Freescale Semiconductor
Technical Data

Document Number: MRF6V13250H
Rev. 1, 7/2011

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF6V13250HR3
MRF6V13250HSR3

RF Power transistors designed for CW and pulsed applications operating at 1300 MHz. These devices are suitable for use in CW and pulsed applications.

- Typical Pulsed Performance: V_{DD} = 50 Volts, I_{DQ} = 100 mA

Signal Type	P_{out} (W)	f (MHz)	G_{ps} (dB)	η_D (%)	IRL (dB)
Pulsed (200 μsec, 10% Duty Cycle)	250 Peak	1300	22.7	57.0	-18

- Typical CW Performance: V_{DD} = 50 Volts, I_{DQ} = 10 mA, T_C = 61°C

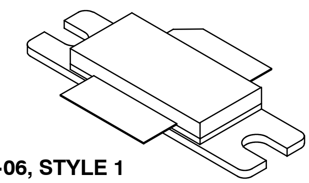
Signal Type	P_{out} (W)	f (MHz)	G_{ps} (dB)	η_D (%)	IRL (dB)
CW	230 CW	1300	20.0	53.0	-25

- Capable of Handling a Load Mismatch of 10:1 VSWR, @ 50 Vdc, 1300 MHz at all Phase Angles, 250 Watts Pulsed Peak Power, 10% Duty Cycle, 200 μsec

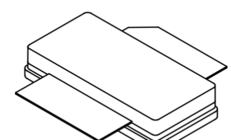
Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 50 V_{DD} Operation
- Characterized from 20 V to 50 V for Extended Power Range
- Integrated ESD Protection
- Greater Negative Gate-Source Voltage Range for Improved Class C Operation
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units, 56 mm Tape Width, 13 inch Reel. For R5 Tape and Reel options, see p. 12.

1300 MHz, 250 W, 50 V
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF6V13250HR3



CASE 465A-06, STYLE 1
NI-780S
MRF6V13250HSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +120	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
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	476 2.38	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Pulsed: Case Temperature 65°C, 250 W Pulsed, 200 μsec Pulse Width, 10% Duty Cycle, 50 Vdc, I_{DQ} = 100 mA, 1300 MHz CW: Case Temperature 77°C, 235 W CW, 50 Vdc, I_{DQ} = 10 mA, 1300 MHz	 $Z_{\theta JC}$ $R_{\theta JC}$	 0.07 0.42	°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}	—	—	1	μAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 50 mA)	$V_{(BR)DSS}$	120	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 90 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	20	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 640 μAdc)	$V_{GS(th)}$	1.0	1.8	2.7	Vdc
Gate Quiescent Voltage (V_{DD} = 50 Vdc, I_D = 100 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2.0	2.4	3.0	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.58 Adc)	$V_{DS(on)}$	0.1	0.25	0.3	Vdc
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.2	—	pF
Output Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	58	—	pF
Input Capacitance (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	340	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 100 mA, P_{out} = 250 W Peak (25 W Avg.), f = 1300 MHz Pulsed, 200 μsec Pulse Width, 10% Duty Cycle					
Power Gain	G_{ps}	21.5	22.7	24.0	dB
Drain Efficiency	η_D	53.5	57.0	—	%
Input Return Loss	IRL	—	-18	-9	dB
Typical CW Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 10 mA, P_{out} = 230 W CW, f = 1300 MHz, T_C = 61°C					
Power Gain	G_{ps}	—	20.0	—	dB
Drain Efficiency	η_D	—	53.0	—	%
Input Return Loss	IRL	—	-25	—	dB
Load Mismatch (In Freescale Application Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 100 mA, P_{out} = 250 W Peak (25 W Avg.), f = 1300 MHz, Pulsed, 200 μsec Pulse Width, 10% Duty Cycle					
VSWR 10:1 at all Phase Angles	Ψ	No Degradation in Output Power			

1. Part internally input matched.

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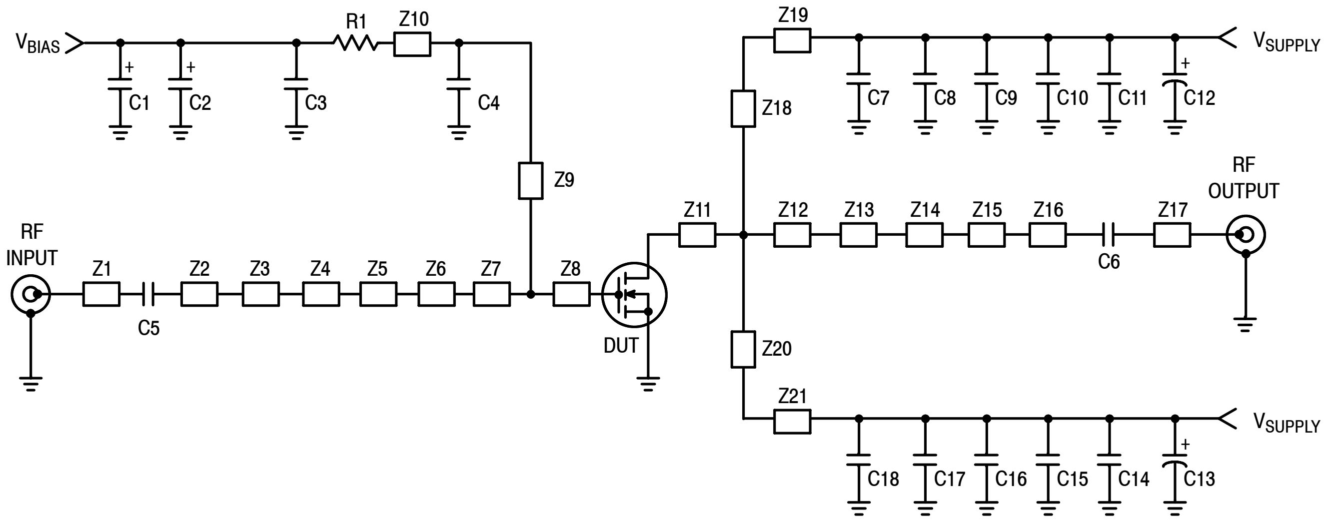

Z1	0.447″ x 0.063″ Microstrip	Z11	0.162″ x 1.160″ Microstrip
Z2	0.030″ x 0.084″ Microstrip	Z12	0.419″ x 1.160″ Microstrip
Z3	0.120″ x 0.063″ Microstrip	Z13	0.468″ x 0.994″ Microstrip
Z4	0.855″ x 0.293″ Microstrip	Z14	0.131″ x 0.472″ Microstrip
Z5	0.369″ x 0.825″ Microstrip	Z15	0.264″ x 0.222″ Microstrip
Z6	0.203″ x 0.516″ Microstrip	Z16	0.500″ x 0.111″ Microstrip
Z7	0.105″ x 0.530″ Microstrip	Z17	0.291″ x 0.063″ Microstrip
Z8	0.105″ x 0.530″ Microstrip	Z18, Z20	0.105″ x 0.388″ Microstrip
Z9*	0.116″ x 0.050″ Microstrip	Z19*, Z21*	0.854″ x 0.052″ Microstrip
Z10	0.122″ x 0.050″ Microstrip		

*Line length includes microstrip bends.

Figure 1. MRF6V13250HR3(HSR3) Test Circuit Schematic — 1300 MHz

Table 5. MRF6V13250HR3(HSR3) Test Circuit Component Designations and Values — 1300 MHz

Part	Description	Part Number	Manufacturer
C1, C2	22 μF, 35 V Tantalum Capacitors	T491X226K035AT	Kemet
C3, C11, C14	0.1 μF, 50 V Chip Capacitors	CDR33BX104AKWS	AVX
C4, C6, C7, C18	100 pF Chip Capacitors	ATC800B101JT500XT	ATC
C5	4.7 pF Chip Capacitor	ATC100B4R7CT500XT	ATC
C8, C17	1000 pF Chip Capacitors	ATC100B102JT50XT	ATC
C9, C16	1000 pF Chip Capacitors	ATC700B102FT50XT	ATC
C10, C15	10K pF Chip Capacitors	ATC200B103KT50XT	ATC
C12, C13	470 μF, 63 V Electrolytic Capacitors	MCGPR63V477M13X26-RH	Multicomp
R1	15 Ω, 1/4 W Chip Resistor	CRCW120615R0FKEA	Vishay
PCB	0.030″, ε_r = 3.50	RO4350B	Rogers

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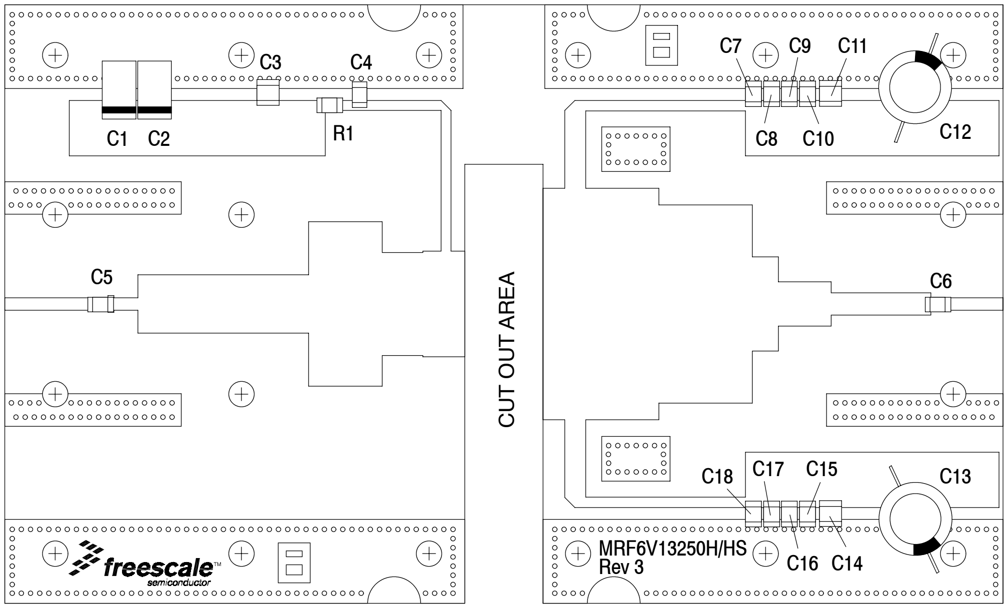

Figure 2. MRF6V13250HR3(HSR3) Test Circuit Component Layout — 1300 MHz

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TYPICAL CHARACTERISTICS — PULSED

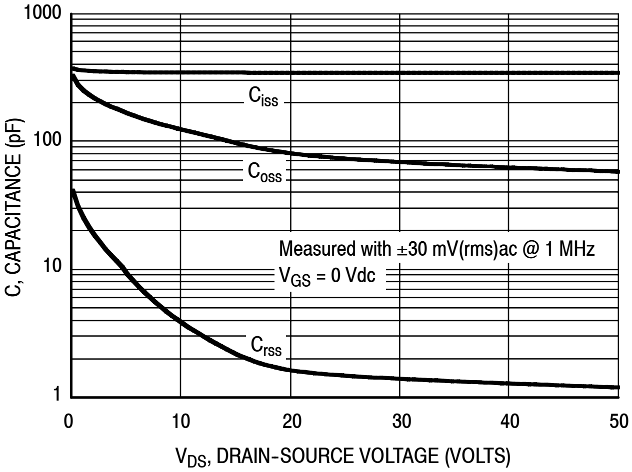

Figure 3. Capacitance versus Drain-Source Voltage

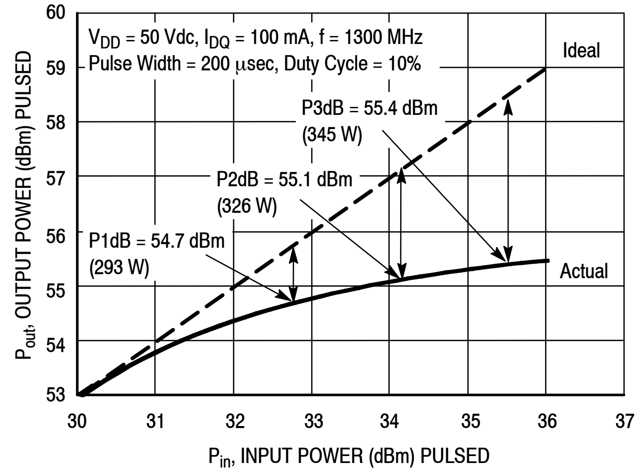

Figure 4. Pulsed Output Power versus Input Power

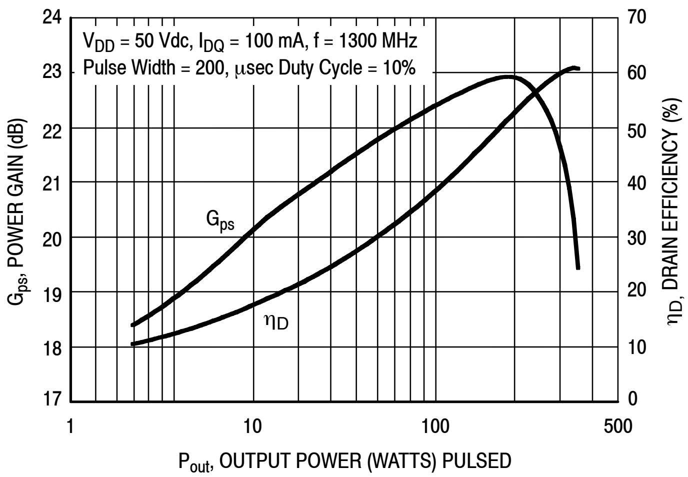

Figure 5. Pulsed Power Gain and Drain Efficiency versus Output Power

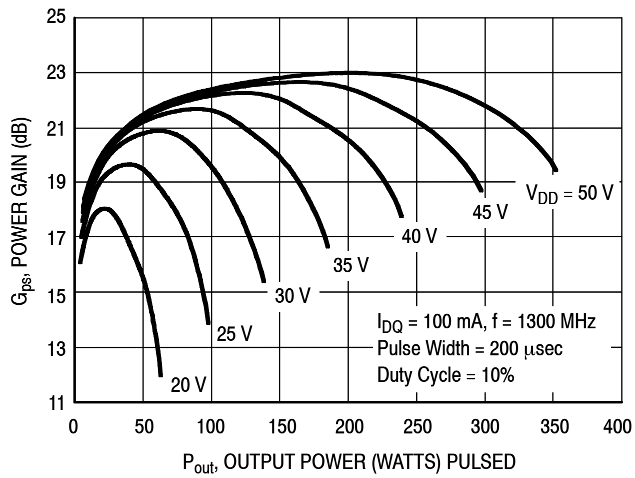

Figure 6. Pulsed Power Gain versus Output Power

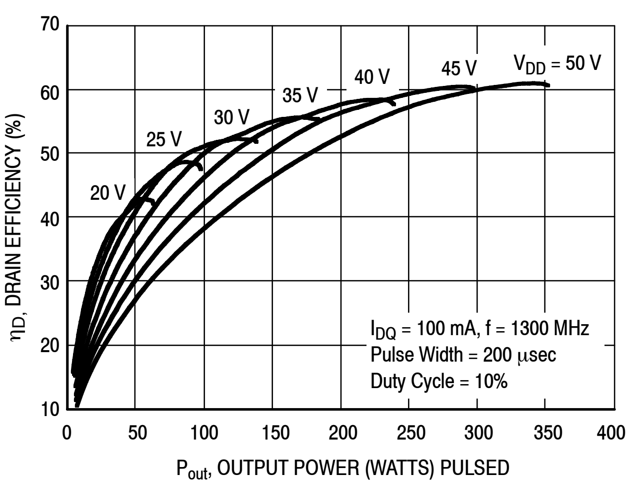

Figure 7. Pulsed Efficiency versus Output Power

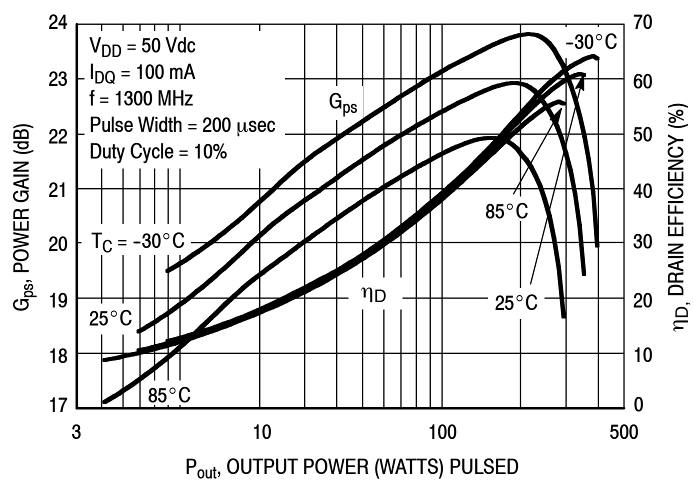

Figure 8. Pulsed Power Gain and Drain Efficiency versus Output Power

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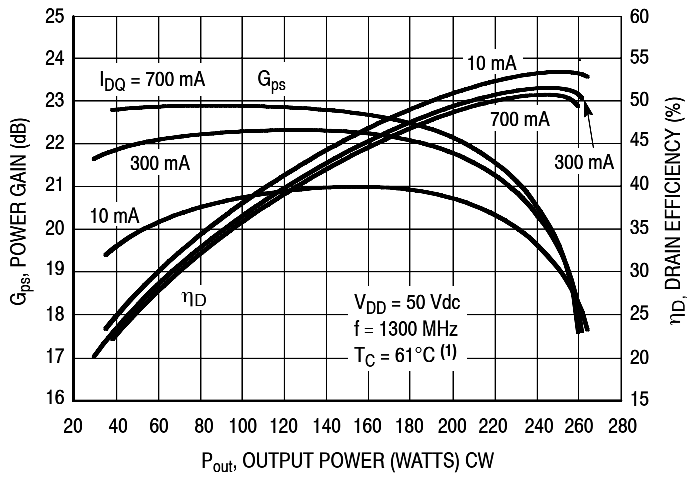
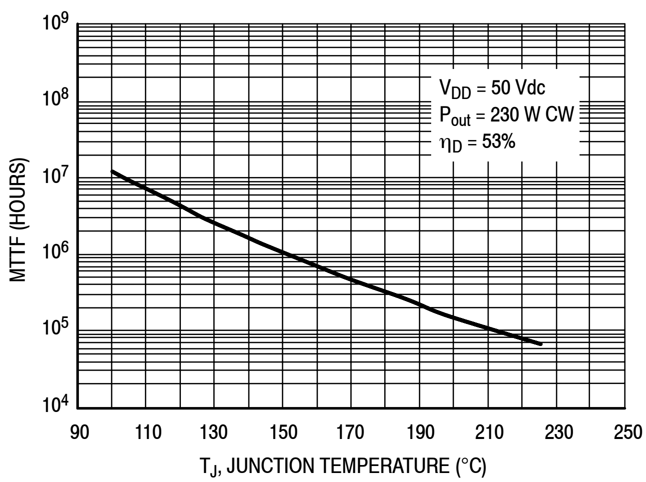
TYPICAL CHARACTERISTICS — CW



1. Data for graph was collected in a water cooled test fixture. The water inlet temperature = 25°C.

Figure 9. CW Power Gain and Drain Efficiency versus Output Power



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

Figure 10. MTTF versus Junction Temperature — CW

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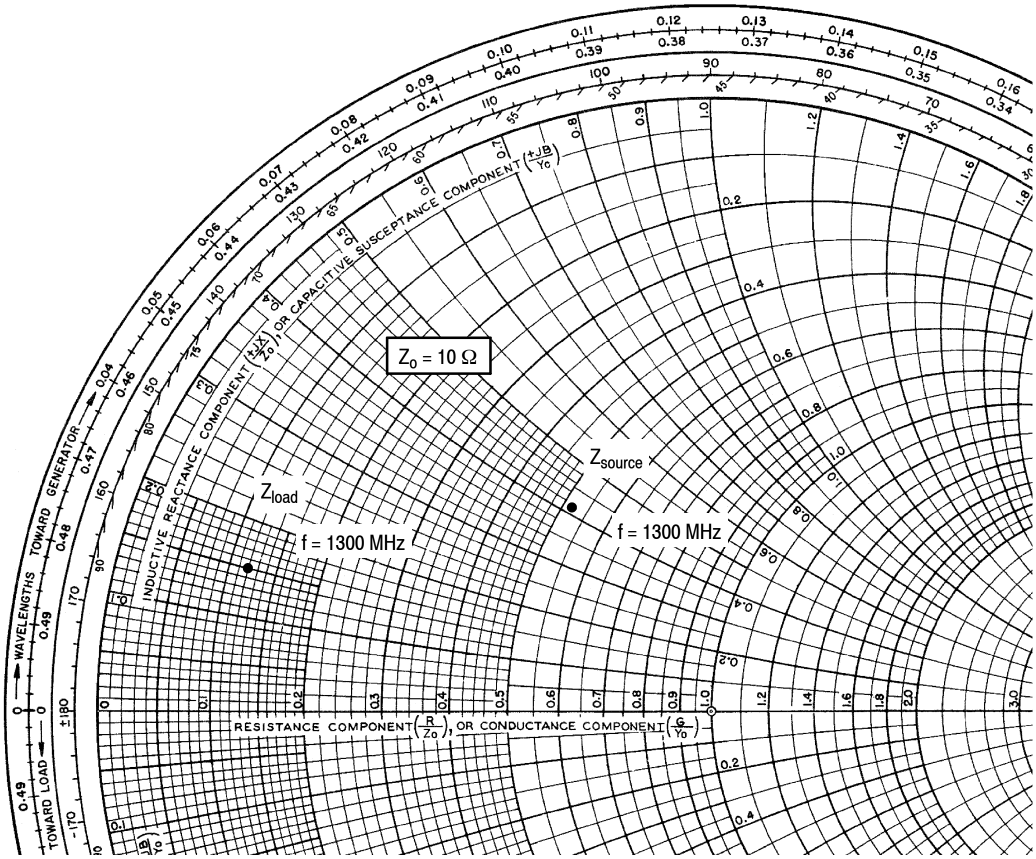

V_{DD} = 50 Vdc, I_{DQ} = 100 mA, P_{out} = 250 W Peak

f MHz	Z_{source} Ω	Z_{load} Ω
1300	5.32 + j4.11	1.17 + j1.48

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

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

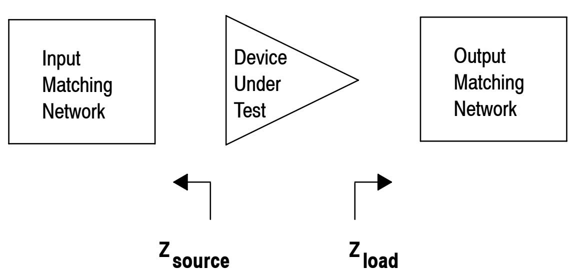

Figure 11. Series Equivalent Source and Load Impedance — Pulsed

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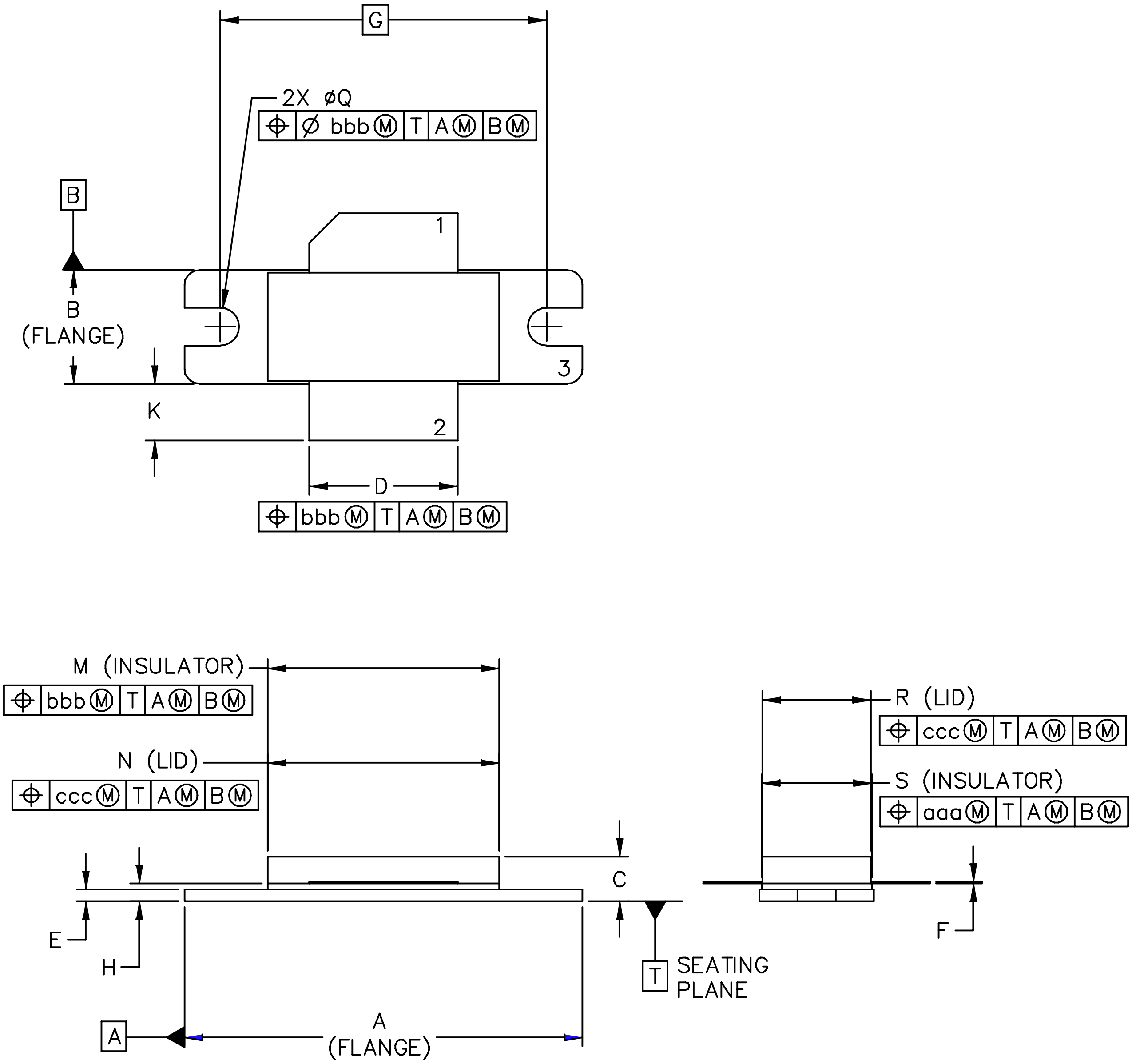

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3. DELETED

4. DIMENSION H IS MEASURED .030 (.762) AWAY FROM PACKAGE BODY.

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

DIM	INCH MIN		INCH MAX	MILLIMETER MIN		MILLIMETER MAX	DIM	INCH MIN		INCH MAX	MILLIMETER MIN		MILLIMETER MAX
A	1.335	–	1.345	33.91	–	34.16	R	.365	–	.375	9.27	–	9.53
B	.380	–	.390	9.65	–	9.91	S	.365	–	.375	9.27	–	9.52
C	.125	–	.170	3.18	–	4.32	aaa	–	.005	–	–	0.127	–
D	.495	–	.505	12.57	–	12.83	bbb	–	.010	–	–	0.254	–
E	.035	–	.045	0.89	–	1.14	ccc	–	.015	–	–	0.381	–
F	.003	–	.006	0.08	–	0.15	–	–	–	–	–	–	–
G	1.100 BSC			27.94 BSC			–	–	–	–	–	–	–
H	.057	–	.067	1.45	–	1.7	–	–	–	–	–	–	–
K	.170	–	.210	4.32	–	5.33	–	–	–	–	–	–	–
M	.774	–	.786	19.66	–	19.96	–	–	–	–	–	–	–
N	.772	–	.788	19.6	–	20	–	–	–	–	–	–	–
Q	ø.118	–	ø.138	ø3	–	ø3.51	–	–	–	–	–	–	–

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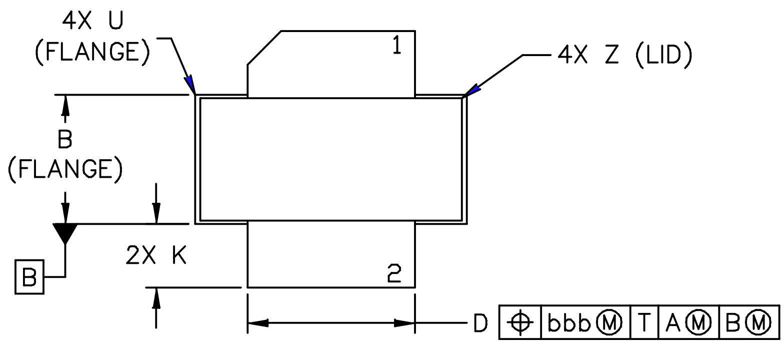

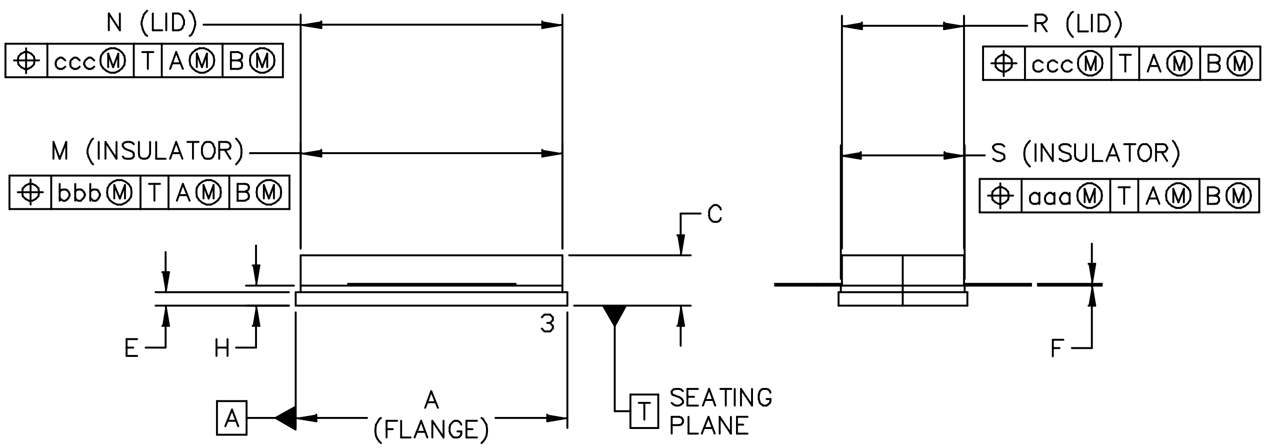

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STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

DIM	INCH MIN		INCH MAX	MILLIMETER MIN		MILLIMETER MAX	DIM	INCH MIN		INCH MAX	MILLIMETER MIN		MILLIMETER MAX
A	.805	–	.815	20.45	–	20.7	U	–	–	.040	–	–	1.02
B	.380	–	.390	9.65	–	9.91	Z	–	–	.030	–	–	0.76
C	.125	–	.170	3.18	–	4.32	aaa	–	.005	–	–	0.127	–
D	.495	–	.505	12.57	–	12.83	bbb	–	.010	–	–	0.254	–
E	.035	–	.045	0.89	–	1.14	ccc	–	.015	–	–	0.381	–
F	.003	–	.006	0.08	–	0.15	–	–	–	–	–	–	–
H	.057	–	.067	1.45	–	1.7	–	–	–	–	–	–	–
K	.170	–	.210	4.32	–	5.33	–	–	–	–	–	–	–
M	.774	–	.786	19.61	–	20.02	–	–	–	–	–	–	–
N	.772	–	.788	19.61	–	20.02	–	–	–	–	–	–	–
R	.365	–	.375	9.27	–	9.53	–	–	–	–	–	–	–
S	.365	–	.375	9.27	–	9.52	–	–	–	–	–	–	–

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PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following documents and software 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
- RF High Power Model
- .s2p File

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.

R5 TAPE AND REEL OPTION

R5 Suffix = 50 Units, 56 mm Tape Width, 13 inch Reel.

The R5 tape and reel option for MRF6V13250H and MRF6V13250HS parts will be available for 2 years after release of MRF6V13250H and MRF6V13250HS. Freescale Semiconductor, Inc. reserves the right to limit the quantities that will be delivered in the R5 tape and reel option. At the end of the 2 year period customers who have purchased these devices in the R5 tape and reel option will be offered MRF6V13250H and MRF6V13250HS in the R3 tape and reel option.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	June 2011	• Initial Release of Data Sheet
1	July 2011	• Added CW information to data sheet including: – Typical Performance Frequency tables, p. 1, 2 – CW Capable bullet and Thermal Characteristics, p. 1 – Fig. 9, CW Power Gain and Drain Efficiency versus Output Power, p. 6 – Fig. 10, MTTF versus Junction Temperature – CW, p. 6

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