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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Freescale Semiconductor
Technical Data

Document Number: MRF6V10250HS
Rev. 2, 4/2010

√RoHS

RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

MRF6V10250HSR3

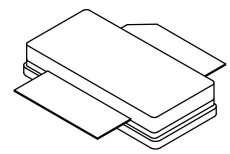
RF Power transistor designed for applications operating at frequencies between 1030 and 1090 MHz, 1% to 20% duty cycle. This device is suitable for use in pulsed applications.

- Typical Pulsed Performance: V_{DD} = 50 Volts, I_{DQ} = 250 mA, P_{out} = 250 Watts Peak (25 W Avg.), f = 1090 MHz, Pulse Width = 100 μsec, Duty Cycle = 10%
  Power Gain — 21 dB
  Drain Efficiency — 60%
- Capable of Handling 10:1 VSWR, @ 50 Vdc, 1090 MHz, 250 Watts Peak Power

Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 50 V_{DD} Operation
- Integrated ESD Protection
- Greater Negative Gate-Source Voltage Range for Improved Class C Operation
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

1090 MHz, 250 W, 50 V
PULSED
LATERAL N-CHANNEL
RF POWER MOSFET



CASE 465A-06, STYLE 1
NI-780S

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +100	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +10	Vdc
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature (1,2)	T_J	225	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 79°C, 250 W Pulsed, 100 μsec Pulse Width, 10% Duty Cycle	$Z_{\theta JC}$	0.10	°C/W

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.
3. 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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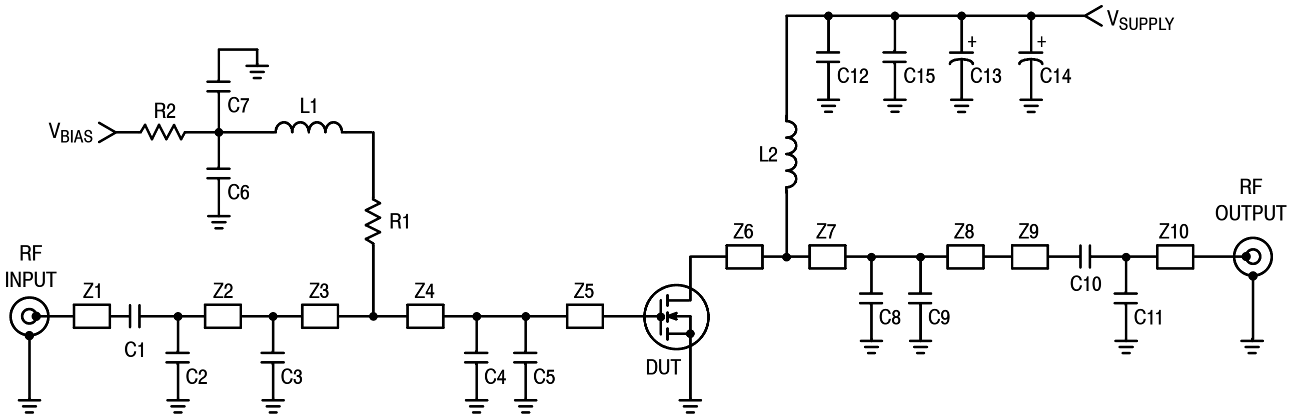
Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2 (Minimum)
Machine Model (per EIA/JESD22-A115)	B (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

Table 4. 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}	—	—	500	nAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 100 mA)	$V_{(BR)DSS}$	100	—	—	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} = 90 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	2	mA
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 528 μAdc)	$V_{GS(th)}$	1	1.8	3	Vdc
Gate Quiescent Voltage (V_{DD} = 50 Vdc, I_D = 250 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.4	3	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.32 Adc)	$V_{DS(on)}$	—	0.25	—	Vdc
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	0.8	—	pF
Output Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	340	—	pF
Input Capacitance (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	280	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 250 mA, P_{out} = 250 W Peak (25 W Avg.), f = 1090 MHz, Pulsed, 100 μsec Pulse Width, 10% Duty Cycle					
Power Gain	G_{ps}	19	21	23	dB
Drain Efficiency	η_D	55	60	—	%
Input Return Loss	IRL	—	-12	-9	dB

1. Part internally matched both on input and output.



Z1	0.40″ x 0.080″ Microstrip	Z5, Z6	0.625″ x 0.300″ Microstrip
Z2*, Z9*	1.29″ x 0.080″ Microstrip	Z10	0.430″ x 0.080″ Microstrip
Z3*, Z8*	0.22″ x 0.480″ Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030″, ε_r = 2.55
Z4, Z7	0.22″ x 0.625″ x 0.220″ Taper		

* Line length includes microstrip bends

Figure 1. MRF6V10250HSR3 Test Circuit Schematic

Table 5. MRF6V10250HSR3 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	240 pF Chip Capacitor	ATC100B241JT500XT	ATC
C2, C9, C11	1.8 pF Chip Capacitors	ATC100B1R8CT500XT	ATC
C3	3.3 pF Chip Capacitor	ATC100B3R3CT500XT	ATC
C4, C5	5.1 pF Chip Capacitors	ATC100B5R1CT500XT	ATC
C6, C10, C12	39 pF Chip Capacitors	ATC100B390JT500XT	ATC
C7, C15	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C8	4.7 pF Chip Capacitor	ATC100B4R7CT500XT	ATC
C13, C14	470 μF, 63 V Electrolytic Capacitors	EKME633ELL471MK25S	Multicomp
L1	5 nH, 2 Turn Inductor	A02TKLC	Coilcraft
L2	7 nH, Hand Wound	2T, 18awg	Freescale
R1	10 Ω, 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay
R2	20 Ω, 1 W Chip Resistor	CRCW251220R0FKEA	Vishay

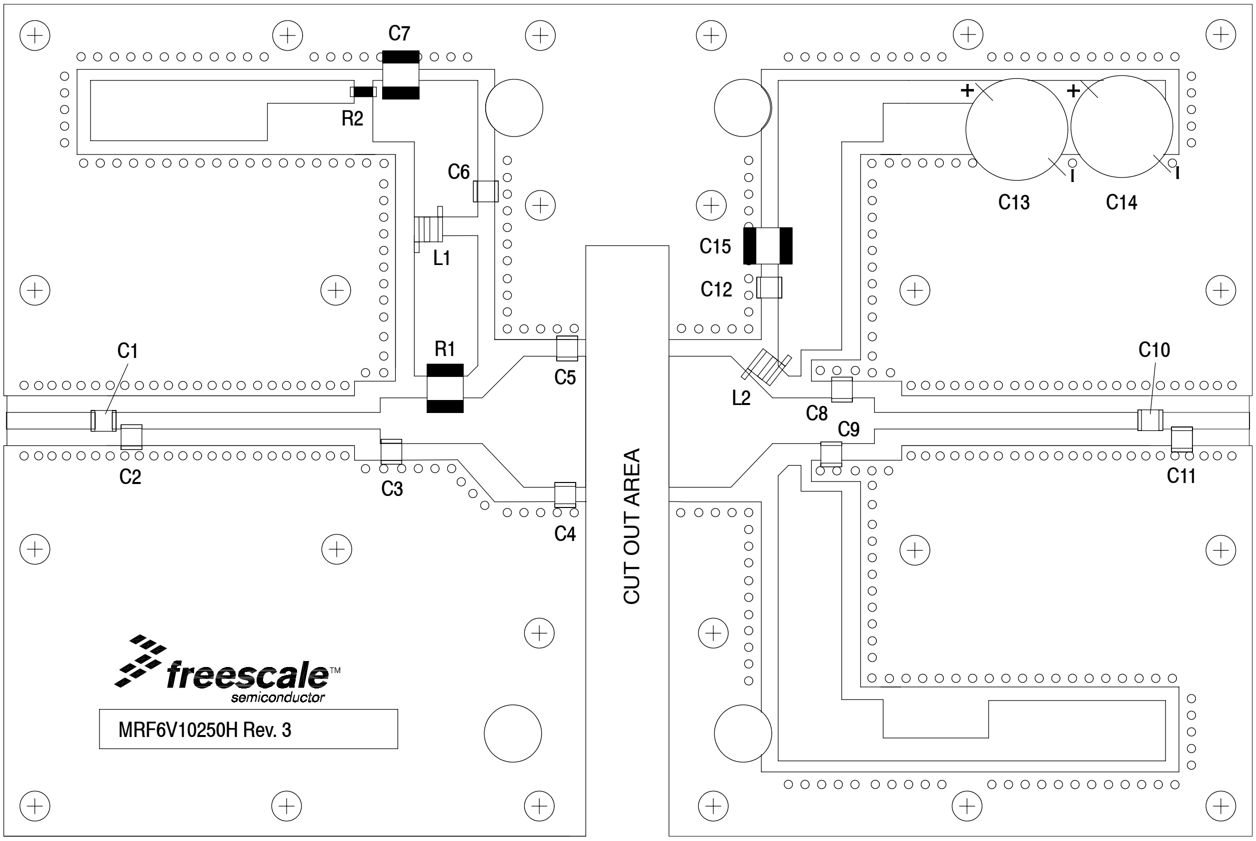


Figure 2. MRF6V10250HSR3 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

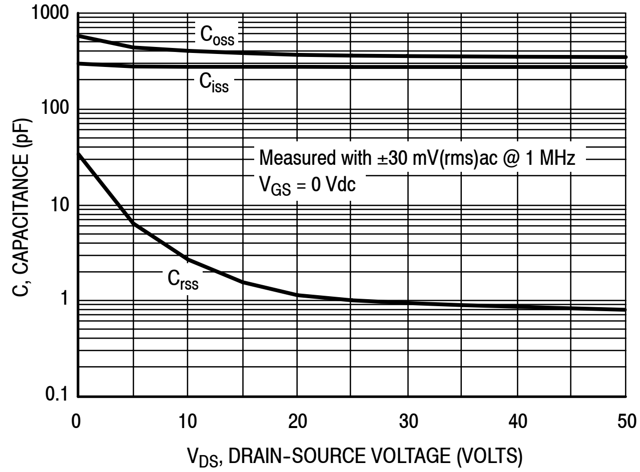


Figure 3. Capacitance versus Drain-Source Voltage

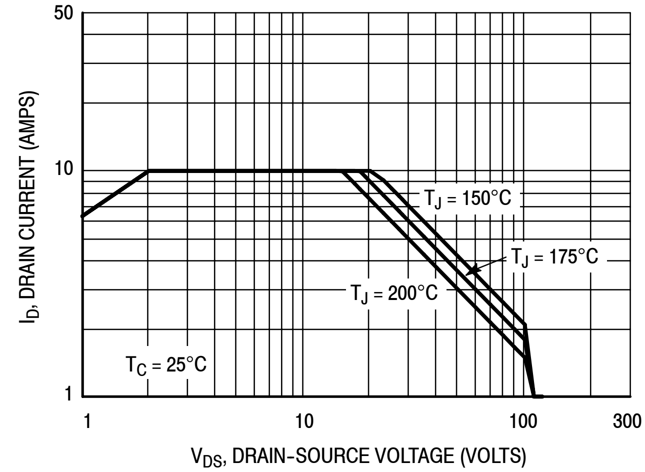


Figure 4. DC Safe Operating Area

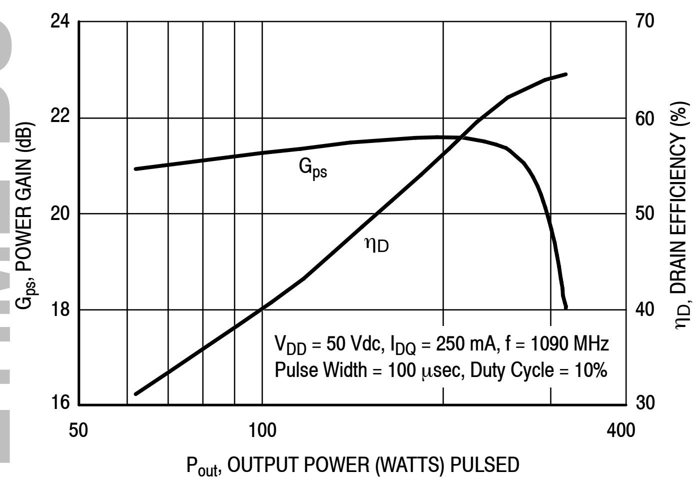


Figure 5. Pulsed Power Gain and Drain Efficiency versus Output Power

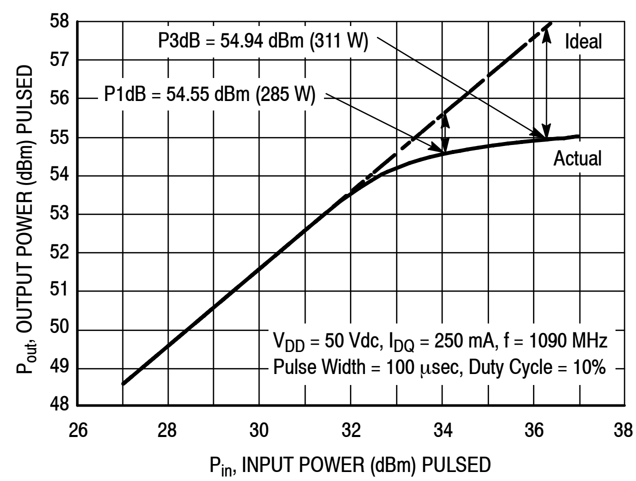


Figure 6. Pulsed Output Power versus Input Power

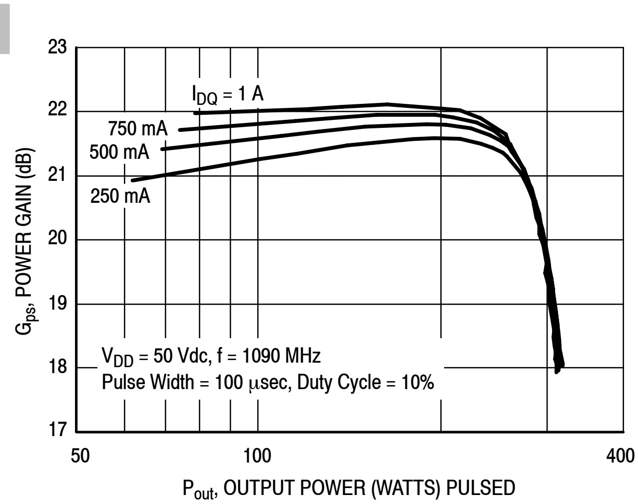


Figure 7. Pulsed Power Gain versus Output Power

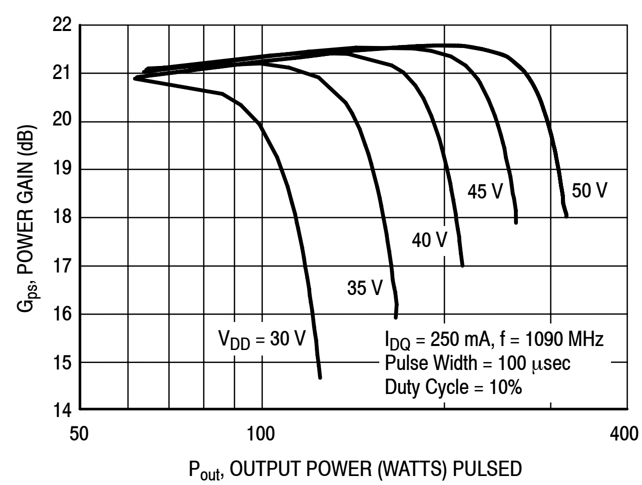


Figure 8. Pulsed Power Gain versus Output Power

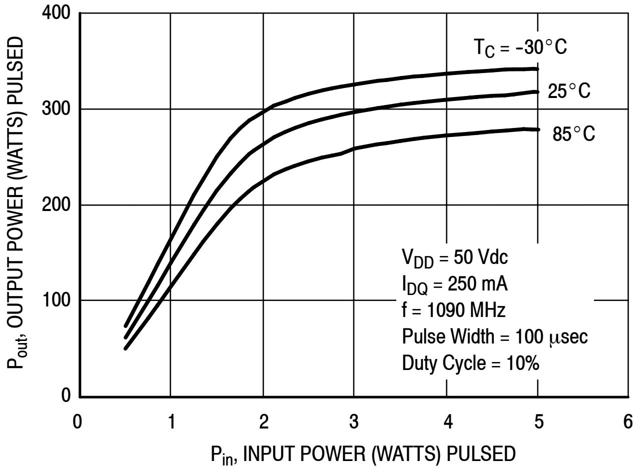


Figure 9. Pulsed Output Power versus Input Power

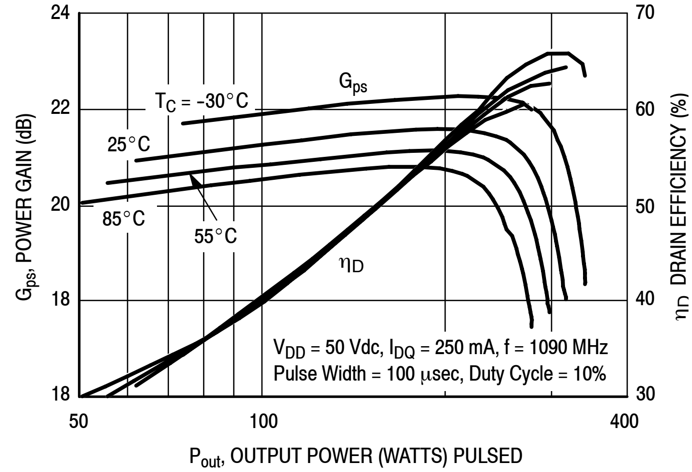
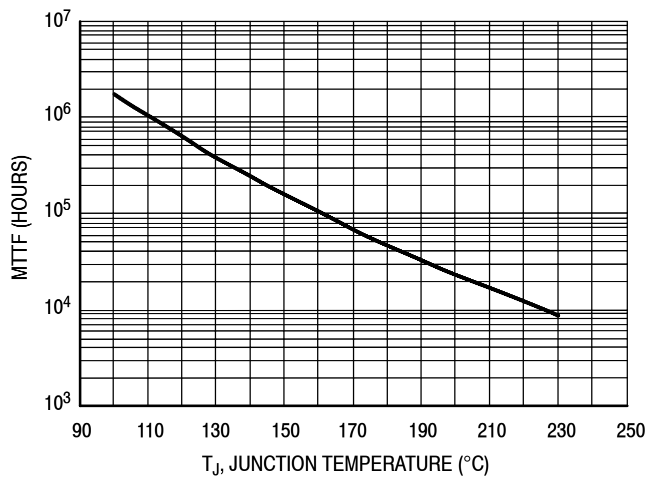


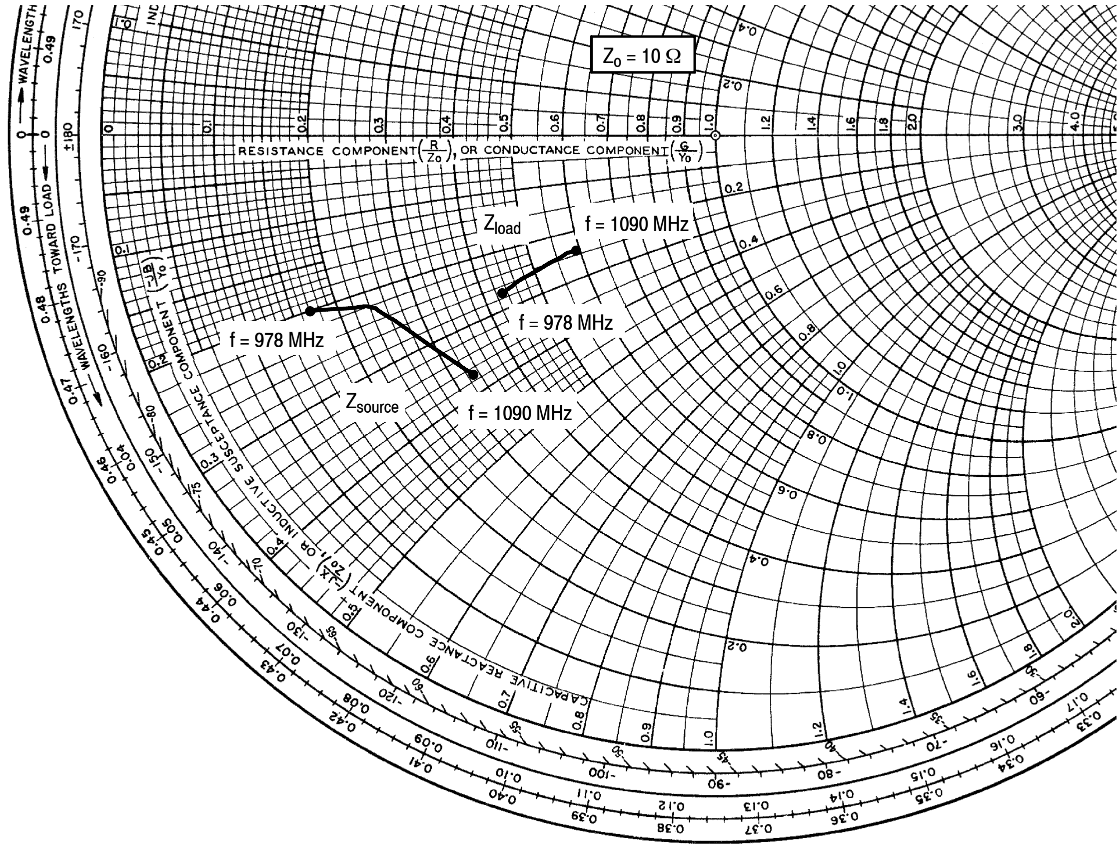
Figure 10. Pulsed Power Gain and Drain Efficiency versus Output Power



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 50 Vdc, P_{out} = 250 W Peak, Pulse Width = 100 μsec, Duty Cycle = 10%, 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 11. MTTF versus Junction Temperature



V_{DD} = 50 Vdc, I_{DQ} = 250 mA, P_{out} = 250 W Peak

f MHz	Z_{source} Ω	Z_{load} Ω
978	1.67 - j2.04	4.3 - j2.72
1030	2.39 - j2.23	5.66 - j2.42
1090	3.26 - j3.72	5.85 - j2.39

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

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

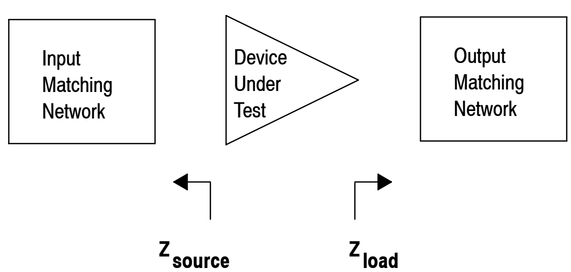
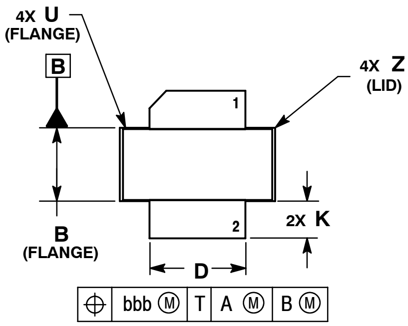
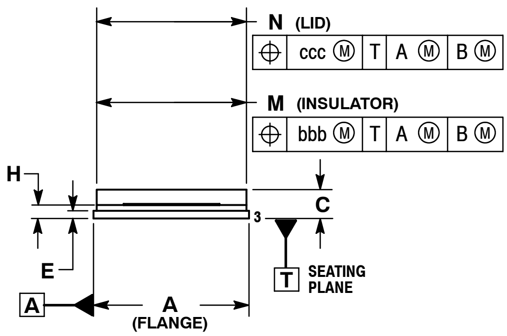
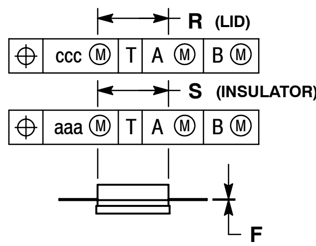


Figure 12. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS







NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

CASE 465A-06
ISSUE H
NI-780S

PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following documents to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator

For Software, do a Part Number search at http://www.freescale.com, and select the “Part Number” link. Go to the Software & Tools tab 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	Feb. 2008	• Initial Release of Data Sheet
1	June 2008	• Added 25 W Avg. to Typical Pulsed Performance bullet, p. 1 • Added Pulsed to Fig. 6, Pulsed Output Power versus Input Power Y axis label to better clarify performance, p. 5 • Corrected Fig. 9 title to read: Pulsed Output Power versus Input Power, p. 6
2	Apr. 2010	• Operating Junction Temperature increased from 200°C to 225°C in Maximum Ratings table and related “Continuous use at maximum temperature will affect MTTF” footnote added, p. 1 • Reporting of pulsed thermal data now shown using the $Z_{\theta JC}$ symbol, p. 1 • Added Electromigration MTTF Calculator availability to Product Software, p. 9

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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:
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