

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

# MT4S32U

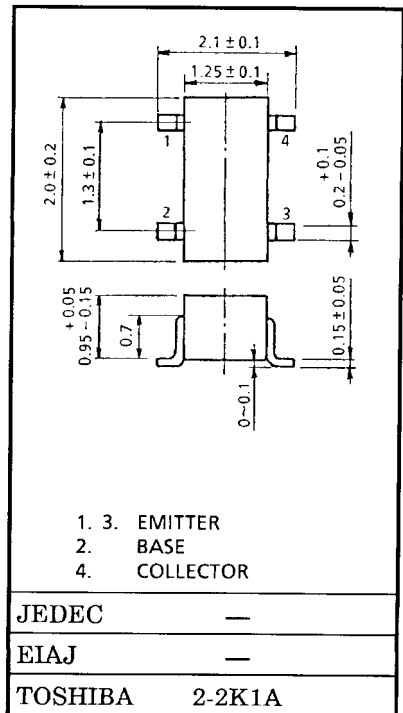
VHF~UHF Band Low Noise Amplifier Applications

- Low Noise Figure:  $NF = 1.4 \text{ dB}$  ( $f = 2 \text{ GHz}$ )
- High Gain:  $|S_{21e}|^2 = 13.5 \text{ dB}$  ( $f = 2 \text{ GHz}$ )

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

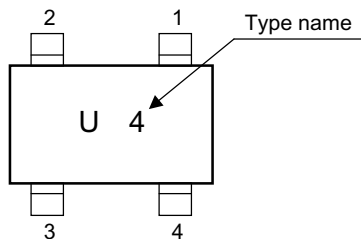
Characteristics	Symbol	Rating	Unit
Collector-base voltage	$V_{CBO}$	8	V
Collector-emitter voltage	$V_{CEO}$	4.5	V
Emitter-base voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	15	mA
Base current	$I_B$	7.5	mA
Collector power dissipation	$P_C$	67.5	mW
Junction temperature	$T_j$	125	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-55~125	$^\circ\text{C}$

Unit in mm



Weight: 0.006 g

### Marking



000707EAA1

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## Microwave Characteristics (Ta = 25°C)

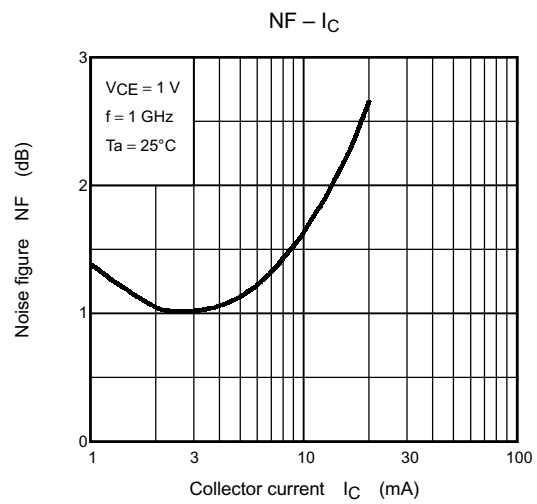
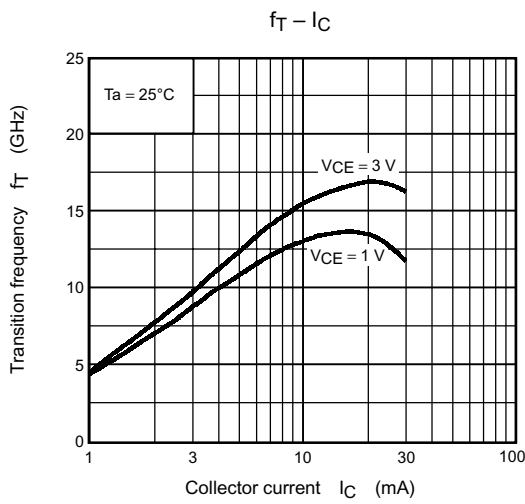
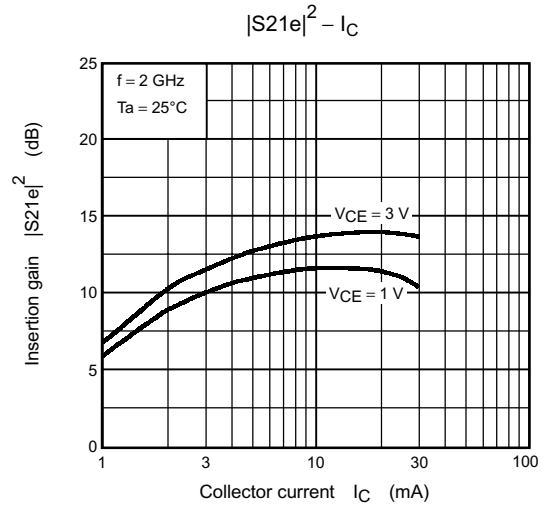
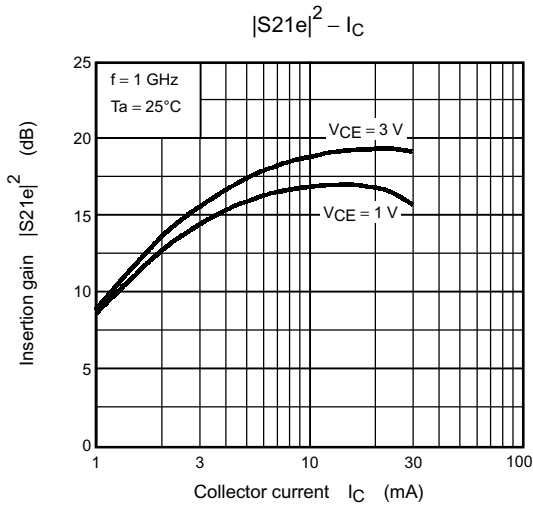
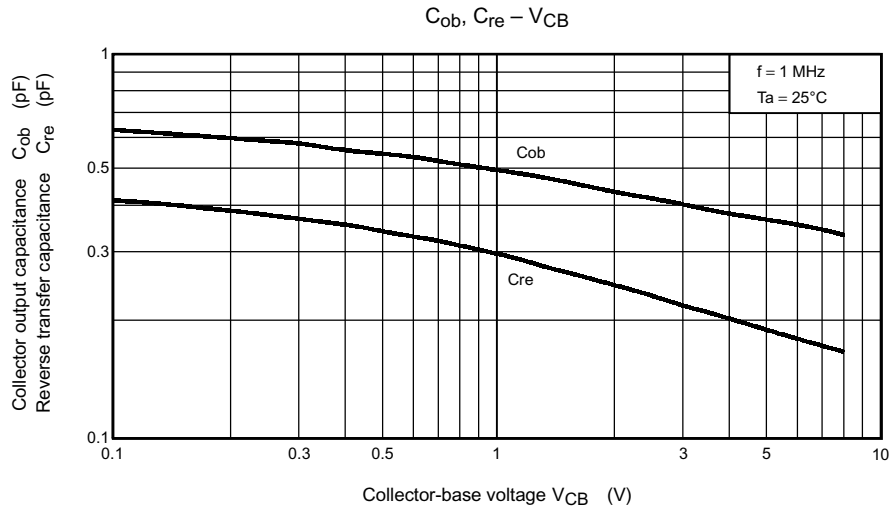
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Transition frequency	$f_T$	$V_{CE} = 3\text{ V}, I_C = 10\text{ mA}$	13	16	—	GHz
Insertion gain	$ S_{21e} ^2(1)$	$V_{CE} = 3\text{ V}, I_C = 10\text{ mA}, f = 1\text{ GHz}$	16.5	19	21.5	dB
	$ S_{21e} ^2(2)$	$V_{CE} = 3\text{ V}, I_C = 10\text{ mA}, f = 2\text{ GHz}$	11.5	13.5	16.5	dB
Noise figure	NF(1)	$V_{CE} = 3\text{ V}, I_C = 3\text{ mA}, f = 1\text{ GHz}$	—	1.0	1.4	dB
	NF(2)	$V_{CE} = 3\text{ V}, I_C = 3\text{ mA}, f = 2\text{ GHz}$	—	1.4	1.8	dB

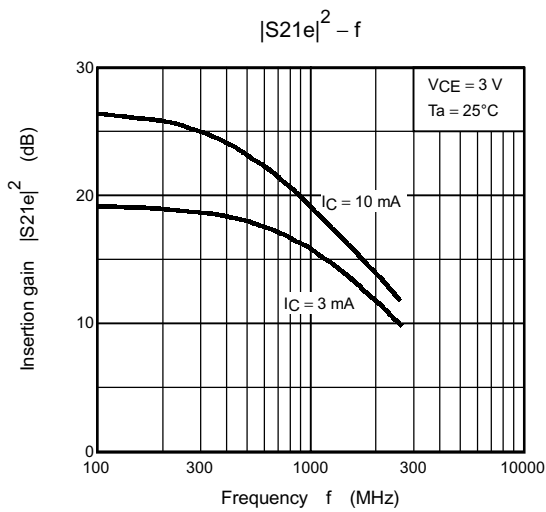
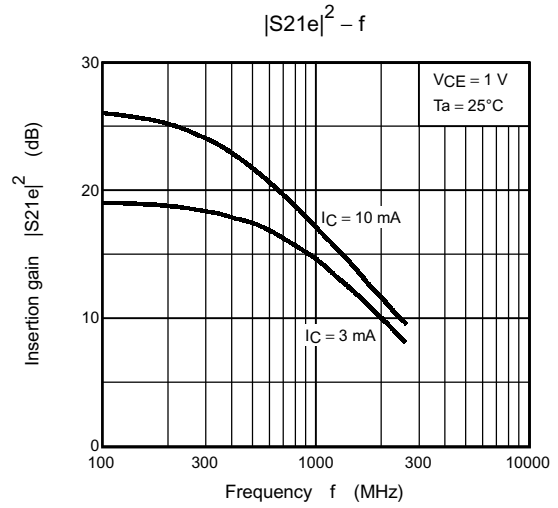
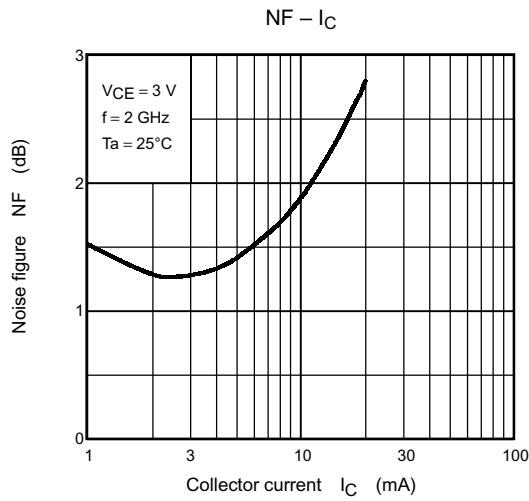
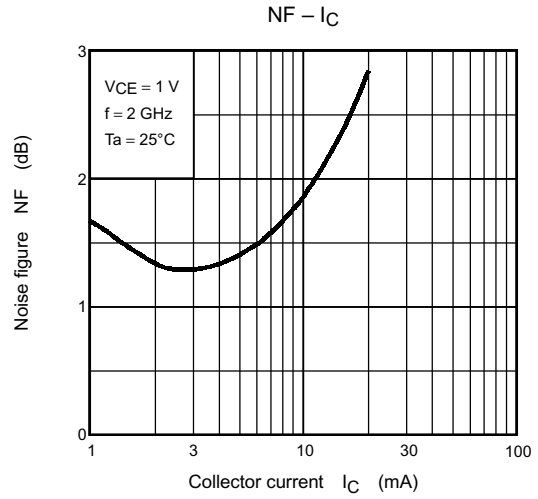
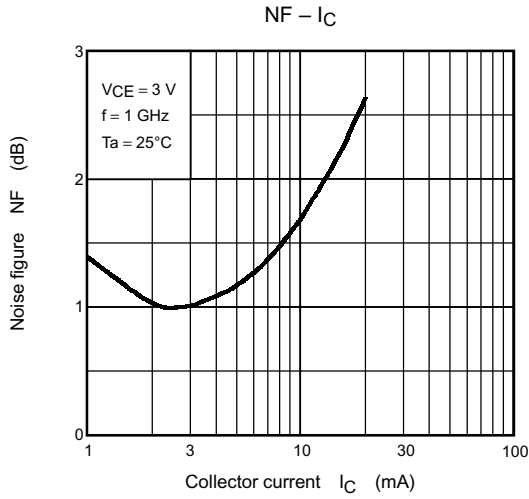
## Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	$V_{CB} = 8\text{ V}, I_E = 0$	—	—	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	$h_{FE}$	$V_{CE} = 3\text{ V}, I_C = 10\text{ mA}$	50	—	150	—
Output capacitance	$C_{ob}$	$V_{CB} = 3\text{ V}, I_E = 0, f = 1\text{ MHz}$	—	0.4	0.65	pF
Reverse transfer capacitance	$C_{re}$	(Note)	—	0.2	0.45	pF

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

CAUTION: This device electrostatic sensitivity. Please handle with caution.





**S parameter  $Z_0 = 50 \Omega$ ,  $T_a = 25^\circ\text{C}$**

**$V_{CE} = 1 \text{ V}$   $I_C = 3 \text{ mA}$**

Frequency f (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
100	0.870	-13.0	8.870	169.4	0.025	87.6	0.980	-9.9
200	0.850	-27.0	8.591	160.0	0.044	73.4	0.957	-19.1
300	0.822	-39.8	8.222	151.0	0.062	65.9	0.916	-28.1
400	0.793	-51.7	7.782	143.0	0.080	60.2	0.866	-36.4
500	0.759	-63.1	7.365	135.5	0.093	55.3	0.814	-43.7
600	0.731	-73.5	6.888	128.5	0.106	50.2	0.761	-50.5
700	0.700	-83.8	6.465	122.3	0.115	44.7	0.710	-56.9
800	0.675	-92.5	6.024	116.6	0.123	40.8	0.661	-62.6
900	0.653	-101.1	5.659	111.3	0.130	37.6	0.619	-67.7
1000	0.635	-108.5	5.307	106.8	0.135	34.8	0.576	-72.8
1100	0.617	-115.9	4.986	102.2	0.139	32.1	0.541	-77.2
1200	0.607	-122.3	4.695	98.2	0.143	29.4	0.508	-81.4
1300	0.595	-128.6	4.420	94.0	0.146	27.3	0.477	-85.3
1400	0.588	-134.1	4.206	90.4	0.148	25.5	0.450	-89.2
1500	0.580	-139.6	3.988	86.9	0.149	23.6	0.422	-92.8
1600	0.577	-144.3	3.814	83.9	0.152	22.6	0.402	-96.2
1700	0.572	-148.8	3.600	80.6	0.154	20.7	0.382	-99.7
1800	0.569	-153.2	3.429	77.6	0.156	20.2	0.364	-102.5
1900	0.566	-157.5	3.277	74.5	0.157	18.4	0.346	-105.9
2000	0.563	-161.2	3.164	71.8	0.156	17.9	0.329	-108.2
2100	0.561	-164.6	3.048	69.5	0.159	17.0	0.316	-111.6
2200	0.560	-168.0	2.902	67.1	0.160	15.9	0.302	-114.0
2300	0.556	-171.3	2.790	64.2	0.159	15.6	0.288	-117.1
2400	0.558	-174.2	2.697	61.5	0.162	14.8	0.278	-119.5
2500	0.554	-177.4	2.637	59.3	0.162	13.9	0.264	-122.8
2600	0.556	179.9	2.533	57.5	0.162	13.7	0.256	-124.7

$V_{CE} = 1\text{ V}$   $I_C = 10\text{ mA}$

Frequency f (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
100	0.647	-27.1	20.049	162.6	0.024	67.2	0.934	-18.9
200	0.621	-53.7	18.111	147.0	0.034	69.1	0.843	-35.6
300	0.590	-75.5	15.953	134.4	0.050	57.5	0.742	-49.8
400	0.564	-92.8	13.932	124.7	0.057	52.4	0.649	-61.0
500	0.544	-107.3	12.227	116.7	0.065	48.7	0.574	-70.2
600	0.532	-118.8	10.749	110.3	0.070	44.8	0.508	-78.2
700	0.526	-128.8	9.574	104.7	0.073	43.1	0.458	-85.3
800	0.519	-136.7	8.592	100.0	0.077	42.3	0.415	-91.5
900	0.517	-143.8	7.816	95.8	0.082	41.7	0.382	-97.2
1000	0.517	-149.7	7.135	92.2	0.085	40.6	0.354	-102.9
1100	0.516	-155.1	6.564	88.7	0.088	40.4	0.331	-107.8
1200	0.518	-159.8	6.079	85.7	0.092	39.5	0.312	-112.8
1300	0.520	-164.2	5.642	82.3	0.096	39.3	0.296	-117.0
1400	0.522	-167.9	5.294	79.6	0.100	38.7	0.283	-121.8
1500	0.525	-171.4	4.979	76.9	0.103	38.3	0.269	-126.3
1600	0.529	-174.6	4.702	74.5	0.107	38.1	0.261	-130.4
1700	0.531	-177.7	4.430	71.9	0.110	37.4	0.252	-134.9
1800	0.534	179.6	4.176	69.5	0.114	37.3	0.245	-138.4
1900	0.539	176.7	3.975	67.0	0.118	36.8	0.238	-142.8
2000	0.540	174.2	3.817	64.9	0.121	36.6	0.230	-146.5
2100	0.544	171.8	3.662	62.9	0.124	35.8	0.226	-150.7
2200	0.547	169.6	3.468	61.1	0.129	35.0	0.222	-154.0
2300	0.547	167.3	3.331	58.5	0.131	35.1	0.216	-158.3
2400	0.551	165.2	3.202	56.2	0.137	34.5	0.213	-161.5
2500	0.555	162.7	3.130	54.4	0.139	33.6	0.209	-165.8
2600	0.557	160.8	3.005	53.1	0.142	33.9	0.206	-169.1

$V_{CE} = 3\text{ V}$   $I_C = 3\text{ mA}$

Frequency f (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
100	0.883	-10.0	8.913	171.0	0.015	82.0	0.989	-6.8
200	0.872	-21.0	8.700	163.6	0.030	76.5	0.975	-13.4
300	0.844	-31.1	8.464	155.8	0.041	72.1	0.946	-20.0
400	0.819	-40.7	8.128	148.9	0.056	67.5	0.912	-25.9
500	0.790	-50.2	7.819	142.2	0.066	62.0	0.877	-31.3
600	0.760	-59.3	7.442	136.0	0.077	57.1	0.834	-36.5
700	0.730	-68.0	7.109	130.1	0.084	52.6	0.795	-41.3
800	0.703	-75.9	6.719	124.8	0.090	48.9	0.753	-45.6
900	0.676	-83.7	6.400	119.7	0.097	45.3	0.714	-49.6
1000	0.653	-90.5	6.065	115.3	0.101	42.4	0.675	-53.3
1100	0.627	-97.6	5.759	110.6	0.106	39.9	0.643	-56.6
1200	0.611	-103.9	5.462	106.7	0.110	37.8	0.609	-59.8
1300	0.595	-110.3	5.197	102.5	0.114	35.3	0.579	-62.6
1400	0.582	-115.8	4.972	98.9	0.116	33.2	0.551	-65.2
1500	0.567	-121.6	4.749	95.5	0.117	31.1	0.522	-67.7
1600	0.559	-126.4	4.564	92.4	0.120	30.1	0.501	-69.9
1700	0.549	-131.2	4.325	89.1	0.122	28.6	0.479	-72.2
1800	0.541	-136.0	4.136	86.1	0.124	27.6	0.460	-74.1
1900	0.533	-140.6	3.964	82.9	0.125	25.8	0.438	-76.2
2000	0.526	-144.7	3.837	80.3	0.124	24.8	0.420	-77.5
2100	0.523	-148.5	3.714	77.8	0.126	24.1	0.404	-79.4
2200	0.517	-152.1	3.531	75.6	0.128	23.2	0.391	-80.8
2300	0.510	-155.7	3.396	72.7	0.127	22.9	0.374	-82.0
2400	0.508	-159.0	3.292	69.9	0.129	22.4	0.364	-83.3
2500	0.503	-162.4	3.225	67.7	0.130	21.3	0.347	-85.1
2600	0.502	-165.5	3.099	66.1	0.130	21.3	0.338	-85.8

$V_{CE} = 3\text{ V}$   $I_C = 10\text{ mA}$

Frequency f (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
100	0.685	-19.0	20.505	165.8	0.011	80.4	0.959	-12.7
200	0.663	-38.5	19.144	153.1	0.025	66.7	0.904	-23.7
300	0.620	-55.5	17.511	141.9	0.035	64.1	0.819	-33.6
400	0.580	-70.4	15.811	132.6	0.044	58.3	0.744	-41.6
500	0.543	-83.6	14.223	124.8	0.049	56.2	0.675	-47.9
600	0.515	-94.7	12.816	118.2	0.054	52.2	0.608	-53.5
700	0.493	-105.3	11.610	112.4	0.057	50.3	0.555	-58.0
800	0.475	-113.8	10.533	107.4	0.061	49.5	0.506	-62.0
900	0.462	-121.8	9.671	103.1	0.065	47.5	0.467	-65.4
1000	0.452	-128.7	8.892	99.3	0.068	46.9	0.432	-68.4
1100	0.446	-135.2	8.223	95.6	0.071	46.6	0.403	-71.1
1200	0.441	-140.6	7.653	92.5	0.075	45.6	0.379	-73.8
1300	0.437	-146.0	7.150	89.1	0.078	45.0	0.356	-76.1
1400	0.436	-150.5	6.720	86.4	0.081	44.6	0.335	-78.3
1500	0.434	-154.9	6.339	83.6	0.084	44.0	0.315	-80.6
1600	0.437	-158.5	6.011	81.3	0.087	44.6	0.301	-82.4
1700	0.436	-162.2	5.667	78.6	0.090	43.1	0.286	-84.9
1800	0.437	-165.6	5.361	76.2	0.094	43.3	0.274	-86.5
1900	0.439	-169.3	5.099	73.6	0.096	41.7	0.260	-89.1
2000	0.440	-172.2	4.911	71.6	0.099	41.8	0.248	-90.1
2100	0.442	-175.0	4.717	69.6	0.102	41.8	0.238	-92.3
2200	0.442	-177.4	4.463	67.9	0.105	41.2	0.229	-93.4
2300	0.442	180.0	4.277	65.4	0.107	41.2	0.216	-95.6
2400	0.443	177.5	4.136	63.0	0.112	40.8	0.208	-96.6
2500	0.445	174.6	4.034	61.3	0.115	39.6	0.197	-98.7
2600	0.449	172.5	3.867	59.9	0.117	39.6	0.189	-99.6