NEC

NPN SILICON RF TWIN TRANSISTOR

μPA841TD

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, 2SC5600)

  Q1: Built-in high-gain transistor

  f_T = 12.0 GHz TYP., $|S_{21e}|^2$ = 8.5 dB TYP. @ V_{CE} = 3 V, I_C = 10 mA, f = 2 GHz

  Q2: Built-in low phase distortion transistor suited for OSC operation

  f_T = 5.0 GHz TYP., $|S_{21e}|^2$ = 4.0 dB TYP. @ V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
- 6-pin lead-less minimold package

BUILT-IN TRANSISTORS

	Q1	Q2
3-pin thin-type ultra super minimold part No.	2SC5435	2SC5600

ORDERING INFORMATION

Part Number	Quantity	Supplying Form
μPA841TD	50 pcs (Non reel)	• 8 mm wide embossed taping
μPA841TD-T3	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 NEC sales representative.
Unit sample quantity is 50 pcs.

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

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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	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	180	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 $cm^2 \times 1.0$ mm (t) glass epoxy substrate

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_{BE} = 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	$\lvert S_{21e} \rvert^2$	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	–	–	600	nA
Emitter Cut-off Current	I_{EBO}	V_{BE} = 1 V, I_C = 0 mA	–	–	600	nA
DC Current Gain	h_{FE} Note 1	V_{CE} = 1 V, I_C = 5 mA	100	–	160	–
Gain Bandwidth Product (1)	f_T	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz	3.5	5.0	–	GHz
Gain Bandwidth Product (2)	f_T	V_{CE} = 1 V, I_C = 15 mA, f = 2 GHz	5.5	6.5	–	GHz
Insertion Power Gain (1)	$\lvert S_{21e} \rvert^2$	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz	3.5	4.0	–	dB
Insertion Power Gain (2)	$\lvert S_{21e} \rvert^2$	V_{CE} = 1 V, I_C = 15 mA, f = 2 GHz	4.5	5.5	–	dB
Noise Figure	NF	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz, $Z_S = Z_{opt}$	–	1.5	2.5	dB
Reverse Transfer Capacitance	C_{re} Note 2	V_{CB} = 0.5 V, I_E = 0 mA, f = 1 MHz	–	0.8	1.0	pF

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

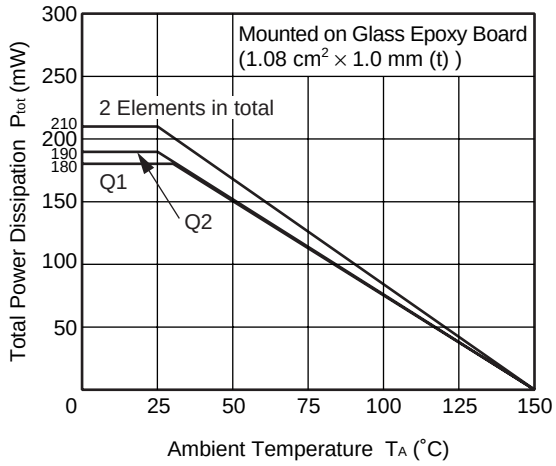
2. Collector to base capacitance when the emitter grounded

h_{FE} CLASSIFICATION

Rank	FB
Marking	nQ
h_{FE} Value of Q1	75 to 150
h_{FE} Value of Q2	100 to 160

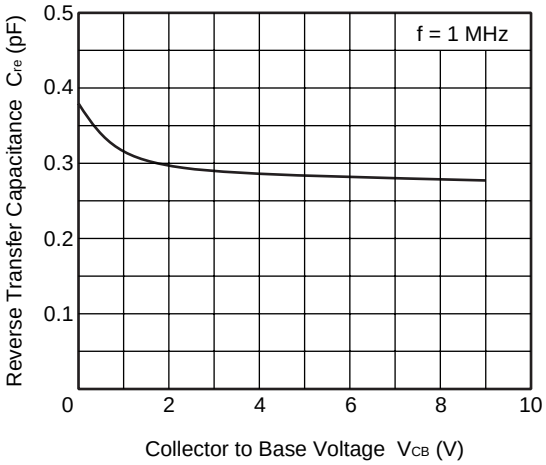
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

TOTAL POWER DISSIPATION
vs. AMBIENT TEMPERATURE



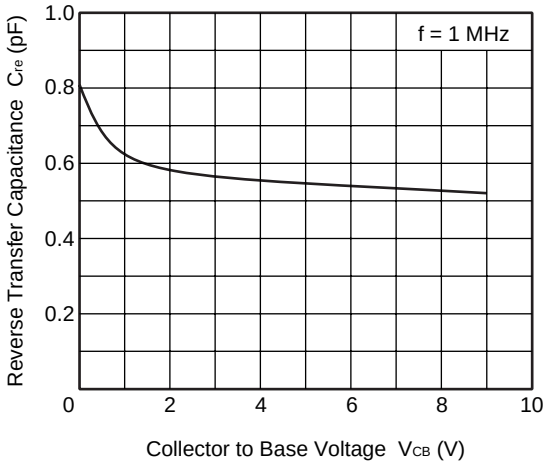
Q1

REVERSE TRANSFER CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE



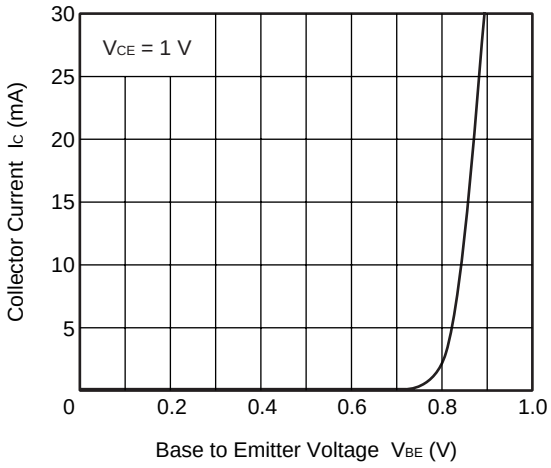
Q2

REVERSE TRANSFER CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE



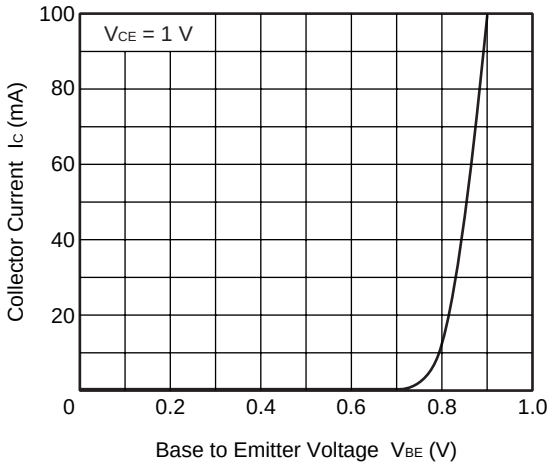
Q1

COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

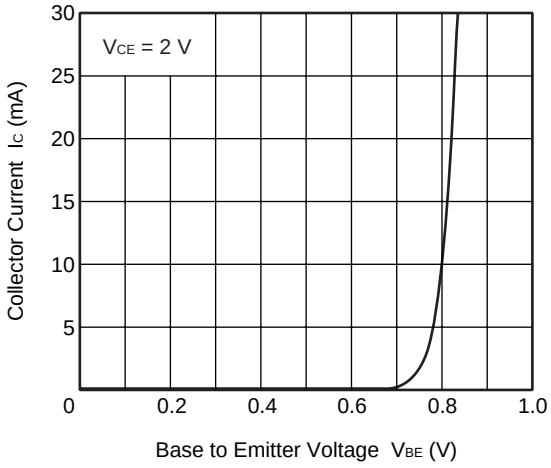


Q2

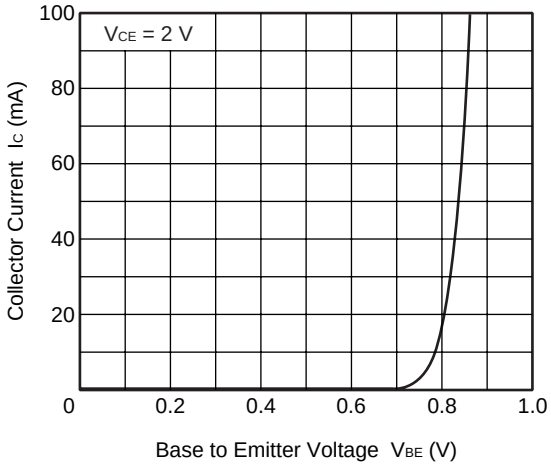
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



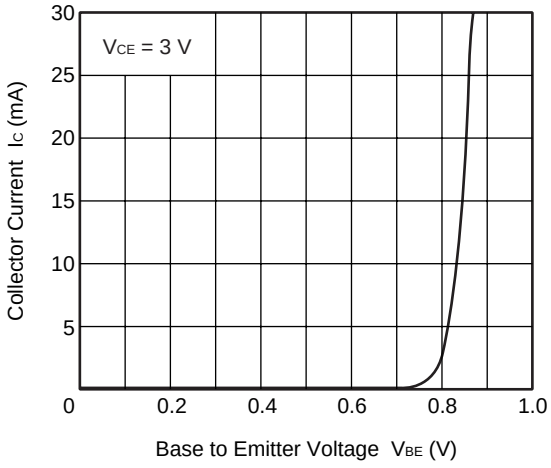
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

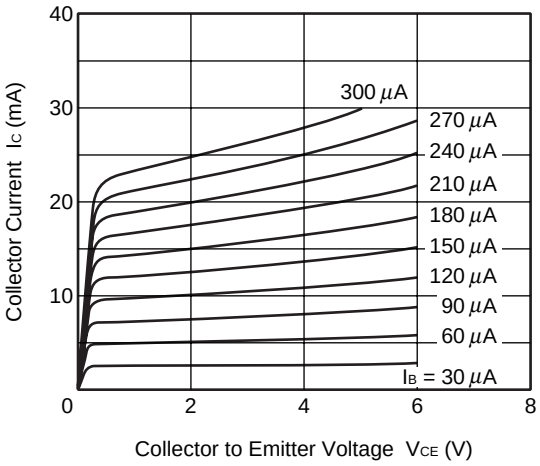


COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



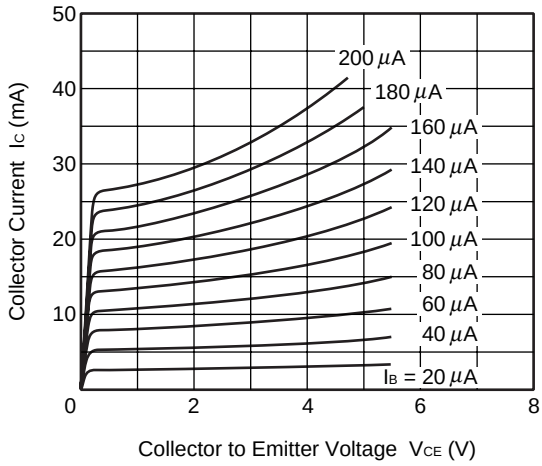
Q1

COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



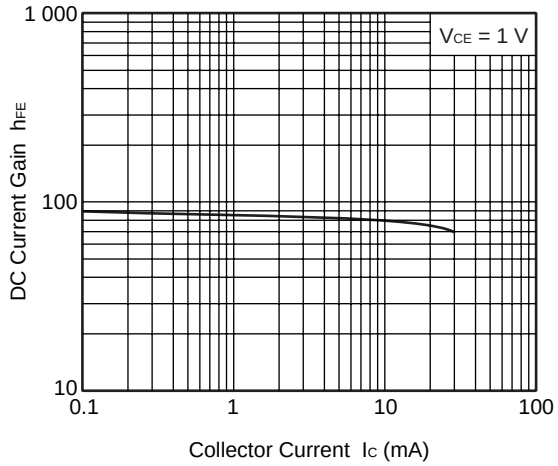
Q2

COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



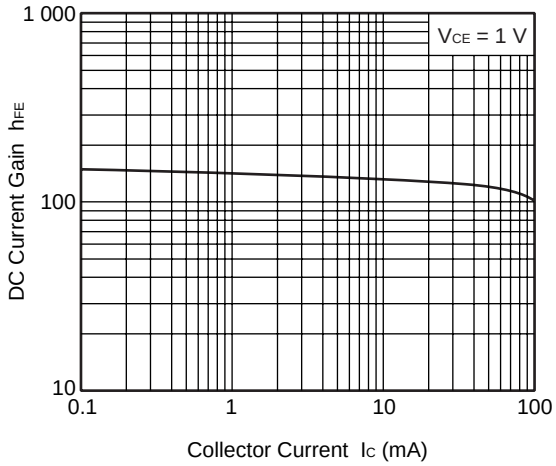
Q1

DC CURRENT GAIN vs.
COLLECTOR CURRENT

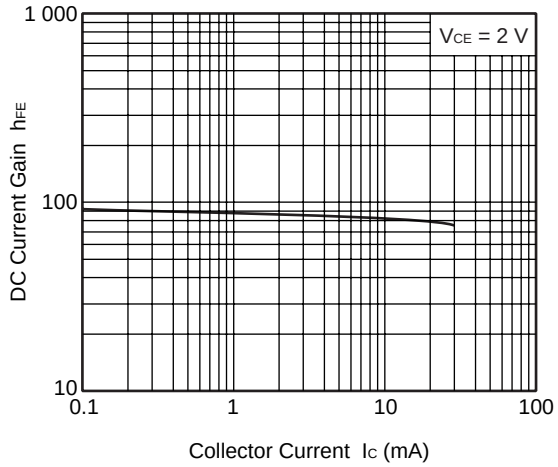


Q2

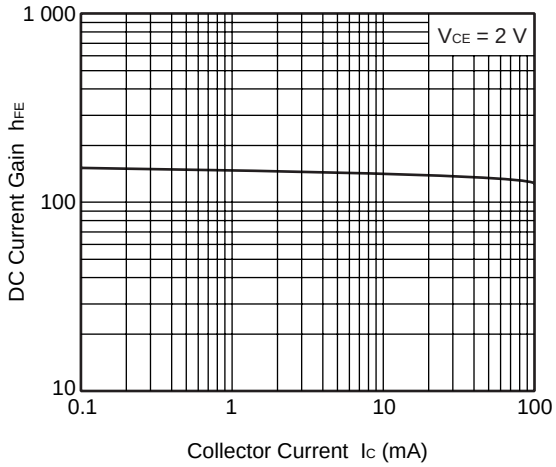
DC CURRENT GAIN vs.
COLLECTOR CURRENT



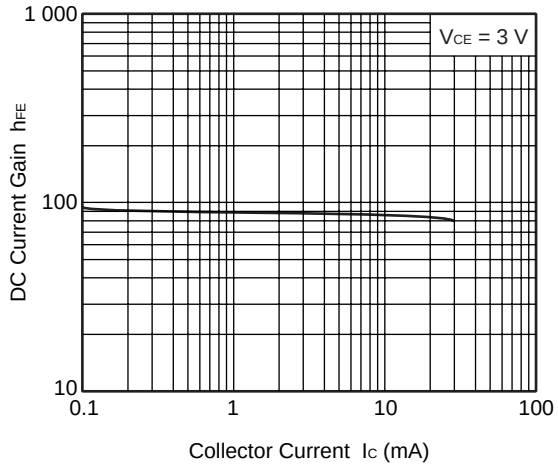
DC CURRENT GAIN vs.
COLLECTOR CURRENT



DC CURRENT GAIN vs.
COLLECTOR CURRENT

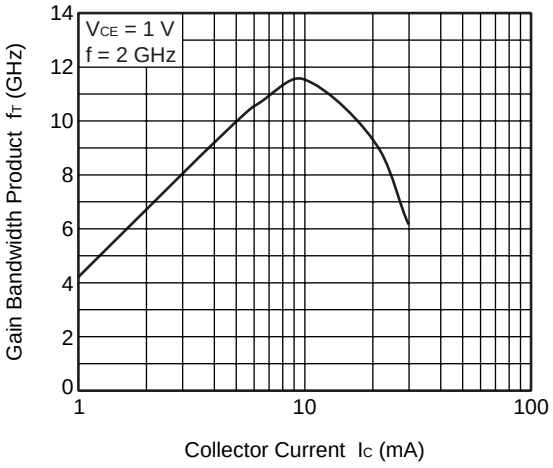


DC CURRENT GAIN vs.
COLLECTOR CURRENT



Q1

GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



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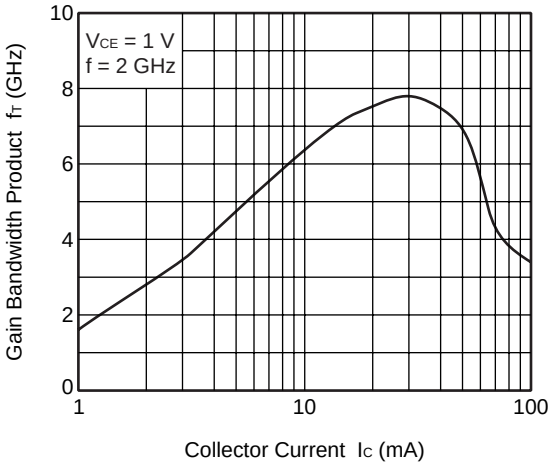
GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT
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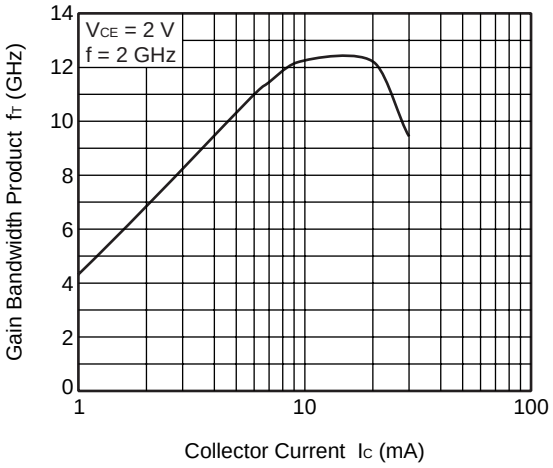
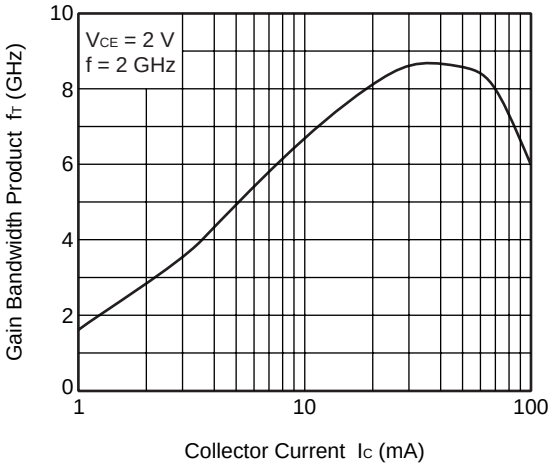


GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT



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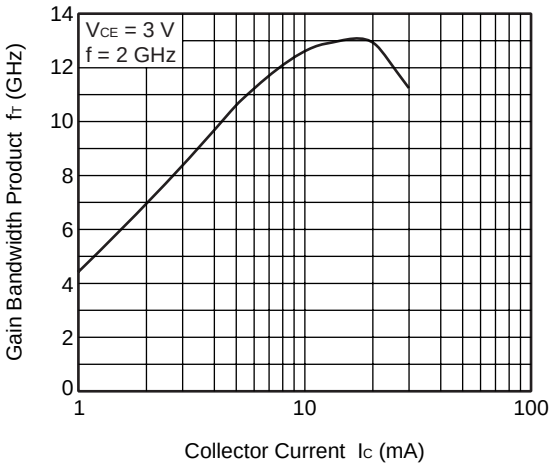
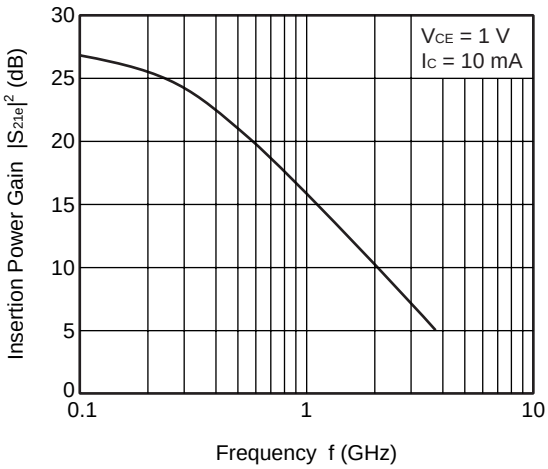


Q1

INSERTION POWER GAIN vs. FREQUENCY



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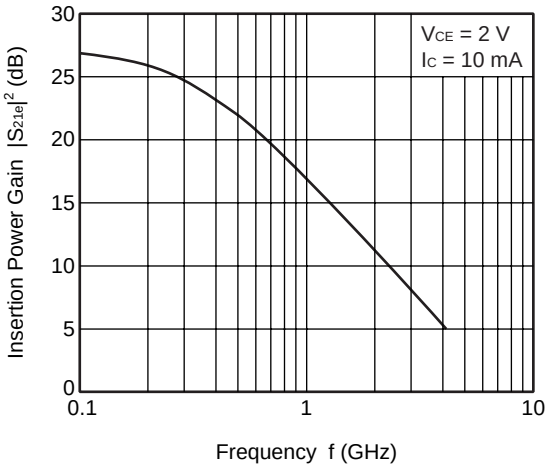

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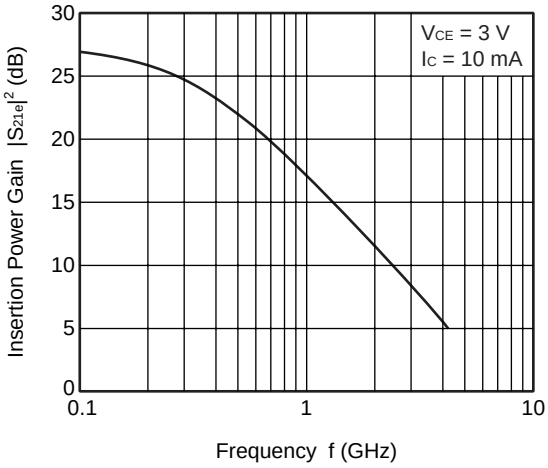
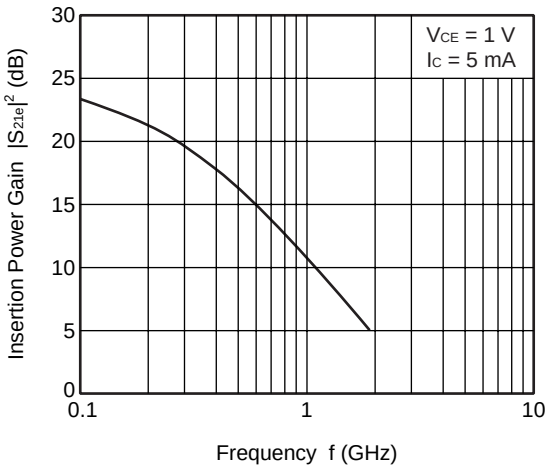


Q2

INSERTION POWER GAIN vs. FREQUENCY



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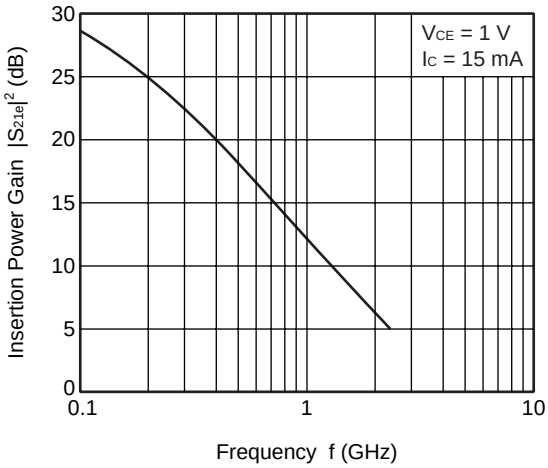

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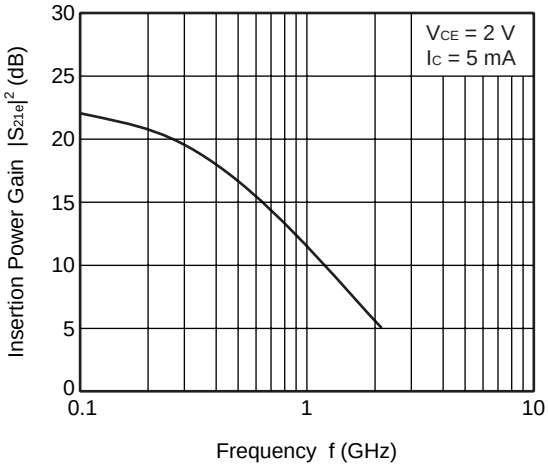
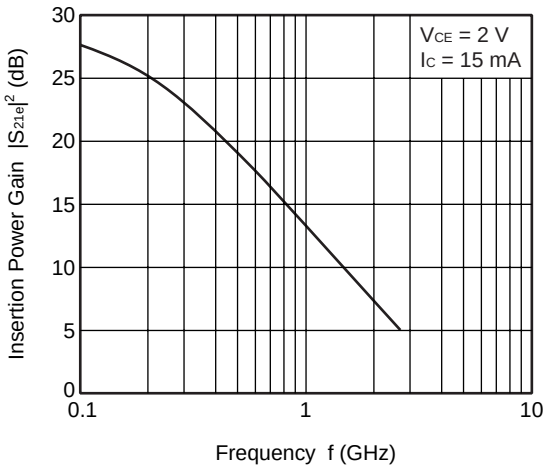


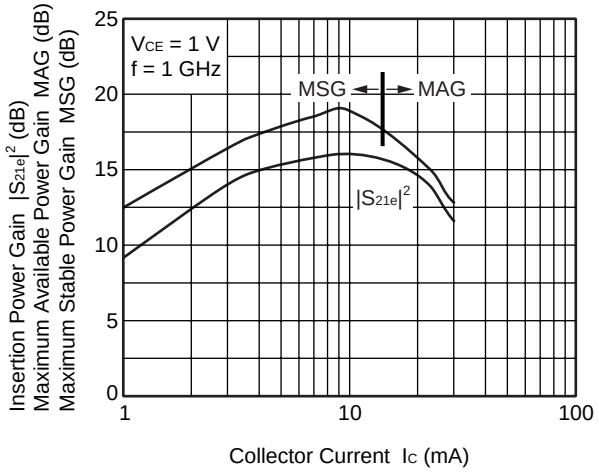
Q2

INSERTION POWER GAIN vs. FREQUENCY



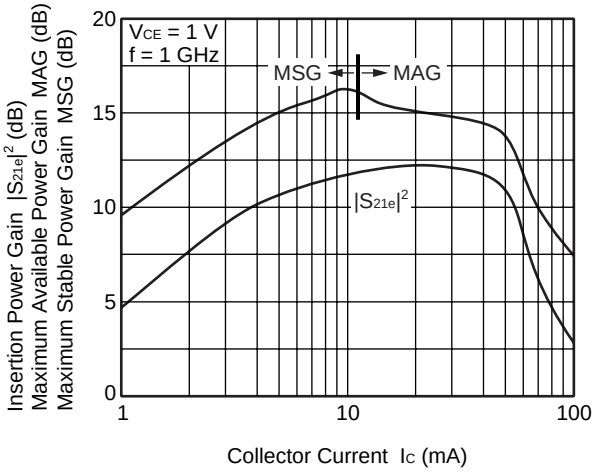
Q1

INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



Q2

INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



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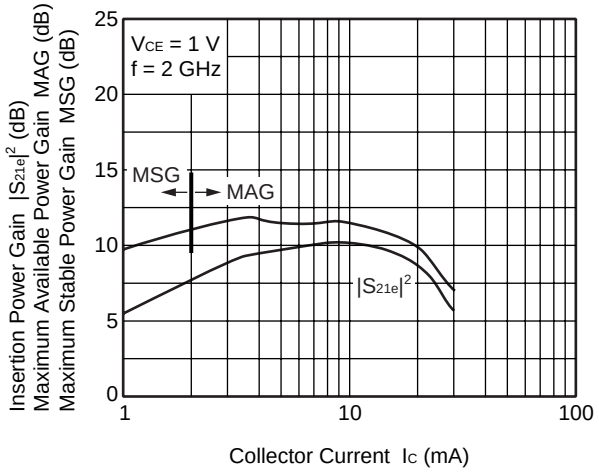
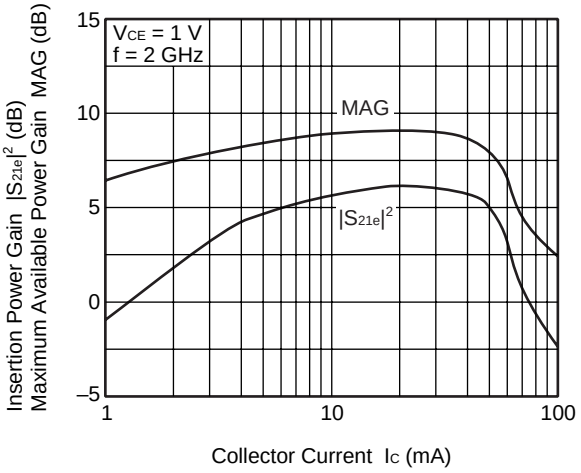
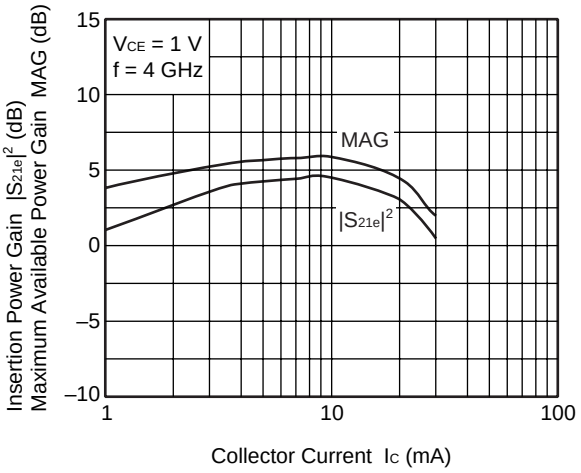


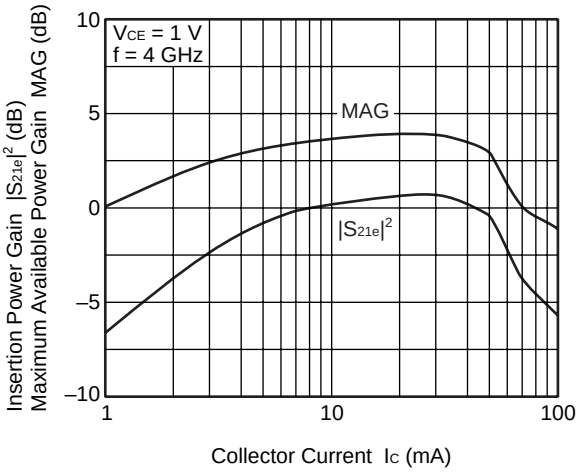
INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT

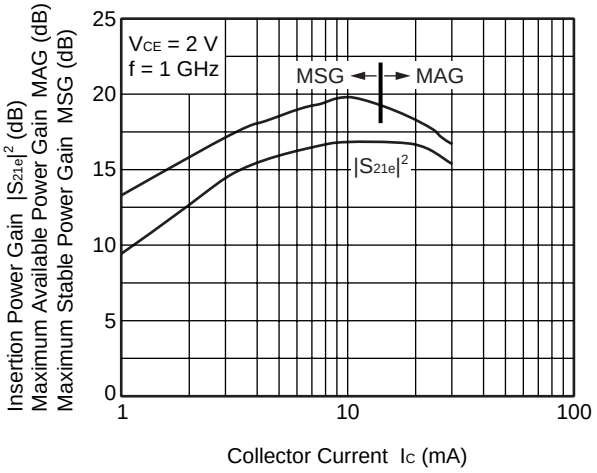


INSERTION POWER GAIN, MAG vs. COLLECTOR CURRENT



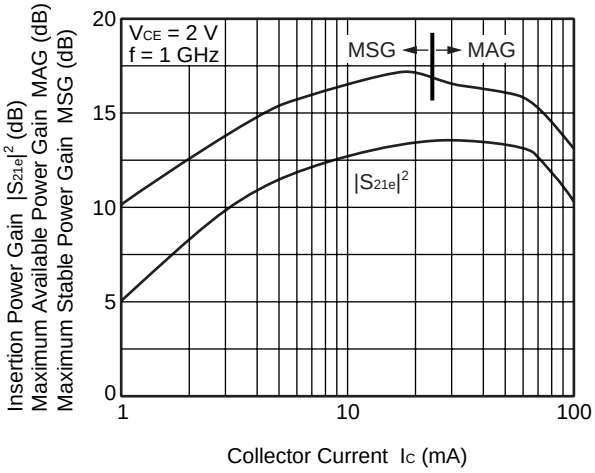
Q1

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

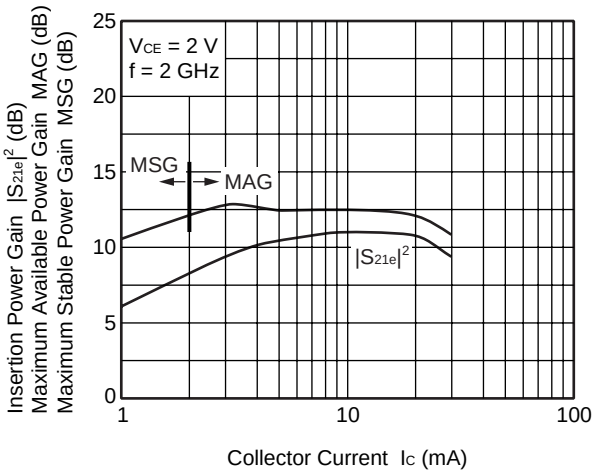


Q2

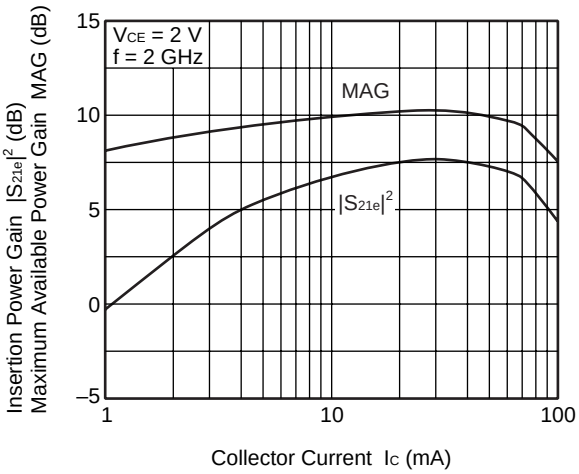
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



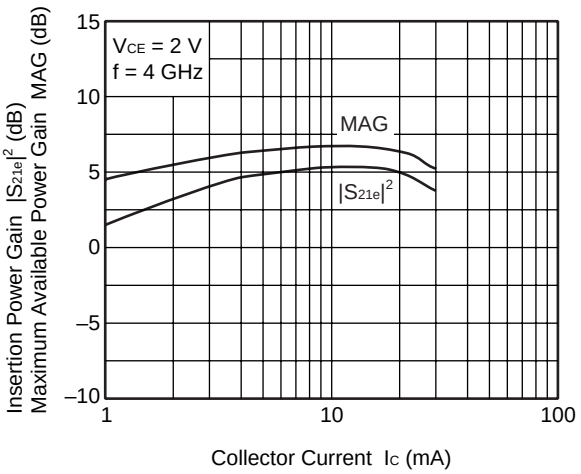
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



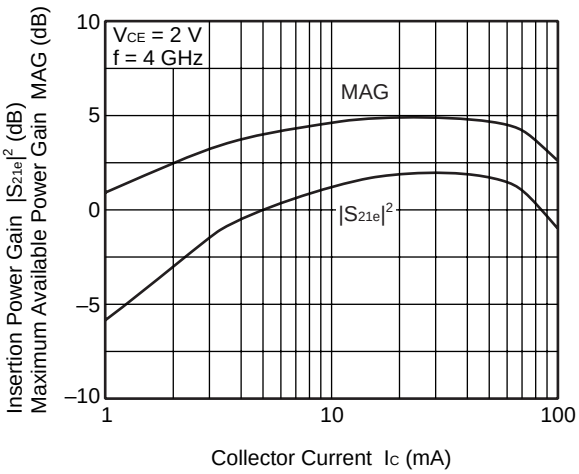
INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

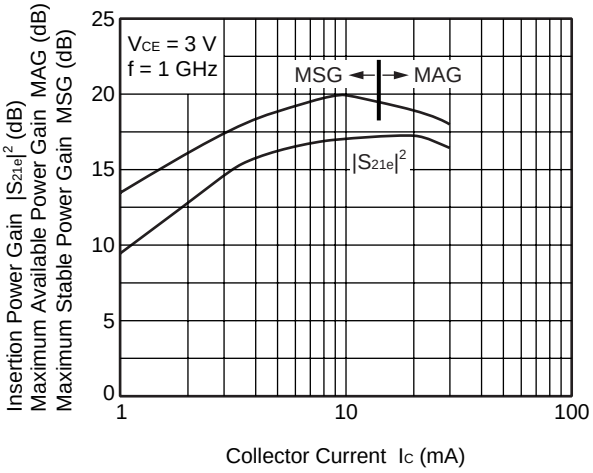


INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

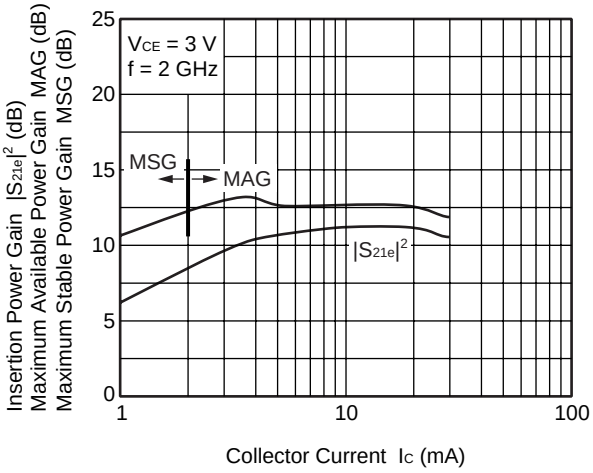


Q1

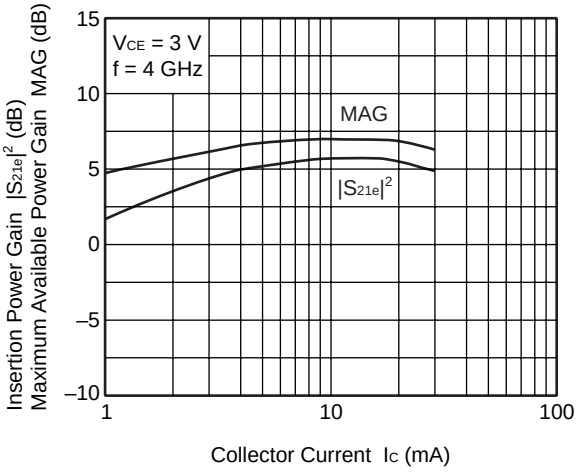
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

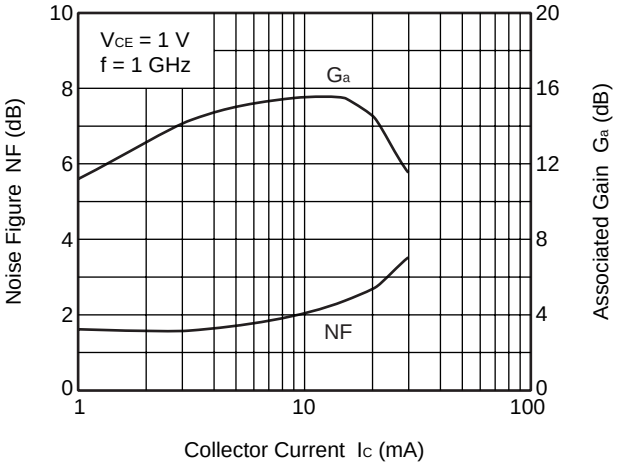


INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



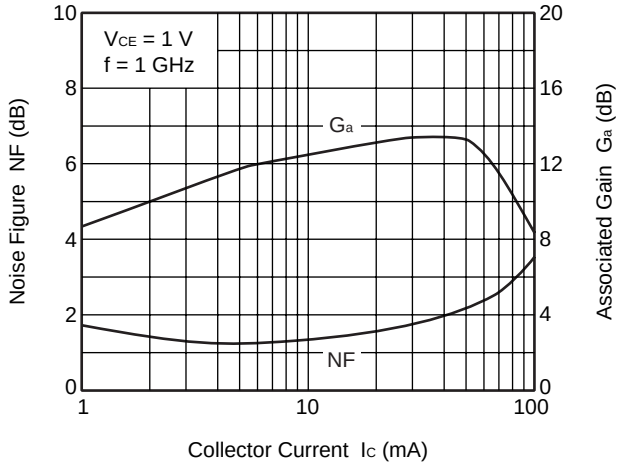
Q1

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

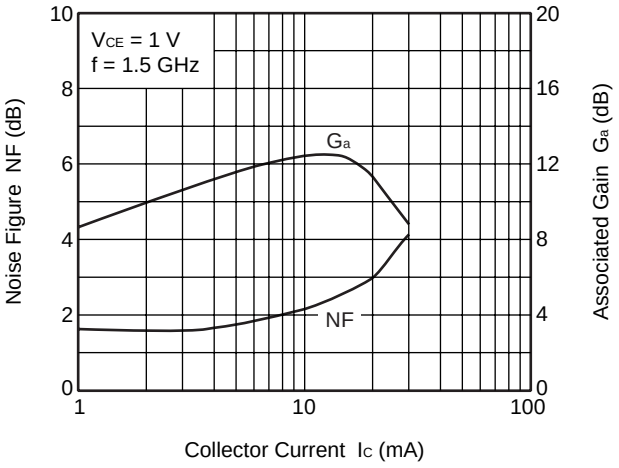


Q2

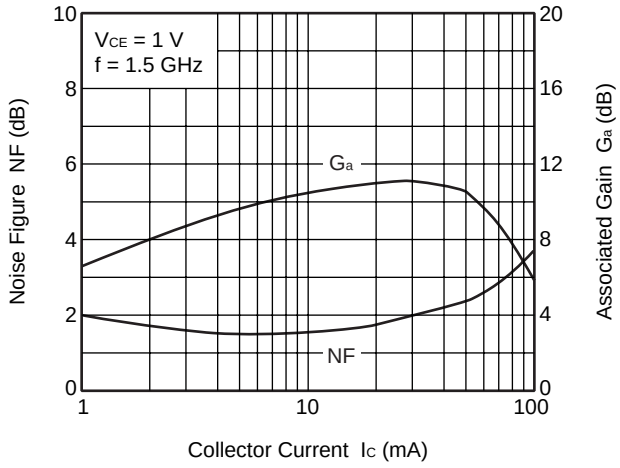
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



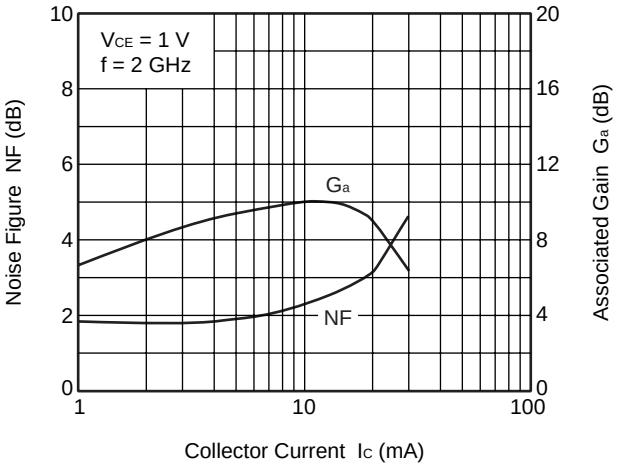
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



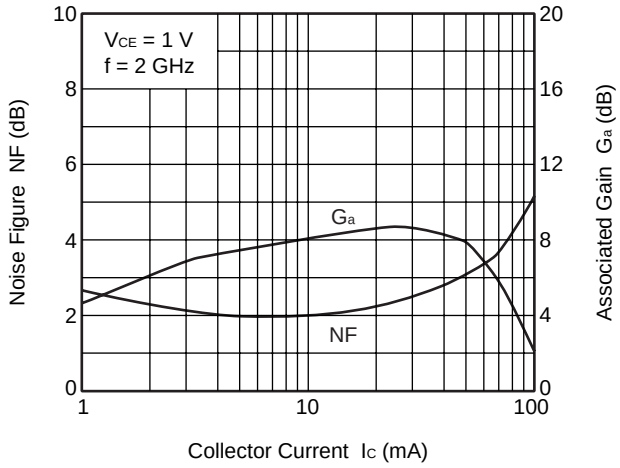
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

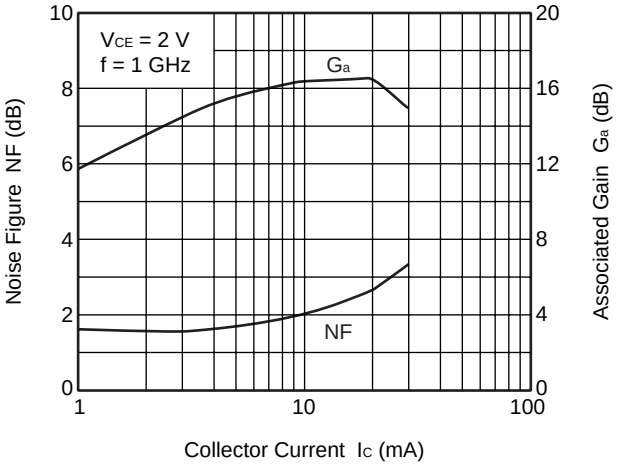


NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



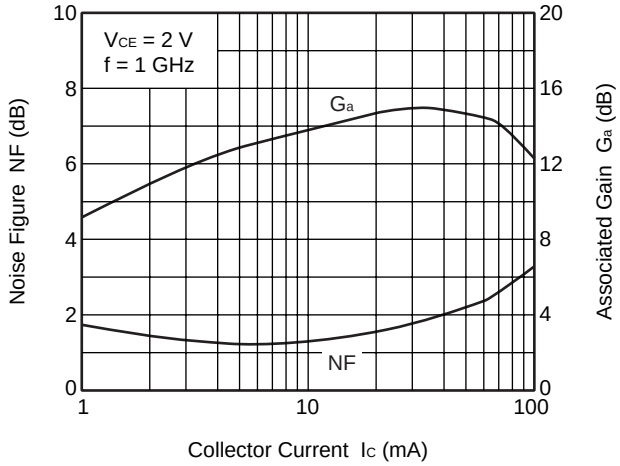
Q1

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

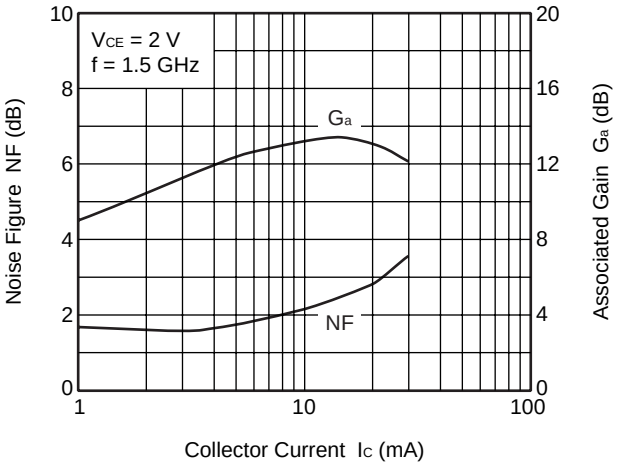


Q2

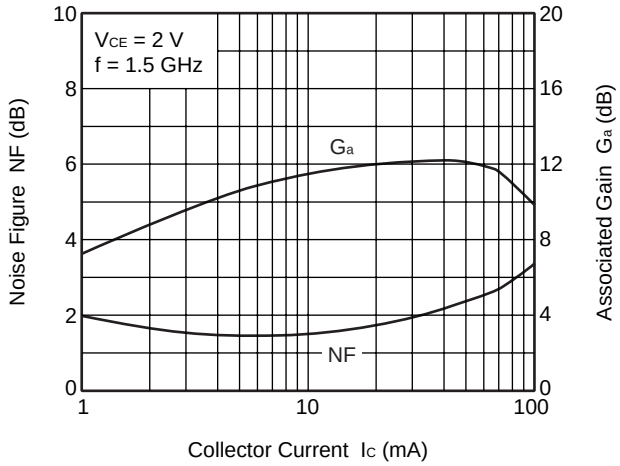
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



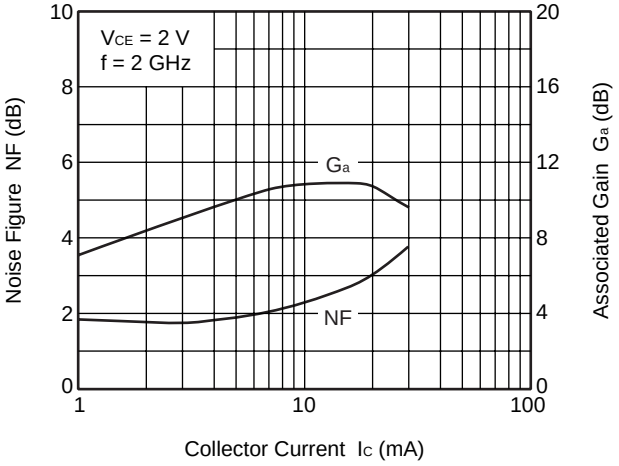
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



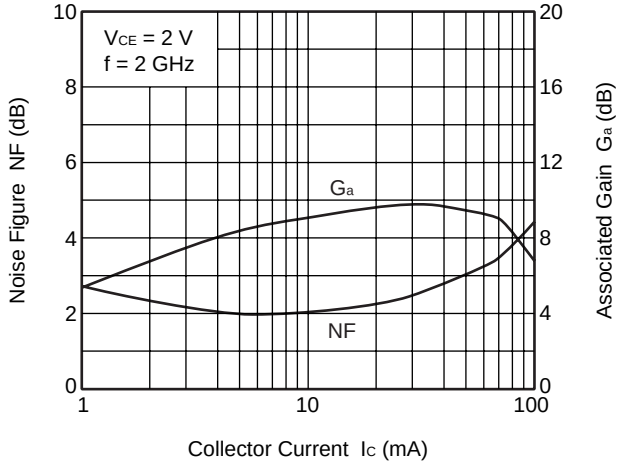
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

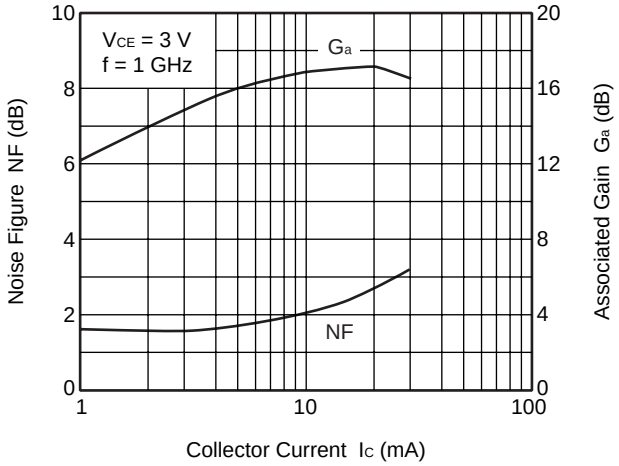


NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

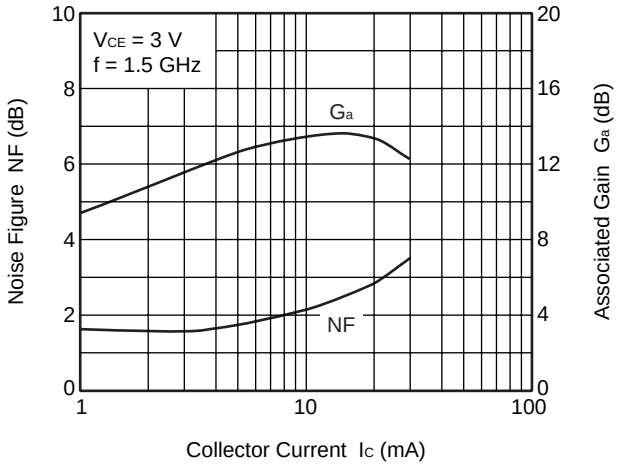


Q1

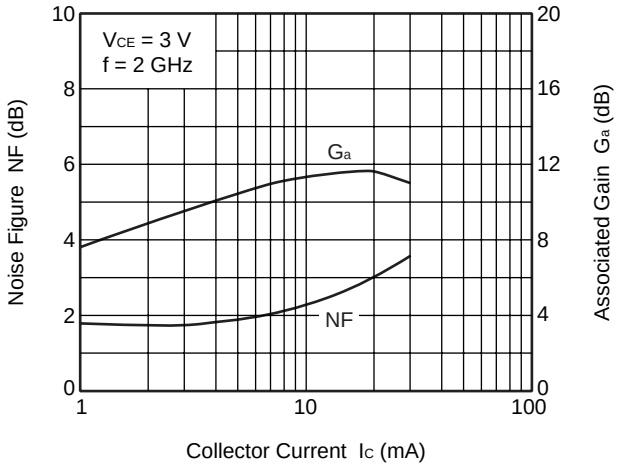
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT



Remark The graphs indicate nominal characteristics.

S-PARAMETERS Q1

Note When K ≥ 1, the MAG (Maximum Available Power Gain) is used. $MAG = \left|\frac{S_{21}}{S_{12}}\right| (K - \sqrt{(K^2 - 1)})$

When K < 1, the MSG (Maximum Stable Power Gain) is used. $MSG = \left|\frac{S_{21}}{S_{12}}\right|$

V_{CE} = 1 V, I_C = 1 mA, Z_O = 50 Ω

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG/MSG Note
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		(dB)
0.1	0.952	–7.1	3.547	172.9	0.020	86.6	0.992	–3.7	0.040	22.55
0.2	0.943	–14.4	3.539	167.2	0.040	80.9	0.989	–7.3	0.083	19.44
0.3	0.931	–21.5	3.494	161.1	0.060	76.6	0.971	–10.6	0.123	17.67
0.4	0.905	–28.3	3.407	154.8	0.079	72.0	0.951	–14.3	0.175	16.35
0.5	0.880	–35.8	3.352	148.4	0.096	67.8	0.929	–17.9	0.212	15.41
0.6	0.845	–43.0	3.274	142.1	0.112	63.4	0.900	–21.6	0.255	14.64
0.7	0.809	–50.3	3.172	136.6	0.127	59.1	0.870	–25.0	0.293	13.97
0.8	0.770	–57.2	3.067	130.7	0.140	55.3	0.837	–28.4	0.339	13.39
0.9	0.731	–64.5	2.965	125.0	0.152	51.5	0.807	–31.9	0.375	12.92
1.0	0.692	–71.4	2.864	119.5	0.161	48.1	0.775	–34.9	0.419	12.49
1.1	0.658	–78.5	2.756	114.6	0.169	44.8	0.746	–37.8	0.454	12.11
1.2	0.626	–85.5	2.640	110.0	0.177	42.1	0.717	–40.4	0.488	11.75
1.3	0.596	–92.3	2.536	105.5	0.182	39.4	0.693	–42.8	0.522	11.44
1.4	0.571	–98.7	2.420	101.1	0.186	36.9	0.669	–45.3	0.559	11.13
1.5	0.549	–104.8	2.325	96.9	0.190	34.8	0.648	–47.3	0.595	10.87
1.6	0.530	–110.8	2.237	93.2	0.193	32.8	0.628	–49.2	0.629	10.65
1.7	0.513	–116.9	2.141	89.7	0.195	31.1	0.609	–50.9	0.666	10.41
1.8	0.498	–122.2	2.059	86.1	0.196	29.5	0.592	–52.3	0.705	10.21
1.9	0.487	–127.6	1.976	83.4	0.197	28.2	0.577	–53.6	0.738	10.00
2.0	0.472	–132.0	1.907	80.2	0.198	27.0	0.562	–54.7	0.785	9.83
2.1	0.468	–137.5	1.844	77.5	0.198	26.1	0.552	–56.3	0.806	9.68
2.2	0.456	–141.5	1.769	74.8	0.198	25.3	0.538	–57.2	0.859	9.50
2.3	0.455	–147.0	1.721	72.3	0.199	24.5	0.533	–58.3	0.870	9.37
2.4	0.447	–150.7	1.663	69.8	0.200	23.9	0.518	–59.2	0.920	9.21
2.5	0.445	–155.3	1.611	67.5	0.200	23.5	0.512	–60.4	0.944	9.07
2.6	0.437	–158.8	1.570	65.5	0.200	22.7	0.505	–62.0	0.978	8.95
2.7	0.437	–162.3	1.517	63.2	0.200	22.3	0.499	–62.7	1.010	8.17
2.8	0.433	–166.1	1.469	61.3	0.199	22.1	0.491	–64.2	1.052	7.28
2.9	0.426	–169.4	1.409	58.1	0.200	21.3	0.472	–65.2	1.130	6.28
3.0	0.419	–173.8	1.381	55.7	0.200	21.3	0.465	–68.0	1.159	5.97
4.0	0.436	149.3	1.136	34.9	0.208	23.7	0.424	–88.2	1.339	3.89
5.0	0.503	118.2	0.905	16.8	0.232	24.5	0.397	–112.6	1.439	1.97

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG/MSG
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		(dB)
0.1	0.853	–13.4	9.491	169.0	0.019	83.5	0.980	–7.6	0.070	26.93
0.2	0.839	–25.7	9.175	158.6	0.038	75.3	0.952	–14.8	0.151	23.88
0.3	0.791	–37.4	8.690	149.4	0.054	69.5	0.897	–21.0	0.223	22.06
0.4	0.735	–48.4	8.100	140.7	0.068	64.1	0.841	–27.0	0.288	20.74
0.5	0.673	–59.7	7.538	132.5	0.080	59.6	0.778	–32.1	0.354	19.76
0.6	0.617	–69.9	6.973	125.3	0.089	55.5	0.717	–36.6	0.421	18.95
0.7	0.565	–79.4	6.435	119.2	0.097	52.3	0.660	–40.3	0.484	18.22
0.8	0.516	–88.6	5.919	113.5	0.103	49.9	0.608	–43.7	0.548	17.58
0.9	0.475	–97.9	5.470	108.4	0.109	47.9	0.564	–46.8	0.603	17.02
1.0	0.440	–106.4	5.081	103.7	0.113	46.2	0.525	–49.7	0.660	16.52
1.1	0.417	–114.8	4.728	99.6	0.118	44.9	0.493	–52.1	0.705	16.04
1.2	0.397	–122.6	4.398	95.9	0.122	44.2	0.463	–54.3	0.752	15.59
1.3	0.384	–130.3	4.113	92.2	0.125	43.4	0.441	–56.2	0.792	15.17
1.4	0.371	–137.5	3.859	89.0	0.129	42.8	0.421	–58.2	0.831	14.77
1.5	0.364	–143.4	3.637	85.8	0.132	42.3	0.404	–59.7	0.868	14.40
1.6	0.357	–149.6	3.441	83.0	0.135	42.1	0.389	–61.0	0.903	14.07
1.7	0.355	–155.0	3.252	80.4	0.138	41.9	0.375	–62.3	0.935	13.72
1.8	0.352	–159.9	3.090	77.7	0.141	41.8	0.362	–63.2	0.967	13.40
1.9	0.352	–164.5	2.940	75.6	0.145	41.9	0.353	–64.2	0.993	13.08
2.0	0.345	–168.5	2.810	73.2	0.148	41.7	0.340	–64.8	1.030	11.73
2.1	0.355	–172.8	2.697	71.1	0.151	41.8	0.334	–66.0	1.040	11.30
2.2	0.349	–176.2	2.578	69.3	0.154	41.9	0.321	–66.3	1.079	10.52
2.3	0.360	179.9	2.488	67.3	0.158	41.9	0.317	–67.1	1.079	10.26
2.4	0.357	177.4	2.396	65.4	0.162	41.9	0.304	–68.2	1.106	9.72
2.5	0.362	174.0	2.305	63.6	0.166	42.0	0.300	–69.1	1.118	9.35
2.6	0.359	171.4	2.235	62.4	0.169	42.0	0.294	–70.9	1.136	8.97
2.7	0.367	169.1	2.155	60.6	0.173	42.0	0.287	–70.9	1.144	8.64
2.8	0.366	165.8	2.079	59.2	0.177	41.8	0.282	–73.1	1.167	8.23
2.9	0.359	164.2	1.983	56.7	0.181	41.2	0.267	–74.4	1.212	7.62
3.0	0.358	159.3	1.937	54.8	0.185	41.3	0.267	–77.6	1.215	7.39
4.0	0.403	131.3	1.524	36.4	0.230	39.4	0.251	–102.6	1.228	5.34
5.0	0.486	107.7	1.201	21.1	0.275	32.1	0.242	–133.9	1.232	3.50

V_{CE} = 1 V, I_C = 5 mA, Z_O = 50 Ω

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG/MSG
(GHz)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		(dB)
0.1	0.783	–18.8	14.076	165.6	0.018	80.3	0.964	–10.8	0.110	28.87
0.2	0.747	–34.7	13.183	152.2	0.036	72.3	0.907	–20.3	0.206	25.70
0.3	0.673	–49.8	12.003	141.1	0.049	65.6	0.823	–27.8	0.305	23.94
0.4	0.607	–62.9	10.741	131.5	0.060	61.0	0.742	–34.4	0.390	22.55
0.5	0.537	–76.1	9.603	123.1	0.068	57.1	0.663	–39.4	0.478	21.49
0.6	0.481	–87.4	8.612	116.2	0.075	54.3	0.594	–43.5	0.559	20.61
0.7	0.437	–98.0	7.754	110.7	0.081	52.7	0.535	–46.7	0.630	19.83
0.8	0.398	–108.0	6.998	105.4	0.086	51.5	0.486	–49.5	0.700	19.11
0.9	0.372	–118.1	6.348	100.9	0.091	50.6	0.444	–52.1	0.759	18.45
1.0	0.351	–127.1	5.824	96.9	0.095	50.1	0.410	–54.6	0.812	17.85
1.1	0.338	–135.6	5.367	93.4	0.100	49.8	0.383	–56.7	0.856	17.31
1.2	0.332	–143.4	4.940	90.4	0.104	49.8	0.359	–58.8	0.896	16.76
1.3	0.326	–151.0	4.598	87.4	0.109	49.7	0.342	–60.4	0.931	16.27
1.4	0.325	–156.9	4.286	84.5	0.113	49.6	0.326	–62.2	0.962	15.79
1.5	0.322	–162.3	4.028	81.7	0.117	49.5	0.313	–63.7	0.990	15.36
1.6	0.324	–167.9	3.798	79.3	0.122	49.6	0.303	–64.9	1.013	14.25
1.7	0.327	–172.4	3.582	77.0	0.126	49.6	0.291	–66.2	1.036	13.37
1.8	0.326	–176.7	3.393	74.6	0.131	49.6	0.282	–67.0	1.060	12.65
1.9	0.330	179.2	3.224	72.8	0.135	49.6	0.275	–68.1	1.075	12.11
2.0	0.326	176.0	3.078	70.5	0.140	49.6	0.264	–68.5	1.098	11.53
2.1	0.338	172.5	2.946	68.7	0.144	49.6	0.260	–69.7	1.101	11.17
2.2	0.336	170.4	2.817	67.1	0.148	49.7	0.248	–70.0	1.125	10.63
2.3	0.347	167.5	2.713	65.3	0.153	49.5	0.245	–70.8	1.120	10.37
2.4	0.345	165.2	2.609	63.6	0.159	49.4	0.234	–72.1	1.138	9.91
2.5	0.352	162.6	2.509	62.1	0.163	49.3	0.231	–72.9	1.142	9.58
2.6	0.351	160.3	2.432	60.8	0.168	49.3	0.224	–75.0	1.150	9.25
2.7	0.358	158.5	2.340	59.2	0.173	49.0	0.219	–74.9	1.156	8.92
2.8	0.359	155.9	2.260	57.8	0.178	48.6	0.215	–77.6	1.168	8.56
2.9	0.352	154.4	2.158	55.6	0.183	47.8	0.202	–79.5	1.199	8.02
3.0	0.353	150.0	2.104	53.8	0.188	47.8	0.205	–83.1	1.197	7.80
4.0	0.402	125.3	1.631	36.5	0.239	43.3	0.203	–111.7	1.191	5.69
5.0	0.486	104.8	1.283	22.1	0.288	33.9	0.212	–147.2	1.187	3.87