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)

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.

NPN SILICON RF TRANSISTOR
2SC5338

NPN SILICON RF TRANSISTOR FOR HIGH-FREQUENCY LOW DISTORTION AMPLIFIER 4-PIN POWER MINIMOLD

FEATURES

- High gain: $|S_{21e}|^2$ = 10 dB TYP. @ V_{CE} = 5 V, I_C = 50 mA, f = 1 GHz
- Low distortion, low voltage: IM_2 = –55 dB TYP., IM_3 = –76 dB TYP. @ V_{CE} = 5 V, I_C = 50 mA, V_{in} = 105 dBμV/75Ω
- 4-pin power minimold package with improved gain from the 2SC4703

★ ORDERING INFORMATION

Part Number	Quantity	Supplying Form
2SC5338	25 pcs (Non reel)	• Magazine case
2SC5338-T1	1 kpcs/reel	• 12 mm wide embossed taping • Collector face the perforation side of the tape

Remark To order evaluation samples, consult your NEC sales representative.
Unit sample quantity is 25 pcs.

ABSOLUTE MAXIMUM RATINGS (T_A = +25°C)

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	V_{CBO}	25	V
Collector to Emitter Voltage	V_{CEO}	12	V
Emitter to Base Voltage	V_{EBO}	2.5	V
Collector Current	I_C	150	mA
Total Power Dissipation	P_{tot} Note	1.8	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

Note Mounted on 16 $cm^2 \times 0.7$ mm (t) ceramic substrate (Copper plating)

Because this product uses high-frequency technology, avoid excessive static electricity, etc.

Document No. P10940EJ2V0DS00 (2nd edition)
Date Published August 2001 NS CP(K)
Printed in Japan

The mark ★ shows major revised points.

ELECTRICAL CHARACTERISTICS (T_A = +25°C)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
DC Characteristics							
Collector Cut-off Current	I_{CBO}	V_{CB} = 20 V, I_E = 0 mA		–	–	1.5	μA
Emitter Cut-off Current	I_{EBO}	V_{BE} = 2 V, I_C = 0 mA		–	–	1.5	μA
DC Current Gain	h_{FE} Note 1	V_{CE} = 5 V, I_C = 50 mA		50	–	250	–
RF Characteristics							
Gain Bandwidth Product	f_T	V_{CE} = 5 V, I_C = 50 mA		–	6.0	–	GHz
Insertion Power Gain	$\lvert S_{21e} \rvert^2$	V_{CE} = 5 V, I_C = 50 mA, f = 1 GHz		8.5	10	–	dB
Noise Figure	NF	V_{CE} = 5 V, I_C = 50 mA, f = 1 GHz		–	–	3.5	dB
Reverse Transfer Capacitance	C_{re} Note 2	V_{CB} = 5 V, I_E = 0 mA, f = 1 MHz		–	1.0	2.0	pF
2nd Order Intermoduration Distortion	IM_2	I_C = 50 mA, V_{in} = 105 dBμV/75 Ω, f = 190 – 90 MHz	V_{CE} = 5 V	–	–55	–	dB
			V_{CE} = 10 V		–63	–	
3rd Order Intermoduration Distortion	IM_3	I_C = 50 mA, V_{in} = 105 dBμV/75 Ω, f = 2 × 190 – 200 MHz	V_{CE} = 5 V	–	–76	–	dB
			V_{CE} = 10 V	–	–83	–	

Notes 1. Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%

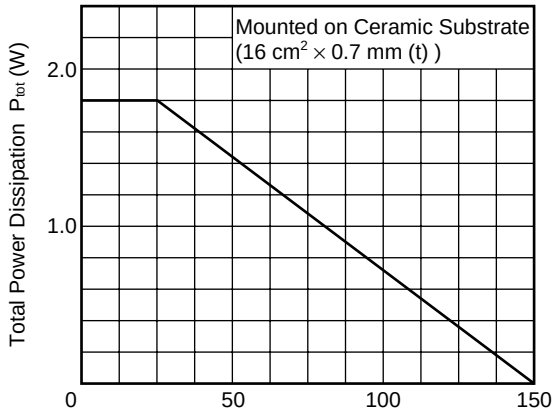
2. Collector to base capacitance when the emitter grounded

h_{FE} CLASSIFICATION

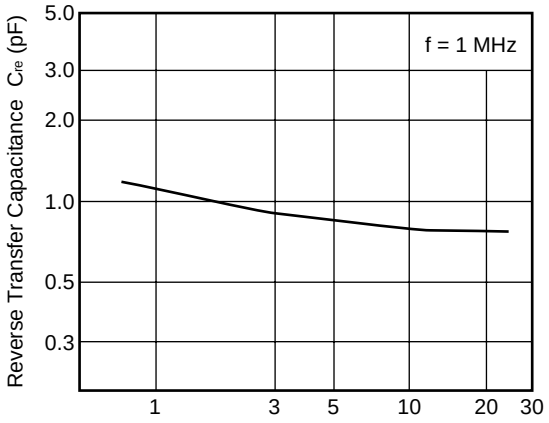
Rank	SH	SF	SE
Marking	SH	SF	SE
h_{FE} Value	50 to 100	80 to 160	125 to 250

★ **TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)**

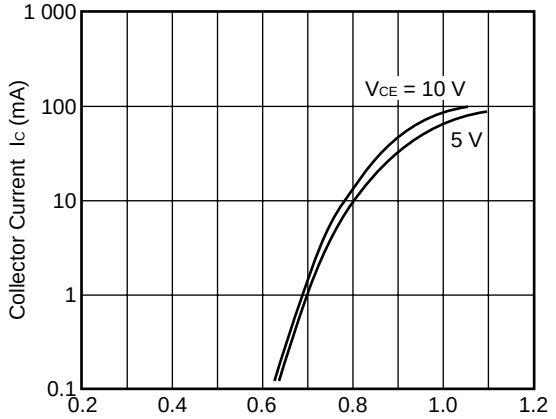
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



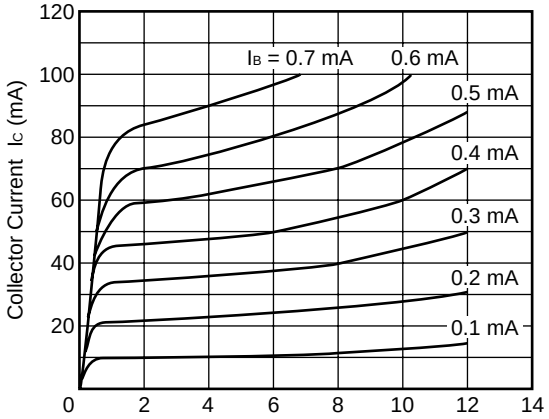
REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



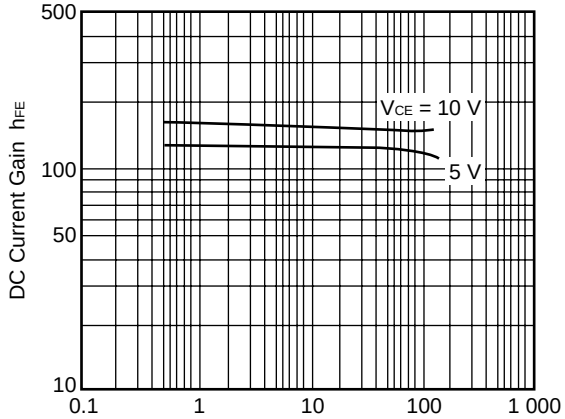
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



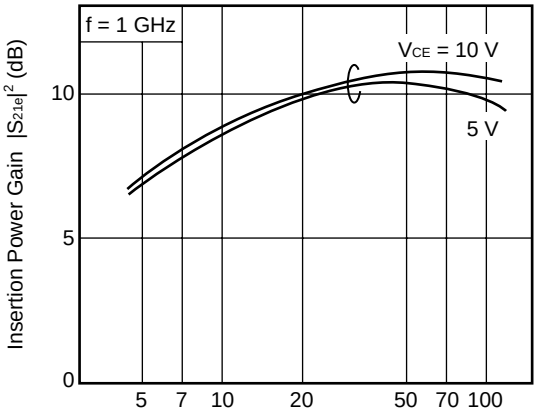
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



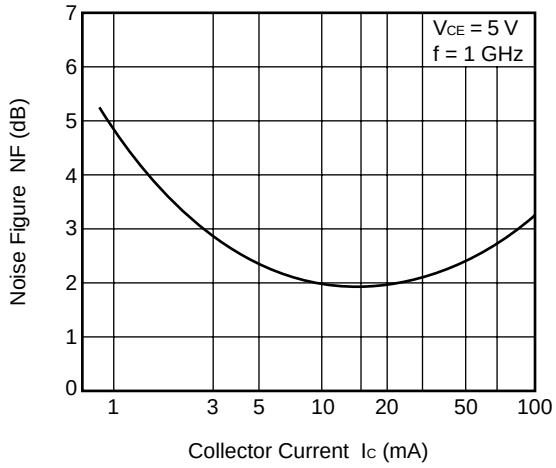
DC CURRENT GAIN vs. COLLECTOR CURRENT



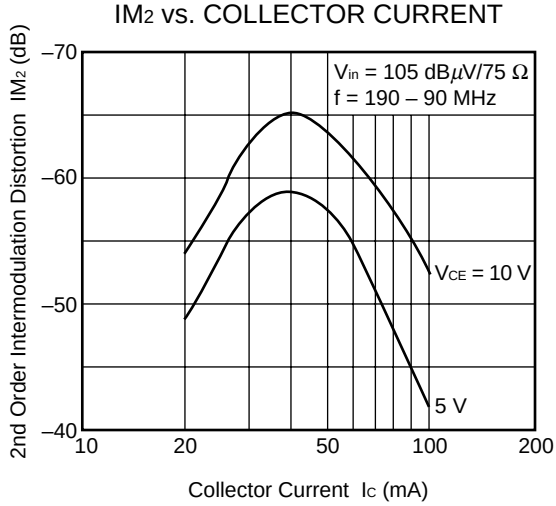
INSERTION POWER GAIN vs. COLLECTOR CURRENT



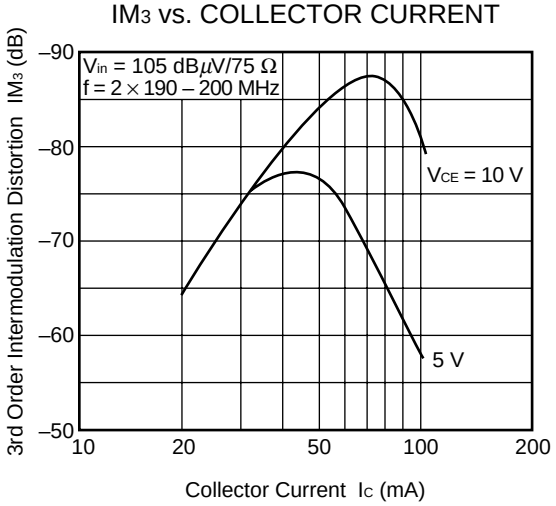
NOISE FIGURE vs.
COLLECTOR CURRENT



IM_2 vs. COLLECTOR CURRENT



IM_3 vs. COLLECTOR CURRENT



Remark The graphs indicate nominal characteristics.

S-PARAMETERS

V_{CE} = 5 V, I_C = 50 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.642	–61.5	19.689	138.5	0.026	64.9	0.603	–39.7
0.2	0.521	–103.0	13.393	116.8	0.045	53.1	0.461	–62.1
0.3	0.464	–123.8	9.708	106.3	0.053	57.8	0.359	–72.8
0.4	0.428	–137.2	7.480	99.5	0.059	62.1	0.304	–75.7
0.5	0.408	–147.7	6.078	94.5	0.072	63.7	0.289	–79.4
0.6	0.390	–154.3	5.104	91.3	0.080	65.9	0.275	–83.2
0.7	0.374	–161.1	4.394	88.6	0.088	66.2	0.277	–82.8
0.8	0.360	–163.9	3.880	86.2	0.097	68.9	0.261	–85.0
0.9	0.348	–168.0	3.527	84.5	0.110	72.1	0.271	–81.6
1.0	0.351	–175.1	3.224	83.3	0.119	72.0	0.268	–79.9
1.1	0.329	–179.9	3.111	81.8	0.125	76.4	0.276	–75.5
1.2	0.328	179.8	3.078	78.9	0.144	73.7	0.321	–75.3
1.3	0.319	171.9	2.914	69.6	0.157	77.8	0.320	–82.4
1.4	0.297	168.9	2.501	66.2	0.166	75.7	0.291	–83.6
1.5	0.307	165.2	2.285	65.3	0.182	77.7	0.325	–83.4
1.6	0.308	159.6	2.115	63.9	0.192	77.7	0.305	–82.7
1.7	0.303	156.6	1.993	62.9	0.201	77.4	0.313	–81.7
1.8	0.309	154.1	1.880	62.0	0.219	75.5	0.327	–83.5
1.9	0.312	150.3	1.786	60.8	0.222	74.9	0.321	–86.3
2.0	0.315	148.4	1.704	59.9	0.242	75.9	0.341	–91.2

V_{CE} = 5 V, I_C = 100 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.647	–73.2	21.091	134.7	0.039	58.3	0.793	–45.3
0.2	0.529	–112.8	13.280	113.6	0.060	53.9	0.561	–71.0
0.3	0.480	–133.5	9.390	103.3	0.072	54.2	0.409	–82.3
0.4	0.459	–146.3	7.213	96.7	0.079	55.6	0.360	–86.1
0.5	0.443	–155.4	5.826	92.0	0.090	58.6	0.333	–90.2
0.6	0.424	–160.9	4.890	89.2	0.102	57.6	0.315	–95.6
0.7	0.406	–166.8	4.206	86.9	0.111	61.4	0.297	–96.0
0.8	0.401	–169.8	3.711	84.3	0.120	64.2	0.292	–95.6
0.9	0.396	–173.9	3.372	82.7	0.135	66.9	0.288	–93.9
1.0	0.391	–178.9	3.093	81.8	0.143	67.0	0.294	–91.3
1.1	0.361	176.3	2.950	80.4	0.157	67.4	0.298	–86.5
1.2	0.366	175.3	2.984	77.2	0.166	67.9	0.338	–86.4
1.3	0.363	167.7	2.788	67.5	0.178	68.5	0.359	–94.6
1.4	0.337	165.3	2.413	64.6	0.192	71.3	0.320	–95.5
1.5	0.352	160.9	2.194	63.4	0.210	70.8	0.322	–96.3
1.6	0.349	157.0	2.017	61.7	0.220	68.8	0.314	–92.3
1.7	0.352	154.7	1.900	60.9	0.236	69.4	0.329	–91.1
1.8	0.353	152.0	1.810	60.3	0.248	69.1	0.339	–93.7
1.9	0.354	147.9	1.730	58.8	0.252	68.8	0.336	–98.1
2.0	0.354	146.6	1.633	57.8	0.261	66.2	0.342	–98.2

V_{CE} = 10 V, I_C = 50 mA

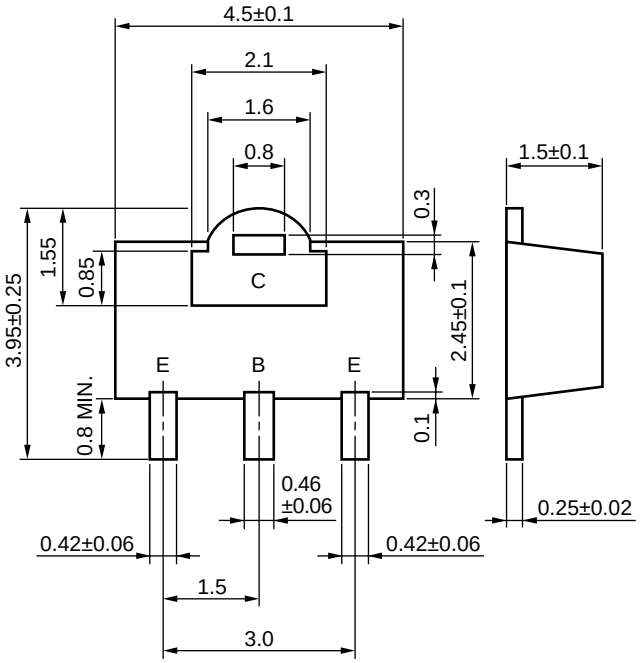
Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.699	–59.3	21.061	140.1	0.037	68.2	0.860	–37.6
0.2	0.540	–97.0	14.088	118.4	0.057	57.8	0.629	–62.0
0.3	0.461	–119.1	10.216	107.1	0.066	55.0	0.464	–72.1
0.4	0.423	–133.2	7.898	99.9	0.076	56.4	0.409	–77.1
0.5	0.403	–144.4	6.431	95.0	0.087	56.6	0.375	–80.6
0.6	0.383	–150.8	5.407	91.8	0.099	58.7	0.363	–86.2
0.7	0.355	–158.1	4.640	89.3	0.110	59.6	0.327	–87.7
0.8	0.338	–161.3	4.093	86.7	0.118	61.4	0.323	–87.8
0.9	0.333	–165.1	3.723	84.9	0.129	63.9	0.310	–86.0
1.0	0.322	–172.7	3.406	84.0	0.137	66.0	0.324	–83.2
1.1	0.303	–177.8	3.245	82.6	0.150	65.6	0.333	–79.9
1.2	0.306	–178.3	3.278	79.5	0.159	66.2	0.371	–80.5
1.3	0.295	171.3	3.074	69.9	0.168	67.6	0.377	–86.5
1.4	0.276	171.0	2.644	67.0	0.180	69.7	0.347	–86.7
1.5	0.283	164.5	2.397	66.2	0.198	70.5	0.363	–88.4
1.6	0.282	159.5	2.208	64.7	0.208	69.1	0.342	–85.6
1.7	0.283	157.3	2.088	64.1	0.220	70.0	0.344	–86.0
1.8	0.287	154.8	1.986	62.6	0.232	70.0	0.366	–87.8
1.9	0.290	150.4	1.886	61.7	0.247	69.4	0.371	–89.3
2.0	0.300	148.7	1.787	60.7	0.254	68.4	0.361	–92.9

V_{CE} = 10 V, I_C = 100 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.651	–64.8	21.694	136.2	0.029	62.4	0.588	–43.4
0.2	0.520	–106.4	14.288	114.6	0.042	53.0	0.435	–62.7
0.3	0.460	–126.5	10.214	104.5	0.051	56.6	0.330	–73.0
0.4	0.420	–140.1	7.822	98.1	0.061	58.4	0.284	–77.1
0.5	0.395	–150.0	6.355	93.2	0.070	65.6	0.270	–78.8
0.6	0.384	–156.3	5.314	90.3	0.077	67.0	0.257	–82.2
0.7	0.367	–162.9	4.569	87.8	0.089	70.9	0.258	–82.1
0.8	0.350	–165.5	4.037	85.6	0.095	71.6	0.241	–82.9
0.9	0.343	–169.3	3.649	83.8	0.106	72.5	0.257	–79.5
1.0	0.339	–177.1	3.353	82.8	0.117	73.9	0.258	–79.3
1.1	0.316	177.9	3.193	81.0	0.125	75.0	0.261	–73.6
1.2	0.315	179.4	3.217	78.4	0.142	75.5	0.311	–72.3
1.3	0.309	170.1	3.026	69.1	0.152	78.1	0.324	–80.4
1.4	0.287	165.6	2.592	65.9	0.164	75.6	0.280	–81.0
1.5	0.303	161.9	2.374	65.2	0.173	80.5	0.308	–82.6
1.6	0.293	157.9	2.179	63.5	0.187	78.1	0.295	–81.4
1.7	0.301	153.7	2.054	62.4	0.200	78.2	0.307	–78.7
1.8	0.303	150.7	1.945	61.4	0.214	75.9	0.313	–82.1
1.9	0.306	148.8	1.840	60.5	0.225	75.4	0.321	–82.8
2.0	0.311	147.2	1.753	59.7	0.240	75.0	0.332	–86.9

★ **PACKAGE DIMENSIONS**

4-PIN POWER MINIMOLD (UNIT: mm)



PIN CONNECTIONS

E : Emitter
C : Collector
B : Base

- **The information in this document is current as of August, 2001. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
- NEC 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 NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
- NEC semiconductor products are classified into the following three quality grades:
  "Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.
  "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
  "Special": 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, life support systems and medical equipment for life support, etc.
  The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.
  (Note)
  (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.
  (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00.4