

2SC5702

Silicon NPN Epitaxial
High Frequency Amplifier / Oscillator

HITACHI

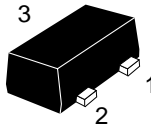
ADE-208-1414 (Z)
1st. Edition
Mar. 2001

Features

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

Outline

MFPAK



1. Emitter
2. Base
3. Collector

Note: Marking is "ZS-".

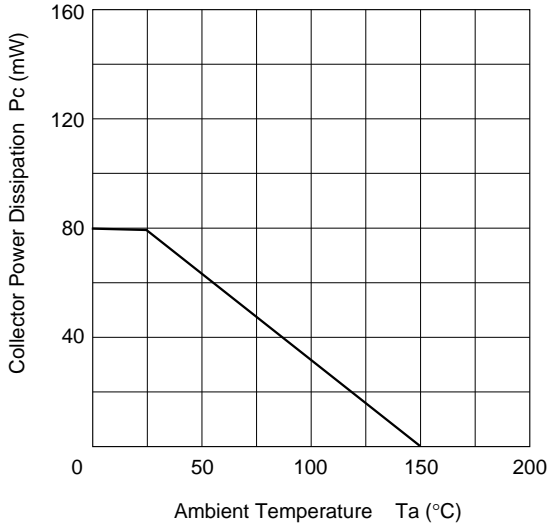
Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

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	P_{c}	80	mW
Junction temperature	T_{j}	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

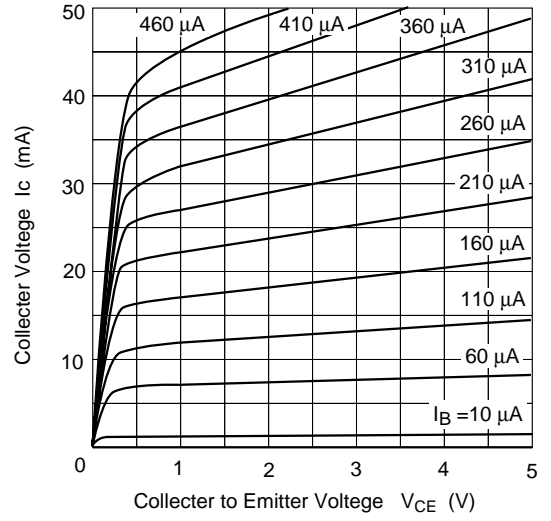
Electrical Characteristics ($T_a = 25^\circ\text{C}$)

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

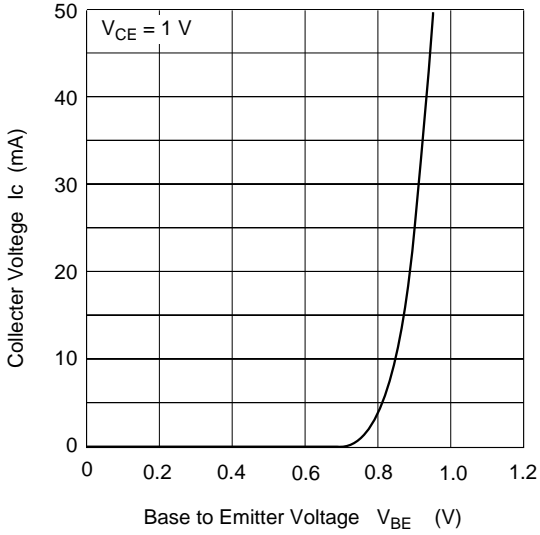
Maximum Collector Dissipation Curve



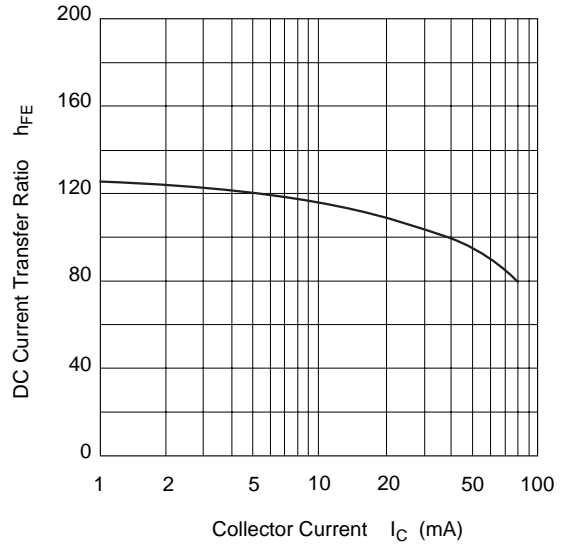
Collector Voltage vs. Collector to Emitter Voltage



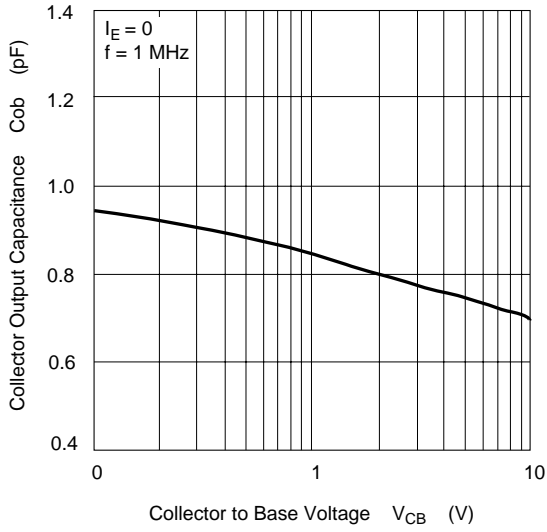
Collector Voltage vs. Base to Emitter Voltage



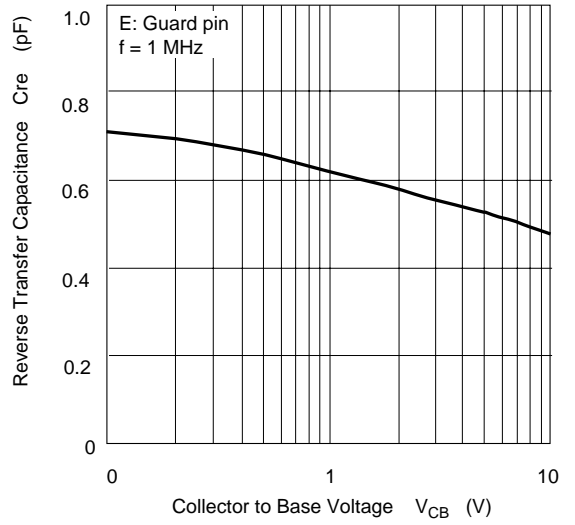
DC Current Transfer Ratio vs. Collector Current



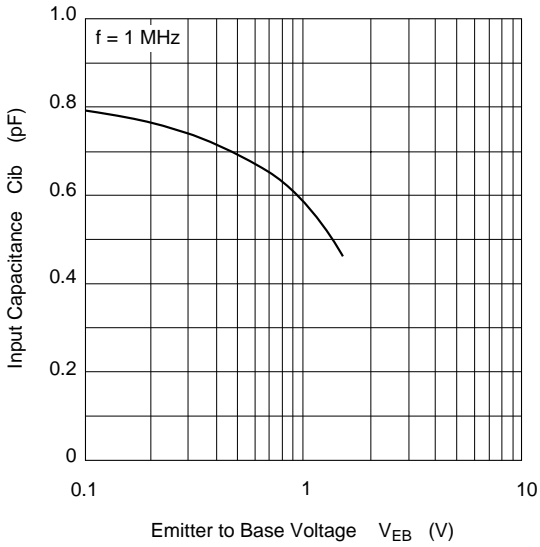
Collector Output Capacitance vs.
Collector to Base Voltage



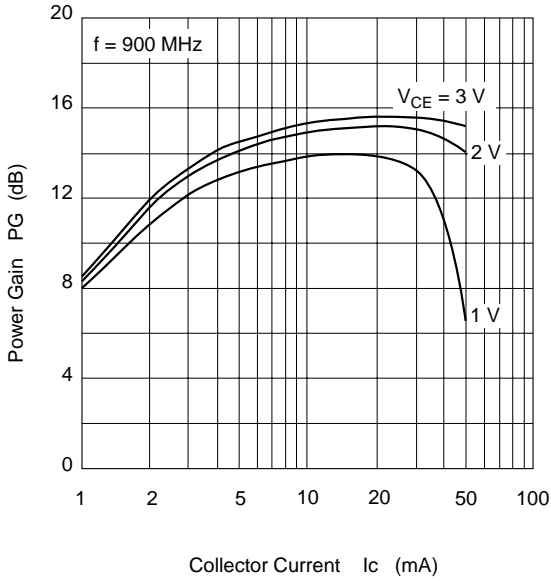
Reverse Transfer capacitance vs.
Collector To Base Voltage



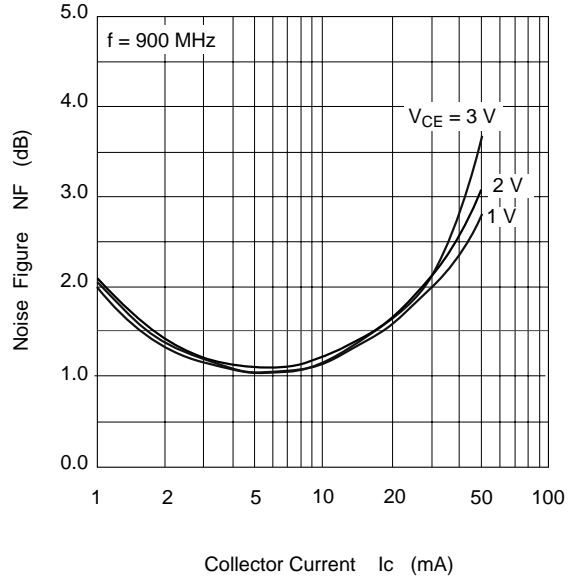
Collector Input Capacitance vs.
Emitter To Base Voltage



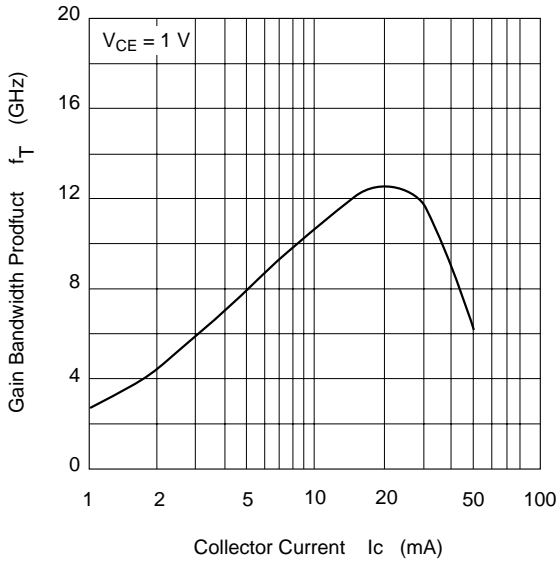
Power Gain vs. Collector Current



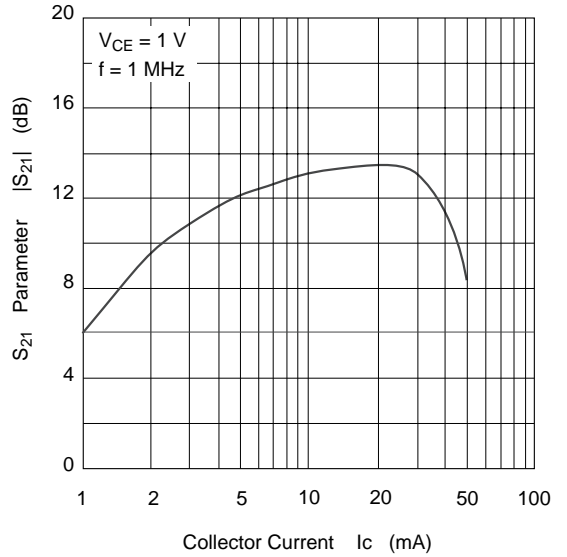
Noise Figure vs. Collector Current



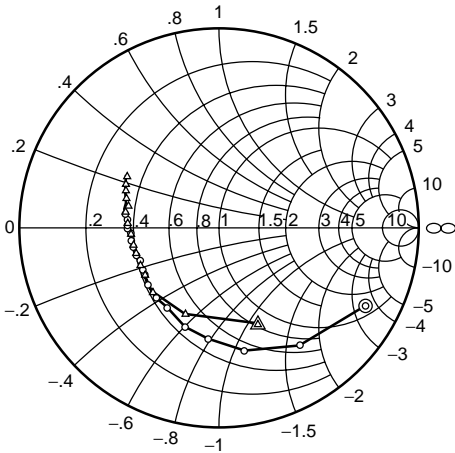
Gain Bandwidth Product vs. Collector Current



S21 Parameter vs. Collector Current

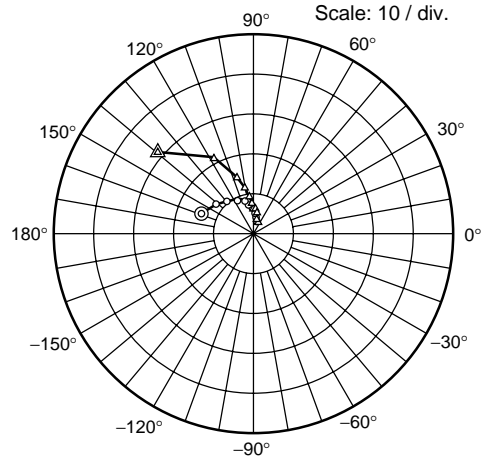


S11 Parameter vs. Frequency



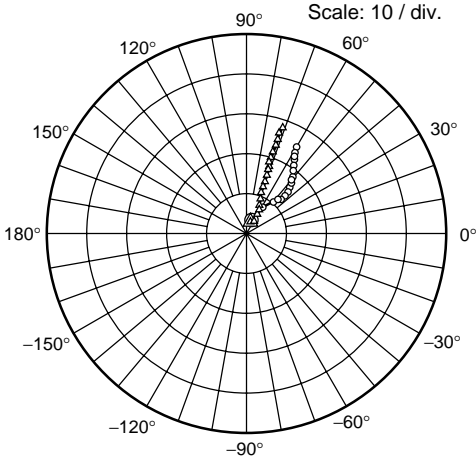
Condition : $V_{CE} = 1\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
 △—△ ($I_C = 20\text{ mA}$)

S21 Paramter vs. Frequency



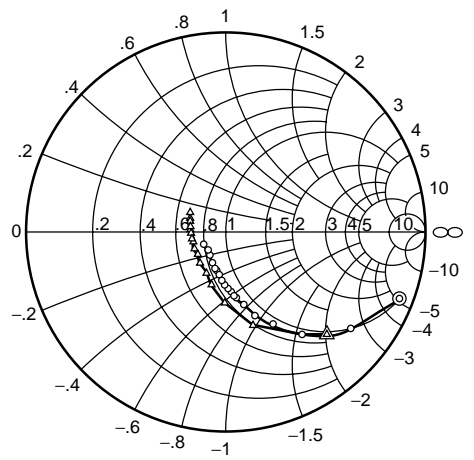
Condition : $V_{CE} = 1\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
 △—△ ($I_C = 20\text{ mA}$)

S12 Parameter vs. Frequency



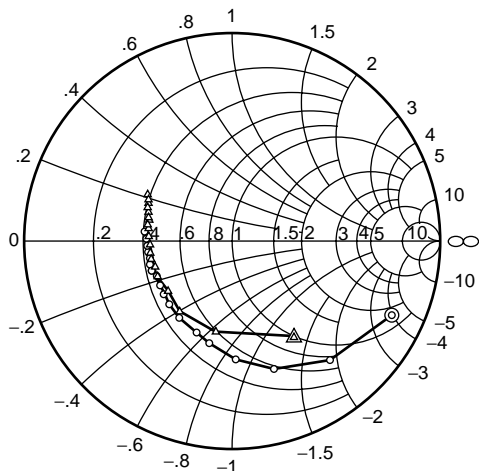
Condition : $V_{CE} = 1\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
 △—△ ($I_C = 20\text{ mA}$)

S22 Parameter vs. Frequency



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

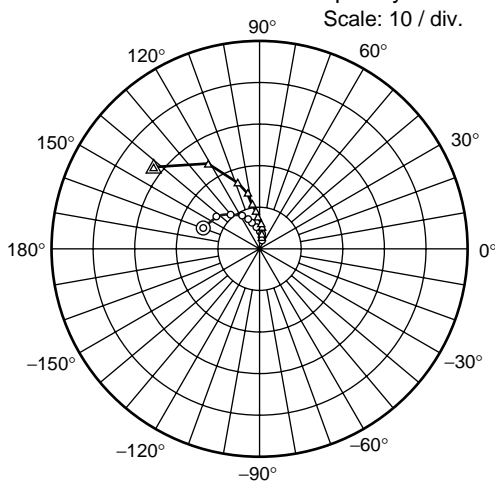
S11 Parameter vs. Frequency



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

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

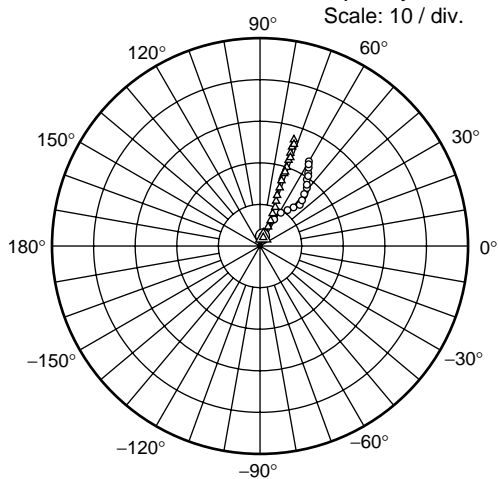
S21 Parameter vs. Frequency



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

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

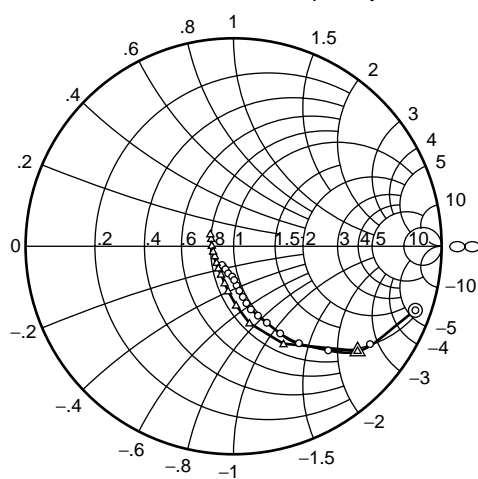
S12 Parameter vs. Frequency



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

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

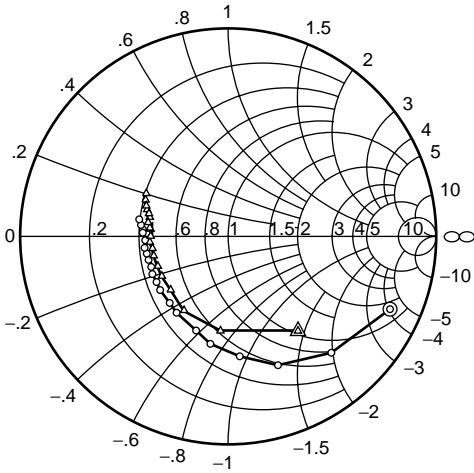
S22 Parameter vs. Frequency



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

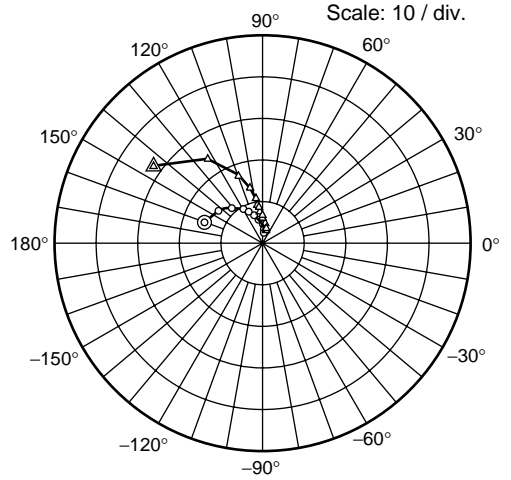
○—○ ($I_C = 5\text{ mA}$)
△—△ ($I_C = 20\text{ mA}$)

S11 Parameter vs. Frequency



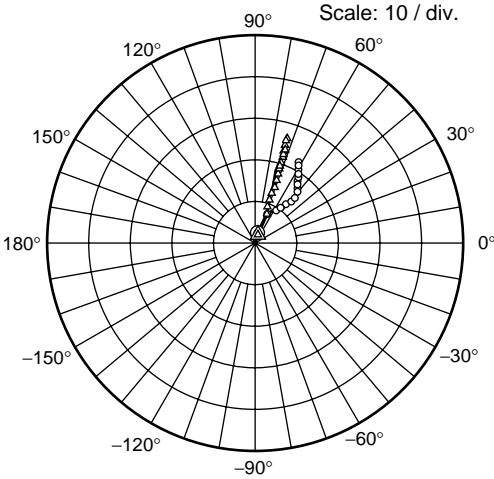
Condition : $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
 △—△ ($I_C = 20\text{ mA}$)

S21 Parameter vs. Frequency



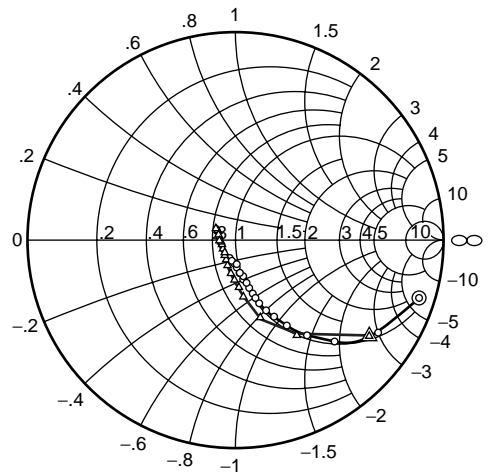
Condition : $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
 △—△ ($I_C = 20\text{ mA}$)

S12 Parameter vs. Frequency



Condition : $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 2000 MHz (100 MHz STEP)
 ○—○ ($I_C = 5\text{ mA}$)
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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 ($V_{CE} = 1\text{ V}$, $I_C = 5\text{ mA}$, $Z_o = 50\ \Omega$)

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

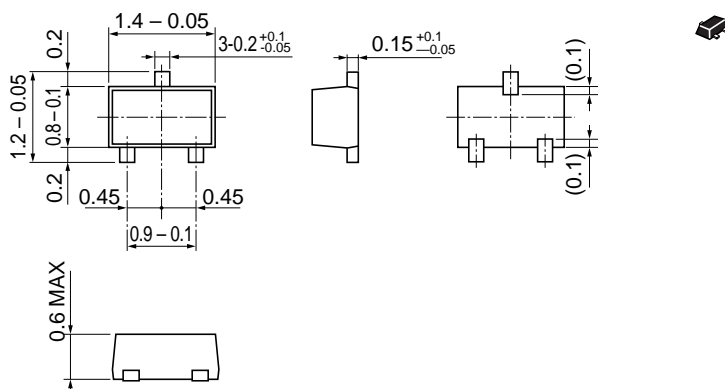
f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.846	-24.1	14.25	161.9	0.0287	75.9	0.9420	-17.0
200	0.748	-48.1	12.56	144.7	0.0534	64.3	0.8245	-32.2
300	0.656	-69.0	10.71	131.2	0.0705	56.4	0.6904	-43.6
400	0.573	-84.9	9.03	121.3	0.0817	52.0	0.5802	-51.5
500	0.516	-99.3	7.75	113.8	0.0895	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	MFPAK
JEDEC	
EIAJ	
Mass (reference value)	0.0016 g

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