Freescale Semiconductor
Technical Data

Document Number: MMRF1004N
Rev. 1, 1/2014

√RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

Designed for Class A or Class AB general purpose applications with frequencies from 1600 to 2200 MHz. Suitable for analog and digital modulation and multipurpose amplifier applications.

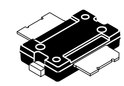
- Typical Two-Tone Performance @ 2170 MHz: V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 10 W PEP
  - Power Gain — 15.5 dB
  - Drain Efficiency — 36%
  - IMD — -34 dBc
- Typical 2-Carrier W-CDMA Performance: V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 1 W Avg., Full Frequency Band (2130-2170 MHz), Channel Bandwidth = 3.84 MHz. PAR = 8.5 dB @ 0.01% Probability
  - Power Gain — 15.5 dB
  - Drain Efficiency — 15%
  - IM3 @ 10 MHz Offset — -47 dBc in 3.84 MHz Channel Bandwidth
  - ACPR @ 5 MHz Offset — -49 dBc in 3.84 MHz Channel Bandwidth
- Typical Single-Carrier N-CDMA Performance: V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 1 W Avg., Full Frequency Band (1930-1990 MHz), IS-95 (Pilot, Sync, Paging, Traffic Codes 8 through 13), Channel Bandwidth = 1.2288 MHz. PAR = 9.8 dB @ 0.01% Probability on CCDF.
  - Power Gain — 15.5 dB
  - Drain Efficiency — 16%
  - ACPR @ 885 kHz Offset = -60 dBc in 30 kHz Bandwidth
- Typical GSM EDGE Performance: V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 4 W Avg., Full Frequency Band (1805-1880 MHz)
  - Power Gain — 16 dB
  - Drain Efficiency — 33%
  - EVM — 1.3% rms
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2000 MHz, 10 W CW Output Power

Features

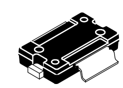
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- 225°C Capable Plastic Package
- In Tape and Reel. R1 Suffix = 500 Units, 24 mm Tape Width, 13-inch Reel.

MMRF1004NR1
MMRF1004GNR1

1600-2200 MHz, 10 W, 28 V
GSM, GSM EDGE
SINGLE N-CDMA
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



TO-270-2
PLASTIC
MMRF1004NR1



TO-270G-2
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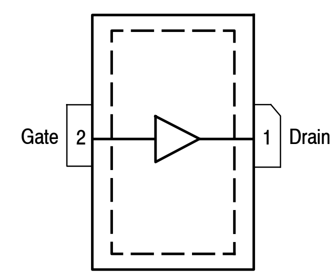
MMRF1004GNR1



(Top View)

Note: The backside of the package is the source terminal for the transistor.

Figure 1. Pin Connections

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +68	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +12	Vdc
Storage Temperature Range	T_{stg}	-65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature (1)	T_J	225	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2)	Unit
Thermal Resistance, Junction to Case Case Temperature 78°C, 1 W CW Case Temperature 79°C, 10 W PEP, Two-Tone Test	$R_{\theta JC}$	 2.3 2.9	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1A
Machine Model (per EIA/JESD22-A115)	A
Charge Device Model (per JESD22-C101)	IV

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	500	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 40 μAdc)	$V_{GS(th)}$	1.5	2.2	3.5	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 130 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 0.4 Adc)	$V_{DS(on)}$	—	0.33	0.4	Vdc
Dynamic Characteristics (4)					
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	20	—	pF
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	11.6	—	pF
Input Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	120	—	pF

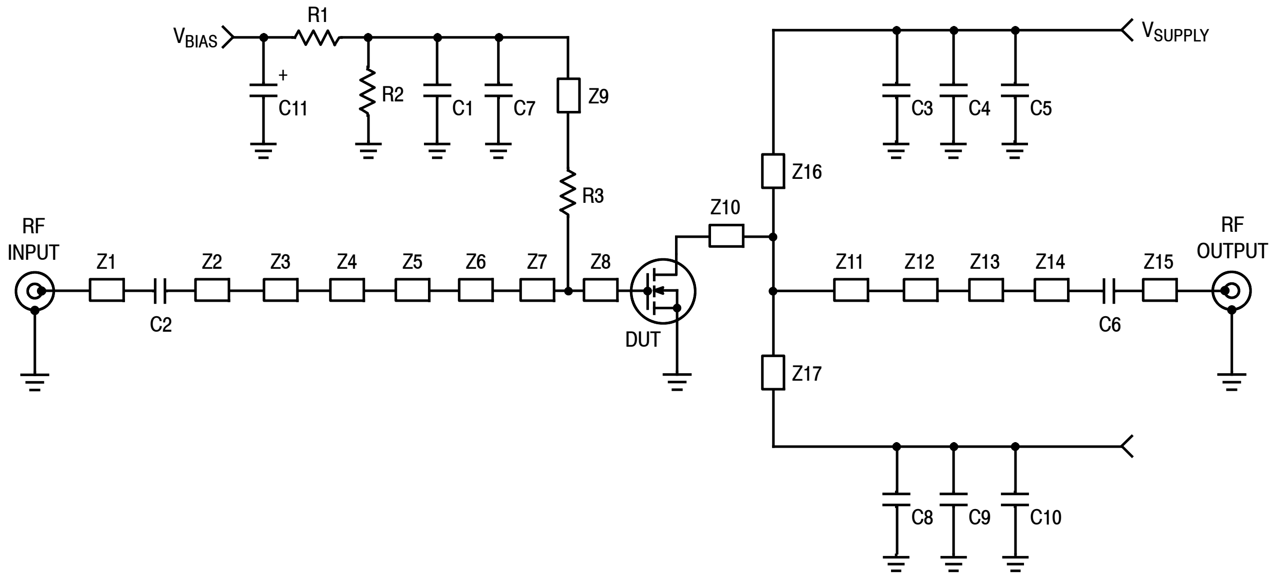
1. Continuous use at maximum temperature will affect MTTF.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.
3. Part internally matched on input.

(continued)

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (1) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 10 W PEP, f1 = 2170 MHz, f2 = 2170.1 MHz, Two-Tone Test					
Power Gain	G_{ps}	14	15.5	17	dB
Drain Efficiency	η_D	33	36	—	%
Intermodulation Distortion	IMD	—	-34	-28	dBc
Input Return Loss	IRL	—	-15	-9	dB
Typical 2-Carrier W-CDMA Performances (In Freescale CDMA Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 1 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, 2-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Bandwidth @ ±10 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	—	15.5	—	dB
Drain Efficiency	η_D	—	15	—	%
Gain Flatness in 30 MHz Bandwidth @ P_{out} = 1 W CW	G_F	—	0.3	—	dB
Intermodulation Distortion	IM3	—	-47	—	dBc
Adjacent Channel Power Ratio	ACPR	—	-49	—	dBc
Typical N-CDMA Performances (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 1 W Avg., 1930 MHz<Frequency<1990 MHz, Single-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carrier. ACPR measured in 30 kHz Channel Bandwidth @ ±885 kHz Offset. PAR = 9.8 dB @ 0.01% Probability on CCDF					
Power Gain	G_{ps}	—	15.5	—	dB
Drain Efficiency	η_D	—	16	—	%
Gain Flatness in 30 MHz Bandwidth @ P_{out} = 1 W CW	G_F	—	0.3	—	dB
Adjacent Channel Power Ratio	ACPR	—	-60	—	dBc
Typical GSM EDGE Performances (In Freescale GSM EDGE Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 4 W Avg., 1805-1880 MHz, EDGE Modulation					
Power Gain	G_{ps}	—	16	—	dB
Drain Efficiency	η_D	—	33	—	%
Gain Flatness in 30 MHz Bandwidth @ P_{out} = 4 W CW	G_F	—	0.3	—	dB
Error Vector Magnitude	EVM	—	1.3	—	% rms
Spectral Regrowth at 400 kHz Offset	SR1	—	-60	—	dBc
Spectral Regrowth at 600 kHz Offset	SR2	—	-70	—	dBc

1. Measurements made with device in straight lead configuration before any lead forming operation is applied. Lead forming is used for gull wing (GN) parts.



Z1, Z15	0.066″ x 0.480″ Microstrip	Z10	0.930″ x 0.350″ Microstrip
Z2	0.066″ x 0.765″ Microstrip	Z11	0.930″ x 0.400″ Microstrip
Z3, Z5	0.066″ x 0.340″ x 0.050″ Taper	Z12	0.050″ x 0.105″ Microstrip
Z4	0.340″ x 0.295″ Microstrip	Z13	0.405″ x 0.242″ Microstrip
Z6	0.020″ x 0.060″ Microstrip	Z14	0.066″ x 0.740″ Microstrip
Z7	0.0905″ x 0.280″ Microstrip	Z16, Z17	0.050″ x 1.250″ Microstrip
Z8	0.0905″ x 0.330″ Microstrip	PCB	Taconic RF-35, 0.030″, ε_r = 3.5
Z9	0.050″ x 0.980″ Microstrip		

Figure 2. MMRF1004NR1 Test Circuit Schematic — 2110-2170 MHz

Table 6. MMRF1004NR1 Test Circuit Component Designations and Values — 2110-2170 MHz

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor	CDR33BX104AKYS	Kemet
C2, C6	4.7 pF Chip Capacitors	ATC100B4R7CT500XT	ATC
C3, C7, C8	9.1 pF Chip Capacitors	ATC100B9R1CT500XT	ATC
C4, C5, C9, C10	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88B	Murata
C11	10 μF, 35 V Tantalum Chip Capacitor	T490D106K035AT	Kemet
R1	1 kΩ, 1/4 W Chip Resistor	CRCW12061001FKEA	Vishay
R2	10 kΩ, 1/4 W Chip Resistor	CRCW12061002FKEA	Vishay
R3	10 Ω, 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay

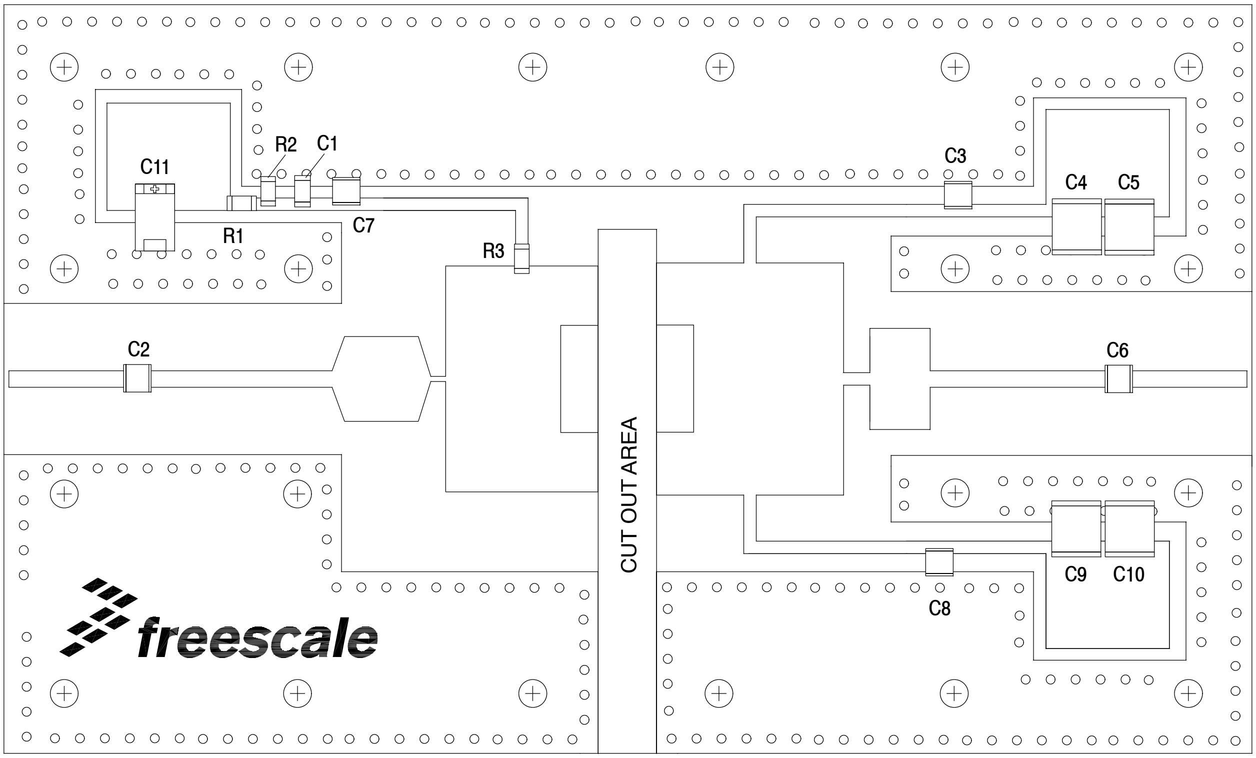


Figure 3. MMRF1004NR1 Test Circuit Component Layout — 2110-2170 MHz

TYPICAL CHARACTERISTICS — 2110-2170 MHz

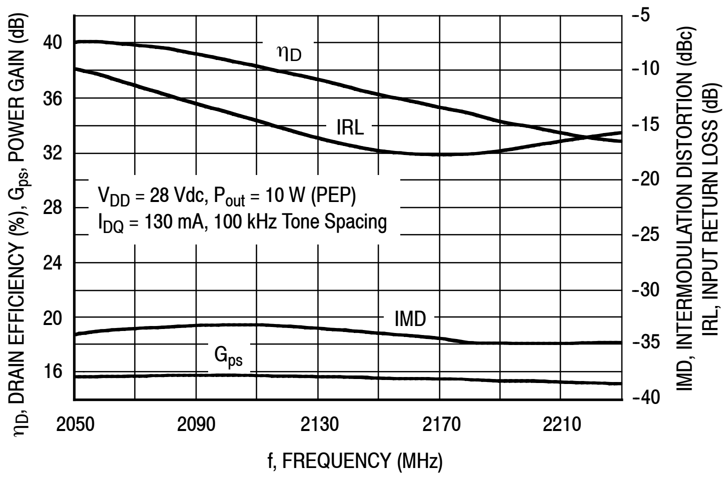


Figure 4. Two-Tone Wideband Performance @ P_{out} = 10 Watts (PEP)

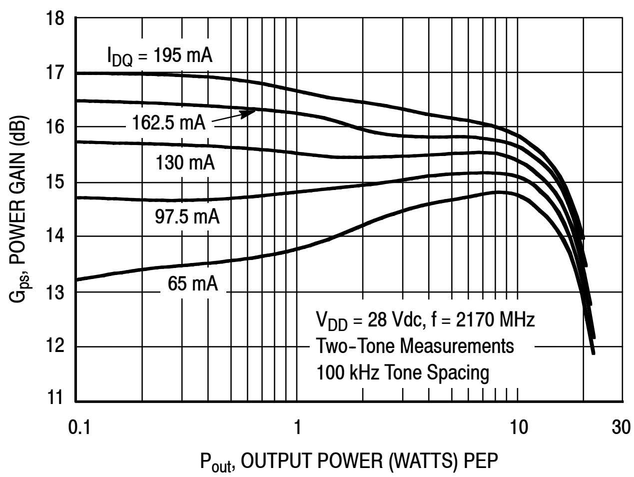


Figure 5. Two-Tone Power Gain versus Output Power

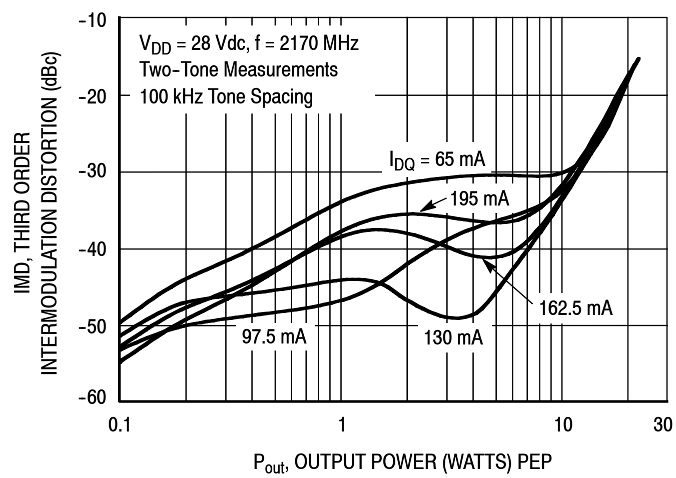


Figure 6. Third Order Intermodulation Distortion versus Output Power

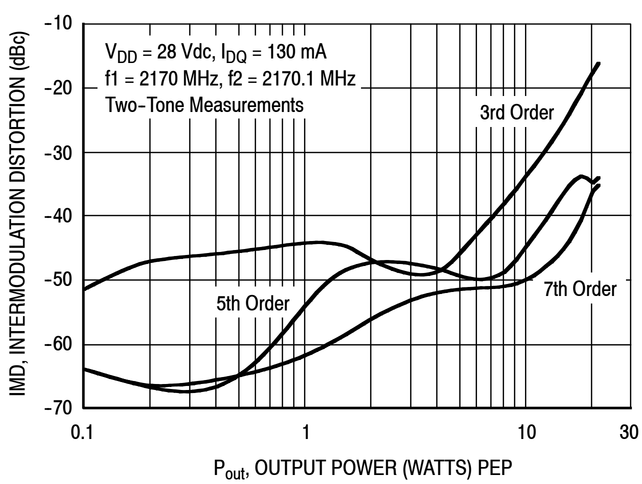


Figure 7. Intermodulation Distortion Products versus Output Power

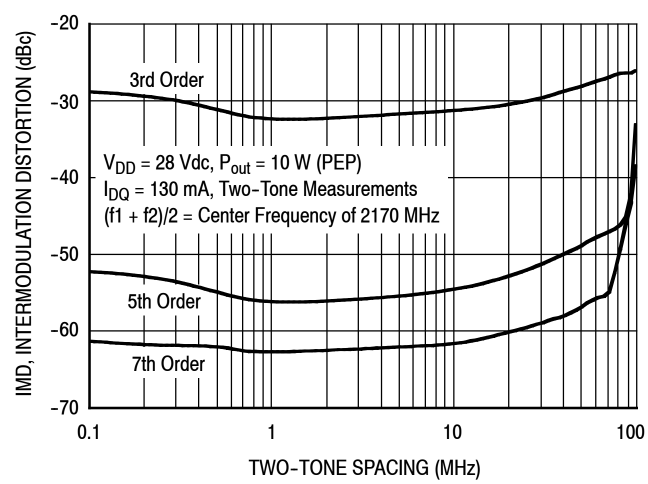


Figure 8. Intermodulation Distortion Products versus Tone Spacing

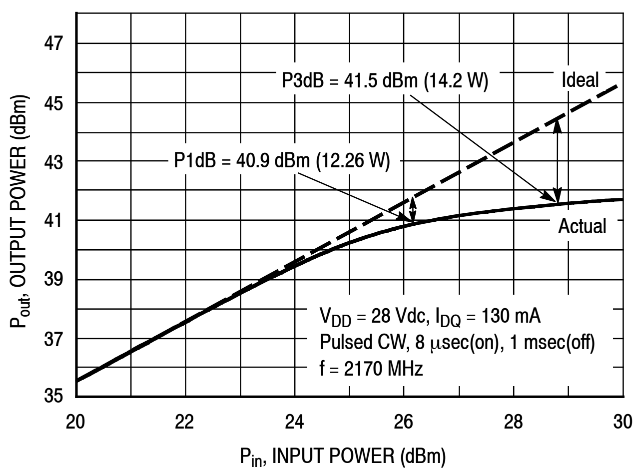


Figure 9. Pulsed CW Output Power versus Input Power

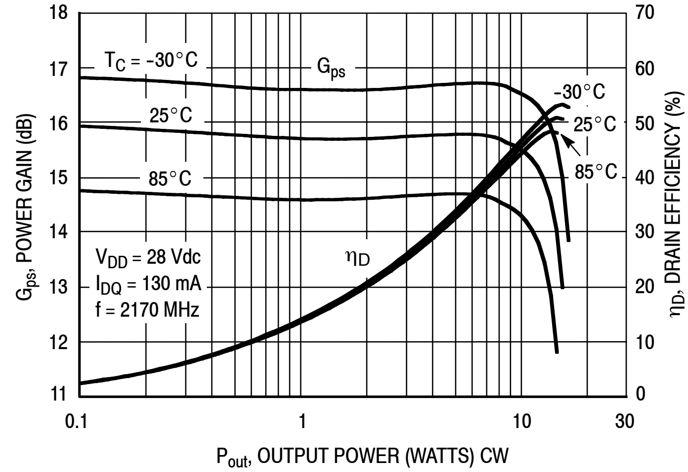


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

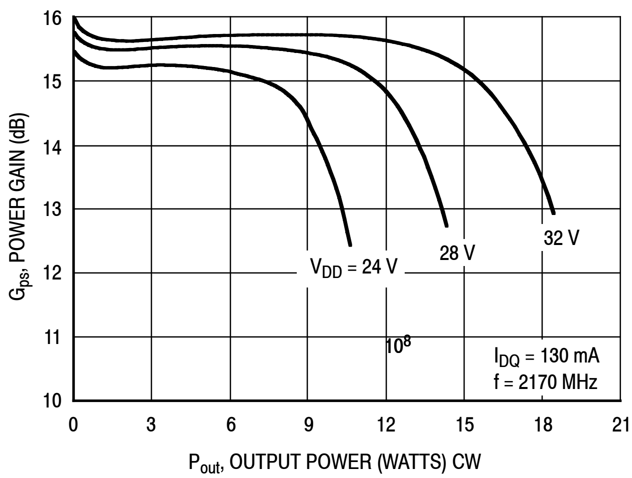


Figure 11. Power Gain versus Output Power

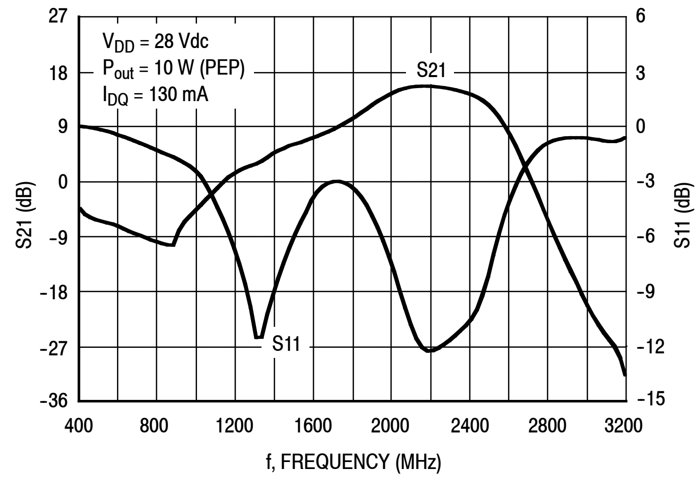
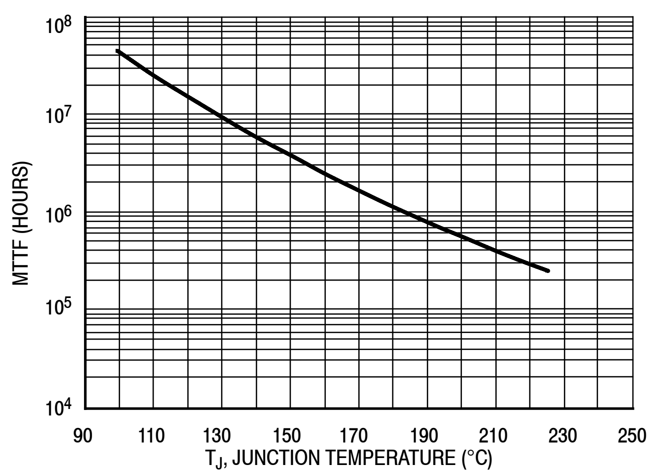


Figure 12. Broadband Frequency Response



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 28 and η_D = 47.2%.

MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

Figure 13. MTTF versus Junction Temperature — CW

W-CDMA TYPICAL CHARACTERISTICS — 2110-2170 MHz

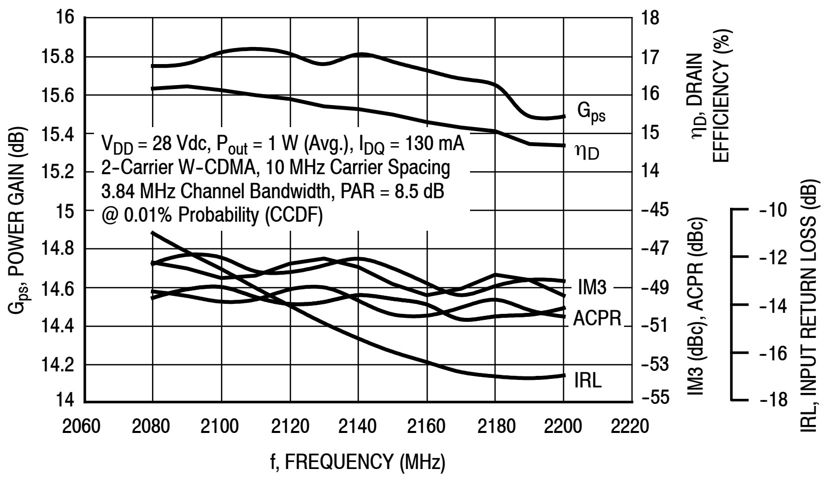


Figure 14. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 1 Watt Avg.

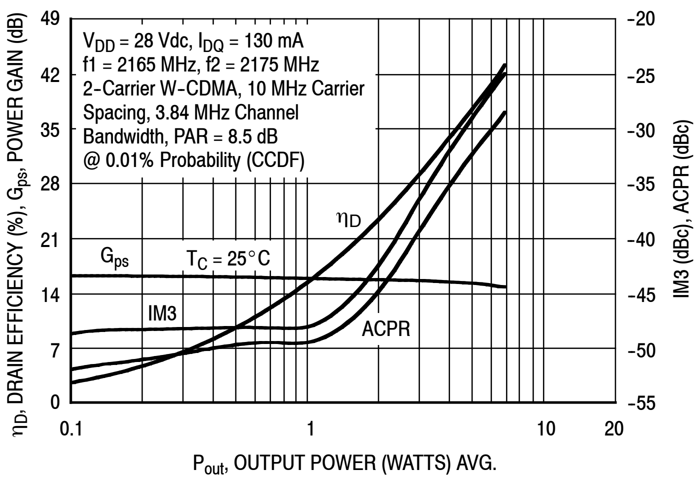


Figure 15. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

W-CDMA TEST SIGNAL

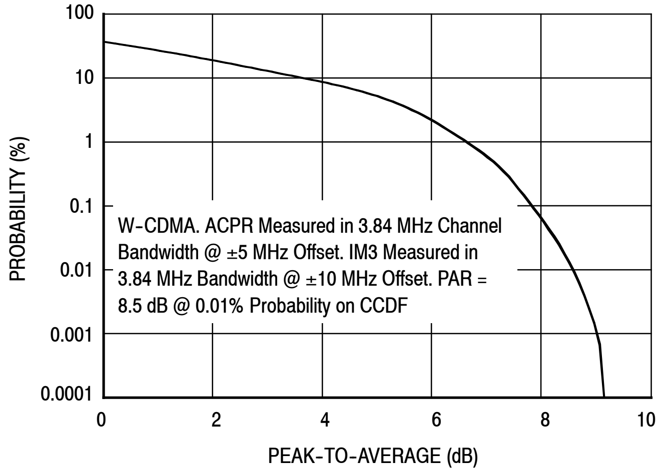


Figure 16. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

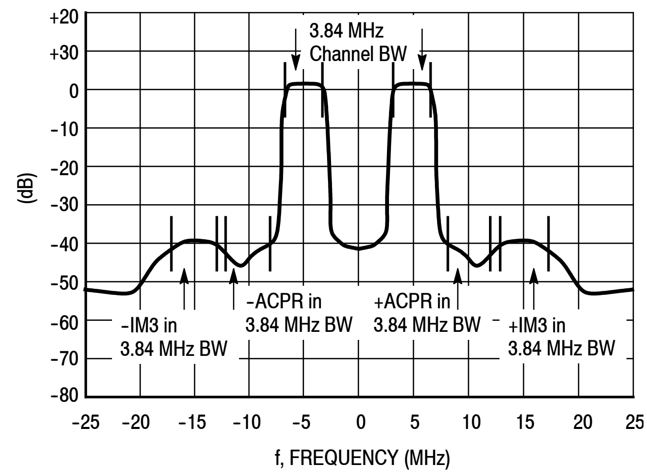
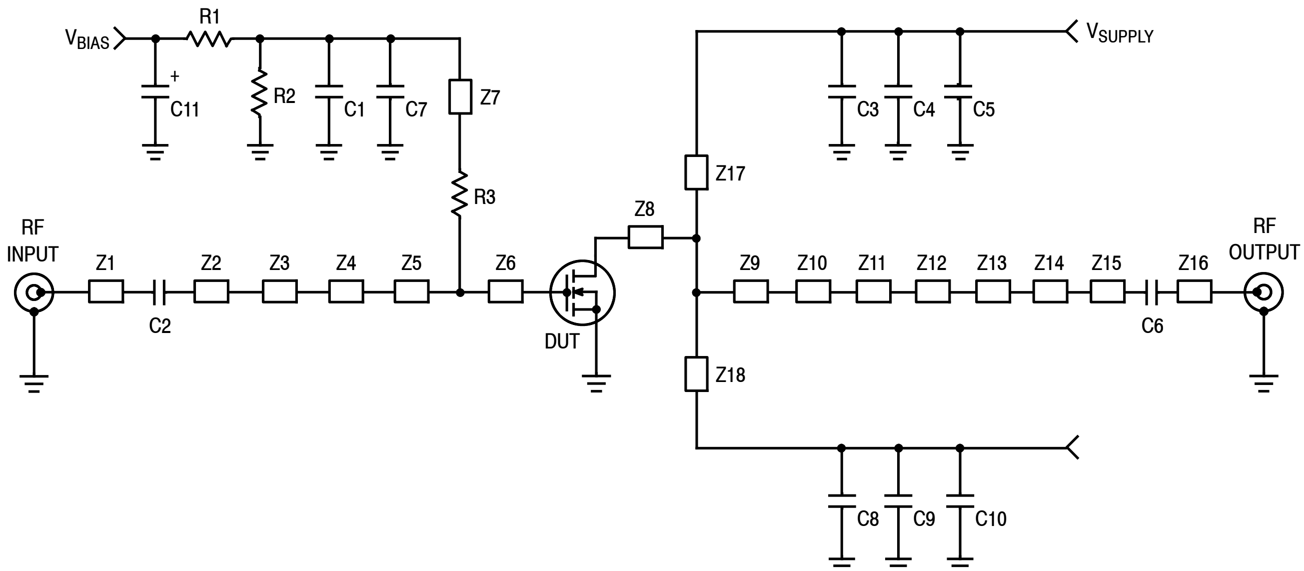


Figure 17. 2-Carrier W-CDMA Spectrum



Z1	0.066″ x 0.480″ Microstrip	Z11	0.244″ x 0.423″ Microstrip
Z2	0.066″ x 0.728″ Microstrip	Z12	0.244″ x 0.066″ x 0.089″ Taper
Z3	0.354″ x 0.512″ Microstrip	Z13	0.066″ x 0.182″ Microstrip
Z4	0.066″ x 0.079″ Microstrip	Z14	0.066″ x 0.263″ Microstrip
Z5, Z6	0.591″ x 0.335″ Microstrip	Z15	0.236″ x 0.118″ Microstrip
Z7	0.050″ x 0.980″ Microstrip	Z16	0.066″ x 0.099″ Microstrip
Z8	1.142″ x 0.350″ Microstrip	Z17, Z18	0.050″ x 1.250″ Microstrip
Z9	1.142″ x 0.516″ Microstrip	PCB	Taconic RF-35, 0.030″, ε_r = 3.5
Z10	0.433″ x 0.276″ Microstrip		

Figure 18. MMRF1004NR1 Test Circuit Schematic — 1930-1990 MHz

Table 7. MMRF1004NR1 Test Circuit Component Designations and Values — 1930-1990 MHz

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor	12065C104KAT	AVX
C2, C6	4.7 pF Chip Capacitors	ATC100B4R7BT500XT	ATC
C3, C7, C8	9.1 pF Chip Capacitors	ATC100B9R1BT500XT	ATC
C4, C5, C9, C10	10 μF Chip Capacitors	C5750X5R1H106MT	TDK
C11	10 μF, 35 V Tantalum Chip Capacitor	TAJD106K035R	AVX
R1, R2	10 kΩ, 1/4 W Chip Resistors	CRCW12061002FKEA	Vishay
R3	10 Ω, 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay

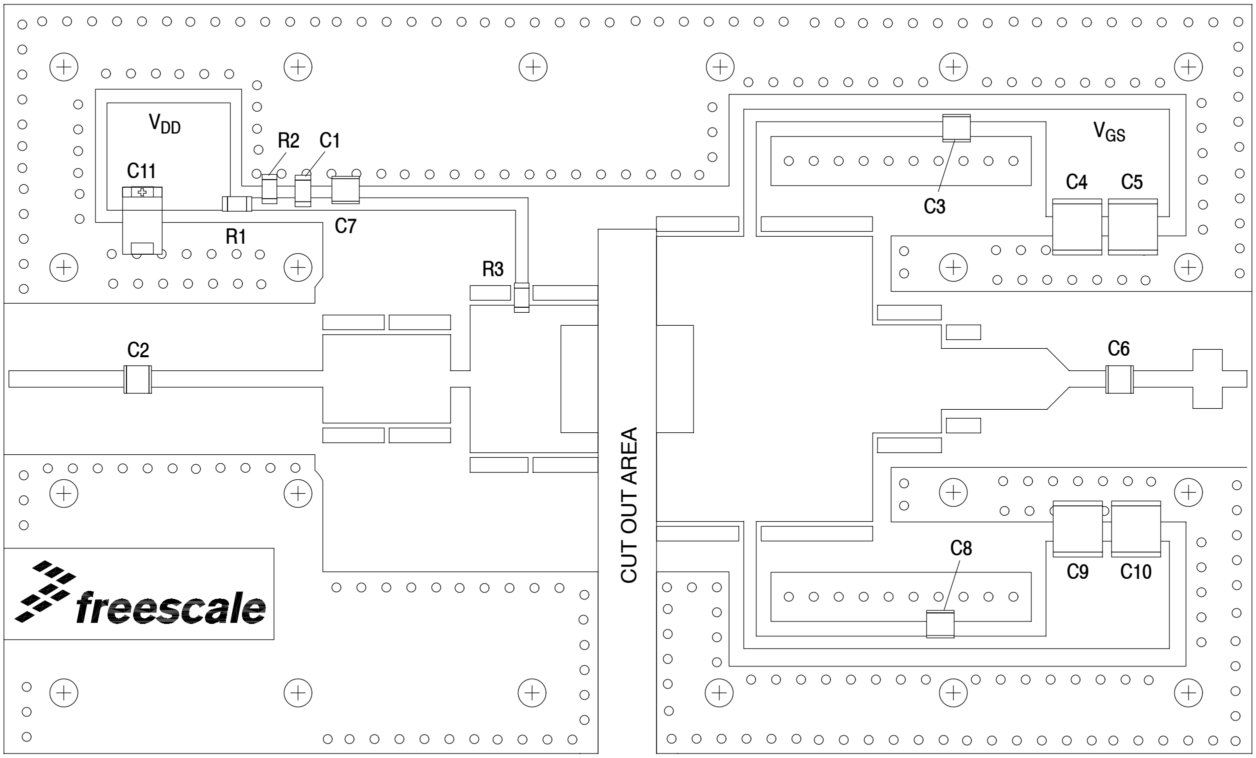


Figure 19. MMRF1004NR1 Test Circuit Component Layout — 1930-1990 MHz

N-CDMA TYPICAL CHARACTERISTICS — 1930-1990 MHz

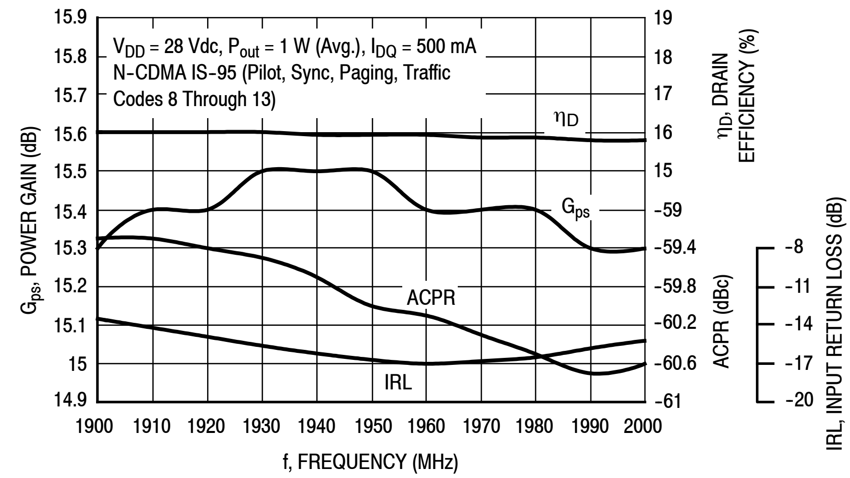


Figure 20. Single-Carrier N-CDMA Broadband Performance @ P_{out} = 1 Watt Avg.

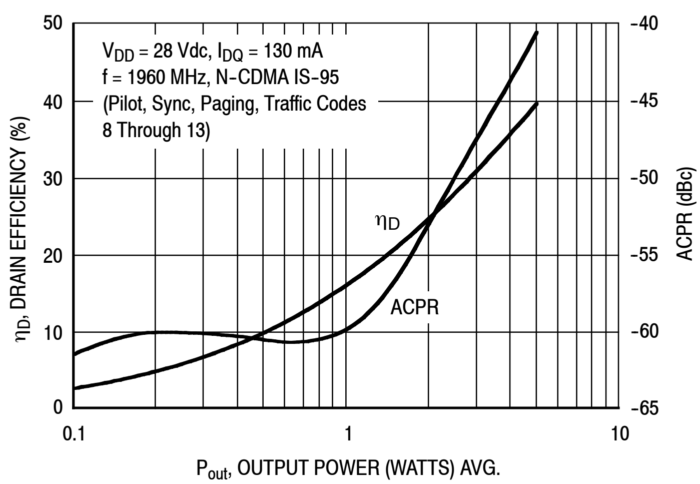


Figure 21. Single-Carrier N-CDMA ACPR and Drain Efficiency versus Output Power

N-CDMA TEST SIGNAL

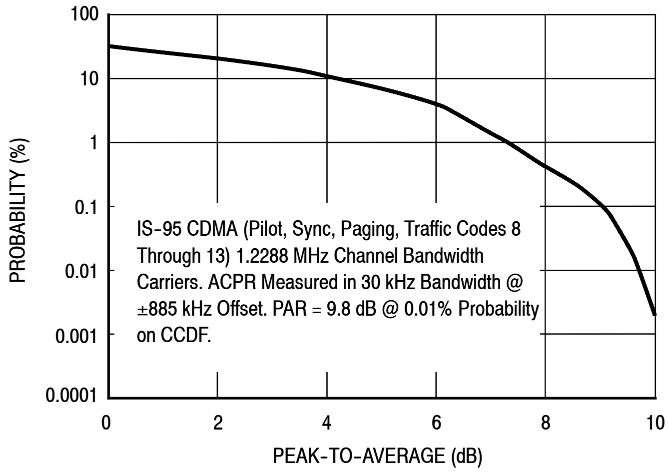


Figure 22. Single-Carrier CCDF N-CDMA

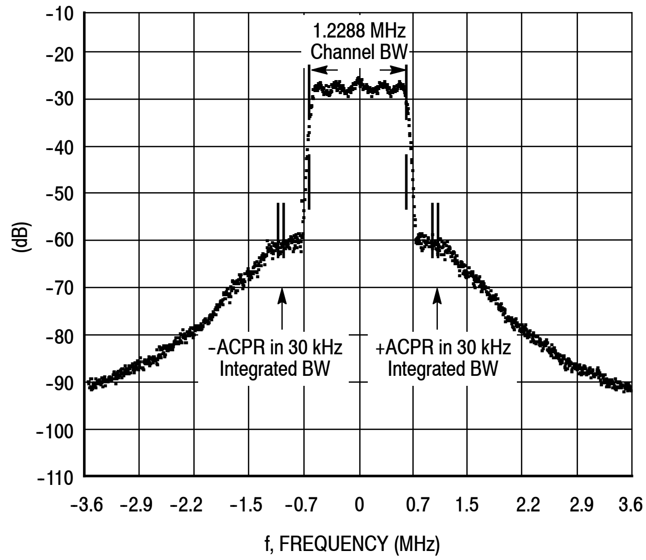
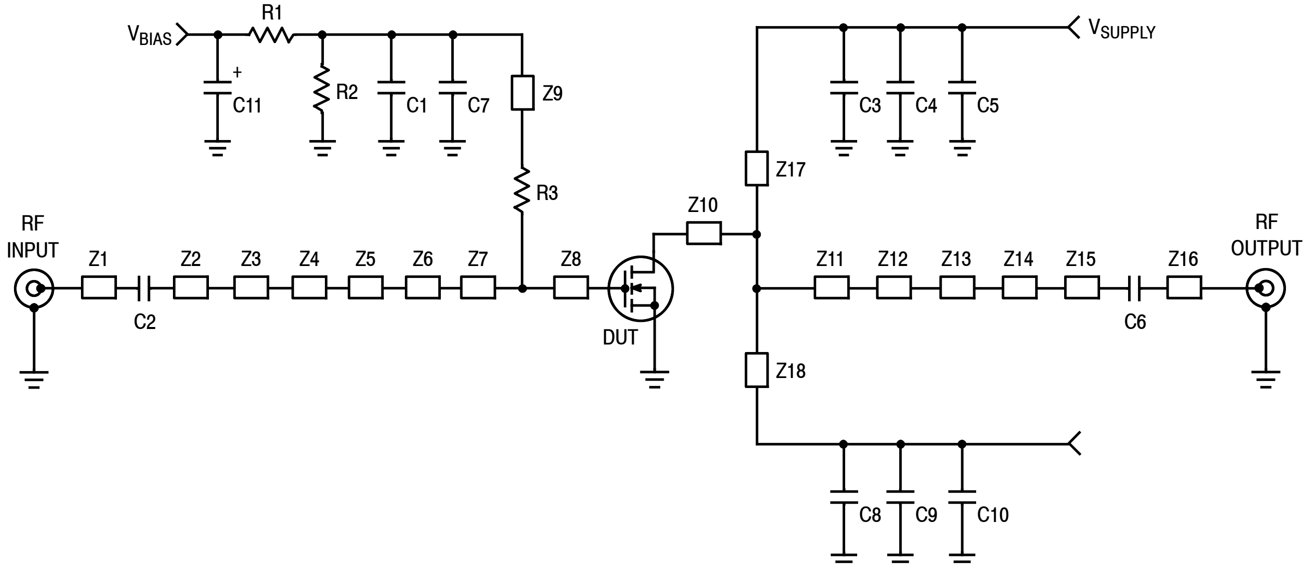


Figure 23. Single-Carrier N-CDMA Spectrum

GSM EDGE TYPICAL CHARACTERISTICS — 1805-1880 MHz



Z1, Z16	0.066″ x 0.480″ Microstrip	Z10	1.142″ x 0.350″ Microstrip
Z2	0.066″ x 0.137″ Microstrip	Z11	1.142″ x 0.516″ Microstrip
Z3	0.236″ x 0.236″ Microstrip	Z12	0.433″ x 0.276″ Microstrip
Z4	0.066″ x 0.354″ Microstrip	Z13	0.276″ x 0.157″ Microstrip
Z5	0.551″ x 0.512″ Microstrip	Z14	0.236″ x 0.433″ Microstrip
Z6	0.066″ x 0.079″ Microstrip	Z15	0.066″ x 0.104″ Microstrip
Z7	0.591″ x 0.189″ Microstrip	Z17, Z18	0.050″ x 1.250″ Microstrip
Z8	0.591″ x 0.334″ Microstrip	PCB	Taconic RF-35, 0.030″, ε_r = 3.5
Z9	0.050″ x 0.980″ Microstrip		

Figure 24. MMRF1004NR1 Test Circuit Schematic — 1805-1880 MHz

Table 8. MMRF1004NR1 Test Circuit Component Designations and Values —1805-1880 MHz

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor	12065C104KAT	AVX
C2, C6	4.7 pF Chip Capacitors	ATC100B4R7BT500XT	ATC
C3, C7, C8	9.1 pF Chip Capacitors	ATC100B9R1BT500XT	ATC
C4, C5, C9, C10	10 μF Chip Capacitors	C5750X5R1H106MT	TDK
C11	10 μF, 35 V Tantalum Chip Capacitor	TAJD106K035R	AVX
R1, R2	10 kΩ, 1/4 W Chip Resistors	CRCW12061001FKEA	Vishay
R3	10 Ω, 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay

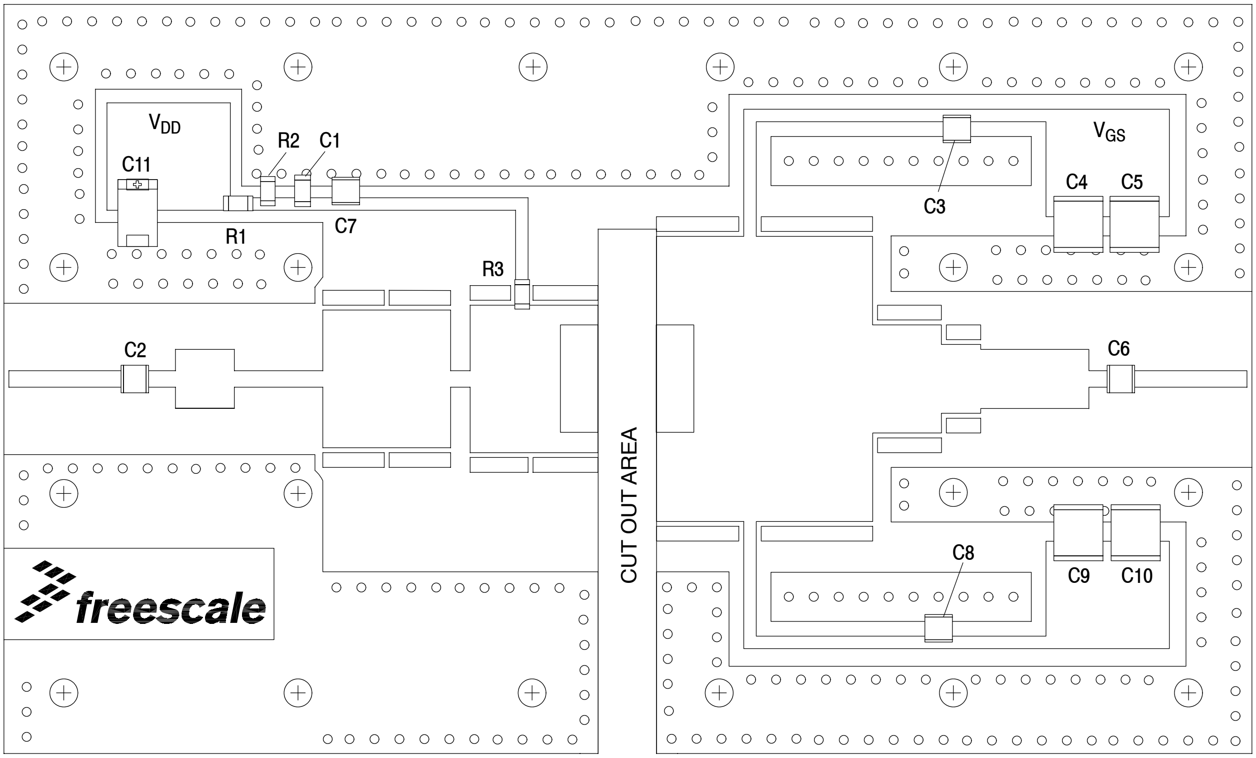


Figure 25. MMRF1004NR1 Test Circuit Component Layout — 1805-1880 MHz

GSM EDGE TYPICAL CHARACTERISTICS — 1805-1880 MHz

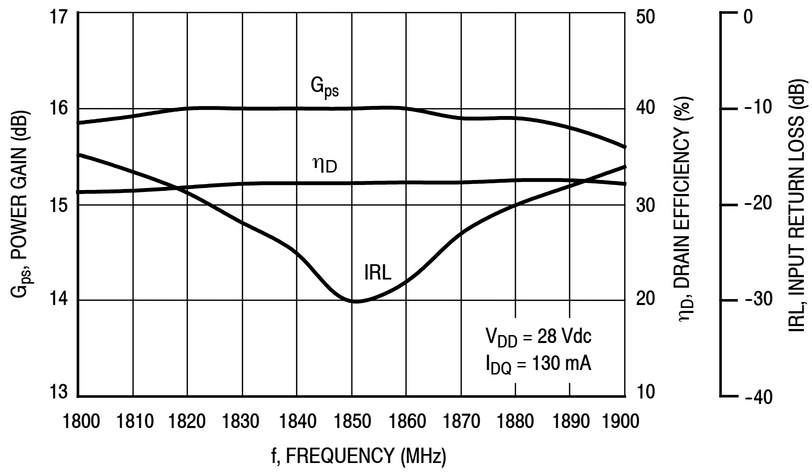


Figure 26. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 4 Watts

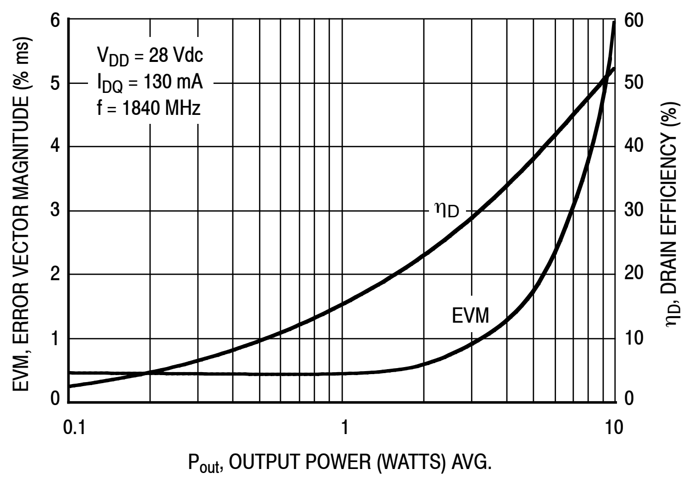


Figure 27. Error Vector Magnitude and Drain Efficiency versus Output Power

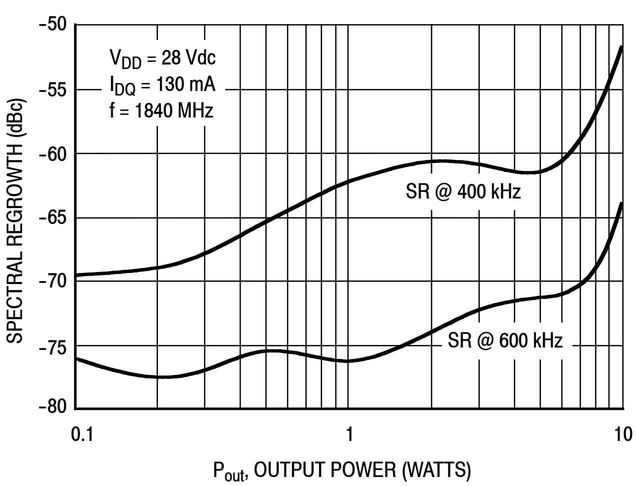


Figure 28. Spectral Regrowth at 400 kHz and 600 kHz versus Output Power

GSM EDGE TEST SIGNAL

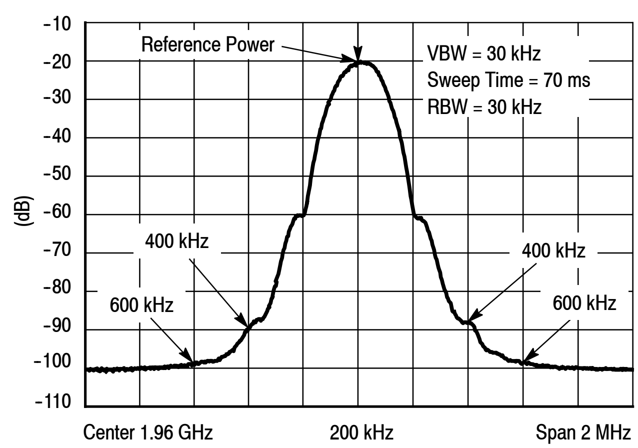
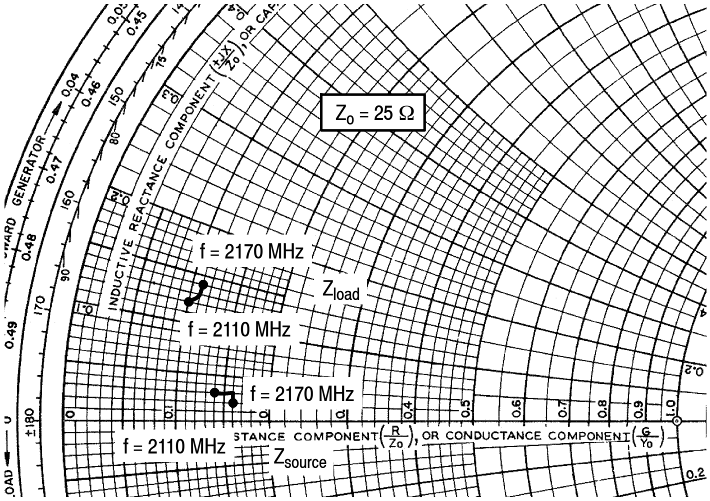


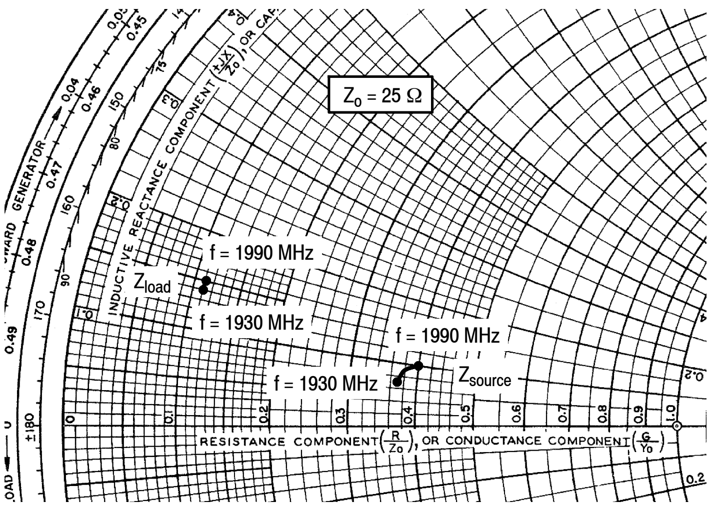
Figure 29. EDGE Spectrum



2170 MHz

V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 10 W PEP

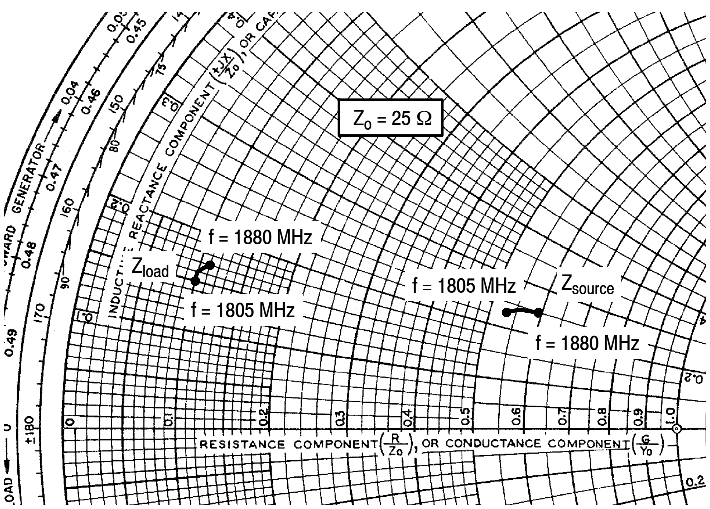
f MHz	Z_{source} Ω	Z_{load} Ω
2110	3.619 + j0.792	2.544 + j3.068
2140	3.918 + j0.797	2.673 + j3.291
2170	4.087 + j0.558	2.818 + j3.406



1900 MHz

V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 1 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
1930	9.237 + j1.849	2.770 + j3.497
1960	9.521 + j2.144	2.754 + j3.668
1990	9.889 + j2.434	2.772 + j3.833



1800 MHz

V_{DD} = 28 Vdc, I_{DQ} = 130 mA, P_{out} = 4 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
1805	13.237 + j5.810	2.445 + j3.698
1840	13.953 + j6.084	2.542 + j3.942
1880	14.858 + j6.279	2.695 + j4.170

Z_{source} = Test circuit impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

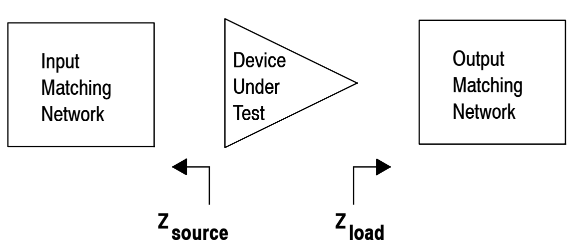


Figure 30. Series Equivalent Source and Load Impedance

Table 9. Common Source Scattering Parameters (V_{DD} = 28 V, I_{DQ} = 126 mA, T_A = 25°C, 50 ohm system)

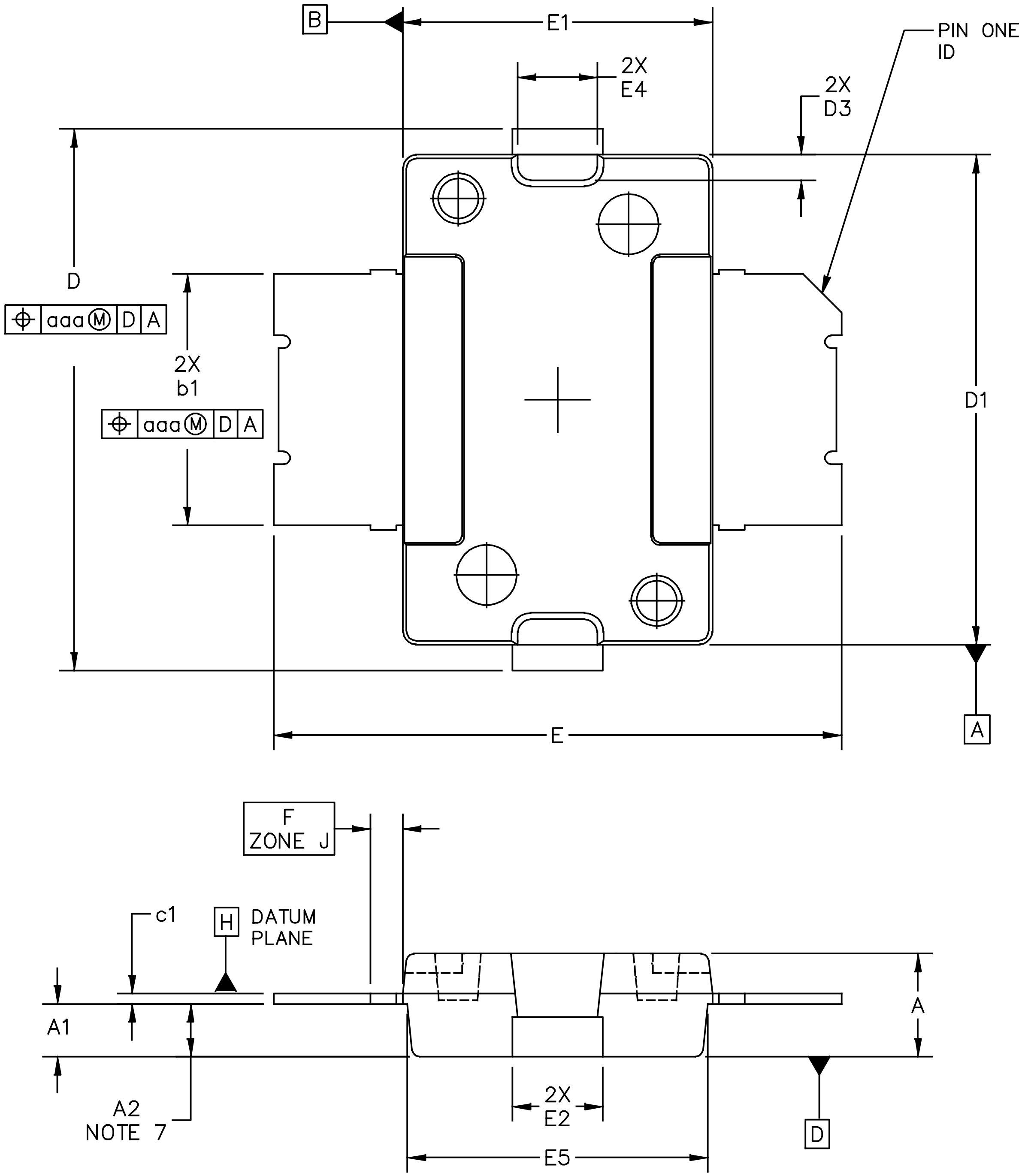
f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ φ	$\|S_{21}\|$	∠ φ	$\|S_{12}\|$	∠ φ	$\|S_{22}\|$	∠ φ
500	0.984	-178.1	1.195	42.42	0.001	-129.1	0.875	-116.3
550	0.986	-179.0	0.947	40.48	0.001	-159.2	0.892	-121.6
600	0.985	179.9	0.747	39.66	0.001	147.4	0.905	-125.9
650	0.986	178.9	0.581	39.89	0.001	119.1	0.913	-129.9
700	0.982	177.9	0.446	41.80	0.001	108.1	0.927	-133.4
750	0.983	177.2	0.336	46.70	0.002	102.9	0.935	-136.4
800	0.983	176.5	0.248	56.02	0.002	96.99	0.941	-139.5
850	0.979	175.5	0.188	72.74	0.003	97.40	0.947	-141.9
900	0.980	174.8	0.168	96.69	0.003	94.63	0.951	-144.4
950	0.977	174.0	0.183	119.3	0.004	91.92	0.955	-146.6
1000	0.978	173.2	0.223	134.3	0.004	92.80	0.960	-148.6
1050	0.972	172.4	0.276	142.2	0.004	89.92	0.962	-150.5
1100	0.972	171.4	0.335	146.4	0.005	89.90	0.966	-152.2
1150	0.963	170.8	0.396	148.5	0.005	87.51	0.977	-153.7
1200	0.964	169.9	0.461	148.8	0.006	89.25	0.971	-155.2
1250	0.956	169.0	0.531	148.2	0.007	86.98	0.977	-156.8
1300	0.948	167.8	0.604	146.9	0.007	85.08	0.982	-157.9
1350	0.939	167.0	0.685	144.8	0.008	82.40	0.986	-159.5
1400	0.927	165.7	0.772	142.2	0.008	79.69	0.988	-160.7
1450	0.910	164.5	0.869	138.7	0.009	77.79	0.994	-162.1
1500	0.889	163.2	0.975	134.7	0.010	75.79	0.991	-163.4
1550	0.861	161.9	1.093	129.7	0.010	72.86	0.993	-164.7
1600	0.821	160.9	1.221	123.8	0.011	69.89	0.996	-166.0
1650	0.780	160.1	1.356	116.7	0.012	63.71	0.984	-167.4
1700	0.722	160.6	1.491	108.3	0.013	57.70	0.985	-168.5
1750	0.666	162.5	1.606	98.77	0.014	49.85	0.977	-169.6
1800	0.618	167.0	1.687	88.09	0.014	41.19	0.970	-170.8
1850	0.603	173.3	1.706	76.98	0.013	32.65	0.958	-171.3
1900	0.614	179.7	1.673	66.08	0.012	25.40	0.954	-171.9
1950	0.654	-175.6	1.591	55.96	0.011	20.73	0.945	-172.3
2000	0.701	-173.5	1.484	47.04	0.010	15.11	0.947	-172.6
2050	0.747	-172.7	1.364	39.29	0.008	10.13	0.947	-173.0
2100	0.783	-172.6	1.242	32.87	0.006	6.333	0.945	-173.6
2150	0.816	-172.9	1.136	27.69	0.004	15.63	0.944	-173.9
2200	0.842	-173.6	1.042	23.26	0.004	42.20	0.944	-174.2
2250	0.864	-174.2	0.961	19.26	0.005	57.76	0.948	-174.6
2300	0.882	-175.0	0.888	15.75	0.006	62.56	0.948	-175.2
2350	0.894	-175.7	0.822	12.69	0.008	59.72	0.949	-175.7
2400	0.906	-176.4	0.764	9.857	0.009	49.09	0.951	-176.1
2450	0.910	-176.9	0.712	7.587	0.008	39.24	0.955	-176.5

(continued)

Table 9. Common Source Scattering Parameters (V_{DD} = 28 V, I_{DQ} = 126 mA, T_A = 25°C, 50 ohm system) **(continued)**

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ φ	$\|S_{21}\|$	∠ φ	$\|S_{12}\|$	∠ φ	$\|S_{22}\|$	∠ φ
2500	0.923	-177.5	0.666	5.462	0.006	42.56	0.957	-177.2
2550	0.927	-178.0	0.625	3.680	0.006	52.25	0.962	-177.8
2600	0.937	-178.8	0.591	1.864	0.006	60.26	0.961	-178.4
2650	0.937	-179.0	0.559	0.237	0.007	64.14	0.964	-179.1
2700	0.942	-179.8	0.529	-1.378	0.007	65.62	0.964	-179.6
2750	0.945	-179.9	0.504	-2.768	0.007	64.71	0.964	179.7
2800	0.946	179.5	0.479	-4.088	0.007	67.58	0.966	179.4
2850	0.950	179.3	0.456	-5.412	0.007	75.44	0.966	178.8
2900	0.949	178.8	0.436	-6.305	0.008	82.04	0.964	178.3
2950	0.952	178.5	0.419	-7.279	0.009	83.60	0.967	177.9
3000	0.950	178.4	0.402	-8.087	0.011	83.41	0.968	177.4
3050	0.958	177.9	0.387	-9.138	0.012	81.35	0.964	176.8
3100	0.953	177.7	0.373	-9.904	0.013	77.45	0.969	176.4
3150	0.957	177.2	0.362	-10.86	0.014	70.98	0.970	176.2
3200	0.960	177.4	0.350	-11.79	0.013	67.00	0.970	175.5

PACKAGE DIMENSIONS



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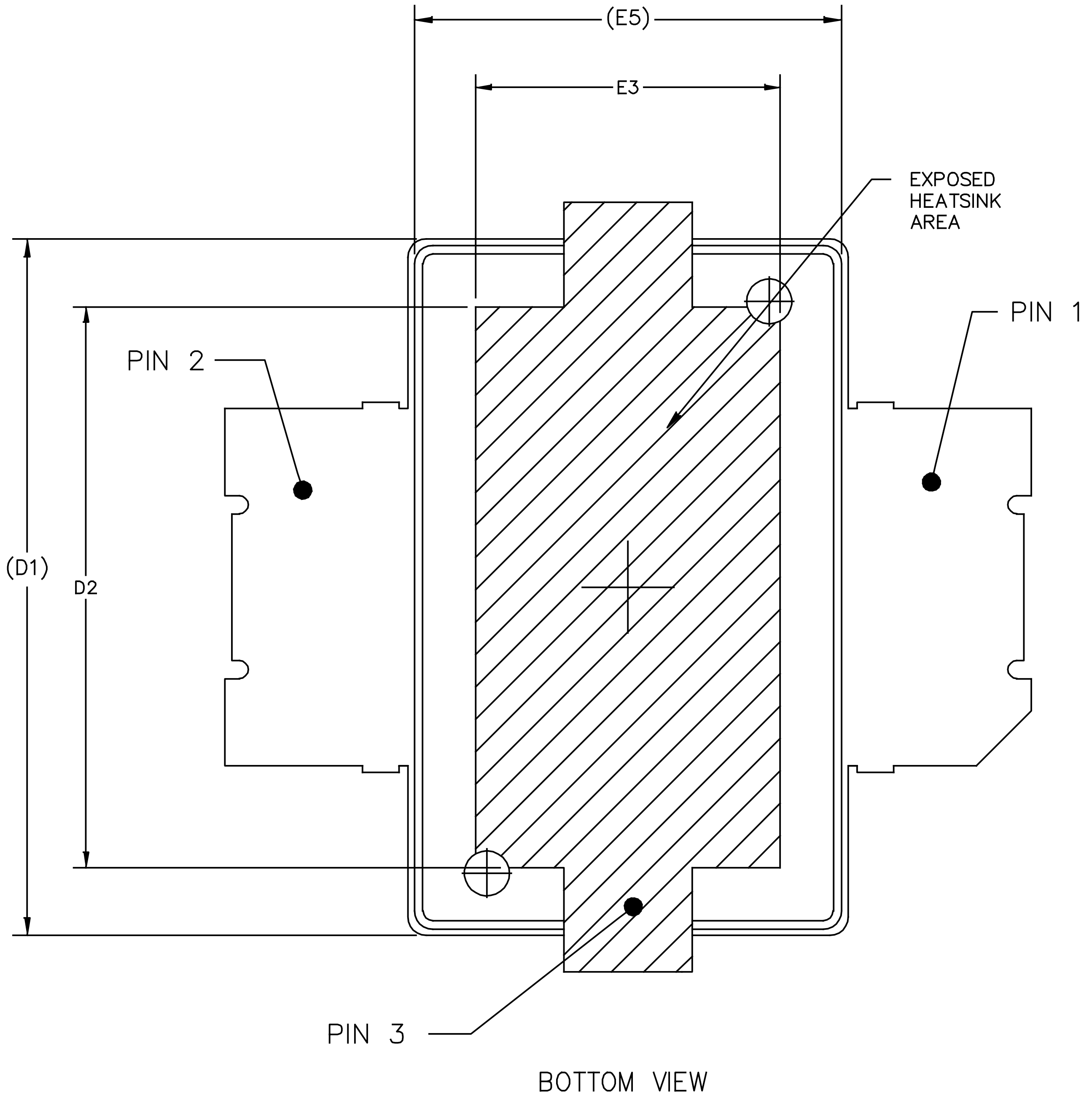
	CASE NUMBER: 1265–09		29 JUN 2007
	STANDARD: JEDEC TO–270 AA		



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TITLE: TO–270 SURFACE MOUNT	DOCUMENT NO: 98ASH98117A	REV: K
	CASE NUMBER: 1265–09	29 JUN 2007
	STANDARD: JEDEC TO–270 AA	

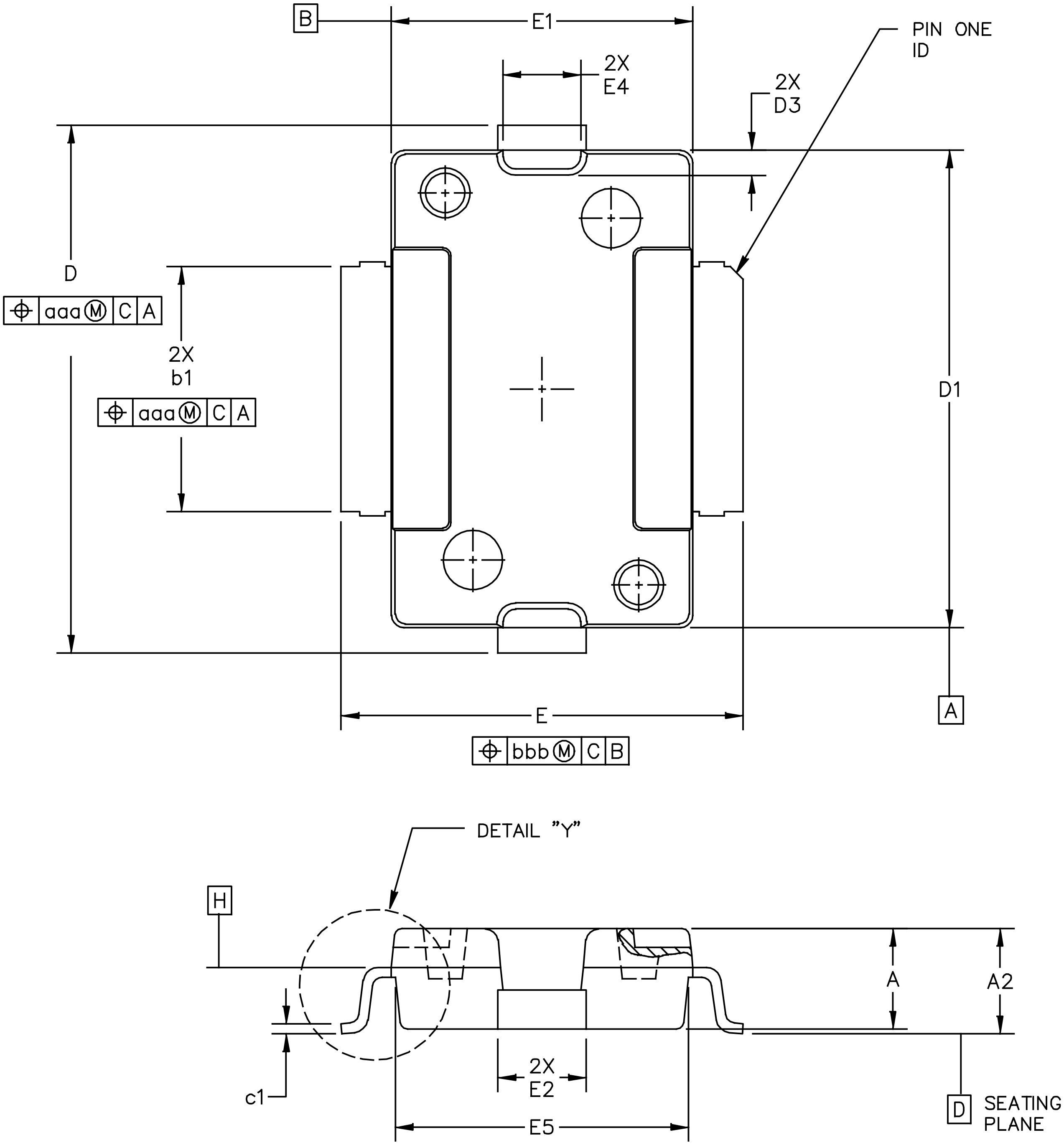
NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DATUM PLANE –H– IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D1" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D1 AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
5. DIMENSION "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.
7. DIMENSION "A2" APPLIES WITHIN ZONE "J" ONLY.
8. DIMENSIONS "D" AND "E2" DO NOT INCLUDE MOLD PROTRUSION. OVERALL LENGTH INCLUDING MOLD PROTRUSION SHOULD NOT EXCEED 0.430 INCH FOR DIMENSION "D" AND 0.080 INCH FOR DIMENSION "E2". DIMENSIONS "D" AND "E2" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –D–.

STYLE 1:
PIN 1 – DRAIN
PIN 2 – GATE
PIN 3 – SOURCE

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	.078	.082	1.98	2.08	F	.025 BSC		0.64 BSC	
A1	.039	.043	0.99	1.09	b1	.193	.199	4.90	5.06
A2	.040	.042	1.02	1.07	c1	.007	.011	0.18	0.28
D	.416	.424	10.57	10.77	aaa	.004		0.10	
D1	.378	.382	9.60	9.70					
D2	.290	----	7.37	----					
D3	.016	.024	0.41	0.61					
E	.436	.444	11.07	11.28					
E1	.238	.242	6.04	6.15					
E2	.066	.074	1.68	1.88					
E3	.150	----	3.81	----					
E4	.058	.066	1.47	1.68					
E5	.231	.235	5.87	5.97					

	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: TO–270 SURFACE MOUNT	DOCUMENT NO: 98ASH98117A	REV: K
	CASE NUMBER: 1265–09	29 JUN 2007
	STANDARD: JEDEC TO–270 AA	



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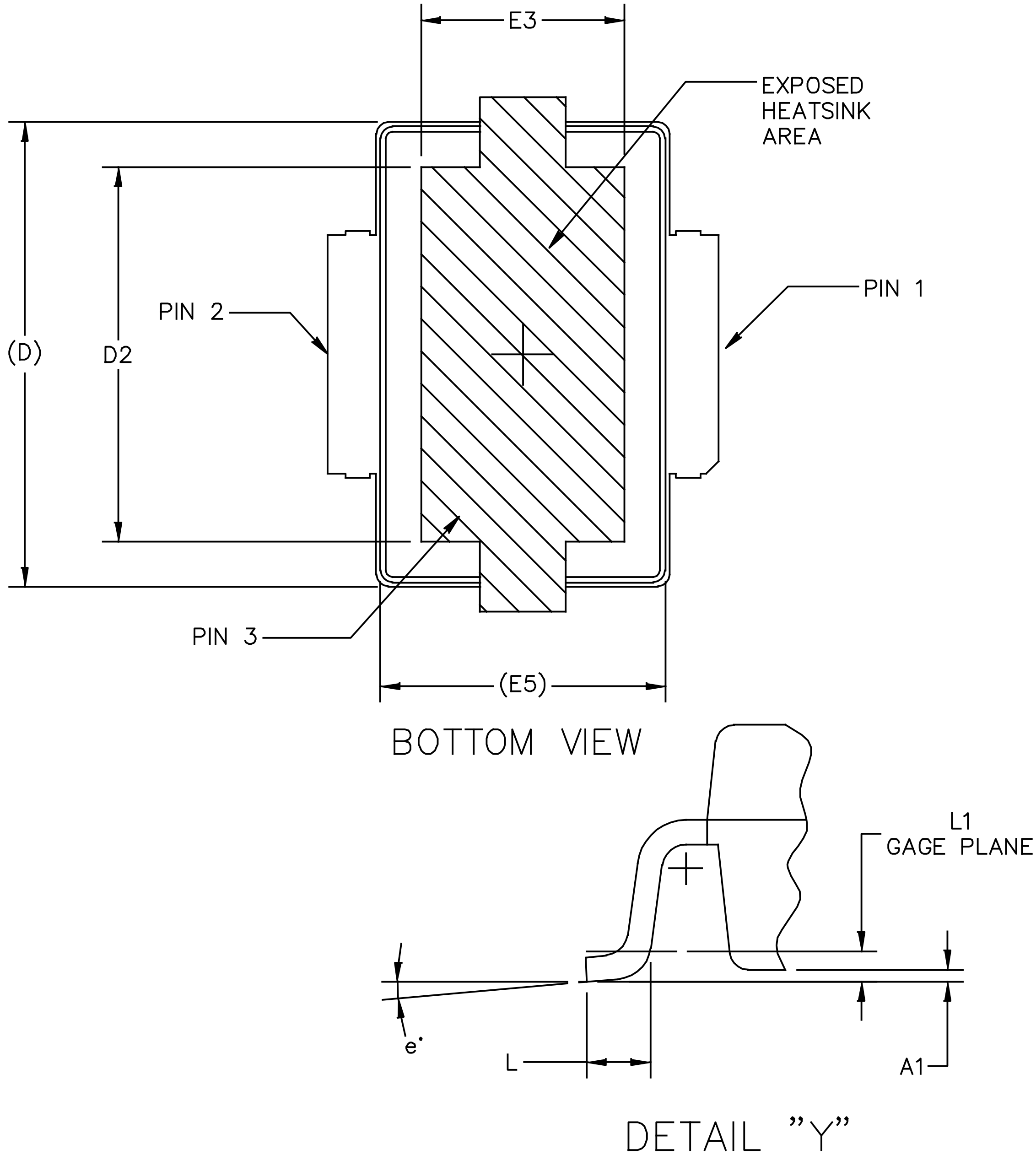
	CASE NUMBER: 1265A−03	02 JUL 2007	
	STANDARD: JEDEC TO−270 BA		



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TITLE: TO–270 GULL WING	DOCUMENT NO: 98ASA99301D		REV: C
	CASE NUMBER: 1265A–03		02 JUL 2007
	STANDARD: JEDEC TO–270 BA		

NOTES:
1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M—1994.
3. DATUM PLANE —H— IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D1" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D1 AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE —H—.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE b1 DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS —A— AND —B— TO BE DETERMINED AT DATUM PLANE —H—.
7. DIMENSIONS "D" AND "E2" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .003 PER SIDE. DIMENSIONS "D AND "E2" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE —D—.

STYLE 1:
PIN 1 — DRAIN
PIN 2 — GATE
PIN 3 — SOURCE

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	.078	.082	1.98	2.08	L	.018	.024	0.46	0.61
A1	.001	.004	0.02	0.10	L1	.01 BSC		0.25 BSC	
A2	.077	.088	1.96	2.24	b1	.193	.199	4.90	5.06
D	.416	.424	10.57	10.77	c1	.007	.011	0.18	0.28
D1	.378	.382	9.60	9.70	e	2°	8°	2°	8°
D2	.290	—	7.37	—	aaa	.004		0.10	
D3	.016	.024	0.41	0.61					
E	.316	.324	8.03	8.23					
E1	.238	.242	6.04	6.15					
E2	.066	.074	1.68	1.88					
E3	.150	—	3.81	—					
E4	.058	.066	1.47	1.68					
E5	.231	.235	5.87	5.97					

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: TO—270 GULL WING	DOCUMENT NO: 98ASA99301D	REV: C
	CASE NUMBER: 1265A—03	02 JUL 2007
	STANDARD: JEDEC TO—270 BA	

PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN3789: Clamping of High Power RF Transistors and RFICs in Over-Molded Plastic Packages

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Dec. 2013	• Initial Release of Data Sheet
1	Jan. 2014	• Fig. 1, Pin Connections: corrected pin 1 and pin 2 labels to align with labelling in the mechanical outline, p. 1 • Table 2. Thermal Characteristics: CW thermal value changed from 2.5 to 2.3°C/W to reflect recent thermal test results; two-tone test corrected from 5 W PEP to 10 W PEP and the thermal value changed from 5.9 to 2.9°C/W to reflect recent thermal test results, p. 2

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