



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

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.

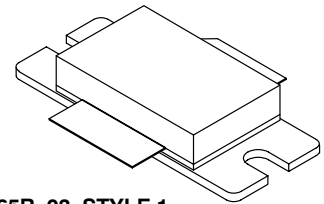
- Typical 2-Carrier W-CDMA Performance for  $V_{DD} = 28$  Volts,  $I_{DQ} = 1600$  mA,  $f_1 = 2112.5$  MHz,  $f_2 = 2122.5$  MHz, Channel bandwidth = 3.84 MHz, adjacent channels at  $\pm 5$  MHz, ACPR and IM3 measured in 3.84 MHz bandwidth. Peak/Avg. = 8.5 dB @ 0.01% probability on CCDF.  
 Output Power — 20 Watts  
 Efficiency — 18%  
 Gain — 13 dB  
 IM3 — -43 dBc  
 ACPR — -45 dBc
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2140 MHz, 125 Watts CW Output Power

### Features

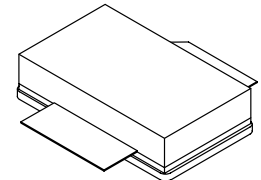
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF21125R3**  
**MRF21125SR3**

**2110-2170 MHz, 125 W, 28 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465B-03, STYLE 1**  
**NI-880**  
**MRF21125R3**



**CASE 465C-02, STYLE 1**  
**NI-880S**  
**MRF21125SR3**

**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 $25^\circ\text{C}$	$P_D$	330 1.89	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	$R_{\theta JC}$	0.53	$^\circ\text{C}/\text{W}$

**Table 3. ESD Protection Characteristics**

Test Conditions	Class
Human Body Model	2 (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 ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\ \mu\text{A}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{A}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{A}$
<b>On Characteristics</b>					
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 3\text{ A}$ )	$g_{fs}$	—	10.8	—	S
Gate Threshold Voltage ( $V_{DS} = 10\text{ V}$ , $I_D = 300\ \mu\text{A}$ )	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ V}$ , $I_D = 1300\text{ mA}$ )	$V_{GS(Q)}$	2.5	3.9	4.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ V}$ , $I_D = 1\text{ A}$ )	$V_{DS(on)}$	—	0.12	—	Vdc
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance (1) ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	5.4	—	pF

**Functional Tests** (In Freescale Test Fixture, 50 ohm system) 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth, IM3 measured in 3.84 MHz Bandwidth. Peak/Avg. = 8.5 dB @ 0.01% probability on CCDF.

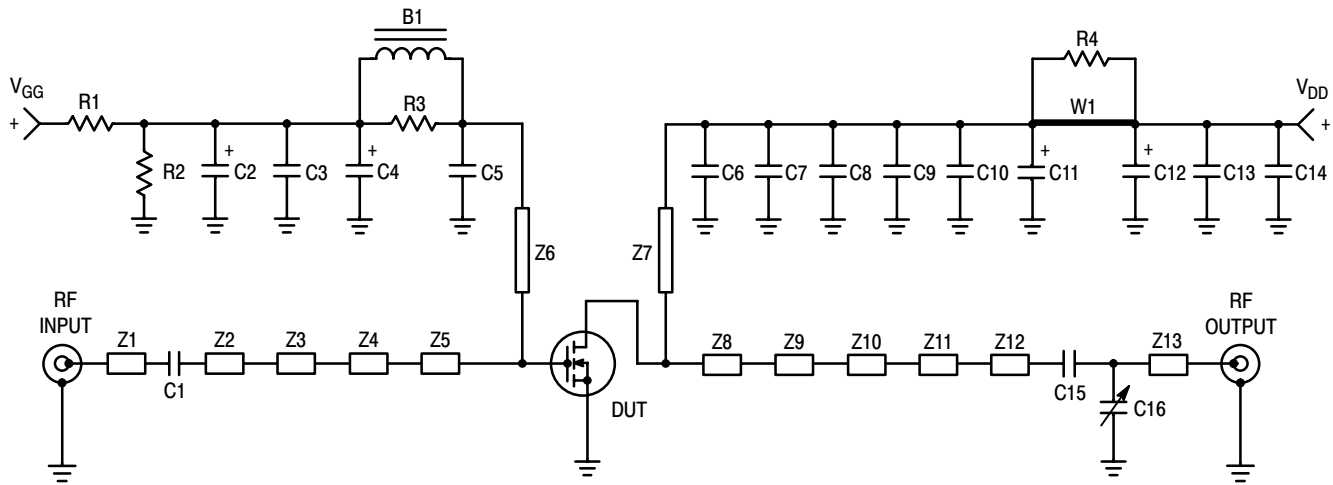
Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 20\text{ W Avg}$ , 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2112.5\text{ MHz}$ , $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$ , $f_2 = 2167.5\text{ MHz}$ )	$G_{ps}$	12	13	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 20\text{ W Avg}$ , 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2112.5\text{ MHz}$ , $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$ , $f_2 = 2167.5\text{ MHz}$ )	$\eta$	17	18	—	%
Third Order Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 20\text{ W Avg}$ , 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2112.5\text{ MHz}$ , $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$ , $f_2 = 2167.5\text{ MHz}$ ; IM3 measured at $f_1 - 10\text{ MHz}$ and $f_2 + 10\text{ MHz}$ referenced to carrier channel power.)	IM3	—	-43	-40	dBc
Adjacent Channel Power Ratio ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 20\text{ W Avg}$ , 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2112.5\text{ MHz}$ , $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$ , $f_2 = 2167.5\text{ MHz}$ ; ACPR measured at $f_1 - 5\text{ MHz}$ and $f_2 + 5\text{ MHz}$ referenced to carrier channel power.)	ACPR	—	-45	-40	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 20\text{ W Avg}$ , 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2112.5\text{ MHz}$ , $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$ , $f_2 = 2167.5\text{ MHz}$ )	IRL	—	-12	-9.0	dB

1. Part 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>Typical Two-Tone Performance</b> (In Freescale Test Fixture)					
Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 125\text{ W PEP}$ , $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$G_{ps}$	—	12	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 125\text{ W PEP}$ , $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$\eta$	—	34	—	%
Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 125\text{ W PEP}$ , $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	IMD	—	-30	—	dBc
<b>Typical CW Performance</b>					
Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 125\text{ W CW}$ , $I_{DQ} = 1600\text{ mA}$ , $f_1 = 2170.0\text{ MHz}$ )	$G_{ps}$	—	11.5	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 125\text{ W CW}$ , $I_{DQ} = 1600\text{ mA}$ , $f = 2170.0\text{ MHz}$ )	$\eta$	—	46	—	%

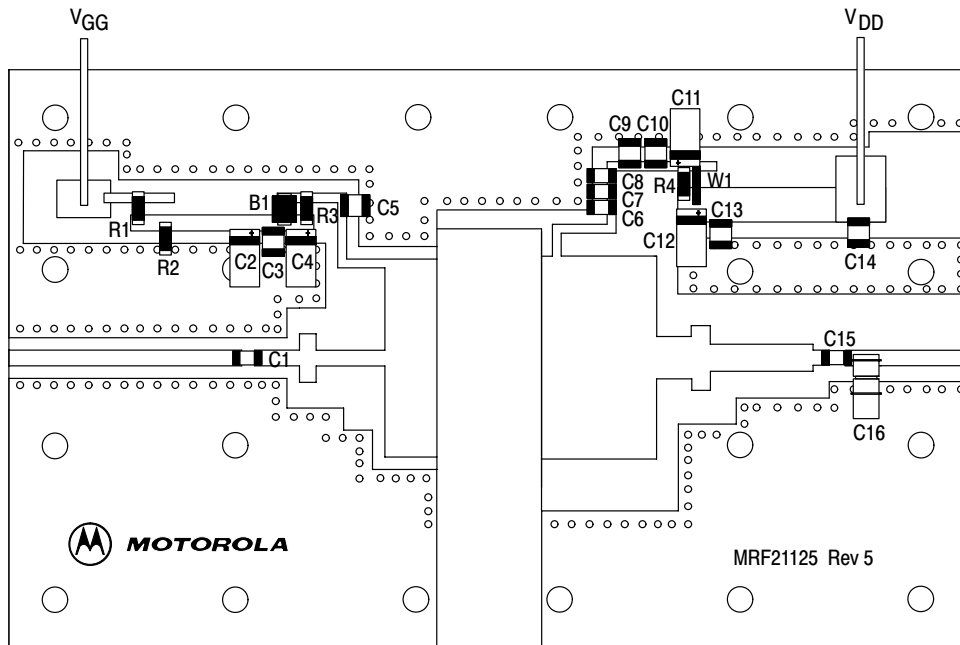


Z1	1.212" x 0.082" Microstrip	Z8	0.600" x 1.056" Microstrip
Z2	0.236" x 0.082" Microstrip	Z9	0.179" x 0.219" Microstrip
Z3	0.086" x 0.254" Microstrip	Z10	0.100" x 0.336" Microstrip
Z4	0.357" x 0.082" Microstrip	Z11	0.534" x 0.142" Microstrip
Z5	0.274" x 1.030" Microstrip	Z12	0.089" x 0.080" Microstrip
Z6	0.466" x 0.050" Microstrip	Z13	0.620" x 0.080" Microstrip
Z7	0.501" x 0.050" Microstrip	PCB	Arlon GX0300-55-22, 0.030", $\epsilon_r = 2.55$

Figure 1. MRF21125 Test Circuit Schematic

Table 5. MRF21125 Test Circuit Component Designations and Values

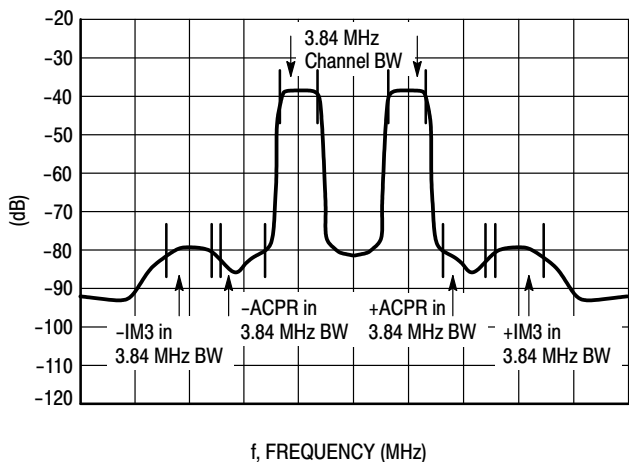
Designators	Description
B1	Ferrite Bead (Square), Fair Rite #2743019447
C1	9.1 pF Chip Capacitor, ATC #100B9R1CCA500X
C2, C4, C11, C12	22 $\mu$ F, 35 V Tantalum Surface Mount Chip Capacitors, Kemet #T491X226K035AS4394
C3, C7	20000 pF Chip Capacitors, ATC #100B203JCA50X
C5, C14	5.1 pF Chip Capacitors, ATC #100B5R1CCA500X
C6	100000 pF Chip Capacitor, ATC #100B104JCA50X
C8	10000 pF Chip Capacitor, ATC #100B103JCA50X
C9	7.5 pF Chip Capacitor, ATC #100B7R5CCA500X
C10	1.2 pF Chip Capacitor, ATC #100B1R2CCA500X
C13	0.1 $\mu$ F Chip Capacitor, Kemet #CDR33BX104AKWS
C15	16 pF Chip Capacitor, ATC #100B160KP500X
C16	0.6 - 4.5 pF Variable Capacitor, Johanson Gigatrim #27271SL
R1	1.0 k $\Omega$ , 1/8 W Chip Resistor
R2	560 k $\Omega$ , 1/8 W Chip Resistor
R3	4.7 $\Omega$ , 1/8 W Chip Resistor
R4	12 $\Omega$ , 1/8 W Chip Resistor
W1	Solid Copper Buss Wire, 16 AWG



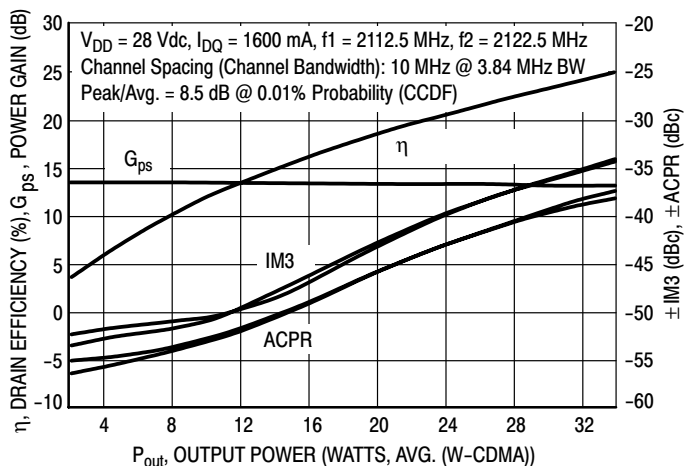
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**Figure 2. MRF21125 Test Circuit Component Layout**

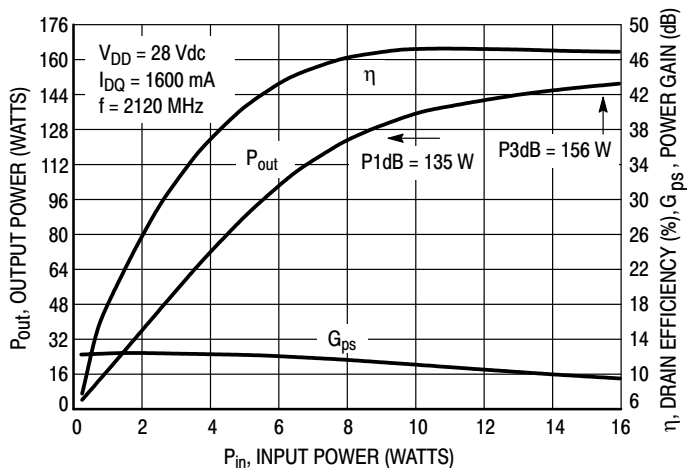
## TYPICAL CHARACTERISTICS



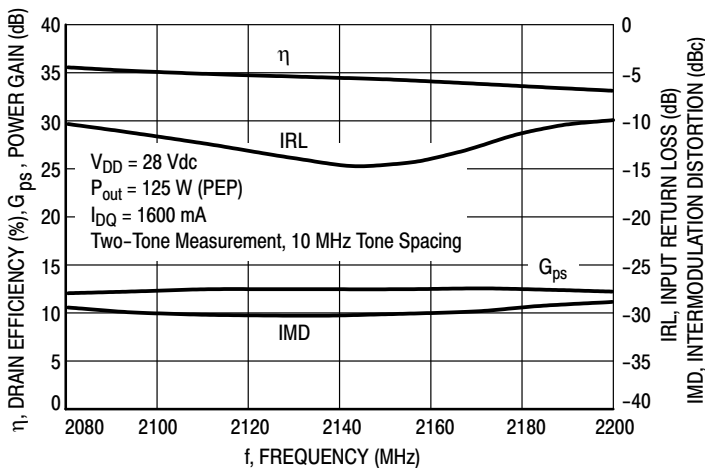
**Figure 3. 2-Carrier (10 MHz Spacing) W-CDMA Spectrum**



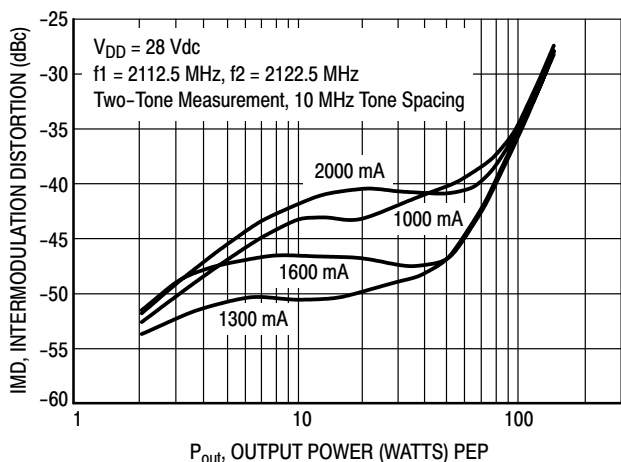
**Figure 4. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



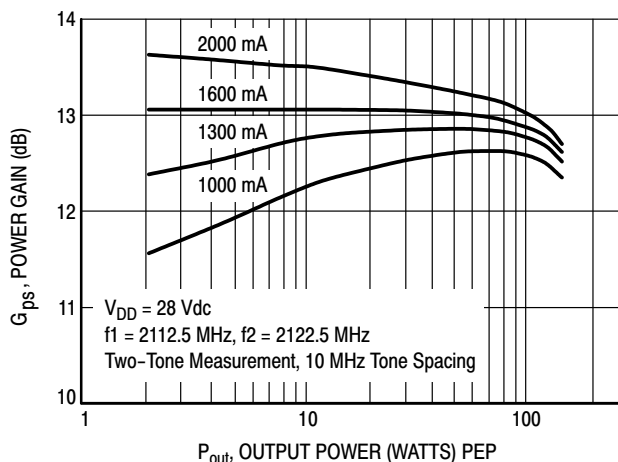
**Figure 5. CW Performance**



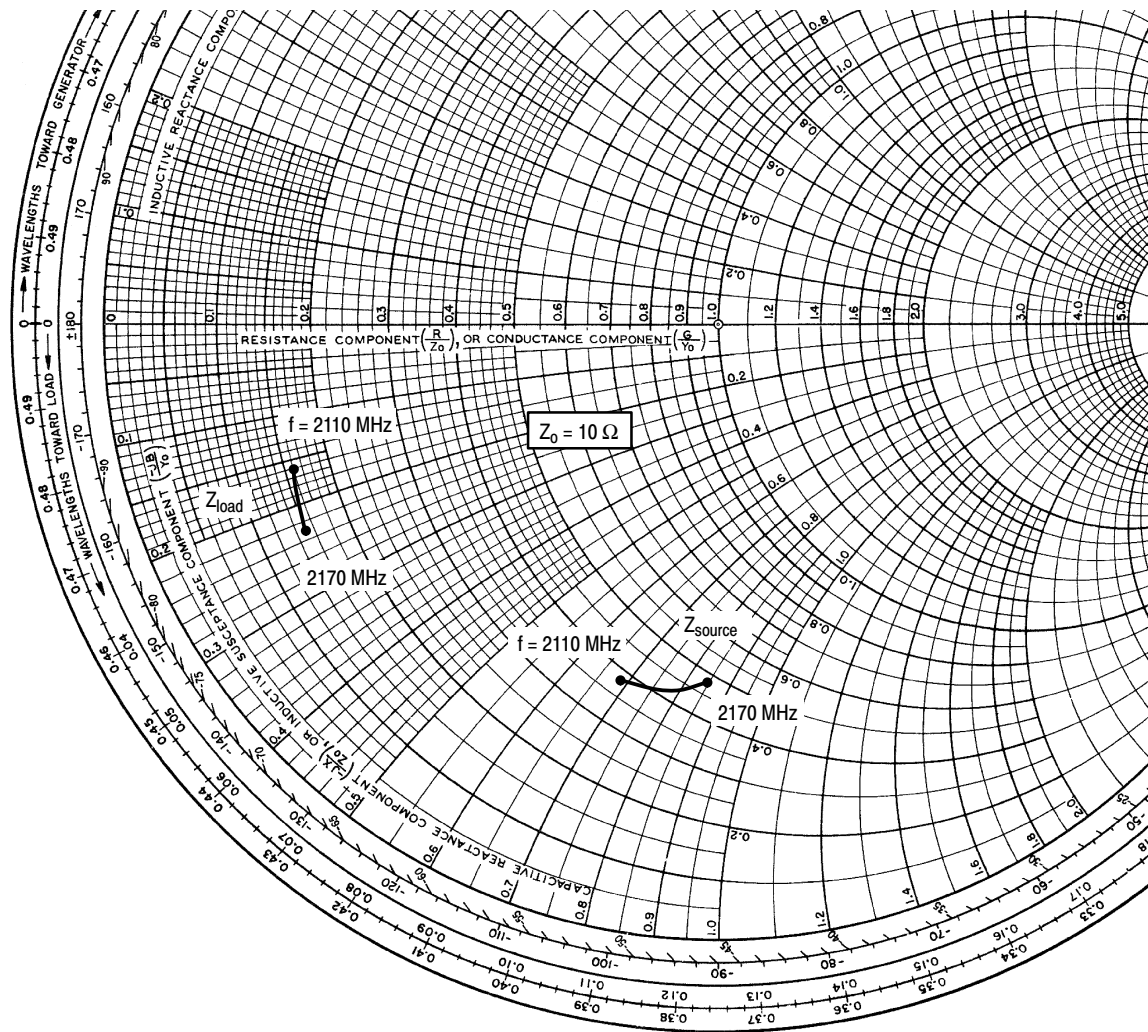
**Figure 6. Broadband Linearity Performance**



**Figure 7. Intermodulation Distortion versus Output Power**



**Figure 8. Power Gain versus Output Power**



$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 1600\text{ mA}$ ,  $P_{out} = 20\text{ W (Avg.)}$ , 2-Carrier W-CDMA

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
2110	$3.81 - j6.86$	$1.56 - j1.58$
2140	$4.33 - j7.90$	$1.53 - j1.90$
2170	$4.84 - j8.46$	$1.48 - j2.26$

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

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

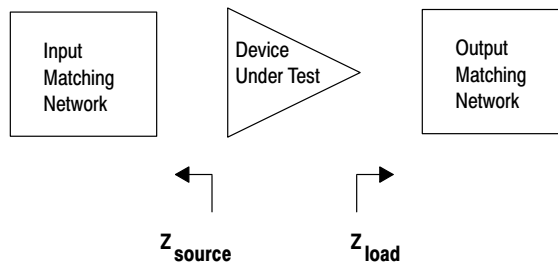


Figure 9. Series Equivalent Source and Load Impedance

# NOTES

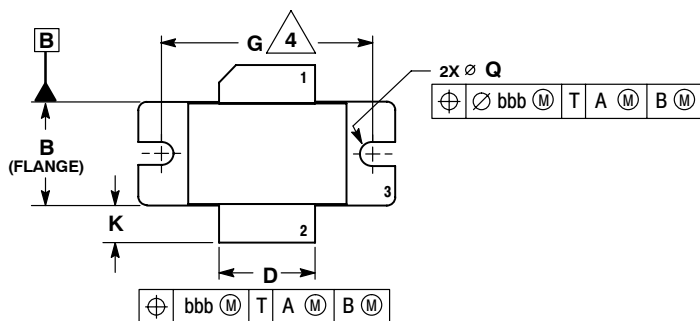




# NOTES

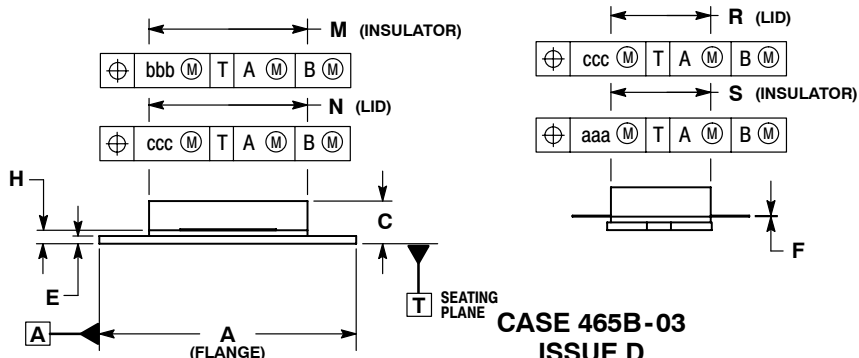
# NOTES

## PACKAGE DIMENSIONS



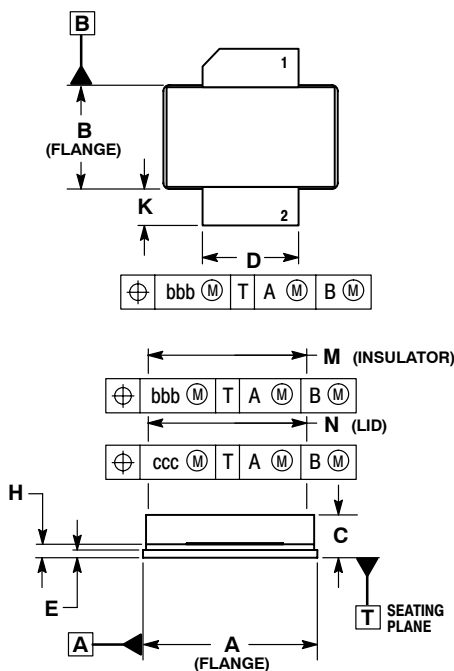
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
  4. RECOMMENDED BOLT CENTER DIMENSION OF 1.16 (29.57) BASED ON M3 SCREW.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.535	0.545	13.6	13.8
C	0.147	0.200	3.73	5.08
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
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.175	0.205	4.44	5.21
M	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
Q	Ø.118	Ø.138	Ø3.00	Ø3.51
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	



**CASE 465B-03  
ISSUE D  
NI-880  
MRF21125R3**

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



**CASE 465C-02  
ISSUE D  
NI-880S  
MRF21125SR3**

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.905	0.915	22.99	23.24
B	0.535	0.545	13.60	13.80
C	0.147	0.200	3.73	5.08
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	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

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