

# The RF MOSFET Line

## RF Power Field Effect Transistors

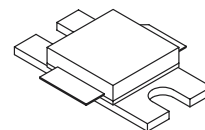
### N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications with frequencies from 2.0 to 2.2 GHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

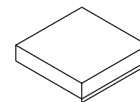
- Wideband CDMA Performance: -45 dB ACPR @ 4.096 MHz, 28 Volts  
Output Power — 3.5 Watts  
Power Gain — 14 dB  
Efficiency — 15%
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2.11 GHz, 30 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- In Tape and Reel. R3 Suffix = 250 Units per 32 mm, 13 Inch Reel.

**MRF21030R3**  
**MRF21030SR3**

**2.2 GHz, 30 W, 28 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465E-03, STYLE 1**  
**NI-400**  
**MRF21030R3**



**CASE 465F-03, STYLE 1**  
**NI-400S**  
**MRF21030SR3**

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	65	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	83.3 0.48	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +200	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

#### ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)

#### THERMAL CHARACTERISTICS

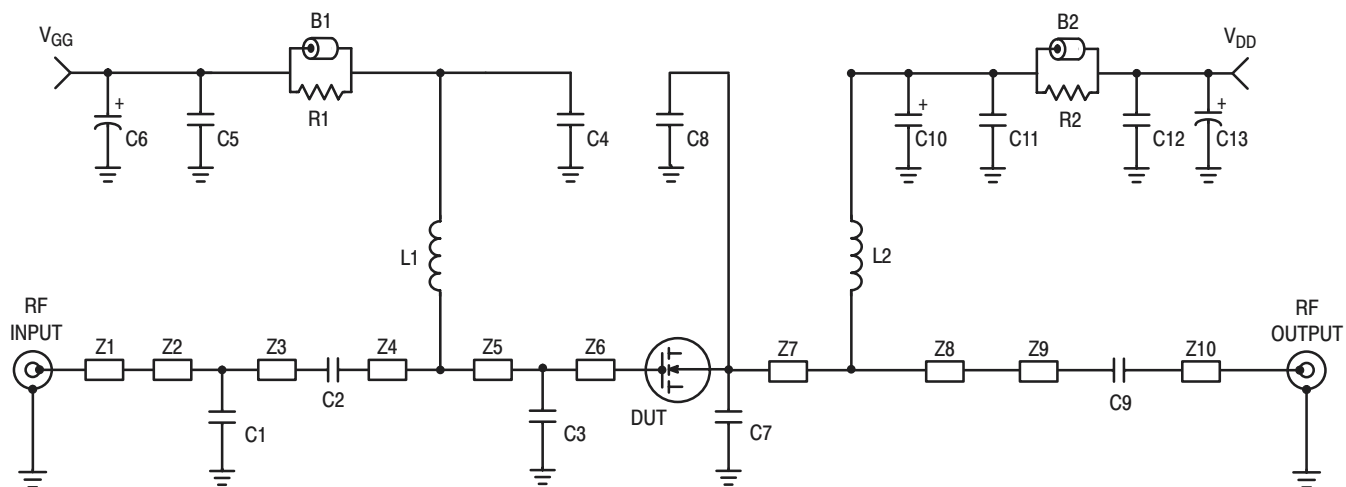
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.1	$^\circ\text{C/W}$

**NOTE – CAUTION** – MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

**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 ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 20\text{ }\mu\text{A}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate–Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>ON CHARACTERISTICS</b>					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{Adc}$ )	$V_{GS(th)}$	2	3	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ Vdc}$ , $I_D = 250\text{ mA}$ )	$V_{GS(Q)}$	2	3.3	4.5	Vdc
Drain–Source On–Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )	$V_{DS(on)}$	—	0.29	0.4	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )	$g_{fs}$	—	2	—	S
<b>DYNAMIC CHARACTERISTICS</b>					
Input Capacitance (Including Input Matching Capacitor in Package) (1) ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{iss}$	—	98.5	—	pF
Output Capacitance (1) ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{oss}$	—	37	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	1.3	—	pF
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system)					
Two–Tone Common–Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2140.0\text{ MHz}$ , $f_2 = 2140.1\text{ MHz}$ )	$G_{ps}$	—	13	—	dB
Two–Tone Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2140.0\text{ MHz}$ , $f_2 = 2140.1\text{ MHz}$ )	$\eta$	—	33	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2140.0\text{ MHz}$ , $f_2 = 2140.1\text{ MHz}$ )	IMD	—	–30	—	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2140.0\text{ MHz}$ , $f_2 = 2140.1\text{ MHz}$ )	IRL	—	–13	—	dB
Two–Tone Common–Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2110.0\text{ MHz}$ , $f_2 = 2110.1\text{ MHz}$ and $f_1 = 2170.0\text{ MHz}$ , $f_2 = 2170.1\text{ MHz}$ )	$G_{ps}$	12	13	—	dB
Two–Tone Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2110.0\text{ MHz}$ , $f_2 = 2110.1\text{ MHz}$ and $f_1 = 2170.0\text{ MHz}$ , $f_2 = 2170.1\text{ MHz}$ )	$\eta$	31	33	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2110.0\text{ MHz}$ , $f_2 = 2110.1\text{ MHz}$ and $f_1 = 2170.0\text{ MHz}$ , $f_2 = 2170.1\text{ MHz}$ )	IMD	—	–30	–27.5	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W PEP}$ , $I_{DQ} = 250\text{ mA}$ , $f_1 = 2110.0\text{ MHz}$ , $f_2 = 2110.1\text{ MHz}$ and $f_1 = 2170.0\text{ MHz}$ , $f_2 = 2170.1\text{ MHz}$ )	IRL	—	–13	–9	dB
Output Mismatch Stress ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 30\text{ W CW}$ , $I_{DQ} = 250\text{ mA}$ , $f = 2110\text{ MHz}$ , $V_{SWR} = 10:1$ , All Phase Angles at Frequency of Tests)	$\Psi$	No Degradation In Output Power Before and After Test			

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



B1, B2	Short Ferrite Beads	Z1	0.153" x 0.087" Microstrip
C1	1 pF Chip Capacitor	Z2	0.509" x 0.156" Microstrip
C2	4.7 pF Chip Capacitor	Z3	0.572" x 0.087" Microstrip
C3	0.5 pF Chip Capacitor	Z4	0.509" x 0.232" Microstrip
C4	3.9 pF Chip Capacitor	Z5	0.277" x 0.143" Microstrip
C5, C12	0.1 $\mu$ F Chip Capacitors	Z6	0.200" x 0.305" Microstrip
C6, C13	470 $\mu$ F, 63 V Electrolytic Chip Capacitors	Z7	0.200" x 0.511" Microstrip
C7, C8	0.3 pF Chip Capacitors	Z8	0.510" x 0.328" Microstrip
C9	3.6 pF Chip Capacitor	Z9	0.608" x 0.081" Microstrip
C10	22 $\mu$ F Tantalum Chip Capacitor	Board	0.030" Glass Teflon <sup>®</sup> , TLX8-0300
C11	5.1 pF Chip Capacitor		Taconix ( $\epsilon_r = 2.55$ )
L1, L2	12.5 nH Inductors		
R1, R2	12 $\Omega$ Chip Resistors (1206)		

Figure 1. MRF21030 Test Circuit Schematic

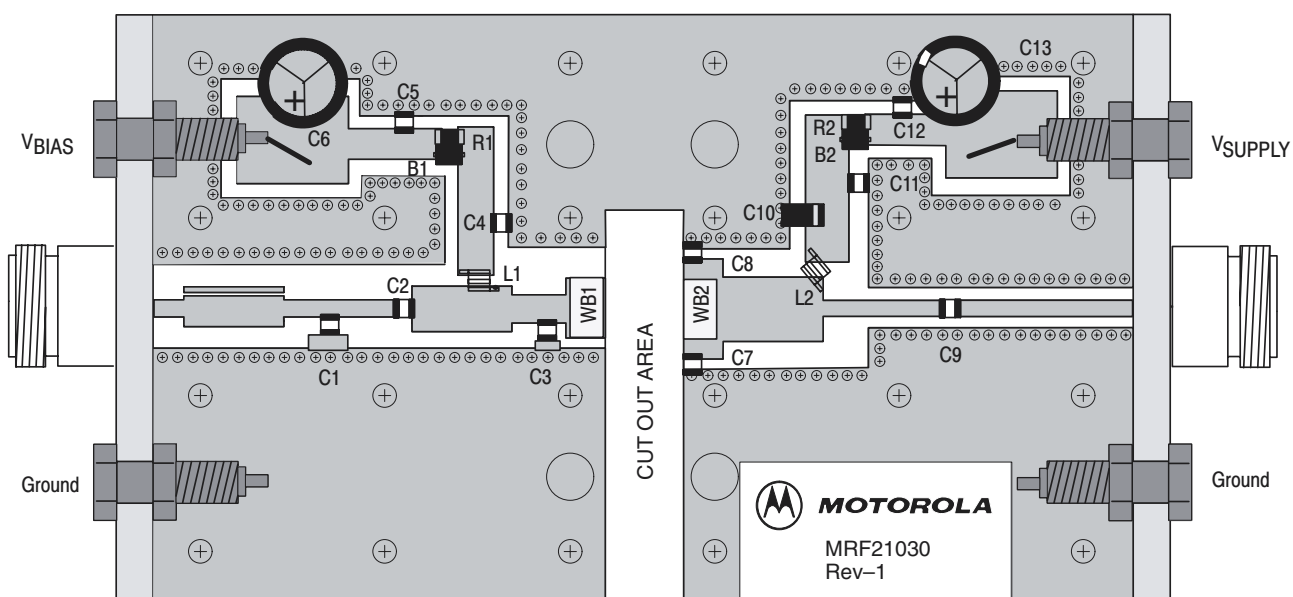


Figure 2. MRF21030 Test Circuit Component Layout

## TYPICAL CHARACTERISTICS

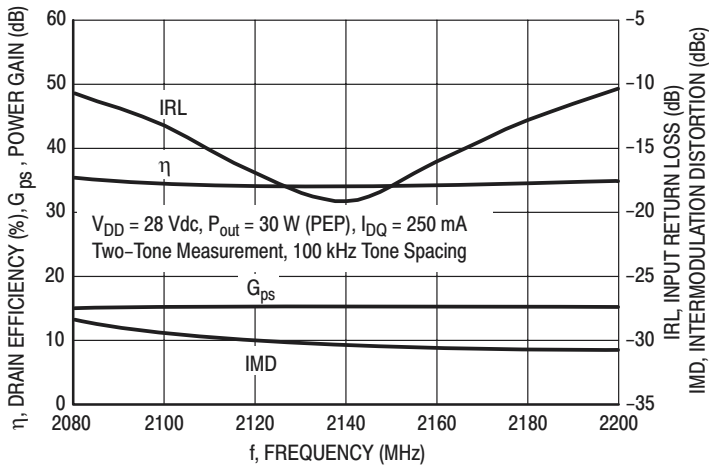


Figure 3. Class AB Broadband Circuit Performance

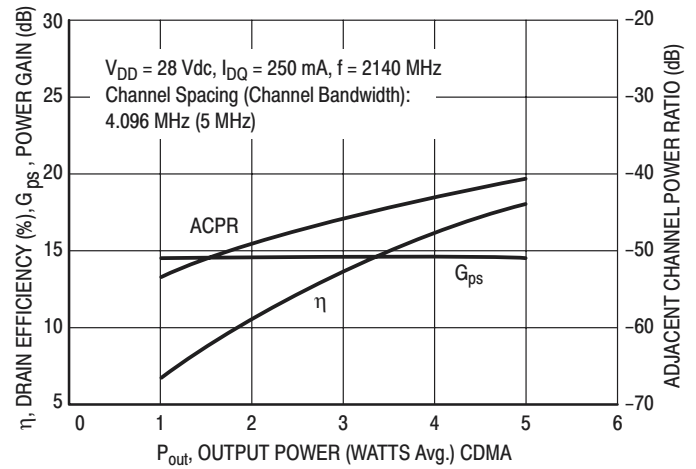


Figure 4. CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

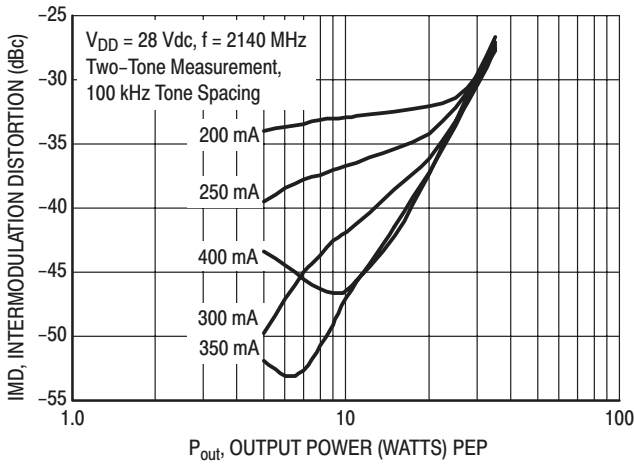


Figure 5. Intermodulation Distortion versus Output Power

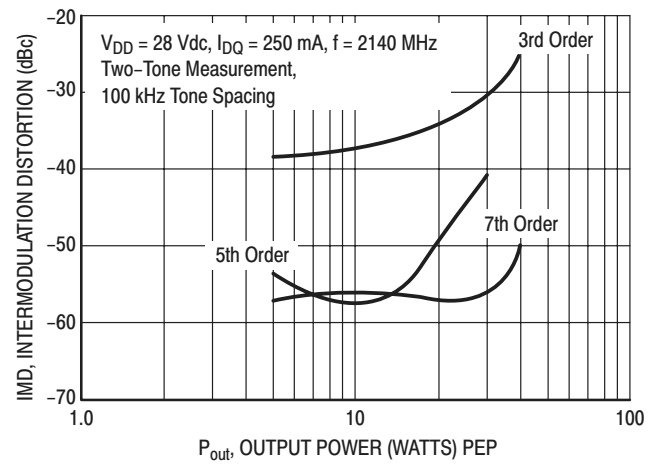


Figure 6. Intermodulation Distortion Products versus Output Power

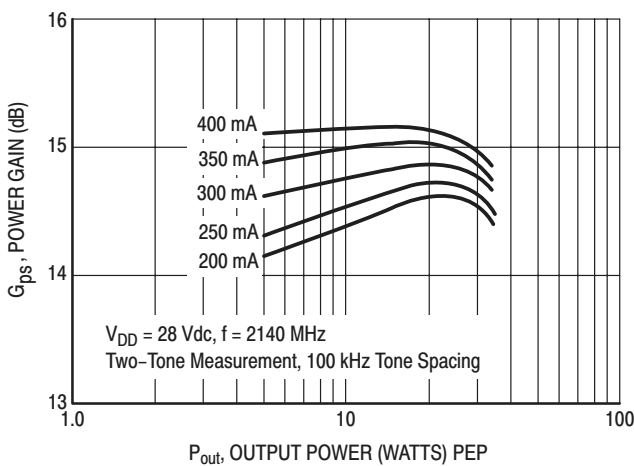


Figure 7. Power Gain versus Output Power

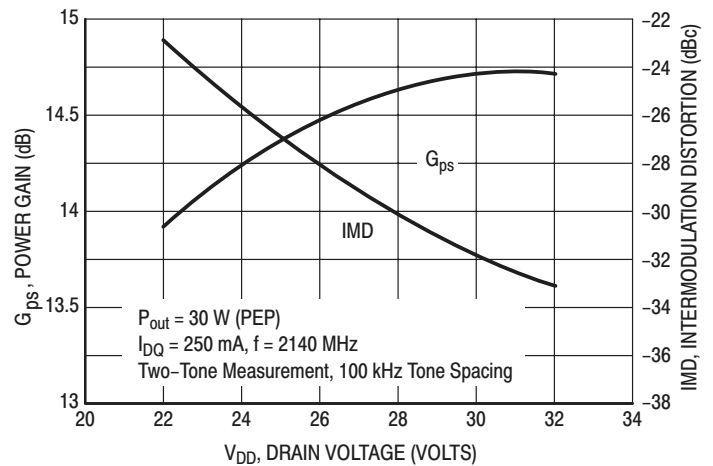
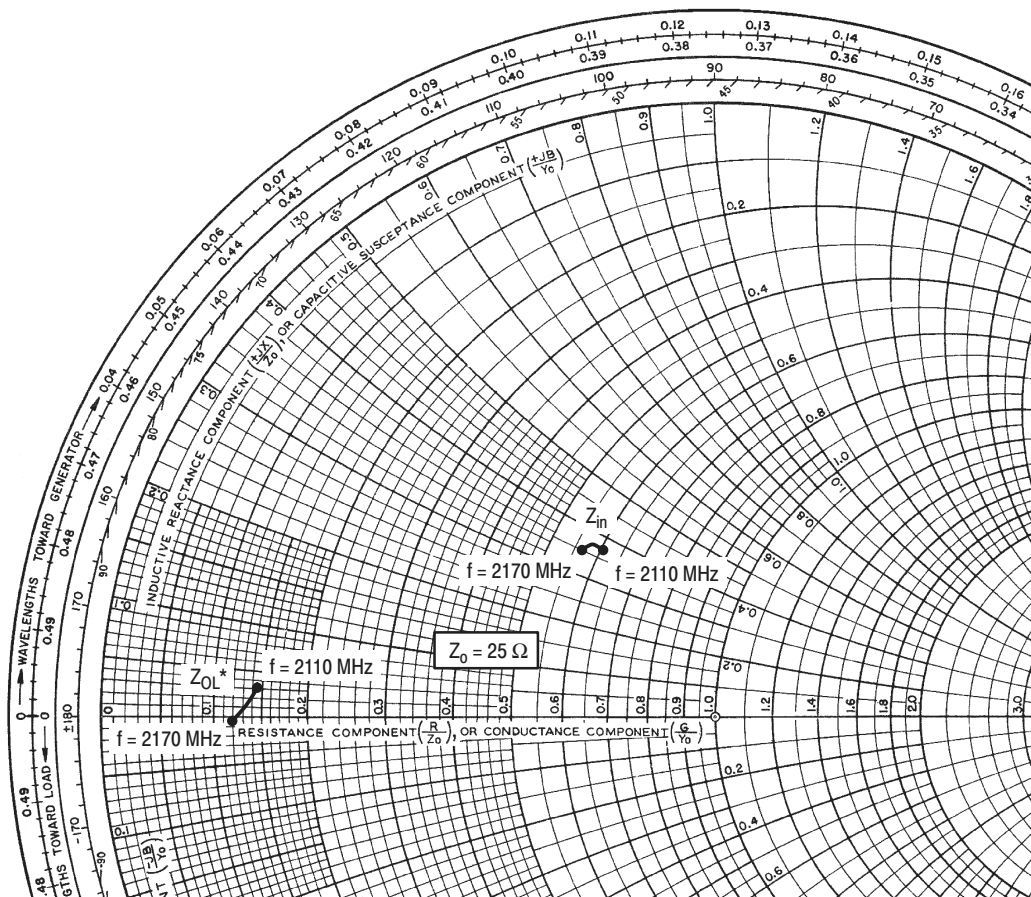


Figure 8. Power Gain and Intermodulation Distortion versus Supply Voltage



$V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 250 \text{ mA}$ ,  $P_{out} = 30 \text{ W PEP}$

f MHz	$Z_{in}$ $\Omega$	$Z_{OL}^*$ $\Omega$
2110	$15.3 + j9.4$	$3.7 + j0.78$
2140	$14.6 + j9.4$	$3.4 + j0.37$
2170	$14.3 + j8.8$	$3.0 - j0.13$

$Z_{in}$  = Complex conjugate of source impedance.

$Z_{OL}^*$  = Complex conjugate of the optimum load impedance at a given output power, voltage, IMD, bias current and frequency.

Note:  $Z_{OL}^*$  was chosen based on tradeoffs between gain, output power, drain efficiency and intermodulation distortion.

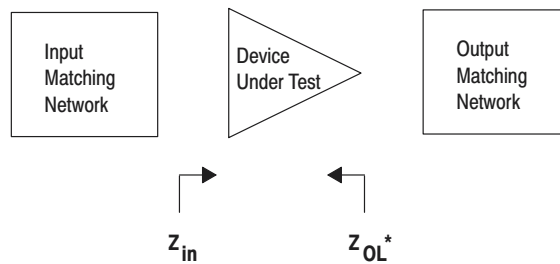
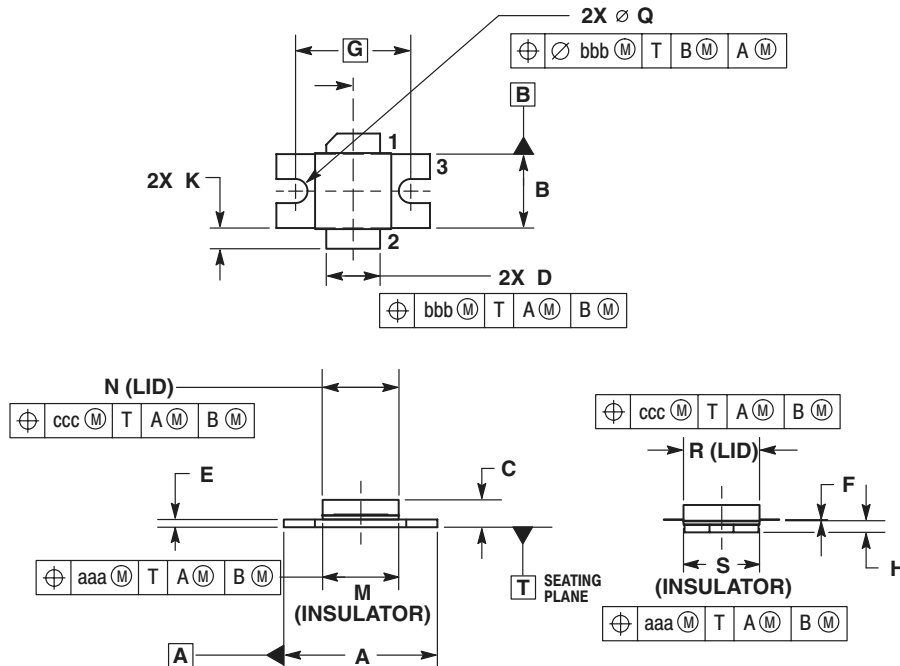


Figure 9. Series Equivalent Input and Output Impedance

# NOTES

## PACKAGE DIMENSIONS



### NOTES:

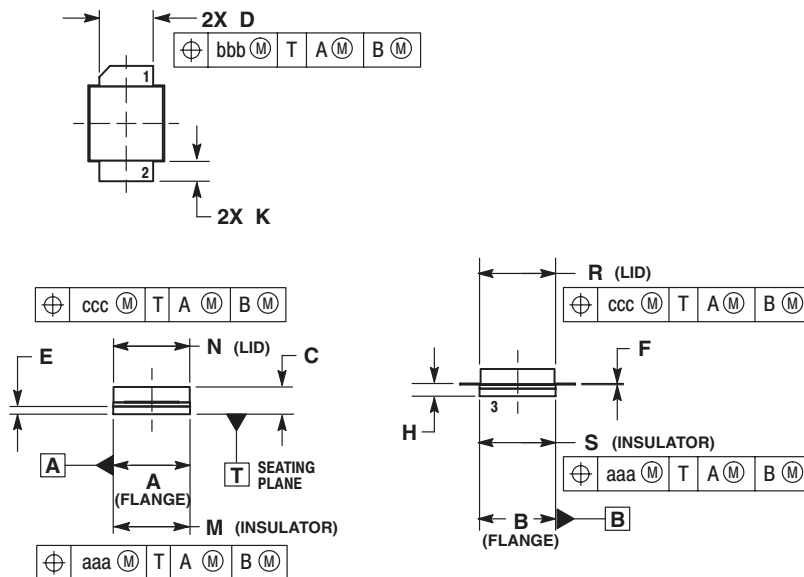
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.795	.805	20.19	20.44
B	.380	.390	9.65	9.9
C	.125	.163	3.17	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.003	.006	0.07	0.15
G	.600 BSC		15.24 BSC	
H	.057	.067	1.45	1.7
K	.092	.122	2.33	3.1
M	.395	.405	10	10.3
N	.395	.405	10	10.3
Q	Ø .110	Ø .130	Ø 2.79	Ø 3.3
R	.395	.405	10	10.3
S	.395	.405	10	10.3
aaa	.005 BSC		0.127 BSC	
bbb	.010 BSC		0.254 BSC	
ccc	.015 BSC		0.381 BSC	

### STYLE 1:

1. DRAIN
2. GATE
3. SOURCE

**CASE 465E-03  
ISSUE D  
NI-400  
MRF21030R3**



### NOTES:


1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.395	.405	10.03	10.29
C	.125	.163	3.18	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.003	.006	0.08	0.15
H	.057	.067	1.45	1.70
K	.092	.122	2.34	3.10
M	.395	.405	10.03	10.29
N	.395	.405	10.03	10.29
R	.395	.405	10.03	10.29
S	.395	.405	10.03	10.29
aaa	.005 REF		0.127 REF	
bbb	.010 REF		0.254 REF	
ccc	.015 REF		0.38 REF	

### STYLE 1:

1. DRAIN
2. GATE
3. SOURCE

**CASE 465F-03  
ISSUE B  
NI-400S  
MRF21030SR3**

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**JAPAN:** Motorola Japan Ltd.; SPS, Technical Information Center, 3-20-1, Minami-Azabu. Minato-ku, Tokyo 106-8573 Japan. 81-3-3440-3569

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852-26668334

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