TOSHIBA PHOTOCOUPLER IRED & PHOTO-IC

TLP104

IPM (Intelligent Power Module)
Industrial Inverter
Operate at high ambient temperatures up to 125°C

The Toshiba TLP104 consists of an infrared LED and integrated high gain, high-speed photodetectors. The TLP104 is housed in the SO6 package. The output stage is an open collector type.

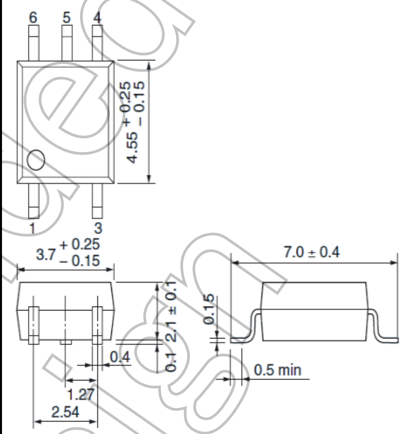
The photodetector has an internal Faraday shield that provides a guaranteed common-mode transient immunity of ±15 kV/μs. TLP104 guarantees minimum and maximum of propagation delay time, switching speed dispersion, and high common mode transient immunity. Therefore TLP104 is suitable for isolation interface between IPM (Intelligent Power Module) in motor control application.

- Inverter logic type (Open collector output)
- Package type: SO6
- Guaranteed performance over temperature: -40 to 125°C
- Power supply voltage: -0.5 to 30 V
- Threshold Input Current: I_{FHL} = 5.0 mA (max)
- Propagation delay time (t_{pHL}/t_{pLH}): t_{pHL} = 400ns (max)
  t_{pLH} = 550ns (max)
- Switching Time Dispersion($|t_{pHL}-t_{pLH}|$): 400ns (max)
- Common mode transient immunity : ±15kV/μs (min)
- Isolation voltage : 3750Vrms (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)
- CQC-approved：GB4943.1, GB8898 Thailand Factory

仅适用于海拔 2000m 以下地区安全使用

Note 1 : When a VDE approved type is needed,
please designate the **Option(V4)**.

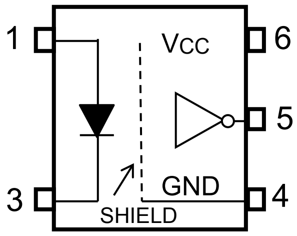
Unit: mm



JEDEC	―
JEITA	―
TOSHIBA	11-4L1

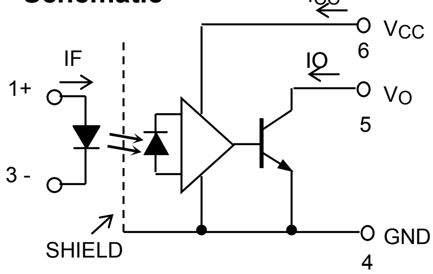
Weight: 0.08 g(typ.)

Pin Configuration (Top View)



1:ANODE
3:CATHODE
4:GND
5:V_O(Output)
6:V_{CC}

Schematic



Truth Table

Input	LED	Output
H	ON	L
L	OFF	H

Construction Mechanical Ratings

Creepage distance	5.0 mm (min)
Clearance distance	5.0 mm (min)
Insulation thickness	0.4 mm (min)

Start of commercial production
2009-10

Absolute Maximum Ratings (Ta = 25°C)

	Characteristic	Symbol	Rating	Unit
LED	Forward Current	I_F	25	mA
	Forward Current Derating (Ta ≥ 110°C)	ΔI_F /°C	-0.67	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	50	mA
	Pulse Forward Current Derating (Ta ≥ 110°C)	ΔI_{FP} /°C	-1.34	mA/°C
	Reverse Voltage	V_R	5	V
	Input Power Dissipation	P_D	40	mW
	Input power Dissipation Derating (Ta ≥ 110°C)	ΔP_D/°C	-1.0	mW/°C
Detector	Output Current (Ta ≤ 125°C)	I_O	8	mA
	Output Voltage	V_O	-0.5 to 30	V
	Supply Voltage	V_{CC}	-0.5 to 30	V
	Output Power Dissipation	P_O	80	mW
	Output Power Dissipation Derating (Ta ≥ 110°C)	ΔP_O /°C	-2.0	mW/°C
Operating Temperature Range		T_{opr}	-40 to 125	°C
Storage Temperature Range		T_{stg}	-55 to 125	°C
Lead Soldering Temperature (10 s)		T_{sol}	260	°C
Isolation Voltage (AC,60 s, R.H.≤ 60 %,Ta=25°C) (Note 2)		BV_S	3750	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 ≤ 10 μs, duty=10 %.

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

Recommended Operating Conditions

Characteristic	Symbol	Min	Typ.	Max	Unit
Input Current , High Level	I_{FHL}	7.5	-	15	mA
Input Voltage , Low Level	V_{FLH}	0	-	0.8	V
Supply Voltage*	V_{CC}	4.5	-	30	V
Operating Temperature	T_{opr}	-40	-	125	°C

* This item denotes operating range, 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 125°C, V_{CC} =4.5 to 30V)

	Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
LED	Forward voltage	V_F	—	I_F = 10 mA, Ta = 25 °C	1.45	1.61	1.85	V
LED	Forward voltage temperature coefficient	$\Delta V_F / \Delta Ta$	—	I_F = 10 mA	—	-1.8	—	mV /°C
LED	Reverse current	I_R	—	V_R = 5 V, Ta = 25 °C	—	—	10	μA
LED	Capacitance between terminals	C_T	—	V = 0 V, f = 1 MHz	—	60	—	pF
Detector	High level output current	I_{OH}	1	V_F = 0.8 V, V_O < V_{CC}	—	—	50	μA
Detector	Low level output voltage	V_{OL}	2	I_F = 10 mA, I_O = 2.4 mA	—	0.2	0.6	V
Detector	Low level supply current	I_{CCL}	3	I_F = 10 mA	—	—	1.3	mA
Detector	High level supply current	I_{CCH}	4	I_F = 0 mA	—	—	1.3	mA
Detector	Output current	I_O	—	I_F = 10 mA, V_O = 0.6 V	4.0	—	—	mA
Input current logic LOW output		I_{FHL}	—	I_O = 0.75mA, V_O < 0.8 V	—	1.0	5	mA
Input voltage logic HIGH output		V_{FLH}	—	I_O = 0.75mA, V_O > 2.0 V	0.8	—	—	V

*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	3750	—	—	V_{rms}

Switching Characteristics (Unless otherwise specified, Ta = −40 to 125°C, V_{CC}=15V)

Characteristic	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Propagation delay time (H→L)	t_{pHL}	5	I_F = 10 mA, R_L = 20 kΩ (Note 1)	C_L=100 pF	30	150	400	ns
				C_L=10 pF	—	90	—	
Propagation delay time (L→H)	t_{pLH}			C_L=100 pF	150	350	550	
				C_L=10 pF	—	100	—	
Switching Time Dispersion between ON and OFF	$\|t_{pHL}-t_{pLH}\|$			C_L = 100 pF	—	—	400	
Propagation Delay Skew (Note 2)	$t_{pLH}-t_{pHL}$				-50	—	450	
Common mode transient immunity at high output level	CM_H	6	V_{CM} = 1500 V_{p-p}, I_F = 0 mA, R_L = 20 kΩ, Ta = 25 °C		15	—	—	kV/μs
Common mode transient Immunity at low output level	CM_L		V_{CM} = 1500 V_{p-p}, I_F = 10 mA, R_L = 20 kΩ, Ta = 25 °C		−15	—	—	kV/μs

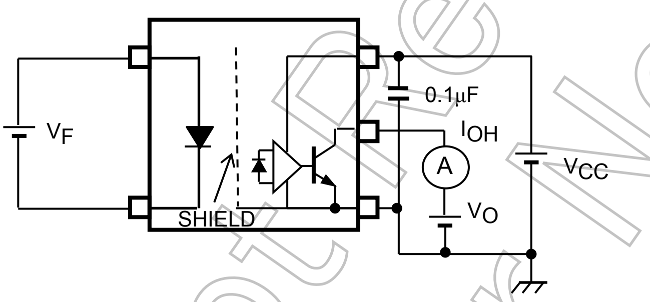
*All typical values are at Ta = 25 °C

Note : A ceramic capacitor (0.1 μF) 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 capacitor and coupler should not exceed 1 cm.

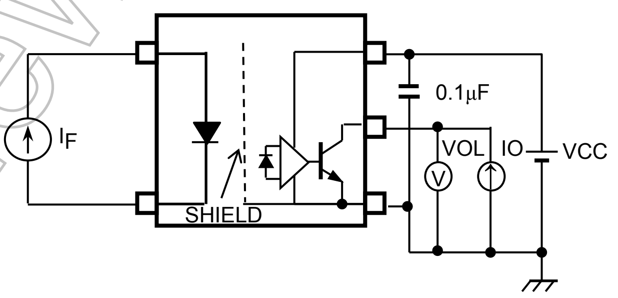
Note 1: f = 10kHz, duty=10%, input current tr = tf = 5 ns

Note 2: Propagation delay skew is defined as the propagation delay time of the largest or smallest t_{pLH} minus the largest or smallest t_{pHL} of multiple samples. Evaluations of these samples are conducted under identical test conditions (supply voltage, input current, temperature, etc.).

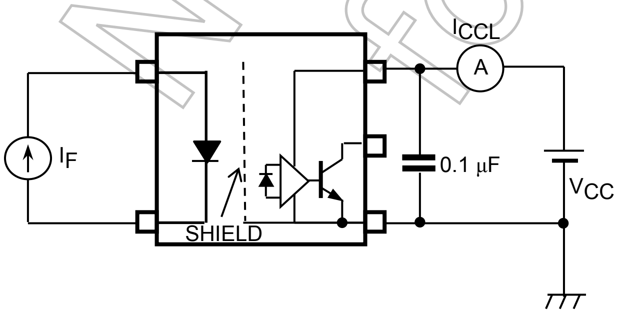
TEST CIRCUIT 1: I_{OH}



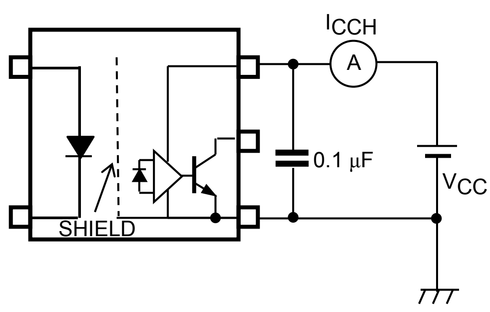
TEST CIRCUIT 2: V_{OL}



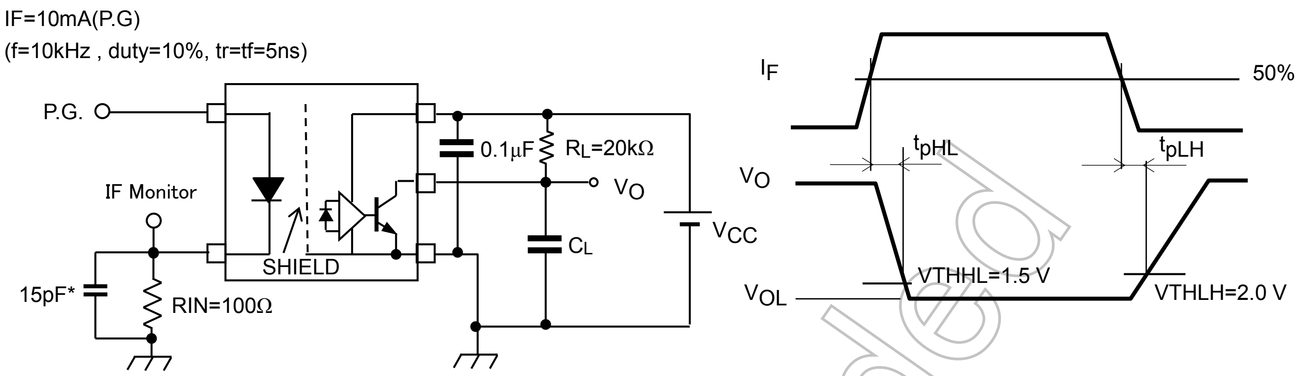
TEST CIRCUIT 3: I_{CCL}



TEST CIRCUIT 4: I_{CCH}

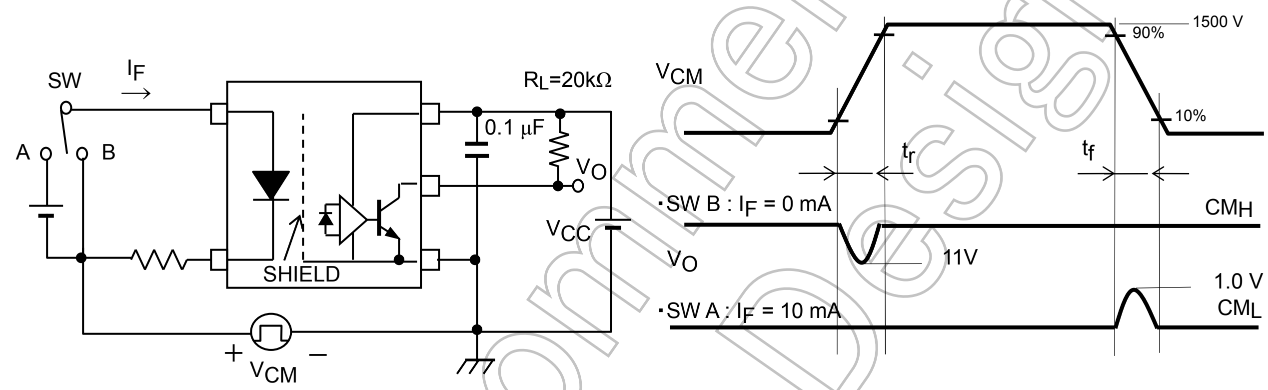


Test Circuit 5: t_{pHL}, t_{pLH}, $|t_{pHL}-t_{pLH}|$

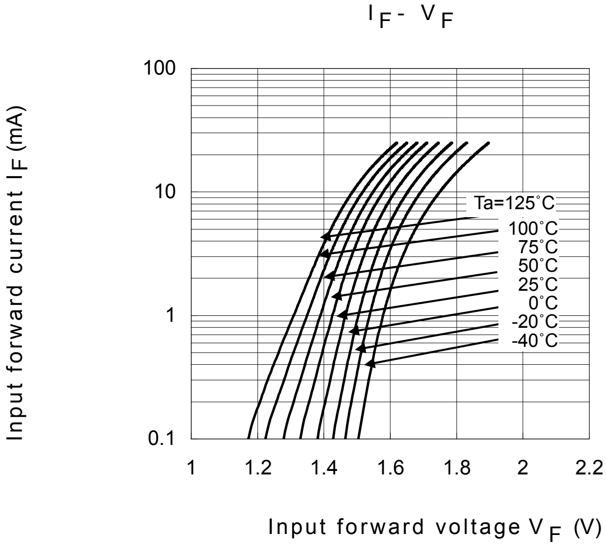


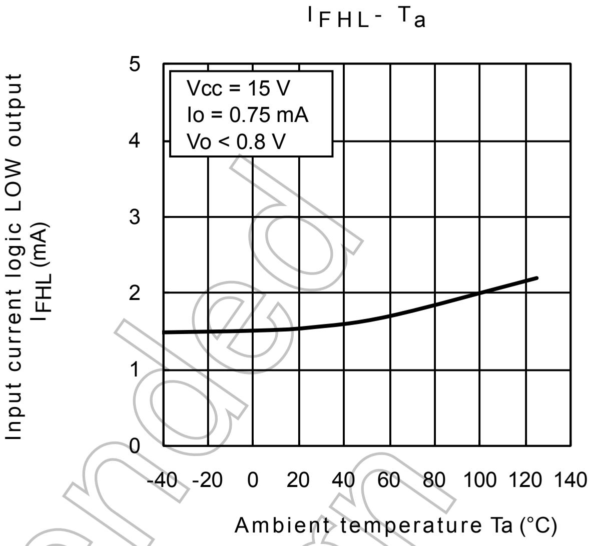
*: probe and stray capacitance.
P.G.: Pulse generator

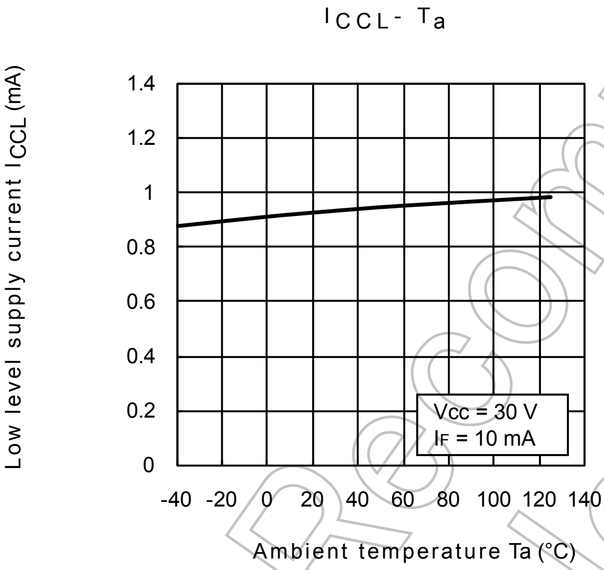
Test Circuit 6: CM_H, CM_L

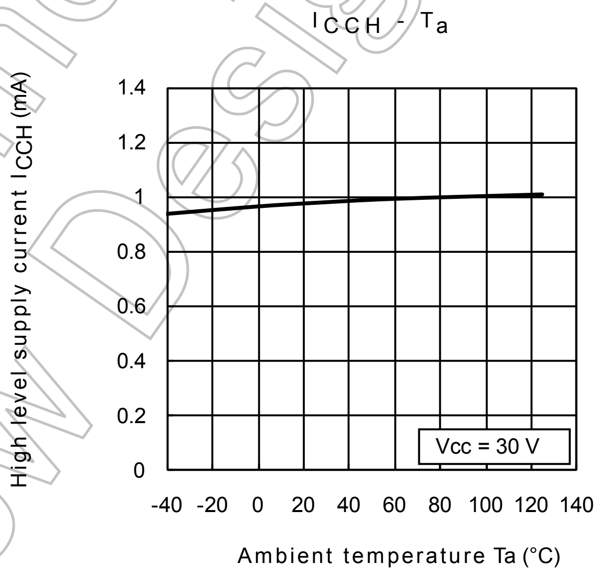


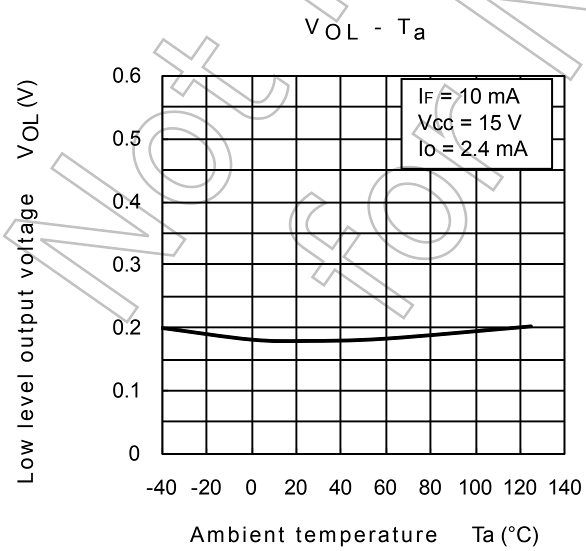
$$CM_H = \frac{1200(V)}{tr(\mu s)} \qquad CM_L = -\frac{1200(V)}{tf(\mu s)}$$

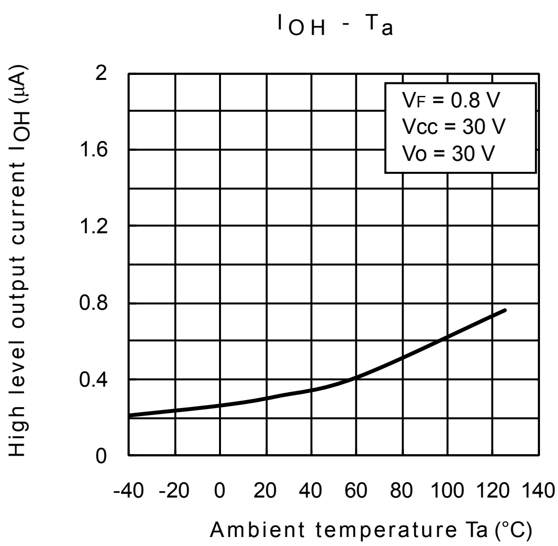






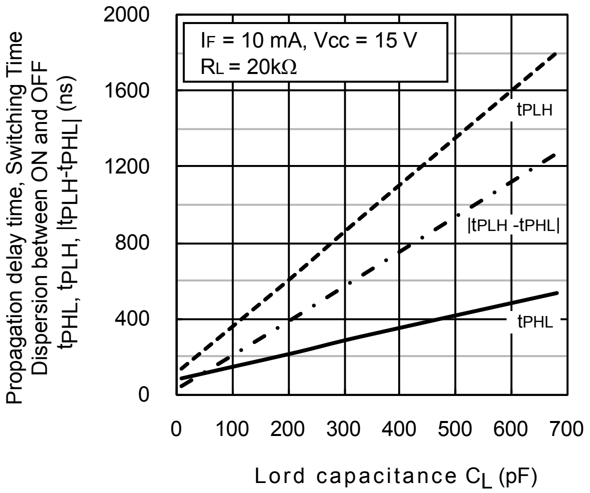




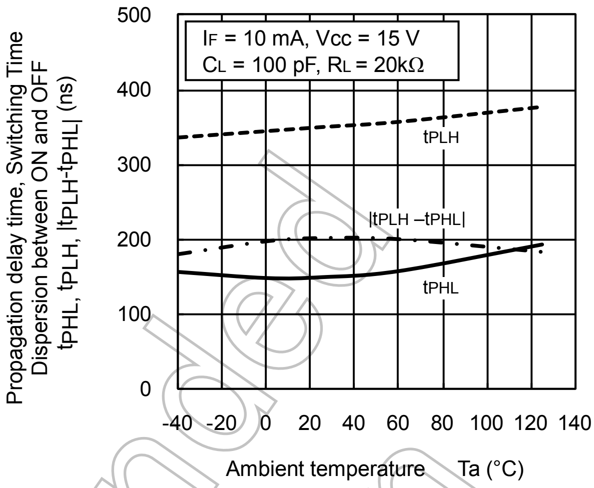


NOTE: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

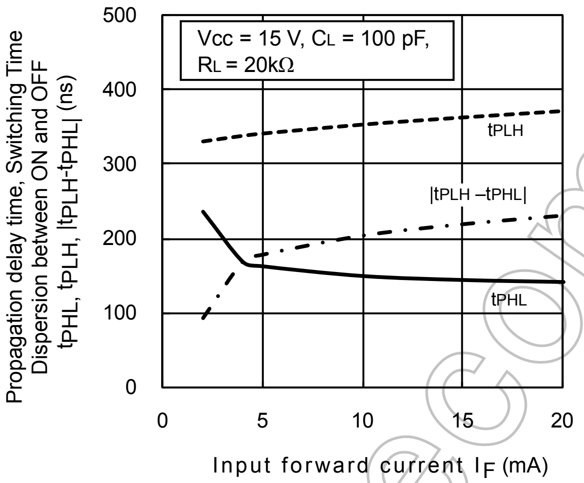
$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - C_L



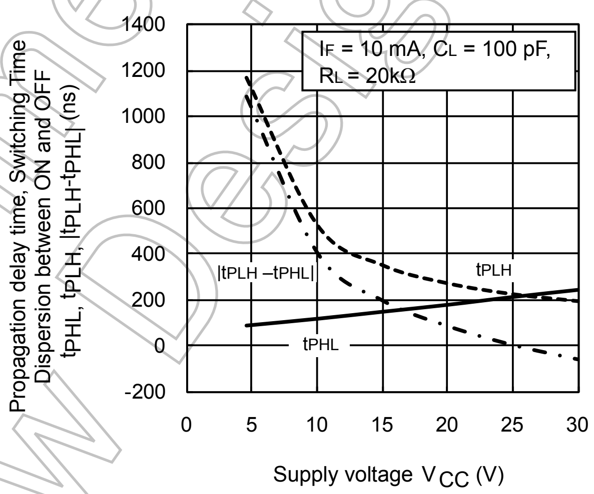
$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - Ta



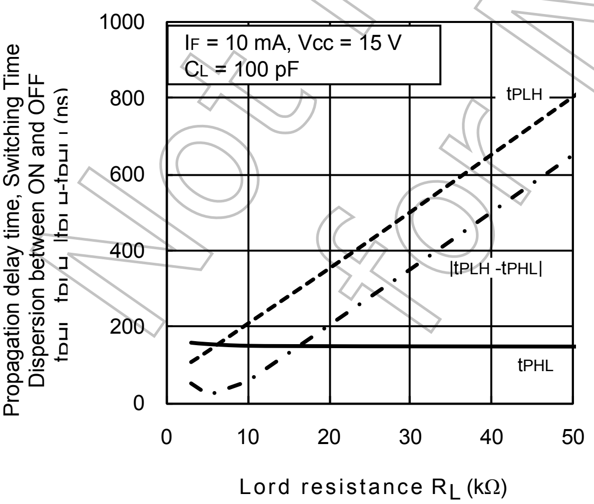
$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - I_F



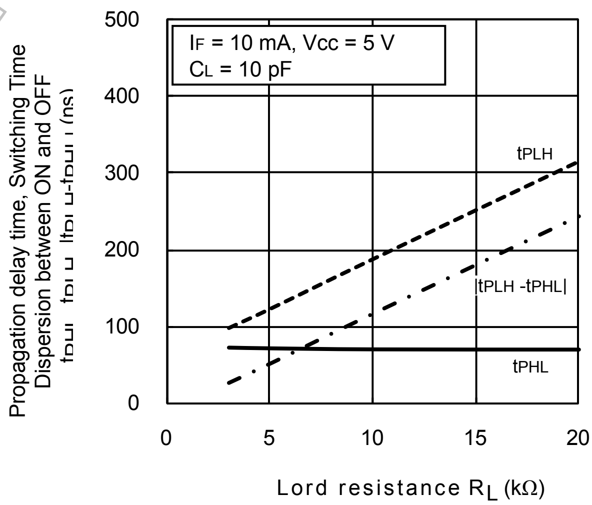
$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - V_{CC}



$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - R_L



$t_{PHL}/t_{PLH}/|t_{PLH}-t_{PHL}|$ - R_L



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

PRECAUTIONS OF SURFACE MOUNTING TYPE PHOTOCOUPLER SOLDERING & GENERAL STORAGE

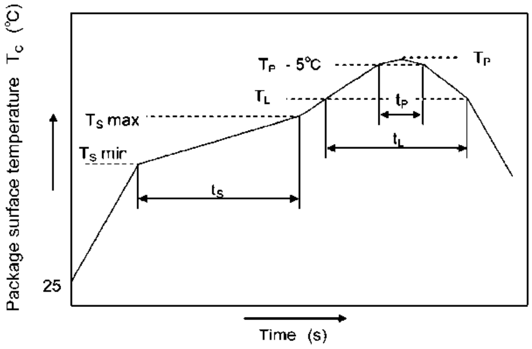
● Precautions for Soldering

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.)

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



	Symbol	Min	Max	Unit
Preheat temperature	T_S	150	200	°C
Preheat time	t_S	60	120	s
Ramp-up rate (T_L to T_P)			3	°C/s
Liquidus temperature	T_L	217		°C
Time above T_L	t_L	60	150	s
Peak temperature	T_P		260	°C
Time during which T_c is between (T_P – 5) and T_P	t_P		30	s
Ramp-down rate (T_P to T_L)			6	°C/s

- 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.

2) When using soldering Flow

- Apply preheating of 150 °C for 60 to 120 seconds.
- Mounting condition of 260 °C or less 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 at any place where they will be exposed to moisture or direct sunlight.

2) When 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 relative humidity should be maintained at between 45% and 75%.

4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

5) Use storage areas where there is minimal temperature fluctuation. Because rapid temperature changes can cause condensation to occur on stored devices, resulting in lead oxidation or corrosion, as a result, the solderability of the leads will be degraded.

6) When repacking devices, use anti-static containers.

7) Do not apply any external force or load directly to devices while they are in storage.

8) If devices have been stored for more than two years, even though the above conditions have been followed, it is recommended that solderability of them should be tested before they are used.

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