Freescale Semiconductor
Technical Data

Document Number: MRF6P21190HR6
Rev. 2, 8/2005

RF Power Field Effect Transistor

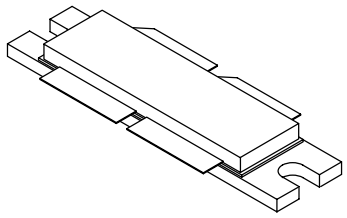
N-Channel Enhancement-Mode Lateral MOSFET

Designed for W-CDMA base station applications with 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} = 2 x 950 mA, P_{out} = 44 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 15.5 dB
  Drain Efficiency — 26.5%
  IM3 @ 10 MHz Offset — -37 dBc @ 3.84 MHz Channel Bandwidth
  ACPR @ 5 MHz Offset — -40 dBc @ 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 190 Watts CW Output Power
- 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
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- Low Gold Plating Thickness on Leads, 40μ″ Nominal.
- Pb-Free and RoHS Compliant
- In Tape and Reel. R6 Suffix = 150 Units per 56 mm, 13 inch Reel.

MRF6P21190HR6

2170 MHz, 44 W AVG., 28 V
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFET



CASE 375D-05, STYLE 1
NI-1230

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°C Derate above 25°C	P_D	700 4	W W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	190	W

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 190 W CW Case Temperature 72°C, 44 W CW	$R_{\theta JC}$	 0.25 0.27	°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.

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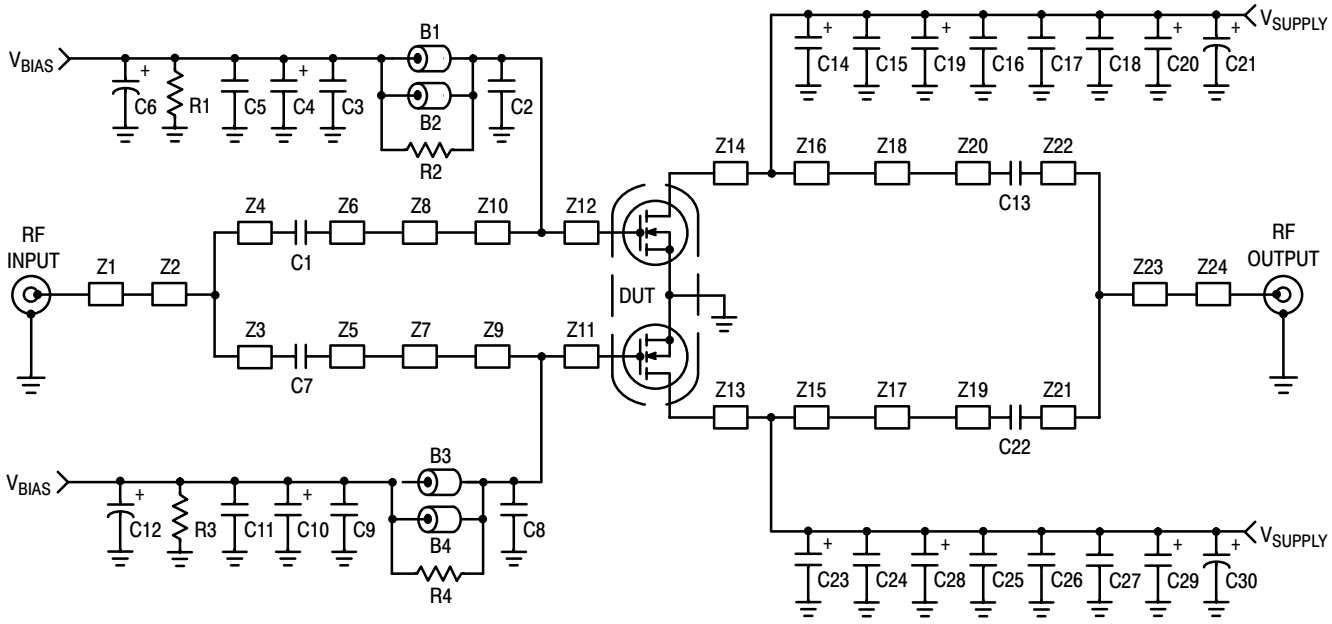
Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	III (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (1)					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 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 (1) (V_{DS} = 10 Vdc, I_D = 250 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (3) (V_{DS} = 28 Vdc, I_D = 1900 mAdc)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (1) (V_{GS} = 10 Vdc, I_D = 2.2 Adc)	$V_{DS(on)}$	0.1	0.21	0.3	Vdc
Forward Transconductance (1) (V_{DS} = 10 Vdc, I_D = 2 Adc)	g_{fs}	—	5.3	—	S
Dynamic Characteristics (1,2)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.5	—	pF
Functional Tests (3) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 2 x 950 mA, P_{out} = 44 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 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}	14.5	15.5	17.5	dB
Drain Efficiency	η_D	25	26.5	—	%
Intermodulation Distortion	IM3	—	-37	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-40	-38	dBc
Input Return Loss	IRL	—	-15	-9	dB

1. Each side of device measured separately.
2. Part is internally matched both on input and output.
3. Measurements made with device in push-pull configuration.

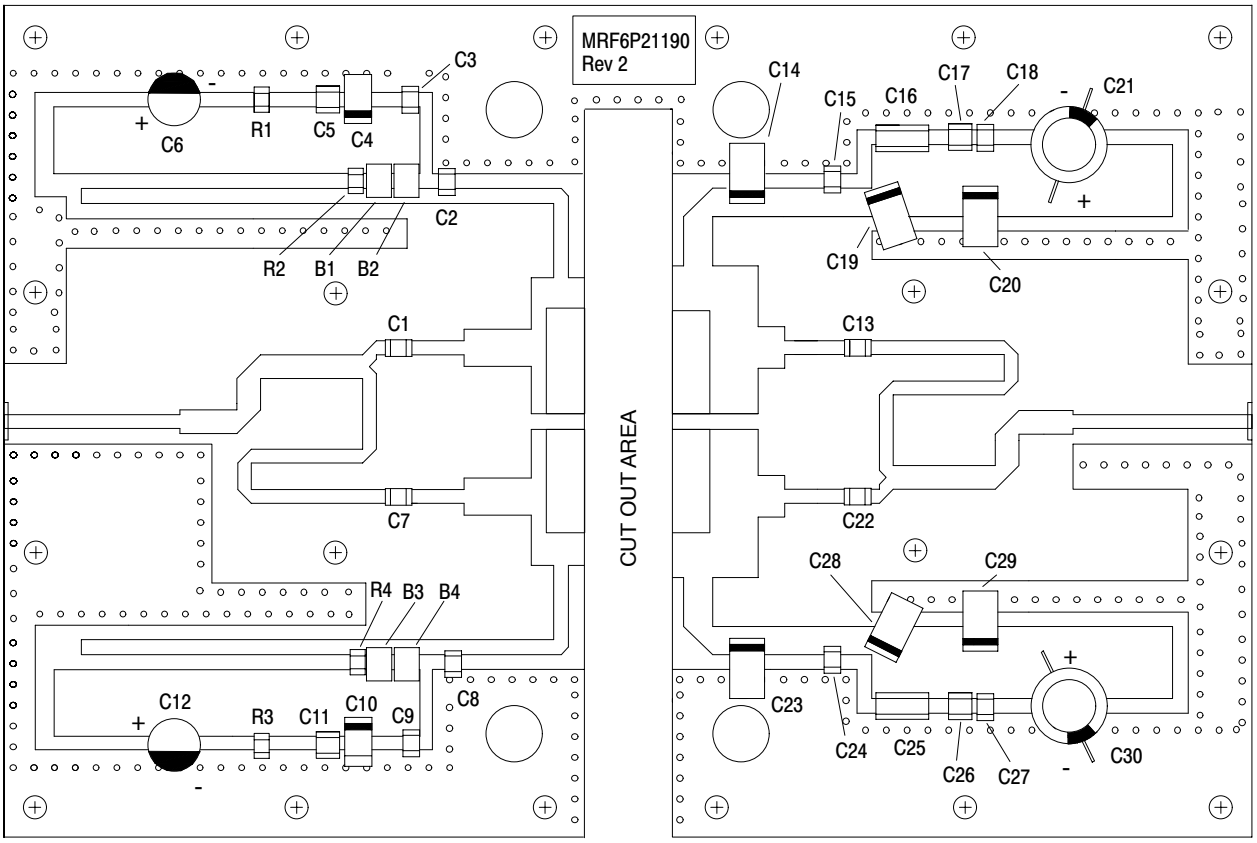


Z1	0.850″ x 0.067″ Microstrip	Z15, Z16	0.289″ x 0.712″ Microstrip
Z2	1.140″ x 0.114″ Microstrip	Z17, Z18	0.127″ x 0.200″ Microstrip
Z3	1.830″ x 0.067″ Microstrip	Z19, Z20	0.288″ x 0.067″ Microstrip
Z4	0.088″ x 0.067″ Microstrip	Z21	0.088″ x 0.067″ Microstrip
Z5, Z6	0.250″ x 0.067″ Microstrip	Z22	1.830″ x 0.067″ Microstrip
Z7, Z8	0.324″ x 0.178″ Microstrip	Z23	1.140″ x 0.114″ Microstrip
Z9, Z10	0.143″ x 0.655″ Microstrip	Z24	0.850″ x 0.066″ Microstrip
Z11, Z12	0.111″ x 0.655″ Microstrip	PCB	Taconic RF-35, 0.030″, ε_r = 3.5
Z13, Z14	0.124″ x 0.712″ Microstrip		

Figure 1. MRF6P21190HR6 Test Circuit Schematic

Table 5. MRF6P21190HR6 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2, B3, B4	RF Beads	2743019447	Fair-Rite
C1, C7	30 pF Chip Capacitors	100B300JP500X	ATC
C2, C8, C15, C24	6.8 pF Chip Capacitors	100B6R8CP500X	ATC
C3, C9, C18, C27	1k pF Chip Capacitors	100B102JP50X	ATC
C4, C10	1 μF, 50 V Tantalum Chip Capacitors	T491C105K050AS	Kemet
C5, C11, C17, C26	0.1 μF Chip Capacitors	CDR33BX104AKWS	Kemet
C6, C12	100 μF, 50 V Electrolytic Capacitors, Radial	MCR50V107M8X11	Multicomp
C13, C22	43 pF Chip Capacitors	100B430JP500X	ATC
C14, C19, C20, C23, C28, C29	22 μF, 35 V Tantalum Chip Capacitors	T491X226K035AS	Kemet
C16, C25	0.56 μF Chip Capacitors (1825)	C1825C564J5RAC	Kemet
C21, C30	470 μF, 63 V Electrolytic Capacitors, Radial	MCR63V477M13X26	Multicomp
R1, R3	1 kΩ, 1/4 W Chip Resistors (1206)	CRCW12061001F100	Vishay
R2, R4	12 Ω, 1/4 W Chip Resistors (1206)	CRCW120612R0F100	Vishay



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. MRF6P21190HR6 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

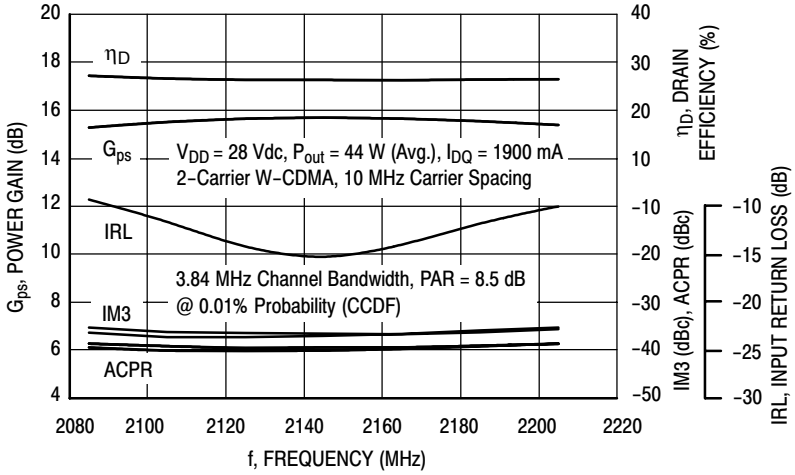


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 44 Watts Avg.

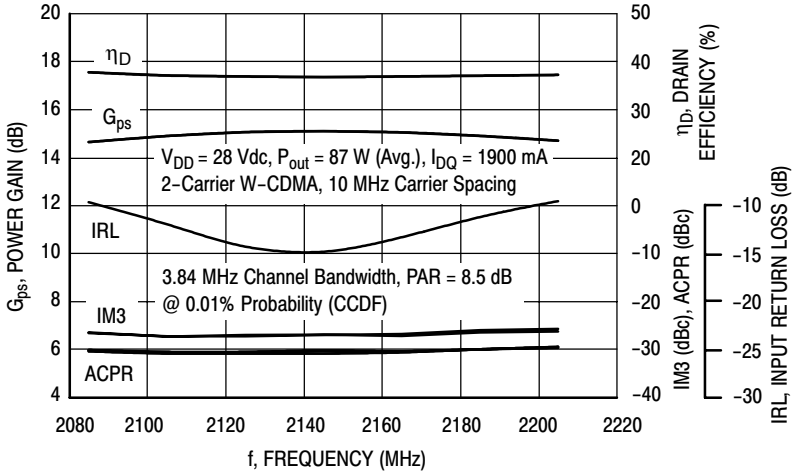


Figure 4. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 87 Watts Avg.

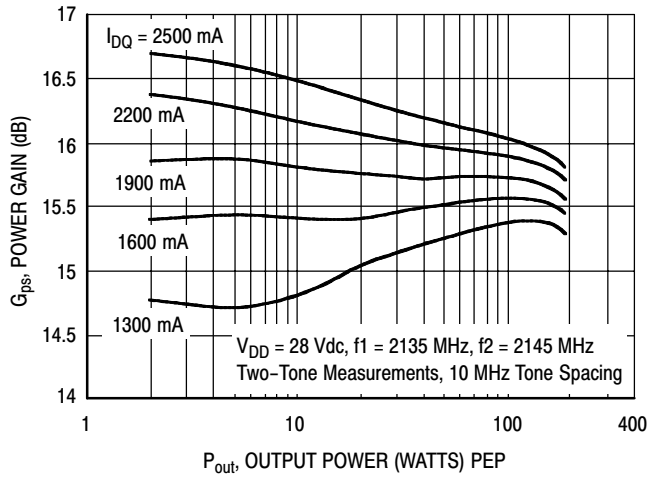


Figure 5. Two-Tone Power Gain versus Output Power

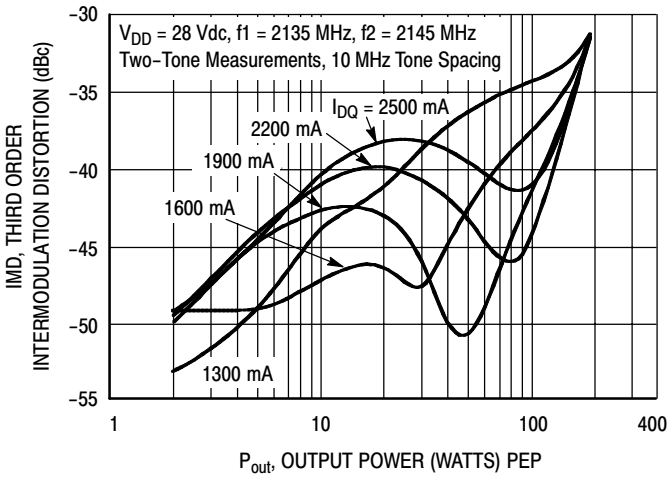


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

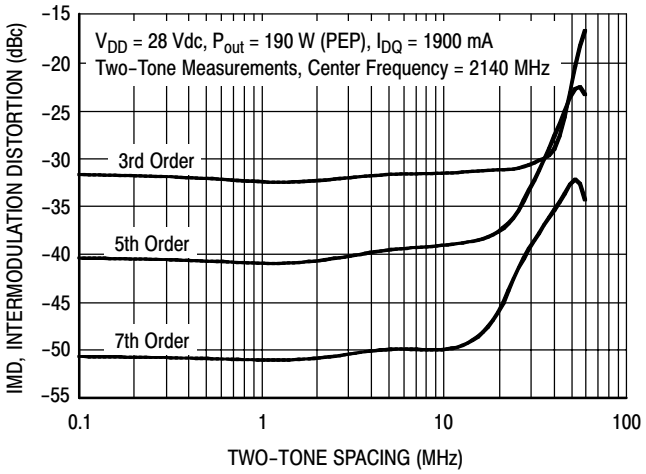


Figure 7. Intermodulation Distortion Products versus Tone Spacing

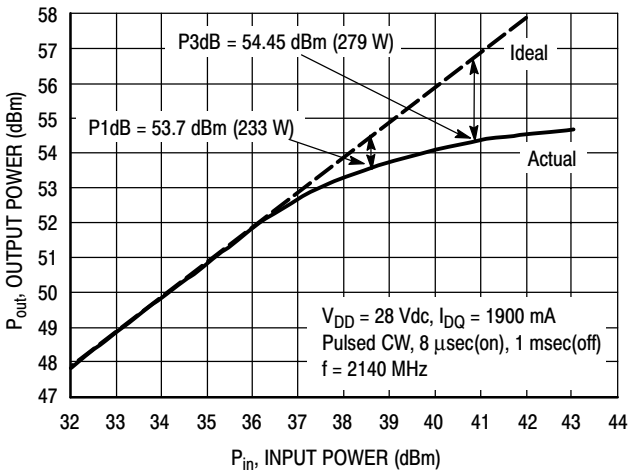


Figure 8. Pulse CW Output Power versus Input Power

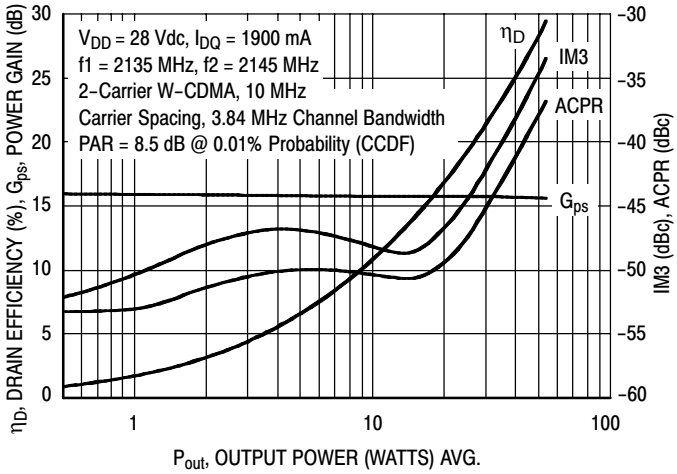


Figure 9. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

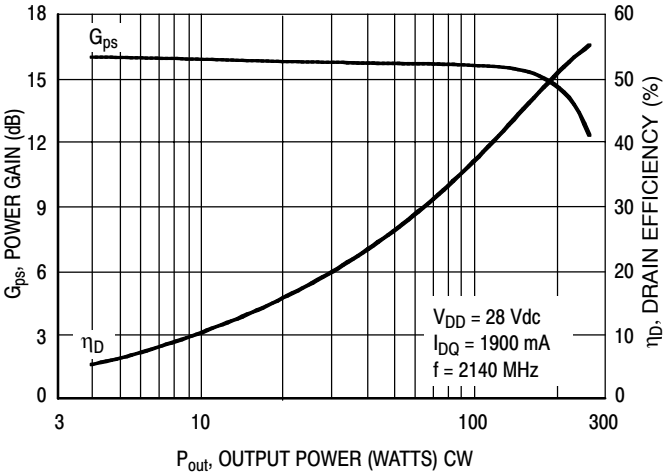


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

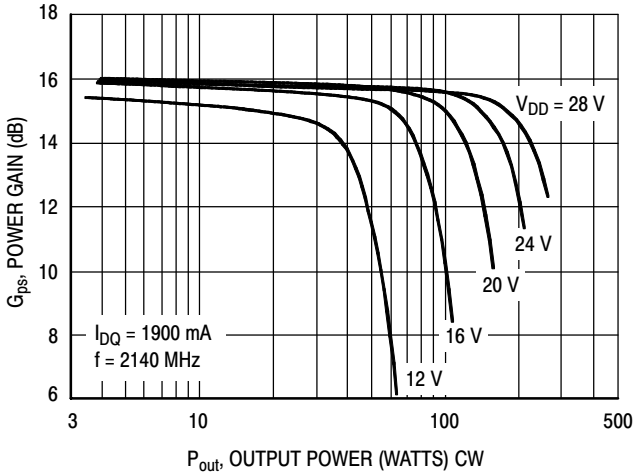
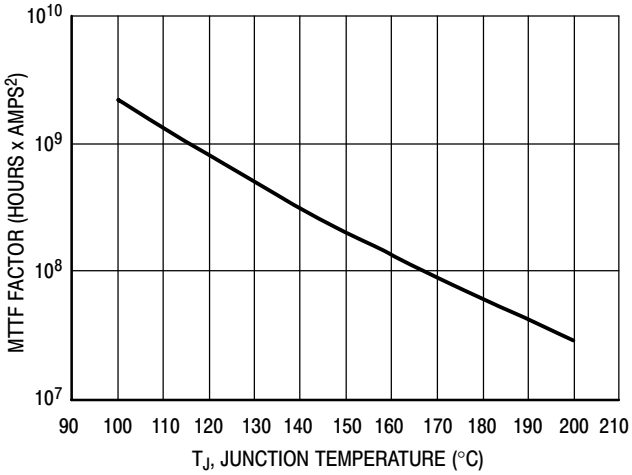


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS



This above graph displays calculated MTTF in hours x 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 12. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

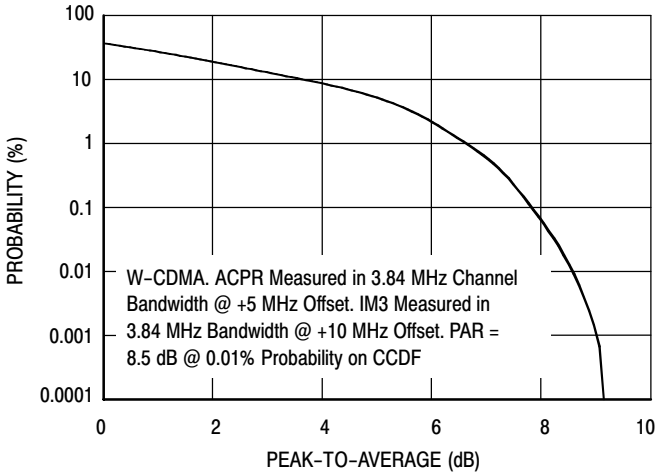


Figure 13. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

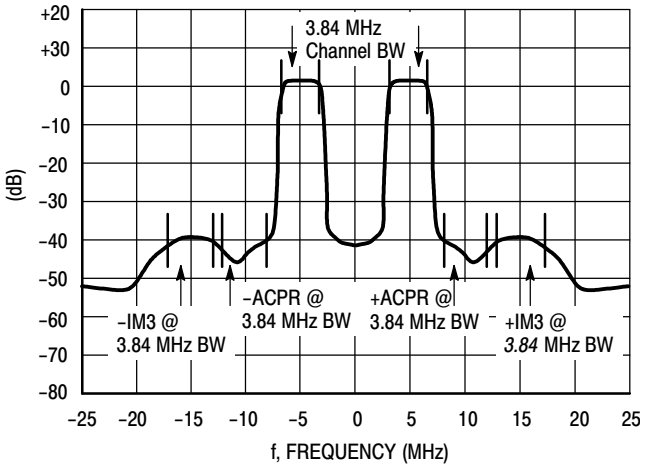
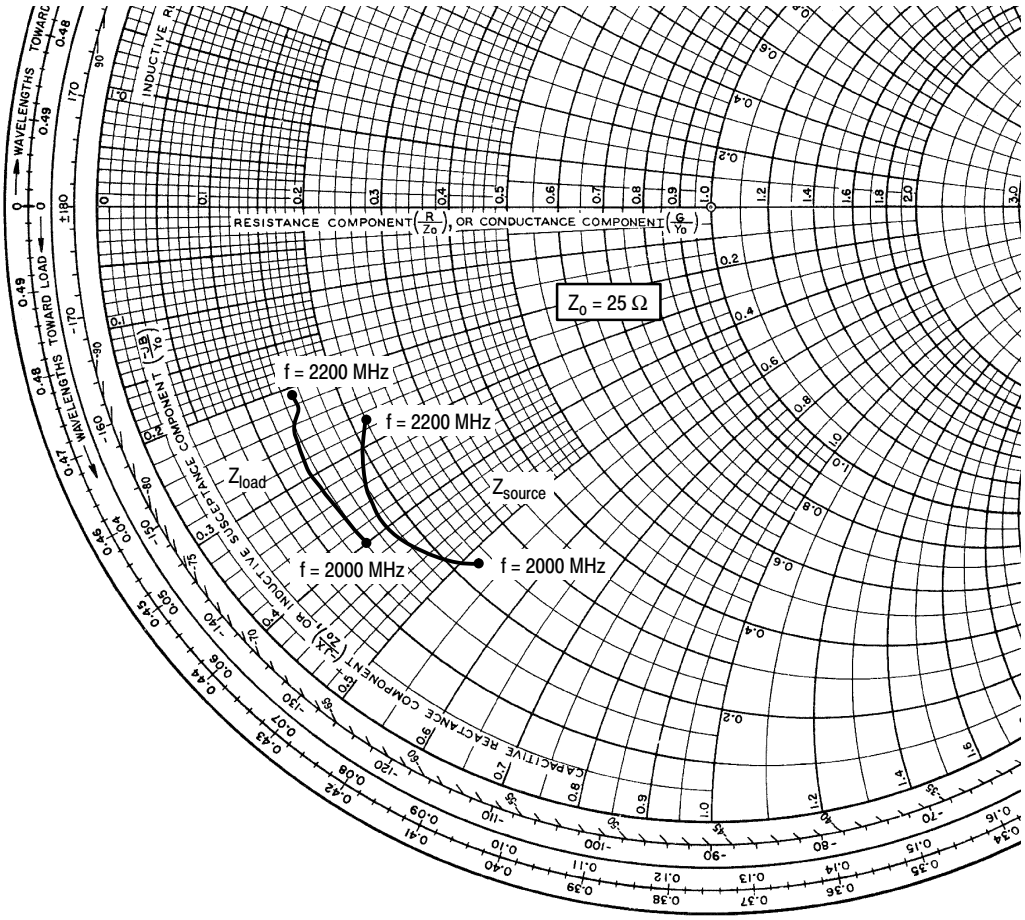


Figure 14. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1900 mA, P_{out} = 44 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2000	5.63 - j12.88	3.43 - j10.06
2110	4.36 - j10.02	3.22 - j7.13
2140	4.56 - j8.49	3.39 - j6.07
2170	5.11 - j7.41	3.76 - j5.45
2200	5.42 - j6.67	3.69 - j5.16

Z_{source} = Test circuit impedance as measured from gate to gate, balanced configuration.

Z_{load} = Test circuit impedance as measured from drain to drain, balanced configuration.

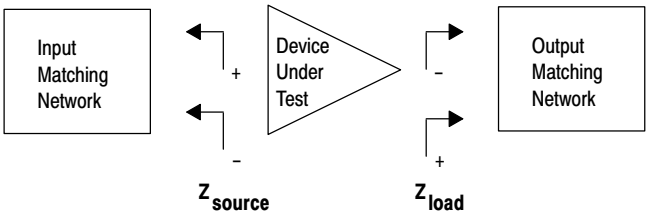
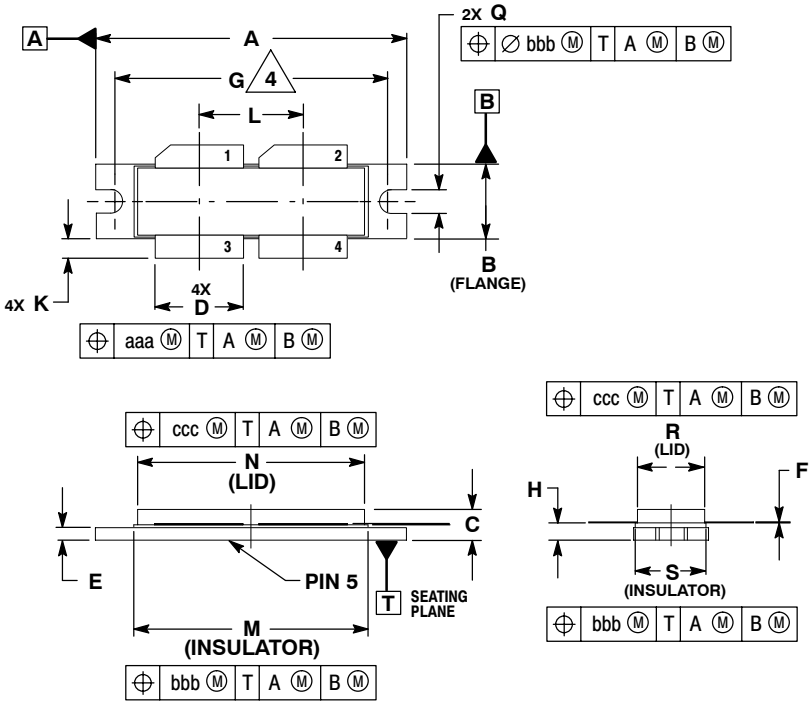


Figure 15. Series Equivalent Source and Load Impedance

NOTES

NOTES

PACKAGE DIMENSIONS



NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. RECOMMENDED BOLT CENTER DIMENSION OF 1.52 (38.61) BASED ON M3 SCREW.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.615	1.625	41.02	41.28
B	0.395	0.405	10.03	10.29
C	0.150	0.200	3.81	5.08
D	0.455	0.465	11.56	11.81
E	0.062	0.066	1.57	1.68
F	0.004	0.007	0.10	0.18
G	1.400 BSC		35.56 BSC	
H	0.082	0.090	2.08	2.29
K	0.117	0.137	2.97	3.48
L	0.540 BSC		13.72 BSC	
M	1.219	1.241	30.96	31.52
N	1.218	1.242	30.94	31.55
Q	0.120	0.130	3.05	3.30
R	0.355	0.365	9.01	9.27
S	0.365	0.375	9.27	9.53
aaa	0.013 REF		0.33 REF	
bbb	0.010 REF		0.25 REF	
ccc	0.020 REF		0.51 REF	

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375D-05
ISSUE E
NI-1230

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