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RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral 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.

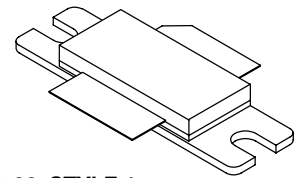
- Typical Single-Carrier W-CDMA Performance: $V_{DD} = 28$ Volts, $I_{DQ} = 500$ mA, $P_{out} = 7$ Watts Avg., $f = 2615$ MHz, Channel Bandwidth = 3.84 MHz. PAR = 8.5 dB @ 0.01% Probability on CCDF.
Power Gain — 16 dB
Drain Efficiency — 22.5%
ACPR @ 5 MHz Offset — -42.5 dBc @ 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2600 MHz, 50 Watts CW Output Power

Features

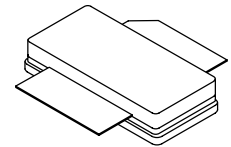
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF6S27050HR3
MRF6S27050HSR3

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



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 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.

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 ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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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 ($V_{DD} = 28 \text{ Vdc}$, $I_D = 500 \text{ mAdc}$, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage ($V_{GS} = 10 \text{ Vdc}$, $I_D = 2.2 \text{ Adc}$)	$V_{DS(on)}$	—	0.21	0.3	Vdc

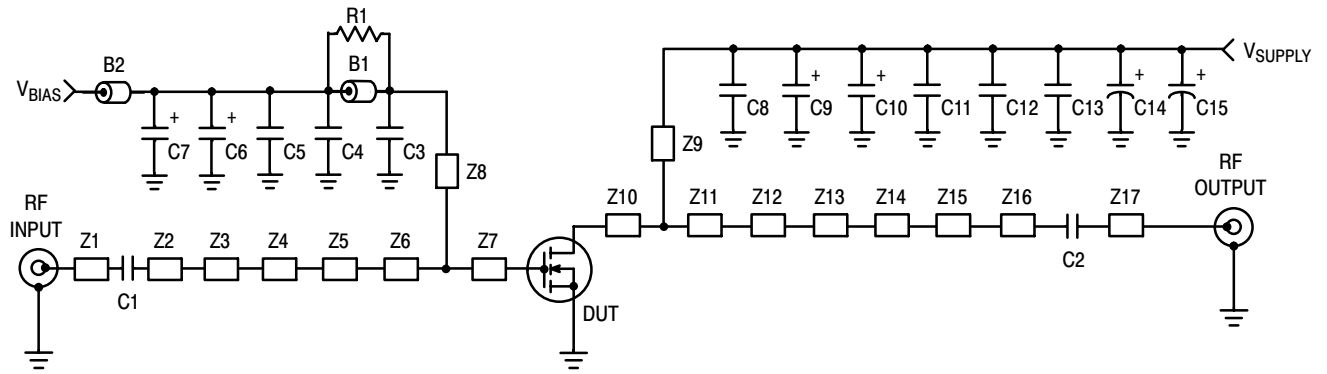
Dynamic Characteristics ⁽¹⁾

Reverse Transfer Capacitance ($V_{DS} = 28 \text{ Vdc} \pm 30 \text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0 \text{ Vdc}$)	C_{rss}	—	0.83	—	pF
Output Capacitance ($V_{DS} = 28 \text{ Vdc} \pm 30 \text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0 \text{ Vdc}$)	C_{oss}	—	232	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28 \text{ Vdc}$, $I_{DQ} = 500 \text{ mA}$, $P_{out} = 7 \text{ W Avg. W-CDMA}$, $f = 2615 \text{ MHz}$, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @ $\pm 5 \text{ MHz}$ 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 CuClad 250GX-0300-55-22, 0.030", $\epsilon_r = 2.55$

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	ATC100B4R3BT500XT	ATC
C3, C8	3.6 pF Chip Capacitors	ATC100B3R6BT500XT	ATC
C4, C11	2.2 μ F, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C5	0.01 μ F, 100 V Chip Capacitor	C1825C103J1RAC	Kemet
C6	22 μ F, 25 V Tantalum Capacitor	T491D226K025AT	Kemet
C7	47 μ F, 16 V Tantalum Capacitor	T491D476K016AT	Kemet
C9, C10	10 μ F, 50 V Tantalum Capacitors	T491D106K050AT	Kemet
C12, C13	1.0 μ F, 50 V Chip Capacitors	GRM32RR71H105KA01B	Murata
C14	330 μ F, 63 V Electrolytic Capacitor	EMVY630GTR331MMH0S	Nippon Chemi-Con
C15	47 μ F, 50 V Electrolytic Capacitor	EMVK500ADA470MHA0G	United Chemi-Con
R1	2.7 Ω , 1/4 W Chip Resistor	CRCW12062R7FKEA	Vishay

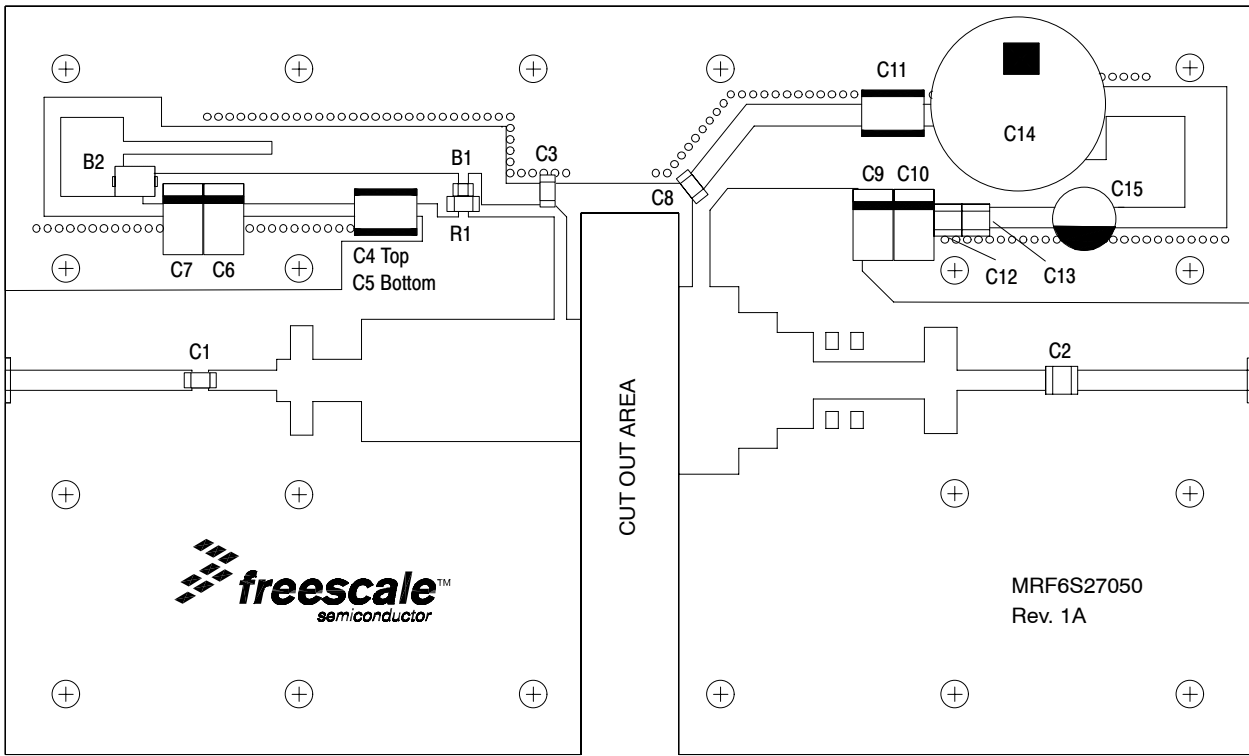


Figure 2. MRF6S27050HR3(SR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

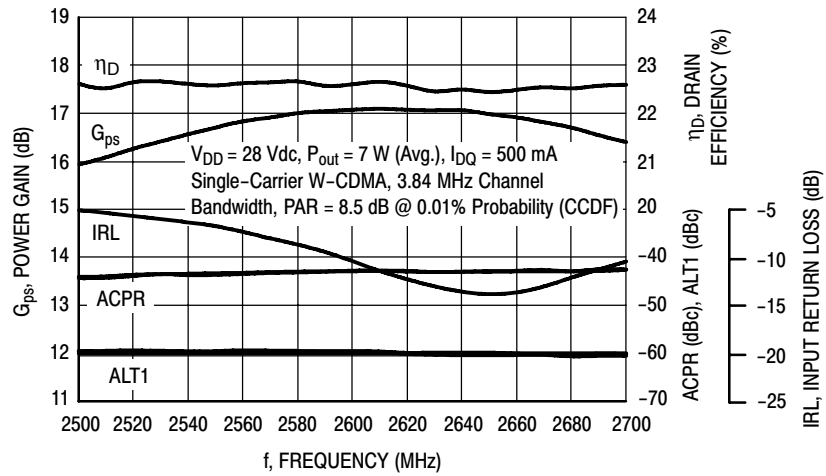


Figure 3. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 7 Watts Avg.

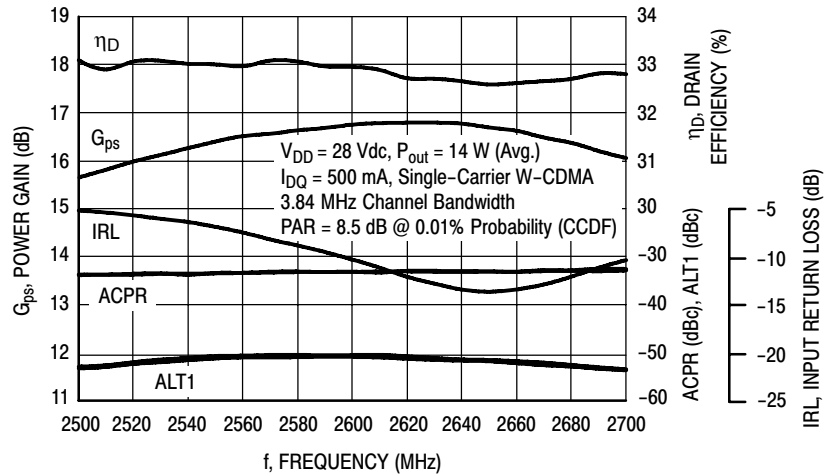


Figure 4. Single-Carrier W-CDMA Broadband Performance @ P_{out} = 14 Watts Avg.

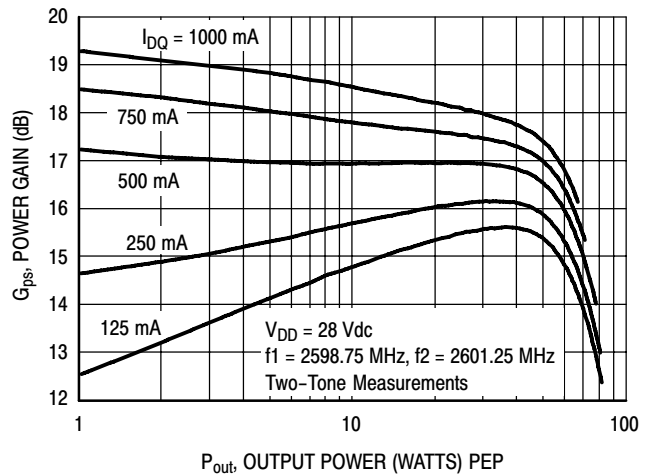


Figure 5. Two-Tone Power Gain versus Output Power

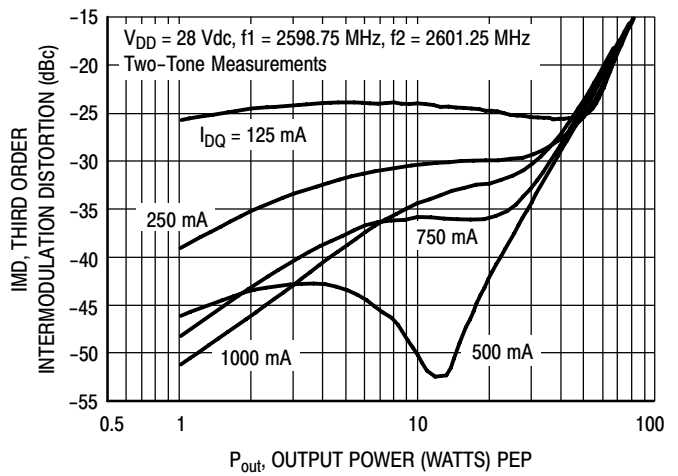


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

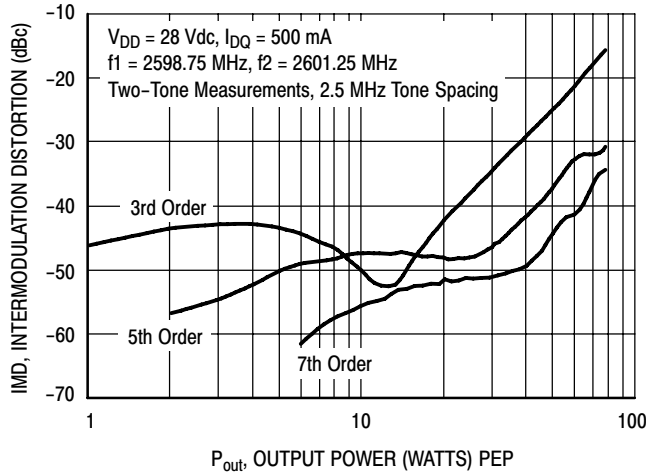


Figure 7. Intermodulation Distortion Products versus Output Power

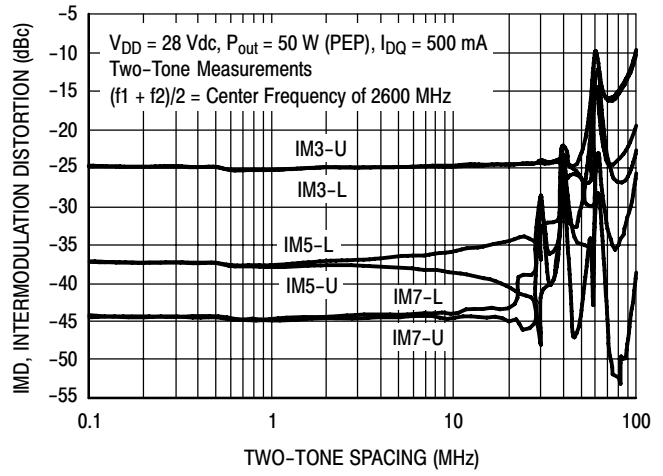


Figure 8. Intermodulation Distortion Products versus Tone Spacing

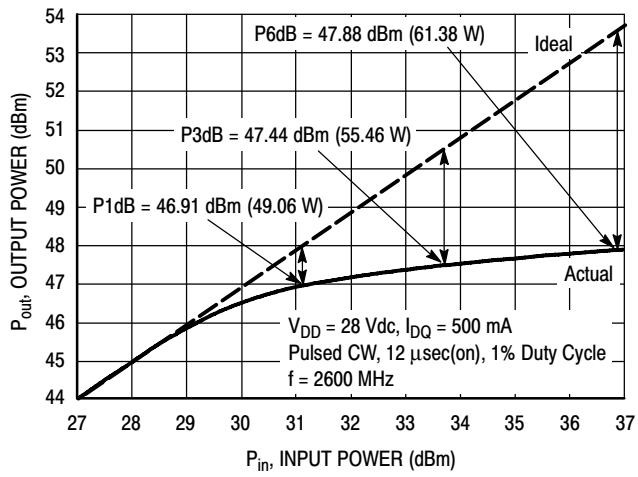


Figure 9. Pulsed CW Output Power versus Input Power

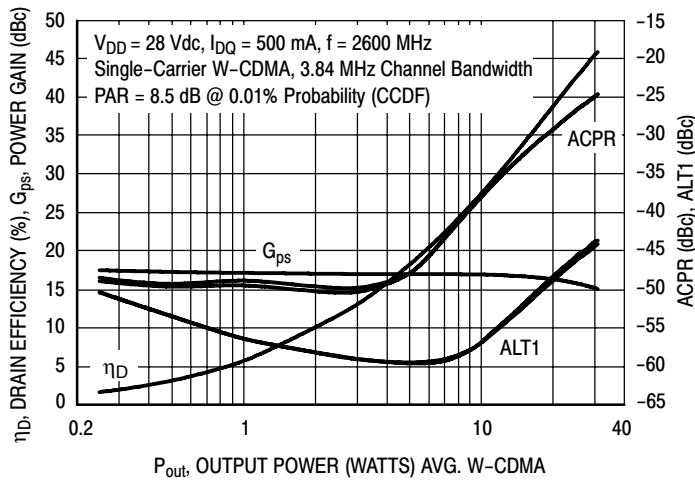


Figure 10. Single-Carrier W-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS

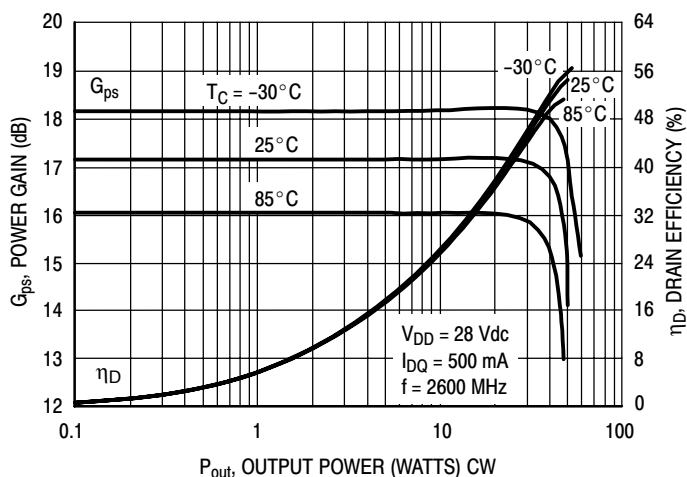


Figure 11. Power Gain and Drain Efficiency versus CW Output Power

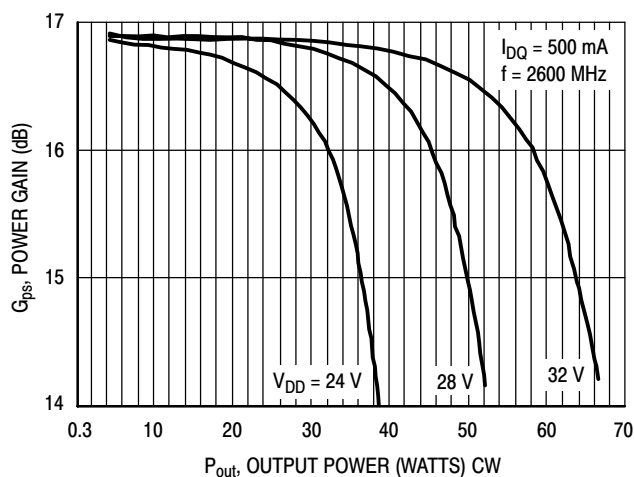


Figure 12. Power Gain versus Output Power

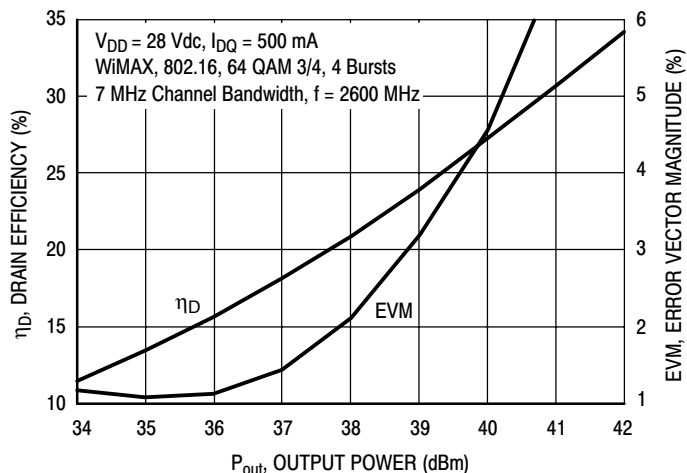
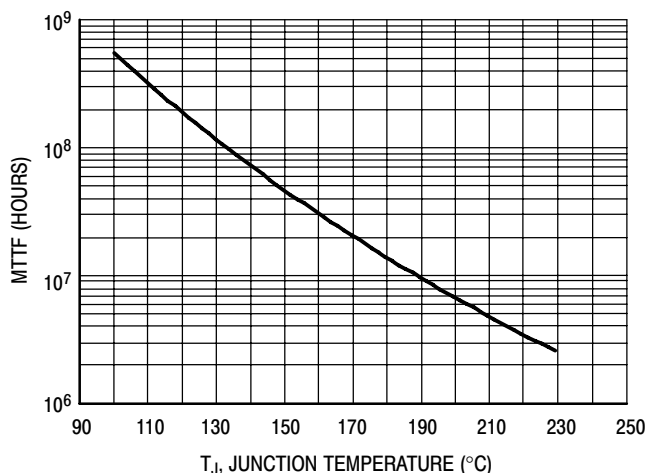


Figure 13. Drain Efficiency and Error Vector Magnitude versus Output Power



This above graph displays calculated MTTF in hours when the device is operated at $V_{DD} = 28$ Vdc, $P_{out} = 7$ W Avg., and $\eta_D = 22.5\%$.

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

Figure 14. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

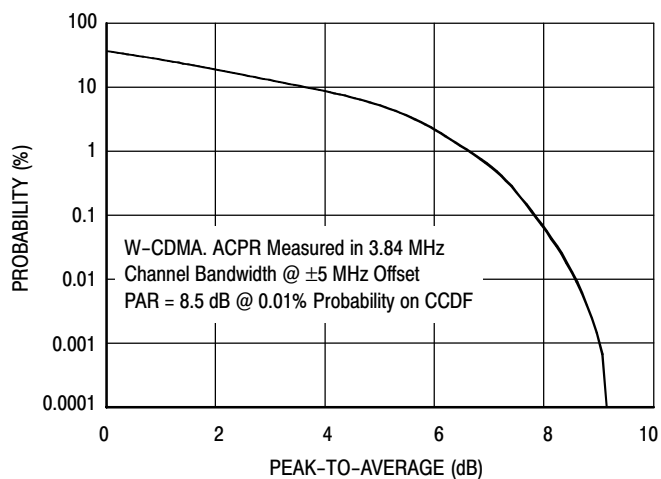


Figure 15. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

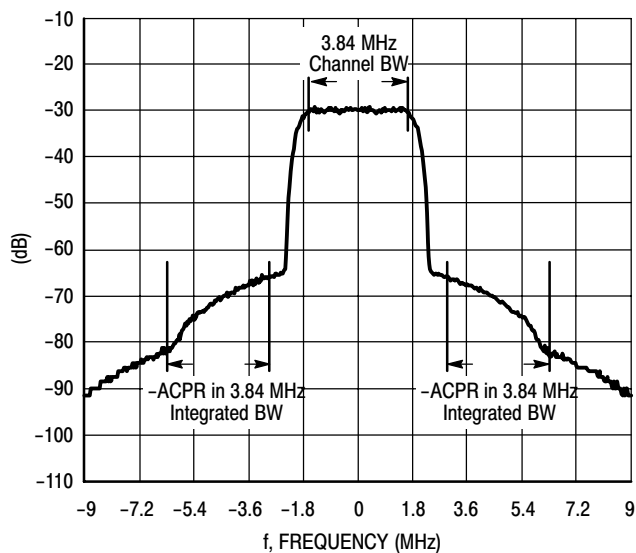
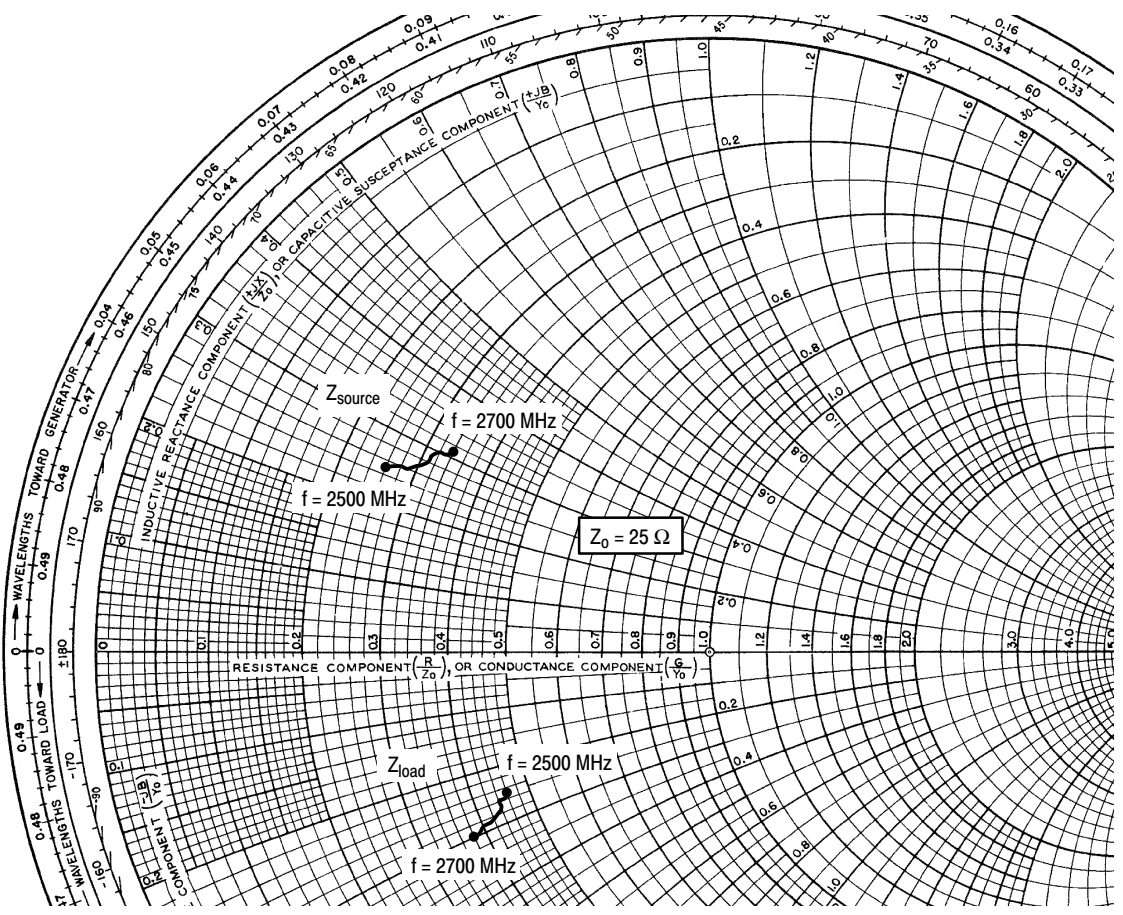


Figure 16. Single-Carrier W-CDMA Spectrum



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

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.

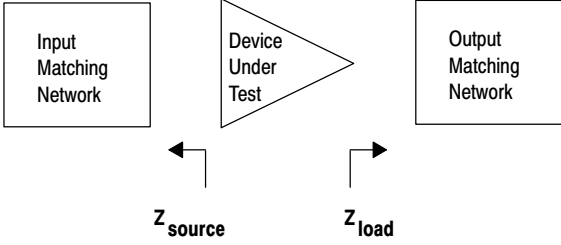
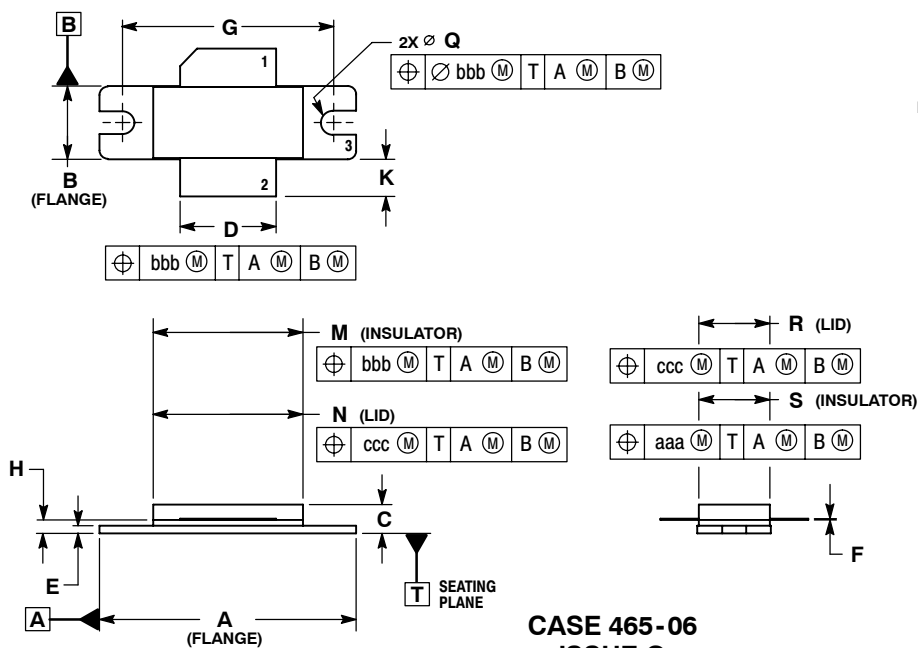


Figure 17. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

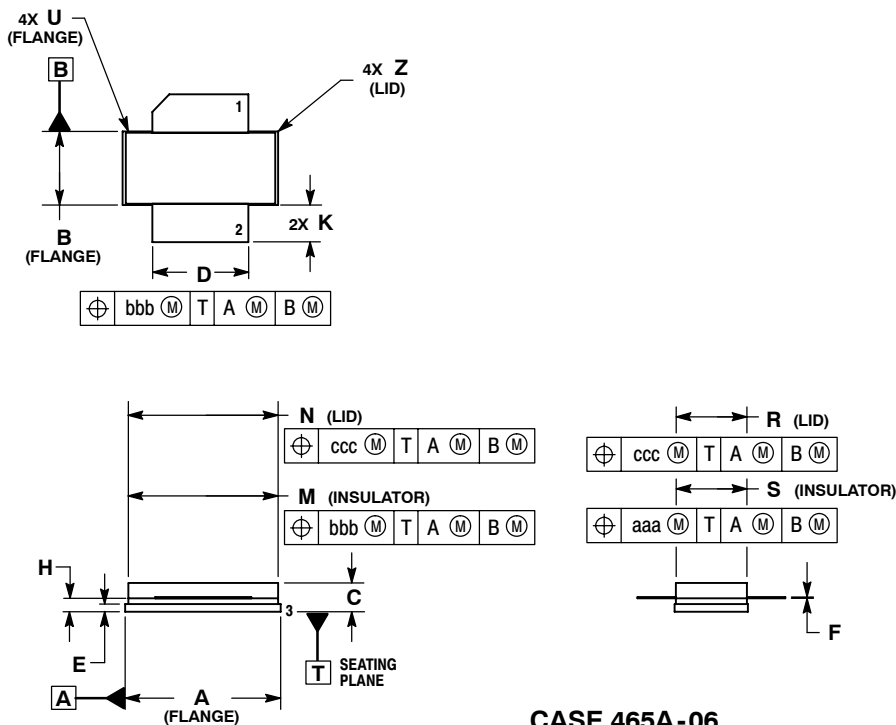


**CASE 465-06
ISSUE G
NI-780
MRF6S27050HR3**

- 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	\varnothing 0.118	\varnothing 0.138	\varnothing 3.00	\varnothing 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 465A-06
ISSUE H
NI-780S
MRF6S27050HSR3**

- 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	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

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	<ul style="list-style-type: none"> • Initial Release of Data Sheet
1	Dec. 2008	<ul style="list-style-type: none"> • Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN13232, p. 1, 2 • Removed Lower Thermal Resistance and Low Gold Plating bullets from Features section as functionality is standard, p. 1 • Corrected V_{DS} to V_{DD} in the RF test condition voltage callout for $V_{GS(Q)}$, On Characteristics table, p. 2 • Updated PCB information to show more specific material details, Fig. 1, Test Circuit Schematic, p. 3 • Updated Part Numbers in Table 5, Component Designations and Values, to latest RoHS compliant part numbers, p. 3 • Replaced Fig. 14, MTTF versus Junction Temperature with updated graph. Removed Amps² and listed operating characteristics and location of MTTF calculator for device, p. 7

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