



RF Power Field Effect Transistors

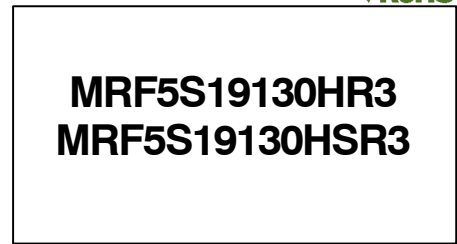
N-Channel Enhancement-Mode Lateral MOSFETs

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, $I_{DQ} = 1200$ mA, $P_{out} = 26$ Watts Avg., Full Frequency Band, 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 — 13 dB
 - Drain Efficiency — 25%
 - IM3 @ 2.5 MHz Offset — -37 dBc in 1.2288 MHz Bandwidth
 - ACPR @ 885 kHz Offset — -51 dB in 30 kHz Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 1960 MHz, 110 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, 40 μ ” Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.



1930-1990 MHz, 26 W AVG., 28 V
2 x N-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs

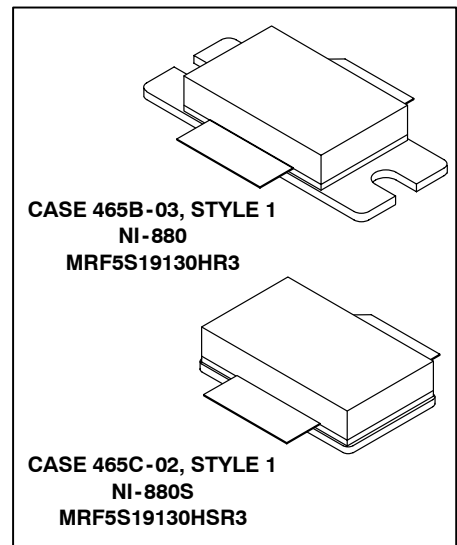


Table 1. Maximum Ratings

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 $^\circ\text{C}$	P_D	438 2.50	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 $^\circ\text{C}$	CW	160 1	W W/ $^\circ\text{C}$

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80 $^\circ\text{C}$, 115 W CW Case Temperature 78 $^\circ\text{C}$, 26 W CW	$R_{\theta JC}$	0.40 0.46	$^\circ\text{C}/\text{W}$

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	2 (Minimum)
Machine Model	M4 (Minimum)
Charge Device Model	C7 (Minimum)

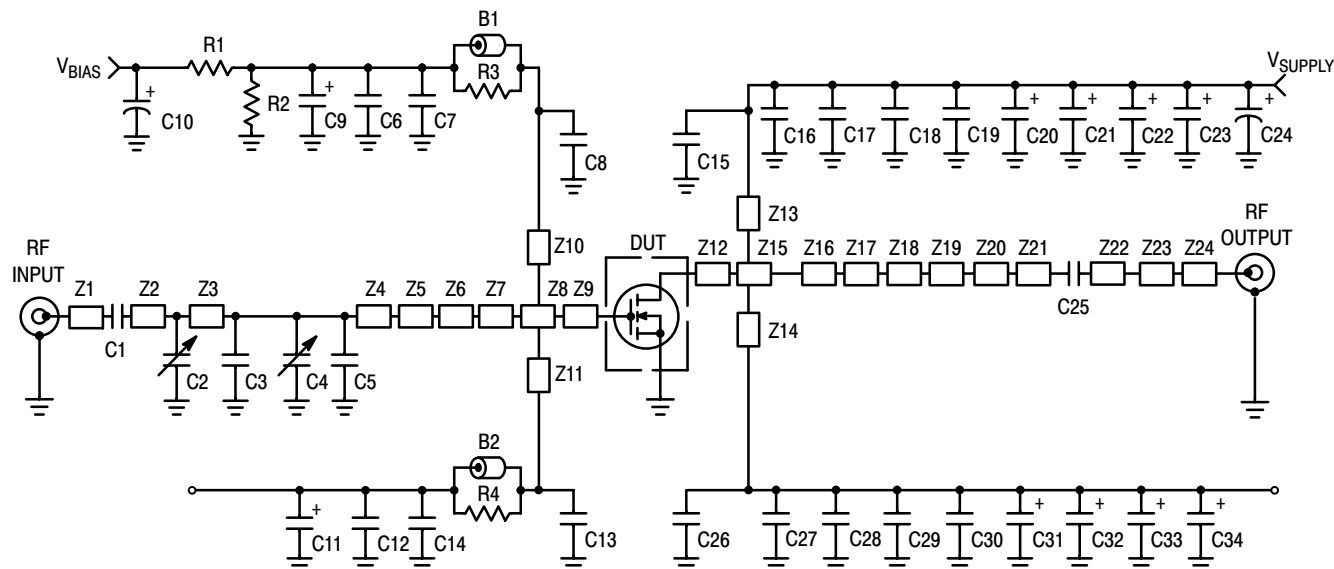
Table 4. Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise noted)

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 ($V_{DS} = 10\text{ Vdc}$, $I_D = 200\ \mu\text{Adc}$)	$V_{GS(th)}$	2.5	2.8	3.5	Vdc
Gate Quiescent Voltage ($V_{DS} = 28\text{ Vdc}$, $I_D = 1200\text{ mAdc}$)	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 3\text{ Adc}$)	$V_{DS(on)}$	—	0.26	—	Vdc
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 3\text{ Adc}$)	g_{fs}	—	7.5	—	S
Dynamic Characteristics					
Reverse Transfer Capacitance ⁽¹⁾ ($V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{rss}	—	2.7	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ} = 1200\text{ mA}$, $P_{out} = 26\text{ W Avg.}$, $f_1 = 1930\text{ MHz}$, $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$, $f_2 = 1990\text{ MHz}$, 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}	12	13	—	dB
Drain Efficiency	η_D	23	25	—	%
Intermodulation Distortion	IM3	—	-37	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-51	-48	dBc
Input Return Loss	IRL	—	-15	-9	dB

1. Part internally matched both on input and output.

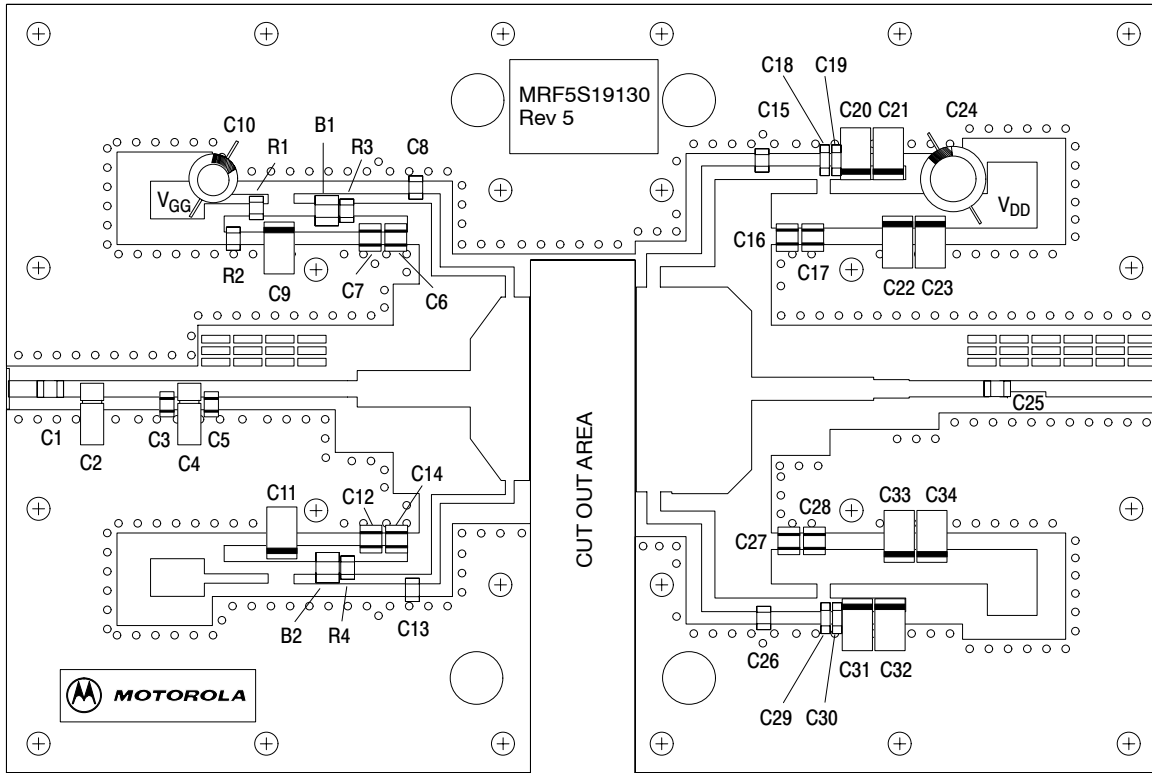


Z1	0.200" x 0.085" Microstrip	Z13, Z14	1.125" x 0.068" Microstrip
Z2	0.170" x 0.085" Microstrip	Z15	0.071" x 1.080" Microstrip
Z3	0.480" x 0.085" Microstrip	Z16	0.060" x 1.080" Microstrip
Z4	0.926" x 0.085" Microstrip	Z17	0.290" x 1.080" Microstrip
Z5	0.590" x 0.085" Microstrip	Z18	1.075" x 0.825" x 0.125" Taper
Z6	0.519" x 0.955" x 0.160" Taper	Z19	0.635" x 0.120" Microstrip
Z7	0.022" x 0.955" Microstrip	Z20	0.185" x 0.096" Microstrip
Z8	0.046" x 0.955" Microstrip	Z21	0.414" x 0.084" Microstrip
Z9	0.080" x 0.955" Microstrip	Z22	0.040" x 0.084" Microstrip
Z10, Z11	1.280" x 0.046" Microstrip	Z23	0.199" x 0.057" Microstrip
Z12	0.053" x 1.080" Microstrip	PCB	Arlon GX0300-55-22, 0.03", $\epsilon_r = 2.55$

Figure 1. MRF5S19130HR3(SR3) Test Circuit Schematic

Table 5. MRF5S19130HR3(SR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2	Short RF Bead	95F786	Newark
C1	0.8 pF Chip Capacitor	100B0R8BP 500X	ATC
C2, C4	0.6 – 4.5 pF Gigatrim Variable Capacitors	44F3358	Newark
C3	2.2 pF Chip Capacitor	100B2R2BP 500X	ATC
C5	1.7 pF Chip Capacitor	100B1R7BP 500X	ATC
C8, C13	9.1 pF Chip Capacitors	100B9R1CP 500X	ATC
C9, C11	1 μ F, 25 V Tantalum Capacitors	92F1845	Newark
C10	47 μ F, 50 V Electrolytic Capacitor	51F2913	Newark
C6, C14, C17, C18, C19, C28, C29, C30	0.1 μ F Chip Capacitors	CDR33BX104AKWS	Kemet
C7, C12, C16, C27	1000 pF Chip Capacitors	100B102JP 500X	ATC
C15, C26	8.2 pF Chip Capacitors	100B8R2CP 500X	ATC
C20, C21, C22, C23, C31, C32, C33, C34	22 μ F, 35 V Tantalum Capacitors	92F1853	Newark
C24	470 μ F, 63 V Electrolytic Capacitor	95F4579	Newark
C25	6.2 pF Chip Capacitor	100B6R2CP 500X	ATC
R1	1 k Ω Chip Resistor	D5534M07B1K00R	Newark
R2	560 k Ω Chip Resistor	CR1206 564JT	Newark
R3, R4	12 Ω Chip Resistors	RM73B2B120JT	Garrett Electronics



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. MRF5S19130HR3(SR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

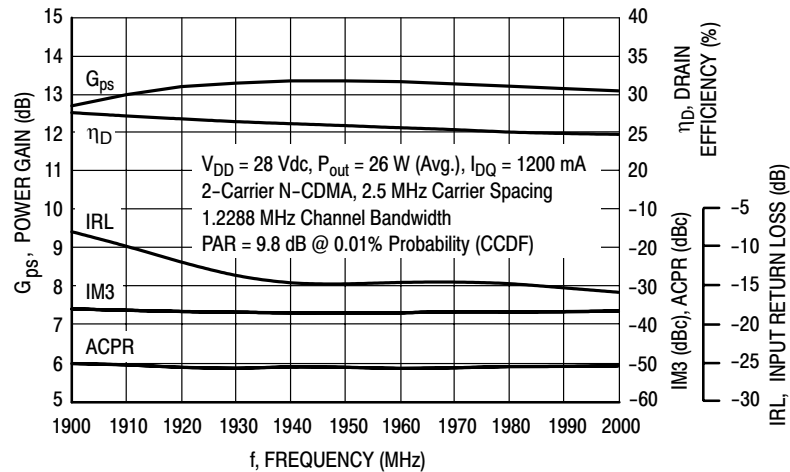


Figure 3. 2-Carrier N-CDMA Broadband Performance @ $P_{out} = 26$ Watts Avg.

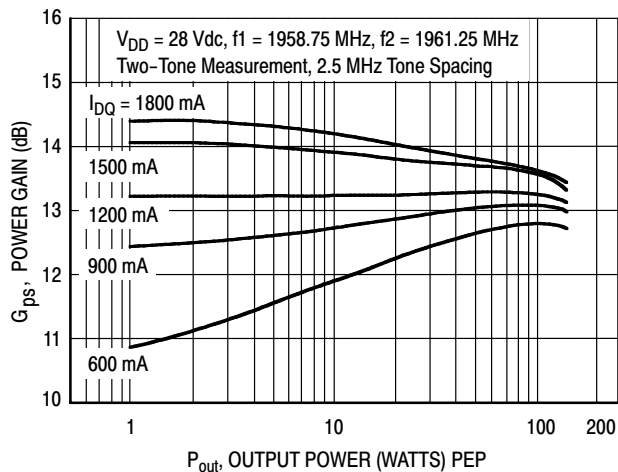


Figure 4. Two-Tone Power Gain versus Output Power

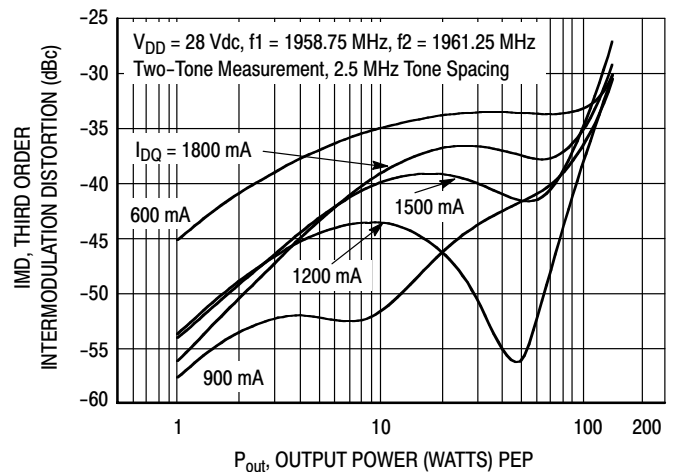


Figure 5. Third Order Intermodulation Distortion versus Output Power

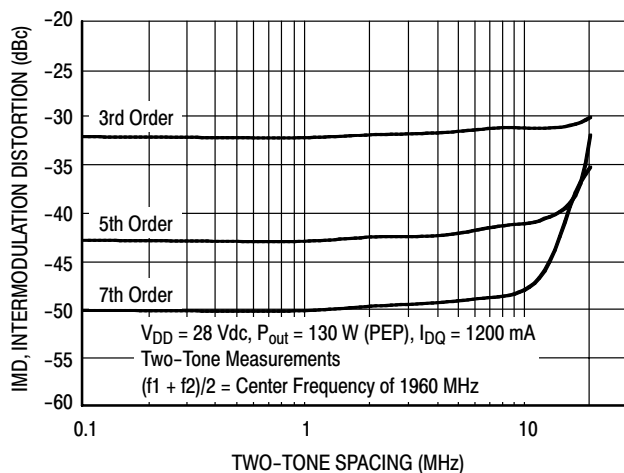


Figure 6. Intermodulation Distortion Products versus Tone Spacing

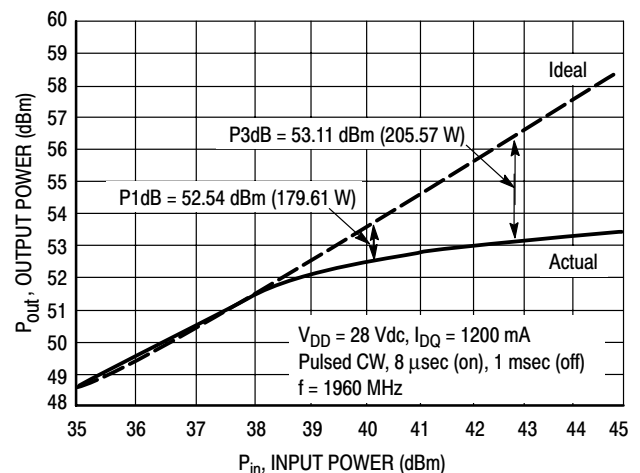


Figure 7. Pulse CW Output Power versus Input Power

MRF5S19130HR3 MRF5S19130HSR3

TYPICAL CHARACTERISTICS

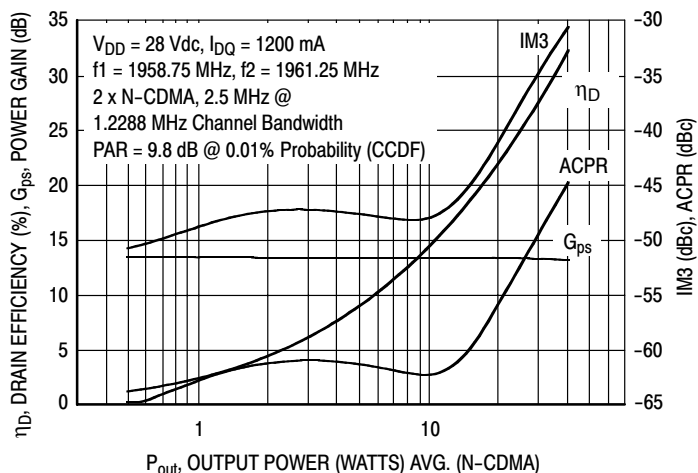
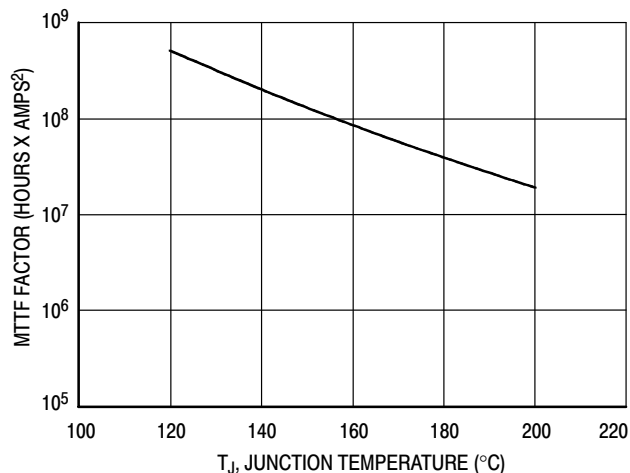


Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power



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

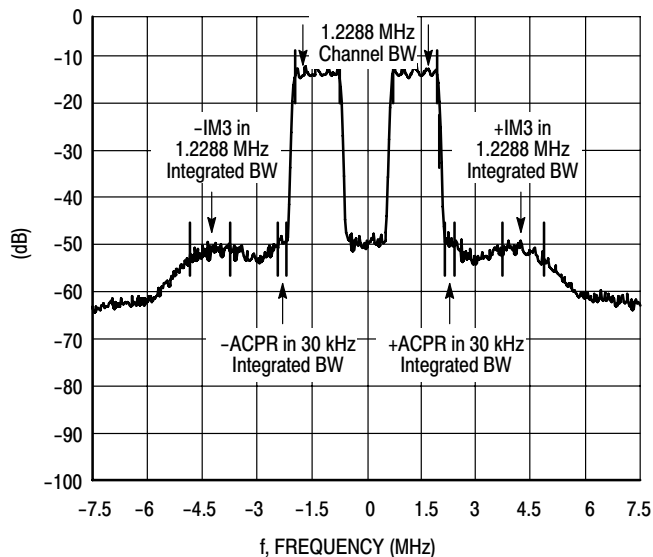
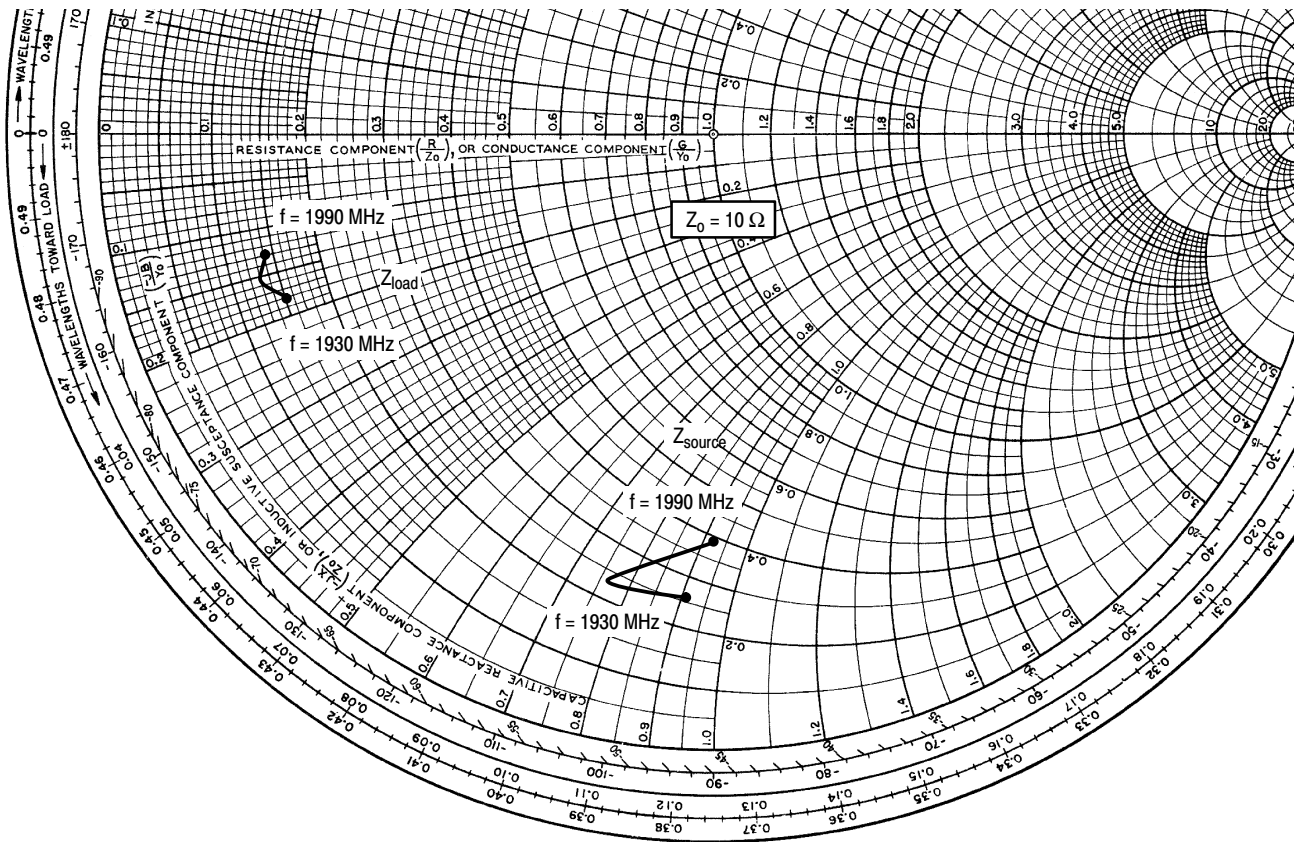


Figure 10. 2-Carrier N-CDMA Spectrum



$V_{DD} = 28\text{ V}$, $I_{DQ} = 1.2\text{ A}$, $P_{out} = 26\text{ W Avg.}$

f MHz	Z_{source} Ω	Z_{load} Ω
1930	$2.57 - j9.1$	$1.48 - j1.8$
1960	$2.35 - j7.6$	$1.28 - j1.5$
1990	$3.86 - j9.2$	$1.42 - j1.3$

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

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

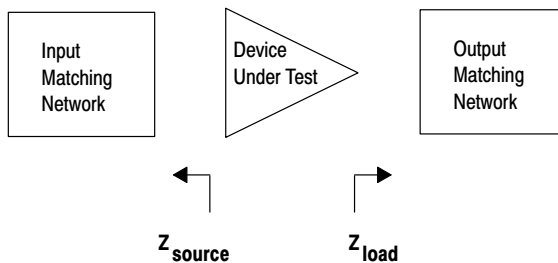


Figure 11. Series Equivalent Source and Load Impedance

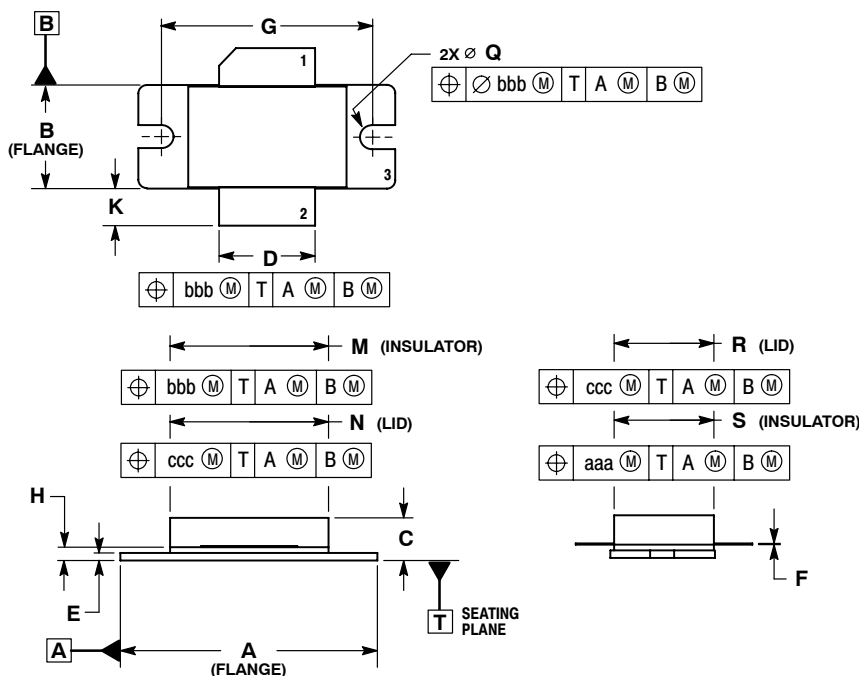
NOTES

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NOTES

PACKAGE DIMENSIONS

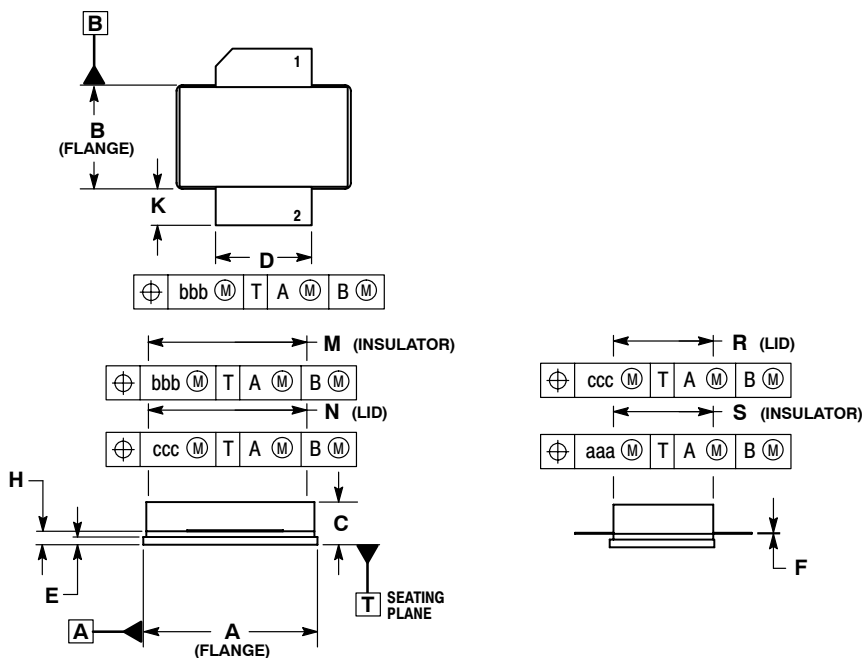


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
 4. DELETED

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	∅.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
 MRF5S19130HR3**



- 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
 2. GATE
 3. SOURCE

**CASE 465C-02
 ISSUE D
 NI-880S
 MRF5S19130HSR3**

How to Reach Us:

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USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

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)
support@freescale.com

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 Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
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