

NPN SILICON EPITAXIAL TRANSISTOR
3 PINS ULTRA SUPER MINI MOLD

DESCRIPTION

The 2SC5009 is an NPN epitaxial silicon transistor designed for use in low noise and small signal amplifiers from VHF band to L band. Low noise figure, high gain, and high current capability achieve a very wide dynamic range and excellent linearity. This is achieved by direct nitride passivated base surface process (NEST3 process) which is an NEC proprietary new fabrication technique.

FEATURES

- Low Voltage Use.
- High f_T : 12.0 GHz TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 5\text{ mA}$, $f = 2\text{ GHz}$)
- Low C_{re} : 0.3 pF TYP. (@ $V_{CE} = 3\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$)
- Low NF : 2.5 dB TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 3\text{ mA}$, $f = 2\text{ GHz}$)
- High $|S_{21e}|^2$: 8.5 dB TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 5\text{ mA}$, $f = 2\text{ GHz}$)
- Ultra Super Mini Mold Package.

ORDERING INFORMATION

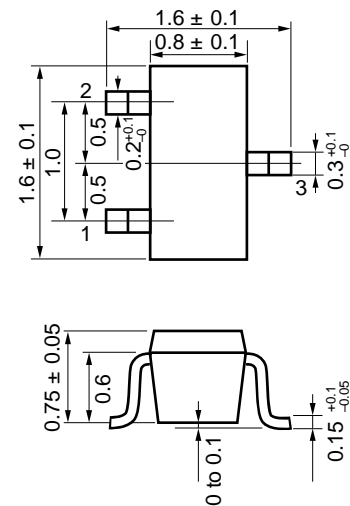
PART NUMBER	QUANTITY	PACKING STYLE
2SC5009	50 pcs./Unit	Embossed tape 8 mm wide. Pin 3 (Collector) face to perforation side of the tape.
2SC5009-T1	3 kpcs./Reel	

* Please contact with responsible NEC person, if you require evaluation sample. Unit sample quantity shall be 50 pcs.

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

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	10	mA
Total Power Dissipation	P_T	60	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

PACKAGE DIMENSIONS
in millimeters



1. Emitter
2. Base
3. Collector

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Collector Cutoff Current	I _{CB0}			0.1	μA	V _{CB} = 5 V, I _E = 0
Emitter Cutoff Current	I _{EB0}			0.1	μA	V _{EB} = 1 V, I _C = 0
DC Current Gain	h _{FE}	75		150		V _{CE} = 3 V, I _C = 5 mA* ¹
Gain Bandwidth Product	f _T		12.0		GHz	V _{CE} = 3 V, I _C = 5 mA, f = 2 GHz
Feed-back Capacitance	C _{re}		0.3	0.5	pF	V _{CB} = 3 V, I _E = 0, f = 1 MHz* ²
Insertion Power Gain	S _{21e} ²	7.0	8.5		dB	V _{CE} = 3 V, I _C = 5 mA, f = 2 GHz
Noise Figure	NF		2.5	4.0	dB	V _{CE} = 3 V, I _C = 3 mA, f = 2 GHz

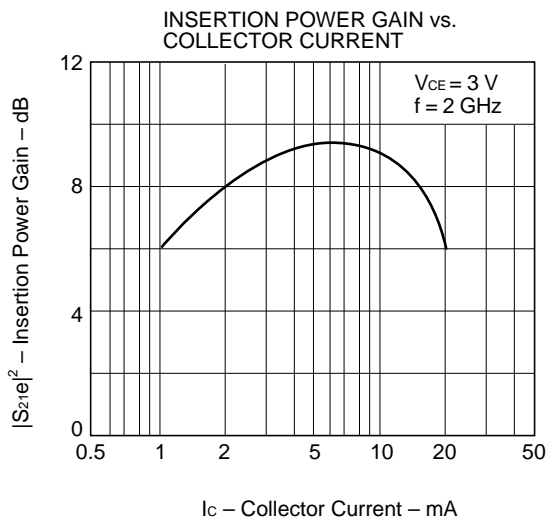
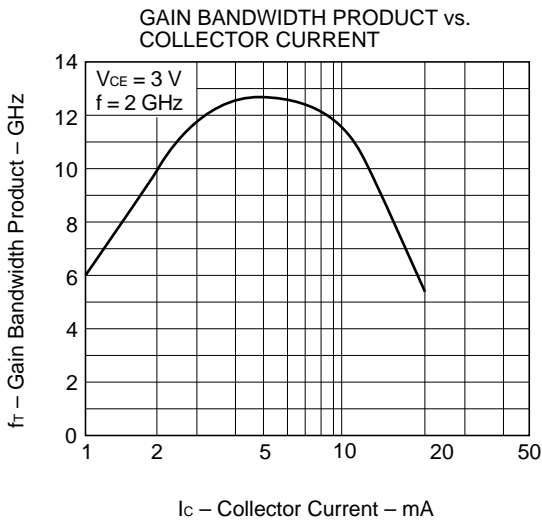
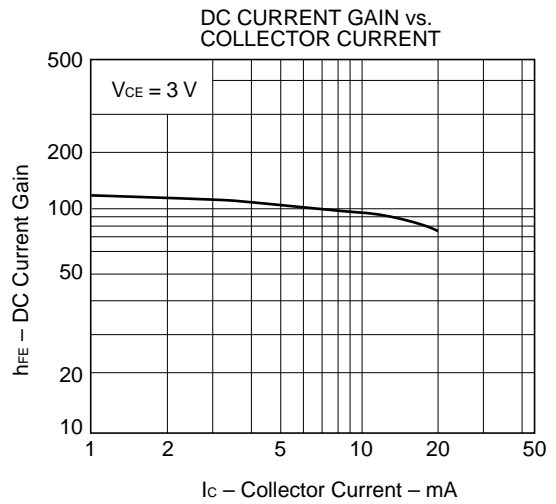
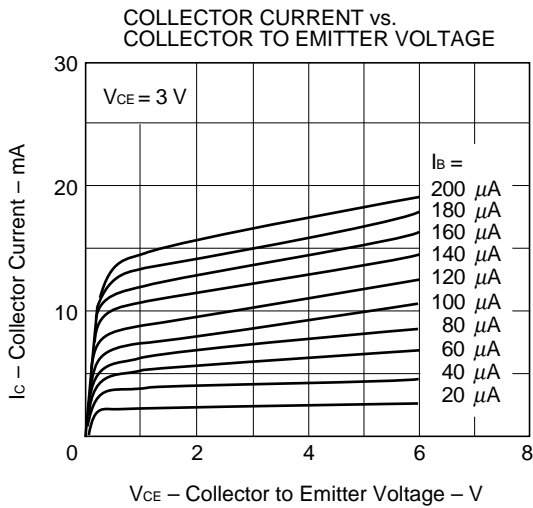
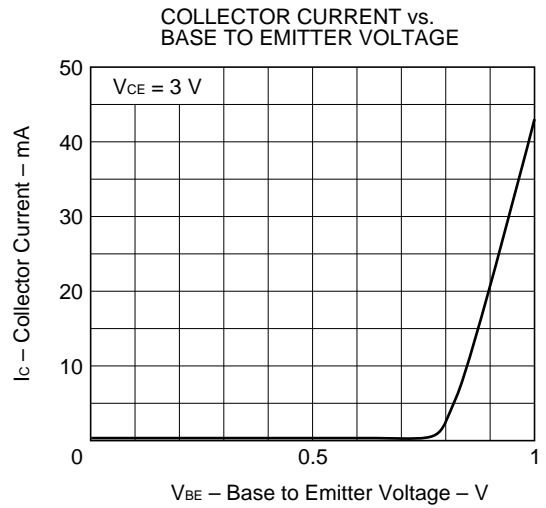
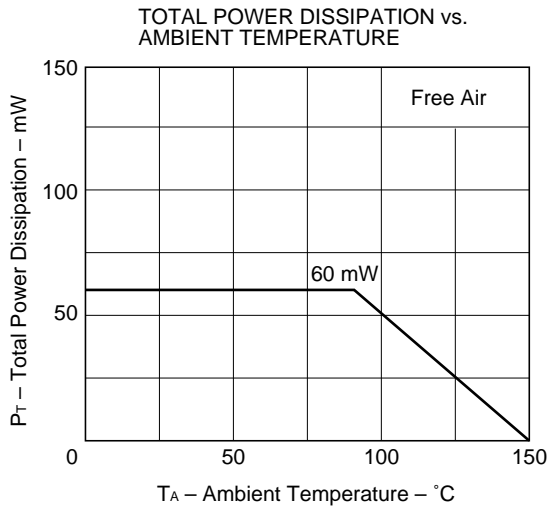
*1 Pulse Measurement PW ≤ 350 μs, Duty Cycle ≤ 2 %

*2 The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

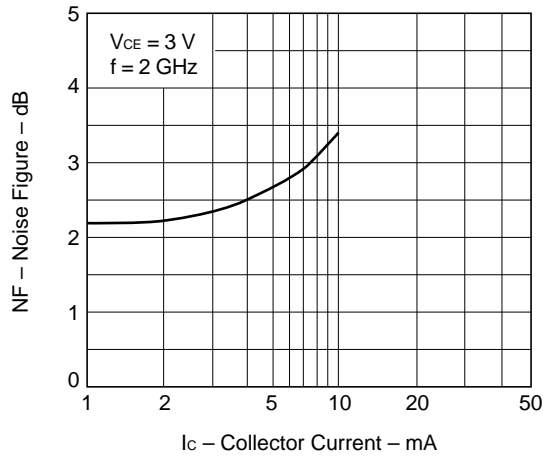
h_{FE} Classification

RANK	FB
Marking	82
h _{FE}	75 to 150

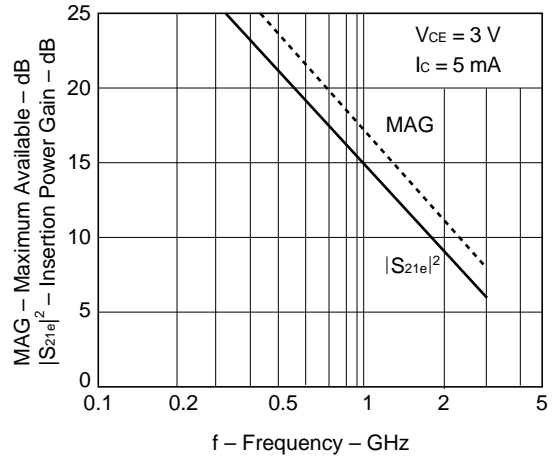
TYPICAL CHARACTERISTICS (T_A = 25 °C)



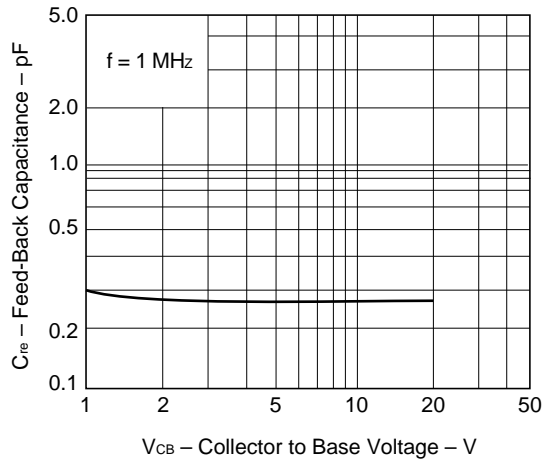
NOISE FIGURE vs.
COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN,
INSERTION POWER GAIN vs. FREQUENCY



FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



S-PARAMETER

(V_{CE} = 3 V, I_c = 7 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.823	-7.1	8.540	153.6	.014	86.5	.979	-6.6
200.00	.791	-16.4	8.151	150.6	.028	77.4	.950	-12.5
300.00	.749	-24.5	7.885	144.1	.041	74.4	.904	-17.8
400.00	.701	-32.0	7.524	136.7	.051	70.2	.857	-22.2
500.00	.648	-38.6	7.149	129.8	.061	67.4	.810	-25.5
600.00	.596	-44.6	6.672	123.2	.069	65.1	.768	-28.4
700.00	.545	-49.6	6.267	117.1	.077	63.0	.728	-30.7
800.00	.499	-54.7	5.890	111.3	.084	61.3	.693	-32.5
900.00	.453	-58.8	5.505	106.4	.092	60.5	.662	-34.4
1000.00	.413	-62.5	5.185	101.6	.099	59.6	.636	-35.6
1100.00	.375	-66.1	4.873	97.2	.106	58.7	.612	-36.9
1200.00	.341	-69.3	4.595	93.2	.113	57.4	.590	-38.2
1300.00	.308	-72.3	4.335	89.2	.120	56.9	.574	-39.2
1400.00	.280	-75.6	4.088	85.7	.126	56.0	.556	-40.5
1500.00	.254	-78.3	3.882	82.1	.134	55.3	.540	-41.5
1600.00	.230	-81.2	3.691	78.9	.141	54.6	.526	-42.9
1700.00	.207	-84.3	3.521	75.8	.147	53.8	.515	-44.1
1800.00	.186	-87.4	3.366	72.9	.154	53.2	.503	-45.5
1900.00	.166	-90.7	3.222	70.0	.161	52.3	.491	-46.8
2000.00	.151	-95.2	3.093	67.1	.169	51.3	.470	-47.7
2100.00	.134	-99.4	2.980	64.5	.177	50.3	.457	-49.1
2200.00	.119	-104.0	2.870	62.0	.184	49.3	.445	-50.6
2300.00	.105	-110.4	2.772	59.3	.191	48.5	.434	-52.1
2400.00	.091	-118.3	2.686	56.8	.198	47.3	.421	-53.8
2500.00	.080	-127.7	2.594	54.2	.206	46.3	.411	-55.4
2600.00	.073	-139.6	2.521	52.0	.214	45.2	.398	-57.5
2700.00	.067	-152.7	2.447	49.5	.222	44.2	.386	-59.3
2800.00	.065	-168.2	2.379	47.1	.227	43.3	.374	-61.1
2900.00	.067	-178.3	2.317	44.7	.235	42.1	.361	-62.8
3000.00	.071	-166.7	2.253	42.6	.242	40.7	.349	-64.8

(V_{CE} = 3 V, I_c = 5 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.866	-5.7	6.885	155.4	.015	83.5	.985	-5.8
200.00	.844	-13.2	6.690	154.2	.029	79.3	.966	-11.2
300.00	.816	-20.0	6.614	149.0	.041	75.3	.932	-16.2
400.00	.780	-26.5	6.457	142.7	.053	72.0	.896	-20.7
500.00	.740	-32.8	6.310	136.7	.064	68.2	.855	-24.4
600.00	.698	-38.5	5.990	130.4	.074	65.8	.816	-27.9
700.00	.650	-44.0	5.766	124.5	.083	63.5	.777	-30.8
800.00	.607	-49.3	5.537	118.6	.092	61.5	.740	-33.3
900.00	.560	-53.8	5.266	113.2	.098	59.9	.706	-35.6
1000.00	.513	-58.4	5.033	108.0	.105	58.9	.674	-37.4
1100.00	.471	-62.4	4.800	103.2	.113	57.1	.647	-39.0
1200.00	.430	-66.2	4.571	98.5	.120	55.6	.621	-40.7
1300.00	.395	-69.7	4.345	94.5	.126	55.1	.599	-41.9
1400.00	.361	-73.3	4.123	90.5	.133	53.8	.578	-43.3
1500.00	.330	-76.4	3.924	86.7	.139	52.9	.561	-44.7
1600.00	.300	-79.6	3.751	83.1	.146	52.2	.543	-46.1
1700.00	.274	-82.8	3.592	79.7	.152	51.2	.526	-47.1
1800.00	.250	-85.9	3.435	76.5	.159	50.4	.514	-48.7
1900.00	.226	-89.3	3.300	73.5	.166	49.9	.499	-50.1
2000.00	.208	-92.9	3.178	70.6	.174	48.7	.476	-51.1
2100.00	.188	-97.0	3.055	67.7	.181	47.9	.460	-52.5
2200.00	.170	-101.1	2.946	64.9	.188	47.1	.448	-54.1
2300.00	.151	-105.7	2.849	62.1	.195	46.1	.434	-55.6
2400.00	.136	-111.3	2.757	59.4	.201	44.9	.419	-57.3
2500.00	.121	-118.4	2.670	56.8	.210	43.9	.408	-58.9
2600.00	.109	-126.0	2.594	54.3	.216	43.0	.395	-60.9
2700.00	.099	-135.3	2.521	51.8	.223	41.9	.382	-62.9
2800.00	.090	-145.5	2.450	49.4	.229	40.8	.368	-64.4
2900.00	.086	-156.8	2.381	46.9	.236	40.1	.355	-66.1
3000.00	.083	-168.1	2.317	44.6	.243	38.7	.341	-68.1

S-PARAMETER

(V_{CE} = 3 V, I_c = 3 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.907	-4.4	4.749	157.0	.015	86.0	.990	-4.8
200.00	.891	-9.9	4.677	157.3	.029	80.9	.979	-9.4
300.00	.877	-15.1	4.716	153.6	.042	77.6	.956	-13.9
400.00	.855	-20.5	4.696	148.3	.056	74.2	.933	-18.1
500.00	.828	-25.7	4.688	143.6	.068	70.9	.903	-21.9
600.00	.800	-30.4	4.513	138.2	.079	67.7	.875	-25.5
700.00	.767	-35.4	4.450	132.9	.089	64.7	.842	-28.8
800.00	.736	-40.4	4.370	127.5	.099	62.2	.810	-31.8
900.00	.697	-44.8	4.233	122.5	.107	60.2	.776	-34.8
1000.00	.656	-49.9	4.195	117.2	.115	57.5	.745	-37.0
1100.00	.610	-54.6	4.117	112.2	.123	56.3	.715	-39.3
1200.00	.568	-59.0	4.021	107.0	.129	54.4	.684	-41.3
1300.00	.528	-63.1	3.871	102.5	.137	52.7	.661	-43.1
1400.00	.489	-67.1	3.749	98.0	.143	51.8	.637	-44.8
1500.00	.454	-70.6	3.612	93.8	.151	50.5	.615	-46.5
1600.00	.419	-73.9	3.484	89.8	.156	49.6	.594	-48.1
1700.00	.386	-77.7	3.369	86.0	.162	48.7	.575	-49.7
1800.00	.356	-81.0	3.232	82.5	.169	47.6	.558	-51.3
1900.00	.328	-84.2	3.127	79.0	.175	46.7	.540	-52.9
2000.00	.302	-88.1	3.029	75.7	.184	45.5	.514	-54.3
2100.00	.279	-91.5	2.928	72.6	.189	44.4	.497	-55.9
2200.00	.256	-95.1	2.832	69.5	.197	43.4	.482	-57.5
2300.00	.233	-99.3	2.755	66.4	.203	42.5	.466	-59.2
2400.00	.213	-103.7	2.669	63.5	.209	41.6	.449	-61.0
2500.00	.193	-108.2	2.588	60.6	.216	40.6	.436	-62.6
2600.00	.178	-114.1	2.526	58.0	.222	39.8	.421	-63.9
2700.00	.160	-119.7	2.455	55.2	.229	38.4	.405	-66.5
2800.00	.146	-126.7	2.390	52.5	.235	37.6	.389	-68.4
2900.00	.134	-134.5	2.331	49.8	.241	36.6	.376	-70.1
3000.00	.123	-142.0	2.269	47.4	.248	35.1	.361	-72.1

(V_{CE} = 3 V, I_c = 1 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.955	-2.7	1.800	158.4	.014	86.4	.994	-3.3
200.00	.943	-6.1	1.806	161.4	.029	83.2	.995	-6.4
300.00	.943	-9.2	1.859	159.5	.045	80.9	.985	-9.4
400.00	.932	-12.6	1.885	155.9	.059	77.8	.979	-12.7
500.00	.928	-15.8	1.941	152.5	.074	74.8	.968	-15.6
600.00	.920	-19.0	1.900	148.4	.086	72.2	.960	-18.6
700.00	.908	-22.2	1.911	144.3	.100	69.5	.947	-21.7
800.00	.900	-25.6	1.912	139.9	.113	66.5	.931	-24.6
900.00	.883	-28.6	1.867	135.4	.126	63.7	.914	-27.8
1000.00	.866	-32.2	1.910	131.6	.136	61.5	.896	-30.5
1100.00	.845	-36.0	1.954	127.5	.148	58.6	.875	-33.3
1200.00	.822	-40.0	1.989	123.3	.157	56.1	.851	-35.9
1300.00	.798	-43.5	1.998	118.9	.167	54.2	.833	-38.4
1400.00	.772	-47.5	2.018	114.9	.175	51.6	.810	-41.0
1500.00	.748	-50.8	2.008	110.7	.185	49.8	.792	-43.4
1600.00	.722	-54.3	1.974	106.7	.192	47.5	.770	-45.8
1700.00	.693	-58.2	1.992	102.5	.200	45.8	.749	-48.0
1800.00	.672	-61.2	1.935	98.8	.207	44.2	.731	-50.5
1900.00	.642	-64.8	1.929	95.2	.213	42.7	.708	-52.6
2000.00	.610	-69.2	1.946	91.2	.223	40.8	.683	-54.7
2100.00	.582	-72.4	1.915	87.7	.230	39.1	.662	-57.0
2200.00	.550	-76.5	1.906	83.8	.238	37.4	.643	-59.1
2300.00	.516	-80.4	1.925	79.9	.242	36.1	.621	-61.4
2400.00	.493	-84.0	1.887	76.7	.249	34.4	.602	-63.7
2500.00	.466	-87.9	1.866	73.2	.253	32.9	.586	-65.8
2600.00	.438	-91.6	1.864	69.7	.259	32.0	.554	-68.1
2700.00	.408	-96.0	1.838	66.2	.265	29.9	.547	-70.6
2800.00	.380	-100.2	1.815	62.8	.269	28.5	.530	-73.0
2900.00	.353	-105.2	1.806	59.4	.274	27.3	.508	-75.0
3000.00	.330	-109.4	1.781	56.4	.279	25.9	.492	-77.4

S-PARAMETER

(V_{CE} = 3 V, I_c = 5 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.848	-7.5	6.214	154.0	.017	81.7	.976	-6.2
200.00	.815	-16.8	5.946	152.2	.033	78.1	.956	-12.0
300.00	.783	-25.0	5.820	146.4	.048	73.3	.922	-17.5
400.00	.741	-32.7	5.623	139.7	.062	68.6	.883	-22.4
500.00	.698	-40.2	5.466	133.3	.073	64.7	.837	-26.5
600.00	.647	-47.1	5.176	126.5	.083	61.5	.793	-30.1
700.00	.596	-53.6	4.962	120.2	.092	59.5	.752	-33.3
800.00	.549	-60.0	4.751	114.1	.101	56.8	.710	-35.9
900.00	.501	-65.5	4.506	108.3	.108	55.4	.673	-38.3
1000.00	.453	-71.2	4.304	103.1	.114	53.0	.639	-40.0
1100.00	.409	-76.2	4.089	98.0	.121	52.4	.609	-41.6
1200.00	.369	-81.3	3.886	93.3	.127	51.1	.583	-43.0
1300.00	.332	-85.7	3.680	89.1	.134	50.5	.559	-44.3
1400.00	.298	-90.3	3.495	84.9	.139	49.6	.540	-45.6
1500.00	.266	-95.2	3.318	81.1	.146	49.1	.520	-46.6
1600.00	.237	-99.6	3.163	77.4	.153	48.3	.504	-47.8
1700.00	.213	-104.6	3.024	74.0	.158	47.5	.487	-49.1
1800.00	.190	-110.0	2.885	70.7	.164	47.3	.476	-50.6
1900.00	.168	-116.0	2.770	67.6	.171	46.5	.461	-51.8
2000.00	.154	-121.6	2.658	64.5	.180	45.9	.437	-52.9
2100.00	.139	-129.2	2.557	61.6	.186	44.9	.423	-54.1
2200.00	.125	-136.5	2.467	58.6	.194	44.4	.412	-55.6
2300.00	.115	-146.2	2.386	56.0	.200	43.1	.399	-57.1
2400.00	.108	-155.8	2.308	53.3	.207	42.5	.384	-59.0
2500.00	.104	-166.9	2.231	50.5	.215	41.7	.375	-60.5
2600.00	.103	-177.4	2.172	48.0	.222	40.6	.363	-62.5
2700.00	.105	171.6	2.104	45.5	.228	39.9	.349	-64.6
2800.00	.110	162.0	2.045	43.1	.236	38.7	.337	-66.4
2900.00	.117	154.2	1.990	40.6	.242	37.8	.324	-68.4
3000.00	.124	146.9	1.939	38.3	.250	36.5	.313	-70.2

(V_{CE} = 3 V, I_c = 3 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.901	-5.2	4.504	156.3	.017	85.9	.987	-5.1
200.00	.883	-11.4	4.431	156.9	.033	80.5	.978	-10.1
300.00	.867	-17.2	4.464	153.0	.049	76.5	.956	-14.8
400.00	.842	-23.0	4.442	147.8	.063	73.1	.932	-19.5
500.00	.816	-28.8	4.434	142.8	.077	69.4	.900	-23.8
600.00	.787	-34.1	4.278	137.2	.090	65.6	.870	-27.9
700.00	.753	-39.7	4.215	131.7	.101	62.2	.836	-31.6
800.00	.719	-45.3	4.151	126.0	.111	59.3	.799	-35.0
900.00	.678	-50.3	4.031	120.9	.120	56.7	.760	-38.4
1000.00	.635	-56.2	3.993	115.3	.128	54.5	.725	-41.1
1100.00	.590	-61.6	3.920	109.9	.136	52.5	.690	-43.5
1200.00	.544	-66.7	3.816	104.7	.143	50.5	.659	-45.7
1300.00	.502	-71.5	3.683	99.9	.149	49.1	.629	-47.7
1400.00	.461	-76.2	3.566	95.2	.156	47.9	.602	-49.6
1500.00	.424	-80.4	3.421	90.9	.162	46.4	.577	-51.4
1600.00	.387	-84.7	3.293	86.7	.167	45.6	.554	-53.1
1700.00	.353	-89.1	3.185	82.7	.174	44.6	.530	-54.7
1800.00	.324	-93.2	3.051	79.1	.179	43.7	.513	-56.5
1900.00	.293	-97.7	2.949	75.4	.185	43.1	.494	-58.1
2000.00	.270	-102.3	2.850	72.1	.193	41.7	.465	-59.5
2100.00	.245	-106.9	2.750	68.8	.199	40.8	.445	-61.1
2200.00	.225	-111.8	2.661	65.8	.206	40.0	.429	-62.9
2300.00	.204	-117.4	2.581	62.5	.213	39.1	.412	-64.4
2400.00	.186	-123.5	2.500	59.6	.218	37.8	.395	-66.3
2500.00	.169	-130.5	2.420	56.7	.225	37.2	.382	-67.8
2600.00	.156	-137.7	2.353	53.9	.231	36.2	.365	-70.2
2700.00	.146	-146.1	2.288	51.2	.238	35.2	.351	-72.0
2800.00	.137	-155.0	2.223	48.5	.244	34.4	.336	-74.0
2900.00	.133	-164.2	2.165	45.8	.249	33.5	.320	-75.8
3000.00	.130	-173.1	2.108	43.4	.257	32.1	.306	-78.1

S-PARAMETER

(V_{CE} = 3 V, I_c = 1 mA, Z_o = 50 Ω)

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.950	-2.9	1.790	158.9	.017	87.7	.994	-3.5
200.00	.942	-6.4	1.783	161.5	.033	83.8	.995	-6.8
300.00	.942	-9.7	1.832	159.5	.050	81.1	.984	-10.2
400.00	.930	-13.4	1.863	155.8	.067	77.2	.978	-13.7
500.00	.926	-16.8	1.914	152.3	.082	74.3	.967	-16.9
600.00	.917	-20.1	1.873	147.9	.097	71.5	.958	-20.2
700.00	.903	-23.7	1.886	143.8	.112	68.3	.944	-23.4
800.00	.897	-27.2	1.893	139.1	.127	65.2	.927	-26.6
900.00	.876	-30.6	1.850	134.6	.140	62.1	.910	-30.1
1000.00	.861	-34.4	1.891	130.3	.152	59.2	.887	-33.2
1100.00	.837	-38.5	1.933	126.1	.165	56.2	.865	-36.2
1200.00	.815	-42.8	1.979	121.8	.175	53.7	.837	-39.2
1300.00	.787	-46.5	1.975	117.2	.186	51.3	.818	-41.9
1400.00	.762	-50.7	1.992	112.9	.195	48.8	.792	-44.7
1500.00	.735	-54.5	1.983	108.6	.204	46.7	.769	-47.4
1600.00	.707	-58.1	1.953	104.4	.212	44.6	.747	-50.1
1700.00	.675	-62.3	1.972	100.2	.220	42.5	.723	-52.5
1800.00	.652	-65.6	1.909	96.3	.227	40.8	.703	-55.2
1900.00	.621	-69.5	1.900	92.5	.233	39.0	.677	-57.4
2000.00	.587	-74.2	1.919	88.3	.243	36.9	.650	-59.7
2100.00	.559	-77.9	1.887	84.6	.249	35.0	.625	-62.3
2200.00	.528	-82.4	1.880	80.7	.256	33.5	.605	-64.5
2300.00	.491	-86.7	1.894	76.7	.261	32.0	.580	-67.0
2400.00	.465	-90.8	1.856	73.3	.267	30.4	.561	-69.4
2500.00	.438	-95.0	1.829	69.8	.272	28.7	.541	-71.7
2600.00	.408	-99.7	1.817	66.2	.277	27.1	.519	-74.6
2700.00	.380	-104.1	1.797	62.7	.282	25.7	.499	-77.0
2800.00	.353	-109.1	1.769	59.3	.286	24.3	.479	-79.5
2900.00	.326	-114.6	1.761	55.8	.290	23.2	.458	-81.8
3000.00	.305	-119.8	1.732	52.8	.295	21.6	.440	-84.3

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