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# 2SC4197

Silicon NPN Epitaxial

# HITACHI

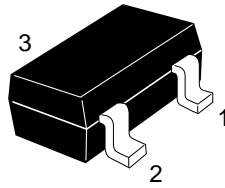
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## Application

UHF frequency converter, wide band amplifier

## Outline

MPAK



- 1. Emitter
- 2. Base
- 3. Collector

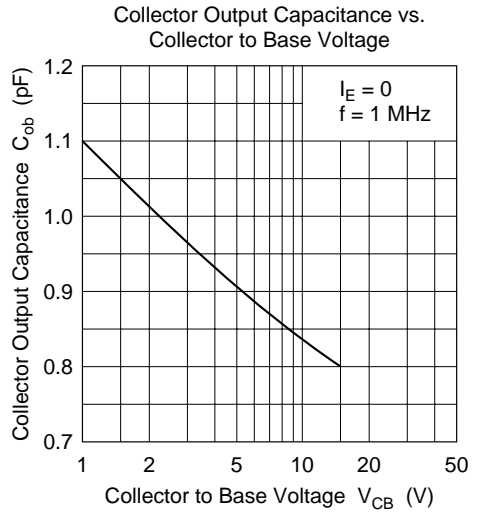
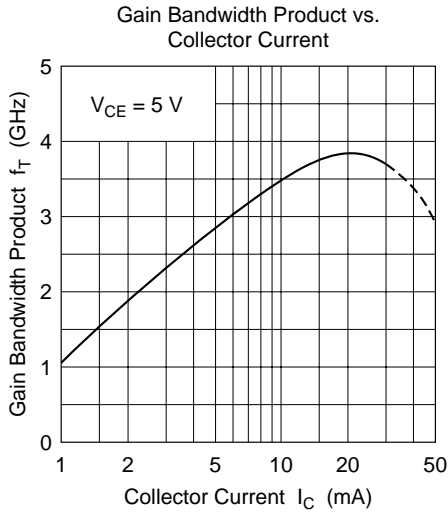
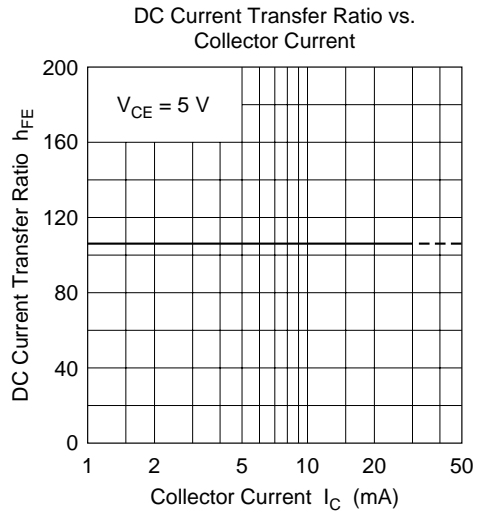
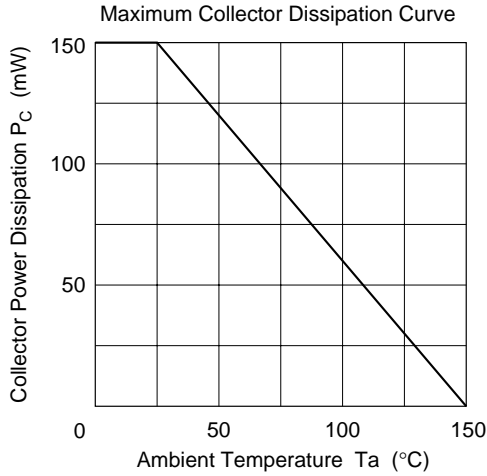
**Absolute Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{\text{CBO}}$	25	V
Collector to emitter voltage	$V_{\text{CEO}}$	13	V
Emitter to base voltage	$V_{\text{EBO}}$	3	V
Collector current	$I_{\text{C}}$	50	mA
Collector power dissipation	$P_{\text{C}}$	150	mW
Junction temperature	$T_{\text{j}}$	150	$^\circ\text{C}$
Storage temperature	$T_{\text{stg}}$	-55 to +150	$^\circ\text{C}$

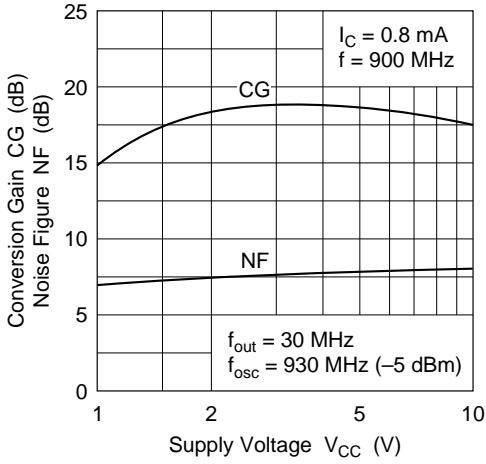
**Electrical Characteristics** ( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Min	Typ	Max	Unit	Test conditions
Collector to base breakdown voltage	$V_{(\text{BR})\text{CBO}}$	25	—	—	V	$I_{\text{C}} = 10 \mu\text{A}$ , $I_{\text{E}} = 0$
Collector cutoff current	$I_{\text{CBO}}$	—	—	0.1	$\mu\text{A}$	$V_{\text{CB}} = 15 \text{V}$ , $I_{\text{E}} = 0$
Collector cutoff current	$I_{\text{CEO}}$	—	—	10	$\mu\text{A}$	$V_{\text{CE}} = 13 \text{V}$ , $R_{\text{BE}} = \infty$
Emitter cutoff current	$I_{\text{EBO}}$	—	—	0.3	$\mu\text{A}$	$V_{\text{EB}} = 3 \text{V}$ , $I_{\text{C}} = 0$
Collector to emitter saturation voltage	$V_{\text{CE}(\text{sat})}$	—	—	0.3	V	$I_{\text{C}} = 20 \text{mA}$ , $I_{\text{B}} = 4 \text{mA}$
DC current transfer ratio	$h_{\text{FE}}$	50	—	180		$V_{\text{CE}} = 5 \text{V}$ , $I_{\text{C}} = 5 \text{mA}$
Collector output capacitance	$C_{\text{ob}}$	—	0.85	1.3	pF	$V_{\text{CB}} = 10 \text{V}$ , $I_{\text{E}} = 0$ , $f = 1\text{MHz}$
Gain bandwidth product	$f_{\text{T}}$	3.0	3.8	—	GHz	$V_{\text{CE}} = 5 \text{V}$ , $I_{\text{C}} = 20 \text{mA}$
Conversion gain	CG	—	19	—	dB	$V_{\text{CC}} = 5 \text{V}$ , $I_{\text{C}} = 0.8 \text{mA}$ , $f_{\text{in}} = 900 \text{MHz}$
Noise figure	NF	—	8	—	dB	$f_{\text{osc}} = 930 \text{MHz}$ (-5dBm), $f_{\text{out}} = 30 \text{MHz}$

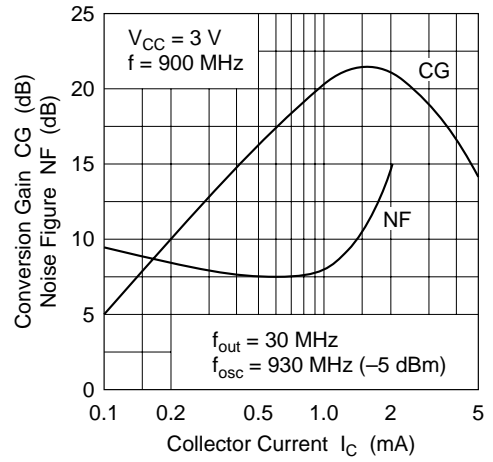
Note: Marking is "TI-".



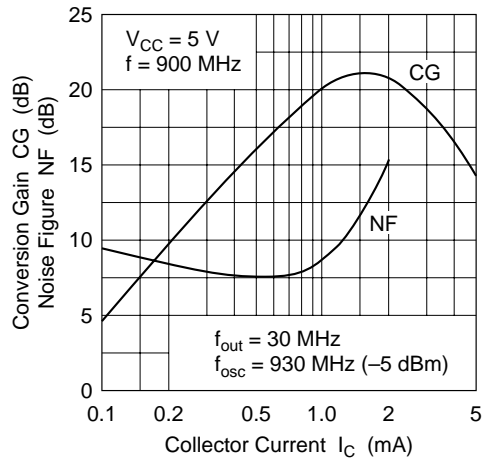
Conversion Gain, Noise Figure vs. Supply Voltage



Conversion Gain, Noise Figure vs. Collector Current



Conversion Gain, Noise Figure vs. Collector Current

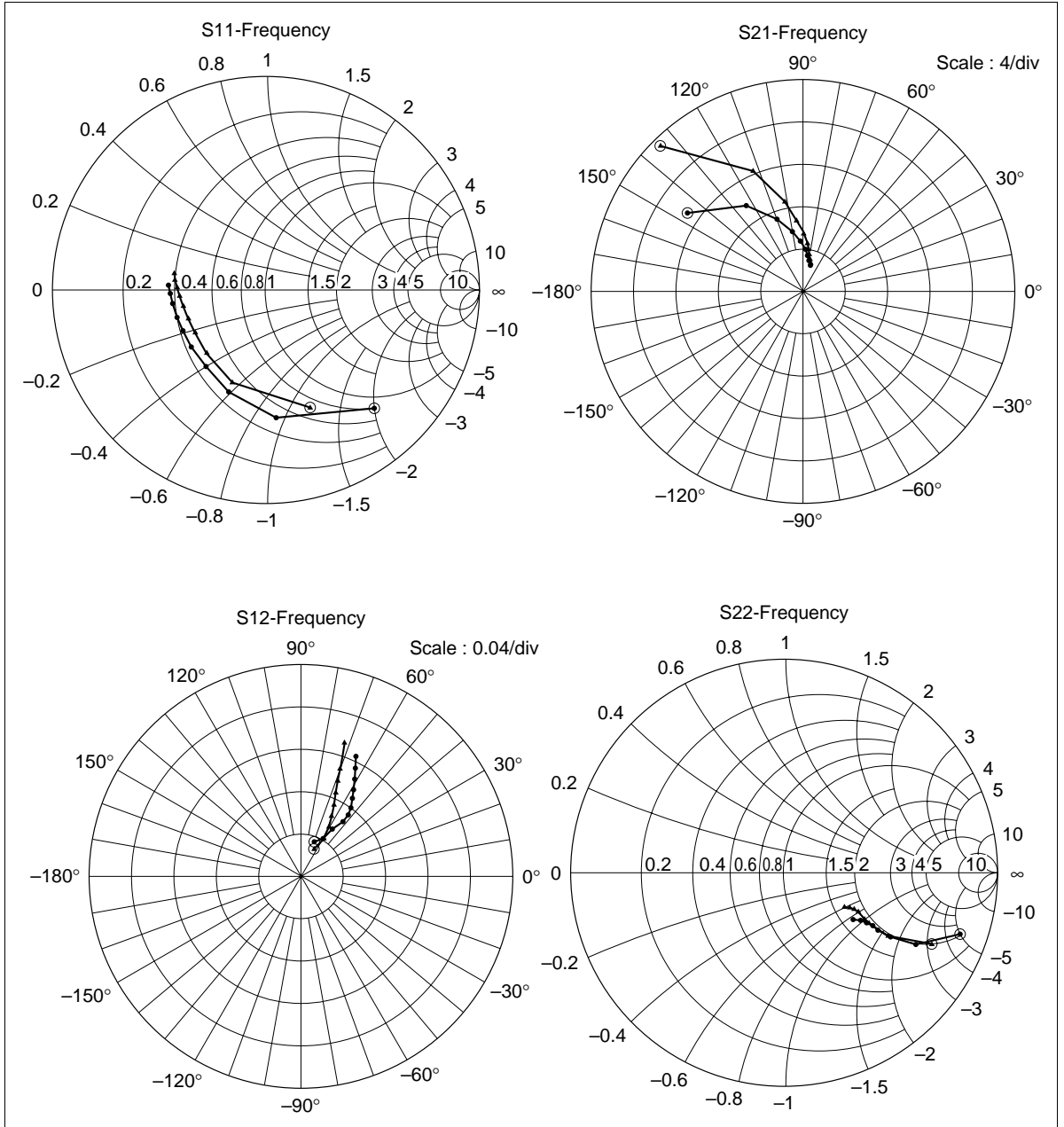


**S Parameters (Emitter Common)**

**Test Condition**  $V_{CE} = 5\text{ V}$ , 100 MHz to 1000 MHz (100 MHz Step),  $Z_0 = 50\ \Omega$

$I_C = 5\text{ mA}$  ● ——— ●

$I_C = 10\text{ mA}$  ▲ ——— ▲



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

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
100	0.744	-48.4	13.142	145.9	0.034	67.5	0.876	-19.1
200	0.599	-85.5	9.669	123.5	0.053	55.9	0.702	-28.2
300	0.506	-110.7	7.201	109.5	0.064	52.6	0.586	-30.9
400	0.457	-128.9	5.696	100.6	0.072	52.7	0.520	-31.2
500	0.440	-143.5	4.687	93.9	0.079	54.3	0.480	-31.2
600	0.430	-155.1	3.977	88.1	0.087	57.1	0.452	-31.5
700	0.437	-163.2	3.453	83.5	0.095	59.4	0.432	-31.7
800	0.441	-170.9	3.070	79.1	0.104	61.3	0.417	-32.4
900	0.452	-177.1	2.746	75.4	0.113	63.6	0.402	-33.4
1000	0.462	177.5	2.508	71.9	0.122	65.6	0.390	-34.5

**Test Condition**  $V_{CE} = 5 \text{ V}$ ,  $I_C = 10 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

Freq. (MHz)	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
100	0.585	-69.3	19.233	134.4	0.028	63.8	0.768	-25.6
200	0.460	-110.1	12.238	112.6	0.041	58.1	0.564	-31.4
300	0.408	-133.9	8.571	101.3	0.052	60.0	0.468	-30.5
400	0.390	-149.7	6.608	94.5	0.062	62.9	0.420	-29.1
500	0.390	-160.7	5.348	88.7	0.073	65.3	0.394	-28.1
600	0.391	-169.8	4.503	84.4	0.084	67.7	0.375	-27.8
700	0.404	-176.7	3.884	80.3	0.095	69.1	0.361	-27.7
800	0.411	178.0	3.446	76.8	0.107	70.3	0.350	-28.2
900	0.426	173.1	3.069	73.4	0.119	71.5	0.339	-29.0
1000	0.436	169.8	2.803	70.7	0.131	72.2	0.330	-29.7

## Y Parameters (Emitter Common)

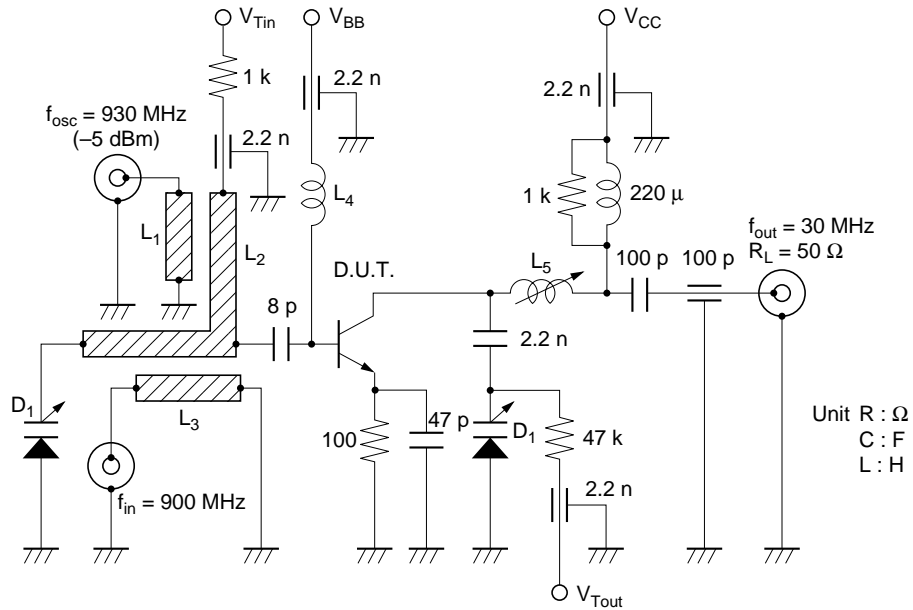
Test Condition  $V_{CE} = 5\text{ V}$ ,  $I_C = 5\text{ mA}$

Freq. (MHz)	Yie (mS)		Yfe (mS)		Yre (mS)		Yoe (mS)	
	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.
100	2.663	5.357	161.804	-34.193	-0.002	-0.425	0.055	0.627
200	5.558	10.174	147.899	-63.499	-0.012	-0.880	0.025	1.270
300	9.651	13.450	125.634	-87.205	-0.041	-1.354	0.026	2.024
400	14.160	15.066	102.261	-102.289	-0.093	-1.820	0.044	2.772
500	18.753	15.624	80.041	-110.827	-0.150	-2.309	0.048	3.510
600	23.019	14.727	57.826	-114.923	-0.214	-2.798	0.124	4.301
700	26.444	13.908	40.437	-113.783	-0.263	-3.305	0.211	4.964
800	29.378	12.040	24.049	-111.316	-0.379	-3.822	0.268	5.828
900	31.931	9.960	10.602	-106.726	-0.466	-4.371	0.407	6.578
1000	33.671	7.667	-0.922	-101.485	-0.586	-4.913	0.524	7.381

Test Condition  $V_{CE} = 5\text{ V}$ ,  $I_C = 10\text{ mA}$

Freq. (MHz)	Yie (mS)		Yfe (mS)		Yre (mS)		Yoe (mS)	
	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.
100	5.212	6.660	273.909	-97.915	-0.002	-0.430	0.029	0.527
200	10.124	10.767	208.225	-154.453	-0.015	-0.876	0.011	1.307
300	15.094	11.730	141.558	-172.198	-0.044	-1.347	0.047	2.035
400	18.933	10.991	93.174	-169.490	-0.089	-1.817	0.064	2.735
500	21.811	10.074	58.181	-158.809	-0.133	-2.299	0.096	3.501
600	23.927	8.389	32.829	-146.284	-0.195	-2.785	0.173	4.226
700	25.848	7.170	15.188	-134.592	-0.276	-3.302	0.224	5.010
800	26.851	5.955	2.733	-123.322	-0.353	-3.808	0.282	5.760
900	28.097	4.633	-7.642	-113.209	-0.443	-4.375	0.394	6.551
1000	28.686	3.829	-13.979	-104.651	-0.523	-4.908	0.466	7.215

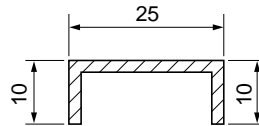
Conversion Gain and Noise Figure Test Circuit



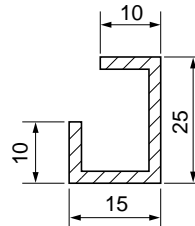
Unit R : Ω  
C : F  
L : H

D<sub>1</sub> : 1 SV 188

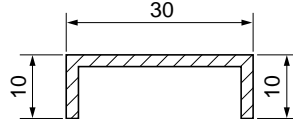
L<sub>1</sub> : φ 1 mm Enameled Copper Wire.



L<sub>2</sub> : φ 1 mm Enameled Copper Wire.



L<sub>3</sub> : φ 1 mm Enameled Copper Wire.

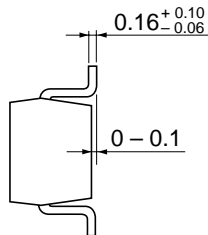
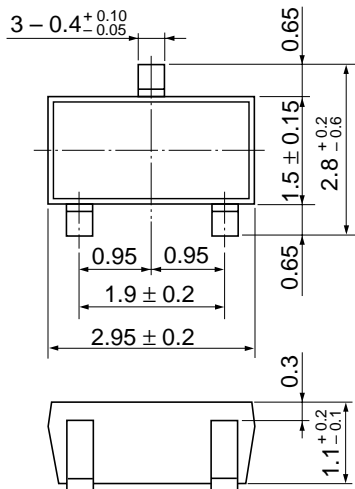


Unit : mm

L<sub>4</sub> : φ 0.5 mm Enameled Copper Wire 1 Turn Inside Dia 3 mm

L<sub>5</sub> : Inside Dia 5 mm Bobin, φ 0.2 mm Enameled Copper Wire 20 Turns with Ferrite Core.





Hitachi Code	MPAK
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.011 g

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