

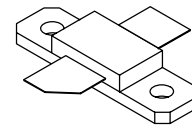
The RF Sub-Micron MOSFET Line
RF Power Field Effect Transistors
N-Channel Enhancement-Mode Lateral MOSFETs

MRF9030LR1
MRF9030LSR1

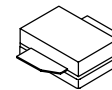
Designed for broadband commercial and industrial applications with frequencies up to 1.0 GHz. The high gain and broadband performance of these devices make them ideal for large-signal, common-source amplifier applications in 26 volt base station equipment.

945 MHz, 30 W, 26 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFETs

- 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
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 945 MHz, 30 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.



CASE 360B-05, STYLE 1
NI-360
MRF9030LR1



CASE 360C-05, STYLE 1
NI-360S
MRF9030LSR1

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------|---------------------------|---------------|
| Drain-Source Voltage | V_{DSS} | 68 | Vdc |
| Gate-Source Voltage | V_{GS} | - 0.5, + 15 | Vdc |
| Total Device Dissipation @ $T_C = 25^\circ C$ Derate above 25°C | P_D | 92 0.53 117 0.67 | Watts W/°C |
| Storage Temperature Range | T_{stg} | - 65 to +150 | °C |
| Operating Junction Temperature | T_J | 200 | °C |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|--------------------------------------|-----------------|------------|------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.9 1.5 | °C/W |

ESD PROTECTION CHARACTERISTICS

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

NOTE - CAUTION - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

Freescale Semiconductor, Inc.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

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

OFF CHARACTERISTICS

| | | | | | |
|--|------------------|---|---|----|------|
| Zero Gate Voltage Drain Leakage Current (V _{DS} = 68 Vdc, V _{GS} = 0 Vdc) | I _{DSS} | — | — | 10 | μAdc |
| Zero Gate Voltage Drain Leakage Current (V _{DS} = 26 Vdc, V _{GS} = 0 Vdc) | I _{DSS} | — | — | 1 | μAdc |
| Gate-Source Leakage Current (V _{GS} = 5 Vdc, V _{DS} = 0 Vdc) | I _{GSS} | — | — | 1 | μAdc |

ON CHARACTERISTICS

| | | | | | |
|---|---------------------|---|------|-----|-----|
| Gate Threshold Voltage (V _{DS} = 10 Vdc, I _D = 100 μAdc) | V _{GS(th)} | 2 | 2.9 | 4 | Vdc |
| Gate Quiescent Voltage (V _{DS} = 26 Vdc, I _D = 250 mAdc) | V _{GS(Q)} | — | 3.8 | — | Vdc |
| Drain-Source On-Voltage (V _{GS} = 10 Vdc, I _D = 0.7 Adc) | V _{DS(on)} | — | 0.19 | 0.4 | Vdc |
| Forward Transconductance (V _{DS} = 10 Vdc, I _D = 2 Adc) | g _{fs} | — | 3 | — | S |

DYNAMIC CHARACTERISTICS

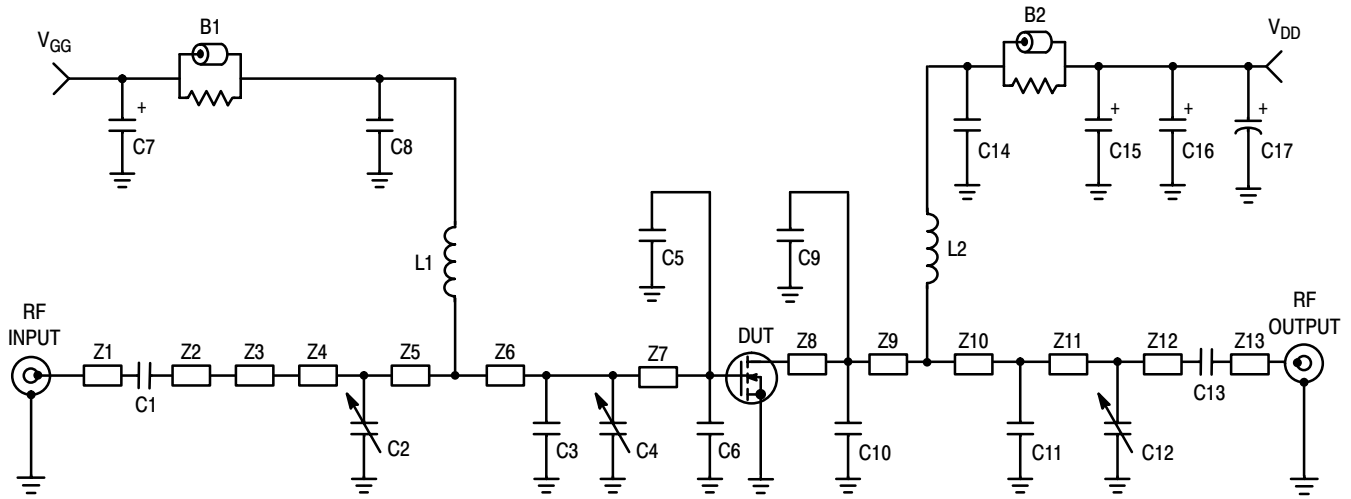
| | | | | | |
|--|------------------|---|------|---|----|
| Input Capacitance (V _{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V _{GS} = 0 Vdc) | C _{iss} | — | 49.5 | — | pF |
| Output Capacitance (V _{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V _{GS} = 0 Vdc) | C _{oss} | — | 26.5 | — | pF |
| Reverse Transfer Capacitance (V _{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V _{GS} = 0 Vdc) | C _{rss} | — | 1 | — | pF |

(continued)

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ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|------------------|--------------------------------|-------|-----|------|
| FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system) | | | | | |
| Two-Tone Common-Source Amplifier Power Gain (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 945.0 MHz, f ₂ = 945.1 MHz) | G _{ps} | 18 | 19 | — | dB |
| Two-Tone Drain Efficiency (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 945.0 MHz, f ₂ = 945.1 MHz) | η | 37 | 41.5 | — | % |
| 3rd Order Intermodulation Distortion (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 945.0 MHz, f ₂ = 945.1 MHz) | IMD | — | -32.5 | -28 | dBc |
| Input Return Loss (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 945.0 MHz, f ₂ = 945.1 MHz) | IRL | — | -15.5 | -9 | dB |
| Two-Tone Common-Source Amplifier Power Gain (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 930.0 MHz, f ₂ = 930.1 MHz and f ₁ = 960.0 MHz, f ₂ = 960.1 MHz) | G _{ps} | — | 19 | — | dB |
| Two-Tone Drain Efficiency (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 930.0 MHz, f ₂ = 930.1 MHz and f ₁ = 960.0 MHz, f ₂ = 960.1 MHz) | η | — | 41.5 | — | % |
| 3rd Order Intermodulation Distortion (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 930.0 MHz, f ₂ = 930.1 MHz and f ₁ = 960.0 MHz, f ₂ = 960.1 MHz) | IMD | — | -33 | — | dBc |
| Input Return Loss (V _{DD} = 26 Vdc, P _{out} = 30 W PEP, I _{DQ} = 250 mA, f ₁ = 930.0 MHz, f ₂ = 930.1 MHz and f ₁ = 960.0 MHz, f ₂ = 960.1 MHz) | IRL | — | -14 | — | dB |
| Power Output, 1 dB Compression Point (V _{DD} = 26 Vdc, P _{out} = 30 W CW, I _{DQ} = 250 mA, f ₁ = 945.0 MHz) | P _{1dB} | — | 30 | — | W |
| Common-Source Amplifier Power Gain (V _{DD} = 26 Vdc, P _{out} = 30 W CW, I _{DQ} = 250 mA, f ₁ = 945.0 MHz) | G _{ps} | — | 19 | — | dB |
| Drain Efficiency (V _{DD} = 26 Vdc, P _{out} = 30 W CW, I _{DQ} = 250 mA, f ₁ = 945.0 MHz) | η | — | 60 | — | % |
| Output Mismatch Stress (V _{DD} = 26 Vdc, P _{out} = 30 W CW, I _{DQ} = 250 mA, f = 945.0 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests) | Ψ | No Degradation In Output Power | | | |



| | | | |
|------------------|--|-----|--|
| 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, B Case | 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, B Case | Z7 | 0.285" x 0.520" Microstrip |
| C5, C6 | 7.5 pF Chip Capacitors, B Case | Z8 | 0.140" x 0.270" Microstrip |
| C7, C15, C16 | 10 μ F, 35 V Tantalum Capacitors | Z9 | 0.450" x 0.270" Microstrip |
| C9, C10 | 10 pF Chip Capacitors, B Case | Z10 | 0.250" x 0.060" Microstrip |
| C11 | 9.1 pF Chip Capacitor, B Case | 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 μ F, 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, $\epsilon_r = 3.55$ |
| Z1 | 0.260" x 0.060" Microstrip | | |
| Z2 | 0.240" x 0.060" Microstrip | | |

Figure 1. 945 MHz Broadband Test Circuit Schematic

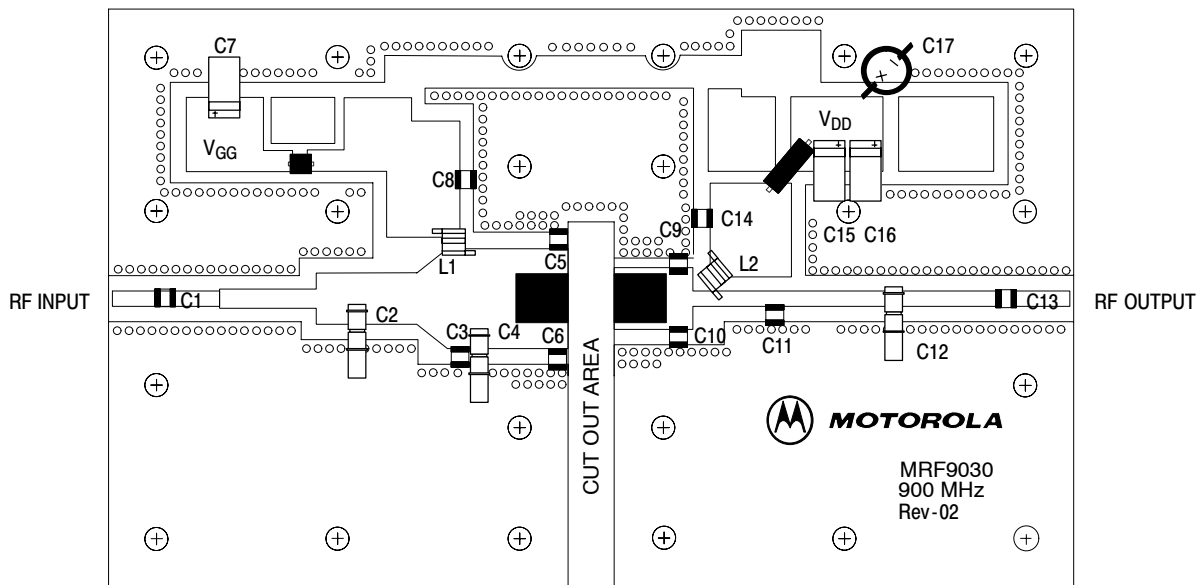


Figure 2. 945 MHz Broadband Test Circuit Component Layout

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TYPICAL CHARACTERISTICS

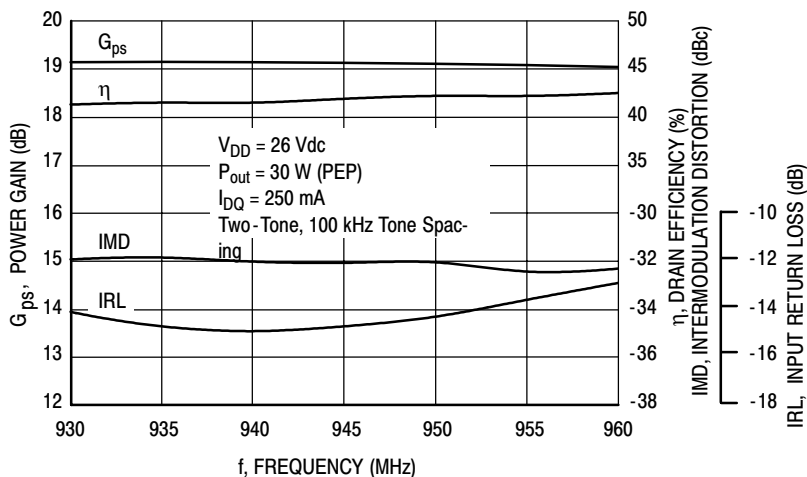


Figure 3. Class AB Broadband Circuit Performance

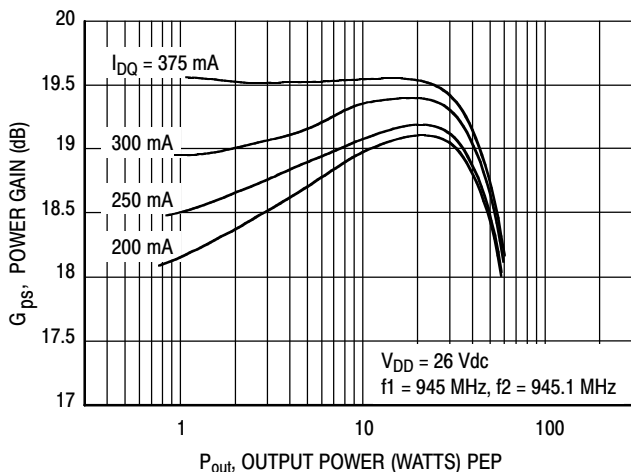


Figure 4. Power Gain versus Output Power

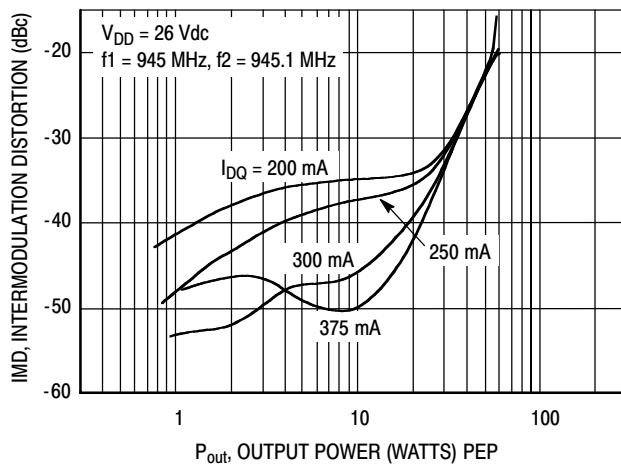


Figure 5. Intermodulation Distortion versus Output Power

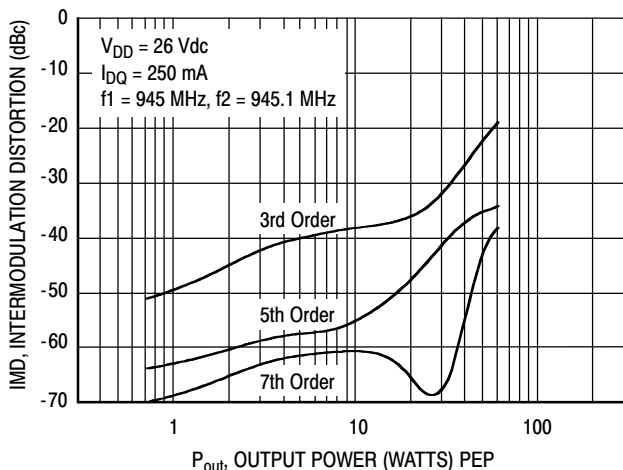


Figure 6. Intermodulation Distortion Products versus Output Power

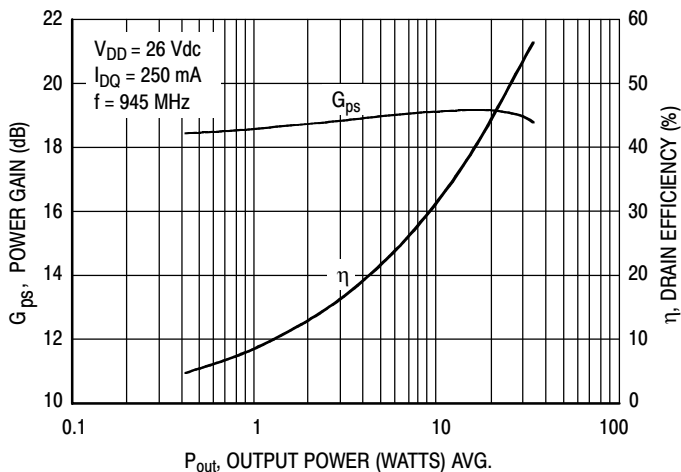


Figure 7. Power Gain and Efficiency versus Output Power

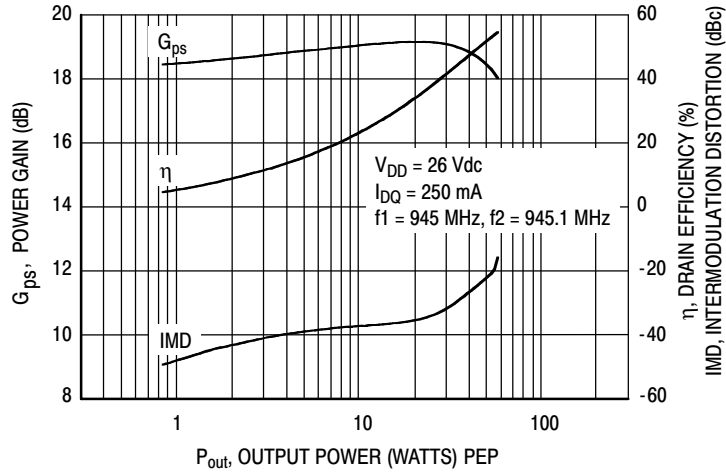
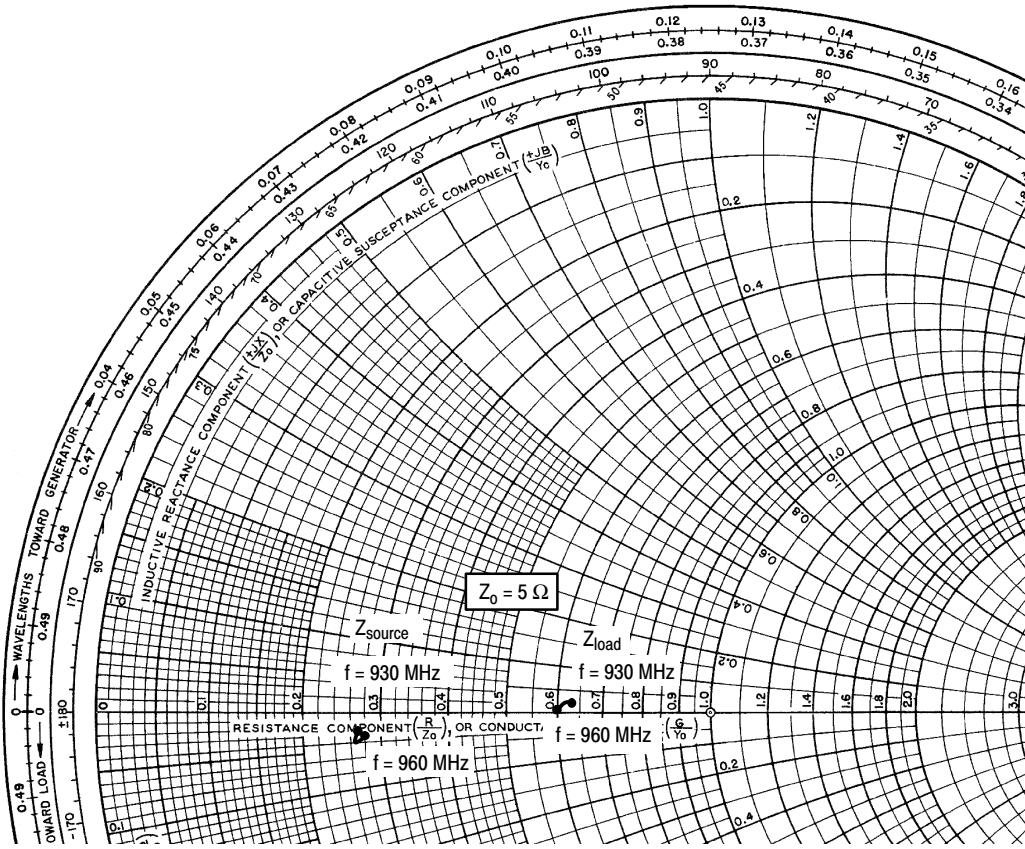


Figure 8. Power Gain, Efficiency and IMD versus Output Power



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

| 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.

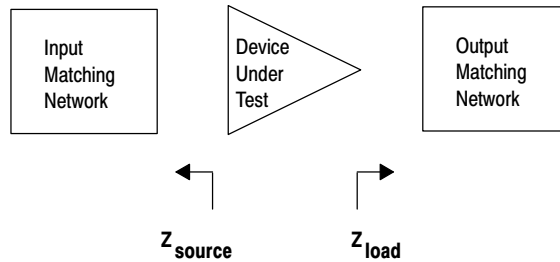


Figure 9. Series Equivalent Input and Output Impedance

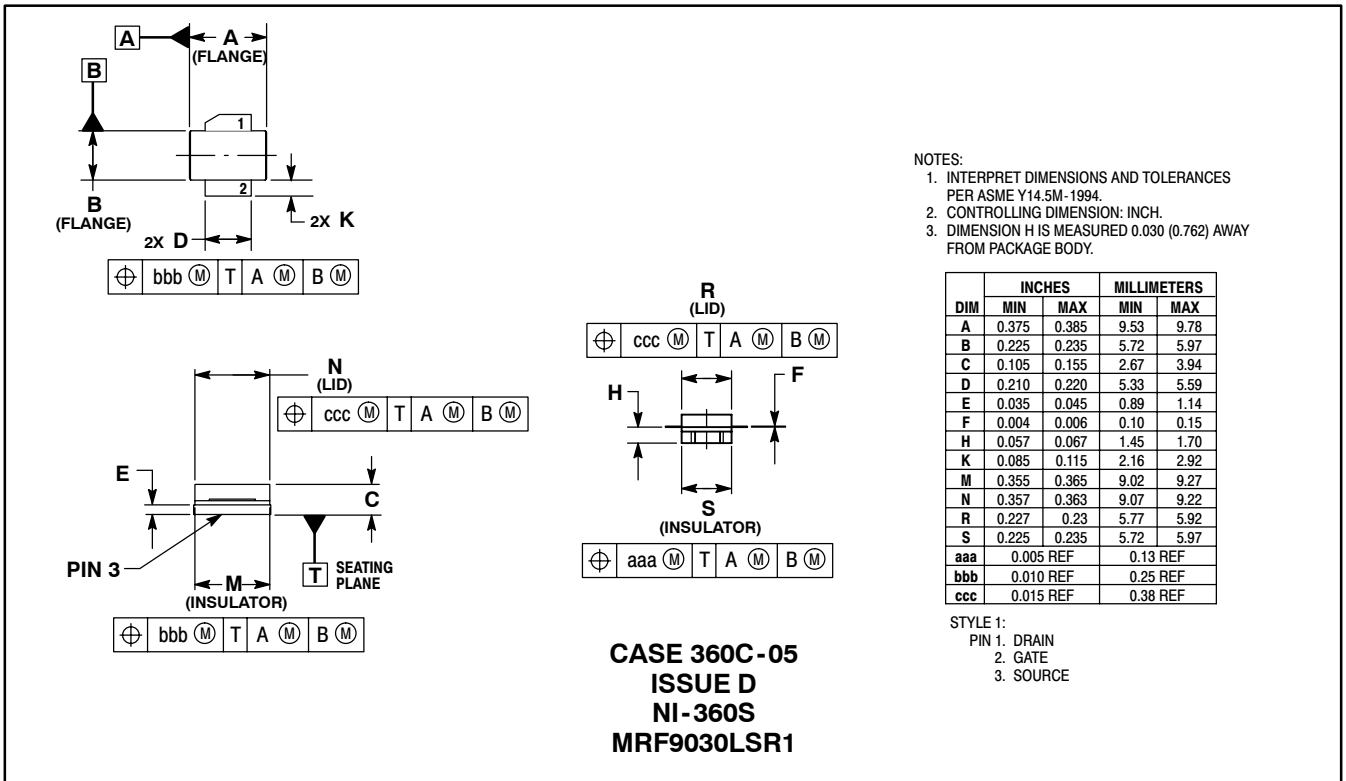
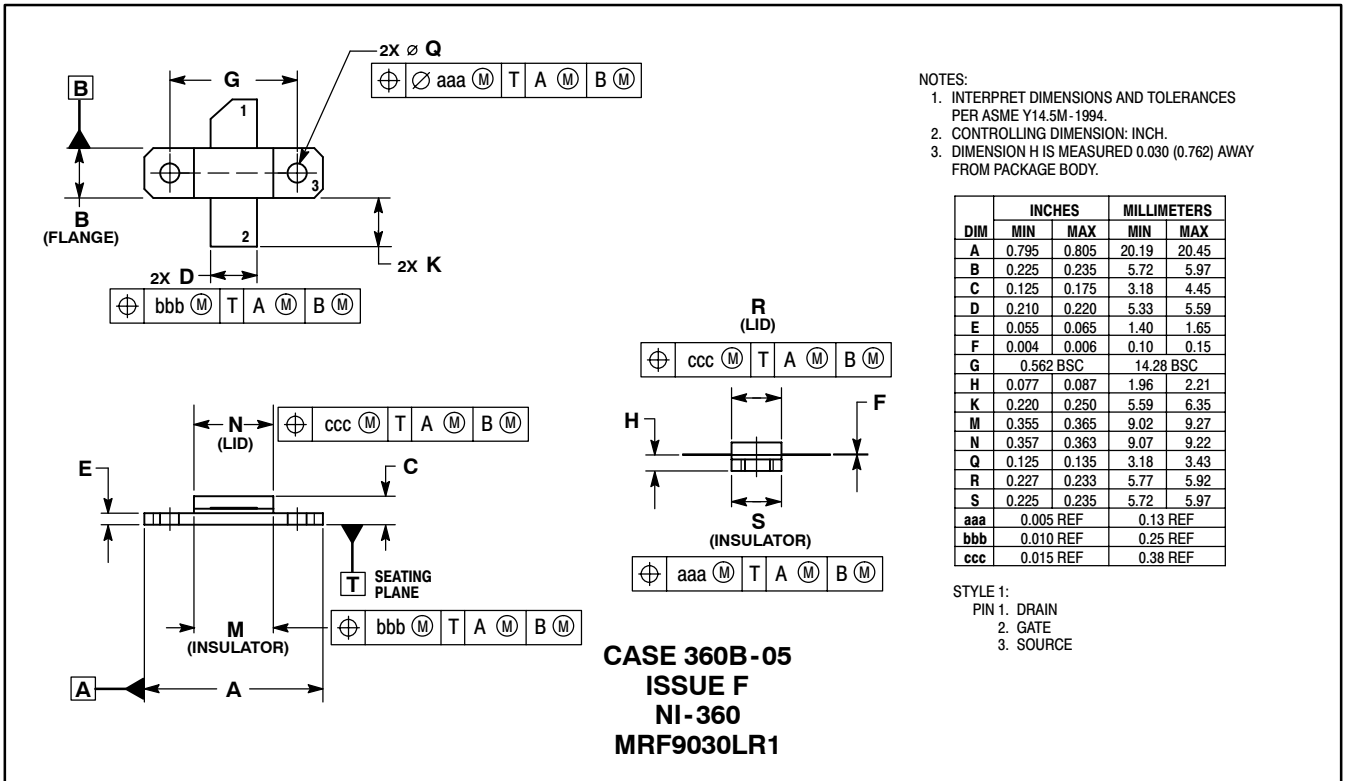
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