Freescale Semiconductor
Technical Data

Document Number: MRF8S21100H
Rev. 1, 3/2011

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF8S21100HR3
MRF8S21100HSR3

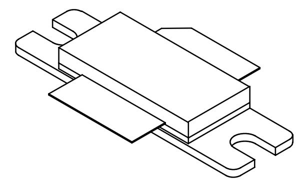
Designed for W-CDMA and LTE base station applications with frequencies from 2110 to 2170 MHz. Can be used in Class AB and Class C for all typical cellular base station modulation formats.

- Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 700 mA, P_{out} = 24 Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.

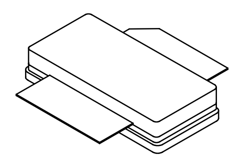
Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	17.9	33.0	6.4	-38.7
2140 MHz	18.1	33.0	6.4	-38.2
2170 MHz	18.3	33.4	6.3	-37.2

- Capable of Handling 10:1 VSWR, @ 32 Vdc, 2140 MHz, 138 Watts CW (1) Output Power (3 dB Input Overdrive from Rated P_{out})
- Typical P_{out} @ 1 dB Compression Point ≃ 100 Watts CW

2110-2170 MHz, 24 W AVG., 28 V
W-CDMA, LTE
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF8S21100HR3



CASE 465A-06, STYLE 1
NI-780S
MRF8S21100HSR3

Features

- 100% PAR Tested for Guaranteed Output Power Capability
- 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
- Designed for Digital Predistortion Error Correction Systems
- Optimized for Doherty Applications
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units, 56 mm Tape Width, 13 inch Reel. For R5 Tape and Reel option, see p. 14.

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +65	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 (2,3)	T_J	225	°C
CW Operation @ T_C = 25°C Derate above 25°C	CW	108 0.57	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (3,4)	Unit
Thermal Resistance, Junction to Case Case Temperature 77°C, 24 W CW, 28 Vdc, I_{DQ} = 700 mA, 2140 MHz Case Temperature 80°C, 100 W CW(1), 28 Vdc, I_{DQ} = 700 mA, 2140 MHz	$R_{\theta JC}$	 0.48 0.45	°C/W

1. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.
2. Continuous use at maximum temperature will affect MTTF.
3. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
4. 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)	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} = 65 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 = 150 μAdc)	$V_{GS(th)}$	1.2	2.0	2.7	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 700 mAdc)	$V_{GS(Q)}$	—	2.7	—	Vdc
Fixture Gate Quiescent Voltage (1) (V_{DD} = 28 Vdc, I_D = 700 mAdc, Measured in Functional Test)	$V_{GG(Q)}$	4.0	5.4	7.0	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.5 Adc)	$V_{DS(on)}$	0.1	0.24	0.3	Vdc

Functional Tests (2) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 700 mA, P_{out} = 24 W Avg., f = 2170 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	17.2	18.3	20.2	dB
Drain Efficiency	η_D	31.0	33.4	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	5.9	6.3	—	dB
Adjacent Channel Power Ratio	ACPR	—	-37.2	-36.0	dBc
Input Return Loss	IRL	—	-12	-7	dB

Typical Broadband Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 700 mA, P_{out} = 24 W Avg., Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)	IRL (dB)
2110 MHz	17.9	33.0	6.4	-38.7	-18
2140 MHz	18.1	33.0	6.4	-38.2	-16
2170 MHz	18.3	33.4	6.3	-37.2	-12

1. V_{GG} = 2 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 matched both on input and output.

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Typical Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 700 mA, 2110-2170 MHz Bandwidth					
P_{out} @ 1 dB Compression Point, CW	P1dB	—	100	—	W
IMD Symmetry @ 36 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}	—	40	—	MHz
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	50	—	MHz
Gain Flatness in 60 MHz Bandwidth @ P_{out} = 24 W Avg.	G_F	—	0.4	—	dB
Gain Variation over Temperature (-30°C to +80°C)	ΔG	—	0.011	—	dB/°C
Output Power Variation over Temperature (-30°C to +80°C) [(1)]	ΔP1dB	—	0.005	—	dB/°C

1. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.

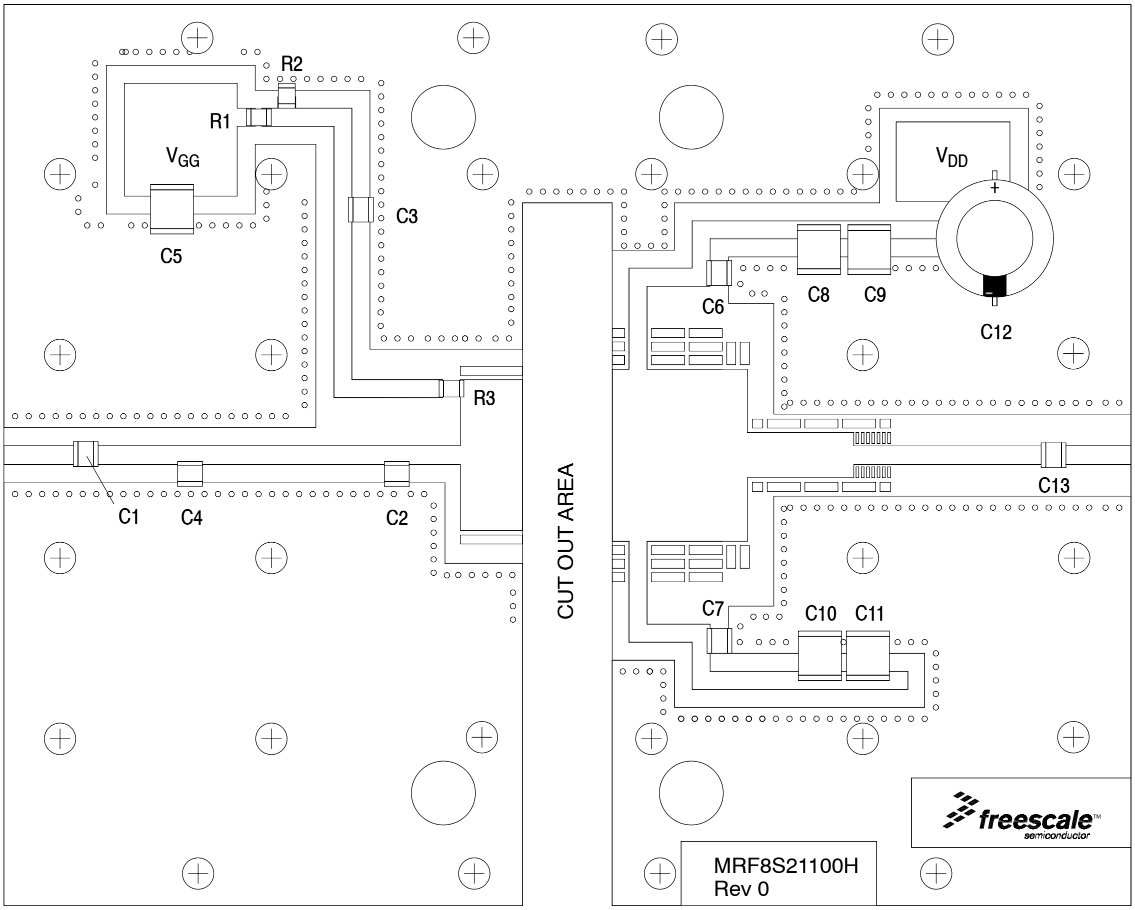


Figure 1. MRF8S21100HR3(HSR3) Test Circuit Component Layout

Table 5. MRF8S21100HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C3, C6, C7	6.8 pF Chip Capacitors	ATC100B6R8CT500XT	ATC
C2	1.6 pF Chip Capacitor	ATC100B1R6BT500XT	ATC
C4	0.2 pF Chip Capacitor	ATC100B0R2BT500XT	ATC
C5, C8, C9, C10, C11	10 μF, 50 V Tantalum Capacitors	293D106X9050E2TE3	Vishay
C12	220 μF, 50 V Electrolytic Capacitor, Radial	227CKS050M	Illinois Capacitor
C13	5.6 pF Chip Capacitor	ATC100B5R6CT500XT	ATC
R1, R2	2 KΩ, 1/4 W Chip Resistors	CRCW12062K00FKEA	Vishay
R3	10 Ω, 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
PCB	0.030″, ε_r = 2.55	AD255A	Arlon

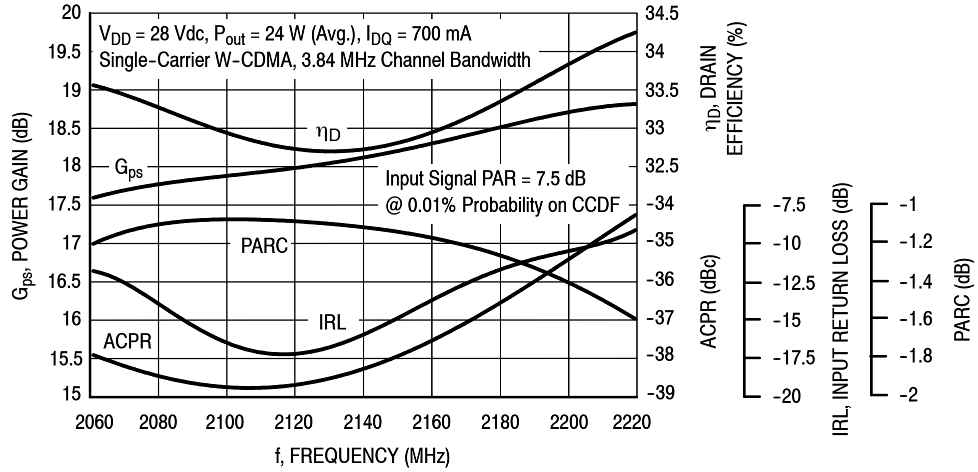


Figure 2. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 24 Watts Avg.

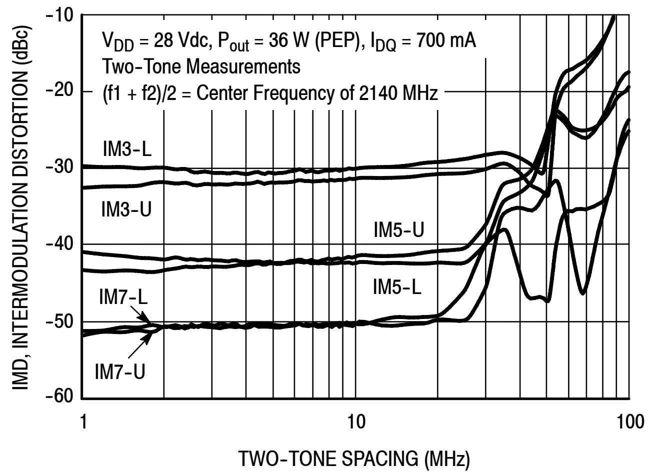


Figure 3. Intermodulation Distortion Products versus Two-Tone Spacing

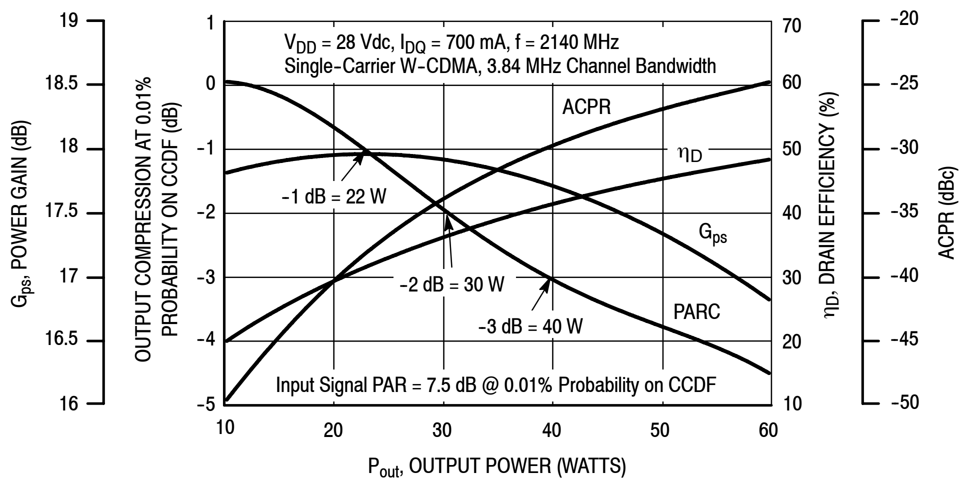


Figure 4. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

TYPICAL CHARACTERISTICS

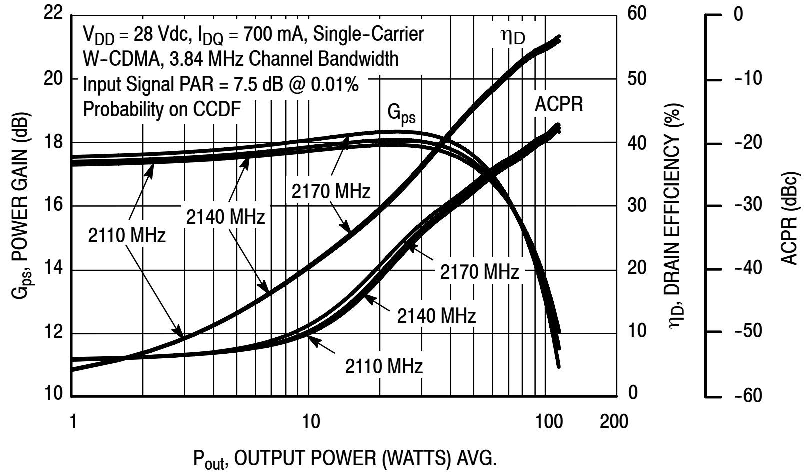


Figure 5. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power

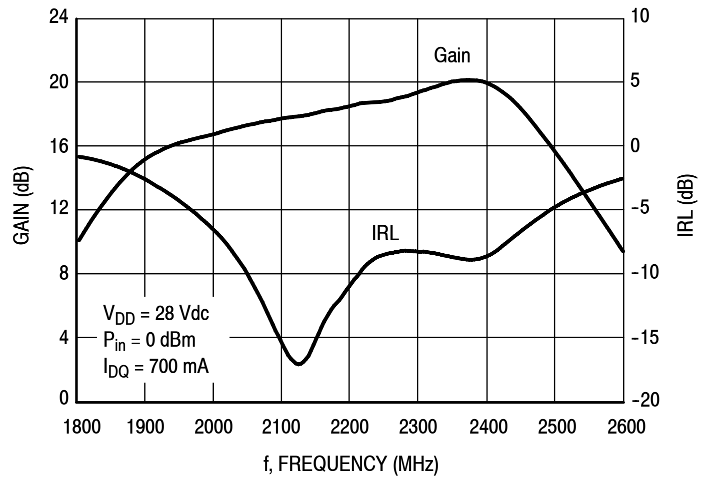


Figure 6. Broadband Frequency Response

W-CDMA TEST SIGNAL

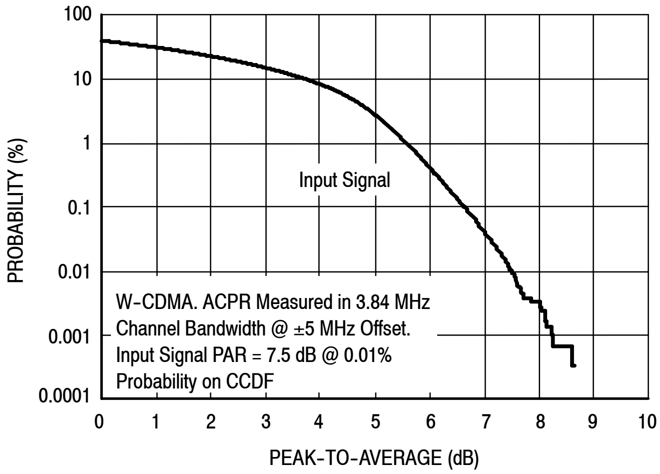


Figure 7. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal

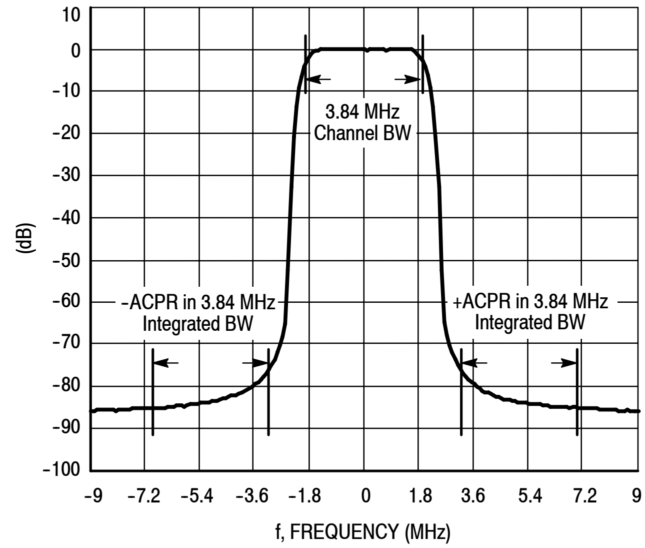


Figure 8. Single-Carrier W-CDMA Spectrum

V_{DD} = 28 Vdc, I_{DQ} = 700 mA, P_{out} = 24 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2060	4.41 - j6.05	3.03 - j3.64
2080	4.38 - j5.67	2.96 - j3.45
2100	4.33 - j5.29	2.89 - j3.26
2120	4.33 - j4.91	2.83 - j3.10
2140	4.33 - j4.54	2.75 - j2.94
2160	4.33 - j4.17	2.69 - j2.75
2180	4.31 - j3.80	2.62 - j2.50
2200	4.32 - j3.39	2.65 - j2.24
2220	4.35 - j2.99	2.67 - j2.04

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

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

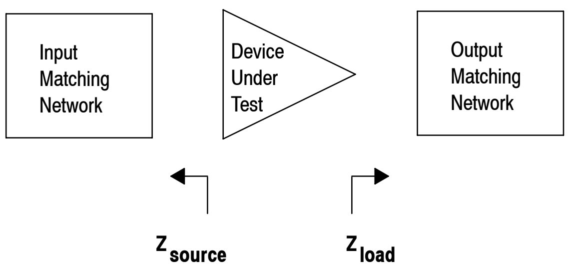
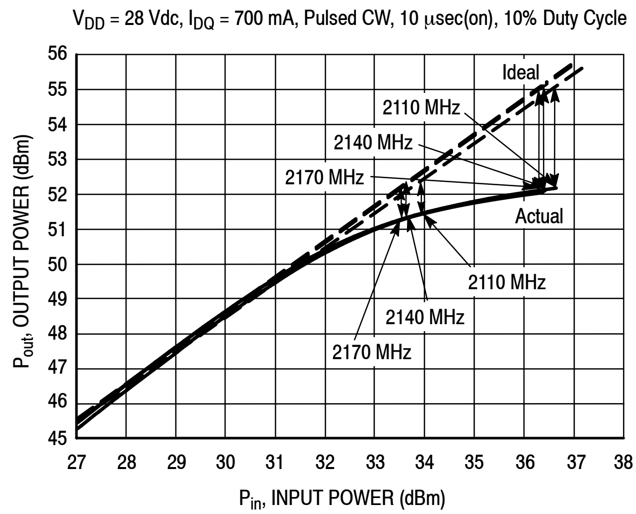


Figure 9. Series Equivalent Source and Load Impedance

ALTERNATIVE PEAK TUNE LOAD PULL CHARACTERISTICS



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

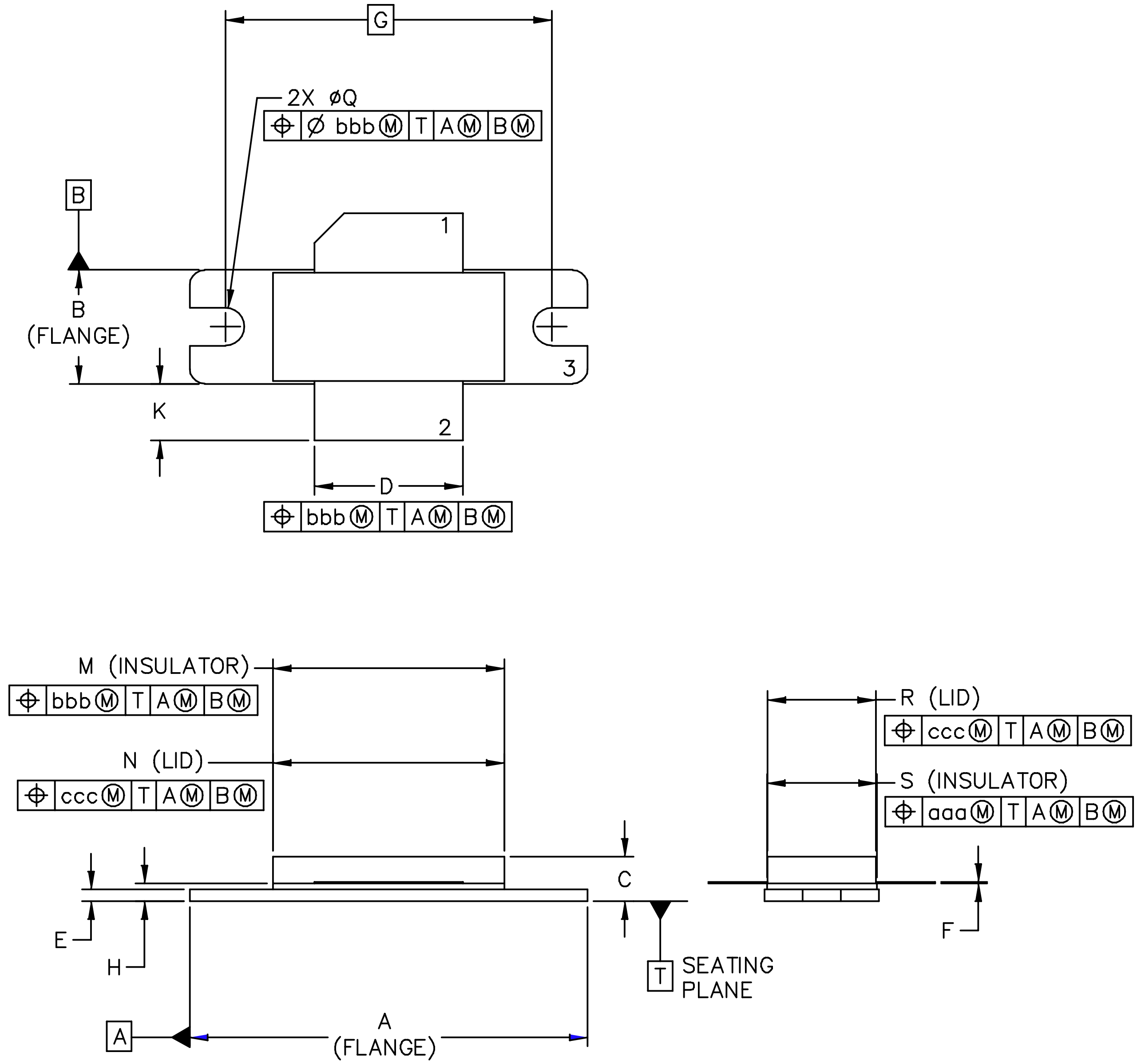
f (MHz)	P1dB		P3dB	
	Watts	dBm	Watts	dBm
2110	141	51.5	166	52.2
2140	141	51.5	162	52.1
2170	138	51.4	158	52.0

Test Impedances per Compression Level

f (MHz)		Z_{source} Ω	Z_{load} Ω
2110	P1dB	3.50 – j7.47	1.65 – j3.64
2140	P1dB	4.21 – j7.53	1.57 – j3.70
2170	P1dB	6.39 – j8.09	1.66 – j3.68

Figure 10. Pulsed CW Output Power versus Input Power @ 28 V

PACKAGE DIMENSIONS



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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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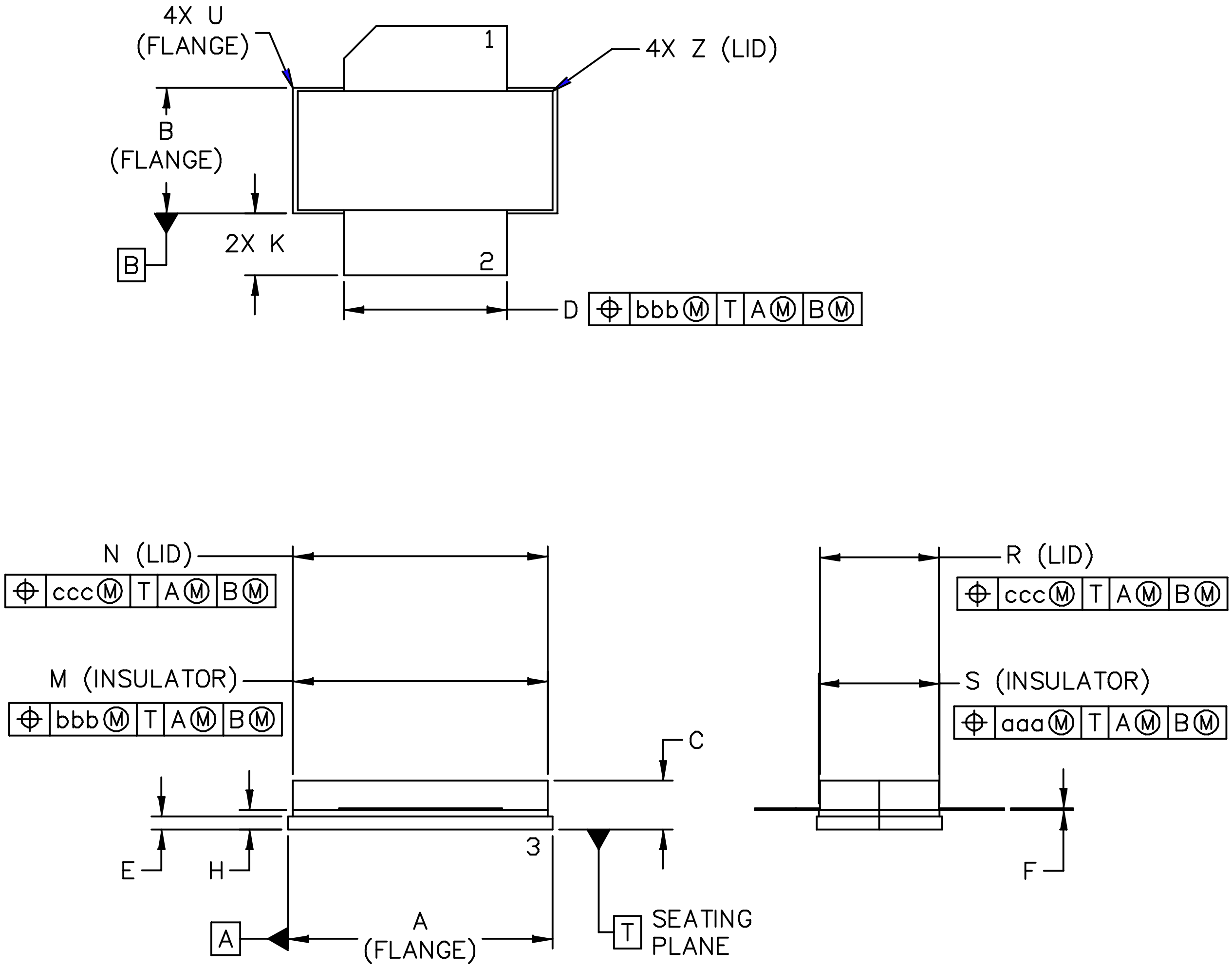

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3. DELETED

4. DIMENSION H IS MEASURED .030 (0.762) 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	.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, 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, 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 MRF8S21100H and MRF8S21100HS parts will be available for 2 years after release of MRF8S21100H and MRF8S21100HS. 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 MRF8S21100H and MRF8S21100HS in the R3 tape and reel option.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Oct. 2010	• Initial Release of Data Sheet
1	Mar. 2011	• Corrected $V_{GG(Q)}$ V_{DD} value from 30 Vdc to 28 Vdc in On Characteristics table to reflect actual test measurement condition, p. 2

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