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# 2SC4994

Silicon NPN Epitaxial

# HITACHI

ADE-208-012  
1st. Edition

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## Application

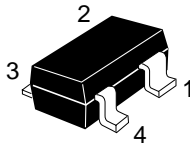
VHF / UHF wide band amplifier

## Features

- High gain bandwidth product  
 $f_T = 10.5 \text{ GHz Typ}$
- High gain, low noise figure  
 $PG = 17.0 \text{ dB Typ}$ ,  $NF = 1.2 \text{ dB Typ}$  at  $f = 900 \text{ MHz}$

## Outline

CMPAK-4



1. Collector
2. Emitter
3. Base
4. Emitter

**Absolute Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{\text{CBO}}$	15	V
Collector to emitter voltage	$V_{\text{CEO}}$	8	V
Emitter to base voltage	$V_{\text{EBO}}$	1.5	V
Collector current	$I_{\text{C}}$	20	mA
Collector power dissipation	$P_{\text{C}}$	100	mW
Junction temperature	$T_{\text{j}}$	150	$^\circ\text{C}$
Storage temperature	$T_{\text{stg}}$	-55 to +150	$^\circ\text{C}$

**Electrical Characteristics** ( $T_a = 25^\circ\text{C}$ )

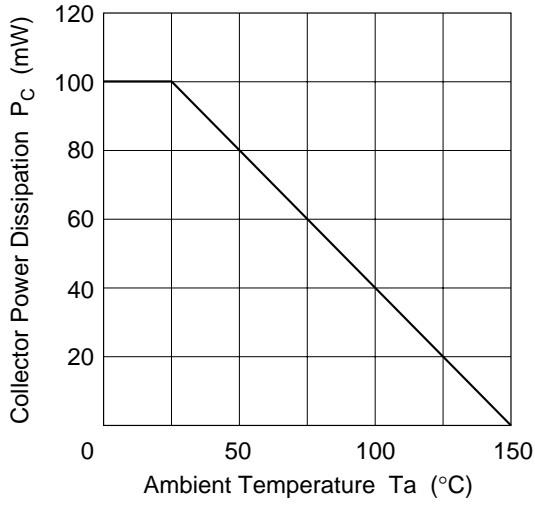
Item	Symbol	Min	Typ	Max	Unit	Test conditions
Collector cutoff current	$I_{\text{CBO}}$	—	—	10	$\mu\text{A}$	$V_{\text{CB}} = 15 \text{ V}, I_{\text{E}} = 0$
	$I_{\text{CEO}}$	—	—	1	mA	$V_{\text{CE}} = 8 \text{ V}, R_{\text{BE}} = \infty$
Emitter cutoff current	$I_{\text{EBO}}$	—	—	10	$\mu\text{A}$	$V_{\text{EB}} = 1.5 \text{ V}, I_{\text{C}} = 0$
DC current transfer ratio	$h_{\text{FE}}$	50	120	250		$V_{\text{CE}} = 5 \text{ V}, I_{\text{C}} = 10 \text{ mA}$
Collector output capacitance	$C_{\text{ob}}$	—	0.4	0.75	pF	$V_{\text{CB}} = 5 \text{ V}, I_{\text{E}} = 0, f = 1 \text{ MHz}$
Gain bandwidth product	$f_{\text{T}}$	7.5	10.5	—	GHz	$V_{\text{CE}} = 5 \text{ V}, I_{\text{C}} = 10 \text{ mA}$
Power gain	PG	14.0	17.0	—	dB	$V_{\text{CE}} = 5 \text{ V}, I_{\text{C}} = 10 \text{ mA},$ $f = 900 \text{ MHz}$
Noise figure	NF	—	1.2	2.5	dB	$V_{\text{CE}} = 5 \text{ V}, I_{\text{C}} = 5 \text{ mA},$ $f = 900 \text{ MHz}$

Note: Marking is "YS-".

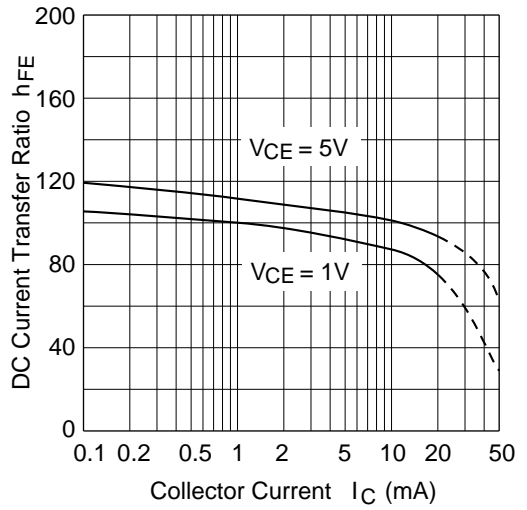
Attention: This device is very sensitive to electro static discharge.

It is recommended to adopt appropriate cautions when handling this transistor.

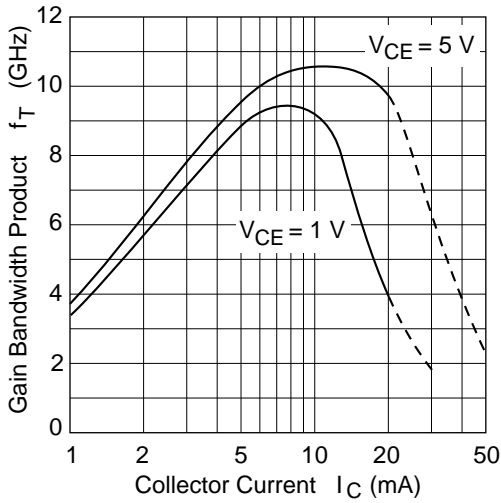
Maximum Collector Dissipation Curve



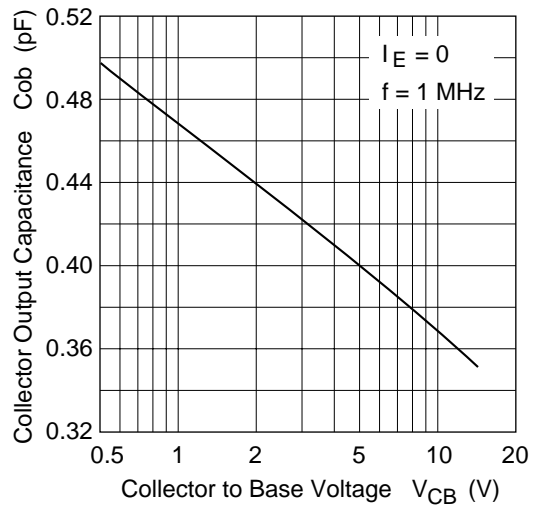
DC Current Transfer Ratio vs. Collector Current



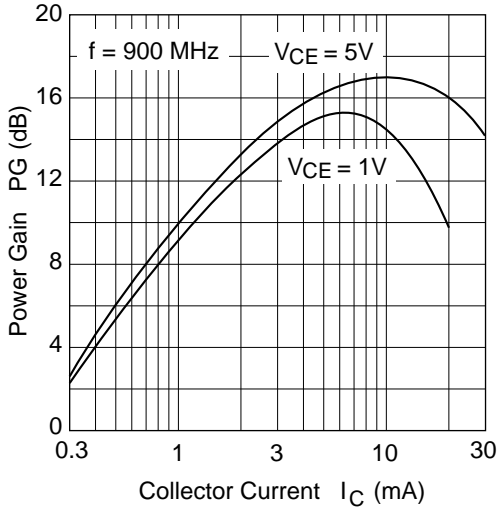
Gain Bandwidth Product vs. Collector Current



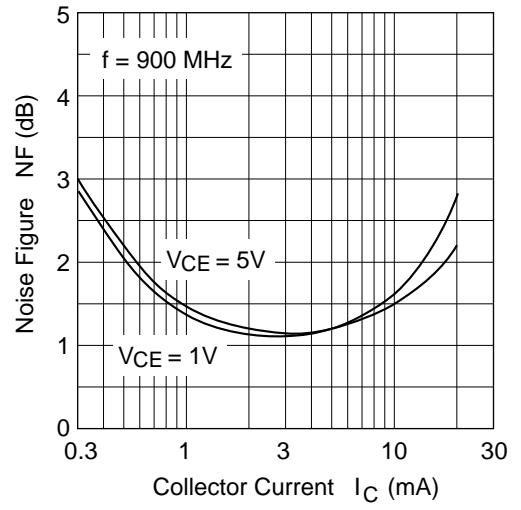
Collector Output Capacitance vs. Collector to Base Voltage



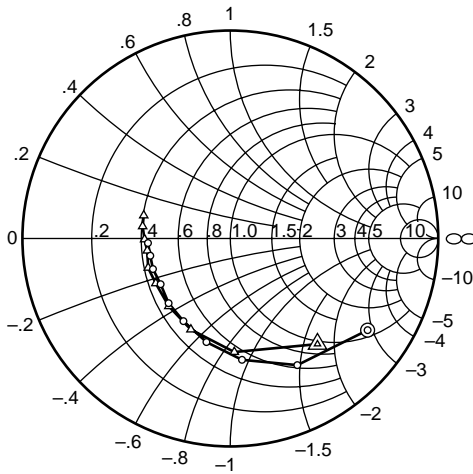
Power Gain vs. Collector Current



Noise Figure vs. Collector Current

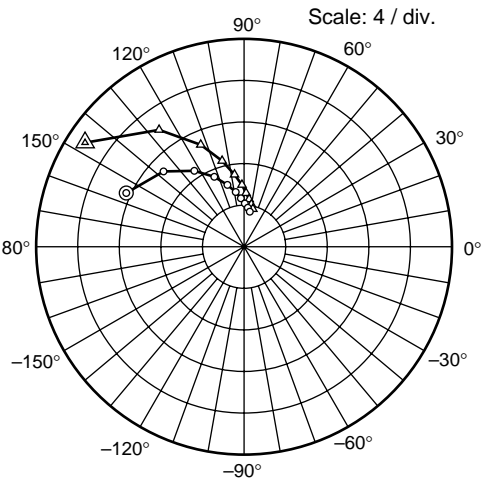


S11 Parameter vs. Frequency



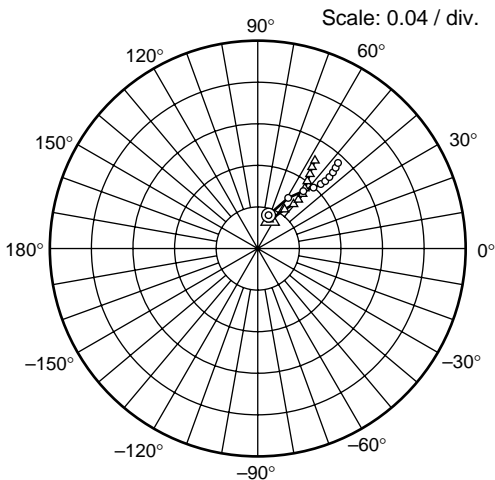
Condition:  $V_{CE} = 5\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 5\text{ mA}$ )  
 △ — △ ( $I_C = 10\text{ mA}$ )

S21 Parameter vs. Frequency



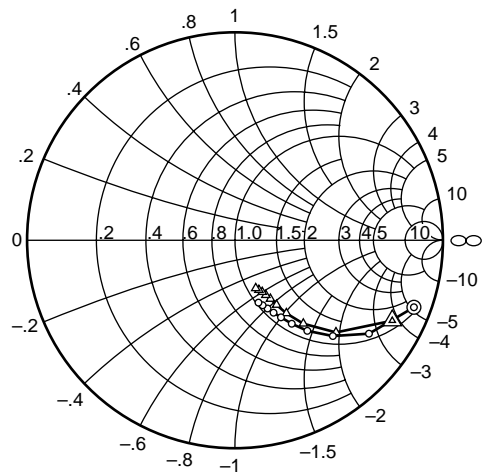
Condition:  $V_{CE} = 5\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 5\text{ mA}$ )  
 △ — △ ( $I_C = 10\text{ mA}$ )

S12 Parameter vs. Frequency



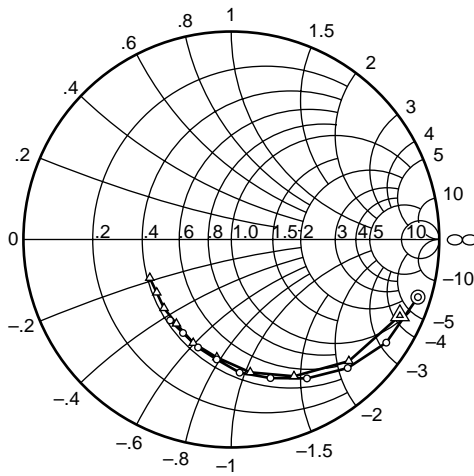
Condition:  $V_{CE} = 5\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 5\text{ mA}$ )  
 △ — △ ( $I_C = 10\text{ mA}$ )

S22 Parameter vs. Frequency



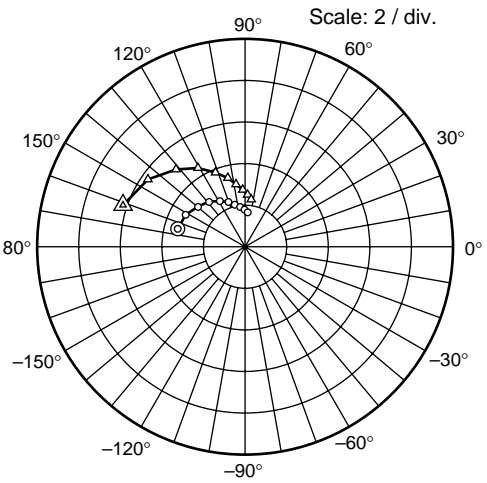
Condition:  $V_{CE} = 5\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 5\text{ mA}$ )  
 △ — △ ( $I_C = 10\text{ mA}$ )

S11 Parameter vs. Frequency



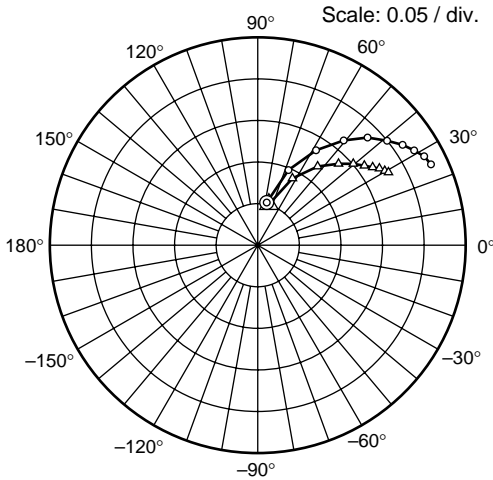
Condition:  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 1\text{ mA}$ )  
 △ — △ ( $I_C = 2\text{ mA}$ )

S21 Parameter vs. Frequency



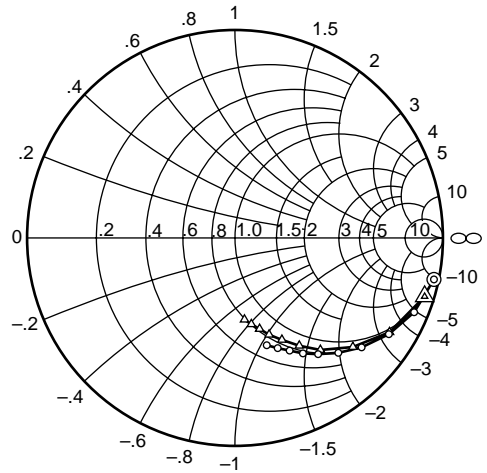
Condition:  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 1\text{ mA}$ )  
 △ — △ ( $I_C = 2\text{ mA}$ )

S12 Parameter vs. Frequency



Condition:  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 1\text{ mA}$ )  
 △ — △ ( $I_C = 2\text{ mA}$ )

S22 Parameter vs. Frequency



Condition:  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 200 to 2000 MHz (200 MHz step)  
 ○ — ○ ( $I_C = 1\text{ mA}$ )  
 △ — △ ( $I_C = 2\text{ mA}$ )

**S Parameters** ( $V_{CE} = 5\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_O = 50\ \Omega$ )

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
200	0.794	-33.7	12.47	155.5	0.0338	71.9	0.919	-20.5
400	0.689	-62.1	10.61	136.9	0.0569	58.9	0.786	-34.9
600	0.586	-84.6	8.73	123.2	0.0706	51.5	0.659	-44.4
800	0.511	-103.0	7.31	113.0	0.0795	47.5	0.558	-51.4
1000	0.457	-119.6	6.16	105.0	0.0867	45.6	0.486	-55.8
1200	0.430	-133.7	5.33	98.6	0.0918	44.9	0.432	-59.2
1400	0.401	-146.8	4.67	93.7	0.0975	44.9	0.395	-62.0
1600	0.400	-158.5	4.16	88.9	0.103	45.3	0.364	-64.5
1800	0.394	-167.9	3.77	84.4	0.108	46.0	0.340	-67.0
2000	0.397	-176.9	3.42	80.6	0.113	46.8	0.321	-69.4

**S Parameters** ( $V_{CE} = 5\text{ V}$ ,  $I_C = 10\text{ mA}$ ,  $Z_O = 50\ \Omega$ )

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
200	0.659	-50.5	18.28	146.8	0.0297	66.3	0.850	-27.1
400	0.547	-88.0	13.90	126.0	0.0456	55.4	0.658	-42.4
600	0.478	-113.4	10.66	113.0	0.0549	51.0	0.519	-50.7
800	0.441	-132.4	8.53	104.3	0.0611	50.2	0.430	-54.9
1000	0.419	-148.9	7.00	97.5	0.0680	50.5	0.370	-57.3
1200	0.420	-160.3	5.96	91.9	0.0735	51.9	0.330	-58.9
1400	0.404	-171.6	5.17	87.8	0.0804	53.6	0.303	-60.7
1600	0.413	-179.3	4.59	83.3	0.0875	54.9	0.282	-62.3
1800	0.426	172.2	4.13	80.1	0.0942	56.3	0.266	-64.4
2000	0.431	165.2	3.73	76.8	0.101	56.9	0.252	-66.7

## 2SC4994

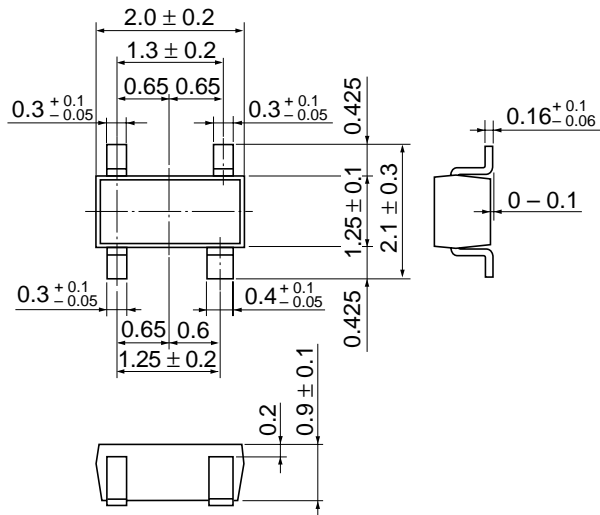
### S Parameters ( $V_{CE} = 1\text{ V}$ , $I_C = 1\text{ mA}$ , $Z_O = 50\ \Omega$ )

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
200	0.939	-17.2	3.35	165.1	0.0525	78.0	0.978	-11.8
400	0.895	-33.7	3.25	151.8	0.0977	67.7	0.933	-22.5
600	0.834	-47.9	2.79	139.8	0.134	58.4	0.873	-32.0
800	0.761	-61.5	2.77	128.9	0.163	50.6	0.805	-40.8
1000	0.693	-74.3	2.51	119.0	0.185	44.4	0.743	-48.0
1200	0.642	-86.5	2.30	110.5	0.200	38.9	0.687	-54.4
1400	0.582	-97.0	2.08	103.9	0.212	34.7	0.644	-59.5
1600	0.544	-107.2	1.93	97.2	0.220	31.2	0.602	-64.1
1800	0.507	-117.4	1.79	91.0	0.227	28.1	0.568	-68.8
2000	0.489	-127.2	1.66	85.7	0.230	25.0	0.538	-73.5

### S Parameters ( $V_{CE} = 1\text{ V}$ , $I_C = 2\text{ mA}$ , $Z_O = 50\ \Omega$ )

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
200	0.889	-24.3	6.20	161.2	0.0508	74.6	0.955	-17.2
400	0.814	-46.0	5.69	145.2	0.0906	62.5	0.871	-31.4
600	0.724	-65.4	4.99	131.7	0.119	52.7	0.773	-42.8
800	0.646	-81.9	4.42	120.8	0.138	45.2	0.678	-52.7
1000	0.572	-97.0	3.85	111.7	0.151	40.4	0.604	-59.2
1200	0.531	-110.2	3.42	104.0	0.160	36.7	0.540	-65.3
1400	0.484	-123.1	3.04	98.2	0.167	34.1	0.494	-70.6
1600	0.463	-134.4	2.75	92.3	0.173	32.2	0.454	-74.9
1800	0.441	-144.5	2.51	87.2	0.177	30.3	0.423	-79.3
2000	0.434	-154.7	2.30	82.6	0.180	29.1	0.396	-83.4





Hitachi Code	CMPAK-4(T)
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.006 g

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