



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for CDMA and multicarrier GSM base station applications with frequencies from 865 to 960 MHz. Can be used in Class AB and Class C for all typical cellular base station modulation formats.

- Typical Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ} = 1700$  mA,  $P_{out} = 75$  Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.

| Frequency | $G_{ps}$ (dB) | $\eta_D$ (%) | Output PAR (dB) | ACPR (dBc) |
|-----------|---------------|--------------|-----------------|------------|
| 920 MHz   | 18.8          | 36.0         | 6.3             | -39.5      |
| 940 MHz   | 18.7          | 37.0         | 6.2             | -38.6      |
| 960 MHz   | 18.6          | 38.5         | 5.9             | -37.1      |

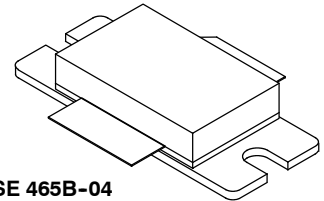
- Capable of Handling 7:1 VSWR, @ 32 Vdc, 940 MHz, 380 Watts CW <sup>(1)</sup> Output Power (3 dB Input Overdrive from Rated  $P_{out}$ ), Designed for Enhanced Ruggedness
- Typical  $P_{out}$  @ 1 dB Compression Point  $\approx$  260 Watts CW

### Features

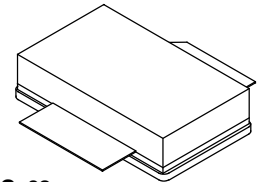
- 100% PAR Tested for Guaranteed Output Power Capability
- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source S-Parameters
- Internally Matched for Ease of Use
- Integrated ESD Protection
- Greater Negative Gate-Source Voltage Range for Improved Class C Operation
- Optimized for Doherty Applications
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF8S9260HR3**  
**MRF8S9260HSR3**

**920-960 MHz, 75 W AVG., 28 V**  
**SINGLE W-CDMA**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465B-04**  
**NI-880**  
**MRF8S9260HR3**



**CASE 465C-03**  
**NI-880S**  
**MRF8S9260HSR3**

**Table 1. Maximum Ratings**

| Rating   | Symbol    | Value       | Unit      |
|--|-----------|-------------|-----------|
| Drain-Source Voltage   | $V_{DSS}$ | -0.5, +70   | Vdc       |
| Gate-Source Voltage  | $V_{GS}$  | -6.0, +10   | Vdc       |
| Operating Voltage  | $V_{DD}$  | 32, +0      | Vdc       |
| Storage Temperature Range                                    | $T_{stg}$ | -65 to +150 | °C        |
| Case Operating Temperature                                   | $T_C$     | 150         | °C        |
| Operating Junction Temperature <sup>(2,3)</sup>              | $T_J$     | 225         | °C        |
| CW Operation @ $T_C = 25^\circ\text{C}$<br>Derate above 25°C | CW        | 280<br>1.5  | W<br>W/°C |

**Table 2. Thermal Characteristics**

| Characteristic  | Symbol          | Value <sup>(3,4)</sup> | Unit |
|---|-----------------|------------------------|------|
| Thermal Resistance, Junction to Case<br>Case Temperature 80°C, 75 W CW, 28 Vdc, $I_{DQ} = 1800$ mA<br>Case Temperature 80°C, 265 W CW, 28 Vdc, $I_{DQ} = 1100$ mA | $R_{\theta JC}$ | 0.37<br>0.31           | °C/W |

1. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.
2. Continuous use at maximum temperature will affect MTTF.
3. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
4. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class |
|---------------------------------------|-------|
| Human Body Model (per JESD22-A114)    | 1C    |
| Machine Model (per EIA/JESD22-A115)   | A     |
| Charge Device Model (per JESD22-C101) | IV    |

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

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

**Off Characteristics**

|   |           |   |   |    |                 |
|---|-----------|---|---|----|-----------------|
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 70\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$ | — | — | 10 | $\mu\text{Adc}$ |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$ | — | — | 1  | $\mu\text{Adc}$ |
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )              | $I_{GSS}$ | — | — | 1  | $\mu\text{Adc}$ |

**On Characteristics**

|  |              |     |     |     |     |
|--|--------------|-----|-----|-----|-----|
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 400\ \mu\text{Adc}$ )                            | $V_{GS(th)}$ | 1.5 | 2.3 | 3   | Vdc |
| Gate Quiescent Voltage<br>( $V_{DD} = 28\text{ Vdc}$ , $I_D = 1700\text{ mAdc}$ , Measured in Functional Test) | $V_{GS(Q)}$  | 2.4 | 3.1 | 3.9 | Vdc |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 4.4\text{ Adc}$ )                               | $V_{DS(on)}$ | 0.1 | 0.2 | 0.3 | Vdc |

**Functional Tests** <sup>(1)</sup> (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 1700\text{ mA}$ ,  $P_{out} = 75\text{ W Avg.}$ ,  $f = 960\text{ MHz}$ , Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

|  |          |      |       |       |     |
|--|----------|------|-------|-------|-----|
| Power Gain   | $G_{ps}$ | 17.5 | 18.6  | 20.0  | dB  |
| Drain Efficiency   | $\eta_D$ | 36.0 | 38.5  | —     | %   |
| Output Peak-to-Average Ratio @ 0.01% Probability on CCDF | PAR      | 5.5  | 5.9   | —     | dB  |
| Adjacent Channel Power Ratio                             | ACPR     | —    | -37.1 | -35.0 | dBc |
| Input Return Loss  | IRL      | —    | -14   | -9    | dB  |

**Typical Broadband Performance** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 1700\text{ mA}$ ,  $P_{out} = 75\text{ W Avg.}$ , Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

| Frequency | $G_{ps}$<br>(dB) | $\eta_D$<br>(%) | Output PAR<br>(dB) | ACPR<br>(dB) | IRL<br>(dB) |
|-----------|------------------|-----------------|--------------------|--------------|-------------|
| 920 MHz   | 18.8             | 36.0            | 6.3                | -39.5        | -16         |
| 940 MHz   | 18.7             | 37.0            | 6.2                | -38.6        | -18         |
| 960 MHz   | 18.6             | 38.5            | 5.9                | -37.1        | -14         |

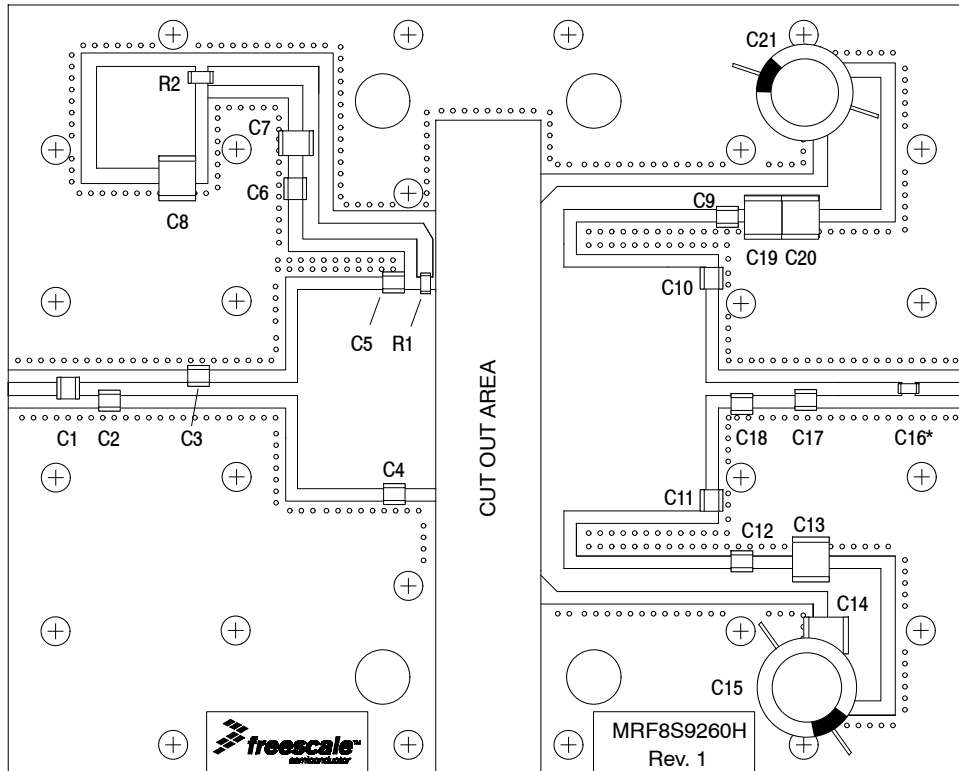
1. Part internally matched both on input and output.

(continued)

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

| Characteristic  | Symbol             | Min | Typ    | Max | Unit                 |
|---|--------------------|-----|--------|-----|----------------------|
| <b>Typical Performance</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ} = 1700\text{ mA}$ , 920-960 MHz Bandwidth                                  |                    |     |        |     |                      |
| $P_{out}$ @ 1 dB Compression Point, CW  | P1dB               | —   | 260    | —   | W                    |
| IMD Symmetry @ 130 W PEP, $P_{out}$ where IMD Third Order Intermodulation $\cong 30\text{ dBc}$<br>(Delta IMD Third Order Intermodulation between Upper and Lower Sidebands > 2 dB) | IMD <sub>sym</sub> | —   | 10     | —   | MHz                  |
| VBW Resonance Point<br>(IMD Third Order Intermodulation Inflection Point)   | VBW <sub>res</sub> | —   | 50     | —   | MHz                  |
| Gain Flatness in 40 MHz Bandwidth @ $P_{out} = 75\text{ W Avg.}$  | G <sub>F</sub>     | —   | 0.2    | —   | dB                   |
| Gain Variation over Temperature<br>( $-30^\circ\text{C}$ to $+85^\circ\text{C}$ )   | $\Delta G$         | —   | 0.024  | —   | dB/ $^\circ\text{C}$ |
| Output Power Variation over Temperature<br>( $-30^\circ\text{C}$ to $+85^\circ\text{C}$ ) (1)   | $\Delta P_{1dB}$   | —   | 0.0075 | —   | dB/ $^\circ\text{C}$ |

1. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.



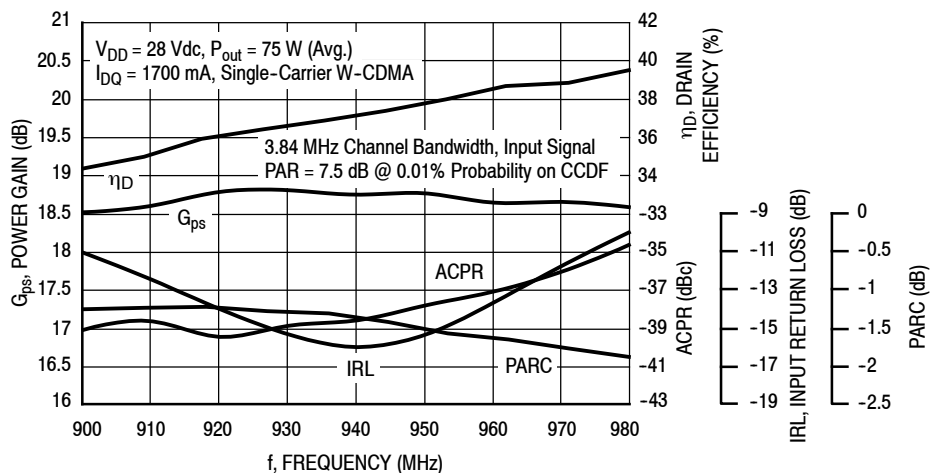
\*C16 is mounted vertically.

Figure 1. MRF8S9260HR3(HSR3) Test Circuit Component Layout

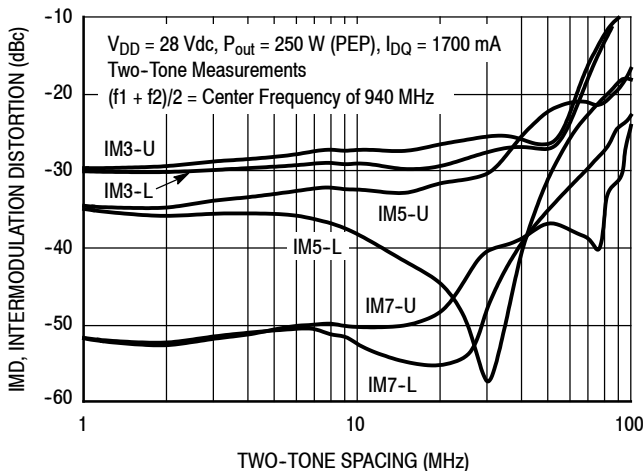
Table 5. MRF8S9260HR3(HSR3) Test Circuit Component Designations and Values

| Part                   | Description                               | Part Number       | Manufacturer       |
|------------------------|---|-------------------|--------------------|
| C1, C6, C9, C12, C16   | 36 pF Chip Capacitors                     | ATC100B360JT500XT | ATC                |
| C2                     | 0.4 pF Chip Capacitor                     | ATC100B0R4BT500XT | ATC                |
| C3                     | 4.7 pF Chip Capacitor                     | ATC100B4R7BT500XT | ATC                |
| C4, C5                 | 8.2 pF Chip Capacitors                    | ATC100B8R2BT500XT | ATC                |
| C7                     | 4.7 $\mu$ F, 50 V Chip Capacitor          | C4532X5R1H475MT   | TDK                |
| C8, C13, C14, C19, C20 | 10 $\mu$ F, 50 V Chip Capacitors          | C5750X5R1H106MT   | TDK                |
| C10, C11               | 5.6 pF Chip Capacitors                    | ATC100B5R6BT500XT | ATC                |
| C15, C21               | 470 $\mu$ F, 63 V Electrolytic Capacitors | 477KXM063M        | Illinois Capacitor |
| C17                    | 4.3 pF Chip Capacitor                     | ATC100B4R3BT500XT | ATC                |
| C18                    | 0.8 pF Chip Capacitor                     | ATC100B0R8BT500XT | ATC                |
| R1                     | 10 $\Omega$ , 1/4 W Chip Resistor         | CRCW120610R0JKEA  | Vishay             |
| R2                     | 0 $\Omega$ , 3.5 A Chip Resistor          | CRCW12060000Z0EA  | Vishay             |
| PCB                    | 0.030", $\epsilon_r = 3.5$                | RF-35             | Taconic            |

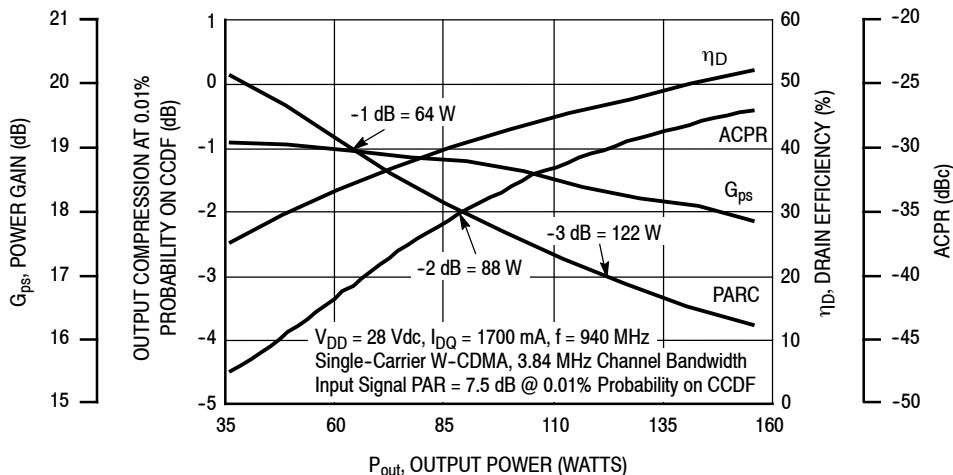
## TYPICAL CHARACTERISTICS



**Figure 2. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 75$  Watts Avg.**

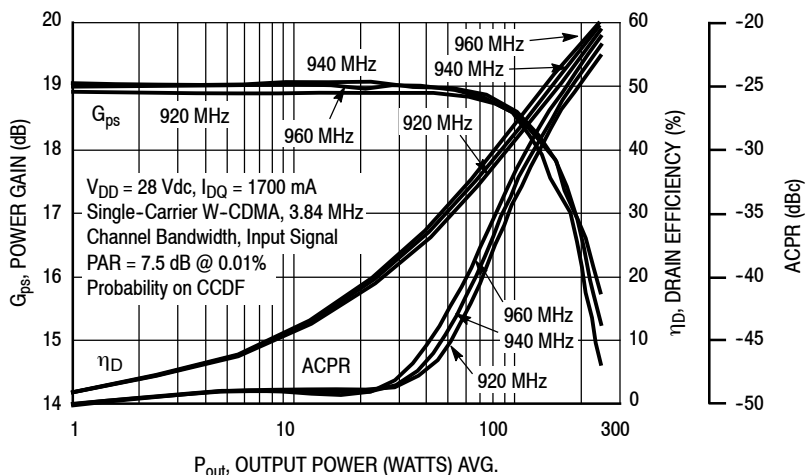


**Figure 3. Intermodulation Distortion Products versus Two-Tone Spacing**

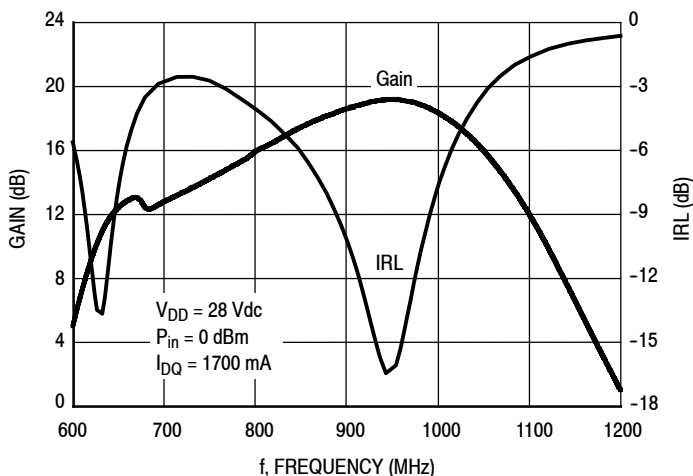


**Figure 4. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**

## TYPICAL CHARACTERISTICS

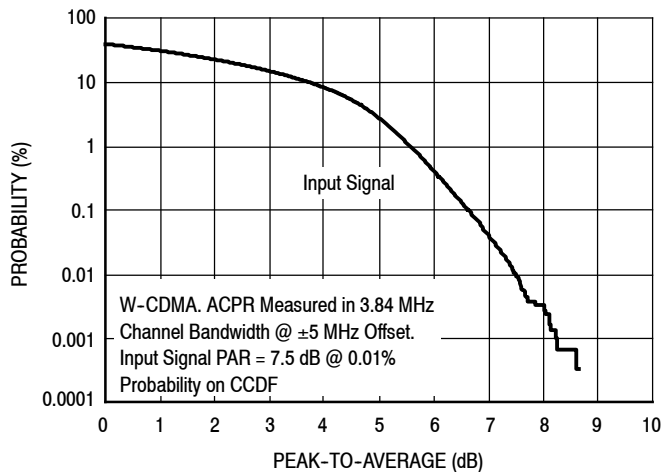


**Figure 5. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power**

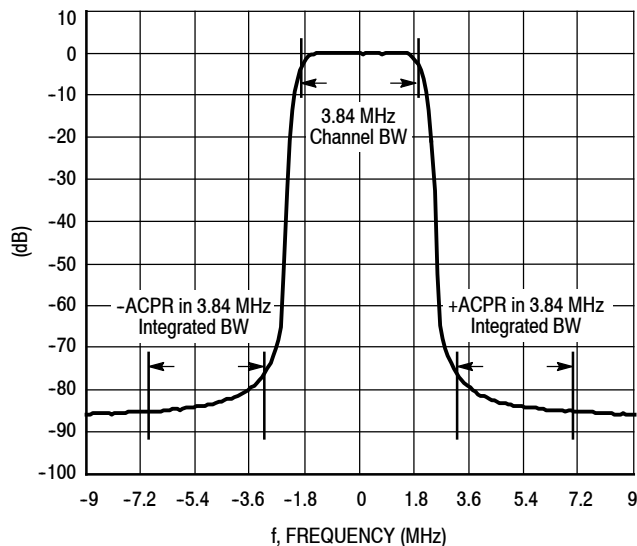


**Figure 6. Broadband Frequency Response**

## W-CDMA TEST SIGNAL



**Figure 7. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal**



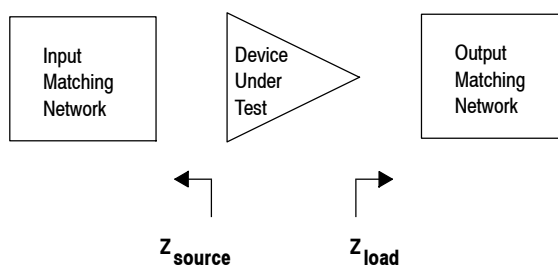
**Figure 8. Single-Carrier W-CDMA Spectrum**

$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 1700 \text{ mA}$ ,  $P_{out} = 75 \text{ W Avg.}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 820      | 2.25 - j2.59             | 1.93 - j1.63           |
| 840      | 2.21 - j2.51             | 1.91 - j1.45           |
| 860      | 2.16 - j2.46             | 1.90 - j1.28           |
| 880      | 2.11 - j2.40             | 1.90 - j1.14           |
| 900      | 1.98 - j2.37             | 1.91 - j1.02           |
| 920      | 1.87 - j2.29             | 1.90 - j0.91           |
| 940      | 1.75 - j2.23             | 1.89 - j0.83           |
| 960      | 1.61 - j2.14             | 1.87 - j0.76           |
| 980      | 1.46 - j2.03             | 1.84 - j0.69           |

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

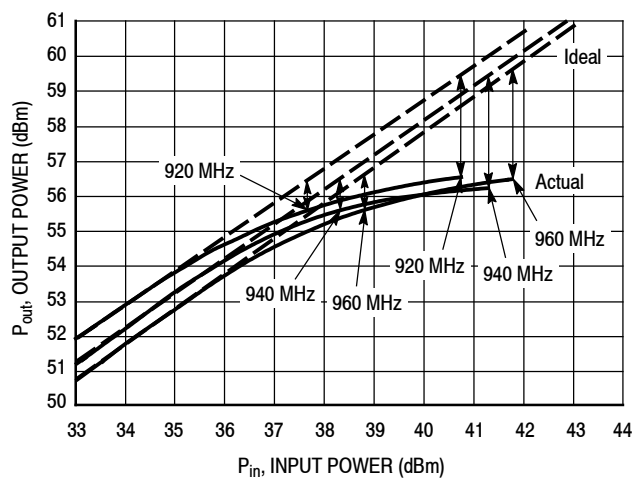
$Z_{load}$  = Test circuit impedance as measured from drain to ground.



**Figure 9. Series Equivalent Source and Load Impedance**

## ALTERNATIVE PEAK TUNE LOAD PULL CHARACTERISTICS

$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 1700 \text{ mA}$ , Pulsed CW, 10  $\mu\text{sec}(\text{on})$ , 10% Duty Cycle



NOTE: Load Pull Test Fixture Tuned for Peak P1dB Output Power @ 28 V

| f<br>(MHz) | P1dB  |      | P3dB  |      |
|------------|-------|------|-------|------|
|            | Watts | dBm  | Watts | dBm  |
| 920        | 363   | 55.6 | 447   | 56.5 |
| 940        | 363   | 55.6 | 417   | 56.2 |
| 960        | 363   | 55.6 | 437   | 56.4 |

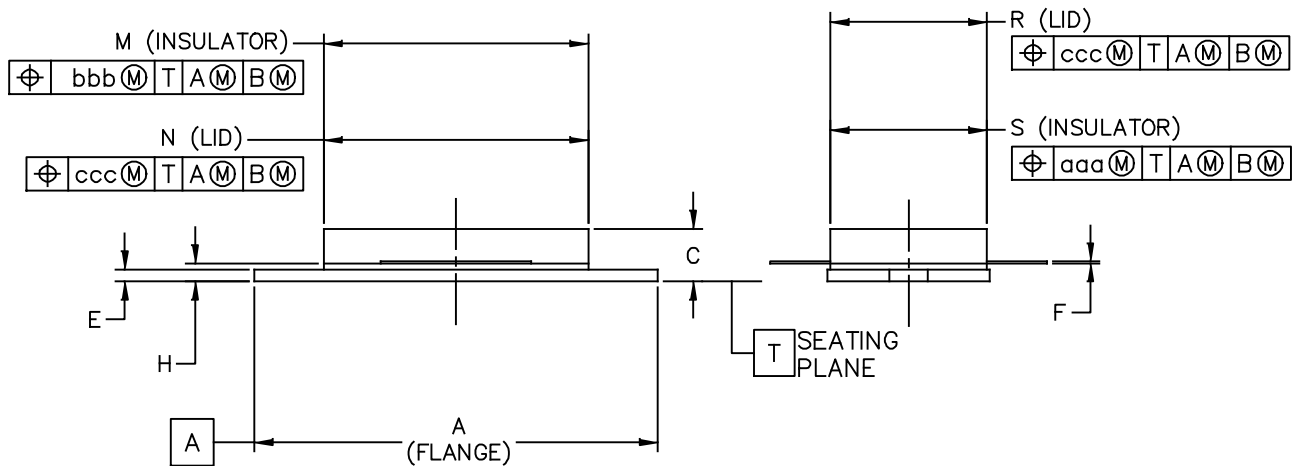
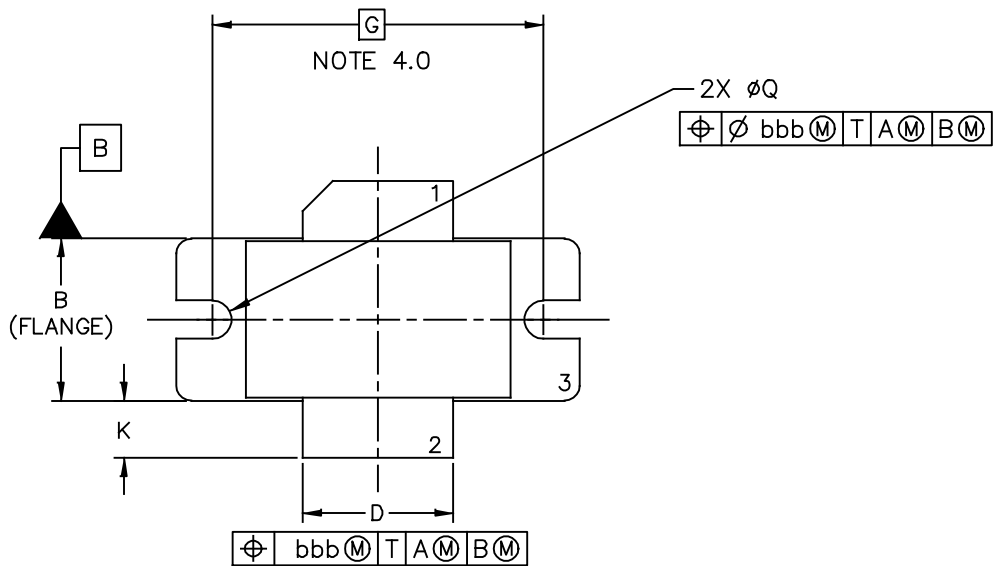
Test Impedances per Compression Level

| f<br>(MHz) |      | $Z_{\text{source}}$<br>$\Omega$ | $Z_{\text{load}}$<br>$\Omega$ |
|------------|------|---------------------------------|-------------------------------|
| 920        | P1dB | 0.94 - j2.68                    | 2.19 - j2.10                  |
| 940        | P1dB | 1.18 - j2.65                    | 2.18 - j2.52                  |
| 960        | P1dB | 1.24 - j3.10                    | 2.72 - j2.11                  |

**Figure 10. Pulsed CW Output Power versus Input Power @ 28 V**



## PACKAGE DIMENSIONS

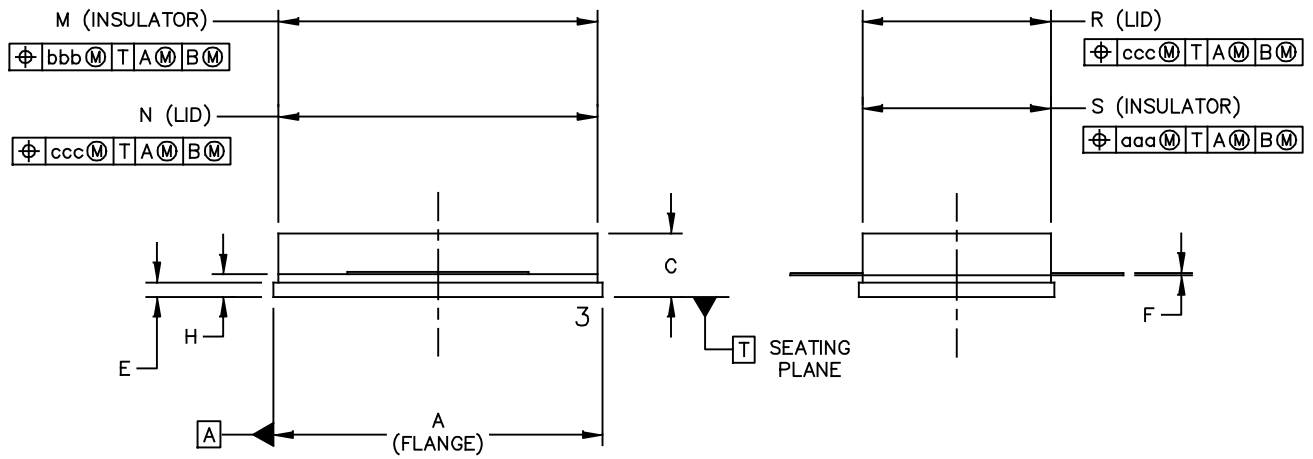
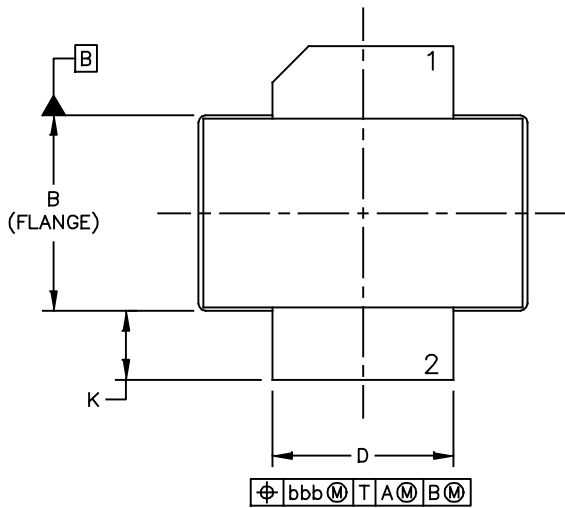


|   |   |                            |
|---|---|----------------------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED.                       | MECHANICAL OUTLINE  | PRINT VERSION NOT TO SCALE |
| TITLE:<br><br><div style="text-align: center; font-size: 1.2em;">NI-880</div> | DOCUMENT NO: 98ARB18493C<br>CASE NUMBER: 465B-04<br>STANDARD: NON-JEDEC | REV: F<br>26 MAY 2011      |

NOTES:

- 1.0 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- 2.0 CONTROLLING DIMENSION: INCH.
- 3.0 DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.
- 4.0 RECOMMENDED BOLT CENTER DIMENSION OF 1.16 (29.57) BASED ON M3 SCREW.

| DIM   | INCH      |       | MILLIMETER         |       | DIM                      | INCH                       |        | MILLIMETER |         |
|---|-----------|-------|--------------------|-------|--------------------------|----------------------------|--------|------------|---------|
|   | MIN       | MAX   | MIN                | MAX   |                          | MIN                        | MAX    | MIN        | MAX     |
| A   | 1.335     | 1.345 | 33.91              | 34.16 | R                        | .515                       | – .525 | 13.08      | – 13.34 |
| B   | .535      | .545  | 13.59              | 13.84 | S                        | .515                       | – .525 | 13.08      | – 13.34 |
| C   | .147      | .200  | 3.73               | 5.08  | aaa                      | –                          | .007 – | –          | 0.178 – |
| D   | .495      | .505  | 12.57              | 12.83 | bbb                      | –                          | .010 – | –          | 0.254 – |
| E   | .035      | .045  | 0.89               | 1.14  | ccc                      | –                          | .015 – | –          | 0.381 – |
| F   | .003      | .006  | 0.08               | 0.15  | –                        | –                          | – –    | –          | – –     |
| G   | 1.100 BSC |       | 27.94 BSC          |       | –                        | –                          | – –    | –          | – –     |
| H   | .057      | .067  | 1.45               | 1.70  | –                        | –                          | – –    | –          | – –     |
| K   | .175      | .205  | 4.45               | 5.21  | –                        | –                          | – –    | –          | – –     |
| M   | .872      | .888  | 22.15              | 22.56 | –                        | –                          | – –    | –          | – –     |
| N   | .871      | .889  | 22.12              | 22.58 | –                        | –                          | – –    | –          | – –     |
| Q   | ∅.118     | ∅.138 | ∅3.00              | ∅3.51 | –                        | –                          | – –    | –          | – –     |
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |           |       | MECHANICAL OUTLINE |       |                          | PRINT VERSION NOT TO SCALE |        |            |         |
| TITLE:<br><br>NI-880                                    |           |       |                    |       | DOCUMENT NO: 98ARB18493C |                            |        | REV: F     |         |
|   |           |       |                    |       | CASE NUMBER: 465B-04     |                            |        | 26 MAY 11  |         |
|   |           |       |                    |       | STANDARD: NON-JEDEC      |                            |        |            |         |



|   |  |                          |                            |
|---|--|--------------------------|----------------------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE       | PRINT VERSION NOT TO SCALE |
| TITLE:<br><br>NI-880S                                   |  | DOCUMENT NO: 98ARB18660C | REV: E                     |
|   |  | CASE NUMBER: 465C-03     | 26 MAY 2011                |
|   |  | STANDARD: NON-JEDEC      |                            |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

| DIM | INCH |        | MILLIMETER |         | DIM | INCH   |     | MILLIMETER |     |
|-----|------|--------|------------|---------|-----|--------|-----|------------|-----|
|     | MIN  | MAX    | MIN        | MAX     |     | MIN    | MAX | MIN        | MAX |
| A   | .905 | – .915 | 22.99      | – 23.24 | aaa | – .007 | –   | – 0.178    | –   |
| B   | .535 | – .545 | 13.59      | – 13.84 | bbb | – .010 | –   | – 0.254    | –   |
| C   | .147 | – .200 | 3.73       | – 5.08  | ccc | – .015 | –   | – 0.381    | –   |
| D   | .495 | – .505 | 12.57      | – 12.83 | –   | –      | –   | –          | –   |
| E   | .035 | – .045 | 0.89       | – 1.14  | –   | –      | –   | –          | –   |
| F   | .003 | – .006 | 0.08       | – 0.15  | –   | –      | –   | –          | –   |
| H   | .057 | .067   | 1.45       | 1.70    | –   | –      | –   | –          | –   |
| K   | .170 | – .210 | 4.32       | – 5.33  | –   | –      | –   | –          | –   |
| M   | .872 | – .888 | 22.15      | – 22.56 | –   | –      | –   | –          | –   |
| N   | .871 | – .889 | 22.12      | – 22.58 | –   | –      | –   | –          | –   |
| R   | .515 | – .525 | 13.08      | – 13.34 | –   | –      | –   | –          | –   |
| S   | .515 | – .525 | 13.08      | – 13.34 | –   | –      | –   | –          | –   |

|   |  |                          |  |                            |  |
|---|--|--------------------------|--|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE       |  | PRINT VERSION NOT TO SCALE |  |
| TITLE:<br><br>NI–880S                                   |  | DOCUMENT NO: 98ARB18660C |  | REV: E                     |  |
|   |  | CASE NUMBER: 465C–03     |  | 26 MAY 2011                |  |
|   |  | STANDARD: NON–JEDEC      |  |                            |  |

## PRODUCT DOCUMENTATION, TOOLS AND SOFTWARE

Refer to the following documents, tools and software to aid your design process.

### Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- Electromigration MTTF Calculator
- RF High Power Model
- .s2p File

For Software and Tools, do a Part Number search at <http://www.freescale.com>, and select the “Part Number” link. Go to the Software & Tools tab on the part’s Product Summary page to download the respective tool.

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description  |
|----------|-----------|--|
| 0        | Dec. 2009 | <ul style="list-style-type: none"><li>• Initial Release of Data Sheet</li></ul>  |
| 1        | Feb. 2012 | <ul style="list-style-type: none"><li>• Table 3, ESD Protection Characteristics, removed the word “Minimum” after the ESD class rating. ESD ratings are characterized during new product development but are not 100% tested during production. ESD ratings provided in the data sheet are intended to be used as a guideline when handling ESD sensitive devices, p. 2.</li><li>• Replaced Case Outline 465B-03, Issue D, with 465B-04, Issue F, p. 1, 9-10. Deleted Style 1 pin note on Sheet 2. On Sheet 2, changed dimension B in mm from 13.6-13.8 to 13.59-13.84, changed dimension H in mm from 1.45-1.7 to 1.45-1.70, changed dimension K in mm from 4.44-5.21 to 4.45-5.21, changed dimension M in mm from 22.15-22.55 to 22.15-22.56, changed dimension N in mm from 19.3-22.6 to 22.12-22.58, changed dimension Q in mm from 3-3.51 to 3.00-3.51, changed dimension R and S in mm from 13.1-13.3 to 13.08-13.34.</li><li>• Replaced Case Outline 465C-02, Issue D, with 465C-03, Issue E, p. 1, 11-12. Deleted Style 1 pin note on Sheet 2. On Sheet 2, changed dimension B in mm from 13.6-13.8 to 13.59-13.84, changed dimension H in mm from 1.45-1.7 to 1.45-1.70, changed dimension M in mm from 22.15-22.55 to 22.15-22.56, changed dimension N in mm from 19.3-22.6 to 22.12-22.58, changed dimension R and S in mm from 13.1-13.3 to 13.08-13.34.</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  
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. 2009, 2012. All rights reserved.

