

MRF5S19150R3 and MRF5S19150SR3 replaced by MRF5S19150HR3 and MRF5S19150HSR3. "H" suffix indicates lower thermal resistance package.

## The RF MOSFET Line

# RF Power Field Effect Transistors

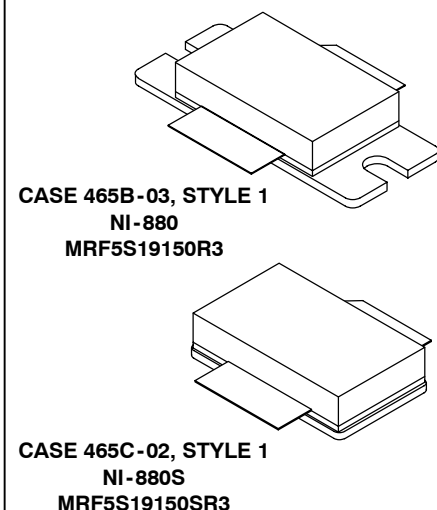
## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications at frequencies from 1.9 to 2.0 GHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

- Typical 2-Carrier N-CDMA Performance for  $V_{DD} = 28$  Volts,  
 $P_{out} = 32$  Watts,  $I_{DQ} = 1400$  mA,  $f_1 = 1958.75$  MHz,  $f_2 = 1961.25$  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 — 32 Watts Avg.  
Power Gain — 14 dB  
Efficiency — 26%  
ACPR — -50 dB  
IM3 — -36.5 dBc
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 5:1 VSWR, @ 28 Vdc,  $f_1 = 1960$  MHz,  
100 Watts CW Output Power
- Excellent Thermal Stability
- Qualified Up to a Maximum of 32 V Operation
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF5S19150R3**  
**MRF5S19150SR3**

**1990 MHz, 32 W, 28 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	65	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	357 2	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$
CW Operation	CW	100	Watts

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature $80^\circ\text{C}$ , 100 W CW Case Temperature $80^\circ\text{C}$ , 32 W CW	$R_{\theta JC}$	0.49 0.53	$^\circ\text{C/W}$

- MTTF calculator available at <http://www.motorola.com/semiconductors/rf>. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.
- Refer to AN1955/D, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.motorola.com/semiconductors/rf>. Select Documentation/Application Notes - AN1955.

**NOTE - CAUTION** - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

## ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C7 (Minimum)

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 65 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	1	μAdc
Gate-Source Leakage Current (V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	—	—	1	μAdc

### ON CHARACTERISTICS

Gate Threshold Voltage (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 360 μAdc)	V <sub>GS(th)</sub>	2.5	2.8	3.5	Vdc
Gate Quiescent Voltage (V <sub>DS</sub> = 28 Vdc, I <sub>D</sub> = 1400 mAdc)	V <sub>GS(Q)</sub>	—	3.8	—	Vdc
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3.6 Adc)	V <sub>DS(on)</sub>	—	0.24	—	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 3.6 Adc)	g <sub>fs</sub>	—	9	—	S

### DYNAMIC CHARACTERISTICS

Reverse Transfer Capacitance (1) (V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0, f = 1 MHz)	C <sub>rss</sub>	—	3.1	—	pF
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**FUNCTIONAL TESTS** (In Motorola 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 <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 32 W Avg, I <sub>DQ</sub> = 1400 mA, f <sub>1</sub> = 1930 MHz, f <sub>2</sub> = 1932.5 MHz and f <sub>1</sub> = 1987.5 MHz, f <sub>2</sub> = 1990 MHz)	G <sub>ps</sub>	13	14	—	dB
Drain Efficiency (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 32 W Avg, I <sub>DQ</sub> = 1400 mA, f <sub>1</sub> = 1930 MHz, f <sub>2</sub> = 1932.5 MHz and f <sub>1</sub> = 1987.5 MHz, f <sub>2</sub> = 1990 MHz)	η	24	26	—	%
Third Order Intermodulation Distortion (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 32 W Avg, I <sub>DQ</sub> = 1400 mA, f <sub>1</sub> = 1930 MHz, f <sub>2</sub> = 1932.5 MHz and f <sub>1</sub> = 1987.5 MHz, f <sub>2</sub> = 1990 MHz; IM3 measured over 1.2288 MHz Bandwidth at f <sub>1</sub> -2.5 MHz and f <sub>2</sub> +2.5 MHz referenced to carrier channel power.)	IM3	—	-36.5	-35	dBc
Adjacent Channel Power Ratio (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 32 W Avg, I <sub>DQ</sub> = 1400 mA, f <sub>1</sub> = 1930 MHz, f <sub>2</sub> = 1932.5 MHz and f <sub>1</sub> = 1987.5 MHz, f <sub>2</sub> = 1990 MHz; ACPR measured over 30 kHz Bandwidth at f <sub>1</sub> -885 MHz and f <sub>2</sub> +885 MHz)	ACPR	—	-50	-48	dBc
Input Return Loss (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 32 W Avg, I <sub>DQ</sub> = 1400 mA, f <sub>1</sub> = 1930 MHz, f <sub>2</sub> = 1932.5 MHz and f <sub>1</sub> = 1987.5 MHz, f <sub>2</sub> = 1990 MHz)	IRL	—	-17	-9	dB

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

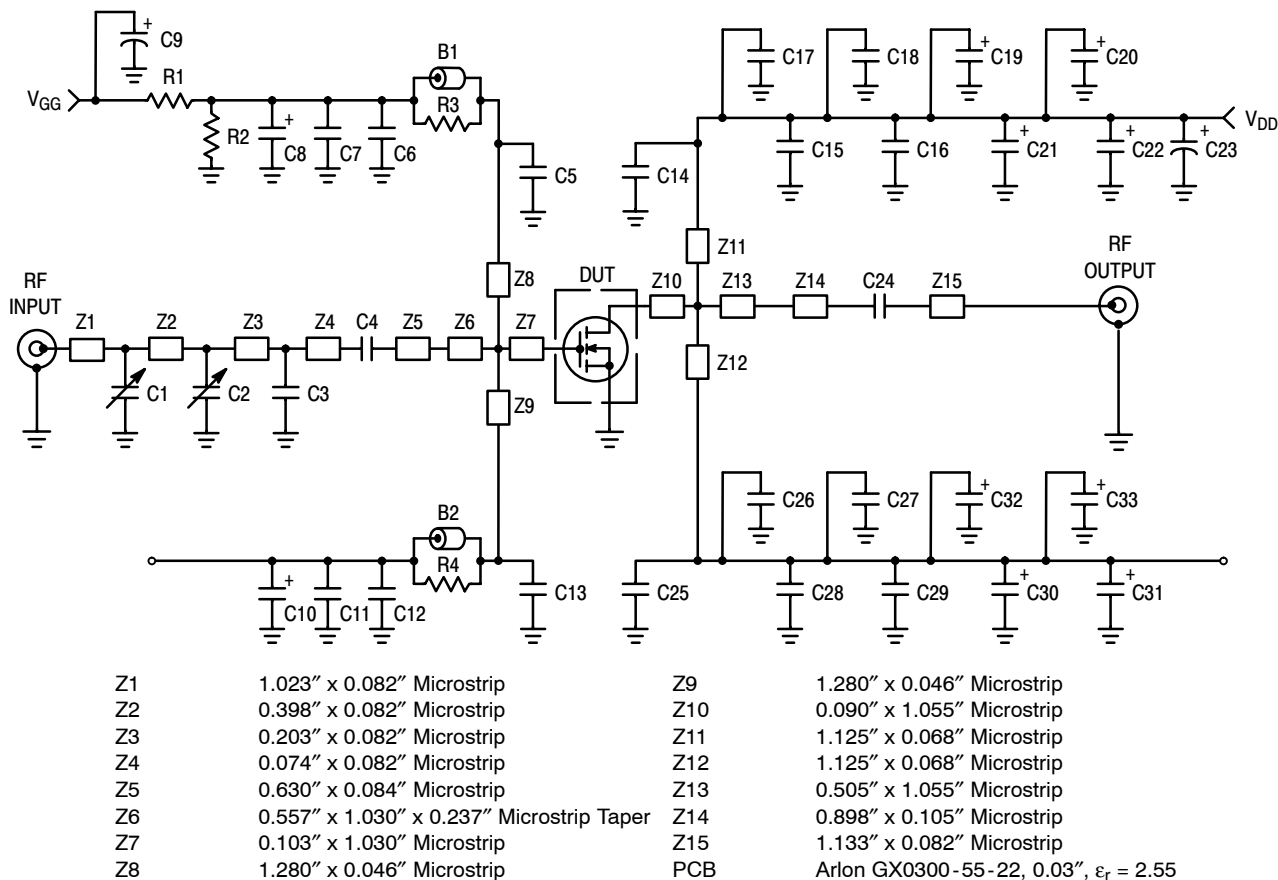


Figure 1. MRF5S19150 Test Circuit Schematic

Table 1. MRF5S19150 Test Circuit Component Designations and Values

Part	Description
B1, B2	Short RF Beads
C1, C2	0.6 – 4.5 Variable Capacitors, Gigatrim
C3	0.8 pF Chip Capacitor, B Case
C4, C5, C13, C14, C24, C25	9.1 pF Chip Capacitors, B Case
C8, C10	1.0 $\mu$ F, 50 V SMT Tantalum Capacitors
C6, C12, C16, C17, C18, C27, C28, C29	0.1 $\mu$ F Chip Capacitors, B Case
C7, C11, C15, C26	1000 pF Chip Capacitors, B Case
C9	100 $\mu$ F, 50 V Electrolytic Capacitor
C23	470 $\mu$ F, 63 V Electrolytic Capacitor
C19, C20, C21, C22, C30, C31, C32, C33	22 $\mu$ F, 35 V Tantalum Capacitors
R1	1 k $\Omega$ Chip Resistor
R2	560 k $\Omega$ Chip Resistor
R3, R4	12 $\Omega$ Chip Resistors

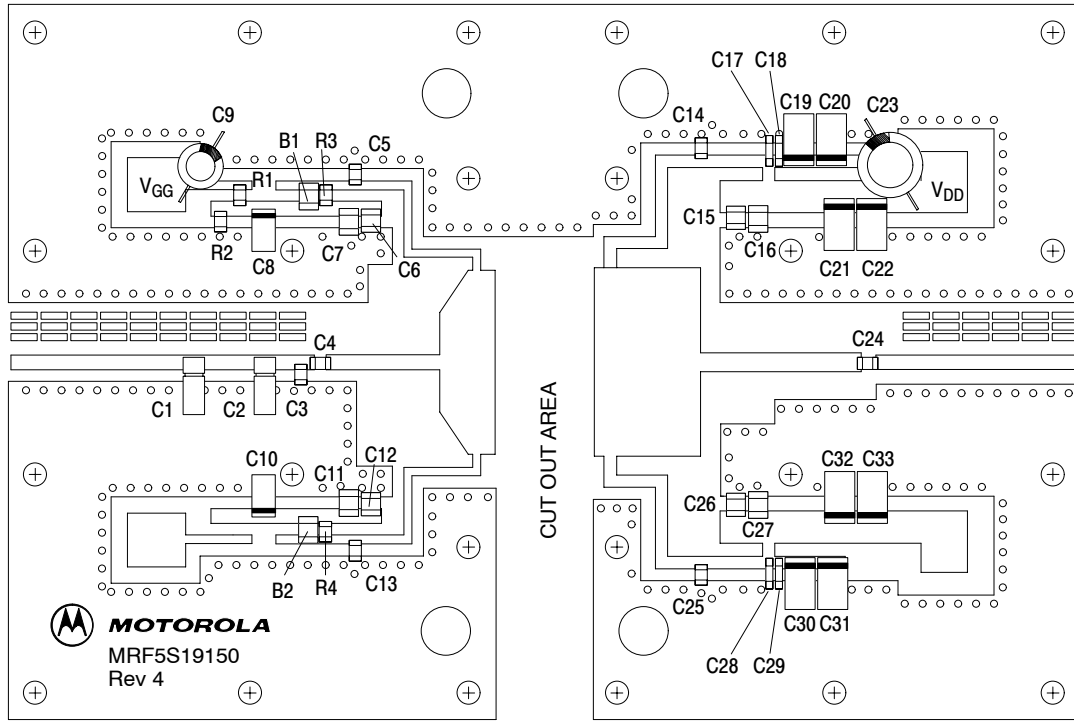


Figure 2. MRF5S19150 Test Circuit Component Layout

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## TYPICAL CHARACTERISTICS

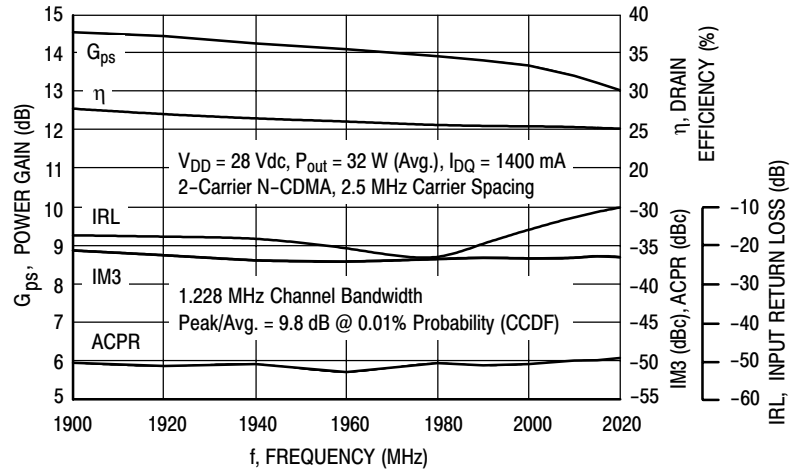


Figure 3. 2-Carrier N-CDMA Broadband Performance

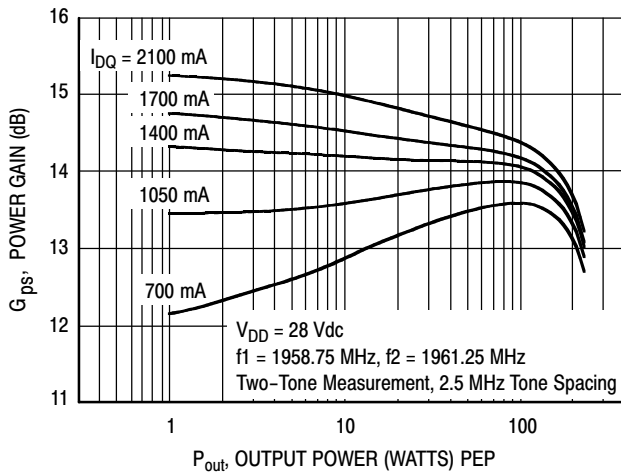


Figure 4. Two-Tone Power Gain versus Output Power

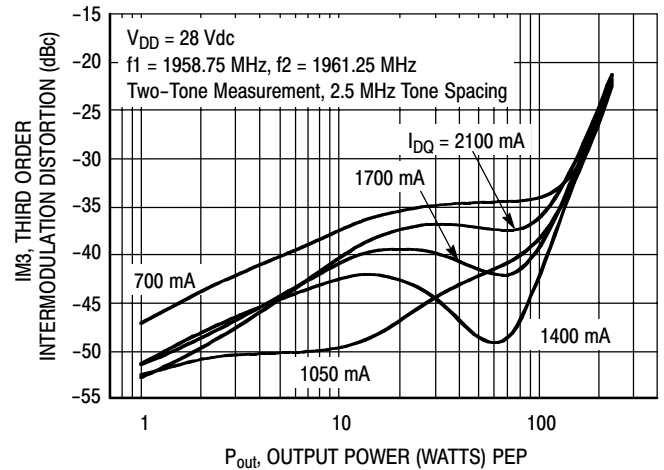


Figure 5. Third Order Intermodulation versus Output Power

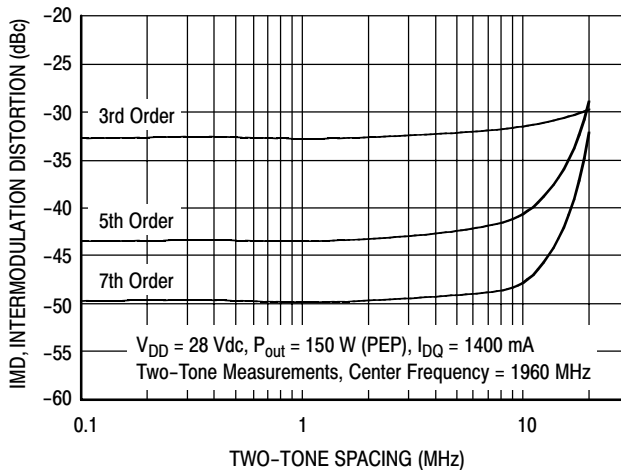


Figure 6. Intermodulation Distortion Products versus Tone Spacing

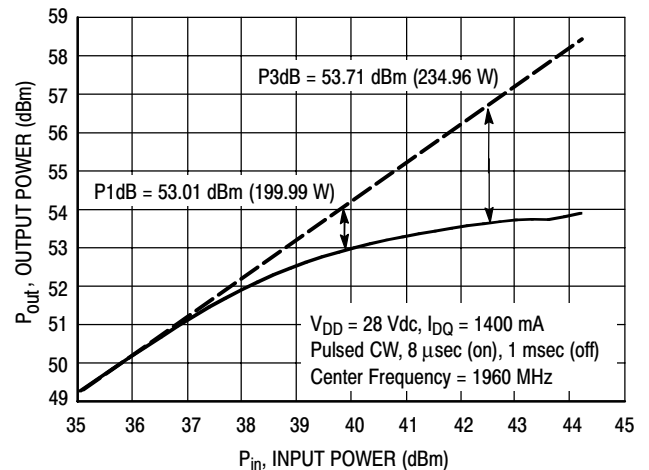
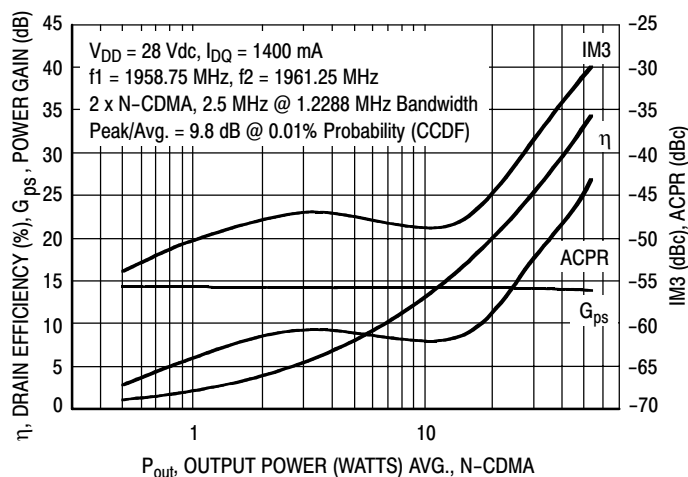
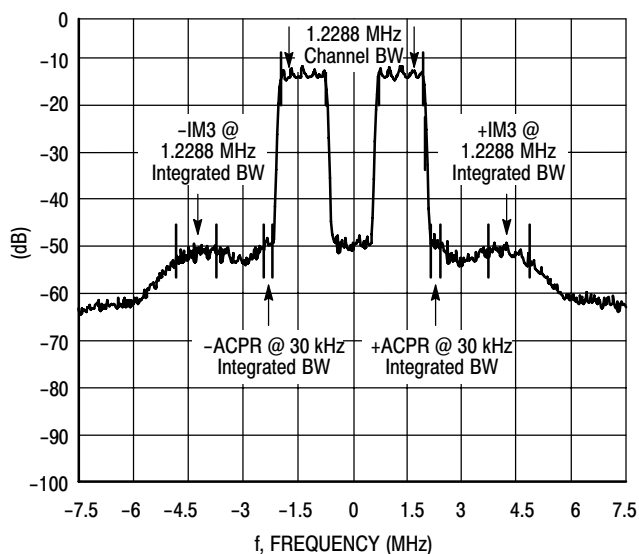


Figure 7. Pulse CW Output Power versus Input Power

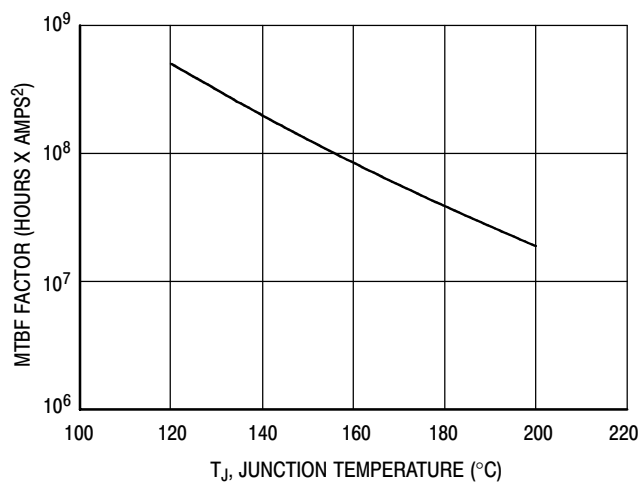
## TYPICAL CHARACTERISTICS



**Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain, Drain Efficiency versus Output Power**

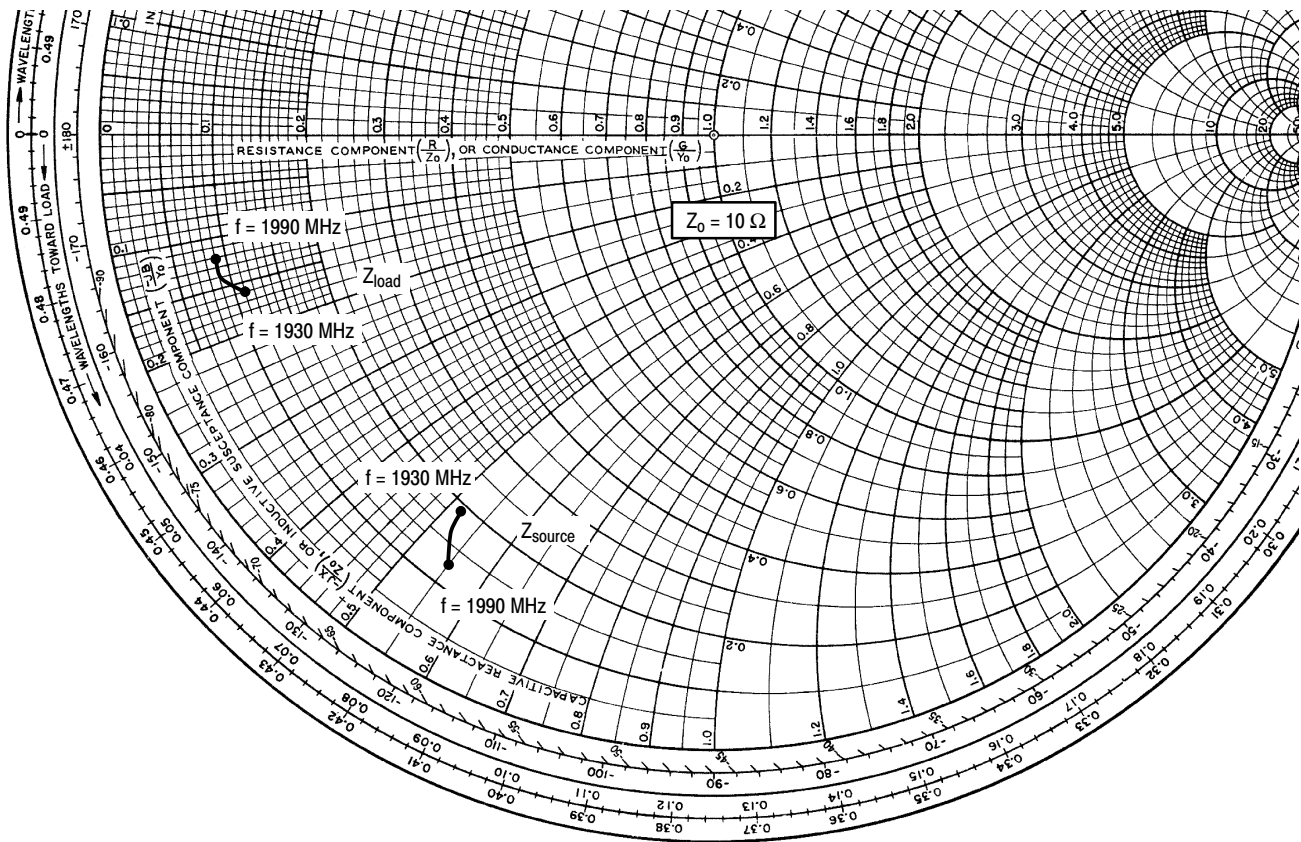


**Figure 9. 2-Carrier N-CDMA Spectrum**



This above graph displays calculated MTBF in hours x ampere<sup>2</sup> drain current. Life tests at elevated temperatures have correlated to better than  $\pm 10\%$  of the theoretical prediction for metal failure. Divide MTBF factor by  $I_D^2$  for MTBF in a particular application.

**Figure 10. MTBF Factor versus Junction Temperature**



$V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 1400 \text{ mA}$ ,  $P_{out} = 32 \text{ W Avg.}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1930	$1.89 - j5.24$	$1.06 - j1.58$
1960	$1.64 - j5.29$	$0.88 - j1.37$
1990	$1.3 - j5.49$	$0.90 - j1.21$

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

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

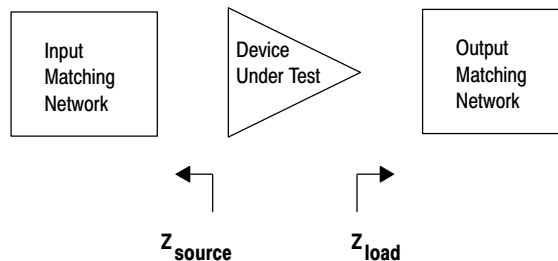


Figure 11. Series Equivalent Input and Output Impedance

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**NOTES**

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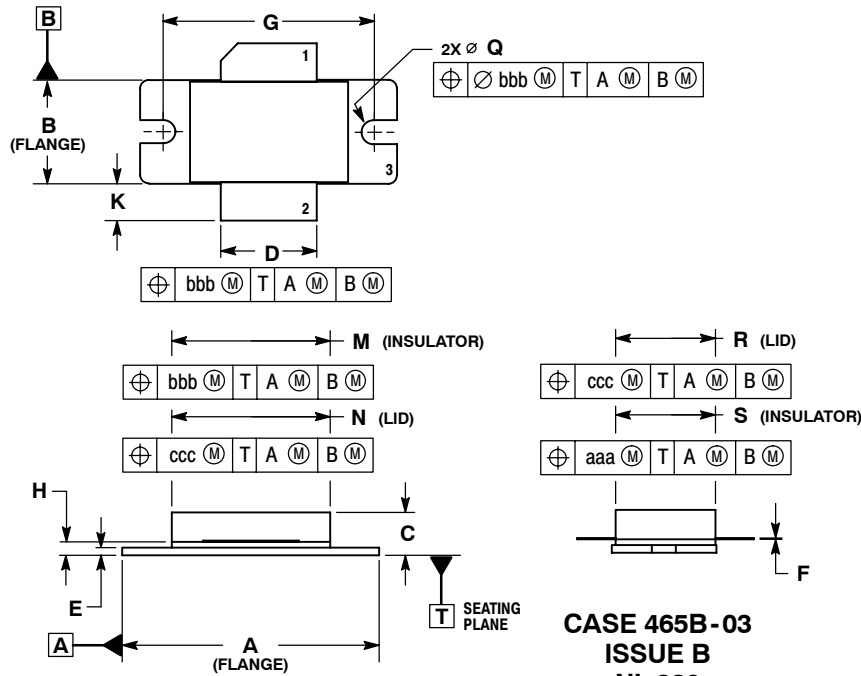
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**NOTES**

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## PACKAGE DIMENSIONS

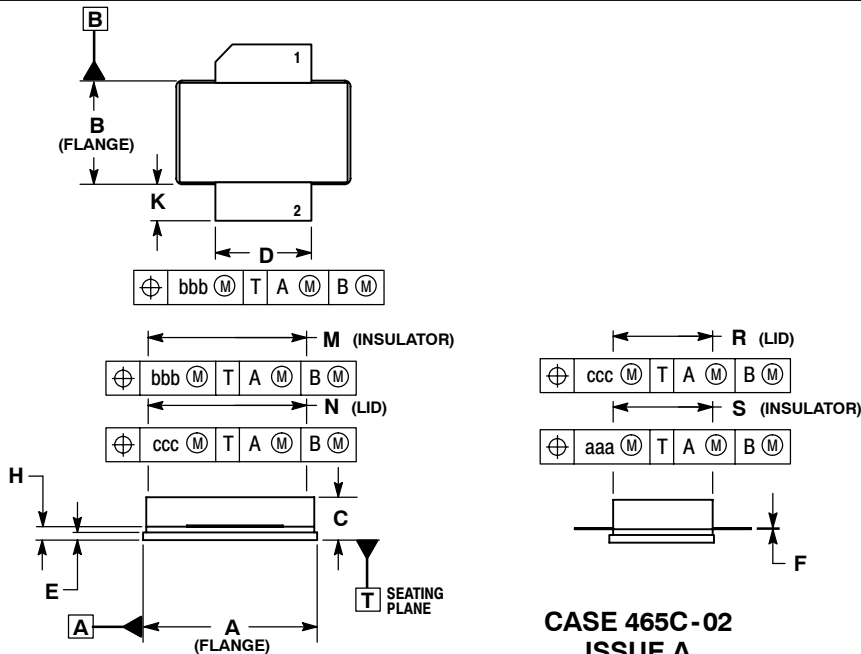


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
  4. DELETED

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.535	0.545	13.6	13.8
C	0.147	0.200	3.73	5.08
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	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
Q	Ø.118	Ø.138	Ø3.00	Ø3.51
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

CASE 465B-03  
ISSUE B  
NI-880  
MRF5S19150R3



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.905	0.915	22.99	23.24
B	0.535	0.545	13.60	13.80
C	0.147	0.200	3.73	5.08
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	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

CASE 465C-02  
ISSUE A  
NI-880S  
MRF5S19150SR3

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