## The RF Sub–Micron MOSFET Line

# RF Power Field Effect Transistors

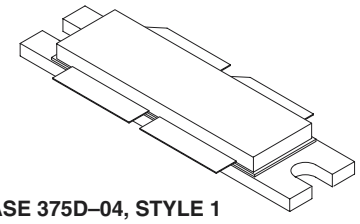
## N–Channel Enhancement–Mode Lateral MOSFETs

# MRF19120
# MRF19120S

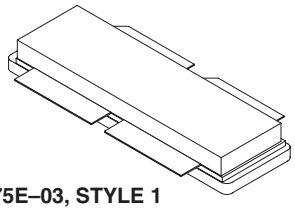
**1990 MHz, 120 W, 26 V**
**LATERAL N–CHANNEL**
**RF POWER MOSFETs**

Designed for CDMA base station applications with frequencies from 1930 to 1990 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN–PCS/cellular radio and WLL applications.

- CDMA Performance @ 1990 MHz, 26 Volts
  IS–97 CDMA Pilot, Sync, Paging, Traffic Codes 8 Thru 13
  885 kHz — –47 dBc @ 30 kHz BW
  1.25 MHz — –55 dBc @ 12.5 kHz BW
  2.25 MHz — –55 dBc @ 1 MHz BW
  Output Power — 15 Watts (Avg.)
  Power Gain — 11.7 dB
  Efficiency — 16%
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency, High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 1990 MHz, 120 Watts (CW) Output Power
- S–Parameter Characterization at High Bias Levels
- Excellent Thermal Stability
- Characterized with Series Equivalent Large–Signal Impedance Parameters



**CASE 375D–04, STYLE 1**
**NI–1230**
**MRF19120**



**CASE 375E–03, STYLE 1**
**NI–1230S**
**MRF19120S**

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain–Source Voltage | $V_{DSS}$ | 65 | Vdc |
| Gate–Source Voltage | $V_{GS}$ | –0.5, +15 | Vdc |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 389<br>2.22 | Watts<br>W/°C |
| Storage Temperature Range | $T_{stg}$ | –65 to +150 | °C |
| Operating Junction Temperature | $T_J$ | 200 | °C |

### ESD PROTECTION CHARACTERISTICS

| Test Conditions | Class |
|---|---|
| Human Body Model | 1 (Minimum) |
| Machine Model | M3 (Minimum) |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.45 | °C/W |

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

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

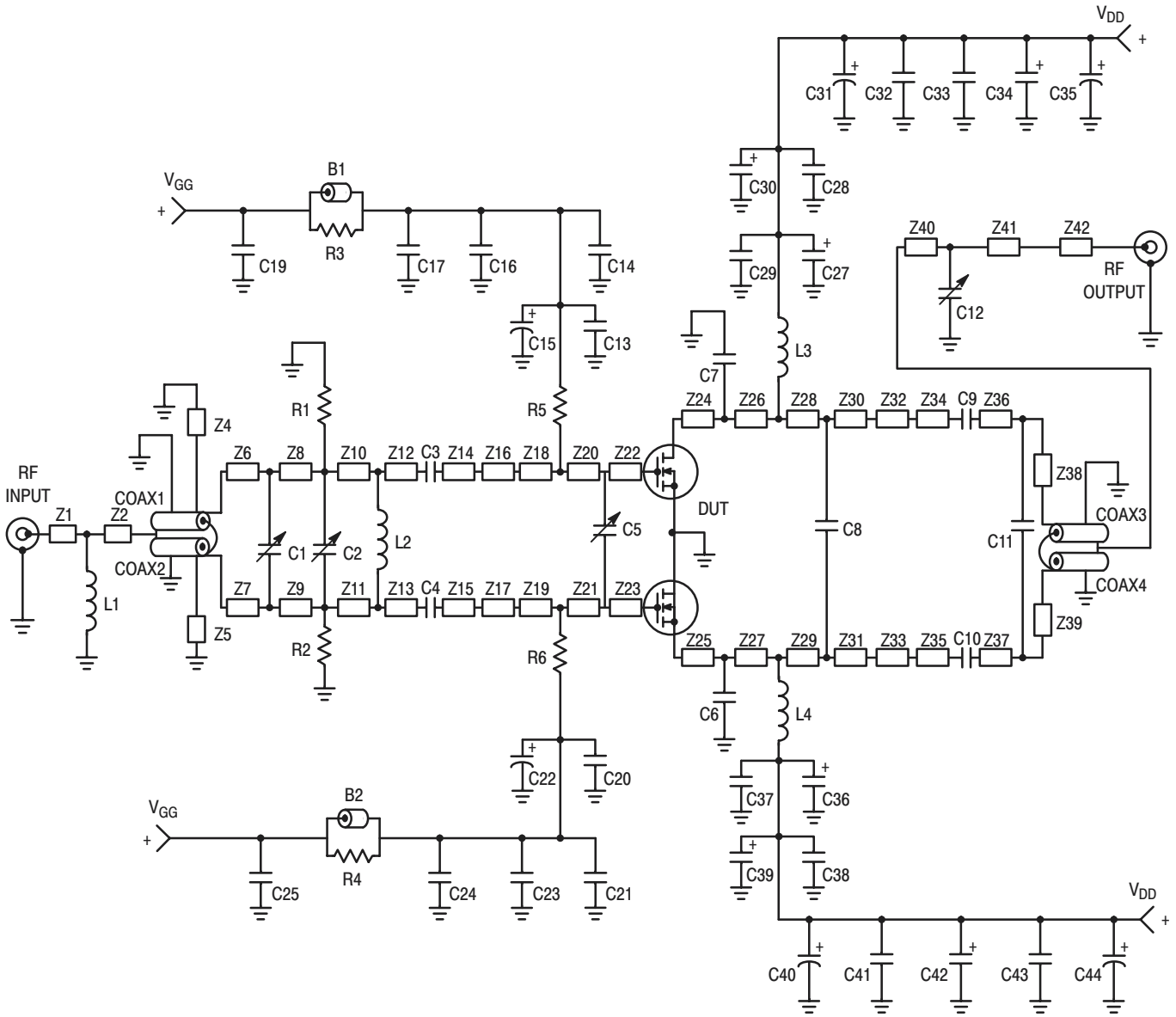
| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** (1) | | | | | | |
| Drain–Source Breakdown Voltage ($V_{GS}$ = 0 Vdc, $I_D$ = 10 μAdc) | | $V_{(BR)DSS}$ | 65 | — | — | Vdc |
| Gate–Source Leakage Current ($V_{GS}$ = 5 Vdc, $V_{DS}$ = 0 Vdc) | | $I_{GSS}$ | — | — | 1 | μAdc |
| Zero Gate Voltage Drain Leakage Current ($V_{DS}$ = 26 Vdc, $V_{GS}$ = 0 Vdc) | | $I_{DSS}$ | — | — | 10 | μAdc |
| **ON CHARACTERISTICS** (1) | | | | | | |
| Forward Transconductance ($V_{DS}$ = 10 Vdc, $I_D$ = 2 Adc) | | $g_{fs}$ | — | 4.8 | — | S |
| Gate Threshold Voltage ($V_{DS}$ = 10 V, $I_D$ = 200 μA) | | $V_{GS(th)}$ | 2.5 | 3 | 3.8 | Vdc |
| Gate Quiescent Voltage ($V_{DS}$ = 26 V, $I_D$ = 500 mA) | | $V_{GS(Q)}$ | 3 | 3.9 | 5 | Vdc |
| Drain–Source On–Voltage ($V_{GS}$ = 10 V, $I_D$ = 2 A) | | $V_{DS(on)}$ | — | 0.38 | 0.5 | Vdc |
| **DYNAMIC CHARACTERISTICS** (1) | | | | | | |
| Reverse Transfer Capacitance ($V_{DS}$ = 26 Vdc, $V_{GS}$ = 0, f = 1 MHz) | | $C_{rss}$ | — | 2.8 | — | pF |
| **FUNCTIONAL TESTS** (In Motorola Test Fixture, 50 ohm system) (2) | | | | | | |
| Common–Source Amplifier Power Gain ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz, f2 = 1990.1 MHz) | MRF19120<br>MRF19120S | $G_{ps}$ | <br>10.7<br>10.5 | <br>11.7<br>11.7 | <br>—<br>— | dB |
| Drain Efficiency ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz, f2 = 1990.1 MHz) | | η | 30 | 34 | — | % |
| Intermodulation Distortion ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz, f2 = 1990.1 MHz) | MRF19120<br>MRF19120S | IMD | <br>—<br>— | <br>–31<br>–31 | <br>–28<br>–27 | dB |
| Input Return Loss ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz, f2 = 1990.1 MHz) | | IRL | — | –12 | –9 | dB |
| Common–Source Amplifier Power Gain ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1930.0 MHz, f2 = 1930.1 MHz) | | $G_{ps}$ | — | 11.7 | — | dB |
| Drain Efficiency ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1930.0 MHz, f2 = 1930.1 MHz) | | η | — | 34 | — | % |
| Intermodulation Distortion ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1930.0 MHz, f2 = 1930.1 MHz) | | IMD | — | –31 | — | dB |
| Input Return Loss ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W PEP, $I_{DQ}$ = 2 × 500 mA, f1 = 1930.0 MHz, f2 = 1930.1 MHz) | | IRL | — | –14 | — | dB |
| Power Output, 1 dB Compression Point ($V_{DD}$ = 26 Vdc, CW, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz) | | P1dB | — | 120 | — | Watts |
| Common–Source Amplifier Power Gain ($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W CW, $I_{DQ}$ = 2 × 500 mA, f1 = 1990.0 MHz) | | $G_{ps}$ | — | 11 | — | dB |

(1) Each side of device measured separately.
(2) Device measured in push–pull configuration.

**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) (2) (continued) | | | | | |
| Drain Efficiency<br>($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W CW, $I_{DQ}$ = 2 × 500 mA,<br>f1 = 1990.0 MHz) | η | — | 45 | — | % |
| Output Mismatch Stress<br>($V_{DD}$ = 26 Vdc, $P_{out}$ = 120 W CW, $I_{DQ}$ = 2 × 500 mA,<br>f = 1990 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests) | Ψ | No Degradation In Output Power<br>Before and After Test | | | |

(2) Device measured in push–pull configuration.




| | |
|---|---|
| B1, B2 | Ferrite Beads, Fair Rite |
| C1, C2 | 0.6 – 4.5 pF Variable Capacitors, Johanson Gigatrim |
| C3, C4, C9, C10 | 10 pF Chip Capacitors, B Case, ATC |
| C5, C12 | 0.4 – 2.5 pF Variable Capacitors, Johanson Gigatrim |
| C6, C7 | 2.0 pF Chip Capacitors, B Case, ATC |
| C8 | 1.1 pF Chip Capacitor, B Case, ATC |
| C11 | 0.1 pF Chip Capacitor, B Case, ATC |
| C13, C20, C29, C37 | 5.1 pF Chip Capacitors, B Case, ATC |
| C14, C21, C28, C38 | 91 pF Chip Capacitors, B Case, ATC |
| C15, C22, C31, C40 | 100 μF, 50 V Electrolytic Capacitors, Sprague |
| C16, C23, C33, C43 | 0.039 μF Chip Capacitors, B Case, ATC |
| C17, C24, C32, C41 | 1000 pF Chip Capacitors, B Case, ATC |
| C19, C25 | 0.020 μF Chip Capacitors, B Case, ATC |
| C27, C34, C36, C42 | 22 μF, 35 V Tantalum Surface Mount Chip Capacitors, Kemet |
| C30, C39 | 1.0 μF, 35 V Tantalum Surface Mount Chip Capacitors, Kemet |
| C35, C44 | 470 μF, 63 V Electrolytic Capacitors, Sprague |
| Coax1, Coax2 | 25 Ω, Semi Rigid Coax, 70 mil OD, 1.05″ Long |
| Coax3, Coax4 | 50 Ω, Semi Rigid Coax, 85 mil OD, 1.05″ Long |
| L1 | 5.0 nH, Minispring Inductor, Coilcraft |
| L2 | 8.0 nH, Minispring Inductor, Coilcraft |
| L3, L4 | 5.60 nH, Microspring Inductors, Coilcraft |
| R1, R2 | 1 kΩ, 1/2 W Fixed Metal Film Resistors, Dale |
| R3, R4 | 270 Ω, 1/8 W Fixed Film Chip Resistors, Dale |
| R5, R6 | 1.0 kΩ, 1/8 W Fixed Film Chip Resistors, Dale |
| Z1 | 0.150″ x 0.080″ Microstrip |
| Z2 | 0.320″ x 0.080″ Microstrip |
| Z4, Z5 | 1.050″ x 0.080″ Microstrip |
| Z6, Z7 | 0.120″ x 0.080″ Microstrip |
| Z8, Z9 | 0.140″ x 0.080″ Microstrip |
| Z10, Z11 | 0.610″ x 0.080″ Microstrip |
| Z12, Z13 | 0.135″ x 0.080″ Microstrip |
| Z14, Z15 | 0.130″ x 0.080″ Microstrip |
| Z16, Z17 | 0.300″ x 0.350″ Microstrip |
| Z18, Z19 | 0.150″ x 0.500″ Microstrip |
| Z20, Z21 | 0.075″ x 0.500″ Microstrip |
| Z22, Z23 | 0.330″ x 0.500″ Microstrip |
| Z24, Z25 | 0.100″ x 0.550″ Microstrip |
| Z26, Z27 | 0.175″ x 0.550″ Microstrip |
| Z28, Z29 | 0.045″ x 0.550″ Microstrip |
| Z30, Z31 | 0.190″ x 0.325″ Microstrip |
| Z32, Z33 | 0.080″ x 0.325″ Microstrip |
| Z34, Z35 | 0.515″ x 0.080″ Microstrip |
| Z36, Z37 | 0.020″ x 0.080″ Microstrip |
| Z38, Z39 | 0.565″ x 0.080″ Microstrip |
| Z40 | 0.100″ x 0.080″ Microstrip |
| Z41 | 0.470″ x 0.080″ Microstrip |
| Z42 | 0.100″ x 0.080″ Microstrip |
| Board Material | 0.03″ Teflon®, $\varepsilon_r$ = 2.55 Copper Clad, 2 oz. Cu |
| Connectors | N–Type Panel Mount, Stripline |

**Figure 1. 1.93 – 1.99 GHz Broadband Test Circuit Schematic**

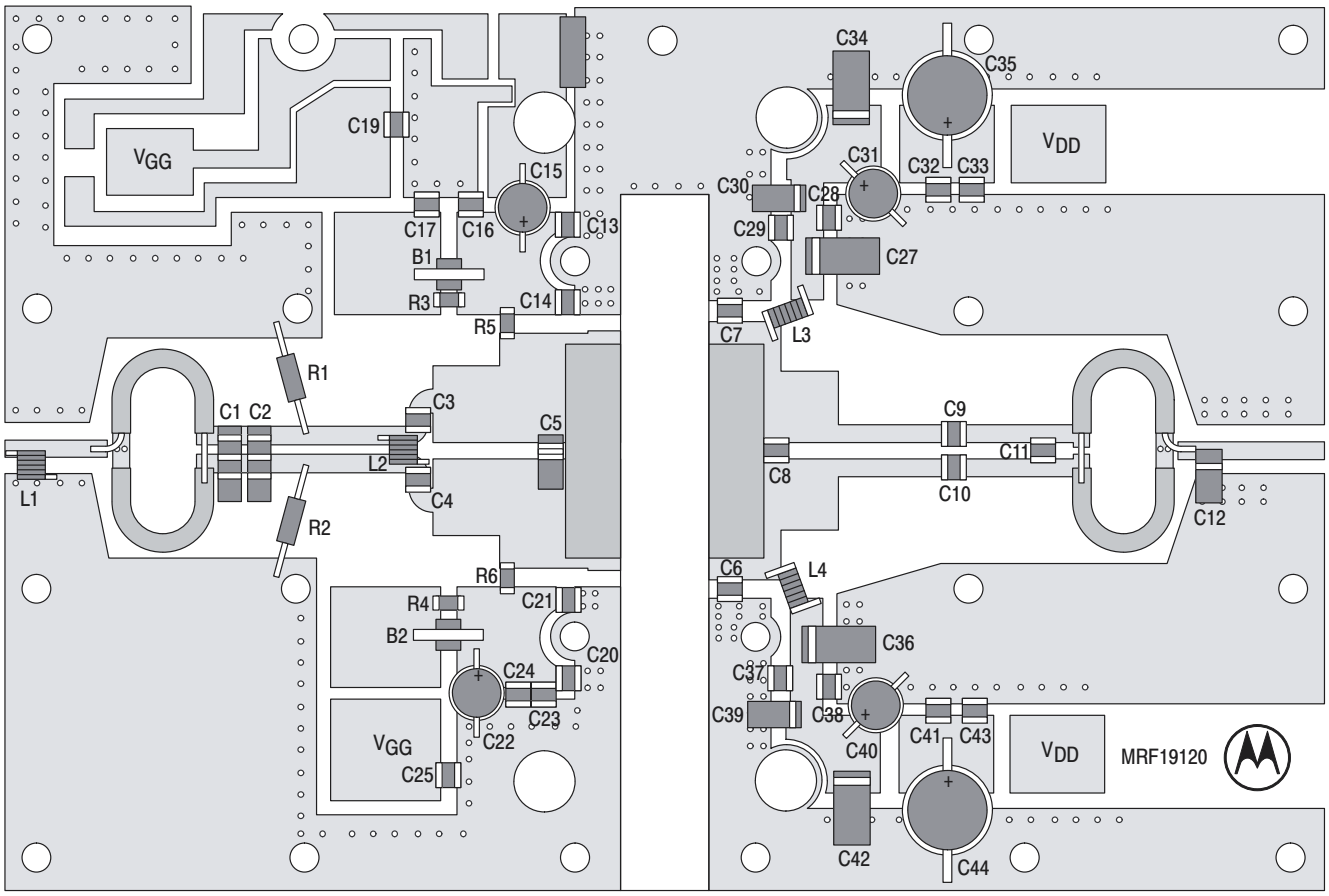



**Figure 2. MRF19120 Test Circuit Component Layout**

## TYPICAL CHARACTERISTICS

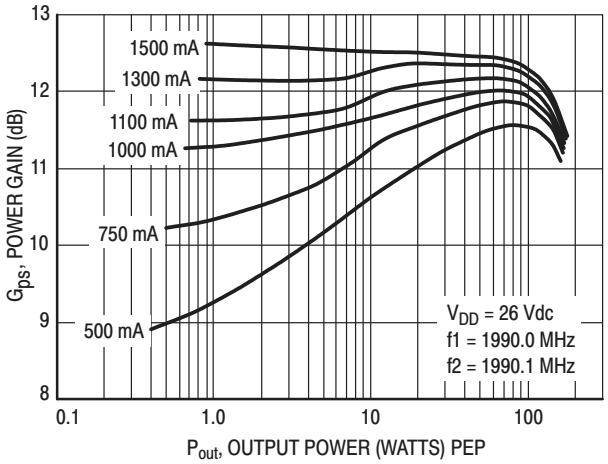



**Figure 3. Power Gain versus Output Power**

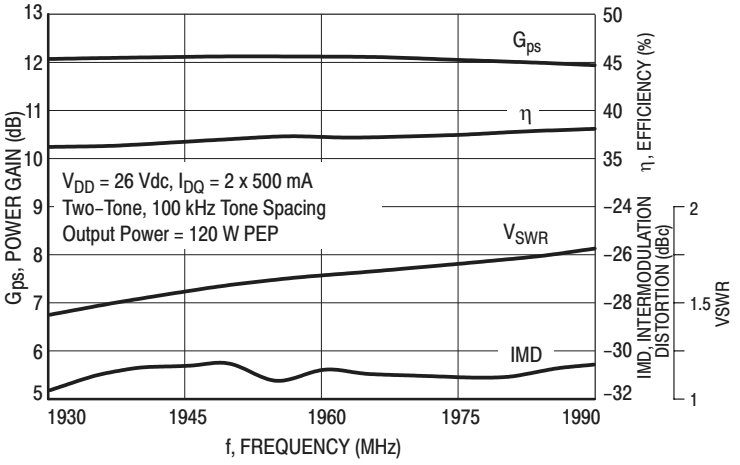



**Figure 4. Class AB Broadband Circuit Performance**

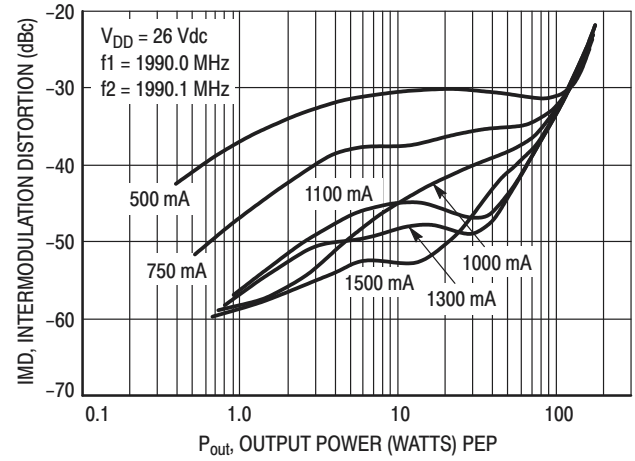



**Figure 5. Intermodulation Distortion versus Output Power**

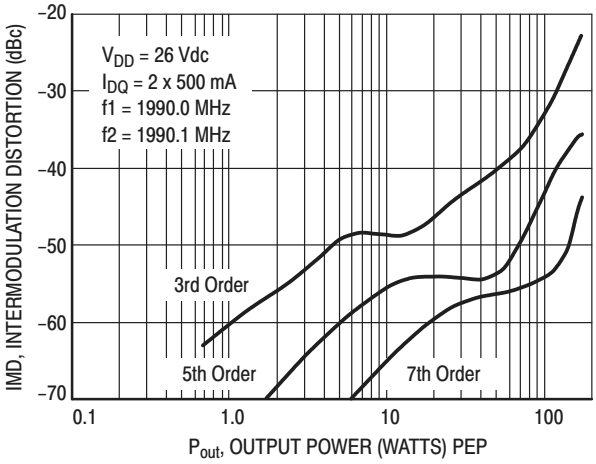



**Figure 6. Intermodulation Distortion Products versus Output Power**

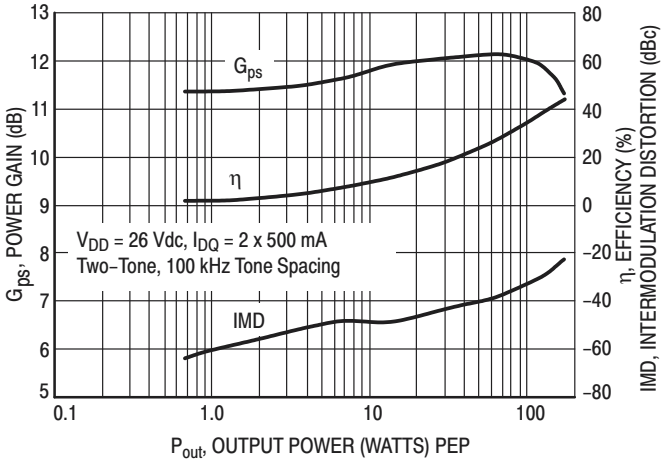



**Figure 7. Power Gain, Efficiency, and IMD versus Output Power**

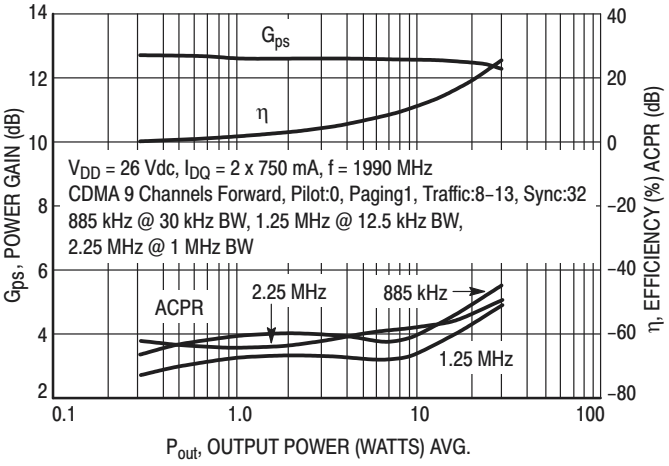
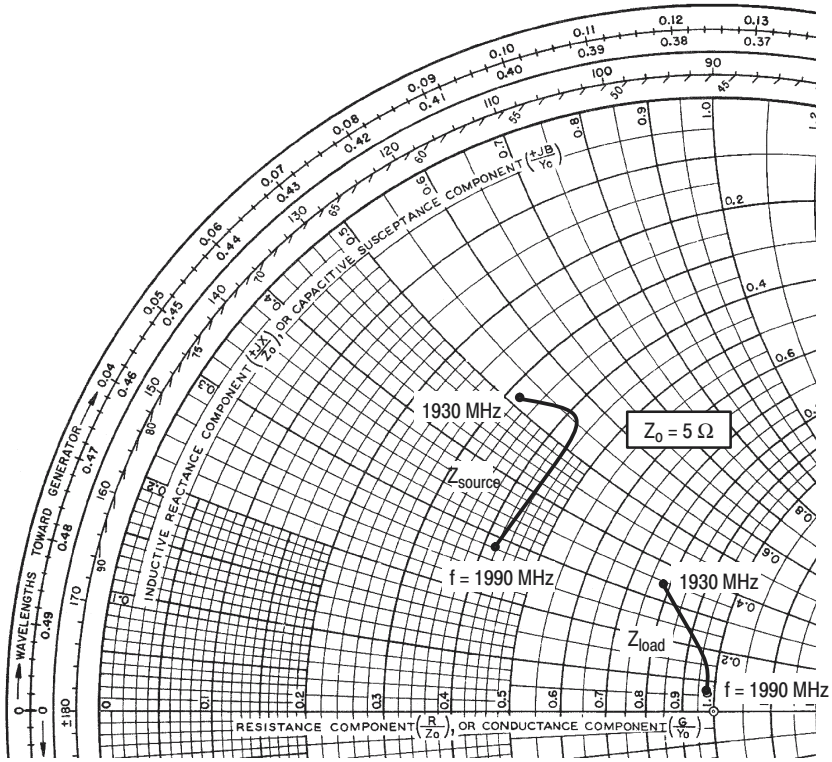



**Figure 8. Power Gain, Efficiency, and ACPR versus Output Power**




$V_{DD}$ = 26 V, $I_{DQ}$ = 2 × 500 mA, $P_{out}$ = 120 W PEP

| f MHz | $Z_{source}$ Ω | $Z_{load}$ Ω |
|---|---|---|
| 1930 | 1.64 + j2.6 | 3.9 + j1.7 |
| 1960 | 2.10 + j2.8 | 4.8 + j0.8 |
| 1990 | 2.10 + j1.4 | 4.9 + j0.3 |

$Z_{source}$ = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$ = Test circuit impedance as measured from drain to drain, balanced configuration.

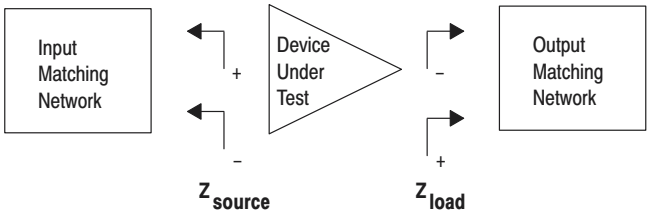


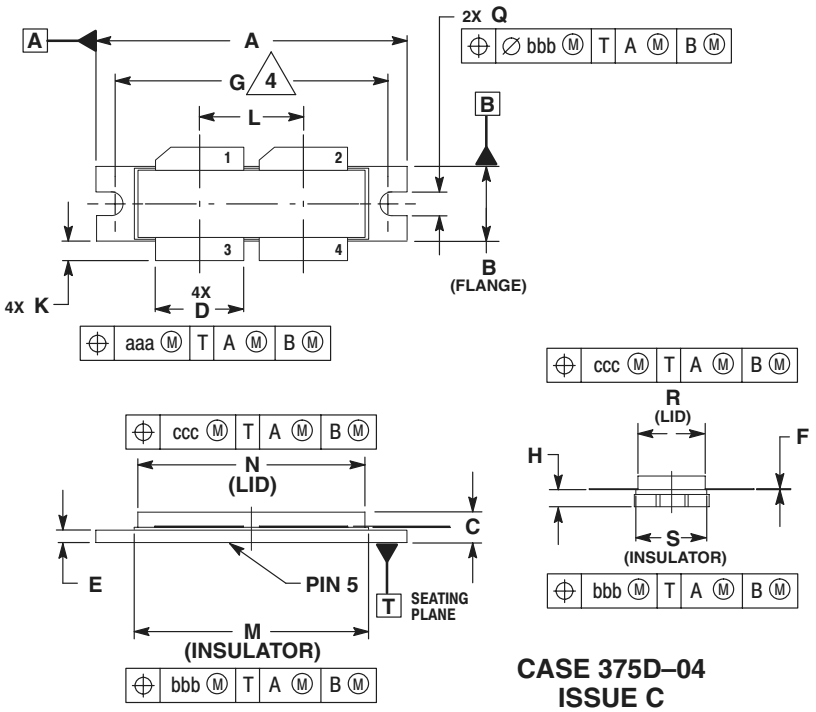

**Figure 9. Series Equivalent Input and Output Impedance**

# NOTES

# NOTES

# NOTES

## PACKAGE DIMENSIONS

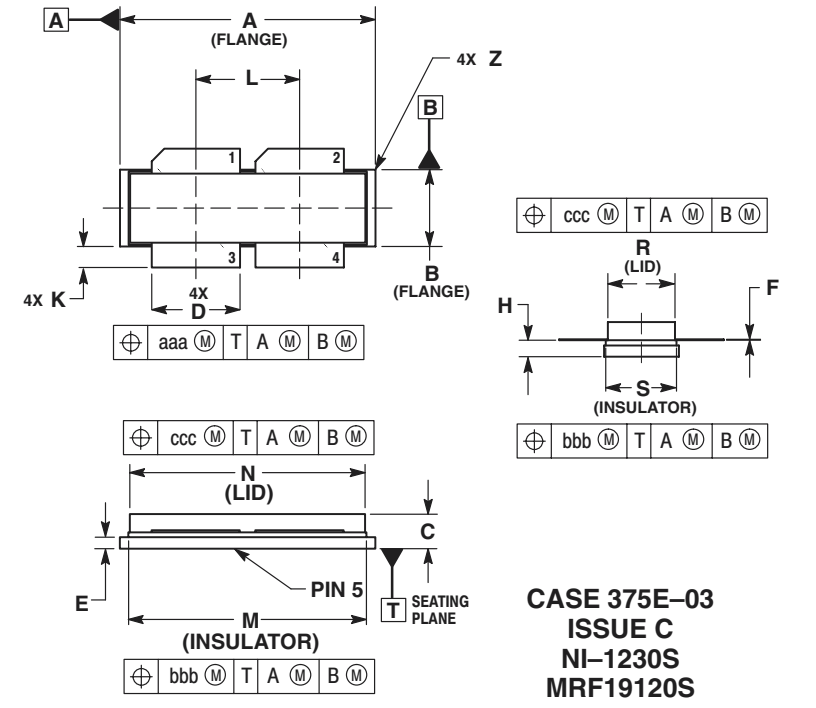



NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. RECOMMENDED BOLT CENTER DIMENSION OF 1.52 (38.61) BASED ON M3 SCREW.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 1.615 | 1.625 | 41.02 | 41.28 |
| B | 0.395 | 0.405 | 10.03 | 10.29 |
| C | 0.150 | 0.200 | 3.81 | 5.08 |
| D | 0.455 | 0.465 | 11.56 | 11.81 |
| E | 0.062 | 0.066 | 1.57 | 1.68 |
| F | 0.004 | 0.007 | 0.10 | 0.18 |
| G | 1.400 BSC | | 35.56 BSC | |
| H | 0.079 | 0.089 | 2.01 | 2.26 |
| K | 0.117 | 0.137 | 2.97 | 3.48 |
| L | 0.540 BSC | | 13.72 BSC | |
| M | 1.219 | 1.241 | 30.96 | 31.52 |
| N | 1.218 | 1.242 | 30.94 | 31.55 |
| Q | 0.120 | 0.130 | 3.05 | 3.30 |
| R | 0.355 | 0.365 | 9.01 | 9.27 |
| S | 0.365 | 0.375 | 9.27 | 9.53 |
| aaa | 0.013 REF | | 0.33 REF | |
| bbb | 0.010 REF | | 0.25 REF | |
| ccc | 0.020 REF | | 0.51 REF | |

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

**CASE 375D–04**
**ISSUE C**
**NI–1230**
**MRF19120**




NOTES:
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2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 1.325 | 1.335 | 33.66 | 33.91 |
| B | 0.395 | 0.405 | 10.03 | 10.29 |
| C | 0.150 | 0.200 | 3.81 | 5.08 |
| D | 0.455 | 0.465 | 11.56 | 11.81 |
| E | 0.062 | 0.066 | 1.57 | 1.68 |
| F | 0.004 | 0.007 | 0.10 | 0.18 |
| H | 0.079 | 0.089 | 2.01 | 2.26 |
| K | 0.117 | 0.137 | 2.97 | 3.48 |
| L | 0.540 BSC | | 13.72 BSC | |
| M | 1.219 | 1.241 | 30.96 | 31.52 |
| N | 1.218 | 1.242 | 30.94 | 31.55 |
| R | 0.355 | 0.365 | 9.01 | 9.27 |
| S | 0.365 | 0.375 | 9.27 | 9.53 |
| Z | 0 | 0.040 | 0 | 1.02 |
| aaa | 0.013 REF | | 0.33 REF | |
| bbb | 0.010 REF | | 0.25 REF | |
| ccc | 0.020 REF | | 0.51 REF | |

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

**CASE 375E–03**
**ISSUE C**
**NI–1230S**
**MRF19120S**

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