

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

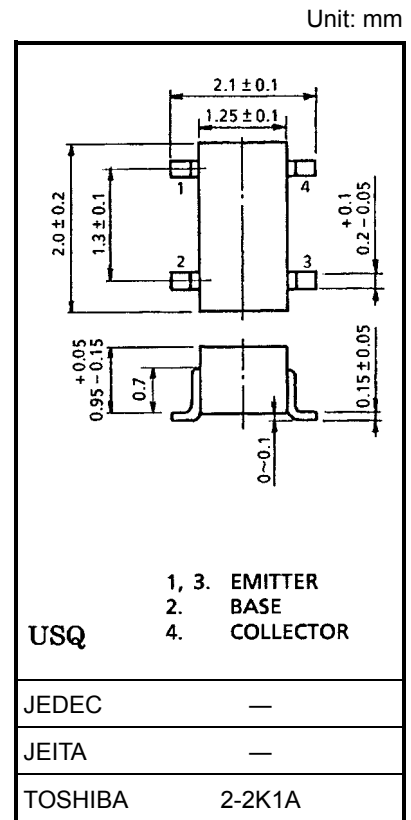
# 2SC5093

## VHF~UHF Band Low Noise Amplifier Applications

- Low noise figure, high gain.
- $NF = 1.8\text{dB}$ ,  $|S_{21e}|^2 = 9.5\text{dB}$  ( $f = 2\text{GHz}$ )

### Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Collector-base voltage	$V_{CBO}$	20	V
Collector-emitter voltage	$V_{CEO}$	10	V
Emitter-base voltage	$V_{EBO}$	1.5	V
Base current	$I_B$	20	mA
Collector current	$I_C$	40	mA
Collector power dissipation	$P_C$	100	mW
Junction temperature	$T_j$	125	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-55~125	$^\circ\text{C}$



### Microwave Characteristics ( $T_a = 25^\circ\text{C}$ )

Weight: 0.006 g (typ.)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Transition frequency	$f_T$	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$	7	10	—	GHz
Insertion gain	$ S_{21e} ^2$ (1)	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$ , $f = 1\text{GHz}$	12	15	—	dB
	$ S_{21e} ^2$ (2)	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$ , $f = 2\text{GHz}$	6.5	9.5	—	
Noise figure	NF (1)	$V_{CE} = 8\text{V}$ , $I_C = 5\text{mA}$ , $f = 1\text{GHz}$	—	1.4	2.5	dB
	NF (2)	$V_{CE} = 8\text{V}$ , $I_C = 5\text{mA}$ , $f = 2\text{GHz}$	—	1.8	3	

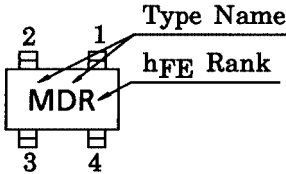
### Electrical Characteristics ( $T_a = 25^\circ\text{C}$ )

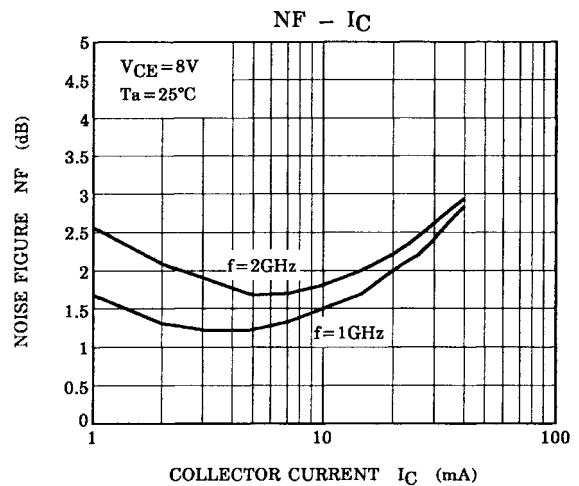
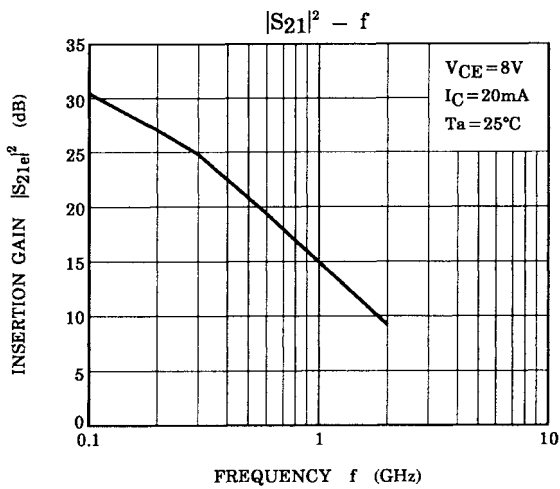
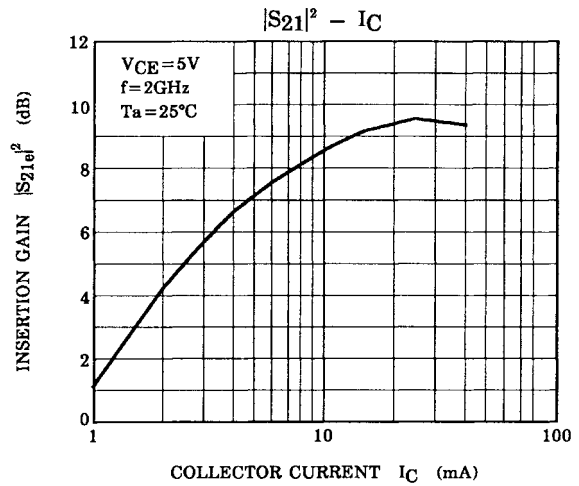
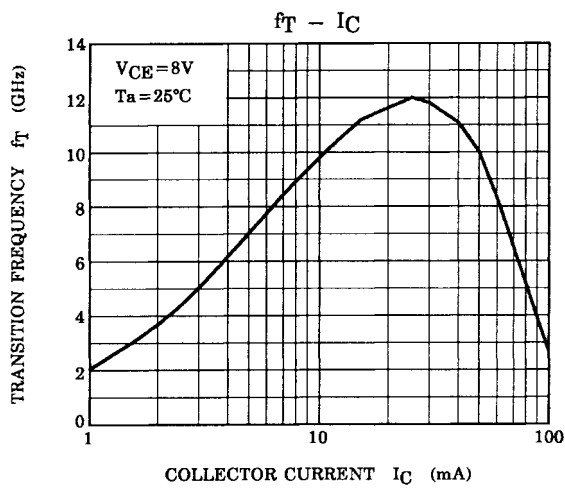
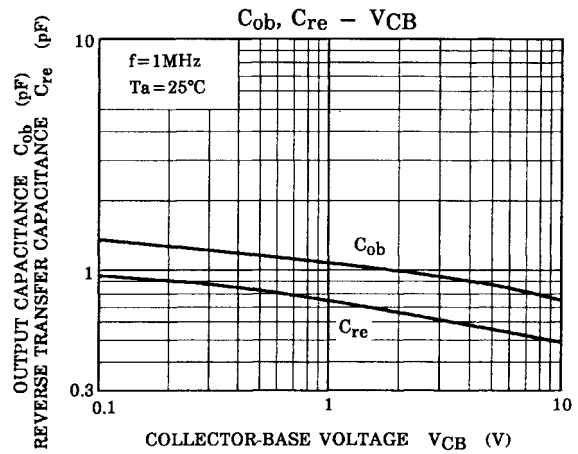
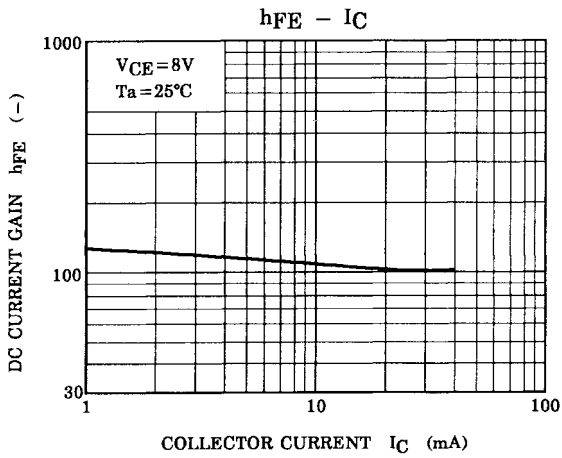
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	$V_{CB} = 10\text{V}$ , $I_E = 0$	—	—	1	$\mu\text{A}$
Emitter cut-off current	$I_{EBO}$	$V_{EB} = 1\text{V}$ , $I_C = 0$	—	—	1	$\mu\text{A}$
DC current gain	$h_{FE}$ (Note 1)	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$	50	—	160	
Output capacitance	$C_{ob}$	$V_{CB} = 15\text{V}$ , $I_E = 0$ , $f = 1\text{MHz}$ (Note 2)	—	0.65	1.05	pF
Reverse transfer capacitance	$C_{re}$		—	0.45	0.95	pF

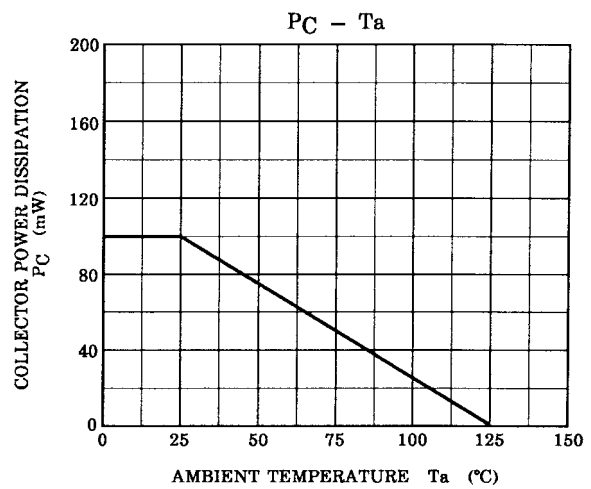
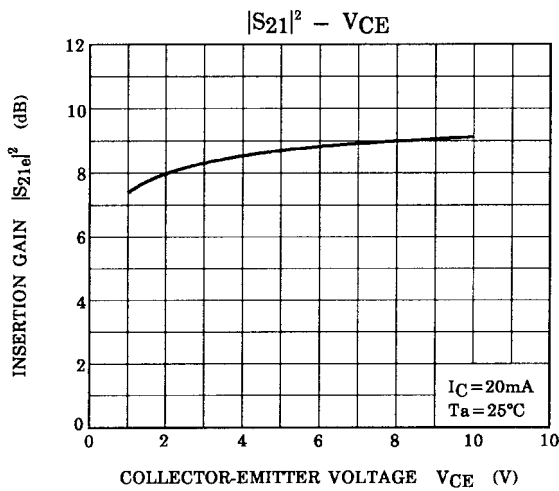
Note 1:  $h_{FE}$  classification R: 50~100, O: 80~160

Note 2:  $C_{re}$  is measured by 3 terminal method with capacitance bridge.

**Marking**







**S-Parameter  $Z_O = 50 \Omega, T_a = 25^\circ\text{C}$**

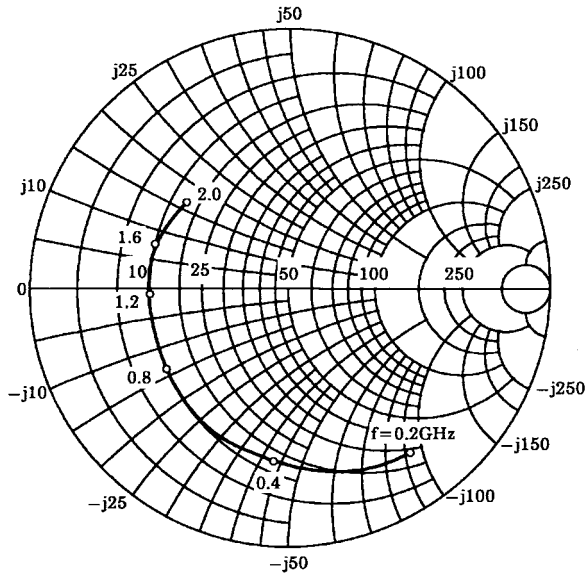
**$V_{CE} = 8 \text{ V}, I_C = 5 \text{ mA}$**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.801	-54.4	12.628	145.4	0.047	63.2	0.864	-32.2
400	0.696	-95.6	9.664	121.9	0.072	48.8	0.675	-54.2
600	0.617	-124.7	7.307	106.2	0.083	42.3	0.543	-68.4
800	0.585	-146.3	5.779	95.1	0.090	39.3	0.456	-79.6
1000	0.554	-163.0	4.674	86.8	0.095	39.5	0.400	-88.6
1200	0.545	-176.5	3.902	80.0	0.099	40.4	0.357	-96.8
1400	0.529	171.3	3.350	75.0	0.103	42.5	0.323	-104.5
1600	0.529	161.1	2.929	70.0	0.108	44.8	0.299	-111.0
1800	0.527	150.4	2.612	66.1	0.116	47.1	0.277	-116.5
2000	0.513	141.0	2.366	62.1	0.122	49.6	0.258	-120.3

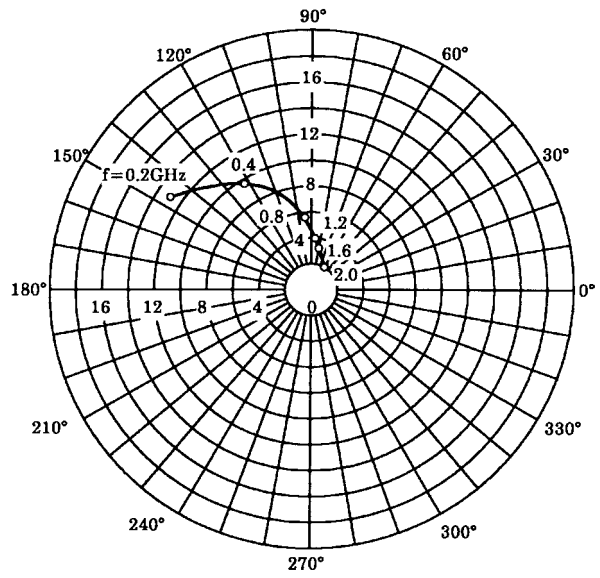
**$V_{CE} = 8 \text{ V}, I_C = 20 \text{ mA}$**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.556	-95.4	23.034	126.0	0.032	55.7	0.629	-53.5
400	0.521	-137.0	13.888	105.1	0.045	52.0	0.407	-75.8
600	0.505	-160.0	9.597	94.2	0.054	54.0	0.311	-89.3
800	0.505	-174.7	7.272	86.8	0.064	56.4	0.263	-101.3
1000	0.508	172.6	5.797	81.0	0.075	59.0	0.233	-112.0
1200	0.519	163.1	4.800	76.5	0.085	60.4	0.208	-122.9
1400	0.518	153.4	4.119	72.8	0.095	62.0	0.189	-132.7
1600	0.525	144.3	3.603	69.1	0.106	63.2	0.172	-141.7
1800	0.532	135.6	3.231	66.4	0.119	63.8	0.153	-149.3
2000	0.523	125.9	2.952	62.8	0.131	64.6	0.131	-153.9

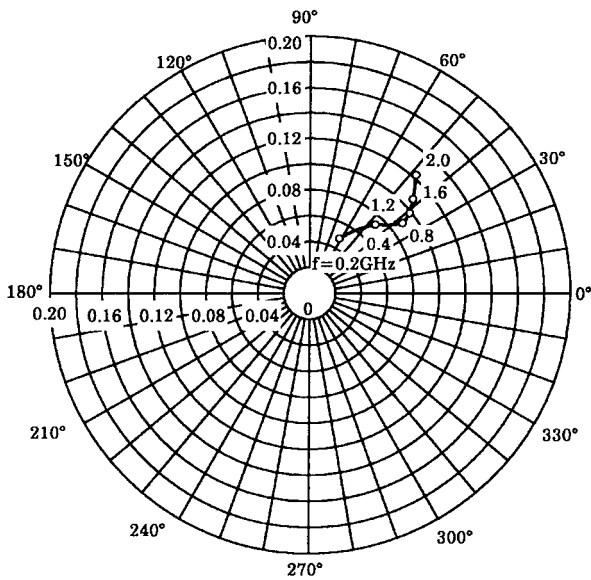
**S<sub>11e</sub>**  
**V<sub>CE</sub> = 8V**  
**I<sub>C</sub> = 5mA**  
**T<sub>a</sub> = 25°C**  
 (Unit : Ω)



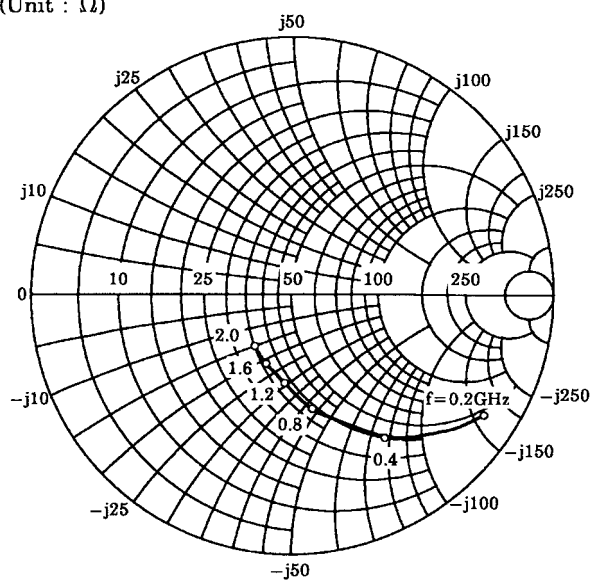
**S<sub>21e</sub>**  
**V<sub>CE</sub> = 8V**  
**I<sub>C</sub> = 5mA**  
**T<sub>a</sub> = 25°C**



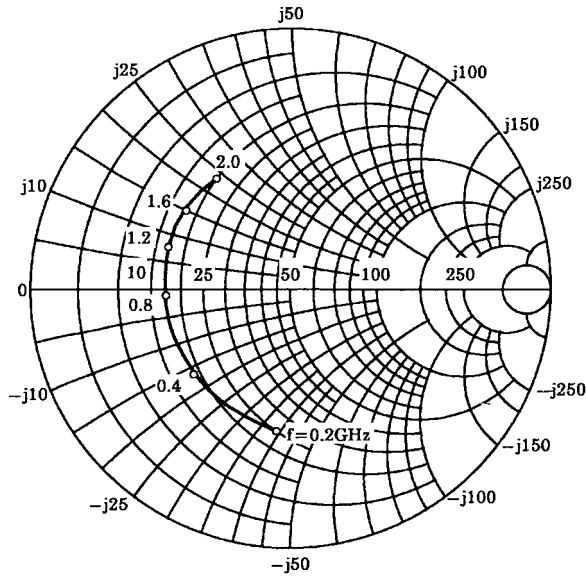
**S<sub>12e</sub>**  
**V<sub>CE</sub> = 8V**  
**I<sub>C</sub> = 5mA**  
**T<sub>a</sub> = 25°C**



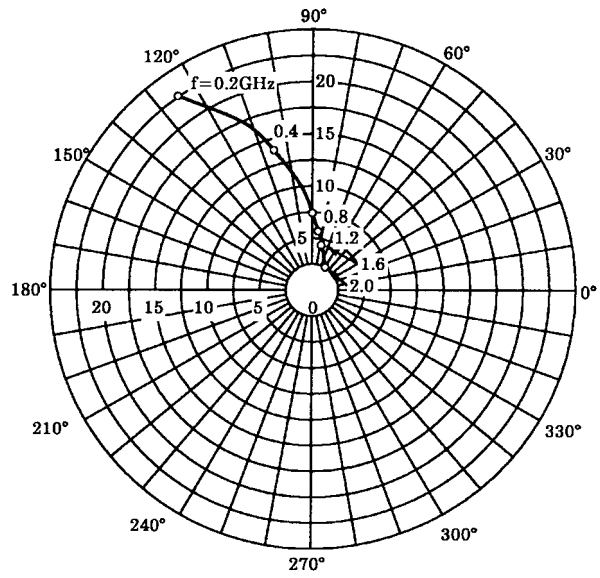
**S<sub>22e</sub>**  
**V<sub>CE</sub> = 8V**  
**I<sub>C</sub> = 5mA**  
**T<sub>a</sub> = 25°C**  
 (Unit : Ω)



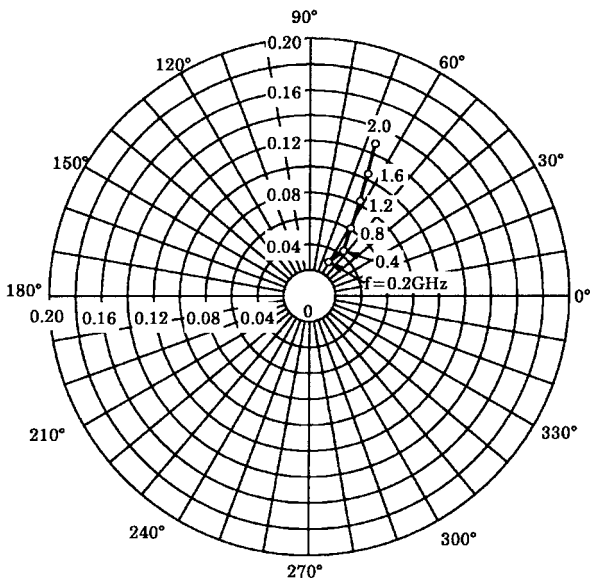
**S11e**  
 VCE=8V  
 IC=20mA  
 Ta=25°C  
 (Unit : Ω)



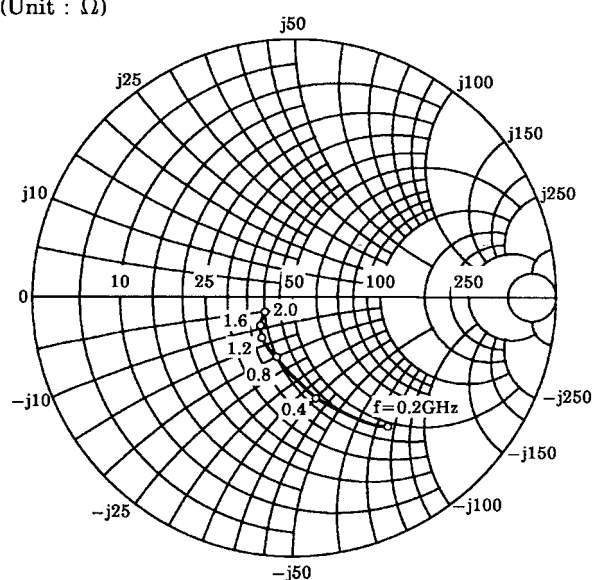
**S21e**  
 VCE=8V  
 IC=20mA  
 Ta=25°C



**S12e**  
 VCE=8V  
 IC=20mA  
 Ta=25°C



**S22e**  
 VCE=8V  
 IC=20mA  
 Ta=25°C  
 (Unit : Ω)



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