

To all our customers

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Renesas Technology Corp.  
Customer Support Dept.  
April 1, 2003

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# 2SC5894

Silicon NPN Epitaxial  
High Frequency Low Noise Amplifier / Oscillator

**RENESAS**

ADE-208-1605A (Z)

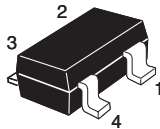
Rev.1  
Nov. 2002

## Features

- High gain bandwidth product  
 $f_T = 20$  GHz typ.
- High power gain and low noise figure;  
PG = 17.5 dB typ., NF = 1.8 dB typ. at  $f = 1.8$  GHz

## Outline

CMPAK-4



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

Note: Marking is "WJ-".

## Absolute Maximum Ratings

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

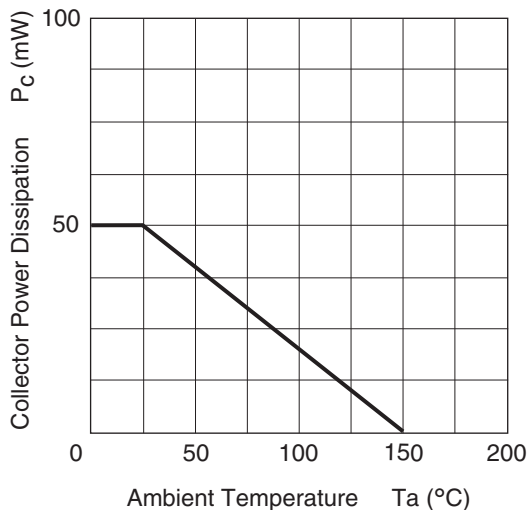
Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{CBO}$	12	V
Collector to emitter voltage	$V_{CEO}$	4.0	V
Emitter to base voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	12	mA
Collector power dissipation	Pc	50	mW
Junction temperature	$T_j$	150	$^\circ\text{C}$
Storage temperature	Tstg	-55 to +150	$^\circ\text{C}$

## Electrical Characteristics

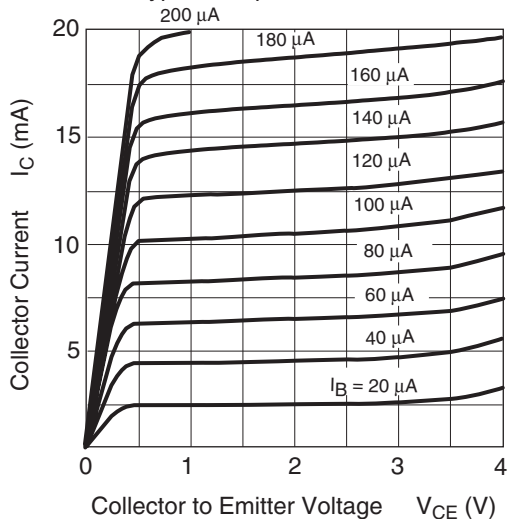
( $T_a = 25\text{ }^\circ\text{C}$ )

Item	Symbol	Min	Typ	Max	Unit	Test conditions
Collector cutoff current	$I_{CBO}$	—	—	1	$\mu\text{A}$	$V_{CB} = 12\text{ V}, I_E = 0$
Collector cutoff current	$I_{CEO}$	—	—	1	$\mu\text{A}$	$V_{CE} = 4\text{ V}, R_{BE} = \infty$
Emitter cutoff current	$I_{EBO}$	—	—	10	$\mu\text{A}$	$V_{EB} = 1.5\text{ V}, I_C = 0$
DC current transfer ratio	$h_{FE}$	70	110	150	—	$V_{CE} = 2\text{ V}, I_C = 10\text{ mA}$
Collector output capacitance	$C_{ob}$	—	0.16	0.4	pF	$V_{CB} = 2\text{ V}, I_E = 0, f = 1\text{ MHz}$
Gain bandwidth product	$f_T$	16	20	—	GHz	$V_{CE} = 2\text{ V}, I_C = 10\text{ mA}$ $f = 2\text{ GHz}$
Power gain	PG	13	17.5	—	dB	$V_{CE} = 2\text{ V}, I_C = 10\text{ mA},$ $f = 1.8\text{ GHz}$
Noise figure	NF	—	1.8	2.4	dB	$V_{CE} = 2\text{ V}, I_C = 3\text{ mA},$ $f = 1.8\text{ GHz}$

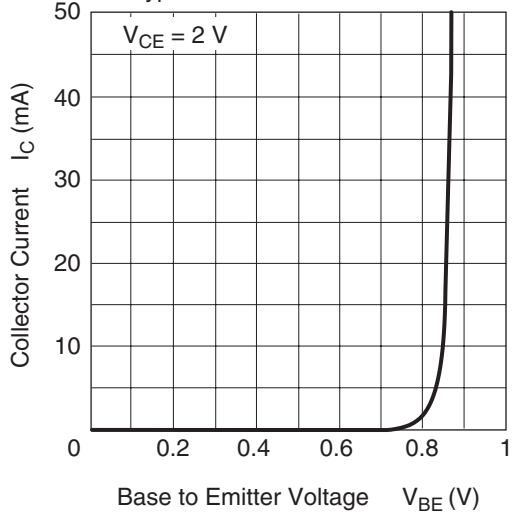
Collector Power Dissipation Curve



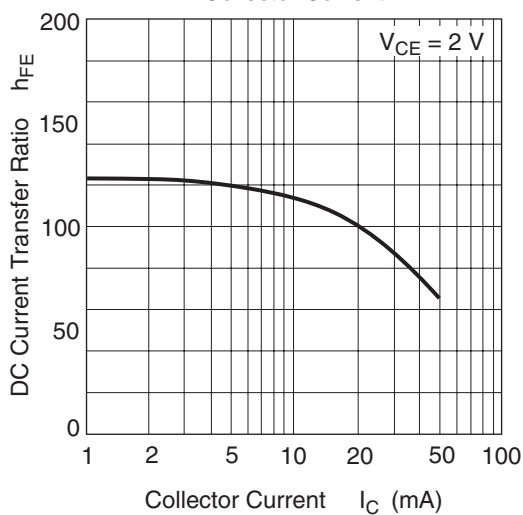
Typical Output Characteristics



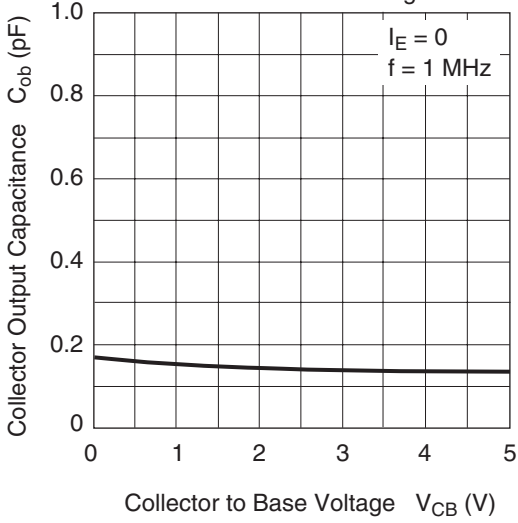
Typical Transfer Characteristics



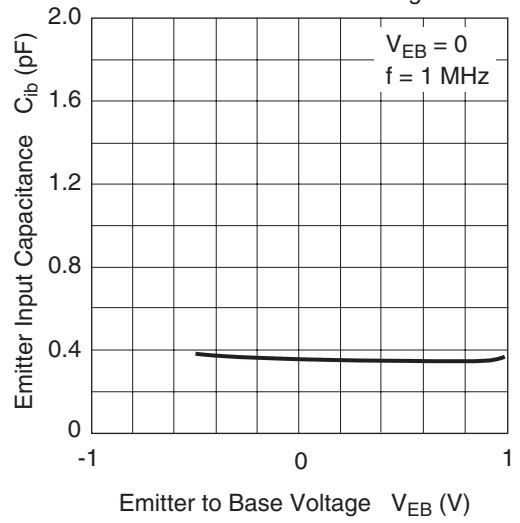
DC Current Transfer Ratio vs. Collector Current



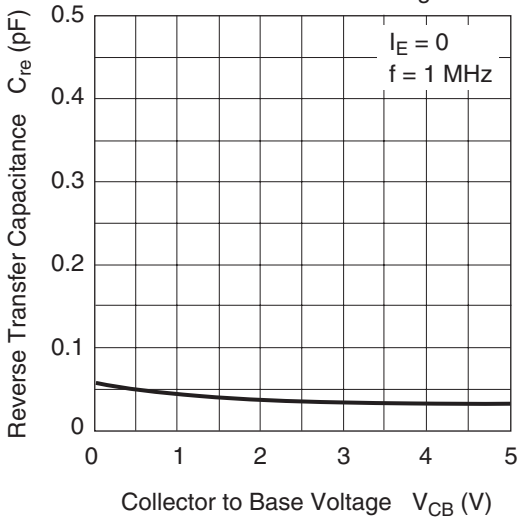
Collector Output Capacitance vs. Collector to Base Voltage



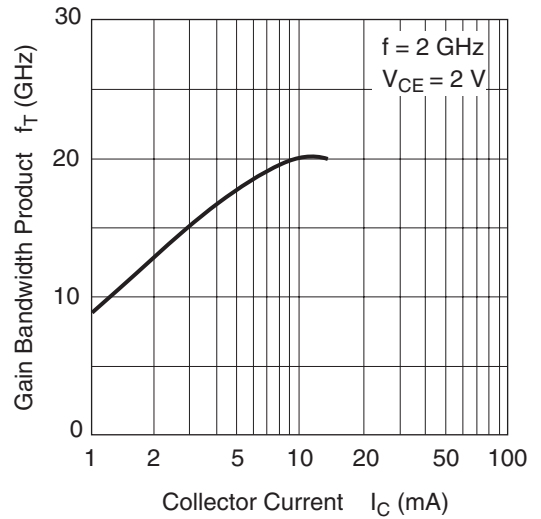
Emitter Input Capacitance vs. Emitter to Base Voltage



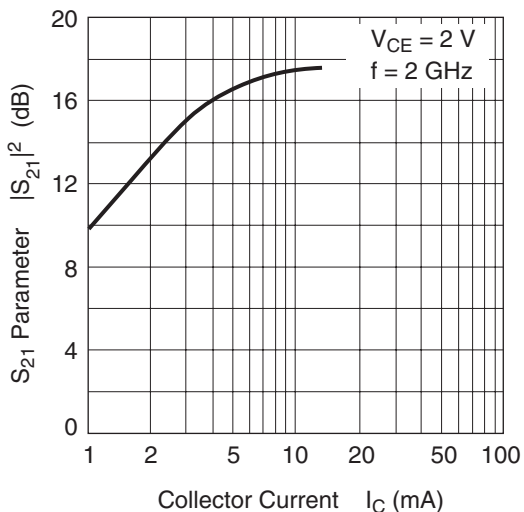
Reverse Transfer Capacitance vs. Collector to Base Voltage



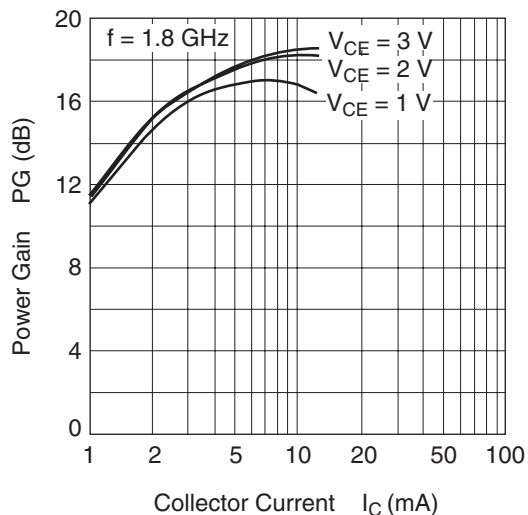
Gain Bandwidth Product vs. Collector Current



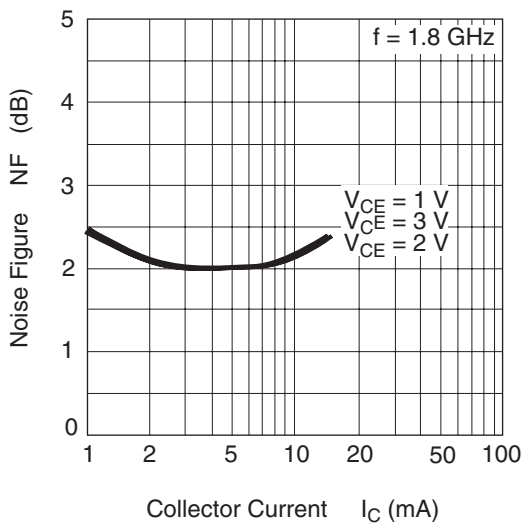
S<sub>21</sub> Parameter vs. Collector Current



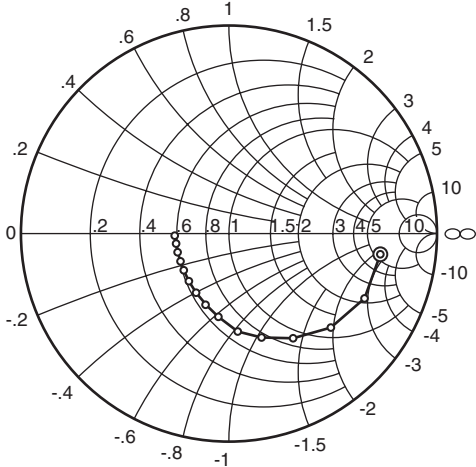
Power Gain vs. Collector Current



Noise Figure vs. Collector Current

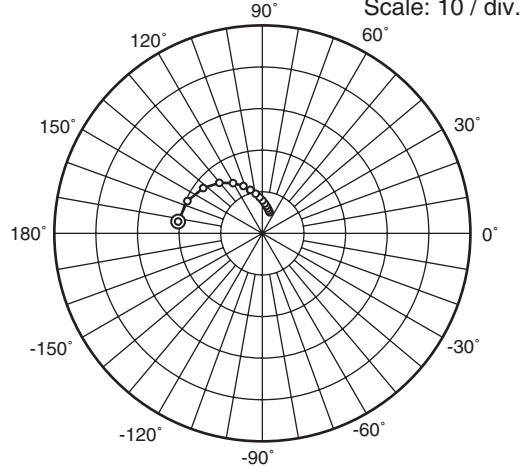


$S_{11}$  Parameter vs. Frequency



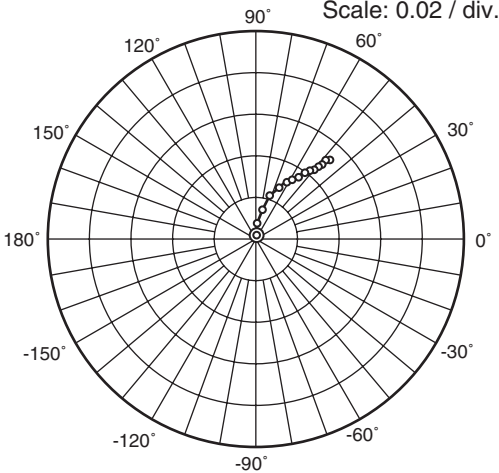
Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 2900 MHz (200 MHz Step)  
 ⊙—○ ( $I_C = 10\text{ mA}$ )

$S_{21}$  Parameter vs. Frequency



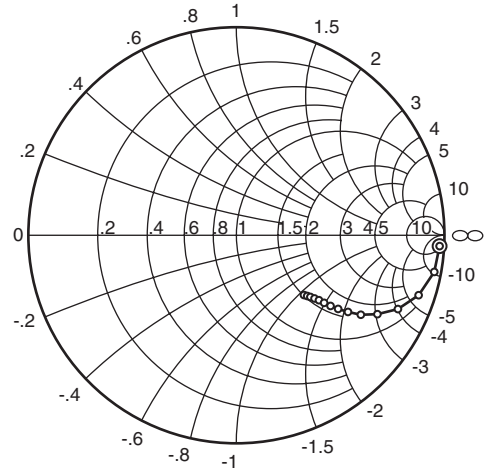
Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 2900 MHz (200 MHz Step)  
 ⊙—○ ( $I_C = 10\text{ mA}$ )

$S_{12}$  Parameter vs. Frequency



Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 2900 MHz (200 MHz Step)  
 ⊙—○ ( $I_C = 10\text{ mA}$ )

$S_{22}$  Parameter vs. Frequency



Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 2900 MHz (200 MHz Step)  
 ⊙—○ ( $I_C = 10\text{ mA}$ )

## S Parameter

 $(V_{CE} = 2 \text{ V}, I_C = 3 \text{ mA}, Z_o = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.890	-4.5	9.05	175.5	0.0030	85.7	0.992	-2.0
200	0.892	-9.2	8.88	171.1	0.0064	89.8	0.994	-4.5
300	0.910	-13.9	8.84	166.5	0.0105	91.0	0.991	-6.7
400	0.885	-18.7	8.69	162.1	0.0139	90.5	0.984	-9.4
500	0.876	-23.6	8.57	157.8	0.0185	87.8	0.978	-12.0
600	0.857	-28.5	8.45	153.4	0.0231	84.4	0.966	-14.6
700	0.838	-33.6	8.46	149.2	0.0271	81.0	0.953	-17.2
800	0.825	-38.3	8.13	145.0	0.0316	77.6	0.935	-19.5
900	0.801	-43.0	7.93	141.1	0.0355	73.4	0.914	-21.8
1000	0.776	-47.5	7.56	137.4	0.0392	70.9	0.895	-23.6
1100	0.793	-52.0	7.27	133.2	0.0432	66.5	0.872	-25.9
1200	0.728	-56.8	7.35	129.9	0.0459	63.5	0.849	-28.0
1300	0.700	-61.3	7.15	126.4	0.0487	60.5	0.827	-29.9
1400	0.674	-65.6	6.94	123.1	0.0510	57.0	0.804	-31.4
1500	0.649	-69.7	6.73	120.0	0.0531	54.5	0.783	-33.0
1600	0.624	-74.0	6.54	117.0	0.0555	52.5	0.763	-34.6
1700	0.598	-78.1	6.34	113.9	0.0576	50.7	0.741	-35.9
1800	0.567	-82.7	6.22	111.0	0.0581	48.6	0.719	-37.3
1900	0.554	-86.7	6.00	107.8	0.0610	45.8	0.699	-38.4
2000	0.526	-89.8	5.81	106.2	0.0613	44.9	0.685	-39.6
2100	0.501	-95.3	5.67	102.5	0.0624	42.4	0.660	-40.5
2200	0.487	-97.3	5.33	101.4	0.0642	40.6	0.657	-41.3
2300	0.471	-102.5	5.32	98.0	0.0646	39.5	0.629	-42.4
2400	0.455	-106.5	5.17	95.6	0.0658	38.0	0.615	-43.4
2500	0.434	-111.3	5.08	93.1	0.0663	36.1	0.596	-44.4
2600	0.424	-114.1	4.87	91.5	0.0666	35.2	0.590	-45.2
2700	0.405	-119.3	4.79	88.7	0.0665	35.1	0.572	-46.0
2800	0.396	-121.9	4.63	87.6	0.0677	33.4	0.567	-47.1
2900	0.385	-127.7	4.56	84.3	0.0685	32.2	0.547	-47.5
3000	0.374	-132.6	4.49	81.6	0.0677	31.1	0.530	-48.1

## 2SC5894

( $V_{CE} = 2\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

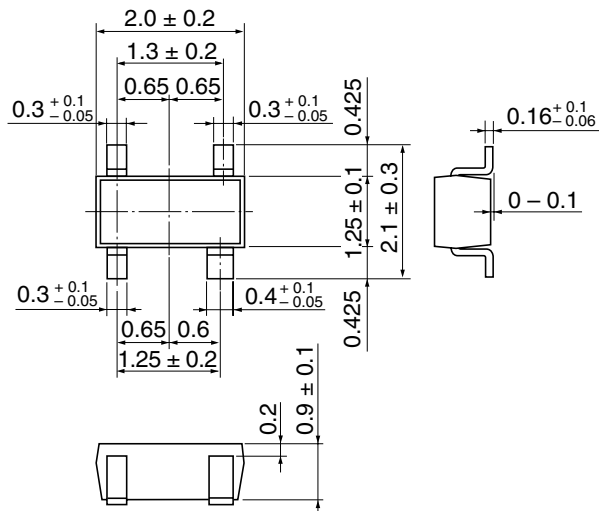
f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.831	-5.8	13.33	174.2	0.0032	85.5	0.988	-2.4
200	0.835	-11.9	13.12	168.6	0.0065	90.4	0.989	-5.4
300	0.844	-18.0	13.04	162.9	0.0101	89.2	0.985	-8.2
400	0.821	-24.2	12.70	157.4	0.0133	88.6	0.974	-11.4
500	0.804	-30.4	12.41	152.0	0.0174	84.4	0.962	-14.5
600	0.779	-36.7	12.07	146.7	0.0216	81.4	0.944	-17.6
700	0.747	-42.7	11.79	141.8	0.0253	77.7	0.921	-20.5
800	0.727	-48.7	11.27	136.8	0.0291	73.9	0.894	-23.1
900	0.695	-54.4	10.82	132.4	0.0319	69.5	0.865	-25.5
1000	0.666	-59.9	10.26	128.0	0.0350	67.6	0.838	-27.4
1100	0.661	-64.8	9.78	123.8	0.0383	62.8	0.808	-29.6
1200	0.601	-70.4	9.57	120.3	0.0399	60.6	0.778	-31.5
1300	0.570	-75.5	9.16	116.7	0.0421	57.8	0.753	-33.1
1400	0.542	-80.3	8.78	113.4	0.0439	55.3	0.726	-34.4
1500	0.516	-85.0	8.40	110.3	0.0454	53.3	0.702	-35.7
1600	0.491	-89.6	8.06	107.4	0.0476	52.5	0.680	-36.8
1700	0.466	-94.2	7.74	104.5	0.0489	50.1	0.658	-37.8
1800	0.440	-99.2	7.48	101.7	0.0492	49.1	0.636	-38.7
1900	0.423	-103.7	7.17	98.9	0.0509	46.8	0.616	-39.5
2000	0.403	-107.6	6.88	97.2	0.0521	46.0	0.603	-40.4
2100	0.383	-113.4	6.65	93.9	0.0522	43.8	0.580	-40.8
2200	0.373	-116.2	6.30	92.6	0.0539	42.9	0.575	-41.5
2300	0.358	-121.5	6.18	89.8	0.0543	42.5	0.553	-42.2
2400	0.347	-125.9	5.97	87.7	0.0554	40.9	0.540	-42.8
2500	0.333	-131.2	5.81	85.5	0.0557	40.7	0.524	-43.5
2600	0.326	-134.6	5.57	83.9	0.0558	40.4	0.519	-44.0
2700	0.314	-140.2	5.43	81.5	0.0579	39.8	0.505	-44.6
2800	0.311	-143.3	5.24	80.3	0.0586	38.4	0.500	-45.4
2900	0.304	-149.0	5.12	77.6	0.0593	38.0	0.484	-45.6
3000	0.301	-153.8	5.00	75.4	0.0585	37.0	0.471	-46.1

( $V_{CE} = 2 \text{ V}$ ,  $I_C = 10 \text{ mA}$ ,  $Z_o = 50 \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.730	-8.4	20.44	172.0	0.0032	93.3	0.978	-3.0
200	0.728	-17.0	20.06	164.3	0.0060	87.1	0.977	-6.8
300	0.722	-25.5	19.61	156.7	0.0090	88.5	0.967	-10.4
400	0.694	-34.2	18.78	149.4	0.0123	86.4	0.946	-14.4
500	0.666	-42.6	17.90	142.5	0.0158	79.7	0.922	-18.2
600	0.630	-50.8	16.93	136.0	0.0191	77.0	0.888	-21.6
700	0.590	-58.5	15.94	130.4	0.0219	73.3	0.853	-24.5
800	0.559	-65.8	14.95	124.9	0.0250	70.9	0.815	-27.0
900	0.523	-72.5	13.98	120.2	0.0271	66.4	0.776	-29.2
1000	0.491	-79.2	13.06	115.8	0.0294	65.3	0.742	-30.7
1100	0.472	-84.8	12.25	111.8	0.0310	62.0	0.709	-32.5
1200	0.430	-91.4	11.57	108.4	0.0331	60.2	0.678	-33.5
1300	0.403	-97.2	10.90	105.2	0.0337	58.6	0.651	-34.5
1400	0.381	-102.9	10.29	102.2	0.0359	56.6	0.627	-35.2
1500	0.360	-108.2	9.73	99.4	0.0365	55.4	0.604	-35.9
1600	0.342	-113.7	9.22	96.8	0.0386	55.2	0.585	-36.5
1700	0.325	-119.0	8.77	94.3	0.0400	53.6	0.566	-36.9
1800	0.309	-124.8	8.36	91.9	0.0404	53.5	0.549	-37.3
1900	0.299	-130.0	7.97	89.6	0.0423	51.8	0.533	-37.6
2000	0.289	-134.9	7.61	87.8	0.0437	52.4	0.522	-38.0
2100	0.279	-140.9	7.28	85.3	0.0439	50.0	0.505	-38.2
2200	0.274	-144.7	6.95	83.7	0.0451	50.0	0.498	-38.6
2300	0.268	-150.1	6.72	81.7	0.0464	49.2	0.484	-39.0
2400	0.264	-154.8	6.46	79.8	0.0478	48.9	0.475	-39.5
2500	0.262	-160.0	6.23	77.9	0.0483	48.5	0.464	-39.8
2600	0.260	-163.9	6.00	76.4	0.0494	47.9	0.458	-40.2
2700	0.258	-169.2	5.80	74.5	0.0510	48.6	0.449	-40.6
2800	0.259	-172.6	5.60	73.1	0.0516	47.4	0.445	-41.1
2900	0.261	-177.2	5.43	71.1	0.0525	47.0	0.434	-41.5
3000	0.263	178.8	5.27	69.3	0.0533	46.4	0.427	-41.8

Package Dimensions

As of July, 2002  
Unit: mm



Hitachi Code	CMPAK-4(T)
JEDEC	—
JEITA	Conforms
Mass (reference value)	0.006 g

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