Document Number: MRF8S9100H
Rev. 0, 9/2009

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF8S9100HR3
MRF8S9100HSR3

920-960 MHz, 72 W CW, 28 V
GSM, GSM EDGE
LATERAL N-CHANNEL
RF POWER MOSFETs

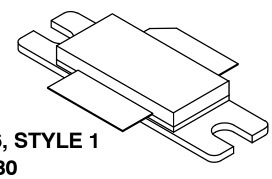
Designed for GSM and GSM EDGE base station applications with frequencies from 865 to 960 MHz. Can be used in Class AB and Class C for all typical cellular base station modulation formats.

- Typical GSM Performance: V_{DD} = 28 Volts, I_{DQ} = 500 mA, P_{out} = 72 Watts CW

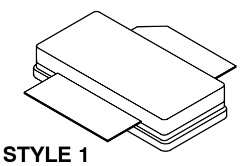
Frequency	G_{ps} (dB)	η_D (%)
920 MHz	19.3	51.6
940 MHz	19.3	52.9
960 MHz	19.1	54.1

- Capable of Handling 10:1 VSWR, @ 32 Vdc, 940 MHz, 133 Watts CW Output Power (3 dB Input Overdrive from Rated P_{out})
- Typical P_{out} @ 1 dB Compression Point ≃ 108 Watts CW
- Typical GSM EDGE Performance: V_{DD} = 28 Volts, I_{DQ} = 700 mA, P_{out} = 45 Watts Avg.

Frequency	G_{ps} (dB)	η_D (%)	SR1 @ 400 kHz (dBc)	SR2 @ 600 kHz (dBc)	EVM (% rms)
920 MHz	19.1	43	-64.1	-74.5	1.8
940 MHz	19.1	44	-63.6	-74.6	2.0
960 MHz	19.0	45	-62.8	-75.1	2.3



CASE 465-06, STYLE 1
NI-780
MRF8S9100HR3



CASE 465A-06, STYLE 1
NI-780S
MRF8S9100HSR3

Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source S-Parameters
- Internally Matched for Ease of Use
- 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.

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +70	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +10	Vdc
Operating Voltage	V_{DD}	32, +0	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

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.

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 100 W CW, 28 Vdc, I_{DQ} = 500 mA Case Temperature 81°C, 72 W CW, 28 Vdc, I_{DQ} = 500 mA Case Temperature 82°C, 45 W CW, 28 Vdc, I_{DQ} = 700 mA	$R_{\theta JC}$	 0.60 0.65 0.69	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (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					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 70 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}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 460 μAdc)	$V_{GS(th)}$	1.4	2.2	2.9	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 500 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2.1	2.9	3.6	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.7 Adc)	$V_{DS(on)}$	0.1	0.17	0.3	Vdc
Functional Tests (3) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 500 mA, P_{out} = 72 W CW, f = 920 MHz					
Power Gain	G_{ps}	18	19.3	23	dB
Drain Efficiency	η_D	50	51.6	—	%
Input Return Loss	IRL	—	-12.4	-9	dB
P_{out} @ 1 dB Compression Point, CW	P1dB	100	—	—	W

Typical Broadband Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 500 mA, P_{out} = 72 W CW

Frequency	G_{ps} (dB)	η_D (%)	IRL (dB)
920 MHz	19.3	51.6	-12.4
940 MHz	19.3	52.9	-14.3
960 MHz	19.1	54.1	-12.2

1. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access 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.
3. Part internally input matched.

(continued)

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Typical Performances (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 500 mA, 920-960 MHz Bandwidth					
P_{out} @ 1 dB Compression Point, CW	P1dB	—	108	—	W
IMD Symmetry @ 100 W PEP, P_{out} where IMD Third Order Intermodulation ≅ 30 dBc (Delta IMD Third Order Intermodulation between Upper and Lower Sidebands > 2 dB)	IMD_{sym}	—	4	—	MHz
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	30	—	MHz
Gain Flatness in 40 MHz Bandwidth @ P_{out} = 72 W CW	G_F	—	0.13	—	dB
Gain Variation over Temperature (-30°C to +85°C)	ΔG	—	0.02	—	dB/°C
Output Power Variation over Temperature (-30°C to +85°C)	ΔP1dB	—	0.005	—	dBm/°C

Typical GSM EDGE Performances (In Freescale GSM EDGE Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 700 mA, P_{out} = 45 W Avg., 920-960 MHz EDGE Modulation

Frequency	G_{ps} (dB)	η_D (%)	SR1 @ 400 kHz (dBc)	SR2 @ 600 kHz (dBc)	EVM (% rms)
920 MHz	19.1	43	-64.1	-74.5	1.8
940 MHz	19.1	44	-63.6	-74.6	2.0
960 MHz	19.0	45	-62.8	-75.1	2.3

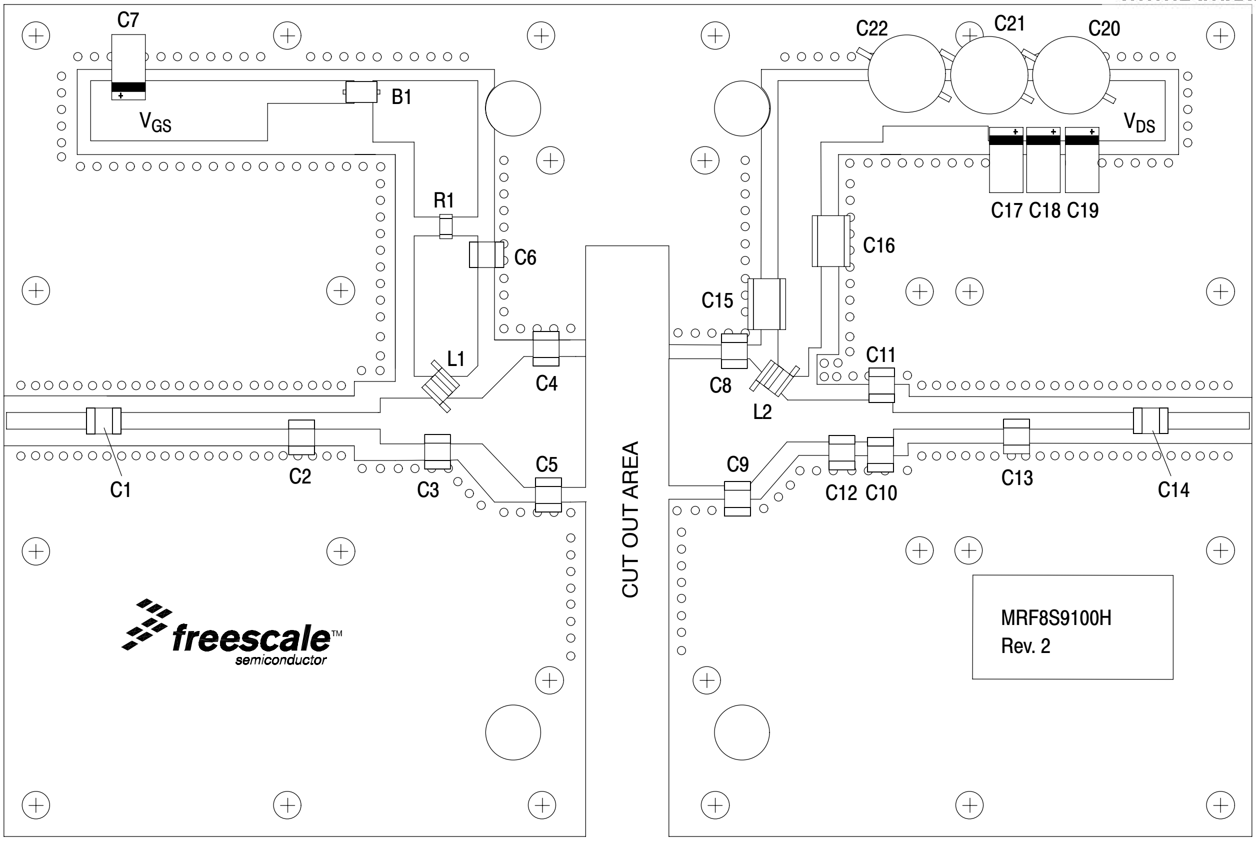


Figure 1. MRF8S9100HR3(HSR3) Test Circuit Component Layout

Table 5. MRF8S9100HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Short RF Bead	2743019447	Fair-Rite
C1, C6	47 pF Chip Capacitors	ATC100B470JT500XT	ATC
C2	5.6 pF Chip Capacitor	ATC100B5R6BT500XT	ATC
C3	7.5 pF Chip Capacitor	ATC100B7R5BT500XT	ATC
C4, C5	9.1 pF Chip Capacitors	ATC100B9R1BT500XT	ATC
C7, C17, C18, C19	10 μF, 35 V Tantalum Capacitors	T491D106K035AT	Kemet
C8, C9	13 pF Chip Capacitors	ATC100B130BT500XT	ATC
C10, C11	2.7 pF Chip Capacitors	ATC100B2R7BT500XT	ATC
C12	6.2 pF Chip Capacitor	ATC100B6R2BT500XT	ATC
C13	1.8 pF Chip Capacitor	ATC100B1R8BT500XT	ATC
C14	20 pF Chip Capacitor	ATC100B200JT500XT	ATC
C15, C16	0.56 μF, 50 V Chip Capacitors	C1825C564J5RAC-TU	Kemet
C20, C21, C22	470 μF, 63 V Electrolytic Capacitors	MCGPR63V477M13X26-RH	Multicomp
L1, L2	12.5 nH, 4 Turn Inductors	A04TJLC	Coilcraft
R1	0 Ω, 3 A Chip Resistor	CRCW12060000Z0EA	Vishay
PCB	0.030″, ε_r = 2.55	AD255A-0300-55-11	Arlon

TYPICAL CHARACTERISTICS

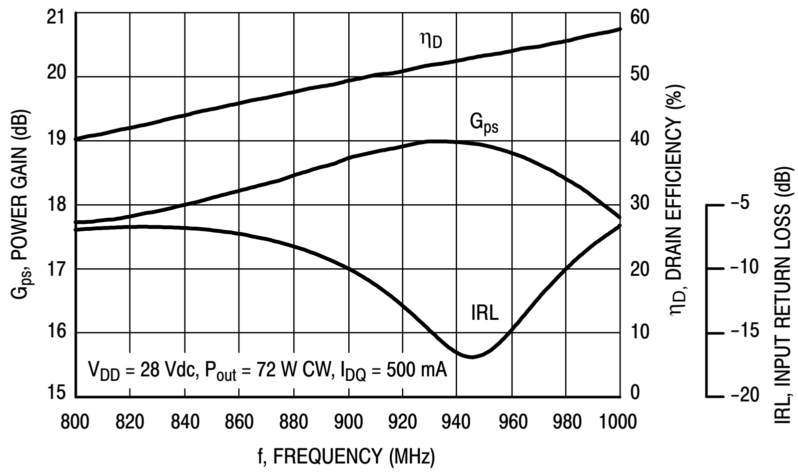


Figure 2. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 72 Watts CW

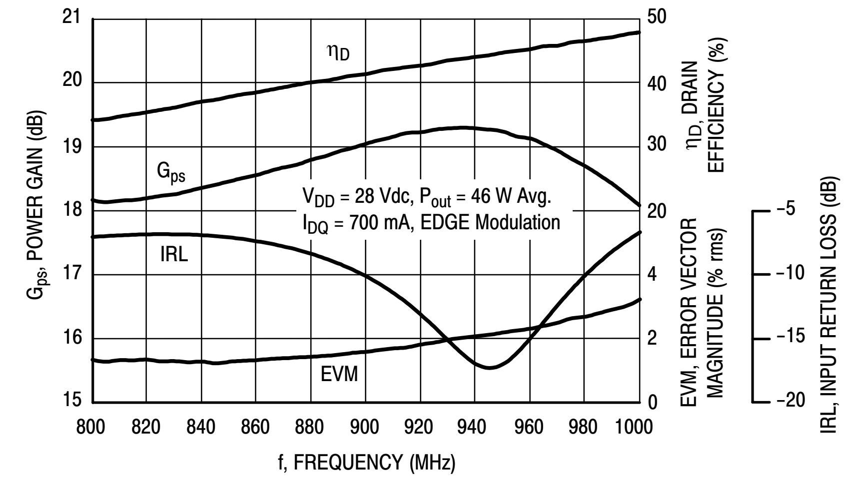


Figure 3. Power Gain, Input Return Loss, EVM and Drain Efficiency versus Frequency @ P_{out} = 46 Watts Avg.

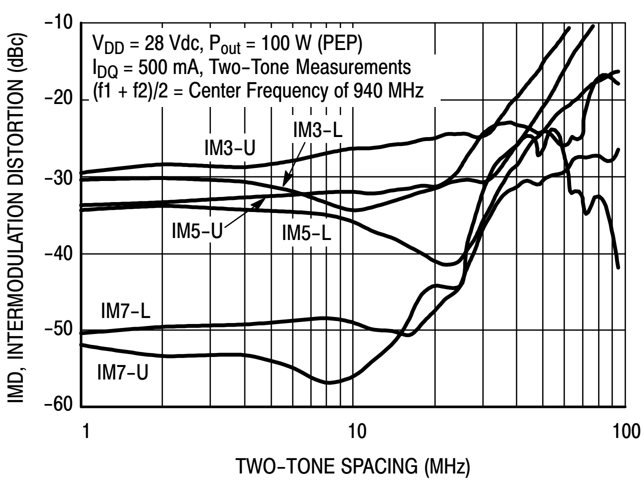


Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing

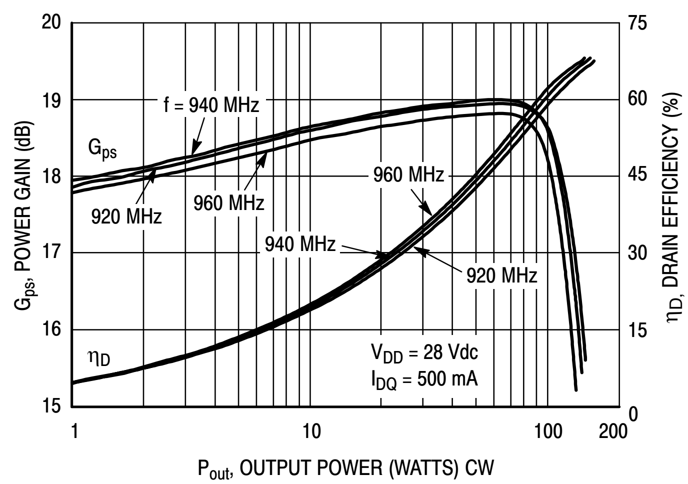


Figure 5. Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS

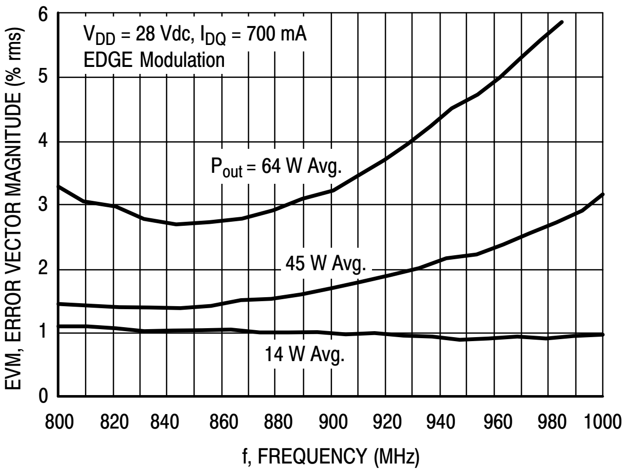


Figure 6. EVM versus Frequency

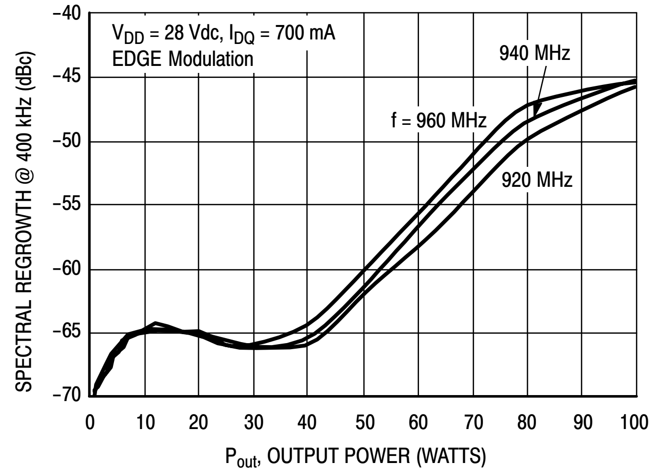


Figure 7. Spectral Regrowth at 400 kHz versus Output Power

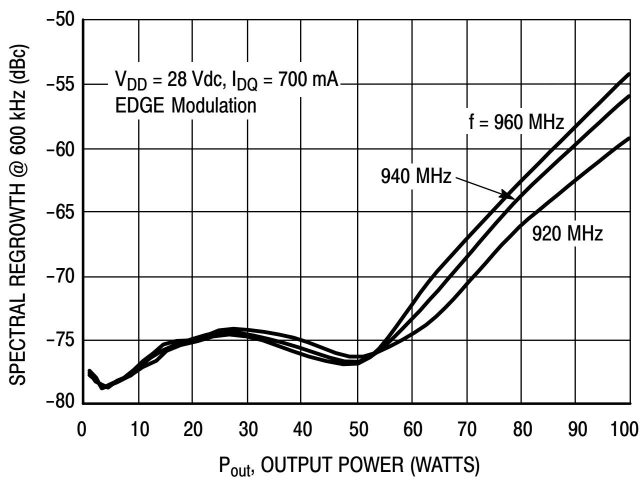


Figure 8. Spectral Regrowth at 600 kHz versus Output Power

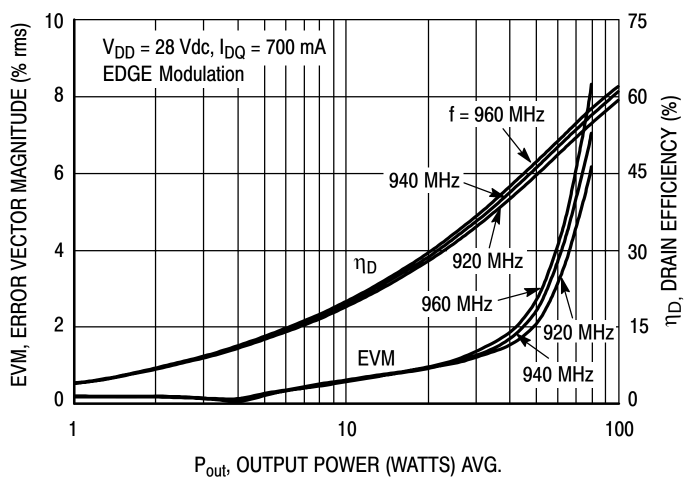


Figure 9. EVM and Drain Efficiency versus Output Power

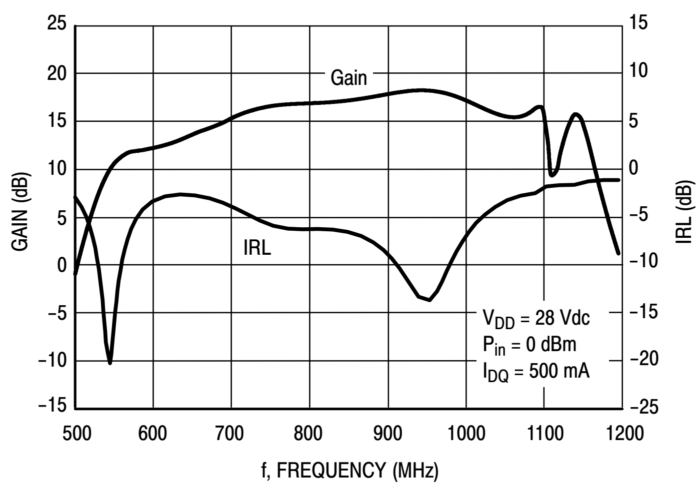


Figure 10. Broadband Frequency Response

GSM TEST SIGNAL

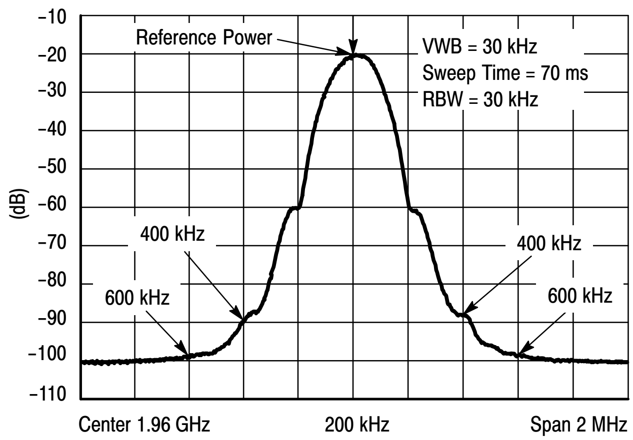


Figure 11. EDGE Spectrum

V_{DD} = 28 Vdc, I_{DQ} = 500 mA, P_{out} = 72 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
820	3.81 - j1.72	1.61 - j0.48
840	3.99 - j1.80	1.62 - j0.34
860	4.13 - j1.97	1.62 - j0.21
880	4.20 - j2.22	1.63 - j0.09
900	4.14 - j2.49	1.62 + j0.02
920	3.96 - j2.74	1.60 + j0.12
940	3.67 - j2.95	1.57 + j0.22
960	3.31 - j3.07	1.53 + j0.32
980	2.91 - j3.09	1.47 + j0.42

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

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

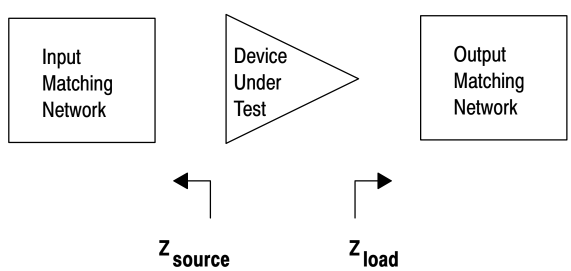
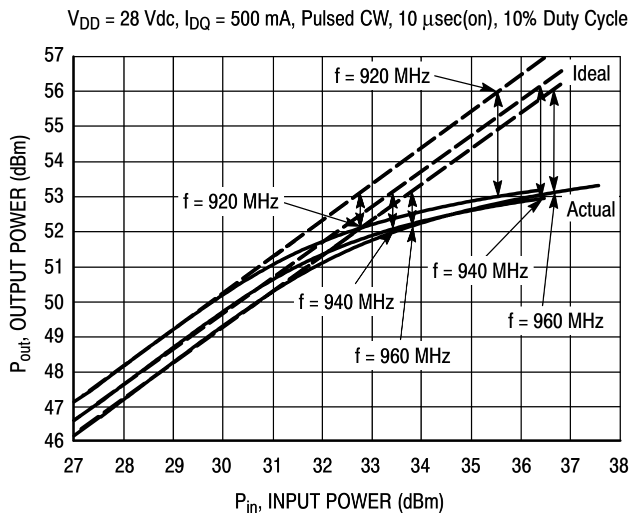


Figure 12. Series Equivalent Source and Load Impedance

ALTERNATIVE PEAK TUNE LOAD PULL CHARACTERISTICS



NOTE: Load Pull Test Fixture Tuned for Peak P1dB Output Power @ 28 V

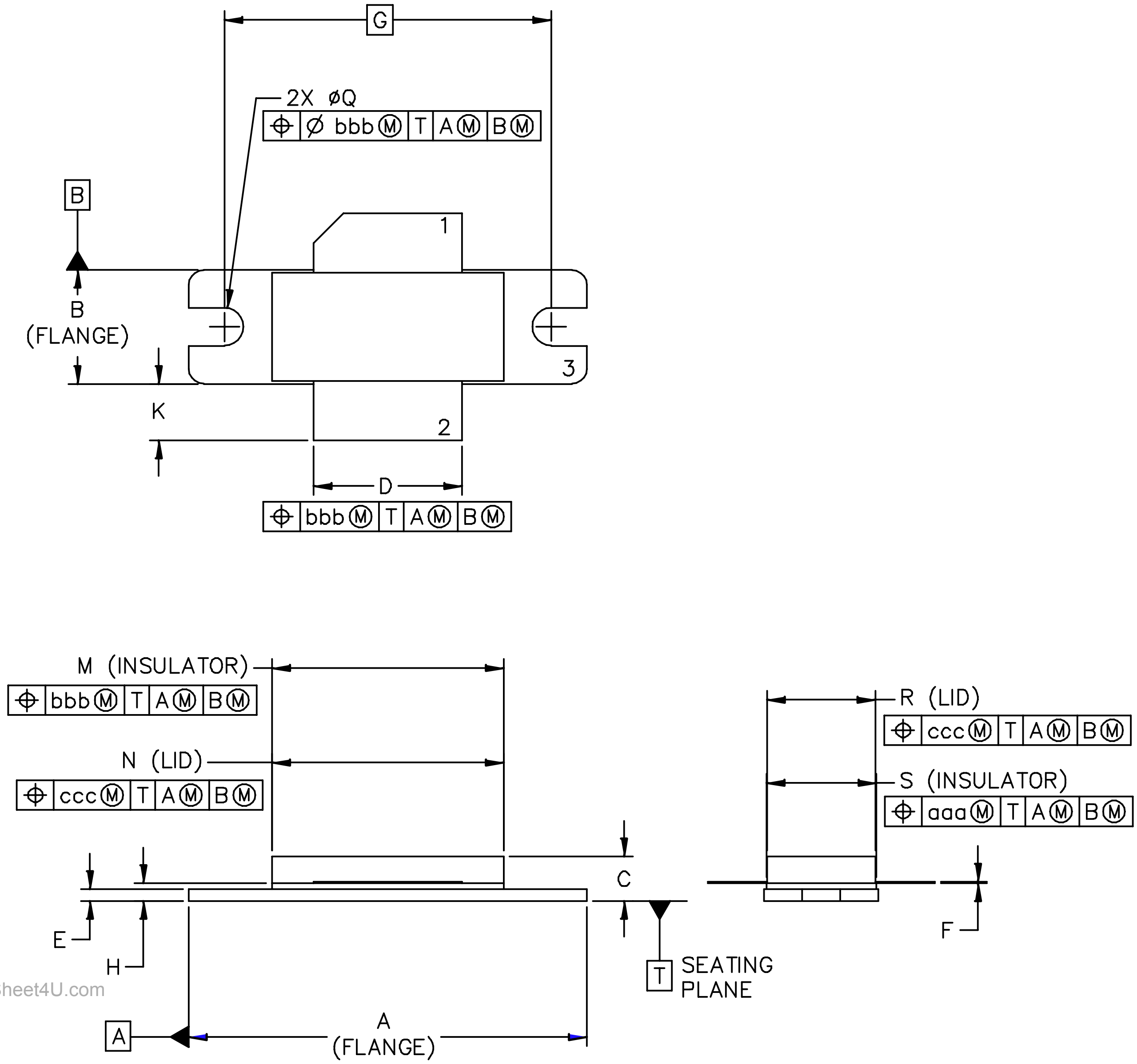
f (MHz)	P1dB		P3dB	
	Watts	dBm	Watts	dBm
920	166	52.2	199	53.0
940	158	52.0	195	52.9
960	166	52.2	209	53.2

Test Impedances per Compression Level

f (MHz)		Z_{source} Ω	Z_{load} Ω
920	P1dB	3.96 - j2.74	1.60 + j0.12
940	P1dB	3.67 - j2.95	1.57 + j0.22
960	P1dB	3.31 - j3.07	1.53 + j0.32

Figure 13. Pulsed CW Output Power versus Input Power @ 28 V

PACKAGE DIMENSIONS



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NOTES:

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2. CONTROLLING DIMENSION: INCH.
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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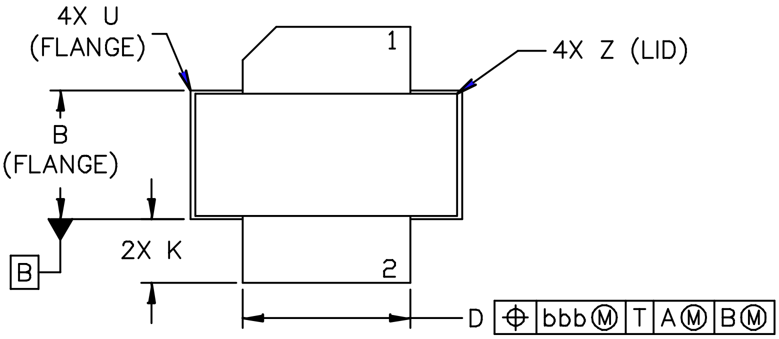

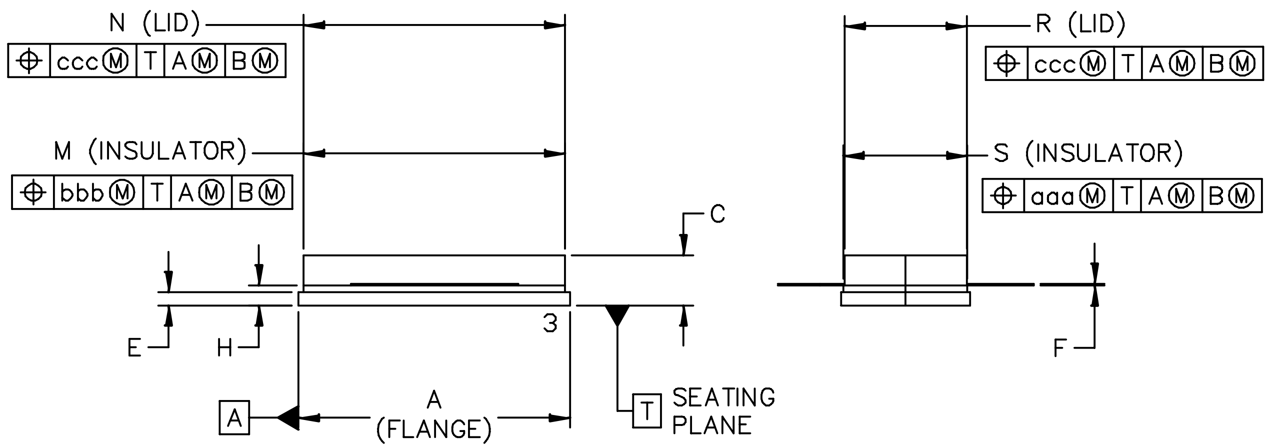

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STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

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, TOOLS AND SOFTWARE

Refer to the following documents, tools 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 and Tools, 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	Sept. 2009	• Initial Release of Data Sheet

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