

MICROWAVE LOW NOISE AMPLIFIER  
NPN SILICON EPITAXIAL TRANSISTOR  
4 PINS MINI MOLD

FEATURES

- Low Voltage Operation, Low Phase Distortion
- Low Noise  
 $NF = 1.5 \text{ dB TYP. @ } V_{CE} = 3 \text{ V, } I_c = 7 \text{ mA, } f = 2 \text{ GHz}$   
 $NF = 1.7 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 3 \text{ mA, } f = 2 \text{ GHz}$
- Large Absolute Maximum Collector Current  
 $I_c = 100 \text{ mA}$
- 4-Pin Mini Mold Package  
 EIAJ: SC-61

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC5192-T1	3 Kpcs/Reel	Embossed tape 8 mm wide. Pin 3 (Base), Pin 4 (Emitter) face to perforation side of the tape.
2SC5192-T2	3 Kpcs/Reel	Embossed tape 8 mm wide. Pin 1 (Collector), Pin 2 (Emitter) face to perforation side of the tape.

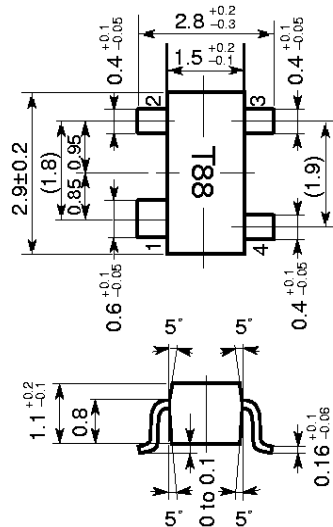
**Remark** If you require an evaluation sample, please contact an NEC Sales Representative. (Unit sample quantity is 50 pcs.)

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25 \text{ }^\circ\text{C}$ )

PARAMETER	SYMBOL	RATING	UNIT
Collector to Base Voltage	$V_{CBO}$	9	V
Collector to Emitter Voltage	$V_{CEO}$	6	V
Emitter to Base Voltage	$V_{EBO}$	2	V
Collector Current	$I_c$	100	mA
Total Power Dissipation	$P_T$	200	mW
Junction Temperature	$T_j$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +150	$^\circ\text{C}$

PACKAGE DRAWINGS

(Unit: mm)



PIN CONNECTIONS

1. Collector
2. Emitter
3. Base
4. Emitter

This device uses radio frequency technology. Take due precautions to protect it from excessive input levels such as static electricity.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cutoff Current	I <sub>CB0</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0			100	nA
Emitter Cutoff Current	I <sub>EB0</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0			100	nA
DC Current Gain	h <sub>FE</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA <sup>Note 1</sup>	80		160	
Insertion Power Gain (1)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz	3	4.0		dB
Insertion Power Gain (2)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz		8		dB
Noise Figure (1)	NF	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz		1.7	2.5	dB
Noise Figure (2)	NF	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 2.0 GHz		1.5		dB
Gain Bandwidth Product (1)	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz	4	4.5		GHz
Gain Bandwidth Product (2)	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz		9		GHz
Collector Capacitance	C <sub>re</sub>	V <sub>CB</sub> = 1 V, I <sub>E</sub> = 0, f = 1.0 MHz <sup>Note 2</sup>		0.65	0.8	pF

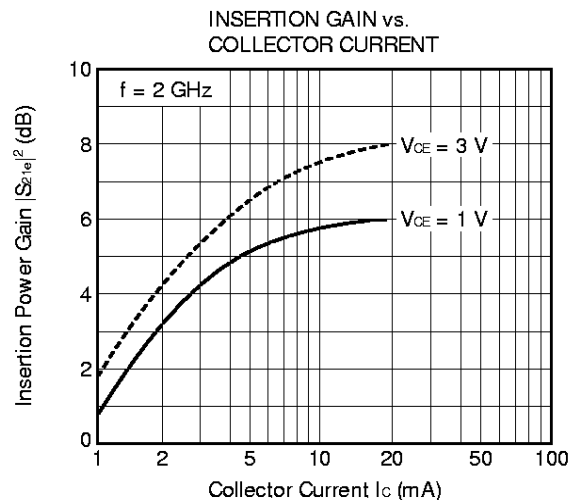
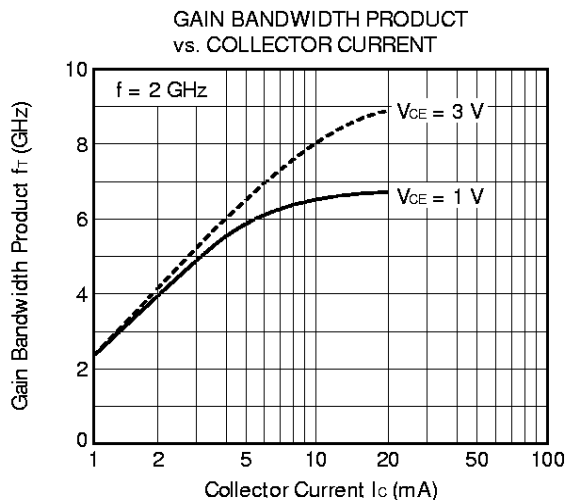
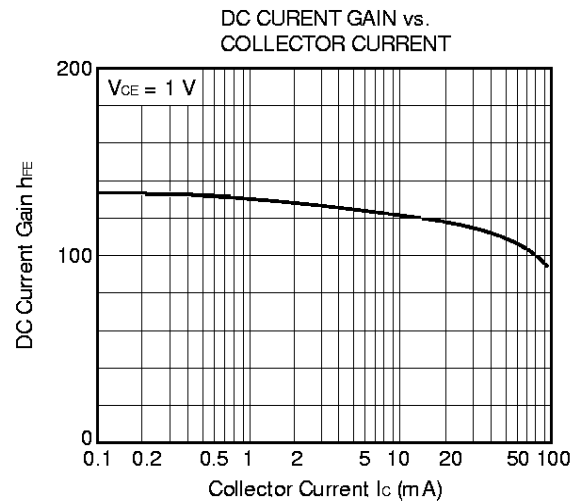
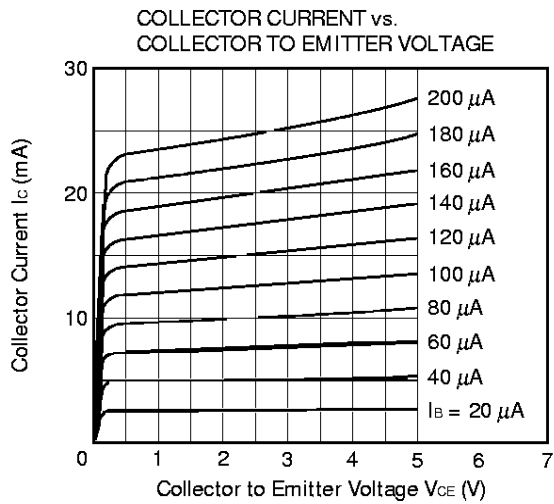
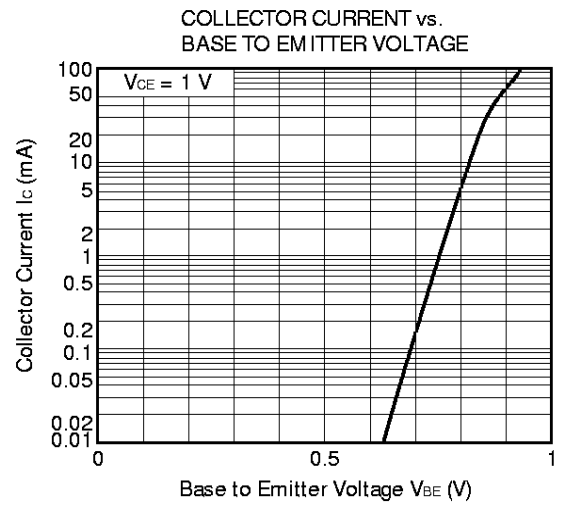
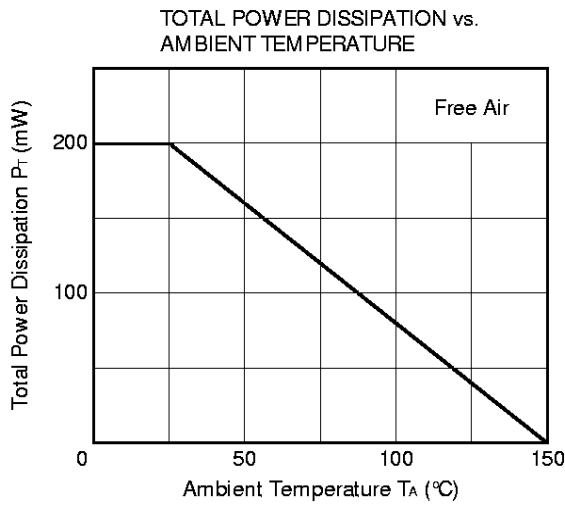
**Notes** 1. Pulse Measurement: PW ≤ 350 μs, Duty cycle ≤ 2 %, Pulsed

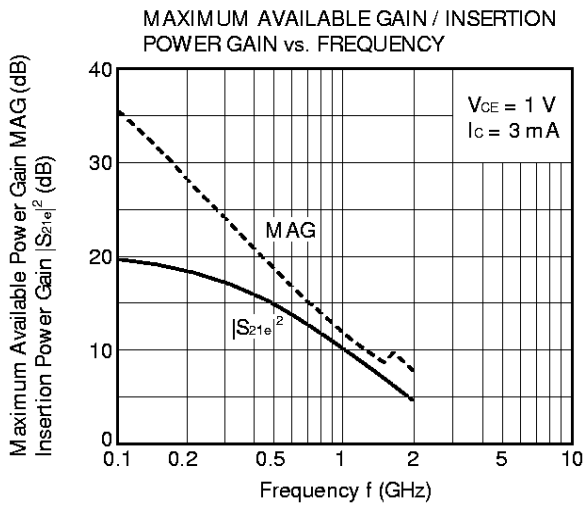
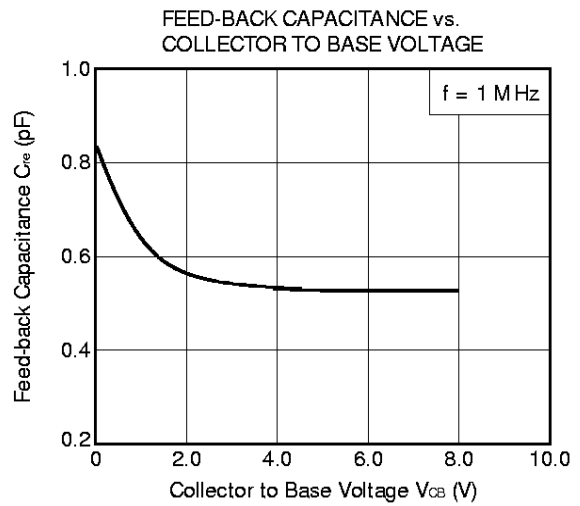
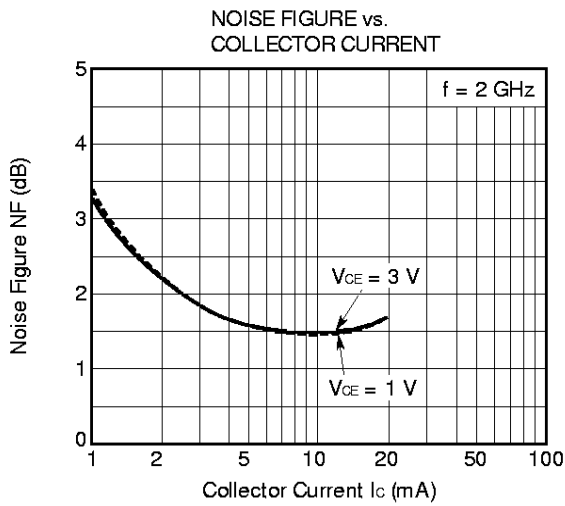
2. Measured with 3-pin bridge, emitter and case should be connected to guard pin of bridge.

**h<sub>FE</sub> Classification**

Rank	FB
Marking	T88
h <sub>FE</sub>	80 to 160

TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)





S-PARAMETERS

$V_{CE} = 1\text{ V}$ ,  $I_C = 1\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.963	-17.1	3.502	166.5	0.048	79.4	0.983	-8.7
200.00	0.934	-34.1	3.413	154.0	0.087	69.6	0.957	-17.1
300.00	0.890	-49.7	3.238	142.6	0.130	60.0	0.906	-25.2
400.00	0.850	-65.3	3.026	131.1	0.156	50.7	0.851	-31.8
500.00	0.806	-79.9	2.825	120.8	0.178	41.8	0.801	-38.3
600.00	0.760	-92.6	2.598	111.3	0.198	37.0	0.744	-43.5
700.00	0.722	-104.8	2.419	103.0	0.209	31.0	0.702	-47.8
800.00	0.695	-116.4	2.238	95.5	0.221	25.2	0.646	-51.5
900.00	0.670	-127.6	2.102	87.9	0.223	20.9	0.615	-55.8
1000.00	0.643	-137.1	1.932	81.4	0.224	18.6	0.575	-58.7
1100.00	0.631	-147.2	1.820	75.3	0.230	14.2	0.544	-62.1
1200.00	0.626	-155.6	1.695	69.8	0.222	10.8	0.520	-66.3
1300.00	0.627	-164.2	1.611	64.4	0.222	8.4	0.497	-69.0
1400.00	0.623	-172.5	1.518	58.6	0.217	7.0	0.482	-72.9
1500.00	0.628	-179.3	1.432	54.0	0.217	2.9	0.468	-75.9
1600.00	0.630	175.7	1.364	49.7	0.212	2.0	0.450	-80.1
1700.00	0.625	168.3	1.280	45.0	0.202	1.0	0.442	-82.8
1800.00	0.629	162.8	1.223	41.3	0.201	0.0	0.433	-88.1
1900.00	0.629	157.5	1.168	37.2	0.190	-1.6	0.417	-89.2
2000.00	0.634	152.4	1.112	33.4	0.189	-0.7	0.419	-94.2

$V_{CE} = 1\text{ V}$ ,  $I_C = 3\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.886	-28.0	9.515	159.3	0.044	74.9	0.943	-17.6
200.00	0.809	-54.2	8.567	141.9	0.078	64.0	0.847	-32.1
300.00	0.734	-75.4	7.425	128.1	0.103	52.3	0.734	-44.8
400.00	0.661	-94.8	6.367	116.2	0.122	44.4	0.630	-53.5
500.00	0.608	-110.6	5.529	106.7	0.130	39.1	0.547	-61.0
600.00	0.568	-124.2	4.813	98.7	0.136	35.6	0.484	-66.5
700.00	0.544	-136.4	4.278	92.0	0.144	33.4	0.434	-70.6
800.00	0.531	-147.4	3.841	86.0	0.145	30.7	0.381	-76.2
900.00	0.520	-157.3	3.473	80.1	0.152	30.1	0.350	-78.8
1000.00	0.517	-165.2	3.151	75.3	0.160	29.5	0.316	-83.6
1100.00	0.506	174.0	2.905	70.6	0.163	27.3	0.293	-89.0
1200.00	0.511	179.5	2.670	66.4	0.166	26.0	0.270	-92.9
1300.00	0.520	172.5	2.506	61.9	0.168	26.8	0.253	-98.5
1400.00	0.526	166.5	2.330	57.6	0.170	26.3	0.250	-101.9
1500.00	0.533	161.0	2.181	53.8	0.173	25.8	0.233	-106.6
1600.00	0.532	157.2	2.054	50.6	0.177	26.1	0.228	-112.2
1700.00	0.543	151.0	1.921	47.0	0.181	23.7	0.219	-117.6
1800.00	0.553	146.8	1.834	43.6	0.187	22.5	0.223	-124.8
1900.00	0.563	143.0	1.734	40.4	0.191	24.6	0.201	-127.3
2000.00	0.566	138.0	1.661	37.2	0.192	24.9	0.208	-133.2

$V_{CE} = 1\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.823	-37.1	13.981	153.6	0.044	70.4	0.904	-25.0
200.00	0.715	-68.3	11.672	133.5	0.073	56.9	0.762	-43.3
300.00	0.633	-92.2	9.511	119.4	0.086	48.9	0.612	-58.0
400.00	0.566	-112.0	7.794	108.2	0.103	43.7	0.508	-66.4
500.00	0.525	-127.9	6.574	99.7	0.106	41.1	0.427	-74.9
600.00	0.504	-141.1	5.620	92.7	0.114	39.9	0.367	-81.4
700.00	0.487	-152.3	4.927	86.7	0.121	39.5	0.331	-86.5
800.00	0.483	-161.7	4.373	81.5	0.132	37.8	0.286	-93.8
900.00	0.477	-171.1	3.928	76.6	0.132	36.2	0.261	-99.0
1000.00	0.482	-177.9	3.550	72.3	0.141	37.9	0.240	-101.7
1100.00	0.483	174.7	3.252	68.1	0.144	36.4	0.222	-110.7
1200.00	0.487	169.3	2.984	64.5	0.153	36.8	0.210	-115.2
1300.00	0.496	163.0	2.794	60.3	0.161	36.4	0.190	-121.5
1400.00	0.504	157.9	2.590	56.4	0.169	35.1	0.199	-127.7
1500.00	0.521	152.8	2.420	52.8	0.175	35.4	0.188	-132.5
1600.00	0.524	150.2	2.282	49.9	0.181	33.1	0.184	-139.9
1700.00	0.529	144.0	2.127	46.6	0.191	32.0	0.174	-146.3
1800.00	0.540	141.0	2.031	43.5	0.201	30.6	0.199	-152.2
1900.00	0.547	137.1	1.913	40.5	0.204	30.3	0.180	-161.7
2000.00	0.551	133.2	1.829	37.7	0.202	31.4	0.184	-163.4

$V_{CE} = 1\text{ V}$ ,  $I_C = 7\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.741	-46.4	17.962	148.1	0.038	63.9	0.844	-31.3
200.00	0.630	-81.9	13.958	126.6	0.064	55.5	0.671	-53.0
300.00	0.554	-106.4	10.862	112.9	0.077	47.6	0.524	-68.1
400.00	0.506	-126.3	8.635	102.7	0.087	44.3	0.416	-77.7
500.00	0.475	-141.7	7.161	95.2	0.096	43.7	0.352	-86.7
600.00	0.465	-153.6	6.072	88.9	0.105	43.5	0.303	-95.3
700.00	0.462	-163.4	5.283	83.6	0.111	43.4	0.267	-100.2
800.00	0.458	-172.3	4.672	78.9	0.121	43.2	0.233	-108.2
900.00	0.462	-179.7	4.168	74.3	0.127	42.7	0.214	-113.6
1000.00	0.465	173.6	3.769	70.5	0.135	44.4	0.199	-120.9
1100.00	0.466	167.5	3.443	66.6	0.139	41.7	0.190	-129.1
1200.00	0.477	162.8	3.161	63.2	0.156	42.0	0.195	-136.0
1300.00	0.490	156.6	2.954	59.3	0.161	42.1	0.181	-142.3
1400.00	0.501	152.0	2.728	55.6	0.171	40.3	0.181	-147.5
1500.00	0.509	147.8	2.551	52.4	0.184	38.7	0.190	-153.3
1600.00	0.516	145.1	2.398	49.4	0.183	39.4	0.188	-162.7
1700.00	0.520	140.0	2.235	46.3	0.198	36.7	0.188	-165.2
1800.00	0.530	137.3	2.133	43.4	0.202	36.3	0.205	-173.6
1900.00	0.547	133.1	2.014	40.4	0.208	34.6	0.196	-178.2
2000.00	0.546	129.5	1.912	37.6	0.212	34.8	0.199	-179.5

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 10 mA, Z<sub>O</sub> = 50 Ω

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.676	-56.3	21.704	142.6	0.038	66.7	0.798	-38.5
200.00	0.561	-95.4	15.685	120.5	0.058	54.2	0.593	-62.6
300.00	0.498	-120.2	11.740	107.7	0.069	50.1	0.443	-78.3
400.00	0.467	-138.8	9.163	98.5	0.077	46.5	0.350	-88.7
500.00	0.453	-152.8	7.523	91.7	0.085	48.5	0.304	-99.0
600.00	0.452	-163.7	6.335	86.0	0.094	48.3	0.260	-107.8
700.00	0.449	-172.6	5.494	81.2	0.106	49.4	0.231	-114.9
800.00	0.452	179.8	4.847	76.8	0.119	47.6	0.213	-123.1
900.00	0.451	172.9	4.318	72.6	0.123	47.7	0.194	-131.3
1000.00	0.458	167.1	3.891	69.1	0.136	47.0	0.188	-135.6
1100.00	0.467	161.4	3.550	65.3	0.146	46.9	0.189	-145.9
1200.00	0.476	157.5	3.251	62.2	0.155	45.1	0.187	-152.3
1300.00	0.482	152.5	3.045	58.5	0.164	45.0	0.185	-158.8
1400.00	0.502	148.6	2.809	54.8	0.173	44.0	0.198	-161.4
1500.00	0.507	144.6	2.638	51.8	0.181	43.0	0.194	-170.2
1600.00	0.512	142.1	2.471	49.0	0.191	41.3	0.205	-174.3
1700.00	0.527	137.6	2.310	45.9	0.197	39.2	0.212	-178.3
1800.00	0.527	133.8	2.196	43.6	0.209	38.1	0.228	177.2
1900.00	0.543	130.8	2.065	40.6	0.217	37.3	0.224	169.1
2000.00	0.545	126.7	1.974	38.1	0.223	35.5	0.234	168.6

V<sub>CE</sub> = 3 V, I<sub>C</sub> = 1 mA, Z<sub>O</sub> = 50 Ω

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.965	-14.8	3.499	168.1	0.034	82.6	0.987	-6.7
200.00	0.944	-29.7	3.439	157.3	0.066	72.1	0.969	-13.1
300.00	0.916	-43.8	3.305	147.1	0.093	64.7	0.940	-19.3
400.00	0.868	-57.8	3.130	136.5	0.116	55.3	0.898	-24.8
500.00	0.831	-71.2	2.978	126.8	0.136	48.8	0.855	-29.8
600.00	0.785	-83.5	2.769	117.8	0.150	41.7	0.816	-34.8
700.00	0.742	-95.4	2.610	109.8	0.167	37.0	0.778	-37.8
800.00	0.712	-106.8	2.435	102.4	0.172	32.5	0.728	-41.7
900.00	0.685	-117.6	2.307	95.0	0.180	26.4	0.703	-44.6
1000.00	0.656	-127.8	2.133	88.3	0.183	22.1	0.667	-47.4
1100.00	0.641	-137.8	2.029	82.3	0.182	19.2	0.637	-50.3
1200.00	0.631	-146.7	1.881	76.7	0.180	16.9	0.609	-53.6
1300.00	0.625	-155.8	1.801	71.4	0.179	13.1	0.592	-56.1
1400.00	0.622	-164.7	1.703	65.7	0.176	9.9	0.577	-59.2
1500.00	0.627	-172.0	1.605	61.0	0.176	9.6	0.561	-61.7
1600.00	0.622	-177.2	1.520	56.3	0.170	9.2	0.543	-64.7
1700.00	0.623	174.5	1.434	51.9	0.167	6.5	0.531	-67.1
1800.00	0.615	168.2	1.369	48.1	0.166	7.6	0.516	-71.0
1900.00	0.621	162.9	1.310	44.2	0.159	6.4	0.505	-73.2
2000.00	0.618	157.0	1.257	39.8	0.157	6.8	0.505	-74.4

$V_{CE} = 3\text{ V}$ ,  $I_C = 3\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.898	-23.3	9.607	162.0	0.033	75.5	0.956	-13.1
200.00	0.834	-45.3	8.890	146.4	0.059	65.2	0.892	-24.3
300.00	0.758	-64.2	7.932	133.5	0.081	54.5	0.801	-33.8
400.00	0.682	-82.0	6.964	121.9	0.095	49.4	0.711	-40.6
500.00	0.623	-97.2	6.174	112.4	0.105	44.9	0.636	-46.5
600.00	0.570	-110.9	5.436	104.2	0.110	41.7	0.573	-50.9
700.00	0.533	-122.3	4.874	97.3	0.120	37.4	0.522	-54.1
800.00	0.511	-134.8	4.398	91.2	0.122	35.7	0.474	-56.7
900.00	0.493	-145.1	4.012	85.4	0.127	33.8	0.443	-59.2
1000.00	0.477	-153.9	3.648	80.2	0.132	31.9	0.407	-61.6
1100.00	0.477	-163.5	3.380	75.5	0.136	33.6	0.383	-64.3
1200.00	0.471	-170.6	3.099	71.2	0.137	31.5	0.357	-66.9
1300.00	0.479	-178.8	2.915	66.9	0.141	32.2	0.337	-69.8
1400.00	0.486	174.1	2.724	62.7	0.149	30.1	0.325	-72.3
1500.00	0.492	167.4	2.554	58.6	0.149	30.6	0.311	-75.4
1600.00	0.493	164.1	2.399	55.3	0.152	29.4	0.298	-79.1
1700.00	0.498	156.6	2.247	51.7	0.164	31.3	0.290	-80.7
1800.00	0.503	152.4	2.144	48.2	0.165	29.4	0.274	-89.1
1900.00	0.513	148.8	2.032	44.9	0.169	30.0	0.253	-88.2
2000.00	0.519	143.3	1.944	41.8	0.170	29.8	0.250	-91.9

$V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.839	-29.8	14.278	157.2	0.031	77.2	0.935	-17.7
200.00	0.736	-56.5	12.457	138.9	0.053	65.0	0.819	-31.9
300.00	0.651	-77.6	10.528	125.1	0.071	56.2	0.694	-42.5
400.00	0.568	-96.3	8.837	113.9	0.081	48.5	0.594	-48.9
500.00	0.515	-111.8	7.559	105.1	0.091	46.6	0.515	-54.8
600.00	0.471	-125.7	6.524	97.8	0.094	44.8	0.452	-58.9
700.00	0.445	-137.6	5.768	91.7	0.101	41.4	0.408	-61.3
800.00	0.436	-148.3	5.134	86.4	0.107	41.0	0.363	-64.6
900.00	0.422	-158.6	4.637	81.3	0.112	40.5	0.335	-66.8
1000.00	0.421	-166.4	4.199	76.8	0.120	40.8	0.308	-69.0
1100.00	0.416	175.0	3.864	72.8	0.123	40.9	0.281	-71.7
1200.00	0.422	178.6	3.540	68.9	0.136	41.3	0.263	-75.9
1300.00	0.430	171.7	3.320	64.9	0.142	40.1	0.245	-80.3
1400.00	0.439	165.9	3.085	61.1	0.145	40.3	0.241	-81.6
1500.00	0.451	159.6	2.888	57.6	0.154	40.3	0.227	-86.3
1600.00	0.457	156.3	2.718	54.6	0.157	38.4	0.211	-90.4
1700.00	0.464	149.7	2.539	51.2	0.164	37.3	0.202	-92.0
1800.00	0.467	145.7	2.410	48.2	0.170	36.8	0.194	-102.8
1900.00	0.483	141.5	2.286	45.1	0.173	36.1	0.172	-102.5
2000.00	0.485	137.6	2.183	42.0	0.181	35.6	0.173	-107.3



$V_{CE} = 3\text{ V}$ ,  $I_C = 7\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.769	-35.8	18.610	152.6	0.026	73.9	0.890	-22.5
200.00	0.658	-66.3	15.310	132.5	0.051	59.8	0.743	-38.5
300.00	0.561	-88.8	12.331	118.8	0.061	53.2	0.604	-49.4
400.00	0.485	-107.9	10.032	108.3	0.071	51.0	0.504	-55.6
500.00	0.444	-124.0	8.438	100.3	0.076	48.0	0.423	-60.5
600.00	0.411	-137.7	7.186	93.6	0.084	49.0	0.371	-64.1
700.00	0.397	-148.5	6.299	88.2	0.093	46.8	0.327	-66.8
800.00	0.395	-158.2	5.583	83.4	0.101	47.6	0.290	-70.2
900.00	0.386	-167.9	5.020	78.8	0.106	48.0	0.268	-73.3
1000.00	0.389	-175.7	4.526	74.7	0.118	44.9	0.245	-75.7
1100.00	0.392	176.0	4.151	70.8	0.126	44.6	0.226	-79.4
1200.00	0.396	170.9	3.801	67.5	0.131	45.8	0.203	-83.8
1300.00	0.404	164.8	3.555	63.7	0.140	44.1	0.195	-87.1
1400.00	0.417	158.7	3.304	60.1	0.150	45.1	0.189	-92.1
1500.00	0.426	153.6	3.091	56.6	0.157	45.6	0.177	-96.9
1600.00	0.432	151.9	2.906	53.9	0.162	42.7	0.168	-103.4
1700.00	0.443	145.2	2.712	50.6	0.173	41.8	0.160	-106.6
1800.00	0.446	141.4	2.588	48.1	0.179	41.6	0.157	-115.7
1900.00	0.466	137.6	2.435	45.2	0.182	41.7	0.141	-120.9
2000.00	0.470	133.4	2.339	42.2	0.192	37.3	0.146	-125.3

$V_{CE} = 3\text{ V}$ ,  $I_C = 10\text{ mA}$ ,  $Z_O = 50\ \Omega$

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	0.698	-42.9	22.901	147.9	0.025	67.3	0.849	-26.9
200.00	0.570	-77.2	17.709	126.7	0.042	60.5	0.666	-44.8
300.00	0.482	-100.1	13.726	113.5	0.055	53.5	0.527	-55.1
400.00	0.424	-119.5	10.922	103.8	0.066	52.4	0.424	-60.8
500.00	0.391	-134.8	9.033	96.5	0.073	52.7	0.359	-66.2
600.00	0.370	-147.6	7.653	90.6	0.083	52.2	0.307	-69.7
700.00	0.364	-158.4	6.669	85.5	0.090	53.4	0.276	-72.5
800.00	0.361	-167.4	5.894	81.1	0.097	52.7	0.243	-75.0
900.00	0.363	-176.0	5.278	76.9	0.107	51.5	0.223	-79.0
1000.00	0.366	177.1	4.764	73.1	0.113	50.6	0.201	-79.3
1100.00	0.368	170.5	4.356	69.6	0.123	50.9	0.182	-85.7
1200.00	0.378	165.3	3.992	66.4	0.129	50.8	0.174	-94.5
1300.00	0.391	159.7	3.733	62.8	0.138	49.8	0.156	-96.1
1400.00	0.402	154.4	3.461	59.4	0.151	47.6	0.158	-101.5
1500.00	0.417	150.4	3.221	56.2	0.162	47.2	0.149	-107.4
1600.00	0.420	147.3	3.035	53.6	0.164	46.2	0.138	-117.4
1700.00	0.431	142.1	2.831	50.6	0.172	44.9	0.135	-120.2
1800.00	0.434	138.4	2.703	47.7	0.179	44.2	0.142	-130.9
1900.00	0.454	135.4	2.547	45.0	0.189	43.0	0.126	-137.6
2000.00	0.461	130.8	2.434	42.1	0.196	40.8	0.127	-143.0

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