Freescale Semiconductor
Technical Data

Document Number: MRF8S18120H
Rev. 1, 10/2010

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF8S18120HR3
MRF8S18120HSR3

Designed for GSM and GSM EDGE base station applications with frequencies from 1805 to 1880 MHz. Can be used in Class AB and Class C for all typical cellular base station modulation formats.

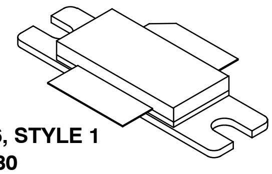
- Typical GSM Performance: V_{DD} = 28 Volts, I_{DQ} = 800 mA, P_{out} = 72 Watts CW

Frequency	G_{ps} (dB)	η_D (%)
1805 MHz	18.2	49.8
1840 MHz	18.6	51.4
1880 MHz	18.7	53.9

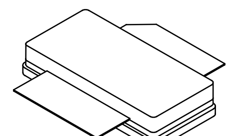
- Capable of Handling 7:1 VSWR, @ 32 Vdc, 1840 MHz, 150 Watts CW Output Power (3 dB Input Overdrive from Rated P_{out})
- Typical P_{out} @ 1 dB Compression Point ≃ 120 Watts CW
- Typical GSM EDGE Performance: V_{DD} = 28 Volts, I_{DQ} = 800 mA, P_{out} = 46 Watts Avg.

Frequency	G_{ps} (dB)	η_D (%)	SR1 @ 400 kHz (dBc)	SR2 @ 600 kHz (dBc)	EVM (% rms)
1805 MHz	17.9	41.0	-64	-76	1.6
1840 MHz	18.2	41.9	-63	-76	1.7
1880 MHz	18.3	43.2	-61	-76	2.0

1805-1880 MHz, 72 W CW, 28 V
GSM, GSM EDGE
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF8S18120HR3



CASE 465A-06, STYLE 1
NI-780S
MRF8S18120HSR3

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
- Optimized for Doherty Applications
- 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, +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 [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 79°C, 72 W CW, 28 Vdc, I_{DQ} = 800 mA Case Temperature 79°C, 120 W CW, 28 Vdc, I_{DQ} = 800 mA	$R_{\theta JC}$	 0.47 0.46	°C/W

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 = 260 μAdc)	$V_{GS(th)}$	1.2	1.8	2.7	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 800 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.8	2.6	3.3	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2.3 Adc)	$V_{DS(on)}$	0.1	0.2	0.3	Vdc
Functional Tests (3) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 800 mA, P_{out} = 72 W CW, f = 1805 MHz					
Power Gain	G_{ps}	17	18.2	20	dB
Drain Efficiency	η_D	48	49.8	—	%
Input Return Loss	IRL	—	-11	-8	dB
P_{out} @ 1 dB Compression Point, CW	P1dB	112	—	—	W

Typical Broadband Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 800 mA, P_{out} = 72 W CW

Frequency	G_{ps} (dB)	η_D (%)	IRL (dB)
1805 MHz	18.2	49.8	-11
1840 MHz	18.6	51.4	-15
1880 MHz	18.7	53.9	-12

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 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 Performances (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 800 mA, 1805–1880 MHz Bandwidth					
P_{out} @ 1 dB Compression Point, CW	P1dB	—	120	—	W
IMD Symmetry @ 94 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}	—	10	—	MHz
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	35	—	MHz
Gain Flatness in 75 MHz Bandwidth @ P_{out} = 72 W CW	G_F	—	0.5	—	dB
Gain Variation over Temperature (–30°C to +85°C)	ΔG	—	0.01	—	dB/°C
Output Power Variation over Temperature (–30°C to +85°C)	ΔP1dB	—	0.004	—	dB/°C

Typical GSM EDGE Performances (In Freescale GSM EDGE Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 800 mA, P_{out} = 46 W Avg., 1805–1880 MHz EDGE Modulation

Frequency	G_{ps} (dB)	η_D (%)	SR1 @ 400 kHz (dBc)	SR2 @ 600 kHz (dBc)	EVM (% rms)
1805 MHz	17.9	41.0	–64	–76	1.6
1840 MHz	18.2	41.9	–63	–76	1.7
1880 MHz	18.3	43.2	–61	–76	2.0

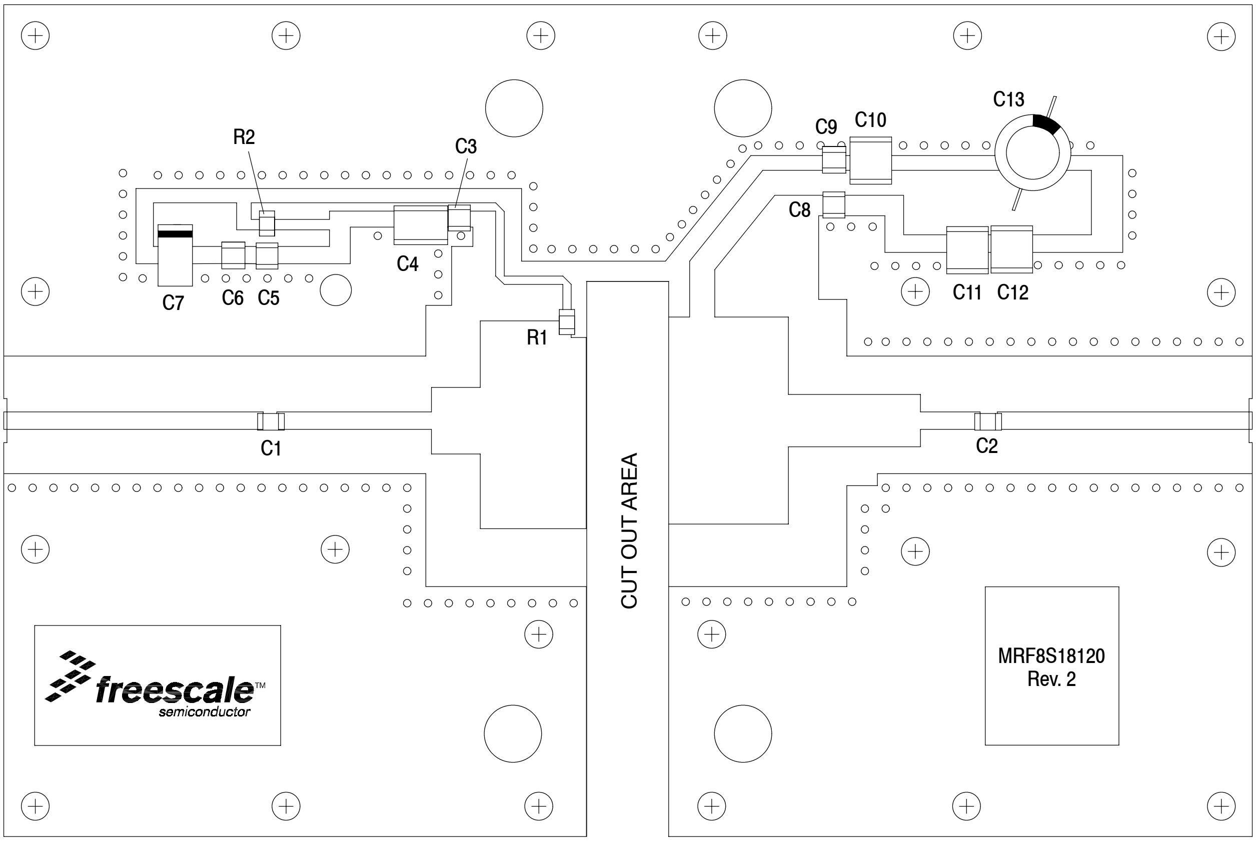


Figure 1. MRF8S18120HR3(HSR3) Test Circuit Component Layout

Table 5. MRF8S18120HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	12 pF Chip Capacitors	ATC100B120JT500XT	ATC
C3, C8	9.1 pF Chip Capacitors	ATC100B9R1CT500XT	ATC
C4	10 nF Chip Capacitor	C1825C103K1GAC-TU	Kemet
C5	8.2 pF Chip Capacitor	ATC100B8R2CT500XT	ATC
C6, C9	2.2 μF, 100 V Chip Capacitors	C3225X7R2A225KT	TDK
C7	47 μF, 16 V Tantalum Capacitor	T491D476K016AT	Kemet
C10, C11, C12	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88L	Murata
C13	330 μF, 63 V Electrolytic Capacitor	MCRH63V337M13X21-RH	Multicomp
R1	10 Ω, 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
R2	4.75 Ω, 1/4 W Chip Resistor	CRCW12064R75FNEA	Vishay
PCB	0.030″, ε_r = 2.55	250GX-0300-55-22	Arlon

TYPICAL CHARACTERISTICS

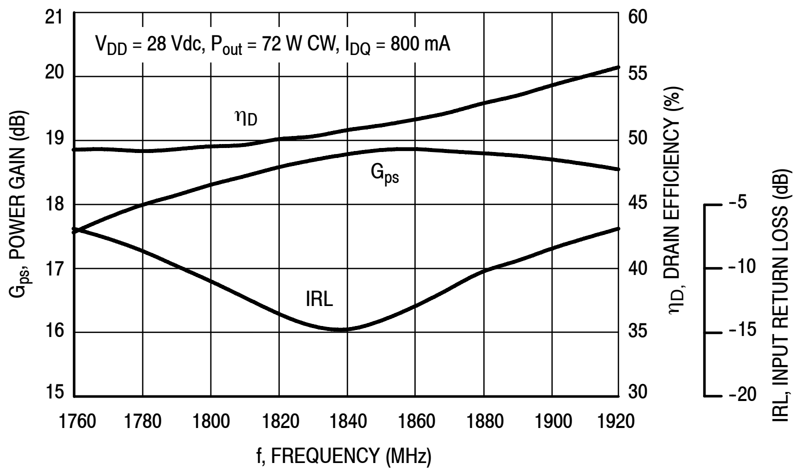


Figure 2. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 72 Watts CW

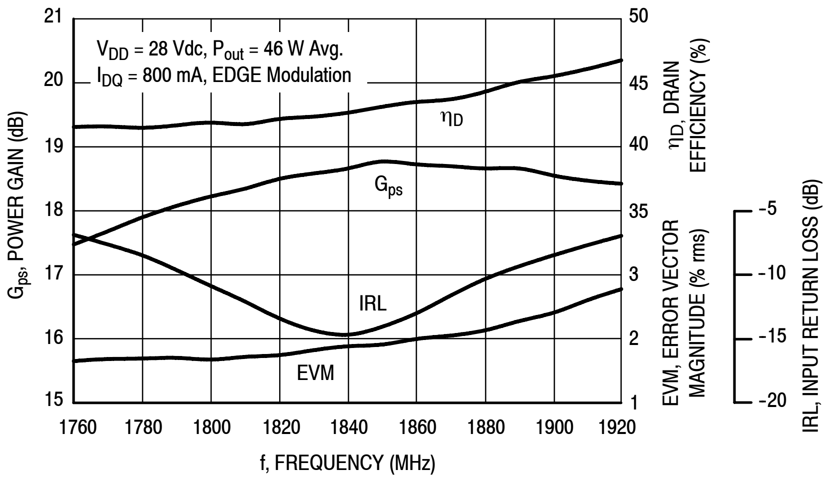


Figure 3. Power Gain, Input Return Loss, EVM and Drain Efficiency versus Frequency @ P_{out} = 46 Watts Avg.

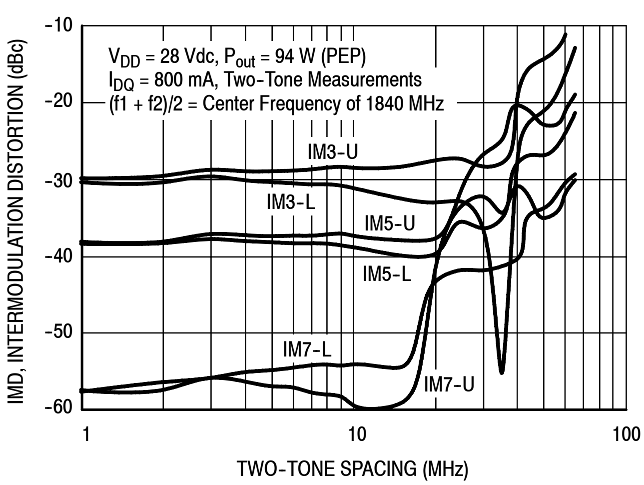


Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing

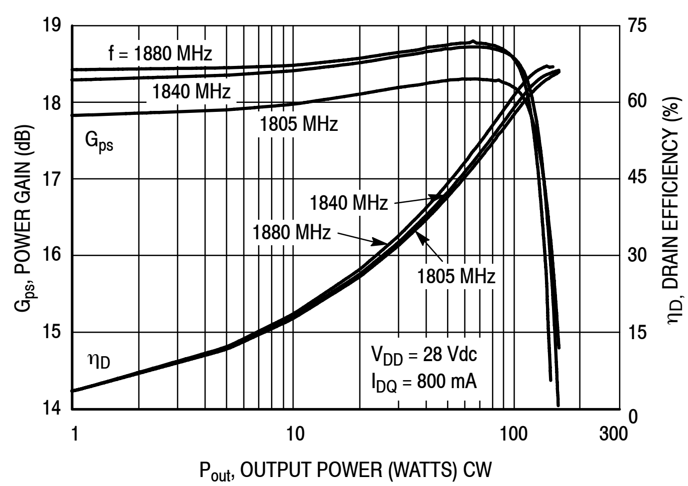


Figure 5. Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS

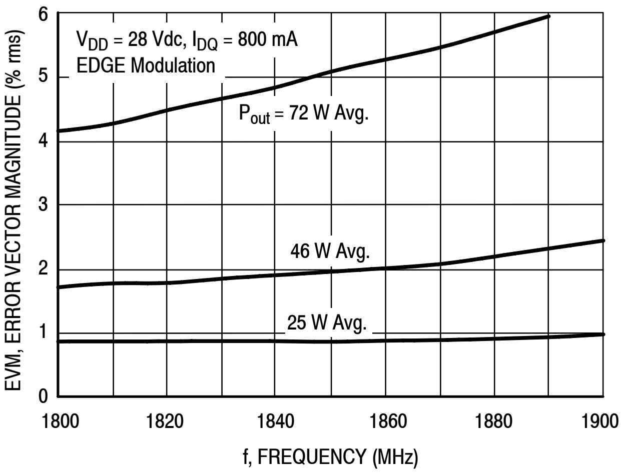


Figure 6. EVM versus Frequency

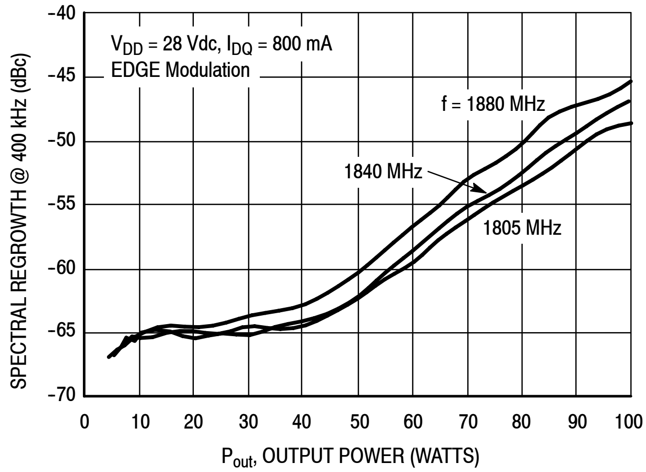


Figure 7. Spectral Regrowth at 400 kHz versus Output Power

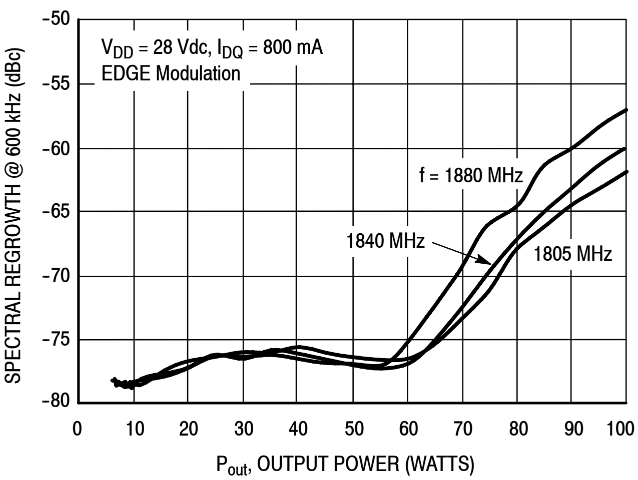


Figure 8. Spectral Regrowth at 600 kHz versus Output Power

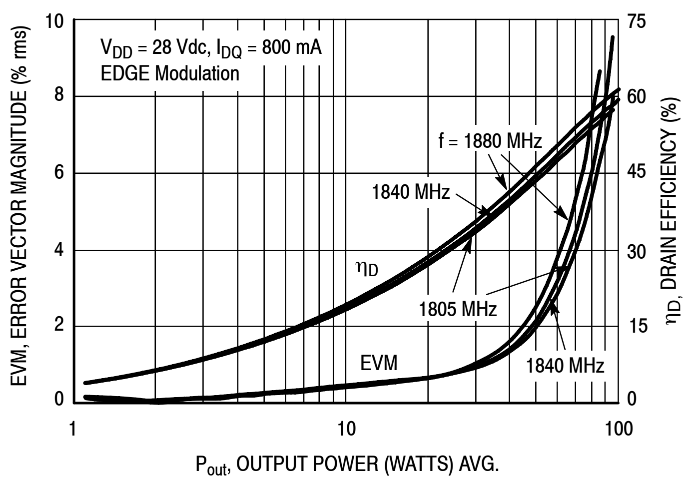


Figure 9. EVM and Drain Efficiency versus Output Power

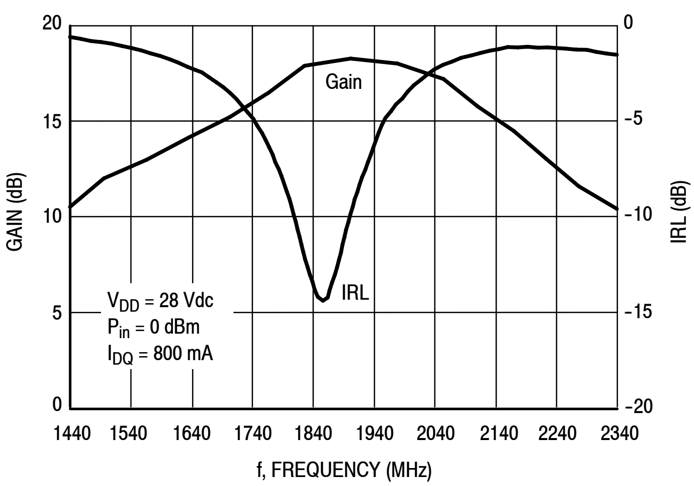


Figure 10. Broadband Frequency Response

GSM TEST SIGNAL

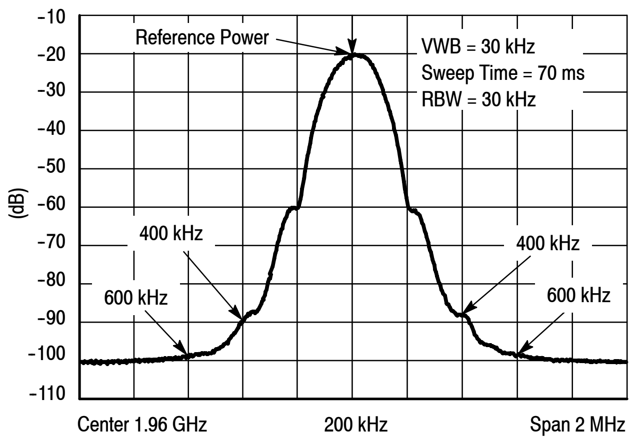


Figure 11. EDGE Spectrum

V_{DD} = 28 Vdc, I_{DQ} = 800 mA, P_{out} = 72 W CW

f MHz	Z_{source} Ω	Z_{load} Ω
1760	1.53 − j1.94	2.32 − j0.41
1780	1.53 − j1.82	2.31 − j0.51
1800	1.56 − j1.90	2.31 − j0.49
1820	1.56 − j1.86	2.32 − j0.40
1840	1.57 − j1.75	2.33 − j0.26
1860	1.51 − j1.64	2.29 − j0.12
1880	1.49 − j1.58	2.29 − j0.01
1900	1.49 − j1.55	2.29 + j0.05
1920	1.48 − j1.53	2.31 + j0.06

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

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

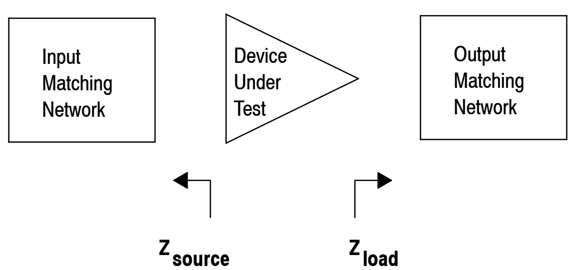
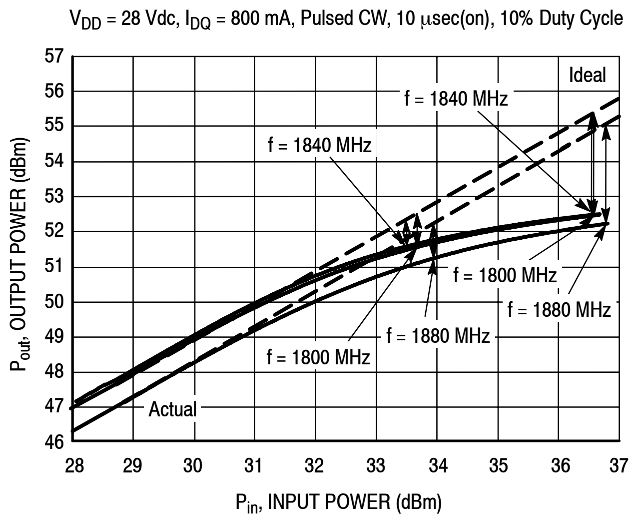


Figure 12. Series Equivalent Source and Load Impedance



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

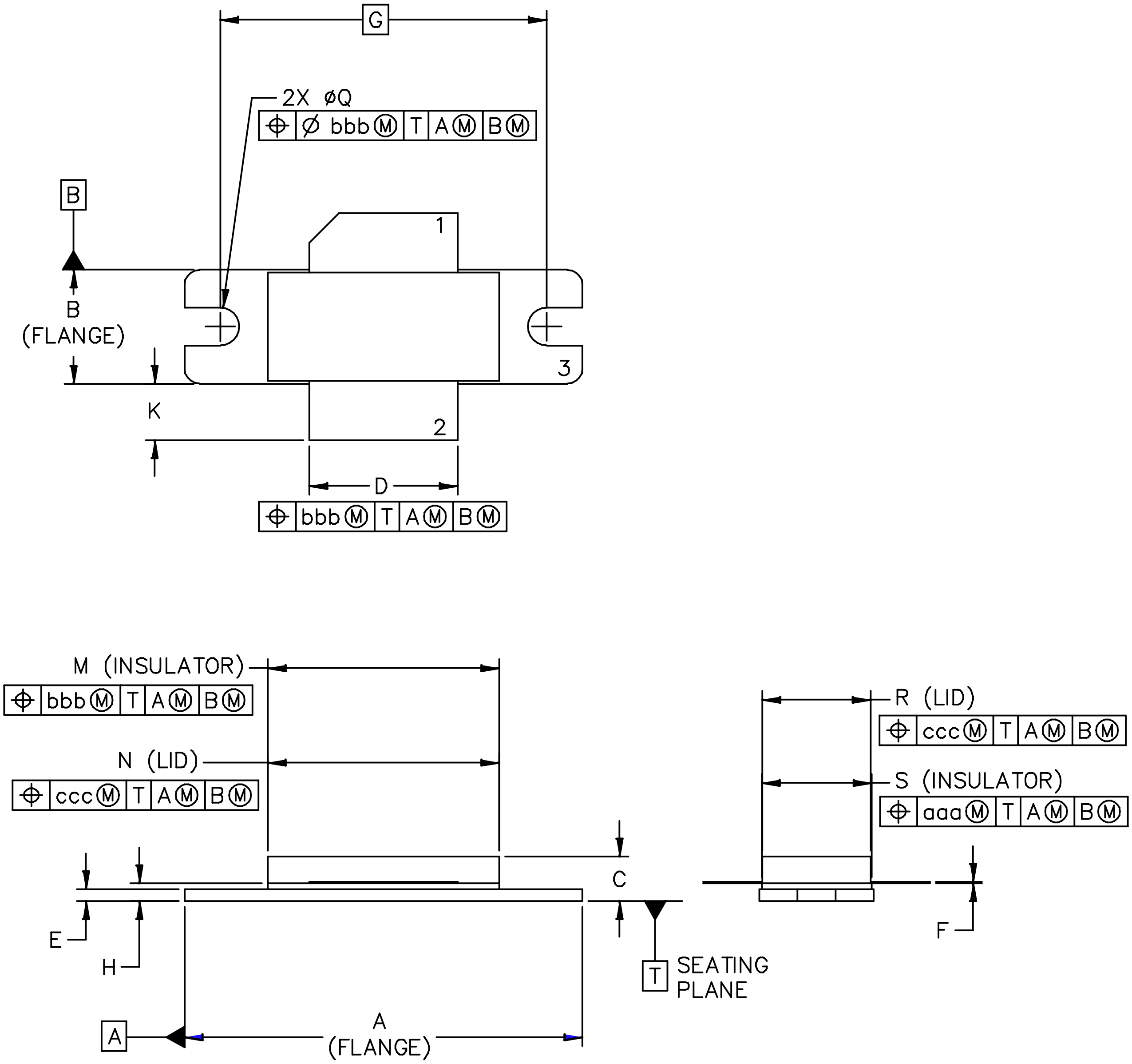
f (MHz)	P1dB		P3dB	
	Watts	dBm	Watts	dBm
1805	145	51.6	178	52.5
1840	141	51.5	178	52.5
1880	135	51.3	170	52.3

Test Impedances per Compression Level

f (MHz)		Z_{source} Ω	Z_{load} Ω
1805	P1dB	1.14 – j4.65	1.54 – j2.60
1840	P1dB	1.04 – j4.88	1.49 – j2.75
1880	P1dB	0.94 – j4.59	1.50 – j2.74

Figure 13. 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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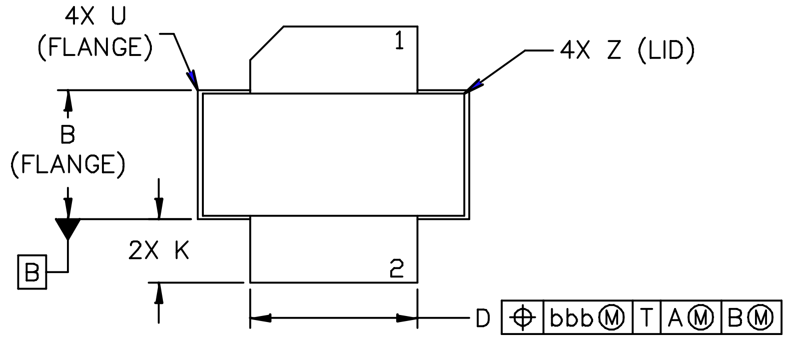

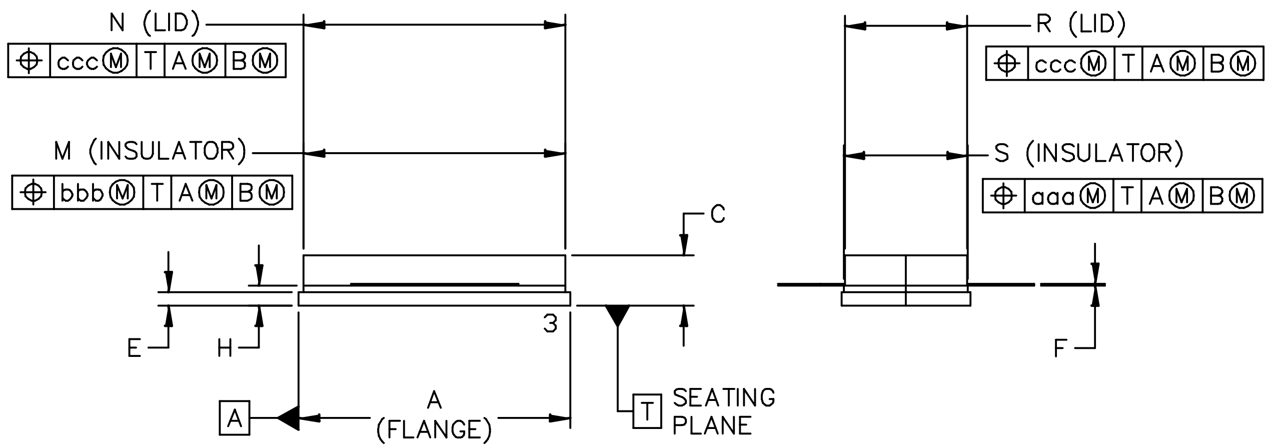

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2. CONTROLLING DIMENSION: INCH.

3. DELETED

4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

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

	INCH			MILLIMETER				INCH			MILLIMETER		
DIM	MIN		MAX	MIN		MAX	DIM	MIN		MAX	MIN		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.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Sept. 2009	• Initial Release of Data Sheet
1	Oct. 2010	• Changed Human Body Model ESD rating from Class 1A to Class 2 to reflect recent ESD test results of the device, p. 2

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