

**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.

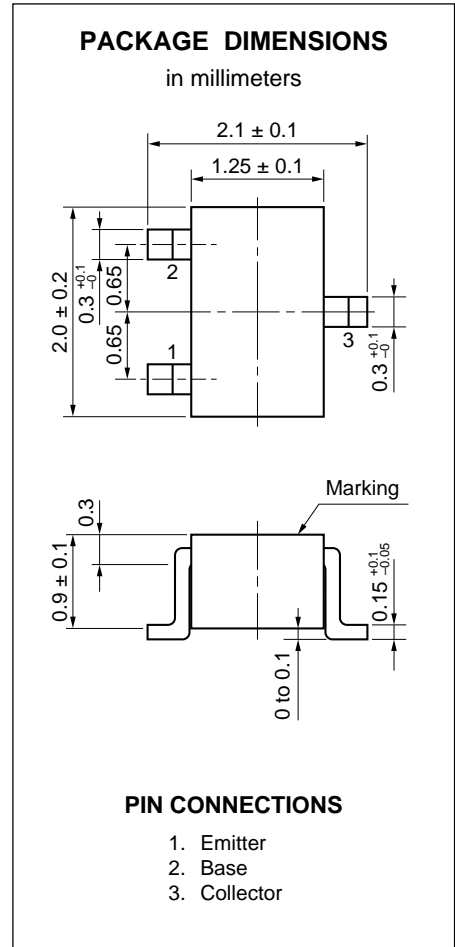
**FEATURES**

- 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)



**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C)**

Collector to Base Voltage	V <sub>CB0</sub>	20	V
Collector to Emitter Voltage	V <sub>CEO</sub>	10	V
Emitter to Base Voltage	V <sub>EBO</sub>	1.5	V
Collector Current	I <sub>c</sub>	35	mA
Total Power Dissipation	P <sub>T</sub>	150	mW
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Collector Cutoff Current	I <sub>CB0</sub>			1.0	μA	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0
Emitter Cutoff Current	I <sub>EBO</sub>			1.0	μA	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0
DC Current Gain	h <sub>FE</sub>	50	100	250		V <sub>CE</sub> = 3 V, I <sub>C</sub> = 5 mA*1
Gain Bandwidth Product	f <sub>T</sub>	5.5	8.0		GHz	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 5 mA, f = 2 GHz
Feedback Capacitance	C <sub>re</sub>		0.3	0.7	pF	V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0, f = 1 MHz*2
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	5.5	7.5		dB	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 5 mA, f = 2 GHz
Noise Figure	NF		1.9	3.2	dB	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 5 mA, f = 2 GHz

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

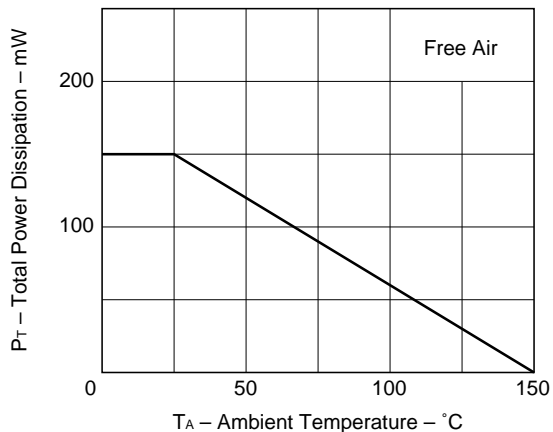
\*2 The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

**h<sub>FE</sub> Classification**

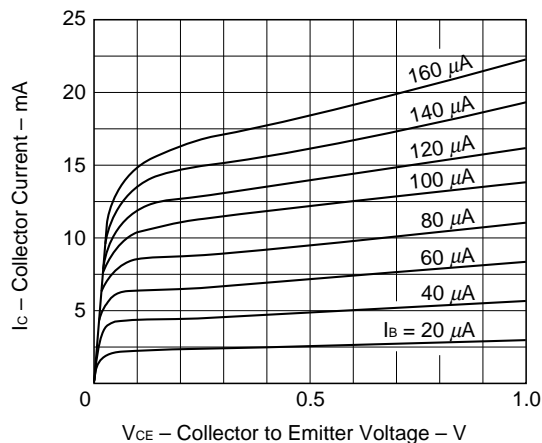
Rank	R43	R44	R45
Marking	R43	R44	R45
h <sub>FE</sub>	50 to 100	80 to 160	125 to 250

TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)

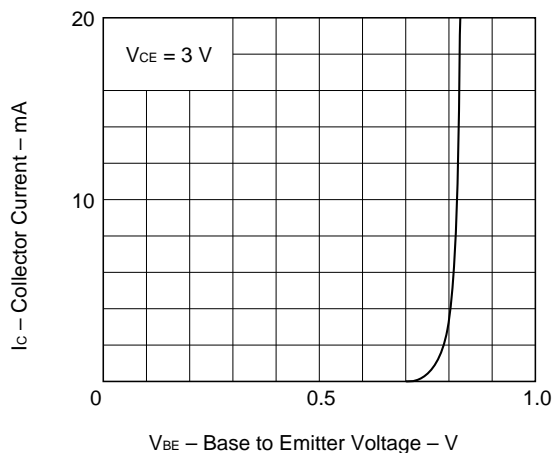
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



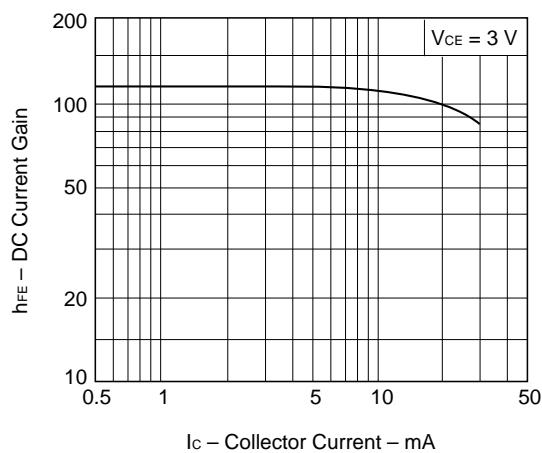
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



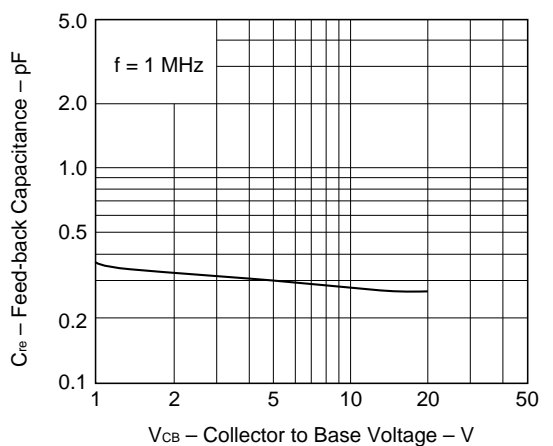
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



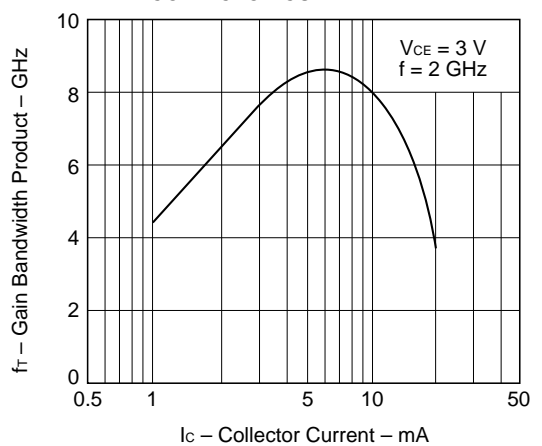
DC CURRENT GAIN vs. COLLECTOR CURRENT



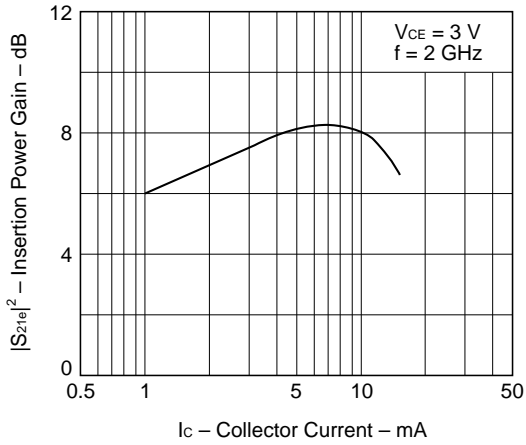
FEED-BACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



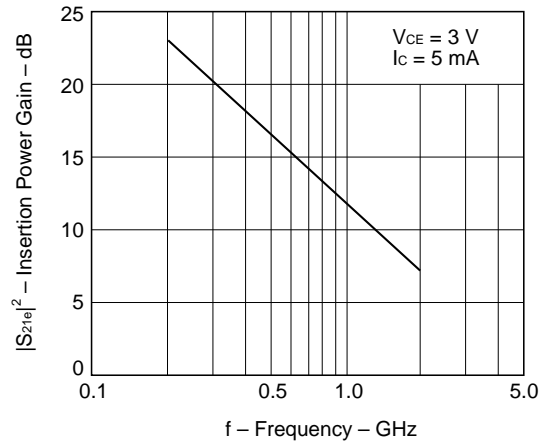
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



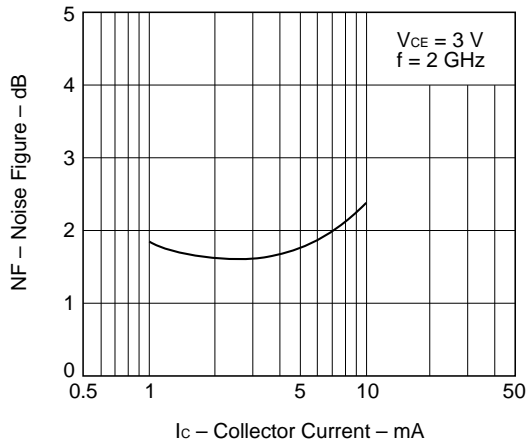
INSERTION POWER GAIN vs. COLLECTOR CURRENT



INSERTION POWER GAIN vs. FREQUENCY



NOISE FIGURE vs. COLLECTOR CURRENT



**S-PARAMETER**

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 5 mA, Z<sub>o</sub> = 50 Ω

FREQUENCY	S11		S21		S12		S22	
	MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG
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<sub>CE</sub> = 3 V, I<sub>c</sub> = 3 mA, Z<sub>o</sub> = 50 Ω

FREQUENCY	S11		S21		S12		S22	
	MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG
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<sub>CE</sub> = 3 V, I<sub>c</sub> = 1 mA, Z<sub>o</sub> = 50 Ω

FREQUENCY	S11		S21		S12		S22	
	MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG
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]

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