Freescale Semiconductor
Technical Data

Document Number: MRF5S19150H
Rev. 4, 10/2008

RoHS

RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

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

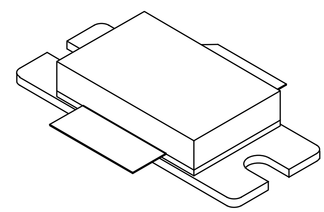
- Typical 2-Carrier N-CDMA Performance for V_{DD} = 28 Volts, I_{DQ} = 1400 mA, Avg., P_{out} = 32 Watts Avg., f = 1990 MHz, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. PAR = 9.8 dB @ 0.01% Probability on CCDF.
  Power Gain — 14 dB
  Drain Efficiency — 26%
  IM3 @ 2.5 MHz Offset — -36.5 dBc in 1.2288 MHz Bandwidth
  ACPR @ 885 kHz Offset — -50 dB in 30 kHz Bandwidth
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 1960 MHz, 100 Watts CW Output Power

Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V Operation
- Integrated ESD Protection
- Lower Thermal Resistance Package
- Low Gold Plating Thickness on Leads, 40μ″ Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF5S19150HR3

1930-1990 MHz, 32 W AVG., 28 V
2 x N-CDMA
LATERAL N-CHANNEL
RF POWER MOSFET



CASE 465B-03, STYLE 1
NI-880

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°C Derate above 25°C	P_D	427 2.44	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation @ T_C = 25°C Derate above 25°C	CW	120 0.76	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 100 W CW Case Temperature 75°C, 32 W CW	$R_{\theta JC}$	 0.41 0.44	°C/W

1. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

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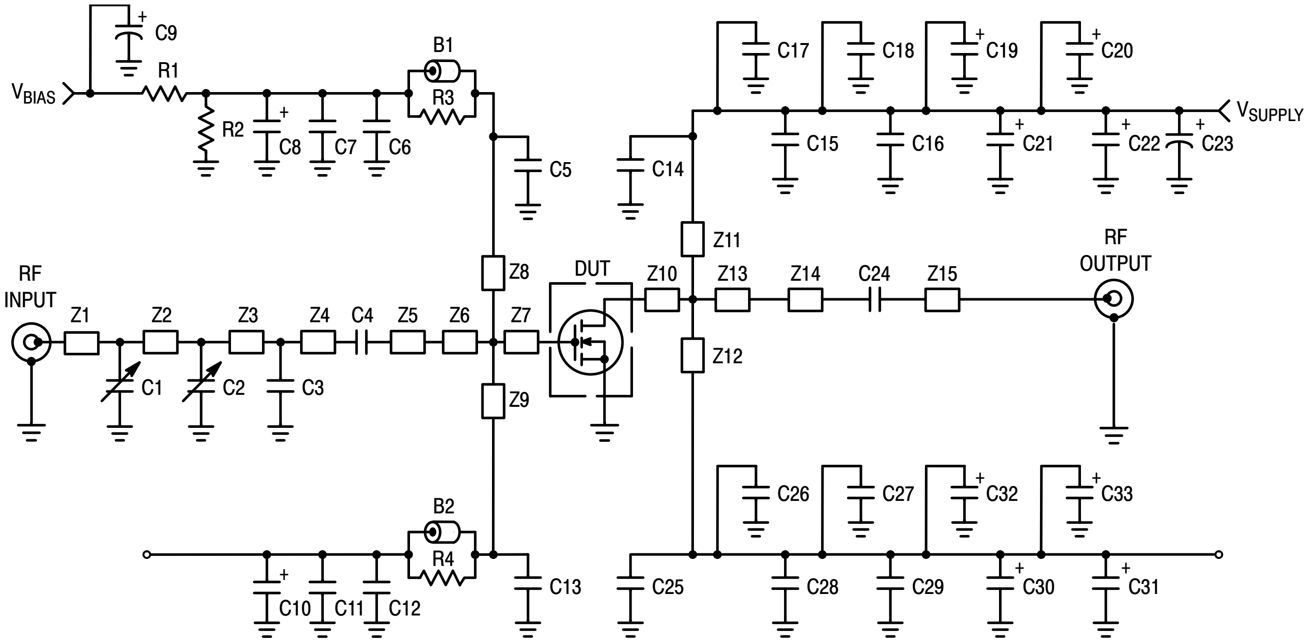
Table 3. ESD Protection Characteristics

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

Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 360 μAdc)	$V_{GS(th)}$	2.5	2.8	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1400 mAdc)	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3.6 Adc)	$V_{DS(on)}$	—	0.24	—	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3.6 Adc)	g_{fs}	—	9	—	S
Dynamic Characteristics					
Reverse Transfer Capacitance (1) (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1 MHz)	C_{rss}	—	3.1	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1400 mA, P_{out} = 32 W Avg., f1 = 1987.5 MHz, f2 = 1990 MHz, 2-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carriers. ACPR measured in 30 kHz Channel Bandwidth @ ±885 kHz Offset. IM3 measured in 1.2288 MHz Channel Bandwidth @ ±2.5 MHz Offset. PAR = 9.8 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	13	14	—	dB
Drain Efficiency	η_D	24	26	—	%
Intermodulation Distortion	IM3	—	-36.5	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-50	-48	dBc
Input Return Loss	IRL	—	-17	-9	dB

1. Part internally matched both on input and output.

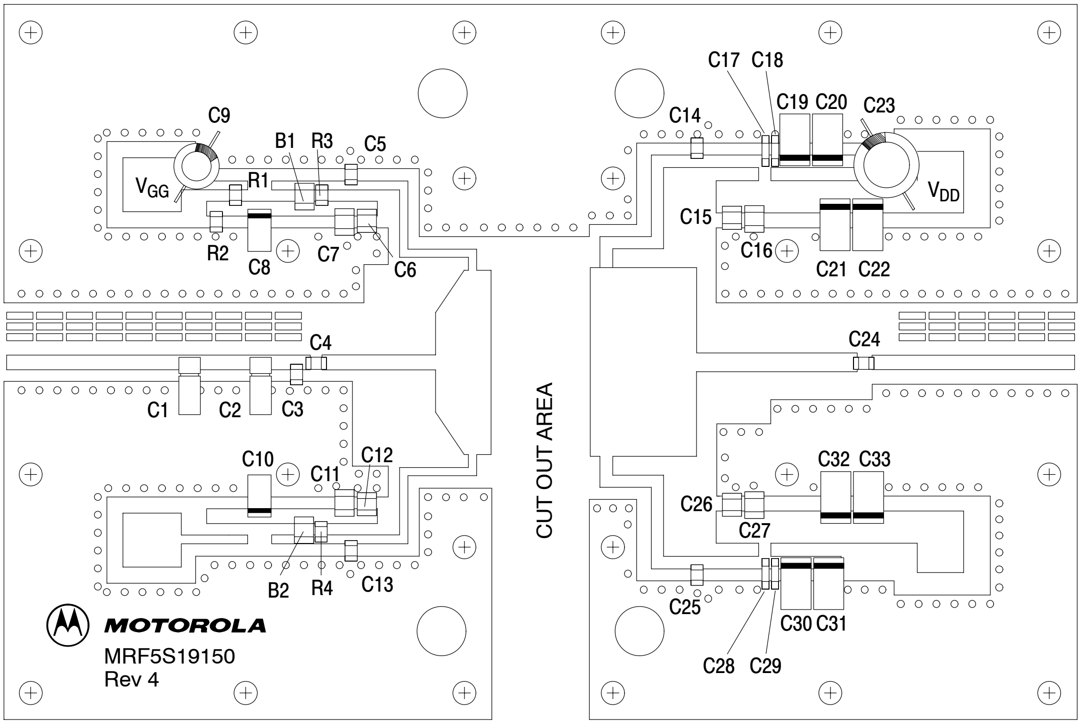


Z1	1.023″ x 0.082″ Microstrip	Z9	1.280″ x 0.046″ Microstrip
Z2	0.398″ x 0.082″ Microstrip	Z10	0.090″ x 1.055″ Microstrip
Z3	0.203″ x 0.082″ Microstrip	Z11	1.125″ x 0.068″ Microstrip
Z4	0.074″ x 0.082″ Microstrip	Z12	1.125″ x 0.068″ Microstrip
Z5	0.630″ x 0.084″ Microstrip	Z13	0.505″ x 1.055″ Microstrip
Z6	0.557″ x 1.030″ x 0.237″ Microstrip Taper	Z14	0.898″ x 0.105″ Microstrip
Z7	0.103″ x 1.030″ Microstrip	Z15	1.133″ x 0.082″ Microstrip
Z8	1.280″ x 0.046″ Microstrip	PCB	Arlon GX0300-55-22, 0.03″, ε_r = 2.55

Figure 1. MRF5S19150HR3 Test Circuit Schematic

Table 5. MRF5S19150HR3 Test Circuit Component Designations and Values

Part	Description
B1, B2	Short RF Beads, Fair-Rite #2743019447
C1, C2	0.6 – 4.5 Variable Capacitors, Gigatrim, Johanson #27271SL
C3	0.8 pF Chip Capacitor, ATC #ATC100B0R8JT500XT
C4, C5, C13, C14, C24, C25	9.1 pF Chip Capacitors, ATC #ATC100B9R1JT500XT
C8, C10	1.0 μF, 50 V SMT Tantalum Capacitors, Kemet #T491C105M050AT
C6, C12, C16, C17, C18, C27, C28, C29	0.1 μF Chip Capacitors, Kemet #CDR33BX104AKYS
C7, C11, C15, C26	1000 pF Chip Capacitors, ATC #ATC100B102JT50XT
C9	100 μF, 50 V Electrolytic Capacitor, Multicomp #MCHT101M1HB-1017-RH
C23	470 μF, 63 V Electrolytic Capacitor, Multicomp #EKME630ELL471MK25S
C19, C20, C21, C22, C30, C31, C32, C33	22 μF, 35 V Tantalum Capacitors, Kemet #T491D226M035AS
R1	1 kΩ, 1/4 W Chip Resistor, Vishay #CRCW12061001FKEA
R2	560 kΩ, 1/4 W Chip Resistor, Vishay #CRCW12065600FKEA
R3, R4	12 Ω, 1/4 W Chip Resistors, Vishay #CRCW120612R0FKEA



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. MRF5S19150HR3 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

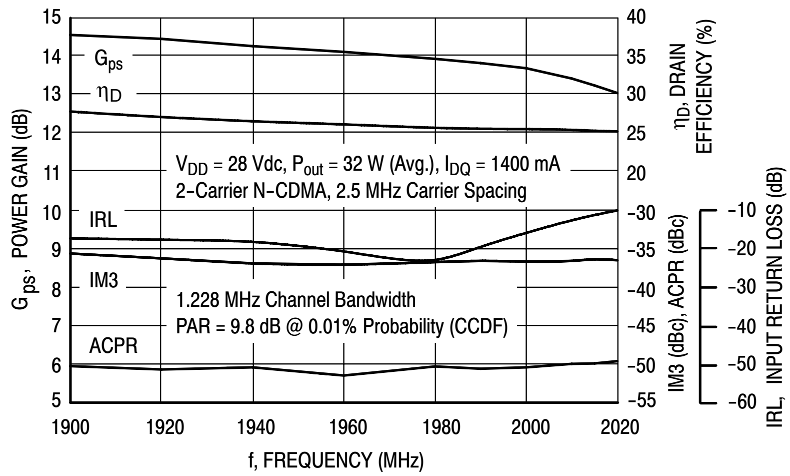


Figure 3. 2-Carrier N-CDMA Broadband Performance @ P_{out} = 32 Watts Avg.

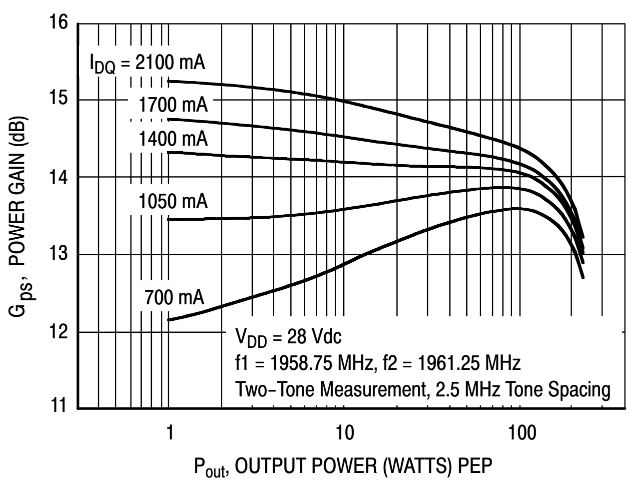


Figure 4. Two-Tone Power Gain versus Output Power

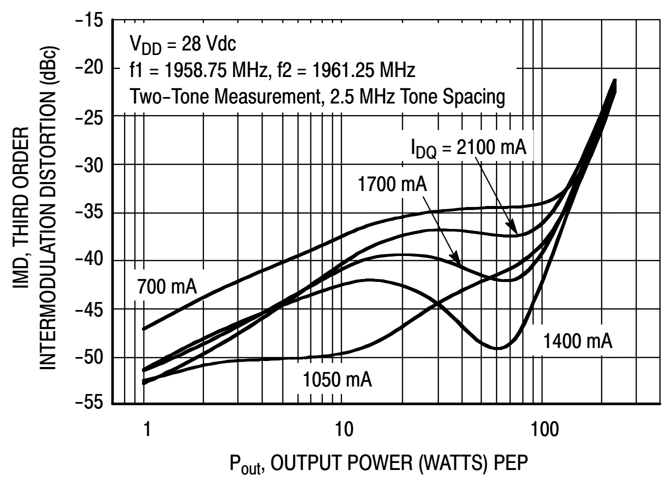


Figure 5. Third Order Intermodulation versus Output Power

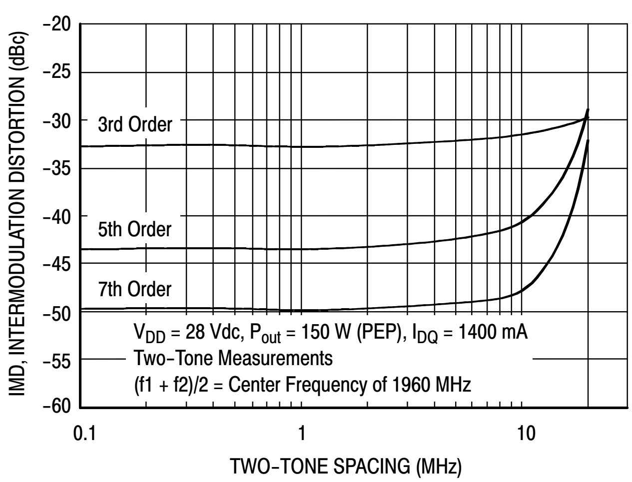


Figure 6. Intermodulation Distortion Products versus Tone Spacing

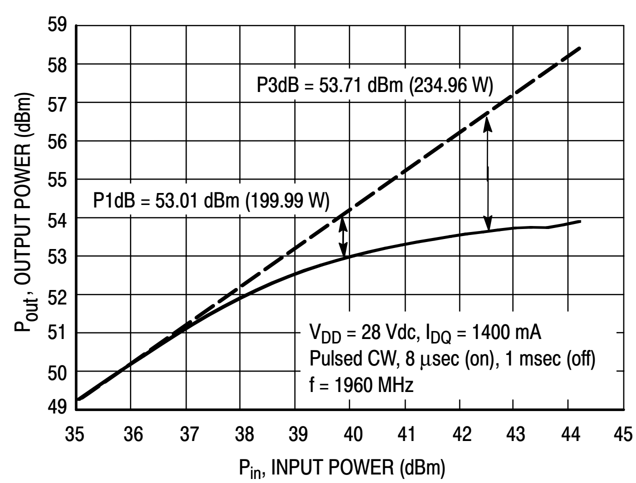


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

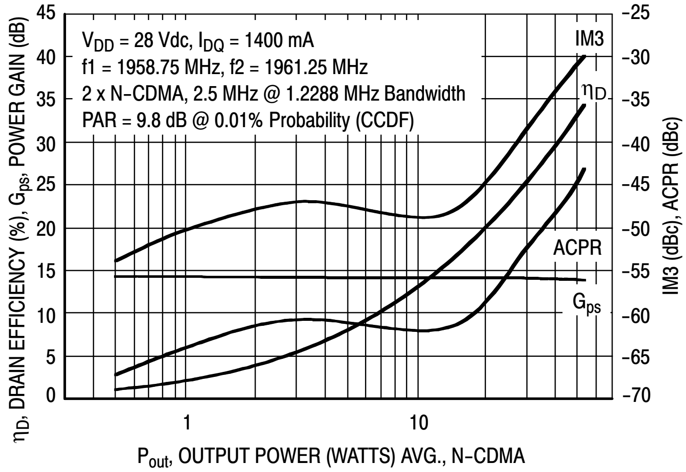
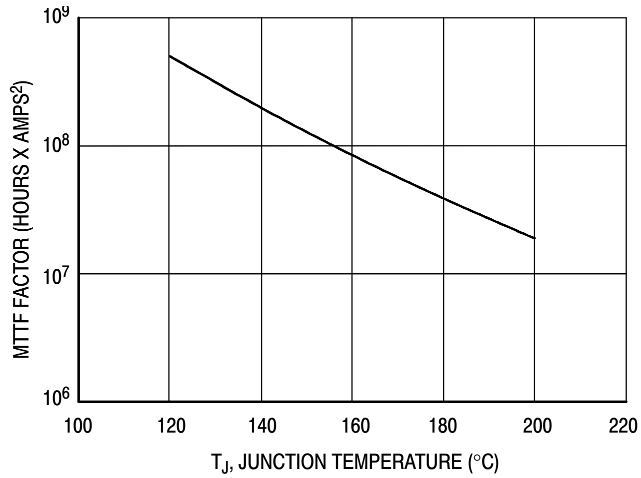


Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain, Drain Efficiency versus Output Power



This above graph displays calculated MTTF in hours x ampere² drain current. Life tests at elevated temperatures have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 9. MTTF Factor versus Junction Temperature

N-CDMA TEST SIGNAL

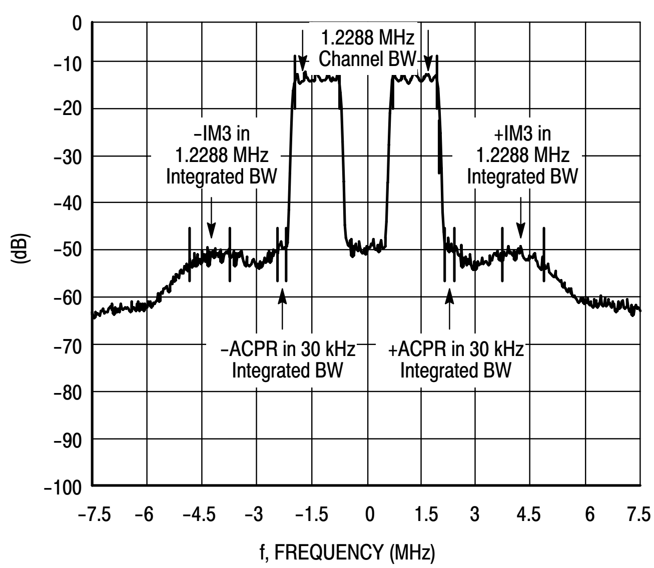
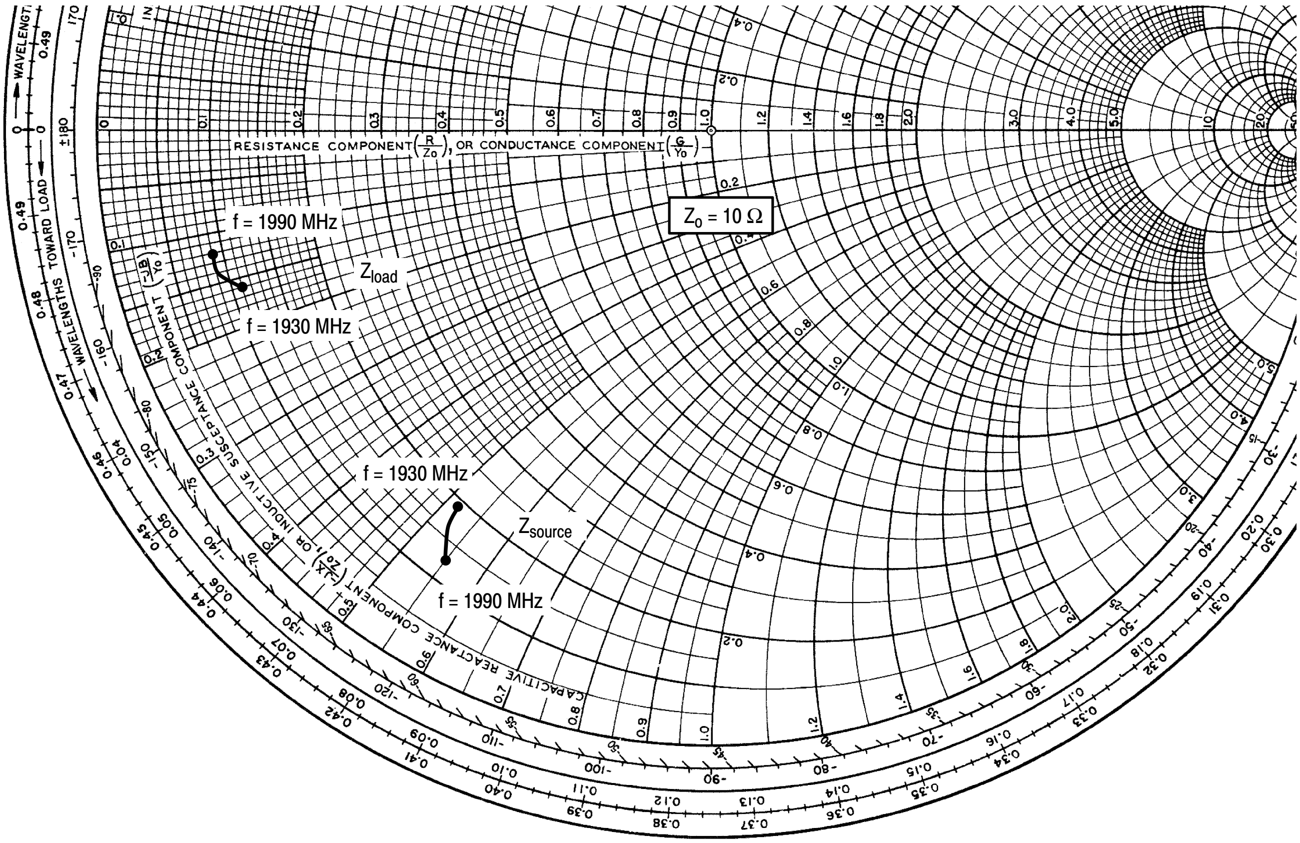


Figure 10. 2-Carrier N-CDMA Spectrum



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

f MHz	Z_{source} Ω	Z_{load} Ω
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.

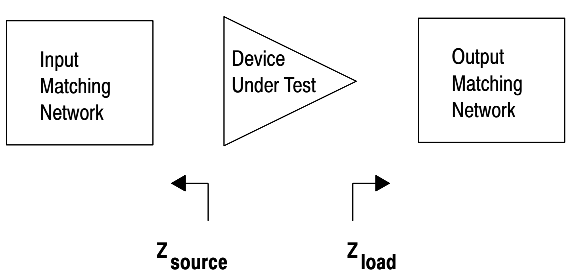
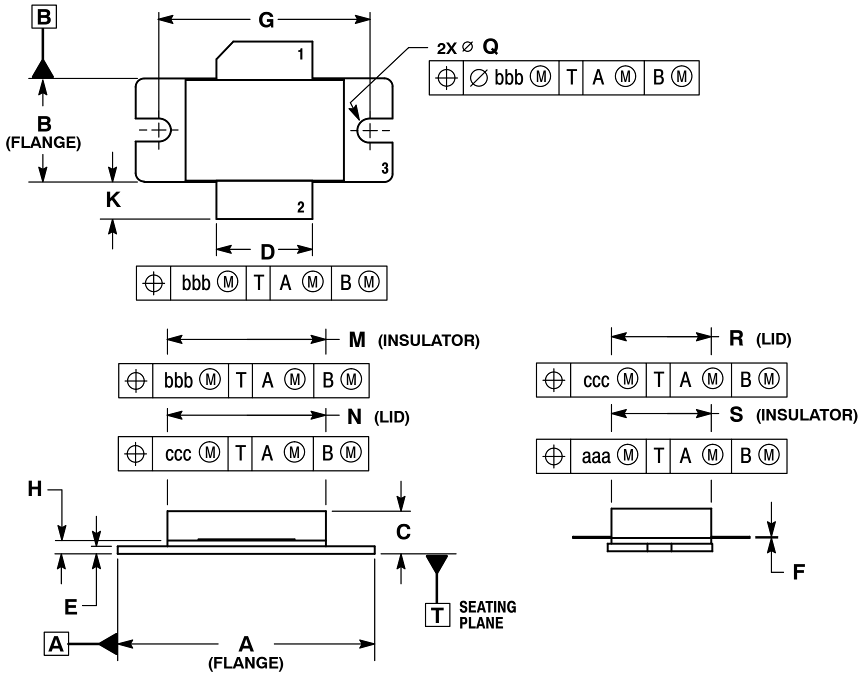


Figure 11. Series Equivalent Source and Load Impedance

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 MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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	∅.118	∅.138	∅3.00	∅3.51
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
2. GATE
3. SOURCE

CASE 465B-03
ISSUE D
NI-880
MRF5S19150HR3

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
4	Nov. 2008	• Data sheet revised to reflect part status change, p. 1 • Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 1, 2 • Updated Part Numbers in Table 5, Component Designations and Values, to latest RoHS compliant part numbers, p. 3 • Added Product Documentation and Revision History, p. 9

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