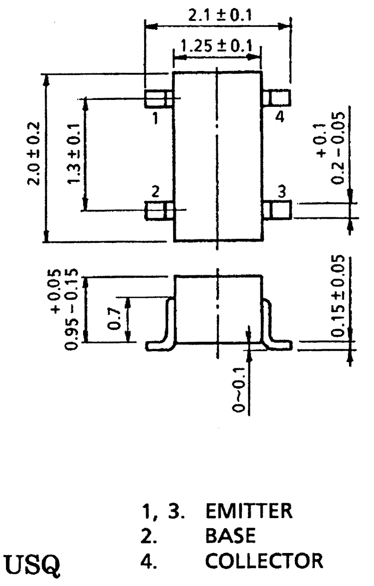
TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

2SC5088

VHF~UHF Band Low Noise Amplifier Applications

Unit: mm

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



JEDEC	―
JEITA	―
TOSHIBA	2-2K1A

Weight: 0.006 g (typ.)

Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	20	V
Collector-emitter voltage	V_{CEO}	12	V
Emitter-base voltage	V_{EBO}	3	V
Base current	I_B	40	mA
Collector current	I_C	80	mA
Collector power dissipation	P_C	100	mW
Junction temperature	T_j	125	°C
Storage temperature range	T_{stg}	−55~125	°C

Microwave Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Transition frequency	f_T	V_{CE} = 10 V, I_C = 20 mA	5	7	―	GHz
Insertion gain	$|S_{21e}|^2$ (1)	V_{CE} = 10 V, I_C = 20 mA, f = 500 MHz	―	18	―	dB
	$|S_{21e}|^2$ (2)	V_{CE} = 10 V, I_C = 20 mA, f = 1 GHz	9.5	13	―	
Noise figure	NF (1)	V_{CE} = 10 V, I_C = 5 mA, f = 500 MHz	―	1	―	dB
	NF (2)	V_{CE} = 10 V, I_C = 5 mA, f = 1 GHz	―	1.1	2	

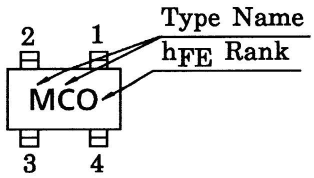
Electrical Characteristics (Ta = 25°C)

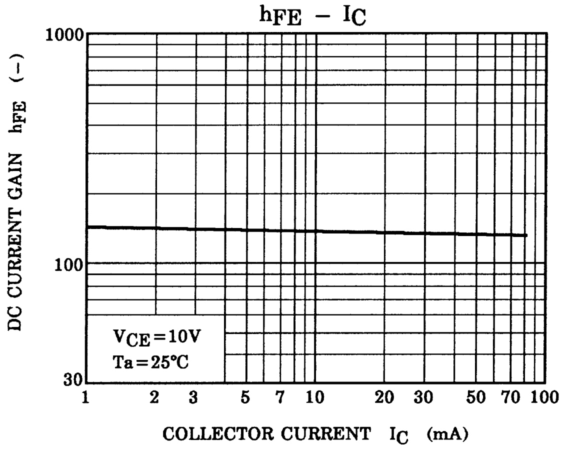
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = 10 V, I_E = 0	―	―	1	μA
Emitter cut-off current	I_{EBO}	V_{EB} = 1 V, I_C = 0	―	―	1	μA
DC current gain	h_{FE} (Note 1)	V_{CE} = 10 V, I_C = 20 mA	80	―	240	
Output capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz (Note 2)	―	1.1	1.6	pF
Reverse transfer capacitance	C_{re}		―	0.65	1.05	pF

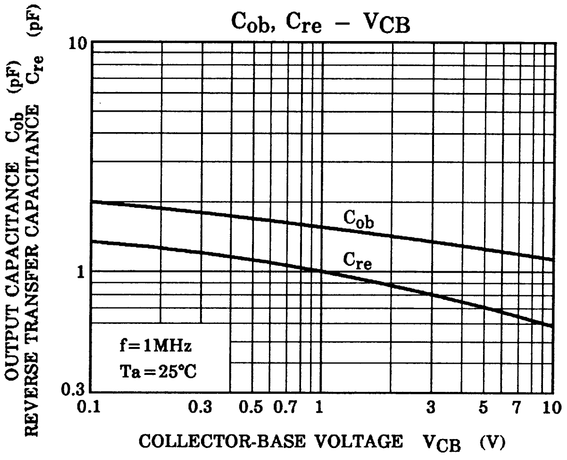
Note 1: h_{FE} classification O: 80~160, Y: 120~240

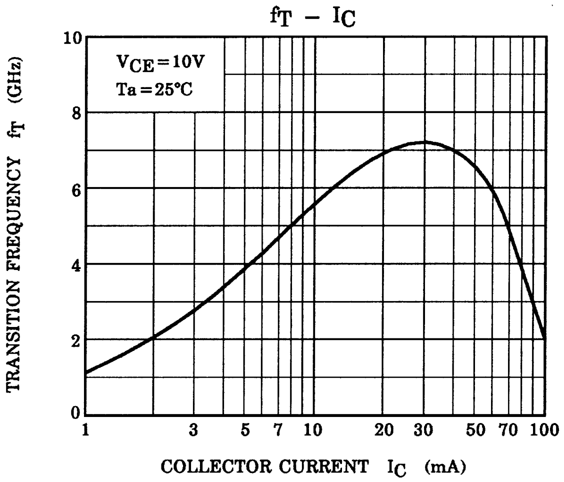
Note 2: C_{re} is measured by 3 terminal method with capacitance bridge.

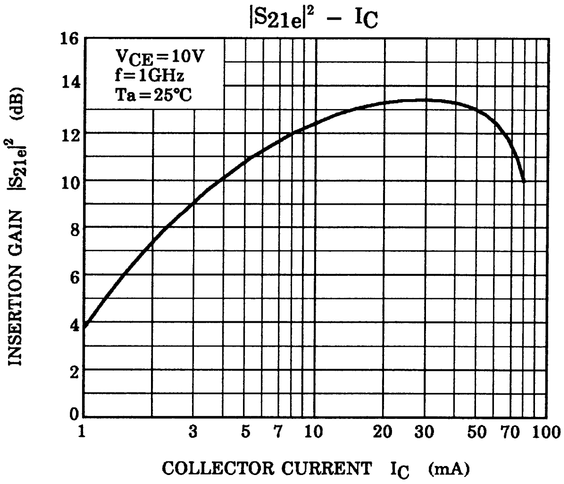
Marking

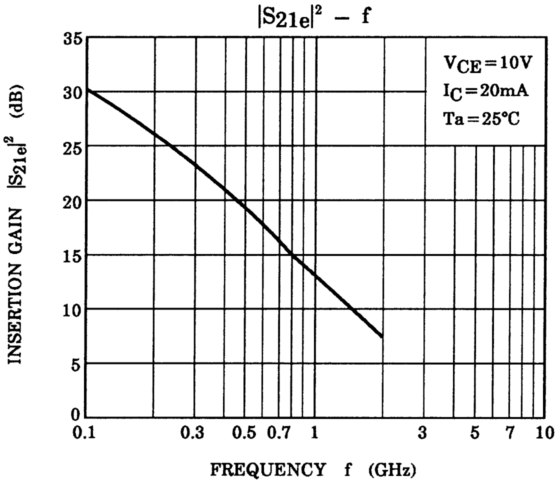


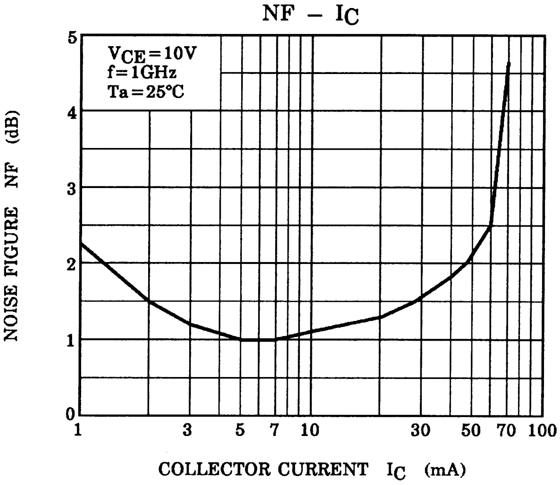

hFE – IC
DC CURRENT GAIN hFE (–)
1000
100
30
VCE=10V
Ta=25°C
1 2 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)

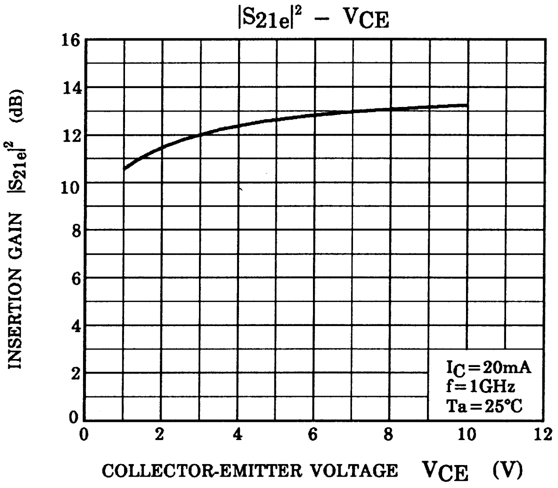

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
10
1
0.3
Cob
Cre
f=1MHz
Ta=25°C
0.1 0.3 0.5 0.7 1 3 5 7 10
COLLECTOR-BASE VOLTAGE VCB (V)

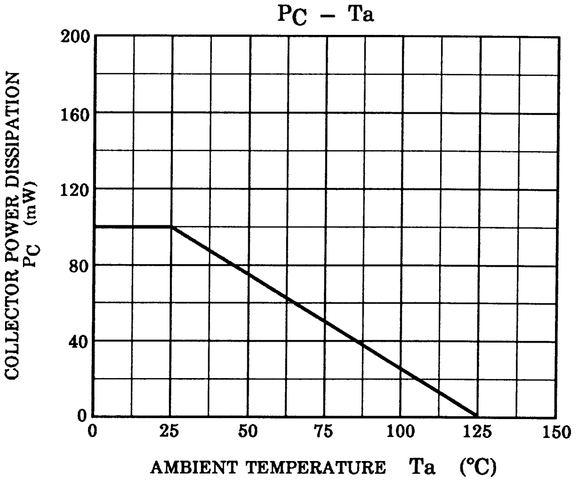

fT – IC
TRANSITION FREQUENCY fT (GHz)
10
8
6
4
2
0
VCE=10V
Ta=25°C
1 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)


|S21e|² – IC
INSERTION GAIN |S21e|² (dB)
16
14
12
10
8
6
4
2
0
VCE=10V
f=1GHz
Ta=25°C
1 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)


|S21e|² – f
INSERTION GAIN |S21e|² (dB)
35
30
25
20
15
10
5
0
VCE=10V
IC=20mA
Ta=25°C
0.1 0.3 0.5 0.7 1 3 5 7 10
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
5
4
3
2
1
0
VCE=10V
f=1GHz
Ta=25°C
1 3 5 7 10 30 50 70 100
COLLECTOR CURRENT IC (mA)





S-Parameter $Z_O = 50\ \Omega$, Ta = 25°C

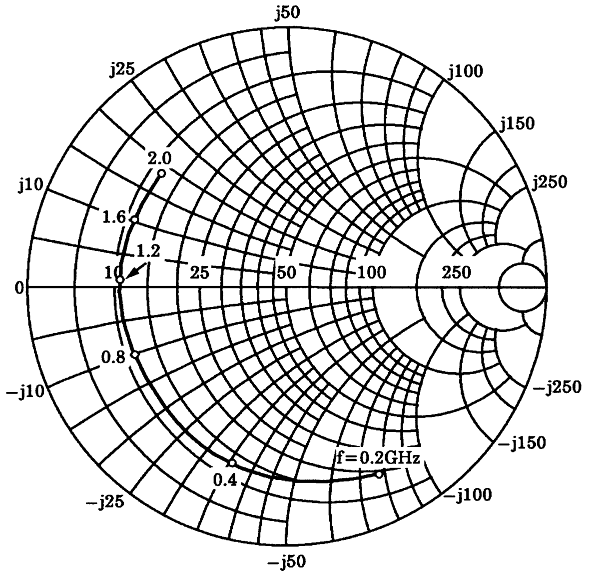
$V_{CE} = 10$ V, $I_C = 5$ mA

Frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.826	−64.3	9.839	139.2	0.056	59.2	0.844	−31.7
400	0.735	−106.8	7.058	115.2	0.083	43.8	0.663	−50.1
600	0.692	−134.4	5.233	99.5	0.094	36.8	0.558	−62.3
800	0.666	−154.3	4.106	88.1	0.100	33.3	0.496	−72.6
1000	0.656	−170.0	3.315	78.9	0.102	32.7	0.458	−81.8
1200	0.653	178.0	2.768	71.3	0.103	33.4	0.429	−90.6
1400	0.649	167.7	2.353	65.4	0.104	36.0	0.407	−99.4
1600	0.655	158.2	2.061	59.6	0.107	39.1	0.393	−107.8
1800	0.653	149.0	1.818	55.3	0.111	42.6	0.378	−115.3
2000	0.654	139.9	1.650	50.7	0.116	46.7	0.367	−121.9

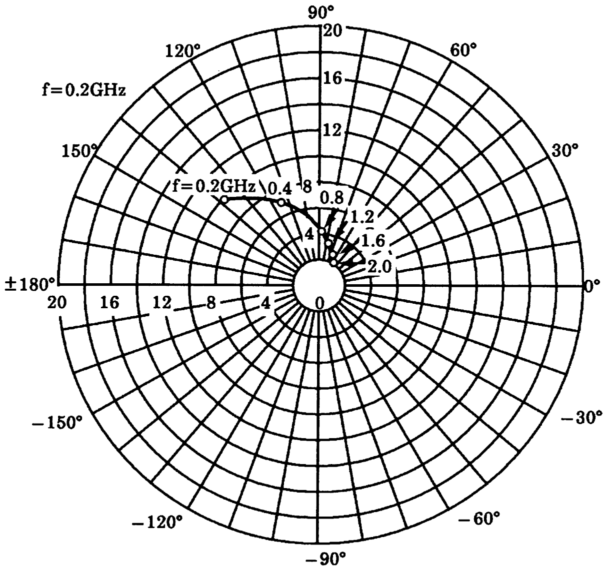
$V_{CE} = 10$ V, $I_C = 20$ mA

Frequency	S11		S21		S12		S22	
(MHz)	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
200	0.747	−87.0	16.492	129.8	0.048	52.1	0.717	−47.1
400	0.675	−130.5	10.431	106.5	0.063	41.8	0.486	−69.1
600	0.648	−154.8	7.298	93.5	0.070	40.8	0.379	−82.0
800	0.636	−170.9	5.547	84.4	0.076	42.0	0.324	−93.0
1000	0.630	176.7	4.423	77.5	0.083	44.7	0.291	−102.7
1200	0.634	166.4	3.660	71.7	0.089	47.7	0.266	−112.1
1400	0.634	157.1	3.125	67.0	0.097	50.8	0.249	−120.8
1600	0.639	148.8	2.741	62.4	0.105	53.2	0.233	−128.9
1800	0.645	139.9	2.451	58.8	0.115	55.6	0.220	−135.8
2000	0.642	131.4	2.233	54.9	0.126	58.1	0.205	−141.2

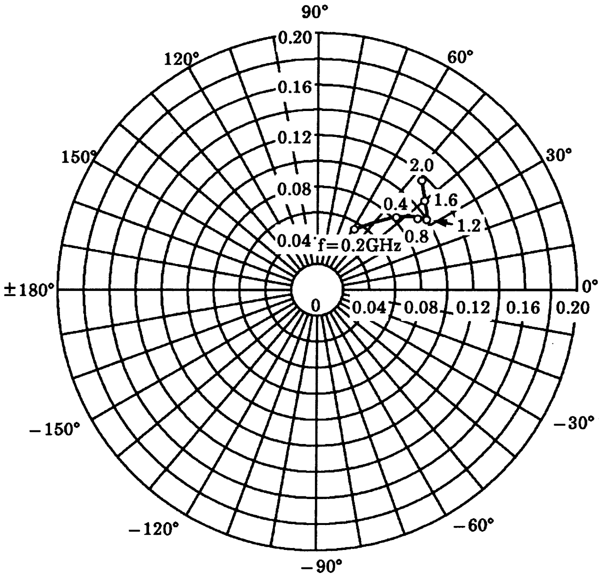
S_{11e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(Unit : Ω)



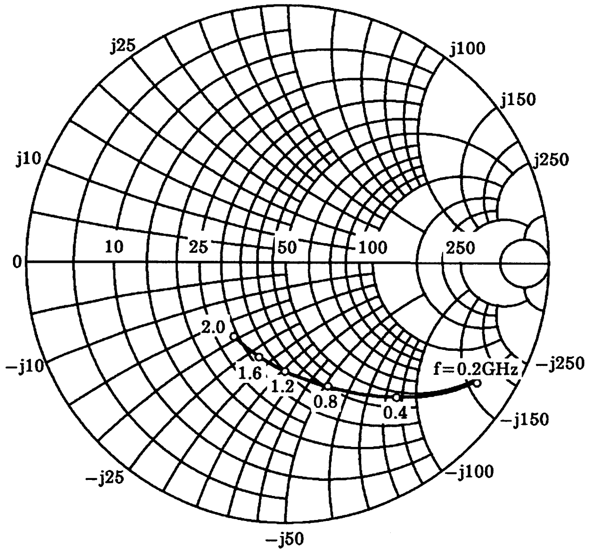
S_{21e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



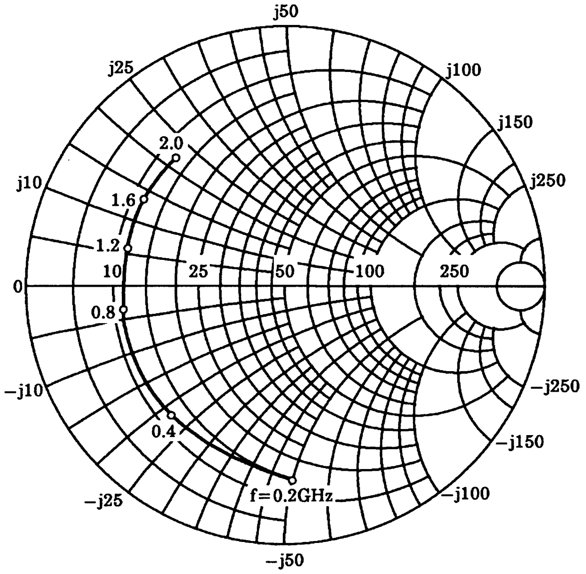
S_{12e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$



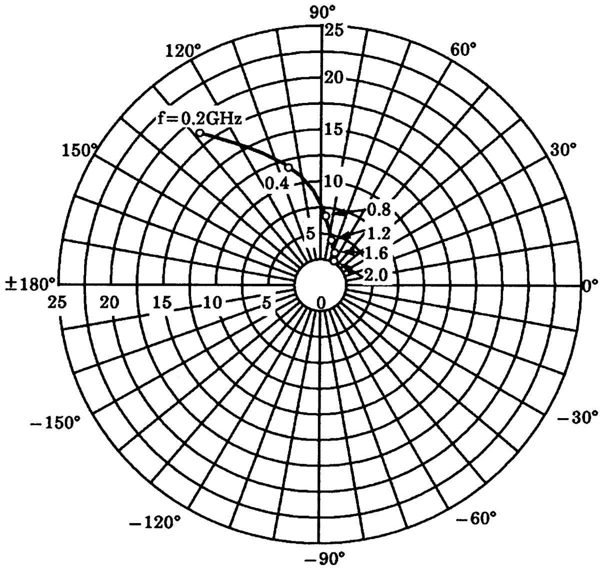
S_{22e}
$V_{CE} = 10V$
$I_C = 5mA$
$Ta = 25°C$
(Unit : Ω)



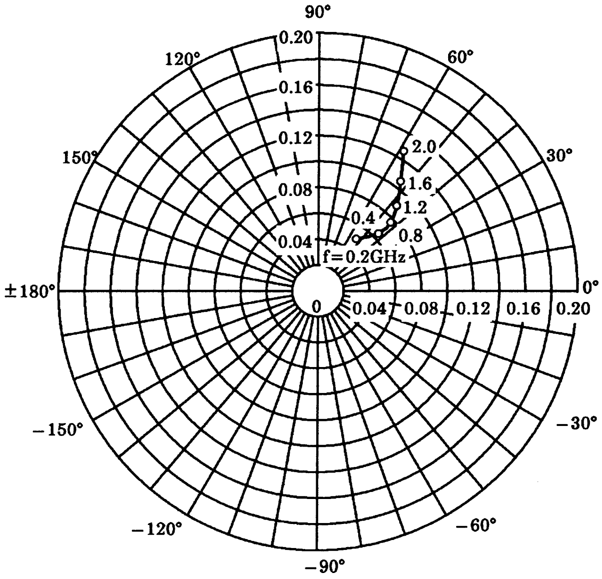
S_{11e}
$V_{CE} = 10V$
$I_C = 20mA$
Ta = 25°C
(Unit : Ω)



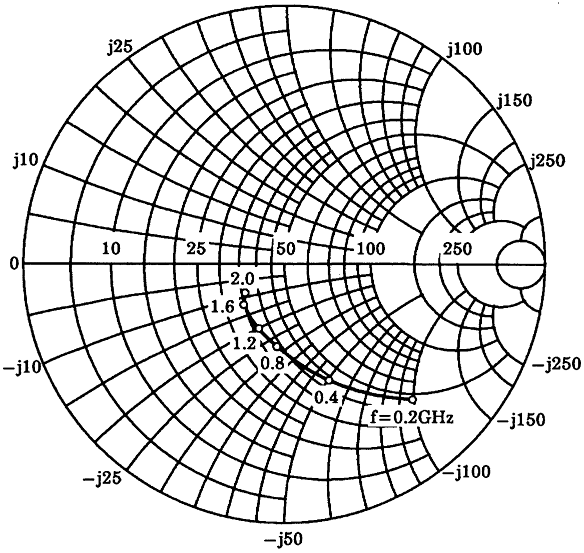
S_{21e}
$V_{CE} = 10V$
$I_C = 20mA$
Ta = 25°C



S_{12e}
$V_{CE} = 10V$
$I_C = 20mA$
Ta = 25°C



S_{22e}
$V_{CE} = 10V$
$I_C = 20mA$
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.