TOSHIBA PHOTOCOUPLER GaAℓAs IRED & PHOTO IC

TLP553

Low input current line receiver

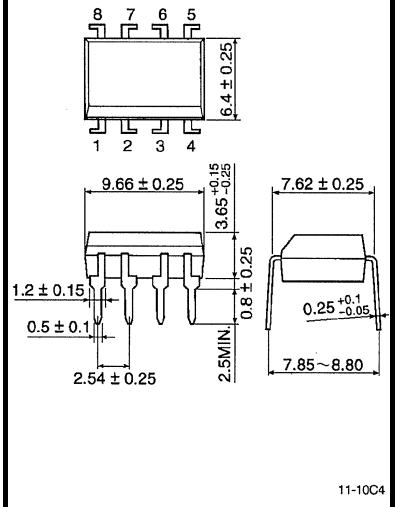
Telephone ring detector

Current loop receiver

Interfaces for computer, measurement equipment and control equipment

Data transfer between circuits of different potentials

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	11-10C4

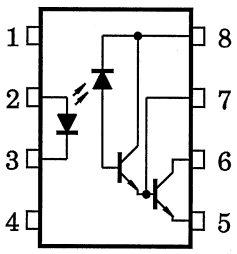
Weight: 0.54 g (typ)

TLP553 is a darlington 8-pin DIP photocoupler, which consists of a GaAℓAs IRED LED, and a photodiode and a high-gain transistor integrated into a detector chip.

As it uses a high-speed, high-gain detector element, TLP553 is ideal for applications which require low-input current and high-speed data transmission.

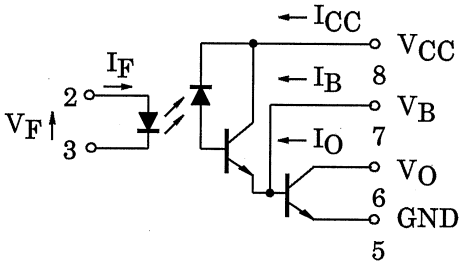
- Current transfer ratio: 400% (min)
  @I_F = 0.5 mA
- Operating temperature: 0 to 70°C (guaranteed)
- Switching speed: t_{pHL} = 2 μs, t_{pLH} = 4 μs (typ.)
  @R_L = 4.7 kΩ, I_F = 0.5 mA
- Isolation voltage: 2500 V_{rms} (min)
- UL recognized: UL1577, file no. E67349

Pin Configurations



1: N.C. 5: GND(emitter)
2: Anode 6: V_O(collector)
3: Cathode 7: Base
4: N.C. 8: V_{CC}

Schematic



Absolute Maximum Rating (Ta = 25°C)

Characteristics			Symbol	Rating	Unit
LED	Forward current	(Note 1)	I_F	20	mA
	Pulse forward current	(Note 2)	I_{FP}	40	mA
	Peak transient forward current	(Note 3)	I_{FPT}	1	A
	Reverse voltage		V_R	5	V
	Diode power dissipation	(Note 4)	P_D	35	mW
Detector	Output current	(Note 5)	I_O	60	mA
	Output voltage		V_O	−0.5 to 18	V
	Supply voltage		V_{CC}	−0.5 to 18	V
	Emitter-base voltage		V_{EB}	0.5	V
	Output power dissipation	(Note 6)	P_O	100	mW
Storage temperature range			T_{stg}	−55 to 125	°C
Operating temperature range			T_{opr}	−40 to 85	°C
Lead solder temperature	(10 s)	(Note 7)	T_{sol}	260	°C
Isolation voltage		(Note 8)	BV_S	2500	V_{rms}

Note: Using continuously under heavy loads (e.g. application of high temperature/current/voltage and a significant change in temperature, etc.) may cause this product to decrease in reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Derate 0.27 mA/°C above 50°C.

Note 2: 50% duty cycle, 1 ms pulse width.

Note 3: Pulse width ≤ 1 μs, 300 pps.

Note 4: Derate 0.47 mW/°C above 50°C.

Note 5: Derate 0.6 mA/°C above 25°C.

Note 6: Derate 1 mW/°C above 25°C.

Note 7: Soldering is performed 2mm from the bottom of the package.

Note 8: AC, 1min, R.H. ≤ 60%

Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7 and 8 shorted together.

Recommended Operating Conditions

Characteristics	Symbol	Min	Typ.	Max	Unit
Supply voltage	V_{CC}	—	—	16	V
Input current	I_F	0.5	—	15	mA
Output current	I_O	—	—	30	mA
Operating temperature	T_{opr}	0	—	70	°C

Note: The recommended operating conditions are given as a design guideline to obtain expected performance of the device. In addition, each item is an independent guideline. In developing designs using this product, please confirm the specified characteristics shown in this document.

Electrical Characteristics (Unless otherwise specified Ta = 0 to 70°C)

Characteristics	Symbol	Test Conditions	Min	Typ*	Max	Unit
Forward voltage	V_F	I_F = 1.6 mA, Ta = 25°C	—	1.55	1.7	V
Temperature coefficient of forward voltage	$\Delta V_F/\Delta Ta$	I_F = 1.6 mA	—	−2.1	—	mV/°C
Input reverse current	I_R	V_R = 5 V, Ta = 25°C	—	—	10	μA
Input capacitance	C_T	V_F = 0 V, f = 1 MHz, Ta = 25°C	—	45	—	pF
"H" level output current	I_{OH}	V_F = 0.8 V, V_O = V_{CC} = 18 V	—	0.1	100	μA
"H" level supply current	I_{CCH}	V_{CC} = 5 V, I_F = 0 mA V_O = Open	—	10	—	nA
"L" level supply current	I_{CCL}	V_{CC} = 5 V, I_F = 1.6 mA V_O = Open	—	0.3	—	mA
Current transfer ratio	I_O / I_F	I_F = 0.5 mA, V_O = 0.4 V V_{CC} = 4.5 V	400	1000	—	%
		I_F = 1.6 mA, V_O = 0.4 V V_{CC} = 4.5 V	500	900	—	
"L" level output voltage	V_{OL}	I_F = 1.6 mA, I_O = 6.4 mA V_{CC} = 4.5 V	—	0.1	0.4	V
		I_F = 5 mA, I_O = 15 mA V_{CC} = 4.5 V	—	0.1	0.4	
		I_F = 12 mA, I_O = 24 mA V_{CC} = 4.5 V	—	0.2	0.4	
Isolation resistance	R_S	V_S = 500 V, R.H. ≤ 60% Ta = 25°C (Note 9)	5×10^{10}	10^{14}	—	Ω
Input to output capacitance	C_S	V = 0 V, f = 1 MHz, Ta = 25°C (Note 9)	—	0.6	—	pF

* : All typical values are at Ta = 25°C.

Note 9: Device considered a 2-terminal device: Pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.

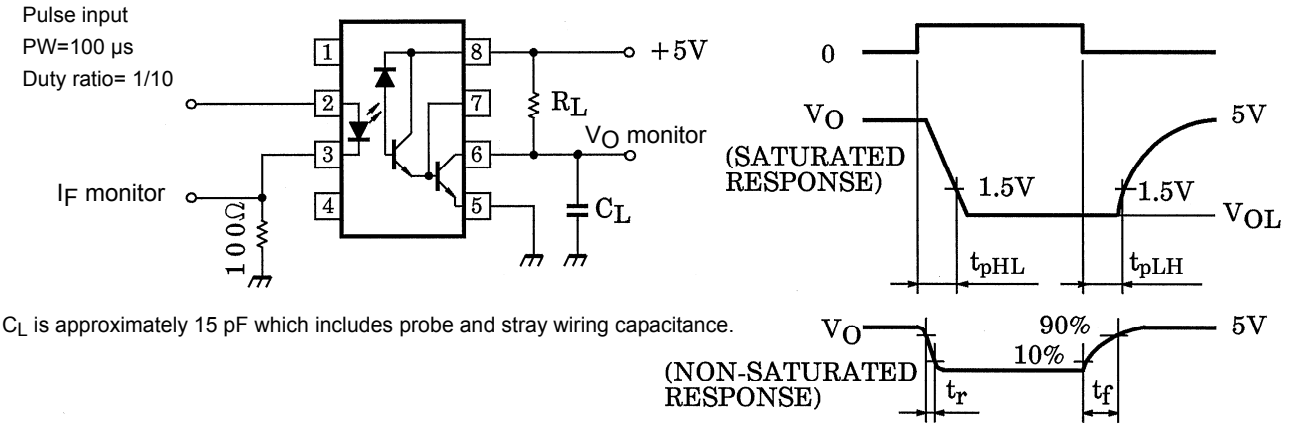
Switching Characteristics (Ta = 25°C, V_{CC} = 5 V)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ	Max	Unit
Propagation delay time (H→L)	t_{pHL}	1	I_F = 0.5 mA, R_L = 4.7 kΩ	—	2	25	μs
			I_F = 12 mA, R_L = 270 Ω	—	0.3	1	
			I_F = 1.6 mA, R_L = 2.2 kΩ	—	—	—	
Propagation delay time (L→H)	t_{pLH}		I_F = 0.5 mA, R_L = 4.7 kΩ	—	4	60	μs
			I_F = 12 mA, R_L = 270 Ω	—	1	7	
			I_F = 1.6 mA, R_L = 2.2 kΩ	—	—	—	
Common mode transient immunity at HIGH level output	CM_H	2	I_F = 0 mA, R_L = 2.2 kΩ (Note 10) V_{CM} = 400 V $V_{O\ (min)}$ = 2 V	—	500	—	V/μs
Common mode transient immunity at LOW level output	CM_L		I_F = 1.6 mA, R_L = 2.2 kΩ (Note 11) V_{CM} = 400 V $V_{O\ (max)}$ = 0.8 V	—	−500	—	V/μs

Note 10: CM_H: The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high output state (i.e., $V_O > 2.0$ V). Measured in volts per microsecond (V / μs).

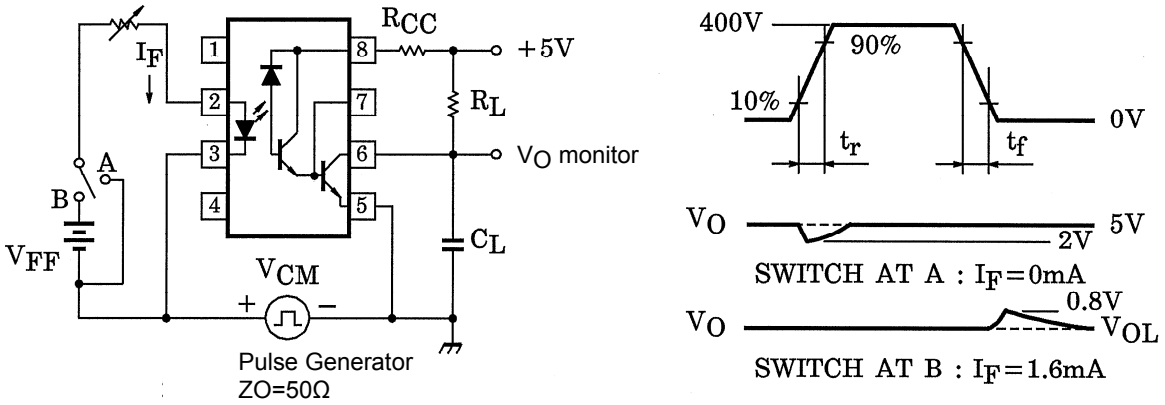
Note 11: CM_L: The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_O < 0.8$ V). Measured in volts per microsecond (V / μs).

Test Circuit 1: t_{pHL}, t_{pLH} Test Circuit



C_L is approximately 15 pF which includes probe and stray wiring capacitance.

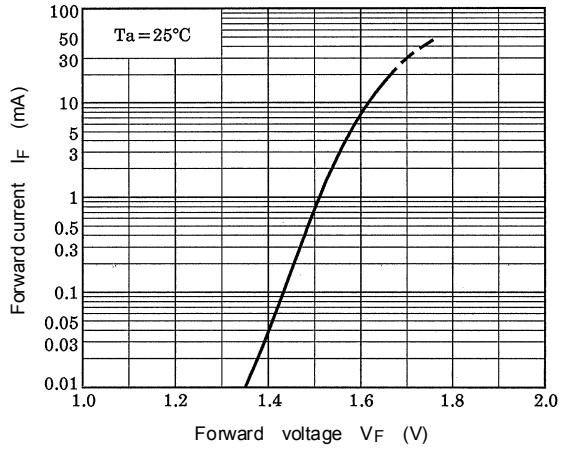
Test Circuit 2: Common Mode Noise Immunity Test Circuit



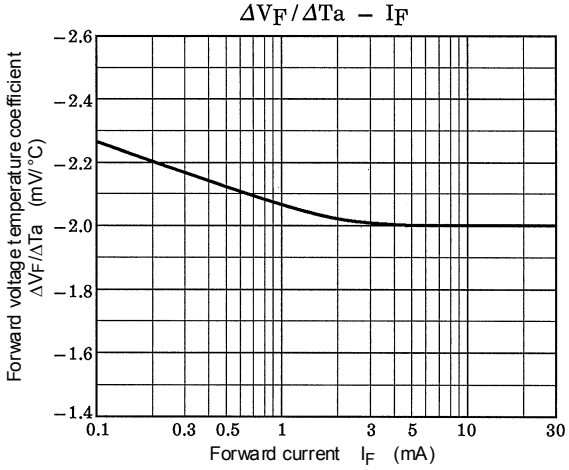
$$CM_H = \frac{320(V)}{t_r(\mu s)}, \quad CM_L = \frac{320(V)}{t_f(\mu s)}$$

C_L is approximately 15 pF which includes probe and stray wiring capacitance.

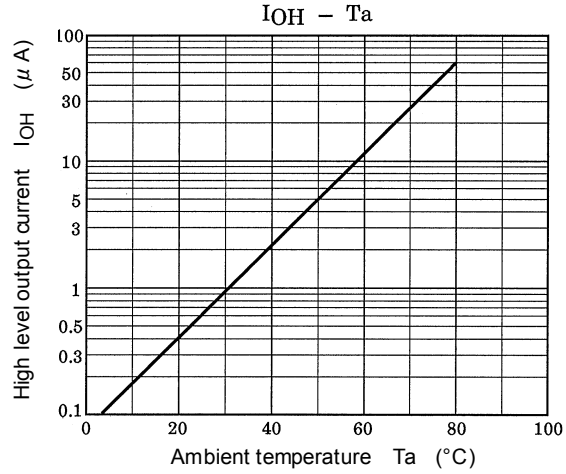
$I_F - V_F$



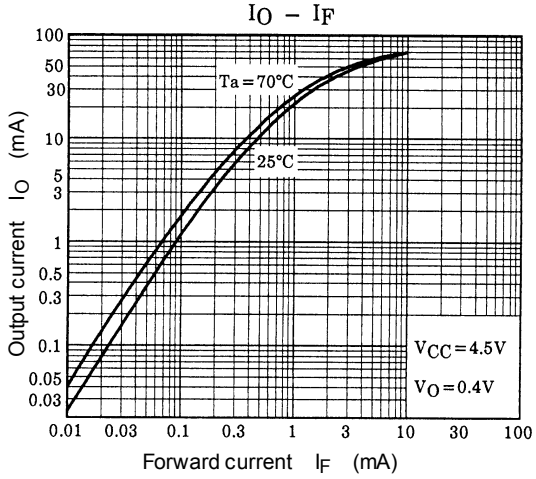
$\Delta V_F / \Delta Ta - I_F$



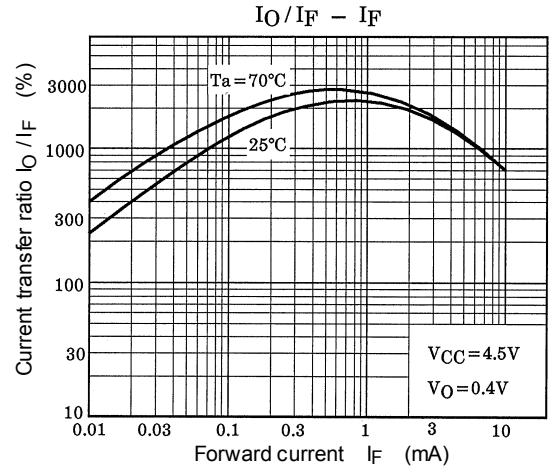
$I_{OH} - Ta$



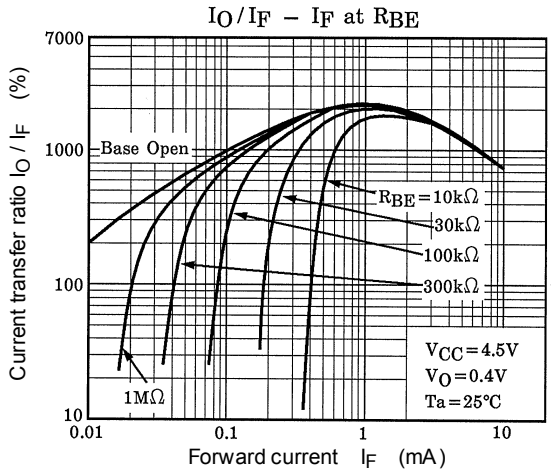
$I_O - I_F$



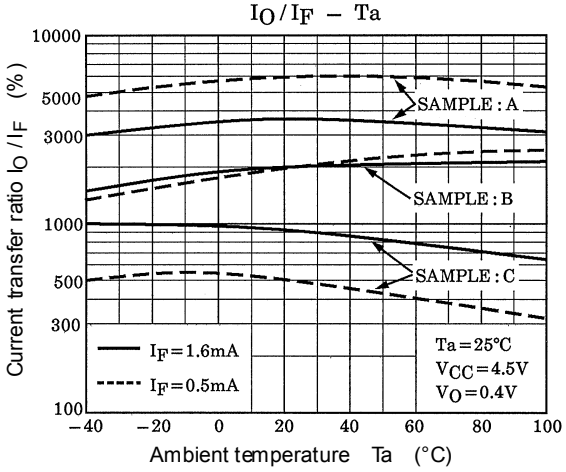
$I_O / I_F - I_F$



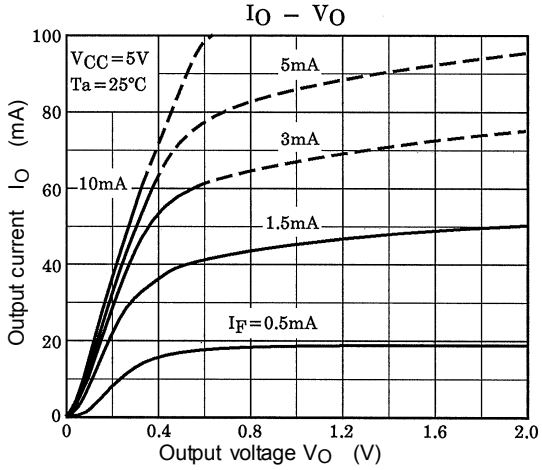
$I_O / I_F - I_F$ at R_{BE}



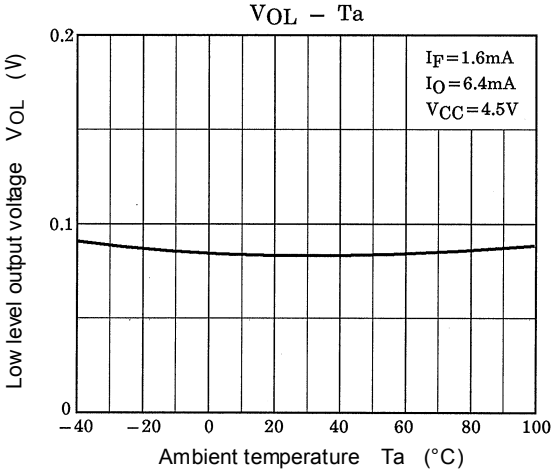
I_O / I_F – Ta



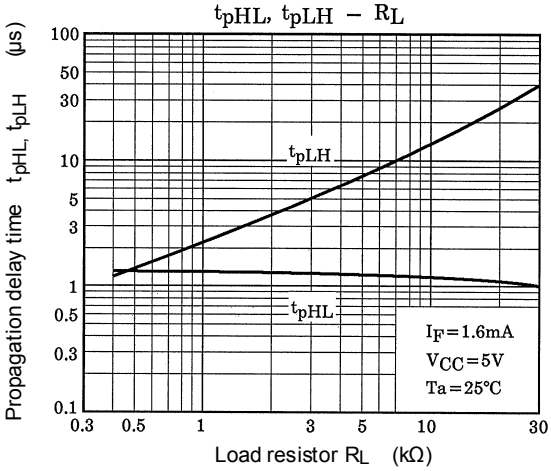
I_O – V_O



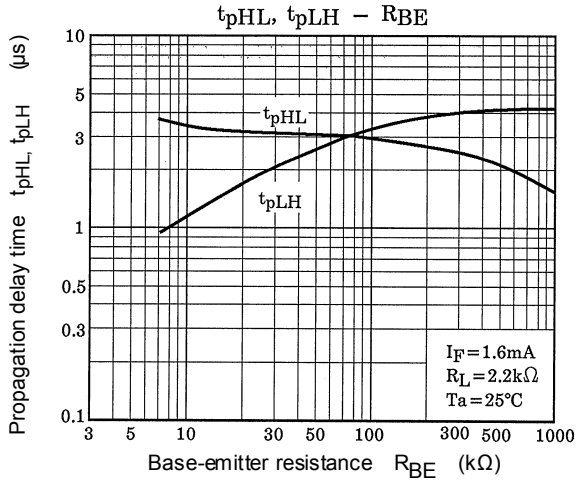
V_{OL} – Ta



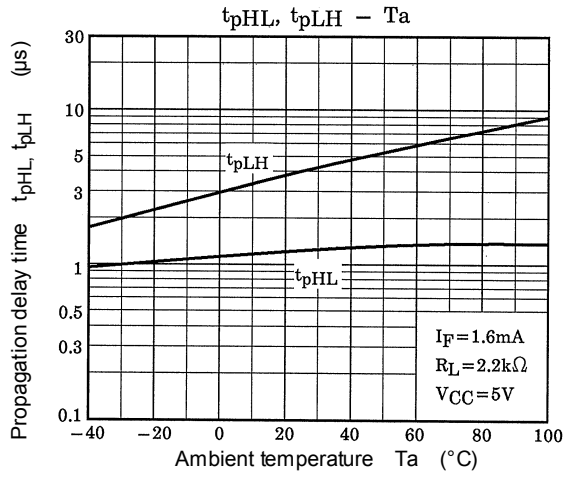
t_{pHL}, t_{pLH} – R_L



t_{pHL}, t_{pLH} – R_{BE}



t_{pHL}, t_{pLH} – Ta



RESTRICTIONS ON PRODUCT USE

- Toshiba Corporation, and its subsidiaries and affiliates (collectively “TOSHIBA”), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively “Product”) without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA’s written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product’s quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before creating and producing designs and using, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the “TOSHIBA Semiconductor Reliability Handbook” and (b) the instructions for the application that Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS’ PRODUCT DESIGN OR APPLICATIONS.**
- Product is intended for use in general electronics applications (e.g., computers, personal equipment, office equipment, measuring equipment, industrial robots and home electronics appliances) or for specific applications as expressly stated in this document. Product is neither intended nor warranted for use in equipment or systems that require extraordinarily high levels of quality and/or reliability and/or a malfunction or failure of which may cause loss of human life, bodily injury, serious property damage or serious public impact (“Unintended Use”). Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. Do not use Product for Unintended Use unless specifically permitted in this document.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- GaAs (Gallium Arsenide) is used in Product. GaAs is harmful to humans if consumed or absorbed, whether in the form of dust or vapor. Handle with care and do not break, cut, crush, grind, dissolve chemically or otherwise expose GaAs in Product.
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. TOSHIBA assumes no liability for damages or losses occurring as a result of noncompliance with applicable laws and regulations.