Freescale Semiconductor
Technical Data

Document Number: MMG3008NT1
Rev. 1, 8/2005

RoHS

Heterojunction Bipolar Transistor (InGaP HBT)

Broadband High Linearity Amplifier

The MMG3008NT1 is a General Purpose Amplifier that is internally input and output matched. It is designed for a broad range of Class A, small-signal, high linearity, general purpose applications. It is suitable for applications with frequencies from 0 to 6000 MHz such as Cellular, PCS, BWA, WLL, PHS, CATV, VHF, UHF, UMTS and general small-signal RF.

Features

- Frequency: 0 to 6000 MHz
- P1dB: 15 dBm @ 900 MHz
- Small-Signal Gain: 18.5 dB @ 900 MHz
- Third Order Output Intercept Point: 26 dBm @ 900 MHz
- Single 5 Volt Supply
- Internally Matched to 50 Ohms
- Low Cost SOT-89 Surface Mount Package
- Pb-Free and RoHS Compliant
- In Tape and Reel. T1 Suffix = 1000 Units per 12 mm, 7 inch Reel.

MMG3008NT1

0-6000 MHz, 18.5 dB
15 dBm
InGaP HBT

CASE 1514-01, STYLE 1
SOT-89
PLASTIC

Table 1. Typical Performance (1)

Characteristic	Symbol	900 MHz	2140 MHz	3500 MHz	Unit
Small-Signal Gain (S21)	G_p	18.5	16	13	dB
Input Return Loss (S11)	IRL	-18	-22	-20	dB
Output Return Loss (S22)	ORL	-20	-18	-16	dB
Power Output @1dB Compression	P1db	15	14	14	dBm
Third Order Output Intercept Point	IP3	26	25.5	25	dBm

1. V_{CC} = 5 Vdc, T_C = 25°C, 50 ohm system

Table 2. Maximum Ratings

Rating	Symbol	Value	Unit
Supply Voltage (2)	V_{CC}	6	V
Supply Current (2)	I_{CC}	80	mA
RF Input Power	P_{in}	10	dBm
Storage Temperature Range	T_{stg}	-65 to +150	°C
Junction Temperature (3)	T_J	150	°C

2. Continuous voltage and current applied to device.
3. For reliable operation, the junction temperature should not exceed 150°C.

Table 3. Thermal Characteristics (V_{CC} = 5 Vdc, I_{CC} = 38 mA, T_C = 25°C)

Characteristic	Symbol	Value (4)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	84	°C/W

4. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

freescale semiconductor

Table 4. Electrical Characteristics (V_{CC} = 5 Vdc, 900 MHz, T_C = 25°C, 50 ohm system, in Freescale Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Small-Signal Gain (S21)	G_p	17	18.5	—	dB
Input Return Loss (S11)	IRL	—	-18	—	dB
Output Return Loss (S22)	ORL	—	-20	—	dB
Power Output @ 1dB Compression	P1dB	—	15	—	dBm
Third Order Output Intercept Point	IP3	—	26	—	dBm
Noise Figure	NF	—	4	—	dB
Supply Current (1)	I_{CC}	32	38	48	mA
Supply Voltage (1)	V_{CC}	—	5	—	V

1. For reliable operation, the junction temperature should not exceed 150°C.

Table 5. Functional Pin Description

Pin Number	Pin Function
1	RF_{in}
2	Ground
3	RF_{out}/DC Supply

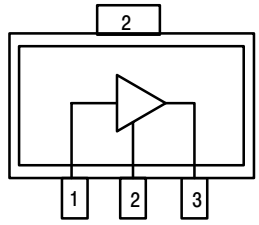


Figure 1. Functional Diagram

Table 6. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD 22-A114)	1A (Minimum)
Machine Model (per EIA/JESD 22-A115)	A (Minimum)
Charge Device Model (per JESD 22-C101)	IV (Minimum)

Table 7. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	1	260	°C

50 OHM TYPICAL CHARACTERISTICS

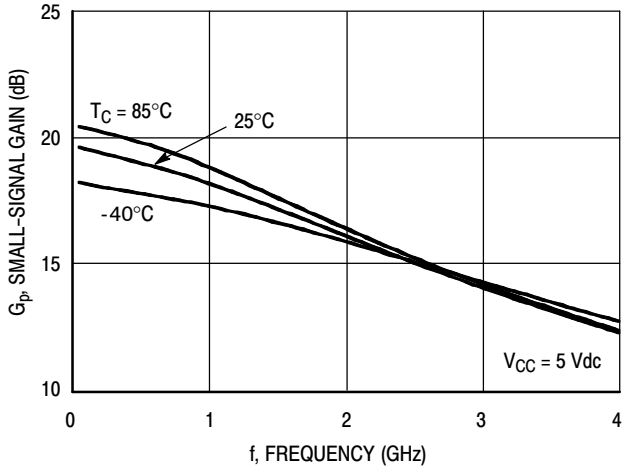


Figure 2. Small-Signal Gain (S21) versus Frequency

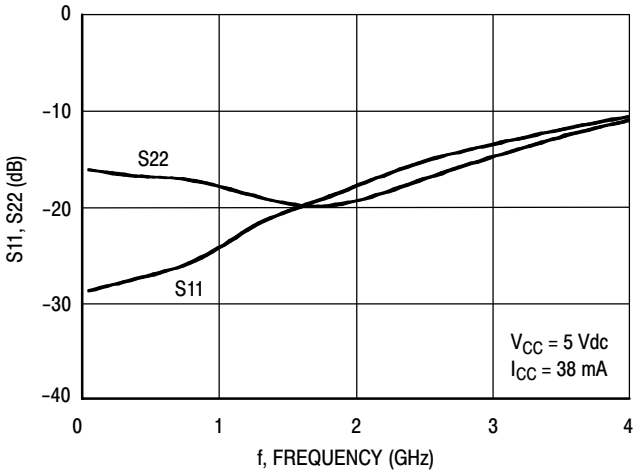


Figure 3. Input/Output Return Loss versus Frequency

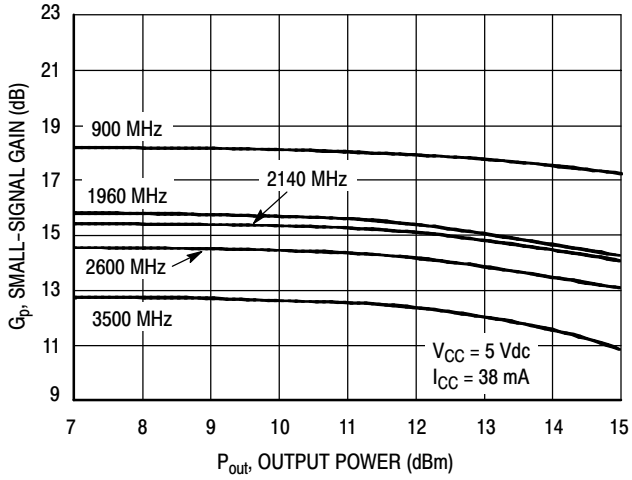


Figure 4. Small-Signal Gain versus Output Power

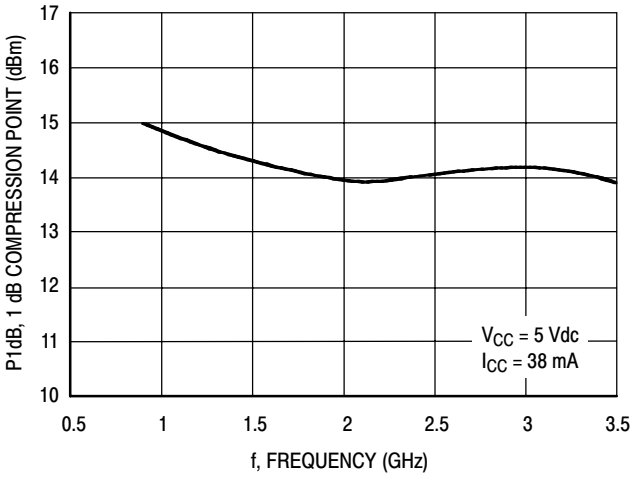


Figure 5. P1dB versus Frequency

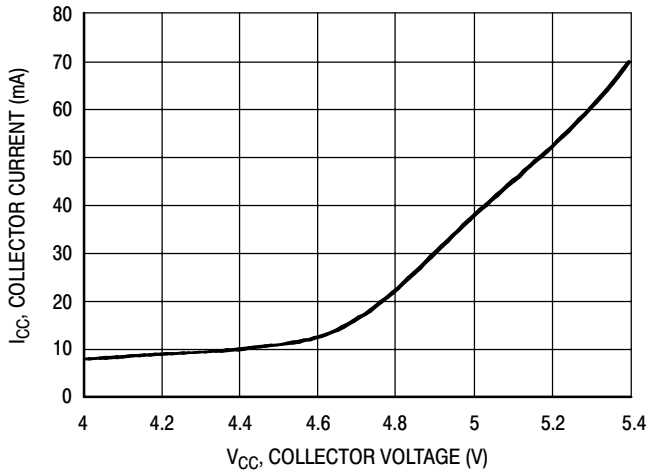


Figure 6. Collector Current versus Collector Voltage

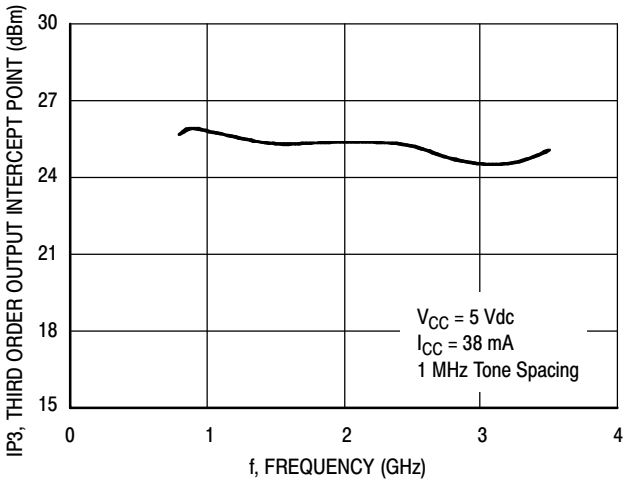


Figure 7. Third Order Output Intercept Point versus Frequency

50 OHM TYPICAL CHARACTERISTICS

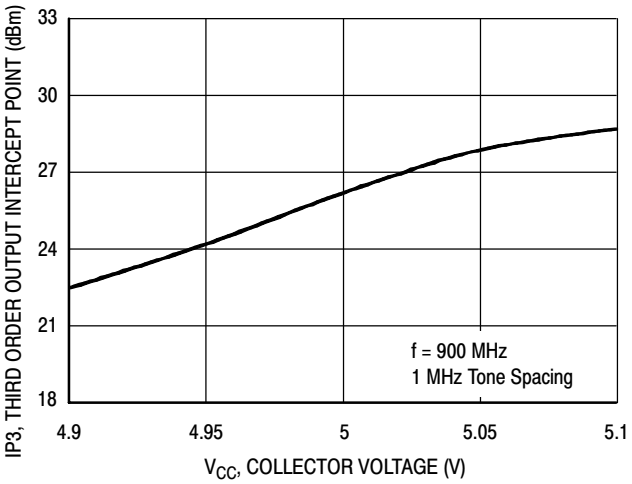


Figure 8. Third Order Output Intercept Point versus Collector Voltage

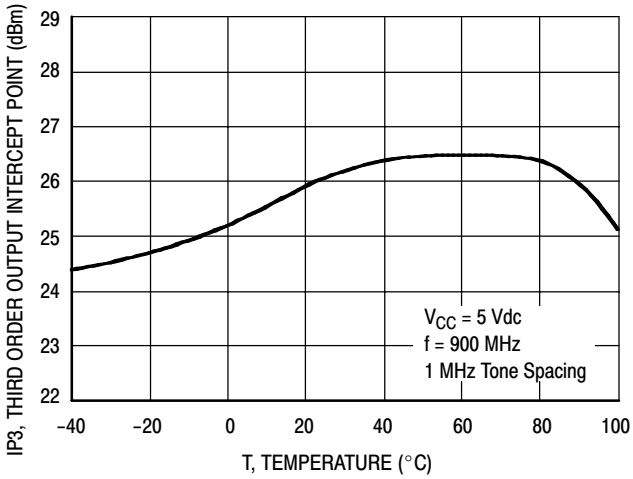


Figure 9. Third Order Output Intercept Point versus Case Temperature

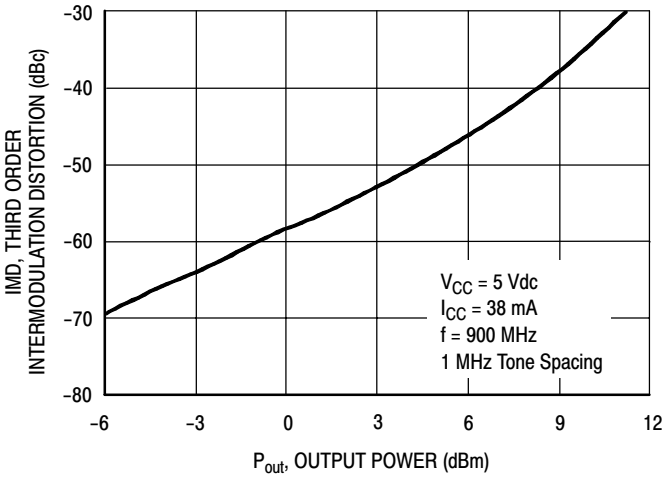
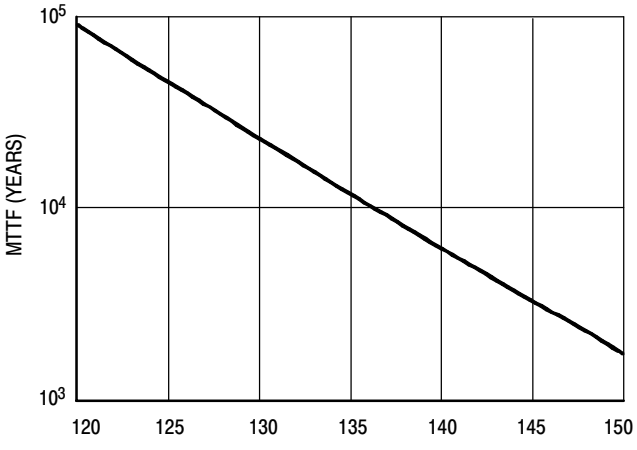


Figure 10. Third Order Intermodulation versus Output Power



NOTE: The MTTF is calculated with V_{CC} = 5 Vdc, I_{CC} = 38 mA

Figure 11. MTTF versus Junction Temperature

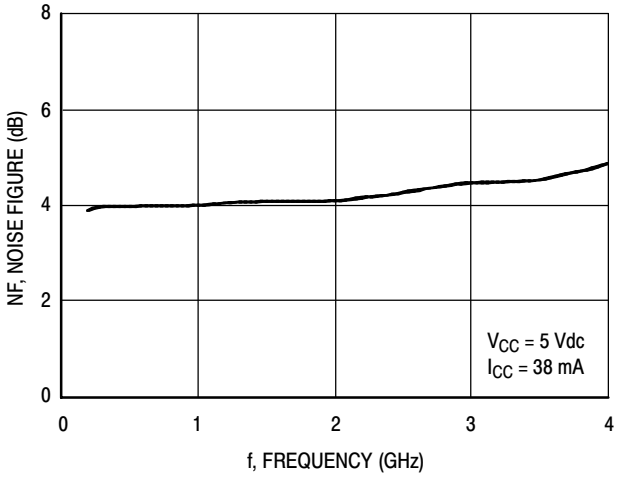


Figure 12. Noise Figure versus Frequency

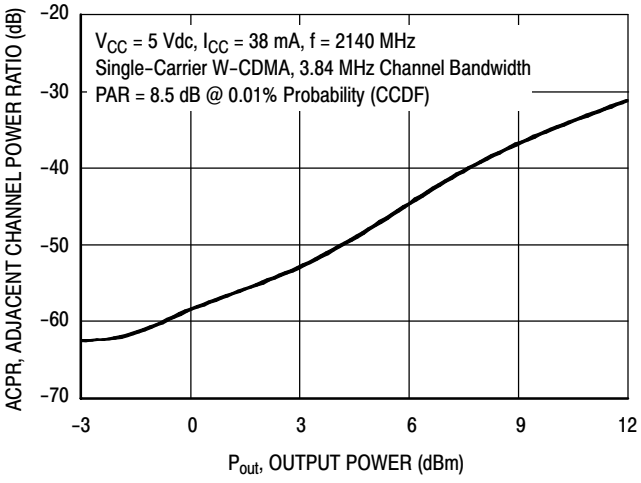
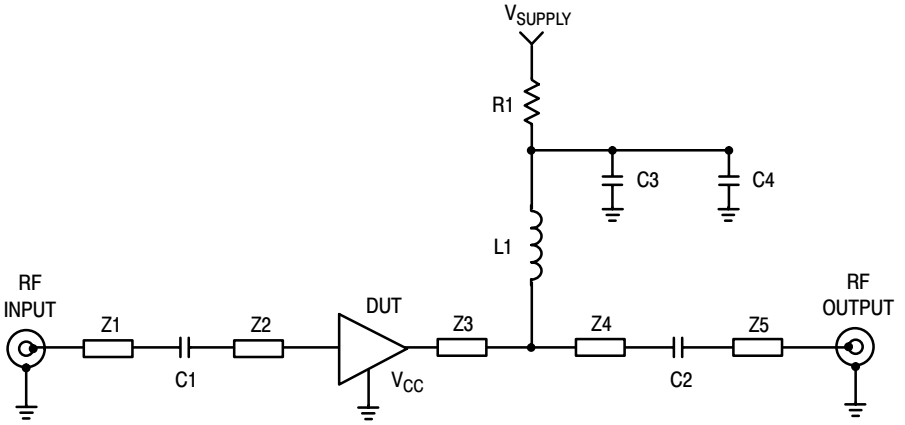


Figure 13. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

50 OHM APPLICATION CIRCUIT: 40-300 MHz



Z1, Z5	0.347″ x 0.058″ Microstrip	Z4	0.403″ x 0.058″ Microstrip
Z2	0.575″ x 0.058″ Microstrip	PCB	Getek Grade ML200C, 0.031″, ε_r = 4.1
Z3	0.172″ x 0.058″ Microstrip		

Figure 14. 50 Ohm Test Circuit Schematic

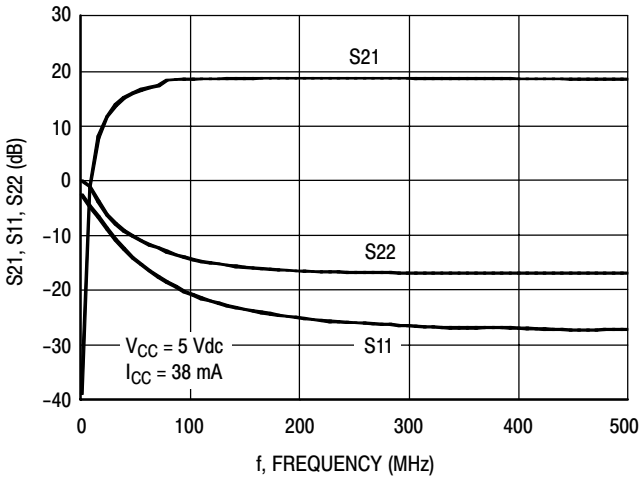


Figure 15. S21, S11 and S22 versus Frequency

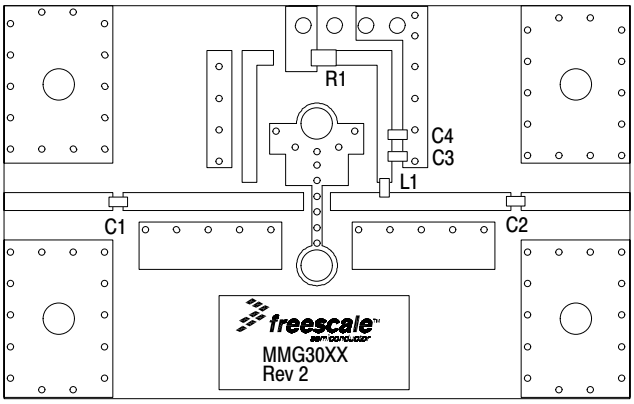
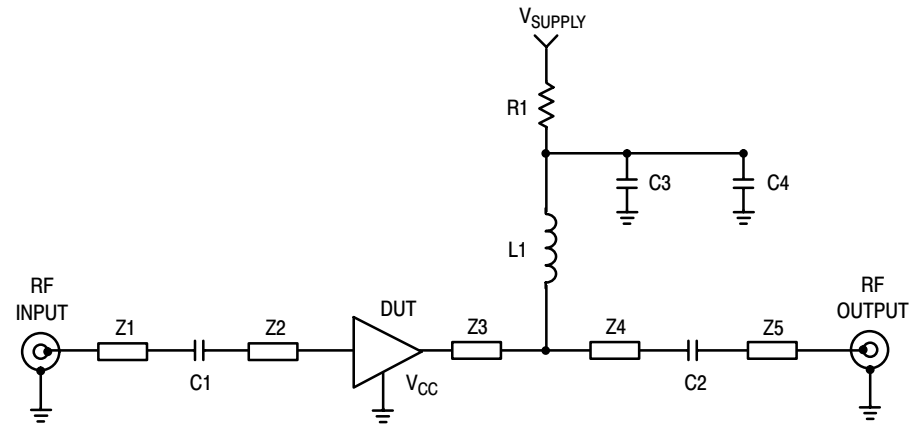


Figure 16. 50 Ohm Test Circuit Component Layout

Table 8. 50 Ohm Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C3	0.01 μF Chip Capacitors	0603A103JAT2A	AVX
C4	1000 pF Chip Capacitor	0603A102JAT2A	AVX
L1	470 nH Chip Inductor	BK2125HM471	Taiyo Yuden
R1	0 Ω Chip Resistor	ERJ3GEY0R00V	Panasonic

50 OHM APPLICATION CIRCUIT: 300 - 3600 MHz



Z1, Z5	0.347″ x 0.058″ Microstrip	Z4	0.403″ x 0.058″ Microstrip
Z2	0.575″ x 0.058″ Microstrip	PCB	Getek Grade ML200C, 0.031″, ε_r = 4.1
Z3	0.172″ x 0.058″ Microstrip		

Figure 17. 50 Ohm Test Circuit Schematic

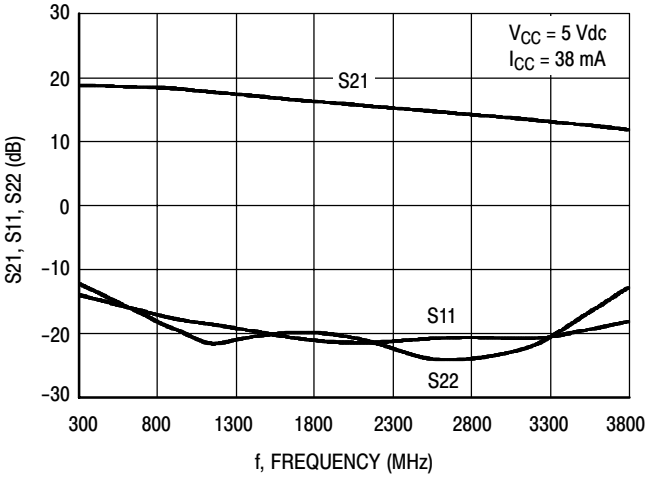


Figure 18. S21, S11 and S22 versus Frequency

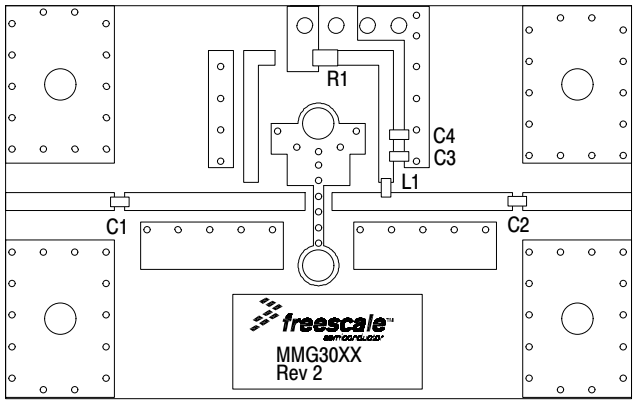


Figure 19. 50 Ohm Test Circuit Component Layout

Table 9. 50 Ohm Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	150 pF Chip Capacitors	06035A151JAT2A	AVX
C3	0.01 μF Chip Capacitor	0603A103JAT2A	AVX
C4	1000 pF Chip Capacitor	0603A102JAT2A	AVX
L1	56 nH Chip Inductor	HK160856NJ-T	Taiyo Yuden
R1	0 Ω Chip Resistor	ERJ3GEY0R00V	Panasonic

50 OHM TYPICAL CHARACTERISTICS

Table 10. Class A Common Emitter S-Parameters at V_{CC} = 5 Vdc, I_{CC} = 38 mA, T_C = 25°C

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
0.1	0.03723	-157.139	9.53422	174.957	0.07125	-0.244	0.15383	-9.473
0.15	0.03824	-159.784	9.45692	172.557	0.07151	-0.321	0.15195	-11.4
0.2	0.03924	-161.141	9.38250	169.351	0.07173	-0.527	0.15038	-15.453
0.25	0.03984	-163.743	9.30193	166.775	0.07196	-0.705	0.14855	-20.132
0.3	0.04044	-165.433	9.23472	164.195	0.07227	-0.968	0.14665	-25.238
0.35	0.04154	-167.556	9.16107	161.651	0.07249	-1.121	0.14473	-29.059
0.4	0.04218	-169.996	9.08796	159.059	0.07267	-1.321	0.14297	-33.099
0.45	0.04330	-171.505	9.01503	156.523	0.07303	-1.54	0.14282	-37.115
0.5	0.04391	-173.121	8.93887	153.864	0.07333	-1.729	0.14257	-40.95
0.55	0.04504	-175.107	8.86645	151.441	0.07360	-1.953	0.14246	-45.011
0.6	0.04579	-177.279	8.79137	148.941	0.07384	-2.108	0.14236	-48.838
0.65	0.04639	-179.085	8.72227	146.469	0.07422	-2.436	0.14207	-52.786
0.7	0.04725	178.481	8.65074	144.076	0.07453	-2.667	0.14191	-56.644
0.75	0.04874	176.513	8.57600	141.652	0.07485	-2.877	0.14153	-60.456
0.8	0.05044	174.578	8.49615	139.244	0.07535	-3.216	0.13860	-64.47
0.85	0.05265	172.441	8.41904	136.846	0.07573	-3.535	0.13706	-68.268
0.9	0.05446	170.794	8.33301	134.487	0.07615	-3.858	0.13387	-72.153
0.95	0.05671	168.866	8.24325	132.225	0.07660	-4.215	0.13169	-76.394
1	0.05987	166.015	8.16300	129.928	0.07706	-4.628	0.12795	-80.615
1.05	0.06338	164.827	8.06445	127.713	0.07745	-5.024	0.12512	-84.753
1.1	0.06818	162.719	7.97785	125.419	0.07782	-5.308	0.12243	-89.314
1.15	0.07156	160.419	7.88628	123.146	0.07832	-5.91	0.11969	-94.022
1.2	0.07622	158.869	7.79192	120.927	0.07888	-6.277	0.11711	-98.985
1.25	0.08148	156.417	7.70036	118.767	0.07940	-6.79	0.11465	-104.195
1.3	0.08625	154.855	7.61312	116.644	0.07998	-7.245	0.11217	-109.672
1.35	0.08847	152.545	7.52137	114.548	0.08040	-7.843	0.10841	-114.968
1.4	0.09042	150.239	7.43401	112.485	0.08082	-8.299	0.10615	-120.795
1.45	0.09247	148.043	7.33853	110.413	0.08128	-8.836	0.10380	-126.657
1.5	0.09461	146.969	7.25672	108.381	0.08193	-9.303	0.10158	-128.442
1.55	0.09681	144.023	7.16705	106.399	0.08243	-9.992	0.10048	-133.06
1.6	0.09928	141.737	7.08702	104.396	0.08305	-10.464	0.09950	-138.358
1.65	0.10270	139.246	6.98699	102.42	0.08347	-11.112	0.09874	-142.307
1.7	0.10530	137.14	6.90998	100.459	0.08398	-11.668	0.09873	-147.8
1.75	0.10836	134.919	6.82646	98.556	0.08445	-12.336	0.09872	-152.853
1.8	0.11174	132.496	6.74375	96.678	0.08491	-12.894	0.09935	-157.527
1.85	0.11560	130.26	6.65836	94.774	0.08539	-13.604	0.09998	-162.646
1.9	0.11980	128.189	6.57651	92.937	0.08590	-14.2	0.10150	-167.628
1.95	0.12349	126.377	6.49376	91.045	0.08640	-14.843	0.10335	-172.451
2	0.12873	124.287	6.41028	89.21	0.08693	-15.588	0.10540	-176.909
2.05	0.13268	121.985	6.33373	87.389	0.08742	-16.17	0.10798	178.048
2.1	0.13725	120.2	6.25726	85.623	0.08786	-16.886	0.11081	174.074
2.15	0.14017	118.487	6.18534	83.864	0.08852	-17.695	0.11466	169.543
2.2	0.14638	116.403	6.10210	82.117	0.08869	-18.285	0.11714	166.109
2.25	0.15016	114.638	6.02971	80.32	0.08941	-19.001	0.12062	161.975
2.3	0.15521	112.618	5.95603	78.605	0.08986	-19.642	0.12414	158.434
2.35	0.15976	110.76	5.88332	76.922	0.09022	-20.411	0.12774	155.044

50 OHM TYPICAL CHARACTERISTICS

Table 10. Class A Common Emitter S-Parameters at V_{CC} = 5 Vdc, I_{CC} = 38 mA, T_C = 25°C (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
2.4	0.16414	109.067	5.81205	75.215	0.09063	-21.132	0.13152	151.453
2.45	0.16931	107.269	5.74220	73.556	0.09110	-21.914	0.13622	148.114
2.5	0.17290	105.625	5.67374	71.895	0.09160	-22.568	0.13975	145.204
2.55	0.17697	103.866	5.60911	70.217	0.09197	-23.366	0.14370	142.104
2.6	0.18119	102.097	5.54039	68.601	0.09243	-24.135	0.14796	139.028
2.65	0.18491	100.467	5.48069	66.985	0.09288	-24.891	0.15201	136.155
2.7	0.18871	98.781	5.41580	65.359	0.09335	-25.672	0.15562	133.387
2.75	0.19276	97.217	5.35397	63.725	0.09367	-26.386	0.16040	130.458
2.8	0.19700	95.483	5.29285	62.113	0.09412	-27.158	0.16438	127.735
2.85	0.20042	93.791	5.23322	60.504	0.09452	-28.071	0.16843	124.907
2.9	0.20441	92.231	5.17959	58.977	0.09485	-28.821	0.17329	122.375
2.95	0.20776	90.583	5.11646	57.358	0.09546	-29.704	0.17724	119.612
3	0.21089	89.007	5.06803	55.76	0.09593	-30.551	0.18220	116.735
3.05	0.21615	87.21	5.01467	54.217	0.09605	-31.388	0.18674	114.476
3.1	0.21938	85.618	4.95573	52.66	0.09660	-32.161	0.19068	111.831
3.15	0.22294	84.139	4.90100	51.117	0.09698	-33.041	0.19574	109.296
3.2	0.22712	82.548	4.85380	49.552	0.09728	-33.934	0.20063	106.823
3.25	0.23123	80.985	4.80281	47.99	0.09759	-34.778	0.20541	104.361
3.3	0.23510	79.448	4.75341	46.438	0.09808	-35.752	0.21019	101.936
3.35	0.23920	77.951	4.70392	44.903	0.09840	-36.597	0.21526	99.673
3.4	0.24357	76.439	4.65357	43.375	0.09872	-37.435	0.22065	97.38
3.45	0.24799	75.054	4.60593	41.828	0.09894	-38.395	0.22551	95.15
3.5	0.25252	73.636	4.55940	40.312	0.09929	-39.286	0.23111	92.952
3.55	0.25708	72.232	4.51351	38.767	0.09959	-40.173	0.23653	90.83
3.6	0.26176	70.859	4.46687	37.242	0.09973	-41.064	0.24174	88.712

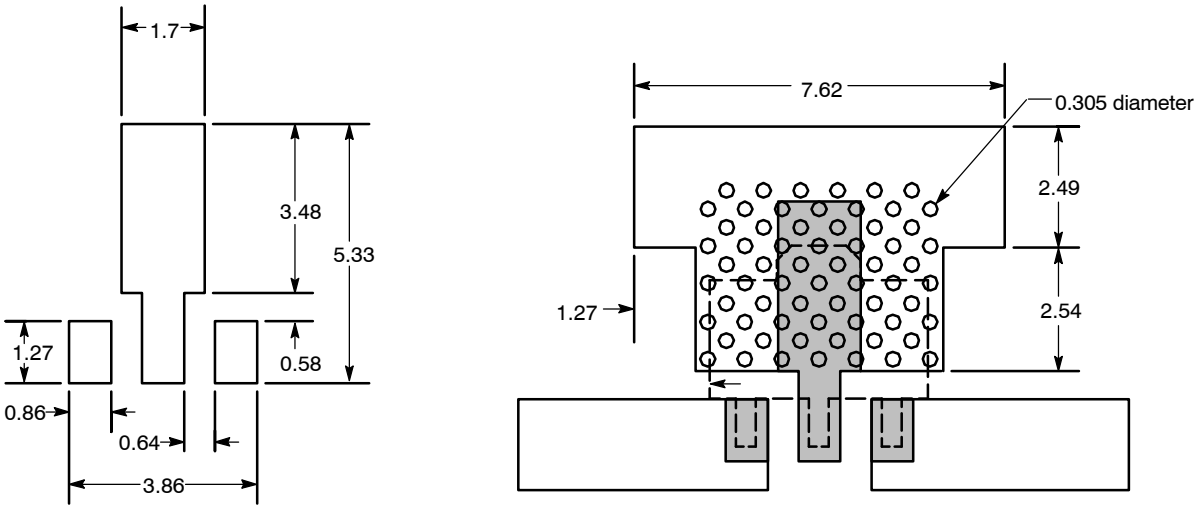
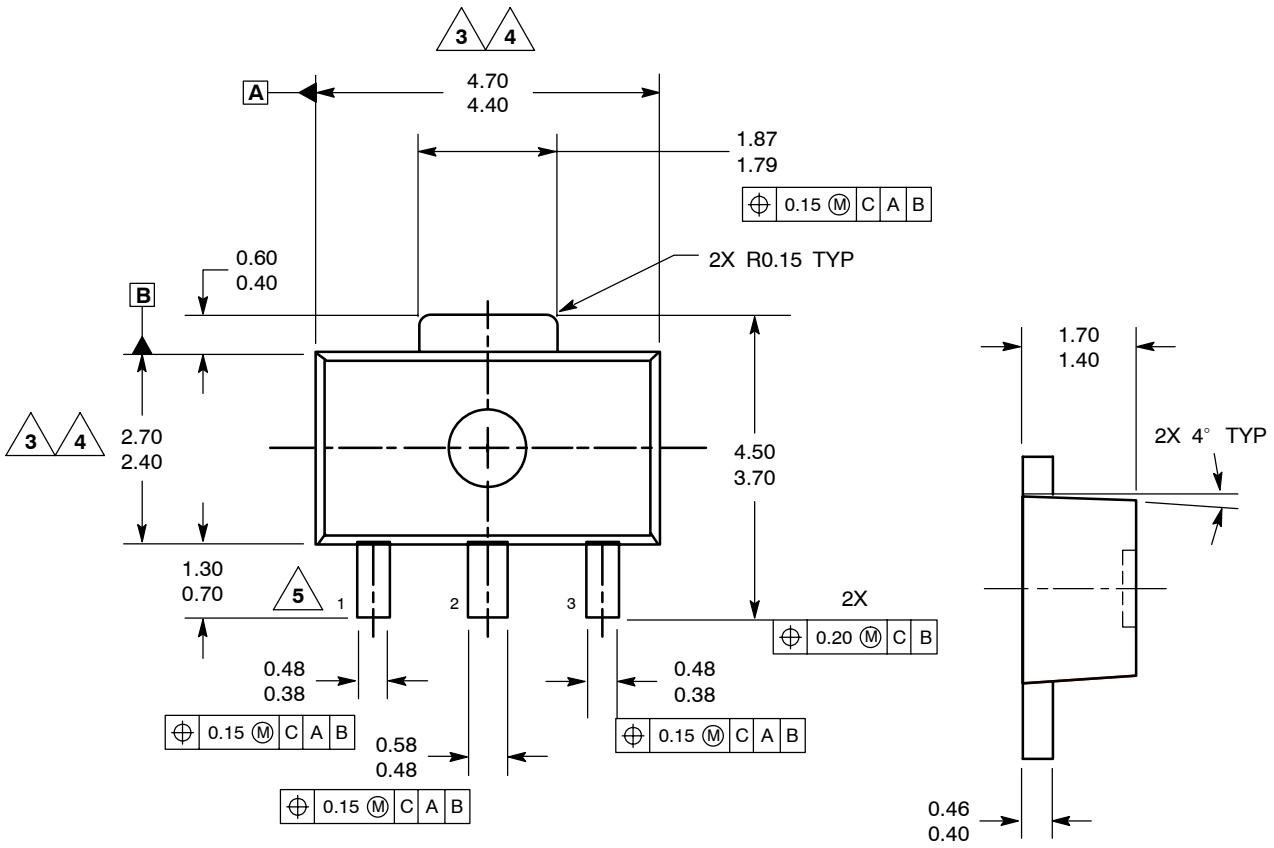
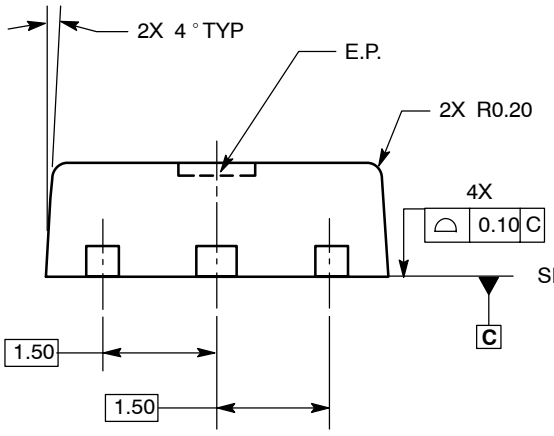


Figure 20. Recommended Mounting Configuration

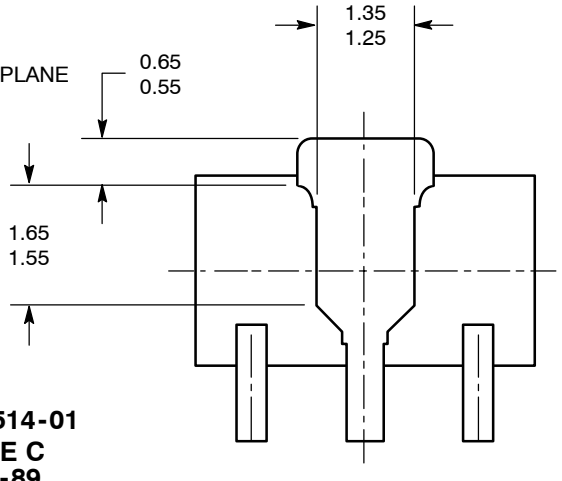
PACKAGE DIMENSIONS





STYLE 1:
PIN 1. RF INPUT
2. GROUND
3. RF OUTPUT

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.5MM PER END. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.5MM PER SIDE.
4. DIMENSIONS ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.



BOTTOM VIEW

CASE 1514-01
ISSUE C
SOT-89
PLASTIC

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