

TLP715

Isolated Bus Drivers

High Speed Line Receivers

Microprocessor System Interfaces

The Toshiba TLP715 consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photodetector. This unit is a 6-pin SDIP. The TLP715 is 50% smaller than the 8-PIN DIP and meets the reinforced insulation class requirements of international safety standards. Therefore the mounting area can be reduced in equipment requiring safety standard certification.

The detector has a totem pole output stage to provide both source and sink driving. The detector IC has an internal shield that provides a guaranteed common-mode transient immunity of 10 kV / μ s.

The TLP715 is buffer logic type. For inverter logic type, the TLP718 is in line-up.

- Buffer logic output (totem pole output)
- Guaranteed performance over temperature : -40 to 100°C
- Power supply voltage : 4.5 to 20 V
- Input current: $I_{FLH} = 3\text{mA}$ (Max)
- Switching time (t_{PLH} / t_{PHL}) : 250 ns (Max)
- Common-mode transient immunity : $\pm 10\text{ kV} / \mu\text{s}$ (Min)
- Isolation voltage : 5000 Vrms (Min)
- UL recognized
UL1577, File No.E67349
- c-UL recognized
CSA Component Acceptance Service No. 5A, File No.E67349
- Option (D4)
TÜV recognized / VDE under application : DIN EN60747-5-5

Maximum Operating Insulation Voltage : 890 V_{PK}

Highest Permissible Over Voltage : 8000 V_{PK}

**(Note) : When a EN60747-5-5 approved type is needed,
Please designate "Option(D4)"**

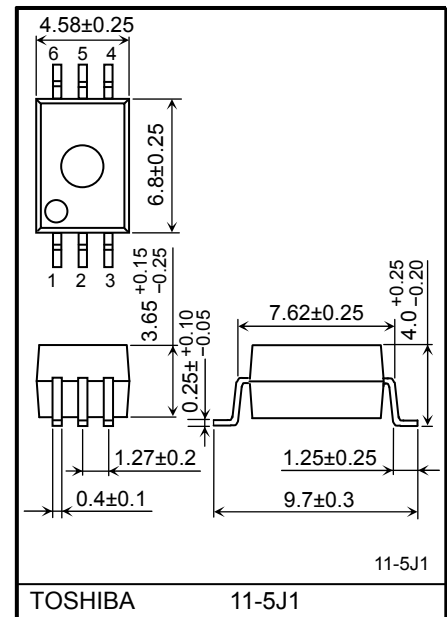
- Construction Mechanical Rating

	7.62 mm pitch TLPXXX type	10.16 mm pitch TLPXXXF type
Creepage Distance	7.0 mm (Min)	8.0 mm (Min)
Clearance	7.0 mm (Min)	8.0 mm (Min)
Insulation Thickness	0.4 mm (Min)	0.4 mm (Min)

Truth Table

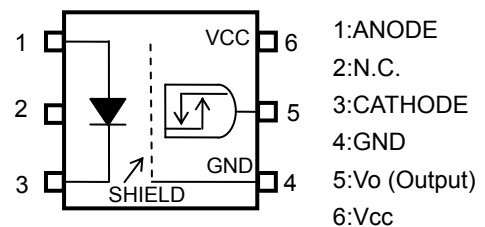
Input	LED	Tr1	Tr2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

Unit in mm

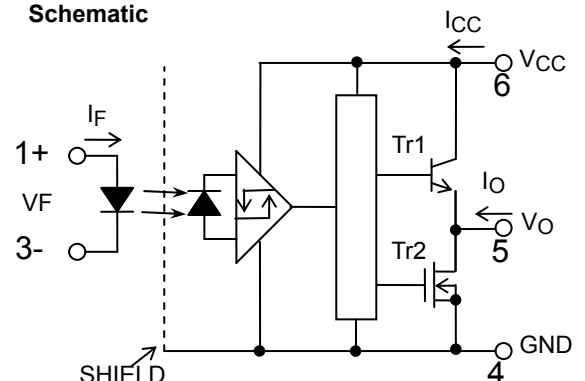


Weight: 0.26 g (typ.)

Pin Configuration (Top View)



Schematic



0.1 μ F bypass capacitor must be connected between pins 6 and 4. (Note 5)

Absolute Maximum Ratings (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current (Ta ≤ 83°C)	I _F	20	mA
	Forward Current Derating (Ta ≥ 83°C)	ΔI _F /ΔTa	-0.48	mA/°C
	Peak Transient Forward Current (Note 1)	I _{FPT}	1	A
	Reverse Voltage	V _R	5	V
	Junction Temperature	T _J	125	°C
DETECTOR	Output Current 1 (Ta ≤ 25°C)	I _{O1}	25 / -15	mA
	Output Current 2 (Ta ≤ 100°C)	I _{O2}	13 / -13	mA
	Output Voltage	V _O	-0.5 to 20	V
	Supply Voltage	V _{CC}	-0.5 to 20	V
	Junction Temperature	T _J	125	°C
Operating Temperature Range		T _{opr}	-40 to 100	°C
Storage Temperature Range		T _{stg}	-55 to 125	°C
Lead Solder Temperature (10 s)		T _{sol}	260	°C
Isolation Voltage (AC, 1 min., R.H. ≤ 60%, Ta = 25°C) (Note 2)		BVs	5000	V _{rms}

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the 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: Pulse width PW ≤ 1μs, 300pps.

Note 2: Device Considered a two terminal device : pins 1,2 and 3 shorted together and pins 4,5 and 6 shorted together.

Recommended Operating Conditions

CHARACTERISTIC	SYMBOL	MIN	TYP.	MAX	UNIT
Input Current, ON	I _F (ON)	4.5	-	10	mA
Input Voltage, OFF	V _F (OFF)	0	-	0.8	V
Supply Voltage*	V _{CC}	4.5	-	20	V
Operating Temperature	T _{opr}	-40	-	100	°C

* This item denotes operating ranges, not meaning of recommended operating conditions.

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

Electrical Characteristics

(Unless otherwise specified, Ta = -40 to 100°C, V_{CC} = 4.5 to 20 V.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN	TYP. *	MAX	UNIT
Input forward voltage	V _F	-	I _F = 5 mA, Ta = 25°C	1.4	1.6	1.7	V
Temperature coefficient of forward voltage	ΔV _F /ΔTa	-	I _F = 5 mA	-	-2.0	-	mV/°C
Input reverse current	I _R	-	V _R = 5 V, Ta = 25°C	-	-	10	μA
Input capacitance	C _T	-	V = 0 V, f = 1 MHz, Ta = 25°C	-	45	-	pF
Logic LOW output voltage	V _{OL}	1	I _{OL} = 3.5 mA, V _F = 0.8 V	-	0.2	0.6	V
Logic HIGH output voltage	V _{OH} (Note3)	2	I _{OH} = -2.6 mA, V _{CC} = 4.5 V	2.7	3.5	-	V
			I _F = 5 mA, V _{CC} = 20 V	17.4	19	-	
Logic LOW supply current	I _{CCL}	3	V _F = 0V	-	-	3.0	mA
Logic HIGH supply current	I _{CCH}	4	I _F = 5 mA	-	-	3.0	mA
Logic LOW short circuit output current (Note4)	I _{OSL}	5	V _F = 0V, V _{CC} = V _O = 5.5 V	15	80	-	mA
			V _{CC} = V _O = 20 V	20	90	-	
Logic HIGH short circuit output current (Note4)	I _{OSH}	6	I _F = 5mA, V _{CC} = 5.5 V	-5	-15	-	mA
			V _O = GND, V _{CC} = 20 V	-10	-20	-	
Input current logic HIGH output	I _{FLH}	-	I _O = -2.6 mA, V _O > 2.4 V	-	0.4	3	mA
Input voltage logic LOW output	V _{FHL}	-	I _O = 3.5 mA, V _O < 0.6V	0.8	-	-	V
Input current hysteresis	I _{HYS}	-	V _{CC} = 5 V	-	0.05	-	mA

* All typical values are at Ta=25°C, V_{CC}=5 V unless otherwise specifiedNote 3: V_{OH} = V_{CC} - V_O [V]

Note 4: Duration of output short circuit time should not exceed 10 ms.

Note 5: A ceramic capacitor (0.1 μF) should be connected from pin 6 to pin 4 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching property. The total lead length between capacitor and coupler should not exceed 1 cm.

Isolation Characteristics (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Capacitance input to output	C _S	V = 0 V, f = 1 MHz (Note 2)	-	1.0	-	pF
Isolation resistance	R _S	R.H. ≤ 60%, V _S = 500 V (Note 2)	1×10 ¹²	10 ¹⁴	-	Ω
Isolation voltage	BV _S	AC, 1 minute	5000	-	-	V _{rms}
		AC, 1 second, in oil	-	10000	-	
		DC, 1 minute, in oil	-	10000	-	V _{dc}

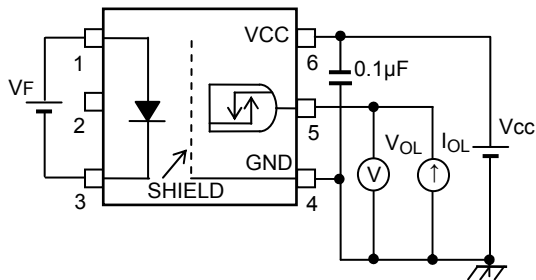
Switching Characteristics

(Unless otherwise specified, $T_a = -40$ to 100°C , $V_{CC} = 4.5$ to 20 V)

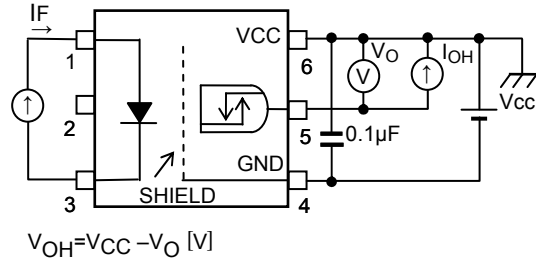
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN	TYP. *	MAX	UNIT
Propagation delay time to logic HIGH output	t_{pLH}	7,8	$I_F = 0 \rightarrow 3$ mA	30	120	250	ns
Propagation delay time to logic LOW output	t_{pHL}		$I_F = 3 \rightarrow 0$ mA	30	120	250	ns
Switching time dispersion between ON and OFF	$ t_{pLH} - t_{pHL} $		-	-	-	220	ns
Rise Time (10 – 90 %)	t_r		$I_F = 0 \rightarrow 3$ mA, $V_{CC} = 5$ V	-	30	-	ns
Fall Time (90 – 10 %)	t_f		$I_F = 3 \rightarrow 0$ mA, $V_{CC} = 5$ V	-	30	-	ns
Common-mode transient Immunity at HIGH level output	CM_H	9	$V_{CM} = 1000$ Vp-p, $I_F = 5$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$	10000	-	-	V/ μs
Common-mode transient Immunity at LOW level output	CM_L		$V_{CM} = 1000$ Vp-p, $I_F = 0$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$	-10000	-	-	V/ μs

*All typical values are at $T_a = 25^\circ\text{C}$.

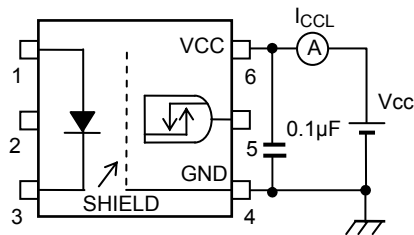
TEST CIRCUIT 1 : V_{OL}



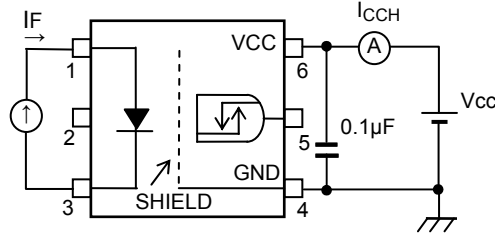
TEST CIRCUIT 2 : V_{OH}



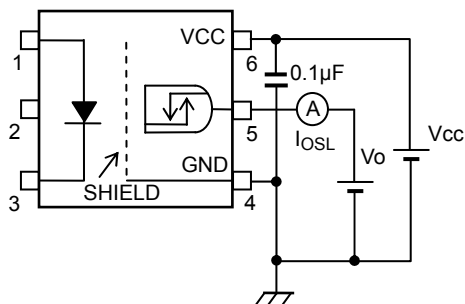
TEST CIRCUIT 3 : I_{CCL}



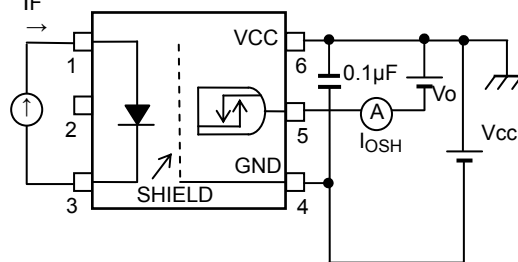
TEST CIRCUIT 4 : I_{CCH}



TEST CIRCUIT 5 : I_{OSL}

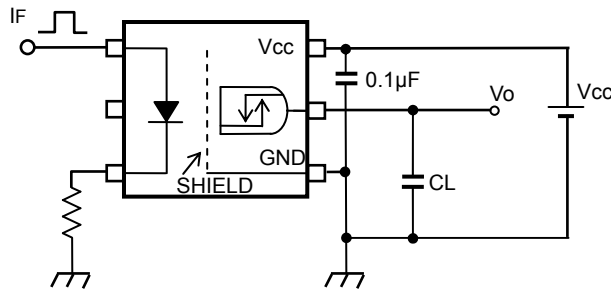


TEST CIRCUIT 6 : I_{OSH}

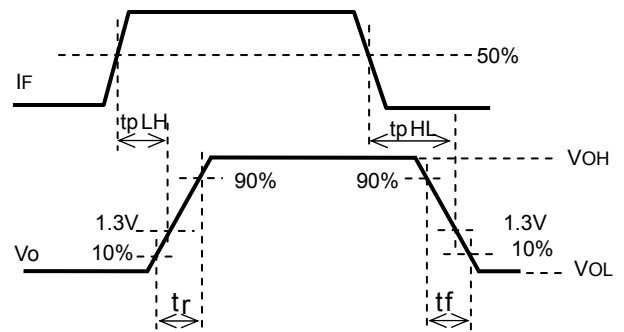


TEST CIRCUIT 7: Switching Time Test Circuit

$I_F = 3 \text{ mA (P.G)}$
($f = 50 \text{ kHz}$, duty=50%
less than $t_r = t_f = 5 \text{ ns}$)

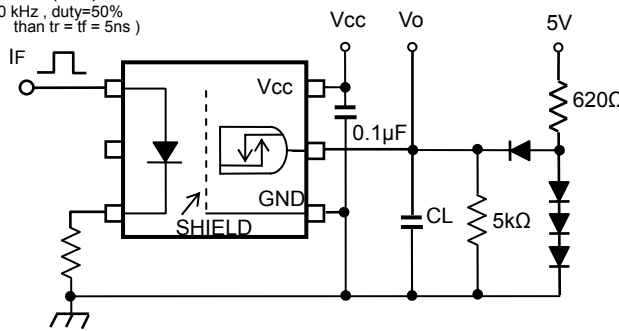


CL: stray capacitance of probe and wiring (to 15 pF)

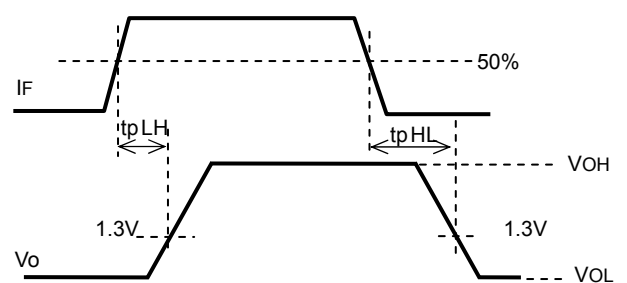


TEST CIRCUIT 8: Switching Time Test Circuit

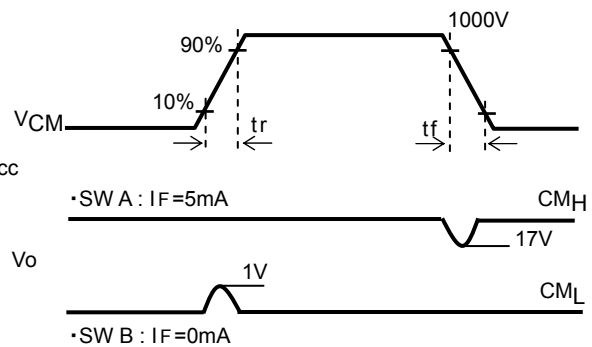
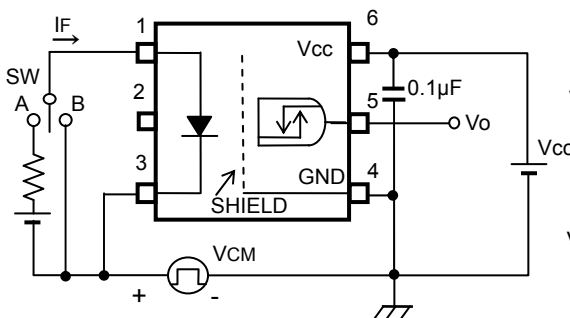
$I_F = 3 \text{ mA (P.G)}$
($f = 50 \text{ kHz}$, duty=50%
less than $t_r = t_f = 5 \text{ ns}$)



CL: stray capacitance of probe and wiring (to 15 pF)



TEST CIRCUIT 9: Common-Mode Transient Immunity Test Circuit



$$CM_L = \frac{800(V)}{t_r(\mu s)} \quad CM_H = -\frac{800(V)}{t_f(\mu s)}$$

CM_H (CM_L) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the high (low) state.

EN60747-5-5 Option:(D4)

Types : TLP715, TLP715F

Type designations for “option: (D4)”, which are tested under EN60747 requirements.

Ex.: TLP715 (D4-TP,F)

D4 : EN60747 option

TP : Standard tape & reel type

F : [[G]]/RoHS COMPATIBLE

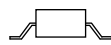
Note: Use TOSHIBA standard type number for safety standard application.

Ex.: TLP715 (D4-TP,F) → TLP715

EN60747 Isolation Characteristics

Description		Symbol	Rating	Unit
Application classification				
for rated mains voltage $\leq 300V_{rms}$ for rated mains voltage $\leq 600V_{rms}$			I-IV I-III	—
Climatic classification			40/ 100 / 21	—
Pollution degree			2	—
Maximum operating insulation voltage	TLPxxx type	V_{IORM}	890	Vpk
	TLPxxxFtype		1140	
Input to output test voltage, method A $V_{pr}=1.5 \times V_{IORM}$, type and sample test $t_p=10s$, partial discharge $<5pC$	TLPxxx type	V_{pr}	1335	Vpk
	TLPxxxFtype		1710	
Input to output test voltage, method B $V_{pr}=1.875 \times V_{IORM}$, 100% production test $t_p=1s$, partial discharge $<5pC$	TLPxxx type	V_{pr}	1670	Vpk
	TLPxxxFtype		2140	
Highest permissible overvoltage (transient overvoltage, $t_{pr} = 60s$)		V_{TR}	8000	Vpk
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve) current (input current I_F , $P_{Si} = 0$) power (output or total power dissipation) temperature		I_{Si} P_{Si} T_{Si}	300 700 150	mA mW °C
Insulation resistance, input-output $V_{IO} = 500V$, $T_a=25^\circ C$ $V_{IO} = 500V$, $T_a=100^\circ C$ $V_{IO} = 500V$, $T_a=T_{Si}$		R_{Si}	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^9$	Ω

Insulation Related Specifications

		 7.62mm pitch TLPxxx type	 10.16mm pitch TLPxxxF type
Minimum creepage distance	Cr	7.0mm	8.0mm
Minimum clearance	Cl	7.0mm	8.0mm
Minimum insulation thickness	ti	0.4mm	
Comperative tracking index	CTI	175	

- 1. If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g.at a standard distance between soldering eye centres of 7.5mm). If this is not permissible, the user shall take suitable measures.
- 2. This photocoupler is suitable for ‘safe electrical isolation’ only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

Marking on product for EN60747 Option:(D4) : **4**

Marking Example :

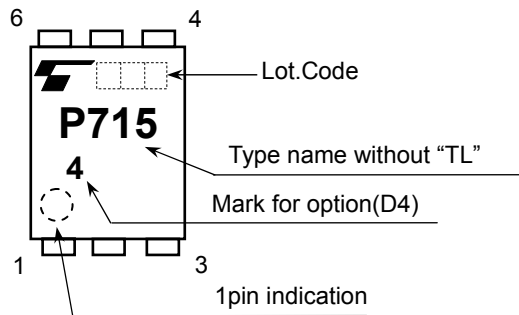


Figure 1 Partial discharge measurement procedure according to EN60747
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests,
destructive tests)

t_1, t_2 = 1 to 10 s
 t_3, t_4 = 1 s
 t_p (Measuring time for
partial discharge) = 10 s
 t_b = 12 s
 t_{ini} = 60 s

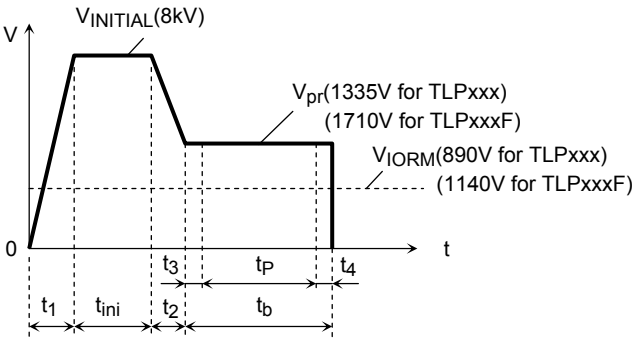


Figure 2 Partial discharge measurement procedure according to EN60747
Non-destructive test for 100% inspection.

Method B

(for sample test, non-
destructive test)

t_3, t_4 = 0.1 s
 t_p (Measuring time for
partial discharge) = 1 s
 t_b = 1.2 s

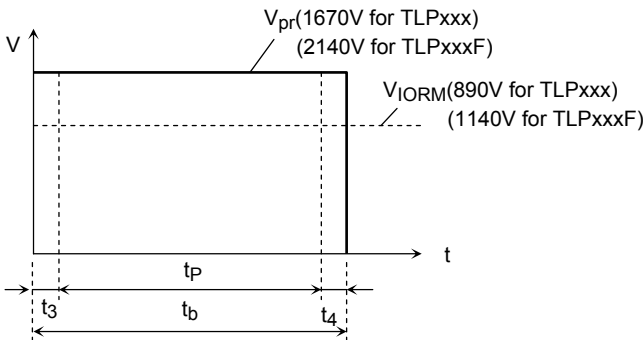
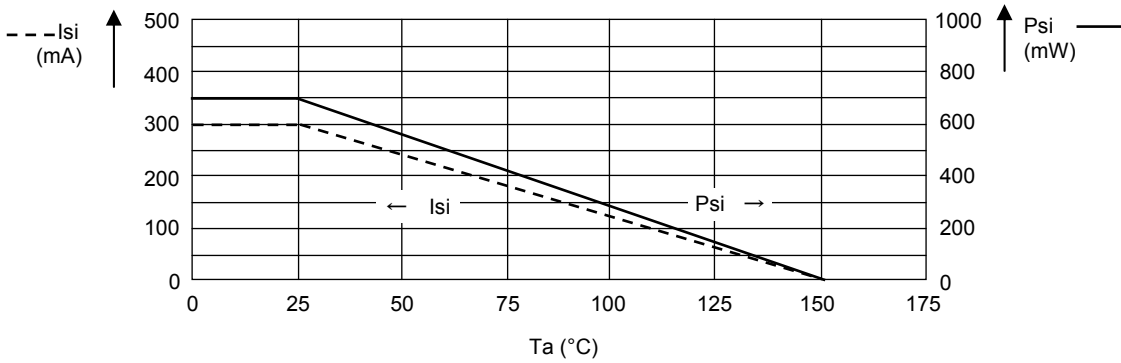


Figure 3 Dependency of maximum safety ratings on ambient temperature (for
photodetector failure)



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 customers use the Product, create designs including the Product, or incorporate the Product into their own applications, 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 with which the 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 NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS 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 AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, 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. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative.
- 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 applicable export laws and regulations including, without limitation, 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.**