

RF Power Field Effect Transistors

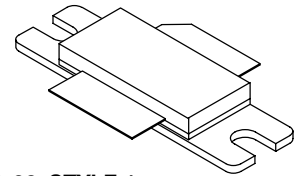
N-Channel Enhancement-Mode Lateral MOSFETs

Designed for N-CDMA base station applications with frequencies from 1930 to 1990 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN - PCS/cellular radio and WLL applications.

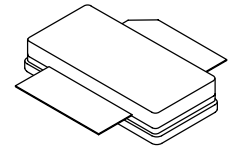
- Typical 2-Carrier N-CDMA Performance: $V_{DD} = 28$ Volts, $I_{DQ} = 900$ mA, $P_{out} = 22$ Watts Avg., Full Frequency Band, IS-95 (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. PAR = 9.8 dB @ 0.01% Probability on CCDF.
Power Gain — 16.1 dB
Drain Efficiency — 28%
IM3 @ 2.5 MHz Offset — -37 dBc @ 1.2288 MHz Channel Bandwidth
ACPR @ 885 kHz Offset — -51 dBc @ 30 kHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 1960 MHz, 100 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Input and Output Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- Lower Thermal Resistance Package
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- Low Gold Plating Thickness on Leads, 40 μ m Nominal.
- Pb-Free and RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF6S19100HR3
MRF6S19100HSR3

1990 MHz, 22 W AVG., 28 V
2 x N-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF6S19100HR3



CASE 465A-06, STYLE 1
NI-780S
MRF6S19100HSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +68	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +12	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	398 2.3	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	100	W

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 100 W CW Case Temperature 77°C, 22 W CW	$R_{\theta JC}$	0.44 0.50	°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.

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

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	3A (Minimum)
Machine Model (per EIA/JESD22-A115)	B (Minimum)
Charge Device Model (per JESD22-C101)	IV (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 ($V_{DS} = 68\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	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 ($V_{DS} = 10\text{ Vdc}$, $I_D = 250\ \mu\text{Adc}$)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage ($V_{DS} = 28\text{ Vdc}$, $I_D = 900\ \text{mAdc}$)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 2.2\ \text{Adc}$)	$V_{DS(on)}$	0.1	0.21	0.3	Vdc
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 2\ \text{Adc}$)	g_{fs}	—	5.3	—	S

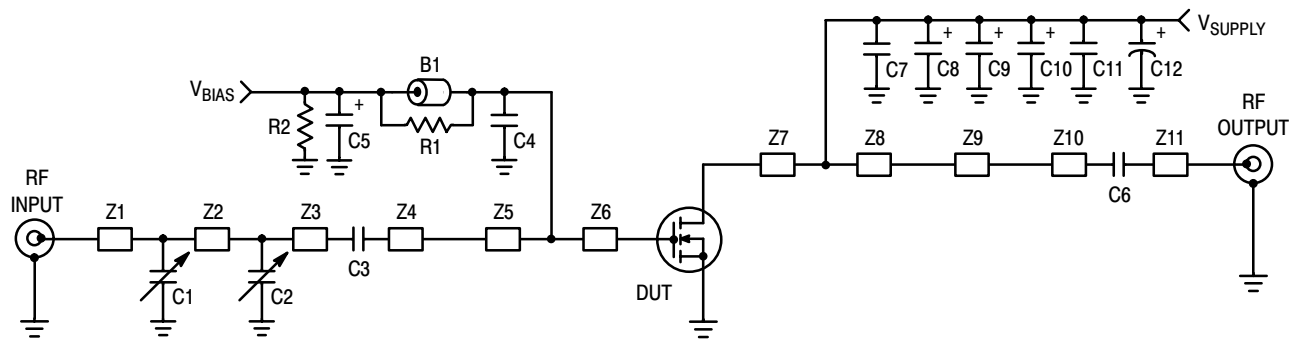
Dynamic Characteristics ⁽¹⁾

Reverse Transfer Capacitance ($V_{DS} = 28\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{rss}	—	1.5	—	pF
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Functional Tests (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ} = 900\ \text{mA}$, $P_{out} = 22\ \text{W Avg.}$, $f_1 = 1930\ \text{MHz}$, $f_2 = 1932.5\ \text{MHz}$ 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}	15	16.1	18	dB
Drain Efficiency	η_D	26	28	—	%
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.

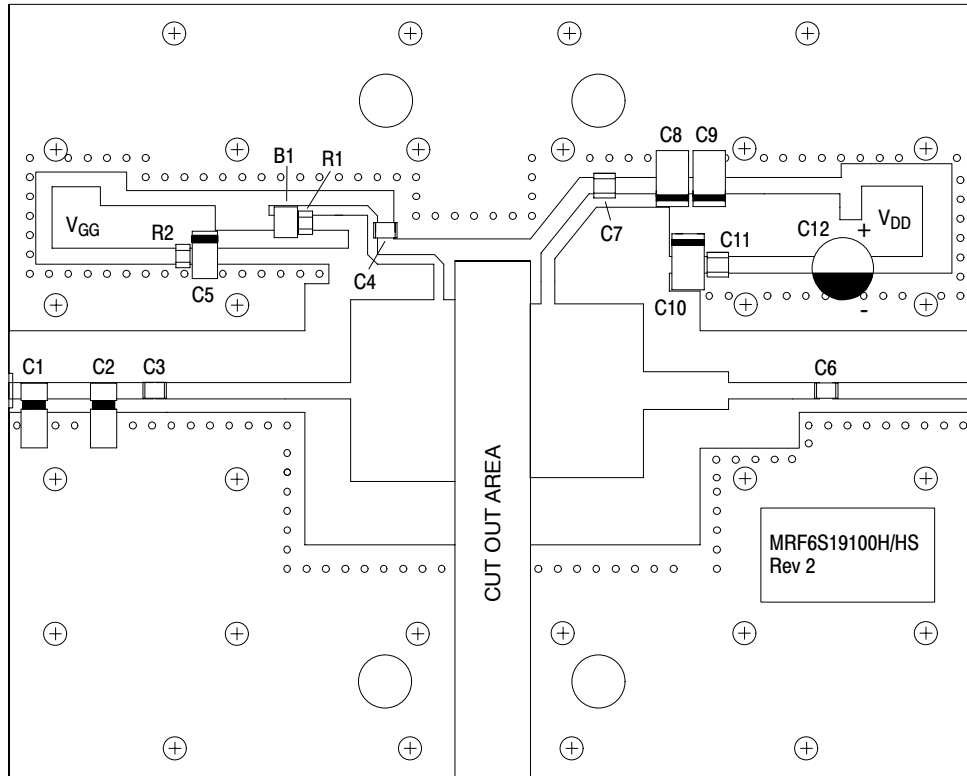


Z1	0.130" x 0.084" Microstrip	Z7	0.091" x 0.900" Microstrip
Z2	0.360" x 0.084" Microstrip	Z8	0.493" x 0.900" Microstrip
Z3	0.260" x 0.084" Microstrip	Z9	0.440" x 0.195" Microstrip
Z4	0.950" x 0.084" Microstrip	Z10	0.470" x 0.084" Microstrip
Z5	0.457" x 0.940" Microstrip	Z11	0.735" x 0.084" Microstrip
Z6	0.083" x 0.940" Microstrip	PCB	Arlon GX-0300-55-22, 0.030", $\epsilon_r = 2.55$

Figure 1. MRF6S19100HR3(HSR3) Test Circuit Schematic

Table 5. MRF6S19100HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	RF Bead	2743019447	Fair-Rite
C1, C2	0.6-4.5 pF Variable Capacitors, Gigatronics	27271SL	Johanson Dielectrics
C3	15 pF Chip Capacitor	100B150CP500X	ATC
C4, C7	5.6 pF Chip Capacitors	100B5R6JP500X	Kemet
C5	1 μ F, 50 V Tantalum Chip Capacitor	T491C105K050AS	Kemet
C6	43 pF Chip Capacitor	100B430CP500X	ATC
C8, C10	22 μ F, 35 V Tantalum Chip Capacitors	T491X226K035AS	Kemet
C9	10 μ F, 35 V Tantalum Chip Capacitor	T491C106K035AS	Kemet
C11	0.1 μ F Chip Capacitor (1825)	C1825C14J5RAC	Kemet
C12	100 μ F, 50 V Electrolytic Capacitor, Radial	MCR50V107M8X11	Multicomp
R1	12 Ω , 1/4 W Chip Resistor (1206)	CRCW120612R0F100	Vishay
R2	2 k Ω , 1/4 W Chip Resistor (1206)	CRCW12062001F100	Vishay



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

Figure 2. MRF6S19100HR3(HSR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

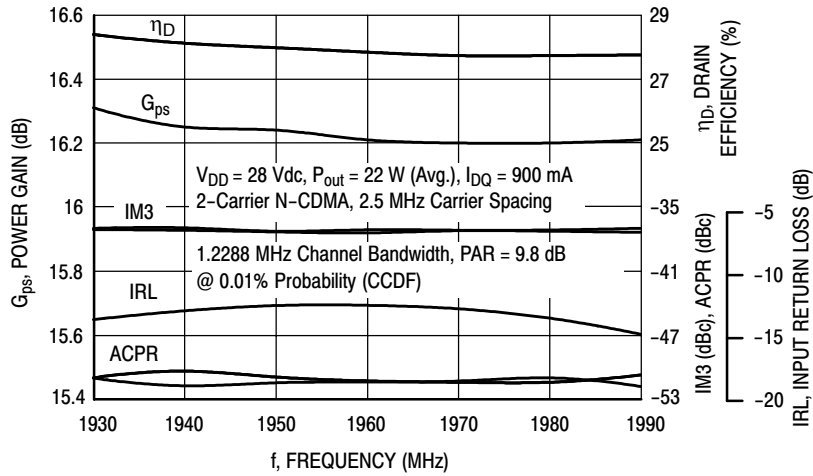


Figure 3. 2-Carrier N-CDMA Broadband Performance @ $P_{out} = 22$ Watts Avg.

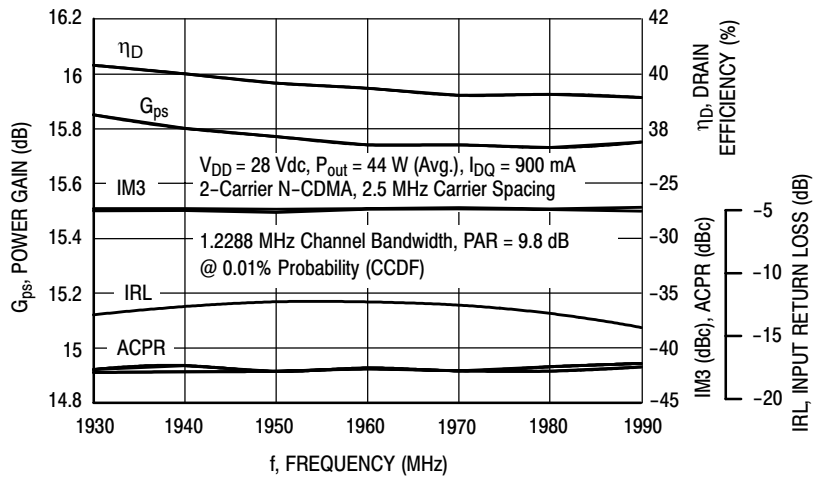


Figure 4. 2-Carrier N-CDMA Broadband Performance @ $P_{out} = 44$ Watts Avg.

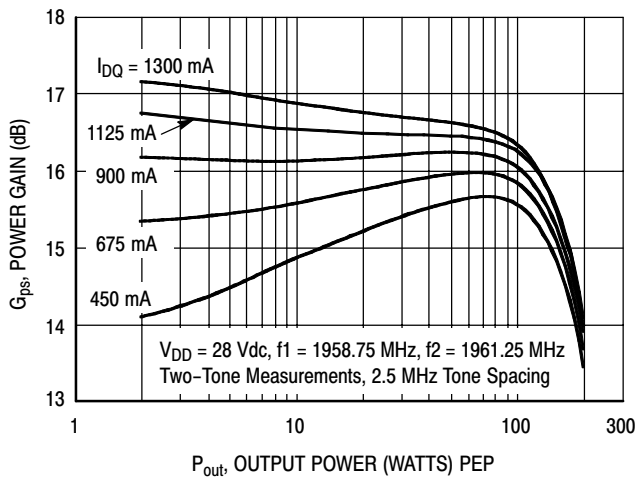


Figure 5. Two-Tone Power Gain versus Output Power

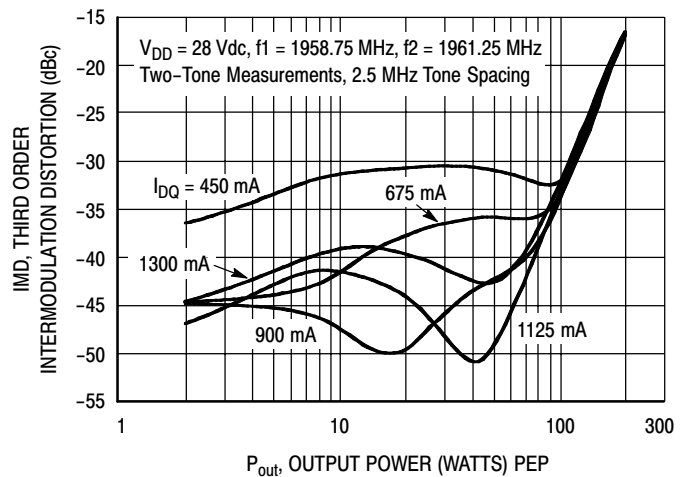


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

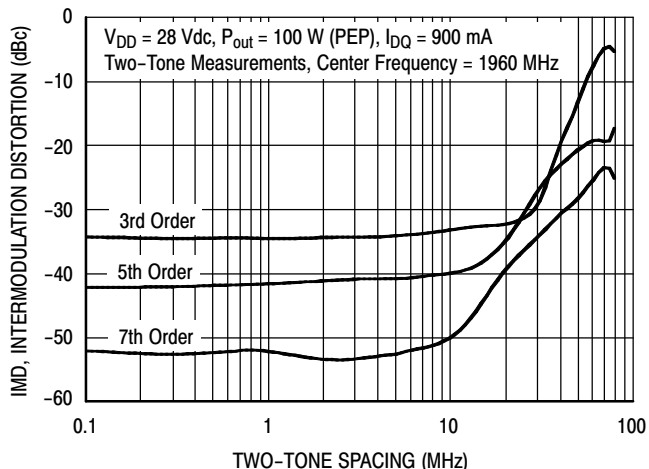


Figure 7. Intermodulation Distortion Products versus Tone Spacing

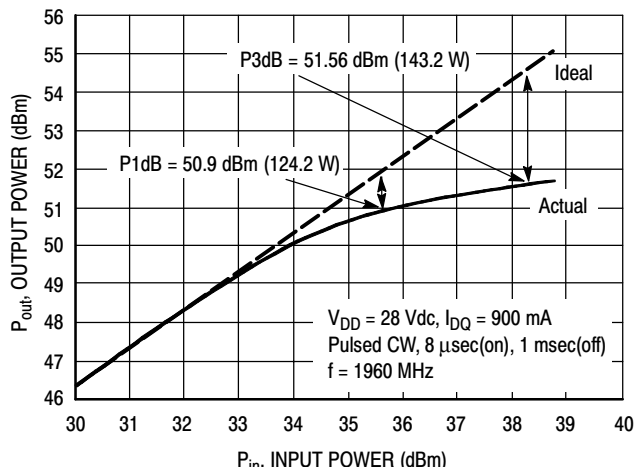


Figure 8. Pulse CW Output Power versus Input Power

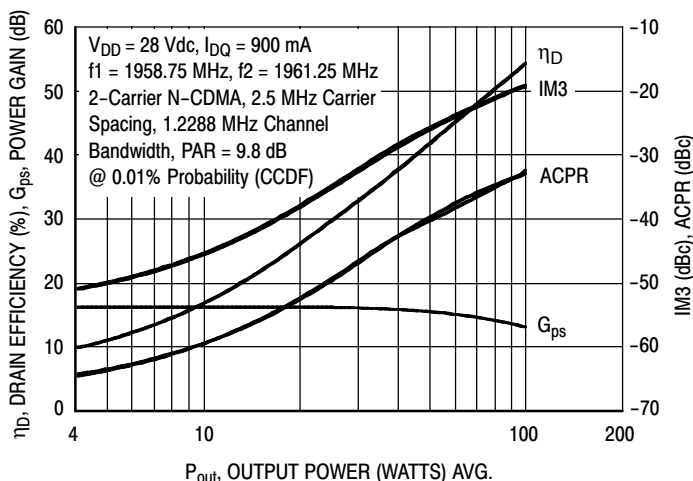


Figure 9. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

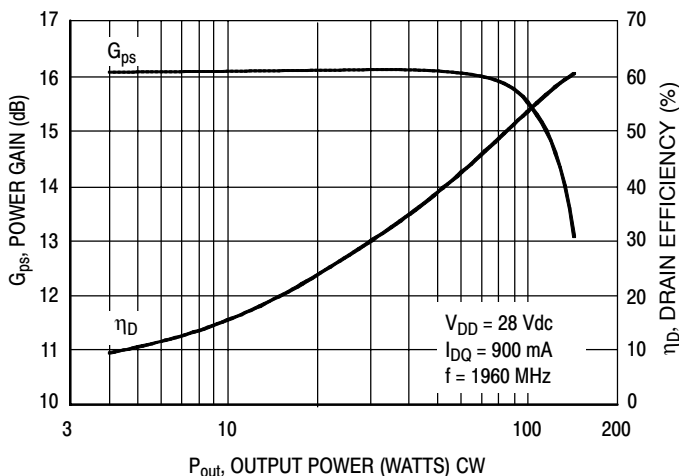


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

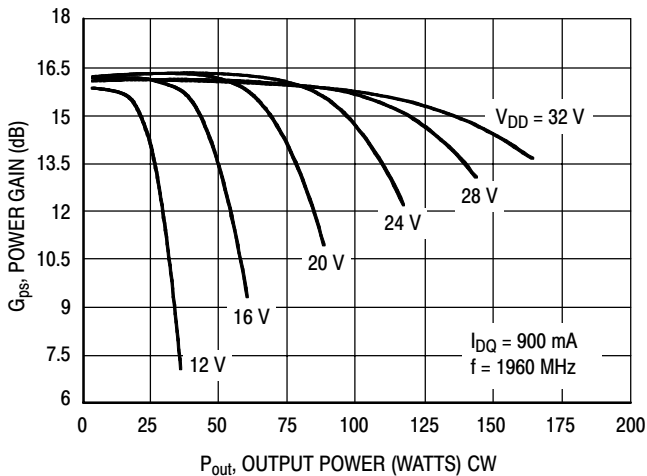
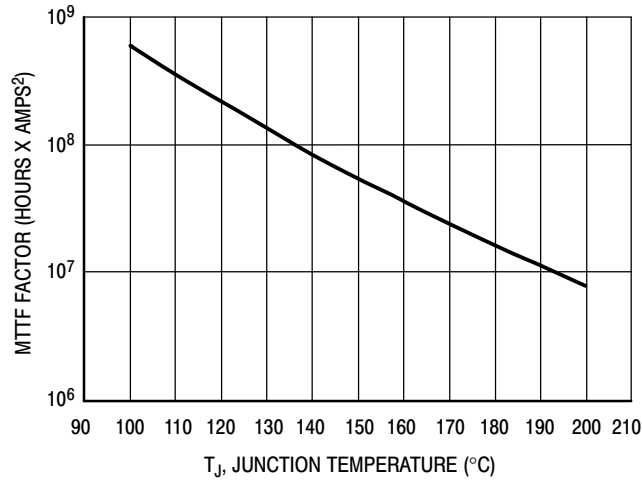


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS



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 12. MTTF Factor versus Junction Temperature

N-CDMA TEST SIGNAL

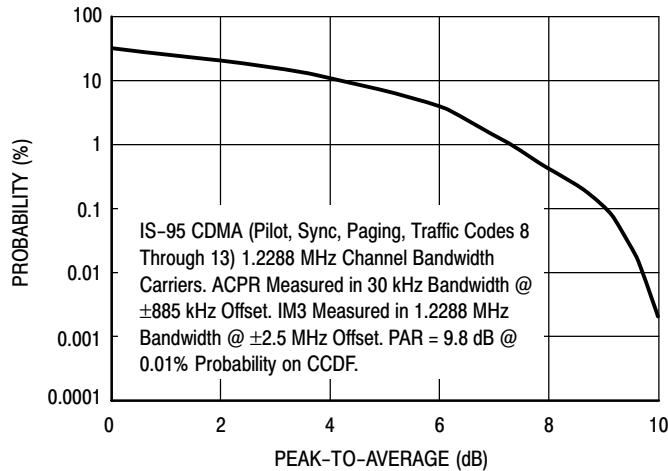


Figure 13. 2-Carrier CCDF N-CDMA

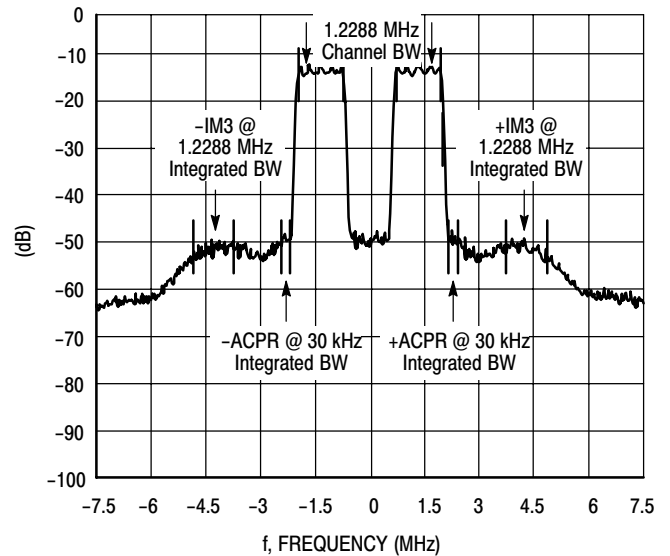
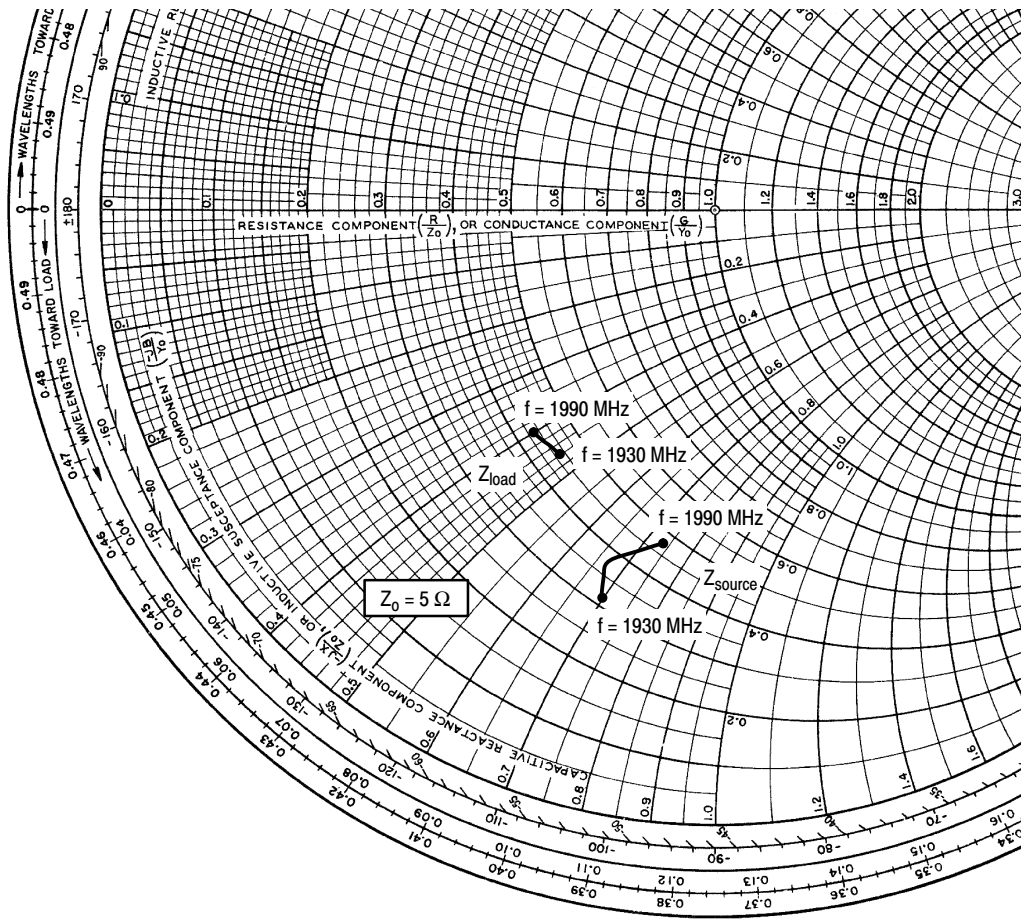


Figure 14. 2-Carrier N-CDMA Spectrum



$V_{DD} = 28 \text{ Vdc}$, $I_{DQ} = 900 \text{ mA}$, $P_{out} = 22 \text{ W Avg.}$

f MHz	Z_{source} Ω	Z_{load} Ω
1930	$1.57 - j3.50$	$2.26 - j2.31$
1960	$1.83 - j3.29$	$2.22 - j2.13$
1990	$2.34 - j3.71$	$2.14 - j2.00$

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

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

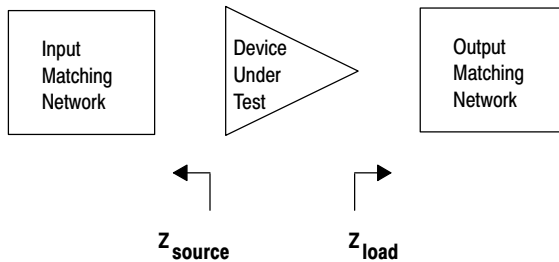


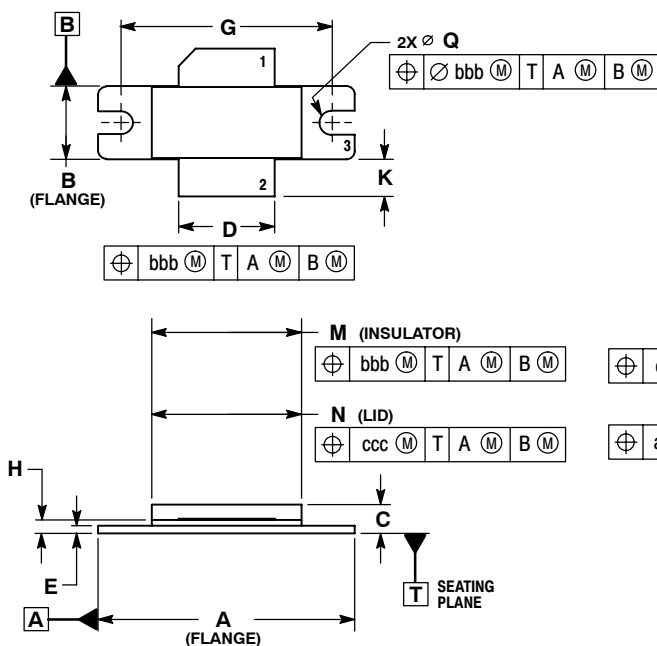
Figure 15. Series Equivalent Source and Load Impedance



NOTES

NOTES

PACKAGE DIMENSIONS

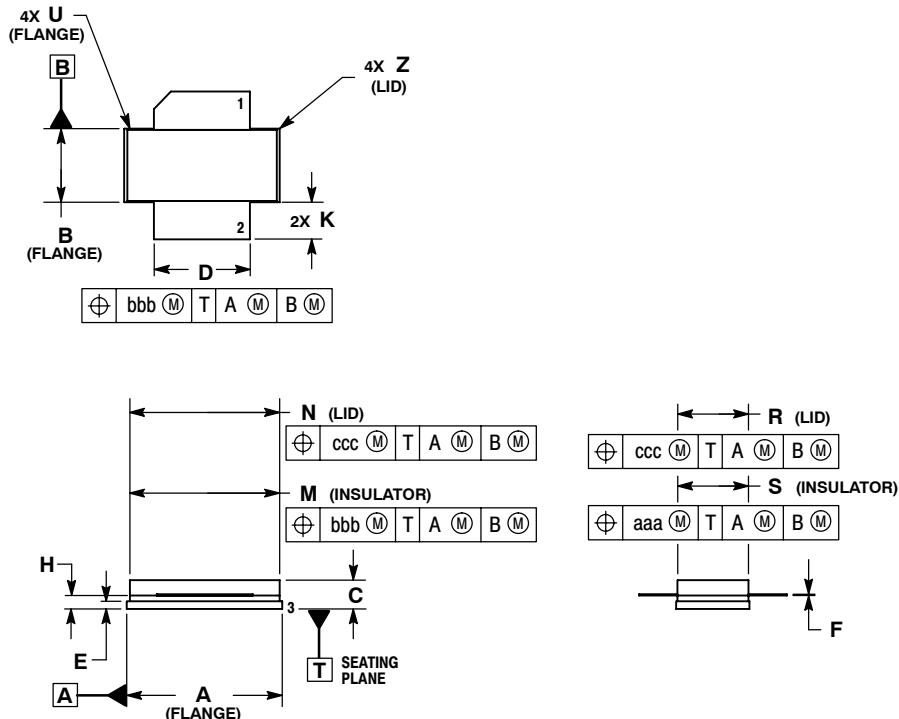


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DELETED
 4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
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	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	∅.118	∅.138	∅3.00	∅3.51
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
aaa	0.005 REF		0.127 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 465-06
 ISSUE G
 NI-780
 MRF6S19100HR3**



- NOTES:
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 4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
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	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

- STYLE 1:
 PIN 1. DRAIN
 2. GATE
 5. SOURCE

**CASE 465A-06
 ISSUE H
 NI-780S
 MRF6S19100HSR3**

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