

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

# 2SC5089

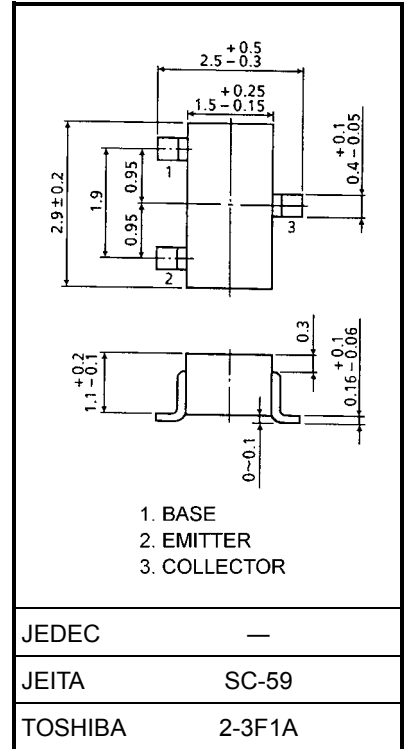
## VHF~UHF Band Low Noise Amplifier Applications

Unit: mm

- Low noise figure, high gain.
- $NF = 1.1\text{dB}$ ,  $|S_{21e}|^2 = 13\text{dB}$  ( $f = 1\text{GHz}$ )

### 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	$P_C$	150	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: 0.012 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)$	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$ , $f = 1\text{GHz}$	10	13	—	dB
	$ S_{21e} ^2 (2)$	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$ , $f = 2\text{GHz}$	—	7	—	
Noise figure	NF (1)	$V_{CE} = 8\text{V}$ , $I_C = 5\text{mA}$ , $f = 1\text{GHz}$	—	1.1	2.5	dB
	NF (2)	$V_{CE} = 8\text{V}$ , $I_C = 5\text{mA}$ , $f = 2\text{GHz}$	—	1.7	—	

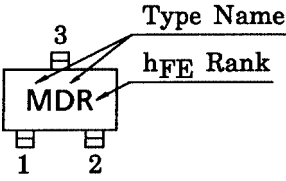
### Electrical Characteristics ( $T_a = 25^\circ\text{C}$ )

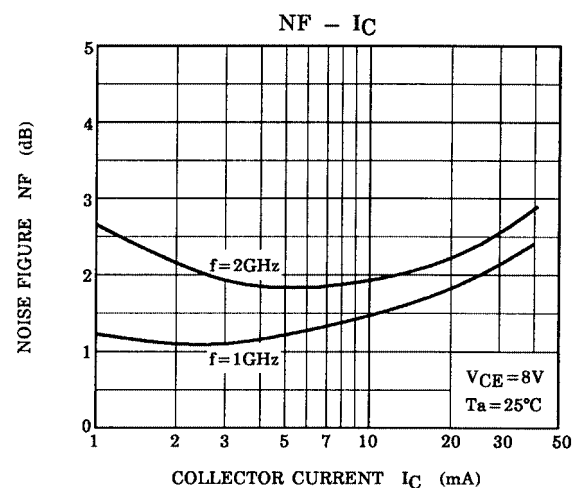
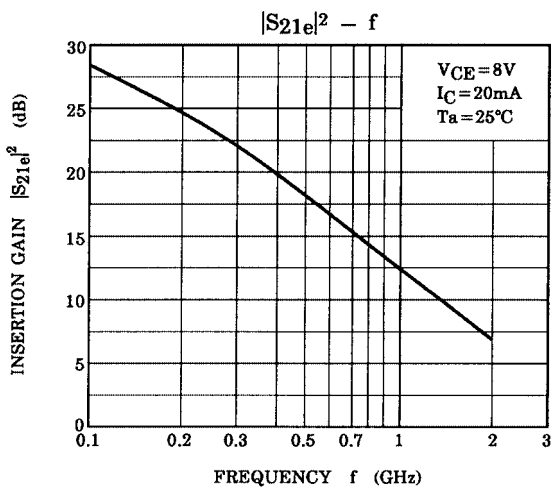
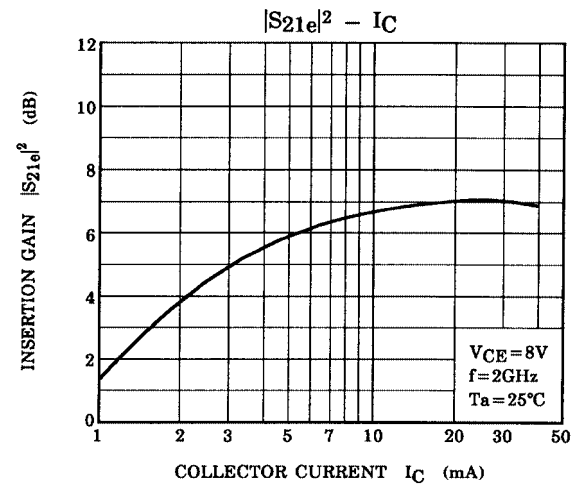
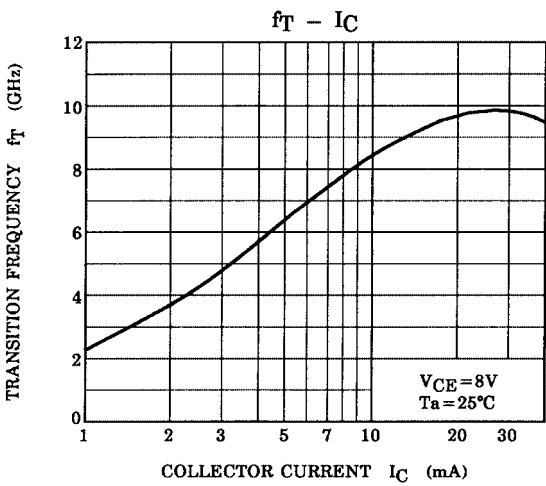
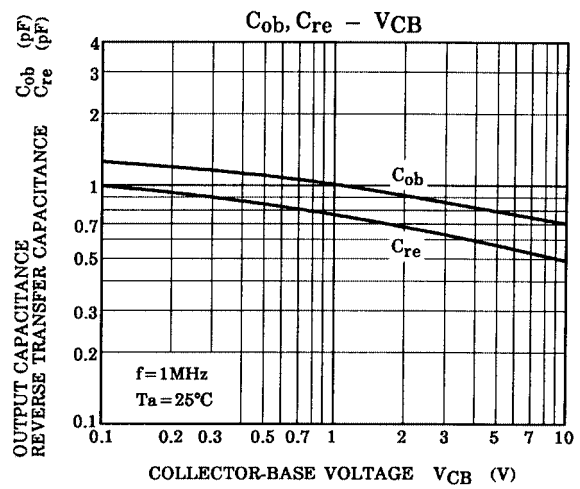
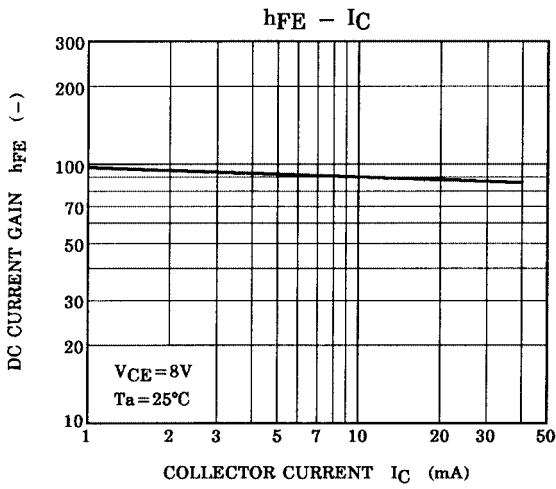
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	$V_{CB} = 10\text{V}$ , $I_E = 0$	—	—	1	$\mu\text{A}$
Emitter cut-off current	$I_{EBO}$	$V_{EB} = 1\text{V}$ , $I_C = 0$	—	—	1	$\mu\text{A}$
DC current gain	$h_{FE}$ (Note 1)	$V_{CE} = 8\text{V}$ , $I_C = 20\text{mA}$	50	—	160	
Output capacitance	$C_{ob}$	$V_{CB} = 10\text{V}$ , $I_E = 0$ , $f = 1\text{MHz}$ (Note 2)	—	0.7	—	pF
Reverse transfer capacitance	$C_{re}$		—	0.5	0.95	pF

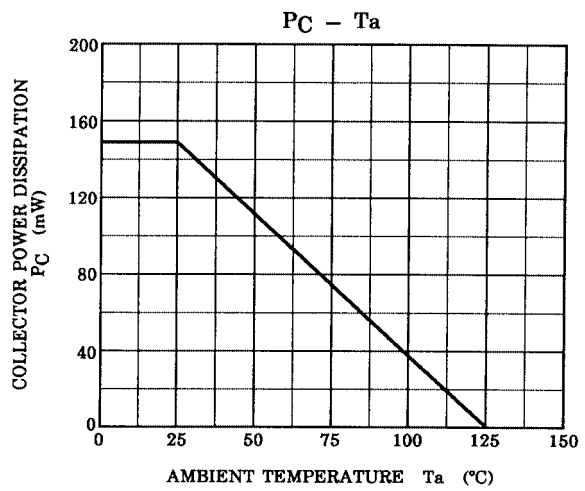
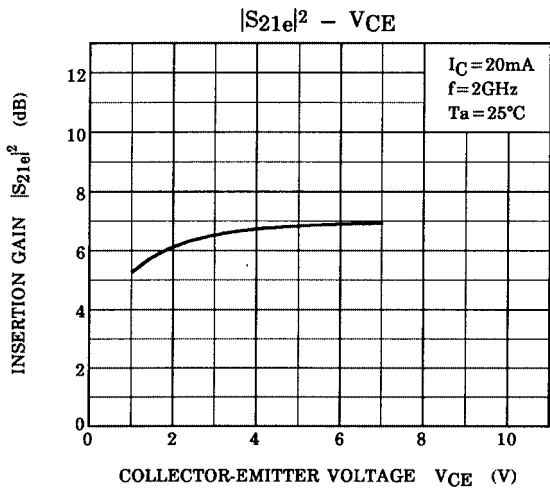
Note 1:  $h_{FE}$  classification R: 50~100, O: 80~160

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

**Marking**







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

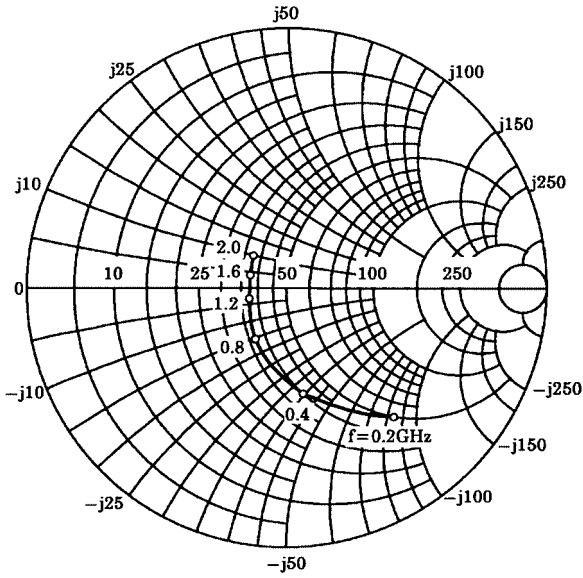
**V<sub>CE</sub> = 8 V, I<sub>C</sub> = 5 mA**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.653	-48.5	10.080	136.2	0.046	63.5	0.766	-27.9
400	0.420	-82.1	7.242	112.7	0.069	57.6	0.561	-35.0
600	0.284	-105.7	5.393	98.9	0.086	57.9	0.466	-35.4
800	0.214	-126.0	4.245	89.7	0.103	59.4	0.420	-34.9
1000	0.169	-146.7	3.508	82.2	0.121	60.6	0.394	-34.7
1200	0.155	-166.4	3.012	75.9	0.140	61.9	0.382	-35.1
1400	0.152	174.1	2.645	70.2	0.162	62.1	0.374	-36.1
1600	0.154	156.7	2.350	65.0	0.182	61.3	0.363	-38.5
1800	0.161	145.9	2.136	60.2	0.202	60.5	0.355	-41.0
2000	0.181	134.5	1.972	55.8	0.224	60.6	0.345	-44.0

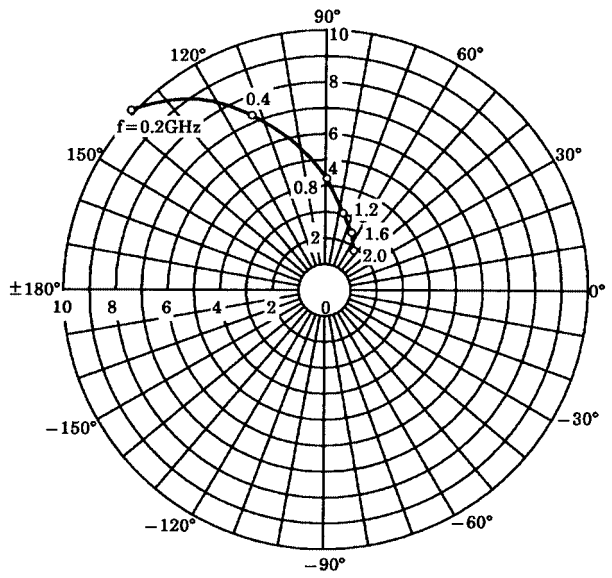
**V<sub>CE</sub> = 8 V, I<sub>C</sub> = 20 mA**

Frequency (MHz)	S11		S21		S12		S22	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.275	-80.2	17.464	114.7	0.033	68.9	0.506	-36.6
400	0.147	-116.5	9.693	97.8	0.057	72.0	0.353	-32.4
600	0.097	-150.0	6.680	88.8	0.082	72.7	0.313	-27.9
800	0.083	179.5	5.088	82.3	0.106	72.1	0.300	-25.9
1000	0.084	151.3	4.141	76.7	0.131	71.2	0.295	-25.2
1200	0.095	135.6	3.497	72.2	0.156	69.8	0.295	-25.7
1400	0.108	124.2	3.058	67.7	0.182	67.7	0.297	-27.3
1600	0.121	113.8	2.699	63.2	0.206	65.2	0.289	-30.1
1800	0.128	108.4	2.432	59.2	0.228	63.0	0.283	-33.2
2000	0.146	104.2	2.241	55.5	0.253	61.6	0.274	-36.5

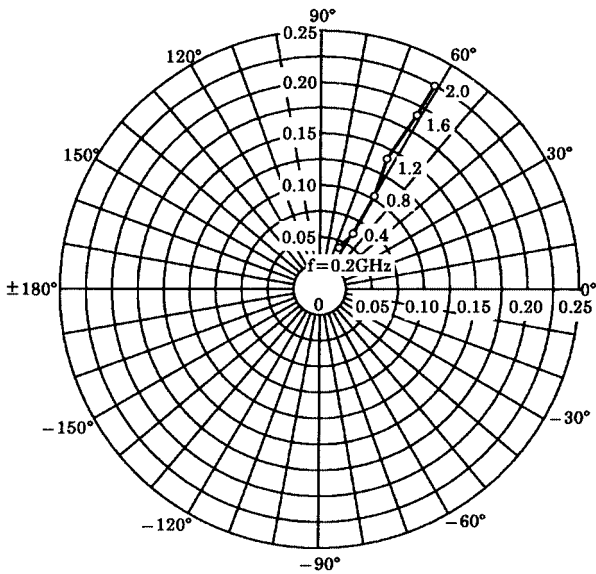
S11e  
 VCE=8V  
 IC=5mA  
 Ta=25°C  
 (UNIT : Ω)



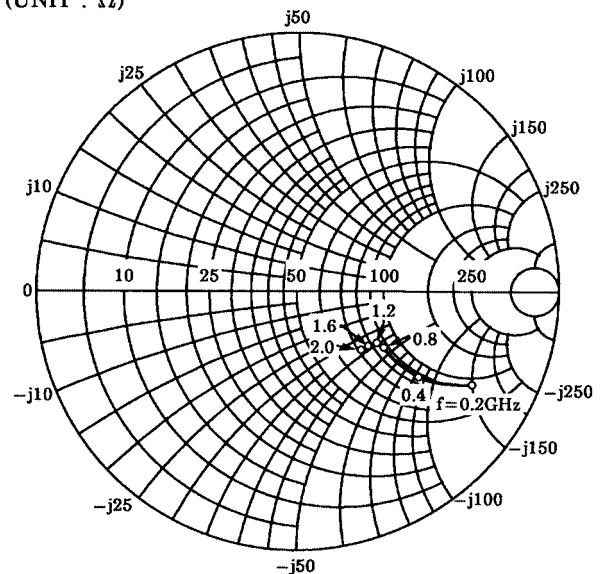
S21e  
 VCE=8V  
 IC=5mA  
 Ta=25°C



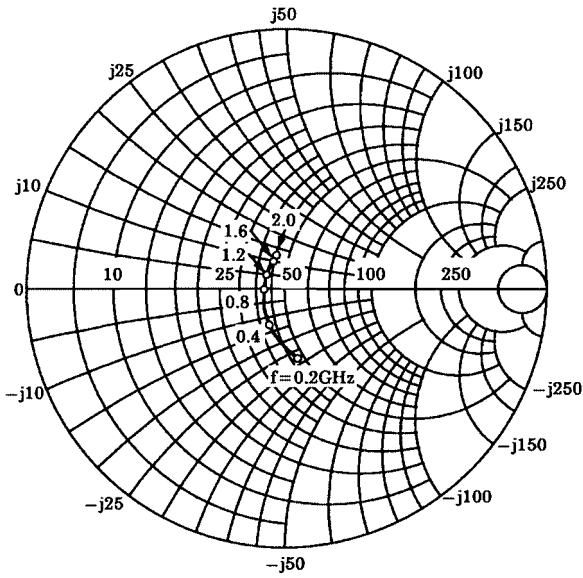
S12e  
 VCE=8V  
 IC=5mA  
 Ta=25°C



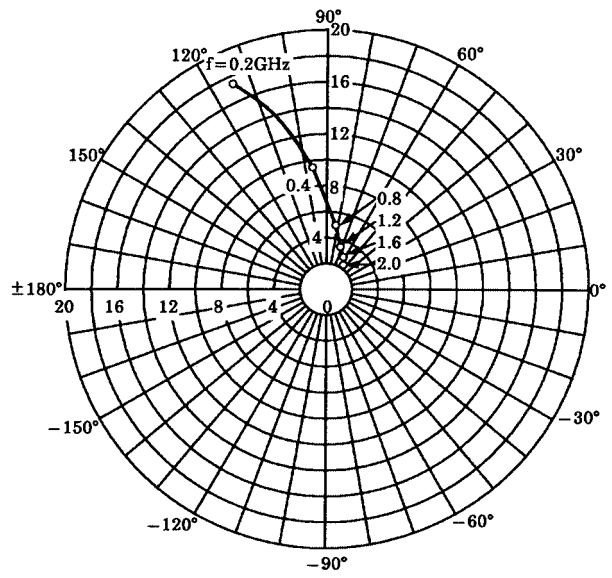
S22e  
 VCE=8V  
 IC=5mA  
 Ta=25°C  
 (UNIT : Ω)



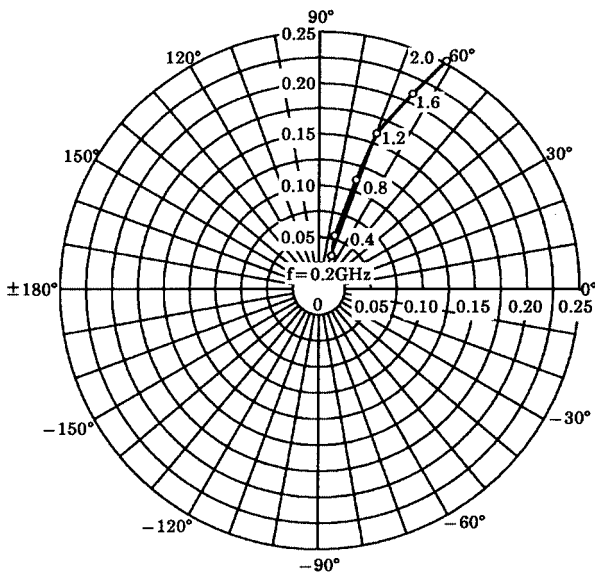
S11e  
 VCE=8V  
 IC=20mA  
 Ta=25°C  
 (UNIT : Ω)



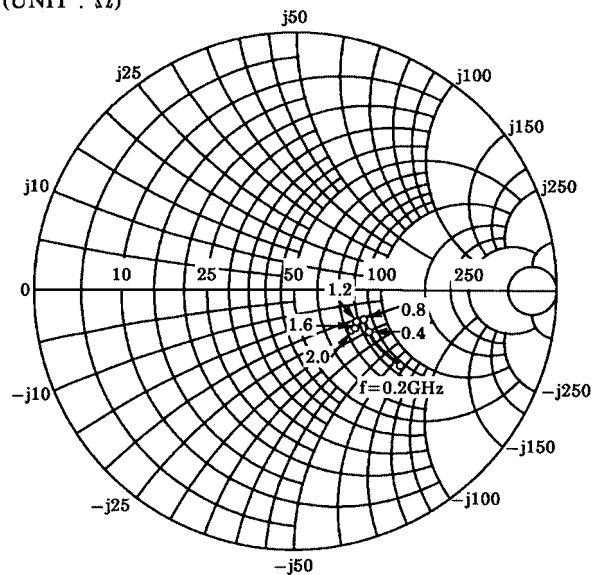
S21e  
 VCE=8V  
 IC=20mA  
 Ta=25°C



S12e  
 VCE=8V  
 IC=20mA  
 Ta=25°C



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



**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.