

To all our customers

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

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# 2SC5702

## Silicon NPN Epitaxial High Frequency Amplifier / Oscillator

# RENESAS

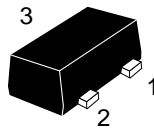
ADE-208-1414 (Z)  
1st. Edition  
Mar. 2001

### Features

- High gain bandwidth product  
 $f_T = 8 \text{ GHz typ.}$
- High power gain and low noise figure ;  
 $PG = 13 \text{ dB typ.}, NF = 1.05 \text{ dB typ. at } f = 900 \text{ MHz}$

### Outline

MFPAK



1. Emitter
2. Base
3. Collector

Note: Marking is "ZS-".

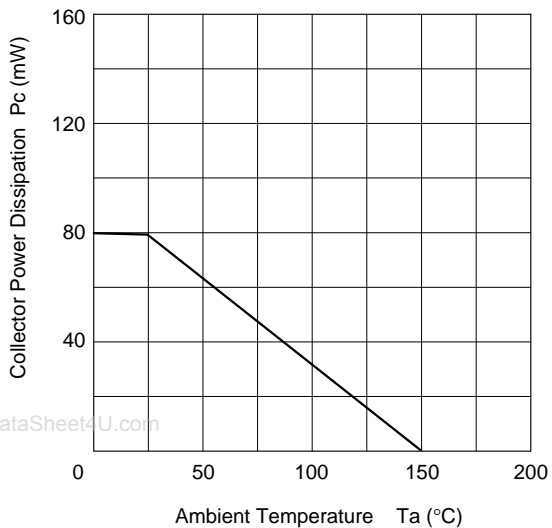
## Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{CBO}$	15	V
Collector to emitter voltage	$V_{CEO}$	6	V
Emitter to base voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	50	mA
Collector power dissipation	Pc	80	mW
Junction temperature	Tj	150	°C
Storage temperature	Tstg	-55 to +150	°C

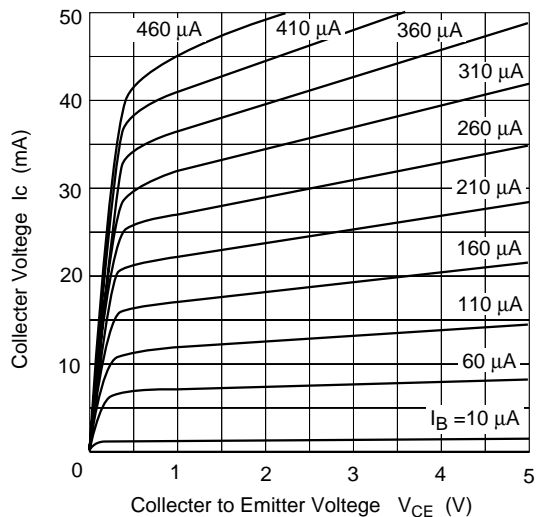
## Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Collector to base breakdown voltage	$V_{(BR)CBO}$	15	18.5	—	V	$I_C = 10 \mu A, I_E = 0$
Collector cutoff current	$I_{CBO}$	—	—	1	$\mu A$	$V_{CB} = 10 V, I_E = 0$
Collector cutoff current	$I_{CEO}$	—	—	1	mA	$V_{CE} = 4 V, R_{BE} = \infty$
Emitter cutoff current	$I_{EBO}$	—	—	10	mA	$V_{EB} = 1.5V, I_C = 0$
DC current transfer ratio	$h_{FE}$	80	120	160	V	$V_{CE} = 1 V, I_C = 5 mA$
Collector output capacitance	Cob	—	0.85	1.2	pF	$V_{CB} = 1 V, I_E = 0$ $f = 1 MHz$
Gain bandwidth product	$f_T$	6.5	8.0	—	GHz	$V_{CE} = 1 V, I_C = 5 mA$ $f = 1 MHz$
Power gain	PG	11	13	—	dB	$V_{CE} = 1 V, I_C = 5 mA$ $f = 900 MHz$
Noise figure	NF	—	1.05	1.9	dB	$V_{CE} = 1 V, I_C = 5 mA$ $f = 900 MHz$

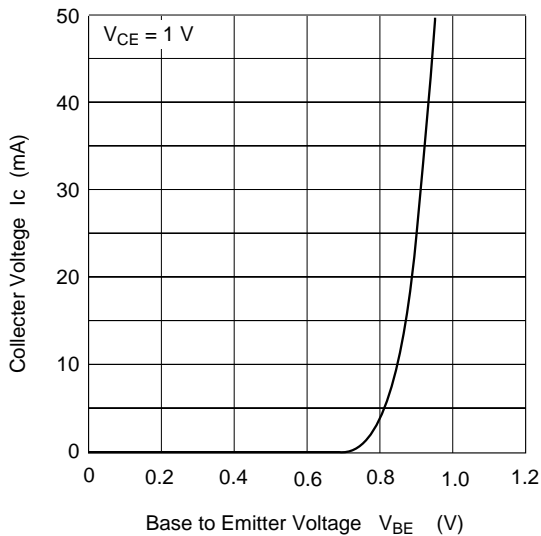
Maximum Collector Dissipation Curve



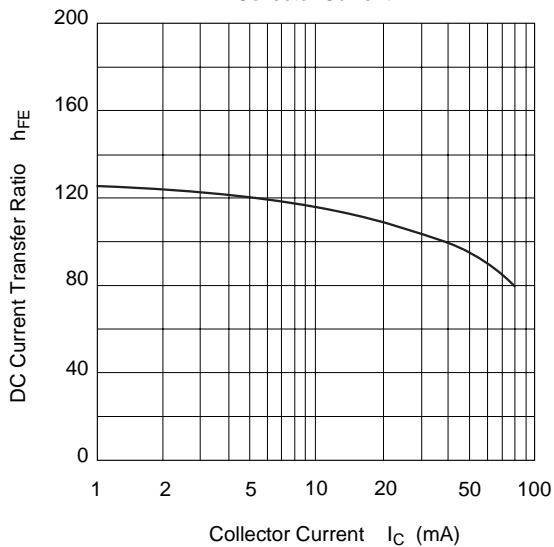
Collector Voltage vs. Collector to Emitter Voltage



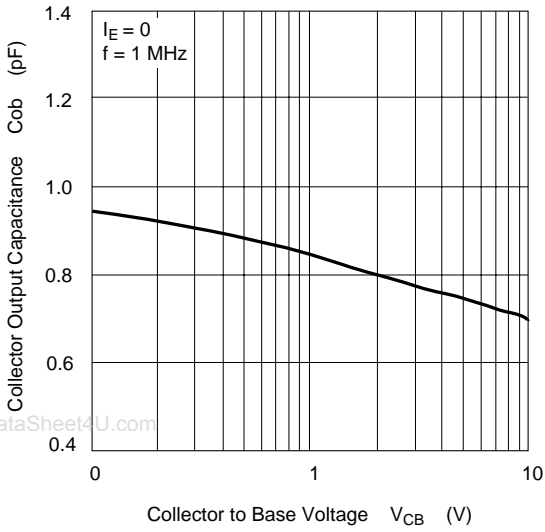
Collector Voltage vs. Base to Emitter Voltage



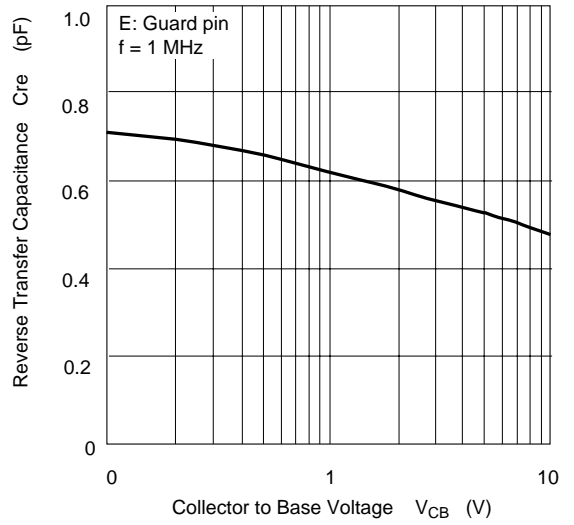
DC Current Transfer Ratio vs. Collector Current



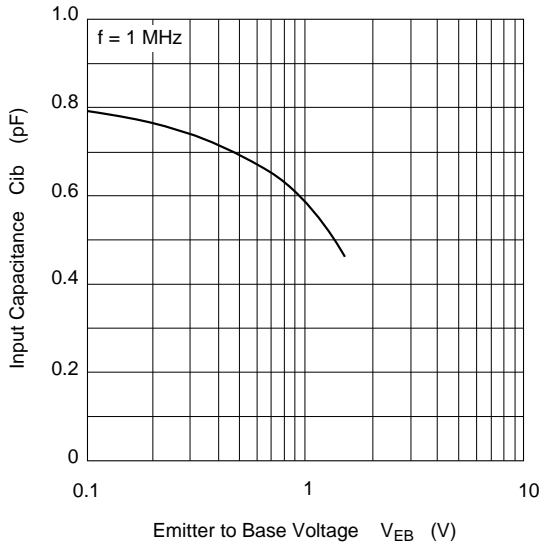
Collector Output Capacitance vs.  
Collector to Base Voltage



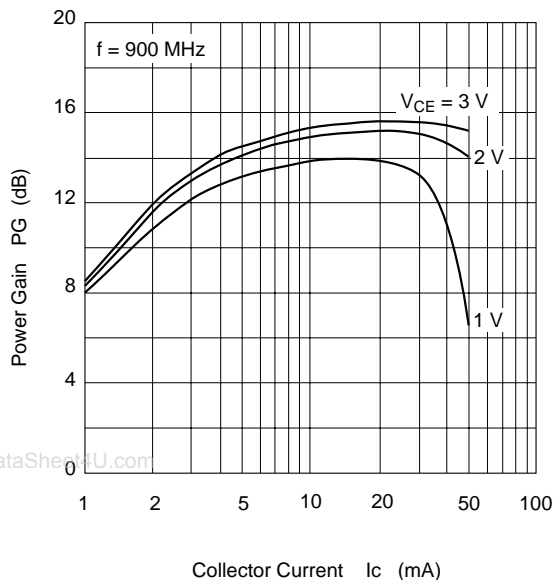
Reverse Transfer capacitance vs.  
Collector To Base Voltage



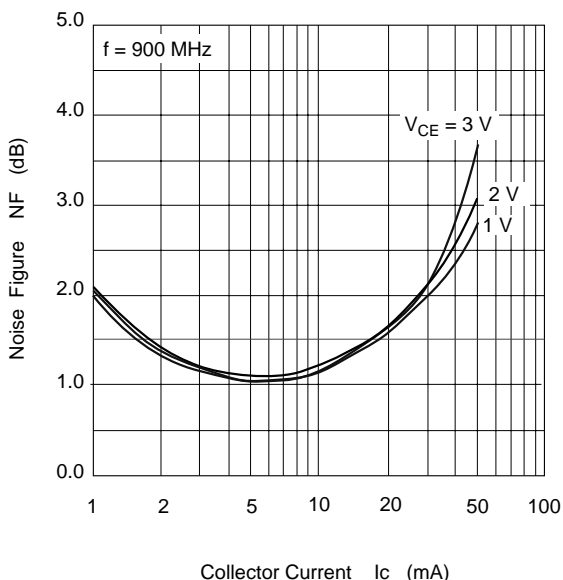
Collector Input Capacitance vs.  
Emitter To Base Voltage



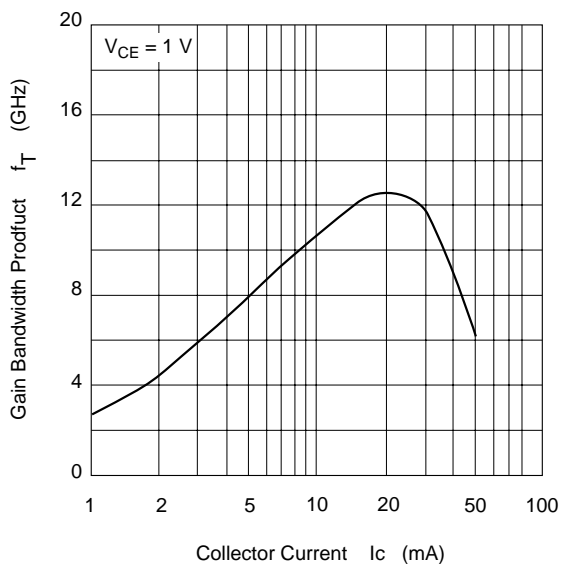
Power Gain vs. Collector Current



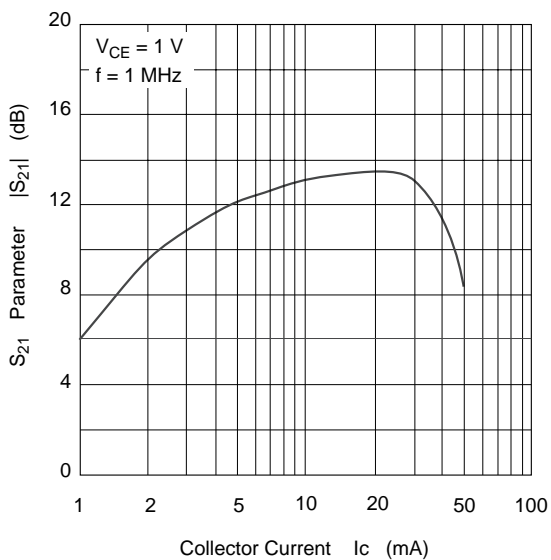
Noise Figure vs. Collector Current



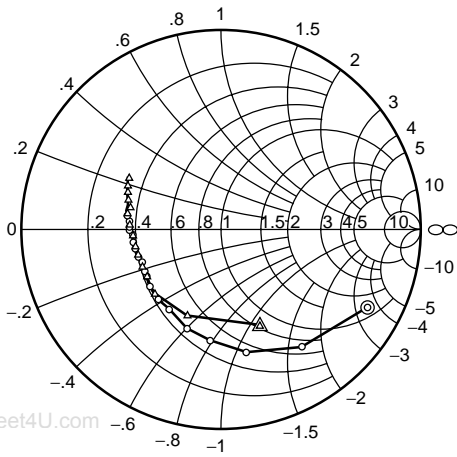
Gain Bandwidth Product vs. Collector Current



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

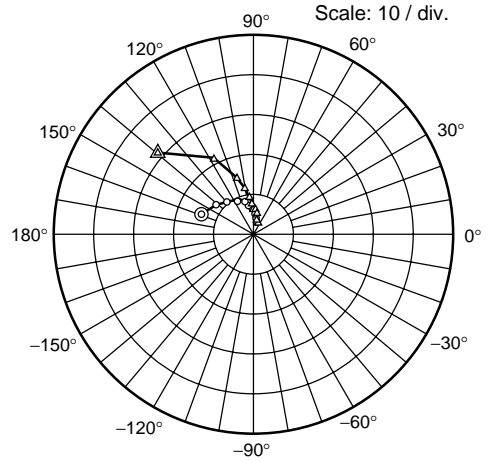


S11 Parameter vs. Frequency



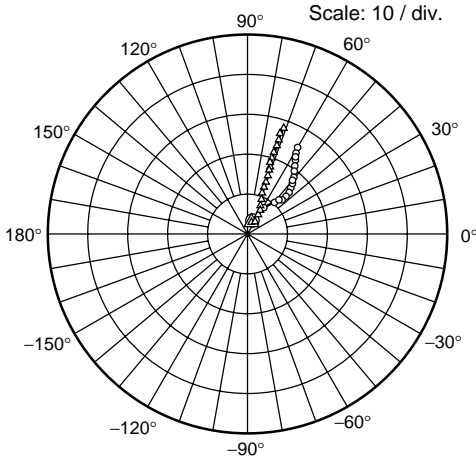
Condition :  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

S21 Parameter vs. Frequency



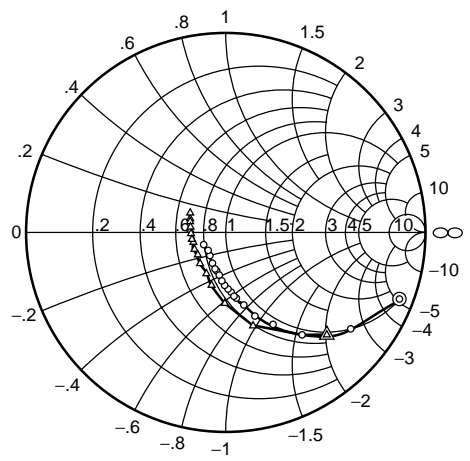
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 100 to 2000 MHz (100 MHz STEP)  
 ○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

S12 Parameter vs. Frequency



Condition :  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

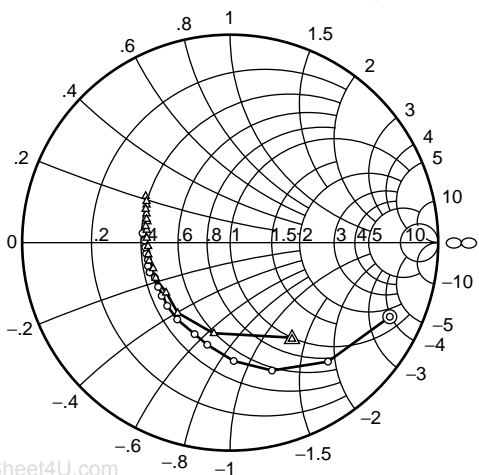
S22 Parameter vs. Frequency



Condition :  $V_{CE} = 1\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )



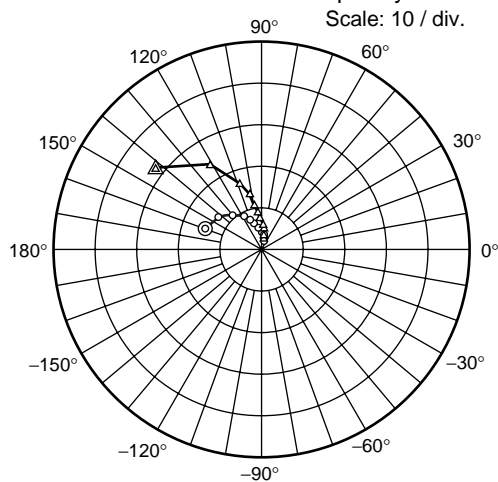
S11 Parameter vs. Frequency



Condition :  $V_{CE} = 2\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)

○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

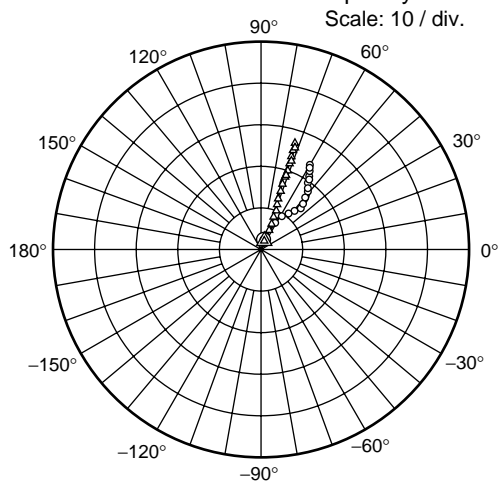
S21 Parameter vs. Frequency



Condition :  $V_{CE} = 2\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)

○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

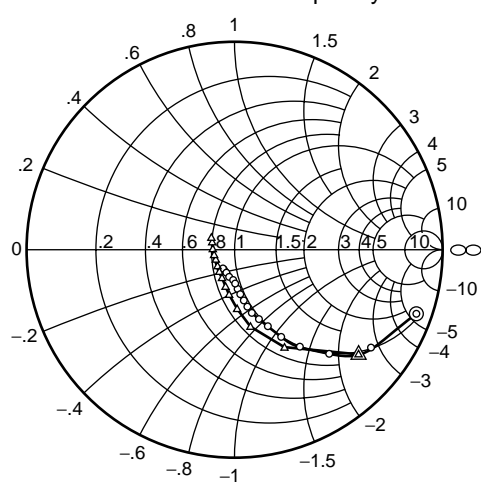
S12 Parameter vs. Frequency



Condition :  $V_{CE} = 2\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)

○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

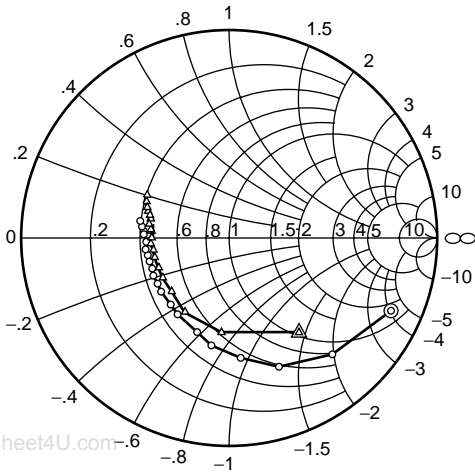
S22 Parameter vs. Frequency



Condition :  $V_{CE} = 2\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)

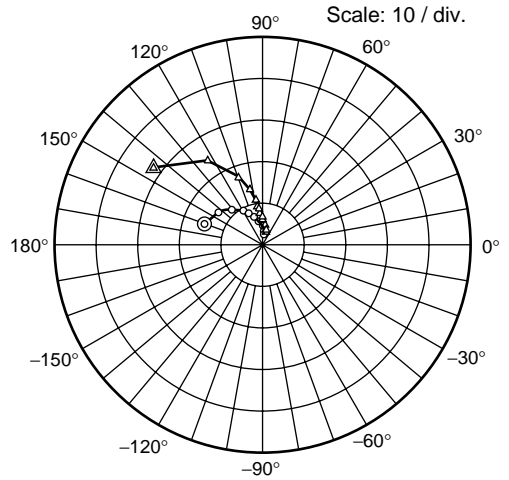
○—○ ( $I_C = 5\text{ mA}$ )  
 △—△ ( $I_C = 20\text{ mA}$ )

S11 Parameter vs. Frequency



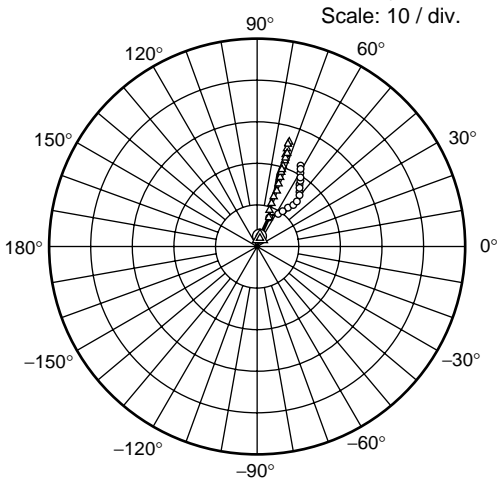
Condition :  $V_{CE} = 3\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○ (  $I_C = 5\text{ mA}$  )  
 △ (  $I_C = 20\text{ mA}$  )

S21 Parameter vs. Frequency



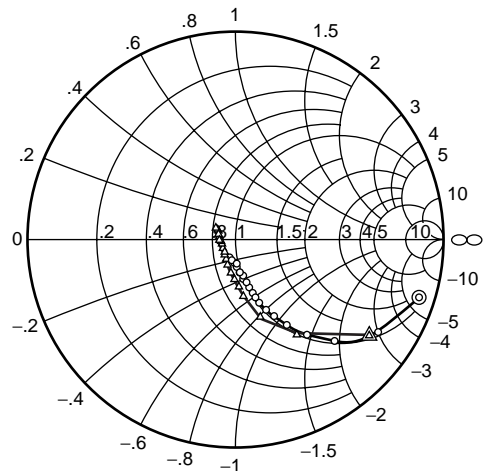
Condition :  $V_{CE} = 3\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○ (  $I_C = 5\text{ mA}$  )  
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S12 Parameter vs. Frequency



Condition :  $V_{CE} = 3\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○ (  $I_C = 5\text{ mA}$  )  
 △ (  $I_C = 20\text{ mA}$  )

S21 Parameter vs. Frequency



Condition :  $V_{CE} = 3\text{ V}$ ,  $Z_o = 50\ \Omega$   
 100 to 2000 MHz (100 MHz STEP)  
 ○ (  $I_C = 5\text{ mA}$  )  
 △ (  $I_C = 20\text{ mA}$  )

Sparameter ( $V_{CE} = 1\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.832	-28.2	14.18	159.9	0.0347	74.2	0.927	-20.7
200	0.723	-55.3	12.19	141.4	0.0624	61.4	0.789	-38.8
300	0.636	-78.0	10.17	127.5	0.0806	52.8	0.644	-52.3
400	0.559	-95.2	8.43	117.9	0.0920	48.9	0.532	-61.8
500	0.513	-110.1	7.15	110.6	0.1001	46.8	0.447	-69.1
600	0.473	-121.4	6.15	105.0	0.1065	45.8	0.378	-75.3
700	0.462	-132.4	5.40	100.2	0.1124	46.0	0.327	-79.8
800	0.443	-139.7	4.84	96.4	0.1182	46.7	0.285	-84.6
900	0.432	-148.1	4.32	92.6	0.1236	47.6	0.250	-89.4
1000	0.435	-153.9	3.94	89.6	0.1294	48.7	0.223	-93.3
1100	0.420	-160.5	3.60	87.2	0.1351	49.5	0.200	-97.4
1200	0.438	-165.4	3.33	84.5	0.1410	50.9	0.181	-102.3
1300	0.428	-168.8	3.11	82.2	0.1471	51.9	0.163	-107.4
1400	0.442	-175.3	2.87	80.0	0.1537	53.2	0.151	-111.4
1500	0.444	-177.1	2.75	78.0	0.1601	54.3	0.138	-117.3
1600	0.448	177.3	2.57	76.1	0.1671	55.2	0.130	-121.8
1700	0.464	176.0	2.44	73.9	0.1739	56.2	0.124	-128.5
1800	0.460	172.7	2.34	72.7	0.1810	56.9	0.119	-135.6
1900	0.474	170.1	2.21	70.7	0.1888	57.8	0.116	-142.0
2000	0.481	168.3	2.13	69.1	0.1952	58.6	0.114	-148.5

## Sparameter ( $V_{CE} = 1\text{ V}$ , $I_C = 20\text{ mA}$ , $Z_o = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.534	-68.4	30.97	140.9	0.0258	65.2	0.735	-45.4
200	0.467	-111.9	20.56	119.2	0.0390	57.4	0.489	-73.4
300	0.451	-135.2	14.57	107.9	0.0490	58.2	0.350	-91.3
400	0.434	-149.5	11.16	101.6	0.0581	60.5	0.276	-104.5
500	0.438	-159.1	9.02	97.1	0.0673	63.1	0.231	-115.5
600	0.430	-165.9	7.58	93.7	0.0772	65.0	0.201	-125.9
700	0.441	-172.5	6.52	90.8	0.0872	66.5	0.182	-135.2
800	0.442	-175.8	5.75	88.3	0.0974	67.7	0.170	-144.0
900	0.451	-178.4	5.09	86.1	0.1081	68.5	0.164	-152.6
1000	0.456	-175.8	4.62	84.0	0.1184	69.5	0.158	-160.2
1100	0.452	-171.2	4.22	82.5	0.1291	69.7	0.157	-166.8
1200	0.470	-169.0	3.87	80.5	0.1395	70.2	0.158	-173.0
1300	0.462	-166.2	3.62	79.0	0.1504	70.2	0.158	-179.2
1400	0.485	-162.5	3.34	77.7	0.1608	70.7	0.162	-176.1
1500	0.483	-162.0	3.16	75.6	0.1719	70.7	0.164	-171.1
1600	0.494	-158.4	2.98	74.5	0.1826	70.6	0.168	-167.2
1700	0.505	-157.3	2.81	72.8	0.1935	70.5	0.175	-164.0
1800	0.503	-155.6	2.69	72.0	0.2040	70.4	0.181	-160.4
1900	0.525	-152.6	2.54	70.5	0.2148	70.5	0.189	-157.1
2000	0.523	-152.4	2.45	69.0	0.2247	70.2	0.195	-154.1

Sparameter ( $V_{CE} = 2\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.837	-25.5	14.31	161.2	0.0306	75.8	0.938	-18.2
200	0.739	-50.1	12.50	143.5	0.0559	63.3	0.813	-34.5
300	0.646	-72.1	10.58	129.9	0.0736	55.0	0.674	-46.5
400	0.565	-88.6	8.85	120.2	0.0848	51.0	0.563	-54.9
500	0.513	-103.4	7.58	112.7	0.0928	48.7	0.476	-61.1
600	0.466	-114.0	6.56	106.9	0.0996	47.7	0.405	-66.1
700	0.444	-125.7	5.77	102.1	0.1055	48.0	0.351	-69.5
800	0.429	-133.3	5.17	98.1	0.1106	48.5	0.307	-72.7
900	0.412	-142.2	4.62	94.1	0.1162	49.2	0.269	-76.1
1000	0.411	-148.8	4.22	91.1	0.1214	50.0	0.239	-78.3
1100	0.395	-155.5	3.87	88.6	0.1276	51.2	0.215	-80.7
1200	0.410	-161.6	3.57	85.7	0.1331	52.3	0.192	-84.0
1300	0.401	-165.3	3.34	83.6	0.1387	53.4	0.171	-86.6
1400	0.413	-172.1	3.08	81.4	0.1447	54.6	0.156	-88.9
1500	0.417	-174.3	2.94	79.1	0.1510	55.8	0.139	-92.9
1600	0.415	-179.2	2.75	77.4	0.1579	56.4	0.128	-95.6
1700	0.431	177.8	2.63	75.0	0.1644	57.6	0.117	-100.4
1800	0.426	175.2	2.50	73.8	0.1709	58.4	0.106	-105.7
1900	0.447	171.4	2.38	71.8	0.1781	59.6	0.097	-112.2
2000	0.450	169.9	2.28	70.1	0.1850	60.2	0.090	-118.3

Sparameter ( $V_{CE} = 2\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.548	-58.6	32.28	143.9	0.0231	67.8	0.777	-38.8
200	0.451	-99.9	22.20	121.9	0.0363	59.6	0.527	-62.6
300	0.415	-125.6	15.97	110.2	0.0464	60.1	0.373	-76.9
400	0.390	-141.4	12.32	103.5	0.0545	61.7	0.283	-86.7
500	0.392	-152.5	9.97	98.7	0.0632	63.8	0.226	-95.1
600	0.382	-160.9	8.41	95.2	0.0726	65.6	0.184	-102.9
700	0.387	-168.1	7.23	92.0	0.0823	67.1	0.155	-110.3
800	0.387	-172.8	6.39	89.5	0.0914	68.5	0.133	-118.3
900	0.390	-178.6	5.66	87.1	0.1019	69.2	0.117	-127.6
1000	0.399	178.2	5.13	85.0	0.1114	70.2	0.104	-136.9
1100	0.400	172.6	4.69	83.4	0.1213	70.6	0.097	-146.4
1200	0.412	170.4	4.29	81.5	0.1309	71.1	0.092	-156.2
1300	0.409	167.8	4.01	79.9	0.1411	71.1	0.091	-166.0
1400	0.433	163.6	3.70	78.6	0.1518	71.6	0.092	-174.7
1500	0.426	162.4	3.50	76.8	0.1615	71.4	0.093	176.8
1600	0.435	158.8	3.30	75.4	0.1714	71.5	0.097	170.5
1700	0.454	157.9	3.10	73.6	0.1817	71.8	0.103	165.0
1800	0.446	155.5	2.97	72.7	0.1918	71.2	0.109	159.1
1900	0.475	153.5	2.81	71.1	0.2021	71.3	0.117	155.2
2000	0.473	152.7	2.71	69.9	0.2113	71.1	0.125	150.3

Sparameter ( $V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.846	-24.1	14.25	161.9	0.0287	75.9	0.9420	-17.0
200	0.748	-48.1	12.56	144.7	0.0534	64.3	0.8245	-32.2
300	0.656	-69.0	10.71	131.2	0.0705	56.4	0.6904	-43.6
400	0.573	-84.9	9.03	121.3	0.0817	52.0	0.5802	-51.5
500	0.516	-99.3	7.75	113.8	0.0895	49.6	0.4932	-57.4
600	0.469	-110.6	6.72	108.0	0.0961	48.6	0.4224	-61.6
700	0.442	-121.8	5.92	102.9	0.1015	48.5	0.3680	-64.4
800	0.423	-130.4	5.31	99.0	0.1071	49.0	0.3229	-67.1
900	0.404	-139.8	4.75	95.2	0.1128	49.9	0.2856	-69.5
1000	0.399	-146.0	4.34	92.0	0.1177	50.7	0.2535	-71.2
1100	0.382	-153.0	3.97	89.3	0.1230	51.7	0.2285	-72.9
1200	0.397	-159.3	3.69	86.5	0.1289	53.2	0.2052	-74.8
1300	0.385	-163.3	3.44	84.5	0.1344	54.2	0.1839	-76.6
1400	0.400	-169.7	3.18	81.8	0.1400	55.1	0.1680	-78.0
1500	0.401	-171.9	3.03	79.7	0.1462	56.2	0.1496	-80.5
1600	0.399	-177.2	2.84	77.8	0.1528	57.4	0.1381	-82.1
1700	0.415	179.5	2.70	75.7	0.1590	58.2	0.1251	-85.4
1800	0.411	176.8	2.57	74.4	0.1658	59.0	0.1122	-89.0
1900	0.430	173.0	2.44	72.3	0.1727	60.1	0.1018	-93.2
2000	0.433	171.4	2.35	70.7	0.1793	61.0	0.0914	-97.8

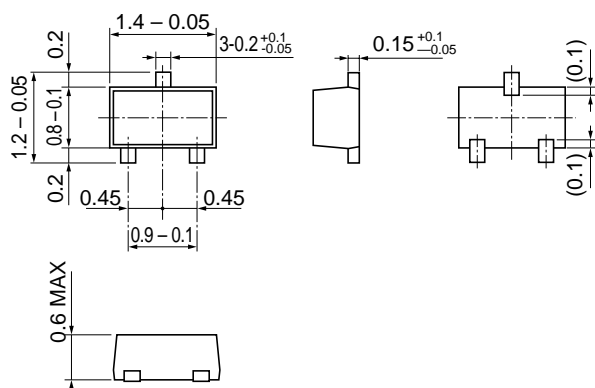
Sparameter ( $V_{CE} = 3\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.564	-54.4	32.56	145.1	0.0221	69.2	0.7913	-35.9
200	0.449	-94.6	22.76	123.2	0.0353	60.3	0.5457	-58.3
300	0.408	-119.2	16.50	111.2	0.0448	60.4	0.3871	-71.0
400	0.377	-136.7	12.76	104.4	0.0529	62.0	0.2929	-78.9
500	0.370	-148.4	10.36	99.6	0.0618	64.1	0.2311	-85.4
600	0.360	-157.6	8.71	95.8	0.0707	65.9	0.1861	-91.3
700	0.365	-165.0	7.52	92.7	0.0801	67.5	0.1524	-96.6
800	0.364	-170.4	6.64	90.0	0.0890	68.4	0.1274	-102.7
900	0.366	-176.1	5.87	87.7	0.0991	69.6	0.1061	-110.4
1000	0.370	-179.9	5.33	85.4	0.1081	70.1	0.0893	-117.9
1100	0.373	174.6	4.87	83.7	0.1178	70.6	0.0768	-126.7
1200	0.387	172.5	4.47	81.8	0.1274	71.1	0.0685	-138.6
1300	0.379	168.0	4.16	80.4	0.1375	71.4	0.0630	-150.7
1400	0.409	164.7	3.85	78.9	0.1473	71.7	0.0603	-162.8
1500	0.399	163.4	3.64	77.1	0.1568	71.6	0.0596	-175.0
1600	0.419	159.1	3.43	75.7	0.1667	71.8	0.0631	174.3
1700	0.427	159.5	3.24	73.9	0.1765	71.8	0.0681	166.3
1800	0.427	156.2	3.09	73.2	0.1862	71.3	0.0757	157.4
1900	0.446	154.6	2.93	71.8	0.1963	71.7	0.0829	152.5
2000	0.444	153.5	2.80	70.2	0.2057	71.4	0.0914	146.9



## Package Dimensions

Unit: mm



Hitachi Code	MFPAC
JEDEC	
EIAJ	
Mass (reference value)	0.0016 g

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# HITACHI

## Hitachi, Ltd.

Semiconductor & Integrated Circuits  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan  
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL	NorthAmerica	: <a href="http://semiconductor.hitachi.com/">http://semiconductor.hitachi.com/</a>
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### For further information write to:

Hitachi Semiconductor (America) Inc. 179 East Tasman Drive, San Jose, CA 95134 Tel: <1> (408) 433-1990 Fax: <1>(408) 433-0223	Hitachi Europe Ltd. Electronic Components Group. Whitebrook Park Lower Cookham Road Maidenhead Berkshire SL6 8YA, United Kingdom Tel: <44> (1628) 585000 Fax: <44> (1628) 585200
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Hitachi Europe GmbH Electronic Components Group Dornacher Straße 3 D-85622 Feldkirchen, Munich Germany Tel: <49> (89) 9 9180-0 Fax: <49> (89) 9 29 30 00
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Hitachi Asia Ltd. Hitachi Tower 16 Collyer Quay #20-00, Singapore 049318 Tel: <65>-538-6533/538-8577 Fax: <65>-538-6933/538-3877 URL: <a href="http://www.hitachi.com.sg">http://www.hitachi.com.sg</a>
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Hitachi Asia Ltd. (Taipei Branch Office) 4/F, No. 167, Tun Hwa North Road, Hung-Kuo Building, Taipei (105), Taiwan Tel: <886>-(2)-2718-3666 Fax: <886>-(2)-2718-8180 Telex: 23222 HAS-TP URL: <a href="http://www.hitachi.com.tw">http://www.hitachi.com.tw</a>
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Hitachi Asia (Hong Kong) Ltd. Group III (Electronic Components) 7/F., North Tower, World Finance Centre, Harbour City, Canton Road Tsim Sha Tsui, Kowloon, Hong Kong Tel: <852>-(2)-735-9218 Fax: <852>-(2)-730-0281 URL: <a href="http://semiconductor.hitachi.com.hk">http://semiconductor.hitachi.com.hk</a>
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