

# DATA SHEET



## NPN SILICON RF TWIN TRANSISTOR

# $\mu$ PA863TD

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

#### FEATURES

- Low voltage operation
- 2 different built-in transistors (2SC5436, 2SC5800)
  - Q1: Built-in high gain transistor  
 $f_T = 12.0 \text{ GHz TYP.}$ ,  $|S_{21e}|^2 = 9.0 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_C = 10 \text{ mA, } f = 2 \text{ GHz}$
  - Q2: Built-in low phase distortion transistor suited for OSC operation  
 $f_T = 4.5 \text{ GHz TYP.}$ ,  $|S_{21e}|^2 = 4.0 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2 \text{ GHz}$
- 6-pin lead-less minimold package

#### BUILT-IN TRANSISTORS

	Q1	Q2
3-pin thin-type ultra super minimold part No.	2SC5436	2SC5800

#### ORDERING INFORMATION

Part Number	Quantity	Supplying Form
$\mu$ PA863TD-A	50 pcs (Non reel)	• 8 mm wide embossed taping
$\mu$ PA863TD-T3-A	10 kpcs/reel	• Pin 1 (Q1 Collector), Pin 6 (Q1 Base) face the perforation side of the tape

**Remark** To order evaluation samples, consult your nearby sales office.  
Unit sample quantity is 50 pcs.

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

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

Parameter	Symbol	Ratings		Unit
		Q1	Q2	
Collector to Base Voltage	$V_{CBO}$	5	9	V
Collector to Emitter Voltage	$V_{CEO}$	3	5.5	V
Emitter to Base Voltage	$V_{EBO}$	2	1.5	V
Collector Current	$I_C$	30	100	mA
Total Power Dissipation	$P_{tot}^{Note}$	90	190	mW
		210 in 2 elements		
Junction Temperature	$T_j$	150		$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +150		$^\circ\text{C}$

**Note** Mounted on  $1.08\text{ cm}^2 \times 1.0\text{ mm}$  (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>BE</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	110	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>	–	1.3	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	–	–	600	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>BE</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	600	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA	100	120	145	–
Gain Bandwidth Product (1)	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz	3.0	4.5	–	GHz
Gain Bandwidth Product (2)	f <sub>T</sub>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 15 mA, f = 2 GHz	5.0	6.5	–	GHz
Insertion Power Gain (1)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 5 mA, f = 2 GHz	3.0	4.0	–	dB
Insertion Power Gain (2)	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 1 V, I <sub>C</sub> = 15 mA, f = 2 GHz	4.5	5.5	–	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>	–	1.9	2.5	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	–	0.6	0.8	pF

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

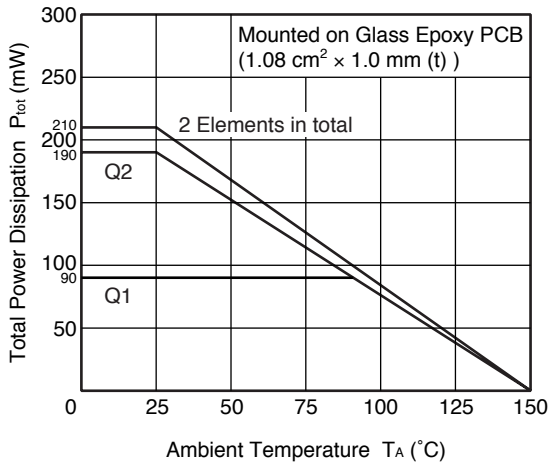
**2.** Collector to base capacitance when the emitter grounded

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

Rank	FB
Marking	xC
h <sub>FE</sub> Value of Q1	70 to 140
h <sub>FE</sub> Value of Q2	100 to 145

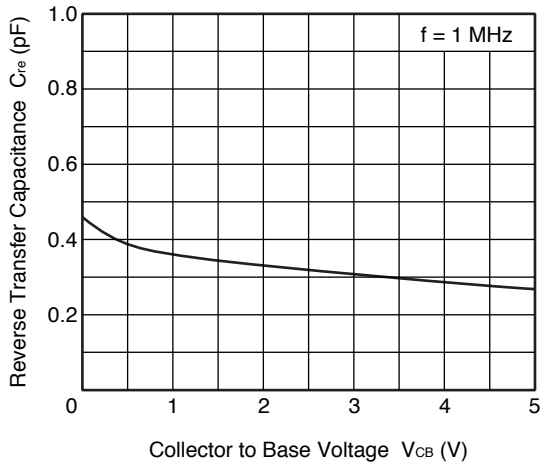
**TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )**

**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**



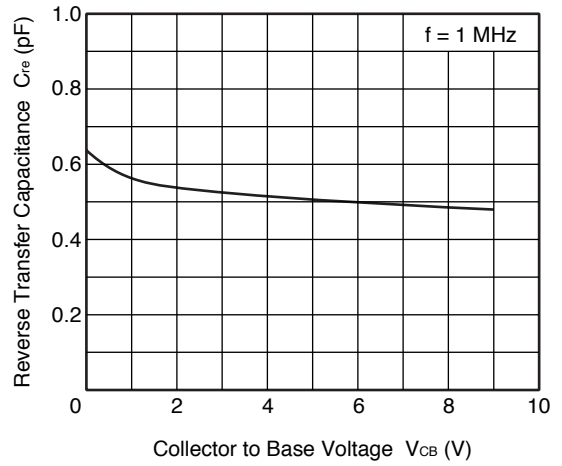
**Q1**

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



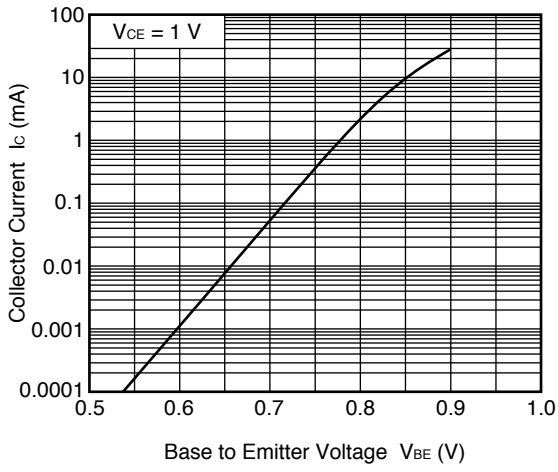
**Q2**

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



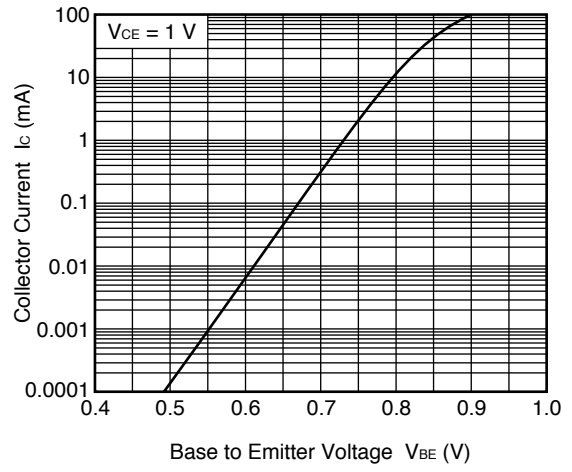
Q1

COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE

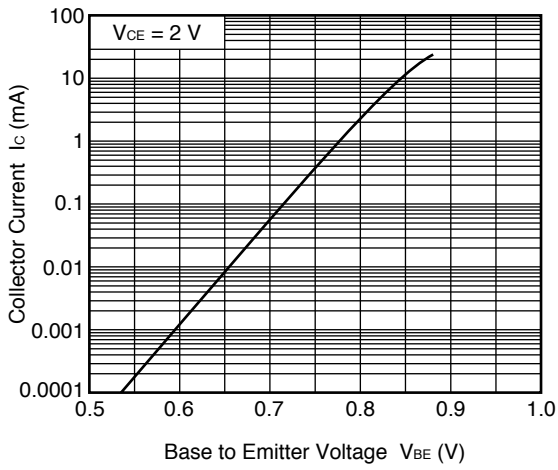


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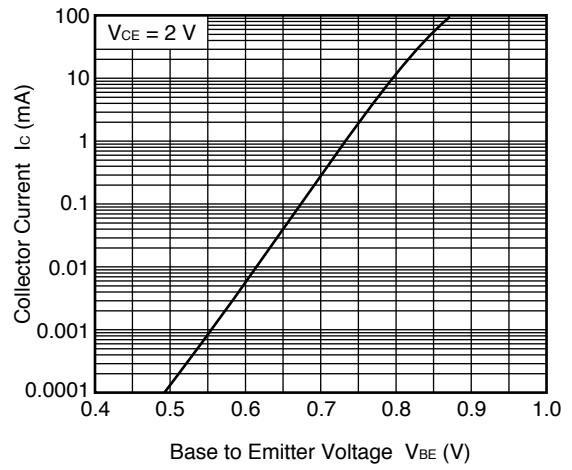
COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE

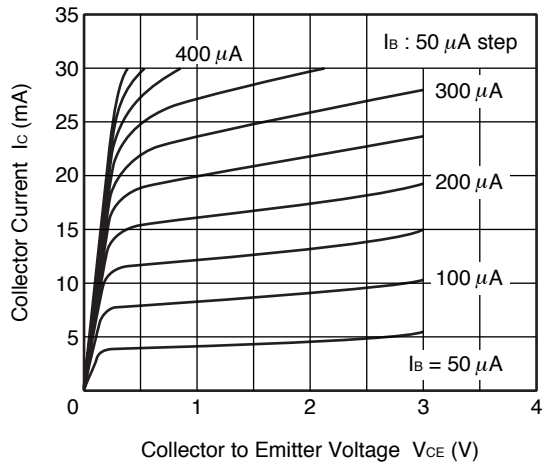


COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE



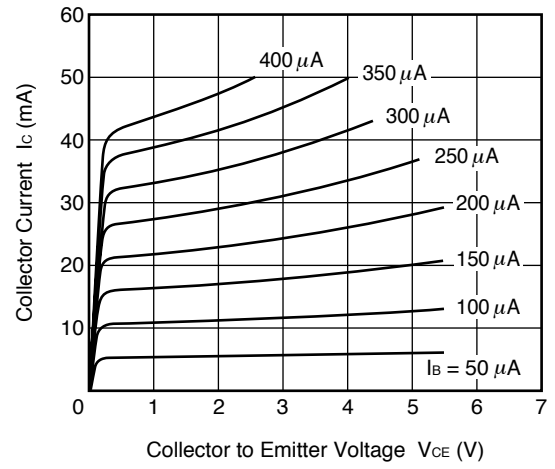
**Q1**

COLLECTOR CURRENT vs.  
COLLECTOR TO EMITTER VOLTAGE



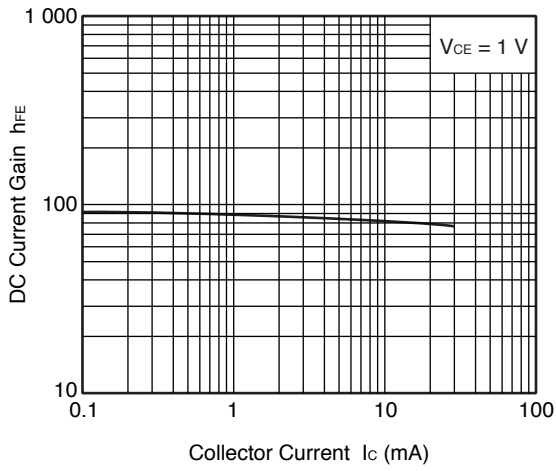
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COLLECTOR CURRENT vs.  
COLLECTOR TO EMITTER VOLTAGE



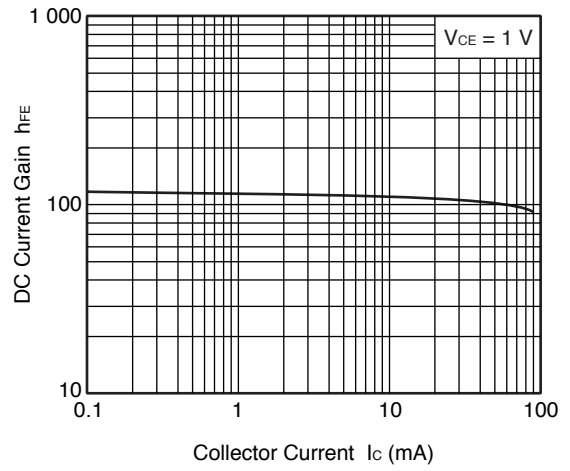
**Q1**

DC CURRENT GAIN vs.  
COLLECTOR CURRENT

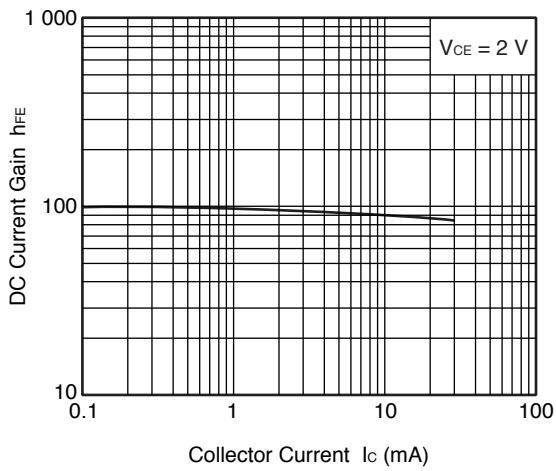


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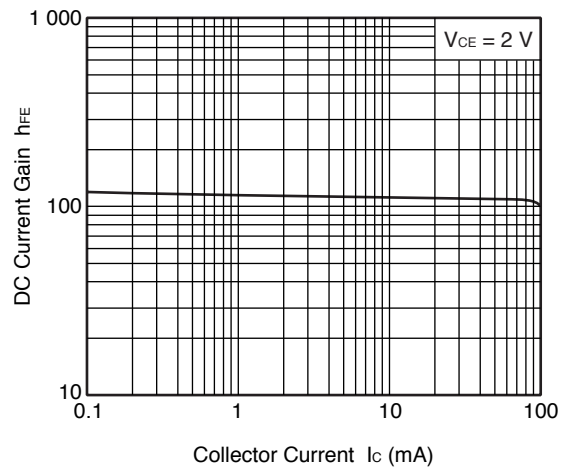
DC CURRENT GAIN vs.  
COLLECTOR CURRENT



DC CURRENT GAIN vs.  
COLLECTOR CURRENT

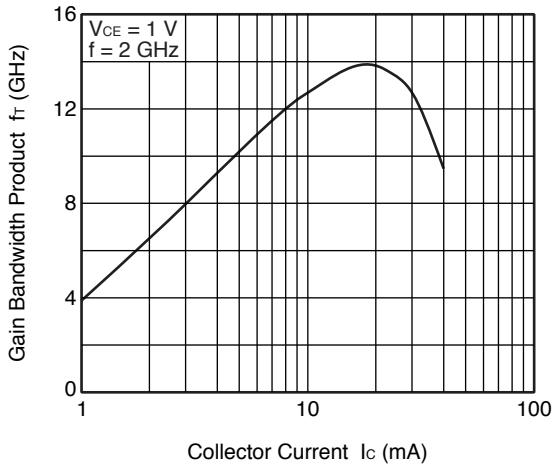


DC CURRENT GAIN vs.  
COLLECTOR CURRENT



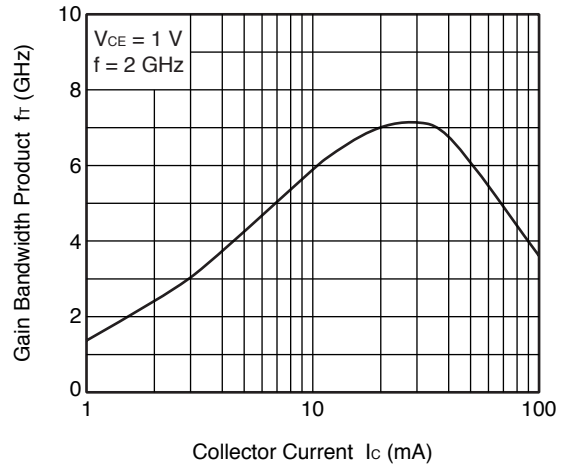
Q1

GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

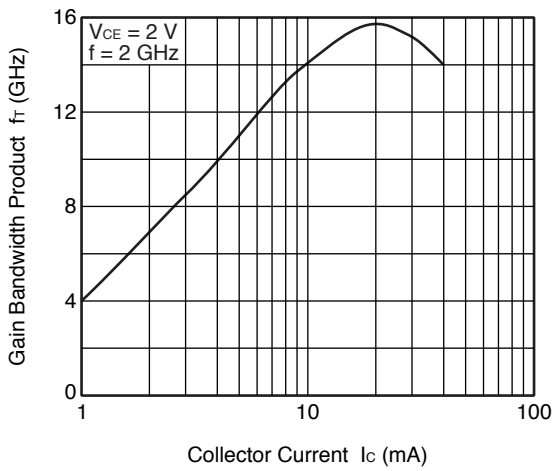


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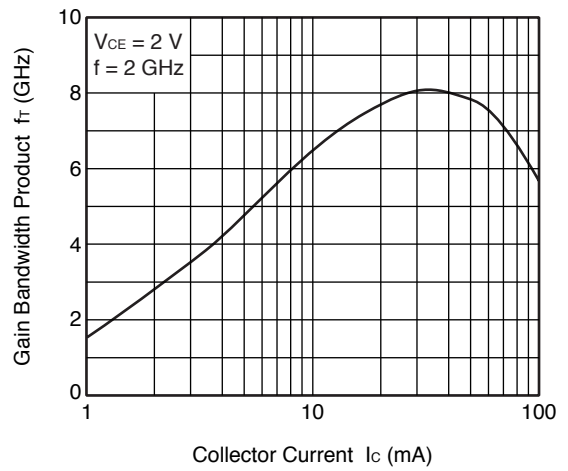
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



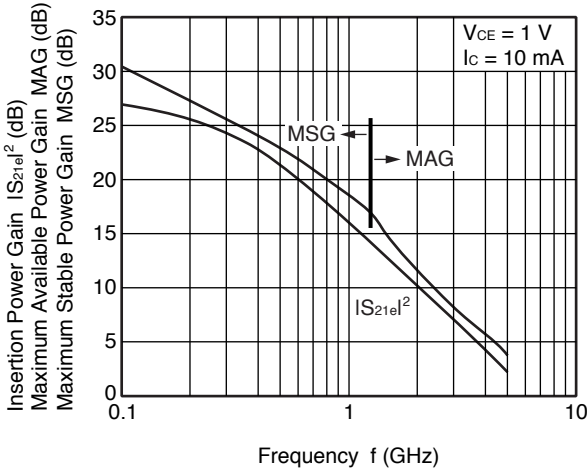
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT





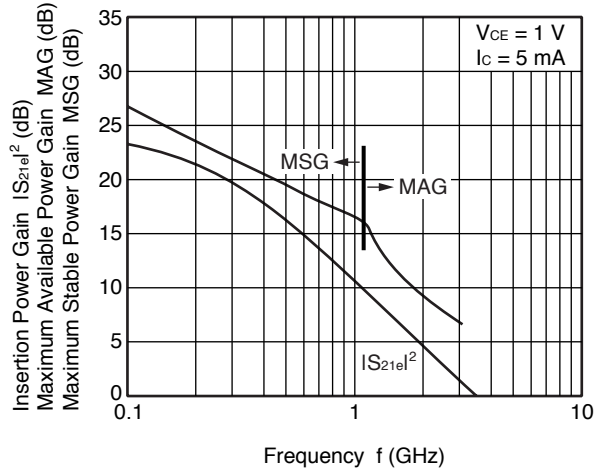
**Q1**

**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**

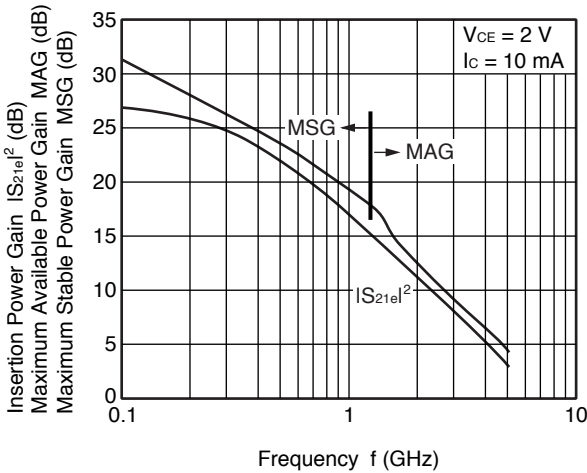


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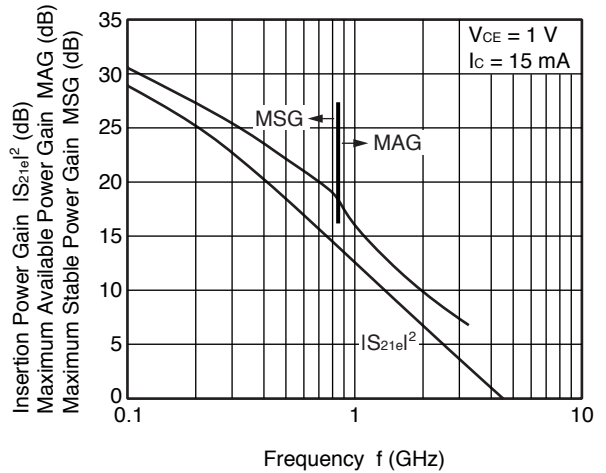
**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**



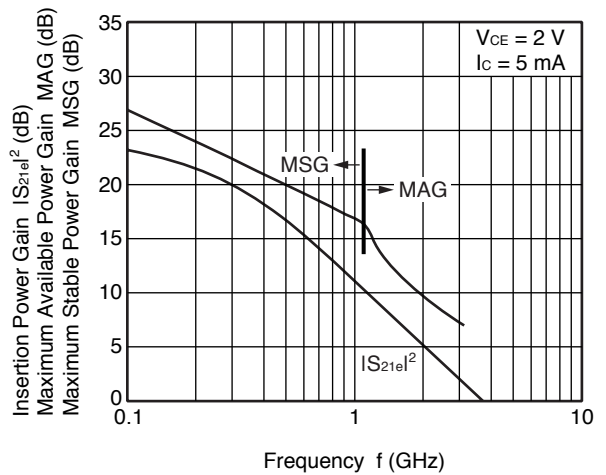
**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**



**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**

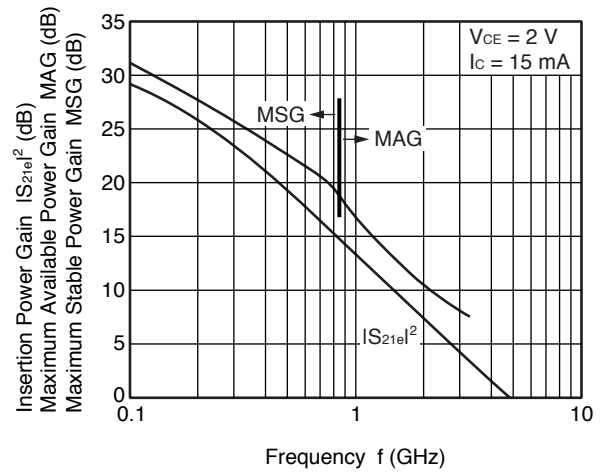


**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**



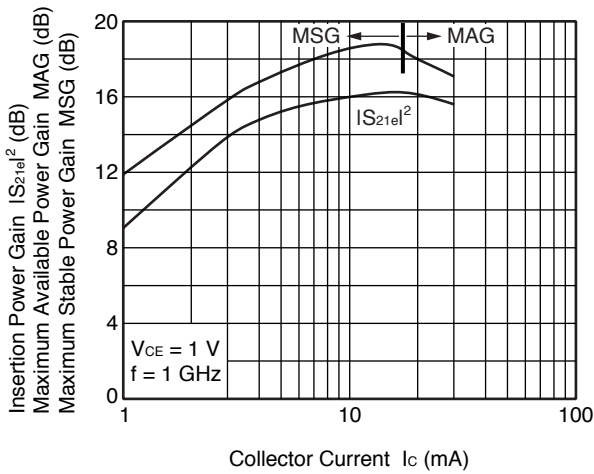
Q2

INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY



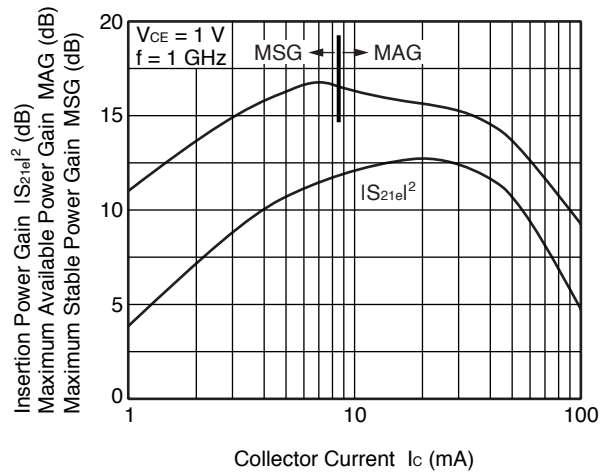
**Q1**

INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT

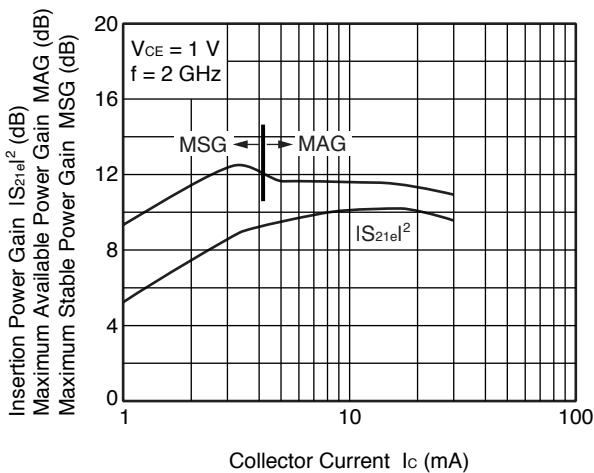


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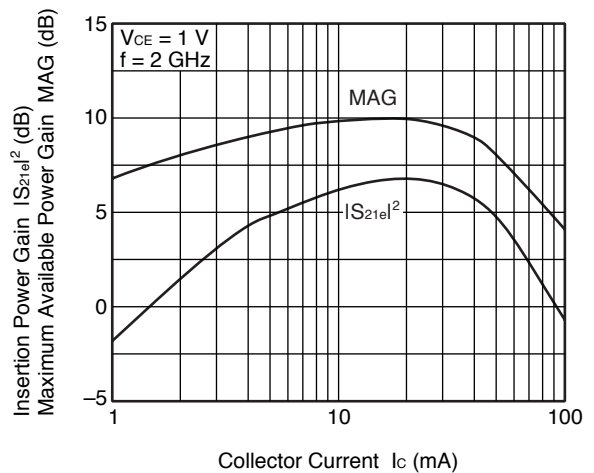
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



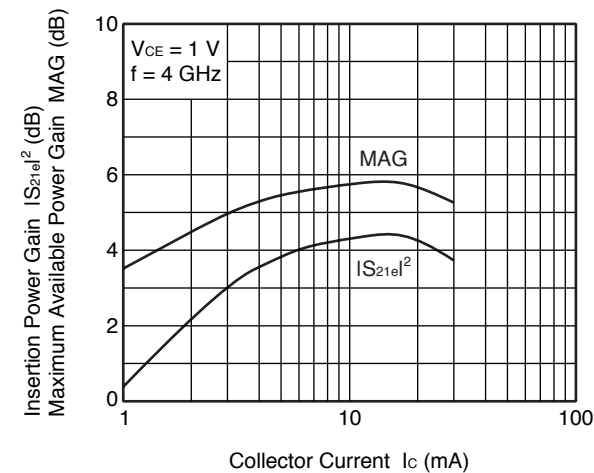
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



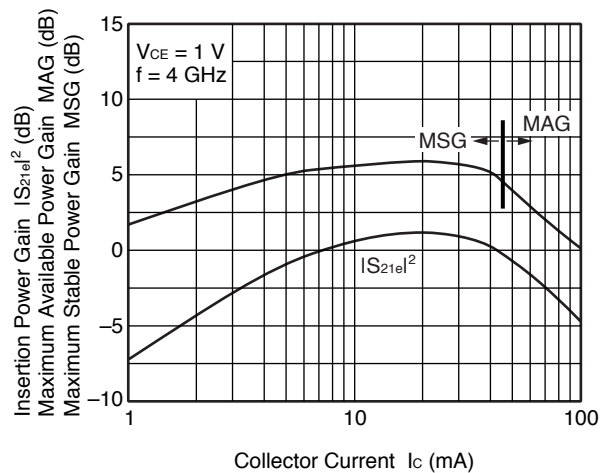
INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



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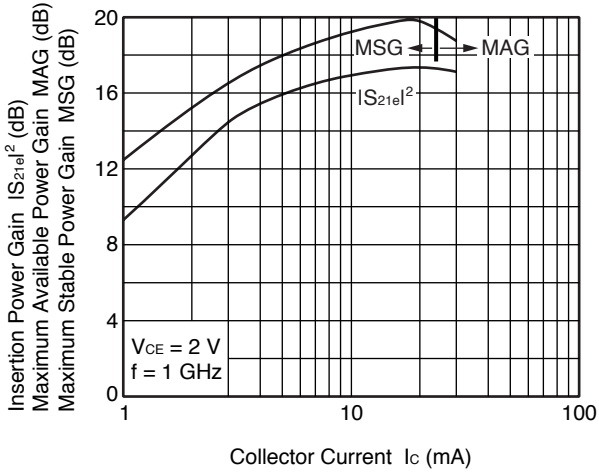


INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



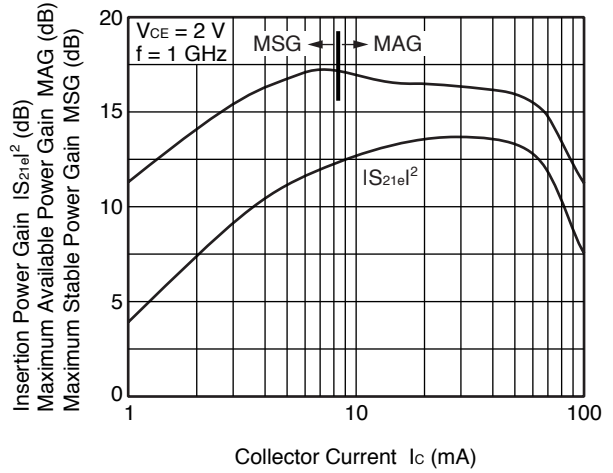
Q1

INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT

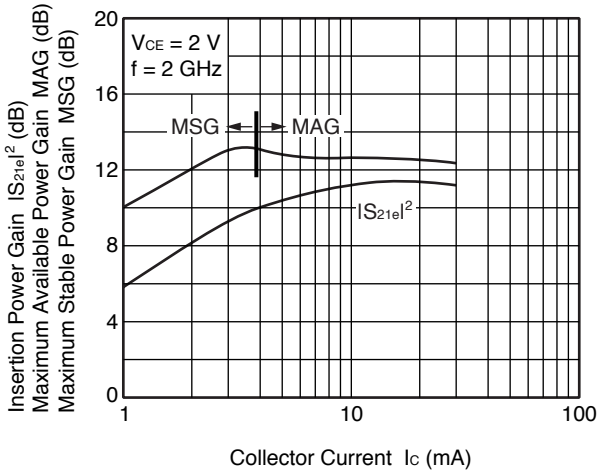


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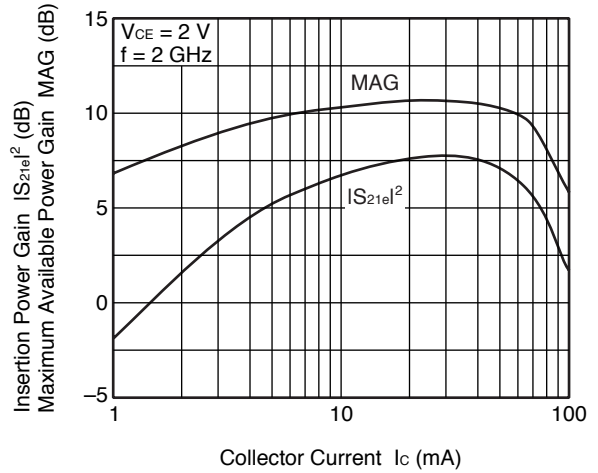
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



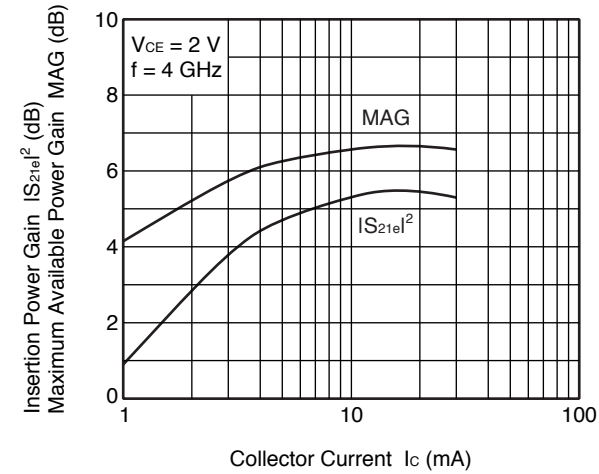
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



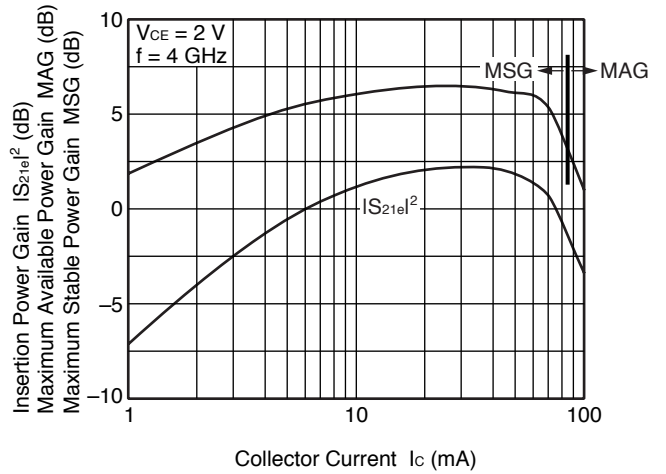
INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



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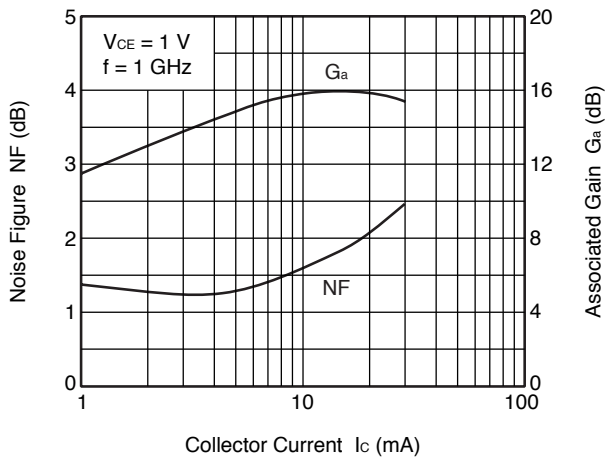


INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



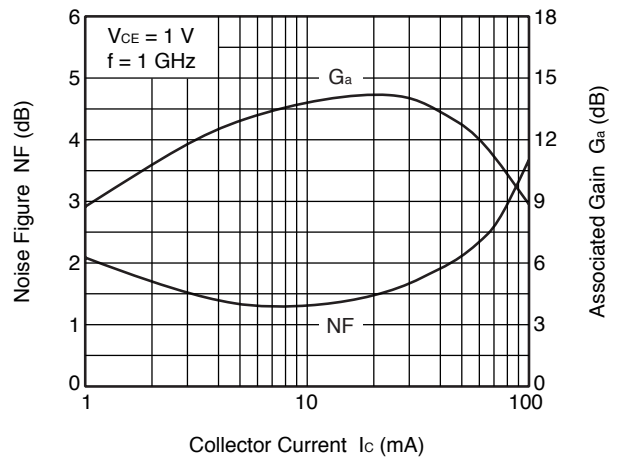
**Q1**

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

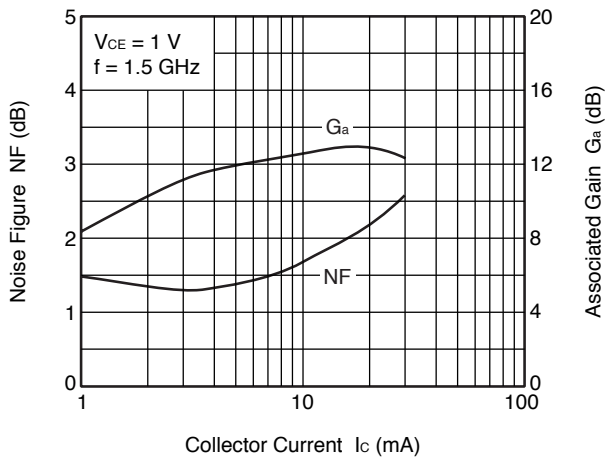


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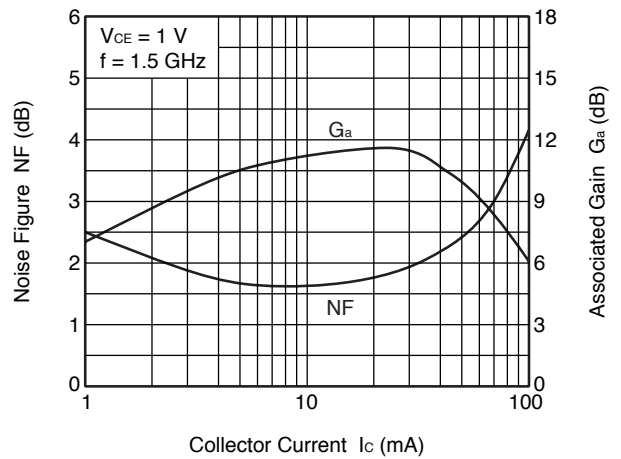
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



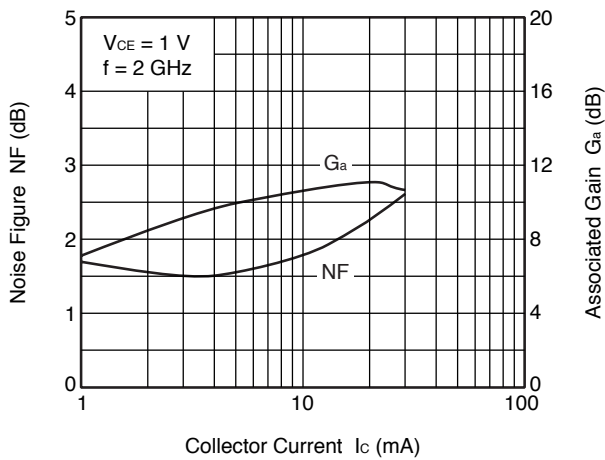
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



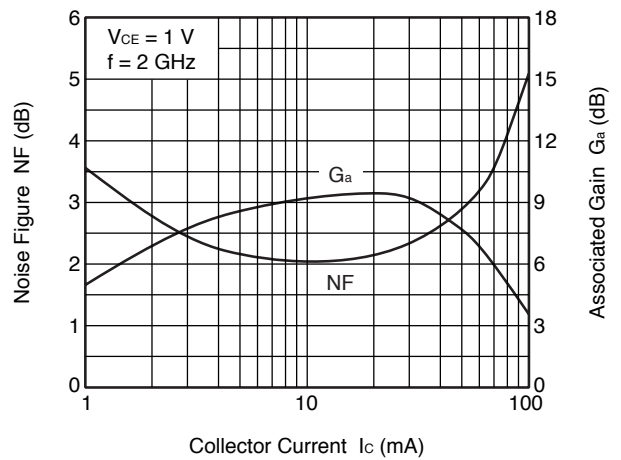
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

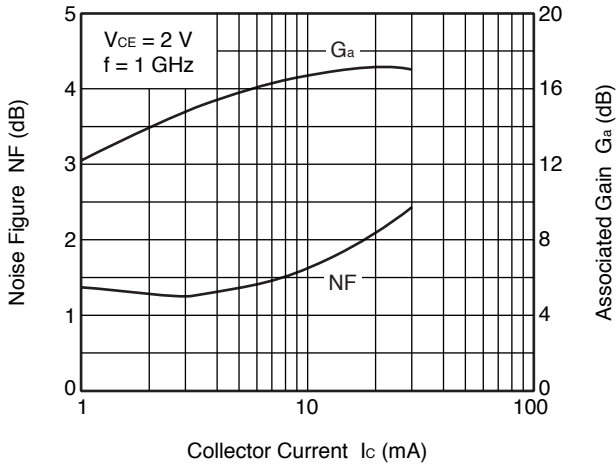


NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



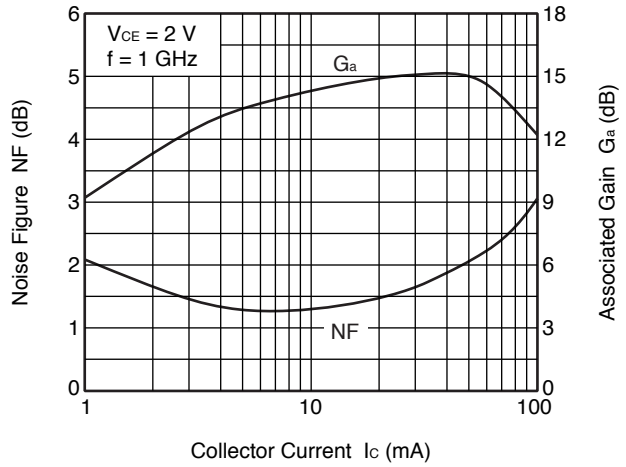
Q1

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

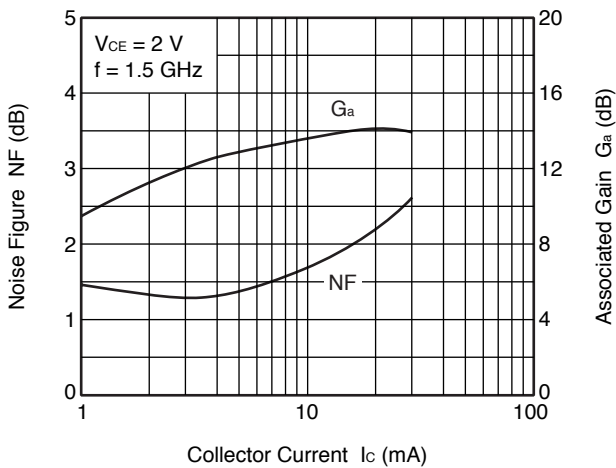


Q2

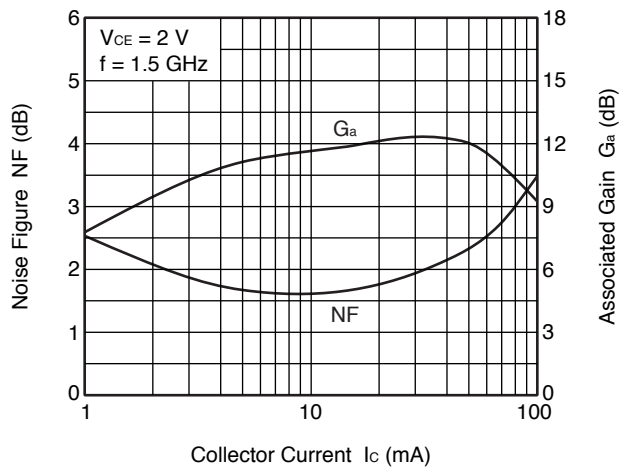
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



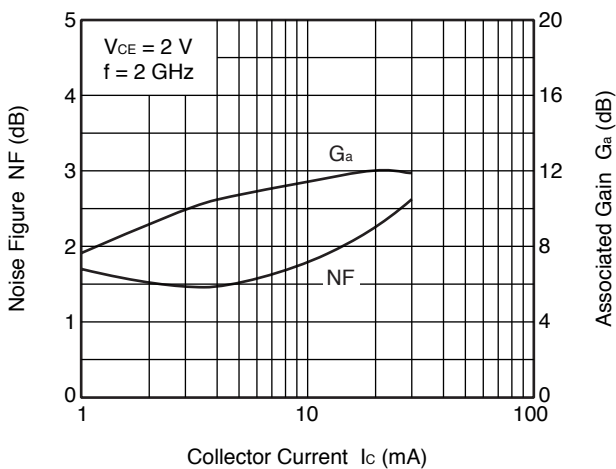
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



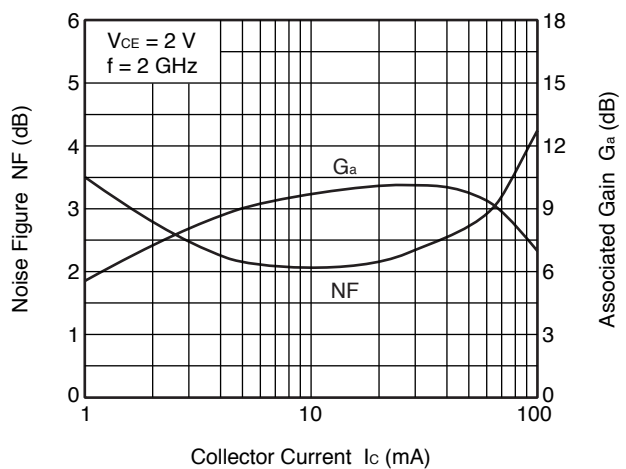
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



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>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	0.953	-9.4	3.604	172.6	0.024	87.4	0.992	-3.9
0.2	0.949	-16.5	3.622	166.4	0.048	80.4	0.983	-8.3
0.3	0.929	-24.4	3.536	160.4	0.071	74.7	0.968	-12.7
0.4	0.911	-33.0	3.494	153.1	0.093	69.7	0.944	-16.9
0.5	0.878	-41.3	3.396	146.7	0.113	64.9	0.918	-21.2
0.6	0.843	-49.5	3.304	140.2	0.131	60.1	0.886	-25.2
0.7	0.809	-57.6	3.187	134.3	0.148	55.6	0.853	-29.2
0.8	0.778	-65.3	3.088	128.2	0.162	51.2	0.815	-33.1
0.9	0.743	-73.7	2.966	122.4	0.173	47.2	0.779	-36.8
1.0	0.706	-81.2	2.850	117.0	0.183	43.4	0.743	-40.4
1.1	0.676	-88.7	2.728	111.9	0.190	39.9	0.709	-43.7
1.2	0.645	-96.0	2.604	106.8	0.197	36.8	0.679	-46.6
1.3	0.620	-103.0	2.476	102.5	0.201	33.7	0.650	-49.2
1.4	0.600	-109.7	2.371	98.2	0.205	31.1	0.623	-51.7
1.5	0.583	-116.3	2.260	94.4	0.208	28.8	0.601	-54.0
1.6	0.572	-122.3	2.160	90.5	0.210	26.6	0.580	-56.1
1.7	0.557	-127.7	2.067	86.9	0.211	24.8	0.562	-57.9
1.8	0.546	-133.5	1.979	83.3	0.211	23.3	0.545	-59.5
1.9	0.537	-138.7	1.897	80.5	0.211	21.7	0.529	-61.2
2.0	0.532	-143.7	1.824	77.2	0.211	20.6	0.513	-62.6
2.1	0.526	-148.1	1.752	74.5	0.209	19.4	0.502	-64.1
2.2	0.525	-152.4	1.687	71.5	0.208	18.6	0.489	-65.7
2.3	0.522	-156.3	1.643	69.0	0.207	17.7	0.479	-67.0
2.4	0.515	-160.1	1.580	66.7	0.206	16.8	0.468	-68.5
2.5	0.515	-164.2	1.531	64.1	0.205	16.4	0.459	-70.1
2.6	0.511	-167.7	1.486	62.2	0.203	15.3	0.456	-71.8
2.7	0.506	-171.3	1.441	59.8	0.202	14.8	0.448	-73.4
2.8	0.503	-175.1	1.391	57.6	0.201	14.3	0.442	-74.9
2.9	0.487	-177.6	1.347	55.4	0.200	14.0	0.432	-76.3
3.0	0.483	-179.3	1.295	53.6	0.199	13.8	0.425	-78.4
4.0	0.527	147.4	1.047	32.9	0.193	19.5	0.390	-99.9
5.0	0.572	117.8	0.831	15.6	0.223	23.6	0.388	-126.5

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	0.870	-14.4	9.420	168.6	0.023	84.3	0.972	-8.5
0.2	0.841	-28.3	9.168	158.1	0.044	74.5	0.936	-17.1
0.3	0.802	-41.3	8.615	149.1	0.064	67.4	0.884	-25.0
0.4	0.745	-54.5	8.091	139.3	0.079	61.6	0.820	-32.1
0.5	0.687	-66.5	7.456	131.5	0.093	56.2	0.756	-38.4
0.6	0.636	-77.7	6.864	124.4	0.103	52.0	0.690	-43.9
0.7	0.591	-88.3	6.327	118.1	0.111	48.4	0.631	-48.8
0.8	0.551	-98.4	5.831	112.2	0.118	45.7	0.577	-53.3
0.9	0.522	-108.1	5.364	107.1	0.123	43.3	0.531	-57.3
1.0	0.494	-116.6	4.968	102.3	0.128	41.5	0.488	-60.9
1.1	0.473	-124.8	4.605	98.3	0.131	40.1	0.452	-64.2
1.2	0.455	-132.6	4.280	94.4	0.134	39.0	0.423	-67.2
1.3	0.447	-139.2	3.993	91.1	0.137	38.1	0.398	-70.0
1.4	0.437	-146.0	3.748	87.9	0.140	37.4	0.375	-72.4
1.5	0.437	-151.7	3.519	84.9	0.143	37.0	0.357	-74.6
1.6	0.434	-156.4	3.315	82.1	0.145	36.6	0.340	-76.7
1.7	0.430	-161.6	3.140	79.5	0.148	36.4	0.326	-78.5
1.8	0.430	-166.2	2.974	76.8	0.151	36.5	0.312	-80.1
1.9	0.431	-170.3	2.828	74.7	0.153	36.4	0.300	-81.6
2.0	0.433	-174.2	2.701	72.3	0.156	36.3	0.289	-83.3
2.1	0.434	-177.7	2.575	70.2	0.158	36.4	0.279	-84.9
2.2	0.434	179.4	2.466	67.8	0.162	36.5	0.270	-86.5
2.3	0.435	176.4	2.387	66.0	0.164	36.7	0.262	-88.1
2.4	0.435	173.4	2.289	64.3	0.168	36.6	0.254	-89.8
2.5	0.438	170.7	2.202	62.2	0.171	36.8	0.248	-91.7
2.6	0.436	168.0	2.133	60.7	0.173	36.6	0.244	-93.5
2.7	0.437	164.8	2.061	58.8	0.177	36.4	0.239	-95.5
2.8	0.434	162.2	1.982	57.0	0.180	36.2	0.236	-97.3
2.9	0.425	160.3	1.912	55.5	0.183	36.0	0.230	-99.8
3.0	0.422	159.0	1.836	54.2	0.186	35.8	0.226	-102.2
4.0	0.481	133.1	1.430	36.1	0.226	36.4	0.229	-129.1
5.0	0.534	109.7	1.125	20.6	0.275	28.9	0.257	-158.3

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	0.800	-19.3	14.009	165.1	0.023	80.1	0.949	-12.1
0.2	0.747	-37.9	13.191	151.8	0.042	71.5	0.884	-24.0
0.3	0.689	-54.3	11.918	140.9	0.057	63.4	0.802	-33.8
0.4	0.627	-69.9	10.725	130.4	0.069	57.9	0.713	-42.0
0.5	0.564	-84.1	9.532	122.4	0.079	53.7	0.632	-48.8
0.6	0.519	-96.3	8.532	115.5	0.086	50.8	0.560	-54.6
0.7	0.482	-107.7	7.647	109.8	0.092	48.6	0.501	-59.5
0.8	0.452	-118.2	6.912	104.5	0.098	47.2	0.449	-64.0
0.9	0.435	-127.5	6.260	100.1	0.102	46.0	0.407	-68.1
1.0	0.419	-136.0	5.728	96.2	0.107	45.5	0.371	-72.1
1.1	0.410	-143.8	5.256	92.6	0.110	45.2	0.342	-75.7
1.2	0.399	-151.3	4.857	89.4	0.114	44.9	0.318	-79.0
1.3	0.400	-157.2	4.501	86.4	0.118	44.8	0.298	-82.0
1.4	0.398	-163.1	4.196	83.8	0.122	44.9	0.281	-84.8
1.5	0.403	-167.9	3.938	81.3	0.126	44.9	0.268	-87.4
1.6	0.404	-172.0	3.696	78.7	0.130	44.9	0.255	-89.8
1.7	0.407	-175.9	3.491	76.5	0.134	44.9	0.244	-92.0
1.8	0.407	-179.7	3.301	74.1	0.138	45.1	0.234	-94.0
1.9	0.410	176.8	3.132	72.3	0.143	45.2	0.225	-95.9
2.0	0.413	173.7	2.983	70.2	0.147	45.3	0.216	-98.1
2.1	0.417	170.8	2.844	68.3	0.151	45.3	0.209	-100.2
2.2	0.421	168.7	2.721	66.2	0.156	45.3	0.202	-102.3
2.3	0.419	165.9	2.633	64.6	0.160	45.3	0.197	-104.3
2.4	0.422	163.8	2.519	63.0	0.165	45.2	0.191	-106.4
2.5	0.424	161.2	2.426	61.2	0.169	45.1	0.187	-108.9
2.6	0.424	159.0	2.345	59.8	0.174	44.9	0.184	-111.0
2.7	0.425	156.1	2.263	58.1	0.179	44.4	0.181	-113.7
2.8	0.425	153.8	2.177	56.3	0.183	43.9	0.180	-115.9
2.9	0.416	152.1	2.097	55.1	0.188	43.3	0.178	-119.2
3.0	0.413	151.3	2.017	54.1	0.191	43.0	0.175	-122.0
4.0	0.475	128.4	1.553	36.9	0.241	40.5	0.205	-148.7
5.0	0.527	106.8	1.216	22.3	0.292	30.2	0.254	-175.5

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	0.728	-24.8	17.770	162.2	0.021	79.7	0.926	-15.3
0.2	0.674	-46.4	16.173	146.8	0.039	68.3	0.835	-29.3
0.3	0.608	-64.8	14.161	135.0	0.052	61.2	0.731	-40.2
0.4	0.541	-81.8	12.306	124.5	0.062	56.4	0.631	-49.0
0.5	0.487	-96.9	10.686	116.7	0.070	53.7	0.546	-55.8
0.6	0.449	-109.5	9.390	110.2	0.076	51.7	0.476	-61.7
0.7	0.422	-120.9	8.299	104.9	0.082	50.5	0.420	-66.6
0.8	0.405	-131.4	7.433	100.1	0.087	50.2	0.373	-71.3
0.9	0.397	-140.5	6.700	96.3	0.092	49.6	0.337	-75.7
1.0	0.388	-148.8	6.099	92.5	0.096	49.8	0.307	-80.0
1.1	0.384	-155.7	5.582	89.4	0.101	49.7	0.283	-84.0
1.2	0.381	-162.3	5.114	86.5	0.106	49.8	0.263	-87.7
1.3	0.385	-167.5	4.730	84.0	0.110	49.9	0.248	-91.2
1.4	0.390	-172.8	4.412	81.6	0.115	50.1	0.234	-94.4
1.5	0.392	-177.1	4.130	79.2	0.120	50.1	0.224	-97.2
1.6	0.397	179.6	3.878	76.9	0.125	50.2	0.214	-100.1
1.7	0.399	175.8	3.660	74.8	0.130	50.2	0.206	-102.7
1.8	0.400	172.7	3.456	72.7	0.135	50.3	0.198	-105.2
1.9	0.405	169.9	3.275	71.1	0.140	50.4	0.191	-107.4
2.0	0.412	167.0	3.121	69.0	0.145	50.2	0.185	-110.0
2.1	0.414	164.8	2.972	67.4	0.150	50.1	0.179	-112.5
2.2	0.418	162.9	2.843	65.3	0.155	50.1	0.174	-115.0
2.3	0.418	160.4	2.742	63.8	0.161	49.8	0.170	-117.5
2.4	0.418	158.2	2.628	62.3	0.166	49.5	0.166	-119.9
2.5	0.423	156.0	2.530	60.5	0.171	49.2	0.164	-122.7
2.6	0.421	154.0	2.445	59.2	0.176	48.9	0.163	-124.9
2.7	0.424	151.4	2.359	57.6	0.182	48.2	0.161	-127.9
2.8	0.423	149.5	2.269	56.0	0.187	47.6	0.162	-130.3
2.9	0.413	148.0	2.190	54.8	0.192	46.8	0.163	-133.7
3.0	0.410	147.0	2.101	53.8	0.195	46.4	0.161	-136.9
4.0	0.474	125.8	1.610	37.3	0.249	42.3	0.204	-160.5
5.0	0.528	105.5	1.256	23.0	0.300	30.8	0.263	175.7



V<sub>CE</sub> = 1 V, I<sub>C</sub> = 10 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	0.653	-29.6	21.936	158.6	0.020	75.0	0.895	-19.0
0.2	0.584	-56.8	19.182	141.4	0.036	67.1	0.774	-35.2
0.3	0.519	-77.0	16.166	129.1	0.047	59.9	0.651	-47.0
0.4	0.461	-96.1	13.618	118.8	0.055	56.9	0.546	-56.0
0.5	0.423	-111.1	11.579	111.4	0.062	55.1	0.463	-62.8
0.6	0.397	-124.0	10.037	105.6	0.068	54.2	0.399	-68.7
0.7	0.385	-135.2	8.793	100.7	0.073	53.9	0.349	-73.8
0.8	0.375	-144.8	7.802	96.5	0.079	53.8	0.309	-79.0
0.9	0.375	-153.0	6.988	93.1	0.084	53.8	0.278	-83.7
1.0	0.371	-160.2	6.340	89.7	0.090	54.1	0.254	-88.7
1.1	0.372	-166.3	5.775	86.9	0.095	54.4	0.235	-93.1
1.2	0.374	-172.3	5.305	84.2	0.101	54.6	0.221	-97.5
1.3	0.381	-176.5	4.916	81.9	0.106	54.7	0.210	-101.5
1.4	0.385	178.8	4.558	79.6	0.111	54.8	0.200	-105.2
1.5	0.392	175.5	4.256	77.6	0.117	54.8	0.193	-108.3
1.6	0.394	172.4	4.001	75.4	0.123	54.8	0.186	-111.6
1.7	0.398	169.4	3.769	73.4	0.128	54.7	0.181	-114.5
1.8	0.402	167.0	3.558	71.5	0.134	54.8	0.175	-117.4
1.9	0.408	164.2	3.374	69.9	0.140	54.5	0.170	-119.9
2.0	0.412	161.7	3.210	68.1	0.145	54.3	0.166	-123.0
2.1	0.413	159.6	3.057	66.5	0.151	54.0	0.162	-125.7
2.2	0.419	157.9	2.927	64.3	0.157	53.7	0.159	-128.5
2.3	0.420	156.0	2.823	63.1	0.163	53.4	0.157	-131.3
2.4	0.422	154.0	2.704	61.6	0.168	52.9	0.154	-134.0
2.5	0.425	152.2	2.601	59.9	0.174	52.5	0.154	-136.8
2.6	0.424	150.3	2.512	58.7	0.179	51.9	0.153	-139.1
2.7	0.425	147.8	2.422	57.2	0.185	51.2	0.154	-142.0
2.8	0.424	145.8	2.336	55.5	0.191	50.5	0.156	-144.3
2.9	0.415	144.7	2.248	54.5	0.196	49.5	0.159	-147.5
3.0	0.413	143.7	2.161	53.6	0.199	49.0	0.159	-150.6
4.0	0.475	123.7	1.647	37.3	0.256	43.6	0.211	-170.0
5.0	0.528	104.4	1.283	23.6	0.307	31.2	0.277	169.0

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 20 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	0.494	-47.3	29.480	151.3	0.017	75.3	0.806	-26.8
0.2	0.422	-82.1	23.446	131.3	0.030	64.7	0.636	-46.5
0.3	0.389	-106.1	18.433	119.0	0.038	60.4	0.499	-59.1
0.4	0.371	-124.9	14.802	109.9	0.045	59.7	0.402	-68.2
0.5	0.361	-139.1	12.264	103.7	0.052	60.4	0.332	-75.3
0.6	0.358	-150.0	10.448	98.7	0.058	60.6	0.283	-81.8
0.7	0.361	-158.8	9.049	94.8	0.064	61.1	0.247	-87.9
0.8	0.365	-165.8	7.976	91.2	0.071	61.3	0.219	-94.2
0.9	0.372	-172.0	7.108	88.4	0.077	61.5	0.201	-100.1
1.0	0.375	-177.3	6.413	85.5	0.084	61.7	0.187	-106.4
1.1	0.383	178.2	5.834	83.2	0.090	62.0	0.178	-111.9
1.2	0.387	174.2	5.347	80.7	0.096	61.8	0.171	-117.1
1.3	0.396	171.2	4.930	78.8	0.103	61.6	0.168	-121.6
1.4	0.402	167.5	4.578	76.8	0.109	61.5	0.164	-125.7
1.5	0.407	165.2	4.280	74.9	0.115	61.3	0.162	-129.1
1.6	0.413	163.0	4.010	72.9	0.122	60.9	0.160	-132.7
1.7	0.416	160.9	3.780	71.2	0.129	60.6	0.159	-135.7
1.8	0.422	158.3	3.567	69.4	0.135	60.4	0.157	-139.0
1.9	0.425	156.5	3.377	68.0	0.141	59.8	0.155	-141.5
2.0	0.431	154.6	3.211	66.2	0.147	59.3	0.154	-144.6
2.1	0.434	153.1	3.059	64.8	0.154	58.7	0.153	-147.4
2.2	0.436	151.7	2.928	62.8	0.160	58.2	0.153	-150.1
2.3	0.440	149.9	2.824	61.6	0.166	57.6	0.153	-152.8
2.4	0.439	148.3	2.708	60.2	0.173	56.9	0.153	-155.3
2.5	0.441	146.6	2.603	58.6	0.179	56.2	0.155	-157.7
2.6	0.441	145.2	2.513	57.4	0.185	55.5	0.156	-159.7
2.7	0.443	143.2	2.422	55.9	0.191	54.6	0.159	-162.2
2.8	0.442	141.2	2.334	54.4	0.197	53.8	0.162	-163.9
2.9	0.433	139.9	2.247	53.4	0.202	52.5	0.168	-166.3
3.0	0.432	139.3	2.163	52.5	0.206	51.8	0.170	-169.0
4.0	0.493	120.8	1.641	36.7	0.265	44.9	0.228	-178.0
5.0	0.542	102.9	1.276	23.3	0.316	31.5	0.300	160.8

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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.970	-8.2	3.571	173.1	0.020	87.7	0.993	-3.3
0.2	0.955	-15.0	3.595	167.6	0.041	81.3	0.986	-7.1
0.3	0.935	-22.1	3.514	162.1	0.061	76.0	0.974	-10.7
0.4	0.921	-30.1	3.485	155.1	0.080	71.6	0.955	-14.5
0.5	0.889	-37.6	3.402	149.1	0.098	66.9	0.934	-18.1
0.6	0.861	-45.3	3.329	143.1	0.114	62.6	0.907	-21.8
0.7	0.827	-52.8	3.227	137.4	0.129	58.4	0.879	-25.2
0.8	0.797	-60.2	3.143	131.7	0.143	54.3	0.846	-28.8
0.9	0.763	-68.0	3.036	126.1	0.154	50.4	0.813	-32.1
1.0	0.728	-75.1	2.936	120.8	0.163	46.8	0.780	-35.3
1.1	0.698	-82.4	2.822	115.7	0.171	43.2	0.749	-38.4
1.2	0.663	-89.6	2.715	110.6	0.177	40.1	0.720	-41.1
1.3	0.639	-96.6	2.586	106.5	0.182	37.1	0.693	-43.6
1.4	0.614	-103.2	2.482	102.1	0.186	34.5	0.668	-45.9
1.5	0.600	-109.6	2.375	98.3	0.189	32.1	0.646	-48.1
1.6	0.583	-115.4	2.272	94.4	0.191	29.9	0.625	-50.1
1.7	0.566	-121.2	2.181	90.7	0.194	28.0	0.608	-51.9
1.8	0.554	-126.8	2.091	87.2	0.194	26.5	0.590	-53.3
1.9	0.543	-131.9	2.006	84.3	0.194	24.9	0.575	-54.9
2.0	0.536	-137.2	1.937	81.1	0.194	23.7	0.559	-56.3
2.1	0.526	-141.9	1.857	78.3	0.193	22.6	0.546	-57.6
2.2	0.525	-146.3	1.791	75.3	0.193	21.7	0.533	-59.0
2.3	0.518	-150.4	1.744	72.8	0.192	20.8	0.523	-60.2
2.4	0.513	-154.2	1.676	70.5	0.191	20.0	0.511	-61.5
2.5	0.509	-158.5	1.625	67.8	0.190	19.4	0.503	-62.9
2.6	0.504	-162.2	1.579	66.0	0.188	18.5	0.498	-64.6
2.7	0.500	-166.1	1.529	63.6	0.187	18.0	0.491	-65.9
2.8	0.494	-170.1	1.476	61.2	0.186	17.5	0.485	-67.4
2.9	0.480	-172.5	1.429	59.0	0.186	17.3	0.473	-68.6
3.0	0.475	-174.6	1.374	57.2	0.185	17.2	0.465	-70.5
4.0	0.510	150.5	1.113	36.3	0.181	23.4	0.423	-90.1
5.0	0.555	119.5	0.882	18.5	0.214	27.9	0.409	-115.2

V<sub>CE</sub> = 2 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	0.884	-13.4	9.448	169.7	0.020	83.2	0.978	-7.0
0.2	0.857	-25.3	9.247	159.9	0.039	76.2	0.947	-14.5
0.3	0.815	-36.8	8.759	151.4	0.055	69.5	0.903	-21.2
0.4	0.764	-48.7	8.310	142.2	0.070	64.2	0.847	-27.5
0.5	0.708	-59.6	7.737	134.6	0.082	59.4	0.790	-33.0
0.6	0.656	-70.2	7.203	127.6	0.092	55.3	0.730	-37.9
0.7	0.610	-80.1	6.675	121.4	0.100	51.7	0.676	-42.2
0.8	0.566	-89.5	6.189	115.6	0.107	48.8	0.623	-46.1
0.9	0.530	-98.9	5.737	110.5	0.112	46.5	0.577	-49.5
1.0	0.497	-107.3	5.341	105.8	0.117	44.6	0.535	-52.7
1.1	0.472	-115.3	4.967	101.6	0.120	43.2	0.499	-55.6
1.2	0.449	-123.3	4.629	97.5	0.124	42.0	0.468	-58.2
1.3	0.435	-130.5	4.329	94.2	0.127	40.9	0.441	-60.5
1.4	0.424	-137.4	4.074	91.0	0.130	40.3	0.418	-62.5
1.5	0.419	-143.3	3.834	88.0	0.132	39.7	0.399	-64.4
1.6	0.411	-148.8	3.613	85.1	0.135	39.2	0.381	-66.0
1.7	0.410	-154.0	3.430	82.3	0.138	39.1	0.366	-67.5
1.8	0.405	-158.7	3.247	79.6	0.140	39.0	0.352	-68.8
1.9	0.405	-163.2	3.088	77.5	0.143	38.8	0.339	-69.9
2.0	0.404	-167.7	2.950	75.1	0.146	38.9	0.327	-71.2
2.1	0.405	-171.1	2.814	73.0	0.148	39.0	0.317	-72.4
2.2	0.408	-174.8	2.698	70.7	0.151	39.1	0.308	-73.6
2.3	0.406	-178.1	2.609	68.9	0.154	39.1	0.299	-74.8
2.4	0.406	-178.9	2.500	67.1	0.157	39.1	0.290	-76.0
2.5	0.406	-175.6	2.409	65.0	0.160	39.2	0.283	-77.6
2.6	0.405	-172.8	2.334	63.4	0.162	39.2	0.279	-79.0
2.7	0.404	-169.7	2.250	61.6	0.166	39.0	0.272	-80.6
2.8	0.405	-166.9	2.163	59.8	0.169	38.8	0.268	-82.1
2.9	0.393	-164.7	2.088	58.3	0.173	38.5	0.261	-84.0
3.0	0.391	-163.4	2.008	56.9	0.175	38.5	0.255	-86.0
4.0	0.448	135.7	1.562	39.0	0.215	39.4	0.239	-111.1
5.0	0.504	111.4	1.227	23.1	0.265	32.0	0.247	-141.4

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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.820	-17.5	14.081	166.5	0.019	86.3	0.958	-10.2
0.2	0.769	-33.1	13.394	154.0	0.036	73.2	0.904	-20.1
0.3	0.708	-47.8	12.315	143.9	0.050	66.2	0.833	-28.6
0.4	0.645	-61.6	11.198	133.8	0.062	61.0	0.754	-35.8
0.5	0.582	-74.6	10.081	125.8	0.071	56.8	0.676	-41.7
0.6	0.529	-86.0	9.099	118.9	0.078	53.8	0.609	-46.6
0.7	0.484	-97.1	8.222	113.2	0.084	51.8	0.550	-50.8
0.8	0.450	-107.3	7.468	107.8	0.090	50.1	0.498	-54.6
0.9	0.425	-116.7	6.802	103.3	0.094	49.0	0.453	-57.9
1.0	0.405	-125.5	6.253	99.1	0.098	48.1	0.416	-61.2
1.1	0.387	-133.8	5.754	95.5	0.102	47.8	0.384	-63.9
1.2	0.375	-141.4	5.332	92.1	0.106	47.4	0.359	-66.3
1.3	0.369	-148.0	4.944	89.3	0.110	47.1	0.337	-68.8
1.4	0.366	-154.7	4.621	86.5	0.114	47.2	0.318	-70.8
1.5	0.369	-160.0	4.328	83.9	0.118	47.1	0.303	-72.8
1.6	0.368	-164.8	4.074	81.3	0.122	47.1	0.288	-74.5
1.7	0.369	-169.4	3.852	79.0	0.126	47.2	0.276	-76.0
1.8	0.369	-173.5	3.645	76.7	0.130	47.3	0.265	-77.5
1.9	0.370	-177.1	3.453	74.9	0.134	47.5	0.255	-78.7
2.0	0.374	179.4	3.293	72.8	0.138	47.4	0.245	-80.3
2.1	0.377	176.3	3.139	70.9	0.142	47.4	0.236	-81.8
2.2	0.381	173.4	3.007	68.8	0.146	47.4	0.229	-83.1
2.3	0.380	170.4	2.904	67.2	0.151	47.4	0.222	-84.6
2.4	0.379	168.2	2.781	65.5	0.155	47.3	0.215	-86.0
2.5	0.383	165.3	2.674	63.7	0.159	47.3	0.209	-88.0
2.6	0.384	163.3	2.584	62.4	0.163	47.0	0.205	-89.5
2.7	0.384	160.1	2.493	60.5	0.168	46.6	0.200	-91.6
2.8	0.384	157.6	2.397	58.9	0.173	46.1	0.197	-93.4
2.9	0.372	156.0	2.315	57.7	0.177	45.6	0.193	-96.2
3.0	0.374	154.9	2.223	56.6	0.180	45.3	0.188	-98.6
4.0	0.435	130.4	1.712	39.5	0.229	43.2	0.195	-127.5
5.0	0.494	108.4	1.338	24.7	0.281	33.0	0.225	-159.0

V<sub>CE</sub> = 2 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	0.760	-21.4	17.929	163.7	0.016	78.7	0.939	-12.7
0.2	0.693	-40.4	16.605	149.5	0.034	71.0	0.863	-24.5
0.3	0.627	-56.5	14.782	138.3	0.046	64.2	0.770	-34.1
0.4	0.557	-71.9	13.050	127.9	0.055	59.8	0.677	-41.6
0.5	0.496	-85.8	11.472	120.1	0.063	56.7	0.596	-47.5
0.6	0.448	-98.3	10.172	113.5	0.070	54.7	0.525	-52.3
0.7	0.414	-109.6	9.052	108.2	0.075	53.5	0.469	-56.2
0.8	0.388	-119.9	8.146	103.2	0.080	52.7	0.419	-59.8
0.9	0.372	-129.7	7.356	99.2	0.085	52.1	0.380	-63.1
1.0	0.358	-137.9	6.720	95.4	0.090	52.0	0.347	-66.2
1.1	0.348	-145.7	6.156	92.2	0.094	52.1	0.320	-69.1
1.2	0.344	-153.6	5.662	89.2	0.098	51.9	0.298	-71.8
1.3	0.343	-159.3	5.257	86.6	0.103	52.1	0.280	-74.3
1.4	0.343	-165.2	4.897	84.1	0.108	52.0	0.264	-76.5
1.5	0.349	-169.9	4.582	81.8	0.113	52.1	0.252	-78.7
1.6	0.351	-174.3	4.301	79.4	0.117	52.2	0.239	-80.7
1.7	0.352	-178.2	4.066	77.2	0.122	52.2	0.230	-82.5
1.8	0.356	178.2	3.843	75.1	0.127	52.4	0.219	-84.1
1.9	0.361	175.2	3.642	73.5	0.131	52.3	0.211	-85.5
2.0	0.365	171.8	3.469	71.5	0.136	52.3	0.203	-87.4
2.1	0.365	169.1	3.302	69.7	0.141	52.1	0.196	-89.1
2.2	0.370	167.0	3.159	67.8	0.146	51.9	0.189	-90.8
2.3	0.371	164.3	3.051	66.2	0.151	51.8	0.183	-92.4
2.4	0.372	162.1	2.919	64.8	0.156	51.6	0.178	-94.3
2.5	0.376	159.8	2.810	63.0	0.161	51.3	0.173	-96.5
2.6	0.375	157.6	2.716	61.7	0.166	50.9	0.170	-98.4
2.7	0.375	155.1	2.619	60.1	0.171	50.4	0.167	-100.7
2.8	0.376	152.5	2.521	58.5	0.176	49.7	0.165	-102.9
2.9	0.367	150.9	2.426	57.3	0.181	48.9	0.162	-106.5
3.0	0.367	150.3	2.335	56.3	0.184	48.5	0.158	-109.3
4.0	0.429	127.9	1.781	39.8	0.237	44.9	0.181	-138.8
5.0	0.488	107.1	1.391	25.5	0.290	33.6	0.225	-169.2

V<sub>CE</sub> = 2 V, I<sub>C</sub> = 10 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	0.679	-26.0	22.271	160.6	0.016	80.6	0.913	-15.6
0.2	0.607	-48.0	19.885	144.5	0.031	69.6	0.812	-29.3
0.3	0.538	-66.7	17.116	132.6	0.042	63.2	0.699	-39.4
0.4	0.471	-83.9	14.643	122.3	0.050	59.6	0.598	-46.9
0.5	0.417	-97.6	12.598	114.8	0.056	57.6	0.515	-52.5
0.6	0.381	-110.5	10.996	108.7	0.062	56.5	0.449	-57.0
0.7	0.356	-122.1	9.682	103.8	0.068	56.2	0.396	-60.9
0.8	0.343	-132.8	8.648	99.3	0.073	56.3	0.352	-64.4
0.9	0.334	-141.8	7.762	95.8	0.078	56.0	0.318	-67.7
1.0	0.328	-150.0	7.056	92.4	0.084	56.3	0.289	-71.1
1.1	0.325	-157.3	6.438	89.5	0.088	56.5	0.267	-74.2
1.2	0.325	-163.8	5.920	86.7	0.094	56.6	0.248	-77.1
1.3	0.329	-169.2	5.484	84.4	0.099	56.5	0.234	-79.9
1.4	0.333	-174.5	5.108	82.1	0.104	56.8	0.221	-82.4
1.5	0.339	-178.6	4.775	79.9	0.110	56.7	0.211	-84.7
1.6	0.342	178.2	4.472	77.8	0.115	56.6	0.201	-87.1
1.7	0.346	174.9	4.213	75.8	0.120	56.5	0.193	-89.3
1.8	0.350	171.5	3.992	73.9	0.126	56.6	0.185	-91.2
1.9	0.353	168.1	3.777	72.3	0.131	56.3	0.178	-93.0
2.0	0.361	165.8	3.597	70.4	0.136	56.1	0.171	-95.1
2.1	0.363	163.6	3.423	68.8	0.141	55.8	0.165	-97.2
2.2	0.366	161.6	3.277	66.8	0.147	55.5	0.160	-99.2
2.3	0.369	159.2	3.165	65.4	0.152	55.3	0.155	-101.3
2.4	0.371	157.5	3.026	63.9	0.158	54.8	0.151	-103.5
2.5	0.372	155.4	2.913	62.4	0.163	54.3	0.148	-105.9
2.6	0.372	153.2	2.808	61.0	0.169	53.9	0.146	-108.1
2.7	0.373	151.0	2.715	59.6	0.175	53.2	0.143	-111.0
2.8	0.373	148.4	2.606	57.9	0.180	52.4	0.143	-113.5
2.9	0.363	147.3	2.511	56.9	0.184	51.5	0.142	-117.3
3.0	0.366	146.4	2.417	55.9	0.188	50.9	0.140	-120.8
4.0	0.429	125.5	1.839	39.9	0.243	46.2	0.176	-148.9
5.0	0.487	106.1	1.431	26.1	0.296	33.9	0.231	-177.0

V<sub>CE</sub> = 2 V, I<sub>C</sub> = 20 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	0.519	-37.7	30.702	153.9	0.015	74.3	0.849	-21.5
0.2	0.441	-67.6	25.245	135.0	0.026	67.6	0.695	-37.8
0.3	0.386	-89.7	20.293	122.7	0.034	63.5	0.561	-47.9
0.4	0.345	-109.1	16.546	113.3	0.041	62.3	0.460	-54.7
0.5	0.318	-124.2	13.819	106.9	0.047	62.3	0.386	-59.4
0.6	0.308	-136.4	11.836	101.7	0.053	62.8	0.330	-63.3
0.7	0.302	-147.0	10.290	97.6	0.059	63.0	0.289	-66.7
0.8	0.302	-156.0	9.102	93.9	0.065	63.4	0.255	-70.3
0.9	0.306	-163.0	8.124	90.9	0.071	63.3	0.230	-73.8
1.0	0.309	-169.9	7.343	88.0	0.077	63.6	0.209	-77.6
1.1	0.315	-175.2	6.687	85.6	0.083	63.8	0.194	-81.2
1.2	0.319	-180.0	6.141	83.3	0.089	63.5	0.181	-84.8
1.3	0.327	176.1	5.669	81.2	0.095	63.3	0.171	-88.3
1.4	0.334	172.1	5.270	79.2	0.101	63.2	0.164	-91.4
1.5	0.340	169.4	4.914	77.2	0.107	63.0	0.157	-94.4
1.6	0.345	166.5	4.599	75.3	0.113	62.6	0.151	-97.2
1.7	0.352	164.0	4.341	73.5	0.119	62.3	0.147	-99.9
1.8	0.354	161.6	4.104	71.8	0.125	62.0	0.141	-102.5
1.9	0.359	159.5	3.886	70.4	0.131	61.6	0.136	-104.6
2.0	0.363	157.1	3.698	68.6	0.137	61.1	0.132	-107.5
2.1	0.369	155.6	3.518	67.1	0.143	60.6	0.129	-110.1
2.2	0.373	154.1	3.364	65.2	0.149	60.1	0.126	-112.7
2.3	0.372	152.5	3.246	64.0	0.155	59.5	0.123	-115.5
2.4	0.376	150.8	3.106	62.6	0.161	58.8	0.120	-118.0
2.5	0.379	149.0	2.988	61.1	0.167	58.2	0.120	-121.1
2.6	0.380	147.3	2.886	59.9	0.172	57.5	0.118	-123.6
2.7	0.380	145.1	2.783	58.5	0.179	56.6	0.119	-126.9
2.8	0.379	143.3	2.674	56.9	0.184	55.8	0.120	-129.6
2.9	0.371	142.2	2.576	56.0	0.188	54.6	0.122	-133.7
3.0	0.371	141.6	2.479	55.2	0.193	54.0	0.122	-137.5
4.0	0.437	122.4	1.877	39.6	0.250	47.7	0.173	-161.2
5.0	0.496	104.4	1.457	26.2	0.303	34.5	0.240	-174.4

**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	0.965	-24.1	3.654	164.3	0.035	77.0	0.985	-6.8
0.2	0.935	-46.4	3.467	149.7	0.068	63.9	0.947	-13.4
0.3	0.904	-66.0	3.152	137.5	0.091	52.8	0.901	-18.9
0.4	0.876	-83.9	2.849	125.4	0.109	43.5	0.850	-23.4
0.5	0.848	-99.0	2.549	115.8	0.120	35.6	0.807	-27.0
0.6	0.826	-111.8	2.286	107.5	0.126	29.4	0.768	-30.3
0.7	0.812	-122.4	2.062	100.2	0.128	24.0	0.740	-33.3
0.8	0.801	-131.7	1.875	93.3	0.128	19.7	0.715	-36.3
0.9	0.793	-139.5	1.703	87.5	0.126	16.0	0.696	-39.3
1.0	0.789	-146.6	1.561	82.0	0.123	13.1	0.679	-42.7
1.1	0.786	-152.5	1.434	77.0	0.117	10.9	0.669	-45.9
1.2	0.780	-157.9	1.323	72.2	0.112	9.3	0.662	-49.2
1.3	0.784	-162.3	1.227	68.4	0.105	8.3	0.656	-52.7
1.4	0.784	-166.8	1.147	64.2	0.099	8.1	0.650	-56.2
1.5	0.791	-170.3	1.077	60.7	0.092	9.0	0.649	-59.8
1.6	0.792	-173.4	1.006	57.4	0.085	10.6	0.646	-63.3
1.7	0.795	-176.4	0.951	54.2	0.079	13.6	0.648	-66.9
1.8	0.795	-179.4	0.895	51.1	0.072	18.2	0.647	-70.5
1.9	0.798	178.0	0.850	48.8	0.067	24.7	0.647	-74.0
2.0	0.802	175.4	0.809	45.9	0.065	32.5	0.648	-77.6
2.1	0.805	173.3	0.768	43.8	0.063	41.4	0.648	-81.2
2.2	0.810	171.1	0.735	41.2	0.065	50.5	0.649	-84.9
2.3	0.809	169.0	0.708	39.7	0.070	58.7	0.648	-88.6
2.4	0.810	167.0	0.677	38.1	0.077	65.6	0.648	-92.5
2.5	0.810	164.8	0.650	36.5	0.086	71.0	0.651	-96.5
2.6	0.810	162.9	0.630	35.5	0.096	74.9	0.654	-100.6
2.7	0.813	160.6	0.607	34.2	0.108	77.3	0.654	-104.5
2.8	0.817	158.7	0.583	33.0	0.120	78.7	0.660	-108.2
2.9	0.811	157.0	0.558	32.5	0.134	79.1	0.661	-111.8
3.0	0.812	154.7	0.536	31.5	0.148	79.1	0.655	-115.8

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	0.885	-35.2	9.632	157.9	0.035	72.0	0.949	-13.6
0.2	0.835	-65.4	8.466	139.8	0.060	56.9	0.843	-24.6
0.3	0.786	-88.2	7.146	126.3	0.075	45.9	0.738	-31.8
0.4	0.753	-107.2	6.038	114.9	0.083	38.6	0.649	-36.5
0.5	0.722	-121.5	5.142	106.5	0.088	33.6	0.584	-39.5
0.6	0.706	-133.1	4.463	99.6	0.090	30.4	0.535	-41.9
0.7	0.698	-142.0	3.918	93.8	0.091	28.3	0.499	-44.1
0.8	0.693	-149.6	3.488	88.4	0.091	27.3	0.470	-46.3
0.9	0.692	-155.9	3.124	84.1	0.090	26.7	0.449	-48.6
1.0	0.688	-161.5	2.836	79.7	0.090	27.1	0.432	-51.3
1.1	0.689	-165.9	2.585	76.0	0.088	28.1	0.421	-54.1
1.2	0.688	-170.1	2.374	72.2	0.087	29.5	0.413	-56.8
1.3	0.694	-173.5	2.197	69.1	0.086	31.3	0.408	-59.9
1.4	0.694	-177.0	2.044	66.0	0.085	33.7	0.404	-63.0
1.5	0.703	-179.4	1.912	63.0	0.086	36.8	0.403	-66.2
1.6	0.705	178.2	1.794	60.0	0.086	39.6	0.402	-69.4
1.7	0.708	176.0	1.692	57.3	0.087	43.0	0.403	-72.6
1.8	0.710	173.8	1.597	54.6	0.089	46.6	0.403	-75.8
1.9	0.713	171.8	1.515	52.3	0.091	50.1	0.404	-78.9
2.0	0.717	169.9	1.441	49.8	0.095	53.4	0.405	-82.3
2.1	0.723	168.4	1.375	47.6	0.099	56.6	0.407	-85.7
2.2	0.725	166.8	1.318	45.0	0.105	59.3	0.409	-89.1
2.3	0.725	165.0	1.274	43.2	0.110	61.8	0.412	-92.5
2.4	0.729	163.4	1.219	41.5	0.118	63.8	0.414	-96.1
2.5	0.731	161.7	1.175	39.4	0.125	65.6	0.418	-99.8
2.6	0.733	160.2	1.136	37.8	0.133	67.1	0.421	-103.6
2.7	0.736	158.4	1.100	36.0	0.142	68.0	0.427	-107.4
2.8	0.741	156.9	1.057	34.3	0.151	68.6	0.433	-110.9
2.9	0.737	155.5	1.020	32.9	0.161	68.6	0.438	-114.5
3.0	0.738	153.3	0.975	31.0	0.172	68.7	0.440	-118.2

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	0.830	-44.6	14.560	152.7	0.032	68.1	0.908	-19.6
0.2	0.756	-79.1	11.937	132.3	0.053	52.8	0.749	-33.2
0.3	0.711	-103.5	9.559	119.1	0.063	43.4	0.617	-40.9
0.4	0.680	-121.8	7.781	108.6	0.069	38.4	0.520	-45.1
0.5	0.660	-134.7	6.481	101.2	0.072	36.0	0.454	-47.8
0.6	0.651	-144.9	5.542	95.2	0.074	35.1	0.406	-49.8
0.7	0.647	-152.5	4.815	90.3	0.076	34.8	0.372	-51.6
0.8	0.647	-159.1	4.262	85.6	0.077	35.6	0.345	-53.7
0.9	0.648	-164.5	3.801	81.9	0.079	36.8	0.326	-56.0
1.0	0.648	-169.0	3.439	78.1	0.080	38.3	0.311	-58.6
1.1	0.648	-172.8	3.130	74.9	0.081	40.2	0.302	-61.3
1.2	0.650	-176.4	2.865	71.7	0.083	42.1	0.294	-64.3
1.3	0.656	-179.0	2.653	68.8	0.085	44.2	0.290	-67.3
1.4	0.659	178.1	2.466	66.0	0.088	46.6	0.287	-70.4
1.5	0.667	175.8	2.308	63.4	0.091	48.8	0.286	-73.6
1.6	0.668	173.8	2.164	60.8	0.094	50.9	0.286	-76.8
1.7	0.673	172.1	2.038	58.3	0.098	52.9	0.288	-79.9
1.8	0.674	170.3	1.925	55.8	0.102	55.2	0.288	-83.0
1.9	0.678	168.7	1.828	53.7	0.107	57.1	0.290	-86.1
2.0	0.682	166.9	1.741	51.3	0.112	58.7	0.291	-89.5
2.1	0.685	165.5	1.660	49.3	0.118	60.2	0.294	-92.7
2.2	0.689	164.2	1.594	46.9	0.123	61.6	0.297	-96.1
2.3	0.691	162.6	1.540	45.2	0.130	62.7	0.299	-99.4
2.4	0.694	161.3	1.477	43.4	0.137	63.5	0.302	-102.9
2.5	0.696	159.9	1.423	41.4	0.144	64.3	0.307	-106.6
2.6	0.699	158.5	1.379	39.8	0.151	65.0	0.312	-110.2
2.7	0.701	156.9	1.334	38.0	0.160	65.0	0.317	-113.8
2.8	0.706	155.5	1.286	36.2	0.168	65.2	0.324	-117.3
2.9	0.703	154.4	1.240	34.9	0.177	64.9	0.330	-120.7
3.0	0.703	152.4	1.191	32.9	0.186	64.8	0.335	-124.3

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	0.776	-53.0	18.356	148.5	0.031	67.4	0.869	-24.3
0.2	0.701	-90.0	14.204	127.3	0.048	50.5	0.676	-39.5
0.3	0.661	-114.1	10.997	114.4	0.055	43.0	0.535	-47.1
0.4	0.643	-131.0	8.762	104.8	0.060	40.1	0.439	-51.3
0.5	0.627	-143.1	7.220	98.1	0.064	39.0	0.376	-53.7
0.6	0.623	-151.8	6.127	92.7	0.066	39.7	0.331	-55.7
0.7	0.623	-158.8	5.301	88.3	0.069	40.5	0.300	-57.6
0.8	0.624	-164.8	4.674	84.1	0.071	42.1	0.275	-59.8
0.9	0.627	-169.2	4.154	80.7	0.074	43.6	0.258	-62.4
1.0	0.629	-173.3	3.752	77.2	0.077	45.5	0.245	-65.3
1.1	0.630	-176.6	3.418	74.2	0.080	47.4	0.236	-68.4
1.2	0.631	-179.9	3.132	71.3	0.084	49.3	0.230	-71.5
1.3	0.639	177.9	2.893	68.7	0.087	51.0	0.227	-74.8
1.4	0.640	175.2	2.691	66.1	0.091	52.8	0.225	-78.1
1.5	0.649	173.3	2.520	63.6	0.096	54.5	0.225	-81.3
1.6	0.652	171.4	2.362	61.2	0.100	56.0	0.225	-84.7
1.7	0.655	169.8	2.224	58.8	0.105	57.3	0.227	-87.7
1.8	0.657	168.3	2.103	56.4	0.110	58.9	0.228	-90.9
1.9	0.660	166.6	1.996	54.6	0.116	60.0	0.230	-93.9
2.0	0.664	165.0	1.900	52.2	0.122	61.0	0.232	-97.3
2.1	0.667	163.9	1.814	50.2	0.128	61.8	0.235	-100.5
2.2	0.673	162.6	1.740	47.9	0.134	62.5	0.238	-103.9
2.3	0.675	161.2	1.684	46.3	0.141	63.0	0.241	-107.1
2.4	0.675	160.0	1.616	44.4	0.148	63.4	0.244	-110.7
2.5	0.680	158.6	1.554	42.6	0.155	63.8	0.250	-114.2
2.6	0.679	157.3	1.506	41.1	0.162	64.1	0.255	-117.5
2.7	0.686	155.9	1.461	39.3	0.170	63.9	0.262	-121.3
2.8	0.687	154.5	1.409	37.5	0.178	63.8	0.269	-124.5
2.9	0.685	153.5	1.360	36.1	0.187	63.3	0.276	-127.8
3.0	0.685	151.8	1.308	34.1	0.195	62.9	0.281	-131.1

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 10 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	0.708	-63.2	22.952	143.0	0.028	63.3	0.812	-30.6
0.2	0.647	-104.2	16.597	121.5	0.042	49.2	0.587	-47.2
0.3	0.617	-126.0	12.376	109.5	0.048	44.0	0.444	-54.7
0.4	0.605	-141.2	9.676	100.9	0.052	43.3	0.355	-59.0
0.5	0.600	-151.8	7.899	95.0	0.056	44.1	0.298	-61.6
0.6	0.600	-159.5	6.665	90.2	0.060	46.1	0.258	-64.1
0.7	0.601	-165.4	5.746	86.2	0.064	47.5	0.230	-66.4
0.8	0.604	-170.5	5.055	82.4	0.068	49.6	0.209	-69.4
0.9	0.610	-174.3	4.489	79.4	0.072	51.2	0.194	-72.6
1.0	0.612	-177.8	4.048	76.2	0.077	52.9	0.183	-76.3
1.1	0.615	179.3	3.674	73.5	0.081	54.4	0.177	-80.1
1.2	0.615	176.5	3.369	70.9	0.086	55.8	0.172	-83.9
1.3	0.625	174.4	3.114	68.4	0.091	57.2	0.171	-87.7
1.4	0.628	172.0	2.897	66.1	0.096	58.4	0.170	-91.3
1.5	0.634	170.5	2.709	63.7	0.102	59.3	0.171	-94.7
1.6	0.638	169.1	2.540	61.3	0.107	60.3	0.172	-98.2
1.7	0.640	167.4	2.398	59.1	0.113	61.0	0.175	-101.3
1.8	0.642	166.0	2.264	56.9	0.119	61.9	0.177	-104.5
1.9	0.647	164.5	2.149	55.1	0.125	62.4	0.180	-107.4
2.0	0.650	163.2	2.046	53.0	0.131	62.8	0.182	-110.7
2.1	0.653	162.0	1.955	51.1	0.138	63.2	0.186	-113.8
2.2	0.658	161.0	1.875	48.8	0.145	63.4	0.189	-117.2
2.3	0.657	159.7	1.811	47.3	0.151	63.5	0.194	-120.2
2.4	0.660	158.5	1.740	45.5	0.159	63.4	0.197	-123.5
2.5	0.662	157.2	1.678	43.6	0.166	63.4	0.204	-126.8
2.6	0.665	156.0	1.626	42.3	0.173	63.4	0.210	-130.0
2.7	0.669	154.7	1.574	40.5	0.181	62.9	0.216	-133.3
2.8	0.671	153.6	1.516	38.7	0.188	62.6	0.224	-136.2
2.9	0.668	152.6	1.468	37.3	0.197	61.9	0.231	-139.2
3.0	0.670	150.6	1.413	35.5	0.205	61.4	0.238	-142.0

V<sub>CE</sub> = 1 V, I<sub>C</sub> = 20 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	0.595	-90.1	30.614	132.0	0.023	57.3	0.670	-44.6
0.2	0.578	-129.8	19.508	111.8	0.032	50.6	0.424	-63.1
0.3	0.571	-147.1	13.843	101.9	0.037	49.8	0.301	-71.5
0.4	0.576	-158.0	10.586	95.1	0.043	52.9	0.232	-77.7
0.5	0.577	-165.5	8.543	90.4	0.048	55.1	0.189	-82.6
0.6	0.582	-170.9	7.163	86.4	0.055	57.3	0.161	-88.1
0.7	0.587	-174.9	6.145	83.1	0.060	59.2	0.143	-93.6
0.8	0.594	-178.7	5.390	79.8	0.067	60.7	0.130	-100.1
0.9	0.599	178.4	4.783	77.4	0.073	61.4	0.123	-106.2
1.0	0.601	175.5	4.308	74.6	0.079	62.6	0.120	-112.5
1.1	0.606	173.3	3.913	72.3	0.085	63.4	0.120	-118.0
1.2	0.608	171.2	3.584	69.9	0.092	63.8	0.121	-122.9
1.3	0.616	169.5	3.312	67.7	0.098	64.3	0.124	-126.9
1.4	0.620	167.6	3.075	65.6	0.105	64.6	0.127	-130.5
1.5	0.626	166.2	2.876	63.4	0.112	64.8	0.131	-133.3
1.6	0.628	165.0	2.698	61.3	0.118	65.0	0.135	-136.3
1.7	0.631	163.7	2.545	59.2	0.125	64.9	0.139	-138.6
1.8	0.636	162.5	2.404	57.1	0.132	65.1	0.143	-141.2
1.9	0.637	161.1	2.282	55.4	0.139	65.0	0.146	-143.2
2.0	0.643	160.0	2.174	53.5	0.146	64.7	0.151	-145.7
2.1	0.644	159.2	2.075	51.8	0.153	64.6	0.155	-148.1
2.2	0.649	158.1	1.994	49.6	0.160	64.2	0.160	-150.4
2.3	0.648	157.0	1.927	48.1	0.167	63.9	0.165	-152.6
2.4	0.649	156.0	1.850	46.5	0.175	63.4	0.170	-155.0
2.5	0.653	154.8	1.783	44.6	0.182	62.9	0.177	-157.2
2.6	0.655	153.7	1.730	43.3	0.189	62.6	0.183	-159.2
2.7	0.657	152.5	1.674	41.6	0.197	61.8	0.190	-161.3
2.8	0.660	151.4	1.619	39.9	0.205	61.1	0.198	-163.2
2.9	0.656	150.5	1.564	38.6	0.212	60.2	0.206	-164.9
3.0	0.657	148.8	1.507	36.9	0.220	59.5	0.212	-166.6

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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.963	-22.6	3.694	164.6	0.032	77.4	0.986	-6.3
0.2	0.934	-45.4	3.525	150.4	0.062	64.8	0.951	-12.5
0.3	0.911	-64.6	3.208	138.6	0.085	53.5	0.909	-17.7
0.4	0.878	-82.4	2.915	126.7	0.101	44.5	0.861	-22.0
0.5	0.847	-97.3	2.615	117.2	0.111	36.9	0.818	-25.4
0.6	0.826	-110.3	2.350	108.9	0.117	30.6	0.782	-28.6
0.7	0.812	-121.0	2.120	101.6	0.119	25.2	0.754	-31.5
0.8	0.802	-130.4	1.931	94.8	0.120	21.0	0.730	-34.4
0.9	0.795	-138.3	1.757	88.9	0.117	17.2	0.711	-37.3
1.0	0.789	-145.4	1.613	83.5	0.114	14.5	0.694	-40.4
1.1	0.784	-151.4	1.483	78.7	0.109	12.3	0.684	-43.6
1.2	0.779	-156.8	1.370	74.0	0.104	10.8	0.676	-46.8
1.3	0.783	-161.5	1.269	70.1	0.098	10.0	0.670	-50.1
1.4	0.783	-165.9	1.185	66.0	0.091	9.9	0.665	-53.5
1.5	0.788	-169.6	1.112	62.6	0.085	11.0	0.663	-56.9
1.6	0.791	-172.7	1.042	59.2	0.078	13.0	0.659	-60.5
1.7	0.793	-175.9	0.983	56.1	0.072	16.4	0.660	-63.8
1.8	0.795	-179.0	0.928	53.0	0.067	21.7	0.658	-67.3
1.9	0.796	178.5	0.878	50.6	0.063	28.7	0.658	-70.7
2.0	0.798	175.9	0.833	47.8	0.061	37.0	0.656	-74.3
2.1	0.802	173.9	0.798	45.5	0.060	46.4	0.656	-77.8
2.2	0.806	171.6	0.761	43.0	0.063	55.4	0.657	-81.3
2.3	0.805	169.4	0.735	41.3	0.068	63.5	0.657	-84.9
2.4	0.805	167.3	0.703	40.1	0.076	69.9	0.655	-88.8
2.5	0.805	165.2	0.673	38.2	0.085	74.8	0.657	-92.6
2.6	0.810	163.1	0.651	37.2	0.096	78.6	0.657	-96.5
2.7	0.811	161.1	0.629	35.9	0.108	80.5	0.658	-100.4
2.8	0.813	159.2	0.604	34.7	0.120	81.7	0.662	-104.1
2.9	0.809	157.4	0.581	34.1	0.133	81.8	0.662	-107.8
3.0	0.807	155.0	0.556	32.9	0.148	81.8	0.656	-111.7

V<sub>CE</sub> = 2 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	0.888	-33.6	9.650	158.8	0.030	72.3	0.954	-12.4
0.2	0.850	-62.4	8.552	141.1	0.055	58.2	0.857	-22.7
0.3	0.794	-85.2	7.287	127.9	0.070	47.1	0.759	-29.5
0.4	0.754	-104.1	6.206	116.5	0.078	39.9	0.674	-33.8
0.5	0.723	-118.6	5.302	108.0	0.083	35.0	0.609	-36.8
0.6	0.705	-130.2	4.613	101.0	0.086	31.5	0.560	-39.1
0.7	0.695	-139.7	4.061	95.2	0.086	29.4	0.525	-41.0
0.8	0.688	-147.6	3.619	89.9	0.086	28.5	0.496	-43.1
0.9	0.688	-153.9	3.244	85.5	0.086	27.8	0.475	-45.2
1.0	0.686	-159.6	2.948	81.1	0.085	28.3	0.458	-47.7
1.1	0.682	-164.3	2.689	77.3	0.083	29.3	0.447	-50.4
1.2	0.682	-168.7	2.470	73.6	0.082	30.6	0.437	-53.0
1.3	0.687	-172.0	2.282	70.5	0.082	32.7	0.431	-55.8
1.4	0.690	-175.5	2.127	67.2	0.081	35.2	0.427	-58.9
1.5	0.696	-178.3	1.991	64.2	0.081	38.2	0.425	-61.9
1.6	0.699	179.2	1.865	61.4	0.081	41.4	0.423	-65.1
1.7	0.701	177.0	1.760	58.7	0.083	45.0	0.424	-68.0
1.8	0.705	174.8	1.661	55.9	0.084	48.7	0.423	-71.1
1.9	0.707	172.7	1.576	53.8	0.087	52.2	0.424	-74.1
2.0	0.709	170.6	1.498	51.1	0.091	55.7	0.423	-77.4
2.1	0.715	169.1	1.429	49.0	0.095	59.0	0.424	-80.7
2.2	0.720	167.6	1.370	46.5	0.100	61.8	0.426	-84.0
2.3	0.721	165.7	1.327	44.7	0.106	64.4	0.427	-87.3
2.4	0.722	164.1	1.268	42.8	0.113	66.3	0.427	-90.9
2.5	0.725	162.3	1.221	40.8	0.121	68.1	0.430	-94.5
2.6	0.727	160.9	1.181	39.3	0.129	69.6	0.434	-98.0
2.7	0.730	159.0	1.141	37.5	0.138	70.3	0.437	-101.8
2.8	0.734	157.5	1.101	35.8	0.147	71.0	0.442	-105.3
2.9	0.730	156.0	1.058	34.3	0.157	70.9	0.445	-108.8
3.0	0.733	154.1	1.011	32.5	0.167	71.1	0.446	-112.6



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. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.847	-42.1	14.583	153.9	0.029	71.4	0.918	-17.8
0.2	0.767	-75.3	12.130	134.1	0.050	54.8	0.772	-30.4
0.3	0.712	-99.6	9.834	120.9	0.059	45.2	0.645	-37.6
0.4	0.676	-117.9	8.066	110.2	0.065	39.6	0.550	-41.6
0.5	0.657	-131.3	6.744	102.7	0.069	37.2	0.484	-43.9
0.6	0.644	-141.8	5.777	96.8	0.071	36.3	0.436	-45.7
0.7	0.641	-150.0	5.041	91.7	0.072	36.0	0.402	-47.3
0.8	0.638	-156.6	4.452	87.0	0.074	36.6	0.375	-49.1
0.9	0.636	-162.2	3.979	83.2	0.075	37.7	0.355	-51.1
1.0	0.639	-167.0	3.604	79.4	0.076	39.4	0.339	-53.4
1.1	0.638	-170.9	3.276	76.2	0.078	41.2	0.329	-55.9
1.2	0.639	-174.7	3.006	73.0	0.079	43.1	0.321	-58.6
1.3	0.645	-177.5	2.783	70.2	0.081	45.4	0.315	-61.5
1.4	0.648	179.5	2.588	67.3	0.084	47.6	0.311	-64.3
1.5	0.656	177.2	2.418	64.7	0.087	49.9	0.310	-67.3
1.6	0.659	175.3	2.266	62.1	0.090	52.1	0.308	-70.3
1.7	0.662	173.3	2.139	59.6	0.094	54.3	0.309	-73.2
1.8	0.664	171.3	2.021	57.2	0.098	56.7	0.308	-76.2
1.9	0.668	169.6	1.914	55.0	0.102	58.6	0.309	-79.2
2.0	0.670	167.9	1.824	52.7	0.107	60.4	0.310	-82.4
2.1	0.674	166.5	1.737	50.6	0.112	61.9	0.311	-85.5
2.2	0.677	165.1	1.667	48.3	0.118	63.3	0.312	-88.9
2.3	0.680	163.6	1.616	46.4	0.125	64.6	0.314	-92.1
2.4	0.682	162.3	1.547	44.7	0.132	65.4	0.315	-95.6
2.5	0.686	160.8	1.491	42.8	0.139	66.3	0.319	-99.1
2.6	0.687	159.4	1.443	41.2	0.146	67.0	0.323	-102.7
2.7	0.692	157.9	1.393	39.5	0.154	67.1	0.326	-106.4
2.8	0.696	156.2	1.345	37.5	0.162	67.2	0.332	-109.8
2.9	0.691	155.2	1.296	36.1	0.171	67.0	0.336	-113.3
3.0	0.693	153.3	1.246	34.3	0.181	66.8	0.340	-117.0

V<sub>CE</sub> = 2 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	0.777	-49.4	18.629	149.9	0.028	69.2	0.882	-22.1
0.2	0.703	-85.8	14.683	129.2	0.045	51.8	0.701	-36.3
0.3	0.660	-109.4	11.476	116.2	0.052	44.3	0.563	-43.4
0.4	0.630	-127.4	9.203	106.4	0.057	41.4	0.469	-47.1
0.5	0.617	-139.8	7.609	99.5	0.060	40.4	0.405	-49.2
0.6	0.612	-148.8	6.468	94.1	0.063	40.8	0.359	-50.7
0.7	0.608	-156.4	5.599	89.7	0.066	41.7	0.327	-52.2
0.8	0.610	-162.3	4.946	85.3	0.068	43.2	0.302	-54.0
0.9	0.612	-167.2	4.401	81.9	0.071	44.7	0.284	-56.1
1.0	0.614	-171.4	3.977	78.5	0.074	46.6	0.270	-58.5
1.1	0.614	-174.9	3.619	75.5	0.077	48.5	0.260	-61.1
1.2	0.616	-178.4	3.321	72.5	0.080	50.4	0.253	-64.0
1.3	0.624	179.1	3.069	70.0	0.084	52.2	0.248	-67.0
1.4	0.627	176.4	2.855	67.3	0.088	54.1	0.244	-69.9
1.5	0.636	174.5	2.668	64.9	0.092	55.7	0.244	-73.0
1.6	0.636	172.9	2.500	62.4	0.096	57.2	0.242	-76.1
1.7	0.639	170.9	2.358	60.1	0.101	58.7	0.243	-79.1
1.8	0.644	169.4	2.229	57.8	0.106	60.4	0.243	-82.0
1.9	0.647	167.6	2.113	55.8	0.111	61.3	0.244	-85.0
2.0	0.650	166.0	2.014	53.6	0.117	62.3	0.245	-88.2
2.1	0.655	164.8	1.922	51.6	0.123	63.3	0.246	-91.5
2.2	0.658	163.5	1.843	49.3	0.129	64.2	0.248	-94.7
2.3	0.658	162.2	1.782	47.6	0.136	64.8	0.250	-97.9
2.4	0.660	161.0	1.710	46.0	0.143	65.0	0.252	-101.5
2.5	0.663	159.6	1.643	44.0	0.150	65.4	0.256	-105.1
2.6	0.665	158.4	1.591	42.4	0.157	65.8	0.260	-108.6
2.7	0.668	156.9	1.540	40.7	0.165	65.6	0.265	-112.3
2.8	0.674	155.5	1.486	38.8	0.172	65.5	0.270	-115.5
2.9	0.669	154.4	1.436	37.5	0.181	65.0	0.276	-119.1
3.0	0.673	152.6	1.380	35.6	0.190	64.7	0.281	-122.6

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

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	0.717	-59.4	23.348	145.1	0.025	63.5	0.833	-27.6
0.2	0.644	-97.6	17.228	123.6	0.039	51.0	0.619	-42.9
0.3	0.611	-120.6	13.025	111.4	0.045	45.3	0.478	-49.8
0.4	0.594	-137.0	10.243	102.6	0.050	44.5	0.388	-53.2
0.5	0.585	-148.1	8.383	96.5	0.054	45.3	0.329	-55.2
0.6	0.583	-156.2	7.082	91.6	0.058	46.7	0.287	-56.9
0.7	0.584	-162.4	6.107	87.6	0.061	48.2	0.259	-58.4
0.8	0.586	-167.8	5.385	83.7	0.065	50.1	0.236	-60.5
0.9	0.590	-171.9	4.775	80.8	0.069	51.8	0.220	-63.0
1.0	0.593	-175.8	4.316	77.6	0.074	53.5	0.207	-65.9
1.1	0.595	-178.8	3.919	74.9	0.078	55.3	0.198	-69.0
1.2	0.596	178.0	3.600	72.2	0.082	56.7	0.192	-72.3
1.3	0.602	176.1	3.326	69.7	0.087	58.1	0.189	-75.7
1.4	0.608	173.6	3.093	67.3	0.092	59.2	0.186	-78.9
1.5	0.617	171.9	2.888	65.0	0.097	60.4	0.186	-82.1
1.6	0.619	170.4	2.708	62.7	0.103	61.1	0.186	-85.4
1.7	0.622	168.8	2.554	60.5	0.108	62.0	0.187	-88.5
1.8	0.626	167.3	2.413	58.3	0.114	63.0	0.187	-91.7
1.9	0.627	166.0	2.289	56.5	0.120	63.5	0.189	-94.6
2.0	0.634	164.2	2.180	54.3	0.126	64.0	0.190	-98.0
2.1	0.634	163.2	2.080	52.4	0.132	64.4	0.192	-101.1
2.2	0.640	162.2	1.998	50.3	0.139	64.7	0.194	-104.5
2.3	0.640	160.9	1.931	48.7	0.146	64.9	0.197	-107.7
2.4	0.641	159.7	1.851	47.0	0.153	64.9	0.199	-111.1
2.5	0.644	158.5	1.786	45.1	0.160	64.9	0.204	-114.7
2.6	0.647	157.2	1.728	43.6	0.167	64.9	0.208	-118.0
2.7	0.649	155.8	1.670	41.9	0.175	64.5	0.213	-121.7
2.8	0.655	154.5	1.616	40.1	0.182	64.1	0.220	-124.8
2.9	0.651	153.5	1.561	38.7	0.190	63.5	0.226	-128.3
3.0	0.654	151.8	1.500	36.9	0.198	63.1	0.231	-131.3

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

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	0.585	-81.0	32.144	134.9	0.021	62.1	0.711	-39.3
0.2	0.555	-121.9	21.060	114.2	0.030	52.7	0.465	-55.9
0.3	0.546	-140.8	15.111	104.0	0.036	51.9	0.336	-62.6
0.4	0.546	-153.5	11.601	96.9	0.041	53.5	0.262	-66.4
0.5	0.544	-161.5	9.389	92.0	0.046	56.0	0.216	-69.1
0.6	0.552	-167.6	7.891	88.1	0.052	58.0	0.183	-72.2
0.7	0.553	-172.1	6.777	84.7	0.058	59.7	0.161	-75.4
0.8	0.559	-176.3	5.942	81.4	0.063	61.3	0.144	-79.7
0.9	0.564	-179.4	5.269	78.9	0.070	62.1	0.133	-84.3
1.0	0.571	177.7	4.754	76.0	0.076	63.1	0.125	-89.5
1.1	0.571	175.3	4.322	73.8	0.082	64.2	0.121	-94.4
1.2	0.576	172.9	3.953	71.4	0.088	64.6	0.119	-99.4
1.3	0.584	171.2	3.650	69.3	0.094	65.0	0.119	-103.9
1.4	0.586	169.1	3.392	67.1	0.100	65.5	0.119	-108.1
1.5	0.596	167.8	3.172	65.0	0.107	65.7	0.122	-111.6
1.6	0.599	166.6	2.975	62.9	0.113	65.9	0.123	-115.2
1.7	0.603	165.1	2.808	60.9	0.120	65.9	0.126	-118.2
1.8	0.604	164.0	2.648	58.9	0.126	66.1	0.128	-121.5
1.9	0.608	162.8	2.514	57.2	0.133	66.1	0.131	-124.2
2.0	0.614	161.6	2.397	55.2	0.140	65.9	0.133	-127.4
2.1	0.616	160.7	2.287	53.6	0.146	65.7	0.137	-130.2
2.2	0.618	159.8	2.193	51.4	0.153	65.4	0.140	-133.3
2.3	0.621	158.5	2.120	49.9	0.161	65.1	0.144	-136.0
2.4	0.620	157.3	2.035	48.3	0.168	64.6	0.148	-139.1
2.5	0.623	156.4	1.960	46.5	0.175	64.2	0.153	-142.0
2.6	0.625	155.3	1.902	45.0	0.182	63.9	0.159	-144.5
2.7	0.628	154.0	1.840	43.6	0.190	63.1	0.165	-147.4
2.8	0.632	152.8	1.775	41.9	0.197	62.5	0.172	-149.7
2.9	0.628	152.0	1.720	40.5	0.205	61.7	0.180	-152.2
3.0	0.631	150.4	1.655	38.8	0.212	61.0	0.186	-154.4