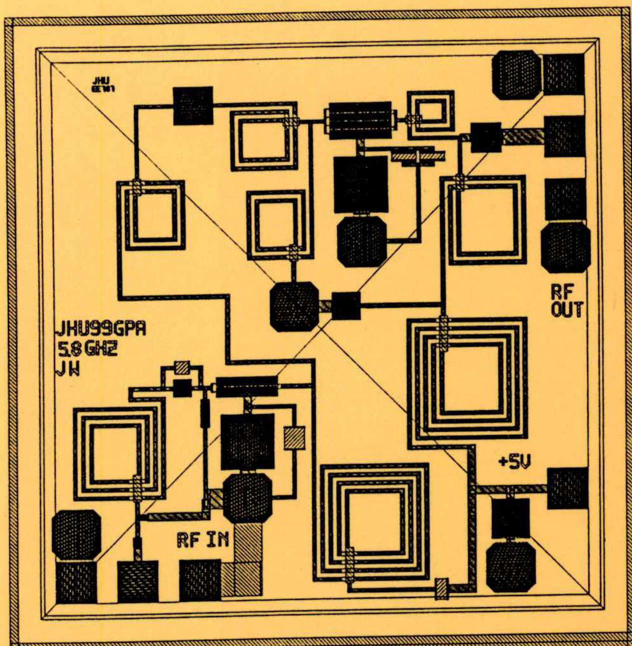
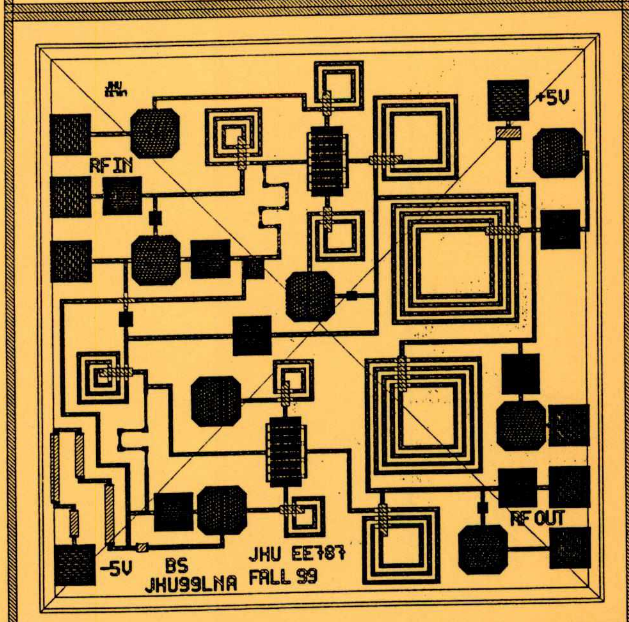
MEASURED RESULTS
MMIC DESIGN
JHU EE787
FALL 1999
STUDENT PROJECTS

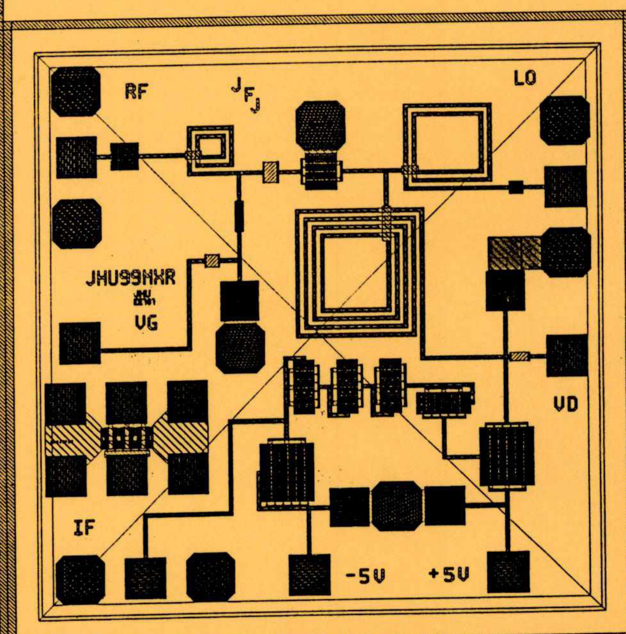
C-BAND GEN AMP JON WEINSTEIN
C-BAND LNA BRIAN SHIVERS
C-BAND MIXER JOE JIACINTO
C-BAND POWER AMP BILL WYCHULIS
C-BAND VCO HSING CHEN

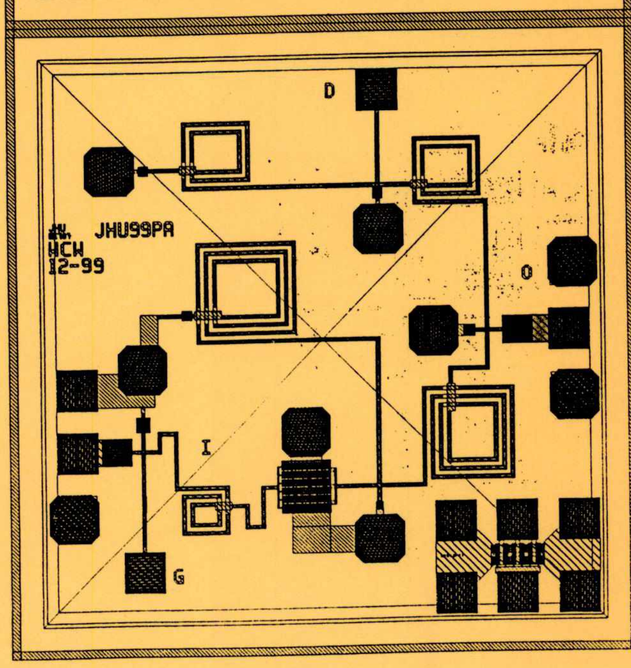
SUPPORTED BY TRIQUINT AND AGILENT EESOF

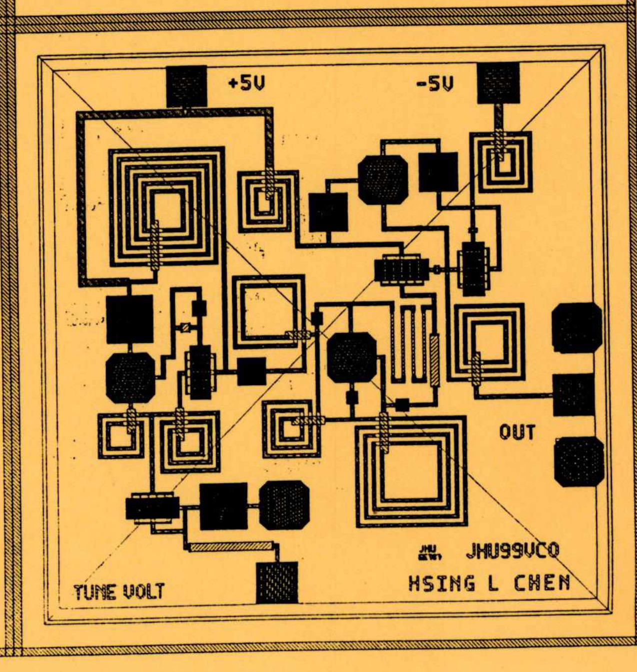
INSTRUCTORS CRAIG MOORE & JOHN PENN











JHU EE787 MMIC Design Course
MMIC Test Measurements – Summer 2000

This is to summarize the recent testing of the MMIC designs from the Fall 1999 JHU MMIC Design Course #787. All circuits were intended for a radar measurement system at 5.7-5.9 GHz and included a mixer, a voltage controlled oscillator (VCO), Low Noise Amplifier (LNA), general purpose power amplifier (GPA), and a medium power amplifier (PA). As a disclaimer to the measured s-parameter files attached, I had problems getting a good calibration with the Wiltron Vector Network Analyzer (VNA). The results are useful but the input and output match measurements could be more accurate with the correct calibration information. A spectrum analyzer was used for measuring the Mixer and the VCO designs.

Summary of Testing:

1) LNA: Brian Shiver's Amplifier biased as expected. About 4 mA on the -5V supply and the expected 40 mA on the +5V supply. There was a conditional stability problem in that the LNA wanted to oscillate around 1 GHz. We were able to make it stable by reducing the drain supply to something between 1.5V and 3V at 25 mA depending on the particular die. The amplifier had broadband gain from 1-6 GHz even though it was only designed for 5.7-5.9 GHz. Input match appeared to be better than 10dB from 5.2 GHz to 6 GHz.
Attached plots and s-parameters were taken with a particular die at 1.75V and 1.5V drain voltage.

2) GPA: Jon Weinstein's design had broad band gain from about 4-6 GHz with a single supply voltage. Easy to "probe test" with two RF probes and a single DC needle probe. Power testing at 5.8 Ghz showed better than +20 dBm output at 1 db compression and saturated power of +21.5 dBm at about 25% power added efficiency (>125 mW RF power with 5V at 103 mA of DC power). Gain was about 23-24 dB at 5.7-5.9 GHz band. Nice design!
Attached plots and s-parameters were taken with a particular die at 5V (single supply).

3) VCO: Hsing Chen's VCO worked with a tuning range of 200 MHz but was about 10% high in frequency. Output of +8 dBm was at 6.45-6.65 GHz instead of the desired 5.7-5.9 GHz. Supplies were –5V at 51 mA and +5V at 86 mA.
Two die samples were measured with nearly identical results. Second design had same oscillation response and maybe 0.25 dB more output power. Measurements of VCO #1...

Vtune	Osc (GHz)	Pout(dBm)	
-0.5V	6.42	7.8	(forward bias)
0	6.45	7.8	
0.5	6.46	8.0	
1.0	6.47	8.1	
1.5	6.53	8.0	
2.0	6.57	8.0	
2.5	6.60	8.0	
3.0	6.60	8.1	
3.5	6.62	8.0	
4.0	6.63	7.8	
5.0	6.64	7.8	

4) Mixer: Joe Jiacinto's Mixer was very difficult to probe test with 3 RF input and 4 DC needle probes on a tiny 54 mil square die. Also, we had trouble finding a decent 3rd probe and used a "damaged" GSG probe, which was now a GS probe. Seemed to work otherwise and we assumed the same 4 dB loss on each leg of RF, IF, and LO. LO and IF legs had ~3ft cable, DC bias tee, short semi-rigid and a probe head for about 4dB loss at 5.8 GHz. RF leg had ~3ft cable

plus the "suspect" damaged picoprobe and was assumed to be a comparable 4dB of loss. I thought we had used the “damaged” probe head on the LO port since that measurement was less sensitive to power level/losses. It appears that we had inadvertently used the “damaged” probe on the RF port making our conversion loss measurements suspect to larger errors. We measured about 8 dB of conversion loss with RF at 5.8 GHz ~4 dBm, LO at 5.8 GHz +10 dBm. Power supplies were -5V at 49 mA, +5V at 49 mA, VG = -0.5V at 0 mA, and VD at 0.4V. When the LO was dropped by 8 dBm to +2 dBm the conversion loss increased by 4 dB. Also, tried RF at 5.4, 5.5, 5.9, and 6.0 GHz for an IF of 100 Mhz, 200 Mhz, and 300 MHz. The mixer device wanted to be biased at 1.3V for the expected conversion gain rather than loss. When we tried to increase the VD bias to 1.3V the circuit appeared to have some kind of gain but also appeared to be oscillating. The oscillation frequency was close to the IF mixer component but seemed to be some kind of independent oscillation. Because the oscillation frequency was so low it is possible that measuring the Mixer die in some kind of package with good decoupling capacitors might improve the performance considerably. With the low VD drain voltage of 0.4V on the mixer device, it would appear that the mixer is operating in a resistive mode and would not have much gain--hence the conversion loss that we saw rather than gain.

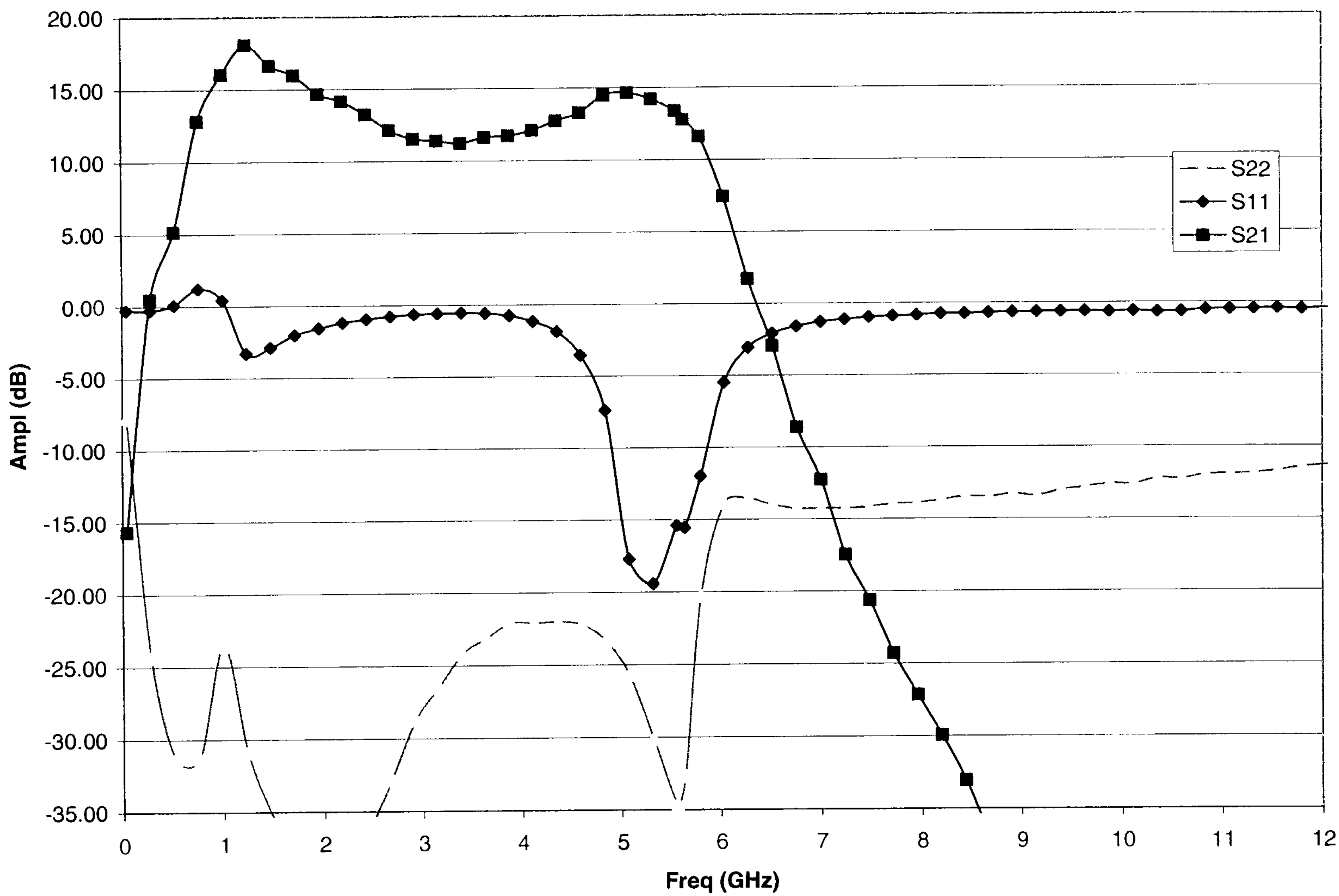
5) Power Amp: Bill Wychulis’ medium power amplifier was intended to operate at 7V on the drain and -0.8V on the gate. The current draw was a bit less than expected but when we tried to increase the drain voltage beyond 7V or increase the current by changing the gate voltage, the circuit appeared to be oscillating. Input match was narrowband around 5.7-5.9 Ghz, as was the gain. But the gain was a disappointing 3 dB and attempts to increase the drain voltage to increase the gain led to oscillations. There is some concern about decoupling of the DC supply pads from the output matching circuit, which could explain the poor gain. Simulations showed 10 dB of gain for the single stage amplifier circuit. The circuit did bias (except for the oscillations at higher drain voltages), and did have some gain and decent input and output matching at the design frequency, but the gain was low.

Thanks to all of our fall 99 MMIC Design students who showed up for the optional testing sessions. Thanks to Agilent EEsof for software support. Thanks to TriQuint for a lot of support and for the IC fabrication.

John Penn and Craig Moore (JHU EE 787 MMIC Design)

s2p files measurements:
lna15v -- Brian's LNA at 1.5V VDD (~25 ma) and -5V at 4mA
lna175v -- Brian's LNA at 1.75V VDD (~25 ma) and -5V at 4mA
gpa5v -- Jon's GPA at 5V (~115 mA) sample #1
gpa5vb -- Jon's GPA at 5V (~115 mA) sample #2
pa7v -- Bill's PA at 7V (~43 mA) and -0.8V at 0 mA sample #1
pa7v2 -- Bill's PA at 7V (~40 mA) and -0.8V at 0 mA sample #2

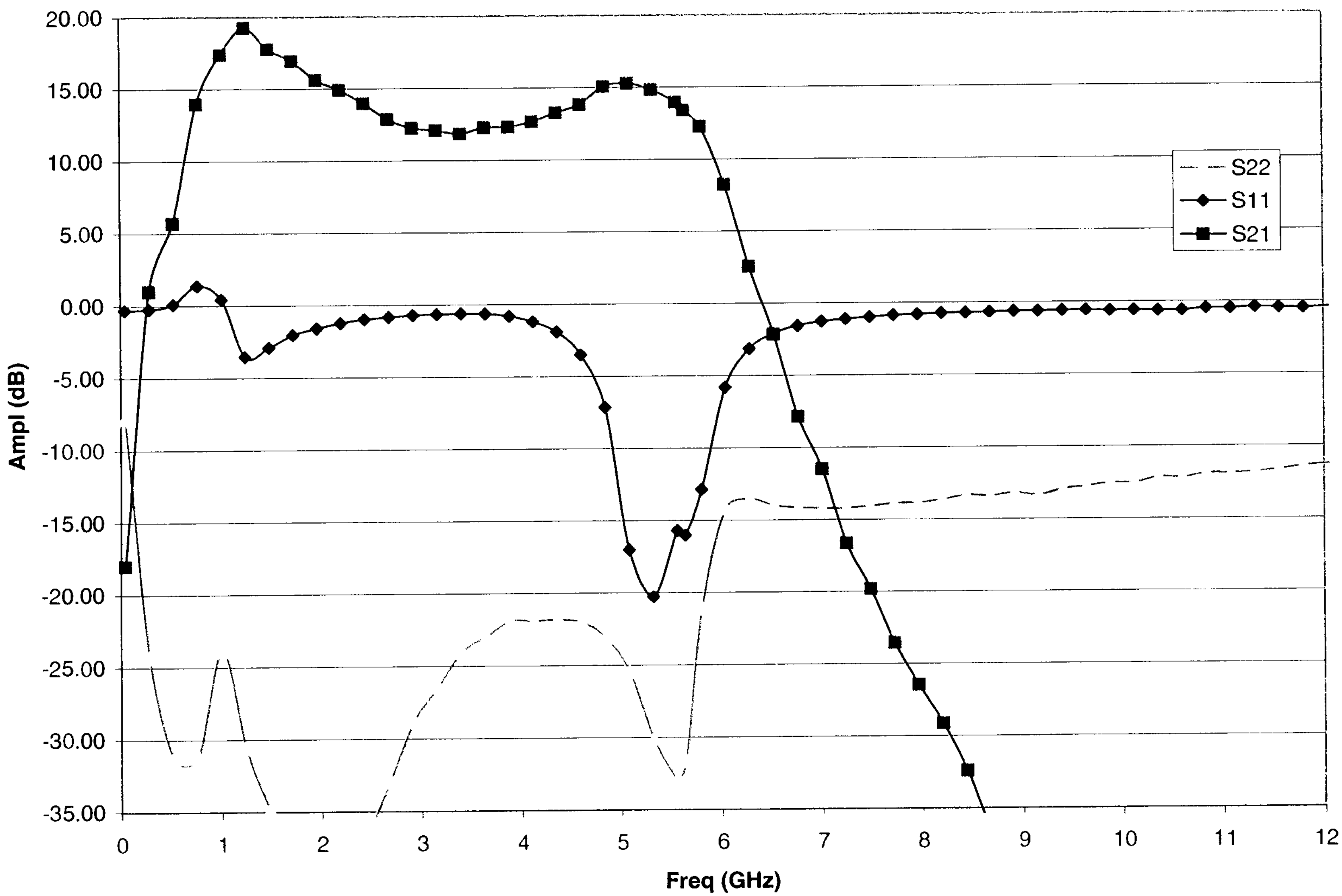
Low Noise Amp 1.5V



# GHZ S MA R 50									S11 dB	S21 dB	S12 dB	S22 dB
0.04	9.69E-01	-3.565	1.65E-01	-98.005	6.98E-03	-137.862	4.11E-01	58.061	-0.27	-15.65	-43.12	-7.72
0.28	9.70E-01	-21.74	1.06E+00	132.958	2.35E-03	41.18	6.07E-02	57.269	-0.26	0.51	-52.58	-24.34
0.52	1.01E+00	-38.817	1.81E+00	89.713	5.93E-03	26.186	2.72E-02	27.867	0.09	5.15	-44.54	-31.31
0.76	1.15E+00	-59.473	4.39E+00	82.255	1.26E-02	3.684	2.72E-02	91.727	1.21	12.85	-37.99	-31.31
1	1.05E+00	-91.136	6.35E+00	-1.571	5.27E-02	4.386	6.66E-02	75.644	0.42	16.06	-25.56	-23.53
1.24	6.84E-01	-103.24	8.04E+00	-75.891	2.65E-02	116.421	2.86E-02	100.719	-3.30	18.11	-31.54	-30.87
1.48	7.16E-01	-101.789	6.81E+00	-121.473	1.47E-02	100.27	1.73E-02	49.003	-2.90	16.66	-36.65	-35.24
1.72	7.91E-01	-111.012	6.29E+00	-149.822	1.06E-02	82.881	1.19E-02	43.041	-2.04	15.97	-39.49	-38.49
1.96	8.36E-01	-122.364	5.42E+00	-173.979	1.24E-02	61.738	8.01E-03	8.812	-1.56	14.68	-38.13	-41.93
2.2	8.72E-01	-133.705	5.11E+00	164.352	1.12E-02	34.333	6.14E-03	-64.089	-1.19	14.17	-39.02	-44.24
2.44	8.97E-01	-144.785	4.60E+00	143.282	1.11E-02	25.298	1.44E-02	-141.401	-0.94	13.26	-39.09	-36.83
2.68	9.15E-01	-155.699	4.06E+00	124.349	1.56E-02	11.475	2.29E-02	-172.151	-0.77	12.17	-36.14	-32.80
2.92	9.28E-01	-166.571	3.78E+00	106.84	1.16E-02	-18.834	3.67E-02	165.187	-0.65	11.55	-38.71	-28.71
3.16	9.34E-01	-177.24	3.72E+00	89.494	1.91E-02	-26.827	4.75E-02	147.436	-0.59	11.41	-34.38	-26.47
3.4	9.38E-01	171.766	3.64E+00	70.826	1.71E-02	-69.84	6.18E-02	127.348	-0.56	11.22	-35.34	-24.18
3.64	9.35E-01	159.937	3.82E+00	51.887	1.82E-02	-70.21	7.00E-02	105.495	-0.58	11.64	-34.80	-23.10
3.88	9.17E-01	147.277	3.86E+00	33.438	2.40E-02	-88.322	7.87E-02	94.048	-0.75	11.73	-32.40	-22.08
4.12	8.74E-01	132.619	4.03E+00	10.664	1.92E-02	-101.426	7.88E-02	88.845	-1.17	12.11	-34.33	-22.07
4.36	8.05E-01	115.118	4.34E+00	-10.354	2.23E-02	-97.088	7.95E-02	78.469	-1.88	12.75	-33.03	-21.99
4.6	6.65E-01	93.521	4.62E+00	-40.094	2.84E-02	-125.975	7.77E-02	65.709	-3.54	13.29	-30.93	-22.19
4.84	4.27E-01	63.917	5.31E+00	-70.964	3.15E-02	-149.044	6.82E-02	53.166	-7.39	14.50	-30.03	-23.32
5.08	1.30E-01	22.236	5.41E+00	-109.358	4.77E-02	-171.639	5.19E-02	42.958	-17.72	14.66	-26.43	-25.70
5.32	1.07E-01	-151.803	5.14E+00	-148.332	5.75E-02	143.92	3.13E-02	58.991	-19.41	14.22	-24.81	-30.09
5.56	1.70E-01	-170.67	4.68E+00	170.237	5.41E-02	114.805	1.86E-02	118.184	-15.39	13.40	-25.34	-34.61
5.64	1.67E-01	-163.853	4.36E+00	154.817	6.97E-02	97.629	2.32E-02	152.079	-15.55	12.79	-23.14	-32.69
5.8	2.52E-01	-139.32	3.81E+00	122.248	8.48E-02	67.975	9.71E-02	160.493	-11.97	11.62	-21.43	-20.26
6.04	5.31E-01	-153.619	2.36E+00	76.857	5.36E-02	-9.404	2.03E-01	113.879	-5.50	7.46	-25.42	-13.85
6.28	7.02E-01	-174.037	1.22E+00	42.927	2.11E-02	-30.78	2.10E-01	81.959	-3.07	1.73	-33.51	-13.56
6.52	7.86E-01	170.161	7.12E-01	22.701	1.67E-02	-54.876	2.00E-01	67.676	-2.09	-2.95	-35.55	-13.98
6.76	8.32E-01	157.995	3.71E-01	4.572	6.00E-03	-65.642	1.94E-01	58.405	-1.60	-8.61	-44.44	-14.24
7	8.60E-01	148.264	2.44E-01	-9.908	4.61E-03	-74.548	1.94E-01	50.344	-1.31	-12.25	-46.73	-14.24
7.24	8.77E-01	139.627	1.34E-01	-22.419	3.24E-03	-62.572	1.94E-01	45.316	-1.14	-17.46	-49.79	-14.24
7.48	8.93E-01	131.911	9.30E-02	-32.248	1.42E-03	-105.284	1.96E-01	38.061	-0.98	-20.63	-56.95	-14.15
7.72	9.00E-01	125.355	6.12E-02	-41.03	1.78E-03	-57.518	2.01E-01	32.316	-0.92	-24.26	-54.99	-13.94
7.96	9.07E-01	118.874	4.39E-02	-50.131	1.50E-03	-94.556	2.02E-01	29.117	-0.85	-27.15	-56.48	-13.89
8.2	9.16E-01	113.056	3.18E-02	-57.801	5.66E-04	-77.703	2.07E-01	24.171	-0.76	-29.95	-64.94	-13.68
8.44	9.17E-01	107.604	2.22E-02	-64.897	1.53E-03	-56.135	2.13E-01	19.261	-0.75	-33.07	-56.31	-13.43
8.68	9.23E-01	101.885	1.43E-02	-73.581	3.37E-04	100.509	2.12E-01	16.619	-0.70	-36.89	-69.45	-13.47
8.92	9.27E-01	96.776	1.08E-02	-71.84	1.14E-03	-143.217	2.17E-01	12.076	-0.66	-39.33	-58.86	-13.27
9.16	9.28E-01	91.753	8.14E-03	-92.102	9.32E-04	-163.335	2.14E-01	8.333	-0.65	-41.79	-60.61	-13.39
9.4	9.31E-01	86.603	4.81E-03	-94.313	7.72E-04	-70.689	2.24E-01	4.238	-0.62	-46.36	-62.25	-13.00
9.64	9.32E-01	82.122	5.01E-03	-115.117	8.05E-04	111.574	2.29E-01	0.558	-0.61	-46.00	-61.88	-12.80
9.88	9.28E-01	77.558	4.37E-03	-104.239	1.70E-03	-110.229	2.35E-01	-2.924	-0.65	-47.19	-55.39	-12.58
10.12	9.33E-01	72.788	6.14E-03	-117.063	1.92E-03	-176.784	2.34E-01	-6.758	-0.60	-44.24	-54.33	-12.62
10.36	9.27E-01	68.673	6.13E-03	-159.832	1.79E-03	-162.59	2.45E-01	-10.675	-0.66	-44.25	-54.94	-12.22
10.6	9.28E-01	64.472	3.09E-03	171.26	4.56E-04	143.275	2.44E-01	-13.698	-0.65	-50.20	-66.82	-12.25
10.84	9.43E-01	60.464	3.77E-03	125.148	5.90E-04	-43.888	2.52E-01	-17.824	-0.51	-48.47	-64.58	-11.97
11.08	9.45E-01	55.982	3.04E-03	88.526	4.71E-04	-114.293	2.53E-01	-21.072	-0.49	-50.34	-66.54	-11.94
11.32	9.47E-01	51.22	3.30E-03	65.877	7.39E-04	145.41	2.55E-01	-23.762	-0.47	-49.63	-62.63	-11.87
11.56	9.51E-01	47.486	2.64E-03	12.945	5.41E-04	98.614	2.60E-01	-27.719	-0.44	-51.57	-65.34	-11.70
11.8	9.44E-01	42.783	1.72E-03	54.373	9.03E-04	-169.642	2.67E-01	-30.846	-0.50	-55.29	-60.89	-11.47
12.04	9.50E-01	38.643	2.48E-03	-11.737	1.38E-03	150.901	2.71E-01	-33.925	-0.45	-52.11	-57.20	-11.34
12.28	9.45E-01	34.714	1.39E-03	139.54	7.65E-04	-109.204	2.75E-01	-37.006	-0.49	-57.14	-62.33	-11.21
12.52	9.45E-01	30.474	9.71E-04	-123.623	2.18E-03	115.269	2.79E-01	-40.54	-0.49	-60.26	-53.23	-11.09
12.76	9.56E-01	26.567	5.28E-04	74.403	8.30E-04	168.636	2.92E-01	-44.401	-0.39	-65.55	-61.62	-10.69
13	9.44E-01	22.755	4.61E-04	107.583	1.31E-03	105.954	2.92E-01	-46.997	-0.50	-66.73	-57.65	-10.69
13.24	9.41E-01	18.404	6.31E-04	82.281	7.74E-04	46.379	2.95E-01	-50.974	-0.53	-64.00	-62.23	-10.60
13.48	9.51E-01	15.057	3.27E-03	105.076	1.12E-03	54.818	2.92E-01	-53.344	-0.44	-49.71	-59.02	-10.69
13.72	9.41E-01	10.891	1.60E-03	116.919	1.37E-03	142.813	3.02E-01	-57.668	-0.53	-55.92	-57.27	-10.40
13.96	9.54E-01	6.812	1.50E-03	-34.294	4.10E-04	71.088	3.11E-01	-61.091	-0.41	-56.48	-67.74	-10.14
14.2	9.52E-01	3.564	3.03E-03	154.05	8.63E-04	103.991	3.19E-01	-64.325	-0.43	-50.37	-61.28	-9.92
14.44	9.48E-01	-0.743	8.34E-04	4.104	1.75E-03	-96.132	3.10E-01	-67.031	-0.46	-61.58	-55.14	-10.17
14.68	9.56E-01	-5.021	2.90E-03	-106.752	2.79E-03	-164.215	3.27E-01	-71.412	-0.39	-50.75	-51.09	-9.71
14.92	9.56E-01	-7.827	7.74E-04	66.272	1.78E-03	-7.673	3.16E-01	-72.16	-0.39	-62.23	-54.99	-10.01
15.16	9.42E-01	-12.56	4.25E-03	127.549	4.81E-03	112.536	3.21E-01	-76.035	-0.52	-47.43	-46.36	-9.87
15.4	9.61E-01	-16.245	2.77E-03	172.092	2.54E-03	81.619	3.30E-01	-79.624	-0.35	-51.15	-51.90	-9.63
15.64	9.53E-01	-19.554	1.35E-03	35.36	9.07E-04	-23.371	3.38E-01	-83.064	-0.42	-57.39	-60.85	-9.42

15.88	9.57E-01	-23.683	4.19E-03	-133.008	2.39E-03	-100.601	3.33E-01	-83.971	-0.38	-47.56	-52.43	-9.55
16.12	9.64E-01	-27.355	2.13E-03	-103.209	1.52E-03	179.253	3.47E-01	-89.952	-0.32	-53.43	-56.36	-9.19
16.36	9.61E-01	-30.966	8.03E-03	177.315	2.78E-03	-131.864	3.47E-01	-91.144	-0.35	-41.91	-51.12	-9.19
16.6	9.69E-01	-34.251	2.85E-03	17.891	9.11E-04	81.769	3.48E-01	-95.925	-0.27	-50.90	-60.81	-9.17
16.84	9.62E-01	-38.269	2.80E-03	-143.517	2.77E-03	-136.471	3.58E-01	-98.735	-0.34	-51.06	-51.15	-8.92
17.08	9.65E-01	-42.173	4.57E-03	102.274	7.13E-04	47.078	3.61E-01	-101.21	-0.31	-46.80	-62.94	-8.85
17.32	9.70E-01	-45.421	4.90E-03	99.544	1.41E-03	65.581	3.62E-01	-105.131	-0.26	-46.20	-57.02	-8.83
17.56	9.59E-01	-49.366	1.60E-03	-149.616	2.43E-03	-13.327	4.31E-01	-107.476	-0.36	-55.92	-52.29	-7.31
17.8	9.79E-01	-53.561	3.70E-03	102.724	3.55E-04	-177.045	3.84E-01	-110.518	-0.18	-48.64	-69.00	-8.31
18.04	9.70E-01	-56.26	2.85E-03	92.534	7.15E-04	93.766	3.95E-01	-117.427	-0.26	-50.90	-62.91	-8.07
18.28	9.79E-01	-60.543	3.11E-03	135.852	2.28E-03	164.442	4.14E-01	-119.013	-0.18	-50.14	-52.84	-7.66
18.52	9.82E-01	-64.075	9.54E-03	105.711	1.46E-03	-65.128	4.06E-01	-120.244	-0.16	-40.41	-56.71	-7.83
18.76	9.86E-01	-67.358	4.06E-03	18.867	5.23E-03	51.603	3.91E-01	-122.381	-0.12	-47.83	-45.63	-8.16
19	9.83E-01	-71.428	7.72E-03	140.865	3.98E-03	-37.746	3.48E-01	-129.675	-0.15	-42.25	-48.00	-9.17
19.24	9.99E-01	-75.877	7.55E-03	30.357	3.76E-03	-174.412	3.61E-01	-132.366	-0.01	-42.44	-48.50	-8.85
19.48	9.87E-01	-78.365	4.79E-03	31.023	3.76E-03	71.842	3.80E-01	-135.449	-0.11	-46.39	-48.50	-8.40
19.72	9.93E-01	-83.093	6.40E-03	-58.726	3.18E-03	-168.559	3.65E-01	-136.185	-0.06	-43.88	-49.95	-8.75
19.96	1.02E+00	-86.053	5.93E-03	29.17	5.21E-03	61.379	3.71E-01	-140.981	0.17	-44.54	-45.66	-8.61

Low Noise Amp 1.75V

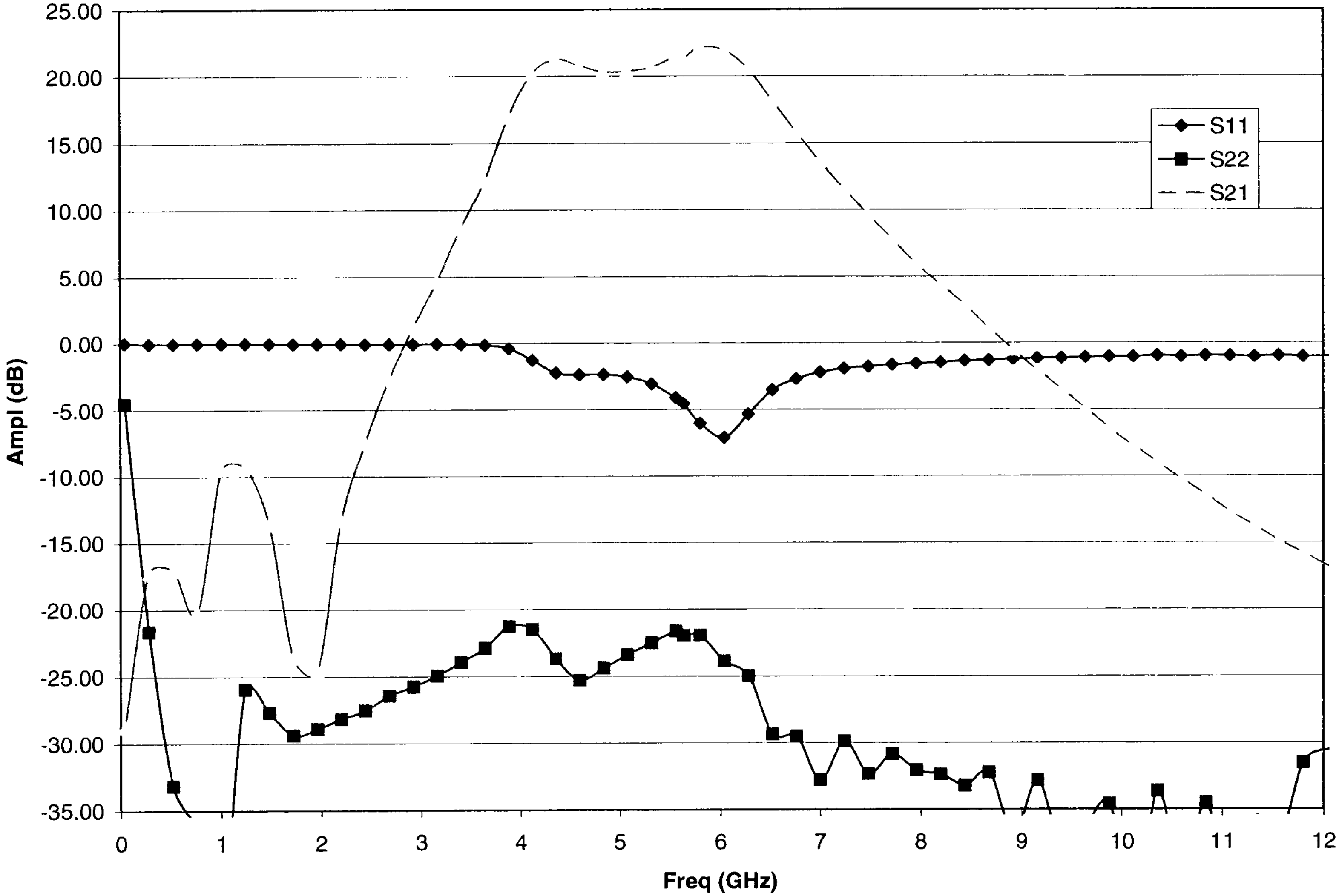


LNA175V

# GHZ S MA R 50									S11 dB	S21 dB	S12 dB	S22 dB
0.04	9.66E-01	-3.47	1.26E-01	-41.496	8.24E-03	-2.88	4.09E-01	57.939	-0.30	-17.99	-41.68	-7.77
0.28	9.71E-01	-21.933	1.12E+00	132.283	2.70E-03	47.007	6.07E-02	57.2	-0.26	0.98	-51.37	-24.34
0.52	1.01E+00	-38.786	1.93E+00	90.01	5.69E-03	29.662	2.73E-02	28.076	0.09	5.71	-44.90	-31.28
0.76	1.17E+00	-58.7	4.99E+00	89.42	1.15E-02	5.503	2.75E-02	92.594	1.36	13.96	-38.79	-31.21
1	1.05E+00	-92.758	7.40E+00	-1.929	4.64E-02	12.077	6.41E-02	80.731	0.42	17.38	-26.67	-23.86
1.24	6.66E-01	-102.565	9.20E+00	-78.572	2.44E-02	113.488	2.98E-02	97.991	-3.53	19.28	-32.25	-30.52
1.48	7.14E-01	-101.558	7.75E+00	-122.611	1.34E-02	98.349	1.81E-02	50.529	-2.93	17.79	-37.46	-34.85
1.72	7.89E-01	-111.272	7.04E+00	-150.457	9.38E-03	85.747	1.25E-02	45.799	-2.06	16.95	-40.56	-38.06
1.96	8.32E-01	-122.677	6.04E+00	-174.501	1.10E-02	65.145	8.51E-03	13.965	-1.60	15.62	-39.17	-41.40
2.2	8.66E-01	-134.026	5.58E+00	163.731	1.03E-02	39.454	6.17E-03	-54.872	-1.25	14.93	-39.74	-44.19
2.44	8.93E-01	-145.179	5.01E+00	142.671	1.23E-02	37.64	1.37E-02	-138.643	-0.98	14.00	-38.20	-37.27
2.68	9.09E-01	-156.104	4.41E+00	123.697	1.37E-02	8.744	2.25E-02	-167.933	-0.83	12.89	-37.27	-32.96
2.92	9.21E-01	-166.99	4.10E+00	106.229	1.24E-02	-7.76	3.63E-02	168.483	-0.71	12.26	-38.13	-28.80
3.16	9.27E-01	-177.519	4.02E+00	89.081	1.84E-02	-21.841	4.76E-02	150.352	-0.66	12.08	-34.70	-26.45
3.4	9.31E-01	171.578	3.91E+00	70.364	1.71E-02	-69.713	6.29E-02	129.222	-0.62	11.84	-35.34	-24.03
3.64	9.29E-01	159.733	4.11E+00	51.726	1.64E-02	-66.619	7.11E-02	106.934	-0.64	12.28	-35.70	-22.96
3.88	9.11E-01	147.231	4.13E+00	33.364	2.20E-02	-86.325	8.02E-02	95.264	-0.81	12.32	-33.15	-21.92
4.12	8.70E-01	132.761	4.30E+00	10.789	1.74E-02	-98.224	8.03E-02	89.831	-1.21	12.67	-35.19	-21.91
4.36	8.02E-01	115.572	4.61E+00	-9.929	2.16E-02	-95.664	8.10E-02	79.324	-1.92	13.27	-33.31	-21.83
4.6	6.68E-01	94.4	4.92E+00	-39.285	2.74E-02	-125.86	7.95E-02	66.52	-3.50	13.84	-31.24	-21.99
4.84	4.39E-01	65.35	5.68E+00	-69.578	3.02E-02	-146.058	7.02E-02	53.856	-7.15	15.09	-30.40	-23.07
5.08	1.41E-01	26.787	5.81E+00	-107.92	4.63E-02	-169.444	5.35E-02	43.223	-17.02	15.28	-26.69	-25.43
5.32	9.69E-02	-152.906	5.52E+00	-146.817	5.42E-02	147.761	3.13E-02	60.138	-20.27	14.84	-25.32	-30.09
5.56	1.64E-01	-175.156	5.00E+00	172.085	5.21E-02	117.702	2.25E-02	113.458	-15.70	13.98	-25.66	-32.96
5.64	1.58E-01	-169.144	4.68E+00	157.227	6.64E-02	100.381	2.60E-02	138.54	-16.03	13.40	-23.56	-31.70
5.8	2.27E-01	-139.738	4.11E+00	124.903	7.78E-02	72.072	8.81E-02	156.492	-12.88	12.28	-22.18	-21.10
6.04	5.12E-01	-151.913	2.58E+00	79.015	5.21E-02	-2.383	1.95E-01	116.008	-5.81	8.23	-25.66	-14.20
6.28	6.95E-01	-173.215	1.34E+00	44.168	2.21E-02	-26.648	2.10E-01	83.445	-3.16	2.54	-33.11	-13.56
6.52	7.84E-01	170.465	7.80E-01	23.516	1.70E-02	-55.406	2.00E-01	68.645	-2.11	-2.16	-35.39	-13.98
6.76	8.33E-01	157.888	4.05E-01	5.09	7.70E-03	-69.942	1.96E-01	59.283	-1.59	-7.85	-42.27	-14.15
7	8.60E-01	147.846	2.66E-01	-9.047	3.26E-03	-55.877	1.95E-01	51.023	-1.31	-11.50	-49.74	-14.20
7.24	8.78E-01	139.149	1.47E-01	-21.977	2.77E-03	-86.775	1.95E-01	45.998	-1.13	-16.65	-51.15	-14.20
7.48	8.92E-01	131.219	1.02E-01	-31.983	2.41E-03	-90.393	1.98E-01	38.75	-0.99	-19.83	-52.36	-14.07
7.72	9.02E-01	124.736	6.63E-02	-40.237	7.69E-04	-64.851	2.02E-01	32.901	-0.90	-23.57	-62.28	-13.89
7.96	9.08E-01	118.158	4.75E-02	-47.845	1.28E-03	-146.052	2.03E-01	29.798	-0.84	-26.47	-57.86	-13.85
8.2	9.17E-01	112.297	3.49E-02	-55.7	1.55E-03	-64.757	2.08E-01	24.875	-0.75	-29.14	-56.19	-13.64
8.44	9.18E-01	106.596	2.39E-02	-61.074	7.23E-04	-175.095	2.15E-01	19.91	-0.74	-32.43	-62.82	-13.35
8.68	9.23E-01	100.909	1.50E-02	-59.473	5.58E-04	11.929	2.14E-01	17.35	-0.70	-36.48	-65.07	-13.39
8.92	9.28E-01	95.616	1.30E-02	-75.128	2.00E-03	-39.998	2.19E-01	12.789	-0.65	-37.72	-53.98	-13.19
9.16	9.28E-01	90.673	1.02E-02	-92.403	8.52E-04	-75.756	2.15E-01	9.078	-0.65	-39.83	-61.39	-13.35
9.4	9.32E-01	85.48	5.52E-03	-96.172	6.49E-04	-151.326	2.25E-01	5.01	-0.61	-45.16	-63.76	-12.96
9.64	9.34E-01	80.994	6.06E-03	-106.915	1.37E-03	-83.769	2.30E-01	1.365	-0.59	-44.35	-57.27	-12.77
9.88	9.30E-01	76.272	4.93E-03	-97.686	1.56E-03	-132.489	2.36E-01	-2.204	-0.63	-46.14	-56.14	-12.54
10.12	9.32E-01	71.386	4.51E-03	-111.275	1.48E-03	-174.532	2.36E-01	-5.924	-0.61	-46.92	-56.59	-12.54
10.36	9.28E-01	67.098	7.41E-03	-154.946	2.56E-03	-116.968	2.47E-01	-9.815	-0.65	-42.60	-51.84	-12.15
10.6	9.31E-01	63.222	3.24E-03	-164.88	1.20E-03	-114.489	2.46E-01	-12.894	-0.62	-49.79	-58.42	-12.18
10.84	9.44E-01	59.203	6.07E-03	129.351	7.31E-04	108.287	2.54E-01	-16.929	-0.50	-44.34	-62.72	-11.90
11.08	9.45E-01	54.544	1.60E-03	135.196	2.61E-04	15.325	2.54E-01	-20.125	-0.49	-55.92	-71.67	-11.90
11.32	9.52E-01	49.869	2.70E-03	51.998	8.62E-04	-2.961	2.57E-01	-22.942	-0.43	-51.37	-61.29	-11.80
11.56	9.49E-01	45.806	1.32E-03	-38.245	3.32E-04	-51.561	2.62E-01	-26.729	-0.45	-57.59	-69.58	-11.63
11.8	9.45E-01	41.083	4.17E-03	105.434	6.95E-04	-32.327	2.69E-01	-29.879	-0.49	-47.60	-63.16	-11.40
12.04	9.54E-01	37.044	4.83E-03	24.129	7.00E-04	-44.347	2.73E-01	-32.851	-0.41	-46.32	-63.10	-11.28
12.28	9.46E-01	33.156	3.49E-03	63.642	1.99E-03	85.225	2.77E-01	-35.87	-0.48	-49.14	-54.02	-11.15
12.52	9.48E-01	28.586	2.15E-03	-54.26	1.58E-03	99.061	2.82E-01	-39.585	-0.46	-53.35	-56.03	-11.00
12.76	9.52E-01	24.832	4.96E-03	-147.294	4.14E-04	-19.028	2.93E-01	-43.315	-0.43	-46.09	-67.66	-10.66
13	9.43E-01	20.91	2.86E-03	-26.189	3.26E-03	113.488	2.95E-01	-45.874	-0.51	-50.87	-49.74	-10.60
13.24	9.45E-01	16.156	4.62E-03	107.774	5.02E-04	30.416	2.96E-01	-49.912	-0.49	-46.71	-65.99	-10.57
13.48	9.55E-01	12.94	1.13E-03	-44.109	6.05E-04	121.321	2.95E-01	-52.214	-0.40	-58.94	-64.36	-10.60
13.72	9.42E-01	9.037	1.91E-03	136.629	3.45E-04	-25.463	3.05E-01	-56.563	-0.52	-54.38	-69.24	-10.31
13.96	9.50E-01	4.836	4.32E-03	-97.644	9.04E-04	-14.938	3.13E-01	-59.862	-0.45	-47.29	-60.88	-10.09
14.2	9.56E-01	1.82	5.27E-03	-148.458	1.38E-03	-23.429	3.21E-01	-63.171	-0.39	-45.56	-57.20	-9.87
14.44	9.45E-01	-2.862	1.15E-03	-170.699	7.44E-04	-114.042	3.13E-01	-65.845	-0.49	-58.79	-62.57	-10.09
14.68	9.52E-01	-6.844	2.98E-03	175.794	1.30E-03	-38.26	3.30E-01	-70.001	-0.43	-50.52	-57.72	-9.63
14.92	9.58E-01	-10.044	1.58E-03	59.668	1.54E-03	-167.386	3.19E-01	-70.99	-0.37	-56.03	-56.25	-9.92
15.16	9.48E-01	-14.714	3.15E-03	-164.82	3.17E-03	86.016	3.24E-01	-74.712	-0.46	-50.03	-49.98	-9.79
15.4	9.63E-01	-17.858	4.19E-03	128.737	2.86E-03	78.928	3.33E-01	-78.163	-0.33	-47.56	-50.87	-9.55
15.64	9.60E-01	-21.728	5.36E-03	104.102	3.01E-03	4.924	3.40E-01	-81.674	-0.35	-45.42	-50.43	-9.37

15.88	9.62E-01	-25.851	4.14E-03	118.808	1.37E-03	-47.229	3.36E-01	-82.843	-0.34	-47.66	-57.27	-9.47
16.12	9.67E-01	-29.127	6.00E-03	-172.673	1.84E-03	-100.013	3.49E-01	-88.391	-0.29	-44.44	-54.70	-9.14
16.36	9.62E-01	-33.227	1.52E-03	-176.786	2.88E-03	147.255	3.49E-01	-89.566	-0.34	-56.36	-50.81	-9.14
16.6	9.67E-01	-36.888	8.50E-03	-169.834	2.28E-03	-5.786	3.50E-01	-94.335	-0.29	-41.41	-52.84	-9.12
16.84	9.65E-01	-40.434	4.76E-03	169.085	9.73E-04	-69.491	3.60E-01	-97.161	-0.31	-46.45	-60.24	-8.87
17.08	9.62E-01	-44.496	3.44E-03	-71.912	1.74E-03	118.518	3.62E-01	-99.533	-0.34	-49.27	-55.19	-8.83
17.32	9.76E-01	-47.882	1.10E-03	139.968	1.98E-03	-125.944	3.63E-01	-103.535	-0.21	-59.17	-54.07	-8.80
17.56	9.66E-01	-51.74	5.72E-03	145.322	2.17E-03	128.919	4.34E-01	-106.239	-0.30	-44.85	-53.27	-7.25
17.8	9.80E-01	-55.202	2.73E-03	40.408	1.21E-03	-169.868	3.88E-01	-109.056	-0.18	-51.28	-58.34	-8.22
18.04	9.75E-01	-59.359	7.76E-03	-100.722	8.36E-04	-125.647	3.98E-01	-115.929	-0.22	-42.20	-61.56	-8.00
18.28	9.80E-01	-62.822	9.18E-03	84.15	7.49E-04	94.947	4.18E-01	-117.307	-0.18	-40.74	-62.51	-7.58
18.52	9.89E-01	-66.881	2.01E-03	-175.059	9.34E-04	90.37	4.08E-01	-118.628	-0.10	-53.94	-60.59	-7.79
18.76	9.88E-01	-70.044	4.58E-03	126.796	3.00E-04	-64.274	3.94E-01	-120.811	-0.10	-46.78	-70.46	-8.09
19	9.90E-01	-74.028	6.80E-03	119.495	1.59E-03	-23.934	3.52E-01	-127.588	-0.09	-43.35	-55.97	-9.07
19.24	1.01E+00	-77.565	2.18E-03	13.344	3.68E-03	11.461	3.64E-01	-130.153	0.09	-53.23	-48.68	-8.78
19.48	9.97E-01	-80.86	2.47E-03	13.516	2.38E-03	103.858	3.83E-01	-134.054	-0.03	-52.15	-52.47	-8.34
19.72	1.01E+00	-86.032	7.94E-03	65.48	1.89E-03	143.062	3.66E-01	-133.934	0.09	-42.00	-54.47	-8.73
19.96	1.03E+00	-88.637	6.26E-03	37.512	6.86E-04	-124.97	3.72E-01	-138.957	0.26	-44.07	-63.27	-8.59

General Purpose Amp

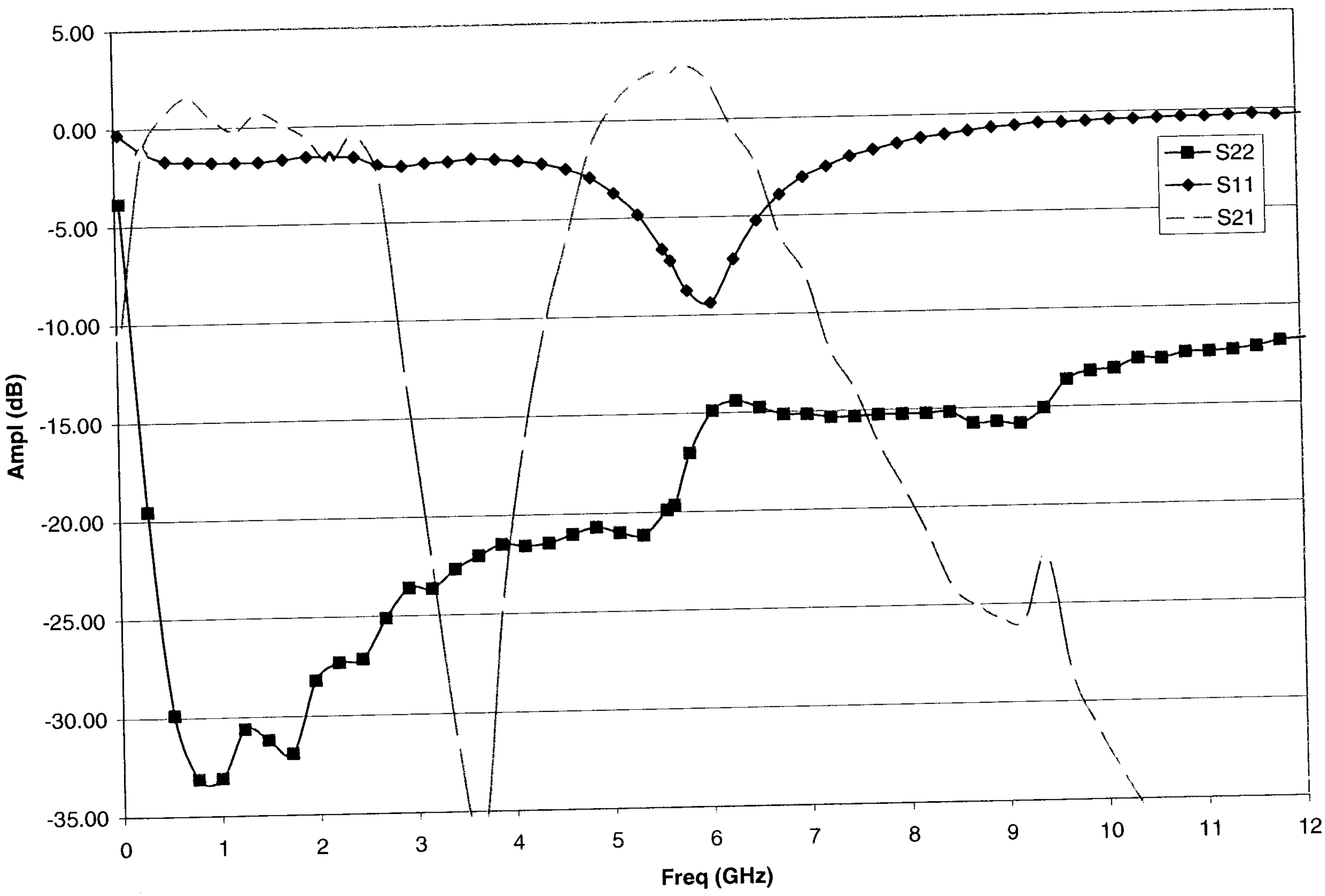


GPA5V

# GHZ S MA R 50									S11 dB	S21 dB	S12 dB	S22 dB
0.04	1.00E+00	-0.94	3.66E-02	0.213	5.28E-03	115.299	5.95E-01	53.999	0.03	-28.74	-45.56	-4.51
0.28	9.95E-01	-6.982	1.38E-01	168.751	2.21E-03	-160.978	8.29E-02	81.654	-0.04	-17.21	-53.12	-21.62
0.52	9.96E-01	-12.376	1.41E-01	100.979	1.30E-03	-35.471	2.20E-02	63.992	-0.03	-17.02	-57.69	-33.16
0.76	9.98E-01	-18.358	9.74E-02	125.947	2.50E-04	-118.105	1.53E-02	133.964	-0.01	-20.23	-72.05	-36.32
1	9.97E-01	-24.252	3.35E-01	108.041	1.66E-03	10.743	8.48E-03	58.224	-0.02	-9.50	-55.58	-41.44
1.24	9.98E-01	-30.077	3.44E-01	34.055	1.32E-03	-172.679	5.06E-02	115.784	-0.01	-9.27	-57.62	-25.92
1.48	9.96E-01	-36.011	2.09E-01	-0.441	3.52E-04	152.4	4.12E-02	75.06	-0.04	-13.61	-69.06	-27.70
1.72	9.94E-01	-42.007	6.62E-02	-18.896	9.83E-04	-137.737	3.39E-02	86.851	-0.05	-23.58	-60.15	-29.39
1.96	9.93E-01	-47.963	5.89E-02	143.365	2.21E-04	-16.562	3.59E-02	79.91	-0.06	-24.60	-73.10	-28.90
2.2	9.93E-01	-54.199	2.15E-01	131.434	6.89E-04	150.506	3.90E-02	66.689	-0.06	-13.34	-63.24	-28.18
2.44	9.90E-01	-60.391	4.21E-01	119.263	4.53E-04	-96.704	4.20E-02	55.662	-0.08	-7.51	-66.89	-27.54
2.68	9.92E-01	-66.818	7.32E-01	104.866	1.94E-04	88.963	4.78E-02	45.413	-0.07	-2.71	-74.24	-26.41
2.92	9.91E-01	-73.719	1.15E+00	89.908	9.43E-05	-76.661	5.15E-02	34.481	-0.08	1.21	-80.51	-25.77
3.16	9.92E-01	-80.632	1.70E+00	74.379	1.50E-03	117.134	5.65E-02	25.145	-0.07	4.62	-56.48	-24.95
3.4	9.90E-01	-88.528	2.69E+00	56.658	1.20E-03	164.361	6.37E-02	10.496	-0.09	8.60	-58.41	-23.92
3.64	9.83E-01	-97.301	4.06E+00	36.872	1.58E-03	-135.735	7.17E-02	-4.073	-0.15	12.18	-56.01	-22.88
3.88	9.56E-01	-107.688	7.06E+00	9.12	3.02E-03	-139.575	8.64E-02	-21.603	-0.39	16.97	-50.41	-21.27
4.12	8.63E-01	-117.764	1.02E+01	-28.964	4.68E-03	179.758	8.43E-02	-40.995	-1.28	20.18	-46.60	-21.49
4.36	7.74E-01	-122.489	1.16E+01	-73.273	5.90E-03	146.958	6.54E-02	-60.893	-2.23	21.26	-44.59	-23.69
4.6	7.61E-01	-127.306	1.10E+01	-103.825	7.24E-03	100.467	5.44E-02	-65.254	-2.37	20.82	-42.80	-25.29
4.84	7.62E-01	-136.358	1.04E+01	-129.86	5.90E-03	78.744	6.03E-02	-64.05	-2.36	20.32	-44.59	-24.40
5.08	7.46E-01	-149.369	1.05E+01	-149.145	8.38E-03	87.416	6.76E-02	-74.79	-2.55	20.38	-41.54	-23.40
5.32	7.02E-01	-167.133	1.08E+01	-171.072	1.41E-02	55.383	7.50E-02	-89.461	-3.08	20.65	-37.02	-22.50
5.56	6.23E-01	166.372	1.18E+01	164.349	1.14E-02	45.255	8.30E-02	-102.161	-4.11	21.43	-38.84	-21.62
5.64	5.91E-01	154.492	1.16E+01	153.59	1.61E-02	27.423	7.97E-02	-105.406	-4.56	21.29	-35.88	-21.98
5.8	4.99E-01	123.285	1.28E+01	135.893	2.17E-02	10.158	8.00E-02	-129.389	-6.04	22.14	-33.29	-21.94
6.04	4.41E-01	54.155	1.25E+01	102.301	1.56E-02	-26.343	6.40E-02	-151.535	-7.11	21.96	-36.13	-23.88
6.28	5.40E-01	-9.911	1.07E+01	68.384	1.53E-02	-51.568	5.63E-02	-169.285	-5.36	20.57	-36.30	-24.99
6.52	6.64E-01	-48.713	8.14E+00	42.071	1.10E-02	-71.566	3.40E-02	-164.93	-3.55	18.22	-39.18	-29.38
6.76	7.32E-01	-72.842	6.21E+00	19.214	9.91E-03	-87.09	3.33E-02	-165.5	-2.71	15.86	-40.08	-29.54
7	7.75E-01	-89.648	4.81E+00	2.191	6.57E-03	-108.463	2.29E-02	-158.419	-2.21	13.64	-43.65	-32.79
7.24	8.00E-01	-102.3	3.80E+00	-14.595	8.32E-03	-125.805	3.20E-02	-162.727	-1.93	11.59	-41.59	-29.91
7.48	8.13E-01	-112.228	3.04E+00	-28.062	4.69E-03	-135.511	2.42E-02	-164.569	-1.80	9.66	-46.58	-32.34
7.72	8.28E-01	-121.092	2.47E+00	-41.436	5.07E-03	-148.024	2.86E-02	-171.45	-1.64	7.85	-45.90	-30.87
7.96	8.35E-01	-128.599	1.99E+00	-53.83	3.45E-03	-137.036	2.49E-02	175.652	-1.56	5.98	-49.24	-32.08
8.2	8.42E-01	-135.872	1.66E+00	-65.496	3.57E-03	-157.426	2.40E-02	-171.35	-1.49	4.38	-48.94	-32.39
8.44	8.55E-01	-142.546	1.40E+00	-76.266	4.67E-03	-168.196	2.18E-02	155.787	-1.36	2.90	-46.62	-33.23
8.68	8.59E-01	-148.778	1.14E+00	-87.431	2.71E-03	155.026	2.44E-02	173.407	-1.32	1.12	-51.35	-32.24
8.92	8.66E-01	-154.92	9.46E-01	-97.221	3.51E-03	-149.638	1.44E-02	139.178	-1.25	-0.49	-49.09	-36.85
9.16	8.73E-01	-160.739	7.86E-01	-107.738	3.00E-03	-157.628	2.28E-02	135.995	-1.18	-2.09	-50.45	-32.84
9.4	8.76E-01	-166.625	6.72E-01	-115.683	1.22E-03	122.869	1.25E-02	140.481	-1.15	-3.45	-58.28	-38.03
9.64	8.82E-01	-172.374	5.68E-01	-123.718	2.94E-03	111.545	1.54E-02	96.246	-1.09	-4.92	-50.64	-36.26
9.88	8.86E-01	-177.733	4.80E-01	-131.381	6.46E-04	-109.722	1.86E-02	77.639	-1.05	-6.37	-63.79	-34.62
10.12	8.86E-01	176.635	4.12E-01	-139.547	2.95E-03	168.966	7.59E-03	105.256	-1.05	-7.71	-50.60	-42.40
10.36	8.94E-01	171.236	3.56E-01	-146.244	4.23E-03	120.022	2.07E-02	20.43	-0.97	-8.98	-47.47	-33.66
10.6	8.89E-01	165.984	3.08E-01	-152.827	2.68E-03	149.919	9.99E-03	53.076	-1.03	-10.23	-51.44	-40.01
10.84	8.95E-01	160.785	2.70E-01	-159.599	2.15E-03	150.609	1.88E-02	-2.591	-0.97	-11.36	-53.37	-34.50
11.08	8.93E-01	155.414	2.32E-01	-165.763	9.66E-04	-80.529	8.19E-03	22.304	-0.99	-12.70	-60.30	-41.73
11.32	8.85E-01	150.377	2.05E-01	-172.02	1.56E-03	144.48	1.66E-02	22.915	-1.06	-13.76	-56.12	-35.60
11.56	8.95E-01	145.116	1.81E-01	-177.042	2.70E-03	134.788	1.38E-02	-34.909	-0.97	-14.86	-51.37	-37.22
11.8	8.86E-01	140.453	1.63E-01	176.632	1.16E-03	68.201	2.65E-02	-34.194	-1.05	-15.76	-58.70	-31.53
12.04	8.86E-01	134.922	1.45E-01	172.309	1.32E-03	-83.246	2.96E-02	-37.788	-1.05	-16.77	-57.58	-30.59
12.28	8.89E-01	130.449	1.28E-01	166.304	2.03E-03	88.67	2.90E-02	-59.257	-1.02	-17.84	-53.84	-30.74
12.52	8.82E-01	125.75	1.17E-01	160.939	3.76E-03	88.844	4.06E-02	-59.667	-1.09	-18.67	-48.49	-27.84
12.76	8.76E-01	120.551	1.08E-01	155.201	3.08E-03	138.613	4.84E-02	-61.88	-1.15	-19.33	-50.24	-26.30
13	8.84E-01	116.254	9.48E-02	152.743	3.02E-03	-15.274	4.50E-02	-70.26	-1.07	-20.47	-50.41	-26.93
13.24	8.72E-01	111.522	8.39E-02	147.914	1.99E-03	107.001	6.10E-02	-77.033	-1.19	-21.53	-54.03	-24.30
13.48	8.75E-01	106.098	7.52E-02	141.176	2.79E-03	25.394	1.70E-02	-91.829	-1.16	-22.48	-51.09	-35.41
13.72	8.80E-01	102.089	7.21E-02	136.05	1.15E-03	107.613	4.65E-02	-106.927	-1.11	-22.85	-58.79	-26.64
13.96	8.63E-01	97.339	6.71E-02	130.47	4.17E-03	-106.063	5.33E-02	-114.916	-1.28	-23.46	-47.60	-25.47
14.2	8.73E-01	92.56	6.40E-02	127.843	1.70E-03	164.518	6.50E-02	-113.577	-1.18	-23.88	-55.41	-23.74
14.44	8.67E-01	88.133	5.87E-02	122.451	3.99E-03	131.555	6.56E-02	-122.689	-1.24	-24.63	-47.98	-23.66
14.68	8.57E-01	83.979	5.91E-02	118.329	3.15E-03	145.221	9.25E-02	-122.432	-1.34	-24.56	-50.03	-20.68
14.92	8.66E-01	78.614	5.06E-02	115.891	5.70E-03	-159.508	7.11E-02	-122.551	-1.25	-25.91	-44.88	-22.97
15.16	8.55E-01	75.283	4.59E-02	110.591	4.12E-03	128.364	8.78E-02	-132.654	-1.37	-26.76	-47.69	-21.13
15.4	8.53E-01	69.868	4.87E-02	103.805	2.84E-04	45.873	9.35E-02	-137.027	-1.38	-26.24	-70.94	-20.59
15.64	8.54E-01	65.725	4.04E-02	103.94	4.54E-03	93.228	1.01E-01	-138.96	-1.37	-27.88	-46.85	-19.88

15.88	8.49E-01	61.277	4.45E-02	93.577	5.09E-03	109.62	1.06E-01	-156.98	-1.42	-27.04	-45.86	-19.51
16.12	8.60E-01	56.481	4.72E-02	88.767	4.57E-03	69.899	1.28E-01	-163.142	-1.31	-26.52	-46.81	-17.84
16.36	8.48E-01	52.756	4.46E-02	82.375	7.02E-03	133.302	1.02E-01	-174.158	-1.43	-27.01	-43.07	-19.85
16.6	8.43E-01	47.711	4.44E-02	80.392	1.13E-03	-13.553	1.33E-01	-170.385	-1.49	-27.05	-58.95	-17.52
16.84	8.42E-01	43.625	3.86E-02	65.699	3.33E-03	-30.813	1.33E-01	-172.212	-1.49	-28.28	-49.55	-17.54
17.08	8.41E-01	39.94	3.79E-02	63.208	4.31E-03	54.344	1.28E-01	-173.795	-1.50	-28.43	-47.32	-17.83
17.32	8.38E-01	35.025	4.02E-02	60.373	6.47E-03	63.228	1.60E-01	-179.093	-1.54	-27.91	-43.78	-15.91
17.56	8.40E-01	31.339	4.06E-02	52.249	5.13E-03	89.073	1.74E-01	-159.731	-1.51	-27.82	-45.81	-15.20
17.8	8.35E-01	26.323	3.99E-02	41.418	3.52E-03	-29.32	1.59E-01	177.582	-1.57	-27.98	-49.07	-15.95
18.04	8.31E-01	22.757	4.70E-02	40.048	7.00E-03	91.473	1.78E-01	172.735	-1.61	-26.56	-43.10	-14.97
18.28	8.30E-01	17.904	4.89E-02	24.656	6.28E-03	42.027	1.75E-01	173.749	-1.62	-26.21	-44.04	-15.14
18.52	8.29E-01	13.528	5.87E-02	10.559	6.04E-03	68.294	1.98E-01	173.254	-1.63	-24.63	-44.37	-14.05
18.76	8.41E-01	10.034	6.12E-02	-13.312	6.02E-03	26.943	1.62E-01	165.848	-1.51	-24.26	-44.41	-15.82
19	8.24E-01	5.86	5.46E-02	-35.902	9.96E-03	39.932	1.98E-01	153.854	-1.68	-25.25	-40.03	-14.06
19.24	8.20E-01	1.381	5.11E-02	-62.324	7.29E-03	27.503	2.32E-01	153.584	-1.73	-25.84	-42.75	-12.68
19.48	8.27E-01	-2.634	3.67E-02	-83.929	1.58E-02	-14.546	2.81E-01	150.956	-1.65	-28.70	-36.01	-11.03
19.72	8.11E-01	-6.803	2.75E-02	-102.901	1.44E-02	-25.41	3.14E-01	136.66	-1.82	-31.22	-36.85	-10.08
19.96	8.15E-01	-11.2	1.59E-02	-115.883	1.14E-02	-38.639	3.31E-01	134.756	-1.78	-35.95	-38.84	-9.62

Power Amp 7V (#1)

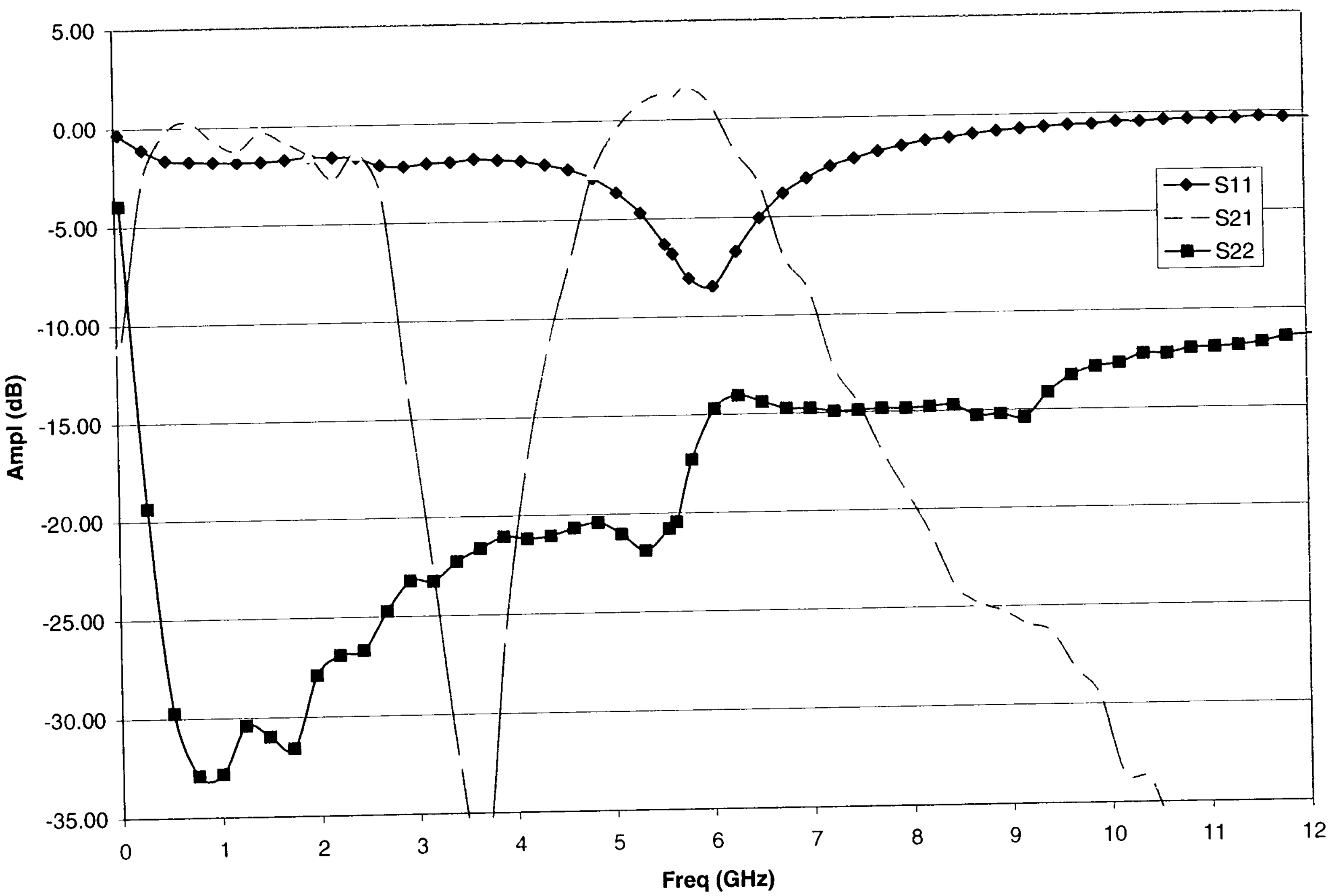


PA7V

# GHZ S MA R 50									S11 dB	S21 dB	S12 dB	S22 dB
0.04	9.64E-01	-5.56	3.01E-01	-29.464	3.69E-02	-77.495	6.43E-01	47.122	-0.32	-10.42	-28.66	-3.83
0.28	8.69E-01	-28.382	8.71E-01	-168.779	8.97E-03	8.162	1.06E-01	86.985	-1.22	-1.20	-40.94	-19.51
0.52	8.22E-01	-46.269	1.08E+00	157.253	9.80E-03	6.219	3.21E-02	69.014	-1.70	0.68	-40.18	-29.88
0.76	8.17E-01	-63.769	1.19E+00	142.902	1.18E-02	17.188	2.21E-02	147.784	-1.76	1.53	-38.57	-33.13
1	8.13E-01	-78.185	1.05E+00	124.641	1.52E-02	-7.534	2.21E-02	128.792	-1.80	0.43	-36.37	-33.09
1.24	8.12E-01	-93.229	9.77E-01	108.875	1.55E-02	-13.515	2.95E-02	84.859	-1.81	-0.20	-36.20	-30.60
1.48	8.14E-01	-106.032	1.09E+00	97.524	2.15E-02	-21.392	2.76E-02	70.627	-1.79	0.72	-33.35	-31.19
1.72	8.24E-01	-118.044	1.02E+00	73.282	2.15E-02	-45.616	2.55E-02	113.312	-1.68	0.15	-33.34	-31.89
1.96	8.35E-01	-129.157	9.35E-01	53.543	2.29E-02	-77.106	3.89E-02	116.058	-1.57	-0.58	-32.80	-28.20
2.2	8.31E-01	-140.779	8.07E-01	38.994	1.40E-02	-86.486	4.31E-02	95.215	-1.60	-1.86	-37.08	-27.30
2.44	8.30E-01	-150.695	9.50E-01	9.981	1.95E-02	-90.988	4.39E-02	95.519	-1.62	-0.45	-34.20	-27.14
2.68	7.89E-01	-159.571	7.39E-01	-44.485	1.69E-02	-142.494	5.57E-02	95.962	-2.06	-2.63	-35.42	-25.09
2.92	7.82E-01	-165.041	2.25E-01	-81.522	5.23E-03	-154.769	6.62E-02	80.214	-2.13	-12.96	-45.62	-23.59
3.16	7.94E-01	-172.161	7.69E-02	-58.825	5.21E-03	-106.438	6.58E-02	70.144	-2.00	-22.28	-45.66	-23.64
3.4	7.99E-01	-178.793	2.67E-02	-28.733	3.20E-03	-121.726	7.35E-02	61.427	-1.95	-31.46	-49.91	-22.67
3.64	8.11E-01	173.305	1.47E-02	44.812	2.71E-03	-91.46	7.92E-02	47.618	-1.82	-36.65	-51.34	-22.02
3.88	8.05E-01	166.074	5.95E-02	126.883	3.23E-03	-68.845	8.45E-02	36.992	-1.88	-24.50	-49.82	-21.46
4.12	7.96E-01	158.784	1.52E-01	124.779	3.19E-03	-59.493	8.35E-02	33.509	-1.99	-16.36	-49.91	-21.57
4.36	7.80E-01	151.551	3.06E-01	109.192	4.55E-03	-9.153	8.46E-02	21.451	-2.16	-10.28	-46.85	-21.45
4.6	7.55E-01	143.9	5.10E-01	96.6	9.66E-03	-4.49	8.87E-02	2.772	-2.45	-5.86	-40.30	-21.04
4.84	7.15E-01	135.769	8.48E-01	62.732	1.76E-02	-21.139	9.23E-02	-26.114	-2.92	-1.43	-35.08	-20.70
5.08	6.51E-01	128.278	1.09E+00	31.843	4.09E-02	-36.045	8.92E-02	-75.232	-3.72	0.74	-27.76	-20.99
5.32	5.72E-01	122.132	1.25E+00	-0.769	6.38E-02	-101.987	8.76E-02	-137.991	-4.85	1.96	-23.90	-21.15
5.56	4.66E-01	117.814	1.34E+00	-35.27	5.88E-02	-123.024	1.01E-01	-178.561	-6.64	2.52	-24.61	-19.90
5.64	4.36E-01	118.882	1.30E+00	-43.198	7.14E-02	-146.462	1.04E-01	167.523	-7.22	2.26	-22.93	-19.65
5.8	3.65E-01	124.661	1.38E+00	-66.746	8.99E-02	-169.5	1.41E-01	141.589	-8.75	2.77	-20.93	-17.01
6.04	3.39E-01	142.721	1.26E+00	-101.407	6.07E-02	137.181	1.80E-01	110.745	-9.40	2.00	-24.33	-14.88
6.28	4.37E-01	153.648	9.53E-01	-132.816	4.16E-02	118.952	1.91E-01	82.593	-7.19	-0.42	-27.63	-14.40
6.52	5.46E-01	152.239	7.67E-01	-156.198	3.72E-02	86.047	1.83E-01	66.368	-5.25	-2.30	-28.59	-14.77
6.76	6.35E-01	146.916	4.98E-01	-175.797	1.78E-02	78.235	1.75E-01	56.041	-3.94	-6.05	-34.98	-15.13
7	7.02E-01	141.021	4.00E-01	165.002	1.06E-02	72.295	1.75E-01	46.55	-3.08	-7.97	-39.46	-15.14
7.24	7.46E-01	135.108	2.55E-01	150.828	7.97E-03	50.181	1.71E-01	40.305	-2.54	-11.85	-41.97	-15.32
7.48	7.89E-01	129.07	2.02E-01	139.088	3.49E-03	53.346	1.71E-01	33.161	-2.06	-13.87	-49.14	-15.32
7.72	8.19E-01	123.926	1.46E-01	130.269	4.44E-03	74.881	1.73E-01	27.154	-1.74	-16.74	-47.05	-15.24
7.96	8.47E-01	118.136	1.12E-01	120.2	3.38E-03	68.368	1.73E-01	23.78	-1.45	-18.98	-49.43	-15.24
8.2	8.73E-01	112.974	8.49E-02	116.711	2.30E-03	81.259	1.73E-01	18.652	-1.18	-21.42	-52.75	-15.22
8.44	8.88E-01	107.691	6.23E-02	116.246	3.62E-03	120.175	1.74E-01	13.561	-1.03	-24.11	-48.83	-15.18
8.68	9.04E-01	102.33	5.59E-02	119.724	4.48E-03	107.12	1.63E-01	12.441	-0.87	-25.06	-46.98	-15.76
8.92	9.20E-01	97.329	5.18E-02	114.534	7.82E-03	110.776	1.64E-01	10.593	-0.72	-25.72	-42.14	-15.70
9.16	9.29E-01	92.604	5.08E-02	104.666	8.46E-03	73.033	1.62E-01	14.213	-0.64	-25.88	-41.45	-15.82
9.4	9.41E-01	87.652	7.46E-02	63.865	2.82E-03	-139.773	1.76E-01	14.327	-0.53	-22.55	-51.00	-15.07
9.64	9.41E-01	83.132	3.74E-02	74.439	4.33E-03	17.505	2.08E-01	6.793	-0.53	-28.54	-47.28	-13.64
9.88	9.44E-01	78.654	2.74E-02	64.18	3.34E-03	-13.911	2.18E-01	1.796	-0.50	-31.24	-49.53	-13.21
10.12	9.53E-01	74.095	2.12E-02	59.574	2.18E-03	-28.836	2.21E-01	-3.089	-0.42	-33.49	-53.21	-13.11
10.36	9.53E-01	69.786	1.68E-02	49.108	2.67E-03	54.144	2.34E-01	-8.327	-0.42	-35.52	-51.49	-12.61
10.6	9.57E-01	65.404	1.45E-02	48.923	1.14E-03	-50.574	2.33E-01	-12.058	-0.38	-36.76	-58.85	-12.65
10.84	9.61E-01	61.339	1.18E-02	44.542	2.41E-03	-8.965	2.41E-01	-16.839	-0.34	-38.54	-52.35	-12.35
11.08	9.60E-01	57.105	6.15E-03	38.669	4.53E-04	43.186	2.42E-01	-20.517	-0.36	-44.23	-66.88	-12.33
11.32	9.64E-01	52.786	7.75E-03	34.595	5.35E-04	25.293	2.44E-01	-23.508	-0.32	-42.21	-65.43	-12.26
11.56	9.71E-01	49.133	2.50E-03	39.42	1.08E-03	-23.636	2.48E-01	-27.743	-0.26	-52.04	-59.35	-12.11
11.8	9.63E-01	44.634	5.78E-03	56.777	6.57E-04	-80.305	2.56E-01	-31.058	-0.33	-44.76	-63.65	-11.84
12.04	9.67E-01	40.718	3.93E-03	-1.799	1.12E-03	35.852	2.59E-01	-34.156	-0.29	-48.12	-59.01	-11.73
12.28	9.68E-01	37.3	3.26E-03	58.4	1.55E-03	47.838	2.63E-01	-37.509	-0.29	-49.72	-56.20	-11.62
12.52	9.69E-01	33.219	2.66E-03	-21.071	1.16E-03	160.238	2.67E-01	-41.309	-0.28	-51.52	-58.70	-11.46
12.76	9.74E-01	29.386	9.15E-04	-33.808	1.99E-03	8.876	2.79E-01	-45.146	-0.23	-60.77	-54.04	-11.09
13	9.69E-01	25.781	3.87E-03	28.408	1.65E-03	85.01	2.79E-01	-47.769	-0.27	-48.24	-55.67	-11.07
13.24	9.65E-01	21.529	1.72E-03	56.089	7.68E-04	126.416	2.82E-01	-52.069	-0.30	-55.28	-62.29	-10.99
13.48	9.77E-01	18.326	1.19E-03	-125.01	2.79E-03	44.196	2.80E-01	-54.2	-0.20	-58.53	-51.09	-11.06
13.72	9.66E-01	14.43	2.33E-03	60.974	1.46E-03	74.596	2.90E-01	-58.595	-0.30	-52.67	-56.73	-10.76
13.96	9.98E-01	11.521	1.89E-01	120.763	3.32E-02	-141.738	3.01E-01	-65.465	-0.02	-14.49	-29.58	-10.43
14.2	9.78E-01	7.428	7.96E-04	-4.595	1.23E-03	123.01	3.05E-01	-65.48	-0.19	-61.98	-58.22	-10.30
14.44	9.74E-01	3.258	2.56E-03	-160.36	2.20E-03	-94.912	2.97E-01	-68.348	-0.23	-51.84	-53.15	-10.56
14.68	9.79E-01	-0.986	9.24E-04	-102.155	7.66E-04	-69.978	3.14E-01	-72.77	-0.19	-60.69	-62.32	-10.07
14.92	9.84E-01	-3.684	4.07E-03	-154.106	3.22E-03	98.468	3.04E-01	-73.677	-0.14	-47.81	-49.83	-10.35
15.16	9.80E-01	-8.296	2.41E-03	83.98	2.90E-03	155.224	3.08E-01	-77.381	-0.17	-52.36	-50.76	-10.23
15.4	9.89E-01	-11.528	1.34E-03	-114.503	4.26E-03	-86.468	3.17E-01	-81.206	-0.09	-57.45	-47.42	-9.98
15.64	9.84E-01	-15.014	7.19E-03	-117.947	1.34E-03	-100.669	3.25E-01	-84.619	-0.14	-42.87	-57.44	-9.76

15.88	9.85E-01	-19.192	4.49E-03	59.346	1.02E-03	51.167	3.19E-01	-85.886	-0.13	-46.96	-59.80	-9.92
16.12	9.98E-01	-21.998	2.68E-03	79.183	4.29E-03	-158.187	3.32E-01	-91.794	-0.02	-51.44	-47.35	-9.59
16.36	9.84E-01	-26.138	2.73E-03	46.708	2.49E-03	-151.208	3.34E-01	-92.696	-0.14	-51.26	-52.09	-9.54
16.6	9.93E-01	-29.986	2.95E-03	163.095	1.94E-03	124.044	3.35E-01	-97.511	-0.06	-50.59	-54.23	-9.49
16.84	9.95E-01	-32.977	2.64E-03	-131.641	1.19E-03	117.167	3.44E-01	-100.447	-0.05	-51.55	-58.51	-9.27
17.08	1.00E+00	-36.946	5.89E-03	-44.499	3.46E-03	100.662	3.47E-01	-102.87	0.00	-44.61	-49.21	-9.18
17.32	1.00E+00	-40.23	2.84E-03	-96.017	4.02E-03	109.809	3.47E-01	-106.904	0.03	-50.92	-47.92	-9.19
17.56	9.95E-01	-43.855	3.44E-03	34.173	5.18E-03	162.101	4.18E-01	-109.176	-0.05	-49.28	-45.71	-7.58
17.8	1.00E+00	-47.479	4.58E-03	162.662	1.18E-03	-29.26	3.69E-01	-112.481	0.01	-46.79	-58.60	-8.66
18.04	1.01E+00	-51.013	5.20E-03	-104.449	9.49E-04	-72.01	3.80E-01	-119.163	0.04	-45.68	-60.46	-8.41
18.28	1.01E+00	-54.885	5.26E-03	159.011	1.14E-03	126.492	3.99E-01	-120.967	0.04	-45.58	-58.85	-7.98
18.52	1.01E+00	-58.14	8.97E-03	107.595	2.03E-03	57.215	3.90E-01	-122.38	0.12	-40.95	-53.83	-8.18
18.76	1.01E+00	-61.655	6.26E-03	159.106	3.65E-03	-52.339	3.74E-01	-124.374	0.10	-44.07	-48.75	-8.53
19	1.01E+00	-65.57	3.67E-03	106.524	3.77E-03	157.334	3.34E-01	-132.076	0.10	-48.70	-48.47	-9.52
19.24	1.02E+00	-69.193	6.63E-03	-138.094	1.98E-04	-103.506	3.46E-01	-134.608	0.19	-43.57	-74.09	-9.21
19.48	1.03E+00	-71.907	9.00E-03	100.64	5.55E-03	89.307	3.63E-01	-137.872	0.22	-40.92	-45.12	-8.81
19.72	1.02E+00	-77.16	4.25E-03	-122.554	1.49E-03	-4.083	3.47E-01	-138.863	0.17	-47.44	-56.52	-9.20
19.96	1.04E+00	-80	1.50E-03	72.793	3.07E-03	77.395	3.56E-01	-143.641	0.37	-56.49	-50.27	-8.96

Power Amp 7V (#2)



PA7V2

# GHZ S MA R 50									S11 dB	S21 dB	S12 dB	S22 dB
0.04	9.63E-01	-5.444	2.79E-01	-29.151	6.81E-03	119.759	6.36E-01	46.006	-0.32	-11.09	-43.34	-3.93
0.28	8.81E-01	-28.052	7.41E-01	-166.803	1.59E-02	-9.656	1.08E-01	85.02	-1.10	-2.60	-35.96	-19.35
0.52	8.26E-01	-46.063	9.74E-01	161.904	1.06E-02	6.856	3.27E-02	66.371	-1.66	-0.23	-39.47	-29.72
0.76	8.19E-01	-63.436	1.03E+00	144.528	1.37E-02	12.389	2.26E-02	144.244	-1.73	0.27	-37.30	-32.90
1	8.15E-01	-77.613	9.24E-01	125.935	1.62E-02	-6.4	2.28E-02	125.618	-1.78	-0.68	-35.82	-32.83
1.24	8.13E-01	-92.511	8.69E-01	111.028	1.68E-02	-15.016	3.02E-02	82.399	-1.80	-1.22	-35.47	-30.41
1.48	8.14E-01	-105.198	9.68E-01	99.045	2.38E-02	-21.544	2.83E-02	68.019	-1.79	-0.29	-32.47	-30.96
1.72	8.22E-01	-117.177	9.08E-01	74.598	2.32E-02	-48.11	2.63E-02	112.04	-1.70	-0.84	-32.68	-31.59
1.96	8.34E-01	-128.286	8.43E-01	55.196	2.54E-02	-77.999	4.02E-02	115.098	-1.58	-1.48	-31.90	-27.91
2.2	8.29E-01	-139.946	7.30E-01	40.364	1.46E-02	-83.889	4.51E-02	94.237	-1.63	-2.73	-36.72	-26.91
2.44	8.27E-01	-149.572	8.48E-01	11.458	2.06E-02	-96.774	4.63E-02	94.139	-1.65	-1.43	-33.72	-26.68
2.68	7.89E-01	-158.504	6.69E-01	-42.123	1.85E-02	-144.98	5.81E-02	94.96	-2.06	-3.49	-34.64	-24.72
2.92	7.82E-01	-164.157	2.10E-01	-78.915	4.75E-03	-156.181	6.91E-02	79.526	-2.14	-13.54	-46.47	-23.20
3.16	7.94E-01	-171.101	7.32E-02	-57.706	6.06E-03	-104.471	6.87E-02	69.736	-2.00	-22.71	-44.35	-23.26
3.4	7.98E-01	-177.699	2.40E-02	-30.64	3.15E-03	-120.627	7.70E-02	61.052	-1.96	-32.40	-50.03	-22.27
3.64	8.10E-01	174.598	1.26E-02	42.134	2.61E-03	-103.413	8.29E-02	47.511	-1.83	-38.02	-51.65	-21.63
3.88	8.04E-01	167.391	4.97E-02	127.919	2.48E-03	-54.698	8.86E-02	37.204	-1.90	-26.08	-52.13	-21.05
4.12	7.97E-01	160.279	1.34E-01	124.753	2.87E-03	-36.214	8.74E-02	34.184	-1.98	-17.45	-50.84	-21.17
4.36	7.77E-01	153.293	2.68E-01	110.281	4.98E-03	0.02	8.86E-02	22.741	-2.19	-11.43	-46.05	-21.05
4.6	7.54E-01	145.665	4.43E-01	98.317	1.03E-02	4.415	9.26E-02	4.889	-2.46	-7.07	-39.77	-20.67
4.84	7.16E-01	137.99	7.37E-01	64.306	1.92E-02	-14.26	9.52E-02	-23.038	-2.91	-2.64	-34.33	-20.42
5.08	6.56E-01	130.959	9.44E-01	34.406	4.79E-02	-29.563	8.89E-02	-72.009	-3.66	-0.50	-26.40	-21.03
5.32	5.81E-01	125.18	1.10E+00	1.59	7.19E-02	-96.578	8.04E-02	-136.383	-4.71	0.79	-22.86	-21.89
5.56	4.83E-01	121.442	1.16E+00	-32.724	6.46E-02	-117.02	9.13E-02	-178.108	-6.32	1.32	-23.79	-20.79
5.64	4.56E-01	122.945	1.13E+00	-40.645	8.05E-02	-141.743	9.48E-02	167.917	-6.81	1.03	-21.88	-20.46
5.8	3.95E-01	127.608	1.21E+00	-63.408	1.00E-01	-163.003	1.36E-01	143.216	-8.06	1.63	-19.96	-17.30
6.04	3.77E-01	141.456	1.09E+00	-97.611	7.11E-02	141.722	1.84E-01	111.461	-8.48	0.77	-22.96	-14.71
6.28	4.60E-01	151.017	8.32E-01	-127.8	4.83E-02	124.413	1.98E-01	82.104	-6.75	-1.60	-26.32	-14.06
6.52	5.59E-01	150.206	6.85E-01	-150.222	4.09E-02	90.21	1.91E-01	65.489	-5.05	-3.29	-27.76	-14.40
6.76	6.44E-01	145.464	4.44E-01	-169.376	1.85E-02	82.087	1.83E-01	54.881	-3.83	-7.06	-34.64	-14.76
7	7.02E-01	139.824	3.66E-01	172.105	1.39E-02	76.367	1.83E-01	45.472	-3.07	-8.72	-37.11	-14.76
7.24	7.52E-01	133.905	2.33E-01	158.006	9.51E-03	63.527	1.79E-01	39.108	-2.47	-12.65	-40.44	-14.93
7.48	7.85E-01	128.173	1.88E-01	146.593	5.40E-03	69.199	1.80E-01	32.148	-2.10	-14.52	-45.35	-14.91
7.72	8.17E-01	123.034	1.40E-01	137.827	4.48E-03	67.869	1.81E-01	26.049	-1.76	-17.08	-46.98	-14.84
7.96	8.41E-01	117.77	1.10E-01	127	4.72E-03	67.162	1.81E-01	22.768	-1.51	-19.16	-46.51	-14.84
8.2	8.65E-01	112.69	8.54E-02	126.582	3.57E-03	117.423	1.82E-01	17.696	-1.26	-21.37	-48.96	-14.78
8.44	8.78E-01	107.688	6.32E-02	121.811	5.24E-03	118.925	1.83E-01	12.529	-1.13	-23.98	-45.61	-14.73
8.68	8.95E-01	102.542	5.73E-02	126.387	5.93E-03	100.151	1.72E-01	11.186	-0.96	-24.83	-44.54	-15.28
8.92	9.09E-01	97.793	5.46E-02	119.548	6.16E-03	97.685	1.74E-01	9.382	-0.83	-25.25	-44.21	-15.20
9.16	9.19E-01	93.078	5.06E-02	109.063	9.03E-03	57.075	1.70E-01	12.459	-0.73	-25.91	-40.89	-15.41
9.4	9.27E-01	88.244	4.83E-02	95.295	6.31E-03	31.555	1.96E-01	11.488	-0.66	-26.32	-44.00	-14.14
9.64	9.37E-01	83.83	3.89E-02	76.661	6.16E-03	40.279	2.17E-01	5.797	-0.57	-28.20	-44.21	-13.28
9.88	9.38E-01	79.286	3.32E-02	70.909	5.08E-03	-22.819	2.28E-01	0.855	-0.56	-29.59	-45.88	-12.86
10.12	9.50E-01	74.755	2.09E-02	60.433	2.10E-03	24.028	2.32E-01	-3.89	-0.45	-33.61	-53.58	-12.69
10.36	9.48E-01	70.576	2.04E-02	50.408	2.68E-03	-8.131	2.45E-01	-9.139	-0.46	-33.79	-51.43	-12.22
10.6	9.55E-01	66.093	1.48E-02	46.187	1.34E-03	-6.024	2.44E-01	-12.984	-0.40	-36.59	-57.43	-12.24
10.84	9.59E-01	62.082	1.28E-02	50.858	1.07E-03	0.87	2.52E-01	-17.625	-0.37	-37.88	-59.45	-11.97
11.08	9.59E-01	57.962	8.39E-03	43.883	6.06E-04	124.604	2.53E-01	-21.181	-0.37	-41.52	-64.35	-11.94
11.32	9.60E-01	53.662	7.26E-03	35.108	6.10E-04	-73.232	2.55E-01	-24.233	-0.35	-42.78	-64.29	-11.87
11.56	9.70E-01	49.584	4.81E-03	31.416	9.62E-04	62.844	2.60E-01	-28.36	-0.27	-46.36	-60.33	-11.70
11.8	9.64E-01	45.538	4.46E-03	65.035	7.63E-04	12.982	2.68E-01	-31.747	-0.32	-47.01	-62.35	-11.45
12.04	9.62E-01	41.556	1.98E-03	31.728	1.46E-03	-0.702	2.71E-01	-34.935	-0.34	-54.05	-56.69	-11.34
12.28	9.64E-01	37.839	1.33E-03	-63.209	4.27E-04	-27.96	2.75E-01	-38.104	-0.32	-57.50	-67.39	-11.20
12.52	9.67E-01	34.041	5.89E-04	-173.66	6.95E-04	18.998	2.80E-01	-41.951	-0.29	-64.59	-63.16	-11.06
12.76	9.79E-01	29.984	1.35E-03	74.904	2.42E-03	-71.461	2.92E-01	-45.658	-0.18	-57.39	-52.33	-10.68
13	9.68E-01	26.508	1.09E-03	-49.416	1.96E-03	-169.781	2.93E-01	-48.496	-0.29	-59.28	-54.14	-10.66
13.24	9.65E-01	22.4	1.18E-03	40.512	2.09E-03	-119.963	2.94E-01	-52.436	-0.31	-58.60	-53.61	-10.62
13.48	9.73E-01	18.865	3.02E-03	28.194	1.11E-03	-52.995	2.93E-01	-54.887	-0.23	-50.39	-59.10	-10.65
13.72	9.65E-01	15.233	1.11E-03	-164.119	1.31E-03	-27.012	3.03E-01	-59.113	-0.31	-59.09	-57.68	-10.36
13.96	9.79E-01	11.008	1.21E-03	-59.345	1.91E-03	150.323	3.12E-01	-62.653	-0.19	-58.37	-54.40	-10.11
14.2	9.77E-01	8.077	1.76E-03	-176.575	1.56E-03	-166.464	3.20E-01	-65.904	-0.20	-55.07	-56.13	-9.90
14.44	9.69E-01	4.096	4.07E-03	-112.906	2.29E-03	101.842	3.11E-01	-68.737	-0.28	-47.82	-52.81	-10.15
14.68	9.82E-01	0.437	6.79E-03	143.246	3.06E-03	105.862	3.28E-01	-73.078	-0.15	-43.37	-50.29	-9.69
14.92	9.82E-01	-3.159	2.48E-03	176.948	2.93E-03	109.921	3.18E-01	-73.977	-0.15	-52.10	-50.66	-9.96
15.16	9.74E-01	-7.712	4.71E-03	-18.237	4.10E-03	84.812	3.23E-01	-77.681	-0.23	-46.54	-47.74	-9.82
15.4	9.94E-01	-10.79	2.47E-03	-2.362	2.06E-03	73.968	3.32E-01	-81.595	-0.06	-52.15	-53.71	-9.59
15.64	9.86E-01	-13.923	2.54E-03	-120.297	2.59E-03	65.926	3.39E-01	-84.952	-0.12	-51.91	-51.73	-9.39

15.88	9.84E-01	-18.14	9.59E-04	-56.252	1.91E-03	-85.793	3.35E-01	-86.39	-0.14	-60.37	-54.39	-9.50
16.12	9.97E-01	-21.448	1.07E-03	-74.87	2.39E-03	-63.201	3.48E-01	-91.897	-0.03	-59.45	-52.45	-9.16
16.36	9.85E-01	-25.033	3.43E-03	164.607	1.83E-03	-160.711	3.49E-01	-93.057	-0.13	-49.30	-54.76	-9.15
16.6	9.94E-01	-29.491	4.46E-03	-112.03	6.01E-04	72.864	3.51E-01	-97.828	-0.05	-47.02	-64.42	-9.08
16.84	9.95E-01	-31.94	5.88E-03	172.117	9.75E-04	95.419	3.60E-01	-100.513	-0.04	-44.62	-60.22	-8.87
17.08	9.88E-01	-35.475	5.93E-03	147.272	1.48E-03	35.662	3.62E-01	-103.314	-0.11	-44.54	-56.58	-8.83
17.32	9.98E-01	-39.449	2.96E-03	124.129	5.55E-04	-132.9	3.61E-01	-106.876	-0.02	-50.57	-65.11	-8.85
17.56	9.97E-01	-42.632	3.03E-03	13.729	4.32E-03	179.532	4.34E-01	-109.322	-0.02	-50.38	-47.30	-7.26
17.8	9.99E-01	-46.395	2.50E-03	44.597	1.29E-03	-109.526	3.88E-01	-112.674	-0.01	-52.06	-57.79	-8.22
18.04	9.93E-01	-49.895	3.20E-03	44.379	1.12E-03	20.587	3.97E-01	-119.404	-0.06	-49.90	-59.02	-8.02
18.28	1.01E+00	-53.51	3.74E-03	117.14	2.75E-03	70.583	4.17E-01	-120.858	0.05	-48.55	-51.21	-7.59
18.52	1.01E+00	-56.912	1.36E-03	63.639	3.34E-03	104.159	4.09E-01	-122.493	0.07	-57.36	-49.53	-7.77
18.76	1.02E+00	-60.484	8.26E-03	170.405	2.87E-03	121.934	3.92E-01	-124.54	0.13	-41.66	-50.86	-8.13
19	1.01E+00	-64.143	2.48E-03	-148.425	5.37E-03	51.957	3.52E-01	-132.158	0.11	-52.13	-45.40	-9.06
19.24	1.01E+00	-67.83	7.66E-04	45.874	3.21E-03	133.288	3.63E-01	-134.75	0.12	-62.31	-49.87	-8.79
19.48	1.02E+00	-70.921	6.35E-03	-54.511	8.69E-04	68.798	3.82E-01	-137.987	0.17	-43.95	-61.22	-8.37
19.72	1.02E+00	-74.913	6.96E-03	33.292	8.54E-04	-53.73	3.64E-01	-138.679	0.16	-43.14	-61.37	-8.77
19.96	1.03E+00	-78.129	8.46E-03	40.66	3.34E-03	-143.709	3.74E-01	-143.654	0.27	-41.46	-49.52	-8.55