Freescale Semiconductor
Technical Data

MRF5S21150H
Rev. 1, 5/2006

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF5S21150HR3
MRF5S21150HSR3

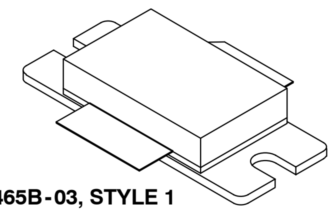
Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

- Typical 2-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1300 mA, P_{out} = 33 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 12.5 dB
  Efficiency — 25%
  IM3 @ 10 MHz Offset — -37 dBc in 3.84 MHz Channel Bandwidth
  ACPR @ 5 MHz Offset — -39 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 125 Watts CW Output Power

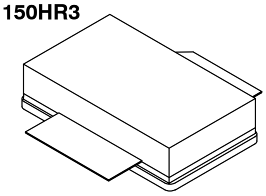
Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} 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.

2110-2170 MHz, 33 W AVG., 28 V
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465B-03, STYLE 1
NI-880
MRF5S21150HR3



CASE 465C-02, STYLE 1
NI-880S
MRF5S21150HSR3

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	380 2.2	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	150 0.84	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, 33 W CW	$R_{\theta JC}$	 0.46 0.47	°C/W

1. MTTF calculator available at http://www.freescale.com/rf. Select Tools/Software/Application Software/Calculators to access the 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°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	—	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1300 mAdc)	$V_{GS(Q)}$	—	3.7	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3.6 Adc)	$V_{DS(on)}$	—	0.26	0.3	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3.6 Adc)	g_{fs}	—	9	—	S
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	3.2	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1300 mA, P_{out} = 33 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Bandwidth @ ±10 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	11	12.5	—	dB
Drain Efficiency	η_D	23	25	—	%
Intermodulation Distortion	IM3		-37	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-39	-37	dBc
Input Return Loss	IRL	—	-12	-9	dB

1. Part internally matched both on input and output.

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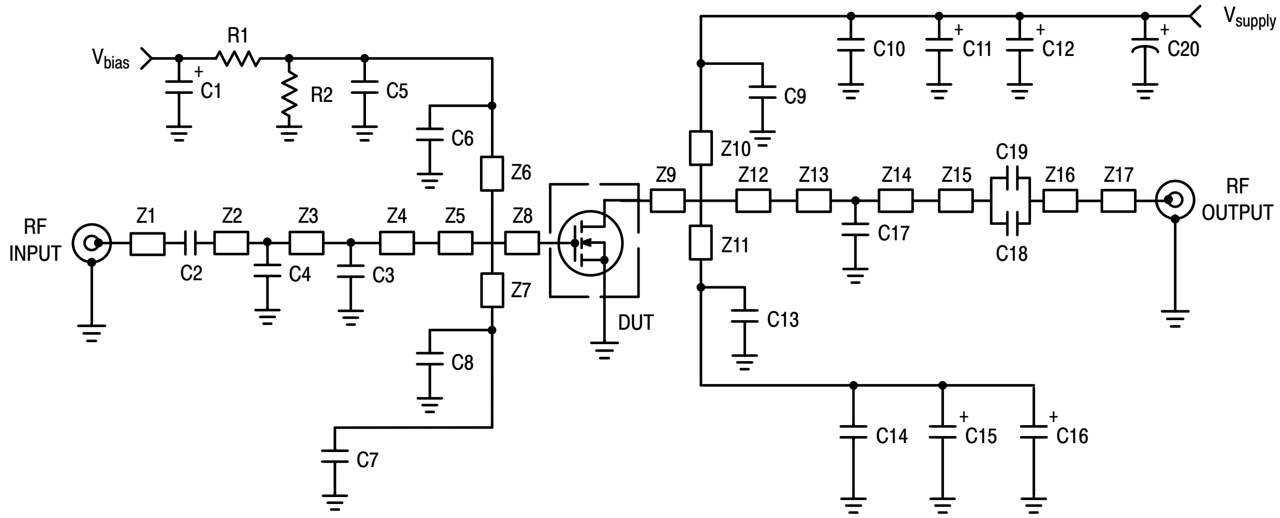

Z1	0.500″ x 0.083″ Microstrip
Z2	0.505″ x 0.083″ Microstrip
Z3	0.536″ x 0.083″ Microstrip
Z4	0.776″ x 0.083″ Microstrip
Z5	0.119″ x 1.024″ Microstrip
Z6, Z7	0.749″ x 0.083″ Microstrip
Z8	0.117″ x 1.024″ Microstrip
Z9	0.117″ x 1.100″ Microstrip
Z10, Z11	0.709″ x 0.083″ Microstrip
Z12	0.415″ x 1.100″ Microstrip
Z13	0.874″ x 0.083″ Microstrip
Z14	1.182″ x 0.083″ Microstrip
Z15, Z16	0.070″ x 0.220″ Microstrip
Z17	0.430″ x 0.083″ Microstrip
PCB	Taconic TLX8, 0.030″, ε_r = 2.55

Figure 1. MRF5S21150HR3(HSR3) Test Circuit Schematic

Table 5. MRF5S21150HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	22 μF, 35 V Tantalum Capacitor	TAJE226M035R	AVX
C2, C6, C8, C9, C13, C18, C19	6.8 pF 100B Chip Capacitors	100B6R8CW	ATC
C3,C4	1.8 pF 100B Chip Capacitors	100B1R8BW	ATC
C5, C7, C10, C14	220 nF Chip Capacitors (1812)	1812Y224KXA	Vishay-Vitramon
C11, C12, C15, C16	10 μF, 35 V Tantalum Capacitors	293D1106X9035D	Vishay-Sprague
C17	0.3 pF Chip Capacitor	100B0R3BW	ATC
C20	470 μF, 63 V Electrolytic Capacitor, Radial	13661471	Philips
R1, R2	10 kΩ, 1/4 W Chip Resistors		

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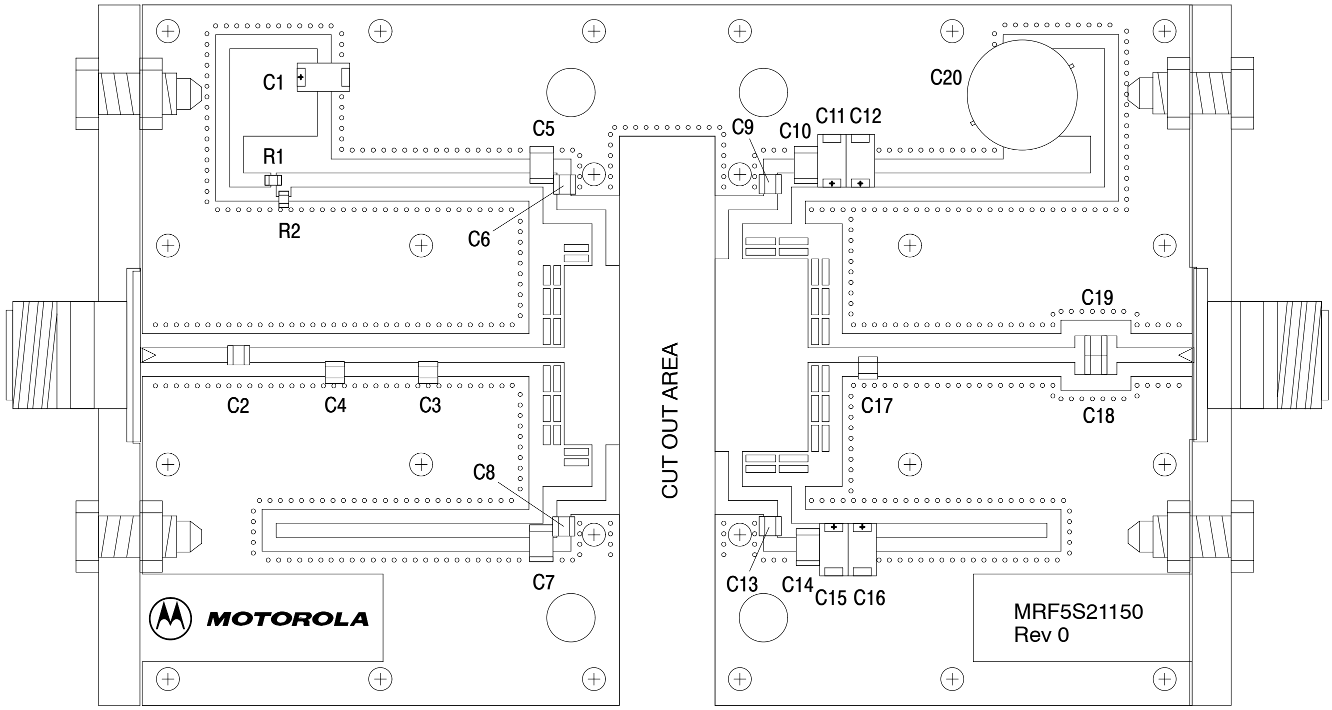

Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. MRF5S21150HR3(HSR3) Test Circuit Component Layout

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TYPICAL CHARACTERISTICS

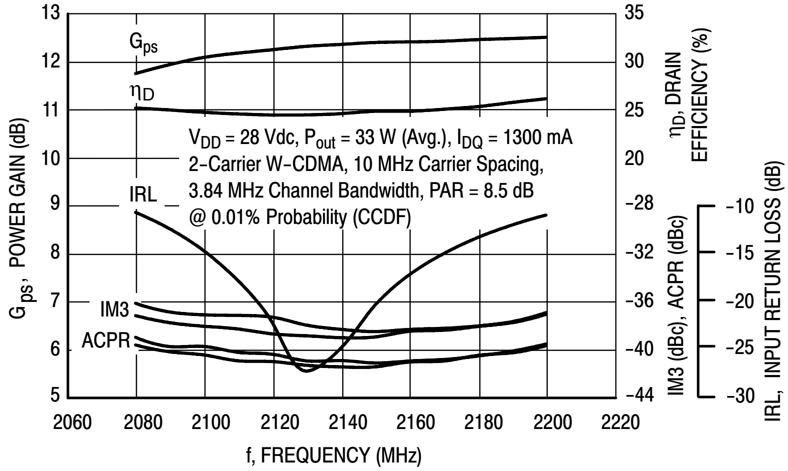


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 33 Watts Avg.

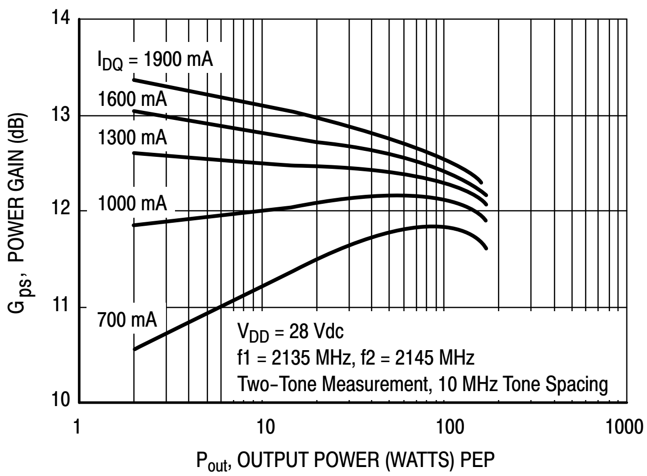


Figure 4. Two-Tone Power Gain versus Output Power

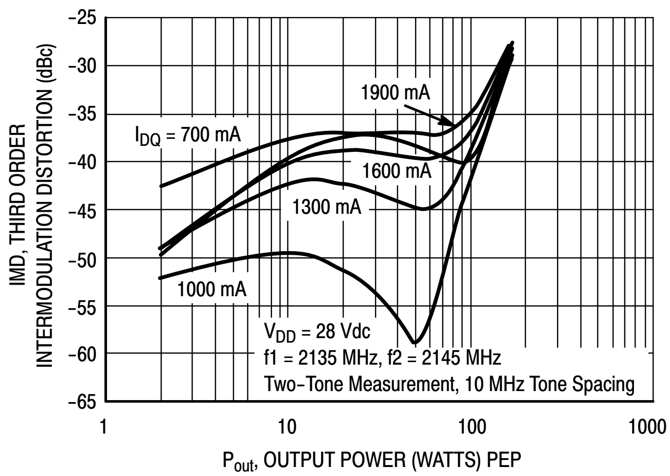


Figure 5. Third Order Intermodulation Distortion versus Output Power

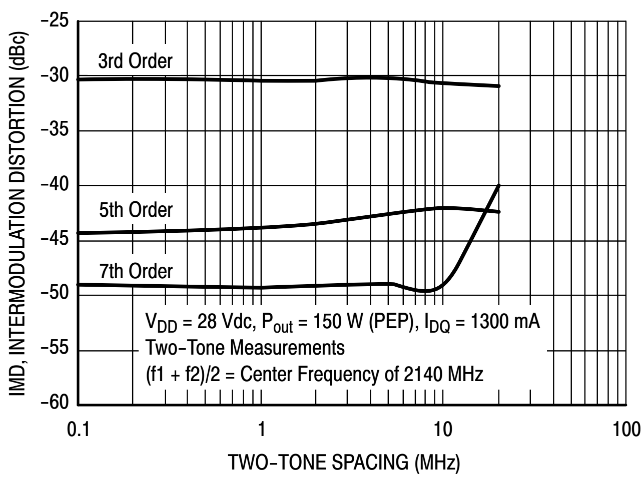


Figure 6. Intermodulation Distortion Products versus Tone Spacing

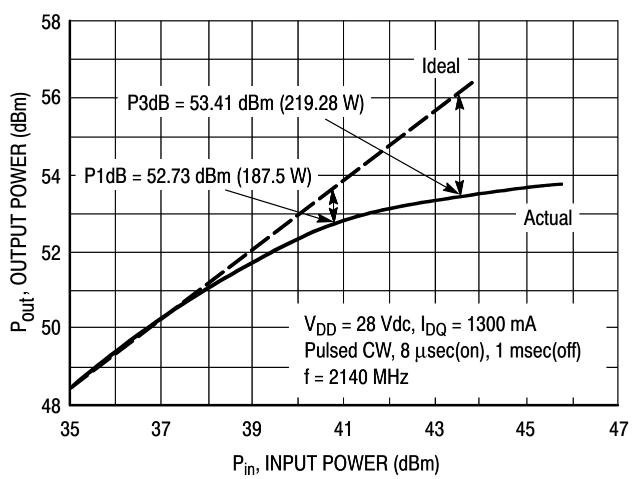


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

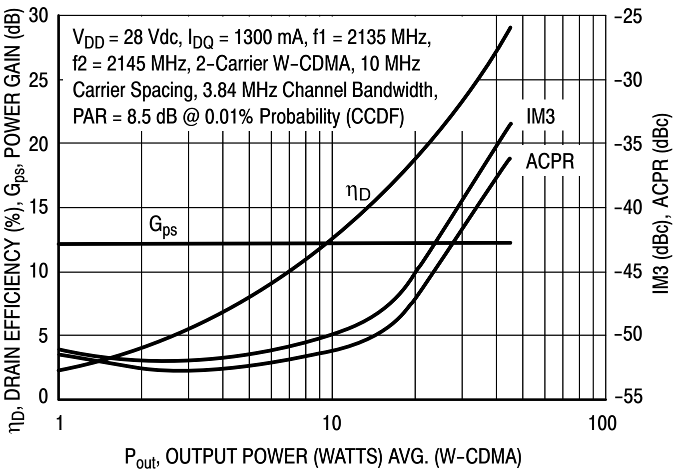
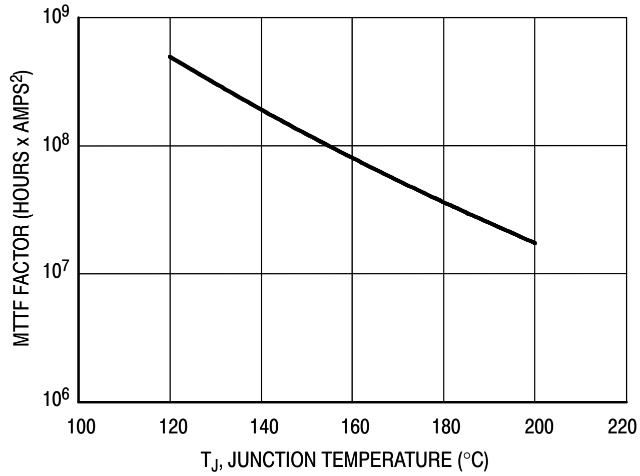


Figure 8. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power



This above graph displays calculated MTTF in hours x ampere^2 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

W-CDMA TEST SIGNAL

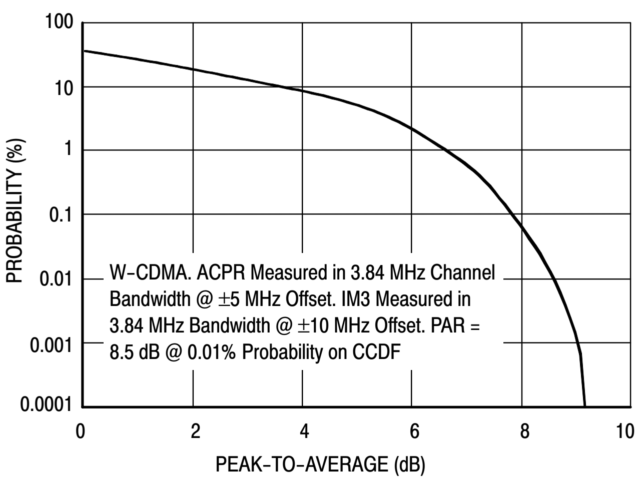


Figure 10. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

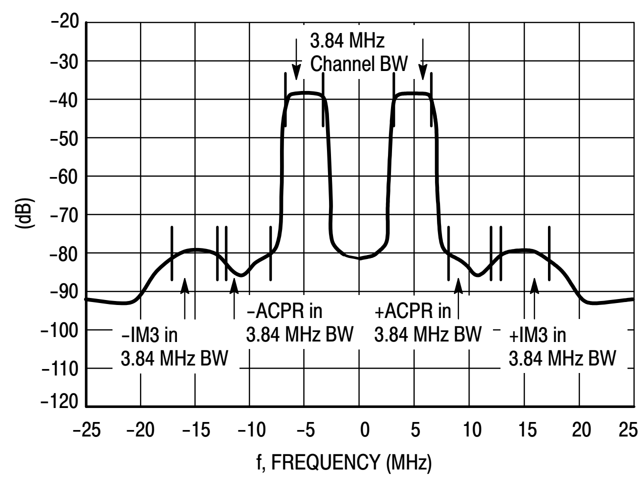
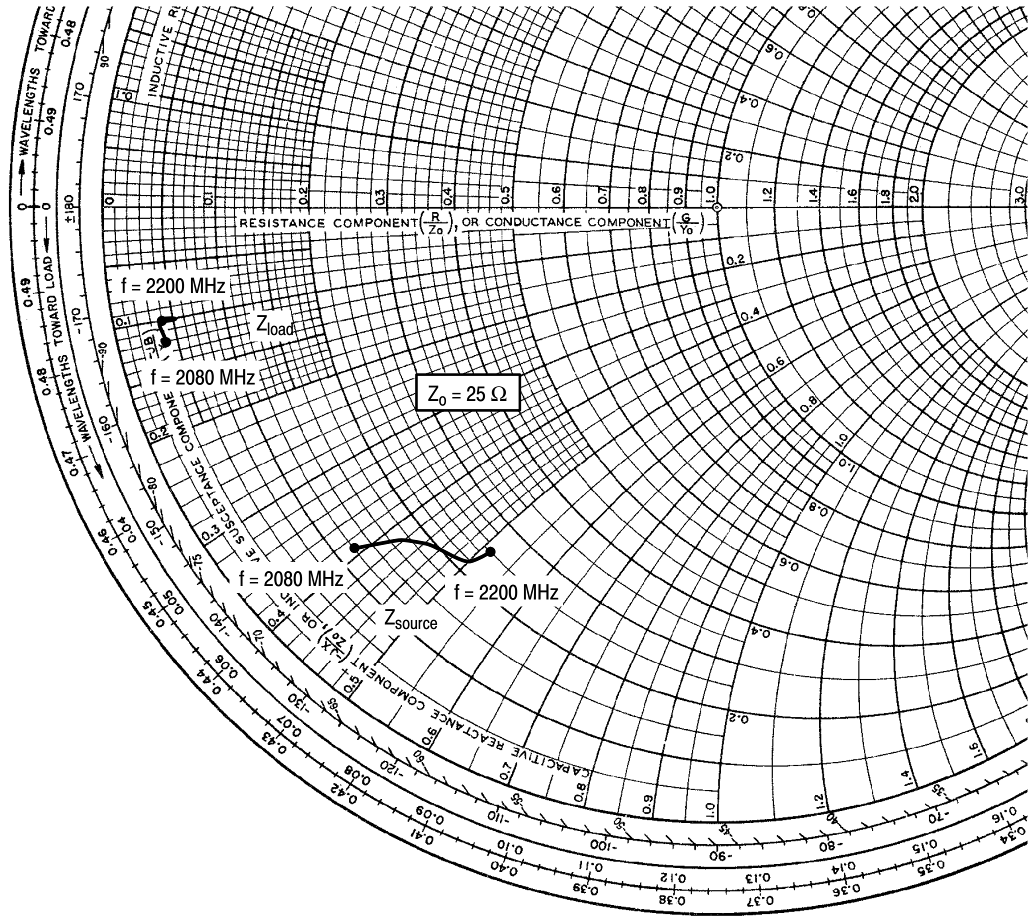


Figure 11. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1300 mA, P_{out} = 33 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2080	3.05 - j9.66	1.02 - j2.94
2110	3.97 - j10.31	1.09 - j2.51
2140	4.70 - j11.03	1.16 - j2.46
2170	5.45 - j12.41	1.16 - j2.58
2200	6.18 - j13.04	1.02 - j2.55

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

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

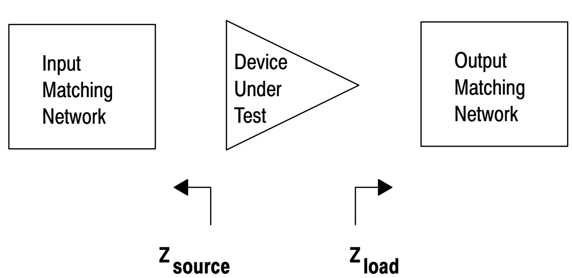


Figure 12. Series Equivalent Source and Load Impedance

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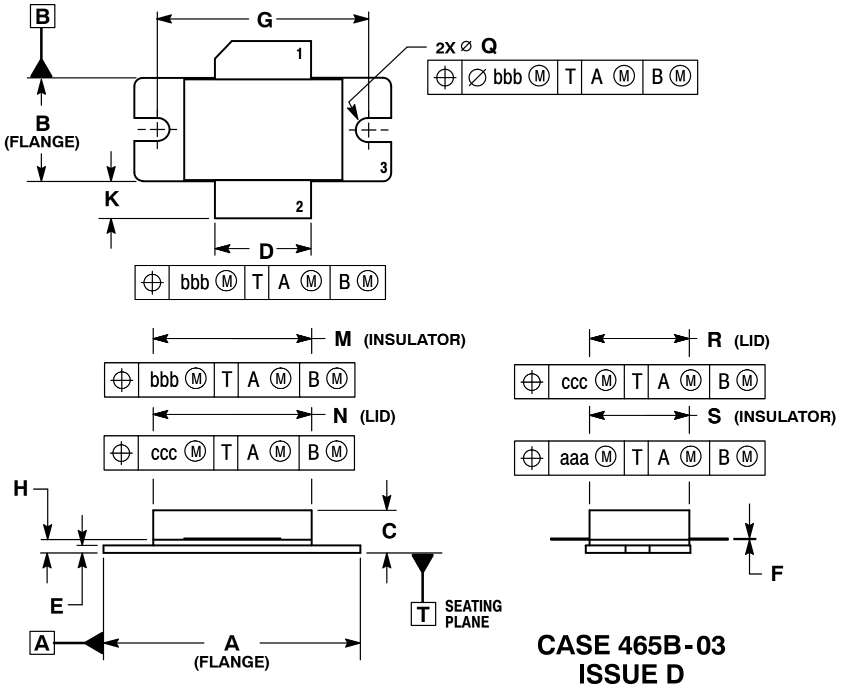
PACKAGE DIMENSIONS

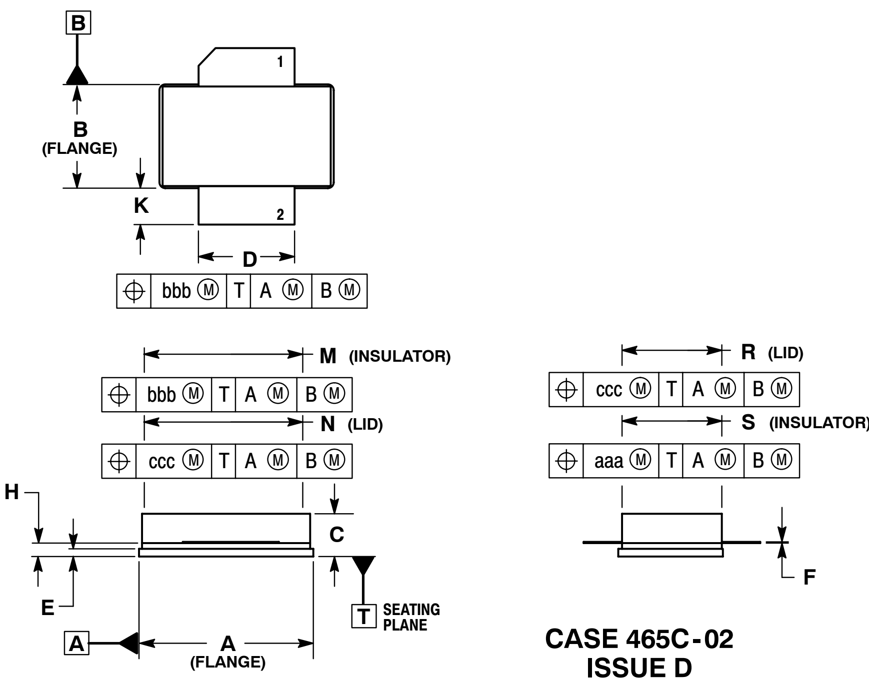


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. DELETED

	INCHES		MILLIMETERS	
DIM	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	∅.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
MRF5S21150HR3



NOTES:
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	INCHES		MILLIMETERS	
DIM	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
2. GATE
3. SOURCE

CASE 465C-02
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