NEC

SILICON TRANSISTOR
2SC4228

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^{TM} process) which is an NEC proprietary fabrication technique.

FEATURES

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

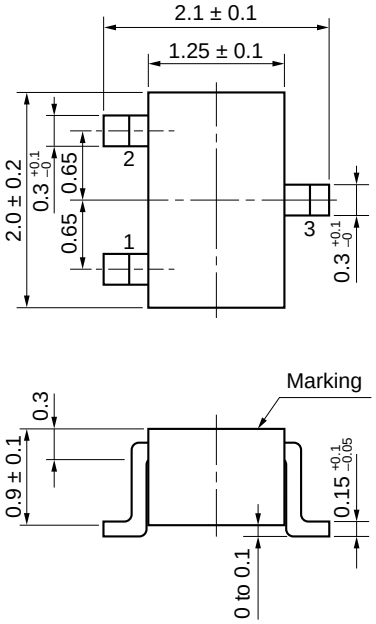
ORDERING INFORMATION

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

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Date Published July 1995 P
Printed in Japan

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 %

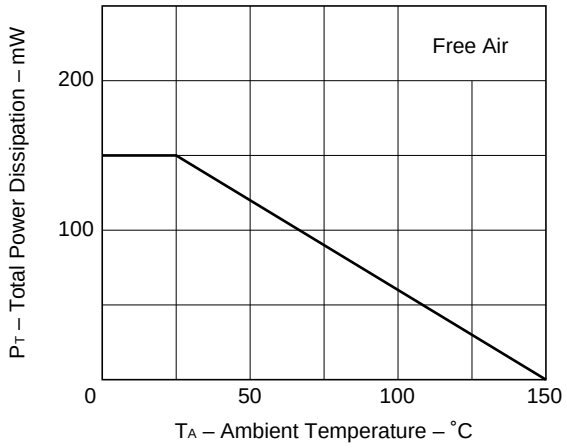
***2** The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

h_{FE} Classification

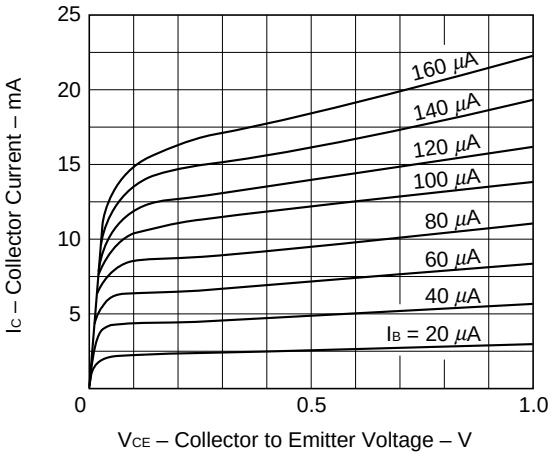
Rank	R43	R44	R45
Marking	R43	R44	R45
h_{FE}	50 to 100	80 to 160	125 to 250

TYPICAL CHARACTERISTICS (T_A = 25 ˚C)

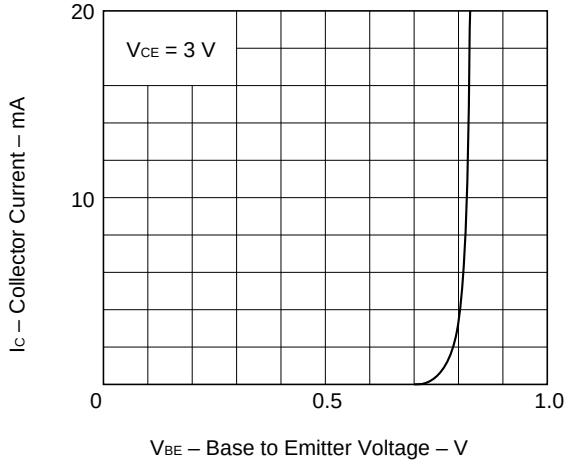
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



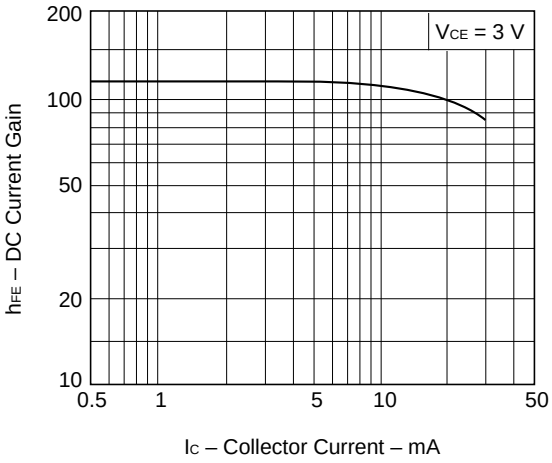
COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



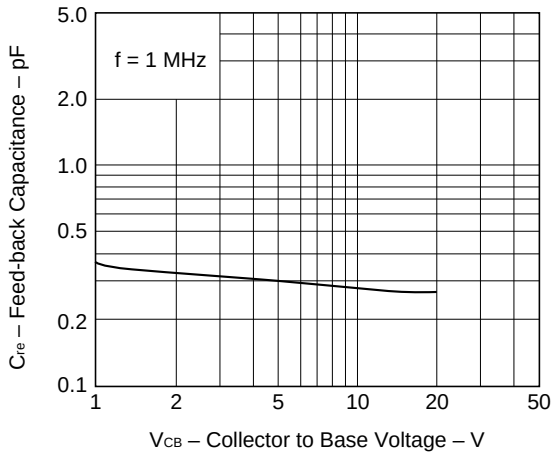
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



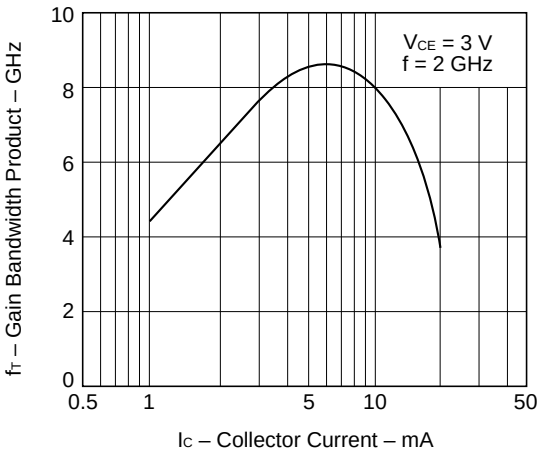
DC CURRENT GAIN vs.
COLLECTOR CURRENT



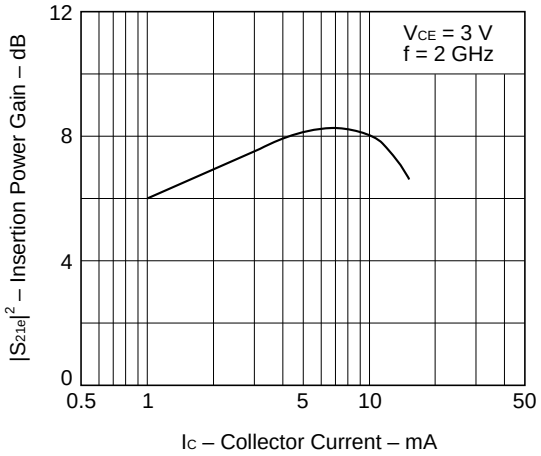
FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



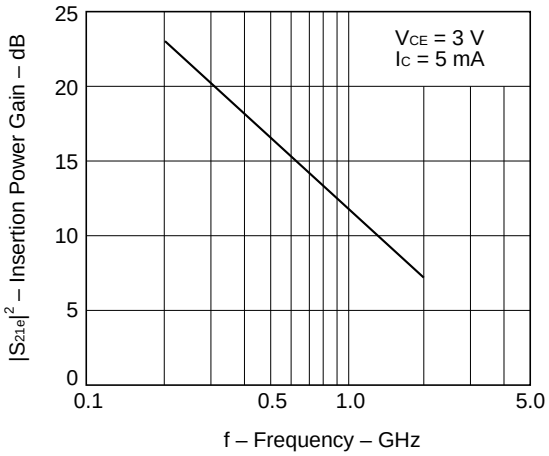
GAIN BANDWIDTH PRODUCT vs.
COLLECTOR CURRENT



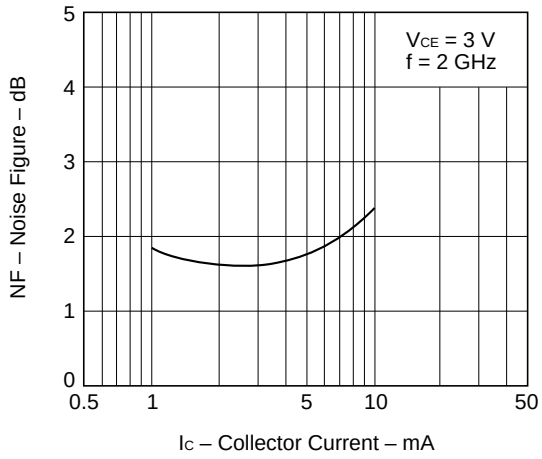
INSERTION POWER GAIN vs.
COLLECTOR CURRENT



INSERTION POWER GAIN vs.
FREQUENCY



NOISE FIGURE vs.
COLLECTOR CURRENT



S-PARAMETER

V_{CE} = 3 V, I_C = 5 mA, Z_O = 50 Ω

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 V, I_C = 3 mA, Z_O = 50 Ω

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 V, I_C = 1 mA, Z_O = 50 Ω

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]