

**HIGH-FREQUENCY LOW-NOISE AMPLIFIER  
NPN SILICON EPITAXIAL TWIN TRANSISTOR  
(WITH BUILT-IN 6-PIN 2 × 2SC5184) THIN-TYPE SMALL MINI MOLD**

**FEATURES**

- Low noise  
 $NF = 1.3 \text{ dB TYP. @ } V_{CE} = 2 \text{ V, } I_c = 3 \text{ mA, } f = 2 \text{ GHz}$   
 $NF = 1.3 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 3 \text{ mA, } f = 2 \text{ GHz}$
- 6-pin thin-type small mini mold package adopted
- Built-in 2 transistors (2 × 2SC5184)

**ORDERING INFORMATION**

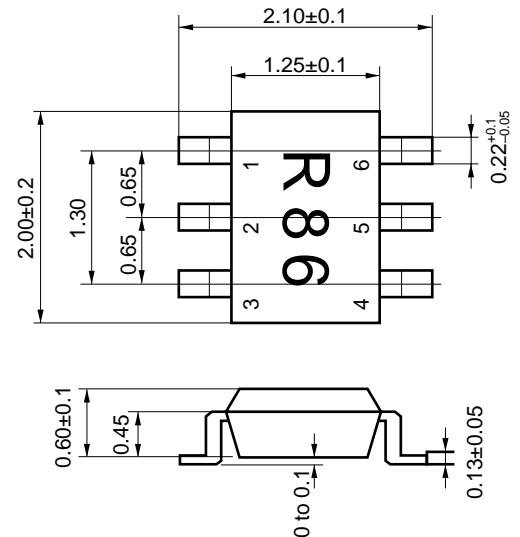
Part Number	Quantity	Packing Style
$\mu$ PA828TF	Loose products (50 pcs)	Embossed tape 8 mm wide. Pin 6 (Q1 Base), Pin 5 (Q2 Emitter), Pin 4 (Q2 Base) face to perforation side of the tape.
$\mu$ PA828TF-T1	Taping products (3 kpcs/reel)	

**Remark** If you require an evaluation sample, please contact an NEC Sales Representative (Unit sample quantity is 50 pcs).

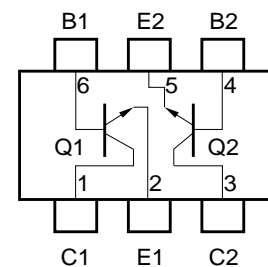
**ABSOLUTE MAXIMUM RATINGS (TA = 25°C)**

Parameter	Symbol	Rating	Unit
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	$I_c$	30	mA
Total Power Dissipation	$P_T$	90 in 1 element 180 in 2 elements	mW
Junction Temperature	$T_j$	150	°C
Storage Temperature	$T_{stg}$	-65 to +150	°C

**PACKAGE DRAWINGS (Unit: mm)**



**PIN CONFIGURATION (Top View)**



**PIN CONNECTIONS**

- |                   |                 |
|-------------------|-----------------|
| 1. Collector (Q1) | 4. Base (Q2)    |
| 2. Emitter (Q1)   | 5. Emitter (Q2) |
| 3. Collector (Q2) | 6. Base (Q1)    |

**Caution is required concerning excess input, such as from static electricity, due to the high-precision fabrication processes used for this device.**

The information in this document is subject to change without notice.

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

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Collector Cutoff Current	I <sub>CBO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0			0.1	μA
Emitter Cutoff Current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0			0.1	μA
DC Current Gain	h <sub>FE</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA <sup>Note 1</sup>	70		140	
Gain Bandwidth Product (1)	f <sub>T</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2 GHz	9	11		GHz
Gain Bandwidth Product (2)	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	7	9		GHz
Feedback Capacitance	C <sub>re</sub>	V <sub>CB</sub> = 2 V, I <sub>E</sub> = 0, f = 1 MHz <sup>Note 2</sup>		0.4	0.8	pF
Insertion Power Gain (1)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2 GHz	7	8.5		dB
Insertion Power Gain (2)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	6	7.5		dB
Noise Figure (1)	NF	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 3 mA, f = 2 GHz		1.3	2	dB
Noise Figure (2)	NF	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2 GHz		1.3	2	dB
h <sub>FE</sub> Ratio	h <sub>FE1</sub> /h <sub>FE2</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA h <sub>FE1</sub> = smaller h <sub>FE</sub> value among Q1 and Q2 h <sub>FE2</sub> = larger h <sub>FE</sub> value among Q1 and Q2	0.85			

**Notes 1.** Pulse measurement P<sub>W</sub> ≤ 350 μs, Duty cycle ≤ 2%

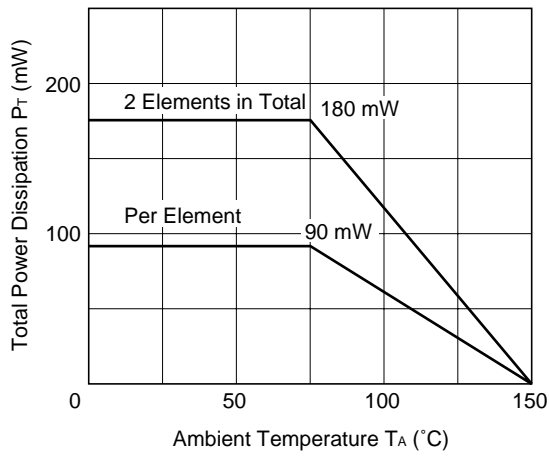
- Capacitance between collector and base measured with a capacitance meter (auto-balancing bridge method). Emitter should be connected to the guard pin of capacitance meter.

**h<sub>FE</sub> CLASSIFICATION**

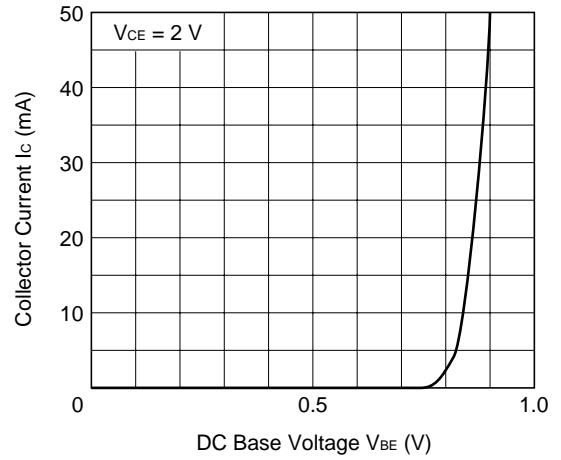
Rank	KB
Marking	R86
h <sub>FE</sub> value	70 to 140

TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ )

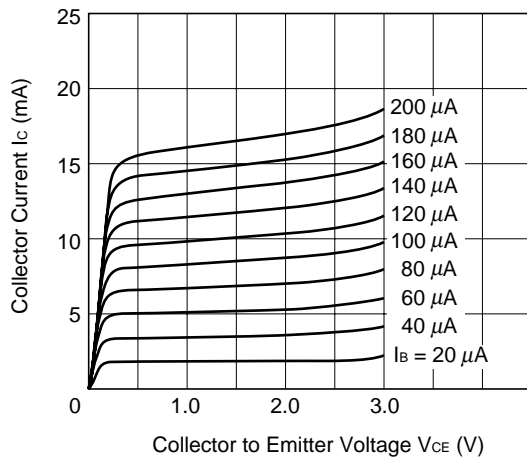
Total Power Dissipation vs. Ambient Temperature



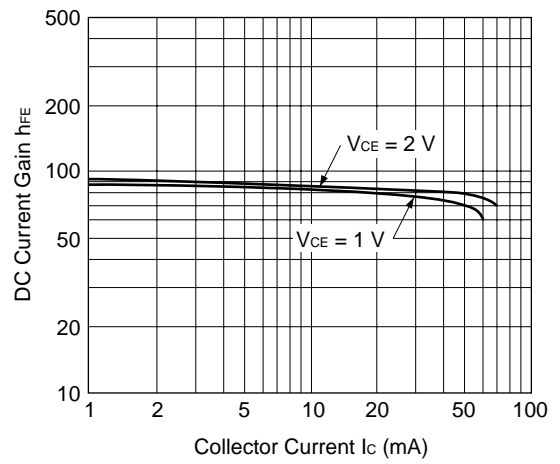
Collector Current vs. DC Base Voltage



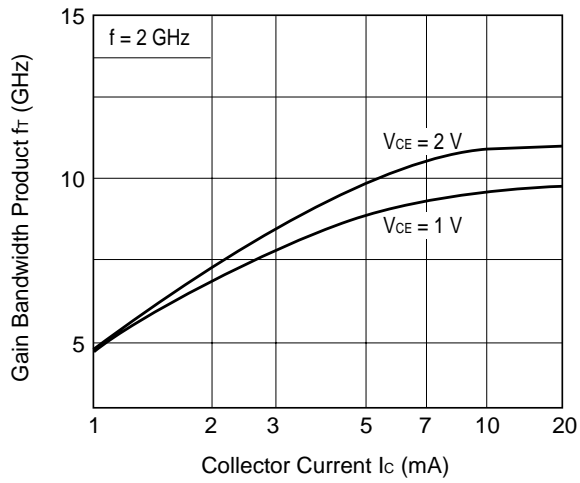
Collector Current vs. Collector to Emitter Voltage



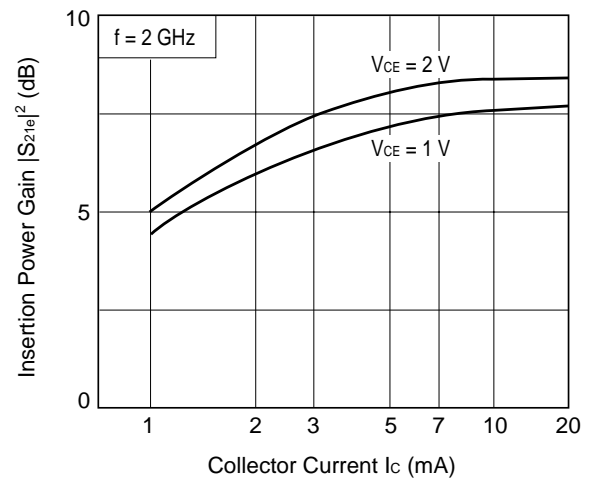
DC Current Gain vs. Collector Current



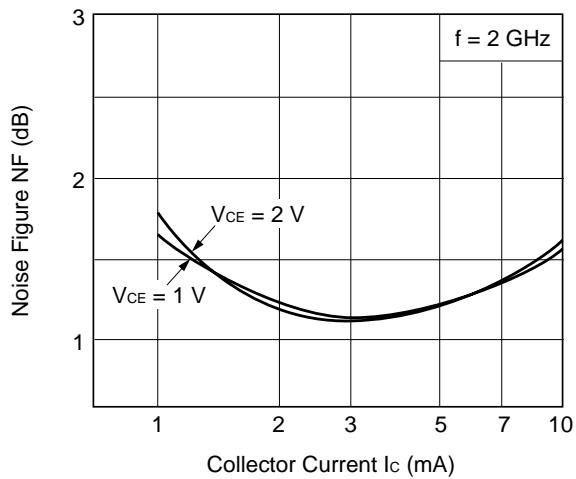
Gain Bandwidth Product vs. Collector Current



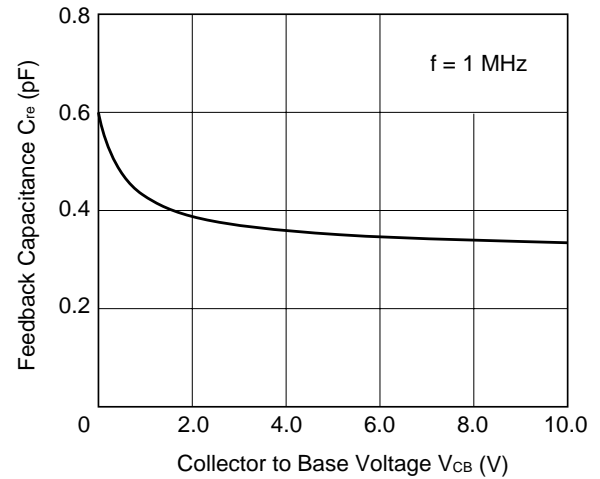
Insertion Power Gain vs. Collector Current



Noise Figure vs. Collector Current



Feedback Capacitance vs. Collector to Base Voltage



**S PARAMETER Q1**

$V_{CE} = 2\text{ V}$ ,  $I_c = 1\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.98	-6.87	2.42	171.77	.02	84.43	.99	-4.42
.20	.96	-13.71	2.40	164.17	.04	79.61	.99	-8.84
.30	.95	-20.79	2.42	157.17	.07	74.54	.97	-12.97
.40	.92	-27.69	2.39	150.27	.09	69.50	.95	-17.23
.50	.90	-34.82	2.39	143.98	.10	65.17	.92	-21.05
.60	.87	-42.10	2.36	138.23	.12	60.29	.90	-25.13
.70	.83	-49.35	2.34	132.19	.14	56.25	.87	-28.47
.80	.80	-56.87	2.32	126.78	.15	52.12	.84	-32.22
.90	.76	-64.78	2.32	120.75	.16	48.48	.81	-34.98
1.00	.72	-72.15	2.26	115.35	.17	45.16	.77	-38.02
1.10	.68	-80.50	2.25	110.20	.18	41.64	.75	-40.84
1.20	.64	-88.71	2.22	104.80	.18	38.79	.72	-43.16
1.30	.60	-97.33	2.16	99.84	.19	35.82	.69	-45.68
1.40	.56	-106.17	2.13	94.75	.19	33.51	.66	-47.79
1.50	.53	-115.63	2.10	89.64	.20	31.12	.63	-49.93
1.60	.50	-124.41	2.04	84.89	.20	29.04	.61	-51.89
1.70	.47	-133.52	1.99	80.39	.20	27.37	.59	-53.75
1.80	.45	-142.93	1.93	75.97	.20	25.64	.57	-55.61
1.90	.44	-152.17	1.87	71.81	.20	24.28	.55	-57.34
2.00	.43	-161.16	1.81	68.21	.20	23.31	.53	-59.13
2.10	.42	-170.55	1.77	63.89	.20	22.18	.51	-60.65
2.20	.41	-179.15	1.72	60.35	.20	21.50	.50	-62.47
2.30	.42	173.21	1.66	56.62	.20	20.78	.48	-64.18
2.40	.42	165.82	1.61	53.39	.20	20.36	.47	-66.09
2.50	.43	158.63	1.57	50.02	.20	20.11	.46	-67.98
2.60	.44	152.11	1.52	47.07	.20	20.00	.45	-69.96
2.70	.45	146.49	1.47	43.96	.20	19.86	.43	-72.10
2.80	.46	140.70	1.43	41.06	.20	20.11	.43	-74.42
2.90	.47	135.62	1.39	38.16	.20	20.18	.42	-76.70
3.00	.48	131.49	1.35	35.61	.20	20.44	.41	-79.07

**S PARAMETER Q1**

$V_{CE} = 2\text{ V}$ ,  $I_c = 3\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.92	-10.76	6.79	166.90	.02	81.64	.97	-8.65
.20	.88	-21.14	6.51	156.23	.04	74.96	.94	-16.65
.30	.83	-31.82	6.40	146.87	.06	68.78	.88	-23.55
.40	.78	-42.04	6.16	138.45	.07	63.27	.82	-29.88
.50	.71	-52.43	5.95	130.70	.09	59.72	.76	-34.56
.60	.65	-62.50	5.66	123.90	.10	55.61	.70	-39.19
.70	.58	-72.69	5.43	116.65	.10	53.36	.65	-42.35
.80	.51	-82.82	5.17	110.41	.11	51.17	.61	-45.67
.90	.45	-92.60	4.88	104.31	.12	49.32	.57	-48.15
1.00	.40	-102.47	4.60	98.90	.12	48.24	.53	-50.32
1.10	.36	-112.48	4.34	94.04	.13	47.06	.50	-52.49
1.20	.32	-122.73	4.09	89.32	.14	46.16	.47	-54.24
1.30	.30	-133.29	3.85	85.28	.14	45.46	.45	-56.10
1.40	.27	-144.06	3.64	81.23	.15	44.88	.43	-57.94
1.50	.26	-155.19	3.45	77.48	.15	44.14	.41	-59.86
1.60	.25	-165.56	3.26	74.10	.16	43.48	.39	-61.58
1.70	.25	-175.58	3.10	70.82	.16	42.97	.37	-63.35
1.80	.26	174.75	2.95	67.58	.17	42.46	.35	-65.35
1.90	.26	166.25	2.82	64.50	.17	41.71	.34	-67.39
2.00	.27	158.59	2.69	61.59	.18	41.41	.32	-69.29
2.10	.28	151.33	2.58	58.69	.19	40.78	.31	-71.31
2.20	.29	145.02	2.47	56.03	.19	40.10	.30	-73.78
2.30	.31	139.72	2.36	53.27	.20	39.55	.29	-76.10
2.40	.32	134.63	2.28	50.82	.20	39.01	.28	-78.86
2.50	.34	130.11	2.20	48.23	.21	38.47	.27	-81.85
2.60	.35	126.08	2.12	45.78	.21	37.90	.26	-84.98
2.70	.37	122.46	2.04	43.24	.22	37.28	.25	-88.17
2.80	.38	119.06	1.97	41.09	.22	36.67	.24	-91.66
2.90	.40	115.90	1.91	38.67	.23	35.90	.23	-95.45
3.00	.41	113.18	1.85	36.49	.23	35.19	.22	-99.22

**S PARAMETER Q1**

$V_{CE} = 2\text{ V}$ ,  $I_c = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.87	-14.09	10.64	163.29	.02	79.93	.95	-11.97
.20	.81	-27.42	9.95	150.51	.04	72.08	.88	-22.31
.30	.73	-40.88	9.52	139.49	.05	66.23	.79	-30.28
.40	.64	-53.67	8.93	129.93	.06	61.90	.71	-36.76
.50	.55	-65.97	8.31	121.13	.07	59.41	.64	-41.09
.60	.48	-77.45	7.63	113.73	.08	57.14	.58	-45.05
.70	.40	-88.32	7.00	106.72	.09	55.84	.53	-47.68
.80	.34	-99.03	6.43	100.97	.10	55.02	.49	-50.09
.90	.30	-109.36	5.89	95.86	.11	54.11	.45	-52.09
1.00	.26	-120.28	5.43	91.26	.11	53.70	.43	-53.78
1.10	.23	-131.28	5.02	87.25	.12	53.10	.40	-55.60
1.20	.21	-143.41	4.67	83.34	.13	52.72	.38	-57.08
1.30	.20	-155.46	4.36	79.89	.13	52.14	.36	-58.90
1.40	.20	-167.22	4.08	76.55	.14	51.70	.34	-60.77
1.50	.20	-178.69	3.84	73.31	.15	50.94	.32	-62.84
1.60	.20	171.39	3.62	70.48	.15	50.53	.31	-64.74
1.70	.21	162.38	3.42	67.63	.16	49.64	.30	-66.88
1.80	.22	154.33	3.24	64.82	.17	48.93	.28	-69.18
1.90	.23	147.57	3.08	62.01	.18	48.25	.27	-71.53
2.00	.25	141.55	2.93	59.55	.18	47.47	.26	-74.05
2.10	.26	136.15	2.81	57.06	.19	46.67	.25	-76.68
2.20	.28	131.40	2.69	54.66	.20	45.88	.24	-80.23
2.30	.29	127.31	2.58	52.10	.20	44.80	.23	-83.11
2.40	.31	123.63	2.48	49.88	.21	44.22	.22	-86.87
2.50	.32	120.25	2.38	47.59	.22	43.28	.21	-90.62
2.60	.34	117.23	2.29	45.27	.22	42.22	.20	-94.98
2.70	.36	114.23	2.21	42.96	.23	41.37	.19	-99.37
2.80	.37	111.67	2.13	40.88	.23	40.49	.19	-104.32
2.90	.39	109.21	2.07	38.78	.24	39.37	.18	-109.07
3.00	.40	107.18	1.99	36.87	.25	38.39	.18	-114.10

**S PARAMETER Q1**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 7 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.82	-17.05	14.01	160.40	.02	78.68	.92	-14.71
.20	.74	-33.00	12.83	146.00	.04	70.70	.83	-26.46
.30	.63	-48.73	11.93	133.68	.05	65.62	.72	-34.67
.40	.53	-63.25	10.85	123.20	.06	62.00	.63	-40.72
.50	.44	-76.15	9.73	114.26	.07	60.73	.56	-44.46
.60	.36	-87.70	8.66	107.33	.08	59.44	.50	-47.65
.70	.30	-98.68	7.74	101.13	.08	58.70	.46	-49.83
.80	.26	-109.94	6.98	96.02	.09	58.45	.42	-51.77
.90	.22	-121.35	6.33	91.57	.10	58.02	.39	-53.47
1.00	.20	-133.61	5.79	87.48	.11	57.58	.37	-54.96
1.10	.18	-146.14	5.31	83.89	.12	57.18	.35	-56.63
1.20	.17	-159.26	4.92	80.50	.12	56.65	.33	-58.16
1.30	.17	-171.86	4.58	77.32	.13	55.98	.31	-59.87
1.40	.17	176.63	4.27	74.26	.14	55.31	.30	-61.97
1.50	.18	166.28	4.01	71.38	.15	54.65	.28	-64.19
1.60	.19	157.38	3.77	68.66	.15	53.86	.27	-66.38
1.70	.20	149.88	3.56	66.07	.16	53.13	.26	-68.92
1.80	.21	143.24	3.38	63.48	.17	52.19	.25	-71.37
1.90	.23	137.70	3.21	60.92	.18	51.24	.24	-74.34
2.00	.24	132.73	3.06	58.46	.18	50.37	.23	-77.26
2.10	.26	128.44	2.92	56.09	.19	49.52	.22	-80.38
2.20	.27	124.40	2.79	53.79	.20	48.39	.21	-84.26
2.30	.29	121.31	2.67	51.50	.21	47.37	.20	-88.09
2.40	.30	118.20	2.57	49.41	.21	46.22	.19	-92.30
2.50	.32	115.34	2.47	47.18	.22	45.21	.18	-97.03
2.60	.34	112.78	2.38	45.18	.23	44.15	.18	-101.80
2.70	.35	110.25	2.29	42.82	.23	43.16	.17	-107.33
2.80	.37	108.03	2.21	40.87	.24	42.05	.17	-112.84
2.90	.38	105.94	2.14	38.86	.25	40.88	.17	-118.72
3.00	.39	104.18	2.06	36.86	.25	39.80	.16	-124.46



**S PARAMETER Q1**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 10 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.75	-21.25	18.39	156.90	.02	77.20	.89	-17.80
.20	.64	-40.55	16.34	140.45	.03	69.69	.77	-30.80
.30	.51	-58.49	14.49	126.78	.04	65.76	.65	-38.64
.40	.41	-73.72	12.55	116.10	.05	64.03	.56	-43.82
.50	.32	-86.53	10.81	107.94	.06	63.08	.49	-46.87
.60	.26	-98.65	9.39	101.73	.07	62.52	.44	-49.28
.70	.22	-110.38	8.27	96.47	.08	62.35	.40	-50.98
.80	.19	-122.98	7.38	92.04	.09	62.04	.37	-52.53
.90	.16	-136.32	6.63	88.10	.10	61.54	.34	-53.99
1.00	.15	-150.20	6.04	84.48	.10	61.35	.32	-55.48
1.10	.14	-164.12	5.53	81.17	.11	60.66	.30	-57.10
1.20	.14	-177.47	5.10	78.09	.12	59.95	.29	-58.71
1.30	.15	170.71	4.73	75.15	.13	59.15	.27	-60.60
1.40	.16	160.52	4.41	72.39	.14	58.38	.26	-62.90
1.50	.17	152.02	4.13	69.70	.15	57.49	.25	-65.42
1.60	.18	144.85	3.88	67.17	.16	56.48	.24	-68.02
1.70	.20	138.84	3.67	64.75	.16	55.54	.23	-70.84
1.80	.21	133.45	3.47	62.20	.17	54.52	.22	-74.09
1.90	.23	129.28	3.29	59.90	.18	53.48	.21	-77.36
2.00	.24	125.28	3.13	57.58	.19	52.37	.20	-80.75
2.10	.26	121.80	2.99	55.23	.20	51.30	.19	-84.72
2.20	.27	118.50	2.85	53.15	.20	50.15	.18	-89.55
2.30	.28	116.06	2.73	50.91	.21	48.75	.18	-94.27
2.40	.30	113.97	2.63	49.04	.22	47.87	.17	-99.35
2.50	.32	111.91	2.53	46.95	.22	46.88	.16	-104.52
2.60	.33	109.85	2.43	45.01	.23	45.56	.16	-110.37
2.70	.35	107.73	2.35	42.94	.24	44.64	.15	-116.16
2.80	.36	105.72	2.26	40.96	.25	43.33	.15	-122.09
2.90	.38	103.86	2.19	38.82	.25	42.06	.15	-128.50
3.00	.39	102.41	2.12	36.99	.26	40.73	.15	-134.83

**S PARAMETER Q1**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 20 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.56	-32.81	27.95	148.87	.02	75.30	.81	-23.54
.20	.42	-58.87	22.23	128.52	.03	70.35	.64	-37.09
.30	.30	-78.37	17.58	115.09	.04	68.59	.51	-43.16
.40	.23	-94.58	14.16	106.19	.05	68.35	.43	-46.08
.50	.18	-109.66	11.73	99.79	.06	68.61	.38	-47.60
.60	.15	-124.96	9.97	94.85	.07	68.48	.34	-48.85
.70	.13	-140.67	8.66	90.57	.08	68.04	.31	-49.86
.80	.12	-156.60	7.65	86.95	.08	67.57	.29	-51.00
.90	.12	-171.52	6.85	83.61	.09	66.89	.27	-52.09
1.00	.13	175.13	6.20	80.43	.10	66.27	.26	-53.64
1.10	.13	163.97	5.66	77.71	.11	65.45	.25	-55.27
1.20	.15	154.42	5.21	74.78	.12	64.40	.24	-57.12
1.30	.16	147.03	4.83	72.31	.13	63.42	.23	-59.41
1.40	.17	140.47	4.49	69.76	.14	62.32	.22	-62.02
1.50	.19	135.04	4.20	67.22	.15	61.17	.21	-65.08
1.60	.20	130.59	3.95	64.99	.16	59.98	.20	-68.14
1.70	.21	126.81	3.73	62.80	.17	58.57	.19	-71.65
1.80	.23	123.18	3.52	60.44	.17	57.56	.18	-75.39
1.90	.24	120.21	3.34	58.24	.18	56.02	.17	-79.66
2.00	.26	117.40	3.17	55.90	.19	55.05	.17	-83.64
2.10	.27	114.82	3.03	53.92	.20	53.52	.16	-88.38
2.20	.28	112.46	2.89	51.91	.21	52.23	.15	-94.64
2.30	.30	110.58	2.77	49.69	.21	50.93	.15	-100.20
2.40	.31	108.94	2.66	47.74	.22	49.90	.14	-106.66
2.50	.33	107.46	2.55	46.23	.23	48.66	.14	-112.73
2.60	.34	105.83	2.46	44.04	.24	47.36	.14	-119.23
2.70	.36	104.14	2.38	42.09	.24	46.17	.14	-126.19
2.80	.37	102.49	2.29	39.95	.25	44.61	.14	-132.72
2.90	.39	100.92	2.22	38.17	.26	43.48	.14	-139.72
3.00	.40	99.59	2.14	36.41	.27	42.04	.14	-146.05

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 1 mA, Z<sub>0</sub> = 50  $\Omega$

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.98	-6.74	2.44	171.33	.02	84.61	.99	-4.39
.20	.96	-13.51	2.41	163.49	.04	79.80	.98	-8.74
.30	.94	-20.37	2.43	156.32	.06	74.82	.96	-12.93
.40	.92	-27.07	2.39	149.41	.08	69.91	.94	-17.05
.50	.89	-33.96	2.39	143.02	.10	65.85	.91	-20.67
.60	.86	-40.84	2.37	137.27	.12	61.45	.88	-24.51
.70	.83	-47.75	2.34	131.22	.13	57.88	.85	-27.55
.80	.80	-54.58	2.32	125.82	.14	54.28	.81	-30.99
.90	.76	-61.78	2.31	119.93	.15	51.24	.78	-33.61
1.00	.72	-68.15	2.25	114.65	.16	48.38	.74	-36.17
1.10	.68	-75.40	2.24	109.63	.17	45.66	.71	-38.83
1.20	.64	-82.34	2.20	104.41	.18	43.56	.68	-40.86
1.30	.61	-89.46	2.15	99.72	.18	41.47	.65	-43.15
1.40	.57	-96.54	2.12	94.60	.19	39.81	.62	-45.20
1.50	.54	-103.94	2.09	90.06	.19	38.22	.60	-47.35
1.60	.51	-110.51	2.04	85.69	.20	36.90	.57	-49.18
1.70	.48	-117.50	1.98	81.41	.20	35.84	.54	-51.11
1.80	.46	-124.73	1.94	77.28	.20	34.52	.52	-53.17
1.90	.44	-131.81	1.89	73.42	.20	34.12	.50	-54.98
2.00	.43	-138.81	1.84	69.85	.21	33.47	.48	-57.05
2.10	.41	-145.59	1.81	65.84	.21	33.15	.46	-58.98
2.20	.40	-152.38	1.76	62.18	.21	32.61	.44	-61.35
2.30	.40	-158.62	1.71	58.78	.21	32.49	.42	-63.57
2.40	.39	-164.92	1.67	55.63	.22	32.58	.40	-66.15
2.50	.39	-171.15	1.64	52.42	.22	32.53	.38	-68.86
2.60	.39	-176.91	1.60	49.27	.22	32.66	.36	-71.68
2.70	.40	177.60	1.56	46.17	.23	32.73	.35	-74.91
2.80	.40	172.40	1.53	43.05	.23	32.98	.33	-78.55
2.90	.40	167.39	1.49	40.32	.23	33.06	.31	-82.01
3.00	.41	163.33	1.45	37.62	.24	33.20	.30	-86.04

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 3 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.92	-10.47	6.76	165.93	.02	82.05	.97	-8.45
.20	.88	-20.49	6.45	154.91	.04	75.09	.93	-16.14
.30	.83	-30.63	6.30	145.29	.06	70.11	.86	-22.48
.40	.77	-40.22	6.03	136.75	.07	65.40	.80	-27.91
.50	.70	-49.54	5.79	128.87	.08	62.38	.73	-31.76
.60	.64	-58.45	5.49	121.94	.09	59.22	.68	-35.44
.70	.57	-66.75	5.22	114.90	.10	57.58	.62	-37.62
.80	.51	-74.87	4.94	108.77	.11	56.19	.58	-39.97
.90	.46	-82.13	4.64	102.99	.12	54.96	.54	-41.46
1.00	.41	-89.08	4.36	97.91	.13	54.27	.50	-42.75
1.10	.37	-95.99	4.10	93.32	.13	53.56	.47	-44.04
1.20	.34	-102.50	3.87	88.99	.14	53.02	.44	-44.99
1.30	.31	-109.65	3.65	85.09	.15	52.49	.42	-45.98
1.40	.29	-116.40	3.45	81.35	.16	51.99	.39	-47.12
1.50	.27	-123.57	3.28	77.89	.16	51.26	.37	-48.16
1.60	.25	-130.78	3.12	74.56	.17	50.83	.35	-49.18
1.70	.24	-137.88	2.97	71.50	.18	50.47	.33	-50.34
1.80	.24	-145.39	2.84	68.40	.19	49.91	.31	-51.49
1.90	.23	-152.42	2.72	65.48	.20	49.22	.29	-52.79
2.00	.23	-159.55	2.61	62.61	.20	48.79	.28	-54.18
2.10	.23	-166.12	2.52	59.74	.21	47.95	.26	-55.52
2.20	.23	-172.60	2.42	57.16	.22	47.35	.24	-57.44
2.30	.24	-178.44	2.34	54.38	.23	46.58	.22	-59.36
2.40	.25	175.70	2.26	51.87	.24	45.96	.21	-61.25
2.50	.26	170.52	2.19	49.35	.24	45.28	.19	-64.05
2.60	.27	165.72	2.12	46.80	.25	44.33	.17	-66.72
2.70	.28	161.24	2.06	44.31	.26	43.50	.16	-70.25
2.80	.29	157.30	2.00	41.90	.27	42.65	.14	-74.78
2.90	.30	153.21	1.95	39.57	.28	41.59	.12	-80.10
3.00	.31	150.49	1.89	37.22	.29	40.55	.11	-86.71

**S PARAMETER Q2**

$V_{CE} = 2\text{ V}$ ,  $I_c = 5\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.87	-13.54	10.54	162.00	.02	80.48	.94	-11.69
.20	.80	-26.19	9.77	148.74	.04	73.48	.87	-21.26
.30	.72	-38.63	9.27	137.38	.05	68.44	.77	-27.99
.40	.63	-49.88	8.60	127.63	.06	65.14	.69	-32.99
.50	.54	-59.78	7.92	118.86	.07	63.41	.62	-35.87
.60	.47	-68.54	7.20	111.69	.08	61.89	.56	-38.30
.70	.41	-75.97	6.55	105.17	.09	61.08	.51	-39.59
.80	.35	-82.95	5.99	99.70	.10	60.63	.47	-40.79
.90	.31	-89.34	5.47	94.96	.11	60.13	.44	-41.55
1.00	.28	-95.57	5.05	90.71	.12	59.77	.41	-42.06
1.10	.25	-102.01	4.67	86.94	.13	59.22	.38	-42.76
1.20	.23	-108.52	4.35	83.30	.14	58.88	.36	-43.16
1.30	.21	-115.80	4.07	80.07	.15	58.01	.34	-43.71
1.40	.20	-122.99	3.82	76.85	.16	57.68	.32	-44.42
1.50	.18	-130.79	3.60	73.93	.16	56.83	.30	-45.15
1.60	.18	-138.76	3.41	71.07	.17	56.28	.28	-45.88
1.70	.17	-146.39	3.24	68.27	.18	55.32	.27	-46.69
1.80	.17	-154.38	3.09	65.56	.19	54.45	.25	-47.67
1.90	.18	-161.58	2.95	63.00	.20	53.52	.23	-48.82
2.00	.18	-168.80	2.83	60.37	.21	52.64	.21	-49.56
2.10	.18	-175.19	2.72	57.83	.22	51.72	.20	-51.08
2.20	.19	178.38	2.61	55.48	.23	50.71	.18	-52.53
2.30	.20	173.15	2.51	53.00	.24	49.69	.17	-53.99
2.40	.21	168.10	2.42	50.71	.25	48.71	.15	-55.88
2.50	.22	163.35	2.35	48.33	.26	47.65	.13	-58.20
2.60	.24	159.17	2.27	45.94	.26	46.48	.12	-60.77
2.70	.25	155.13	2.20	43.64	.27	45.46	.10	-63.87
2.80	.26	151.66	2.13	41.53	.28	44.18	.08	-69.81
2.90	.28	148.18	2.08	36.18	.29	42.92	.07	-75.78
3.00	.29	145.87	2.02	37.27	.30	41.79	.05	-87.46

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 7 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.82	-16.31	13.83	158.85	.02	80.20	.92	-14.08
.20	.73	-31.08	12.52	143.87	.04	72.60	.81	-24.73
.30	.62	-44.88	11.48	131.26	.05	68.63	.70	-31.03
.40	.52	-56.37	10.28	120.77	.06	66.33	.61	-35.17
.50	.43	-65.51	9.08	112.24	.07	65.41	.55	-37.29
.60	.37	-73.22	8.02	105.64	.08	64.65	.49	-38.81
.70	.31	-79.68	7.15	99.96	.09	64.16	.45	-39.42
.80	.27	-85.85	6.43	95.22	.10	63.84	.41	-39.69
.90	.24	-91.96	5.83	91.06	.11	63.27	.38	-40.33
1.00	.21	-97.97	5.33	87.23	.12	63.10	.36	-40.45
1.10	.19	-104.32	4.91	83.95	.13	62.37	.34	-40.77
1.20	.17	-111.26	4.56	80.63	.14	61.78	.32	-40.91
1.30	.16	-119.09	4.25	77.69	.15	60.94	.30	-41.30
1.40	.15	-126.82	3.98	74.75	.16	60.35	.28	-41.80
1.50	.14	-135.36	3.75	71.91	.17	59.27	.27	-42.41
1.60	.14	-143.98	3.54	69.32	.18	58.46	.25	-43.05
1.70	.14	-152.02	3.36	66.71	.19	57.56	.23	-43.89
1.80	.14	-160.48	3.20	64.28	.20	56.54	.22	-44.59
1.90	.15	-167.52	3.06	61.81	.20	55.40	.20	-45.49
2.00	.16	-174.81	2.93	59.35	.21	54.51	.19	-46.25
2.10	.16	179.19	2.80	57.01	.22	53.36	.17	-47.28
2.20	.17	173.23	2.69	54.64	.23	52.09	.15	-48.52
2.30	.19	168.26	2.59	52.26	.24	50.84	.14	-49.66
2.40	.20	163.59	2.50	50.03	.25	49.75	.12	-51.03
2.50	.21	159.22	2.42	47.84	.26	48.61	.11	-53.42
2.60	.22	155.66	2.34	45.62	.27	47.35	.09	-55.58
2.70	.24	151.91	2.27	43.50	.28	46.19	.07	-57.80
2.80	.25	148.68	2.20	41.24	.29	44.87	.05	-63.33
2.90	.27	145.44	2.14	39.10	.30	43.57	.04	-71.16
3.00	.28	143.38	2.07	37.17	.31	42.15	.02	-89.77

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 10 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.75	-19.94	18.04	155.05	.02	78.63	.88	-16.88
.20	.63	-37.17	15.75	137.91	.03	72.31	.75	-27.99
.30	.50	-51.43	13.66	124.24	.04	69.65	.63	-33.45
.40	.40	-61.93	11.63	113.99	.06	68.34	.54	-36.33
.50	.33	-69.47	9.93	106.39	.07	68.06	.48	-37.48
.60	.28	-76.10	8.60	100.66	.08	67.81	.43	-38.05
.70	.24	-81.76	7.55	95.75	.09	67.13	.40	-38.12
.80	.21	-87.66	6.74	91.57	.10	66.95	.37	-38.22
.90	.18	-93.58	6.07	87.88	.11	66.28	.34	-38.12
1.00	.16	-99.63	5.53	84.54	.12	65.72	.32	-38.04
1.10	.14	-106.61	5.07	81.36	.13	65.07	.30	-38.26
1.20	.13	-113.93	4.70	78.47	.14	64.27	.29	-38.23
1.30	.12	-122.95	4.38	75.61	.15	63.38	.27	-38.44
1.40	.12	-131.42	4.09	72.98	.16	62.56	.25	-38.92
1.50	.11	-140.96	3.85	70.36	.17	61.30	.24	-39.44
1.60	.12	-150.17	3.64	68.00	.18	60.41	.22	-39.88
1.70	.12	-158.80	3.45	65.54	.19	59.28	.21	-40.33
1.80	.12	-167.29	3.27	63.09	.20	58.03	.19	-40.98
1.90	.13	-174.00	3.13	60.80	.21	56.82	.18	-41.90
2.00	.14	179.16	2.99	58.43	.22	55.73	.16	-42.20
2.10	.15	173.55	2.86	56.12	.23	54.42	.15	-43.12
2.20	.16	168.05	2.76	53.85	.24	53.25	.13	-43.66
2.30	.17	163.79	2.66	51.62	.25	51.73	.12	-44.54
2.40	.19	159.55	2.56	49.61	.26	50.61	.10	-45.17
2.50	.20	155.56	2.48	47.37	.27	49.39	.08	-46.33
2.60	.21	152.29	2.38	45.19	.28	47.95	.07	-46.51
2.70	.23	148.78	2.31	42.99	.29	46.76	.05	-47.10
2.80	.24	146.04	2.24	40.81	.30	45.28	.03	-50.69
2.90	.26	143.20	2.18	38.94	.31	43.89	.01	-48.82
3.00	.27	141.08	2.11	36.88	.31	42.38	0.00	134.74

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 20 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
.10	.56	-29.15	27.12	146.32	.02	77.78	.80	-21.74
.20	.41	-48.92	20.90	125.74	.03	74.05	.63	-31.76
.30	.31	-60.35	16.10	113.19	.04	72.89	.51	-34.75
.40	.24	-68.27	12.87	104.89	.05	73.12	.44	-35.38
.50	.19	-74.29	10.65	98.93	.06	72.74	.39	-34.92
.60	.16	-80.26	9.05	94.42	.07	72.28	.36	-34.40
.70	.14	-85.96	7.87	90.42	.08	71.80	.33	-33.68
.80	.12	-92.36	6.97	86.91	.09	71.03	.31	-33.35
.90	.11	-99.97	6.25	83.77	.11	70.29	.29	-33.01
1.00	.10	-107.48	5.67	80.84	.12	69.37	.28	-32.76
1.10	.09	-116.81	5.19	78.17	.13	68.41	.26	-32.72
1.20	.08	-126.82	4.79	75.44	.14	67.25	.25	-32.69
1.30	.08	-138.28	4.46	73.03	.15	66.21	.24	-32.69
1.40	.08	-148.91	4.17	70.45	.16	65.13	.22	-33.03
1.50	.09	-159.16	3.92	68.12	.17	63.75	.21	-33.54
1.60	.09	-168.23	3.69	65.84	.18	62.57	.20	-33.82
1.70	.10	-175.51	3.50	63.56	.19	61.27	.18	-34.18
1.80	.11	177.57	3.33	61.31	.20	59.98	.17	-34.31
1.90	.12	172.34	3.17	59.18	.21	58.56	.16	-34.89
2.00	.13	167.06	3.03	56.95	.22	57.22	.14	-34.48
2.10	.15	163.12	2.91	54.84	.23	55.75	.13	-34.89
2.20	.16	158.95	2.79	52.71	.24	54.34	.11	-34.41
2.30	.17	155.66	2.68	50.45	.25	53.02	.09	-33.91
2.40	.19	152.47	2.58	48.31	.26	51.60	.08	-32.52
2.50	.20	149.55	2.50	46.34	.27	50.20	.06	-30.22
2.60	.22	146.94	2.42	44.20	.28	48.59	.05	-25.48
2.70	.23	144.10	2.33	42.05	.29	47.38	.03	-14.13
2.80	.25	141.69	2.26	40.12	.30	45.92	.02	4.75
2.90	.26	139.23	2.20	38.08	.31	44.36	.02	62.68
3.00	.28	137.58	2.13	35.99	.32	42.85	.03	93.61



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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.