



SANYO Semiconductors

DATA SHEET

2SC6023 — NPN Epitaxial Planar Silicon Transistor

UHF to C Band Low-Noise Amplifier and OSC Applications

Features

- Low-noise use : NF=1.2dB typ (f=2GHz).
- High cut-off frequency : $f_T=14.5\text{GHz}$ typ ($V_{CE}=1\text{V}$).
- High cut-off frequency : $f_T=22\text{GHz}$ typ ($V_{CE}=3\text{V}$).
- Low operating voltage.
- High gain : $|S_{21e}|^2=14\text{dB}$ typ (f=2GHz).

Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Collector-to-Base Voltage	V_{CBO}		9	V
Collector-to-Emitter Voltage	V_{CEO}		3.5	V
Emitter-to-Base Voltage	V_{EBO}		2	V
Collector Current	I_C		35	mA
Collector Dissipation	P_C		120	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}	$V_{CB}=5\text{V}, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=1\text{V}, I_C=0$			1	μA
DC Current Gain	h_{FE}	$V_{CE}=3\text{V}, I_C=15\text{mA}$	80		160	
Gain-Bandwidth Product	f_T1	$V_{CE}=1\text{V}, I_C=5\text{mA}$		14.5		GHz
	f_T2	$V_{CE}=3\text{V}, I_C=15\text{mA}$	18	22		GHz
Reverse Transfer Capacitance	C_{re}	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.18		pF
Forward Transfer Gain	$ S_{21e} ^21$	$V_{CE}=1\text{V}, I_C=5\text{mA}, f=2\text{GHz}$	9.5	11		dB
	$ S_{21e} ^22$	$V_{CE}=3\text{V}, I_C=15\text{mA}, f=2\text{GHz}$		14		dB
Noise Figure	NF	$V_{CE}=1\text{V}, I_C=5\text{mA}, f=2\text{GHz}$		1.2		dB

Marking : NF

■ Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.

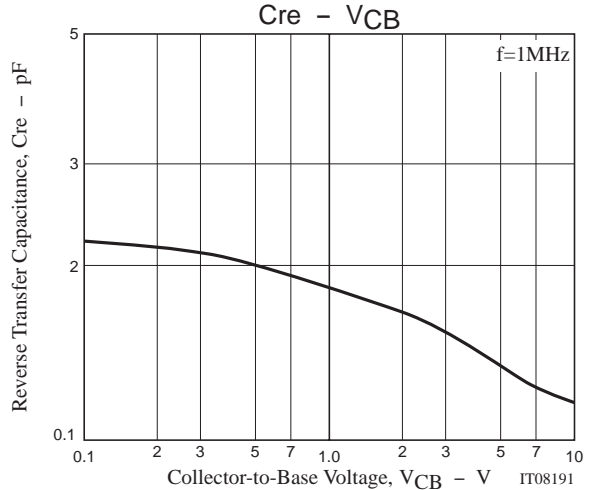
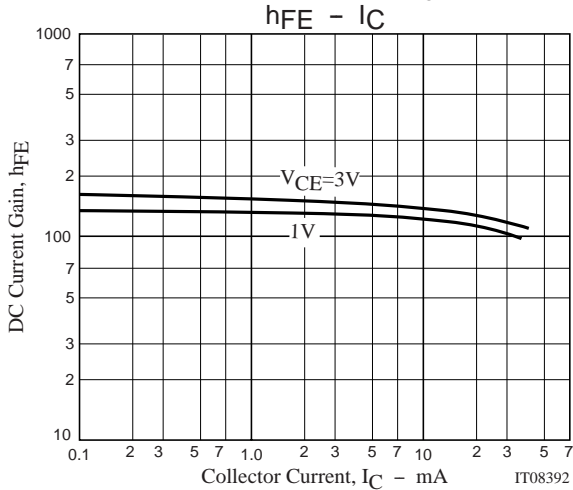
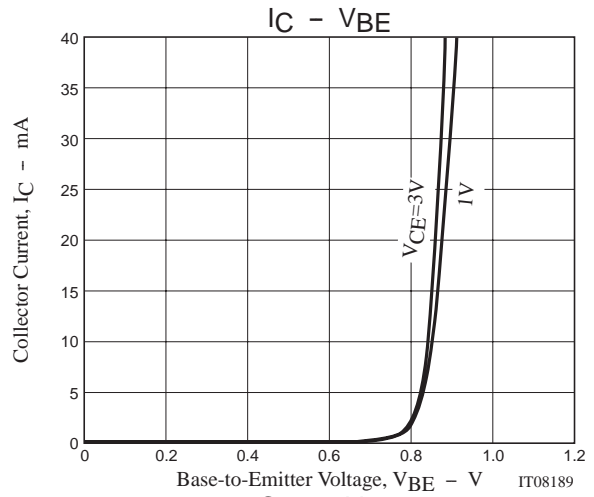
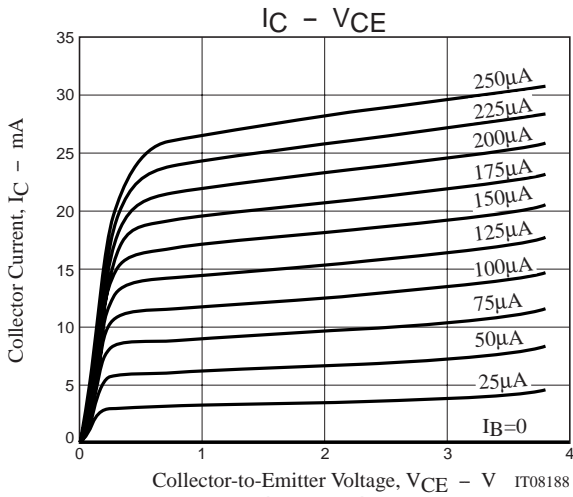
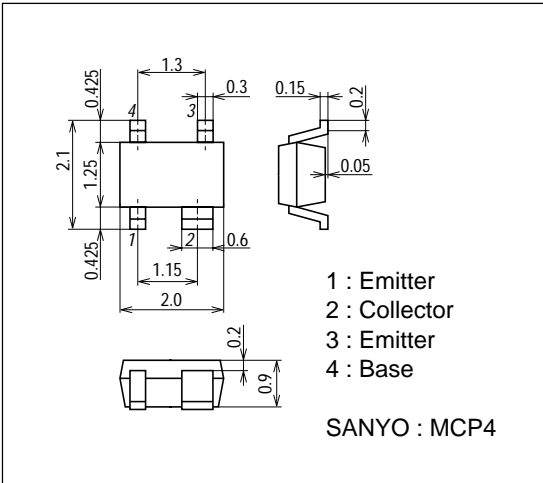
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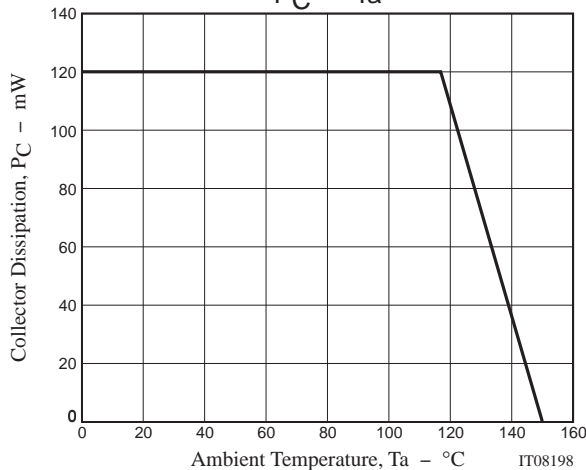
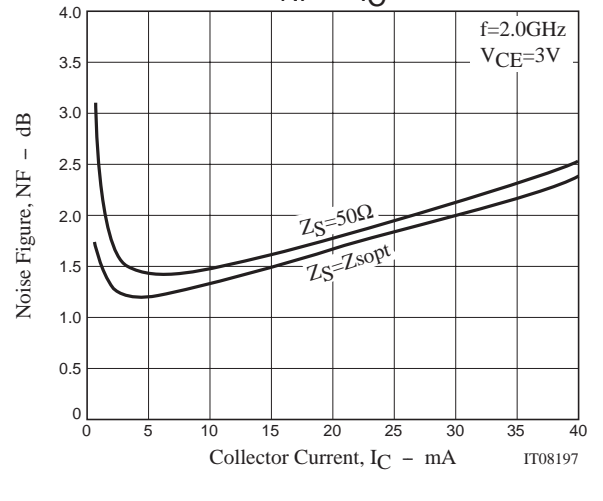
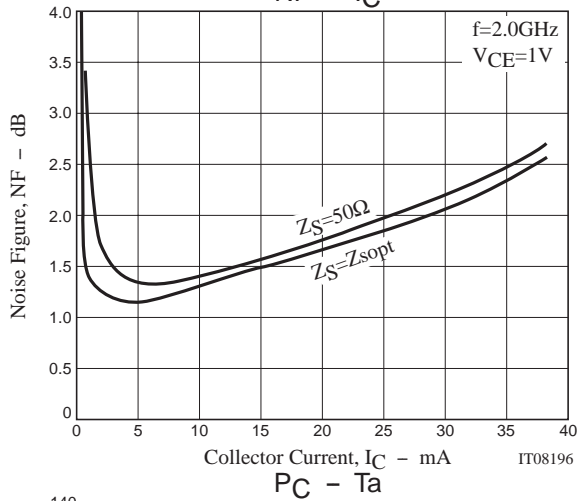
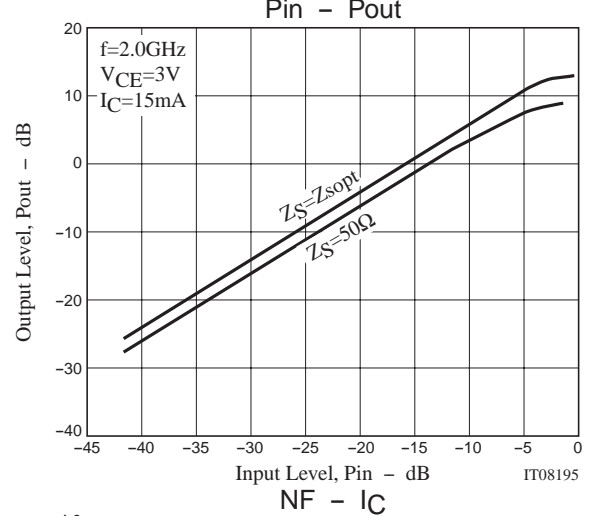
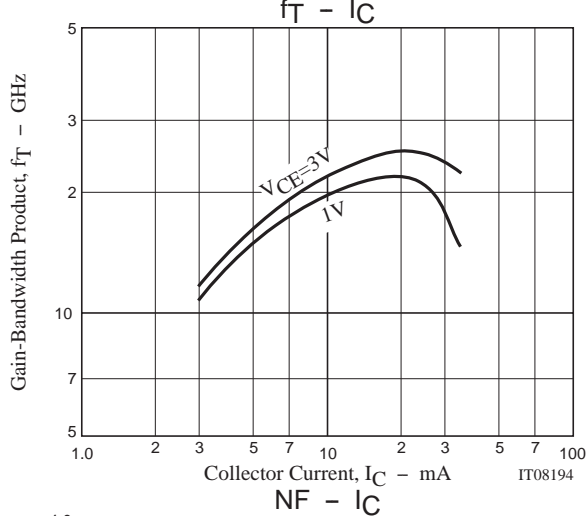
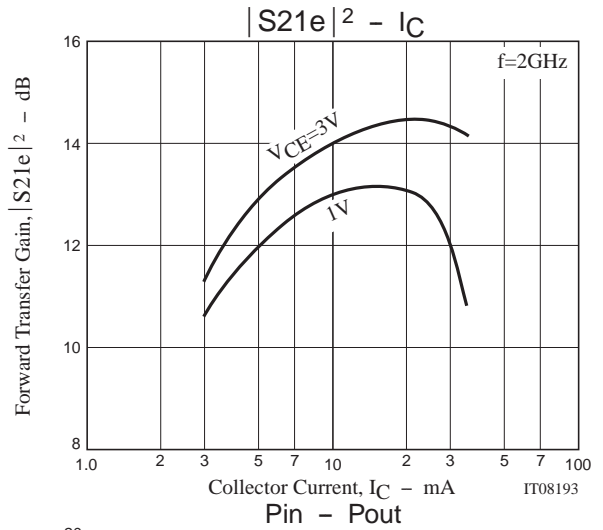
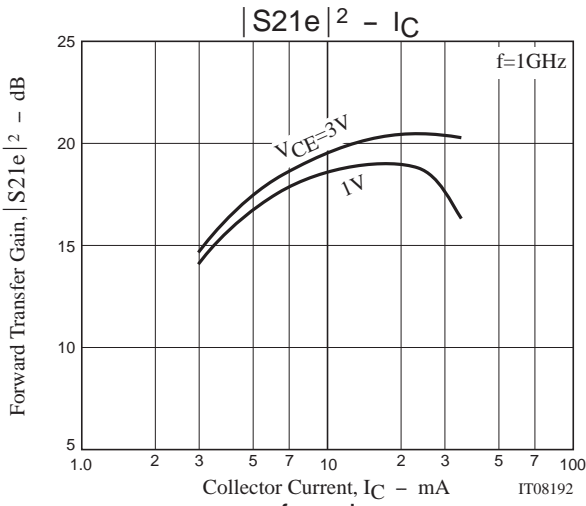
SANYO Electric Co., Ltd. Semiconductor Company

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Package Dimensions

unit : mm
2161A



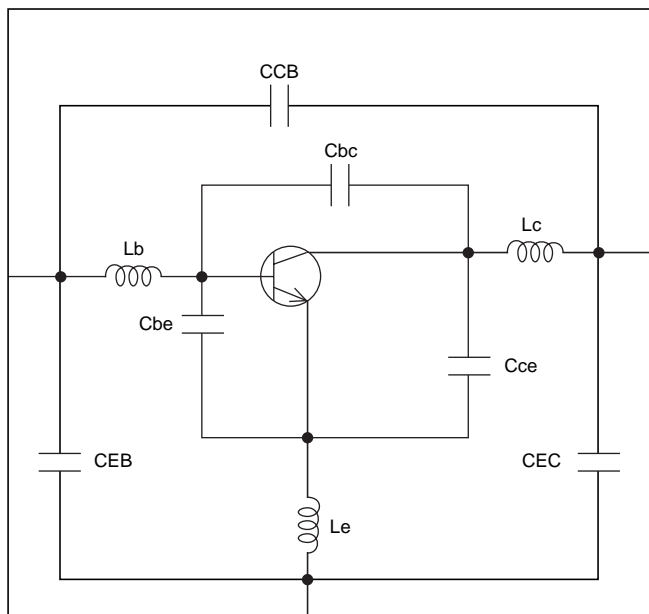


SPICE PARAMETERS

model : Gummel-Poon

Parameter	Value	Unit	Parameter	Value	Unit
IS	124.2a	A	TF	4.500p	S
BF	168.7		XTF	10.00m	
NF	1.007		VTF	8	V
VAF	5.762	V	ITF	549.7m	A
IKF	141.1m	A	PTF	25	°C
ISE	181.0f	A	CJC	168.1f	F
NE	2.295		VJC	165.7m	V
BR	11.54		MJC	571.4m	
NR	1		XCJC	330.0m	
VAR	3.43	V	TR	10.00p	S
IKR	21.00m	A	FC	800.0m	
ISC	1.800f	A	CJS	0	F
NC	1.24		VJS	0	V
RB	2.86	Ω	MJS	0	
IRB	100.0μ	A	LE	415.0p	F
RBM	1.254	Ω	LB	2.300n	F
RE	1.297	Ω	LC	989.3p	F
RC	2.552	Ω	Cbc	20.00f	F
XTB	0		Cce	505.0f	F
EG	1.11	eV	Cbe	320.0f	F
XTI	3		CCB	212.0f	H
CJE	98.40f	F	CEC	580.0f	H
VJE	10	V	CEB	320.0f	H
MJE	100.0m				

SCHEMATIC



IT08199

*Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production.

S Parameters (Common emitter) $V_{CE}=1V, I_C=5mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.886	-19.6	9.563	159.2	0.025	82.2	0.952	-19.4
400	0.809	-41.9	9.578	140.5	0.050	70.9	0.878	-37.7
600	0.740	-61.1	8.407	127.4	0.069	61.5	0.778	-53.8
800	0.651	-79.0	7.402	115.0	0.083	54.0	0.688	-66.5
1000	0.563	-99.0	6.862	103.9	0.092	49.4	0.609	-76.5
1200	0.498	-115.3	6.118	95.0	0.098	46.1	0.551	-84.9
1400	0.462	-127.2	5.350	88.4	0.105	43.8	0.508	-91.9
1600	0.429	-140.6	4.833	82.0	0.111	42.4	0.474	-98.0
1800	0.408	-151.5	4.359	76.5	0.116	41.3	0.449	-103.5
2000	0.397	-161.6	3.961	71.5	0.121	40.6	0.431	-108.7
2200	0.389	-170.0	3.610	67.1	0.126	39.9	0.418	-112.8
2400	0.386	-178.9	3.336	62.6	0.131	39.7	0.407	-117.2
2600	0.383	173.8	3.085	58.6	0.136	39.4	0.400	-121.0
2800	0.386	167.1	2.868	54.7	0.141	39.1	0.396	-124.5
3000	0.388	160.7	2.688	51.1	0.148	38.9	0.396	-127.6
3200	0.395	154.9	2.527	47.5	0.154	38.7	0.398	-130.9
3400	0.402	149.4	2.387	43.9	0.160	38.0	0.400	-133.9
3600	0.410	144.1	2.262	40.5	0.166	37.7	0.404	-137.0
3800	0.418	139.4	2.148	37.1	0.173	37.2	0.408	-139.9
4000	0.427	134.8	2.042	33.8	0.180	36.6	0.414	-142.8
4200	0.436	130.4	1.947	30.6	0.186	35.8	0.419	-145.6
4400	0.445	126.3	1.861	27.4	0.193	35.1	0.426	-148.2
4600	0.454	122.4	1.780	24.3	0.200	34.1	0.432	-150.8
4800	0.463	118.6	1.707	21.3	0.207	33.1	0.439	-153.3
5000	0.472	114.9	1.638	18.3	0.214	32.3	0.447	-155.9
5200	0.481	111.4	1.573	15.4	0.221	31.2	0.453	-158.5
5400	0.490	108.0	1.514	12.6	0.228	30.2	0.461	-160.9
5600	0.498	104.8	1.458	9.8	0.236	29.1	0.468	-163.2
5800	0.504	101.5	1.406	7.2	0.243	28.0	0.475	-165.4
6000	0.511	98.4	1.359	4.5	0.251	26.9	0.482	-167.5

S Parameters (Common emitter) $V_{CE}=1V, I_C=10mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.779	-30.7	15.686	152.1	0.023	77.6	0.898	-26.9
400	0.673	-61.6	14.941	130.3	0.043	66.7	0.769	-49.4
600	0.573	-89.0	12.508	113.8	0.056	59.5	0.643	-66.7
800	0.497	-109.9	10.142	102.2	0.066	55.9	0.548	-79.3
1000	0.444	-127.9	8.487	93.4	0.074	54.2	0.480	-88.9
1200	0.412	-142.8	7.217	86.5	0.082	52.7	0.434	-97.0
1400	0.396	-154.4	6.226	81.0	0.089	52.4	0.403	-103.5
1600	0.386	-165.1	5.481	76.0	0.097	51.7	0.381	-109.1
1800	0.381	-174.2	4.886	71.6	0.105	51.5	0.366	-114.4
2000	0.382	177.5	4.404	67.4	0.112	50.7	0.356	-119.3
2200	0.382	170.1	4.001	63.6	0.120	50.3	0.349	-123.1
2400	0.386	163.2	3.673	59.8	0.128	49.5	0.345	-127.2
2600	0.389	157.1	3.389	56.3	0.135	48.8	0.343	-130.7
2800	0.396	151.5	3.147	52.9	0.143	48.0	0.344	-134.0
3000	0.400	146.3	2.938	49.6	0.152	47.4	0.346	-136.8
3200	0.409	141.6	2.762	46.4	0.160	46.4	0.350	-139.8
3400	0.417	137.1	2.605	43.2	0.168	45.3	0.356	-142.5
3600	0.426	132.6	2.463	40.0	0.177	44.2	0.362	-145.3
3800	0.435	128.6	2.339	37.0	0.184	43.0	0.368	-148.0
4000	0.444	124.7	2.223	33.9	0.192	41.8	0.375	-150.6
4200	0.452	120.9	2.119	31.0	0.200	40.5	0.381	-153.1
4400	0.461	117.3	2.025	28.0	0.208	39.2	0.389	-155.6
4600	0.469	114.0	1.936	25.1	0.216	37.7	0.396	-157.9
4800	0.477	110.6	1.858	22.3	0.224	36.3	0.403	-160.2
5000	0.485	107.3	1.782	19.5	0.231	34.9	0.411	-162.6
5200	0.493	104.1	1.713	16.7	0.239	33.3	0.418	-164.9
5400	0.500	101.1	1.649	14.0	0.246	32.0	0.425	-167.1
5600	0.507	98.1	1.590	11.5	0.254	30.5	0.432	-169.1
5800	0.513	95.2	1.537	8.9	0.261	29.0	0.439	-171.0
6000	0.518	92.3	1.485	6.4	0.269	27.5	0.447	-172.9

S Parameters (Common emitter) $V_{CE}=1V, I_C=15mA, Z_O=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.663	-45.9	18.500	145.2	0.022	76.5	0.850	-31.9
400	0.568	-79.6	17.444	122.6	0.039	64.9	0.690	-56.0
600	0.486	-107.3	13.861	106.6	0.049	60.2	0.562	-73.2
800	0.439	-127.6	10.864	96.4	0.059	58.9	0.476	-85.6
1000	0.410	-143.4	8.868	89.0	0.068	58.1	0.419	-94.9
1200	0.395	-156.5	7.457	83.0	0.077	57.8	0.382	-102.7
1400	0.388	-166.8	6.401	78.1	0.085	57.4	0.358	-109.2
1600	0.387	-176.2	5.611	73.6	0.094	56.6	0.342	-114.6
1800	0.387	175.9	4.990	69.6	0.102	56.2	0.332	-119.7
2000	0.392	168.6	4.492	65.6	0.111	55.3	0.326	-124.5
2200	0.394	162.1	4.077	62.1	0.120	54.4	0.323	-128.1
2400	0.400	156.0	3.738	58.5	0.128	53.3	0.321	-132.1
2600	0.404	150.6	3.447	55.1	0.136	52.6	0.322	-135.2
2800	0.412	145.5	3.199	51.9	0.146	51.5	0.324	-138.4
3000	0.417	140.7	2.987	48.8	0.154	50.4	0.328	-141.0
3200	0.426	136.5	2.806	45.6	0.163	49.1	0.334	-143.8
3400	0.434	132.3	2.644	42.6	0.172	47.8	0.340	-146.4
3600	0.443	128.3	2.501	39.6	0.181	46.6	0.348	-149.1
3800	0.451	124.5	2.373	36.6	0.189	45.1	0.354	-151.7
4000	0.460	120.9	2.256	33.6	0.198	43.8	0.362	-154.1
4200	0.468	117.3	2.150	30.8	0.206	42.3	0.369	-156.5
4400	0.476	114.0	2.053	27.9	0.214	40.6	0.377	-158.8
4600	0.484	110.8	1.964	25.1	0.223	39.1	0.384	-161.0
4800	0.492	107.6	1.885	22.3	0.230	37.5	0.391	-163.2
5000	0.500	104.4	1.809	19.6	0.238	35.9	0.400	-165.4
5200	0.506	101.4	1.738	16.9	0.246	34.3	0.407	-167.7
5400	0.513	98.4	1.675	14.3	0.253	32.8	0.415	-169.8
5600	0.519	95.6	1.616	11.8	0.261	31.1	0.421	-171.8
5800	0.525	92.7	1.560	9.2	0.269	29.6	0.428	-173.6
6000	0.530	89.9	1.509	6.8	0.277	28.0	0.436	-175.5

S Parameters (Common emitter) $V_{CE}=1V, I_C=20mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.571	-63.5	19.420	139.4	0.022	73.7	0.804	-35.4
400	0.502	-97.2	17.635	117.0	0.035	65.6	0.629	-60.2
600	0.448	-121.0	13.965	102.5	0.046	62.1	0.508	-77.3
800	0.422	-139.6	10.852	93.2	0.055	61.1	0.432	-89.3
1000	0.405	-153.5	8.819	86.5	0.064	61.0	0.382	-98.5
1200	0.397	-165.0	7.402	81.0	0.074	60.7	0.351	-106.0
1400	0.396	-174.3	6.343	76.4	0.083	60.1	0.332	-112.5
1600	0.397	177.3	5.553	72.1	0.092	59.5	0.319	-117.7
1800	0.400	170.3	4.937	68.3	0.102	58.9	0.313	-122.6
2000	0.406	163.7	4.440	64.4	0.110	57.5	0.309	-127.3
2200	0.410	157.6	4.031	61.0	0.120	56.9	0.308	-130.8
2400	0.416	152.1	3.695	57.5	0.129	55.6	0.308	-134.6
2600	0.421	146.9	3.405	54.2	0.138	54.5	0.310	-137.7
2800	0.429	142.3	3.160	51.1	0.146	53.3	0.313	-140.8
3000	0.435	137.8	2.950	48.0	0.156	52.1	0.319	-143.2
3200	0.443	133.7	2.770	44.9	0.165	50.7	0.325	-145.9
3400	0.452	129.8	2.611	41.9	0.175	49.4	0.332	-148.4
3600	0.460	126.0	2.469	39.0	0.183	47.8	0.340	-151.0
3800	0.469	122.4	2.342	36.0	0.192	46.2	0.347	-153.4
4000	0.477	119.0	2.226	33.1	0.201	44.7	0.356	-155.8
4200	0.485	115.4	2.121	30.3	0.209	43.0	0.363	-158.0
4400	0.492	112.2	2.028	27.4	0.217	41.4	0.371	-160.4
4600	0.500	109.1	1.939	24.7	0.226	39.9	0.379	-162.5
4800	0.507	106.1	1.860	21.9	0.234	38.2	0.386	-164.8
5000	0.515	103.0	1.784	19.2	0.242	36.5	0.395	-166.8
5200	0.521	99.9	1.716	16.6	0.250	34.9	0.403	-169.1
5400	0.528	97.1	1.653	14.0	0.258	33.3	0.410	-171.0
5600	0.534	94.3	1.595	11.5	0.265	31.6	0.418	-173.1
5800	0.539	91.5	1.541	9.0	0.272	30.0	0.424	-174.9
6000	0.791	145.7	0.122	-69.1	0.122	-69.0	0.898	-158.6

S Parameters (Common emitter) $V_{CE}=1V, I_C=25mA, Z_O=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.518	-80.0	19.415	135.0	0.021	73.2	0.762	-38.4
400	0.475	-112.6	16.674	113.0	0.034	65.1	0.580	-63.2
600	0.440	-132.4	13.356	99.8	0.044	62.3	0.466	-80.0
800	0.425	-148.8	10.399	91.1	0.054	62.7	0.397	-91.8
1000	0.414	-160.9	8.489	84.9	0.063	62.7	0.354	-100.9
1200	0.410	-171.0	7.152	79.6	0.073	62.4	0.329	-108.4
1400	0.412	-179.6	6.123	75.1	0.082	61.8	0.312	-114.6
1600	0.415	172.8	5.367	71.0	0.092	60.9	0.303	-119.7
1800	0.418	166.4	4.778	67.2	0.101	60.1	0.299	-124.5
2000	0.425	160.3	4.297	63.4	0.111	59.1	0.296	-129.1
2200	0.430	154.6	3.898	60.0	0.120	57.9	0.297	-132.4
2400	0.436	149.4	3.574	56.5	0.129	56.8	0.299	-136.1
2600	0.441	144.6	3.294	53.3	0.138	55.7	0.301	-139.2
2800	0.450	140.2	3.056	50.1	0.148	54.3	0.306	-142.0
3000	0.455	135.9	2.853	47.1	0.157	53.0	0.312	-144.5
3200	0.463	132.0	2.680	44.0	0.166	51.5	0.319	-147.1
3400	0.471	128.2	2.527	41.0	0.175	50.1	0.327	-149.4
3600	0.480	124.5	2.390	38.1	0.185	48.5	0.335	-151.9
3800	0.488	121.0	2.267	35.1	0.193	46.9	0.344	-154.4
4000	0.496	117.7	2.154	32.2	0.202	45.2	0.352	-156.7
4200	0.504	114.3	2.052	29.4	0.211	43.7	0.360	-158.9
4400	0.511	111.1	1.961	26.5	0.219	41.9	0.368	-161.3
4600	0.518	108.0	1.876	23.8	0.228	40.4	0.377	-163.4
4800	0.526	105.0	1.800	21.0	0.236	38.6	0.384	-165.5
5000	0.533	102.0	1.727	18.4	0.244	36.9	0.393	-167.6
5200	0.539	99.0	1.660	15.7	0.252	35.2	0.401	-169.9
5400	0.546	96.2	1.600	13.2	0.260	33.5	0.409	-171.8
5600	0.551	93.4	1.543	10.7	0.267	31.9	0.416	-173.7
5800	0.556	90.6	1.491	8.2	0.275	30.1	0.423	-175.6
6000	0.560	87.8	1.441	5.7	0.283	28.6	0.430	-177.4

S Parameters (Common emitter) $V_{CE}=3V$, $I_C=5mA$, $Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.902	-16.9	9.926	160.8	0.020	84.3	0.965	-16.2
400	0.841	-36.5	10.048	143.1	0.040	78.0	0.911	-32.1
600	0.779	-53.1	8.776	130.8	0.058	68.7	0.823	-46.8
800	0.688	-69.7	7.912	118.3	0.072	60.7	0.736	-58.5
1000	0.591	-88.5	7.495	107.1	0.082	55.3	0.656	-67.8
1200	0.515	-103.8	6.736	98.0	0.089	51.8	0.594	-75.5
1400	0.470	-115.0	5.914	91.4	0.095	48.9	0.546	-82.0
1600	0.422	-128.6	5.391	84.6	0.100	47.7	0.507	-87.6
1800	0.394	-139.8	4.875	79.0	0.106	46.4	0.479	-92.8
2000	0.374	-150.1	4.434	73.9	0.111	45.5	0.458	-97.3
2200	0.361	-159.3	4.051	69.4	0.116	45.0	0.441	-101.6
2400	0.352	-168.9	3.750	64.9	0.122	44.4	0.428	-105.6
2600	0.346	-176.7	3.466	60.8	0.127	44.4	0.419	-109.2
2800	0.345	175.8	3.226	57.0	0.132	44.0	0.413	-112.5
3000	0.345	168.8	3.024	53.3	0.138	43.8	0.411	-115.8
3200	0.350	162.3	2.843	49.6	0.144	43.5	0.412	-119.0
3400	0.356	156.3	2.688	46.1	0.151	43.2	0.413	-122.2
3600	0.364	150.5	2.548	42.6	0.158	42.7	0.416	-125.4
3800	0.372	145.2	2.417	39.2	0.164	42.1	0.419	-128.4
4000	0.381	140.3	2.300	35.8	0.171	41.6	0.424	-131.4
4200	0.389	135.5	2.193	32.6	0.178	40.8	0.429	-134.3
4400	0.398	131.0	2.095	29.3	0.185	40.0	0.435	-137.2
4600	0.408	126.9	2.004	26.2	0.192	39.2	0.441	-140.0
4800	0.417	122.7	1.920	23.1	0.199	38.2	0.449	-142.8
5000	0.427	119.0	1.842	20.1	0.206	37.1	0.456	-145.3
5200	0.437	115.3	1.768	17.2	0.214	36.2	0.463	-148.1
5400	0.445	111.7	1.700	14.3	0.221	35.2	0.470	-150.7
5600	0.454	108.4	1.636	11.5	0.228	34.0	0.476	-153.2
5800	0.462	105.0	1.577	8.8	0.236	33.1	0.484	-155.5
6000	0.470	101.9	1.524	6.2	0.244	31.9	0.492	-157.8

S Parameters (Common emitter) $V_{CE}=3V, I_C=10mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.821	-23.6	16.540	155.6	0.018	82.5	0.929	-21.2
400	0.727	-50.3	15.780	134.6	0.036	73.8	0.832	-40.5
600	0.624	-74.0	13.461	118.6	0.049	67.3	0.714	-56.1
800	0.528	-93.7	11.167	106.3	0.059	61.9	0.613	-67.7
1000	0.450	-112.1	9.502	96.7	0.067	59.1	0.536	-76.4
1200	0.401	-127.3	8.122	89.3	0.075	57.3	0.481	-83.4
1400	0.372	-139.4	7.029	83.7	0.083	56.5	0.442	-89.4
1600	0.351	-151.3	6.206	78.5	0.090	55.8	0.414	-94.6
1800	0.339	-161.6	5.540	73.9	0.097	55.2	0.393	-99.4
2000	0.333	-171.0	4.999	69.6	0.104	54.5	0.378	-103.8
2200	0.331	-179.5	4.545	65.7	0.112	53.5	0.368	-107.7
2400	0.332	172.5	4.175	61.9	0.120	53.2	0.361	-111.7
2600	0.332	165.5	3.851	58.3	0.127	52.6	0.356	-115.1
2800	0.337	159.1	3.578	54.9	0.134	51.9	0.354	-118.2
3000	0.342	153.3	3.341	51.7	0.142	51.0	0.355	-121.2
3200	0.349	147.9	3.140	48.4	0.150	50.0	0.358	-124.4
3400	0.357	142.8	2.962	45.1	0.158	49.0	0.362	-127.4
3600	0.366	138.1	2.803	42.0	0.166	48.1	0.367	-130.5
3800	0.376	133.5	2.658	38.9	0.174	46.9	0.373	-133.4
4000	0.386	129.4	2.528	35.8	0.182	45.6	0.378	-136.3
4200	0.395	125.3	2.408	32.8	0.190	44.5	0.385	-139.1
4400	0.404	121.4	2.300	29.8	0.198	43.2	0.392	-141.8
4600	0.413	117.9	2.200	26.9	0.205	41.9	0.399	-144.5
4800	0.422	114.3	2.108	24.0	0.213	40.5	0.407	-147.1
5000	0.430	110.9	2.022	21.1	0.221	39.0	0.414	-149.5
5200	0.439	107.7	1.943	18.4	0.229	37.8	0.422	-152.1
5400	0.447	104.5	1.869	15.7	0.236	36.3	0.429	-154.5
5600	0.455	101.4	1.801	13.0	0.244	34.9	0.436	-156.8
5800	0.461	98.4	1.738	10.4	0.252	33.5	0.443	-158.9
6000	0.468	95.5	1.680	7.8	0.259	32.0	0.451	-161.1

S Parameters (Common emitter) $V_{CE}=3V, I_C=15mA, Z_O=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.741	-29.7	21.968	151.6	0.017	81.0	0.898	-24.5
400	0.626	-61.9	19.649	128.0	0.032	73.0	0.773	-45.2
600	0.516	-88.7	15.734	111.1	0.044	67.8	0.643	-60.7
800	0.441	-109.1	12.475	100.0	0.054	64.3	0.544	-71.7
1000	0.390	-126.3	10.223	91.8	0.062	62.7	0.474	-80.0
1200	0.359	-140.5	8.604	85.5	0.070	62.6	0.427	-86.6
1400	0.342	-152.5	7.399	80.4	0.078	61.4	0.394	-92.3
1600	0.332	-163.3	6.483	75.8	0.086	60.5	0.371	-97.4
1800	0.328	-172.8	5.768	71.6	0.095	59.7	0.355	-101.9
2000	0.328	178.7	5.192	67.7	0.103	58.8	0.343	-106.2
2200	0.330	171.0	4.716	64.0	0.111	57.9	0.336	-110.2
2400	0.334	163.9	4.324	60.5	0.120	57.0	0.332	-114.0
2600	0.337	157.6	3.985	57.1	0.128	56.2	0.329	-117.3
2800	0.344	151.8	3.698	53.9	0.136	55.1	0.329	-120.4
3000	0.349	146.6	3.455	50.8	0.145	54.0	0.332	-123.4
3200	0.358	141.7	3.243	47.6	0.153	52.9	0.336	-126.5
3400	0.366	137.2	3.058	44.6	0.162	51.5	0.342	-129.5
3600	0.375	132.9	2.892	41.6	0.170	50.2	0.348	-132.4
3800	0.386	128.7	2.742	38.5	0.178	49.0	0.354	-135.4
4000	0.395	124.9	2.608	35.6	0.187	47.5	0.360	-138.2
4200	0.404	121.1	2.484	32.7	0.195	46.2	0.368	-140.9
4400	0.412	117.5	2.373	29.8	0.203	44.5	0.375	-143.6
4600	0.422	114.1	2.269	26.9	0.211	43.2	0.383	-146.2
4800	0.431	110.7	2.174	24.1	0.219	41.6	0.391	-148.8
5000	0.439	107.6	2.086	21.4	0.227	40.0	0.399	-151.2
5200	0.447	104.4	2.005	18.6	0.235	38.5	0.407	-153.7
5400	0.455	101.4	1.928	16.0	0.242	36.9	0.414	-156.0
5600	0.462	98.5	1.858	13.4	0.250	35.4	0.421	-158.3
5800	0.468	95.6	1.794	10.8	0.258	33.8	0.428	-160.4
6000	0.475	92.9	1.734	8.3	0.265	32.2	0.436	-162.6

S Parameters (Common emitter) $V_{CE}=3V, I_C=20mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.666	-35.3	26.045	148.3	0.016	80.9	0.873	-26.5
400	0.548	-71.2	21.825	123.2	0.030	73.7	0.731	-47.8
600	0.455	-98.7	16.689	106.9	0.040	69.1	0.599	-62.9
800	0.397	-119.1	12.955	96.6	0.050	67.0	0.504	-73.4
1000	0.363	-135.6	10.483	89.2	0.059	65.6	0.440	-81.3
1200	0.343	-149.2	8.764	83.4	0.067	65.2	0.397	-87.6
1400	0.333	-160.6	7.515	78.6	0.076	64.3	0.367	-93.1
1600	0.329	-170.6	6.572	74.3	0.085	63.5	0.348	-97.9
1800	0.329	-179.3	5.840	70.3	0.093	62.5	0.334	-102.4
2000	0.332	172.8	5.252	66.5	0.102	61.5	0.325	-106.6
2200	0.336	165.7	4.768	63.0	0.111	60.4	0.320	-110.6
2400	0.341	159.2	4.367	59.5	0.119	59.3	0.317	-114.3
2600	0.346	153.3	4.025	56.3	0.128	58.2	0.316	-117.7
2800	0.353	148.0	3.735	53.2	0.136	57.0	0.317	-120.8
3000	0.359	143.2	3.485	50.1	0.145	56.1	0.320	-123.6
3200	0.368	138.5	3.272	47.0	0.154	54.4	0.325	-126.7
3400	0.377	134.3	3.084	44.1	0.163	53.2	0.331	-129.6
3600	0.386	130.2	2.917	41.1	0.172	51.8	0.338	-132.6
3800	0.396	126.3	2.764	38.1	0.180	50.3	0.345	-135.6
4000	0.405	122.6	2.629	35.2	0.189	48.7	0.352	-138.4
4200	0.414	119.1	2.504	32.3	0.197	47.3	0.360	-141.1
4400	0.423	115.6	2.390	29.4	0.205	45.6	0.368	-143.7
4600	0.432	112.3	2.287	26.6	0.214	44.1	0.375	-146.4
4800	0.440	109.1	2.190	23.9	0.222	42.4	0.384	-148.9
5000	0.448	106.0	2.101	21.1	0.230	40.8	0.393	-151.3
5200	0.456	103.0	2.018	18.4	0.238	39.3	0.401	-153.8
5400	0.464	100.0	1.942	15.8	0.245	37.7	0.408	-156.2
5600	0.471	97.2	1.872	13.3	0.253	36.0	0.415	-158.5
5800	0.477	94.3	1.806	10.7	0.261	34.5	0.422	-160.6
6000	0.483	91.6	1.746	8.2	0.268	32.9	0.431	-162.7

S Parameters (Common emitter) $V_{CE}=3V, I_C=25mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.603	-40.6	28.896	145.7	0.016	73.4	0.857	-27.7
400	0.492	-78.8	22.927	120.0	0.028	73.4	0.701	-49.1
600	0.417	-106.4	17.051	104.2	0.038	69.7	0.570	-63.6
800	0.375	-126.8	13.094	94.5	0.048	68.5	0.479	-73.6
1000	0.351	-142.6	10.532	87.5	0.057	68.3	0.419	-81.1
1200	0.339	-155.6	8.780	82.0	0.066	67.6	0.379	-87.2
1400	0.333	-166.2	7.520	77.4	0.075	66.2	0.352	-92.5
1600	0.333	-175.5	6.568	73.2	0.084	65.3	0.334	-97.3
1800	0.335	176.3	5.831	69.3	0.093	64.4	0.322	-101.7
2000	0.339	168.9	5.241	65.6	0.101	63.3	0.315	-105.7
2200	0.344	162.3	4.756	62.2	0.110	62.1	0.311	-109.7
2400	0.351	156.2	4.355	58.7	0.119	60.7	0.309	-113.4
2600	0.355	150.6	4.012	55.6	0.128	59.5	0.308	-116.7
2800	0.363	145.6	3.723	52.4	0.136	58.5	0.310	-119.8
3000	0.371	141.1	3.474	49.4	0.145	57.1	0.315	-122.7
3200	0.379	136.5	3.261	46.4	0.154	55.8	0.320	-125.8
3400	0.388	132.5	3.073	43.4	0.164	54.2	0.327	-128.8
3600	0.397	128.6	2.903	40.4	0.172	52.7	0.334	-131.7
3800	0.407	124.9	2.755	37.5	0.180	51.2	0.341	-134.7
4000	0.417	121.3	2.618	34.5	0.189	49.5	0.349	-137.7
4200	0.426	117.8	2.494	31.7	0.198	48.0	0.357	-140.3
4400	0.434	114.4	2.379	28.8	0.207	46.4	0.365	-143.0
4600	0.443	111.2	2.276	26.0	0.215	44.7	0.373	-145.6
4800	0.451	108.0	2.180	23.3	0.223	43.1	0.382	-148.2
5000	0.459	105.1	2.091	20.6	0.231	41.4	0.391	-150.7
5200	0.467	102.0	2.008	17.9	0.239	39.9	0.399	-153.2
5400	0.475	99.1	1.932	15.3	0.247	38.2	0.407	-155.7
5600	0.481	96.4	1.862	12.7	0.255	36.6	0.415	-157.9
5800	0.487	93.5	1.797	10.2	0.263	35.0	0.422	-160.0
6000	0.493	90.9	1.736	7.7	0.270	33.3	0.430	-162.2

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