

# NPN SILICON RF TRANSISTOR 2SC5507

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

#### FEATURES

- Low noise and high gain with low collector current
- $NF = 1.2 \text{ dB}$ ,  $G_a = 16 \text{ dB TYP.}$  @  $f = 2 \text{ GHz}$ ,  $V_{CE} = 2 \text{ V}$ ,  $I_c = 2 \text{ mA}$
- Maximum stable power gain:  $MSG = 22 \text{ dB TYP.}$  @  $f = 2 \text{ GHz}$ ,  $V_{CE} = 2 \text{ V}$ ,  $I_c = 5 \text{ mA}$
- $f_r = 25 \text{ GHz}$  technology
- Flat-lead 4-pin thin super mini-mold ( $t = 0.59 \text{ mm}$ )

#### ORDERING INFORMATION

Part Number	Quantity	Packaging Style
2SC5507	Loose product (50 pcs)	<ul style="list-style-type: none"> <li>• 8 mm wide emboss taping</li> <li>• 1 pin (emitter), 2 pin (collector) feed hole direction</li> </ul>
2SC5507-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	$I_c$	12	mA
Total Power Dissipation	$P_{tot}^{Note}$	39	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	$R_{th-j-c}$	240	°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<sub>A</sub> = +25 °C)**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC characteristics						
Collector Cut-off Current	I <sub>CB0</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0	–	–	100	nA
Emitter Cut-off Current	I <sub>EB0</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0	–	–	100	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA	50	70	100	–
RF Characteristics						
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 2 V, I <sub>E</sub> = 0, f = 1 MHz	–	0.08	0.12	pF
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 10 mA, f = 2 GHz	20	25	–	GHz
Noise Figure	NF	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 2 mA, f = 2 GHz, Z <sub>S</sub> = Z <sub>opt</sub>	–	1.2	1.5	dB
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA, f = 2 GHz	14	17	–	dB
Maximum Stable Power Gain	MSG <sup>Note 3</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA, f = 2 GHz	–	22	–	dB
Output Power at 1 dB Compression Point	P <sub>-1</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA <sup>Note 4</sup> , f = 2 GHz	–	5	–	dBm
Output Power at Third Order Intercept Point	OIP <sub>3</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA <sup>Note 4</sup> , f = 2 GHz	–	15	–	–

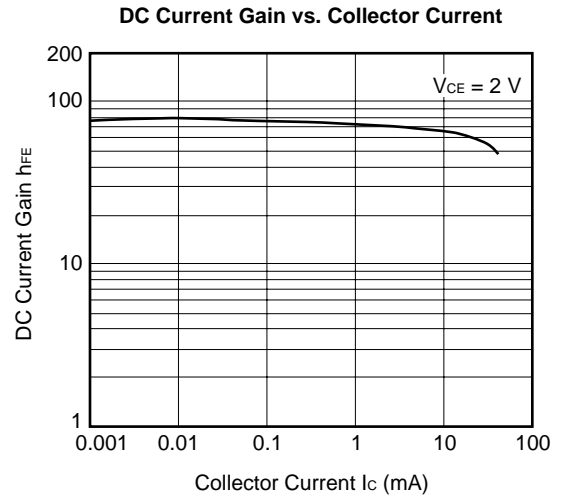
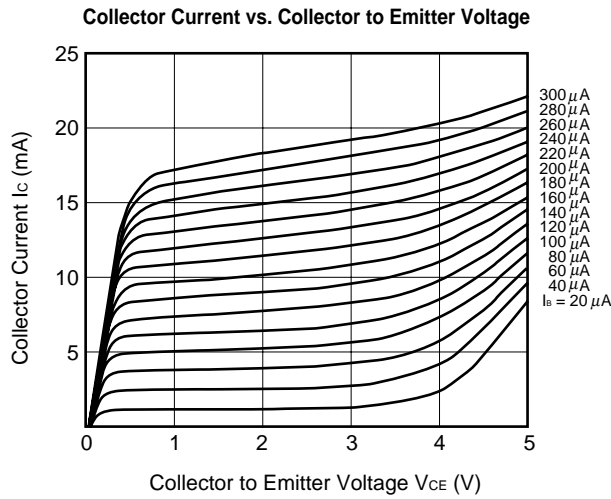
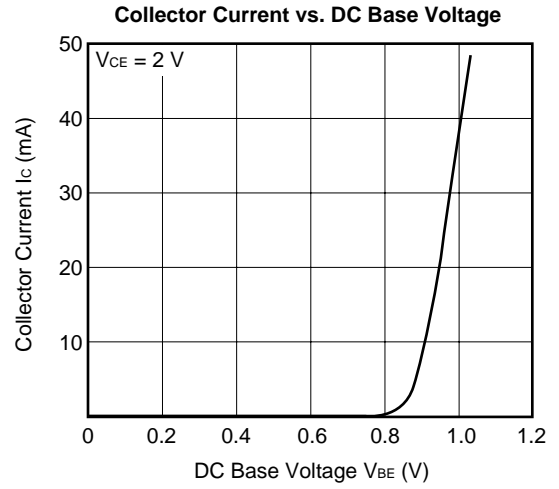
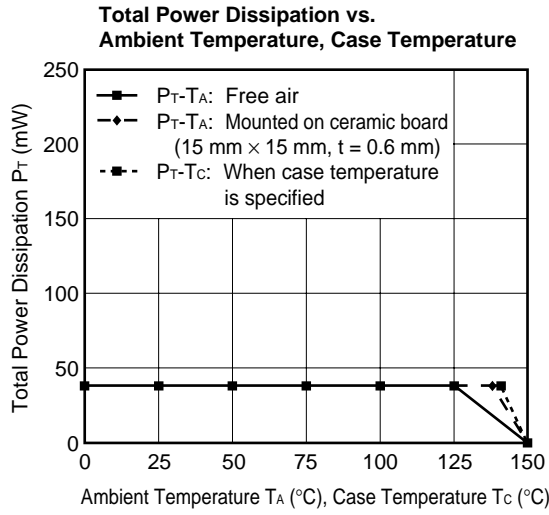
- Notes**
1. Pulse measurement PW ≤ 350 μs, Duty cycle ≤ 2%
  2. Emitter to base capacitance measured using capacitance meter (self-balancing bridge method) when the emitter is connected to the guard pin
  3.  $MSG = \left| \frac{S_{21}}{S_{12}} \right|$
  4. Collector current when P<sub>-1</sub> is output

**h<sub>FE</sub> CLASSIFICATION**

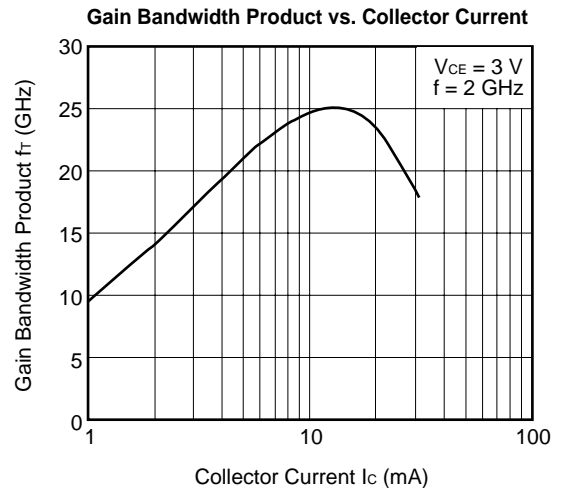
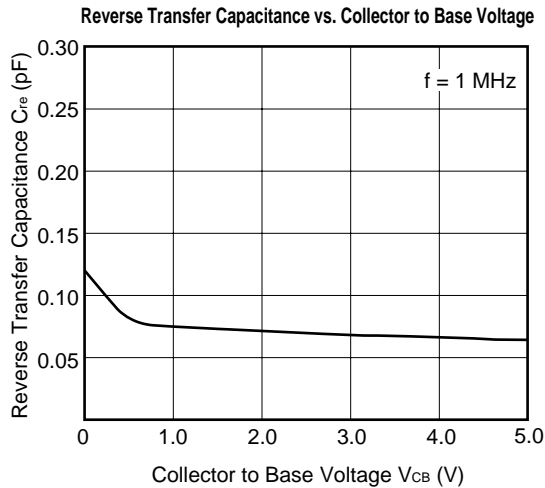
Rank	FB
Marking	T78
h <sub>FE</sub>	50 to 100

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

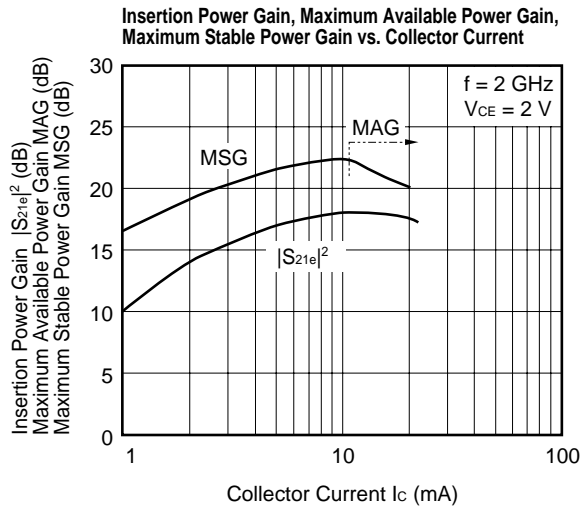
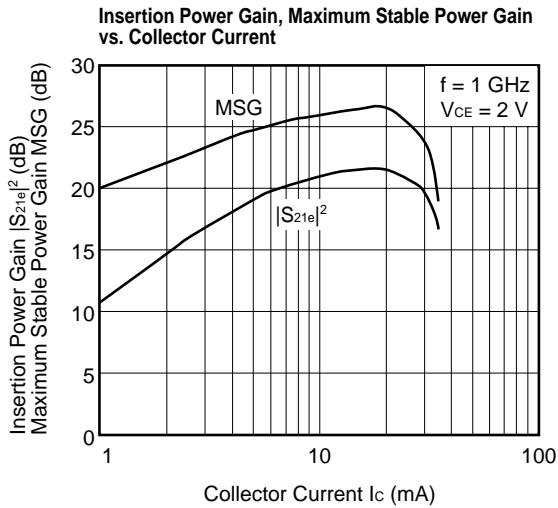
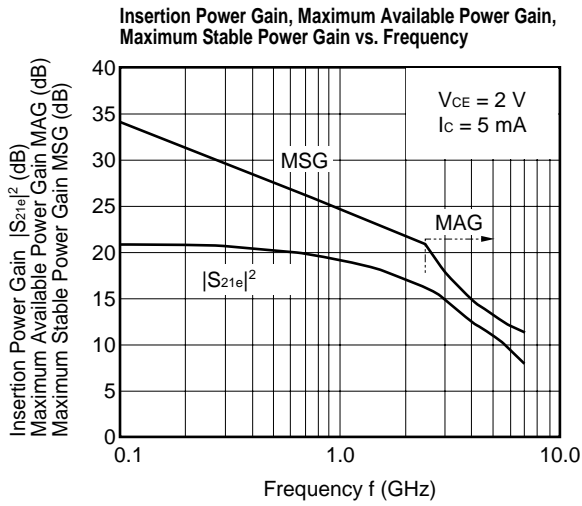
Thermal/DC Characteristics



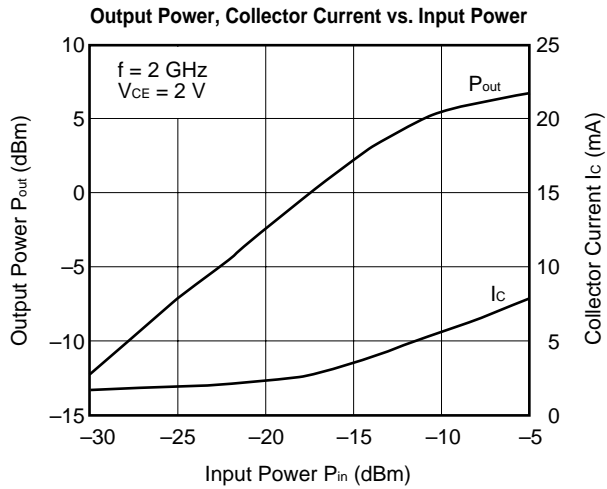
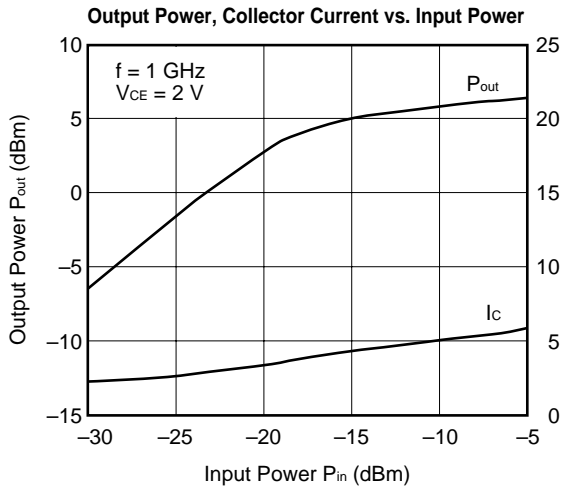
Capacitance/ $f_T$  Characteristics



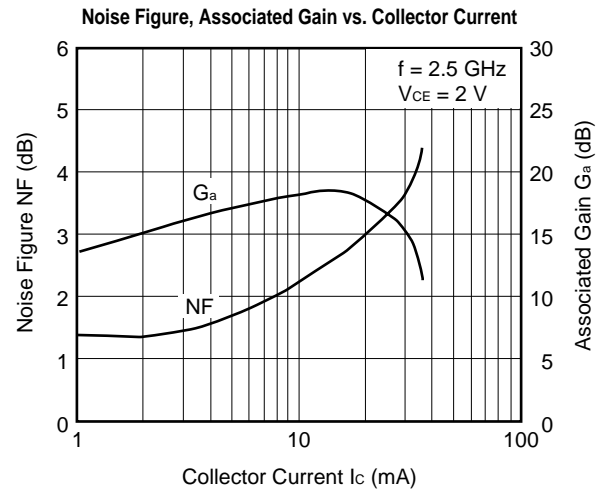
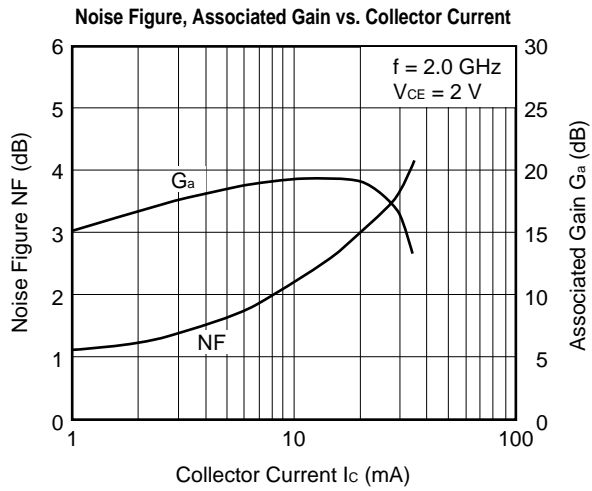
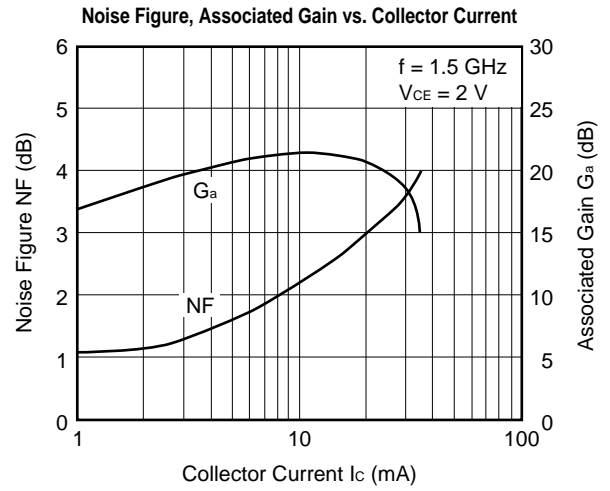
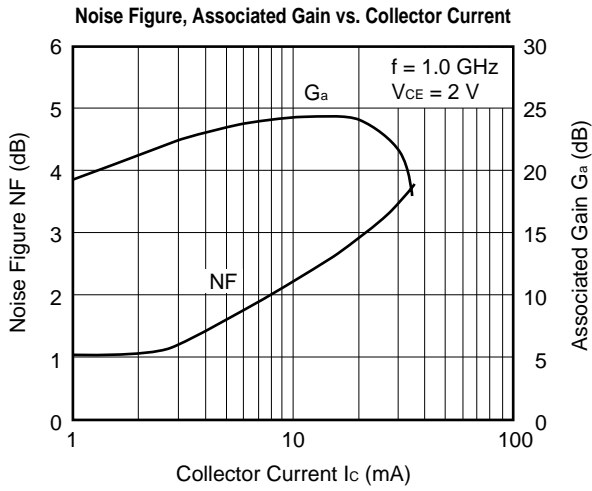
Gain Characteristics



Output Characteristics



Noise Characteristics



**S PARAMETER**

V<sub>CE</sub> = 2 V, I<sub>c</sub> = 2 mA

Frequency GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.90	-3.7	6.45	174.8	0.00	81.9	0.98	-3.6
0.2	0.89	-7.1	6.25	170.8	0.01	77.9	0.95	-6.0
0.3	0.89	-10.6	6.12	167.2	0.01	75.5	0.94	-7.9
0.4	0.88	-14.2	6.02	163.6	0.02	75.7	0.92	-9.5
0.5	0.87	-17.6	5.96	160.2	0.02	74.1	0.91	-11.0
0.6	0.87	-21.0	5.87	156.9	0.02	72.4	0.90	-12.7
0.7	0.86	-24.6	5.79	153.4	0.03	70.0	0.89	-14.3
0.8	0.84	-28.0	5.69	150.3	0.03	68.7	0.88	-15.6
0.9	0.83	-31.5	5.64	147.1	0.03	66.9	0.87	-17.3
1.0	0.82	-35.0	5.54	143.8	0.03	65.2	0.86	-18.9
1.1	0.80	-38.6	5.50	140.7	0.04	63.3	0.84	-20.3
1.2	0.79	-42.0	5.42	137.7	0.04	62.2	0.83	-21.8
1.3	0.77	-45.8	5.37	134.5	0.04	60.1	0.82	-23.3
1.4	0.76	-49.4	5.28	131.6	0.04	58.4	0.81	-24.9
1.5	0.74	-53.4	5.25	128.5	0.05	57.0	0.80	-26.4
1.6	0.72	-57.1	5.19	125.2	0.05	55.0	0.78	-27.8
1.7	0.70	-61.0	5.14	122.4	0.05	53.1	0.77	-29.3
1.8	0.68	-65.0	5.06	119.2	0.05	52.1	0.76	-30.7
1.9	0.66	-69.2	5.04	116.1	0.06	50.9	0.75	-32.2
2.0	0.64	-73.3	4.98	113.0	0.06	49.1	0.73	-33.6
2.1	0.62	-77.7	4.91	109.9	0.06	46.6	0.72	-35.1
2.2	0.60	-82.1	4.82	106.9	0.06	45.6	0.71	-36.3
2.3	0.58	-86.9	4.78	103.6	0.06	43.8	0.69	-37.8
2.4	0.56	-91.8	4.68	100.6	0.06	42.2	0.68	-39.2
2.5	0.55	-97.1	4.62	97.5	0.07	40.5	0.66	-40.5
2.6	0.52	-102.5	4.53	94.1	0.07	39.0	0.65	-41.9
2.7	0.50	-108.7	4.46	90.8	0.07	37.0	0.63	-43.0
2.8	0.47	-115.5	4.29	87.5	0.07	34.8	0.62	-44.1
2.9	0.42	-120.2	4.11	85.2	0.06	34.7	0.61	-44.0
3.0	0.40	-119.0	4.06	84.6	0.06	38.1	0.61	-45.4
4.0	0.47	-159.3	3.24	66.5	0.07	33.4	0.51	-55.3
5.0	0.49	163.9	2.74	45.5	0.07	33.5	0.44	-69.8
6.0	0.56	141.2	2.34	26.7	0.08	35.9	0.40	-88.9
7.0	0.63	123.9	2.00	9.3	0.09	37.0	0.38	-112.9
8.0	0.69	111.6	1.70	-6.5	0.11	35.9	0.39	-138.6
9.0	0.74	102.1	1.44	-21.4	0.12	31.3	0.44	-163.4
10.0	0.79	95.1	1.19	-34.9	0.13	25.3	0.52	175.7

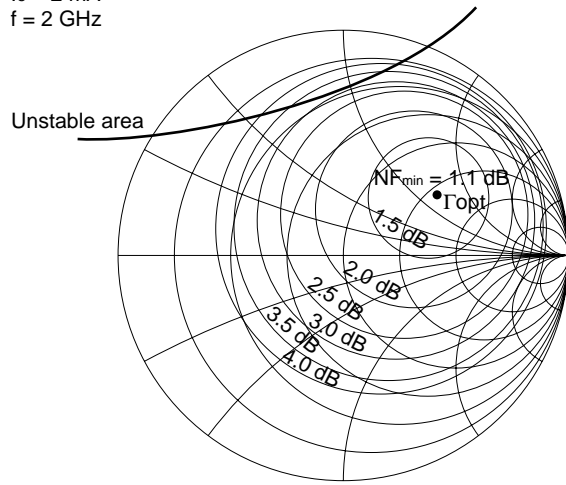
V<sub>CE</sub> = 2 V, I<sub>c</sub> = 5 mA

Frequency GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
0.1	0.82	-4.7	10.44	173.8	0.00	80.8	0.97	-4.1
0.2	0.82	-9.2	10.28	168.8	0.01	75.3	0.94	-7.1
0.3	0.80	-13.8	10.09	164.2	0.01	75.0	0.92	-9.4
0.4	0.79	-18.0	9.89	159.8	0.01	74.1	0.90	-11.5
0.5	0.78	-22.4	9.73	155.6	0.02	72.2	0.88	-13.4
0.6	0.76	-26.6	9.55	151.5	0.02	70.4	0.87	-15.4
0.7	0.74	-31.1	9.36	147.4	0.02	68.0	0.85	-17.3
0.8	0.72	-35.3	9.19	143.5	0.03	66.6	0.84	-18.9
0.9	0.70	-39.4	9.01	139.6	0.03	64.9	0.82	-20.8
1.0	0.68	-43.6	8.82	135.8	0.03	63.3	0.80	-22.4
1.1	0.66	-47.9	8.67	132.0	0.03	61.2	0.78	-23.9
1.2	0.63	-51.9	8.46	128.6	0.04	60.7	0.77	-25.5
1.3	0.61	-56.2	8.27	124.8	0.04	58.7	0.75	-26.9
1.4	0.58	-60.3	8.07	121.5	0.04	57.8	0.73	-28.4
1.5	0.56	-64.7	7.91	117.9	0.04	56.3	0.72	-29.7
1.6	0.53	-68.9	7.72	114.5	0.04	55.5	0.70	-31.0
1.7	0.51	-73.3	7.54	111.3	0.05	53.8	0.69	-32.3
1.8	0.49	-77.6	7.35	108.2	0.05	53.4	0.67	-33.6
1.9	0.46	-82.0	7.18	105.0	0.05	51.9	0.65	-34.9
2.0	0.44	-86.7	7.00	102.0	0.05	51.6	0.64	-36.1
2.1	0.42	-91.6	6.83	98.9	0.05	49.6	0.62	-37.2
2.2	0.40	-96.5	6.66	95.9	0.05	49.6	0.61	-38.2
2.3	0.38	-101.9	6.49	92.9	0.05	48.3	0.60	-39.5
2.4	0.36	-107.6	6.32	90.0	0.05	47.4	0.58	-40.5
2.5	0.35	-113.6	6.16	87.0	0.06	46.2	0.57	-41.7
2.6	0.33	-120.2	6.00	84.1	0.06	45.3	0.55	-42.7
2.7	0.32	-127.9	5.82	80.9	0.06	44.6	0.53	-43.4
2.8	0.30	-137.3	5.59	77.9	0.06	42.5	0.52	-43.8
2.9	0.25	-144.7	5.29	76.3	0.06	44.1	0.52	-43.2
3.0	0.23	-142.4	5.22	76.0	0.06	48.2	0.52	-44.8
4.0	0.31	175.3	4.23	62.3	0.06	46.8	0.44	-48.3
5.0	0.42	147.1	3.50	41.8	0.08	45.6	0.36	-70.4
6.0	0.51	130.2	2.94	25.6	0.09	42.7	0.31	-89.6
7.0	0.58	116.8	2.52	9.8	0.10	38.6	0.29	-115.3
8.0	0.65	106.9	2.16	-5.0	0.12	34.4	0.31	-143.0
9.0	0.71	99.0	1.85	-19.3	0.13	28.7	0.36	-168.2
10.0	0.76	92.8	1.57	-32.6	0.14	22.9	0.44	172.1
11.0	0.78	89.2	1.36	-44.5	0.14	17.8	0.53	158.5
12.0	0.79	84.8	1.16	-55.1	0.15	13.4	0.60	149.8

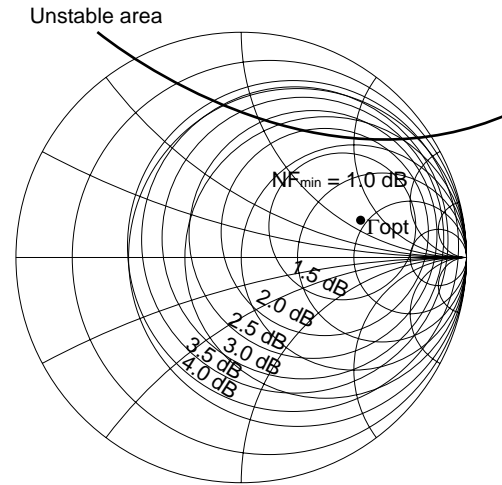
NOISE PARAMETER

<Equal NF circle>

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



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



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

f (GHz)	NF <sub>min</sub> (dB)	G <sub>a</sub> (dB)	Γ <sub>opt</sub>		R <sub>n</sub> /50
			MAG.	ANG.	
0.8	0.93	22.9	0.54	13.3	0.47
0.9	0.95	22.2	0.54	14.9	0.47
1.0	0.97	21.6	0.54	16.4	0.47
1.5	1.08	18.8	0.53	24.6	0.45
1.8	1.14	17.5	0.51	30.3	0.43
1.9	1.16	17.1	0.50	32.4	0.42
2.0	1.18	16.7	0.49	34.6	0.41
2.5	1.29	15.2	0.44	47.7	0.35

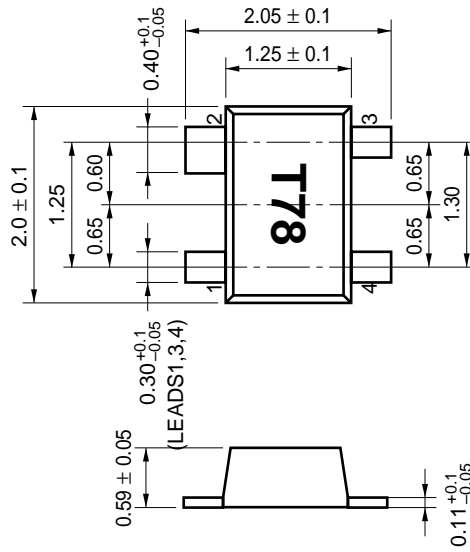
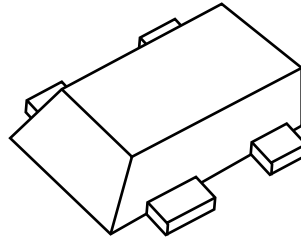
$V_{CE} = 2\text{ V}, I_C = 5\text{ mA}$

f (GHz)	NF <sub>min</sub> (dB)	G <sub>a</sub> (dB)	Γ <sub>opt</sub>		R <sub>n</sub> /50
			MAG.	ANG.	
0.8	1.59	24.7	0.38	10.7	0.43
0.9	1.60	24.1	0.38	11.9	0.43
1.0	1.60	23.4	0.38	13.2	0.43
1.5	1.62	20.7	0.36	20.5	0.41
1.8	1.63	19.3	0.34	25.7	0.38
1.9	1.63	18.9	0.33	27.5	0.38
2.0	1.63	18.5	0.32	29.4	0.37
2.5	1.65	16.9	0.26	40.1	0.32



PACKAGE DRAWINGS

Flat-lead 4-pin thin super mini-mold (unit: mm)



Pin connections

- 1. Emitter
- 2. Collector
- 3. Emitter
- 4. Base

**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 <sup>Note</sup>	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 <sup>Note</sup>	VP15-00-2
Wave soldering	Solder bath temperature: 260 °C, Time: 10 sec max., Number of times: once, Maximum number of days: None <sup>Note</sup>	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]

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Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

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

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.