

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

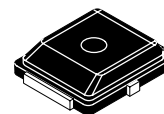
- 1.5 Watts P1dB @ 3550 MHz, CW

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**

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.freescal.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)	IV (Minimum)

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	1	260	°C

Table 5. Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise noted)

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

Functional Tests (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 6\text{ Vdc}$, $I_{DQ} = 65\text{ mA}$, $P_{out} = 158\text{ mW Avg.}$, $f = 3550\text{ MHz}$, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @ $\pm 5\text{ MHz}$ 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) $V_{DD} = 6\text{ Vdc}$, $I_{DQ} = 65\text{ mA}$, $f = 3550\text{ MHz}$

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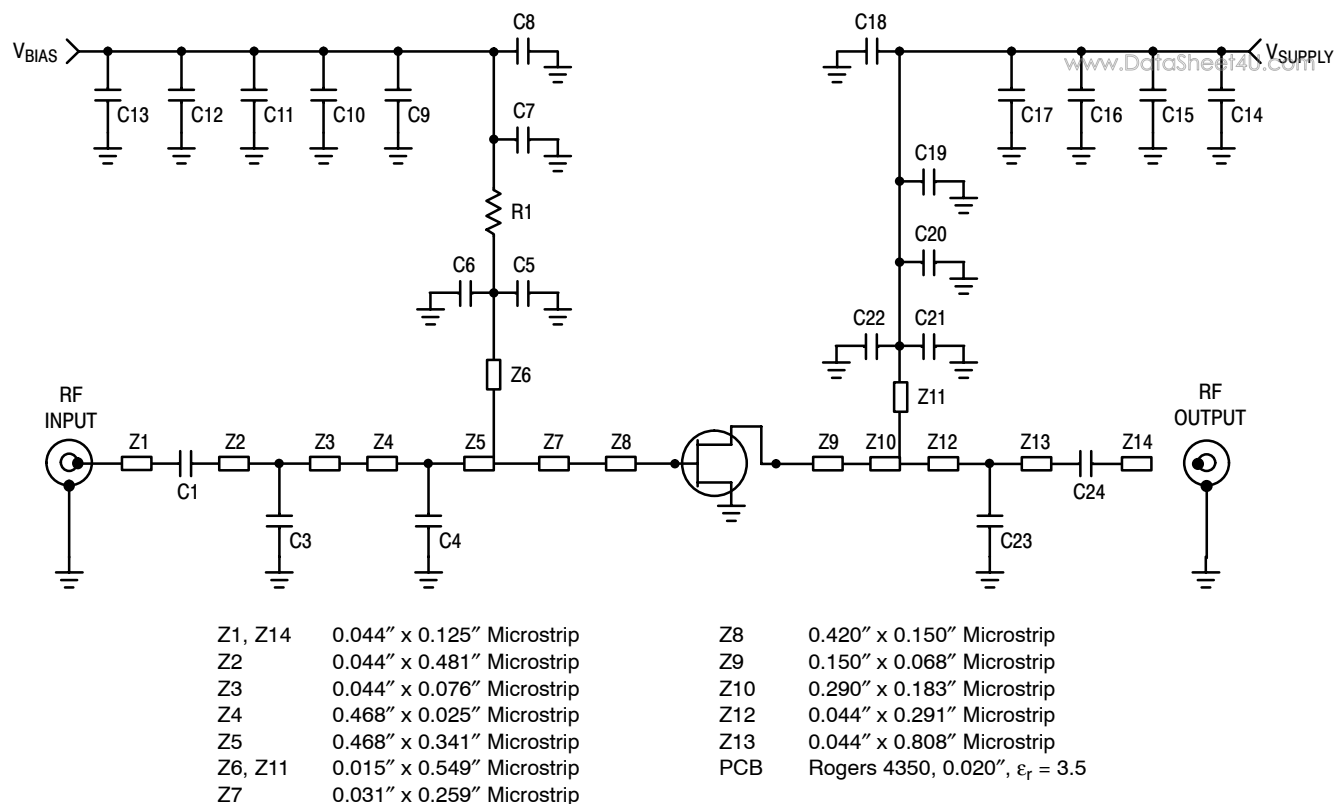


Table 6. MRFG35002N6A Test Circuit Component Designations and Values

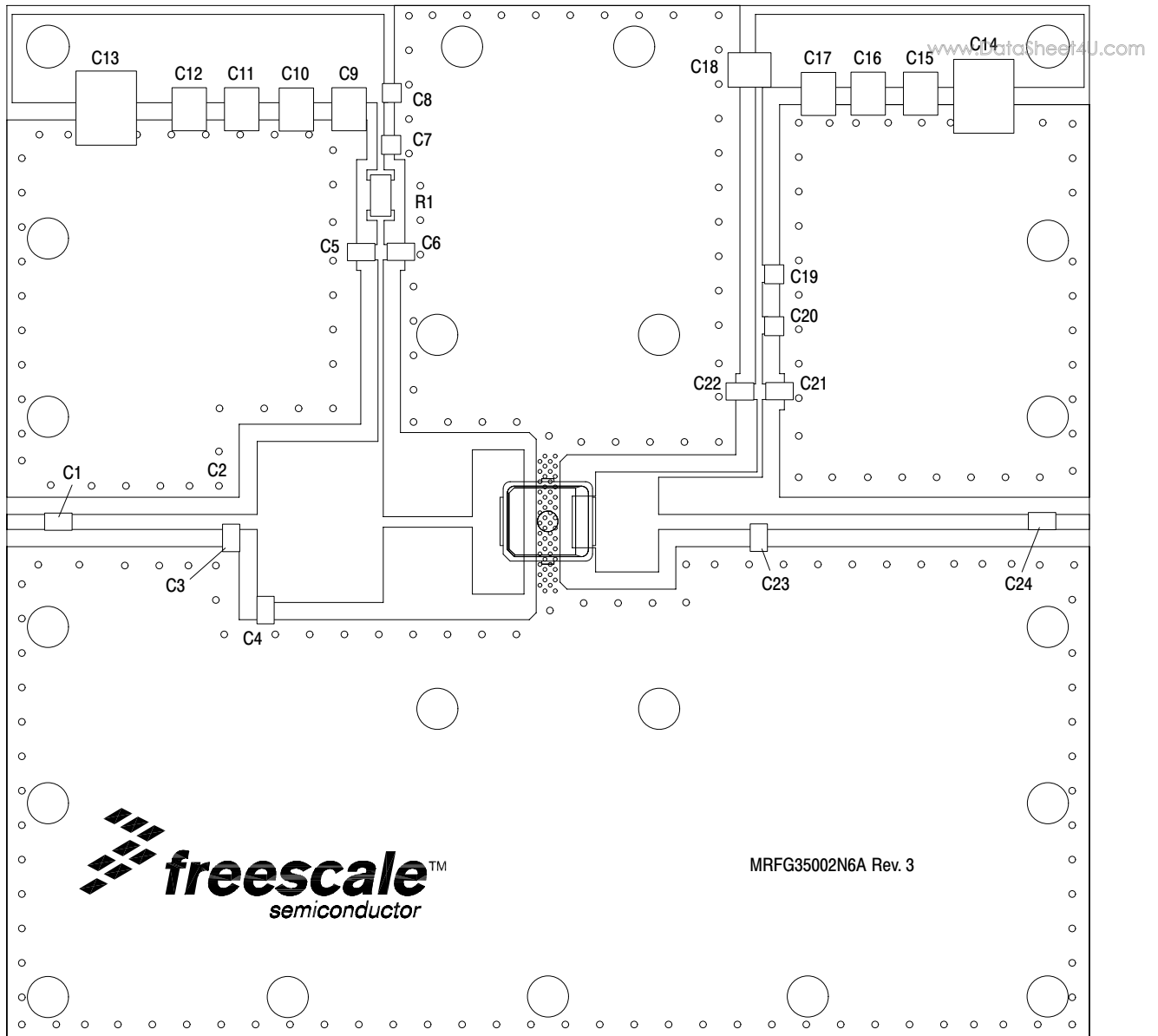


Figure 2. MRFG35002N6A Test Circuit Component Layout

TYPICAL CHARACTERISTICS

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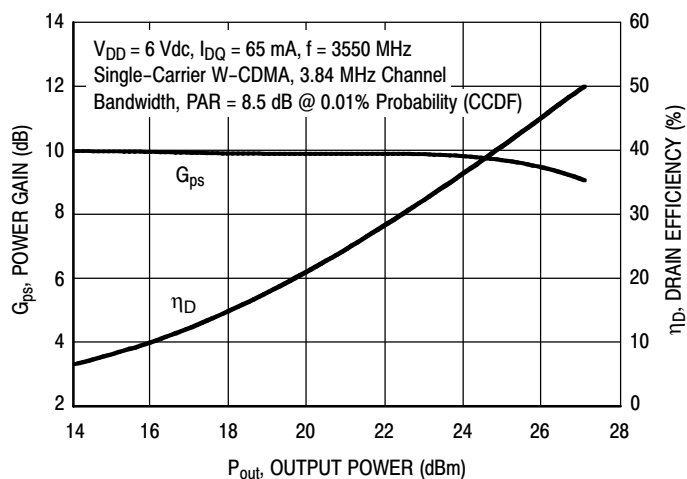


Figure 3. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power

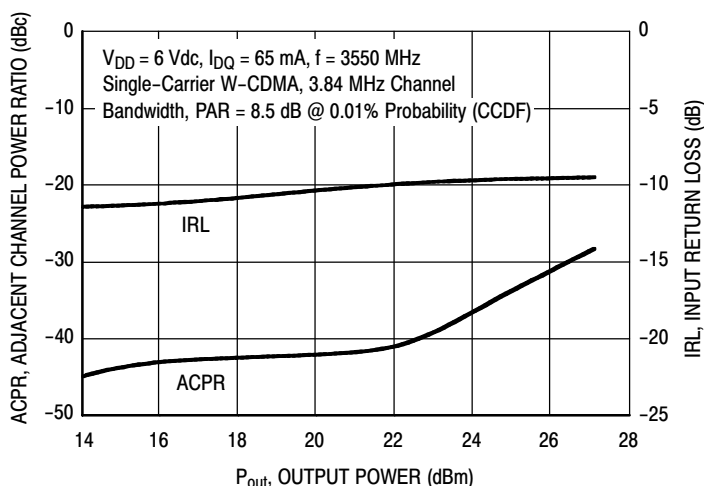


Figure 4. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power

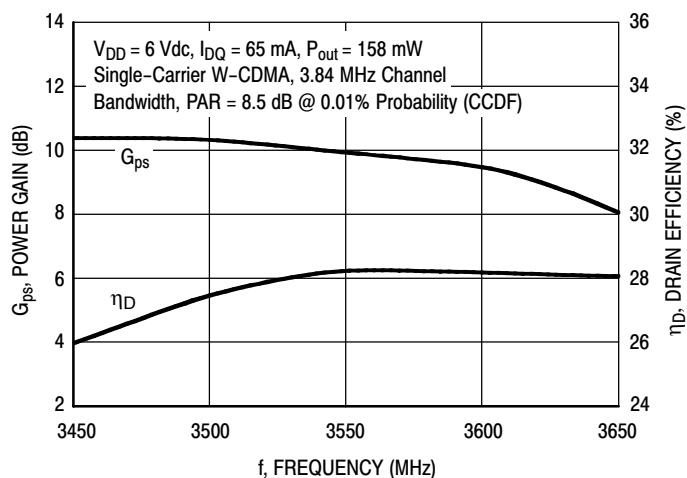


Figure 5. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Frequency

NOTE: Data is generated from the test circuit shown.

TYPICAL CHARACTERISTICS

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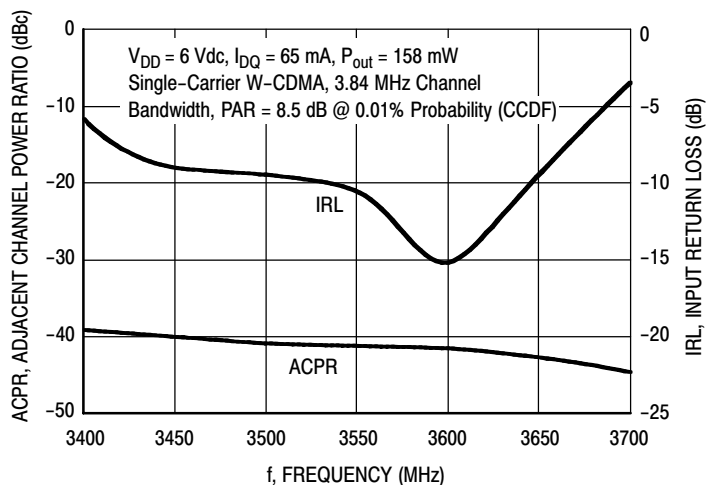


Figure 6. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Frequency

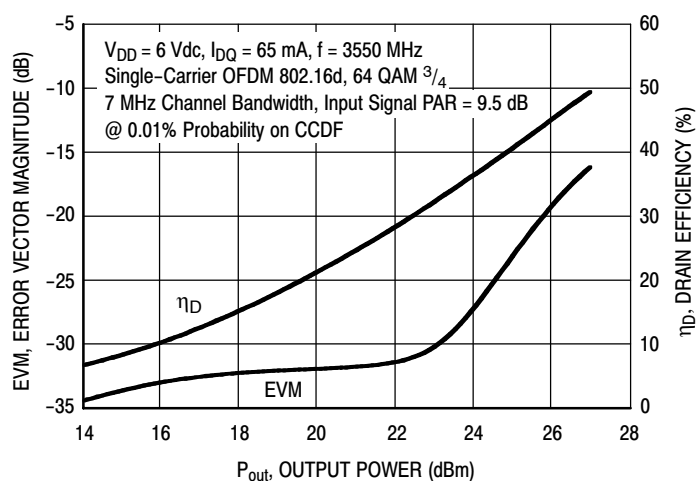


Figure 7. Single-Channel OFDM Error Vector Magnitude and Drain Efficiency versus Output Power

NOTE: Data is generated from the test circuit shown.

Table 7. Common Source S-Parameters ($V_{DD} = 6 \text{ Vdc}$, $I_{DQ} = 65 \text{ mA}$, $T_C = 25^\circ\text{C}$, 50 Ohm System)

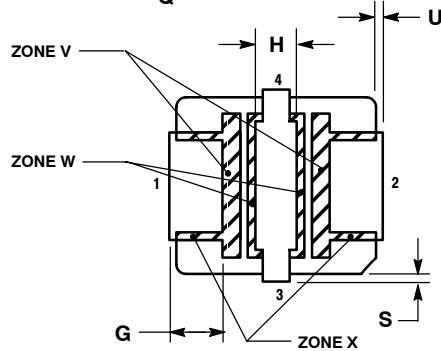
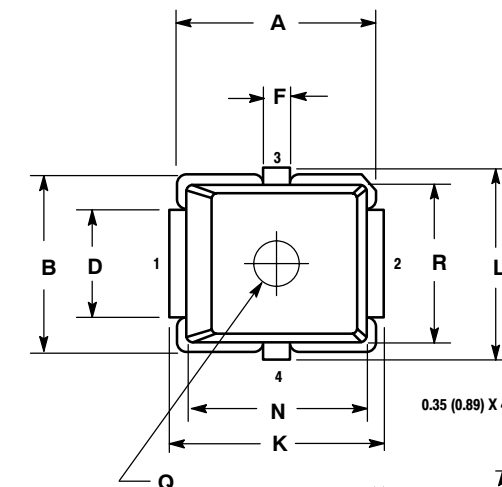
f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	S ₁₁	$\angle \phi$	S ₂₁	$\angle \phi$	S ₁₂	$\angle \phi$	S ₂₂	$\angle \phi$
500	0.910	-175.1	5.223	82.8	0.036	0.0	0.703	-176.6
550	0.911	-176.9	4.775	80.9	0.036	-1.2	0.702	-177.9
600	0.911	-178.5	4.396	79.1	0.036	-2.3	0.701	-179.1
650	0.911	-179.9	4.078	77.4	0.037	-3.3	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)

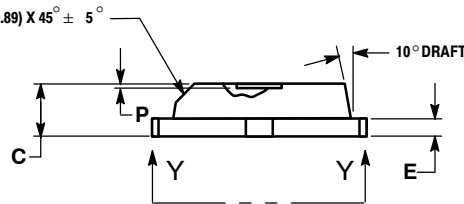
Table 7. Common Source S-Parameters ($V_{DD} = 6 \text{ Vdc}$, $I_{DQ} = 65 \text{ mA}$, $T_C = 25^\circ\text{C}$, 50 Ohm System) (continued)

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	S ₁₁	$\angle \phi$	S ₂₁	$\angle \phi$	S ₁₂	$\angle \phi$	S ₂₂	$\angle \phi$
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



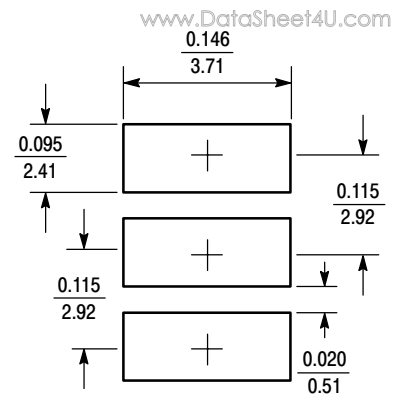
NOTES:

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
- GATE
- SOURCE
- 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

www.DataSheet4U.com

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

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