RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF5S21130HR3
MRF5S21130HSR3

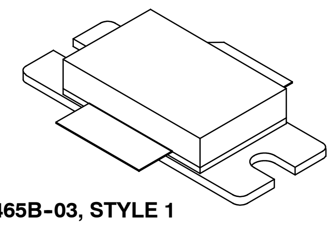
2110-2170 MHz, 28 W AVG., 28 V
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs

Designed for W-CDMA base station applications at 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.

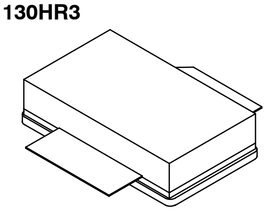
- Typical 2-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1200 mA, P_{out} = 28 Watts Avg., f = 2112.5 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  - Power Gain — 13.5 dB
  - Efficiency — 26%
  - IM3 @ 10 MHz Offset — -37 dBc in 3.84 MHz Channel Bandwidth
  - ACPR @ 5 MHz Offset — -39 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 92 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.



CASE 465B-03, STYLE 1
NI-880
MRF5S21130HR3



CASE 465C-02, STYLE 1
NI-880S
MRF5S21130HSR3

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	372 2.13	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	100 0.54	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 92 W CW Case Temperature 76°C, 28 W CW	$R_{\theta JC}$	 0.44 0.47	°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.

ARCHIVE INFORMATION

Table 3. ESD Protection Characteristics

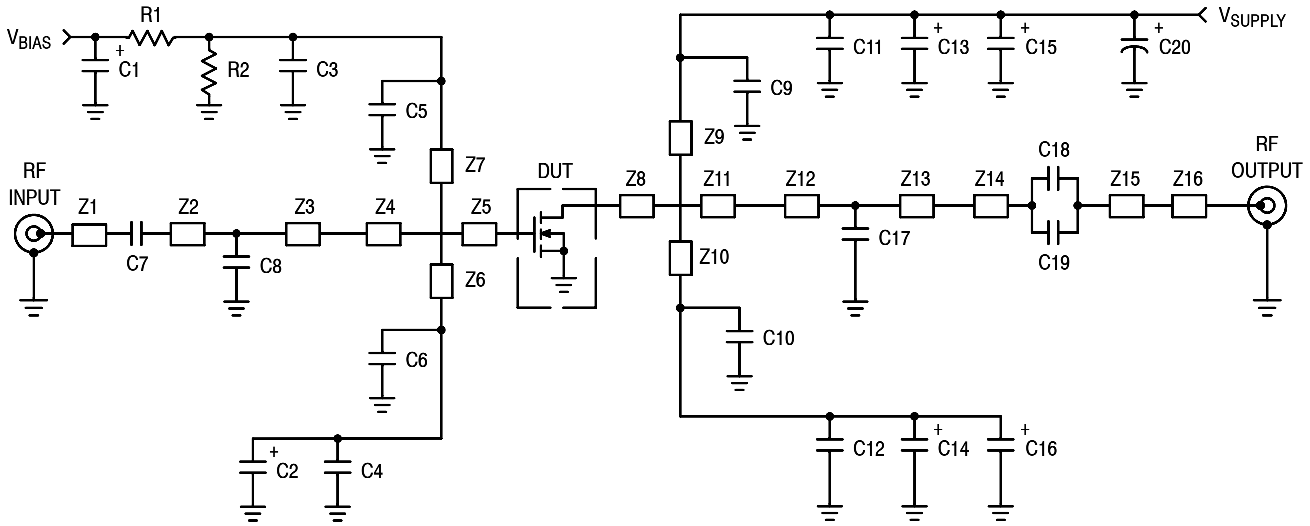
Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M4 (Minimum)
Charge Device Model	C7 (Minimum)

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 = 300 μAdc)	$V_{GS(th)}$	2.5	2.7	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1200 mAdc)	$V_{GS(Q)}$	—	3.7	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3 Adc)	$V_{DS(on)}$	—	0.26	0.3	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3 Adc)	g_{fs}	—	7.5	—	S
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.6	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1200 mA, P_{out} = 28 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 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 Channel Bandwidth @ ±10 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	12	13.5	—	dB
Drain Efficiency	η_D	24	26	—	%
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.

ARCHIVE INFORMATION



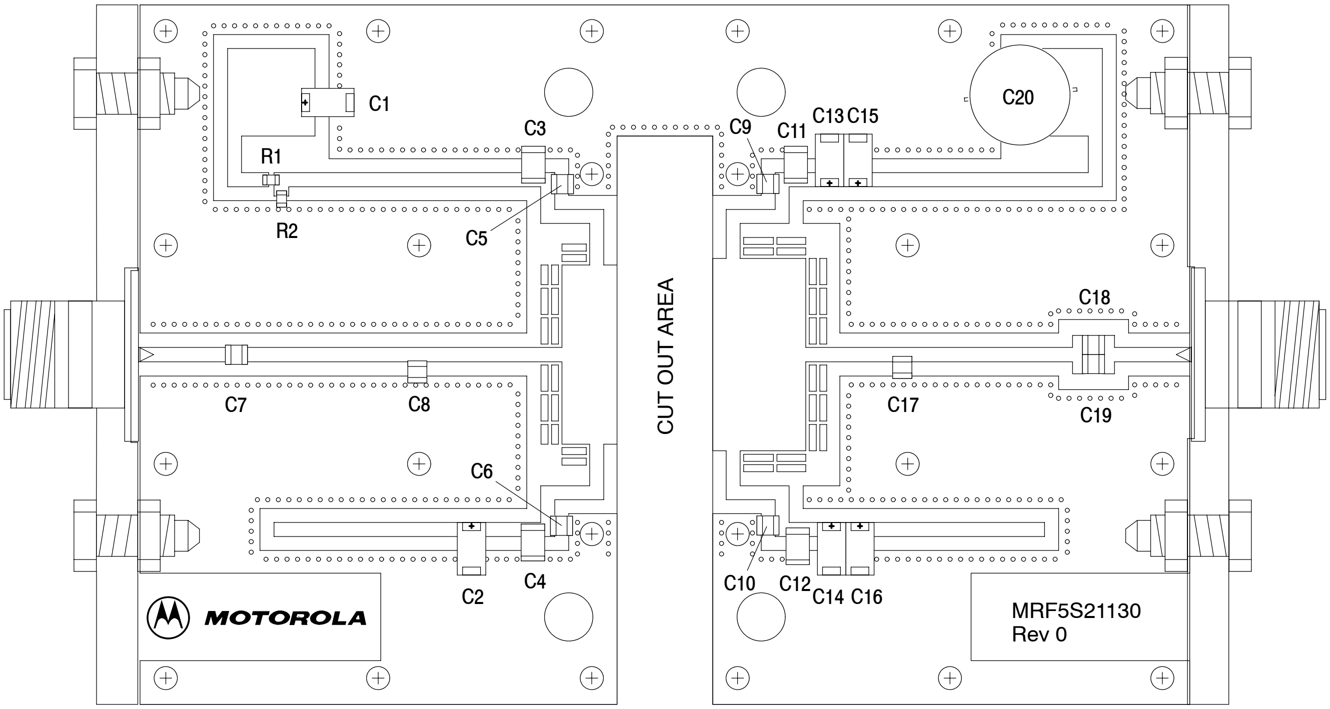
Z1	0.500″ x 0.083″ Microstrip	Z9, Z10	0.709″ x 0.083″ Microstrip
Z2	0.995″ x 0.083″ Microstrip	Z11	0.415″ x 1.000″ Microstrip
Z3	0.905″ x 0.083″ Microstrip	Z12	0.531″ x 0.083″ Microstrip
Z4	0.159″ x 1.024″ Microstrip	Z13	0.994″ x 0.083″ Microstrip
Z5	0.117″ x 1.024″ Microstrip	Z14, Z15	0.070″ x 0.220″ Microstrip
Z6, Z7	0.749″ x 0.083″ Microstrip	Z16	0.430″ x 0.083″ Microstrip
Z8	0.117″ x 1.000″ Microstrip	PCB	Taconic TLX8, 0.030″, ε_r = 2.55

Figure 1. MRF5S21130HR3(SR3) Test Circuit Schematic

Table 5. MRF5S21130HR3(SR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C13, C14, C15, C16	10 μF, 35 V Tantalum Capacitors	T491D106M035AT	Kemet
C3, C4, C11, C12	220 nF Chip Capacitors (1812)	1812Y224KAT	AVX
C5, C6, C7, C9, C10, C18, C19	6.8 pF 100B Chip Capacitors	ATC100B6R8CT500XT	ATC
C8	0.1 pF 100B Chip Capacitor	ATC100B0R1BT500XT	ATC
C17	0.5 pF 100B Chip Capacitor	ATC100B0R5BT500XT	ATC
C20	220 μF, 63 V Electrolytic Capacitor, Radial	2222-136-68221	Vishay
R1, R2	1 kΩ, 1/4 W Chip Resistors	CRCW12061001FKEA	Vishay

ARCHIVE INFORMATION



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. MRF5S21130HR3(SR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

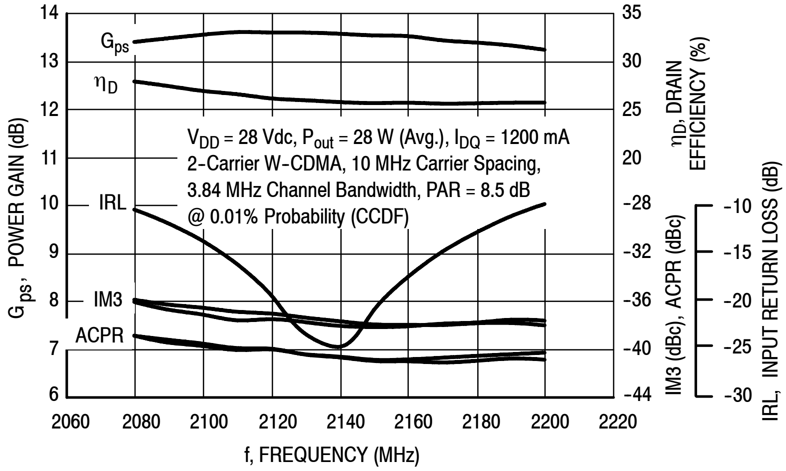


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 28 Watts Avg.

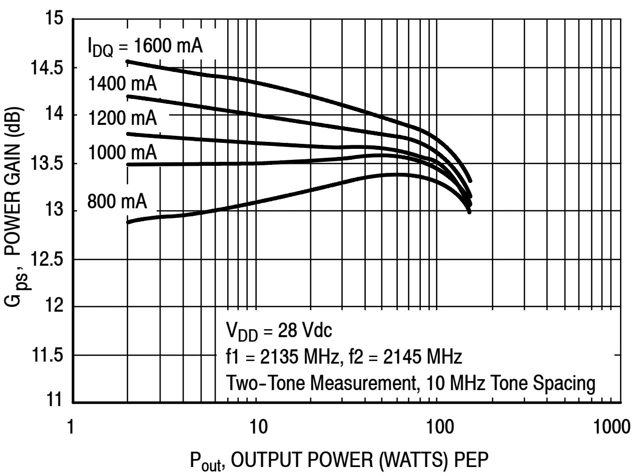


Figure 4. Two-Tone Power Gain versus Output Power

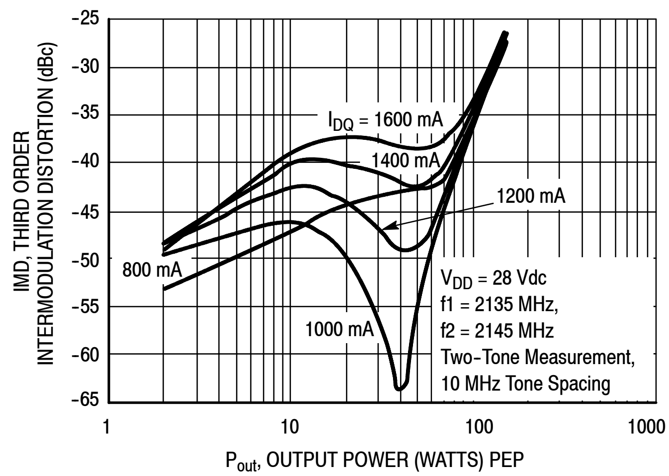


Figure 5. Third Order Intermodulation Distortion versus Output Power

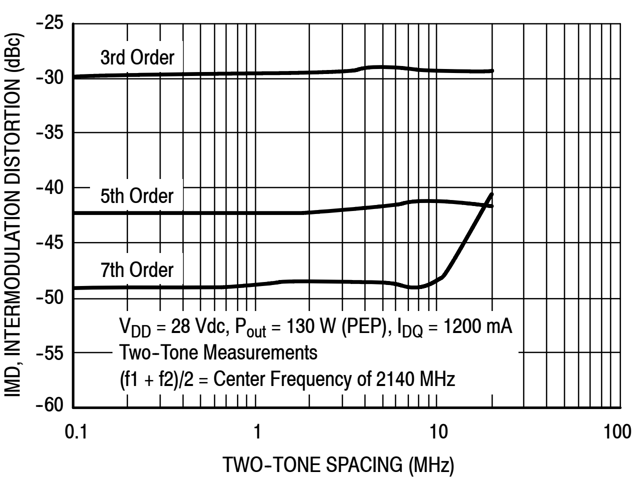


Figure 6. Intermodulation Distortion Products versus Tone Spacing

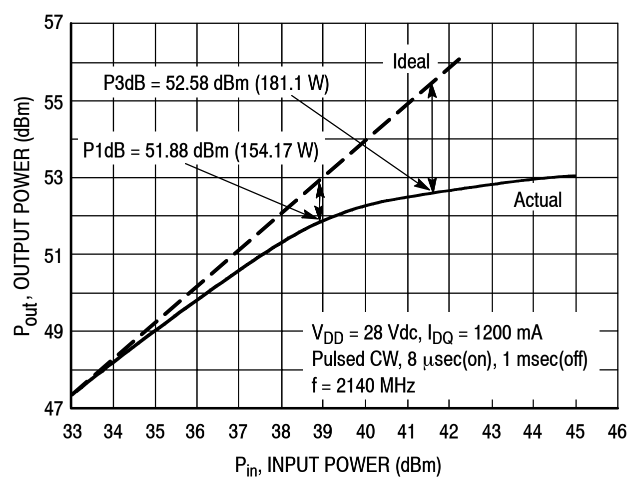


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

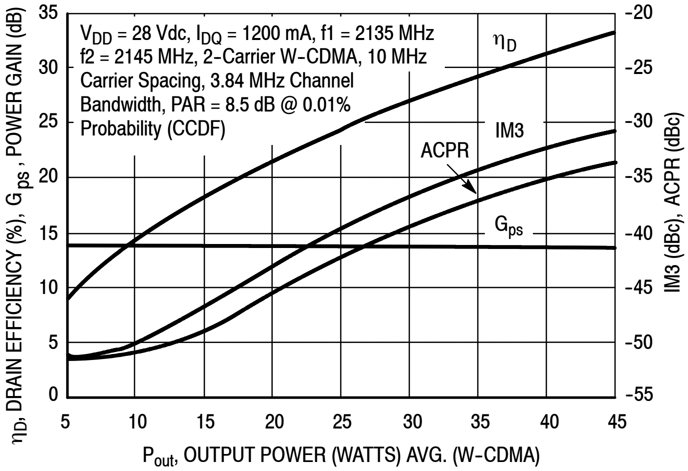
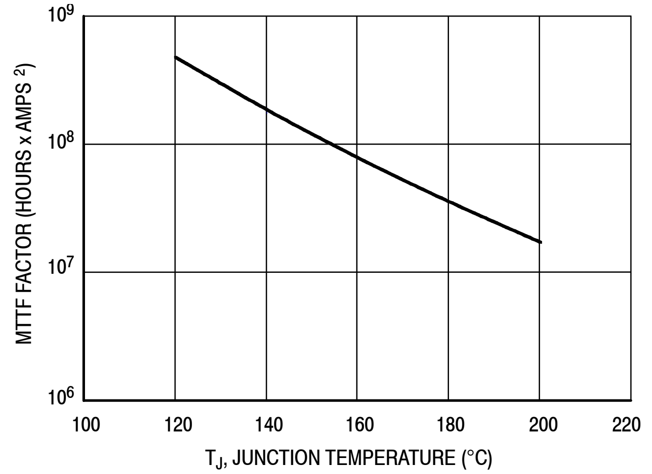


Figure 8. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power



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

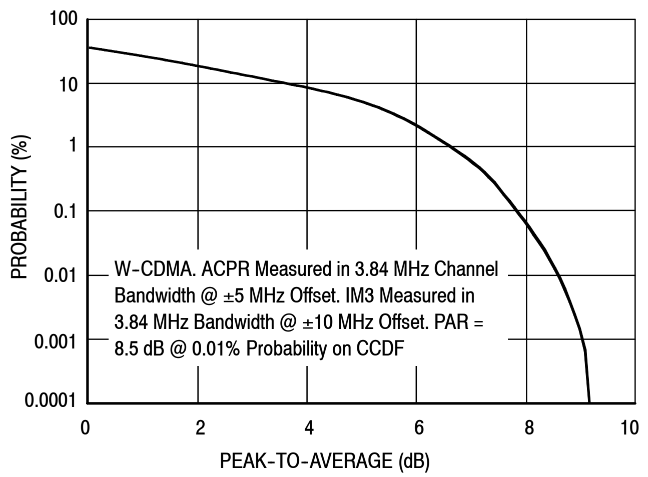


Figure 10. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

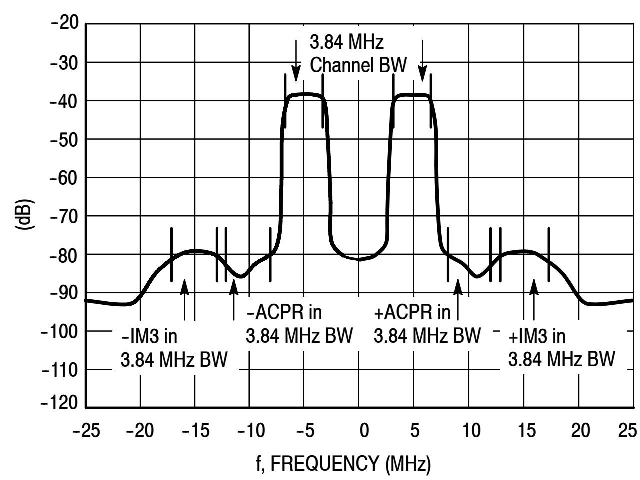
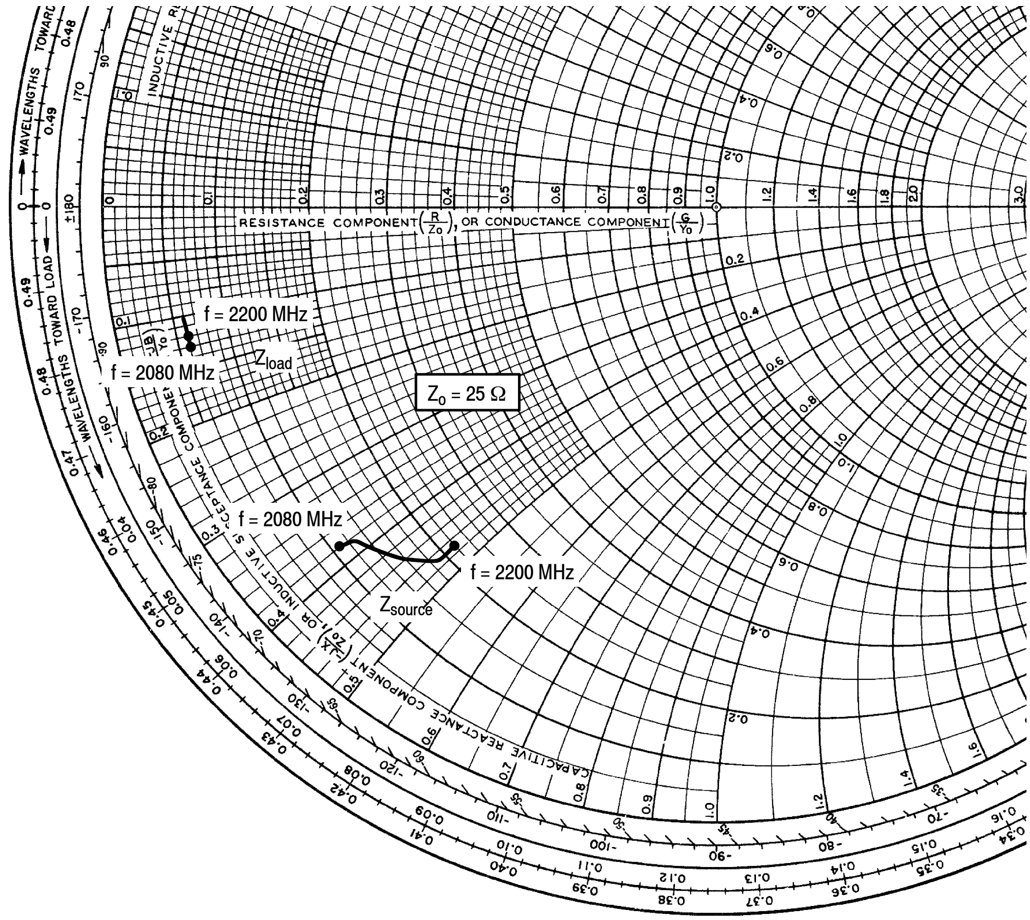


Figure 11. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1200 mA, P_{out} = 28 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2080	2.87 – j9.49	1.51 – j2.97
2110	3.13 – j9.86	1.52 – j2.54
2140	4.05 – j10.90	1.59 – j2.68
2170	4.80 – j11.75	1.62 – j2.70
2200	5.55 – j11.87	1.54 – j3.13

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

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

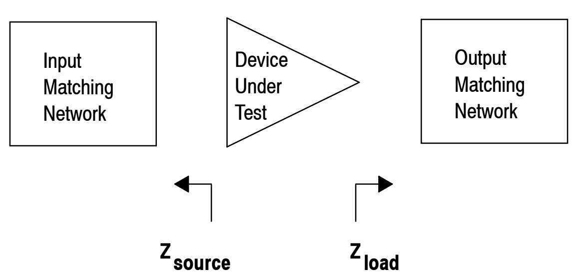
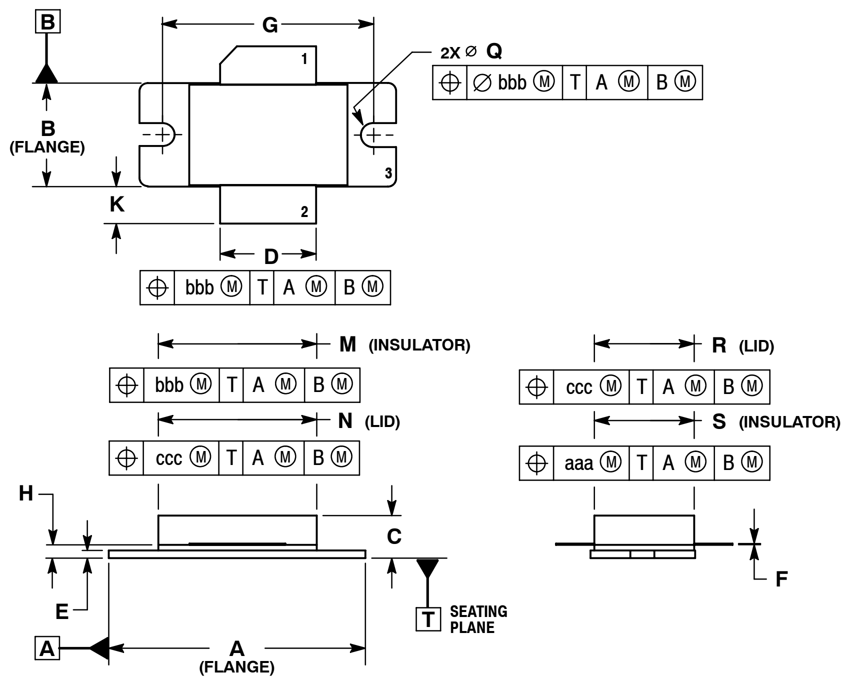


Figure 12. Series Equivalent Source and Load Impedance

ARCHIVE INFORMATION

PACKAGE DIMENSIONS

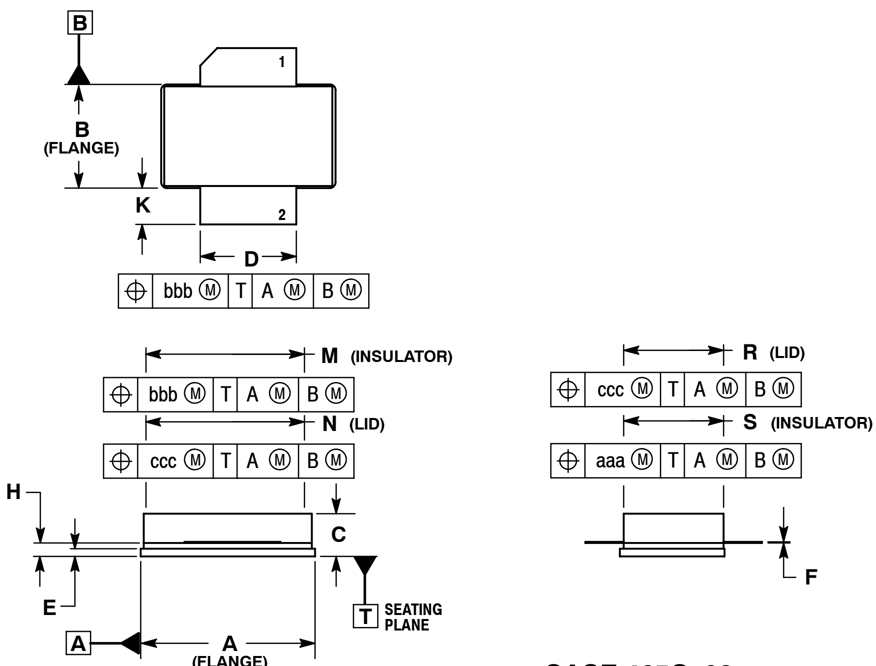


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. DELETED

	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	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
2. GATE
3. SOURCE

CASE 465B-03
ISSUE D
NI-880
MRF5S21130HR3



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.

	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
ISSUE D
NI-880S
MRF5S21130HSR3

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	Dec. 2010	• 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 RoHS compliant part numbers, p. 3 • Added Product Documentation and Revision History, p. 9 • Data sheet archived. Part no longer manufactured.

ARCHIVE INFORMATION

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
1-800-441-2447 or +1-303-675-2140
Fax: +1-303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com