

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

FEATURES

- Low voltage operation
- 2 different built-in transistors (2SC5435, 2SC5786)
 - Q1: High-gain transistor
 $f_T = 12.0 \text{ GHz TYP.}$, $|S_{21e}|^2 = 8.5 \text{ dB TYP. @ } V_{CE} = 3 \text{ V, } I_C = 10 \text{ mA, } f = 2 \text{ GHz}$
 - Q2: Low phase distortion transistor suitable for 3 GHz or higher OSC applications
 $f_T = 20.0 \text{ GHz TYP.}$, $|S_{21e}|^2 = 13.0 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_C = 20 \text{ mA, } f = 2 \text{ GHz}$
 $NF = 1.4 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2 \text{ GHz, } Z_S = Z_{opt}$
- 6-pin lead-less minimold package

BUILT-IN TRANSISTORS

	Q1	Q2
3-pin thin-type ultra super minimold part No.	2SC5435	2SC5786

ORDERING INFORMATION

Part Number	Quantity	Supplying Form
μ PA860TD	50 pcs (Non reel)	• 8 mm wide embossed taping
μ PA860TD-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.

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}	9	9	V
Collector to Emitter Voltage	V _{CEO}	6	3	V
Emitter to Base Voltage	V _{EBO}	2	1.5	V
Collector Current	I _C	30	35	mA
Total Power Dissipation	P _{tot} ^{Note}	180	105	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} = 3 V, I _C = 10 mA	75	–	150	–
Gain Bandwidth Product	f _T	V _{CE} = 3 V, I _C = 10 mA, f = 2 GHz	10.0	12.0	–	GHz
Insertion Power Gain	S _{21e} ²	V _{CE} = 3 V, I _C = 10 mA, f = 2 GHz	7.0	8.5	–	dB
Noise Figure	NF	V _{CE} = 3 V, I _C = 3 mA, f = 2 GHz, Z _S = Z _{opt}	–	1.5	2.5	dB
Reverse Transfer Capacitance	C _{re} ^{Note 2}	V _{CB} = 3 V, I _E = 0 mA, f = 1 MHz	–	0.4	0.7	pF

(2) Q2

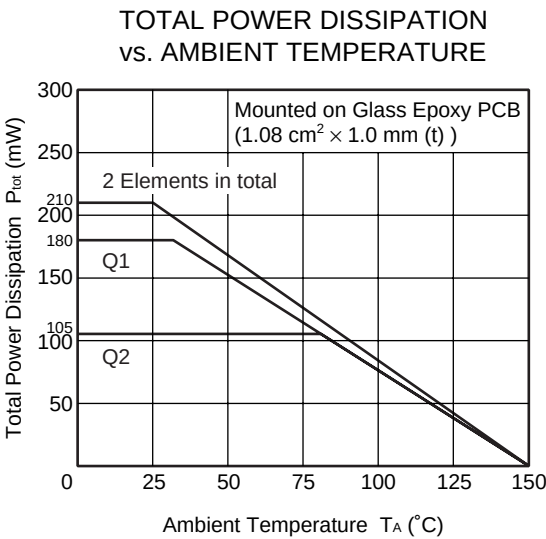
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I _{CBO}	V _{CB} = 5 V, I _E = 0 mA	–	–	100	nA
Emitter Cut-off Current	I _{EBO}	V _{EB} = 1 V, I _C = 0 mA	–	–	100	nA
DC Current Gain	h _{FE} ^{Note 1}	V _{CE} = 1 V, I _C = 5 mA	50	75	100	–
Gain Bandwidth Product	f _T	V _{CE} = 1 V, I _C = 20 mA, f = 2 GHz	17.0	20.0	–	GHz
Insertion Power Gain	S _{21e} ²	V _{CE} = 1 V, I _C = 20 mA, f = 2 GHz	11.0	13.0	–	dB
Noise Figure	NF	V _{CE} = 1 V, I _C = 5 mA, f = 2 GHz, Z _S = Z _{opt}	–	1.4	2.5	dB
Reverse Transfer Capacitance	C _{re} ^{Note 2}	V _{CB} = 0.5 V, I _E = 0 mA, f = 1 MHz	–	0.22	0.30	pF

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

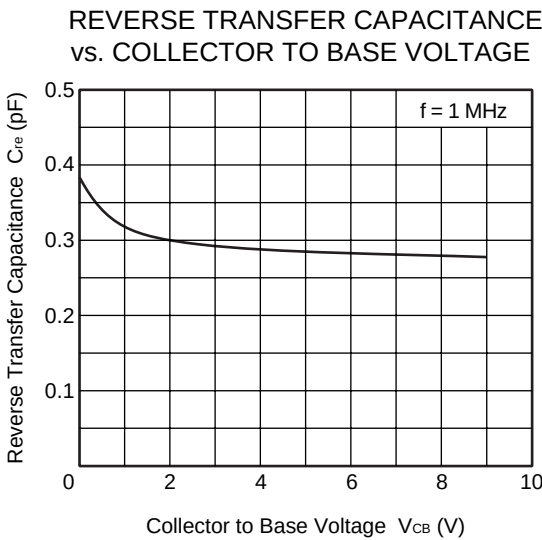
h_{FE} CLASSIFICATION

Rank	FB
Marking	vV
h _{FE} Value of Q1	75 to 150
h _{FE} Value of Q2	50 to 100

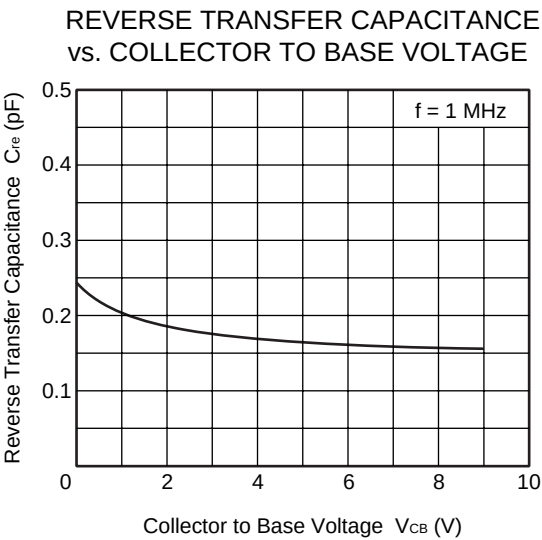
TYPICAL CHARACTERISTICS (Unless otherwise specified, $T_A = +25^{\circ}\text{C}$)



Q1

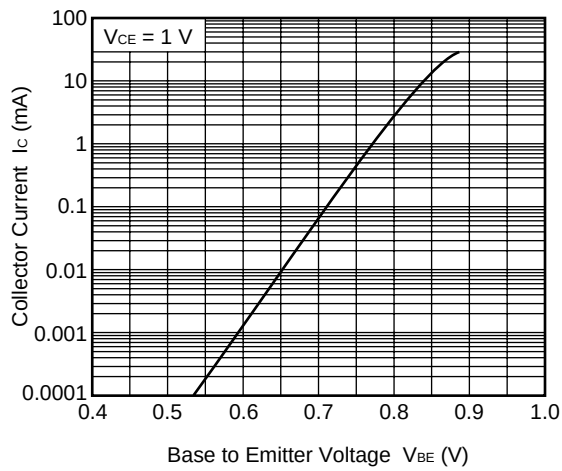


Q2



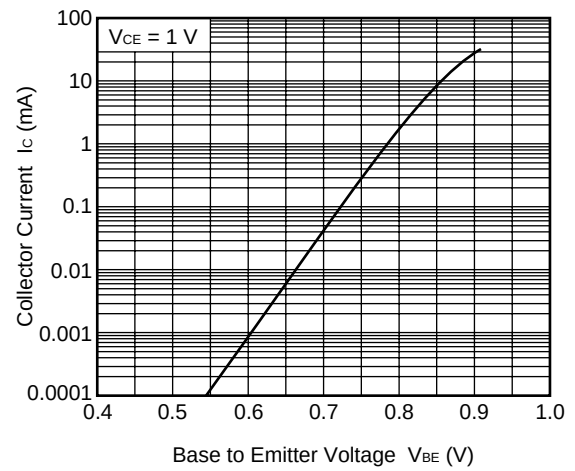
Q1

COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

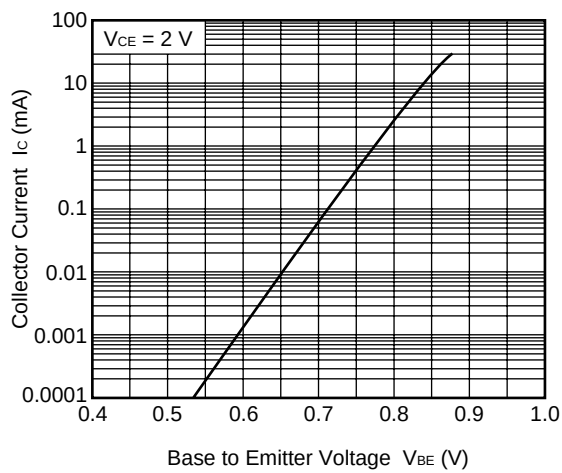


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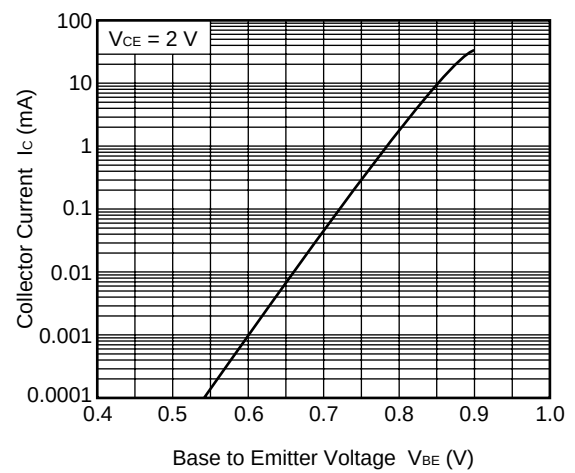
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



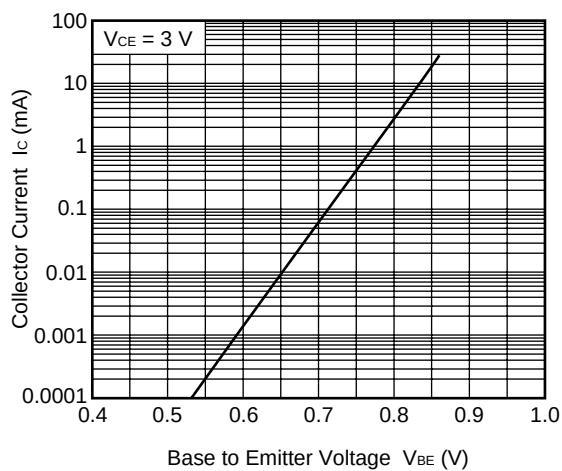
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



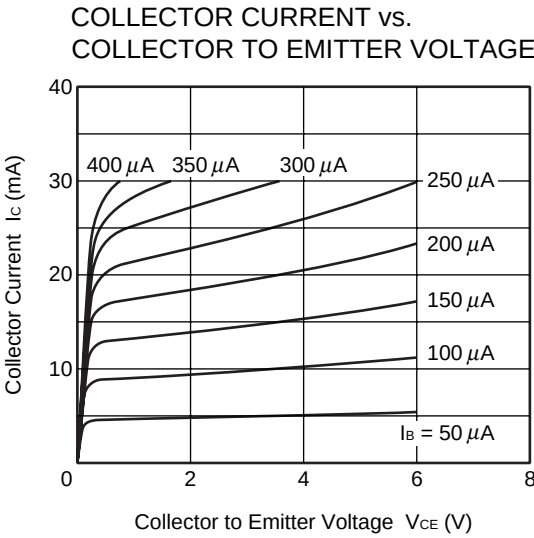
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



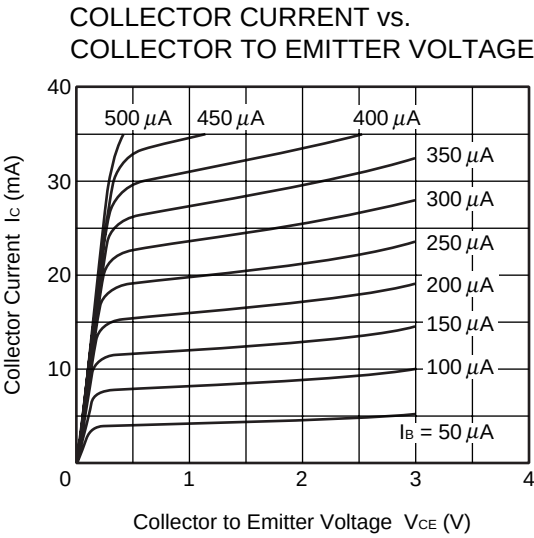
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



Q1

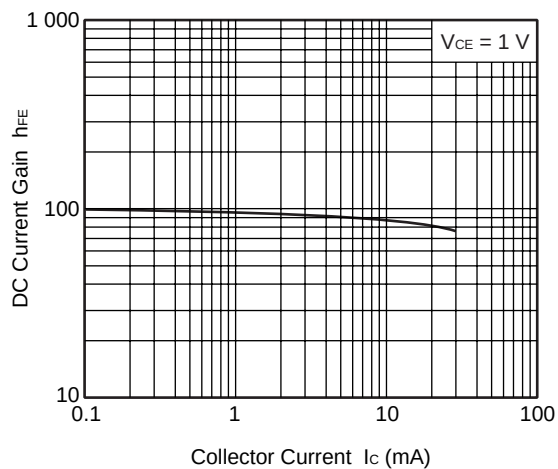


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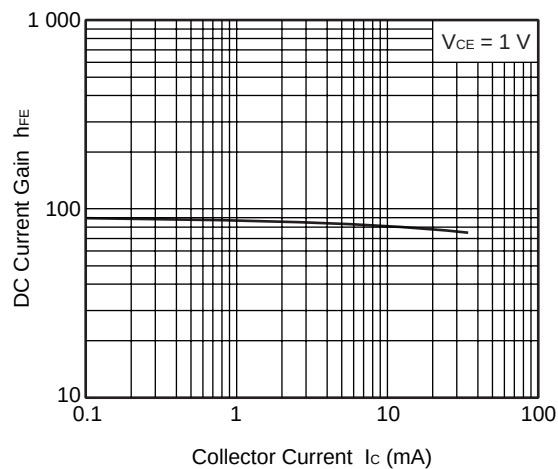
Q1

DC CURRENT GAIN vs.
COLLECTOR CURRENT

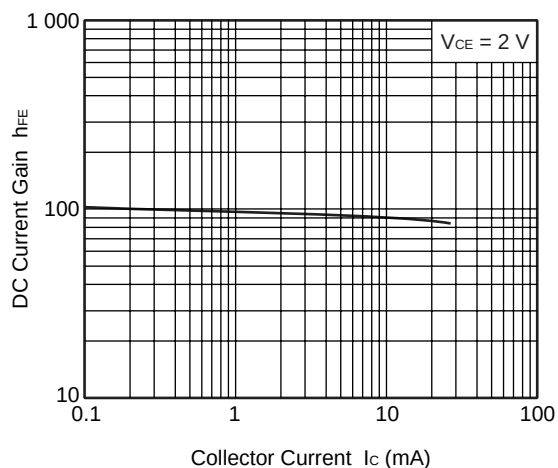


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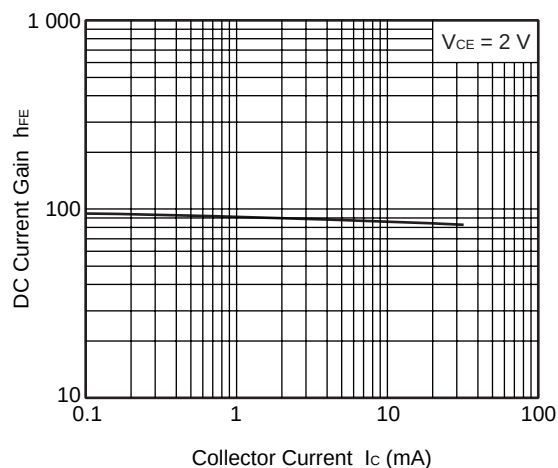
DC CURRENT GAIN vs.
COLLECTOR CURRENT



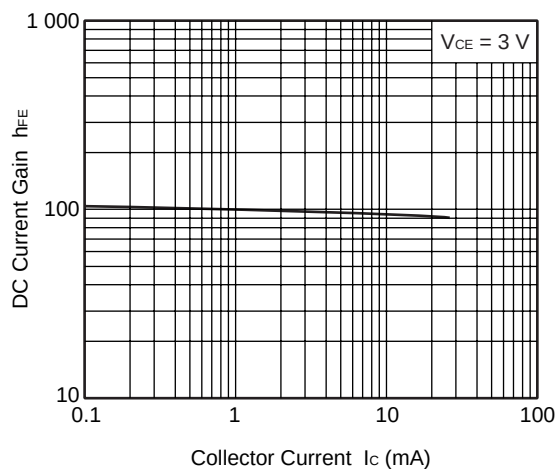
DC CURRENT GAIN vs.
COLLECTOR CURRENT



DC CURRENT GAIN vs.
COLLECTOR CURRENT

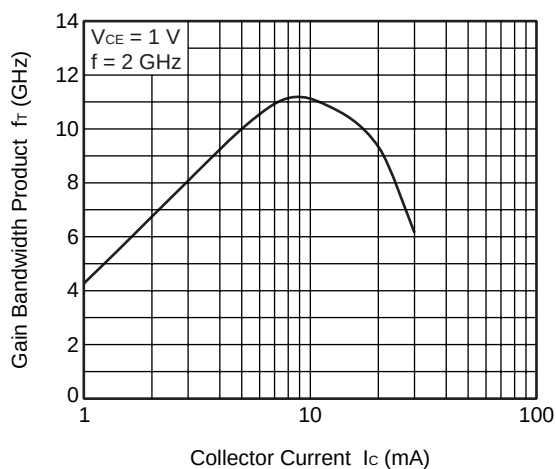


DC CURRENT GAIN vs.
COLLECTOR CURRENT



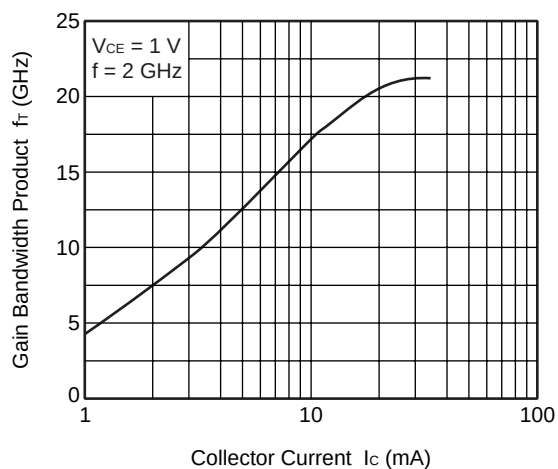
Q1

GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

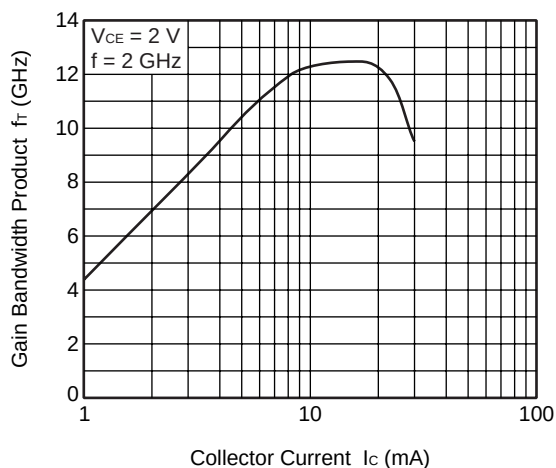


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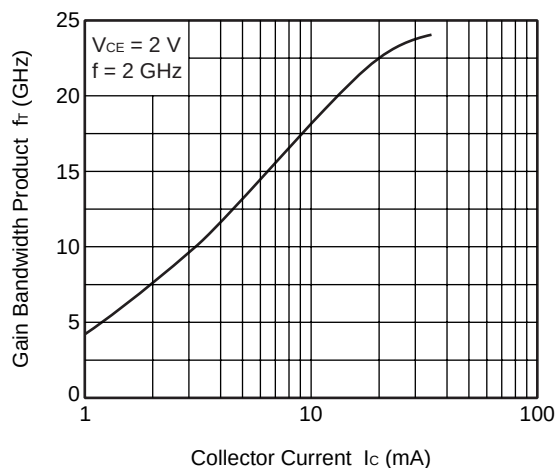
GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



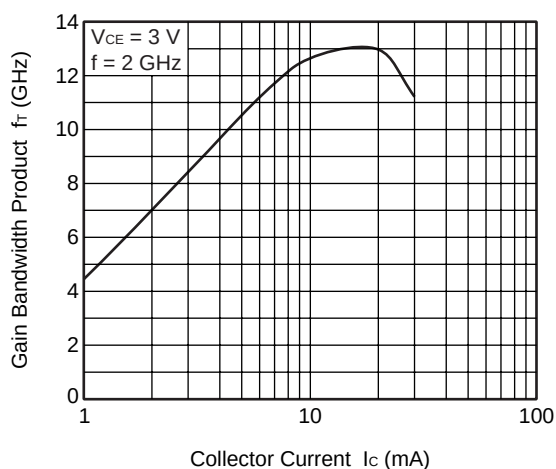
GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

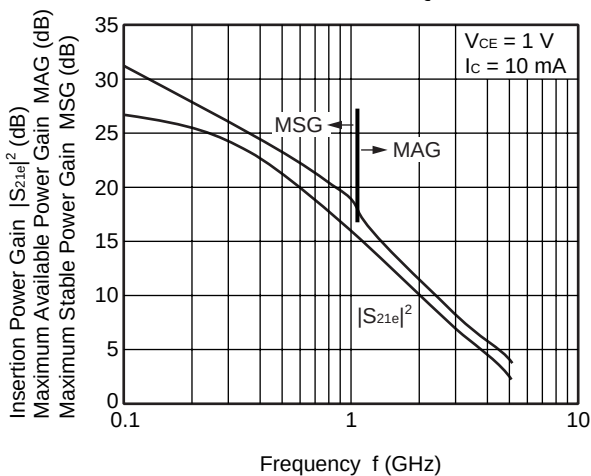


GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



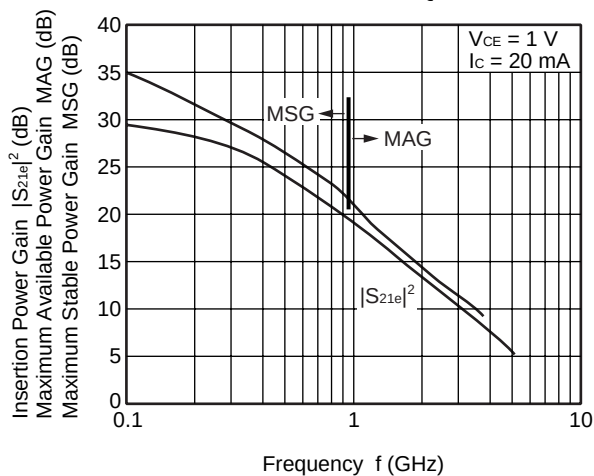
Q1

INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY

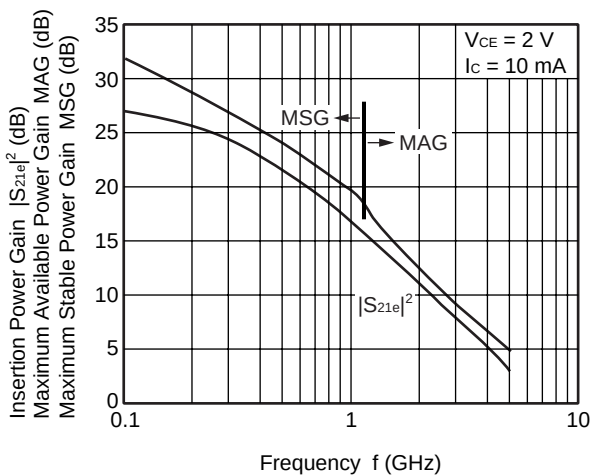


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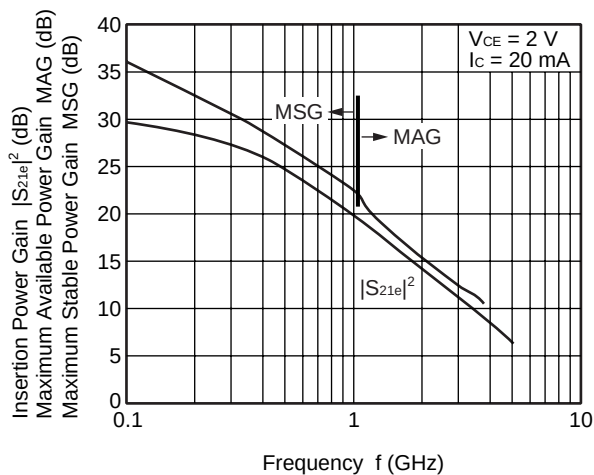
INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY



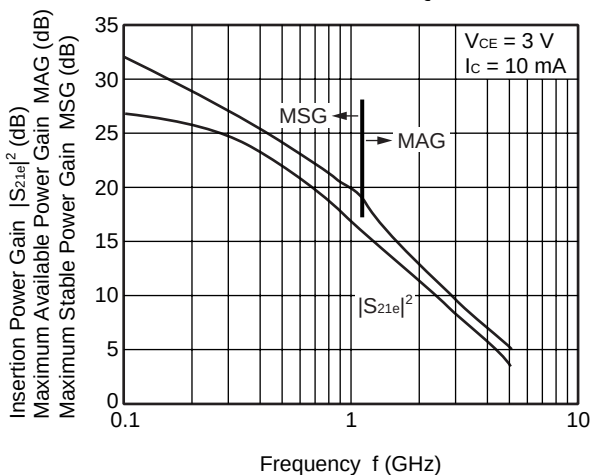
INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY



INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY

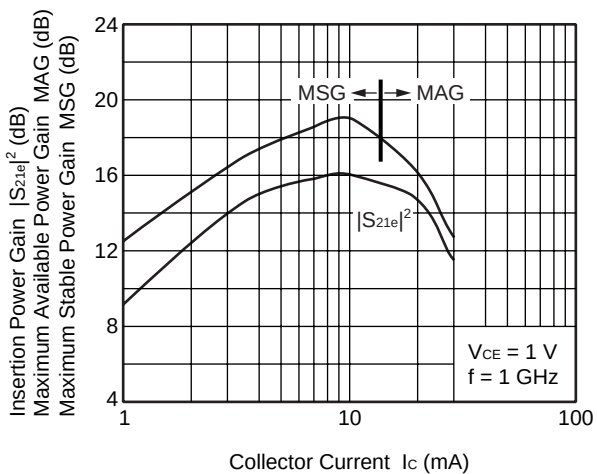


INSERTION POWER GAIN,
MAG, MSG vs. FREQUENCY



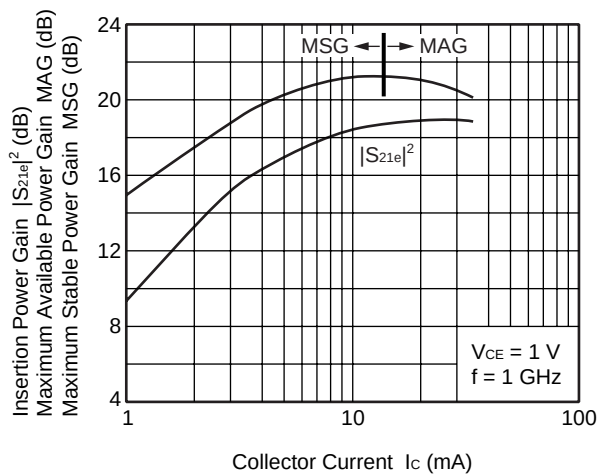
Q1

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

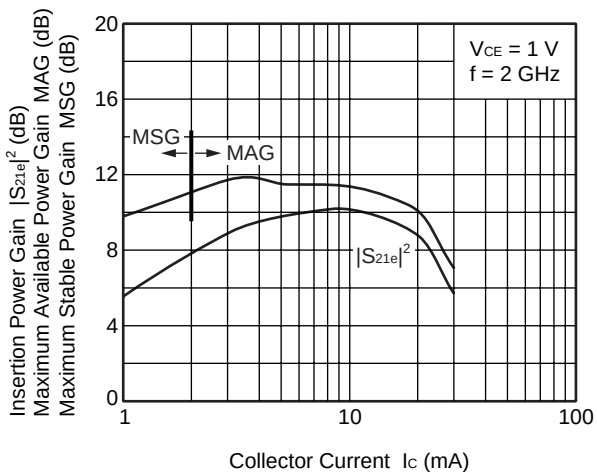


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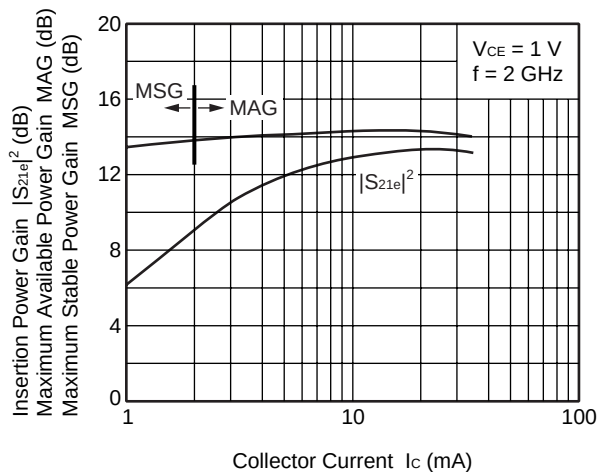
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



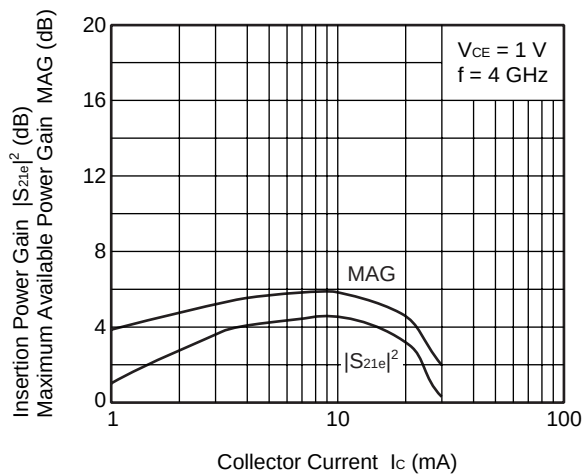
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



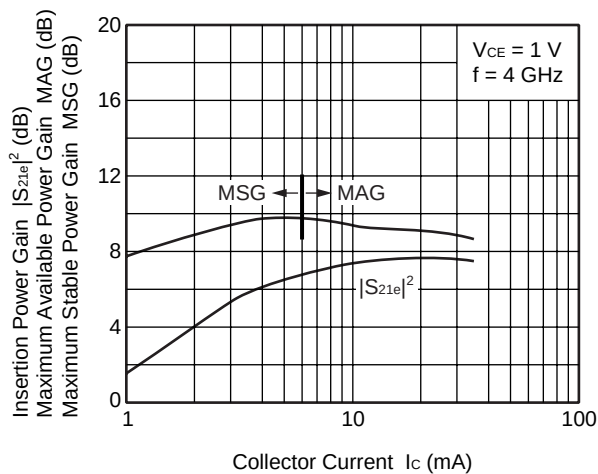
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

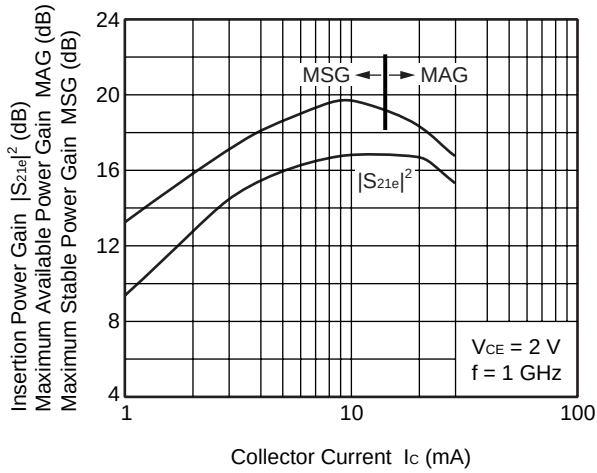


INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



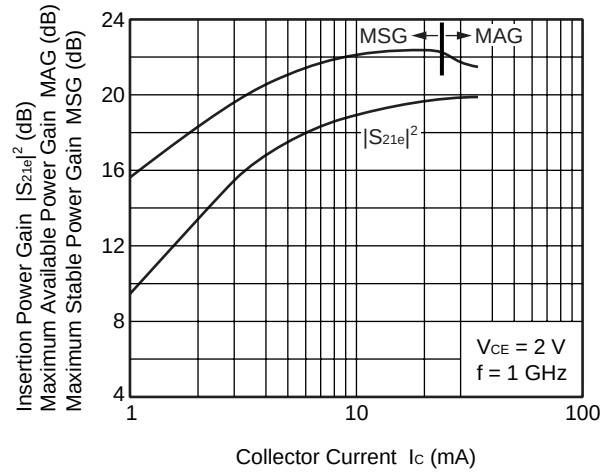
Q1

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

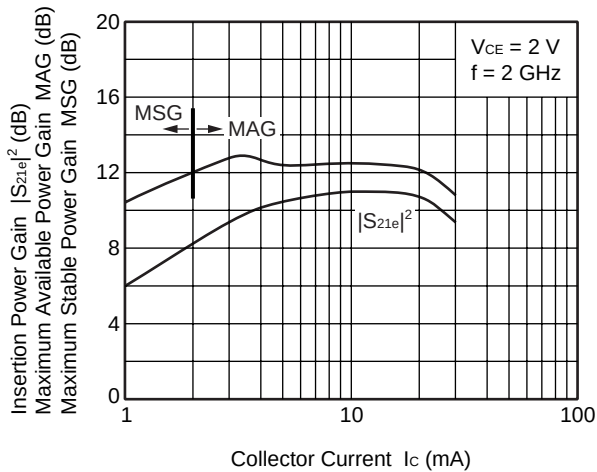


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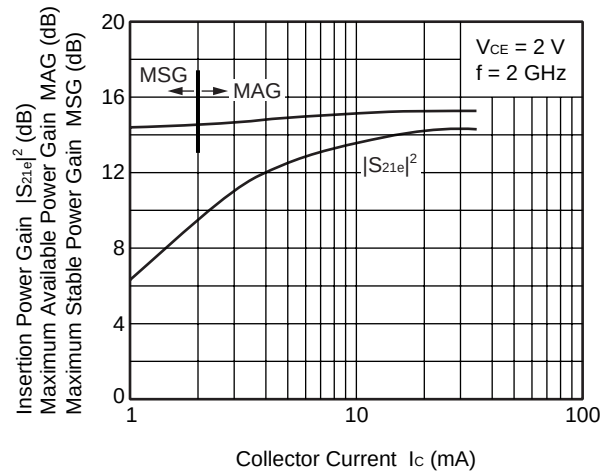
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



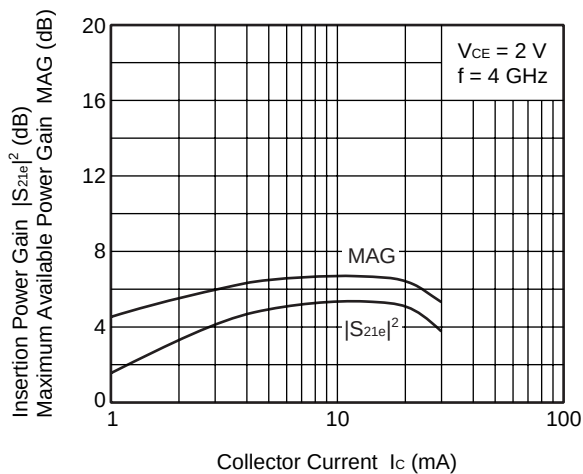
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



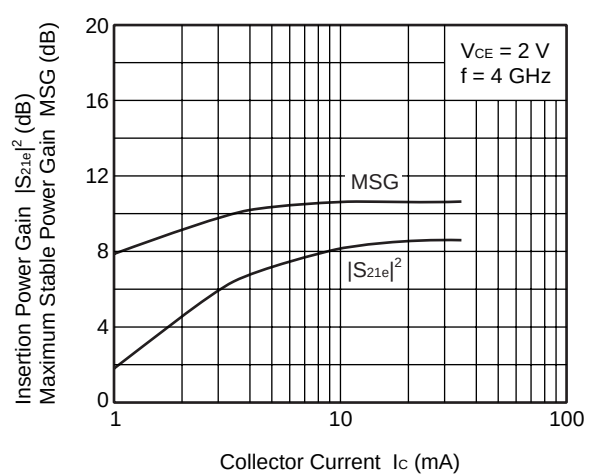
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

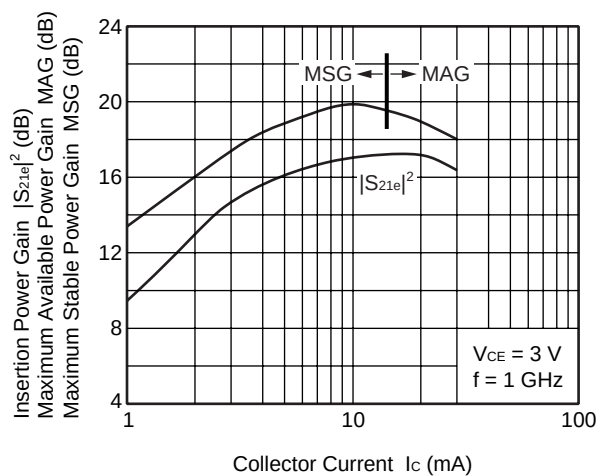


INSERTION POWER GAIN, MSG
vs. COLLECTOR CURRENT

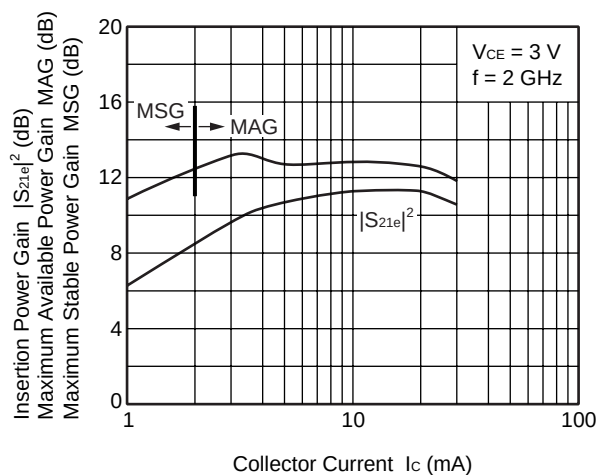


Q1

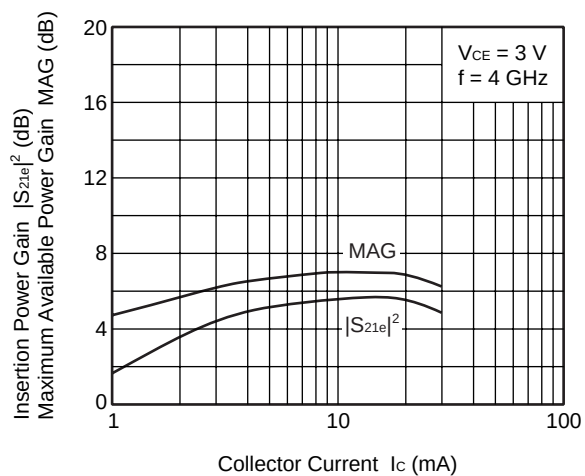
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

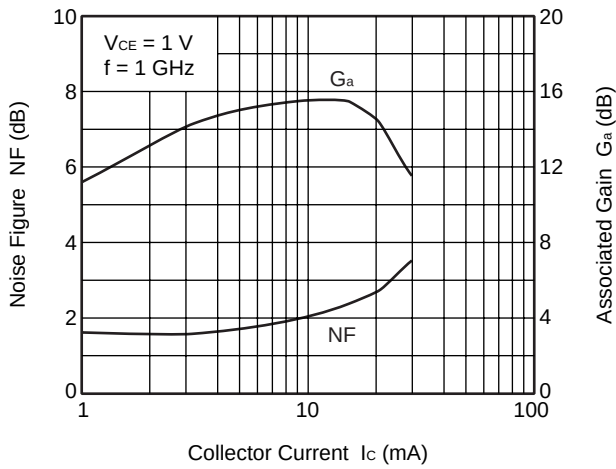


INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



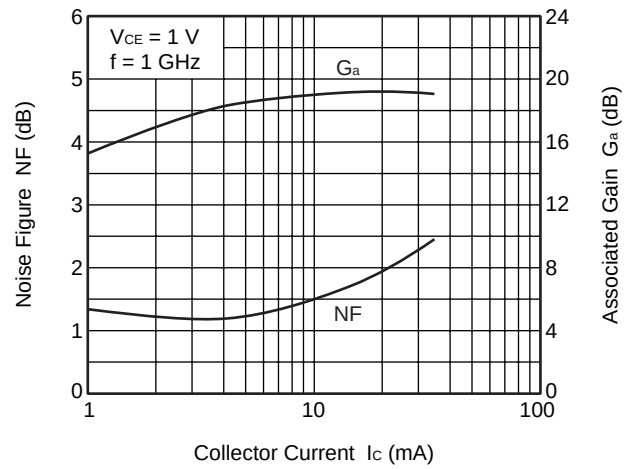
Q1

NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

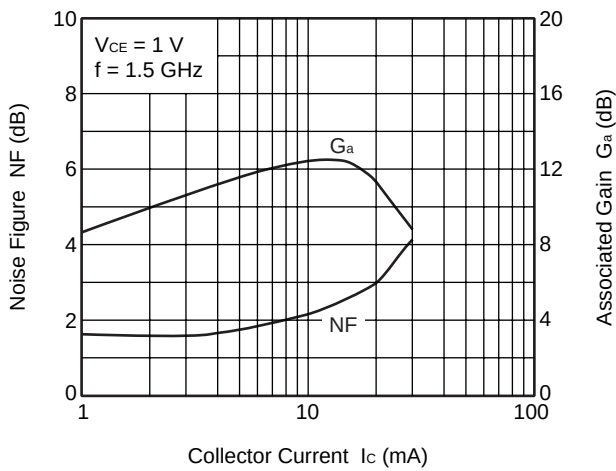


Q2

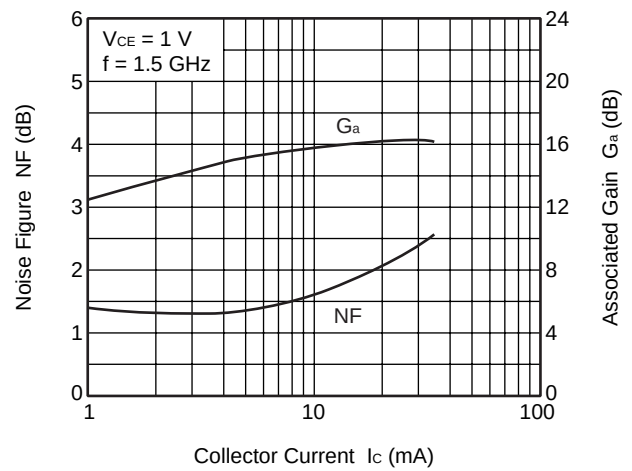
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



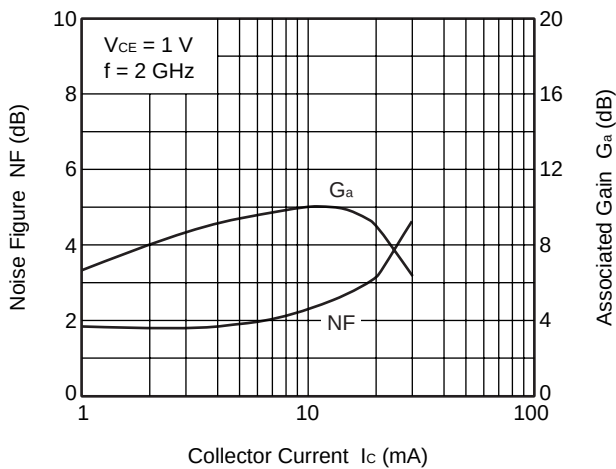
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



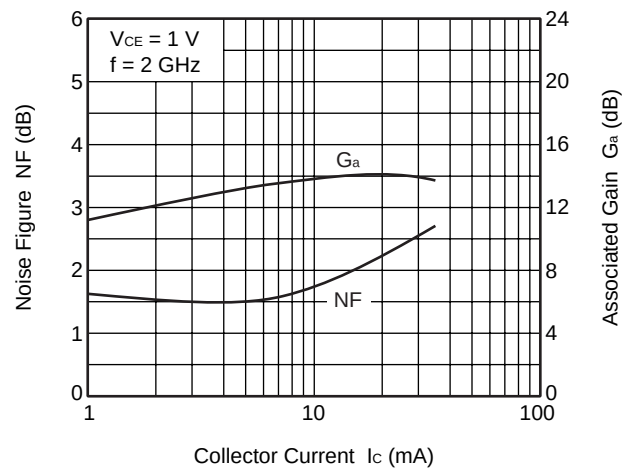
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

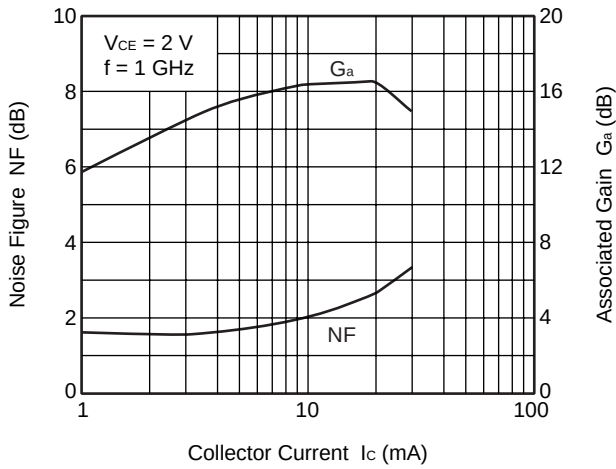


NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



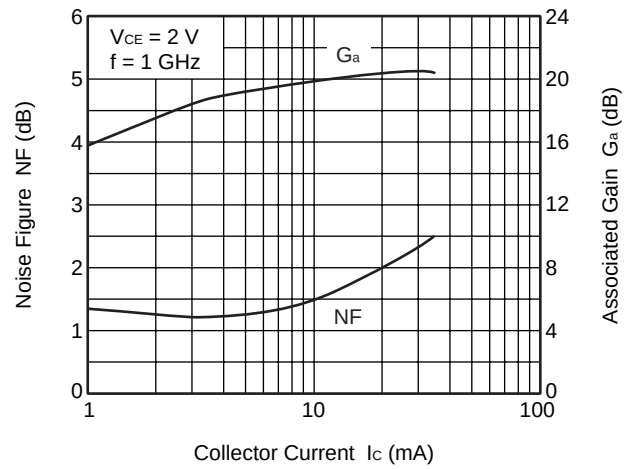
Q1

NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

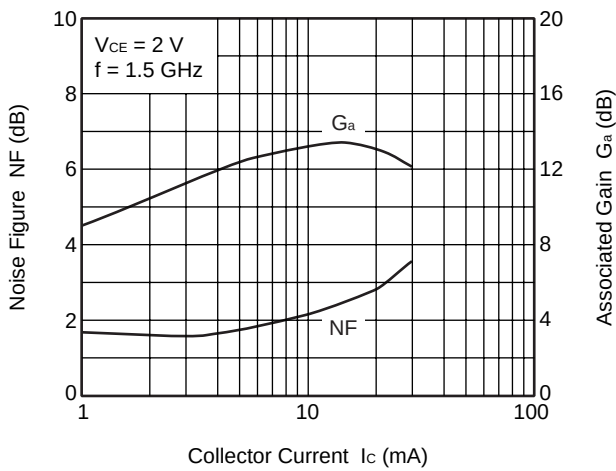


Q2

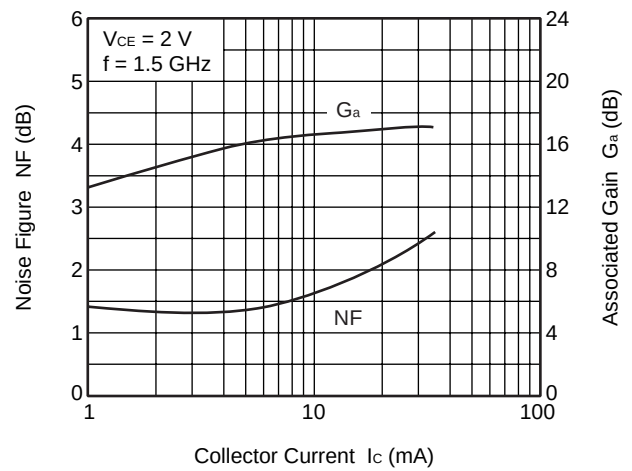
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



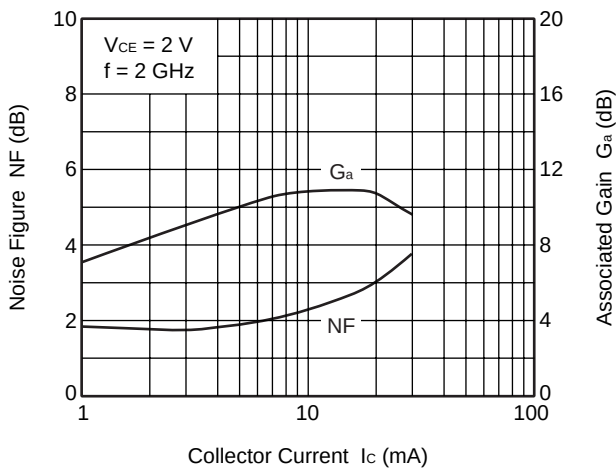
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



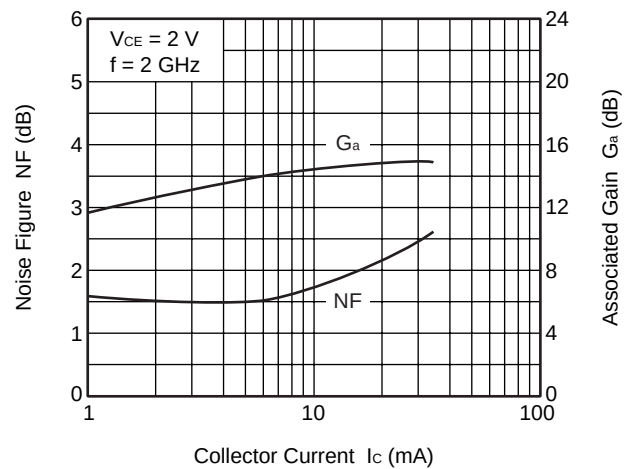
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

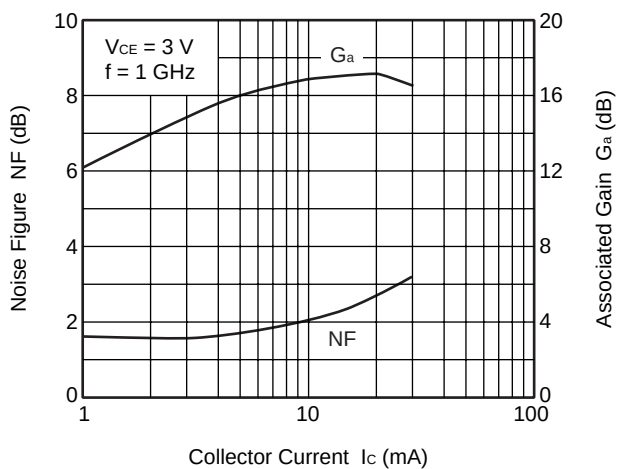


NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT

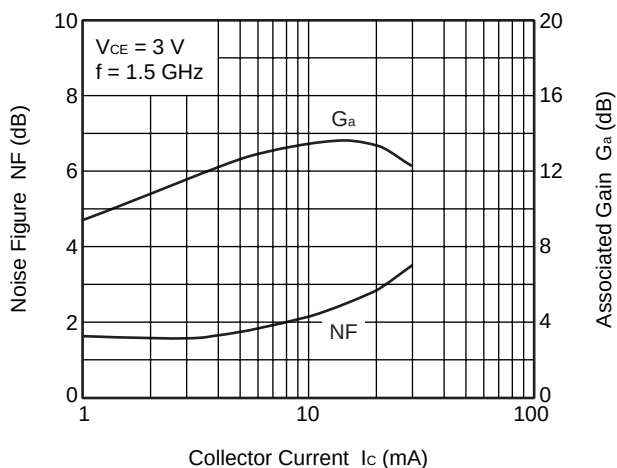


Q1

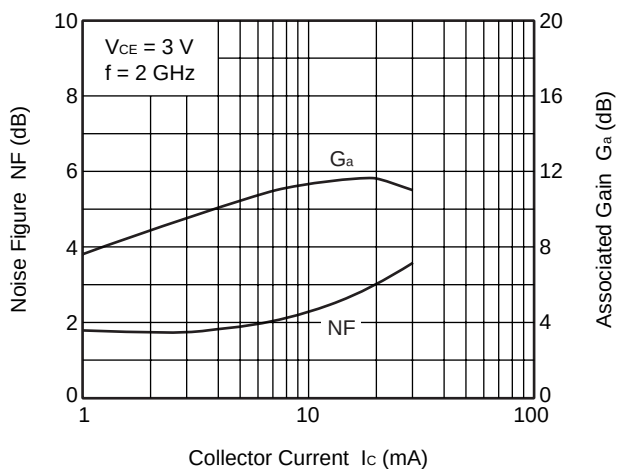
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



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	0.952	-7.1	3.547	172.9	0.020	86.6	0.992	-3.7
0.2	0.943	-14.4	3.539	167.2	0.040	80.9	0.989	-7.3
0.3	0.931	-21.5	3.494	161.1	0.060	76.6	0.971	-10.6
0.4	0.905	-28.3	3.407	154.8	0.079	72.0	0.951	-14.3
0.5	0.880	-35.8	3.352	148.4	0.096	67.8	0.929	-17.9
0.6	0.845	-43.0	3.274	142.1	0.112	63.4	0.900	-21.6
0.7	0.809	-50.3	3.172	136.6	0.127	59.1	0.870	-25.0
0.8	0.770	-57.2	3.067	130.7	0.140	55.3	0.837	-28.4
0.9	0.731	-64.5	2.965	125.0	0.152	51.5	0.807	-31.9
1.0	0.692	-71.4	2.864	119.5	0.161	48.1	0.775	-34.9
1.1	0.658	-78.5	2.756	114.6	0.169	44.8	0.746	-37.8
1.2	0.626	-85.5	2.640	110.0	0.177	42.1	0.717	-40.4
1.3	0.596	-92.3	2.536	105.5	0.182	39.4	0.693	-42.8
1.4	0.571	-98.7	2.420	101.1	0.186	36.9	0.669	-45.3
1.5	0.549	-104.8	2.325	96.9	0.190	34.8	0.648	-47.3
1.6	0.530	-110.8	2.237	93.2	0.193	32.8	0.628	-49.2
1.7	0.513	-116.9	2.141	89.7	0.195	31.1	0.609	-50.9
1.8	0.498	-122.2	2.059	86.1	0.196	29.5	0.592	-52.3
1.9	0.487	-127.6	1.976	83.4	0.197	28.2	0.577	-53.6
2.0	0.472	-132.0	1.907	80.2	0.198	27.0	0.562	-54.7
2.1	0.468	-137.5	1.844	77.5	0.198	26.1	0.552	-56.3
2.2	0.456	-141.5	1.769	74.8	0.198	25.3	0.538	-57.2
2.3	0.455	-147.0	1.721	72.3	0.199	24.5	0.533	-58.3
2.4	0.447	-150.7	1.663	69.8	0.200	23.9	0.518	-59.2
2.5	0.445	-155.3	1.611	67.5	0.200	23.5	0.512	-60.4
2.6	0.437	-158.8	1.570	65.5	0.200	22.7	0.505	-62.0
2.7	0.437	-162.3	1.517	63.2	0.200	22.3	0.499	-62.7
2.8	0.433	-166.1	1.469	61.3	0.199	22.1	0.491	-64.2
2.9	0.426	-169.4	1.409	58.1	0.200	21.3	0.472	-65.2
3.0	0.419	-173.8	1.381	55.7	0.200	21.3	0.465	-68.0
4.0	0.436	149.3	1.136	34.9	0.208	23.7	0.424	-88.2
5.0	0.503	118.2	0.905	16.8	0.232	24.5	0.397	-112.6

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	0.853	-13.4	9.491	169.0	0.019	83.5	0.980	-7.6
0.2	0.839	-25.7	9.175	158.6	0.038	75.3	0.952	-14.8
0.3	0.791	-37.4	8.690	149.4	0.054	69.5	0.897	-21.0
0.4	0.735	-48.4	8.100	140.7	0.068	64.1	0.841	-27.0
0.5	0.673	-59.7	7.538	132.5	0.080	59.6	0.778	-32.1
0.6	0.617	-69.9	6.973	125.3	0.089	55.5	0.717	-36.6
0.7	0.565	-79.4	6.435	119.2	0.097	52.3	0.660	-40.3
0.8	0.516	-88.6	5.919	113.5	0.103	49.9	0.608	-43.7
0.9	0.475	-97.9	5.470	108.4	0.109	47.9	0.564	-46.8
1.0	0.440	-106.4	5.081	103.7	0.113	46.2	0.525	-49.7
1.1	0.417	-114.8	4.728	99.6	0.118	44.9	0.493	-52.1
1.2	0.397	-122.6	4.398	95.9	0.122	44.2	0.463	-54.3
1.3	0.384	-130.3	4.113	92.2	0.125	43.4	0.441	-56.2
1.4	0.371	-137.5	3.859	89.0	0.129	42.8	0.421	-58.2
1.5	0.364	-143.4	3.637	85.8	0.132	42.3	0.404	-59.7
1.6	0.357	-149.6	3.441	83.0	0.135	42.1	0.389	-61.0
1.7	0.355	-155.0	3.252	80.4	0.138	41.9	0.375	-62.3
1.8	0.352	-159.9	3.090	77.7	0.141	41.8	0.362	-63.2
1.9	0.352	-164.5	2.940	75.6	0.145	41.9	0.353	-64.2
2.0	0.345	-168.5	2.810	73.2	0.148	41.7	0.340	-64.8
2.1	0.355	-172.8	2.697	71.1	0.151	41.8	0.334	-66.0
2.2	0.349	-176.2	2.578	69.3	0.154	41.9	0.321	-66.3
2.3	0.360	179.9	2.488	67.3	0.158	41.9	0.317	-67.1
2.4	0.357	177.4	2.396	65.4	0.162	41.9	0.304	-68.2
2.5	0.362	174.0	2.305	63.6	0.166	42.0	0.300	-69.1
2.6	0.359	171.4	2.235	62.4	0.169	42.0	0.294	-70.9
2.7	0.367	169.1	2.155	60.6	0.173	42.0	0.287	-70.9
2.8	0.366	165.8	2.079	59.2	0.177	41.8	0.282	-73.1
2.9	0.359	164.2	1.983	56.7	0.181	41.2	0.267	-74.4
3.0	0.358	159.3	1.937	54.8	0.185	41.3	0.267	-77.6
4.0	0.403	131.3	1.524	36.4	0.230	39.4	0.251	-102.6
5.0	0.486	107.7	1.201	21.1	0.275	32.1	0.242	-133.9