



ULTRA HIGH DYNAMIC RANGE

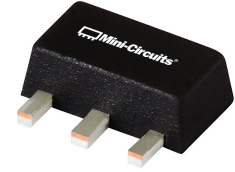
# Monolithic Amplifier

## PHA-13LN+

50Ω 1 MHz 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.



Generic photo used for illustration purposes only

CASE STYLE: DF782

### APPLICATIONS

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

#### +RoHS Compliant

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

### 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: 1 MHz to 1 GHz	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.

\* Enhancement mode pseudomorphic High Electron Mobility Transistor.

REV. A  
ECO-010399  
PHA-13LN+  
MCL NY  
240722





ULTRA HIGH DYNAMIC RANGE

# Monolithic Amplifier

## PHA-13LN+

50Ω 1 MHz to 1 GHz

### ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, 50Ω, UNLESS NOTED OTHERWISE.

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	
	1000		8.9		7.8	
Reverse Isolation	500		26.1		25.7	dB
Output Power @1 dB compression	1		+21.3		+15.1	dBm
	20		+23.0		+16.9	
	250		+24.4		+19.5	
	500		+24.5		+19.5	
	1000		+24.2		+18.7	
Output IP3 <sup>2</sup>	1	—	+37.0	—	+30.6	dBm
	20	—	+40.2	—	+33.3	
	250	—	+40.2	—	+33.4	
	500	+36.0	+39.0	—	+32.3	
	1000	—	+36.4	—	+28.6	
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 Junction-to-ground lead at 85°C stage temperature			23.3		23.3	°C/W

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



ULTRA HIGH DYNAMIC RANGE

# Monolithic Amplifier

## PHA-13LN+

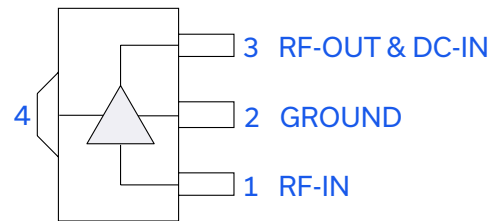
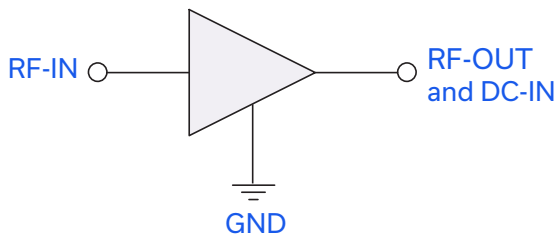
50Ω 1 MHz to 1 GHz

### 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	+10 V

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 95°C.  
 6. up to 85°C, derate linearly to 18 dBm at 95°C.

### 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.



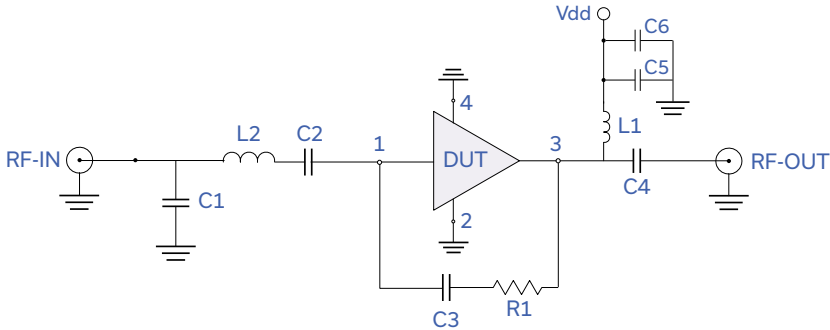
ULTRA HIGH DYNAMIC RANGE

# Monolithic Amplifier

## PHA-13LN+

50Ω 1 MHz to 1 GHz

### CHARACTERIZATION TEST / RECOMMENDED APPLICATION CIRCUIT



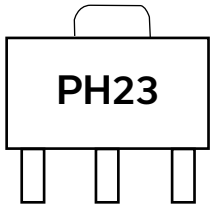
Components	Size	Value	Manufacturer	P/N
C1	0402	1.5 pF	Murata	GRM1555C1H1R5CZ01
C2	0603	2.2 uF		GRM188R61C225KE15
C3	0402	0.1uF		GRM155R71C104KA88
C4	0603	2.2 uF		GRM188R61C225KE15
C5	0402	1000 pF		GRM1555C1H102JA01
C6	0805	10 uF		GRM21BR61C106KE15
L1	1210	15 uH	Coilcraft	LQH32DN150K53L
L2	0603	5.1 nH	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:  $P_{IN} = -25\text{dBm}$
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





ULTRA HIGH DYNAMIC RANGE

# Monolithic Amplifier

## PHA-13LN+

50Ω 1 MHz to 1 GHz

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. [CLICK HERE](#)

Performance Data	Data Table Swept Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	DF782 (SOT 89) Plastic package, exposed paddle lead finish: matte-tin
Tape & Reel Standard quantities available on reel	F55 7" reels with 20, 50, 100, 200, 500 or 1K devices
Suggested Layout for PCB Design	PL-523
Evaluation Board	TB-969-13LN+
Environmental Ratings	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

- 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)



## 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)	K	Measure	(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)	K	Measure	(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)	K	Measure	(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)	K	Measure	(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)	K	Measure	(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)			(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)

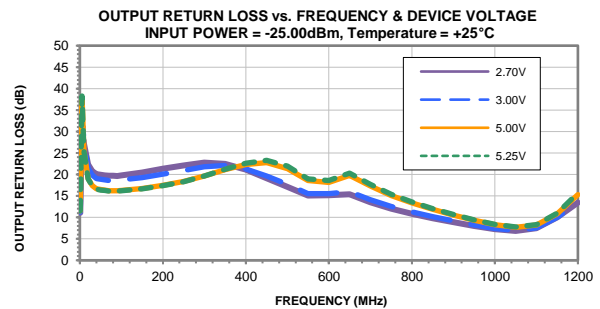
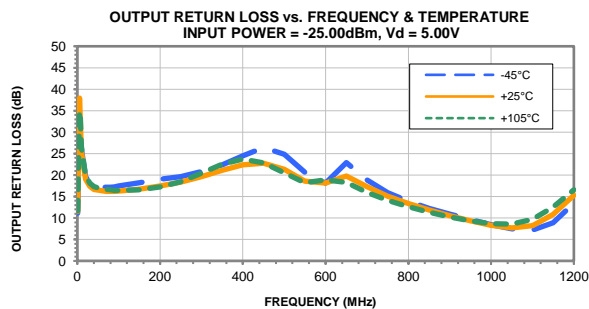
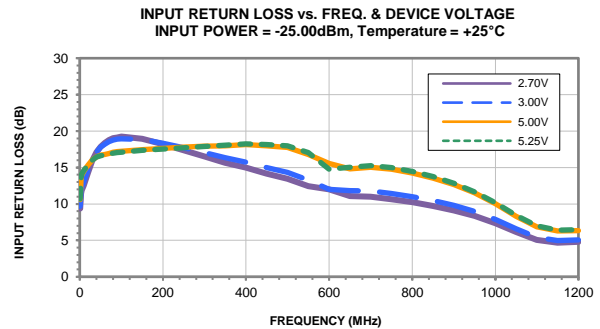
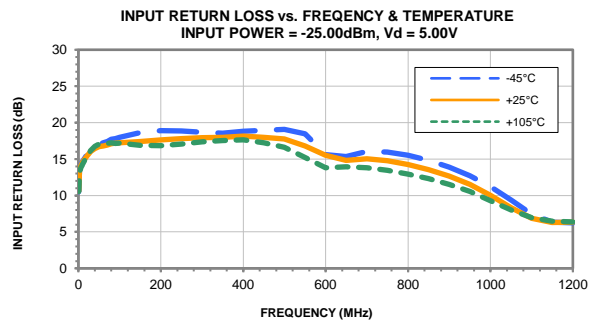
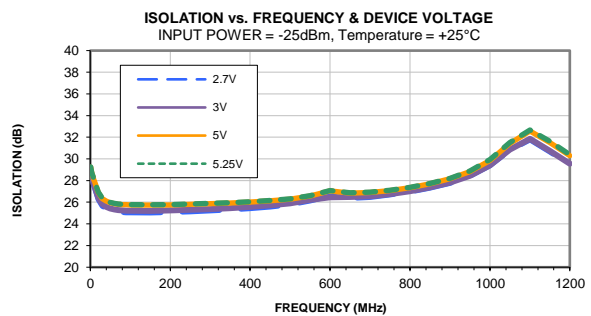
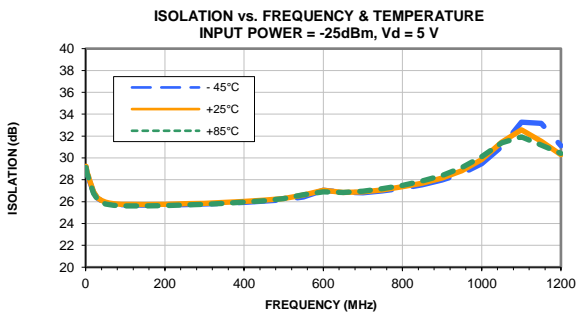
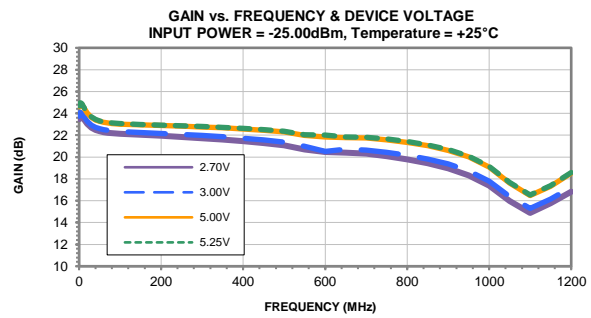
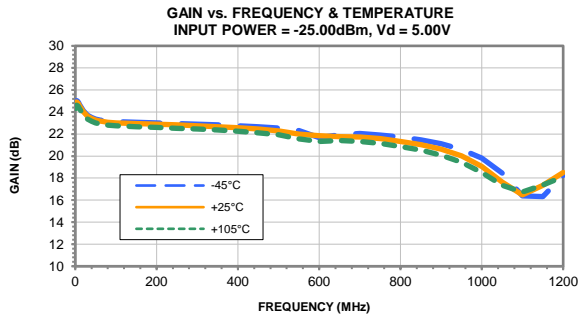
Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

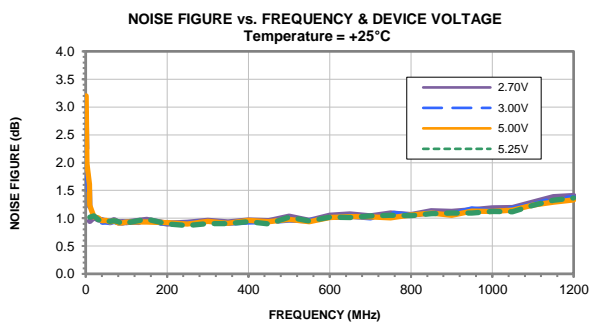
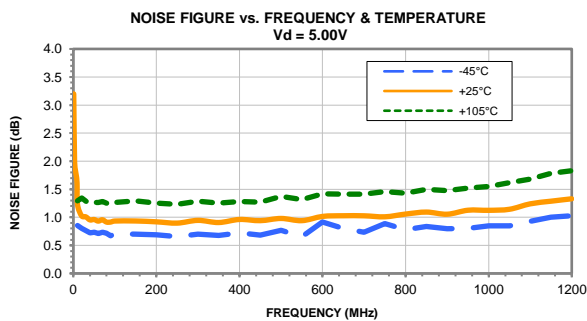
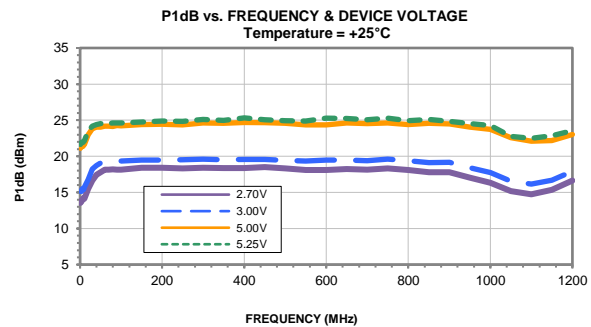
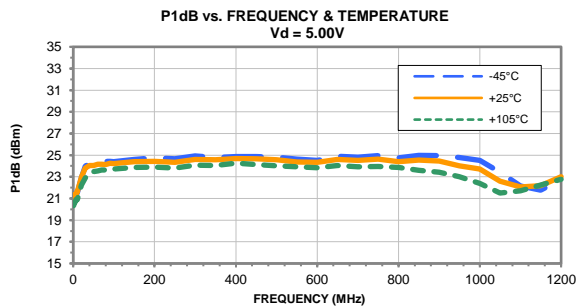
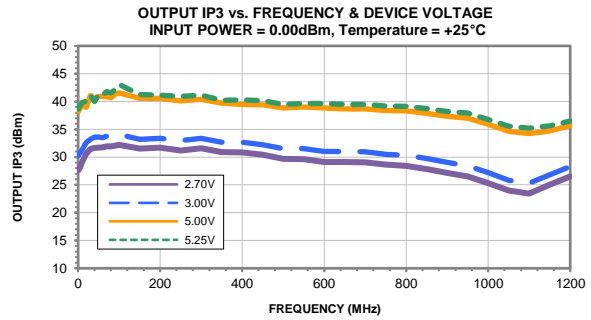
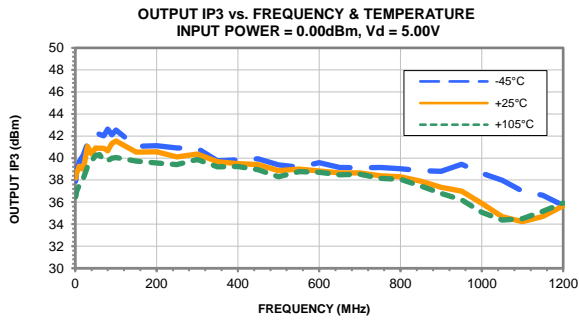
TEST CONDITIONS: Vd = 5.25V, Id = 145.54mA @ Temperature = +105°C

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)	K	Measure	(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

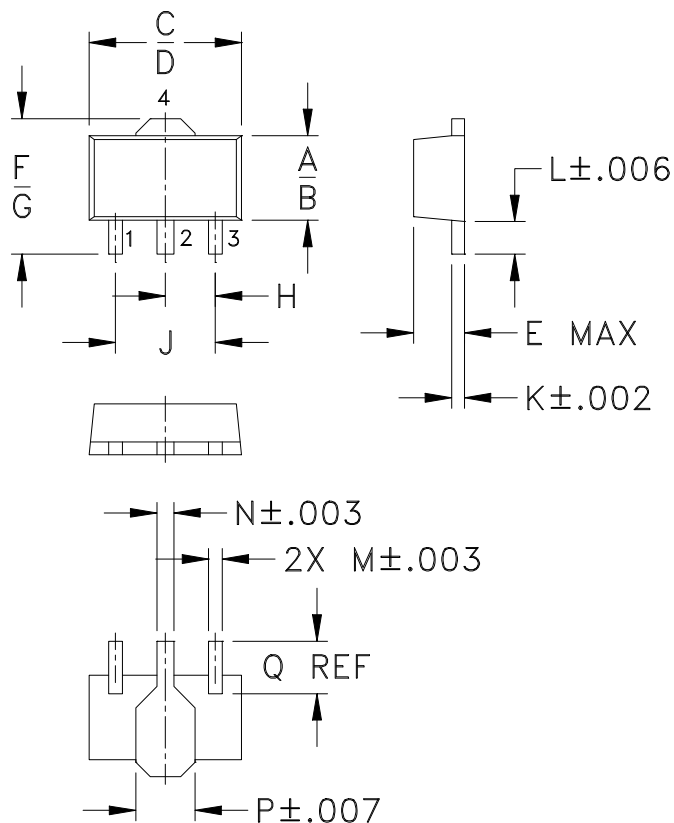
## Typical Performance Curves



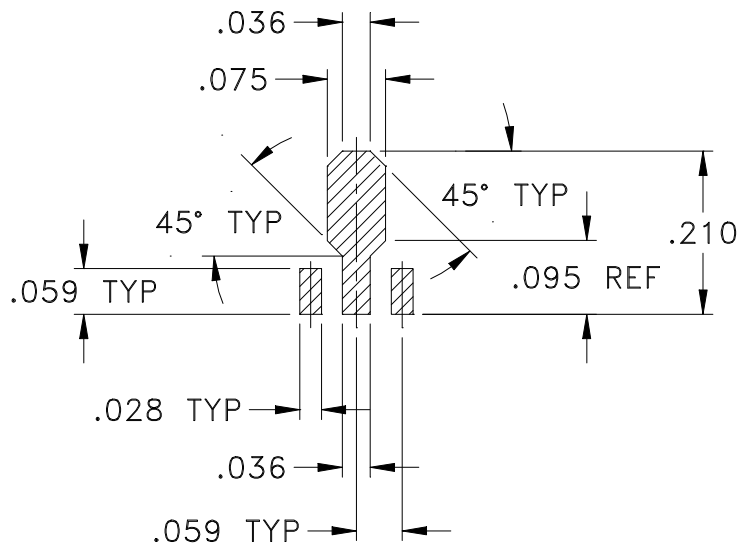
## Typical Performance Curves



### 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>

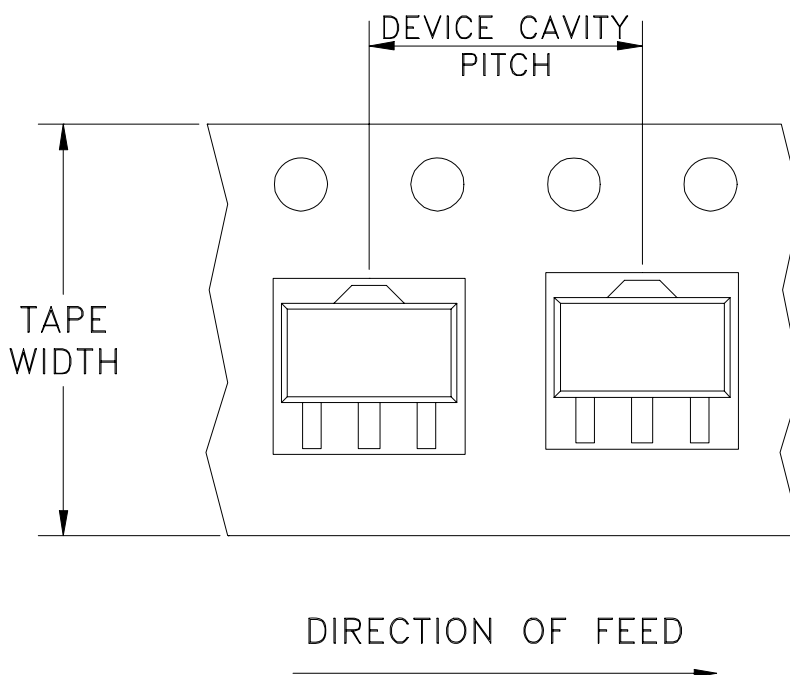
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

Mini-Circuits ISO 9001 & ISO 14001 Certified

# 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)

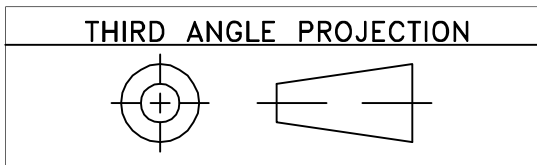


INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

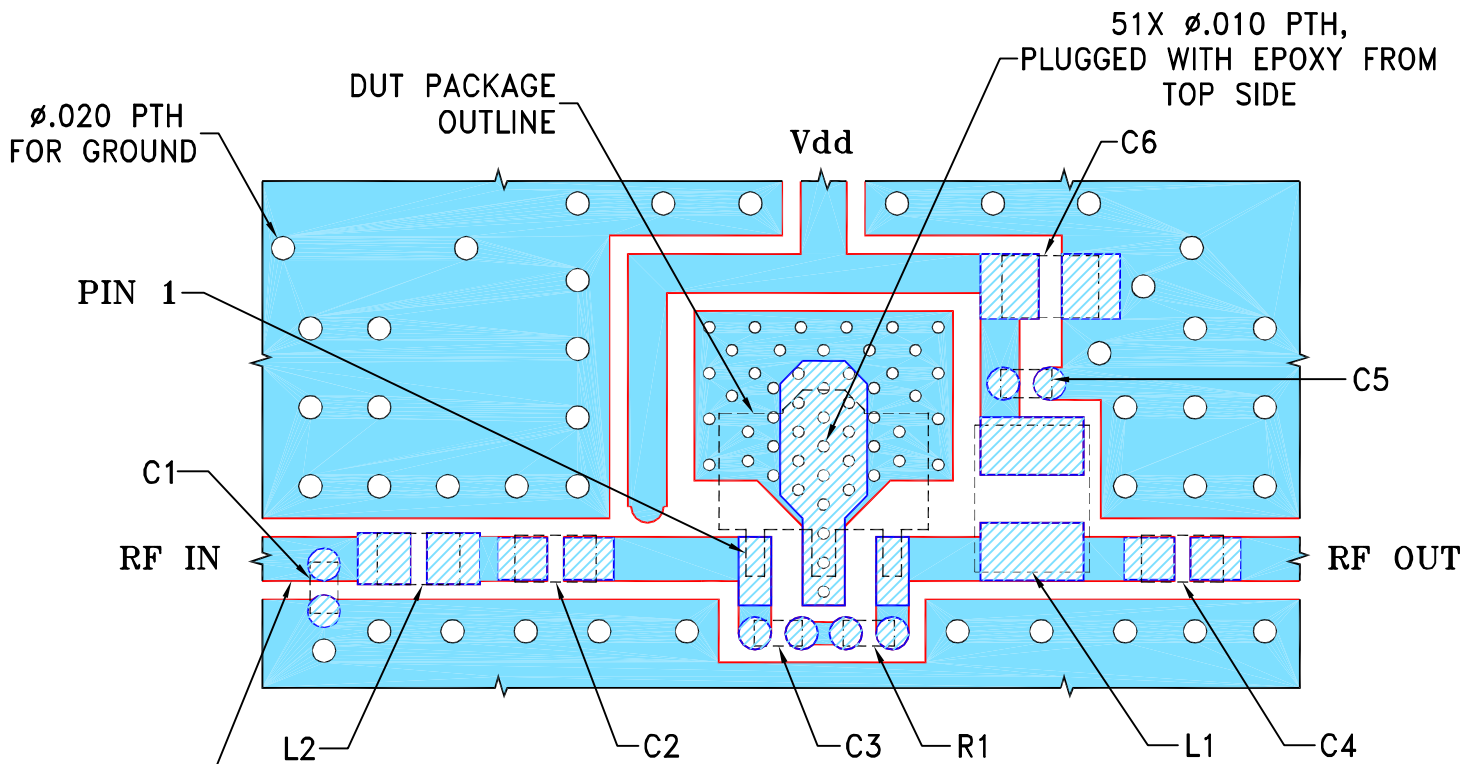
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

Mini-Circuits ISO 9001 & ISO 14001 Certified



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**



COPLANAR WAVEGUIDE:  
 .038±.002 TRACE WIDTH &  
 .0157 ±.002 GAP, 3 PL.  
 (SEE NOTE 1 BELOW)

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 ±		

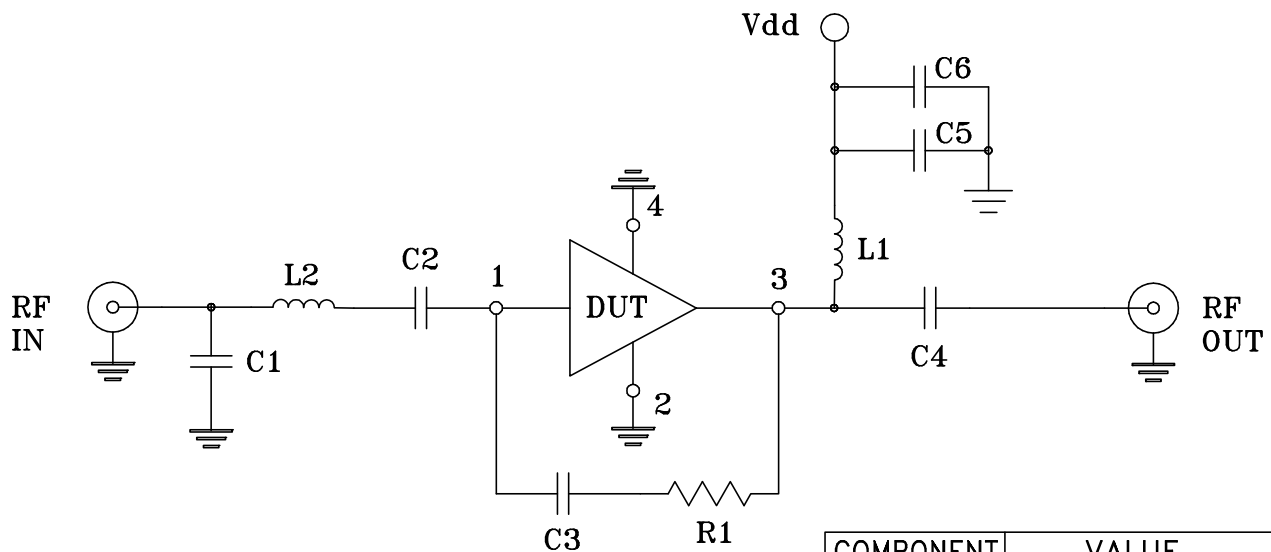
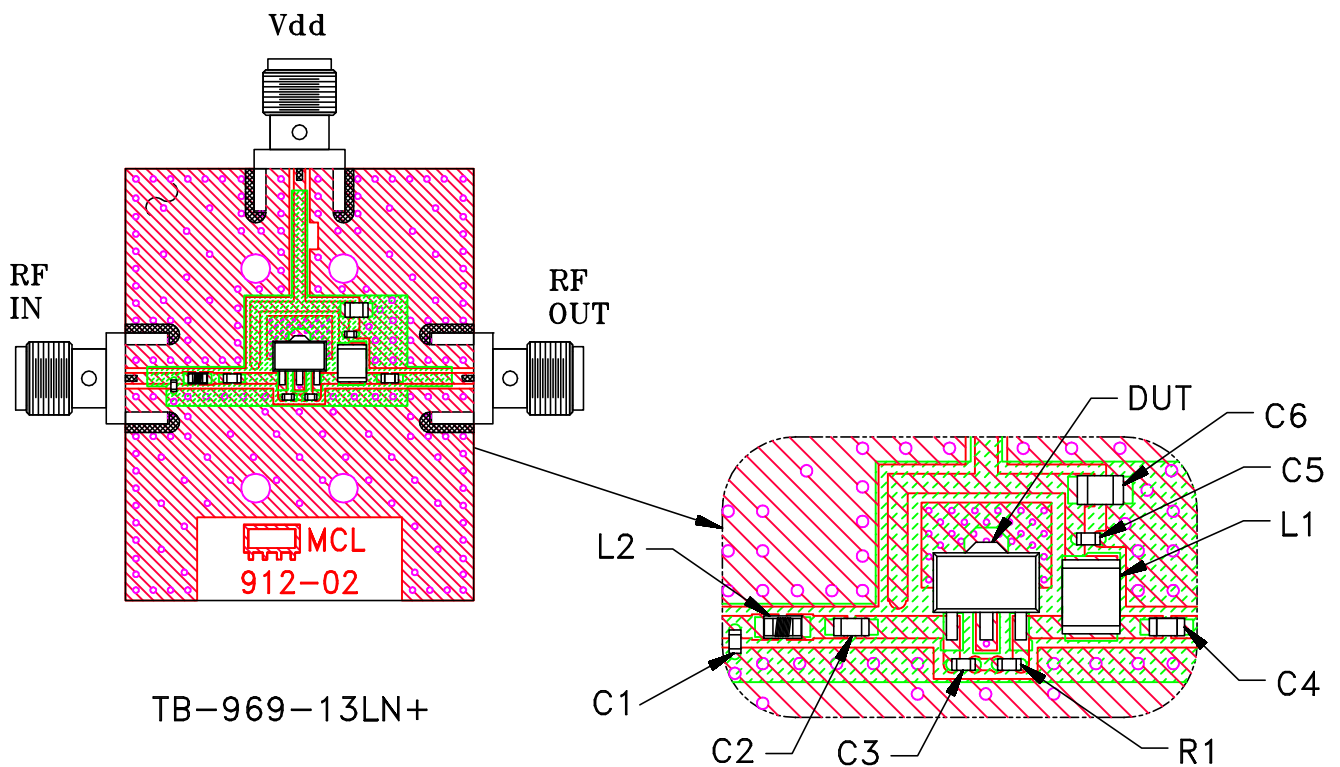
**Mini-Circuits®** 13 Neptune Avenue  
 Brooklyn NY 11235

**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	

Mini-Circuits®  
 THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS. EXCEPT FOR USE EXPRESSLY GRANTED, IN WRITING, TO ITS VENDORS, VENDEE AND THE UNITED STATES GOVERNMENT, MINI-CIRCUITS RESERVES ALL PROPRIETARY DESIGN, USE, MANUFACTURING AND REPRODUCTION RIGHTS THERETO. THESE CONTENTS SHALL NOT BE USED, DUPLICATED OR DISCLOSED TO ANY OUTSIDE PARTY, IN WHOLE OR IN PART, WITHOUT WRITTEN PERMISSION OF MINI-CIRCUITS.

# 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	