To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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HSG2004

SiGe HBT
High Frequency Medium Power Amplifier

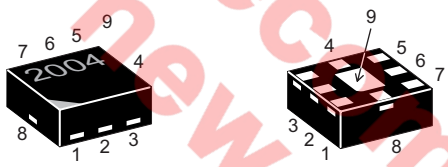
REJ03G0484-0400
Rev.4.00
Jun 21, 2006

Features

- High Transition Frequency
  f_T = 30 GHz typ.
- Low Distortion and Excellent Linearity
  P1dB at output = +14.5 dBm typ. f = 5.8 GHz
- High Collector to Emitter Voltage
  V_{CEO} = 5 V
- Ideal for 2 GHz, 5 GHz Band applications. e.g. WLAN, Digital cordless phone.

Outline

Renesas Package code: PWQN0008ZA-A
(Package name: HWQFN-8 <TNP-8TV>)



1. Collector
2. Collector
3. Collector
4. Emitter
5. Emitter
6. Base
7. Emitter
8. Emitter
9. Emitter

Note: Marking is “2004”.

Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit
Collector to base voltage	V_{CBO}	12	V
Collector to emitter voltage	V_{CEO}	5	V
Emitter to base voltage	V_{EBO}	1.2	V
Collector current	I_C	200	mA
Collector power dissipation	Pc	1 Note	W
Junction temperature	Tj	150	°C
Storage temperature	Tstg	–55 to +150	°C

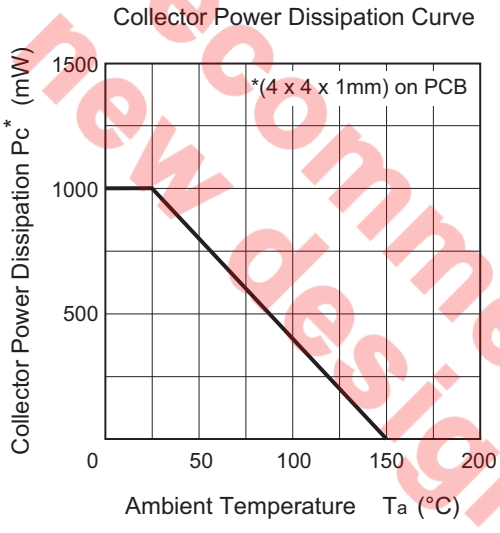
Note: Value on PCB (40 x 40 x 1.0 mm)

Electrical Characteristics

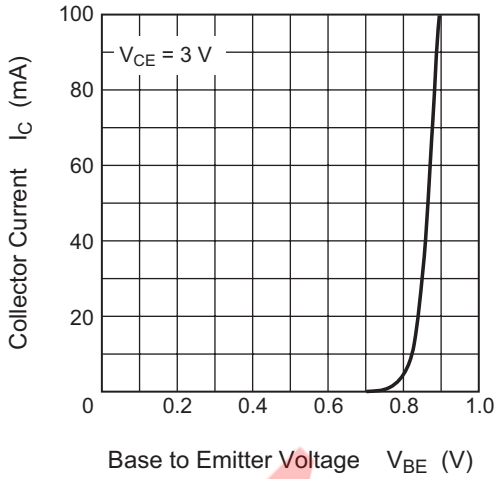
(Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
DC current transfer ratio	h_{FE}	170	240	320	—	V_{CE} = 3 V, I_C = 30 mA
Reverse Transfer Capacitance	C_{re}	—	—	0.6	pF	V_{CB} = 3 V, I_E = 0, f = 1 MHz, emitter grounded
Transition Frequency	f_T	—	30.0	—	GHz	V_{CE} = 3 V, I_C = 30 mA, f = 1 GHz
Maximum Stable Gain	MSG	14	15.5	—	dB	V_{CE} = 3 V, I_C = 30 mA, f = 5.8 GHz
Maximum Available Gain	MAG	—	21	—	dB	V_{CE} = 3 V, I_C = 30 mA, f = 2.4 GHz
Maximum Available Gain	MAG	—	12	—	dB	V_{CE} = 3 V, I_C = 30 mA, f = 5.8 GHz
Power Gain	PG	—	11.5	—	dB	V_{CE} = 3.6 V, I_{idle} = 30 mA, f = 5.8 GHz, Pin = +0 dBm
1dB Compression Point at output	P1dB	—	+14.5	—	dBm	V_{CE} = 3.6 V, I_{idle} = 30 mA, f = 5.8 GHz
Saturation Output Power	Po(sat)	—	+22	—	dBm	V_{CE} = 3.6 V, I_{idle} = 30 mA, f = 5.8 GHz, Pin = +0 dBm

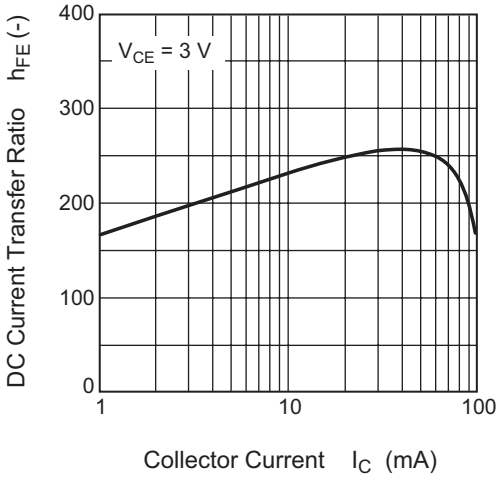
Main Characteristics



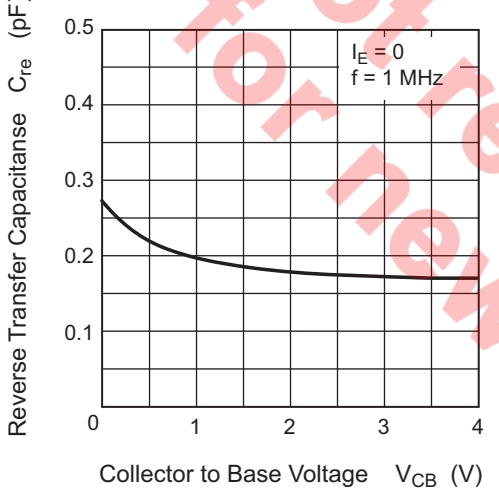
Typical Transfer Characteristics



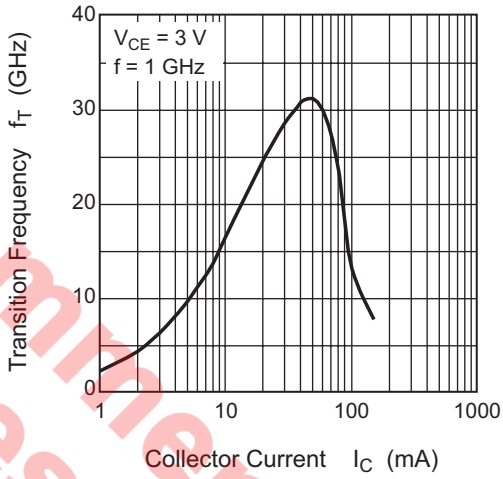
DC Current Transfer Ratio vs. Collector Current



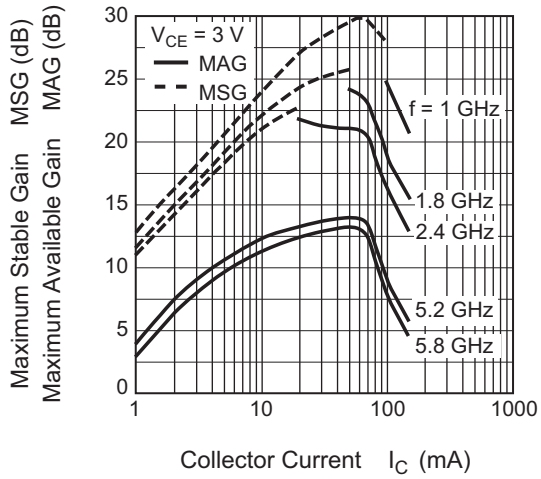
Reverse Transfer Capacitanse vs. Collector to Base Voltage



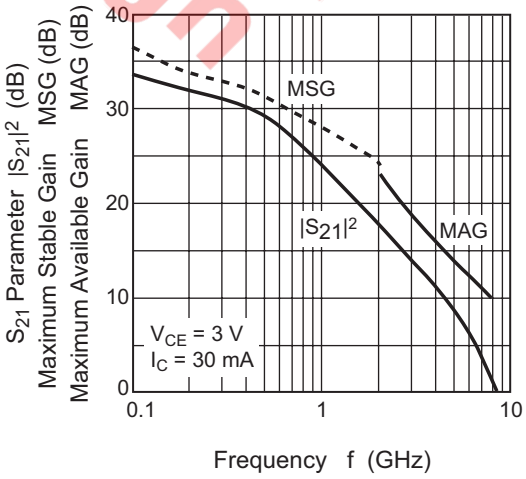
Transition Frequency vs. Collector Current



Maximum Stable Gain, Maximum Available Gain vs. Collector Current

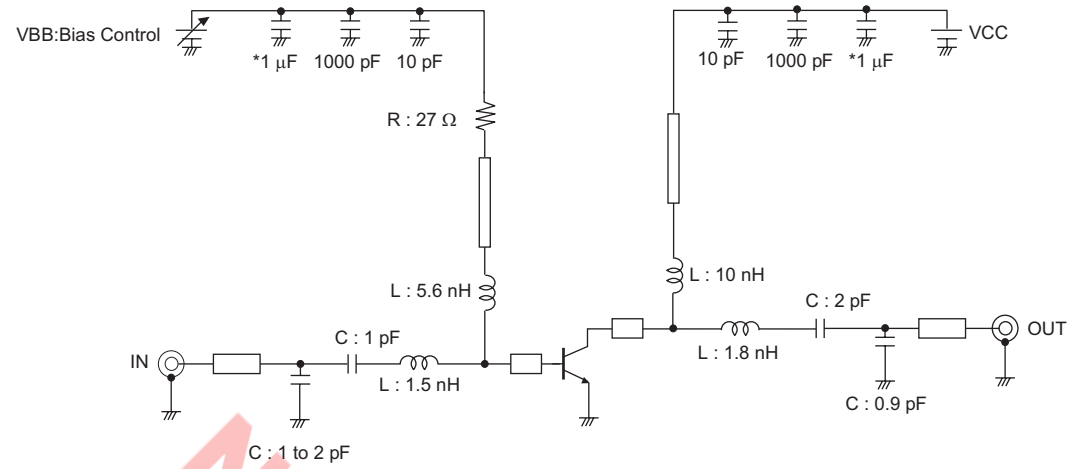


S_{21} Parameter, Maximum Available Gain, Maximum Stable Gain vs. Frequency



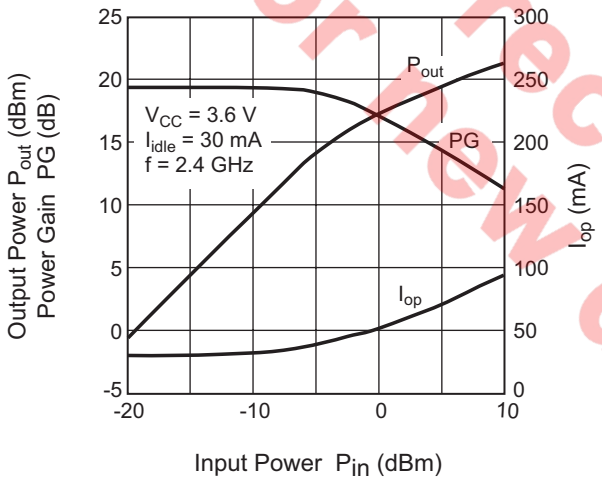
2.4 GHz Characteristics

Evaluation Board Circuit

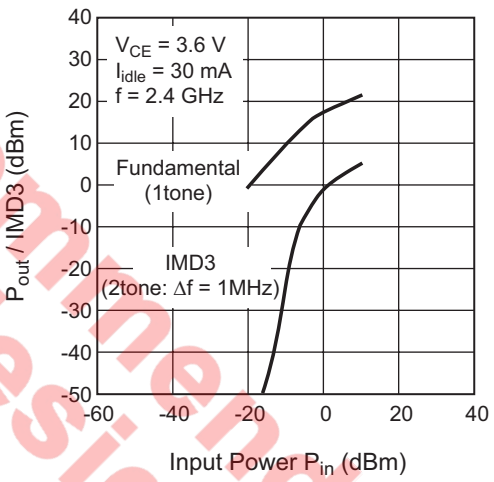


P_{in} - P_{out} Characteristics

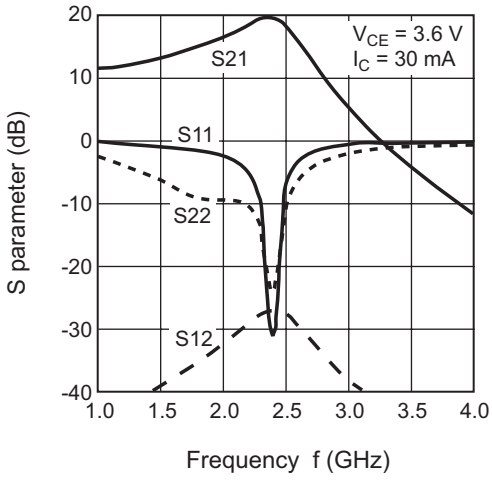
P_{in} - P_{out} Characteristics



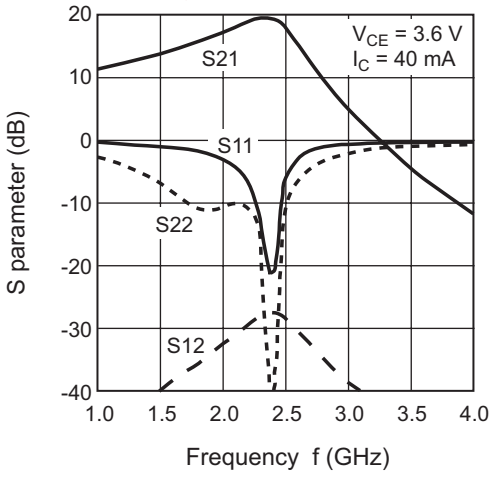
3rd. Order Intermodulation Distortion (IMD3)



S parameter vs. Frequency

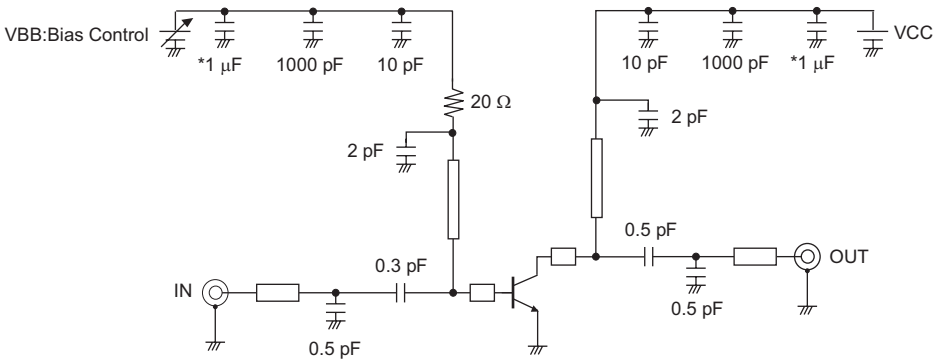


S parameter vs. Frequency



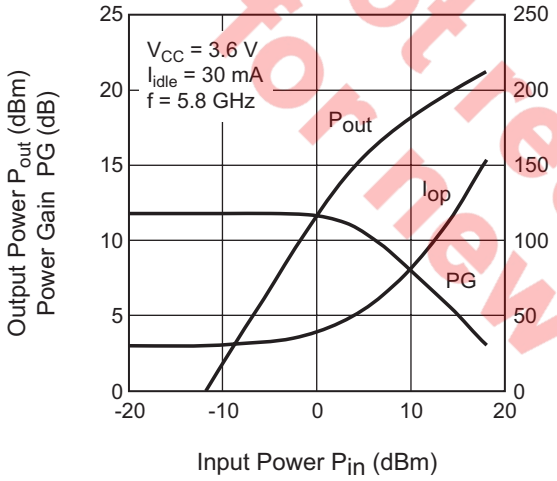
5.8 GHz Characteristics

Evaluation Board Circuit

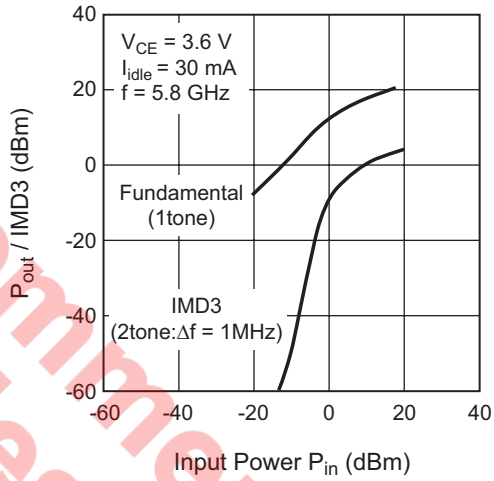


P_{in} - P_{out} Characteristics

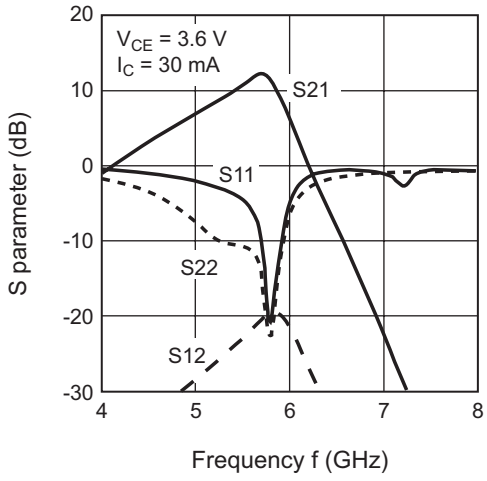
P_{in} - P_{out} Characteristics



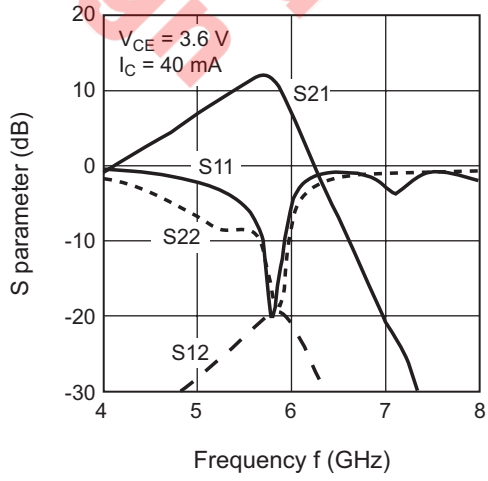
3rd. Order Intermodulation Distortion (IMD3)



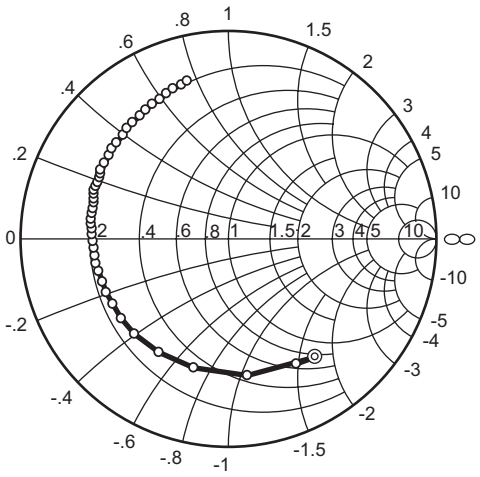
S parameter vs. Frequency



S parameter vs. Frequency



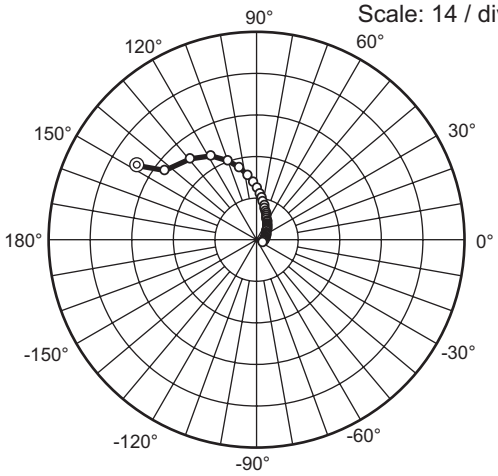
S_{11} Parameter vs. Frequency



Condition: V_{CE} = 3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{21} Parameter vs. Frequency

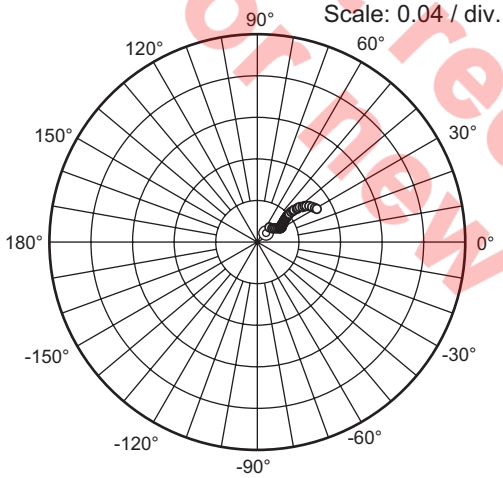
Scale: 14 / div.



Condition: V_{CE} = 3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

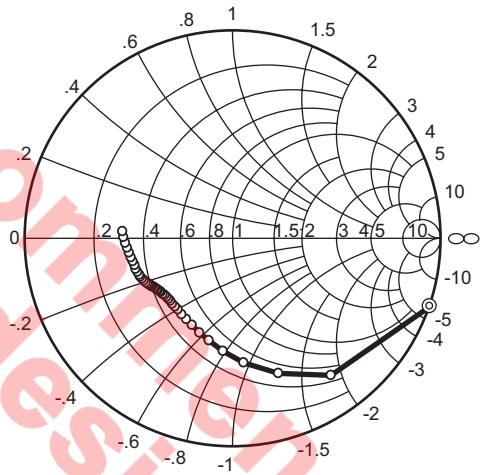
S_{12} Parameter vs. Frequency

Scale: 0.04 / div.



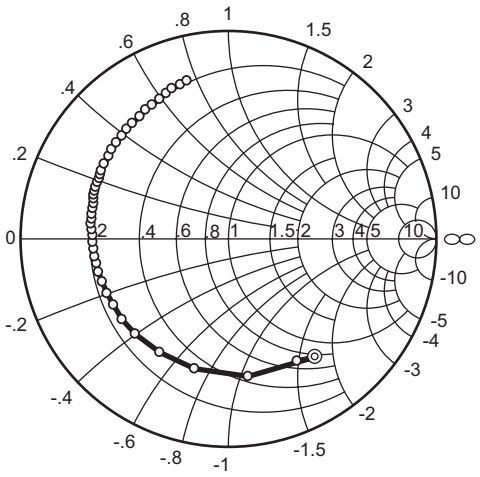
Condition: V_{CE} = 3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{22} Parameter vs. Frequency



Condition: V_{CE} = 3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

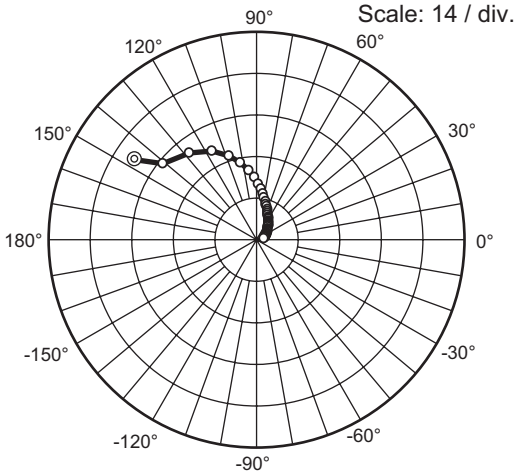
S_{11} Parameter vs. Frequency



Condition: V_{CE} = 3.3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{21} Parameter vs. Frequency

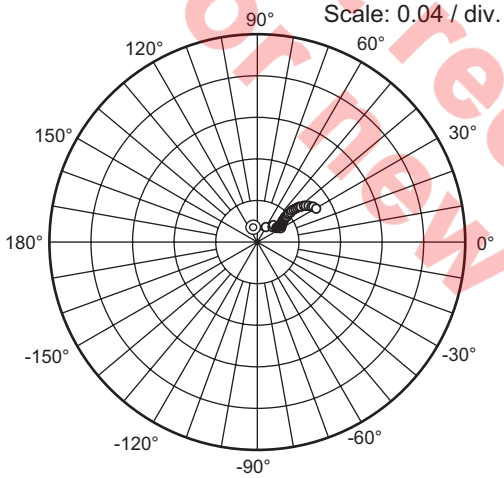
Scale: 14 / div.



Condition: V_{CE} = 3.3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

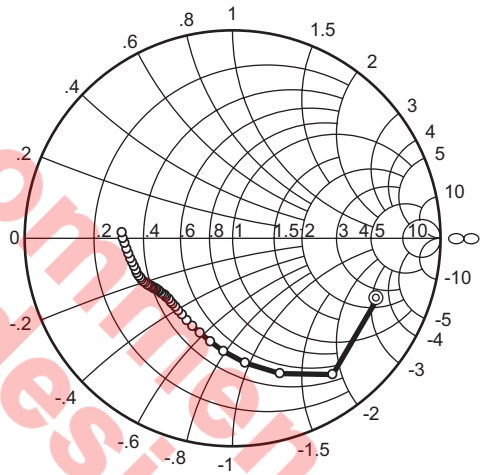
S_{12} Parameter vs. Frequency

Scale: 0.04 / div.



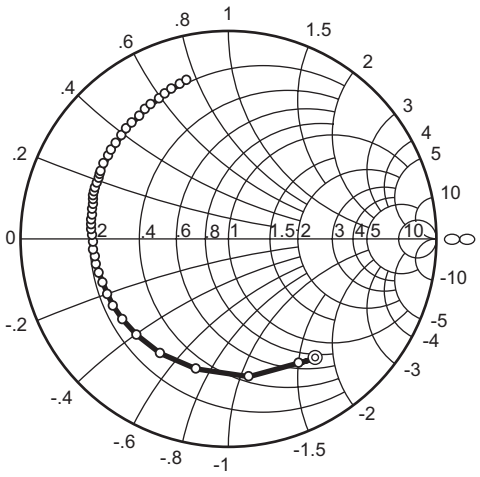
Condition: V_{CE} = 3.3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{22} Parameter vs. Frequency



Condition: V_{CE} = 3.3 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

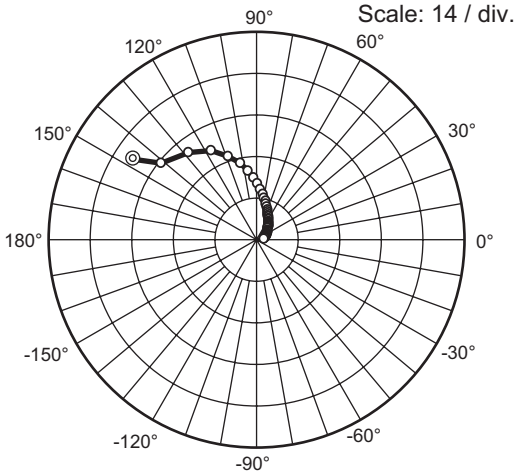
S_{11} Parameter vs. Frequency



Condition: V_{CE} = 3.6 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{21} Parameter vs. Frequency

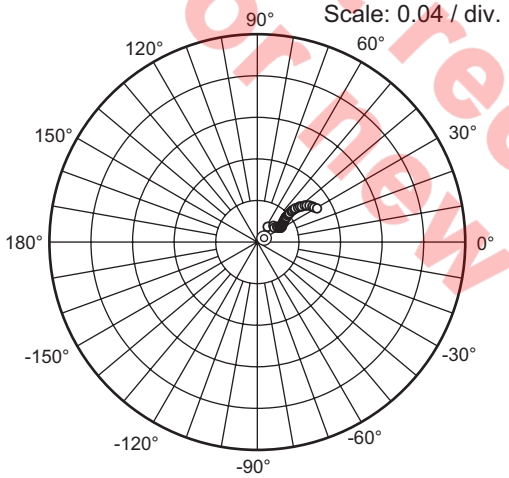
Scale: 14 / div.



Condition: V_{CE} = 3.6 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

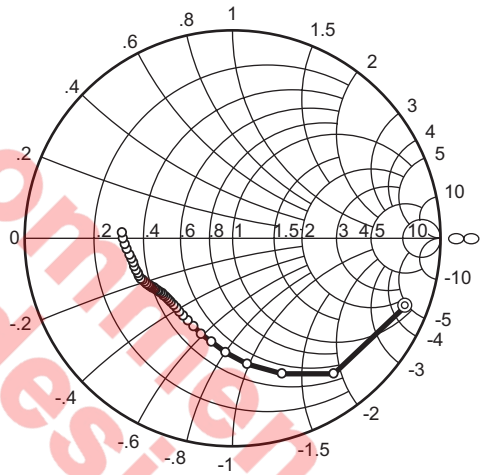
S_{12} Parameter vs. Frequency

Scale: 0.04 / div.



Condition: V_{CE} = 3.6 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S_{22} Parameter vs. Frequency



Condition: V_{CE} = 3.6 V, I_C = 30 mA, Zo = 50 Ω
100 to 3000 MHz (100 MHz Step)
3200 to 6000 MHz (200 MHz Step)

S parameter

(V_{CE} = 3 V, I_C = 30 mA, Zo = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.684	-61.3	47.90	147.5	0.0103	39.8	1.006	-19.0
200	0.708	-53.6	39.45	142.1	0.0168	50.5	0.811	-53.9
300	0.664	-81.8	35.97	128.9	0.0180	41.9	0.685	-71.2
400	0.644	-105.0	32.90	117.8	0.0192	36.7	0.601	-84.9
500	0.638	-121.4	29.04	109.5	0.0214	34.3	0.543	-94.8
600	0.640	-134.8	25.80	102.8	0.0225	31.8	0.505	-102.7
700	0.640	-143.6	22.83	97.7	0.0240	29.2	0.480	-109.5
800	0.640	-150.6	20.30	93.4	0.0238	28.5	0.460	-115.0
900	0.641	-156.5	18.23	89.8	0.0242	30.5	0.447	-119.7
1000	0.641	-161.6	16.44	86.5	0.0249	30.4	0.437	-123.8
1100	0.644	-166.1	15.00	83.6	0.0250	27.9	0.431	-127.3
1200	0.648	-169.8	13.75	80.9	0.0252	29.1	0.427	-130.2
1300	0.649	-173.1	12.70	78.4	0.0258	29.4	0.425	-132.7
1400	0.651	-176.2	11.78	76.0	0.0262	29.7	0.423	-134.9
1500	0.651	-179.2	10.97	73.9	0.0263	30.7	0.423	-136.9
1600	0.656	177.9	10.23	71.8	0.0270	32.4	0.424	-138.7
1700	0.660	175.5	9.58	69.9	0.0274	33.0	0.425	-140.3
1800	0.665	173.5	9.01	68.0	0.0282	33.6	0.427	-141.7
1900	0.667	171.5	8.52	66.1	0.0285	34.5	0.429	-143.0
2000	0.668	169.3	8.08	64.1	0.0294	34.3	0.432	-144.1
2100	0.669	167.1	7.65	62.4	0.0297	35.2	0.435	-145.2
2200	0.673	164.9	7.27	60.7	0.0304	35.9	0.438	-146.2
2300	0.678	163.1	6.92	59.2	0.0310	36.5	0.441	-147.3
2400	0.683	161.5	6.61	57.6	0.0318	37.7	0.444	-148.0
2500	0.687	160.0	6.32	55.9	0.0327	38.0	0.448	-148.9
2600	0.687	158.2	6.05	54.2	0.0337	37.6	0.450	-149.6
2700	0.688	156.4	5.80	52.5	0.0339	38.8	0.454	-150.3
2800	0.689	154.5	5.57	50.9	0.0348	38.8	0.457	-150.9
2900	0.693	152.9	5.35	49.5	0.0359	39.4	0.460	-151.6
3000	0.698	151.5	5.16	48.2	0.0364	39.9	0.463	-152.2
3200	0.702	148.6	4.80	45.0	0.0381	40.5	0.468	-153.4
3400	0.703	145.0	4.48	41.8	0.0399	40.5	0.473	-154.6
3600	0.709	142.1	4.19	39.0	0.0418	40.7	0.477	-156.0
3800	0.712	139.0	3.95	36.0	0.0436	40.1	0.480	-157.3
4000	0.715	135.4	3.72	32.7	0.0453	39.9	0.483	-158.9
4200	0.723	132.3	3.51	29.9	0.0477	39.2	0.485	-160.6
4400	0.726	129.2	3.33	27.0	0.0489	39.3	0.487	-162.5
4600	0.730	125.4	3.14	23.7	0.0511	38.3	0.490	-164.8
4800	0.742	122.4	2.98	20.8	0.0531	37.1	0.493	-167.0
5000	0.747	119.4	2.84	17.8	0.0555	36.5	0.497	-169.5
5200	0.753	115.9	2.69	14.5	0.0571	35.1	0.503	-172.1
5400	0.765	113.0	2.55	11.5	0.0592	33.4	0.509	-174.9
5600	0.773	110.3	2.43	8.4	0.0612	31.6	0.517	-177.8
5800	0.779	106.9	2.30	5.3	0.0628	30.0	0.525	179.3
6000	0.790	104.5	2.18	2.2	0.0643	28.2	0.534	176.2

S parameter

(V_{CE} = 3.3 V, I_C = 30 mA, Zo = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.674	-60.3	48.82	147.33	0.0124	106.4	0.755	-22.6
200	0.708	-53.6	40.51	141.98	0.0146	57.5	0.814	-53.5
300	0.668	-81.6	36.68	128.82	0.0189	39.9	0.690	-70.4
400	0.646	-104.3	33.30	117.87	0.0211	42.3	0.598	-83.9
500	0.637	-121.1	29.33	109.63	0.0216	34.1	0.544	-94.1
600	0.638	-134.3	26.04	102.93	0.0229	32.8	0.506	-102.0
700	0.640	-143.1	23.01	97.82	0.0234	31.7	0.480	-108.7
800	0.639	-150.2	20.48	93.51	0.0239	29.8	0.460	-114.2
900	0.639	-156.1	18.38	89.85	0.0244	30.0	0.448	-119.1
1000	0.639	-161.2	16.56	86.63	0.0247	28.7	0.436	-123.2
1100	0.643	-165.7	15.11	83.71	0.0248	29.6	0.431	-126.6
1200	0.647	-169.5	13.85	80.95	0.0252	27.6	0.426	-129.5
1300	0.648	-172.8	12.80	78.44	0.0259	30.7	0.424	-132.0
1400	0.649	-175.9	11.87	76.09	0.0258	30.7	0.422	-134.3
1500	0.650	-178.9	11.05	73.89	0.0269	31.0	0.422	-136.4
1600	0.653	178.2	10.31	71.81	0.0273	32.5	0.423	-138.2
1700	0.658	175.8	9.66	69.89	0.0276	31.8	0.424	-139.8
1800	0.663	173.7	9.08	67.99	0.0281	33.4	0.426	-141.2
1900	0.665	171.7	8.58	66.10	0.0288	34.3	0.428	-142.5
2000	0.667	169.5	8.14	64.14	0.0294	35.0	0.431	-143.6
2100	0.667	167.3	7.71	62.39	0.0297	35.5	0.434	-144.8
2200	0.671	165.1	7.33	60.67	0.0305	35.8	0.437	-145.7
2300	0.676	163.3	6.97	59.20	0.0311	36.7	0.440	-146.7
2400	0.682	161.6	6.66	57.56	0.0318	37.6	0.443	-147.6
2500	0.685	160.1	6.36	55.90	0.0322	37.5	0.447	-148.4
2600	0.685	158.4	6.10	54.14	0.0337	39.1	0.450	-149.2
2700	0.687	156.5	5.85	52.44	0.0342	38.8	0.453	-149.8
2800	0.688	154.7	5.61	50.90	0.0348	39.2	0.456	-150.6
2900	0.692	153.1	5.39	49.52	0.0355	39.3	0.459	-151.2
3000	0.696	151.6	5.19	48.15	0.0361	39.5	0.462	-151.8
3200	0.701	148.7	4.84	44.97	0.0380	40.5	0.467	-153.0
3400	0.702	145.2	4.51	41.72	0.0397	40.5	0.472	-154.2
3600	0.708	142.3	4.22	39.02	0.0414	40.1	0.476	-155.6
3800	0.710	139.2	3.98	35.99	0.0437	41.0	0.479	-156.9
4000	0.714	135.5	3.75	32.71	0.0458	40.5	0.483	-158.5
4200	0.722	132.4	3.54	29.88	0.0477	39.9	0.484	-160.3
4400	0.724	129.4	3.35	26.99	0.0490	38.8	0.487	-162.2
4600	0.729	125.5	3.17	23.61	0.0509	38.5	0.489	-164.4
4800	0.740	122.4	3.01	20.69	0.0530	37.5	0.493	-166.7
5000	0.746	119.5	2.86	17.76	0.0554	36.7	0.497	-169.1
5200	0.752	115.9	2.71	14.45	0.0573	35.6	0.502	-171.7
5400	0.764	113.1	2.57	11.42	0.0592	33.8	0.509	-174.6
5600	0.773	110.4	2.45	8.38	0.0614	31.9	0.516	-177.5
5800	0.778	107.0	2.32	5.20	0.0623	30.6	0.524	179.6
6000	0.789	104.5	2.19	2.09	0.0639	28.1	0.534	176.6

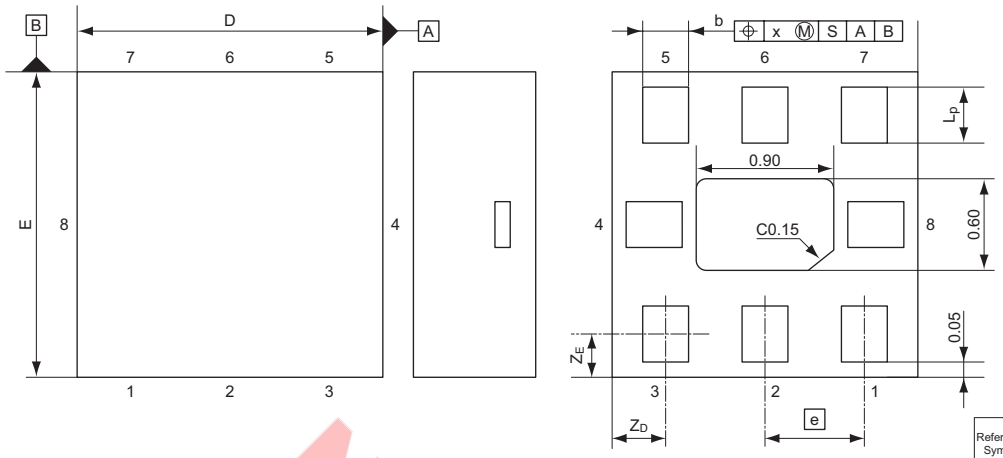
S parameter

(V_{CE} = 3.6 V, I_C = 30 mA, Zo = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.686	-60.1	49.50	147.35	0.0070	30.5	0.897	-21.2
200	0.713	-53.6	41.32	141.93	0.0155	53.8	0.815	-52.9
300	0.669	-81.1	37.11	128.90	0.0200	42.6	0.690	-69.6
400	0.645	-103.8	33.55	118.06	0.0199	37.3	0.605	-83.3
500	0.637	-120.5	29.52	109.81	0.0221	34.8	0.546	-93.3
600	0.638	-133.6	26.17	103.15	0.0222	31.6	0.507	-101.4
700	0.638	-142.5	23.13	98.02	0.0238	30.5	0.481	-108.1
800	0.637	-149.7	20.59	93.66	0.0239	28.3	0.461	-113.7
900	0.638	-155.6	18.47	90.02	0.0243	28.8	0.447	-118.4
1000	0.638	-160.8	16.65	86.77	0.0245	29.0	0.437	-122.5
1100	0.642	-165.3	15.20	83.83	0.0251	29.2	0.431	-125.9
1200	0.645	-169.1	13.93	81.07	0.0256	29.2	0.427	-129.0
1300	0.645	-172.4	12.87	78.55	0.0253	30.2	0.424	-131.4
1400	0.648	-175.6	11.94	76.19	0.0263	30.9	0.423	-133.8
1500	0.648	-178.6	11.11	73.98	0.0268	30.6	0.422	-135.8
1600	0.652	178.5	10.37	71.89	0.0271	32.1	0.423	-137.7
1700	0.657	176.1	9.71	69.97	0.0274	32.5	0.424	-139.3
1800	0.662	174.0	9.13	68.06	0.0279	33.0	0.426	-140.7
1900	0.664	171.9	8.62	66.16	0.0287	33.5	0.428	-142.1
2000	0.665	169.8	8.18	64.18	0.0292	34.2	0.431	-143.2
2100	0.666	167.5	7.75	62.44	0.0298	34.7	0.433	-144.3
2200	0.670	165.3	7.37	60.71	0.0306	35.9	0.436	-145.4
2300	0.675	163.5	7.01	59.24	0.0310	36.8	0.439	-146.3
2400	0.680	161.9	6.69	57.59	0.0316	36.8	0.443	-147.1
2500	0.684	160.4	6.40	55.92	0.0322	37.7	0.446	-148.0
2600	0.683	158.7	6.13	54.16	0.0335	38.0	0.450	-148.8
2700	0.684	156.8	5.88	52.46	0.0338	39.0	0.453	-149.5
2800	0.686	154.9	5.64	50.91	0.0345	39.3	0.455	-150.1
2900	0.691	153.2	5.42	49.54	0.0349	39.4	0.459	-150.8
3000	0.695	151.8	5.22	48.16	0.0364	39.8	0.462	-151.4
3200	0.700	148.9	4.86	44.99	0.0383	40.4	0.467	-152.5
3400	0.700	145.3	4.53	41.72	0.0399	40.5	0.472	-153.9
3600	0.706	142.4	4.24	39.01	0.0420	40.3	0.476	-155.2
3800	0.709	139.3	4.00	36.00	0.0430	40.9	0.479	-156.6
4000	0.713	135.6	3.77	32.71	0.0452	40.3	0.482	-158.1
4200	0.721	132.6	3.56	29.88	0.0471	40.2	0.485	-159.9
4400	0.723	129.5	3.37	26.99	0.0489	39.2	0.487	-161.8
4600	0.728	125.6	3.18	23.59	0.0510	38.4	0.489	-164.0
4800	0.739	122.6	3.02	20.67	0.0527	37.6	0.492	-166.4
5000	0.745	119.7	2.87	17.72	0.0551	36.4	0.496	-168.8
5200	0.751	116.1	2.72	14.42	0.0573	35.6	0.502	-171.4
5400	0.762	113.2	2.58	11.39	0.0590	33.7	0.509	-174.3
5600	0.771	110.4	2.46	8.34	0.0610	32.0	0.516	-177.2
5800	0.777	107.1	2.33	5.17	0.0624	30.4	0.524	179.8
6000	0.788	104.7	2.21	2.04	0.0638	28.5	0.533	176.8

Package Dimensions

Package Name	JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
HWQFN-8	P-HWQFN8-2x2-0.65	PWQN0008ZA-A	TNP-8TV	0.009g



Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	1.965	2.00	2.075
E	1.965	2.00	2.075
A	—	—	0.80
A_1	0	—	0.05
A_2	—	—	—
b	—	0.3	—
e	—	0.65	—
L_p	—	0.35	—
x	—	—	0.10
y	—	—	0.08
y_1	—	—	0.10
Z_D	—	0.350	—
Z_E	—	0.225	—

Ordering Information

Part Name	Quantity	Shipping Container
HSG2004TB-E	2000 pcs.	ϕ178 mm Reel, 8 mm Emboss Taping

Note: Therefore especially small contact area of terminal, miss contact may occur if inadequate soldering condition is applied.
Contact Renesas sales office for any question regarding recommended soldering condition of Renesas.

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

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