RF Power Field Effect Transistor

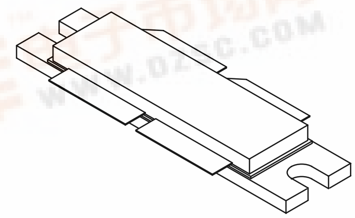
N-Channel Enhancement-Mode Lateral MOSFET

Designed for N-CDMA base station applications with frequencies from 2600 to 2700 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

- Typical Single-Carrier N-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 2 x 900 mA, P_{out} = 35 Watts Avg., Full Frequency Band, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.
  - Power Gain — 14.6 dB
  - Drain Efficiency — 22.6%
  - ACPR @ 885 kHz Offset — -47.8 dBc @ 30 kHz Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2700 MHz, 160 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched, Controlled Q, 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.
- In Tape and Reel. R6 Suffix = 150 Units per 56 mm, 13 inch Reel.

MRF6P27160HR6

**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
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	603 3.45	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	160	W

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	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. 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/D, *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.

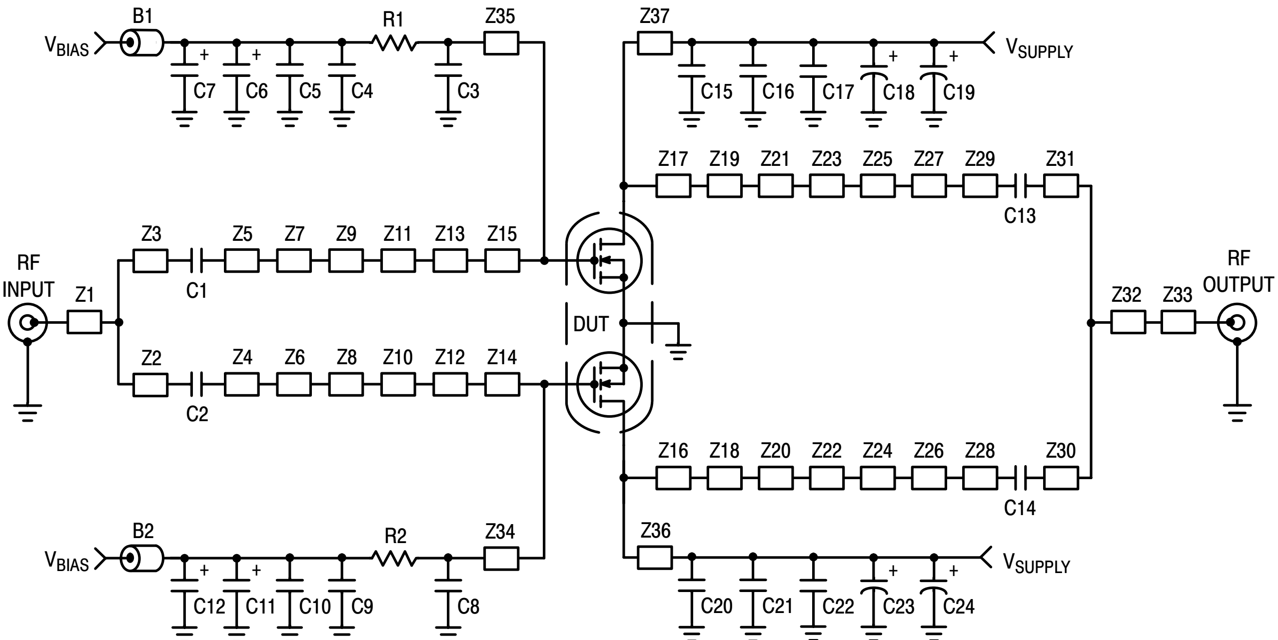
Table 3. ESD Protection Characteristics

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					
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 Volta (V_{DS} = 10 Vdc, I_D = 250 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 900 mAdc)	$V_{GS(Q)}$	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
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 2 Adc)	g_{fs}	—	5.3	—	S
Dynamic Characteristics [(1)]					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.8	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 2 x 900 mA, P_{out} = 35 W Avg. N-CDMA, f = 2630 and 2660 MHz, Single-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carrier. ACPR measured in 30 kHz Channel Bandwidth @ ±885 kHz Offset. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF					
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. Part is internally matched both on input and output.

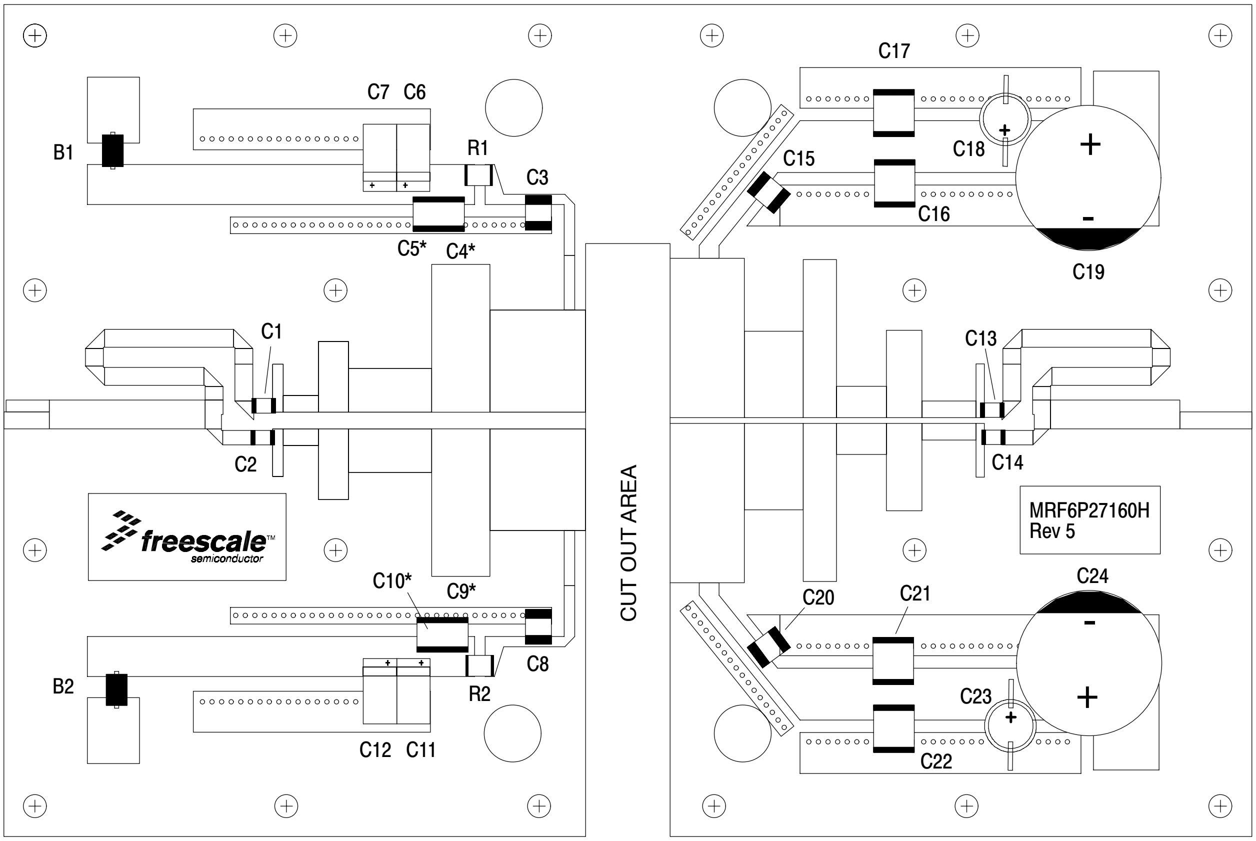


Z1	1.011″ x 0.139″ Microstrip
Z2, Z31	0.150″ x 0.070″ Microstrip
Z3, Z30	1.500″ x 0.086″ Microstrip
Z4, Z5	0.050″ x 0.230″ Microstrip
Z6, Z7	0.170″ x 0.080″ Microstrip
Z8, Z9	0.144″ x 0.340″ Microstrip
Z10, Z11	0.400″ x 0.210″ Microstrip
Z12, Z13	0.280″ x 0.710″ Microstrip
Z14, Z15	0.461″ x 0.490″ Microstrip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

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	100B5R6CP500X	ATC
C3, C8, C15, C20	3.3 pF Chip Capacitors	100B3R3CP500X	ATC
C4, C9	0.01 μF Chip Capacitors (1825)	C1825C103J1RAC	Kemet
C5, C10	2.2 μF, 50 V Chip Capacitors (1825)	C1825C225J5RAC	Kemet
C6, C11	22 μF, 25 V Tantalum Chip Capacitors	ECS-T1ED226R	Panasonic TE Series
C7, C12	47 μF, 16 V Tantalum Chip Capacitors	T491D476K016AS	Kemet
C13, C14	4.3 pF Chip Capacitors	100B4R3CP500X	ATC
C16, C17, C21, C22	10 μF, 50 V Chip Capacitors (2220)	GRM55DR61H106KA88B	Murata
C18, C23	47 μF, 50 V Electrolytic Capacitors	MVK50VC47RM8X10TP	Nippon
C19, C24	330 μF, 63 V Electrolytic Capacitors	NACZF331M63V	Nippon
R1, R2	3.3 Ω, 1/4 W Chip Resistors (1210)	ERJ-14YJ3R3U	Dale/Vishay



*Stacked

Figure 2. MRF6P27160HR6 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

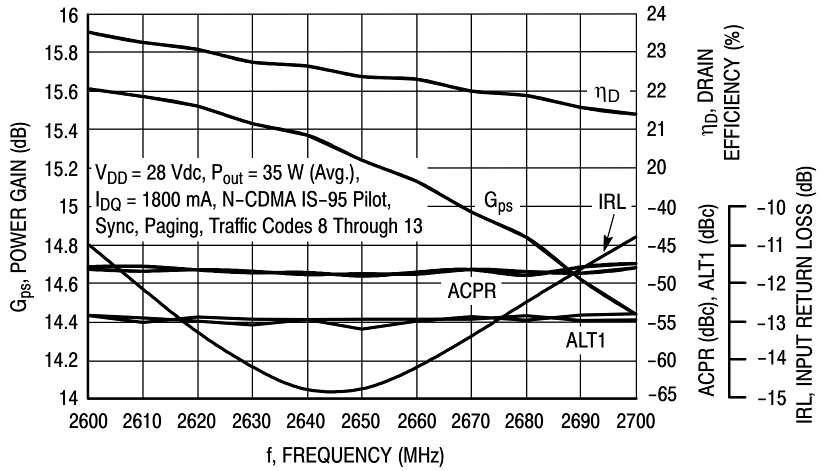


Figure 3. Single-Carrier N-CDMA Broadband Performance @ P_{out} = 35 Watts Avg.

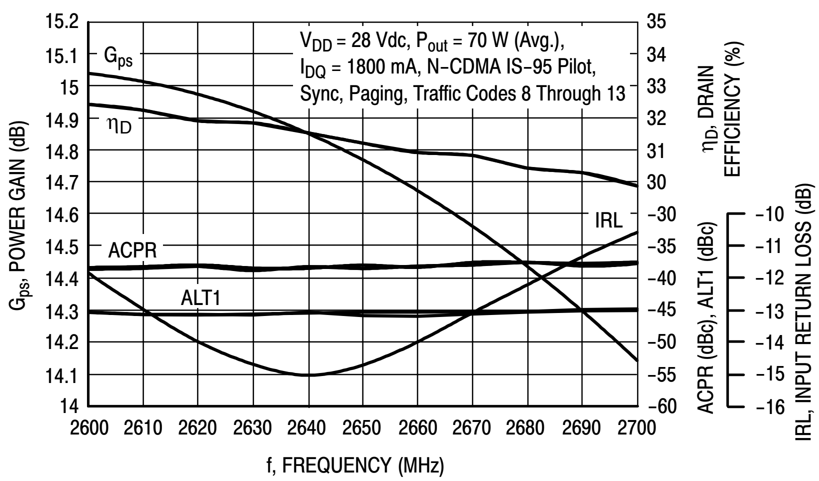


Figure 4. Single-Carrier N-CDMA Broadband Performance @ P_{out} = 70 Watts Avg.

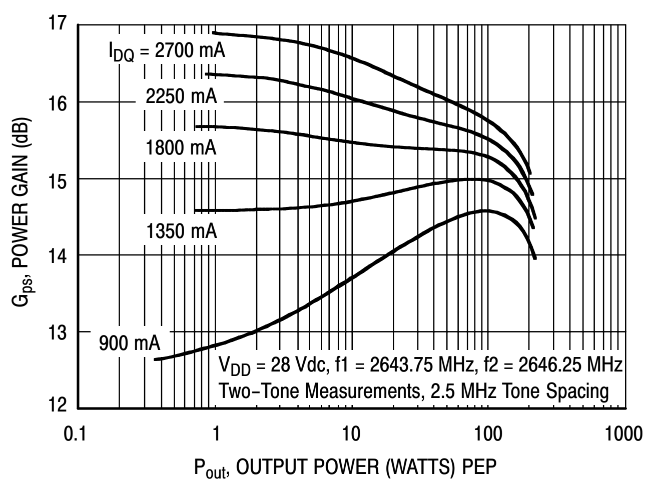


Figure 5. Two-Tone Power Gain versus Output Power

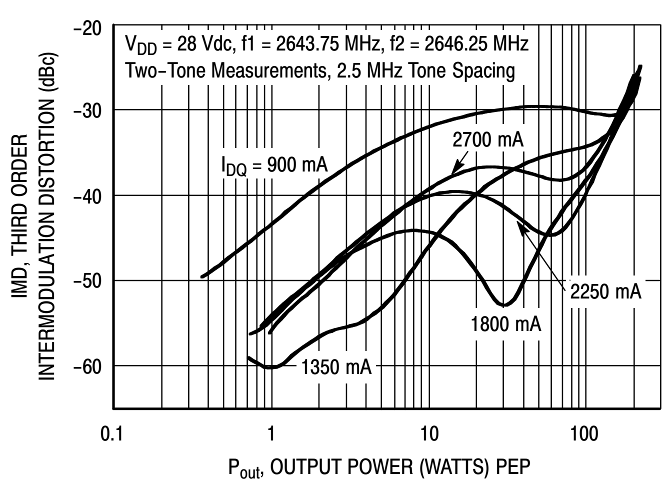


Figure 6. Third Order Intermodulation Distortion versus Output Power

TYPICAL CHARACTERISTICS

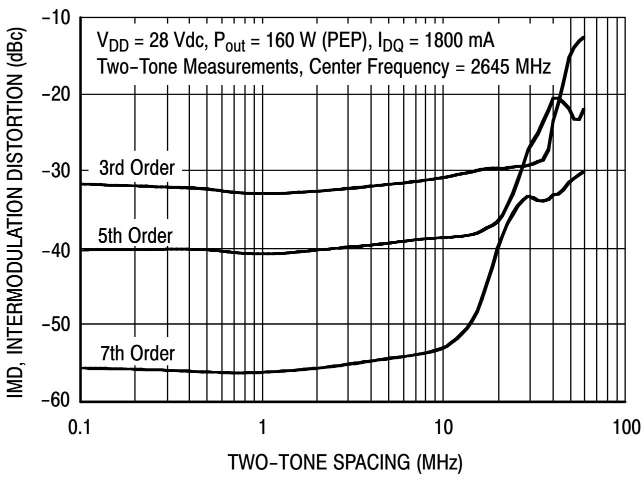


Figure 7. Intermodulation Distortion Products versus Tone Spacing

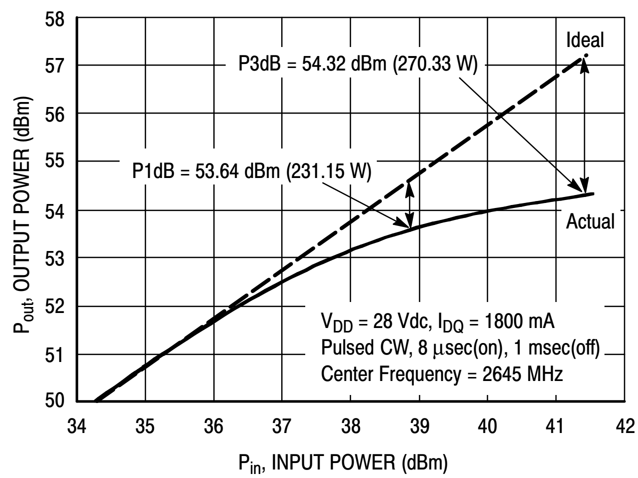


Figure 8. Pulse CW Output Power versus Input Power

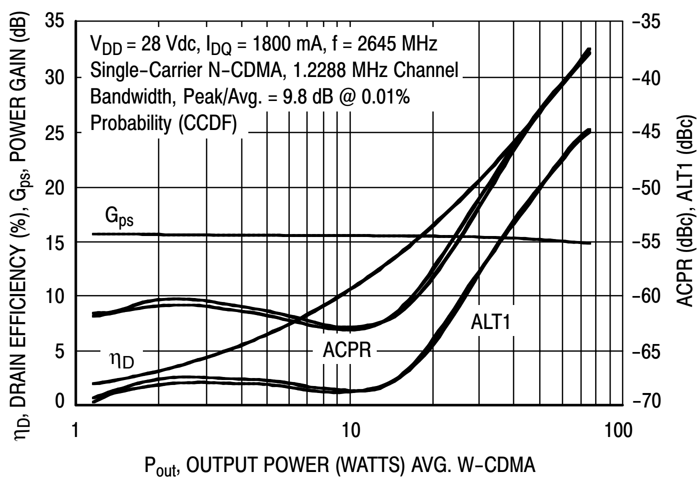


Figure 9. Single-Carrier N-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power

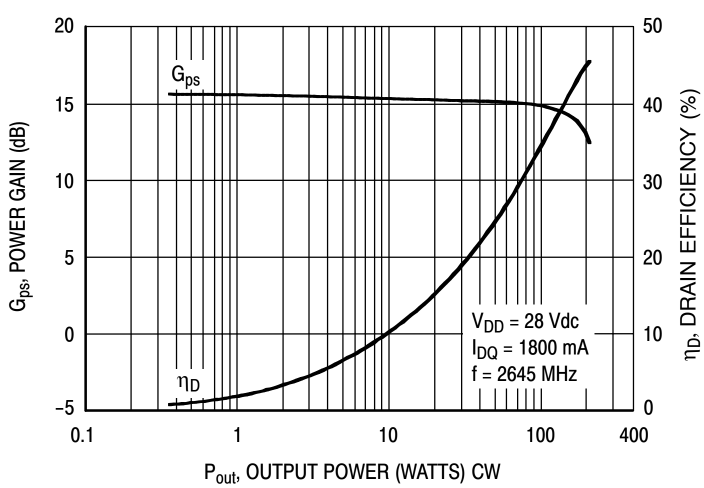


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

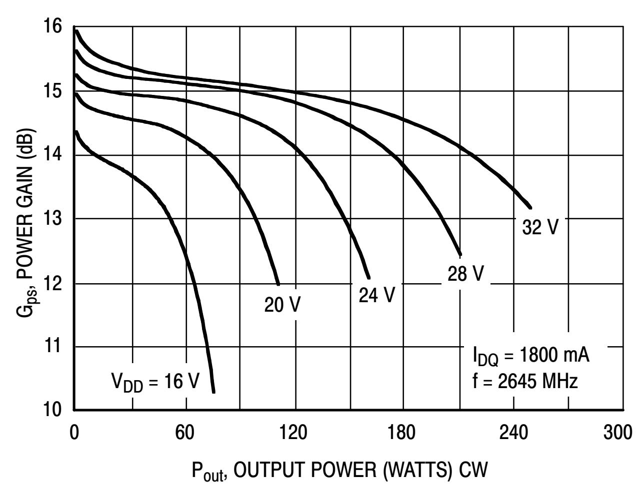


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS
N-CDMA TEST SIGNAL

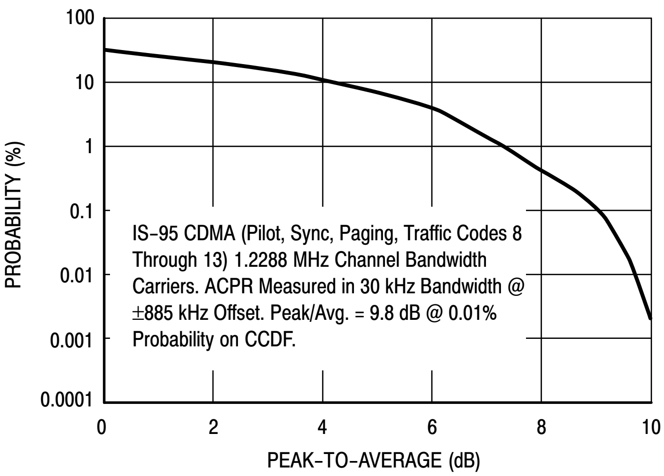


Figure 12. Single-Carrier CCDF N-CDMA

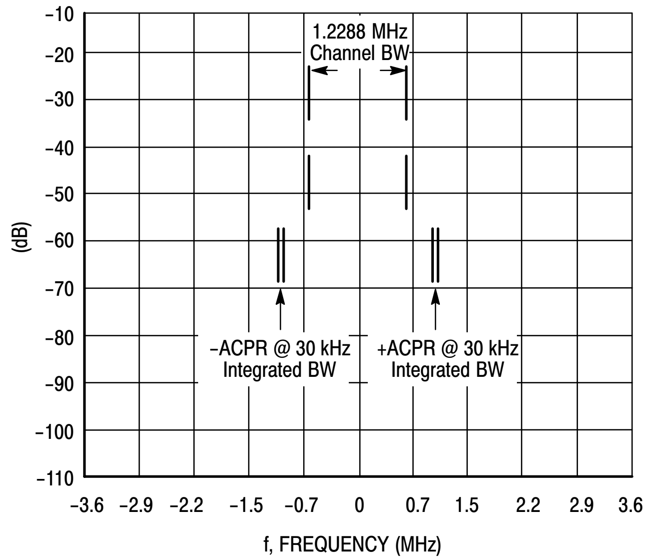
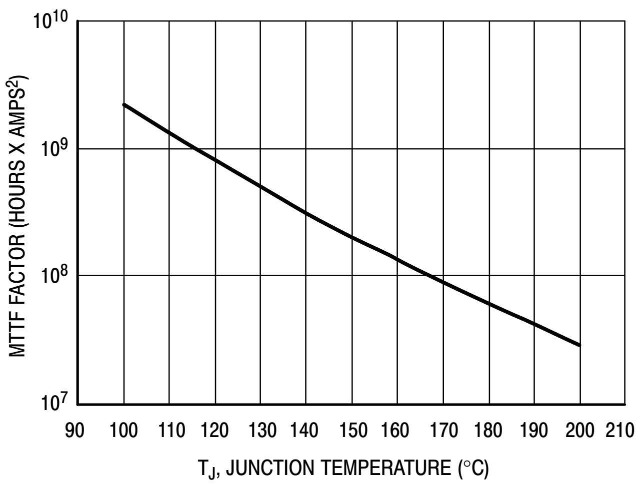
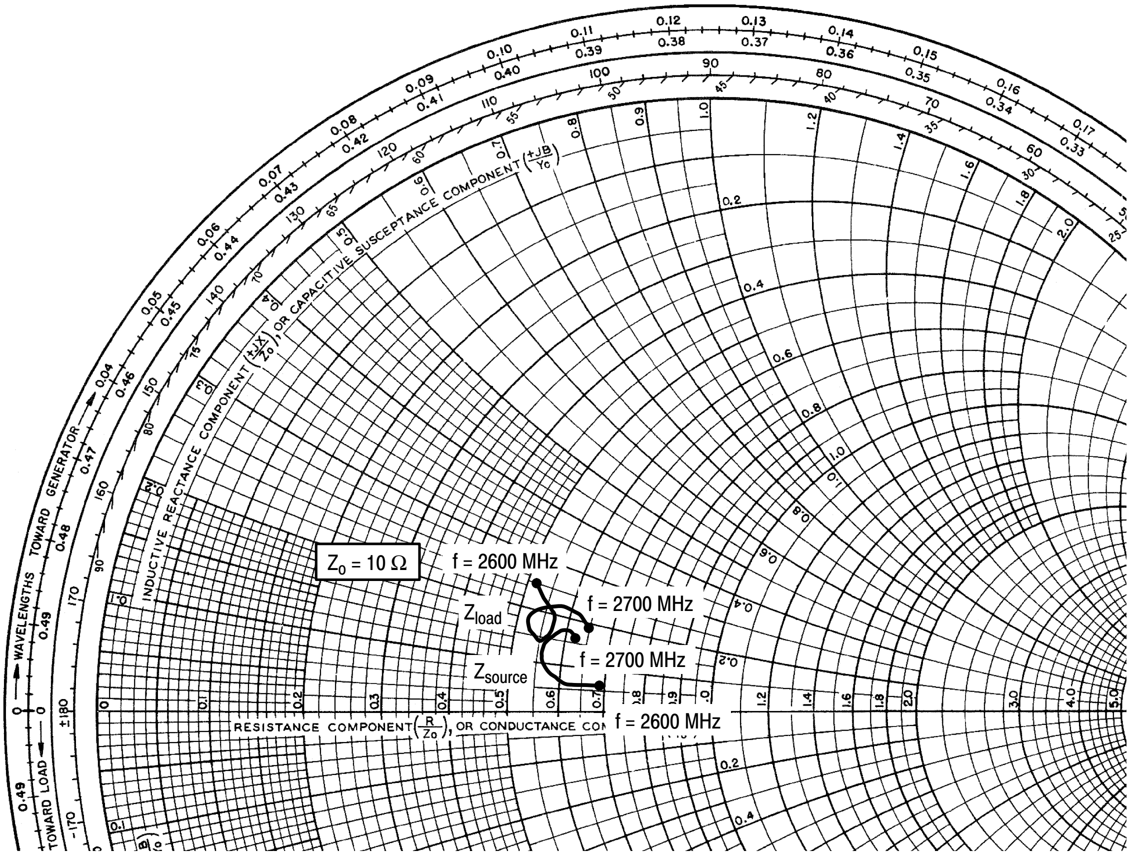


Figure 13. Single-Carrier N-CDMA Spectrum



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



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.

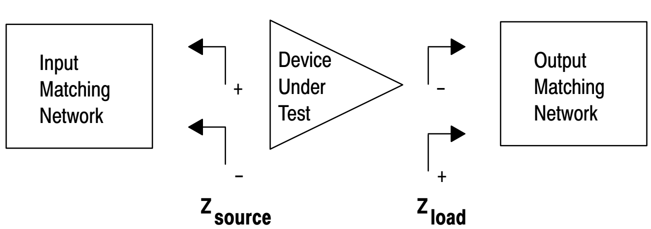
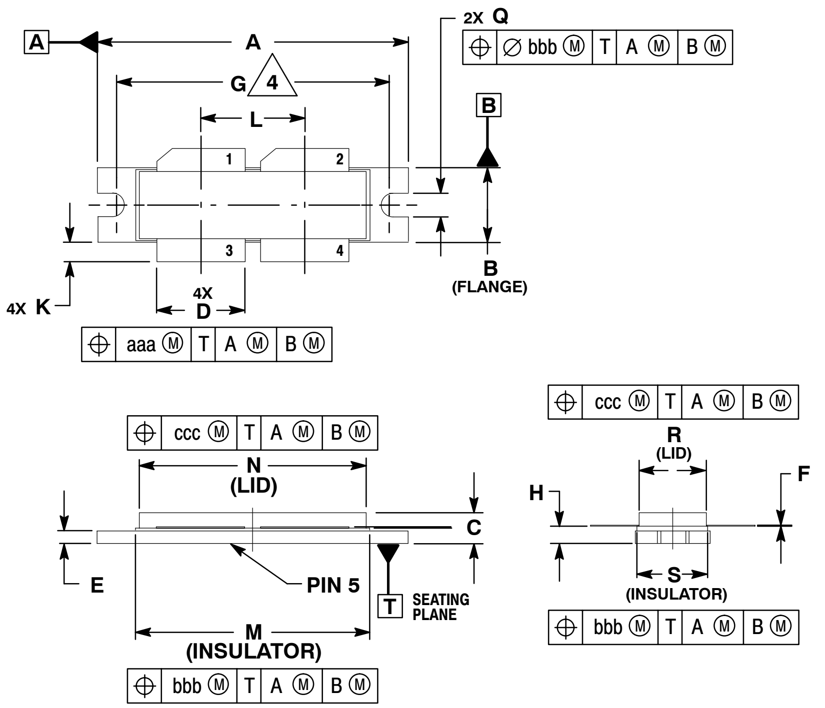


Figure 15. Series Equivalent Source and Load Impedance

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 D
NI-1230

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support@freescale.com

USA/Europe or Locations Not Listed:
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

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)
support@freescale.com

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
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