



# RF Power Field Effect Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

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

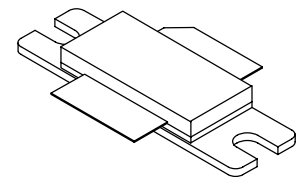
- Typical 2-Carrier N-CDMA Performance for  $V_{DD} = 26$  Volts,  $I_{DQ} = 850$  mA,  $P_{out} = 18$  Watts Avg.,  $f_1 = 1930$  MHz,  $f_2 = 1932.5$  MHz IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) 1.2288 MHz Channel Bandwidth Carrier. Adjacent Channels Measured over a 30 kHz Bandwidth at  $f_1 - 885$  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 40 $\mu$ " Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 Inch Reel.

**MRF19085LR3**

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



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

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

**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 ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\ \mu\text{Adc}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>On Characteristics (DC)</b>					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 200\ \mu\text{Adc}$ )	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 850\text{ mAdc}$ )	$V_{GS(Q)}$	2.5	3.5	4.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$V_{DS(on)}$	—	0.18	0.210	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$g_{fs}$	—	6	—	S
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance (1) ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$	—	3.6	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system) 2-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carriers. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.					
Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	$G_{ps}$	12	13	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	$\eta$	21	23	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ ; 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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ ; ACPR measured over 30 kHz bandwidth @ $f_1 =$ $-885\text{ MHz}$ and $f_2 = +885\text{ MHz}$ )	ACPR	—	-51	-48	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$G_{ps}$	—	13	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	$\eta$	—	36	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IMD	—	-31	—	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1930\text{ MHz}$ and $1990\text{ MHz}$ , Tone Spacing = $100\text{ kHz}$ )	IRL	—	-12	—	dB
$P_{out}$ , 1 dB Compression Point ( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1990\text{ MHz}$ )	P1dB	—	90	—	W

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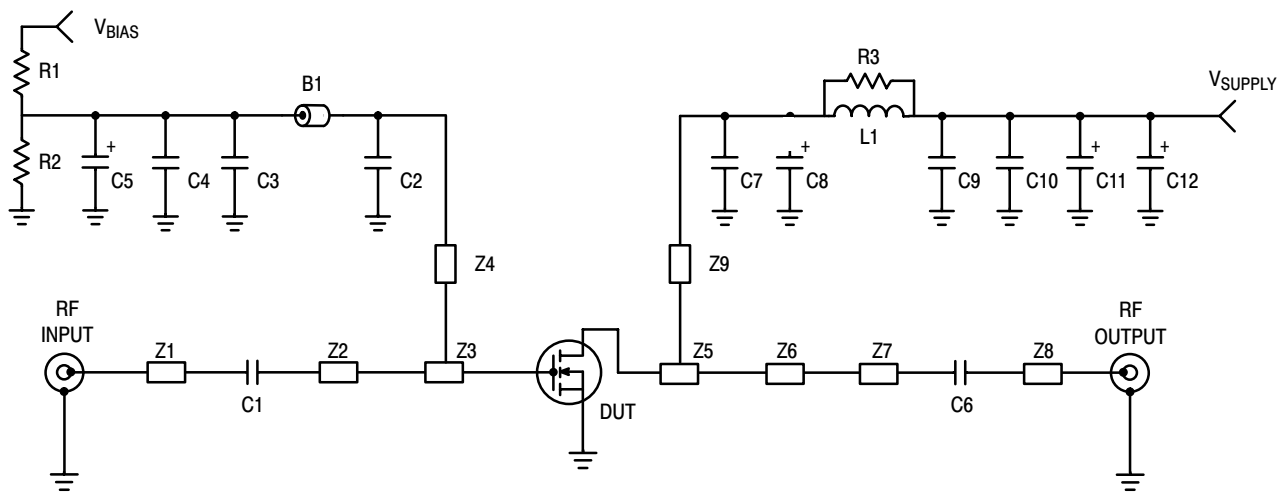
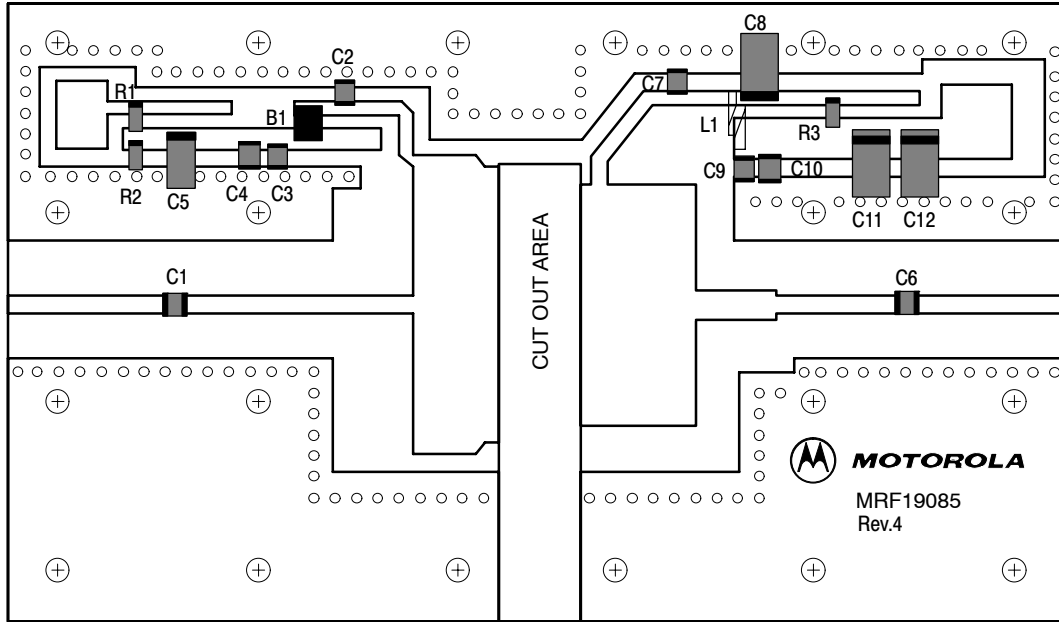


Figure 1. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Schematic

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

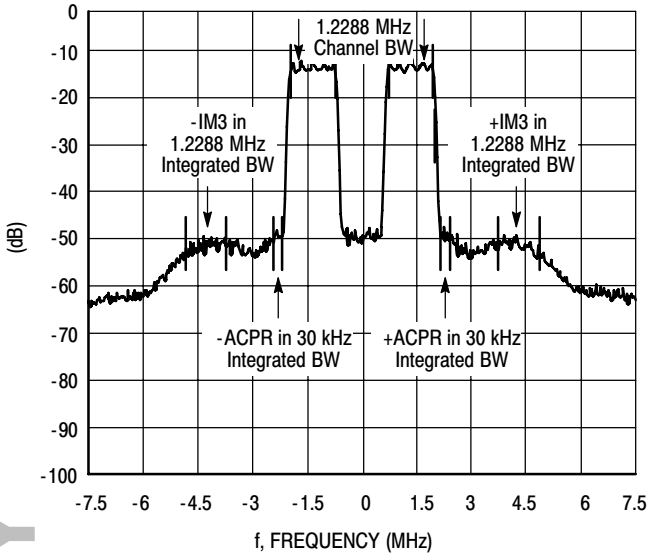
Part	Description	Part Number	Manufacturer
B1	Short Ferrite Bead	2743019447	Fair Rite
C1	51 pF Chip Capacitor	ATC100B510JT500XT	ATC
C2, C7	5.1 pF Chip Capacitors	ATC100B5R1JT500XT	ATC
C3, C9	1000 pF Chip Capacitors	ATC100B102JT500XT	ATC
C4, C10	0.1 μF Chip Capacitors	CDR33BX104AKYS	Kemet
C5	0.1 μF Tantalum 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, ε <sub>r</sub> = 2.55	Arlon
PCB	Etched Circuit Boards	MRF19085 Rev. 4	CMR



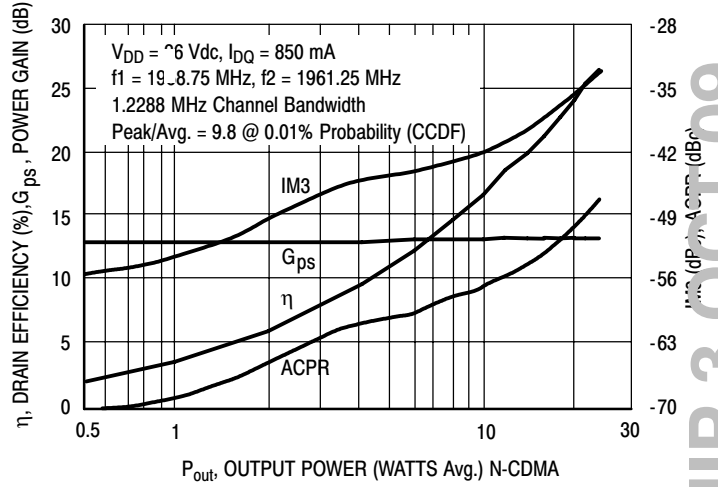
Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

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

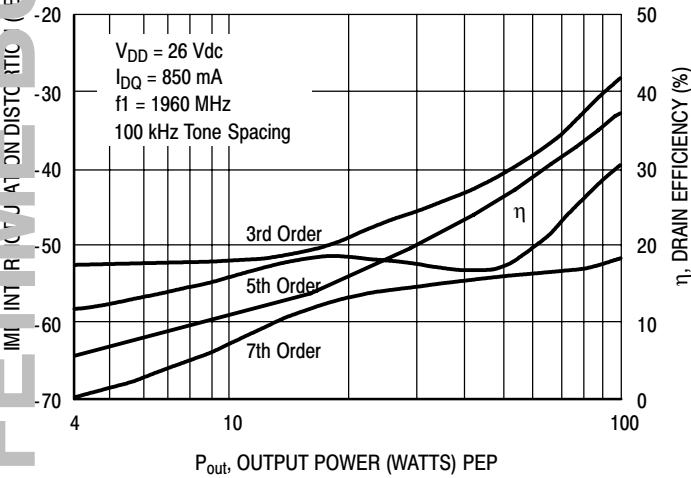
## TYPICAL CHARACTERISTICS



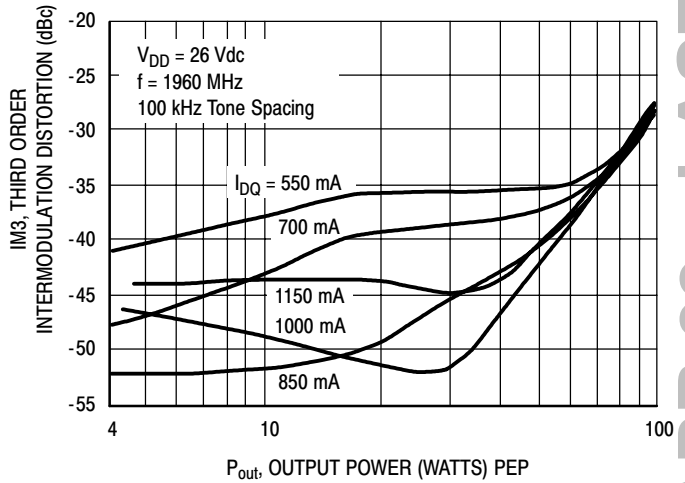
**Figure 3. 2-Carrier N-CDMA Spectrum**



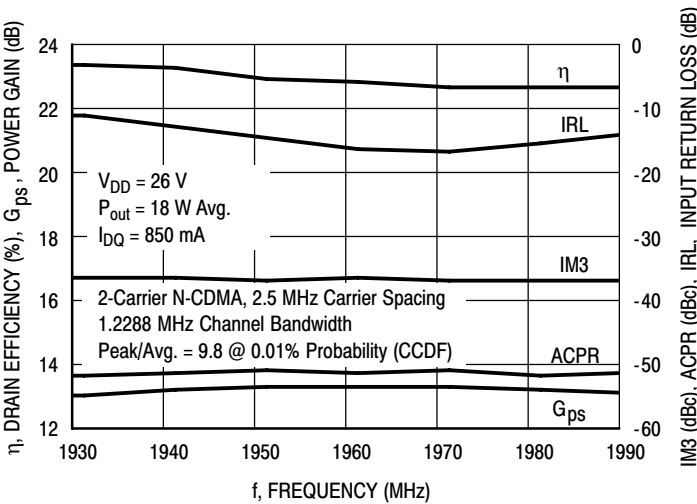
**Figure 4. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



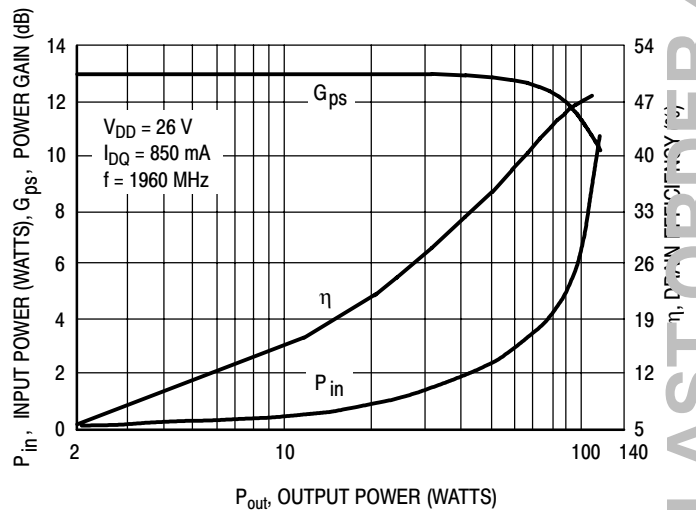
**Figure 5. Intermodulation Distortion Products versus Output Power**



**Figure 6. Third Order Intermodulation Distortion versus Output Power and IDQ**



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



**Figure 8. CW Performance**

## TYPICAL CHARACTERISTICS

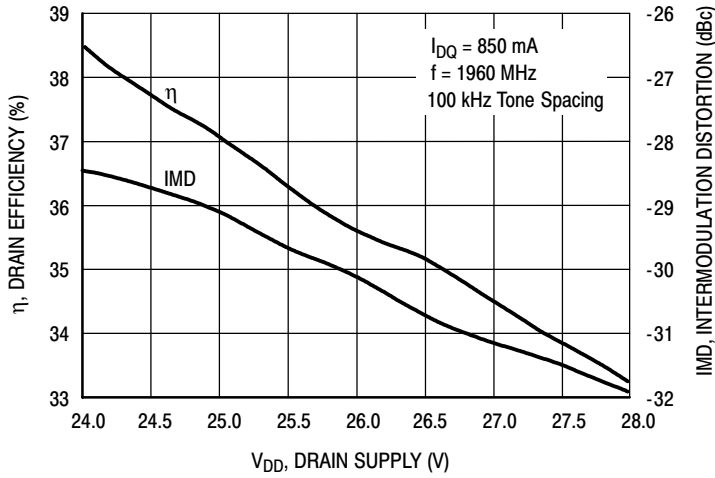


Figure 9. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply

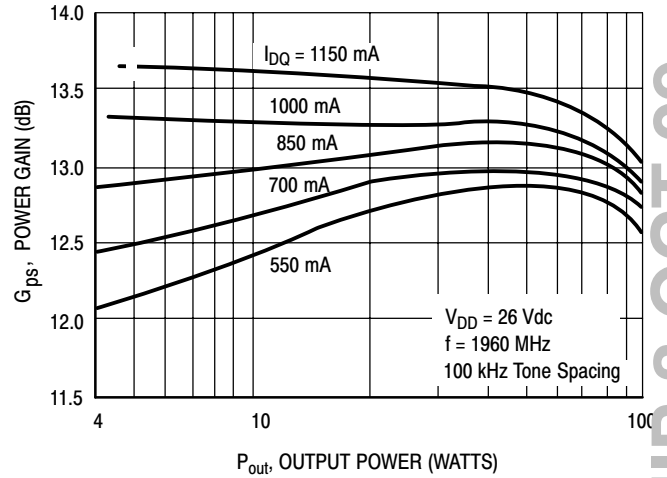


Figure 10. Two-Tone Power Gain versus Output Power

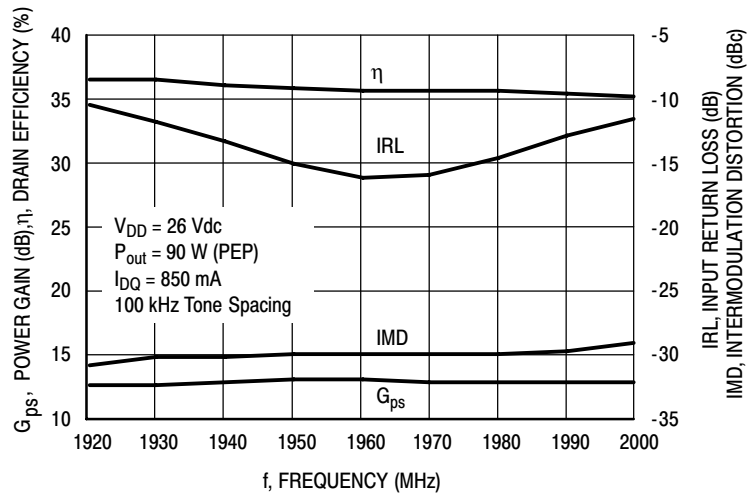
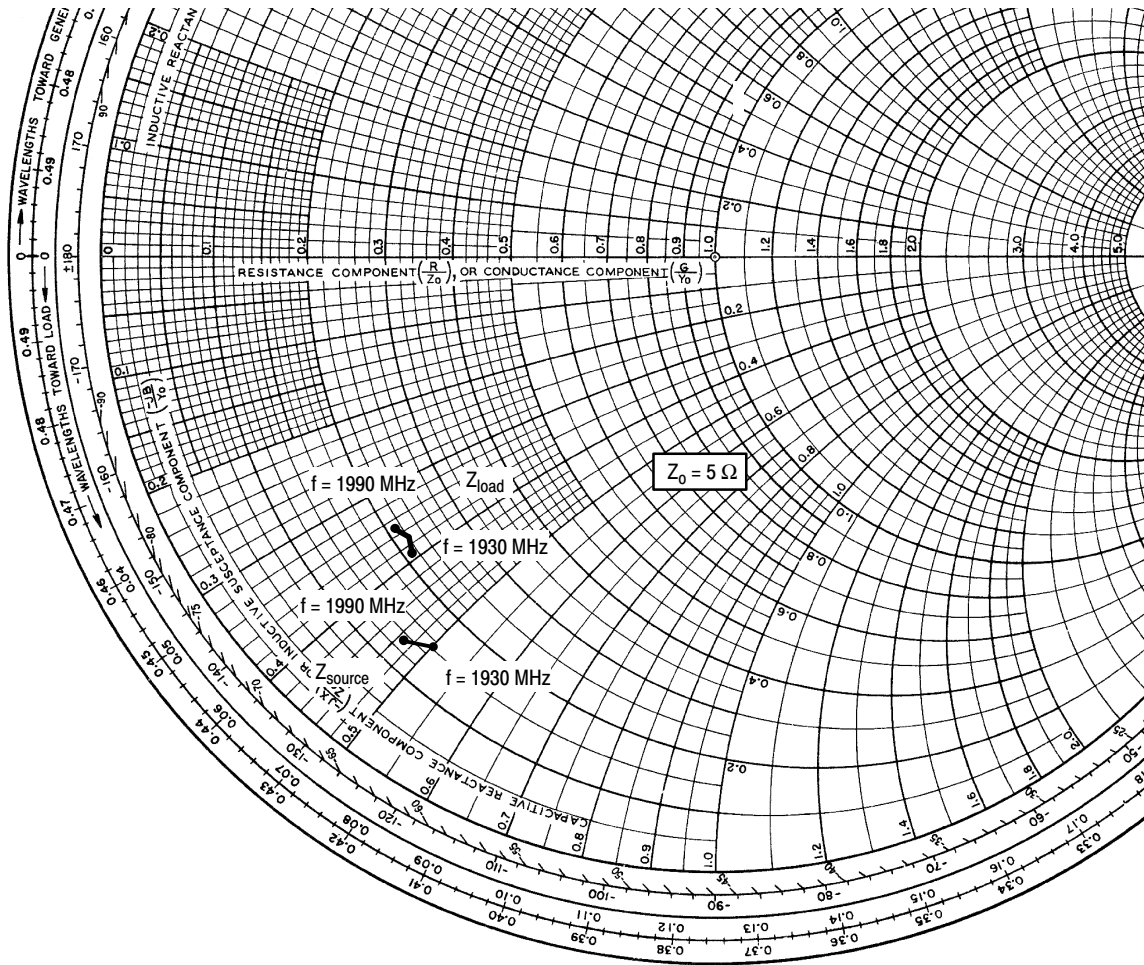


Figure 11. Two-Tone Broadband Performance

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

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

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

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

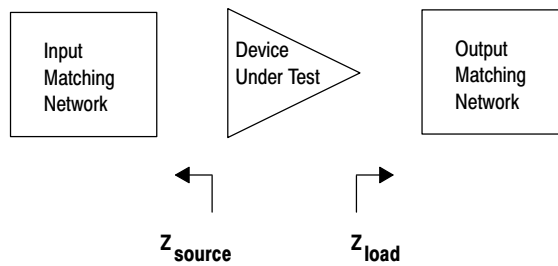
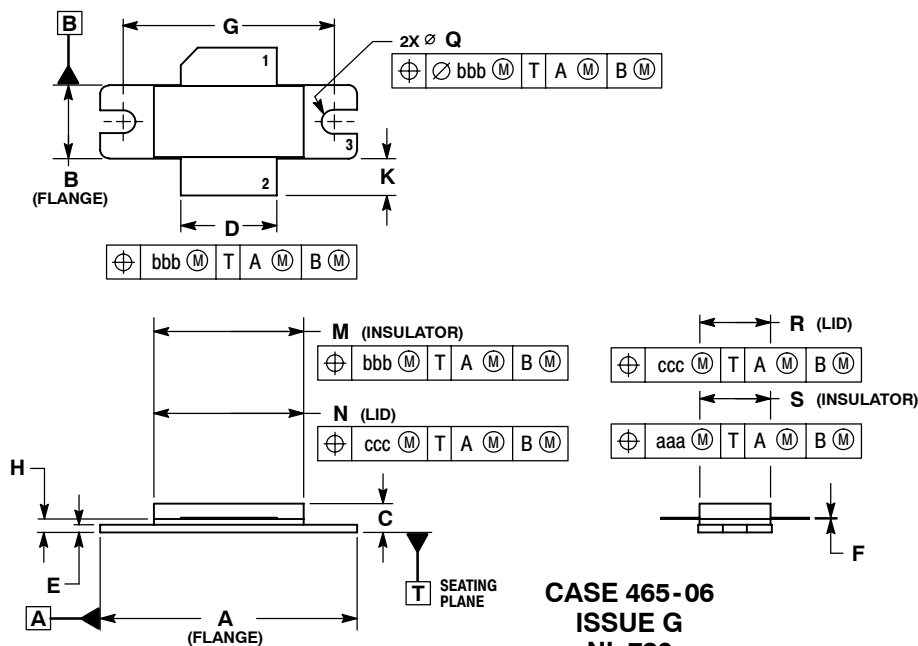


Figure 12. Series Equivalent Source and Load Impedance



# 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	Ø3.00	Ø3.51
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:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE

**CASE 465-06  
 ISSUE G  
 NI-780  
 MRF19085LR3**

## 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
10	Oct. 2008	<ul style="list-style-type: none"><li>• Data sheet revised to reflect part status change, p. 1, including use of applicable overlay.</li><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2</li><li>• Updated Part Numbers in Table 5, Component Designations and Values, to RoHS compliant part numbers, p. 4</li><li>• Added Product Documentation and Revision History, p. 10</li></ul>

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