

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 ± 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°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
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Off Characteristics

Drain-Source Breakdown Voltage ($V_{GS} = 0\text{ Vdc}$, $I_D = 100\text{ }\mu\text{Adc}$)	$V_{(BR)DSS}$	65	—	—	Vdc
Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	1	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc

On Characteristics

Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 3\text{ Adc}$)	g_{fs}	—	10.8	—	S
Gate Threshold Voltage ($V_{DS} = 10\text{ V}$, $I_D = 300\text{ }\mu\text{A}$)	$V_{GS(th)}$	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

Dynamic Characteristics

Reverse Transfer Capacitance (1) ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$)	C_{rss}	—	5.4	—	pF
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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.

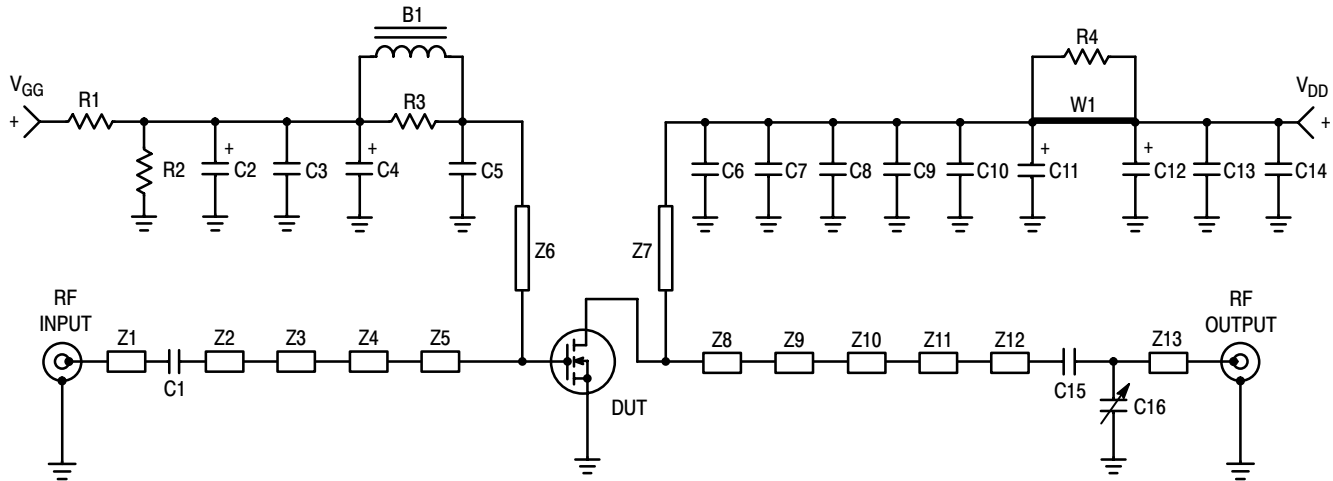
Common-Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 20\text{ W Avg}$, 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$, $f_1 = 2112.5\text{ MHz}$, $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$, $f_2 = 2167.5\text{ MHz}$)	G_{ps}	12	13	—	dB
Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 20\text{ W Avg}$, 2-carrier W-CDMA, $I_{DQ} = 1600\text{ mA}$, $f_1 = 2112.5\text{ MHz}$, $f_2 = 2122.5\text{ MHz}$ and $f_1 = 2157.5\text{ MHz}$, $f_2 = 2167.5\text{ MHz}$)	η	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
Typical Two-Tone Performance (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 $f_1 = 2160\text{ MHz}$, $f_2 = 2170\text{ MHz}$)	η	—	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
Typical CW Performance					
Common-Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 125\text{ W CW}$, $I_{DQ} = 1600\text{ mA}$, $f = 2170.0\text{ MHz}$)	G_{ps}	—	11.5	—	dB
Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 125\text{ W CW}$, $I_{DQ} = 1600\text{ mA}$, $f = 2170.0\text{ MHz}$)	η	—	46	—	%

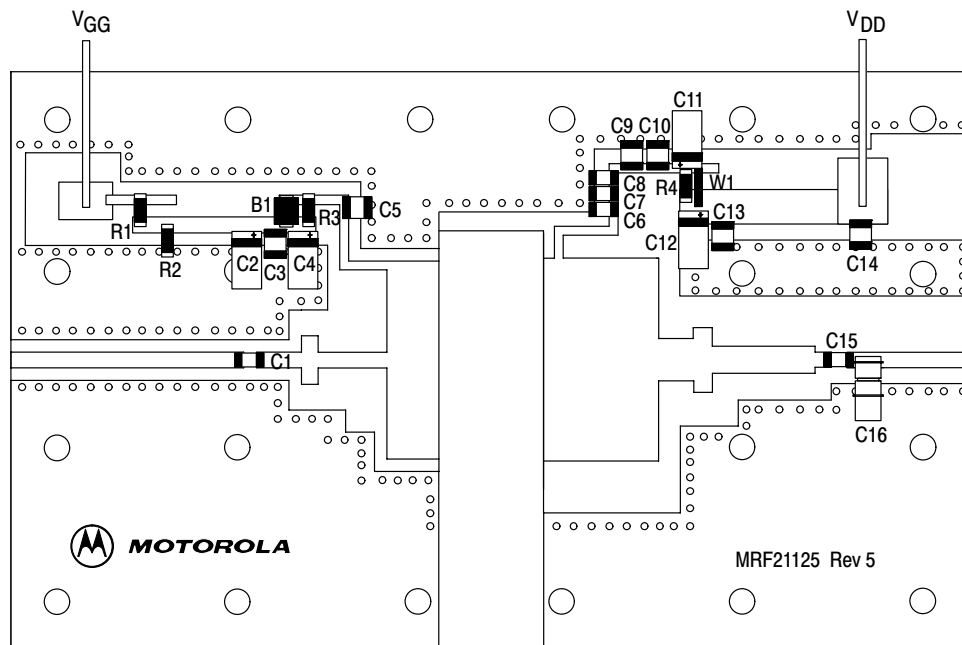


Z1	1.212" x 0.082" Microstrip	Z8	0.600" x 1.056" Microstrip
Z2	0.236" x 0.082" Microstrip	Z9	0.179" x 0.219" Microstrip
Z3	0.086" x 0.254" Microstrip	Z10	0.100" x 0.336" Microstrip
Z4	0.357" x 0.082" Microstrip	Z11	0.534" x 0.142" Microstrip
Z5	0.274" x 1.030" Microstrip	Z12	0.089" x 0.080" Microstrip
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 μ 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 μ 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 Ω , 1/8 W Chip Resistor
R2	560 k Ω , 1/8 W Chip Resistor
R3	4.7 Ω , 1/8 W Chip Resistor
R4	12 Ω , 1/8 W Chip Resistor
W1	Solid Copper Buss Wire, 16 AWG



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

Figure 2. MRF21125 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

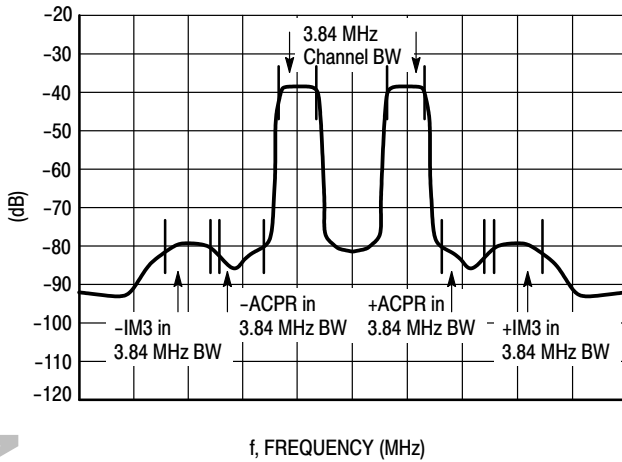


Figure 3. 2-Carrier (10 MHz Spacing) W-CDMA Spectrum

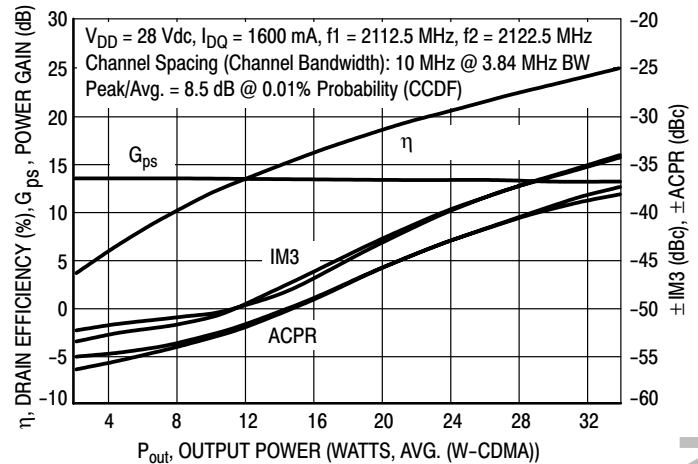


Figure 4. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

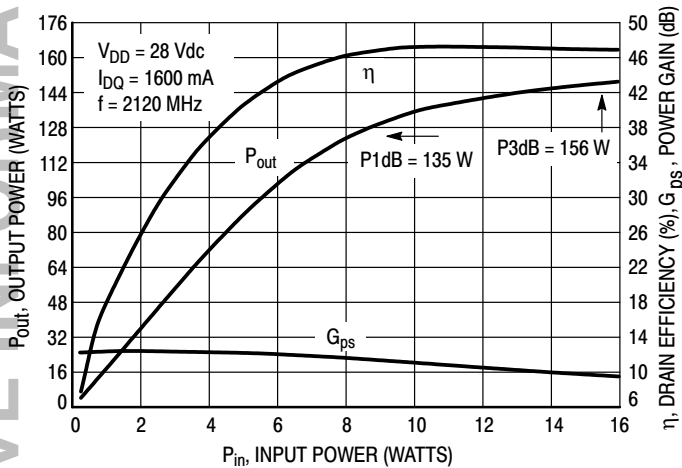


Figure 5. CW Performance

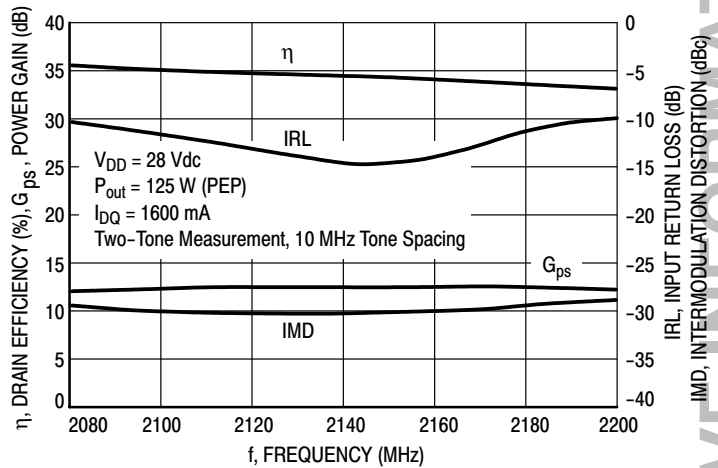


Figure 6. Broadband Linearity Performance

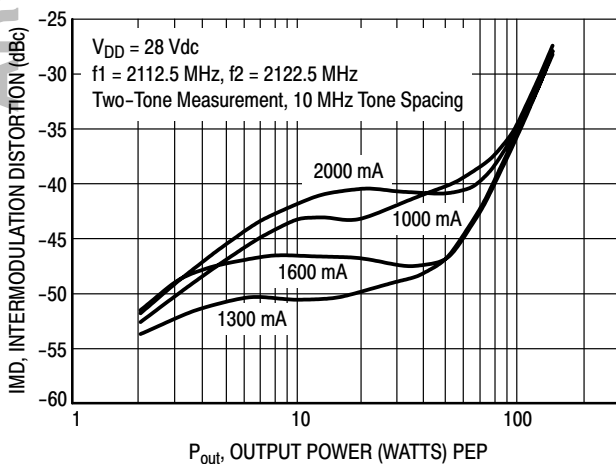


Figure 7. Intermodulation Distortion versus Output Power

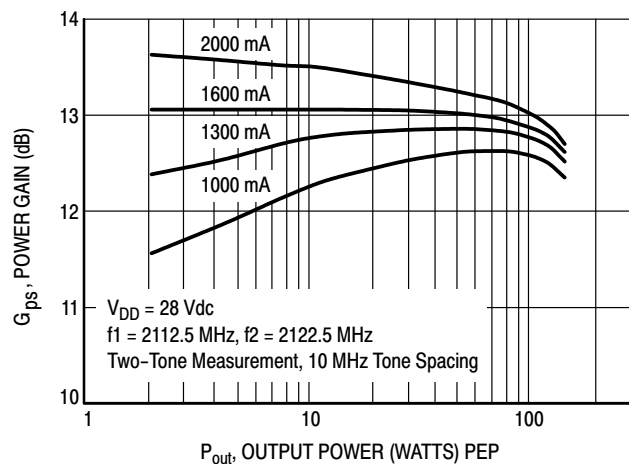
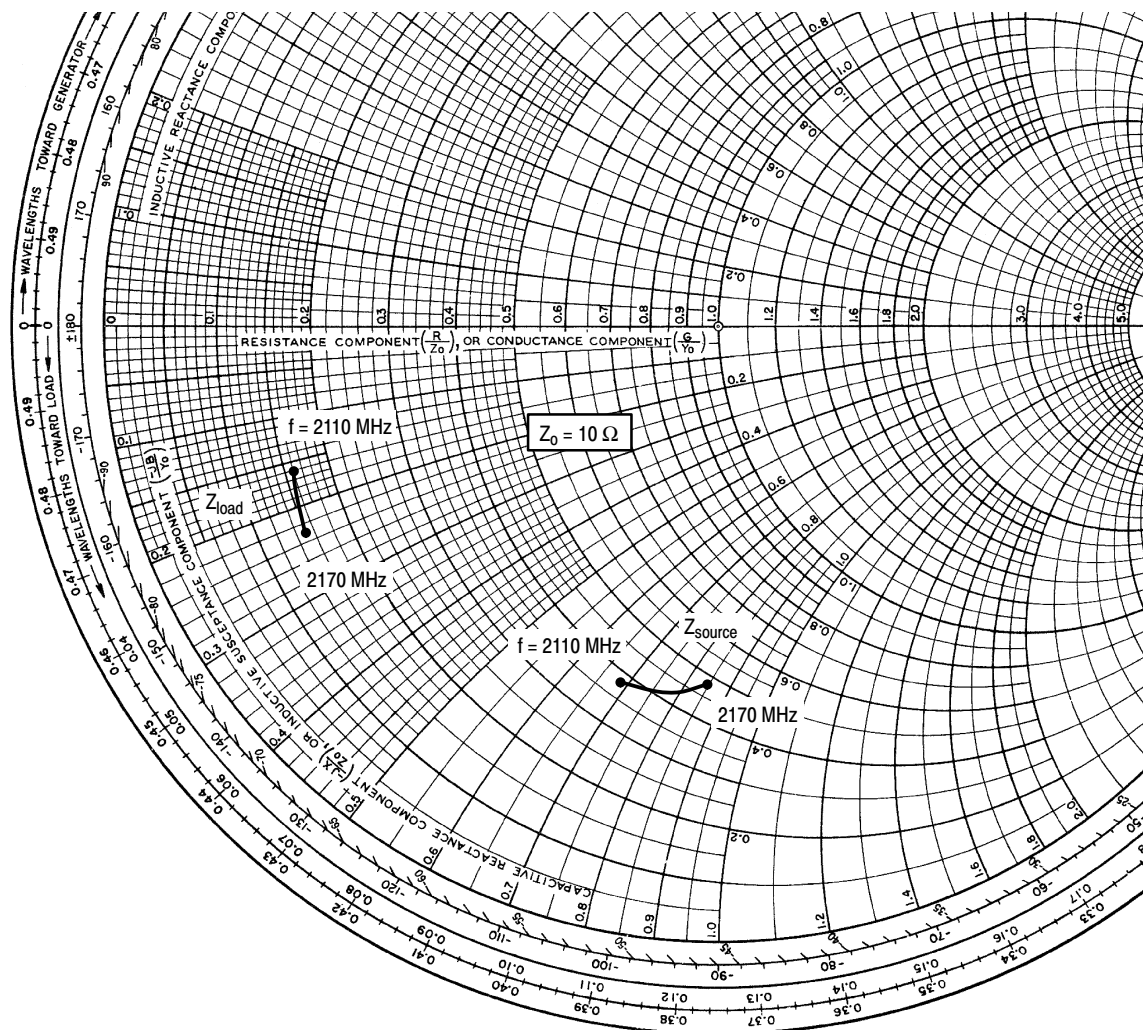


Figure 8. Power Gain versus Output Power



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

f MHz	Z_{source} Ω	Z_{load} Ω
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.

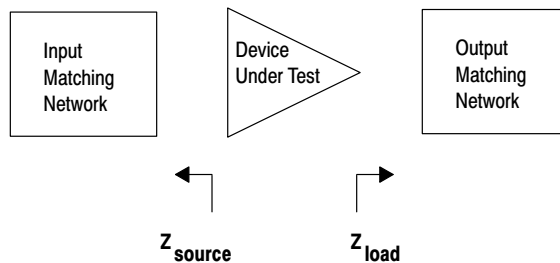


Figure 9. Series Equivalent Source and Load Impedance

ARCHIVE INFORMATION

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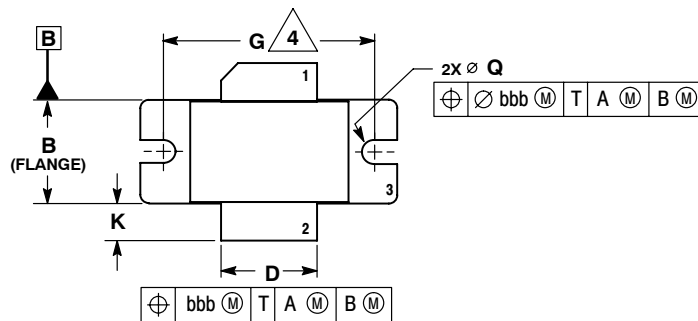


NOTES

ARCHIVE INFORMATION

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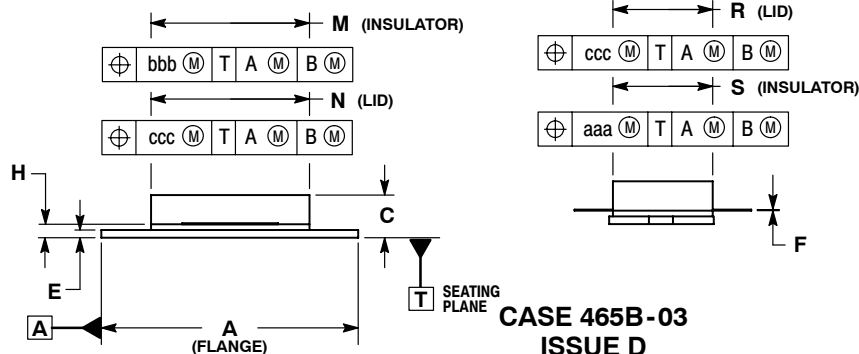
PACKAGE DIMENSIONS



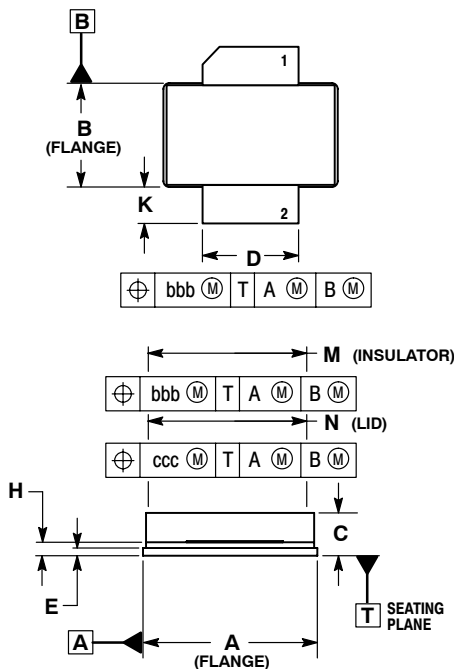
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
 4. RECOMMENDED BOLT CENTER DIMENSION OF 1.16 (29.57) BASED ON M3 SCREW.

DIM	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	$\varnothing$ 1.118	$\varnothing$ 1.138	$\varnothing$ 3.00	$\varnothing$ 3.51
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	

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



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



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 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	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

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

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