



RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

Designed for broadband commercial and industrial applications with frequencies up to 1000 MHz. The high gain and broadband performance of this device make it ideal for large-signal, common-source amplifier applications in 26 volt base station equipment.

- Typical Two-Tone Performance at 945 MHz, 26 Volts
 - Output Power — 30 Watts PEP
 - Power Gain — 19 dB
 - Efficiency — 41.5%
 - IMD — -32.5 dBc
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 945 MHz, 30 Watts CW Output Power

Features

- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.

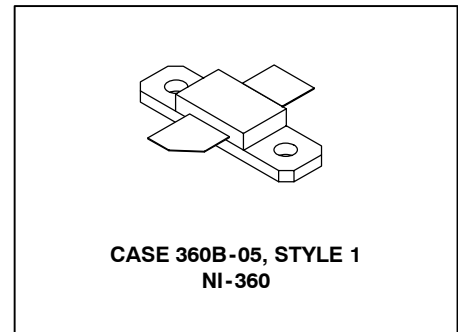
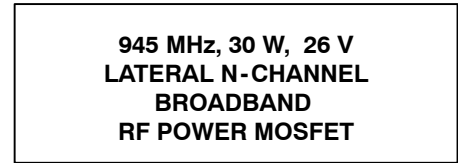


Table 1. Maximum Ratings

| Rating | Symbol | Value | Unit |
|--|-----------|--------------|-----------|
| Drain-Source Voltage | V_{DSS} | - 0.5, +68 | Vdc |
| Gate-Source Voltage | V_{GS} | - 0.5, +15 | Vdc |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 92 0.53 | W W/°C |
| Storage Temperature Range | T_{stg} | - 65 to +150 | °C |
| Case Operating Temperature | T_C | 150 | °C |
| Operating Junction Temperature | T_J | 200 | °C |

Table 2. Thermal Characteristics

| Characteristic | Symbol | Value | Unit |
|--------------------------------------|-----------------|-------|------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.9 | °C/W |

Table 3. ESD Protection Characteristics

| Test Conditions | Class |
|------------------|--------------|
| Human Body Model | 1 (Minimum) |
| Machine Model | M1 (Minimum) |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|--------------|-----|------|-----|-----------------|
| Off Characteristics | | | | | |
| Zero Gate Voltage Drain Leakage Current ($V_{DS} = 68\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$) | I_{DSS} | — | — | 10 | μAdc |
| Zero Gate Voltage Drain Leakage Current ($V_{DS} = 26\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$) | I_{DSS} | — | — | 1 | μAdc |
| Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$) | I_{GSS} | — | — | 1 | μAdc |
| On Characteristics | | | | | |
| Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 100\ \mu\text{Adc}$) | $V_{GS(th)}$ | 2 | 2.9 | 4 | Vdc |
| Gate Quiescent Voltage ($V_{DS} = 26\text{ Vdc}$, $I_D = 250\ \text{mAdc}$) | $V_{GS(Q)}$ | — | 3.8 | — | Vdc |
| Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 0.7\ \text{Adc}$) | $V_{DS(on)}$ | — | 0.19 | 0.4 | Vdc |
| Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 2\ \text{Adc}$) | g_{fs} | — | 3 | — | S |
| Dynamic Characteristics | | | | | |
| Input Capacitance ($V_{DS} = 26\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$) | C_{iss} | — | 49.5 | — | pF |
| Output Capacitance ($V_{DS} = 26\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$) | C_{oss} | — | 26.5 | — | pF |
| Reverse Transfer Capacitance ($V_{DS} = 26\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$) | C_{rss} | — | 1 | — | pF |

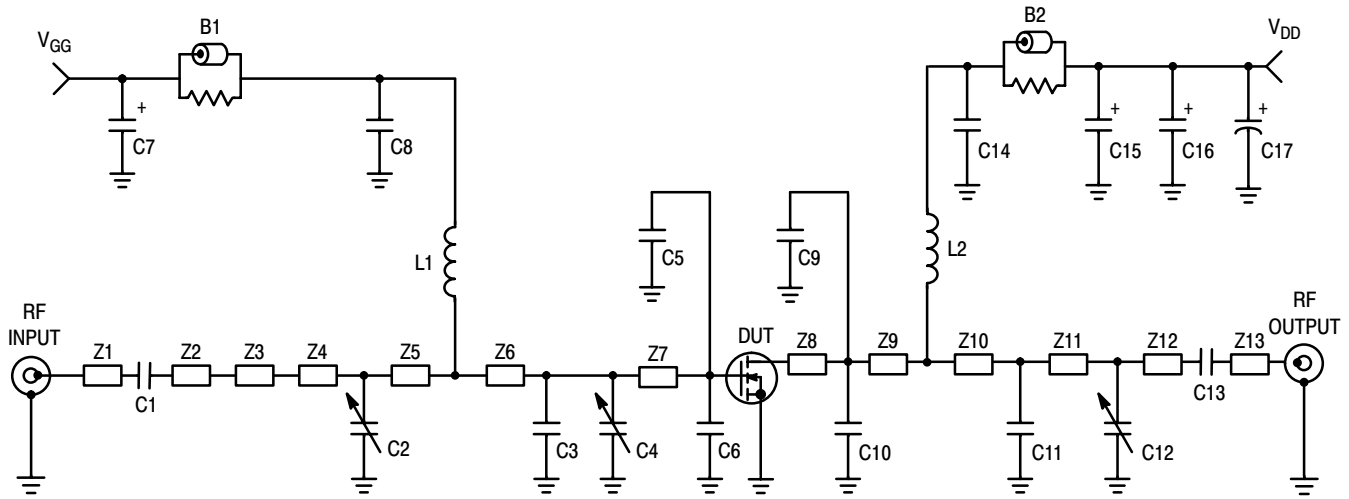
(continued)

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-----------|-----|-------|-----|------|
| Functional Tests (In Freescale Test Fixture, 50 ohm system) | | | | | |
| Two-Tone Common-Source Amplifier Power Gain ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$) | G_{ps} | 18 | 19 | — | dB |
| Two-Tone Drain Efficiency ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$) | η | 37 | 41.5 | — | % |
| 3rd Order Intermodulation Distortion ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$) | IMD | — | -32.5 | -28 | dBc |
| Input Return Loss ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$) | IRL | — | -15.5 | -9 | dB |
| Two-Tone Common-Source Amplifier Power Gain ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 930.0\text{ MHz}$, $f_2 = 930.1\text{ MHz}$ and $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$) | G_{ps} | — | 19 | — | dB |
| Two-Tone Drain Efficiency ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 930.0\text{ MHz}$, $f_2 = 930.1\text{ MHz}$ and $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$) | η | — | 41.5 | — | % |
| 3rd Order Intermodulation Distortion ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 930.0\text{ MHz}$, $f_2 = 930.1\text{ MHz}$ and $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$) | IMD | — | -33 | — | dBc |
| Input Return Loss ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W PEP}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 930.0\text{ MHz}$, $f_2 = 930.1\text{ MHz}$ and $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$) | IRL | — | -14 | — | dB |
| Power Output, 1 dB Compression Point ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W CW}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$) | P_{1dB} | — | 30 | — | W |
| Common-Source Amplifier Power Gain ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W CW}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$) | G_{ps} | — | 19 | — | dB |
| Drain Efficiency ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 30\text{ W CW}$, $I_{DQ} = 250\text{ mA}$, $f_1 = 945.0\text{ MHz}$) | η | — | 60 | — | % |

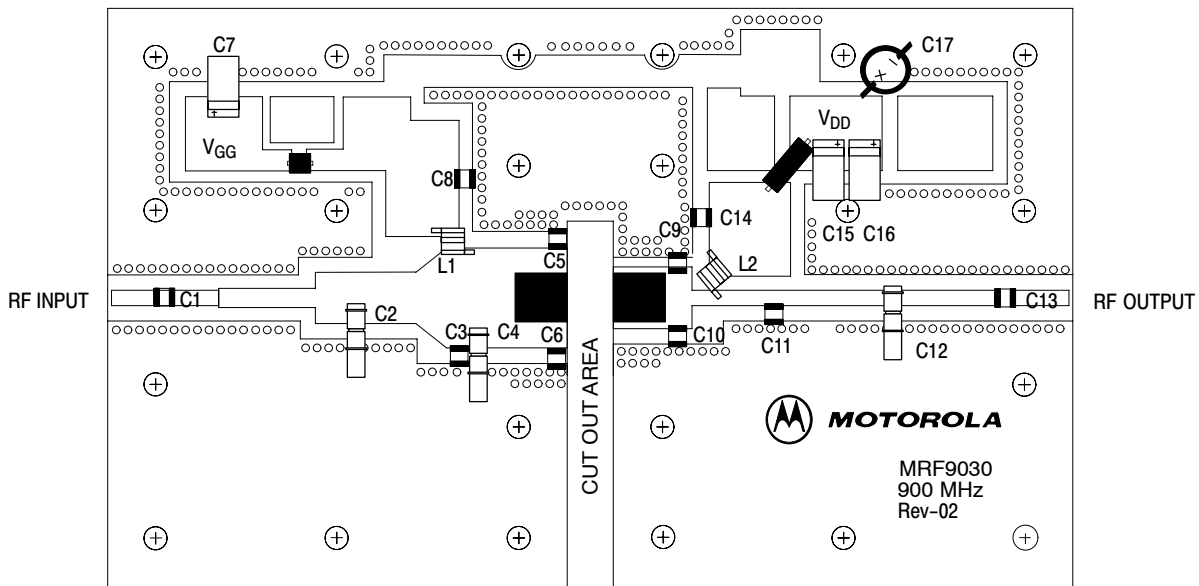
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| | | | |
|------------------|-------------------------------------|-----|--|
| B1 | Short Ferrite Bead | Z3 | 0.500" x 0.100" Microstrip |
| B2 | Long Ferrite Bead | Z4 | 0.215" x 0.270" Microstrip |
| C1, C8, C13, C14 | 47 pF Chip Capacitors | Z5 | 0.315" x 0.270" Microstrip |
| C2, C4 | 0.8 pF to 8.0 pF Trim Capacitors | Z6 | 0.160" x 0.270" x 0.520", Taper |
| C3 | 3.9 pF Chip Capacitor | Z7 | 0.285" x 0.520" Microstrip |
| C5, C6 | 7.5 pF Chip Capacitors | Z8 | 0.450" x 0.270" Microstrip |
| C7, C15, C16 | 10 μF, 35 V Tantalum Capacitors | Z9 | 0.140" x 0.270" Microstrip |
| C9, C10 | 10 pF Chip Capacitors | Z10 | 0.250" x 0.060" Microstrip |
| C11 | 9.1 pF Chip Capacitor | Z11 | 0.720" x 0.060" Microstrip |
| C12 | 0.6 pF to 4.5 pF Trim Capacitor | Z12 | 0.490" x 0.060" Microstrip |
| C17 | 220 μF, 50 V Electrolytic Capacitor | Z13 | 0.290" x 0.060" Microstrip |
| L1, L2 | 12.5 nH Surface Mount Inductors | PCB | Taconic RF-35-0300, 30 mil, ε _r = 3.55 |
| Z1 | 0.260" x 0.060" Microstrip | | |
| Z2 | 0.240" x 0.060" Microstrip | | |

Figure 1. 945 MHz Broadband Test Circuit Schematic



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

Figure 2. 945 MHz Broadband Test Circuit Component Layout

TYPICAL CHARACTERISTICS

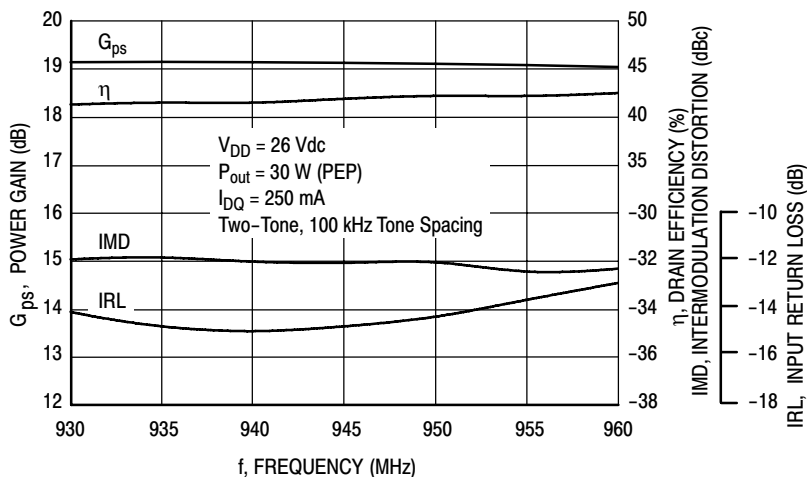


Figure 3. Class AB Broadband Circuit Performance

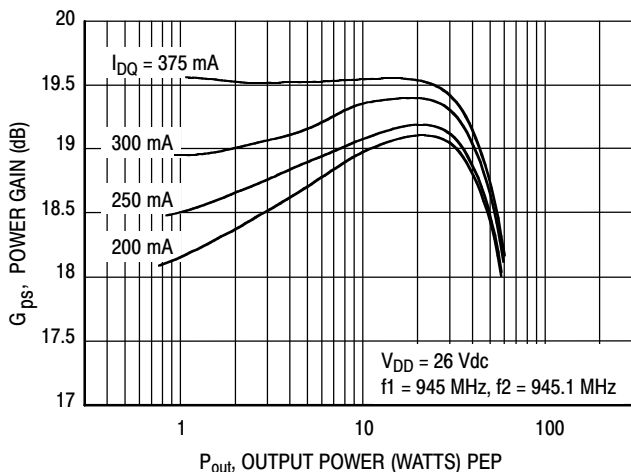


Figure 4. Power Gain versus Output Power

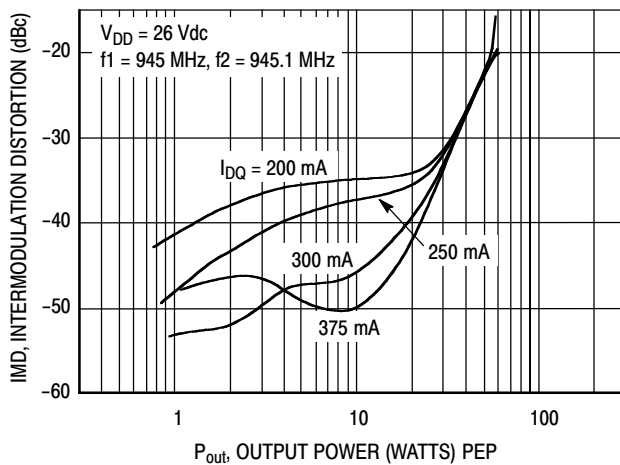


Figure 5. Intermodulation Distortion versus Output Power

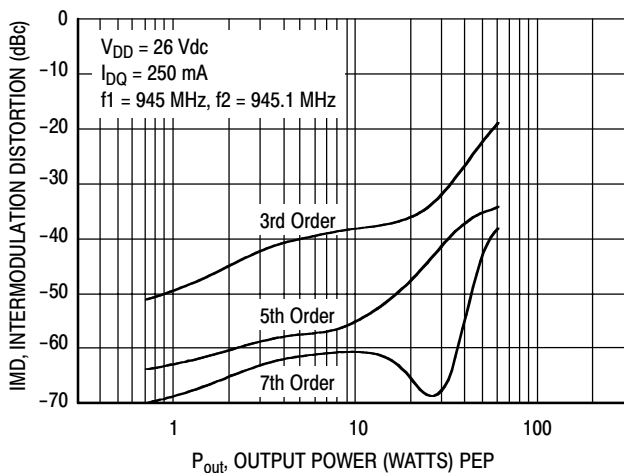


Figure 6. Intermodulation Distortion Products versus Output Power

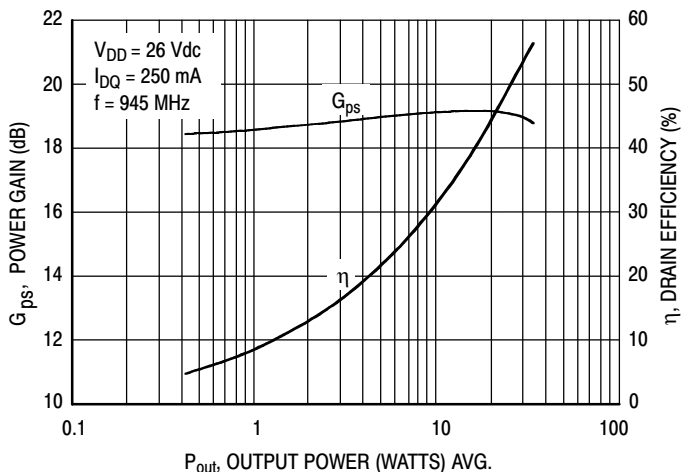


Figure 7. Power Gain and Efficiency versus Output Power

TYPICAL CHARACTERISTICS

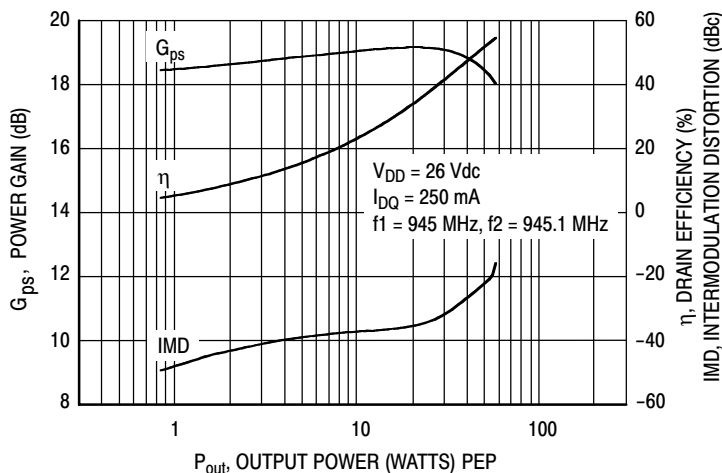
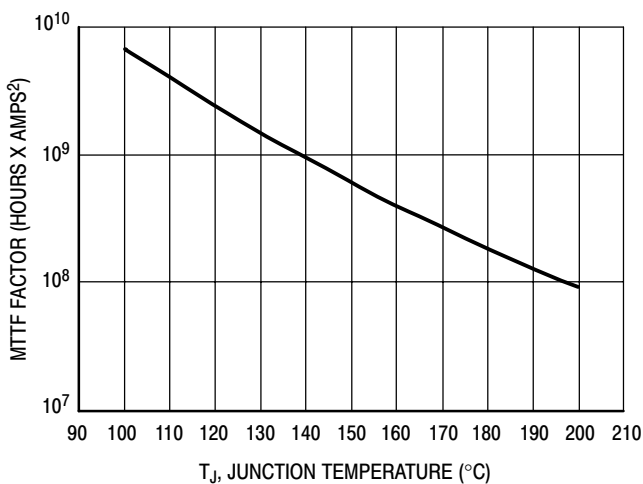
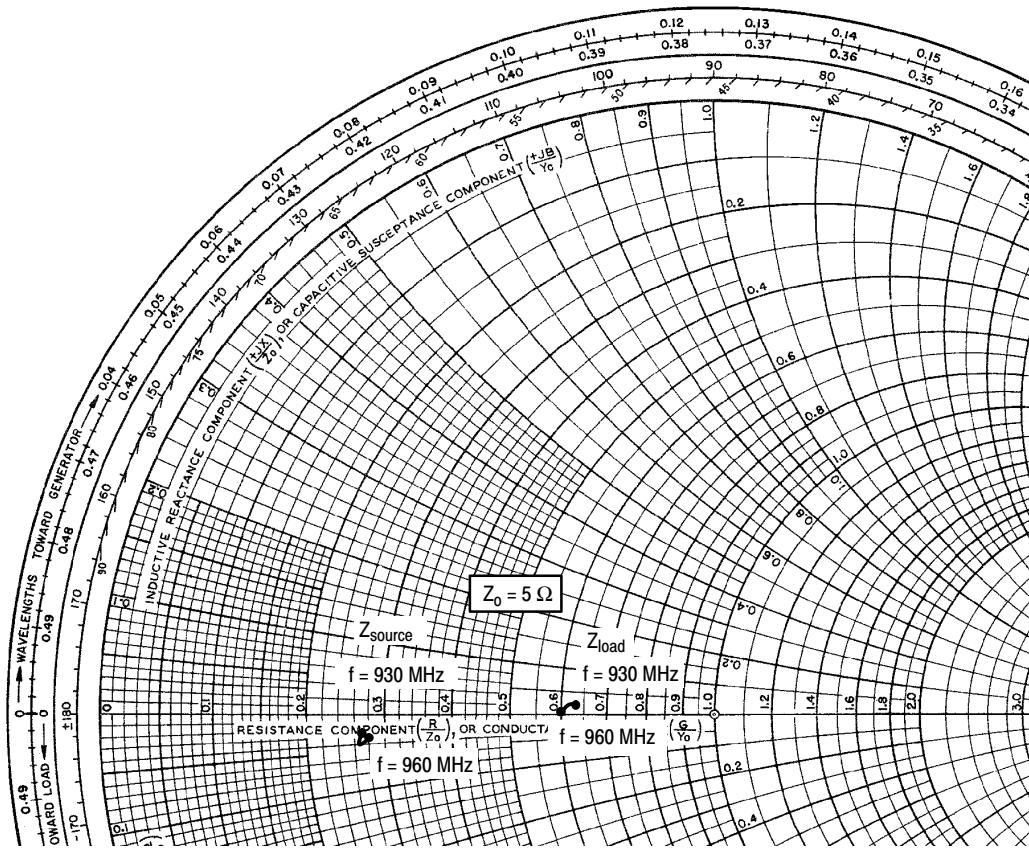


Figure 8. Power Gain, Efficiency and IMD versus Output Power



This above graph displays calculated MTTF in hours x ampere² drain current. Life tests at elevated temperatures have correlated to better than $\pm 10\%$ of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 9. MTTF Factor versus Junction Temperature



$V_{DD} = 26\text{ V}$, $I_{DQ} = 250\text{ mA}$, $P_{out} = 30\text{ W PEP}$

| f MHz | Z_{source} Ω | Z_{load} Ω |
|----------|--------------------------|------------------------|
| 930 | $1.34 - j0.1$ | $3.175 + j0.09$ |
| 945 | $1.36 - j0.2$ | $3.1 + j0.08$ |
| 960 | $1.4 - j0.14$ | $3.0 + j0.05$ |

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

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

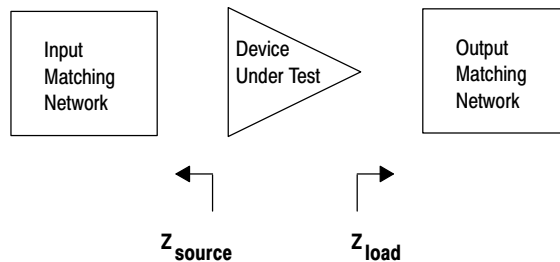
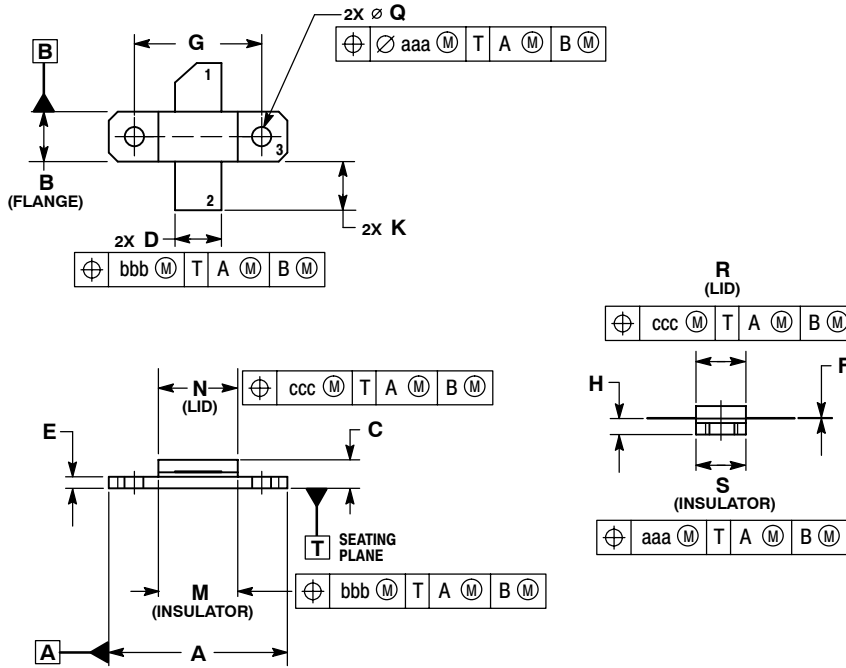


Figure 10. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME 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 | 0.795 | 0.805 | 20.19 | 20.45 |
| B | 0.225 | 0.235 | 5.72 | 5.97 |
| C | 0.125 | 0.175 | 3.18 | 4.45 |
| D | 0.210 | 0.220 | 5.33 | 5.59 |
| E | 0.055 | 0.065 | 1.40 | 1.65 |
| F | 0.004 | 0.006 | 0.10 | 0.15 |
| G | 0.562 BSC | | 14.28 BSC | |
| H | 0.077 | 0.087 | 1.96 | 2.21 |
| K | 0.220 | 0.250 | 5.59 | 6.35 |
| M | 0.355 | 0.365 | 9.02 | 9.27 |
| N | 0.357 | 0.363 | 9.07 | 9.22 |
| Q | 0.125 | 0.135 | 3.18 | 3.43 |
| R | 0.227 | 0.233 | 5.77 | 5.92 |
| S | 0.225 | 0.235 | 5.72 | 5.97 |
| aaa | 0.005 REF | | 0.13 REF | |
| bbb | 0.010 REF | | 0.25 REF | |
| ccc | 0.015 REF | | 0.38 REF | |

- STYLE 1:
 PIN 1. DRAIN
 2. GATE
 3. SOURCE

CASE 360B-05
ISSUE G
NI-360
MRF9030LR1

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 | Sept. 2008 | <ul style="list-style-type: none">• Data sheet revised to reflect part status change, p. 1, including use of applicable overlay.• Added Product Documentation and Revision History, p. 9 |

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