

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

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.,  $f_1 = 1960$  MHz,  $f_2 = 1962.5$  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  $f_1 - 885$  KHz and  $f_2 + 885$  kHz. Distortion  
Products Measured over 1.2288 MHz Bandwidth at  $f_1 - 2.5$  MHz and  
 $f_2 + 2.5$  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.

**MRF19085LR3**  
**MRF19085LSR3**

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

**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF19085LR3**

**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF19085LSR3**

**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 @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 273<br>1.56  | W<br>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 <sup>(1)</sup> | Unit               |
|--------------------------------------|-----------------|----------------------|--------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.79                 | $^\circ\text{C/W}$ |

**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.

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

| Characteristic                                                                                                                                                                                                                                                                                                                              | Symbol        | Min | Typ   | Max   | Unit            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|-------|-------|-----------------|
| <b>Off Characteristics</b>                                                                                                                                                                                                                                                                                                                  |               |     |       |       |                 |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{Adc}$ )                                                                                                                                                                                                                                            | $V_{(BR)DSS}$ | 65  | —     | —     | Vdc             |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                                                                                                                                                                                                                                                   | $I_{DSS}$     | —   | —     | 10    | $\mu\text{Adc}$ |
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                                                                                                                                                                                                                                        | $I_{GSS}$     | —   | —     | 1     | $\mu\text{Adc}$ |
| <b>On Characteristics (DC)</b>                                                                                                                                                                                                                                                                                                              |               |     |       |       |                 |
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 200\text{ }\mu\text{Adc}$ )                                                                                                                                                                                                                                                   | $V_{GS(th)}$  | 2   | —     | 4     | Vdc             |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 850\text{ mAdc}$ )                                                                                                                                                                                                                                                            | $V_{GS(Q)}$   | 2.5 | 3.5   | 4.5   | Vdc             |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )                                                                                                                                                                                                                                                              | $V_{DS(on)}$  | —   | 0.18  | 0.210 | Vdc             |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )                                                                                                                                                                                                                                                             | $g_{fs}$      | —   | 6     | —     | S               |
| <b>Dynamic Characteristics</b>                                                                                                                                                                                                                                                                                                              |               |     |       |       |                 |
| Reverse Transfer Capacitance (1)<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )                                                                                                                                                                                                                                      | $C_{rss}$     | —   | 3.6   | —     | pF              |
| <b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system) 2-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carriers.<br>Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.                                                                                                                                                              |               |     |       |       |                 |
| Common-Source Amplifier Power Gain<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )                                                                                                  | $G_{ps}$      | 12  | 13    | —     | dB              |
| Drain Efficiency<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )                                                                                                                    | $\eta$        | 21  | 23    | —     | %               |
| 3rd Order Intermodulation Distortion<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ ); IM3 measured over 1.2288 MHz bandwidth @ $f_1 - 2.5\text{ MHz}$ and $f_2 = +2.5\text{ MHz}$ ) | IMD           | —   | -36.5 | -35   | dBc             |
| Adjacent Channel Power Ratio<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ ); ACPR measured over 30 kHz bandwidth @ $f_1 - 885\text{ MHz}$ and $f_2 = +885\text{ MHz}$ )            | ACPR          | —   | -51   | -48   | dBc             |
| Input Return Loss<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )                                                                                                                   | IRL           | —   | -12   | -9    | dB              |

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

(continued)

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

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

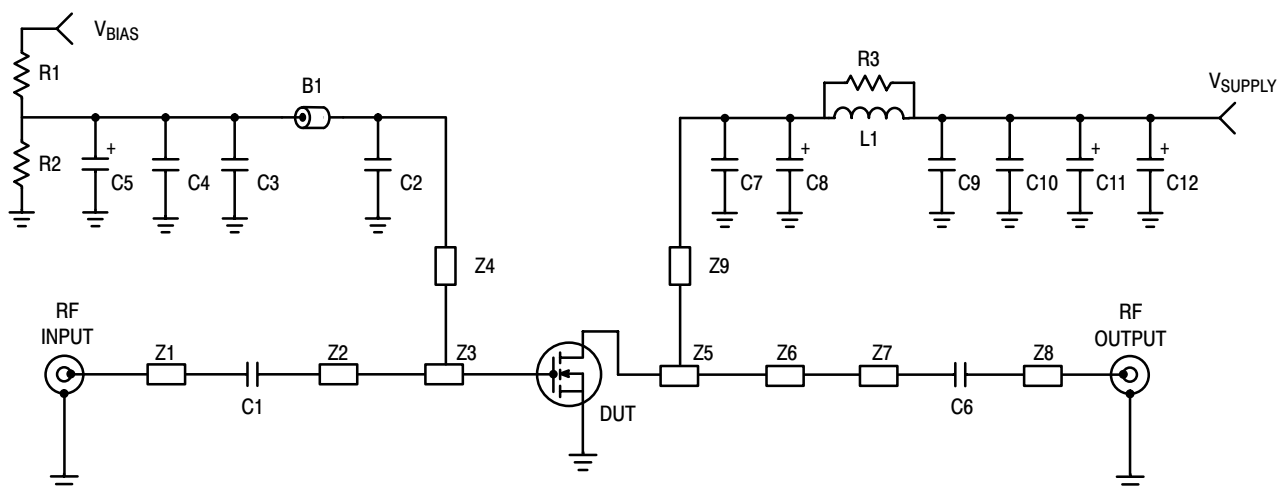
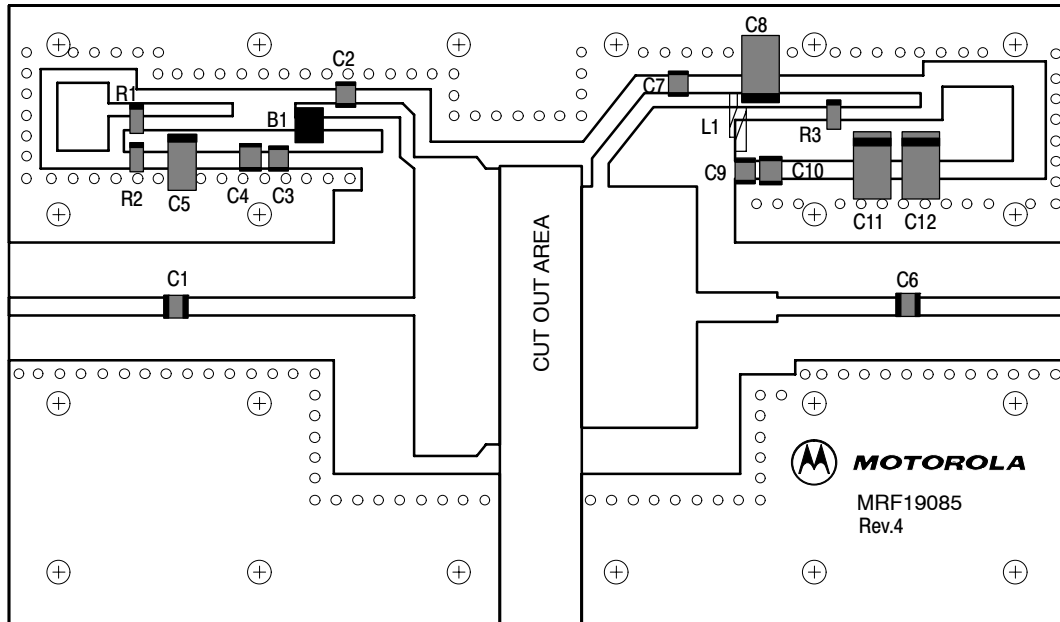


Figure 1. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Schematic

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

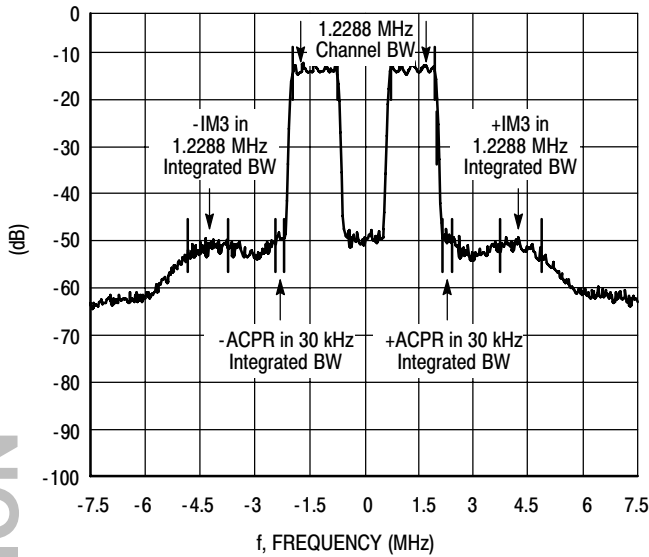
| Part     | Description                                  | Part Number                        | Manufacturer |
|----------|----------------------------------------------|------------------------------------|--------------|
| B1       | Short Ferrite Bead                           | 2743019447                         | Fair Rite    |
| C1       | 51 pF Chip Capacitor                         | 100B510JCA500X                     | ATC          |
| C2, C7   | 5.1 pF Chip Capacitors                       | 100B5R1JCA500X                     | ATC          |
| C3, C9   | 1000 pF Chip Capacitors                      | 100B102JCA500X                     | ATC          |
| C4, C10  | 0.1 $\mu$ F Chip Capacitors                  | CDR33BX104AKWS                     | Kemet        |
| C5       | 0.1 $\mu$ F Tantalum Surface Mount Capacitor | T491C105M050                       | Kemet        |
| C6       | 10 pF Chip Capacitor                         | 100B100JCA500X                     | ATC          |
| C8       | 10 $\mu$ F Tantalum Surface Mount Capacitor  | T495X106K035AS4394                 | Kemet        |
| C11, C12 | 22 $\mu$ F Tantalum Surface Mount Capacitors | T491X226K035AS4394                 | Kemet        |
| L1       | 1 Turn, 20 AWG, 0.100" ID                    |                                    |              |
| N1, N2   | Type N Flange Mounts                         | 3052-1648-10                       | Omni Spectra |
| R1       | 1.0 k $\Omega$ , 1/8 W Chip Resistor         |                                    |              |
| R2       | 220 k $\Omega$ , 1/8 W Chip Resistor         |                                    |              |
| R3       | 10 $\Omega$ , 1/8 W Chip Resistor            |                                    |              |
| 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, $\epsilon_r = 2.55$ | Keene        |
| PCB      | Etched Circuit Boards                        | MRF19085 Rev. 4                    | CMR          |



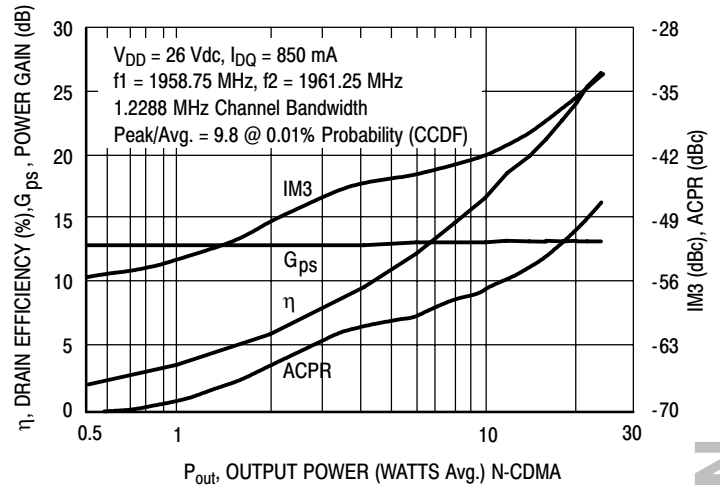
Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

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

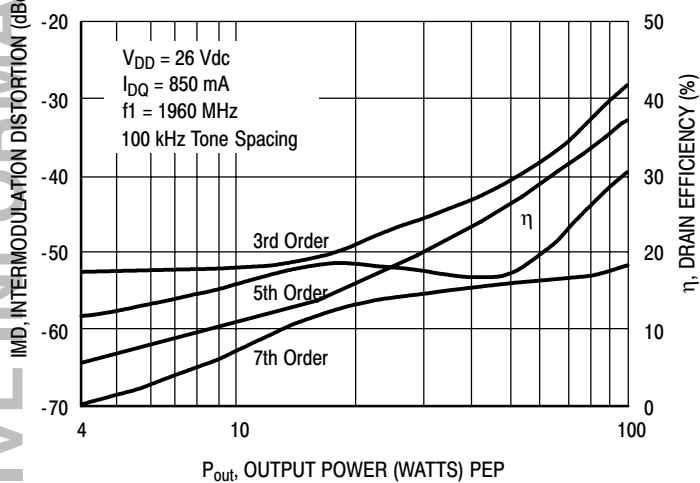
## TYPICAL CHARACTERISTICS



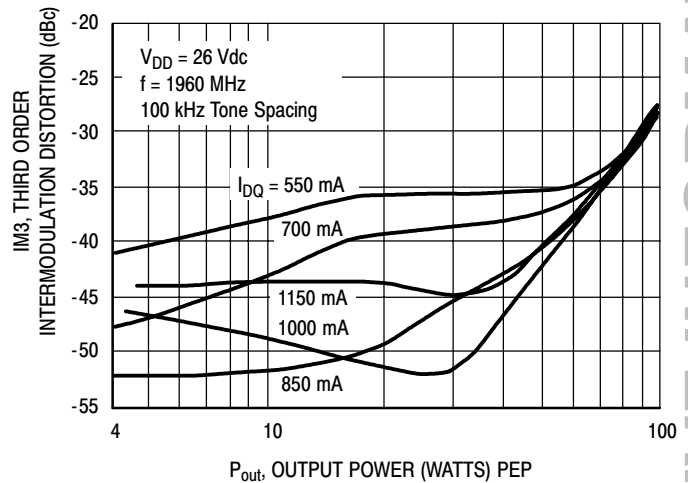
**Figure 3. 2-Carrier N-CDMA Spectrum**



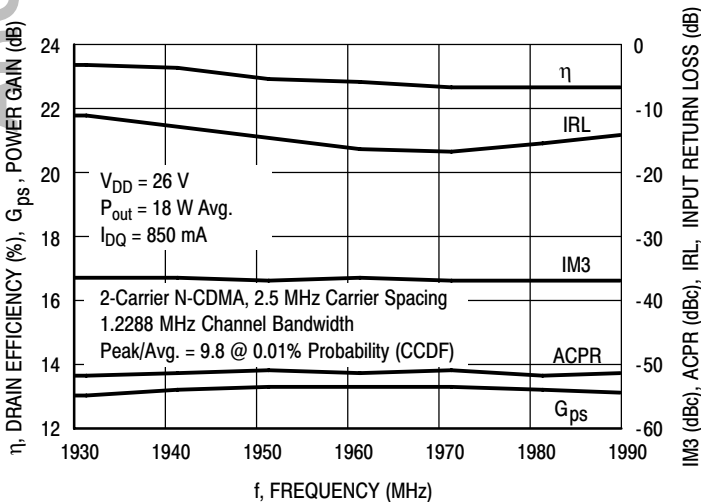
**Figure 4. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



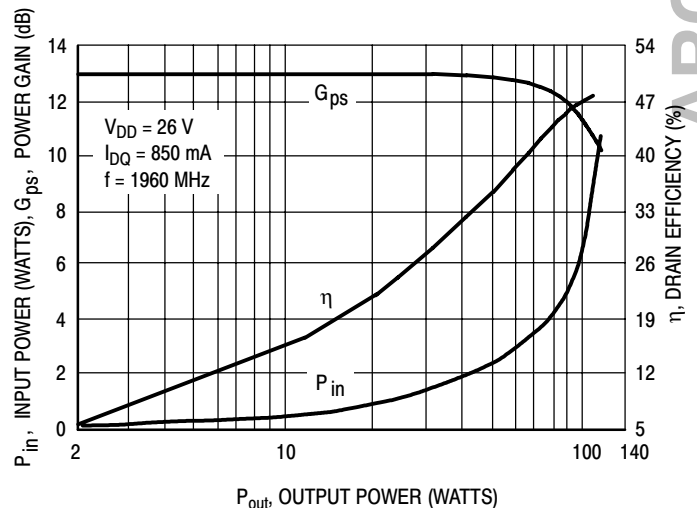
**Figure 5. Intermodulation Distortion Products versus Output Power**



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



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



**Figure 8. CW Performance**

## TYPICAL CHARACTERISTICS

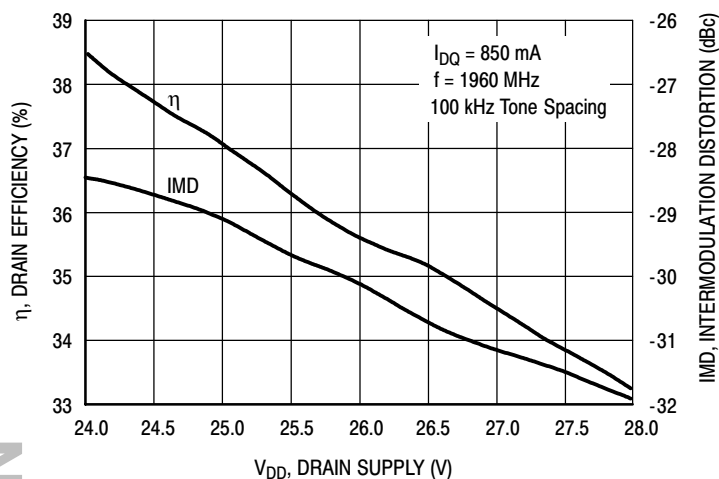


Figure 9. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply

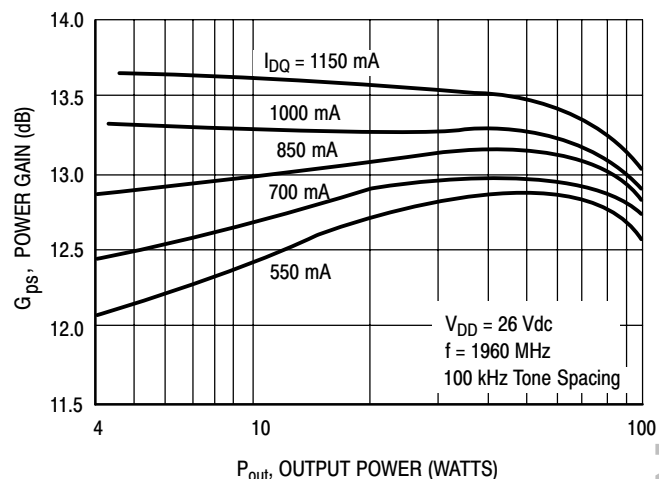


Figure 10. Two-Tone Power Gain versus Output Power

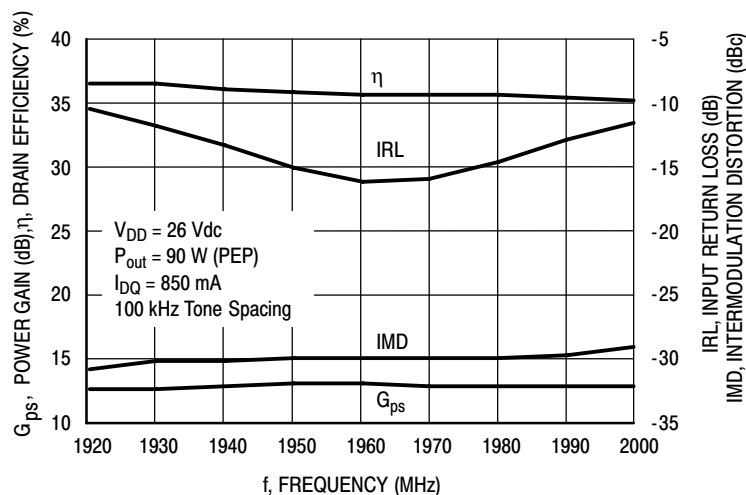
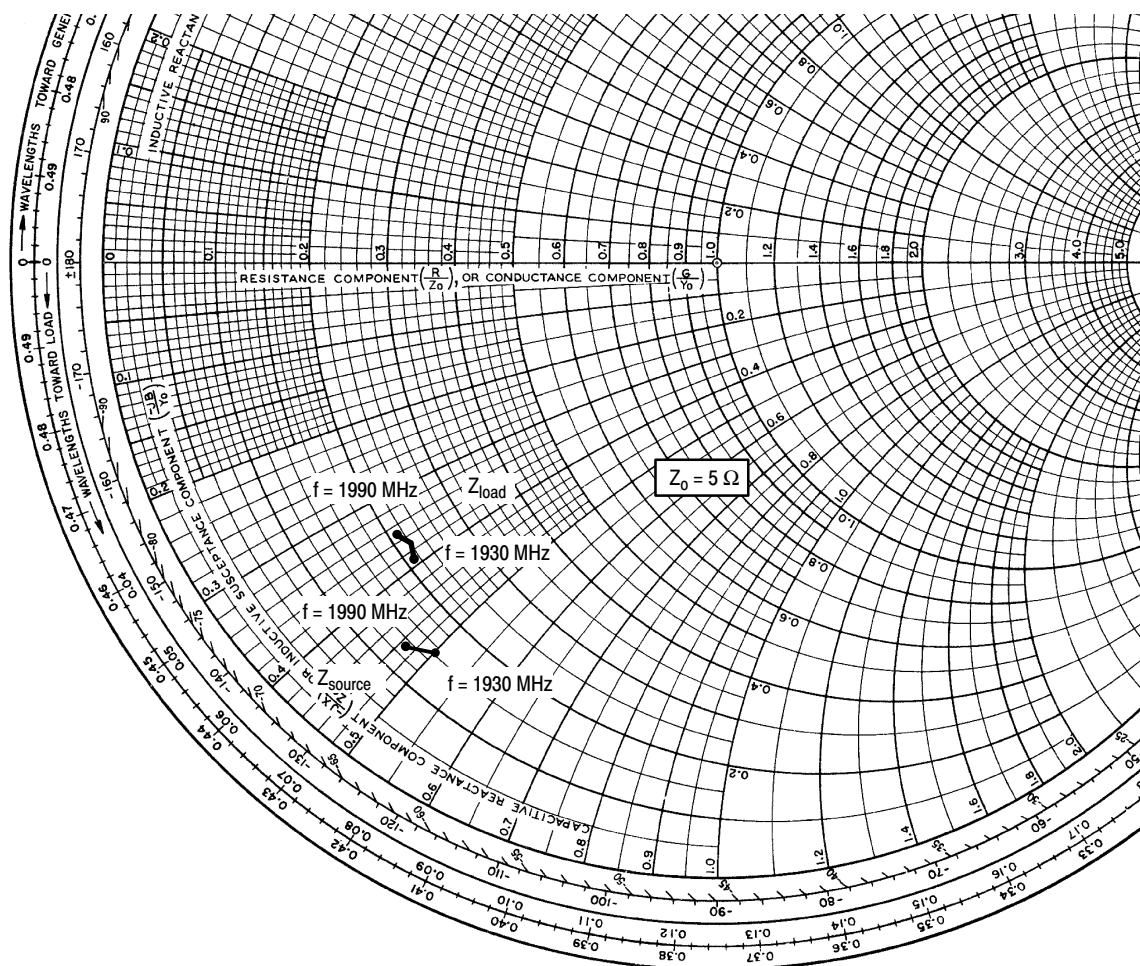


Figure 11. Two-Tone Broadband Performance



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

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

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

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

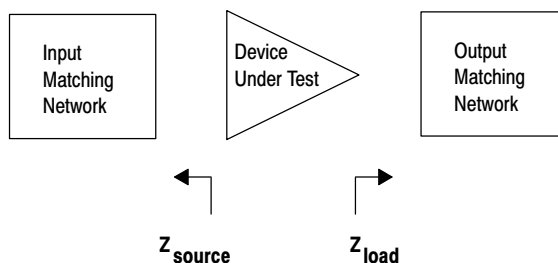


Figure 12. Series Equivalent Source and Load Impedance



## NOTES

ARCHIVE INFORMATION

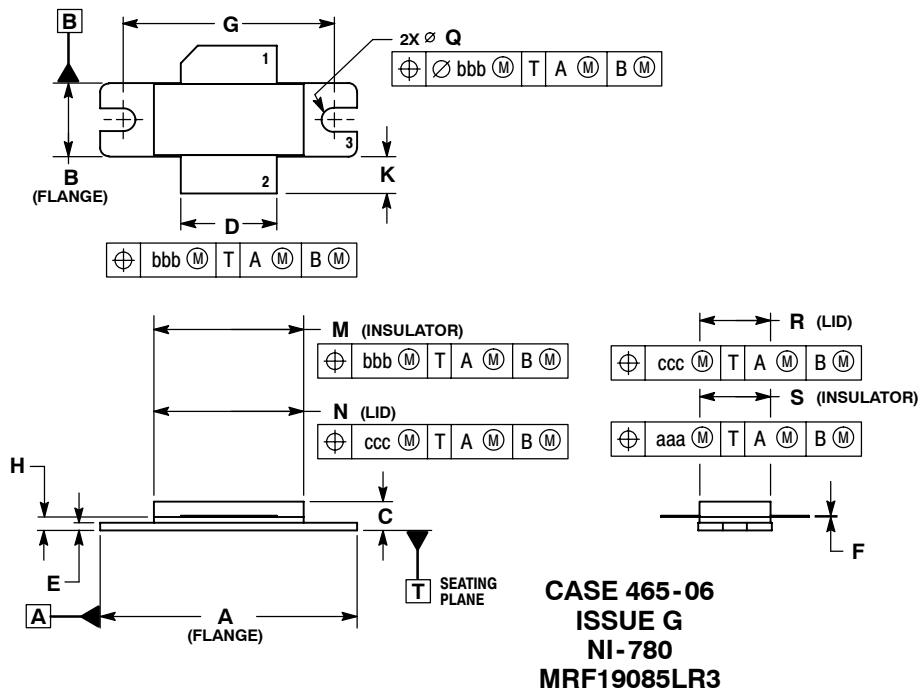
ARCHIVE INFORMATION

## NOTES

ARCHIVE INFORMATION

ARCHIVE INFORMATION

## PACKAGE DIMENSIONS



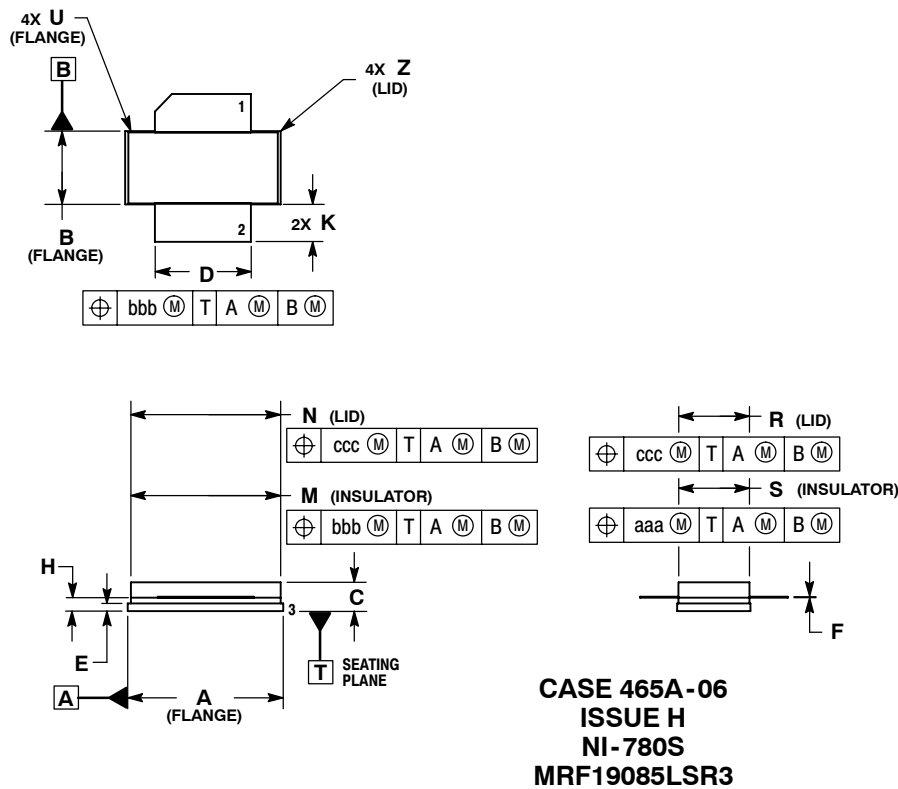
### NOTES:

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.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.335     | 1.345 | 33.91       | 34.16 |
| 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  |
| G   | 1.100 BSC |       | 27.94 BSC   |       |
| H   | 0.057     | 0.067 | 1.45        | 1.70  |
| K   | 0.170     | 0.210 | 4.32        | 5.33  |
| M   | 0.774     | 0.786 | 19.66       | 19.96 |
| N   | 0.772     | 0.788 | 19.60       | 20.00 |
| Q   | Ø.118     | Ø.138 | Ø.300       | Ø.351 |
| R   | 0.365     | 0.375 | 9.27        | 9.53  |
| S   | 0.365     | 0.375 | 9.27        | 9.52  |
| aaa | 0.005 REF |       | 0.127 REF   |       |
| bbb | 0.010 REF |       | 0.254 REF   |       |
| ccc | 0.015 REF |       | 0.381 REF   |       |

### STYLE 1:

1. DRAIN
2. GATE
3. SOURCE



### 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.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | 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:

1. DRAIN
2. GATE
5. SOURCE

MRF19085LR3 MRF19085LSR3

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