Freescale Semiconductor
Technical Data

Document Number: MRF8HP21080H
Rev. 0, 6/2011

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF8HP21080HR3
MRF8HP21080HSR3

2110-2170 MHz, 16 W AVG., 28 V
W-CDMA, LTE
LATERAL N-CHANNEL
RF POWER MOSFETs

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.

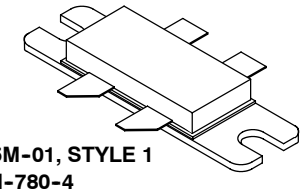
- Typical Doherty Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, P_{out} = 16 Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	14.1	46.7	8.3	-30.6
2140 MHz	14.5	46.2	8.2	-32.1
2170 MHz	14.4	45.7	8.1	-33.6

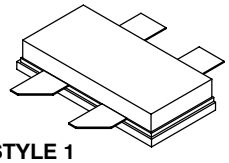
- Capable of Handling 10:1 VSWR, @ 32 Vdc, 2140 MHz, 110 Watts CW Output Power (3 dB Input Overdrive from Rated P_{out})
- Typical P_{out} @ 3 dB Compression Point ≃ 100 Watts (1)

Features

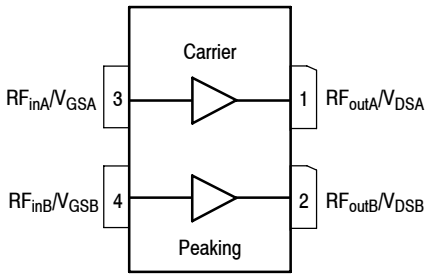
- Advanced High Performance In-Package Doherty
- Production Tested in a Doherty Configuration
- 100% PAR Tested for Guaranteed Output Power Capability
- Characterized with Large-Signal Load-Pull Parameters and Common Source S-Parameters
- Internally Matched for Ease of Use
- Integrated ESD Protection
- Greater Negative Gate-Source Voltage Range for Improved Class C Operation
- Designed for Digital Predistortion Error Correction Systems
- RoHS Compliant
- NI-780-4 in Tape and Reel. R3 Suffix = 250 Units, 56 mm Tape Width, 13 inch Reel. For R5 Tape and Reel option, see p. 13.
- NI-780S-4 in Tape and Reel. R3 Suffix = 250 Units, 32 mm Tape Width, 13 inch Reel. For R5 Tape and Reel option, see p. 13.



CASE 465M-01, STYLE 1
NI-780-4
MRF8HP21080HR3



CASE 465H-02, STYLE 1
NI-780S-4
MRF8HP21080HSR3



(Top View)

Figure 1. Pin Connections

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	220 3.3	W W/°C

1. P3dB = P_{avg} + 7.0 dB where P_{avg} is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.
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.

freescale semiconductor

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 77°C, 16 W CW, 28 Vdc, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, 2170 MHz Case Temperature 81°C, 80 W CW(3), 28 Vdc, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, 2170 MHz	$R_{\theta JC}$	 1.0 0.61	°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)	III (Minimum)

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

Characteristic	Symbol	Min	Typ	Max
Off Characteristics (4)				
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1
On Characteristics - Side A (4)				
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 100 μAdc)	$V_{GS(th)}$	1.1	2.0	2.6
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_{DA} = 150 mA, Measured in Functional Test)	$V_{GS(Q)}$	2.0	2.7	3.5
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 0.5 Adc)	$V_{DS(on)}$	0.1	0.24	0.3
On Characteristics - Side B (4)				
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 75 μAdc)	$V_{GS(th)}$	1.2	2.0	2.7
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 0.7 Adc)	$V_{DS(on)}$	0.1	0.24	0.3
Functional Tests (5,6) (In Freescale Doherty Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, P_{out} = 16 W Avg., f = 2170 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.				
Power Gain	G_{ps}	13.8	14.4	16.8
Drain Efficiency	η_D	42.4	45.7	—
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	7.3	8.1	—
Adjacent Channel Power Ratio	ACPR	—	-33.6	-28.9
Input Return Loss	IRL	—	-17	-9

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. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.
4. Each side of device measured separately.
5. Part internally matched both on input and output.
6. Measurement made with device in a Doherty configuration.

(continued)

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

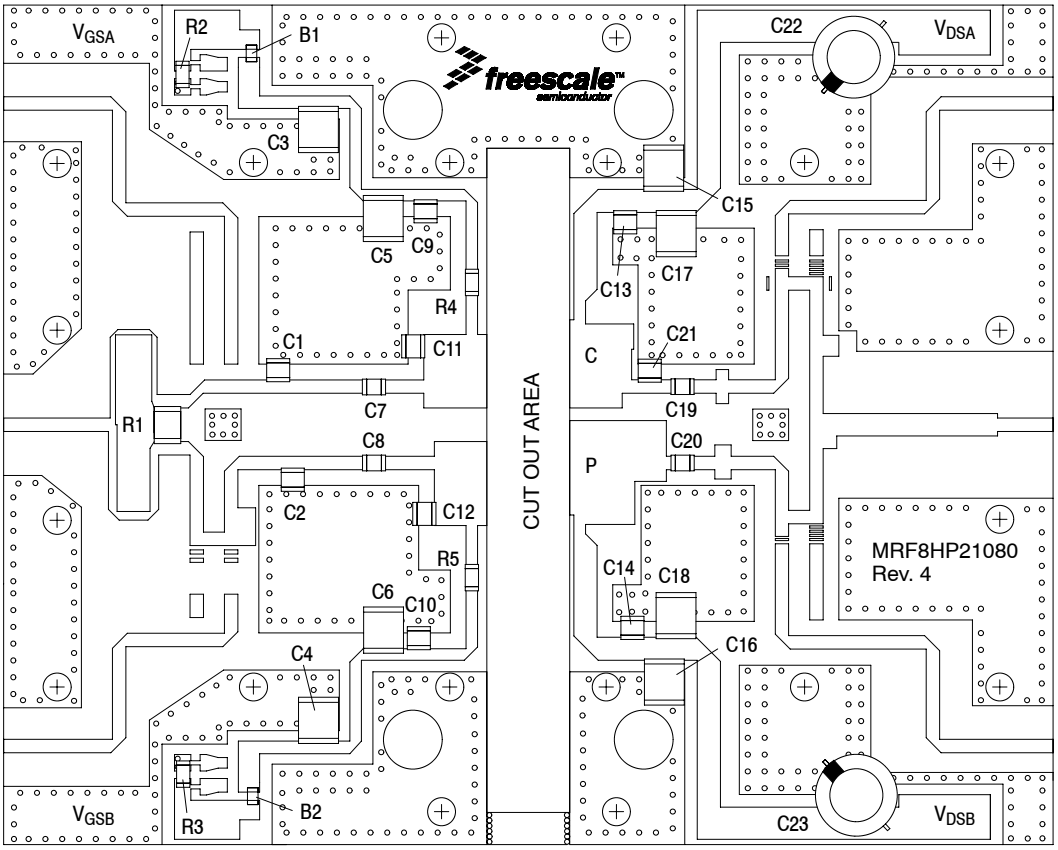
Typical Broadband Performance (1) — (In Freescale Doherty Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, P_{out} = 16 W Avg., Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)	IRL (dB)
2110 MHz	14.1	46.7	8.3	-30.6	-17
2140 MHz	14.5	46.2	8.2	-32.1	-17
2170 MHz	14.4	45.7	8.1	-33.6	-18

Typical Performances (1) (In Freescale Doherty Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQA} = 150 mA, V_{GSB} = 1.1 Vdc, 2110-2170 MHz Bandwidth

Characteristic	Symbol	Min	Typ	Max	Unit
P_{out} @ 1 dB Compression Point, CW	P1dB	—	60	—	W
P_{out} @ 3 dB Compression Point (2)	P3dB	—	100	—	W
IMD Symmetry @ 10 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}	—	78	—	MHz
Gain Flatness in 60 MHz Bandwidth @ P_{out} = 16 W Avg.	G_F	—	0.4	—	dB
Gain Variation over Temperature (-30°C to +85°C)	ΔG	—	0.012	—	dB/°C
Output Power Variation over Temperature (-30°C to +85°C)	ΔP1dB	—	0.01	—	dB/°C

1. Measurement made with device in a Doherty configuration.
2. P3dB = P_{avg} + 7.0 dB where P_{avg} is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.



*C7, C8, C19 and C20 are mounted vertically.

Figure 2. MRF8HP21080HR3(HSR3) Test Circuit Component Layout

Table 5. MRF8HP21080HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2	30 Ω Ferrite Beads	MPZ2012S300A	TDK
C1, C2	1.6 pF Chip Capacitors	ATC100B1R6BT500XT	ATC
C3, C4, C5, C6, C15, C16, C17, C18	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88L	Murata
C7*, C8*, C9, C10, C13, C14, C19*, C20*	6.8 pF Chip Capacitors	ATC100B6R8CT500XT	ATC
C11	1.0 pF Chip Capacitor	ATC100B1R0BT500XT	ATC
C12	1.5 pF Chip Capacitor	ATC100B1R5BT500XT	ATC
C21	0.5 pF Chip Capacitor	ATC100B0R5BT500XT	ATC
C22,C23	220 μF, 50 V Electrolytic Capacitors	227CKS050M	Illinois Capacitor
R1	100 Ω, 4 W Chip Resistor	CW12010T0100GBK	ATC
R2, R3	20 kΩ, 1/4 W Chip Resistors	CRCW120620K0JNEA	Vishay
R4, R5	3 Ω, 1/4 W Chip Resistors	CRCW12063R00FKEA	Vishay
PCB	0.030″, ε_r = 3.5	R04350	Rogers

TYPICAL CHARACTERISTICS

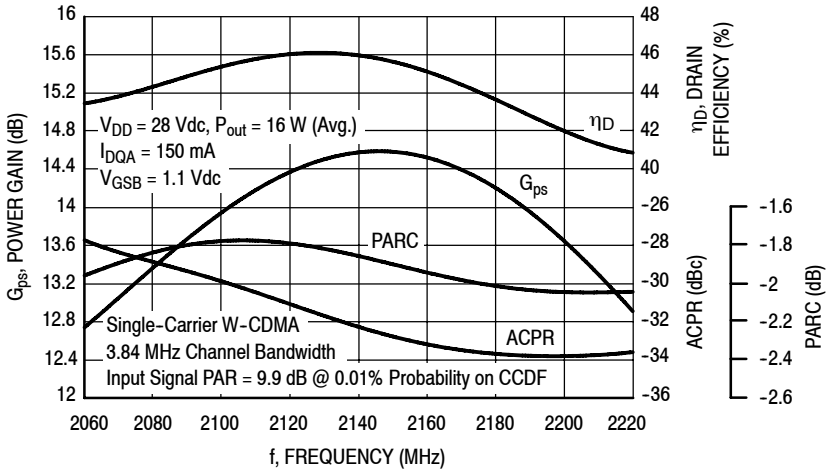


Figure 3. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 16 Watts Avg.

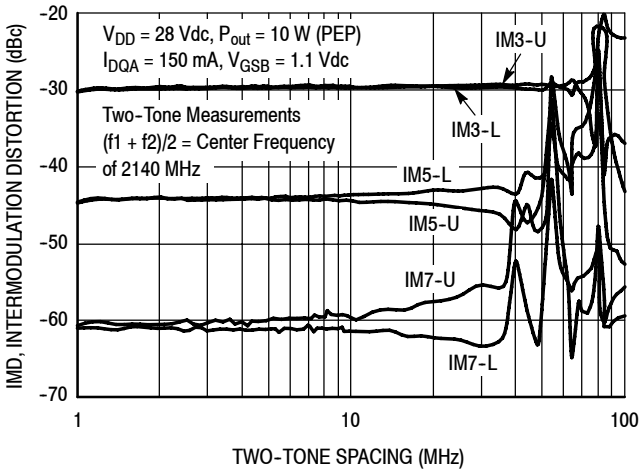


Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing

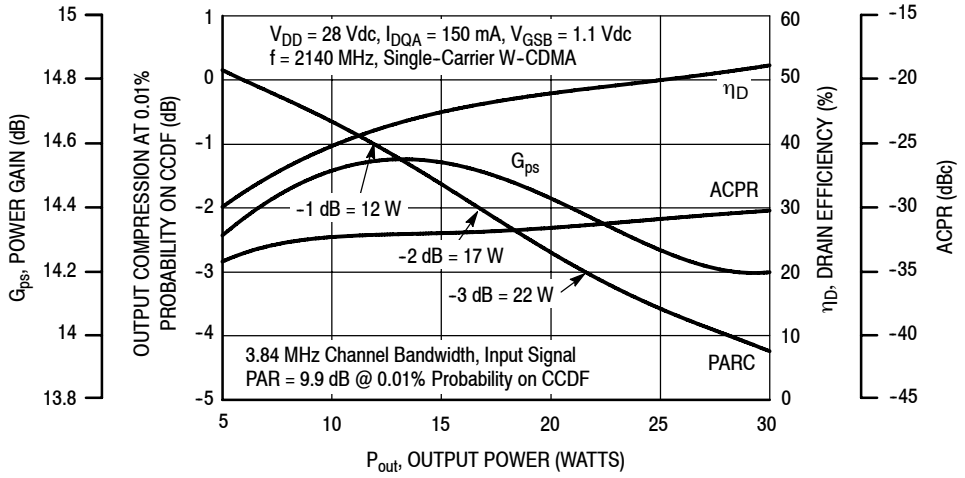


Figure 5. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

TYPICAL CHARACTERISTICS

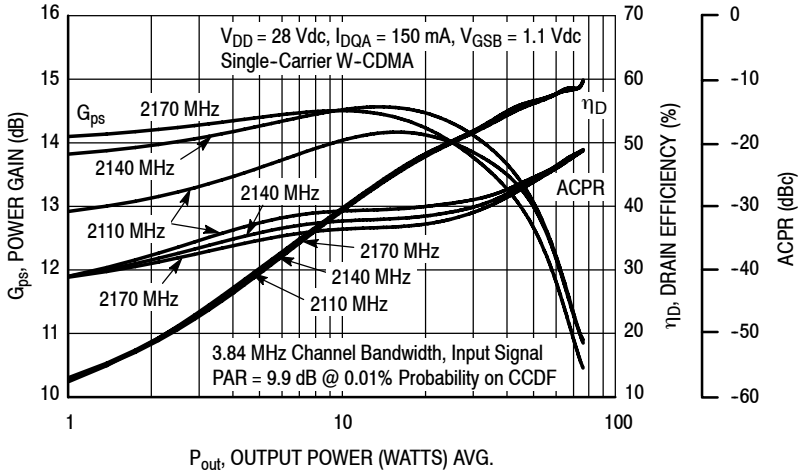


Figure 6. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power

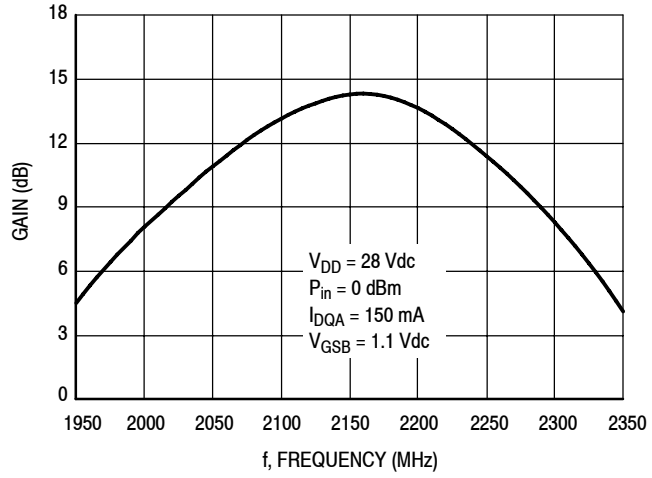


Figure 7. Broadband Frequency Response

W-CDMA TEST SIGNAL

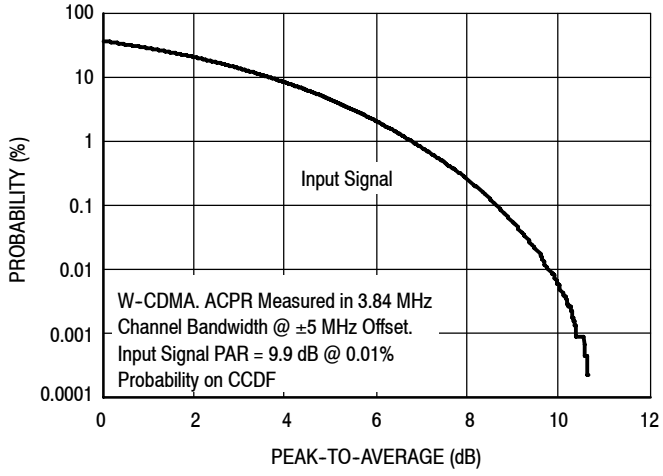


Figure 8. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal

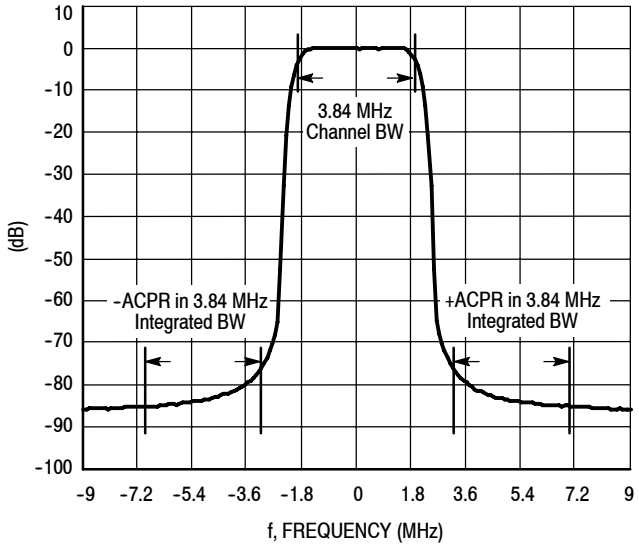


Figure 9. Single-Carrier W-CDMA Spectrum

V_{DD} = 28 Vdc, I_{DQA} = 150 mA, Pulsed CW, 10 μsec(on), 10% Duty Cycle

f (MHz)	Z_{source} (Ω)	Z_{load} (1) (Ω)	Max Output Power					
			P1dB			P3dB		
			(dBm)	(W)	η_D (%)	(dBm)	(W)	η_D (%)
2110	6.97 – j14.8	6.61 – j11.5	47.2	53	57.1	48.0	63	57.4
2140	7.61 – j17.9	6.33 – j12.0	47.1	51	55.7	48.0	63	56.0
2170	6.68 – j18.7	6.41 – j11.2	46.9	49	54.5	47.9	62	56.1

(1) Load impedance for optimum P1dB power.

Z_{source} = Impedance as measured from gate contact to ground.
Z_{load} = Impedance as measured from drain contact to ground.

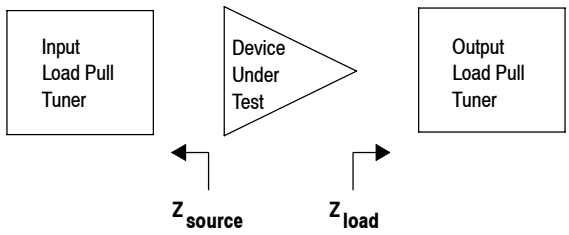


Figure 10. Carrier Side Load Pull Performance — Maximum P1dB Tuning

V_{DD} = 28 Vdc, I_{DQA} = 150 mA, Pulsed CW, 10 μsec(on), 10% Duty Cycle

f (MHz)	Z_{source} (Ω)	Z_{load} (1) (Ω)	Max Drain Efficiency					
			P1dB			P3dB		
			(dBm)	(W)	η_D (%)	(dBm)	(W)	η_D (%)
2110	6.97 – j14.8	14.3 – j9.22	45.6	36	65.1	46.7	47	65.9
2140	7.61 – j17.9	14.4 – j9.52	45.5	36	64.2	46.7	47	65.1
2170	6.68 – j18.7	13.8 – j8.09	45.6	36	63.9	46.6	46	65.9

(1) Load impedance for optimum P1dB efficiency.

Z_{source} = Impedance as measured from gate contact to ground.
Z_{load} = Impedance as measured from drain contact to ground.

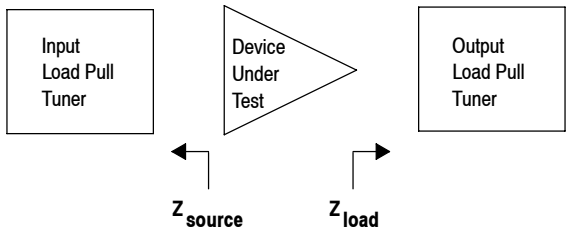


Figure 11. Carrier Side Load Pull Performance — Maximum Efficiency Tuning

V_{DD} = 28 Vdc, V_{GSB} = 1.1 Vdc, Pulsed CW, 10 μsec(on), 10% Duty Cycle

f (MHz)	Z_{source} (Ω)	Z_{load} (1) (Ω)	Max Output Power					
			P1dB			P3dB		
			(dBm)	(W)	η_D (%)	(dBm)	(W)	η_D (%)
2110	4.73 – j9.34	3.70 – j6.50	48.6	72	60.2	49.3	85	61.1
2140	6.50 – j11.3	3.39 – j6.80	48.7	74	59.7	49.4	87	59.5
2170	7.08 – j13.3	3.30 – j7.10	48.6	72	59.1	49.4	87	59.0

(1) Load impedance for optimum P1dB power.

Z_{source} = Impedance as measured from gate contact to ground.
Z_{load} = Impedance as measured from drain contact to ground.

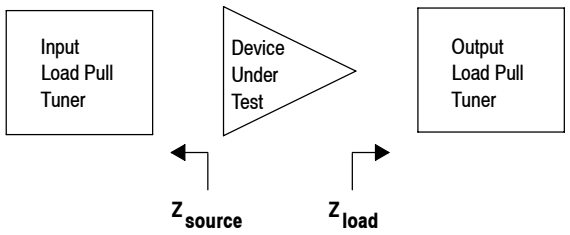


Figure 12. Peaking Side Load Pull Performance — Maximum P1dB Tuning

V_{DD} = 28 Vdc, V_{GSB} = 1.1 Vdc, Pulsed CW, 10 μsec(on), 10% Duty Cycle

f (MHz)	Z_{source} (Ω)	Z_{load} (1) (Ω)	Max Drain Efficiency					
			P1dB			P3dB		
			(dBm)	(W)	η_D (%)	(dBm)	(W)	η_D (%)
2110	4.73 – j9.34	8.22 – j9.10	46.7	47	70.6	47.5	56	70.5
2140	6.50 –j11.3	9.00 – j8.20	46.6	46	71.0	47.4	55	70.4
2170	7.08 – j13.3	9.10 – j7.55	46.4	44	69.6	47.9	62	69.0

(1) Load impedance for optimum P1dB efficiency.

Z_{source} = Impedance as measured from gate contact to ground.
Z_{load} = Impedance as measured from drain contact to ground.

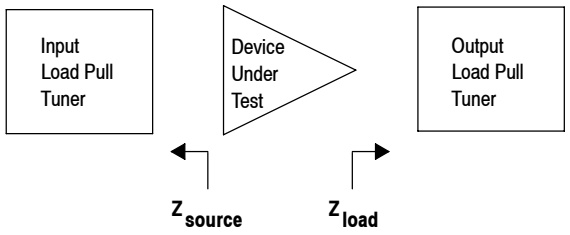
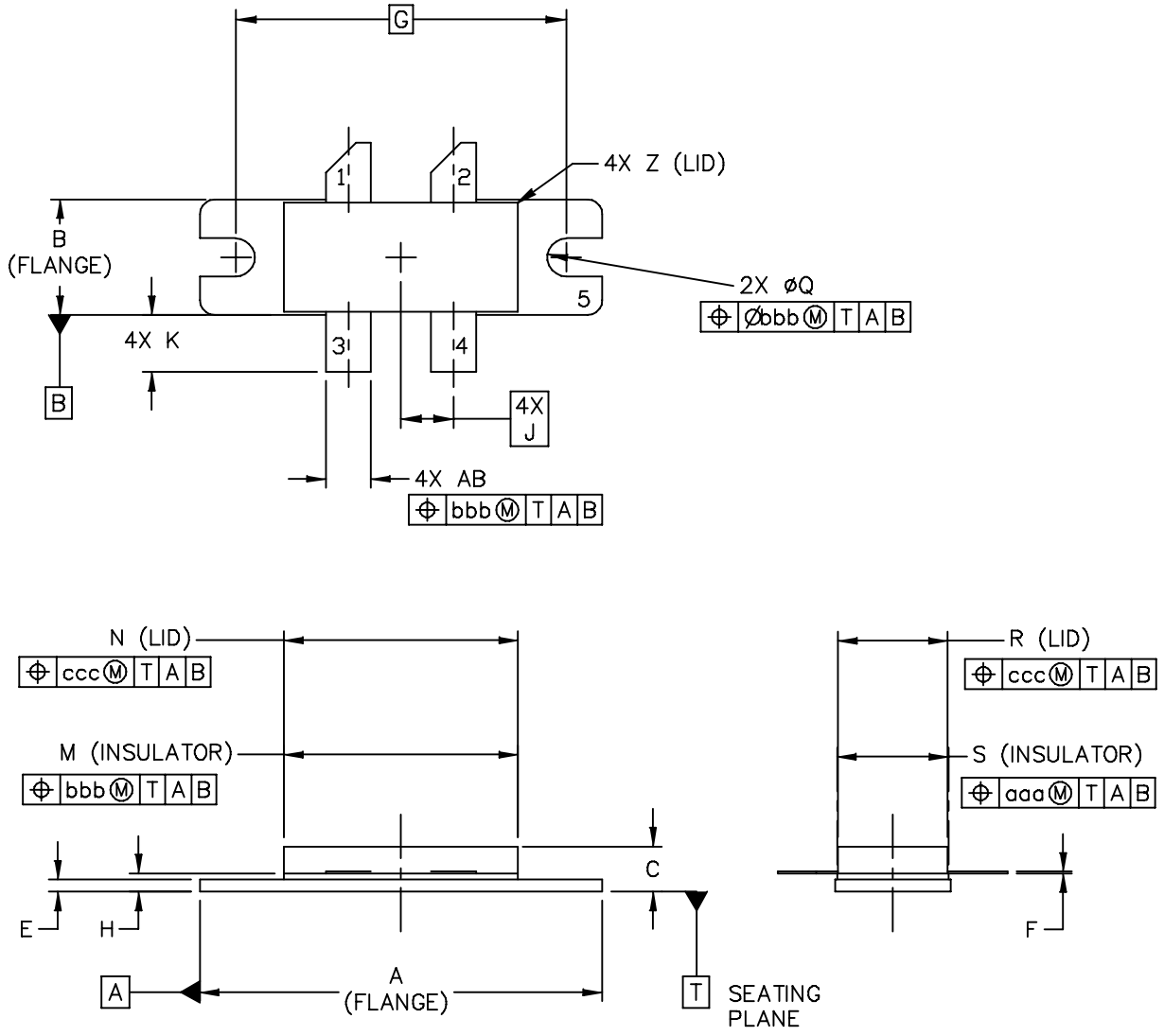


Figure 13. Peaking Side Load Pull Performance — Maximum Efficiency Tuning

PACKAGE DIMENSIONS



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TITLE: NI 780-4	DOCUMENT NO: 98ASA10793D	REV: O
	CASE NUMBER: 465M-01	27 MAR 2007
	STANDARD: NON-JEDEC	

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. 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	U		.040		1.02
E	.035	.045	0.89	1.14	Z		.030		0.76
F	.003	.006	0.08	0.15	AB	.145	.155	3.68	3.94
G	1.100 BSC		27.94 BSC						
H	.057	.067	1.45	1.7	aaa		.005		0.127
J	.175 BSC		4.44 BSC		bbb		.010		0.254
K	.170	.210	4.32	5.33	ccc		.015		0.381
M	.774	.786	19.61	20.02					
N	.772	.788	19.61	20.02					
Q	ø.118	ø.138	ø3	ø3.51					

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TITLE: NI 780–4

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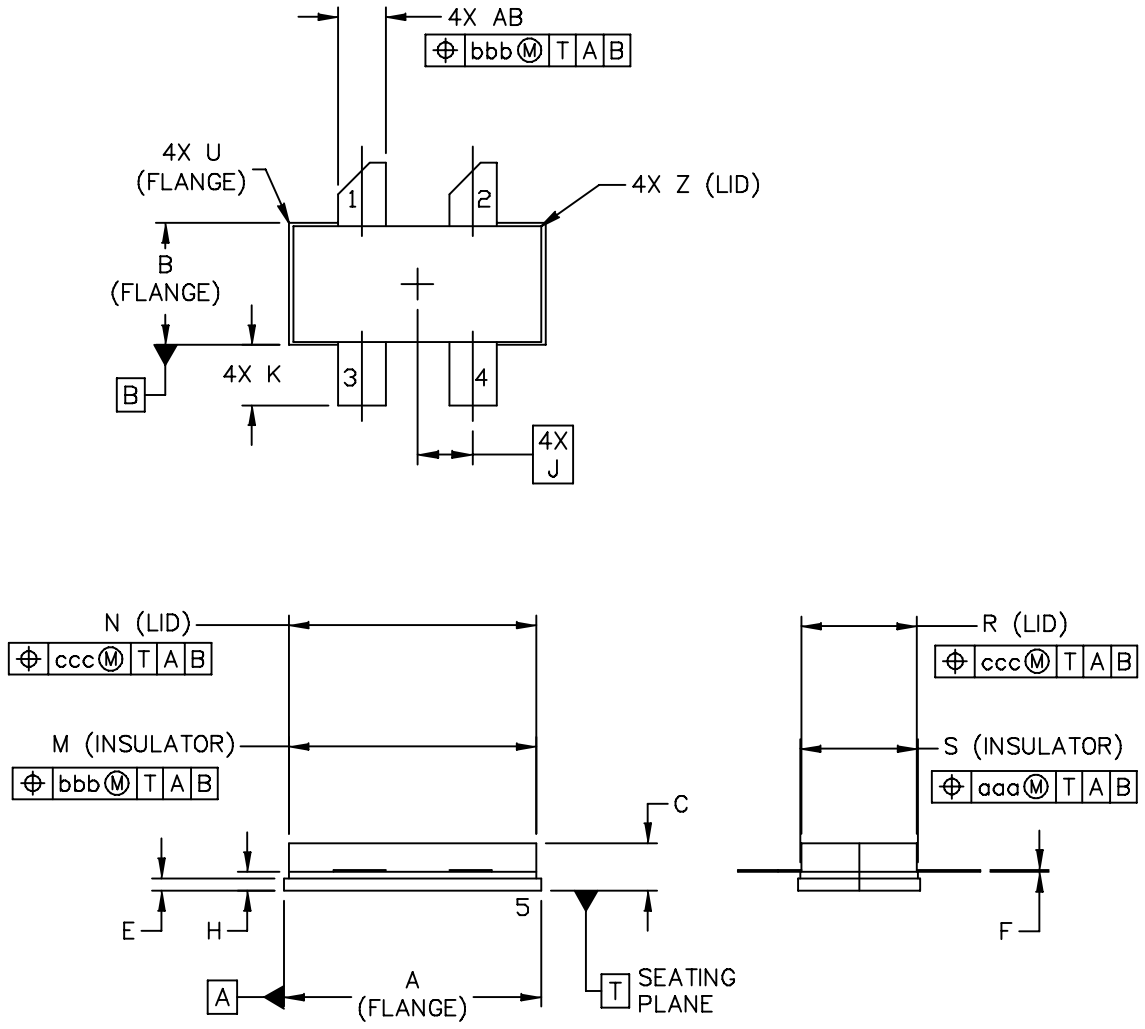
CASE NUMBER: 465M–01 | 27 MAR 2007

STANDARD: NON–JEDEC



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	CASE NUMBER: 465H−02	27 MAR 2007
	STANDARD: NON−JEDEC	

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. 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	AB	.145	.155	3.68	3.94
E	.035	.045	0.89	1.14					
F	.003	.006	0.08	0.15	aaa		.005		0.127
H	.057	.067	1.45	1.7	bbb		.010		0.254
J	.175 BSC		4.44 BSC		ccc		.015		0.381
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					

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE: NI 780S–4

DOCUMENT NO: 98ASA10718D | REV: A

CASE NUMBER: 465H–02 | 27 MAR 2007

STANDARD: NON–JEDEC

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 MRF8HP21080H and MRF8HP21080HS parts will be available for 2 years after release of MRF8HP21080H and MRF8HP21080HS. 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 MRF8HP21080H and MRF8HP21080HS 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

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