

NPN EPITAXIAL SILICON TRANSISTOR  
4-PIN MINI MOLD

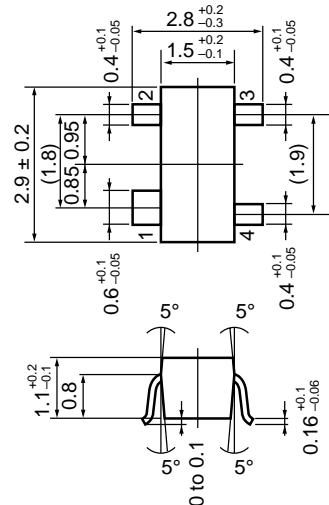
## FEATURE

- High gain, low noise
- Small reverse transfer capacitance
- Can operate at low voltage

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	$I_C$	50	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 DIMENSIONS (in mm)



## PIN CONNECTIONS

- 1: Collector  
2: Emitter  
3: Base  
4: Emitter

ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ )

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	$I_{CBO}$	$V_{CB} = 5\text{ V}, I_E = 0$			0.1	$\mu\text{A}$
Emitter Cut-off Current	$I_{EBO}$	$V_{EB} = 1\text{ V}, I_C = 0$			0.1	$\mu\text{A}$
DC Current Gain	$h_{FE}$	$V_{CE} = 3\text{ V}, I_C = 20\text{ mA}$ <sup>Note 1</sup>	75		150	
Gain Bandwidth Product	$f_T$	$V_{CE} = 3\text{ V}, I_C = 20\text{ mA}, f = 2\text{ GHz}$		14.5		GHz
Reverse Transfer Capacitance	$C_{re}$	$V_{CB} = 3\text{ V}, I_E = 0, f = 1\text{ MHz}$ <sup>Note 2</sup>		0.3	0.5	pF
Insertion Power Gain	$ S_{21e} ^2$	$V_{CE} = 3\text{ V}, I_C = 20\text{ mA}, f = 2\text{ GHz}$	10	12.0		dB
Noise Figure	NF	$V_{CE} = 3\text{ V}, I_C = 5\text{ mA}, f = 2\text{ GHz}$		1.5	2.5	dB

**Notes** 1. Pulse measurement  $P_w \leq 350\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

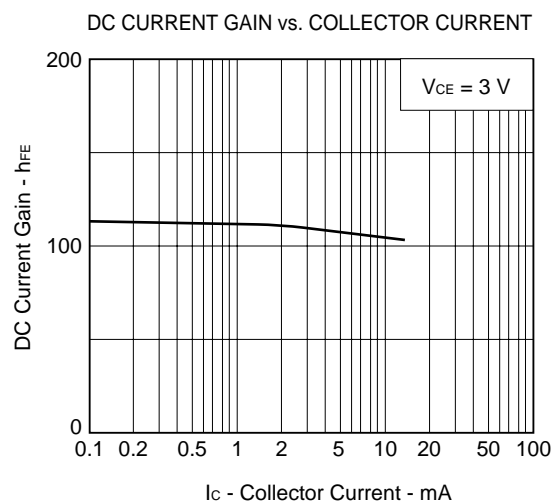
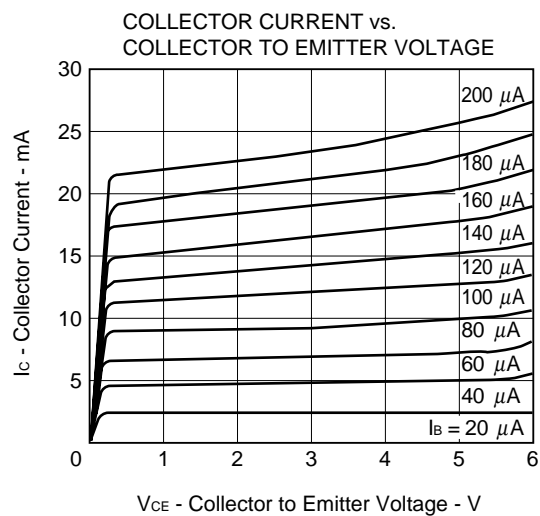
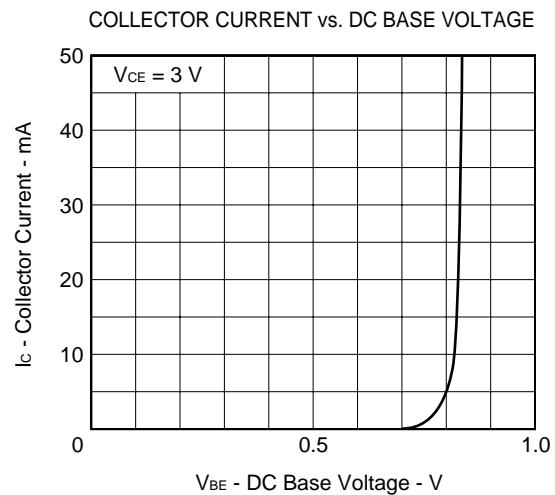
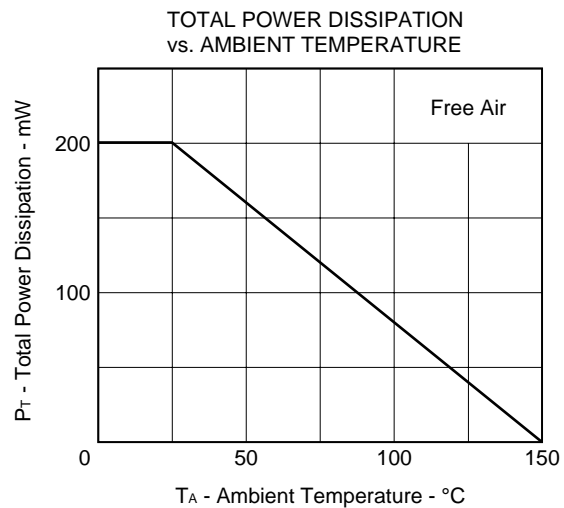
2. Collector to base capacitance measured by capacitance meter (automatic balance bridge method) when emitter pin is connected to the guard pin.

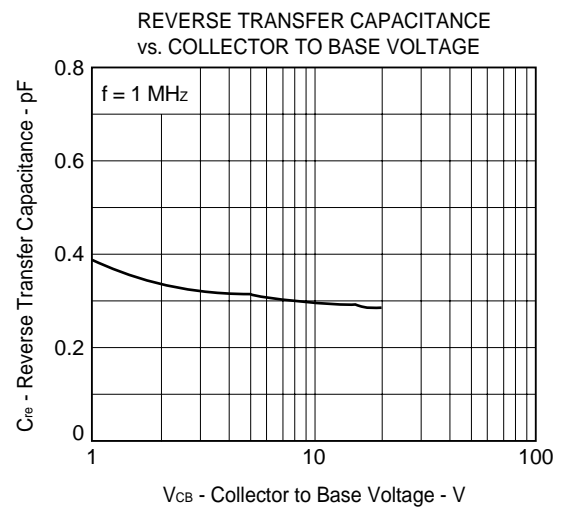
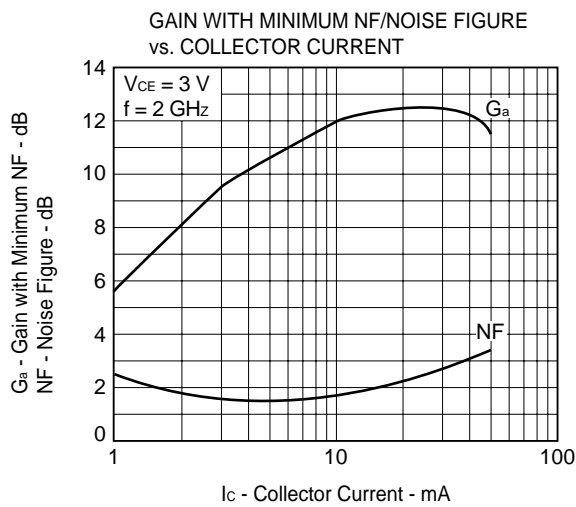
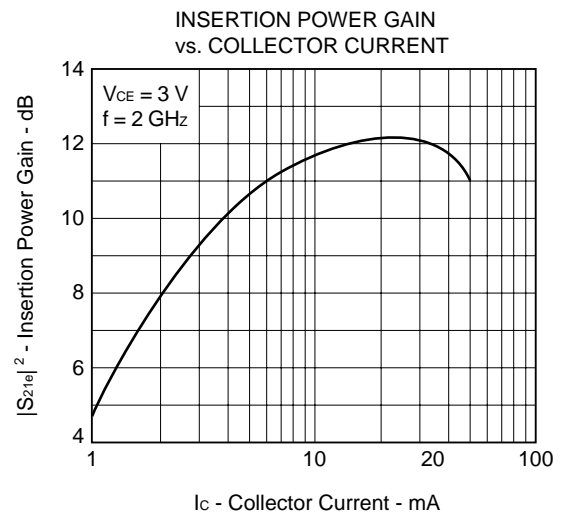
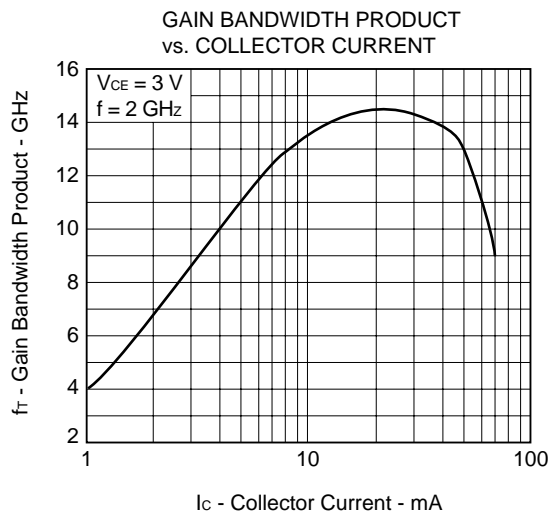
Because this product uses high-frequency process, avoid excessive input of static electricity, etc.

The information in this document is subject to change without notice.

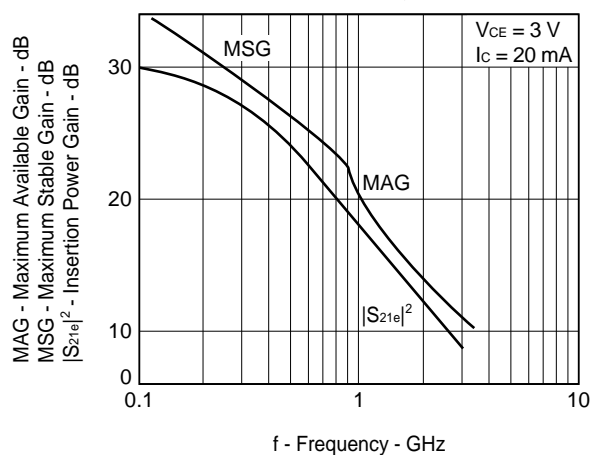
**h<sub>FE</sub> CLASSIFICATION**

RANK	FB
Marking	R54
h <sub>FE</sub>	75 to 150

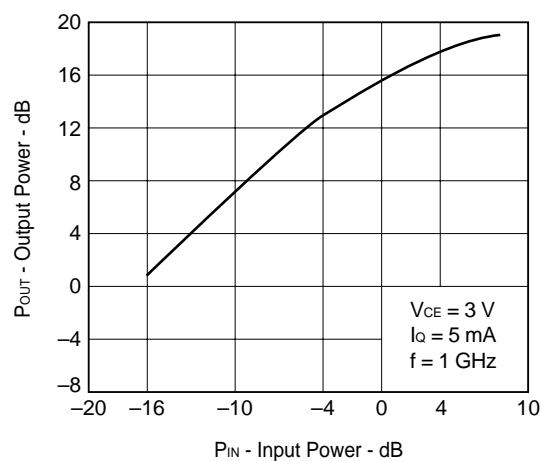
**TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**



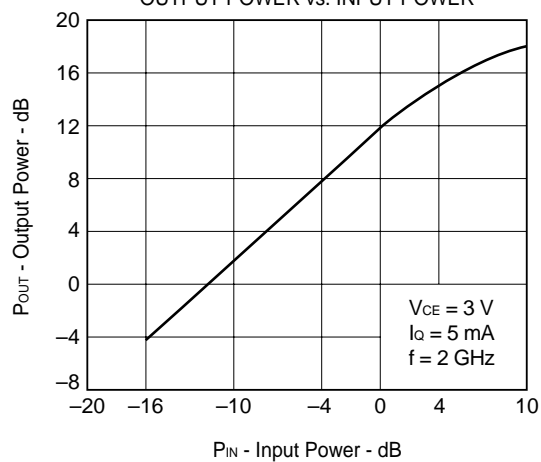
MAXIMUM AVAILABLE GAIN/  
MAXIMUM STABLE GAIN/INSERTION  
POWER GAIN vs. FREQUENCY



OUTPUT POWER vs. INPUT POWER



OUTPUT POWER vs. INPUT POWER



## 2SC5454 S PARAMETER

 $V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.829	-19.2	14.261	164.7	0.015	78.1	0.972	-11.1
200.00	0.783	-37.0	13.252	150.7	0.029	69.1	0.913	-21.6
300.00	0.727	-54.1	12.245	139.2	0.040	59.1	0.843	-30.2
400.00	0.666	-68.7	10.804	129.3	0.048	52.8	0.764	-37.5
500.00	0.606	-82.9	9.964	118.9	0.053	49.2	0.699	-42.6
600.00	0.556	-95.8	9.028	111.1	0.057	44.9	0.645	-47.3
700.00	0.517	-106.6	8.120	104.1	0.061	42.4	0.591	-51.3
800.00	0.486	-117.5	7.393	98.0	0.063	40.0	0.557	-54.4
900.00	0.462	-126.8	6.709	92.5	0.065	39.3	0.518	-57.9
1000.00	0.446	-135.6	6.178	87.4	0.067	38.3	0.491	-60.3
1100.00	0.433	-143.5	5.702	82.9	0.069	38.2	0.470	-63.3
1200.00	0.426	-151.0	5.280	78.5	0.071	37.7	0.450	-65.9
1300.00	0.422	-157.9	4.919	74.6	0.072	38.3	0.433	-69.2
1400.00	0.420	-164.1	4.610	70.6	0.073	37.5	0.420	-71.6
1500.00	0.422	-170.2	4.331	67.0	0.075	37.7	0.408	-75.3
1600.00	0.424	-175.5	4.070	63.3	0.077	39.3	0.400	-78.3
1700.00	0.429	179.4	3.856	59.7	0.078	39.0	0.393	-81.8
1800.00	0.434	174.8	3.661	56.5	0.082	40.2	0.389	-84.7
1900.00	0.441	170.2	3.481	53.1	0.083	40.5	0.378	-89.2
2000.00	0.448	166.4	3.306	50.0	0.086	41.9	0.378	-91.4
2100.00	0.456	162.2	3.150	46.6	0.088	41.7	0.372	-96.5
2200.00	0.465	158.7	3.013	43.5	0.090	42.7	0.378	-98.3
2300.00	0.470	155.1	2.857	40.2	0.093	43.1	0.370	-104.0
2400.00	0.482	151.7	2.758	37.3	0.097	44.1	0.380	-105.1
2500.00	0.484	148.8	2.637	34.8	0.100	45.1	0.378	-110.7
2600.00	0.495	145.8	2.526	31.7	0.105	44.9	0.389	-112.3
2700.00	0.503	143.4	2.456	28.6	0.109	45.7	0.394	-117.8
2800.00	0.512	140.4	2.347	25.9	0.113	45.7	0.403	-120.2
2900.00	0.522	138.0	2.261	22.7	0.119	45.6	0.413	-125.1
3000.00	0.528	135.3	2.171	20.3	0.123	45.0	0.418	-128.1

 $V_{CE} = 3\text{ V}$ ,  $I_C = 10\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.706	-27.6	23.264	159.2	0.014	75.1	0.940	-15.8
200.00	0.636	-52.0	20.474	141.9	0.026	64.8	0.837	-29.1
300.00	0.561	-73.4	17.706	128.5	0.033	57.4	0.724	-38.7
400.00	0.503	-90.1	14.932	118.5	0.039	52.2	0.628	-45.8
500.00	0.457	-105.7	12.978	109.0	0.042	50.5	0.557	-49.8
600.00	0.423	-119.0	11.348	102.1	0.046	49.0	0.503	-53.5
700.00	0.401	-130.0	9.988	96.1	0.049	48.7	0.457	-56.6
800.00	0.386	-140.1	8.935	90.8	0.052	48.1	0.424	-59.5
900.00	0.377	-148.8	8.023	86.3	0.055	48.0	0.394	-61.9
1000.00	0.373	-156.7	7.305	82.0	0.057	48.8	0.374	-64.3
1100.00	0.370	-163.6	6.687	78.2	0.061	48.6	0.355	-67.5
1200.00	0.371	-170.1	6.157	74.4	0.065	48.9	0.342	-69.5
1300.00	0.375	-175.8	5.720	70.9	0.068	49.7	0.326	-73.0
1400.00	0.378	178.9	5.332	67.6	0.071	50.0	0.320	-75.5
1500.00	0.384	174.1	4.997	64.4	0.074	50.5	0.309	-79.4
1600.00	0.389	169.7	4.693	61.1	0.078	50.2	0.307	-82.4
1700.00	0.397	165.8	4.450	58.0	0.081	50.4	0.298	-86.4
1800.00	0.403	162.1	4.192	55.0	0.084	50.5	0.296	-89.1
1900.00	0.413	158.6	3.978	51.8	0.089	49.8	0.289	-94.6
2000.00	0.420	155.7	3.791	49.0	0.092	49.7	0.293	-96.8
2100.00	0.431	152.1	3.590	46.1	0.096	49.8	0.286	-102.4
2200.00	0.441	149.5	3.450	43.2	0.100	49.5	0.292	-104.1
2300.00	0.447	146.4	3.276	40.3	0.103	49.3	0.289	-111.0
2400.00	0.461	143.8	3.139	37.8	0.107	48.9	0.296	-111.1
2500.00	0.462	141.3	3.011	35.5	0.111	49.2	0.293	-117.1
2600.00	0.475	138.7	2.882	32.7	0.117	48.7	0.307	-118.2
2700.00	0.484	136.9	2.803	29.9	0.122	48.2	0.315	-124.0
2800.00	0.494	134.2	2.689	27.4	0.127	47.3	0.323	-126.8
2900.00	0.504	132.3	2.588	24.5	0.132	46.8	0.334	-131.5
3000.00	0.511	129.7	2.493	22.3	0.136	46.1	0.341	-134.8

## 2SC5454 S PARAMETER

 $V_{CE} = 3\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.550	-39.8	33.319	152.6	0.012	73.8	0.886	-21.4
200.00	0.478	-71.8	27.020	132.5	0.021	63.3	0.734	-36.5
300.00	0.420	-96.3	21.715	118.9	0.027	56.8	0.598	-45.6
400.00	0.381	-115.0	17.550	109.5	0.032	55.7	0.502	-51.2
500.00	0.363	-129.9	14.737	101.5	0.035	56.4	0.439	-54.1
600.00	0.351	-141.9	12.630	95.6	0.039	55.7	0.395	-57.3
700.00	0.344	-151.7	10.983	90.4	0.043	56.8	0.357	-59.7
800.00	0.344	-160.1	9.738	86.1	0.047	57.1	0.335	-61.7
900.00	0.343	-167.5	8.689	82.0	0.051	57.2	0.310	-64.5
1000.00	0.347	-173.7	7.876	78.3	0.055	57.8	0.294	-66.3
1100.00	0.350	-179.2	7.199	74.9	0.059	57.7	0.281	-69.5
1200.00	0.355	175.4	6.619	71.5	0.063	57.6	0.268	-72.1
1300.00	0.362	171.0	6.132	68.4	0.068	57.7	0.261	-75.9
1400.00	0.367	166.7	5.704	65.3	0.072	57.4	0.257	-78.1
1500.00	0.375	163.0	5.338	62.4	0.076	57.1	0.246	-82.3
1600.00	0.382	159.4	5.011	59.5	0.080	56.6	0.246	-86.2
1700.00	0.391	156.4	4.728	56.6	0.085	56.4	0.239	-90.0
1800.00	0.398	153.4	4.476	54.0	0.089	56.0	0.240	-93.9
1900.00	0.408	150.5	4.226	50.8	0.093	55.7	0.237	-99.8
2000.00	0.416	148.3	4.028	48.4	0.098	54.7	0.238	-102.1
2100.00	0.427	145.1	3.829	45.6	0.102	54.1	0.235	-108.6
2200.00	0.437	143.2	3.661	42.9	0.107	53.2	0.241	-109.3
2300.00	0.443	140.4	3.489	40.3	0.110	52.7	0.239	-116.7
2400.00	0.457	138.3	3.330	37.8	0.115	51.6	0.247	-117.1
2500.00	0.459	136.1	3.206	35.6	0.119	51.7	0.250	-124.4
2600.00	0.473	133.8	3.603	33.0	0.125	50.8	0.259	-124.2
2700.00	0.480	132.5	2.967	30.2	0.130	50.9	0.271	-131.1
2800.00	0.492	129.8	2.857	28.0	0.135	48.9	0.277	-133.2
2900.00	0.501	128.3	2.747	25.2	0.140	47.7	0.292	-138.6
3000.00	0.509	125.7	2.655	23.3	0.144	46.8	0.295	-141.0

 $V_{CE} = 3\text{ V}$ ,  $I_C = 30\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.459	-49.1	38.164	148.7	0.011	70.7	0.849	-24.6
200.00	0.404	-85.8	29.422	127.7	0.019	62.8	0.674	-40.3
300.00	0.368	-111.3	22.866	114.5	0.024	58.5	0.537	-48.1
400.00	0.347	-129.3	18.143	105.5	0.029	57.5	0.445	-53.4
500.00	0.341	-142.9	15.068	98.2	0.033	59.4	0.386	-55.5
600.00	0.337	-153.4	12.826	92.7	0.037	60.8	0.350	-57.7
700.00	0.337	-162.3	11.115	87.9	0.040	60.4	0.317	-60.2
800.00	0.340	-169.5	9.819	83.9	0.046	61.1	0.296	-62.3
900.00	0.343	-176.0	8.752	80.1	0.049	61.1	0.278	-64.4
1000.00	0.349	178.6	7.932	76.6	0.054	61.0	0.264	-66.5
1100.00	0.354	173.9	7.224	73.3	0.058	61.2	0.253	-70.0
1200.00	0.360	169.2	6.638	70.2	0.063	61.4	0.243	-72.3
1300.00	0.368	165.4	6.149	67.2	0.068	61.1	0.234	-76.6
1400.00	0.374	161.6	5.716	64.2	0.073	61.1	0.231	-79.1
1500.00	0.382	158.3	5.351	61.4	0.077	59.7	0.226	-83.8
1600.00	0.389	155.1	5.015	58.5	0.081	59.8	0.223	-87.6
1700.00	0.399	152.5	4.742	55.6	0.085	58.8	0.221	-92.5
1800.00	0.405	149.7	4.476	52.9	0.090	57.8	0.223	-95.9
1900.00	0.415	147.1	4.229	50.2	0.095	57.0	0.217	-101.9
2000.00	0.423	145.1	4.021	47.5	0.100	56.1	0.220	-103.7
2100.00	0.434	142.2	3.814	44.8	0.104	55.3	0.218	-111.0
2200.00	0.444	140.5	3.659	42.2	0.109	54.6	0.225	-111.8
2300.00	0.450	137.8	3.473	39.6	0.114	53.5	0.225	-120.1
2400.00	0.464	135.8	3.323	37.2	0.117	53.2	0.231	-119.7
2500.00	0.465	133.7	3.194	34.9	0.122	52.7	0.236	-127.5
2600.00	0.479	131.8	3.056	32.5	0.127	52.0	0.247	-127.2
2700.00	0.487	130.4	2.981	30.0	0.133	50.5	0.258	-134.1
2800.00	0.498	127.9	2.852	27.8	0.138	49.6	0.267	-136.0
2900.00	0.508	126.4	2.740	25.0	0.143	47.8	0.279	-141.3
3000.00	0.515	124.0	2.652	23.0	0.147	47.4	0.285	-144.2

## 2SC5454 S PARAMETER

V<sub>CE</sub> = 5 V, I<sub>c</sub> = 5 mA, Z<sub>0</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	0.836	-18.3	14.254	165.1	0.014	78.2	0.970	-10.4
200.00	0.792	-35.6	13.300	151.4	0.027	69.3	0.920	-20.6
300.00	0.736	-52.0	12.328	140.2	0.038	60.4	0.849	-28.9
400.00	0.675	-66.1	10.931	130.3	0.046	54.1	0.776	-35.8
500.00	0.612	-80.1	10.126	119.9	0.051	49.6	0.715	-40.9
600.00	0.561	-92.6	9.208	112.1	0.055	45.8	0.659	-45.5
700.00	0.521	-103.4	8.276	105.2	0.059	43.1	0.608	-49.2
800.00	0.487	-113.9	7.567	99.0	0.061	41.3	0.572	-52.4
900.00	0.461	-123.3	6.874	93.5	0.063	39.9	0.536	-55.6
1000.00	0.442	-132.2	6.347	88.3	0.064	39.2	0.509	-58.1
1100.00	0.429	-140.1	5.862	83.8	0.066	38.8	0.486	-61.0
1200.00	0.419	-147.9	5.432	79.4	0.068	38.5	0.468	-63.8
1300.00	0.414	-154.8	5.068	75.4	0.069	38.8	0.450	-66.7
1400.00	0.410	-161.3	4.754	71.4	0.071	39.0	0.437	-69.4
1500.00	0.411	-167.3	4.461	67.8	0.073	39.6	0.425	-72.7
1600.00	0.413	-172.9	4.195	64.1	0.074	40.2	0.418	-75.6
1700.00	0.417	-178.1	3.983	60.7	0.076	40.6	0.407	-79.1
1800.00	0.421	177.1	3.779	57.3	0.078	41.3	0.405	-81.9
1900.00	0.428	172.3	3.582	53.7	0.080	41.6	0.396	-86.2
2000.00	0.434	168.4	3.411	50.7	0.083	43.0	0.395	-88.6
2100.00	0.442	164.0	3.253	47.0	0.086	43.6	0.386	-93.7
2200.00	0.452	160.5	3.114	44.2	0.089	43.9	0.392	-95.3
2300.00	0.457	156.7	2.969	40.9	0.091	44.6	0.383	-100.7
2400.00	0.468	153.2	2.846	37.9	0.094	45.5	0.393	-102.0
2500.00	0.470	150.3	2.733	35.5	0.097	46.2	0.387	-107.2
2600.00	0.481	147.2	2.621	32.0	0.102	46.8	0.401	-108.9
2700.00	0.490	144.8	2.540	29.2	0.107	47.2	0.408	-114.1
2800.00	0.500	141.7	2.432	26.5	0.112	47.1	0.415	-117.1
2900.00	0.509	139.3	2.340	23.2	0.116	46.7	0.426	-121.8
3000.00	0.517	136.4	2.250	21.0	0.121	46.5	0.428	-125.0

V<sub>CE</sub> = 5 V, I<sub>c</sub> = 10 mA, Z<sub>0</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	0.722	-26.0	23.176	159.8	0.013	77.0	0.943	-14.8
200.00	0.653	-49.0	20.533	142.9	0.024	65.3	0.844	-27.7
300.00	0.575	-69.4	17.914	129.9	0.032	57.6	0.738	-36.6
400.00	0.512	-86.2	15.194	119.8	0.037	52.9	0.647	-43.5
500.00	0.462	-101.1	13.254	110.1	0.041	51.2	0.575	-47.5
600.00	0.423	-113.9	11.637	103.2	0.045	49.3	0.522	-51.5
700.00	0.398	-125.2	10.262	97.1	0.047	48.9	0.475	-54.3
800.00	0.379	-135.3	9.193	92.0	0.050	48.9	0.443	-56.8
900.00	0.367	-144.3	8.257	87.4	0.054	48.6	0.413	-59.6
1000.00	0.361	-152.5	7.531	82.8	0.057	49.3	0.392	-61.6
1100.00	0.357	-159.6	6.895	79.0	0.059	49.6	0.374	-64.4
1200.00	0.356	-166.5	6.370	75.2	0.062	49.8	0.358	-66.6
1300.00	0.358	-172.4	5.906	71.9	0.065	50.2	0.345	-69.7
1400.00	0.361	-177.9	5.512	68.4	0.069	50.1	0.338	-72.1
1500.00	0.367	177.1	5.172	65.1	0.072	50.4	0.327	-75.9
1600.00	0.371	172.4	4.856	62.0	0.075	50.7	0.321	-78.9
1700.00	0.379	168.4	4.615	58.6	0.079	50.8	0.313	-82.6
1800.00	0.385	164.5	4.332	55.8	0.083	50.9	0.313	-85.5
1900.00	0.395	160.7	4.123	52.5	0.086	50.8	0.304	-90.4
2000.00	0.402	157.9	3.914	49.8	0.089	51.2	0.308	-92.6
2100.00	0.413	153.9	3.734	46.9	0.093	50.7	0.300	-98.1
2200.00	0.424	151.3	3.579	44.1	0.098	50.6	0.305	-99.6
2300.00	0.429	148.2	3.390	41.2	0.101	50.7	0.299	-106.1
2400.00	0.443	145.4	3.257	38.6	0.105	50.3	0.305	-106.8
2500.00	0.444	142.9	3.135	36.2	0.109	50.2	0.306	-112.7
2600.00	0.458	140.2	2.999	33.5	0.114	49.8	0.319	-113.7
2700.00	0.467	138.4	2.909	30.5	0.119	50.0	0.325	-119.6
2800.00	0.477	135.5	2.797	28.1	0.124	48.8	0.332	-122.0
2900.00	0.487	133.7	2.695	25.2	0.129	48.2	0.345	-127.6
3000.00	0.495	131.0	2.592	22.9	0.133	47.2	0.348	-130.5

## 2SC5454 S PARAMETER

 $V_{CE} = 5\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.584	-36.1	33.272	153.6	0.012	73.1	0.896	-19.7
200.00	0.503	-65.9	27.312	134.0	0.020	63.7	0.751	-34.7
300.00	0.434	-89.4	22.196	120.4	0.027	58.1	0.618	-43.4
400.00	0.385	-107.3	18.070	110.8	0.031	56.3	0.526	-48.9
500.00	0.361	-122.5	15.219	102.7	0.034	56.6	0.459	-51.9
600.00	0.341	-135.0	13.079	96.8	0.038	57.0	0.415	-54.6
700.00	0.331	-145.4	11.392	91.4	0.042	57.1	0.374	-56.9
800.00	0.327	-154.4	10.113	87.1	0.046	57.1	0.353	-58.8
900.00	0.325	-162.3	9.025	83.0	0.049	57.2	0.326	-61.5
1000.00	0.326	-169.1	8.193	79.2	0.054	57.6	0.312	-63.2
1100.00	0.329	-175.0	7.486	75.8	0.057	57.9	0.300	-65.7
1200.00	0.334	179.1	6.878	72.4	0.061	58.2	0.288	-68.2
1300.00	0.338	174.5	6.379	69.3	0.066	58.0	0.278	-71.6
1400.00	0.344	169.9	5.935	66.2	0.070	57.7	0.270	-74.6
1500.00	0.352	165.9	5.566	63.2	0.074	57.3	0.263	-78.1
1600.00	0.358	162.1	5.220	60.3	0.078	57.4	0.260	-81.1
1700.00	0.367	158.9	4.949	57.4	0.082	57.0	0.255	-85.8
1800.00	0.373	155.7	4.651	54.6	0.087	56.6	0.254	-88.9
1900.00	0.385	152.7	4.411	51.8	0.091	55.6	0.248	-94.5
2000.00	0.391	150.3	4.195	49.0	0.096	55.2	0.250	-96.7
2100.00	0.403	147.2	3.990	46.3	0.099	54.3	0.246	-103.1
2200.00	0.414	145.1	3.817	43.9	0.104	53.8	0.252	-104.1
2300.00	0.421	142.2	3.633	41.0	0.108	53.5	0.247	-111.5
2400.00	0.435	140.0	3.488	38.6	0.113	52.6	0.256	-112.0
2500.00	0.436	137.8	3.349	36.3	0.116	52.3	0.258	-118.4
2600.00	0.450	135.4	3.203	33.9	0.121	51.7	0.269	-118.7
2700.00	0.459	134.0	3.126	31.2	0.127	51.2	0.275	-125.1
2800.00	0.470	131.3	2.995	28.7	0.132	49.6	0.285	-127.4
2900.00	0.481	129.7	2.881	26.0	0.137	48.8	0.296	-133.1
3000.00	0.489	127.2	2.788	24.0	0.141	48.0	0.302	-136.2

 $V_{CE} = 5\text{ V}$ ,  $I_C = 30\text{ mA}$ ,  $Z_0 = 50\ \Omega$ 

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	0.508	-42.8	38.283	149.9	0.011	72.3	0.861	-22.9
200.00	0.433	-76.3	30.011	129.4	0.019	61.8	0.692	-37.6
300.00	0.378	-100.7	23.555	116.0	0.023	59.8	0.558	-45.6
400.00	0.342	-119.6	18.822	107.1	0.028	59.3	0.472	-50.4
500.00	0.332	-133.8	15.690	99.5	0.032	59.2	0.411	-52.5
600.00	0.321	-145.1	13.390	93.9	0.036	61.0	0.369	-54.9
700.00	0.317	-154.9	11.613	89.1	0.041	60.5	0.337	-57.0
800.00	0.316	-163.1	10.259	84.9	0.045	60.7	0.315	-58.5
900.00	0.318	-169.9	9.171	81.1	0.048	61.6	0.297	-60.9
1000.00	0.323	-176.1	8.300	77.5	0.053	60.8	0.283	-62.7
1100.00	0.326	178.5	7.579	74.2	0.058	60.9	0.271	-65.6
1200.00	0.332	173.3	6.964	71.1	0.062	61.2	0.263	-67.9
1300.00	0.339	169.1	6.463	68.1	0.066	61.0	0.256	-71.6
1400.00	0.345	165.0	6.012	65.1	0.071	60.2	0.248	-74.6
1500.00	0.354	161.5	5.620	62.3	0.074	59.9	0.241	-78.7
1600.00	0.359	158.0	5.271	59.4	0.080	59.6	0.242	-82.4
1700.00	0.369	155.0	4.972	56.4	0.083	58.7	0.236	-86.8
1800.00	0.376	152.4	4.693	54.0	0.088	58.0	0.233	-90.5
1900.00	0.387	149.5	4.454	51.2	0.092	57.5	0.229	-96.2
2000.00	0.393	147.5	4.222	48.6	0.097	56.9	0.232	-97.9
2100.00	0.405	144.4	4.035	45.7	0.102	56.3	0.232	-104.8
2200.00	0.416	142.5	3.850	43.2	0.107	54.9	0.233	-106.3
2300.00	0.422	139.9	3.660	40.5	0.111	54.1	0.231	-114.3
2400.00	0.436	137.9	3.517	38.0	0.115	54.0	0.240	-113.8
2500.00	0.438	135.7	3.360	36.0	0.119	53.1	0.240	-120.9
2600.00	0.453	133.5	3.235	33.6	0.124	52.5	0.254	-121.0
2700.00	0.461	132.3	3.147	31.0	0.130	51.6	0.262	-127.4
2800.00	0.473	129.6	3.010	28.6	0.135	50.2	0.270	-129.8
2900.00	0.483	128.1	2.905	25.9	0.140	49.3	0.283	-135.7
3000.00	0.491	125.6	2.800	23.9	0.144	48.1	0.286	-138.5



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