Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Freescale Semiconductor
Technical Data

Document Number: MRF6S21050L
Rev. 2, 12/2008

√RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF6S21050LR3
MRF6S21050LSR3

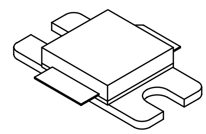
2110-2170 MHz, 11.5 W AVG., 28 V
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs

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.

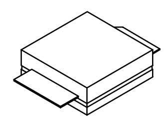
- Typical 2-carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 450 mA, P_{out} = 11.5 Watts Avg., f = 2157 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  - Power Gain — 16 dB
  - Drain Efficiency — 27.7%
  - IM3 @ 10 MHz Offset — -37 dBc in 3.84 MHz Channel Bandwidth
  - ACPR @ 5 MHz Offset — -40 dBc in 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 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 32 mm, 13 inch Reel.



CASE 465E-04, STYLE 1
NI-400
MRF6S21050LR3



CASE 465F-04, STYLE 1
NI-400S
MRF6S21050LSR3

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, 50 W CW Case Temperature 76°C, 12 W CW	$R_{\theta JC}$	 1.16 1.28	°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.

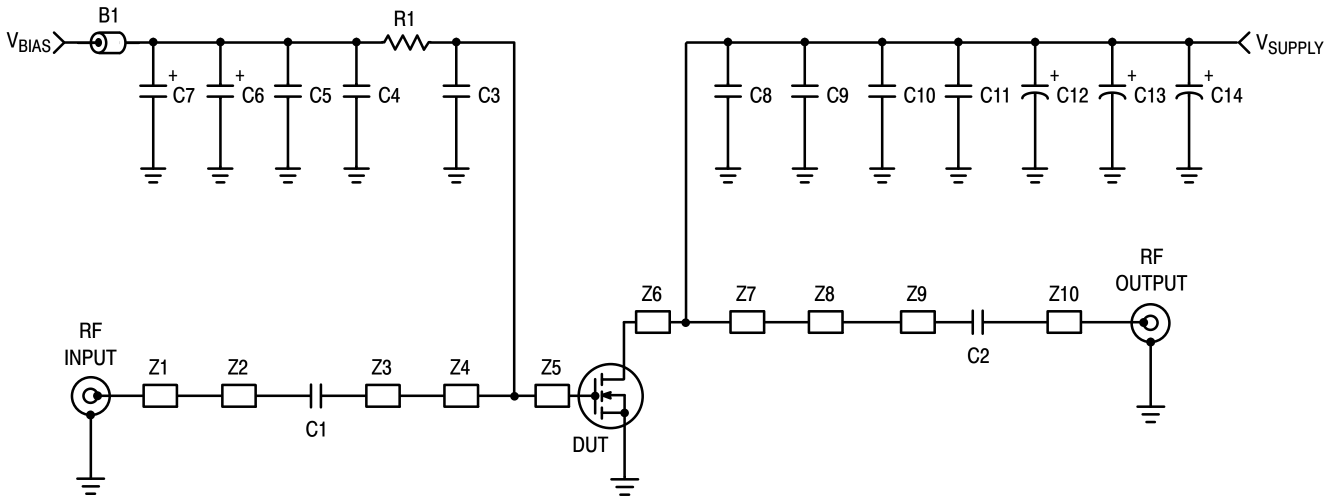
Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	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 Voltage (V_{DS} = 10 Vdc, I_D = 200 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 450 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.9	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.1 Adc)	$V_{DS(on)}$	—	0.21	0.3	Vdc
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	0.75	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{out} = 11.5 W Avg., f = 2157 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}	15	16	18	dB
Drain Efficiency	η_D	26	27.7	—	%
Intermodulation Distortion	IM3	—	-37	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-40	-38	dBc
Input Return Loss	IRL	—	-15	-9	dB

1. Part is internally matched both on input and output.

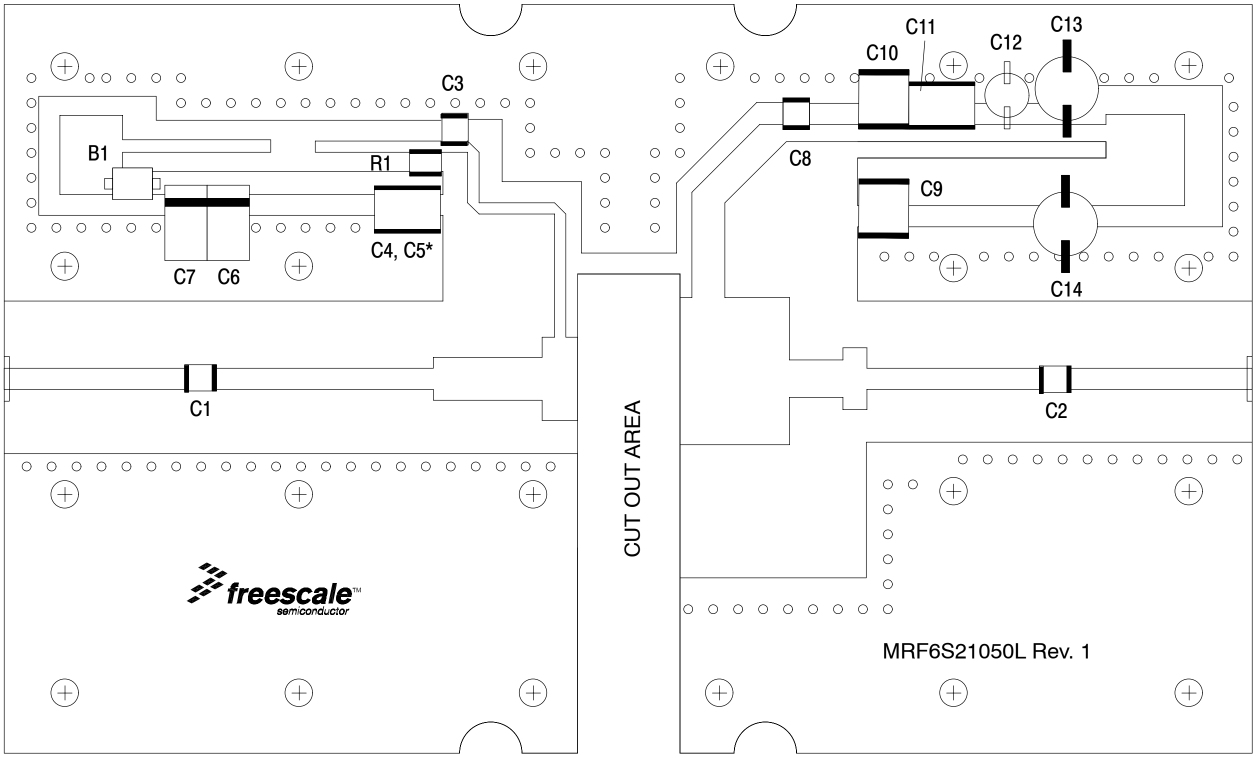


Z1, Z10	0.750″ x 0.084″ Microstrip	Z6	0.113″ x 0.590″ Microstrip
Z2	0.905″ x 0.084″ Microstrip	Z7	0.325″ x 0.590″ Microstrip
Z3	0.435″ x 0.173″ Microstrip	Z8	0.214″ x 0.150″ Microstrip
Z4	0.073″ x 0.333″ Microstrip	Z9	0.723″ x 0.084″ Microstrip
Z5	0.070″ x 0.333″ Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030″, ε_r = 2.55

Figure 1. MRF6S21050LR3(LSR3) Test Circuit Schematic

Table 5. MRF6S21050LR3(LSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Bead, Surface Mount	2743019447	Fair-Rite
C1, C2, C3, C8	6.8 pF Chip Capacitors	ATC100B6R8CT500XT	ATC
C4	0.01 μF Chip Capacitor	C1825C103J1RAC	Kemet
C5, C11	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C6	22 μF, 25 V Tantalum Capacitor	T491D226K025AT	Kemet
C7	47 μF, 16 V Tantalum Capacitor	T491D476K016AT	Kemet
C9, C10	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88B	Murata
C12	47 μF, 50 V Electrolytic Capacitor	EMVY500ADA470MF80G	Nippon
C13, C14	220 μF, 50 V Electrolytic Capacitors	EMVY500ADA221MJA0G	Chemi-Con
R1	3.3 Ω, 1/3 W Chip Resistor	CRCW12103R30FKEA	Vishay



* C4 on bottom, C5 on top.

Figure 2. MRF6S21050LR3(LSR3) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

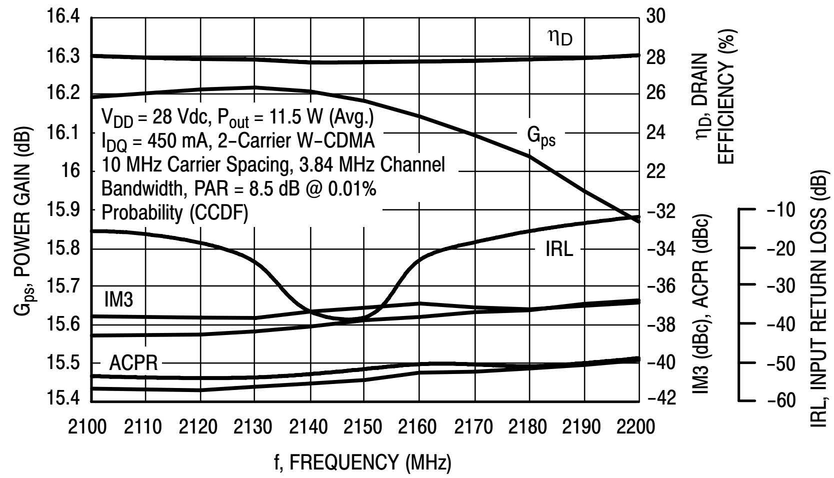


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 11.5 Watts

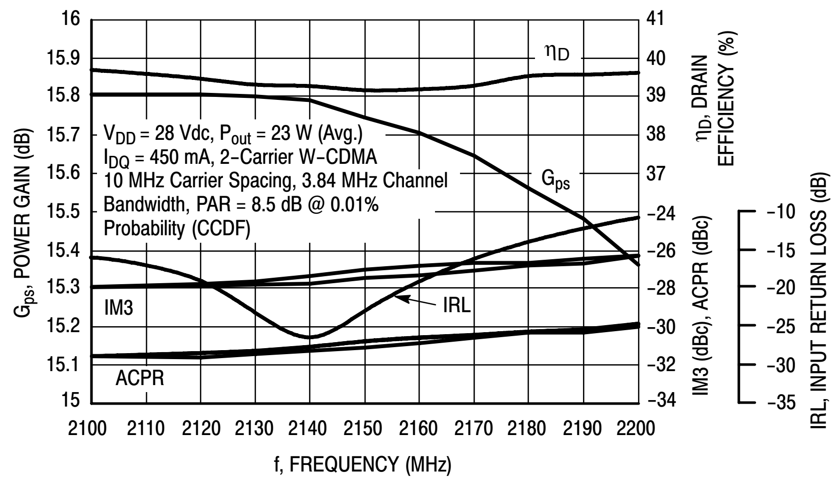


Figure 4. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 23 Watts

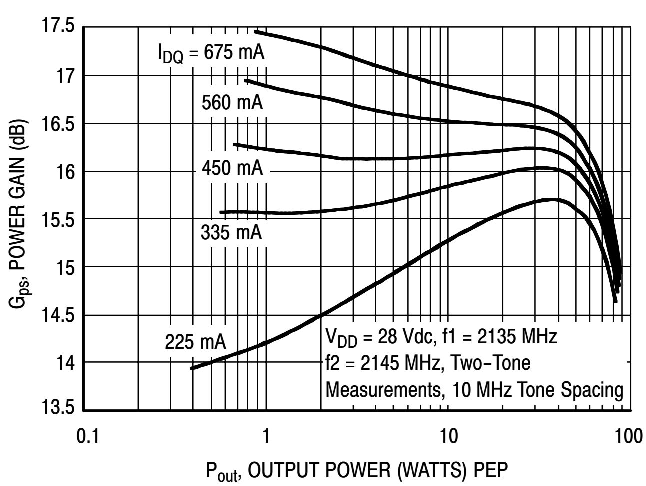


Figure 5. Two-Tone Power Gain versus Output Power

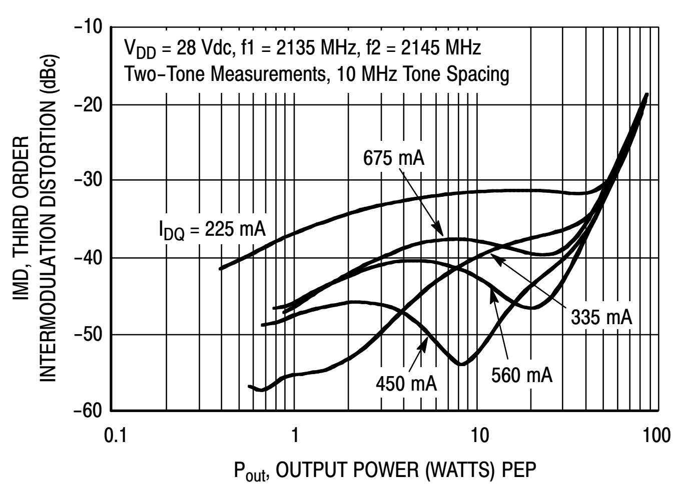


Figure 6. Third Order Intermodulation Distortion versus Output Power

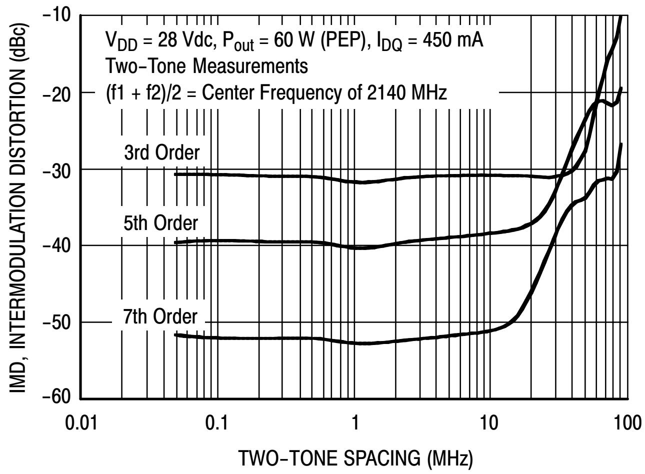


Figure 7. Intermodulation Distortion Products versus Tone Spacing

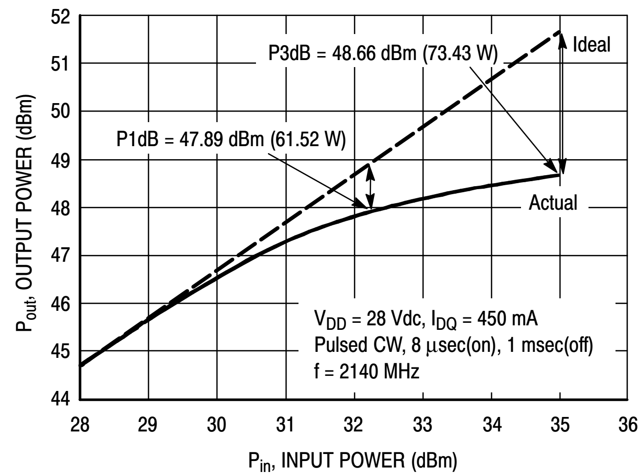


Figure 8. Pulsed CW Output Power versus Input Power

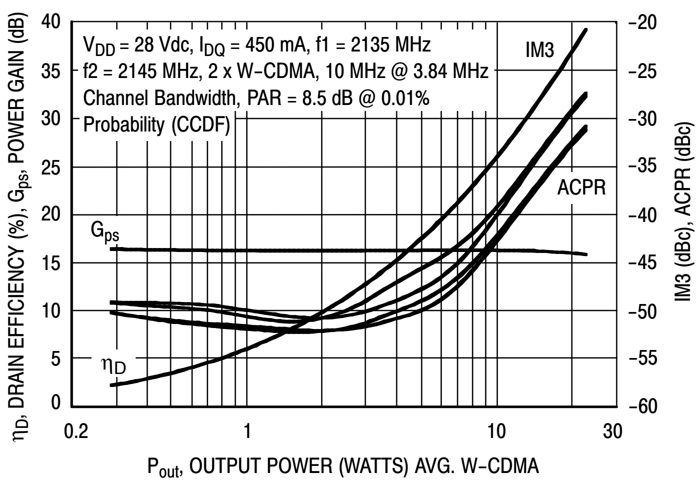


Figure 9. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

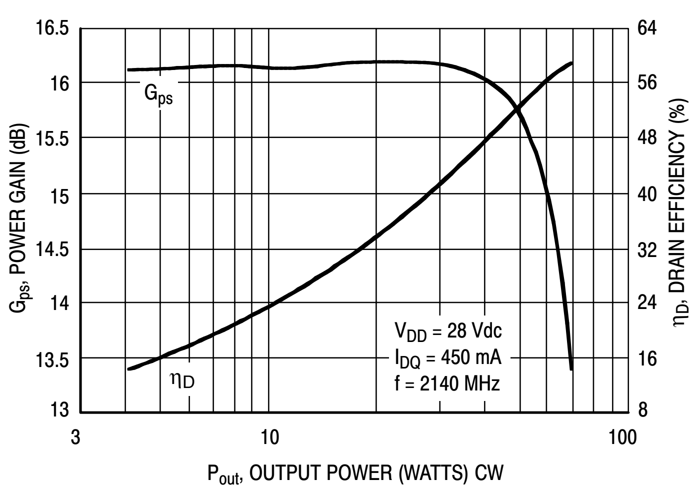


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

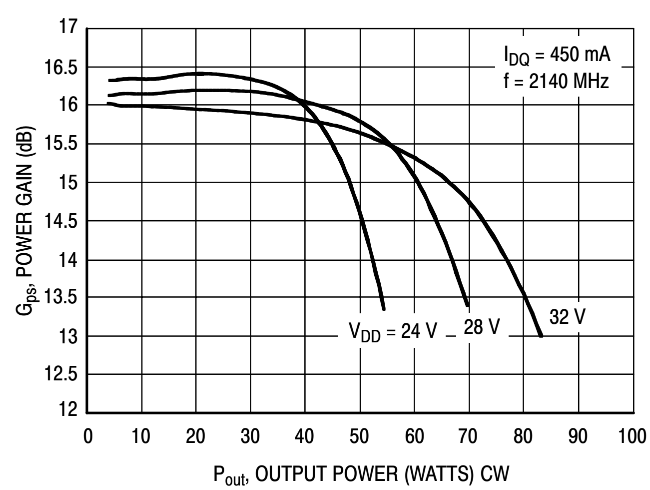
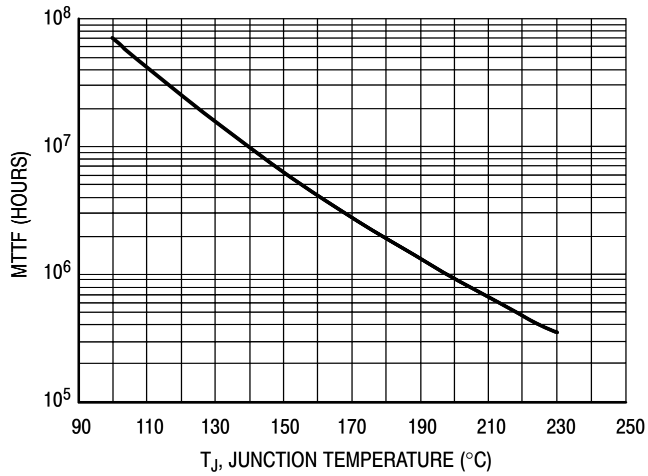


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 28 Vdc, P_{out} = 11.5 W Avg., and η_D = 27.7%.

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

Figure 12. MTTF Factor versus Junction Temperature

W-CDMA TEST SIGNAL

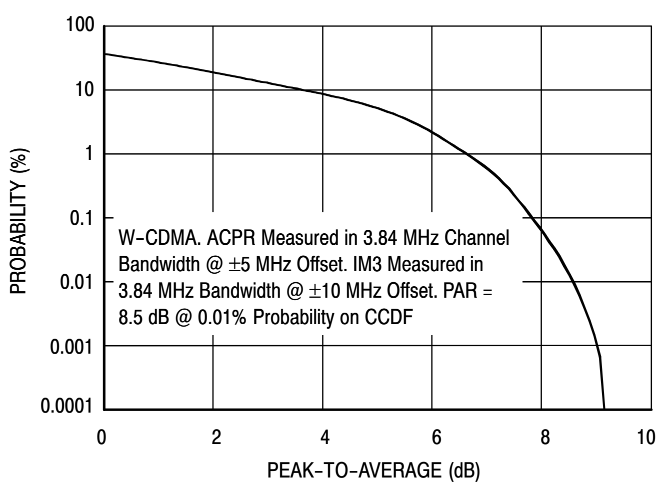


Figure 13. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

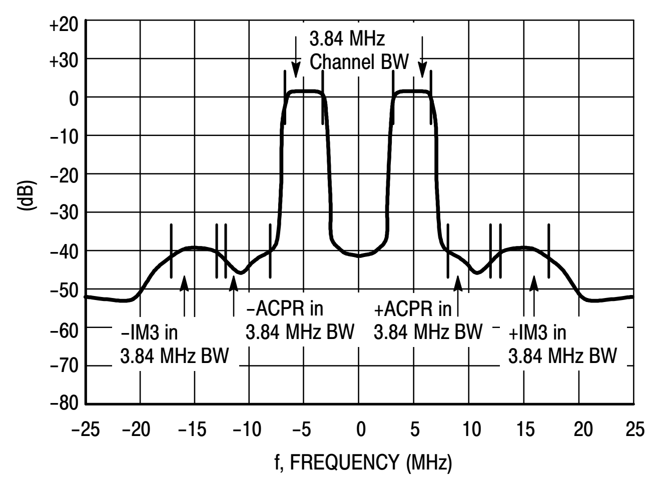
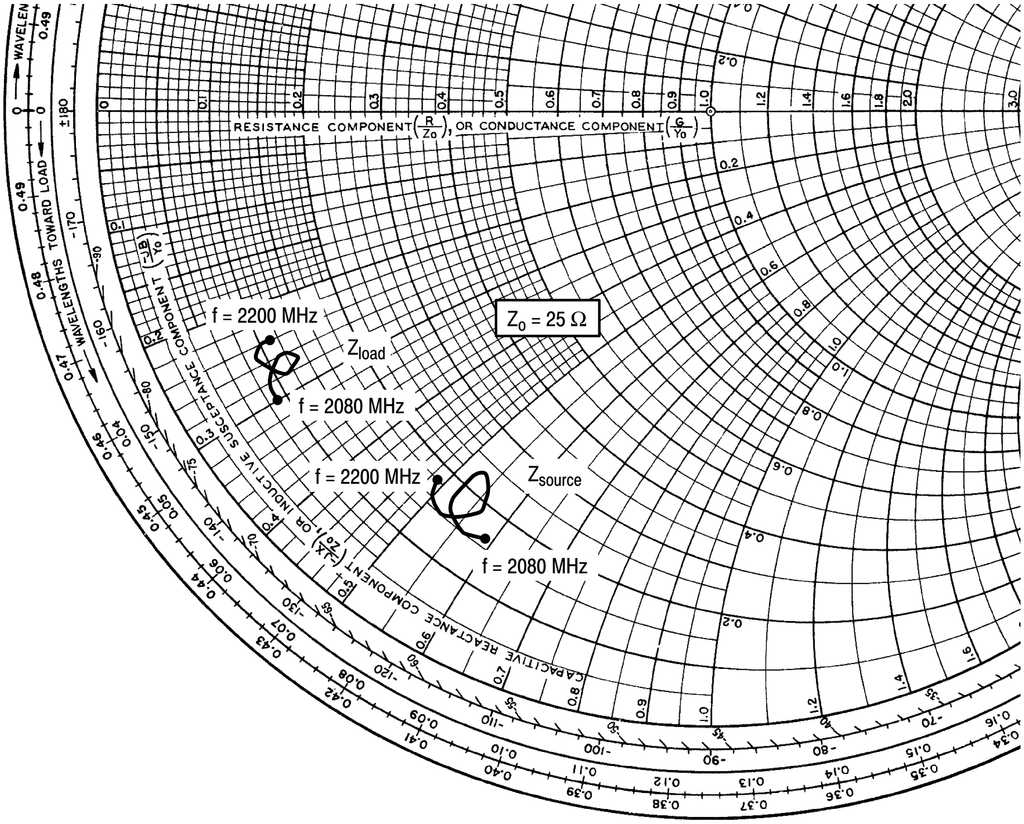


Figure 14. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{out} = 11.5 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2080	4.09 - j14.65	2.36 - j7.52
2090	3.74 - j13.95	2.25 - j7.11
2100	3.95 - j13.36	2.40 - j6.78
2110	4.44 - j13.00	2.68 - j6.59
2120	5.03 - j12.89	2.99 - j6.52
2130	5.55 - j13.05	3.26 - j6.64
2140	5.76 - j13.26	3.32 - j6.68
2150	5.57 - j13.70	3.20 - j6.87
2160	4.86 - j13.92	2.82 - j6.93
2170	4.04 - j13.61	2.44 - j6.70
2180	3.69 - j12.91	2.33 - j6.29
2190	3.91 - j12.44	2.49 - j6.05
2200	4.41 - j12.32	2.77 - j5.96

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

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

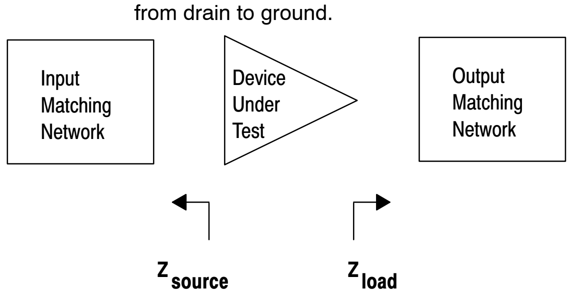
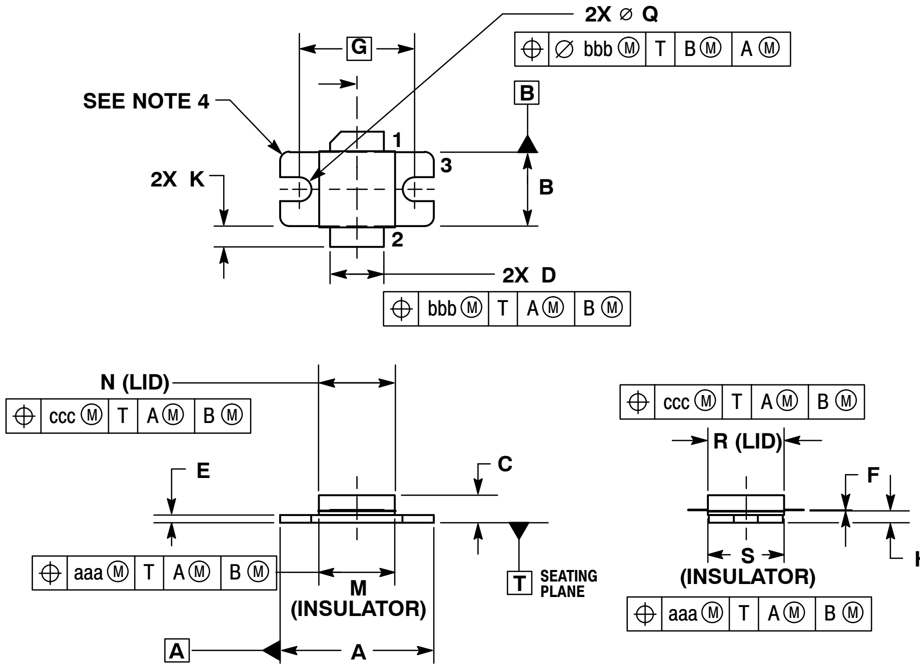


Figure 15. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

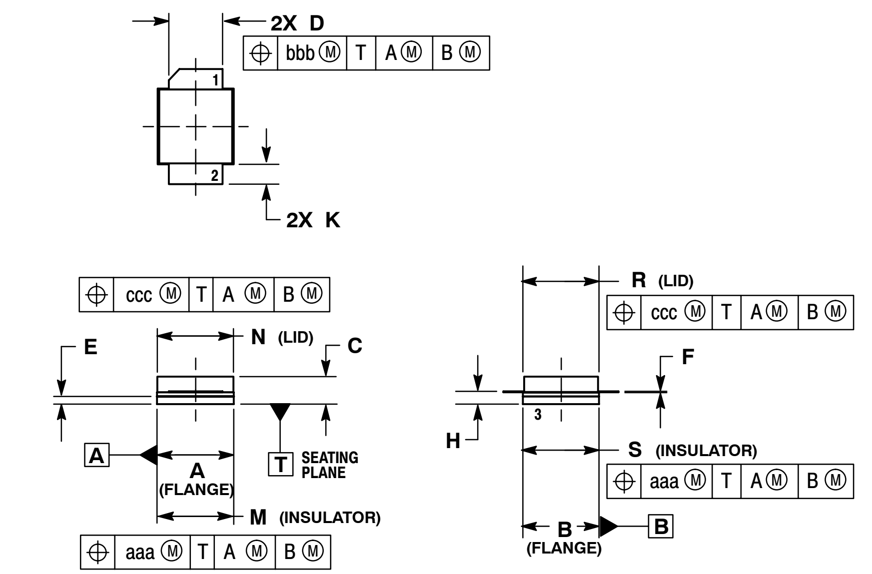


NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
4. INFORMATION ONLY: CORNER BREAK (4X) TO BE .060±.005 (1.52±0.13) RADIUS OR .06±.005 (1.52±0.13) x 45° CHAMFER.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.795	.805	20.19	20.44
B	.380	.390	9.65	9.9
C	.125	.163	3.17	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.004	.006	0.10	0.15
G	.600 BSC		15.24 BSC	
H	.057	.067	1.45	1.7
K	.092	.122	2.33	3.1
M	.395	.405	10	10.3
N	.395	.405	10	10.3
Q	∅ .120	∅ .130	∅ 3.05	∅ 3.3
R	.395	.405	10	10.3
S	.395	.405	10	10.3
aaa	.005 BSC		0.127 BSC	
bbb	.010 BSC		0.254 BSC	
ccc	.015 BSC		0.381 BSC	

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

CASE 465E-04
ISSUE F
NI-400
MRF6S21050LR3



NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.395	.405	10.03	10.29
C	.125	.163	3.18	4.14
D	.275	.285	6.98	7.24
E	.035	.045	0.89	1.14
F	.004	.006	0.10	0.15
H	.057	.067	1.45	1.70
K	.092	.122	2.34	3.10
M	.395	.405	10.03	10.29
N	.395	.405	10.03	10.29
R	.395	.405	10.03	10.29
S	.395	.405	10.03	10.29
aaa	.005 REF		0.127 REF	
bbb	.010 REF		0.254 REF	
ccc	.015 REF		0.38 REF	

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

CASE 465F-04
ISSUE E
NI-400S
MRF6S21050LSR3

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 Low Gold Plating bullet 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 and 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 • 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 • 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: MRF6S21050L
Rev. 2, 12/2008