

## NPN High-Frequency Low-Noise Transistor

### Description

The 2SC4228 is an ultra-high frequency low-noise transistor using a planar NPN silicon epitaxial bipolar process with high power gain and low noise. Due to the ultra-small SOT-323 package, it is especially suitable for high-density surface mount mounting, mainly for VHF, UHF low noise amplifiers.

### Key Features

High Gain: |S<sub>21e</sub>|<sub>2</sub> Type Value: 5.5 dB

Low-Noise: NF Type 2.0dB

Gain-Bandwidth Product: fT Type Value: 8GHz

@ VCE=3V, IC=5mA, f=2GHz

@ VCE=3V, IC=5mA, f=2GHz

@ VCE=3V, IC=5mA, f=2GHz

### Operating Limit Range (TA= 25°C)

Parameters	Symbols	MAX/MIN	Unit
Collector-Base Breakdown Voltage	V <sub>CBO</sub>	20	V
Collector-Base Breakdown Voltage	V <sub>CEO</sub>	10	V
Collector-Base Breakdown Voltage	V <sub>EBO</sub>	1.5	V
Collector current	I <sub>C</sub>	35	mA
Power consumption	P <sub>C</sub>	150	mW
Junction Temperature	T <sub>j</sub>	150	°C
Storage temperature	T <sub>stg</sub>	-65 ~ +150	°C

### hFE Specification

Grading	A	B	C	D	E
Number	R43	R44	R45		
hFE	60-100	90-140	130-180	170-250	250-300

**Electrical Property (TA=25°C)**

Parameters	Symbols	MIN	Typical	MAX	Unit	Testing conditions
Collector-Base Breakdown Voltage	VCBO	20			V	IC=1.0μA
Collector-Base Leakage Current	ICBO			0.1	μA	VCB=10V
Emitter-Base Leakage Current	IEBO			0.1	μA	VEB=1V
DC gain module	hFE	60	150	300		VCE=3V,IC=5mA
Characteristic frequency	f <sub>T</sub>		8	8.5	GHz	VCE=3V,IC=5mA,f=2GHz
Output Feedback Capacitance	C <sub>re</sub>		0.65	1.0	pF	VCB=10V,IE=0mA,f=1MHz
Power Gain	S <sub>21e</sub>   <sup>2</sup>		5.5		dB	VCE=3V,IC=5mA,f=2GHz
Noise Factor	NF		2.0		dB	VCE=3V,IC=5mA,f=2GHz

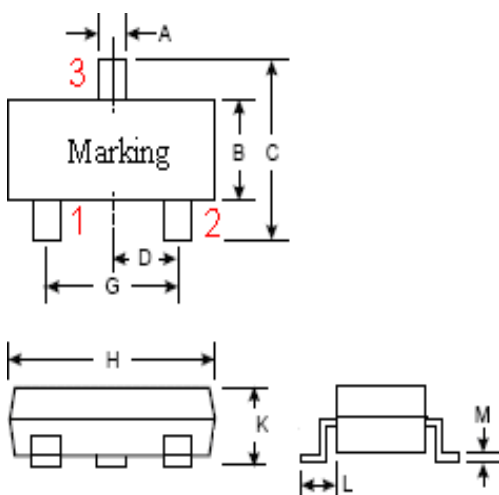
**Packaging mode**

SOT-323

Pin Description: 1: Base

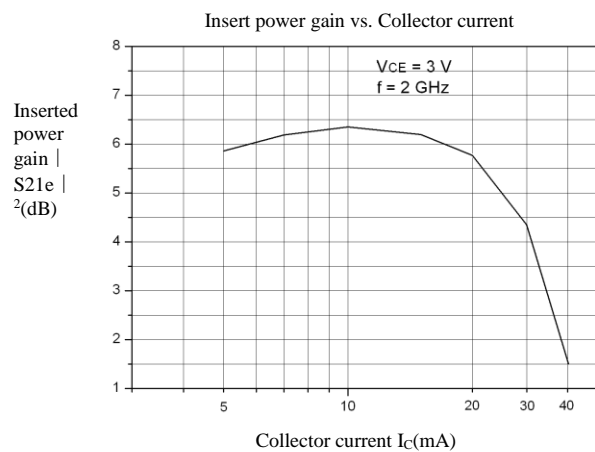
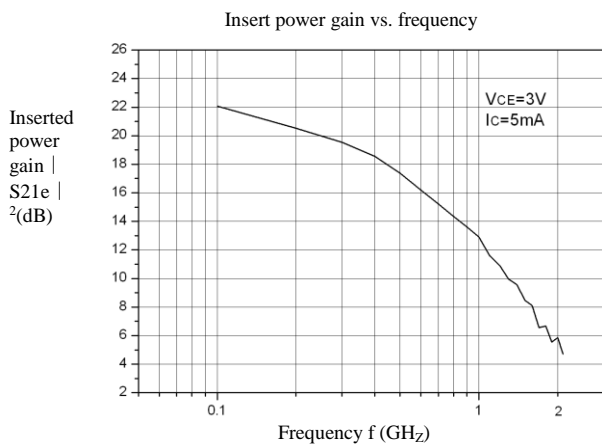
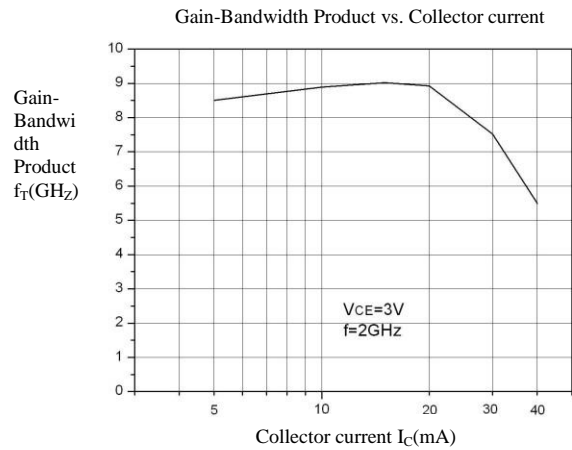
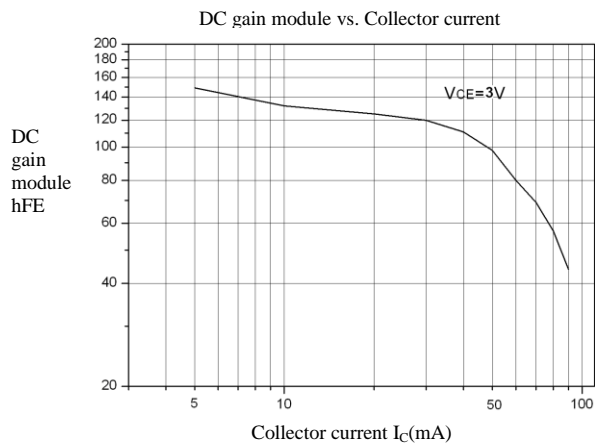
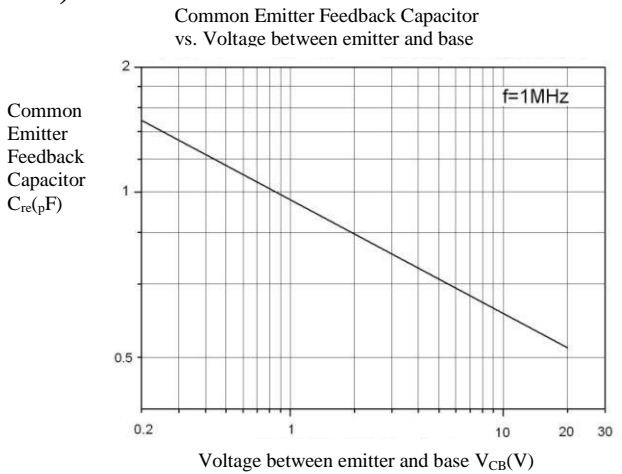
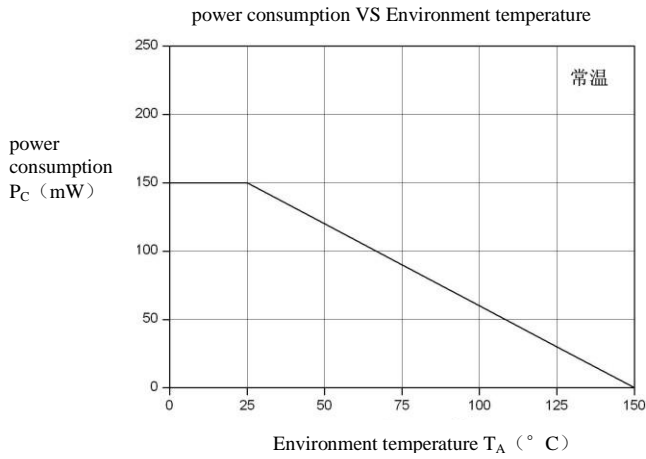
2: Emitter

3: Collector

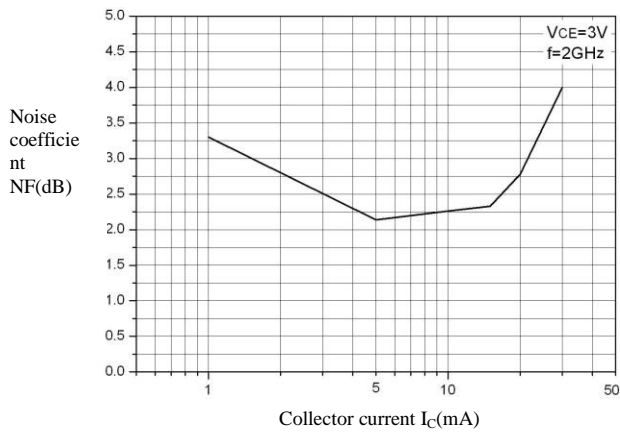


Symbol	Min(mm)	Max(mm)
A	0.200	0.400
B	1.150	1.350
C	2.150	2.450
D	0.650	
G	1.200	1.400
H	2.000	2.200
K	0.900	1.100
L	0.525	
M	0.080	0.150

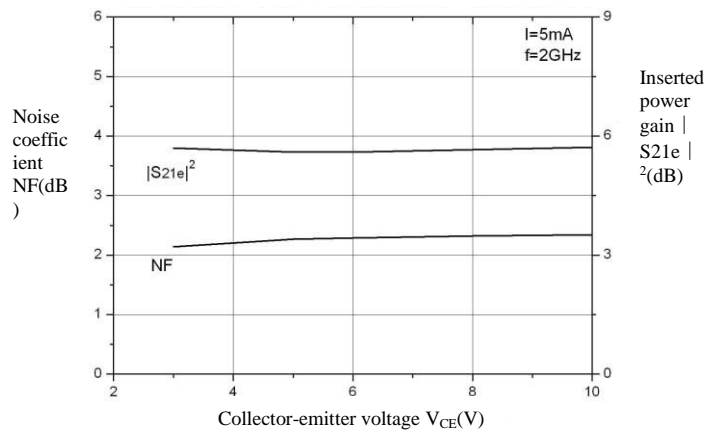
## Typical characteristic curve (@TA= 25°C)



Noise coefficient vs. Collector current



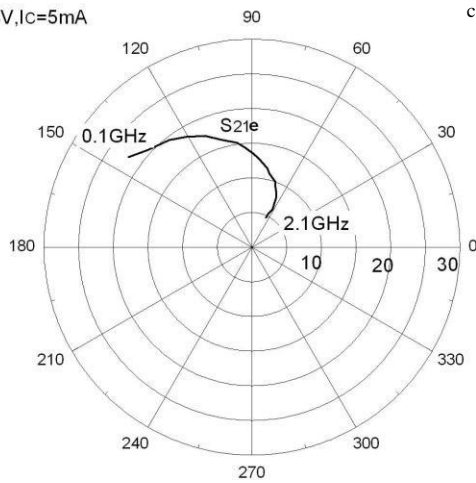
Noise coefficient, Inserted power gain VS. Collector-emitter voltage



## SMITH

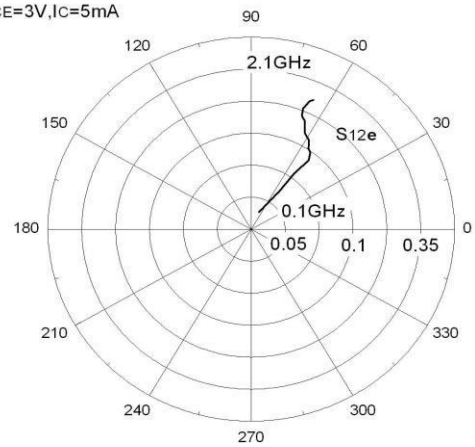
Test Condition:  $V_{CE}=3V, I_C=5mA$   
 $S_{21e}$  -FREQUENCY

conditions :  $V_{CE}=3V, I_C=5mA$



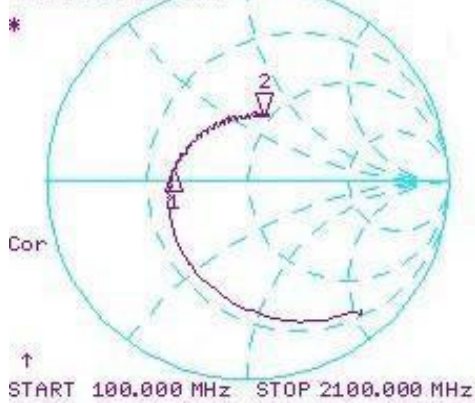
$S_{12e}$  -FREQUENCY

conditions :  $V_{CE}=3V, I_C=5mA$



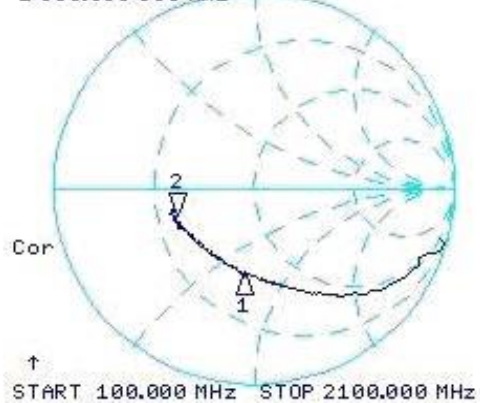
$S_{11e}$  -FREQUENCY

2: 45.533  $\Omega$  34.387  $\Omega$  2.7364 nH  
 2 000.000 000 MHz



$S_{22e}$  -FREQUENCY

2: 20.903  $\Omega$  -7.1650  $\Omega$  11.106 pF  
 2 000.000 000 MHz



## Scattering Parameter (S-PARAMETER)

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

Test Frequency	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	0.855	-48.801	12.710	143.87	0.025	67.576	0.966	-14.735
0.2	0.763	-66.883	10.616	136.77	0.041	62.939	0.854	-33.989
0.3	0.655	-88.554	9.497	127.74	0.060	62.861	0.726	-48.126
0.4	0.567	-106.56	8.465	120.78	0.071	60.028	0.638	-57.838
0.5	0.514	-122.96	7.400	112.79	0.077	56.08	0.574	-65.518
0.6	0.470	-137.89	6.452	106.21	0.086	51.689	0.525	-72.426
0.7	0.432	-152.05	5.762	98.138	0.095	53.654	0.490	-79.297
0.8	0.411	-164.33	5.220	93.86	0.097	53.803	0.462	-85.2
0.9	0.384	-176.4	4.788	86.638	0.102	56.147	0.445	-91.2
1	0.380	170.73	4.416	85.732	0.105	54.511	0.436	-98.459
1.1	0.352	160.05	3.802	79.059	0.115	58.39	0.418	-103.85
1.2	0.348	149.81	3.511	76.588	0.116	58.262	0.406	-109.92
1.3	0.331	140.8	3.147	70.039	0.125	62.108	0.399	-115.82
1.4	0.335	130.41	3.011	69.561	0.134	63.053	0.394	-122.38
1.5	0.320	123.19	2.654	65.367	0.140	67.835	0.393	-125.76
1.6	0.330	112.5	2.543	67.393	0.152	64.829	0.395	-134.48
1.7	0.323	105.92	2.130	62.177	0.163	69.09	0.397	-137.99
1.8	0.337	95.571	2.155	61.964	0.187	67.97	0.393	-146.38
1.9	0.318	89.396	1.893	61.427	0.187	72.16	0.406	-149.87
2	0.344	77.432	1.962	63.618	0.218	67.927	0.424	-160.91
2.1	0.346	71.601	1.719	64.762	0.229	67.533	0.438	-162.29