To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

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

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RENESAS

PRELIMINARY DATA SHEET

RENESAS

Silicon Transistor

μPA833TF

NPN SILICON EPITAXIAL TRANSISTOR (WITH 2 DIFFERENT ELEMENTS) IN A 6-PIN THIN-TYPE SMALL MINI MOLD PACKAGE

DESCRIPTION

The μPA833TF has two different built-in transistors (Q1 and Q2) for low noise amplification in the VHF band to UHF band.

FEATURES

- Low noise
  Q1 : NF = 1.7 dB TYP. @ f = 2 GHz, V_{CE} = 1 V, I_C = 3 mA
  Q2 : NF = 1.5 dB TYP. @ f = 2 GHz, V_{CE} = 3 V, I_C = 3 mA
- High gain
  Q1 : $|S_{21e}|^2$ = 3.5 dB TYP. @ f = 2 GHz, V_{CE} = 1 V, I_C = 3 mA
  Q2 : $|S_{21e}|^2$ = 8.5 dB TYP. @ f = 2 GHz, V_{CE} = 3 V, I_C = 10 mA
- 6-pin thin-type small mini mold package
- 2 different transistors on-chip (2SC5193, 2SC4959)

ON-CHIP TRANSISTORS

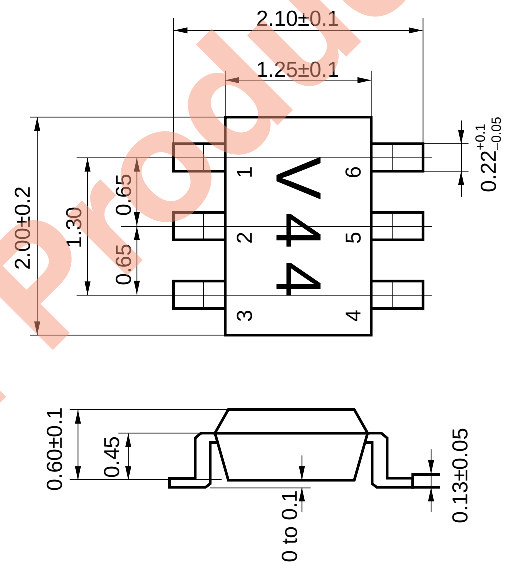
	Q1	Q2
3-pin small mini mold part No.	2SC5193	2SC4959

The μPA836TF features the Q1 and Q2 in inverted positions.

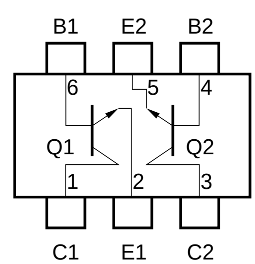
ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
μPA833TF	Loose products (50 pcs)	8-mm wide embossed tape. Pin 6 (Q1 Base), pin 5 (Q2 Emitter), and pin 4 (Q2 Base) face perforated side of tape.
μPA833TF-T1	Taping products (3 kpcs/reel)	

PACKAGE DRAWINGS (Unit:mm)



PIN CONFIGURATION (Top View)



PIN CONNECTIONS

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

Caution is required concerning excess input, such as from static electricity, because the high-frequency process is used for this device.

The information in this document is subject to change without notice.

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Date Published August 1997 N
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ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

PARAMETER	SYMBOL	RATING		UNIT
		Q1	Q2	
Collector to base voltage	V_{CBO}	9	9	V
Collector to emitter voltage	V_{CEO}	6	6	V
Emitter to base voltage	V_{EBO}	2	2	V
Collector current	I_C	100	30	mA
Total power dissipation	P_T	150 in 1 element	150 in 1 element	mW
		200 in 2 elements[Note]		
Junction temperature	T_j	150	150	°C
Storage temperature	T_{stg}	−65 to +150		°C

Note 110 mW must not be exceeded for 1 element.

(1) Q1

ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	I_{CBO}	V_{CB} = 5 V, I_E = 0			0.1	μA
Emitter cutoff current	I_{EBO}	V_{EB} = 1 V, I_C = 0			0.1	μA
DC current gain	h_{FE}	V_{CE} = 1 V, I_C = 3 mA[Note 1]	100		145	
Gain bandwidth product (1)	f_T	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz	4.0	4.5		GHz
Gain bandwidth product (2)	f_T	V_{CE} = 3 V, I_C = 20 mA, f = 2 GHz		9.0		GHz
Feedback capacitance	C_{re}	V_{CB} = 1 V, I_E = 0, f = 1 MHz[Note 2]		0.75	0.85	pF
Insertion power gain (1)	$\|S_{21e}\|^2$	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz	2.5	3.5		dB
Insertion power gain (2)	$\|S_{21e}\|^2$	V_{CE} = 3 V, I_C = 20 mA, f = 2 GHz		6.5		dB
Noise figure (1)	NF	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz		1.7	2.5	dB
Noise figure (2)	NF	V_{CE} = 3 V, I_C = 7 mA, f = 2 GHz		1.5		dB

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

2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

(2) Q2

ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	I_{CBO}	V_{CB} = 5 V, I_E = 0			0.1	μA
Emitter cutoff current	I_{EBO}	V_{EB} = 1 V, I_C = 0			0.1	μA
DC current gain	h_{FE}	V_{CE} = 3 V, I_C = 10 mA Note 1	75		150	
Gain bandwidth product	f_T	V_{CE} = 3 V, I_C = 10 mA, f = 2 GHz		12		GHz
Feedback capacitance	C_{re}	V_{CB} = 3 V, I_E = 0, f = 1 MHz Note 2		0.4	0.7	pF
Insertion power gain	$\|S_{21e}\|^2$	V_{CE} = 3 V, I_C = 10 mA, f = 2 GHz	7	8.5		dB
Noise figure	NF	V_{CE} = 3 V, I_C = 3 mA, f = 2 GHz		1.5	2.5	dB

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

2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

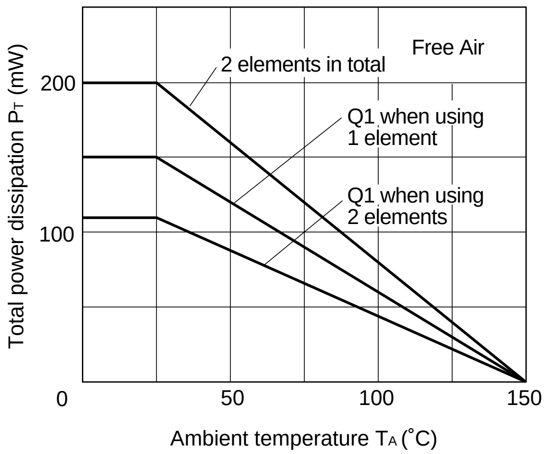
h_{FE} CLASSIFICATION

Rank	FB
Marking	V44
h_{FE} value of Q1	100 to 145
h_{FE} value of Q2	75 to 150

TYPICAL CHARACTERISTICS (T_A = 25°C)

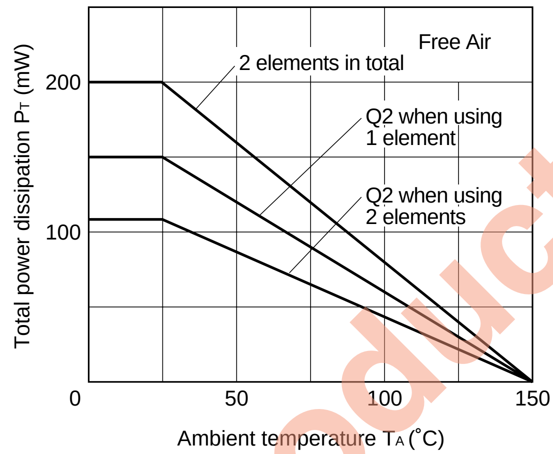
Q1

Total Power Dissipation vs. Ambient Temperature

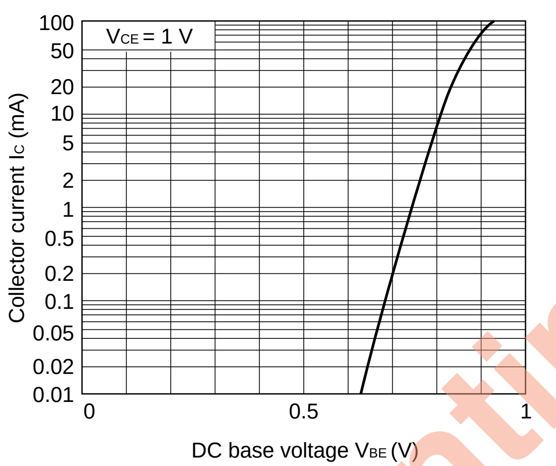


Q2

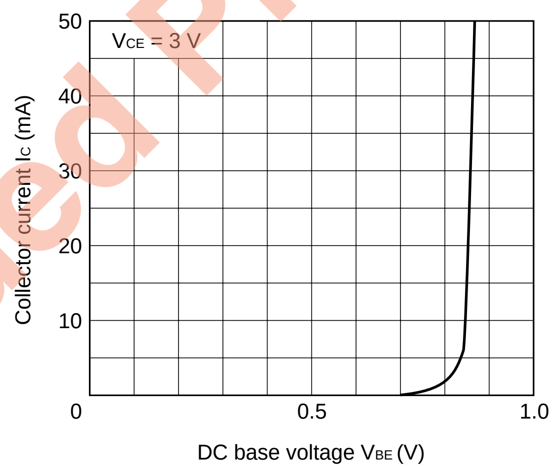
Total Power Dissipation vs. Ambient Temperature



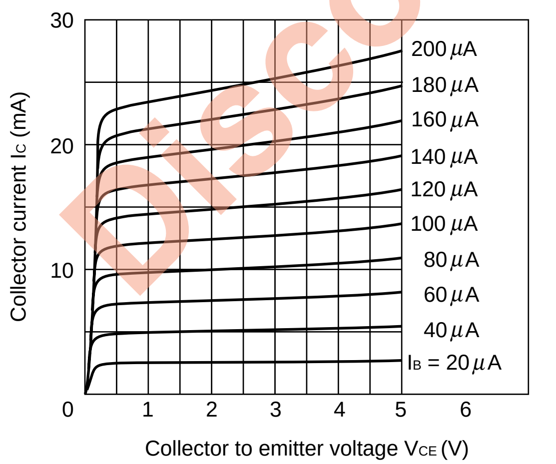
Collector Current vs. DC Base Voltage



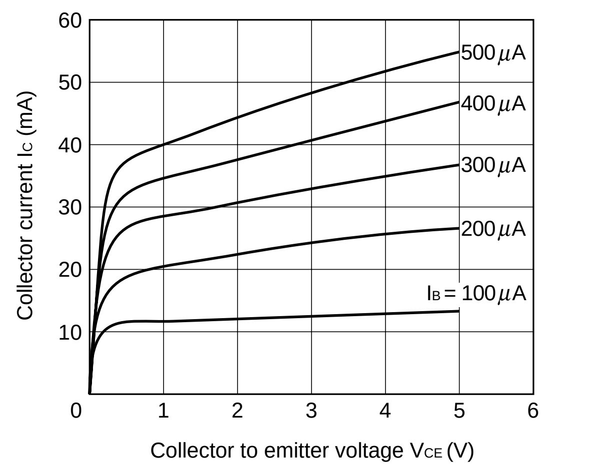
Collector Current vs. DC Base Voltage



Collector Current vs. Collector to Emitter Voltage

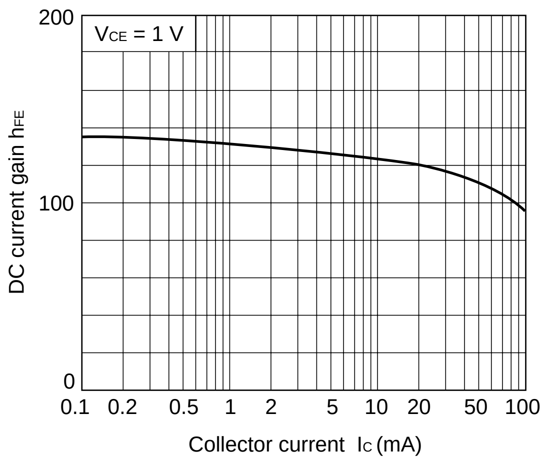


Collector Current vs. Collector to Emitter Voltage



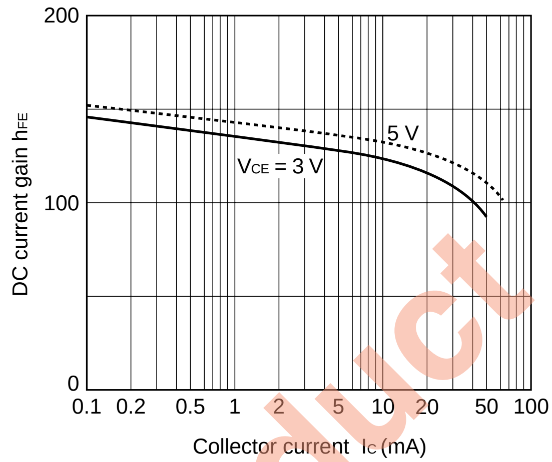
Q1

DC Current Gain vs. Collector Current

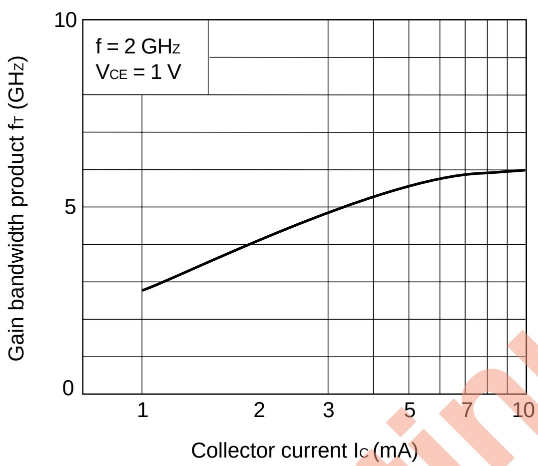


Q2

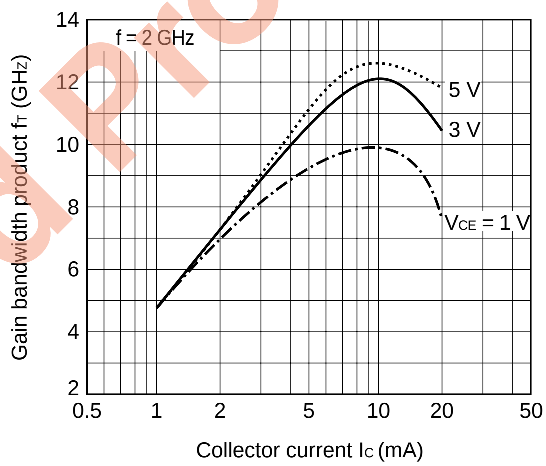
DC Current Gain vs. Collector Current



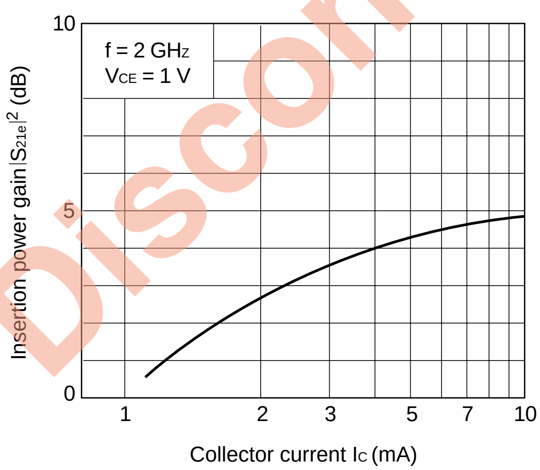
Gain Bandwidth Product vs. Collector Current



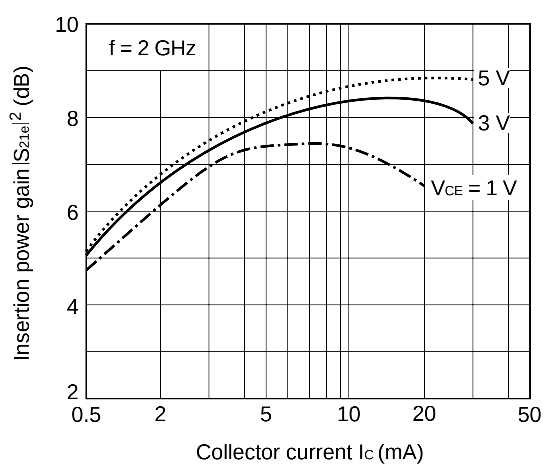
Gain Bandwidth Product vs. Collector Current



Insertion Power Gain vs. Collector Current



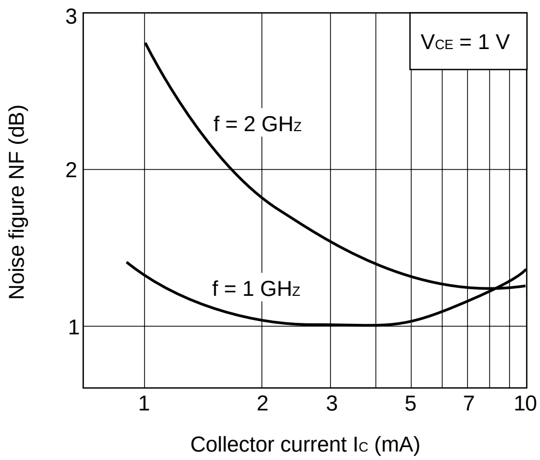
Insertion Power Gain vs. Collector Current



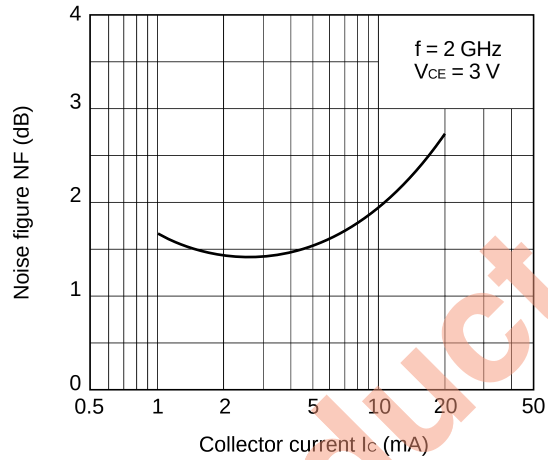
Q1

Q2

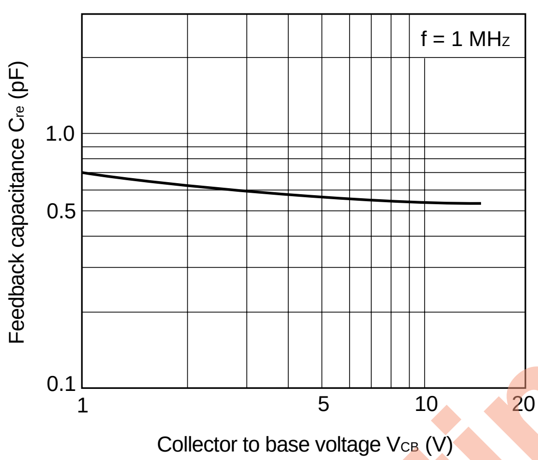
Noise Figure vs. Collector Current



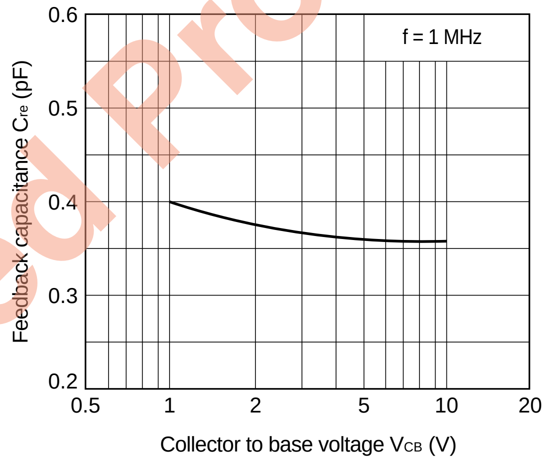
Noise Figure vs. Collector Current



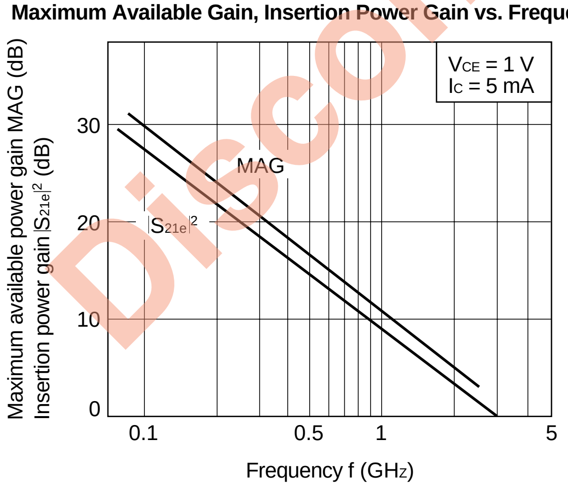
Feedback Capacitance vs. Collector to Base Voltage



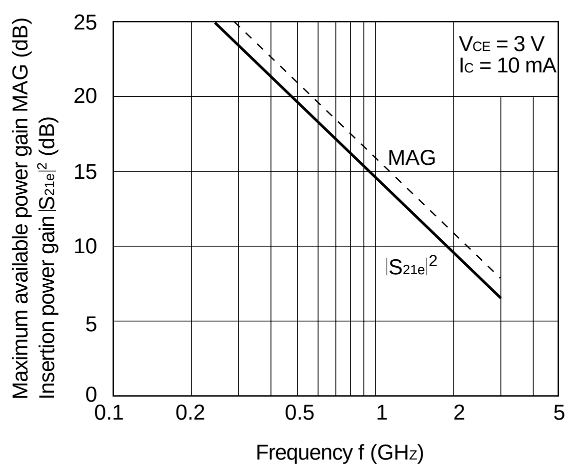
Feedback Capacitance vs. Collector to Base Voltage



Maximum Available Gain, Insertion Power Gain vs. Frequency

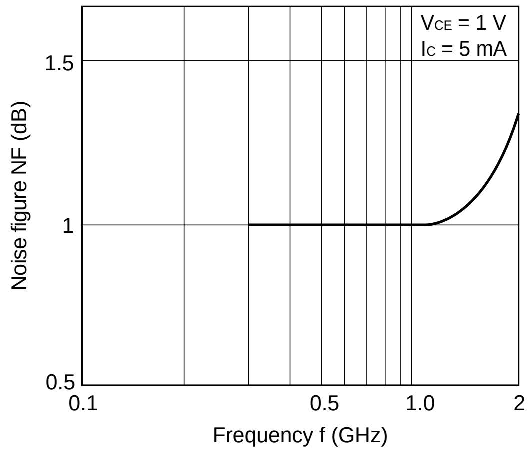


Maximum Available Gain, Insertion Power Gain vs. Frequency



Q1

Noise Figure vs. Frequency



S-PARAMETERS Q1

V_{CE} = 3 V, I_C = 1 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.97	−14.33	2.43	166.54	.04	80.24	.99	−7.18
.20	.95	−28.67	2.38	154.71	.07	70.60	.97	−13.99
.30	.91	−42.88	2.36	144.04	.10	62.11	.92	−19.89
.40	.87	−56.75	2.27	134.07	.13	54.03	.88	−25.53
.50	.83	−70.72	2.23	125.01	.15	47.25	.83	−29.96
.60	.79	−84.33	2.16	116.71	.16	40.79	.78	−34.25
.70	.75	−97.41	2.08	108.43	.17	35.62	.75	−37.36
.80	.71	−109.76	1.99	101.04	.17	31.08	.70	−40.60
.90	.68	−122.09	1.92	93.80	.18	26.89	.67	−43.12
1.00	.66	−133.22	1.82	87.30	.18	23.81	.64	−45.41
1.10	.64	−144.02	1.74	81.47	.18	21.08	.62	−47.82
1.20	.62	−154.11	1.66	75.63	.18	19.11	.60	−49.75
1.30	.61	−163.41	1.57	70.50	.17	17.32	.58	−51.90
1.40	.61	−172.15	1.50	65.55	.17	16.33	.57	−54.11
1.50	.61	179.69	1.43	60.93	.17	15.48	.56	−56.32
1.60	.61	172.31	1.36	56.58	.16	15.52	.54	−58.59
1.70	.61	165.55	1.29	52.57	.16	15.97	.54	−61.07
1.80	.62	159.12	1.24	48.65	.15	16.87	.53	−63.68
1.90	.63	153.12	1.18	44.96	.15	18.29	.52	−66.32
2.00	.63	147.73	1.12	41.71	.15	20.29	.52	−69.09
2.10	.64	142.54	1.08	38.29	.15	22.73	.51	−71.98
2.20	.65	137.65	1.03	35.21	.15	25.25	.51	−75.26
2.30	.66	133.23	.99	32.01	.15	27.87	.51	−78.60
2.40	.67	129.32	.95	29.64	.15	30.83	.50	−82.11
2.50	.67	125.32	.92	27.04	.15	33.50	.50	−85.80
2.60	.68	121.78	.88	24.60	.16	36.03	.50	−89.61
2.70	.69	118.50	.85	22.41	.17	38.41	.50	−93.50
2.80	.70	115.24	.82	20.14	.17	40.23	.50	−97.66
2.90	.71	112.33	.79	18.25	.18	41.83	.50	−101.66
3.00	.72	109.50	.76	16.28	.19	42.71	.50	−105.83

V_{CE} = 3 V, I_C = 3 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.91	−20.87	6.85	160.51	.04	76.06	.95	−14.18
.20	.84	−40.75	6.38	145.81	.06	64.42	.87	−26.10
.30	.77	−60.61	6.07	133.27	.08	55.69	.77	−34.95
.40	.69	−79.21	5.65	122.38	.10	49.28	.68	−41.90
.50	.62	−96.87	5.20	112.63	.11	45.15	.61	−46.55
.60	.57	−112.43	4.72	104.66	.12	41.99	.54	−50.59
.70	.52	−126.51	4.31	97.30	.12	40.07	.50	−53.40
.80	.49	−139.31	3.94	91.09	.13	38.98	.46	−55.90
.90	.47	−150.57	3.59	85.51	.13	38.14	.42	−58.00
1.00	.46	−160.97	3.31	80.44	.14	38.00	.40	−60.02
1.10	.46	−170.30	3.05	75.95	.14	37.60	.38	−62.10
1.20	.46	−178.72	2.83	71.60	.14	37.86	.36	−63.86
1.30	.46	173.69	2.64	67.73	.15	37.91	.34	−66.00
1.40	.47	166.63	2.47	63.86	.15	38.15	.33	−68.28
1.50	.47	160.24	2.32	60.26	.16	38.28	.32	−70.83
1.60	.48	154.42	2.19	56.86	.16	38.60	.31	−73.24
1.70	.49	149.16	2.07	53.60	.17	38.76	.30	−76.06
1.80	.50	144.23	1.96	50.43	.17	39.12	.29	−78.94
1.90	.51	139.58	1.86	47.34	.18	38.98	.28	−81.98
2.00	.52	135.44	1.77	44.29	.18	39.31	.28	−85.18
2.10	.53	131.39	1.70	41.48	.19	39.23	.27	−88.50
2.20	.54	127.65	1.62	38.94	.20	39.28	.26	−92.55
2.30	.55	124.36	1.55	36.05	.20	39.08	.26	−96.16
2.40	.57	121.18	1.49	33.64	.21	39.04	.26	−100.32
2.50	.58	118.19	1.43	31.34	.22	39.03	.26	−104.63
2.60	.59	115.58	1.38	28.95	.22	38.56	.26	−109.15
2.70	.60	112.99	1.33	26.70	.23	38.53	.26	−113.50
2.80	.61	110.43	1.29	24.45	.24	38.23	.26	−118.22
2.90	.62	108.13	1.24	22.28	.24	37.87	.26	−122.53
3.00	.63	105.91	1.20	20.22	.25	37.38	.26	−126.83

S-PARAMETERS Q1

V_{CE} = 3 V, I_C = 5 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.85	–26.44	10.69	155.98	.03	73.46	.92	–19.86
.20	.75	–51.20	9.61	139.24	.06	61.17	.79	–34.91
.30	.64	–75.20	8.75	125.25	.07	54.17	.65	–44.33
.40	.56	–96.72	7.76	113.92	.08	50.16	.55	–51.20
.50	.49	–115.03	6.80	104.72	.09	48.17	.48	–55.56
.60	.45	–130.31	5.95	97.69	.10	47.13	.42	–59.25
.70	.42	–143.59	5.26	91.52	.11	46.84	.38	–61.89
.80	.41	–155.39	4.72	86.26	.11	46.85	.35	–64.36
.90	.40	–165.50	4.25	81.56	.12	46.62	.32	–66.67
1.00	.40	–174.72	3.87	77.29	.13	46.83	.30	–68.91
1.10	.40	177.10	3.55	73.37	.13	46.91	.28	–71.34
1.20	.41	169.76	3.28	69.66	.14	46.94	.27	–73.69
1.30	.41	163.14	3.04	66.19	.15	46.69	.25	–76.39
1.40	.42	157.10	2.83	62.87	.16	46.57	.24	–79.41
1.50	.43	151.58	2.66	59.70	.16	46.31	.23	–82.66
1.60	.44	146.60	2.50	56.66	.17	45.94	.22	–86.03
1.70	.45	142.01	2.36	53.73	.18	45.59	.22	–89.61
1.80	.46	137.81	2.23	50.83	.19	45.07	.21	–93.69
1.90	.48	133.84	2.12	48.10	.19	44.55	.21	–97.41
2.00	.49	130.04	2.01	45.17	.20	44.01	.20	–101.67
2.10	.50	126.68	1.93	42.52	.21	43.30	.20	–105.84
2.20	.51	123.26	1.83	40.17	.22	42.61	.20	–111.09
2.30	.52	120.32	1.76	37.50	.22	41.82	.19	–115.75
2.40	.53	117.64	1.69	35.27	.23	41.27	.20	–120.90
2.50	.54	114.93	1.62	32.99	.24	40.36	.20	–125.90
2.60	.56	112.60	1.56	30.62	.25	39.55	.20	–131.14
2.70	.57	110.25	1.50	28.52	.25	38.85	.20	–136.28
2.80	.58	108.05	1.46	26.39	.26	38.08	.21	–141.19
2.90	.59	105.95	1.41	24.29	.27	37.27	.21	–145.61
3.00	.60	103.96	1.36	22.18	.27	36.49	.21	–149.97

V_{CE} = 3 V, I_C = 7 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.79	–31.67	14.14	152.27	.03	71.15	.88	–24.58
.20	.67	–60.82	12.28	133.87	.05	59.89	.72	–41.34
.30	.55	–87.90	10.67	119.07	.06	54.65	.57	–50.83
.40	.47	–110.16	9.04	108.13	.07	52.59	.47	–57.33
.50	.42	–127.95	7.66	99.95	.08	51.97	.40	–61.50
.60	.39	–142.37	6.59	93.83	.09	51.63	.35	–65.05
.70	.38	–154.76	5.76	88.35	.10	52.13	.32	–67.82
.80	.37	–165.47	5.12	83.75	.11	52.11	.29	–70.62
.90	.37	–174.83	4.59	79.53	.12	52.18	.27	–73.11
1.00	.37	176.89	4.16	75.64	.13	52.20	.25	–75.82
1.10	.38	169.63	3.81	72.18	.13	51.99	.23	–78.72
1.20	.38	162.95	3.50	68.56	.14	51.72	.22	–81.78
1.30	.39	156.98	3.25	65.42	.15	51.33	.21	–85.11
1.40	.40	151.53	3.03	62.34	.16	50.81	.20	–88.95
1.50	.41	146.63	2.83	59.33	.17	50.15	.19	–92.87
1.60	.42	141.98	2.66	56.50	.18	49.40	.19	–97.18
1.70	.44	137.93	2.51	53.72	.19	48.77	.18	–101.69
1.80	.45	133.89	2.38	50.97	.20	48.00	.18	–106.30
1.90	.46	130.36	2.26	48.32	.20	47.04	.18	–110.96
2.00	.47	126.94	2.14	45.65	.21	46.10	.17	–116.39
2.10	.48	123.80	2.05	43.03	.22	45.20	.17	–120.97
2.20	.49	120.71	1.95	40.91	.23	44.15	.17	–126.84
2.30	.50	118.00	1.87	38.45	.24	43.05	.18	–132.13
2.40	.52	115.48	1.80	36.15	.24	42.04	.18	–137.40
2.50	.53	113.00	1.73	33.97	.25	41.08	.18	–142.69
2.60	.54	110.80	1.66	31.82	.26	39.96	.19	–148.07
2.70	.55	108.67	1.60	29.74	.26	39.23	.19	–152.96
2.80	.56	106.60	1.55	27.34	.27	38.14	.20	–157.19
2.90	.58	104.57	1.50	25.66	.28	37.25	.21	–161.69
3.00	.59	102.82	1.45	23.37	.29	36.23	.21	–165.54

S-PARAMETERS Q1

V_{CE} = 3 V, I_C = 10 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.71	–39.03	18.58	147.71	.03	68.69	.83	–30.16
.20	.57	–73.63	15.31	127.39	.05	59.38	.63	–48.07
.30	.45	–102.58	12.43	112.73	.06	56.68	.49	–57.41
.40	.39	–124.33	10.08	102.91	.07	56.27	.40	–63.51
.50	.36	–141.02	8.36	95.89	.08	56.57	.34	–67.57
.60	.35	–154.37	7.10	90.47	.09	56.86	.29	–71.19
.70	.34	–165.44	6.16	85.73	.10	57.18	.26	–74.31
.80	.34	–175.03	5.44	81.62	.11	57.18	.24	–77.41
.90	.34	176.63	4.87	77.75	.12	57.09	.22	–80.56
1.00	.35	169.25	4.40	74.22	.13	56.69	.21	–83.81
1.10	.36	162.75	4.02	71.00	.14	56.34	.20	–87.55
1.20	.37	156.83	3.70	67.77	.15	55.55	.19	–91.34
1.30	.38	151.50	3.42	64.82	.16	54.83	.18	–95.70
1.40	.39	146.60	3.19	61.79	.17	53.99	.17	–100.40
1.50	.40	142.12	2.98	59.04	.17	53.03	.17	–104.99
1.60	.41	138.03	2.80	56.45	.18	52.03	.16	–110.36
1.70	.42	134.21	2.63	53.75	.19	51.04	.16	–115.48
1.80	.43	130.67	2.50	51.05	.20	49.91	.16	–120.86
1.90	.45	127.37	2.37	48.74	.21	48.75	.16	–126.15
2.00	.46	124.22	2.25	46.04	.22	47.77	.16	–131.74
2.10	.47	121.31	2.15	43.60	.23	46.48	.16	–136.39
2.20	.48	118.37	2.05	41.36	.24	45.20	.17	–142.70
2.30	.49	115.87	1.96	38.90	.25	43.97	.17	–147.46
2.40	.50	113.55	1.89	36.95	.25	42.65	.18	–152.75
2.50	.52	111.30	1.81	34.71	.26	41.70	.19	–157.66
2.60	.53	109.28	1.74	32.62	.27	40.45	.19	–162.35
2.70	.54	107.16	1.67	30.43	.28	39.28	.20	–166.91
2.80	.55	105.27	1.62	28.76	.28	38.16	.21	–170.83
2.90	.57	103.43	1.57	26.44	.29	37.04	.22	–174.49
3.00	.58	101.61	1.51	24.93	.30	36.10	.23	–177.86

V_{CE} = 3 V, I_C = 20 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.52	–60.10	28.62	137.10	.02	67.35	.71	–41.30
.20	.39	–103.44	19.94	115.16	.04	63.08	.48	–59.79
.30	.33	–130.53	14.51	103.51	.05	63.34	.35	–68.39
.40	.31	–148.95	11.26	96.02	.06	64.33	.28	–74.25
.50	.30	–162.62	9.15	90.56	.07	65.01	.24	–78.55
.60	.30	–172.99	7.69	86.27	.08	65.06	.21	–82.95
.70	.31	178.35	6.63	82.36	.09	64.97	.19	–87.11
.80	.31	170.80	5.84	78.82	.11	64.40	.18	–91.38
.90	.32	164.26	5.21	75.55	.12	63.46	.16	–96.07
1.00	.33	158.34	4.70	72.35	.13	62.64	.16	–100.35
1.10	.34	153.02	4.28	69.45	.14	61.47	.15	–105.51
1.20	.35	148.21	3.94	66.66	.15	60.45	.15	–110.63
1.30	.36	143.86	3.63	63.96	.16	59.09	.15	–116.00
1.40	.37	139.65	3.38	61.26	.17	58.05	.15	–121.72
1.50	.38	135.96	3.16	58.61	.18	56.50	.15	–127.25
1.60	.40	132.38	2.97	56.19	.19	55.17	.15	–133.07
1.70	.41	129.06	2.79	53.72	.20	53.77	.15	–138.41
1.80	.42	126.14	2.64	51.32	.21	52.54	.16	–143.83
1.90	.43	123.11	2.50	48.96	.22	51.02	.16	–148.58
2.00	.44	120.40	2.38	46.54	.23	49.64	.17	–153.87
2.10	.46	117.80	2.27	44.17	.24	48.25	.18	–157.74
2.20	.47	115.23	2.16	42.21	.25	46.65	.18	–162.91
2.30	.48	112.96	2.07	39.64	.26	45.13	.19	–167.09
2.40	.49	110.86	1.99	37.96	.27	43.59	.20	–171.04
2.50	.50	108.77	1.90	35.67	.27	42.37	.21	–174.96
2.60	.51	106.98	1.84	33.82	.28	40.93	.22	–178.81
2.70	.53	105.14	1.77	31.79	.29	39.70	.23	177.40
2.80	.54	103.40	1.72	29.93	.30	38.37	.24	174.62
2.90	.55	101.60	1.65	28.01	.30	37.05	.25	171.56
3.00	.56	100.10	1.61	26.09	.31	35.76	.26	168.73

S-PARAMETERS Q2

V_{CE} = 3 V, I_C = 1 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.98	–5.93	2.43	171.79	.02	85.64	.99	–3.75
.20	.97	–11.82	2.41	164.40	.04	80.86	.99	–7.53
.30	.95	–17.85	2.42	157.59	.05	76.45	.97	–11.10
.40	.93	–23.59	2.39	151.04	.07	72.26	.95	–14.56
.50	.90	–29.61	2.38	144.91	.09	68.73	.93	–17.91
.60	.87	–35.62	2.37	139.49	.10	64.78	.90	–21.19
.70	.84	–41.49	2.34	133.87	.11	61.52	.87	–23.71
.80	.81	–47.40	2.32	128.66	.12	58.06	.85	–26.91
.90	.77	–53.49	2.32	123.12	.13	55.30	.82	–29.05
1.00	.73	–59.00	2.26	118.06	.14	52.86	.78	–31.52
1.10	.69	–65.20	2.25	113.30	.15	50.42	.76	–33.73
1.20	.65	–71.05	2.21	108.31	.16	48.61	.73	–35.51
1.30	.62	–77.22	2.17	103.81	.16	46.62	.70	–37.59
1.40	.58	–83.22	2.15	99.18	.17	45.21	.68	–39.34
1.50	.54	–89.53	2.13	94.49	.17	43.82	.66	–41.12
1.60	.51	–95.27	2.07	90.14	.18	42.57	.63	–42.89
1.70	.47	–101.29	2.02	86.01	.18	41.68	.61	–44.56
1.80	.45	–107.59	1.99	82.00	.18	40.66	.59	–46.38
1.90	.42	–114.02	1.95	78.38	.19	40.08	.57	–47.99
2.00	.40	–120.45	1.90	74.87	.19	39.57	.55	–49.87
2.10	.38	–127.04	1.87	70.82	.19	39.19	.53	–51.49
2.20	.36	–133.41	1.83	67.34	.20	38.84	.51	–53.44
2.30	.35	–139.83	1.78	63.84	.20	38.49	.50	–55.39
2.40	.34	–146.46	1.74	60.75	.20	38.49	.48	–57.67
2.50	.33	–153.17	1.71	57.60	.21	38.43	.46	–59.91
2.60	.32	–159.96	1.68	54.38	.21	38.28	.45	–62.31
2.70	.32	–166.01	1.64	51.35	.22	38.20	.43	–64.97
2.80	.32	–172.06	1.61	48.28	.22	38.44	.41	–67.87
2.90	.32	–177.98	1.58	45.54	.23	38.28	.40	–70.94
3.00	.33	177.01	1.54	42.57	.23	38.11	.38	–74.21

V_{CE} = 3 V, I_C = 3 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.93	–9.39	6.76	166.53	.02	82.60	.98	–7.24
.20	.90	–18.39	6.46	155.80	.03	76.86	.94	–13.64
.30	.84	–27.39	6.32	146.52	.05	71.65	.89	–18.91
.40	.79	–35.83	6.06	138.21	.06	67.47	.83	–23.49
.50	.72	–44.06	5.82	130.60	.07	64.58	.77	–26.46
.60	.66	–51.67	5.54	123.94	.08	61.95	.72	–29.65
.70	.59	–58.86	5.28	117.07	.09	60.46	.68	–31.43
.80	.53	–65.57	5.01	111.07	.10	59.12	.64	–33.17
.90	.48	–71.57	4.72	105.46	.10	57.98	.60	–34.36
1.00	.43	–77.20	4.45	100.46	.11	57.39	.57	–35.31
1.10	.38	–82.70	4.20	95.95	.12	56.96	.55	–36.47
1.20	.34	–87.82	3.95	91.74	.13	56.54	.52	–37.08
1.30	.31	–93.49	3.74	87.96	.13	56.14	.50	–37.96
1.40	.28	–98.65	3.55	84.35	.14	55.72	.48	–38.83
1.50	.26	–104.50	3.37	80.85	.15	55.21	.46	–39.70
1.60	.24	–110.31	3.21	77.72	.15	54.91	.44	–40.63
1.70	.22	–116.75	3.06	74.57	.16	54.46	.43	–41.65
1.80	.21	–123.46	2.94	71.63	.17	53.91	.41	–42.70
1.90	.20	–130.51	2.81	68.84	.18	53.57	.39	–43.76
2.00	.19	–137.84	2.71	66.02	.18	53.01	.38	–44.95
2.10	.18	–145.47	2.61	63.33	.19	52.38	.36	–46.23
2.20	.18	–152.73	2.52	60.80	.20	51.91	.35	–47.64
2.30	.18	–160.13	2.44	58.00	.21	51.17	.33	–49.19
2.40	.18	–167.47	2.36	55.57	.22	50.80	.32	–50.82
2.50	.19	–174.18	2.29	53.07	.22	49.89	.30	–52.82
2.60	.20	179.79	2.23	50.72	.23	49.17	.28	–54.67
2.70	.20	173.96	2.16	48.10	.24	48.35	.27	–56.94
2.80	.21	168.73	2.10	45.81	.25	47.49	.25	–59.46
2.90	.22	163.65	2.05	43.41	.26	46.43	.24	–62.59
3.00	.24	159.82	1.99	41.14	.26	45.56	.22	–65.40

S-PARAMETERS Q2

V_{CE} = 3 V, I_C = 5 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.89	–12.31	10.46	162.72	.02	81.62	.96	–9.77
.20	.83	–23.63	9.75	149.86	.03	74.55	.90	–17.75
.30	.75	–34.70	9.25	138.82	.04	69.69	.81	–23.24
.40	.66	–44.55	8.62	129.30	.06	66.77	.74	–27.15
.50	.57	–53.23	7.96	120.72	.06	64.98	.68	–29.45
.60	.50	–60.42	7.27	113.73	.07	63.78	.62	–31.18
.70	.43	–66.51	6.64	107.23	.08	63.28	.58	–32.03
.80	.37	–71.94	6.08	101.84	.09	62.73	.55	–32.89
.90	.33	–76.60	5.57	97.19	.10	62.37	.52	–33.36
1.00	.29	–81.19	5.15	92.96	.10	62.23	.49	–33.76
1.10	.26	–85.79	4.77	89.24	.11	61.85	.47	–34.33
1.20	.23	–90.41	4.45	85.71	.12	61.60	.45	–34.67
1.30	.21	–95.79	4.17	82.52	.13	61.06	.43	–35.08
1.40	.19	–100.84	3.91	79.44	.14	60.78	.42	–35.79
1.50	.17	–106.89	3.70	76.63	.14	60.08	.40	–36.32
1.60	.16	–113.52	3.50	73.79	.15	59.69	.39	–37.17
1.70	.15	–120.69	3.33	71.22	.16	58.93	.37	–38.02
1.80	.14	–128.54	3.18	68.57	.17	58.47	.36	–38.84
1.90	.13	–136.73	3.04	66.08	.18	57.63	.34	–40.00
2.00	.13	–145.48	2.92	63.46	.19	57.05	.33	–40.74
2.10	.13	–153.95	2.81	61.14	.20	56.13	.32	–42.01
2.20	.13	–161.96	2.71	58.79	.20	55.20	.30	–43.19
2.30	.14	–169.65	2.61	56.38	.21	54.17	.29	–44.77
2.40	.15	–177.12	2.53	53.98	.22	53.43	.27	–46.33
2.50	.15	176.33	2.45	51.77	.23	52.54	.26	–48.08
2.60	.17	170.73	2.37	49.49	.24	51.49	.24	–49.77
2.70	.18	165.64	2.31	47.17	.25	50.53	.22	–51.64
2.80	.19	160.85	2.24	45.04	.26	49.38	.21	–54.34
2.90	.20	156.69	2.18	42.82	.27	48.22	.19	–56.82
3.00	.22	153.43	2.12	40.65	.27	47.15	.17	–59.19

V_{CE} = 3 V, I_C = 10 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.79	–18.18	17.81	156.05	.02	79.00	.92	–14.07
.20	.67	–33.75	15.65	139.27	.03	72.98	.80	–22.91
.30	.55	–46.32	13.67	125.80	.04	69.74	.69	–27.06
.40	.44	–55.16	11.71	115.64	.05	69.07	.61	–28.96
.50	.37	–61.11	10.03	108.02	.06	68.93	.56	–29.47
.60	.31	–65.90	8.70	102.30	.07	68.67	.52	–29.62
.70	.26	–69.64	7.66	97.45	.07	68.49	.49	–29.55
.80	.23	–73.22	6.84	93.31	.08	68.26	.46	–29.57
.90	.20	–76.64	6.18	89.63	.09	68.18	.44	–29.61
1.00	.18	–80.09	5.63	86.38	.10	67.74	.43	–29.60
1.10	.15	–84.01	5.17	83.43	.11	67.32	.41	–29.87
1.20	.14	–88.42	4.80	80.51	.12	66.68	.40	–29.99
1.30	.12	–94.33	4.47	77.83	.13	65.96	.38	–30.36
1.40	.11	–100.18	4.18	75.30	.14	65.40	.37	–30.99
1.50	.10	–107.91	3.94	72.79	.15	64.56	.36	–31.58
1.60	.09	–116.38	3.72	70.38	.15	63.80	.34	–32.25
1.70	.08	–126.27	3.53	68.12	.16	62.66	.33	–33.11
1.80	.08	–137.48	3.36	65.70	.17	62.05	.32	–33.82
1.90	.08	–148.12	3.21	63.57	.18	60.90	.31	–34.82
2.00	.09	–158.61	3.08	61.31	.19	59.98	.29	–35.72
2.10	.09	–168.26	2.96	59.03	.20	58.90	.28	–36.80
2.20	.10	–176.89	2.85	56.80	.21	57.81	.26	–37.90
2.30	.11	176.30	2.74	54.71	.22	56.71	.25	–39.12
2.40	.12	170.07	2.66	52.56	.23	55.52	.24	–40.48
2.50	.13	164.55	2.57	50.55	.24	54.48	.22	–42.08
2.60	.14	160.22	2.49	48.36	.25	53.37	.21	–43.45
2.70	.16	156.24	2.41	46.36	.26	52.12	.19	–44.76
2.80	.17	152.57	2.34	44.39	.27	50.92	.17	–46.97
2.90	.19	149.35	2.29	42.02	.27	49.67	.16	–49.05
3.00	.20	146.66	2.21	40.11	.28	48.32	.14	–51.14

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