

TLP5214A

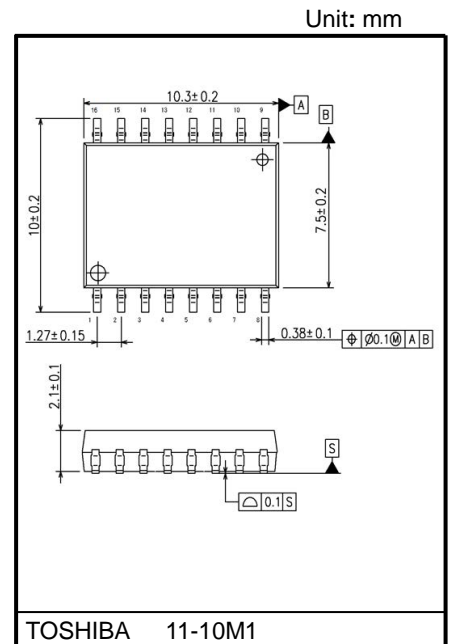
Isolated IGBT/Power MOSFET gate drive
 AC and brushless DC motor drives
 Industrial Inverters and Uninterruptible Power Supply (UPS)

The TLP5214A is a highly integrated 4.0 A output current IGBT gate drive photocoupler housed in a long creepage and clearance SO16L package.

The TLP5214A, a smart gate driver photocoupler, includes functions of IGBT desaturation detection, isolated fault status feedback, soft IGBT turn-off, active Miller clamping and under voltage lockout (UVLO). Moreover, this photocoupler has features of the desaturation leading edge blanking time, filtering time, and optimisation of the soft-shutdown performance for secure operation of applications. This photocoupler is suitable for driving IGBT and power MOSFET used in inverter applications.

The TLP5214A consists two GaAs infrared light-emitting diodes (LEDs) and two high-gain and high-speed ICs. They realize high current, high-speed output control and output fault status feedback.

- Peak output current: ± 4.0 A (max)
- Guaranteed performance over temperature: -40 to 110 °C
- Supply current: 3.8 mA (max)
- Power supply voltage: 15 V to 30 V
- Threshold input current: 6 mA (max)
- Propagation delay time: 150 ns (max)
- DESAT leading edge blanking time: 1.1 μ s (typ.)
- Common mode transient immunity: ± 35 kV/ μ s (min)
- Isolation voltage: 5000 Vrms (min)
- UL approved : UL1577, File No.E67349
- c-UL approved :CSA Component Acceptance Service No. 5A, File No.E67349
- Option (D4) VDE: DIN EN60747-5-5 (Note 1)
 EN60065 or EN60950-1, EN62368-1
- CQC: GB4943.1, GB8898 Japan Factory (Pending)



Weight: 0.37 g (typ.)

- Construction mechanical rating

	SO16L
Height	2.3 mm (max)
Creepage Distance	8.0 mm (min)
Clearance	8.0 mm (min)
Insulation Thickness	0.4 mm (min)

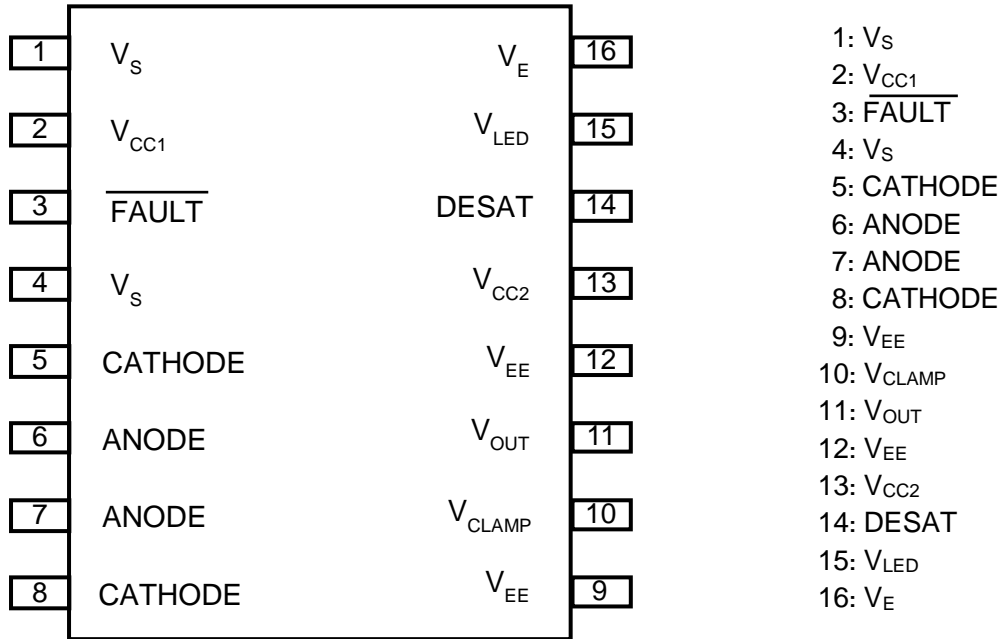
Note 1: When a EN60747-5-5 approved type is needed, please designate “Option(D4)”

Truth Table

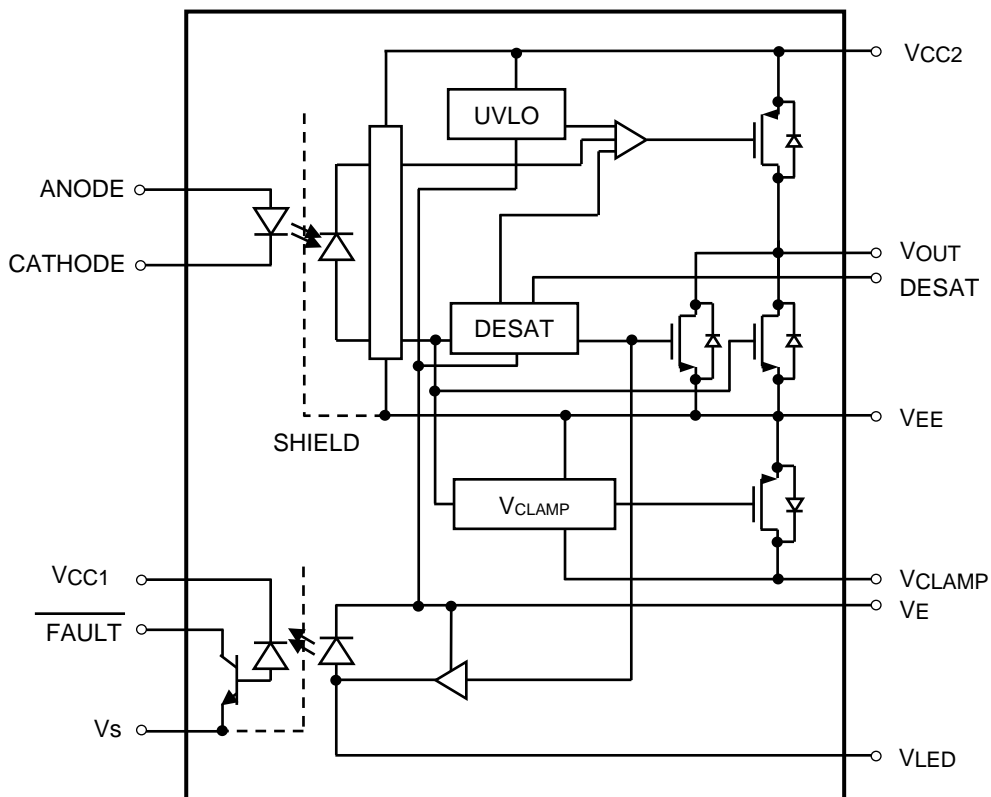
I _F	UVLO (V _{CC2} -V _E)	DESAT (14Pin DESAT Terminal Input)	FAULT (3Pin FAULT Terminal Output)	V _O
OFF	Not Active (> V _{UVLO} ⁺)	Not Active	High	Low
ON	Not Active (> V _{UVLO} ⁺)	Low (< V _{DESAT} th)	High	High
ON	Not Active (> V _{UVLO} ⁺)	High (> V _{DESAT} th)	Low (FAULT)	Low
ON	Active (< V _{UVLO} ⁻)	Not Active	High	Low
OFF	Active (< V _{UVLO} ⁻)	Not Active	High	Low

Start of commercial production
 2017-03

Pin Configuration (top view)



Internal Circuit



Note: A 1- μ F bypass capacitor must be connected between pins 9 and 13, pins 13 and 16.

Absolute Maximum Ratings (Note) (Unless otherwise specified, Ta = 25 °C)

	Characteristics	Symbol	Rating	Unit
LED	Input forward current	I _F	25	mA
	Input forward current derating (Ta ≥ 95°C)	ΔI _F /ΔTa	-1	mA/°C
	Peak transient input forward current (Note 1)	I _{FPT}	1	A
	Peak transient input forward current derating (Ta ≥ 95°C)	ΔI _{FPT} /ΔTa	-25	mA/°C
	Reverse input voltage	V _R	6	V
	Input power dissipation	P _D	145	mW
	Input power dissipation derating (Ta ≥ 95°C)	ΔP _D /ΔTa	-5.0	mW/°C
Detector	Positive input supply voltage	V _{CC1}	-0.5 to 7	V
	"H" peak output current	I _{OPH}	-4.0	A
	"L" peak output current			
	FAULT output current	I _{FAULT}	8	mA
	FAULT pin voltage	V _{FAULT}	-0.5 to V _{CC1}	V
	Total output supply voltage	(V _{CC2} -V _{EE})	-0.5 to 35	V
	Negative output supply voltage	(V _E -V _{EE})	-0.5 to 15	V
	Positive output supply voltage	(V _{CC2} -V _E)	-0.5 to 35 - (V _E -V _{EE})	V
	Output voltage	V _O	-0.5 to V _{CC2}	V
	Peak clamping sinking current	I _{Clamp}	1.7	A
	Miller clamping pin voltage	V _{Clamp}	-0.5 to V _{CC2}	V
	DESAT voltage	V _{DESAT}	V _E to V _E + 10	V
	Output power dissipation	P _O	410	mW
	Output power dissipation derating (Ta ≥ 95°C)	ΔP _O /ΔTa	-14.0	mW/°C
	Common	Operating temperature range	T _{opr}	-40 to 110
Storage temperature range		T _{stg}	-55 to 125	°C
Lead soldering temperature (10 s) (Note 3)		T _{sol}	260	°C
Isolation voltage (AC, 60 s, R.H. ≤ 60%) (Note 4)		BV _S	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: A ceramic capacitor (1 μF) should be connected between pins 9 and 13, pins 13 and 16 to stabilize the operation of the high gain linear amplifier. Furthermore, in case V_E - V_{EE} > 0 V, a bypass capacitor, which has good high frequency characteristic, a ceramic capacitor (1 μF) should be connected between pins 9 and 16. Failure to provide the bypassing may impair the switching property. The total lead length between capacitor and coupler should not exceed 1 cm.

Note 1: Pulse width P_W ≤ 1 μs, 300 pps

Note 2: Exponential waveform pulse width P_W ≤ 0.2 μs, f ≤ 15 kHz, V_{CC2} = 15 V

Note 3: For the effective lead soldering area.

Note 4: This device considered a two-terminal device: All pins on the LED side are shorted together, and all pin on the photodetector side are shorted together.

Recommended Operating Conditions (Note)

Characteristics	Symbol	Min	Typ.	Max	Unit
Total output supply voltage (Note 1)	(V _{CC2} -V _{EE})	15	-	30	V
Negative output supply voltage	(V _E -V _{EE})	0	-	15	V
Positive output supply voltage	(V _{CC2} -V _E)	15	-	30 - (V _E -V _{EE})	V
Positive input supply voltage	V _{CC1}	3.3	-	5.5	V
Input on-state current (Note 2)	I _{F(ON)}	7.5	-	10	mA
Input off-state voltage	V _{F(OFF)}	0	-	0.8	V
Operating frequency (Note 3)	f	-	-	50	kHz

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.

Note 1: If the V_{CC2} rise slope is sharp, an internal circuit might not operate with stability. Please design the V_{CC2} rise slope under 3.0 V / μs.

Note 2: Input signal rise time (fall time) ≤ 0.5 μs.

Note 3: Exponential waveform. I_{OPH} ≥ -4.0 A (≤ 90 ns), I_{OPL} ≤ 4.0 A (≤ 90 ns), Ta = 110 °C

Electrical Characteristics (Note)

(Unless otherwise specified, Ta = -40 to 110 °C, VCC2 - VEE = 15 to 30 V, VE - VEE = 0 V)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V _F	—	I _F = 10 mA, Ta = 25°C	1.4	-	1.7	V
Input reverse current	I _R	—	V _R = 5 V	-	-	10	μA
Input capacitance	C _t	—	V = 0 V, f = 1 MHz, Ta = 25 °C	-	95	-	pF
FAULT low level output voltage	V _{FAULTL}	—	I _{FAULT} = 1.1 mA, V _{CC1} = 5.5 V	-	0.2	0.4	V
			I _{FAULT} = 1.1 mA, V _{CC1} = 3.3 V	-	0.2	0.4	
FAULT high level output current	I _{FAULTH}	—	V _{FAULT} = 5.5 V, V _{CC1} = 5.5 V, Ta = 25 °C	-	-	0.5	μA
			V _{FAULT} = 5.5 V, V _{CC1} = 3.3 V, Ta = 25 °C	-	-	0.3	
High level output current (Note 1)	I _{OPH}	1	V _O = V _{CC2} - 4 V	-	-4.0	-1.2	A
			V _O = V _{CC2} - 7 V	-	-6.5	-3.0	
Low level output current (Note 1)	I _{OPL}	2	V _O = V _{EE} + 2.5 V	1.2	3.5	-	
			V _O = V _{EE} + 7 V	3	5.5	-	
Low level output current during fault condition	I _{OLF}	—	V _O - V _{EE} = 14 V	90	150	230	mA
High level output voltage	V _{OH}	3	I _O = -100 mA	V _{CC2} -0.3	V _{CC2} -0.1	-	V
Low level output voltage	V _{OL}	4	I _O = 100 mA	-	0.1	0.2	
Clamp pin threshold voltage	V _{tClamp}	—	—	-	2.5	-	
Clamp low level sinking current	I _{CL}	—	V _O = V _{EE} + 2.5 V	0.56	1.8	-	A
High level supply current	I _{CC2H}	5	I _O = 0 mA	-	2.4	3.8	mA
Low level supply current	I _{CC2L}	6	I _O = 0 mA	-	2.3	3.8	
Blanking capacitor charging current	I _{CHG}	7	V _{DESAT} = 2 V	-0.33	-0.24	-0.13	
Blanking capacitor discharge current	I _{DSCHG}	8	V _{DESAT} = 7 V	10	49	-	
DESAT threshold voltage	V _{DESAT}	—	V _{CC2} - V _E > V _{UVLO-}	5.9	6.5	7.5	V
UVLO threshold voltage	V _{UVLO+}	9	V _O > 5 V	10.5	11.6	13.5	
	V _{UVLO-}	9	V _O < 5 V	9.2	10.3	11.1	
UVLO hysteresis	V _{UVLOHYS}	—	—	-	1.3	-	
Threshold input current (L/H)	I _{FLH}	10	V _{CC2} = 30 V, V _O < 5 V	-	0.8	6	mA
Threshold input voltage (H/L)	V _{FHL}	—	V _{CC2} = 30 V, V _O > 5 V	0.8	-	-	V

Note: All typical values are at Ta = 25 °C

Note: This product is more sensitive than conventional products to electrostatic discharge ESD owing to its low power consumption design.

It is therefore all the more necessary to observe general precautions regarding ESD when handling this component.

Note 1: I_O application time ≤ 50 μs, 1 pulse

Isolation Characteristics (Note) (Ta = 25 °C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C _S	V _S = 0 V, f = 1 MHz	-	1.0	-	pF
Isolation resistance	R _S	R.H. ≤ 60 %, V _S = 500 V	1×10 ¹²	10 ¹⁴	-	Ω
Isolation voltage	BV _S	AC, 60 s	5000	-	-	V _{rms}
		AC, 1 s, in oil	-	10000	-	
		DC, 60 s, in oil	-	10000	-	V _{dc}

Note: This device considered a two-terminal device: All pins on the LED side are shorted together, and all pin on the photodetector side are shorted together.

Switching Characteristics (Note)

(Unless otherwise specified, $T_a = -40$ to 110 °C, $V_{CC2} - V_{EE} = 15$ to 30 V, $V_E - V_{EE} = 0$ V)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
Propagation delay time (Note 1)	L → H	11	$R_g = 10 \Omega$, $C_g = 25$ nF, $V_{CC2} = 30$ V	$I_F = 0 \rightarrow 10$ mA	50	85	150	ns
	H → L			$I_F = 10 \rightarrow 0$ mA	50	90	150	
Output rise time (10-90 %) (Note 1)	t_r			$I_F = 0 \rightarrow 10$ mA	-	32	-	
Output fall time (90-10 %) (Note 1)	t_f			$I_F = 10 \rightarrow 0$ mA	-	18	-	
Pulse with distortion (Note 1)	$ t_{pHL} - t_{pLH} $			$I_F = 0 \leftrightarrow 10$ mA	-	-	50	
Propagation delay skew (Note 1) (device to device) (Note 2)	t_{psk}			$I_F = 0 \leftrightarrow 10$ mA	-80	-	80	
DESAT sense to 90% delay	$t_{DESAT(90\%)}$	12	$C_{DESAT} = 100$ pF, $R_g = 10 \Omega$, $V_{CC2} = 30$ V, $R_F = 2.1$ k Ω , $V_{CC1} = 5$ V	$C_g = 25$ nF	-	230	500	μ s
DESAT sense to 10% delay	$t_{DESAT(10\%)}$			$C_g = 25$ nF	-	7.0	8.5	
DESAT leading edge blanking time	$t_{DESAT(LEB)}$			$C_g = 10$ nF	-	2.5	3.5	
DESAT filter time	$t_{DESAT(FILTER)}$			-	-	1.1	-	ns
DESAT sense to low level FAULT signal delay	$t_{DESAT(FAULT)}$			-	-	350	550	ns
DESAT sense to low propagation delay	$t_{DESAT(LOW)}$			-	-	200	-	ns
DESAT input mute	$t_{DESAT(MUTE)}$	-	-	7	20	-	μ s	
RESET to high level FAULT signal delay	$t_{RESET(FAULT)}$	-	$C_{DESAT} = 100$ pF, $R_g = 10 \Omega$, $V_{CC2} = 30$ V, $R_F = 2.1$ k Ω , $V_{CC1} = 5.5$ V	0.2	0.6	2	μ s	
Common-mode transient immunity at high level output (Note 3)	CM_H	13 to 16	$T_a = 25$ °C, $R_g = 10 \Omega$, $C_g = 25$ nF, $V_{CC2} = 30$ V, $R_F = 2.1$ k Ω , $C_F = 15$ pF, $V_{CM} = 1500$ V _{p-p}	V_O (min) = 26 V, $V_{FAULT(min)} = 2$ V	± 35	-	-	kV/ μ s
Common-mode transient immunity at low level output (Note 4)	CM_L			V_O (max) = 1 V, $V_{FAULT(max)} = 0.8$ V	± 35	-	-	

Note: All typical values are at $T_a = 25$ °C.

Note 1: Input signal ($f = 10$ kHz, duty = 50%, $t_r = t_f = 5$ ns or less)

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

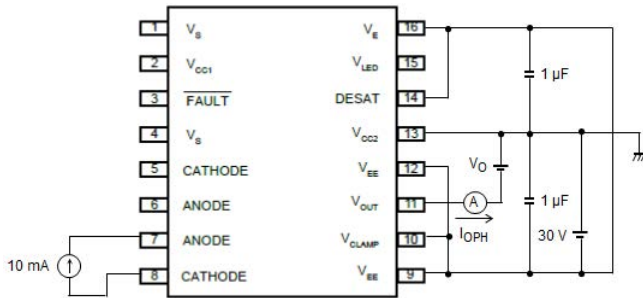
Note 2: The propagation delay skew, t_{psk} , is equal to the magnitude of the worst-case difference in t_{pHL} and/or t_{pLH} that will be seen between units at the same given conditions (supply voltage, input current, temperature, etc).

Note 3: CM_H is the maximum rate of fall of the common mode voltage that can sustained with the output voltage in the logic high state ($V_O > 26$ V or $V_{FAULT} > 2$ V).

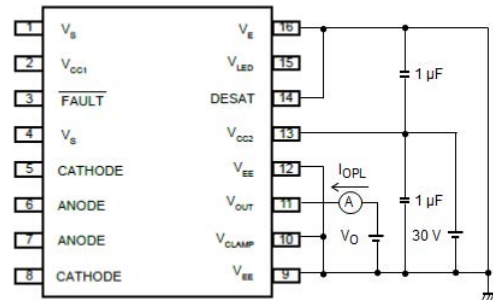
Note 4: CM_L is the maximum rate of rise of the common mode voltage that can sustained with the output voltage in the logic low state ($V_O < 1$ V or $V_{FAULT} < 0.8$ V).

Test Circuit

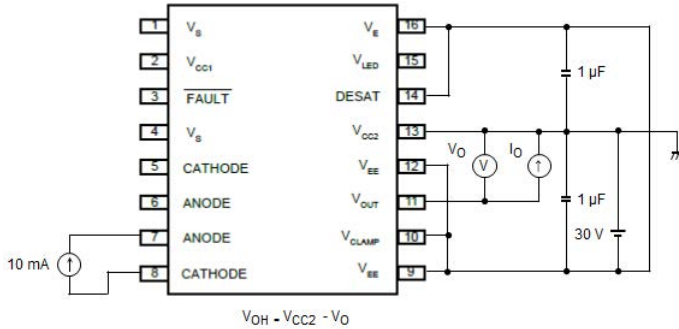
Test Circuit 1: IOPH



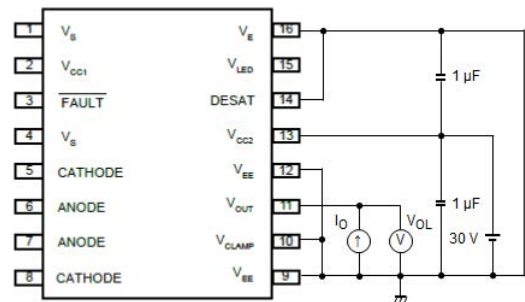
Test Circuit 2: IOPL



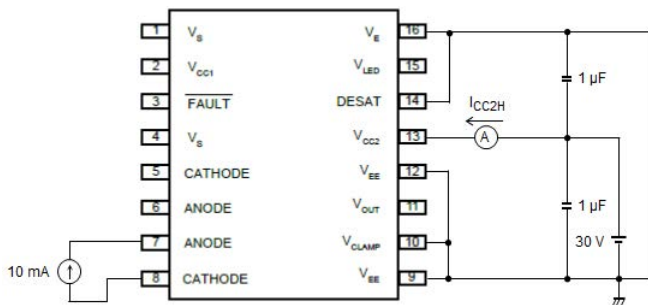
Test Circuit 3: VOH



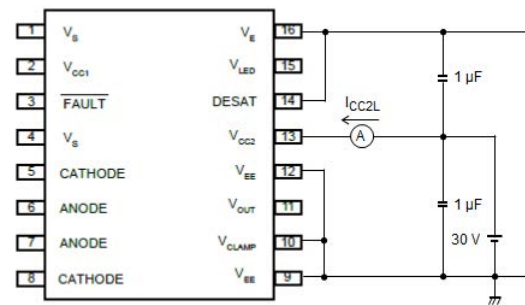
Test Circuit 4: VOL



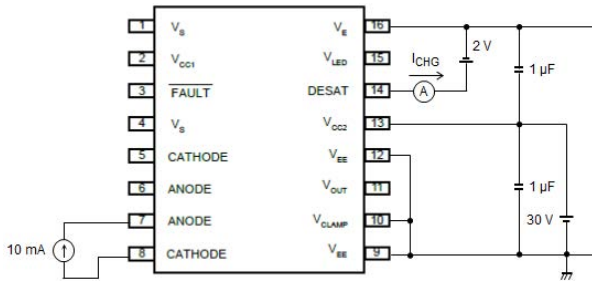
Test Circuit 5: ICC2H



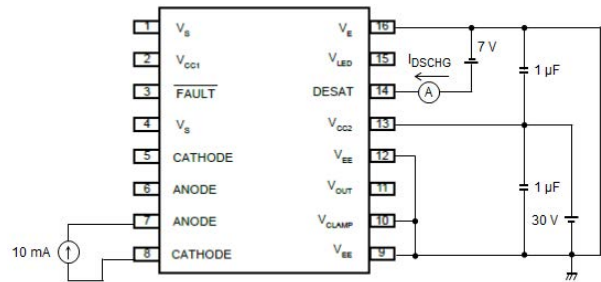
Test Circuit 6: ICC2L



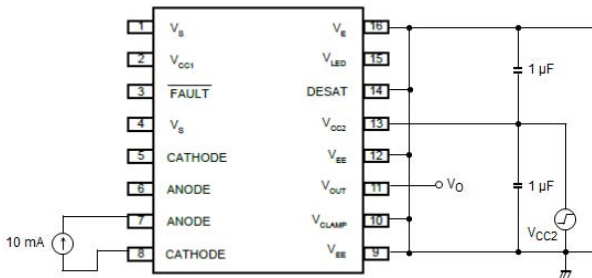
Test Circuit 7: I_{CHG}



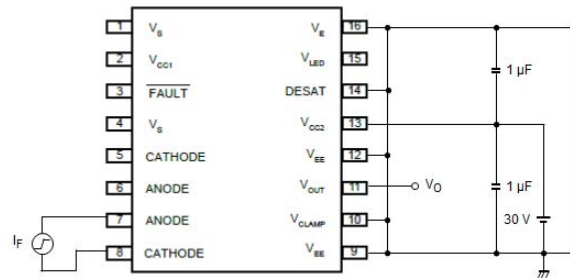
Test Circuit 8: I_{DSCHG}



Test Circuit 9: V_{VULO}



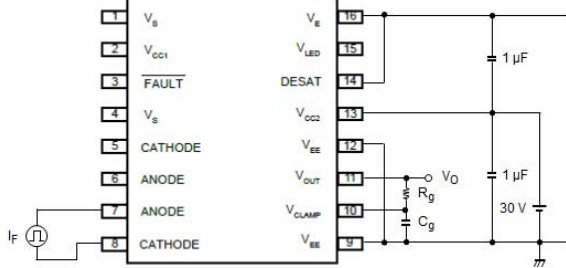
Test Circuit 10: I_{FLH}



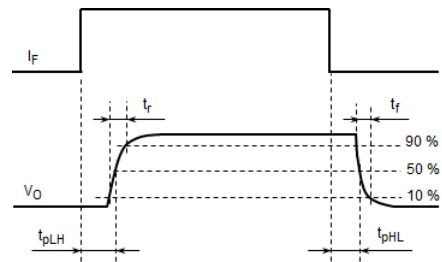
Test Circuit 11: t_{pLH}, t_{pHL}, t_r, t_f, | t_{pHL}-t_{pLH} |

I_F = 10 mA (P.G.)

(f = 10 kHz, duty = 50%, t_r = t_f = 5 ns or less)



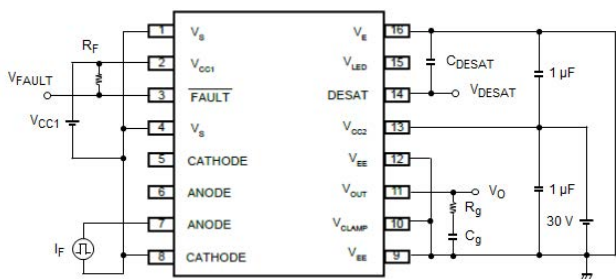
P.G.: Pulse generator



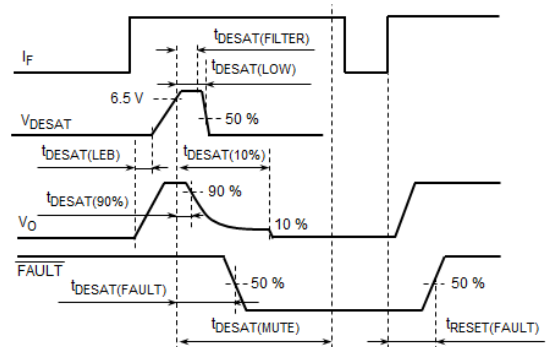
Test Circuit 12: t_{DESAT(90%)}, t_{DESAT(10%)}, t_{DESAT(LEB)}, t_{DESAT(FILTER)}, t_{DESAT(FAULT)}, t_{DESAT(Low)}, t_{DESAT(MUTE)}, t_{RESET(FAULT)}

I_F = 10 mA (P.G.)

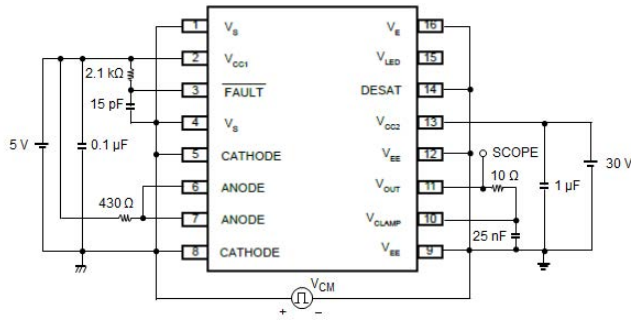
(f = 10 kHz, duty = 50%, t_r = t_f = 5 ns or less)



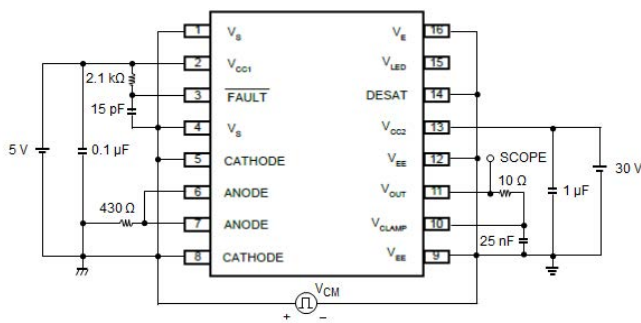
P.G.: Pulse generator



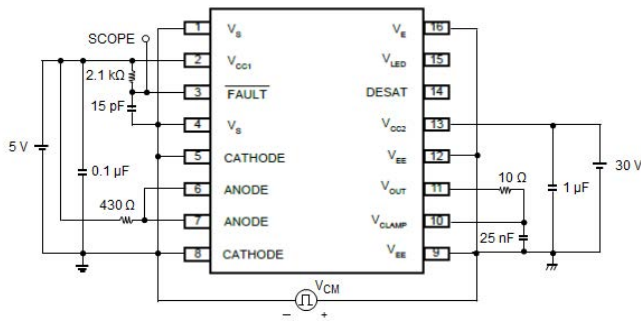
Test Circuit 13: CMR_LED1 ON



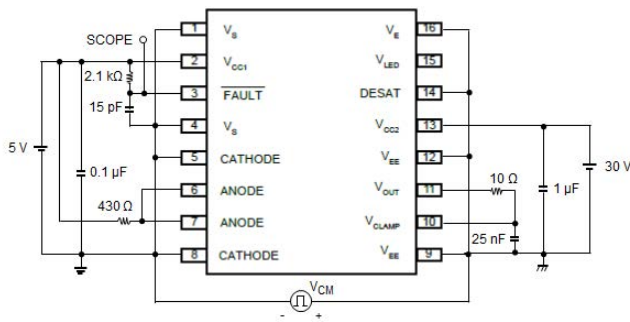
Test Circuit 14: CMR_LED1 OFF



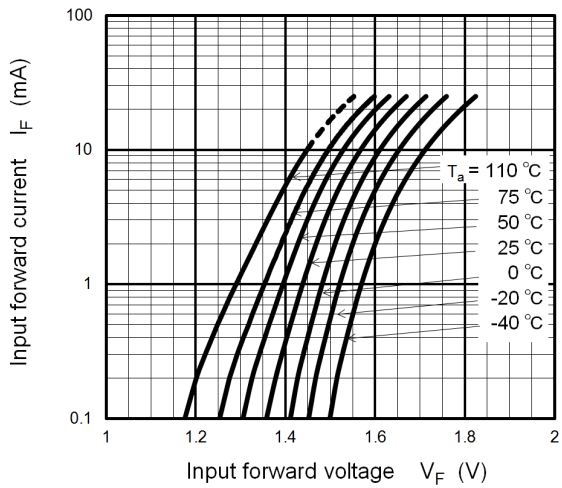
Test Circuit 15: CMR_LED2 ON



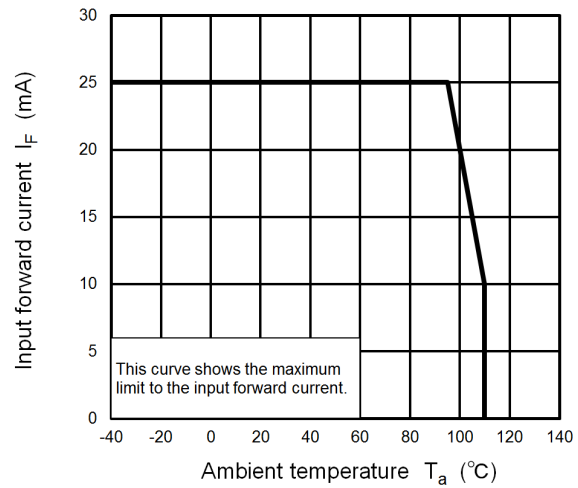
Test Circuit 16: CMR_LED2 OFF



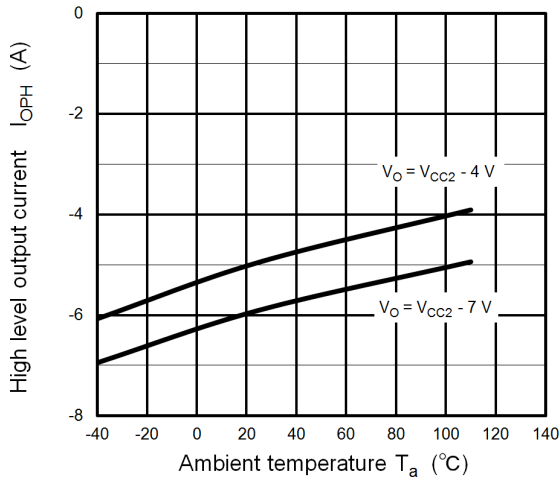
Characteristics Curves (Note)



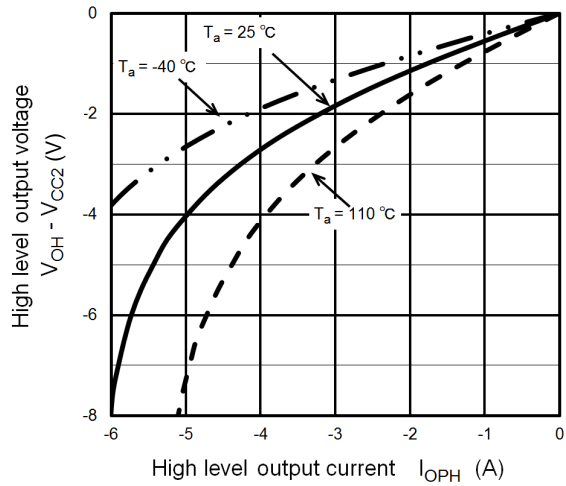
$I_F - V_F$



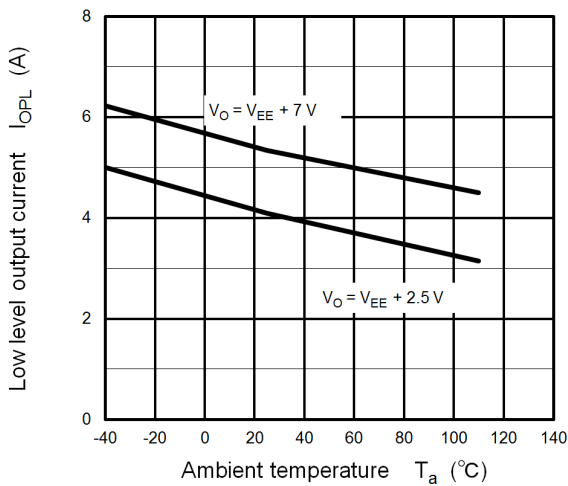
$I_F - T_a$



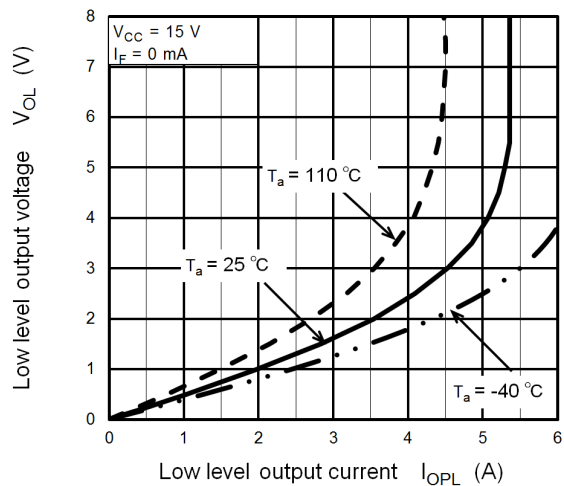
$I_{OPH} - T_a$



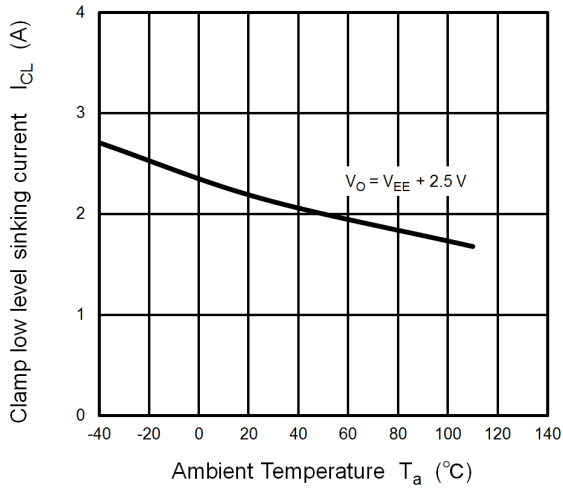
$(V_{OH} - V_{CC2}) - I_{OPH}$



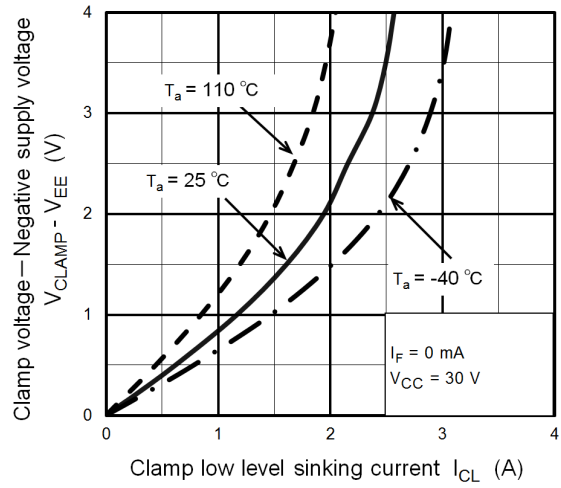
$I_{OPL} - T_a$



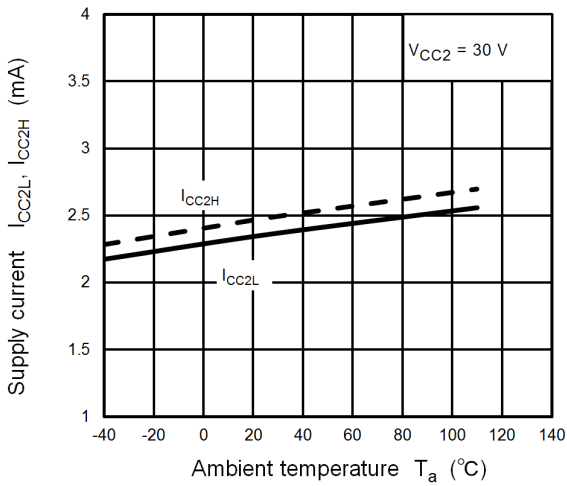
$V_{OL} - I_{OPL}$



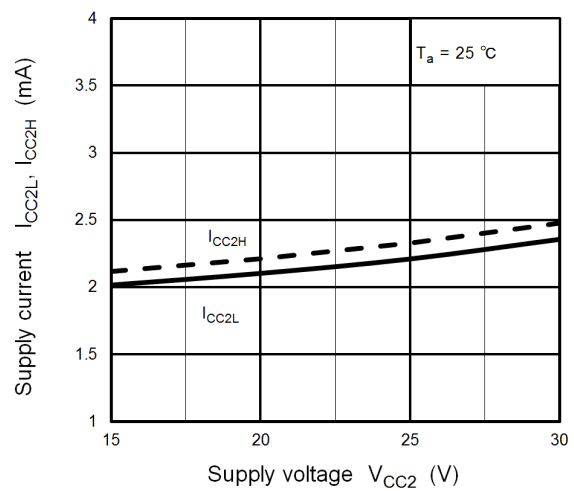
$I_{CL} - T_a$



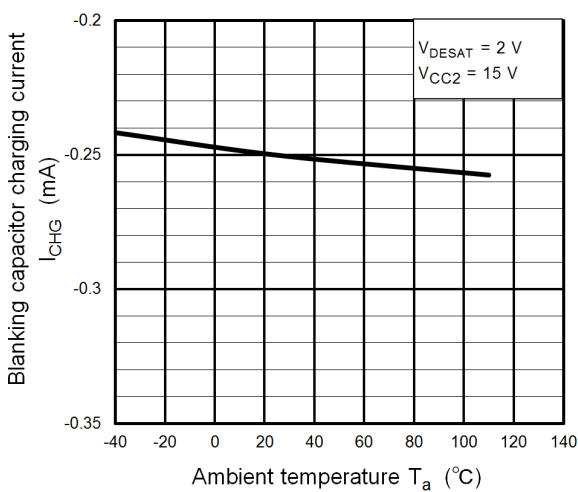
$(V_{CLAMP} - V_{EE}) - I_{CL}$



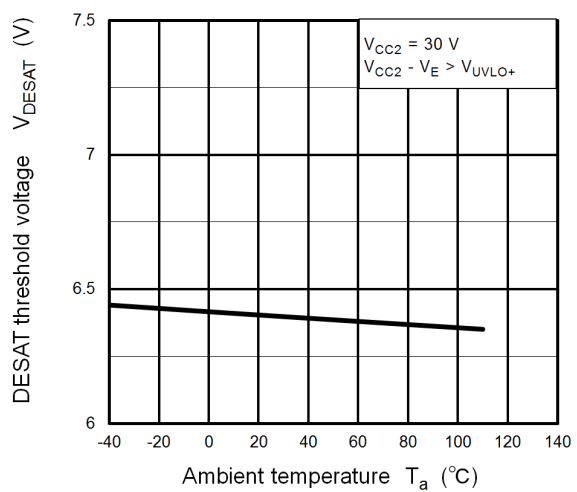
$I_{CC2L}, I_{CC2H} - T_a$



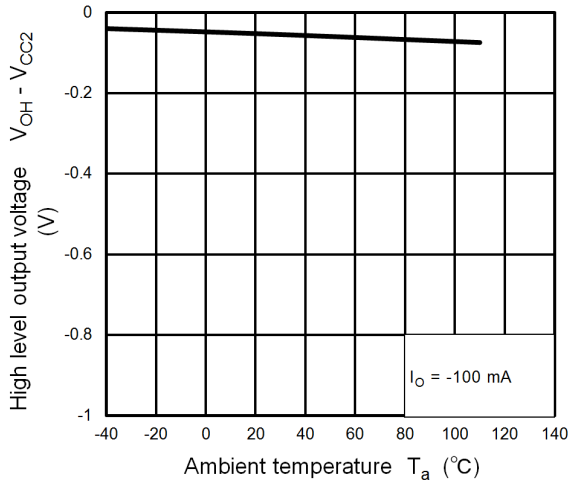
$I_{CC2L}, I_{CC2H} - V_{CC2}$



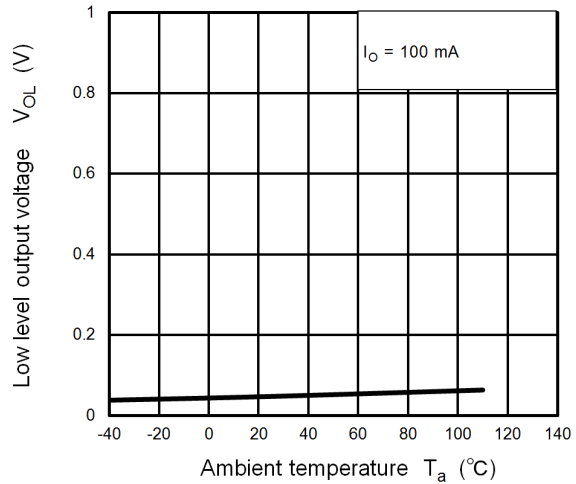
$I_{CHG} - T_a$



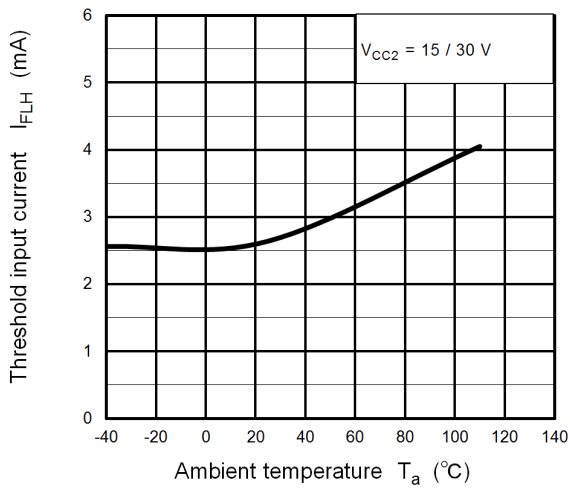
$V_{DESAT} - T_a$



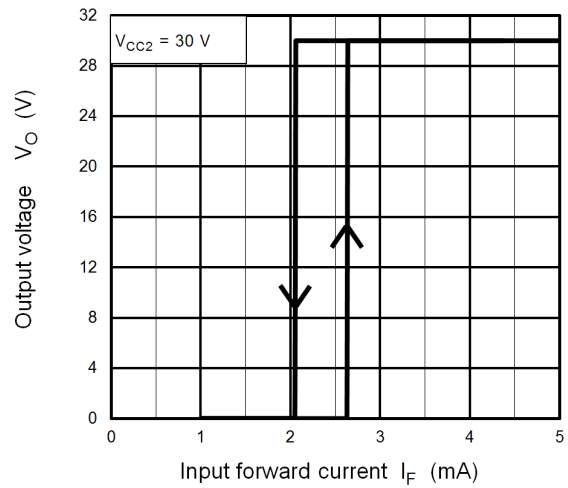
$(V_{OH} - V_{CC2}) - T_a$



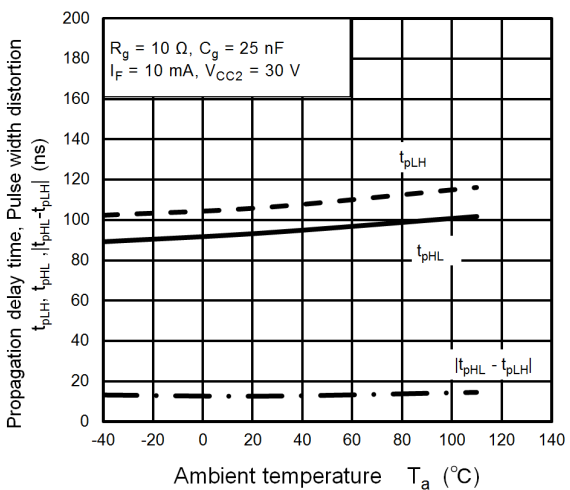
$V_{OL} - T_a$



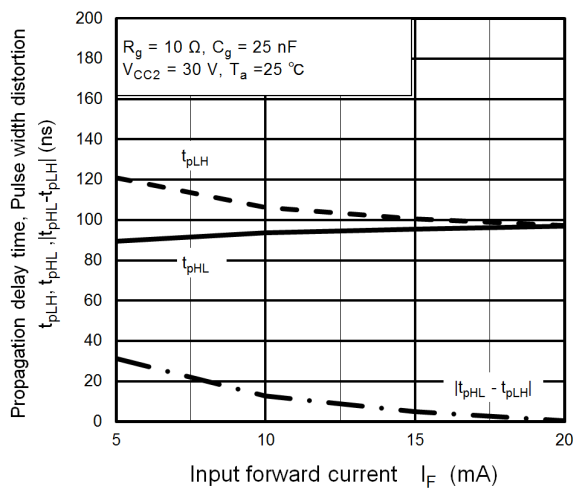
$I_{FLH} - T_a$



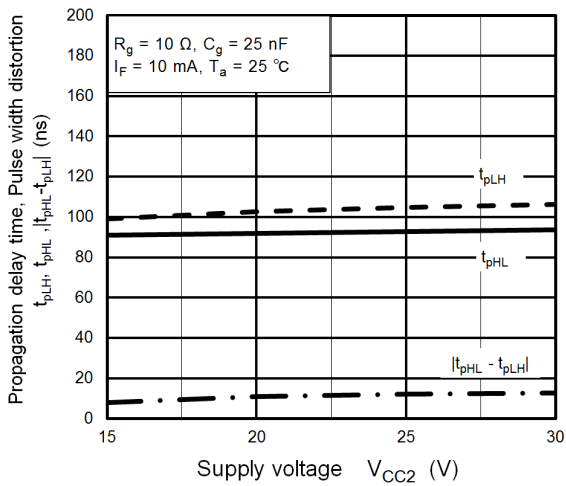
$V_O - I_F$



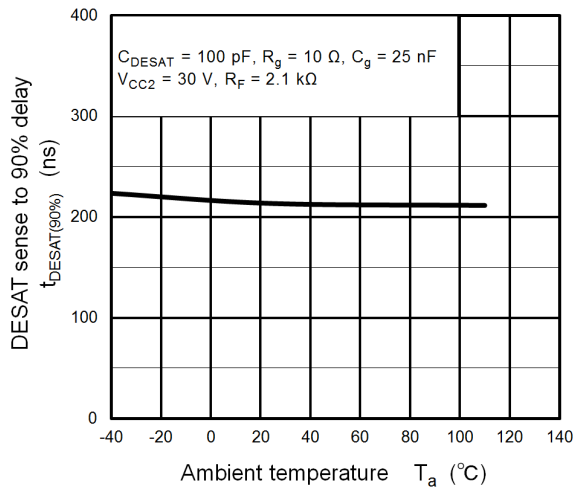
$t_{pHL}, t_{pLH}, |t_{pHL} - t_{pLH}| - T_a$



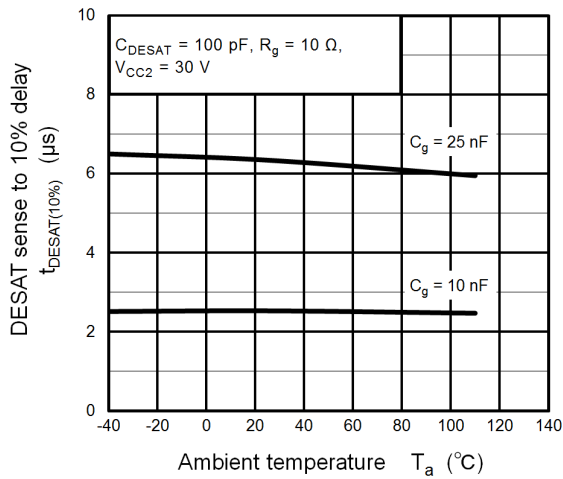
$t_{pHL}, t_{pLH}, |t_{pHL} - t_{pLH}| - I_F$



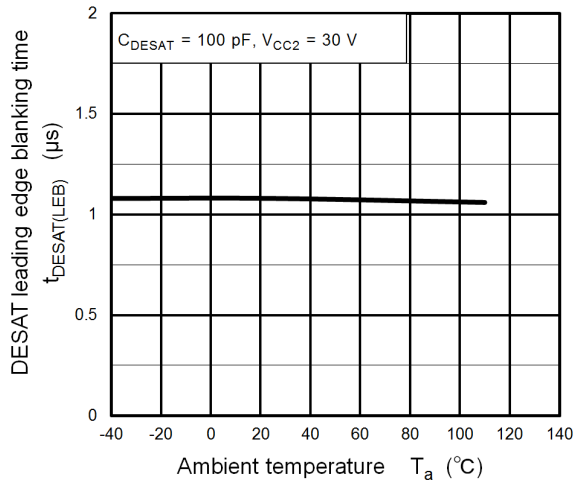
$t_{pHL}, t_{pLH}, |t_{pHL} - t_{pLH}| - V_{CC2}$



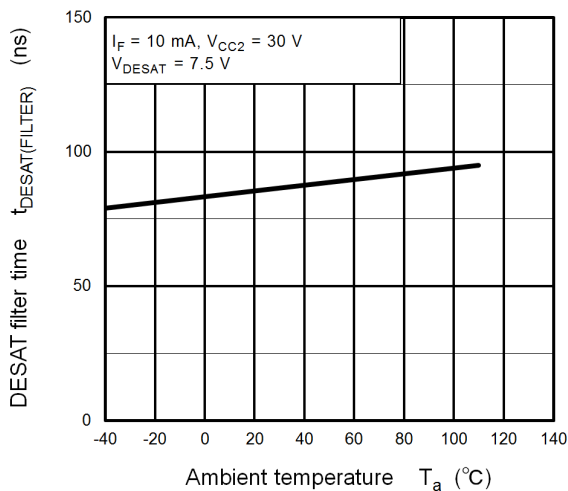
$t_{DESAT(90\%)} - T_a$



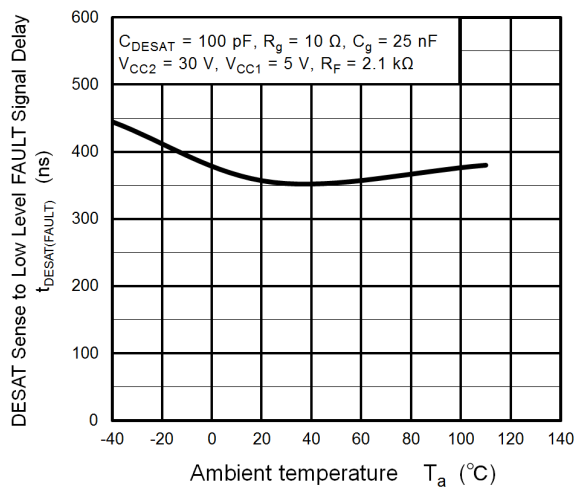
$t_{DESAT(10\%)} - T_a$



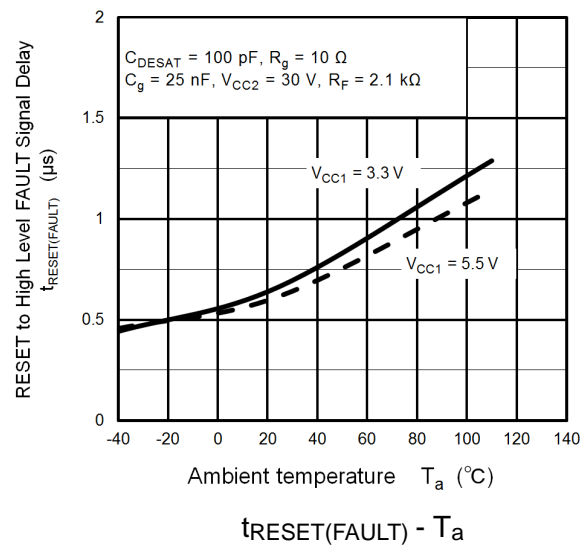
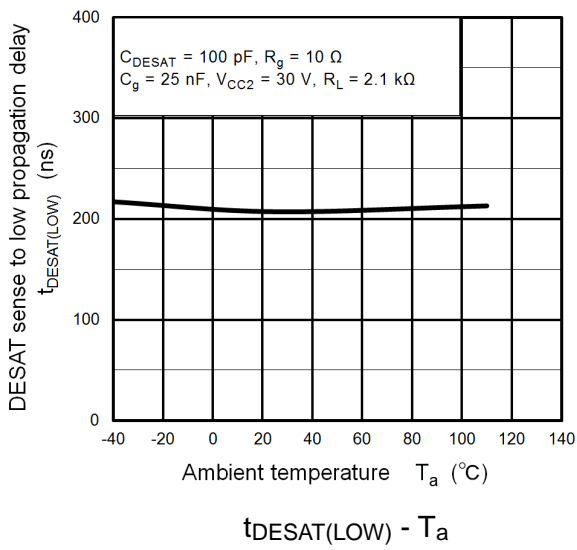
$t_{DESAT(LEB)} - T_a$



$t_{DESAT(FILTER)} - T_a$



$t_{DESAT(FAULT)} - T_a$



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.

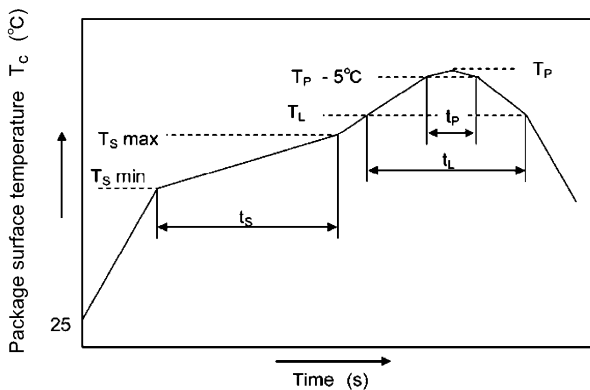
- When using soldering reflow

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 complicated with the interval from the first to the last mountings being 2 weeks.



	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

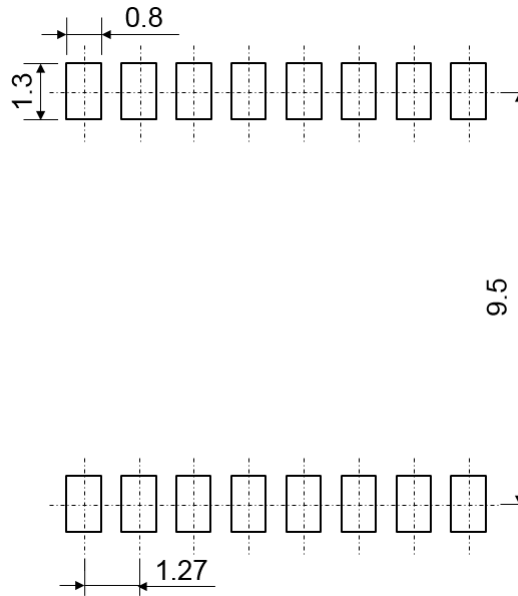
An example of a temperature profile when lead(Pb)-free solder is used

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

(2) Precautions for General Storage

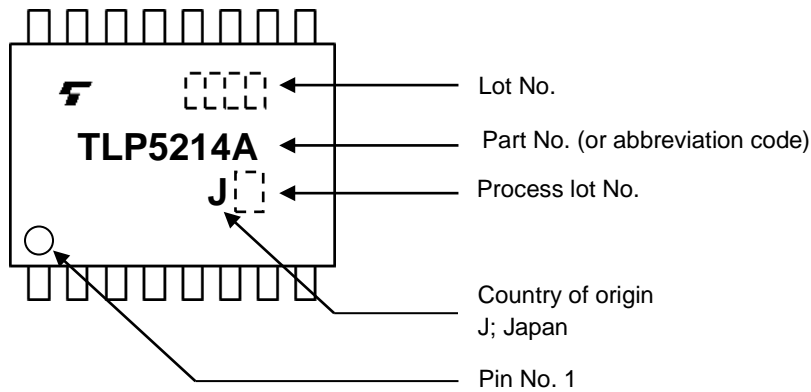
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5 °C to 35 °C and 45 % to 75 %.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- Store the products in locations with minimal temperature fluctuations. Rapid temperature changes during storage can cause condensation, resulting in lead oxidation or corrosion, which will deteriorate the solderability of the leads.
- When restoring devices after removal from their packing, use anti-static containers.
- Do not allow loads to be applied directly to devices while they are in storage.
- If devices have been stored for more than two years under normal storage conditions, it is recommended that you check the leads for ease of soldering prior to use.

Land Pattern Dimensions for Reference Only



Unit: mm

Marking



Embossed-Tape Packing (TP) Specification for Mini-Flat Photocouplers

1. Applicable Package

Package	Product Type
SO16L	Long creepage mini flat coupler

2. Product Naming Conventions

Type of package used for shipment is denoted by a symbol suffix after a part number. The method of classification is as below.

Example) TLP5214A(TP,E(O

Part number: TLP5214A

Tape type: TP

[[G]]/RoHS COMPATIBLE: E (Note 1)

Domestic ID (Country / Region of origin: Japan): (O

Note 1 : Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

3. Tape Dimensions Specification

Tape Type	Division	Packing Amount (A unit per reel)
TP	—	1500

3.1 Orientation of Device in Relation to Direction of Feed

Device orientation in the carrier cavities as shown in Figure 1.

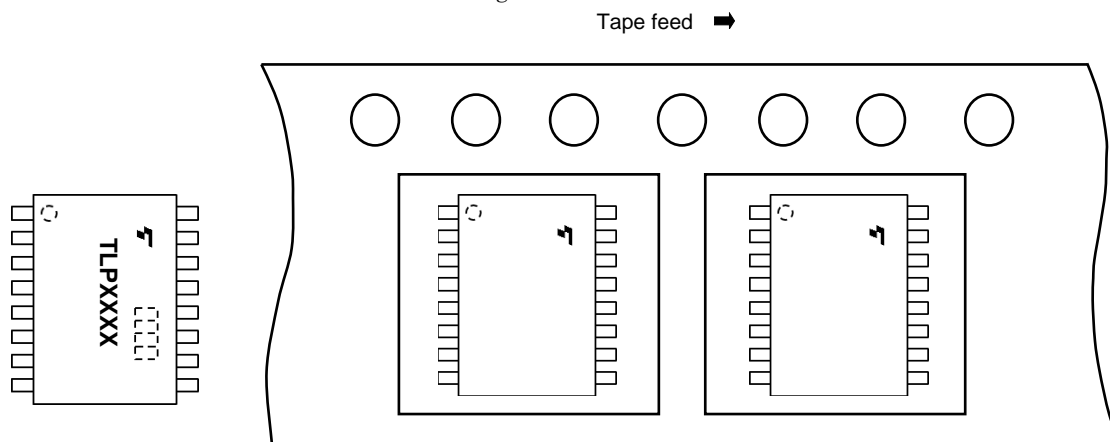


Figure 1 Device Orientation

3.2 Empty Cavities

Characteristics	Criterion	Remarks
Occurrences of 2 or more successive empty cavities	0 device	Within any given 40-mm section of tape, not including leader and trailer
Single empty cavity	6 devices (max) per reel	Not including leader and trailer

3.5 Reel Specification

Material: Plastic

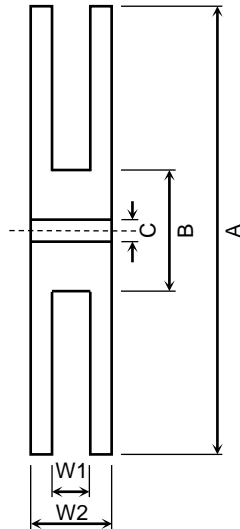
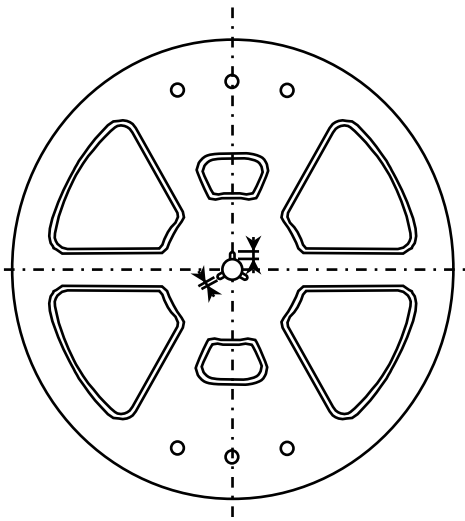
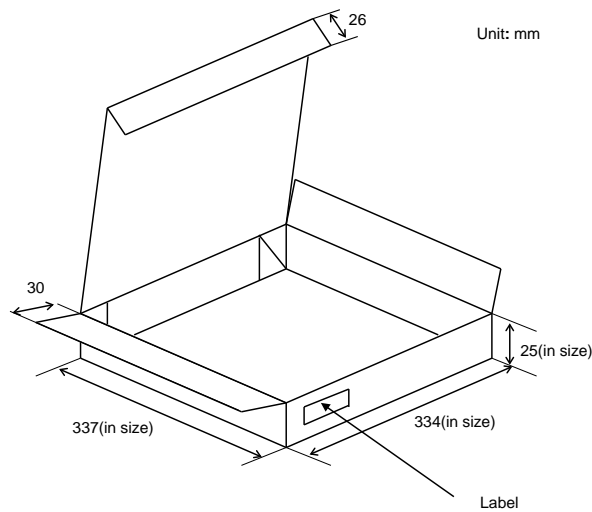


Table Reel Dimensions

Unit: mm

Symbol	Dimension
A	$\Phi 330 \pm 2$
B	$\Phi 100 \pm 1$
C	$\Phi 13 \pm 0.5$
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	17.4 ± 1.0
W2	21.4 ± 1.0

4. Packing (Note)



Unit: mm

Note: Taping reel diameter: $\Phi 330$ mm

5. Label Format

- (1) Carton: The label provides the part number, quantity, lot number, the Toshiba logo, etc.
- (2) Reel: The label provides the part number, the taping name, quantity, lot number, etc.

6. Ordering Method

When placing an order, please specify the part number, the tape and the quantity (Multiples of 1500) as shown in the following example.

Example) TLP5214A(TP,E(O 1500 pcs

Part number: TLP5214A

Tape type: TP (12-mm pitch)

[[G]]/RoHS COMPATIBLE: E (Note 1)

Domestic ID (Country/Region of origin: Japan): O

Quantity (must be a multiple of 1500): 1500 pcs

Note 1 :Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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