

# RF Power Field Effect Transistors

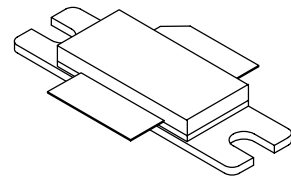
## N-Channel Enhancement-Mode Lateral MOSFETs

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

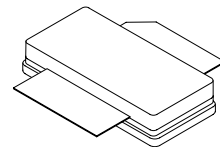
- Typical CDMA Performance: 1960 MHz, 26 Volts  
 IS-97 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
 Output Power — 7.5 Watts  
 Power Gain — 12.5 dB  
 Adjacent Channel Power —  
     885 kHz: -47 dBc @ 30 kHz BW  
     1.25 MHz: -55 dBc @ 12.5 kHz BW  
     2.25 MHz: -55 dBc @ 1 MHz BW
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 1930 MHz, 60 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 Inch Reel.

**MRF19060R3**  
**MRF19060SR3**

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



**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF19060R3**



**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF19060SR3**

**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 $25^\circ\text{C}$	$P_D$	180 1.03	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +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	$R_{\theta JC}$	0.97	$^\circ\text{C}/\text{W}$

**Table 3. ESD Protection Characteristics**

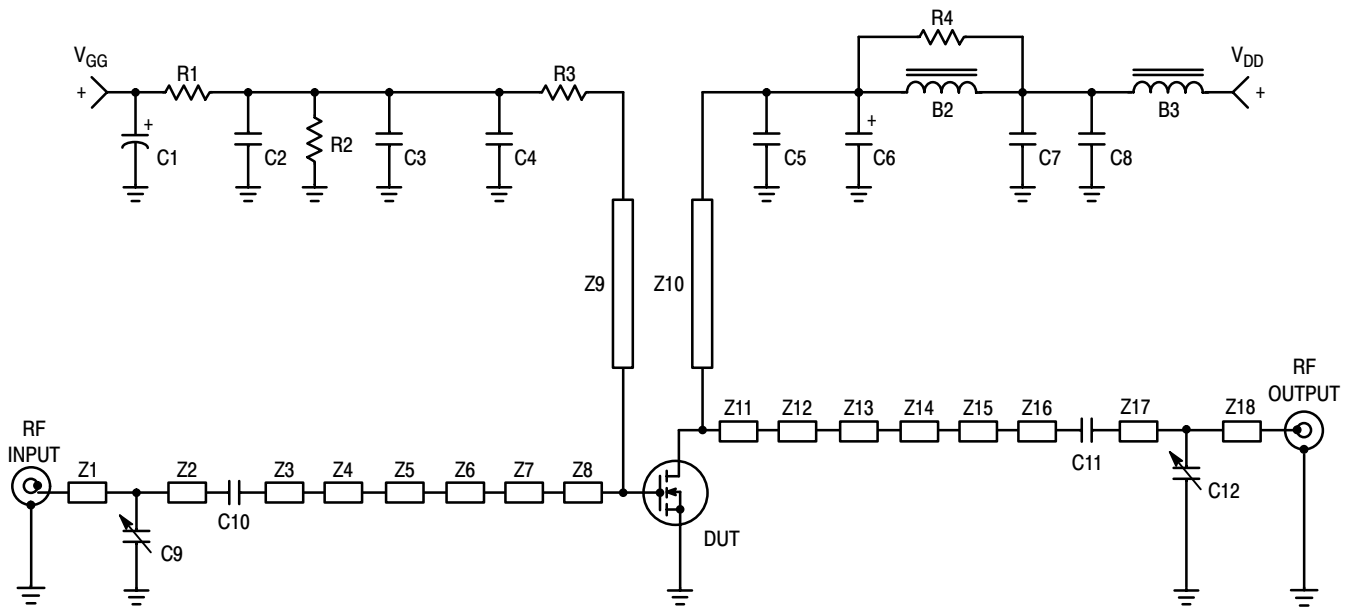
Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)

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

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

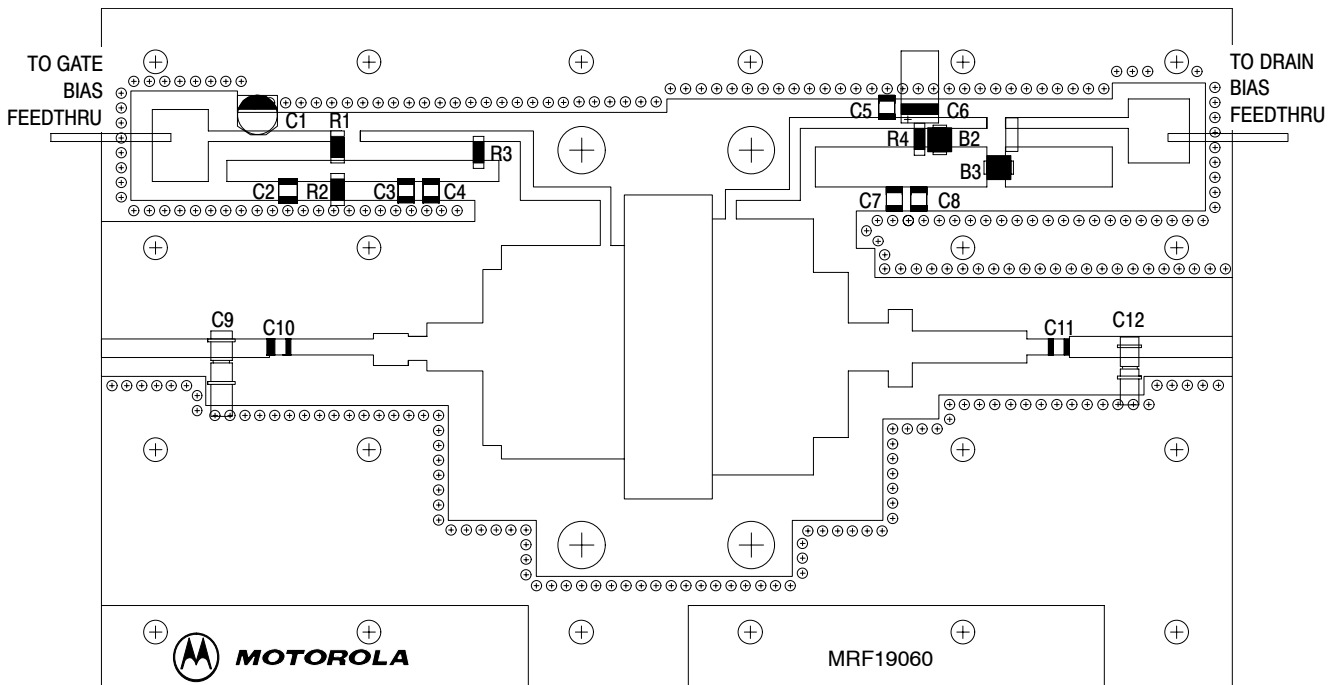
Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 10\ \mu\text{Adc}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	6	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>On Characteristics</b>					
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$g_{fs}$	—	4.7	—	S
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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W CW}$ , $f = 1990\text{ MHz}$ )	$P_{1dB}$	—	60	—	W
Output Mismatch Stress ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W CW}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1930\text{ MHz}$ , VSWR = 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.



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. MRF19060 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. MRF19060 Test Circuit Component Layout**

## TYPICAL CHARACTERISTICS

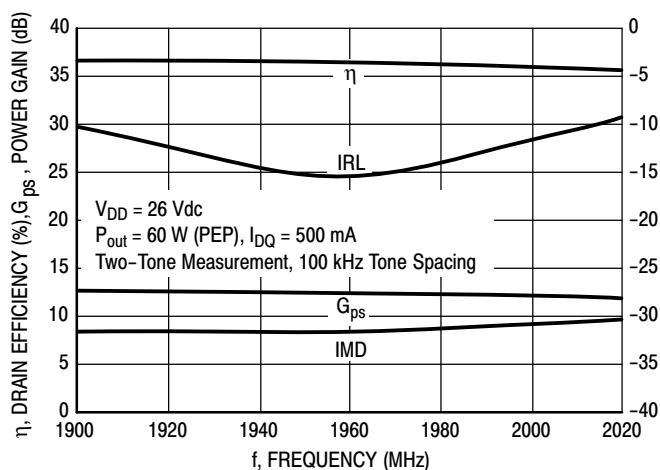


Figure 3. Class AB Broadband Circuit Performance

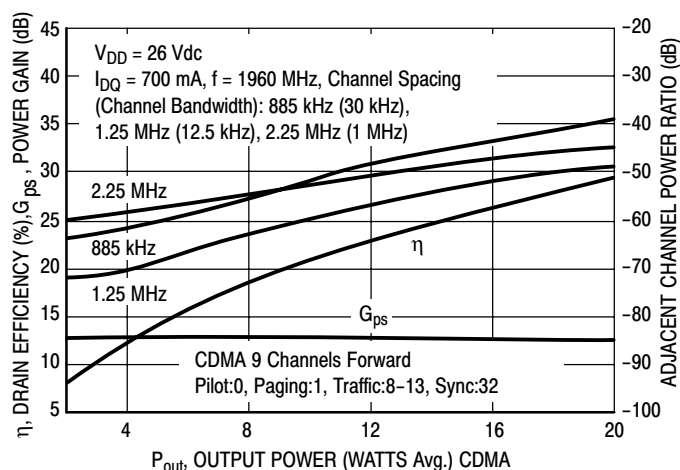


Figure 4. CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

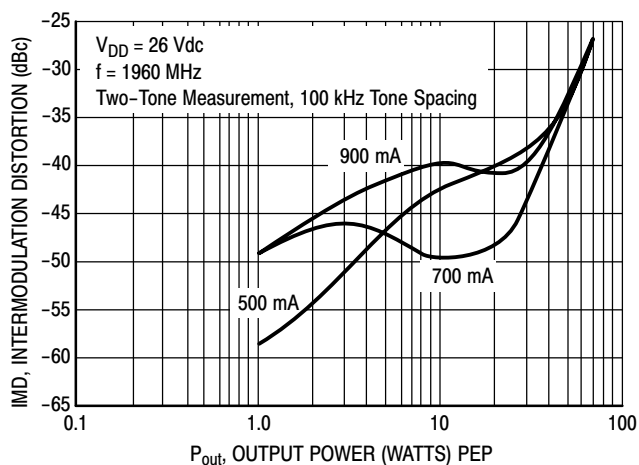


Figure 5. Intermodulation Distortion versus Output Power

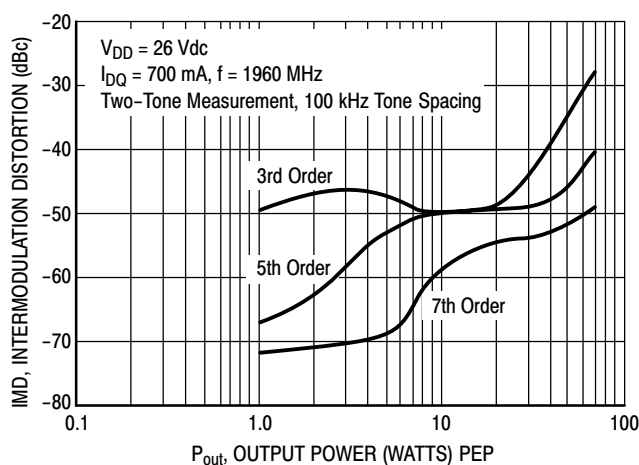


Figure 6. Intermodulation Products versus Output Power

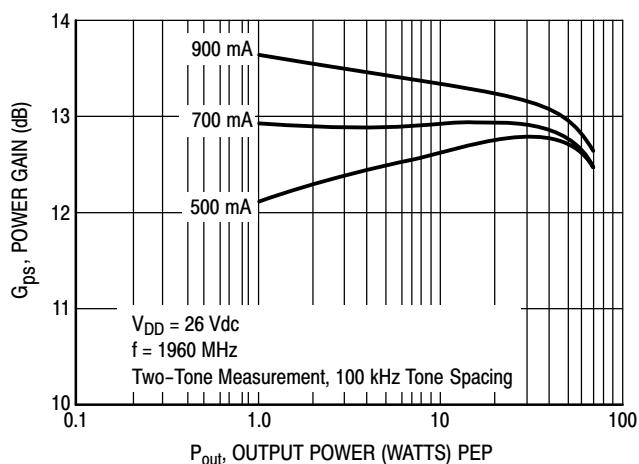


Figure 7. Power Gain versus Output Power

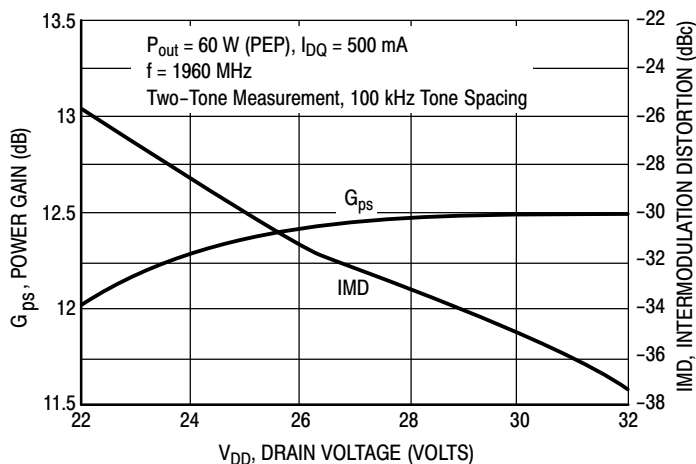
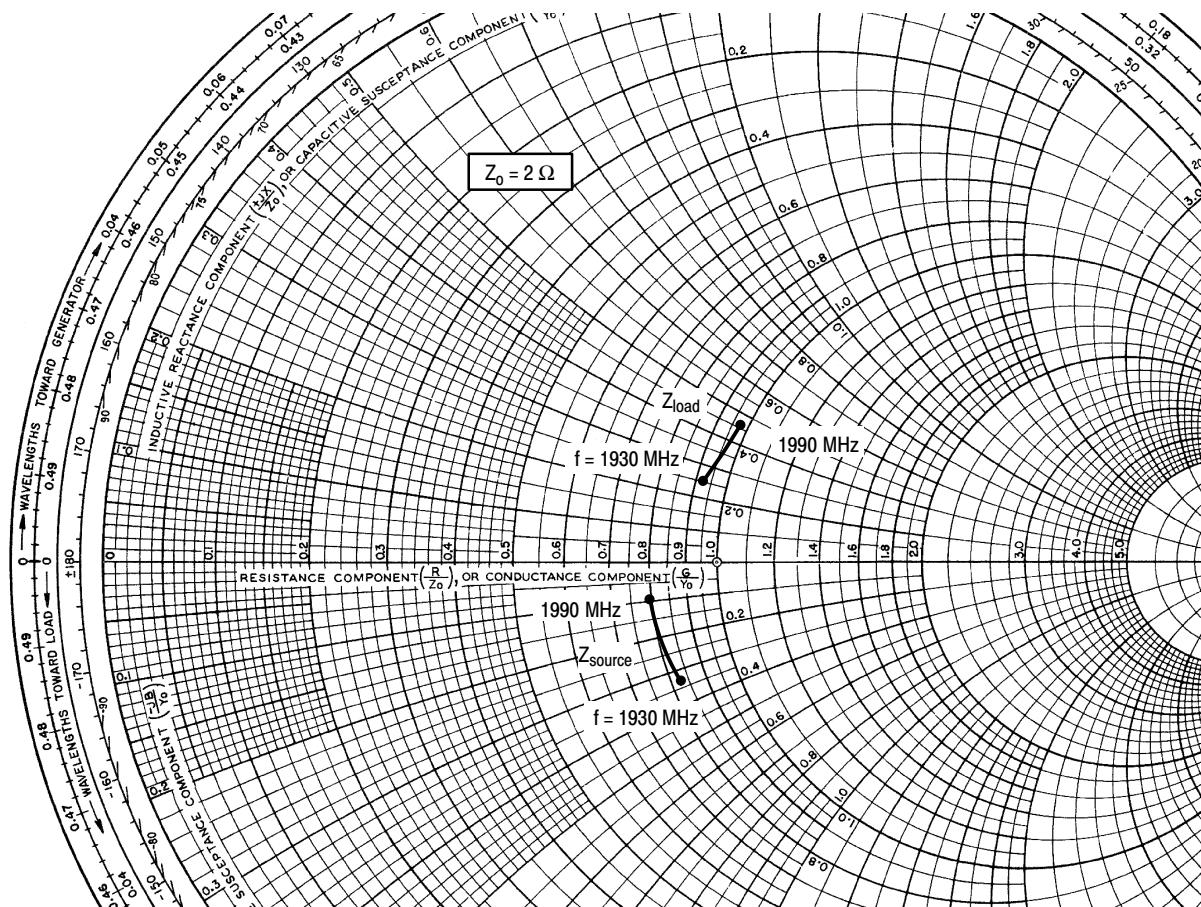


Figure 8. Power Gain and Intermodulation Distortion versus Supply Voltage

MRF19060R3 MRF19060SR3



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

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.

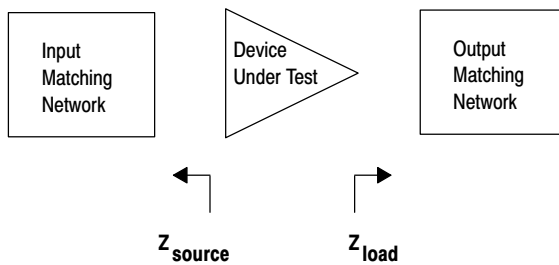
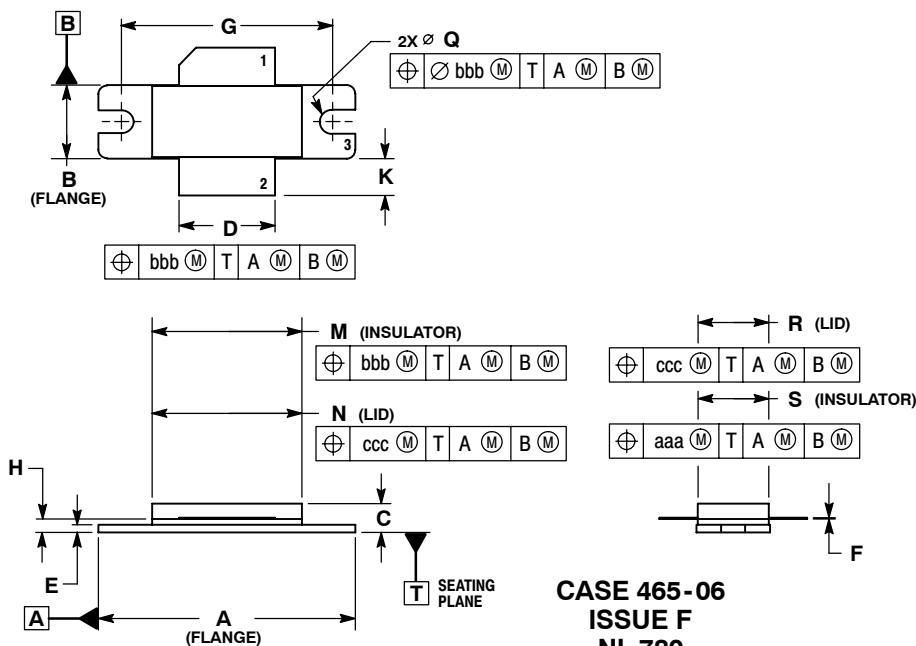


Figure 9. Series Equivalent Source and Load Impedance

## PACKAGE DIMENSIONS

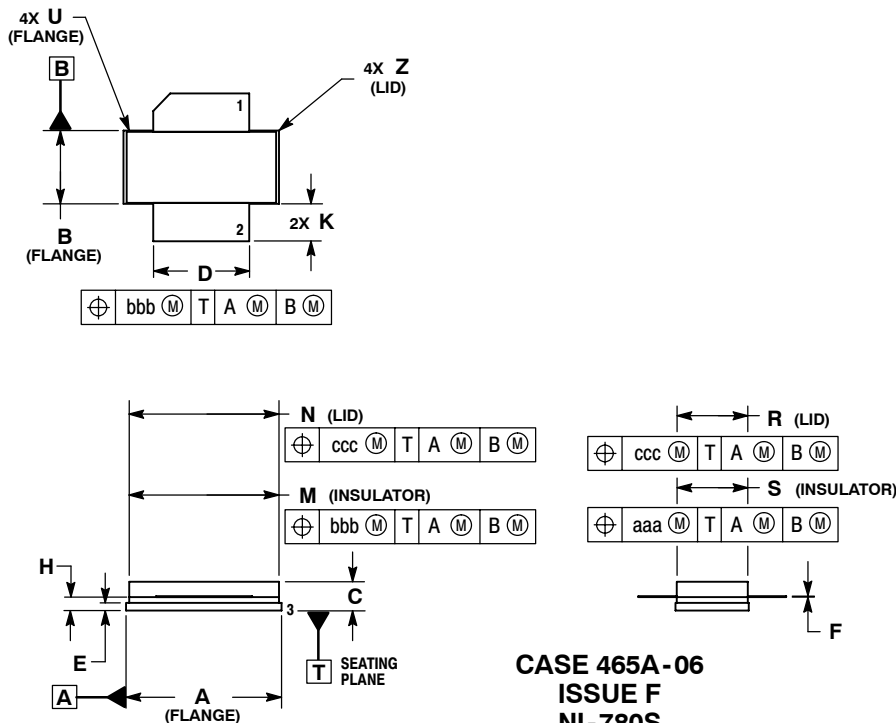


**CASE 465-06  
ISSUE F  
NI-780  
MRF19060**

- 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	

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



**CASE 465A-06  
ISSUE F  
NI-780S  
MRF19060SR3**

- 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	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

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