

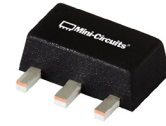
# Ultra High Dynamic Range Monolithic Amplifier

## PHA-13LN+

50Ω      1MHz to 1 GHz

### The Big Deal

- Ultra-High IP3, +39 dBm typ.
- Low supply voltage, 3 to 5V
- Excellent Noise Figure, 0.9 dB typ.



SOT-89 PACKAGE

### Product Overview

PHA-13LN+ (RoHS compliant) is an advanced wideband amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PHA-13LN+ has good input and output return loss over a broad frequency range. Relatively low supply voltage gives the model advantage in low power consumption. PHA-13LN+ is enclosed in a SOT-89 package and has very good thermal performance.

### Key Features

Feature	Advantages
Broad Band: 1MHz to 1GHz	Broadband covering primary wireless communications bands: VHF, UHF, Cellular
Extremely High IP3 40 dBm typical at 20 MHz 39 dBm typical at 0.5GHz	The PHA-13LN+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and E-PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being approximately 15 dB above the P1dB point. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none"><li>• Driver amplifiers for complex waveform up converter paths</li><li>• Drivers in linearized transmit systems</li><li>• Secondary amplifiers in ultra-High Dynamic range receivers</li></ul>
Low Noise Figure 0.9 dB at 0.5 GHz	Enables lower system noise figure performance and along with High OIP3 provides high dynamic range.
Low Supply Voltage, 3 to 5V	PHA-13LN+ supports low supply voltage operation which indicate low power consumption, 3V operation is ideal for battery operated system.

#### 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](http://www.minicircuits.com/MCLStore/terms.jsp)



# Ultra High Dynamic Range Monolithic Amplifier

1MHz to 1 GHz

## Product Features

- High IP3, 39 dBm typ. at 0.5GHz
- Gain, 22.4 dB typ. at 0.5 GHz
- Low noise figure, 0.9 dB at 0.5 GHz
- Low Voltage, 5V and 3V.



Generic photo used for illustration purposes only

CASE STYLE: DF782

## Typical Applications

- Base station infrastructure
- CATV
- Cellular
- VHF/UHF

## PGA-13LN+

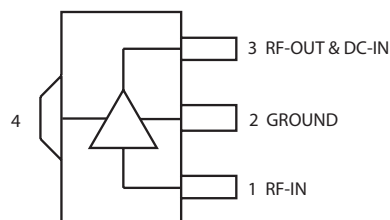
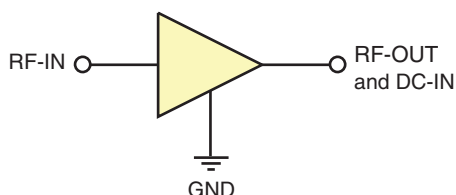
**+RoHS Compliant**

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

## General Description

PHA-13LN+ (RoHS compliant) is an advanced wideband amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PHA-13LN+ has good input and output return loss over a broad frequency range. Relatively low supply voltage gives the model advantage in low power consumption. PHA-13LN+ is enclosed in a SOT-89 package and has very good thermal performance.

### simplified schematic and pin description



Function	Pin Number	Description
RF IN	1	RF Input
RF-OUT and DC-IN	3	RF Output and DC Bias
GND	2,4	Connections to ground.

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Electrical Specifications<sup>1</sup> at 25°C, 50Ω, unless noted

Parameter	Condition (MHz)	Vd=5V <sup>1</sup>			Vd=3V <sup>1</sup>	Units
		Min.	Typ.	Max.	Typ.	
Frequency Range		1		1000	1-1000	MHz
Gain	1	22.1	24.6	27.1	23.7	dB
	20	—	24.0	—	23.3	
	250	—	22.8	—	22.1	
	500	20.2	22.4	24.6	21.5	
	1000	—	20.1	—	18.7	
Input Return Loss	1		10.3		9.4	dB
	20		15.4		14.6	
	250		17.5		17.9	
	500		17.4		14.7	
	1000		10.2		7.9	
Output Return Loss	1		11.3		11.0	dB
	20		19.1		21.5	
	250		17.7		20.2	
	500		23.9		20.0	
Reverse isolation	1		8.9		7.8	dB
	20		26.1		25.7	
	250		21.3		15.1	
	500		23.0		16.9	
Output Power @1 dB compression	1		24.4		19.5	dBm
	20		24.5		19.5	
	250		24.2		18.7	
	500		37.0	—	30.6	
	1000		40.2	—	33.3	
Output IP3 <sup>2</sup>	1	—	40.2	—	33.4	dBm
	20	—	39.0	—	32.3	
	250	—	36.4	—	28.6	
	500	36				
	1000	—				
Noise Figure	1		3.1		3.0	dB
	20		1.2		1.1	
	250		0.9		0.9	
	500		1.0		1.0	
	1000		1.2		1.3	
Device Operating Voltage			5.0		3.0	V
Device Operating Current		—	138.9	162	71.2	mA
Device Current Variation vs. Temperature <sup>3</sup>			21.7		30.3	μA/°C
Device Current Variation vs Voltage			0.0338		0.0338	mA/mV
Thermal Resistance, junction-to-ground lead			23.3		23.3	°C/W
Junction-to-ground lead at 85°C stage temperature						

1. Measured on Mini-Circuits Characterization test board TB-969-13LN+. See Characterization Test Circuit (Fig. 1)

2. Tested at Pout= 0 dBm / tone.

3. (Current at 85°C — Current at -45°C)/130

Absolute Maximum Ratings<sup>4</sup>

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 105°C
Storage Temperature	-65°C to 150°C
Power Dissipation	3.3 W <sup>5</sup>
Input Power (CW)	+21 dBm (5 minutes max) <sup>6</sup> +6 dBm (continuous) for 1-10 MHz +8 dBm (continuous) for 10-1000 MHz
DC Voltage on Pin 3	10V

4. Permanent damage may occur if any of these limits are exceeded.

Electrical maximum ratings are not intended for continuous normal operation.

5. up to 85°C, derate linearly to 2.5 W at 105°C

6. up to 85°C, derate linearly to +18dBm at 105°C

## Notes

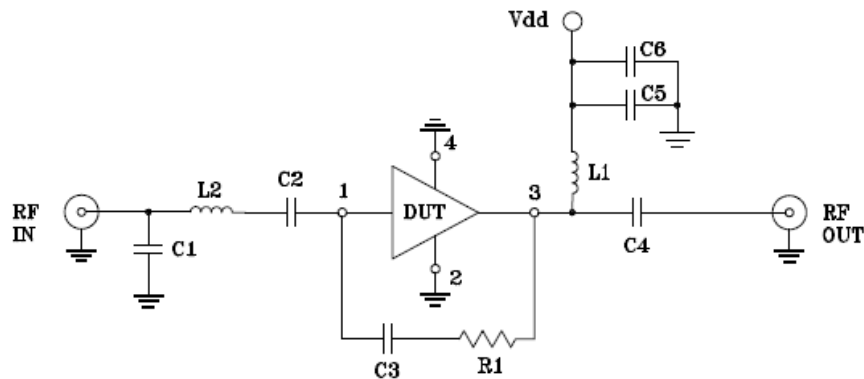
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Characterization Test / Recommended Application Circuit



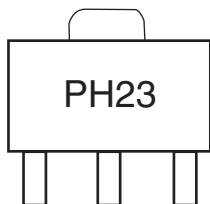
Components	Size	Value	Manufacturer	P/N
C1	0402	1.5 pF	Murata	GRM1555C1H1R5CZ01
C2	0603	2.2 uF		GRM188R61C225KE15
C3	0402	0.1uF		GRM155R71C104KA88
C4	0603	2.2 uF		GRM188R61C225KE15
C5	0402	1000 pF		GRM1555C1H102JA01
C6	0805	10 uF		GRM21BR61C106KE15
L1	1210	15 uH		LQH32DN150K53L
L2	0603	5.1 nH	Coilcraft	0603CS-5N1XJL
R1	0402	1500 Ω	Koa	RK73H1ET1501F

**Fig 1. Block Diagram of Test Circuit used for characterization.** (DUT soldered on Mini-Circuits Characterization test board TB-969-13LN+) 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 0.5 MHz apart, 0 dBm/ tone at output.

**Product Marking**



Marking may contain other features or characters for internal lot control

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Additional Detailed Technical Information	
<i>additional information is available on our dash board. To access this information <a href="#">click here</a></i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set (.zip file)
<b>Case Style</b>	DF782 (SOT 89) <i>Plastic package, exposed paddle lead finish: Matt-Tin</i>
<b>Tape &amp; Reel</b> Standard quantities available on reel	F55 <i>7" reels with 20, 50, 100, 200, 500 or 1K devices</i>
<b>Suggested Layout for PCB Design</b>	PL-523
<b>Evaluation Board</b>	TB-969-13LN+
<b>Environmental Ratings</b>	ENV08T9

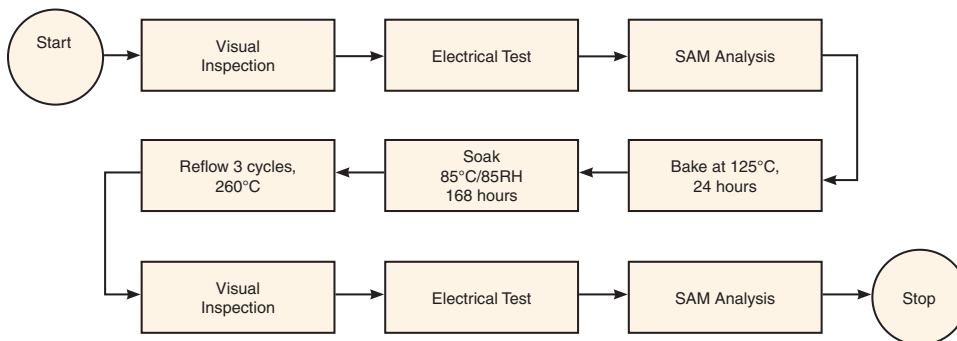
**ESD Rating**

Human Body Model (HBM): Class 1B (Pass 500 V) in accordance with ANSI/ESD STM 5.1 - 2001

**MSL Rating**

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

**MSL Test Flow Chart**



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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 = 3.00V, Id = 71.85mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	23.76	28.88	9.66	11.21	1.10	0.63	30.27	15.15	2.92
3.00	24.08	28.40	11.87	21.70	1.09	0.67	30.53	15.13	1.94
5.00	24.05	28.18	12.33	28.61	1.08	0.66	30.75	15.49	1.69
7.00	23.98	27.92	12.62	31.32	1.06	0.65	31.03	15.44	1.51
9.00	23.88	27.65	12.92	28.87	1.05	0.63	31.26	15.42	1.50
10.00	23.83	27.51	13.11	27.67	1.05	0.63	31.31	15.71	1.21
20.00	23.28	26.41	14.67	21.50	1.02	0.56	32.61	16.79	1.02
30.00	22.91	25.84	16.10	19.82	1.02	0.52	33.18	18.24	0.96
40.00	22.71	25.58	17.10	19.05	1.03	0.50	33.60	18.71	0.93
50.00	22.58	25.41	17.80	18.85	1.03	0.49	33.60	19.06	0.93
60.00	22.50	25.32	18.20	18.73	1.03	0.48	33.49	19.25	0.92
70.00	22.44	25.27	18.53	18.62	1.03	0.48	33.77	19.24	0.94
80.00	22.40	25.25	18.77	18.60	1.04	0.48	33.68	19.36	0.92
90.00	22.37	25.22	18.89	18.57	1.04	0.48	33.79	19.35	0.91
100.00	22.34	25.21	18.93	18.72	1.04	0.48	34.06	19.33	0.93
150.00	22.25	25.20	18.84	19.26	1.04	0.49	33.21	19.48	0.92
200.00	22.17	25.24	18.32	20.10	1.04	0.51	33.39	19.48	0.91
250.00	22.08	25.29	17.71	20.88	1.05	0.54	32.95	19.51	0.91
300.00	21.98	25.36	17.03	21.78	1.05	0.56	33.34	19.60	0.95
350.00	21.86	25.46	16.34	22.07	1.05	0.59	32.68	19.54	0.91
400.00	21.72	25.57	15.74	21.30	1.06	0.62	32.66	19.58	0.94
450.00	21.57	25.71	14.99	19.66	1.06	0.66	32.23	19.57	0.94
500.00	21.35	25.89	14.32	17.71	1.07	0.69	31.53	19.42	0.97
550.00	21.00	26.23	13.28	15.54	1.09	0.75	31.54	19.33	0.95
600.00	20.53	26.47	11.98	15.52	1.13	0.83	31.03	19.46	1.01
650.00	20.73	26.48	11.81	15.97	1.11	0.80	31.00	19.49	1.04
700.00	20.65	26.54	11.76	14.12	1.11	0.80	30.94	19.39	1.01
750.00	20.43	26.76	11.44	12.56	1.12	0.81	30.52	19.59	1.09
800.00	20.15	27.02	11.00	11.30	1.13	0.82	30.32	19.38	1.05
850.00	19.81	27.36	10.46	10.19	1.15	0.84	29.75	19.14	1.11
900.00	19.36	27.82	9.82	9.18	1.19	0.86	29.04	19.15	1.07
950.00	18.73	28.45	8.98	8.25	1.25	0.89	28.40	18.42	1.17
1000.00	17.80	29.41	7.89	7.42	1.35	0.93	27.21	17.73	1.13
1050.00	16.40	30.85	6.58	6.97	1.58	1.00	25.85	16.56	1.18
1100.00	15.30	31.85	5.41	7.56	1.82	1.11	25.31	16.14	1.24
1150.00	16.16	30.75	4.97	10.02	1.62	1.20	26.79	16.69	1.35
1200.00	17.25	29.56	5.08	13.51	1.40	1.23	28.28	17.94	1.37

## 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 = 140.16mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	24.61	29.24	10.61	11.48	1.08	0.59	38.19	21.11	3.20
3.00	24.91	28.78	13.45	23.26	1.07	0.62	38.69	21.35	1.99
5.00	24.88	28.57	13.96	37.93	1.06	0.61	38.81	21.40	1.84
7.00	24.79	28.32	14.20	34.06	1.05	0.60	38.97	21.36	1.75
9.00	24.68	28.06	14.41	27.17	1.04	0.59	39.14	21.61	1.61
10.00	24.62	27.93	14.56	25.53	1.04	0.58	39.26	21.60	1.23
20.00	24.02	26.89	15.35	19.03	1.01	0.52	38.97	22.99	1.03
30.00	23.62	26.35	16.04	17.40	1.01	0.48	41.06	23.81	1.01
40.00	23.40	26.10	16.44	16.68	1.02	0.46	40.37	24.04	0.95
50.00	23.27	25.95	16.68	16.46	1.02	0.45	40.90	24.03	0.96
60.00	23.18	25.86	16.81	16.33	1.03	0.45	40.89	24.16	0.93
70.00	23.11	25.81	16.93	16.22	1.03	0.44	40.88	24.16	0.96
80.00	23.07	25.79	17.08	16.20	1.03	0.44	40.66	24.13	0.92
90.00	23.04	25.76	17.17	16.18	1.03	0.44	41.33	24.25	0.92
100.00	23.02	25.76	17.23	16.30	1.03	0.44	41.55	24.23	0.93
150.00	22.94	25.74	17.43	16.74	1.04	0.45	40.54	24.39	0.93
200.00	22.89	25.76	17.62	17.48	1.04	0.47	40.56	24.42	0.92
250.00	22.82	25.80	17.79	18.33	1.04	0.49	40.09	24.35	0.90
300.00	22.75	25.85	17.93	19.62	1.05	0.51	40.37	24.60	0.95
350.00	22.67	25.92	17.98	21.10	1.05	0.54	39.68	24.58	0.91
400.00	22.57	26.01	18.15	22.35	1.06	0.56	39.50	24.68	0.96
450.00	22.46	26.12	17.98	22.74	1.07	0.59	39.40	24.66	0.94
500.00	22.29	26.28	17.75	21.37	1.08	0.62	38.84	24.57	0.98
550.00	21.98	26.59	16.79	18.55	1.10	0.68	38.99	24.37	0.94
600.00	21.83	27.03	15.54	18.15	1.13	0.76	38.83	24.33	1.02
650.00	21.77	26.84	14.82	19.78	1.12	0.73	38.64	24.60	1.03
700.00	21.74	26.89	15.02	17.29	1.12	0.72	38.66	24.52	1.03
750.00	21.57	27.09	14.75	15.11	1.13	0.74	38.40	24.63	1.01
800.00	21.34	27.35	14.24	13.37	1.15	0.76	38.30	24.40	1.06
850.00	21.03	27.70	13.54	11.89	1.18	0.78	37.89	24.55	1.09
900.00	20.62	28.17	12.66	10.56	1.22	0.80	37.34	24.46	1.06
950.00	20.01	28.83	11.50	9.36	1.29	0.83	37.00	24.03	1.13
1000.00	19.07	29.87	10.01	8.30	1.43	0.88	35.89	23.73	1.12
1050.00	17.63	31.42	8.32	7.69	1.72	0.96	34.66	22.58	1.14
1100.00	16.47	32.57	6.87	8.22	2.06	1.05	34.23	22.08	1.24
1150.00	17.34	31.52	6.29	10.80	1.82	1.12	34.70	22.17	1.29
1200.00	18.52	30.29	6.35	15.29	1.54	1.15	35.66	23.01	1.33

## 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 = 2.70V, Id = 61.08mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
1.00	23.47	28.75	9.37	11.07	1.10	0.65	27.65	13.55	--
3.00	23.81	28.27	11.44	20.95	1.09	0.68	27.92	13.86	--
5.00	23.79	28.04	11.87	26.31	1.08	0.67	28.19	13.87	--
7.00	23.72	27.78	12.17	28.49	1.07	0.66	28.63	14.15	--
9.00	23.63	27.50	12.47	27.80	1.05	0.65	28.99	14.12	--
10.00	23.57	27.36	12.63	27.19	1.05	0.64	29.10	14.12	0.95
20.00	23.04	26.25	14.33	22.32	1.02	0.57	30.59	15.50	1.02
30.00	22.69	25.67	15.94	20.77	1.02	0.53	31.46	16.65	0.98
40.00	22.49	25.40	17.11	20.05	1.03	0.51	31.66	17.43	0.97
50.00	22.36	25.23	17.86	19.89	1.03	0.50	31.68	17.80	0.94
60.00	22.28	25.14	18.37	19.79	1.03	0.49	31.76	18.15	0.94
70.00	22.22	25.10	18.77	19.68	1.04	0.49	31.93	18.17	0.97
80.00	22.18	25.07	19.00	19.67	1.04	0.49	31.93	18.18	0.92
90.00	22.14	25.04	19.13	19.64	1.04	0.49	32.03	18.17	0.93
100.00	22.12	25.03	19.25	19.81	1.04	0.49	32.20	18.14	0.93
150.00	22.03	25.02	18.96	20.44	1.04	0.50	31.50	18.43	0.97
200.00	21.94	25.06	18.21	21.33	1.05	0.52	31.69	18.43	0.90
250.00	21.85	25.13	17.37	22.10	1.05	0.55	31.21	18.33	0.92
300.00	21.73	25.21	16.52	22.74	1.05	0.58	31.60	18.42	0.96
350.00	21.61	25.31	15.66	22.46	1.05	0.61	30.90	18.36	0.93
400.00	21.46	25.43	14.98	21.12	1.06	0.64	30.84	18.38	0.96
450.00	21.29	25.58	14.17	19.13	1.07	0.68	30.41	18.50	0.95
500.00	21.06	25.78	13.45	17.10	1.08	0.71	29.70	18.34	1.03
550.00	20.69	26.12	12.43	15.05	1.09	0.77	29.65	18.10	0.96
600.00	20.45	26.57	11.98	15.15	1.10	0.83	29.12	18.12	1.05
650.00	20.41	26.38	11.08	15.37	1.11	0.83	29.11	18.23	1.07
700.00	20.32	26.46	10.99	13.54	1.11	0.82	29.04	18.13	1.04
750.00	20.09	26.68	10.65	12.05	1.12	0.83	28.64	18.32	1.09
800.00	19.79	26.96	10.23	10.86	1.13	0.84	28.44	18.10	1.06
850.00	19.43	27.30	9.71	9.81	1.15	0.86	27.86	17.79	1.13
900.00	18.97	27.77	9.12	8.86	1.19	0.88	27.15	17.78	1.12
950.00	18.32	28.40	8.35	7.99	1.24	0.90	26.53	17.02	1.15
1000.00	17.37	29.37	7.36	7.22	1.35	0.94	25.33	16.32	1.18
1050.00	15.97	30.80	6.15	6.84	1.58	1.01	23.97	15.18	1.18
1100.00	14.88	31.77	5.07	7.50	1.82	1.12	23.43	14.73	1.29
1150.00	15.76	30.65	4.67	10.03	1.61	1.22	25.02	15.35	1.38
1200.00	16.84	29.46	4.79	13.47	1.39	1.26	26.54	16.63	1.40



## 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 = 148.77mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
1.00	24.66	29.25	10.67	11.48	1.08	0.58	38.68	21.64	--
3.00	24.97	28.80	13.57	23.30	1.07	0.61	39.26	21.90	--
5.00	24.93	28.58	14.09	38.27	1.06	0.60	39.36	21.96	--
7.00	24.84	28.34	14.33	33.80	1.05	0.59	39.55	21.91	--
9.00	24.74	28.08	14.54	27.00	1.04	0.58	39.74	22.04	--
10.00	24.67	27.95	14.63	25.39	1.04	0.58	39.82	22.13	1.02
20.00	24.07	26.92	15.39	18.93	1.01	0.52	40.03	23.52	1.04
30.00	23.67	26.39	15.99	17.31	1.01	0.48	41.13	24.18	0.98
40.00	23.45	26.13	16.45	16.59	1.02	0.46	39.98	24.41	0.95
50.00	23.31	25.98	16.63	16.38	1.02	0.45	41.45	24.51	0.95
60.00	23.22	25.89	16.75	16.24	1.03	0.44	41.18	24.52	0.94
70.00	23.16	25.85	16.82	16.14	1.03	0.44	41.79	24.51	0.95
80.00	23.12	25.82	16.97	16.12	1.03	0.44	41.53	24.63	0.94
90.00	23.08	25.80	17.05	16.11	1.03	0.44	42.13	24.61	0.90
100.00	23.06	25.79	17.11	16.21	1.03	0.44	43.05	24.60	0.92
150.00	22.99	25.77	17.35	16.66	1.04	0.45	41.27	24.75	0.98
200.00	22.93	25.78	17.53	17.41	1.04	0.47	41.16	24.90	0.90
250.00	22.87	25.83	17.72	18.27	1.04	0.49	40.89	24.83	0.87
300.00	22.80	25.88	17.90	19.60	1.05	0.51	41.13	25.09	0.90
350.00	22.72	25.95	18.04	21.17	1.05	0.53	40.22	24.96	0.91
400.00	22.63	26.04	18.24	22.61	1.06	0.56	40.27	25.32	0.94
450.00	22.52	26.15	18.15	23.26	1.07	0.59	40.15	25.04	0.90
500.00	22.35	26.31	17.99	21.95	1.08	0.62	39.46	24.95	1.02
550.00	22.05	26.61	17.04	18.98	1.10	0.67	39.67	24.90	0.95
600.00	22.00	27.06	14.75	18.57	1.14	0.76	39.67	25.30	1.02
650.00	21.84	26.87	15.04	20.33	1.12	0.72	39.44	25.26	1.01
700.00	21.81	26.92	15.26	17.66	1.12	0.72	39.48	25.06	1.04
750.00	21.65	27.12	14.99	15.36	1.13	0.73	39.21	25.30	1.05
800.00	21.41	27.38	14.47	13.56	1.15	0.75	39.13	24.95	1.05
850.00	21.11	27.74	13.75	12.03	1.18	0.77	38.75	25.10	1.08
900.00	20.69	28.21	12.84	10.67	1.22	0.80	38.23	24.85	1.09
950.00	20.08	28.88	11.66	9.44	1.30	0.83	37.91	24.55	1.10
1000.00	19.14	29.93	10.14	8.38	1.44	0.88	36.74	24.24	1.12
1050.00	17.69	31.51	8.43	7.77	1.74	0.96	35.58	22.78	1.12
1100.00	16.53	32.67	6.98	8.32	2.09	1.05	35.20	22.48	1.23
1150.00	17.39	31.62	6.40	10.96	1.85	1.12	35.63	22.83	1.32
1200.00	18.59	30.39	6.44	15.65	1.56	1.14	36.46	23.54	1.37

## 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 = 3.00V, Id = 70.03mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	23.85	28.92	9.60	10.94	1.09	0.62	30.25	15.06	--
3.00	24.19	28.43	11.91	21.26	1.08	0.66	30.67	15.34	--
5.00	24.17	28.19	12.39	27.76	1.07	0.65	30.86	15.39	--
7.00	24.10	27.93	12.69	30.48	1.06	0.64	31.09	15.35	--
9.00	24.00	27.66	13.00	28.53	1.05	0.62	31.31	15.65	--
10.00	23.94	27.52	13.18	27.51	1.04	0.61	31.43	15.63	0.73
20.00	23.38	26.45	14.71	21.56	1.02	0.55	32.66	17.00	0.78
30.00	23.02	25.89	16.14	19.98	1.02	0.51	33.42	18.19	0.74
40.00	22.82	25.61	17.19	19.30	1.02	0.49	33.62	18.95	0.71
50.00	22.70	25.46	17.86	19.19	1.03	0.48	33.52	19.30	0.72
60.00	22.62	25.36	18.32	19.15	1.03	0.47	33.66	19.36	0.71
70.00	22.56	25.31	18.74	19.13	1.03	0.47	33.82	19.37	0.73
80.00	22.52	25.28	19.06	19.18	1.03	0.47	33.71	19.50	0.71
90.00	22.49	25.25	19.27	19.23	1.04	0.47	33.96	19.49	0.66
100.00	22.47	25.25	19.43	19.47	1.04	0.47	34.24	19.47	0.70
150.00	22.40	25.22	19.76	20.33	1.04	0.48	33.22	19.63	0.73
200.00	22.33	25.24	19.41	21.11	1.04	0.49	33.48	19.64	0.67
250.00	22.26	25.29	18.74	21.51	1.04	0.51	32.97	19.71	0.66
300.00	22.17	25.36	17.85	22.27	1.05	0.54	33.32	19.77	0.72
350.00	22.07	25.44	17.02	22.75	1.05	0.57	32.66	19.73	0.66
400.00	21.94	25.55	16.50	22.33	1.06	0.60	32.62	19.76	0.71
450.00	21.81	25.67	15.84	20.80	1.06	0.63	32.21	19.78	0.69
500.00	21.63	25.83	15.28	18.65	1.07	0.66	31.51	19.65	0.76
550.00	21.35	26.10	14.41	16.15	1.08	0.70	31.49	19.46	0.69
600.00	20.71	26.72	12.41	14.71	1.13	0.81	30.72	19.20	0.97
650.00	20.95	26.50	12.25	17.08	1.11	0.79	30.89	19.50	0.79
700.00	20.99	26.47	12.51	14.88	1.10	0.76	30.90	19.50	0.77
750.00	20.82	26.65	12.30	13.05	1.11	0.77	30.52	19.74	0.92
800.00	20.58	26.89	11.92	11.67	1.12	0.78	30.33	19.54	0.78
850.00	20.29	27.19	11.41	10.51	1.14	0.80	29.84	19.38	0.83
900.00	19.92	27.59	10.79	9.48	1.16	0.81	29.20	19.44	0.78
950.00	19.40	28.12	9.96	8.51	1.20	0.84	28.66	18.79	0.82
1000.00	18.62	28.95	8.86	7.54	1.28	0.87	27.59	18.25	0.80
1050.00	17.31	30.34	7.44	6.71	1.46	0.92	26.10	16.76	0.83
1100.00	15.40	32.32	5.84	6.49	1.86	1.02	24.33	15.57	0.91
1150.00	15.38	32.06	4.87	8.11	1.86	1.15	25.17	15.59	1.01
1200.00	17.18	30.09	4.90	12.10	1.47	1.21	27.66	17.50	0.99

## 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 = 141.11mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	24.70	29.14	10.51	11.15	1.07	0.56	37.90	21.14	--
3.00	25.03	28.67	13.52	22.40	1.07	0.59	38.83	21.12	--
5.00	25.00	28.45	14.08	32.24	1.06	0.58	39.09	21.48	--
7.00	24.91	28.21	14.35	33.00	1.04	0.57	39.27	21.42	--
9.00	24.80	27.96	14.57	27.55	1.03	0.56	39.49	21.54	--
10.00	24.73	27.83	14.65	26.03	1.03	0.55	39.66	21.51	0.85
20.00	24.11	26.83	15.50	19.62	1.01	0.50	40.28	22.91	0.81
30.00	23.71	26.31	16.21	18.05	1.01	0.47	41.33	23.97	0.76
40.00	23.49	26.06	16.74	17.39	1.02	0.45	41.95	24.23	0.72
50.00	23.36	25.91	17.00	17.25	1.02	0.44	42.39	24.32	0.74
60.00	23.27	25.82	17.24	17.18	1.02	0.43	42.15	24.33	0.71
70.00	23.21	25.77	17.42	17.14	1.03	0.43	42.01	24.33	0.73
80.00	23.17	25.75	17.70	17.20	1.03	0.43	42.63	24.44	0.71
90.00	23.14	25.72	17.80	17.25	1.03	0.43	42.10	24.42	0.67
100.00	23.12	25.71	17.96	17.43	1.03	0.43	42.54	24.41	0.70
150.00	23.06	25.68	18.62	18.23	1.04	0.44	41.06	24.59	0.70
200.00	23.02	25.69	18.89	19.03	1.04	0.45	41.13	24.74	0.69
250.00	22.96	25.73	18.85	19.62	1.04	0.46	40.91	24.67	0.66
300.00	22.90	25.79	18.66	20.81	1.05	0.48	40.89	24.92	0.70
350.00	22.84	25.86	18.57	22.38	1.05	0.51	39.77	24.77	0.67
400.00	22.75	25.94	18.80	24.47	1.06	0.53	39.83	24.87	0.72
450.00	22.66	26.04	18.93	26.42	1.06	0.56	39.92	24.87	0.69
500.00	22.54	26.18	19.07	24.82	1.07	0.58	39.38	24.82	0.77
550.00	22.31	26.43	18.45	20.65	1.09	0.63	39.18	24.64	0.66
600.00	21.68	27.05	15.59	18.11	1.14	0.74	39.58	24.52	0.92
650.00	21.94	26.85	15.36	22.94	1.12	0.71	39.13	24.91	0.80
700.00	22.04	26.80	16.05	18.86	1.11	0.69	39.12	24.81	0.73
750.00	21.92	26.97	15.95	15.91	1.12	0.69	39.13	24.95	0.89
800.00	21.72	27.22	15.51	13.88	1.14	0.71	39.04	24.75	0.78
850.00	21.46	27.55	14.81	12.27	1.16	0.73	38.84	24.98	0.84
900.00	21.11	27.97	13.90	10.89	1.20	0.75	38.81	24.97	0.80
950.00	20.61	28.56	12.72	9.62	1.25	0.78	39.45	24.79	0.80
1000.00	19.81	29.48	11.20	8.42	1.36	0.82	38.63	24.50	0.85
1050.00	18.43	31.04	9.37	7.44	1.62	0.88	38.00	23.41	0.85
1100.00	16.40	33.27	7.46	7.19	2.22	0.98	36.98	22.15	0.93
1150.00	16.32	33.15	6.32	8.89	2.28	1.08	36.62	21.75	1.00
1200.00	18.24	31.10	6.24	13.45	1.72	1.13	35.70	22.74	1.03

## 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 = 2.70V, Id = 59.22mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	23.59	28.81	9.32	10.83	1.10	0.63	27.68	13.60	--
3.00	23.94	28.31	11.50	20.65	1.09	0.67	28.05	13.90	--
5.00	23.93	28.07	11.96	25.94	1.08	0.66	28.30	13.95	--
7.00	23.85	27.81	12.27	28.17	1.06	0.65	28.65	13.91	--
9.00	23.76	27.54	12.57	27.61	1.05	0.63	29.01	14.20	--
10.00	23.70	27.39	12.74	27.06	1.05	0.63	29.16	14.18	0.71
20.00	23.16	26.31	14.39	22.29	1.02	0.57	30.46	15.55	0.77
30.00	22.80	25.74	15.94	20.83	1.02	0.53	31.42	16.72	0.75
40.00	22.61	25.46	17.16	20.20	1.03	0.50	31.84	17.51	0.71
50.00	22.49	25.30	17.91	20.14	1.03	0.49	31.54	17.89	0.70
60.00	22.41	25.20	18.50	20.13	1.03	0.48	31.68	18.26	0.70
70.00	22.36	25.15	18.87	20.10	1.03	0.48	31.93	18.28	0.75
80.00	22.31	25.12	19.23	20.17	1.04	0.48	31.88	18.27	0.69
90.00	22.28	25.09	19.46	20.24	1.04	0.48	32.04	18.28	0.65
100.00	22.26	25.08	19.62	20.50	1.04	0.48	32.24	18.25	0.70
150.00	22.19	25.06	19.75	21.44	1.04	0.49	31.37	18.55	0.72
200.00	22.12	25.09	19.18	22.26	1.04	0.51	31.59	18.56	0.71
250.00	22.03	25.14	18.31	22.60	1.05	0.53	31.11	18.48	0.64
300.00	21.93	25.21	17.27	23.17	1.05	0.55	31.45	18.56	0.71
350.00	21.82	25.31	16.31	23.20	1.05	0.58	30.80	18.51	0.67
400.00	21.69	25.42	15.64	22.15	1.06	0.61	30.72	18.52	0.67
450.00	21.54	25.56	14.89	20.15	1.06	0.65	30.29	18.53	0.64
500.00	21.35	25.72	14.28	17.90	1.07	0.68	29.58	18.39	0.76
550.00	21.05	26.00	13.40	15.51	1.08	0.72	29.56	18.47	0.68
600.00	20.39	26.63	11.57	14.29	1.12	0.83	28.69	17.86	1.02
650.00	20.63	26.41	11.43	16.36	1.11	0.81	28.91	18.18	0.80
700.00	20.66	26.39	11.61	14.19	1.10	0.79	28.93	18.20	0.76
750.00	20.47	26.57	11.37	12.47	1.10	0.79	28.54	18.39	0.91
800.00	20.22	26.82	11.01	11.18	1.12	0.80	28.35	18.21	0.77
850.00	19.92	27.13	10.53	10.09	1.13	0.82	27.85	17.96	0.81
900.00	19.53	27.53	9.95	9.13	1.16	0.83	27.17	17.67	0.78
950.00	18.99	28.07	9.20	8.21	1.20	0.86	26.60	17.33	0.82
1000.00	18.20	28.90	8.19	7.31	1.27	0.89	25.51	16.77	0.81
1050.00	16.88	30.28	6.89	6.55	1.45	0.94	24.02	15.28	0.83
1100.00	14.98	32.22	5.42	6.40	1.83	1.04	22.21	13.76	0.92
1150.00	14.99	31.92	4.52	8.10	1.82	1.17	23.10	14.13	1.02
1200.00	16.78	29.95	4.57	12.13	1.45	1.24	25.79	16.15	1.04

## 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 = 148.66mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	24.76	29.16	10.55	11.15	1.07	0.55	38.92	21.70	--
3.00	25.08	28.68	13.63	22.42	1.06	0.58	39.83	21.67	--
5.00	25.05	28.46	14.20	32.33	1.05	0.58	40.22	22.02	--
7.00	24.96	28.22	14.44	32.84	1.04	0.57	40.43	21.96	--
9.00	24.85	27.97	14.67	27.41	1.03	0.55	40.59	21.94	--
10.00	24.78	27.85	14.80	25.87	1.03	0.55	40.65	22.21	0.84
20.00	24.16	26.85	15.56	19.53	1.01	0.50	40.93	23.60	0.80
30.00	23.75	26.34	16.20	17.95	1.01	0.47	41.59	24.47	0.76
40.00	23.53	26.09	16.68	17.30	1.02	0.45	42.63	24.60	0.72
50.00	23.40	25.94	16.95	17.17	1.02	0.44	42.60	24.70	0.71
60.00	23.31	25.85	17.14	17.09	1.02	0.43	42.38	24.83	0.69
70.00	23.25	25.80	17.29	17.08	1.03	0.43	42.69	24.81	0.72
80.00	23.21	25.77	17.55	17.11	1.03	0.43	43.13	24.81	0.68
90.00	23.18	25.75	17.70	17.17	1.03	0.43	42.54	24.91	0.66
100.00	23.16	25.74	17.84	17.34	1.03	0.43	43.02	24.90	0.69
150.00	23.10	25.71	18.50	18.14	1.04	0.44	41.97	25.08	0.67
200.00	23.05	25.72	18.77	18.94	1.04	0.45	41.76	25.11	0.68
250.00	23.00	25.76	18.75	19.54	1.04	0.46	41.57	25.04	0.64
300.00	22.94	25.82	18.59	20.75	1.05	0.48	41.72	25.29	0.64
350.00	22.88	25.88	18.53	22.34	1.05	0.50	40.77	25.16	0.67
400.00	22.80	25.97	18.78	24.60	1.06	0.53	40.47	25.38	0.70
450.00	22.71	26.07	18.97	27.02	1.06	0.55	40.85	25.36	0.68
500.00	22.58	26.20	19.17	25.58	1.07	0.58	40.19	25.21	0.62
550.00	22.36	26.45	18.59	21.11	1.09	0.63	40.00	25.15	0.65
600.00	21.72	27.08	15.70	18.48	1.14	0.74	40.60	25.17	0.70
650.00	21.99	26.88	15.47	23.60	1.12	0.71	40.04	25.42	0.79
700.00	22.09	26.83	16.19	19.15	1.12	0.68	40.11	25.32	0.75
750.00	21.97	27.00	16.10	16.08	1.13	0.69	40.24	25.48	0.77
800.00	21.77	27.26	15.64	14.00	1.14	0.71	40.21	25.28	0.76
850.00	21.51	27.58	14.93	12.36	1.17	0.72	40.05	25.52	0.82
900.00	21.16	28.01	14.00	10.96	1.20	0.75	40.15	25.35	0.76
950.00	20.66	28.61	12.82	9.67	1.26	0.78	40.89	25.18	0.83
1000.00	19.85	29.54	11.27	8.47	1.37	0.82	39.98	25.04	0.81
1050.00	18.46	31.11	9.42	7.49	1.63	0.88	39.45	23.96	0.82
1100.00	16.42	33.36	7.51	7.26	2.26	0.98	38.65	22.67	0.90
1150.00	16.35	33.24	6.38	8.99	2.32	1.08	38.09	22.28	1.01
1200.00	18.27	31.19	6.30	13.62	1.74	1.13	36.66	23.39	1.04

## 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 = 3.00V, Id = 73.09mA @ Temperature = +105°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
1.00	23.49	28.72	9.54	11.31	1.10	0.65	29.46	14.51	--
3.00	23.81	28.26	11.54	21.28	1.09	0.68	29.78	14.81	--
5.00	23.79	28.03	11.96	26.61	1.08	0.67	29.99	14.86	--
7.00	23.72	27.77	12.25	28.62	1.07	0.66	30.27	15.13	--
9.00	23.63	27.49	12.57	27.78	1.06	0.64	30.52	15.11	--
10.00	23.57	27.35	12.74	27.12	1.05	0.64	30.66	15.08	1.23
20.00	23.03	26.26	14.45	22.21	1.02	0.57	32.14	16.48	1.27
30.00	22.67	25.68	16.07	20.63	1.03	0.53	33.10	17.64	1.27
40.00	22.47	25.40	17.29	19.84	1.03	0.51	33.33	18.40	1.23
50.00	22.35	25.23	17.98	19.60	1.03	0.50	33.18	18.61	1.23
60.00	22.26	25.15	18.46	19.39	1.04	0.49	33.33	18.93	1.22
70.00	22.20	25.09	18.73	19.16	1.04	0.49	33.53	18.95	1.26
80.00	22.15	25.07	18.94	19.04	1.04	0.49	33.57	18.95	1.24
90.00	22.11	25.05	19.00	18.91	1.04	0.49	33.69	19.06	1.21
100.00	22.08	25.04	18.98	18.92	1.04	0.49	33.94	19.04	1.24
150.00	21.98	25.05	18.34	19.11	1.05	0.51	33.21	19.17	1.21
200.00	21.89	25.10	17.60	19.97	1.05	0.53	33.40	19.16	1.25
250.00	21.79	25.18	16.99	21.17	1.05	0.56	32.94	19.06	1.20
300.00	21.67	25.26	16.34	22.57	1.06	0.59	33.42	19.27	1.19
350.00	21.55	25.37	15.66	22.52	1.06	0.62	32.62	19.21	1.25
400.00	21.39	25.50	15.03	20.89	1.07	0.65	32.60	19.26	1.28
450.00	21.22	25.67	14.21	18.77	1.07	0.69	32.18	19.22	1.23
500.00	20.97	25.89	13.39	16.76	1.09	0.72	31.43	19.05	1.31
550.00	20.58	26.26	12.22	15.15	1.11	0.78	31.45	19.09	1.27
600.00	20.30	26.53	11.18	15.63	1.13	0.84	31.12	18.85	1.69
650.00	20.38	26.47	11.19	14.90	1.12	0.82	30.84	19.17	1.42
700.00	20.24	26.61	10.98	13.22	1.13	0.82	30.74	19.03	1.38
750.00	20.00	26.85	10.64	11.87	1.14	0.83	30.31	19.20	1.46
800.00	19.70	27.15	10.22	10.76	1.16	0.85	30.11	18.98	1.40
850.00	19.32	27.53	9.73	9.80	1.19	0.86	29.52	18.97	1.48
900.00	18.84	28.02	9.15	8.96	1.24	0.89	28.84	18.64	1.46
950.00	18.18	28.67	8.40	8.25	1.31	0.92	28.24	17.86	1.51
1000.00	17.26	29.61	7.45	7.73	1.44	0.97	27.19	17.52	1.53
1050.00	16.13	30.73	6.41	7.72	1.65	1.05	26.29	16.66	1.58
1100.00	15.56	31.18	5.55	8.78	1.78	1.14	26.28	16.48	1.66
1150.00	16.19	30.39	5.22	11.21	1.63	1.22	27.27	16.93	1.75
1200.00	16.86	29.63	5.18	13.78	1.47	1.24	28.26	17.75	1.81

## 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 = 137.78mA @ Temperature = +105°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
1.00	24.33	29.11	10.56	11.62	1.09	0.61	36.47	20.33	--
3.00	24.62	28.66	13.16	23.16	1.08	0.63	36.94	20.62	--
5.00	24.59	28.44	13.63	34.66	1.07	0.63	37.14	20.66	--
7.00	24.51	28.19	13.88	34.83	1.06	0.61	37.32	20.91	--
9.00	24.41	27.93	14.13	28.17	1.05	0.60	37.48	20.89	--
10.00	24.34	27.79	14.25	26.53	1.04	0.59	37.61	20.88	1.30
20.00	23.75	26.76	15.30	19.81	1.02	0.54	38.17	22.23	1.34
30.00	23.37	26.22	16.16	18.11	1.02	0.50	39.22	22.90	1.29
40.00	23.15	25.96	16.76	17.32	1.02	0.48	39.71	23.33	1.25
50.00	23.02	25.80	17.04	17.05	1.03	0.47	40.26	23.47	1.27
60.00	22.93	25.71	17.10	16.84	1.03	0.46	40.31	23.53	1.26
70.00	22.87	25.66	17.16	16.65	1.03	0.46	39.76	23.63	1.28
80.00	22.82	25.64	17.23	16.54	1.04	0.46	39.74	23.62	1.26
90.00	22.78	25.62	17.15	16.42	1.04	0.46	40.00	23.73	1.23
100.00	22.76	25.61	17.18	16.43	1.04	0.46	40.05	23.73	1.27
150.00	22.66	25.61	16.87	16.56	1.04	0.47	39.72	23.87	1.29
200.00	22.59	25.65	16.82	17.27	1.05	0.49	39.56	23.88	1.25
250.00	22.52	25.70	17.07	18.45	1.05	0.51	39.40	23.81	1.23
300.00	22.45	25.76	17.37	20.43	1.06	0.54	39.86	24.07	1.29
350.00	22.36	25.84	17.55	22.56	1.06	0.57	39.19	24.04	1.25
400.00	22.25	25.95	17.64	23.70	1.07	0.59	39.22	24.26	1.28
450.00	22.12	26.08	17.23	22.85	1.08	0.62	38.95	24.12	1.27
500.00	21.92	26.28	16.59	20.52	1.09	0.66	38.31	24.00	1.37
550.00	21.57	26.63	15.20	18.20	1.12	0.72	38.77	23.93	1.32
600.00	21.31	26.90	13.79	18.88	1.14	0.77	38.72	23.85	1.42
650.00	21.42	26.83	13.94	18.30	1.13	0.75	38.49	24.04	1.41
700.00	21.33	26.95	13.82	15.94	1.14	0.75	38.55	23.92	1.41
750.00	21.13	27.18	13.45	14.07	1.16	0.77	38.17	23.96	1.46
800.00	20.87	27.48	12.94	12.58	1.18	0.79	38.08	23.88	1.43
850.00	20.53	27.88	12.30	11.32	1.22	0.81	37.46	23.60	1.50
900.00	20.07	28.40	11.52	10.24	1.27	0.84	36.79	23.43	1.47
950.00	19.42	29.11	10.53	9.32	1.36	0.87	36.21	23.00	1.52
1000.00	18.50	30.12	9.29	8.65	1.52	0.93	35.09	22.39	1.55
1050.00	17.33	31.37	7.99	8.58	1.80	1.01	34.37	21.50	1.62
1100.00	16.74	31.93	6.93	9.70	1.99	1.09	34.51	21.71	1.68
1150.00	17.39	31.17	6.48	12.58	1.81	1.15	35.17	22.25	1.78
1200.00	18.14	30.40	6.37	16.53	1.61	1.17	35.91	22.77	1.83

## 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 = 2.70V, Id = 63.36mA @ Temperature = +105°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
1.00	23.24	28.59	9.27	11.17	1.10	0.66	26.44	13.24	--
3.00	23.56	28.12	11.15	20.52	1.09	0.69	26.61	13.54	--
5.00	23.54	27.89	11.56	24.75	1.08	0.68	26.93	13.58	--
7.00	23.48	27.62	11.84	26.39	1.07	0.67	27.47	13.53	--
9.00	23.39	27.35	12.17	26.36	1.06	0.65	27.89	13.83	--
10.00	23.33	27.21	12.33	26.11	1.05	0.65	28.11	13.83	1.21
20.00	22.80	26.09	14.13	22.86	1.03	0.58	30.12	15.21	1.27
30.00	22.45	25.52	15.85	21.52	1.03	0.54	31.38	16.38	1.26
40.00	22.26	25.23	17.17	20.83	1.03	0.52	31.69	17.15	1.22
50.00	22.13	25.07	18.07	20.63	1.03	0.51	31.57	17.53	1.21
60.00	22.05	24.97	18.62	20.45	1.04	0.50	31.74	17.74	1.22
70.00	21.99	24.92	19.00	20.22	1.04	0.50	31.94	17.76	1.27
80.00	21.95	24.90	19.20	20.09	1.04	0.50	32.00	17.91	1.22
90.00	21.91	24.88	19.30	19.94	1.04	0.50	32.10	17.91	1.22
100.00	21.88	24.87	19.23	19.98	1.04	0.50	32.33	17.88	1.25
150.00	21.77	24.88	18.51	20.21	1.05	0.52	31.64	18.01	1.31
200.00	21.67	24.93	17.50	21.13	1.05	0.54	31.85	18.14	1.25
250.00	21.56	25.02	16.68	22.32	1.05	0.57	31.34	18.02	1.22
300.00	21.44	25.11	15.86	23.28	1.06	0.61	31.73	18.25	1.26
350.00	21.30	25.23	15.04	22.35	1.06	0.64	30.96	18.03	1.26
400.00	21.14	25.37	14.32	20.25	1.07	0.67	30.90	18.33	1.26
450.00	20.95	25.55	13.47	18.02	1.08	0.70	30.43	18.16	1.28
500.00	20.69	25.78	12.65	16.08	1.09	0.74	29.71	17.98	1.35
550.00	20.29	26.17	11.54	14.61	1.11	0.80	29.62	17.87	1.28
600.00	20.01	26.44	10.58	15.08	1.13	0.86	29.31	17.88	1.64
650.00	20.07	26.38	10.56	14.26	1.12	0.84	29.06	18.07	1.41
700.00	19.92	26.52	10.34	12.66	1.13	0.84	28.98	17.92	1.39
750.00	19.67	26.77	10.00	11.39	1.14	0.85	28.56	18.05	1.47
800.00	19.35	27.07	9.60	10.35	1.16	0.86	28.35	17.83	1.44
850.00	18.97	27.45	9.14	9.44	1.19	0.88	27.78	17.47	1.48
900.00	18.47	27.95	8.60	8.66	1.23	0.90	27.10	17.45	1.48
950.00	17.80	28.60	7.91	8.00	1.30	0.93	26.52	16.66	1.53
1000.00	16.87	29.53	7.02	7.54	1.43	0.98	25.47	15.98	1.54
1050.00	15.75	30.64	6.05	7.57	1.64	1.06	24.55	15.10	1.59
1100.00	15.19	31.06	5.26	8.66	1.76	1.16	24.50	15.27	1.67
1150.00	15.81	30.25	4.95	11.08	1.61	1.23	25.58	15.74	1.77
1200.00	16.47	29.50	4.92	13.47	1.45	1.26	26.60	16.57	1.86



## Typical Performance Data

### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

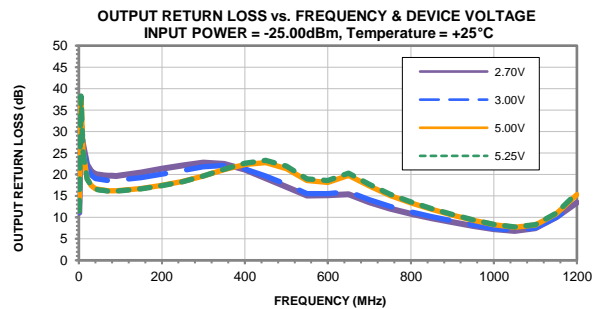
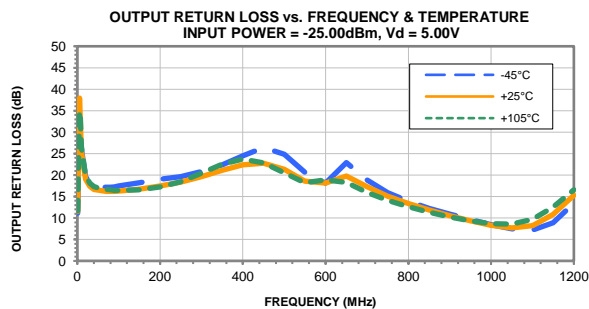
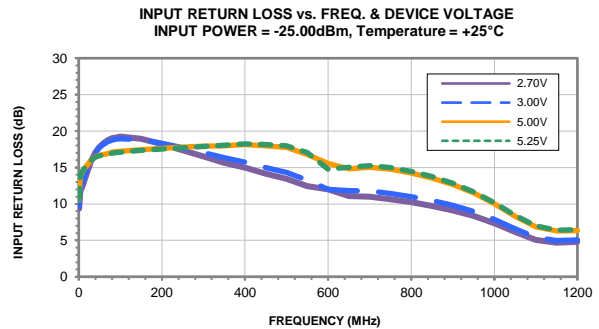
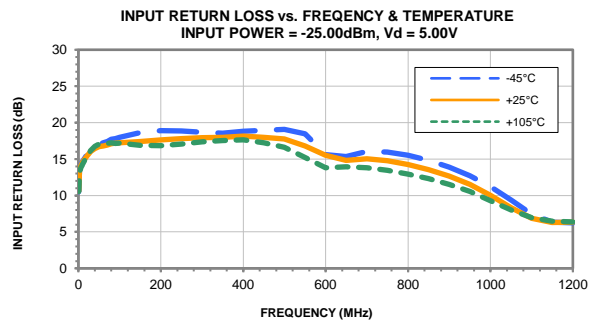
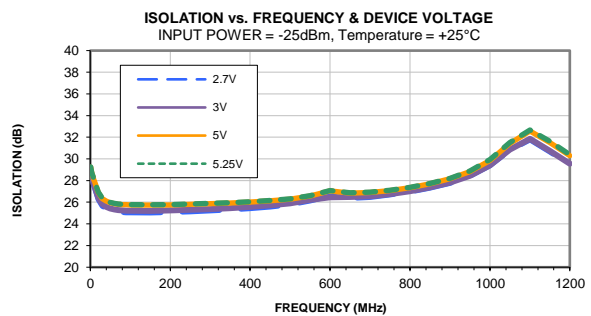
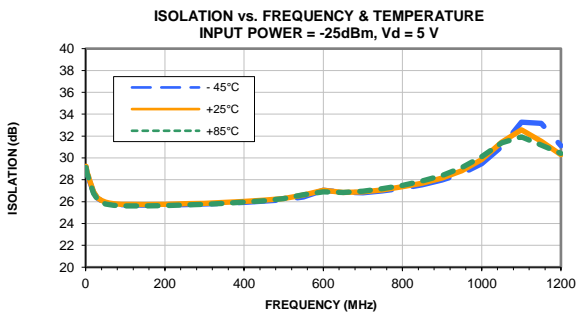
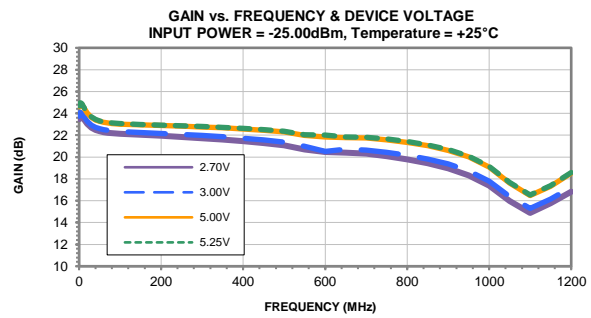
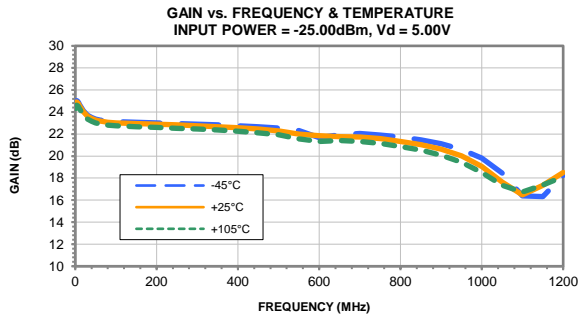
Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

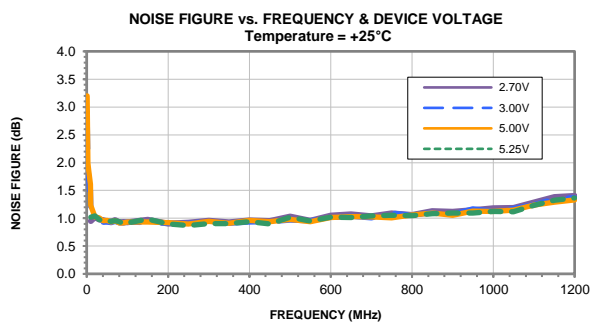
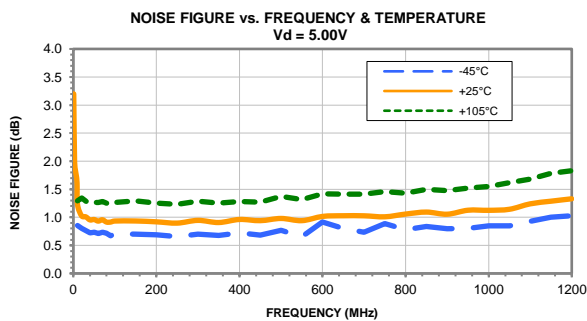
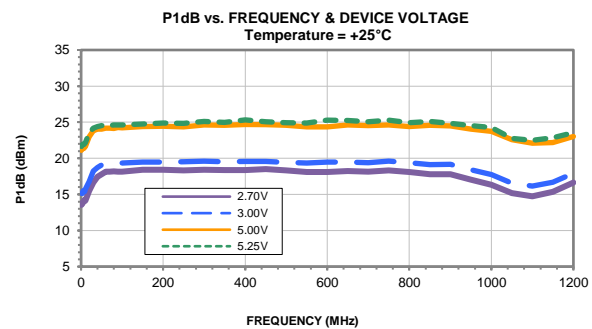
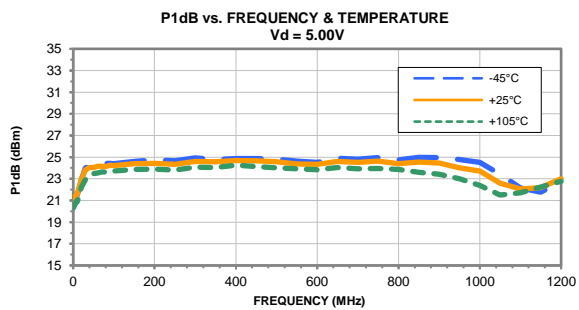
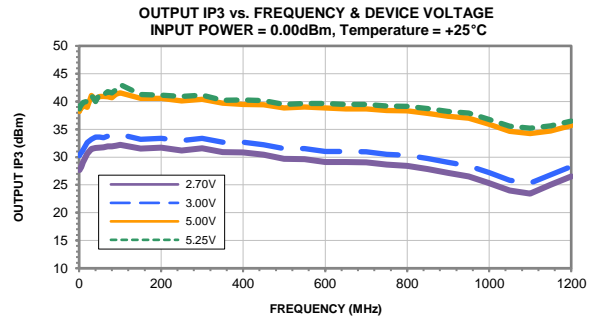
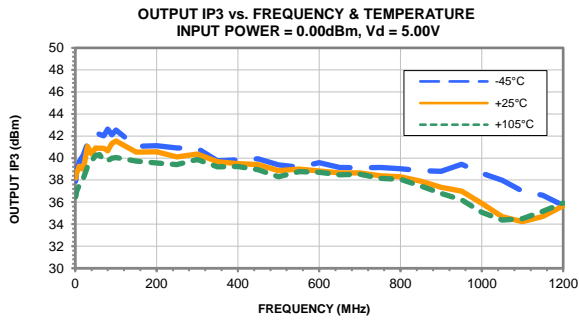
TEST CONDITIONS: Vd = 5.25V, Id = 145.54mA @ Temperature = +105°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)			(dBm)	(dBm)	(dB)
1.00	24.37	29.12	10.65	11.62	1.09	0.60	36.69	20.85	--
3.00	24.67	28.68	13.29	23.19	1.08	0.63	37.18	21.13	--
5.00	24.63	28.46	13.78	34.86	1.07	0.62	37.36	21.17	--
7.00	24.55	28.21	14.03	34.66	1.06	0.61	37.57	21.13	--
9.00	24.45	27.95	14.27	28.05	1.05	0.60	37.71	21.41	--
10.00	24.39	27.82	14.37	26.38	1.04	0.59	37.79	21.38	1.32
20.00	23.80	26.79	15.35	19.71	1.02	0.54	38.89	22.70	1.38
30.00	23.41	26.24	16.17	18.04	1.02	0.50	39.43	23.37	1.32
40.00	23.19	25.98	16.67	17.26	1.02	0.48	39.40	23.67	1.29
50.00	23.06	25.83	16.92	16.98	1.03	0.47	39.67	23.83	1.27
60.00	22.97	25.74	17.01	16.76	1.03	0.46	40.43	23.98	1.29
70.00	22.90	25.70	17.01	16.58	1.03	0.46	40.19	23.99	1.32
80.00	22.86	25.67	17.12	16.46	1.04	0.46	40.24	24.09	1.27
90.00	22.82	25.65	17.06	16.34	1.04	0.46	40.77	24.09	1.26
100.00	22.79	25.65	16.98	16.36	1.04	0.46	40.30	24.08	1.27
150.00	22.70	25.65	16.72	16.49	1.04	0.47	40.03	24.22	1.28
200.00	22.63	25.68	16.70	17.21	1.05	0.49	40.08	24.35	1.28
250.00	22.56	25.73	17.02	18.39	1.05	0.51	39.78	24.29	1.27
300.00	22.49	25.79	17.34	20.43	1.06	0.54	40.17	24.55	1.20
350.00	22.41	25.87	17.62	22.70	1.06	0.56	39.68	24.41	1.29
400.00	22.30	25.98	17.79	24.15	1.07	0.59	39.59	24.63	1.30
450.00	22.17	26.11	17.42	23.43	1.08	0.62	39.36	24.62	1.28
500.00	21.97	26.30	16.80	21.00	1.09	0.66	38.77	24.49	1.37
550.00	21.63	26.66	15.43	18.57	1.12	0.72	39.23	24.41	1.32
600.00	21.37	26.93	13.98	19.32	1.15	0.77	39.30	24.35	1.43
650.00	21.48	26.86	14.12	18.66	1.14	0.75	39.10	24.55	1.46
700.00	21.40	26.98	14.01	16.18	1.14	0.75	39.11	24.43	1.45
750.00	21.20	27.21	13.65	14.25	1.16	0.76	38.82	24.58	1.47
800.00	20.94	27.52	13.13	12.72	1.19	0.78	38.69	24.25	1.45
850.00	20.60	27.92	12.49	11.43	1.22	0.80	38.16	24.07	1.50
900.00	20.14	28.44	11.69	10.33	1.28	0.83	37.53	23.78	1.50
950.00	19.49	29.16	10.68	9.40	1.37	0.87	36.88	23.17	1.55
1000.00	18.56	30.19	9.42	8.73	1.54	0.93	35.75	22.84	1.63
1050.00	17.39	31.45	8.09	8.67	1.82	1.01	35.10	21.97	1.61
1100.00	16.79	32.01	7.04	9.83	2.02	1.09	35.34	22.18	1.69
1150.00	17.44	31.27	6.58	12.80	1.83	1.15	36.01	22.64	1.79
1200.00	18.21	30.50	6.46	16.98	1.63	1.17	36.74	23.32	1.83

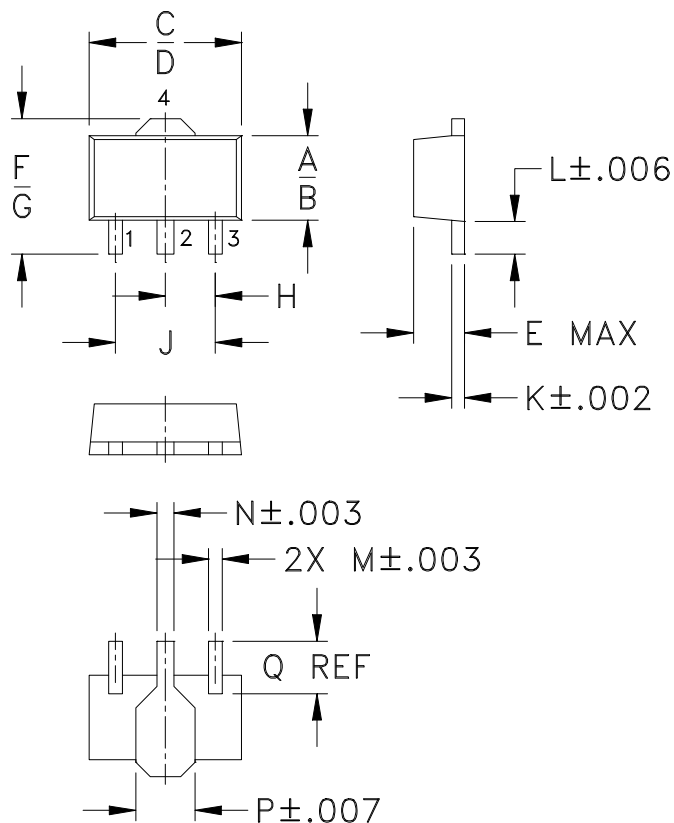
## Typical Performance Curves



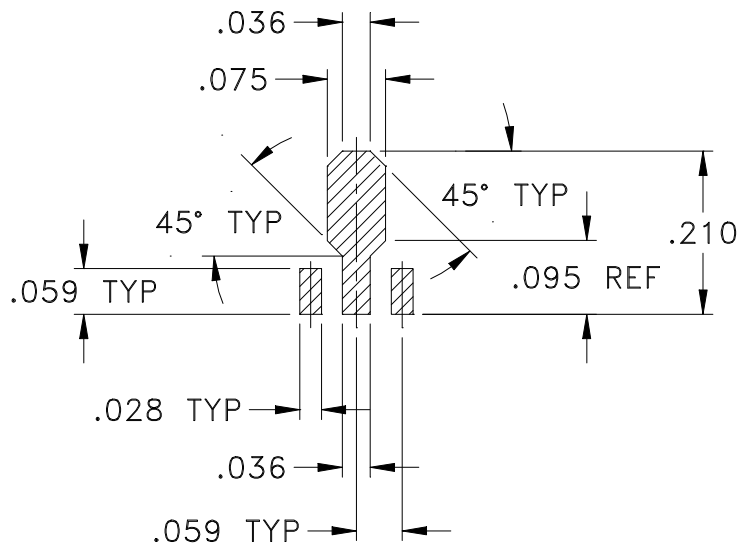
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

CASE #	A	B	C	D	E	F	G	H	J	K	L	M
DF782	.102 (2.59)	.090 (2.29)	.181 (4.60)	.173 (4.39)	.063 (1.60)	.167 (4.24)	.155 (3.94)	.059 (1.50)	.118 (3.00)	.015 (0.38)	.041 (1.04)	.016 (0.41)

CASE #	N	P	Q	WT. GRAM
DF782	.019 (0.48)	.065 (1.65)	.062 (1.57)	.2

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .01$ ; 3Pl.  $\pm .005$

#### Notes:

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



INTERNET <http://www.minicircuits.com>

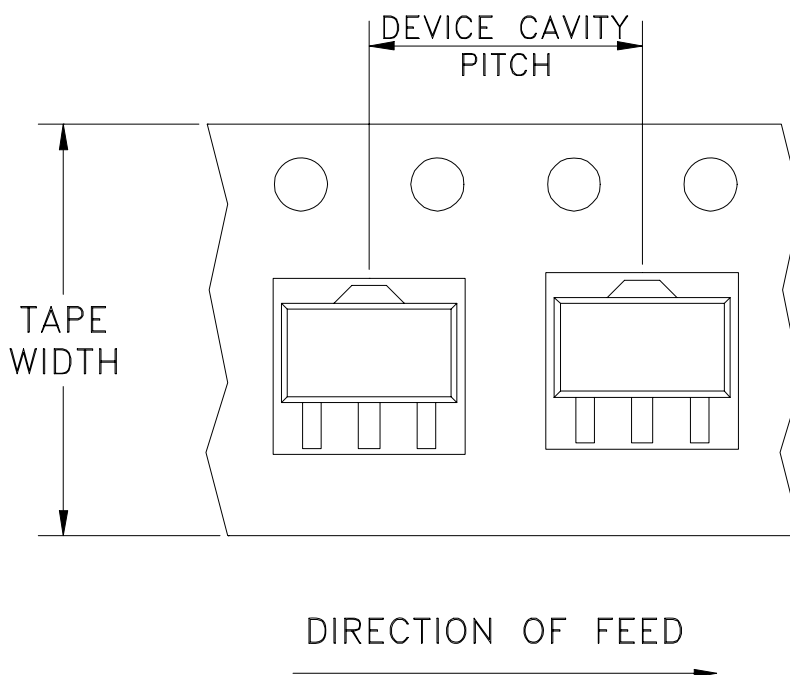
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# Tape & Reel Packaging TR-F55

## DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
12	8	7	Small quantity standard (see note)	20
				50
				100
				200
			500	
			Standard	1000

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](http://www.minicircuits.com/pages/pdfs/tape.pdf)

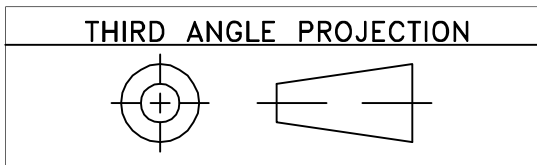


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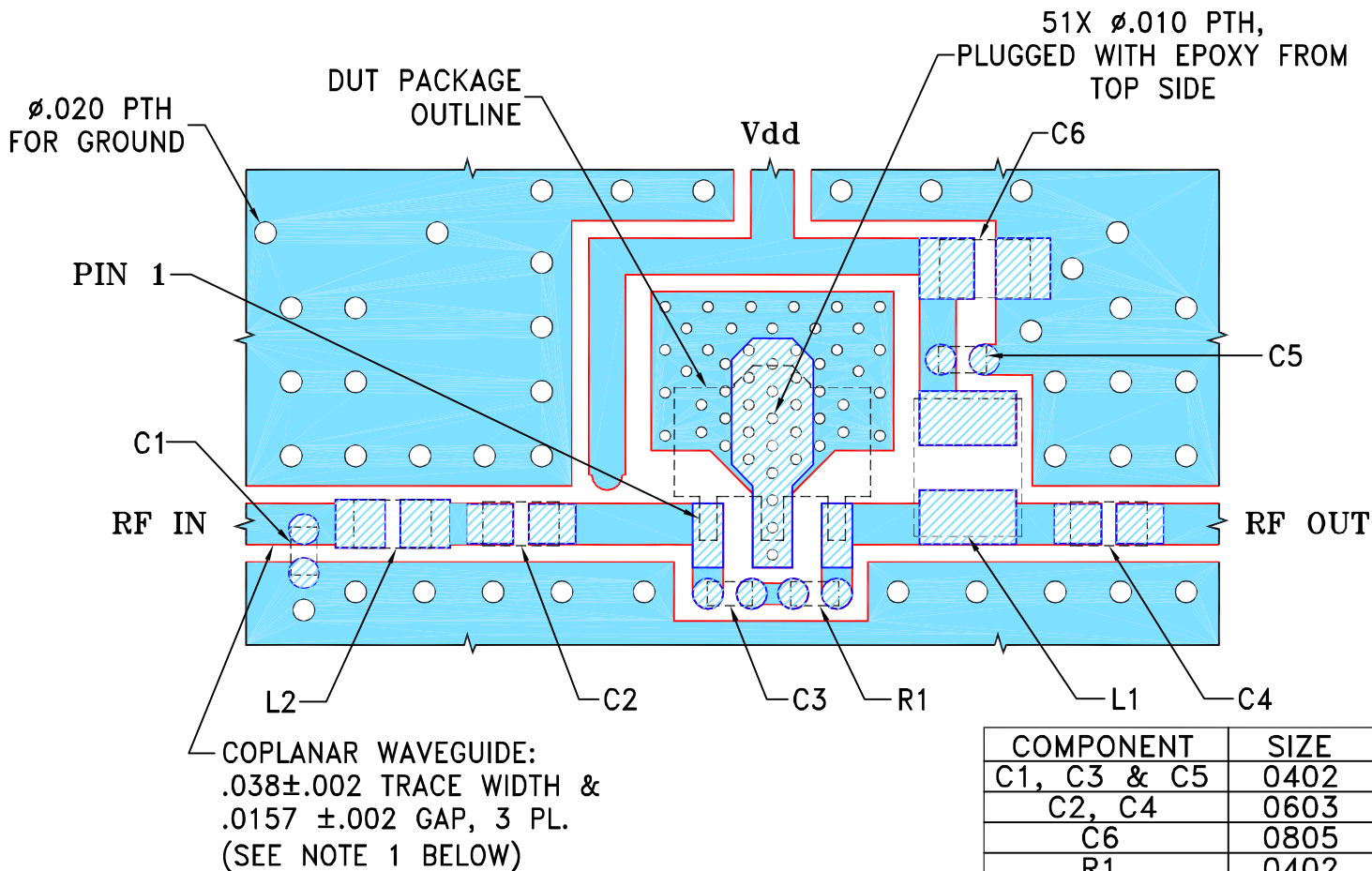
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REVISIONS					
REV OR	ECN No.	DESCRIPTION	DATE	DR	AUTH
	M162958	NEW RELEASE	08/11/17	CA	RS

**SUGGESTED MOUNTING CONFIGURATION FOR  
DF782 CASE STYLE, "04AM03" PIN CONNECTION**



COMPONENT	SIZE
C1, C3 & C5	0402
C2, C4	0603
C6	0805
R1	0402
L1	1210
L2	0603

**NOTES:**

1. TRACE WIDTH AND GAP PARAMETERS ARE SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .020" ±0015; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. CHIP COMPONENT FOOT PRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-969-13HLN+ AND TB-969-13LN+.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS 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	CA	08/07/17
TOLERANCES ON:	GF	08/11/17
2 PL DECIMALS ±	RS	08/11/17
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		



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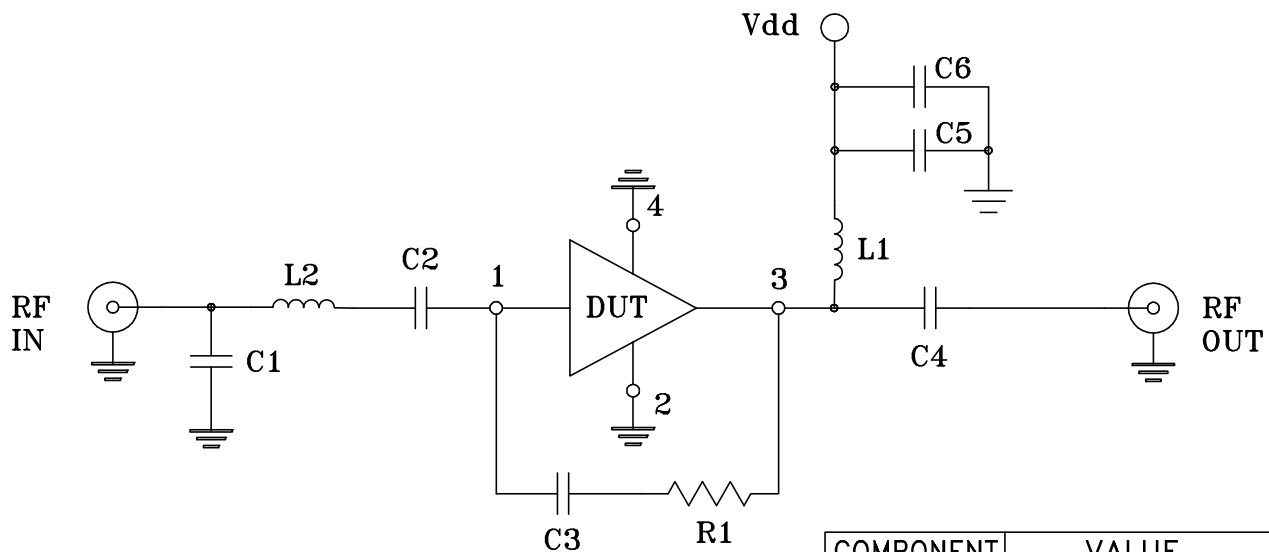
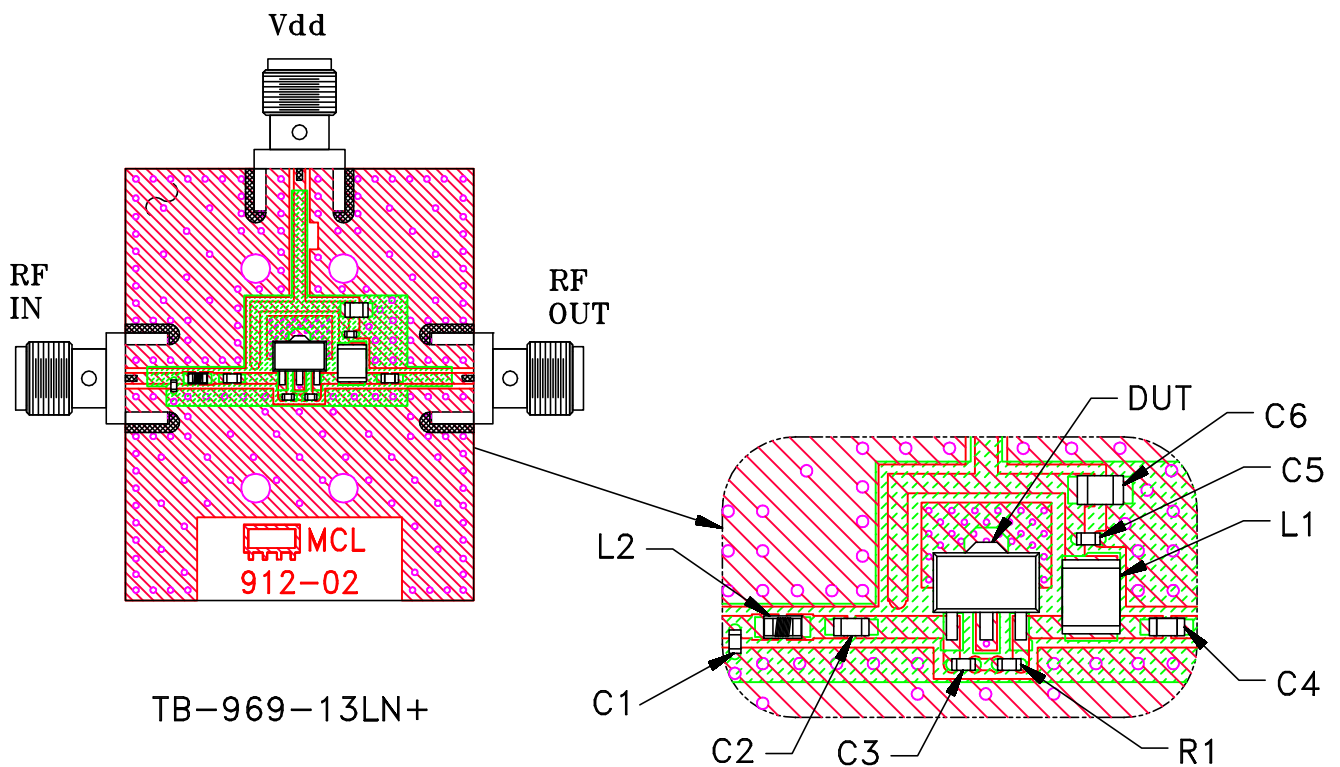
13 Neptune Avenue  
Brooklyn NY 11235

**PL, 04M03, DF782, TB-969-13(H)LN+**

SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-523	REV: OR
FILE: 98PL523	SCALE: 6:1	SHEET: 1 OF 1	

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# Evaluation Board and Circuit




Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.020 inch.

COMPONENT	VALUE	SIZE
DUT	PHA-13LN+	SOT-89
C1	Capacitor 1.5 pF	0402
C2,C4	Capacitor 2.2 uF	0603
C3	Capacitor 0.1 uF	0402
C5	Capacitor 0.001 uF	
C6	Capacitor 10 uF	0805
R1	Resistor 1.5 KOhm	0402
L1	Inductor 15 uH	1210
L2	Inductor 5.1 nH	0603

 **Mini-Circuits®**



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 95° C / 105° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
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-C, 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-020C, 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
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether +	MIL-STD-202, Method 215





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
	monoethanolamine at 63°C to 70°C	