

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 40 μ " Nominal.
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.

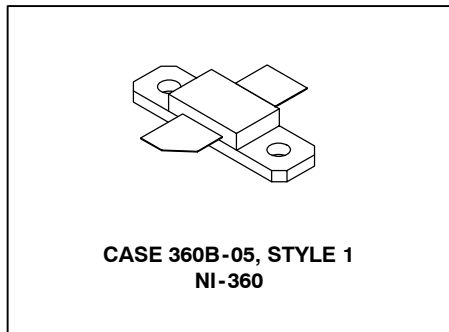
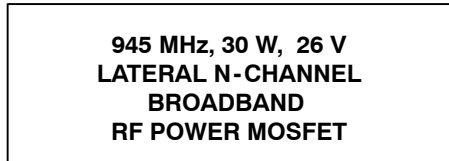


Table 1. Maximum Ratings

| 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 $^\circ\text{C}$ | P_D | 92 0.53 | W 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 | $R_{\theta JC}$ | 1.9 | $^\circ\text{C}/\text{W}$ |

Table 3. ESD Protection Characteristics

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

NOT RECOMMENDED FOR NEW DESIGN

NOT RECOMMENDED FOR NEW DESIGN

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)

NOT RECOMMENDED FOR NEW DESIGN

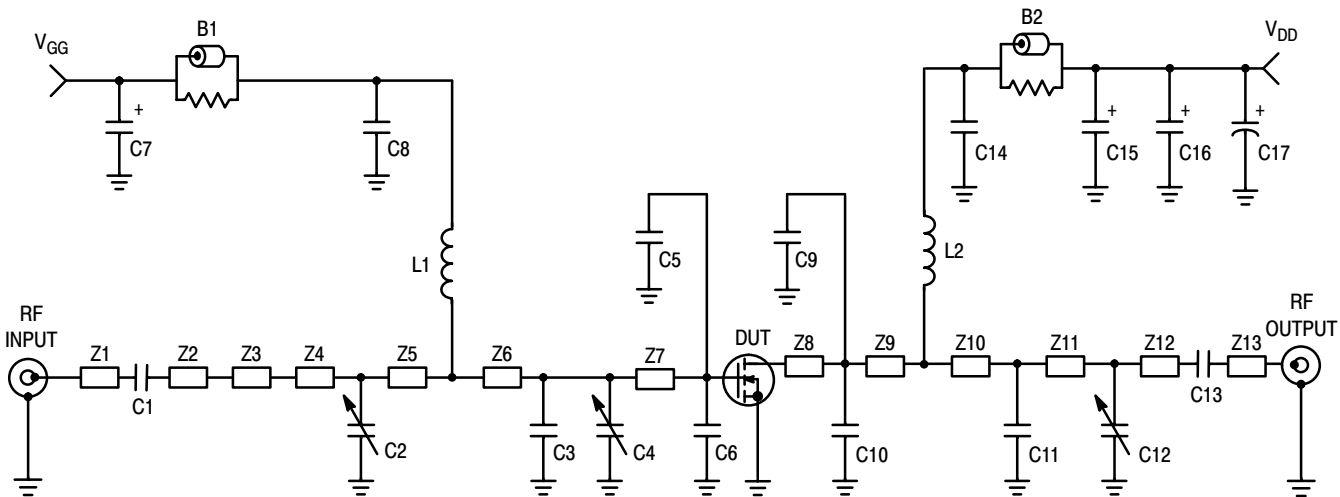
NOT RECOMMENDED FOR NEW DESIGN

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 | — | % |

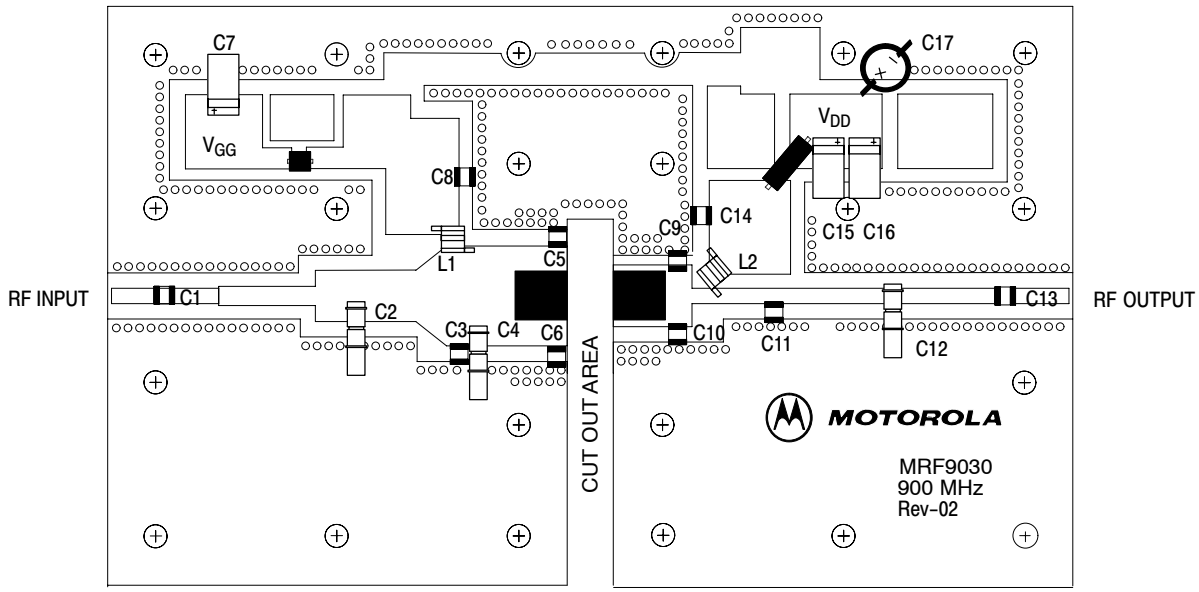
NOT RECOMMENDED FOR NEW DESIGN

NOT RECOMMENDED FOR NEW DESIGN



| | | | |
|------------------|-------------------------------------|-----|--|
| 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



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. 945 MHz Broadband Test Circuit Component Layout

TYPICAL CHARACTERISTICS

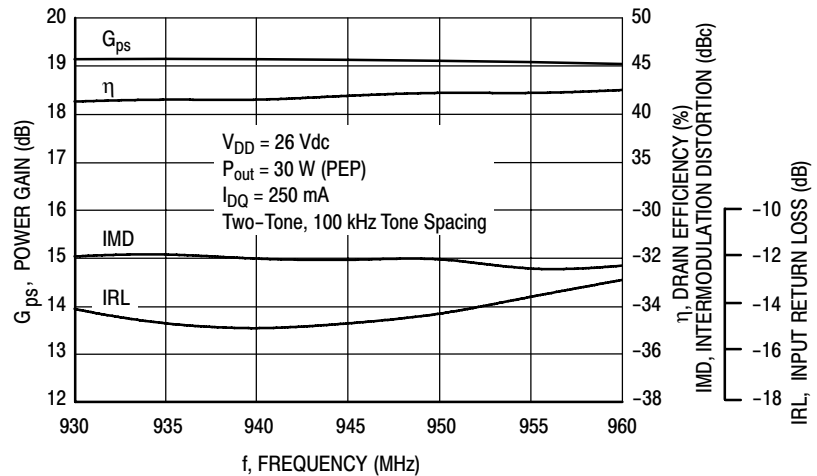


Figure 3. Class AB Broadband Circuit Performance

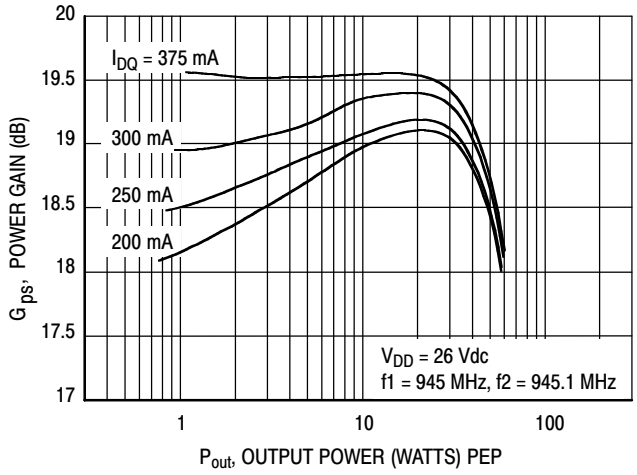


Figure 4. Power Gain versus Output Power

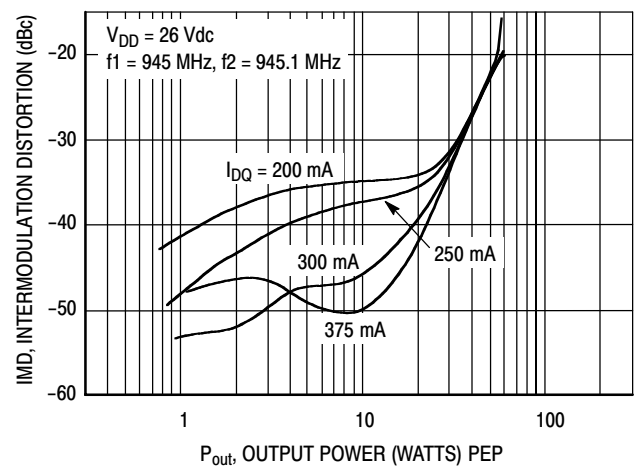


Figure 5. Intermodulation Distortion versus Output Power

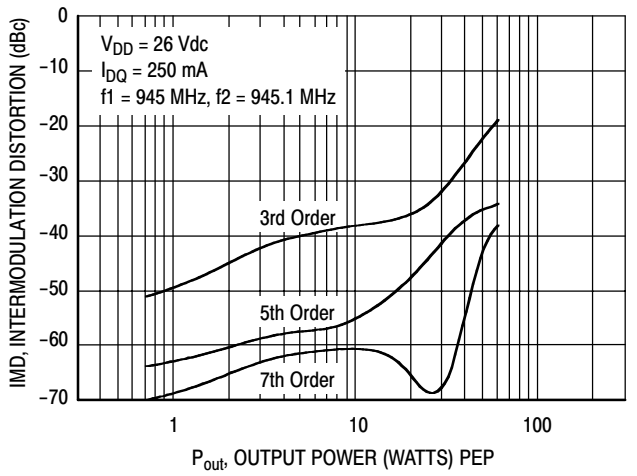


Figure 6. Intermodulation Distortion Products versus Output Power

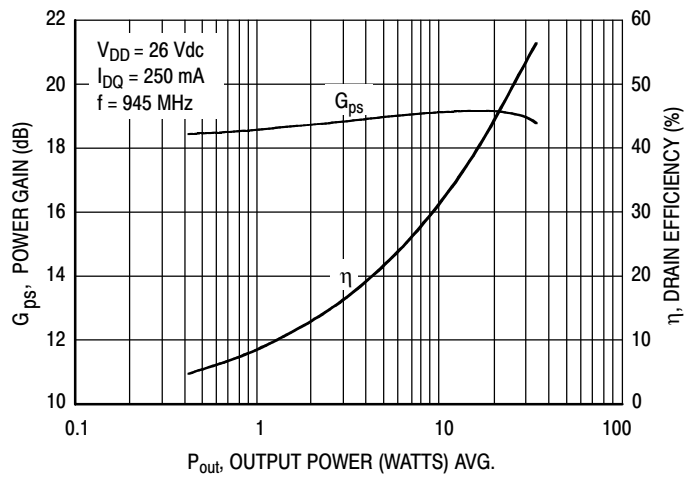


Figure 7. Power Gain and Efficiency versus Output Power

NOT RECOMMENDED FOR NEW DESIGN

NOT RECOMMENDED FOR NEW DESIGN

TYPICAL CHARACTERISTICS

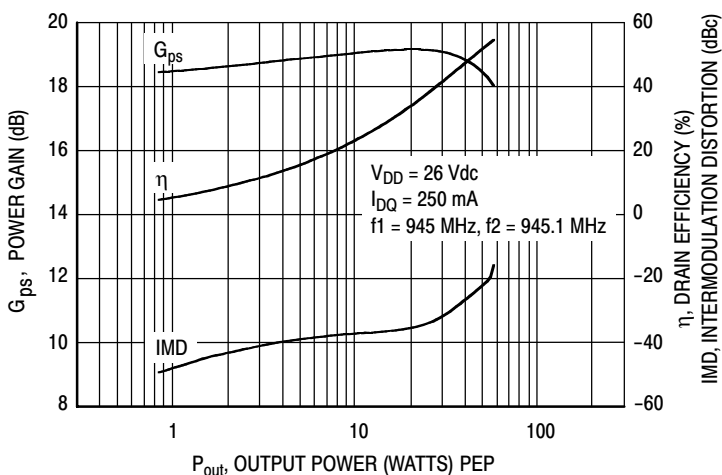
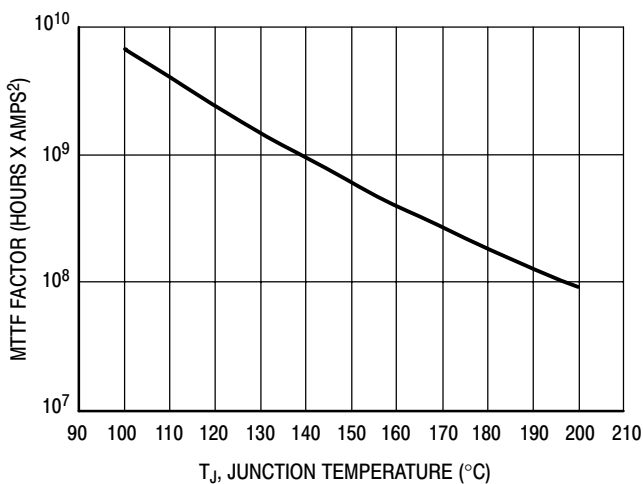
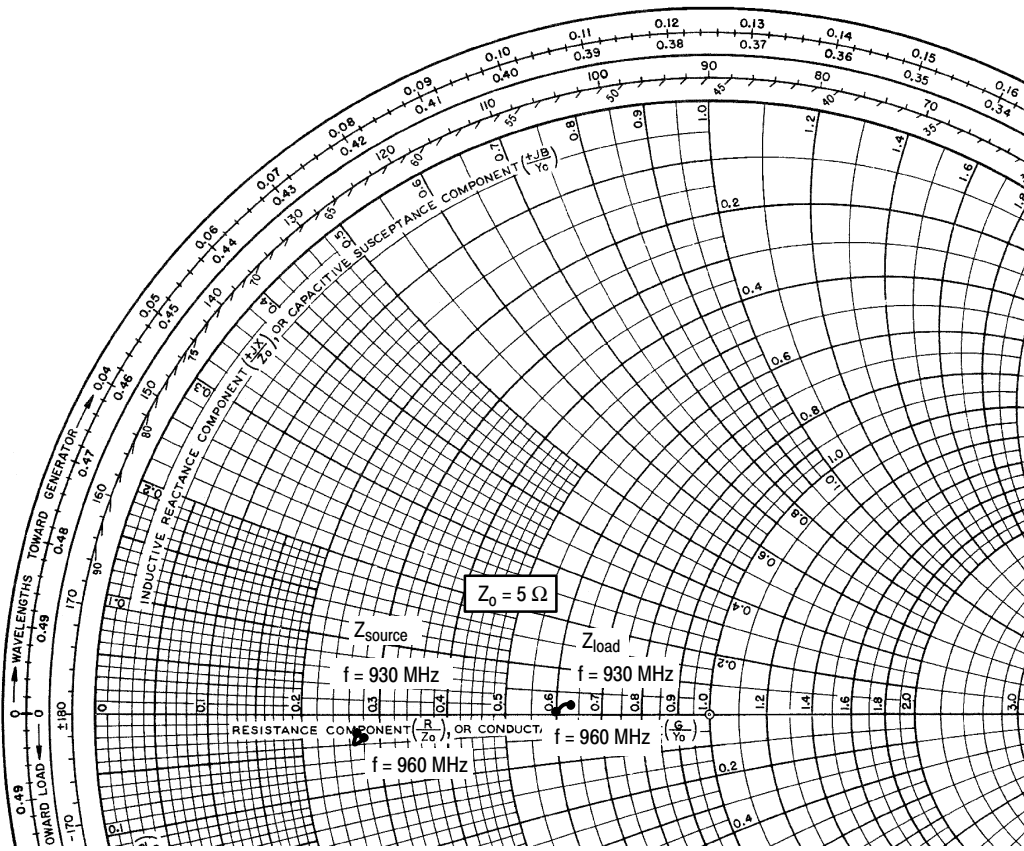


Figure 8. Power Gain, Efficiency and IMD versus Output Power



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.

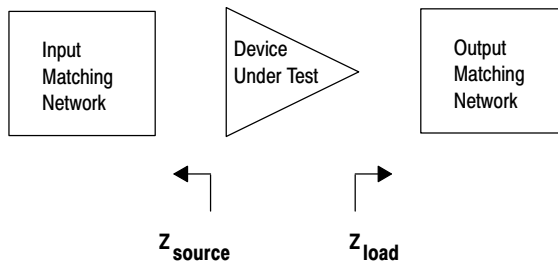
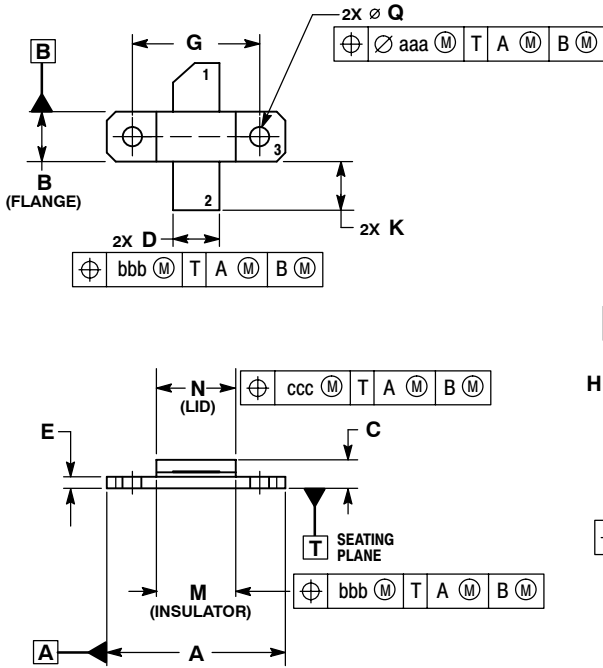


Figure 10. Series Equivalent Source and Load Impedance

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**

NOT RECOMMENDED FOR NEW DESIGN

NOT RECOMMENDED FOR NEW DESIGN

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 |

NOT RECOMMENDED FOR NEW DESIGN

NOT RECOMMENDED FOR NEW DESIGN

How to Reach Us:**Home Page:**

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

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

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

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

For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or +1-303-675-2140
Fax: +1-303-675-2150
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. 2008. All rights reserved.