

**NPN SILICON EPITAXIAL TRANSISTOR (WITH 2 DIFFERENT ELEMENTS)  
IN A 6-PIN THIN-TYPE SMALL MINI MOLD PACKAGE**

**DESCRIPTION**

The  $\mu$ PA831TF has two different built-in transistors (Q1 and Q2) for low noise amplification in the VHF band to UHF band.

**FEATURES**

- Low noise  
Q1 : NF = 1.2 dB TYP., Q2 : NF = 1.4 dB TYP.  
@f = 1 GHz,  $V_{CE} = 3$  V,  $I_c = 7$  mA
- High gain  
Q1 :  $|S_{21e}|^2 = 9.0$  dB TYP. Q2 :  $|S_{21e}|^2 = 12.0$  dB TYP.  
@f = 1 GHz,  $V_{CE} = 3$  V,  $I_c = 7$  mA
- 6-pin thin-type small mini mold package
- 2 different transistors on-chip (2SC4226, 2SC4227)

**ON-CHIP TRANSISTORS**

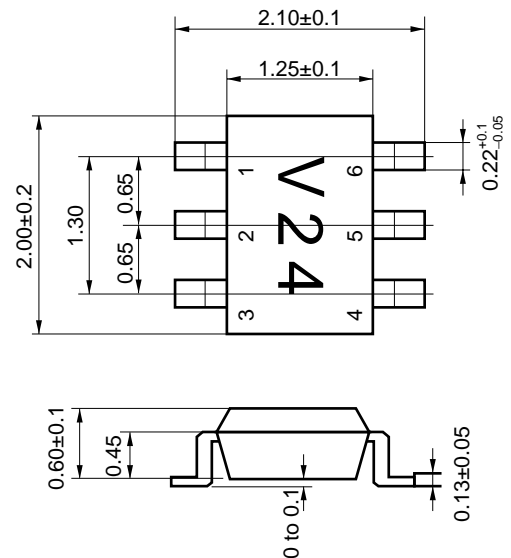
	Q1	Q2
3-pin small mini mold part No.	2SC4226	2SC4227

The  $\mu$ PA834TF features the Q1 and Q2 in inverted positions.

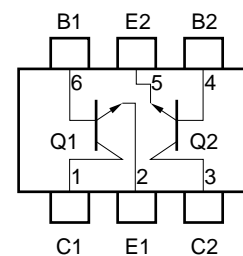
**ORDERING INFORMATION**

PART NUMBER	QUANTITY	PACKING STYLE
$\mu$ PA831TF	Loose products (50 pcs)	8-mm wide embossed tape. Pin 6 (Q1 Base), pin 5 (Q2 Emitter), and pin 4 (Q2 Base) face perforated side of tape.
$\mu$ PA831TF-T1	Taping products (3 kpcs/reel)	

**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, because the high-frequency process is used for this device.**

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

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

PARAMETER	SYMBOL	RATING		UNIT
		Q1	Q2	
Collector to base voltage	V <sub>CBO</sub>	20	20	V
Collector to emitter voltage	V <sub>CEO</sub>	12	10	V
Emitter to base voltage	V <sub>EBO</sub>	3	1.5	V
Collector current	I <sub>C</sub>	100	65	mA
Total power dissipation	P <sub>T</sub>	150 in 1 element	150 in 1 element	mW
		200 in 2 elements <sup>Note</sup>		
Junction temperature	T <sub>J</sub>	150	150	°C
Storage temperature	T <sub>stg</sub>	-65 to +150		°C

**Note** 110 mW must not be exceeded for 1 element.

(1) Q1

**ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	I <sub>CBO</sub>	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0			1	μA
Emitter cutoff current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0			1	μA
DC current gain	h <sub>FE</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA <sup>Note 1</sup>	100		145	
Gain bandwidth product	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz	3.0	4.5		GHz
Feedback capacitance	C <sub>re</sub>	V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0, f = 1 MHz <sup>Note 2</sup>		0.7	1.5	pF
Insertion power gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz	7	9		dB
Noise figure	NF	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz		1.2	2.5	dB

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

2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

(2) Q2

**ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	I <sub>CBO</sub>	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0			0.8	μA
Emitter cutoff current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0			0.8	μA
DC current gain	h <sub>FE</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA <sup>Note 1</sup>	70		150	
Gain bandwidth product	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz	4.5	7.0		GHz
Feedback capacitance	C <sub>re</sub>	V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0, f = 1 MHz <sup>Note 2</sup>		0.45	0.9	pF
Insertion power gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz	10	12		dB
Noise figure	NF	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 1 GHz		1.4	2.7	dB

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

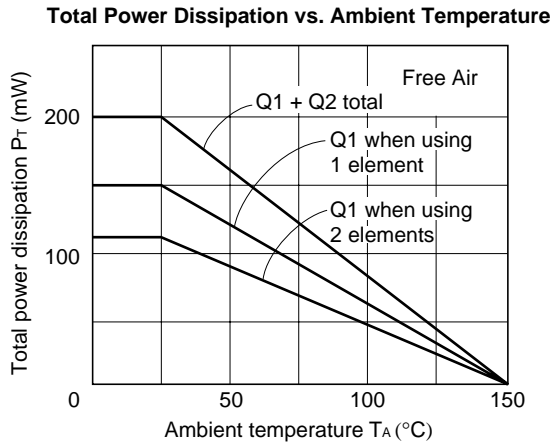
2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

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

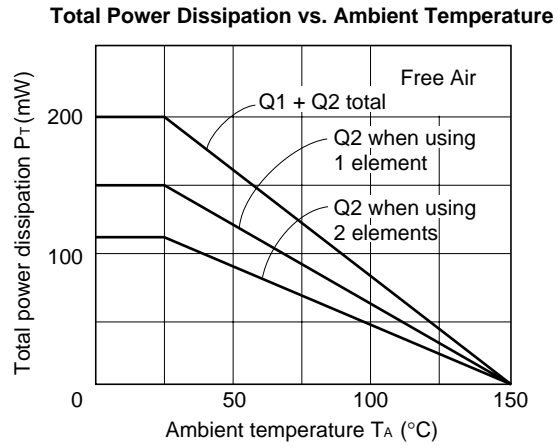
Rank	FB
Marking	V24
h <sub>FE</sub> value of Q1	100 to 145
h <sub>FE</sub> value of Q2	70 to 150

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

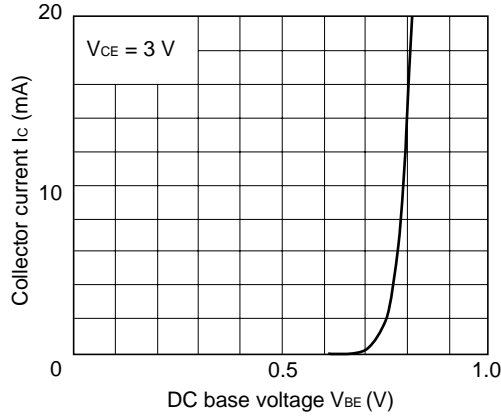
Q1



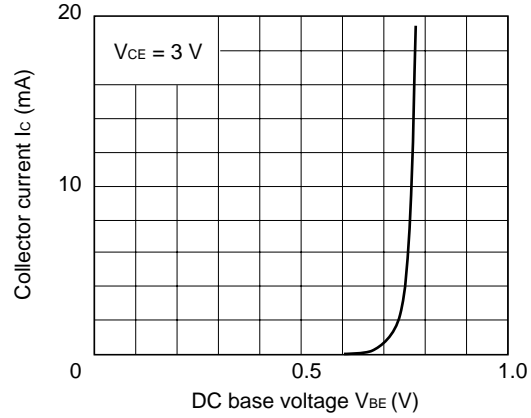
Q2



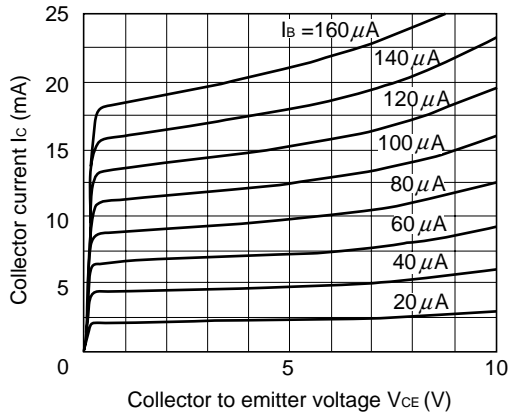
**Collector Current vs. DC Base Voltage**



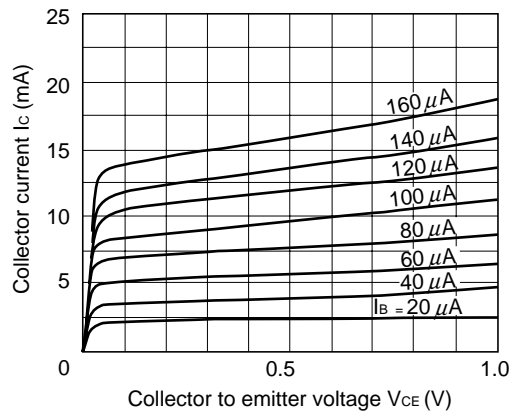
**Collector Current vs. DC Base Voltage**



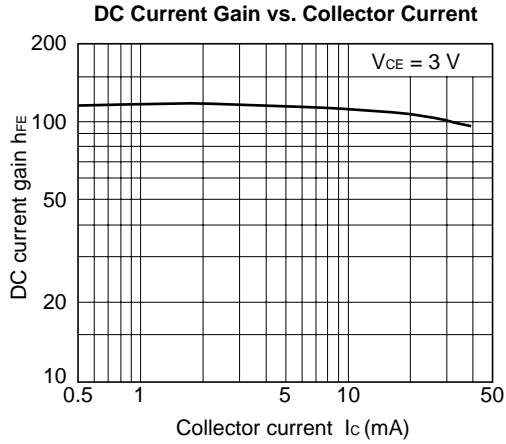
**Collector Current vs. Collector to Emitter Voltage**



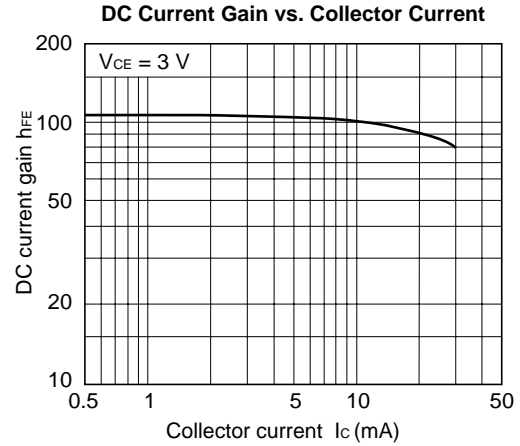
**Collector Current vs. Collector to Emitter Voltage**



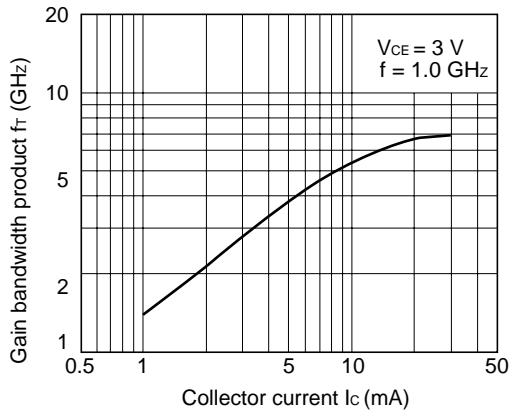
Q1



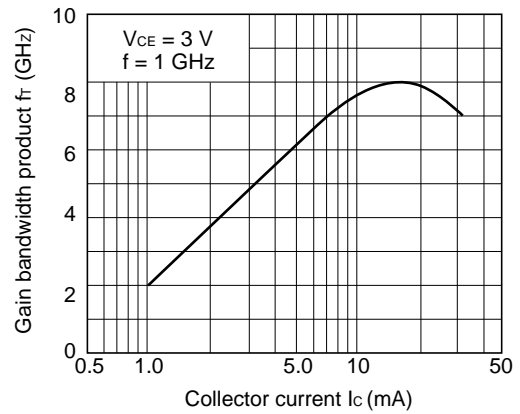
Q2



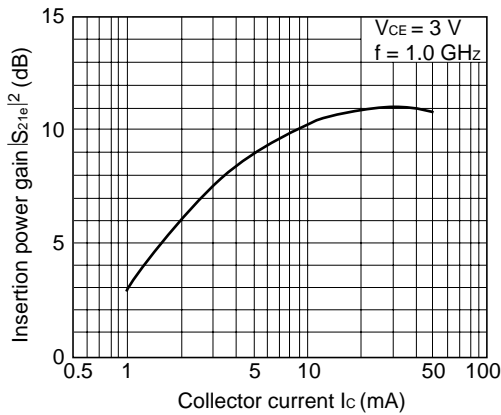
**Gain Bandwidth Product vs. Collector Current**



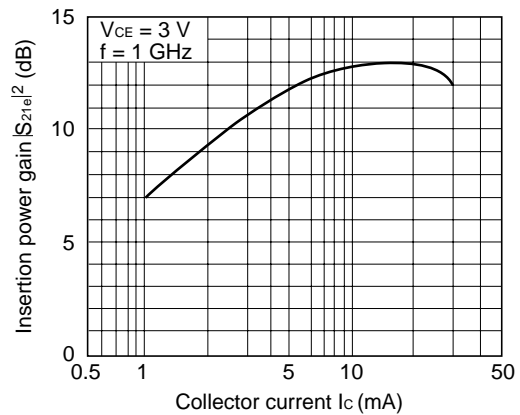
**Gain Bandwidth Product vs. Collector Current**



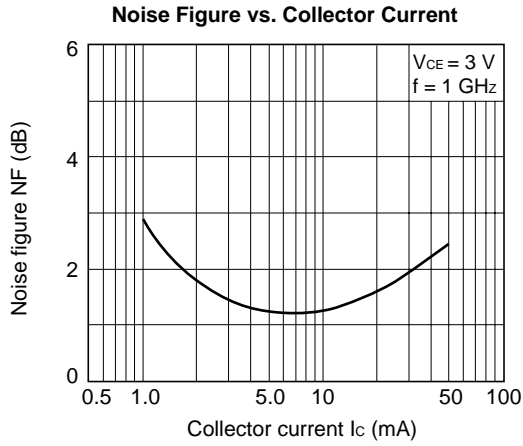
**Insertion Power Gain vs. Collector Current**



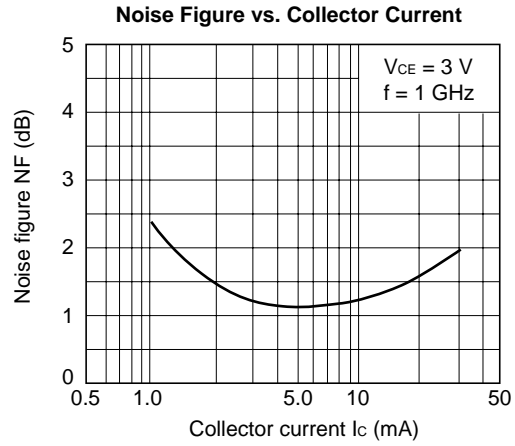
**Insertion Power Gain vs. Collector Current**



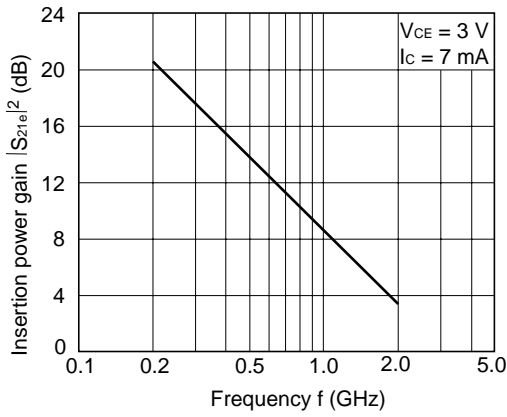
Q1



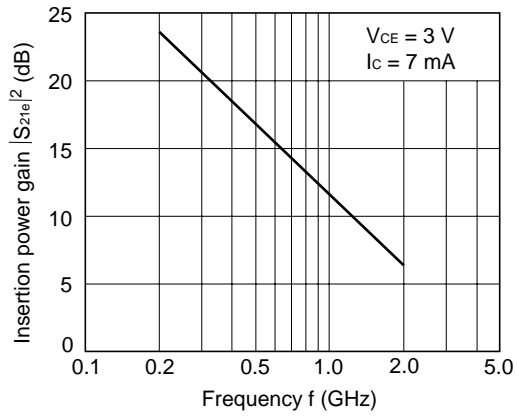
Q2



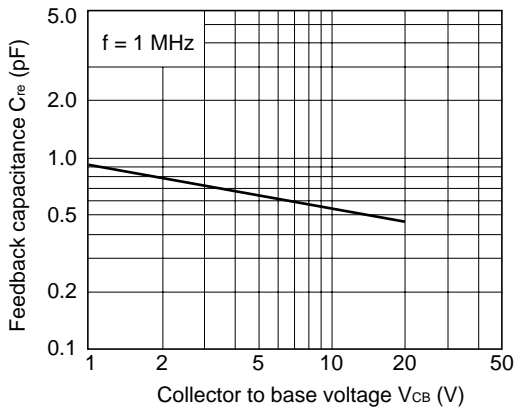
**Insertion Power Gain vs. Frequency**



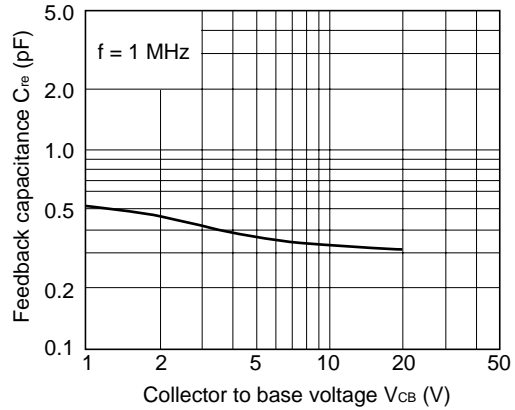
**Insertion Power Gain vs. Frequency**



**Feedback Capacitance vs. Collector to Base Voltage**



**Feedback Capacitance vs. Collector to Base Voltage**



**S-PARAMETERS Q1**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 1 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.97	-20.45	2.38	162.85	.04	76.56	.98	-8.59
.20	.94	-40.17	2.31	148.19	.08	63.82	.94	-16.05
.30	.90	-59.57	2.25	135.26	.11	52.97	.89	-22.20
.40	.86	-77.29	2.10	123.99	.13	43.63	.83	-27.30
.50	.82	-94.54	2.03	113.53	.15	36.13	.78	-31.16
.60	.79	-110.15	1.92	104.19	.16	29.28	.74	-34.67
.70	.76	-124.06	1.80	95.54	.16	23.65	.70	-37.55
.80	.74	-136.61	1.69	87.82	.16	19.18	.67	-40.06
.90	.72	-148.19	1.59	80.80	.16	15.47	.65	-42.54
1.00	.71	-158.16	1.48	74.49	.16	12.65	.64	-44.88
1.10	.71	-167.38	1.39	68.76	.15	10.12	.62	-47.25
1.20	.70	-175.72	1.30	63.28	.15	8.37	.61	-49.79
1.30	.71	176.48	1.22	58.43	.14	7.41	.60	-52.21
1.40	.71	169.61	1.15	53.77	.13	7.31	.59	-54.99
1.50	.71	162.88	1.09	49.18	.13	7.58	.59	-57.73
1.60	.72	157.03	1.03	45.04	.12	9.20	.58	-61.04
1.70	.72	151.31	.97	41.14	.12	11.56	.58	-64.34
1.80	.73	146.29	.92	37.65	.11	14.82	.58	-67.77
1.90	.74	141.40	.87	34.21	.11	18.79	.57	-71.13
2.00	.75	136.95	.83	31.08	.11	23.61	.57	-74.83
2.10	.75	132.61	.79	27.91	.11	28.60	.57	-78.77
2.20	.76	128.64	.76	25.12	.11	33.65	.57	-82.60
2.30	.77	124.97	.72	22.56	.12	38.01	.57	-86.85
2.40	.77	121.29	.69	20.26	.12	41.76	.57	-90.91
2.50	.78	117.97	.66	18.15	.13	45.08	.57	-95.23
2.60	.79	114.71	.63	16.20	.14	47.62	.57	-99.78
2.70	.79	111.76	.60	14.55	.15	49.09	.57	-104.24
2.80	.80	108.85	.58	12.80	.16	49.98	.58	-109.00
2.90	.81	106.05	.56	11.46	.18	50.29	.58	-113.69
3.00	.81	103.52	.54	10.02	.19	50.48	.58	-118.13

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

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.90	-29.24	6.73	156.08	.04	70.94	.93	-16.82
.20	.83	-56.61	6.15	138.83	.07	55.92	.82	-29.40
.30	.75	-82.38	5.66	124.38	.09	46.12	.70	-37.28
.40	.70	-104.35	5.08	112.82	.10	39.45	.61	-42.73
.50	.65	-122.97	4.52	102.90	.11	35.38	.54	-45.93
.60	.62	-138.09	4.00	94.98	.11	32.50	.49	-48.61
.70	.60	-150.60	3.57	88.01	.11	30.78	.45	-50.55
.80	.59	-161.35	3.21	82.00	.11	30.02	.42	-52.19
.90	.59	-170.46	2.90	76.74	.12	29.88	.40	-54.08
1.00	.59	-178.60	2.65	71.87	.12	30.03	.38	-55.78
1.10	.59	174.04	2.43	67.34	.12	30.52	.37	-57.60
1.20	.59	167.50	2.25	62.99	.12	31.42	.36	-59.72
1.30	.60	161.38	2.08	59.07	.12	32.31	.35	-61.84
1.40	.60	156.04	1.95	55.38	.13	33.59	.34	-64.46
1.50	.61	150.72	1.82	51.53	.13	34.65	.33	-67.05
1.60	.62	146.09	1.71	48.04	.13	35.76	.33	-70.23
1.70	.63	141.52	1.61	44.61	.14	36.98	.32	-73.46
1.80	.64	137.65	1.53	41.49	.14	38.11	.32	-76.96
1.90	.65	133.69	1.45	38.35	.15	38.91	.32	-80.43
2.00	.66	130.09	1.38	35.44	.15	39.97	.31	-84.11
2.10	.67	126.52	1.32	32.33	.16	40.67	.31	-88.21
2.20	.68	123.26	1.26	29.70	.16	41.25	.31	-92.12
2.30	.69	120.27	1.20	26.91	.17	41.76	.31	-96.67
2.40	.69	117.15	1.15	24.44	.18	42.09	.31	-100.78
2.50	.70	114.27	1.10	21.83	.19	42.08	.31	-105.22
2.60	.71	111.71	1.06	19.60	.19	42.18	.31	-109.89
2.70	.72	109.21	1.02	17.12	.20	42.29	.32	-114.66
2.80	.73	106.70	.97	14.96	.21	41.78	.32	-119.25
2.90	.74	104.47	.94	12.97	.22	41.42	.33	-124.21
3.00	.75	102.28	.91	10.82	.22	41.10	.33	-128.59

**S-PARAMETERS Q1**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 5 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.84	-37.26	10.52	150.99	.04	67.19	.89	-23.52
.20	.74	-70.72	9.17	131.67	.06	52.38	.72	-38.66
.30	.65	-100.14	7.97	116.47	.07	44.81	.58	-46.62
.40	.60	-122.73	6.76	105.34	.08	41.17	.48	-51.47
.50	.57	-139.98	5.74	96.73	.09	39.62	.42	-54.25
.60	.55	-153.16	4.95	89.92	.09	38.83	.37	-56.48
.70	.54	-163.95	4.33	84.13	.10	38.89	.34	-58.22
.80	.54	-173.01	3.85	78.92	.10	39.22	.31	-59.93
.90	.54	179.14	3.44	74.44	.11	40.21	.30	-61.82
1.00	.54	172.20	3.13	70.19	.11	40.98	.28	-63.63
1.10	.55	165.80	2.86	66.20	.12	41.45	.27	-65.68
1.20	.55	160.12	2.63	62.35	.12	42.12	.26	-68.02
1.30	.56	154.92	2.43	58.82	.13	42.51	.25	-70.57
1.40	.57	150.12	2.27	55.44	.13	43.29	.24	-73.51
1.50	.58	145.43	2.12	51.94	.14	43.44	.23	-76.52
1.60	.59	141.31	1.99	48.73	.15	43.67	.23	-80.31
1.70	.60	137.23	1.88	45.70	.15	44.06	.22	-84.21
1.80	.61	133.70	1.78	42.72	.16	44.00	.22	-88.16
1.90	.62	130.17	1.68	39.69	.16	43.77	.22	-92.09
2.00	.63	126.82	1.60	37.07	.17	43.80	.22	-96.22
2.10	.64	123.64	1.53	34.06	.18	43.62	.22	-101.16
2.20	.65	120.71	1.46	31.55	.18	43.25	.22	-105.74
2.30	.66	117.99	1.40	28.81	.19	42.92	.22	-110.57
2.40	.67	115.08	1.33	26.41	.20	42.38	.22	-115.34
2.50	.68	112.54	1.28	23.75	.21	41.92	.22	-120.22
2.60	.68	110.13	1.23	21.72	.21	41.46	.22	-125.18
2.70	.69	107.78	1.18	19.41	.22	40.69	.23	-130.36
2.80	.70	105.52	1.14	17.04	.23	39.95	.24	-134.71
2.90	.71	103.31	1.10	15.04	.23	39.10	.24	-139.65
3.00	.72	101.25	1.06	12.85	.24	38.40	.25	-144.01

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 7 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.79	-44.32	13.71	146.95	.04	64.19	.84	-28.71
.20	.67	-82.73	11.45	126.15	.05	50.70	.64	-44.98
.30	.59	-113.49	9.41	111.03	.07	45.71	.49	-52.71
.40	.55	-134.72	7.67	100.87	.07	44.09	.40	-57.18
.50	.52	-150.16	6.37	93.24	.08	43.89	.35	-59.82
.60	.52	-161.98	5.44	87.20	.08	44.29	.31	-62.08
.70	.51	-171.56	4.71	81.95	.09	44.90	.28	-63.86
.80	.51	-179.64	4.17	77.28	.10	45.68	.26	-65.85
.90	.52	173.30	3.73	73.14	.10	46.53	.24	-67.95
1.00	.52	167.06	3.38	69.28	.11	47.24	.23	-70.01
1.10	.53	161.26	3.08	65.48	.12	47.44	.22	-72.42
1.20	.54	156.05	2.83	61.95	.12	47.51	.21	-75.34
1.30	.54	151.22	2.61	58.77	.13	47.41	.20	-78.33
1.40	.55	146.81	2.44	55.41	.14	47.76	.19	-81.85
1.50	.56	142.49	2.28	52.20	.14	47.48	.19	-85.78
1.60	.57	138.66	2.14	49.11	.15	47.27	.18	-90.06
1.70	.58	134.85	2.02	46.08	.16	47.00	.18	-94.72
1.80	.59	131.54	1.91	43.25	.17	46.66	.18	-99.13
1.90	.60	128.16	1.81	40.43	.17	45.91	.18	-103.95
2.00	.61	125.10	1.72	37.91	.18	45.50	.18	-108.59
2.10	.62	122.05	1.64	34.92	.19	44.78	.18	-114.11
2.20	.63	119.27	1.57	32.41	.20	44.24	.18	-118.98
2.30	.64	116.70	1.50	29.76	.20	43.38	.18	-124.21
2.40	.65	113.87	1.43	27.41	.21	42.59	.18	-129.50
2.50	.66	111.51	1.37	25.17	.22	41.98	.19	-134.34
2.60	.67	109.16	1.32	22.83	.22	41.02	.19	-139.54
2.70	.68	106.97	1.27	20.70	.23	40.16	.20	-144.26
2.80	.69	104.65	1.22	18.35	.24	39.22	.21	-148.76
2.90	.70	102.63	1.18	16.37	.25	38.29	.22	-153.16
3.00	.71	100.68	1.14	14.21	.25	37.45	.23	-157.18



**S-PARAMETERS Q2**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 1 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.98	-10.86	2.42	168.67	.03	82.29	.99	-5.27
.20	.96	-21.63	2.38	158.63	.05	75.10	.97	-10.32
.30	.93	-32.48	2.38	149.52	.08	68.06	.94	-15.03
.40	.90	-42.91	2.31	140.98	.10	61.46	.91	-19.41
.50	.87	-53.63	2.29	133.17	.11	56.13	.87	-22.87
.60	.83	-64.20	2.25	125.99	.13	50.41	.83	-26.69
.70	.79	-74.42	2.19	118.72	.14	46.33	.80	-29.29
.80	.75	-84.40	2.13	112.19	.14	42.16	.76	-32.26
.90	.71	-94.53	2.10	105.36	.15	38.75	.73	-34.46
1.00	.68	-103.53	2.02	99.41	.15	36.15	.70	-36.40
1.10	.65	-112.84	1.96	93.81	.16	33.86	.67	-38.57
1.20	.62	-121.59	1.90	88.26	.16	32.01	.65	-40.20
1.30	.60	-129.96	1.83	83.34	.16	30.54	.62	-42.02
1.40	.58	-137.90	1.77	78.40	.16	29.59	.60	-43.95
1.50	.57	-145.60	1.71	73.71	.16	29.15	.58	-45.97
1.60	.56	-152.58	1.65	69.43	.16	28.80	.57	-47.82
1.70	.55	-159.13	1.59	65.42	.16	29.10	.55	-49.98
1.80	.55	-165.54	1.54	61.40	.15	29.88	.53	-52.18
1.90	.55	-171.51	1.49	57.68	.15	30.88	.52	-54.64
2.00	.55	-177.12	1.44	54.11	.16	32.04	.51	-57.16
2.10	.55	177.71	1.40	50.42	.16	33.77	.49	-59.87
2.20	.55	172.74	1.35	47.14	.16	35.33	.48	-62.87
2.30	.55	168.14	1.31	43.70	.16	37.46	.47	-66.21
2.40	.56	163.90	1.28	40.75	.16	69.67	.46	-69.77
2.50	.57	159.65	1.24	37.59	.17	41.52	.44	-73.66
2.60	.57	155.86	1.21	34.64	.18	43.20	.43	-77.93
2.70	.58	152.13	1.17	31.65	.18	44.96	.42	-82.33
2.80	.59	148.79	1.14	28.80	.19	46.21	.41	-87.47
2.90	.60	145.37	1.11	26.00	.20	47.12	.40	-92.35
3.00	.60	142.54	1.08	23.49	.21	47.77	.39	-97.59

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

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.92	-16.40	6.78	162.42	.03	78.93	.96	-10.26
.20	.87	-32.07	6.39	149.12	.05	69.04	.90	-19.01
.30	.80	-47.67	6.14	137.78	.06	61.85	.81	-25.29
.40	.73	-62.40	5.78	127.84	.08	56.50	.74	-30.21
.50	.65	-76.67	5.43	118.67	.09	53.06	.67	-33.01
.60	.59	-89.52	5.01	111.01	.09	50.34	.61	-35.62
.70	.53	-101.31	4.64	103.74	.10	49.05	.57	-36.97
.80	.49	-112.10	4.29	97.61	.11	48.17	.53	-38.30
.90	.45	-121.85	3.96	92.07	.11	47.67	.50	-39.13
1.00	.43	-130.75	3.67	87.21	.12	47.43	.47	-39.97
1.10	.41	-139.20	3.42	82.77	.12	47.62	.45	-40.84
1.20	.40	-146.82	3.20	78.56	.13	47.88	.43	-41.51
1.30	.39	-154.09	3.00	74.75	.13	48.07	.41	-42.38
1.40	.39	-160.74	2.82	71.06	.14	48.31	.39	-43.48
1.50	.39	-166.97	2.67	67.56	.15	48.47	.37	-44.78
1.60	.39	-172.58	2.53	64.32	.15	48.70	.36	-45.86
1.70	.39	-177.84	2.41	61.15	.16	48.92	.34	-47.49
1.80	.39	177.23	2.30	58.00	.17	49.32	.33	-48.98
1.90	.40	172.58	2.20	54.87	.17	49.37	.31	-50.86
2.00	.41	168.36	2.11	52.04	.18	49.48	.30	-52.76
2.10	.41	164.52	2.03	49.15	.19	49.28	.28	-54.99
2.20	.42	160.70	1.96	46.40	.19	49.06	.27	-57.53
2.30	.43	157.30	1.89	43.44	.20	48.89	.26	-60.32
2.40	.44	154.02	1.83	40.90	.21	48.71	.24	-63.52
2.50	.45	150.91	1.77	38.21	.22	48.34	.23	-67.38
2.60	.46	148.07	1.71	35.73	.23	47.76	.21	-71.54
2.70	.47	145.25	1.66	32.88	.24	47.41	.20	-76.23
2.80	.49	142.65	1.62	30.44	.25	46.67	.18	-81.94
2.90	.50	139.98	1.57	27.86	.26	45.98	.17	-87.86
3.00	.51	138.06	1.52	25.73	.27	45.20	.16	-94.47

**S-PARAMETERS Q2**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 5 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.87	-21.14	10.54	157.81	.02	75.42	.93	-14.27
.20	.78	-40.83	9.60	142.32	.04	65.90	.83	-24.65
.30	.68	-60.06	8.88	129.34	.06	60.29	.71	-30.56
.40	.58	-77.36	8.02	118.40	.07	56.88	.62	-34.29
.50	.50	-92.42	7.14	109.32	.07	55.62	.55	-35.99
.60	.44	-105.23	6.32	102.30	.08	54.62	.50	-37.17
.70	.40	-116.35	5.64	96.25	.09	54.78	.46	-37.50
.80	.37	-126.53	5.09	91.05	.10	54.68	.43	-38.10
.90	.35	-135.66	4.61	86.42	.10	54.91	.41	-38.22
1.00	.34	-143.84	4.22	82.27	.11	55.25	.38	-38.54
1.10	.33	-151.49	3.89	78.59	.12	55.23	.36	-38.98
1.20	.33	-158.47	3.61	74.93	.13	55.53	.35	-39.34
1.30	.33	-164.93	3.37	71.63	.13	55.49	.33	-39.85
1.40	.33	-170.67	3.16	68.50	.14	55.41	.32	-40.67
1.50	.33	-176.15	2.98	65.28	.15	55.16	.30	-41.72
1.60	.33	178.94	2.81	62.44	.16	54.93	.29	-42.66
1.70	.34	174.48	2.67	59.53	.17	54.56	.27	-43.96
1.80	.35	170.19	2.55	56.72	.17	54.03	.26	-45.25
1.90	.36	166.22	2.43	53.90	.18	53.71	.25	-46.88
2.00	.37	162.68	2.33	51.31	.19	53.22	.23	-48.42
2.10	.38	159.35	2.24	48.56	.20	52.54	.22	-50.34
2.20	.39	156.09	2.15	46.03	.21	51.87	.20	-52.64
2.30	.40	153.11	2.07	43.46	.22	51.10	.19	-55.18
2.40	.41	150.30	2.00	41.00	.23	50.45	.17	-58.24
2.50	.42	147.53	1.94	38.54	.24	49.58	.16	-62.15
2.60	.43	145.08	1.88	35.97	.25	48.60	.14	-66.33
2.70	.45	142.49	1.82	33.27	.25	47.69	.13	-71.05
2.80	.46	140.30	1.76	31.11	.26	46.60	.11	-78.26
2.90	.47	137.82	1.71	28.59	.27	45.56	.10	-85.54
3.00	.48	136.02	1.66	26.58	.28	44.44	.08	-95.21

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 7 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.82	-25.53	13.87	154.03	.02	74.13	.90	-17.35
.20	.70	-48.93	12.25	136.79	.04	64.47	.76	-28.32
.30	.58	-70.56	10.84	122.67	.05	60.39	.63	-33.36
.40	.48	-88.76	9.35	111.78	.06	58.88	.55	-35.74
.50	.41	-103.39	8.02	103.61	.07	58.61	.49	-36.45
.60	.36	-115.73	6.95	97.46	.08	58.55	.44	-36.82
.70	.33	-126.32	6.11	92.14	.08	58.93	.41	-36.53
.80	.31	-135.93	5.46	87.62	.09	59.18	.38	-36.68
.90	.30	-144.44	4.92	83.59	.10	59.34	.36	-36.49
1.00	.29	-152.17	4.48	79.82	.11	59.51	.34	-36.62
1.10	.29	-159.26	4.11	76.41	.12	59.53	.32	-36.78
1.20	.29	-165.53	3.81	73.17	.13	59.39	.31	-37.07
1.30	.29	-171.36	3.55	70.09	.13	59.05	.29	-37.41
1.40	.30	-176.72	3.32	67.05	.14	58.84	.28	-38.01
1.50	.30	178.39	3.12	64.12	.15	58.27	.27	-39.05
1.60	.31	173.90	2.95	61.44	.16	57.62	.25	-39.87
1.70	.32	169.88	2.80	58.72	.17	57.18	.24	-41.01
1.80	.33	166.06	2.66	56.07	.18	56.32	.23	-42.06
1.90	.34	162.59	2.54	53.39	.19	55.76	.21	-43.61
2.00	.35	159.36	2.43	50.86	.20	55.01	.20	-44.79
2.10	.36	156.27	2.33	48.28	.21	54.16	.19	-46.76
2.20	.37	153.42	2.25	45.89	.22	52.97	.17	-48.48
2.30	.38	150.63	2.16	43.05	.23	52.00	.16	-50.86
2.40	.39	148.12	2.09	40.78	.24	51.15	.14	-53.66
2.50	.41	145.66	2.02	38.61	.24	50.13	.13	-57.04
2.60	.42	143.34	1.96	36.14	.25	48.95	.11	-61.10
2.70	.43	140.96	1.89	33.67	.26	47.89	.09	-66.21
2.80	.44	138.81	1.83	31.28	.27	46.76	.08	-73.49
2.90	.46	136.66	1.78	29.14	.28	45.56	.06	-83.84
3.00	.47	135.02	1.73	26.84	.29	44.44	.05	-97.11

**S-PARAMETERS Q2**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 10 mA, Z<sub>0</sub> = 50 Ω

FREQUENCY		S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
.10	.75	-31.69	18.15	149.45	.02	72.88	.86	-20.87	
.20	.60	-59.65	15.27	130.00	.04	64.34	.68	-31.44	
.30	.46	-83.01	12.63	115.55	.05	61.90	.56	-34.79	
.40	.38	-100.85	10.36	105.74	.05	62.10	.48	-35.76	
.50	.33	-114.89	8.65	98.71	.06	62.36	.43	-35.53	
.60	.30	-126.72	7.39	93.39	.07	62.91	.39	-35.09	
.70	.28	-136.66	6.44	88.76	.08	63.12	.36	-34.48	
.80	.27	-145.74	5.71	84.77	.09	63.61	.34	-34.25	
.90	.27	-153.56	5.13	81.10	.10	63.35	.32	-33.89	
1.00	.26	-160.53	4.66	77.73	.11	63.27	.31	-33.85	
1.10	.26	-166.88	4.27	74.64	.12	62.91	.29	-34.07	
1.20	.27	-172.68	3.95	71.54	.13	62.53	.28	-34.09	
1.30	.27	-177.77	3.68	68.67	.14	62.04	.27	-34.41	
1.40	.28	177.46	3.44	65.84	.15	61.42	.25	-35.12	
1.50	.29	173.18	3.23	63.03	.16	60.56	.24	-35.98	
1.60	.30	169.29	3.05	60.50	.17	59.82	.23	-36.56	
1.70	.30	165.76	2.89	58.07	.17	58.92	.22	-37.60	
1.80	.32	162.29	2.75	55.43	.18	57.96	.20	-38.49	
1.90	.32	159.29	2.62	52.94	.19	57.13	.19	-39.89	
2.00	.34	156.32	2.51	50.27	.20	56.28	.17	-40.62	
2.10	.35	153.54	2.40	47.83	.21	55.15	.16	-42.62	
2.20	.36	150.92	2.31	45.61	.22	53.97	.15	-43.94	
2.30	.37	148.50	2.22	42.91	.23	52.83	.13	-45.84	
2.40	.38	146.21	2.15	40.75	.24	51.67	.12	-48.25	
2.50	.40	143.83	2.08	38.52	.25	50.51	.10	-50.92	
2.60	.41	141.72	2.00	36.05	.26	49.30	.08	-54.37	
2.70	.42	139.53	1.94	33.72	.27	48.15	.07	-58.39	
2.80	.44	137.55	1.88	31.41	.28	46.86	.05	-66.06	
2.90	.45	135.45	1.83	29.26	.29	45.59	.03	-77.18	
3.00	.46	133.92	1.77	27.15	.30	44.27	.02	-101.29	

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