Document Number: MMRF1318N
Rev. 0, 12/2014

RoHS

RF Power LDMOS Transistor

Enhancement-Mode Lateral MOSFET

Designed primarily for CW large-signal output and driver applications with frequencies up to 600 MHz. Devices are unmatched and are suitable for use in military and commercial CW and pulse applications, such as radio communications and radar.

Typical Performance: V_{DD} = 50 Vdc, T_A = 25°C

Frequency (MHz)	Signal Type	P_{out} (W)	G_{ps} (dB)	η_D (%)
450	CW	300	22	60

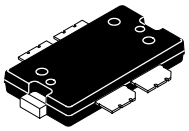
- Capable of Handling 10:1 VSWR @ 50 Vdc, 450 MHz, 300 W CW Output Power

Features

- Characterized with series equivalent large-signal impedance parameters
- Qualified for operation at 50 Vdc
- Integrated ESD protection
- Greater negative gate-source voltage range for improved Class C operation
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13-inch Reel.

MMRF1318NR1

10–600 MHz, 300 W, 50 V
BROADBAND
RF POWER LDMOS TRANSISTOR



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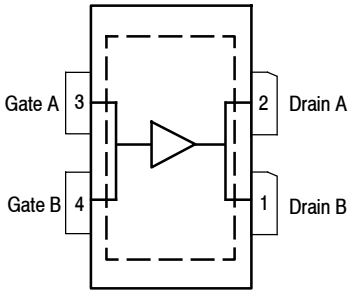
PLASTIC



(Top View)

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

Figure 1. Pin Connections

freescale

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +110	Vdc
Gate-Source Voltage	V_{GS}	–6.0, +10	Vdc
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–40 to +150	°C
Operating Junction Temperature Range (1,2)	T_J	–40 to +225	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 83°C, 300 W CW, 50 Vdc, I_{DQ} = 900 mA, 450 MHz	$R_{\theta JC}$	0.24	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C, passes 1950 V
Machine Model (per EIA/JESD22-A115)	A, passes 150 V
Charge Device Model (per JESD22-C101)	IV, passes 2000 V

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)

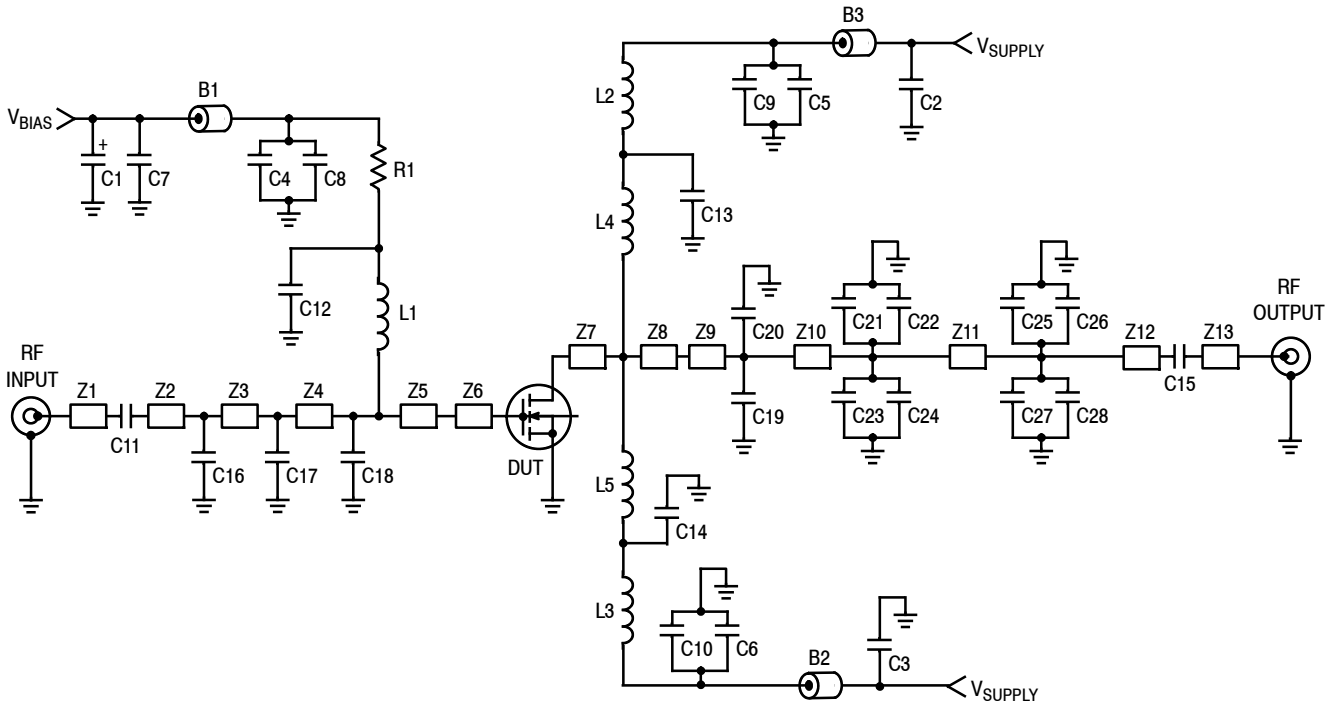
Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	10	μAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 150 mAdc)	$V_{(BR)DSS}$	120	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	50	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 100 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 800 μAdc)	$V_{GS(th)}$	0.9	1.65	2.4	Vdc
Gate Quiescent Voltage (V_{DD} = 50 Vdc, I_D = 900 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.9	2.7	3.4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2 Adc)	$V_{DS(on)}$	—	0.25	—	Vdc

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product. (Calculator available when part is in production.)
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Dynamic Characteristics					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.8	—	pF
Output Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	105	—	pF
Input Capacitance (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	304	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 900 mA, P_{out} = 300 W CW, f = 450 MHz, CW					
Power Gain	G_{ps}	20.0	22.0	24.0	dB
Drain Efficiency	η_D	58.0	60.0	—	%
Input Return Loss	IRL	—	–16	–9	dB



Z1	0.900″ x 0.082″ Microstrip	Z8	0.380″ x 0.220″ Microstrip
Z2	0.115″ x 0.170″ Microstrip	Z9	0.040″ x 0.170″ Microstrip
Z3	0.260″ x 0.170″ Microstrip	Z10	0.315″ x 0.170″ Microstrip
Z4	0.380″ x 0.170″ Microstrip	Z11	0.230″ x 0.170″ Microstrip
Z5	0.220″ x 0.220″ Microstrip	Z12	0.390″ x 0.170″ Microstrip
Z6	0.290″ x 0.630″ Microstrip	Z13	0.680″ x 0.082″ Microstrip
Z7	0.220″ x 0.630″ Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030″, ε_r = 2.55

Figure 2. MMRF1318NR1 Test Circuit Schematic

Table 6. MMRF1318NR1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Short Ferrite Bead	2743019447	Fair-Rite
B2, B3	Long Ferrite Beads	2743021447	Fair-Rite
C1	47 μF, 25 V, Tantalum Capacitor	T491B476M025AT	Kemet
C2, C3	22 μF, 50 V, Chip Capacitors	C5750JF1H226ZT	TDK
C4, C5, C6, C7	1 μF, 100 V, Chip Capacitors	C3225JB2A105KT	TDK
C8, C9, C10	15 nF, 100 V, Chip Capacitors	C3225CH2A153JT	TDK
C11, C12, C13, C14, C15	240 pF, Chip Capacitors	ATC100B241JT500XT	ATC
C16	9.1 pF, Chip Capacitor	ATC100B9R1JT500XT	ATC
C17	15 pF, Chip Capacitor	ATC100B150JT500XT	ATC
C18	51 pF, Chip Capacitor	ATC100B510JT500XT	ATC
C19, C20	5.6 pF, Chip Capacitors	ATC100B5R6JT500XT	ATC
C21, C22, C23, C24	4.3 pF, Chip Capacitors	ATC100B4R3JT500XT	ATC
C25, C26, C27, C28	4.7 pF, Chip Capacitors	ATC100B4R7JT500XT	ATC
L1	27 nH Inductor	1812SMS-27NJLC	Coilcraft
L2, L3	47 nH Inductors	1812SMS-47NJLC	Coilcraft
L4, L5	5 Turn, #18 AWG Inductors, Hand Wound	Copper Wire	
R1	10 Ω, 1/4 W, Chip Resistor	CRCW120610R1FKEA	Vishay

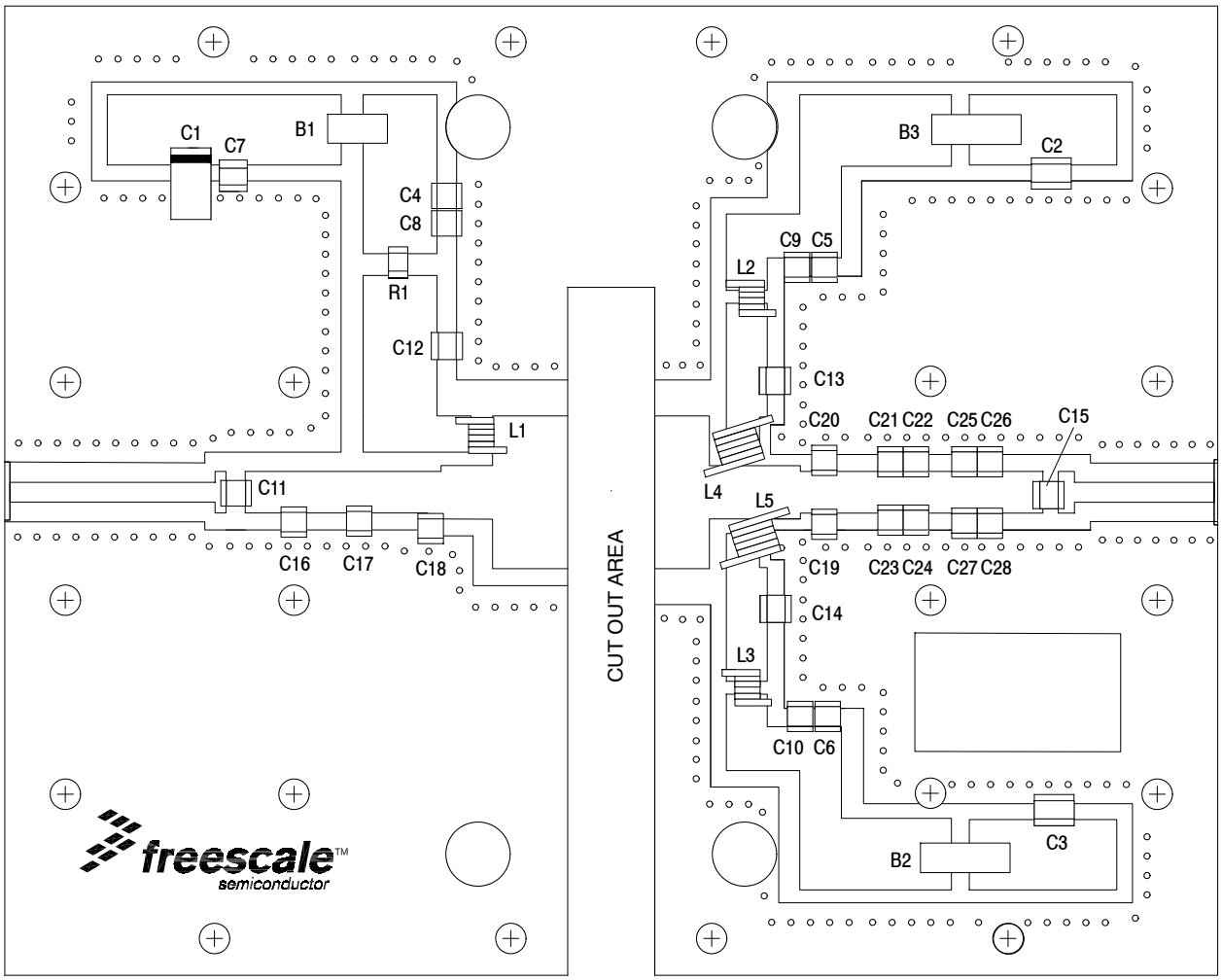


Figure 3. MMRF1318NR1 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

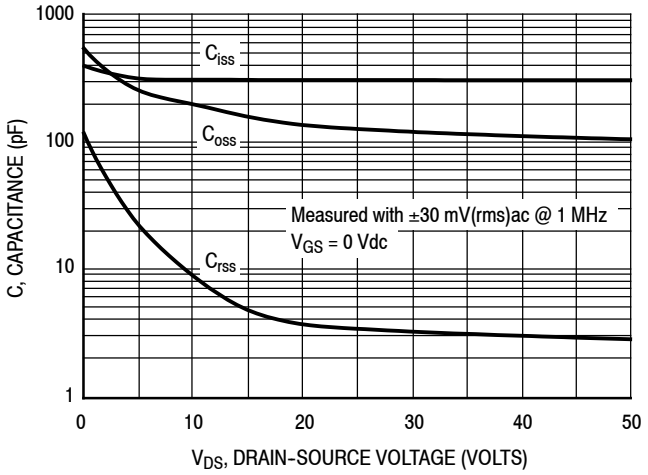


Figure 4. Capacitance versus Drain-Source Voltage

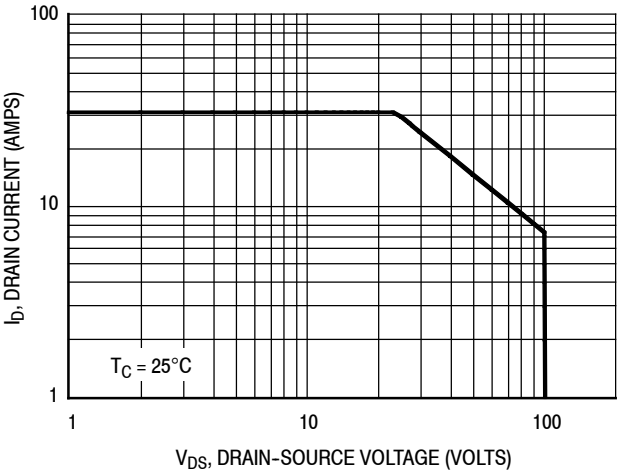


Figure 5. DC Safe Operating Area

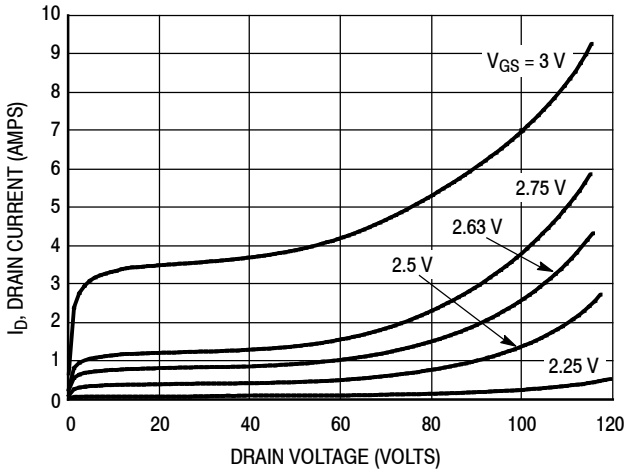


Figure 6. DC Drain Current versus Drain Voltage

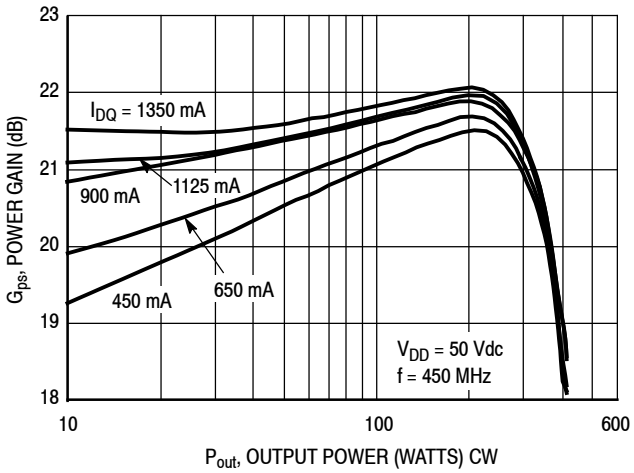


Figure 7. CW Power Gain versus Output Power

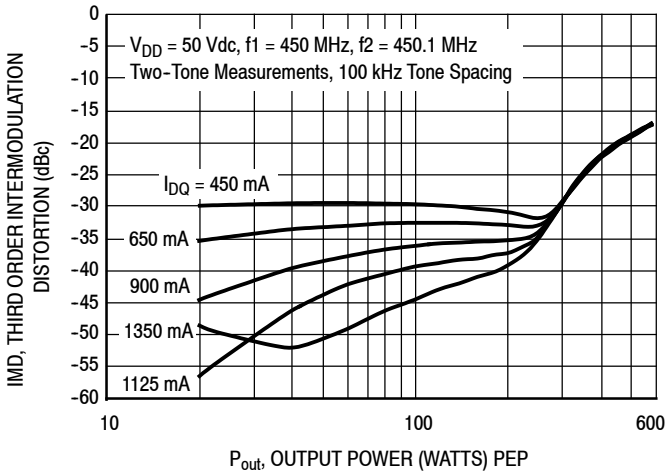


Figure 8. Third Order Intermodulation Distortion versus Output Power

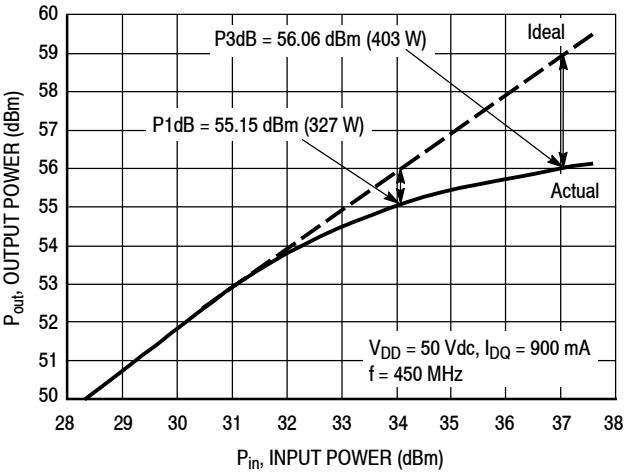


Figure 9. CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

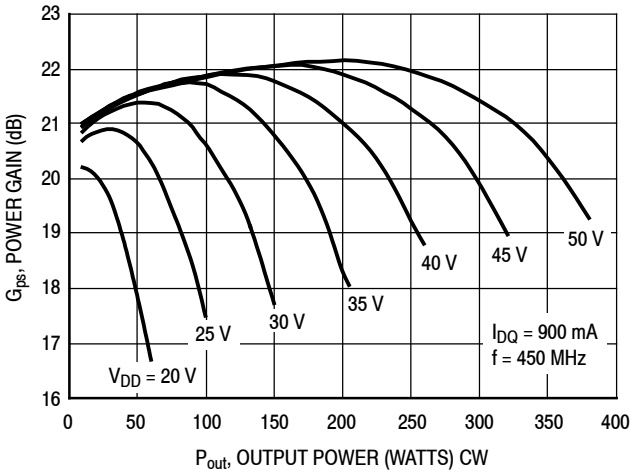


Figure 10. Power Gain versus Output Power

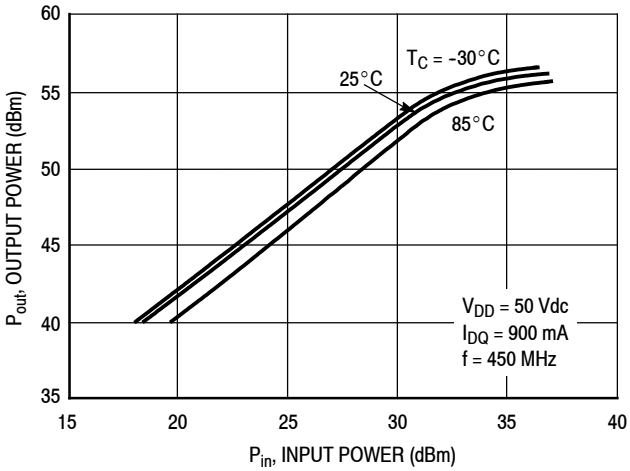


Figure 11. Power Output versus Power Input

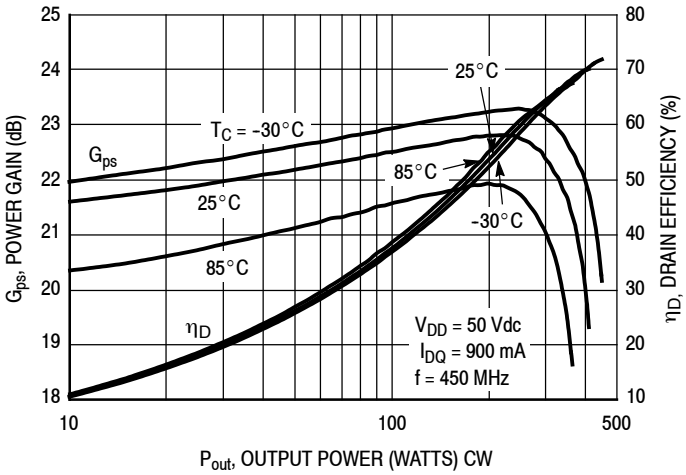
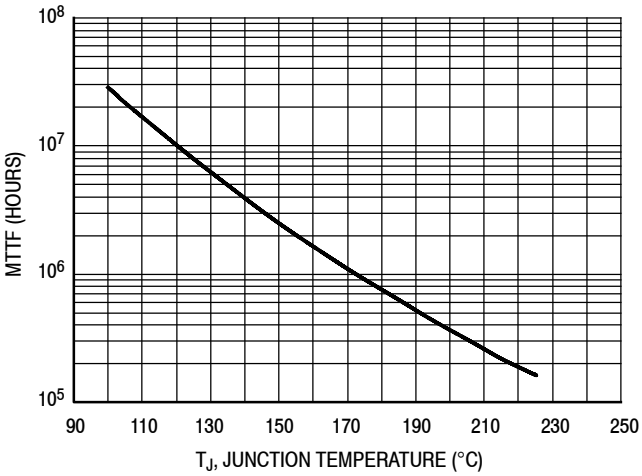


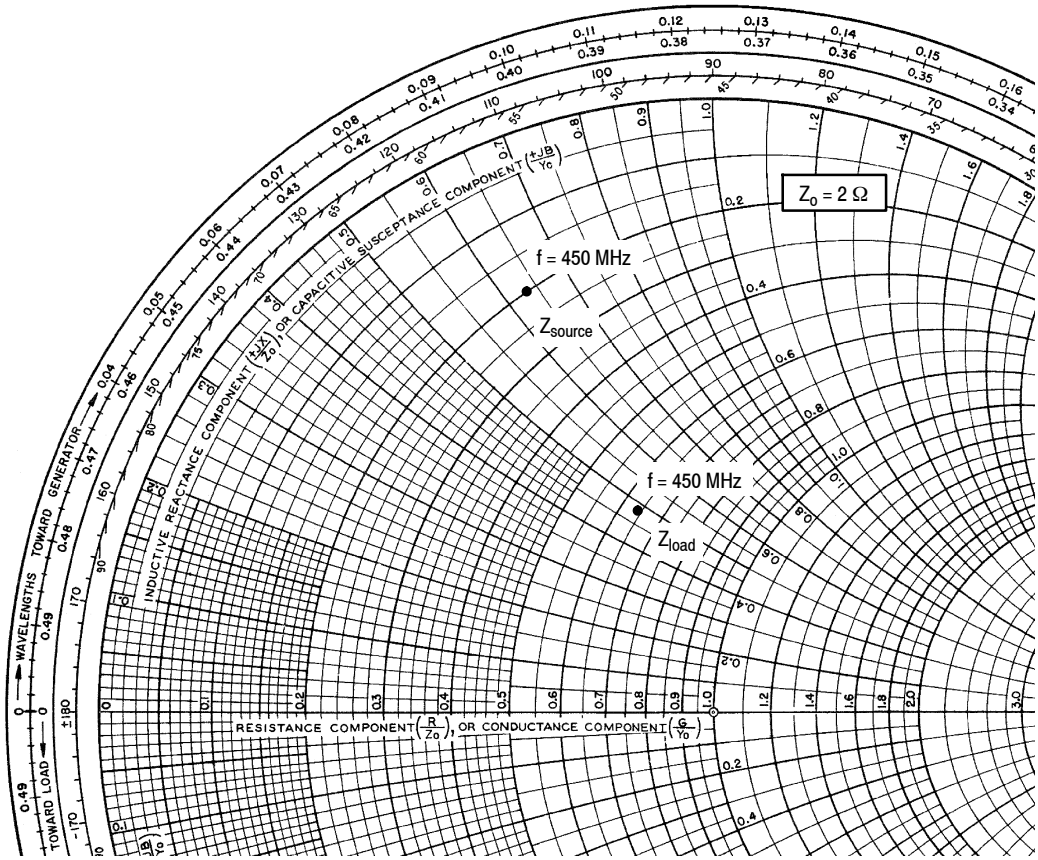
Figure 12. Power Gain and Drain Efficiency versus CW Output Power



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 50 Vdc, P_{out} = 300 W, and η_D = 60%.

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



V_{DD} = 50 Vdc, I_{DQ} = 900 mA, P_{out} = 300 W CW

f MHz	Z_{source} Ω	Z_{load} Ω
450	0.39 + j1.26	1.27 + j0.96

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

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

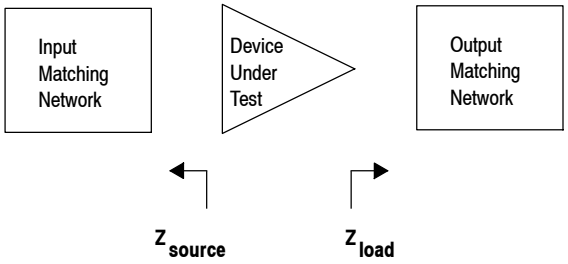
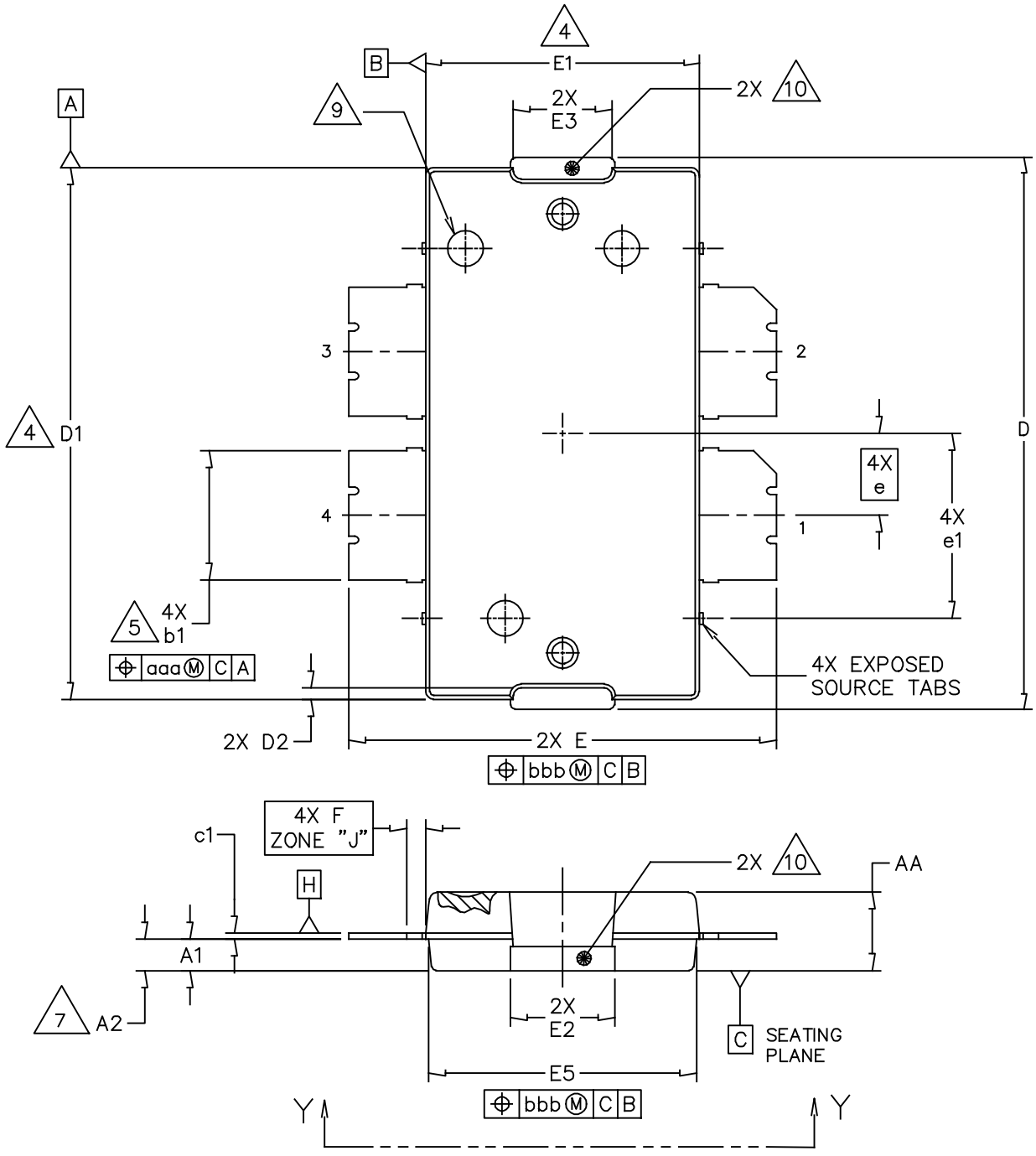


Figure 14. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



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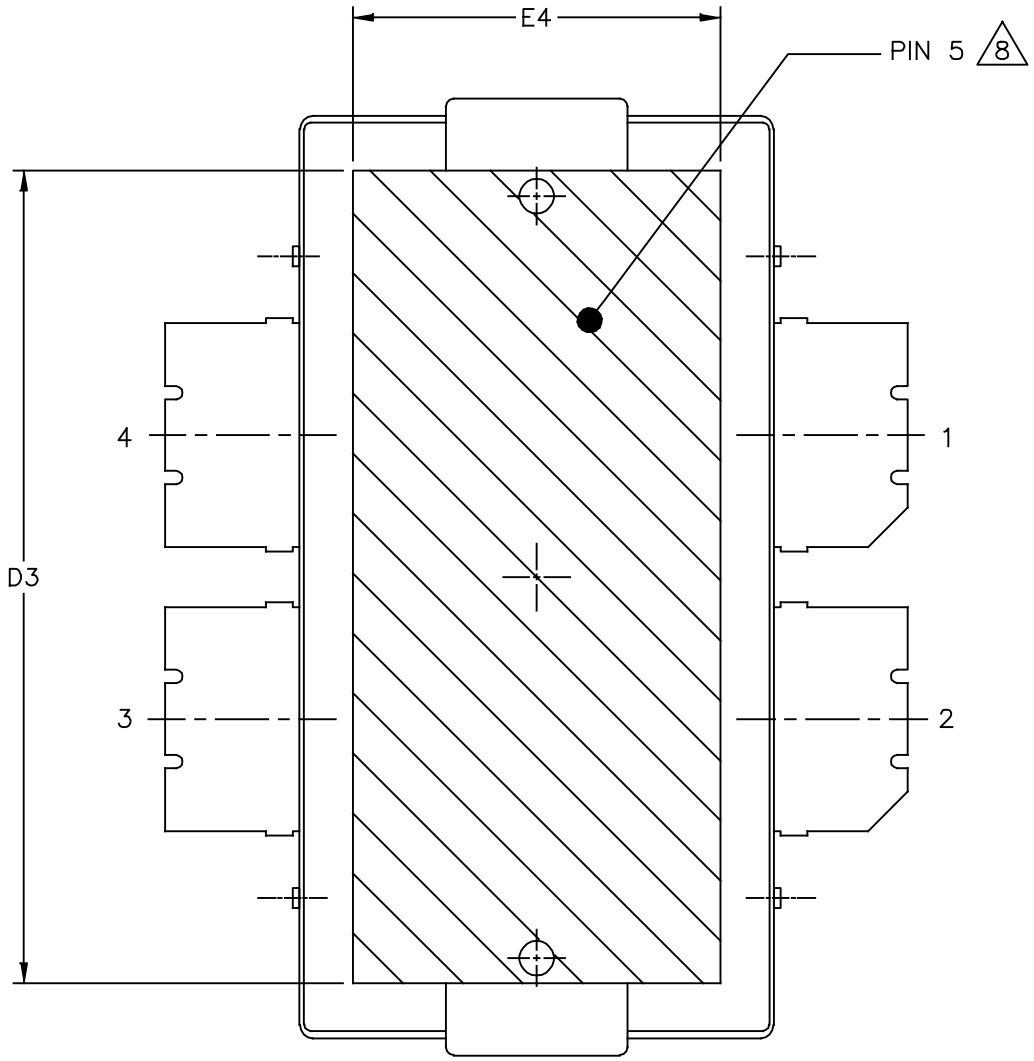

VIEW Y–Y

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NOTES:

1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DATUM PLANE H IS LOCATED AT THE 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 INCH (0.15MM) PER SIDE. DIMENSIONS D1 AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.

5. DIMENSIONS b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 INCH (0.13MM) 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. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. DIMENSIONS D3 AND D4 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF HEAT SLUG.

9. DIMPLED HOLE REPRESENTS INPUT SIDE.

10. THESE SURFACES OF THE HEAT SLUG ARE NOT PART OF THE SOLDERABLE SURFACES AND MAY REMAIN UNPLATED.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	.100	.104	2.54	2.64	F	.025 BSC		0.64 BSC	
A1	.039	.043	0.99	1.09	b1	.164	.170	4.17	4.32
A2	.040	.042	1.02	1.07	c1	.007	.011	0.18	0.28
D	.712	.720	18.08	18.29	e	.106 BSC		2.69 BSC	
D1	.688	.692	17.48	17.58	e1	.239 INFO ONLY		6.07 INFO ONLY	
D2	.011	.019	0.28	0.48	aaa	.004		0.10	
D3	.600	---	15.24	---	bbb	.008		0.20	
E	.551	.559	14.00	14.20					
E1	.353	.357	8.97	9.07					
E2	.132	.140	3.35	3.56					
E3	.124	.132	3.15	3.35					
E4	.270	---	6.86	---					
E5	.346	.350	8.79	8.89					

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PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following resources 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

Software

- Electromigration MTTF Calculator

For Software and Tools, do a Part Number search at http://www.freescale.com, and select the “Part Number” link. Go to Software & Tools on the part’s Product Summary page to download the respective tool.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Dec. 2014	• Initial Release of Data Sheet

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Document Number: MMRF1318N
Rev. 0, 12/2014