

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

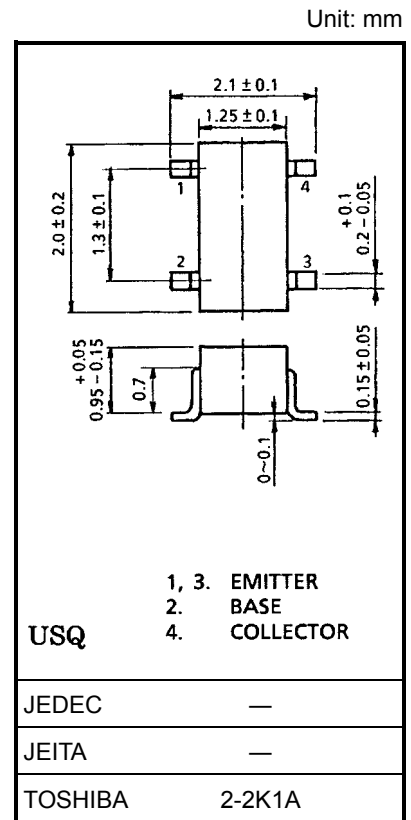
# 2SC5098

## VHF~UHF Band Low Noise Amplifier Applications

- Low noise figure, high gain.
- $NF = 1.8\text{dB}$ ,  $|S_{21e}|^2 = 10\text{dB}$  ( $f = 2\text{GHz}$ )

### 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	$I_B$	7	mA
Collector current	$I_C$	15	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	$f_T$	$V_{CE} = 6\text{V}$ , $I_C = 7\text{mA}$	7	10	—	GHz
Insertion gain	$ S_{21e} ^2$ (1)	$V_{CE} = 6\text{V}$ , $I_C = 7\text{mA}$ , $f = 1\text{GHz}$	12.5	15.5	—	dB
	$ S_{21e} ^2$ (2)	$V_{CE} = 6\text{V}$ , $I_C = 7\text{mA}$ , $f = 2\text{GHz}$	7	10	—	
Noise figure	NF (1)	$V_{CE} = 6\text{V}$ , $I_C = 3\text{mA}$ , $f = 1\text{GHz}$	—	1.3	2.5	dB
	NF (2)	$V_{CE} = 6\text{V}$ , $I_C = 3\text{mA}$ , $f = 2\text{GHz}$	—	1.8	3.0	

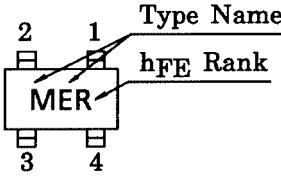
### Electrical Characteristics ( $T_a = 25^\circ\text{C}$ )

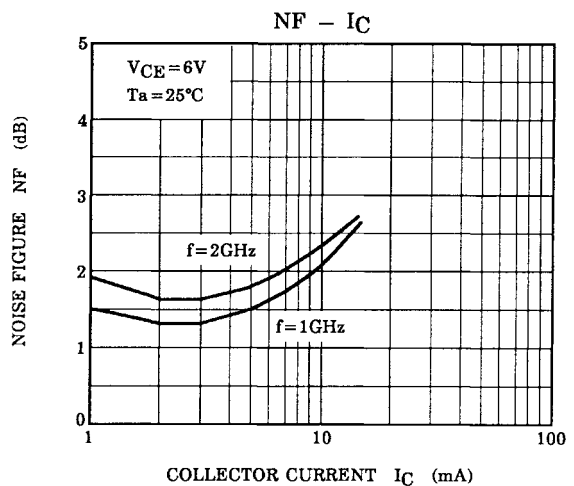
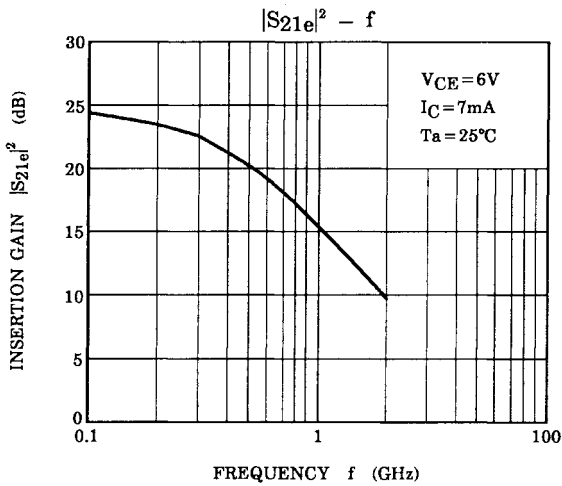
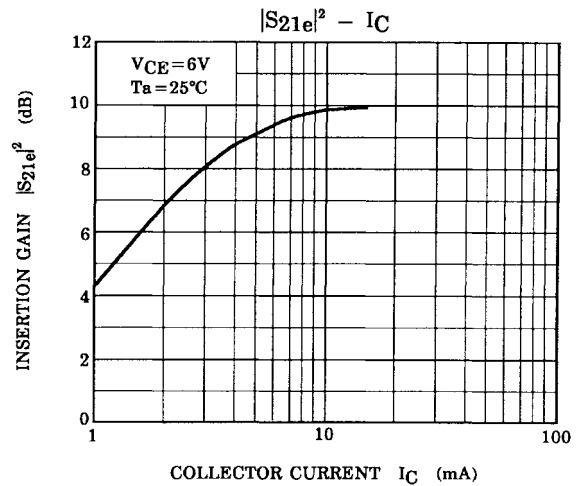
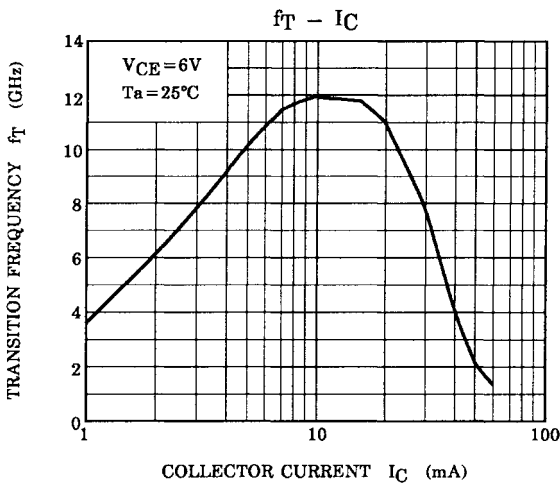
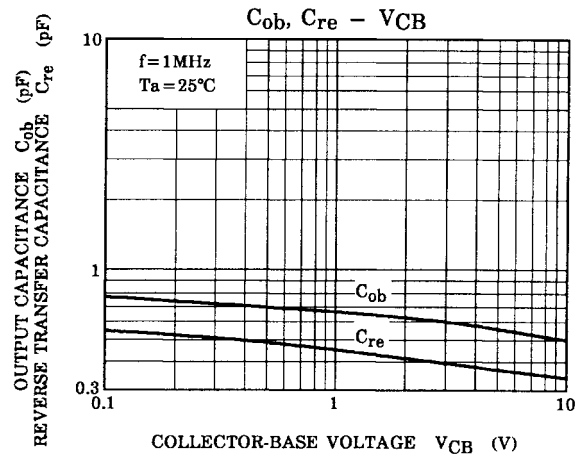
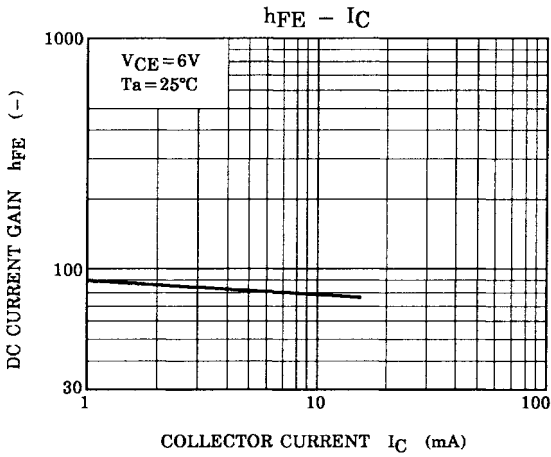
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	$V_{CB} = 10\text{V}$ , $I_E = 0$	—	—	1	$\mu\text{A}$
Emitter cut-off current	$I_{EBO}$	$V_{EB} = 1\text{V}$ , $I_C = 0$	—	—	1	$\mu\text{A}$
DC current gain	$h_{FE}$ (Note 1)	$V_{CE} = 6\text{V}$ , $I_C = 7\text{mA}$	50	—	160	
Output capacitance	$C_{ob}$	$V_{CB} = 10\text{V}$ , $I_E = 0$ , $f = 1\text{MHz}$ (Note 2)	—	0.5	0.9	pF
Reverse transfer capacitance	$C_{re}$		—	0.34	0.75	pF

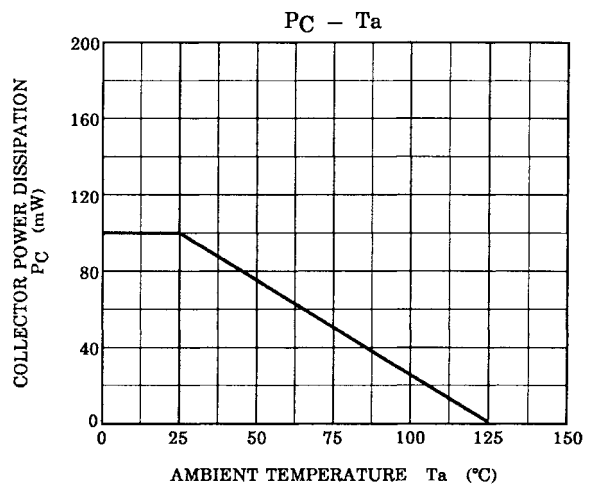
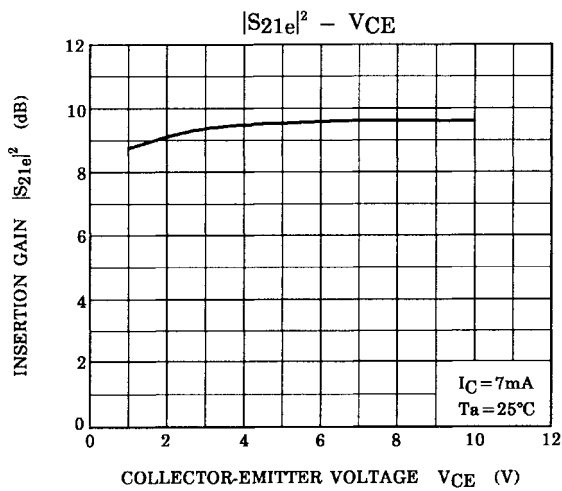
Note 1:  $h_{FE}$  classification R: 50~100, O: 80~160

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

**Marking**







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

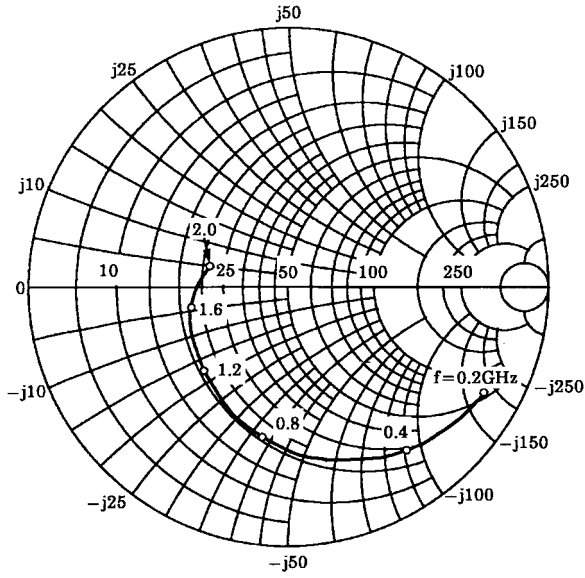
**$V_{CE} = 5 \text{ V}, I_C = 5 \text{ mA}$**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.870	-27.8	8.387	159.6	0.041	76.0	0.962	-20.1
400	0.791	-54.0	7.700	141.8	0.074	63.5	0.876	-38.7
600	0.692	-77.8	6.701	125.7	0.097	54.2	0.774	-54.4
800	0.599	-99.2	5.798	112.6	0.113	47.9	0.677	-67.7
1000	0.518	-118.1	4.928	102.0	0.122	43.8	0.596	-78.6
1200	0.462	-135.9	4.239	93.5	0.129	40.7	0.524	-87.8
1400	0.406	-151.0	3.692	86.5	0.132	39.7	0.463	-95.9
1600	0.376	-166.0	3.256	80.5	0.137	39.6	0.420	-102.4
1800	0.334	179.9	2.897	75.9	0.143	39.9	0.382	-107.7
2000	0.305	166.3	2.623	71.3	0.147	40.7	0.350	-111.0

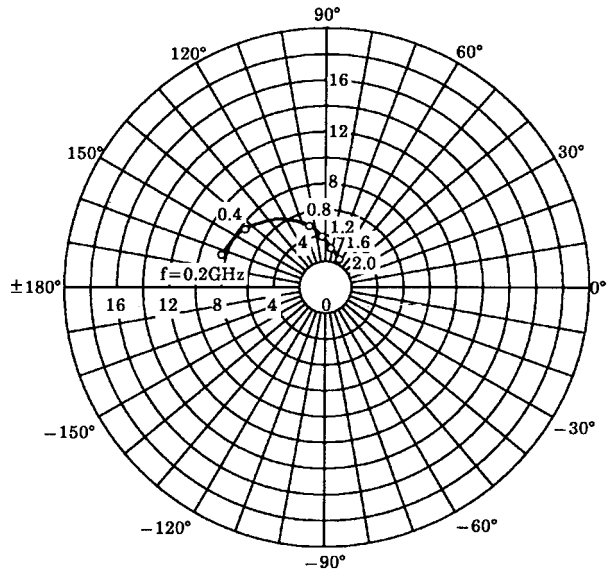
**$V_{CE} = 5 \text{ V}, I_C = 10 \text{ mA}$**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.737	-42.4	14.597	150.5	0.037	70.4	0.900	-28.4
400	0.625	-77.4	11.757	128.3	0.060	58.8	0.735	-50.2
600	0.521	-105.4	9.204	112.6	0.074	52.5	0.600	-65.3
800	0.455	-128.8	7.420	101.5	0.085	50.0	0.503	-77.3
1000	0.412	-147.7	6.078	92.9	0.093	49.5	0.433	-86.9
1200	0.388	-165.4	5.105	86.1	0.100	49.3	0.376	-95.4
1400	0.370	179.0	4.377	80.9	0.108	50.4	0.330	-102.8
1600	0.360	165.6	3.855	76.2	0.116	51.4	0.295	-108.7
1800	0.348	151.3	3.441	72.3	0.126	52.3	0.265	-113.4
2000	0.333	137.7	3.114	68.4	0.135	53.2	0.238	-115.5

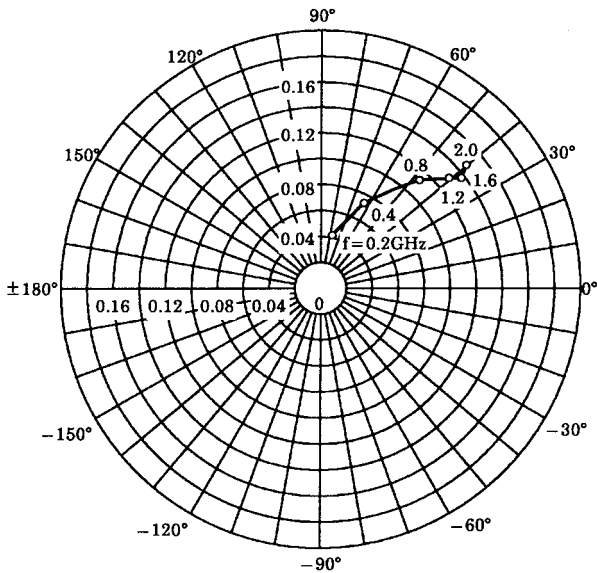
**S11e**  
 $V_{CE} = 6V$   
 $I_C = 3mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



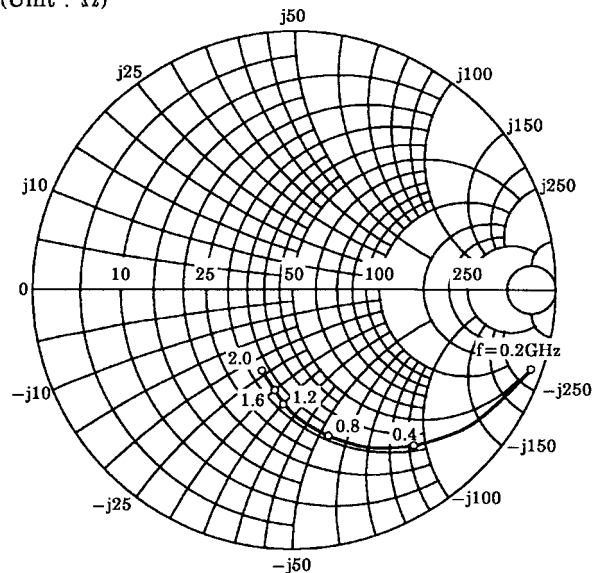
**S21e**  
 $V_{CE} = 6V$   
 $I_C = 3mA$   
 $T_a = 25^\circ C$



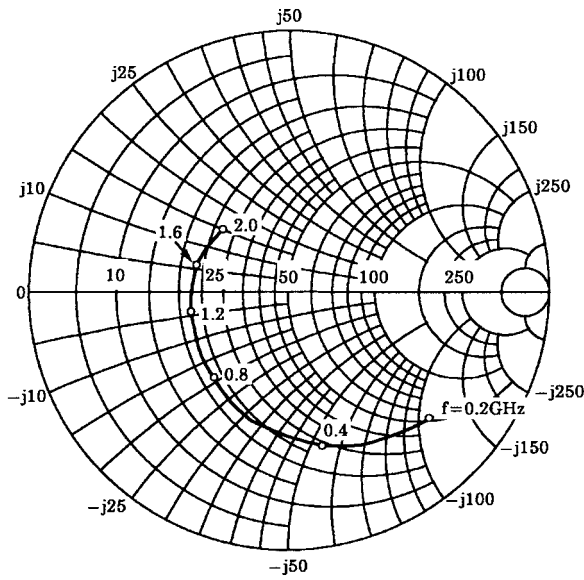
**S12e**  
 $V_{CE} = 6V$   
 $I_C = 3mA$   
 $T_a = 25^\circ C$



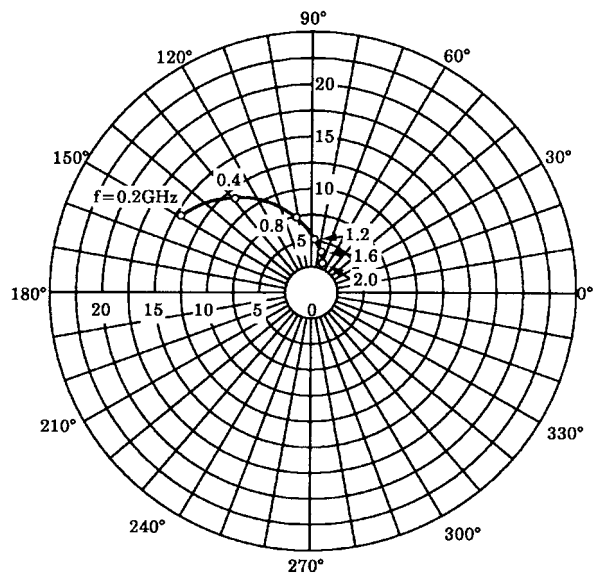
**S22e**  
 $V_{CE} = 6V$   
 $I_C = 3mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



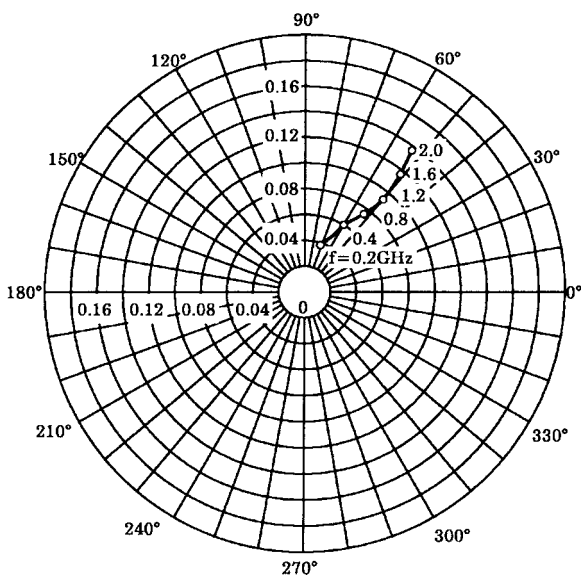
**S11e**  
 $V_{CE} = 6V$   
 $I_C = 7mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



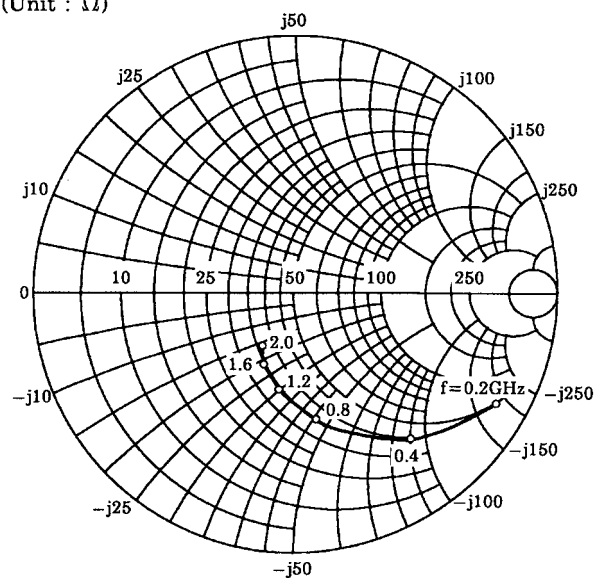
**S21e**  
 $V_{CE} = 6V$   
 $I_C = 7mA$   
 $T_a = 25^\circ C$



**S12e**  
 $V_{CE} = 6V$   
 $I_C = 7mA$   
 $T_a = 25^\circ C$



**S22e**  
 $V_{CE} = 6V$   
 $I_C = 7mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



**RESTRICTIONS ON PRODUCT USE**

000707EAA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.  
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.