

# RF Power Field Effect Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

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.

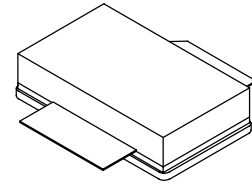
- Typical CDMA Performance: 1930 MHz, 26 Volts  
IS-95 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
Output Power — 9 Watts Avg.  
Power Gain — 10 dB  
Adjacent Channel Power —  
885 kHz: -47 dBc @ 30 kHz BW  
1.25 MHz: -55 dBc @ 12.5 kHz BW  
2.25 MHz: -55 dBc @ 1 MHz BW
- Capable of Handling 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.

**MRF19090SR3**

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



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

**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 @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 270<br>1.54  | W<br>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  | $^\circ\text{C}/\text{W}$ |

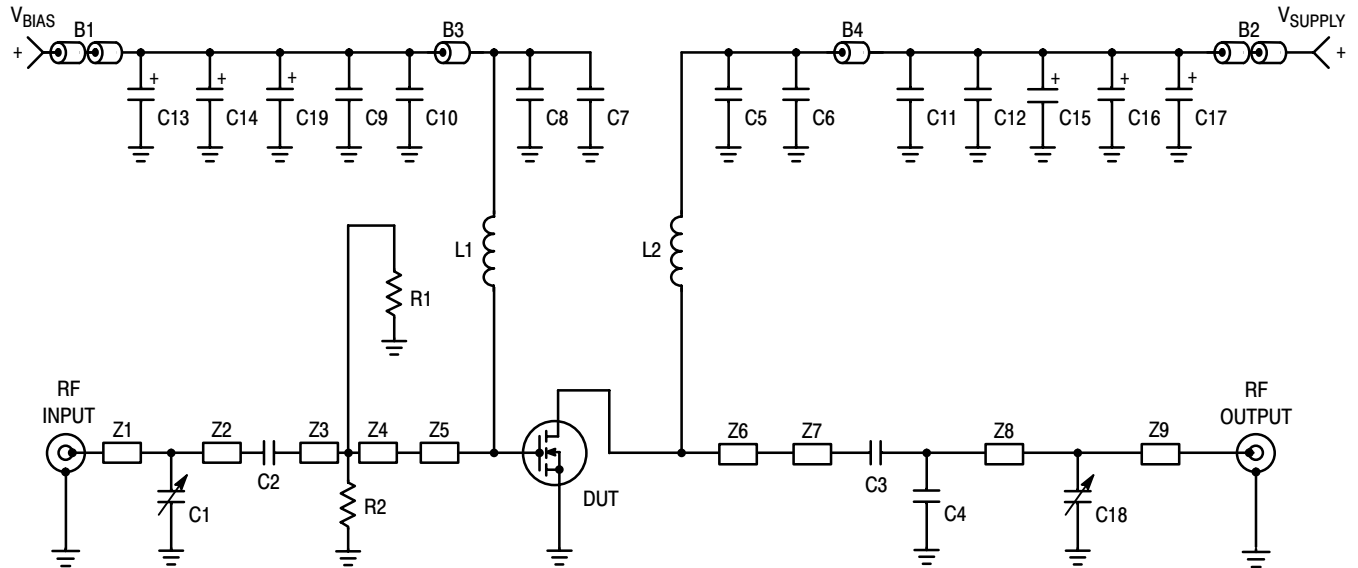
**Table 3. ESD Protection Characteristics**

| 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<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{A}$ )                                                                                          | $V_{(BR)DSS}$ | 65  | —    | —   | Vdc             |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                                                                                               | $I_{DSS}$     | —   | —    | 10  | $\mu\text{Adc}$ |
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                                                                                    | $I_{GSS}$     | —   | —    | 1   | $\mu\text{Adc}$ |
| <b>On Characteristics</b>                                                                                                                                                               |               |     |      |     |                 |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 3\text{ Adc}$ )                                                                                                         | $g_{fs}$      | —   | 7.2  | —   | S               |
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 300\text{ }\mu\text{Adc}$ )                                                                                               | $V_{GS(th)}$  | 2.0 | —    | 4.0 | Vdc             |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 750\text{ mAdc}$ )                                                                                                        | $V_{GS(Q)}$   | 2.5 | 3.8  | 4.5 | Vdc             |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )                                                                                                          | $V_{DS(on)}$  | —   | 0.10 | —   | Vdc             |
| <b>Dynamic Characteristics</b>                                                                                                                                                          |               |     |      |     |                 |
| Reverse Transfer Capacitance <sup>(1)</sup><br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )                                                                         | $C_{rss}$     | —   | 4.2  | —   | pF              |
| <b>Functional Tests</b> (In Freescale Test Fixture)                                                                                                                                     |               |     |      |     |                 |
| Two-Tone Common-Source Amplifier Power Gain<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ ,<br>$f = 1930\text{ MHz}$ , Tone Spacing = 100 kHz) | $G_{ps}$      | 10  | 11.5 | —   | dB              |
| Two-Tone Drain Efficiency<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ ,<br>$f = 1930\text{ MHz}$ , Tone Spacing = 100 kHz)                   | $\eta$        | 33  | 35   | —   | %               |
| 3rd Order Intermodulation Distortion<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ ,<br>$f = 1930\text{ MHz}$ , Tone Spacing = 100 kHz)        | IMD           | —   | -30  | -28 | dBc             |
| Input Return Loss<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 750\text{ mA}$ ,<br>$f = 1930\text{ MHz}$ , Tone Spacing = 100 kHz)                           | IRL           | —   | -12  | —   | dB              |
| $P_{out, 1\text{ dB}}$ Compression Point<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W CW}$ , $f = 1930\text{ MHz}$ )                                                           | $P_{1dB}$     | —   | 90   | —   | W               |

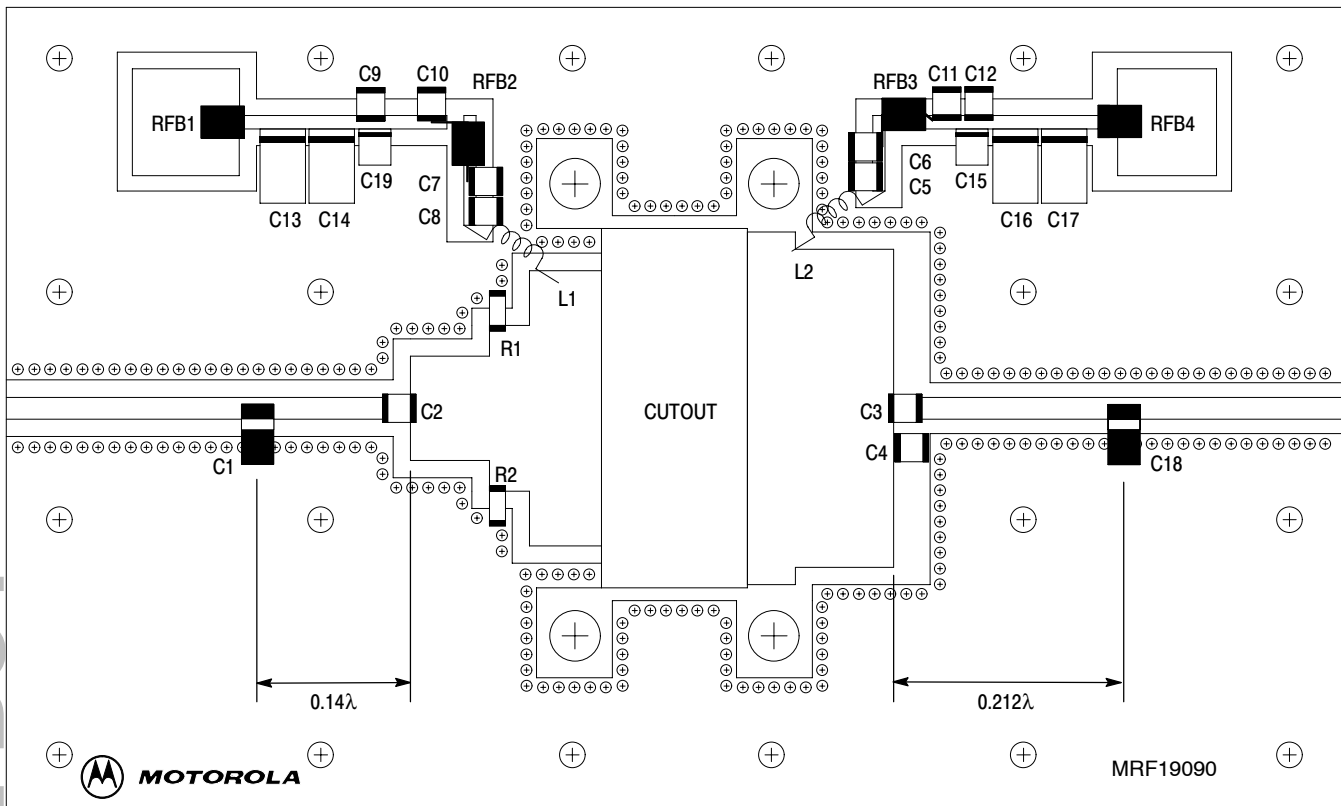
1. Part is internally matched both on input and output.



|            |                                                                  |
|------------|------------------------------------------------------------------|
| B1, B2     | 2 Ferrite Beads, Round, Ferroxcube #56-590-65-3B                 |
| B3, B34    | Ferrite Beads, Surface Mount, Fair-Rite 2743019447               |
| C1, C18    | 0.4 - 2.5 pF Variable Capacitors, Johanson Gigatrim #27280       |
| C2, C5, C8 | 10 pF Chip Capacitors, ATC #100B100CT500XT                       |
| C3         | 12 pF Chip Capacitor, ATC #100B120CT500XT                        |
| C4         | 0.3 pF Chip Capacitor, ATC #100B0R3CT500XT                       |
| C6, C7     | 120 pF Chip Capacitors, ATC #100B12R1CT500XT                     |
| C9, C12    | 0.1 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKYS               |
| C10, C11   | 1000 pF Chip Capacitors, ATC #100B102JT50XT                      |
| C13, C17   | 22 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T491X226K035AT |
| C14, C16   | 10 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T495X106K035AT |
| C15, C19   | 1 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T495X105K035AT  |

|                  |                                                                                          |
|------------------|------------------------------------------------------------------------------------------|
| L1, L2           | 8 Turns, #26 AWG, 0.085" OD, 0.330" Long, Copper Wire                                    |
| R1, R2           | 270 $\Omega$ , 1/4 W Chip Resistors, Garrett Instruments #RM73B2B271JT                   |
| Z1               | ZO = 50 Ohms                                                                             |
| Z2               | ZO = 50 Ohms, Lambda = 0.123                                                             |
| Z3               | ZO = 15.24 Ohms, Lambda = 0.0762                                                         |
| Z4               | ZO = 10.11 Ohms, Lambda = 0.0392                                                         |
| Z5               | ZO = 6.34 Ohms, Lambda = 0.0711                                                          |
| Z6               | ZO = 5.02 Ohms, Lambda = 0.0476                                                          |
| Z7               | ZO = 5.54 Ohms, Lambda = 0.0972                                                          |
| Z8               | ZO = 50.0 Ohms, Lambda = 0.194                                                           |
| Z9               | ZO = 50.0 Ohms                                                                           |
| 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

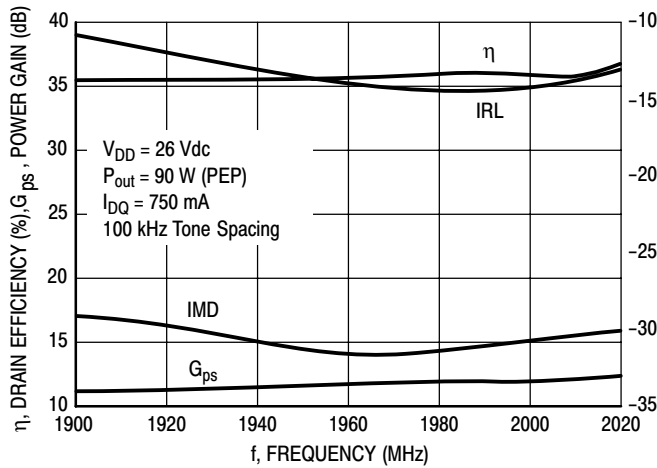


Figure 3. Class AB Performance versus Frequency

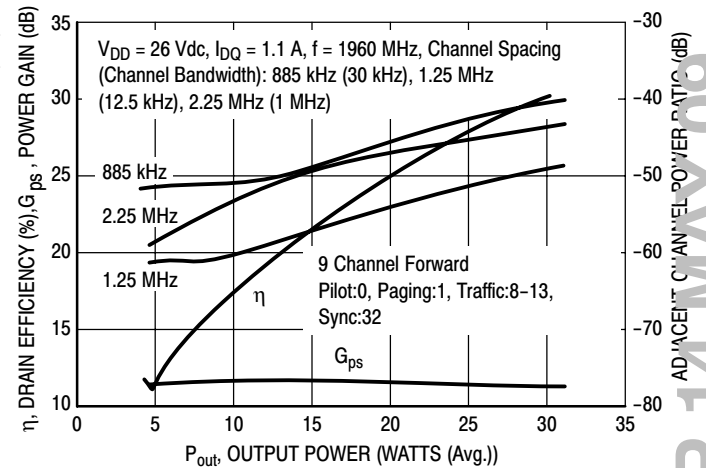


Figure 4. CDMA Performance ACPR, Gain and Drain Efficiency versus Output Power

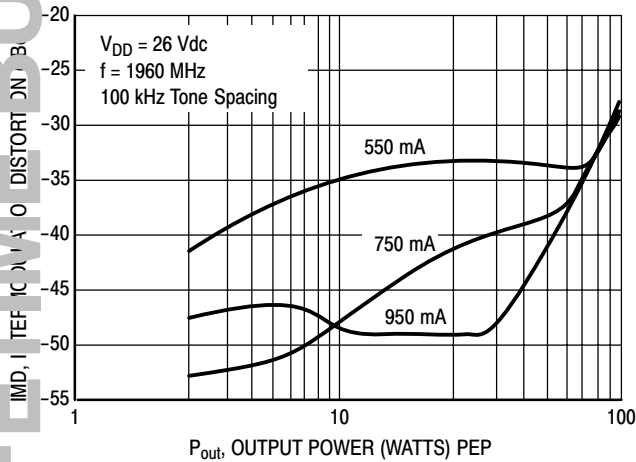


Figure 5. Third Order Intermodulation Distortion versus Output Power

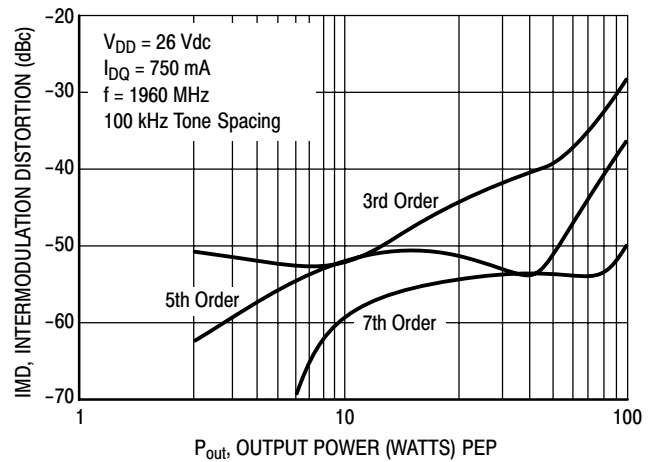


Figure 6. Intermodulation Products versus Output Power

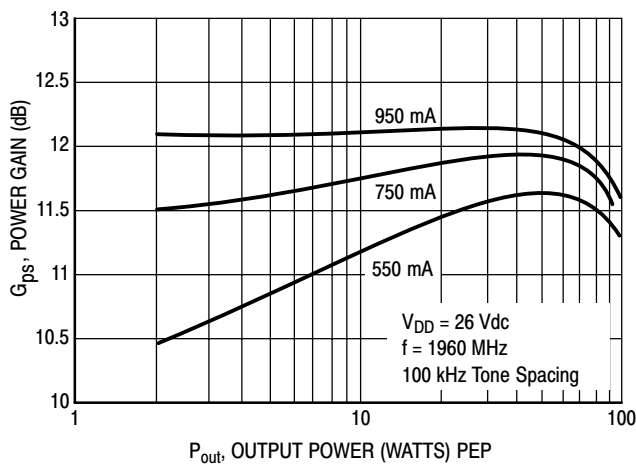


Figure 7. Power Gain versus Output Power

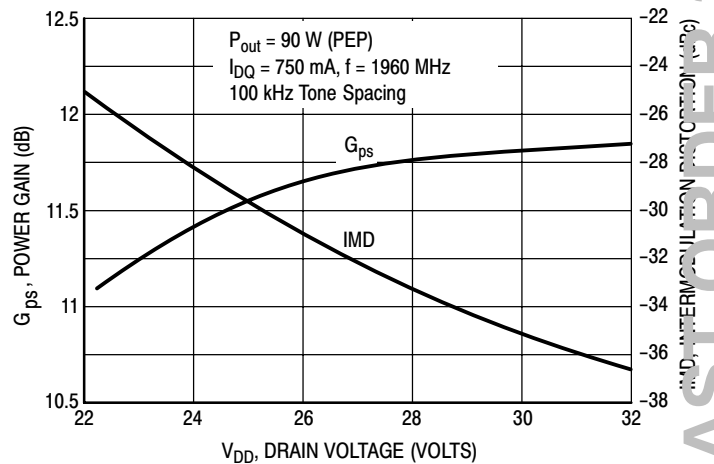
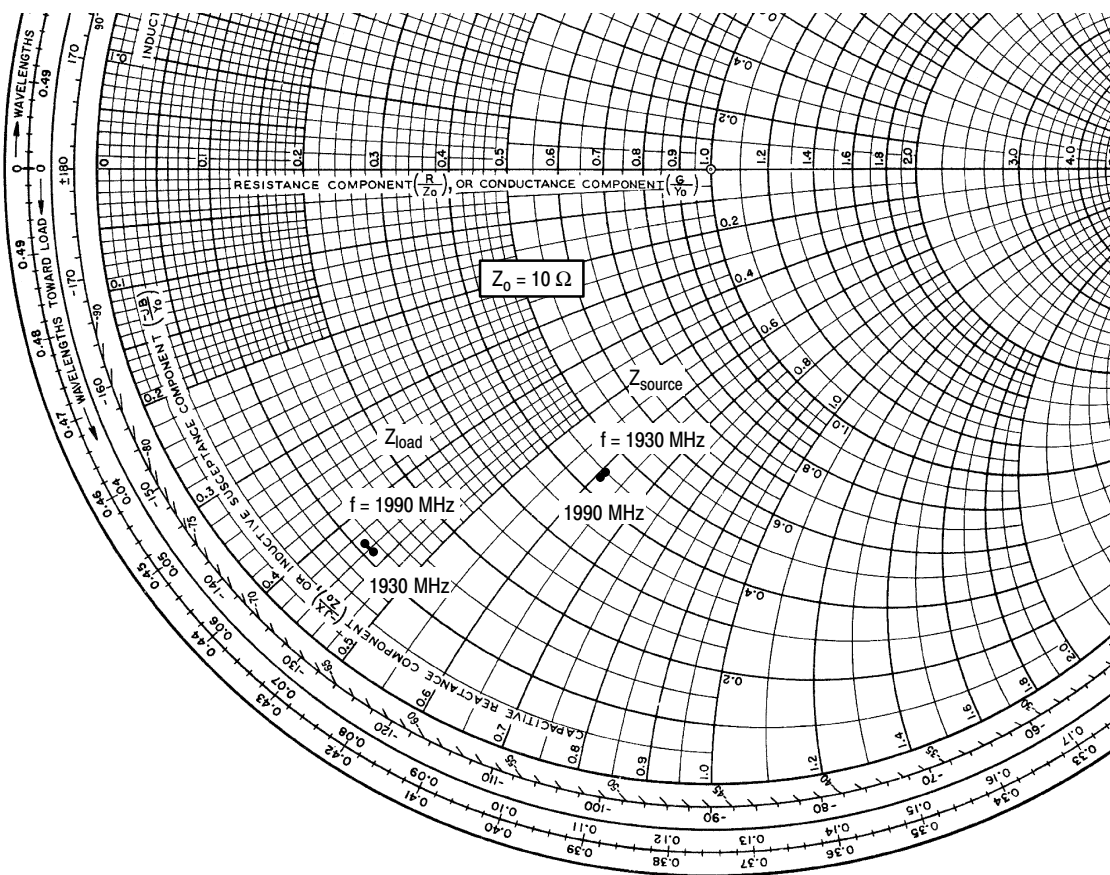


Figure 8. Third Order Intermodulation Distortion and Gain versus Supply Voltage



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

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 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.

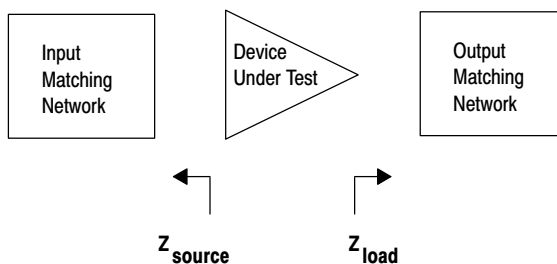
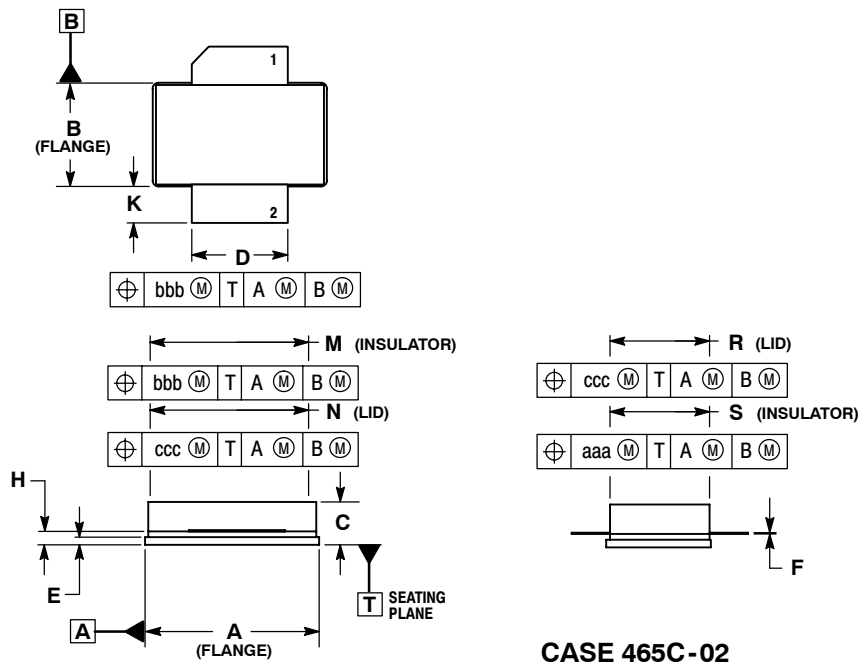


Figure 9. Series Equivalent Source and Load Impedance

## 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.

| 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
- GATE
- SOURCE

**CASE 465C-02  
ISSUE D  
NI-880S  
MRF19090SR3**

## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8        | Oct. 2008 | <ul style="list-style-type: none"><li>• Data sheet revised to reflect part status change, p. 1, including use of applicable overlay.</li><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2</li><li>• Updated Part Numbers in Figure 1, Test Circuit Schematic, to RoHS compliant part numbers, p. 3</li><li>• Added Product Documentation and Revision History, p. 8</li></ul> |

## ***How to Reach Us:***

### **Home Page:**

[www.freescale.com](http://www.freescale.com)

### **Web Support:**

<http://www.freescale.com/support>

### **USA/Europe or Locations Not Listed:**

Freescale Semiconductor, Inc.  
Technical Information Center, EL516  
2100 East Elliot Road  
Tempe, Arizona 85284  
1-800-521-6274 or +1-480-768-2130  
[www.freescale.com/support](http://www.freescale.com/support)

### **Europe, Middle East, and Africa:**

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
81829 Muenchen, Germany  
+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
[www.freescale.com/support](http://www.freescale.com/support)

### **Japan:**

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
[support.japan@freescale.com](mailto:support.japan@freescale.com)

### **Asia/Pacific:**

Freescale Semiconductor China Ltd.  
Exchange Building 23F  
No. 118 Jianguo Road  
Chaoyang District  
Beijing 100022  
China  
+86 10 5879 8000  
[support.asia@freescale.com](mailto:support.asia@freescale.com)

### **For Literature Requests Only:**

Freescale Semiconductor Literature Distribution Center  
P.O. Box 5405  
Denver, Colorado 80217  
1-800-441-2447 or +1-303-675-2140  
Fax: +1-303-675-2150  
[LDCForFreescaleSemiconductor@hibbertgroup.com](mailto:LDCForFreescaleSemiconductor@hibbertgroup.com)

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2008. All rights reserved.

