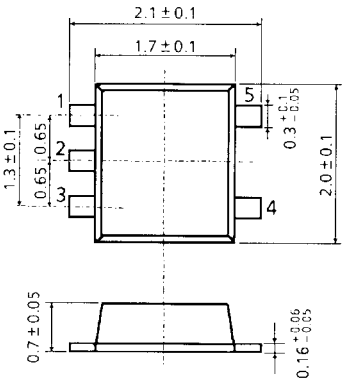
Silicon P Channel MOS Type (U-MOSII)/Silicon Epitaxial Schottky Barrier Diode

SSM5G02TU

DC-DC Converter

Unit: mm



1 : GATE 4 : CATHODE
2 : SOURCE 5 : DRAIN
3 : ANODE

UFV

JEDEC	—
JEITA	—
TOSHIBA	2-2R1A

Weight: 7 mg (typ.)

- Combined Pch MOSFET and Schottky Diode into one Package.
- Low $R_{DS\ (ON)}$ and Low V_F

Maximum Ratings (Ta = 25°C) MOSFET

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	−12	V
Gate-Source voltage		V_{GSS}	±12	V
Drain current	DC	I_D	−1.0	A
	Pulse	I_{DP} (Note 2)	−2.0	
Drain power dissipation		P_D (Note 1)	0.5	W
		t = 10s	0.8	
Channel temperature		T_{ch}	150	°C

Maximum Ratings (Ta = 25°C) SCHOTTKY DIODE

Characteristics	Symbol	Rating	Unit
Maximum (peak) reverse voltage	V_{RM}	15	V
Reverse voltage	V_R	12	V
Average forward current	I_O	0.5	A
Peak one cycle surge forward current (non-repetitive)	I_{FSM}	2 (50 Hz)	A
Junction temperature	T_j	125	°C

Maximum Ratings (Ta = 25°C) MOSFET, DIODE COMMON

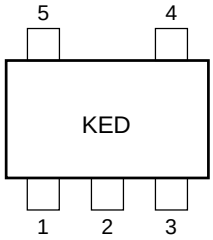
Characteristics	Symbol	Rating	Unit
Storage temperature	T_{stg}	−55~125	°C
Operating temperature	T_{opr} (Note 3)	−40~85	°C

Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu pad: 645 mm^2)

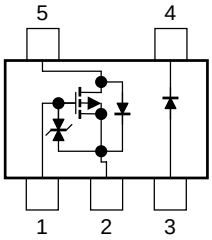
Note 2: The pulse width limited by max channel temperature.

Note 3: Operating temperature limited by max channel temperature and max junction temperature.

Marking



Equivalent Circuit



Handling Precaution

When handling individual devices (which are not yet mounting on a circuit board), be sure that the environment is protected against electrostatic discharge. Operators should wear anti-static clothing and use containers and other objects that are made of anti-static materials.

The Channel-to-Ambient thermal resistance $R_{th\ (ch\text{-}a)}$ and the drain power dissipation P_D vary according to the board material, board area, board thickness and pad area. When using this device, please take heat dissipation fully into account.

MOSFET

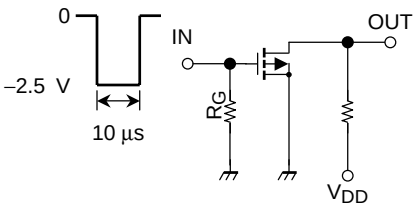
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0	—	—	±1	μA
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = –1 mA, V_{GS} = 0	–12	—	—	V
		$V_{(BR)\ DSX}$	I_D = –1 mA, V_{GS} = +8 V	–4	—	—	
Drain Cut-off current		I_{DSS}	V_{DS} = –12 V, V_{GS} = 0	—	—	–1	μA
Gate threshold voltage		V_{th}	V_{DS} = –3V, I_D = –0.1 mA	–0.4	—	–1.1	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = –3 V, I_D = –0.5 A (Note 4)	1.3	2.5	—	S
Drain-Source ON resistance		$R_{DS\ (ON)}$	I_D = –0.5 A, V_{GS} = –4 V (Note 4)	—	125	160	mΩ
			I_D = –0.5 A, V_{GS} = –2.5 V (Note 4)	—	180	240	
Input capacitance		C_{iss}	V_{DS} = –10 V, V_{GS} = 0, f = 1 MHz	—	310	—	pF
Reverse transfer capacitance		C_{rss}	V_{DS} = –10 V, V_{GS} = 0, f = 1 MHz	—	70	—	pF
Output capacitance		C_{oss}	V_{DS} = –10 V, V_{GS} = 0, f = 1 MHz	—	110	—	pF
Switching time	Turn-on time	t_{on}	V_{DD} = –10 V, I_D = –0.5 A	—	20	—	ns
	Turn-off time	t_{off}	V_{GS} = 0~–2.5 V, R_G = 4.7 Ω	—	32	—	

Note 4: Pulse measurement

Switching Time Test Circuit

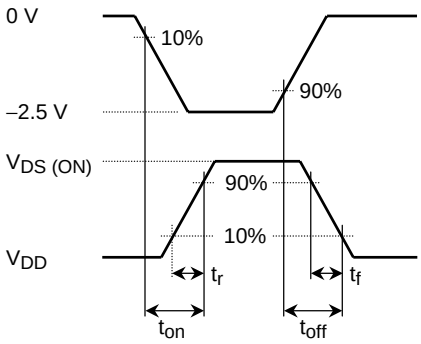
(a) Test circuit



V_{DD} = –10 V
R_G = 4.7 Ω
Duty ≦ 1%
V_{IN}: t_r, t_f < 5 ns
Common source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



Precaution

V_{th} can be expressed as voltage between gate and source when low operating current value is I_D = –100 μA for this product. For normal switching operation, $V_{GS\ (on)}$ requires higher voltage than V_{th} and $V_{GS\ (off)}$ requires lower voltage than V_{th}.

(Relationship can be established as follows: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$)

Please take this into consideration for using the device.

V_{GS} recommended voltage of –2.5 V or higher to turn on this product.

Schottky Diode

Electrical Characteristics (Ta = 25°C)

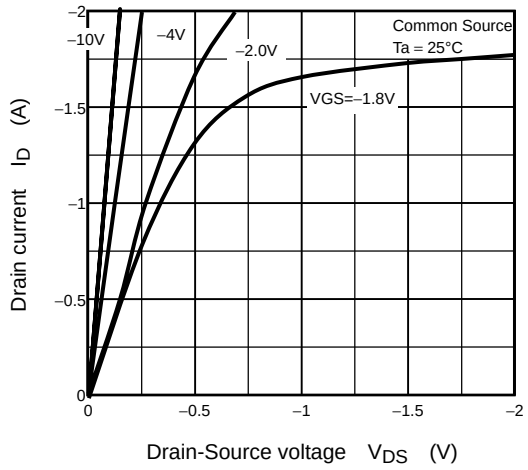
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_{F\ (1)}$	I_F = 0.3 A	—	0.33	0.39	V
	$V_{F\ (2)}$	I_F = 0.5 A	—	0.37	0.43	V
Reverse current	I_R	V_R = 12 V	—	—	100	μA
Total capacitance	C_T	V_R = 0 V, f = 1 MHz	—	80	—	pF

Precaution

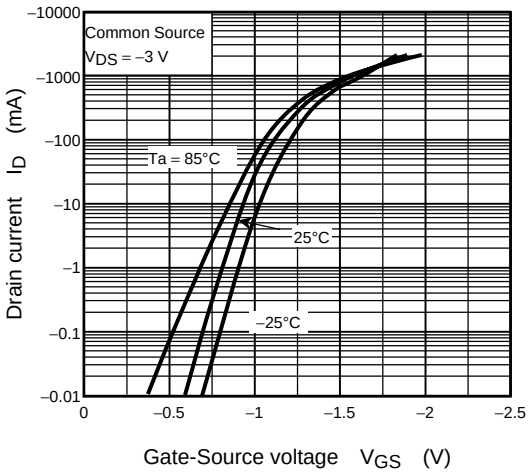
The schottky barrier diode of this product are having large-reverse-current-leakage characteristic compare to the other switching diodes. This current leakage and not proper operating temperature or voltage may cause thermal runaway. Please take forward and reverse loss into consideration when you design.

MOSFET Electrical Characteristics Graph

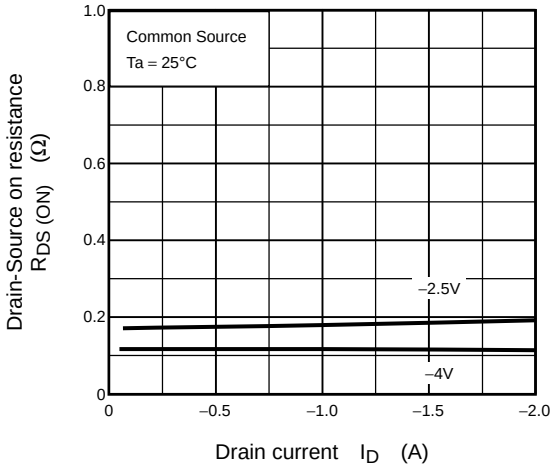
I_D – V_{DS} (MOSFET)



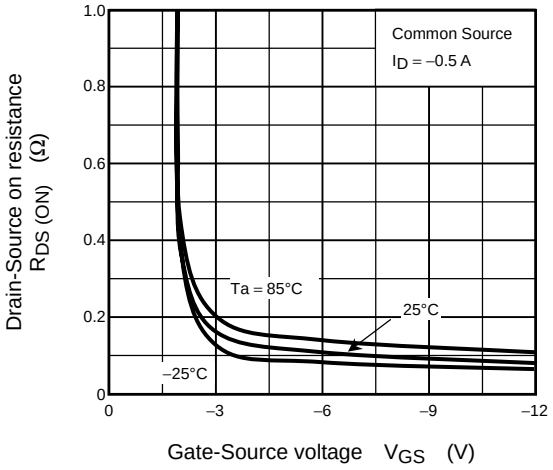
I_D – V_{GS} (MOSFET)



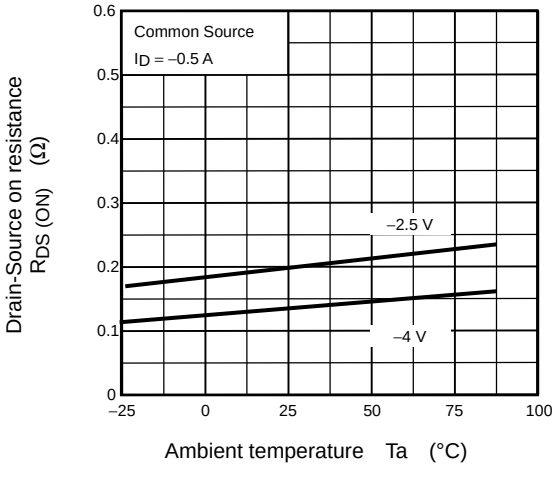
$R_{DS\ (ON)}$ – I_D (MOSFET)



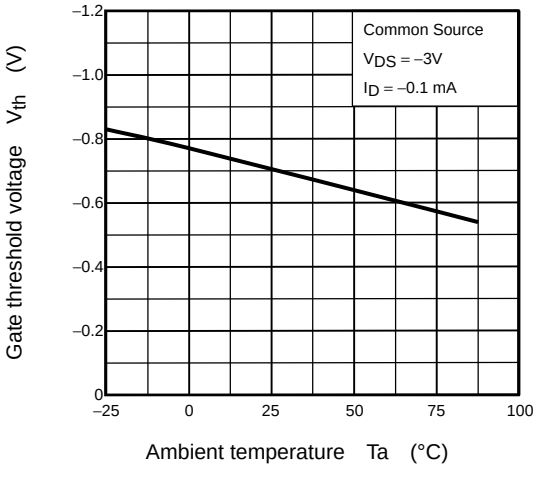
$R_{DS\ (ON)}$ – V_{GS} (MOSFET)



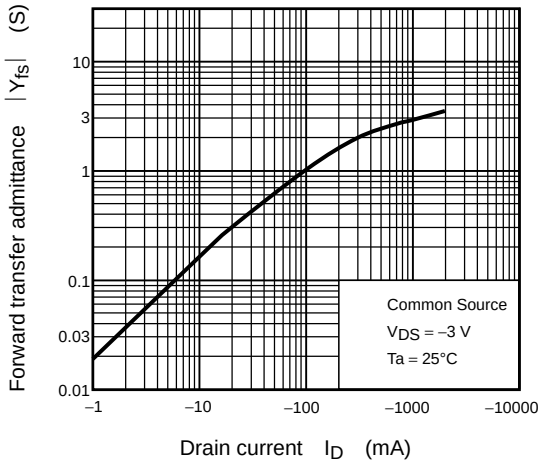
$R_{DS\ (ON)}$ – Ta (MOSFET)



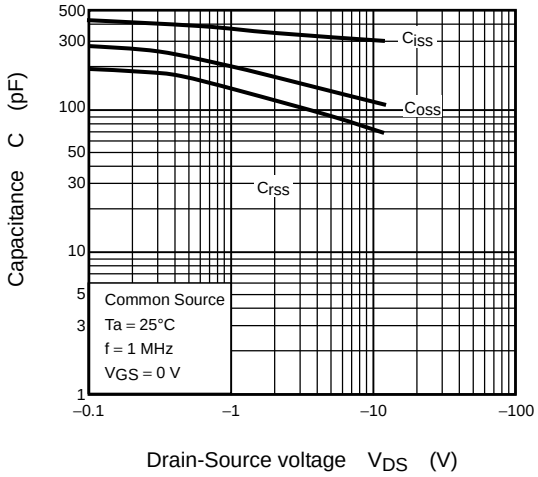
V_{th} – Ta (MOSFET)



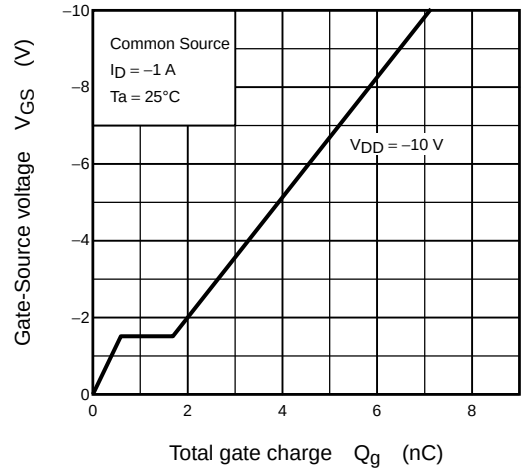
$|Y_{fs}|$ – I_D (MOSFET)



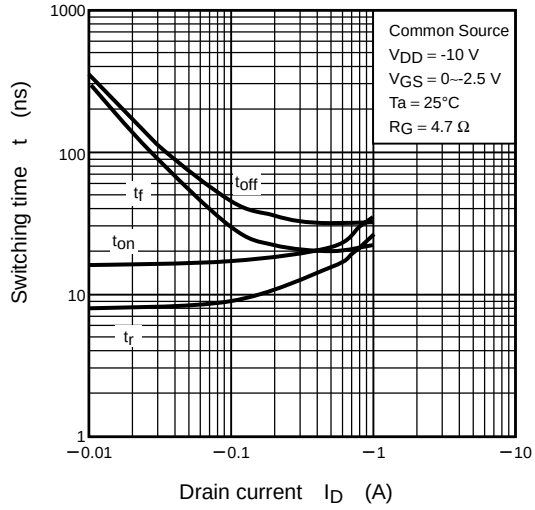
C – V_{DS} (MOSFET)



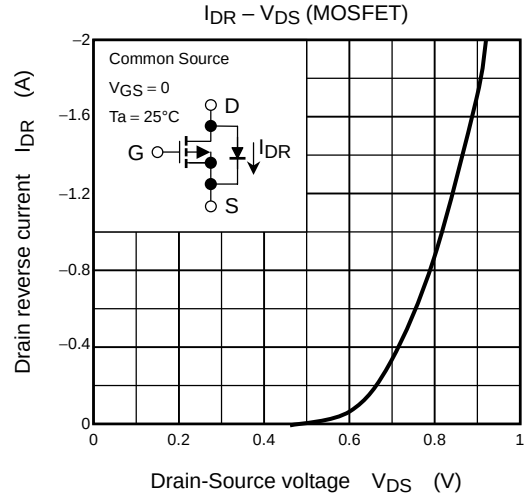
Dynamic input characteristic (MOSFET)



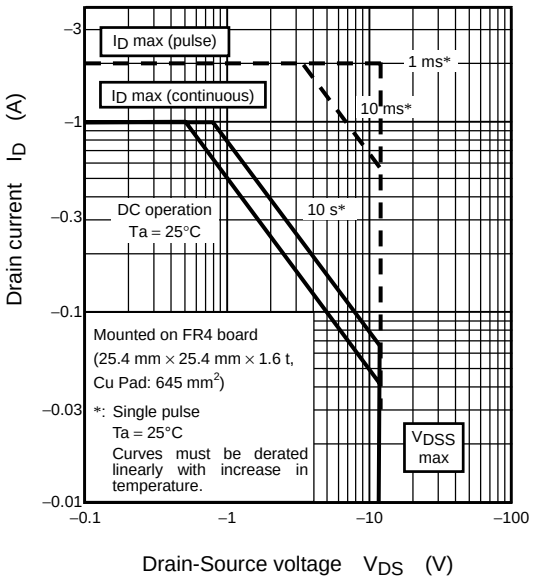
t – I_D (MOSFET)



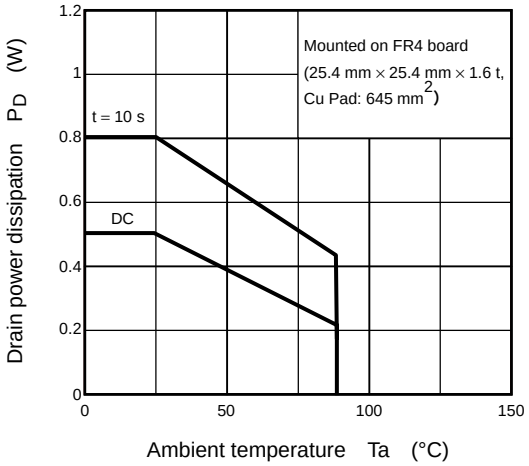
I_{DR} – V_{DS} (MOSFET)



Safe operating area (MOSFET)

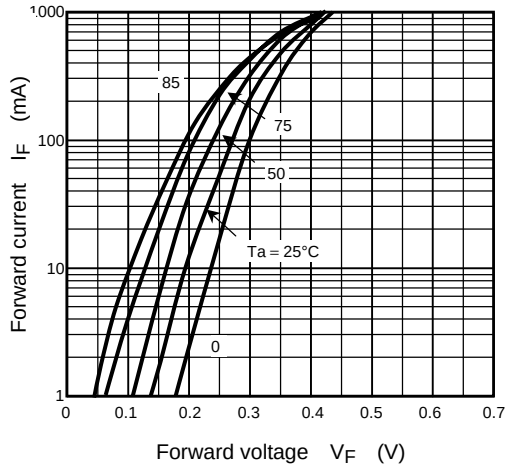


P_D – Ta (MOSFET)

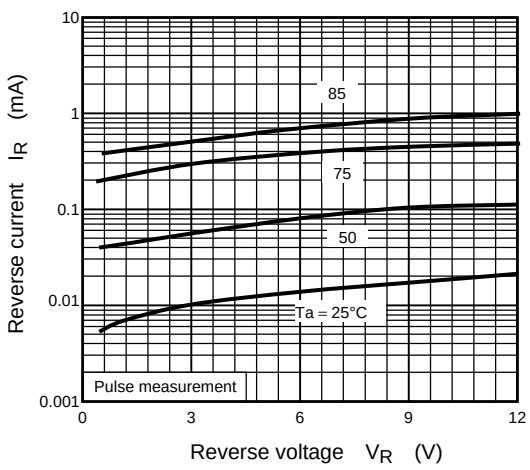


SBD Electrical Characteristics Graph

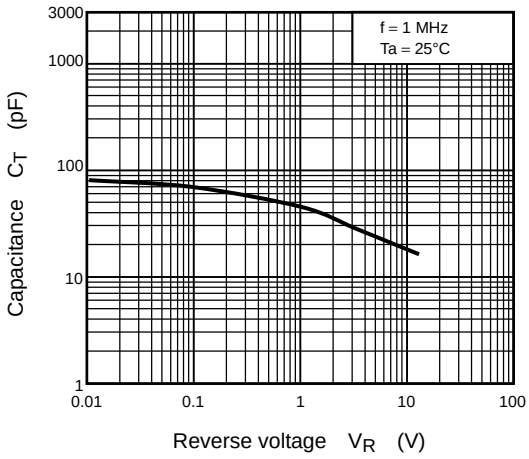
$I_F – V_F$ (SBD)



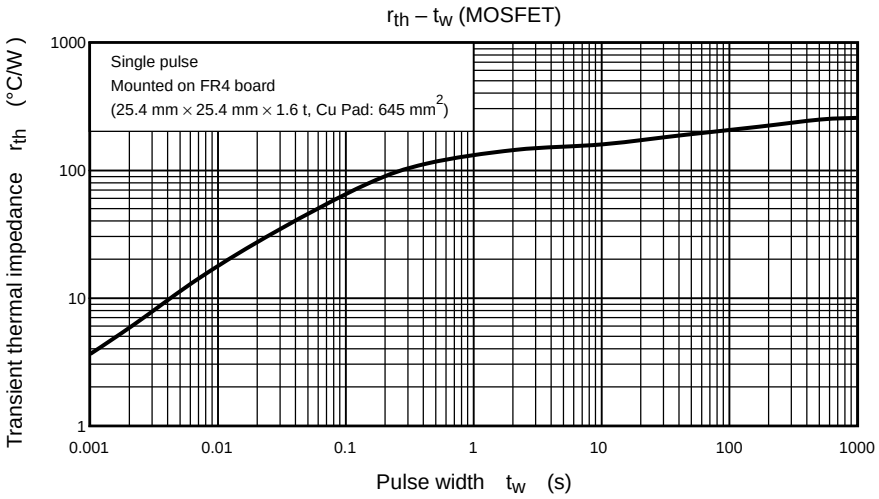
$I_R – V_R$ (SBD)

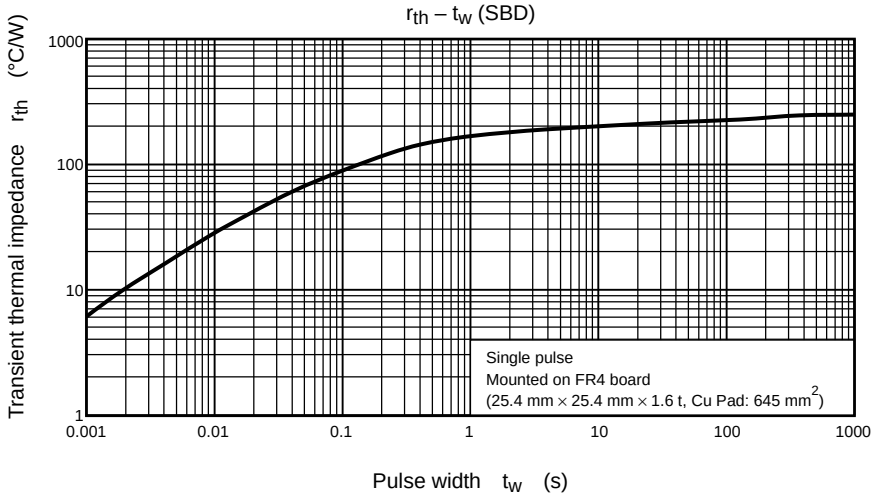


$C_T – V_R$ (SBD)



Transient thermal impedance Graph





RESTRICTIONS ON PRODUCT USE

030619EAA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- 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.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.