TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

2SC4320

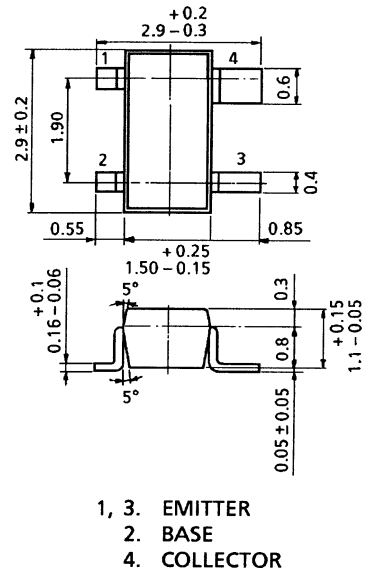
VHF~UHF Band Low Noise Amplifier Applications

- Low noise figure, high gain.
- NF = 1.1dB, $|S_{21e}|^2$ = 15dB (f = 1 GHz)

Maximum Ratings (Ta = 25°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	150	mW
Junction temperature	T_j	125	°C
Storage temperature range	T_{stg}	−55~125	°C

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2-3J1C

Weight: 0.012 g (typ.)

Microwave Characteristics (Ta = 25°C)

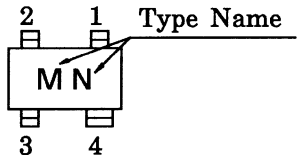
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Transition frequency	f_T	V_{CE} = 8 V, I_C = 20 mA	7	10	—	GHz
Insertion gain	$\|S_{21e}\|^2$ (1)	V_{CE} = 8 V, I_C = 20 mA, f = 1 GHz	12	15	—	dB
	$\|S_{21e}\|^2$ (2)	V_{CE} = 8 V, I_C = 20 mA, f = 2 GHz	—	9	—	
Noise figure	NF (1)	V_{CE} = 8 V, I_C = 5 mA, f = 1 GHz	—	1.1	2.5	dB
	NF (2)	V_{CE} = 8 V, I_C = 5 mA, f = 2 GHz	—	1.7	—	

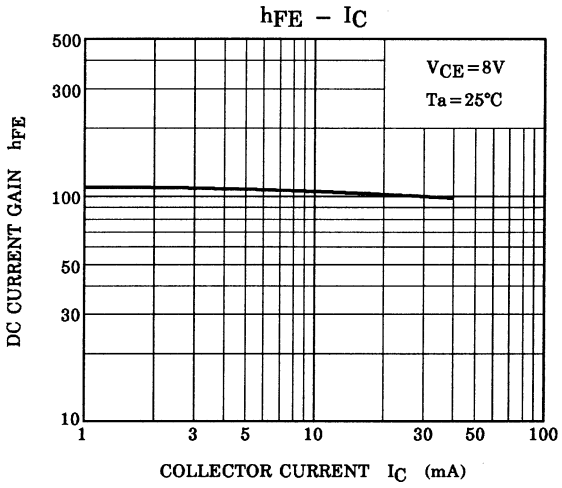
Electrical Characteristics (Ta = 25°C)

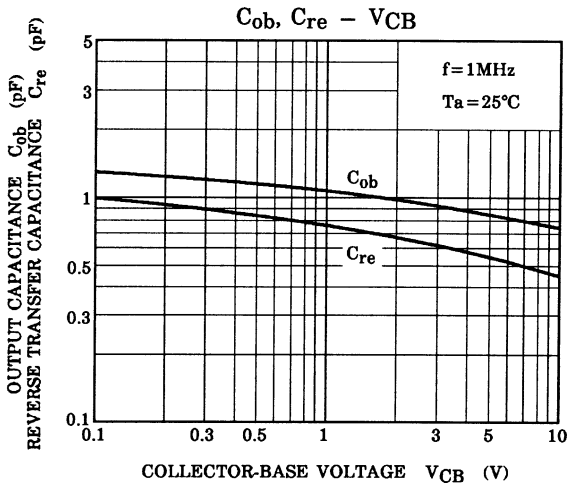
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = 10 V, I_E = 0	—	—	1	μA
Emitter cut-off current	I_{EBO}	V_{EB} = 1 V, I_C = 0	—	—	1	μA
DC current gain	h_{FE}	V_{CE} = 8 V, I_C = 20 mA	50	—	250	
Output capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz (Note)	—	0.75	—	pF
Reverse transfer capacitance	C_{re}		—	0.45	0.9	pF

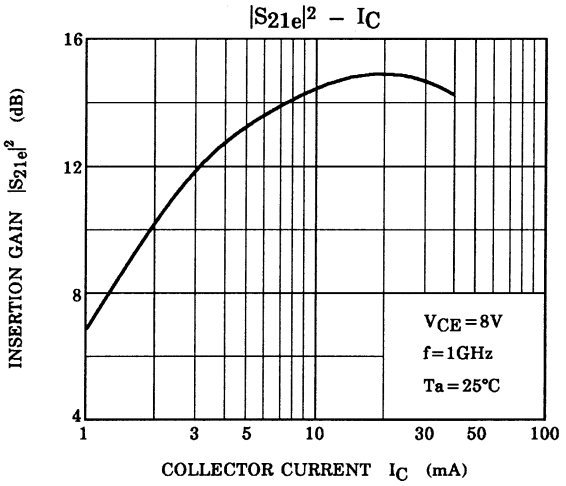
Note: C_{re} is measured by 3 terminal method with capacitance bridge.

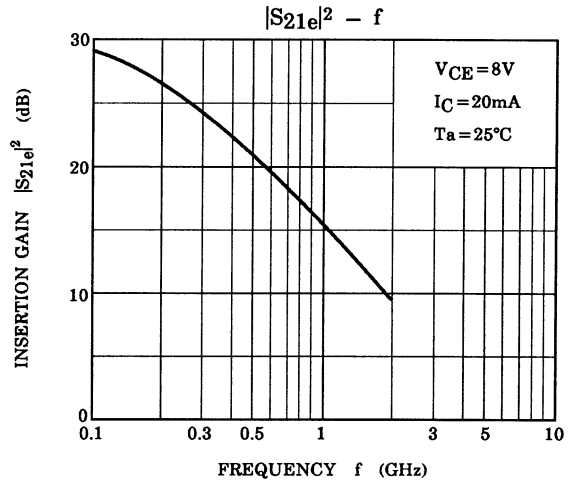
Marking

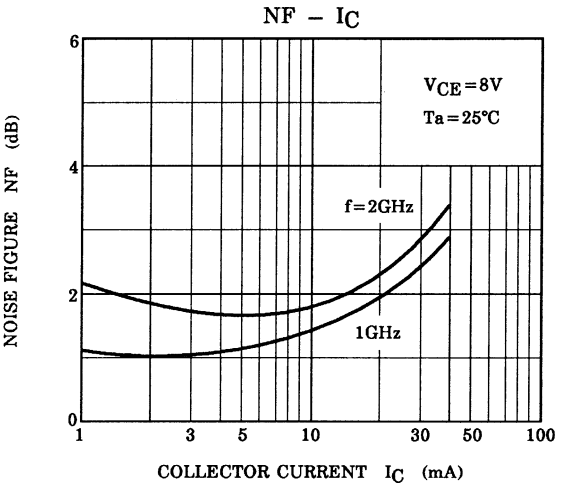


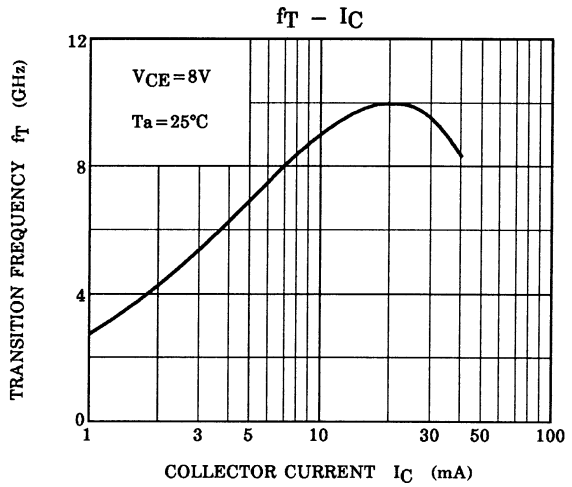

h_{FE} – I_C
V_{CE} = 8V
Ta = 25°C
DC CURRENT GAIN h_{FE}
500
300
100
50
30
10
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)

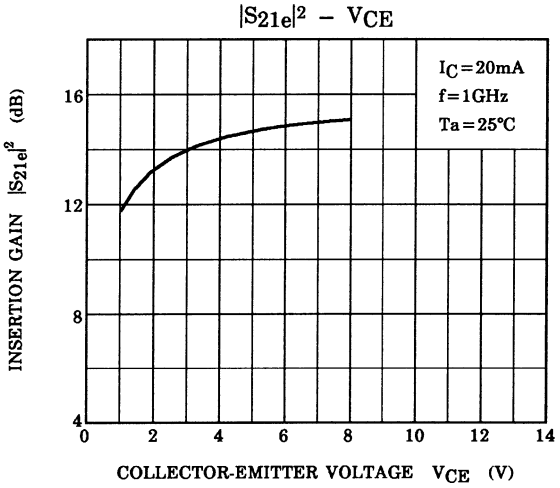

C_{ob}, C_{re} – V_{CB}
f = 1MHz
Ta = 25°C
C_{ob}
C_{re}
OUTPUT CAPACITANCE C_{ob} (pF)
REVERSE TRANSFER CAPACITANCE C_{re} (pF)
5
3
1
0.5
0.3
0.1
0.1
0.3
0.5
1
3
5
10
COLLECTOR-BASE VOLTAGE V_{CB} (V)

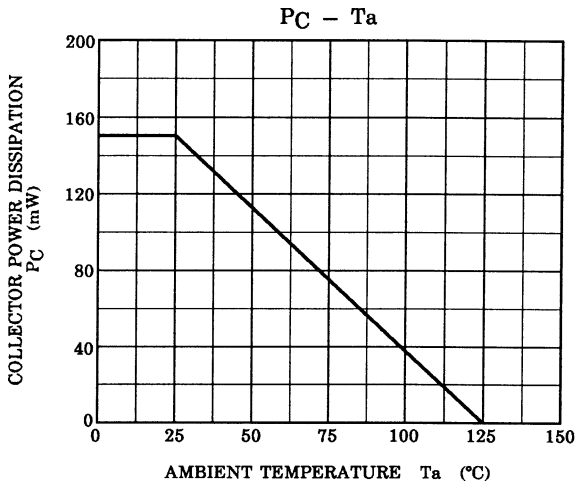

$|S_{21e}|^2$ – I_C
V_{CE} = 8V
f = 1GHz
Ta = 25°C
INSERTION GAIN $|S_{21e}|^2$ (dB)
16
12
8
4
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)


$|S_{21e}|^2$ – f
V_{CE} = 8V
I_C = 20mA
Ta = 25°C
INSERTION GAIN $|S_{21e}|^2$ (dB)
30
20
10
0
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (GHz)


NF – I_C
V_{CE} = 8V
Ta = 25°C
f = 2GHz
1GHz
NOISE FIGURE NF (dB)
6
4
2
0
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)


f_T – I_C
V_{CE} = 8V
Ta = 25°C
TRANSITION FREQUENCY f_T (GHz)
12
8
4
0
1
3
5
10
30
50
100
COLLECTOR CURRENT I_C (mA)





S-Parameter Z_O = 50 Ω, Ta = 25°C

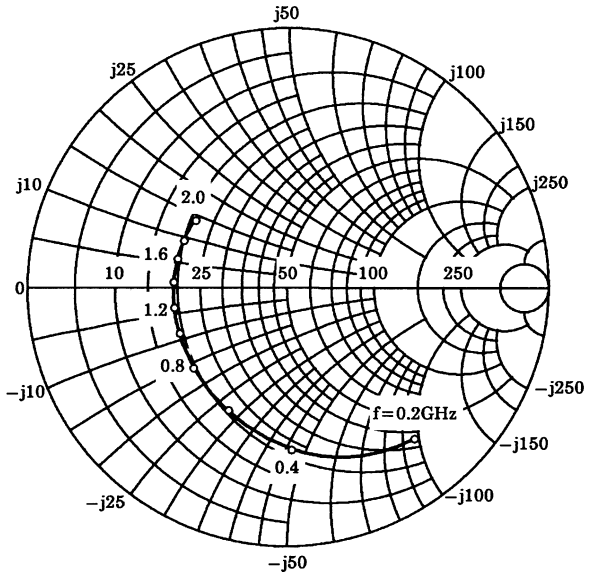
V_{CE} = 8 V, I_C = 5 mA

Frequency	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.764	–49.6	11.754	147.1	0.047	64.2	0.869	–29.4
400	0.624	–87.9	8.966	124.6	0.072	48.9	0.669	–48.3
600	0.532	–115.7	6.947	110.5	0.084	42.1	0.526	–59.5
800	0.485	–137.5	5.581	100.4	0.091	39.3	0.429	–66.6
1000	0.446	–155.0	4.636	92.9	0.097	38.6	0.370	–71.3
1200	0.441	–169.2	4.003	86.3	0.102	38.8	0.330	–75.3
1400	0.432	177.1	3.487	80.1	0.107	39.6	0.305	–77.6
1600	0.426	166.1	3.144	75.1	0.114	40.1	0.288	–80.7
1800	0.431	154.4	2.900	70.0	0.119	41.9	0.276	–83.9
2000	0.425	145.2	2.652	65.5	0.127	43.1	0.272	–87.3

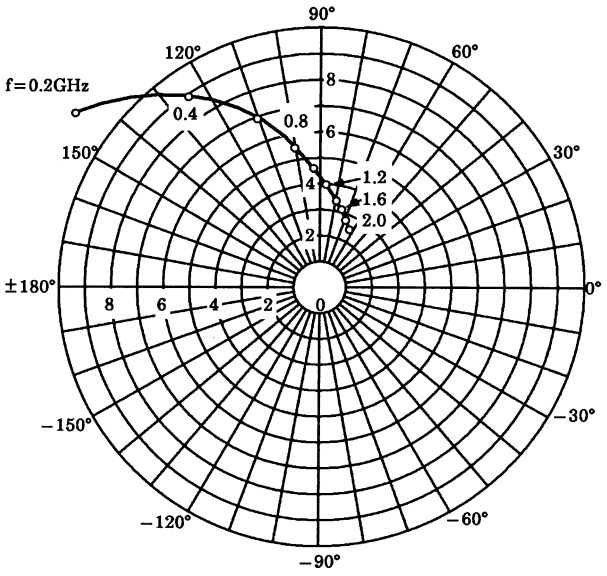
V_{CE} = 8 V, I_C = 20 mA

Frequency	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200	0.540	–90.3	21.037	129.7	0.033	55.7	0.670	–46.8
400	0.479	–134.8	13.017	108.7	0.046	50.0	0.417	–64.5
600	0.461	–159.4	9.230	98.1	0.054	51.2	0.297	–71.9
800	0.454	–176.0	7.117	90.5	0.063	54.1	0.230	–75.4
1000	0.454	170.7	5.816	85.1	0.073	56.1	0.191	–76.7
1200	0.452	160.0	4.944	79.8	0.084	57.9	0.168	–77.0
1400	0.461	149.1	4.299	74.7	0.094	58.7	0.156	–75.7
1600	0.459	140.7	3.838	70.6	0.105	59.0	0.151	–75.8
1800	0.461	131.9	3.483	66.0	0.117	59.4	0.154	–76.6
2000	0.450	124.2	3.171	61.8	0.130	59.0	0.161	–79.3

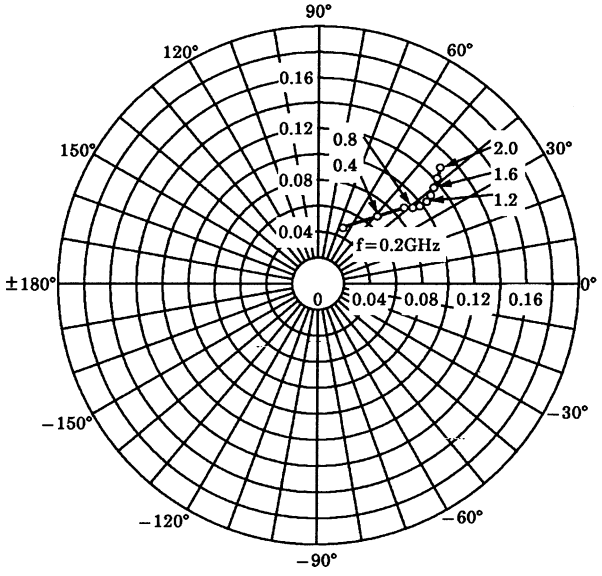
S_{11e}
V_{CE} = 8V
I_C = 5mA
Ta = 25°C
(UNIT : Ω)



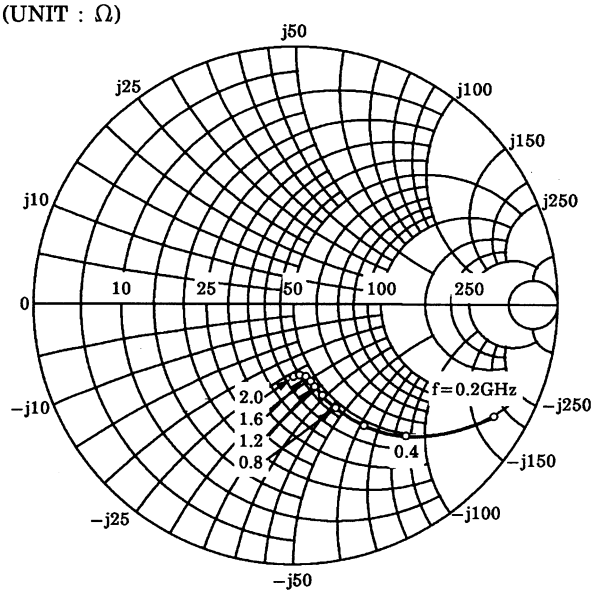
S_{21e}
V_{CE} = 8V
I_C = 5mA
Ta = 25°C



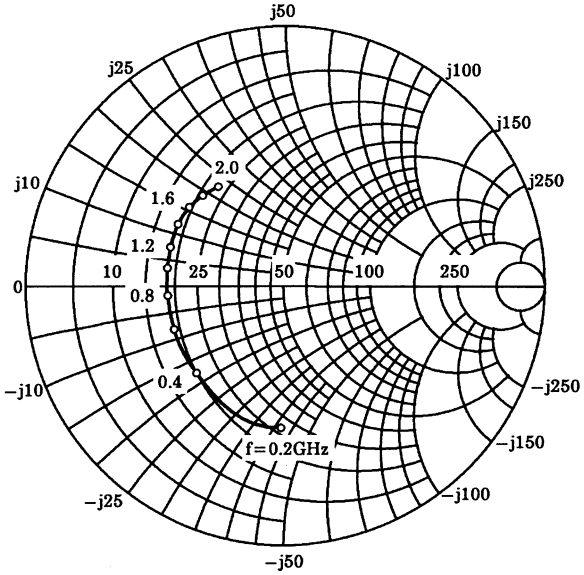
S_{12e}
V_{CE} = 8V
I_C = 5mA
Ta = 25°C



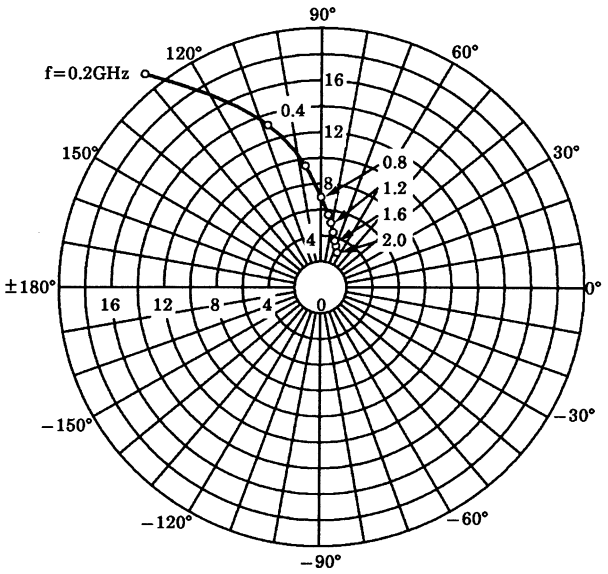
S_{22e}
V_{CE} = 8V
I_C = 5mA
Ta = 25°C
(UNIT : Ω)



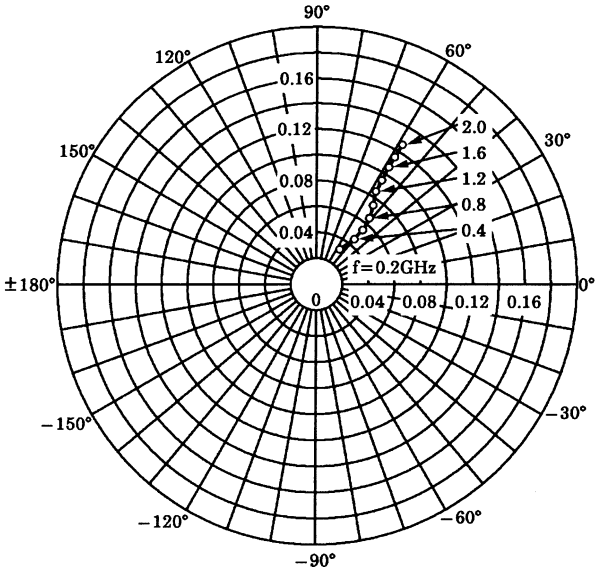
S_{11e}
V_{CE} = 8V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



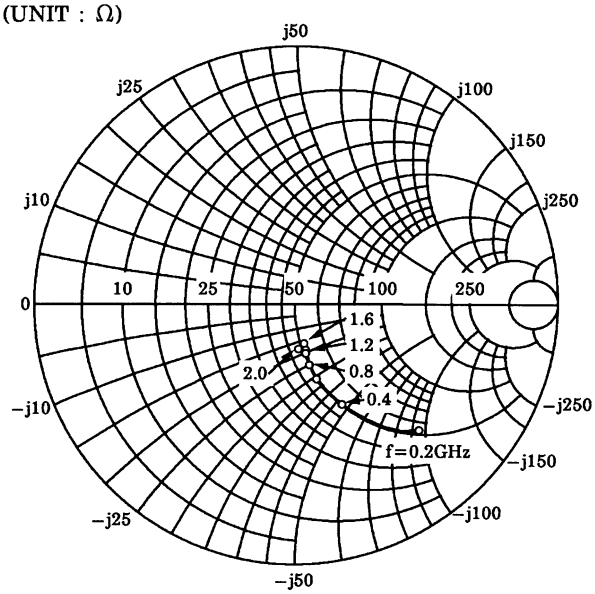
S_{21e}
V_{CE} = 8V
I_C = 20mA
Ta = 25°C



S_{12e}
V_{CE} = 8V
I_C = 20mA
Ta = 25°C



S_{22e}
V_{CE} = 8V
I_C = 20mA
Ta = 25°C
(UNIT : Ω)



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