

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.

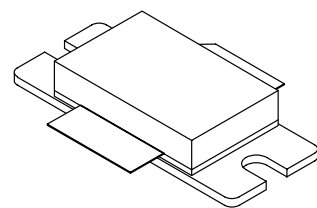
- Typical 2-Carrier N-CDMA Performance for $V_{DD} = 28$ Volts, $I_{DQ} = 1400$ mA, Avg., $P_{out} = 32$ Watts Avg., $f = 1990$ MHz, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. PAR = 9.8 dB @ 0.01% Probability on CCDF.
Power Gain — 14 dB
Drain Efficiency — 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 @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	427 2.44	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	$^\circ\text{C}$
CW Operation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	CW	120 0.76	W W/ $^\circ\text{C}$

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	$^\circ\text{C}/\text{W}$

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.

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 ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

Off Characteristics

Zero Gate Voltage Drain Leakage Current ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	1	μAdc

On Characteristics

Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 360\text{ }\mu\text{Adc}$)	$V_{GS(th)}$	2.5	2.8	3.5	Vdc
Gate Quiescent Voltage ($V_{DS} = 28\text{ Vdc}$, $I_D = 1400\text{ mAdc}$)	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 3.6\text{ Adc}$)	$V_{DS(on)}$	—	0.24	—	Vdc
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 3.6\text{ Adc}$)	g_{fs}	—	9	—	S

Dynamic Characteristics

Reverse Transfer Capacitance ⁽¹⁾ ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$)	C_{rss}	—	3.1	—	pF
---	-----------	---	-----	---	----

Functional Tests (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ} = 1400\text{ mA}$, $P_{out} = 32\text{ W Avg.}$, $f_1 = 1987.5\text{ MHz}$, $f_2 = 1990\text{ MHz}$, 2-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carriers. ACPR measured in 30 kHz Channel Bandwidth @ $\pm 885\text{ kHz}$ Offset. IM3 measured in 1.2288 MHz Channel Bandwidth @ $\pm 2.5\text{ MHz}$ 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.

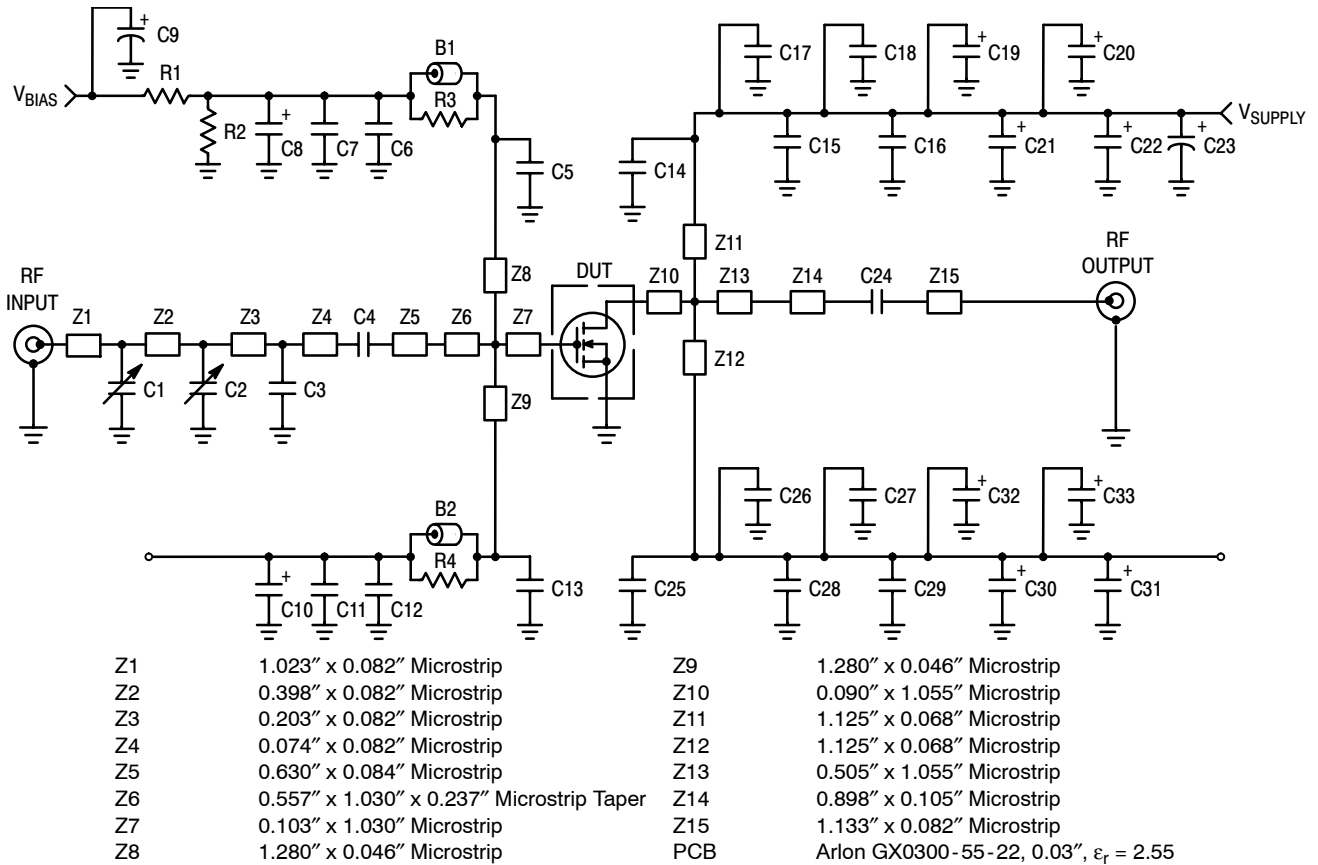
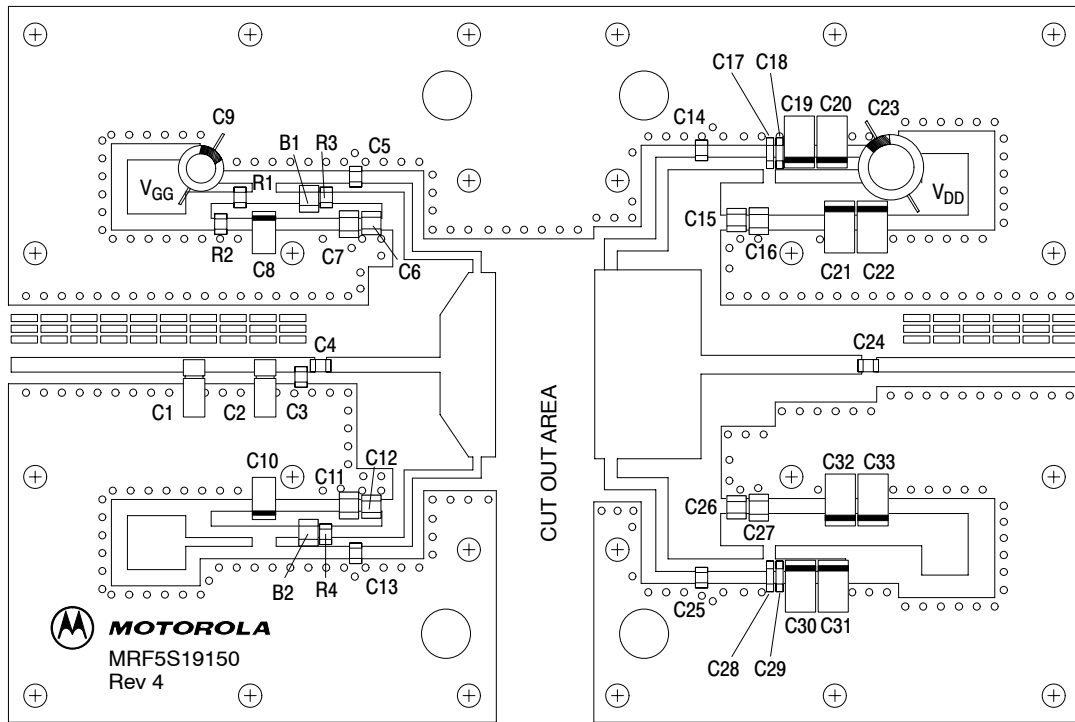


Figure 1. MRF5S19150HR3 Test Circuit Schematic

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 μ F, 50 V SMT Tantalum Capacitors, Kemet #T491C105M050AT
C6, C12, C16, C17, C18, C27, C28, C29	0.1 μ F Chip Capacitors, Kemet #CDR33BX104AKYS
C7, C11, C15, C26	1000 pF Chip Capacitors, ATC #ATC100B102JT50XT
C9	100 μ F, 50 V Electrolytic Capacitor, Multicomp #MCHT101M1HB-1017-RH
C23	470 μ F, 63 V Electrolytic Capacitor, Multicomp #EKME630ELL471MK25S
C19, C20, C21, C22, C30, C31, C32, C33	22 μ F, 35 V Tantalum Capacitors, Kemet #T491D226M035AS
R1	1 k Ω , 1/4 W Chip Resistor, Vishay #CRCW12061001FKEA
R2	560 k Ω , 1/4 W Chip Resistor, Vishay #CRCW12065600FKEA
R3, R4	12 Ω , 1/4 W Chip Resistors, Vishay #CRCW120612R0FKEA



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. MRF5S19150HR3 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

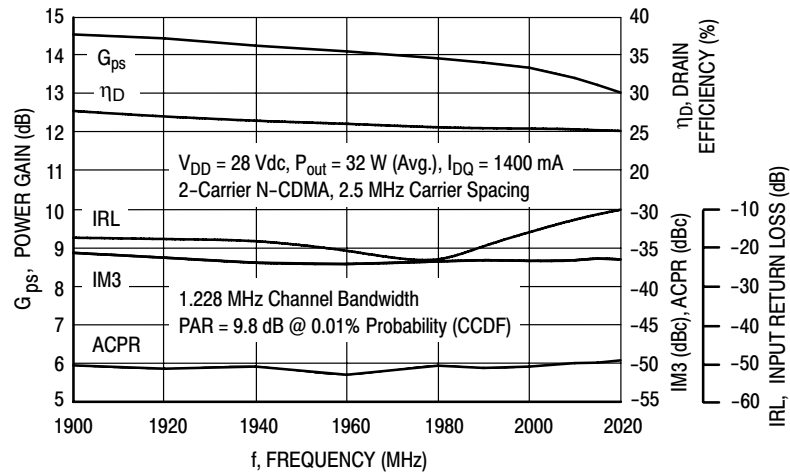


Figure 3. 2-Carrier N-CDMA Broadband Performance
@ $P_{out} = 32$ Watts Avg.

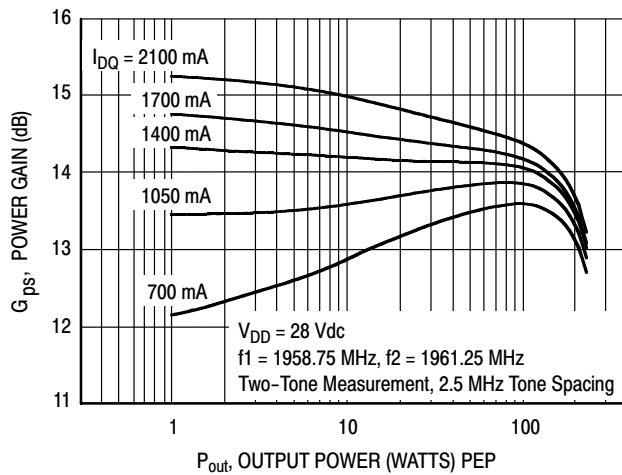


Figure 4. Two-Tone Power Gain versus Output Power

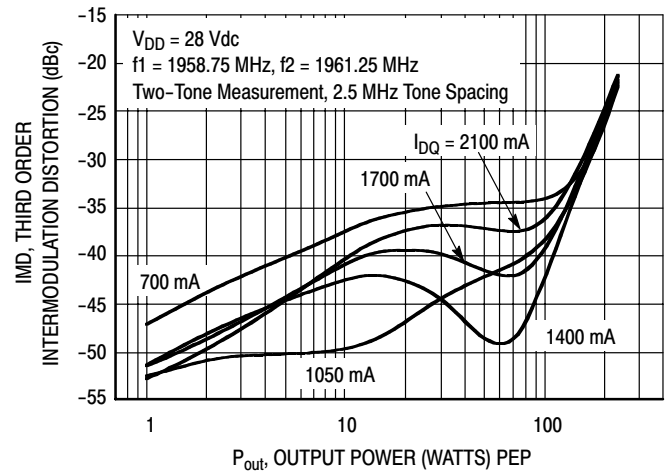


Figure 5. Third Order Intermodulation versus Output Power

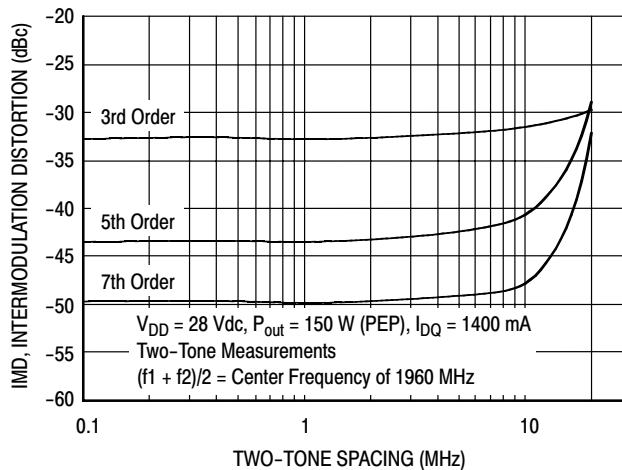


Figure 6. Intermodulation Distortion Products versus Tone Spacing

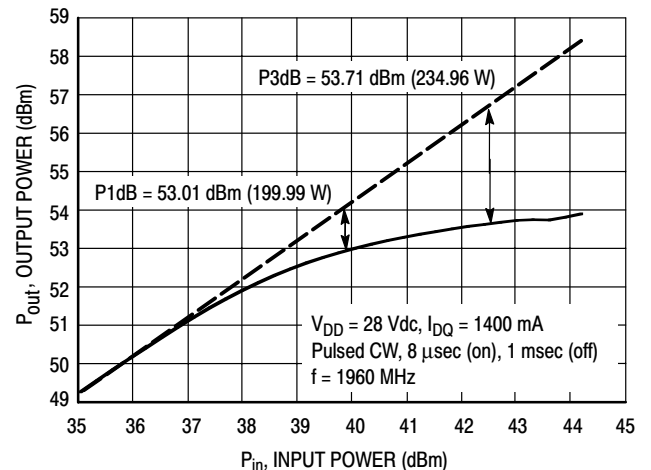


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

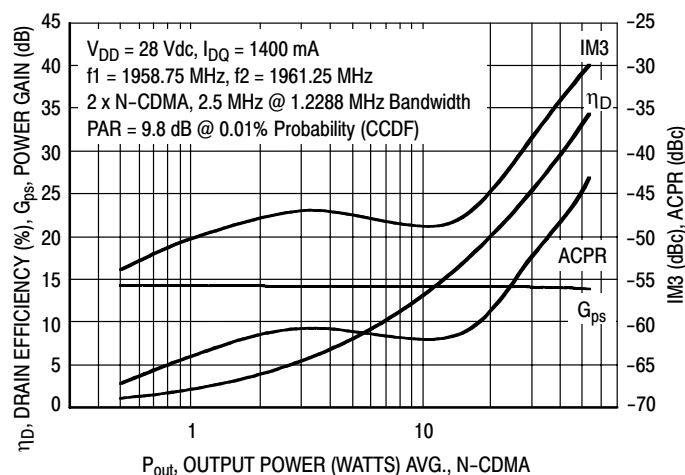
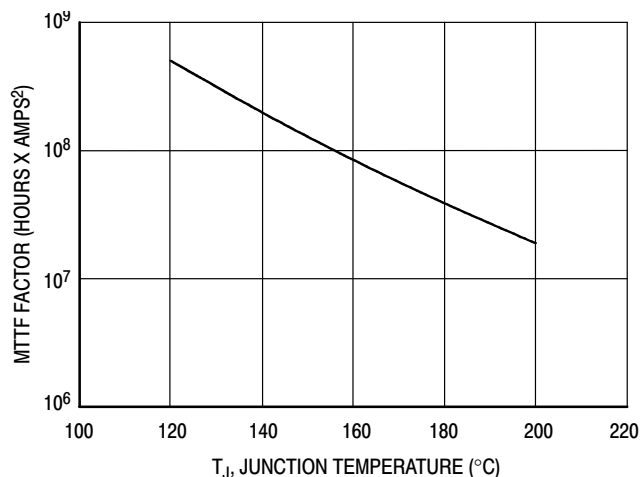


Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain, Drain Efficiency versus Output Power



This above graph displays calculated MTTF in hours x ampere² drain current. Life tests at elevated temperatures have correlated to better than $\pm 10\%$ 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

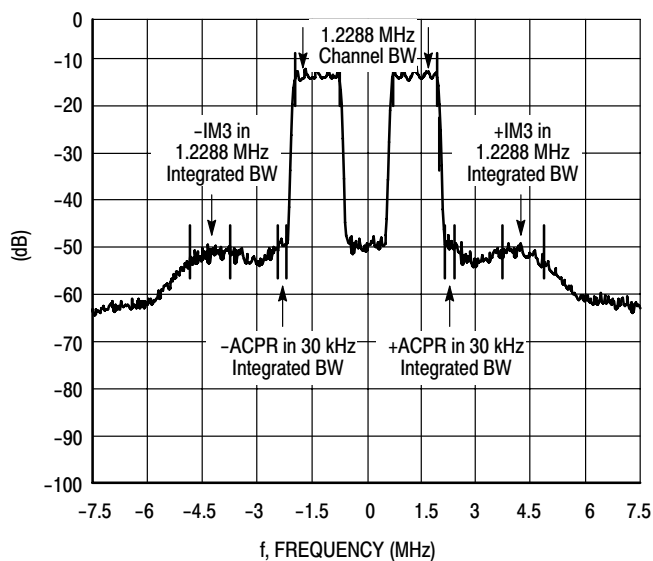
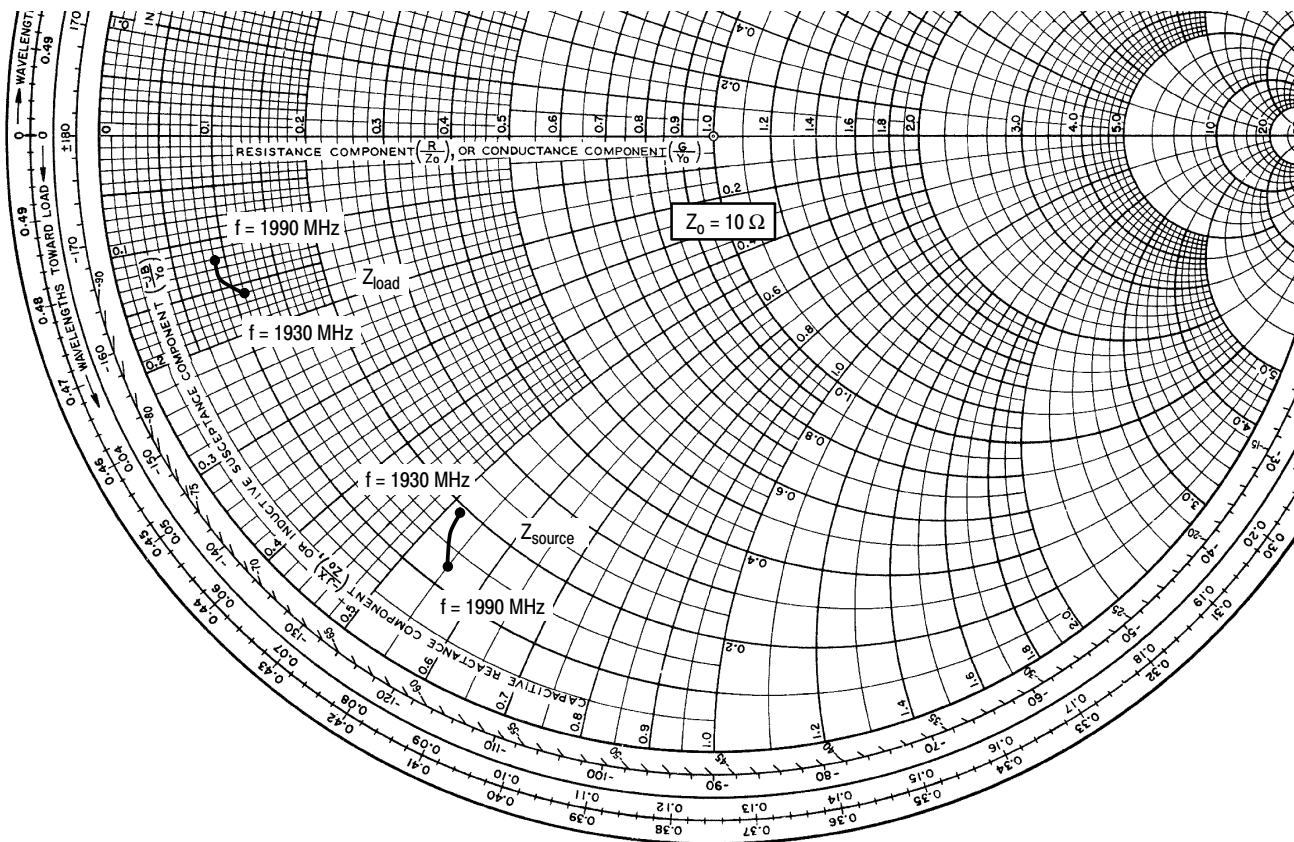


Figure 10. 2-Carrier N-CDMA Spectrum



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

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.

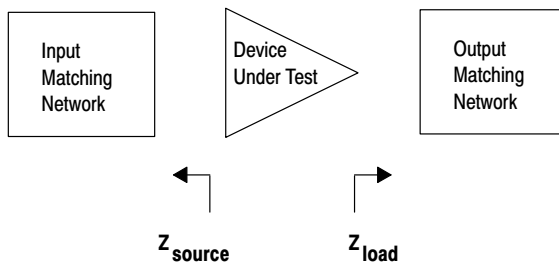
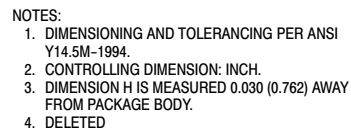


Figure 11. Series Equivalent Source and Load Impedance



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	Ø 3.00	Ø 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

How to Reach Us:

Home Page:

www.freescale.com

Web Support:

<http://www.freescale.com/support>

USA/Europe or Locations Not Listed:

Freescale Semiconductor, Inc.
Technical Information Center, EL516
2100 East Elliot Road
Tempe, Arizona 85284
1-800-521-6274 or +1-480-768-2130
www.freescale.com/support

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
www.freescale.com/support

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor China Ltd.
Exchange Building 23F
No. 118 Jianguo Road
Chaoyang District
Beijing 100022
China
+86 10 5879 8000
support.asia@freescale.com

For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or +1-303-675-2140
Fax: +1-303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2008. All rights reserved.

