Freescale Semiconductor
Technical Data

Document Number: MRF19085-1
Rev. 9, 10/2008

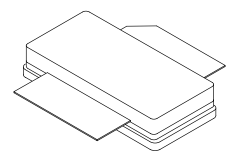
RoHS

# RF Power Field Effect Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

**MRF19085LSR3**

**1930-1990 MHz, 90 W, 26 V**
**LATERAL N-CHANNEL**
**RF POWER MOSFET**



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

Designed for PCN and PCS base station applications with frequencies from 1900 to 2000 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

- Typical 2-Carrier N-CDMA Performance for $V_{DD}$ = 26 Volts, $I_{DQ}$ = 850 mA, $P_{out}$ = 18 Watts Avg., f1 = 1930 MHz, f2 = 1932.5 MHz IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) 1.2288 MHz Channel Bandwidth Carrier. Adjacent Channels Measured over a 30 kHz Bandwidth at f1 -885 Khz and f2 +885 kHz. Distortion Products Measured over 1.2288 MHz Bandwidth at f1 -2.5 MHz and f2 +2.5 MHz. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.
  - Output Power — 18 Watts Avg.
  - Power Gain — 13.0 dB
  - Efficiency — 23%
  - ACPR — -51 dB
  - IM3 — -36.5 dBc
- Capable of Handling 5:1 VSWR, @ 26 Vdc, 1960 MHz, 90 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
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- 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.

**Table 1. Maximum Ratings**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | -0.5, +65 | Vdc |
| Gate-Source Voltage | $V_{GS}$ | -0.5, +15 | Vdc |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 273<br>1.56 | W<br>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 (1) | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.79 | °C/W |

**Table 3. ESD Protection Characteristics**

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

1. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

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**Table 4. Electrical Characteristics** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Off Characteristics** | | | | | |
| Drain-Source Breakdown Voltage ($V_{GS}$ = 0 Vdc, $I_D$ = 100 μAdc) | $V_{(BR)DSS}$ | 65 | — | — | Vdc |
| Zero Gate Voltage Drain Current ($V_{DS}$ = 26 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 10 | μAdc |
| Gate-Source Leakage Current ($V_{GS}$ = 5 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | — | — | 1 | μAdc |
| **On Characteristics (DC)** | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = 10 Vdc, $I_D$ = 200 μAdc) | $V_{GS(th)}$ | 2 | — | 4 | Vdc |
| Gate Quiescent Voltage ($V_{DS}$ = 26 Vdc, $I_D$ = 850 mAdc) | $V_{GS(Q)}$ | 2.5 | 3.5 | 4.5 | Vdc |
| Drain-Source On-Voltage ($V_{GS}$ = 10 Vdc, $I_D$ = 2 Adc) | $V_{DS(on)}$ | — | 0.18 | 0.210 | Vdc |
| Forward Transconductance ($V_{DS}$ = 10 Vdc, $I_D$ = 2 Adc) | $g_{fs}$ | — | 6 | — | S |
| **Dynamic Characteristics** | | | | | |
| Reverse Transfer Capacitance (1) ($V_{DS}$ = 26 Vdc, $V_{GS}$ = 0, f = 1.0 MHz) | $C_{rss}$ | — | 3.6 | — | pF |
| **Functional Tests** (In Freescale Test Fixture, 50 ohm system) 2-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carriers. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF. | | | | | |
| Common-Source Amplifier Power Gain ($V_{DD}$ = 26 Vdc, $P_{out}$ = 18 W Avg., $I_{DQ}$ = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz) | $G_{ps}$ | 12 | 13 | — | dB |
| Drain Efficiency ($V_{DD}$ = 26 Vdc, $P_{out}$ = 18 W Avg., $I_{DQ}$ = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz) | η | 21 | 23 | — | % |
| 3rd Order Intermodulation Distortion ($V_{DD}$ = 26 Vdc, $P_{out}$ = 18 W Avg., $I_{DQ}$ = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz; IM3 measured over 1.2288 MHz bandwidth @ f1 = -2.5 MHz and f2 = +2.5 MHz) | IMD | — | -36.5 | -35 | dBc |
| Adjacent Channel Power Ratio ($V_{DD}$ = 26 Vdc, $P_{out}$ = 18 W Avg., $I_{DQ}$ = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz; ACPR measured over 30 kHz bandwidth @ f1 = -885 MHz and f2 = +885 MHz) | ACPR | — | -51 | -48 | dBc |
| Input Return Loss ($V_{DD}$ = 26 Vdc, $P_{out}$ = 18 W Avg., $I_{DQ}$ = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz) | IRL | — | -12 | -9 | dB |

1. Part is internally matched both on input and output.

(continued)

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**Table 4. Electrical Characteristics** ($T_C$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Functional Tests** (In Freescale Test Fixture) | | | | | |
| Two-Tone Common-Source Amplifier Power Gain ($V_{DD}$ = 26 Vdc, $P_{out}$ = 90 W PEP, $I_{DQ}$ = 850 mA, f = 1930 MHz and 1990 MHz, Tone Spacing = 100 kHz) | $G_{ps}$ | — | 13 | — | dB |
| Two-Tone Drain Efficiency ($V_{DD}$ = 26 Vdc, $P_{out}$ = 90 W PEP, $I_{DQ}$ = 850 mA, f = 1930 MHz and 1990 MHz, Tone Spacing = 100 kHz) | η | — | 36 | — | % |
| 3rd Order Intermodulation Distortion ($V_{DD}$ = 26 Vdc, $P_{out}$ = 90 W PEP, $I_{DQ}$ = 850 mA, f = 1930 MHz and 1990 MHz, Tone Spacing = 100 kHz) | IMD | — | -31 | — | dBc |
| Input Return Loss ($V_{DD}$ = 26 Vdc, $P_{out}$ = 90 W PEP, $I_{DQ}$ = 850 mA, f = 1930 MHz and 1990 MHz, Tone Spacing = 100 kHz) | IRL | — | -12 | — | dB |
| $P_{out}$, 1 dB Compression Point ($V_{DD}$ = 26 Vdc, $I_{DQ}$ = 850 mA, f = 1990 MHz) | P1dB | — | 90 | — | W |

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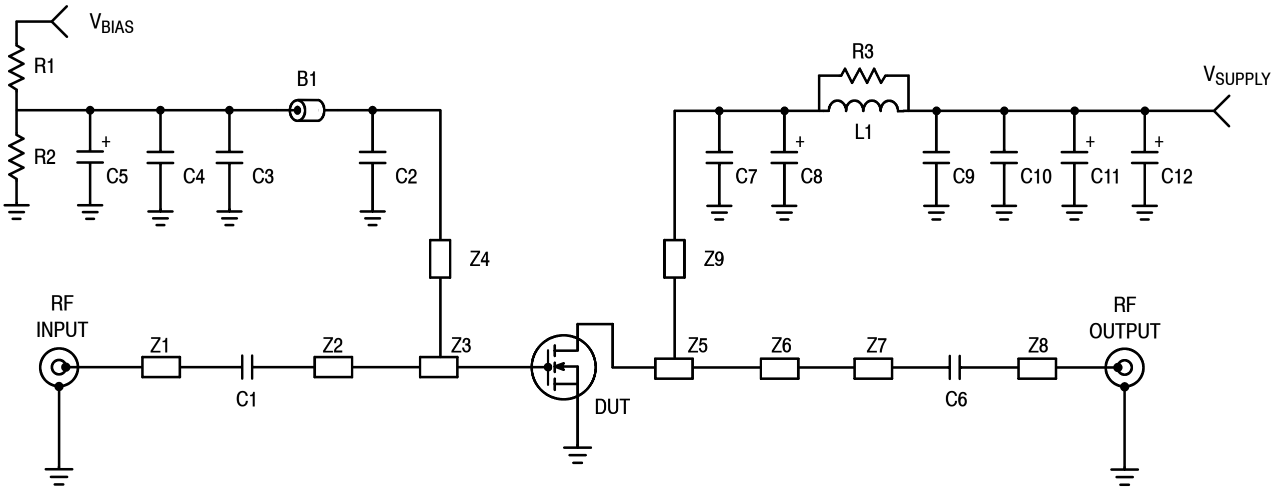


**Figure 1. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Schematic**

**Table 5. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Component Designations and Values**

| Part | Description | Part Number | Manufacturer |
|---|---|---|---|
| B1 | Short Ferrite Bead | 2743019447 | Fair Rite |
| C1 | 51 pF Chip Capacitor | ATC100B510JT500XT | ATC |
| C2, C7 | 5.1 pF Chip Capacitors | ATC100B5R1JT500XT | ATC |
| C3, C9 | 1000 pF Chip Capacitors | ATC100B102JT500XT | ATC |
| C4, C10 | 0.1 μF Chip Capacitors | CDR33BX104AKYS | Kemet |
| C5 | 0.1 μF Tantalum Surface Mount Capacitor | T491C105M050AT | Kemet |
| C6 | 10 pF Chip Capacitor | ATC100B100JT500XT | ATC |
| C8 | 10 μF Tantalum Surface Mount Capacitor | T495D106K035AT | Kemet |
| C11, C12 | 22 μF Tantalum Surface Mount Capacitors | T491D226K035AT | Kemet |
| L1 | 1 Turn, 20 AWG, 0.100″ ID | | |
| R1 | 1.0 kΩ, 1/4 W Chip Resistor | CRCW12061001FKEA | Vishay |
| R2 | 220 kΩ, 1/4 W Chip Resistor | CRCW12062200FKEA | Vishay |
| R3 | 10 Ω, 1/4 W Chip Resistor | CRCW120610R0FKEA | Vishay |
| Z1 | Microstrip | 0.750″ x 0.0840″ | |
| Z2 | Microstrip | 1.090″ x 0.0840″ | |
| Z3 | Microstrip | 0.400″ x 1.400″ | |
| Z4 | Microstrip | 0.520″ x 0.050″ | |
| Z5 | Microstrip | 0.540″ x 1.133″ | |
| Z6 | Microstrip | 0.400″ x 0.140″ | |
| Z7 | Microstrip | 0.555″ x 0.0840″ | |
| Z8 | Microstrip | 0.720″ x 0.0840″ | |
| Z9 | Microstrip | 0.560″ x 0.070″ | |
| Board | 0.030″ Glass Teflon® | GX-0300-55-22, $\varepsilon_r$ = 2.55 | Arlon |
| PCB | Etched Circuit Boards | MRF19085 Rev. 4 | CMR |

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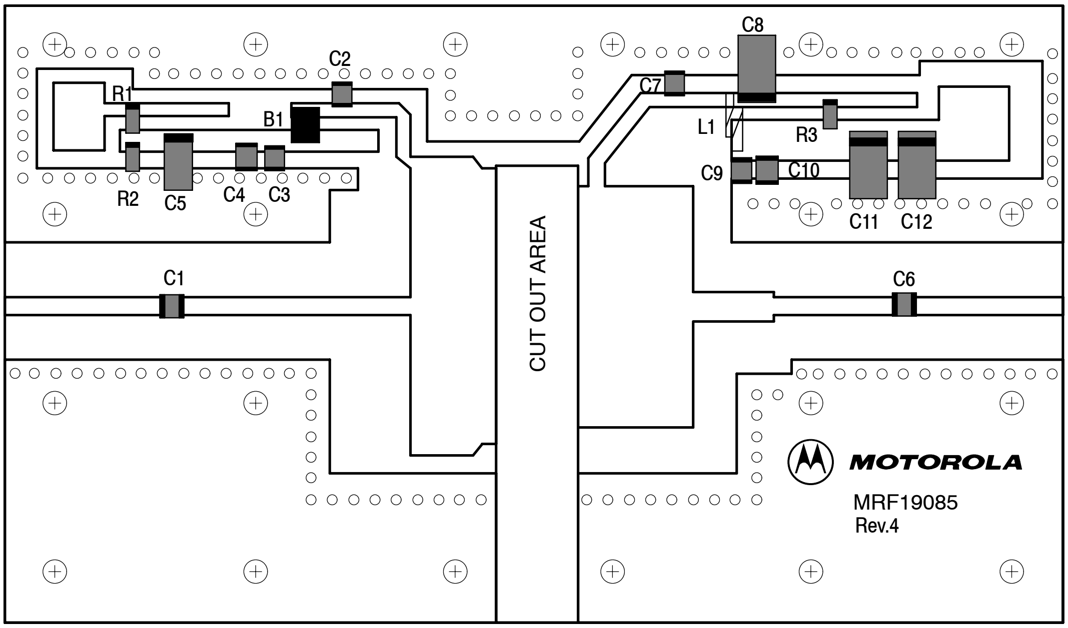


Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Component Layout**

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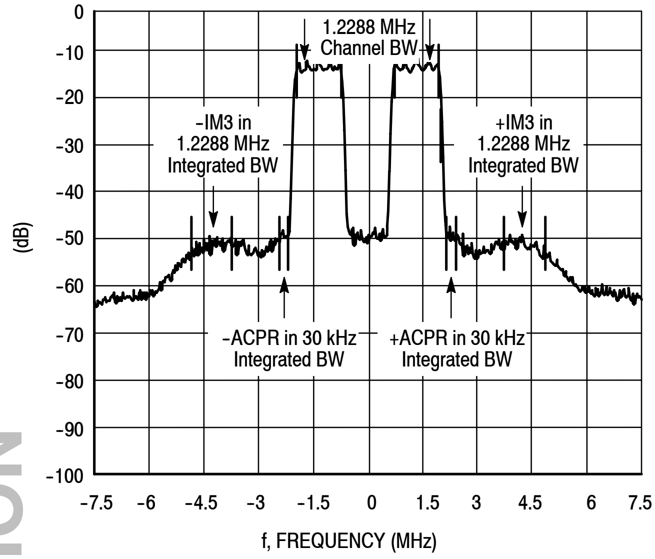


**Figure 3. 2-Carrier N-CDMA Spectrum**

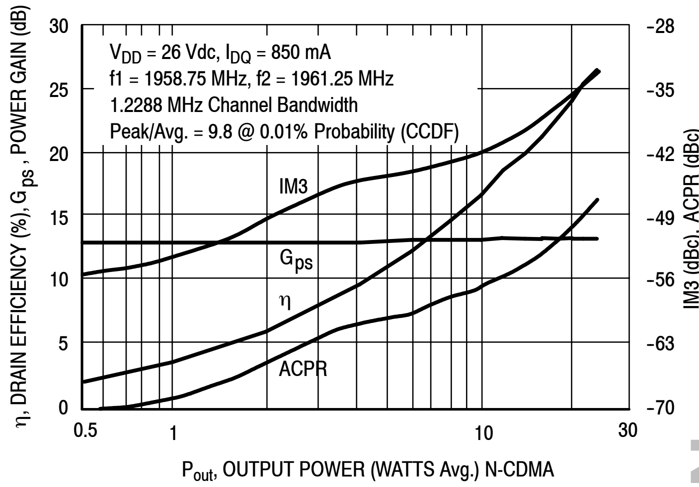


**Figure 4. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**

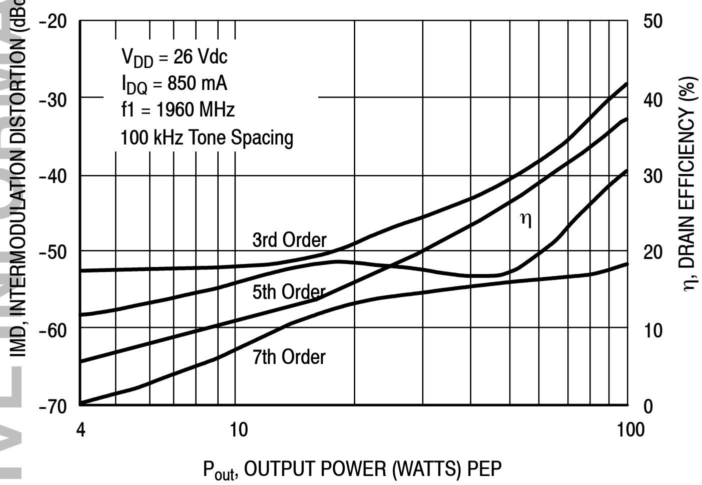


**Figure 5. Intermodulation Distortion Products versus Output Power**

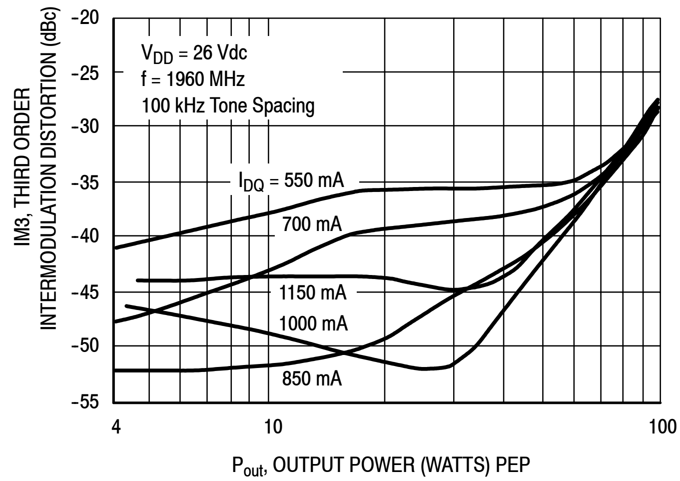


**Figure 6. Third Order Intermodulation Distortion versus Output Power and $I_{DQ}$**

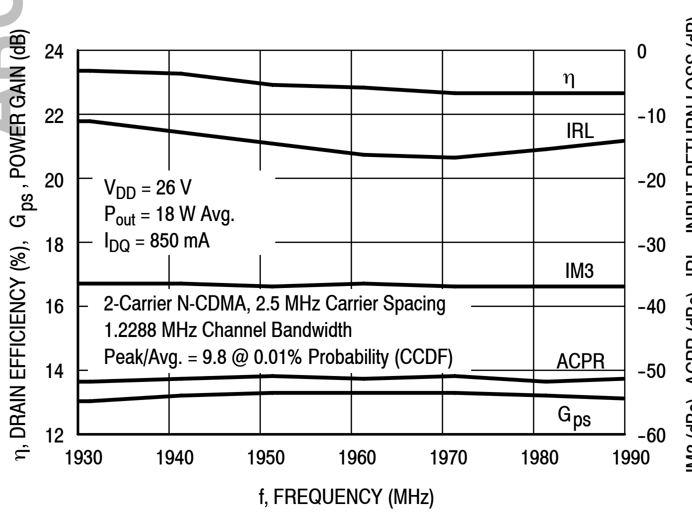


**Figure 7. 2-Carrier N-CDMA Broadband Performance**

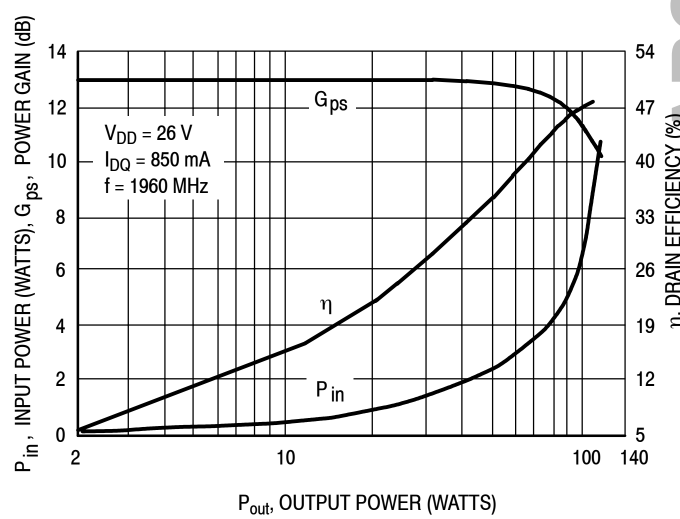


**Figure 8. CW Performance**

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## TYPICAL CHARACTERISTICS

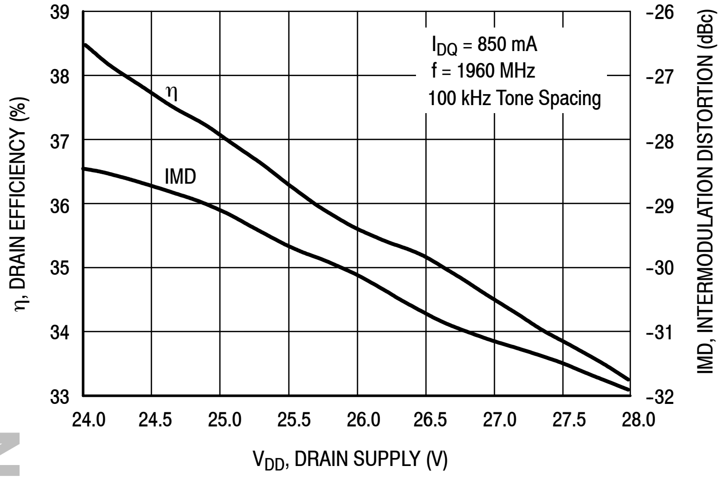


**Figure 9. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply**

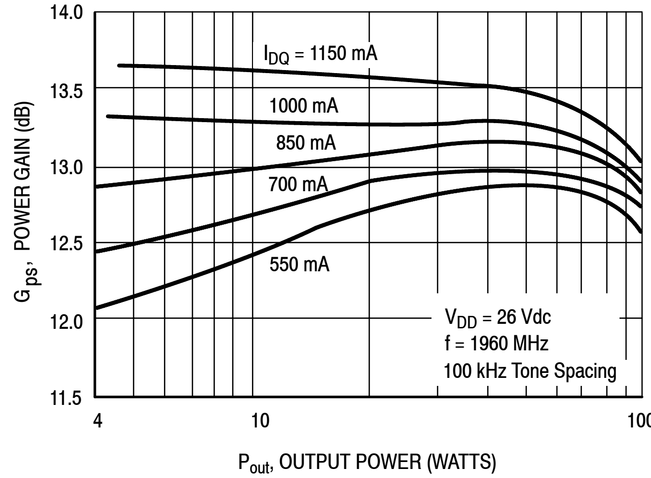


**Figure 10. Two-Tone Power Gain versus Output Power**

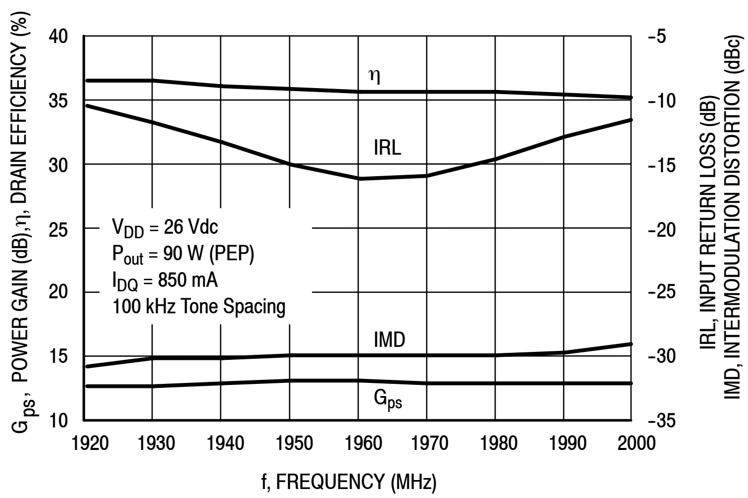


**Figure 11. Two-Tone Broadband Performance**

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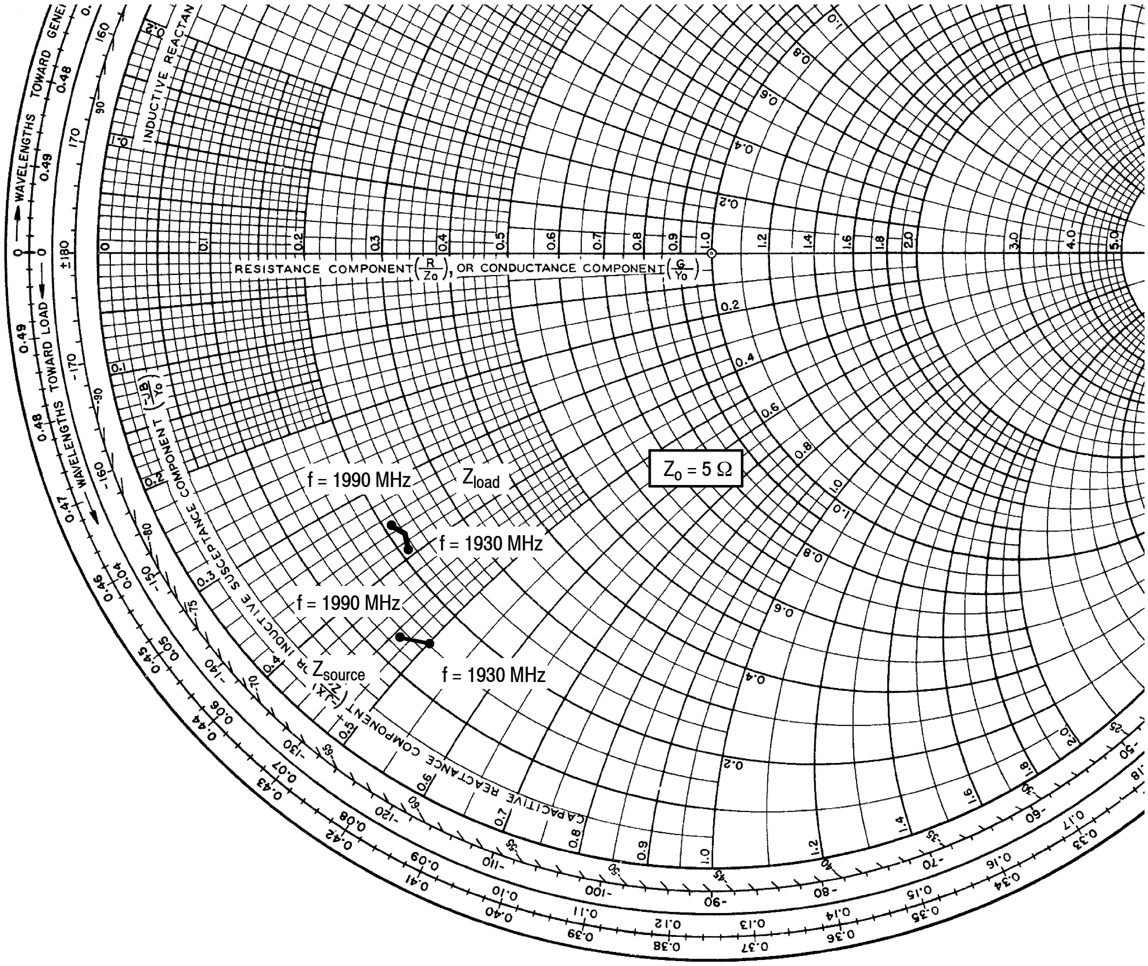


$V_{DD}$ = 26 V, $I_{DQ}$ = 850 mA, $P_{out}$ = 18 W Avg.

| f<br>MHz | $Z_{source}$<br>Ω | $Z_{load}$<br>Ω |
|---|---|---|
| 1930 | 0.75 - j2.50 | 1.05 - j1.95 |
| 1960 | 0.70 - j2.40 | 1.10 - j1.85 |
| 1990 | 0.65 - j2.35 | 1.05 - j1.75 |

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

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

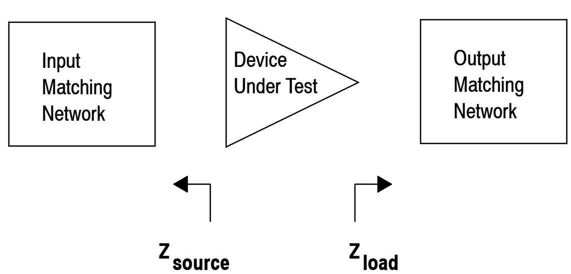


**Figure 12. Series Equivalent Source and Load Impedance**

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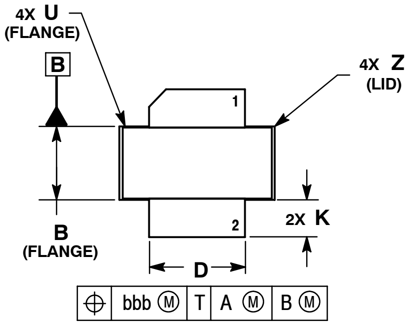
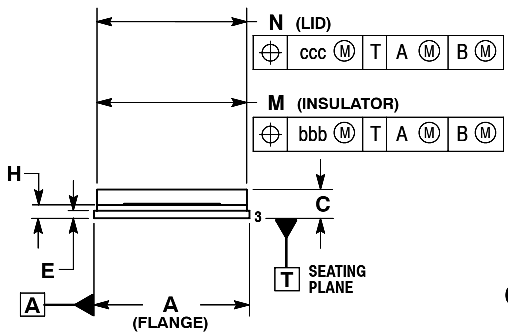
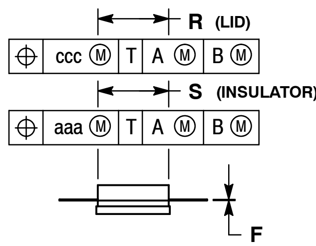
## PACKAGE DIMENSIONS




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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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
2. GATE
5. SOURCE

**CASE 465A-06**
**ISSUE H**
**NI-780S**
**MRF19085LSR3**

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## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

**Application Notes**

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

**Engineering Bulletins**

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date | Description |
|---|---|---|
| 9 | Oct. 2008 | • Data sheet revised to reflect part status change, p. 1, including use of applicable overlay.<br>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2<br>• Updated Part Numbers in Table 5, Component Designations and Values, to RoHS compliant part numbers, p. 4<br>• Added Product Documentation and Revision History, p. 10<br>• Data sheet split due to change in part life cycle (-1, -2 added to enable visibility on web). |
| | Dec. 2010 | • MRF19085-1 Rev. 9 (MRF19085LSR3) data sheet archived. Part no longer manufactured. See MRF19085-2 Rev. 10 for MRF19085LR3. |

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