	36.34	1.46
6000	6.26	12.67	6.30	17.48	1.08	0.93	36.52	1.51
6200	5.96	12.44	5.95	16.26	1.07	0.94	36.19	1.64
6400	5.69	12.24	5.76	15.97	1.07	0.94	36.57	1.86
6600	5.38	12.09	5.48	14.79	1.07	0.95	36.78	1.62
6800	5.08	11.93	5.29	14.57	1.07	0.96	36.64	1.92
7000	4.64	11.92	5.40	13.46	1.11	0.95	36.36	1.82

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 = 5V, Rbias=1.69K ohms, Id=52 mA @ Temperature = +85degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dB)
50	25.42	31.13	10.09	11.09	1.10	0.70	32.04	1.59
100	25.45	30.40	9.63	15.38	1.06	0.74	31.57	1.38
300	24.35	29.39	8.66	20.17	1.03	0.83	31.95	0.75
500	22.77	28.28	7.72	22.18	1.02	0.91	32.05	0.74
600	21.96	27.68	7.41	23.29	1.02	0.94	32.76	0.83
800	20.39	26.71	6.92	24.88	1.04	0.99	33.26	0.82
1000	18.99	25.75	6.64	26.60	1.06	1.02	33.24	0.94
1200	17.74	24.83	6.39	27.73	1.08	1.04	34.38	1.01
1400	16.63	23.95	6.26	28.43	1.09	1.06	34.11	1.10
1600	15.62	23.18	6.11	28.47	1.11	1.07	34.42	1.25
1700	15.15	22.80	6.03	28.61	1.11	1.08	34.35	1.11
1900	14.32	22.02	6.03	28.42	1.11	1.08	34.95	1.10
2100	13.55	21.34	5.95	28.26	1.12	1.08	35.04	1.16
2300	12.86	20.67	5.98	28.50	1.12	1.08	35.16	1.31
2500	12.16	20.20	6.20	30.13	1.16	1.08	35.14	1.32
2700	11.44	19.64	5.94	26.12	1.15	1.10	35.26	1.62
2900	11.05	18.98	6.13	27.98	1.14	1.08	35.56	1.48
3000	10.79	18.73	6.23	28.48	1.15	1.07	35.47	1.43
3200	10.30	18.20	6.30	28.58	1.15	1.07	35.73	1.52
3400	9.85	17.71	6.55	29.69	1.16	1.06	35.57	1.50
3600	9.43	17.24	6.73	28.66	1.17	1.05	35.80	1.65
3800	9.05	16.78	6.88	27.88	1.17	1.04	35.67	1.69
4000	8.68	16.36	7.11	26.88	1.18	1.03	35.63	1.80
4100	8.45	16.19	7.15	25.98	1.18	1.02	35.61	1.92
4300	8.02	15.85	7.29	24.98	1.20	1.02	35.33	1.99
4500	7.68	15.44	7.48	24.66	1.21	1.01	35.17	1.95
4700	7.25	15.15	7.73	23.79	1.24	1.00	35.39	2.29
4900	6.99	14.75	7.33	23.92	1.21	1.00	36.13	2.21
5100	6.79	14.38	7.08	23.32	1.18	1.01	36.42	1.97
5300	6.52	14.04	6.89	22.42	1.17	1.01	36.42	2.23
5400	6.38	13.90	6.86	22.12	1.17	1.01	36.30	2.28
5600	6.10	13.60	6.72	20.79	1.16	1.00	36.43	2.18
5800	5.80	13.35	6.48	19.71	1.15	1.01	36.35	2.52
6000	5.52	13.10	6.28	18.62	1.15	1.01	36.66	2.65
6200	5.24	12.90	6.03	17.90	1.14	1.02	36.50	2.60
6400	4.96	12.70	5.83	17.34	1.14	1.03	36.36	2.82
6600	4.65	12.54	5.63	16.45	1.14	1.03	36.38	3.05
6800	4.31	12.44	5.48	15.88	1.15	1.04	36.58	3.34
7000	3.84	12.42	5.73	14.86	1.22	1.03	36.44	3.33

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 = 5V, Id=40 mA @ Temperature = +25degC (1)

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output (2)	
								Current Limit 70mA	Current Limit 80mA
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	
50	24.99	31.31	10.54	10.82	1.13	0.74	29.18	22.07	22.09
100	25.01	30.06	10.34	15.27	1.07	0.74	29.39	21.72	22.28
300	24.06	28.92	9.03	20.58	1.03	0.80	29.61	21.68	22.31
500	22.63	27.99	7.91	23.24	1.02	0.89	30.08	21.67	22.53
600	21.87	27.54	7.48	24.59	1.02	0.93	30.41	21.60	22.60
800	20.39	26.55	6.88	27.28	1.03	0.98	30.98	21.65	22.70
1000	19.02	25.69	6.49	30.05	1.05	1.02	31.03	21.67	22.74
1200	17.80	24.73	6.22	32.01	1.06	1.04	31.98	21.71	22.82
1400	16.70	23.92	6.04	33.06	1.08	1.06	31.83	21.70	22.81
1600	15.72	23.10	5.93	32.60	1.08	1.07	32.18	21.61	22.72
1700	15.27	22.74	5.87	32.62	1.09	1.08	32.74	21.73	22.84
1900	14.44	22.03	5.83	31.13	1.10	1.08	32.34	21.64	22.74
2100	13.69	21.28	5.83	31.13	1.10	1.08	32.06	21.57	22.70
2300	13.03	20.65	5.85	31.37	1.10	1.08	32.47	21.58	22.71
2500	12.41	19.96	5.96	31.75	1.10	1.07	32.85	21.56	22.68
2700	11.54	19.68	5.80	26.83	1.13	1.11	32.90	21.57	22.69
2900	11.30	18.84	6.00	29.47	1.11	1.07	32.94	21.45	22.57
3000	11.07	18.55	6.08	29.57	1.11	1.06	33.10	21.48	22.61
3200	10.63	17.99	6.21	29.54	1.10	1.05	32.94	21.58	22.69
3400	10.21	17.46	6.35	29.31	1.10	1.04	33.48	21.66	22.77
3600	9.81	16.96	6.49	28.76	1.10	1.03	33.55	21.69	22.81
3800	9.42	16.51	6.63	27.87	1.10	1.02	33.38	21.66	22.78
4000	9.04	16.09	6.71	26.55	1.11	1.01	32.64	21.69	22.82
4100	8.85	15.89	6.74	25.68	1.11	1.01	32.99	21.75	22.89
4300	8.44	15.56	6.69	23.86	1.11	1.01	32.27	21.68	22.85
4500	8.11	15.17	6.65	22.82	1.11	1.00	33.15	21.99	23.09
4700	7.76	14.84	6.74	21.80	1.12	0.99	32.76	21.96	23.14
4900	7.22	14.67	7.02	20.78	1.17	0.99	33.32	22.05	23.17
5100	7.12	14.14	6.24	20.44	1.10	1.00	33.50	22.25	23.36
5300	6.85	13.84	6.03	19.61	1.09	1.01	33.67	22.02	23.20
5400	6.71	13.68	5.93	19.15	1.08	1.01	33.03	22.02	23.17
5600	6.42	13.44	5.76	18.32	1.08	1.01	33.46	21.97	23.07
5800	6.12	13.16	5.58	17.54	1.07	1.01	33.94	21.86	23.03
6000	5.82	12.95	5.47	16.88	1.07	1.02	33.76	21.95	23.06
6200	5.55	12.72	5.24	16.31	1.06	1.02	33.25	21.97	23.12
6400	5.28	12.50	5.06	15.75	1.06	1.03	33.34	21.97	23.12
6600	5.00	12.31	4.91	15.26	1.05	1.03	33.82	22.17	23.37
6800	4.71	12.14	4.78	14.79	1.06	1.04	33.16	22.21	23.44
7000	4.36	12.05	4.75	14.20	1.08	1.04	33.00	22.26	23.09

FREQ	Noise Figure
(MHz)	(dB)
50	1.39
100	0.85
400	0.65
600	0.71
800	0.74
1100	0.81
1300	0.85
1600	0.93
1800	1.06
2000	0.90
2300	1.05
2500	1.05
2700	1.53
3000	1.15
3200	1.22
3400	1.20
3700	1.26
3900	1.26
4100	1.37
4400	1.64
4600	1.67
4900	1.92
5100	1.93
5300	1.93
5600	1.73
5800	2.05
6000	2.23
6400	2.38
6600	2.60
6800	2.37
7000	3.20

(1) External Rbias resistor is adjusted to obtain desired current

(2) Current is externally limited during P1dB measurements. Unit is capable of higher output power if current is not limited.

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 = 5V, Id=60 mA @ Temperature = +25degC (1)

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output (2)	
								Current Limit 70mA	Current Limit 80mA
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	
50	25.84	30.54	11.10	11.86	1.04	0.66	33.16	22.07	22.09
100	25.74	30.57	11.40	17.34	1.07	0.73	32.90	21.72	22.28
300	24.66	29.56	9.71	25.72	1.05	0.80	32.83	21.68	22.31
500	23.13	28.70	8.30	29.70	1.06	0.88	33.22	21.67	22.53
600	22.33	28.10	7.80	31.05	1.06	0.91	33.60	21.60	22.60
800	20.79	27.07	7.12	32.45	1.07	0.96	34.10	21.65	22.70
1000	19.39	26.02	6.70	31.66	1.08	0.99	33.86	21.67	22.74
1200	18.14	25.03	6.42	30.32	1.09	1.02	34.83	21.71	22.82
1400	17.03	24.11	6.23	29.09	1.09	1.03	34.75	21.70	22.81
1600	16.04	23.29	6.11	28.10	1.10	1.04	35.09	21.61	22.72
1700	15.58	22.84	6.05	27.75	1.10	1.04	35.14	21.73	22.84
1900	14.74	22.06	6.01	27.20	1.10	1.05	35.44	21.64	22.74
2100	13.99	21.30	6.01	27.13	1.10	1.05	35.14	21.57	22.70
2300	13.32	20.59	6.05	27.45	1.10	1.04	35.38	21.58	22.71
2500	12.70	19.93	6.16	28.05	1.10	1.04	35.59	21.56	22.68
2700	11.82	19.64	5.99	26.09	1.13	1.07	35.85	21.57	22.69
2900	11.58	18.73	6.19	27.06	1.10	1.03	35.86	21.45	22.57
3000	11.34	18.43	6.27	27.44	1.10	1.02	35.85	21.48	22.61
3200	10.90	17.86	6.41	27.88	1.10	1.01	35.93	21.58	22.69
3400	10.47	17.33	6.56	28.12	1.10	1.00	36.02	21.66	22.77
3600	10.07	16.83	6.70	27.99	1.09	0.99	36.15	21.69	22.81
3800	9.67	16.36	6.84	27.64	1.10	0.98	36.15	21.66	22.78
4000	9.29	15.94	6.91	26.47	1.10	0.98	35.83	21.69	22.82
4100	9.09	15.77	6.94	25.66	1.10	0.98	35.81	21.75	22.89
4300	8.69	15.40	6.90	23.82	1.10	0.97	35.68	21.68	22.85
4500	8.36	15.02	6.85	22.56	1.10	0.97	35.99	21.99	23.09
4700	8.00	14.70	6.93	21.36	1.11	0.96	35.70	21.96	23.14
4900	7.46	14.53	7.20	20.16	1.16	0.96	36.15	22.05	23.17
5100	7.36	14.01	6.42	19.91	1.09	0.97	36.42	22.25	23.36
5300	7.08	13.70	6.18	19.07	1.08	0.97	36.35	22.02	23.20
5400	6.94	13.55	6.10	18.64	1.07	0.97	36.18	22.02	23.17
5600	6.65	13.29	5.92	17.82	1.07	0.97	36.35	21.97	23.07
5800	6.35	13.03	5.73	17.14	1.06	0.98	36.09	21.86	23.03
6000	6.05	12.82	5.61	16.45	1.06	0.98	36.42	21.95	23.06
6200	5.78	12.59	5.38	15.88	1.06	0.98	36.15	21.97	23.12
6400	5.51	12.38	5.20	15.35	1.05	0.99	35.90	21.97	23.12
6600	5.22	12.18	5.05	14.85	1.05	0.99	36.20	22.17	23.37
6800	4.94	12.02	4.92	14.38	1.05	1.00	35.58	22.21	23.44
7000	4.58	11.94	4.88	13.78	1.07	1.00	35.69	22.26	23.09

FREQ	Noise Figure
(MHz)	(dB)
50	1.48
100	0.89
400	0.66
600	0.69
800	0.72
1100	0.83
1300	0.86
1600	0.93
1800	0.99
2000	0.90
2300	0.99
2500	1.08
2700	1.47
3000	1.15
3200	1.25
3400	1.22
3700	1.29
3900	1.36
4100	1.44
4400	1.60
4600	1.67
4900	1.84
5100	1.81
5300	1.84
5600	2.15
5800	2.10
6000	2.17
6400	2.35
6600	2.48
6800	2.67
7000	2.83

(1) External Rbias resistor is adjusted to obtain desired current

(2) Current is externally limited during P1dB measurements. Unit is capable of higher output power if current is not limited.

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 = 5V, Id=74 mA @ Temperature = +25degC (1)

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output (2)	
								Current Limit 70mA	Current Limit 80mA
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	
50	26.19	31.66	11.46	12.40	1.09	0.73	35.86	22.07	22.09
100	26.03	30.80	11.88	17.93	1.07	0.73	34.47	21.72	22.28
300	24.90	29.91	9.97	27.33	1.07	0.80	33.88	21.68	22.31
500	23.33	28.95	8.45	31.19	1.07	0.88	34.10	21.67	22.53
600	22.52	28.43	7.91	31.85	1.08	0.91	34.56	21.60	22.60
800	20.95	27.22	7.22	31.35	1.08	0.95	35.04	21.65	22.70
1000	19.54	26.15	6.79	29.89	1.09	0.98	34.87	21.67	22.74
1200	18.28	25.15	6.51	28.47	1.09	1.00	35.60	21.71	22.82
1400	17.16	24.20	6.32	27.56	1.10	1.02	35.78	21.70	22.81
1600	16.16	23.29	6.20	26.73	1.10	1.03	35.84	21.61	22.72
1700	15.70	22.87	6.13	26.46	1.10	1.03	35.89	21.73	22.84
1900	14.86	22.07	6.09	26.06	1.10	1.03	36.34	21.64	22.74
2100	14.11	21.30	6.09	26.03	1.10	1.03	36.21	21.57	22.70
2300	13.44	20.60	6.12	26.46	1.10	1.03	36.43	21.58	22.71
2500	12.81	19.91	6.24	27.01	1.10	1.02	36.60	21.56	22.68
2700	11.93	19.60	6.07	25.77	1.13	1.06	37.05	21.57	22.69
2900	11.69	18.73	6.27	26.31	1.10	1.02	36.85	21.45	22.57
3000	11.46	18.42	6.36	26.76	1.10	1.01	36.87	21.48	22.61
3200	11.01	17.84	6.50	27.29	1.09	1.00	37.14	21.58	22.69
3400	10.58	17.29	6.65	27.65	1.09	0.99	37.02	21.66	22.77
3600	10.17	16.81	6.79	27.76	1.09	0.98	36.95	21.69	22.81
3800	9.78	16.33	6.93	27.47	1.09	0.97	37.14	21.66	22.78
4000	9.39	15.91	7.00	26.34	1.09	0.96	36.97	21.69	22.82
4100	9.19	15.72	7.03	25.57	1.10	0.96	37.07	21.75	22.89
4300	8.79	15.38	6.99	23.82	1.10	0.96	36.97	21.68	22.85
4500	8.46	14.99	6.95	22.46	1.10	0.95	36.99	21.99	23.09
4700	8.10	14.67	7.02	21.28	1.11	0.95	36.84	21.96	23.14
4900	7.56	14.47	7.28	20.04	1.15	0.94	37.17	22.05	23.17
5100	7.45	13.98	6.49	19.79	1.09	0.95	37.64	22.25	23.36
5300	7.18	13.65	6.26	18.97	1.07	0.95	37.46	22.02	23.20
5400	7.03	13.53	6.18	18.52	1.07	0.96	37.63	22.02	23.17
5600	6.74	13.24	5.99	17.73	1.07	0.96	37.45	21.97	23.07
5800	6.45	13.00	5.80	17.02	1.06	0.96	36.97	21.86	23.03
6000	6.14	12.78	5.68	16.37	1.06	0.96	37.36	21.95	23.06
6200	5.87	12.55	5.46	15.80	1.05	0.97	37.47	21.97	23.12
6400	5.60	12.32	5.26	15.27	1.05	0.97	36.98	21.97	23.12
6600	5.32	12.14	5.11	14.77	1.05	0.98	37.10	22.17	23.37
6800	5.03	11.98	4.97	14.29	1.05	0.98	36.74	22.21	23.44
7000	4.67	11.90	4.94	13.70	1.07	0.98	39.23	22.26	23.09

FREQ	Noise Figure
(MHz)	(dB)
50	1.57
100	0.93
400	0.68
600	0.72
800	0.75
1100	0.82
1300	0.89
1600	0.95
1800	1.13
2000	0.92
2300	1.01
2500	1.11
2700	1.57
3000	1.17
3200	1.30
3400	1.41
3700	1.36
3900	1.41
4100	1.51
4400	1.77
4600	1.69
4900	2.19
5100	1.86
5300	2.07
5600	2.03
5800	2.07
6000	2.28
6400	2.57
6600	2.73
6800	2.69
7000	2.96

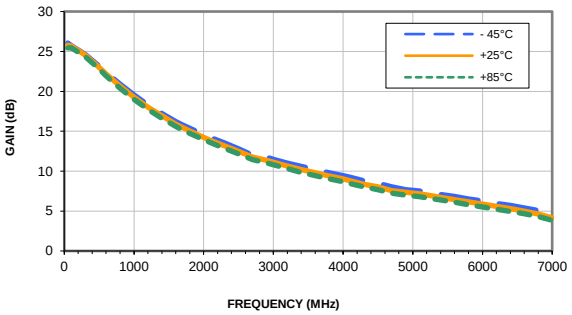
(1) External Rbias resistor is adjusted to obtain desired current

(2) Current is externally limited during P1dB measurements. Unit is capable of higher output power if current is not limited.

Typical Performance Curves

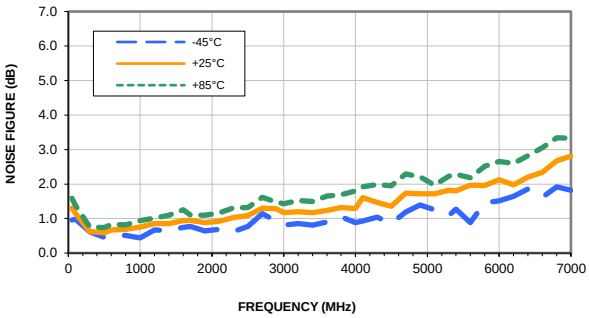
GAIN vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms



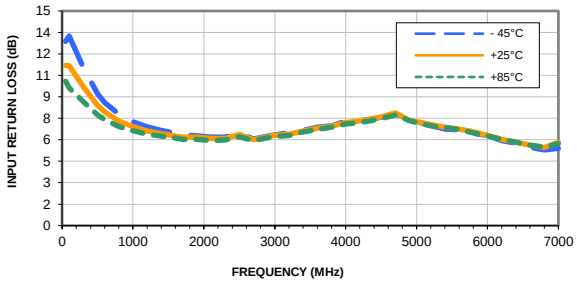
NOISE FIGURE vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms



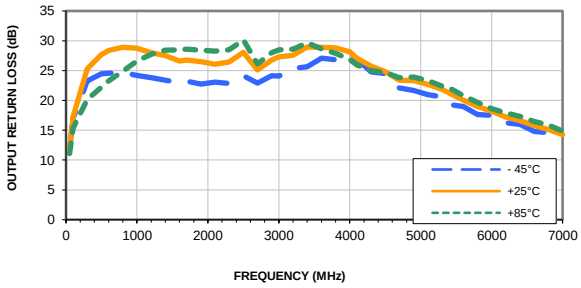
INPUT RETURN LOSS vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms



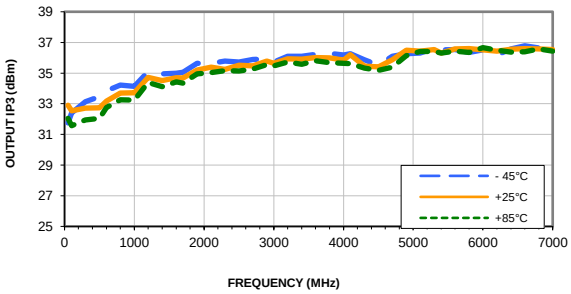
OUTPUT RETURN LOSS vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms



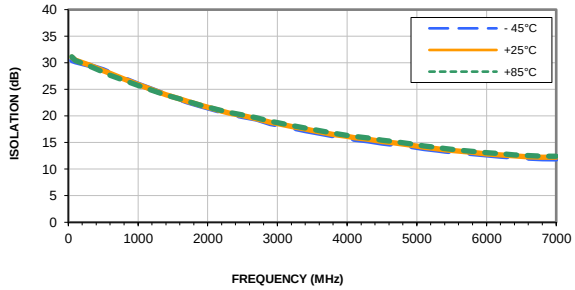
OUTPUT IP3 vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms



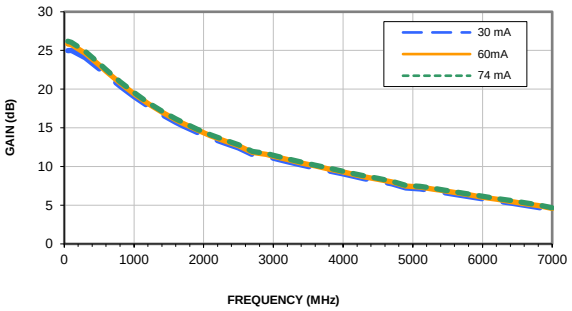
ISOLATION vs. FREQUENCY & TEMPERATURE

Vd = 5V, Rbias=1.69K ohms

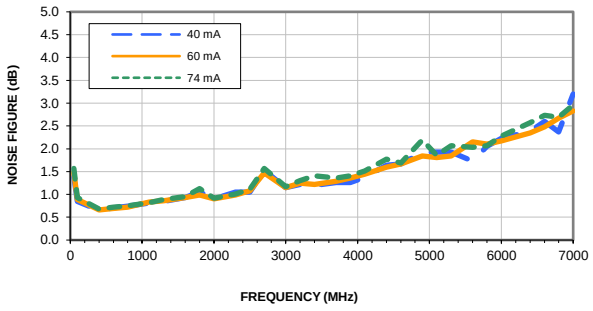


Typical Performance Curves

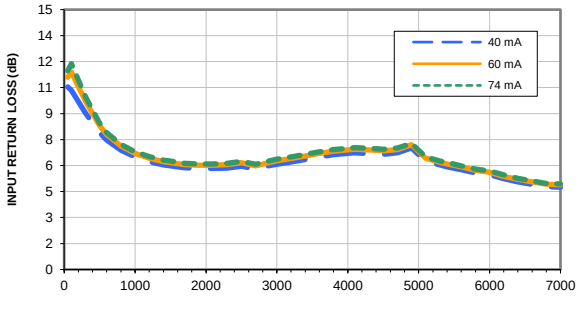
GAIN vs. FREQUENCY & BIAS CURRENT(1)



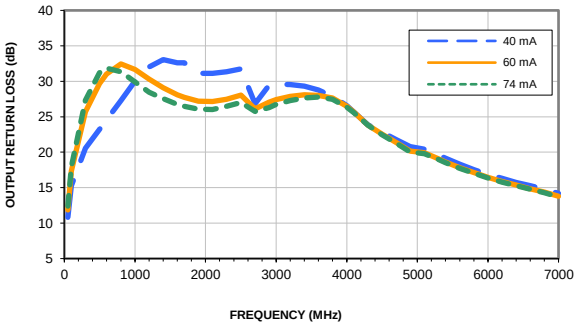
NOISE FIGURE vs. FREQUENCY & BIAS CURRENT(1)



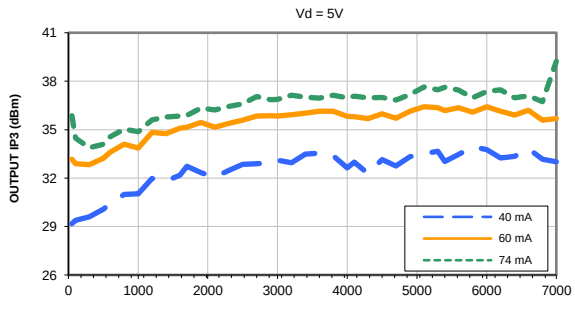
IINPUT RETURN LOSS vs. FREQUENCY & BIAS CURRENT(1)



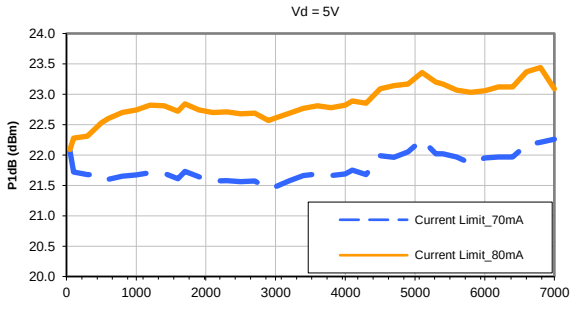
OUTPUT RETURN LOSS vs. FREQUENCY & BIAS CURRENT(1)



OUTPUT IP3 vs. FREQUENCY & BIAS CURRENT(1)



P1dB vs. FREQUENCY & CURRENT LIMIT (2)

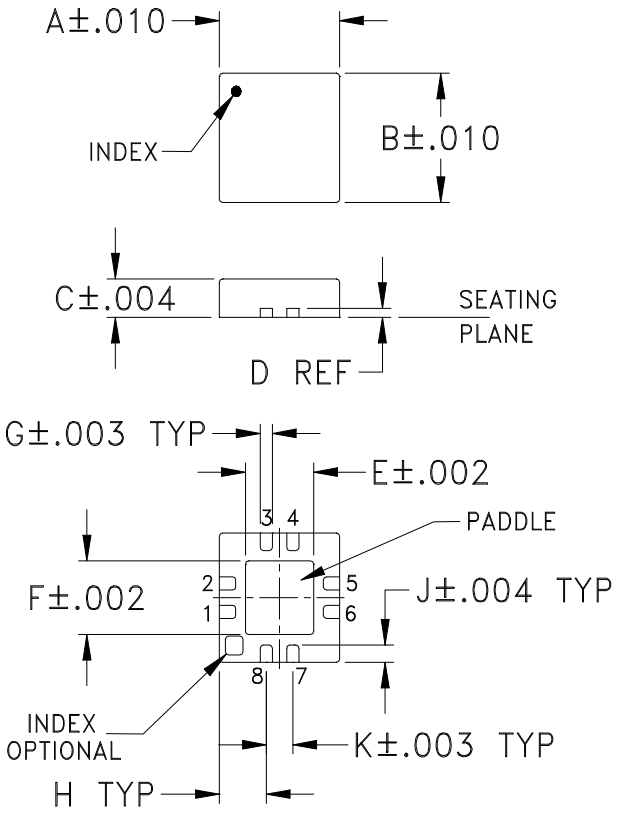


(1) External Rbias resistor is adjusted to obtain desired current
(2) Current is externally limited during P1dB measurements. Unit is capable of higher output power if current is not limited.

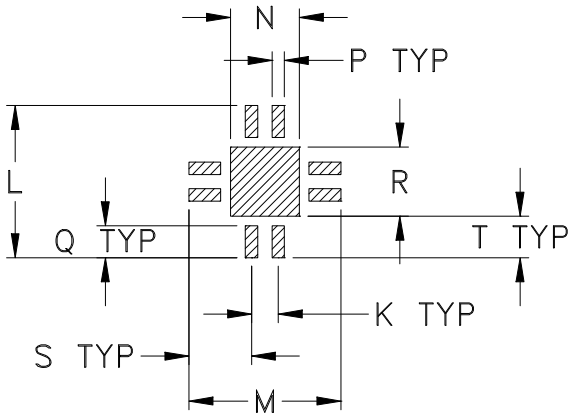
Case Style DQ

DQ849

Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N
DQ849	.118 (3.00)	.118 (3.00)	.035 (0.89)	.008 (0.20)	.067 (1.70)	.067 (1.70)	.012 (0.30)	.046 (1.17)	.016 (0.41)	.026 (0.66)	.148 (3.76)	.148 (3.76)	.067 (1.70)

CASE #	P	Q	R	S	T	WT. GRAM
DQ849	.012 (0.30)	.031 (0.79)	.067 (1.70)	.061 (1.55)	.041 (1.04)	.02

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .004

Notes:

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier or Matte-Tin plated. All models, (+) suffix. See Data sheet.
   For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
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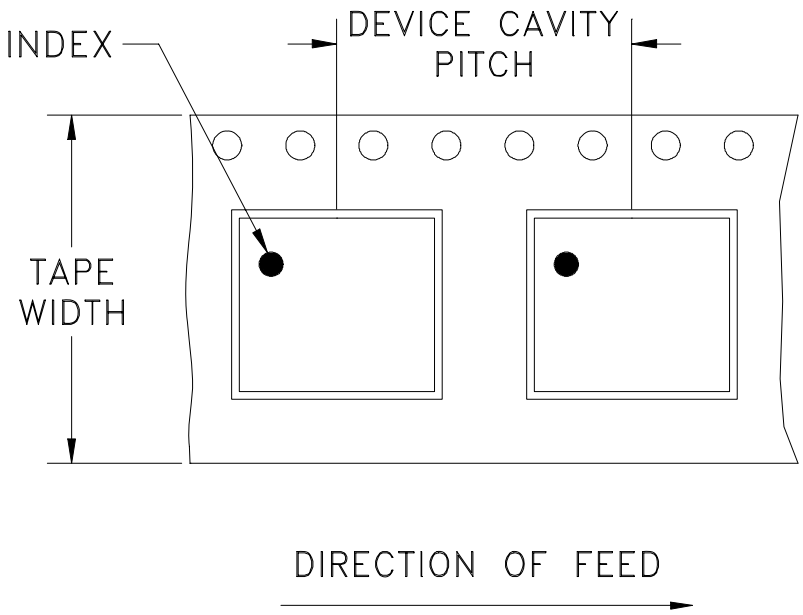
Tape & Reel Packaging TR-F104

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
8	4	7	Small quantity standards (see note)	20
				50
				100
				200
				500
				1000
		7	Standard	2000

Note: Please Consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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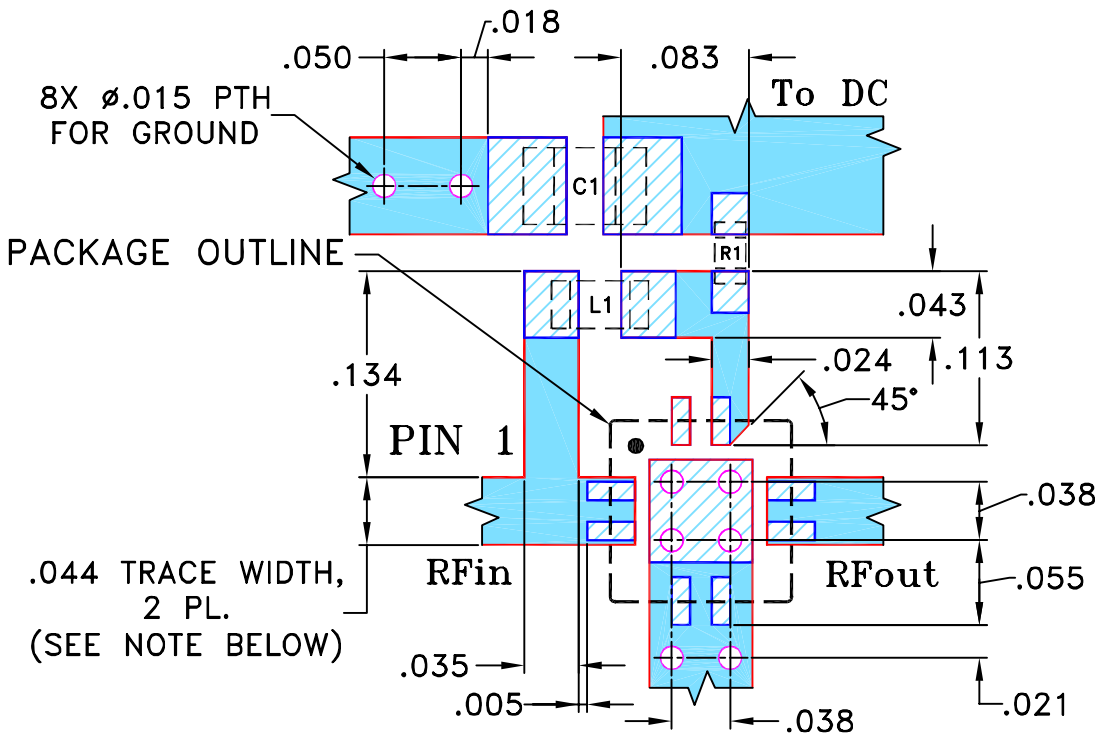
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M121752	NEW RELEASE	03/05/09	PW	TH
A	M129864	ADDED DIMENSIONS	12/14/10	MMG	MM
B	M137913	REMOVED COMPONENT VALUES	07/10/12	GF	DJ

SUGGESTED MOUNTING CONFIGURATION FOR DQ849 CASE STYLES "08AM01" PIN CONNECTION



RESISTOR R1: 0402 SIZE
INDUCTOR L1: 0603 SIZE
CAPACITOR C1: 0805 SIZE

NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. R1, L1 AND C1 FOOTPRINTS SHOWN FOR REFERENCE ONLY.
3. BOTTOM SIDE OF THE PCB IS CONTINOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	PW	02/26/09
TOLERANCES ON:	CHECKED	IL	03/04/09
2 PL DECIMALS ±	APPROVED	TH	03/05/09
3 PL DECIMALS ± .005			
ANGLES ± 1°			
FRACTIONS ±			

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ASHEETA1.DWG REV:A DATE:01/12/95

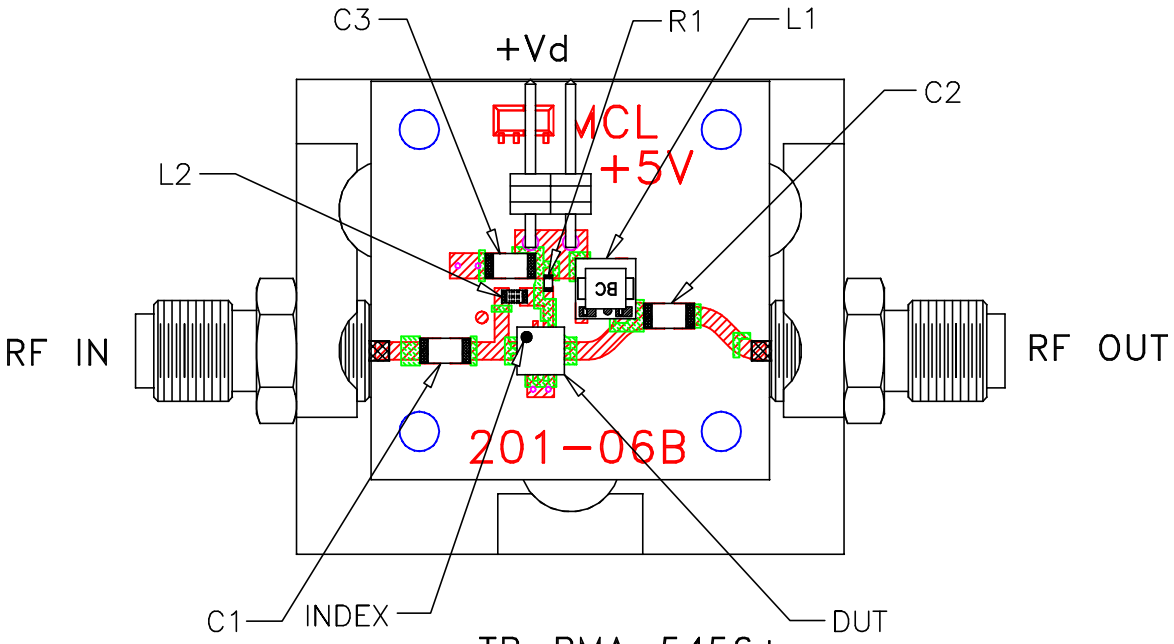
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, 08AM01, DQ849, TB-501(-X)+

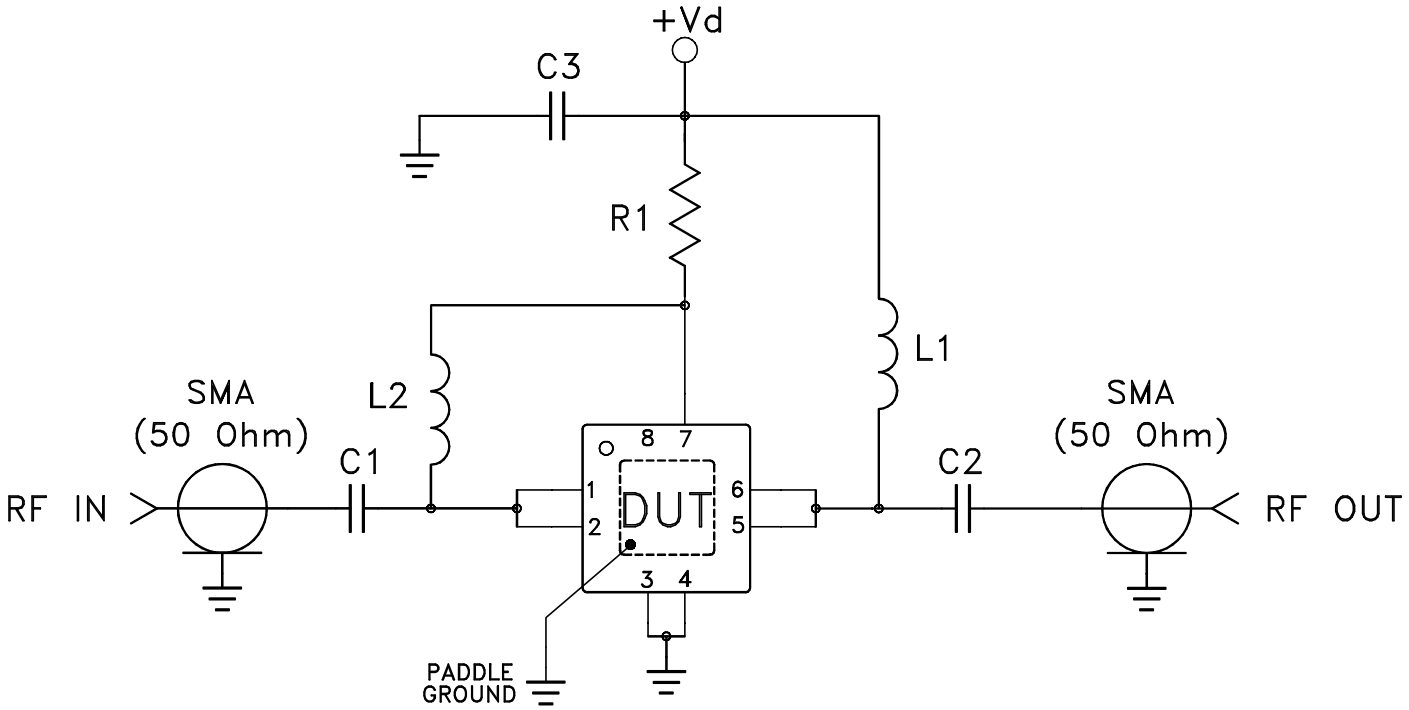
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-299	B

FILE:	SCALE:	SHEET:
98PL299	8:1	1 OF 1

Evaluation Board and Circuit



TB-PMA-5456+



COMPONENT	VALUE/PART NUMBER
DUT	Mini-Circuits PMA-5456+
C1, C2, C3	0.1 uF
L1	Mini-Circuits TCCH-80+
L2	390 nH
R1	1.69k Ohm

Schematic Diagram

Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.020 inch.

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Mini-Circuits

Environmental Specifications ENV08T1

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 -45° to 85° C or -55° to 105° C or -40° to 105° C or -40° to 95° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
HTOL	1000 hours at 125°C	MIL-STD-883, Method 1005, Condition B
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Mechanical Shock	1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only	MIL-STD-883, Method 2002, Condition B, except Y1 direction only
Vibration (Variable Frequency)	50g peak	MIL-STD-883, Method 2007, Condition B
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102, Condition C
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak	J-STD-020

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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
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215

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