



# 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.

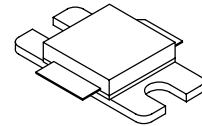
- Typical CDMA Performance @ 1930 MHz, 26 Volts,  $I_{DQ} = 550$  mA  
Multi-carrier IS-95 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
Output Power — 9.5 Watts Avg.  
Power Gain — 14.9 dB  
Efficiency — 23.5%  
Adjacent Channel Power —  
885 kHz: -50 dBc @ 30 kHz BW  
IM3 — -37 dBc
- Capable of Handling 5:1 VSWR, @ 26 Vdc, 1960 MHz, 45 Watts CW Output Power

### Features

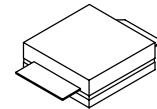
- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads, 40 $\mu$ m Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 32 mm, 13 Inch Reel.

**MRF19045LR3**  
**MRF19045LSR3**

**1930-1990 MHz, 45 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465E-04, STYLE 1**  
**NI-400**  
**MRF19045LR3**



**CASE 465F-04, STYLE 1**  
**NI-400S**  
**MRF19045LSR3**

ARCHIVE INFORMATION

ARCHIVE INFORMATION

**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 $^\circ\text{C}$	$P_D$	105 0.60	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 <sup>(1)</sup>	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.65	$^\circ\text{C}/\text{W}$

**Table 3. ESD Protection Characteristics**

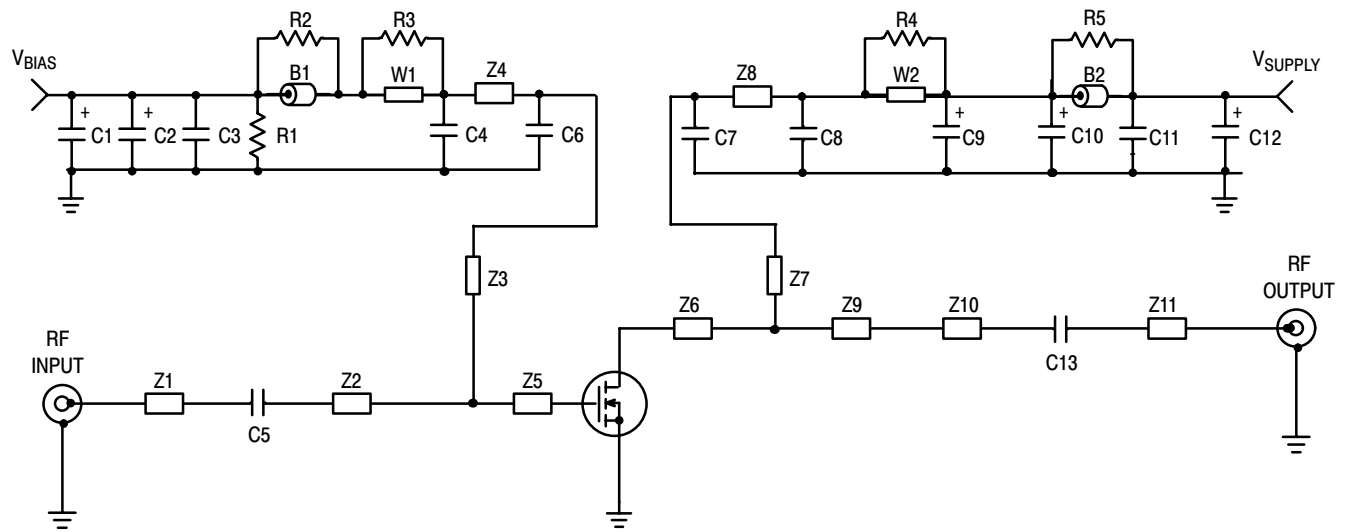
Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)

1. Refer to AN1955/D, *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 ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 100\ \mu\text{Adc}$ )	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 550\text{ mAdc}$ )	$V_{GS(Q)}$	3	3.8	5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )	$V_{DS(on)}$	—	0.19	0.21	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$g_{fs}$	—	4.2	—	S
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance (1) ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$	—	1.8	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system) 2-carrier N-CDMA, 1.2288 MHz Channel Bandwidth, IM3 measured in 1.2288 MHz Integrated Bandwidth. ACPR measured in 30 kHz Integrated Bandwidth.					
Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 9.5\text{ W Avg}$ , 2-Carrier N-CDMA, $I_{DQ} = 550\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	$G_{ps}$	13	14.5	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 9.5\text{ W Avg}$ , 2-Carrier N-CDMA, $I_{DQ} = 550\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	$\eta$	21	23.5	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 9.5\text{ W Avg}$ , 2-Carrier N-CDMA, $I_{DQ} = 550\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ ; IM3 Measured in a 1.2288 MHz Integrated Bandwidth Centered at $f_1 - 2.5\text{ MHz}$ and $f_2 + 2.5\text{ MHz}$ , Referenced to the Carrier Channel Power)	IM3	—	-37	-35	dBc
Adjacent Channel Power Ratio ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 9.5\text{ W Avg}$ , 2-carrier N-CDMA, $I_{DQ} = 550\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ ; ACPR measured in a 30 kHz Integrated Bandwidth Centered at $f_1 - 885\text{ kHz}$ and $f_2 + 885\text{ kHz}$ )	ACPR	—	-51	-45	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 9.5\text{ W Avg}$ , 2-Carrier N-CDMA, $I_{DQ} = 550\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ )	IRL	—	-16	-9	dB
$P_{out}$ , 1 dB Compression Point ( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 550\text{ mA}$ , $f = 1930\text{ MHz}$ )	P1dB	—	45	—	W

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



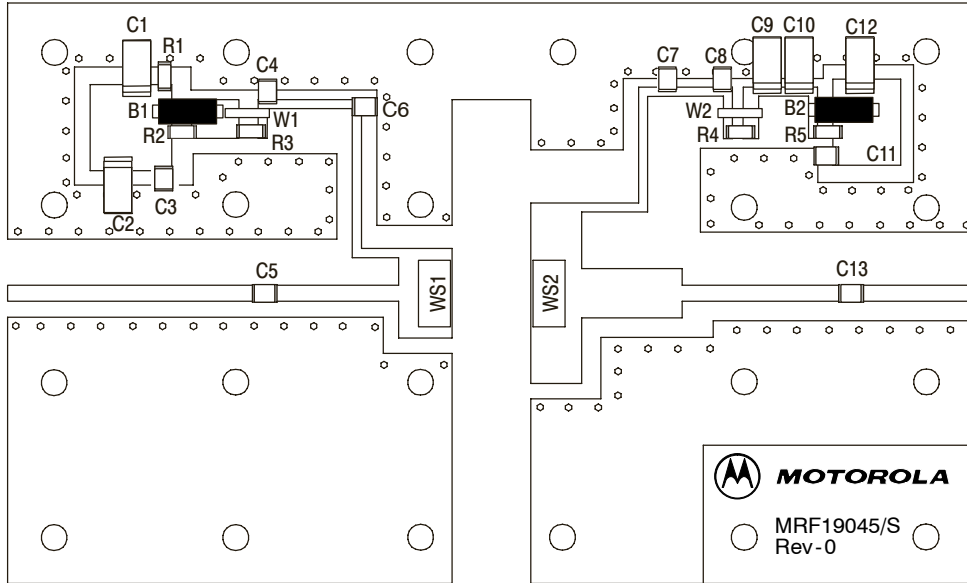
Z1	1.336" x 0.081" Microstrip	Z8	0.216" x 0.047" Microstrip
Z2	0.693" x 0.081" Microstrip	Z9	0.519" x 0.254" Microstrip
Z3	1.033" x 0.047" Microstrip	Z10	0.874" x 0.081" Microstrip
Z4	0.468" x 0.047" Microstrip	Z11	0.645" x 0.081" Microstrip
Z5	0.271" x 0.460" Microstrip	PCB	Arlon GX0300-55-22, 30 mils, $\epsilon_r = 2.55$
Z6	0.263" x 0.930" Microstrip		
Z7	1.165" x 0.047" Microstrip		

NOTE: Z3, Z4, Z7, Z8 lengths and component placement tolerances are  $\pm 0.050''$ .  
 Zx lengths are microstrip lengths between components, center-line to center-line.  
 All component and z-length tolerances are  $\pm 0.015''$ , except as noted.

**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**

Designators	Description
B1, B2	0.120" x 0.333" x 0.100", Surface Mount Ferrite Beads, Fair Rite #2743019446
C1, C2	10 $\mu$ F, 35 V Tantalum Surface Mount Chip Capacitors, Kemet #T495X106K035AS4394
C3, C11	0.1 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKWS
C4, C8	24 pF Chip Capacitors, ATC #100B240JP500X
C5	470 pF Chip Capacitor, ATC #100B471JP200X
C6, C7	11 pF Chip Capacitors, ATC #100B110JP500X
C9, C10, C12	22 $\mu$ F, 35 V Tantalum Surface Mount Chip Capacitors, Kemet #T491X226K035AS4394
C13	8.2 pF Chip Capacitor, ATC #100B8R2CP500X
R1	560 k $\Omega$ , 1/4 W Chip Resistor (0.08" x 0.13")
R2, R3, R4, R5	8.2 $\Omega$ , 1/4 W Chip Resistors (0.08" x 0.13"), Garrett Instruments #RM73B2B110JT
W1, W2	Solid Copper Buss Wire, 16 AWG
WS1, WS2	Beryllium Copper Wear Blocks (0.005" x 0.150" x 0.350") Nominal



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**

## TYPICAL CHARACTERISTICS

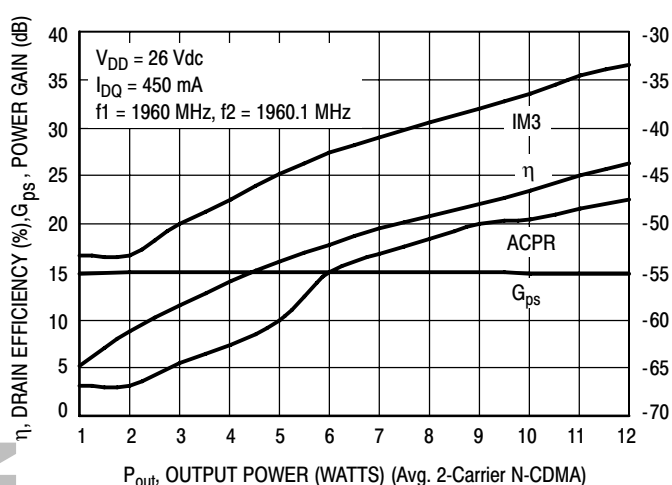


Figure 3. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

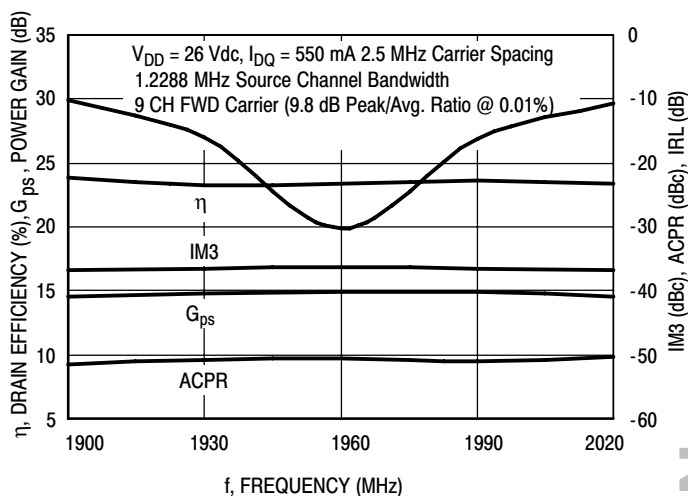


Figure 4. 2-Carrier N-CDMA ACPR, IM3, Power Gain, IRL and Drain Efficiency versus Output Power

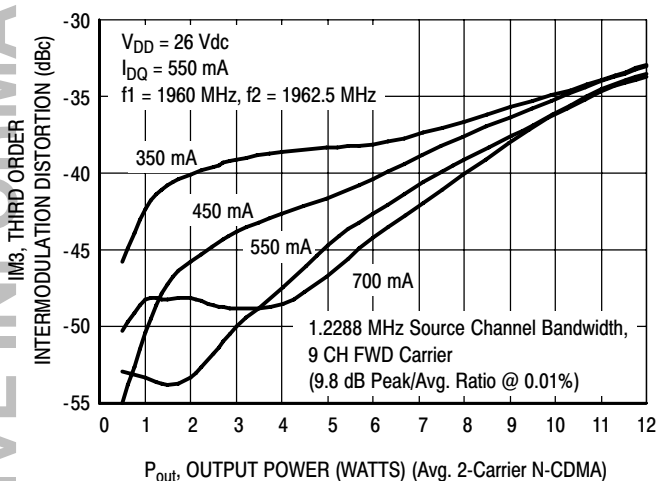


Figure 5. 2-Carrier N-CDMA IM3 versus Output Power

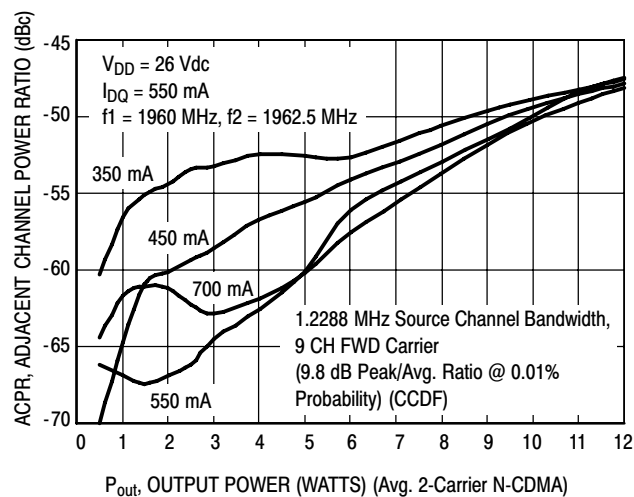


Figure 6. 2-Carrier N-CDMA ACPR versus Output Power

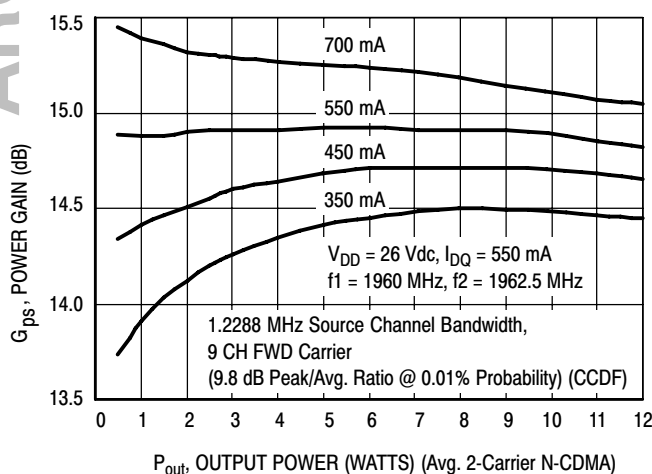


Figure 7. 2-Carrier N-CDMA Power Gain versus Output Power

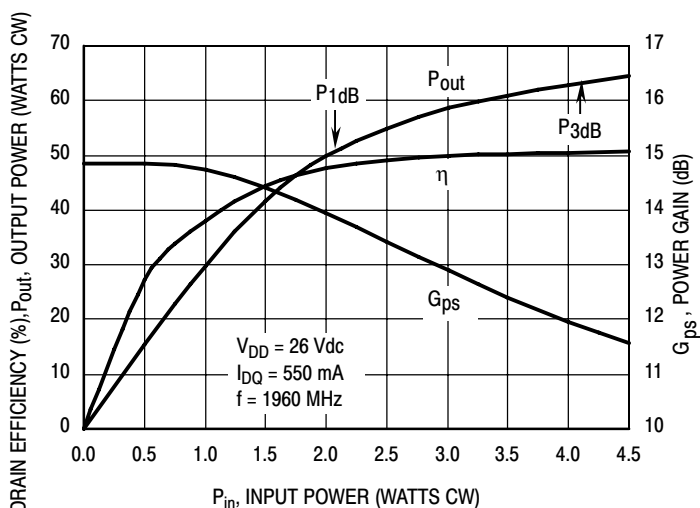
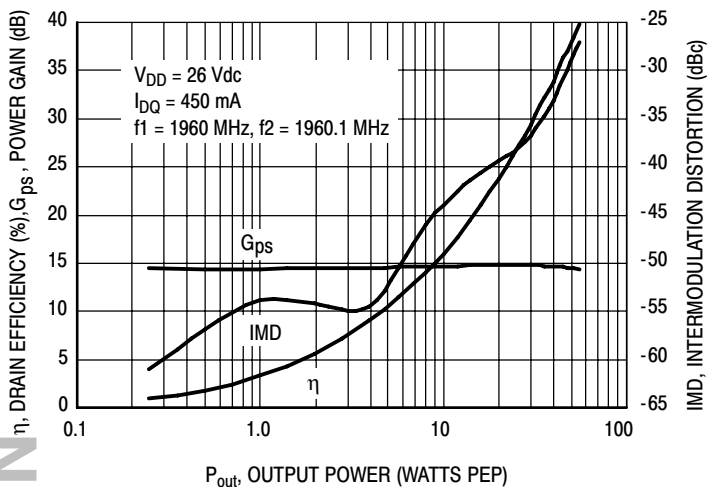


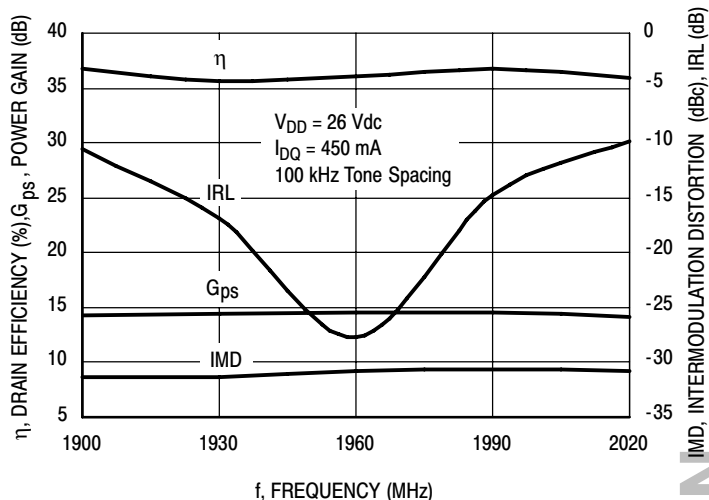
Figure 8. CW Output Power, Power Gain and Drain Efficiency versus Input Power

MRF19045LR3 MRF19045LSR3

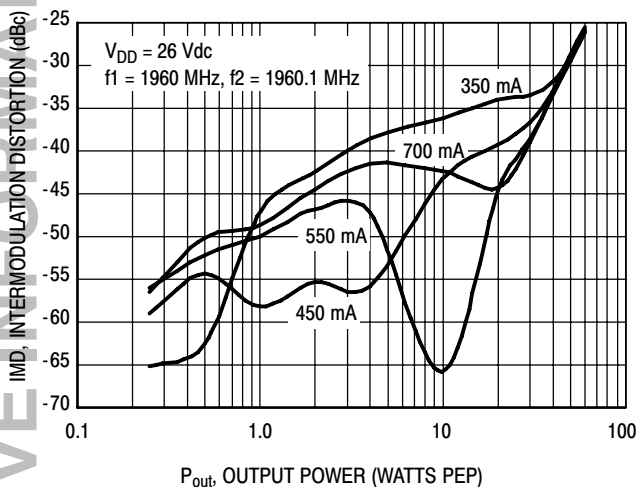
## TYPICAL CHARACTERISTICS



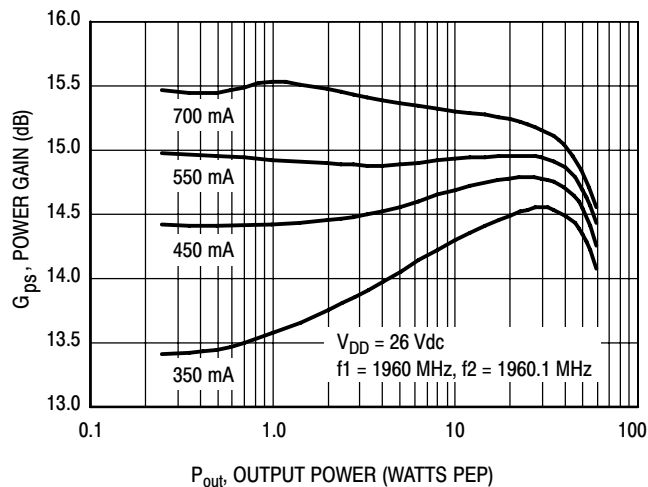
**Figure 9. CW Two-Tone Power Gain, IMD and Drain Efficiency versus Output Power**



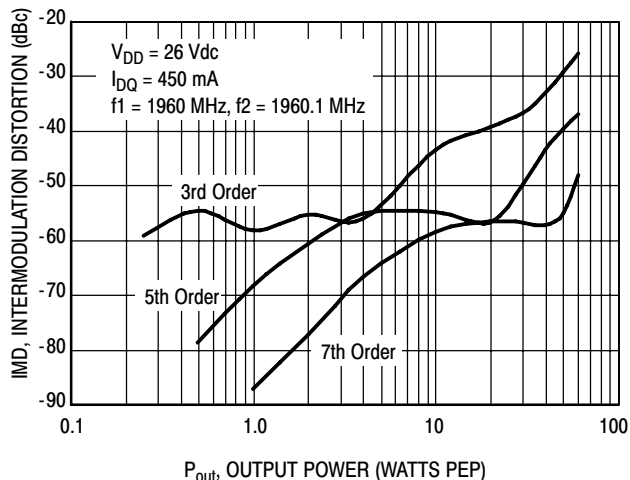
**Figure 10. CW Two-Tone Power Gain, Input Return Loss, IMD and Drain Efficiency versus Frequency**



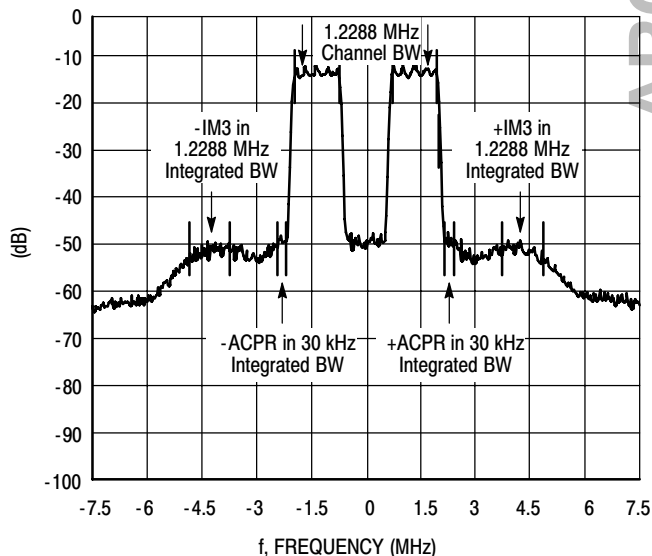
**Figure 11. CW Two-Tone Intermodulation Distortion versus Output Power**



**Figure 12. CW Two-Tone Power Gain versus Output Power**

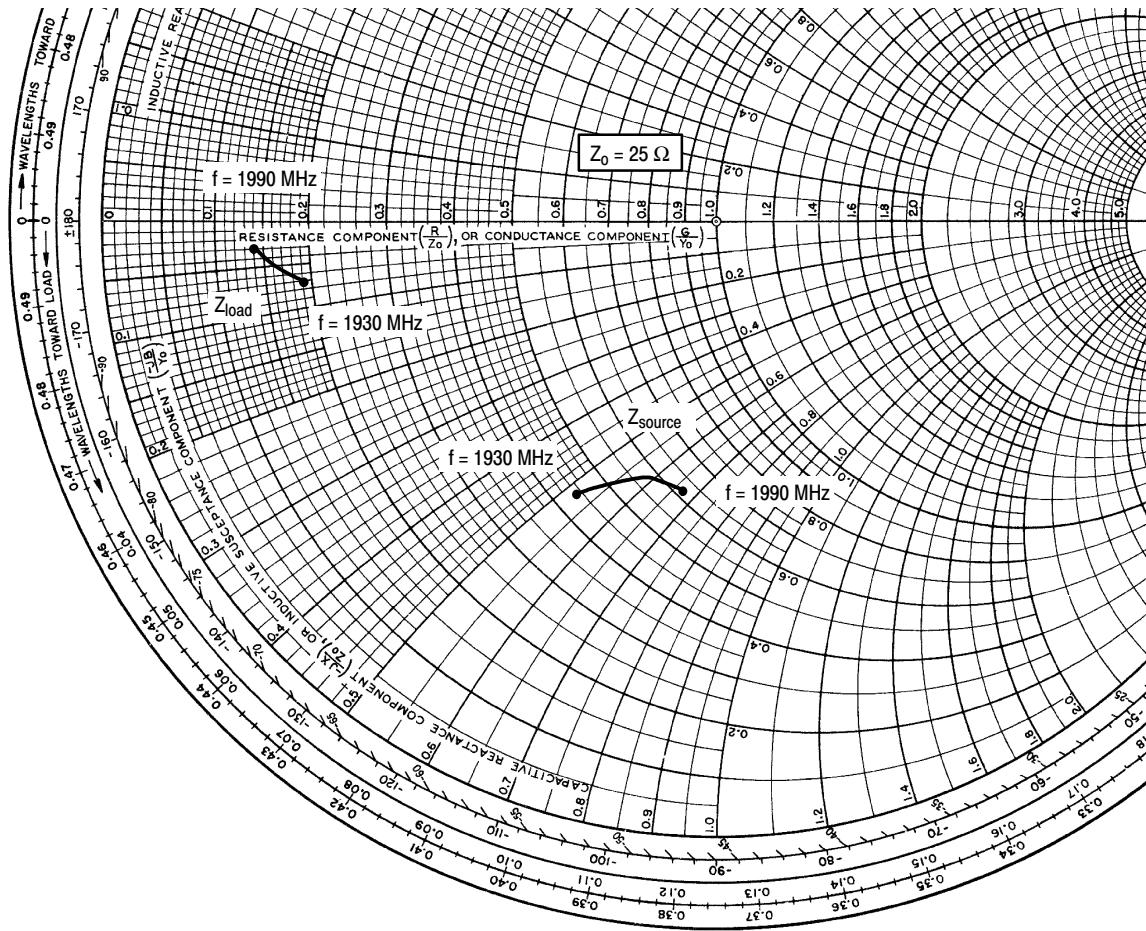


**Figure 13. CW Two-Tone Intermodulation Distortion Products versus Output Power**



**Figure 14. 2-Carrier N-CDMA Spectrum**

MRF19045LR3 MRF19045LSR3



$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 550\text{ mA}$ ,  $P_{out} = 9.5\text{ W Avg.}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1930	$15.52 - j16.5$	$4.52 - j1.86$
1960	$14.24 - j14.44$	$3.85 - j1.04$
1990	$11.11 - j13.01$	$3.44 - j0.69$

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

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

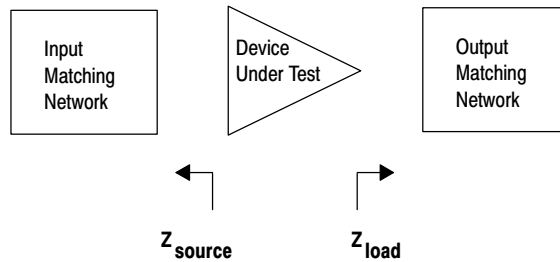
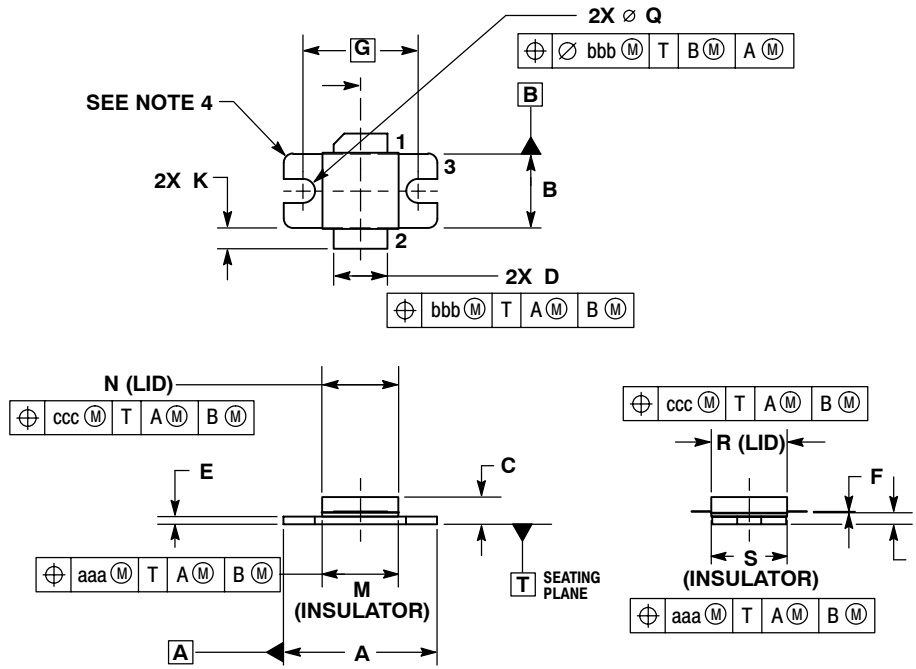


Figure 15. Series Equivalent Source and Load Impedance



**PACKAGE DIMENSIONS**

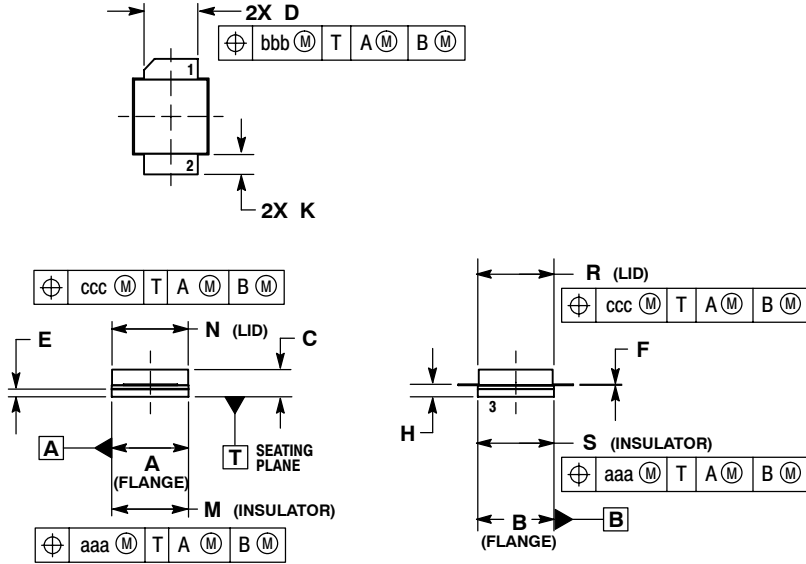


- NOTES:
1. CONTROLLING DIMENSION: INCH.
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
  4. INFORMATION ONLY: CORNER BREAK (4X) TO BE .060±.005 (1.52±0.13) RADIUS OR .06±.005 (1.52±0.13) x 45° CHAMFER.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.795	.805	20.19	20.44
B	.380	.390	9.65	9.9
C	.125	.163	3.17	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.004	.006	0.10	0.15
G	.600 BSC		15.24 BSC	
H	.057	.067	1.45	1.7
K	.092	.122	2.33	3.1
M	.395	.405	10	10.3
N	.395	.405	10	10.3
Q	Ø .120	Ø .130	Ø 3.05	Ø 3.3
R	.395	.405	10	10.3
S	.395	.405	10	10.3
aaa	.005 BSC		0.127 BSC	
bbb	.010 BSC		0.254 BSC	
ccc	.015 BSC		0.381 BSC	

- STYLE 1:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE

**CASE 465E-04  
 ISSUE F  
 NI-400  
 MRF19045LR3**



- NOTES:
1. CONTROLLING DIMENSION: INCH.
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.395	.405	10.03	10.29
C	.125	.163	3.18	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.004	.006	0.10	0.15
H	.057	.067	1.45	1.70
K	.092	.122	2.34	3.10
M	.395	.405	10.03	10.29
N	.395	.405	10.03	10.29
R	.395	.405	10.03	10.29
S	.395	.405	10.03	10.29
aaa	.005 REF		0.127 REF	
bbb	.010 REF		0.254 REF	
ccc	.015 REF		0.38 REF	

- STYLE 1:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE

**CASE 465F-04  
 ISSUE E  
 NI-400S  
 MRF19045LSR3**



## 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	<ul style="list-style-type: none"><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2</li><li>• Data sheet archived. Part no longer manufactured.</li><li>• Added Product Documentation and Revision History, p. 9</li></ul>

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