

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and GSM EDGE base station applications with frequencies from 921 to 960 MHz, the high gain and broadband performance of these devices make them ideal for large-signal, common-source amplifier applications in 28 volt base station equipment.

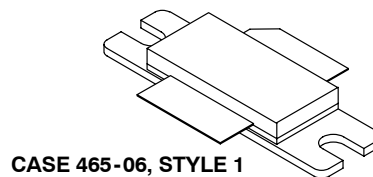
- Typical Performance for GSM Frequencies, 921 to 960 MHz, 28 Volts Output Power @ P1dB — 135 Watts  
Power Gain — 16.5 dB @ 130 Watts Output Power  
Efficiency — 48% @ 130 Watts Output Power
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 945 MHz, 130 Watts CW Output Power

### Features

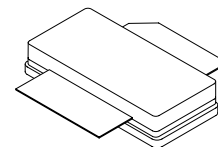
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness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

**MRF9130LR3**  
**MRF9130LSR3**

**GSM/GSM EDGE**  
**921-960 MHz, 130 W, 28 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF9130LR3**



**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF9130LSR3**

**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	$P_D$	298 1.7	W W/°C
Storage Temperature Range	$T_{stg}$	- 65 to +200	°C
Case Operating Temperature	$T_C$	150	°C
Operating Junction Temperature	$T_J$	200	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.6	°C/W

**Table 3. ESD Protection Characteristics**

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M2 (Minimum)
Charge Device Model	C7 (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65 \text{ Vdc}$ , $V_{GS} = 0 \text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage 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 ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 450 \mu\text{Adc}$ )	$V_{GS(th)}$	2	3	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28 \text{ Vdc}$ , $I_D = 1000 \text{ mAdc}$ )	$V_{GS(Q)}$	—	3.6	—	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10 \text{ Vdc}$ , $I_D = 3 \text{ Adc}$ )	$V_{DS(on)}$	—	0.2	0.4	Vdc
Forward Transconductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 9 \text{ Adc}$ )	$g_{fs}$	—	12	—	S
<b>Dynamic Characteristics</b> (1)					
Output Capacitance ( $V_{DS} = 28 \text{ Vdc} \pm 30 \text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0 \text{ Vdc}$ )	$C_{oss}$	—	110	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 28 \text{ Vdc} \pm 30 \text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0 \text{ Vdc}$ )	$C_{rss}$	—	4.4	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture)					
Power Output, 1 dB Compression Point ( $V_{DD} = 28 \text{ Vdc}$ , $I_{DQ} = 1000 \text{ mA}$ , $f = 921$ and $960 \text{ MHz}$ )	$P_{1dB}$	120	135	—	W
Common-Source Amplifier Power Gain ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 130 \text{ W}$ , $I_{DQ} = 1000 \text{ mA}$ , $f = 921$ and $960 \text{ MHz}$ )	$G_{ps}$	15.5	16.5	—	dB
Drain Efficiency ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 130 \text{ W}$ , $I_{DQ} = 1000 \text{ mA}$ , $f = 921$ and $960 \text{ MHz}$ )	$\eta$	43	48	—	%
Input Return Loss ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 130 \text{ W}$ , $I_{DQ} = 1000 \text{ mA}$ , $f = 921$ and $960 \text{ MHz}$ )	IRL	—	-12	-9	dB

1. Part internally input matched.

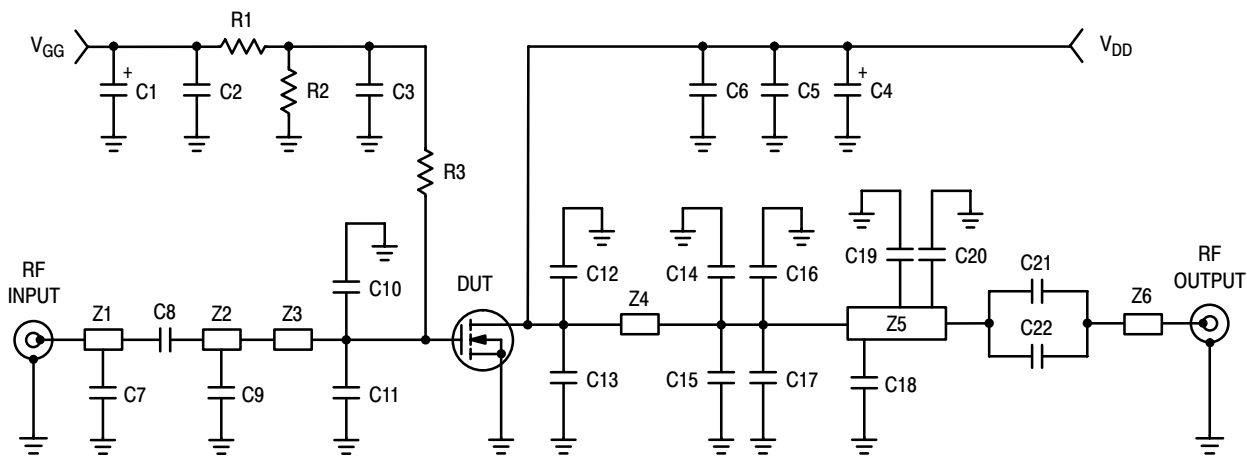
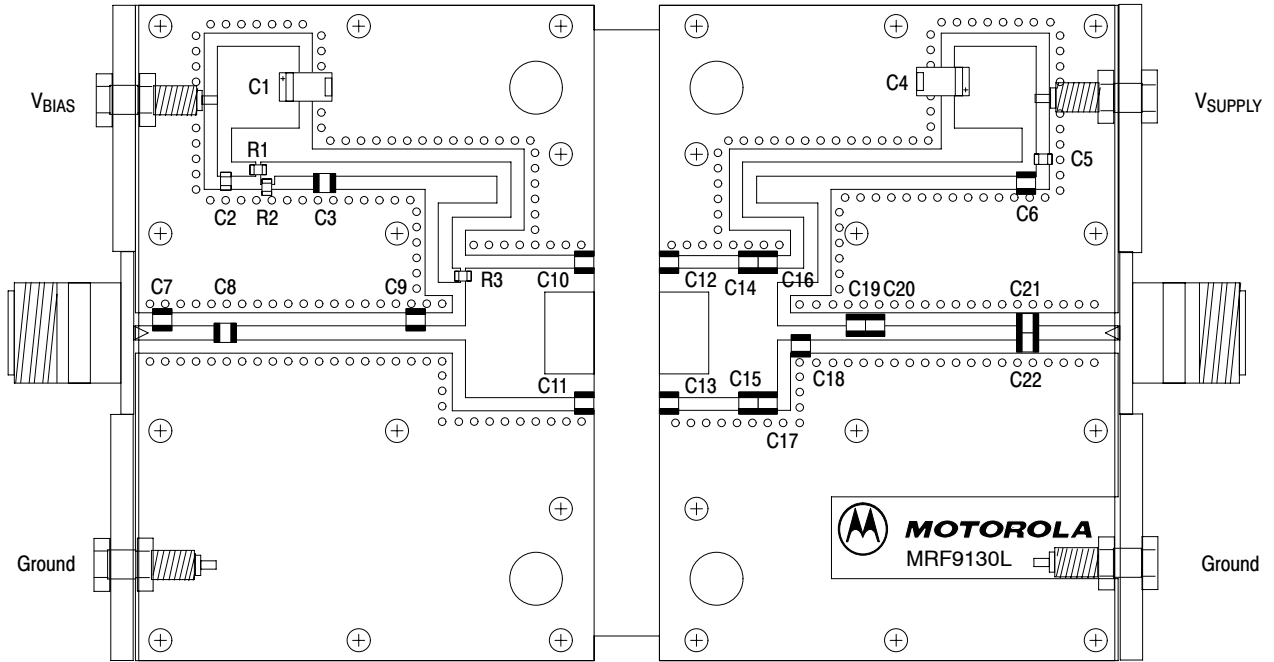


Figure 1. 921 - 960 MHz Test Circuit Schematic

Table 5. 921 - 960 MHz Test Circuit Component Designations and Values

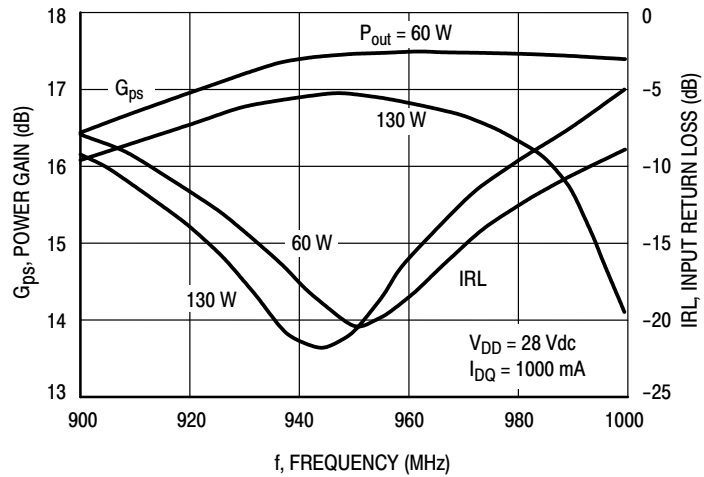
Designators	Description
C1, C4	10 $\mu$ F, 35 V Tantalum Capacitors, Vishay -Sprague #293D106X9035D
C2, C5	100 nF Chip Capacitors (1206), AVX #1206C104KATDA
C3, C8, C21, C22	22 pF, 100B Chip Capacitors, ATC #100B220C
C6	33 pF, 100B Chip Capacitor, ATC #100B330JW
C7	1.0 pF, 100B Chip Capacitor, ATC #100B1R0BW
C9	4.7 pF, 100B Chip Capacitor, ATC #100B4R7BW
C10	8.2 pF, 100B Chip Capacitor, ATC #100B8R2CW
C11	10 pF, 100B Chip Capacitor, ATC #100B100GW
C12, C13	12 pF, 100B Chip Capacitors, ATC #100B120GW
C14, C15	2.7 pF, 100B Chip Capacitors, ATC #100B2R7BW
C16, C17, C18	3.9 pF, 100B Chip Capacitors, ATC #100B3R9BW
C19	3.3 pF, 100B Chip Capacitor, ATC #100B3R3BW
C20	1.8 pF, 100B Chip Capacitor, ATC #100B1R8BW
R1	18 k $\Omega$ , 1/8 W Chip Resistor (1206)
R2	10 k $\Omega$ , 1/8 W Chip Resistor (1206)
R3	1.0 k $\Omega$ , 1/8 W Chip Resistor (1206)
Z1	0.117" x 0.600" Microstrip
Z2	0.117" x 1.851" Microstrip
Z3	1.074" x 1.068" Microstrip
Z4	1.074" x 0.980" Microstrip
Z5	0.117" x 1.933" Microstrip
Z6	0.117" x 0.605" Microstrip
PCB	Taconic TLX8, 0.030", $\epsilon_r = 2.55$



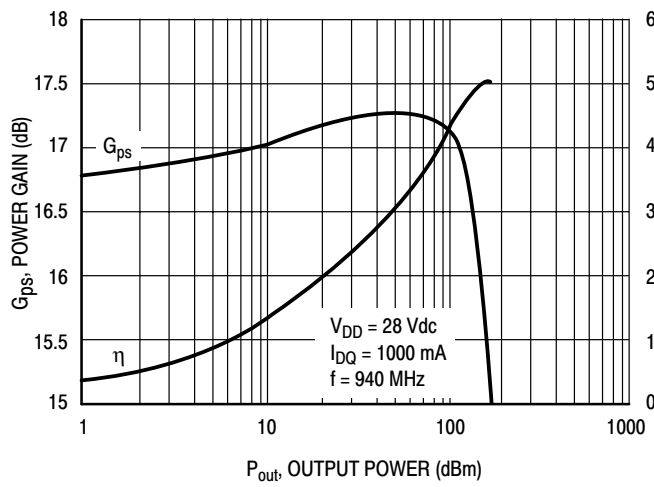
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. 921-960 MHz Test Circuit Component Layout**

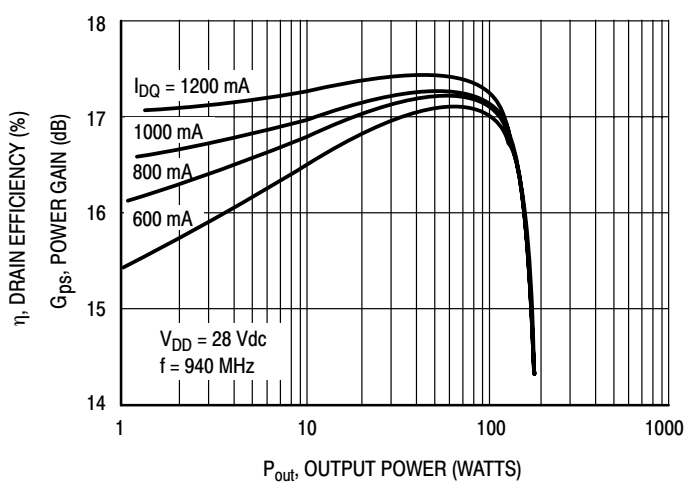
### TYPICAL CHARACTERISTICS



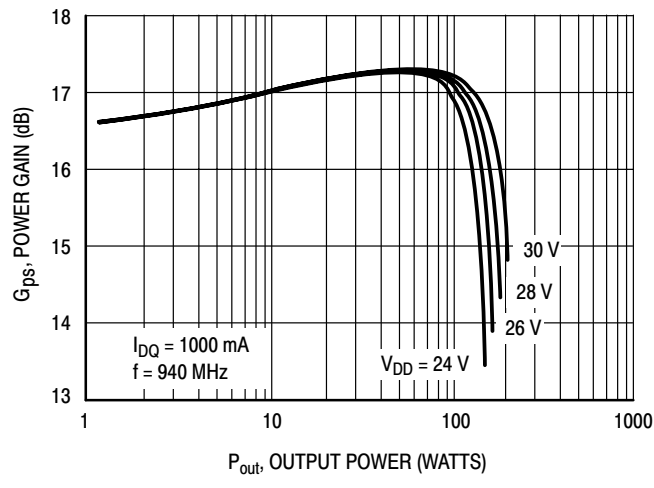
**Figure 3. Power Gain and Input Return Loss versus Frequency**



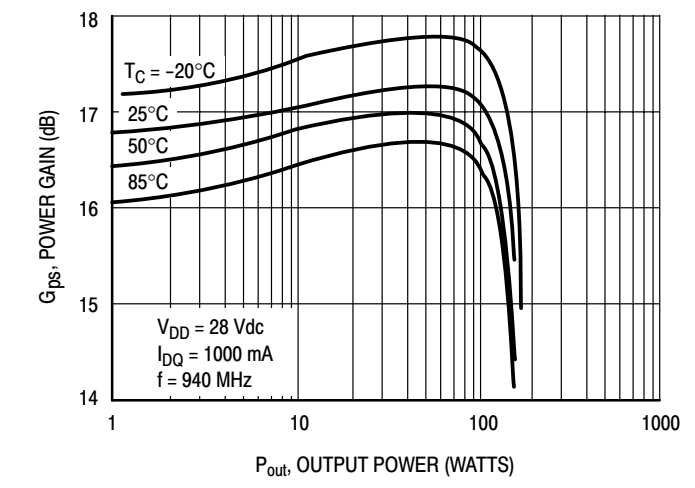
**Figure 4. Power Gain and Efficiency versus Output Power**



**Figure 5. Power Gain versus Output Power**

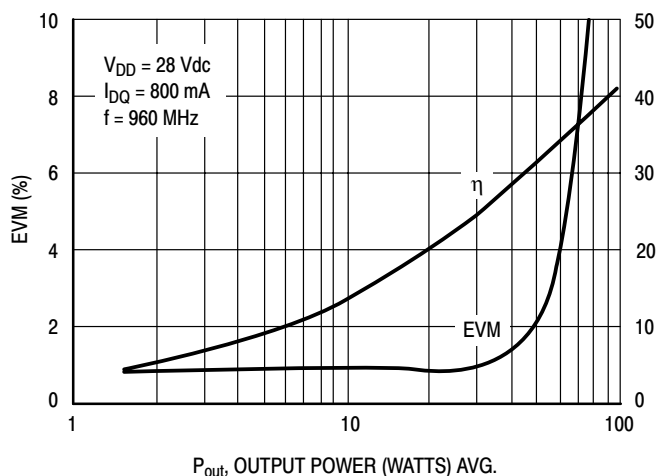


**Figure 6. Power Gain versus Output Power**

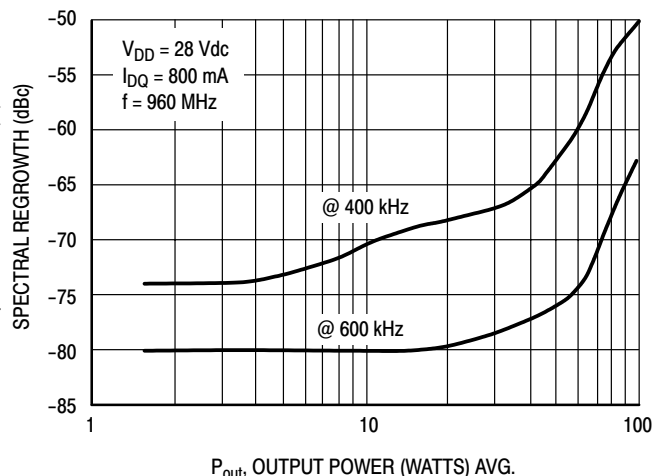


**Figure 7. Power Gain versus Output Power**

### TYPICAL CHARACTERISTICS

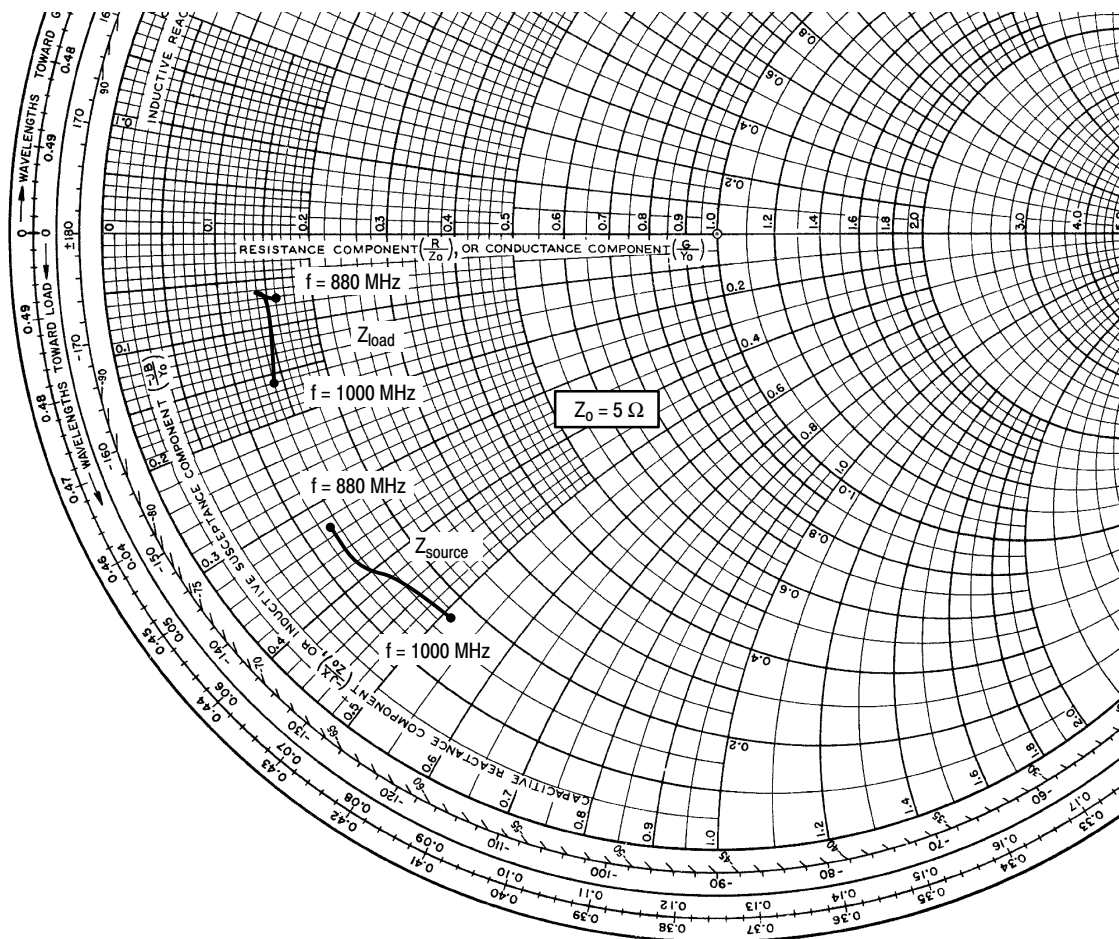


**Figure 8. EVM and Efficiency versus Output Power**



**Figure 9. Spectral Regrowth versus Output Power**

Note: Curves on Figure 8 and 9 gathered on a GSM EDGE optimized text fixture.



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 1000 \text{ mA}$ ,  $P_{out} = 130 \text{ W CW}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
880	$0.63 - j1.66$	$0.82 - j0.36$
920	$0.67 - j1.88$	$0.72 - j0.30$
960	$0.82 - j2.18$	$0.74 - j0.37$
1000	$0.86 - j2.56$	$0.69 - j0.79$

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

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

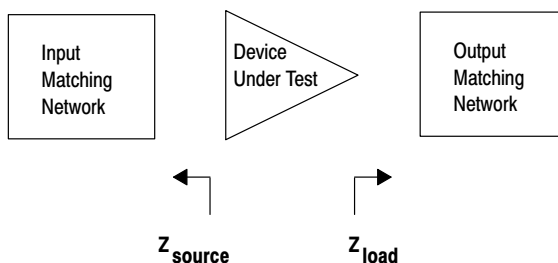


Figure 10. Series Equivalent Source and Load Impedance

MRF9130LR3 MRF9130LSR3

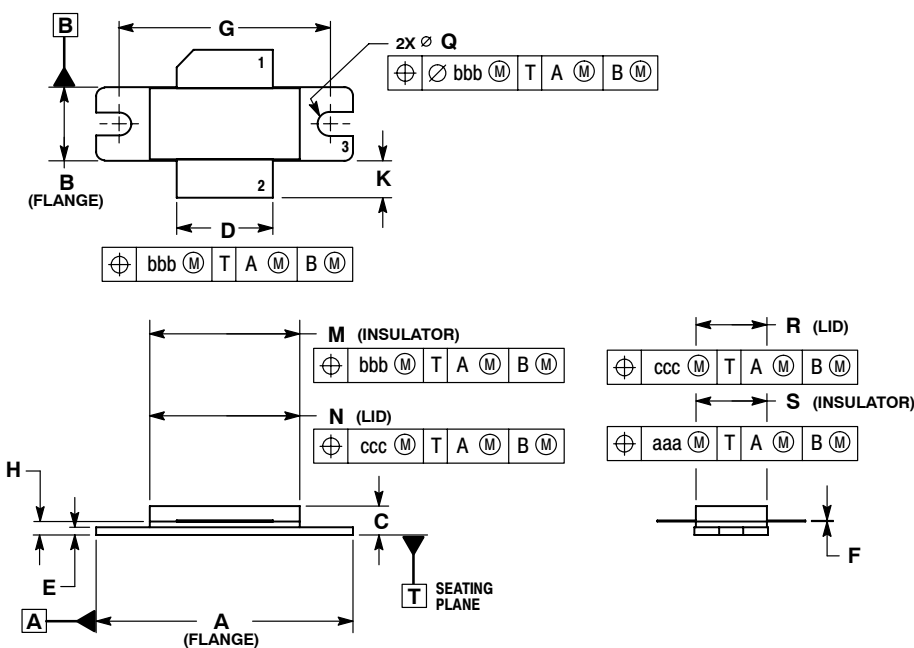
# NOTES



# NOTES

# NOTES

## PACKAGE DIMENSIONS

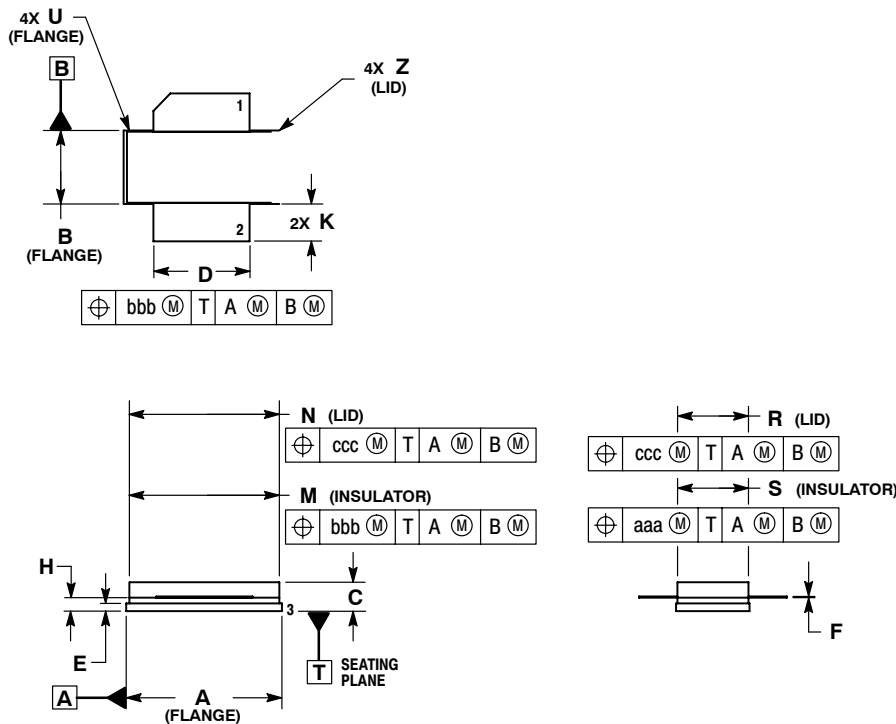


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DELETED
  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
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
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	Ø.118	Ø.138	Ø.300	Ø.351
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
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  
 3. SOURCE

### CASE 465-06 ISSUE G NI-780 MRF9130LR3



- NOTES:
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  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

### CASE 465A-06 ISSUE H NI-780S MRF9130LSR3

MRF9130LR3 MRF9130LSR3

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