

NPN SILICON RF TRANSISTOR 2SC5508

NPN SILICON RF TRANSISTOR FOR LOW NOISE, HIGH-GAIN AMPLIFICATION FLAT-LEAD 4-PIN THIN SUPER MINI-MOLD

FEATURES

- Ideal for low-noise, high-gain amplification applications
- $NF = 1.1 \text{ dB}$, $G_a = 16 \text{ dB TYP.}$ @ $f = 2 \text{ GHz}$, $V_{CE} = 2 \text{ V}$, $I_C = 5 \text{ mA}$
- Maximum available power gain: $MAG = 19 \text{ dB TYP.}$ @ $f = 2 \text{ GHz}$, $V_{CE} = 2 \text{ V}$, $I_C = 20 \text{ mA}$
- $f_T = 25 \text{ GHz}$ technology
- Flat-lead 4-pin thin super mini-mold ($t = 0.59 \text{ mm}$)

ORDERING INFORMATION

Part Number	Quantity	Packaging Style
2SC5508	Loose product (50 pcs)	• 8 mm wide emboss taping • 1 pin (emitter), 2 pin (collector) feed hole direction
2SC5508-T2	Taping product (3 kpcs/reel)	

Remark To order evaluation samples, consult your NEC sales representative (available in 50-pcs units).

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	V_{CBO}	15	V
Collector to Emitter Voltage	V_{CEO}	3.3	V
Emitter to Base Voltage	V_{EBO}	1.5	V
Collector Current	I_C	35	mA
Total Power Dissipation	P_{Tot}^{Note}	115	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-65 to +150	°C

Note $T_A = +25 \text{ °C}$ (free air)

THERMAL RESISTANCE

Item	Symbol	Value	Unit
Junction to Case Resistance	$R_{th j-c}$	150	°C/W
Junction to Ambient Resistance	$R_{th j-a}$	650	°C/W

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

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

ELECTRICAL CHARACTERISTICS (T_A = +25 °C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Collector Cut-off Current	I _{CBO}	V _{CB} = 5 V, I _E = 0	—	—	200	nA
Emitter Cut-off Current	I _{EBO}	V _{EB} = 1 V, I _C = 0	—	—	200	nA
DC Current Gain	h _{FE} ^{Note 1}	V _{CE} = 2 V, I _C = 5 mA	50	70	100	—
RF Characteristics						
Reverse Transfer Capacitance	C _{re} ^{Note 2}	V _{CB} = 2 V, I _E = 0, f = 1 MHz	—	0.18	0.24	pF
Gain Bandwidth Product	f _T	V _{CE} = 3 V, I _C = 30 mA, f = 2 GHz	20	25	—	GHz
Noise Figure	NF	V _{CE} = 2 V, I _C = 5 mA, f = 2 GHz, Z _S = Z _{opt}	—	1.1	1.5	dB
Insertion Power Gain	S _{21e} ²	V _{CE} = 2 V, I _C = 20 mA, f = 2 GHz	14	17	—	dB
Maximum Available Power Gain	MAG ^{Note 3}	V _{CE} = 2 V, I _C = 20 mA, f = 2 GHz	—	19	—	—
Maximum Stable Power Gain	MSG ^{Note 4}	V _{CE} = 2 V, I _C = 20 mA, f = 2 GHz	—	20	—	dB
Output Power at 1 dB Compression Point	P ₋₁	V _{CE} = 2 V, I _C = 20 mA ^{Note 5} , f = 2 GHz	—	11	—	dBm
Output Power at Third Order Intercept Point	OIP ₃	V _{CE} = 2 V, I _C = 20 mA ^{Note 5} , f = 2 GHz	—	22	—	—

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

2. Emitter to base capacitance measured using capacitance meter (self-balancing bridge method) when the emitter is connected to the guard pin

$$3. \text{ MAG} = \left| \frac{S_{21}}{S_{12}} \right| \left(k - \sqrt{k^2 - 1} \right)$$

$$4. \text{ MSG} = \left| \frac{S_{21}}{S_{12}} \right|$$

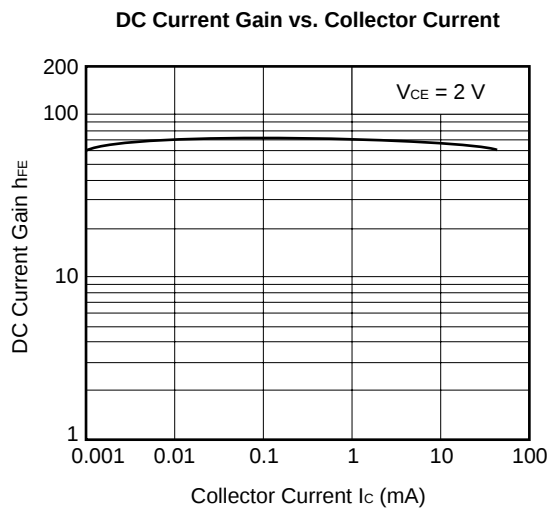
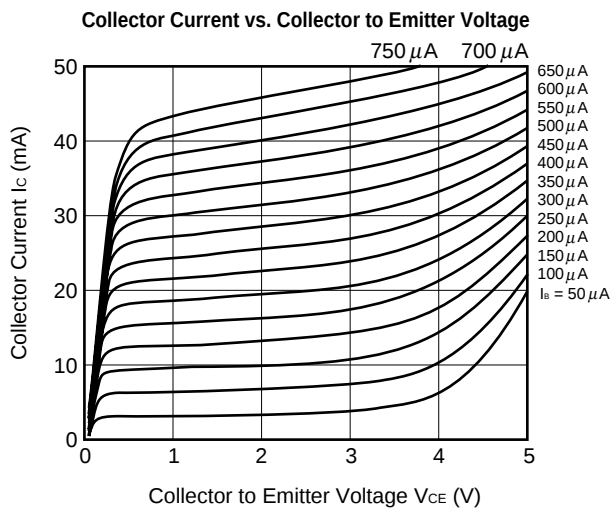
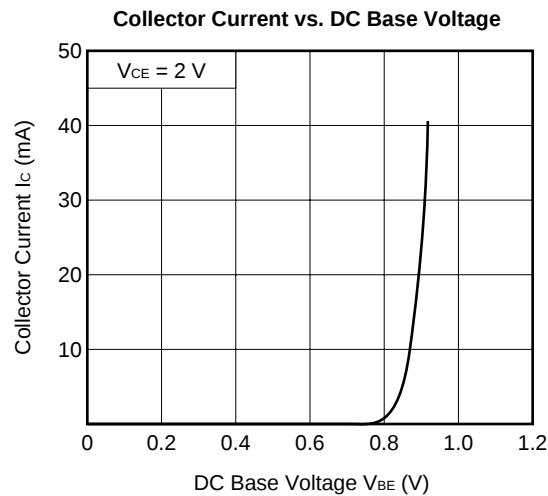
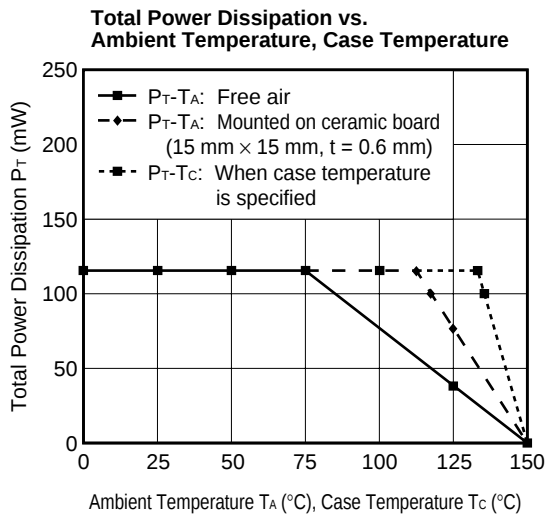
5. Collector current when P₋₁ is output

h_{FE} CLASSIFICATION

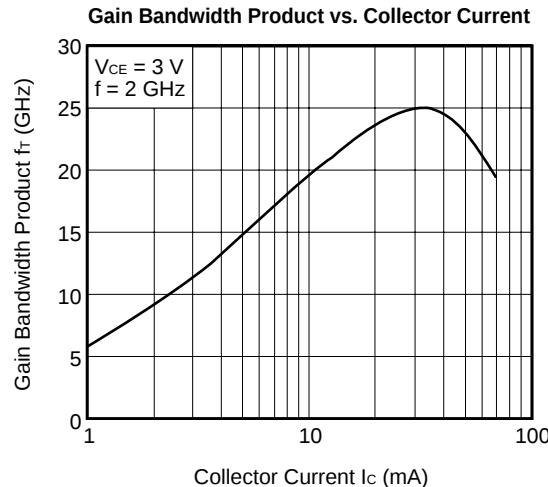
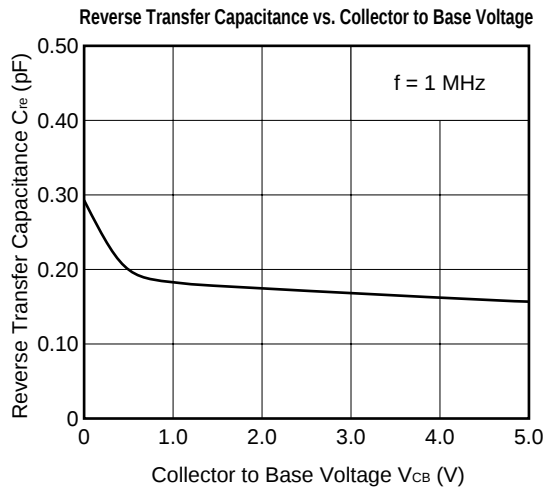
Rank	FB
Marking	T79
h _{FE}	50 to 100

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

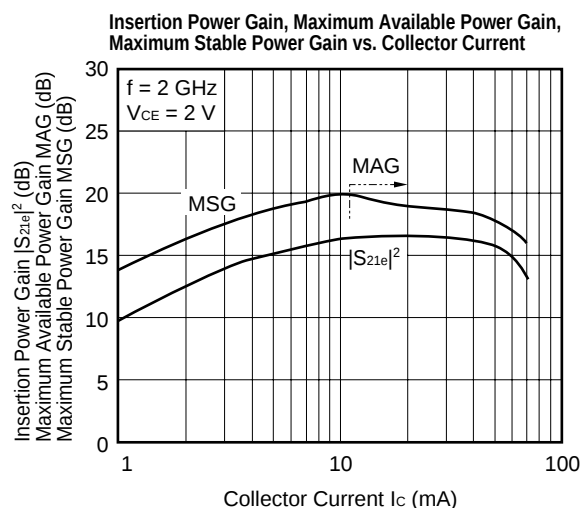
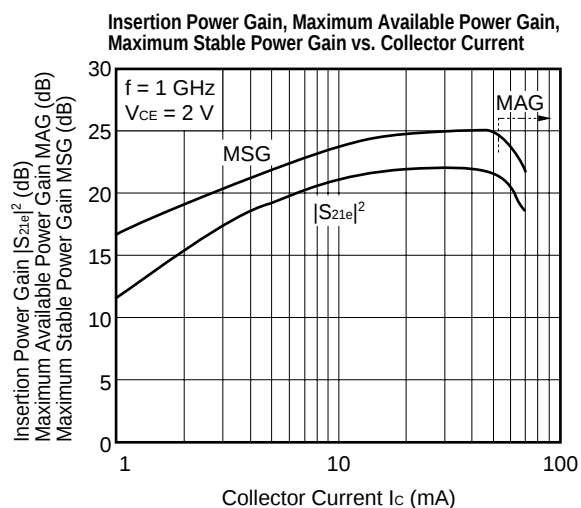
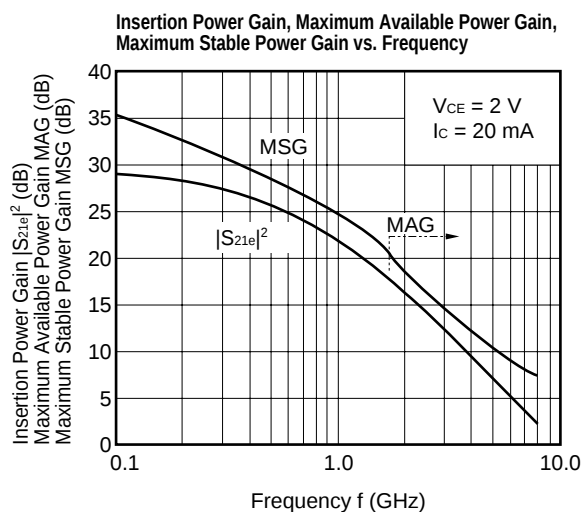
Thermal/DC Characteristics



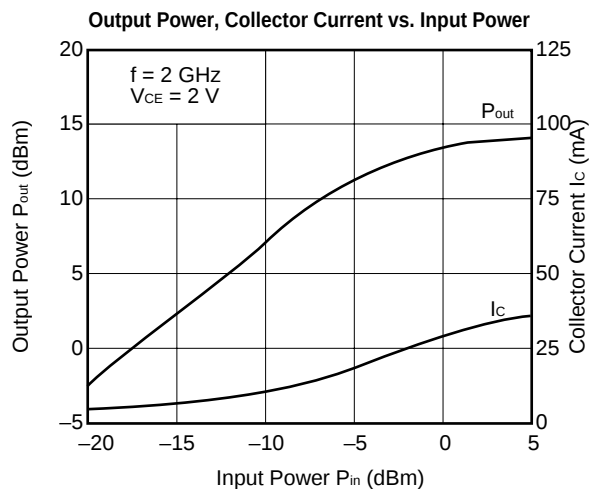
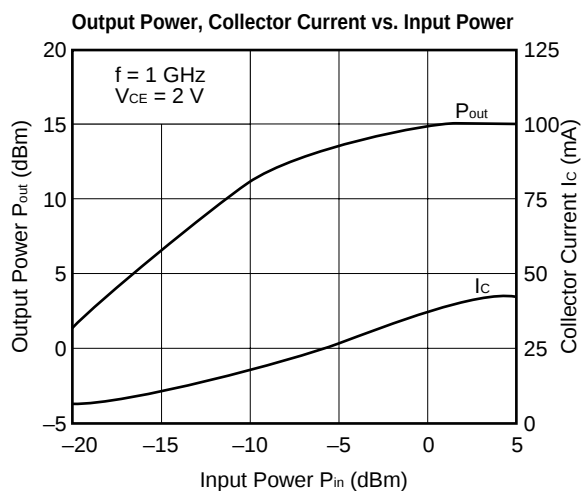
Capacitance/ f_T Characteristics



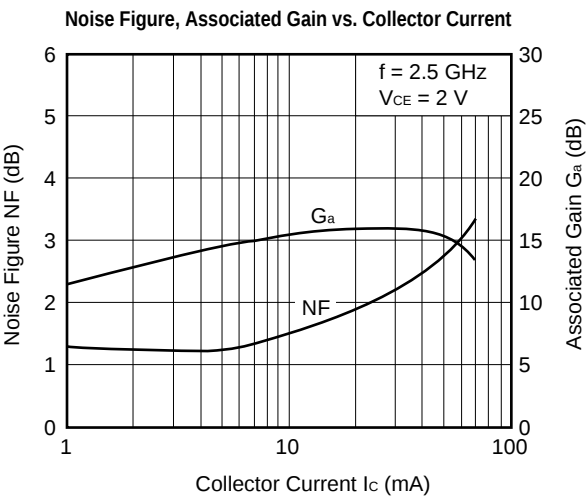
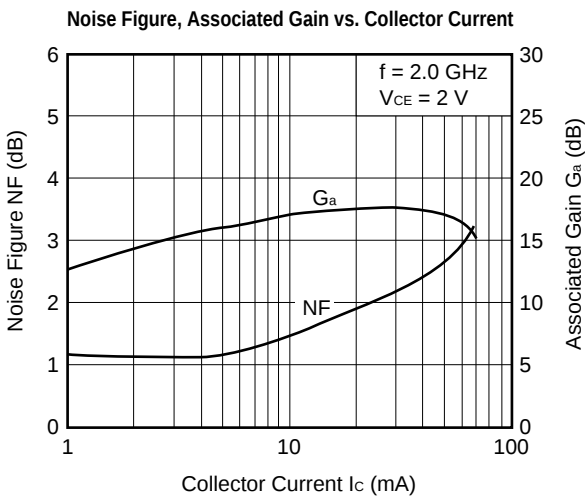
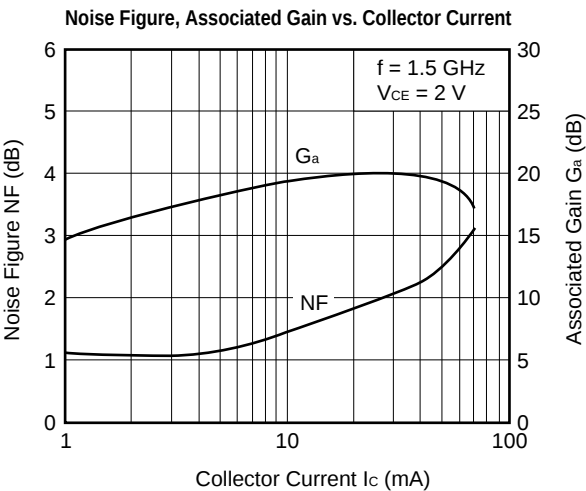
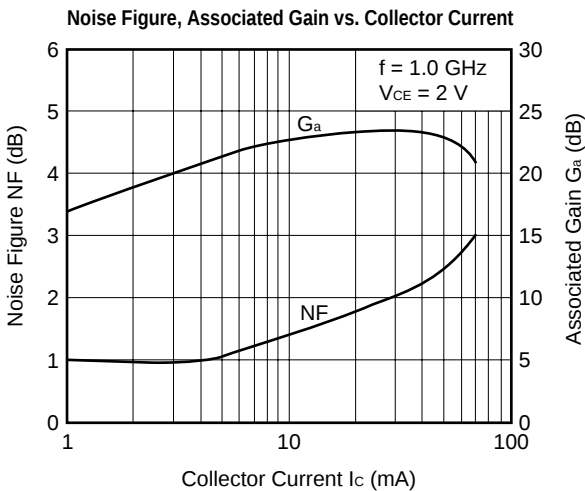
Gain Characteristics



Output Characteristics



Noise Characteristics



S PARAMETER

 $V_{CE} = 2\text{ V}$, $I_C = 3\text{ mA}$

Frequency GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.82	-9.0	10.69	170.8	0.01	82.1	0.98	-6.1
0.2	0.81	-17.5	10.04	163.4	0.02	76.0	0.95	-11.6
0.3	0.80	-25.8	9.59	156.9	0.03	71.8	0.91	-16.1
0.4	0.78	-33.6	9.10	150.9	0.04	67.5	0.88	-20.2
0.5	0.76	-41.4	8.74	145.4	0.04	63.8	0.85	-23.8
0.6	0.74	-49.0	8.34	140.3	0.05	60.1	0.81	-27.2
0.7	0.72	-56.8	8.03	135.3	0.05	56.5	0.78	-30.5
0.8	0.70	-64.1	7.69	130.8	0.06	53.7	0.75	-33.5
0.9	0.68	-71.4	7.41	126.0	0.07	50.3	0.72	-36.5
1.0	0.66	-78.6	7.09	121.6	0.07	47.1	0.69	-39.3
1.1	0.64	-86.1	6.85	117.2	0.07	44.7	0.66	-41.9
1.2	0.63	-93.2	6.58	113.1	0.08	42.2	0.63	-44.4
1.3	0.61	-100.5	6.33	108.8	0.08	39.4	0.60	-46.8
1.4	0.60	-107.4	6.07	105.1	0.08	37.3	0.58	-49.0
1.5	0.58	-114.6	5.85	101.1	0.08	35.3	0.55	-51.1
1.6	0.57	-121.5	5.63	97.3	0.09	33.3	0.53	-53.3
1.7	0.56	-128.1	5.43	93.6	0.09	31.4	0.50	-55.3
1.8	0.55	-134.4	5.20	90.1	0.09	29.7	0.48	-57.1
1.9	0.55	-141.0	5.02	86.6	0.09	28.6	0.46	-59.0
2.0	0.54	-147.2	4.84	83.4	0.09	27.0	0.44	-60.9
2.1	0.54	-153.0	4.64	80.1	0.09	25.5	0.42	-62.8
2.2	0.54	-158.7	4.48	76.9	0.09	24.1	0.40	-64.3
2.3	0.54	-164.3	4.32	73.8	0.09	23.1	0.39	-66.3
2.4	0.54	-169.3	4.16	70.9	0.09	21.9	0.37	-68.1
2.5	0.54	-174.3	4.01	68.1	0.10	21.2	0.35	-70.0
2.6	0.55	-179.2	3.87	65.1	0.09	20.6	0.34	-71.9
2.7	0.55	176.3	3.74	62.3	0.09	19.6	0.33	-73.8
2.8	0.55	171.9	3.61	59.5	0.10	19.2	0.31	-75.7
2.9	0.56	167.9	3.48	57.0	0.10	18.6	0.30	-77.8
3.0	0.57	164.1	3.38	54.5	0.10	17.9	0.29	-80.1
4.0	0.66	142.0	2.45	38.2	0.10	12.8	0.20	-106.9
5.0	0.72	124.8	1.90	20.7	0.10	13.4	0.19	-140.5
6.0	0.77	112.4	1.53	5.3	0.10	13.2	0.22	-171.1
7.0	0.80	101.6	1.26	-9.4	0.11	11.8	0.29	167.7
8.0	0.84	93.5	1.04	-22.2	0.12	9.7	0.37	152.4

$V_{CE} = 2\text{ V}$, $I_C = 5\text{ mA}$

Frequency GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.75	-11.1	14.43	169.5	0.01	82.3	0.97	-7.6
0.2	0.74	-21.5	13.69	160.9	0.02	75.0	0.93	-14.2
0.3	0.72	-31.7	12.98	153.5	0.03	69.7	0.89	-19.8
0.4	0.69	-41.3	12.27	146.7	0.03	64.7	0.84	-24.6
0.5	0.67	-50.6	11.67	140.5	0.04	61.2	0.80	-28.9
0.6	0.64	-59.6	11.06	134.8	0.04	57.2	0.76	-32.9
0.7	0.62	-68.5	10.51	129.5	0.05	53.9	0.72	-36.4
0.8	0.60	-77.1	9.98	124.5	0.05	51.7	0.68	-39.5
0.9	0.58	-85.4	9.49	119.5	0.06	48.6	0.64	-42.7
1.0	0.56	-93.6	9.00	114.9	0.06	45.8	0.61	-45.5
1.1	0.54	-101.6	8.58	110.4	0.06	43.9	0.57	-48.0
1.2	0.53	-109.2	8.17	106.2	0.07	42.3	0.54	-50.3
1.3	0.51	-116.7	7.77	102.1	0.07	40.2	0.51	-52.6
1.4	0.50	-124.2	7.40	98.3	0.07	38.6	0.48	-54.9
1.5	0.49	-131.5	7.07	94.5	0.07	37.2	0.46	-56.8
1.6	0.48	-138.3	6.74	91.0	0.07	36.1	0.43	-58.8
1.7	0.48	-144.8	6.45	87.7	0.08	35.3	0.41	-60.8
1.8	0.48	-151.1	6.16	84.2	0.08	33.8	0.39	-62.4
1.9	0.47	-157.2	5.90	81.1	0.08	33.1	0.37	-64.4
2.0	0.48	-163.1	5.65	78.1	0.08	32.5	0.35	-66.2
2.1	0.48	-168.7	5.41	75.0	0.08	31.3	0.34	-68.0
2.2	0.48	-174.0	5.20	72.2	0.08	30.6	0.32	-69.7
2.3	0.48	-179.0	4.99	69.4	0.08	29.6	0.30	-71.6
2.4	0.49	176.2	4.78	66.7	0.08	29.8	0.29	-73.8
2.5	0.50	171.9	4.60	64.2	0.08	28.6	0.27	-75.9
2.6	0.50	167.6	4.42	61.5	0.09	28.3	0.26	-77.6
2.7	0.51	163.8	4.27	59.0	0.09	27.9	0.25	-80.3
2.8	0.52	159.9	4.11	56.5	0.09	27.3	0.24	-82.9
2.9	0.53	156.5	3.97	54.1	0.09	27.4	0.22	-85.1
3.0	0.54	153.2	3.85	51.8	0.09	26.7	0.21	-87.8
4.0	0.64	136.4	2.74	37.4	0.09	22.6	0.14	-127.0
5.0	0.70	121.3	2.13	21.1	0.10	21.2	0.16	-164.7
6.0	0.75	110.6	1.72	6.5	0.11	18.9	0.21	168.2
7.0	0.79	99.7	1.42	-7.7	0.12	15.1	0.28	152.1
8.0	0.82	92.7	1.19	-19.8	0.13	11.4	0.36	140.0

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

Frequency GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.63	-15.1	20.76	167.3	0.01	80.6	0.95	-10.0
0.2	0.61	-29.6	19.66	156.9	0.02	72.0	0.90	-18.5
0.3	0.58	-43.0	18.37	148.0	0.02	66.8	0.83	-25.6
0.4	0.55	-55.6	17.15	140.0	0.03	62.9	0.77	-31.5
0.5	0.52	-67.5	15.96	132.9	0.03	58.7	0.71	-36.1
0.6	0.50	-78.7	14.82	126.5	0.04	56.0	0.66	-40.5
0.7	0.48	-89.4	13.79	120.7	0.04	53.3	0.61	-44.1
0.8	0.46	-99.6	12.85	115.4	0.04	51.8	0.56	-47.1
0.9	0.44	-108.8	11.98	110.5	0.05	49.6	0.52	-49.9
1.0	0.43	-118.0	11.20	105.9	0.05	48.0	0.48	-52.3
1.1	0.42	-126.5	10.49	101.6	0.05	47.4	0.45	-54.5
1.2	0.41	-134.4	9.84	97.8	0.05	46.7	0.42	-56.5
1.3	0.41	-142.0	9.24	94.1	0.06	45.4	0.39	-58.4
1.4	0.41	-149.1	8.70	90.6	0.06	45.0	0.37	-60.2
1.5	0.41	-155.7	8.23	87.3	0.06	44.9	0.35	-62.0
1.6	0.41	-161.9	7.80	84.1	0.06	43.8	0.33	-63.8
1.7	0.41	-167.7	7.40	81.1	0.06	43.4	0.31	-65.7
1.8	0.42	-173.1	7.03	78.1	0.07	42.8	0.29	-67.2
1.9	0.42	-178.0	6.69	75.5	0.07	42.5	0.27	-69.3
2.0	0.43	177.2	6.38	72.8	0.07	42.3	0.26	-71.0
2.1	0.44	172.7	6.09	70.2	0.07	41.1	0.24	-73.1
2.2	0.44	168.6	5.82	67.6	0.07	41.0	0.23	-75.0
2.3	0.45	164.7	5.59	65.2	0.08	40.3	0.21	-77.7
2.4	0.46	161.1	5.34	62.8	0.08	40.2	0.20	-79.8
2.5	0.47	157.8	5.12	60.5	0.08	38.9	0.19	-82.6
2.6	0.48	154.3	4.93	58.2	0.08	38.9	0.18	-85.3
2.7	0.48	151.3	4.75	55.9	0.08	39.1	0.17	-88.5
2.8	0.49	148.2	4.56	53.8	0.09	37.4	0.16	-92.0
2.9	0.50	145.5	4.40	51.6	0.09	37.4	0.15	-95.6
3.0	0.51	143.0	4.28	49.6	0.09	36.4	0.14	-99.6
4.0	0.63	130.0	3.01	36.5	0.10	31.7	0.12	-162.6
5.0	0.69	117.3	2.34	21.3	0.11	28.0	0.17	165.5
6.0	0.75	107.8	1.90	7.9	0.12	23.2	0.23	146.7
7.0	0.78	97.5	1.57	-5.5	0.13	17.2	0.30	135.7
8.0	0.82	91.1	1.32	-17.0	0.14	12.4	0.36	127.0

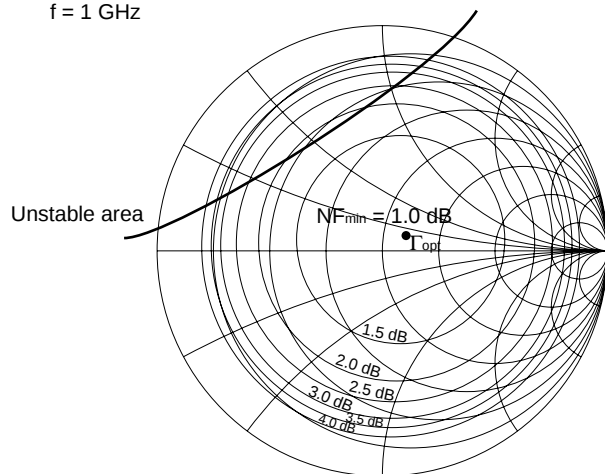
$V_{CE} = 2\text{ V}$, $I_C = 20\text{ mA}$

Frequency GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.48	-21.4	27.42	164.9	0.01	78.5	0.93	-12.3
0.2	0.46	-41.3	25.60	152.5	0.02	70.7	0.85	-22.8
0.3	0.43	-59.2	23.38	142.0	0.02	65.2	0.77	-31.0
0.4	0.41	-75.4	21.22	133.1	0.02	61.7	0.69	-37.2
0.5	0.39	-89.9	19.27	125.5	0.03	58.8	0.62	-42.0
0.6	0.38	-102.6	17.45	118.9	0.03	56.6	0.56	-46.2
0.7	0.37	-114.2	15.92	113.2	0.04	55.4	0.51	-49.5
0.8	0.36	-124.7	14.56	108.1	0.04	54.7	0.46	-52.0
0.9	0.36	-134.1	13.39	103.6	0.04	53.5	0.43	-54.3
1.0	0.36	-142.6	12.35	99.3	0.04	53.3	0.39	-56.4
1.1	0.36	-150.5	11.45	95.4	0.05	52.9	0.36	-58.1
1.2	0.36	-157.4	10.65	91.9	0.05	52.5	0.34	-60.0
1.3	0.37	-163.8	9.94	88.5	0.05	51.5	0.31	-61.6
1.4	0.37	-169.6	9.30	85.5	0.05	51.4	0.29	-63.3
1.5	0.38	-175.2	8.76	82.4	0.05	51.0	0.27	-64.8
1.6	0.39	179.9	8.26	79.5	0.06	50.8	0.25	-66.6
1.7	0.40	175.3	7.81	77.0	0.06	50.2	0.24	-68.4
1.8	0.40	171.1	7.39	74.3	0.06	49.8	0.22	-70.3
1.9	0.41	167.1	7.02	71.8	0.06	49.7	0.21	-72.4
2.0	0.42	163.4	6.68	69.2	0.07	49.4	0.19	-74.6
2.1	0.43	159.9	6.35	67.0	0.07	48.5	0.18	-77.1
2.2	0.44	156.6	6.08	64.7	0.07	48.1	0.17	-79.3
2.3	0.45	153.4	5.81	62.4	0.07	46.5	0.16	-82.6
2.4	0.46	150.6	5.56	60.2	0.08	46.2	0.15	-85.9
2.5	0.47	147.9	5.35	58.0	0.08	45.3	0.14	-89.5
2.6	0.47	145.2	5.12	56.0	0.08	45.4	0.13	-93.5
2.7	0.48	142.8	4.93	53.8	0.08	44.7	0.12	-97.7
2.8	0.49	140.2	4.72	51.7	0.09	43.5	0.11	-103.0
2.9	0.50	138.0	4.58	49.9	0.09	43.4	0.11	-108.0
3.0	0.51	136.0	4.43	47.8	0.09	42.2	0.10	-113.9
4.0	0.64	125.8	3.08	35.5	0.10	36.2	0.13	172.2
5.0	0.70	114.7	2.39	21.1	0.12	30.9	0.19	149.5
6.0	0.75	105.8	1.94	8.2	0.13	24.6	0.26	135.5
7.0	0.78	96.0	1.60	-4.5	0.14	18.4	0.32	126.7
8.0	0.82	89.8	1.36	-15.6	0.14	13.0	0.38	119.4
9.0	0.83	83.4	1.17	-26.8	0.15	6.5	0.43	114.0
10.0	0.86	78.9	1.00	-35.9	0.15	1.6	0.48	109.5

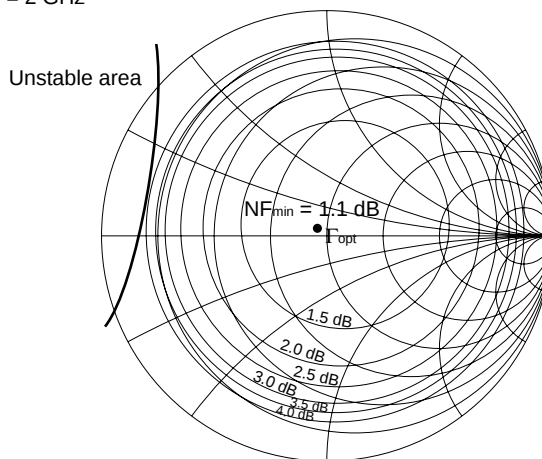
NOISE PARAMETER

<Equal NF circle>

$V_{CE} = 2\text{ V}$
 $I_C = 5\text{ mA}$
 $f = 1\text{ GHz}$



$V_{CE} = 2\text{ V}$
 $I_C = 5\text{ mA}$
 $f = 2\text{ GHz}$



$V_{CE} = 2\text{ V}$, $I_C = 3\text{ mA}$

f (GHz)	NF _{min} (dB)	G _a (dB)	Γ _{opt}		Rn/50
			MAG.	ANG.	
0.8	0.78	21.4	0.26	31.7	0.17
0.9	0.80	20.7	0.26	32.7	0.17
1.0	0.82	20.0	0.26	34.7	0.17
1.5	0.93	17.0	0.23	57.0	0.16
1.8	1.00	15.6	0.20	78.0	0.14
1.9	1.02	15.2	0.19	86.0	0.14
2.0	1.04	14.8	0.19	94.2	0.13
2.5	1.15	13.5	0.20	138.3	0.10

$V_{CE} = 2\text{ V}$, $I_C = 5\text{ mA}$

f (GHz)	NF _{min} (dB)	G _a (dB)	Γ _{opt}		Rn/50
			MAG.	ANG.	
0.8	0.93	22.5	0.12	28.1	0.15
0.9	0.94	21.8	0.12	28.8	0.15
1.0	0.96	21.1	0.12	31.7	0.15
1.5	1.03	18.1	0.09	71.1	0.14
1.8	1.07	16.7	0.08	106.2	0.13
1.9	1.09	16.3	0.08	118.5	0.13
2.0	1.10	15.9	0.08	130.5	0.12
2.5	1.17	14.3	0.14	-179.7	0.11

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

f (GHz)	NF _{min} (dB)	G _a (dB)	Γ _{opt}		Rn/50
			MAG.	ANG.	
0.8	1.28	23.7	0.07	−159.4	0.13
0.9	1.29	23.0	0.07	−157.5	0.13
1.0	1.30	22.3	0.08	−155.7	0.13
1.5	1.37	19.3	0.13	−149.2	0.13
1.8	1.41	17.8	0.16	−146.1	0.13
1.9	1.43	17.3	0.17	−145.0	0.13
2.0	1.44	16.9	0.19	−143.9	0.13
2.5	1.51	15.3	0.25	−136.7	0.13

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

f (GHz)	NF _{min} (dB)	G _a (dB)	Γ _{opt}		Rn/50
			MAG.	ANG.	
0.8	1.59	24.5	0.26	−158.1	0.12
0.9	1.61	23.7	0.26	−155.5	0.13
1.0	1.63	23.0	0.27	−153.1	0.13
1.5	1.72	19.9	0.30	−142.6	0.14
1.8	1.78	18.3	0.33	−137.3	0.15
1.9	1.79	17.9	0.34	−135.7	0.06
2.0	1.81	17.5	0.35	−134.1	0.16
2.5	1.90	15.8	0.40	−126.5	0.18

SOLDERING CONDITIONS

Solder this product under the following recommended conditions.

For soldering methods and conditions other than those recommended, consult NEC.

Soldering Method(s)	Soldering Conditions	Recommended Conditions Symbol
Infrared reflow	Package peak temperature: 235 °C, Time: 30 sec max. (210 °C min.), Number of times: twice max., Maximum number of days: None ^{Note}	IR35-00-2
VPS	Package peak temperature: 215 °C, Time: 40 sec max. (200 °C min.), Number of times: twice max., Maximum number of days: None ^{Note}	VP15-00-2
Wave soldering	Solder bath temperature: 260 °C, Time: 10 sec max., Number of times: once, Maximum number of days: None ^{Note}	WS60-00-1

Note Number of days in storage after the dry pack has been opened. The storage conditions are at 25 °C, 65% RH MAX.

Caution Do not use two or more soldering methods in combination.

For details of the recommended soldering conditions, refer to information document **Semiconductor Device Mounting Technology Manual (C10535E)**.

[MEMO]

[MEMO]

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Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.