Freescale Semiconductor
Technical Data

Document Number: MRF6S27050H
Rev. 0, 11/2006

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF6S27050HR3
MRF6S27050HSR3

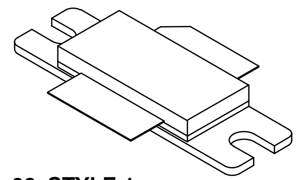
2500-2700 MHz, 7 W AVG., 28 V
SINGLE W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs

Designed for CDMA base station applications with frequencies from 2500 to 2700 MHz. Suitable for WiMAX, WiBro, BWA, and OFDM multicarrier Class AB and Class C amplifier applications.

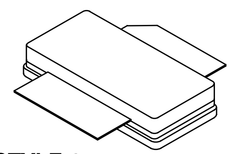
- Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 500 mA, P_{out} = 7 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz. PAR = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 16 dB
  Drain Efficiency — 22.5%
  ACPR @ 5 MHz Offset — -42.5 dBc @ 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2600 MHz, 50 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_{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.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.



CASE 465-06, STYLE 1
NI-780
MRF6S27050HR3



CASE 465A-06, STYLE 1
NI-780S
MRF6S27050HSR3

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
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

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 43 W CW Case Temperature 72°C, 7 W CW	$R_{\theta JC}$	 0.85 0.98	°C/W

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.freescale.com/rf. Select Tools/Software/Application Software/Calculators to access the 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.

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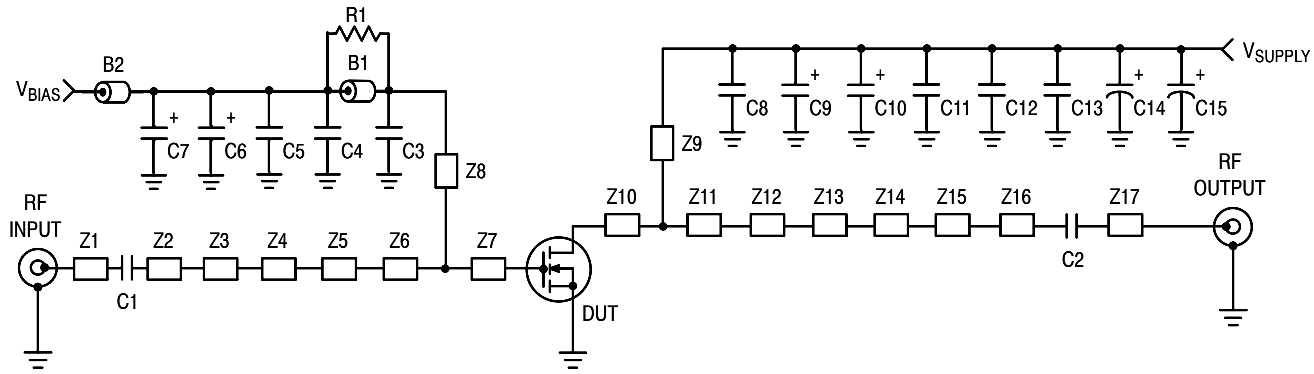
Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1A (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} = 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 (V_{DS} = 10 Vdc, I_D = 250 µAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 500 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2.2 Adc)	$V_{DS(on)}$	—	0.21	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}	—	0.83	—	pF
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	232	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 500 mA, P_{out} = 7 W Avg. W-CDMA, f = 2585 MHz and 2615 MHz, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	15	16	18	dB
Drain Efficiency	η_D	20.5	22.5	—	%
Adjacent Channel Power Ratio	ACPR	-40	-42.5	—	dBc
Input Return Loss	IRL	—	-10	—	dB

1. Part internally matched both on input and output.



Z1	0.748″ x 0.081″ Microstrip	Z10	0.091″ x 0.753″ Microstrip
Z2	0.273″ x 0.081″ Microstrip	Z11	0.150″ x 0.753″ Microstrip
Z3	0.055″ x 0.220″ Microstrip	Z12	0.153″ x 0.543″ Microstrip
Z4	0.090″ x 0.440″ Microstrip	Z13	0.145″ x 0.384″ Microstrip
Z5	0.195″ x 0.170″ Microstrip	Z14	0.446″ x 0.148″ Microstrip
Z6	0.797″ x 0.490″ Microstrip	Z15	0.130″ x 0.425″ Microstrip
Z7	0.082″ x 0.490″ Microstrip	Z16	0.384″ x 0.081″ Microstrip
Z8	0.050″ x 0.476″ Microstrip	Z17	0.730″ x 0.081″ Microstrip
Z9	0.070″ x 0.350″ Microstrip	PCB	Arlon GX0300-55-22, 0.030″, ε_r = 2.55

Figure 1. MRF6S27050HR3(SR3) Test Circuit Schematic

Table 5. MRF6S27050HR3(SR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Ferrite Bead	2508051107Y0	Fair-Rite
B2	Ferrite Bead, Short	2743019447	Fair-Rite
C1, C2	4.3 pF Chip Capacitors	600B4R3BT250XT	ATC
C3, C8	3.6 pF Chip Capacitors	600B3R6BT250XT	ATC
C4, C11	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C5	0.01 μF, 100 V Chip Capacitor	C1825C103J1RAC	Kemet
C6	22 μF, 25 V Tantulum Capacitor	ECS-T1ED226R	Panasonic TE series
C7	47 μF, 16 V Tantalum Capacitor	T491D476K016AT	Kemet
C9, C10	10 μF, 50 V Tantalum Capacitors	522Z-050/100MTRE	Tecate
C12, C13	1.0 μF, 50 V Chip Capacitors	GRM32RR71H105KA01B	Murata
C14	330 μF, 63 V Electrolytic Capacitor	SME63V331M12X25LL	Nippon Chemi-Con
C15	47 μF, 50 V Electrolytic Capacitor	MVK50VC47RM8X10TP	United Chemi-Con
R1	2.7 Ω, 1/4 W Chip Resistor	CRCW12062R7F100	Vishay

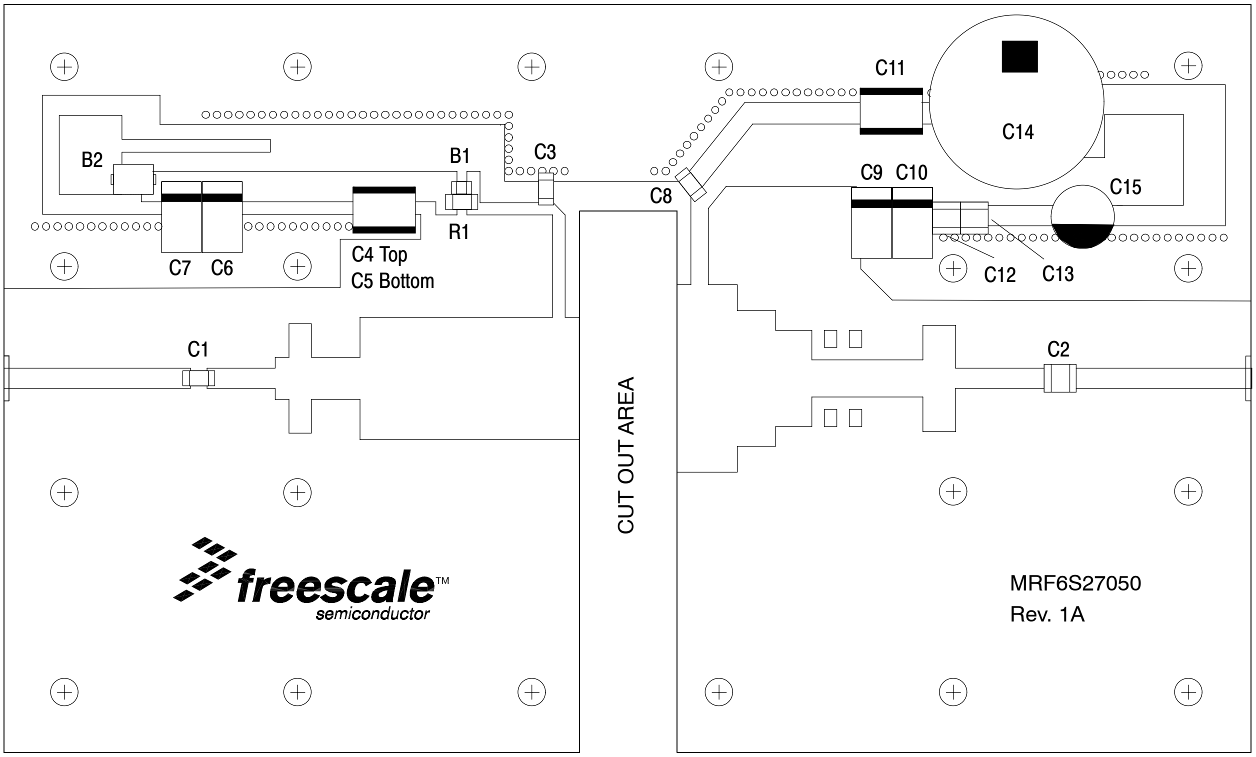


Figure 2. MRF6S27050HR3(SR3) Test Circuit Component Layout

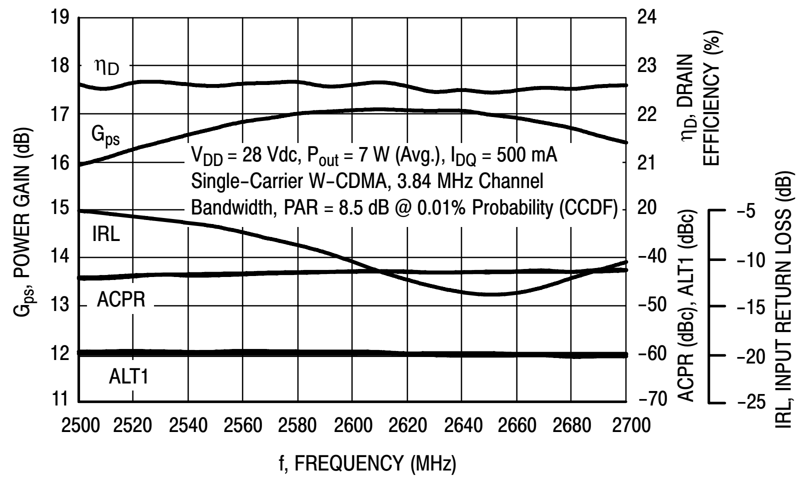


Figure 3. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 7 Watts Avg.

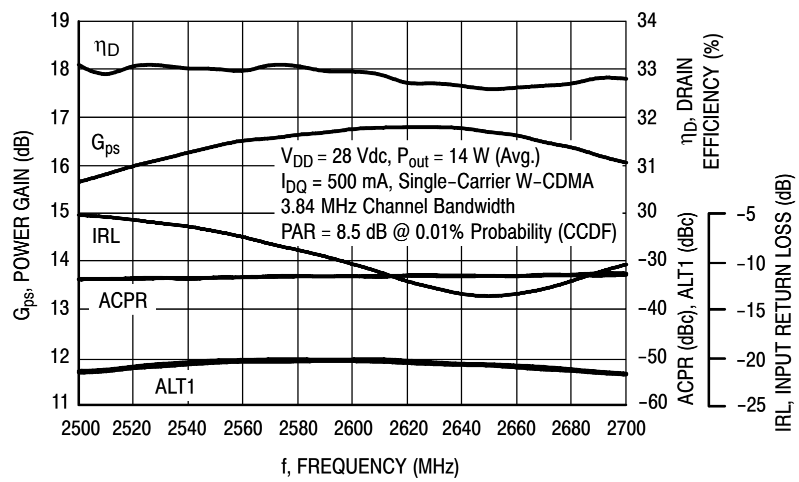


Figure 4. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 14 Watts Avg.

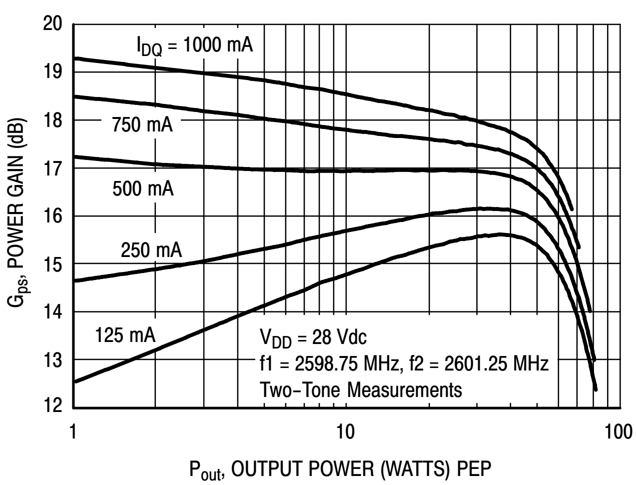


Figure 5. Two-Tone Power Gain versus Output Power

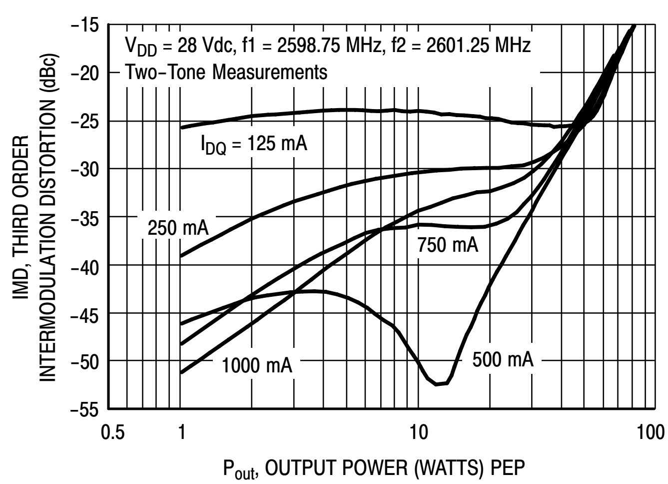


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

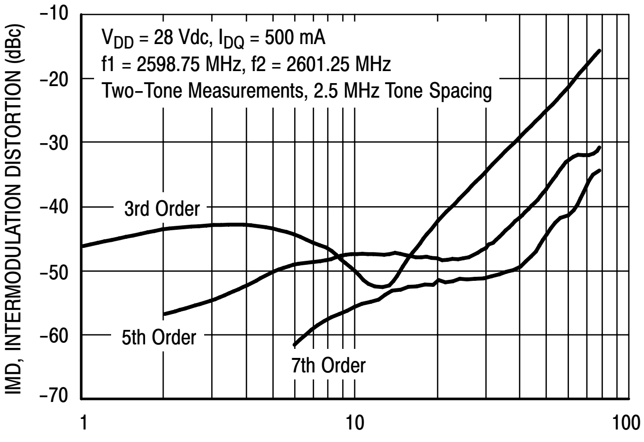


Figure 7. Intermodulation Distortion Products versus Output Power

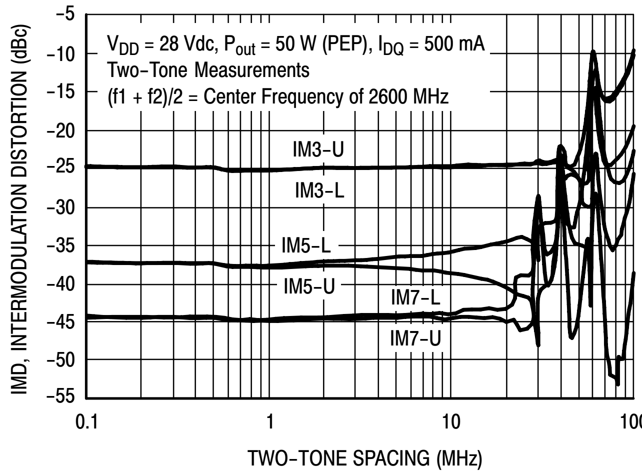


Figure 8. Intermodulation Distortion Products versus Tone Spacing

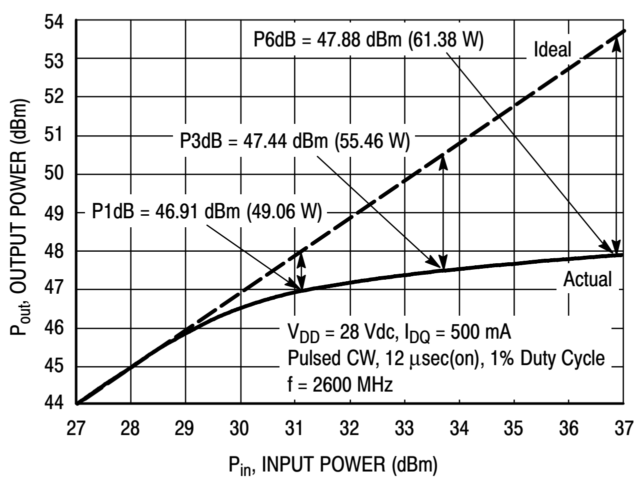


Figure 9. Pulsed CW Output Power versus Input Power

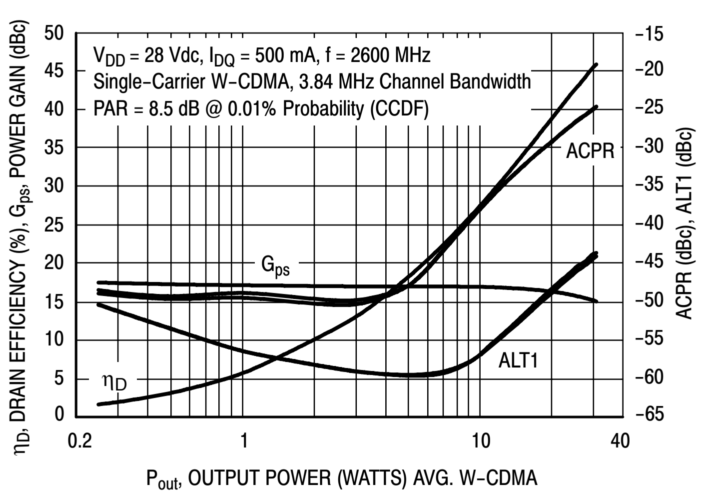


Figure 10. Single-Carrier W-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power

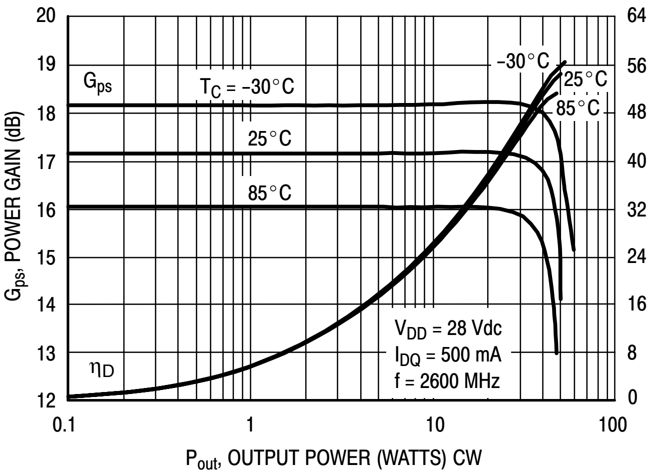


Figure 11. Power Gain and Drain Efficiency versus CW Output Power

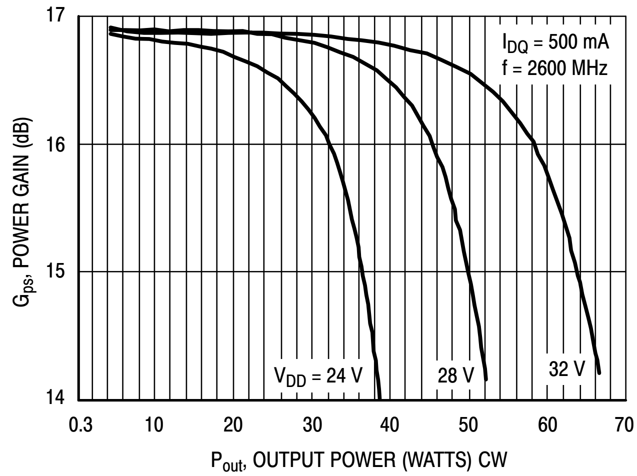


Figure 12. Power Gain versus Output Power

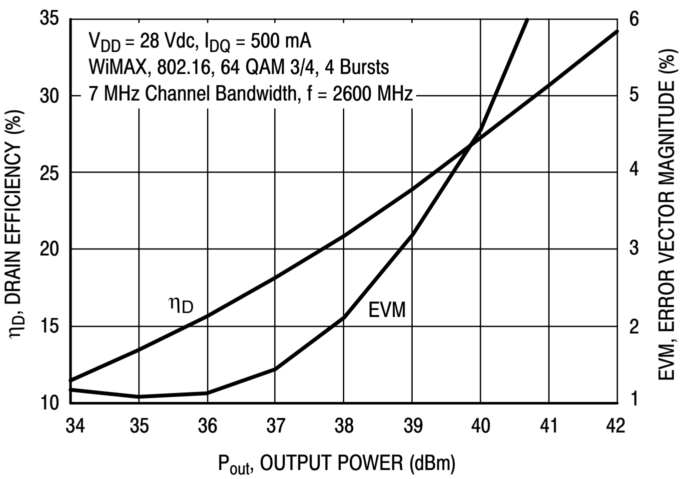
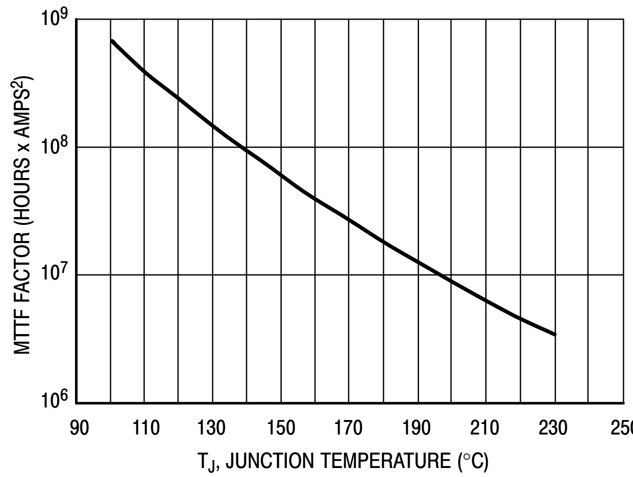


Figure 13. Drain Efficiency and Error Vector Magnitude versus Output Power



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 14. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

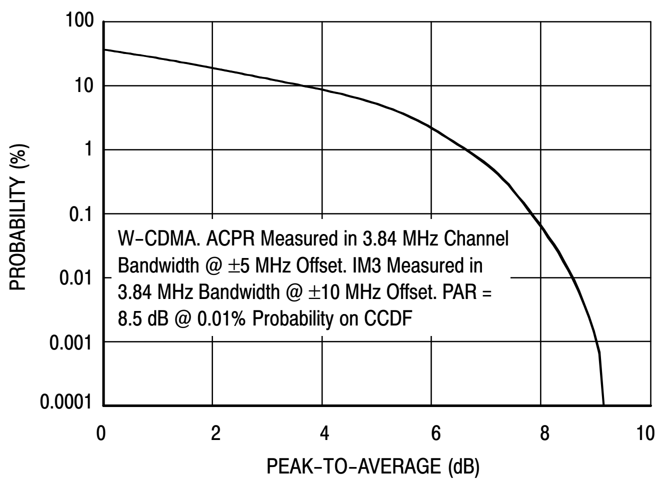


Figure 15. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

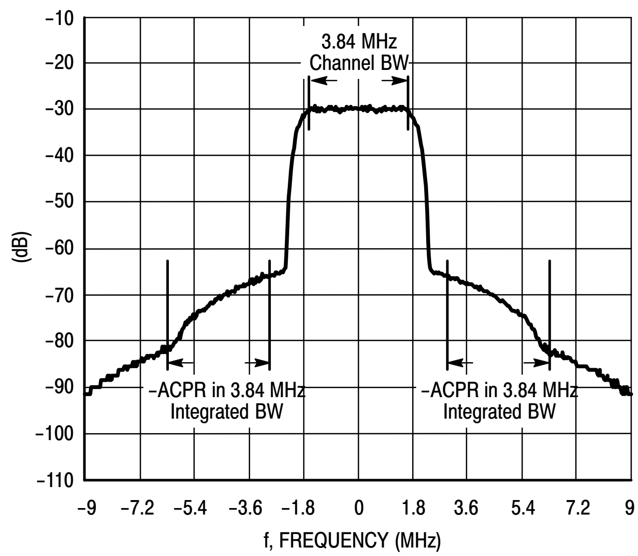
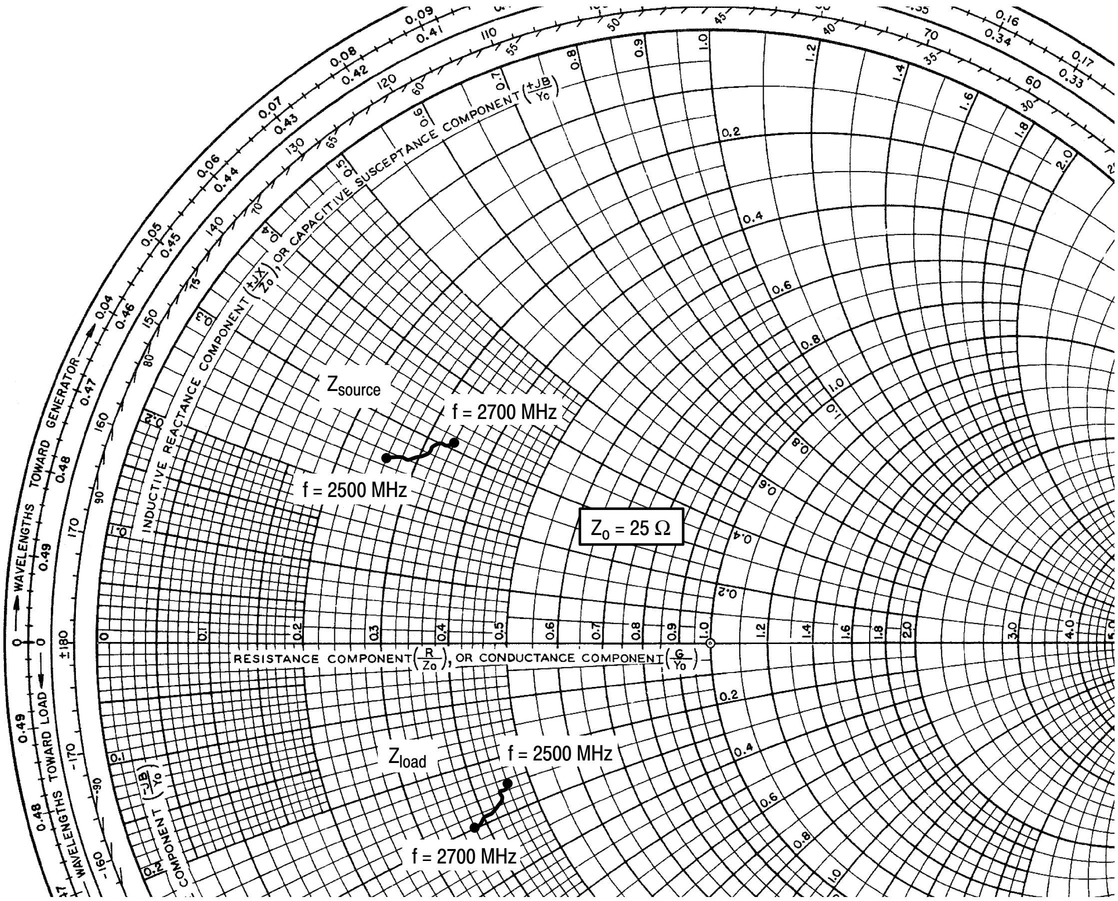


Figure 16. Single-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 500 mA, P_{out} = 7 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2500	6.897 + j6.212	11.524 - j6.193
2525	7.062 + j6.412	11.325 - j6.396
2550	7.239 + j6.611	11.110 - j6.594
2575	7.428 + j6.808	10.880 - j6.783
2600	7.630 + j7.002	10.634 - j6.962
2625	7.846 + j7.193	10.373 - j7.130
2650	8.075 + j7.380	10.098 - j7.283
2675	8.320 + j7.561	9.810 - j7.420
2700	8.579 + j7.737	9.511 - j7.541

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

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

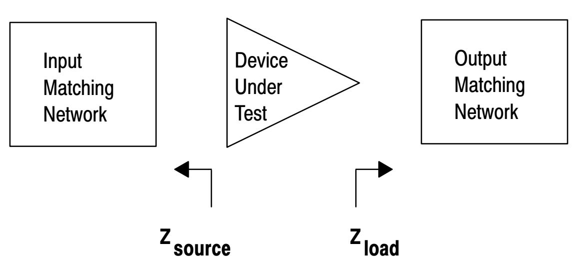
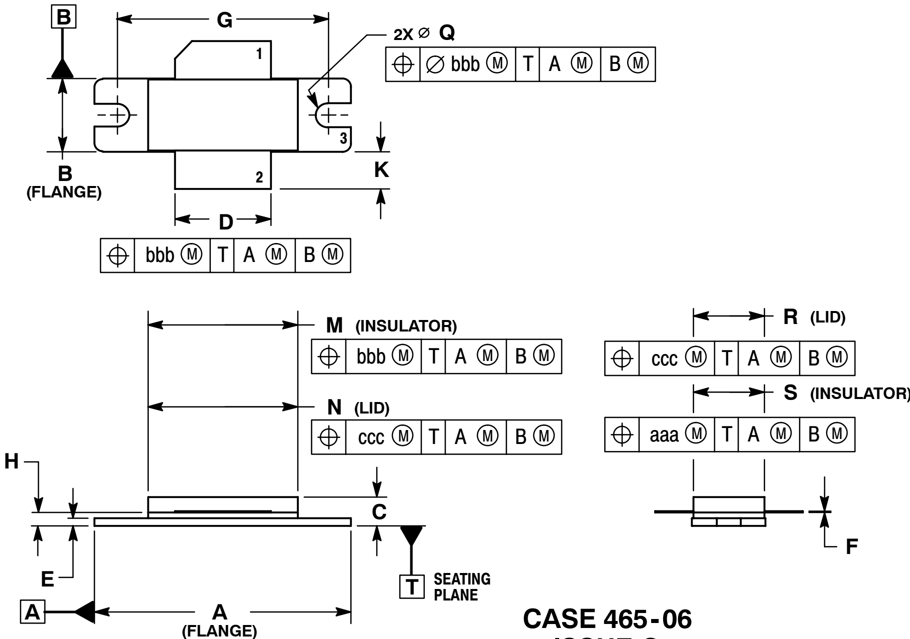


Figure 17. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

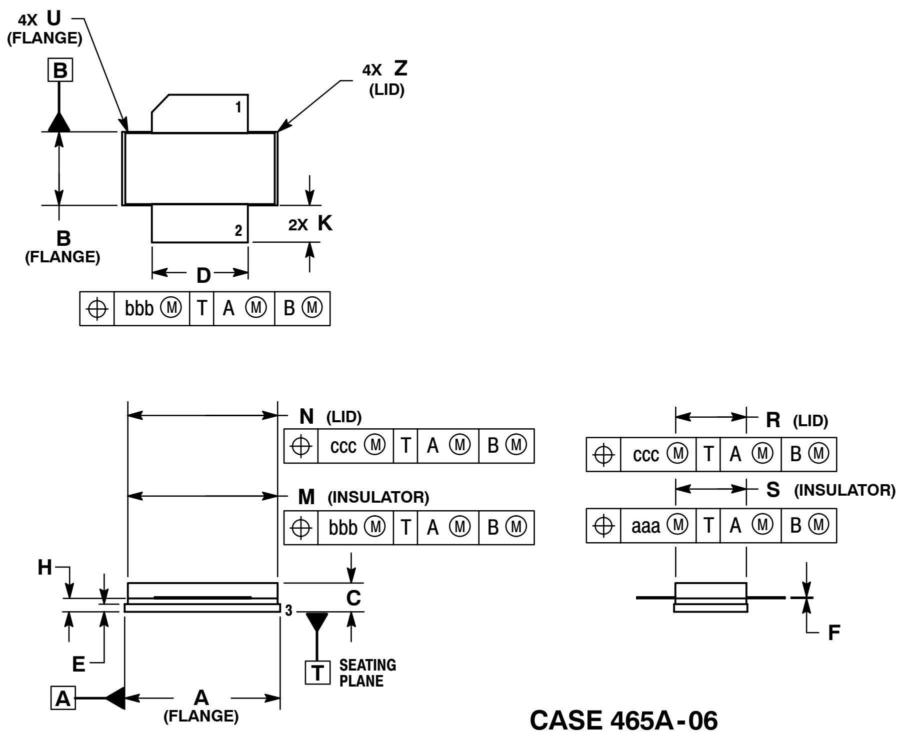


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M−1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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
MRF6S27050HR3



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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
MRF6S27050HSR3

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	Nov. 2006	• Initial Release of Data Sheet

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