



# 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.

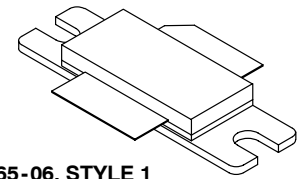
- Typical 2-Carrier N-CDMA Performance for  $V_{DD} = 26$  Volts,  
 $I_{DQ} = 850$  mA,  $P_{out} = 18$  Watts Avg.,  $f_1 = 1960$  MHz,  $f_2 = 1962.5$  MHz  
IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13)  
1.2288 MHz Channel Bandwidth Carrier. Adjacent Channels Measured  
over a 30 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

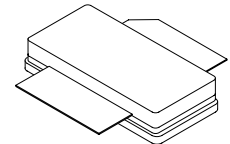
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40 $\mu$ " 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 @ $T_C = 25^\circ\text{C}$ 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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )	$G_{ps}$	12	13	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )	$\eta$	21	23	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ 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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ 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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 18\text{ W Avg.}$ , $I_{DQ} = 850\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ 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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 90\text{ W PEP}$ , $I_{DQ} = 850\text{ mA}$ , $f = 1930\text{ MHz}$ 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

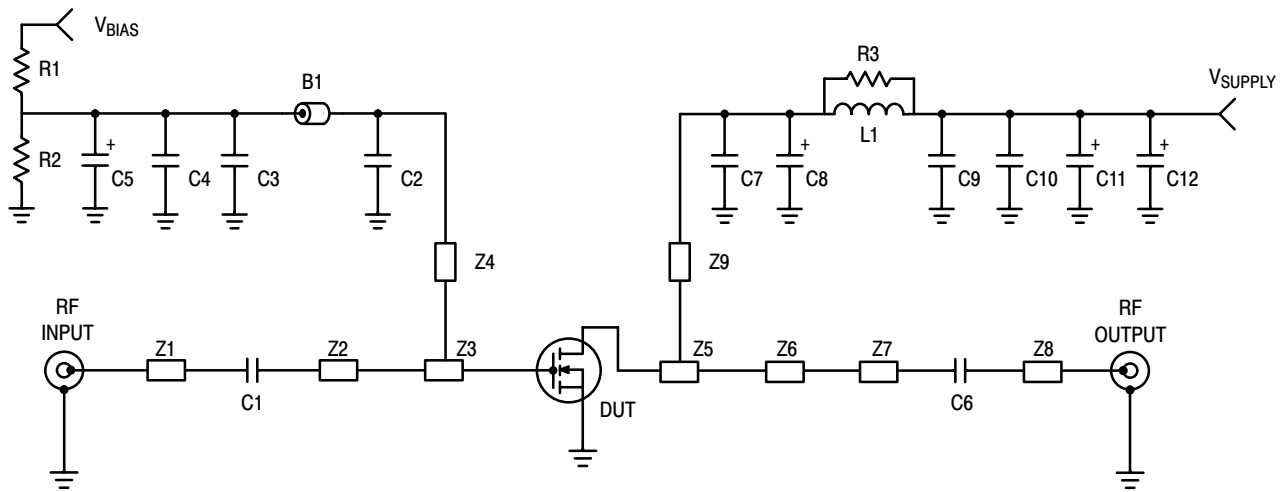
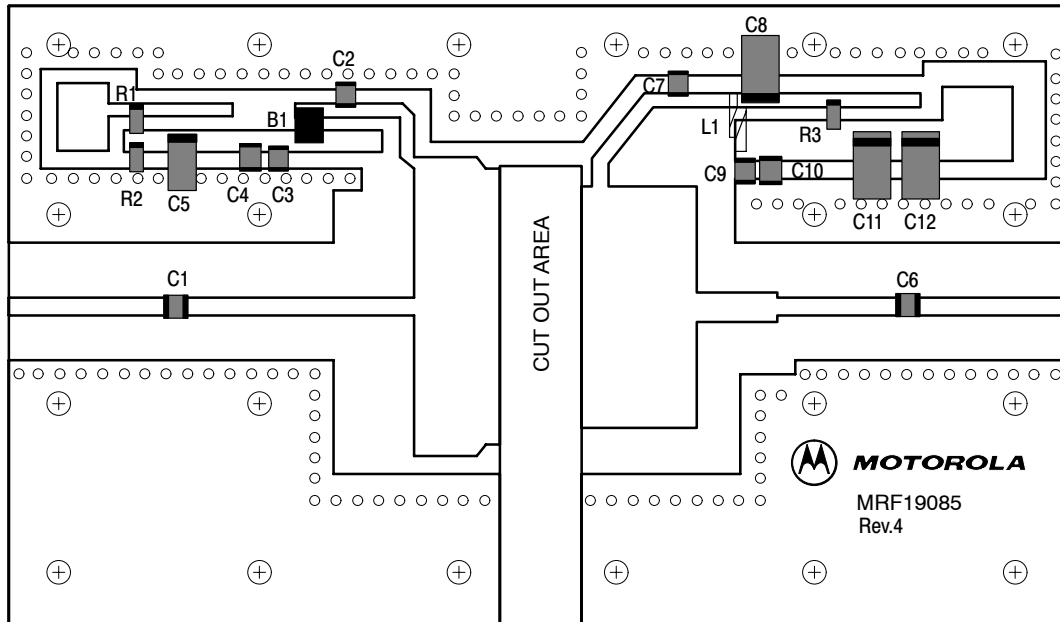


Figure 1. 1930 - 1990 MHz 2-Carrier N-CDMA Test Circuit Schematic

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

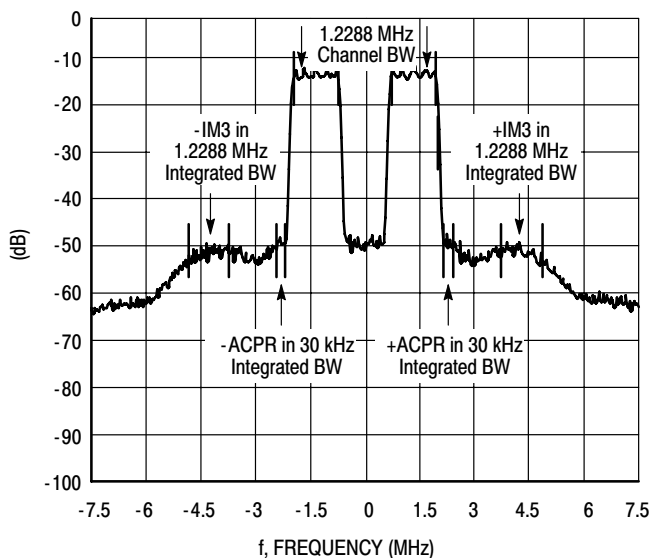
Part	Description	Part Number	Manufacturer
B1	Short Ferrite Bead	2743019447	Fair Rite
C1	51 pF Chip Capacitor	100B510JCA500X	ATC
C2, C7	5.1 pF Chip Capacitors	100B5R1JCA500X	ATC
C3, C9	1000 pF Chip Capacitors	100B102JCA500X	ATC
C4, C10	0.1 $\mu$ F Chip Capacitors	CDR33BX104AKWS	Kemet
C5	0.1 $\mu$ F Tantalum 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 <sup>®</sup>	GX-0300-55-22, $\epsilon_r = 2.55$	Keene
PCB	Etched Circuit Boards	MRF19085 Rev. 4	CMR



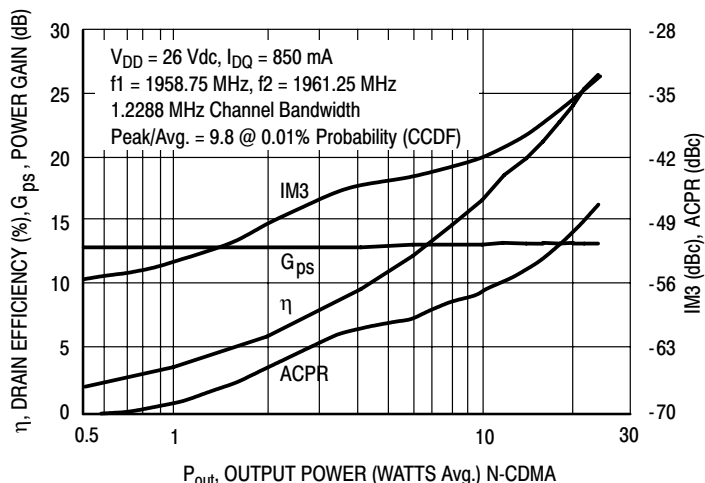
Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

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

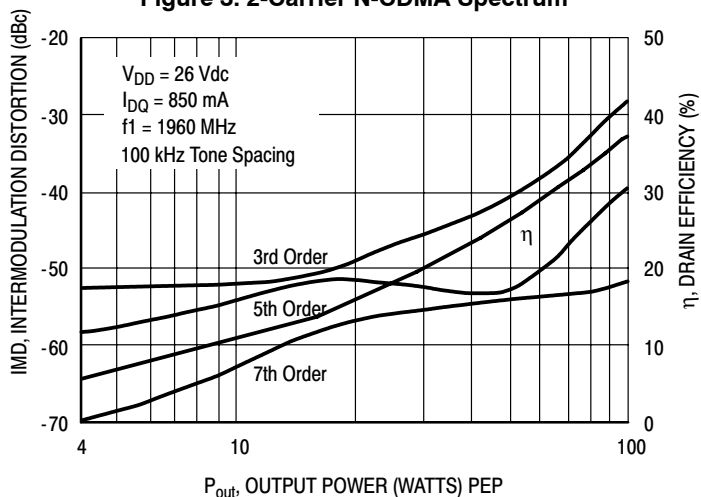
## TYPICAL CHARACTERISTICS



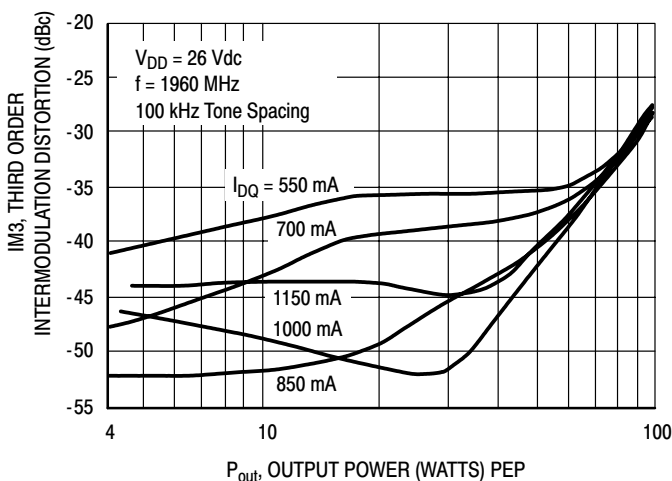
**Figure 3. 2-Carrier N-CDMA Spectrum**



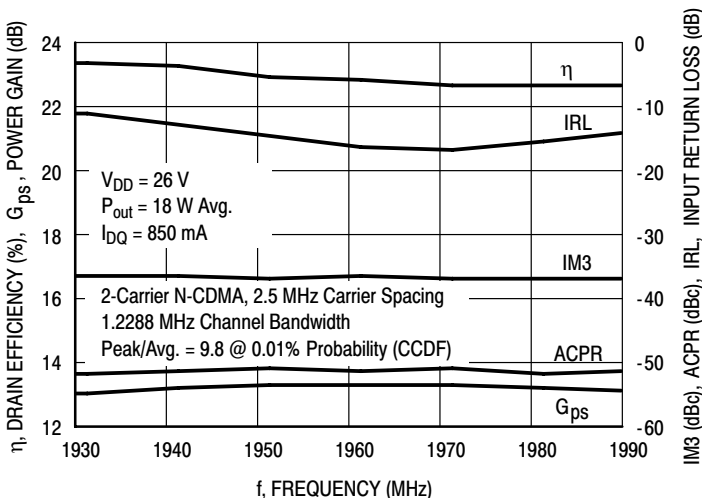
**Figure 4. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



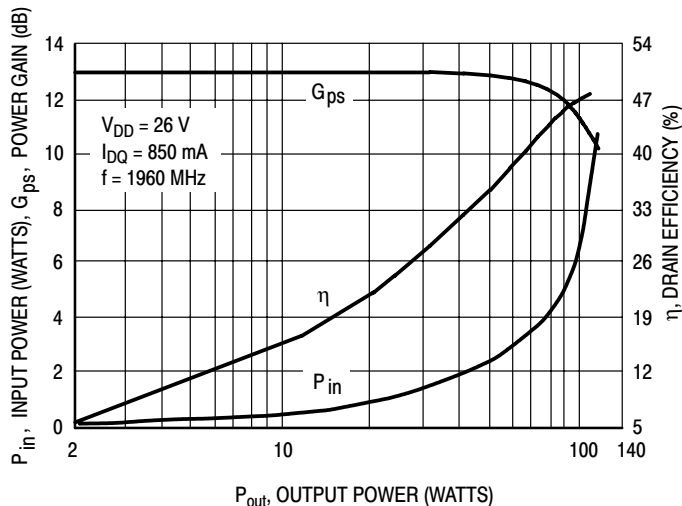
**Figure 5. Intermodulation Distortion Products versus Output Power**



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



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



**Figure 8. CW Performance**

## TYPICAL CHARACTERISTICS

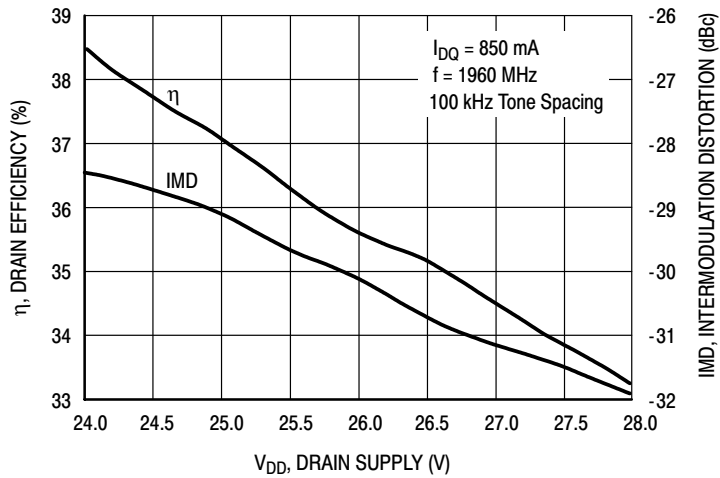


Figure 9. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply

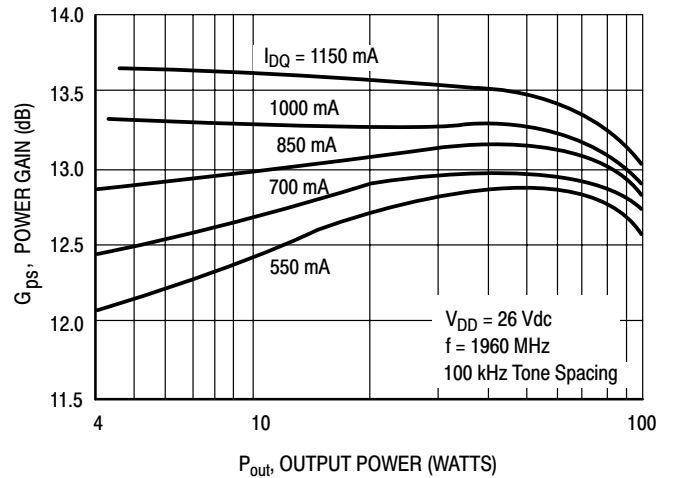


Figure 10. Two-Tone Power Gain versus Output Power

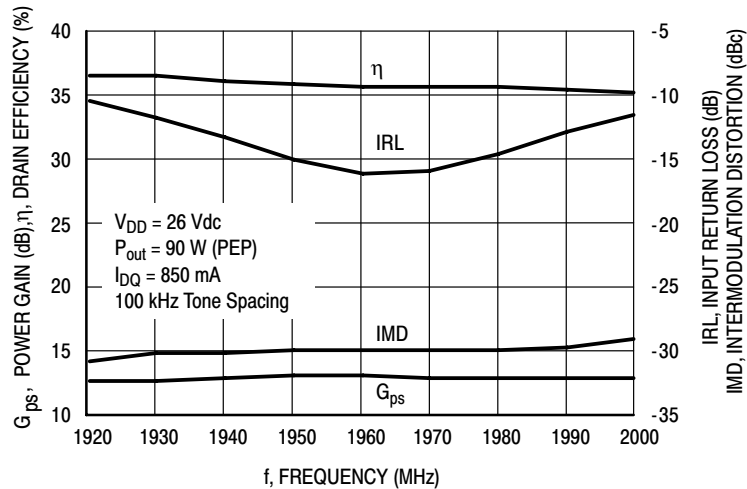
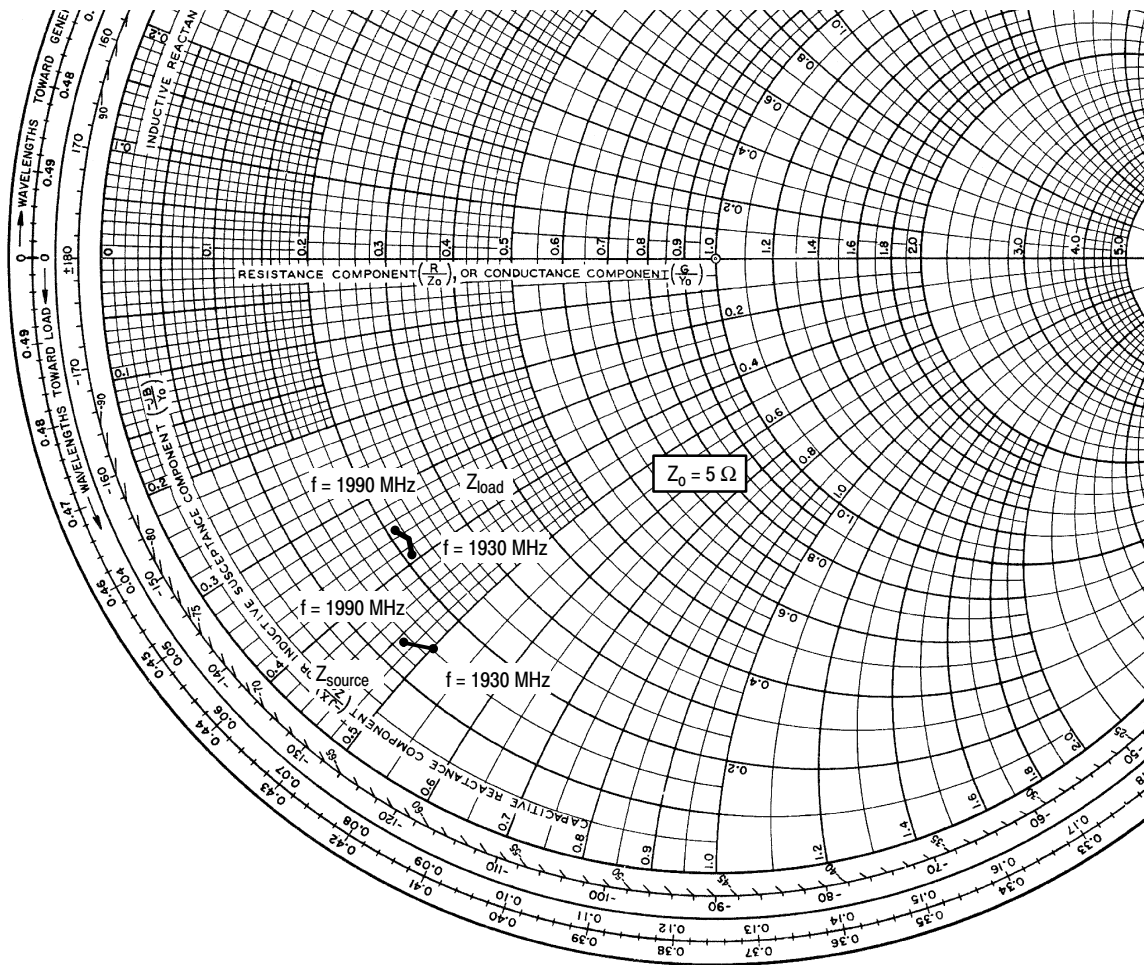


Figure 11. Two-Tone Broadband Performance



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

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.

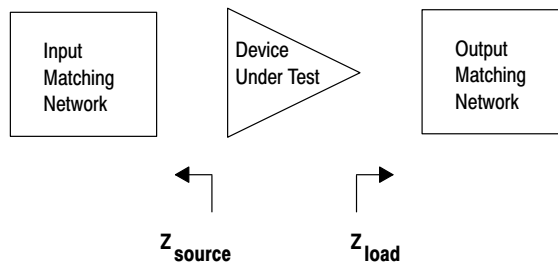


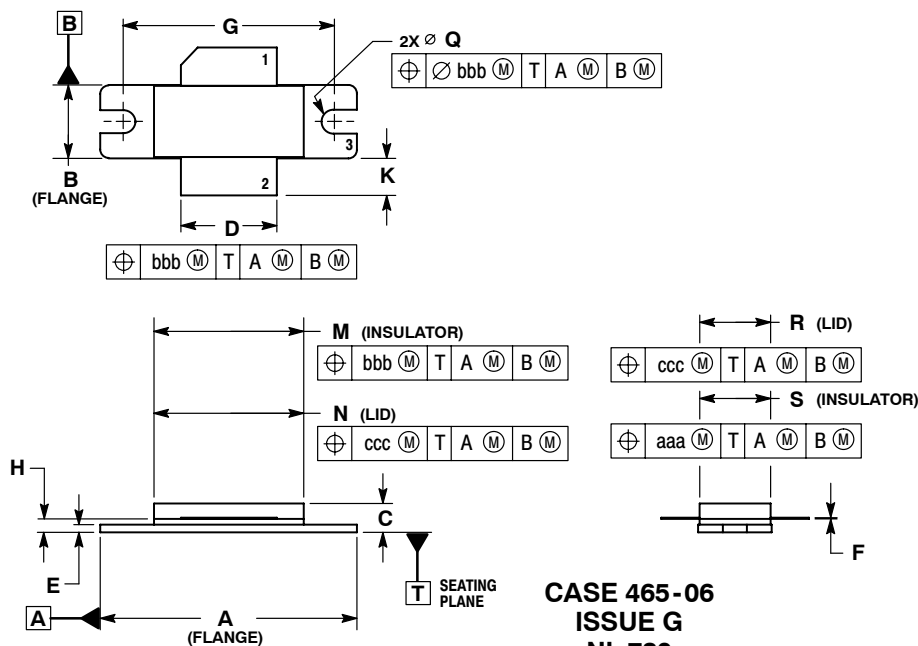
Figure 12. Series Equivalent Source and Load Impedance



# NOTES

# NOTES

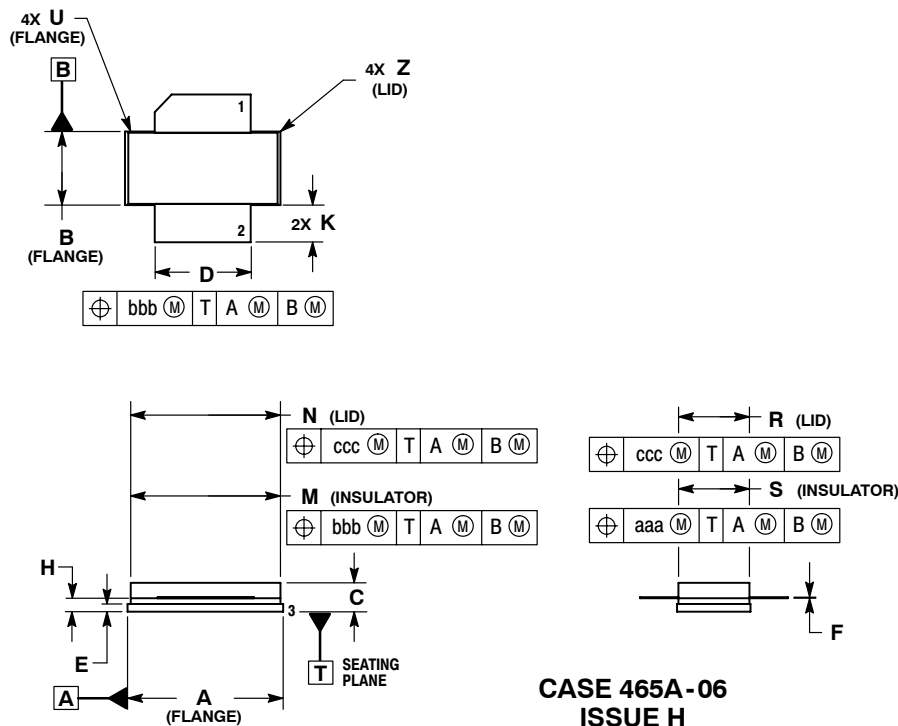
## PACKAGE DIMENSIONS



- 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



- 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:  
 PIN 1. DRAIN  
 2. GATE  
 5. SOURCE

**MRF19085LR3 MRF19085LSR3**

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