

### HIGH-FREQUENCY LOW NOISE AMPLIFIER NPN SILICON EPITAXIAL TWIN TRANSISTOR (WITH BUILT-IN 6-PIN 2 × 2SC5179) THIN-TYPE SMALL MINI MOLD

#### FEATURES

- High gain with low operating current  
 $|S_{21e}|^2 = 9 \text{ dB TYP. @ } V_{CE} = 2 \text{ V, } I_c = 7 \text{ mA, } f = 2 \text{ GHz}$   
 $|S_{21e}|^2 = 8.5 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 5 \text{ mA, } f = 2 \text{ GHz}$
- 6-pin thin-type small mini mold package
- Built-in 2 transistors (2 × 2SC5179)

#### ORDERING INFORMATION

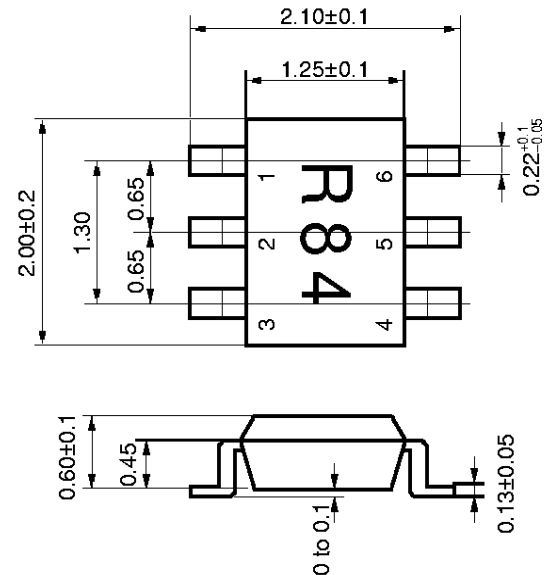
Part Number	Quantity	Packing Style
$\mu$ PA827TF	Loose products (50 pcs)	Embossed tape 8 mm wide. Pin 6 (Q1 Base), Pin 5 (Q2 Emitter), Pin 4 (Q2 Base) face to perforation side of the tape.
$\mu$ PA827TF-T1	Taping products (3 kpcs/reel)	

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

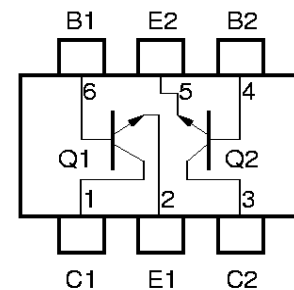
#### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)

Parameter	Symbol	Rating	Unit
Collector to Base Voltage	V <sub>CB0</sub>	5	V
Collector to Emitter Voltage	V <sub>CE0</sub>	3	V
Emitter to Base Voltage	V <sub>EB0</sub>	2	V
Collector Current	I <sub>c</sub>	10	mA
Total Power Dissipation	P <sub>T</sub>	30 in 1 element 60 in 2 element	mW
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-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)**

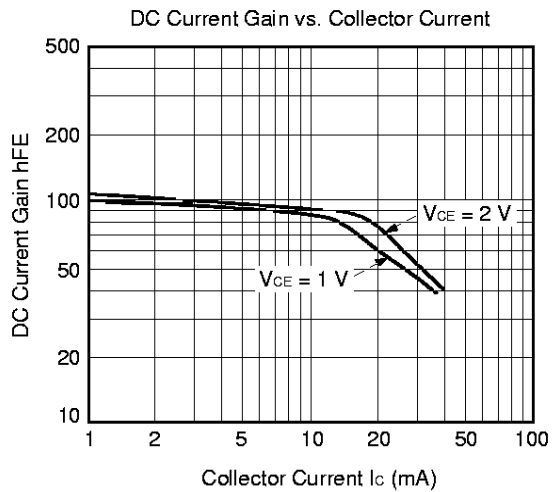
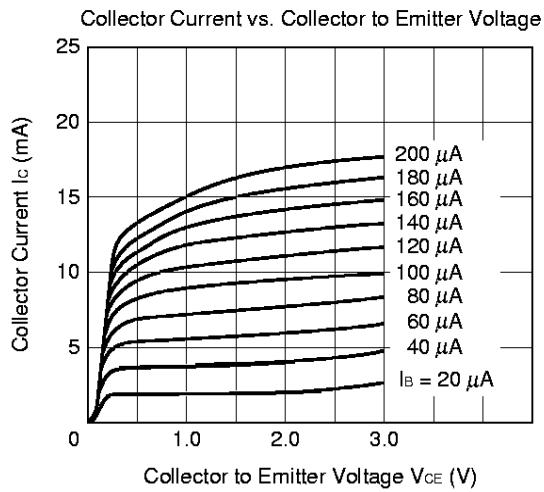
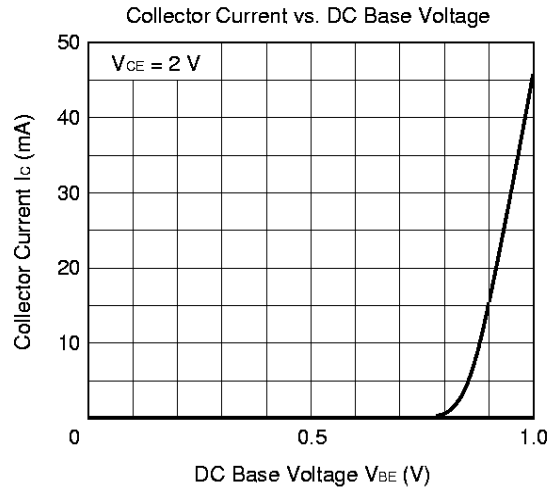
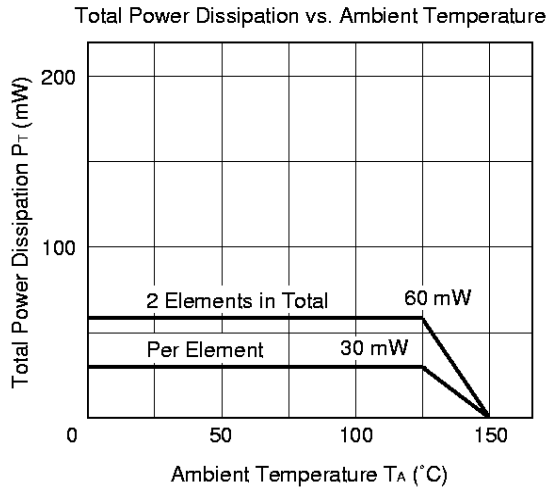
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Collector Cutoff Current	I <sub>CO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0			0.1	μA
Emitter Cutoff Current	I <sub>EO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0			0.1	μA
DC Current Gain	h <sub>FE</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 7 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> = 7 mA, f = 2 GHz	10	13		GHz
Gain Bandwidth Product (2)	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz	8.5	12		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	0.6	pF
Insertion Power Gain (1)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 7 mA, f = 2 GHz	7.5	9		dB
Insertion Power Gain (2)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz	7	8.5		dB
Noise Figure (1)	NF	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 3 mA, f = 2 GHz		1.5	2	dB
Noise Figure (2)	NF	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2 GHz		1.5	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> = 7 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%
  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.

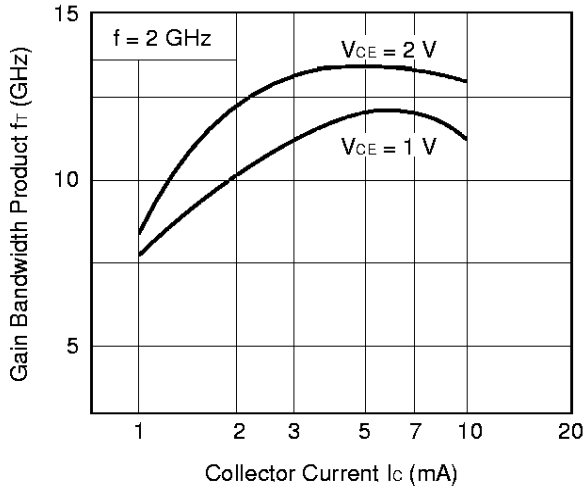
**h<sub>FE</sub> CLASSIFICATION**

Rank	FB
Marking	R84
h <sub>FE</sub> value	70 to 140

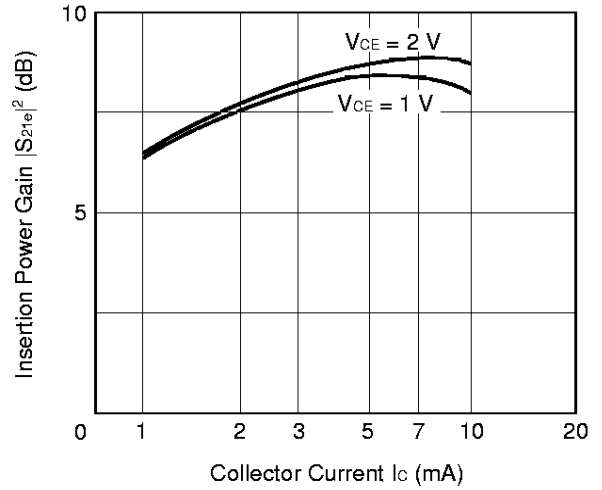
TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )



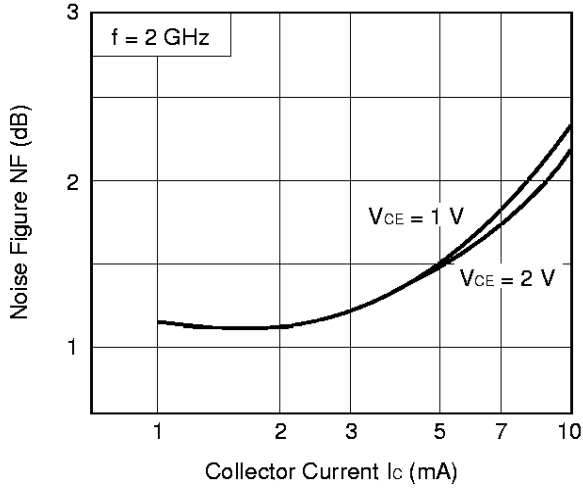
Gain Bandwidth Product vs. Collector Current



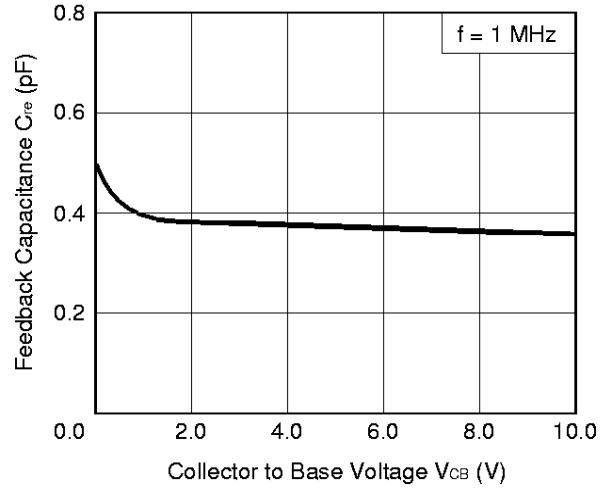
Insertion Power Gain vs. Collector Current



Noise Figure vs. Collector Current



Feedback Capacitance vs. Collector to Base Voltage



**S PARAMETER Q1**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 1 mA, Z<sub>o</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	.97	-3.79	2.37	173.89	.02	86.19	.99	-3.35
.20	.96	-7.62	2.35	168.24	.03	83.85	.99	-6.52
.30	.95	-11.53	2.40	162.95	.05	80.08	.98	-9.88
.40	.94	-15.36	2.38	157.51	.06	77.05	.97	-13.07
.50	.92	-19.27	2.39	152.51	.08	74.32	.96	-16.16
.60	.90	-23.25	2.38	147.98	.09	71.00	.95	-19.49
.70	.88	-27.31	2.37	143.24	.10	68.16	.93	-22.31
.80	.86	-31.26	2.37	139.10	.12	65.24	.91	-25.62
.90	.83	-35.44	2.37	134.35	.13	62.59	.89	-28.16
1.00	.80	-39.13	2.33	129.91	.14	59.95	.86	-31.26
1.10	.77	-43.61	2.35	125.86	.15	57.37	.85	-33.92
1.20	.74	-47.66	2.32	121.47	.16	55.12	.82	-36.57
1.30	.71	-52.04	2.29	117.90	.17	52.56	.80	-39.19
1.40	.68	-56.57	2.29	113.98	.18	50.68	.78	-41.56
1.50	.63	-61.74	2.31	109.55	.19	48.35	.75	-44.21
1.60	.60	-65.94	2.27	105.23	.19	46.43	.73	-46.35
1.70	.56	-70.44	2.23	101.17	.20	44.53	.70	-48.82
1.80	.52	-75.94	2.23	97.06	.21	42.61	.68	-51.11
1.90	.49	-81.18	2.20	93.49	.21	41.09	.66	-53.22
2.00	.46	-86.95	2.16	90.13	.22	38.96	.64	-55.67
2.10	.40	-93.37	2.17	85.56	.22	37.97	.62	-57.37
2.20	.36	-99.55	2.14	81.32	.22	36.44	.60	-59.77
2.30	.33	-105.09	2.08	77.76	.23	35.07	.58	-61.66
2.40	.31	-112.50	2.04	74.59	.23	34.03	.56	-63.91
2.50	.27	-120.95	2.03	70.78	.24	32.87	.54	-65.96
2.60	.25	-130.23	1.99	67.57	.24	31.71	.52	-68.17
2.70	.24	-138.44	1.93	64.40	.24	30.49	.51	-70.41
2.80	.21	-150.84	1.92	60.87	.25	29.78	.49	-72.61
2.90	.20	-161.77	1.87	57.91	.25	28.42	.47	-75.12
3.00	.20	-171.57	1.83	54.75	.25	27.71	.46	-77.11

**S PARAMETER Q1**

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	.90	-6.40	6.38	170.12	.02	84.82	.98	-5.79
.20	.88	-12.71	6.21	161.60	.03	80.22	.96	-11.39
.30	.85	-19.07	6.16	153.85	.04	76.19	.93	-16.48
.40	.81	-25.04	6.00	146.67	.06	72.09	.90	-21.27
.50	.76	-31.15	5.84	140.06	.07	69.59	.85	-25.20
.60	.71	-36.82	5.65	134.24	.08	66.27	.81	-29.17
.70	.66	-42.59	5.49	128.01	.09	64.30	.77	-32.16
.80	.61	-48.04	5.32	122.51	.10	61.95	.73	-35.33
.90	.55	-53.11	5.12	116.88	.10	60.14	.70	-37.63
1.00	.50	-57.87	4.92	111.77	.11	59.19	.67	-39.81
1.10	.45	-62.61	4.72	106.90	.12	57.53	.64	-42.04
1.20	.40	-66.68	4.51	102.30	.12	56.73	.61	-43.76
1.30	.35	-71.16	4.31	98.20	.13	55.55	.59	-45.68
1.40	.31	-75.23	4.12	93.99	.14	54.75	.56	-47.37
1.50	.27	-79.47	3.95	90.17	.15	53.86	.54	-49.15
1.60	.23	-83.55	3.76	86.77	.15	52.84	.52	-50.87
1.70	.20	-88.30	3.60	83.36	.16	52.11	.50	-52.50
1.80	.17	-93.90	3.46	80.11	.17	51.23	.48	-54.26
1.90	.14	-100.21	3.31	77.09	.17	50.32	.47	-55.98
2.00	.11	-108.97	3.18	74.09	.18	49.45	.45	-57.74
2.10	.09	-121.06	3.07	71.15	.18	48.70	.44	-59.41
2.20	.07	-137.25	2.96	68.42	.19	47.94	.42	-61.53
2.30	.06	-157.89	2.85	65.71	.20	47.06	.41	-63.47
2.40	.06	178.00	2.75	63.25	.20	46.25	.39	-65.56
2.50	.07	158.31	2.66	60.75	.21	45.49	.38	-64.84
2.60	.09	143.83	2.58	58.17	.22	44.42	.37	-70.22
2.70	.11	135.29	2.50	55.72	.22	43.55	.35	-72.46
2.80	.12	127.09	2.42	53.36	.23	42.64	.34	-75.23
2.90	.15	121.79	2.36	50.97	.23	41.72	.33	-77.95
3.00	.16	118.39	2.29	48.87	.24	40.58	.32	-80.67

**S PARAMETER Q1**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 5 mA, Z<sub>o</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	.84	-8.61	9.63	167.48	.01	83.50	.97	-7.47
.20	.81	-16.87	9.22	157.02	.03	78.74	.93	-14.37
.30	.75	-25.06	8.95	147.63	.04	74.43	.88	-20.21
.40	.69	-32.53	8.53	139.05	.05	70.86	.83	-25.24
.50	.63	-39.52	8.10	131.27	.06	68.32	.77	-28.95
.60	.56	-45.81	7.61	124.52	.07	65.84	.72	-32.34
.70	.49	-51.34	7.14	117.79	.08	64.80	.68	-34.71
.80	.43	-56.32	6.69	111.95	.09	63.52	.64	-37.13
.90	.38	-60.38	6.24	106.68	.09	62.41	.61	-38.90
1.00	.33	-63.94	5.84	102.01	.10	61.60	.58	-40.52
1.10	.28	-67.30	5.45	97.74	.11	61.00	.55	-42.09
1.20	.24	-70.15	5.11	93.83	.11	60.05	.53	-43.35
1.30	.21	-73.75	4.81	90.14	.12	59.47	.51	-44.63
1.40	.17	-76.50	4.53	86.78	.13	58.72	.49	-46.21
1.50	.14	-79.92	4.29	83.51	.14	58.06	.47	-47.64
1.60	.11	-83.85	4.06	80.56	.14	57.25	.45	-49.09
1.70	.09	-88.68	3.86	77.71	.15	56.63	.44	-50.66
1.80	.06	-96.14	3.69	74.99	.16	55.67	.43	-52.11
1.90	.04	-108.25	3.51	72.27	.16	54.87	.41	-53.78
2.00	.03	-138.49	3.37	69.75	.17	54.06	.40	-55.61
2.10	.03	168.35	3.23	67.06	.18	53.24	.39	-57.35
2.20	.04	135.93	3.10	64.76	.19	52.26	.37	-59.40
2.30	.06	124.72	2.98	62.16	.19	51.32	.36	-61.48
2.40	.08	117.47	2.88	60.11	.20	50.46	.35	-63.66
2.50	.10	113.65	2.78	57.82	.21	49.57	.34	-66.03
2.60	.11	110.21	2.69	55.62	.21	48.40	.33	-68.49
2.70	.13	108.23	2.60	53.30	.22	47.62	.31	-71.05
2.80	.15	105.94	2.52	51.10	.23	46.35	.30	-73.85
2.90	.17	104.37	2.44	48.98	.23	45.44	.29	-76.93
3.00	.19	102.94	2.37	46.90	.24	44.23	.28	-79.95

**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	.79	-10.59	12.26	165.48	.01	83.48	.96	-8.71
.20	.74	-20.57	11.58	153.36	.03	77.65	.91	-16.50
.30	.67	-30.03	10.98	142.68	.04	73.57	.84	-22.47
.40	.59	-38.34	10.23	133.14	.05	70.32	.77	-27.22
.50	.52	-45.42	9.42	124.76	.06	68.50	.72	-30.47
.60	.45	-51.28	8.61	117.78	.07	66.94	.67	-33.23
.70	.38	-56.02	7.87	111.39	.07	65.98	.62	-35.02
.80	.33	-59.86	7.22	105.98	.08	65.26	.59	-36.80
.90	.28	-63.19	6.63	101.18	.09	64.24	.56	-38.15
1.00	.24	-65.89	6.12	96.90	.10	63.87	.53	-39.31
1.10	.20	-68.25	5.67	93.21	.10	63.07	.51	-40.58
1.20	.17	-70.37	5.29	89.57	.11	62.59	.49	-41.59
1.30	.14	-73.22	4.94	86.29	.12	61.96	.47	-42.78
1.40	.11	-75.26	4.64	83.15	.13	61.26	.46	-44.10
1.50	.08	-78.15	4.37	80.22	.13	60.52	.44	-45.40
1.60	.06	-81.89	4.14	77.51	.14	59.83	.43	-46.87
1.70	.04	-88.25	3.92	74.77	.15	58.88	.42	-48.34
1.80	.01	-110.43	3.74	72.30	.16	58.12	.40	-49.91
1.90	.01	150.04	3.56	69.79	.16	57.24	.39	-51.48
2.00	.03	118.89	3.40	67.28	.17	56.41	.38	-53.28
2.10	.05	111.36	3.26	64.88	.18	55.59	.37	-54.95
2.20	.07	106.69	3.13	62.60	.18	54.52	.36	-57.07
2.30	.09	105.56	3.00	60.31	.19	53.39	.34	-59.13
2.40	.10	103.67	2.90	58.27	.20	52.57	.33	-61.37
2.50	.12	102.62	2.80	55.99	.21	51.57	.32	-63.74
2.60	.14	101.43	2.70	53.96	.21	50.41	.31	-66.24
2.70	.16	100.80	2.61	51.80	.22	49.35	.30	-68.78
2.80	.17	99.39	2.53	49.66	.23	48.28	.29	-71.72
2.90	.19	98.88	2.46	47.55	.23	47.18	.28	-74.69
3.00	.21	98.26	2.38	45.77	.24	45.88	.27	-77.81



**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 1 mA, Z<sub>o</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	.97	-3.76	2.38	173.74	.02	86.91	.99	-3.32
.20	.96	-7.50	2.35	167.97	.03	83.65	.99	-6.56
.30	.95	-11.38	2.39	162.59	.05	80.52	.98	-9.72
.40	.94	-15.24	2.38	157.14	.06	77.30	.97	-12.95
.50	.92	-19.09	2.38	152.09	.08	74.64	.95	-15.89
.60	.91	-23.00	2.38	147.56	.09	71.39	.93	-19.16
.70	.89	-26.94	2.37	142.82	.11	68.87	.91	-21.99
.80	.86	-30.85	2.37	138.70	.12	65.96	.89	-25.12
.90	.84	-34.90	2.37	133.96	.13	63.53	.86	-27.55
1.00	.82	-38.48	2.33	129.63	.14	61.18	.84	-30.48
1.10	.79	-42.66	2.35	125.53	.15	58.84	.82	-32.89
1.20	.76	-46.39	2.32	121.22	.16	56.71	.79	-35.31
1.30	.74	-50.53	2.30	117.61	.17	54.36	.76	-37.98
1.40	.71	-54.81	2.29	113.70	.18	52.96	.73	-40.02
1.50	.67	-59.42	2.32	109.38	.19	50.94	.71	-42.55
1.60	.64	-63.19	2.28	105.21	.20	49.37	.68	-44.73
1.70	.61	-67.25	2.24	101.17	.20	47.51	.65	-47.09
1.80	.58	-71.93	2.24	97.21	.21	45.59	.63	-49.36
1.90	.55	-76.49	2.21	93.83	.22	44.19	.60	-51.44
2.00	.53	-81.17	2.17	90.51	.22	42.47	.57	-53.85
2.10	.49	-86.20	2.18	86.01	.23	41.53	.55	-55.53
2.20	.45	-90.83	2.16	82.13	.23	40.04	.52	-57.88
2.30	.43	-94.90	2.11	78.60	.24	38.91	.50	-59.87
2.40	.41	-99.92	2.07	75.50	.24	37.70	.47	-62.30
2.50	.38	-105.57	2.05	71.84	.25	36.57	.45	-64.55
2.60	.36	-111.16	2.02	68.66	.25	35.59	.43	-66.95
2.70	.35	-116.36	1.98	65.60	.26	34.64	.41	-69.42
2.80	.32	-122.76	1.96	62.03	.26	33.73	.39	-72.03
2.90	.31	-128.79	1.92	59.14	.27	32.55	.36	-75.01
3.00	.30	-134.37	1.89	56.05	.27	31.69	.34	-77.62

**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	.90	-6.34	6.39	169.68	.02	84.84	.98	-5.82
.20	.88	-12.58	6.20	160.94	.03	80.33	.96	-11.25
.30	.85	-18.91	6.14	153.06	.04	76.31	.92	-16.31
.40	.82	-24.80	5.97	145.83	.06	73.00	.88	-20.79
.50	.77	-30.57	5.79	139.18	.07	70.49	.83	-24.41
.60	.73	-36.24	5.59	133.26	.08	67.69	.79	-28.04
.70	.68	-41.66	5.41	127.08	.09	65.74	.74	-30.52
.80	.63	-46.88	5.23	121.55	.10	63.80	.70	-33.20
.90	.58	-51.46	5.02	116.05	.11	62.24	.66	-35.07
1.00	.53	-55.76	4.80	111.07	.11	61.38	.63	-36.80
1.10	.49	-59.82	4.60	106.45	.12	60.05	.60	-38.48
1.20	.45	-63.47	4.39	102.03	.13	59.31	.57	-39.71
1.30	.42	-67.34	4.19	98.04	.14	58.37	.54	-40.97
1.40	.38	-70.77	4.01	94.17	.15	57.55	.51	-42.29
1.50	.35	-74.44	3.84	90.52	.15	56.69	.49	-43.54
1.60	.33	-78.08	3.67	87.27	.16	55.98	.47	-44.79
1.70	.30	-82.13	3.52	84.07	.17	54.93	.44	-46.16
1.80	.28	-86.33	3.39	80.77	.18	54.04	.42	-47.31
1.90	.26	-90.80	3.25	77.74	.18	53.16	.40	-48.48
2.00	.24	-95.31	3.13	74.96	.19	52.36	.38	-49.40
2.10	.22	-100.32	3.02	72.04	.20	51.56	.36	-50.55
2.20	.20	-105.66	2.92	69.38	.21	50.62	.34	-51.95
2.30	.19	-111.76	2.82	66.73	.21	49.76	.32	-53.14
2.40	.18	-118.32	2.74	64.32	.22	48.98	.31	-54.66
2.50	.17	-125.55	2.66	61.81	.23	48.10	.29	-56.28
2.60	.16	-133.16	2.58	59.27	.24	47.12	.27	-57.94
2.70	.16	-141.34	2.51	56.77	.24	46.27	.25	-59.85
2.80	.16	-149.28	2.44	54.42	.25	45.03	.23	-62.03
2.90	.16	-157.91	2.38	51.99	.26	44.06	.21	-64.06
3.00	.16	-165.06	2.31	49.68	.27	43.08	.20	-66.61

**S PARAMETER Q2**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 5 mA, Z<sub>o</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	.85	-8.48	9.64	166.89	.02	84.41	.96	-7.49
.20	.81	-16.64	9.18	156.10	.03	78.90	.93	-14.33
.30	.76	-24.62	8.86	146.53	.04	74.77	.87	-19.83
.40	.70	-31.82	8.41	137.99	.05	71.59	.81	-24.44
.50	.64	-38.43	7.94	130.11	.06	69.76	.75	-27.48
.60	.58	-44.27	7.42	123.39	.07	67.75	.70	-30.40
.70	.52	-49.15	6.93	116.87	.08	66.58	.65	-32.23
.80	.47	-53.51	6.46	111.31	.09	65.57	.61	-33.93
.90	.42	-57.21	6.02	106.26	.10	64.64	.57	-35.12
1.00	.38	-60.41	5.61	101.76	.10	64.35	.54	-35.99
1.10	.35	-63.44	5.25	97.82	.11	63.37	.52	-36.91
1.20	.32	-66.17	4.92	94.00	.12	62.73	.49	-37.55
1.30	.29	-69.34	4.64	90.67	.13	62.15	.47	-38.23
1.40	.27	-72.17	4.38	87.39	.14	61.45	.45	-39.04
1.50	.24	-75.63	4.15	84.22	.15	60.64	.43	-39.89
1.60	.23	-79.30	3.95	81.47	.15	59.97	.41	-40.88
1.70	.21	-83.46	3.76	78.57	.16	59.12	.39	-41.88
1.80	.19	-87.86	3.60	75.79	.17	58.10	.37	-42.61
1.90	.17	-92.73	3.44	73.21	.18	57.09	.36	-43.50
2.00	.16	-98.16	3.30	70.63	.19	56.34	.34	-44.07
2.10	.15	-103.97	3.18	68.17	.19	55.49	.32	-45.10
2.20	.13	-110.80	3.06	65.76	.20	54.52	.30	-46.17
2.30	.13	-119.04	2.95	63.34	.21	53.54	.29	-47.26
2.40	.12	-127.28	2.86	61.14	.22	52.63	.27	-48.28
2.50	.12	-136.85	2.77	58.94	.23	51.71	.26	-49.68
2.60	.12	-146.05	2.68	56.54	.24	50.53	.24	-51.08
2.70	.12	-155.85	2.61	54.31	.24	49.41	.22	-52.45
2.80	.12	-164.27	2.53	52.14	.25	48.46	.21	-54.40
2.90	.13	-173.46	2.46	49.88	.26	47.21	.19	-56.16
3.00	.14	-179.75	2.39	47.87	.27	46.04	.17	-57.81

**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	.79	-10.37	12.25	164.70	.01	82.96	.95	-8.66
.20	.74	-20.08	11.49	152.30	.03	78.29	.90	-16.20
.30	.68	-29.16	10.81	141.44	.04	74.48	.82	-21.74
.40	.60	-36.85	10.00	131.96	.05	71.50	.76	-25.90
.50	.53	-43.25	9.14	123.66	.06	70.09	.69	-28.46
.60	.47	-48.47	8.31	116.90	.07	68.61	.64	-30.60
.70	.42	-52.50	7.57	110.84	.08	67.97	.60	-31.88
.80	.37	-56.05	6.92	105.69	.08	67.35	.56	-32.88
.90	.34	-59.04	6.36	101.15	.09	66.54	.53	-33.54
1.00	.30	-61.69	5.87	97.08	.10	66.31	.51	-34.05
1.10	.28	-64.24	5.44	93.51	.11	65.67	.48	-34.63
1.20	.25	-66.62	5.07	90.12	.12	64.95	.46	-35.02
1.30	.23	-69.70	4.77	87.01	.13	64.42	.44	-35.41
1.40	.21	-72.31	4.47	84.06	.13	63.86	.42	-36.02
1.50	.19	-75.77	4.24	81.19	.14	63.09	.41	-36.74
1.60	.18	-79.73	4.02	78.60	.15	62.24	.39	-37.64
1.70	.16	-84.55	3.82	75.92	.16	61.07	.37	-38.42
1.80	.14	-89.59	3.64	73.36	.17	60.34	.36	-39.08
1.90	.13	-95.32	3.49	70.83	.18	59.39	.34	-39.82
2.00	.12	-101.92	3.34	68.51	.18	58.41	.32	-40.40
2.10	.11	-109.17	3.20	66.21	.19	57.52	.31	-41.23
2.20	.10	-117.57	3.08	63.91	.20	56.39	.29	-42.11
2.30	.10	-127.51	2.98	61.54	.21	55.50	.28	-43.18
2.40	.10	-137.68	2.88	59.39	.22	54.58	.26	-44.02
2.50	.10	-148.42	2.79	57.44	.23	53.55	.25	-45.38
2.60	.10	-158.38	2.70	55.13	.24	52.30	.23	-46.57
2.70	.11	-168.26	2.62	52.89	.24	51.29	.22	-47.66
2.80	.12	-176.05	2.55	50.96	.25	50.03	.20	-49.50
2.90	.13	175.72	2.47	48.79	.26	48.92	.18	-50.70
3.00	.14	170.66	2.41	46.77	.27	47.51	.17	-52.42

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