



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

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

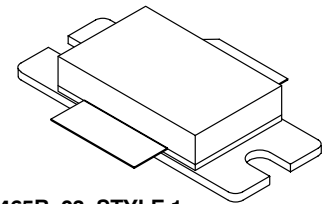
- Typical CDMA Performance: 1990 MHz, 26 Volts  
 IS-95 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
 Output Power — 9 Watts Avg.  
 Power Gain — 10 dB  
 Adjacent Channel Power —  
     885 kHz: -47 dBc @ 30 kHz BW  
     1.25 MHz: -55 dBc @ 12.5 kHz BW  
     2.25 MHz: -55 dBc @ 1 MHz BW
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 1960 MHz, 90 Watts CW Output Power

### Features

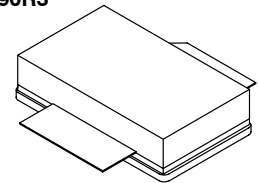
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- RoHS Compliant
- In Tape and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

**MRF19090R3**  
**MRF19090SR3**

**1930-1990 MHz, 90 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465B-03, STYLE 1**  
**NI-880**  
**MRF19090R3**



**CASE 465C-02, STYLE 1**  
**NI-880S**  
**MRF19090SR3**

**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 $25^\circ\text{C}$	$P_D$	270 1.54	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	$R_{\theta JC}$	0.65	$^\circ\text{C}/\text{W}$

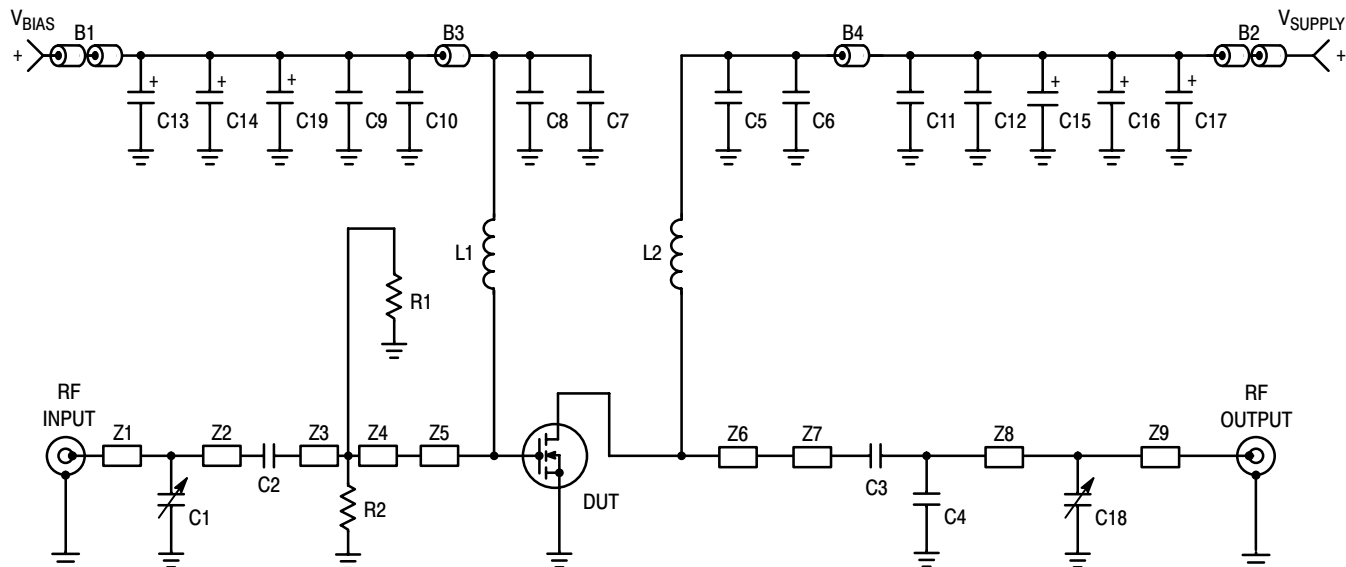
**Table 3. ESD Protection Characteristics**

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

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

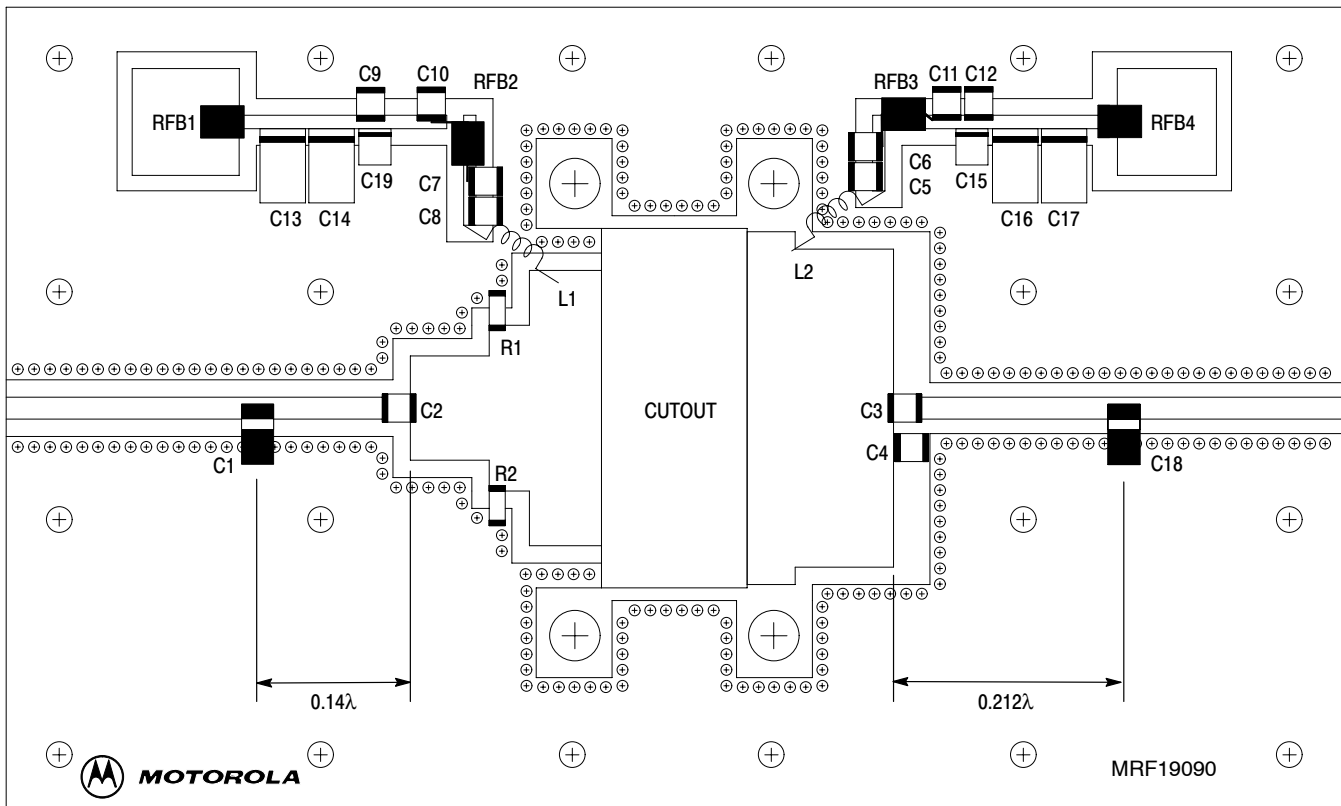
Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\ \mu\text{A}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
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 ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 3\text{ Adc}$ )	$g_{fs}$	—	7.2	—	S
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 300\ \mu\text{Adc}$ )	$V_{GS(th)}$	2.0	—	4.0	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 750\text{ mAdc}$ )	$V_{GS(Q)}$	2.5	3.8	4.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )	$V_{DS(on)}$	—	0.10	—	Vdc
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance (1) ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	4.2	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture)					
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$G_{ps}$	10	11.5	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$\eta$	33	35	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IMD	—	-30	-28	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IRL	—	-12	—	dB
$P_{out, 1\text{ dB}}$ Compression Point ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W CW}$ , $f = 1990\text{ MHz}$ )	P1dB	—	90	—	W

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



B1, B2	2 Ferrite Beads, Round, Ferroxcube #56-590-65-3B	L1, L2	8 Turns, #26 AWG, 0.085" OD, 0.330" Long, Copper Wire
B3, B34	Ferrite Beads, Surface Mount, Ferroxcube	R1, R2	270 $\Omega$ , 1/4 W Chip Resistors, Garrett Instruments #RM73B2B271JT
C1, C18	0.4 - 2.5 pF Variable Capacitors, Johanson Gigatrim #27285	Z1	ZO = 50 Ohms
C2, C5, C8	10 pF Chip Capacitors, ATC #100B100CCA500X	Z2	ZO = 50 Ohms, Lambda = 0.123
C3	12 pF Chip Capacitor, ATC #100B120CCA500X	Z3	ZO = 15.24 Ohms, Lambda = 0.0762
C4	0.3 pF Chip Capacitor, ATC #100B0R3CCA500X	Z4	ZO = 10.11 Ohms, Lambda = 0.0392
C6, C7	120 pF Chip Capacitors, ATC #100B12R1CCA500X	Z5	ZO = 6.34 Ohms, Lambda = 0.0711
C9, C12	0.1 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKWS	Z6	ZO = 5.02 Ohms, Lambda = 0.0476
C10, C11	1000 pF Chip Capacitors, ATC #100B102JCA50X	Z7	ZO = 5.54 Ohms, Lambda = 0.0972
C13, C17	22 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T491X226K035AS4394	Z8	ZO = 50.0 Ohms, Lambda = 0.194
C14, C16	10 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T495X106K035AS4394	Z9	ZO = 50.0 Ohms
C15, C19	1 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T495X105K035AS4394	Raw PCB Material	0.030" Glass Teflon <sup>®</sup> , $\epsilon_r = 2.55$ , 2 oz Copper, 3" x 5" Dimensions

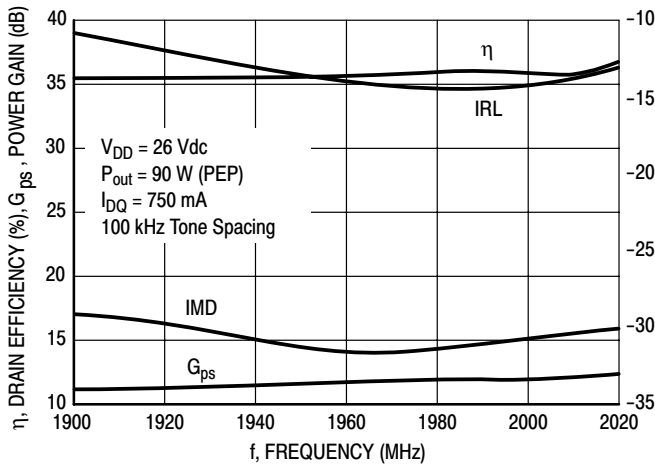
Figure 1. MRF19090 Test Circuit Schematic



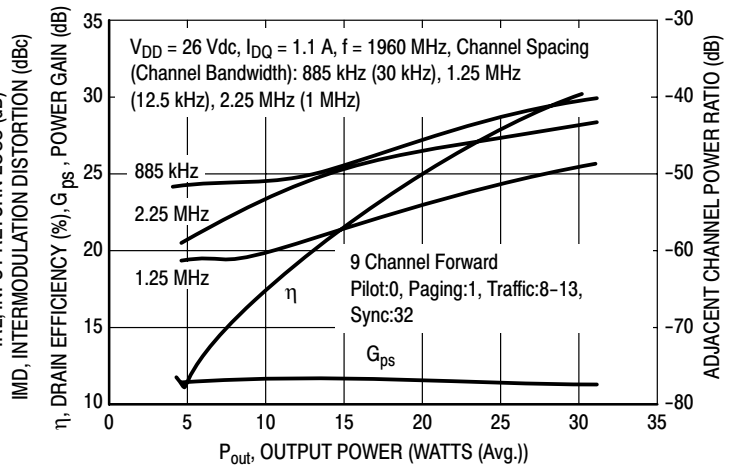
Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. MRF19090 Test Circuit Component Layout**

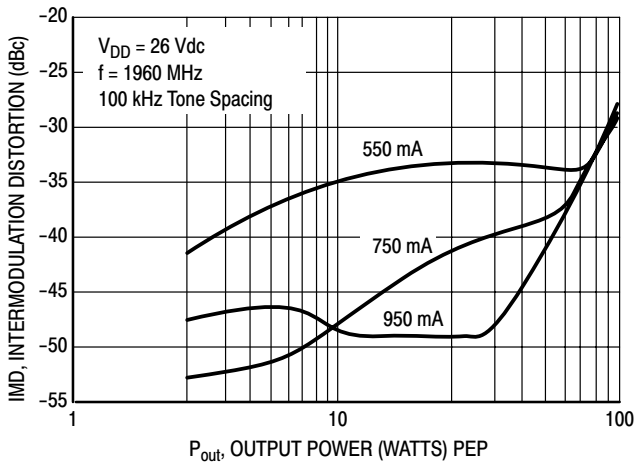
## TYPICAL CHARACTERISTICS



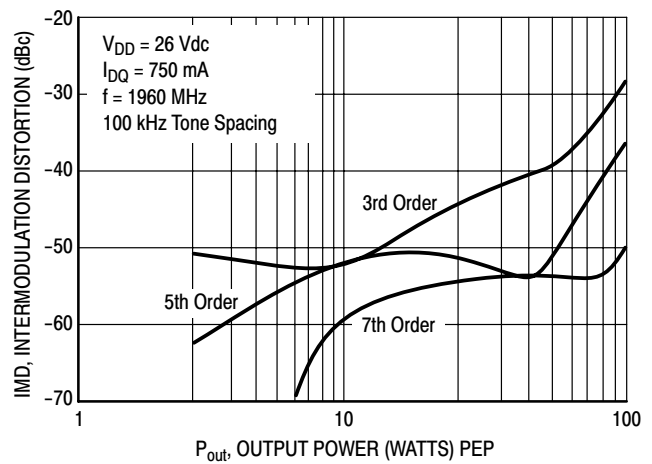
**Figure 3. Class AB Performance versus Frequency**



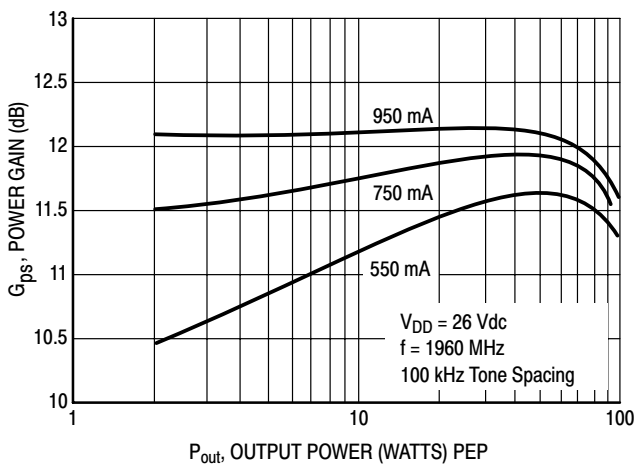
**Figure 4. CDMA Performance ACPR, Gain and Drain Efficiency versus Output Power**



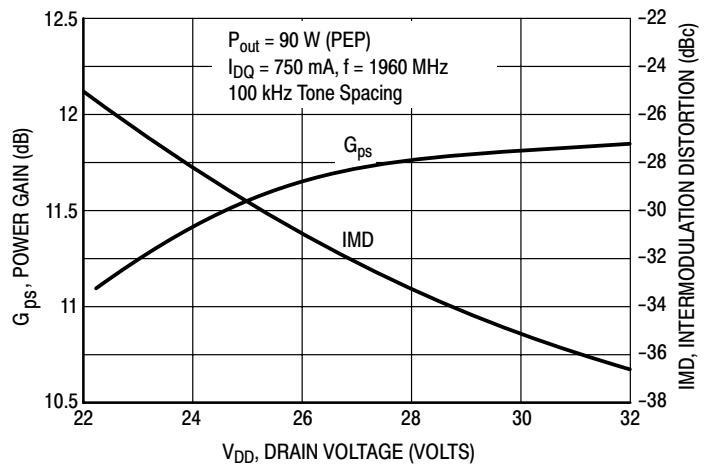
**Figure 5. Third Order Intermodulation Distortion versus Output Power**



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

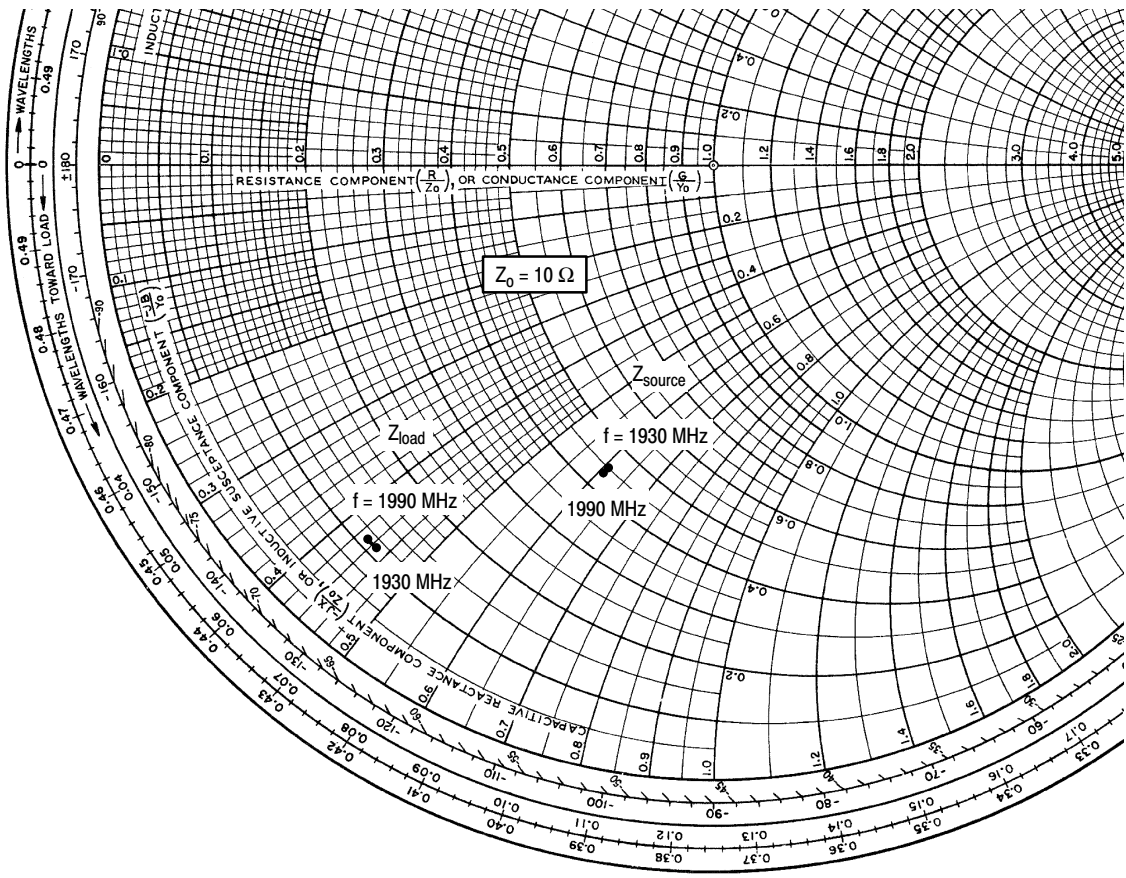


**Figure 7. Power Gain versus Output Power**



**Figure 8. Third Order Intermodulation Distortion and Gain versus Supply Voltage**

MRF19090R3 MRF19090SR3



$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 750\text{ mA}$ ,  $P_{out} = 90\text{ Watts (PEP)}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1930	$4.5 - j6.1$	$1.1 - j4.5$
1960	$4.4 - j6.0$	$1.1 - j4.4$
1990	$4.3 - j6.1$	$1.1 - j4.3$

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

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

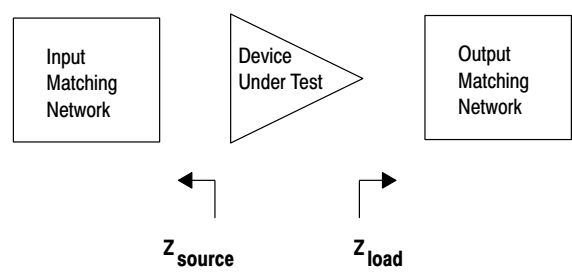
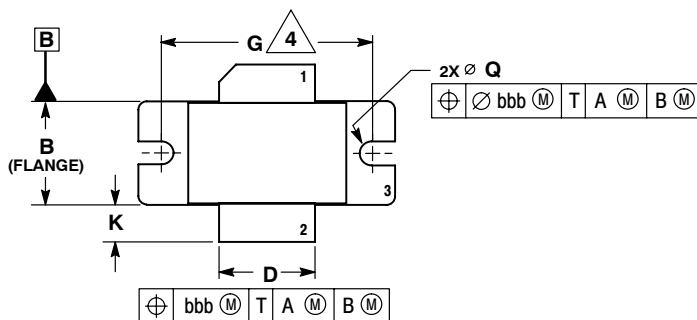


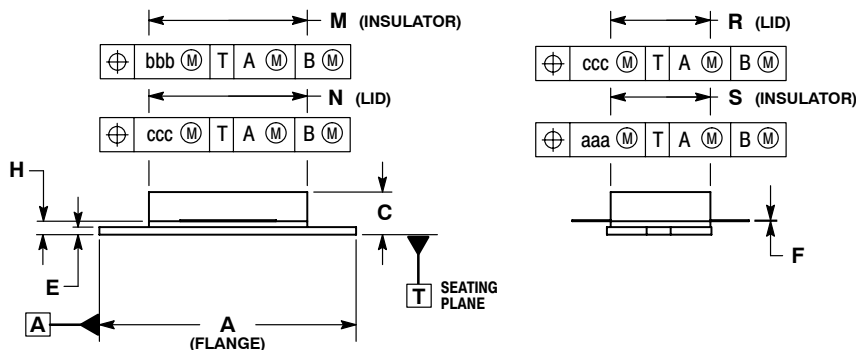
Figure 9. Series Equivalent Source and Load Impedance

## PACKAGE DIMENSIONS



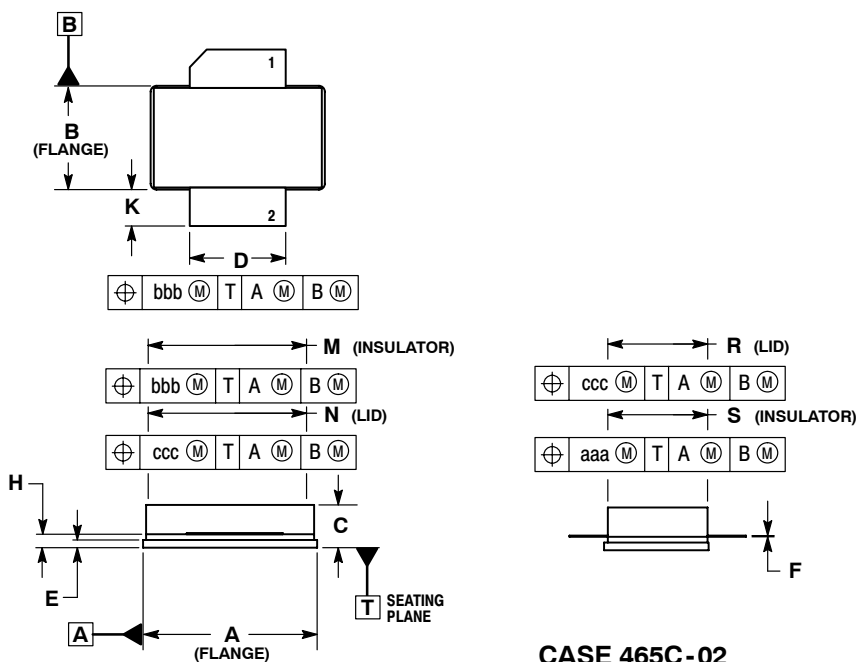
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
  4. RECOMMENDED BOLT CENTER DIMENSION OF 1.16 (29.57) BASED ON M3 SCREW.

DIM	INCHES		MILLIMETERS	
	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	Ø.118	Ø.138	Ø.300	Ø.351
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  
 MRF19090R3**



- 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.

DIM	INCHES		MILLIMETERS	
	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  
 MRF19090SR3**

**MRF19090R3 MRF19090SR3**

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