

To our customers,

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## Old Company Name in Catalogs and Other Documents

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On April 1<sup>st</sup>, 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 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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NPN SILICON RF TWIN TRANSISTOR

**Phase-out/Discontinued**

**μPA855TD**

**NPN SILICON RF TRANSISTOR (WITH 2 DIFFERENT ELEMENTS)  
IN A 6-PIN LEAD-LESS MINIMOLD**

**FEATURES**

- Low voltage operation
- 2 different built-in transistors (2SC5737, 2SC5745)
  - Q1: Low noise transistor  
 $NF = 1.5 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 3 \text{ mA, } f = 2 \text{ GHz}$
  - Q2: Low phase distortion transistor suited for OSC operation  
 $f_T = 5.5 \text{ GHz TYP., } |S_{21e}|^2 = 4.5 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 10 \text{ mA, } f = 2 \text{ GHz}$
- 6-pin lead-less minimold package

**BUILT-IN TRANSISTORS**

	Q1	Q2
3-pin thin-type ultra super minimold part No.	2SC5737	2SC5745

**ORDERING INFORMATION**

Part Number	Quantity	Supplying Form
μPA855TD	50 pcs (Non reel)	• 8 mm wide embossed taping
μPA855TD-T3	10 kpcs/reel	• Pin 1 (Q1 Collector), Pin 6 (Q1 Base) face the perforation side of the tape

**Remark** To order evaluation samples, contact your nearby sales office.  
The unit sample quantity is 50 pcs.

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

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Not all devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

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

Parameter	Symbol	Ratings		Unit
		Q1	Q2	
Collector to Base Voltage	V <sub>CBO</sub>	5	15	V
Collector to Emitter Voltage	V <sub>CEO</sub>	3	5.5	V
Emitter to Base Voltage	V <sub>EBO</sub>	2	1.5	V
Collector Current	I <sub>C</sub>	30	100	mA
Total Power Dissipation	P <sub>tot</sub> <sup>Note</sup>	90	190	mW
		210 in 2 elements		
Junction Temperature	T <sub>j</sub>	150		°C
Storage Temperature	T <sub>stg</sub>	-65 to +150		°C

**Note** Mounted on 1.08 cm<sup>2</sup> × 1.0 mm (t) glass epoxy PCB

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

**(1) Q1**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA	–	–	100	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	100	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA	70	–	140	–
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	10.0	12.0	–	GHz
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	7.0	9.0	–	dB
Noise Figure	NF	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2 GHz, Z <sub>S</sub> = Z <sub>opt</sub>	–	1.5	2.0	dB
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 0.5 V, I <sub>E</sub> = 0 mA, f = 1 MHz	–	0.4	0.7	pF

**(2) Q2**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA	–	–	100	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	100	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA	100	–	145	–
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	4.0	5.5	–	GHz
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz	3.0	4.5	–	dB
Noise Figure	NF	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 10 mA, f = 2 GHz, Z <sub>S</sub> = Z <sub>opt</sub>	–	2.0	3.0	dB
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 0.5 V, I <sub>E</sub> = 0 mA, f = 1 MHz	0.65	0.75	0.85	pF

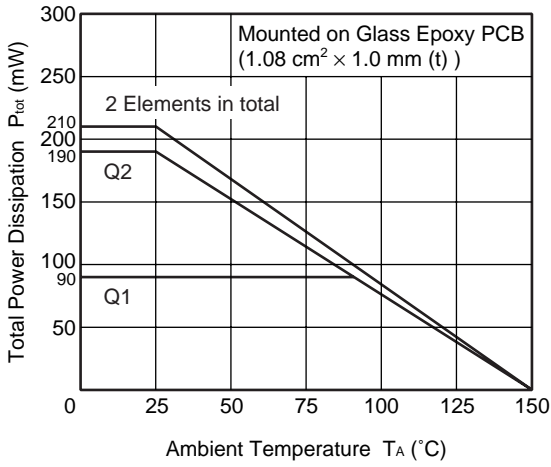
- Notes** 1. Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%  
 2. Collector to base capacitance when the emitter grounded

**hFE CLASSIFICATION**

Rank	FB
Marking	vN
hFE Value of Q1	70 to 140
hFE Value of Q2	100 to 145

**TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )**

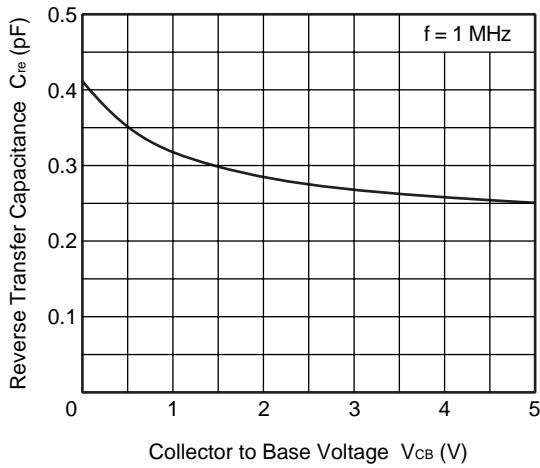
**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**



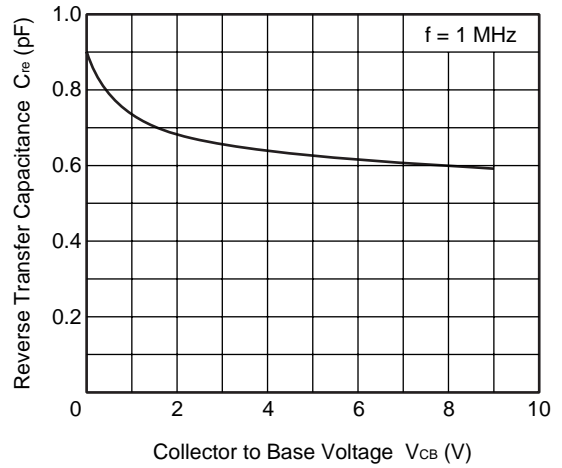
**Q1**

**Q2**

**REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE**

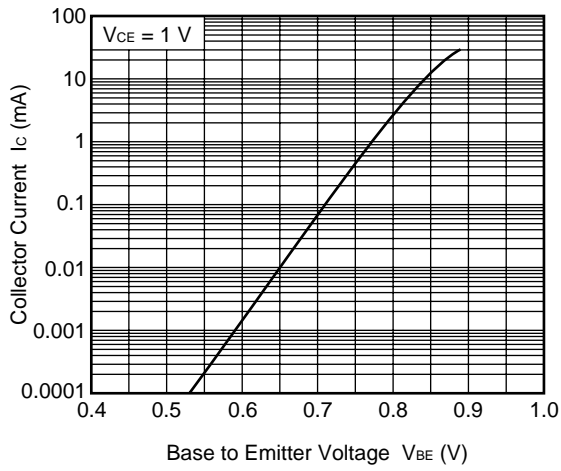


**REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE**



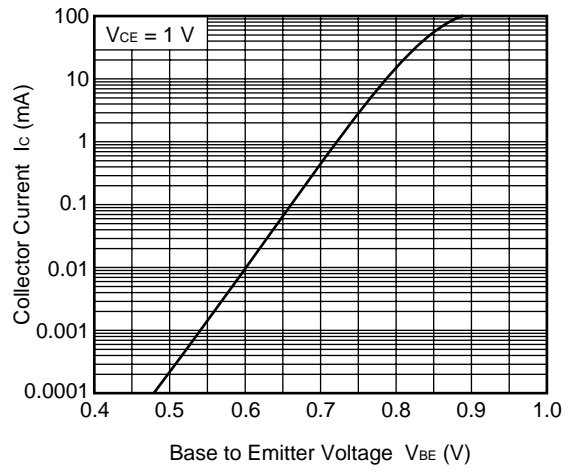
Q1

COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE

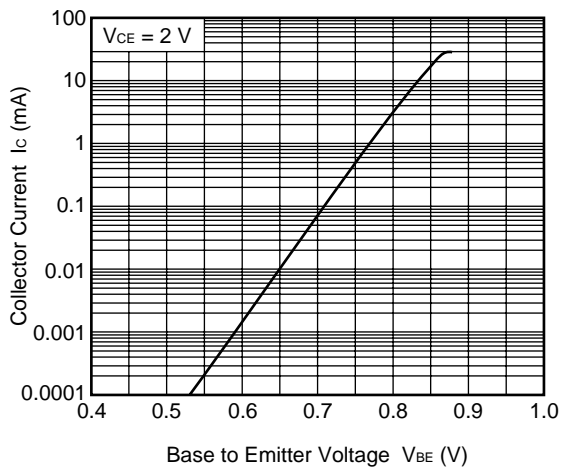


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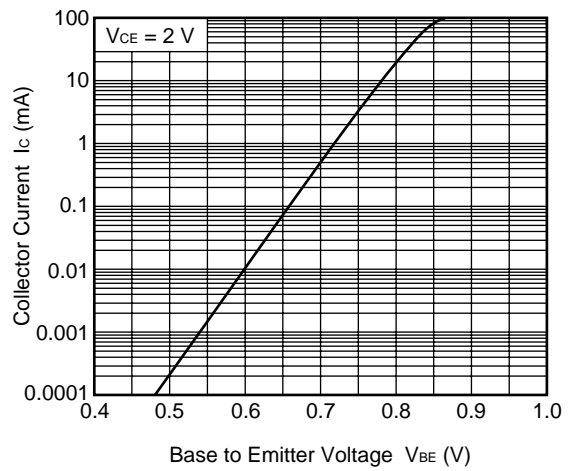
COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE

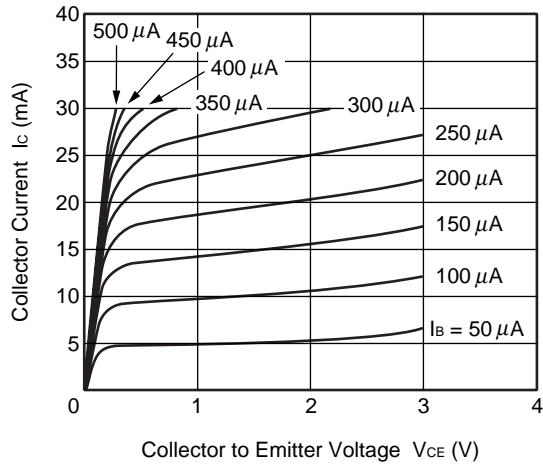


COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE



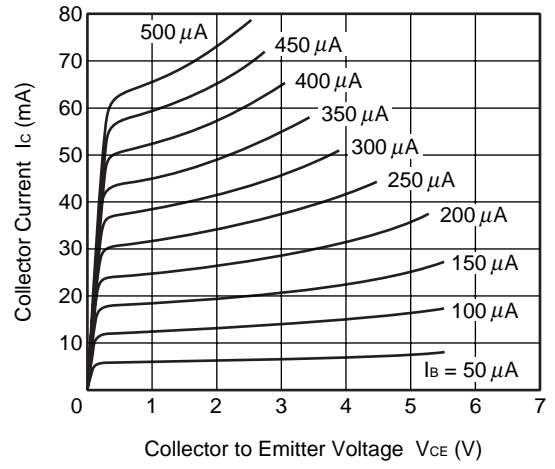
Q1

COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



Q2

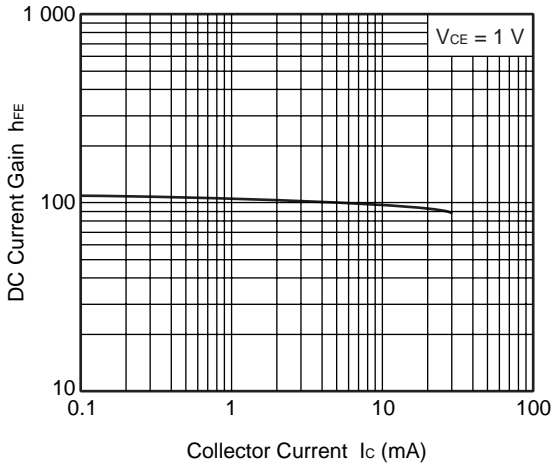
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE





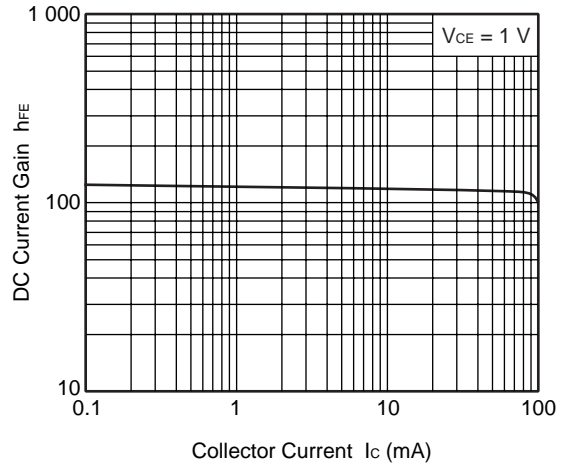
Q1

DC CURRENT GAIN vs. COLLECTOR CURRENT

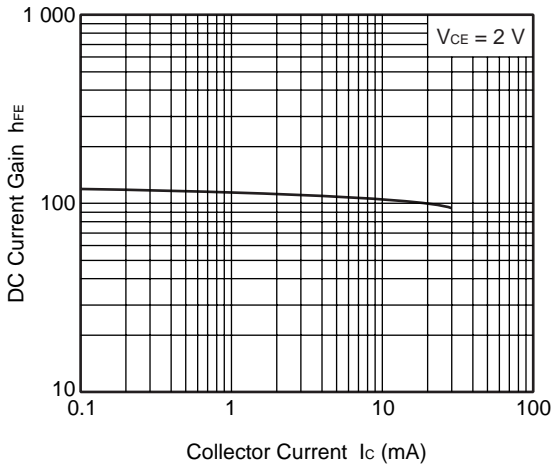


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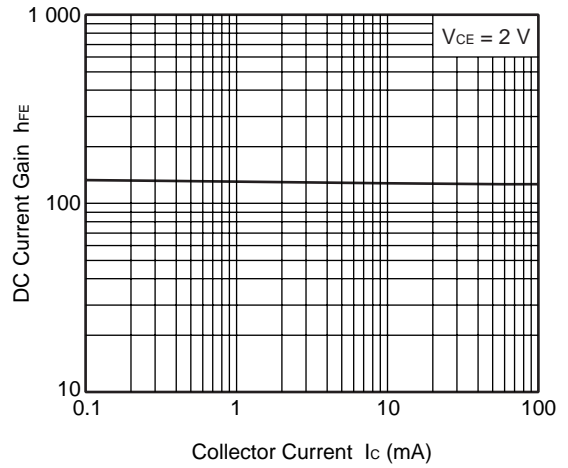
DC CURRENT GAIN vs. COLLECTOR CURRENT



DC CURRENT GAIN vs. COLLECTOR CURRENT

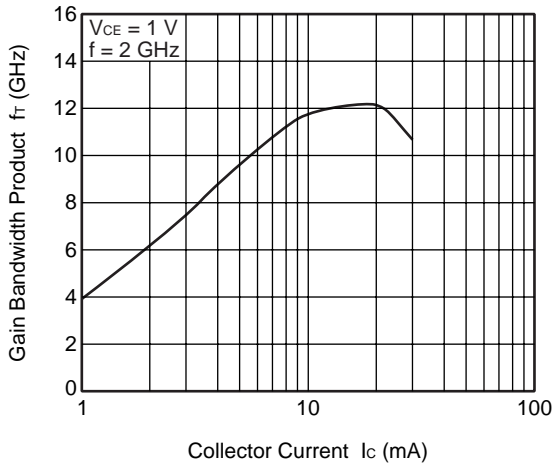


DC CURRENT GAIN vs. COLLECTOR CURRENT



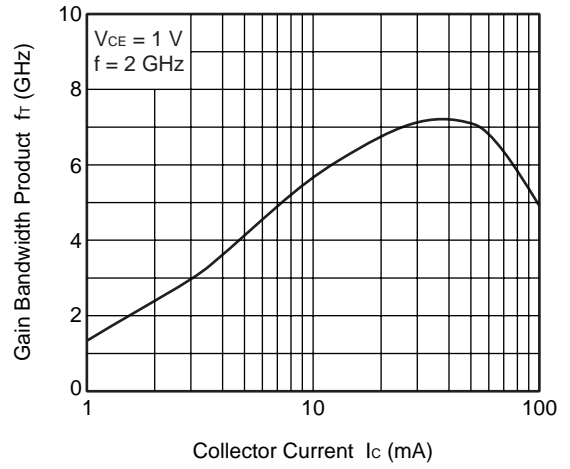
Q1

GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

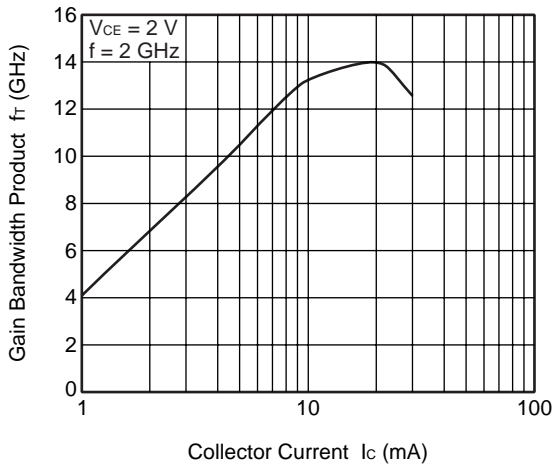


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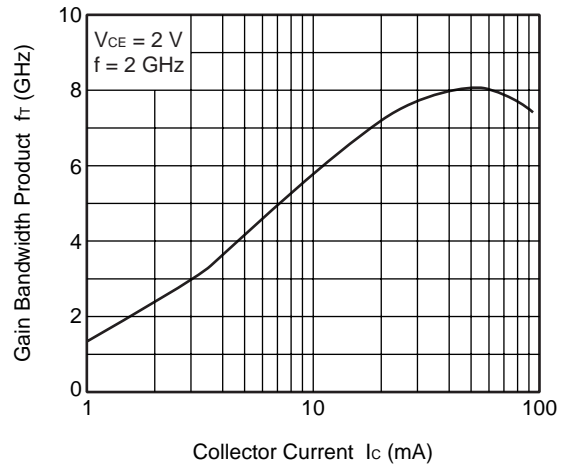
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

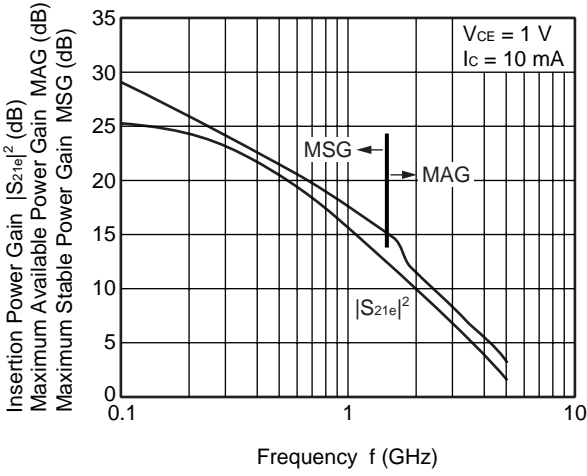


GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



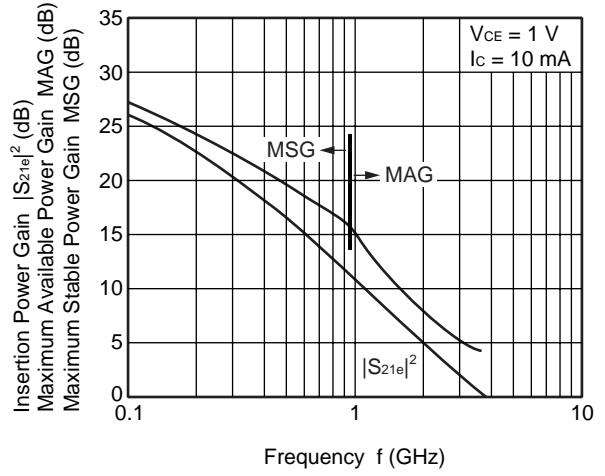
Q1

INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY

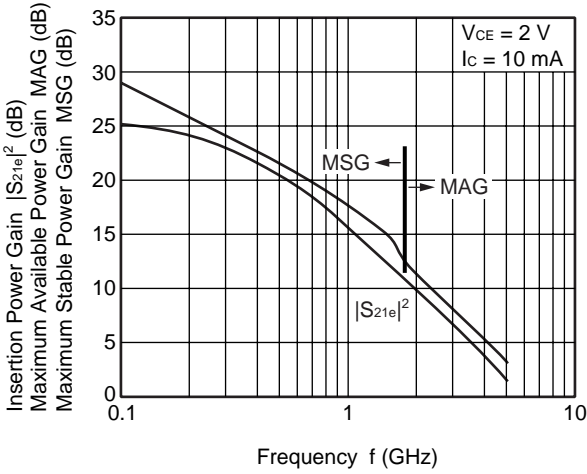


Q2

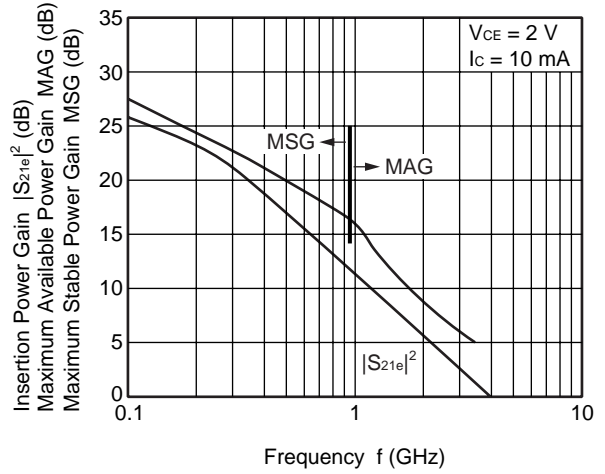
INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY



INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY

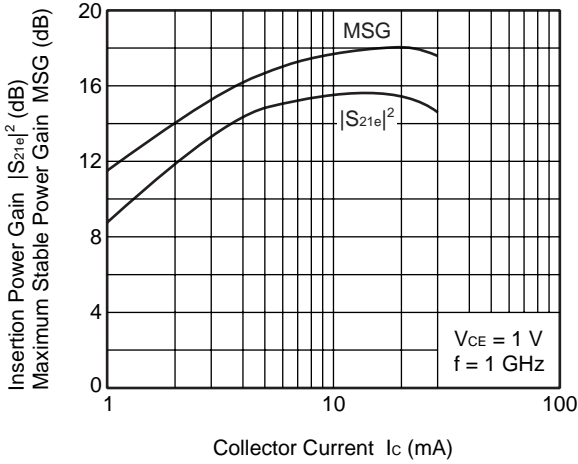


INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY



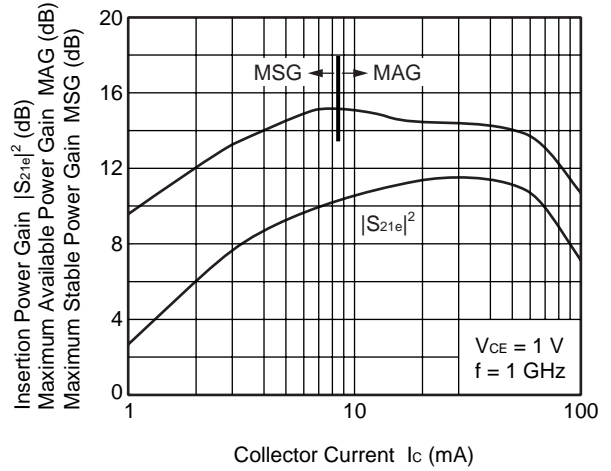
Q1

INSERTION POWER GAIN, MSG vs. COLLECTOR CURRENT

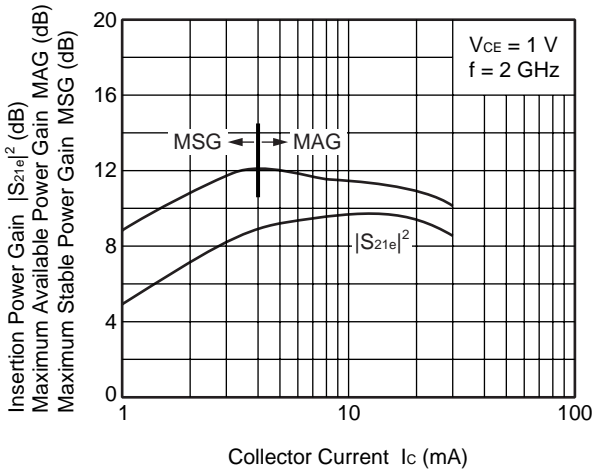


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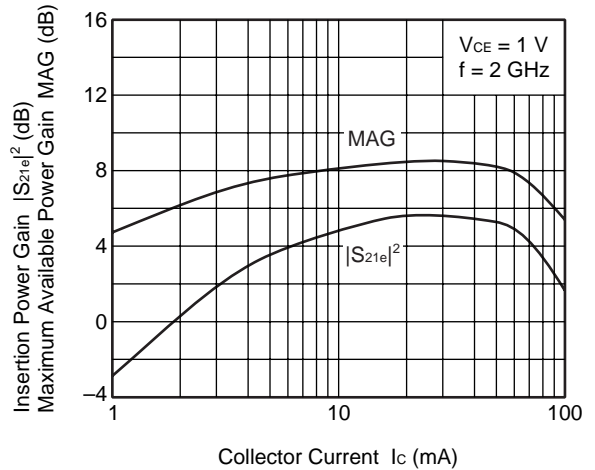
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



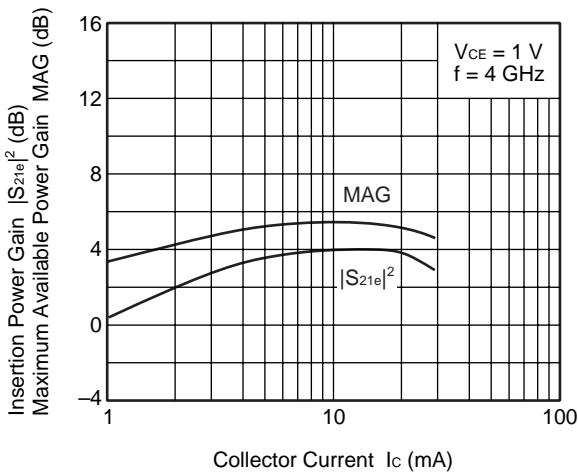
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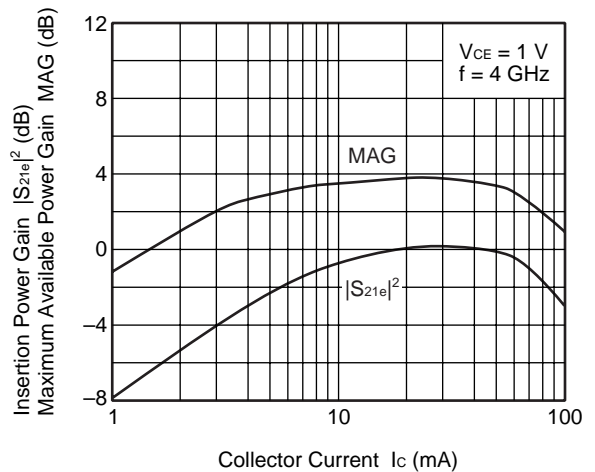
INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT

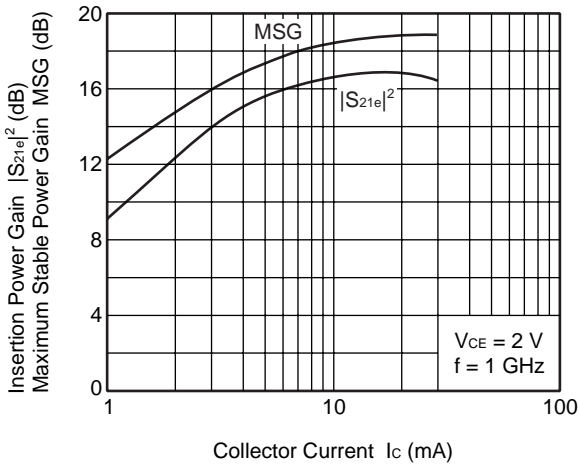


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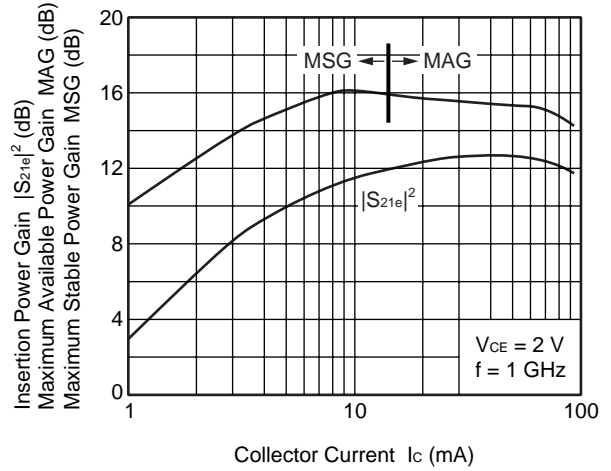
Q1

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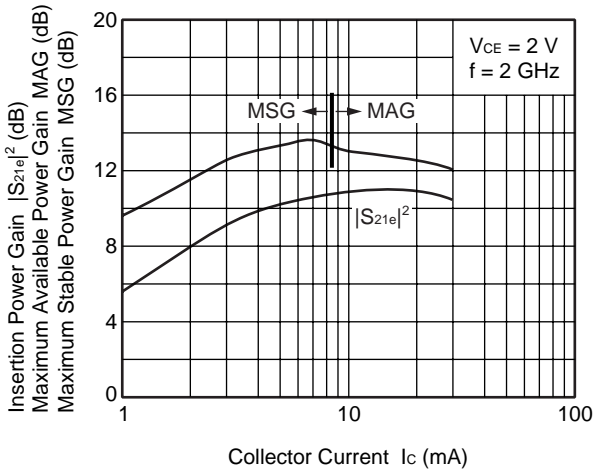


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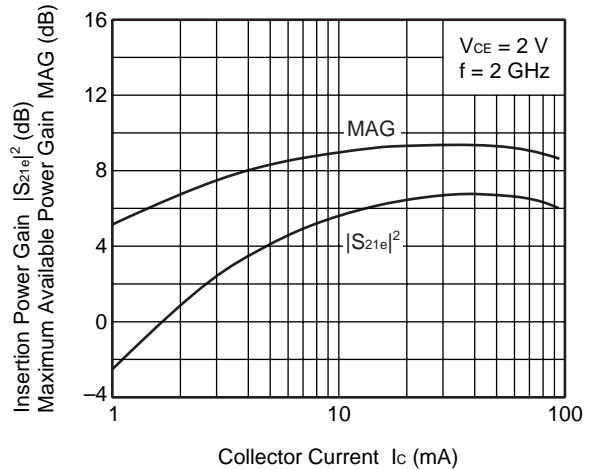
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



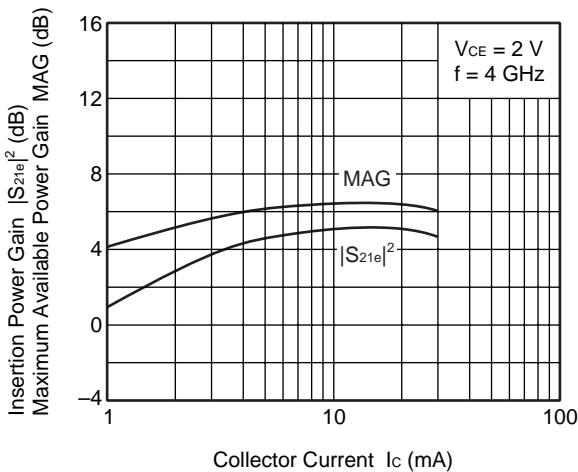
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



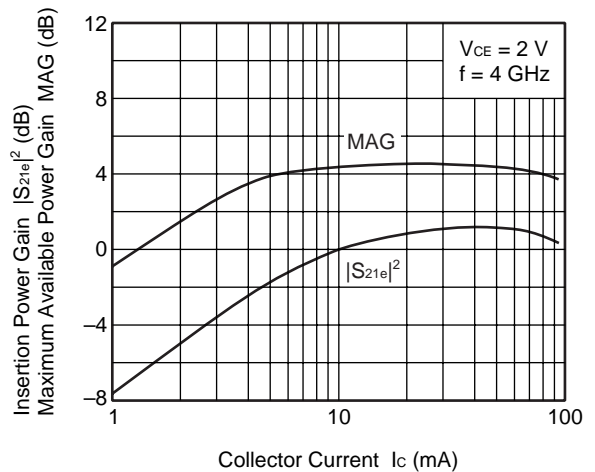
INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT

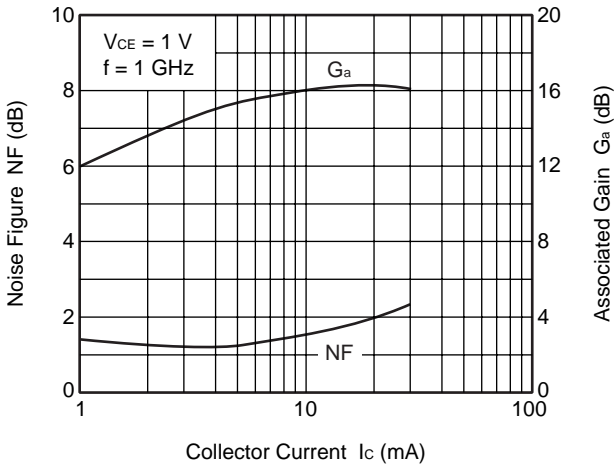


INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



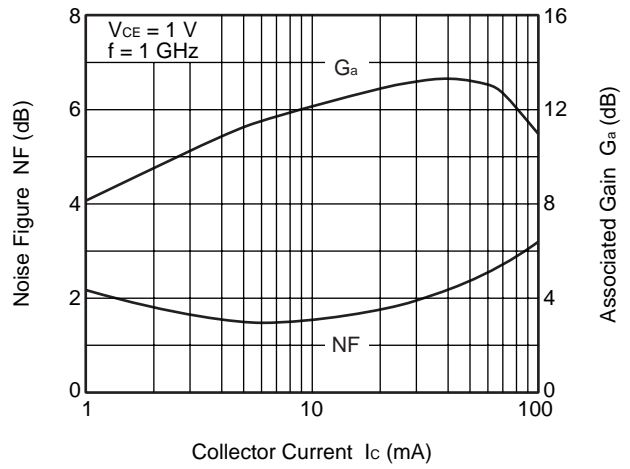
**Q1**

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

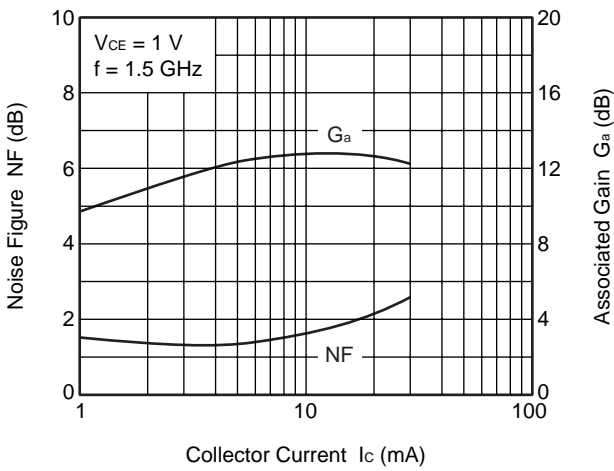


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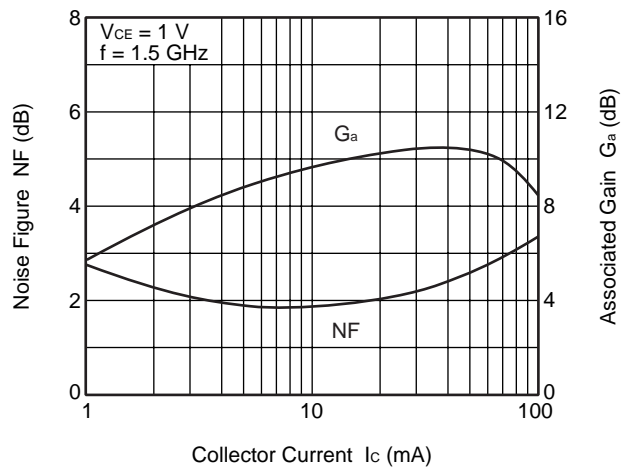
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



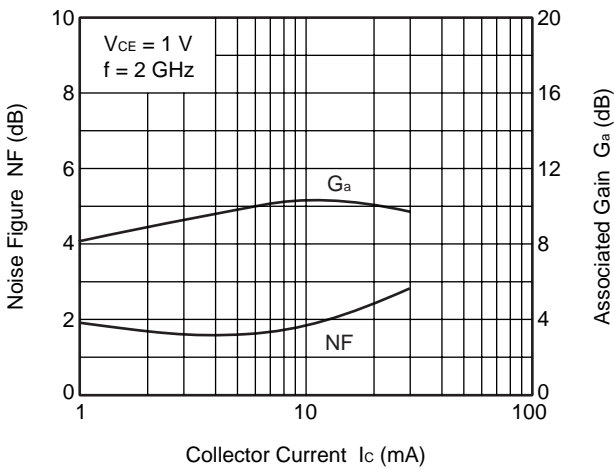
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



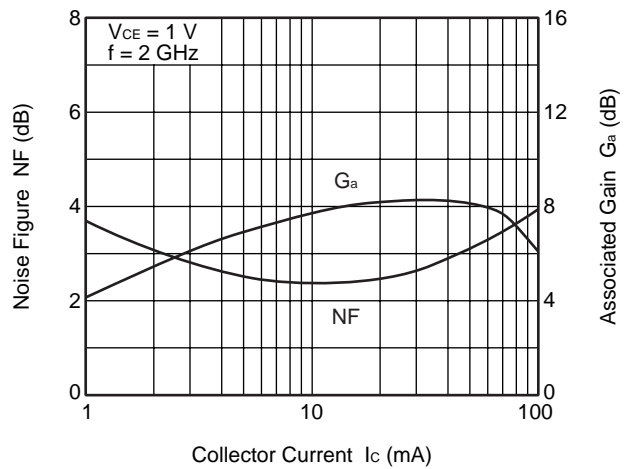
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

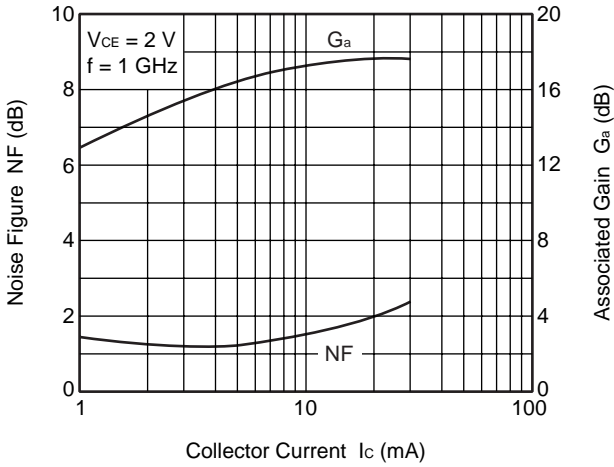


NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



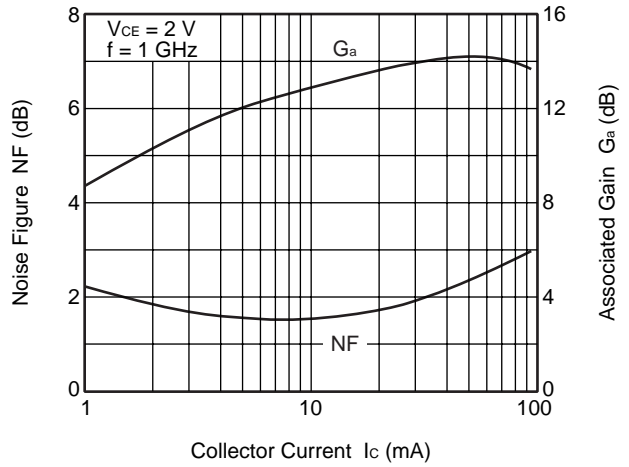
Q1

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

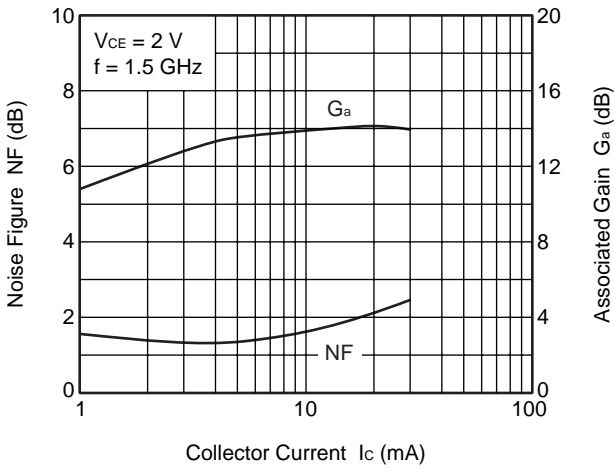


Q2

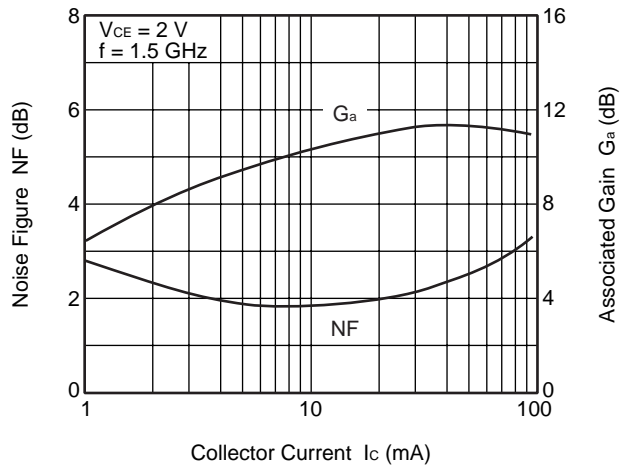
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



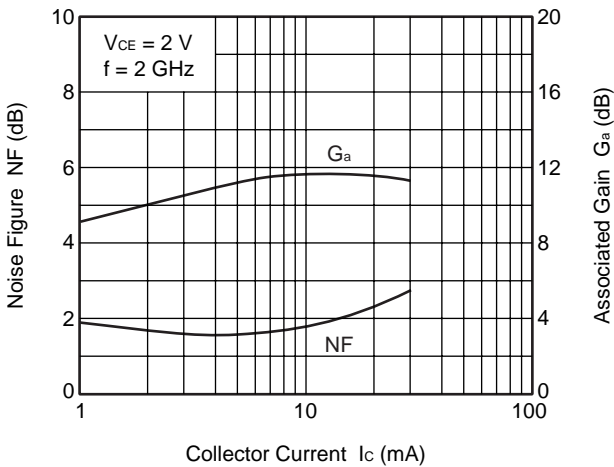
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



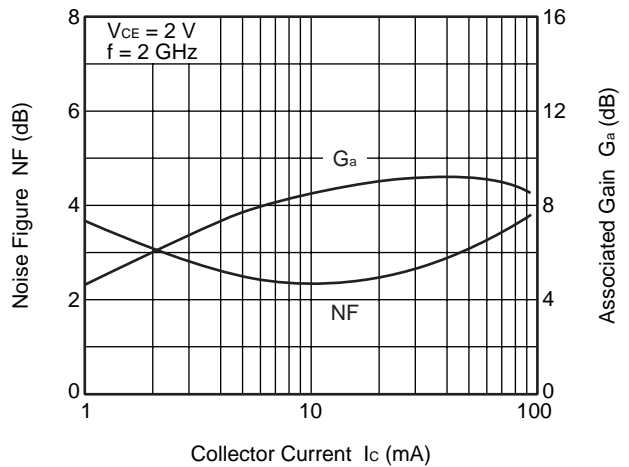
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



Remark The graphs indicate nominal characteristics.

**S-PARAMETERS Q1**

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 1 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.961	-8.4	3.504	171.5	0.024	80.6	0.996	-4.3
0.2	0.961	-15.5	3.429	166.5	0.049	79.5	0.984	-8.6
0.3	0.921	-24.3	3.361	160.1	0.074	75.1	0.975	-12.7
0.4	0.914	-32.7	3.329	153.0	0.096	70.1	0.952	-17.1
0.5	0.894	-40.6	3.294	146.8	0.118	65.1	0.933	-21.2
0.6	0.854	-48.3	3.179	139.9	0.138	60.1	0.892	-25.5
0.7	0.821	-56.5	3.093	134.1	0.155	55.8	0.864	-29.3
0.8	0.782	-64.0	2.979	127.8	0.169	51.5	0.821	-33.2
0.9	0.743	-71.7	2.853	122.7	0.182	47.5	0.787	-36.9
1.0	0.714	-79.5	2.743	117.4	0.192	43.9	0.744	-40.4
1.1	0.682	-87.0	2.625	112.0	0.201	40.4	0.716	-43.8
1.2	0.658	-94.6	2.525	106.9	0.209	37.5	0.681	-46.9
1.3	0.633	-101.3	2.402	102.5	0.215	34.2	0.658	-49.9
1.4	0.607	-108.3	2.298	97.6	0.219	31.4	0.627	-52.5
1.5	0.583	-114.2	2.193	93.8	0.223	29.1	0.609	-55.1
1.6	0.567	-120.7	2.097	89.7	0.225	26.7	0.581	-57.2
1.7	0.556	-126.5	2.014	86.2	0.226	24.6	0.563	-59.4
1.8	0.536	-132.0	1.926	82.2	0.226	23.0	0.540	-60.9
1.9	0.528	-136.4	1.849	79.5	0.226	21.4	0.526	-63.0
2.0	0.525	-141.8	1.769	76.1	0.226	20.2	0.508	-64.4
2.1	0.524	-146.5	1.713	73.4	0.226	19.0	0.497	-66.4
2.2	0.521	-150.5	1.666	70.9	0.225	18.0	0.484	-67.7
2.3	0.517	-154.4	1.604	67.9	0.224	17.1	0.479	-69.7
2.4	0.513	-158.8	1.557	66.0	0.223	16.1	0.466	-70.9
2.5	0.513	-162.4	1.498	63.5	0.221	15.5	0.461	-72.7
2.6	0.511	-166.4	1.457	60.4	0.220	13.9	0.455	-74.6
2.7	0.510	-169.2	1.422	58.4	0.219	13.4	0.449	-76.1
2.8	0.507	-173.0	1.377	56.0	0.218	12.6	0.443	-77.0
2.9	0.504	-175.7	1.342	54.1	0.219	12.9	0.433	-78.4
3.0	0.499	-179.3	1.304	51.9	0.217	12.7	0.423	-79.5
4.0	0.515	146.5	1.036	30.8	0.211	15.9	0.367	-101.8
5.0	0.556	113.6	0.823	12.1	0.243	19.4	0.373	-129.5

V<sub>CE</sub> = 1 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.878	-13.6	8.711	168.3	0.024	82.5	0.978	-8.4
0.2	0.871	-26.1	8.365	159.1	0.047	74.9	0.944	-16.6
0.3	0.808	-39.5	7.891	150.1	0.067	68.6	0.903	-24.0
0.4	0.773	-52.1	7.470	140.8	0.085	62.2	0.841	-31.1
0.5	0.726	-63.9	7.046	132.9	0.100	57.0	0.785	-37.3
0.6	0.665	-74.3	6.469	125.4	0.112	52.4	0.712	-43.0
0.7	0.620	-84.9	6.014	119.3	0.121	48.8	0.659	-47.9
0.8	0.576	-94.2	5.541	113.2	0.128	45.7	0.598	-52.4
0.9	0.541	-103.6	5.127	108.5	0.135	43.1	0.552	-56.7
1.0	0.517	-112.2	4.764	103.9	0.140	41.1	0.505	-60.5
1.1	0.491	-120.7	4.409	99.4	0.144	39.5	0.472	-64.1
1.2	0.477	-128.3	4.137	95.4	0.148	38.3	0.438	-67.7
1.3	0.465	-134.9	3.852	91.9	0.152	36.9	0.416	-70.6
1.4	0.451	-142.0	3.610	88.1	0.154	35.8	0.388	-73.6
1.5	0.442	-148.1	3.396	85.3	0.157	35.3	0.373	-75.8
1.6	0.438	-154.2	3.198	82.1	0.159	34.7	0.348	-78.2
1.7	0.438	-158.9	3.034	79.7	0.162	34.2	0.336	-80.3
1.8	0.430	-164.5	2.874	76.6	0.164	34.0	0.316	-82.1
1.9	0.426	-167.7	2.751	74.5	0.167	33.7	0.306	-84.2
2.0	0.435	-171.9	2.605	71.9	0.170	33.8	0.291	-85.8
2.1	0.439	-175.3	2.501	69.7	0.172	33.5	0.285	-88.2
2.2	0.438	-178.2	2.417	67.9	0.175	33.6	0.273	-89.5
2.3	0.436	179.1	2.317	65.4	0.178	33.5	0.270	-91.8
2.4	0.439	175.2	2.238	63.9	0.180	33.5	0.261	-92.9
2.5	0.440	172.4	2.144	62.1	0.183	33.5	0.258	-94.8
2.6	0.443	169.6	2.067	59.6	0.186	32.8	0.252	-96.2
2.7	0.442	167.3	2.020	58.0	0.189	32.8	0.248	-97.8
2.8	0.445	164.3	1.949	56.1	0.192	32.5	0.242	-98.7
2.9	0.444	162.5	1.894	54.5	0.197	32.8	0.236	-100.6
3.0	0.442	159.0	1.832	52.8	0.200	32.7	0.227	-101.7
4.0	0.478	132.4	1.395	34.7	0.239	31.9	0.213	-133.1
5.0	0.524	105.6	1.101	17.6	0.293	24.4	0.251	-161.8



V<sub>CE</sub> = 1 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.835	-18.0	12.432	165.7	0.023	77.9	0.962	-11.7
0.2	0.798	-34.1	11.680	153.8	0.045	71.8	0.906	-22.3
0.3	0.718	-50.7	10.667	143.3	0.062	65.1	0.838	-31.6
0.4	0.673	-64.9	9.750	133.1	0.077	58.9	0.753	-39.9
0.5	0.621	-78.5	8.900	124.8	0.088	54.2	0.680	-46.6
0.6	0.559	-90.1	7.952	117.6	0.097	50.4	0.600	-52.9
0.7	0.518	-101.3	7.232	111.9	0.104	48.0	0.541	-58.0
0.8	0.482	-111.3	6.549	106.3	0.109	46.0	0.482	-62.7
0.9	0.461	-121.1	5.965	102.0	0.115	44.6	0.438	-67.1
1.0	0.446	-129.7	5.476	98.0	0.119	43.6	0.398	-71.4
1.1	0.431	-137.6	5.020	94.1	0.124	42.9	0.370	-75.3
1.2	0.425	-145.0	4.670	90.5	0.128	42.6	0.341	-79.3
1.3	0.420	-151.2	4.327	87.6	0.132	41.8	0.323	-82.4
1.4	0.415	-157.8	4.033	84.3	0.135	41.5	0.301	-85.9
1.5	0.410	-162.8	3.787	81.8	0.139	41.5	0.288	-88.2
1.6	0.412	-168.1	3.553	79.0	0.143	41.3	0.269	-91.2
1.7	0.415	-172.5	3.357	76.9	0.147	41.1	0.259	-93.6
1.8	0.414	-177.4	3.178	74.3	0.151	41.2	0.243	-96.0
1.9	0.409	-179.9	3.037	72.4	0.154	41.2	0.237	-98.4
2.0	0.419	176.4	2.869	70.1	0.159	41.3	0.224	-100.7
2.1	0.426	173.8	2.749	68.1	0.163	41.1	0.221	-103.5
2.2	0.426	171.4	2.652	66.4	0.167	41.2	0.211	-105.3
2.3	0.425	168.8	2.549	64.2	0.172	41.1	0.210	-107.8
2.4	0.428	165.6	2.456	62.9	0.176	41.0	0.202	-109.2
2.5	0.431	163.5	2.349	61.2	0.180	40.9	0.201	-111.5
2.6	0.435	160.6	2.267	58.9	0.185	40.4	0.196	-113.0
2.7	0.435	158.7	2.204	57.3	0.189	40.1	0.193	-115.0
2.8	0.437	156.2	2.129	55.7	0.193	39.6	0.188	-116.0
2.9	0.437	154.3	2.067	54.2	0.200	39.6	0.184	-118.4
3.0	0.434	151.5	1.997	52.6	0.204	39.4	0.176	-120.1
4.0	0.475	127.5	1.506	35.5	0.252	35.9	0.194	-153.6
5.0	0.517	102.6	1.186	19.3	0.308	25.6	0.250	-178.6

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 7 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.774	-20.9	15.184	163.6	0.021	78.7	0.946	-14.0
0.2	0.742	-40.3	13.955	150.1	0.043	70.1	0.872	-26.5
0.3	0.656	-58.3	12.422	138.8	0.059	62.6	0.785	-36.9
0.4	0.607	-74.1	11.049	128.3	0.071	57.3	0.689	-45.8
0.5	0.556	-88.6	9.870	119.8	0.081	53.0	0.609	-52.7
0.6	0.500	-100.8	8.697	113.1	0.088	50.4	0.528	-59.1
0.7	0.468	-112.4	7.821	107.7	0.094	48.7	0.472	-64.3
0.8	0.438	-122.5	7.013	102.4	0.099	47.6	0.417	-69.3
0.9	0.423	-132.2	6.352	98.6	0.105	46.5	0.377	-73.9
1.0	0.415	-140.6	5.789	95.0	0.110	46.2	0.340	-78.7
1.1	0.405	-147.9	5.296	91.3	0.114	45.9	0.316	-82.8
1.2	0.405	-154.8	4.903	88.1	0.119	45.9	0.292	-87.4
1.3	0.404	-160.3	4.538	85.3	0.124	45.5	0.277	-90.6
1.4	0.401	-166.3	4.214	82.3	0.128	45.4	0.259	-94.7
1.5	0.401	-171.1	3.956	80.0	0.133	45.4	0.249	-97.3
1.6	0.404	-175.9	3.705	77.5	0.137	45.4	0.232	-100.8
1.7	0.410	-179.5	3.503	75.4	0.142	45.3	0.226	-103.3
1.8	0.408	176.2	3.312	73.1	0.146	45.4	0.212	-106.4
1.9	0.405	173.5	3.162	71.4	0.151	45.4	0.208	-109.1
2.0	0.418	170.5	2.984	69.1	0.156	45.5	0.197	-111.9
2.1	0.423	168.0	2.858	67.2	0.161	45.2	0.196	-114.8
2.2	0.424	166.0	2.758	65.7	0.166	45.1	0.188	-117.0
2.3	0.424	163.7	2.647	63.5	0.171	45.0	0.187	-119.6
2.4	0.429	160.9	2.551	62.3	0.175	44.8	0.181	-121.3
2.5	0.430	158.9	2.437	60.6	0.181	44.6	0.181	-123.6
2.6	0.434	156.2	2.355	58.4	0.185	43.9	0.176	-125.2
2.7	0.435	154.4	2.289	57.1	0.191	43.6	0.175	-127.4
2.8	0.437	152.2	2.211	55.3	0.196	43.0	0.170	-128.8
2.9	0.435	150.6	2.142	53.9	0.202	42.8	0.168	-131.3
3.0	0.437	147.5	2.071	52.4	0.207	42.4	0.161	-133.7
4.0	0.477	125.2	1.553	35.9	0.259	37.6	0.196	-165.1
5.0	0.520	101.3	1.218	20.1	0.316	26.1	0.260	-173.2

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 10 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.724	-24.8	18.069	161.1	0.022	161.1	0.925	-16.7
0.2	0.681	-47.1	16.226	146.0	0.041	67.7	0.830	-31.1
0.3	0.591	-67.7	13.997	134.1	0.055	61.2	0.727	-42.5
0.4	0.542	-84.4	12.159	123.5	0.066	56.5	0.622	-51.8
0.5	0.498	-99.6	10.637	115.3	0.074	52.9	0.540	-58.9
0.6	0.451	-112.2	9.261	109.0	0.081	51.0	0.462	-65.5
0.7	0.428	-123.6	8.230	103.9	0.086	50.2	0.408	-70.9
0.8	0.408	-133.7	7.343	99.2	0.092	49.4	0.359	-76.3
0.9	0.399	-142.7	6.616	95.5	0.097	49.0	0.323	-81.3
1.0	0.395	-150.4	6.012	92.1	0.103	49.1	0.293	-86.7
1.1	0.393	-157.3	5.480	89.0	0.108	49.2	0.273	-91.1
1.2	0.396	-163.5	5.054	85.9	0.113	49.3	0.253	-96.3
1.3	0.396	-168.6	4.671	83.4	0.118	49.0	0.242	-99.8
1.4	0.400	-173.9	4.336	80.4	0.123	49.0	0.227	-104.5
1.5	0.400	-178.2	4.066	78.5	0.128	49.1	0.220	-107.2
1.6	0.405	177.5	3.804	76.0	0.133	49.1	0.207	-111.4
1.7	0.412	174.6	3.586	74.2	0.138	48.9	0.202	-114.1
1.8	0.412	170.4	3.392	71.9	0.144	49.1	0.191	-117.9
1.9	0.410	168.0	3.243	70.3	0.149	48.9	0.189	-120.4
2.0	0.418	165.6	3.056	68.2	0.155	48.9	0.180	-124.0
2.1	0.426	163.3	2.923	66.4	0.161	48.5	0.181	-126.7
2.2	0.428	161.7	2.820	65.0	0.166	48.4	0.174	-129.5
2.3	0.427	159.6	2.706	62.8	0.172	48.1	0.176	-132.0
2.4	0.431	156.7	2.611	61.6	0.177	47.7	0.170	-134.0
2.5	0.434	155.0	2.495	60.1	0.182	47.4	0.171	-136.1
2.6	0.440	152.4	2.404	58.0	0.187	46.8	0.167	-137.9
2.7	0.437	150.9	2.340	56.5	0.193	46.3	0.167	-140.1
2.8	0.442	148.7	2.257	55.0	0.199	45.6	0.162	-141.8
2.9	0.440	147.1	2.190	53.7	0.205	45.2	0.162	-144.4
3.0	0.440	144.4	2.117	52.1	0.210	44.7	0.156	-147.0
4.0	0.479	123.5	1.580	36.0	0.265	38.8	0.205	-174.6
5.0	0.523	100.3	1.240	20.6	0.322	26.4	0.274	166.6

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 20 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.608	-35.8	22.647	156.5	0.020	69.4	0.869	-22.4
0.2	0.565	-63.1	19.141	138.2	0.039	63.6	0.736	-40.2
0.3	0.486	-88.1	15.689	125.8	0.049	57.8	0.610	-52.9
0.4	0.452	-106.0	13.073	115.8	0.058	55.3	0.501	-62.8
0.5	0.432	-121.3	11.093	108.2	0.065	53.2	0.424	-70.1
0.6	0.407	-133.7	9.495	102.6	0.072	53.0	0.357	-77.5
0.7	0.397	-144.1	8.346	98.2	0.077	52.9	0.312	-83.4
0.8	0.394	-152.7	7.372	94.0	0.083	53.3	0.273	-90.1
0.9	0.396	-160.6	6.613	91.0	0.089	53.2	0.248	-96.0
1.0	0.403	-166.5	5.971	87.9	0.095	53.5	0.228	-102.7
1.1	0.401	-172.0	5.424	85.1	0.101	53.9	0.216	-107.9
1.2	0.410	-177.1	4.996	82.3	0.107	54.0	0.205	-114.2
1.3	0.415	179.3	4.607	80.2	0.113	53.9	0.199	-117.9
1.4	0.420	174.9	4.267	77.5	0.119	53.9	0.191	-123.4
1.5	0.422	171.5	3.999	75.8	0.125	53.9	0.188	-126.2
1.6	0.429	167.8	3.738	73.5	0.131	53.9	0.181	-131.2
1.7	0.436	165.7	3.522	71.8	0.137	53.6	0.180	-133.6
1.8	0.438	162.3	3.330	69.8	0.143	53.5	0.174	-138.3
1.9	0.433	160.4	3.183	68.2	0.149	53.2	0.174	-140.6
2.0	0.445	158.4	3.000	66.2	0.155	52.9	0.170	-144.7
2.1	0.450	156.5	2.871	64.4	0.162	52.4	0.173	-146.9
2.2	0.452	155.0	2.763	63.1	0.168	52.1	0.169	-149.9
2.3	0.452	153.0	2.657	61.0	0.174	51.6	0.172	-152.0
2.4	0.455	151.0	2.558	60.0	0.180	51.1	0.168	-154.1
2.5	0.460	149.3	2.443	58.5	0.186	50.6	0.171	-155.9
2.6	0.464	147.2	2.354	56.5	0.192	49.8	0.168	-157.7
2.7	0.460	145.6	2.295	55.2	0.197	49.2	0.169	-159.6
2.8	0.464	143.7	2.216	53.5	0.203	48.3	0.166	-161.6
2.9	0.464	142.2	2.150	52.4	0.210	47.8	0.167	-163.7
3.0	0.464	140.0	2.076	50.8	0.216	47.1	0.163	-166.8
4.0	0.502	120.8	1.545	35.1	0.273	39.9	0.226	172.9
5.0	0.541	98.2	1.211	20.2	0.330	26.4	0.298	158.0

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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.946	-7.0	3.466	172.3	0.019	87.8	0.998	-3.5
0.2	0.966	-13.6	3.390	167.9	0.041	80.9	0.989	-7.0
0.3	0.934	-21.4	3.330	162.2	0.061	76.9	0.983	-10.3
0.4	0.925	-29.0	3.308	155.7	0.081	72.4	0.964	-14.1
0.5	0.910	-36.1	3.293	150.0	0.099	68.0	0.950	-17.5
0.6	0.875	-43.1	3.205	143.5	0.117	63.5	0.917	-21.2
0.7	0.845	-50.5	3.139	138.2	0.132	59.6	0.896	-24.6
0.8	0.809	-57.5	3.042	132.2	0.145	55.4	0.859	-28.1
0.9	0.769	-64.6	2.931	127.3	0.158	51.7	0.828	-31.4
1.0	0.741	-71.7	2.838	122.2	0.168	48.2	0.791	-34.4
1.1	0.710	-78.9	2.733	117.0	0.177	44.9	0.766	-37.6
1.2	0.681	-86.1	2.648	112.0	0.184	42.0	0.733	-40.4
1.3	0.656	-92.7	2.527	107.6	0.191	38.7	0.714	-43.2
1.4	0.629	-99.3	2.434	102.8	0.196	35.9	0.683	-45.6
1.5	0.602	-105.4	2.328	98.9	0.200	33.6	0.667	-48.1
1.6	0.583	-111.7	2.237	94.8	0.202	31.2	0.640	-50.1
1.7	0.568	-117.4	2.156	91.3	0.204	29.1	0.623	-52.3
1.8	0.548	-123.2	2.067	87.3	0.205	27.3	0.599	-53.8
1.9	0.534	-127.6	1.986	84.5	0.206	25.7	0.583	-55.6
2.0	0.532	-133.3	1.904	81.0	0.206	24.5	0.566	-56.8
2.1	0.528	-138.1	1.844	78.2	0.207	23.2	0.554	-58.9
2.2	0.521	-142.2	1.794	75.7	0.206	22.3	0.541	-59.9
2.3	0.513	-146.4	1.727	72.8	0.206	21.4	0.535	-61.6
2.4	0.507	-151.0	1.681	70.8	0.205	20.4	0.522	-63.0
2.5	0.503	-155.0	1.616	68.4	0.203	19.7	0.516	-64.5
2.6	0.503	-159.0	1.575	65.3	0.203	18.2	0.511	-66.3
2.7	0.499	-162.1	1.537	63.2	0.202	17.7	0.504	-67.8
2.8	0.497	-166.0	1.489	60.7	0.201	16.9	0.498	-68.5
2.9	0.493	-168.8	1.444	58.8	0.203	17.3	0.489	-69.5
3.0	0.485	-173.0	1.406	56.6	0.201	17.0	0.478	-70.6
4.0	0.491	150.8	1.120	35.1	0.200	20.7	0.412	-90.2
5.0	0.533	116.2	0.889	15.8	0.235	24.2	0.402	-115.8

V<sub>CE</sub> = 2 V, I<sub>C</sub> = 3 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.899	-12.1	8.488	169.7	0.019	84.5	0.984	-6.7
0.2	0.889	-22.1	8.219	161.7	0.039	76.8	0.958	-13.3
0.3	0.830	-33.1	7.859	153.5	0.056	71.9	0.928	-19.3
0.4	0.803	-44.3	7.532	145.0	0.073	66.2	0.878	-25.2
0.5	0.760	-54.6	7.205	137.6	0.087	61.4	0.834	-30.5
0.6	0.699	-63.9	6.714	130.3	0.099	56.8	0.770	-35.5
0.7	0.652	-73.5	6.322	124.3	0.108	53.5	0.722	-39.9
0.8	0.603	-82.1	5.886	118.4	0.115	50.1	0.665	-43.9
0.9	0.564	-90.8	5.494	113.6	0.122	47.6	0.620	-47.6
1.0	0.532	-99.1	5.140	108.9	0.128	45.4	0.574	-50.9
1.1	0.502	-107.2	4.793	104.4	0.133	43.6	0.541	-54.1
1.2	0.481	-115.1	4.524	100.1	0.137	42.2	0.505	-57.1
1.3	0.464	-121.9	4.219	96.5	0.140	40.6	0.483	-59.6
1.4	0.445	-129.3	3.973	92.7	0.143	39.5	0.452	-62.1
1.5	0.430	-135.2	3.751	89.8	0.147	38.7	0.435	-64.0
1.6	0.419	-141.5	3.539	86.4	0.149	38.1	0.409	-66.1
1.7	0.416	-147.0	3.366	83.9	0.152	37.3	0.395	-67.7
1.8	0.405	-153.0	3.195	80.8	0.154	37.1	0.375	-69.0
1.9	0.398	-156.6	3.052	78.6	0.156	36.7	0.363	-70.8
2.0	0.404	-161.9	2.896	76.0	0.159	36.6	0.346	-71.9
2.1	0.406	-165.5	2.786	73.7	0.162	36.4	0.338	-74.0
2.2	0.405	-168.9	2.685	71.9	0.165	36.5	0.326	-74.9
2.3	0.404	-172.1	2.582	69.4	0.168	36.3	0.321	-76.7
2.4	0.405	-175.9	2.489	67.9	0.170	36.2	0.311	-77.5
2.5	0.405	-179.3	2.387	66.0	0.173	36.2	0.306	-79.2
2.6	0.407	177.2	2.310	63.5	0.175	35.6	0.301	-80.3
2.7	0.405	174.9	2.249	61.9	0.179	35.5	0.295	-81.6
2.8	0.405	171.7	2.169	59.9	0.182	35.2	0.290	-82.1
2.9	0.406	169.4	2.101	58.4	0.186	35.5	0.282	-83.4
3.0	0.403	165.8	2.038	56.5	0.189	35.4	0.273	-84.2
4.0	0.437	136.6	1.557	38.2	0.228	34.9	0.233	-110.9
5.0	0.486	108.0	1.225	20.9	0.281	27.8	0.245	-141.1

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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.839	-14.1	11.944	167.5	0.019	80.9	0.971	-8.9
0.2	0.830	-27.6	11.355	157.5	0.038	75.6	0.931	-17.4
0.3	0.756	-41.5	10.589	148.1	0.053	68.9	0.882	-25.0
0.4	0.714	-53.8	9.885	138.6	0.067	63.4	0.813	-32.0
0.5	0.664	-65.6	9.207	130.6	0.079	58.7	0.751	-37.7
0.6	0.597	-75.8	8.378	123.3	0.088	54.9	0.675	-43.1
0.7	0.549	-86.0	7.729	117.5	0.095	52.4	0.621	-47.4
0.8	0.504	-95.6	7.074	111.8	0.101	50.1	0.561	-51.5
0.9	0.470	-104.8	6.490	107.4	0.107	48.3	0.516	-55.2
1.0	0.446	-113.3	6.003	103.2	0.112	47.2	0.472	-58.6
1.1	0.423	-121.7	5.544	99.0	0.116	46.2	0.441	-61.8
1.2	0.408	-129.7	5.178	95.3	0.120	45.6	0.409	-64.9
1.3	0.397	-136.4	4.804	92.2	0.124	44.6	0.388	-67.4
1.4	0.386	-143.5	4.496	88.7	0.128	44.1	0.362	-70.0
1.5	0.380	-149.3	4.229	86.1	0.132	43.9	0.348	-72.0
1.6	0.377	-155.5	3.978	83.2	0.135	43.6	0.325	-74.1
1.7	0.377	-160.5	3.769	81.0	0.139	43.3	0.313	-75.9
1.8	0.370	-166.1	3.569	78.2	0.143	43.3	0.295	-77.4
1.9	0.364	-169.3	3.407	76.3	0.146	43.2	0.285	-79.4
2.0	0.372	-173.3	3.226	73.9	0.150	43.2	0.270	-80.6
2.1	0.379	-176.8	3.093	71.8	0.154	43.1	0.265	-82.9
2.2	0.378	-180.0	2.980	70.2	0.158	43.1	0.254	-83.9
2.3	0.377	177.8	2.861	67.9	0.163	43.0	0.250	-86.0
2.4	0.378	174.1	2.758	66.6	0.166	42.8	0.241	-86.8
2.5	0.381	171.3	2.638	64.9	0.170	42.8	0.238	-88.8
2.6	0.385	168.3	2.548	62.5	0.174	42.2	0.233	-89.8
2.7	0.386	166.2	2.479	61.0	0.178	42.0	0.228	-91.2
2.8	0.388	163.2	2.389	59.2	0.182	41.4	0.223	-91.7
2.9	0.386	161.3	2.316	57.7	0.188	41.6	0.217	-93.3
3.0	0.385	158.0	2.240	56.1	0.192	41.3	0.208	-94.2
4.0	0.425	131.8	1.694	39.0	0.239	38.5	0.191	-126.6
5.0	0.476	105.0	1.325	22.6	0.296	28.7	0.223	-157.5

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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.805	-16.7	14.517	166.0	0.018	80.4	0.961	-10.6
0.2	0.780	-31.7	13.607	154.4	0.036	73.4	0.907	-20.5
0.3	0.699	-47.1	12.452	144.1	0.051	67.3	0.843	-28.9
0.4	0.652	-60.6	11.390	134.3	0.063	62.0	0.761	-36.4
0.5	0.598	-73.5	10.393	126.0	0.073	57.6	0.690	-42.4
0.6	0.530	-84.2	9.318	119.0	0.081	54.5	0.612	-47.9
0.7	0.487	-95.1	8.489	113.5	0.088	52.7	0.555	-52.1
0.8	0.446	-104.6	7.695	107.9	0.093	51.0	0.497	-56.2
0.9	0.419	-114.0	7.017	103.8	0.098	49.8	0.453	-59.9
1.0	0.400	-122.8	6.442	99.9	0.103	49.1	0.413	-63.5
1.1	0.382	-131.1	5.929	96.2	0.108	48.6	0.384	-66.6
1.2	0.376	-138.7	5.500	92.7	0.112	48.4	0.355	-70.0
1.3	0.368	-145.5	5.107	89.7	0.117	47.7	0.337	-72.5
1.4	0.362	-152.2	4.760	86.5	0.121	47.5	0.313	-75.4
1.5	0.356	-157.8	4.465	84.2	0.126	47.4	0.301	-77.3
1.6	0.357	-163.6	4.196	81.5	0.130	47.3	0.280	-79.7
1.7	0.360	-168.2	3.966	79.5	0.134	47.0	0.270	-81.6
1.8	0.354	-173.5	3.758	76.8	0.138	47.1	0.253	-83.5
1.9	0.352	-176.3	3.587	75.1	0.142	46.9	0.246	-85.5
2.0	0.363	-180.0	3.387	72.8	0.147	47.1	0.232	-87.0
2.1	0.367	176.6	3.250	70.8	0.152	46.8	0.228	-89.6
2.2	0.369	174.2	3.127	69.3	0.156	46.8	0.218	-90.8
2.3	0.368	171.7	3.002	67.1	0.161	46.6	0.215	-93.1
2.4	0.371	168.5	2.893	66.0	0.166	46.4	0.207	-94.0
2.5	0.375	166.1	2.764	64.3	0.170	46.2	0.205	-96.0
2.6	0.378	163.2	2.666	62.1	0.175	45.6	0.200	-97.0
2.7	0.376	161.3	2.599	60.6	0.179	45.3	0.196	-98.8
2.8	0.380	158.8	2.502	58.9	0.184	44.7	0.191	-99.3
2.9	0.379	156.6	2.425	57.6	0.191	44.7	0.186	-101.2
3.0	0.378	153.2	2.346	55.9	0.195	44.2	0.178	-102.4
4.0	0.422	129.2	1.762	39.4	0.246	40.1	0.177	-137.7
5.0	0.472	103.7	1.373	23.5	0.303	29.1	0.222	-167.1

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 10 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.757	-18.6	17.288	164.0	0.017	79.7	0.949	-12.5
0.2	0.730	-36.4	15.936	151.1	0.035	71.7	0.879	-23.8
0.3	0.638	-53.4	14.259	140.2	0.048	65.7	0.798	-33.0
0.4	0.585	-68.3	12.756	129.9	0.059	60.9	0.706	-40.9
0.5	0.532	-81.3	11.422	121.7	0.068	57.1	0.628	-46.9
0.6	0.470	-93.0	10.109	115.0	0.075	54.9	0.550	-52.4
0.7	0.432	-103.8	9.097	109.6	0.081	53.4	0.494	-56.6
0.8	0.398	-113.9	8.189	104.6	0.086	52.5	0.439	-60.6
0.9	0.379	-123.8	7.416	100.7	0.092	51.7	0.398	-64.3
1.0	0.367	-132.2	6.779	97.0	0.097	51.5	0.361	-68.0
1.1	0.355	-140.6	6.207	93.5	0.102	51.4	0.335	-71.3
1.2	0.351	-147.9	5.767	90.4	0.107	51.2	0.309	-74.9
1.3	0.348	-154.3	5.316	87.7	0.111	50.9	0.293	-77.5
1.4	0.347	-160.2	4.956	84.7	0.116	50.7	0.273	-80.7
1.5	0.344	-165.8	4.648	82.4	0.121	50.7	0.262	-82.8
1.6	0.345	-171.1	4.359	80.0	0.126	50.6	0.244	-85.5
1.7	0.350	-175.2	4.119	78.0	0.131	50.4	0.236	-87.5
1.8	0.351	179.5	3.895	75.7	0.136	50.4	0.220	-89.7
1.9	0.346	177.2	3.718	73.9	0.140	50.3	0.215	-92.0
2.0	0.358	174.3	3.513	71.8	0.146	50.3	0.202	-93.8
2.1	0.363	171.3	3.363	69.9	0.151	49.9	0.199	-96.6
2.2	0.366	169.3	3.238	68.5	0.156	49.8	0.190	-98.1
2.3	0.363	166.6	3.107	66.3	0.161	49.6	0.188	-100.6
2.4	0.367	163.6	2.991	65.3	0.166	49.2	0.181	-101.7
2.5	0.370	161.7	2.858	63.7	0.171	49.0	0.180	-103.9
2.6	0.375	158.8	2.757	61.6	0.176	48.3	0.175	-105.0
2.7	0.375	157.4	2.679	60.1	0.181	47.9	0.172	-106.9
2.8	0.377	154.5	2.585	58.5	0.186	47.2	0.167	-107.5
2.9	0.376	152.8	2.509	57.2	0.193	47.0	0.164	-109.8
3.0	0.377	149.9	2.424	55.6	0.198	46.5	0.156	-111.2
4.0	0.422	126.9	1.809	39.6	0.251	41.3	0.171	-147.7
5.0	0.472	102.4	1.411	24.0	0.309	29.4	0.226	-174.9

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 20 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.693	-23.2	20.755	161.5	0.018	76.8	0.924	-15.1
0.2	0.646	-44.1	18.601	146.4	0.034	69.2	0.833	-28.1
0.3	0.554	-63.5	16.123	134.7	0.045	64.2	0.733	-38.2
0.4	0.502	-79.4	14.027	124.5	0.055	59.7	0.630	-46.3
0.5	0.457	-94.1	12.284	116.5	0.062	57.1	0.551	-52.1
0.6	0.407	-106.1	10.702	110.1	0.069	55.8	0.474	-57.3
0.7	0.383	-117.8	9.538	105.3	0.074	55.1	0.420	-61.5
0.8	0.356	-128.4	8.513	100.5	0.080	54.7	0.370	-65.4
0.9	0.346	-137.6	7.666	97.1	0.085	54.4	0.333	-69.2
1.0	0.344	-145.8	6.969	93.8	0.091	54.4	0.301	-73.2
1.1	0.337	-153.3	6.358	90.7	0.096	54.5	0.279	-76.6
1.2	0.339	-160.1	5.876	87.6	0.102	54.6	0.257	-80.6
1.3	0.341	-165.1	5.440	85.1	0.107	54.2	0.244	-83.4
1.4	0.343	-171.1	5.040	82.3	0.112	54.1	0.227	-87.0
1.5	0.345	-175.7	4.720	80.4	0.118	54.2	0.219	-89.2
1.6	0.348	179.7	4.413	78.0	0.123	54.1	0.203	-92.2
1.7	0.355	176.3	4.170	76.3	0.128	53.9	0.197	-94.5
1.8	0.356	171.7	3.950	74.0	0.134	53.8	0.184	-97.3
1.9	0.354	169.7	3.765	72.5	0.139	53.5	0.180	-99.8
2.0	0.364	167.1	3.555	70.4	0.145	53.3	0.169	-102.2
2.1	0.371	164.7	3.399	68.6	0.151	53.0	0.168	-105.2
2.2	0.371	163.0	3.275	67.2	0.156	52.7	0.160	-107.1
2.3	0.372	161.1	3.140	65.2	0.162	52.3	0.160	-109.9
2.4	0.374	158.2	3.027	64.1	0.167	51.9	0.154	-111.0
2.5	0.380	156.5	2.892	62.6	0.173	51.5	0.154	-113.5
2.6	0.383	153.7	2.786	60.5	0.178	50.7	0.149	-114.7
2.7	0.383	152.3	2.707	59.2	0.183	50.2	0.147	-116.9
2.8	0.387	150.0	2.611	57.6	0.189	49.4	0.143	-117.7
2.9	0.384	148.5	2.536	56.2	0.195	49.0	0.140	-120.2
3.0	0.386	145.6	2.448	54.8	0.201	48.5	0.133	-122.3
4.0	0.431	124.7	1.820	39.2	0.256	42.2	0.165	-158.8
5.0	0.478	100.9	1.416	24.1	0.314	29.5	0.228	-177.0

**S-PARAMETERS Q2**

V<sub>CE</sub> = 1 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.954	-27.3	3.559	163.5	0.049	74.8	0.978	-9.3
0.2	0.920	-50.9	3.308	146.1	0.091	60.9	0.925	-17.3
0.3	0.885	-72.7	2.962	131.9	0.120	48.9	0.862	-23.7
0.4	0.848	-90.9	2.618	120.1	0.139	39.3	0.801	-28.8
0.5	0.820	-105.9	2.305	109.6	0.151	31.6	0.749	-32.8
0.6	0.794	-118.4	2.056	101.4	0.157	25.5	0.707	-36.3
0.7	0.782	-129.3	1.849	93.5	0.159	20.5	0.674	-39.5
0.8	0.772	-138.0	1.654	86.8	0.159	16.3	0.649	-42.7
0.9	0.766	-145.7	1.504	80.9	0.156	13.1	0.630	-46.2
1.0	0.762	-152.2	1.377	75.6	0.153	10.3	0.618	-49.5
1.1	0.762	-157.8	1.268	70.6	0.147	8.3	0.605	-53.3
1.2	0.761	-162.6	1.175	66.3	0.141	6.7	0.599	-56.9
1.3	0.761	-167.0	1.089	61.9	0.135	5.8	0.593	-60.8
1.4	0.759	-170.9	1.014	57.9	0.128	5.6	0.591	-64.8
1.5	0.763	-174.3	0.952	54.4	0.120	5.9	0.591	-68.7
1.6	0.766	-177.5	0.895	51.0	0.113	7.1	0.591	-72.8
1.7	0.771	180.0	0.845	48.1	0.106	9.3	0.591	-76.8
1.8	0.774	177.0	0.802	45.4	0.099	12.3	0.595	-80.8
1.9	0.775	174.7	0.758	42.9	0.094	16.5	0.597	-84.5
2.0	0.779	172.3	0.721	40.4	0.090	21.8	0.601	-88.5
2.1	0.779	170.1	0.682	38.6	0.088	27.8	0.603	-92.4
2.2	0.783	167.7	0.652	36.4	0.088	34.3	0.607	-96.4
2.3	0.784	165.6	0.625	34.4	0.091	41.1	0.610	-100.1
2.4	0.786	163.4	0.600	33.0	0.095	47.0	0.615	-103.9
2.5	0.785	161.4	0.573	31.1	0.102	52.6	0.617	-107.8
2.6	0.786	159.2	0.552	30.2	0.110	56.8	0.621	-111.8
2.7	0.784	157.2	0.528	28.9	0.120	59.9	0.622	-115.6
2.8	0.785	155.0	0.514	28.3	0.131	62.5	0.625	-119.1
2.9	0.782	152.4	0.492	27.5	0.144	63.7	0.625	-123.3
3.0	0.785	150.1	0.475	26.4	0.157	64.8	0.626	-127.1
4.0	0.796	130.0	0.402	23.3	0.299	56.2	0.654	-166.1
5.0	0.789	118.9	0.414	18.9	0.382	37.8	0.630	158.7

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 3 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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.892	-38.7	9.055	156.6	0.046	70.7	0.930	-18.0
0.2	0.822	-70.5	7.760	136.2	0.078	53.2	0.799	-31.4
0.3	0.772	-95.7	6.385	121.4	0.096	42.3	0.677	-40.3
0.4	0.733	-114.4	5.303	110.7	0.105	35.1	0.579	-45.9
0.5	0.707	-128.1	4.464	101.8	0.111	30.5	0.509	-49.6
0.6	0.694	-139.1	3.858	95.3	0.113	27.4	0.456	-52.9
0.7	0.688	-148.0	3.376	89.2	0.114	25.4	0.419	-55.7
0.8	0.683	-155.1	2.979	84.2	0.114	24.4	0.391	-58.5
0.9	0.683	-161.1	2.675	79.6	0.113	23.9	0.370	-61.5
1.0	0.683	-166.2	2.424	75.6	0.113	24.1	0.356	-64.6
1.1	0.686	-170.6	2.217	71.8	0.112	24.7	0.344	-68.0
1.2	0.685	-174.4	2.039	68.3	0.111	25.6	0.337	-71.4
1.3	0.689	-177.6	1.887	64.9	0.111	27.0	0.333	-75.0
1.4	0.689	179.3	1.755	61.6	0.110	28.8	0.332	-78.8
1.5	0.693	176.7	1.641	58.7	0.110	30.8	0.332	-82.4
1.6	0.696	174.1	1.542	55.9	0.111	33.0	0.334	-86.1
1.7	0.703	172.4	1.456	53.4	0.112	35.4	0.337	-89.8
1.8	0.705	170.1	1.383	50.9	0.114	38.0	0.341	-93.3
1.9	0.706	168.6	1.310	48.9	0.116	40.5	0.346	-96.7
2.0	0.713	166.8	1.250	46.5	0.120	42.9	0.351	-100.2
2.1	0.711	165.0	1.191	44.5	0.123	45.4	0.356	-103.6
2.2	0.717	163.2	1.141	41.9	0.128	47.5	0.362	-107.1
2.3	0.716	161.5	1.094	39.9	0.134	49.6	0.368	-110.5
2.4	0.717	159.8	1.051	37.9	0.141	51.3	0.375	-113.8
2.5	0.716	158.0	1.011	36.0	0.147	53.1	0.380	-117.3
2.6	0.721	156.3	0.977	34.2	0.154	54.4	0.389	-120.5
2.7	0.720	154.6	0.934	32.2	0.163	55.2	0.394	-123.9
2.8	0.719	153.0	0.907	30.6	0.171	56.0	0.401	-127.0
2.9	0.719	150.5	0.872	29.2	0.180	56.2	0.405	-130.7
3.0	0.723	148.8	0.844	27.1	0.190	56.6	0.411	-134.0
4.0	0.757	130.9	0.638	13.2	0.296	50.6	0.486	-169.9
5.0	0.777	120.0	0.527	5.7	0.372	36.1	0.525	157.5

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 5 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.824	-48.0	13.346	151.1	0.044	66.4	0.884	-25.3
0.2	0.752	-84.5	10.655	129.4	0.069	49.9	0.702	-42.0
0.3	0.708	-110.6	8.326	115.1	0.081	40.3	0.558	-52.2
0.4	0.678	-127.8	6.706	105.4	0.087	35.3	0.456	-58.6
0.5	0.660	-140.2	5.536	97.7	0.091	32.9	0.386	-63.0
0.6	0.656	-149.9	4.720	92.0	0.094	32.0	0.337	-66.9
0.7	0.653	-157.7	4.098	86.7	0.096	31.7	0.301	-70.2
0.8	0.649	-163.5	3.597	82.4	0.098	32.2	0.276	-73.8
0.9	0.652	-168.6	3.219	78.5	0.099	33.2	0.257	-77.4
1.0	0.653	-172.8	2.907	75.0	0.102	34.2	0.244	-81.1
1.1	0.657	-176.5	2.657	71.7	0.103	35.6	0.235	-85.0
1.2	0.659	-179.9	2.441	68.6	0.106	36.8	0.230	-89.0
1.3	0.663	-177.6	2.253	65.6	0.108	38.5	0.227	-92.9
1.4	0.664	174.7	2.095	62.7	0.111	40.2	0.228	-96.7
1.5	0.667	172.6	1.963	60.0	0.115	41.8	0.229	-100.5
1.6	0.671	170.4	1.841	57.6	0.118	43.4	0.233	-103.9
1.7	0.676	168.8	1.742	55.2	0.122	45.0	0.237	-107.3
1.8	0.679	166.8	1.650	53.0	0.126	46.5	0.242	-110.6
1.9	0.681	165.5	1.567	51.0	0.131	47.9	0.247	-113.4
2.0	0.685	163.8	1.493	48.7	0.136	49.2	0.253	-116.4
2.1	0.684	162.4	1.424	46.9	0.142	50.3	0.259	-119.4
2.2	0.689	160.8	1.367	44.5	0.148	51.3	0.265	-122.3
2.3	0.688	159.1	1.310	42.5	0.155	52.2	0.272	-125.1
2.4	0.690	157.5	1.264	40.4	0.162	52.8	0.279	-128.0
2.5	0.691	156.0	1.214	38.4	0.168	53.6	0.285	-130.9
2.6	0.694	154.5	1.177	36.7	0.175	54.1	0.293	-133.5
2.7	0.690	152.7	1.127	34.9	0.183	54.2	0.299	-136.5
2.8	0.690	151.4	1.096	33.1	0.191	54.4	0.307	-139.1
2.9	0.690	149.2	1.054	31.5	0.199	54.2	0.313	-142.3
3.0	0.694	147.7	1.021	29.3	0.208	54.1	0.320	-145.0
4.0	0.733	131.0	0.769	13.5	0.299	47.6	0.409	-176.9
5.0	0.765	120.7	0.618	3.1	0.368	34.6	0.468	153.6

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 7 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.775	-57.2	16.568	147.2	0.041	64.9	0.845	-31.0
0.2	0.702	-94.9	12.497	124.8	0.062	47.4	0.634	-50.1
0.3	0.669	-120.3	9.470	111.2	0.072	40.4	0.484	-61.3
0.4	0.646	-136.1	7.481	102.1	0.077	37.1	0.386	-68.7
0.5	0.636	-147.5	6.115	95.3	0.081	36.0	0.321	-74.2
0.6	0.632	-156.3	5.199	90.1	0.085	36.1	0.276	-79.3
0.7	0.632	-162.9	4.501	85.3	0.088	36.7	0.244	-84.0
0.8	0.633	-168.4	3.949	81.4	0.091	38.1	0.222	-88.7
0.9	0.635	-172.9	3.521	77.7	0.094	39.3	0.206	-93.5
1.0	0.640	-176.6	3.180	74.5	0.098	40.6	0.196	-98.1
1.1	0.644	-180.0	2.898	71.5	0.102	42.1	0.190	-102.8
1.2	0.646	177.0	2.661	68.7	0.105	43.6	0.187	-107.2
1.3	0.651	174.7	2.458	65.9	0.109	44.9	0.186	-111.4
1.4	0.652	172.3	2.283	63.3	0.114	46.1	0.189	-115.2
1.5	0.655	170.3	2.143	60.7	0.119	47.5	0.191	-118.8
1.6	0.660	168.2	2.007	58.5	0.124	48.5	0.196	-122.0
1.7	0.665	166.8	1.901	56.3	0.129	49.6	0.200	-124.9
1.8	0.666	165.0	1.802	54.1	0.135	50.5	0.206	-127.6
1.9	0.667	163.5	1.709	52.2	0.140	51.2	0.211	-130.2
2.0	0.672	162.1	1.629	50.1	0.146	51.9	0.217	-132.8
2.1	0.671	160.9	1.553	48.4	0.153	52.4	0.222	-134.9
2.2	0.674	159.3	1.491	46.0	0.159	52.8	0.229	-137.5
2.3	0.673	157.7	1.429	43.9	0.167	53.3	0.235	-139.8
2.4	0.673	156.4	1.379	42.0	0.173	53.6	0.242	-142.1
2.5	0.675	154.7	1.326	39.9	0.181	53.9	0.248	-144.6
2.6	0.679	153.2	1.287	38.2	0.187	54.0	0.256	-146.4
2.7	0.676	151.6	1.234	36.3	0.195	53.8	0.262	-149.0
2.8	0.679	150.2	1.200	34.6	0.203	53.7	0.268	-151.0
2.9	0.676	148.0	1.158	33.0	0.210	53.1	0.276	-153.8
3.0	0.681	146.5	1.121	30.8	0.219	52.8	0.282	-156.1
4.0	0.722	131.0	0.850	14.4	0.303	45.7	0.373	-176.0
5.0	0.759	120.8	0.676	2.7	0.366	33.6	0.438	150.1

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 10 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.720	-65.4	20.099	142.6	0.039	61.6	0.796	-37.9
0.2	0.663	-106.0	14.329	120.1	0.055	46.4	0.562	-59.6
0.3	0.631	-129.9	10.488	107.2	0.063	41.2	0.417	-72.3
0.4	0.620	-144.1	8.222	99.2	0.068	39.7	0.327	-81.4
0.5	0.618	-154.5	6.671	92.9	0.073	40.1	0.270	-88.8
0.6	0.618	-162.1	5.630	88.3	0.077	41.4	0.232	-95.9
0.7	0.619	-168.1	4.856	84.0	0.082	42.7	0.206	-102.4
0.8	0.618	-172.6	4.253	80.4	0.086	44.3	0.190	-109.0
0.9	0.624	-176.8	3.791	77.1	0.091	45.6	0.179	-115.1
1.0	0.629	179.8	3.417	74.3	0.096	47.0	0.174	-120.8
1.1	0.635	176.9	3.115	71.3	0.101	48.2	0.172	-126.0
1.2	0.635	174.4	2.861	68.8	0.106	49.3	0.172	-130.5
1.3	0.640	172.0	2.639	66.2	0.112	50.3	0.174	-134.7
1.4	0.642	169.8	2.452	63.7	0.118	51.2	0.178	-137.9
1.5	0.645	167.8	2.294	61.3	0.124	51.9	0.182	-141.0
1.6	0.650	166.0	2.150	59.2	0.130	52.6	0.187	-143.6
1.7	0.654	164.8	2.035	57.1	0.136	53.1	0.191	-145.9
1.8	0.656	163.1	1.929	55.1	0.142	53.6	0.196	-147.9
1.9	0.656	161.7	1.830	53.2	0.149	53.9	0.202	-149.8
2.0	0.658	160.4	1.747	51.1	0.155	54.3	0.207	-151.6
2.1	0.660	159.2	1.665	49.5	0.162	54.3	0.212	-153.3
2.2	0.663	157.8	1.600	47.2	0.169	54.4	0.217	-155.2
2.3	0.665	156.2	1.537	45.3	0.177	54.5	0.223	-156.9
2.4	0.664	154.8	1.484	43.4	0.184	54.3	0.229	-158.5
2.5	0.665	153.4	1.427	41.4	0.192	54.3	0.234	-160.4
2.6	0.664	152.3	1.383	40.1	0.198	54.2	0.240	-161.7
2.7	0.665	150.8	1.329	38.2	0.206	53.7	0.246	-163.7
2.8	0.663	149.5	1.294	36.6	0.214	53.4	0.252	-165.3
2.9	0.662	147.4	1.248	35.0	0.221	52.7	0.259	-167.5
3.0	0.668	145.9	1.210	32.8	0.230	52.2	0.264	-169.2
4.0	0.709	130.9	0.918	15.9	0.306	44.1	0.353	167.8
5.0	0.752	121.2	0.735	3.3	0.365	32.3	0.417	144.6

V<sub>CE</sub> = 1 V, I<sub>c</sub> = 20 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.617	-85.6	26.053	134.1	0.032	56.7	0.695	-52.0
0.2	0.596	-125.3	16.791	112.7	0.044	46.5	0.452	-78.5
0.3	0.596	-146.0	11.822	101.7	0.051	45.7	0.332	-95.0
0.4	0.597	-157.1	9.113	95.1	0.057	46.9	0.268	-108.0
0.5	0.597	-165.1	7.322	89.7	0.063	48.9	0.232	-119.0
0.6	0.602	-170.8	6.144	85.8	0.070	50.9	0.212	-128.8
0.7	0.605	-175.5	5.283	81.8	0.076	52.3	0.201	-137.1
0.8	0.610	-179.1	4.617	78.9	0.083	53.7	0.197	-144.3
0.9	0.613	177.4	4.107	76.1	0.090	54.8	0.197	-150.4
1.0	0.617	174.6	3.704	73.5	0.097	55.5	0.199	-155.3
1.1	0.625	172.1	3.371	70.9	0.104	56.3	0.203	-159.5
1.2	0.628	169.9	3.092	68.6	0.110	56.6	0.207	-163.0
1.3	0.632	168.2	2.855	66.3	0.117	56.9	0.212	-165.8
1.4	0.634	166.2	2.650	64.0	0.125	57.3	0.217	-168.0
1.5	0.638	164.7	2.481	61.9	0.132	57.4	0.221	-170.2
1.6	0.641	162.9	2.326	60.0	0.139	57.3	0.226	-171.9
1.7	0.643	161.9	2.200	58.2	0.147	57.3	0.230	-173.5
1.8	0.645	160.3	2.082	56.2	0.154	57.2	0.234	-174.9
1.9	0.649	159.3	1.979	54.7	0.161	57.0	0.238	-176.1
2.0	0.652	158.2	1.891	52.7	0.169	56.8	0.241	-177.4
2.1	0.648	156.9	1.802	51.2	0.177	56.4	0.245	-178.8
2.2	0.654	155.7	1.731	49.0	0.184	56.0	0.249	-180.0
2.3	0.653	154.3	1.664	47.2	0.192	55.7	0.252	-178.8
2.4	0.652	153.1	1.606	45.4	0.200	55.0	0.256	177.7
2.5	0.653	151.6	1.547	43.6	0.208	54.7	0.259	176.2
2.6	0.656	150.2	1.501	41.9	0.214	54.2	0.263	175.4
2.7	0.653	148.7	1.444	40.1	0.223	53.4	0.267	173.9
2.8	0.653	147.5	1.403	38.5	0.230	52.8	0.271	172.8
2.9	0.652	145.4	1.356	36.9	0.237	51.8	0.276	171.4
3.0	0.655	144.2	1.317	34.8	0.245	51.0	0.279	170.0
4.0	0.699	130.3	1.007	18.2	0.315	41.5	0.356	153.5
5.0	0.741	121.2	0.808	5.1	0.365	30.3	0.408	135.2



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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.966	-25.3	3.445	164.7	0.042	77.7	0.982	-7.9
0.2	0.925	-48.0	3.237	148.0	0.078	62.9	0.939	-14.9
0.3	0.888	-69.0	2.922	134.3	0.106	51.3	0.887	-20.6
0.4	0.856	-86.8	2.611	122.8	0.124	41.9	0.831	-25.3
0.5	0.823	-101.9	2.323	112.4	0.136	34.4	0.785	-29.0
0.6	0.799	-114.8	2.084	104.1	0.142	28.3	0.746	-32.3
0.7	0.784	-125.5	1.880	96.4	0.145	23.2	0.715	-35.3
0.8	0.774	-134.6	1.691	89.7	0.145	19.3	0.691	-38.3
0.9	0.764	-142.7	1.538	83.8	0.143	16.0	0.673	-41.4
1.0	0.759	-149.4	1.408	78.5	0.140	13.4	0.658	-44.5
1.1	0.757	-155.4	1.300	73.5	0.135	11.5	0.647	-48.0
1.2	0.757	-160.6	1.205	69.0	0.130	10.1	0.638	-51.4
1.3	0.758	-165.2	1.118	64.6	0.124	9.4	0.632	-55.1
1.4	0.755	-169.2	1.042	60.7	0.118	9.4	0.629	-58.9
1.5	0.760	-172.9	0.978	57.0	0.111	10.0	0.625	-62.6
1.6	0.759	-176.2	0.918	53.8	0.105	11.5	0.625	-66.4
1.7	0.765	-179.0	0.869	50.9	0.099	13.8	0.624	-70.2
1.8	0.766	178.0	0.827	48.1	0.094	17.3	0.624	-73.9
1.9	0.768	175.7	0.783	45.7	0.089	21.8	0.624	-77.6
2.0	0.770	173.2	0.745	43.3	0.086	27.3	0.627	-81.4
2.1	0.769	171.0	0.707	41.6	0.085	33.1	0.628	-85.2
2.2	0.774	168.6	0.679	39.1	0.086	39.5	0.629	-88.9
2.3	0.775	166.5	0.648	37.3	0.090	46.0	0.630	-92.6
2.4	0.775	164.2	0.621	35.6	0.095	51.4	0.634	-96.3
2.5	0.775	162.1	0.595	33.9	0.102	56.5	0.634	-100.2
2.6	0.774	160.1	0.575	32.9	0.110	60.4	0.636	-103.7
2.7	0.774	157.9	0.549	31.4	0.120	63.2	0.635	-107.4
2.8	0.774	155.8	0.532	30.9	0.132	65.4	0.638	-110.9
2.9	0.770	153.1	0.510	30.1	0.143	66.5	0.633	-114.9
3.0	0.773	150.9	0.495	28.4	0.157	67.4	0.634	-118.8
4.0	0.782	130.4	0.415	24.1	0.297	58.6	0.645	-158.3
5.0	0.779	119.1	0.421	19.4	0.382	39.6	0.616	164.7

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 3 mA, Z<sub>o</sub> = 50  $\Omega$

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.903	-34.7	8.906	158.5	0.039	74.2	0.945	-15.2
0.2	0.834	-64.8	7.810	139.3	0.070	56.4	0.832	-26.9
0.3	0.779	-89.4	6.552	124.6	0.087	45.4	0.722	-34.8
0.4	0.738	-107.9	5.519	113.8	0.097	38.0	0.629	-40.0
0.5	0.706	-122.2	4.686	104.8	0.103	33.2	0.560	-43.3
0.6	0.690	-133.7	4.069	98.1	0.106	30.2	0.508	-46.1
0.7	0.680	-143.3	3.584	91.8	0.107	27.9	0.469	-48.4
0.8	0.676	-150.7	3.174	86.7	0.107	26.8	0.441	-50.9
0.9	0.672	-157.4	2.846	82.0	0.107	26.3	0.418	-53.3
1.0	0.671	-162.6	2.584	78.0	0.107	26.3	0.402	-56.0
1.1	0.675	-167.7	2.368	74.1	0.106	26.9	0.389	-58.9
1.2	0.674	-171.4	2.181	70.7	0.106	28.0	0.380	-61.7
1.3	0.676	-174.8	2.013	67.2	0.105	29.5	0.373	-65.0
1.4	0.679	-178.2	1.879	63.9	0.105	31.2	0.370	-68.4
1.5	0.680	179.2	1.757	60.9	0.105	33.2	0.368	-71.7
1.6	0.682	176.3	1.650	58.2	0.106	35.3	0.368	-75.3
1.7	0.689	174.3	1.559	55.7	0.107	37.7	0.368	-78.6
1.8	0.689	172.0	1.479	53.0	0.109	40.3	0.370	-82.1
1.9	0.692	170.0	1.399	50.7	0.112	42.8	0.373	-85.6
2.0	0.696	168.1	1.336	48.4	0.115	45.2	0.375	-88.9
2.1	0.696	166.5	1.270	46.5	0.119	47.5	0.379	-92.3
2.2	0.700	164.4	1.218	43.9	0.123	49.7	0.383	-95.8
2.3	0.702	162.8	1.165	41.8	0.130	51.8	0.386	-99.1
2.4	0.704	161.0	1.124	39.7	0.136	53.5	0.391	-102.5
2.5	0.705	159.1	1.078	37.6	0.142	55.2	0.394	-105.9
2.6	0.706	157.6	1.045	36.0	0.149	56.7	0.400	-109.0
2.7	0.705	155.8	1.002	34.1	0.157	57.4	0.403	-112.5
2.8	0.706	154.1	0.968	32.5	0.166	58.4	0.408	-115.7
2.9	0.704	151.8	0.929	30.7	0.175	58.6	0.411	-119.5
3.0	0.707	149.8	0.900	28.7	0.184	59.0	0.415	-122.8
4.0	0.744	131.5	0.674	14.1	0.291	53.2	0.472	-160.4
5.0	0.768	120.7	0.552	5.8	0.370	38.1	0.507	164.3

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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.847	-42.0	12.951	154.1	0.039	70.8	0.910	-20.8
0.2	0.767	-76.3	10.756	133.3	0.063	53.3	0.752	-35.5
0.3	0.716	-101.9	8.625	118.9	0.076	43.6	0.617	-44.4
0.4	0.674	-119.7	7.037	108.8	0.083	38.0	0.515	-49.9
0.5	0.652	-132.9	5.863	100.8	0.087	35.3	0.443	-53.3
0.6	0.643	-143.6	5.033	94.8	0.090	34.0	0.391	-56.3
0.7	0.638	-152.0	4.387	89.4	0.092	33.4	0.353	-58.7
0.8	0.636	-158.5	3.863	84.9	0.094	33.8	0.325	-61.2
0.9	0.635	-164.2	3.457	80.8	0.096	34.3	0.303	-63.8
1.0	0.638	-168.9	3.130	77.3	0.098	35.3	0.288	-66.6
1.1	0.639	-173.0	2.859	73.9	0.100	36.6	0.276	-69.7
1.2	0.641	-176.3	2.631	70.7	0.101	37.9	0.267	-72.9
1.3	0.644	-179.5	2.430	67.7	0.104	39.6	0.261	-76.3
1.4	0.647	177.6	2.259	64.8	0.107	41.2	0.259	-79.8
1.5	0.649	175.2	2.114	62.0	0.109	42.8	0.257	-83.2
1.6	0.655	172.9	1.984	59.7	0.113	44.4	0.258	-86.7
1.7	0.659	171.2	1.875	57.2	0.117	46.0	0.259	-90.0
1.8	0.659	169.0	1.780	54.9	0.121	47.6	0.262	-93.4
1.9	0.664	167.5	1.686	52.8	0.125	49.2	0.265	-96.5
2.0	0.666	165.7	1.608	50.5	0.130	50.4	0.268	-99.6
2.1	0.666	164.2	1.530	48.7	0.135	51.7	0.272	-102.7
2.2	0.671	162.7	1.468	46.4	0.141	52.6	0.276	-106.1
2.3	0.671	160.9	1.408	44.2	0.148	53.6	0.280	-109.1
2.4	0.672	159.5	1.357	42.1	0.154	54.3	0.286	-112.2
2.5	0.673	157.7	1.303	40.1	0.161	55.2	0.290	-115.3
2.6	0.673	156.2	1.261	38.5	0.167	55.6	0.297	-118.3
2.7	0.674	154.4	1.211	36.5	0.175	55.8	0.301	-121.7
2.8	0.674	152.9	1.176	34.8	0.183	56.2	0.306	-124.5
2.9	0.674	150.5	1.129	33.0	0.191	55.9	0.312	-128.1
3.0	0.678	149.1	1.095	30.7	0.200	55.9	0.316	-131.0
4.0	0.720	132.3	0.822	14.2	0.292	50.0	0.388	-166.3
5.0	0.758	121.6	0.652	2.9	0.364	36.7	0.445	161.2

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

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.787	-48.2	16.146	150.8	0.037	67.9	0.878	-25.4
0.2	0.713	-85.0	12.789	129.1	0.057	51.6	0.691	-42.1
0.3	0.667	-110.5	9.922	115.1	0.069	43.1	0.546	-51.7
0.4	0.641	-127.4	7.982	105.7	0.074	39.3	0.444	-57.7
0.5	0.625	-140.0	6.575	98.3	0.078	37.6	0.374	-61.7
0.6	0.617	-149.7	5.595	93.0	0.082	37.5	0.323	-65.2
0.7	0.614	-157.1	4.865	87.9	0.085	37.9	0.287	-68.1
0.8	0.613	-163.2	4.277	83.8	0.088	38.8	0.261	-71.2
0.9	0.615	-168.4	3.821	80.1	0.091	40.0	0.240	-74.5
1.0	0.619	-172.5	3.452	76.8	0.094	41.3	0.226	-77.9
1.1	0.623	-176.5	3.152	73.6	0.098	42.7	0.215	-81.5
1.2	0.624	-179.5	2.894	70.8	0.101	43.9	0.208	-85.3
1.3	0.628	177.5	2.671	67.9	0.105	45.3	0.203	-89.1
1.4	0.630	174.9	2.486	65.1	0.109	46.7	0.202	-92.7
1.5	0.633	172.9	2.324	62.6	0.114	47.9	0.201	-96.4
1.6	0.638	170.7	2.182	60.3	0.118	49.1	0.203	-99.9
1.7	0.642	169.2	2.064	58.0	0.123	50.1	0.204	-103.1
1.8	0.643	167.2	1.956	55.8	0.128	51.1	0.207	-106.4
1.9	0.646	165.7	1.854	53.9	0.133	52.0	0.211	-109.3
2.0	0.650	163.9	1.768	51.7	0.139	52.8	0.215	-112.2
2.1	0.650	162.7	1.682	49.8	0.145	53.5	0.219	-115.0
2.2	0.654	160.9	1.616	47.6	0.151	54.1	0.224	-118.0
2.3	0.653	159.6	1.550	45.6	0.159	54.6	0.228	-120.6
2.4	0.656	158.1	1.493	43.5	0.165	54.9	0.234	-123.5
2.5	0.657	156.3	1.436	41.5	0.172	55.3	0.238	-126.4
2.6	0.658	155.1	1.390	39.8	0.179	55.5	0.244	-128.8
2.7	0.655	153.5	1.336	37.9	0.186	55.3	0.249	-131.8
2.8	0.658	152.0	1.298	36.2	0.194	55.4	0.255	-134.3
2.9	0.657	149.7	1.250	34.3	0.202	54.9	0.261	-137.6
3.0	0.662	148.2	1.211	32.2	0.210	54.7	0.266	-140.1
4.0	0.706	132.1	0.911	15.2	0.294	48.2	0.345	-172.8
5.0	0.749	122.1	0.720	2.7	0.361	35.6	0.410	157.6

$V_{CE} = 2\text{ V}$ ,  $I_C = 10\text{ mA}$ ,  $Z_o = 50\ \Omega$

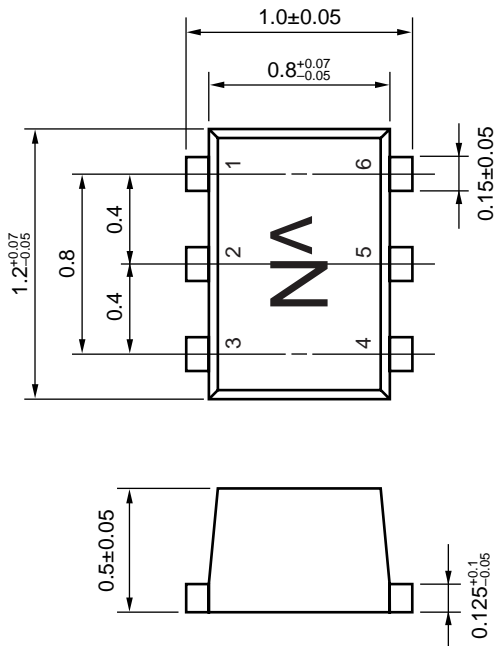
Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.750	-54.7	19.640	147.0	0.034	65.3	0.841	-30.7
0.2	0.663	-94.2	14.787	124.9	0.052	50.7	0.627	-49.4
0.3	0.633	-119.4	11.146	111.5	0.061	43.4	0.478	-60.1
0.4	0.609	-135.3	8.835	102.9	0.067	41.7	0.379	-67.0
0.5	0.599	-146.8	7.212	96.1	0.071	41.4	0.313	-71.9
0.6	0.594	-155.5	6.107	91.1	0.076	42.0	0.267	-76.7
0.7	0.592	-162.4	5.292	86.5	0.079	42.9	0.234	-80.8
0.8	0.595	-167.5	4.640	82.7	0.084	44.5	0.210	-85.3
0.9	0.597	-172.2	4.146	79.4	0.088	45.6	0.193	-89.8
1.0	0.602	-176.0	3.742	76.3	0.093	46.8	0.181	-94.3
1.1	0.607	-179.6	3.413	73.4	0.097	48.2	0.172	-99.1
1.2	0.609	177.6	3.133	70.7	0.102	49.2	0.168	-103.5
1.3	0.614	175.0	2.889	68.0	0.107	50.3	0.165	-107.9
1.4	0.618	172.7	2.689	65.5	0.113	51.2	0.165	-111.9
1.5	0.619	170.6	2.513	63.2	0.118	52.1	0.166	-115.7
1.6	0.623	168.7	2.358	60.9	0.124	52.8	0.169	-119.0
1.7	0.628	167.2	2.230	58.8	0.129	53.5	0.171	-122.1
1.8	0.631	165.4	2.115	56.7	0.135	54.1	0.175	-124.9
1.9	0.633	164.1	2.002	54.9	0.141	54.4	0.179	-127.6
2.0	0.637	162.7	1.913	52.9	0.148	54.8	0.183	-130.0
2.1	0.635	161.3	1.823	51.2	0.154	55.0	0.187	-132.3
2.2	0.640	159.9	1.748	49.0	0.161	55.1	0.191	-134.8
2.3	0.639	158.6	1.677	47.0	0.168	55.3	0.196	-137.0
2.4	0.640	156.9	1.618	45.1	0.175	55.3	0.202	-139.3
2.5	0.640	155.6	1.556	43.1	0.182	55.3	0.206	-141.7
2.6	0.642	153.9	1.508	41.3	0.189	55.2	0.212	-143.6
2.7	0.642	152.4	1.449	39.5	0.197	54.8	0.217	-146.3
2.8	0.643	151.1	1.408	37.7	0.204	54.7	0.222	-148.2
2.9	0.642	148.9	1.358	36.1	0.211	53.9	0.228	-151.0
3.0	0.646	147.4	1.314	33.9	0.220	53.6	0.233	-153.0
4.0	0.693	132.4	0.994	16.7	0.297	46.3	0.316	178.6
5.0	0.743	122.4	0.789	3.5	0.359	34.4	0.384	152.4

$V_{CE} = 2\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_o = 50\ \Omega$

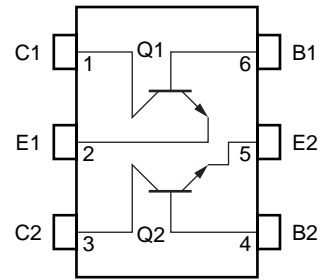
Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.665	-69.1	25.836	140.2	0.030	64.2	0.762	-41.4
0.2	0.593	-110.6	17.854	118.0	0.044	49.3	0.521	-63.6
0.3	0.575	-133.6	12.908	106.0	0.051	46.6	0.380	-76.8
0.4	0.567	-147.4	10.035	98.6	0.057	46.7	0.296	-86.7
0.5	0.562	-157.2	8.093	92.8	0.063	48.4	0.243	-94.8
0.6	0.568	-164.1	6.831	88.5	0.069	50.1	0.209	-102.9
0.7	0.572	-169.7	5.881	84.5	0.074	51.4	0.186	-110.7
0.8	0.574	-174.0	5.147	81.6	0.080	52.8	0.171	-118.0
0.9	0.576	-178.1	4.581	78.3	0.087	53.8	0.163	-125.1
1.0	0.584	178.8	4.127	75.7	0.093	54.7	0.159	-131.3
1.1	0.589	175.9	3.764	73.0	0.099	55.5	0.158	-137.1
1.2	0.592	173.5	3.451	70.6	0.106	56.0	0.159	-141.9
1.3	0.597	171.2	3.188	68.3	0.112	56.5	0.161	-146.1
1.4	0.599	169.3	2.960	65.9	0.119	56.9	0.164	-149.4
1.5	0.602	167.6	2.770	63.8	0.126	57.1	0.167	-152.5
1.6	0.607	165.7	2.595	61.7	0.133	57.3	0.171	-155.0
1.7	0.612	164.5	2.454	59.8	0.139	57.3	0.175	-157.2
1.8	0.614	162.8	2.326	58.0	0.146	57.4	0.178	-159.1
1.9	0.617	161.6	2.207	56.2	0.153	57.3	0.182	-160.9
2.0	0.620	160.5	2.105	54.3	0.160	57.1	0.185	-162.5
2.1	0.618	159.4	2.007	52.8	0.168	56.8	0.189	-164.2
2.2	0.621	157.8	1.925	50.6	0.175	56.6	0.192	-165.7
2.3	0.622	156.5	1.847	48.7	0.183	56.4	0.196	-167.1
2.4	0.620	155.1	1.783	46.9	0.190	55.9	0.200	-168.6
2.5	0.622	153.8	1.714	45.0	0.197	55.6	0.203	-170.2
2.6	0.624	152.3	1.663	43.4	0.204	55.2	0.207	-171.3
2.7	0.624	150.9	1.599	41.5	0.212	54.5	0.211	-172.9
2.8	0.624	149.6	1.553	40.0	0.219	54.0	0.216	-174.4
2.9	0.622	147.5	1.497	38.2	0.226	53.1	0.221	-176.1
3.0	0.626	146.3	1.456	36.3	0.234	52.4	0.224	-177.6
4.0	0.675	132.0	1.102	19.2	0.304	43.8	0.305	162.6
5.0	0.727	123.0	0.880	5.7	0.357	32.4	0.365	141.9

**PACKAGE DIMENSIONS**

**6-PIN LEAD-LESS MINIMOLD (UNIT: mm)**



(Top View)



**PIN CONNECTIONS**

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

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