

DATA SHEET

NEC

NPN SILICON RF TWIN TRANSISTOR μ PA859TD

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, 2SC5676)
 - Q1: Low noise transistor
NF = 1.5 dB TYP. @ $V_{CE} = 1$ V, $I_c = 3$ mA, $f = 2$ GHz
 - Q2: Low phase distortion transistor suited for OSC applications
 $f_T = 5.5$ GHz TYP., $|S_{21e}|^2 = 4.0$ dB TYP. @ $V_{CE} = 1$ V, $I_c = 10$ mA, $f = 2$ GHz
- 6-pin lead-less minimold package

BUILT-IN TRANSISTORS

	Q1	Q2
3-pin thin-type ultra super minimold part No.	2SC5737	2SC5676

ORDERING INFORMATION

Part Number	Quantity	Supplying Form
μ PA859TD	50 pcs (Non reel)	• 8 mm wide embossed taping • Pin 1 (Q1 Collector), Pin 6 (Q1 Base) face the perforation side of the tape
μ PA859TD-T3	10 kpcs/reel	

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.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
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_A = +25°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		°C
Storage Temperature	T _{stg}	−65 to +150		°C

Note Mounted on 1.08 cm² × 1.0 mm (t) glass epoxy PCB

ELECTRICAL CHARACTERISTICS (T_A = +25°C)

(1) Q1

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I _{CBO}	V _{CB} = 5 V, I _E = 0 mA	—	—	100	nA
Emitter Cut-off Current	I _{EBO}	V _{EB} = 1 V, I _C = 0 mA	—	—	100	nA
DC Current Gain	h _{FE} ^{Note 1}	V _{CE} = 1 V, I _C = 10 mA	70	110	140	—
Gain Bandwidth Product	f _T	V _{CE} = 1 V, I _C = 10 mA, f = 2 GHz	10.0	12.0	—	GHz
Insertion Power Gain	S _{21e} ²	V _{CE} = 1 V, I _C = 10 mA, f = 2 GHz	7.0	9.0	—	dB
Noise Figure	NF	V _{CE} = 1 V, I _C = 3 mA, f = 2 GHz, Z _S = Z _{opt}	—	1.5	2.0	dB
Reverse Transfer Capacitance	C _{re} ^{Note 2}	V _{CB} = 0.5 V, I _E = 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 _{CBO}	V _{CB} = 5 V, I _E = 0 mA	—	—	200	nA
Emitter Cut-off Current	I _{EBO}	V _{EB} = 1 V, I _C = 0 mA	—	—	200	nA
DC Current Gain	h _{FE} ^{Note 1}	V _{CE} = 1 V, I _C = 10 mA	100	120	160	—
Gain Bandwidth Product	f _T	V _{CE} = 1 V, I _C = 10 mA, f = 2 GHz	4.0	5.5	—	GHz
Insertion Power Gain	S _{21e} ²	V _{CE} = 1 V, I _C = 10 mA, f = 2 GHz	2.5	4.0	—	dB
Noise Figure	NF	V _{CE} = 1 V, I _C = 10 mA, f = 2 GHz, Z _S = Z _{opt}	—	1.8	3.0	dB
Reverse Transfer Capacitance	C _{re} ^{Note 2}	V _{CB} = 0.5 V, I _E = 0 mA, f = 1 MHz	—	0.9	1.2	pF

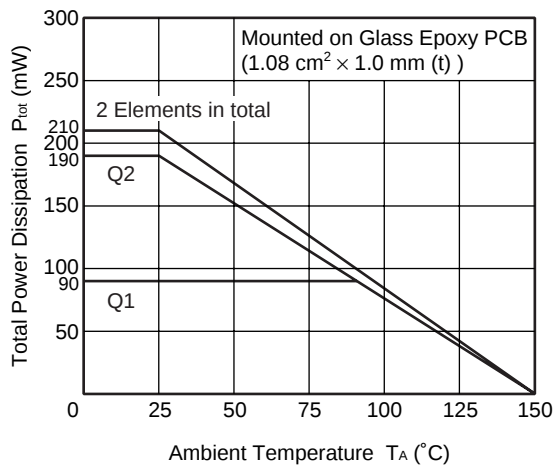
- Notes** 1. Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%
2. Collector to base capacitance when the emitter grounded

h_{FE} CLASSIFICATION

Rank	FB
Marking	vT
h _{FE} Value of Q1	70 to 140
h _{FE} Value of Q2	100 to 160

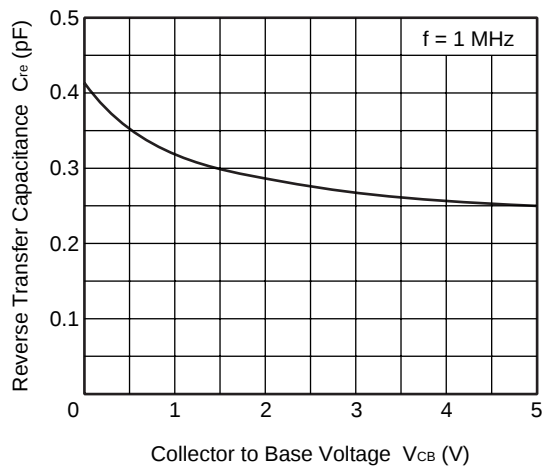
TYPICAL CHARACTERISTICS (Unless otherwise specified, $T_A = +25^\circ\text{C}$)

**TOTAL POWER DISSIPATION
vs. AMBIENT TEMPERATURE**



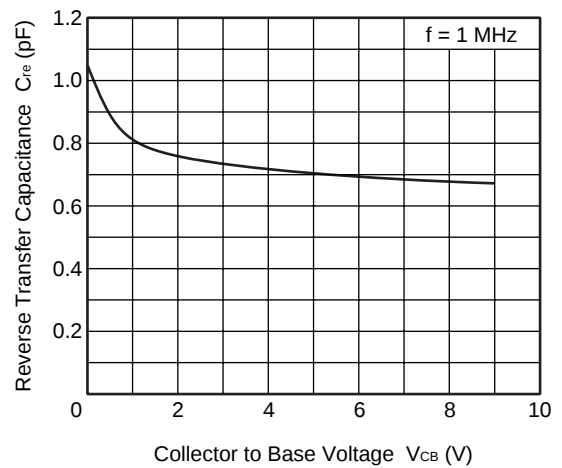
Q1

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

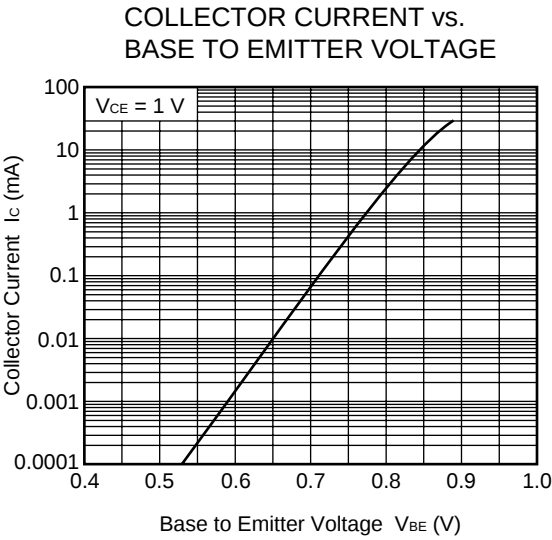


Q2

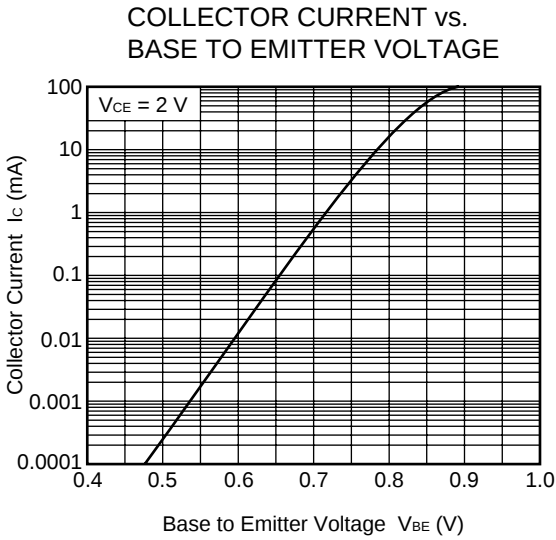
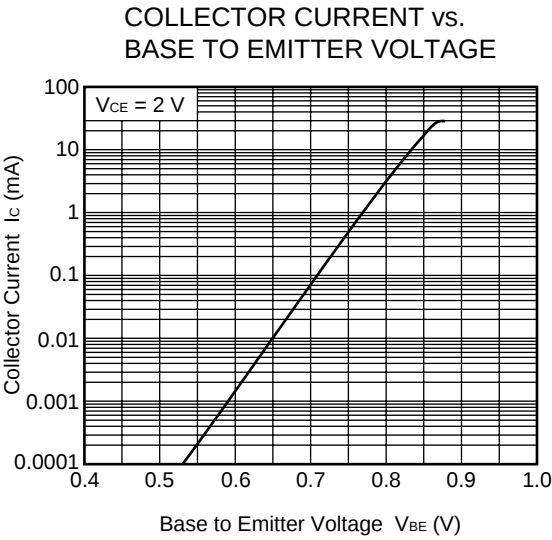
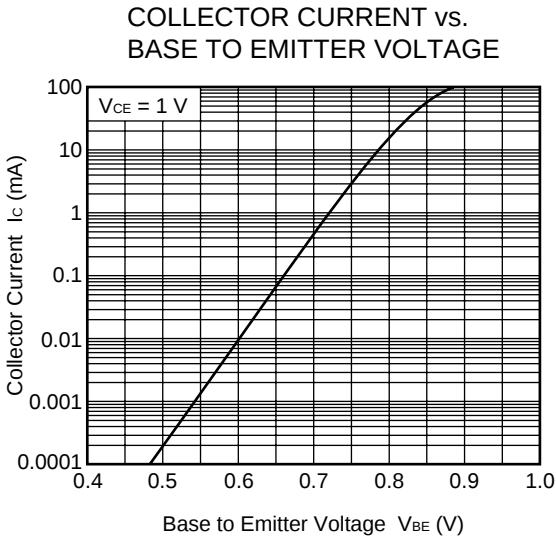
**REVERSE TRANSFER CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE**



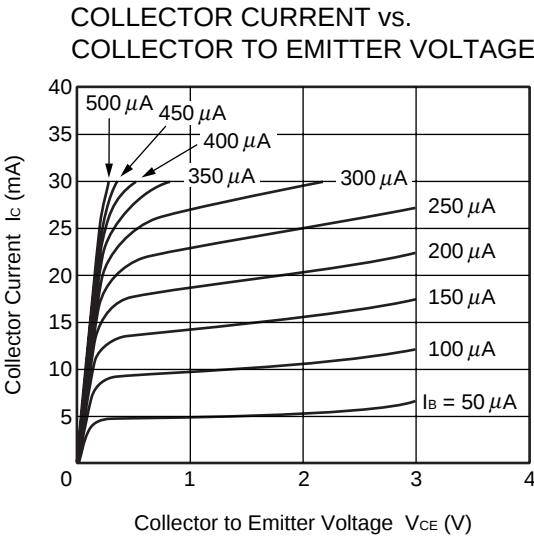
Q1



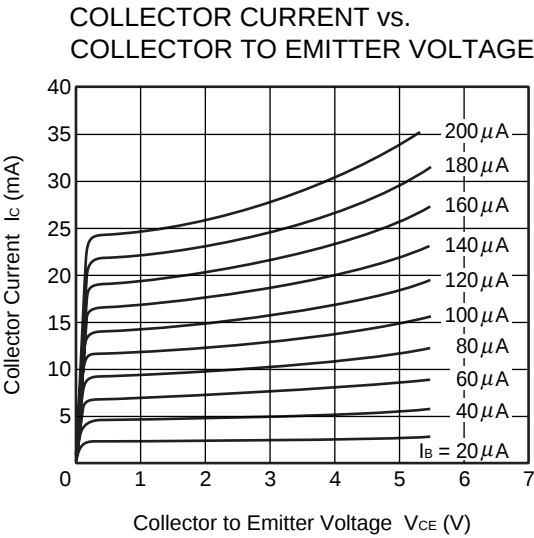
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Q1

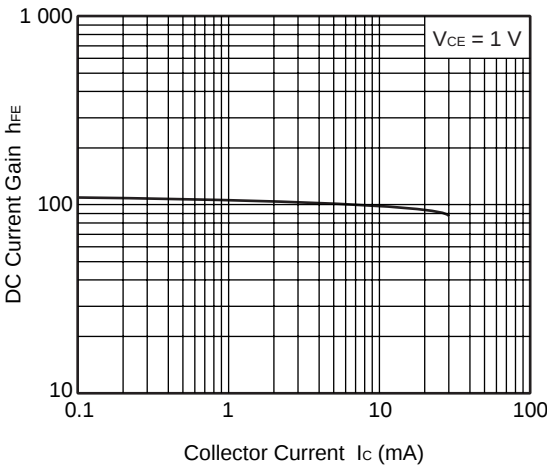


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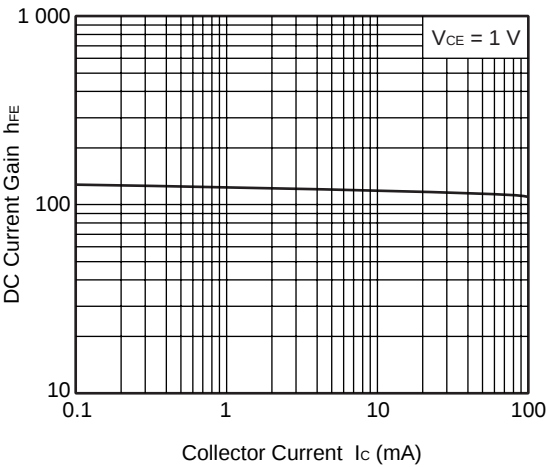
Q1

DC CURRENT GAIN vs.
COLLECTOR CURRENT

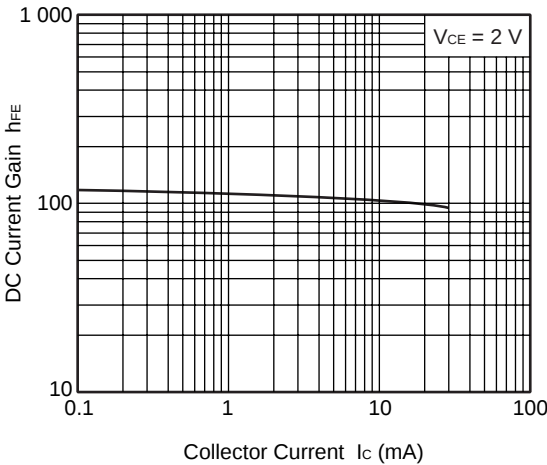


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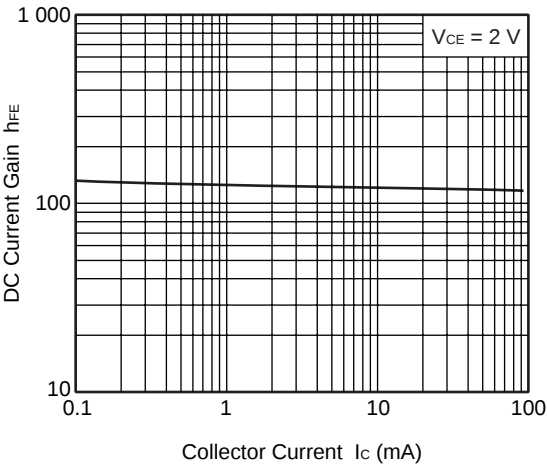
DC CURRENT GAIN vs.
COLLECTOR CURRENT



DC CURRENT GAIN vs.
COLLECTOR CURRENT

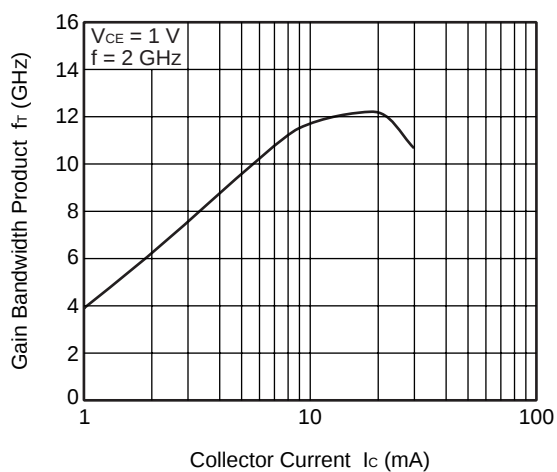


DC CURRENT GAIN vs.
COLLECTOR CURRENT



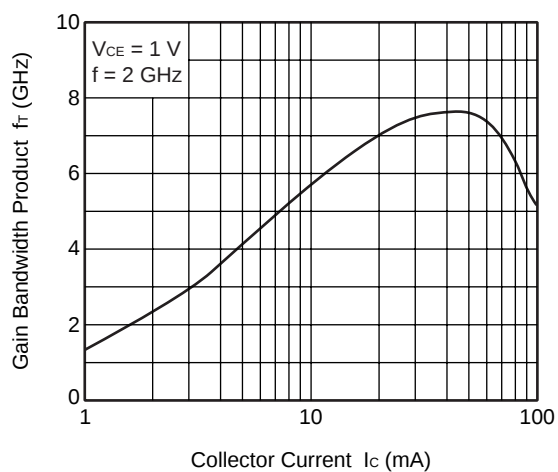
Q1

GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

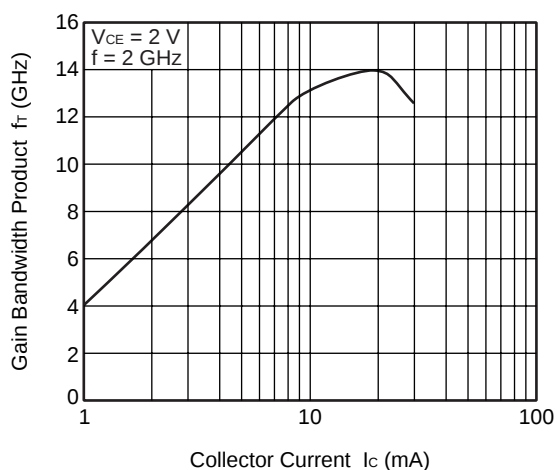


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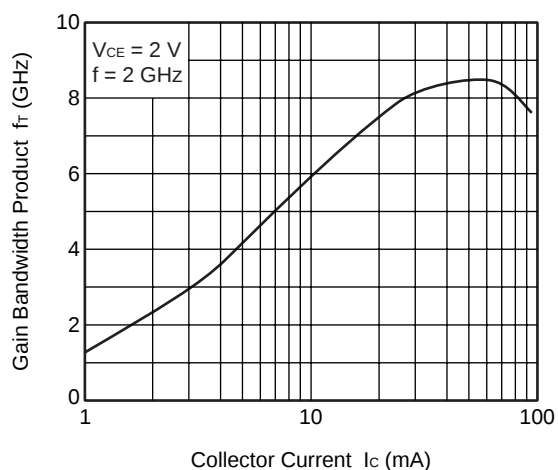
GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

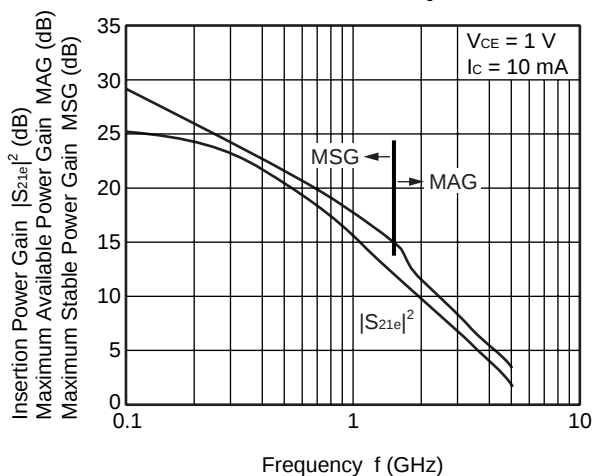


GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



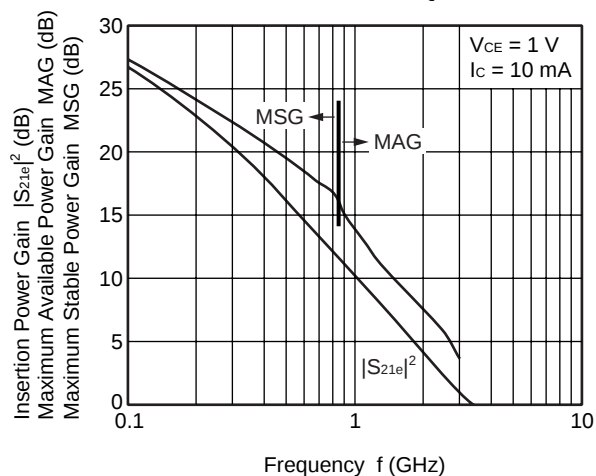
Q1

INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY

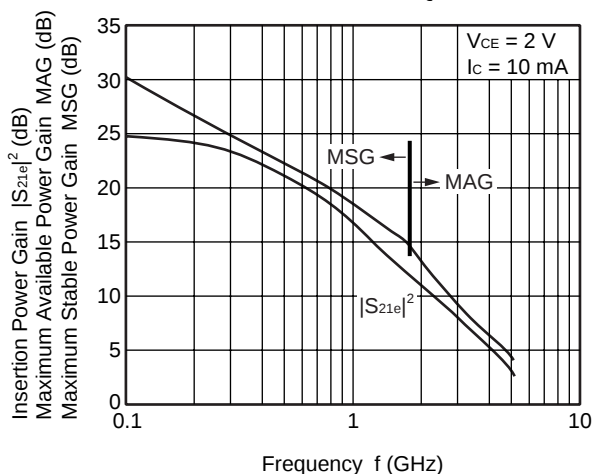


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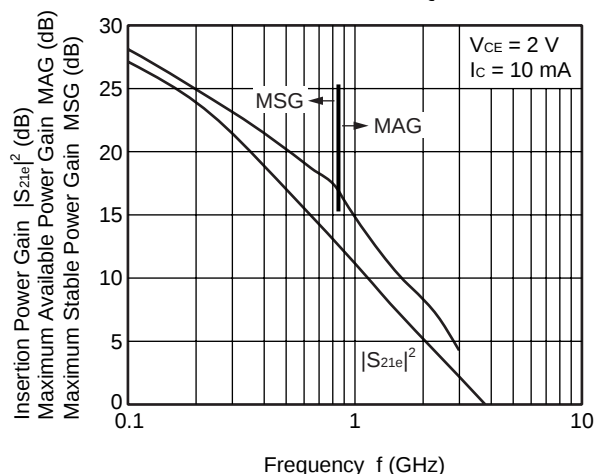
INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY



INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY

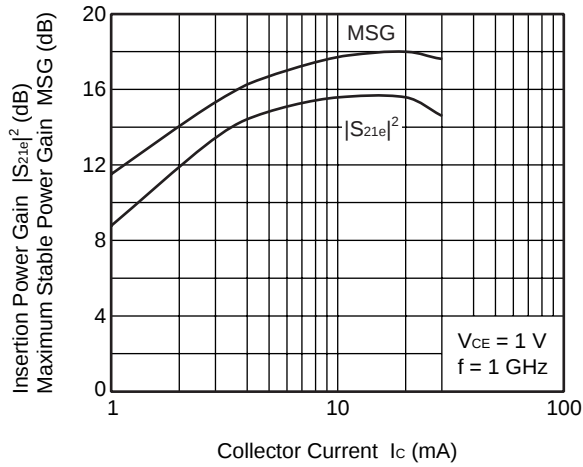


INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY



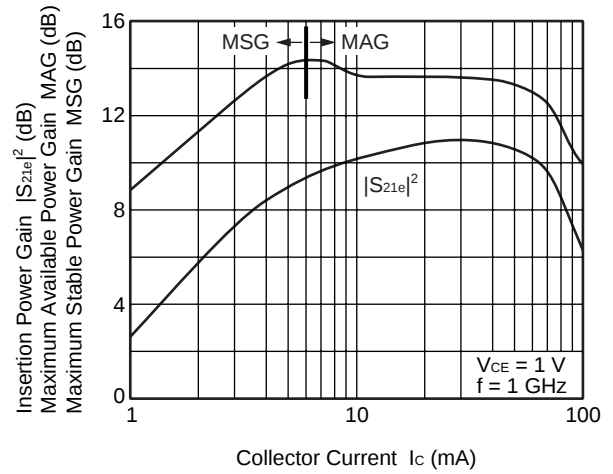
Q1

INSERTION POWER GAIN, MSG
vs. COLLECTOR CURRENT

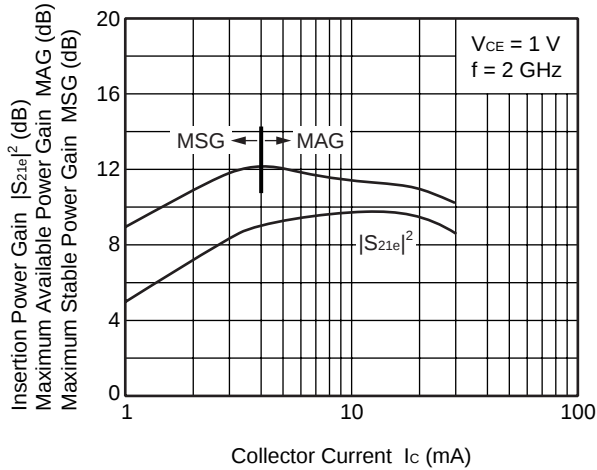


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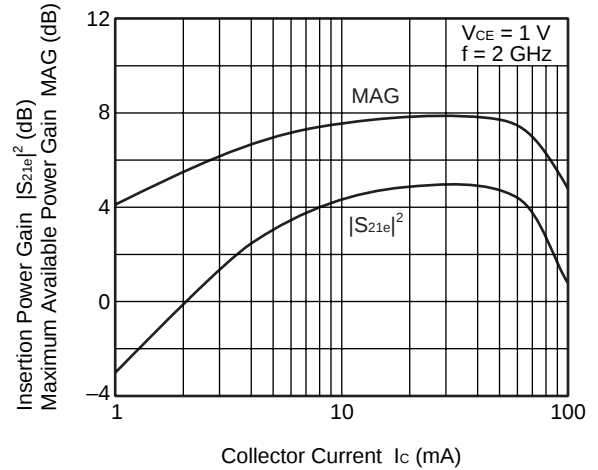
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



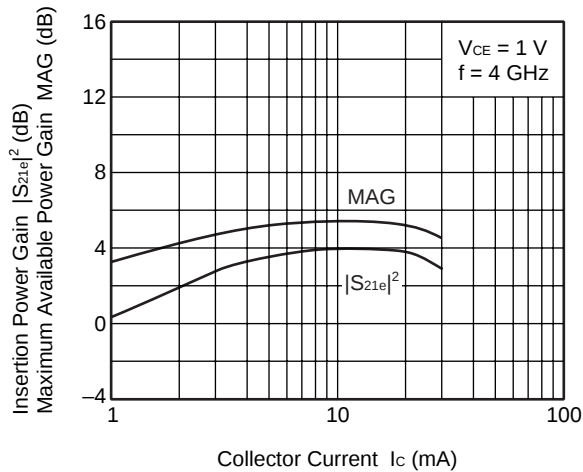
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



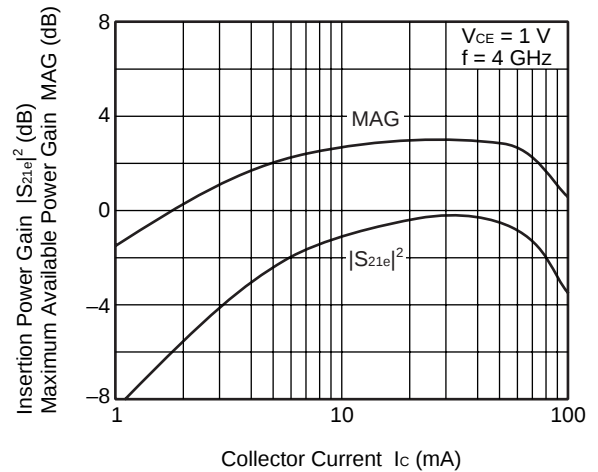
INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

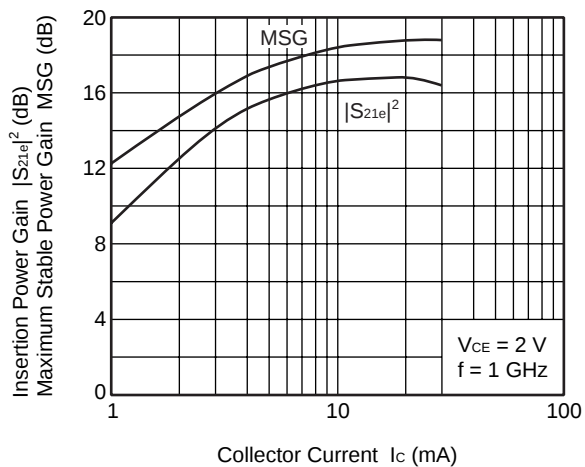


INSERTION POWER GAIN, MAG
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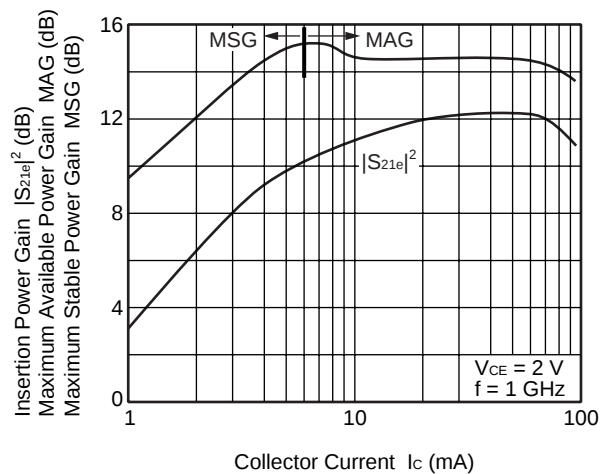
Q1

INSERTION POWER GAIN, MSG
vs. COLLECTOR CURRENT

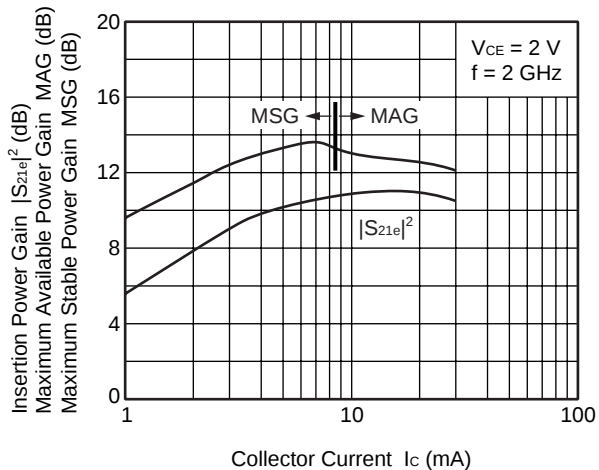


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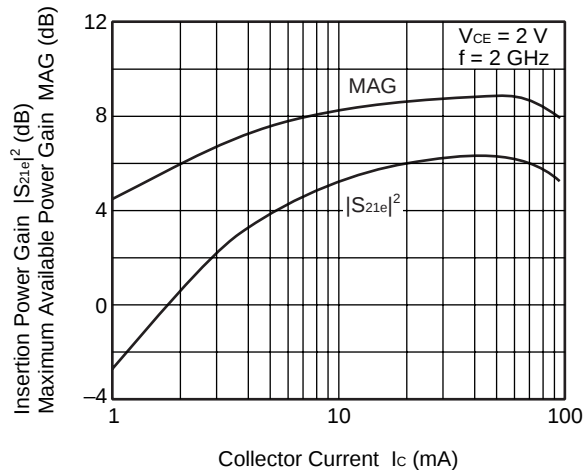
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



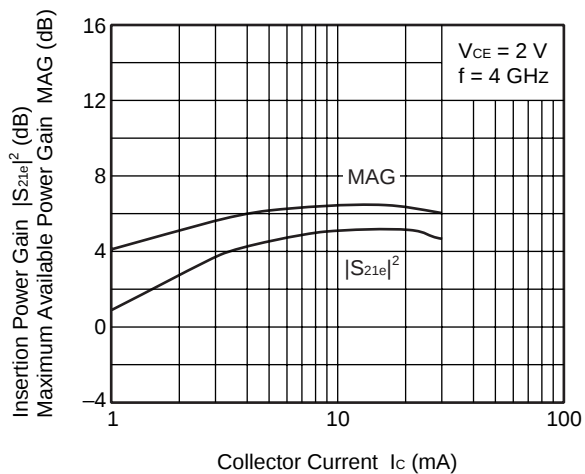
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



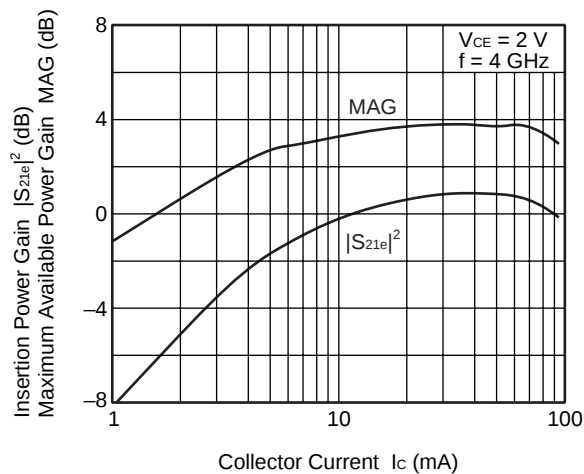
INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

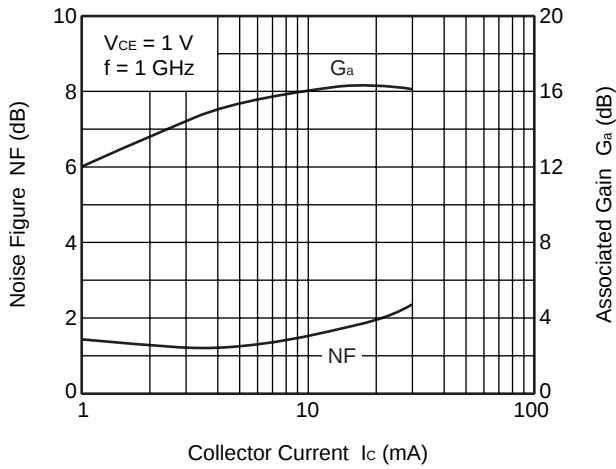


INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



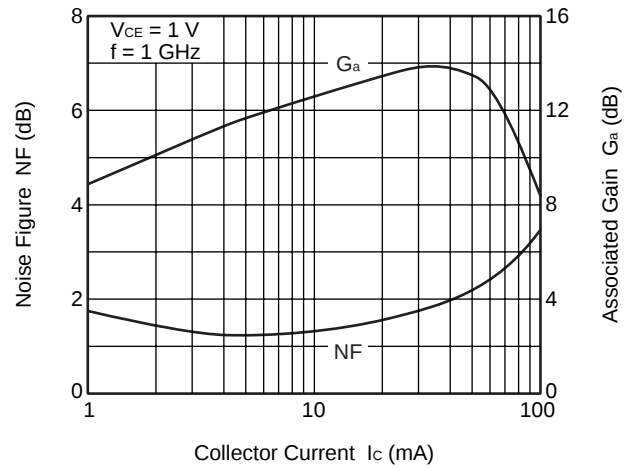
Q1

NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

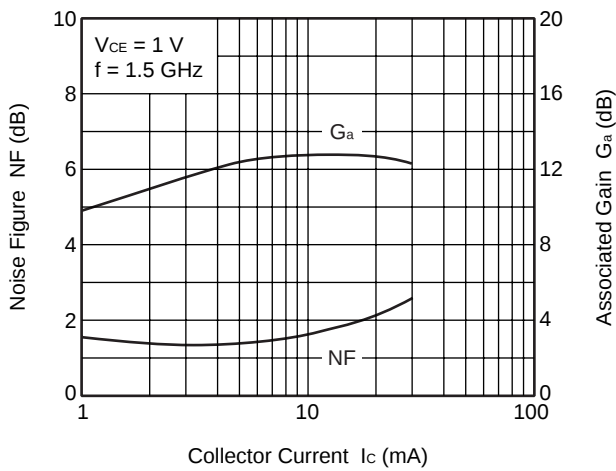


Q2

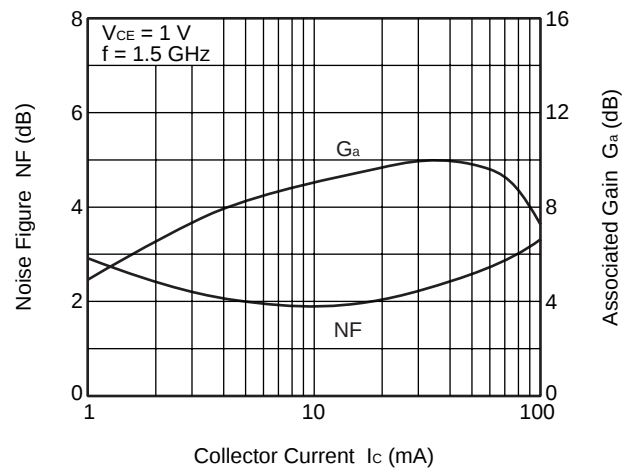
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



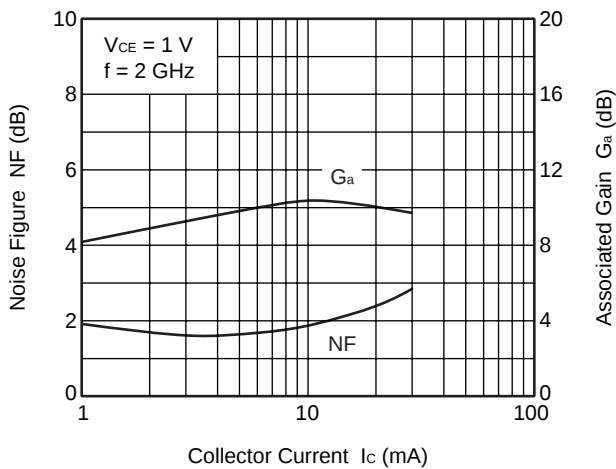
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



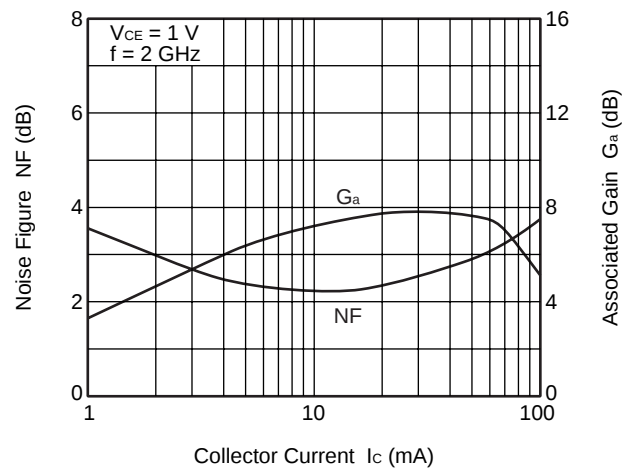
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

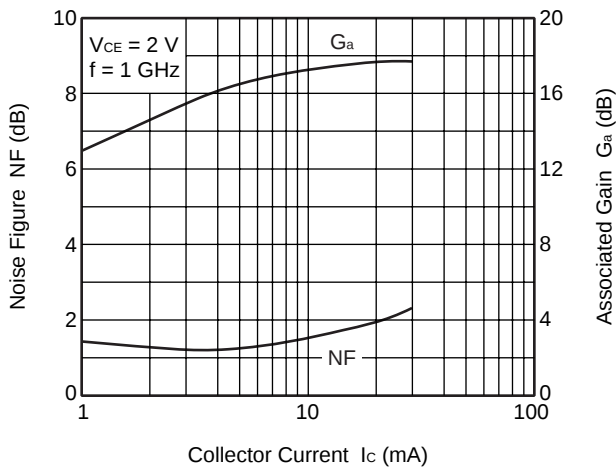


NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



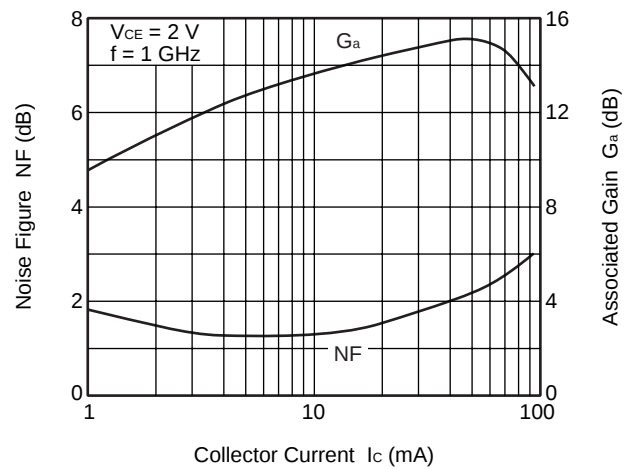
Q1

NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

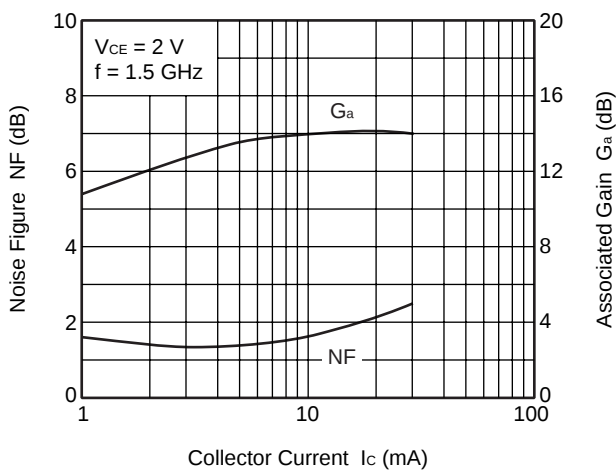


Q2

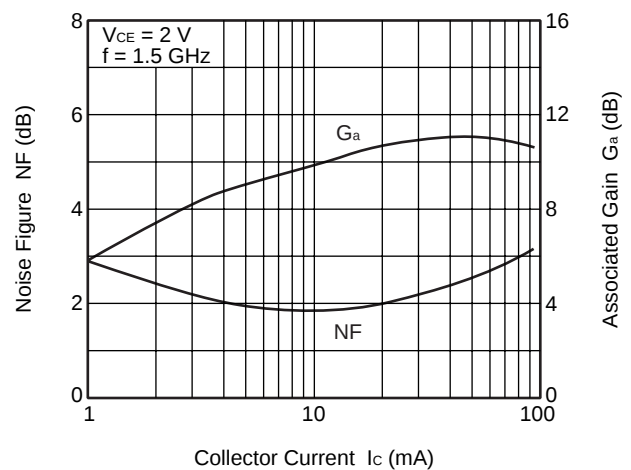
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



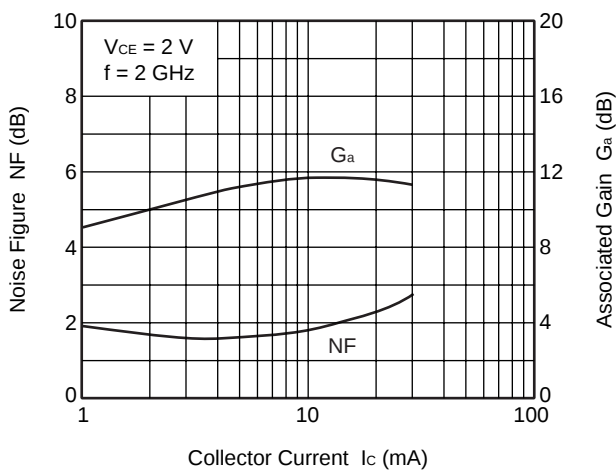
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



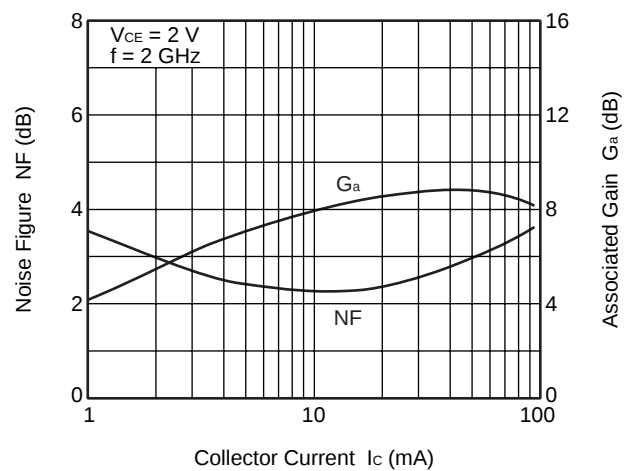
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



Remark The graphs indicate nominal characteristics.

S-PARAMETERS Q1

V_{CE} = 1 V, I_C = 1 mA, Z₀ = 50 Ω

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	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_{CE} = 1 V, I_C = 3 mA, Z₀ = 50 Ω

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	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