

HIGH FREQUENCY LOW NOISE AMPLIFIER
NPN SILICON EPITAXIAL TRANSISTOR
SUPER MINI MOLD**DESCRIPTION**

The 2SC4228 is a low supply voltage transistor designed for VHF, UHF low noise amplifier.

It is suitable for a high density surface mount assembly since the transistor has been applied super mini mold package.

This is achieved by direct nitride passivated base surface process (NESAT™ process) which is an NEC proprietary fabrication technique.

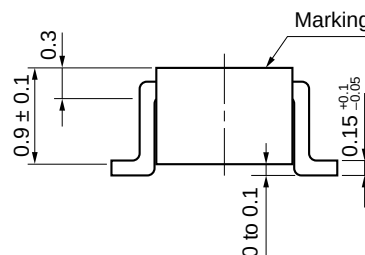
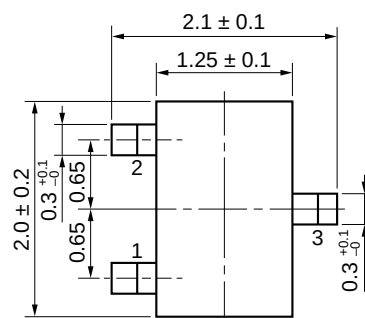
FEATURES

- High f_T : 8.0 GHz TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 5\text{ mA}$, $f = 2\text{ GHz}$)
- Low C_{re} : 0.3 pF TYP. (@ $V_{CB} = 3\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$)
- High $|S_{21e}|^2$: 7.5 dB TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 5\text{ mA}$, $f = 2\text{ GHz}$)
- Super Mini Mold Package. (EIAJ: SC-70)

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC4228-T1	3 kpcs/Reel.	Embossed tape 8 mm wide. Pin3 (Collector) face to perforation side of the tape.
2SC4228-T2	3 kpcs/Reel.	Embossed tape 8 mm wide. Pin1 (Emitter), Pin2 (Base) face to perforation side of the tape.

- * Please contact with responsible NEC person, if you require evaluation sample. Unit sample quantity shall be 50 pcs. (Part No.: 2SC4228)

PACKAGE DIMENSIONS
in millimeters**PIN CONNECTIONS**

1. Emitter
2. Base
3. Collector

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Collector to Base Voltage	V _{CBO}	20	V
Collector to Emitter Voltage	V _{CEO}	10	V
Emitter to Base Voltage	V _{EBO}	1.5	V
Collector Current	I _C	35	mA
Total Power Dissipation	P _T	150	mW
Junction Temperature	T _J	150	°C
Storage Temperature	T _{stg}	−65 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

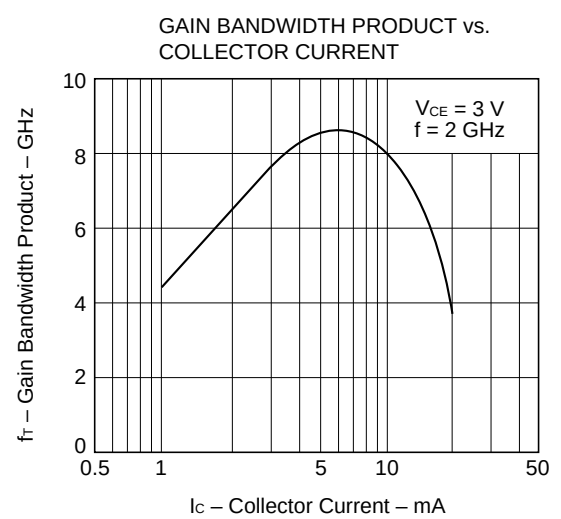
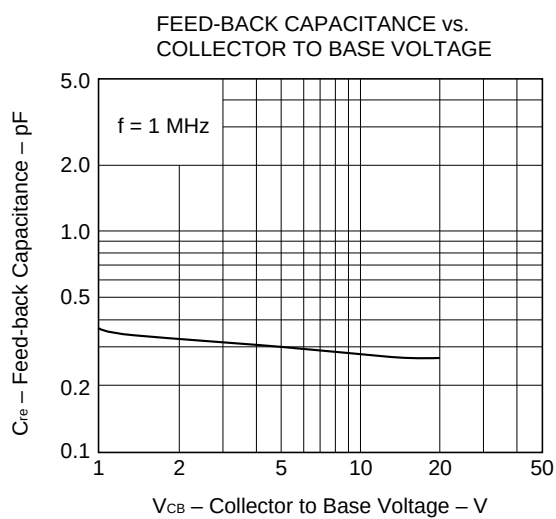
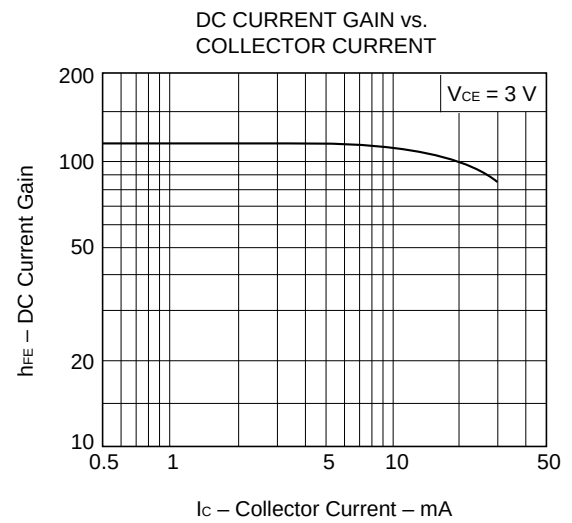
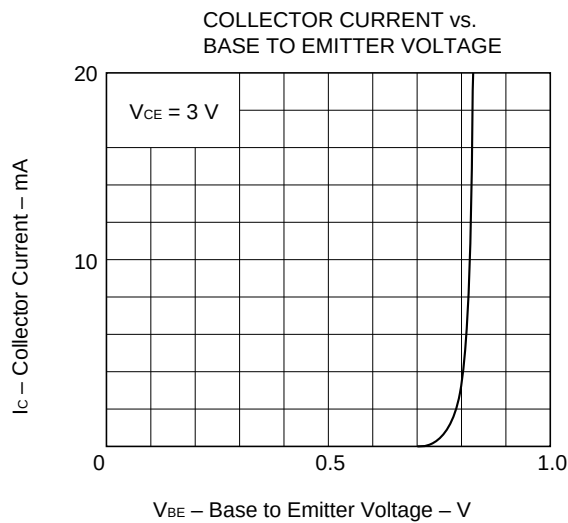
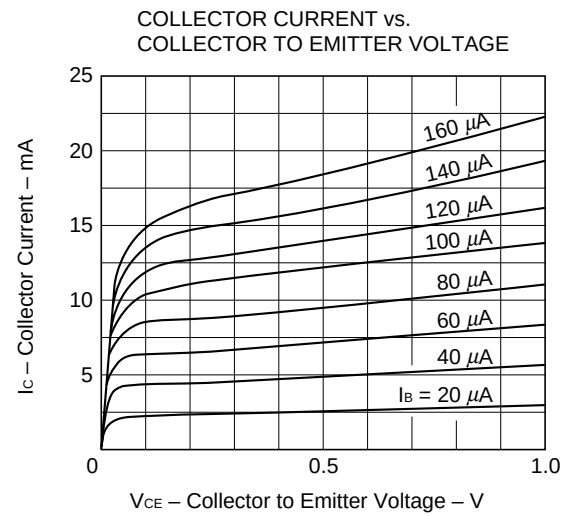
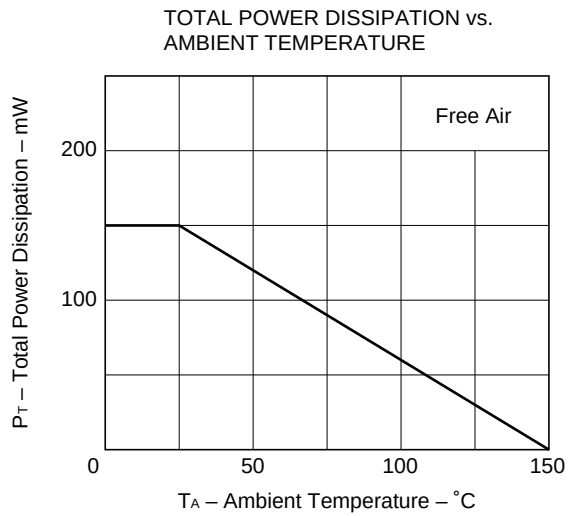
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Collector Cutoff Current	I _{CBO}			1.0	μA	V _{CB} = 10 V, I _E = 0
Emitter Cutoff Current	I _{EBO}			1.0	μA	V _{EB} = 1 V, I _C = 0
DC Current Gain	h _{FE}	50	100	250		V _{CE} = 3 V, I _C = 5 mA* ¹
Gain Bandwidth Product	f _T	5.5	8.0		GHz	V _{CE} = 3 V, I _C = 5 mA, f = 2 GHz
Feedback Capacitance	C _{re}		0.3	0.7	pF	V _{CB} = 3 V, I _E = 0, f = 1 MHz* ²
Insertion Power Gain	S _{21e} ²	5.5	7.5		dB	V _{CE} = 3 V, I _C = 5 mA, f = 2 GHz
Noise Figure	NF		1.9	3.2	dB	V _{CE} = 3 V, I _C = 5 mA, f = 2 GHz

*1 Pulse Measurement; PW ≤ 350 μs, Duty Cycle ≤ 2 %

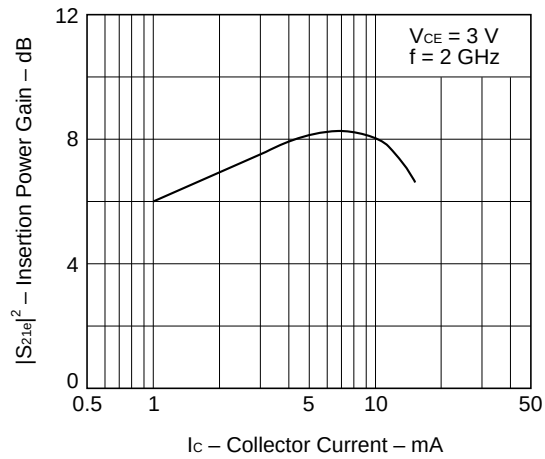
*2 The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

h_{FE} Classification

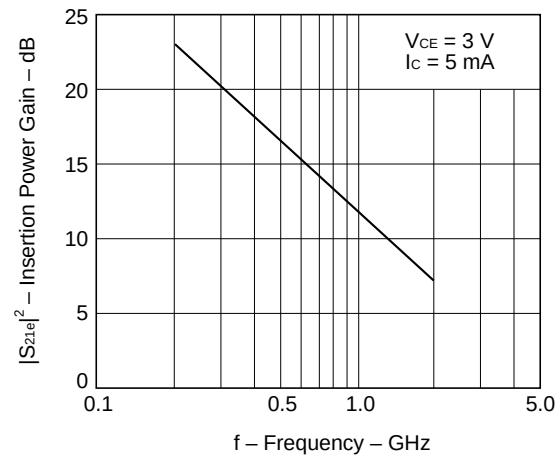
Rank	R43	R44	R45
Marking	R43	R44	R45
h _{FE}	50 to 100	80 to 160	125 to 250

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

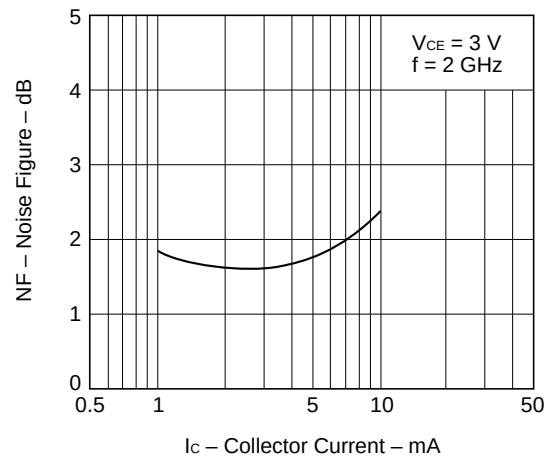
INSERTION POWER GAIN vs.
COLLECTOR CURRENT



INSERTION POWER GAIN vs.
FREQUENCY



NOISE FIGURE vs.
COLLECTOR CURRENT



S-PARAMETER

 $V_{CE} = 3 \text{ V}$, $I_C = 5 \text{ mA}$, $Z_0 = 50 \Omega$

FREQUENCY		S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
100.00	.875	-18.6	14.087	161.1	.018	78.2	.958	-10.1	
200.00	.762	-35.0	12.290	145.1	.034	68.6	.888	-17.7	
300.00	.677	-47.2	10.888	133.6	.048	66.6	.800	-24.4	
400.00	.565	-59.4	9.275	123.6	.055	65.8	.719	-26.7	
500.00	.495	-67.5	8.300	115.7	.063	63.5	.669	-28.7	
600.00	.425	-76.1	7.184	108.9	.074	61.1	.610	-30.3	
700.00	.372	-81.6	6.454	104.8	.084	63.8	.600	-30.6	
800.00	.327	-88.5	5.818	99.5	.089	62.7	.560	-31.3	
900.00	.289	-93.6	5.231	95.5	.092	64.6	.543	-30.1	
1000.00	.255	-100.5	4.820	92.0	.104	62.8	.519	-33.4	
1100.00	.236	-105.2	4.444	88.8	.105	64.2	.512	-31.8	
1200.00	.214	-112.2	4.142	85.3	.113	64.2	.497	-33.4	
1300.00	.195	-117.6	3.842	83.2	.122	63.6	.476	-33.2	
1400.00	.182	-123.8	3.554	79.3	.127	65.0	.481	-34.2	
1500.00	.165	-129.9	3.343	77.4	.139	64.1	.467	-34.6	
1600.00	.153	-137.4	3.218	75.3	.140	64.5	.466	-34.8	
1700.00	.145	-144.3	3.091	73.6	.152	65.4	.458	-37.2	
1800.00	.139	-151.8	2.857	70.4	.162	64.3	.456	-36.1	
1900.00	.134	-157.0	2.764	68.7	.168	62.3	.451	-38.4	
2000.00	.129	-164.7	2.624	66.4	.176	64.8	.445	-39.0	

 $V_{CE} = 3 \text{ V}$, $I_C = 3 \text{ mA}$, $Z_0 = 50 \Omega$

FREQUENCY		S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
100.00	.943	-13.4	9.384	165.9	.020	84.1	.969	-7.7	
200.00	.868	-26.6	8.668	152.8	.038	77.2	.936	-13.8	
300.00	.815	-37.7	8.165	142.9	.051	67.9	.876	-20.9	
400.00	.717	-48.9	7.279	132.9	.062	63.9	.804	-23.5	
500.00	.655	-56.8	6.780	125.5	.075	63.9	.764	-26.7	
600.00	.577	-65.5	6.061	118.0	.084	60.0	.708	-29.7	
700.00	.518	-71.2	5.504	112.8	.091	59.7	.685	-31.1	
800.00	.468	-78.1	5.074	106.7	.098	57.0	.639	-32.0	
900.00	.420	-83.7	4.632	102.8	.102	59.0	.611	-32.8	
1000.00	.380	-90.6	4.340	98.3	.105	56.6	.592	-35.0	
1100.00	.344	-94.8	3.951	94.8	.112	57.8	.579	-34.1	
1200.00	.321	-101.6	3.717	90.5	.121	59.0	.551	-35.0	
1300.00	.291	-105.9	3.485	87.6	.128	58.7	.532	-35.9	
1400.00	.273	-111.7	3.306	84.3	.135	59.8	.535	-36.6	
1500.00	.250	-117.2	3.134	80.7	.140	58.0	.511	-37.5	
1600.00	.228	-122.4	2.959	79.0	.145	59.5	.516	-37.7	
1700.00	.219	-128.5	2.819	76.0	.153	59.0	.504	-39.0	
1800.00	.199	-135.3	2.699	73.9	.161	58.4	.493	-39.9	
1900.00	.193	-139.6	2.572	71.9	.163	60.3	.489	-41.4	
2000.00	.182	-146.9	2.474	68.3	.175	59.8	.482	-41.4	

S-PARAMETER
 $V_{CE} = 3 \text{ V}$, $I_C = 1 \text{ mA}$, $Z_O = 50 \ \Omega$

FREQUENCY		S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
100.00	1.023	-7.6	3.505	172.1	.025	86.4	.995	-4.6	
200.00	.983	-16.1	3.400	163.3	.039	79.3	.986	-7.8	
300.00	.975	-22.4	3.368	157.3	.061	74.6	.976	-12.8	
400.00	.922	-31.8	3.219	149.1	.075	70.7	.936	-15.1	
500.00	.899	-36.9	3.186	143.3	.093	66.4	.922	-18.8	
600.00	.849	-44.7	3.046	135.7	.105	62.2	.885	-22.5	
700.00	.812	-50.6	2.905	131.1	.113	61.7	.880	-24.4	
800.00	.774	-57.1	2.830	124.4	.128	55.7	.846	-27.2	
900.00	.727	-62.9	2.694	119.2	.134	55.6	.808	-28.8	
1000.0	.680	-69.3	2.597	114.1	.146	53.7	.790	-31.8	
1100.00	.651	-74.1	2.479	109.3	.146	50.3	.766	-32.8	
1200.00	.616	-79.8	2.392	104.8	.155	49.8	.741	-34.9	
1300.00	.575	-85.2	2.302	101.1	.155	46.2	.714	-35.9	
1400.00	.546	-90.6	2.207	96.0	.160	46.7	.708	-36.8	
1500.00	.512	-95.8	2.110	92.1	.168	43.6	.685	-38.4	
1600.00	.481	-100.6	2.034	88.8	.165	45.5	.676	-40.1	
1700.00	.463	-106.3	1.989	85.5	.176	45.3	.667	-41.8	
1800.00	.440	-111.8	1.903	82.2	.173	43.8	.649	-42.3	
1900.00	.419	-116.4	1.854	78.9	.174	43.5	.633	-44.2	
2000.00	.394	-121.2	1.779	75.5	.173	43.7	.630	-45.2	

[MEMO]

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customer must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

“Standard”, “Special”, and “Specific”. The Specific quality grade applies only to devices developed based on a customer designated “quality assurance program” for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

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 in “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 NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.