

NPN EPITAXIAL SILICON TRANSISTOR IN MINI-MOLD PACKAGE  
FOR LOW-NOISE MICROWAVE AMPLIFICATION

FEATURES

- Low Current Consumption and High Gain  
 $|S_{21e}|^2 = 9.0 \text{ dB TYP. @ } V_{CE} = 2 \text{ V, } I_c = 7 \text{ mA, } f = 2 \text{ GHz}$   
 $|S_{21e}|^2 = 8.5 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 5 \text{ mA, } f = 2 \text{ GHz}$
- Mini-Mold package  
 EIAJ: SC-59

ORDERING INFORMATION

PART NUMBER	QUANTITY	ARRANGEMENT
2SC5177-T1	3 000 units/reel	Embossed tape, 8 mm wide, pin No. 3 (collector) facing the perforations
2SC5177-T2	3 000 units/reel	Embossed tape, 8 mm wide, pins No. 1 (emitter) and No. 2 (base) facing the perforations

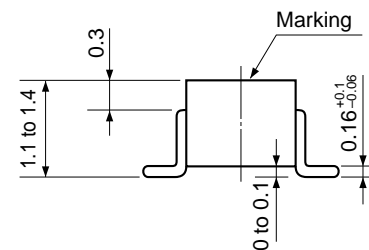
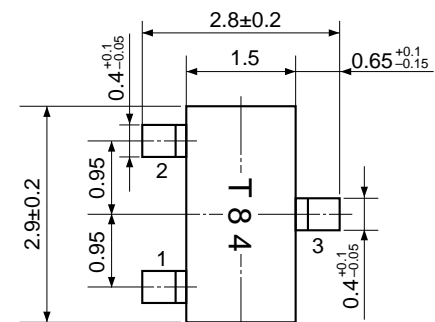
**Remark** Contact your NEC sales representatives to order samples for evaluation (available in batches of 50).

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25 \text{ }^\circ\text{C}$ )

Collector to Base Voltage	$V_{CBO}$	5	V
Collector to Emitter Voltage	$V_{CEO}$	3	V
Emitter to Base Voltage	$V_{EBO}$	2	V
Collector Current	$I_c$	10	mA
Total Power Dissipation	$P_T$	30	mW
Junction Temperature	$T_j$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +150	$^\circ\text{C}$

PACKAGE DIMENSIONS

(Units: mm)



PIN CONNECTIONS

1. Emitter
2. Base
3. Collector

**CAUTION;** This transistor uses high-frequency technology. Be careful not to allow excessive current to flow through the transistor, including static electricity.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	I <sub>CBO</sub>			100	nA	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0
Emitter Cutoff Current	I <sub>EBO</sub>			100	nA	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0
DC Current Gain	h <sub>FE</sub>	70		140		V <sub>CE</sub> = 2 V, I <sub>C</sub> = 7 mA* <sup>1</sup>
Insertion Power Gain (1)	S <sub>21e</sub>   <sup>2</sup>	7.5	9		dB	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 7 mA, f = 2 GHz
Insertion Power Gain (2)	S <sub>21e</sub>   <sup>2</sup>	7	8.5		dB	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz
Noise Figure (1)	NF		1.5	2.0	dB	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.5	2.0	dB	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	f <sub>T</sub>	10	13		GHz	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 7 mA, f = 2 GHz
Gain Bandwidth Product (2)	f <sub>T</sub>	8.5	12		GHz	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz
Feedback Capacitance	C <sub>re</sub>		0.5	0.6	pF	V <sub>CB</sub> = 2 V, I <sub>E</sub> = 0 mA, f = 1 MHz* <sup>2</sup>

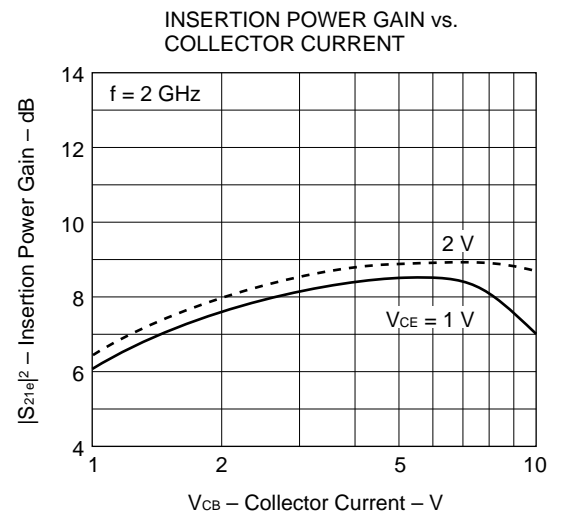
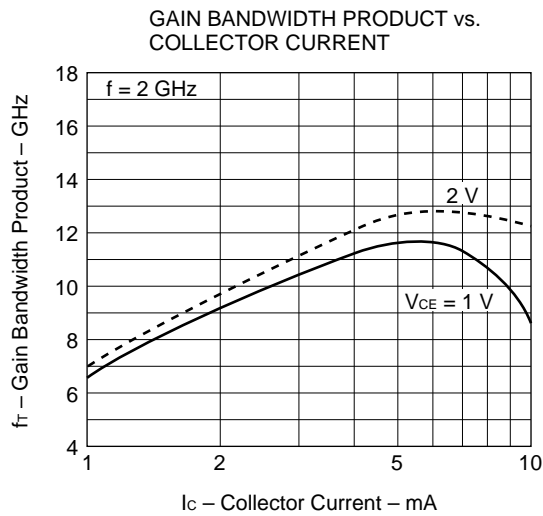
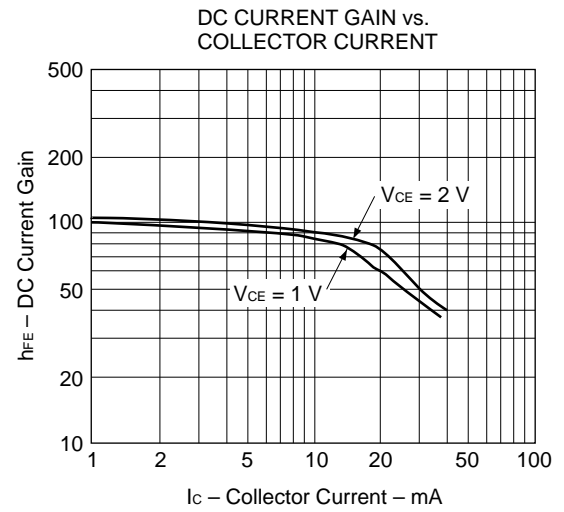
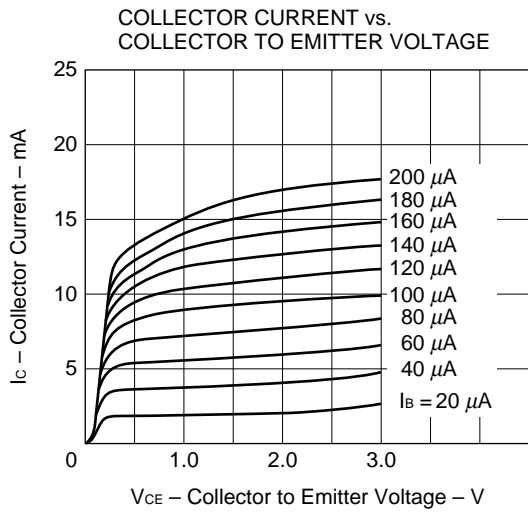
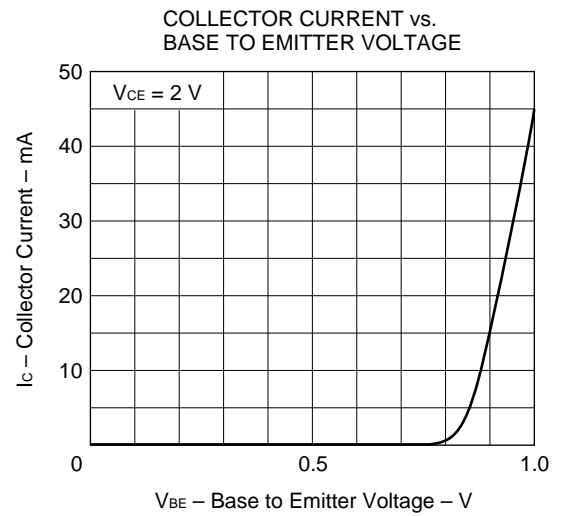
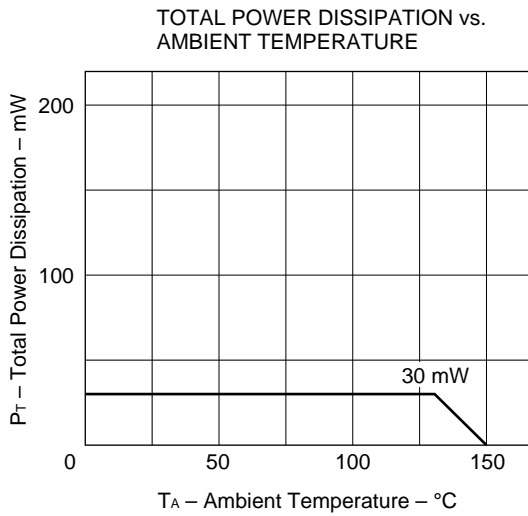
\*1: Measured with pulses: Pulse width ≤ 350 μs, duty cycle ≤ 2 %, pulsed.

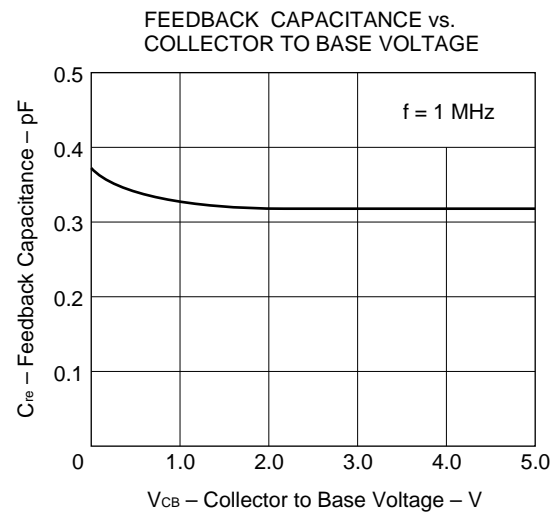
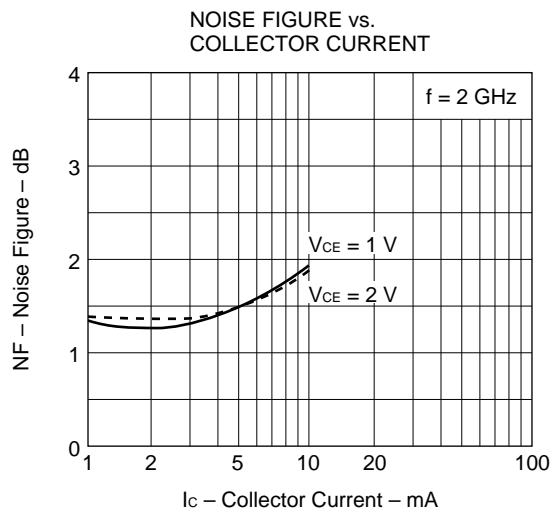
\*2: Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

**h<sub>FE</sub> Class**

Class	FB
Marking	T84
h <sub>FE</sub>	70 to 140

CHARACTERISTICS CURVES (T<sub>A</sub> = 25 °C)





S-PARAMETER

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 1 mA, Z<sub>o</sub> = 50 Ω

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.967	-7.9	2.211	173.0	0.047	87.2	0.999	-6.2
400.00	0.966	-16.2	2.243	165.3	0.085	82.9	1.000	-12.6
600.00	0.954	-24.5	2.306	157.4	0.120	72.1	0.980	-19.4
800.00	0.924	-33.4	2.399	147.7	0.158	65.6	0.962	-27.4
1000.00	0.392	-43.7	2.444	137.3	0.193	59.3	0.929	-34.2
1200.00	0.312	-53.9	2.446	126.1	0.222	52.8	0.890	-41.0
1400.00	0.756	-62.4	2.389	116.2	0.247	47.4	0.822	-48.2
1600.00	0.673	-71.9	2.251	105.6	0.260	42.2	0.753	-52.8
1800.00	0.590	-79.0	2.210	97.2	0.267	37.4	0.688	-59.5
2000.00	0.543	-87.9	2.085	89.2	0.283	36.0	0.645	-63.9
2200.00	0.460	-92.7	1.978	81.7	0.231	32.8	0.596	-67.5
2400.00	0.410	-101.7	1.917	74.6	0.293	30.6	0.548	-71.3
2600.00	0.347	-105.9	1.860	68.4	0.281	28.6	0.518	-74.7
2800.00	0.277	-115.6	1.740	62.4	0.309	29.9	0.475	-76.9
3000.00	0.224	-127.1	1.725	56.4	0.312	26.6	0.465	-80.4

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 3 mA, Z<sub>o</sub> = 50 Ω

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.951	-10.3	3.773	171.8	0.043	85.3	0.993	-8.0
400.00	0.942	-20.9	3.848	163.1	0.081	78.7	0.981	-16.7
600.00	0.918	-32.2	3.961	153.6	0.123	64.6	0.951	-26.1
800.00	0.858	-44.8	4.054	142.0	0.146	58.8	0.904	-35.4
1000.00	0.794	-58.7	4.047	129.6	0.182	54.4	0.844	-45.0
1200.00	0.682	-71.1	3.898	117.2	0.198	49.9	0.762	-52.8
1400.00	0.579	-83.1	3.645	106.5	0.209	44.8	0.672	-59.4
1600.00	0.466	-92.7	3.335	95.7	0.221	43.3	0.586	-63.9
1800.00	0.381	-102.8	3.118	87.5	0.240	41.5	0.518	-69.5
2000.00	0.324	-108.9	2.843	80.0	0.211	41.6	0.471	-70.8
2200.00	0.258	-114.7	2.620	73.4	0.249	40.9	0.426	-72.8
2400.00	0.211	-123.8	2.463	67.3	0.255	40.8	0.398	-73.7
2600.00	0.154	-125.2	2.294	61.9	0.276	39.2	0.367	-75.4
2800.00	0.106	-142.8	2.148	56.8	0.289	41.1	0.336	-77.6
3000.00	0.090	-176.6	2.075	51.3	0.298	36.0	0.313	-79.4

$V_{CE} = 1\text{ V}$ ,  $I_c = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.918	-12.7	5.022	168.4	0.042	89.0	0.977	-10.1
400.00	0.894	-25.1	4.958	156.8	0.086	77.0	0.958	-19.7
600.00	0.839	-38.5	4.883	145.2	0.112	70.4	0.898	-30.0
800.00	0.761	-51.4	4.751	132.9	0.148	59.8	0.831	-39.3
1000.00	0.673	-65.4	4.510	120.6	0.164	54.7	0.746	-48.4
1200.00	0.554	-78.5	4.205	109.2	0.187	46.4	0.668	-55.7
1400.00	0.462	-89.4	3.840	99.5	0.196	45.5	0.585	-61.2
1600.00	0.377	-98.4	3.467	90.0	0.202	48.7	0.507	-64.1
1800.00	0.297	-106.9	3.209	82.7	0.215	46.7	0.457	-67.7
2000.00	0.239	-114.7	2.928	75.9	0.218	42.5	0.418	-69.0
2200.00	0.199	-121.0	2.670	69.9	0.230	47.0	0.383	-71.5
2400.00	0.157	-135.0	2.518	64.1	0.252	45.9	0.354	-72.7
2600.00	0.090	-147.9	2.357	59.5	0.262	41.8	0.310	-73.5
2800.00	0.076	-175.4	2.197	54.3	0.287	42.4	0.288	-79.4
3000.00	0.082	141.5	2.113	49.4	0.312	43.6	0.317	-78.3

$V_{CE} = 1\text{ V}$ ,  $I_c = 7\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.820	-20.3	8.814	155.7	0.042	81.2	0.926	-15.3
400.00	0.698	-37.1	7.520	136.2	0.076	72.4	0.814	-27.1
600.00	0.576	-48.6	6.310	121.8	0.097	64.5	0.699	-34.5
800.00	0.463	-57.4	5.368	109.9	0.120	63.5	0.618	-39.9
1000.00	0.380	-66.0	4.606	100.3	0.135	62.2	0.558	-43.5
1200.00	0.299	-73.4	4.049	92.5	0.160	58.3	0.502	-46.4
1400.00	0.255	-77.0	3.575	85.9	0.185	56.5	0.463	-49.6
1600.00	0.207	-83.0	3.193	79.0	0.195	55.5	0.421	-51.0
1800.00	0.165	-88.7	2.942	74.1	0.220	56.4	0.400	-54.4
2000.00	0.131	-95.4	2.692	68.9	0.230	55.1	0.370	-57.1
2200.00	0.087	-98.6	2.474	64.0	0.248	52.1	0.367	-59.5
2400.00	0.074	-101.7	2.316	59.4	0.264	50.7	0.319	-63.8
2600.00	0.029	-119.5	2.220	54.9	0.287	49.1	0.314	-67.5
2800.00	0.030	155.8	2.061	50.7	0.310	45.8	0.285	-70.4
3000.00	0.070	129.1	2.014	46.9	0.337	44.0	0.303	-72.3

$V_{CE} = 2\text{ V}$ ,  $I_c = 1\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.972	-7.7	2.454	171.2	0.036	77.4	0.993	-6.5
400.00	0.947	-15.5	2.452	162.4	0.079	79.0	0.991	-12.6
600.00	0.937	-23.1	2.454	154.1	0.116	74.3	0.962	-19.1
800.00	0.897	-31.7	2.469	144.6	0.147	65.5	0.936	-25.4
1000.00	0.863	-40.4	2.479	135.1	0.173	60.9	0.913	-32.3
1200.00	0.797	-49.9	2.430	125.2	0.202	55.8	0.871	-38.6
1400.00	0.741	-57.6	2.352	116.2	0.227	50.6	0.811	-43.9
1600.00	0.669	-64.0	2.245	106.6	0.242	47.8	0.751	-49.2
1800.00	0.601	-72.1	2.221	99.1	0.260	45.7	0.713	-53.7
2000.00	0.543	-79.5	2.104	91.6	0.263	41.7	0.664	-37.1
2200.00	0.488	-85.9	1.997	84.4	0.285	36.7	0.631	-62.3
2400.00	0.432	-92.6	1.955	77.4	0.274	35.1	0.577	-67.1
2600.00	0.361	-96.4	1.868	71.6	0.281	34.7	0.553	-68.5
2800.00	0.308	-105.7	1.756	65.8	0.296	34.4	0.528	-70.2
3000.00	0.252	-114.0	1.766	60.0	0.318	31.0	0.507	-74.8

$V_{CE} = 2\text{ V}$ ,  $I_c = 3\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.942	-11.2	4.553	168.8	0.037	77.6	0.990	-8.3
400.00	0.907	-21.4	4.474	157.7	0.068	72.3	0.957	-16.8
600.00	0.866	-31.7	4.378	147.2	0.112	69.4	0.922	-25.2
800.00	0.793	-42.7	4.286	136.1	0.139	61.5	0.863	-33.0
1000.00	0.728	-52.8	4.104	125.0	0.158	58.4	0.805	-40.2
1200.00	0.631	-63.2	3.878	114.6	0.178	54.2	0.737	-47.1
1400.00	0.546	-71.4	3.604	105.4	0.194	52.0	0.673	-42.3
1600.00	0.461	-79.9	3.310	96.3	0.214	48.1	0.597	-55.3
1800.00	0.380	-86.3	3.119	88.7	0.214	46.2	0.537	-60.7
2000.00	0.324	-91.6	2.889	82.2	0.237	45.4	0.518	-62.5
2200.00	0.269	-96.8	2.651	75.7	0.237	45.1	0.481	-65.5
2400.00	0.224	-102.1	2.506	70.0	0.249	44.3	0.435	-67.0
2600.00	0.167	-103.3	2.377	64.6	0.271	42.8	0.398	-70.2
2800.00	0.114	-113.2	2.212	59.6	0.249	40.3	0.382	-71.4
3000.00	0.089	-137.8	2.183	54.2	0.295	37.0	0.367	-71.3

$V_{CE} = 2\text{ V}$ ,  $I_c = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.900	-13.9	6.328	164.5	0.034	76.0	0.971	-10.9
400.00	0.845	-26.5	5.951	150.3	0.071	77.4	0.928	-20.4
600.00	0.755	-38.0	5.522	137.7	0.104	71.5	0.847	-27.9
800.00	0.671	-48.1	5.092	126.0	0.131	60.9	0.786	-36.3
1000.00	0.580	-57.1	4.654	115.2	0.147	58.7	0.707	-42.7
1200.00	0.501	-66.9	4.234	105.6	0.159	55.4	0.644	-46.6
1400.00	0.418	-73.5	3.826	97.8	0.172	55.4	0.575	-51.2
1600.00	0.347	-79.9	3.476	89.9	0.189	54.7	0.528	-53.3
1800.00	0.289	-85.8	3.230	83.5	0.215	52.0	0.488	-57.2
2000.00	0.253	-89.0	2.979	77.9	0.222	50.3	0.438	-61.4
2200.00	0.200	-98.0	2.740	72.1	0.226	51.4	0.432	-59.5
2400.00	0.159	-92.3	2.586	66.7	0.255	48.4	0.393	-63.7
2600.00	0.121	-94.3	2.450	62.0	0.269	44.1	0.365	-64.5
2800.00	0.063	-119.9	2.277	56.8	0.293	45.8	0.345	-67.6
3000.00	0.026	-159.8	2.219	52.6	0.299	43.6	0.345	-69.4

$V_{CE} = 2\text{ V}$ ,  $I_c = 7\text{ mA}$ ,  $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.815	-19.5	9.516	155.6	0.035	78.4	0.934	-14.8
400.00	0.696	-34.3	8.064	136.1	0.064	70.8	0.828	-25.2
600.00	0.575	-44.5	6.741	121.9	0.082	63.5	0.709	-32.0
800.00	0.463	-50.8	5.714	110.5	0.111	63.6	0.641	-36.7
1000.00	0.391	-57.4	4.896	101.2	0.130	63.3	0.576	-39.8
1200.00	0.310	-62.1	4.297	93.6	0.151	61.9	0.524	-42.0
1400.00	0.270	-65.4	3.798	87.3	0.172	61.0	0.487	-43.6
1600.00	0.228	-65.7	3.392	81.0	0.193	59.4	0.464	-46.2
1800.00	0.188	-71.0	3.107	76.1	0.213	56.1	0.435	-48.7
2000.00	0.172	-68.4	2.852	71.0	0.227	56.6	0.415	-52.7
2200.00	0.139	-69.7	2.631	66.8	0.234	54.3	0.400	-52.3
2400.00	0.107	-71.3	2.485	62.0	0.266	52.9	0.365	-58.1
2600.00	0.077	-58.0	2.343	58.0	0.277	50.9	0.368	-59.4
2800.00	0.029	-46.1	2.174	54.0	0.292	50.0	0.327	-64.3
3000.00	0.020	82.9	2.124	50.3	0.315	48.8	0.331	-63.4

[MEMO]

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NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.



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