Freescale Semiconductor
Technical Data

Document Number: MRF6S27015N
Rev. 0, 8/2006

√RoHS

RF Power Field Effect Transistors
N-Channel Enhancement-Mode Lateral MOSFETs

MRF6S27015NR1
MRF6S27015GNR1

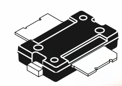
Designed for CDMA base station applications with frequencies from 2000 to 2700 MHz. Suitable for WiMAX, WiBro, BWA, and OFDM multicarrier Class AB and Class C amplifier applications.

- Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 160 mA, P_{out} = 3 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 14 dB
  Drain Efficiency — 22%
  ACPR @ 5 MHz Offset — -45 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2600 MHz, 15 Watts CW Output Power

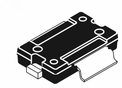
Features

- 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
- 200°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 24 mm, 13 inch Reel.

2300-2700 MHz, 3 W AVG., 28 V
SINGLE W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 1265-08, STYLE 1
TO-270-2
PLASTIC
MRF6S27015NR1



CASE 1265A-02, STYLE 1
TO-270-2 GULL
PLASTIC
MRF6S27015GNR1

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 +175	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 7.5 W Avg., Two-Tone Case Temperature 79°C, 3 W CW	$R_{\theta JC}$	 2.0 2.2	°C/W

Table 3. ESD Protection Characteristics

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

1. MTTF calculator available at http://www.freescale.com/rf. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

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Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	3	260	°C

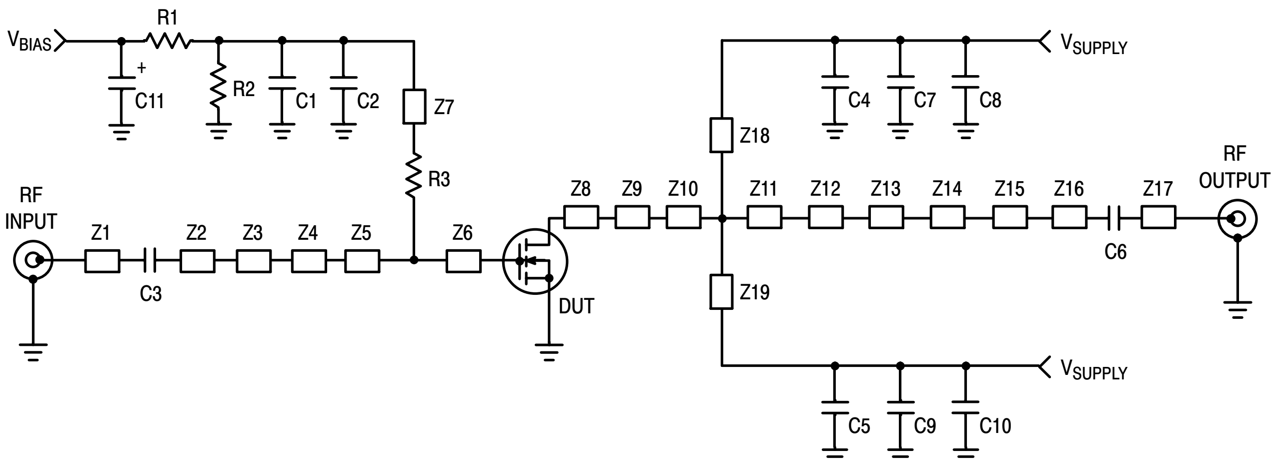
Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted)

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	nAdc
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 (1) (V_{DS} = 28 Vdc, I_D = 160 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	3.5	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 0.4 Adc)	$V_{DS(on)}$	—	0.4	0.33	Vdc
Dynamic Characteristics (2)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	11.6	—	pF
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	0.02	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 160 mA, P_{out} = 3 W Avg., f = 2600 MHz, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	12.5	14	16	dB
Drain Efficiency	η_D	19	22	—	%
Adjacent Channel Power Ratio	ACPR	—	-45	-42	dBc
Input Return Loss	IRL	—	-18	-9	dB

1. V_{GG} = 11/10 x $V_{GS(Q)}$. Parameter measured on Freescale Test Fixture, due to resistive divider network on the board. Refer to Test Circuit schematic.
2. Part internally input matched.



Z1	0.503″ x 0.066″ Microstrip	Z11	0.143″ x 0.816″ Microstrip
Z2	0.905″ x 0.066″ Microstrip	Z12	0.101″ x 0.667″ Microstrip
Z3	0.371″ x 0.300″ x 0.049″ Taper	Z13	0.073″ x 0.485″ Microstrip
Z4	0.041″ x 0.016″ Microstrip	Z14	0.120″ x 0.021″ Microstrip
Z5	0.245″ x 0.851″ Microstrip	Z15	0.407″ x 0.170″ Microstrip
Z6	0.248″ x 0.851″ Microstrip	Z16	0.714″ x 0.066″ Microstrip
Z7	0.973″ x 0.050″ Microstrip	Z17	0.496″ x 0.066″ Microstrip
Z8	0.085″ x 0.485″ Microstrip	Z18	0.475″ x 0.050″ Microstrip
Z9	0.091″ x 0.667″ Microstrip	Z19	0.480″ x 0.050″ Microstrip
Z10	0.138″ x 0.816″ Microstrip	PCB	Taconic RF-35, 0.030″, ε_r = 3.5

Figure 1. MRF6S27015NR1(GNR1) Test Circuit Schematic

Table 6. MRF6S27015NR1(GNR1) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor	CDR33BX104AKWS	AVX
C2	4.7 pF Chip Capacitor	600B4R7BT250XT	ATC
C3	9.1 pF Chip Capacitor	600B9R1BT250XT	ATC
C4, C5, C6	8.2 pF Chip Capacitors	600B8R2BT250XT	ATC
C7, C8, C9, C10	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88L	Murata
C11	10 μF, 35 V Tantalum Chip Capacitor	T491D106K035AS	Kemet
R1	1 KΩ, 1/4 W Chip Resistor	CRCW12061001F100	Vishay
R2	10 KΩ,1/4 W Chip Resistor	CRCW12061002F100	Vishay
R3	10 Ω, 1/4 W Chip Resistor	CRCW120610R0F100	Vishay

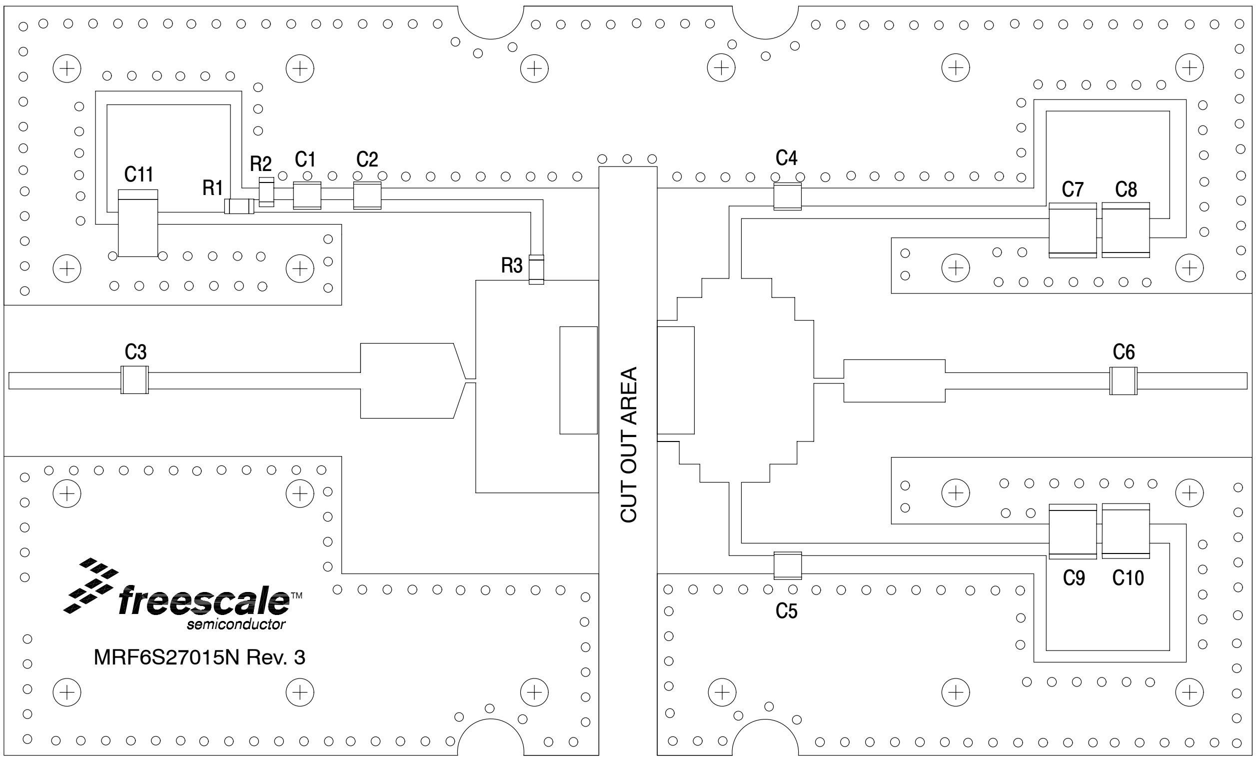


Figure 2. MRF6S27015NR1(GNR1) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

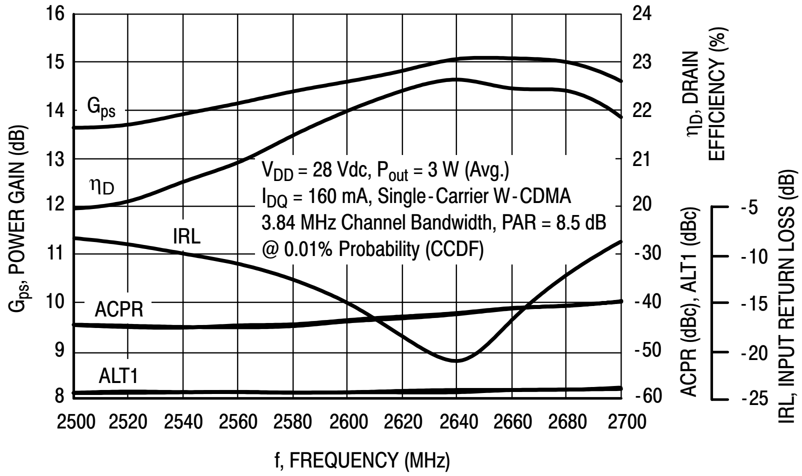


Figure 3. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 3 Watts Avg.

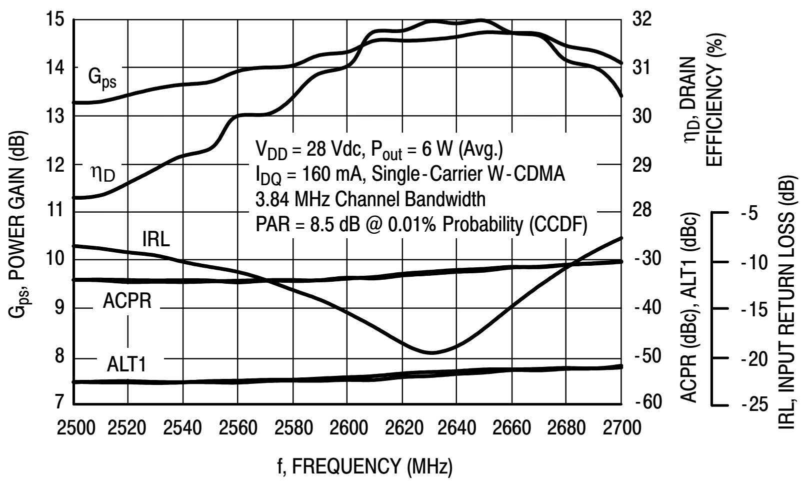


Figure 4. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 6 Watts Avg.

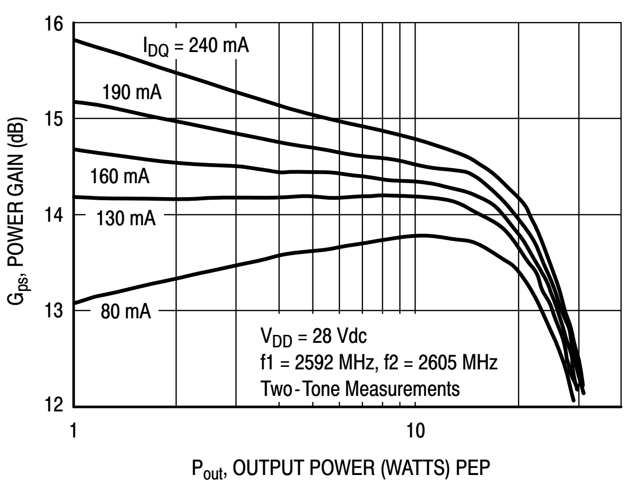


Figure 5. Two-Tone Power Gain versus Output Power

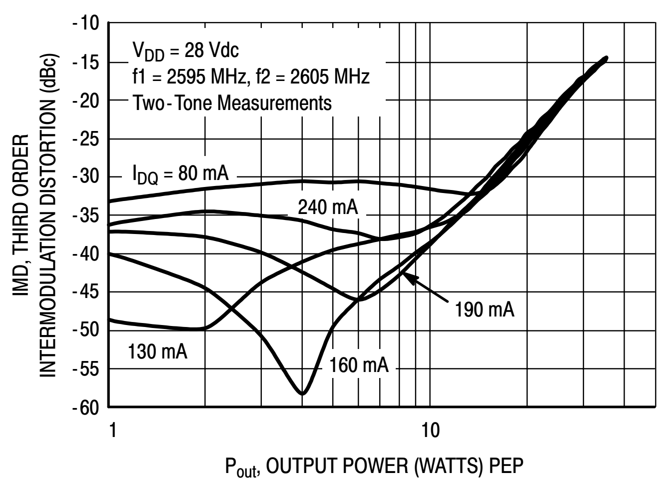


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

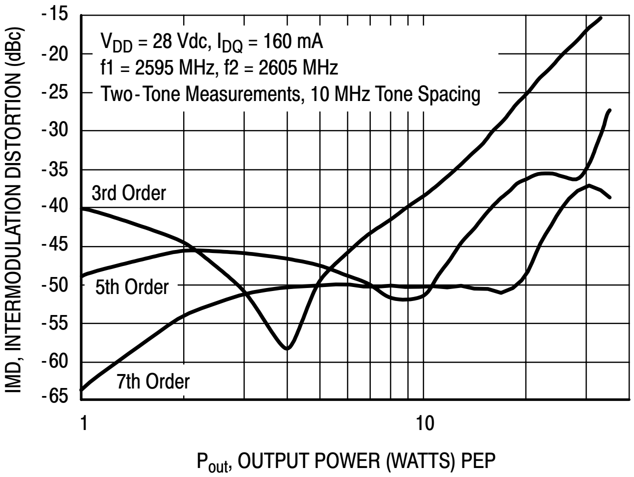


Figure 7. Intermodulation Distortion Products versus Output Power

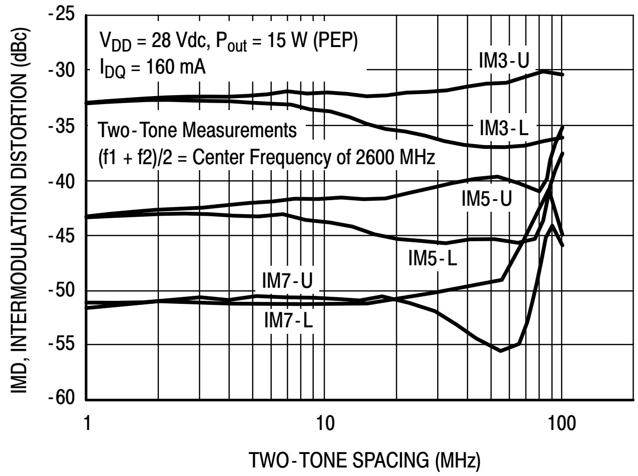


Figure 8. Intermodulation Distortion Products versus Tone Spacing

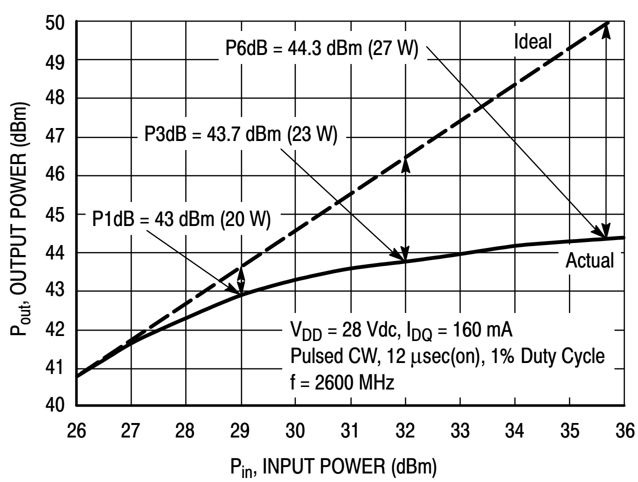


Figure 9. Pulsed CW Output Power versus Input Power

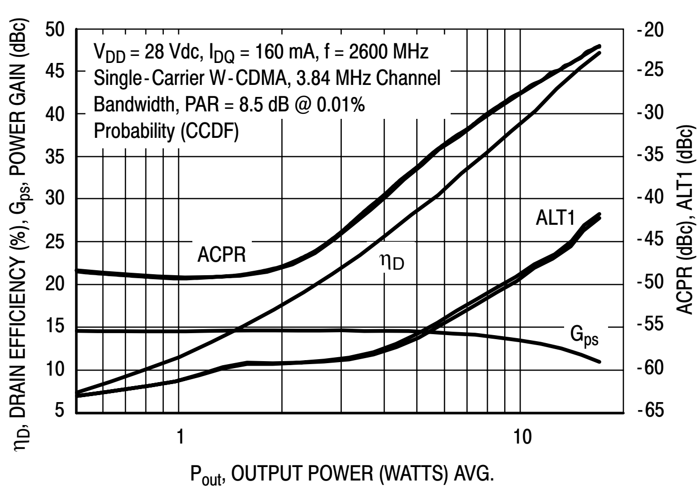


Figure 10. Single-Carrier W-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS

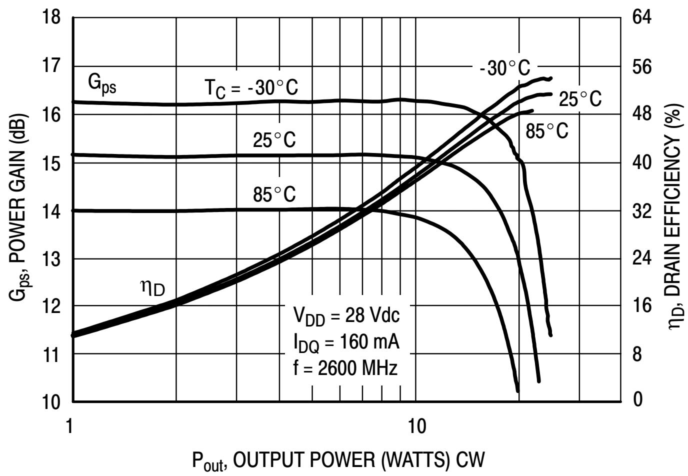


Figure 11. Power Gain and Drain Efficiency versus CW Output Power

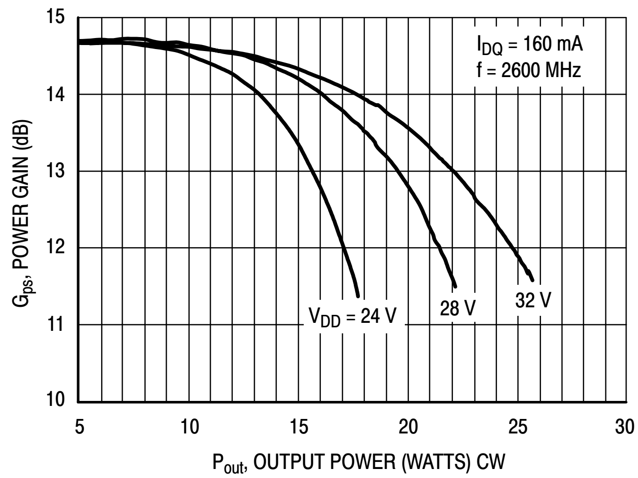


Figure 12. Power Gain versus Output Power

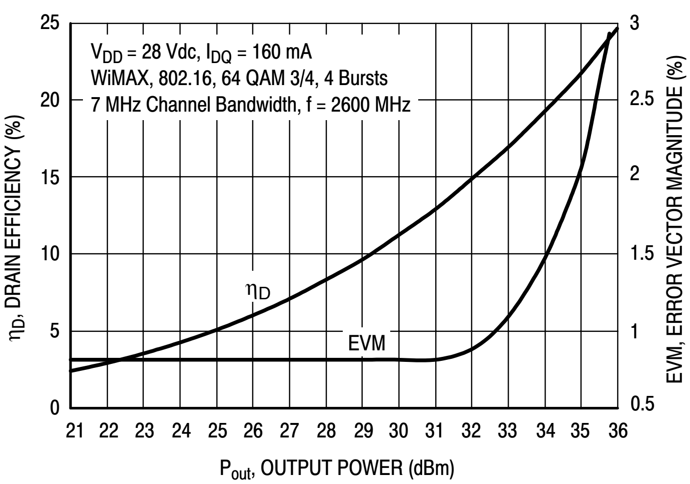
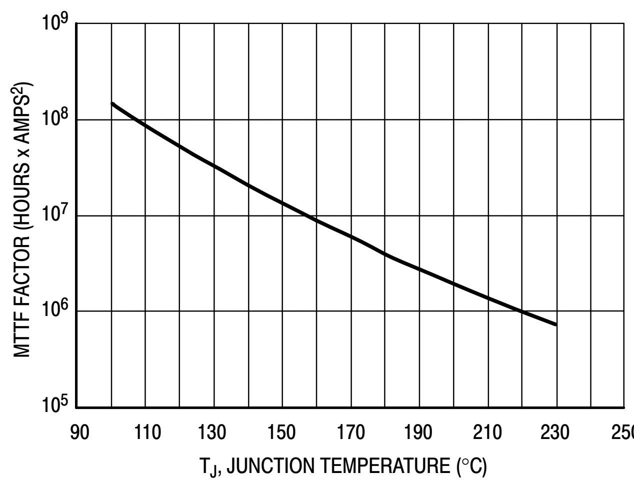


Figure 13. Drain Efficiency and Error Vector Magnitude versus Output Power



This above graph displays calculated MTTF in hours x ampere^2 drain current. Life tests at elevated temperatures have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 14. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

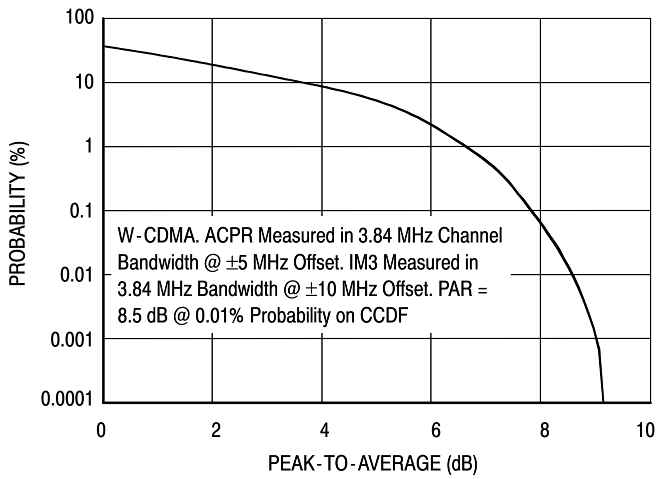


Figure 15. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

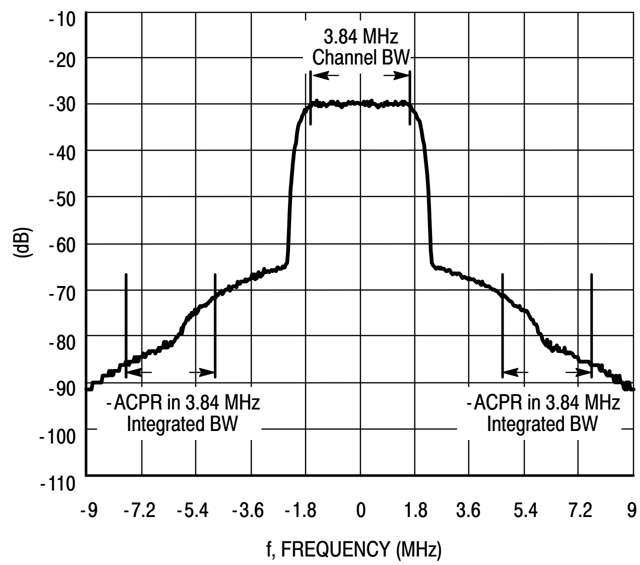
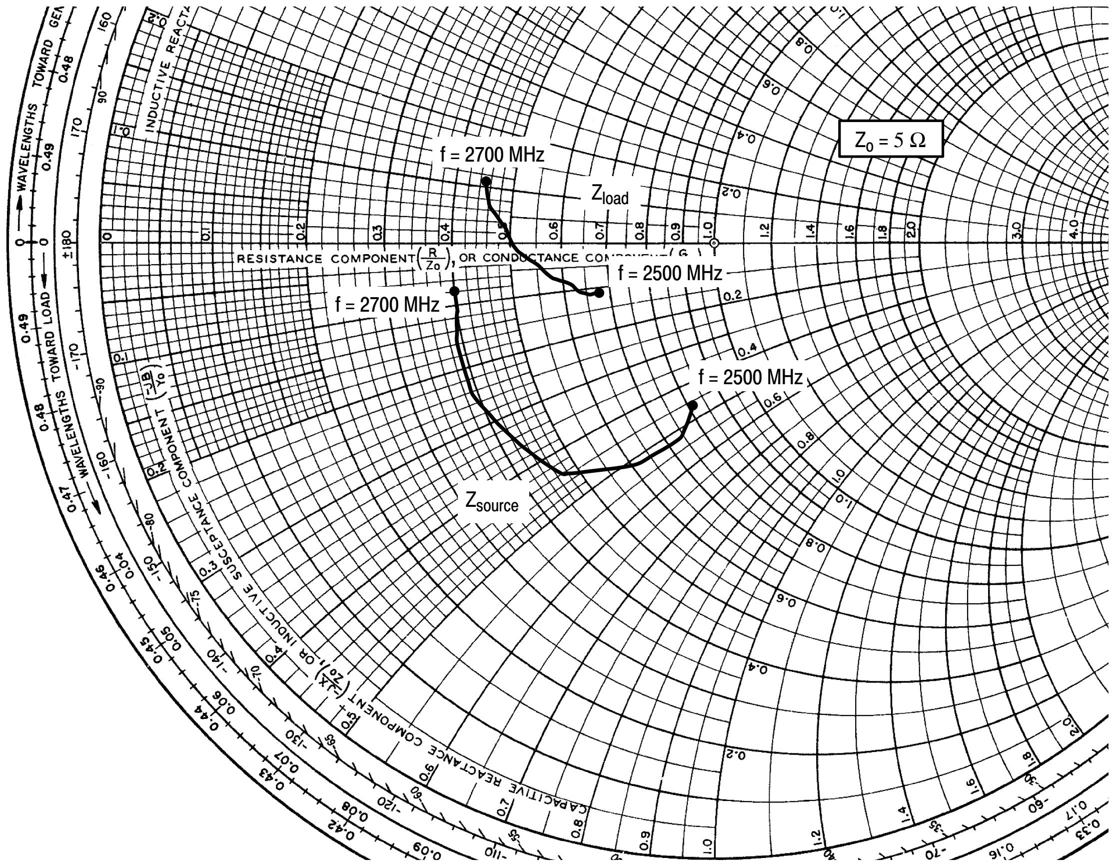


Figure 16. Single-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 160 mA, P_{out} = 3 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2500	4.059 - j2.284	3.380 - j0.543
2525	3.679 - j2.593	3.265 - j0.546
2550	3.006 - j2.574	3.077 - j0.449
2575	2.355 - j2.190	2.892 - j0.336
2600	2.075 - j1.657	2.727 - j0.182
2625	1.930 - j1.179	2.564 - j0.034
2650	1.973 - j0.771	2.435 + j0.140
2675	2.017 - j0.557	2.286 + j0.340
2700	2.024 - j0.379	2.227 + j0.538

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

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

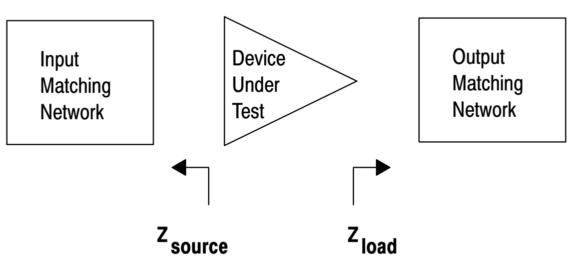


Figure 17. Series Equivalent Source and Load Impedance

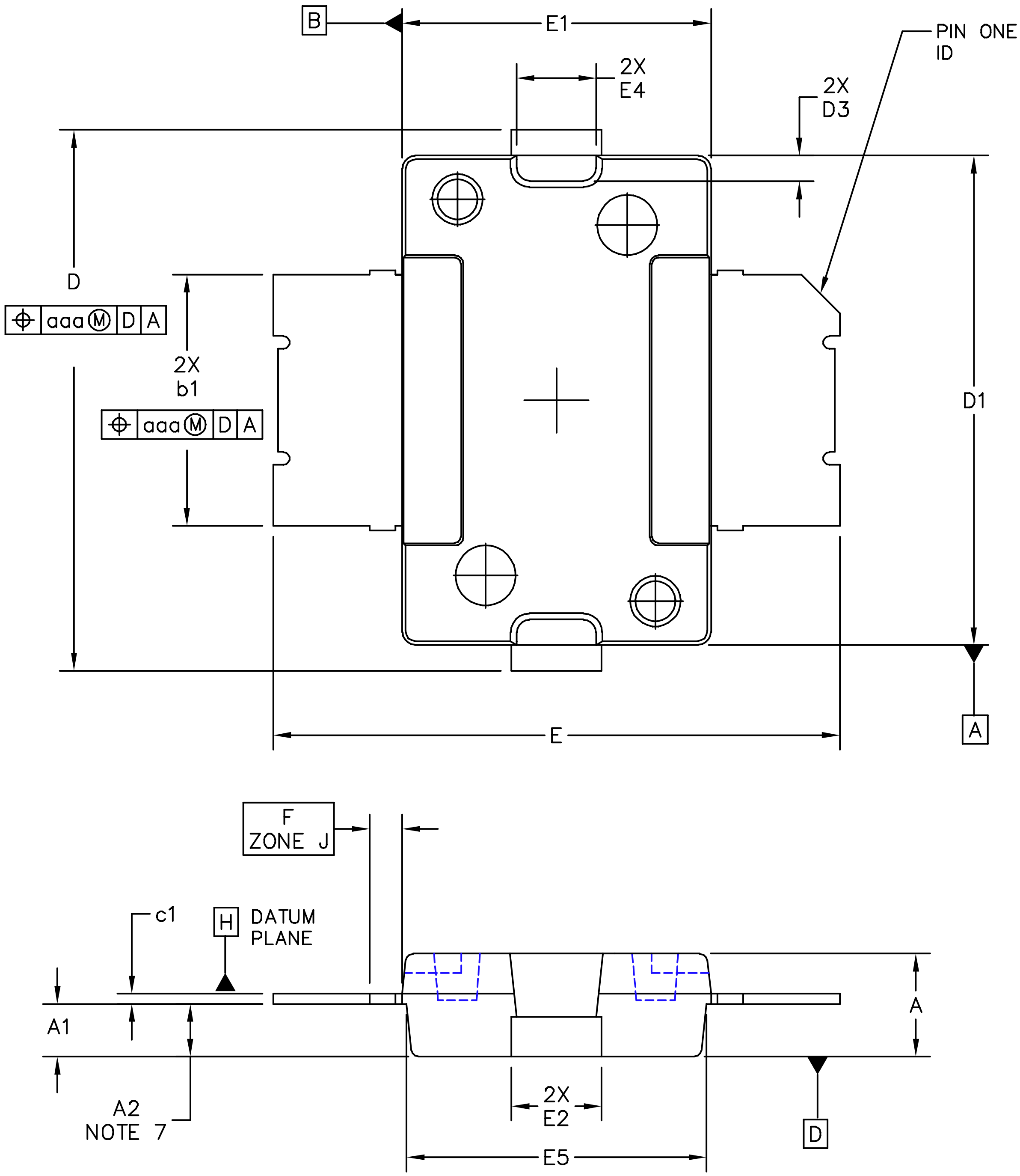
Table 7. Common Source Scattering Parameters (V_{DD} = 28 V, I_{DQ} = 160 mA, T_C = 25°C, 50 ohm system)

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	$\angle \phi$	$\|S_{21}\|$	$\angle \phi$	$\|S_{12}\|$	$\angle \phi$	$\|S_{22}\|$	$\angle \phi$
500	0.984	-178.2	1.453	39.2	0.001	-109.8	0.870	-122.3
550	0.984	-179.0	1.180	36.5	0.000	-121.0	0.888	-127.6
600	0.986	180.0	0.958	34.4	0.000	159.6	0.901	-132.0
650	0.987	179.0	0.776	33.0	0.001	118.4	0.911	-135.8
700	0.987	178.1	0.627	32.3	0.001	106.5	0.921	-139.1
750	0.986	177.3	0.502	32.5	0.001	104.2	0.931	-142.1
800	0.985	176.5	0.397	34.1	0.002	96.0	0.940	-144.8
850	0.985	175.8	0.308	37.7	0.002	95.6	0.944	-147.3
900	0.984	175.1	0.235	44.5	0.003	94.0	0.951	-149.5
950	0.983	174.5	0.180	56.5	0.003	91.2	0.956	-151.5
1000	0.982	173.8	0.146	75.6	0.003	91.2	0.962	-153.4
1050	0.981	173.2	0.142	98.9	0.004	89.9	0.965	-155.2
1100	0.980	172.5	0.163	118.0	0.004	89.2	0.969	-156.8
1150	0.978	171.9	0.199	129.9	0.005	88.9	0.973	-158.3
1200	0.976	171.2	0.243	136.6	0.005	87.4	0.976	-159.8
1250	0.974	170.5	0.291	140.2	0.006	86.5	0.980	-161.1
1300	0.970	169.8	0.342	141.8	0.006	86.3	0.983	-162.4
1350	0.966	169.0	0.395	142.1	0.006	84.6	0.986	-163.7
1400	0.960	168.3	0.452	141.5	0.006	84.8	0.988	-164.9
1450	0.953	167.5	0.514	140.2	0.007	86.9	0.990	-166.1
1500	0.945	166.6	0.580	138.4	0.007	92.5	0.993	-167.3
1550	0.933	165.8	0.655	135.9	0.009	100.3	0.992	-168.4
1600	0.918	164.9	0.738	132.5	0.011	93.7	0.994	-169.4
1650	0.901	164.1	0.828	128.4	0.013	83.6	0.996	-170.4
1700	0.879	163.2	0.925	123.5	0.014	75.4	0.997	-171.6
1750	0.850	162.5	1.030	117.6	0.014	69.1	0.998	-172.8
1800	0.815	162.2	1.139	110.8	0.015	62.8	0.995	-173.9
1850	0.775	162.5	1.246	102.7	0.016	55.8	0.991	-175.0
1900	0.734	164.0	1.337	93.6	0.016	48.2	0.984	-176.0
1950	0.700	167.0	1.399	83.5	0.015	40.3	0.976	-176.9
2000	0.683	171.0	1.420	73.1	0.015	33.2	0.966	-177.6
2050	0.687	175.1	1.396	62.9	0.014	26.5	0.957	-178.0
2100	0.710	178.5	1.338	53.4	0.012	22.1	0.951	-178.3
2150	0.741	-179.3	1.259	45.0	0.011	19.8	0.948	-178.6
2200	0.774	-178.2	1.169	37.6	0.010	19.7	0.947	-178.9
2250	0.805	-177.8	1.079	31.1	0.009	19.7	0.947	-179.2
2300	0.832	-177.9	0.993	25.8	0.008	19.6	0.948	-179.5
2350	0.855	-178.2	0.917	21.2	0.007	22.6	0.950	-179.9

Table 7. Common Source Scattering Parameters (V_{DD} = 28 V, I_{DQ} = 160 mA, T_C = 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
2400	0.873	-178.8	0.848	17.2	0.006	31.2	0.953	179.7
2450	0.887	-179.4	0.786	13.7	0.006	42.2	0.955	179.2
2500	0.897	-179.9	0.731	10.6	0.007	45.6	0.956	178.7
2550	0.907	179.6	0.682	7.9	0.007	46.5	0.957	178.2
2600	0.914	179.1	0.639	5.5	0.007	48.0	0.958	177.8
2650	0.919	178.8	0.600	3.3	0.007	47.0	0.960	177.2
2700	0.926	178.3	0.566	1.3	0.007	45.8	0.962	176.8
2750	0.931	177.9	0.534	-0.6	0.006	52.1	0.964	176.2
2800	0.936	177.4	0.505	-2.2	0.006	62.3	0.965	175.7
2850	0.940	177.0	0.480	-3.8	0.006	69.8	0.966	175.2
2900	0.942	176.6	0.457	-5.2	0.007	73.2	0.967	174.7
2950	0.945	176.3	0.436	-6.5	0.007	78.7	0.968	174.2
3000	0.947	175.8	0.416	-7.6	0.008	85.1	0.969	173.8
3050	0.949	175.6	0.399	-8.7	0.009	87.9	0.969	173.2
3100	0.950	175.1	0.382	-9.6	0.011	88.2	0.970	172.9
3150	0.953	174.8	0.368	-10.5	0.012	86.9	0.972	172.6
3200	0.955	174.5	0.355	-11.5	0.014	85.1	0.974	172.1

PACKAGE DIMENSIONS



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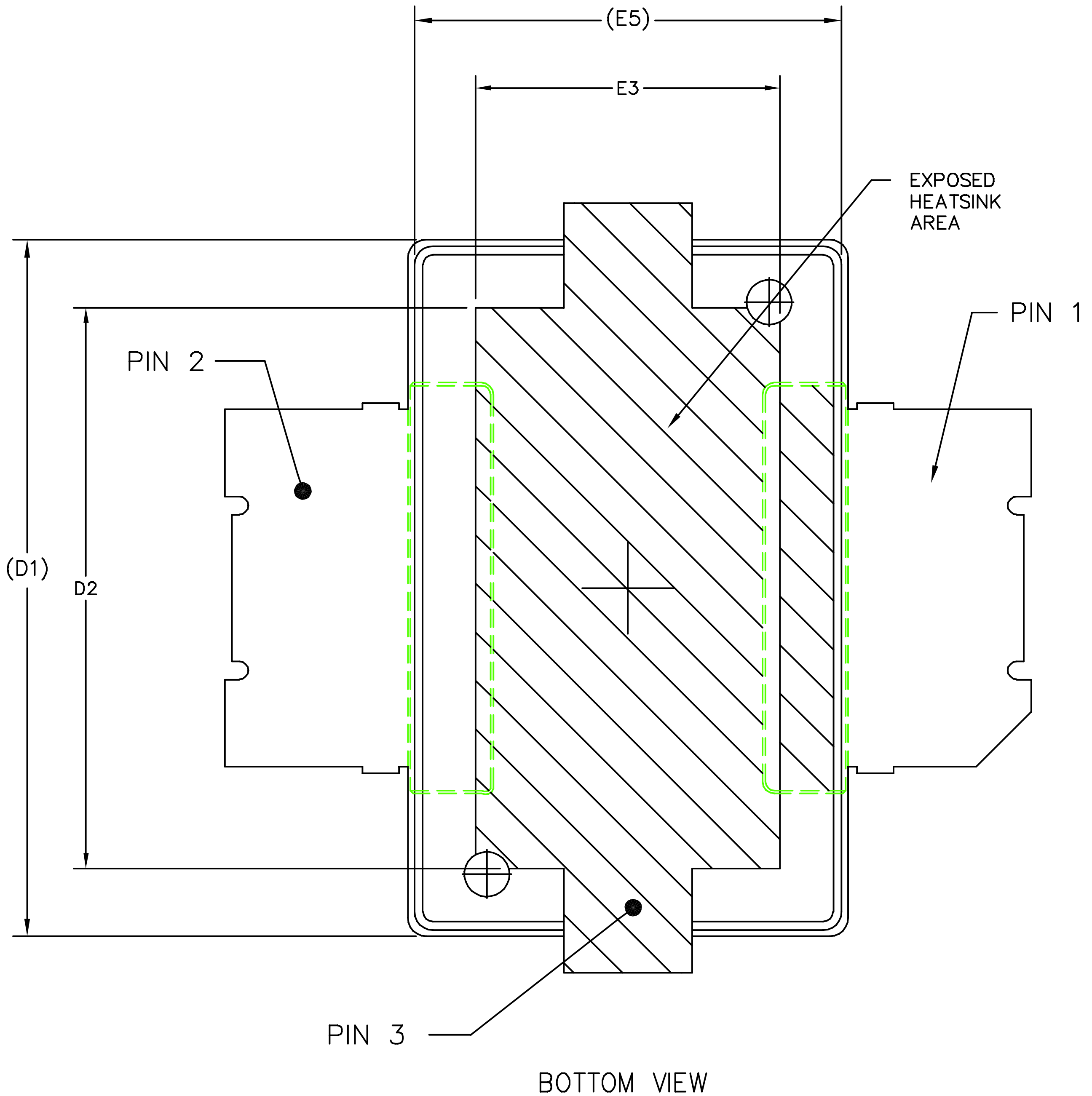
	CASE NUMBER: 1265–08	01 APR 2005
	STANDARD: NON–JEDEC	



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TITLE: TO–270 SURFACE MOUNT	DOCUMENT NO: 98ASH98117A		REV: J
	CASE NUMBER: 1265–08		01 APR 2005
	STANDARD: NON–JEDEC		

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.

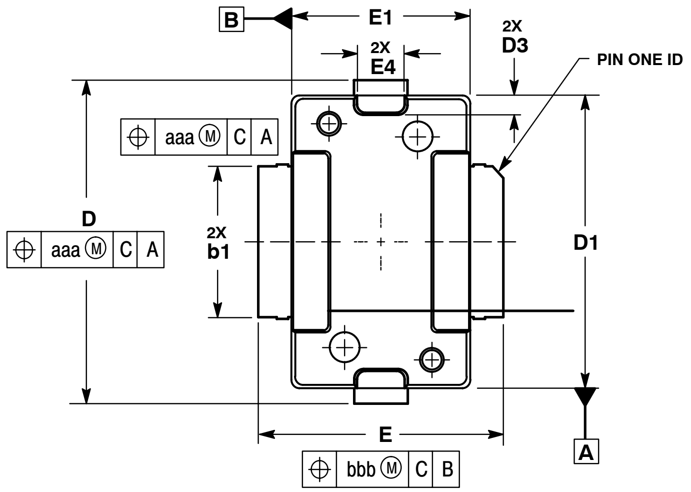
8. DIMENSIONS "D" AND "E2" DO NOT INCLUDE MOLD PROTRUSION. OVERALL LENGTH INCLUDING MOLD PROTRUSION SHOULD NOT EXCEED 0.430 INCH FOR DIMENSION "D" AND 0.080 INCH FOR DIMENSION "E2". DIMENSIONS "D" AND "E2" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –D–.

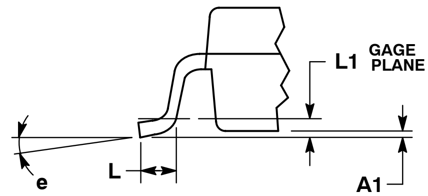
STYLE 1:
PIN 1 – DRAIN
PIN 2 – GATE
PIN 3 – SOURCE

	INCH		MILLIMETER			INCH		MILLIMETER	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	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	.320	7.37	8.13					
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	.180	3.81	4.57					
E4	.058	.066	1.47	1.68					
E5	.231	.235	5.87	5.97					

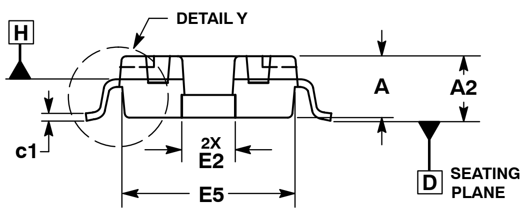
MECHANICAL OUTLINE PRINT VERSION NOT TO SCALE

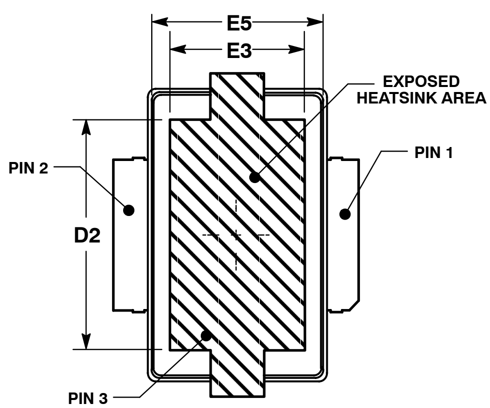
TITLE:		
TO–270 SURFACE MOUNT	DOCUMENT NO: 98ASH98117A	REV: J
	CASE NUMBER: 1265–08	01 APR 2005
	STANDARD: NON–JEDEC	





DETAIL Y





BOTTOM VIEW

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-.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.078	.082	1.98	2.08
A1	.001	.004	0.02	0.10
A2	.077	.088	1.96	2.24
D	.416	.424	10.57	10.77
D1	.378	.382	9.60	9.70
D2	.290	.320	7.37	8.13
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	.180	3.81	4.57
E4	.058	.066	1.47	1.68
E5	.231	.235	5.87	5.97
L	.018	.024	4.90	5.06
L1	.01 BSC		0.25 BSC	
b1	.193	.199	4.90	5.06
c1	.007	.011	0.18	0.28
e	2°	8°	2°	8°
aaa	.004		0.10	

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

CASE 1265A-02
ISSUE B
TO-270-2 GULL
PLASTIC
MRF6S27015GN

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