

To our customers,

---

## Old Company Name in Catalogs and Other Documents

---

On April 1<sup>st</sup>, 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 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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

Send any inquiries to <http://www.renesas.com/inquiry>.

## Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.
  - “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.
  - “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.
  - “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

## 2SC5998

### Silicon NPN Epitaxial High Frequency Medium Power Amplifier

REJ03G0169-0101

Rev.1.01

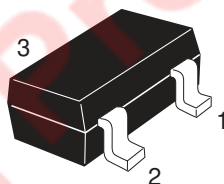
Jan 27, 2006

#### Features

- High Transition Frequency  
 $f_T = 11 \text{ GHz typ.}$
- High gain and Excellent Efficiency  
Maximum Available Gain (MAG) = +22 dB typ. at  $V_{CE} = 3.6 \text{ V}$ ,  $I_C = 100 \text{ mA}$ ,  $f = 500 \text{ MHz}$   
Power Added Efficiency (PAE) = 70% typ. at  $P_{in} = +16 \text{ dBm}$ ,  $f = 500 \text{ MHz}$
- High Collector to Emitter Voltage  
 $V_{CEO} = 5 \text{ V}$
- Ideal for up to 2 GHz applications.  
e.g.FRS(Family Radio Service) Power Amplifier ,  
GMRS (General Mobile Radio Service) Driver Amplifier

#### Outline

RENESAS Package code: PLSP0003ZB-A  
(Package name: MPAK)



1. Collector
2. Base
3. Emitter

Note: Marking is "YC-".

#### Absolute Maximum Ratings

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

Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{CBO}$	13	V
Collector to emitter voltage	$V_{CEO}$	5	V
Emitter to base voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	500	mA
Collector power dissipation	$P_C$	700 <sup>note</sup>	mW
Junction temperature	$T_j$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

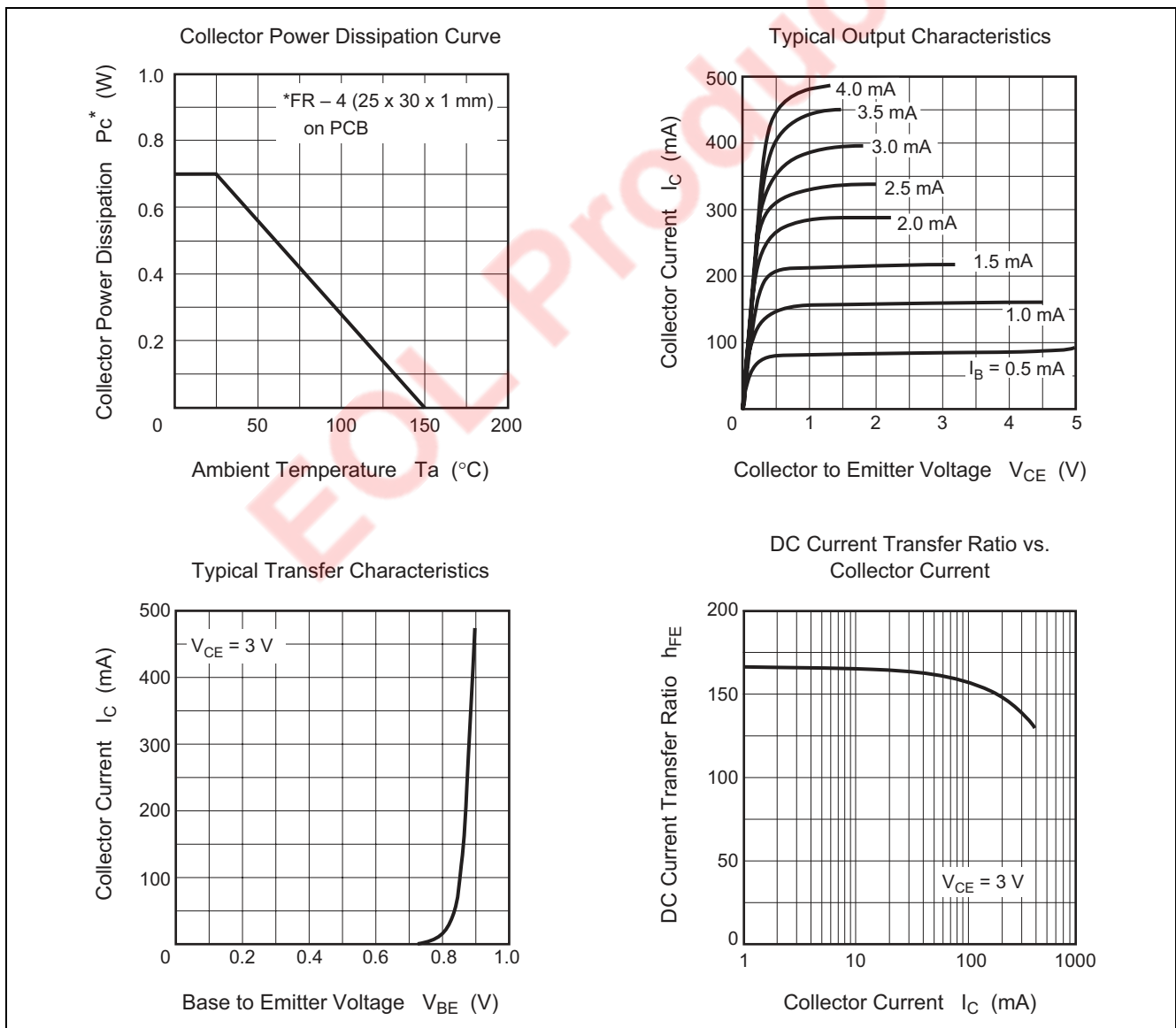
Note: Value on PCB (FR-4 : 25 x 30 x 1.0mm Double side)

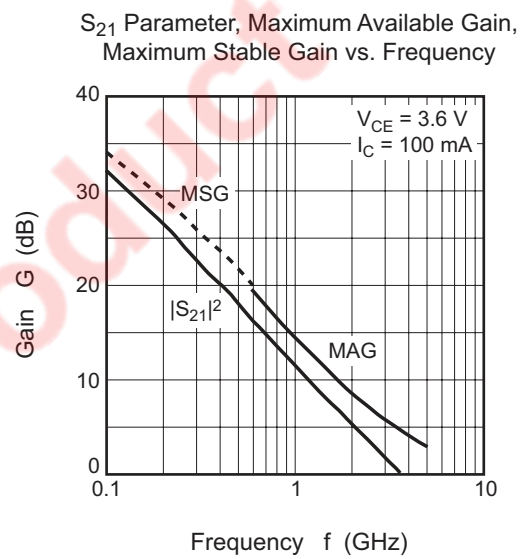
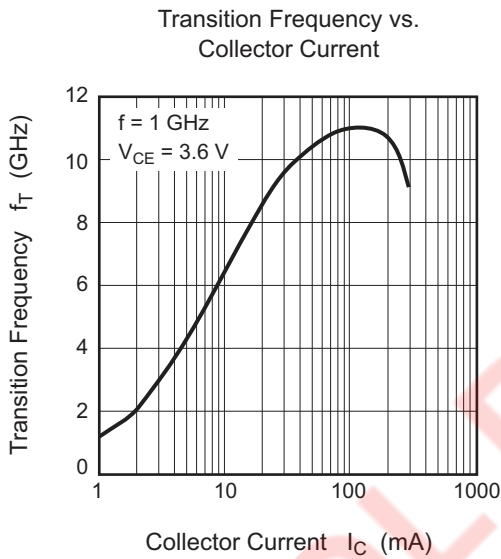
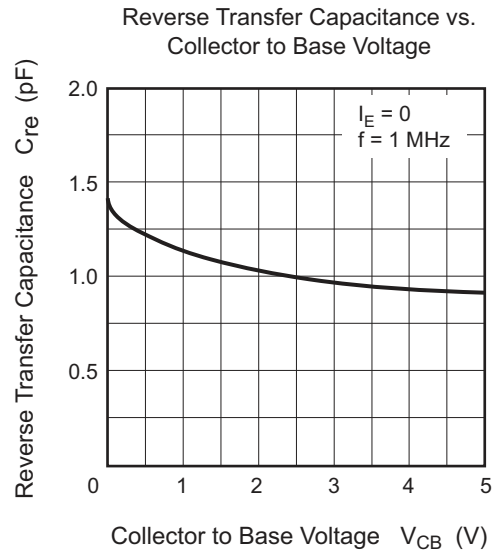
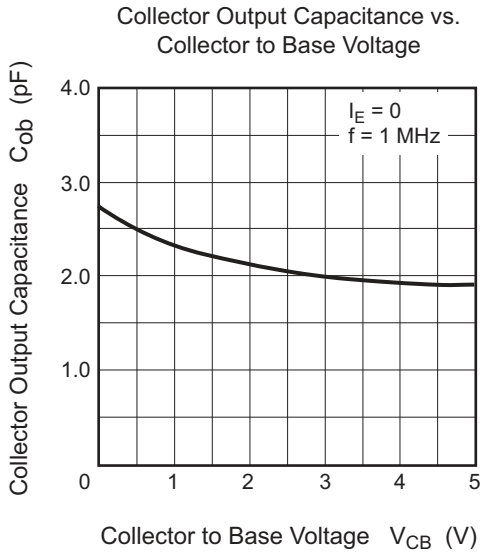
## Electrical Characteristics

(Ta = 25°C)

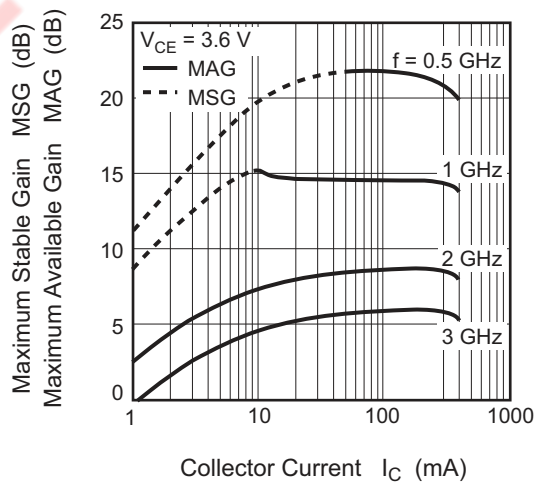
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
DC current transfer ratio	$h_{FE}$	110	150	190	—	$V_{CE} = 3\text{ V}$ , $I_C = 100\text{ mA}$
Collector output capacitance	$C_{ob}$	—	2.0	—	pF	$V_{CB} = 3\text{ V}$ , $I_E = 0$ , $f = 1\text{ MHz}$
Reverse Transfer Capacitance	$C_{re}$	—	0.95	1.5	pF	$V_{CB} = 3\text{ V}$ , $f = 1\text{ MHz}$ , Emitter grounded
Transition Frequency	$f_T$	—	10.5	—	GHz	$V_{CE} = 3.6\text{ V}$ , $I_C = 100\text{ mA}$ , $f = 1\text{ GHz}$
Maximum Available Gain	MAG	—	22	—	dB	$V_{CE} = 3.6\text{ V}$ , $I_C = 100\text{ mA}$ , $f = 0.5\text{ GHz}$
Power Gain	PG	11	13	—	dB	$V_{CE} = 3.6\text{ V}$ , $I_{CQ} = 20\text{ mA}$ , $f = 0.5\text{ GHz}$ , $P_{in} = +16\text{ dBm}$
1dB Compression Point at output	P1dB	—	28	—	dBm	$V_{CE} = 3.6\text{ V}$ , $I_{CQ} = 20\text{ mA}$ , $f = 0.5\text{ GHz}$
Power Added Efficiency	PAE	—	70	—	%	$V_{CE} = 3.6\text{ V}$ , $I_{CQ} = 20\text{ mA}$ , $f = 0.5\text{ GHz}$ , $P_{in} = +16\text{ dBm}$

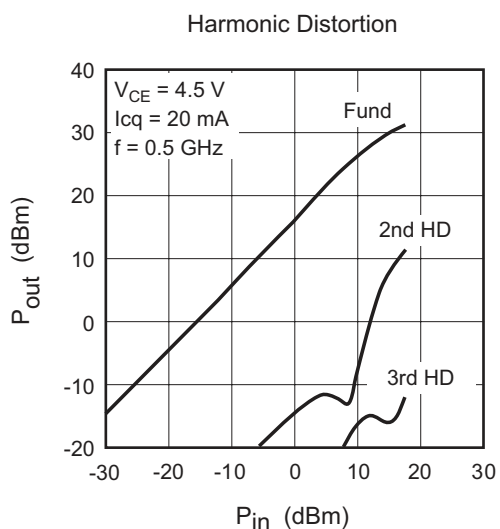
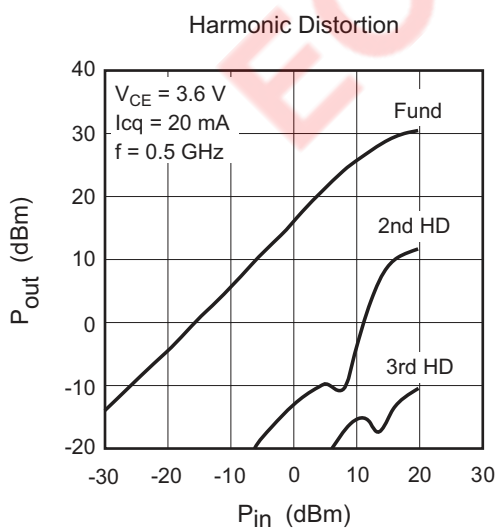
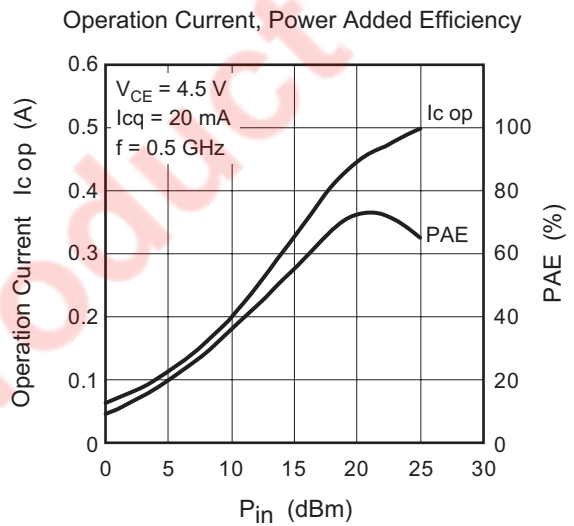
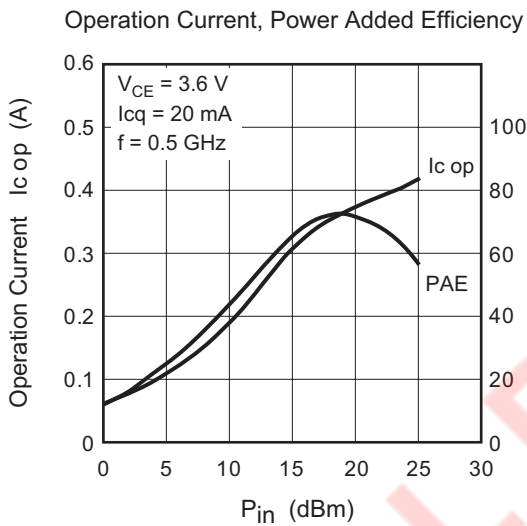
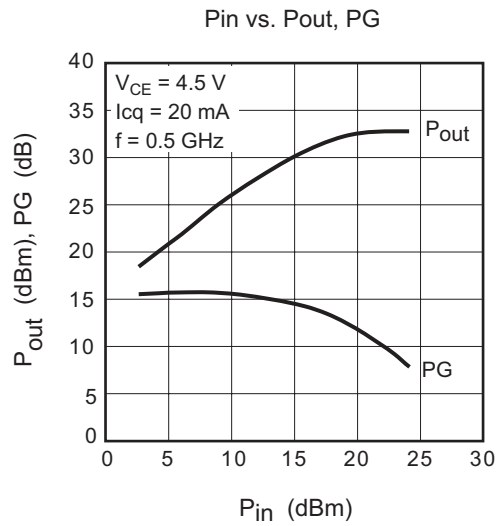
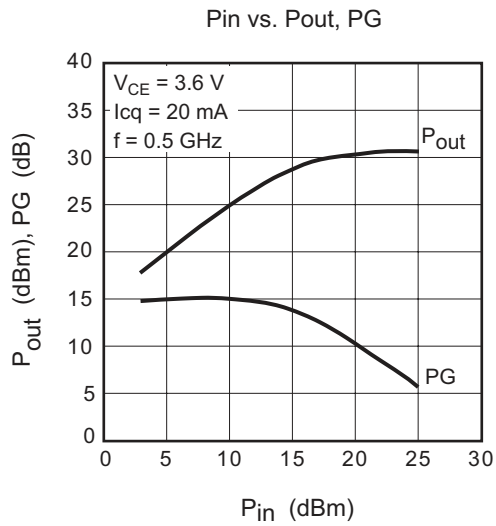
## Main Characteristics

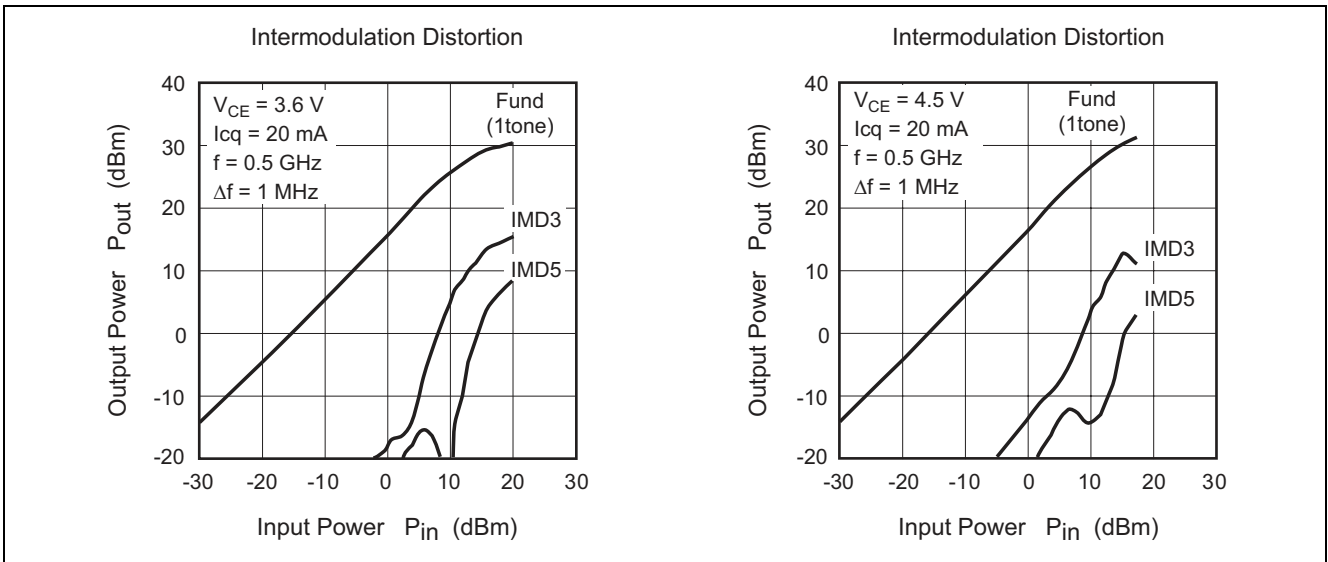




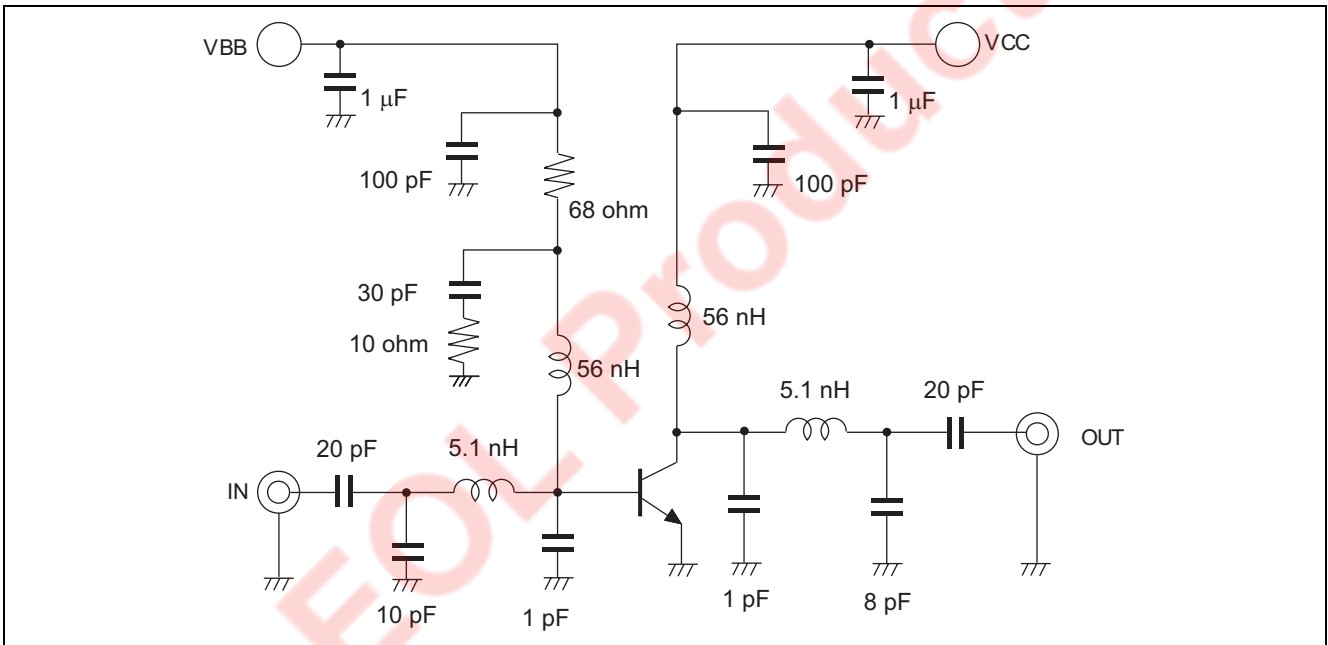
Maximum Available Gain, Maximum Stable Gain vs. Collector Current







**0.5GHz Evaluation Circuit**



## S parameter

(V<sub>CE</sub> = 3.6 V, I<sub>C</sub> = 20 mA, Z<sub>o</sub> = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.643	-108.1	31.06	121.7	0.0292	48.9	0.630	-81.4
200	0.635	-143.5	18.05	101.3	0.0371	41.8	0.469	-115.8
300	0.641	-158.8	12.26	91.2	0.0437	45.4	0.423	-134.7
400	0.645	-168.0	9.17	84.4	0.0500	48.0	0.409	-147.1
500	0.651	-174.7	7.24	79.3	0.0560	49.6	0.404	-155.7
600	0.657	-180.0	5.96	75.0	0.0641	51.3	0.407	-162.6
700	0.662	175.5	5.05	71.2	0.0716	52.4	0.410	-168.4
800	0.667	171.4	4.37	67.9	0.0795	52.6	0.415	-173.4
900	0.672	167.7	3.85	64.8	0.0874	53.2	0.420	-177.7
1000	0.677	164.2	3.43	61.9	0.0949	52.3	0.426	178.2
1100	0.682	161.1	3.10	59.1	0.1024	52.0	0.431	174.7
1200	0.686	158.0	2.83	56.4	0.1100	51.0	0.436	171.2
1300	0.690	155.1	2.60	53.7	0.1176	50.3	0.442	168.1
1400	0.696	152.2	2.41	51.2	0.1251	49.2	0.448	165.1
1500	0.701	149.6	2.24	48.6	0.1322	48.1	0.455	162.2
1600	0.706	147.0	2.09	46.1	0.1391	47.2	0.462	159.6
1700	0.711	144.5	1.97	43.8	0.1457	45.9	0.469	157.1
1800	0.716	142.1	1.85	41.4	0.1527	44.7	0.476	154.7
1900	0.721	139.7	1.75	39.0	0.1592	43.4	0.483	152.4
2000	0.725	137.4	1.66	36.7	0.1653	41.9	0.489	150.1
2100	0.731	135.2	1.58	34.5	0.1714	40.6	0.496	148.0
2200	0.736	133.0	1.51	32.2	0.1771	39.4	0.504	145.9
2300	0.741	130.9	1.44	30.0	0.1831	38.0	0.511	144.0
2400	0.745	128.9	1.38	27.8	0.1884	36.5	0.519	141.9
2500	0.750	126.9	1.33	25.7	0.1940	35.1	0.526	140.0
2600	0.756	125.0	1.28	23.6	0.1995	34.0	0.534	138.1
2700	0.760	123.0	1.23	21.5	0.2043	32.5	0.540	136.3
2800	0.764	121.1	1.18	19.5	0.2083	31.2	0.548	134.5
2900	0.768	119.3	1.14	17.5	0.2130	29.7	0.555	132.8
3000	0.773	117.6	1.11	15.6	0.2172	28.2	0.562	131.2



## S parameter

(V<sub>CE</sub> = 3.6 V, I<sub>C</sub> = 50 mA, Z<sub>o</sub> = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.586	-142.9	38.37	109.9	0.0190	53.1	0.525	-110.1
200	0.616	-163.8	20.35	94.5	0.0276	57.6	0.450	-140.8
300	0.629	-172.9	13.52	86.7	0.0355	61.5	0.441	-154.9
400	0.638	-178.7	10.03	81.3	0.0448	62.6	0.445	-163.4
500	0.645	176.8	7.89	77.1	0.0532	63.9	0.449	-169.9
600	0.650	172.8	6.48	73.6	0.0628	63.6	0.457	-174.8
700	0.656	169.3	5.48	70.4	0.0717	63.0	0.463	-179.2
800	0.661	165.9	4.75	67.5	0.0808	62.2	0.469	176.8
900	0.665	162.8	4.18	64.8	0.0904	61.7	0.475	173.5
1000	0.670	159.8	3.73	62.2	0.0989	59.9	0.481	170.0
1100	0.674	157.0	3.38	59.7	0.1075	58.4	0.487	167.0
1200	0.678	154.2	3.08	57.2	0.1162	56.9	0.492	164.1
1300	0.683	151.7	2.83	54.8	0.1247	55.5	0.498	161.4
1400	0.688	149.1	2.62	52.4	0.1326	53.9	0.504	158.7
1500	0.693	146.6	2.44	50.0	0.1403	52.4	0.510	156.2
1600	0.697	144.2	2.28	47.7	0.1478	50.9	0.516	153.8
1700	0.702	141.9	2.14	45.5	0.1550	49.2	0.523	151.5
1800	0.707	139.6	2.02	43.2	0.1625	47.5	0.529	149.3
1900	0.712	137.4	1.91	41.0	0.1690	46.0	0.535	147.2
2000	0.716	135.2	1.81	38.8	0.1756	44.3	0.541	145.1
2100	0.722	133.1	1.73	36.7	0.1819	42.5	0.548	143.0
2200	0.727	131.1	1.65	34.5	0.1879	41.1	0.555	141.1
2300	0.731	129.1	1.57	32.5	0.1941	39.4	0.561	139.2
2400	0.736	127.1	1.51	30.3	0.1994	37.7	0.567	137.3
2500	0.741	125.2	1.45	28.3	0.2054	36.3	0.574	135.3
2600	0.746	123.4	1.39	26.3	0.2108	34.7	0.580	133.6
2700	0.751	121.5	1.34	24.3	0.2152	33.2	0.586	131.8
2800	0.754	119.7	1.29	22.3	0.2200	31.6	0.593	130.2
2900	0.758	117.9	1.25	20.5	0.2244	30.2	0.600	128.5
3000	0.763	116.3	1.21	18.6	0.2286	28.5	0.606	126.9

## S parameter

 $(V_{CE} = 3.6 \text{ V}, I_C = 100 \text{ mA}, Z_o = 50 \Omega)$ 

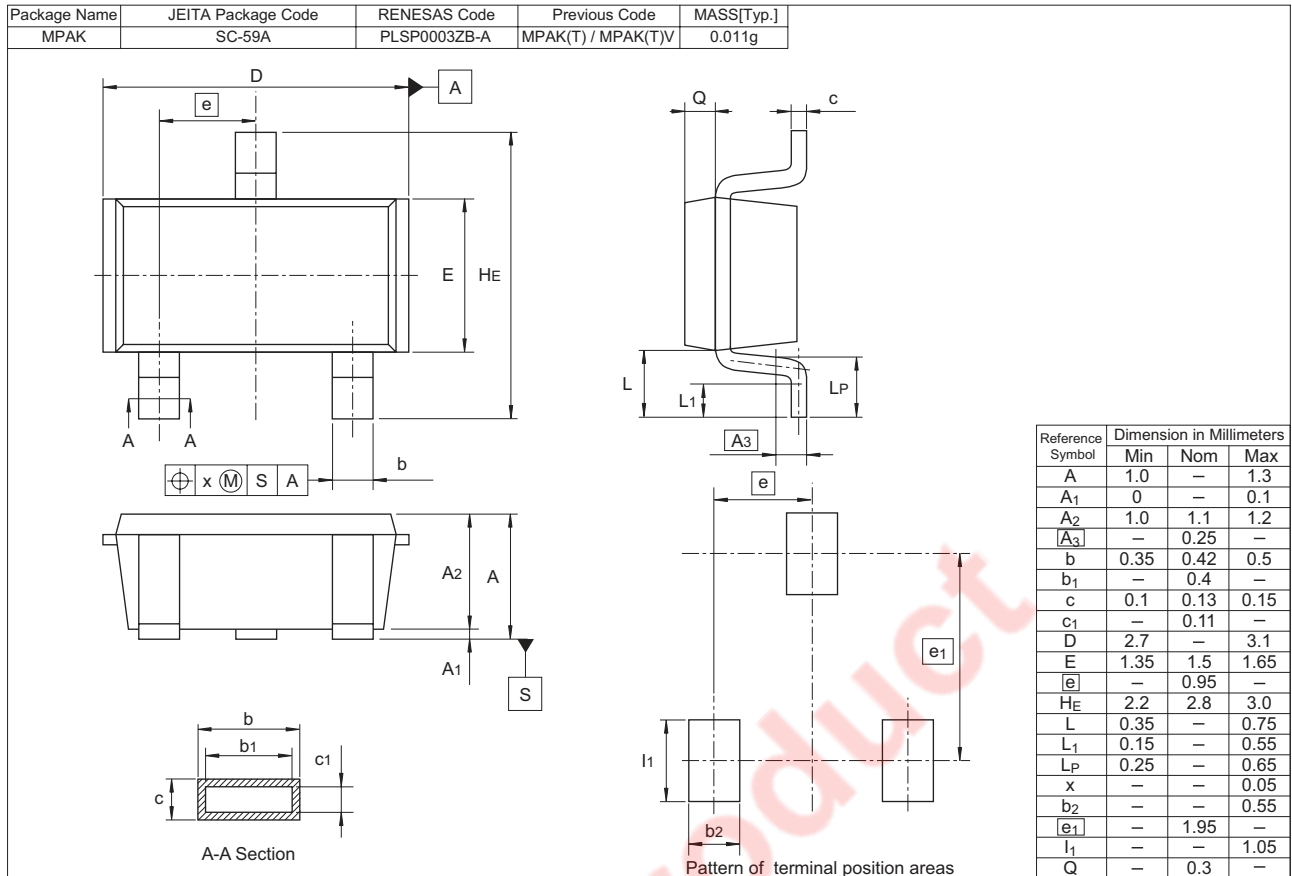
f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.587	-158.5	40.54	105.4	0.0155	56.9	0.499	-123.7
200	0.618	-171.9	20.95	91.8	0.0245	66.6	0.459	-150.4
300	0.631	-178.0	13.81	85.0	0.0342	69.1	0.460	-161.9
400	0.640	177.3	10.20	80.2	0.0433	70.4	0.467	-169.2
500	0.647	173.4	8.02	76.5	0.0532	69.5	0.473	-174.7
600	0.652	170.0	6.58	73.3	0.0630	68.0	0.481	-179.2
700	0.657	166.8	5.58	70.4	0.0728	66.8	0.487	177.0
800	0.662	163.7	4.84	67.7	0.0829	65.5	0.493	173.3
900	0.666	160.8	4.27	65.2	0.0924	64.2	0.498	170.3
1000	0.671	158.0	3.81	62.8	0.1009	62.6	0.504	167.1
1100	0.675	155.4	3.45	60.3	0.1097	60.7	0.510	164.3
1200	0.678	152.7	3.15	58.0	0.1187	58.9	0.515	161.5
1300	0.683	150.2	2.90	55.6	0.1273	57.3	0.520	159.0
1400	0.687	147.8	2.69	53.3	0.1354	55.4	0.526	156.5
1500	0.692	145.4	2.50	50.9	0.1434	53.6	0.531	154.0
1600	0.696	143.1	2.34	48.7	0.1513	52.1	0.538	151.7
1700	0.701	140.8	2.20	46.5	0.1586	50.2	0.543	149.5
1800	0.706	138.6	2.08	44.3	0.1658	48.6	0.549	147.4
1900	0.711	136.4	1.97	42.1	0.1733	46.8	0.555	145.3
2000	0.715	134.3	1.87	39.9	0.1799	45.1	0.561	143.3
2100	0.721	132.2	1.78	37.8	0.1860	43.3	0.567	141.3
2200	0.725	130.2	1.69	35.7	0.1917	41.7	0.574	139.4
2300	0.730	128.2	1.62	33.6	0.1981	40.1	0.580	137.5
2400	0.734	126.3	1.55	31.5	0.2038	38.3	0.586	135.6
2500	0.739	124.4	1.49	29.5	0.2099	36.7	0.592	133.8
2600	0.744	122.6	1.43	27.5	0.2151	35.1	0.599	132.0
2700	0.749	120.8	1.38	25.6	0.2198	33.4	0.605	130.3
2800	0.753	119.0	1.33	23.6	0.2242	31.9	0.611	128.7
2900	0.757	117.2	1.28	21.8	0.2290	30.3	0.617	127.0
3000	0.761	115.5	1.24	19.9	0.2326	28.7	0.623	125.4

## S parameter

 $(V_{CE} = 3.6 \text{ V}, I_C = 200 \text{ mA}, Z_o = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.607	-166.7	39.88	103.2	0.0111	80.5	0.492	-131.3
200	0.631	-176.2	20.31	90.5	0.0231	72.6	0.471	-155.0
300	0.646	178.9	13.30	84.3	0.0332	72.3	0.474	-165.6
400	0.654	175.0	9.81	80.0	0.0443	72.9	0.482	-172.3
500	0.660	171.4	7.72	76.6	0.0536	72.5	0.488	-177.5
600	0.664	168.2	6.35	73.7	0.0633	70.8	0.493	178.3
700	0.668	165.1	5.40	70.9	0.0737	69.1	0.499	174.6
800	0.672	162.2	4.70	68.4	0.0836	67.3	0.504	171.2
900	0.676	159.4	4.15	65.9	0.0934	65.5	0.508	168.2
1000	0.680	156.7	3.72	63.5	0.1022	63.6	0.514	165.2
1100	0.684	154.2	3.37	61.1	0.1111	61.8	0.518	162.5
1200	0.687	151.6	3.09	58.6	0.1201	60.1	0.522	159.9
1300	0.691	149.2	2.84	56.3	0.1292	58.2	0.527	157.5
1400	0.695	146.7	2.64	53.9	0.1372	56.2	0.532	155.1
1500	0.700	144.4	2.46	51.6	0.1452	54.4	0.539	152.8
1600	0.704	142.1	2.30	49.3	0.1529	52.7	0.544	150.5
1700	0.708	139.9	2.17	47.0	0.1599	50.9	0.549	148.3
1800	0.713	137.7	2.05	44.8	0.1679	49.1	0.555	146.2
1900	0.718	135.5	1.94	42.6	0.1748	47.4	0.561	144.2
2000	0.722	133.5	1.84	40.4	0.1815	45.4	0.567	142.3
2100	0.728	131.4	1.75	38.3	0.1880	43.8	0.573	140.3
2200	0.732	129.4	1.67	36.1	0.1941	42.0	0.580	138.4
2300	0.736	127.5	1.60	34.1	0.2001	40.3	0.586	136.6
2400	0.740	125.6	1.53	31.9	0.2059	38.6	0.592	134.7
2500	0.745	123.7	1.47	29.9	0.2117	37.0	0.598	132.9
2600	0.750	121.9	1.42	27.9	0.2166	35.4	0.605	131.2
2700	0.755	120.1	1.36	26.0	0.2217	33.7	0.609	129.4
2800	0.758	118.3	1.32	24.0	0.2262	32.1	0.616	127.8
2900	0.762	116.5	1.27	22.2	0.2314	30.5	0.622	126.1
3000	0.767	114.9	1.23	20.3	0.2348	28.9	0.628	124.5

### Package Dimensions



### Ordering Information

Part Name	Quantity	Shipping Container
2SC5998YC-TL-E	3000 pcs.	φ178 mm Reel, 8 mm Emboss taping

Note: For some grades, production may be terminated. Please contact the Renesas sales office to check the state of production before ordering the product.

**Keep safety first in your circuit designs!**

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

**Notes regarding these materials**

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.  
The information described here may contain technical inaccuracies or typographical errors.  
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.  
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.  
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



**RENESAS SALES OFFICES**

<http://www.renesas.com>

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

**Renesas Technology America, Inc.**

450 Holger Way, San Jose, CA 95134-1368, U.S.A  
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

**Renesas Technology Europe Limited**

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

**Renesas Technology (Shanghai) Co., Ltd.**

Unit 204, 205, AZIAcenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120  
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

**Renesas Technology Hong Kong Ltd.**

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong  
Tel: <852> 2265-6688, Fax: <852> 2730-6071

**Renesas Technology Taiwan Co., Ltd.**

10th Floor, No.99, Fushing North Road, Taipei, Taiwan  
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

**Renesas Technology Singapore Pte. Ltd.**

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

**Renesas Technology Korea Co., Ltd.**

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea  
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

**Renesas Technology Malaysia Sdn. Bhd**

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: <603> 7955-9390, Fax: <603> 7955-9510