



# SBFP420D

## UHF to C Band Low Noise Amplifier, Oscillation Applications

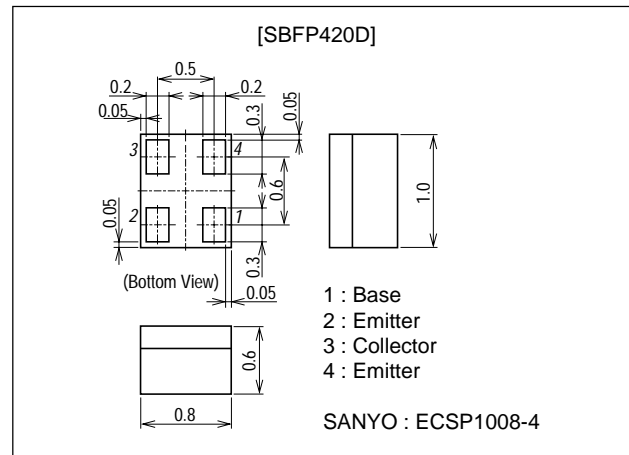
### Features

- Low noise : NF=1.1dB typ (f=1.8GHz).
- High cut-off frequency :  $f_T=20\text{GHz}$  typ ( $V_{CE}=1\text{V}$ ),  
:  $f_T=25\text{GHz}$  typ ( $V_{CE}=3\text{V}$ ).
- Low voltage operation.
- High Gain :  $|S_{21e}|^2=17\text{dB}$  typ (f=1.8GHz).
- Ultrasmall (1008 size), thin (0.6mm) leadless package.

### Package Dimensions

unit : mm

2215



### Specifications

Absolute Maximum Ratings at  $T_a=25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Ratings	Unit
Collector-to-Base Voltage	$V_{CBO}$		15	V
Collector-to-Emitter Voltage	$V_{CEO}$		4.5	V
Emitter-to-Base Voltage	$V_{EBO}$		1.5	V
Collector Current	$I_C$		35	mA
Collector Dissipation	$P_C$		100	mW
Junction Temperature	$T_J$		150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$		-55 to +150	$^\circ\text{C}$

Electrical Characteristics at  $T_a=25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Collector Cutoff Current	$I_{CBO}$	$V_{CB}=5\text{V}, I_E=0$			200	nA
Emitter Cutoff Current	$I_{EBO}$	$V_{EB}=1.5\text{V}, I_C=0$			35	$\mu\text{A}$
DC Current Gain	$h_{FE}$	$V_{CE}=4\text{V}, I_C=20\text{mA}$	50		150	
Gain-Bandwidth Product	$f_{T1}$	$V_{CE}=1\text{V}, I_C=10\text{mA}$		20		GHz
	$f_{T2}$	$V_{CE}=3\text{V}, I_C=30\text{mA}$	18	25		GHz
Reverse Transfer Capacitance	$C_{re}$	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.17	0.27	pF
Forward Transfer Gain	$ S_{21e} ^2_1$	$V_{CE}=1\text{V}, I_C=10\text{mA}, f=1.8\text{GHz}$		16		dB
	$ S_{21e} ^2_2$	$V_{CE}=2\text{V}, I_C=20\text{mA}, f=1.8\text{GHz}$	14	17		dB
Noise Figure	NF	$V_{CE}=2\text{V}, I_C=5\text{mA}, f=1.8\text{GHz}$		1.1	1.5	dB

Marking : AD

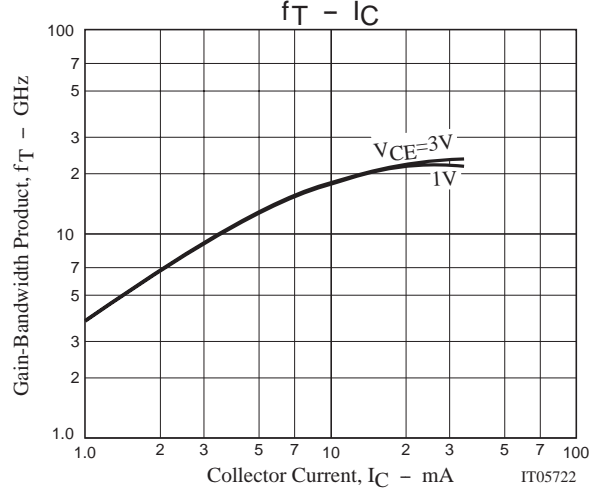
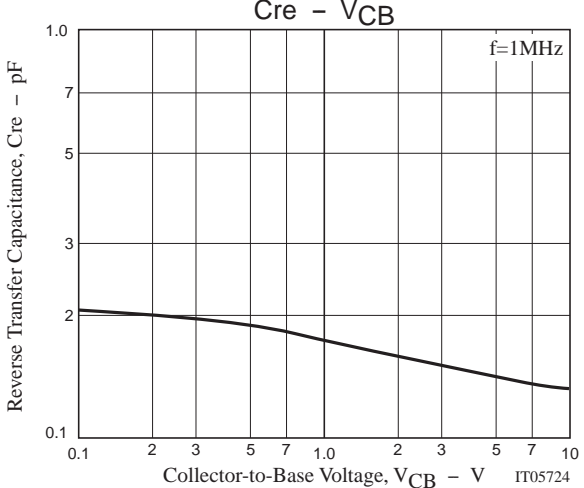
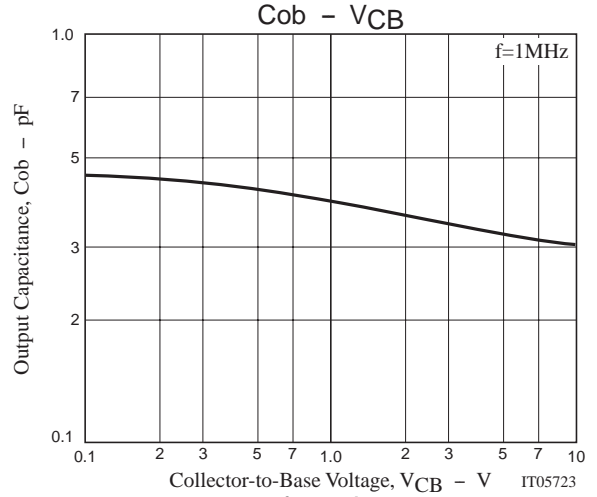
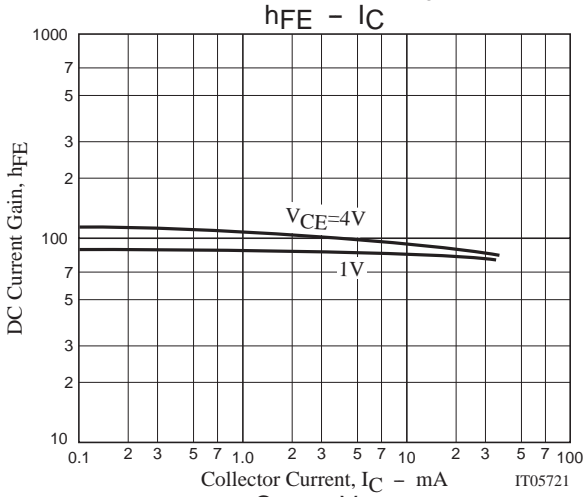
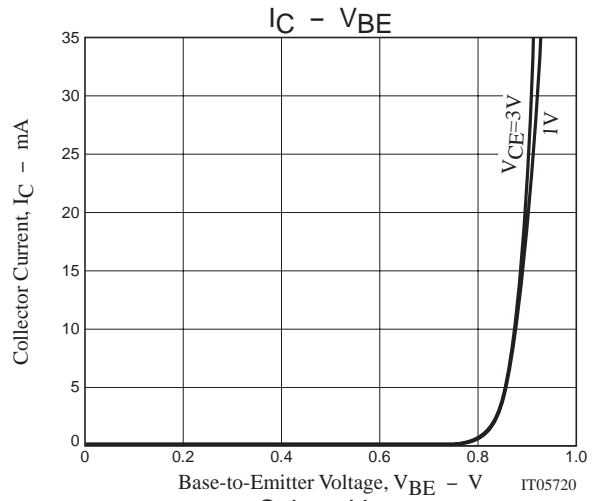
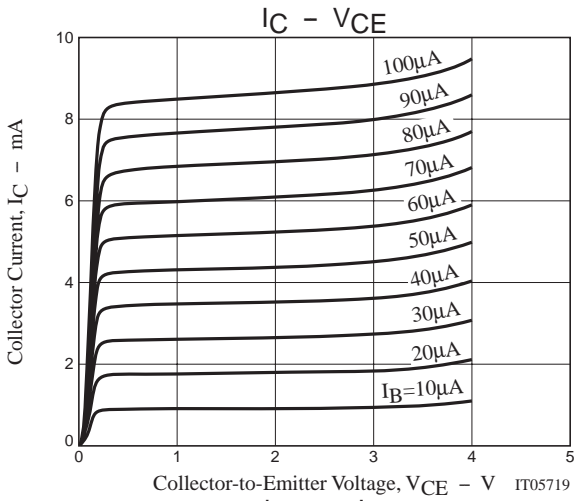
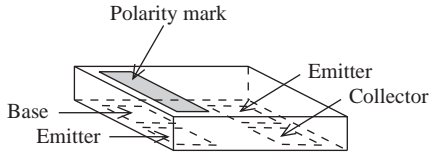
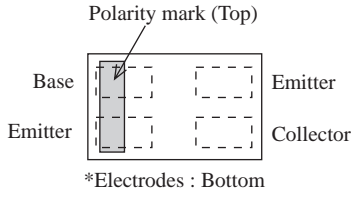
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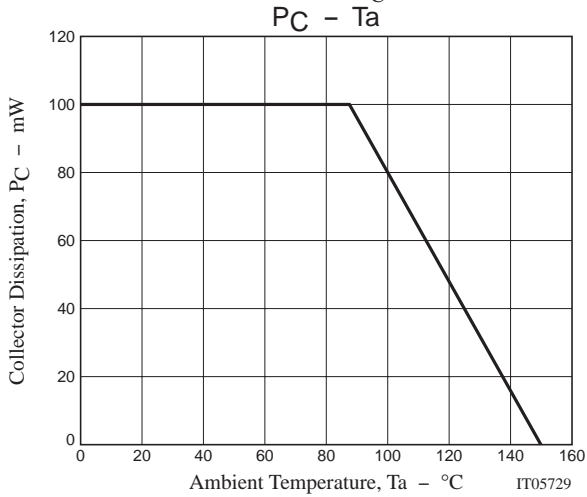
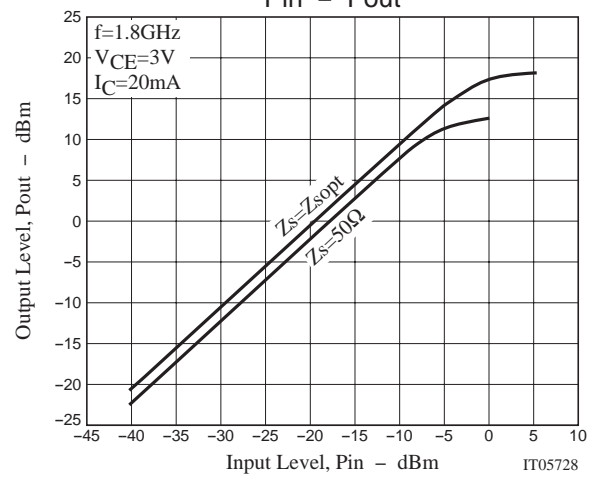
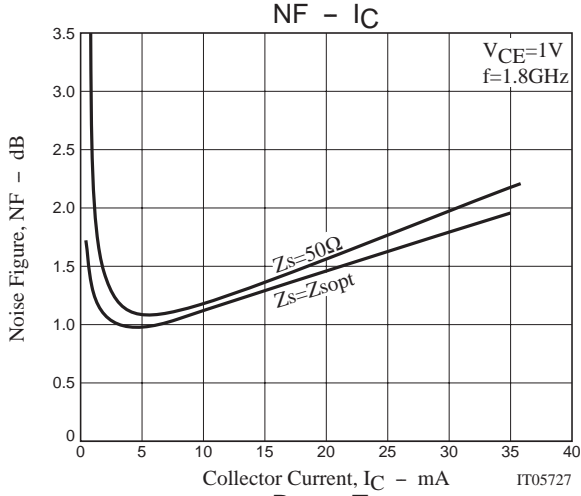
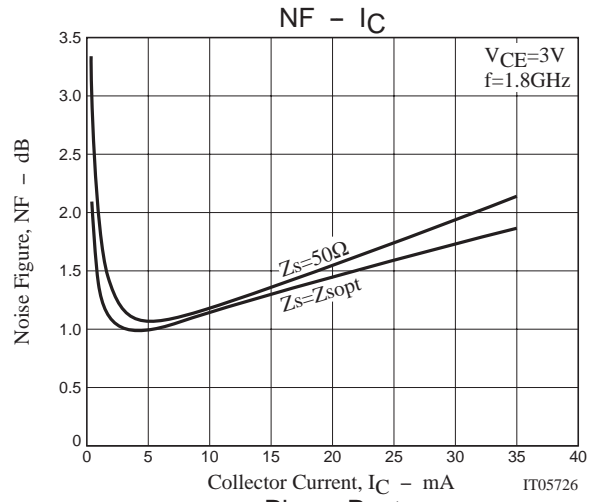
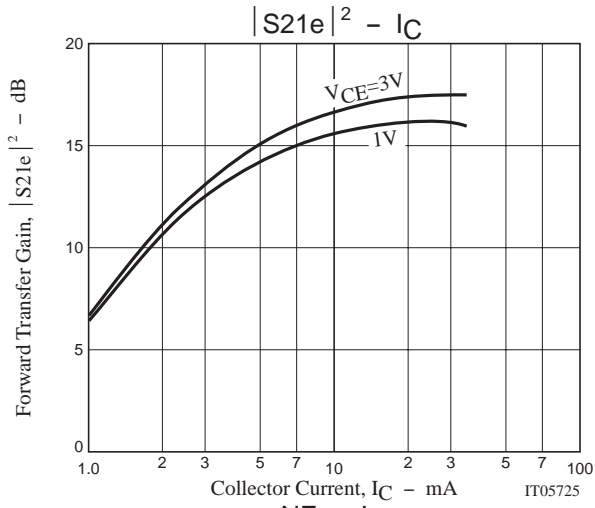
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

# SBFP420D

## Electrical Connection (Top view)



# SBFP420D



## SBFP420D

### S Parameters (Common emitter)

VCE=1V, IC=1mA, ZO=50Ω

Freq(MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
200	0.965	-11.9	2.513	167.8	0.025	81.7	0.992	-7.1
400	0.955	-22.6	2.215	157.9	0.047	74.3	0.968	-13.6
600	0.932	-35.0	2.442	149.3	0.068	67.3	0.935	-19.4
800	0.903	-46.4	2.437	139.3	0.087	60.5	0.898	-24.9
1000	0.888	-55.1	2.087	131.7	0.102	54.3	0.858	-30.1
1200	0.843	-69.4	2.483	124.3	0.115	49.1	0.813	-33.9
1400	0.811	-80.1	2.465	117.8	0.127	44.1	0.787	-37.4
1600	0.811	-86.4	2.054	112.3	0.132	38.8	0.741	-43.1
1800	0.777	-96.8	2.094	105.5	0.140	36.0	0.704	-44.4
2000	0.760	-103.9	1.917	100.0	0.146	32.3	0.680	-46.9
2200	0.733	-113.3	1.933	94.8	0.150	28.9	0.656	-49.5
2400	0.725	-119.3	1.770	90.4	0.152	26.0	0.636	-51.8
2600	0.711	-126.1	1.685	85.7	0.153	23.5	0.612	-54.4
2800	0.692	-133.2	1.648	81.3	0.154	21.7	0.592	-56.3
3000	0.684	-138.6	1.543	77.3	0.154	19.8	0.576	-58.2
3200	0.665	-145.7	1.543	73.3	0.154	18.3	0.562	-60.1
3400	0.661	-150.7	1.461	69.8	0.153	16.9	0.550	-61.9
3600	0.653	-156.0	1.409	66.3	0.152	15.8	0.539	-64.0
3800	0.644	-161.3	1.374	62.8	0.151	15.1	0.528	-65.8
4000	0.642	-165.7	1.309	59.6	0.150	14.4	0.520	-67.6
4200	0.633	-170.8	1.281	56.3	0.148	14.0	0.512	-69.5
4400	0.629	-175.2	1.236	53.3	0.147	13.8	0.504	-71.4
4600	0.628	-179.4	1.191	50.3	0.146	13.8	0.498	-73.3
4800	0.623	176.3	1.160	47.6	0.145	14.0	0.492	-75.3
5000	0.622	172.4	1.113	44.9	0.144	14.5	0.488	-77.2
5200	0.618	168.4	1.090	42.2	0.143	15.0	0.483	-79.2
5400	0.616	164.5	1.060	39.5	0.142	15.8	0.478	-81.3
5600	0.615	160.8	1.028	37.0	0.142	16.7	0.474	-83.3
5800	0.612	157.0	1.004	34.5	0.142	17.8	0.470	-85.4
6000	0.613	153.5	0.971	32.2	0.143	19.0	0.467	-87.5

## SBFP420D

### S Parameters (Common emitter)

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

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.825	-21.6	10.855	158.3	0.023	79.0	0.953	-16.0
400	0.785	-39.8	9.143	144.6	0.040	65.7	0.858	-28.7
600	0.706	-64.1	9.668	132.4	0.053	57.5	0.758	-38.1
800	0.658	-80.1	8.470	122.4	0.062	52.4	0.668	-45.6
1000	0.608	-95.8	7.634	113.3	0.069	48.8	0.592	-51.5
1200	0.553	-112.3	7.130	104.8	0.075	46.6	0.530	-55.5
1400	0.527	-123.6	6.391	98.7	0.079	44.6	0.488	-58.7
1600	0.512	-133.0	5.733	93.5	0.083	44.8	0.444	-62.5
1800	0.498	-140.6	5.158	89.0	0.088	44.2	0.410	-64.7
2000	0.489	-147.6	4.692	85.1	0.092	43.6	0.384	-66.8
2200	0.480	-154.1	4.317	81.3	0.096	43.6	0.362	-68.9
2400	0.476	-159.4	3.973	78.1	0.100	43.7	0.344	-70.7
2600	0.468	-165.0	3.700	74.7	0.105	43.8	0.327	-72.6
2800	0.464	-169.9	3.451	71.8	0.110	43.9	0.313	-74.3
3000	0.460	-174.3	3.232	68.9	0.114	44.0	0.301	-76.0
3200	0.458	-178.7	3.051	66.1	0.119	43.8	0.291	-77.7
3400	0.456	177.4	2.883	63.6	0.123	43.9	0.282	-79.3
3600	0.455	173.5	2.737	60.9	0.128	43.8	0.275	-81.1
3800	0.453	169.9	2.604	58.4	0.134	43.6	0.268	-82.7
4000	0.453	166.4	2.485	56.0	0.139	43.3	0.261	-84.5
4200	0.452	162.9	2.375	53.5	0.144	42.9	0.256	-86.2
4400	0.452	159.7	2.275	51.3	0.149	42.6	0.251	-88.2
4600	0.452	156.5	2.186	48.9	0.155	42.2	0.247	-90.1
4800	0.452	153.5	2.102	46.7	0.160	41.6	0.243	-92.0
5000	0.452	150.4	2.026	44.5	0.166	40.9	0.240	-93.9
5200	0.451	147.4	1.956	42.3	0.172	40.5	0.237	-95.8
5400	0.452	144.5	1.889	40.1	0.177	39.9	0.234	-97.8
5600	0.452	141.6	1.830	38.0	0.183	39.2	0.231	-99.9
5800	0.452	138.7	1.771	35.9	0.189	38.7	0.229	-101.9
6000	0.453	136.0	1.718	33.9	0.195	38.0	0.227	-103.8

## SBFP420D

### S Parameters (Common emitter)

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

Freq(MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
200	0.685	-32.5	18.349	152.1	0.021	74.8	0.904	-22.9
400	0.622	-59.7	15.120	135.3	0.033	61.7	0.747	-38.6
600	0.536	-90.8	14.363	120.7	0.043	56.8	0.619	-48.5
800	0.499	-108.7	11.882	110.8	0.049	54.8	0.523	-55.5
1000	0.466	-124.5	10.160	102.6	0.055	53.8	0.452	-60.7
1200	0.446	-136.7	8.770	96.4	0.061	53.3	0.399	-64.3
1400	0.435	-145.9	7.659	91.4	0.065	53.8	0.362	-67.3
1600	0.429	-153.5	6.757	87.1	0.072	54.0	0.331	-70.6
1800	0.425	-159.8	6.029	83.4	0.078	54.2	0.303	-72.9
2000	0.422	-165.3	5.446	80.1	0.083	54.2	0.284	-75.2
2200	0.421	-170.4	4.968	77.1	0.089	54.2	0.266	-77.3
2400	0.419	-174.9	4.566	74.2	0.095	54.2	0.252	-79.3
2600	0.418	-179.2	4.222	71.4	0.101	54.4	0.240	-81.4
2800	0.416	176.9	3.925	68.9	0.107	54.0	0.229	-83.5
3000	0.416	173.3	3.667	66.4	0.114	53.7	0.221	-85.1
3200	0.415	169.7	3.442	64.1	0.120	53.1	0.213	-87.1
3400	0.415	166.4	3.253	61.7	0.127	52.6	0.207	-89.1
3600	0.415	163.2	3.079	59.4	0.133	52.1	0.201	-91.1
3800	0.415	160.1	2.923	57.2	0.140	51.5	0.196	-93.0
4000	0.415	157.2	2.788	54.9	0.146	50.4	0.192	-95.1
4200	0.416	154.2	2.660	52.7	0.153	49.8	0.188	-97.2
4400	0.416	151.5	2.546	50.7	0.160	49.0	0.185	-99.3
4600	0.417	148.7	2.444	48.6	0.167	48.1	0.182	-101.4
4800	0.417	145.9	2.347	46.5	0.173	47.2	0.179	-103.7
5000	0.417	143.2	2.262	44.5	0.180	46.2	0.177	-105.6
5200	0.418	140.5	2.182	42.4	0.186	45.0	0.175	-107.8
5400	0.418	138.0	2.104	40.4	0.192	44.2	0.173	-110.2
5600	0.419	135.4	2.036	38.4	0.199	43.1	0.172	-112.3
5800	0.420	132.8	1.971	36.4	0.205	42.1	0.170	-114.5
6000	0.420	130.3	1.911	34.5	0.212	40.9	0.169	-116.9

## SBFP420D

### S Parameters (Common emitter)

V<sub>CE</sub>=1V, I<sub>C</sub>=20mA, Z<sub>O</sub>=50Ω

Freq(MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
200	0.483	-61.7	25.818	143.2	0.016	72.0	0.830	-30.6
400	0.458	-100.6	20.544	122.8	0.027	61.2	0.624	-47.6
600	0.420	-122.2	17.275	110.4	0.035	60.2	0.490	-56.9
800	0.410	-137.3	13.707	102.0	0.040	59.7	0.403	-63.0
1000	0.402	-148.5	11.322	95.7	0.048	60.8	0.346	-67.5
1200	0.399	-156.9	9.556	90.8	0.054	61.4	0.303	-71.0
1400	0.397	-163.5	8.268	86.6	0.060	62.2	0.275	-73.8
1600	0.398	-169.1	7.234	83.1	0.068	63.2	0.251	-77.4
1800	0.398	-173.9	6.438	79.9	0.075	62.5	0.233	-79.7
2000	0.398	-178.3	5.798	77.0	0.081	62.1	0.218	-82.5
2200	0.399	177.8	5.275	74.4	0.088	61.8	0.205	-84.8
2400	0.400	174.2	4.844	71.8	0.095	61.4	0.195	-87.4
2600	0.400	170.7	4.470	69.3	0.102	60.8	0.186	-89.8
2800	0.400	167.5	4.150	67.0	0.109	60.1	0.178	-92.0
3000	0.400	164.5	3.874	64.8	0.117	59.4	0.172	-94.3
3200	0.401	161.6	3.630	62.7	0.124	58.6	0.167	-96.5
3400	0.401	158.6	3.429	60.5	0.131	57.5	0.163	-98.8
3600	0.401	155.9	3.243	58.3	0.138	56.6	0.159	-101.3
3800	0.402	153.3	3.076	56.2	0.146	55.6	0.156	-103.7
4000	0.403	150.6	2.932	54.1	0.153	54.6	0.153	-106.0
4200	0.404	148.1	2.795	52.1	0.160	53.4	0.150	-108.4
4400	0.404	145.6	2.675	50.1	0.168	52.2	0.148	-110.9
4600	0.405	143.1	2.567	48.1	0.175	51.1	0.147	-113.1
4800	0.405	140.6	2.465	46.2	0.181	49.9	0.145	-115.6
5000	0.406	138.2	2.376	44.2	0.188	48.6	0.144	-117.8
5200	0.407	135.7	2.289	42.2	0.195	47.6	0.143	-120.6
5400	0.407	133.3	2.207	40.3	0.202	46.4	0.143	-123.1
5600	0.408	131.0	2.136	38.4	0.209	45.1	0.142	-125.5
5800	0.408	128.6	2.067	36.5	0.216	43.9	0.142	-127.9
6000	0.408	126.1	2.004	34.6	0.223	42.5	0.141	-130.2

## SBFP420D

### S Parameters (Common emitter)

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

Freq(MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
200	0.968	-11.0	2.452	168.9	0.019	82.4	0.995	-5.7
400	0.959	-21.1	2.176	159.8	0.037	76.5	0.978	-11.0
600	0.940	-32.5	2.399	151.7	0.054	69.3	0.954	-15.7
800	0.914	-43.4	2.439	142.2	0.069	63.3	0.926	-20.4
1000	0.902	-51.6	2.071	135.0	0.082	57.7	0.896	-24.8
1200	0.860	-65.1	2.508	127.9	0.093	52.9	0.859	-28.2
1400	0.828	-75.6	2.526	121.5	0.103	48.0	0.839	-31.4
1600	0.831	-81.4	2.059	116.1	0.108	42.5	0.798	-36.6
1800	0.796	-91.8	2.149	109.4	0.116	40.0	0.764	-37.7
2000	0.779	-98.8	1.963	103.9	0.121	36.3	0.743	-40.1
2200	0.750	-108.3	2.004	98.7	0.125	33.1	0.721	-42.5
2400	0.740	-114.4	1.841	94.3	0.128	30.1	0.702	-44.6
2600	0.726	-121.1	1.743	89.7	0.128	27.7	0.679	-47.0
2800	0.704	-128.4	1.720	85.2	0.129	25.8	0.658	-48.8
3000	0.696	-133.8	1.605	81.2	0.130	24.1	0.643	-50.5
3200	0.675	-141.0	1.618	77.1	0.130	22.6	0.629	-52.2
3400	0.669	-146.3	1.534	73.6	0.130	21.4	0.617	-53.9
3600	0.660	-151.6	1.477	70.0	0.128	20.4	0.605	-55.7
3800	0.649	-157.1	1.445	66.4	0.128	19.5	0.594	-57.3
4000	0.646	-161.7	1.374	63.3	0.127	19.0	0.585	-58.9
4200	0.635	-167.0	1.349	59.9	0.126	18.9	0.577	-60.6
4400	0.629	-171.7	1.304	56.8	0.125	19.0	0.569	-62.3
4600	0.627	-175.9	1.253	53.9	0.124	19.1	0.562	-64.0
4800	0.621	179.6	1.223	51.1	0.123	19.4	0.556	-65.9
5000	0.619	175.6	1.173	48.4	0.123	20.2	0.551	-67.6
5200	0.615	171.3	1.148	45.6	0.122	20.8	0.545	-69.4
5400	0.612	167.4	1.116	42.9	0.121	22.2	0.540	-71.2
5600	0.610	163.4	1.081	40.4	0.122	23.1	0.535	-73.0
5800	0.606	159.5	1.057	37.8	0.122	24.5	0.530	-75.0
6000	0.606	155.9	1.021	35.5	0.123	25.8	0.527	-76.7



## SBFP420D

### S Parameters (Common emitter)

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

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.842	-18.9	10.781	160.6	0.015	74.9	0.968	-12.4
400	0.808	-35.1	9.216	147.7	0.031	68.0	0.891	-22.4
600	0.733	-56.5	9.827	136.2	0.042	62.2	0.810	-29.8
800	0.680	-71.8	8.816	126.2	0.051	55.8	0.734	-35.9
1000	0.631	-85.8	7.959	117.4	0.057	52.6	0.665	-40.7
1200	0.562	-102.7	7.659	108.4	0.063	50.7	0.610	-43.7
1400	0.527	-114.3	6.938	102.1	0.066	48.1	0.570	-46.4
1600	0.508	-123.6	6.235	96.7	0.071	48.0	0.527	-49.3
1800	0.490	-131.7	5.643	91.9	0.075	47.6	0.494	-51.0
2000	0.476	-139.0	5.140	87.8	0.079	47.1	0.469	-52.7
2200	0.463	-146.1	4.746	83.9	0.082	47.1	0.446	-54.2
2400	0.457	-151.7	4.366	80.5	0.086	46.9	0.428	-55.5
2600	0.447	-157.7	4.068	77.1	0.090	47.1	0.410	-57.1
2800	0.441	-163.0	3.800	74.0	0.094	47.3	0.395	-58.2
3000	0.435	-167.7	3.558	71.1	0.098	47.3	0.383	-59.4
3200	0.430	-172.5	3.361	68.3	0.102	47.6	0.373	-60.8
3400	0.428	-176.7	3.173	65.7	0.107	47.4	0.363	-61.9
3600	0.424	179.2	3.013	63.0	0.111	47.5	0.355	-63.3
3800	0.423	175.3	2.865	60.5	0.116	47.5	0.347	-64.6
4000	0.422	171.5	2.731	58.0	0.120	47.0	0.340	-65.9
4200	0.420	167.9	2.611	55.6	0.125	46.9	0.334	-67.3
4400	0.420	164.4	2.500	53.3	0.130	46.7	0.329	-68.7
4600	0.419	161.0	2.399	51.0	0.135	46.1	0.323	-70.2
4800	0.419	157.8	2.304	48.8	0.140	45.7	0.318	-71.8
5000	0.419	154.6	2.218	46.6	0.145	45.3	0.315	-73.3
5200	0.419	151.5	2.141	44.3	0.150	44.9	0.310	-74.8
5400	0.418	148.4	2.068	42.2	0.156	44.2	0.307	-76.5
5600	0.418	145.3	2.001	40.0	0.160	43.7	0.303	-78.1
5800	0.419	142.3	1.935	37.9	0.166	43.1	0.300	-79.8
6000	0.420	139.4	1.875	35.9	0.172	42.5	0.297	-81.4

## SBFP420D

### S Parameters (Common emitter)

VCE=3V, IC=10mA, ZO=50Ω

Freq(MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
200	0.709	-27.1	18.955	155.1	0.015	74.2	0.927	-17.6
400	0.651	-50.3	15.902	139.2	0.027	65.6	0.799	-29.8
600	0.547	-79.2	15.340	124.6	0.035	60.1	0.687	-37.4
800	0.497	-97.1	12.952	114.5	0.041	57.5	0.599	-42.6
1000	0.453	-113.0	11.179	105.9	0.047	56.7	0.533	-46.2
1200	0.422	-126.2	9.750	99.2	0.052	56.9	0.483	-48.6
1400	0.404	-136.3	8.549	93.9	0.055	56.8	0.447	-50.4
1600	0.395	-144.5	7.567	89.4	0.062	57.5	0.414	-52.4
1800	0.389	-151.4	6.757	85.5	0.066	57.1	0.388	-54.0
2000	0.384	-157.5	6.108	82.0	0.071	57.2	0.367	-55.4
2200	0.380	-163.1	5.572	78.9	0.077	57.3	0.349	-56.8
2400	0.377	-167.9	5.119	76.0	0.082	57.4	0.335	-57.9
2600	0.374	-172.8	4.732	73.1	0.087	57.2	0.322	-59.2
2800	0.372	-177.1	4.397	70.5	0.093	57.4	0.311	-60.4
3000	0.370	178.9	4.107	68.0	0.098	56.8	0.300	-61.6
3200	0.369	175.1	3.855	65.6	0.104	56.4	0.293	-62.8
3400	0.369	171.5	3.638	63.3	0.110	55.8	0.285	-64.1
3600	0.368	168.0	3.442	60.9	0.116	55.2	0.279	-65.4
3800	0.368	164.8	3.269	58.7	0.121	54.7	0.273	-66.7
4000	0.369	161.6	3.111	56.4	0.128	54.0	0.267	-68.0
4200	0.369	158.4	2.966	54.3	0.134	53.3	0.262	-69.5
4400	0.369	155.4	2.837	52.2	0.140	52.5	0.258	-71.1
4600	0.370	152.4	2.721	50.1	0.146	51.5	0.253	-72.6
4800	0.371	149.6	2.612	48.0	0.151	50.7	0.250	-74.3
5000	0.371	146.8	2.515	46.0	0.158	49.6	0.247	-76.0
5200	0.371	144.0	2.424	43.9	0.164	48.8	0.243	-77.4
5400	0.372	141.3	2.337	41.9	0.169	47.9	0.241	-79.2
5600	0.373	138.5	2.260	39.9	0.175	46.9	0.237	-80.8
5800	0.373	135.8	2.184	38.0	0.182	46.0	0.234	-82.6
6000	0.375	133.2	2.116	36.1	0.188	44.9	0.232	-84.3

## SBFP420D

### S Parameters (Common emitter)

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

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.521	-41.9	29.747	149.1	0.013	75.8	0.866	-22.8
400	0.451	-76.8	23.811	129.0	0.022	65.1	0.698	-35.6
600	0.389	-106.1	19.370	114.5	0.029	64.6	0.574	-42.2
800	0.366	-123.5	15.515	105.4	0.034	63.2	0.491	-46.0
1000	0.353	-136.7	12.836	98.6	0.040	64.0	0.435	-48.4
1200	0.345	-146.6	10.875	93.3	0.046	64.4	0.394	-50.2
1400	0.342	-154.7	9.403	88.9	0.052	64.6	0.362	-51.6
1600	0.341	-161.1	8.260	85.0	0.058	65.5	0.341	-53.1
1800	0.340	-166.5	7.347	81.7	0.064	65.0	0.321	-54.6
2000	0.341	-171.5	6.612	78.7	0.070	64.9	0.304	-56.0
2200	0.341	-175.8	6.017	75.9	0.076	64.3	0.290	-57.2
2400	0.341	-179.9	5.520	73.3	0.082	63.8	0.279	-58.4
2600	0.340	176.3	5.090	70.7	0.088	63.8	0.268	-59.7
2800	0.341	172.7	4.721	68.4	0.095	63.0	0.259	-60.8
3000	0.340	169.4	4.406	66.1	0.101	62.3	0.252	-62.2
3200	0.341	166.3	4.127	64.0	0.107	61.5	0.245	-63.5
3400	0.341	163.2	3.894	61.8	0.114	60.7	0.239	-64.8
3600	0.342	160.2	3.679	59.6	0.120	59.6	0.234	-66.2
3800	0.343	157.3	3.490	57.6	0.126	58.7	0.229	-67.7
4000	0.343	154.4	3.323	55.5	0.133	57.8	0.224	-69.3
4200	0.344	151.7	3.166	53.4	0.140	56.6	0.221	-70.8
4400	0.345	149.0	3.027	51.5	0.146	55.4	0.216	-72.4
4600	0.346	146.2	2.902	49.5	0.153	54.2	0.213	-74.1
4800	0.347	143.7	2.785	47.6	0.159	53.4	0.210	-75.8
5000	0.348	141.2	2.680	45.6	0.165	52.0	0.207	-77.5
5200	0.348	138.6	2.581	43.6	0.171	50.9	0.204	-79.2
5400	0.350	136.2	2.488	41.7	0.178	49.9	0.202	-80.9
5600	0.351	133.6	2.405	39.8	0.184	48.7	0.199	-82.8
5800	0.352	131.1	2.326	37.9	0.191	47.4	0.196	-84.5
6000	0.353	128.7	2.252	36.1	0.197	46.2	0.194	-86.3

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