Freescale Semiconductor
Technical Data

Document Number: MRF7S21170H
Rev. 1, 6/2006

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF7S21170HR3
MRF7S21170HSR3

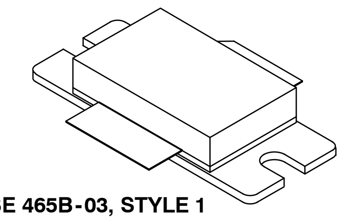
Designed for CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for CDMA and multicarrier amplifier applications. To be used in Class AB and Class C for PCN-PCS/cellular radio and WLL applications.

- Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1400 mA, P_{out} = 50 Watts Avg., Full Frequency Band, 3GPP Test Model 1, 64 DPCH with 50% Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.
  - Power Gain — 16 dB
  - Drain Efficiency — 31%
  - Device Output Signal PAR — 6.1 dB @ 0.01% Probability on CCDF
  - ACPR @ 5 MHz Offset — -37 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 170 Watts CW Peak Tuned Output Power
- P_{out} @ 1 dB Compression Point ≥ 170 W CW

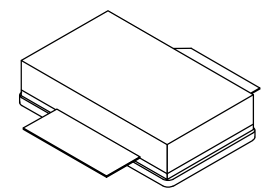
Features

- 100% PAR Tested for Guaranteed Output Power Capability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Integrated ESD Protection
- Designed for Digital Predistortion Error Correction Systems
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

2110-2170 MHz, 50 W AVG., 28 V
SINGLE W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465B-03, STYLE 1
NI-880
MRF7S21170HR3



CASE 465C-02, STYLE 1
NI-880S
MRF7S21170HSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +10	Vdc
Operating Voltage	V_{DD}	32, +0	Vdc
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 170 W CW Case Temperature 73°C, 25 W CW	$R_{\theta JC}$	 0.31 0.36	°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.

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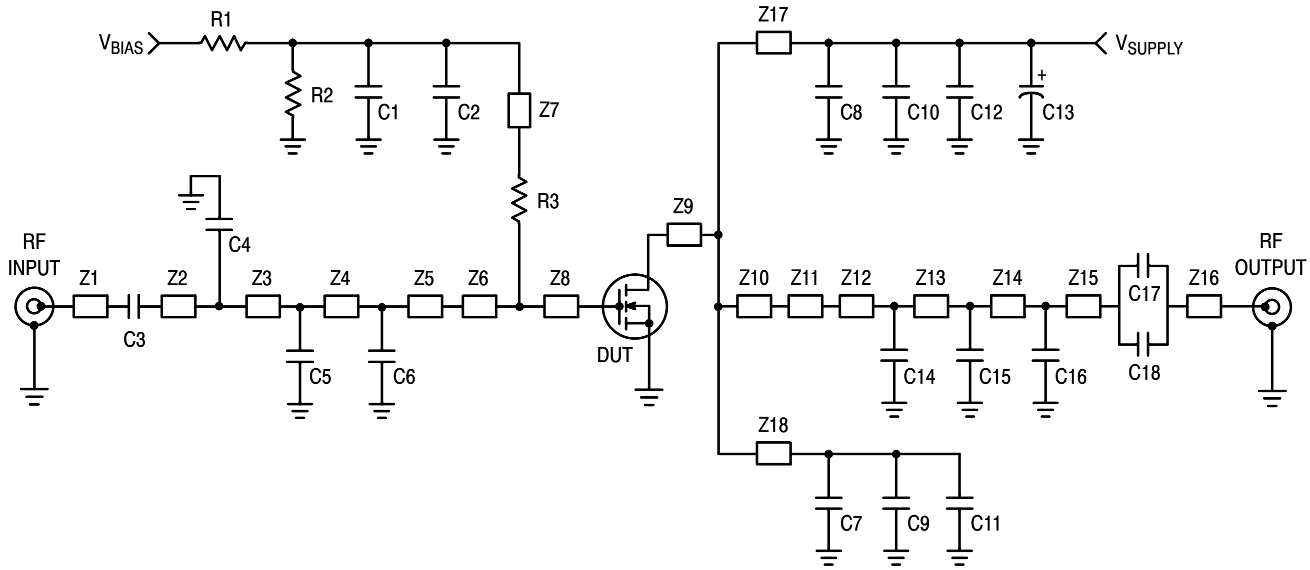
Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1A (Minimum)
Machine Model (per EIA/JESD22-A115)	B (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} = 65 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}	—	—	500	nAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 270 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (1) (V_{DS} = 28 Vdc, I_D = 1400 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2.7 Adc)	$V_{DS(on)}$	0.1	0.15	0.3	Vdc
Dynamic Characteristics (2)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	0.9	—	pF
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	703	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1400 mA, P_{out} = 50 W Avg., f= 2112.5 MHz and f = 2167.5 MHz, Single-Carrier W-CDMA, 3GPP Test Model 1, 64 DPCH, 50% Clipping, PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.					
Power Gain	G_{ps}	15	16	18	dB
Drain Efficiency	η_D	29	31	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	5.7	6.1	—	dB
Adjacent Channel Power Ratio	ACPR	—	-37	-35	dBc
Input Return Loss	IRL	—	-15	-9	dB
Typical Performances (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1400 mA, 2110-2170 MHz Bandwidth					
Video Bandwidth (Tone Spacing from 100 kHz to VBW) ΔIMD3 = IMD3 @ VBW frequency - IMD3 @ 100 kHz <1 dBc (both sidebands)	VBW	—	25	—	MHz
Part-to-Part Phase Variation @ P_{out} = 170 W CW	ΔΦ	—	18	—	°
Gain Variation over Temperature	ΔG	—	0.015	—	dB/°C
Output Power Variation over Temperature	ΔP1dB	—	0.01	—	dBm/°C

1. VGG = 2 x $V_{GS(Q)}$. Parameter measured on Freescale Test Fixture, due to resistive divider network on the board. Refer to Test Circuit schematic.
2. Part internally matched both on input and output.



Z1	0.250″ x 0.083″ Microstrip
Z2*	0.090″ x 0.083″ Microstrip
Z3*	0.842″ x 0.083″ Microstrip
Z4*	0.379″ x 0.083″ Microstrip
Z5*	0.307″ x 0.083″ Microstrip
Z6	0.119″ x 0.787″ Microstrip
Z7	1.160″ x 0.080″ Microstrip
Z8	0.156″ x 0.787″ Microstrip
Z9	0.770″ x 0.880″ Microstrip
Z10	0.459″ x 1.000″ Microstrip
Z11	0.060″ x 0.076″ Microstrip
Z12*	0.129″ x 0.083″ Microstrip
Z13*	0.436″ x 0.083″ Microstrip
Z14*	0.490″ x 0.083″ Microstrip
Z15*	0.275″ x 0.083″ Microstrip
Z16	0.230″ x 0.083″ Microstrip
Z17, Z18	0.900″ x 0.080″ Microstrip
PCB	Taconix TLX8-0300, 0.030″, ε_r = 2.55

* Variable for tuning

Figure 1. MRF7S21170HR3(HSR3) Test Circuit Schematic

Table 5. MRF7S21170HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	100 pF 100B Chip Capacitor	100B101JW500XT	ATC
C2, C3, C7, C8, C17, C18	6.8 pF 600B Chip Capacitors	600B6R8BT500XT	ATC
C4, C15	0.3 pF 700B Chip Capacitors	700B0R3BW500XT	ATC
C5	0.8 pF 600B Chip Capacitor	600B0R8BT500XT	ATC
C6	0.2 pF 700B Chip Capacitor	700B0R2BW500XT	ATC
C9, C10, C11, C12	10 μF Chip Capacitors	C5750X5R1H106MT	TDK
C13	470 μF, 63 V Electrolytic Capacitor, Radial	13661471	Philips
C14	0.4 pF 700B Chip Capacitor	700B0R4BW500XT	ATC
C16	0.1 pF 700B Chip Capacitor	700B0R1BW500XT	ATC
R1, R2	10 kΩ, 1/4 W Chip Resistors		
R3	10 Ω, 1/4 W Chip Resistor		

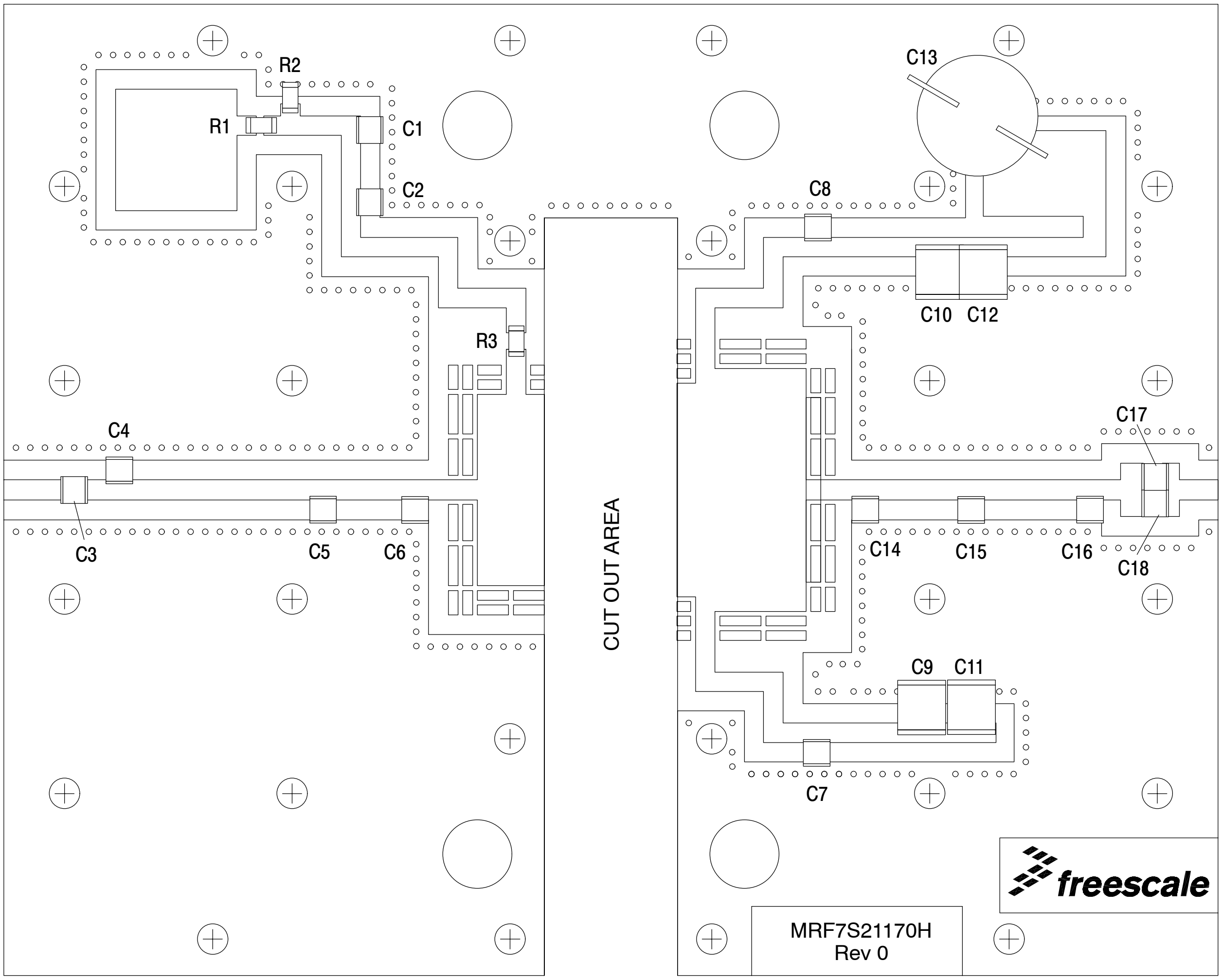


Figure 2. MRF7S21170HR3(HSR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

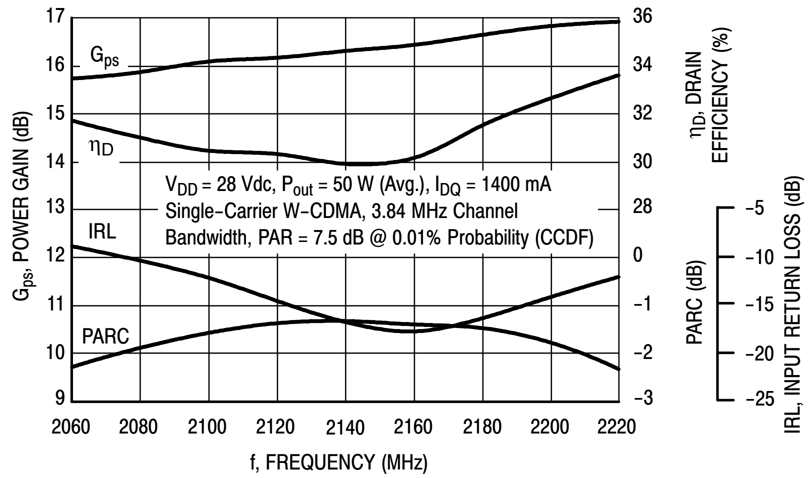


Figure 3. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 50 Watts Avg.

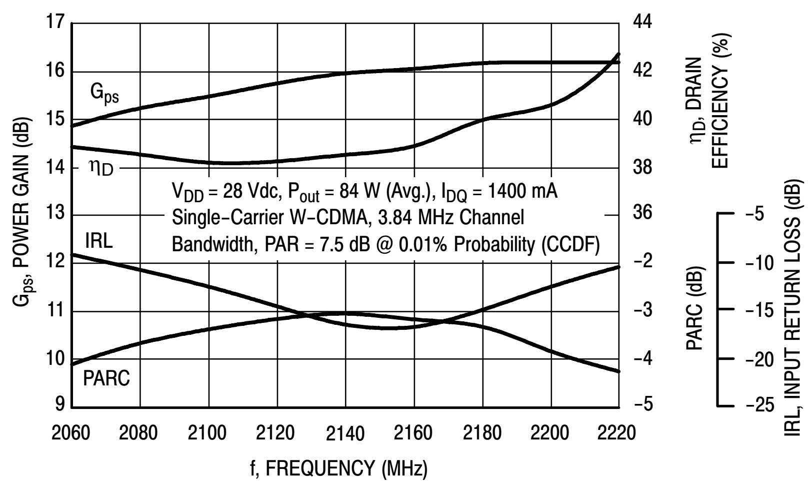


Figure 4. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 84 Watts Avg.

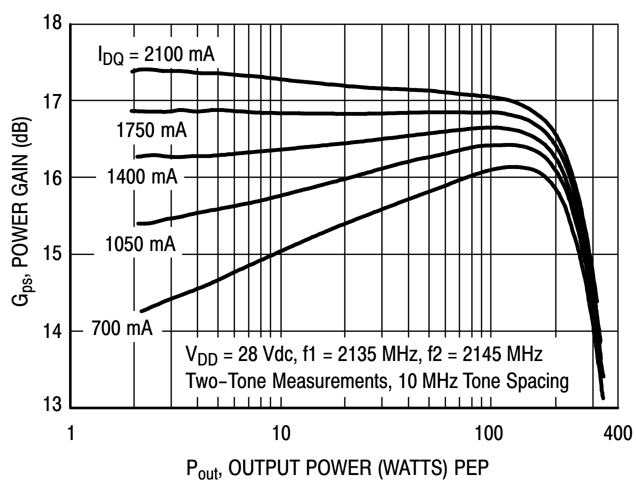


Figure 5. Two-Tone Power Gain versus Output Power

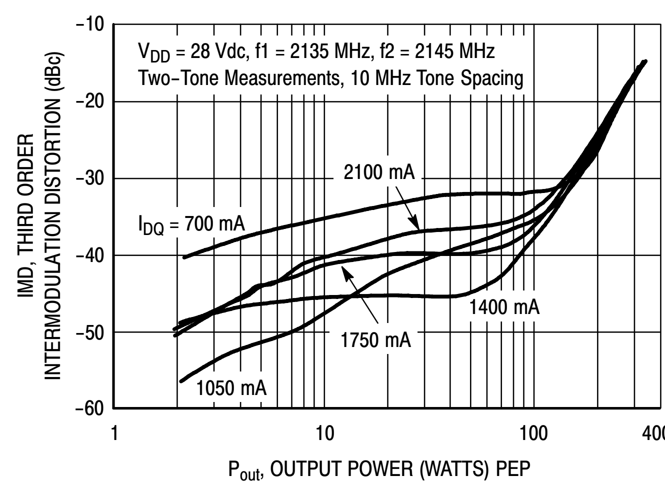


Figure 6. Third Order Intermodulation Distortion versus Output Power

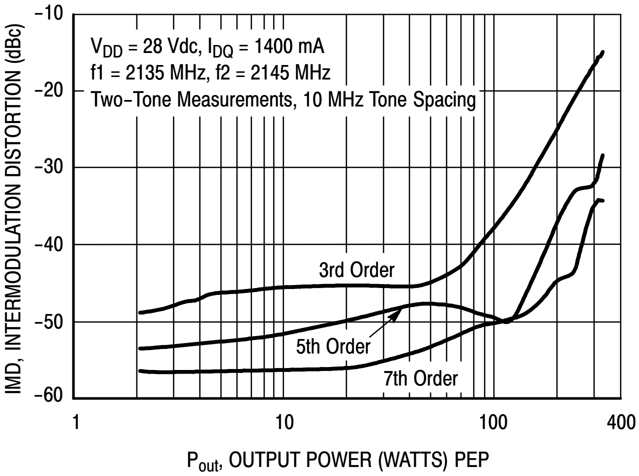


Figure 7. Intermodulation Distortion Products versus Output Power

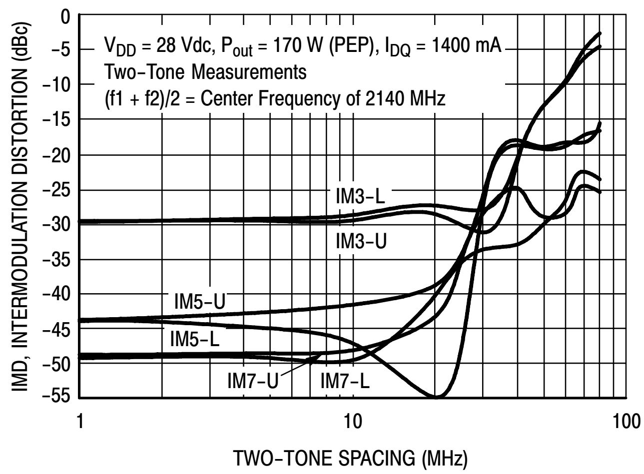


Figure 8. Intermodulation Distortion Products versus Tone Spacing

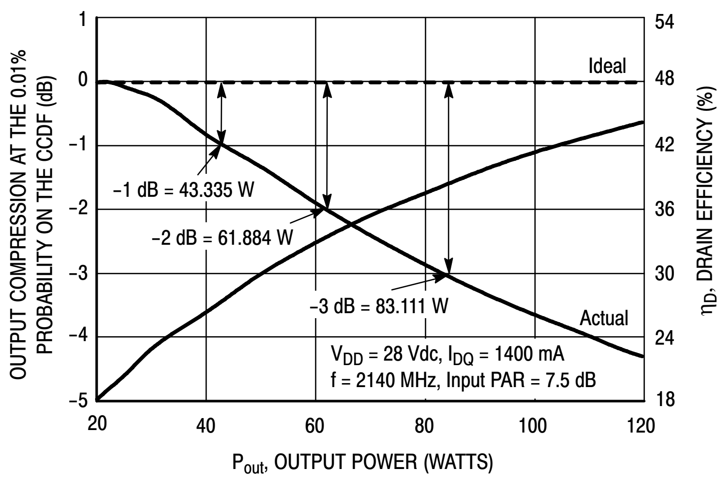


Figure 9. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

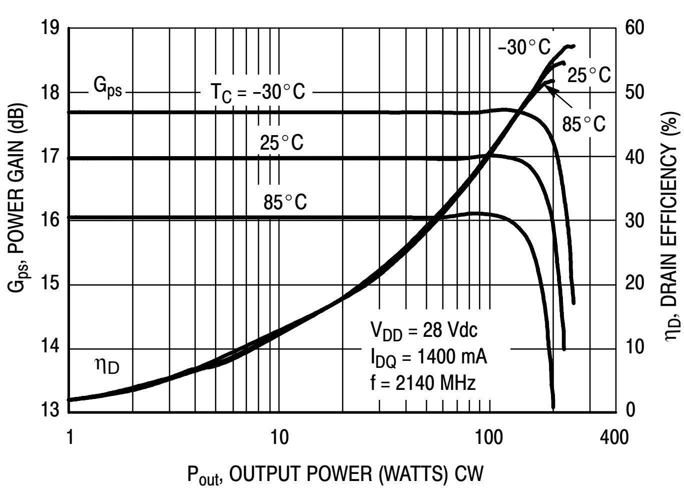


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

TYPICAL CHARACTERISTICS

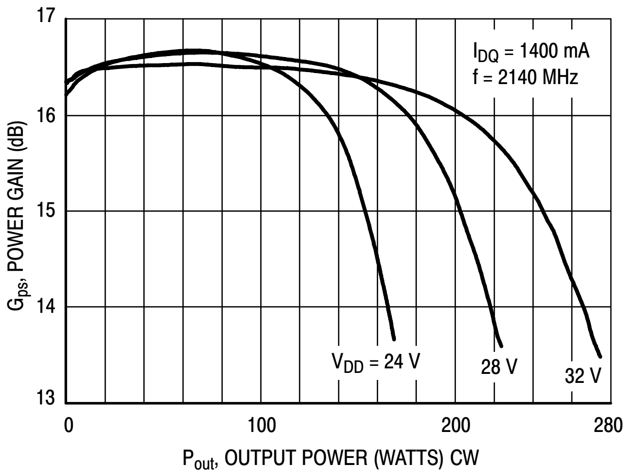
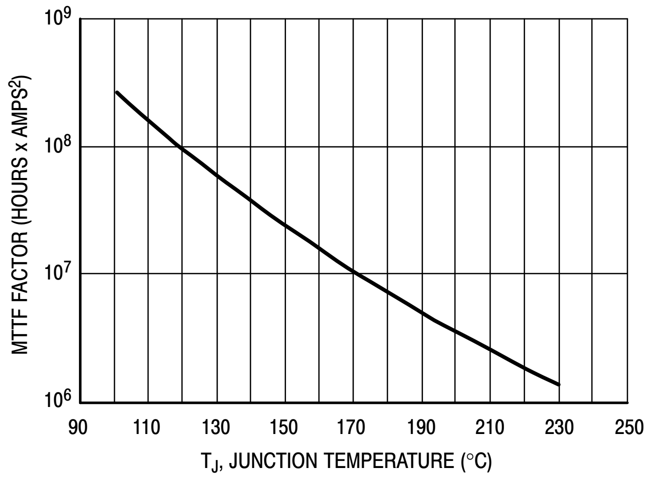


Figure 11. Power Gain versus Output Power



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 12. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

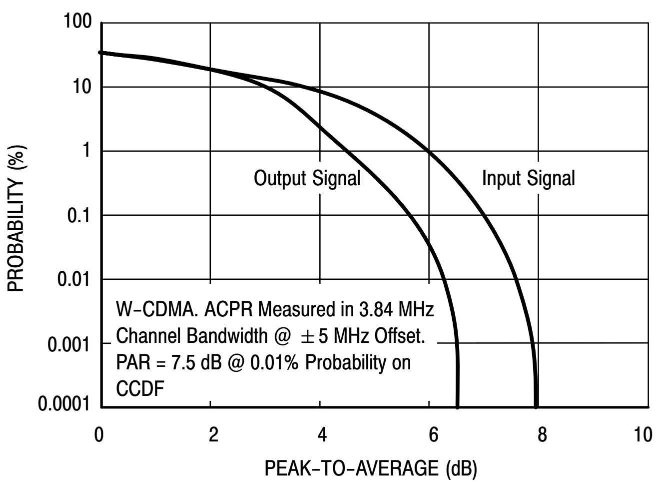


Figure 13. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 50% Clipping, Single-Carrier Test Signal

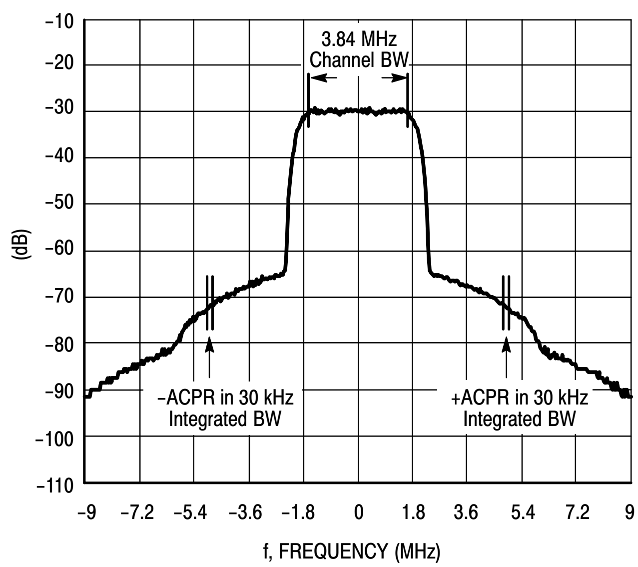
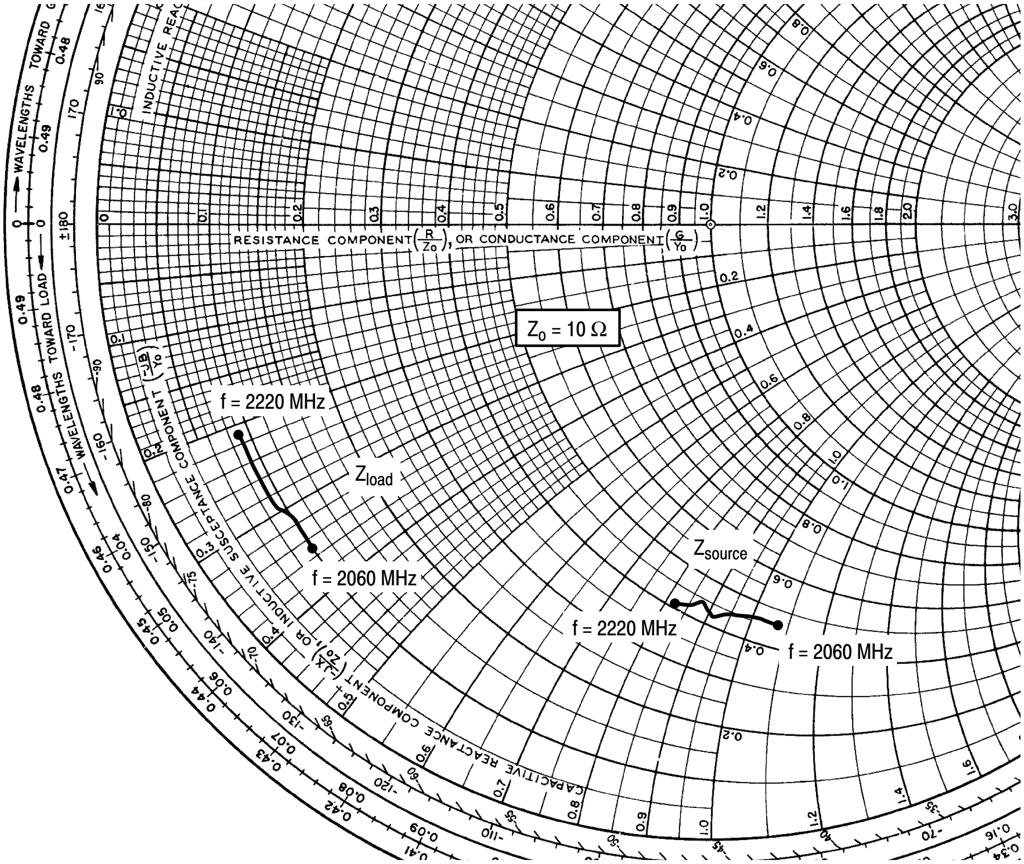


Figure 14. Single-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1400 mA, P_{out} = 50 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2060	4.57 - j10.70	1.02 - j3.54
2080	4.57 - j10.38	0.99 - j3.34
2100	4.57 - j10.06	0.96 - j3.14
2120	4.52 - j9.72	0.93 - j2.94
2140	4.40 - j9.42	0.92 - j2.76
2160	4.15 - j9.12	0.91 - j2.59
2180	4.44 - j8.82	0.89 - j2.42
2200	4.19 - j8.53	0.88 - j2.25
2220	4.12 - j8.23	0.88 - j2.09

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

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

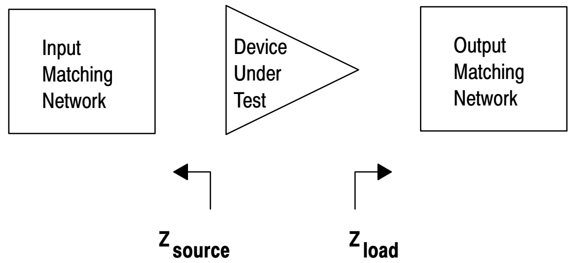
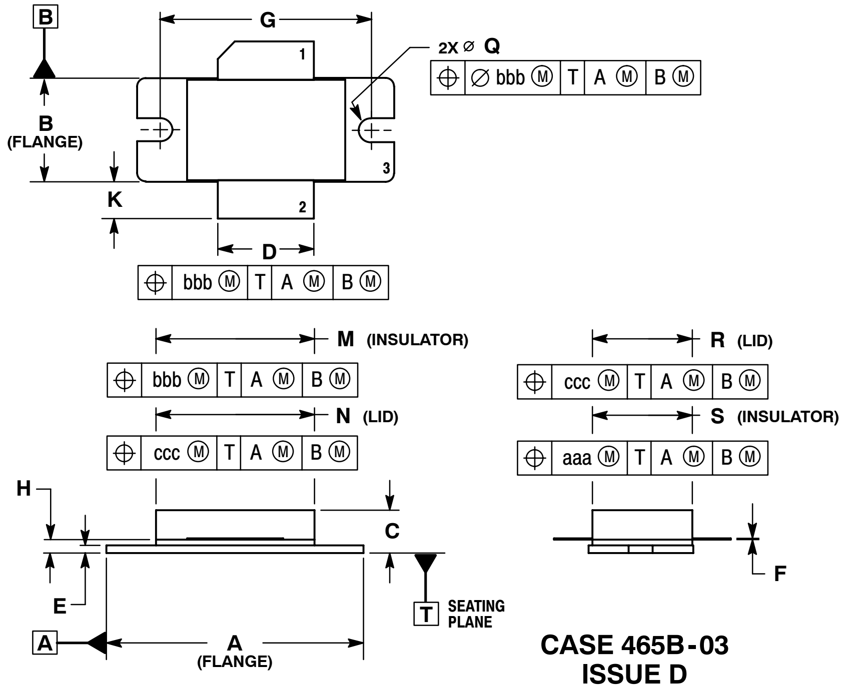


Figure 15. Series Equivalent Source and Load Impedance

NOTES

PACKAGE DIMENSIONS

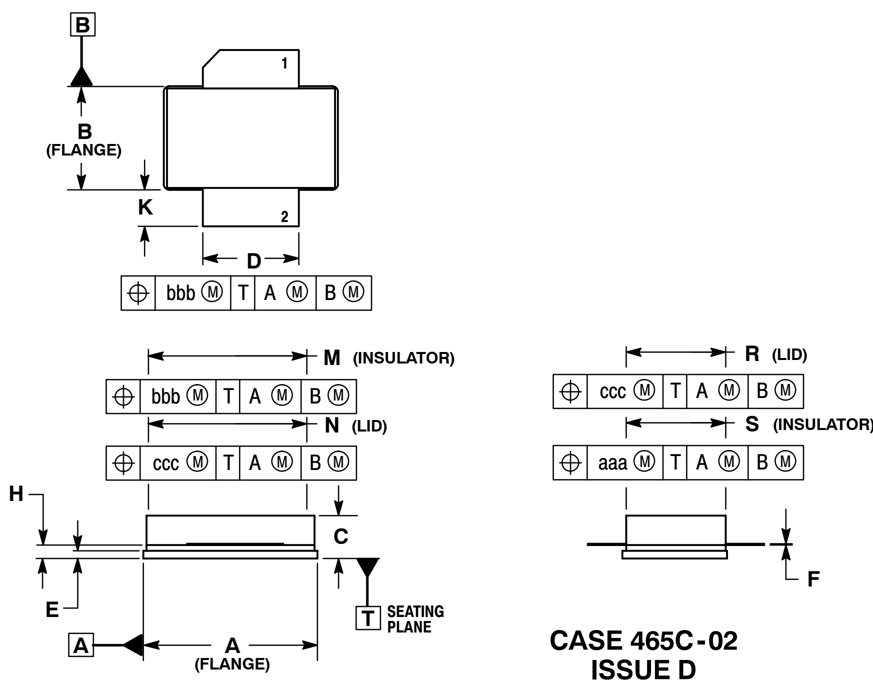


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M−1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. DELETED

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	1.335	1.345	33.91	34.16
B	0.535	0.545	13.6	13.8
C	0.147	0.200	3.73	5.08
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	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
Q	∅.118	∅.138	∅3.00	∅3.51
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 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 465B-03
ISSUE D
NI-880
MRF7S21170HR3



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DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.905	0.915	22.99	23.24
B	0.535	0.545	13.60	13.80
C	0.147	0.200	3.73	5.08
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	0.872	0.888	22.15	22.55
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S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

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