

TLP708, TLP708F

Factory Automation (FA)
Home Electrical Appliances
Operates at high ambient temperature up to 125°C

The Toshiba TLP708 consists of an infrared emitting diode and an integrated high-gain, high-speed photodetector. The TLP708 is housed in the SDIP6 package. Compared to the standard DIP8 package, TLP708 is smaller in size, yet comes with international safety standards under a reinforced isolation category. As such, it is possible to reduce the mounting footprint for applications that require certifications for safety standards.

The photodetector has an open-collector output stage, and an internal Faraday shield that provides a guaranteed common-mode transient immunity of ± 15 kV/ μ s. As TLP708 is also able to operate up to 125°C, it is suitable for use in applications like industrial equipments where it is necessary to operate under high ambient temperature.

TLP708F is of a long creepage distance and clearance distance type.

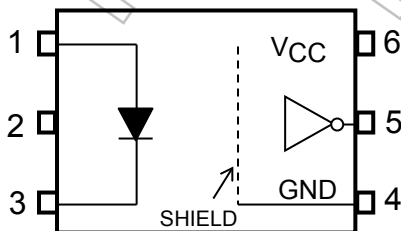
- Input threshold current : $I_{FHL} = 5\text{mA (max)}$
- Switching time (t_{pHL}/t_{pLH}): 75ns (max)
- Data transfer rate: 15 MBd (typ.)
- Guaranteed Performance over temperature: -40 to 125 °C
- Power supply voltage: 4.5 to 5.5 V
- Common mode transient immunity: ± 15 kV/ μ s (min)
- Isolation voltage: 5000 V_{rms} (min)
- Construction mechanical rating

	7.62 mm Pitch TLP708 Type	10.16 mm Pitch TLP708F Type
Creepage distance	7.0 mm (min)	8.0 mm (min)
Clearance distance	7.0 mm (min)	8.0 mm (min)
Insulation thickness	0.4 mm (min)	0.4 mm (min)

- UL-recognized: UL 1577, File No. E67349
- cUL-recognized: CSA Component Acceptance Service No.5A
File No. E67349
- VDE-approved: EN 60747-5-5, EN 62368-1 (Note 1)

Note 1 : When a VDE approved type is needed,
please designate the **Option (D4)**.

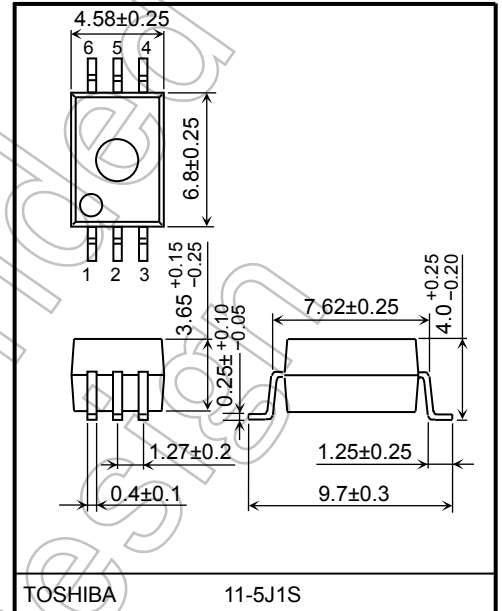
Pin Configuration (Top View)



- 1:ANODE
- 2:N.C.
- 3:CATHODE
- 4:GND
- 5:V_O(Output)
- 6:VCC

TLP708

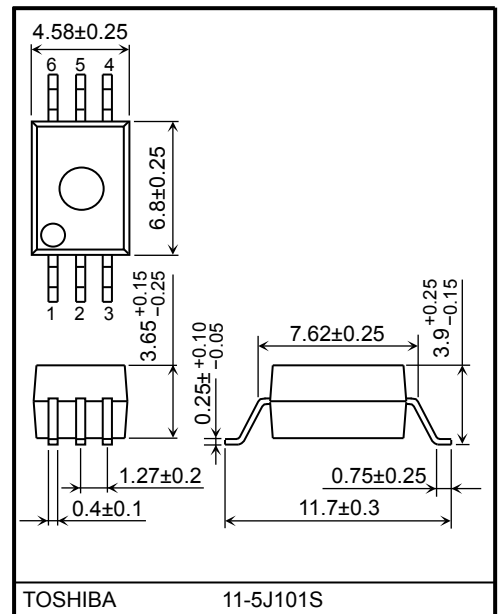
Unit: mm



Weight: 0.26 g (typ.)

TLP708F

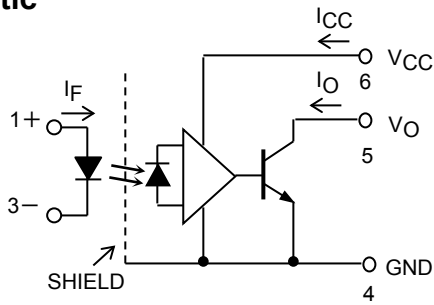
Unit: mm



Weight: 0.26 g (typ.)

Start of commercial production
2010-06

Schematic



Note: A 0.1 μ F bypass capacitor must be connected between pins 6 and 4.

Truth Table

Input	Output
H	L
L	H

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
LED	Forward Current (Ta < 110°C)	I _F	25	mA
	Forward Current Derating (Ta ≥ 110°C)	$\Delta I_F/^\circ\text{C}$	-0.67	mA/°C
	Pulse Forward Current (Note 1) (Ta < 110°C)	I _{FP}	50	mA
	Pulse Forward Current Derating (Ta ≥ 110°C)	$\Delta I_{FP}/^\circ\text{C}$	-1.34	mA/°C
	Reverse Voltage	V _R	5	V
	Input Power Dissipation (Ta < 110°C)	P _D	40	mW
	Input Power Dissipation Derating (Ta ≥ 110°C)	$\Delta P_D/^\circ\text{C}$	-1.0	mW/°C
DETECTOR	Output Current (Ta ≤ 125°C)	I _O	25	mA
	Output Voltage	V _O	6	V
	Supply Voltage	V _{CC}	6	V
	Output Power Dissipation (Ta < 110°C)	P _O	80	mW
	Output Power Dissipation Derating (Ta ≥ 110°C)	$\Delta P_O/^\circ\text{C}$	-2.0	mW/°C
Operating Temperature Range		T _{opr}	-40 to 125	°C
Storage Temperature Range		T _{stg}	-55 to 150	°C
Lead solder Temperature (10 s)		T _{sol}	260	°C
Isolation voltage (Note 2)		BV _S	5000	V _{rms}

Note: Using continuously under heavy loads (e.g. an 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: Pulse width ≤ 1ms, duty = 50 %

Note 2: R.H. ≤ 60 %, Ta = 25 °C, AC 60 s

This device is regarded as a two-terminal device: pins 1, 2 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

Recommended Operating Condition

Characteristics	Symbol	Min	Typ.	Max	Unit
'L' level input voltage	V _{FL}	0	—	0.8	V
'H' level input current	I _{FH}	7.5	—	15	mA
Supply voltage*	V _{CC}	4.5	—	5.5	V
Operating temperature range	T _{opr}	-40	—	125	°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. 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 = -40 to 125°C, V_{CC} = 4.5 to 5.5V)

Characteristic	Symbol	Test Circuit	Test Conditions	Min	Typ.*	Max	Unit
Input forward current	V _F	—	I _F = 10 mA, Ta = 25 °C	1.40	1.57	1.80	V
Temperature coefficient of forward voltage	ΔV _F /ΔTa	—	I _F = 10 mA	—	-1.8	—	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	—	60	—	pF
"H" level output current	I _{OH}	1	V _F = 0.8 V, V _O = 5.5 V	—	—	250	μA
			V _F = 0.8 V, V _O = 5.5 V Ta = 25 °C		0.5	10	
"L" level output voltage	V _{OL}	2	I _F = 10 mA, I _{OL} = 13 mA (sink)	—	0.3	0.6	V
Input threshold current	I _{FHL}	—	I _{OL} = 13 mA (sink), V _O < 0.6 V	—	1.5	5.0	mA
"H" level supply current	I _{CCH}	3	I _F = 0 mA	—	1.5	5.0	mA
"L" level supply current	I _{CCL}	4	I _F = 10 mA	—	1.4	5.0	mA

*All typical values are at Ta = 25 °C, V_{CC} = 5 V unless otherwise specified.

Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Capacitance input to output	C _S	V _S = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R _S	R.H. ≤ 60 %, V _S = 500 V	10 ¹²	10 ¹⁴	—	Ω
Isolation voltage	BV _S	AC, 60 s	5000	—	—	V _{rms}

Note : This device is regarded as a two-terminal device: pins 1, 2 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

Switching Characteristics

(Unless otherwise specified, $T_a = -40$ to 125°C , $V_{CC} = 4.5$ to 5.5 V)

Characteristic	Symbol	Test Circuit	Test Conditions		Min	Typ.*	Max	Unit
Propagation delay time to logic low output	t_{pHL}	5	$I_F = 0 \rightarrow 7.5$ mA	$R_L = 350 \Omega$ $C_L = 15$ pF (Note 4)	—	35	75	ns
Propagation delay time to logic high output	t_{pLH}							
Switching time dispersion between ON and OFF	$ t_{pHL} - t_{pLH} $		$I_F = 0 \leftrightarrow 7.5$ mA	$R_L = 350 \Omega$ $C_L = 15$ pF (Note 4)	—	12	35	ns
Propagation delay skew (Note 5)	t_{psk}							
Output fall time (90-10%)	t_f		$I_F = 0 \rightarrow 7.5$ mA	$R_L = 350 \Omega$ $C_L = 15$ pF (Note 4)	—	6	—	ns
Output rise time (10-90%)	t_r							
Common mode transient immunity at high level output	CM_H	6	$V_{CM} = 1000$ V _{p-p} , $I_F = 0$ mA, $V_{CC} = 5$ V, $T_a = 25^\circ\text{C}$		+15	—	—	kV/ μ s
Common mode transient immunity at low level output	CM_L		$V_{CM} = 1000$ V _{p-p} , $I_F = 10$ mA, $V_{CC} = 5$ V, $T_a = 25^\circ\text{C}$		-15	—	—	kV/ μ s

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

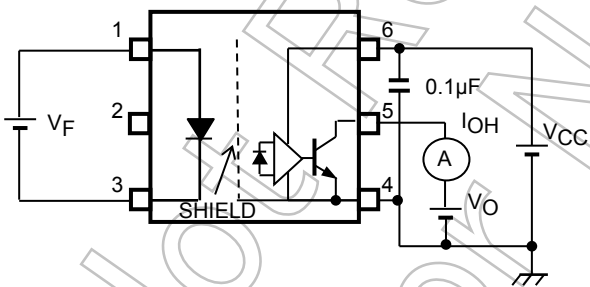
Note 3: A ceramic capacitor (0.1 μ F) should be connected from pin 6 (V_{CC}) to pin 4 (GND) to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property. The total lead length between the capacitor and coupler should not exceed 1 cm.

Note 4: $f = 5$ MHz, duty=50 %, input current $t_r = t_f = 4.5$ ns.

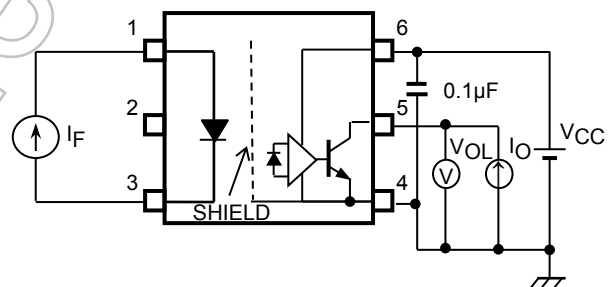
C_L is less than 15 pF which includes probe and jig/stray wiring capacitance.

Note 5 Propagation delay skew is defined as the difference between the largest and smallest propagation delay times (i.e. t_{pHL} or t_{pLH}) of multiple samples. Evaluations of these samples are conducted under identical test conditions (supply voltage, input current, temperature, etc).

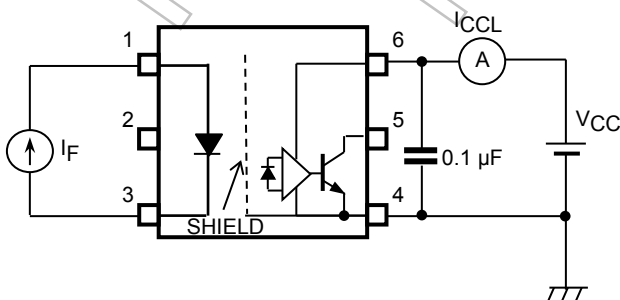
TEST CIRCUIT 1: I_{OH} Test Circuit



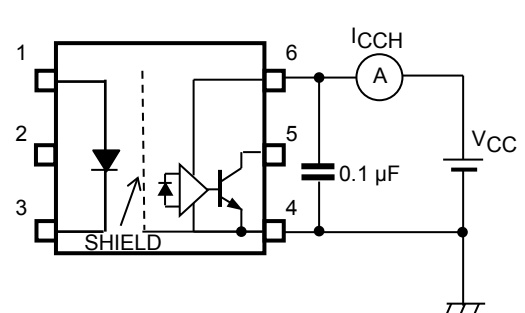
TEST CIRCUIT 2: V_{OL} Test Circuit



TEST CIRCUIT 3: I_{cCL} Test Circuit

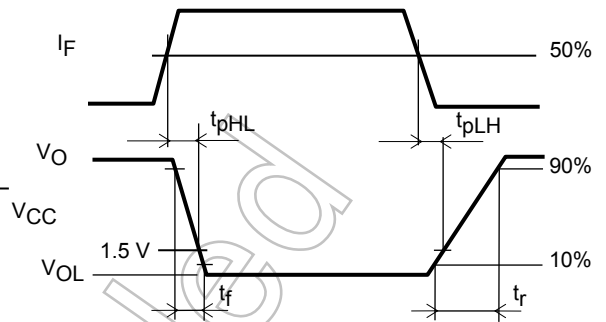
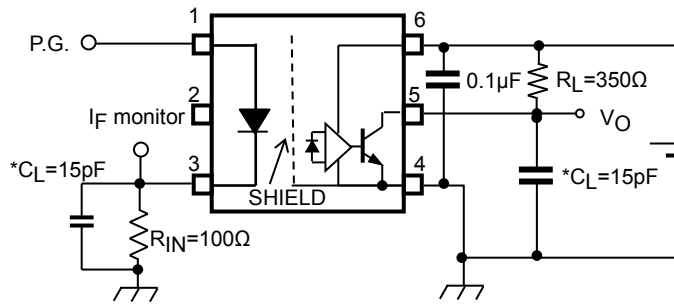


TEST CIRCUIT 4: I_{cCH} Test Circuit



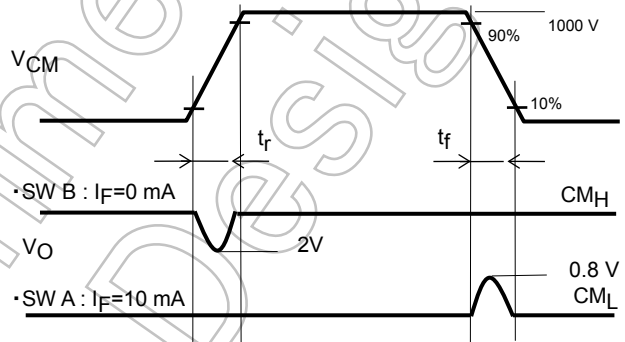
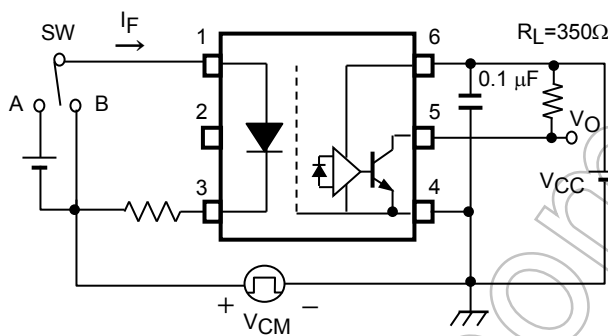
TEST CIRCUIT 5: t_{pHL} , t_{pLH} Test Circuit

$I_F = 7.5\text{mA (P.G.)}$
 ($f = 5\text{MHz}$, $\text{duty} = 50\%$, $t_r = t_f = 4.5\text{ns}$)

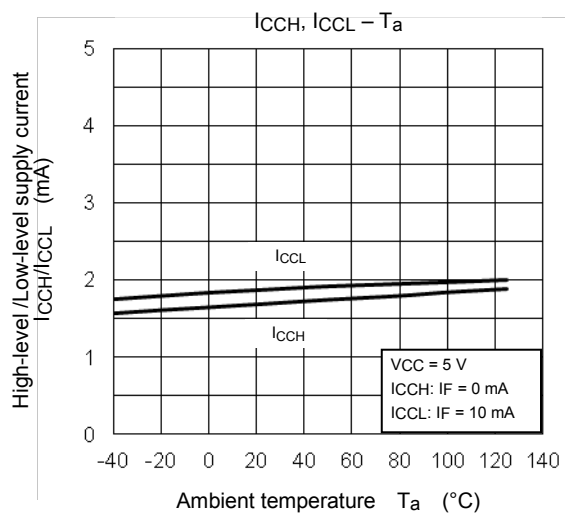
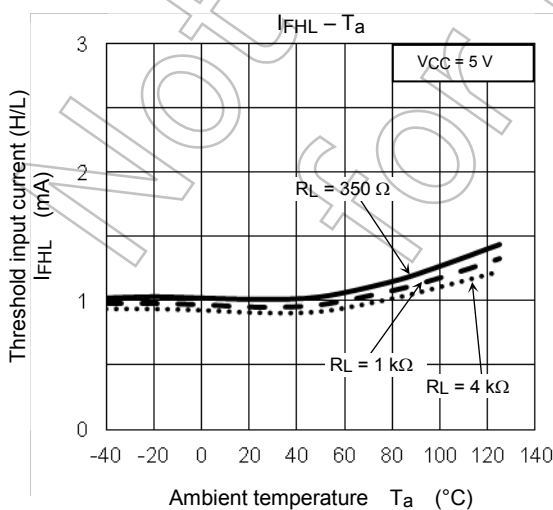
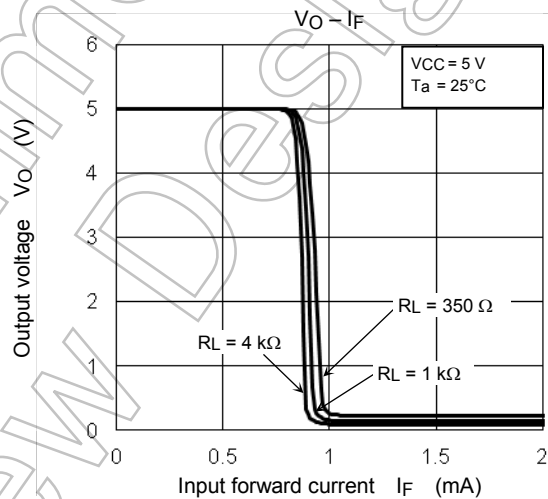
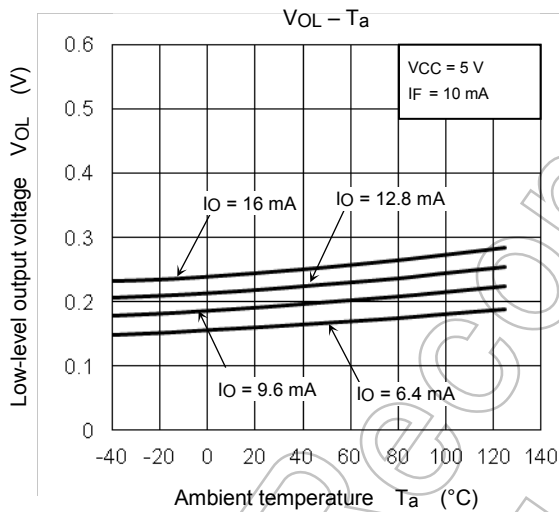
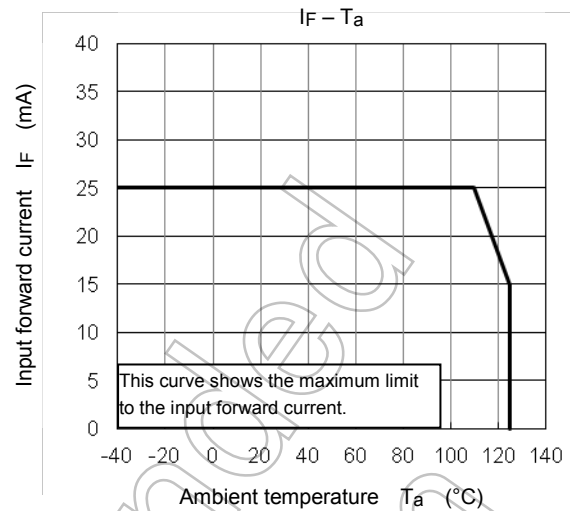
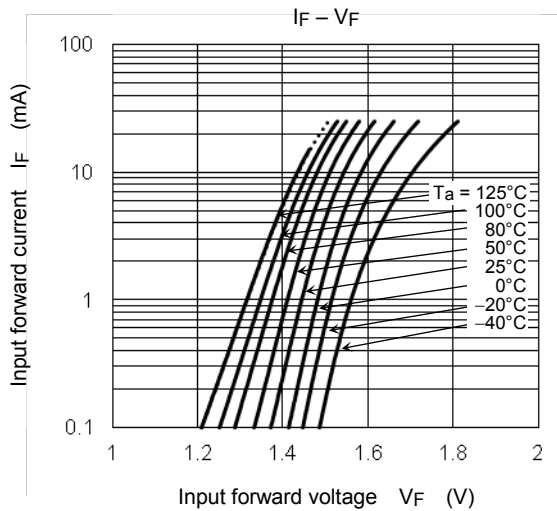


C_L includes probe and stray capacitance.
 P.G.: Pulse generator

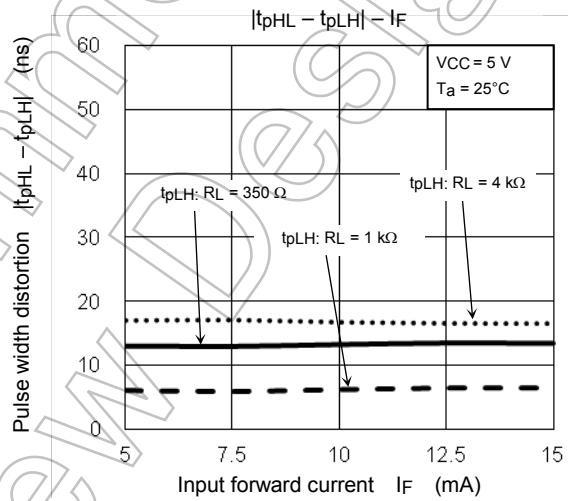
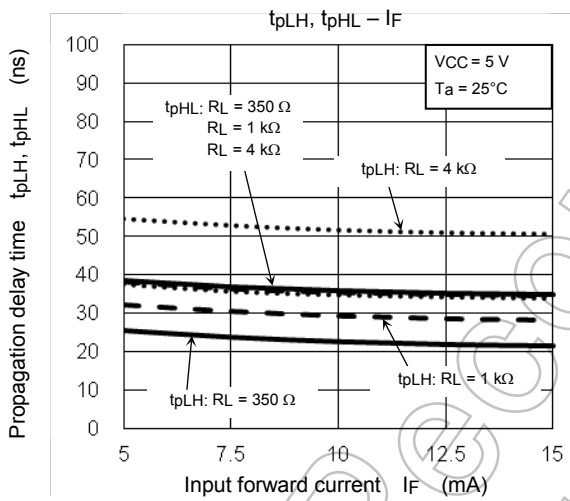
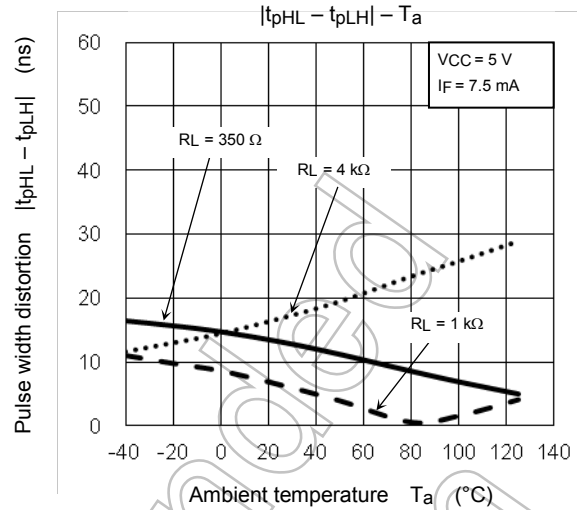
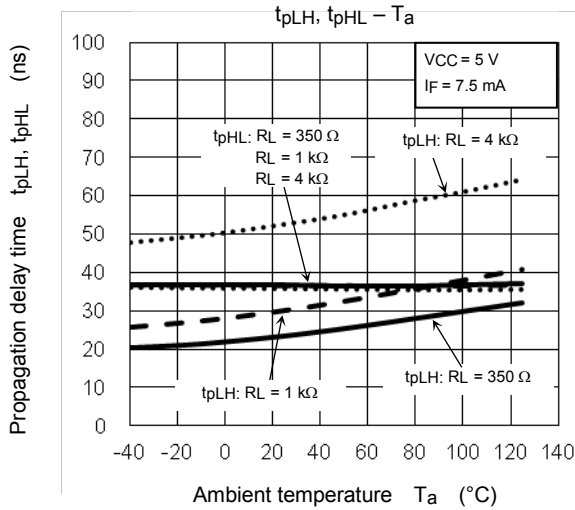
TEST CIRCUIT 6: Common-Mode Transient Immunity Test Circuit



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



NOTE: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



NOTE: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Soldering and Storage

(1) Precautions for Soldering

The soldering temperature should be controlled as closely as possible to the conditions shown below, irrespective of whether a soldering iron or a reflow soldering method is used.

1) When Using Soldering Reflow

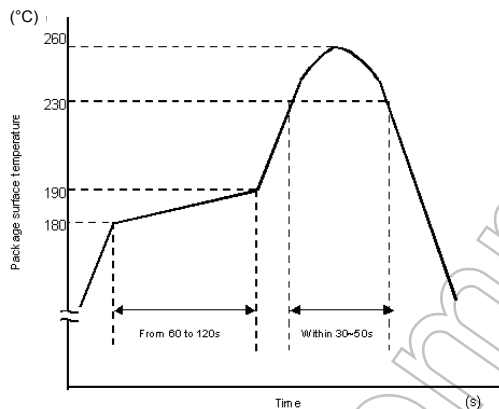
The soldering temperature profile is based on the package surface temperature.

(See the figure shown below, which is based on the package surface temperature.)

Reflow soldering must be performed once or twice.

The mounting should be completed with the interval from the first to the last mountings being 2 weeks.

- An example of a temperature profile when lead(Pb)-free solder is used:



This profile is based on the device's maximum heat resistance guaranteed value.

Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

2) When using soldering flow

- Preheat the device at a temperature of 150 °C (package surface temperature) for 60 to 120 seconds.
- Mounting condition of 260 °C within 10 seconds is recommended.
- Flow soldering must be performed once

3) When using soldering Iron

- Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C.
- Heating by soldering iron must be only once per 1 lead

(2) Precautions for General Storage

- 1) Do not store devices in places where they will be exposed to moisture or direct sunlight.
- 2) During transportation or storage of devices, follow the cautions indicated on the carton box.
- 3) The storage area temperature should be kept within a temperature range of 5°C to 35°C, and the relative humidity should be maintained between 45% and 75%.
- 4) Do not store devices in the presence of harmful (especially corrosive) gases, or under dusty conditions.
- 5) Use storage areas where there is minimal temperature fluctuation. The solderability of the leads will be degraded as rapid temperature changes can cause condensation to form on the stored devices, resulting in lead oxidation or corrosion.
- 6) When repacking devices, use anti-static containers.
- 7) Do not apply any external force or load directly to devices when they are in storage.
- 8) If devices have been stored for more than two years, it is recommended that their solderability be tested before they are used even if the above precautions have been followed.

Not Recommended for New Design

RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA". Hardware, software and systems described in this document are collectively referred to as "Product".

- TOSHIBA reserves the right to make changes to the information in this document and related 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, lifesaving and/or life supporting 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, and devices related to power plant. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative or contact us via our website.
- 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.**