Technical Data

MBC13916/D
Rev. 0, mm/2002

General Purpose
SiGe:C RF Cascode
Amplifier

MOTOROLA
intelligence everywhere™

digital dna™

MBC13916

(Scale 2:1)

Package Information
Plastic Package
Case 1404
(SOT-343R)

Ordering Information

Device	Device Marking	Package
MBC13916T1	916	SOT-343R

The MBC13916 is a cost-effective, high isolation amplifier fabricated with Motorola's Advanced RF BiCMOS process using the SiGe:C module. It is intended to be a similar replacement for the MRFIC0916 and is housed in the smaller SOT-343R surface mount package. As with the MRFIC0916, the device is designed for general purpose RF applications, but has improved high frequency gain and noise figure. On-chip bias circuitry sets the bias point, while matching is accomplished off-chip, affording the maximum in application flexibility.

- Usable Frequency Range = 100 to 2500 MHz
- 19 dB typical gain at 900 MHz, V_{CC} = 2.7 V
- NF_{min} (Device Level) = 0.9 dB @ 900 MHz
- NF_{min} (Device Level) = 1.9 dB @ 1.9 GHz
- 2.5 dBm typical Output Power at 1.0 dB Gain Compression at 900 MHz, V_{CC} = 2.7 V
- 45 dB Typical Reverse Isolation (Device Level) at 900 MHz, V_{CC} = 2.7 V
- 4.7 mA Typ Bias Current at V_{CC} = 2.7 V
- 2.7 to 5.0 V Supply
- Industry Standard SOT-343R Package
- Available Only in Tape and Reel Packaging
- Device Weight = 0.00642 g (Typ)

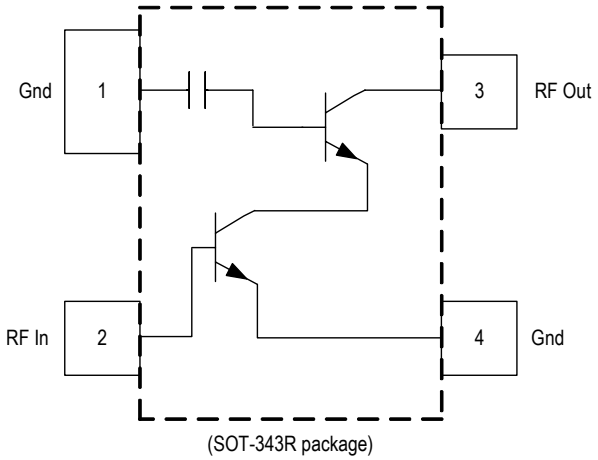

Figure 1. Functional Block Diagram

Table 1. Maximum Ratings

Ratings	Symbol	Value	Unit
Supply Voltage	V_{CC}	6.0	Vdc
RF Input Power	P_{RF}	10	dBm
Power Dissipation	P_{DIS}	100	mW
Supply Current	I_{CC}	20	mA
Thermal Resistance, Junction to Case	$R_{\theta JC}$	400	C/W
Storage Temperature Range	T_{stg}	-65 to 150	°C

NOTES: 1. Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Recommended Operating Conditions and Electrical Characteristics tables.
2. ESD (electrostatic discharge) immunity meets Human Body Model (HBM) ≤550 V and Machine Model (MM) ≤50 V. Additional ESD data available upon request.

Table 2. Recommended Operating Conditions

Characteristic	Symbol	Min	Typ	Max	Unit
RF Frequency	f_{RF}	100	-	2500	MHz
Supply Voltage	V_{CC}	2.7	-	5.0	Vdc

Table 3. Device Level Characteristics

(V_{CC} = 2.7 V, T_A = 25°C, measured in S-parameter test fixture, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Insertion Gain f = 900 MHz f = 1900 MHz	$\|S_{21}\|^2$	 - -	 16.5 10	 - -	dB
Maximum Stable Gain and/or Minimum Available Gain [Note 1] f = 900 MHz f = 1900 MHz	MSG, MAG	 - -	 24.5 14.3	 - -	dB

Table 3. Device Level Characteristics (Continued)

(V_{CC} = 2.7 V, T_A = 25°C, measured in S-parameter test fixture, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Minimum Noise Figure [Note 2]	NF_{min}				dB
f = 900 MHz		-	0.9	-	
f = 1900 MHz		-	1.9	-	
Output Third Order Intercept Point [Note 3]	OIP3				dBm
f = 900 MHz		-	16.5	-	
f = 1900 MHz		-	17	-	
Reverse Isolation	$\|S_{12}\|^2$				dB
f = 900 MHz		-	-45	-	
f = 1900 MHz		-	-31	-	

NOTES: 1. Maximum Available Gain and Maximum Stable Gain are defined by the K factor as follows:

$$MAG = \left|\frac{S_{21}}{S_{12}}\left(K \pm \sqrt{K^2 - 1}\right)\right|, \text{ if } K > 1, \; MSG = \left|\frac{S_{21}}{S_{12}}\right|, \text{ if } K < 1$$

2. Device matched for best noise figure.
3. Z_{out} matched for optimum IP3.

Table 4. Electrical Characteristics

(V_{CC} = 2.7 V, T_A = 25°C, f_{RF} = 900 MHz, Tested in Circuit Shown in Figure 2, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Small Signal Gain	S_{21}	17	19	21	dB
Noise Figure	NF	-	1.25	-	dB
Power Output at 1.0 dB Gain Compression	P_{1dB}	0	2.5	-	dBm
Output 3rd Order Intercept Point	OIP3	-	13	-	dBm
Reverse Isolation	S_{12}	-	-42	-	dB
Supply Current	I_{CC}	3.8	4.7	5.6	mA

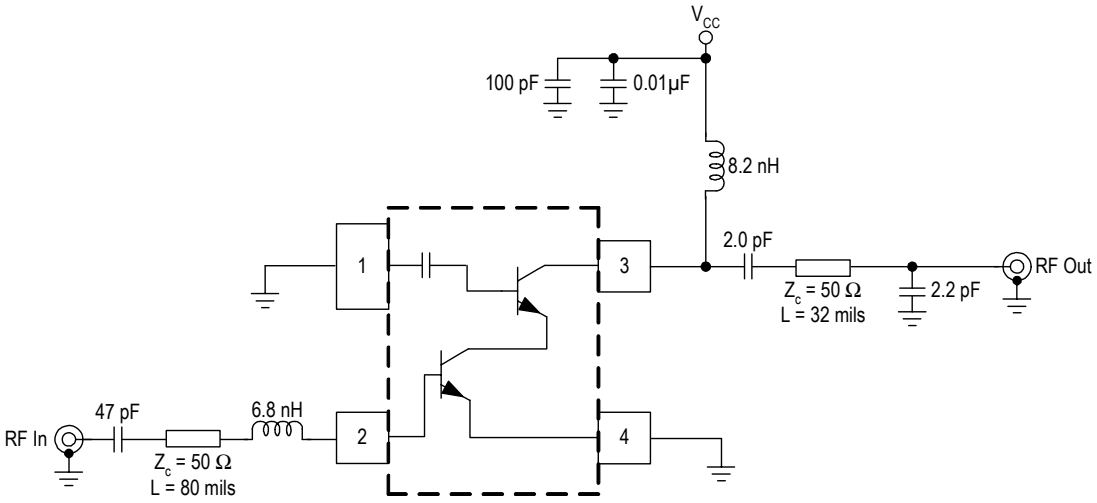

Figure 2. 900 MHz Applications Circuit Configuration

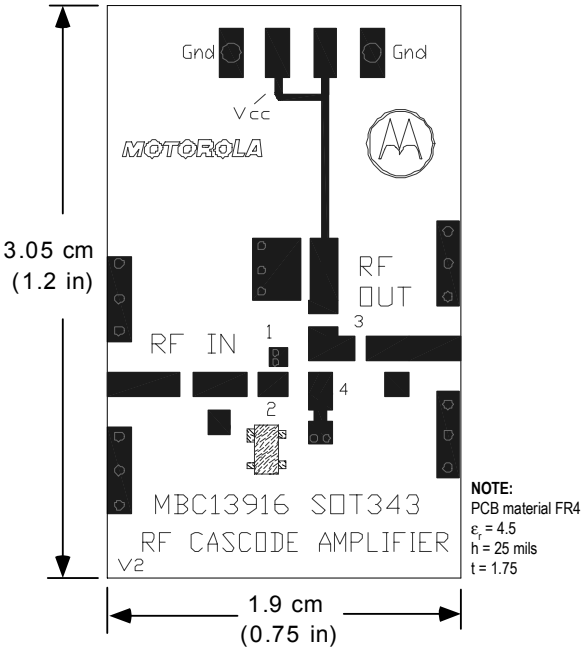

Figure 3. 900 MHz Printed Circuit Board

Table 5. Electrical Characteristics

(V_{CC} = 2.7 V, T_A = 25°C, f_{RF} = 1.9 GHz, Tested in Circuit Shown in Figure 4, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Small Signal Gain	S_{21}	9.5	11.5	13.5	dB
Noise Figure	NF	-	2.1	-	dB
Power Output at 1.0 dB Gain Compression	P_{1dB}	-	-4.0	-	dBm
Output 3rd Order Intercept Point	OIP3	-	5.5	-	dBm
Reverse Isolation	S_{12}	-	-28	-	dB
Supply Current	I_{CC}	3.8	4.7	5.6	mA

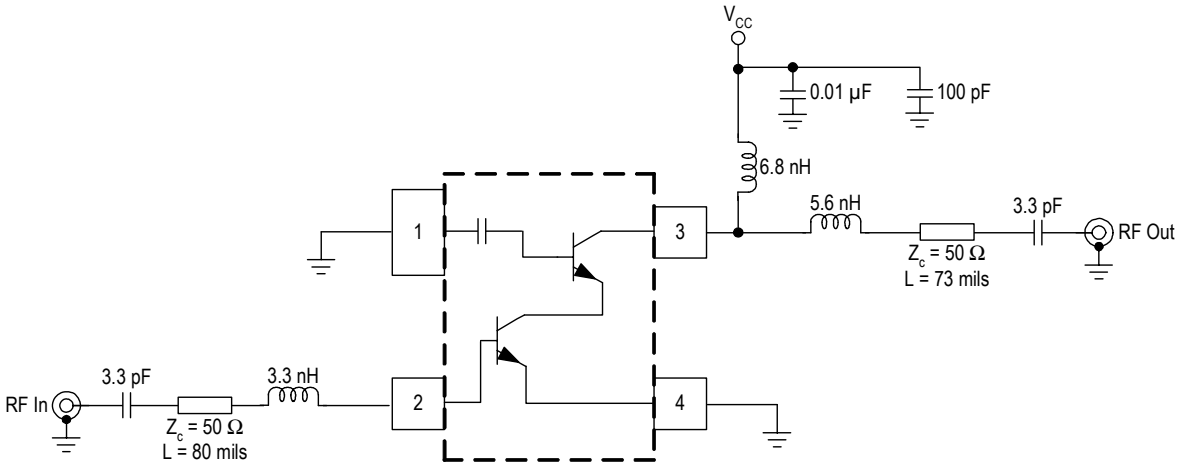

Figure 4. 1.9 GHz Application Configuration Circuit

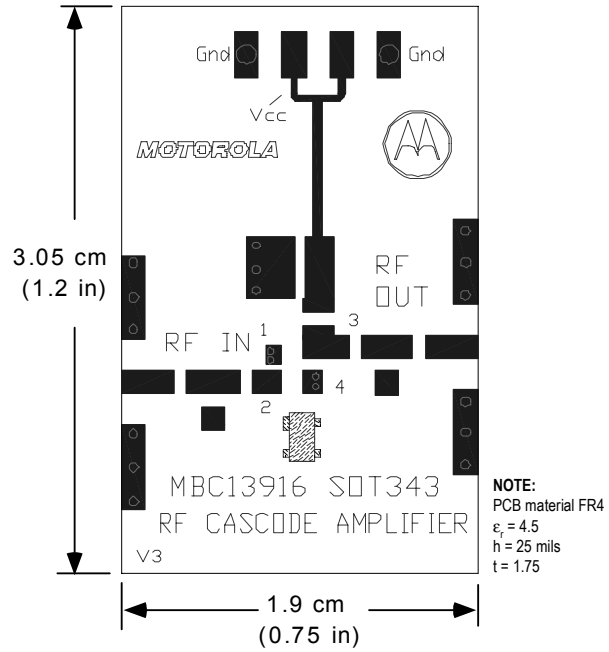

Figure 5. 1.9 GHz Printed Circuit Board

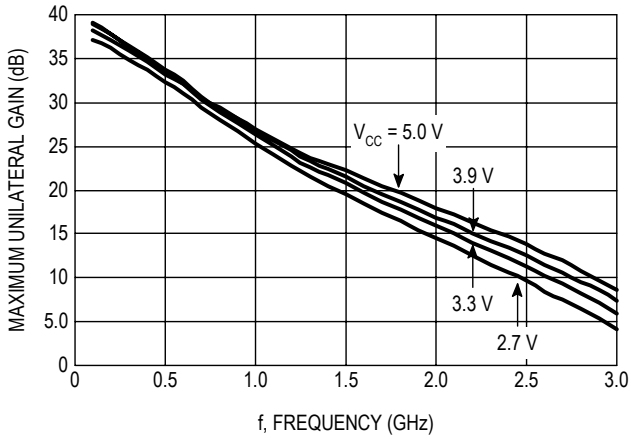

Figure 6. GUmax versus Frequency

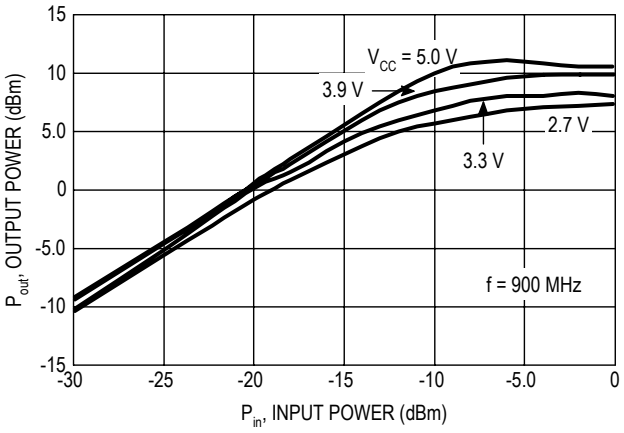

Figure 7. Output Power versus Input Power

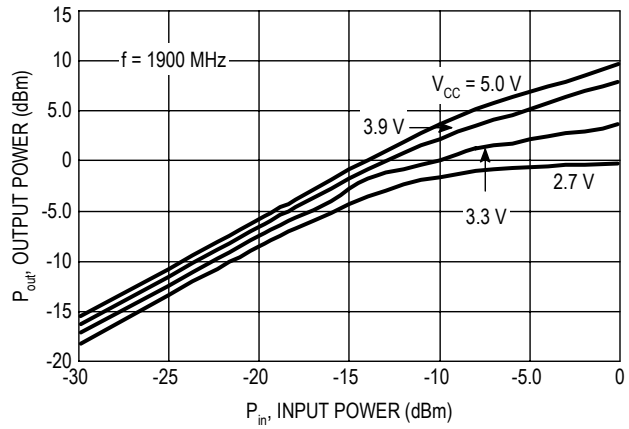

Figure 8. Output Power versus Input Power

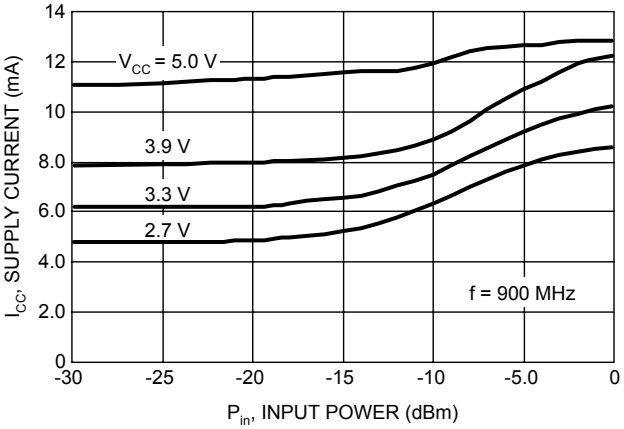

Figure 9. Supply Current versus Input Power

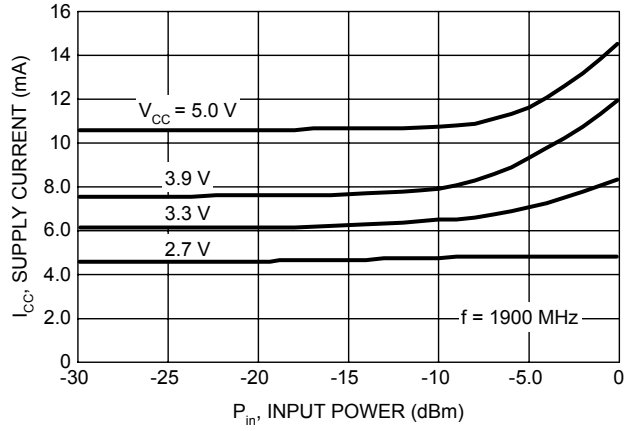

Figure 10. Supply Current versus Input Power

Table 6. Scattering Parameters

(V_{CC} = 2.7 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\lvert S_{11}\rvert$	$\angle\phi$	$\lvert S_{21}\rvert$	$\angle\phi$	$\lvert S_{12}\rvert$	$\angle\phi$	$\lvert S_{22}\rvert$	$\angle\phi$
100	0.829	-11	11.98	165	0.001	17	0.955	-4
200	0.798	-21	11.43	152	0.002	47	0.957	-7
300	0.753	-31	10.69	139	0.002	55	0.956	-11
400	0.701	-39	10.12	128	0.003	56	0.955	-14
500	0.648	-46	9.28	118	0.003	51	0.955	-18
600	0.599	-53	8.66	108	0.004	49	0.954	-22
700	0.554	-58	7.95	98	0.004	41	0.947	-26
800	0.518	-61	7.33	90	0.004	24	0.941	-30
900	0.485	-65	6.83	82	0.004	15	0.933	-34
1000	0.458	-67	6.23	74	0.004	-4	0.926	-38
1100	0.438	-69	5.78	67	0.004	-28	0.915	-43
1200	0.426	-71	5.39	60	0.005	-50	0.902	-46
1300	0.417	-72	4.97	52	0.006	-74	0.893	-51
1400	0.414	-73	4.59	46	0.008	-93	0.879	-54
1500	0.415	-74	4.31	39	0.011	-106	0.868	-58
1600	0.421	-75	3.99	32	0.014	-115	0.851	-62
1700	0.430	-76	3.66	25	0.018	-125	0.835	-66
1800	0.441	-78	3.43	19	0.022	-131	0.818	-70
1900	0.455	-80	3.16	12	0.027	-139	0.803	-73
2000	0.474	-82	2.93	5	0.033	-146	0.777	-77
2100	0.490	-85	2.70	-1	0.039	-152	0.761	-81
2200	0.504	-88	2.48	-8	0.045	-159	0.735	-85
2300	0.524	-92	2.27	-14	0.052	-163	0.707	-89
2400	0.542	-95	2.09	-21	0.059	-169	0.683	-93
2500	0.559	-98	1.90	-28	0.067	-175	0.651	-98
2600	0.572	-103	1.70	-34	0.075	180	0.624	-102
2700	0.587	-106	1.56	-40	0.083	174	0.593	-107
2800	0.603	-110	1.40	-48	0.091	169	0.562	-111
2900	0.610	-114	1.26	-55	0.098	163	0.533	-116
3000	0.613	-118	1.11	-60	0.105	160	0.501	-120

Table 7. Scattering Parameters

(V_{CC} = 3.0 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
100	0.812	-11	13.42	165	0.001	11	0.954	-3
200	0.778	-21	12.73	151	0.001	50	0.955	-7
300	0.731	-30	11.82	138	0.002	58	0.956	-11
400	0.677	-38	11.10	127	0.003	50	0.954	-14
500	0.623	-44	10.12	116	0.003	51	0.954	-18
600	0.575	-50	9.37	107	0.003	43	0.952	-22
700	0.533	-54	8.56	98	0.003	30	0.945	-26
800	0.499	-57	7.85	90	0.004	24	0.937	-30
900	0.470	-59	7.29	82	0.004	8	0.930	-34
1000	0.448	-61	6.63	74	0.003	-11	0.923	-38
1100	0.433	-63	6.14	67	0.004	-38	0.911	-42
1200	0.423	-64	5.72	60	0.005	-58	0.900	-46
1300	0.418	-65	5.27	53	0.006	-77	0.891	-50
1400	0.421	-66	4.87	47	0.008	-96	0.878	-54
1500	0.425	-67	4.56	40	0.011	-108	0.868	-58
1600	0.432	-68	4.23	34	0.014	-120	0.852	-61
1700	0.444	-70	3.89	27	0.018	-126	0.838	-65
1800	0.459	-72	3.63	21	0.022	-133	0.822	-69
1900	0.473	-74	3.35	15	0.027	-140	0.809	-73
2000	0.490	-77	3.12	8	0.033	-147	0.784	-77
2100	0.509	-80	2.87	2	0.039	-152	0.769	-80
2200	0.527	-83	2.64	-5	0.045	-159	0.744	-84
2300	0.545	-86	2.42	-11	0.051	-163	0.717	-88
2400	0.560	-90	2.23	-17	0.059	-170	0.694	-92
2500	0.579	-94	2.03	-24	0.067	-175	0.663	-97
2600	0.594	-98	1.82	-30	0.075	-180	0.637	-101
2700	0.606	-101	1.68	-36	0.083	175	0.607	-105
2800	0.620	-105	1.50	-43	0.090	169	0.576	-110
2900	0.630	-110	1.35	-50	0.097	164	0.548	-114
3000	0.636	-113	1.19	-55	0.105	160	0.516	-119

Table 8. Scattering Parameters

(V_{CC} = 3.9 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
100	0.796	-11	14.82	164	0.001	25	0.954	-3
200	0.760	-20	13.98	150	0.001	50	0.955	-7
300	0.711	-29	12.90	137	0.002	46	0.955	-11
400	0.655	-36	12.03	126	0.002	55	0.955	-14
500	0.602	-42	10.90	115	0.003	50	0.954	-18
600	0.556	-46	10.04	106	0.003	45	0.954	-22
700	0.517	-50	9.12	97	0.003	34	0.947	-26
800	0.487	-52	8.34	89	0.003	22	0.940	-30
900	0.463	-54	7.72	82	0.003	11	0.933	-34
1000	0.444	-56	7.02	74	0.003	-6	0.927	-38
1100	0.432	-57	6.49	67	0.003	-40	0.917	-42
1200	0.428	-58	6.03	61	0.005	-69	0.905	-46
1300	0.427	-59	5.55	53	0.006	-88	0.896	-50
1400	0.430	-60	5.13	48	0.008	-99	0.883	-53
1500	0.437	-61	4.81	41	0.011	-111	0.874	-57
1600	0.449	-62	4.45	35	0.014	-118	0.858	-61
1700	0.462	-64	4.09	29	0.018	-128	0.843	-64
1800	0.475	-66	3.83	23	0.022	-134	0.829	-68
1900	0.493	-69	3.53	17	0.027	-140	0.815	-72
2000	0.512	-72	3.28	10	0.032	-148	0.790	-76
2100	0.529	-75	3.03	4	0.038	-152	0.776	-79
2200	0.544	-78	2.79	-2	0.045	-159	0.752	-83
2300	0.565	-82	2.56	-8	0.051	-164	0.726	-87
2400	0.583	-85	2.37	-14	0.058	-169	0.704	-91
2500	0.599	-89	2.16	-21	0.067	-175	0.674	-96
2600	0.613	-93	1.94	-27	0.075	-179	0.648	-100
2700	0.629	-97	1.79	-32	0.083	175	0.621	-105
2800	0.643	-101	1.60	-39	0.091	170	0.589	-109
2900	0.650	-105	1.44	-46	0.098	164	0.562	-114
3000	0.653	-109	1.28	-51	0.105	160	0.531	-118

Table 9. Scattering Parameters

(V_{CC} = 5.0 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
100	0.719	-9	21.47	161	0.001	5	0.939	-3
200	0.678	-17	19.60	145	0.001	18	0.939	-7
300	0.628	-23	17.43	132	0.001	38	0.940	-10
400	0.579	-27	15.66	120	0.002	47	0.937	-14
500	0.540	-30	13.78	110	0.002	38	0.936	-18
600	0.512	-32	12.40	101	0.003	37	0.934	-22
700	0.492	-34	11.05	93	0.002	32	0.927	-26
800	0.480	-34	9.97	86	0.002	9	0.920	-30
900	0.472	-35	9.12	79	0.002	-14	0.914	-34
1000	0.470	-37	8.21	73	0.002	-54	0.908	-38
1100	0.473	-37	7.54	67	0.003	-75	0.899	-42
1200	0.478	-39	6.97	61	0.004	-90	0.890	-46
1300	0.484	-40	6.37	54	0.006	-101	0.884	-50
1400	0.496	-42	5.86	50	0.008	-114	0.875	-54
1500	0.509	-44	5.49	44	0.010	-120	0.871	-57
1600	0.521	-46	5.08	39	0.013	-128	0.858	-60
1700	0.535	-49	4.67	34	0.017	-133	0.848	-63
1800	0.552	-51	4.38	29	0.021	-139	0.838	-67
1900	0.570	-54	4.06	23	0.025	-144	0.829	-70
2000	0.587	-56	3.80	18	0.030	-150	0.807	-73
2100	0.604	-60	3.54	13	0.036	-154	0.795	-76
2200	0.621	-63	3.28	7	0.042	-160	0.772	-79
2300	0.643	-67	3.04	2	0.048	-164	0.746	-83
2400	0.658	-70	2.84	-4	0.056	-169	0.722	-87
2500	0.673	-74	2.61	-10	0.063	-175	0.687	-91
2600	0.690	-78	2.36	-16	0.071	-179	0.657	-96
2700	0.705	-82	2.19	-21	0.079	176	0.623	-101
2800	0.715	-86	1.97	-27	0.088	170	0.588	-107
2900	0.720	-91	1.78	-33	0.094	164	0.556	-113
3000	0.723	-94	1.57	-38	0.101	161	0.523	-119