

# RF Power Field Effect Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

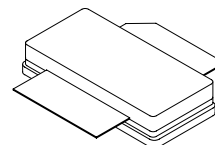
- Typical 2-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ} = 1000$  mA,  $P_{out} = 19$  Watts Avg.,  $f = 2112.5$  MHz, Channel Bandwidth = 3.84 MHz, Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.  
 Power Gain — 13.6 dB  
 Drain Efficiency — 23%  
 IM3 @ 10 MHz Offset — -37.5 dBc in 3.84 MHz Channel Bandwidth  
 ACPR @ 5 MHz Offset — -41 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2140 MHz, 90 Watts CW Output Power

### Features

- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40 $\mu$ " Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF21085LSR3**

**2110-2170 MHz, 90 W, 28 V  
 LATERAL N-CHANNEL  
 RF POWER MOSFET**



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

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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +65	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	$P_D$	224 1.28	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Case Operating Temperature	$T_C$	150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.78	$^\circ\text{C}/\text{W}$

**Table 3. ESD Protection Characteristics**

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)

**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\ \mu\text{Adc}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>On Characteristics (DC)</b>					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 200\ \mu\text{Adc}$ )	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ Vdc}$ , $I_D = 1000\ \text{mAdc}$ )	$V_{GS(Q)}$	3	3.9	5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$V_{DS(on)}$	—	0.18	0.21	Vdc
<b>Dynamic Characteristics (1)</b>					
Reverse Transfer Capacitance ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$	—	3.6	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system) 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers, ACPR and IM3 measured in 3.84 MHz Bandwidth. Peak/Avg. = 8.3 dB @ 0.01% Probability on CCDF.					
Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 19\text{ W Avg.}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2112.5\text{ MHz}$ )	$G_{ps}$	12	13.6	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 19\text{ W Avg.}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2112.5\text{ MHz}$ )	$\eta$	20	23	—	%
Third Order Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 19\text{ W Avg.}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2112.5\text{ MHz}$ ; IM3 measured over 3.84 MHz BW at $f_1 -10\text{ MHz}$ and $f_2 +10\text{ MHz}$ referenced to carrier channel power.)	IM3	—	-37.5	-35	dBc
Adjacent Channel Power Ratio ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 19\text{ W Avg.}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2112.5\text{ MHz}$ ; ACPR measured over 3.84 MHz at $f_1 -5\text{ MHz}$ and $f_2 +5\text{ MHz}$ .)	ACPR	—	-41	-38	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 19\text{ W Avg.}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2112.5\text{ MHz}$ )	IRL	—	-12	-9	dB

1. Part is internally matched both on input and output.

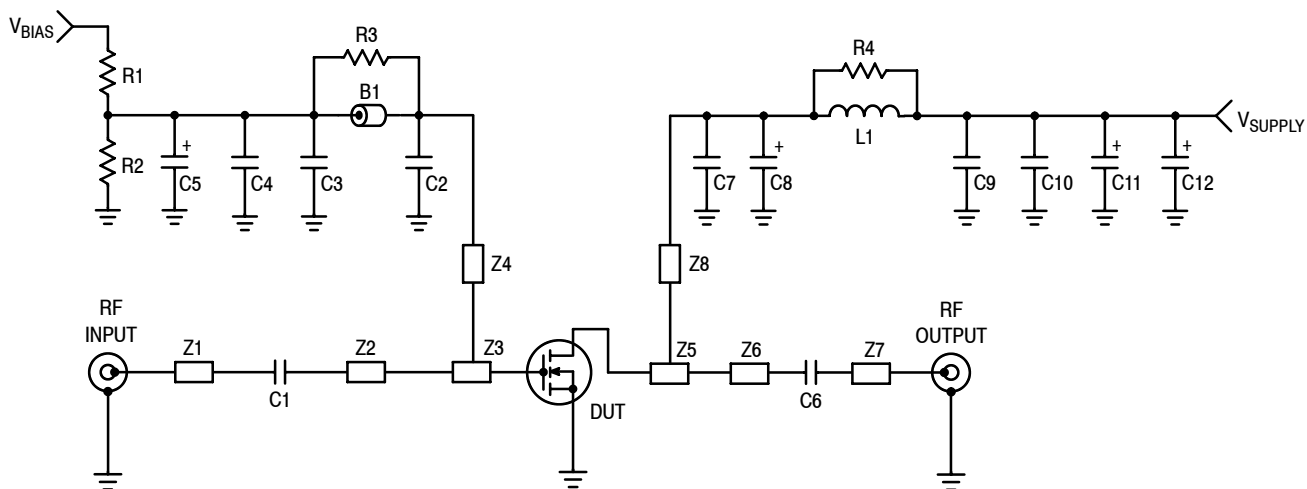
(continued)

**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system) <b>(continued)</b>					
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$G_{ps}$	—	13.6	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$\eta$	—	36	—	%
Two-Tone Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	IMD	—	-31	—	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	IRL	—	-12	—	dB
$P_{out}$ , 1 dB Compression Point ( $V_{DD} = 28\text{ Vdc}$ , $I_{DQ} = 1000\text{ mA}$ , $f = 2170\text{ MHz}$ )	P1dB	—	100	—	W

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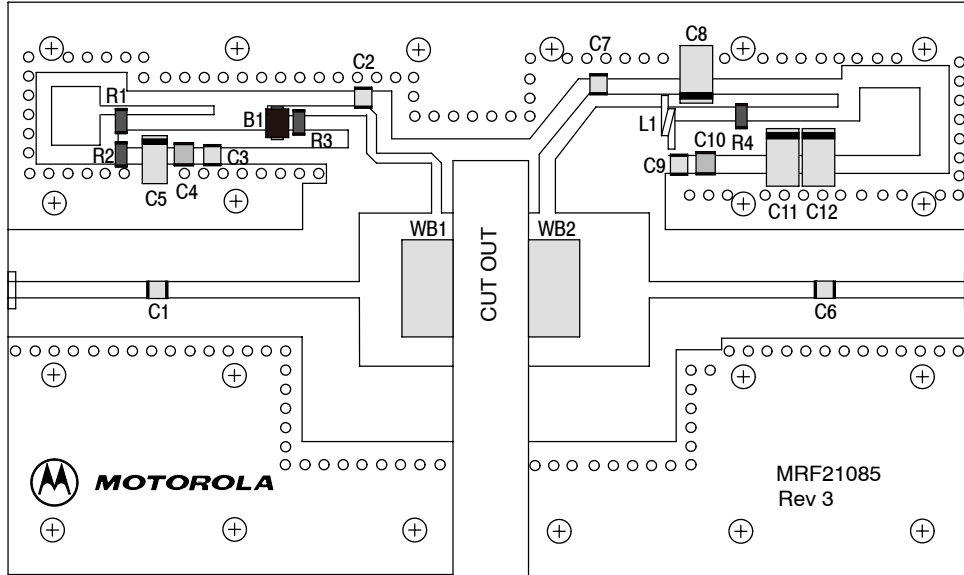
Z1	0.750" x 0.084" Microstrip
Z2	1.015" x 0.084" Microstrip
Z3	0.480" x 0.800" Microstrip
Z4	0.750" x 0.050" Microstrip
Z5	0.610" x 0.800" Microstrip
Z6	0.885" x 0.084" Microstrip
Z7	0.720" x 0.084" Microstrip
Z8	0.800" x 0.070" Microstrip

Board 0.030" Glass Teflon®,  
Keene GX-0300-55-22,  $\epsilon_r = 2.55$   
PCB Etched Circuit Boards  
MRF21085 Rev. 3, CMR

Figure 1. MRF21085L Test Circuit Schematic

Table 5. MRF21085 Test Circuit Component Designations and Values

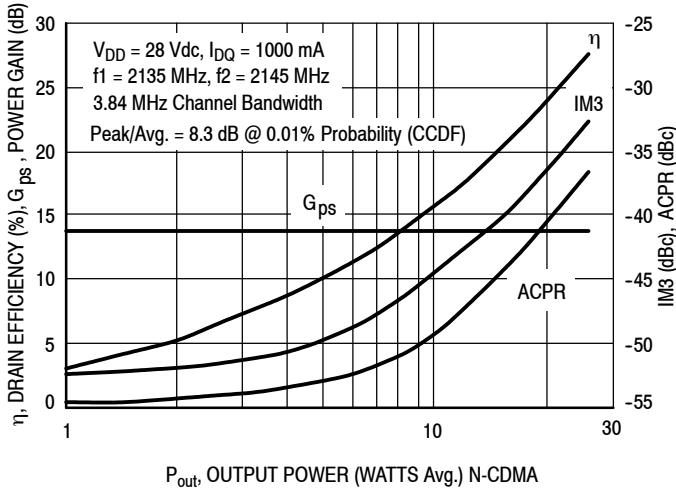
Designators	Description
B1	Short Ferrite Bead, Fair Rite, #2743019447
C1, C6	43 pF Chip Capacitors, ATC #100B430JCA500X
C2	10 pF Chip Capacitor, ATC #100B100JCA500X
C3, C9	1000 pF Chip Capacitors, ATC #100B102JCA500X
C4, C10	0.1 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKWS
C5	1.0 $\mu$ F Tantalum Chip Capacitor, Kemet #T491C105M050
C7	2.7 pF Chip Capacitor, ATC #100B2R7JCA500X
C8	10 $\mu$ F Tantalum Chip Capacitor, Kemet #T495X106K035AS4394
C11, C12	22 $\mu$ F Tantalum Chip Capacitors, Kemet #T491X226K035AS4394
L1	1 Turn, #20 AWG, 0.100" ID
N1, N2	Type N Flange Mounts, Omni Spectra #3052-1648-10
R1	1.0 k $\Omega$ , 1/8 W Chip Resistor
R2	180 k $\Omega$ , 1/8 W Chip Resistor
R3, R4	10 $\Omega$ , 1/8 W Chip Resistors



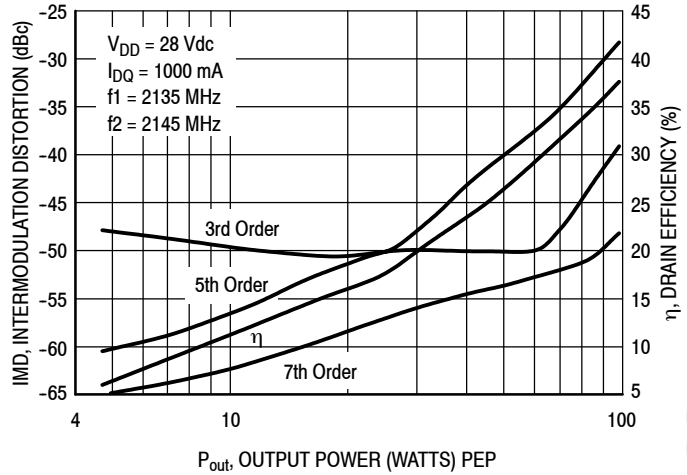
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. MRF21085L Test Circuit Component Layout**

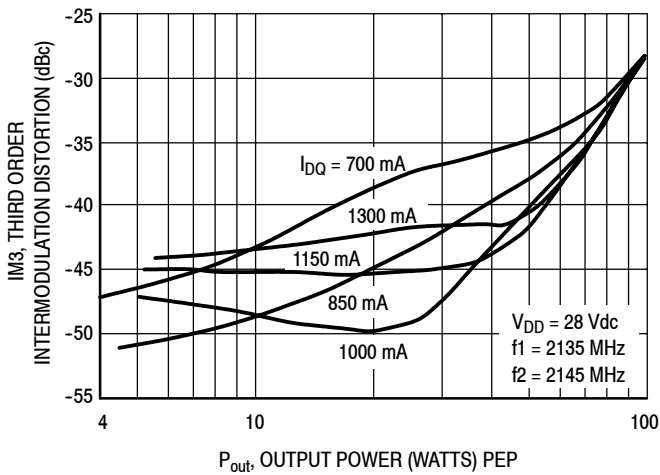
### TYPICAL CHARACTERISTICS



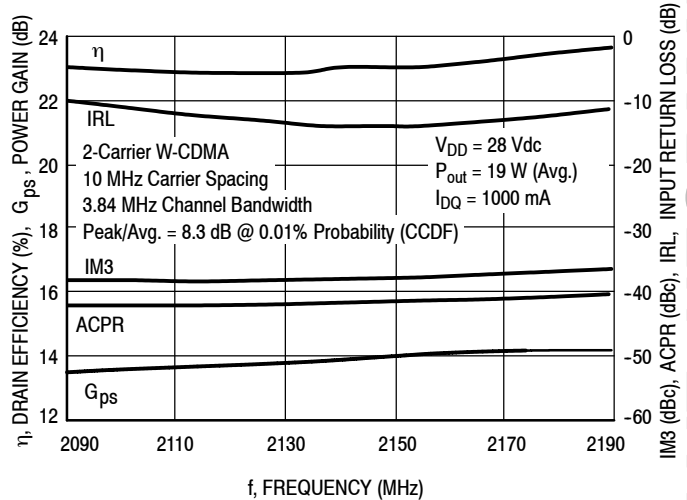
**Figure 3. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



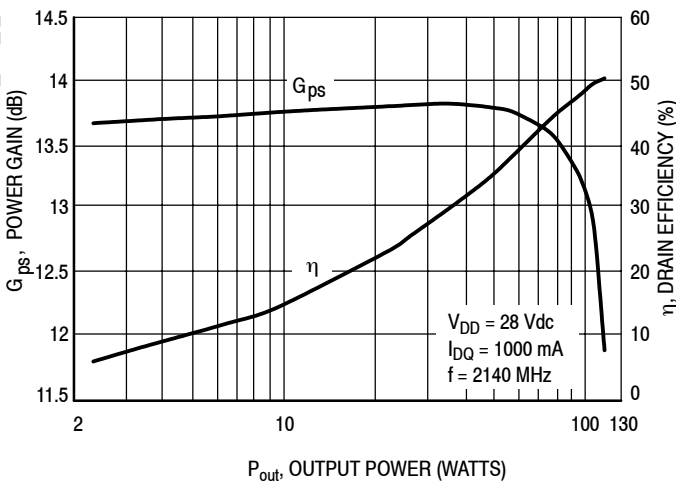
**Figure 4. Intermodulation Distortion Products versus Output Power**



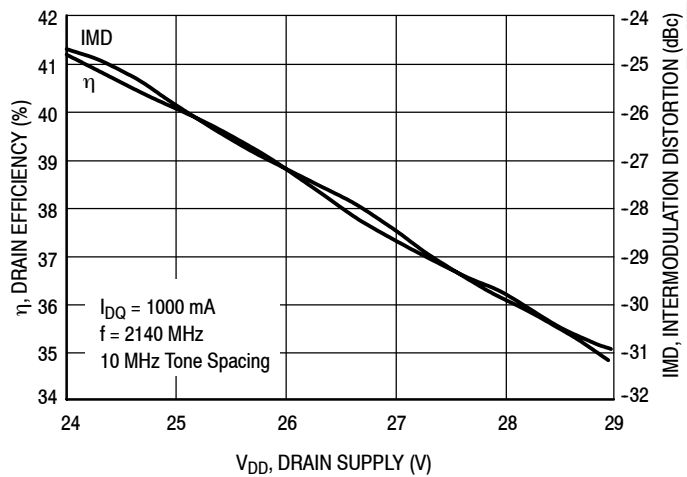
**Figure 5. Third Order Intermodulation Distortion versus Output Power**



**Figure 6. 2-Carrier W-CDMA Broadband Performance**



**Figure 7. CW Performance**

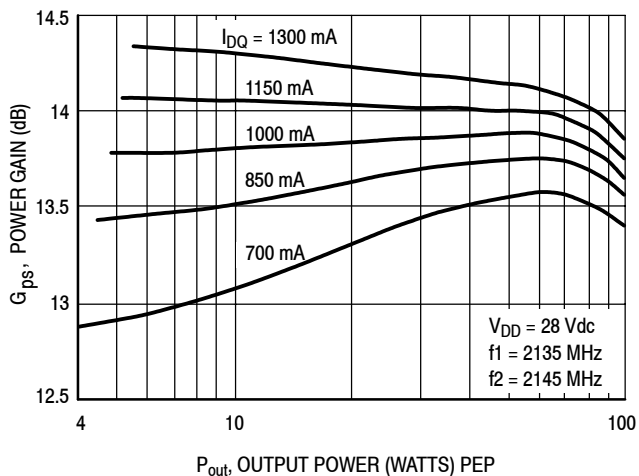


**Figure 8. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply**

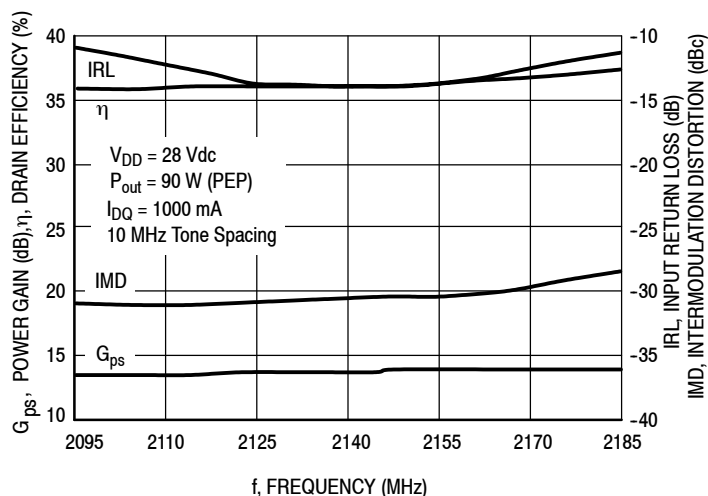
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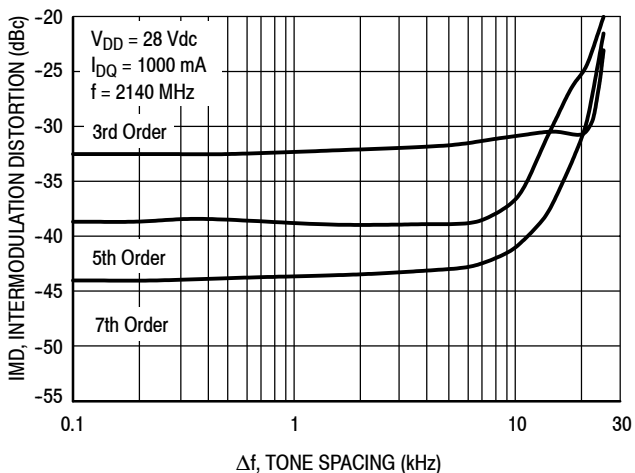
### TYPICAL CHARACTERISTICS



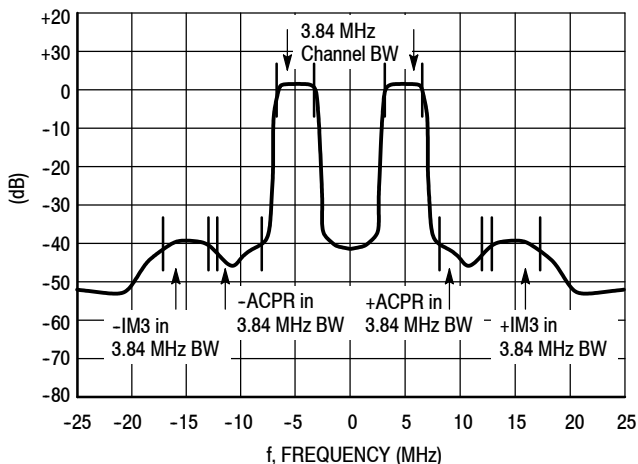
**Figure 9. Two-Tone Power Gain versus Output Power**



**Figure 10. Two-Tone Broadband Performance**



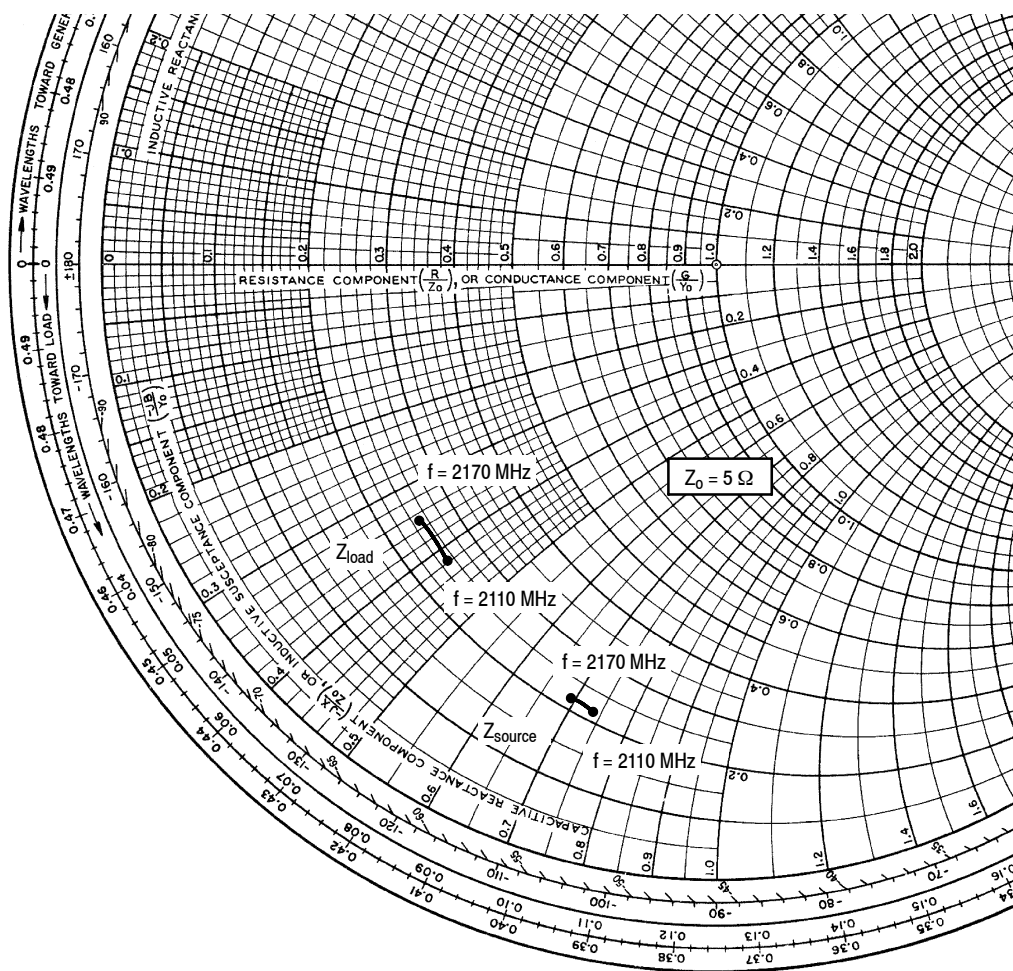
**Figure 11. Intermodulation Distortion Products versus Two-Tone Spacing**



**Figure 12. 2-Carrier W-CDMA Spectrum**

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$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 1000\text{ mA}$ ,  $P_{out} = 19\text{ W Avg.}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
2110	$1.10 - j3.71$	$1.23 - j2.10$
2140	$1.11 - j3.57$	$1.26 - j1.92$
2170	$1.12 - j3.40$	$1.25 - j1.76$

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

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

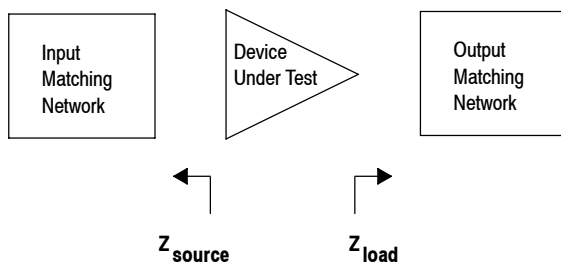
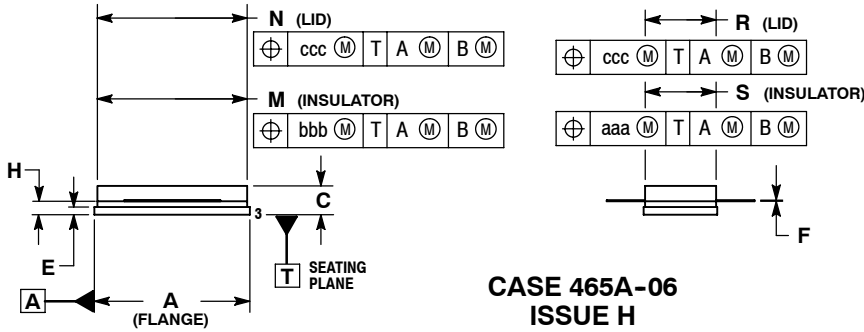
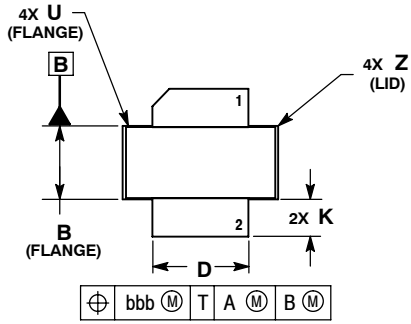


Figure 13. Series Equivalent Source and Load Impedance



## PACKAGE DIMENSIONS



**CASE 465A-06  
ISSUE H  
NI-780S  
MRF21085LSR3**

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DELETED
  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

- STYLE 1:  
PIN 1: DRAIN  
2: GATE  
5: SOURCE

## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
11	Oct. 2008	<ul style="list-style-type: none"> <li>• Data sheet revised to reflect part status change, p. 1, including use of applicable overlay.</li> <li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2</li> <li>• Added Product Documentation and Revision History, p. 10</li> <li>• Data sheet split due to change in part life cycle (-1, -2 added to enable visibility on web).</li> </ul>
	Dec. 2010	<ul style="list-style-type: none"> <li>• MRF21085-2 Rev. 11 (MRF21085LSR3) data sheet archived. Part no longer manufactured. See MRF21085-1 Rev. 10 for MRF21085LR3.</li> </ul>

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