

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications with frequencies from 1800 to 2000 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications. Specified for GSM 1805 - 1880 MHz.

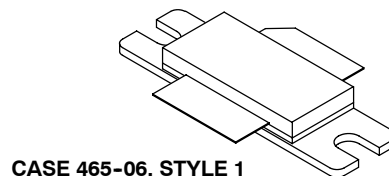
- Typical GSM Performance, Full Frequency Band (1805 - 1880 MHz)  
 Power Gain — 13 dB @ 60 Watts  
 Efficiency — 45% @ 60 Watts
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 1840 MHz, 60 Watts CW Output Power

### Features

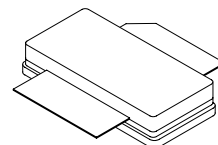
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 Inch Reel.

**MRF18060ALR3**  
**MRF18060ALSR3**

**1805-1880 MHz, 60 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF18060ALR3**



**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF18060ALSR3**

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**Table 1. Maximum Ratings**

| Rating  | Symbol           | Value        | Unit      |
|---|------------------|--------------|-----------|
| Drain-Source Voltage  | V <sub>DSS</sub> | -0.5, +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>   | 180<br>1.03  | W<br>W/°C |
| Storage Temperature Range   | T <sub>stg</sub> | - 65 to +150 | °C        |
| Case Operating Temperature  | T <sub>C</sub>   | 150          | °C        |
| Operating Junction Temperature  | T <sub>J</sub>   | 200          | °C        |

**Table 2. Thermal Characteristics**

| Characteristic                       | Symbol           | Value | Unit |
|--------------------------------------|------------------|-------|------|
| Thermal Resistance, Junction to Case | R <sub>θJC</sub> | 0.97  | °C/W |

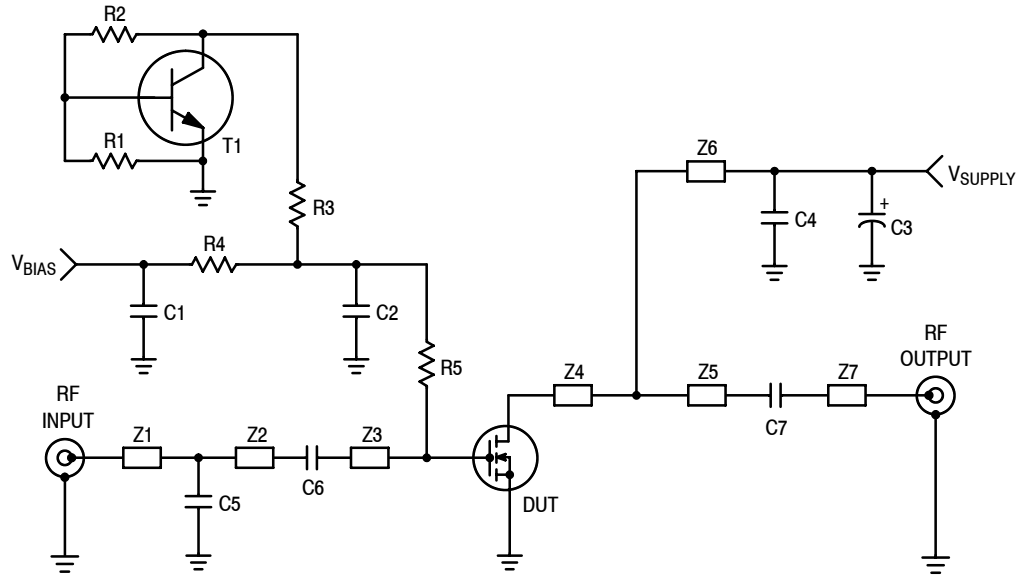
**Table 3. ESD Protection Characteristics**

| 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)

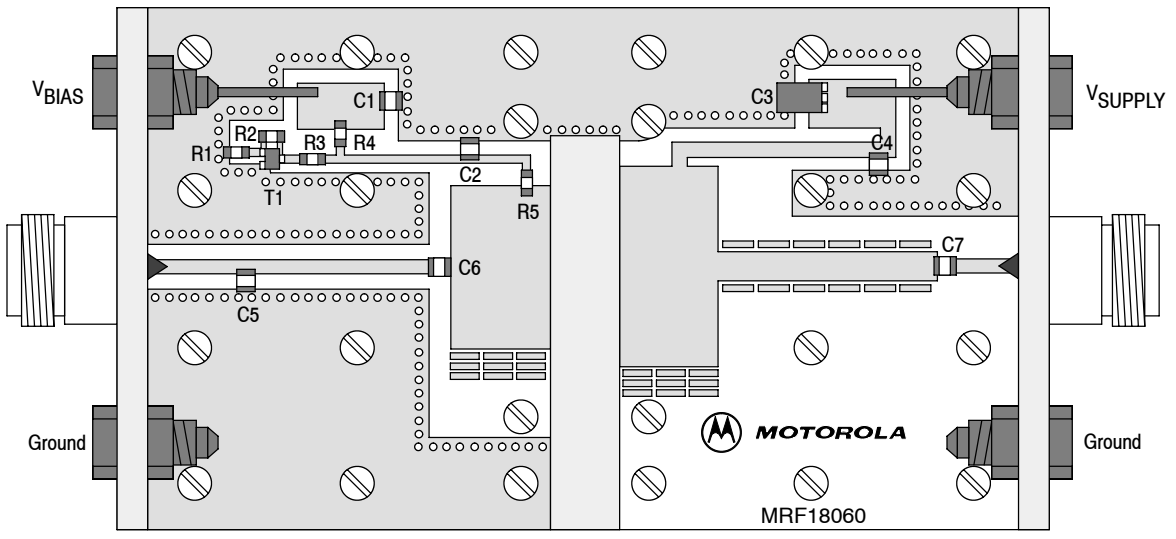
| Characteristic   | Symbol        | Min  | Typ  | Max | Unit            |
|--|---------------|------|------|-----|-----------------|
| <b>Off Characteristics</b>   |               |      |      |     |                 |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 10\ \mu\text{Adc}$ )  | $V_{(BR)DSS}$ | 65   | —    | —   | Vdc             |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )  | $I_{DSS}$     | —    | —    | 6   | $\mu\text{Adc}$ |
| 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 Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 300\ \mu\text{Adc}$ )  | $V_{GS(th)}$  | 2    | —    | 4   | Vdc             |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 500\ \text{mAdc}$ )  | $V_{GS(Q)}$   | 2.5  | 3.9  | 4.5 | Vdc             |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )   | $V_{DS(on)}$  | —    | 0.27 | —   | Vdc             |
| <b>Dynamic Characteristics</b>   |               |      |      |     |                 |
| Input Capacitance (Including Input Matching Capacitor in Package) (1)<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ ) | $C_{iss}$     | —    | 160  | —   | pF              |
| Output Capacitance (1)<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )  | $C_{oss}$     | —    | 740  | —   | pF              |
| Reverse Transfer Capacitance<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )  | $C_{rss}$     | —    | 2.7  | —   | pF              |
| <b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system)   |               |      |      |     |                 |
| Common-Source Amplifier Power Gain @ 60 W (2)<br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )                        | $G_{ps}$      | 11.5 | 13   | —   | dB              |
| Drain Efficiency @ 60 W (2)<br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 500\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )  | $\eta$        | 43   | 45   | —   | %               |
| Input Return Loss (2)<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 60\text{ W CW}$ , $I_{DQ} = 500\text{ mA}$ ,<br>$f = 1805 - 1880\text{ MHz}$ )                | IRL           | —    | —    | -10 | dB              |

- Part is internally matched both on input and output.
- To meet application requirements, Freescale test fixtures have been designed to cover the full GSM1800 band, ensuring batch-to-batch consistency.



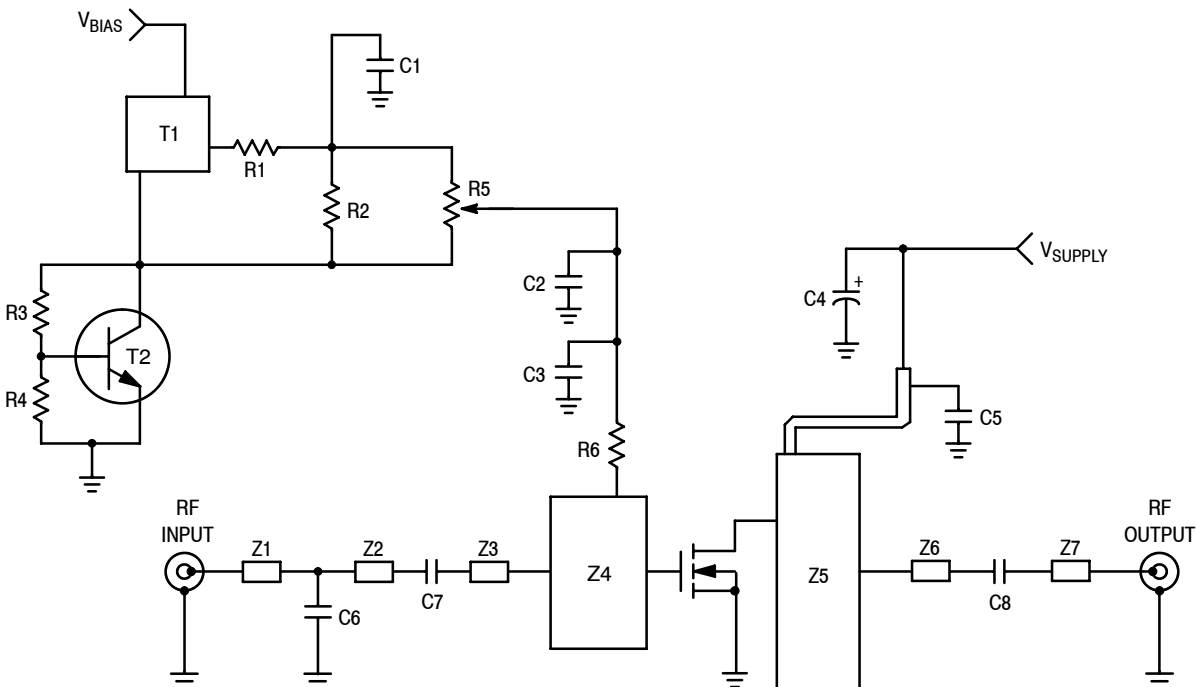
|            |  |    |                          |
|------------|--|----|--------------------------|
| C1         | 100 nF Chip Capacitor (1203)                     | Z1 | 0.47" x 0.09" Microstrip |
| C2, C4, C7 | 10 pF Chip Capacitors                            | Z2 | 1.16" x 0.09" Microstrip |
| C3         | 10 $\mu$ F, 35 V Electrolytic Tantalum Capacitor | Z3 | 0.57" x 0.95" Microstrip |
| C5         | 1.2 pF Chip Capacitor                            | Z4 | 0.59" x 1.18" Microstrip |
| C6         | 1.0 pF Chip Capacitor                            | Z5 | 1.26" x 0.15" Microstrip |
| R1, R3     | 2.2 k $\Omega$ Chip Resistors (0805)             | Z6 | 1.15" x 0.09" Microstrip |
| R2, R4     | 2.7 k $\Omega$ Chip Resistors (0805)             | Z7 | 0.37" x 0.09" Microstrip |
| R5         | 1.1 k $\Omega$ Chip Resistor (0805)              |    |                          |
| T1         | BC847 Transistor SOT-23                          |    |                          |

**Figure 1. 1805 - 1880 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. 1805 - 1880 MHz Test Fixture Component Layout**

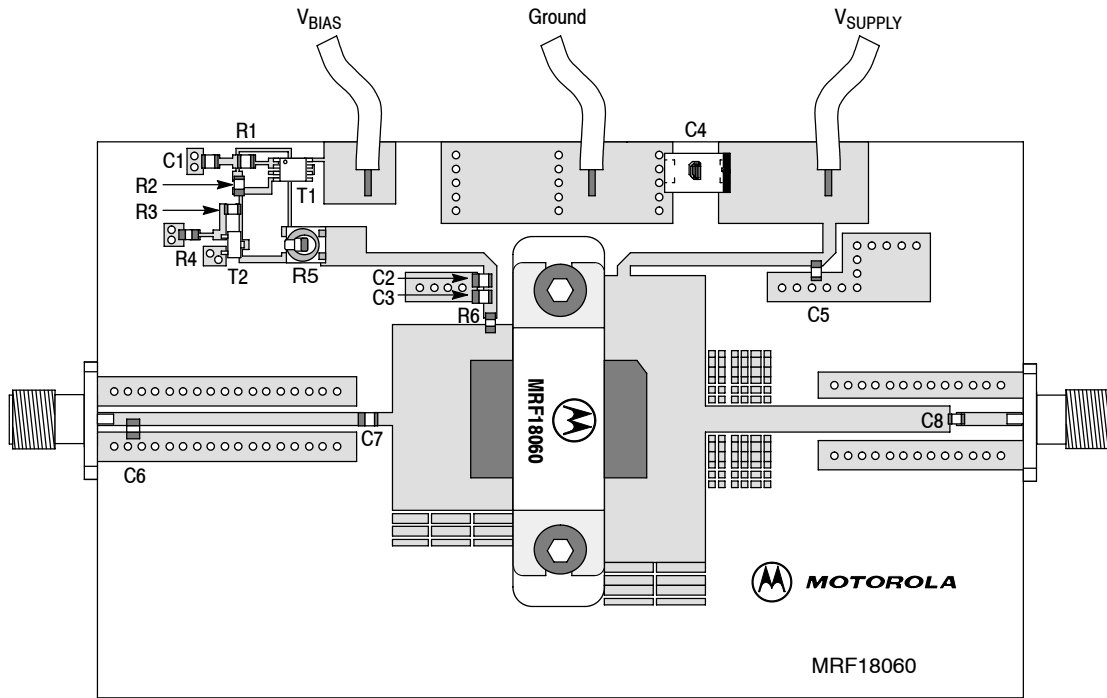


|            |  |   |                                  |
|------------|--|---|----------------------------------|
| C1         | 1 $\mu$ F Chip Capacitor (0805)                  | T1  | LP2951 Micro-8 Voltage Regulator |
| C2         | 100 nF Chip Capacitor (0805)                     | T2  | BC847 SOT-23 NPN Transistor      |
| C3, C5, C8 | 10 pF Chip Capacitors, ACCU-P (0805)             | Z1  | 0.159" x 0.055" Microstrip       |
| C4         | 10 $\mu$ F, 35 V Tantalum Electrolytic Capacitor | Z2  | 0.982" x 0.055" Microstrip       |
| C6         | 1.8 pF Chip Capacitor, ACCU-P (0805)             | Z3  | 0.087" x 0.055" Microstrip       |
| C7         | 1 pF Chip Capacitor, ACCU-P (0805)               | Z4  | 0.512" x 0.787" Microstrip       |
| R1         | 10 $\Omega$ Chip Resistor (0805)                 | Z5  | 0.433" x 1.220" Microstrip       |
| R2, R6     | 1 k $\Omega$ Chip Resistors (0805)               | Z6  | 1.039" x 0.118" Microstrip       |
| R3         | 1.2 k $\Omega$ Chip Resistor (0805)              | Z7  | 0.268" x 0.055" Microstrip       |
| R4         | 2.2 k $\Omega$ Chip Resistor (0805)              | Substrate = 0.5 mm Teflon <sup>®</sup> Glass, $\epsilon_r = 2.55$ |                                  |
| R5         | 5 k $\Omega$ , SMD Potentiometer                 |   |                                  |

Figure 3. 1800 - 2000 MHz Demo Board Schematic

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**Figure 4. 1800 - 2000 MHz Demo Board Component Layout**

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TYPICAL CHARACTERISTICS (DATA TAKEN USING WIDEBAND DEMONSTRATION BOARD)

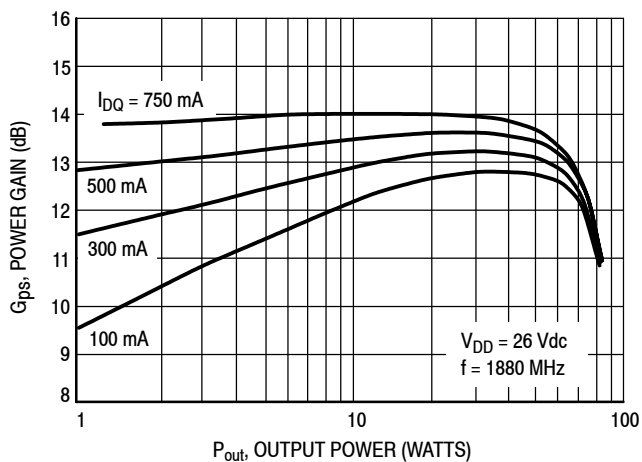


Figure 5. Power Gain versus Output Power

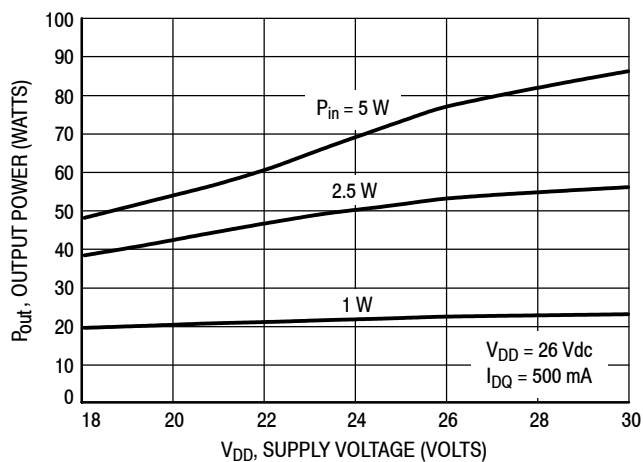


Figure 6. Output Power versus Supply Voltage

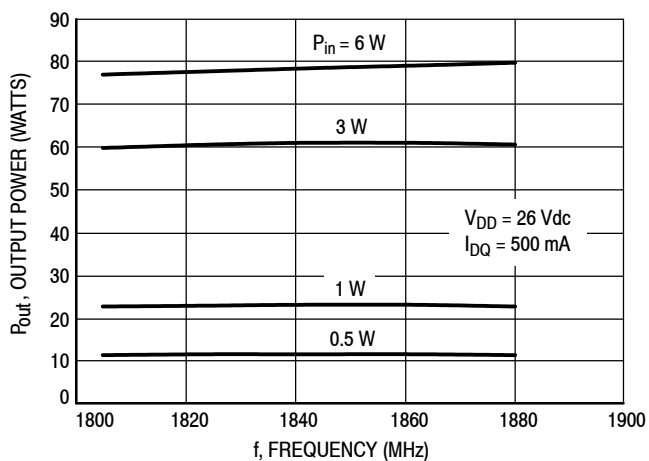


Figure 7. Output Power versus Frequency

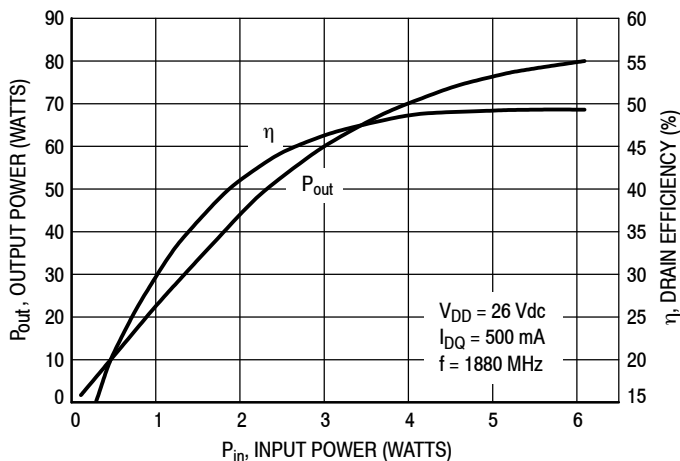


Figure 8. Output Power and Efficiency versus Input Power

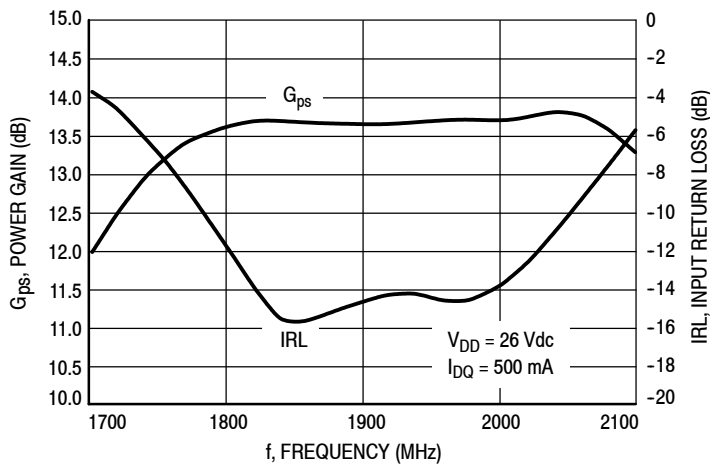
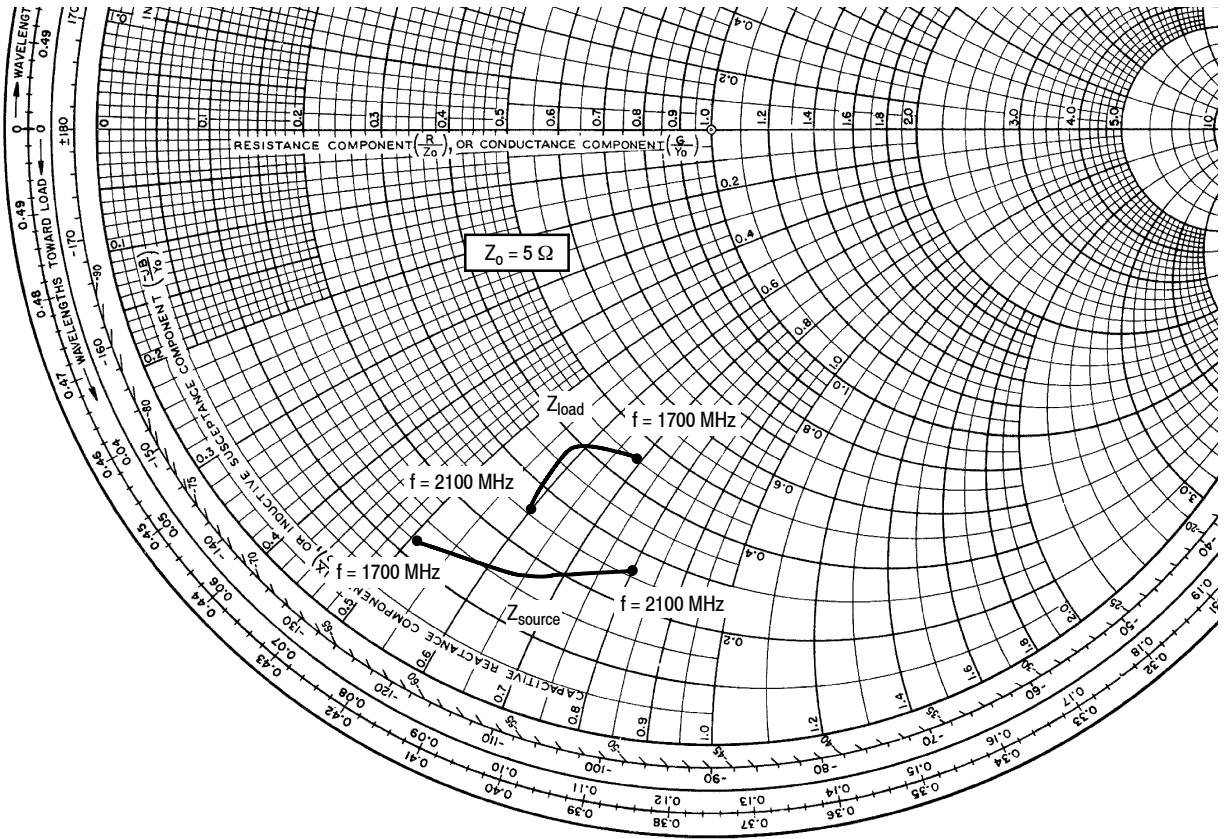


Figure 9. Wideband Gain and IRL (at Small Signal)

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$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ ,  $P_{out} = 60\text{ W CW}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1700     | $0.60 - j2.53$           | $2.27 - j3.44$         |
| 1800     | $0.80 - j3.20$           | $2.05 - j3.05$         |
| 1900     | $0.92 - j3.42$           | $1.90 - j2.90$         |
| 2000     | $1.07 - j3.59$           | $1.64 - j2.88$         |
| 2100     | $1.31 - j4.00$           | $1.29 - j2.99$         |

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

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

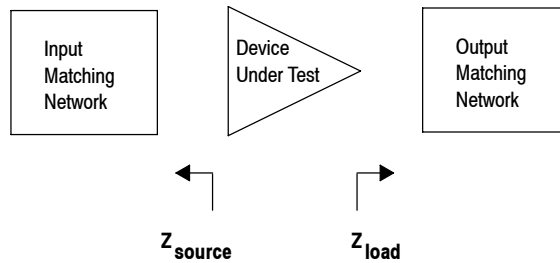


Figure 10. Series Equivalent Source and Load Impedance

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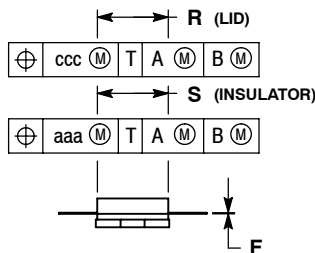
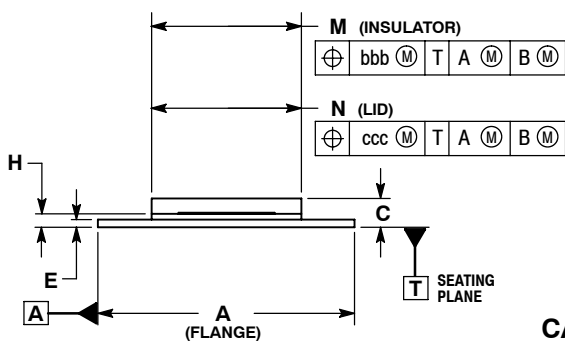
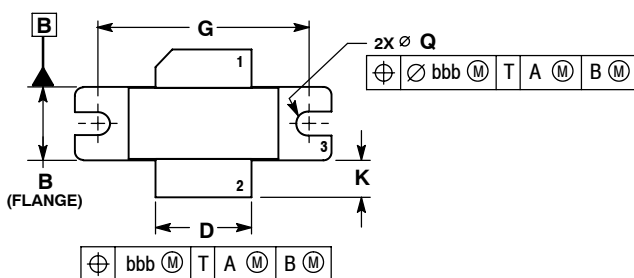
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### PACKAGE DIMENSIONS



**CASE 465-06  
ISSUE G  
NI-780  
MRF18060ALR3**

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

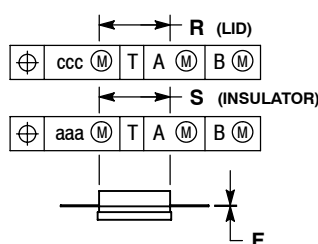
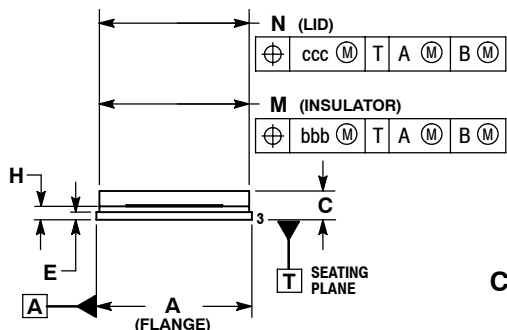
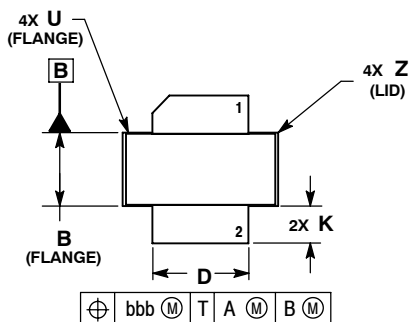
| DIM | INCHES              |       | MILLIMETERS |        |
|-----|---------------------|-------|-------------|--------|
|     | MIN                 | MAX   | MIN         | MAX    |
| A   | 1.335               | 1.345 | 33.91       | 34.16  |
| B   | 0.380               | 0.390 | 9.65        | 9.91   |
| 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   | Ø.118               | Ø.138 | Ø.300       | Ø.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

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**CASE 465A-06  
ISSUE H  
NI-780S  
MRF18060ALSR3**

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. 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

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description  |
|----------|-----------|--|
| 9        | Dec. 2010 | <ul style="list-style-type: none"> <li>• MRF18060A Rev. 9 data sheet archived. Data sheet split due to change in part life cycle. See MRF18060A-1 Rev. 10 for MRF18060ALSR3 and MRF18060A-2 Rev. 11 for MRF18030ALR3.</li> </ul> |

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