

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and EDGE base station applications with frequencies from 1.9 to 2.0 GHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in class AB for GSM and EDGE cellular radio applications.

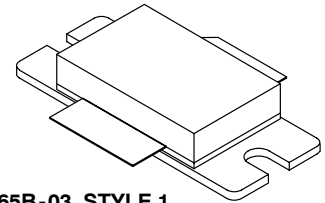
- GSM and EDGE Performances, Full Frequency Band  
Power Gain — 13.5 dB (Typ) @ 90 Watts (CW)  
Efficiency — 45% (Typ) @ 90 Watts (CW)
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 90 Watts CW Output Power

### Features

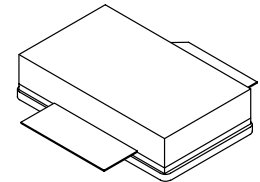
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- RoHS Compliant
- In Tape and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

**MRF18090BR3**  
**MRF18090BSR3**

**1.90 - 1.99 GHz, 90 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETS**



**CASE 465B-03, STYLE 1**  
**NI-880**  
**MRF18090BR3**



**CASE 465C-02, STYLE 1**  
**NI-880S**  
**MRF18090BSR3**

**Table 1. Maximum Ratings**

| Rating                                                                                 | Symbol    | Value        | Unit                     |
|----------------------------------------------------------------------------------------|-----------|--------------|--------------------------|
| Drain-Source Voltage                                                                   | $V_{DS}$  | -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 $25^\circ\text{C}$ | $P_D$     | 250<br>1.43  | 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 | $R_{\theta JC}$ | 0.7   | $^\circ\text{C/W}$ |

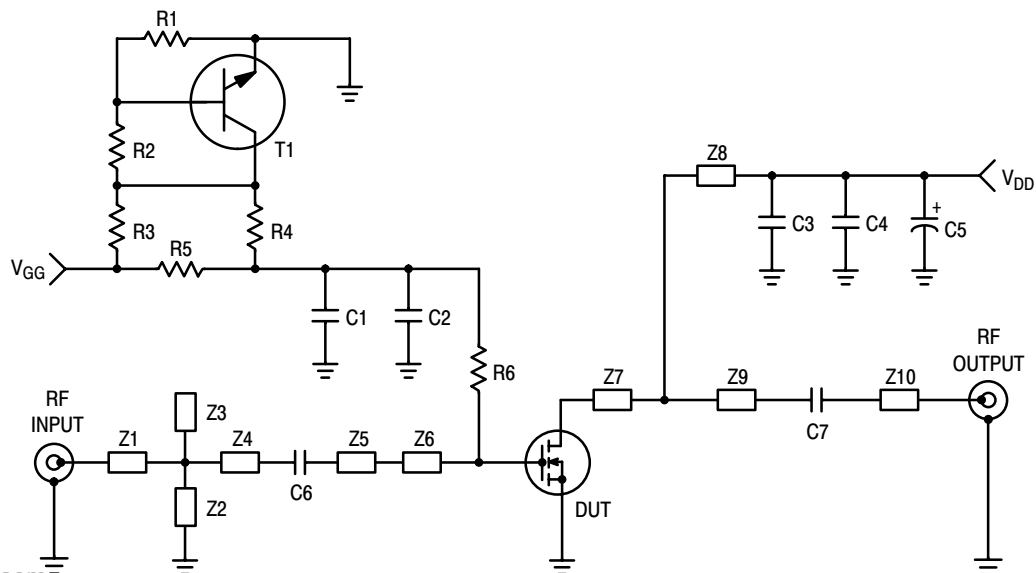
**Table 3. ESD Protection Characteristics**

| Test Conditions  | Class        |
|------------------|--------------|
| Human Body Model | 2 (Minimum)  |
| Machine Model    | M3 (Minimum) |

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

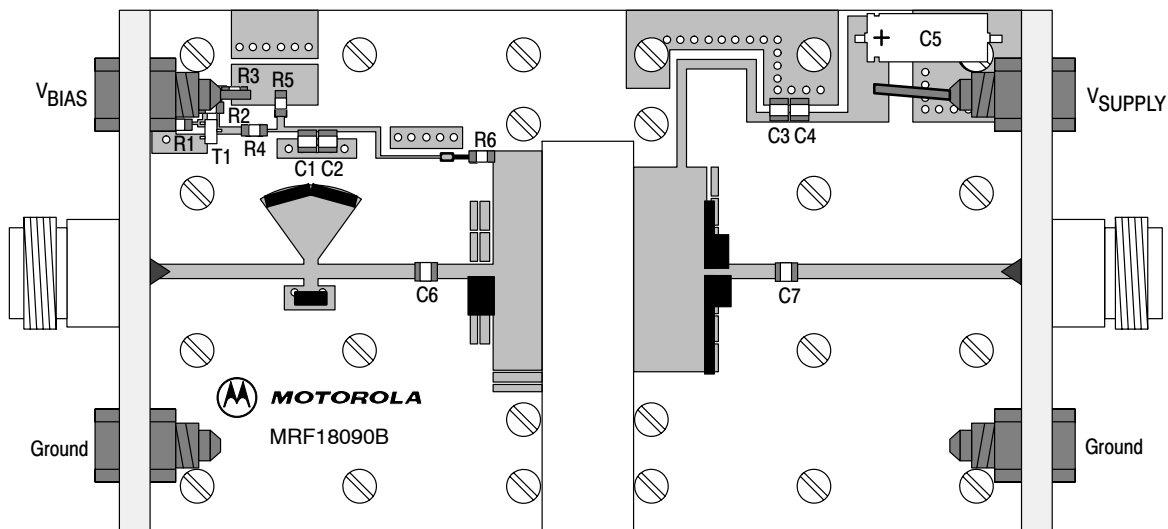
| Characteristic                                                                                                                                             | Symbol        | Min | Typ  | Max  | Unit            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|------|------|-----------------|
| <b>Off Characteristics</b>                                                                                                                                 |               |     |      |      |                 |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{Adc}$ )                                                           | $V_{(BR)DSS}$ | 65  | —    | —    | Vdc             |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                                                                  | $I_{DSS}$     | —   | —    | 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>                                                                                                                                  |               |     |      |      |                 |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 750\text{ mA}$ )                                                                             | $V_{GS(Q)}$   | 2.5 | 3.7  | 4.5  | Vdc             |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )                                                                             | $V_{DS(on)}$  | —   | 0.1  | —    | Vdc             |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 3\text{ Adc}$ )                                                                            | $g_{fs}$      | —   | 7.2  | —    | S               |
| <b>Dynamic Characteristics</b>                                                                                                                             |               |     |      |      |                 |
| Reverse Transfer Capacitance<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )                                      | $C_{rss}$     | —   | 4.2  | —    | pF              |
| <b>Functional Tests (In Freescale Test Fixture)</b>                                                                                                        |               |     |      |      |                 |
| Common-Source Amplifier Power Gain @ 90 W <sup>(1)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930 - 1990\text{ MHz}$ )         | $G_{ps}$      | 12  | 13.5 | —    | dB              |
| Drain Efficiency @ 90 W <sup>(1)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 750\text{ mA}$ , $f = 1930 - 1990\text{ MHz}$ )                           | $\eta$        | 40  | 45   | —    | %               |
| Input Return Loss <sup>(1)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W CW}$ , $I_{DQ} = 750\text{ mA}$ ,<br>$f = 1930 - 1990\text{ MHz}$ ) | IRL           | —   | —    | - 10 | dB              |

1. To meet application requirements, Freescale test fixtures have been designed to cover the full GSM1900 band, ensuring batch-to-batch consistency.



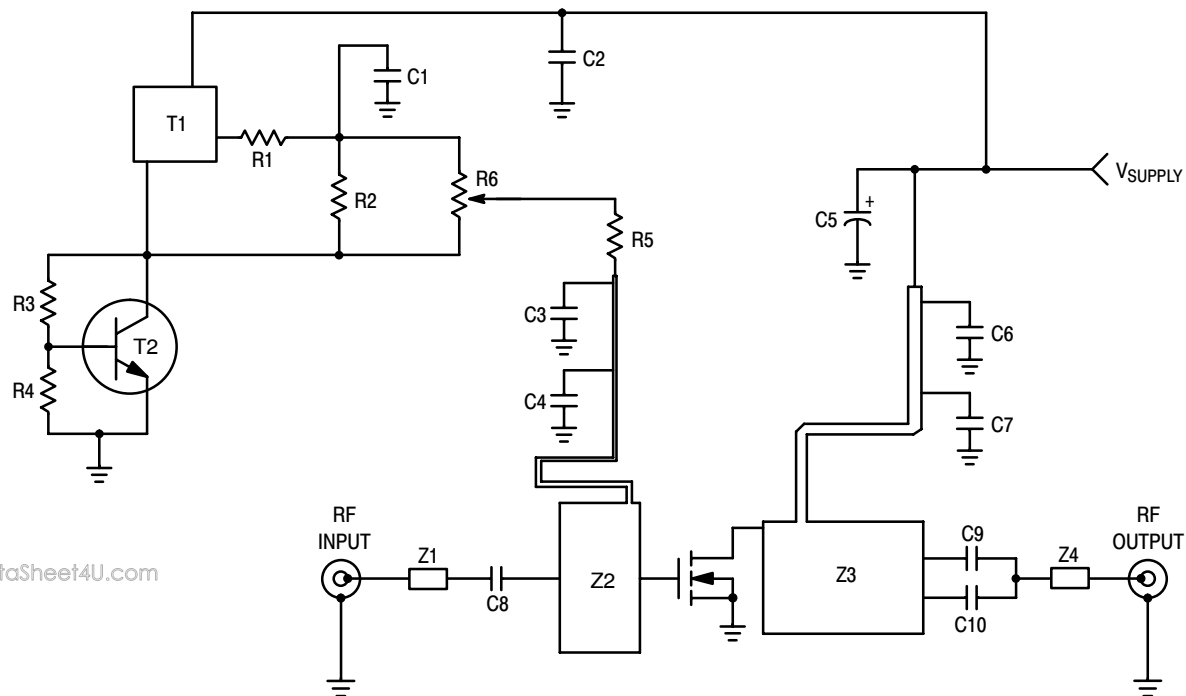
|            |                                          |     |                                |
|------------|------------------------------------------|-----|--------------------------------|
| C1         | 1.0 $\mu$ F Chip Capacitor (0805)        | Z2  | Printed Inductance             |
| C2         | 1.0 nF Chip Capacitor (0805)             | Z3  | Printed Inductance (Butterfly) |
| C3, C4     | 6.8 pF, 100B Chip Capacitors             | Z4  | 0.70" x 0.09" Microstrip       |
| C5         | 220 $\mu$ F, 50 V Electrolytic Capacitor | Z5  | 0.36" x 0.09" Microstrip       |
| C6, C7     | 12 pF, 100B Chip Capacitors              | Z6  | 0.21" x 1.25" Microstrip       |
| R1         | 2.2 k $\Omega$ Chip Resistor (0805)      | Z7  | 0.45" x 1.18" Microstrip       |
| R2, R3, R6 | 1.0 k $\Omega$ Chip Resistors (0805)     | Z8  | 1.37" x 0.05" Microstrip       |
| R4         | 10 k $\Omega$ Chip Resistor (0805)       | Z9  | 0.39" x 0.09" Microstrip       |
| R5         | 6.8 k $\Omega$ Chip Resistor (0805)      | Z10 | 1.25" x 0.09" Microstrip       |
| T1         | BC847 SOT-23                             | PCB | Teflon <sup>®</sup> Glass      |
| Z1         | 0.85" x 0.09" Microstrip                 |     |                                |

Figure 1. 1.93 - 1.99 MHz Test Fixture Schematic



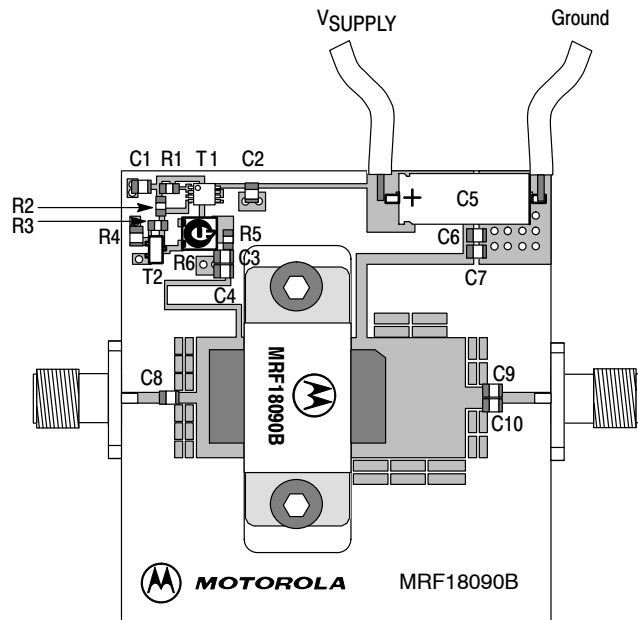
Freescle has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescle Semiconductor signature/logo. PCBs may have either Motorola or Freescle markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. 1.93 - 1.99 GHz Test Fixture Component Layout



|             |                                          |                                              |                                    |
|-------------|------------------------------------------|----------------------------------------------|------------------------------------|
| C1, C3      | 1 $\mu$ F Chip Capacitors (0805)         | R5                                           | 10 k $\Omega$ Chip Resistor (0603) |
| C2          | 0.1 $\mu$ F Chip Capacitor (0805)        | R6                                           | 5 k $\Omega$ , SMD Potentiometer   |
| C4          | 1 nF Chip Capacitor (0805)               | T1                                           | LP2951 Micro-8 Voltage Regulator   |
| C5          | 220 $\mu$ F, 50 V Electrolytic Capacitor | T2                                           | BC847 SOT-23 NPN Transistor        |
| C6, C7      | 8.2 pF, 100A Chip Capacitors             | Z1                                           | 0.491" x 0.110" Microstrip         |
| C8, C9, C10 | 22 pF, 100A Chip Capacitors              | Z2                                           | 0.756" x 1.260" Microstrip         |
| R1          | 10 $\Omega$ Chip Resistor (0805)         | Z3                                           | 1.433" x 1.260" Microstrip         |
| R2, R3      | 1 k $\Omega$ Chip Resistors (0805)       | Z4                                           | 0.567" x 0.110" Microstrip         |
| R4          | 2.2 k $\Omega$ Chip Resistor (0805)      | Substrate = 0.5 mm Teflon <sup>®</sup> Glass |                                    |

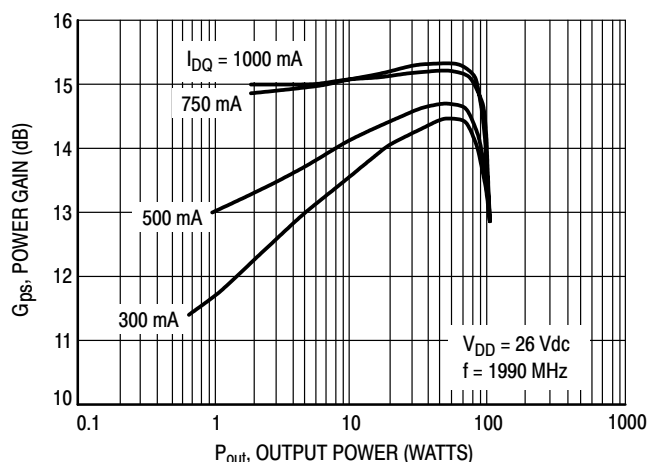
**Figure 3. 1.93 - 1.99 GHz Demo Board Schematic**



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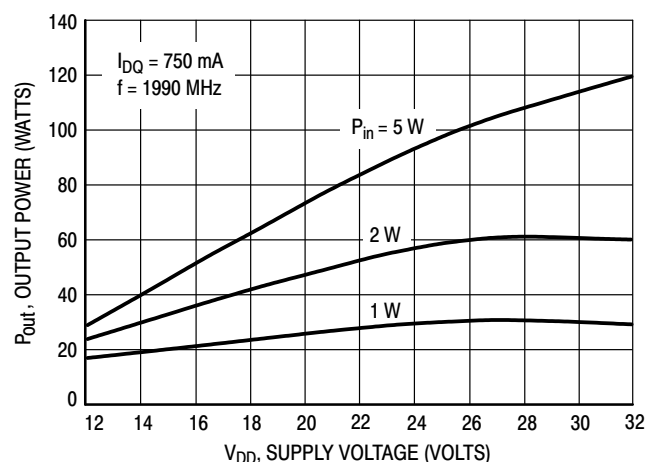
**Figure 4. 1.93 - 1.99 GHz Demo Board Component Layout**

## TYPICAL CHARACTERISTICS

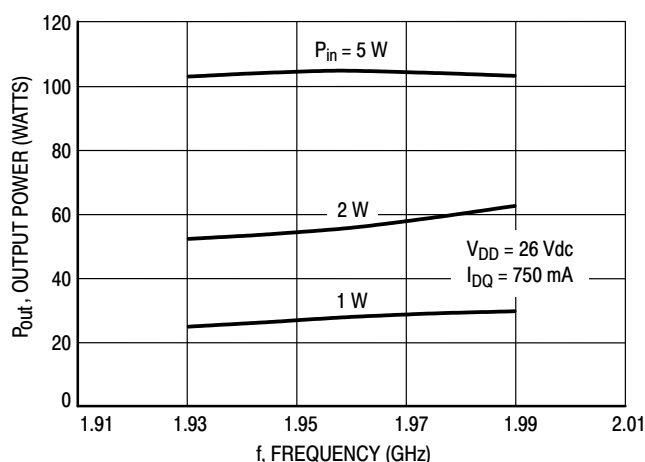


**Figure 5. Power Gain versus Output Power**

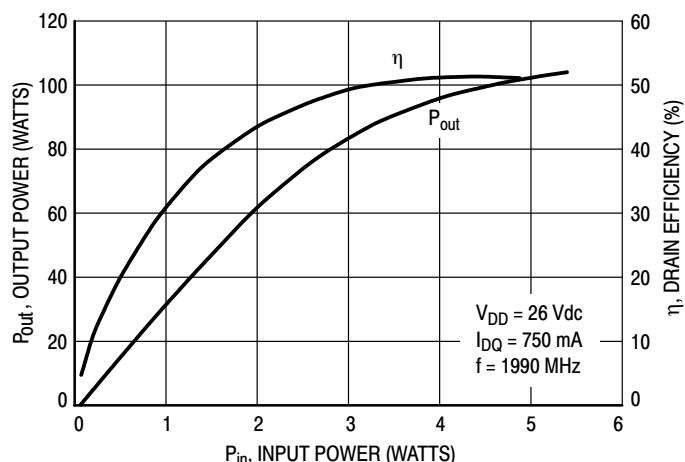
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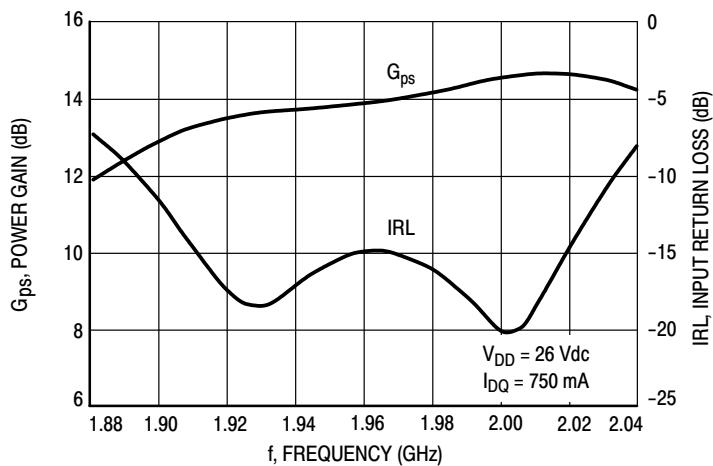
**Figure 6. Output Power versus Supply Voltage**



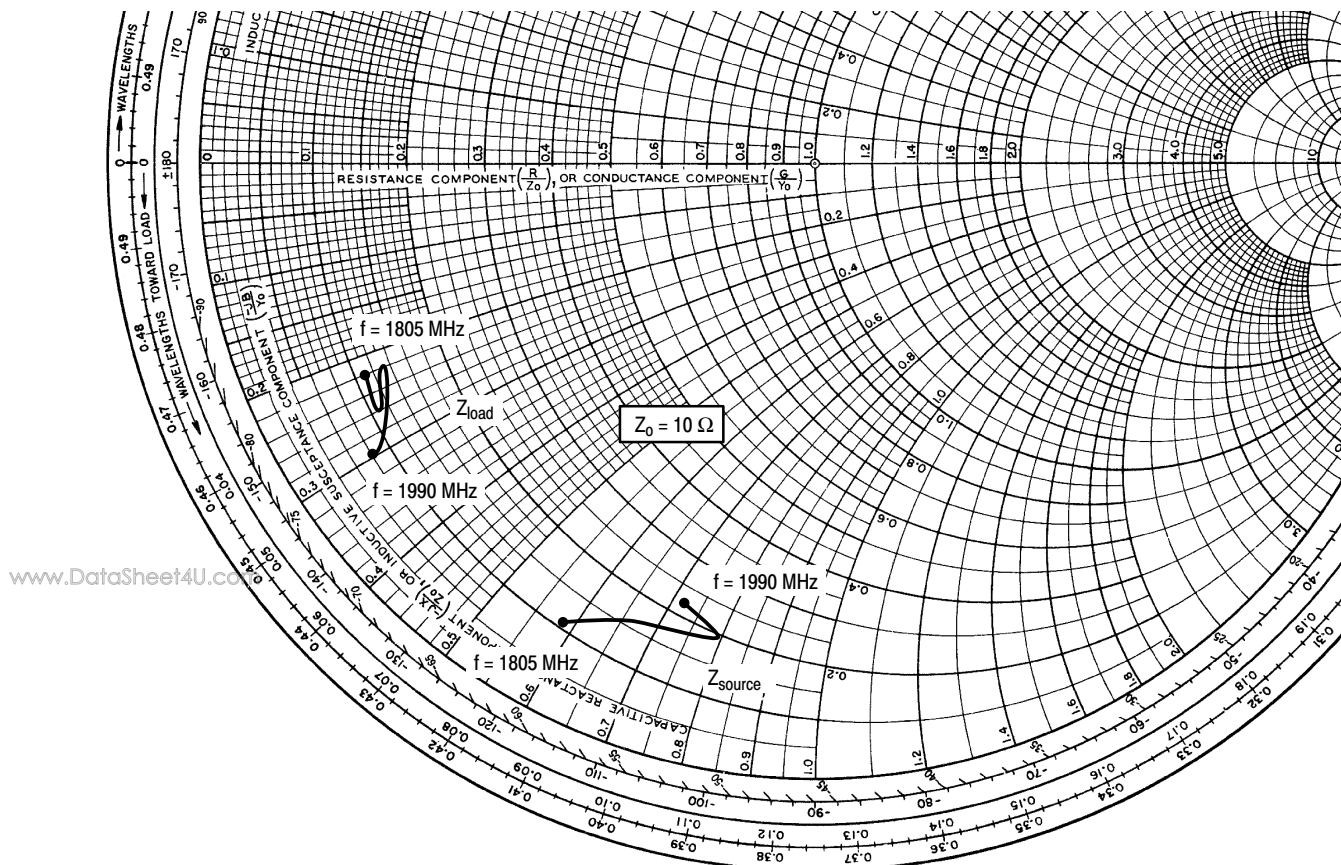
**Figure 7. Output Power versus Frequency**



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



**Figure 9. Wideband Gain and IRL (at Small Signal)**



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

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1805     | $1.10 - j5.85$           | $1.15 - j2.16$         |
| 1880     | $1.56 - j6.75$           | $1.13 - j2.60$         |
| 1930     | $2.05 - j8.00$           | $1.30 - j2.23$         |
| 1990     | $2.30 - j7.30$           | $0.82 - j2.90$         |

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

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

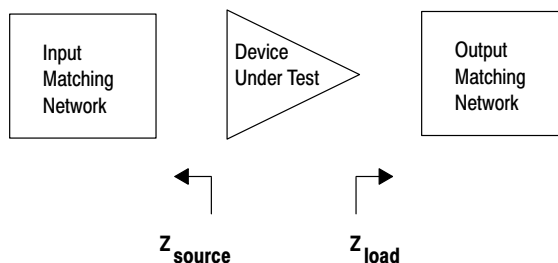
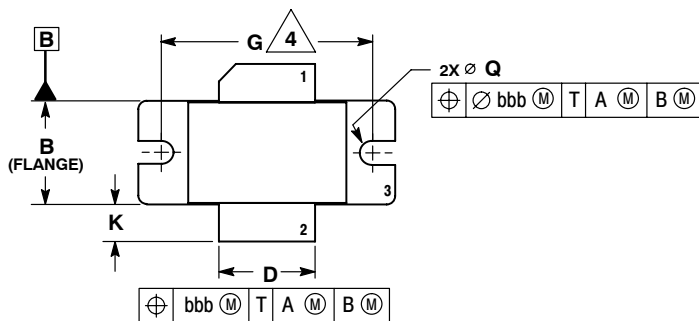


Figure 10. Large Signal Source and Load Impedance

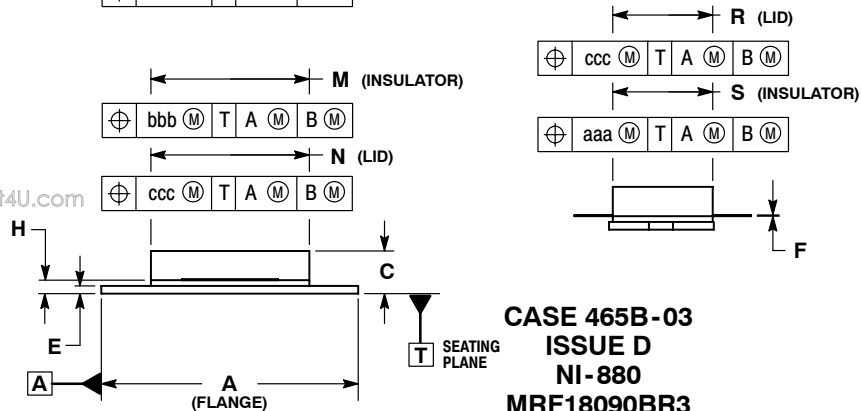
## PACKAGE DIMENSIONS



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.

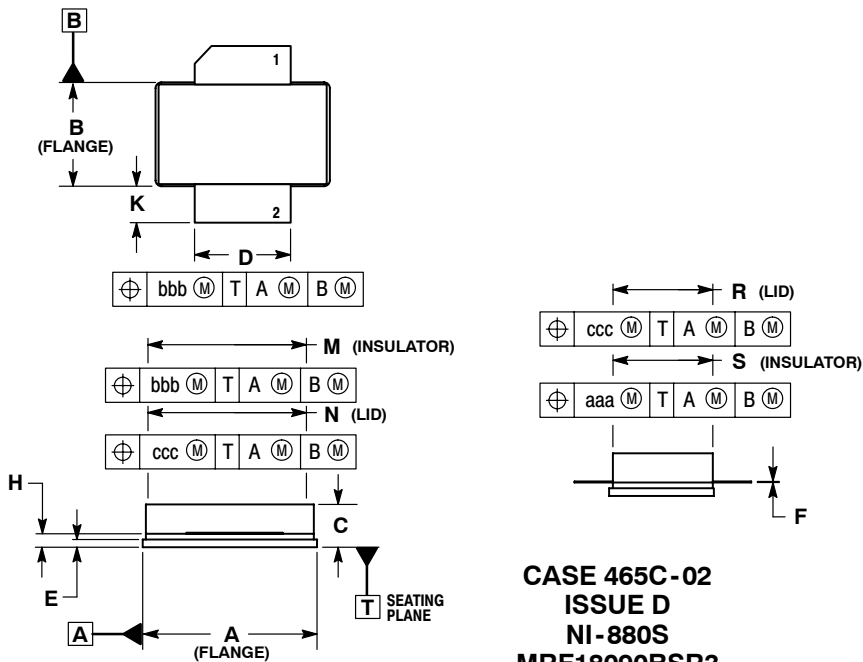
| DIM | INCHES    |        | MILLIMETERS |        |
|-----|-----------|--------|-------------|--------|
|     | MIN       | MAX    | MIN         | MAX    |
| A   | 1.335     | 1.345  | 33.91       | 34.16  |
| B   | 0.535     | 0.545  | 13.6        | 13.8   |
| C   | 0.147     | 0.200  | 3.73        | 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 3.00      | Ø 3.51 |
| 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   |        |



**CASE 465B-03  
ISSUE D  
NI-880  
MRF18090BR3**

STYLE 1:

- PIN 1. DRAIN  
2. GATE  
3. SOURCE



**CASE 465C-02  
ISSUE D  
NI-880S  
MRF18090BSR3**

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   |
| <b>A</b>   | 0.905     | 0.915 | 22.99       | 23.24 |
| <b>B</b>   | 0.535     | 0.545 | 13.60       | 13.80 |
| <b>C</b>   | 0.147     | 0.200 | 3.73        | 5.08  |
| <b>D</b>   | 0.495     | 0.505 | 12.57       | 12.83 |
| <b>E</b>   | 0.035     | 0.045 | 0.89        | 1.14  |
| <b>F</b>   | 0.003     | 0.006 | 0.08        | 0.15  |
| <b>H</b>   | 0.057     | 0.067 | 1.45        | 1.70  |
| <b>K</b>   | 0.170     | 0.210 | 4.32        | 5.33  |
| <b>M</b>   | 0.872     | 0.888 | 22.15       | 22.55 |
| <b>N</b>   | 0.871     | 0.889 | 19.30       | 22.60 |
| <b>R</b>   | 0.515     | 0.525 | 13.10       | 13.30 |
| <b>S</b>   | 0.515     | 0.525 | 13.10       | 13.30 |
| <b>aaa</b> | 0.007 REF |       | 0.178 REF   |       |
| <b>bbb</b> | 0.010 REF |       | 0.254 REF   |       |
| <b>ccc</b> | 0.015 REF |       | 0.381 REF   |       |

STYLE 1:

- PIN 1. DRAIN  
2. GATE  
3. SOURCE

**MRF18090BR3 MRF18090BSR3**

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