## TOSHIBA TRANSISTOR SILICON NPN EPITAXIAL PLANAR TYPE

# 2 S C 5 3 1 9

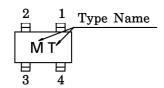
VHF~UHF BAND LOW NOISE AMPLIFIER APPLICATIONS

Low Noise Figure : NF = 1.3 dB (f = 2 GHz)
 High Gain : Ga = 11.5 dB (f = 2 GHz)

MAXIMUM RATINGS (Ta = 25°C)

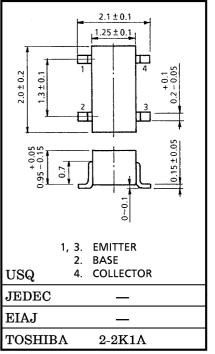
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	$v_{CBO}$	8	V
Collector-Emitter Voltage	$v_{CEO}$	5	V
Emitter-Base Voltage	$V_{ m EBO}$	1.5	V
Collector Current	$I_{\mathbf{C}}$	20	mA
Base Current	$I_{\mathbf{B}}$	10	mA
Collector Power Dissipation	$P_{\mathbf{C}}$	100	mW
Junction Temperature	$T_{j}$	125	°C
Storage Temperature Range	$\mathrm{T_{stg}}$	-55~125	°C

## **MARKING**



## MICROWAVE CHARACTERISTICS (Ta = 25°C)

Unit in mm



Weight: 0.006 g

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Transition Frequency	${ m f_T}$	$V_{CE} = 3 \text{ V}, I_{C} = 15 \text{ mA}$	13	16	_	GHz	
Insertion Gain	$ S_{21e} ^2$ (1)	$V_{CE} = 3 \text{ V}, I_{C} = 15 \text{ mA}, f = 1 \text{ GHz}$	14.5	17	_	dB	
	$ S_{21e} ^2$ (2)	$V_{CE} = 3 \text{ V}, I_{C} = 15 \text{ mA}, f = 2 \text{ GHz}$	8.5	11.5	_	иь	
Noise Eigene	NF (1)	$V_{ m CE}=3~{ m V},~{ m I}_{ m C}=5~{ m mA},~{ m f}=1~{ m GHz}$		0.9	1.8	dB	
Noise Figure	NF (2)	$V_{CE} = 3 V$ , $I_{C} = 5 \text{ mA}$ , $f = 2 \text{ GHz}$	_	1.3	2.2	u.b	

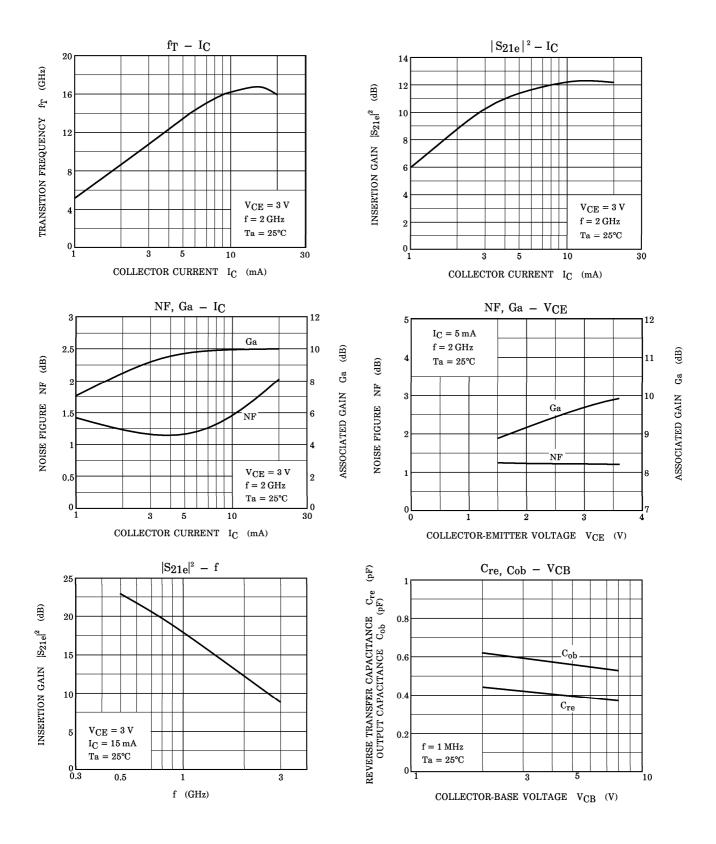
## ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	ICBO	$V_{CB} = 8 V, I_{E} = 0$	_	_	1	$\mu$ A
Emitter Cut-off Current	$I_{EBO}$	$V_{EB} = 1 V, I_{C} = 0$	_	_	1	$\mu$ A
DC Current Gain	$h_{ extbf{FE}}$	$V_{CE} = 3 V$ , $I_{C} = 15 mA$	50	_	250	V
Output Capacitance	$C_{ob}$	$V_{CB} = 2.5 \text{ V}, I_{E} = 0,$	_	0.6	_	pF
Reverse Transfer Capacitance	$\mathrm{c}_{\mathrm{re}}$	f = 1  MHz (Note)	_	0.4	0.85	pF

(Note):  $C_{re}$  is measured by 3 terminal method with Capacitance Bridge.

## **CAUTION**

This device electrostatic sensitivity. Please handle with caution.



S-PARAMETI V <sub>CE</sub> = 3 V, I	ER Z <sub>O</sub> = 5 C = 1 mA	$0 \Omega$ , Ta = 2	5°C					
${f f}$	S	11	S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
800	0.838	-52.3	3.011	134.2	0.146	56.2	0.880	-38.1
900	0.813	-57.7	2.956	130.8	0.161	53.4	0.854	-40.8
1000	0.793	-62.3	2.839	125.4	0.174	49.5	0.842	-44.8
1100	0.780	-67.0	2.758	122.9	0.183	46.4	0.811	-47.9
1200	0.736	-72.6	2.584	116.6	0.194	42.6	0.798	-51.6
1300	0.733	-77.0	2.597	115.6	0.198	39.5	0.778	-54.5
1400	0.709	-82.4	2.500	109.2	0.202	38.0	0.760	-57.6
1500	0.688	-87.2	2.414	105.8	0.206	36.1	0.739	-60.7
1600	0.686	-89.8	2.331	102.2	0.213	35.7	0.728	-63.5
1700	0.668	-93.8	2.229	100.1	0.228	34.4	0.713	-66.2
1800	0.643	-97.7	2.201	95.4	0.236	30.4	0.707	-69.3
1900	0.619	-102.6	2.094	90.4	0.236	27.4	0.698	-71.5
2000	0.589	-107.3	2.003	90.5	0.239	24.9	0.686	-74.7
2100	0.593	-107.8	1.941	84.9	0.236	23.0	0.678	-76.7
2200	0.560	-112.4	1.864	86.0	0.240	22.5	0.666	-79.6
2300	0.564	-116.6	1.942	79.1	0.247	19.6	0.668	-81.8
2400	0.590	-119.3	1.753	81.6	0.239	16.5	0.656	-84.0
V <sub>CE</sub> = 3 V, I	_	11	a	21	S1	o.	S2	10
(MHz)		11	52	41				
(WIIIZ) 800	Mag	Ana	Mog	Ana				
000	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
	0.634	-83.6	6.442	118.6	Mag. 0.113	Ang. 48.4	Mag. 0.682	Ang. -56.4
900	$0.634 \\ 0.606$	-83.6 -91.1	6.442 $6.105$	118.6 114.7	Mag. 0.113 0.121	Ang. 48.4 45.7	Mag. 0.682 0.644	Ang. -56.4 -59.7
900 1000	0.634 0.606 0.587	-83.6 -91.1 -96.3	6.442 6.105 5.681	118.6 114.7 110.0	Mag. 0.113 0.121 0.126	Ang. 48.4 45.7 42.8	Mag. 0.682 0.644 0.613	Ang. -56.4 -59.7 -64.2
900 1000 1100	0.634 0.606 0.587 0.562	-83.6 -91.1 -96.3 -101.2	6.442 6.105 5.681 5.375	118.6 114.7 110.0 107.1	Mag. 0.113 0.121 0.126 0.131	Ang. 48.4 45.7 42.8 40.8	Mag. 0.682 0.644 0.613 0.582	Ang 56.4 - 59.7 - 64.2 - 66.9
900 1000 1100 1200	0.634 0.606 0.587 0.562 0.528	-83.6 -91.1 -96.3 -101.2 -108.0	6.442 6.105 5.681 5.375 4.899	118.6 114.7 110.0 107.1 102.1	Mag. 0.113 0.121 0.126 0.131 0.133	Ang. 48.4 45.7 42.8 40.8 38.6	Mag. 0.682 0.644 0.613 0.582 0.555	Ang56.4 -59.7 -64.2 -66.9 -70.9
900 1000 1100 1200 1300	0.634 0.606 0.587 0.562 0.528 0.524	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7	6.442 6.105 5.681 5.375 4.899 4.756	118.6 114.7 110.0 107.1 102.1 100.3	Mag. 0.113 0.121 0.126 0.131 0.133 0.135	Ang. 48.4 45.7 42.8 40.8 38.6 37.7	Mag. 0.682 0.644 0.613 0.582 0.555 0.532	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0
900 1000 1100 1200 1300 1400	0.634 0.606 0.587 0.562 0.528 0.524 0.504	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2	6.442 6.105 5.681 5.375 4.899 4.756 4.473	118.6 114.7 110.0 107.1 102.1 100.3 96.2	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1
900 1000 1100 1200 1300 1400 1500	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7
900 1000 1100 1200 1300 1400 1500	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4
900 1000 1100 1200 1300 1400 1500 1600	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3
900 1000 1100 1200 1300 1400 1500 1600 1700 1800	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9 -134.4	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150 0.153	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7
900 1000 1100 1200 1300 1400 1500 1600	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445 0.428	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662 3.441	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7 81.0	Mag. 0.113 0.121 0.126 0.131 0.135 0.137 0.140 0.144 0.150 0.153 0.153	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9 33.3	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457 0.442	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7 -89.9
900 1000 1100 1200 1300 1400 1500 1600 1700 1800	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9 -134.4 -140.0	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150 0.153	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7
900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445 0.428 0.424	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9 -134.4 -140.0 -143.1	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662 3.441 3.329	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7 81.0 81.0	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150 0.153 0.153 0.152	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9 33.3 32.5	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457 0.442 0.436	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7 -89.9 -92.4
900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445 0.428 0.424 0.404	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9 -134.4 -140.0 -143.1 -145.6	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662 3.441 3.329 3.149	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7 81.0 81.0 77.3	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150 0.153 0.152 0.153	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9 33.3 32.5 33.0	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457 0.442 0.436 0.432	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7 -89.9 -92.4 -94.1
900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100	0.634 0.606 0.587 0.562 0.528 0.524 0.504 0.470 0.480 0.459 0.445 0.428 0.424 0.404 0.385	-83.6 -91.1 -96.3 -101.2 -108.0 -113.7 -118.2 -124.2 -127.2 -128.9 -134.4 -140.0 -143.1 -145.6 -149.3	6.442 6.105 5.681 5.375 4.899 4.756 4.473 4.223 4.049 3.813 3.662 3.441 3.329 3.149 3.041	118.6 114.7 110.0 107.1 102.1 100.3 96.2 93.0 90.2 88.8 84.7 81.0 77.3 77.5	Mag. 0.113 0.121 0.126 0.131 0.133 0.135 0.137 0.140 0.144 0.150 0.153 0.153 0.153 0.155 0.157	Ang. 48.4 45.7 42.8 40.8 38.6 37.7 37.6 37.0 37.3 35.8 33.9 33.3 32.5 33.0 33.0	Mag. 0.682 0.644 0.613 0.582 0.555 0.532 0.507 0.489 0.477 0.459 0.457 0.442 0.436 0.432 0.420	Ang56.4 -59.7 -64.2 -66.9 -70.9 -74.0 -77.1 -79.7 -82.4 -85.3 -87.7 -89.9 -92.4 -94.1 -97.2

$V_{CE} = 3 V, I$	$I_C = 5 \text{ mA}$								
${f f}$	S	11		S21 S		2	S	S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	
800	0.539	-101.6	7.906	110.6	0.093	47.0	0.557	-66.6	
900	0.512	-109.5	7.361	106.9	0.098	45.0	0.516	-70.0	
1000	0.498	-114.8	6.733	102.6	0.102	43.5	0.486	-74.0	
1100	0.472	-122.2	6.308	100.0	0.105	42.9	0.455	-76.7	
1200	0.461	-126.3	5.709	95.8	0.108	41.9	0.431	-80.0	
1300	0.450	-131.8	5.487	94.0	0.109	41.9	0.411	-82.8	
1400	0.439	-136.7	5.146	90.4	0.112	42.6	0.392	-86.0	
1500	0.413	-143.8	4.796	87.9	0.116	42.8	0.377	-88.3	
1600	0.435	-146.5	4.593	85.4	0.121	43.3	0.368	-90.9	
1700	0.411	-146.6	4.305	83.9	0.126	42.5	0.355	-93.4	
1800	0.402	-153.7	4.099	80.0	0.128	41.5	0.354	-95.7	
1900	0.386	-159.0	3.870	77.6	0.129	41.5	0.343	-97.9	
2000	0.386	-161.9	3.729	77.2	0.131	41.4	0.340	-99.9	
2100	0.369	-164.5	3.519	74.1	0.133	42.4	0.337	-101.7	
2200	0.368	-168.2	3.407	74.2	0.138	42.6	0.332	-104.1	
2300	0.378	-172.1	3.339	69.1	0.140	41.8	0.334	-105.2	
2400	0.398	-170.2	3.153	71.0	0.140	42.4	0.328	-107.2	

## RESTRICTIONS ON PRODUCT USE

000707EAA

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