Freescale Semiconductor
Technical Data

Document Number: MMG3010NT1
Rev. 1, 8/2005

RoHS

Heterojunction Bipolar Transistor (InGaP HBT)

Broadband High Linearity Amplifier

The MMG3010NT1 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: 17 dBm @ 900 MHz
- Small-Signal Gain: 15 dB @ 900 MHz
- Third Order Output Intercept Point: 31 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.

MMG3010NT1

0-6000 MHz, 15 dB
17 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	15	14	12	dB
Input Return Loss (S11)	IRL	-15	-17	-22	dB
Output Return Loss (S22)	ORL	-25	-25	-15	dB
Power Output @1dB Compression	P1db	17	16.5	15.5	dBm
Third Order Output Intercept Point	IP3	31	30	28	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}	300	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} = 54 mA, T_C = 25°C)

Characteristic	Symbol	Value (4)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83	°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	14	15	—	dB
Input Return Loss (S11)	IRL	—	-15	—	dB
Output Return Loss (S22)	ORL	—	-25	—	dB
Power Output @ 1dB Compression	P1dB	—	17	—	dBm
Third Order Output Intercept Point	IP3	—	31	—	dBm
Noise Figure	NF	—	4.5	—	dB
Supply Current (1)	I_{CC}	46	54	63	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

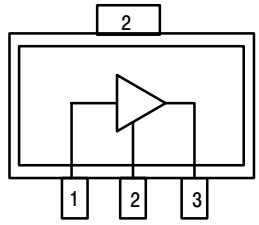


Figure 1. Functional Diagram

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

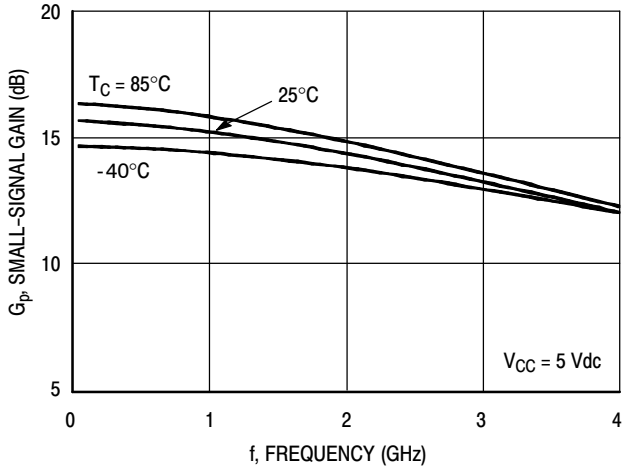


Figure 2. Small-Signal Gain (S21) versus Frequency

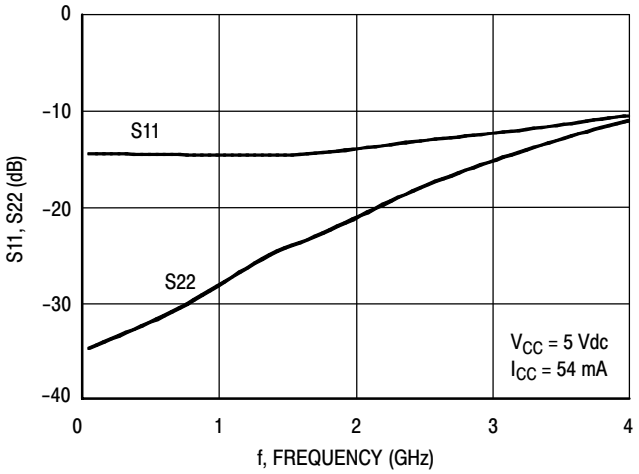


Figure 3. Input/Output Return Loss versus Frequency

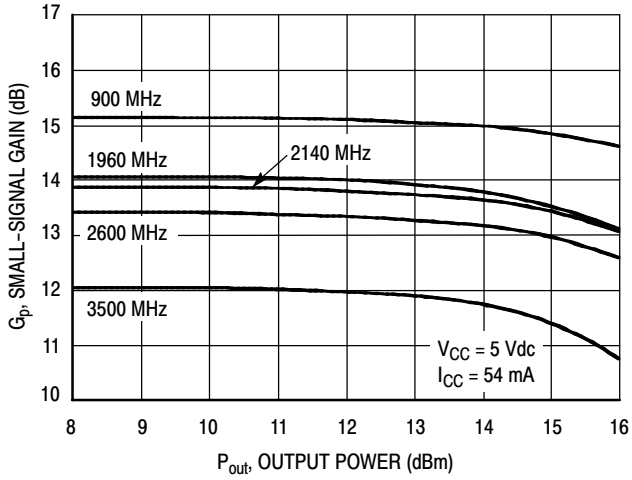


Figure 4. Small-Signal Gain versus Output Power

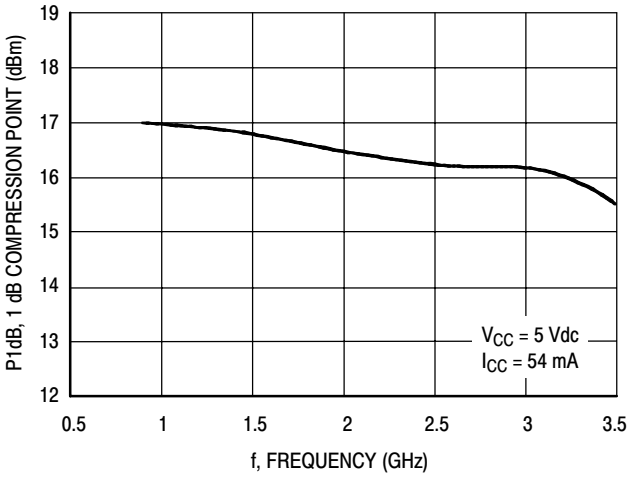


Figure 5. P1dB versus Frequency

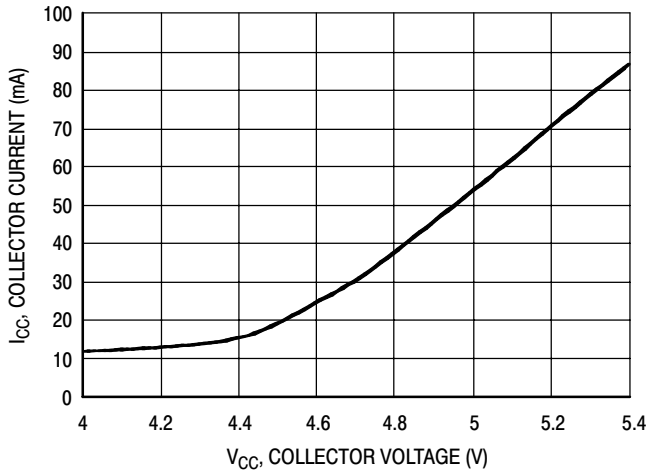


Figure 6. Collector Current versus Collector Voltage

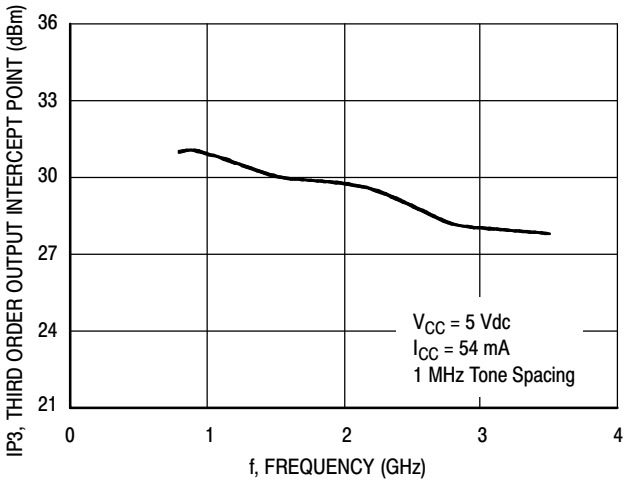


Figure 7. Third Order Output Intercept Point versus Frequency

50 OHM TYPICAL CHARACTERISTICS

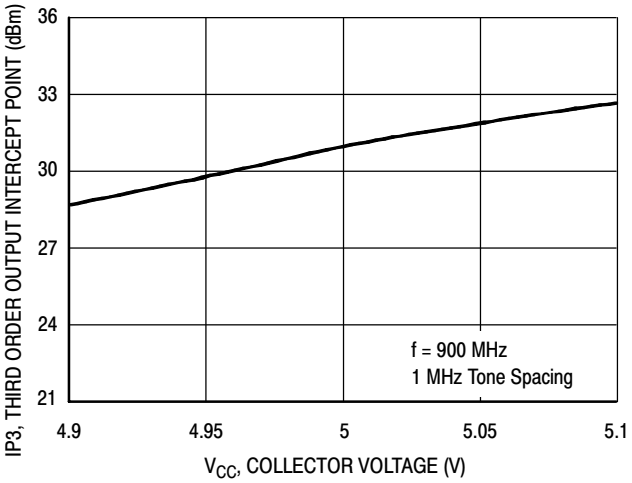


Figure 8. Third Order Output Intercept Point versus Collector Voltage

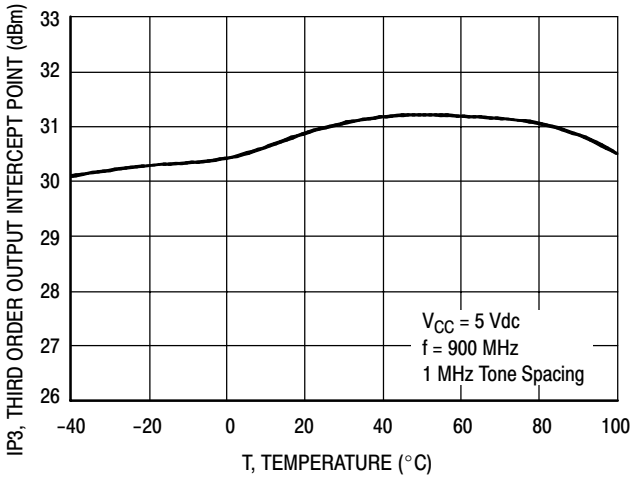


Figure 9. Third Order Output Intercept Point versus Case Temperature

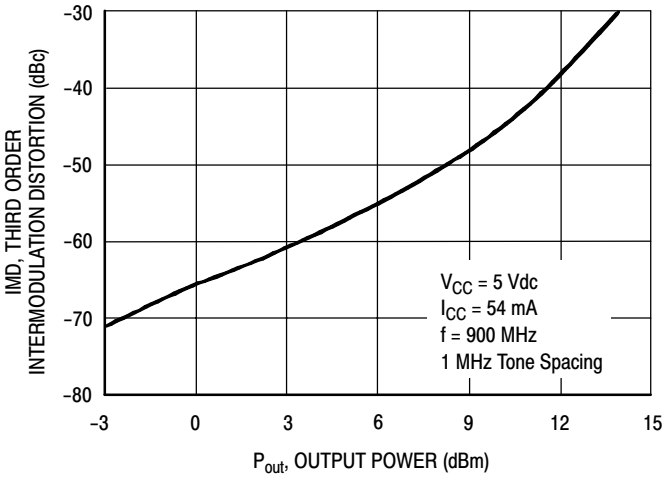
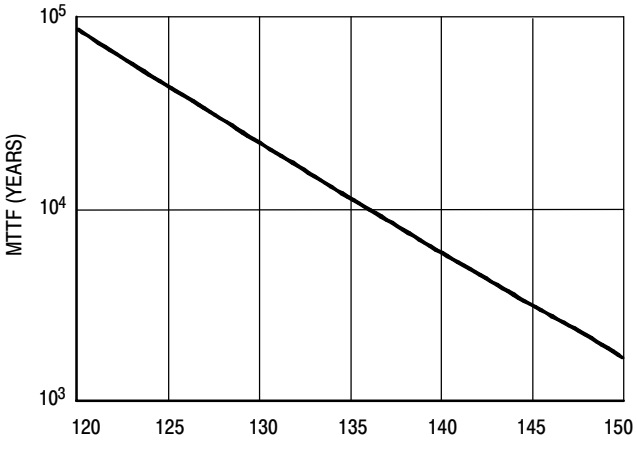


Figure 10. Third Order Intermodulation versus Output Power



NOTE: The MTTF is calculated with V_{CC} = 5 Vdc, I_{CC} = 54 mA

Figure 11. MTTF versus Junction Temperature

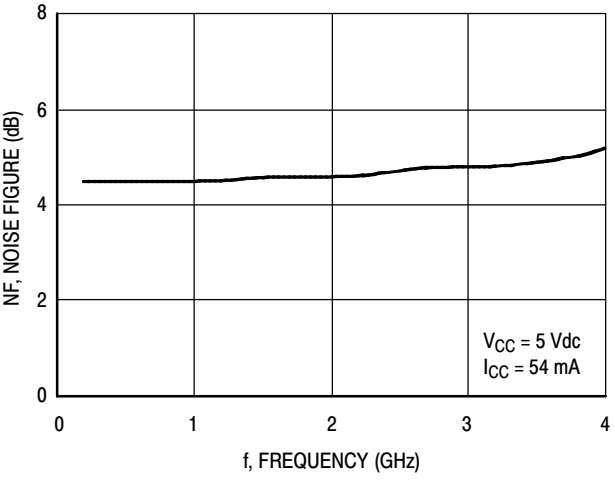


Figure 12. Noise Figure versus Frequency

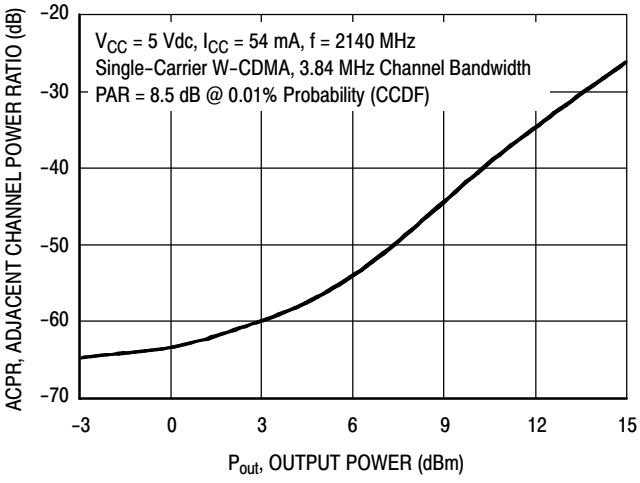
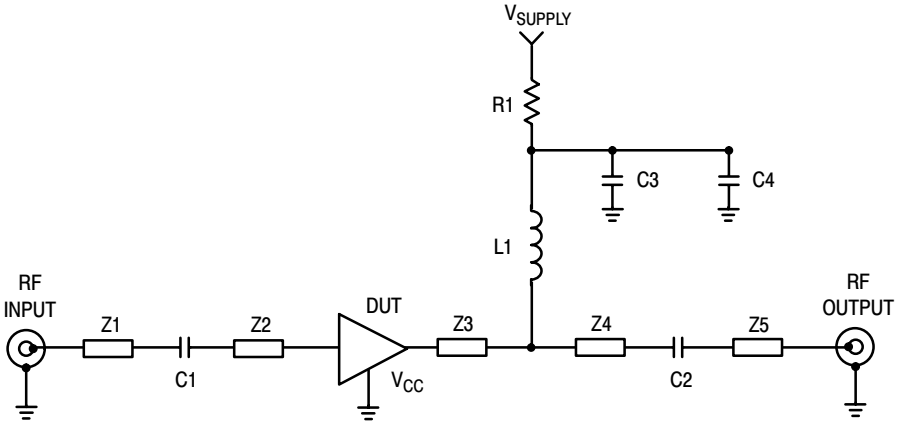


Figure 13. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

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

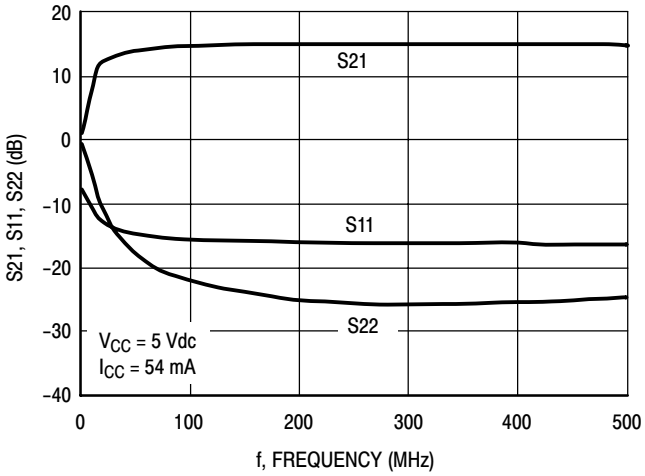


Figure 15. S21, S11 and S22 versus Frequency

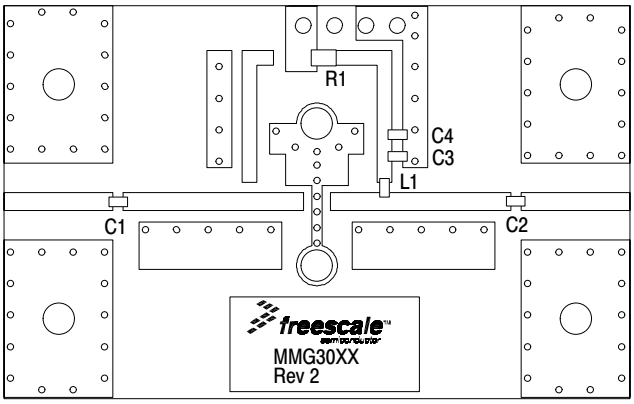
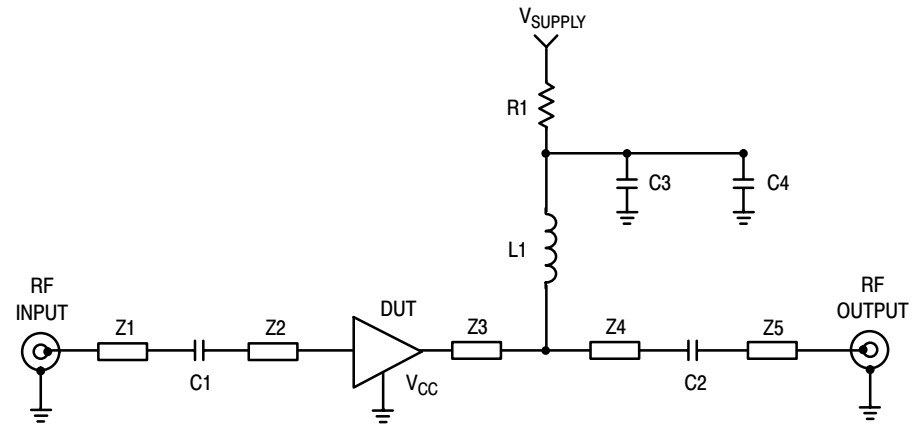


Figure 16. 50 Ohm Test Circuit Component Layout

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

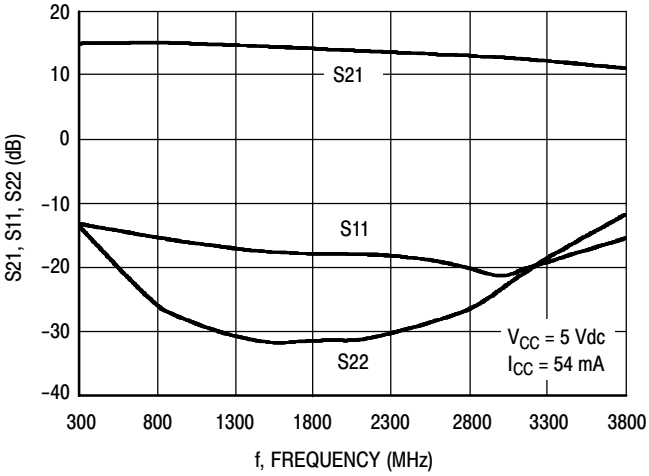


Figure 18. S21, S11 and S22 versus Frequency

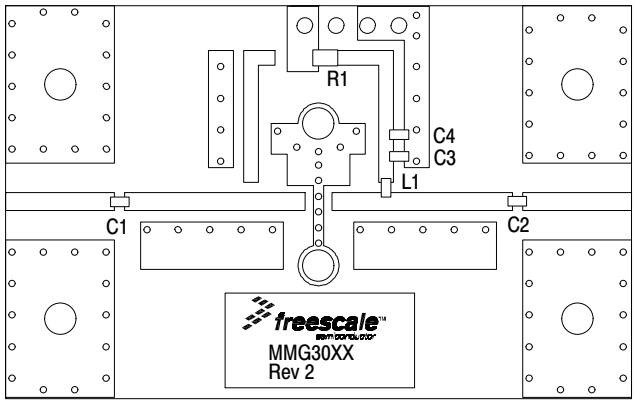


Figure 19. 50 Ohm Test Circuit Component Layout

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} = 54 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	0.18961	174.356	6.08599	176.121	0.10045	-1.147	0.01890	-117.716
0.15	0.18946	172.591	6.06991	173.709	0.10051	-1.684	0.01961	-119.073
0.2	0.18931	170.087	6.05558	171.476	0.10055	-2.764	0.02022	-121.834
0.25	0.18916	168.286	6.04027	169.492	0.10060	-3.23	0.02108	-123.647
0.3	0.18900	166.103	6.03125	167.447	0.10065	-3.883	0.02178	-125.155
0.35	0.18887	163.926	6.01832	165.299	0.10069	-4.61	0.02240	-127.572
0.4	0.18873	161.691	6.00664	163.288	0.10073	-5.218	0.02324	-129.668
0.45	0.18856	159.363	5.99750	161.184	0.10078	-5.914	0.02417	-131.224
0.5	0.18844	157.207	5.98612	159.055	0.10085	-6.577	0.02490	-133.739
0.55	0.18829	154.948	5.97231	157.036	0.10090	-7.176	0.02589	-135.854
0.6	0.18813	152.775	5.95537	154.979	0.10098	-7.816	0.02683	-137.345
0.65	0.18799	150.556	5.94078	152.921	0.10111	-8.444	0.02784	-139.784
0.7	0.18783	148.43	5.92660	150.895	0.10103	-9.124	0.02895	-141.384
0.75	0.18769	146.278	5.90891	148.835	0.10115	-9.76	0.03030	-143.84
0.8	0.18753	144.103	5.88998	146.803	0.10113	-10.388	0.03176	-145.852
0.85	0.18738	142.071	5.86905	144.751	0.10130	-11.106	0.03328	-147.52
0.9	0.18723	140.126	5.84578	142.751	0.10126	-11.715	0.03472	-148.773
0.95	0.18703	138.174	5.82588	140.772	0.10142	-12.347	0.03683	-150.721
1	0.18689	136.334	5.80670	138.776	0.10134	-13.049	0.03847	-153.215
1.05	0.18674	134.574	5.77963	136.782	0.10156	-13.635	0.04077	-155.358
1.1	0.18657	132.862	5.75495	134.777	0.10146	-14.317	0.04304	-159.06
1.15	0.18643	131.57	5.72982	132.79	0.10159	-14.945	0.04551	-162.691
1.2	0.18629	130.147	5.70191	130.817	0.10169	-15.594	0.04827	-166.671
1.25	0.18613	128.841	5.67762	128.866	0.10184	-16.271	0.05112	-170.497
1.3	0.18599	127.621	5.65132	126.933	0.10183	-16.958	0.05460	-174.453
1.35	0.18582	126.515	5.62394	124.986	0.10196	-17.615	0.05759	-178.275
1.4	0.18568	125.418	5.59479	123.074	0.10201	-18.236	0.06146	178.051
1.45	0.18567	124.471	5.56625	121.175	0.10211	-18.888	0.06306	174.258
1.5	0.18569	123.602	5.54822	119.257	0.10220	-19.552	0.06362	170.85
1.55	0.18591	122.392	5.52432	117.274	0.10258	-20.344	0.06362	163.521
1.6	0.18645	120.668	5.49674	115.354	0.10272	-20.962	0.06377	160.673
1.65	0.18767	119.047	5.46526	113.429	0.10283	-21.702	0.06570	158.125
1.7	0.18855	117.338	5.43646	111.53	0.10301	-22.327	0.06858	155.716
1.75	0.19030	115.719	5.40925	109.673	0.10315	-23.09	0.07094	153.133
1.8	0.19186	114.043	5.38177	107.795	0.10333	-23.804	0.07392	151.055
1.85	0.19364	112.379	5.35341	105.878	0.10340	-24.547	0.07711	148.881
1.9	0.19581	110.938	5.32341	104.011	0.10356	-25.192	0.08039	147.016
1.95	0.19775	109.449	5.29221	102.117	0.10384	-25.884	0.08395	145.259
2	0.20022	108.079	5.25998	100.28	0.10401	-26.62	0.08764	143.574
2.05	0.20274	106.526	5.22900	98.422	0.10405	-27.296	0.09155	141.882
2.1	0.20483	105.054	5.20224	96.556	0.10413	-28.065	0.09523	140.434
2.15	0.20673	103.673	5.16895	94.728	0.10441	-28.819	0.09969	138.992
2.2	0.21006	102.263	5.13639	92.885	0.10441	-29.517	0.10388	137.594
2.25	0.21183	100.83	5.10466	91.074	0.10468	-30.238	0.10812	136.199
2.3	0.21443	99.385	5.07001	89.25	0.10472	-30.97	0.11217	134.891
2.35	0.21661	98.005	5.03818	87.453	0.10489	-31.768	0.11632	133.499

50 OHM TYPICAL CHARACTERISTICS

Table 10. Class A Common Emitter S-Parameters at V_{CC} = 5 Vdc, I_{CC} = 54 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	0.21882	96.635	5.00516	85.611	0.10502	-32.469	0.12050	132.176
2.45	0.22193	95.395	4.97224	83.821	0.10521	-33.265	0.12557	130.946
2.5	0.22303	93.907	4.93831	82.052	0.10527	-34.008	0.12957	129.503
2.55	0.22524	92.5	4.90747	80.256	0.10541	-34.706	0.13384	128.151
2.6	0.22731	91.106	4.87540	78.504	0.10567	-35.467	0.13842	126.605
2.65	0.22921	89.599	4.84438	76.72	0.10587	-36.255	0.14269	125.06
2.7	0.23072	88.26	4.81170	74.931	0.10582	-37.021	0.14690	123.585
2.75	0.23259	86.873	4.77720	73.147	0.10600	-37.804	0.15188	122.036
2.8	0.23443	85.515	4.74514	71.382	0.10623	-38.579	0.15645	120.364
2.85	0.23625	84.122	4.71210	69.615	0.10637	-39.349	0.16075	118.48
2.9	0.23786	82.84	4.68334	67.904	0.10648	-40.152	0.16529	116.779
2.95	0.23979	81.448	4.64992	66.078	0.10664	-41.004	0.16969	114.827
3	0.24125	80.072	4.61988	64.334	0.10700	-41.819	0.17439	112.861
3.05	0.24422	78.711	4.58846	62.607	0.10702	-42.586	0.17909	111.23
3.1	0.24610	77.547	4.55812	60.863	0.10736	-43.392	0.18404	109.114
3.15	0.24792	76.337	4.52495	59.115	0.10733	-44.248	0.18914	107.101
3.2	0.25072	75.174	4.49699	57.356	0.10748	-45.078	0.19427	105.076
3.25	0.25383	73.947	4.46681	55.612	0.10765	-45.892	0.19983	102.924
3.3	0.25590	72.848	4.43561	53.877	0.10784	-46.753	0.20478	100.877
3.35	0.25874	71.738	4.40430	52.133	0.10813	-47.687	0.21036	98.897
3.4	0.26159	70.666	4.37458	50.384	0.10814	-48.565	0.21586	96.818
3.45	0.26531	69.68	4.34458	48.649	0.10821	-49.382	0.22115	94.763
3.5	0.26829	68.707	4.31385	46.916	0.10846	-50.314	0.22678	92.769
3.55	0.27180	67.687	4.28470	45.167	0.10856	-51.229	0.23264	90.836
3.6	0.27525	66.773	4.25389	43.44	0.10871	-52.108	0.23850	88.858

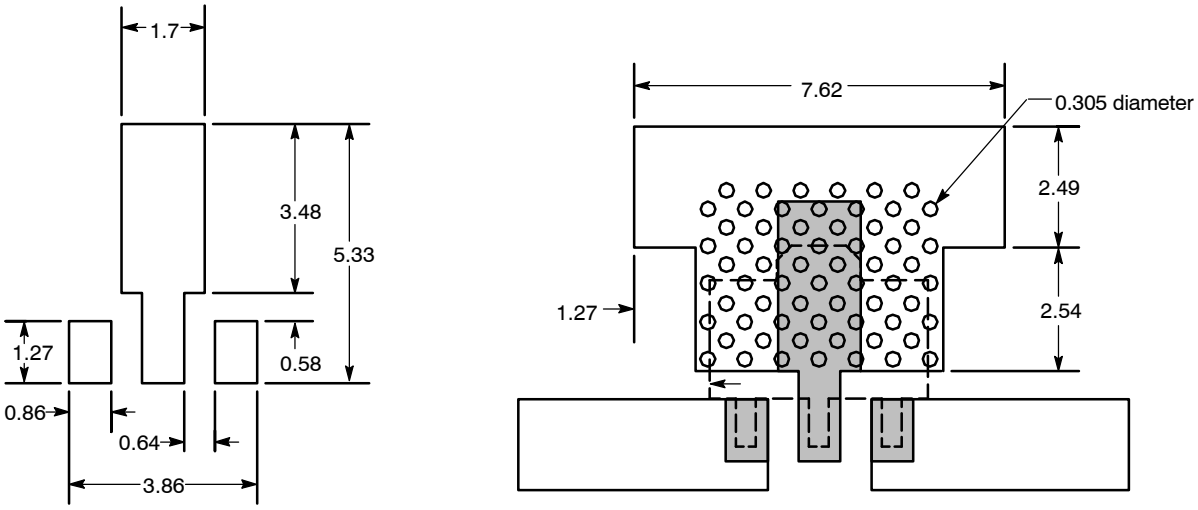
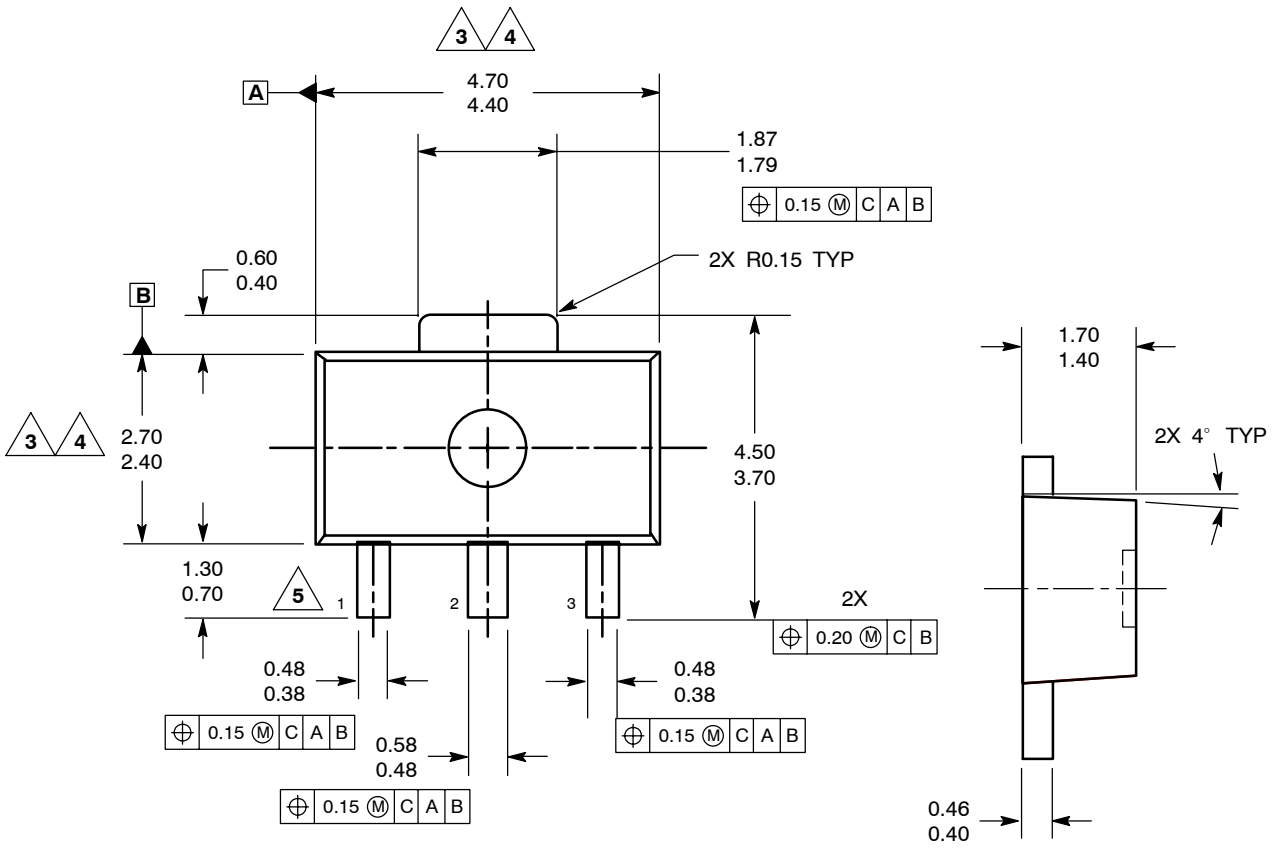
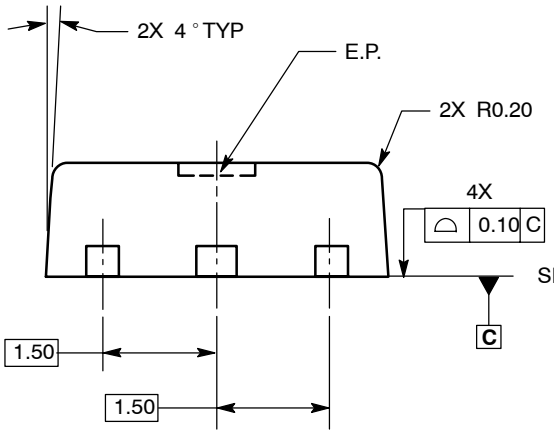


Figure 20. Recommended Mounting Configuration

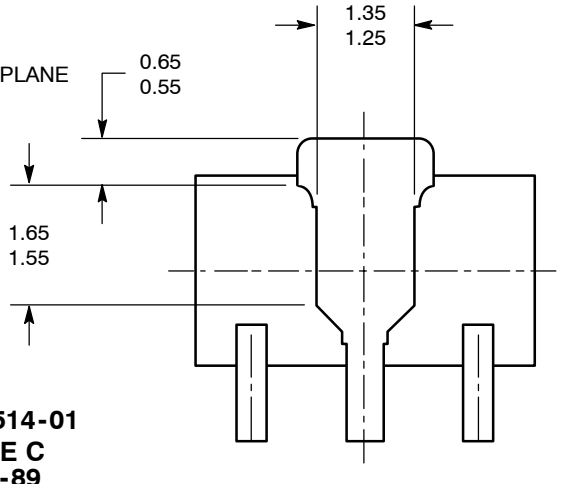
PACKAGE DIMENSIONS





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

How to Reach Us:

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USA/Europe or Locations Not Listed:
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
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