. :eescale Semiconductor
Technical Data

Document Number: MRF6S19200H
Rev. 0, 3/2008

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF6S19200HR3
MRF6S19200HSR3

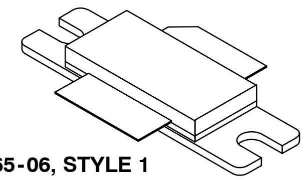
Designed for CDMA base station applications with frequencies from 1930 to 1990 MHz. Suitable for CDMA and multicarrier amplifier applications. To be used in Class AB and Class C for PCN-PCS/cellular radio applications.

- Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1600 mA, P_{out} = 56 Watts Avg., Full Frequency Band, 3GPP Test Model 1, 64 DPCH with 50% Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 17.9 dB
  Drain Efficiency — 29.5%
  Device Output Signal PAR — 5.9 dB @ 0.01% Probability on CCDF
  ACPR @ 5 MHz Offset — -36 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 32 Vdc, 1960 MHz, 130 Watts CW Output Power

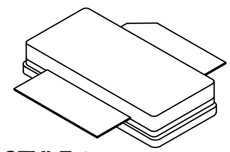
Features

- 100% PAR Tested for Guaranteed Output Power Capability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Integrated ESD Protection
- Greater Negative Gate-Source Voltage Range for Improved Class C Operation
- Optimized for Doherty Applications
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

1930-1990 MHz, 56 W AVG., 28 V
SINGLE W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF6S19200HR3



CASE 465A-06, STYLE 1
NI-780S
MRF6S19200HSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +66	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +10	Vdc
Operating Voltage	V_{DD}	32, +0	Vdc
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature (1,2)	T_J	225	°C
CW Operation @ T_C = 25°C Derate above 25°C	CW	130 0.49	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 110°C, 89 W CW Case Temperature 100°C, 55 W CW	$R_{\theta JC}$	 0.35 0.36	°C/W

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

freescale™ semiconductor

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1B (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (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} = 66 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}	—	—	10	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 372 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 1600 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	3	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3.71 Adc)	$V_{DS(on)}$	0.1	0.2	0.3	Vdc
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.3	—	pF
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	185	—	pF
Input Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	503	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1600 mA, P_{out} = 56 W Avg., f = 1932.5 MHz and f = 1987.5 MHz, Single-Carrier W-CDMA, 3GPP Test Model 1, 64 DPCH, 50% Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

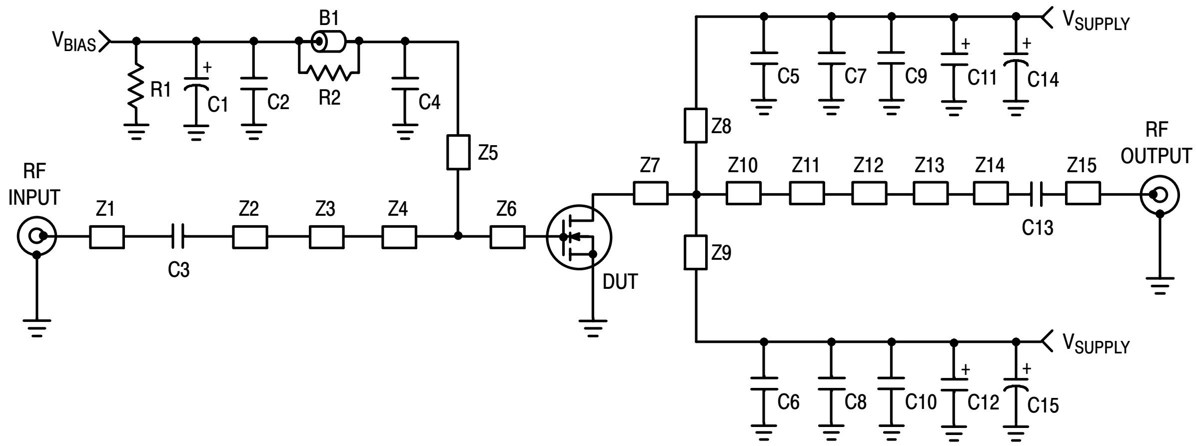
Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	15	17.9	19	dB
Drain Efficiency	η_D	26	29.5	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	5.5	5.9	—	dB
Adjacent Channel Power Ratio	ACPR	—	-36	-34	dBc
Input Return Loss	IRL	—	-14	-8	dB

1. Part internally matched both on input and output.

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Typical Performances (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1600 mA, 1930-1990 MHz Bandwidth					
IMD Symmetry @ 130 W PEP, P_{out} where IMD Third Order Intermodulation ≅ 30 dBc (Delta IMD Third Order Intermodulation between Upper and Lower Sidebands > 2 dB)	IMD_{sym}	—	20	—	MHz
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	50	—	MHz
Gain Flatness in 60 MHz Bandwidth @ P_{out} = 56 W Avg.	G_F	—	0.6	—	dB
Average Deviation from Linear Phase in 60 MHz Bandwidth @ P_{out} = 130 W CW	Φ	—	1.94	—	°
Average Group Delay @ P_{out} = 130 W CW, f = 1960 MHz	Delay	—	2.44	—	ns
Part-to-Part Insertion Phase Variation @ P_{out} = 130 W CW, f = 1960 MHz, Six Sigma Window	ΔΦ	—	59.4	—	°
Gain Variation over Temperature (-30°C to +85°C)	ΔG	—	0.04	—	dB/°C



Z1	0.859″ x 0.084″ Microstrip	Z10	0.547″ x 1.203″ Microstrip
Z2	0.470″ x 0.084″ Microstrip	Z11	0.119″ x 0.755″ Microstrip
Z3	0.362″ x 0.244″ Microstrip	Z12	0.222″ x 0.365″ Microstrip
Z4	0.145″ x 1.040″ Microstrip	Z13	0.225″ x 0.220″ Microstrip
Z5	0.040″ x 0.257″ Microstrip	Z14	0.192″ x 0.084″ Microstrip
Z6	0.418″ x 1.040″ Microstrip	Z15	0.843″ x 0.084″ Microstrip
Z7	0.103″ x 1.203″ Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030″, ε_r = 2.55
Z8, Z9	0.198″ x 0.160″ Microstrip		

Figure 1. MRF6S19200HR3(HSR3) Test Circuit Schematic

Table 5. MRF6S19200HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Short Ferrite Bead	2743019447	Fair Rite
C1	10 μF, 50 V Electrolytic Capacitor	EMVY500ADA100MF55G	Nippon Chemi-Con
C2, C9, C10	0.1 μF, 100 V Capacitors	CDR33BX104AKYS	Kemet
C3, C13	33 pF Chip Capacitors	ATC100B330JT500XT	ATC
C4, C5, C6	10 pF Chip Capacitors	ATC100B100CT500XT	ATC
C7, C8	10 μF, 50 V Capacitors	GRMSSDRG1H106KA88B	Murata
C11, C12	22 μF, 35 V Tantalum Capacitors	T491X226K035AT	Kemet
C14, C15	22 μF, 50 V Electrolytic Capacitors	EMVY500ADA220MF55G	Nippon Chemi-Con
R1	1000 Ω, 1/4 W Chip Resistor	CRCW12061001FKEA	Vishay
R2	10 Ω, 1/4 W Chip Resistor	CRCW120610R1FKEA	Vishay

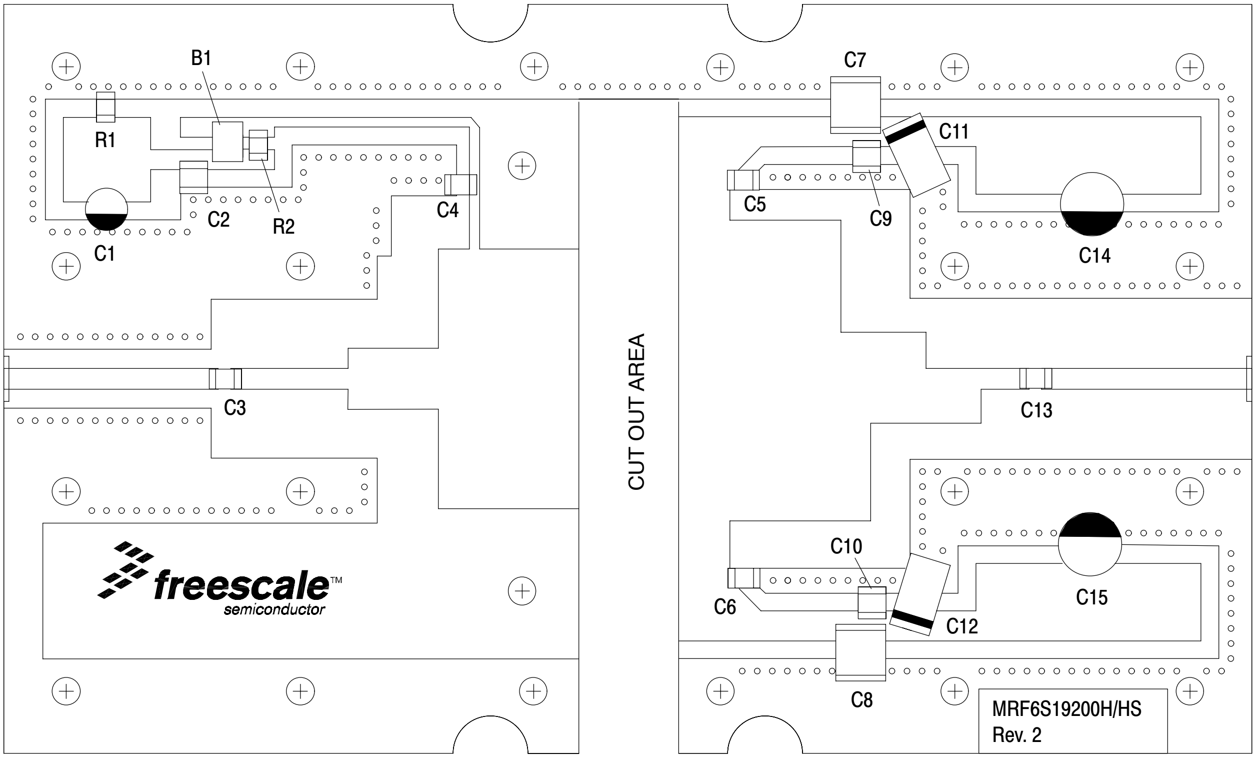


Figure 2. MRF6S19200HR3(HSR3) Test Circuit Component Layout

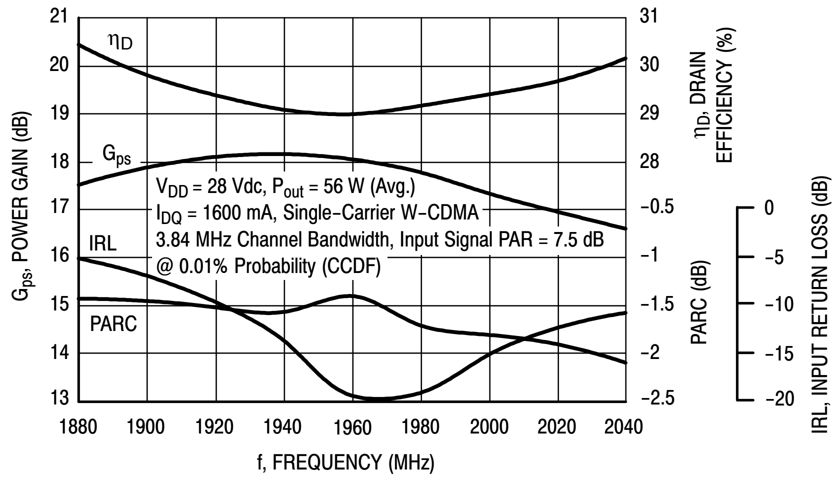


Figure 3. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 56 Watts Avg.

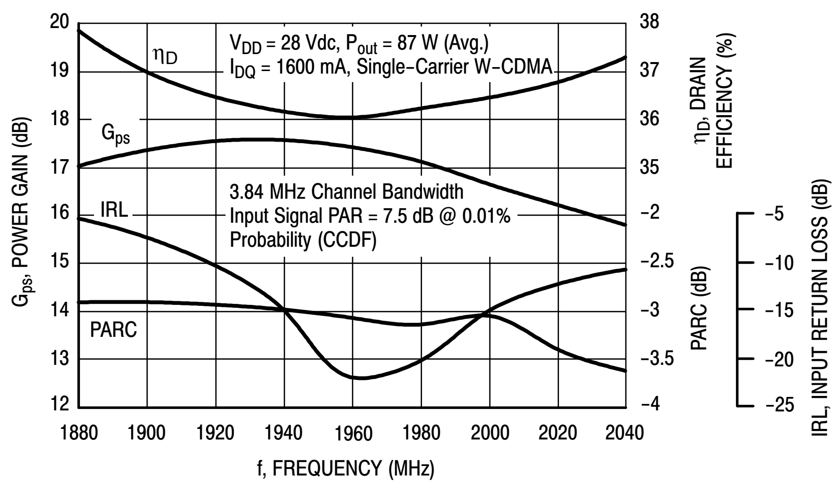


Figure 4. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 87 Watts Avg.

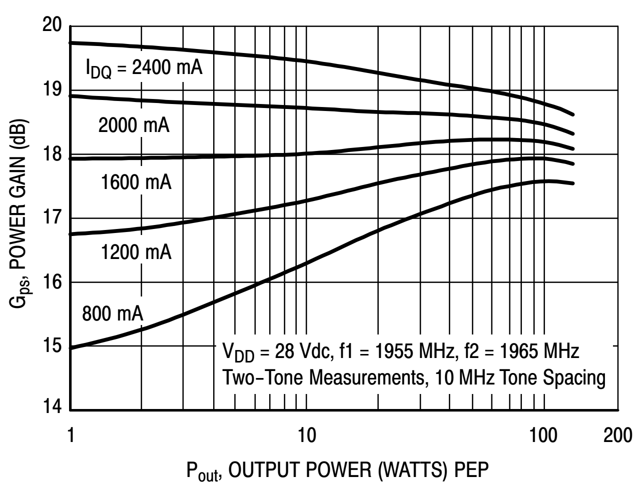


Figure 5. Two-Tone Power Gain versus Output Power

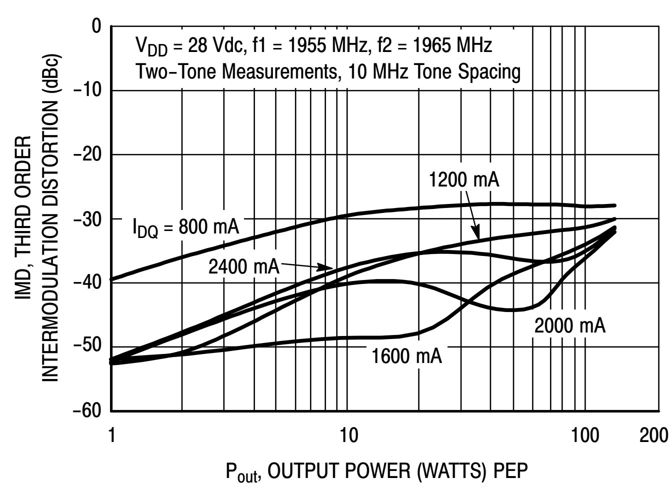


Figure 6. Third Order Intermodulation Distortion versus Output Power

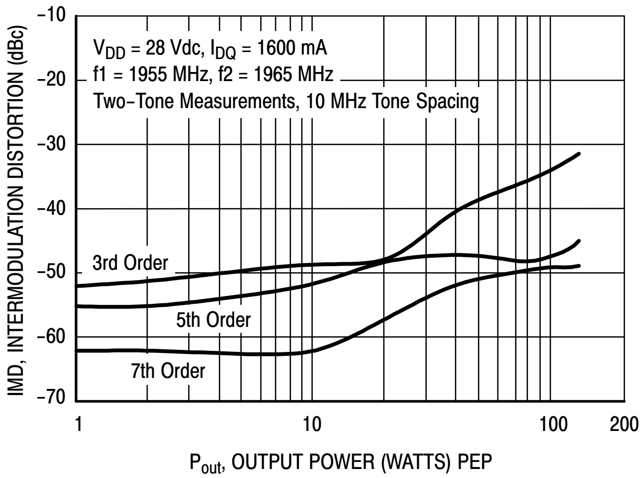


Figure 7. Intermodulation Distortion Products versus Output Power

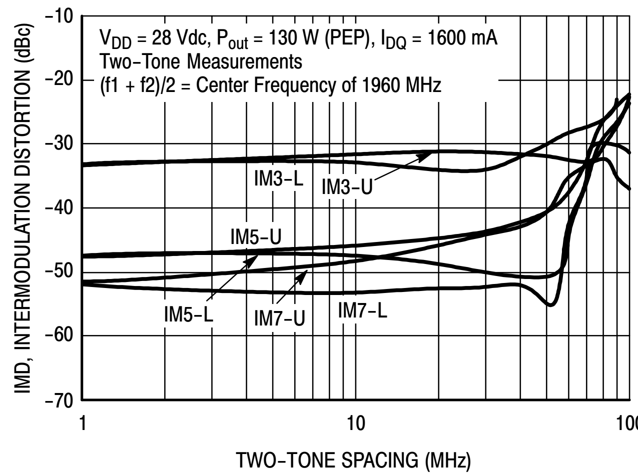


Figure 8. Intermodulation Distortion Products versus Tone Spacing

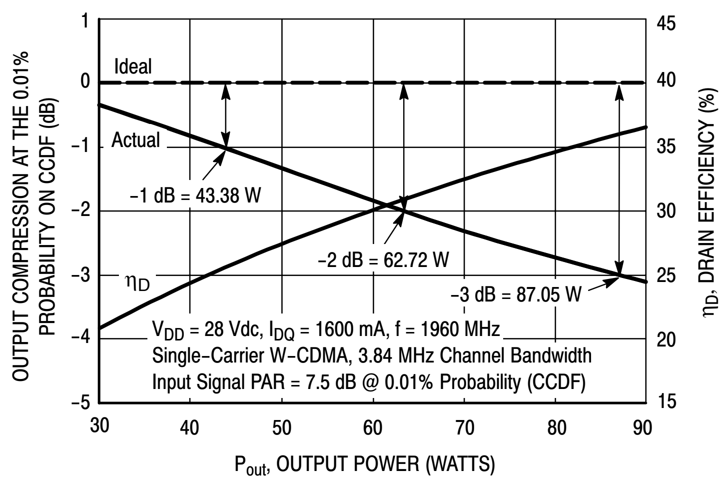


Figure 9. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

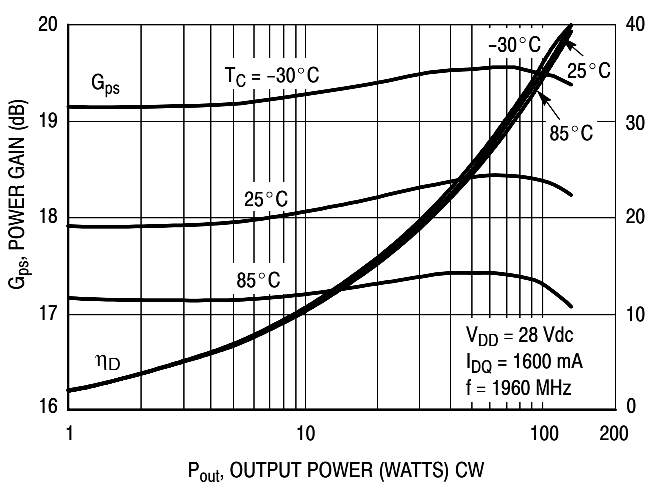


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

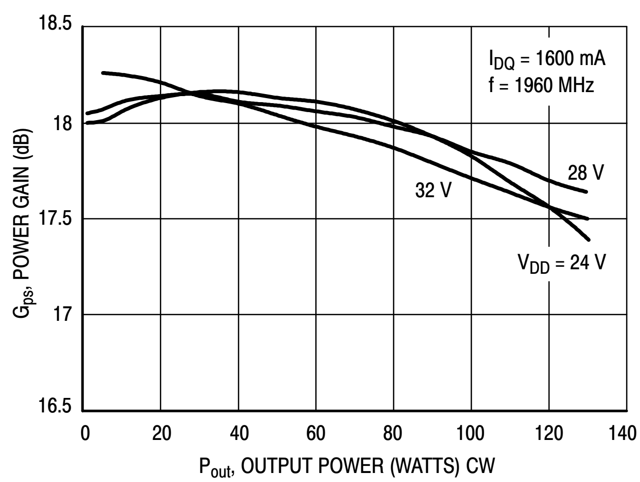
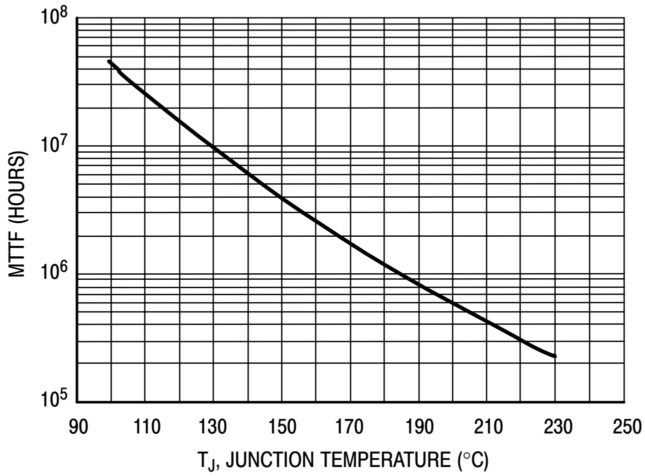


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 28 Vdc, P_{out} = 56 W Avg., and η_D = 29.5%.

MTTF calculator available at http:/www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

Figure 12. MTTF versus Junction Temperature

W-CDMA TEST SIGNAL

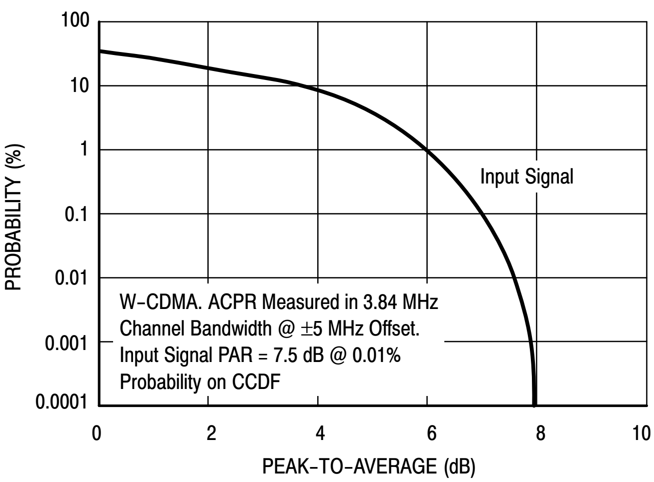


Figure 13. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 50% Clipping, Single-Carrier Test Signal

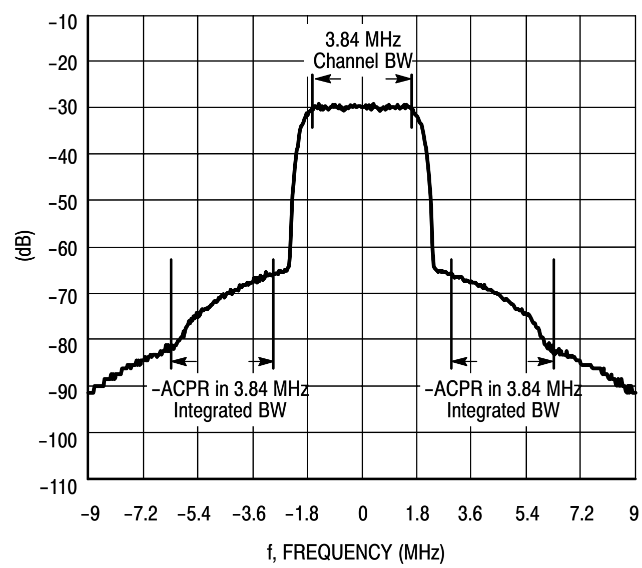
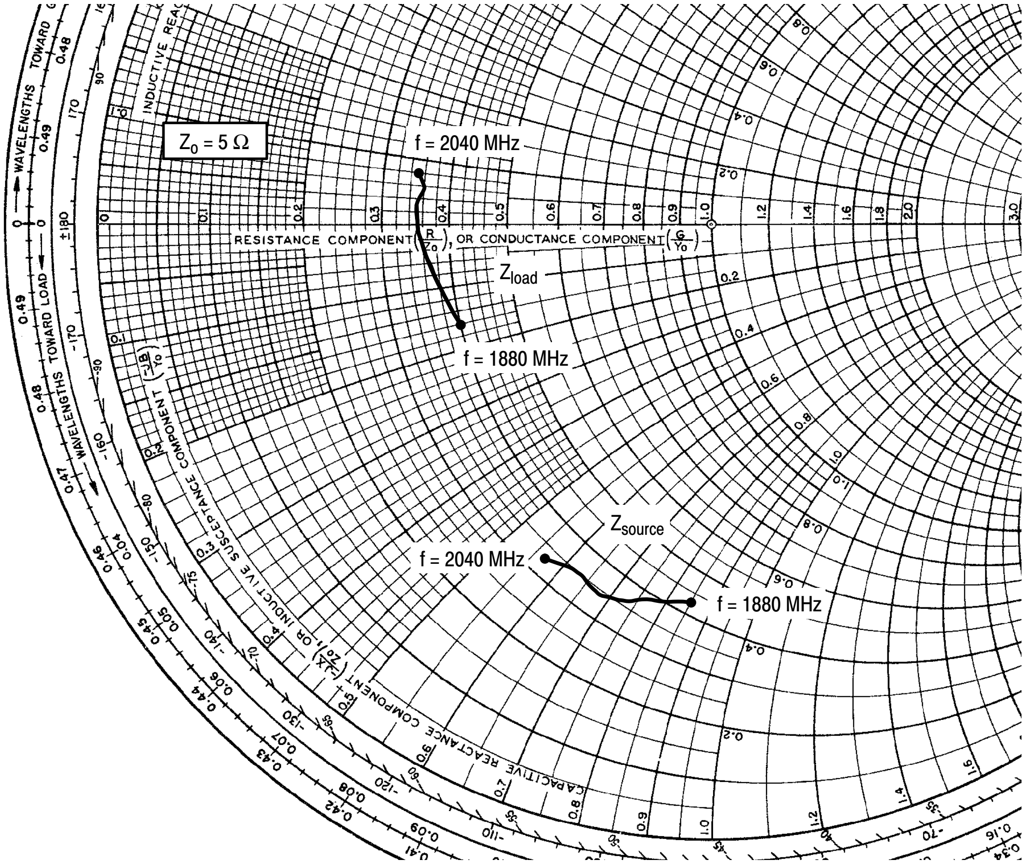


Figure 14. Single-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1600 mA, P_{out} = 56 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
1880	2.11 - j4.27	1.99 - j0.79
1900	2.05 - j4.11	1.96 - j0.64
1920	1.98 - j3.95	1.92 - j0.49
1940	1.92 - j3.80	1.86 - j0.34
1960	1.82 - j3.63	1.78 - j0.20
1980	1.72 - j3.40	1.74 + j0.01
2000	1.74 - j3.17	1.77 + j0.15
2020	1.71 - j3.02	1.78 + j0.29
2040	1.66 - j2.85	1.75 + j0.42

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

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

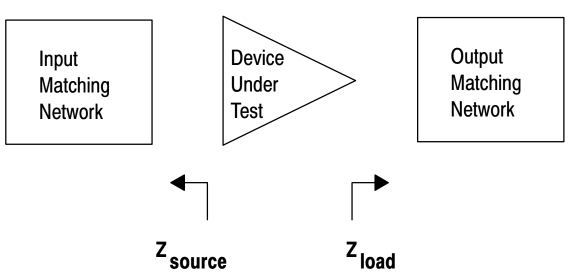
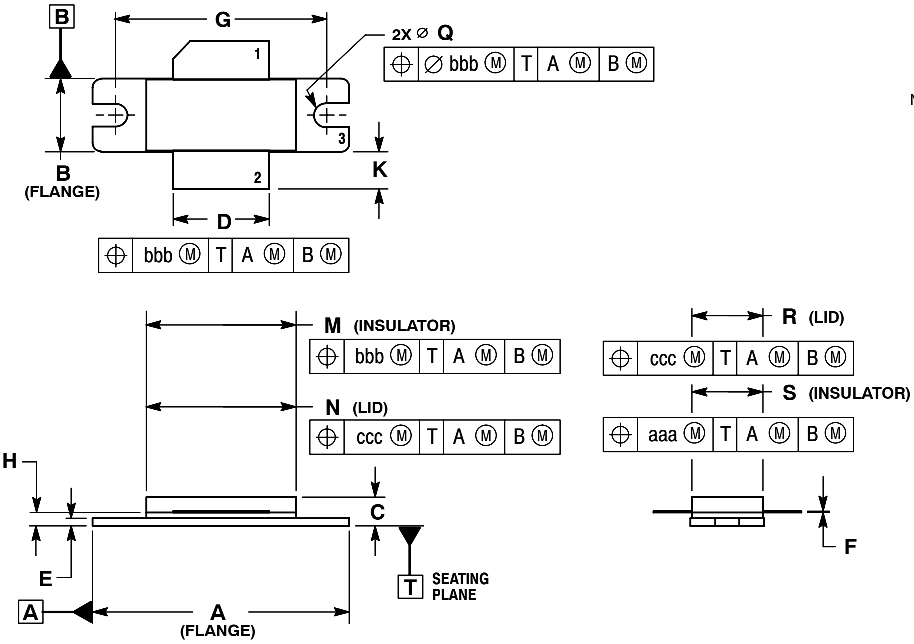


Figure 15. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

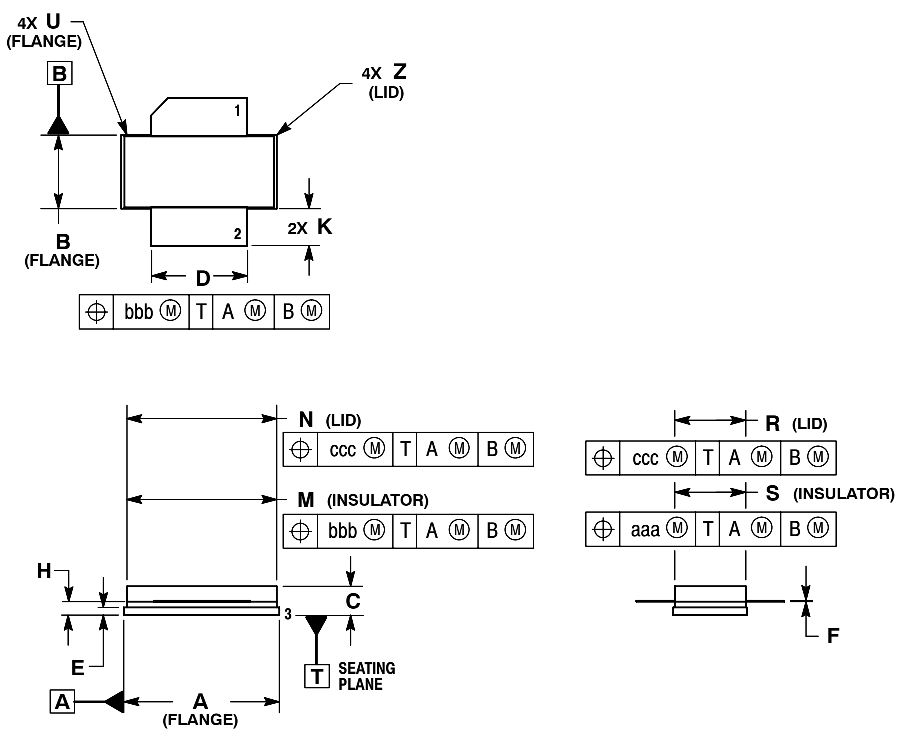


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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
MRF6S19200HR3



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 MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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
MRF6S19200HSR3

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
0	Mar. 2008	• Initial Release of Data Sheet

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

For Literature Requests Only:
Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or 303-675-2140
Fax: 303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Document Number: MRF6S19200H
Rev. 0, 3/2008