Freescale Semiconductor
Technical Data

Document Number: MRF5P21240HR6
Rev. 1, 5/2006

RoHS

RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

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

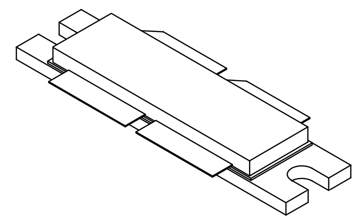
- Typical 2-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 2200 mA, P_{out} = 52 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 13 dB
  Drain Efficiency — 24%
  IM3 @ 10 MHz Offset — -36 dBc in 3.84 MHz Channel Bandwidth
  ACPR @ 5 MHz Offset — -39 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2140 MHz, 180 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
- Low Gold Plating Thickness on Leads, 40μ″ Nominal.
- RoHS Compliant
- In Tape and Reel. R6 Suffix = 150 Units per 56 mm, 13 inch Reel.

MRF5P21240HR6

2110-2170 MHz, 52 W AVG., 28 V
2 x W-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, +65	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +15	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	603 3.4	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation @ T_C = 25°C Derate above 25°C	CW	200 1.18	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 82°C, 180 W CW Case Temperature 77°C, 52 W CW	$R_{\theta JC}$	 0.29 0.32	°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.

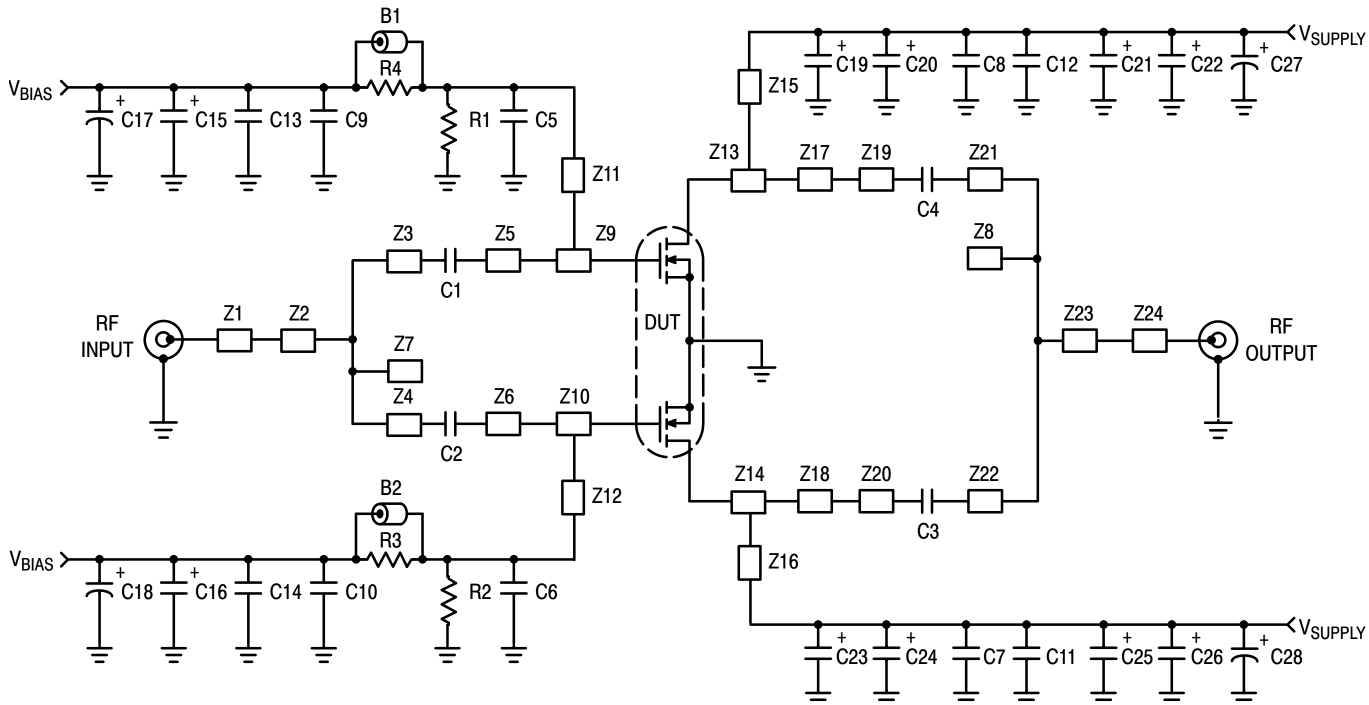
Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model (per JESD22-A114)	2 (Minimum)
Machine Model (per EIA/JESD22-A115)	M3 (Minimum)
Charge Device Model (per JESD22-C101)	C6 (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} = 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}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage [1] (V_{DS} = 10 Vdc, I_D = 300 μAdc)	$V_{GS(th)}$	2	2.8	4	Vdc
Gate Quiescent Voltage [3] (V_{DS} = 28 Vdc, I_D = 2200 mAdc)	$V_{GS(Q)}$	3	3.8	5	Vdc
Drain-Source On-Voltage [1] (V_{GS} = 10 Vdc, I_D = 3 Adc)	$V_{DS(on)}$	—	0.26	0.3	Vdc
Forward Transconductance [1] (V_{DS} = 10 Vdc, I_D = 3 Adc)	g_{fs}	—	7.5	—	S
Dynamic Characteristics [1,2]					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1 MHz)	C_{rss}	—	2.75	—	pF
Functional Tests [3] (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 2200 mA, P_{out} = 52 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, 2-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Bandwidth @ ±10 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	12	13	—	dB
Drain Efficiency	η_D	22.5	24	—	%
Intermodulation Distortion	IM3	—	-36	-34	dBc
Adjacent Channel Power Ratio	ACPR	—	-39	-37	dBc
Input Return Loss	IRL	—	-12	-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.

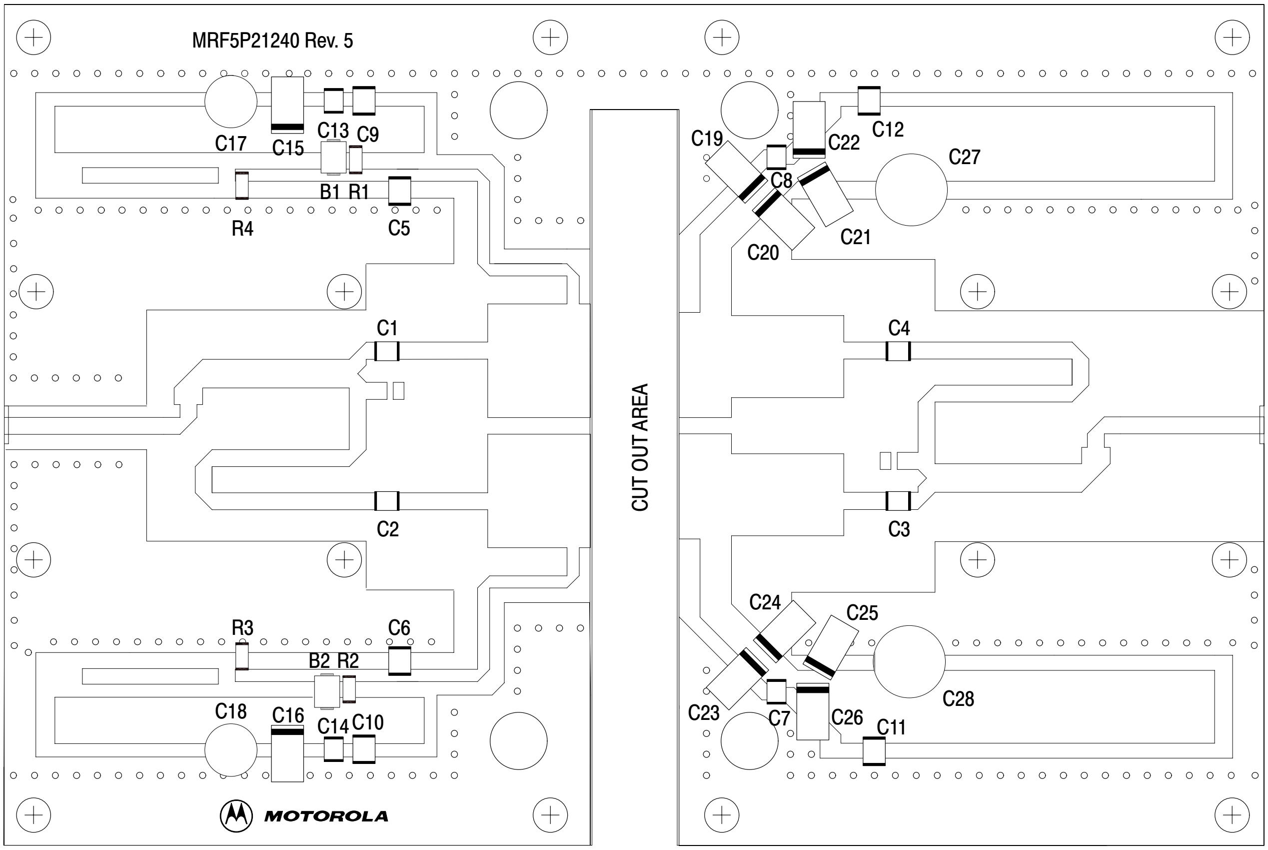


Z1	0.898″ x 0.080″ Microstrip	Z11, Z12	1.270″ x 0.058″ Microstrip
Z2, Z23	0.775″ x 0.136″ Microstrip	Z13, Z14	0.250″ x 0.500″ Microstrip
Z3, Z22	0.060″ x 0.080″ Microstrip	Z15, Z16	0.850″ x 0.150″ Microstrip
Z4, Z21	1.867″ x 0.080″ Microstrip	Z17, Z18	0.535″ x 0.390″ Microstrip
Z5, Z6	0.443″ x 0.080″ Microstrip	Z19, Z20	0.218″ x 0.080″ Microstrip
Z7, Z8	0.100″ x 0.080″ Microstrip	Z24	0.825″ x 0.080″ Microstrip
Z9, Z10	0.490″ x 0.540″ Microstrip	PCB	Arlon GX-0300-55-22, 0.030″, ε_r = 2.55

Figure 1. MRF5P21240HR6 Test Circuit Schematic

Table 5. MRF5P21240HR6 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2	Short Ferrite Beads	2743019447	Fair Rite
C1, C2, C3, C4	18 pF Chip Capacitors	100B180JCA500X	ATC
C5, C6, C7, C8	6.8 pF Chip Capacitors	100B6R8JCA500X	ATC
C9, C10, C11, C12	0.1 μF Chip Capacitors	CDR33BX104AKWS	Kemet
C13, C14	1000 pF Chip Capacitors	100B102JCA500X	ATC
C15, C16	4.7 μF Tantalum Capacitors	T491C475M050	Kemet
C17, C18	10 μF Electrolytic Capacitors	EEV-HB1H100P	Panasonic
C19, C20, C21, C22 C23, C24, C25, C26	22 μF Tantalum Capacitors	T491X226K035AS4394	Kemet
C27, C28	100 μF Electrolytic Capacitors	517D107M050BB6A	Sprague
R1, R2	1.0 kΩ, 1/8 W Chip Resistors		
R3, R4	10 Ω, 1/8 W Chip Resistors		



Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. MRF5P21240HR6 Test Circuit Component Layout

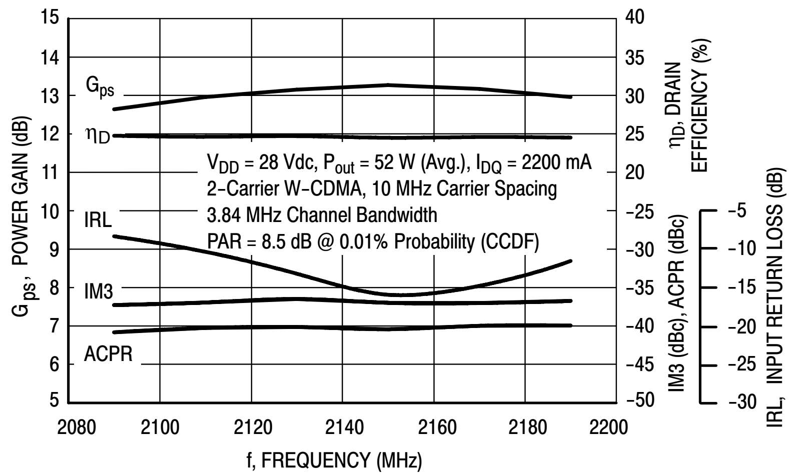


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 52 Watts Avg.

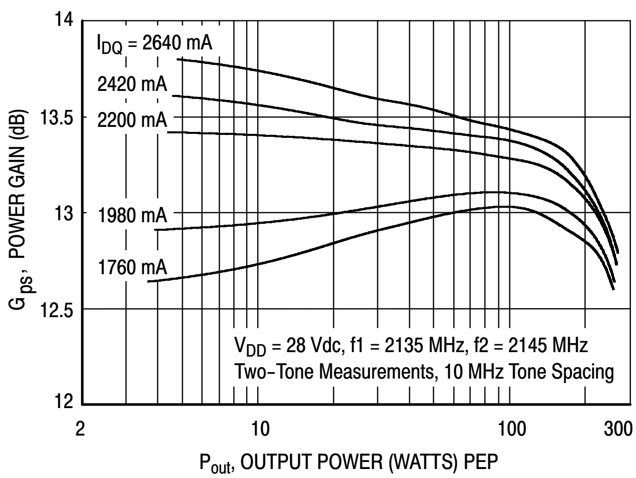


Figure 4. Two-Tone Power Gain versus Output Power

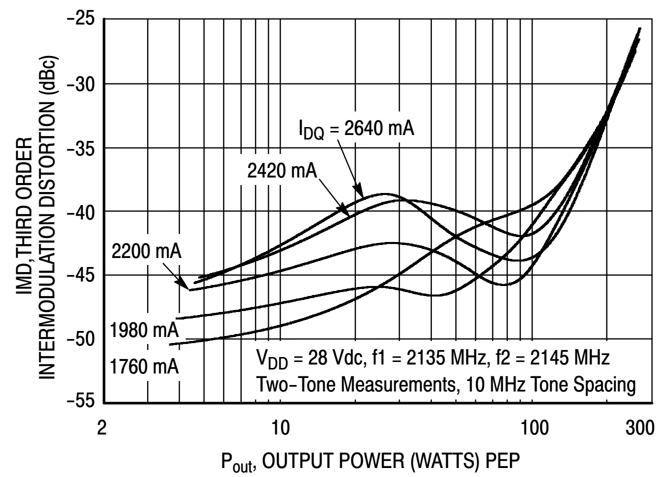


Figure 5. Third Order Intermodulation Distortion versus Output Power

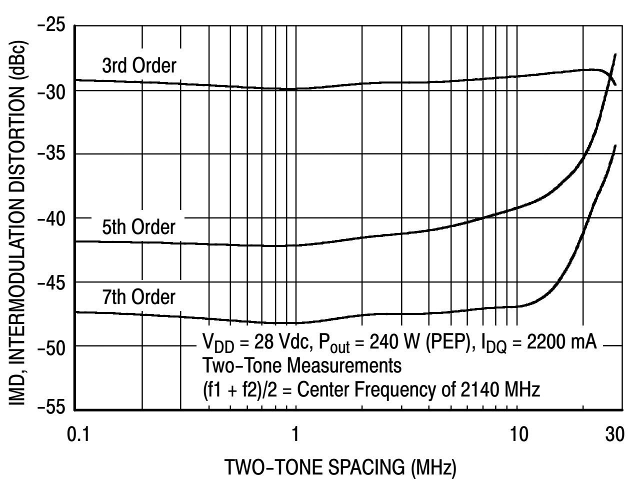


Figure 6. Intermodulation Distortion Products versus Tone Spacing

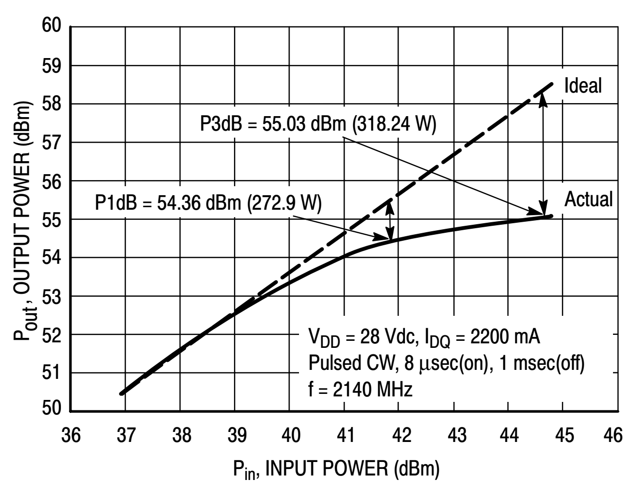


Figure 7. Pulse CW Output Power versus Input Power

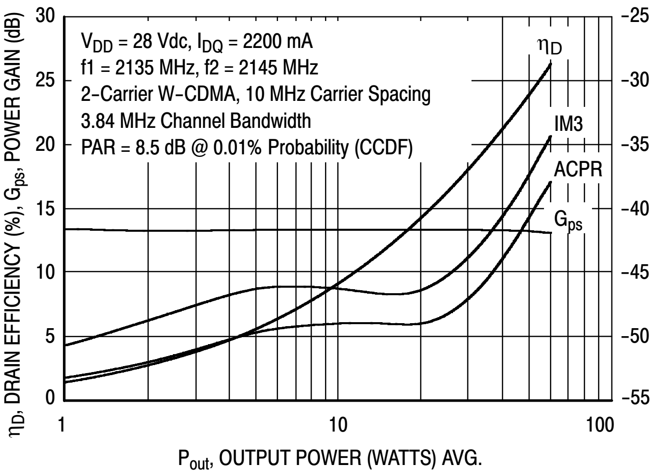
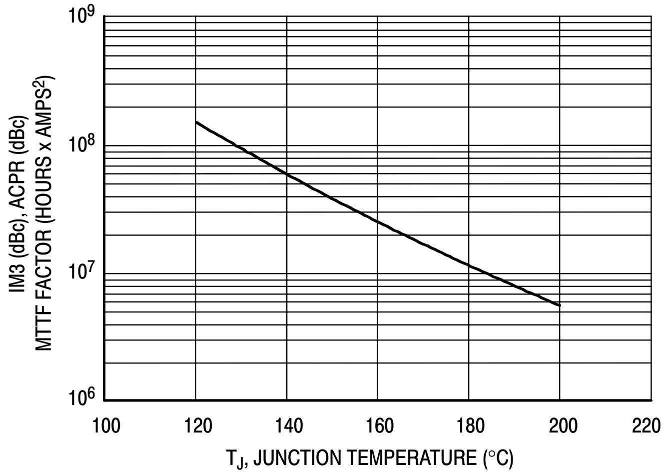


Figure 8. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power



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 9. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

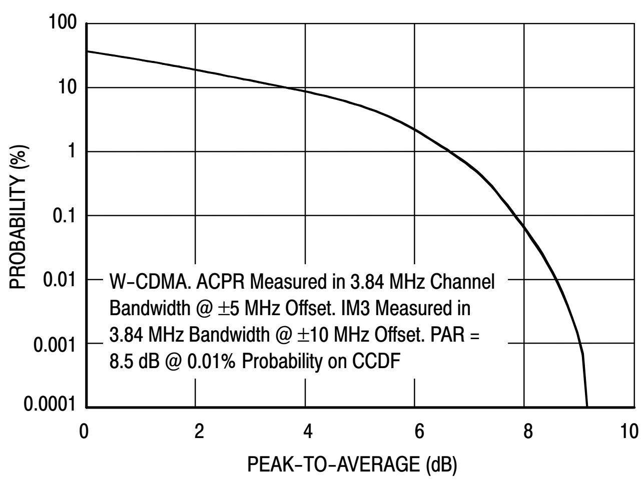


Figure 10. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

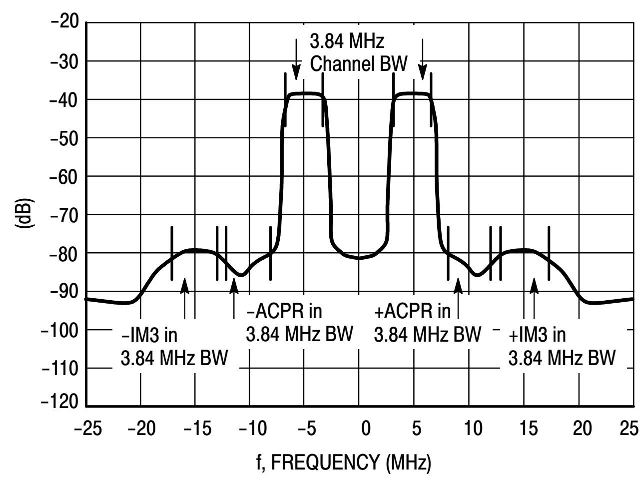
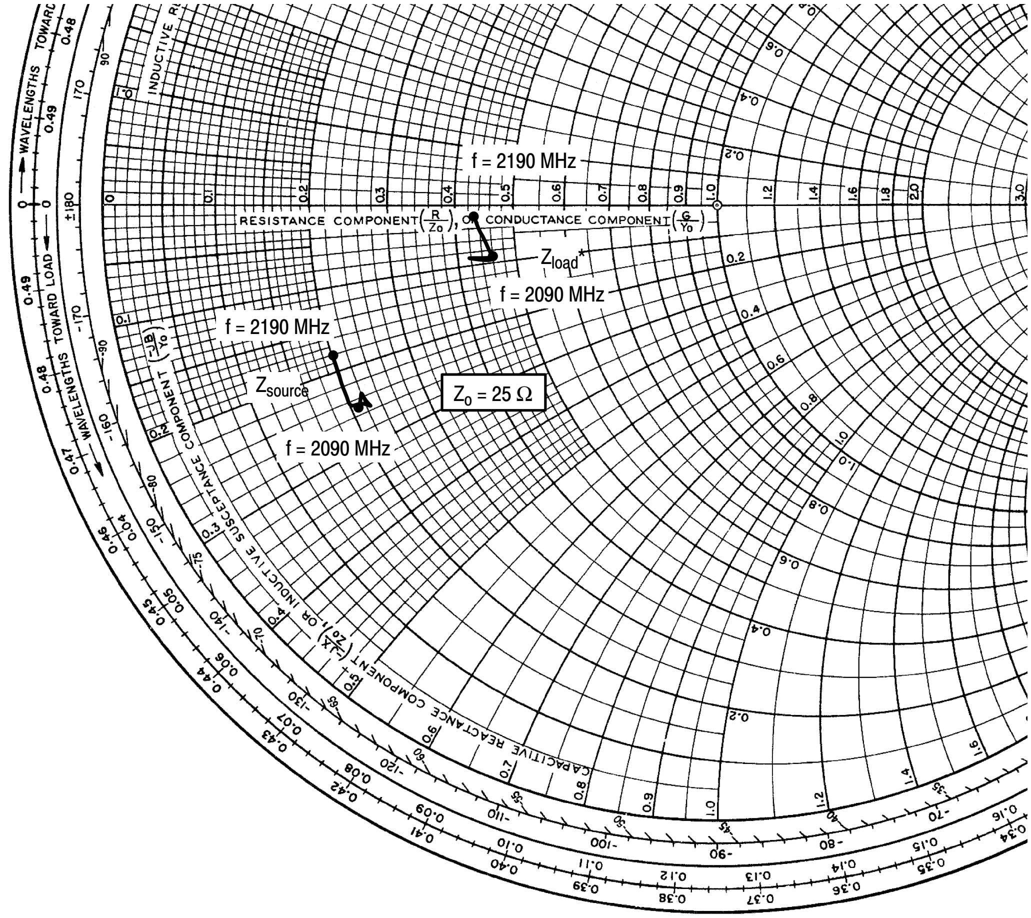


Figure 11. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 2200 mA, P_{out} = 52 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2090	5.33 - j6.21	11.42 - j2.25
2110	5.44 - j5.88	10.45 - j2.16
2130	5.40 - j6.16	11.28 - j2.14
2150	5.12 - j6.06	11.38 - j2.14
2170	4.96 - j5.25	11.04 - j1.25
2190	4.98 - j4.47	10.73 - j0.40

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.

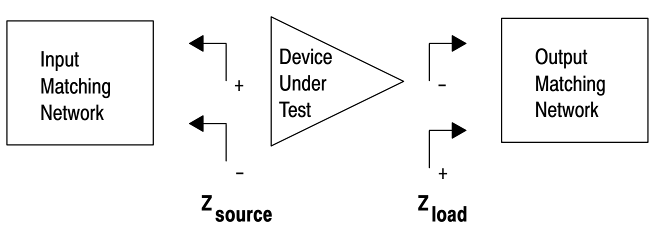


Figure 12. Series Equivalent Source and Load Impedance

NOTES

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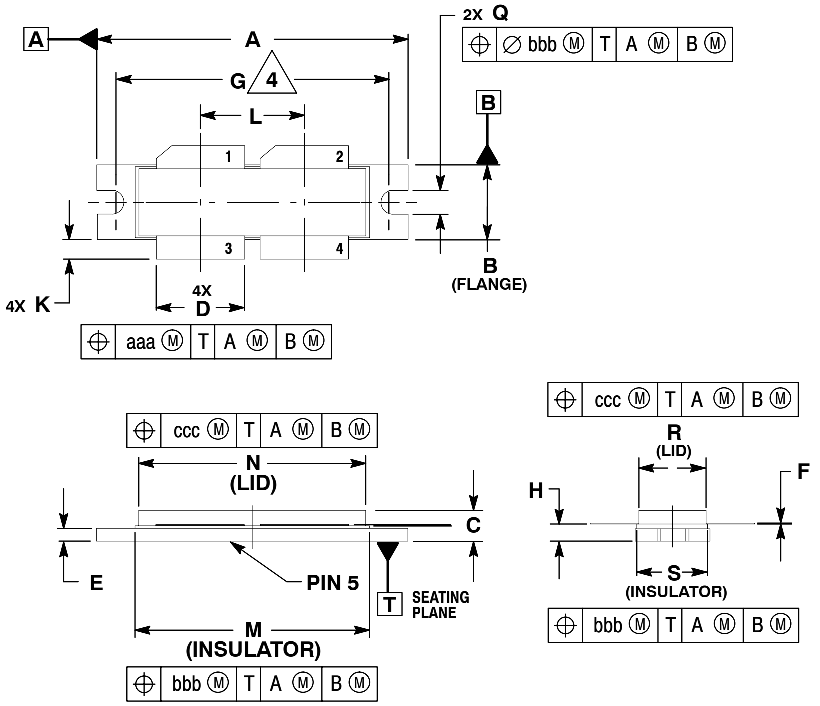
NOTES

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 E
NI-1230

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