

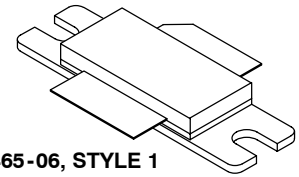
**The RF Sub-Micron MOSFET Line**  
**RF Power Field Effect Transistors**  
**N-Channel Enhancement-Mode Lateral MOSFETs**

**MRF9130LR3**  
**MRF9130LSR3**

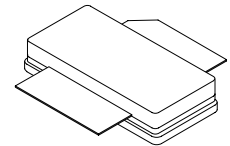
Designed for GSM and GSM EDGE base station applications with frequencies from 921 to 960 MHz, the high gain and broadband performance of these devices make them ideal for large-signal, common-source amplifier applications in 28 volt base station equipment.

- 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
- 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 5:1 VSWR, @ 28 Vdc, All Frequency Band, 130 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads, 40μ" Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**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**

**MAXIMUM RATINGS**

| Rating                                                                | Symbol           | Value        | Unit          |
|-----------------------------------------------------------------------|------------------|--------------|---------------|
| Drain-Source Voltage                                                  | V <sub>DSS</sub> | 65           | Vdc           |
| Gate-Source Voltage                                                   | V <sub>GS</sub>  | - 0.5, +15   | Vdc           |
| Total Device Dissipation @ T <sub>C</sub> = 25°C<br>Derate above 25°C | P <sub>D</sub>   | 298<br>1.7   | Watts<br>W/°C |
| Storage Temperature Range                                             | T <sub>stg</sub> | - 65 to +200 | °C            |
| Operating Junction Temperature                                        | T <sub>J</sub>   | 200          | °C            |

**THERMAL CHARACTERISTICS**

| Characteristic                       | Symbol           | Value | Unit |
|--------------------------------------|------------------|-------|------|
| Thermal Resistance, Junction to Case | R <sub>θJC</sub> | 0.6   | °C/W |

**ESD PROTECTION CHARACTERISTICS**

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

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

# Freescale Semiconductor, Inc.

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                |                  |   |   |    |                  |
|------------------------------------------------------------------------------------------------|------------------|---|---|----|------------------|
| Zero Gate Voltage Drain Leakage Current<br>(V <sub>DS</sub> = 65 Vdc, V <sub>GS</sub> = 0 Vdc) | I <sub>DSS</sub> | — | — | 10 | μA <sub>dc</sub> |
| Zero Gate Voltage Drain Leakage Current<br>(V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0 Vdc) | I <sub>DSS</sub> | — | — | 1  | μA <sub>dc</sub> |
| Gate-Source Leakage Current<br>(V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)              | I <sub>GSS</sub> | — | — | 1  | μA <sub>dc</sub> |

### ON CHARACTERISTICS

|                                                                                               |                     |   |     |     |     |
|-----------------------------------------------------------------------------------------------|---------------------|---|-----|-----|-----|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 450 μA <sub>dc</sub> )  | V <sub>GS(th)</sub> | 2 | 3   | 4   | Vdc |
| Gate Quiescent Voltage<br>(V <sub>DS</sub> = 28 Vdc, I <sub>D</sub> = 1000 mA <sub>dc</sub> ) | V <sub>GS(Q)</sub>  | — | 3.6 | —   | Vdc |
| Drain-Source On-Voltage<br>(V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3 A <sub>dc</sub> )    | V <sub>DS(on)</sub> | — | 0.2 | 0.4 | Vdc |
| Forward Transconductance<br>(V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 9 A <sub>dc</sub> )   | g <sub>fs</sub>     | — | 12  | —   | S   |

### DYNAMIC CHARACTERISTICS (1)

|                                                                                                                        |                  |   |     |   |    |
|------------------------------------------------------------------------------------------------------------------------|------------------|---|-----|---|----|
| Output Capacitance<br>(V <sub>DS</sub> = 28 Vdc ± 30 mV(rms) <sub>ac</sub> @ 1 MHz, V <sub>GS</sub> = 0 Vdc)           | C <sub>oss</sub> | — | 110 | — | pF |
| Reverse Transfer Capacitance<br>(V <sub>DS</sub> = 28 Vdc ± 30 mV(rms) <sub>ac</sub> @ 1 MHz, V <sub>GS</sub> = 0 Vdc) | C <sub>rss</sub> | — | 4.4 | — | pF |

### FUNCTIONAL TESTS (In Motorola Test Fixture)

|                                                                                                                                                                               |                  |                                                      |      |    |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------|------|----|----|
| Power Output, 1 dB Compression Point<br>(V <sub>DD</sub> = 28 Vdc, I <sub>DQ</sub> = 1000 mA, f = 921 and 960 MHz)                                                            | P <sub>1dB</sub> | 120                                                  | 135  | —  | W  |
| Common-Source Amplifier Power Gain<br>(V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 130 W, I <sub>DQ</sub> = 1000 mA, f = 921 and 960 MHz)                                    | G <sub>ps</sub>  | 15.5                                                 | 16.5 | —  | dB |
| Drain Efficiency<br>(V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 130 W, I <sub>DQ</sub> = 1000 mA, f = 921 and 960 MHz)                                                      | η                | 43                                                   | 48   | —  | %  |
| Input Return Loss<br>(V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 130 W, I <sub>DQ</sub> = 1000 mA, f = 921 and 960 MHz)                                                     | IRL              | —                                                    | -12  | -9 | dB |
| Output Mismatch Stress<br>(V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 130 W CW, I <sub>DQ</sub> = 1000 mA, f = 921 MHz, VSWR = 5:1, All Phase Angles at Frequency of Tests) | Ψ                | No Degradation In Output Power Before and After Test |      |    |    |

(1) Part is internally input matched.

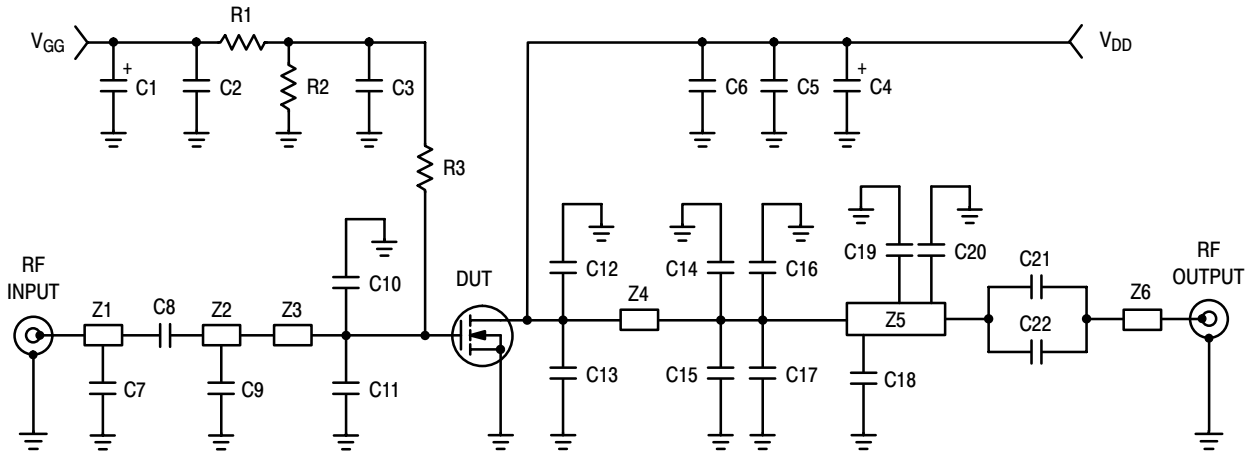


Figure 1. 921-960 MHz Test Circuit Schematic

Table 1. 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", $\epsilon_r = 2.55$                             |

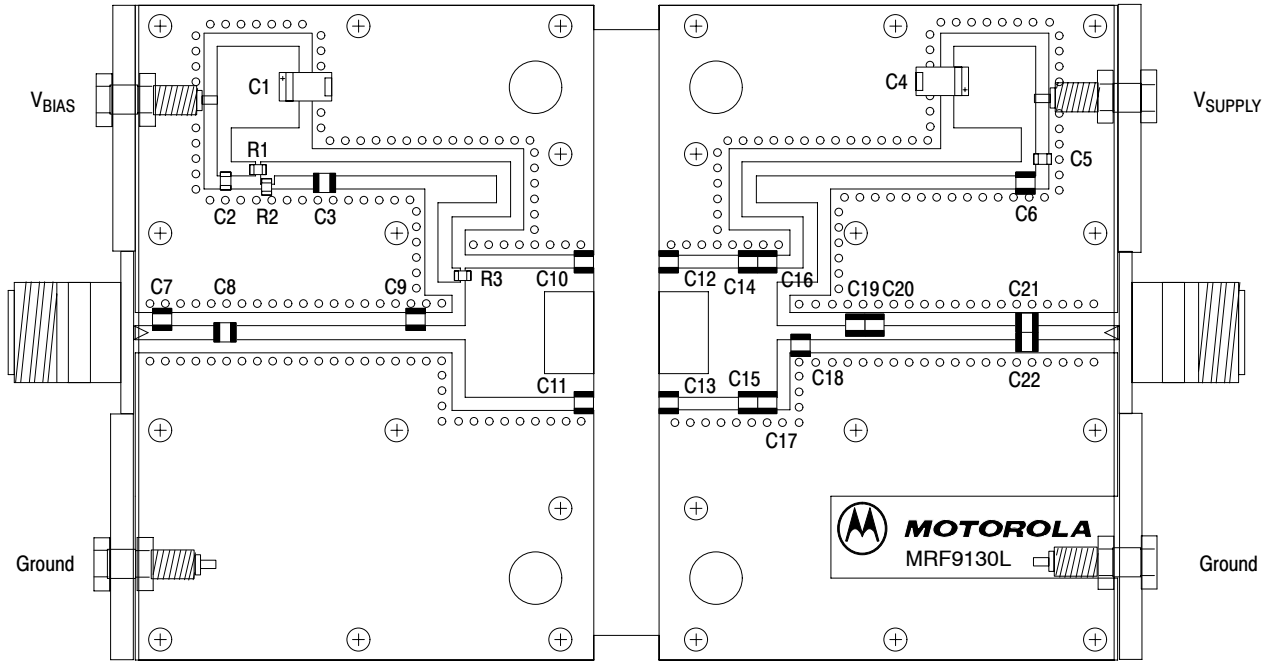
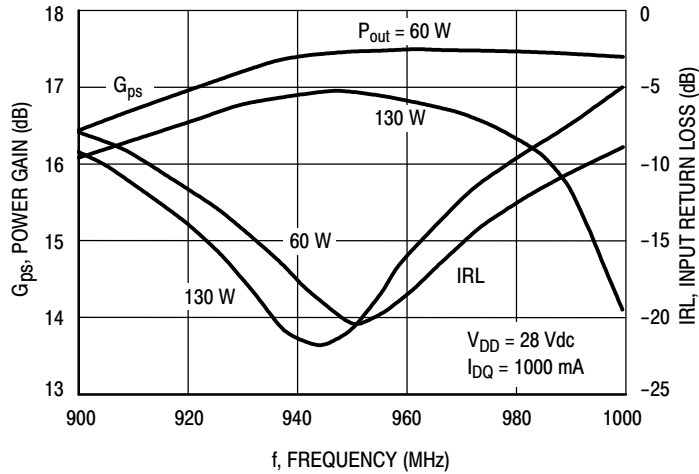


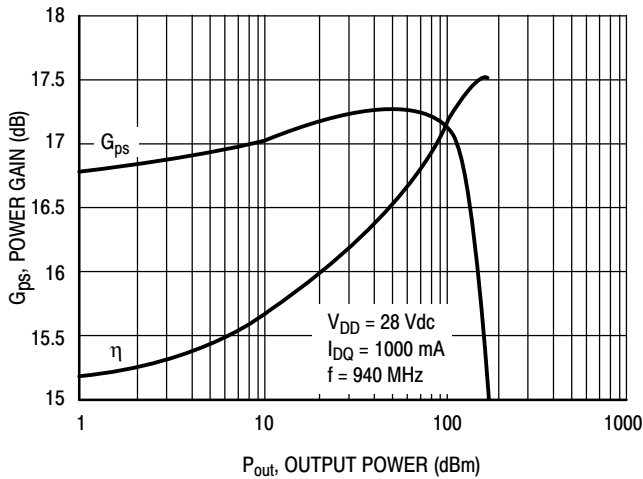
Figure 2. 921-960 MHz Test Circuit Component Layout

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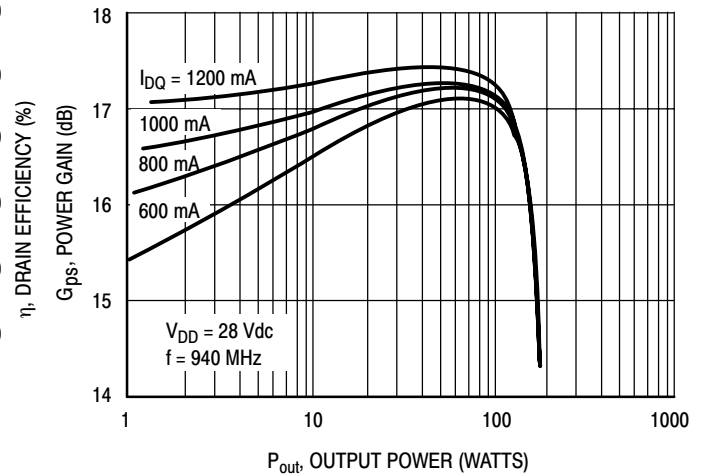
## TYPICAL CHARACTERISTICS



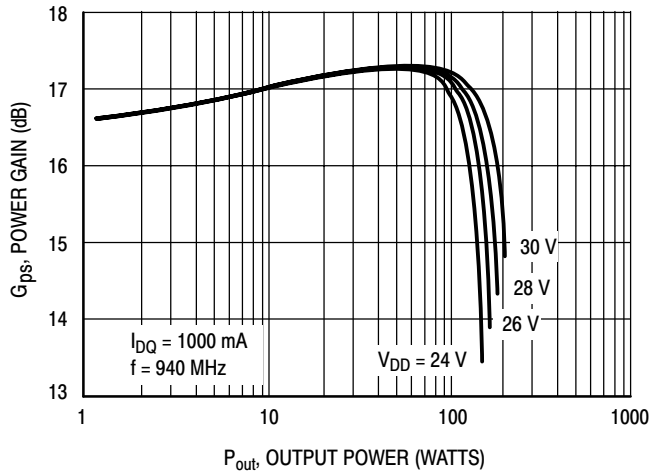
**Figure 3. Power Gain and Input Return Loss versus Frequency**



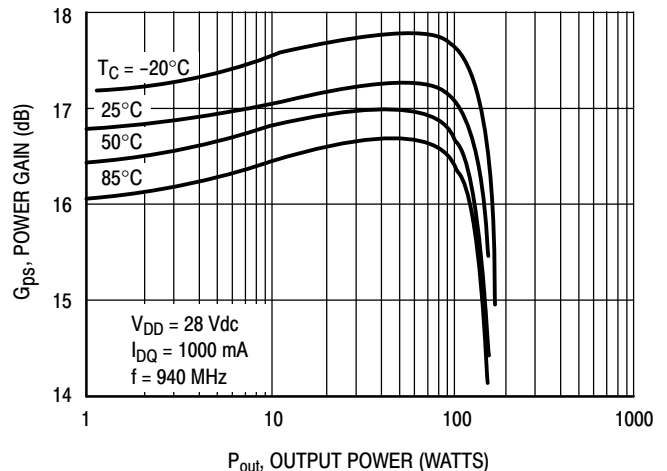
**Figure 4. Power Gain and Efficiency versus Output Power**



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

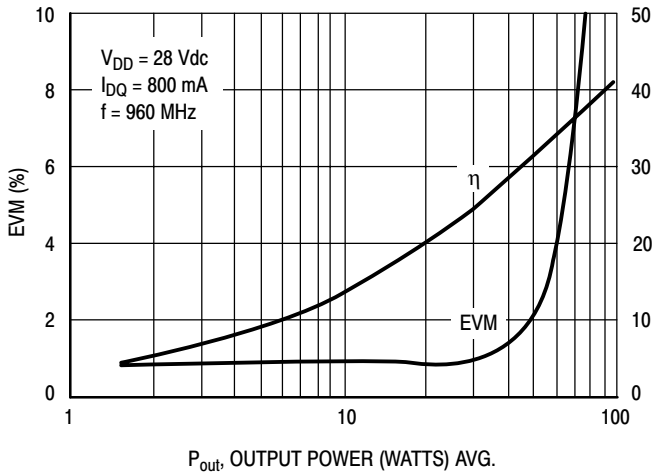


**Figure 6. Power Gain versus Output Power**

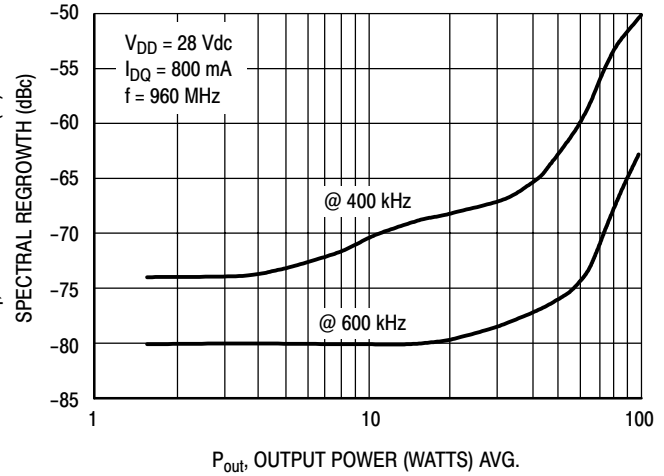


**Figure 7. Power Gain versus Output Power**

## TYPICAL CHARACTERISTICS

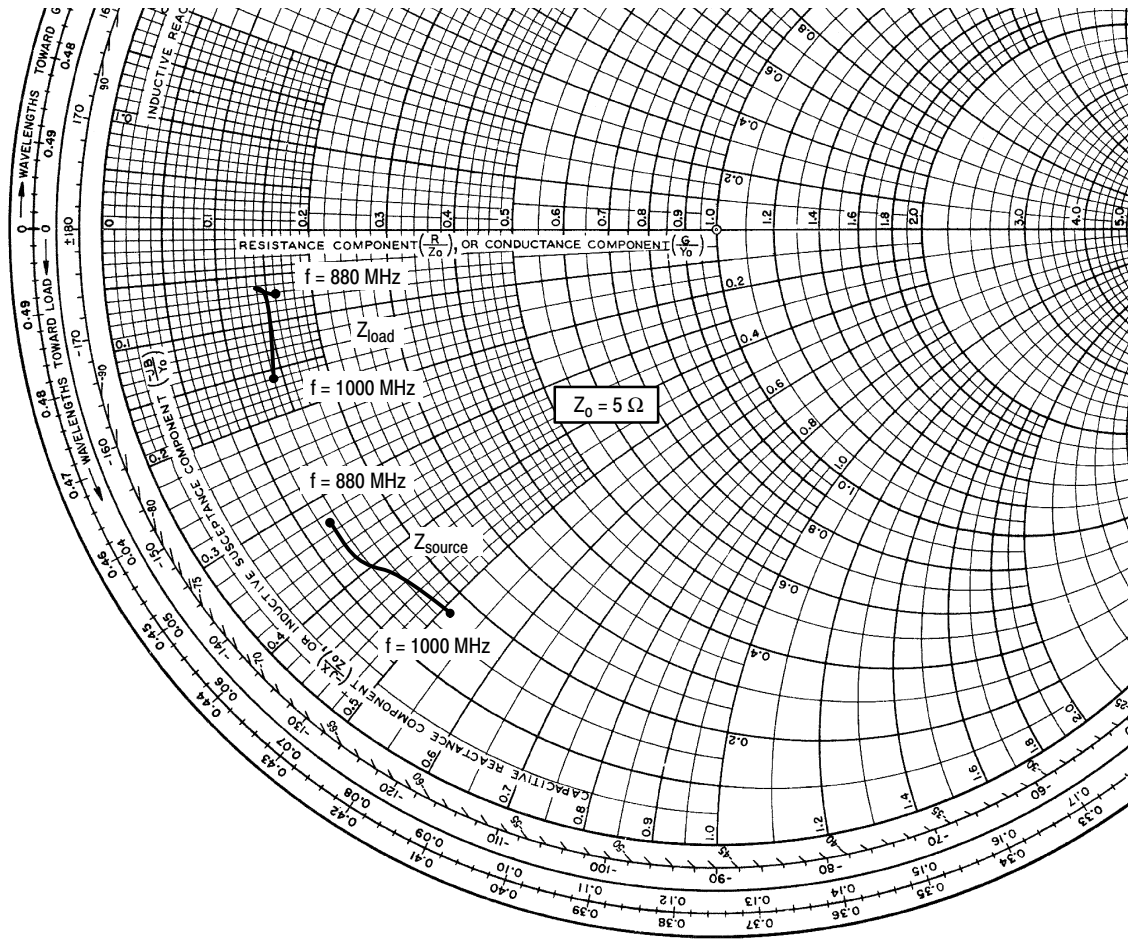


**Figure 8. EVM and Efficiency versus Output Power**



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

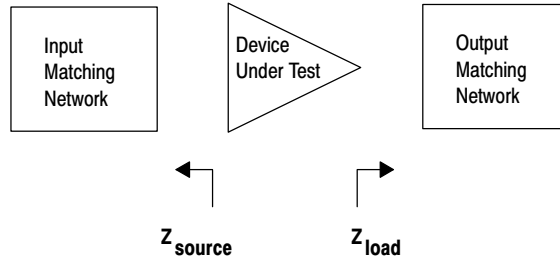


Figure 10. Series Equivalent Input and Output Impedance

**NOTES**



**NOTES**

**NOTES**

# Freescale Semiconductor, Inc.

## PACKAGE DIMENSIONS

**Case 465-06  
Issue F  
NI-780  
MRF9130LR3**

**NOTES:**

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- CONTROLLING DIMENSION: INCH.
- DELETED
- 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   | ∅.118     | ∅.138 | ∅3.00       | ∅3.51 |
| 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
- GATE
- SOURCE

**Case 465A-06  
Issue F  
NI-780S  
MRF9130LSR3**

**NOTES:**

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- CONTROLLING DIMENSION: INCH.
- DELETED
- 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
- GATE
- SOURCE

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