



ULTRA-HIGH DYNAMIC RANGE, SHUTDOWN

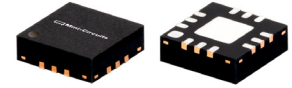
# Monolithic Amplifier

## TSS-13HLN+

50Ω 1 MHz to 1 GHz

### THE BIG DEAL

- Ultra-High IP3, +42.9 dBm typ.
- Gain, 23 dB typ. at 0.5 GHz
- Medium power, +28.4 dBm typ.
- Excellent Noise Figure, 1.4 dB typ.
- Shutdown feature
- Suitable for low phase noise applications



Generic photo used for illustration purposes only

CASE STYLE: DQ1225

### +RoHS Compliant

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

### APPLICATIONS

- Base station infrastructure
- CATV
- Cellular

### PRODUCT OVERVIEW

TSS-13HLN+ (RoHS compliant) is an advanced wideband amplifier with shutdown feature. It is fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the TSS-13HLN+ has good input and output return loss over a broad frequency range. TSS-13HLN+ is enclosed in a 3x3mm, 12-lead MCLP 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 +40.6 dBm typical at 1 MHz +42.9 dBm typical at 0.5 GHz	The TSS-13HLN+ 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 14-15 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>
Shutdown feature	Allow users to turn on and off the amplifier with pulsed signals while keeping the power supply at constant voltage to minimize DC power consumption
Low Noise Figure 1.4 dB at 0.5 GHz	Enables lower system noise figure performance and along with High OIP3 provides high dynamic range
High P1dB, +28.4 dBm at 0.5 GHz	High P1dB, High OIP3, Low NF results in a very dynamic range preventing amplifier saturation under strong interfering signals.
Low additive phase noise, typically -162 dBc/Hz @10 KHz offset	Ideal for low phase noise synthesizer applications

REV. B  
ECO-011809  
TSS-13HLN+  
MCL NY  
240805





ULTRA-HIGH DYNAMIC RANGE, SHUTDOWN

# Monolithic Amplifier

# TSS-13HLN+

Mini-Circuits

50Ω 1 MHz to 1 GHz

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

Parameter	Condition (MHz)	Vd = +8V		Vd = +5V		Vd = +3V		Units
		ON State	OFF State	ON State	OFF State	ON State	OFF State	
Frequency Range		1-1000	1-1000	1-1000	1-1000	1-1000	1-1000	MHz
Noise Figure	1	3	—	3.1	—	3	—	dB
	20	1.4	—	1.1	—	1.1	—	
	250	1.3	—	1.1	—	1.1	—	
	500	1.4	—	1.1	—	1.1	—	
	1000	1.6	—	1.2	—	1.3	—	
Additive Phase Noise 1.0 GHz, 10KHz offset		-162						dBc/Hz
Gain	1	25	-24	24.7	-24	23.9	-24	dB
	20	24.4	-22	24.2	-21	23.5	-22	
	250	23.2	-21	23	-21	22.3	-21	
	500	23	-22	22.8	-22	21.9	-22	
	1000	21.1	-26	20.9	-27	19.5	-27	
Reversed Isolation	1-1000	26	27	26	27	26	27	dB
Input Return Loss	1	11	12	11	12	10	12	dB
	20	16	12	15	12	15	12	
	250	17	12	18	12	19	12	
	500	20	12	21	12	17	12	
	1000	14	10	14	10	10	10	
Output Return Loss	1	11	1	11	1	11	1	dB
	20	19	2	19	2	21	2	
	250	18	2	18	2	21	2	
	500	33	2	25	2	21	2	
	1000	12	2	11	2	10	2	
Output Power @1dB compression AMP-ON	1	25.2	--	+20.3	--	+14.2	--	dBm
	20	26.7	--	+22.4	--	+16.3	--	
	250	28	--	+24.1	--	+19.3	--	
	500	28.4	--	+24.5	--	+19.5	--	
	1000	26.7	--	+23.4	--	+18.3	--	
Output IP3 (Pout = 0dBm/Tone)	1	40.6	--	+38.4	--	+31.6	--	dBm
	20	41.3	--	+40.3	--	+33.2	--	
	250	41.2	--	+39.6	--	+34.4	--	
	500	42.9	--	+39.2	--	+33	--	
	1000	40.8	--	+36.2	--	+29.4	--	
Device Operating Voltage(VDD)		+8	+8	+5	+5	+3	+3	V
Device Operating Current(ID) <sup>4</sup>		234	7.5	142	5	72	3	mA
Control Voltage (VG)		0	+5	0	+5	0	+5	V
Device Current Variation vs. Temperature <sup>3</sup>		-136	--	10	--	33	--	uA/degC
Device Current Variation vs. Voltage		0.025	--	0.025	--	0.033	--	mA/mV
Thermal Resistance		23.3	--	23.3	--	23.3	--	degC/W

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

2. (Current at 95°C – Current at -45°C)/140

## ABSOLUTE MAXIMUM RATINGS<sup>3</sup>

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to +95°C
Storage Temperature	-65°C to +150°C
Total Power Dissipation	3.3W
Input Power	+28 dBm (5 minutes max.) +10 dBm (continuous) for 1- 30 MHz +18 dBm (continuous) for 0.03-1 GHz
DC Voltage V <sub>DD</sub> <sup>4</sup> (Pad 7)	+10 V
DC Voltage V <sub>G</sub> <sup>5</sup> (Pad 1)	+10 V

3 Permanent damage may occur if these limits are exceeded.

4 Measured by keeping VG=0V.

5 Measured by keeping Vdd=8V.

## CONTROL VOLTAGE (V<sub>G</sub>) FIG. 1

	Min.	Typ.	Max.	Units
Amplifier-ON	—	0	0.7	V
Amplifier-OFF	1.9	5	—	V





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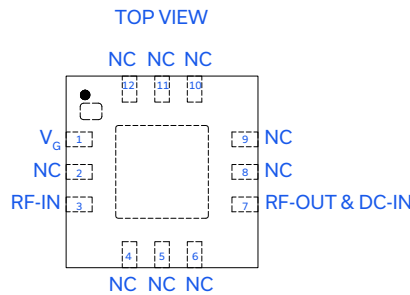
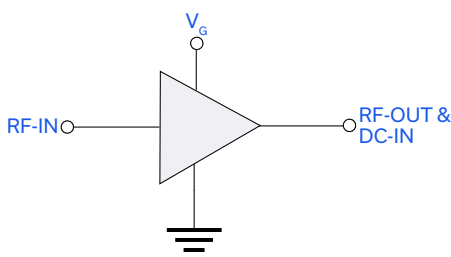
# TSS-13HLN+

50Ω 1 MHz to 1 GHz

## SWITCHING SPECIFICATIONS

Parameter		Min.	Typ.	Max.	Units
Amplifier ON to Shutdown	OFF TIME (50% Control to 10% RF)	—	5.3	—	μs
	FALL TIME (90 to 10% RF)	—	7.3	—	
Amplifier Shutdown to ON	ON TIME (50% Control to 90% RF)	—	77.7	—	μs
	RISE TIME (10% to 90% RF)	—	54.2	—	
Control Voltage Leakage		—	633.3	—	mV

## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Pad Number	Description
RF-IN	3	RF Input
RF-OUT and DC-IN	7	RF Output and DC Bias
GND	Paddle	Connections to ground.
NC	2, 4-6, 8-12	No connection, grounded externally
VG	1	Control voltage for shutdown (VG)



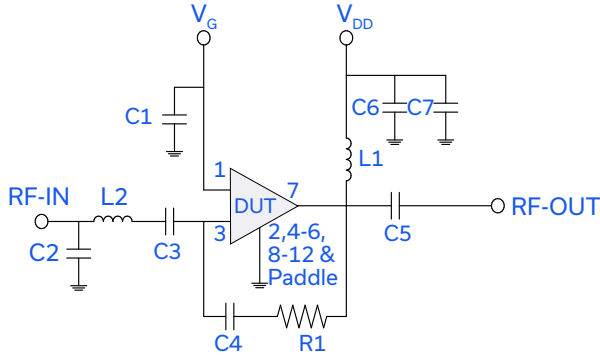
ULTRA-HIGH DYNAMIC RANGE, SHUTDOWN

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## CHARACTERIZATION TEST CIRCUIT / RECOMMENDED APPLICATION CIRCUIT



Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71C104KA88D	Murata
C2	0402	1.5pF	GRM1555C1H1R5CA1D	Murata
C3	0603	2.2uF	GRM188C71E225KE11D	Murata
C4	0402	0.1uF	GRM155R71C104KA88D	Murata
C5	0603	2.2uF	GRM188C71E225KE11D	Murata
C6	0402	1000pF	GRM1555C1H102JA01D	Murata
C7	0805	10uF	GRM21BC71E106KE11L	Murata
L1	1210	15uH	LQH32DN150K53L	Murata
L2	0603	5.1nH	0603CS-5N1XJLU	Coilcraft
R1	0402	1.5KOhm	RK73H1ETTP1501F	Koa

Fig 1. Block diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization test board TB-TSS-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 1 MHz apart, +0dBm/tone at output.
3. Switching Time  
RF Signal:  $P_{IN} = -25\text{ dBm}$ ,  $f_{RF} = 500\text{ MHz}$ .  
 $V_{DD} = 8\text{V DC}$ ,  $V_G = \text{Pulse signal at } 1\text{ KHz with } V_{HIGH} = 5\text{V}, V_{LOW} = 0\text{V}, 50\% \text{ duty cycle.}$

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control



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## TSS-13HLN+

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	DQ1225 Plastic package, exposed paddle lead finish: Matte-Tin
Tape & Reel Standard quantities available on reel	F66 7" reels with 20, 50, 100, 200, 500, 1K, or 2K devices
Suggested Layout for PCB Design	PL-623
Evaluation Board	TB-TSS-13HLN+
Environmental Ratings	ENV08T9

### ESD RATING

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

- 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/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)



## 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 = 8.00V, Id = 236mA @ 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	25.00	29.23	11.03	11.06	1.07	0.53	41.17	25.22	2.87
3	25.35	28.74	14.88	22.04	1.06	0.55	40.94	25.32	1.84
5	25.31	28.45	15.47	30.39	1.05	0.54	40.81	25.28	1.49
7	25.20	28.15	15.60	30.86	1.04	0.52	41.00	25.35	1.52
9	25.08	28.09	15.74	27.06	1.03	0.53	41.05	25.55	1.35
10	25.01	27.84	15.62	24.51	1.02	0.52	41.15	25.59	1.40
20	24.36	26.81	15.80	19.35	1.00	0.46	41.83	26.80	1.39
30	23.93	26.44	15.89	17.70	1.01	0.45	42.68	26.68	1.28
40	23.69	26.24	15.95	17.06	1.02	0.44	42.89	26.96	1.26
50	23.56	25.96	15.96	16.69	1.02	0.43	43.33	28.68	1.25
60	23.45	25.98	15.95	16.60	1.03	0.42	43.53	27.46	1.26
70	23.39	25.95	15.94	16.52	1.03	0.42	43.50	27.74	1.28
80	23.35	25.83	15.97	16.46	1.03	0.41	43.49	27.41	1.26
90	23.32	25.87	16.04	16.47	1.03	0.42	43.56	27.87	1.29
100	23.29	25.89	16.05	16.50	1.03	0.42	43.80	28.31	1.30
150	23.23	25.84	16.34	16.82	1.04	0.42	40.24	28.02	1.30
200	23.20	25.88	16.63	17.37	1.04	0.44	43.04	28.04	1.29
250	23.18	25.92	17.07	18.23	1.04	0.45	39.88	28.18	1.29
300	23.16	25.92	17.57	19.30	1.04	0.45	44.87	28.25	1.29
350	23.14	26.01	18.10	20.66	1.05	0.47	39.66	28.34	1.34
400	23.11	26.01	18.74	22.72	1.05	0.48	40.58	28.31	1.35
450	23.07	26.18	19.43	25.77	1.06	0.51	43.22	28.28	1.34
500	22.99	26.26	20.27	31.15	1.07	0.53	42.35	28.46	1.35
550	22.81	26.49	20.85	43.22	1.08	0.58	43.47	28.04	1.36
600	22.53	26.78	18.75	34.76	1.11	0.64	43.37	28.11	1.39
650	22.73	26.69	18.59	30.67	1.10	0.61	40.36	28.11	1.37
700	22.71	26.72	18.98	24.77	1.10	0.61	42.77	28.20	1.38
750	22.61	26.87	18.95	21.24	1.10	0.63	42.38	28.05	1.39
800	22.47	27.11	18.54	18.74	1.12	0.66	41.25	28.03	1.44
850	22.29	27.31	17.87	16.71	1.13	0.68	40.81	27.90	1.39
900	22.03	27.62	16.90	15.03	1.16	0.72	43.27	27.81	1.48
950	21.67	28.10	15.58	13.56	1.21	0.76	40.24	27.06	1.47
1000	21.09	28.66	13.83	12.45	1.28	0.82	41.25	26.95	1.53
1050	20.16	29.70	11.58	12.24	1.44	0.92	39.94	26.39	1.58
1100	19.51	30.45	9.66	14.86	1.61	1.02	39.98	26.20	1.69
1150	19.94	30.04	8.98	18.10	1.50	1.03	42.31	27.05	1.74
1200	20.10	30.00	8.60	14.93	1.43	1.02	40.48	27.17	1.79

## 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 = 7.60V, Id = 224mA @ 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	25.00	29.26	10.98	11.05	1.07	0.53	41.68	24.85	-
3	25.35	28.69	14.73	22.10	1.06	0.55	41.61	24.98	-
5	25.30	28.50	15.31	30.86	1.05	0.54	41.49	24.96	-
7	25.20	28.26	15.46	31.17	1.04	0.54	41.67	25.13	-
9	25.08	28.25	15.63	27.13	1.04	0.55	41.74	25.19	-
10	25.01	27.87	15.45	24.94	1.02	0.52	41.83	25.21	1.31
20	24.36	26.83	15.77	19.25	1.00	0.47	42.49	26.38	1.31
30	23.93	26.39	15.86	17.68	1.01	0.44	43.15	26.32	1.23
40	23.69	26.24	16.00	17.02	1.02	0.44	43.56	26.59	1.21
50	23.56	26.02	15.90	16.71	1.02	0.43	43.78	28.24	1.20
60	23.45	25.97	16.03	16.58	1.03	0.42	44.09	27.10	1.16
70	23.39	25.96	16.03	16.45	1.03	0.43	44.33	27.34	1.18
80	23.35	25.91	16.05	16.40	1.03	0.42	44.19	27.07	1.17
90	23.31	25.89	16.09	16.41	1.03	0.42	44.45	27.47	1.21
100	23.29	25.91	16.13	16.45	1.03	0.43	44.34	27.55	1.25
150	23.23	25.83	16.44	16.76	1.04	0.42	42.96	27.62	1.25
200	23.20	25.87	16.75	17.32	1.04	0.43	40.94	27.64	1.22
250	23.18	25.86	17.16	18.17	1.04	0.44	42.92	27.80	1.22
300	23.16	25.86	17.70	19.25	1.04	0.45	42.17	27.85	1.23
350	23.13	26.00	18.24	20.64	1.05	0.47	38.01	27.95	1.27
400	23.11	26.02	18.87	22.67	1.05	0.48	38.63	27.91	1.25
450	23.06	26.17	19.59	25.70	1.06	0.51	40.84	27.87	1.28
500	22.99	26.19	20.43	31.10	1.06	0.53	42.35	28.01	1.29
550	22.81	26.44	20.99	39.90	1.08	0.57	43.34	27.64	1.27
600	22.53	26.76	18.83	34.06	1.11	0.63	42.43	27.73	1.28
650	22.72	26.64	18.71	32.14	1.09	0.61	41.30	27.71	1.27
700	22.70	26.72	19.08	25.28	1.10	0.61	44.15	27.81	1.35
750	22.61	26.85	19.07	21.57	1.10	0.63	41.78	27.65	1.33
800	22.47	27.04	18.66	18.92	1.12	0.66	43.57	27.65	1.39
850	22.28	27.29	17.97	16.88	1.13	0.68	41.35	27.63	1.36
900	22.03	27.58	16.97	15.15	1.16	0.72	41.94	27.54	1.38
950	21.67	27.99	15.66	13.66	1.20	0.76	41.90	26.84	1.43
1000	21.09	28.68	13.90	12.52	1.28	0.82	41.64	26.63	1.43
1050	20.18	29.59	11.64	12.26	1.43	0.91	40.06	26.19	1.51
1100	19.53	30.42	9.70	14.74	1.60	1.02	40.85	25.90	1.61
1150	19.95	30.04	9.02	18.04	1.49	1.03	41.00	26.70	1.62
1200	20.11	29.90	8.63	15.07	1.42	1.02	41.68	26.83	1.73

## 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 = 8.40V, Id = 246mA @ 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	24.98	29.11	11.15	11.03	1.07	0.51	40.46	25.58	-
3	25.33	28.89	15.08	21.93	1.07	0.57	40.21	25.69	-
5	25.29	28.63	15.62	29.84	1.06	0.56	40.09	25.76	-
7	25.18	28.35	15.77	30.44	1.05	0.55	40.33	25.84	-
9	25.06	28.05	15.85	27.09	1.03	0.53	40.39	25.93	-
10	25.00	27.83	15.97	25.11	1.03	0.51	40.44	25.95	1.47
20	24.35	26.98	15.86	19.35	1.01	0.48	41.20	27.22	1.46
30	23.91	26.45	15.87	17.86	1.01	0.45	41.80	27.02	1.36
40	23.68	26.18	15.90	17.26	1.02	0.44	42.31	27.31	1.30
50	23.54	26.14	16.02	16.77	1.03	0.43	42.48	29.07	1.31
60	23.44	25.98	15.86	16.75	1.03	0.43	42.71	27.79	1.31
70	23.37	25.90	15.84	16.65	1.03	0.42	42.87	28.15	1.33
80	23.33	25.94	15.89	16.59	1.03	0.43	42.97	27.72	1.32
90	23.30	25.85	15.92	16.60	1.03	0.42	43.08	28.25	1.35
100	23.28	25.91	15.96	16.65	1.03	0.43	43.09	28.68	1.36
150	23.22	25.81	16.24	16.97	1.04	0.42	41.45	28.42	1.37
200	23.18	25.88	16.52	17.53	1.04	0.44	42.87	28.40	1.39
250	23.17	25.86	16.93	18.40	1.04	0.44	41.98	28.53	1.35
300	23.15	25.96	17.44	19.46	1.05	0.46	43.39	28.60	1.34
350	23.12	25.96	17.98	20.85	1.05	0.47	39.79	28.68	1.40
400	23.09	26.06	18.59	22.87	1.05	0.49	38.23	28.71	1.39
450	23.05	26.14	19.26	25.94	1.06	0.51	41.81	28.69	1.38
500	22.98	26.29	20.05	31.28	1.07	0.54	43.49	28.79	1.40
550	22.79	26.43	20.60	49.39	1.08	0.58	42.17	28.44	1.43
600	22.52	26.85	18.56	36.16	1.12	0.64	40.68	28.43	1.43
650	22.71	26.67	18.39	28.96	1.10	0.61	40.12	28.51	1.37
700	22.69	26.76	18.77	23.93	1.10	0.62	41.79	28.54	1.47
750	22.59	26.88	18.74	20.76	1.11	0.63	42.44	28.39	1.45
800	22.45	27.13	18.32	18.39	1.12	0.66	43.57	28.34	1.47
850	22.26	27.36	17.66	16.46	1.14	0.69	40.93	28.18	1.49
900	22.01	27.69	16.67	14.83	1.17	0.72	41.10	28.10	1.51
950	21.64	28.08	15.39	13.40	1.20	0.76	40.10	27.30	1.57
1000	21.05	28.74	13.66	12.34	1.29	0.82	40.73	27.11	1.59
1050	20.12	29.78	11.46	12.20	1.46	0.92	41.34	26.54	1.66
1100	19.46	30.46	9.57	14.90	1.61	1.02	40.06	26.34	1.73
1150	19.90	30.13	8.90	17.99	1.51	1.04	40.17	27.34	1.84
1200	20.05	30.04	8.52	14.69	1.44	1.02	41.09	27.43	1.82



## Typical Performance Data

### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 8.00V, Id = 240mA @ 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	25.09	29.06	10.69	10.93	1.06	0.50	42.83	26.06	-
3	25.43	28.87	14.47	22.00	1.06	0.56	48.68	26.14	-
5	25.38	28.26	15.13	30.23	1.04	0.51	49.31	26.26	-
7	25.29	28.22	15.38	31.31	1.04	0.52	50.15	26.36	-
9	25.17	27.91	15.47	26.95	1.02	0.50	49.72	26.60	-
10	25.14	28.14	15.72	24.44	1.03	0.54	34.50	26.64	1.55
20	24.46	26.74	16.05	19.24	1.00	0.44	39.39	26.96	1.16
30	24.04	26.30	15.99	17.58	1.00	0.42	37.78	26.58	0.96
40	23.80	26.21	16.03	16.99	1.01	0.42	48.05	28.35	0.89
50	23.66	26.01	15.88	16.61	1.01	0.41	39.93	28.34	0.95
60	23.55	25.97	16.08	16.47	1.02	0.41	39.46	28.04	0.90
70	23.50	25.92	16.18	16.46	1.02	0.40	44.18	27.45	0.92
80	23.45	25.89	16.22	16.43	1.03	0.40	44.97	28.09	0.95
90	23.43	25.92	16.33	16.48	1.03	0.41	42.81	28.54	0.98
100	23.41	25.84	16.42	16.55	1.03	0.40	39.50	27.96	0.99
150	23.35	25.81	16.77	16.94	1.03	0.40	42.06	28.10	0.97
200	23.33	25.84	17.20	17.45	1.04	0.41	42.25	28.24	0.97
250	23.31	25.80	17.54	18.21	1.04	0.42	39.33	28.42	0.94
300	23.29	25.92	18.02	19.05	1.04	0.44	43.85	28.62	0.96
350	23.28	25.91	18.49	20.27	1.04	0.44	39.20	28.66	0.94
400	23.25	25.95	19.22	22.03	1.04	0.46	38.62	28.72	0.99
450	23.22	26.08	20.06	24.49	1.05	0.48	41.60	28.47	0.96
500	23.16	26.13	21.04	29.00	1.06	0.50	43.34	28.37	0.96
550	23.03	26.34	22.43	37.77	1.07	0.54	44.54	28.70	0.92
600	22.61	26.79	20.19	28.43	1.11	0.63	42.63	28.55	0.99
650	22.89	26.57	19.52	33.23	1.08	0.58	44.99	28.73	1.01
700	22.92	26.55	20.18	27.67	1.08	0.58	42.19	28.61	1.00
750	22.84	26.74	20.45	23.25	1.09	0.60	41.93	28.52	1.01
800	22.72	26.89	20.29	20.21	1.10	0.62	41.32	28.76	1.04
850	22.56	27.12	19.74	17.88	1.11	0.65	43.10	28.89	1.01
900	22.35	27.40	18.86	15.91	1.13	0.68	42.48	28.68	1.05
950	22.05	27.74	17.51	14.20	1.16	0.72	41.24	28.61	1.08
1000	21.56	28.28	15.64	12.69	1.22	0.77	40.95	28.52	1.08
1050	20.65	29.21	13.04	11.69	1.35	0.86	42.28	27.74	1.12
1100	19.46	30.50	10.24	13.07	1.61	1.00	40.45	26.98	1.18
1150	20.02	30.04	9.25	20.20	1.51	1.03	43.29	27.68	1.25
1200	20.54	29.52	9.17	17.47	1.37	0.99	42.83	28.28	1.25

## 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 = 7.60V, Id = 226mA @ 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	25.06	29.30	10.66	10.92	1.07	0.53	42.50	25.57	-
3	25.40	28.66	14.40	21.98	1.05	0.54	48.16	25.65	-
5	25.36	28.47	15.02	29.78	1.05	0.53	48.99	25.62	-
7	25.27	28.15	15.34	31.03	1.03	0.52	49.27	25.83	-
9	25.14	28.17	15.39	26.91	1.03	0.54	49.70	25.95	-
10	25.13	27.64	16.13	25.84	1.02	0.47	35.76	26.10	1.42
20	24.43	26.81	15.97	19.25	1.00	0.45	39.74	26.55	1.09
30	24.02	26.37	16.07	17.61	1.01	0.43	41.23	26.24	0.93
40	23.78	26.17	16.09	17.09	1.01	0.42	40.47	27.87	0.88
50	23.64	25.98	16.07	16.72	1.03	0.41	42.82	27.92	0.91
60	23.53	25.91	16.20	16.57	1.02	0.40	42.38	27.64	0.87
70	23.48	25.87	16.32	16.57	1.02	0.40	41.94	27.17	0.87
80	23.43	25.80	16.36	16.56	1.02	0.40	43.12	27.68	0.97
90	23.41	25.83	16.47	16.60	1.03	0.40	45.57	28.10	1.00
100	23.39	25.77	16.55	16.66	1.03	0.39	38.71	27.62	0.97
150	23.33	25.82	16.90	17.04	1.03	0.41	44.42	27.71	0.97
200	23.31	25.80	17.34	17.58	1.03	0.41	43.31	27.79	0.96
250	23.29	25.74	17.72	18.38	1.03	0.41	40.84	28.03	0.92
300	23.27	25.84	18.20	19.19	1.04	0.43	43.67	28.16	0.92
350	23.26	25.84	18.67	20.45	1.04	0.44	39.72	28.27	0.94
400	23.23	25.98	19.42	22.22	1.05	0.46	38.91	28.25	0.96
450	23.20	26.02	20.25	24.78	1.05	0.48	40.88	27.99	0.95
500	23.15	26.14	21.26	29.48	1.06	0.50	44.98	27.96	0.90
550	23.01	26.34	22.70	38.10	1.07	0.54	42.38	28.23	0.92
600	22.59	26.78	20.30	28.44	1.11	0.63	41.61	28.15	0.97
650	22.88	26.55	19.61	34.08	1.08	0.58	45.33	28.25	0.99
700	22.90	26.58	20.32	27.64	1.08	0.58	44.38	28.20	0.99
750	22.82	26.71	20.55	23.11	1.09	0.60	44.20	28.03	1.02
800	22.70	26.85	20.41	20.10	1.10	0.62	43.76	28.35	1.03
850	22.54	27.11	19.80	17.79	1.11	0.65	42.06	28.43	1.03
900	22.34	27.32	18.92	15.86	1.13	0.68	43.91	28.31	1.01
950	22.04	27.73	17.55	14.16	1.16	0.72	44.67	28.23	1.07
1000	21.55	28.21	15.70	12.66	1.21	0.76	40.91	28.19	1.05
1050	20.64	29.26	13.08	11.65	1.36	0.86	41.59	27.44	1.11
1100	19.45	30.46	10.26	12.99	1.61	1.00	42.16	26.67	1.17
1150	20.00	30.01	9.26	20.05	1.51	1.03	43.77	27.21	1.21
1200	20.53	29.54	9.20	17.48	1.37	0.99	43.39	27.84	1.28

## 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 = 8.40V, Id = 253mA @ 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	25.11	29.10	10.71	10.89	1.06	0.50	42.49	26.71	-
3	25.44	28.91	14.57	22.02	1.06	0.56	48.73	26.68	-
5	25.40	28.52	15.19	30.68	1.05	0.53	48.63	26.80	-
7	25.31	28.26	15.48	31.42	1.04	0.52	49.67	26.90	-
9	25.19	27.83	15.52	26.86	1.02	0.49	50.28	27.11	-
10	25.17	27.59	16.28	26.06	1.01	0.46	38.32	27.16	1.67
20	24.47	26.94	15.94	19.03	1.00	0.46	41.85	27.44	1.22
30	24.06	26.39	15.95	17.48	1.01	0.43	41.89	26.92	1.00
40	23.82	26.21	15.94	16.91	1.01	0.42	43.74	28.77	0.92
50	23.68	26.07	16.08	16.61	1.02	0.41	44.37	28.69	0.93
60	23.57	25.93	16.03	16.43	1.02	0.40	41.83	28.42	0.92
70	23.51	25.93	16.09	16.41	1.02	0.40	41.48	27.79	0.92
80	23.47	25.92	16.11	16.37	1.03	0.41	43.98	28.50	0.97
90	23.45	25.84	16.27	16.44	1.03	0.40	47.91	28.94	0.99
100	23.43	25.85	16.34	16.49	1.03	0.40	38.32	28.33	1.01
150	23.37	25.79	16.66	16.89	1.03	0.40	45.97	28.49	1.01
200	23.34	25.87	17.08	17.37	1.04	0.42	41.57	28.63	1.01
250	23.32	25.90	17.43	18.10	1.04	0.43	39.47	28.81	0.96
300	23.31	25.85	17.90	18.97	1.04	0.43	45.35	29.00	0.94
350	23.29	25.93	18.39	20.15	1.04	0.44	40.29	29.04	0.96
400	23.27	26.03	19.09	21.84	1.05	0.46	38.96	29.10	0.99
450	23.24	26.11	19.86	24.33	1.05	0.48	42.96	28.86	0.95
500	23.18	26.20	20.89	28.72	1.06	0.50	43.61	28.77	0.98
550	23.04	26.39	22.32	37.39	1.07	0.54	42.29	29.09	0.96
600	22.62	26.77	20.10	28.40	1.11	0.62	45.25	28.94	0.98
650	22.91	26.58	19.37	32.64	1.08	0.58	46.24	29.13	1.02
700	22.93	26.65	20.07	27.71	1.08	0.58	41.54	29.01	1.00
750	22.85	26.74	20.33	23.27	1.09	0.60	44.96	28.93	1.00
800	22.73	26.94	20.22	20.24	1.10	0.62	42.84	29.15	1.04
850	22.58	27.11	19.65	17.92	1.11	0.65	43.48	29.18	1.03
900	22.37	27.43	18.79	15.94	1.14	0.68	45.52	28.96	1.03
950	22.07	27.73	17.47	14.22	1.16	0.72	41.82	28.98	1.08
1000	21.58	28.34	15.61	12.71	1.22	0.77	43.13	28.77	1.08
1050	20.66	29.28	13.04	11.72	1.36	0.86	40.33	27.96	1.13
1100	19.47	30.58	10.23	13.13	1.62	1.00	42.07	27.20	1.23
1150	20.03	29.98	9.23	20.33	1.50	1.03	42.21	28.04	1.27
1200	20.55	29.55	9.16	17.48	1.37	0.99	41.81	28.63	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 = 8.00V, Id = 216mA @ Temperature = +95°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	24.58	29.00	11.47	11.16	1.08	0.54	35.59	25.14	-
3	24.87	28.77	15.14	21.58	1.09	0.60	36.64	25.58	-
5	24.84	28.50	15.64	27.10	1.07	0.59	36.91	25.64	-
7	24.75	28.26	15.90	28.41	1.06	0.58	37.01	25.76	-
9	24.64	27.95	15.92	26.62	1.05	0.56	37.17	25.87	-
10	24.59	27.90	16.78	26.44	1.05	0.56	37.19	25.92	1.72
20	23.95	26.92	16.12	20.39	1.02	0.53	37.93	26.22	1.85
30	23.57	26.42	15.99	19.02	1.02	0.50	38.71	26.08	1.72
40	23.34	26.08	15.93	18.46	1.03	0.47	39.26	27.23	1.64
50	23.22	26.00	15.83	18.10	1.03	0.49	39.54	26.92	1.72
60	23.11	25.96	15.85	17.86	1.04	0.47	39.82	27.08	1.70
70	23.06	25.92	15.88	17.86	1.04	0.47	39.92	26.86	1.73
80	23.01	25.78	15.94	17.82	1.04	0.46	40.17	27.19	1.80
90	23.00	25.91	16.00	17.83	1.04	0.47	40.15	27.21	1.75
100	22.97	25.80	16.03	17.87	1.04	0.46	40.22	27.16	1.78
150	22.91	25.80	16.17	18.20	1.05	0.47	41.12	27.29	1.80
200	22.87	25.92	16.49	18.77	1.05	0.49	39.82	27.36	1.81
250	22.85	25.87	16.87	19.79	1.05	0.49	37.74	27.41	1.75
300	22.82	25.91	17.33	21.09	1.06	0.50	41.17	27.53	1.80
350	22.80	25.97	17.74	22.94	1.06	0.52	38.38	27.48	1.76
400	22.76	26.08	18.32	25.34	1.07	0.54	37.62	27.49	1.79
450	22.71	26.15	18.83	29.07	1.07	0.55	39.62	27.31	1.82
500	22.62	26.33	19.27	35.05	1.09	0.58	39.71	27.38	1.81
550	22.42	26.52	19.45	37.35	1.10	0.62	38.23	26.99	1.77
600	22.21	26.80	17.73	38.33	1.13	0.67	38.91	26.90	1.83
650	22.33	26.75	17.60	25.85	1.12	0.65	39.29	27.18	1.83
700	22.30	26.87	17.70	21.78	1.12	0.66	40.12	26.93	1.92
750	22.19	27.02	17.47	19.12	1.13	0.68	38.53	26.80	1.86
800	22.03	27.22	17.04	17.15	1.15	0.70	39.35	26.62	1.95
850	21.81	27.50	16.28	15.50	1.17	0.73	38.15	26.26	1.95
900	21.54	27.81	15.33	14.14	1.20	0.76	37.64	25.94	1.98
950	21.15	28.28	14.13	12.97	1.25	0.80	38.68	26.05	2.00
1000	20.57	28.97	12.60	12.21	1.34	0.86	37.97	25.50	2.08
1050	19.76	29.81	10.83	12.36	1.50	0.94	36.67	24.92	2.15
1100	19.24	30.39	9.31	14.38	1.62	1.03	37.05	24.65	2.25
1150	19.41	30.28	8.57	15.79	1.57	1.05	37.76	25.33	2.33
1200	19.45	30.34	8.04	13.74	1.52	1.05	37.50	25.45	2.44

## 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 = 7.60V, Id = 209mA @ Temperature = +95°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	24.59	29.10	11.33	11.22	1.09	0.56	36.86	24.95	-
3	24.88	28.66	14.89	21.72	1.08	0.59	37.19	25.29	-
5	24.85	28.34	15.40	27.47	1.07	0.57	37.34	25.38	-
7	24.76	28.29	15.65	28.98	1.06	0.58	37.44	25.46	-
9	24.65	27.85	15.70	26.92	1.04	0.55	37.54	25.56	-
10	24.65	28.09	16.23	25.76	1.05	0.58	37.57	25.60	1.66
20	24.02	26.98	16.03	20.27	1.02	0.53	38.33	25.87	1.70
30	23.63	26.36	15.99	18.68	1.02	0.48	39.10	25.77	1.63
40	23.40	26.12	16.02	18.13	1.03	0.47	39.64	26.92	1.58
50	23.27	25.98	16.05	17.80	1.03	0.48	39.96	26.69	1.66
60	23.17	26.01	15.98	17.54	1.04	0.47	40.19	26.79	1.56
70	23.11	25.85	16.00	17.50	1.04	0.45	40.31	26.61	1.66
80	23.06	25.87	16.04	17.44	1.04	0.46	40.54	26.88	1.78
90	23.05	25.87	16.12	17.48	1.04	0.46	40.57	26.93	1.69
100	23.02	25.74	16.17	17.55	1.04	0.45	40.58	26.87	1.71
150	22.95	25.93	16.36	17.84	1.05	0.48	39.13	26.94	1.76
200	22.92	25.81	16.64	18.39	1.05	0.47	40.85	27.06	1.74
250	22.90	25.87	17.03	19.36	1.05	0.48	37.95	27.14	1.65
300	22.87	25.87	17.49	20.64	1.05	0.49	39.80	27.26	1.70
350	22.85	25.93	17.97	22.46	1.06	0.51	37.79	27.23	1.68
400	22.81	26.07	18.55	24.81	1.07	0.53	36.90	27.24	1.75
450	22.76	26.15	19.10	28.59	1.07	0.55	40.54	27.06	1.77
500	22.67	26.24	19.59	36.15	1.08	0.57	40.63	27.05	1.78
550	22.48	26.53	19.75	42.52	1.10	0.62	39.61	26.79	1.72
600	22.26	26.75	17.97	48.43	1.12	0.66	39.03	26.70	1.72
650	22.39	26.72	17.83	27.47	1.11	0.64	39.26	27.03	1.77
700	22.36	26.80	17.95	22.71	1.11	0.65	39.76	26.81	1.80
750	22.25	26.93	17.71	19.79	1.12	0.67	39.16	26.59	1.76
800	22.09	27.17	17.29	17.63	1.14	0.69	39.40	26.52	1.89
850	21.88	27.40	16.52	15.91	1.16	0.72	39.07	26.18	1.82
900	21.61	27.74	15.57	14.45	1.19	0.75	38.28	25.87	1.91
950	21.23	28.22	14.34	13.22	1.24	0.80	39.11	25.89	1.93
1000	20.66	28.85	12.78	12.36	1.32	0.85	38.28	25.45	1.95
1050	19.85	29.74	10.96	12.43	1.48	0.94	37.90	24.87	2.03
1100	19.32	30.30	9.39	14.42	1.60	1.02	37.11	24.58	2.11
1150	19.49	30.22	8.65	16.07	1.55	1.05	38.78	25.17	2.30
1200	19.54	30.16	8.13	14.08	1.49	1.05	37.15	25.30	2.29

## Typical Performance Data

### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

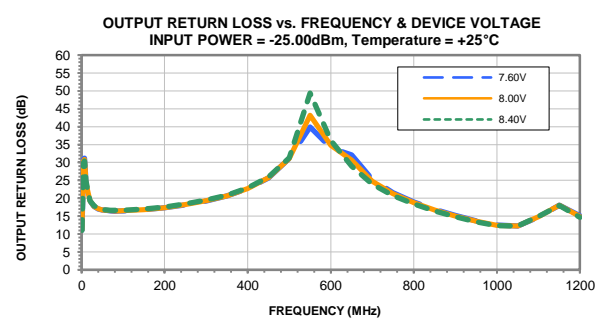
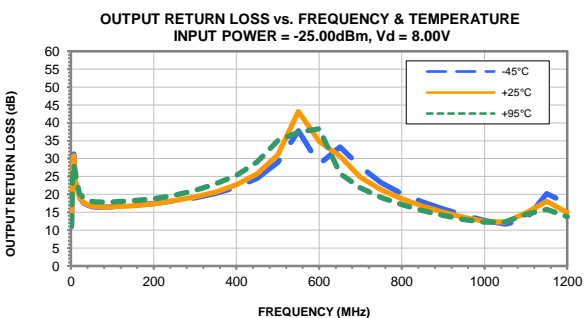
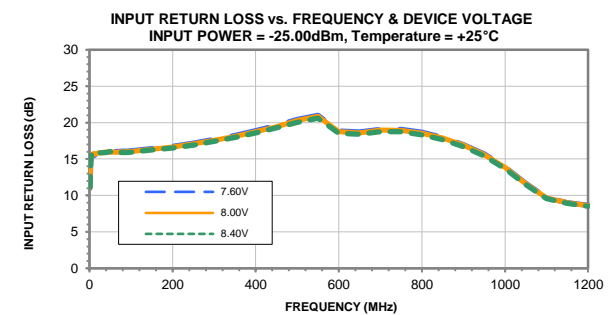
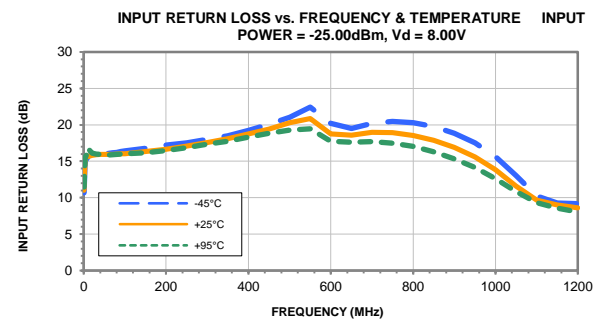
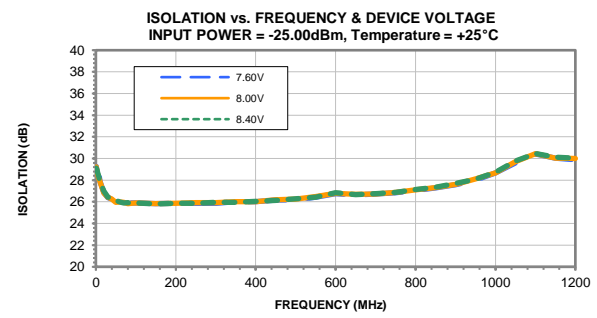
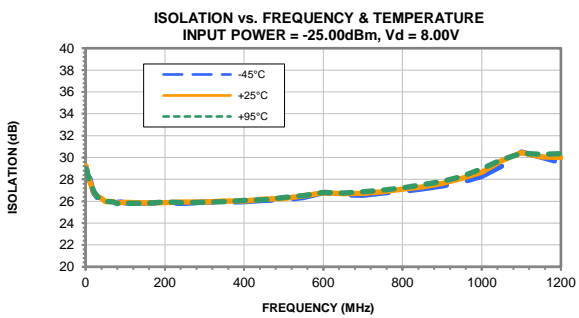
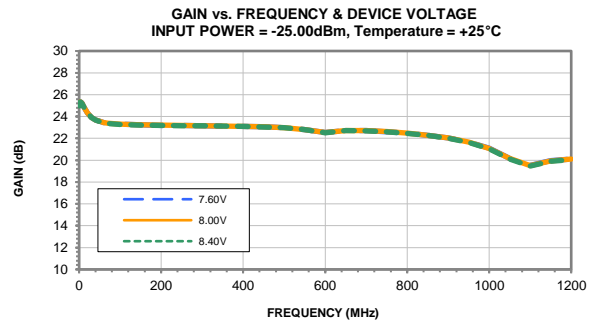
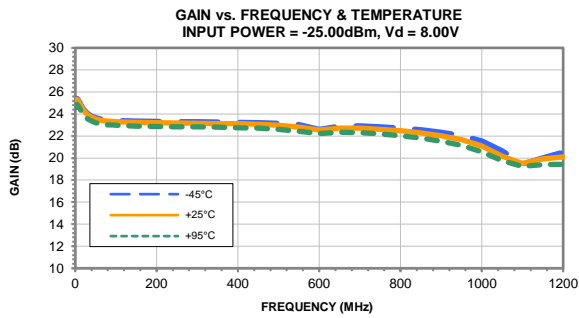
Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

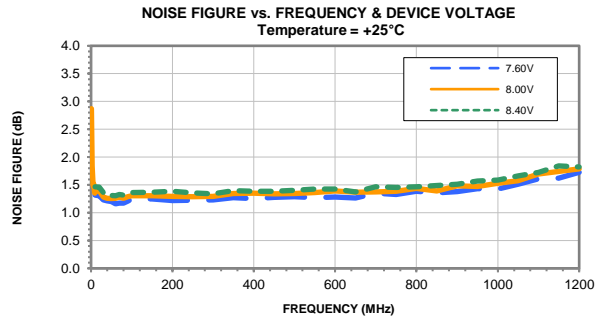
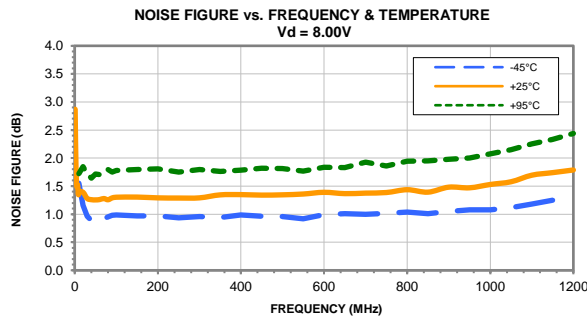
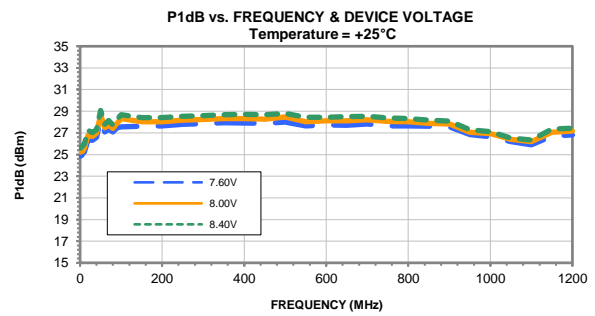
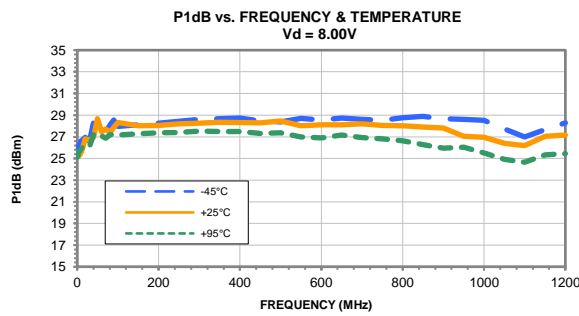
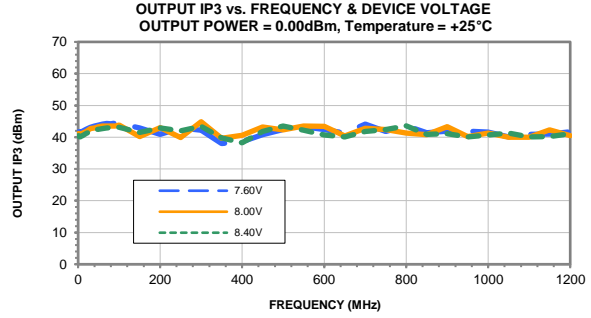
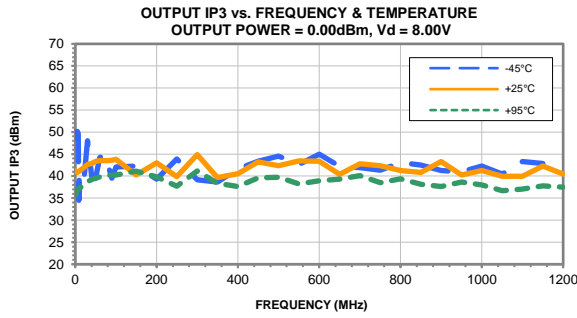
TEST CONDITIONS: Vd = 8.40V, Id = 223mA @ Temperature = +95°C

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	24.51	29.37	11.70	11.10	1.11	0.58	35.49	25.52	-
3	24.81	28.79	15.41	21.32	1.09	0.60	36.37	25.96	-
5	24.77	28.69	15.99	26.18	1.09	0.61	36.57	26.02	-
7	24.69	28.28	16.16	27.69	1.07	0.58	36.73	26.11	-
9	24.57	28.07	16.14	26.23	1.06	0.58	36.83	26.22	-
10	24.53	27.96	16.86	25.41	1.06	0.57	36.95	26.28	1.85
20	23.90	26.92	16.21	20.62	1.03	0.53	37.61	26.58	1.92
30	23.52	26.44	15.99	19.24	1.03	0.51	38.38	26.39	1.78
40	23.30	26.09	15.85	18.68	1.03	0.48	38.80	27.57	1.74
50	23.18	26.03	15.90	18.48	1.03	0.47	39.22	27.19	1.78
60	23.07	26.07	15.76	18.14	1.04	0.49	39.38	27.41	1.77
70	23.02	25.93	15.76	18.14	1.04	0.48	39.48	27.16	1.79
80	22.97	25.91	15.79	18.09	1.04	0.48	39.67	27.52	1.86
90	22.96	25.85	15.87	18.12	1.04	0.47	39.79	27.59	1.83
100	22.94	25.81	15.90	18.17	1.04	0.47	39.84	27.49	1.85
150	22.87	25.88	16.02	18.48	1.05	0.49	38.82	27.62	1.86
200	22.83	25.89	16.32	19.09	1.05	0.49	38.78	27.69	1.84
250	22.81	25.91	16.68	20.11	1.06	0.50	39.16	27.73	1.83
300	22.78	25.91	17.13	21.45	1.06	0.51	40.34	27.83	1.82
350	22.76	26.02	17.54	23.33	1.06	0.53	38.83	27.77	1.85
400	22.72	26.12	18.08	25.79	1.07	0.55	41.51	27.79	1.90
450	22.67	26.14	18.58	29.43	1.07	0.56	37.91	27.60	1.89
500	22.57	26.34	19.02	33.83	1.09	0.59	38.28	27.68	1.91
550	22.38	26.59	19.20	34.45	1.11	0.63	37.88	27.16	1.85
600	22.17	26.84	17.55	35.05	1.13	0.68	38.32	27.08	1.89
650	22.29	26.80	17.42	24.83	1.12	0.66	39.25	27.44	1.95
700	22.26	26.91	17.48	21.20	1.12	0.67	38.14	27.19	1.98
750	22.14	27.05	17.25	18.71	1.13	0.68	38.22	27.05	2.00
800	21.98	27.29	16.81	16.80	1.15	0.71	38.45	26.78	1.98
850	21.76	27.55	16.08	15.23	1.17	0.73	37.28	26.49	1.99
900	21.48	27.90	15.16	13.90	1.21	0.77	37.33	26.09	2.03
950	21.09	28.39	13.96	12.78	1.26	0.81	38.50	26.20	2.11
1000	20.51	28.97	12.48	12.06	1.34	0.86	37.37	25.63	2.16
1050	19.70	29.86	10.73	12.25	1.51	0.95	37.22	25.04	2.24
1100	19.18	30.47	9.24	14.31	1.64	1.03	36.62	24.77	2.34
1150	19.34	30.34	8.50	15.61	1.58	1.05	37.86	25.47	2.43
1200	19.38	30.48	7.96	13.52	1.54	1.05	37.69	25.58	2.56

## Typical Performance Curves



## Typical Performance Curves

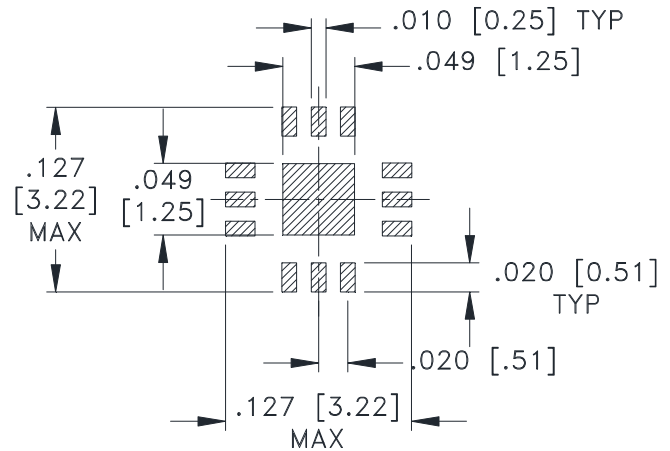




### Outline Dimensions



### PCB Land Pattern



SUGGESTED LAYOUT,  
TOLERANCE TO BE WITHIN  $\pm .002$

**Weight: .02 Grams**

**Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3 Pl.  $\pm .004$**

### Notes:

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

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# Tape & Reel Packaging TR-F66



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
8	4	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000, 2000, 3000

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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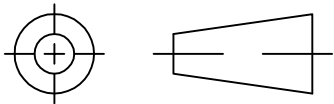
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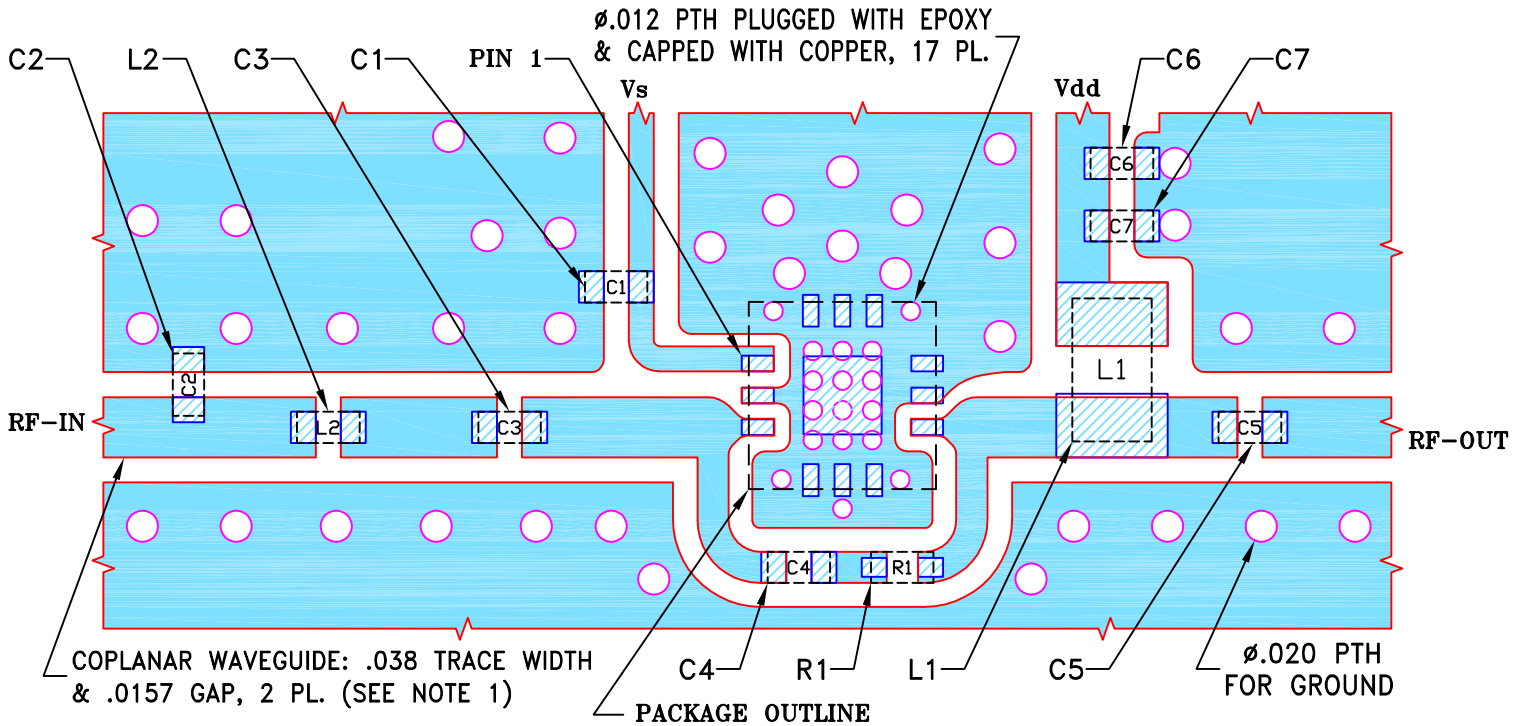
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M172056	NEW RELEASE	01/18/19	NP	GH

SUGGESTED MOUNTING CONFIGURATION FOR  
DQ1225 CASE STYLE, "12AM05" PIN CODE



COMPONENT	SIZE
C1...C7;L2;R1	0402
L1	0805

NOTES:

1. TRACE WIDTH & 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 FOOTPRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-TSS-13LN+ OR TB-TSS-13HLN+.
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
DRAWN	NP	01/18/19
CHECKED	GF	01/18/19
APPROVED	GH	01/18/19

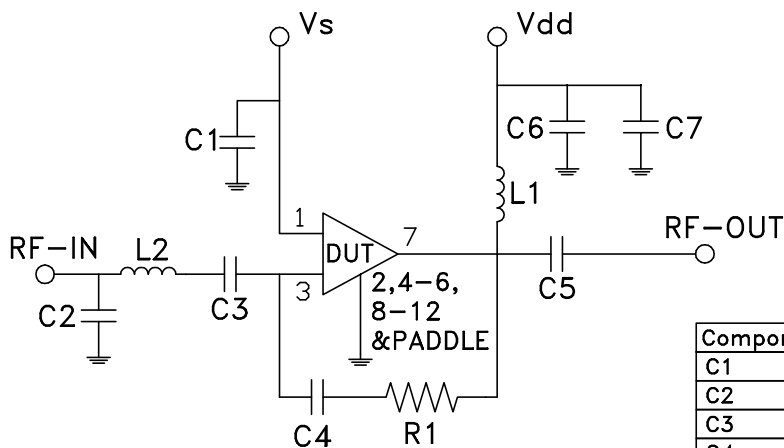
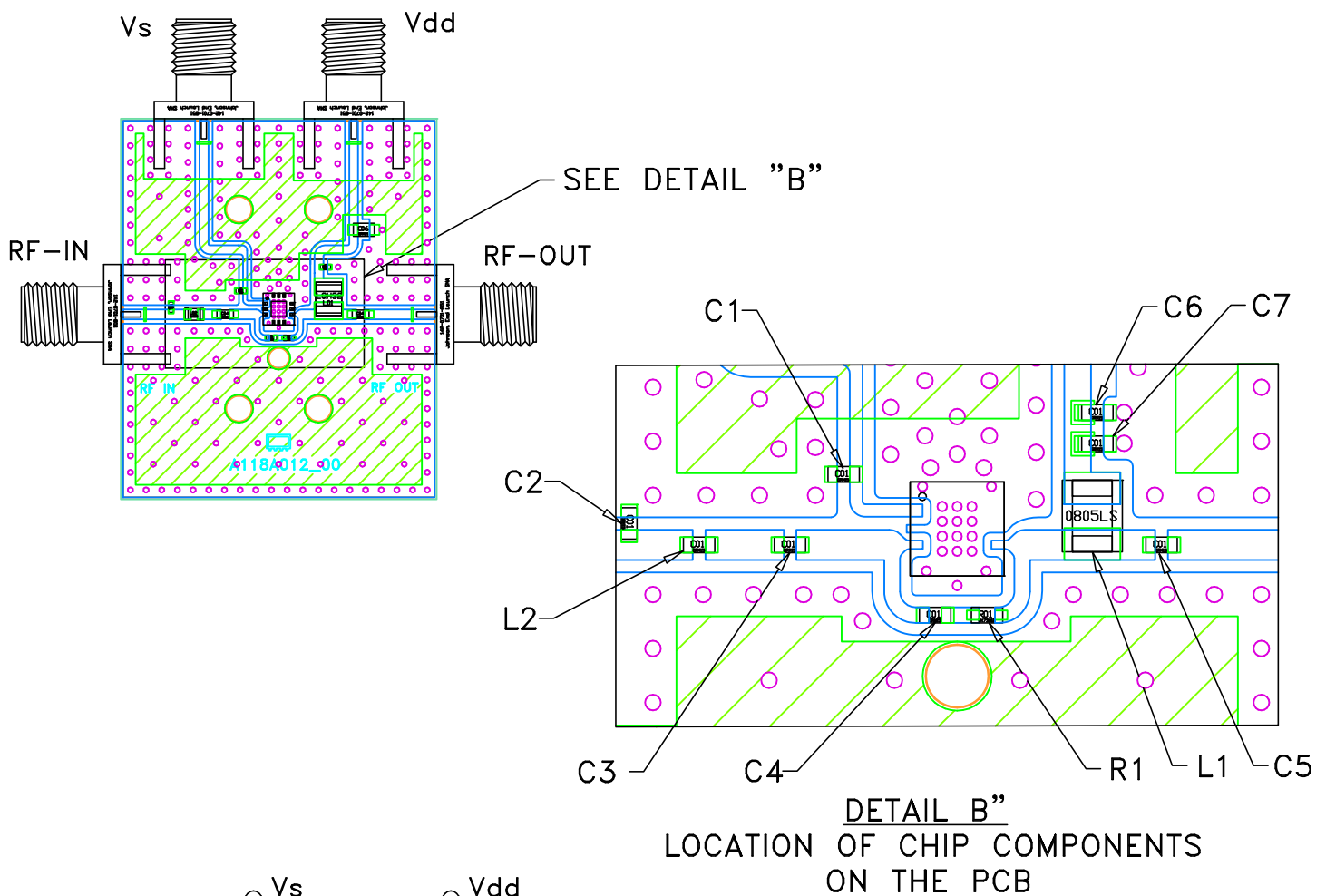
**Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

PL, 12AM05, DQ1225, TB-TSS-13LN+/13HLN+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-623	OR
FILE:	98PL623	SCALE: 8:1	SHEET: 1 OF 1

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# Evaluation Board and Circuit

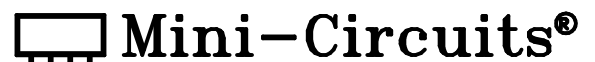


Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71C104KA88D	Murata
C2	0402	1.5pF	GRM1555C1H1R5CA1D	Murata
C3	0603	2.2uF	GRM188C71E225KE11D	Murata
C4	0402	0.1uF	GRM155R71C104KA88D	Murata
C5	0603	2.2uF	GRM188C71E225KE11D	Murata
C6	0402	1000pF	GRM1555C1H102JA01D	Murata
C7	0805	10uF	GRM21BC71E106KE11L	Murata
L1	1210	15uH	LQH32DN150K53L	Murata
L2	0603	5.1nH	O603CS-5N1XJLU	Coilcraft
R1	0402	1.5KOhm	RK73H1ETTP1501F	Koa

Schematic Diagram

**NOTES:**

1. 50 Ohm SMA Female Connectors.
2. PCB Material: Roger R04350B or equivalent, Dielectric constant=3.5, Thickness=0.02 inch





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	