Freescale Semiconductor
Technical Data

Document Number: MMG3007NT1
Rev. 1, 8/2005

RoHS

Heterojunction Bipolar Transistor (InGaP HBT)

Broadband High Linearity Amplifier

The MMG3007NT1 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: 16 dBm @ 900 MHz
- Small-Signal Gain: 19 dB @ 900 MHz
- Third Order Output Intercept Point: 30 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.

MMG3007NT1

0-6000 MHz, 19 dB
16 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	19	16.5	14	dB
Input Return Loss (S11)	IRL	-14	-21	-21	dB
Output Return Loss (S22)	ORL	-20	-17	-25	dB
Power Output @1dB Compression	P1db	16	15.5	16	dBm
Third Order Output Intercept Point	IP3	30	29	28.5	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}	7	V
Supply Current (2)	I_{CC}	250	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} = 47 mA, T_C = 25°C)

Characteristic	Symbol	Value (4)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	77	°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	18	19	—	dB
Input Return Loss (S11)	IRL	—	-14	—	dB
Output Return Loss (S22)	ORL	—	-20	—	dB
Power Output @ 1dB Compression	P1dB	—	16	—	dBm
Third Order Output Intercept Point	IP3	—	30	—	dBm
Noise Figure	NF	—	3.8	—	dB
Supply Current (1)	I_{CC}	39	47	55	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

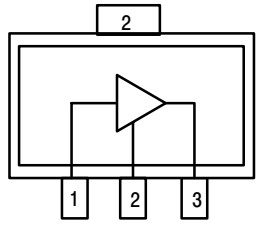


Figure 1. Functional Diagram

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

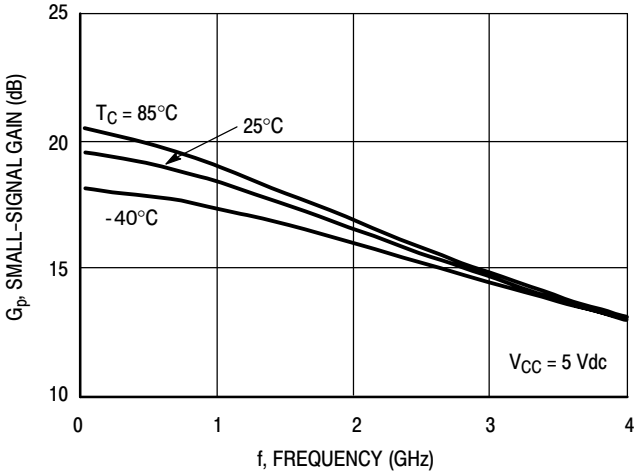


Figure 2. Small-Signal Gain (S21) versus Frequency

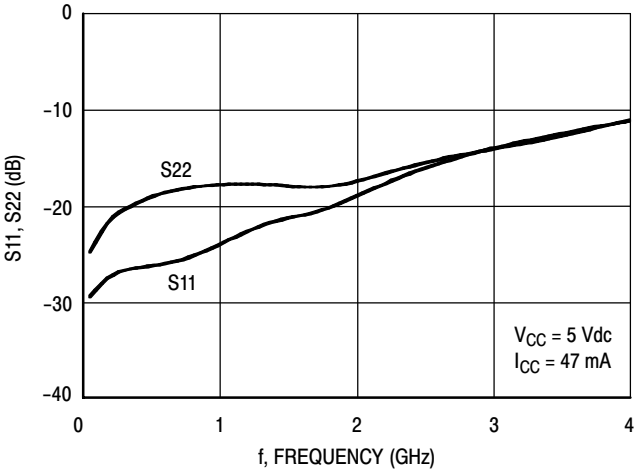


Figure 3. Input/Output Return Loss versus Frequency

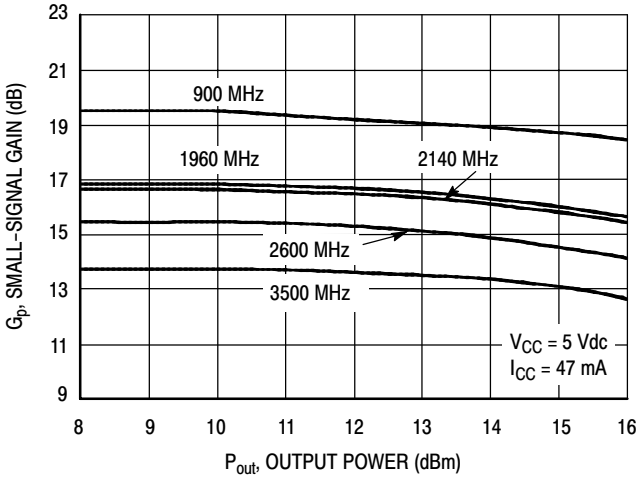


Figure 4. Small-Signal Gain versus Output Power

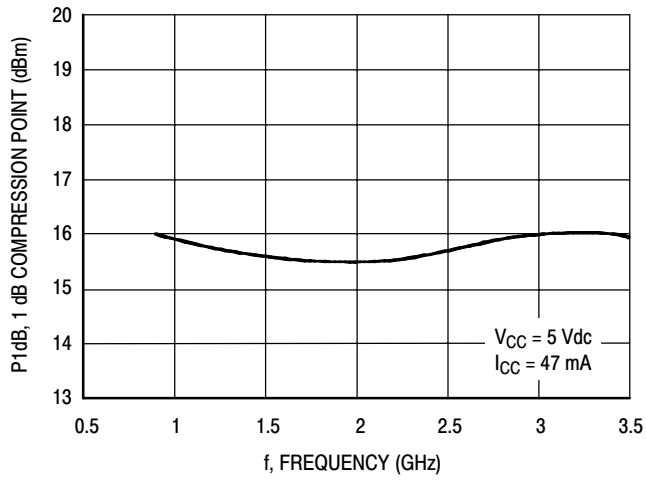


Figure 5. P1dB versus Frequency

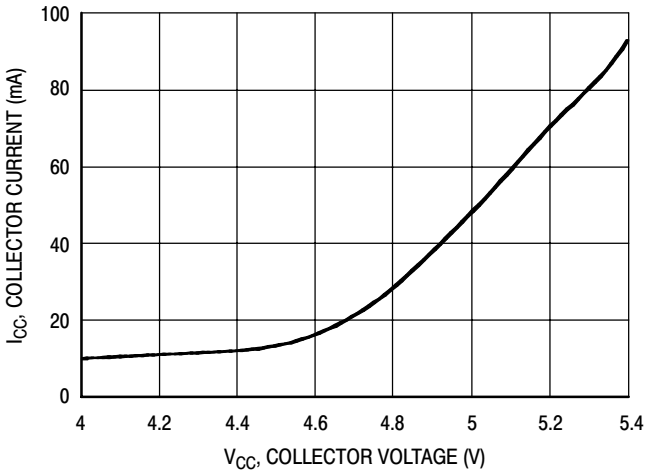


Figure 6. Collector Current versus Collector Voltage

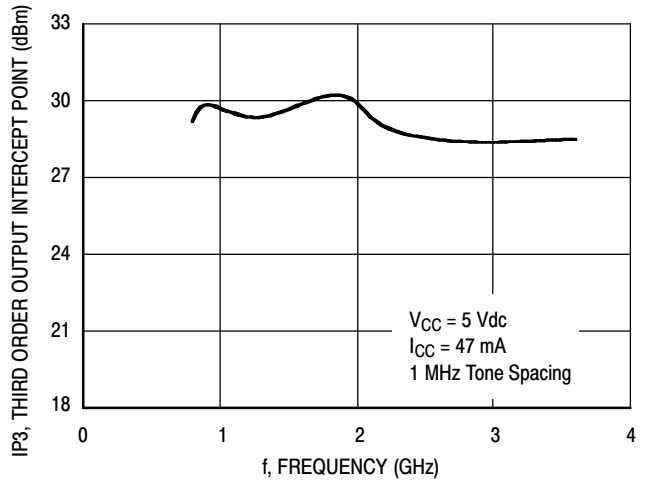


Figure 7. Third Order Output Intercept Point versus Frequency

50 OHM TYPICAL CHARACTERISTICS

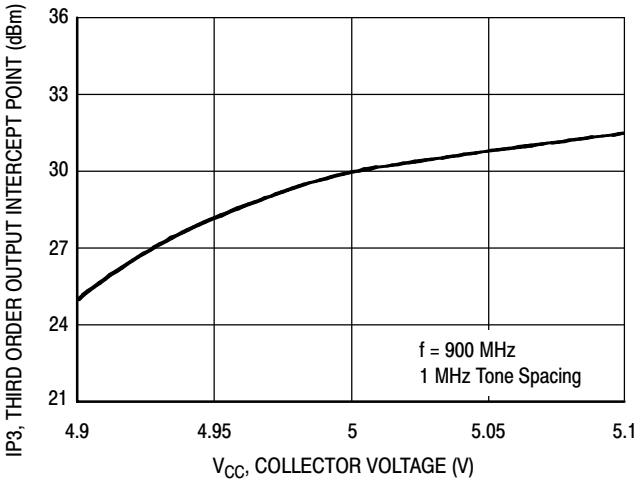


Figure 8. Third Order Output Intercept Point versus Collector Voltage

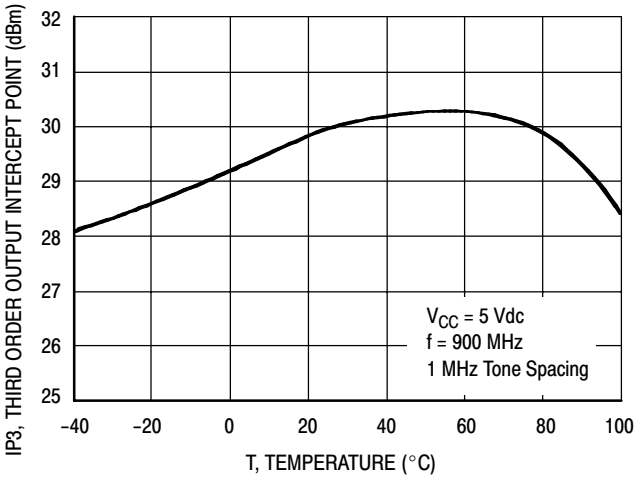


Figure 9. Third Order Output Intercept Point versus Case Temperature

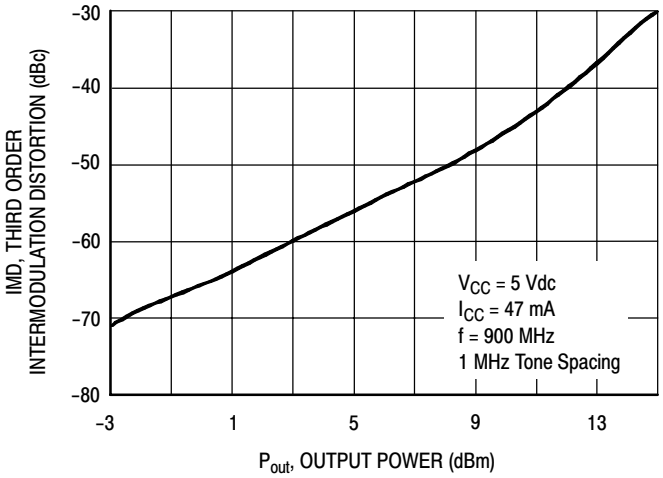
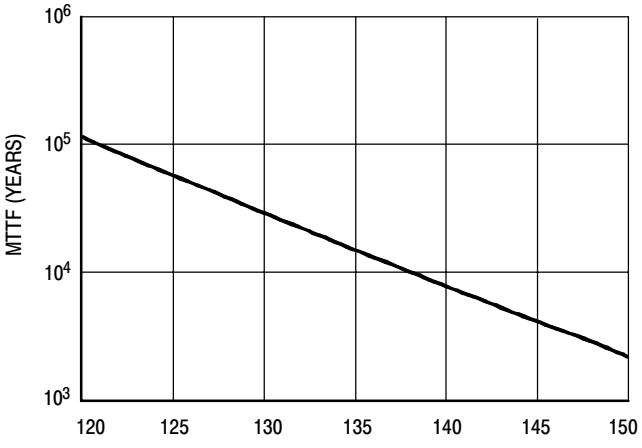


Figure 10. Third Order Intermodulation versus Output Power



NOTE: The MTTF is calculated with V_{CC} = 5 Vdc, I_{CC} = 47 mA

Figure 11. MTTF versus Junction Temperature

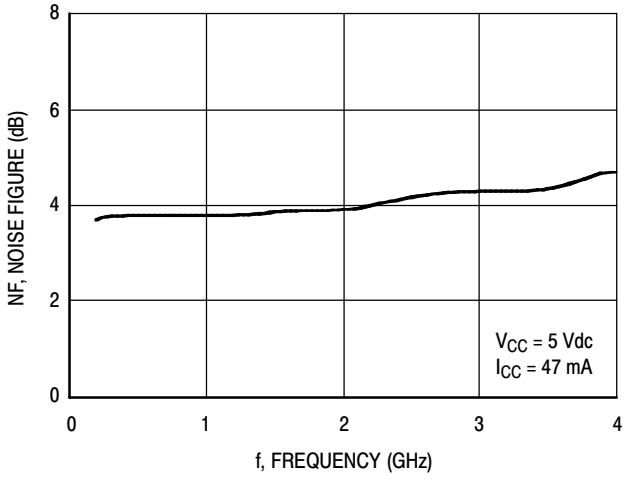


Figure 12. Noise Figure versus Frequency

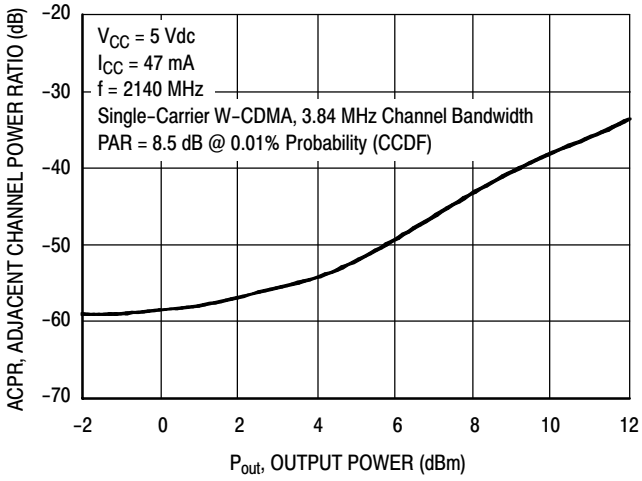
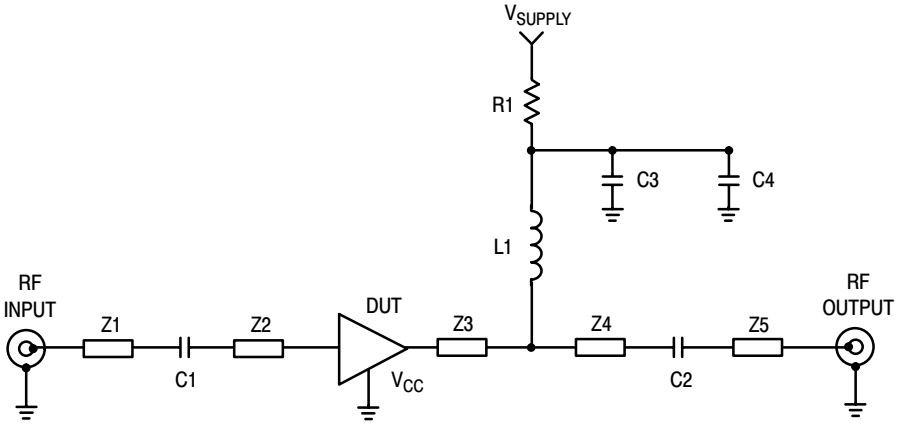


Figure 13. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

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

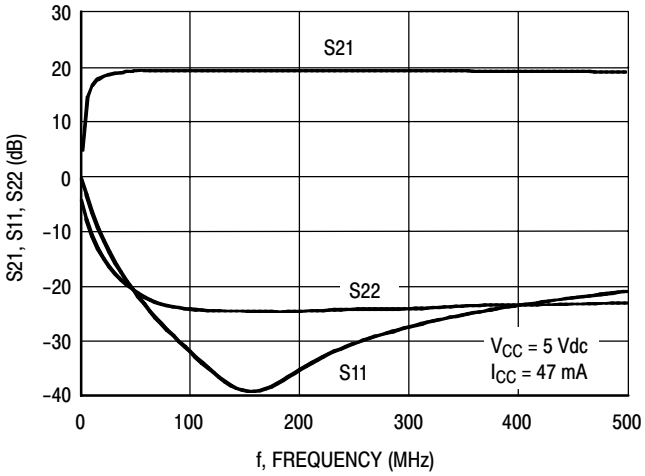


Figure 15. S21, S11 and S22 versus Frequency

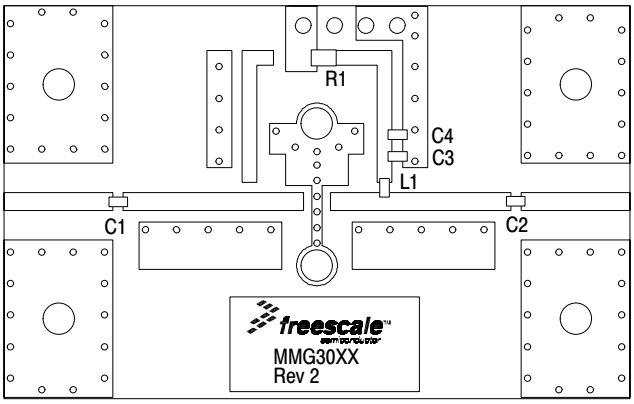
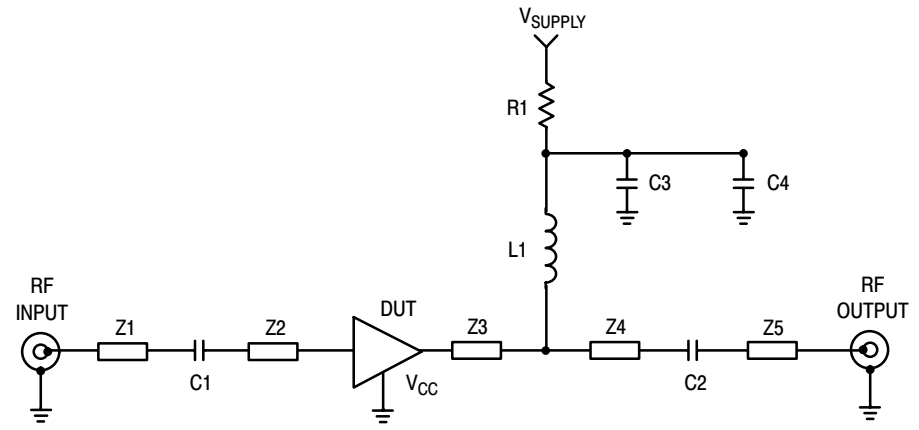


Figure 16. 50 Ohm Test Circuit Component Layout

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

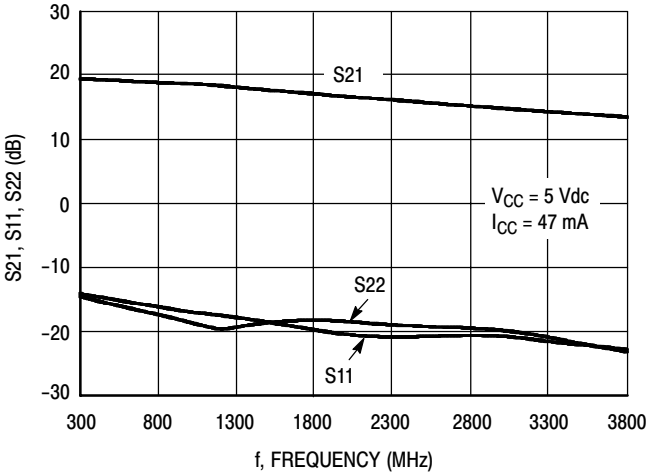


Figure 18. S21, S11 and S22 versus Frequency

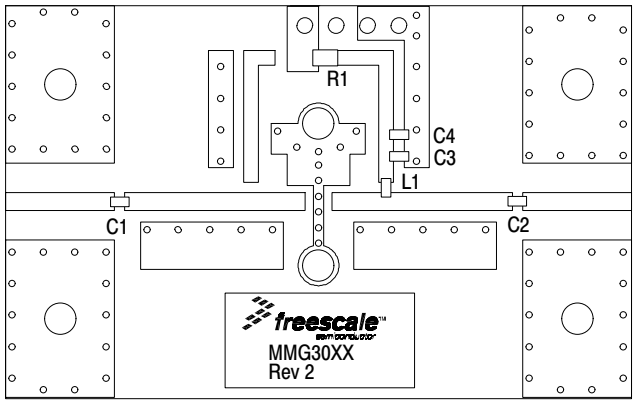


Figure 19. 50 Ohm Test Circuit Component Layout

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

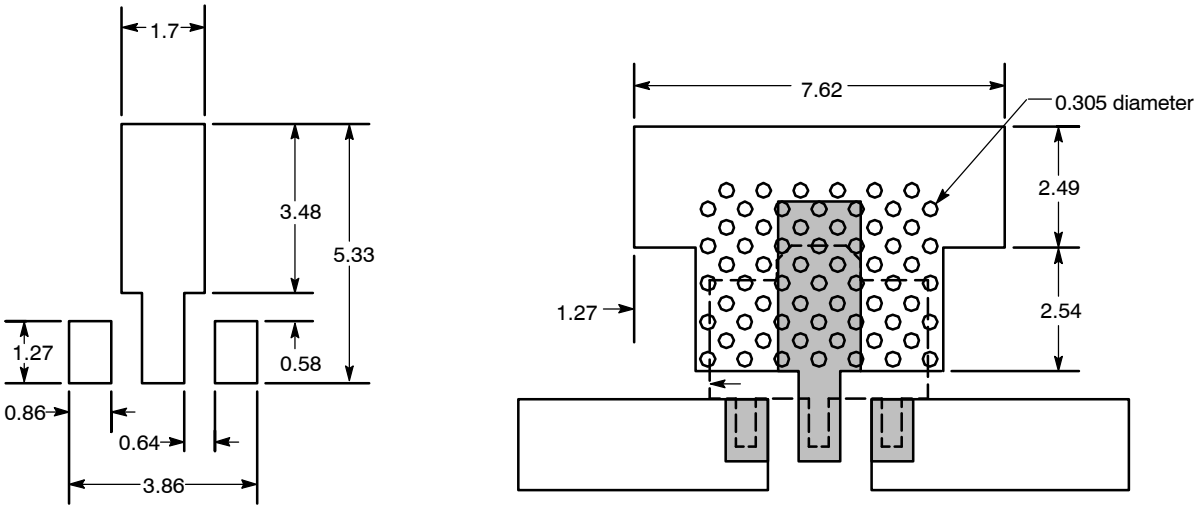
50 OHM TYPICAL CHARACTERISTICS

Table 10. Class A Common Emitter S-Parameters at V_{CC} = 5 Vdc, I_{CC} = 47 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	0.03698	162.744	9.488476	175.169	0.07218	-0.406	0.06601	-6.062
0.15	0.0413	161.759	9.431009	172.714	0.073936	-0.163	0.07813	-11.706
0.2	0.04475	159.333	9.37615	169.547	0.07479	-1.111	0.089562	-18.834
0.25	0.046352	159.222	9.34083	167.191	0.0744	-1.219	0.09748	-25.724
0.3	0.048403	155.469	9.29558	164.704	0.07458	-1.237	0.10124	-32.775
0.35	0.05	151.008	9.26495	162.138	0.07444	-1.639	0.10466	-36.946
0.4	0.0499	147.696	9.21219	159.65	0.07473	-1.957	0.10811	-41.977
0.45	0.04922	144.11	9.16094	157.234	0.07499	-2.087	0.11164	-46.631
0.5	0.04838	141.343	9.10787	154.702	0.07517	-2.464	0.11391	-50.846
0.55	0.04902	137.521	9.04991	152.326	0.07536	-2.681	0.11765	-55.096
0.6	0.04911	134.226	8.98419	149.922	0.07567	-2.89	0.11998	-59.312
0.65	0.0497	130.851	8.91939	147.525	0.07584	-3.227	0.12163	-63.354
0.7	0.05086	127.93	8.85099	145.201	0.07618	-3.577	0.12411	-67.411
0.75	0.05247	124.848	8.78068	142.838	0.07642	-3.81	0.12586	-71.332
0.8	0.05441	122.43	8.70765	140.522	0.07659	-4.138	0.12711	-75.244
0.85	0.05624	120.786	8.63598	138.198	0.07702	-4.463	0.12825	-79.297
0.9	0.05818	118.791	8.5575	135.918	0.0774	-4.812	0.12922	-83.181
0.95	0.06054	117.037	8.47718	133.677	0.07767	-5.244	0.13	-87.373
1.00	0.06284	115.852	8.40286	131.466	0.07806	-5.558	0.13077	-91.474
1.05	0.06676	114.603	8.31905	129.243	0.07848	-5.948	0.13124	-95.143
1.10	0.06962	113.845	8.23305	127.045	0.07874	-6.3	0.13158	-99.674
1.15	0.07142	114.019	8.14799	124.84	0.07912	-6.731	0.13134	-104.011
1.20	0.07473	113.644	8.05859	122.666	0.07962	-7.194	0.13136	-108.404
1.25	0.07822	113.329	7.97269	120.536	0.07992	-7.652	0.13147	-112.847
1.30	0.08137	113.158	7.89042	118.443	0.08035	-8.105	0.1318	-117.291
1.35	0.08501	112.83	7.80455	116.374	0.08077	-8.476	0.13257	-121.809
1.40	0.085621	112.341	7.71693	114.349	0.08135	-8.943	0.13274	-126.4
1.45	0.08691	112.503	7.62844	112.301	0.08168	-9.492	0.130129	-130.945
1.50	0.087447	112.516	7.55444	110.29	0.08226	-9.966	0.127178	-132.429
1.55	0.088958	110.702	7.46781	108.325	0.08275	-10.605	0.125783	-135.873
1.60	0.088598	108.771	7.39276	106.371	0.08326	-11.086	0.12282	-139.82
1.65	0.089575	107.354	7.30109	104.406	0.08366	-11.654	0.1228	-142.9
1.70	0.09071	105.666	7.2314	102.488	0.0841	-12.158	0.12308	-146.866
1.75	0.0938	104.101	7.15066	100.592	0.08459	-12.724	0.12424	-150.805
1.80	0.097	102.621	7.07137	98.688	0.0851	-13.319	0.12564	-154.586
1.85	0.10094	101.285	6.98725	96.791	0.08555	-13.926	0.12718	-158.448
1.90	0.10562	99.475	6.90714	94.976	0.08607	-14.507	0.12895	-162.5
1.95	0.10927	97.823	6.83262	93.117	0.0865	-15.154	0.13127	-166.07
2.00	0.11424	96.4	6.75439	91.288	0.08691	-15.771	0.13415	-169.355
2.05	0.11811	94.531	6.67977	89.43	0.08733	-16.325	0.13706	-172.886
2.10	0.12221	93.106	6.60249	87.648	0.08781	-17.024	0.14095	-175.782
2.15	0.12585	91.879	6.53055	85.88	0.0884	-17.685	0.14488	-179.155
2.20	0.13197	90.391	6.44752	84.16	0.08868	-18.268	0.14844	178.18
2.25	0.13625	88.624	6.37451	82.389	0.08924	-18.993	0.15223	175.153
2.30	0.14158	86.951	6.30389	80.681	0.08971	-19.632	0.15572	172.537
2.35	0.14606	85.398	6.23166	78.989	0.09007	-20.321	0.15962	170.114

Table 10. Class A Common Emitter S-Parameters at V_{CC} = 5 Vdc, I_{CC} = 47 mA, T_C = 25°C (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
2.40	0.15065	83.971	6.16179	77.288	0.09053	-20.98	0.16279	167.517
2.45	0.15511	82.457	6.09153	75.581	0.09088	-21.711	0.16641	165.072
2.50	0.15948	80.991	6.02115	73.906	0.09142	-22.394	0.16996	162.826
2.55	0.16385	79.722	5.95767	72.273	0.09177	-23.024	0.17342	160.459
2.60	0.16854	78.35	5.89249	70.612	0.09216	-23.702	0.17676	157.989
2.65	0.17283	76.864	5.82721	68.994	0.09255	-24.506	0.17953	155.564
2.70	0.17698	75.562	5.76221	67.358	0.09293	-25.194	0.18268	153.165
2.75	0.18126	74.328	5.70193	65.748	0.09333	-25.926	0.18543	150.629
2.80	0.1858	72.976	5.64062	64.155	0.09391	-26.671	0.18837	148.259
2.85	0.18957	71.773	5.58104	62.533	0.09428	-27.402	0.19087	145.593
2.90	0.19403	70.699	5.52616	60.973	0.09472	-28.203	0.19395	143.044
2.95	0.19798	69.575	5.46422	59.362	0.09518	-28.947	0.19629	140.485
3.00	0.20132	68.53	5.41159	57.778	0.09558	-29.733	0.19941	137.461
3.05	0.20676	67.445	5.36032	56.228	0.09592	-30.462	0.20221	135.101
3.10	0.21059	66.347	5.30349	54.654	0.09653	-31.263	0.20477	132.383
3.15	0.21388	65.517	5.25234	53.104	0.09687	-32.035	0.20796	129.58
3.20	0.21774	64.628	5.20188	51.53	0.09729	-32.944	0.21083	126.913
3.25	0.22229	63.76	5.15023	49.962	0.09771	-33.702	0.21442	124.314
3.30	0.22492	62.653	5.10104	48.396	0.09812	-34.531	0.21656	121.289
3.35	0.2287	61.882	5.05108	46.866	0.09855	-35.414	0.22001	118.535
3.40	0.23228	60.924	5.00022	45.297	0.099	-36.284	0.2241	115.888
3.45	0.2365	60.161	4.95117	43.756	0.09926	-37.17	0.22826	113.148
3.50	0.24039	59.326	4.90461	42.216	0.09948	-38.046	0.23275	110.547
3.55	0.24401	58.457	4.85739	40.692	0.09979	-38.943	0.23669	107.983
3.60	0.24834	57.659	4.80824	39.155	0.10008	-39.768	0.24177	105.495

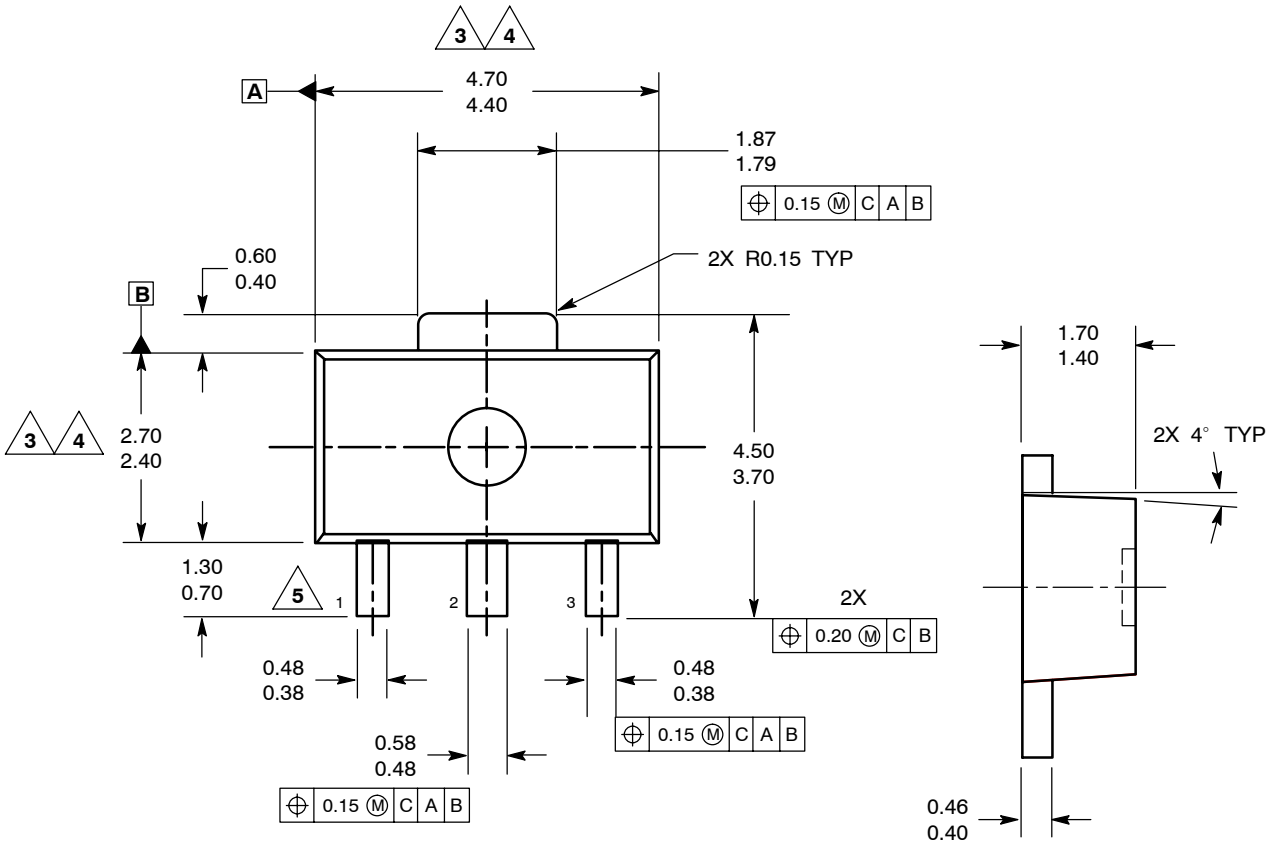


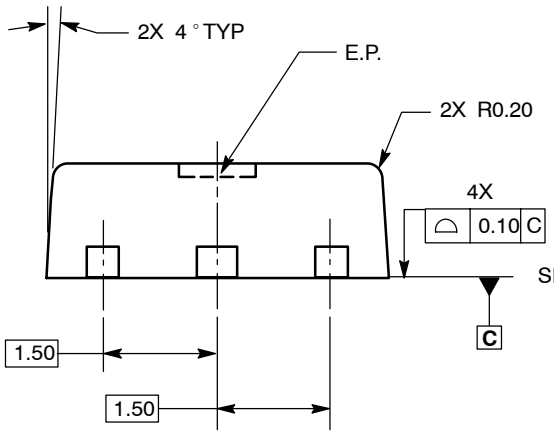
Recommended Solder Stencil

NOTES:
1. THERMAL AND RF GROUNDING CONSIDERATIONS SHOULD BE USED IN PCB LAYOUT DESIGN.
2. DEPENDING ON PCB DESIGN RULES, AS MANY VIAS AS POSSIBLE SHOULD BE PLACED ON THE LANDING PATTERN.
3. IF VIAS CANNOT BE PLACED ON THE LANDING PATTERN, THEN AS MANY VIAS AS POSSIBLE SHOULD BE PLACED AS CLOSE TO THE LANDING PATTERN AS POSSIBLE FOR OPTIMAL THERMAL AND RF PERFORMANCE.
4. RECOMMENDED VIA PATTERN SHOWN HAS 0.381 x 0.762 MM PITCH.

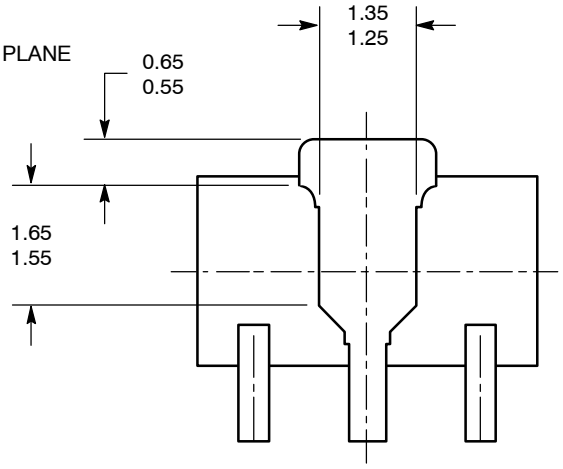
Figure 20. Recommended Mounting Configuration

PACKAGE DIMENSIONS





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.



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

BOTTOM VIEW

CASE 1514-01
ISSUE C
SOT-89
PLASTIC

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