. :eescale Semiconductor
Technical Data

Document Number: MRF6P27160H
Rev. 2, 12/2008

RoHS

RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

Designed for CDMA base station applications with frequencies from 2600 to 2700 MHz. Suitable for WiMAX, WiBro and multicarrier amplifier applications. To be used in Class AB and Class C for WLL applications.

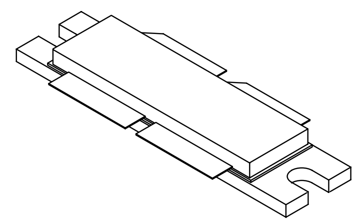
- Typical Single-Carrier N-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1800 mA, P_{out} = 35 Watts Avg., f = 2660 MHz, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13), Channel Bandwidth = 1.2288 MHz, PAR = 9.8 dB @ 0.01% Probability on CCDF.
  Power Gain — 14.6 dB
  Drain Efficiency — 22.6%
  ACPR @ 885 kHz Offset — -47.8 dBc in 30 kHz Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2650 MHz, 160 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. R6 Suffix = 150 Units per 56 mm, 13 inch Reel.

MRF6P27160HR6

**2600-2700 MHz, 35 W AVG., 28 V
SINGLE N-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
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 79°C, 160 W CW Case Temperature 71°C, 35 W CW	$R_{\theta JC}$	 0.29 0.31	°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)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	III (Minimum)

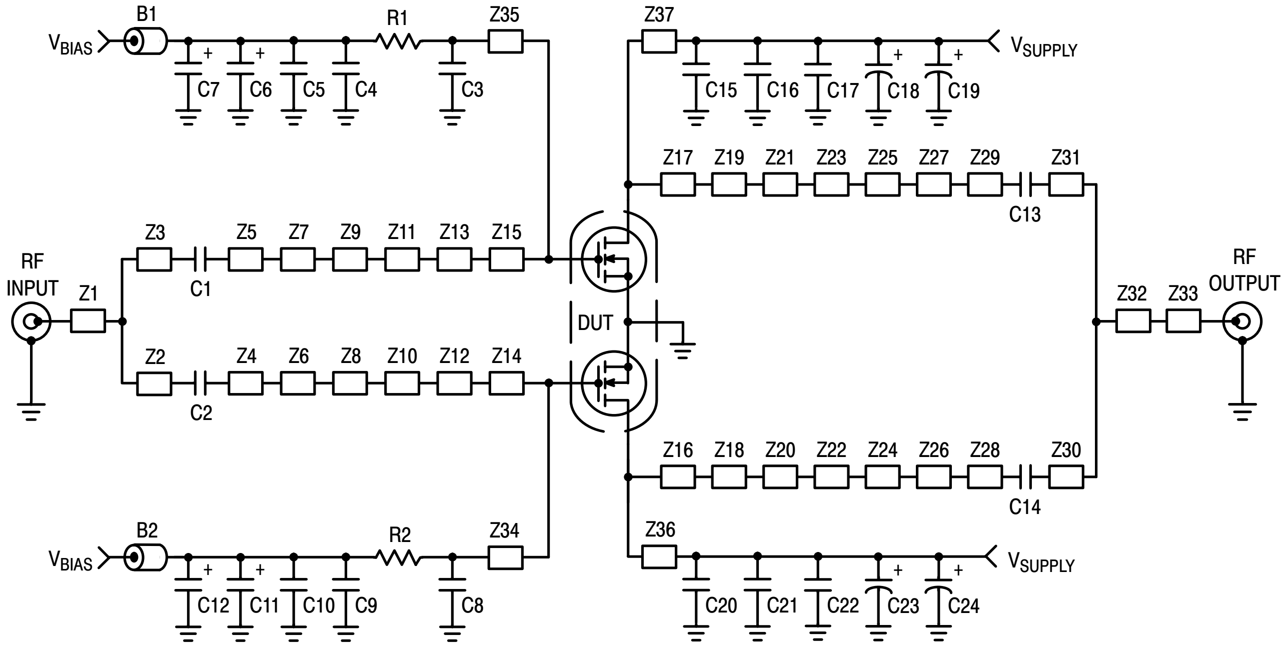
Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

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_{DD} = 28 Vdc, I_D = 1800 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (1) (V_{GS} = 10 Vdc, I_D = 2.2 Adc)	$V_{DS(on)}$	—	0.21	0.3	Vdc
Dynamic Characteristics (1,2)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.8	—	pF

Functional Tests (3) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1800 mA, P_{out} = 35 W Avg. N-CDMA, f = 2660 MHz, Single-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carrier. ACPR measured in 30 kHz Channel Bandwidth @ ±885 kHz Offset. PAR = 9.8 dB @ 0.01% Probability on CCDF.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	13	14.6	16	dB
Drain Efficiency	η_D	20	22.6	—	%
Adjacent Channel Power Ratio	ACPR	—	-47.8	-45	dBc
Input Return Loss	IRL	—	-13	-9	dB

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

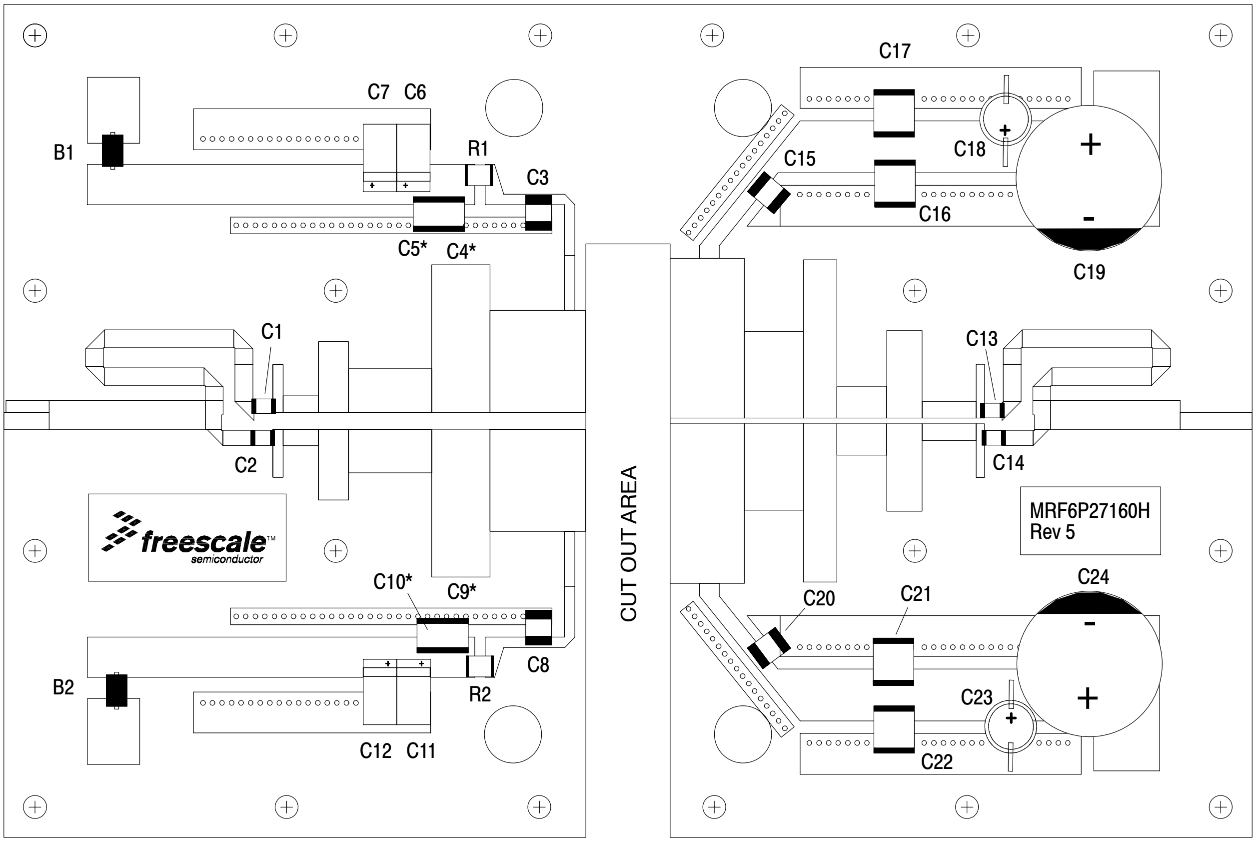


Z1	1.011″ x 0.139″ Microstrip	Z20, Z21	0.160″ x 0.760″ Microstrip
Z2, Z30	0.150″ x 0.070″ Microstrip	Z22, Z23	0.240″ x 0.150″ Microstrip
Z3, Z31	1.500″ x 0.086″ Microstrip	Z24, Z25	0.170″ x 0.420″ Microstrip
Z4, Z5	0.050″ x 0.230″ Microstrip	Z26, Z27	0.260″ x 0.080″ Microstrip
Z6, Z7	0.170″ x 0.080″ Microstrip	Z28, Z29	0.040″ x 0.258″ Microstrip
Z8, Z9	0.144″ x 0.340″ Microstrip	Z32	0.622″ x 0.139″ Microstrip
Z10, Z11	0.400″ x 0.210″ Microstrip	Z33	0.346″ x 0.081″ Microstrip
Z12, Z13	0.280″ x 0.710″ Microstrip	Z34, Z35	0.801″ x 0.050″ Microstrip
Z14, Z15	0.461″ x 0.490″ Microstrip	Z36, Z37	0.460″ x 0.095″ Microstrip
Z16, Z17	0.357″ x 0.766″ Microstrip	PCB	Arlon GX-0300-5022, 0.030″, ε_r = 2.5
Z18, Z19	0.284″ x 0.415″ Microstrip		

Figure 1. MRF6P27160HR6 Test Circuit Schematic

Table 5. MRF6P27160HR6 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2	Beads, Surface Mount	2743019447	Fair-Rite
C1, C2	5.6 pF Chip Capacitors	ATC100B5R6CT500XT	ATC
C3, C8, C15, C20	3.3 pF Chip Capacitors	ATC100B3R3CT500XT	ATC
C4, C9	0.01 μF Chip Capacitors	C1825C103J1RAC	Kemet
C5, C10	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C6, C11	22 μF, 25 V Tantalum Chip Capacitors	T491D226K025AT	Kemet
C7, C12	47 μF, 16 V Tantalum Chip Capacitors	T491D476K016AT	Kemet
C13, C14	4.3 pF Chip Capacitors	ATC100B4R3CT500XT	ATC
C16, C17, C21, C22	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88B	Murata
C18, C23	47 μF, 50 V Electrolytic Capacitors	EMVY500ADA470MF80G	Chemi-Con
C19, C24	330 μF, 63 V Electrolytic Capacitors	EMVY630GTR331MMH0S	Chemi-Con
R1, R2	3.3 Ω, 1/3 W Chip Resistors	CRCW121003R3FKEA	Vishay



*Stacked

Figure 2. MRF6P27160HR6 Test Circuit Component Layout

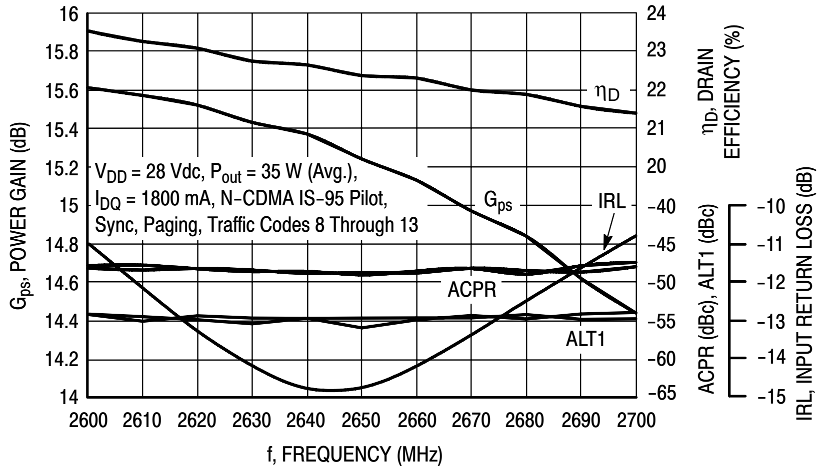


Figure 3. Single-Carrier N-CDMA Broadband Performance @ P_{out} = 35 Watts Avg.

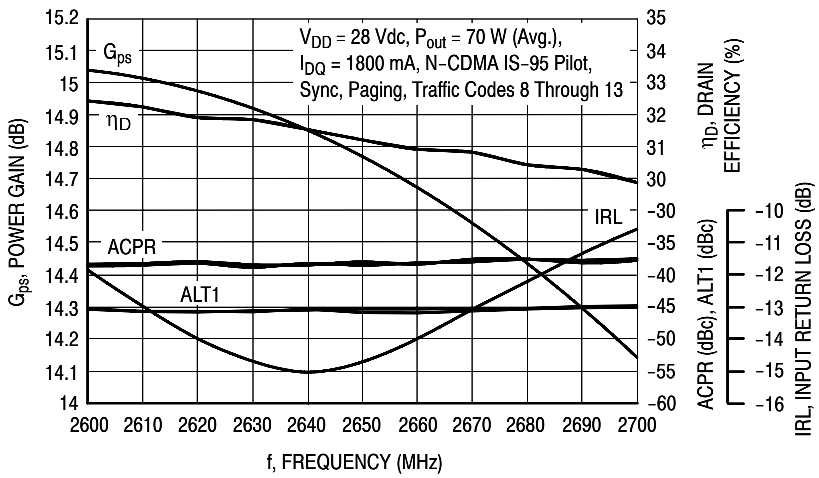


Figure 4. Single-Carrier N-CDMA Broadband Performance @ P_{out} = 70 Watts Avg.

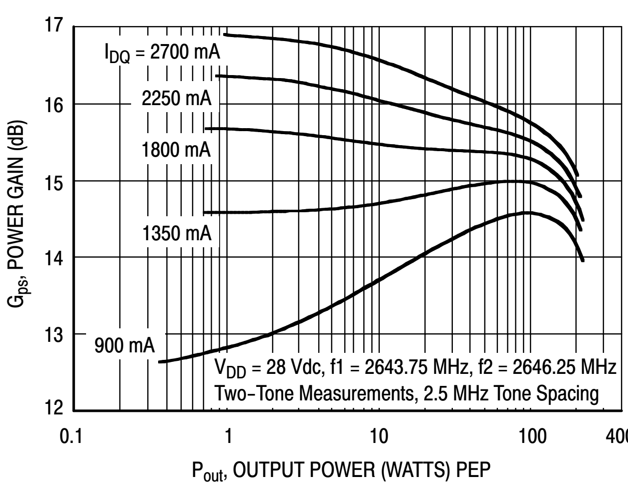


Figure 5. Two-Tone Power Gain versus Output Power

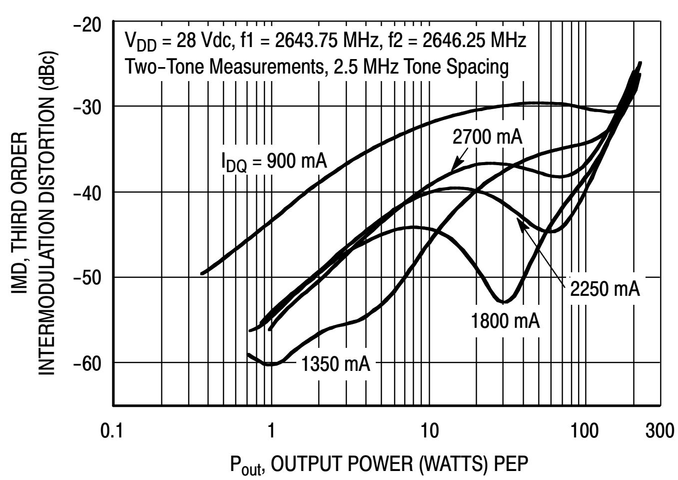


Figure 6. Third Order Intermodulation Distortion versus Output Power

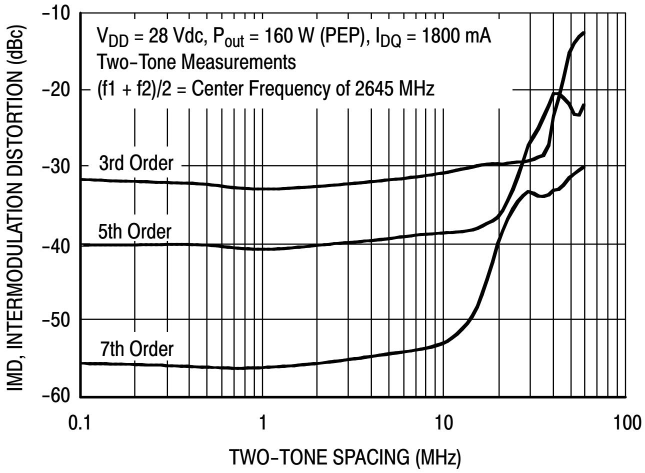


Figure 7. Intermodulation Distortion Products versus Tone Spacing

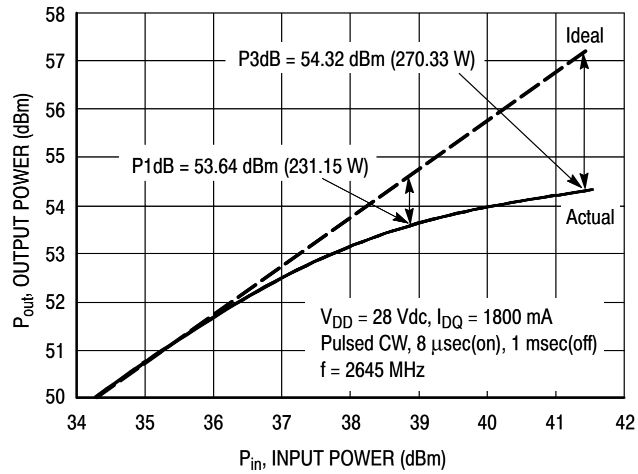


Figure 8. Pulsed CW Output Power versus Input Power

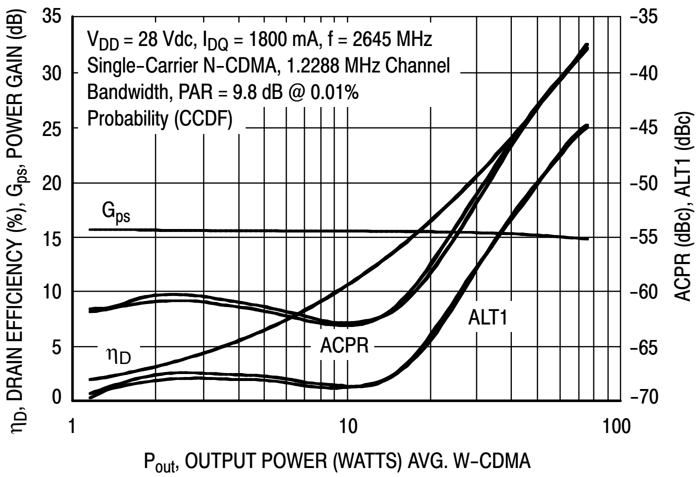


Figure 9. Single-Carrier N-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power

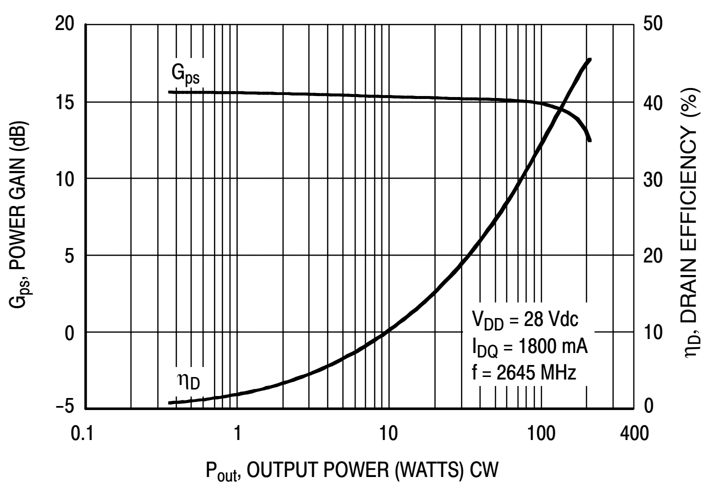


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

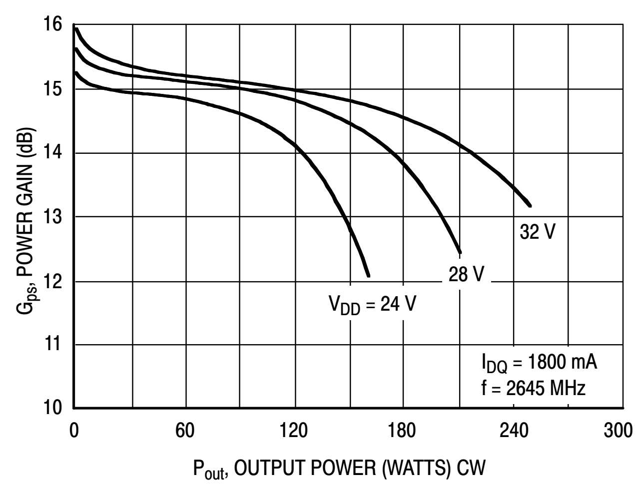
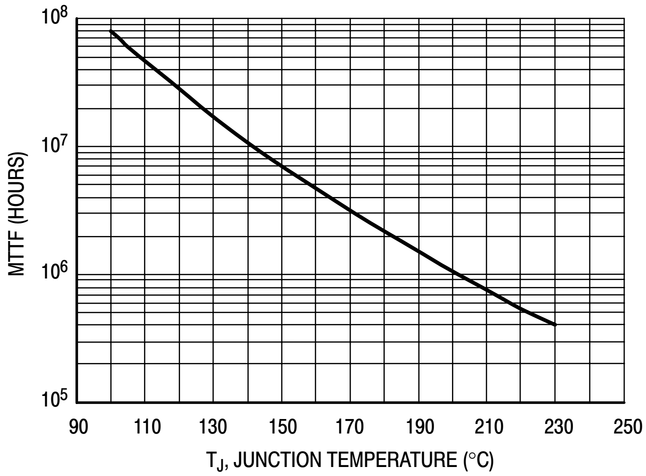


Figure 11. Power Gain versus Output Power



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 28 Vdc, P_{out} = 35 W Avg., and η_D = 22.6%.

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

N-CDMA TEST SIGNAL

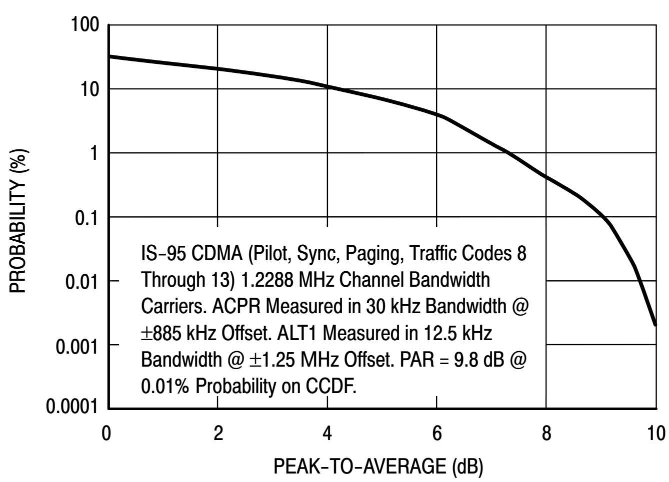


Figure 13. Single-Carrier CCDF N-CDMA

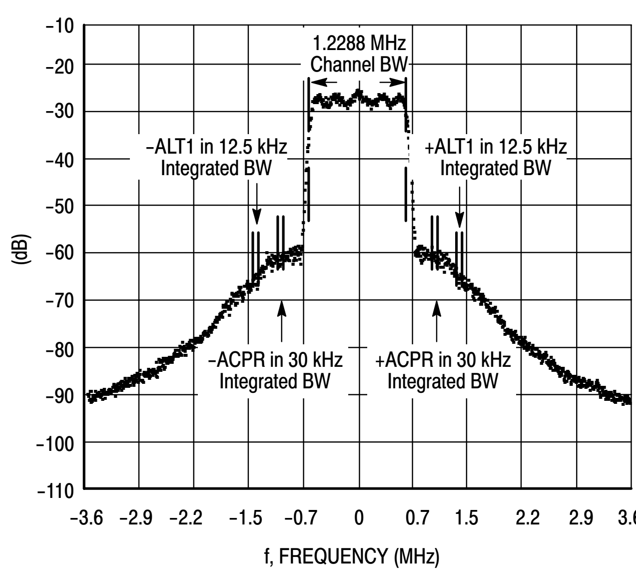
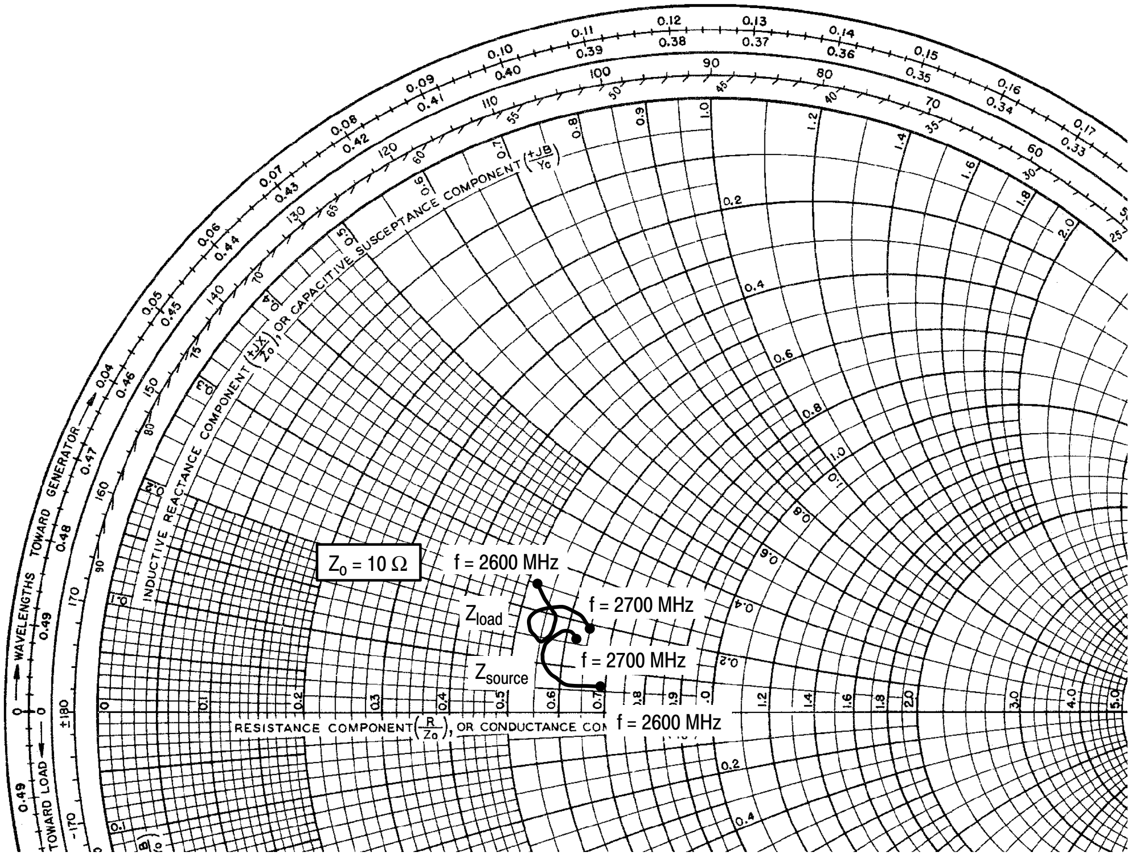


Figure 14. Single-Carrier N-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1800 mA, P_{out} = 35 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2600	6.90 + j0.61	5.24 + j2.46
2610	6.85 + j0.63	5.69 + j2.04
2620	6.76 + j0.59	5.71 + j1.59
2630	6.50 + j0.59	5.62 + j1.48
2640	6.13 + j0.56	5.45 + j1.42
2645	5.95 + j0.69	5.38 + j1.49
2650	5.81 + j0.83	5.31 + j1.58
2660	5.61 + j1.15	5.24 + j1.81
2670	5.69 + j1.48	5.45 + j2.09
2680	5.91 + j1.67	5.84 + j2.22
2690	6.12 + j1.68	6.22 + j2.12
2700	6.17 + j1.60	6.49 + j1.92

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.

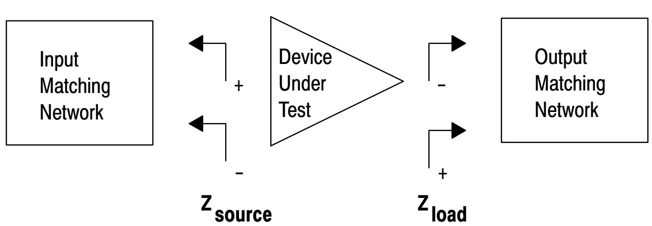
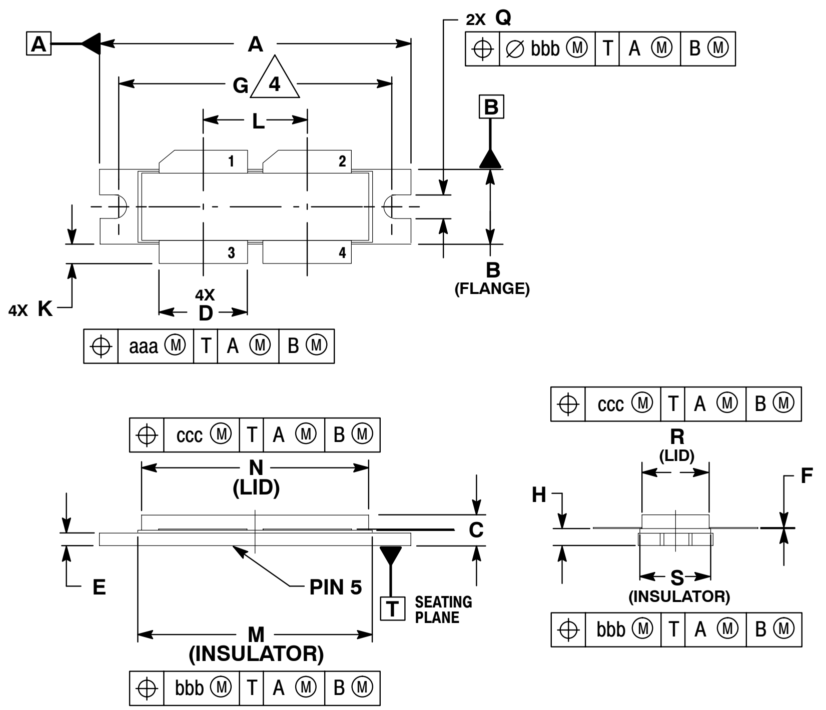


Figure 15. Series Equivalent Source and Load Impedance

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

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
2	Dec. 2008	• 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 • Removed Total Device Dissipation from Max Ratings table as data was redundant (information already provided in Thermal Characteristics table), p. 1 • Operating Junction Temperature increased from 200°C to 225°C in Maximum Ratings table; related "Continuous use at maximum temperature will affect MTTF" footnote added, p. 1 • Corrected V_{DS} to V_{DD} in the RF test condition voltage callout for $V_{GS(Q)}$, and added "Measured in Functional Test", On Characteristics table, p. 2 • Removed Forward Transconductance from On Characteristics table as it no longer provided usable information, p. 2 • Changed "Z2, Z31" to "Z2, Z30" and "Z3, Z30" to "Z3, Z31" in Z list for 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 • Adjusted scale for Fig. 5, Two-Tone Power Gain versus Output Power, to better match the device's capabilities, p. 5 • Removed lower voltage tests from Fig. 11, Power Gain versus Output Power, due to fixed tuned fixture limitations, p. 6 • Replaced Fig. 12, MTTF versus Junction Temperature, with updated graph. Removed $Amps^2$ and listed operating characteristics and location of MTTF calculator for device, p. 7 • Added Product Documentation and Revision History, p. 10

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 China Ltd.
Exchange Building 23F
No. 118 Jianguo Road
Chaoyang District
Beijing 100022
China
+86 10 5879 8000
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 +1-303-675-2140
Fax: +1-303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Document Number: MRF6P27160H
Rev. 2, 12/2008