



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications with frequencies from 1900 to 2000 MHz. Suitable for CDMA, TDMA, GSM and multicarrier amplifier applications.

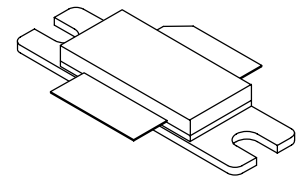
- Typical CDMA Performance: 1960 MHz, 26 Volts  
IS-95 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
Output Power — 7.5 Watts  
Power Gain — 12.5 dB  
Adjacent Channel Power —  
885 kHz: -47 dBc @ 30 kHz BW  
1.25 MHz: -55 dBc @ 12.5 kHz BW  
2.25 MHz: -55 dBc @ 1 MHz BW
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 1960 MHz, 60 Watts CW Output Power

### Features

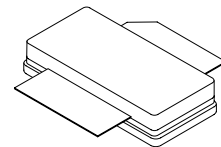
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating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

**MRF19060LR3**  
**MRF19060LSR3**

**1930-1990 MHz, 60 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF19060LR3**



**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF19060LSR3**

**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	$P_D$	180 1.03	W W/°C
Storage Temperature Range	$T_{stg}$	- 65 to +150	°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	$R_{\theta JC}$	0.97	°C/W

**Table 3. ESD Protection Characteristics**

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

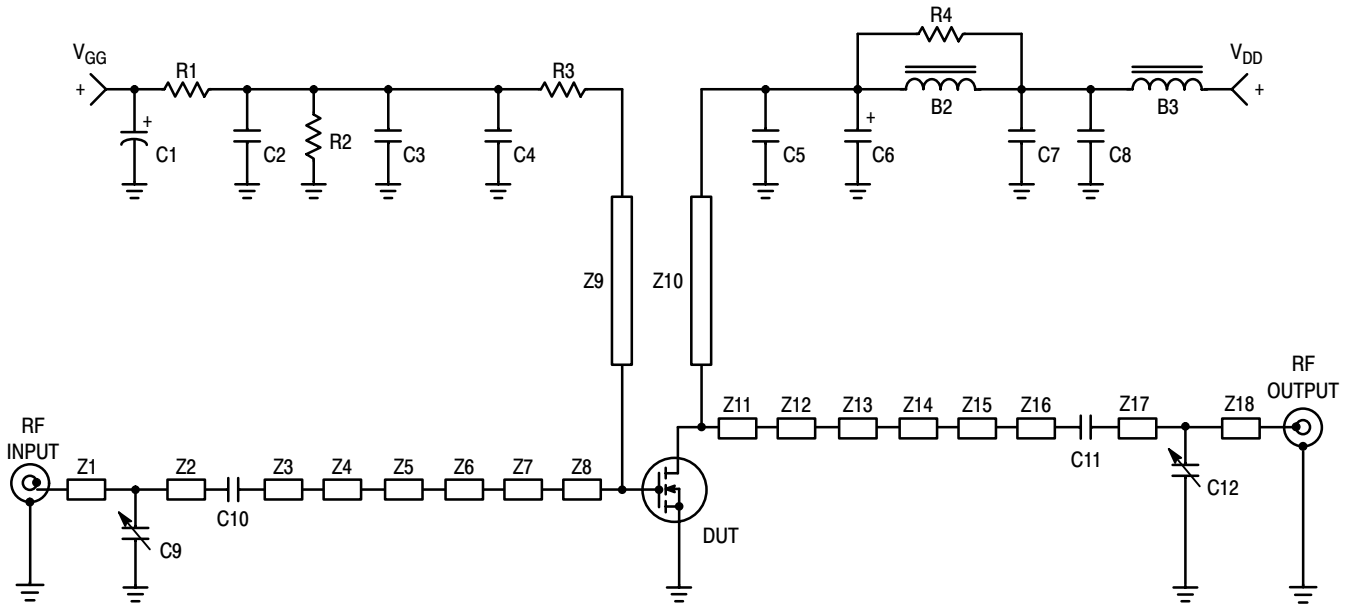
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**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

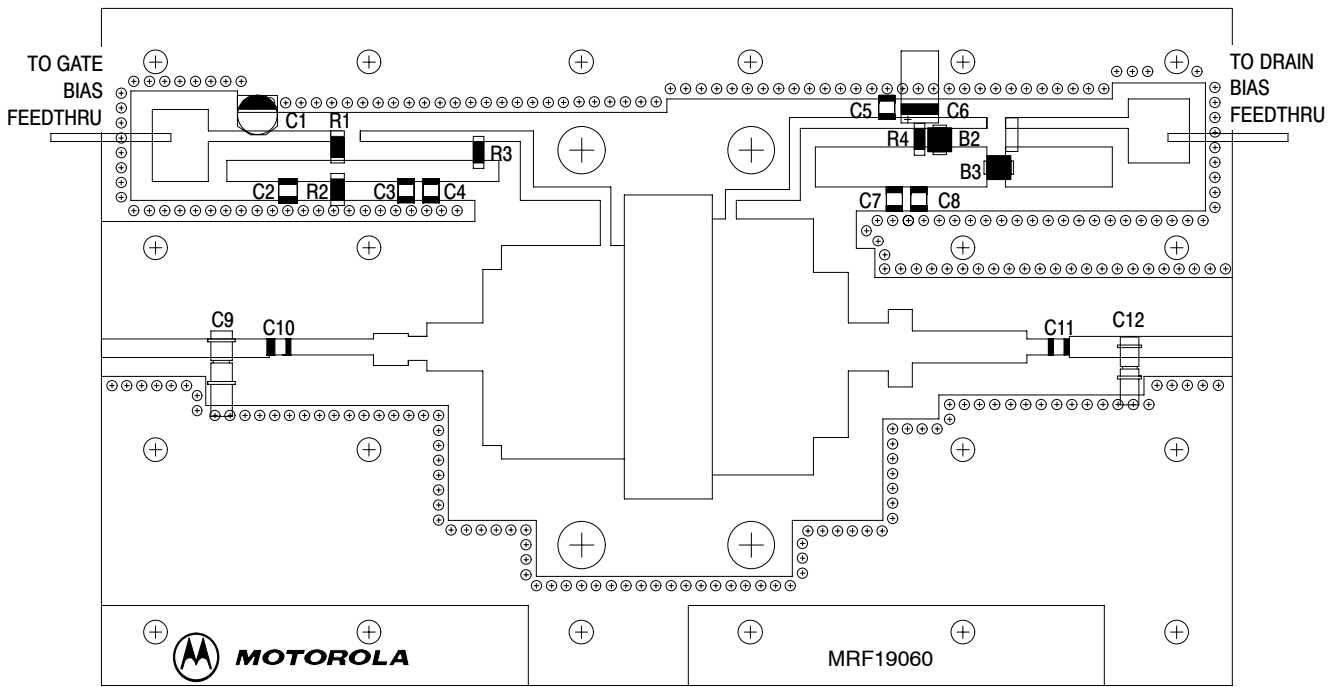
Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 10\ \mu\text{Adc}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	6	$\mu\text{Adc}$
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 ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 300\ \mu\text{Adc}$ )	$V_{GS(th)}$	2	—	4	V
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 500\text{ mAdc}$ )	$V_{GS(Q)}$	2.5	3.9	4.5	V
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$V_{DS(on)}$	—	0.27	—	V
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance (1) ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	2.7	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system)					
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$G_{ps}$	11	12.5	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$\eta$	33	36	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IMD	—	-31	-28	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IRL	—	-12	—	dB
$P_{out}$ , 1 dB Compression Point ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W CW}$ , $f = 1990\text{ MHz}$ )	P1dB	—	60	—	W

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



B2 - B3	Ferrite Beads, Fair Rite, 2743019447	Z4	0.152" x 0.140" Microstrip
C1	10 $\mu$ F, 50 V Electrolytic Capacitor, Panasonic #ECEV1HV100R	Z5	0.090" x 0.102" Microstrip
C2, C7	1000 pF Chip Capacitors, ATC #100B102JCA500X	Z6	0.245" x 0.217" Microstrip
C3, C8	0.10 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKWS	Z7	0.090" x 0.737" Microstrip
C4	5.1 pF Chip Capacitor, ATC #100B5R1JCA500X	Z8	0.530" x 0.941" Microstrip
C5	6.2 pF Chip Capacitor, ATC #100B6R2JCA500X	Z9	1.010" x 0.050" Microstrip
C6	22 $\mu$ F, 35 V Tantalum Capacitor, SMT, Sprague	Z10	1.060" x 0.050" Microstrip
C9	0.8 pF - 8.0 pF Variable Capacitor, Johanson Gigatrim	Z11	0.446" x 1.137" Microstrip
C10, C11	10 pF Chip Capacitors, ATC #100B100JCA500X	Z12	0.152" x 0.567" Microstrip
C12	0.4 pF - 2.5 pF Variable Capacitor, Johanson Gigatrim	Z13	0.183" x 0.220" Microstrip
R1	1 k $\Omega$ , 1/4 W Fixed Film Chip Resistor, 0.08" x 0.13"	Z14	0.100" x 0.338" Microstrip
R2	560 k $\Omega$ , 1/4 W Fixed Film Chip Resistor, 0.08" x 0.13"	Z15	0.480" x 0.142" Microstrip
R3	15 $\Omega$ , 1/4 W Fixed Film Chip Resistor, 0.08" x 0.13"	Z16	0.140" x 0.080" Microstrip
R4	10 $\Omega$ , 1/4 W Fixed Film Chip Resistor, 0.08" x 0.13"	Z17	0.173" x 0.080" Microstrip
Z1	0.580" x 0.074" Microstrip	Z18	0.420" x 0.080" Microstrip
Z2	0.100" x 0.074" Microstrip	Board	0.030" Glass Teflon <sup>®</sup> Arlon GX-0300-55-22, 2 oz Cu
Z3	0.384" x 0.074" Microstrip		

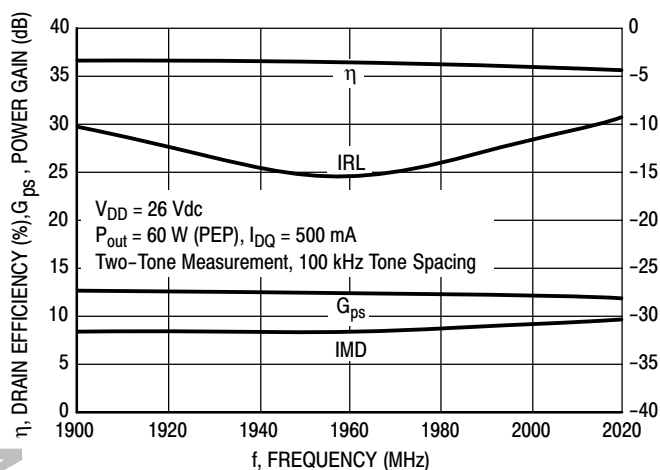
**Figure 1. MRF19060L Test Circuit Schematic**



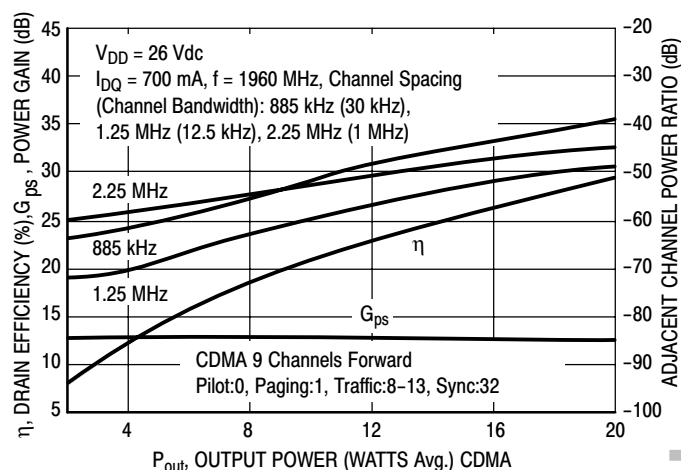
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. MRF19060L Test Circuit Component Layout**

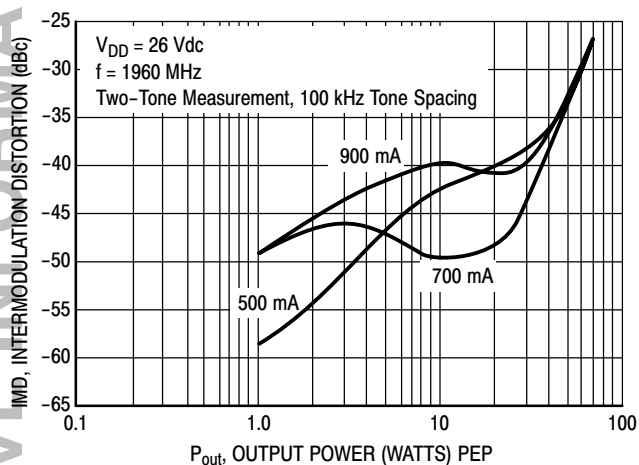
## TYPICAL CHARACTERISTICS



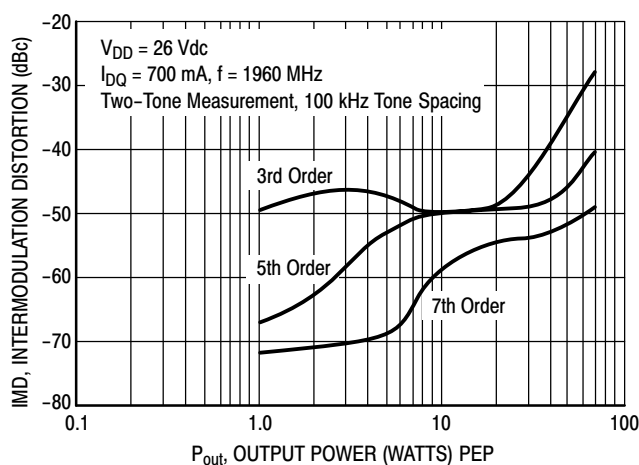
**Figure 3. Class AB Broadband Circuit Performance**



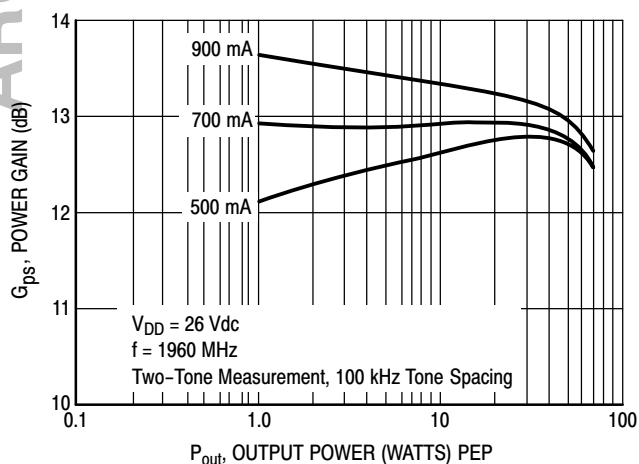
**Figure 4. CDMA ACPR, Power Gain and Drain Efficiency versus Output Power**



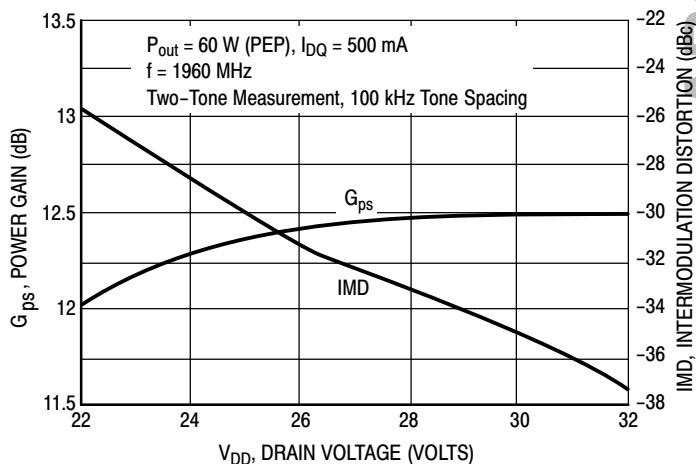
**Figure 5. Intermodulation Distortion versus Output Power**



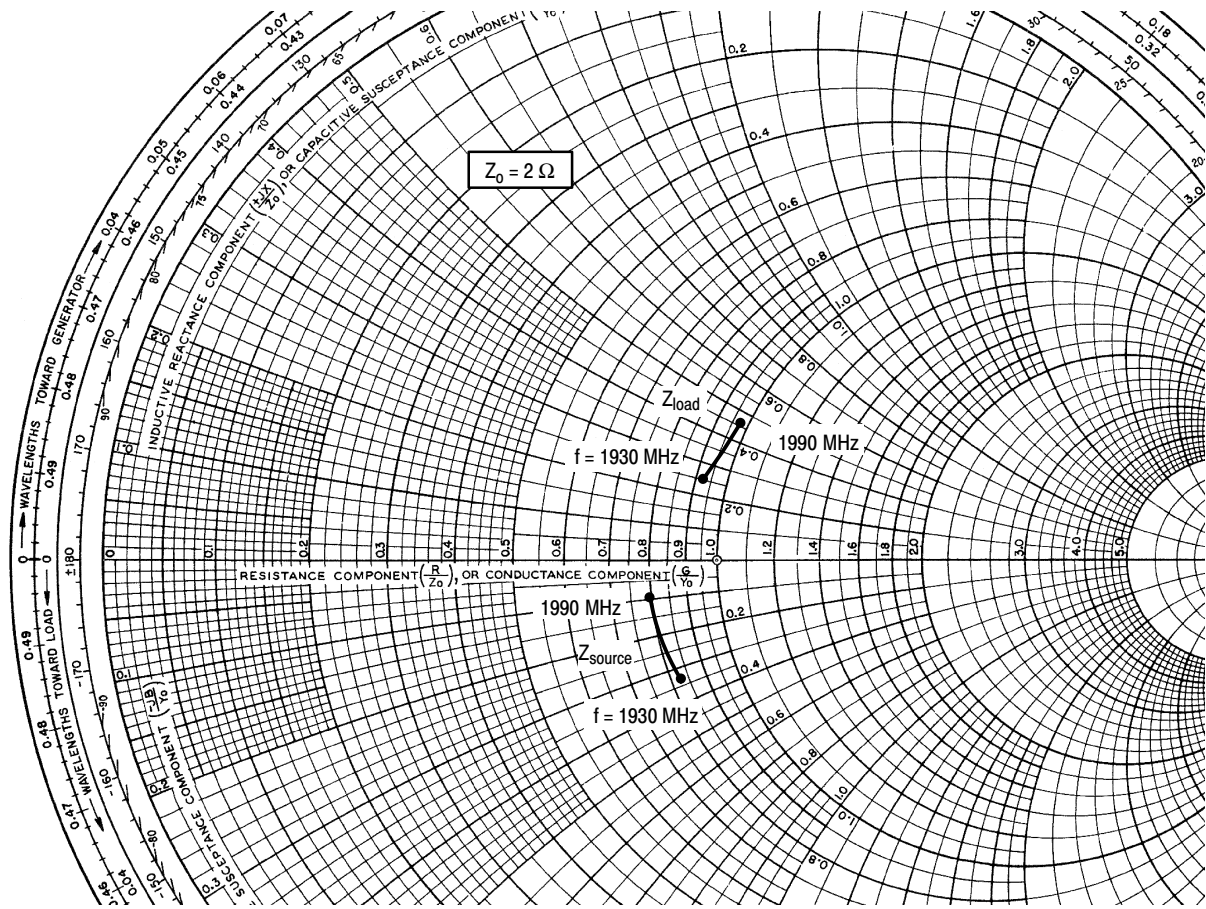
**Figure 6. Intermodulation Products versus Output Power**



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



**Figure 8. Power Gain and Intermodulation Distortion versus Supply Voltage**



$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ ,  $P_{out} = 60\text{ W PEP}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1930	$1.65 - j0.67$	$1.85 + j0.50$
1960	$1.64 - j0.45$	$1.89 + j0.74$
1990	$1.60 - j0.20$	$1.96 + j0.94$

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

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

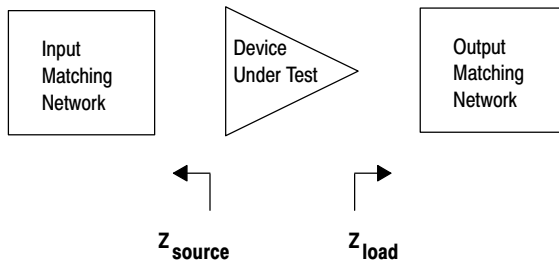
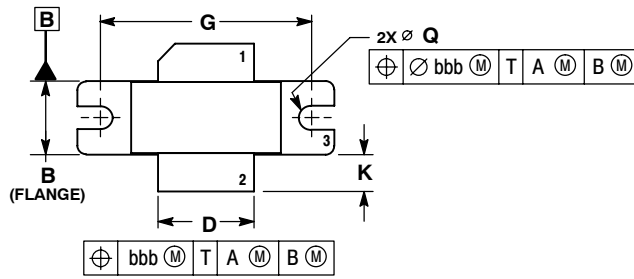


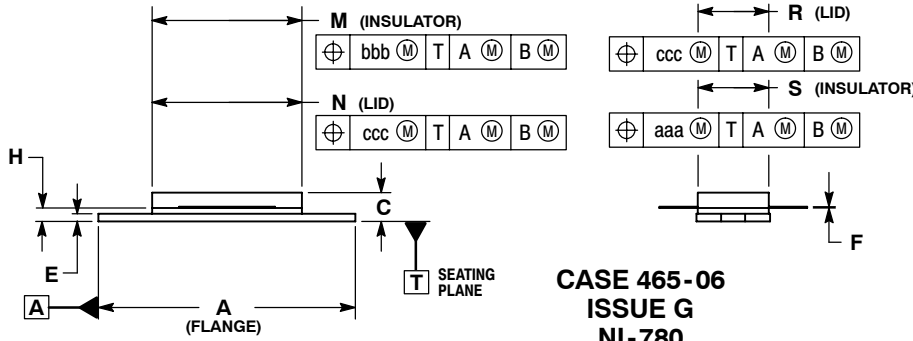
Figure 9. Series Equivalent Source and Load Impedance

## PACKAGE DIMENSIONS



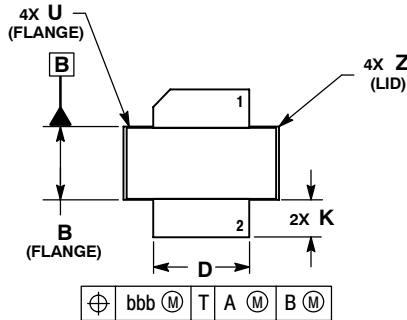
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DELETED
  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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	Ø3.00	Ø3.51
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	



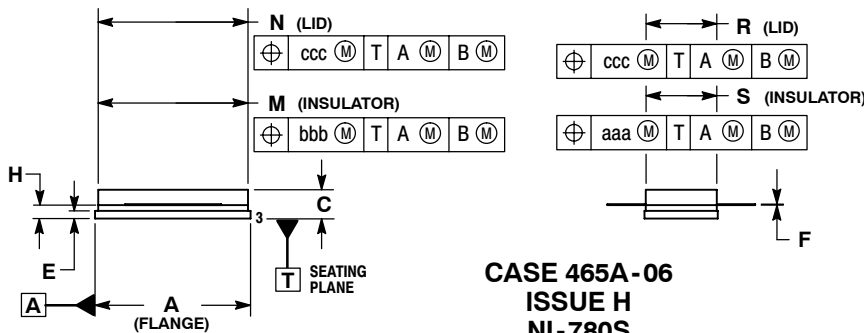
**CASE 465-06  
ISSUE G  
NI-780  
MRF19060LR3**

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



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
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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	



**CASE 465A-06  
ISSUE H  
NI-780S  
MRF19060LSR3**

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

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