RF Power Field Effect Transistors

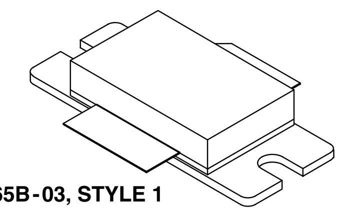
N-Channel Enhancement-Mode Lateral MOSFETs

MRF5S19130HR3
MRF5S19130HSR3

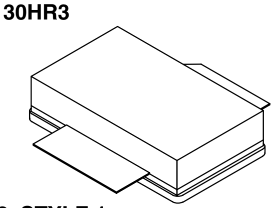
Designed for PCN and PCS base station applications at frequencies from 1900 to 2000 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

- 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. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.
  Power Gain — 13 dB
  Drain Efficiency — 25%
  IM3 @ 2.5 MHz Offset — -37 dBc @ 1.2288 MHz Bandwidth
  ACPR @ 885 kHz Offset — -51 dB @ 30 kHz Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, f1 = 1960 MHz, 110 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched, Controlled Q, 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.
- Available in Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

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



CASE 465B-03, STYLE 1
NI-880
MRF5S19130HR3



CASE 465C-02, STYLE 1
NI-880S
MRF5S19130HSR3

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	438 2.50	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	110	W

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 115 W CW Case Temperature 78°C, 26 W CW	$R_{\theta JC}$	 0.40 0.46	°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/D, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

NOTE - **CAUTION** - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

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Table 3. ESD Protection Characteristics

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

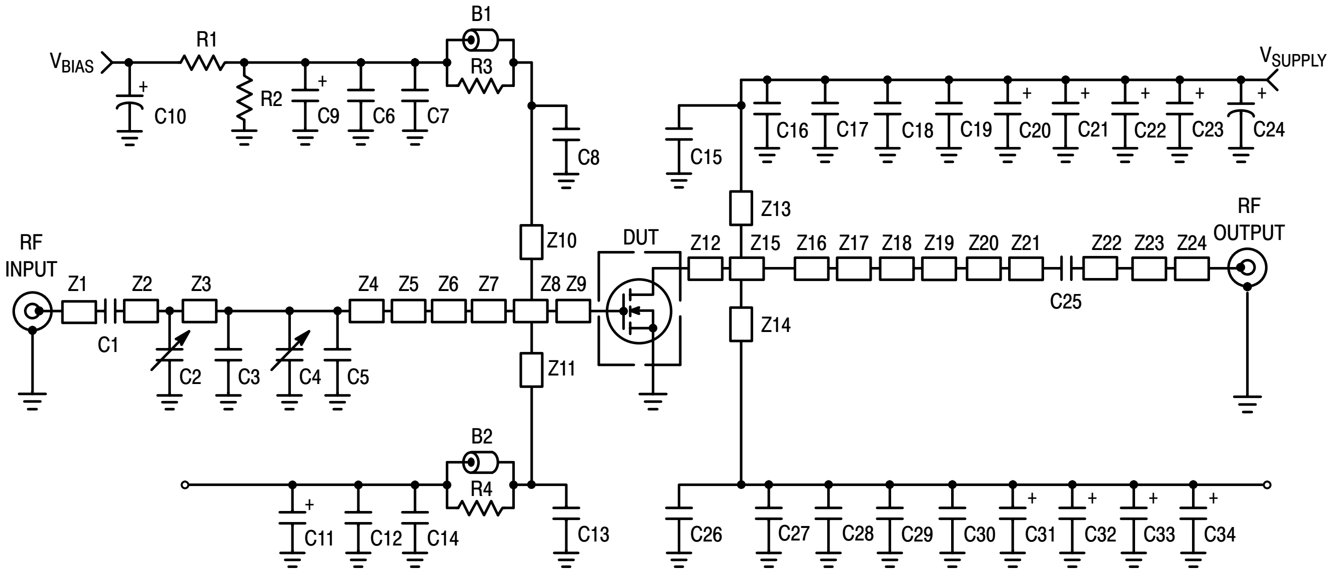
Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

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

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1200 mA, P_{out} = 26 W Avg., f1 = 1930 MHz, f2 = 1932.5 MHz and 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. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.

Characteristic	Symbol	Min	Typ	Max	Unit
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 is internally matched both on input and output.

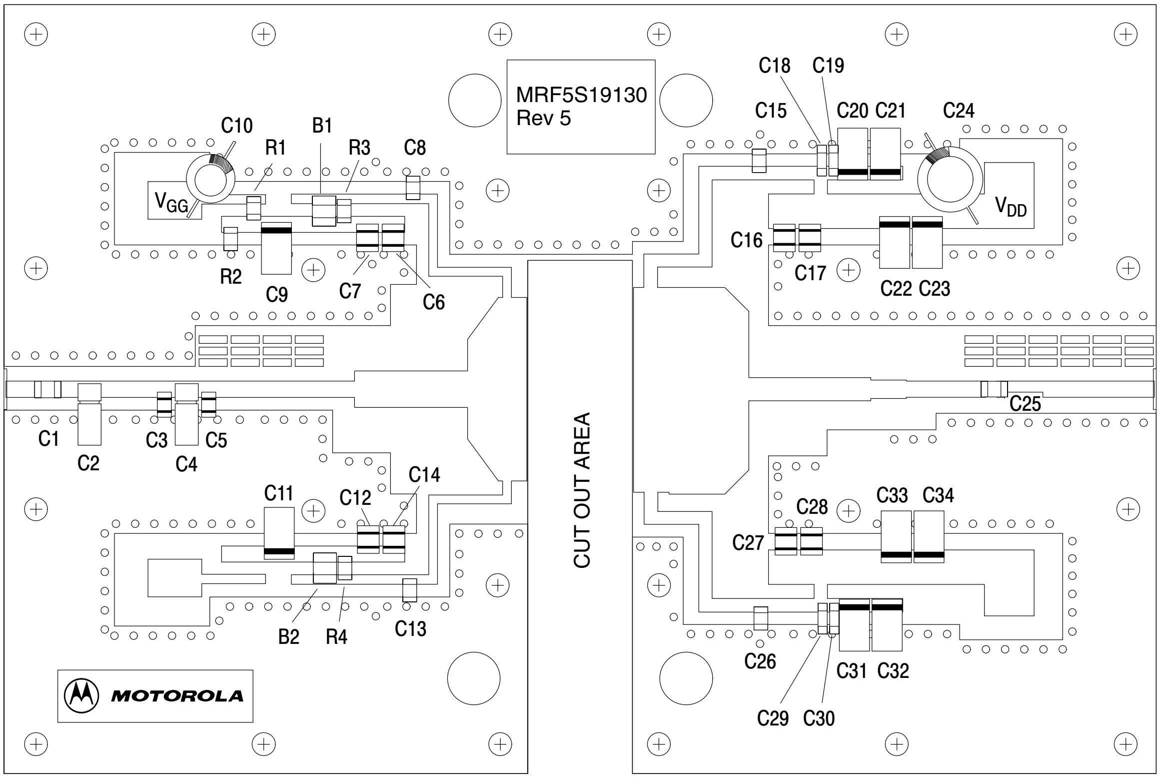


Z1	0.200″ x 0.085″ Microstrip	Z13, Z14	1.125″ x 0.068″ Microstrip
Z2	0.170″ x 0.085″ Microstrip	Z15	0.071″ x 1.080″ Microstrip
Z3	0.480″ x 0.085″ Microstrip	Z16	0.060″ x 1.080″ Microstrip
Z4	0.926″ x 0.085″ Microstrip	Z17	0.290″ x 1.080″ Microstrip
Z5	0.590″ x 0.085″ Microstrip	Z18	1.075″ x 0.825″ x 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″, ε_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 μF, 25 V Tantalum Capacitors	92F1845	Newark
C10	47 μF, 50 V Electrolytic Capacitor	51F2913	Newark
C6, C14, C17, C18, C19, C28, C29, C30	0.1 μF 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 μF, 35 V Tantalum Capacitors	92F1853	Newark
C24	470 μF, 63 V Electrolytic Capacitor	95F4579	Newark
C25	6.2 pF Chip Capacitor	100B6R2CP 500X	ATC
R1	1 kΩ Chip Resistor	D5534M07B1K00R	Newark
R2	560 kΩ Chip Resistor	CR1206 564JT	Newark
R3, R4	12 Ω Chip Resistors	RM73B2B120JT	Garrett Electtonics



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

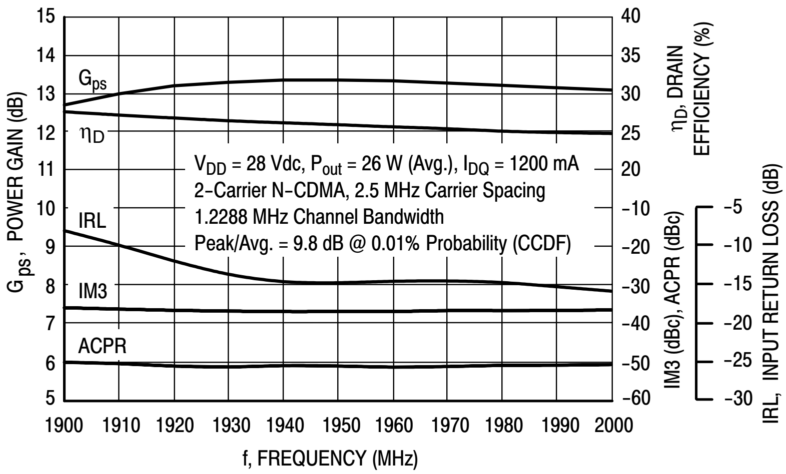


Figure 3. 2-Carrier N-CDMA Broadband Performance

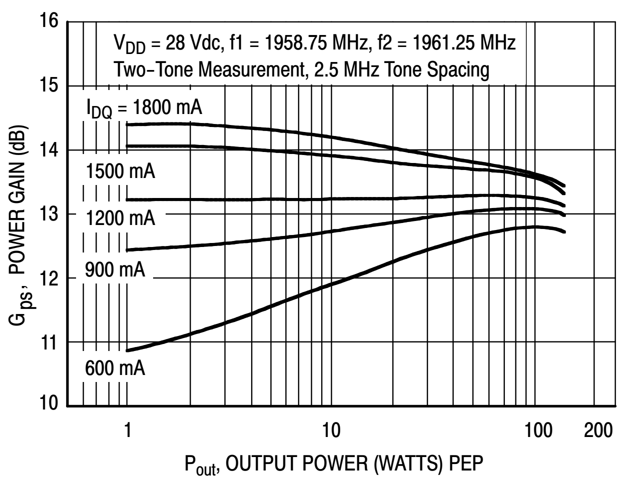


Figure 4. Two-Tone Power Gain versus Output Power

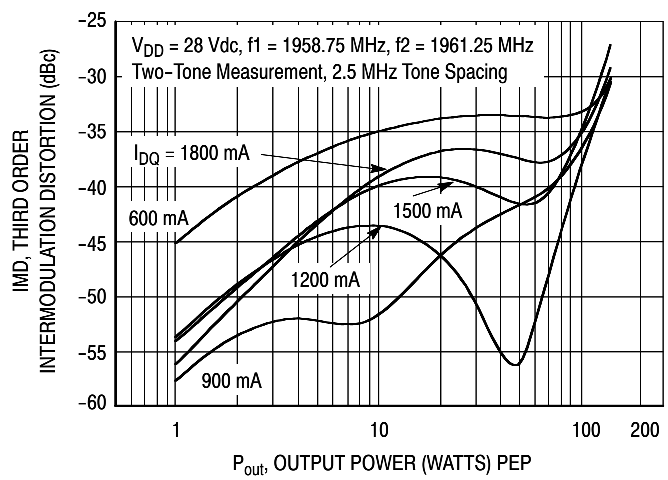


Figure 5. Third Order Intermodulation Distortion versus Output Power

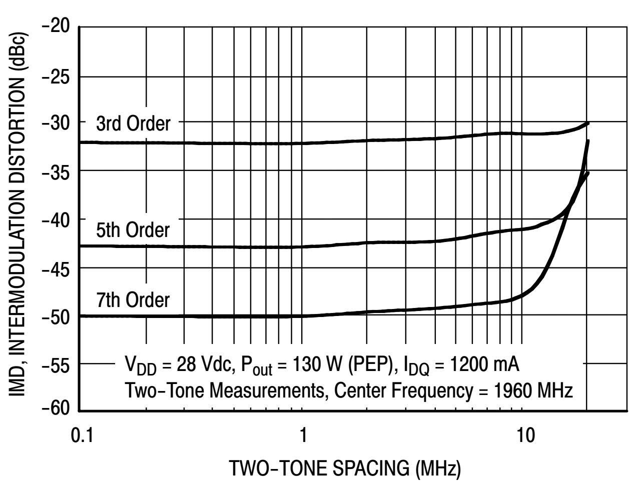


Figure 6. Intermodulation Distortion Products versus Tone Spacing

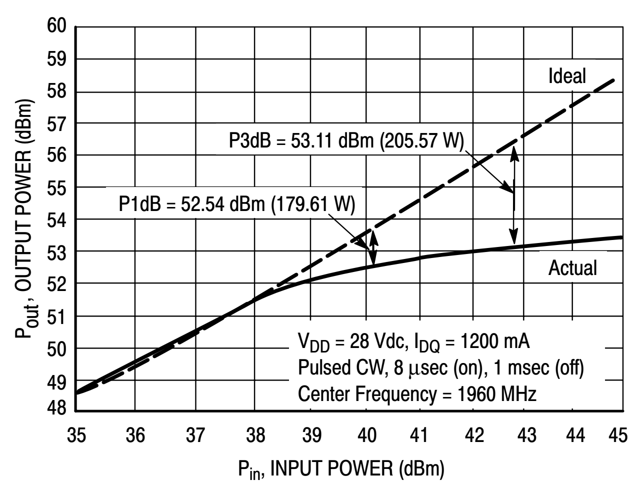


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

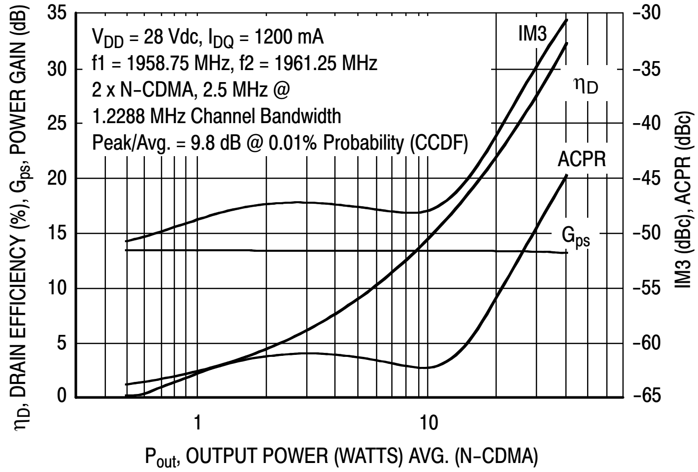


Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

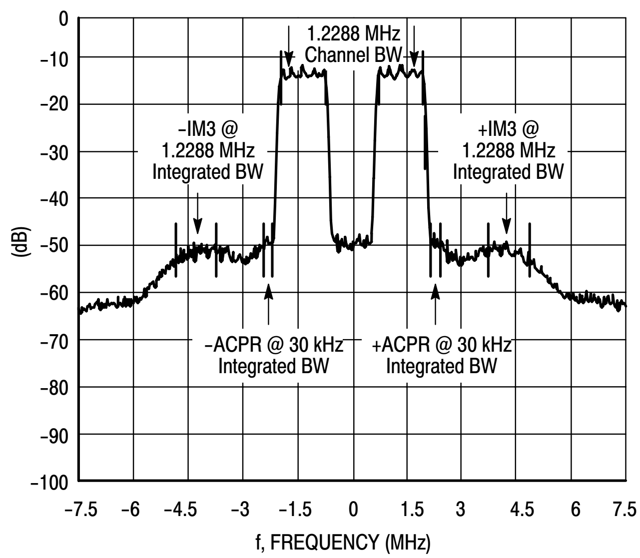
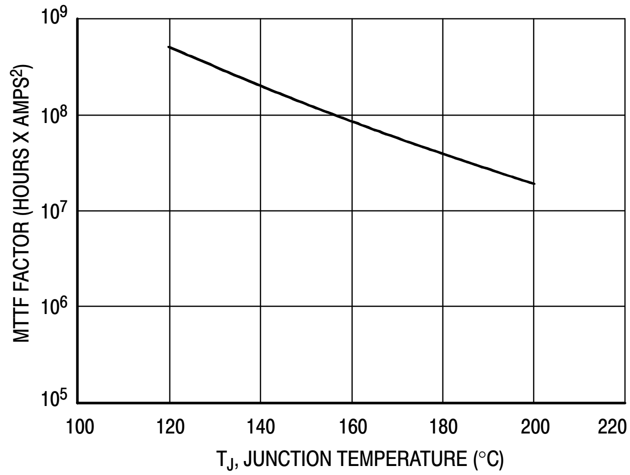
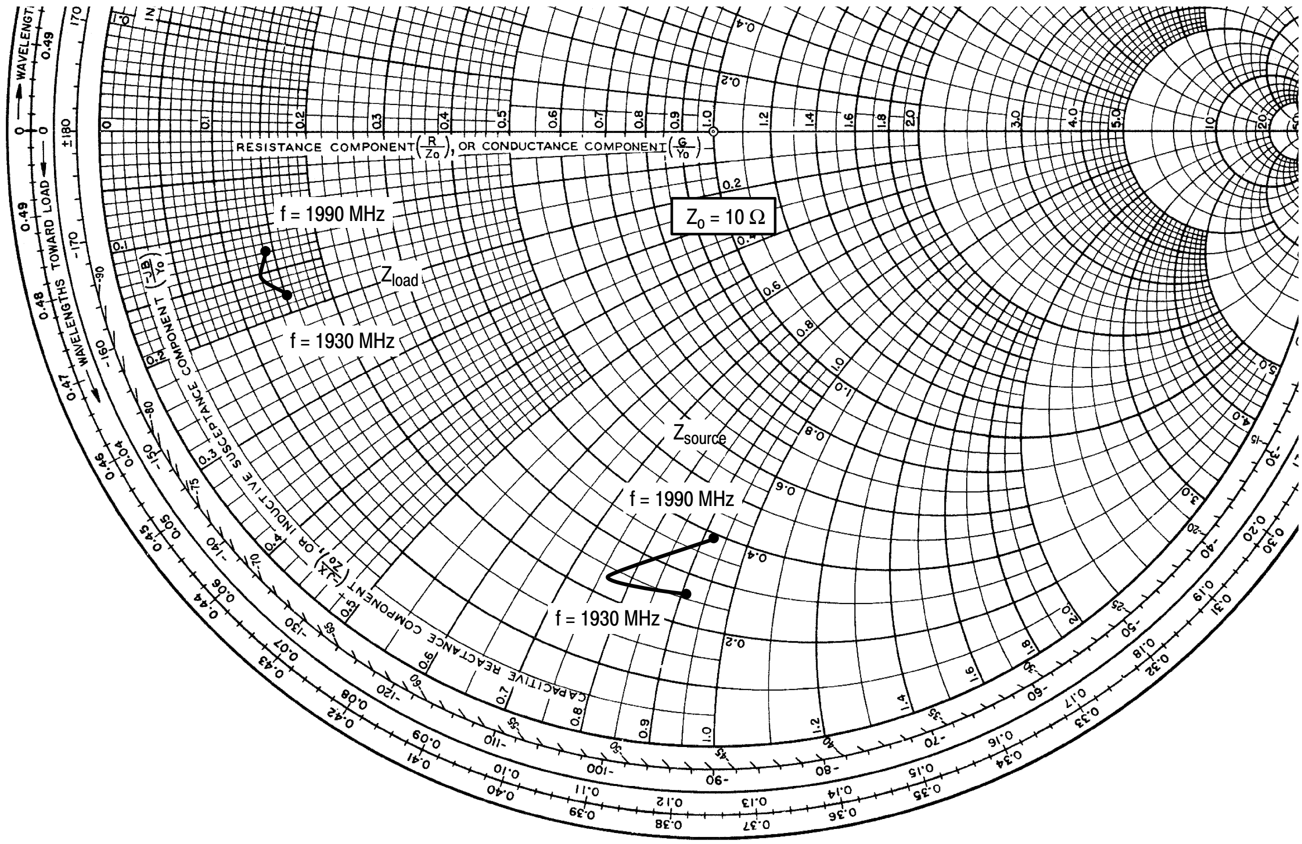


Figure 9. 2-Carrier N-CDMA Spectrum



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 10. MTTF Factor versus Junction Temperature



V_{DD} = 28 V, I_{DQ} = 1.2 A, P_{out} = 26 W (2-Carrier N-CDMA)

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.

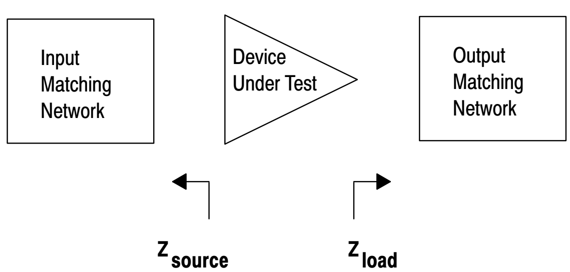


Figure 11. Series Equivalent Source and Load Impedance

NOTES

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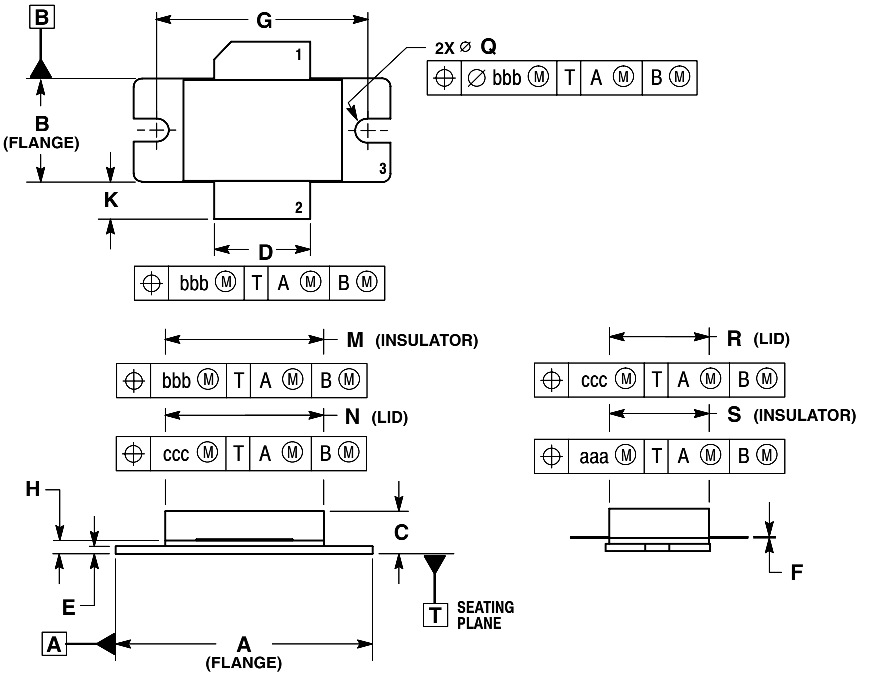
PACKAGE DIMENSIONS

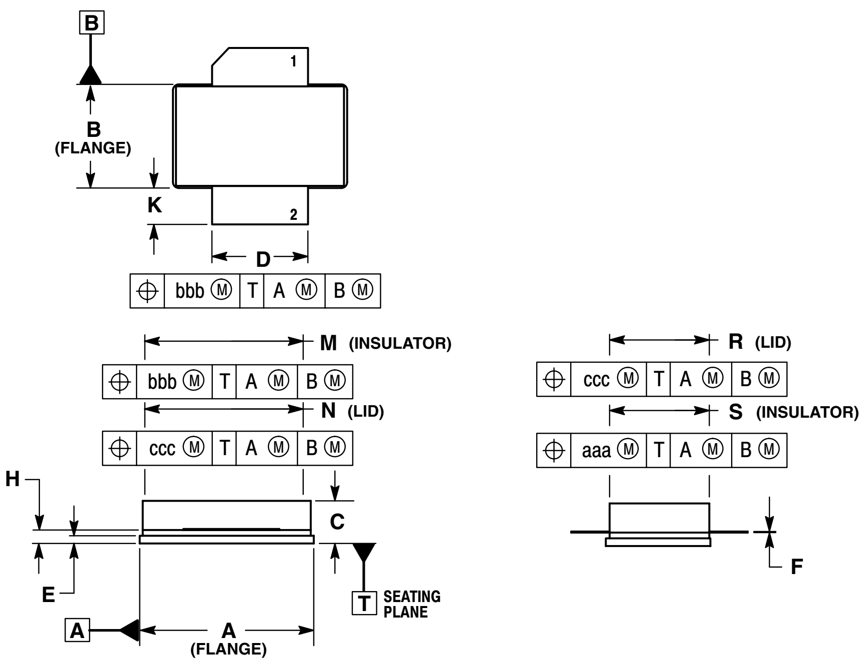


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. DELETED

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 B
NI-880
MRF5S19130HR3



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DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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 A
NI-880S
MRF5S19130HSR3

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