Freescale Semiconductor
Technical Data

Document Number: MRFG35002N6A
Rev. 2, 6/2009

RoHS

Gallium Arsenide PHEMT

RF Power Field Effect Transistor

Designed for WLL/MMDS/BWA or UMTS driver applications. Characterized from 500 to 5000 MHz. Device is unmatched and is suitable for use in Class AB Customer Premise Equipment (CPE) applications.

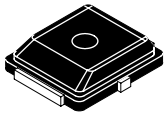
- Typical Single-Carrier W-CDMA Performance: V_{DD} = 6 Volts, I_{DQ} = 65 mA, P_{out} = 158 mWatts Avg., 3550 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.
  - Power Gain — 10 dB
  - Drain Efficiency — 26.5%
  - ACPR @ 5 MHz Offset — -42 dBc in 3.84 MHz Channel Bandwidth
- 1.5 Watts P1dB @ 3550 MHz, CW

Features

- Excellent Phase Linearity and Group Delay Characteristics
- High Gain, High Efficiency and High Linearity
- RoHS Compliant
- In Tape and Reel. T1 Suffix = 1000 Units per 12 mm, 7 inch Reel.

MRFG35002N6AT1

3.5 GHz, 1.5 W, 6 V
POWER FET
GaAs PHEMT



CASE 466-03, STYLE 1
PLD-1.5
PLASTIC

LIFETIME BUY

LAST ORDER 1 JUL 11 LAST SHIP 30 JUN 12

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	8	Vdc
Gate-Source Voltage	V_{GS}	-5	Vdc
RF Input Power	P_{in}	22	dBm
Storage Temperature Range	T_{stg}	-65 to +150	°C
Channel Temperature (1)	T_{ch}	175	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	13.7	°C/W

1. For reliable operation, the operating channel temperature should not exceed 150°C.
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)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted)

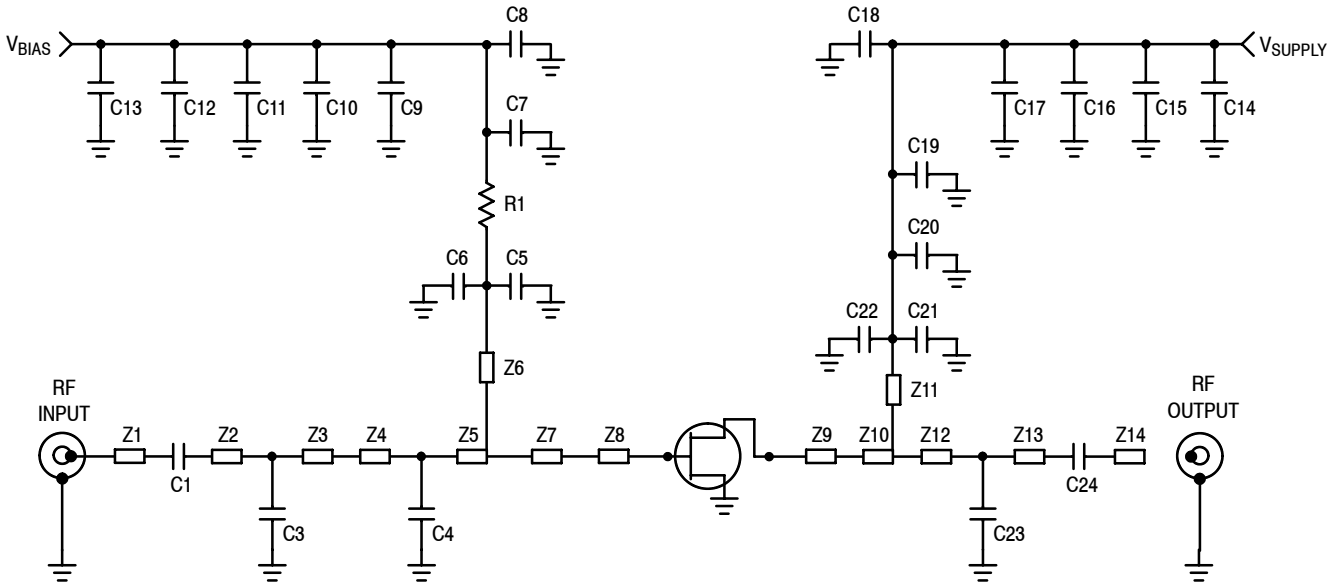
Characteristic	Symbol	Min	Typ	Max	Unit
Saturated Drain Current (V_{DS} = 3.5 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	1.7	—	Adc
Off State Leakage Current (V_{GS} = -0.4 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	< 1.0	100	μAdc
Off State Drain Current (V_{DS} = 6 Vdc, V_{GS} = -2.5 Vdc)	I_{DSO}	—	—	600	μAdc
Off State Current (V_{DS} = 28.5 Vdc, V_{GS} = -2.5 Vdc)	I_{DSX}	—	< 1.0	9	mAdc
Gate-Source Cut-off Voltage (V_{DS} = 3.5 Vdc, I_{DS} = 8.7 mA)	$V_{GS(th)}$	-1.2	-0.95	-0.7	Vdc
Quiescent Gate Voltage (V_{DS} = 6 Vdc, I_D = 65 mA)	$V_{GS(Q)}$	-1.1	-0.85	-0.6	Vdc

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 6 Vdc, I_{DQ} = 65 mA, P_{out} = 158 mW Avg., f = 3550 MHz, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	G_{ps}	8.5	10	—	dB
Drain Efficiency	η_D	23	26.5	—	%
Adjacent Channel Power Ratio	ACPR	—	-42	-38	dBc

Typical RF Performance (In Freescale Test Fixture, 50 ohm system) V_{DD} = 6 Vdc, I_{DQ} = 65 mA, f = 3550 MHz

P_{out} @ 1 dB Compression Point, CW	P_{1dB}	—	1.5	—	W



Z1, Z14	0.044″ x 0.125″ Microstrip	Z8	0.420″ x 0.150″ Microstrip
Z2	0.044″ x 0.481″ Microstrip	Z9	0.150″ x 0.068″ Microstrip
Z3	0.044″ x 0.076″ Microstrip	Z10	0.290″ x 0.183″ Microstrip
Z4	0.468″ x 0.025″ Microstrip	Z12	0.044″ x 0.291″ Microstrip
Z5	0.468″ x 0.341″ Microstrip	Z13	0.044″ x 0.808″ Microstrip
Z6, Z11	0.015″ x 0.549″ Microstrip	PCB	Rogers 4350, 0.020″, ε_r = 3.5
Z7	0.031″ x 0.259″ Microstrip		

Figure 1. MRFG35002N6A Test Circuit Schematic

Table 6. MRFG35002N6A Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C24	13 pF Chip Capacitors	ATC100A130JT500XT	ATC
C2	Not used		
C3	1.2 pF Chip Capacitor	08051J1R2BBS	AVX
C4	0.7 pF Chip Capacitor	08051J0R7BBS	AVX
C5, C6, C21, C22	5.6 pF Chip Capacitors	08051J5R6BBS	AVX
C7, C20	10 pF Chip Capacitors	ATC100A100JT500XT	ATC
C8, C19	100 pF Chip Capacitors	ATC100A101JT500XT	ATC
C9, C18	100 pF Chip Capacitors	ATC100B101JT500XT	ATC
C10, C17	1000 pF Chip Capacitors	ATC100B102JT50XT	ATC
C11, C16	0.01 μF Chip Capacitors	ATC200B103KT50XT	ATC
C12, C15	39K pF Chip Capacitors	ATC200B393KT50XT	ATC
C13, C14	10 μF Chip Capacitors	GRM55DR61H106KA88B	Murata
C23	0.2 pF Chip Capacitor	08051J0R2BBS	AVX
R1	100 Ω, 1/4 W Chip Resistor	CRCW12061000FKEA	Vishay

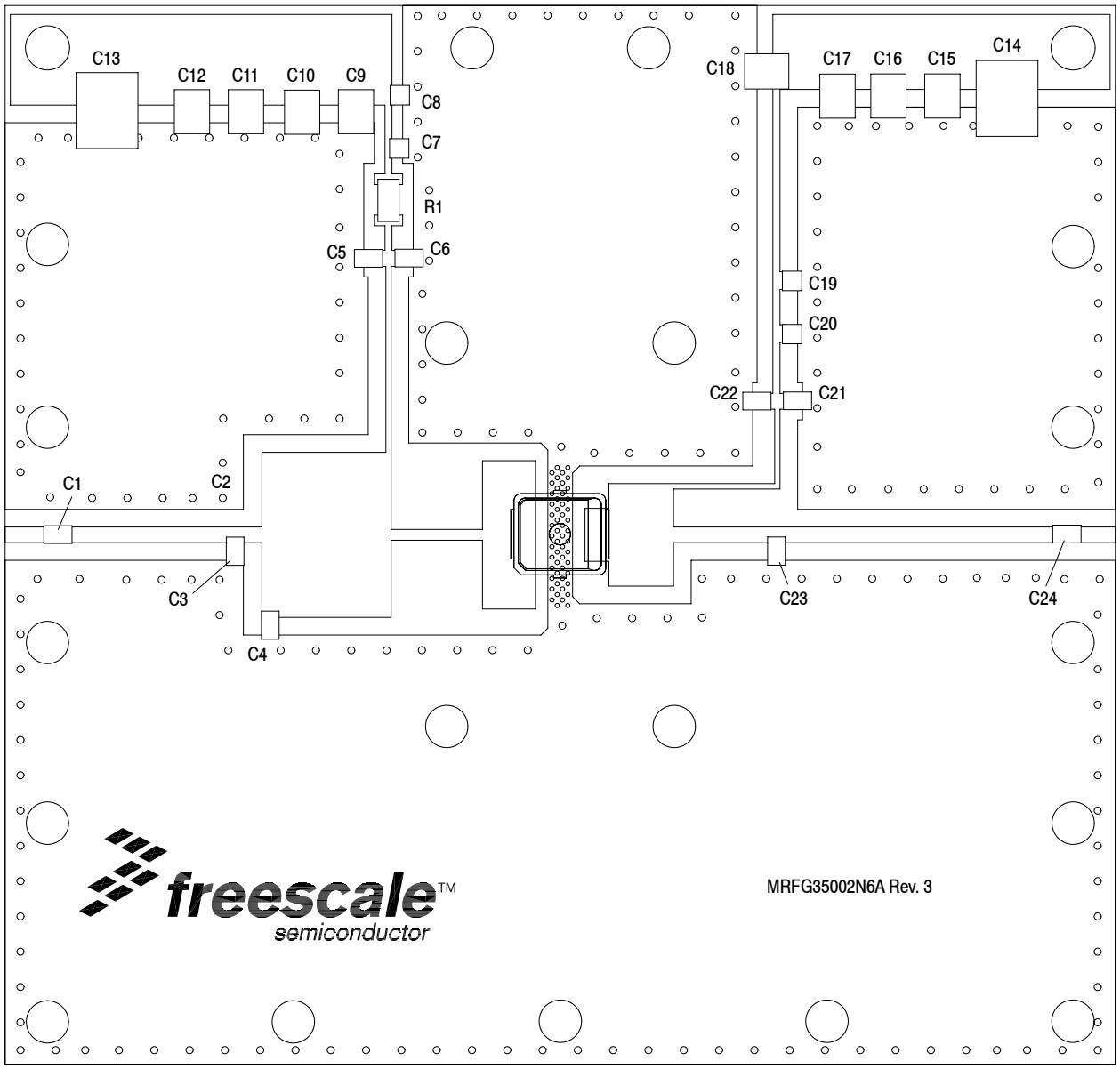


Figure 2. MRFG35002N6A Test Circuit Component Layout

TYPICAL CHARACTERISTICS

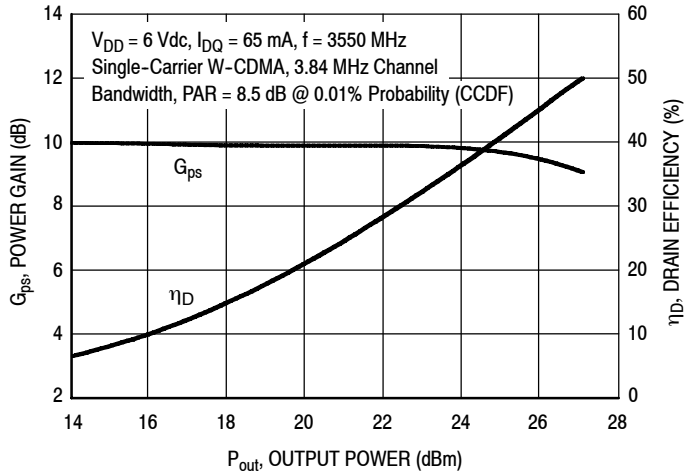


Figure 3. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power

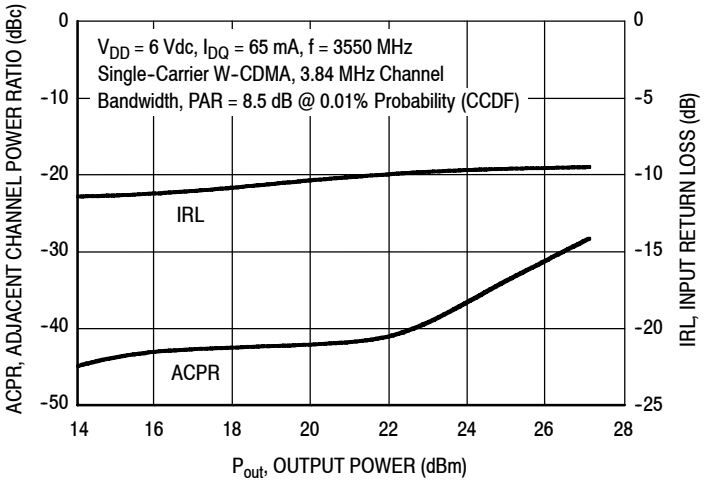


Figure 4. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power

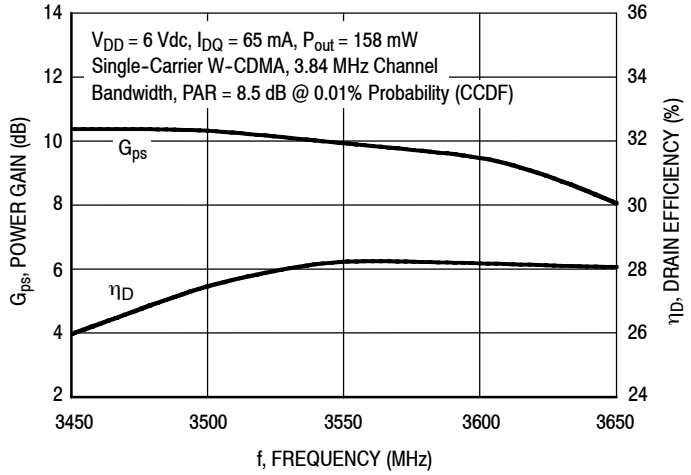


Figure 5. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Frequency

NOTE: Data is generated from the test circuit shown.

TYPICAL CHARACTERISTICS

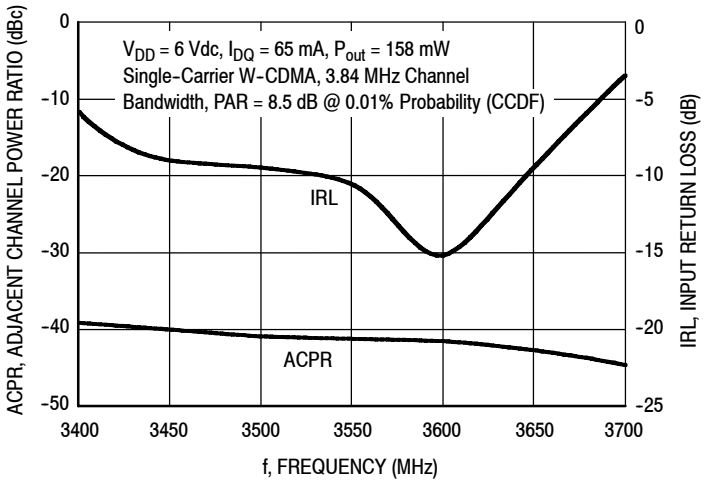


Figure 6. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Frequency

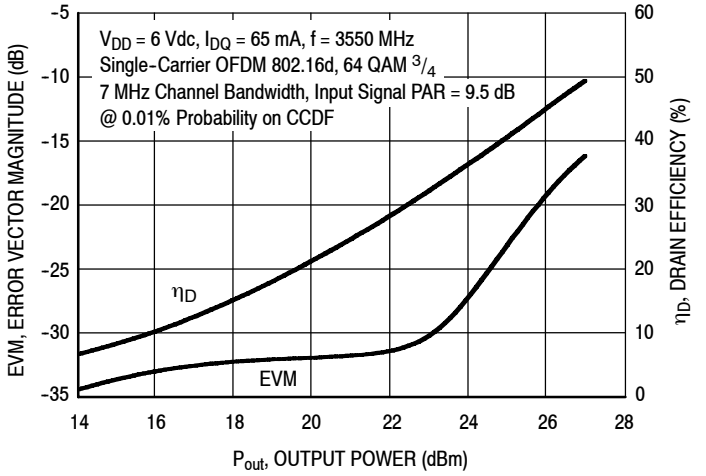


Figure 7. Single-Channel OFDM Error Vector Magnitude and Drain Efficiency versus Output Power

NOTE: Data is generated from the test circuit shown.

Table 7. Common Source S-Parameters (V_{DD} = 6 Vdc, I_{DQ} = 65 mA, T_A = 25°C, 50 Ohm System)

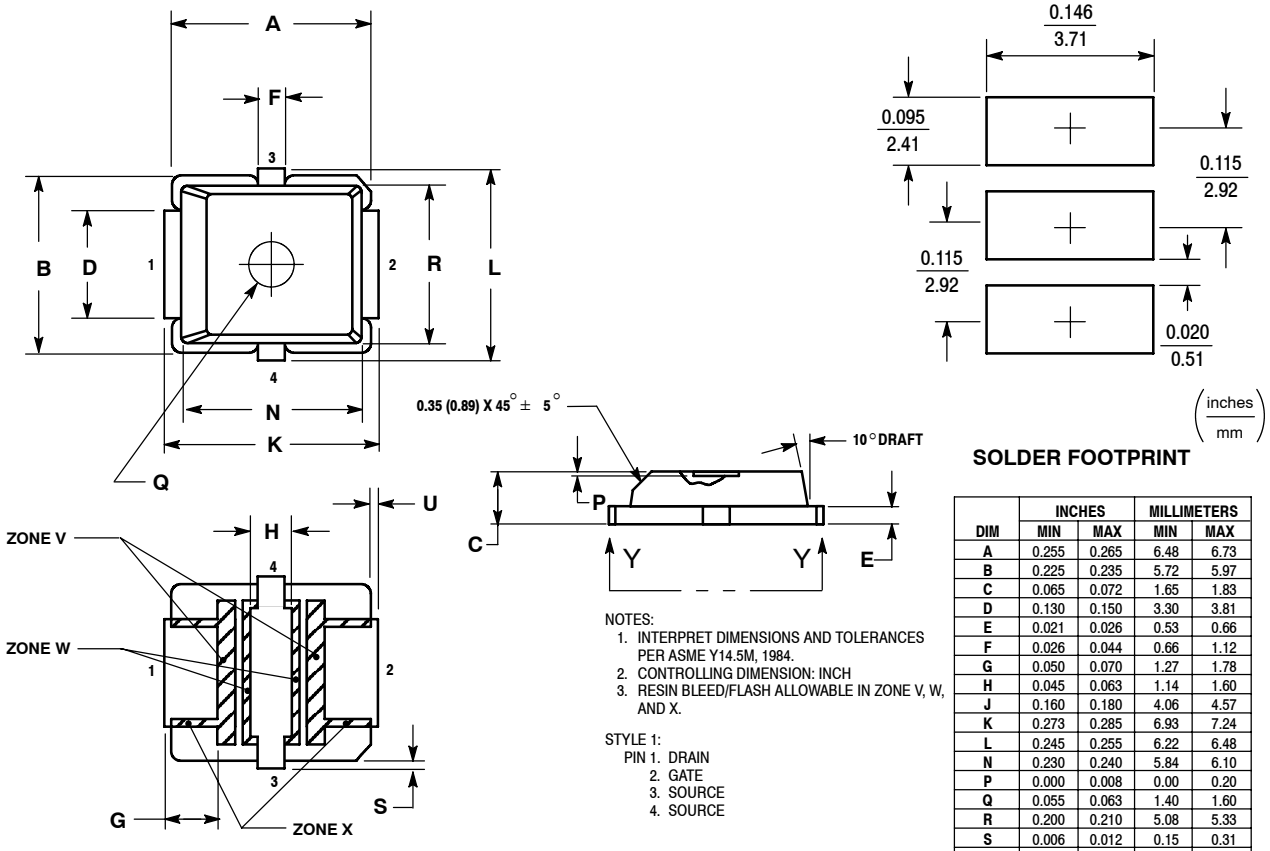
f	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	$\|S_{11}\|$	∠ ϕ	$\|S_{21}\|$	∠ ϕ	$\|S_{12}\|$	∠ ϕ	$\|S_{22}\|$	∠ ϕ
500	0.910	-175.1	5.223	82.8	0.036	0.0	0.703	-176.6
550	0.911	-176.9	4.775	80.9	0.036	-1.2	0.702	-177.9
600	0.911	-178.5	4.396	79.1	0.036	-2.3	0.701	-179.1
650	0.911	-179.9	4.078	77.4	0.037	-3.3	0.699	179.6
700	0.910	178.8	3.808	75.7	0.037	-4.4	0.698	178.5
750	0.910	177.7	3.574	74.0	0.037	-5.3	0.697	177.3
800	0.910	176.6	3.371	72.5	0.037	-6.2	0.696	176.1
850	0.910	175.7	3.191	70.9	0.037	-7.1	0.695	175.0
900	0.910	174.9	3.029	69.4	0.037	-7.8	0.694	173.8
950	0.910	174.2	2.883	67.9	0.037	-8.7	0.693	172.7
1000	0.909	173.4	2.748	66.3	0.037	-9.5	0.692	171.5
1050	0.910	172.7	2.632	65.0	0.037	-10.3	0.692	170.3
1100	0.910	172.1	2.520	63.5	0.038	-11.0	0.691	169.1
1150	0.909	171.4	2.421	62.0	0.038	-11.9	0.690	168.0
1200	0.910	170.8	2.329	60.6	0.038	-12.6	0.691	167.0
1250	0.909	170.1	2.246	59.2	0.038	-13.3	0.690	165.9
1300	0.908	169.5	2.168	57.8	0.038	-14.1	0.689	164.9
1350	0.907	168.8	2.097	56.4	0.038	-14.9	0.689	164.0
1400	0.907	168.1	2.030	54.9	0.038	-15.4	0.690	163.0
1450	0.907	167.2	1.968	53.5	0.038	-16.4	0.690	162.1
1500	0.906	166.3	1.911	52.0	0.038	-17.1	0.690	161.3
1550	0.904	163.0	1.874	50.4	0.039	-18.0	0.687	162.6
1600	0.903	162.2	1.823	49.0	0.039	-18.8	0.686	161.8
1650	0.903	161.3	1.775	47.6	0.039	-19.6	0.685	161.0
1700	0.903	160.5	1.729	46.2	0.039	-20.5	0.686	160.1
1750	0.902	159.8	1.686	44.7	0.039	-21.0	0.686	159.3
1800	0.902	158.9	1.645	43.3	0.039	-21.8	0.685	158.4
1850	0.901	158.1	1.607	41.9	0.039	-22.5	0.685	157.5
1900	0.901	157.4	1.570	40.5	0.039	-23.3	0.686	156.7
1950	0.902	156.6	1.535	39.1	0.039	-24.1	0.686	155.8
2000	0.901	155.9	1.502	37.7	0.039	-24.9	0.686	155.0
2050	0.901	155.1	1.470	36.3	0.039	-25.6	0.686	154.1
2100	0.901	154.3	1.441	34.9	0.040	-26.5	0.685	153.4
2150	0.906	153.3	1.415	33.5	0.040	-27.2	0.689	152.3
2200	0.900	152.8	1.388	32.0	0.040	-28.1	0.686	151.8
2250	0.900	151.9	1.364	30.6	0.040	-28.7	0.685	150.9
2300	0.899	151.0	1.342	29.2	0.040	-29.6	0.684	150.0
2350	0.898	150.2	1.321	27.7	0.040	-30.3	0.683	149.2
2400	0.899	149.3	1.302	26.2	0.040	-31.4	0.683	148.4
2450	0.897	148.4	1.284	24.8	0.041	-32.1	0.681	147.4
2500	0.896	147.4	1.268	23.3	0.041	-33.2	0.679	146.6
2550	0.896	146.5	1.254	21.8	0.041	-34.1	0.678	145.7
2600	0.893	145.4	1.240	20.2	0.041	-34.8	0.675	144.8
2650	0.894	144.5	1.227	18.7	0.042	-35.6	0.674	143.9
2700	0.891	143.4	1.216	17.2	0.042	-36.7	0.672	142.9
2750	0.891	142.4	1.206	15.6	0.042	-37.4	0.669	142.0

(continued)

Table 7. Common Source S-Parameters (V_{DD} = 6 Vdc, I_{DQ} = 65 mA, T_A = 25°C, 50 Ohm System) **(continued)**

f	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	$\|S_{11}\|$	∠ ϕ	$\|S_{21}\|$	∠ ϕ	$\|S_{12}\|$	∠ ϕ	$\|S_{22}\|$	∠ ϕ
2800	0.890	141.2	1.197	14.0	0.043	-38.6	0.667	141.1
2850	0.887	140.1	1.189	12.4	0.043	-39.5	0.663	140.2
2900	0.888	138.9	1.182	10.8	0.043	-40.4	0.661	139.2
2950	0.886	137.6	1.175	9.1	0.044	-41.4	0.658	138.2
3000	0.886	136.4	1.170	7.5	0.044	-42.4	0.656	137.2
3050	0.885	135.1	1.163	5.8	0.045	-43.5	0.652	136.3
3100	0.882	133.8	1.159	4.1	0.045	-44.5	0.649	135.2
3150	0.881	132.5	1.155	2.4	0.046	-45.5	0.645	134.2
3200	0.879	131.1	1.151	0.7	0.046	-46.8	0.642	133.1
3250	0.877	129.8	1.148	-1.0	0.047	-47.7	0.638	132.0
3300	0.876	128.4	1.145	-2.7	0.047	-48.9	0.634	130.9
3350	0.875	127.0	1.143	-4.5	0.048	-50.0	0.630	129.8
3400	0.874	125.6	1.141	-6.3	0.048	-51.3	0.627	128.7
3450	0.873	124.1	1.139	-8.0	0.049	-52.4	0.624	127.5
3500	0.870	122.6	1.137	-9.8	0.049	-53.8	0.620	126.4
3550	0.869	121.1	1.134	-11.6	0.050	-55.0	0.616	125.2
3600	0.867	119.7	1.133	-13.4	0.050	-56.2	0.612	124.0
3650	0.867	118.1	1.131	-15.2	0.051	-57.3	0.609	122.8
3700	0.865	116.6	1.130	-17.0	0.051	-58.4	0.605	121.5
3750	0.863	115.0	1.128	-18.8	0.052	-59.5	0.602	120.2
3800	0.861	113.5	1.127	-20.7	0.052	-60.9	0.598	118.9
3850	0.860	111.9	1.126	-22.5	0.053	-62.1	0.595	117.6
3900	0.858	110.3	1.125	-24.4	0.053	-63.4	0.591	116.2
3950	0.856	108.6	1.124	-26.3	0.054	-64.5	0.588	114.9
4000	0.854	107.0	1.122	-28.3	0.054	-65.7	0.585	113.4
4050	0.853	105.3	1.122	-30.2	0.055	-67.0	0.582	112.0
4100	0.851	103.5	1.122	-32.1	0.055	-68.1	0.579	110.5
4150	0.849	101.7	1.121	-34.2	0.056	-69.5	0.575	109.0
4200	0.847	99.8	1.120	-36.2	0.057	-70.9	0.572	107.4
4250	0.845	97.9	1.119	-38.3	0.057	-72.4	0.569	105.9
4300	0.842	96.0	1.119	-40.4	0.057	-73.8	0.566	104.2
4350	0.841	94.1	1.119	-42.6	0.058	-75.2	0.563	102.4
4400	0.838	92.0	1.118	-44.7	0.058	-76.6	0.559	100.7
4450	0.836	89.9	1.118	-47.0	0.059	-78.4	0.557	98.8
4500	0.836	87.7	1.118	-49.3	0.060	-80.0	0.553	96.8
4550	0.832	85.3	1.116	-51.7	0.060	-81.7	0.550	94.8
4600	0.828	83.3	1.114	-54.0	0.061	-83.3	0.547	92.7
4650	0.830	80.6	1.114	-56.4	0.061	-85.0	0.542	90.5
4700	0.826	78.3	1.114	-58.8	0.062	-86.6	0.539	88.3
4750	0.830	75.9	1.111	-61.3	0.062	-88.6	0.535	85.9
4800	0.827	72.9	1.109	-64.0	0.063	-90.6	0.532	83.6
4850	0.827	70.4	1.107	-66.6	0.063	-92.6	0.529	81.0
4900	0.828	67.5	1.104	-69.2	0.064	-94.4	0.525	78.4
4950	0.824	64.8	1.099	-71.8	0.064	-96.4	0.522	75.8
5000	0.824	61.8	1.095	-74.6	0.064	-98.6	0.518	72.9

PACKAGE DIMENSIONS



VIEW Y–Y

NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1984.
2. CONTROLLING DIMENSION: INCH
3. RESIN BLEED/FLASH ALLOWABLE IN ZONE V, W, AND X.

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

CASE 466-03
ISSUE D
PLD-1.5
PLASTIC

SOLDER FOOTPRINT

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.255	0.265	6.48	6.73
B	0.225	0.235	5.72	5.97
C	0.065	0.072	1.65	1.83
D	0.130	0.150	3.30	3.81
E	0.021	0.026	0.53	0.66
F	0.026	0.044	0.66	1.12
G	0.050	0.070	1.27	1.78
H	0.045	0.063	1.14	1.60
J	0.160	0.180	4.06	4.57
K	0.273	0.285	6.93	7.24
L	0.245	0.255	6.22	6.48
N	0.230	0.240	5.84	6.10
P	0.000	0.008	0.00	0.20
Q	0.055	0.063	1.40	1.60
R	0.200	0.210	5.08	5.33
S	0.006	0.012	0.15	0.31
U	0.006	0.012	0.15	0.31
ZONE V	0.000	0.021	0.00	0.53
ZONE W	0.000	0.010	0.00	0.25
ZONE X	0.000	0.010	0.00	0.25

PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Dec. 2007	• Initial Release of Data Sheet
1	Dec. 2008	• Removed ”Operating Case Temperature Range” from Maximum Ratings table so that the maximum channel temperature rating is the limiting thermal design criteria and not the case temperature range, p. 1
2	June 2009	• Modified data sheet to reflect MSL rating change from 1 to 3 as a result of the standardization of packing process as described in Product and Process Change Notification number, PCN13516, p. 2

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Freescale Semiconductor, Inc.
Technical Information Center, EL516
2100 East Elliot Road
Tempe, Arizona 85284
1-800-521-6274 or +1-480-768-2130
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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

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