The RF MOSFET Line

Heterojunction Bipolar Transistor Technology (InGaP HBT)

Broadband High Linearity Amplifier

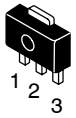
MMG3002NT1

The MMG3002NT1 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 40 to 3600 MHz such as Cellular, PCS, BWA, WLL, PHS, CATV, VHF, UHF, UMTS and general small-signal RF.

40-3600 MHz, 20 dB
21 dBm
InGaP HBT

Features

- Frequency: 40-3600 MHz
- P1dB: 21 dBm
- Power Gain: 20 dB
- Third Order Output Intercept Point: 37.5 dBm
- Single Voltage Supply
- Internally Matched to 50 Ohms
- Low Cost SOT-89 Surface Mount Package
- Pb-Free Leads
- In Tape and Reel. T1 Suffix = 1000 Units per 12 mm, 7 inch Reel.



CASE 1514-01, STYLE 1
SOT-89
PLASTIC

TYPICAL PERFORMANCE (1)

Characteristic	Symbol	900 MHz	2140 MHz	3500 MHz	Unit
Power Gain (S21)	G_p	20	18	14.5	dB
Input Return Loss (S11)	IRL	-16	-26	-16	dB
Output Return Loss (S22)	ORL	-12	-8	-11	dB
Power Output @ 1dB Compression	P1db	21	21	18.5	dBm
Third Order Output Intercept Point	IP3	37.5	36	32	dBm

(1) V_{CC} = 5.2 Vdc, T_C = 25°C, 50 ohm system

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage (2)	V_{CC}	7	V
Supply Current (2)	I_{CC}	400	mA
RF Input Power	P_{in}	12	dBm
Storage Temperature Range	T_{stg}	-65 to +150	°C
Junction Temperature (3)	T_J	150	°C

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

THERMAL CHARACTERISTICS (V_{CC} = 5.2 Vdc, I_{CC} = 110 mA, T_C = 25°C)

Characteristic	Symbol	Value (4)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	46.5	°C/W

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

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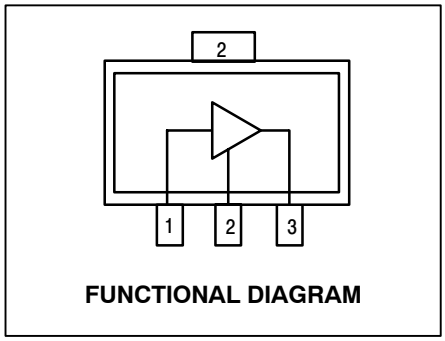
For More Information On This Product,
Go to: www.freescale.com

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.2 Vdc, 900 MHz, T_C = 25°C, 50 ohm system, in Motorola Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain (S21)	G_p	19.3	20	—	dB
Input Return Loss (S11)	IRL	—	-16	—	dB
Output Return Loss (S22)	ORL	—	-12	—	dB
Power Output @ 1dB Compression	P1dB	—	21	—	dBm
Third Order Output Intercept Point	IP3	—	37.5	—	dBm
Noise Figure	NF	—	4.2	—	dB
Supply Current (1)	I_{CC}	95	110	125	mA
Supply Voltage (1)	V_{CC}	—	5.2	—	V

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



FUNCTIONAL DIAGRAM

FUNCTIONAL PIN DESCRIPTION	
Pin Number	**Pin Function**
1	RF_{in}
2	Ground
3	RF_{out}/DC Supply

ESD PROTECTION CHARACTERISTICS

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

MOISTURE SENSITIVITY LEVEL

Test Methodology	Rating
Per JESD 22-A113	1

50 OHM TYPICAL CHARACTERISTICS

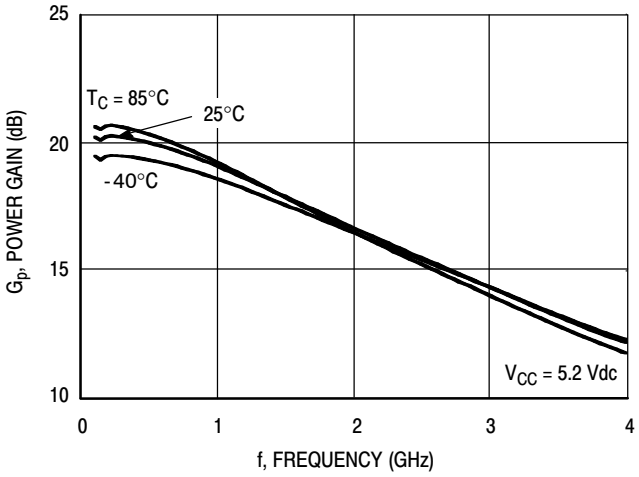


Figure 1. Unmatched Power Gain (S21) versus Frequency

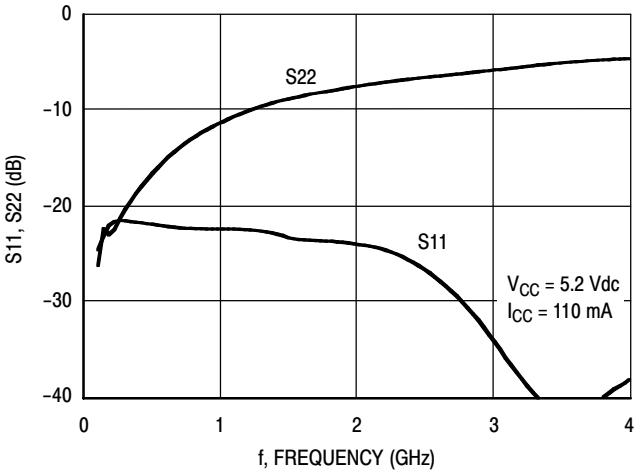


Figure 2. Unmatched Input/Output Return Loss versus Frequency

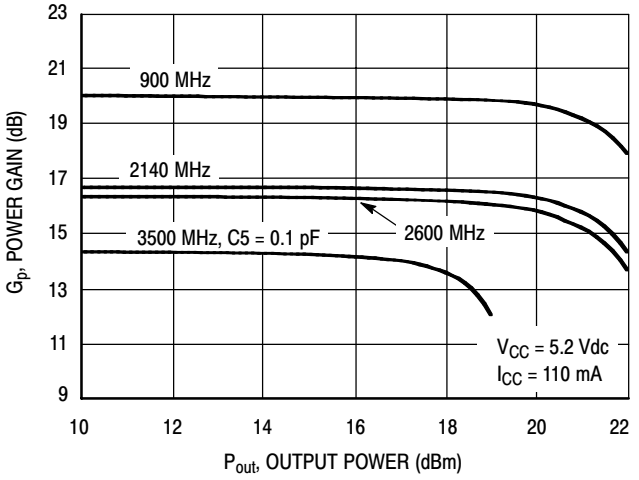


Figure 3. Power Gain versus Output Power

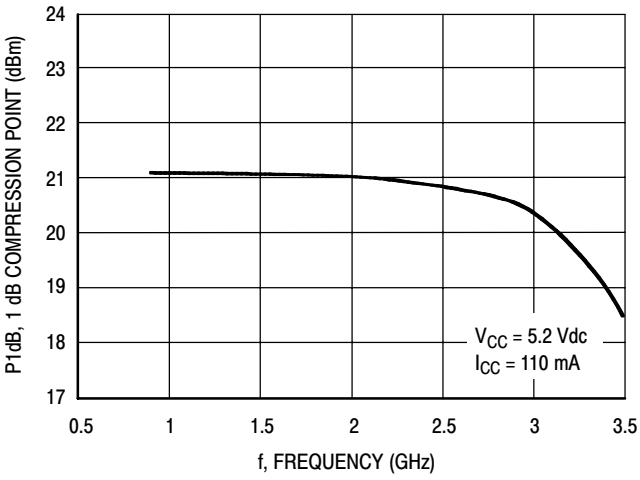


Figure 4. P1dB versus Frequency

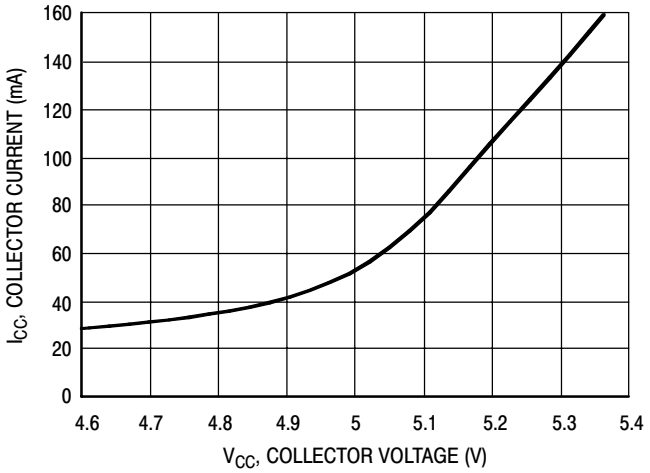


Figure 5. Collector Current versus Collector Voltage

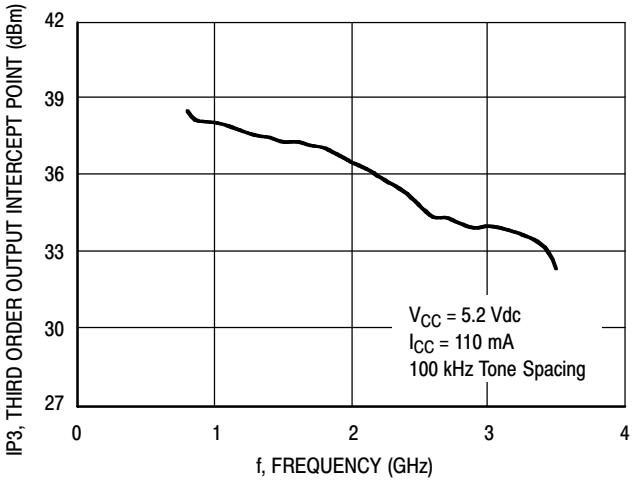


Figure 6. Third Order Output Intercept Point versus Frequency

50 OHM TYPICAL CHARACTERISTICS

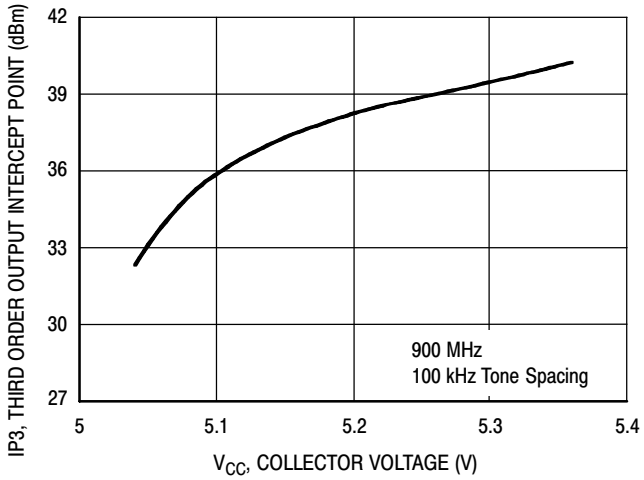


Figure 7. Third Order Output Intercept Point versus Collector Voltage

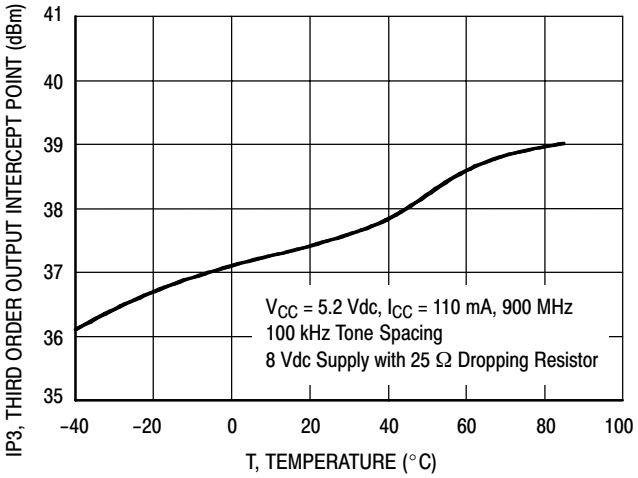


Figure 8. Third Order Output Intercept Point versus Case Temperature

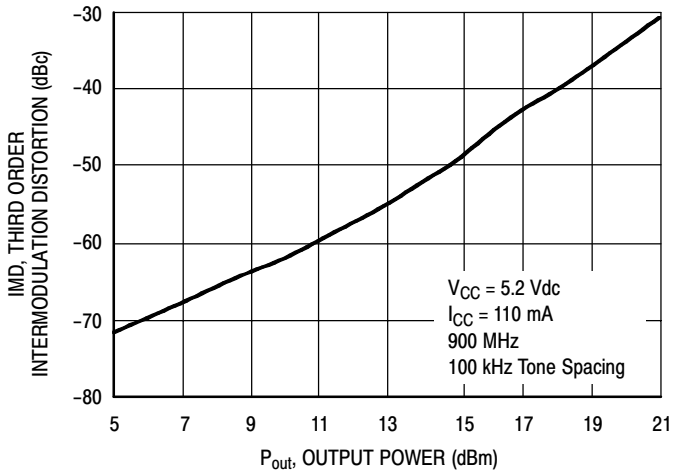
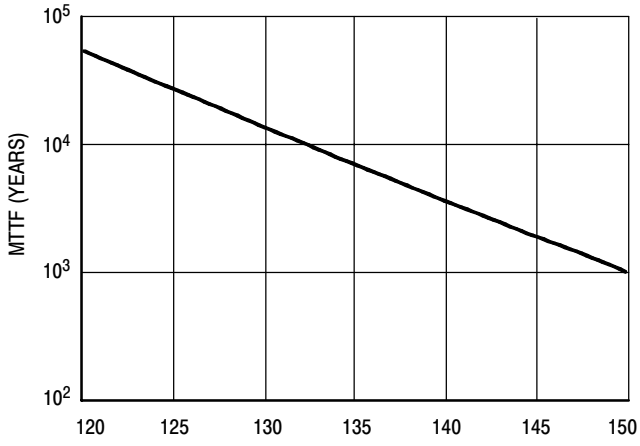


Figure 9. Third Order Intermodulation versus Output Power



NOTE: The MTTF is calculated with V_{CC} = 5.2 Vdc, I_{CC} = 110 mA

Figure 10. MTTF versus Junction Temperature

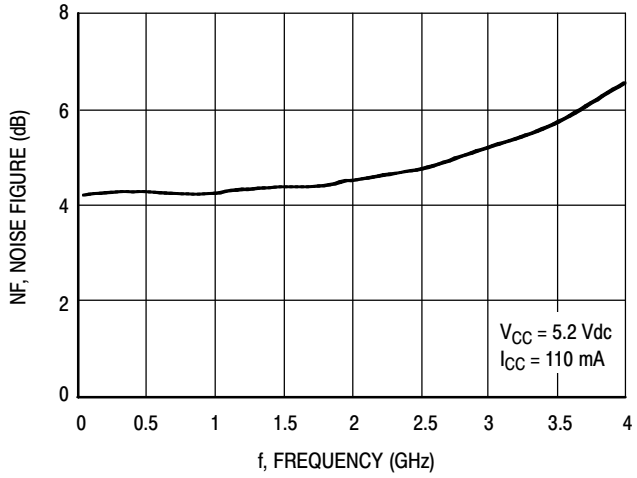


Figure 11. Noise Figure versus Frequency

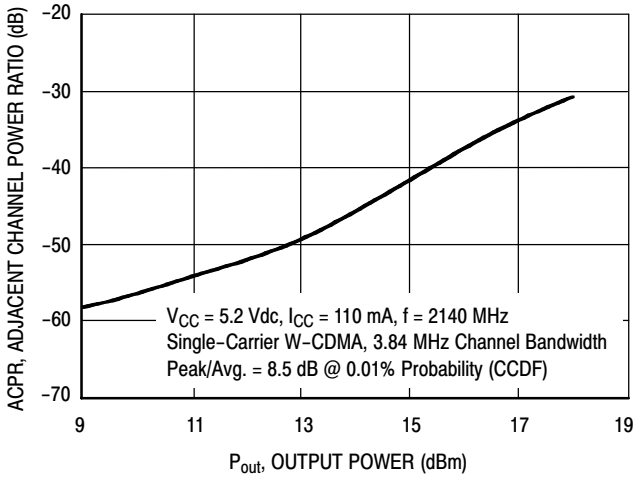
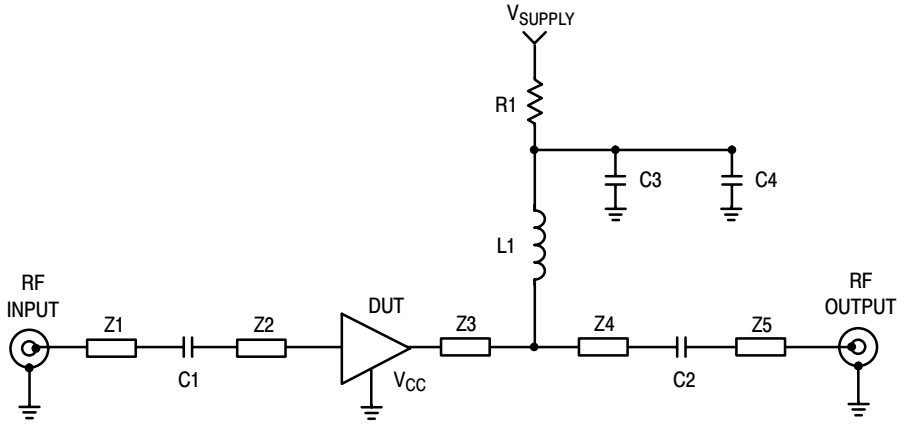


Figure 12. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

50 OHM APPLICATION CIRCUIT: 40-800 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 13. 50 Ohm Test Circuit Schematic

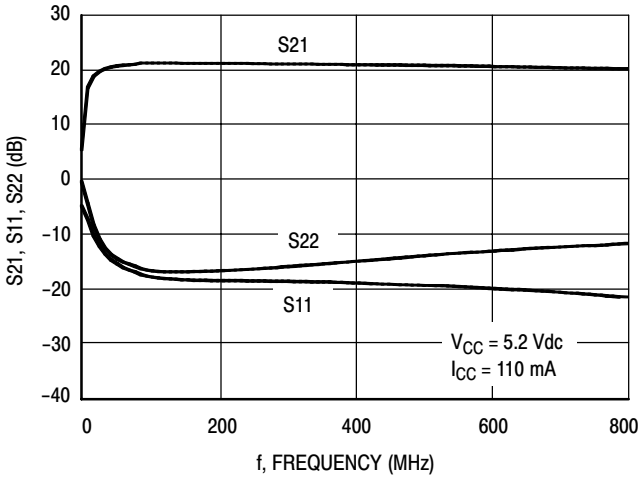


Figure 14. S21, S11 and S22 versus Frequency

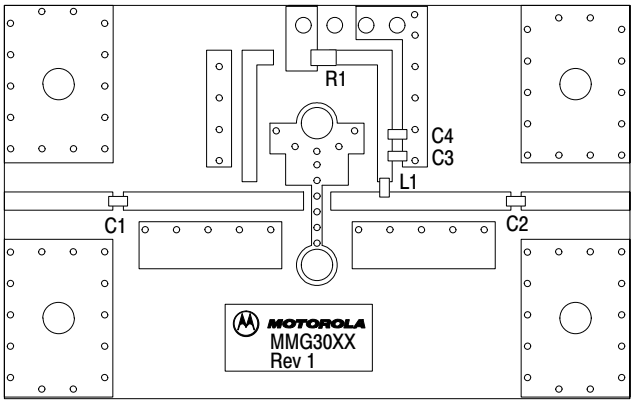


Figure 15. 50 Ohm Test Circuit Component Layout

Table 1. 50 Ohm Test Circuit Component Designations and Values

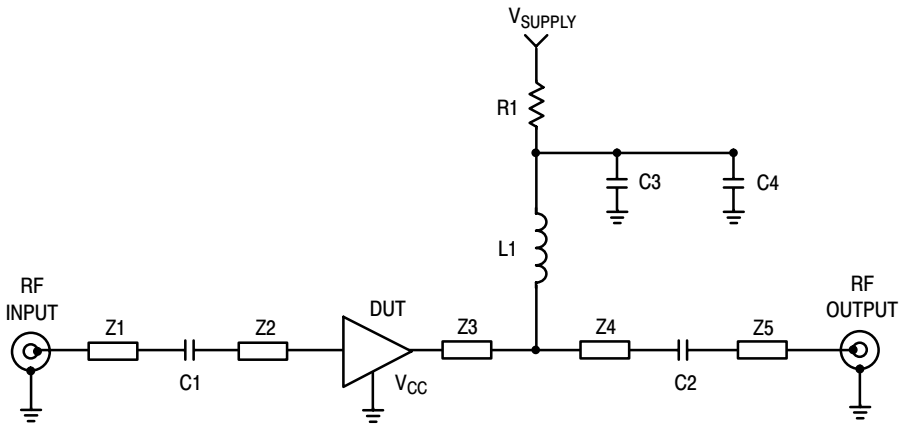
Part	Description	Part Number	Manufacturer
C1, C2	0.01 μF Chip Capacitors	0603A103JAT2A	AVX
C3	0.1 μF Chip Capacitor	0603A102JAT2A	AVX
C4	1 μF Chip Capacitor	0603A105JAT2A	AVX
L1	470 nH Chip Inductor	BK2125HM471	Taiyo Yuden
R1	7.5 Ω Chip Resistor	RK73B2AT7R5J	KOA Speer

Table 2. Supply Voltage versus R1 Values

Supply Voltage	6	7	8	9	10	11	12	V
R1 Value	7.3	16	25	35	44	53	62	Ω

NOTE: To provide V_{CC} = 5.2 Vdc and I_{CC} = 110 mA at the device.

50 OHM APPLICATION CIRCUIT: 800 - 3400 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 16. 50 Ohm Test Circuit Schematic

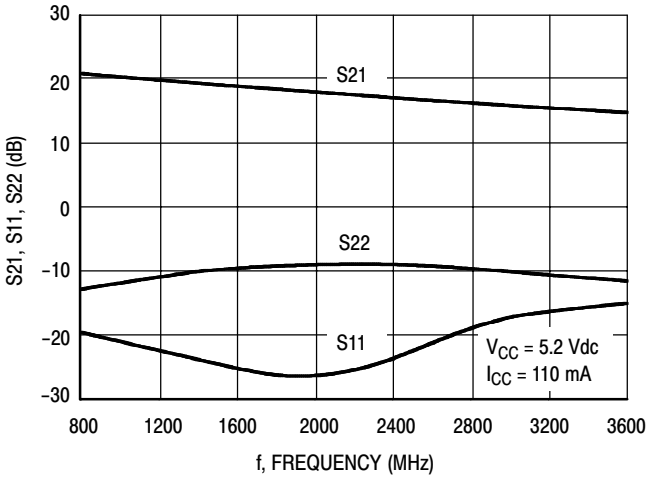


Figure 17. S21, S11 and S22 versus Frequency

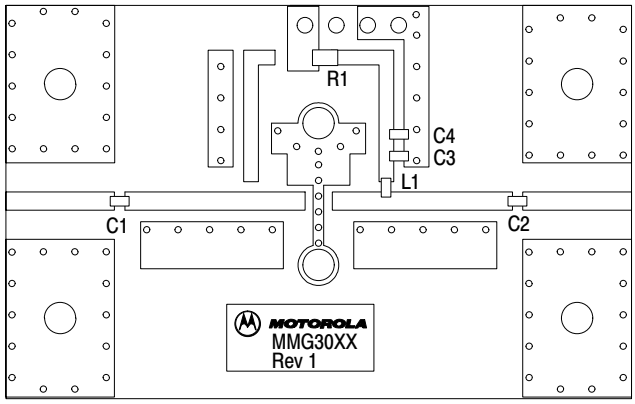
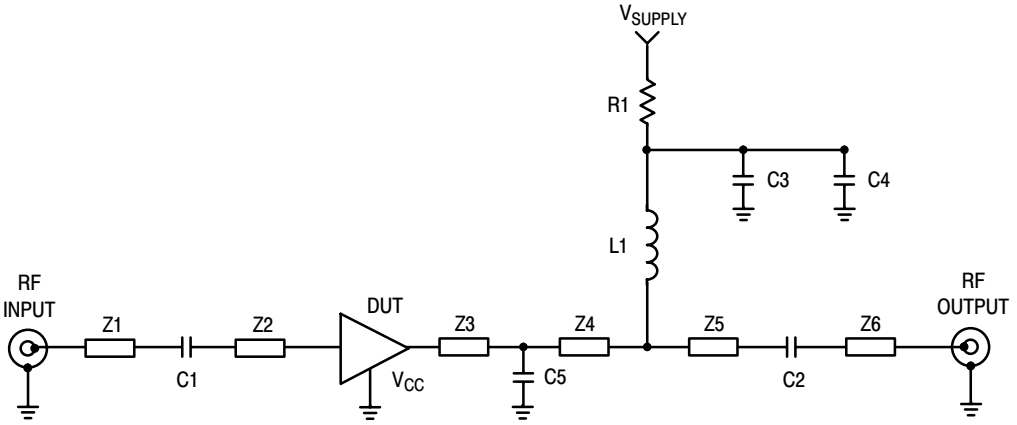


Figure 18. 50 Ohm Test Circuit Component Layout

Table 3. 50 Ohm Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	150 pF Chip Capacitors	0603A151JAT2A	AVX
C3	0.1 μF Chip Capacitor	0603A102JAT2A	AVX
C4	1 μF Chip Capacitor	0603A105JAT2A	AVX
L1	56 nH Chip Inductor	HK160856NJ-T	Taiyo Yuden
R1	7.5 Ω Chip Resistor	RK73B2AT7R5J	KOA Speer

50 OHM APPLICATION CIRCUIT: 3.4 - 3.6 GHz



Z1, Z6	0.347″ x 0.058″ Microstrip	Z4	0.085″ x 0.058″ Microstrip
Z2	0.575″ x 0.058″ Microstrip	Z5	0.404″ x 0.058″ Microstrip
Z3	0.086″ x 0.058″ Microstrip	PCB	Getek Grade ML200C, 0.031″, ε_r = 4.1

Figure 19. 50 Ohm Test Circuit Schematic

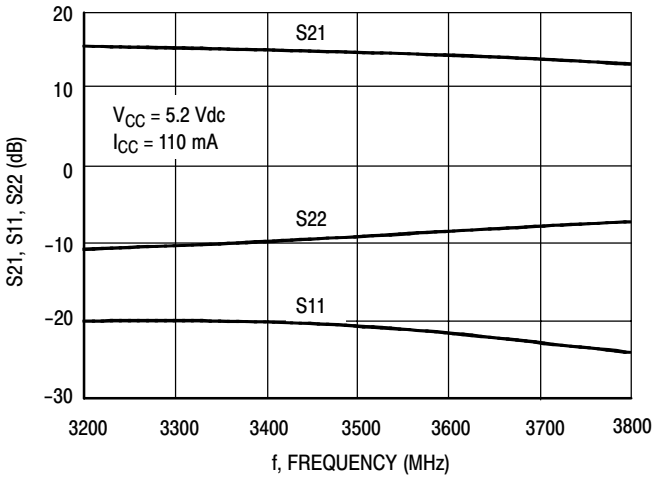


Figure 20. S21, S11 and S22 versus Frequency

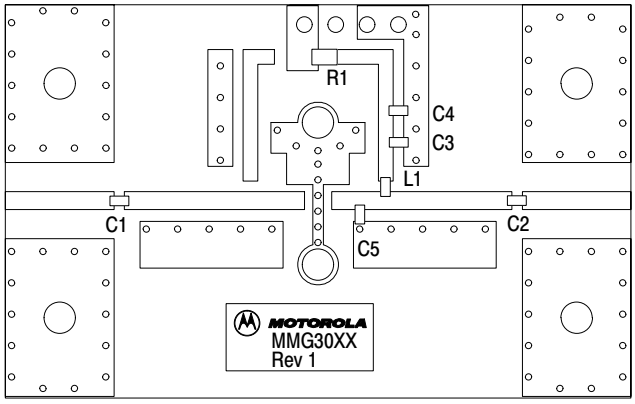


Figure 21. 50 Ohm Test Circuit Component Layout

Table 4. 50 Ohm Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	150 pF Chip Capacitors	0603A151JAT2A	AVX
C3	0.1 μF Chip Capacitor	0603A102JAT2A	AVX
C4	1 μF Chip Capacitor	0603A105JAT2A	AVX
C5 (1)	0.1 pF Chip Capacitor for 3400 - 3600 MHz	06035J0R1BBT	AVX
L1	39 nH Chip Inductor	HK160839NJ - T	Taiyo Yuden
R1	7.5 Ω Chip Resistor	RK73B2AT7R5J	KOA Speer

(1) Tuning capacitor: Capacitor value and location on the transmission line are varied for different frequencies.

50 OHM TYPICAL CHARACTERISTICS

Table 5. Class A Common Emitter S-Parameters at V_{CC} = 5.2 Vdc, I_{CC} = 110 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	0.05966	176.181	10.25158	174.805	0.07235	-0.722	0.04946	-167.612
0.15	0.07228	-178.627	9.96687	171.111	0.07071	-1.821	0.0953	-129.396
0.2	0.09041	151.476	10.46556	167.719	0.07464	-3.053	0.05913	-124.668
0.25	0.0909	149.96	10.36837	164.949	0.07424	-3.553	0.08015	-125.378
0.3	0.08882	145.472	10.30366	162.017	0.07406	-4.277	0.09694	-122.814
0.35	0.08508	140.833	10.2505	158.995	0.07407	-4.934	0.11062	-121.876
0.4	0.08377	136.078	10.17971	156.158	0.07405	-5.7	0.12723	-122.007
0.45	0.08191	131.492	10.10383	153.293	0.07365	-6.307	0.14156	-122.555
0.5	0.07982	125.857	10.02536	150.437	0.07358	-7.037	0.15558	-123.436
0.55	0.07776	120.816	9.94165	147.642	0.07346	-7.676	0.1685	-124.8
0.6	0.0773	115.435	9.85596	144.898	0.07336	-8.2	0.18177	-126.796
0.65	0.07677	110.371	9.76098	142.109	0.07321	-8.911	0.19472	-128.506
0.7	0.07664	104.874	9.6623	139.374	0.07301	-9.464	0.20662	-130.47
0.75	0.07628	100.112	9.56168	136.692	0.0729	-10.069	0.21833	-132.663
0.8	0.07619	95.73	9.45426	134.024	0.07275	-10.618	0.22977	-134.835
0.85	0.07601	91.72	9.34921	131.391	0.07273	-11.184	0.24125	-137.084
0.9	0.07567	87.313	9.23967	128.792	0.07257	-11.821	0.25232	-139.685
0.95	0.07642	83.036	9.13144	126.149	0.07238	-12.312	0.26303	-142.257
1	0.07619	80.021	9.01205	123.659	0.07228	-12.88	0.27394	-144.736
1.05	0.07666	76.201	8.90327	121.137	0.07218	-13.474	0.28332	-147.346
1.1	0.07678	73.008	8.78013	118.657	0.07202	-13.93	0.29417	-150.042
1.15	0.07673	70.68	8.66342	116.191	0.0719	-14.519	0.30394	-152.767
1.2	0.07674	68.773	8.53991	113.779	0.07178	-15.062	0.31393	-155.358
1.25	0.07628	66.216	8.42251	111.392	0.07176	-15.551	0.32286	-157.992
1.3	0.07618	64.635	8.30514	109.034	0.07164	-16.115	0.33259	-160.483
1.35	0.07454	62.959	8.18109	106.673	0.07149	-16.539	0.34127	-162.981
1.4	0.07373	60.65	8.06498	104.367	0.07152	-17.114	0.34972	-165.377
1.45	0.0724	59.062	7.94403	102.073	0.07137	-17.565	0.35931	-167.823
1.5	0.06466	48.656	7.85198	99.72	0.0715	-18.187	0.35762	-170.82
1.55	0.0646	44.563	7.73641	97.503	0.07167	-18.755	0.36484	-172.845
1.6	0.06495	39.856	7.63068	95.372	0.07161	-19.217	0.37158	-174.751
1.65	0.0657	35.953	7.52257	93.247	0.07165	-19.614	0.37821	-176.697
1.7	0.06599	31.949	7.43591	91.089	0.07171	-20.239	0.38558	-178.85
1.75	0.0666	28.693	7.31976	88.981	0.07168	-20.731	0.39036	179.588
1.8	0.06649	25.448	7.22121	86.872	0.07176	-21.241	0.39732	177.775
1.85	0.06637	22.687	7.11782	84.83	0.07181	-21.685	0.40211	175.992
1.9	0.06563	19.369	7.01794	82.771	0.07188	-22.233	0.40749	174.294
1.95	0.06514	15.516	6.91688	80.824	0.07197	-22.678	0.41306	172.684
2	0.0641	13.294	6.82126	78.739	0.07217	-23.218	0.41825	170.97
2.05	0.06323	9.843	6.72865	76.797	0.07214	-23.632	0.42367	169.372
2.1	0.06288	6.976	6.63794	74.849	0.07234	-24.15	0.42905	167.644
2.15	0.06195	4.218	6.55483	72.888	0.07244	-24.689	0.43442	166.014
2.2	0.06084	2.075	6.46275	70.939	0.07265	-25.273	0.43857	164.274
2.25	0.05942	-0.3	6.37821	69.013	0.07275	-25.755	0.44419	162.598
2.3	0.05808	-2.187	6.29055	67.098	0.07295	-26.316	0.44756	160.879
2.35	0.05526	-4.038	6.20851	65.179	0.07318	-26.813	0.45231	159.11

Table 5. Class A Common Emitter S-Parameters at V_{CC} = 5.2 Vdc, I_{CC} = 110 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	0.05338	-6.096	6.12256	63.315	0.07337	-27.387	0.45571	157.425
2.45	0.05054	-7.643	6.04461	61.45	0.07359	-27.903	0.46063	155.679
2.5	0.04768	-10.036	5.96594	59.564	0.07386	-28.462	0.46419	153.884
2.55	0.04494	-12.811	5.88833	57.733	0.07416	-29.19	0.4681	152.005
2.6	0.04239	-14.731	5.81782	55.868	0.07435	-29.754	0.47249	150.142
2.65	0.0393	-16.676	5.74121	53.98	0.07445	-30.312	0.47601	148.126
2.7	0.03707	-20.889	5.66538	52.04	0.0748	-31.053	0.47991	146.214
2.75	0.0346	-21.7	5.59155	50.247	0.07499	-31.654	0.48371	144.147
2.8	0.03163	-24.056	5.51967	48.401	0.07519	-32.344	0.48777	142.183
2.85	0.02869	-26.756	5.44631	46.54	0.0754	-33.048	0.49144	140.072
2.9	0.02667	-28.324	5.37422	44.74	0.07563	-33.749	0.4961	138.081
2.95	0.02324	-29.457	5.30336	42.914	0.07577	-34.431	0.50017	136.001
3	0.02069	-34.403	5.23613	41.138	0.07596	-35.209	0.5054	133.872
3.05	0.01861	-37.625	5.16698	39.322	0.07624	-35.917	0.50901	131.91
3.1	0.01563	-41.101	5.09908	37.495	0.07648	-36.648	0.51431	129.855
3.15	0.01407	-49.967	5.03148	35.696	0.0766	-37.389	0.51844	127.844
3.2	0.01296	-54.052	4.96452	33.935	0.07684	-38.12	0.52333	125.818
3.25	0.01129	-59.44	4.89769	32.159	0.07708	-38.894	0.52814	123.86
3.3	0.01031	-67.904	4.83271	30.407	0.07721	-39.663	0.53368	121.891
3.35	0.00977	-71.657	4.76883	28.702	0.07742	-40.479	0.53765	120.096
3.4	0.00821	-77.779	4.707	26.984	0.07764	-41.116	0.54299	118.206
3.45	0.0076	-90.054	4.64886	25.288	0.07774	-41.964	0.54702	116.357
3.5	0.0074	-97.151	4.59041	23.575	0.07797	-42.707	0.55121	114.75
3.55	0.00666	-114.876	4.5319	21.885	0.07819	-43.538	0.55593	113.11
3.6	0.00749	-127.171	4.47455	20.231	0.07843	-44.293	0.55935	111.522

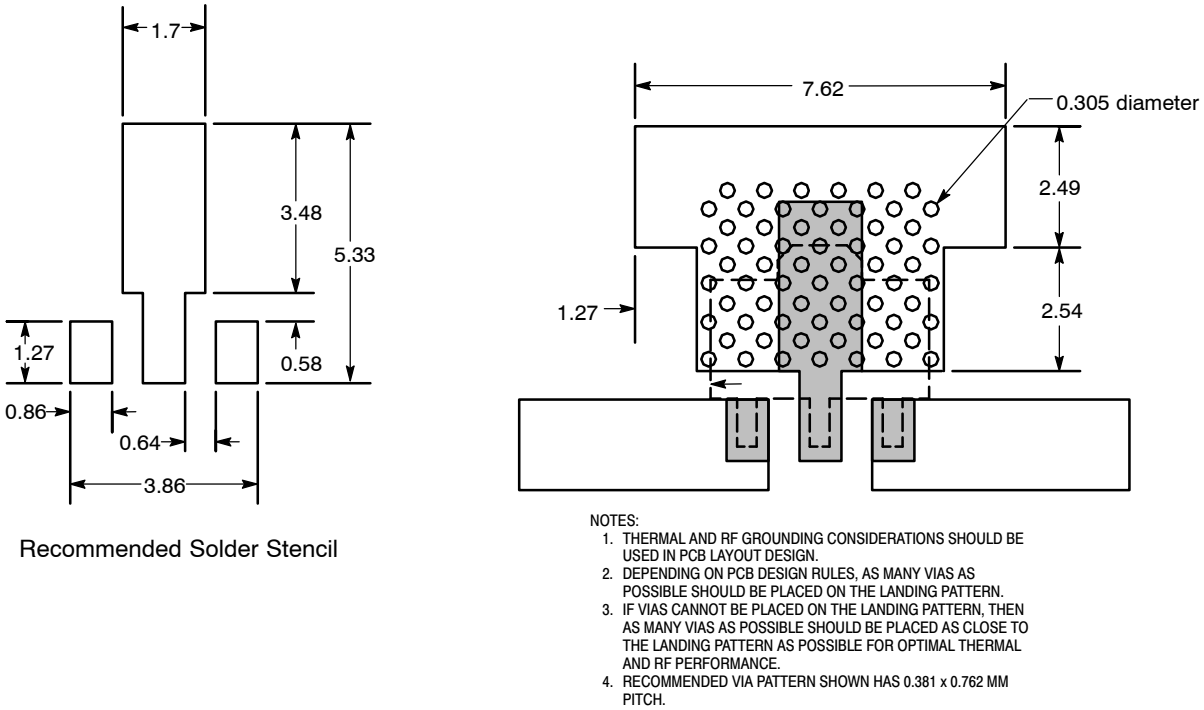


Figure 22. Recommended Mounting Configuration

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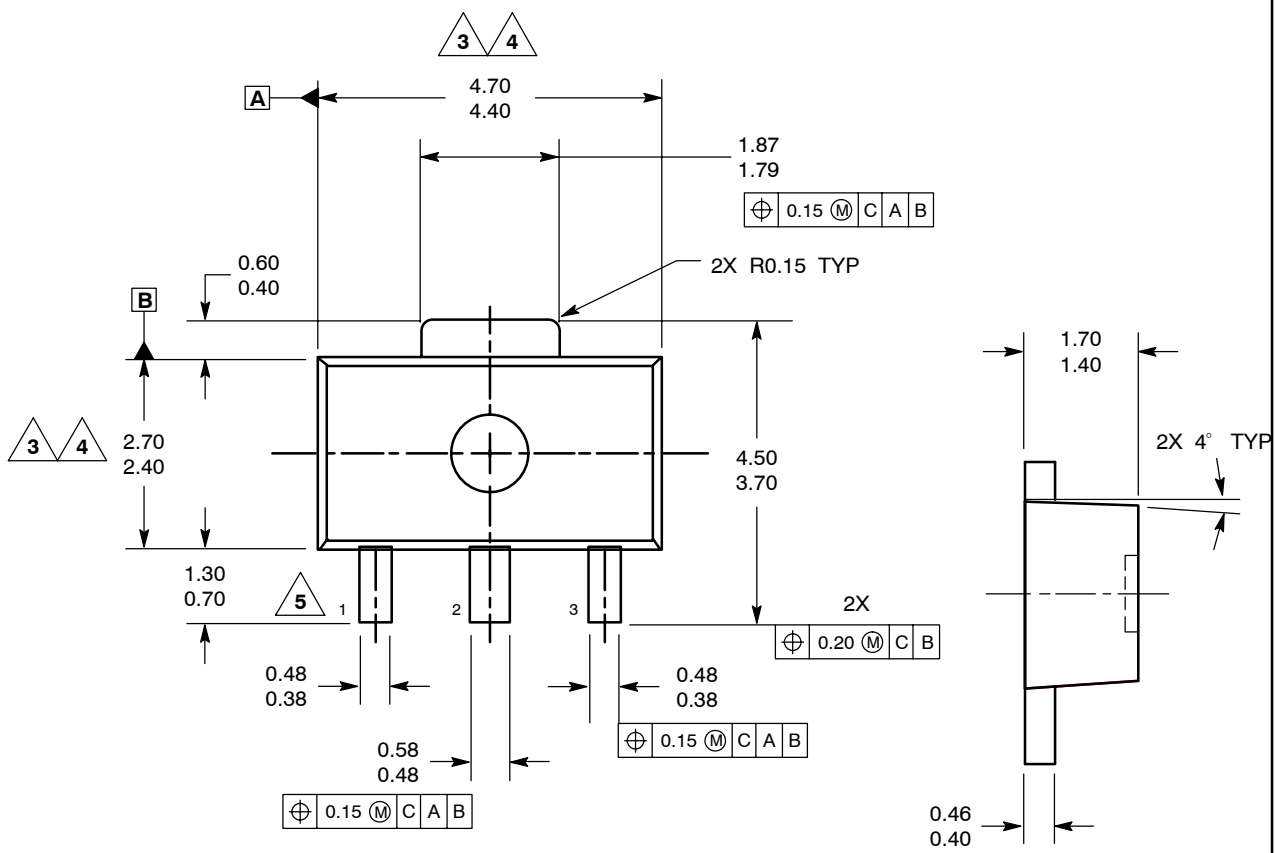
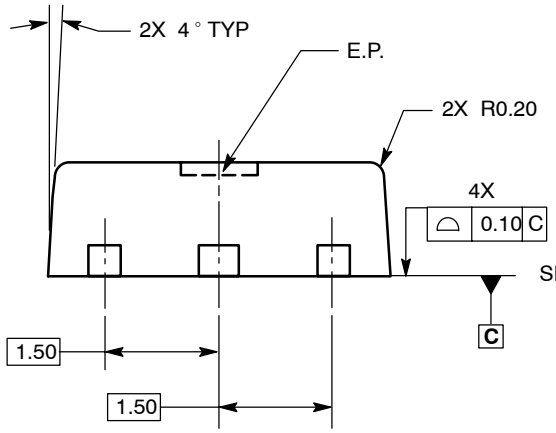
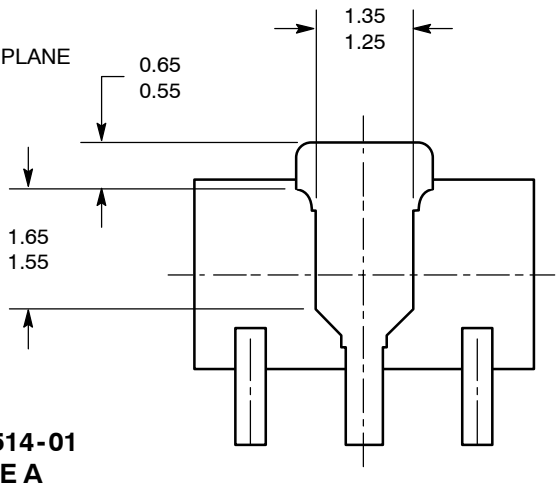
PACKAGE DIMENSIONS





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.



BOTTOM VIEW

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

CASE 1514-01
ISSUE A
SOT-89
PLASTIC

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