



SANYO Semiconductors

DATA SHEET

2SC6024 — 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 : $f_T=14\text{GHz}$ typ ($V_{CE}=1\text{V}$).
- : $f_T=21\text{GHz}$ typ ($V_{CE}=3\text{V}$).
- Low operating voltage.
- High gain : $|S_{21e}|^2=12.5\text{dB}$ typ (f=2GHz).
- Ultraminiature and thin flat leadless package (1.4mmX0.8mmX0.6mm).

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}	$V_{CB}=5\text{V}, I_E=0\text{A}$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=1\text{V}, I_C=0\text{A}$			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		GHz
	f_{T2}	$V_{CE}=3\text{V}, I_C=15\text{mA}$	18	21		GHz
Output Capacitance	C_{ob}	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.5	0.7	pF
Reverse Transfer Capacitance	C_{re}	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.3		pF
Forward Transfer Gain	$ S_{21e} ^2_1$	$V_{CE}=1\text{V}, I_C=5\text{mA}, f=2\text{GHz}$	9	10.5		dB
	$ S_{21e} ^2_2$	$V_{CE}=3\text{V}, I_C=15\text{mA}, f=2\text{GHz}$		12.5		dB
Noise Figure	NF	$V_{CE}=1\text{V}, I_C=5\text{mA}, f=2\text{GHz}$		1.2		dB

Marking : NM

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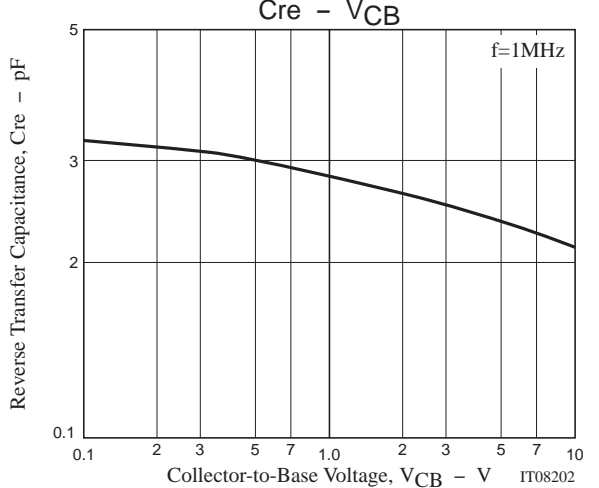
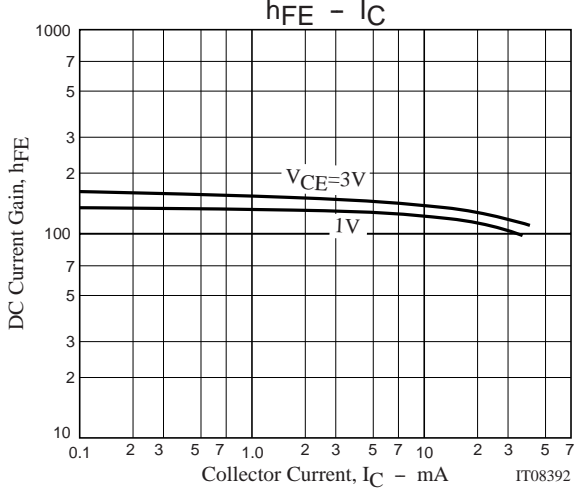
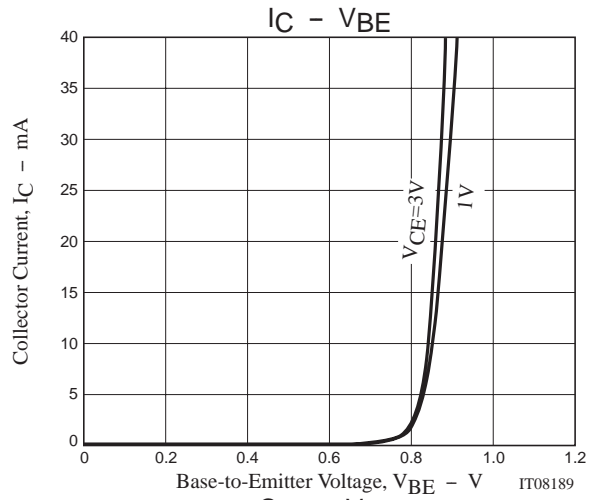
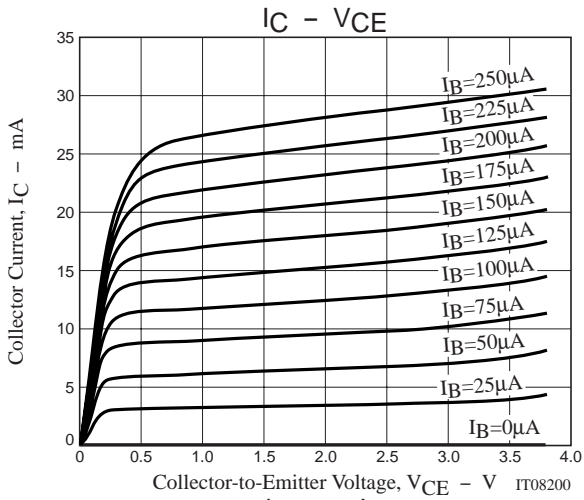
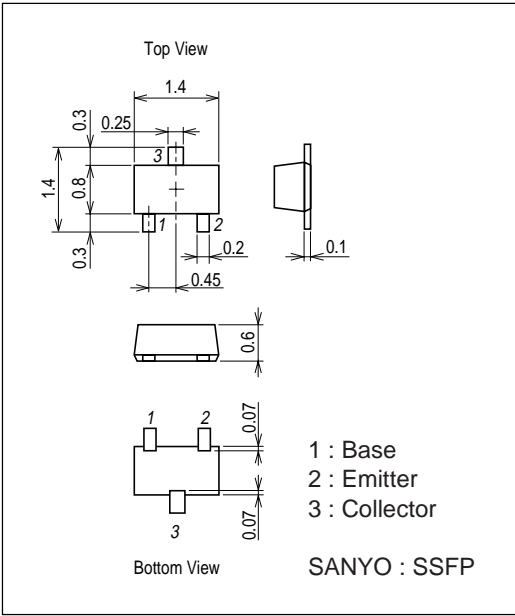
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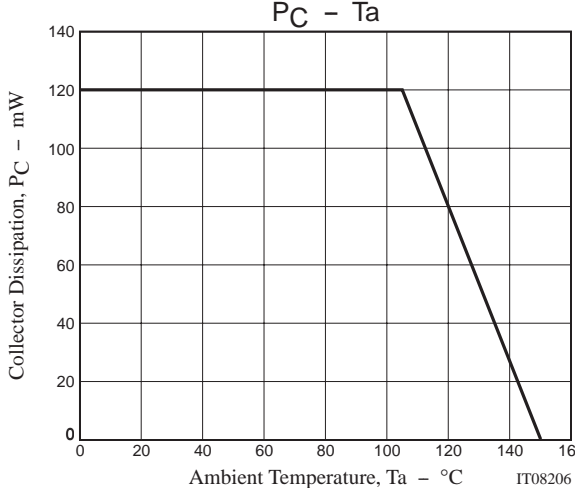
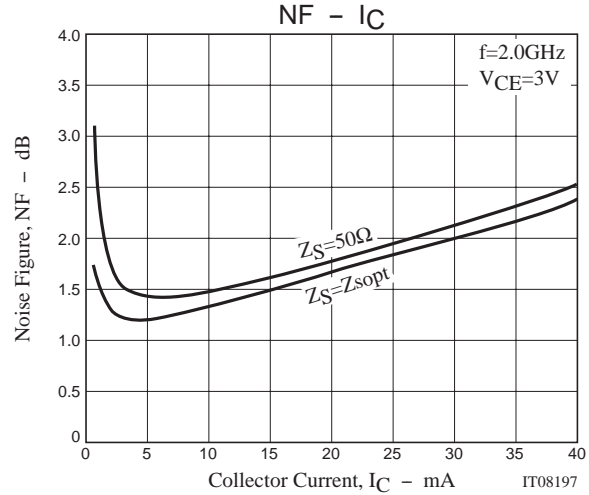
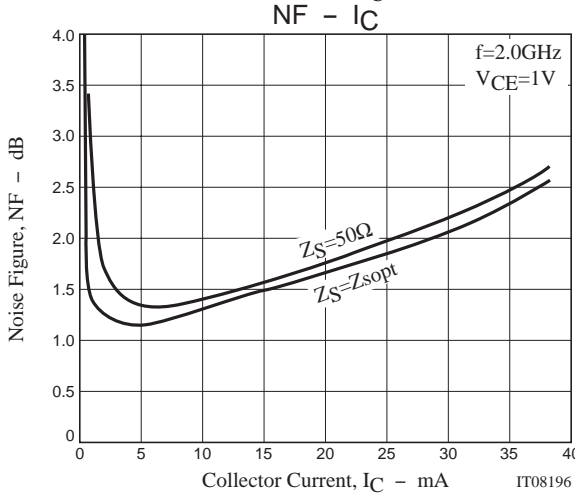
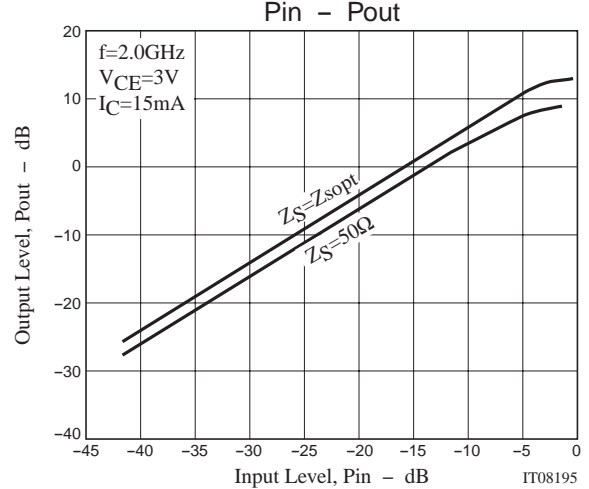
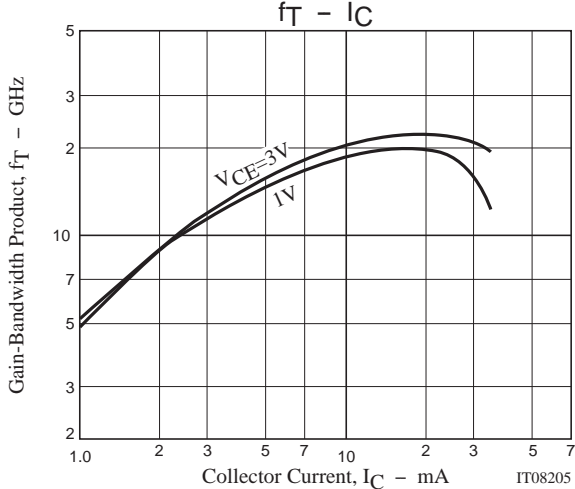
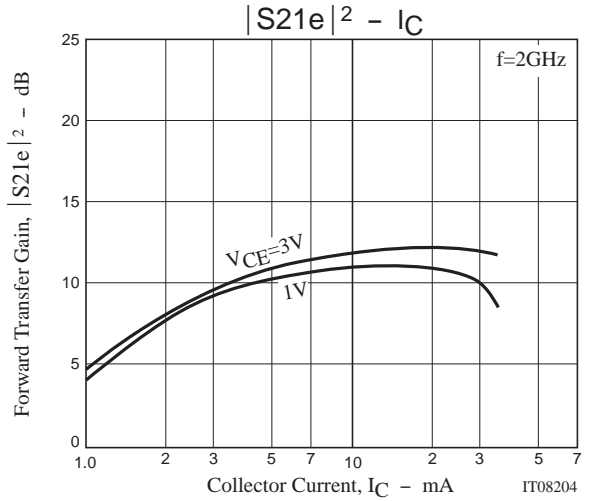
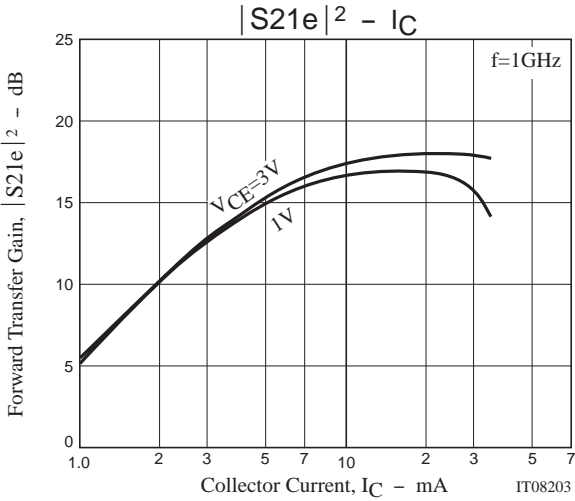
SANYO Electric Co., Ltd. Semiconductor Company

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

Package Dimensions

unit : mm
7029-002



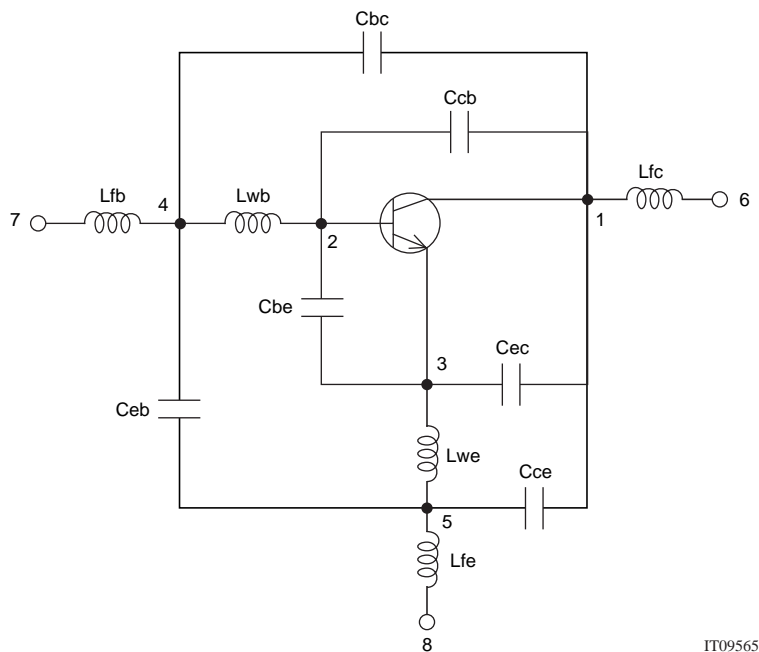


SPICE PARAMETERS

model : Gummel-Poon

Parameter	Value	Unit	Parameter	Value	Unit
IS	124.2a	A	XTF	10.00m	
BF	168.7		VTF	8	V
NF	1.007		ITF	549.7m	A
VAF	5.762	V	PTF	25	°C
IKF	141.1m	A	CJC	168.1f	F
ISE	181.0f	A	VJC	165.7m	V
NE	2.295		MJC	571.4m	
BR	11.54		XCJC	330.0m	
NR	1		TR	10.00p	S
VAR	3.43	V	FC	800.0m	
IKR	21.00m	A	CJS	0	F
ISC	1.800f	A	VJS	0	V
NC	1.24		MJS	0	
RB	2.86	Ω	Lfc	188.0p	H
IRB	100.0μ	A	Lwb	1.222n	H
RBM	1.254	Ω	Lfb	180.0p	H
RE	1.297	Ω	Lwe	423.0p	H
RC	2.552	Ω	Lfe	256.0p	H
XTB	0		Ccb	18.00f	F
EG	1.11	eV	Cbe	1.22f	F
XTI	3		Cec	13.00f	F
CJE	98.40f	F	Cbc	328.0f	F
VJE	10	V	Ccb	358.0f	F
MJE	100.0m		Cce	280.0f	F
TF	4.500p	S			

SCHEMATIC



*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	0.87	-22.0	8.91	155.2	0.03	80.5	0.92	-23.5
400	0.80	-40.2	7.30	139.1	0.06	67.7	0.80	-44.3
600	0.69	-61.6	7.00	124.2	0.08	61.3	0.68	-59.6
800	0.57	-84.7	6.70	110.5	0.10	57.1	0.57	-70.9
1000	0.51	-96.9	5.63	102.5	0.11	55.8	0.50	-79.6
1200	0.44	-111.8	5.05	94.7	0.12	55.0	0.44	-87.0
1400	0.41	-121.2	4.42	89.2	0.13	54.6	0.40	-93.2
1600	0.38	-131.0	3.97	84.1	0.14	55.0	0.37	-98.7
1800	0.36	-138.8	3.58	79.8	0.15	55.2	0.35	-103.7
2000	0.35	-145.8	3.27	75.9	0.16	55.6	0.33	-108.3
2200	0.34	-151.8	3.01	72.4	0.17	55.9	0.32	-112.3
2400	0.34	-157.9	2.79	69.0	0.18	56.0	0.31	-116.3
2600	0.33	-163.0	2.60	65.8	0.19	56.3	0.30	-120.0
2800	0.33	-167.7	2.43	62.9	0.20	56.4	0.30	-123.3
3000	0.33	-172.0	2.30	60.1	0.21	56.5	0.29	-126.3
3200	0.33	-176.3	2.18	57.3	0.23	56.4	0.29	-129.7
3400	0.33	-180.0	2.07	54.7	0.24	56.4	0.29	-132.6
3600	0.33	176.0	1.98	52.1	0.25	56.0	0.29	-135.8
3800	0.34	172.5	1.90	49.5	0.26	55.7	0.30	-138.6
4000	0.34	169.6	1.82	47.1	0.28	55.3	0.30	-141.6
4200	0.34	166.0	1.75	44.7	0.29	54.7	0.30	-144.4
4400	0.34	163.0	1.69	42.4	0.30	54.2	0.30	-147.0
4600	0.35	160.0	1.63	40.1	0.32	53.5	0.31	-149.9
4800	0.35	157.1	1.58	37.9	0.33	52.7	0.31	-152.8
5000	0.36	154.4	1.53	35.8	0.34	52.0	0.32	-155.3
5200	0.36	151.6	1.49	33.7	0.36	51.1	0.32	-158.0
5400	0.37	148.9	1.45	31.7	0.37	50.3	0.32	-160.7
5600	0.37	146.3	1.41	29.7	0.38	49.3	0.33	-163.3
5800	0.37	143.7	1.37	27.9	0.40	48.4	0.33	-165.7
6000	0.38	141.4	1.34	26.0	0.41	47.4	0.34	-168.3

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	0.76	-33.4	14.54	148.2	0.03	75.0	0.84	-32.2
400	0.64	-62.6	12.14	127.3	0.05	66.5	0.67	-55.8
600	0.52	-88.7	10.04	111.3	0.07	63.3	0.53	-71.2
800	0.42	-111.1	8.34	99.8	0.08	63.0	0.44	-82.1
1000	0.39	-123.8	6.81	93.2	0.09	62.9	0.38	-90.7
1200	0.36	-135.5	5.79	87.8	0.11	63.2	0.34	-97.8
1400	0.34	-144.1	5.00	83.4	0.12	63.3	0.31	-103.8
1600	0.33	-151.7	4.42	79.5	0.13	63.6	0.29	-109.2
1800	0.33	-158.3	3.95	76.0	0.15	63.5	0.27	-114.1
2000	0.33	-164.0	3.58	72.9	0.16	63.5	0.26	-118.6
2200	0.32	-168.9	3.28	69.8	0.17	63.2	0.26	-122.5
2400	0.32	-173.8	3.03	66.9	0.18	62.7	0.25	-126.5
2600	0.32	-177.9	2.82	64.1	0.20	62.5	0.25	-129.9
2800	0.32	178.1	2.63	61.6	0.21	62.0	0.25	-133.0
3000	0.32	174.4	2.48	59.1	0.23	61.5	0.24	-135.9
3200	0.33	171.0	2.35	56.6	0.24	60.7	0.25	-139.0
3400	0.33	167.9	2.23	54.2	0.25	59.9	0.25	-141.6
3600	0.33	164.6	2.13	51.9	0.27	59.1	0.25	-144.7
3800	0.34	161.7	2.04	49.5	0.28	58.3	0.25	-147.1
4000	0.34	159.3	1.95	47.3	0.30	57.5	0.25	-149.9
4200	0.34	156.0	1.88	45.0	0.31	56.5	0.26	-152.4
4400	0.34	153.6	1.81	42.9	0.32	55.4	0.26	-154.9
4600	0.35	151.1	1.75	40.7	0.34	54.5	0.27	-157.6
4800	0.35	148.5	1.69	38.7	0.35	53.4	0.27	-160.1
5000	0.36	146.2	1.64	36.7	0.36	52.3	0.28	-162.3
5200	0.36	143.7	1.59	34.6	0.38	51.2	0.28	-164.7
5400	0.37	141.5	1.55	32.7	0.39	50.1	0.29	-167.2
5600	0.37	139.2	1.50	30.9	0.40	48.9	0.29	-169.6
5800	0.37	137.0	1.47	29.0	0.42	47.7	0.29	-171.4
6000	0.38	134.9	1.43	27.2	0.43	46.5	0.30	-173.9

S Parameters (Common emitter) $V_{CE}=1V, I_C=15mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.65	-46.8	17.50	142.1	0.03	73.1	0.77	-37.6
400	0.51	-83.8	14.35	118.4	0.05	66.5	0.58	-61.8
600	0.43	-107.8	11.02	104.4	0.06	65.7	0.45	-76.7
800	0.38	-125.8	8.73	95.4	0.08	66.5	0.38	-87.4
1000	0.35	-137.7	7.07	89.6	0.09	67.2	0.33	-96.1
1200	0.34	-147.5	5.94	85.0	0.10	67.4	0.29	-103.2
1400	0.33	-155.2	5.12	81.1	0.12	67.7	0.27	-109.2
1600	0.33	-161.6	4.51	77.6	0.13	67.4	0.26	-114.5
1800	0.33	-167.3	4.03	74.4	0.15	67.0	0.25	-119.3
2000	0.33	-172.3	3.64	71.5	0.16	66.6	0.24	-123.9
2200	0.33	-176.6	3.33	68.6	0.17	65.9	0.23	-127.6
2400	0.33	179.1	3.08	65.9	0.19	65.3	0.23	-131.4
2600	0.33	175.4	2.86	63.3	0.20	64.6	0.23	-134.8
2800	0.33	172.0	2.67	60.8	0.22	64.0	0.23	-137.9
3000	0.33	168.7	2.52	58.4	0.23	63.2	0.23	-140.5
3200	0.34	165.6	2.38	56.0	0.25	62.2	0.23	-143.5
3400	0.34	162.8	2.26	53.8	0.26	61.4	0.23	-146.0
3600	0.34	159.8	2.15	51.5	0.27	60.4	0.23	-148.9
3800	0.35	157.1	2.06	49.2	0.29	59.3	0.24	-151.2
4000	0.35	154.9	1.98	47.0	0.30	58.3	0.24	-153.9
4200	0.35	151.9	1.90	44.9	0.32	57.1	0.25	-156.3
4400	0.35	149.6	1.83	42.7	0.33	56.1	0.25	-158.5
4600	0.36	147.4	1.77	40.7	0.34	54.8	0.26	-161.2
4800	0.36	144.9	1.71	38.6	0.36	53.7	0.26	-163.5
5000	0.37	142.6	1.66	36.7	0.37	52.5	0.27	-165.4
5200	0.37	140.4	1.61	34.7	0.39	51.2	0.27	-167.9
5400	0.37	138.3	1.57	32.8	0.40	50.1	0.28	-170.3
5600	0.38	136.0	1.52	31.0	0.41	48.8	0.28	-172.5
5800	0.38	134.0	1.48	29.2	0.43	47.7	0.28	-174.5
6000	0.38	132.0	1.45	27.4	0.44	46.4	0.29	-176.8

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	0.56	-63.0	18.41	136.6	0.03	73.7	0.72	-41.2
400	0.45	-101.1	14.55	112.8	0.04	67.9	0.53	-65.3
600	0.39	-121.7	10.96	100.6	0.06	68.3	0.41	-80.0
800	0.36	-136.0	8.68	93.0	0.07	69.5	0.34	-90.6
1000	0.35	-146.8	7.02	87.7	0.09	69.6	0.30	-99.2
1200	0.34	-155.3	5.90	83.3	0.10	69.9	0.27	-106.2
1400	0.34	-162.1	5.08	79.7	0.12	69.6	0.25	-112.2
1600	0.34	-167.8	4.47	76.4	0.13	69.2	0.24	-117.6
1800	0.34	-172.8	3.99	73.4	0.15	68.9	0.23	-122.3
2000	0.34	-177.2	3.61	70.5	0.16	68.2	0.22	-126.7
2200	0.34	178.8	3.30	67.7	0.18	67.5	0.22	-130.4
2400	0.34	174.9	3.05	65.1	0.19	66.7	0.22	-134.1
2600	0.34	171.5	2.83	62.5	0.20	65.8	0.22	-137.4
2800	0.34	168.3	2.65	60.1	0.22	65.1	0.22	-140.2
3000	0.35	165.2	2.49	57.7	0.23	64.2	0.22	-142.8
3200	0.35	162.3	2.36	55.4	0.25	63.1	0.22	-145.8
3400	0.35	159.7	2.24	53.1	0.26	62.1	0.23	-148.2
3600	0.36	156.9	2.13	50.9	0.28	61.0	0.23	-150.9
3800	0.36	154.3	2.04	48.5	0.29	59.9	0.24	-153.2
4000	0.36	152.2	1.96	46.4	0.31	58.8	0.24	-155.8
4200	0.36	149.3	1.88	44.3	0.32	57.6	0.24	-158.1
4400	0.37	147.1	1.82	42.2	0.34	56.4	0.25	-160.3
4600	0.37	145.0	1.75	40.1	0.35	55.2	0.25	-162.9
4800	0.38	142.6	1.70	38.2	0.36	54.0	0.26	-165.1
5000	0.38	140.5	1.64	36.2	0.38	52.7	0.26	-167.0
5200	0.38	138.2	1.59	34.2	0.39	51.4	0.27	-169.5
5400	0.39	136.3	1.55	32.4	0.40	50.3	0.27	-171.8
5600	0.39	134.1	1.51	30.6	0.42	49.0	0.28	-174.0
5800	0.39	132.0	1.47	28.8	0.43	47.7	0.28	-175.7
6000	0.40	130.1	1.44	27.0	0.44	46.4	0.29	-178.0

S Parameters (Common emitter) $V_{CE}=1V, I_C=25mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.50	-80.1	18.18	131.6	0.03	71.9	0.67	-44.1
400	0.43	-116.3	13.78	109.2	0.04	68.7	0.48	-67.9
600	0.39	-134.0	10.29	98.2	0.06	70.2	0.37	-82.3
800	0.37	-145.0	8.31	91.4	0.07	70.9	0.31	-92.9
1000	0.36	-154.4	6.74	86.3	0.09	71.1	0.27	-101.1
1200	0.35	-161.6	5.69	82.1	0.10	71.4	0.25	-108.3
1400	0.35	-167.7	4.90	78.6	0.12	70.9	0.24	-114.2
1600	0.35	-172.7	4.31	75.3	0.13	70.3	0.23	-119.5
1800	0.35	-177.2	3.86	72.3	0.15	70.1	0.22	-124.1
2000	0.36	178.7	3.49	69.4	0.16	69.3	0.22	-128.4
2200	0.36	175.1	3.19	66.7	0.18	68.4	0.21	-132.0
2400	0.36	171.5	2.95	64.1	0.19	67.5	0.21	-135.6
2600	0.36	168.5	2.74	61.5	0.21	66.7	0.21	-138.6
2800	0.36	165.4	2.56	59.1	0.22	65.9	0.22	-141.5
3000	0.36	162.4	2.42	56.7	0.24	64.7	0.22	-143.9
3200	0.37	159.7	2.28	54.4	0.25	63.7	0.22	-146.8
3400	0.37	157.3	2.17	52.1	0.26	62.7	0.23	-149.1
3600	0.38	154.5	2.07	49.9	0.28	61.5	0.23	-151.8
3800	0.38	152.0	1.98	47.6	0.30	60.4	0.23	-154.1
4000	0.38	150.0	1.90	45.5	0.31	59.2	0.24	-156.7
4200	0.38	147.2	1.83	43.3	0.32	57.9	0.24	-158.9
4400	0.39	145.1	1.76	41.2	0.34	56.8	0.25	-161.1
4600	0.39	142.9	1.70	39.2	0.35	55.6	0.25	-163.6
4800	0.40	140.6	1.65	37.2	0.37	54.2	0.26	-165.9
5000	0.40	138.5	1.60	35.3	0.38	53.0	0.27	-167.8
5200	0.40	136.3	1.55	33.3	0.39	51.7	0.27	-170.2
5400	0.41	134.4	1.51	31.5	0.41	50.3	0.28	-172.4
5600	0.41	132.2	1.46	29.6	0.42	49.1	0.28	-174.6
5800	0.41	130.1	1.43	27.9	0.44	47.8	0.29	-176.4
6000	0.41	128.3	1.39	26.1	0.45	46.4	0.29	-178.8

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	0.90	-19.1	8.82	157.1	0.03	82.6	0.93	-20.0
400	0.84	-34.5	7.18	141.9	0.05	71.5	0.84	-38.4
600	0.73	-53.9	7.12	127.5	0.07	65.3	0.72	-52.5
800	0.61	-74.2	6.92	114.1	0.09	61.1	0.62	-63.0
1000	0.54	-85.8	5.89	105.8	0.10	59.0	0.54	-70.9
1200	0.46	-100.2	5.36	97.6	0.11	57.9	0.48	-77.7
1400	0.42	-109.1	4.71	91.9	0.12	57.3	0.44	-83.3
1600	0.38	-118.9	4.26	86.5	0.13	57.4	0.40	-88.1
1800	0.36	-126.8	3.86	82.1	0.14	57.5	0.37	-92.7
2000	0.34	-134.1	3.52	78.0	0.15	57.9	0.35	-96.8
2200	0.33	-140.3	3.24	74.4	0.16	58.0	0.34	-100.5
2400	0.32	-146.7	3.01	71.0	0.17	58.2	0.32	-104.2
2600	0.31	-152.3	2.80	67.8	0.18	58.5	0.31	-107.6
2800	0.30	-157.1	2.63	64.8	0.19	58.8	0.31	-110.7
3000	0.30	-162.0	2.48	61.9	0.20	58.8	0.30	-113.8
3200	0.30	-166.6	2.35	59.1	0.22	58.7	0.30	-117.0
3400	0.30	-170.6	2.24	56.4	0.23	58.6	0.30	-120.1
3600	0.30	-175.0	2.13	53.8	0.24	58.5	0.30	-123.2
3800	0.30	-178.8	2.05	51.2	0.25	58.1	0.30	-126.1
4000	0.30	178.0	1.96	48.8	0.26	57.7	0.30	-129.2
4200	0.30	174.1	1.88	46.3	0.28	57.2	0.30	-132.3
4400	0.31	170.9	1.82	44.0	0.29	56.7	0.30	-135.1
4600	0.31	167.7	1.76	41.6	0.30	56.2	0.30	-138.2
4800	0.32	164.4	1.70	39.4	0.32	55.4	0.31	-141.2
5000	0.32	161.5	1.65	37.2	0.33	54.7	0.31	-144.0
5200	0.33	158.5	1.60	35.0	0.35	53.9	0.32	-146.8
5400	0.33	155.6	1.55	32.9	0.36	53.0	0.32	-149.9
5600	0.33	152.9	1.51	30.9	0.37	52.1	0.32	-152.6
5800	0.34	150.1	1.47	29.0	0.39	51.2	0.33	-155.1
6000	0.34	147.6	1.43	27.1	0.40	50.2	0.33	-158.0

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	0.80	-27.4	15.08	150.9	0.03	77.6	0.87	-26.9
400	0.69	-51.6	12.49	131.4	0.05	70.6	0.72	-47.8
600	0.56	-75.9	10.73	115.0	0.06	66.7	0.58	-61.7
800	0.44	-97.3	9.06	102.6	0.08	65.5	0.48	-71.4
1000	0.39	-109.9	7.43	95.7	0.09	65.6	0.41	-78.9
1200	0.35	-121.9	6.34	89.9	0.10	65.5	0.37	-84.9
1400	0.33	-130.9	5.48	85.4	0.11	65.7	0.33	-90.0
1600	0.31	-139.1	4.84	81.3	0.12	65.6	0.31	-94.6
1800	0.30	-146.2	4.34	77.9	0.14	65.5	0.29	-98.8
2000	0.29	-152.6	3.93	74.6	0.15	65.4	0.27	-102.9
2200	0.29	-158.1	3.60	71.6	0.16	65.1	0.26	-106.4
2400	0.28	-163.5	3.32	68.7	0.18	64.8	0.25	-110.0
2600	0.28	-168.4	3.09	65.9	0.19	64.4	0.25	-113.4
2800	0.28	-172.7	2.88	63.3	0.20	64.1	0.24	-116.4
3000	0.28	-176.7	2.72	60.8	0.21	63.5	0.24	-119.2
3200	0.28	179.5	2.57	58.3	0.23	62.9	0.24	-122.4
3400	0.28	176.2	2.44	55.9	0.24	62.1	0.24	-125.3
3600	0.29	172.5	2.32	53.6	0.25	61.5	0.24	-128.4
3800	0.29	169.2	2.22	51.1	0.27	60.7	0.24	-131.3
4000	0.29	166.5	2.13	48.9	0.28	59.8	0.24	-134.2
4200	0.29	163.2	2.05	46.7	0.29	58.7	0.25	-137.1
4400	0.30	160.5	1.97	44.5	0.31	57.9	0.25	-139.7
4600	0.30	157.9	1.90	42.3	0.32	56.9	0.25	-142.8
4800	0.31	154.9	1.84	40.3	0.34	56.0	0.26	-145.6
5000	0.31	152.5	1.78	38.2	0.35	54.9	0.26	-148.2
5200	0.31	150.0	1.73	36.1	0.36	53.8	0.27	-150.9
5400	0.32	147.6	1.68	34.2	0.38	52.7	0.27	-153.6
5600	0.32	145.2	1.63	32.2	0.39	51.6	0.28	-156.2
5800	0.33	142.8	1.59	30.4	0.40	50.4	0.28	-158.5
6000	0.33	140.7	1.55	28.5	0.42	49.2	0.28	-161.3

S Parameters (Common emitter) $V_{CE}=3V, I_C=15mA, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.71	-34.5	19.75	146.3	0.02	77.2	0.83	-30.7
400	0.57	-65.8	15.86	123.3	0.04	70.8	0.65	-52.0
600	0.45	-90.5	12.29	107.8	0.06	69.4	0.51	-65.2
800	0.37	-109.6	9.71	97.9	0.07	69.3	0.42	-74.3
1000	0.34	-122.2	7.86	91.8	0.08	69.5	0.36	-81.5
1200	0.31	-133.1	6.61	86.9	0.10	69.6	0.32	-87.1
1400	0.30	-141.7	5.70	82.9	0.11	69.4	0.29	-92.0
1600	0.29	-149.0	5.01	79.4	0.12	69.2	0.27	-96.4
1800	0.28	-155.6	4.48	76.2	0.14	68.9	0.25	-100.7
2000	0.28	-161.3	4.05	73.2	0.15	68.4	0.24	-104.6
2200	0.28	-166.2	3.70	70.3	0.16	67.8	0.23	-108.2
2400	0.28	-171.2	3.41	67.6	0.18	67.2	0.23	-111.7
2600	0.28	-175.5	3.17	65.0	0.19	66.7	0.22	-115.0
2800	0.28	-179.2	2.96	62.6	0.20	66.1	0.22	-118.1
3000	0.28	176.9	2.78	60.2	0.22	65.2	0.22	-120.8
3200	0.28	173.4	2.63	57.8	0.23	64.5	0.22	-124.0
3400	0.28	170.5	2.50	55.5	0.25	63.5	0.22	-126.8
3600	0.29	167.0	2.38	53.3	0.26	62.7	0.22	-130.0
3800	0.29	164.1	2.28	50.9	0.27	61.6	0.23	-132.8
4000	0.29	161.8	2.18	48.8	0.29	60.7	0.23	-135.7
4200	0.30	158.5	2.09	46.6	0.30	59.6	0.23	-138.6
4400	0.30	156.1	2.02	44.5	0.32	58.6	0.23	-141.1
4600	0.31	153.8	1.95	42.4	0.33	57.5	0.24	-144.2
4800	0.31	151.1	1.88	40.4	0.34	56.3	0.24	-147.0
5000	0.31	148.9	1.82	38.3	0.36	55.2	0.25	-149.5
5200	0.32	146.5	1.77	36.3	0.37	54.1	0.25	-152.2
5400	0.32	144.2	1.72	34.5	0.38	52.9	0.25	-154.9
5600	0.33	141.9	1.67	32.5	0.40	51.6	0.26	-157.5
5800	0.33	139.8	1.62	30.7	0.41	50.5	0.26	-159.6
6000	0.34	137.7	1.58	28.9	0.42	49.2	0.27	-162.3

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	0.64	-41.1	23.07	142.7	0.02	76.3	0.80	-33.1
400	0.49	-75.9	17.49	118.2	0.04	72.3	0.60	-54.0
600	0.39	-99.9	12.86	104.1	0.05	71.8	0.47	-66.4
800	0.34	-117.8	9.93	95.5	0.07	71.8	0.39	-75.1
1000	0.31	-130.1	8.00	89.8	0.08	72.1	0.33	-81.7
1200	0.30	-140.3	6.70	85.3	0.09	71.7	0.30	-87.3
1400	0.29	-148.3	5.76	81.5	0.11	71.8	0.27	-92.1
1600	0.28	-155.1	5.06	78.2	0.12	71.3	0.25	-96.4
1800	0.28	-161.2	4.51	75.1	0.14	70.9	0.24	-100.4
2000	0.28	-166.6	4.08	72.3	0.15	70.3	0.23	-104.4
2200	0.28	-171.1	3.73	69.5	0.16	69.4	0.22	-107.9
2400	0.28	-175.6	3.44	66.9	0.18	68.7	0.22	-111.4
2600	0.28	-179.6	3.19	64.3	0.19	68.1	0.21	-114.8
2800	0.28	176.8	2.98	61.9	0.21	67.3	0.21	-117.8
3000	0.28	173.3	2.80	59.6	0.22	66.4	0.21	-120.5
3200	0.29	170.1	2.64	57.3	0.23	65.5	0.21	-123.7
3400	0.29	167.3	2.51	55.0	0.25	64.5	0.21	-126.5
3600	0.29	164.1	2.39	52.8	0.26	63.5	0.21	-129.6
3800	0.30	161.3	2.29	50.5	0.28	62.4	0.22	-132.4
4000	0.30	159.1	2.19	48.4	0.29	61.3	0.22	-135.5
4200	0.30	156.0	2.10	46.2	0.31	60.3	0.22	-138.3
4400	0.31	153.7	2.03	44.2	0.32	59.1	0.23	-140.8
4600	0.31	151.5	1.96	42.0	0.33	57.9	0.23	-143.8
4800	0.32	148.8	1.89	40.1	0.35	56.7	0.24	-146.7
5000	0.32	146.8	1.83	38.1	0.36	55.6	0.24	-149.2
5200	0.33	144.5	1.77	36.1	0.37	54.4	0.25	-151.9
5400	0.33	142.3	1.72	34.2	0.39	53.2	0.25	-154.7
5600	0.33	140.1	1.67	32.3	0.40	51.9	0.26	-157.3
5800	0.34	137.9	1.63	30.5	0.41	50.7	0.26	-159.5
6000	0.34	136.1	1.59	28.7	0.43	49.4	0.26	-162.2

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	0.57	-47.1	25.29	139.7	0.02	75.7	0.77	-34.5
400	0.43	-83.6	18.16	115.0	0.04	72.6	0.57	-54.6
600	0.36	-107.3	13.03	101.9	0.05	73.3	0.45	-66.3
800	0.32	-124.3	9.96	93.9	0.07	73.8	0.37	-74.5
1000	0.30	-136.2	7.99	88.5	0.08	74.1	0.32	-81.0
1200	0.29	-145.8	6.68	84.2	0.09	73.5	0.28	-86.1
1400	0.29	-153.4	5.74	80.5	0.11	73.3	0.26	-90.7
1600	0.29	-159.7	5.04	77.3	0.12	72.8	0.24	-94.8
1800	0.29	-165.3	4.49	74.3	0.14	72.0	0.23	-98.8
2000	0.29	-170.2	4.06	71.5	0.15	71.5	0.22	-102.6
2200	0.29	-174.6	3.71	68.8	0.16	70.7	0.22	-106.1
2400	0.29	-178.8	3.42	66.2	0.18	69.9	0.21	-109.7
2600	0.29	177.4	3.17	63.7	0.19	69.1	0.21	-112.9
2800	0.29	174.0	2.96	61.3	0.21	68.2	0.21	-115.8
3000	0.29	170.8	2.79	59.0	0.22	67.3	0.21	-118.6
3200	0.30	167.7	2.63	56.6	0.23	66.3	0.21	-121.9
3400	0.30	165.0	2.50	54.4	0.25	65.4	0.21	-124.8
3600	0.30	162.0	2.38	52.2	0.26	64.4	0.21	-127.8
3800	0.31	159.3	2.28	49.9	0.28	63.2	0.22	-130.7
4000	0.31	157.3	2.18	47.8	0.29	62.2	0.22	-133.6
4200	0.31	154.3	2.09	45.6	0.31	61.0	0.22	-136.5
4400	0.32	152.1	2.02	43.5	0.32	59.8	0.23	-139.1
4600	0.32	149.9	1.94	41.4	0.34	58.5	0.23	-142.2
4800	0.33	147.4	1.88	39.4	0.35	57.4	0.24	-145.1
5000	0.33	145.4	1.82	37.4	0.36	56.2	0.24	-147.7
5200	0.34	143.2	1.76	35.4	0.38	54.9	0.25	-150.5
5400	0.34	141.0	1.71	33.6	0.39	53.7	0.25	-153.3
5600	0.35	138.8	1.66	31.7	0.40	52.4	0.26	-155.9
5800	0.35	136.7	1.62	29.8	0.42	51.2	0.26	-158.2
6000	0.35	134.8	1.58	28.1	0.43	49.9	0.26	-160.9

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