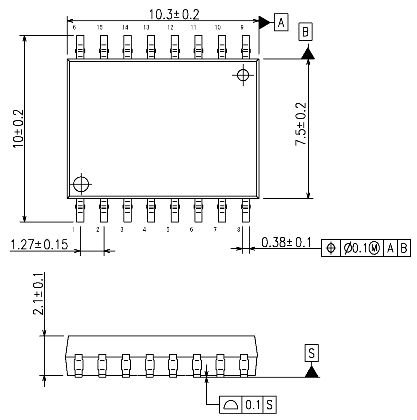
Photocouplers GaAℓAs Infrared LED & Photo IC

TLP5214

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

Unit: mm



TOSHIBA 11-10M1

Weight: 0.37 g (typ.)

The TLP5214 is a highly integrated 4.0A output current IGBT gate drive photocoupler housed in a long creepage and clearance SO16L package.
The TLP5214, 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).
This photocoupler is suitable for driving IGBT and power MOSFET used in inverter applications.
The TLP5214 consists two GaAℓAs 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: 3.5 mA (max)
- Power supply voltage: 15 to 30 V
- Threshold input current: I_{FLH} = 6 mA (max)
- Switching time (t_{pLH} / t_{pHL}): 150 ns (max)
- Common mode transient immunity: ±35 kV/μs (min)
- Isolation voltage: 5000 Vrms (min)

- Construction mechanical rating

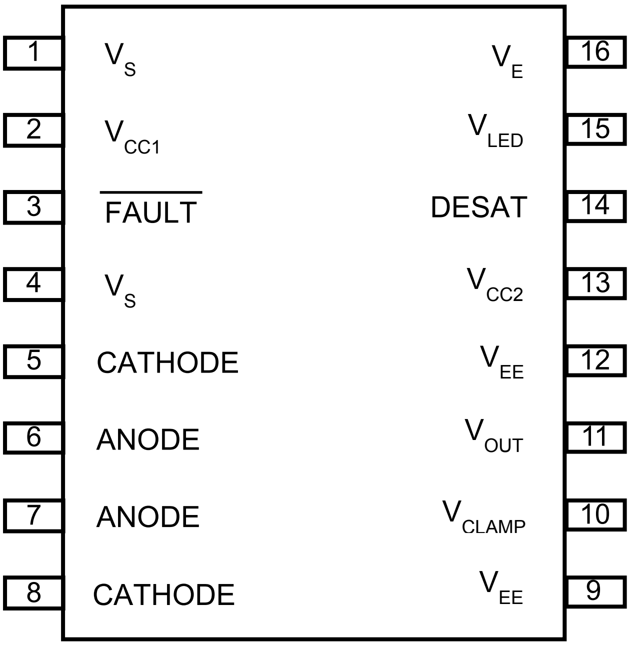
	SO16L
Height	2.3 mm (max)
Creepage Distance	8.0 mm (min)
Clearance	8.0 mm (min)
Insulation Thickness	0.4 mm (min)

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 (< $V_{DESATth}$)	High	High
ON	Not Active (> V_{UVLO}^+)	High (> $V_{DESATth}$)	Low (FAULT)	Low
ON	Active (< V_{UVLO}^-)	Not Active	High	Low
OFF	Active (< V_{UVLO}^-)	Not Active	High	Low

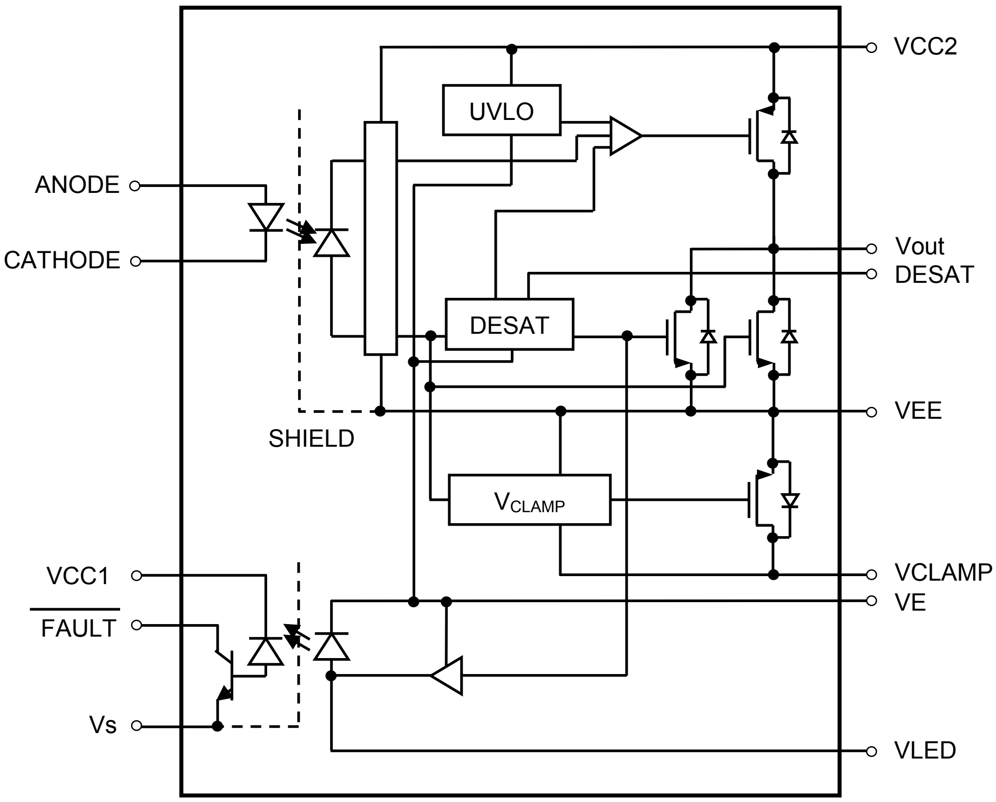
Start of commercial production
2014-05

Pin Configuration



1 : V_S
2 : V_{CC1}
3 : $\overline{\text{FAULT}}$
4 : V_S
5 : CATHODE
6 : ANODE
7 : ANODE
8 : CATHODE
9 : V_{EE}
10 : V_{CLAMP}
11 : V_{OUT}
12 : V_{EE}
13 : V_{CC2}
14 : DESAT
15 : V_{LED}
16 : V_E

Internal Circuit



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

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

	Characteristics		Symbol	Rating	Unit
LED	Input forward current		I_F	25	mA
	Input forward current derating (Ta ≧ 95°C)		$\Delta I_F/\Delta Ta$	−1	mA/°C
	Peak transient input forward current (Note 1)		I_{FPT}	1	A
	Peak transient input forward current derating (Ta ≧ 95°C)		$\Delta I_{FPT}/\Delta Ta$	−25	mA/°C
	Reverse Input Volteage		V_R	6	V
	Input power dissipation		P_D	40	mW
	Input power dissipation derating (Ta ≧ 95°C)		$\Delta P_D/\Delta Ta$	−1.3	mW/°C
Detector	Positive Input Supply Voltage		V_{CC1}	−0.5 to 7	V
	"H" peak output current	Ta = −40 to 110 °C (Note 2)	I_{OPH}	−4.0	A
	"L" peak output current		I_{OPL}	+4.0	A
	$\overline{FAULT}$ Output Current		$I_{\overline{FAULT}}$	8	mA
	$\overline{FAULT}$ Pin Voltage		$V_{\overline{FAULT}}$	−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	160	mW
	Output power dissipation (Ta ≧ 95°C)		$\Delta P_O/\Delta Ta$	−5.3	mW/°C
Common	Operating temperature range		T_{opr}	−40 to 110	°C
	Storage temperature range		T_{stg}	−55 to 125	°C
	Lead soldering temperature (10 s) (Note 3)		T_{sol}	260	°C
	Isolation voltage (AC, 1 minute, R.H. ≦ 60%) (Note 4)		BV_S	5000	Vrms

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 from pin 9 to pin 13 and from pin 13 to pin 16 to stabilize the operation of the high gain linear amplifier. Furthermore, in case VE-VEE>0V, a bypass capacitor, which has good high frequency characteristic, a ceramic capacitor (1 μF) should be connected from pin 9 to pin 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_{CC} = 15 V

Note 3: For the effective lead soldering area.

Note 4: This device considered a two-terminal device: pins 1, 2, 3, 4, 5, 6, 7and 8 are shorted together, and pins 9, 10, 11, 12, 13, 14, 15 and 16 are shorted together.

Recommended Operating Conditions

Characteristics	Symbol	Min	Typ.	Max	Unit
Total Output Supply Voltage (Note 5)	$(V_{CC2}–V_{EE})$	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
Input On-State Current (Note 6)	$I_{F(ON)}$	7.5	—	12	mA
Input On-State Voltage	$V_{F(OFF)}$	0	—	0.8	V
Operating frequency (Note 7)	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 5 : If the Vcc rise slope is sharp, an internal circuit might not operate with stability. Please design the V_{CC} rise slope under 3.0 V / μs.

Note 6 : Input signal rise time (fall time) ≦ 0.5 μs.

Note 7 : Exponential waveform. I_{OPH} ≧ -4.0 A (≦ 90 ns), I_{OPL} ≦ 4.0 A (≦ 90 ns), Ta = 110°C

Electrical Characteristics (Ta = −40 to 110 °C, unless otherwise specified)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit
Input Forward Voltage	V_F	—	I_F = 10mA, Ta = 25°C	1.4	—	1.8	V
Input Reverse Current	I_R	—	V_R = 5V	—	—	10	μA
Input Capacitance	C_t	—	V=0, f=1MHz, Ta = 25°C	—	95	—	pF
FAULT Low Level Output Voltage	$V_{\overline{FAULT}L}$	—	$I_{\overline{FAULT}}$ = 1.1 mA, $V_{CC}1$=5.5V	—	0.2	0.4	V
			$I_{\overline{FAULT}}$ = 1.1 mA, $V_{CC}1$=3.3V	—	0.2	0.4	
FAULT High Level Output Current	$I_{\overline{FAULT}H}$	—	$V_{\overline{FAULT}}$= 5.5V, $V_{CC}1$ = 5.5 V, Ta = 25°C	—	—	0.5	μA
			$V_{\overline{FAULT}}$= 5.5 V, $V_{CC}1$ = 3.3 V, Ta = 25°C	—	—	0.3	
High Level Output Current (Note 8)	I_{OPH}	1	$V_O = V_{CC}2 − 4$ V	—	−4.0	−1.2	A
			$V_O = V_{CC}2 − 7$ V	—	−6.5	−3.0	
Low Level Output Current (Note 8)	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	$V_{CC}2$−0.3	$V_{CC}2$−0.2	—	V
Low Level Output Voltage	V_{OL}	5	I_O = 100 mA	—	0.1	0.2	
Clamp Pin Threshold Voltage	V_{tClamp}	—	—	—	3.0	—	
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	3.5	mA
Low Level Supply Current	I_{CC2L}	6	I_O = 0 mA	—	2.3	3.5	
Blanking Capacitor Charging Current	I_{CHG}	7	V_{DESAT} = 2V	−0.13	−0.24	−0.33	
Blanking Capacitor Discharge Current	I_{DSCHG}	8	V_{DESAT} = 7V	10	49	—	
DESAT Threshold Voltage	V_{DESAT}	—	$V_{CC}2-V_E > V_{UVLO-}$	6	6.5	7.5	V
UVLO Threshold Voltage	V_{UVLO}^{+}	9	V_O > 5V	10.5	11.6	13.5	
	V_{UVLO}^{-}	10	V_O < 5V	9.2	10.3	11.1	
UVLO hysteresis	$UVLO_{HYS}$	—	—	—	1.3	—	

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

Note 8: I_O application time ≦ 50 μs, 1 pulse

Electrical Characteristics (Ta = −40 to 110 °C, unless otherwise specified)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.*	Max	Unit
Threshold Input Current(L/H)	I_{FLH}	10	V_{CC} = 30 V, V_O < 5 V	–	0.8	6	mA
Threshold Input Voltage (H/L)	V_{FHL}	—	V_{CC} = 30 V, V_O > 5 V	0.8	–	–	V

(*): 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.

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

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C_S	Vs = 0 V, f = 1 MHz	–	1.0	–	pF
Isolation resistance	R_S	R.H. ≦ 60 %, V_S = 500 V	1×10^{12}	1×10^{14}	–	Ω
Isolation voltage	BV_S	AC, 1 minute	5000	–	–	Vrms
		AC, 1 second, in oil	–	10000	–	Vrms
		DC, 1 minute, in oil	–	10000	–	Vdc

Note: This device considered a two-terminal device: pins 1, 2, 3, 4, 5, 6, 7and 8 are shorted together, and pins 9, 10, 11, 12, 13, 14, 15 and 16 are shorted together.

Switching Characteristics (Ta = −40 to 110 °C, unless otherwise specified)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.*	Max	Unit
Propagation delay time (Note 9)	L → H	t_{pLH}	11	V_{CC2} = 30 V, R_g = 10 Ω, C_g = 25 nF, Duty = 50%	I_F = 0 → 10 mA	50	85	150	ns
	H → L	t_{pHL}			I_F = 10 → 0 mA	50	90	150	ns
Output rise time (10−90 %) (Note 9)		t_r			I_F = 0 → 10 mA	–	32	–	ns
Output fall time (90−10 %) (Note 9)		t_f			I_F = 10 → 0 mA	–	18	–	ns
Pulse with distortion (Note 9)		$\lvert t_{pHL}-t_{pLH}\rvert$			I_F = 0 ↔ 10 mA	–	–	50	ns
Propagation delay skew (device to device) (Note 9)(Note 10)		t_{psk}			I_F = 0 ↔ 10 mA	−80	–	80	ns
DESAT Sense to 90% Delay		$t_{DESAT(90\%)}$	12	C_{DESAT} = 100pF,Rg = 10 Ω, Cg = 25nF, V_{CC2} = 30 V, R_F = 2.1kΩ		–	180	500	ns
DESAT Sense to 10% Delay		$t_{DESAT(10\%)}$				–	3.5	5	μs
DESAT Sense to Low Level FAULT Signal Delay		$t_{DESAT(FAULT)}$		C_{DESAT} = 100pF,Rg = 10 Ω, Cg = 25nF, V_{CC2} = 30 V, R_F = 2.1kΩ, C_F = Open		–	300	500	ns
DESAT Sense to Low Propagation Delay		$t_{DESAT(LOW)}$				–	200	–	ns
DESAT Input Mute		$t_{DESAT(MUTE)}$				7	14	–	μs
RESET to High Level FAULT Signal Delay		$t_{RESET(FAULT)}$			V_{CC1} = 5.5V	0.2	0.45	2	μs
Common Mode Transient Immunity at High Level Output		CM_H	13		I_F = 10 mA, $V_{O\ (min)}$ = 26 V	±35	–	–	kV/μs
Common Mode Transient Immunity at Low Level Output		CM_L			I_F = 0 mA, $V_{O\ (max)}$ = 1 V	±35	–	–	kV/μs

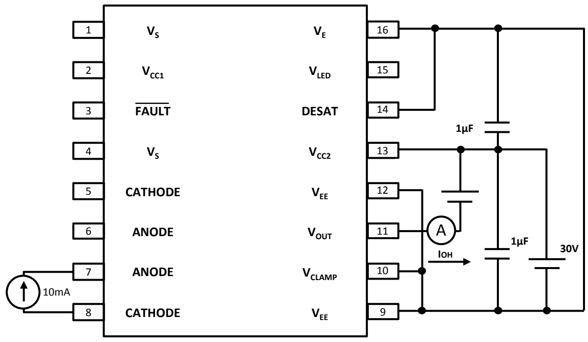
(*): All typical values are at Ta = 25 °C.

Note 9: Input signal (f = 10 kHz, duty = 50%, tr = tf = 5 ns or less)
CL is approximately 15 pF which includes probe and stray wiring capacitance.

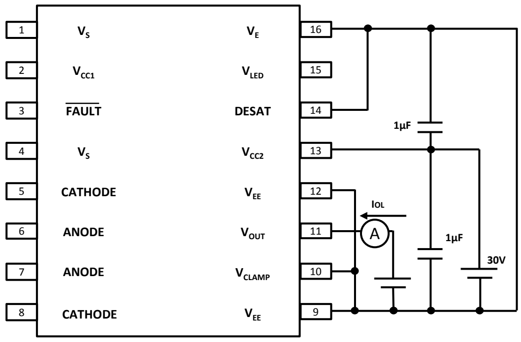
Note 10: The propagation delay skew, t_{psk}, is equal to the magnitude of the worst-case difference in t_{pHL} and/or t_{pLH} that will be seen between units at the same given conditions (supply voltage, input current, temperature, etc).

Test Circuit

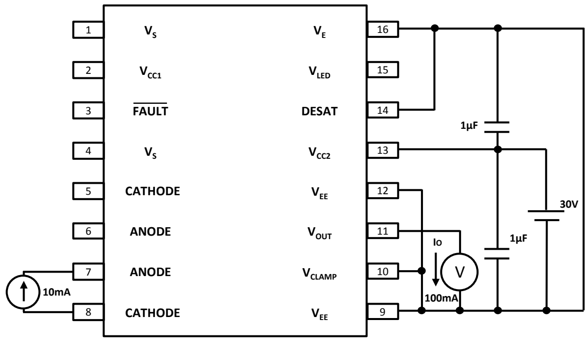
Test Circuit 1: I_{OPH}



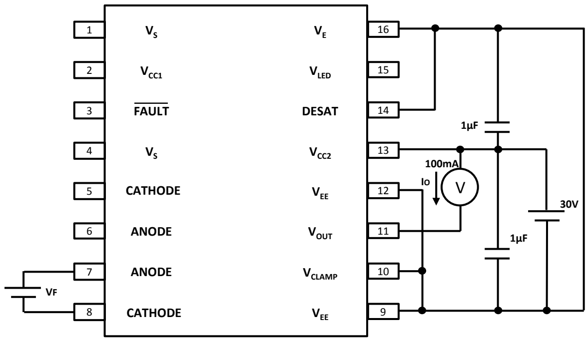
Test Circuit 2: I_{OPL}



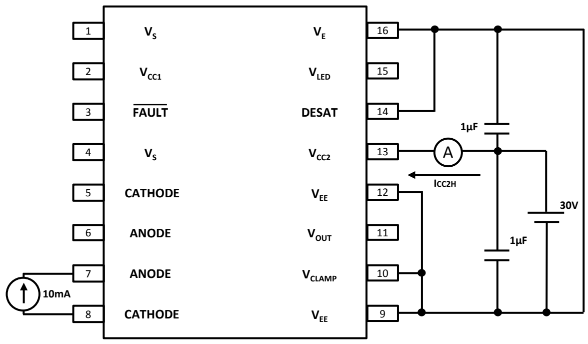
Test Circuit 3: V_{OH}



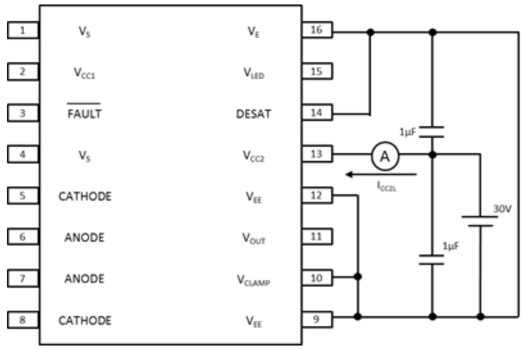
Test Circuit 4: V_{OL}



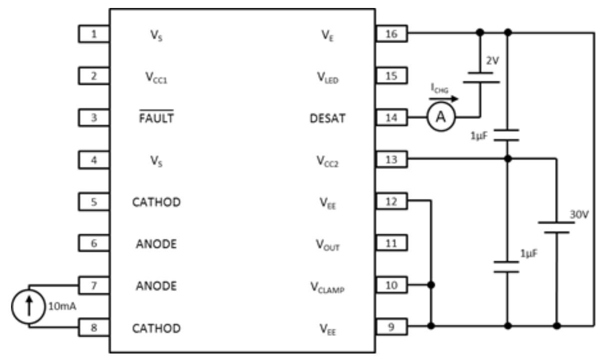
Test Circuit 5: I_{CC2H}



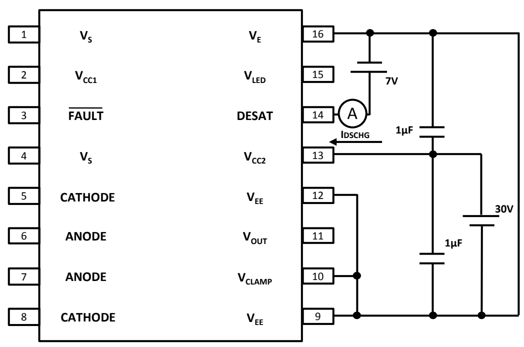
Test Circuit 6: I_{CC2L}



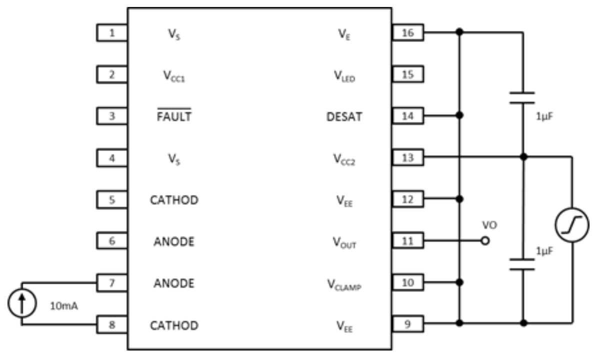
Test Circuit 7: I_{CHG}



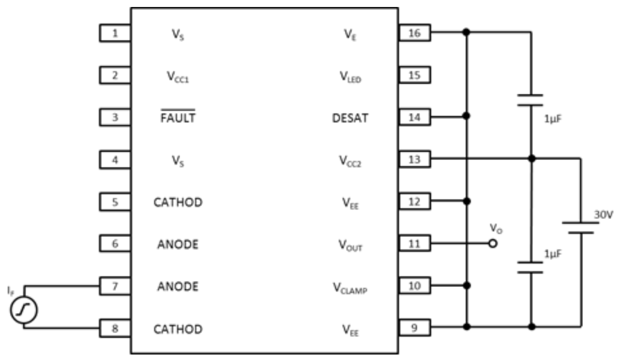
Test Circuit 8: I_{DSCHG}



Test Circuit 9: V_{UVLO}

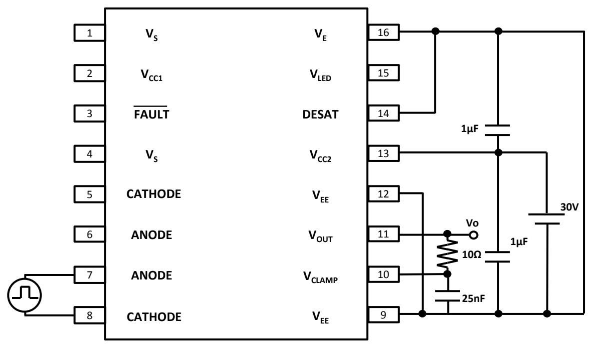


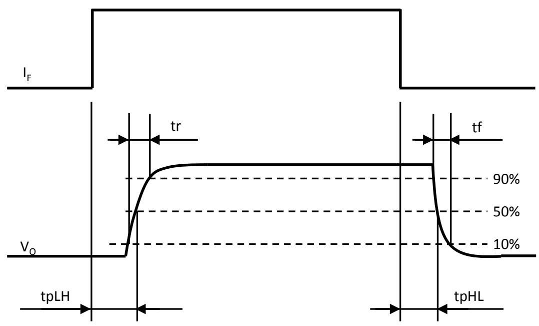
Test Circuit 10: I_{FLH}



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

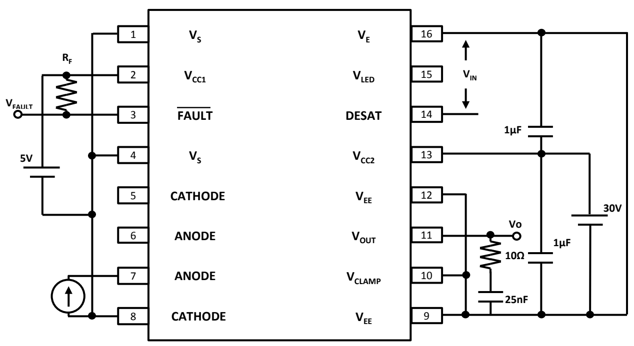
I_F = 10 mA (P.G.)
(f =10kHz, duty = 50%, tr = tf = 5ns of less)

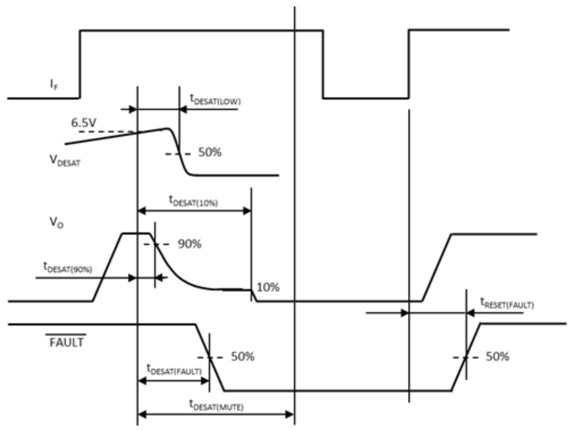




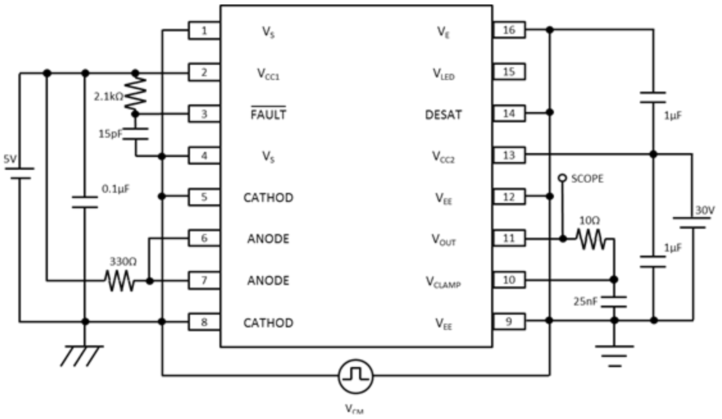
Test Circuit 12: $t_{DESAT(90\%)}$, $t_{DESAT(10\%)}$, $t_{DESAT(FAULT)}$, $t_{DESAT(Low)}$, $t_{DESAT(MUTE)}$, $t_{RESET(FAULT)}$

I_F = 10 mA (P.G.)
(f =10kHz, duty = 50%, tr = tf = 5ns of less)

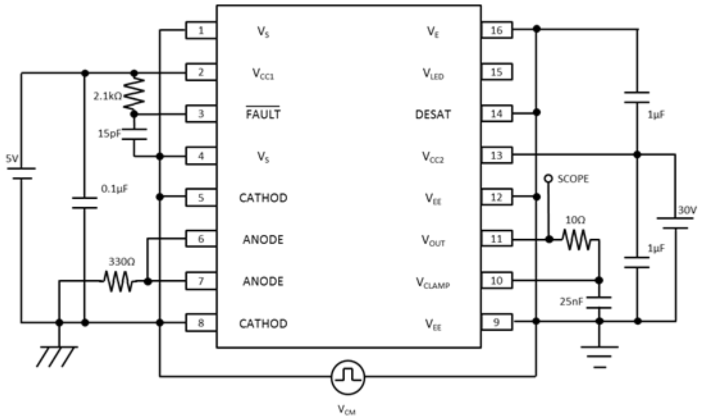




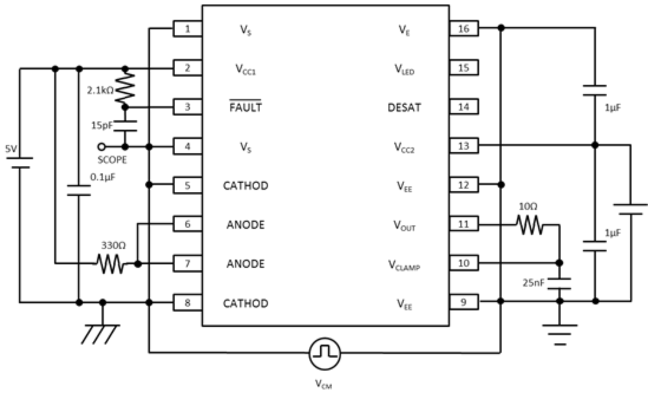
Test Circuit 13: CMR_LED1 ON



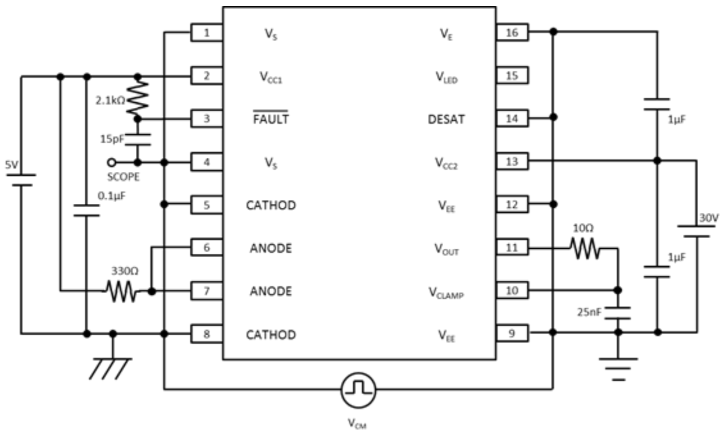
Test Circuit 13: CMR_LED1 OFF



Test Circuit 13: CMR_LED2 ON

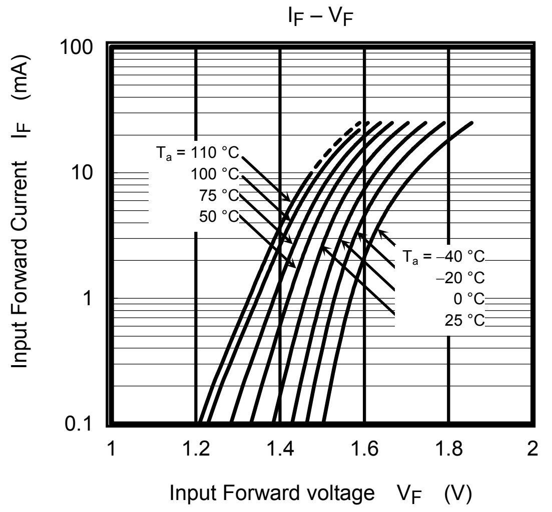


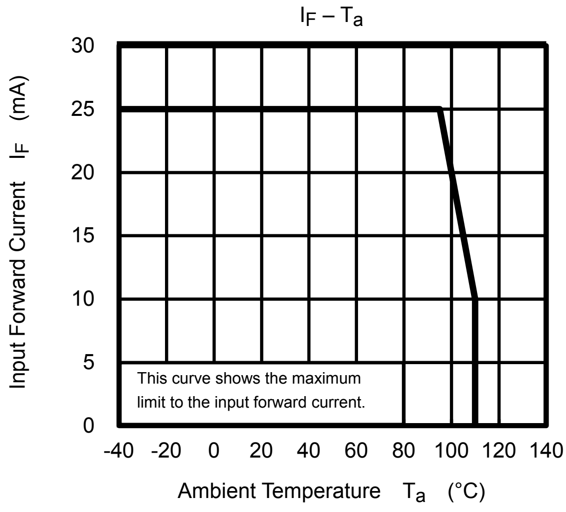
Test Circuit 13: CMR_LED2 OFF

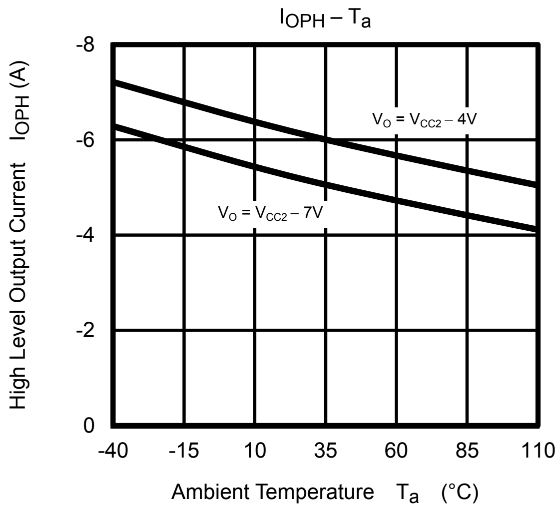


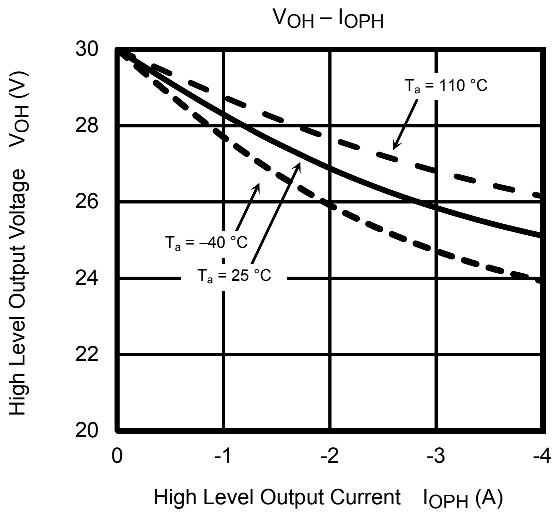
CM_L (CM_H) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the LOW (HIGH) state.

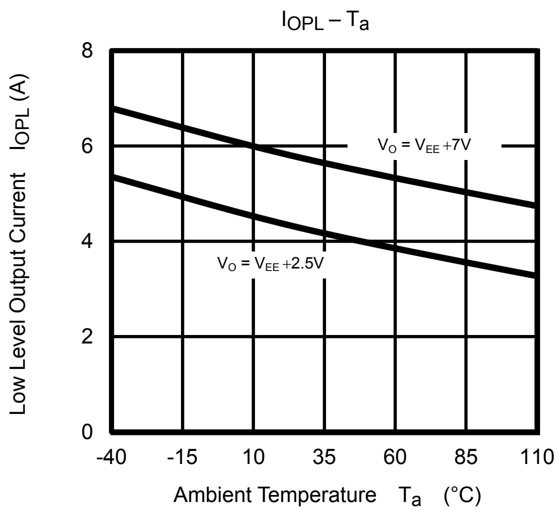
Characteristics Curve

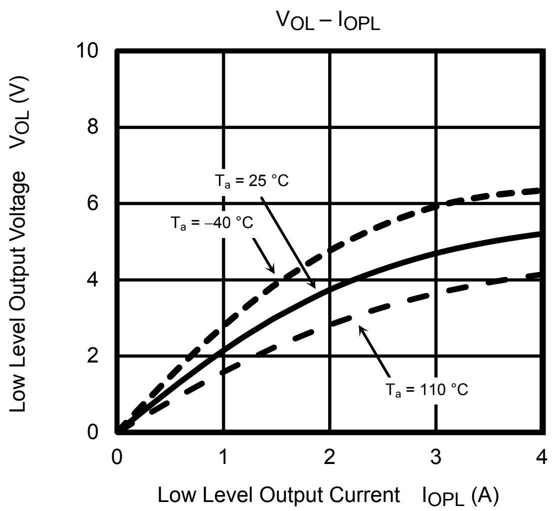


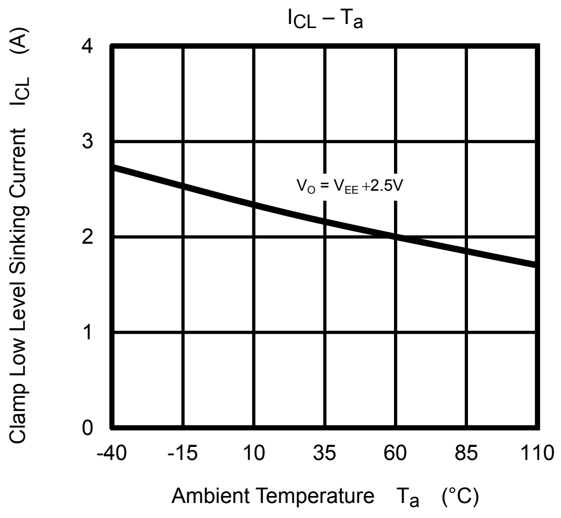


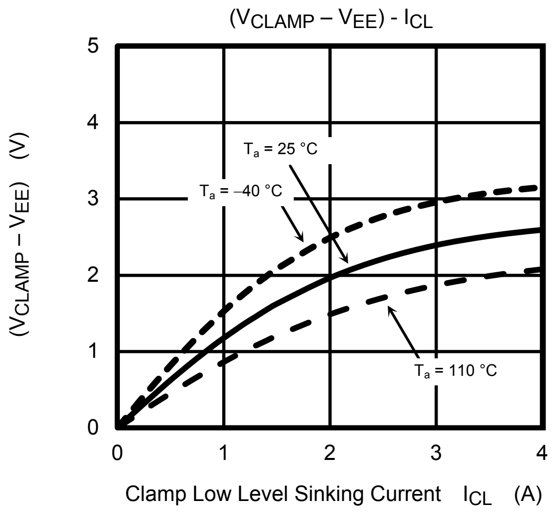


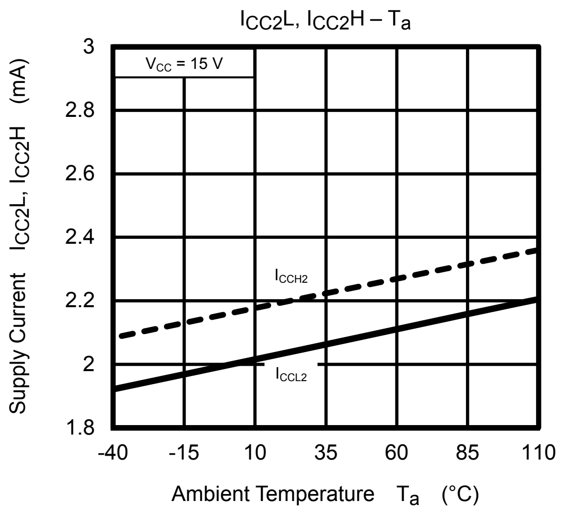


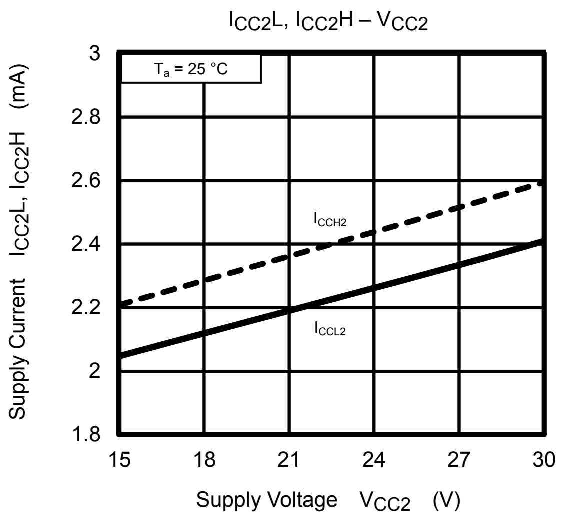


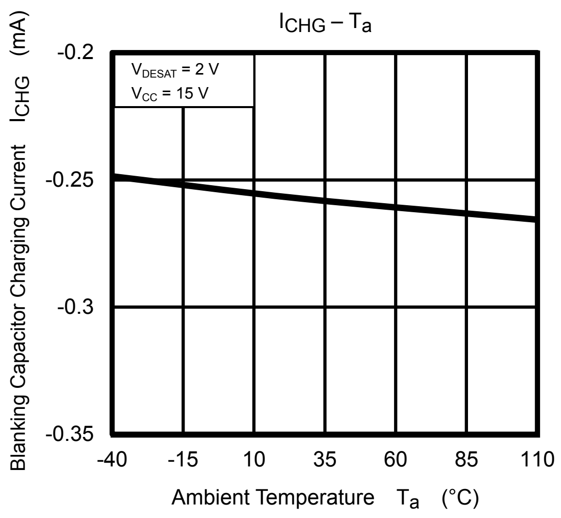


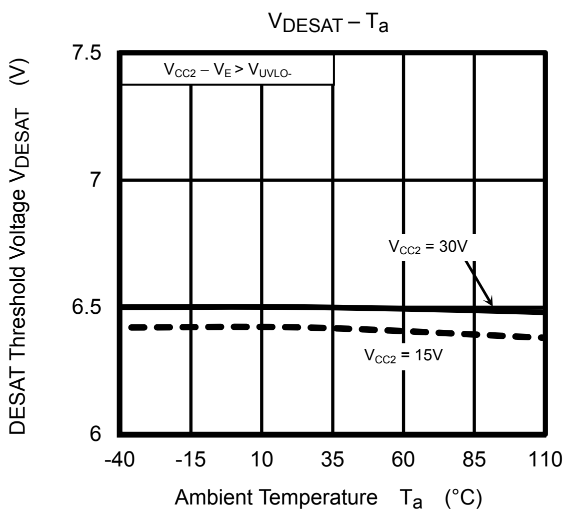

ICL – Ta
Clamp Low Level Sinking Current ICL (A)
VO = VEE +2.5V
Ambient Temperature Ta (°C)
0
1
2
3
4
-40
-15
10
35
60
85
110

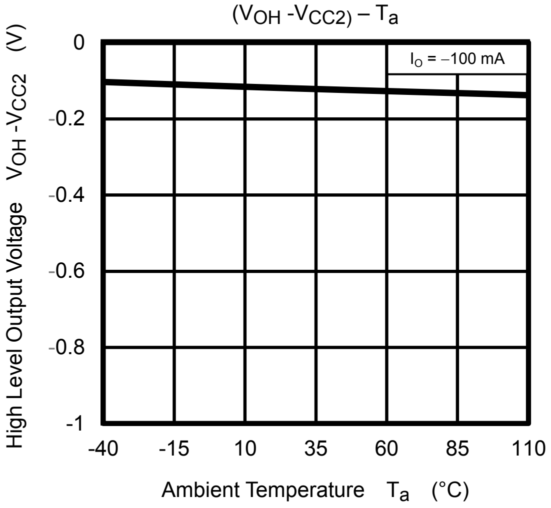

(VCLAMP – VEE) - ICL
(VCLAMP – VEE) (V)
Ta = 25 °C
Ta = –40 °C
Ta = 110 °C
Clamp Low Level Sinking Current ICL (A)
0
1
2
3
4
5

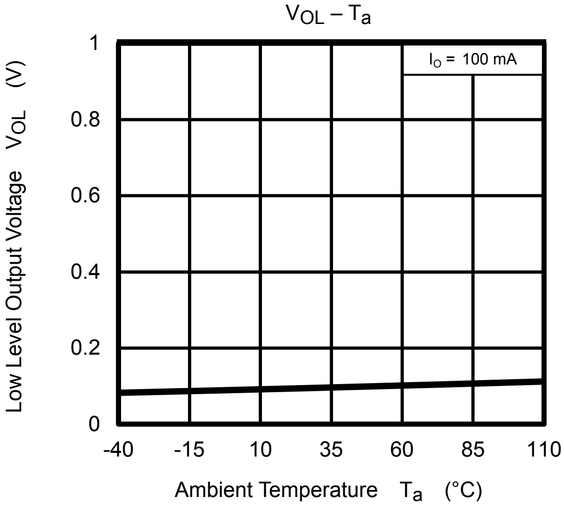

ICC2L, ICC2H – Ta
Supply Current ICC2L, ICC2H (mA)
VCC = 15 V
ICCH2
ICCL2
Ambient Temperature Ta (°C)
1.8
2
2.2
2.4
2.6
2.8
3
-40
-15
10
35
60
85
110

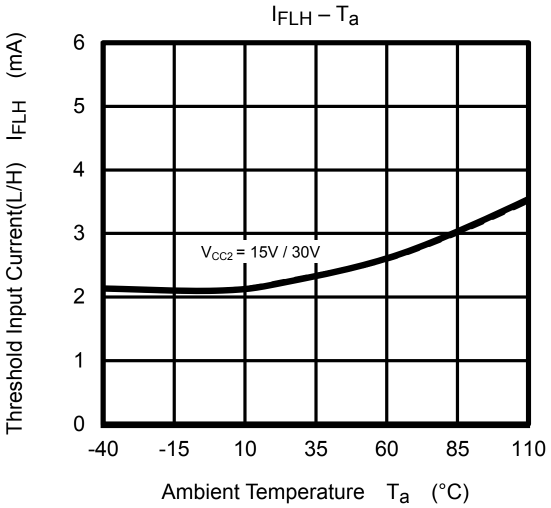

ICC2L, ICC2H – VCC2
Supply Current ICC2L, ICC2H (mA)
Ta = 25 °C
ICCH2
ICCL2
Supply Voltage VCC2 (V)
1.8
2
2.2
2.4
2.6
2.8
3
15
18
21
24
27
30

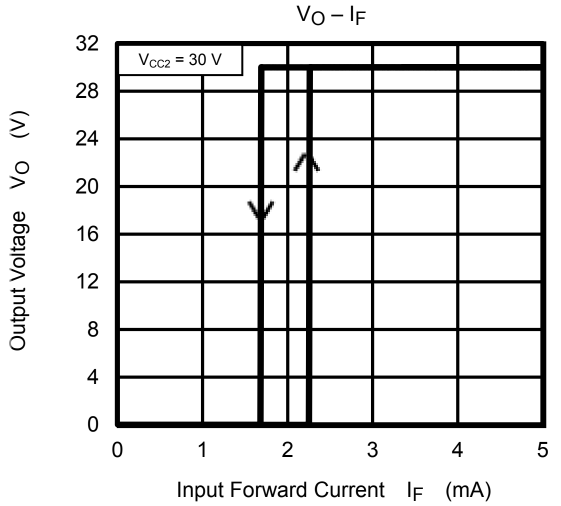

ICHG – Ta
Blanking Capacitor Charging Current ICHG (mA)
VDESAT = 2 V
VCC = 15 V
Ambient Temperature Ta (°C)
-0.2
-0.25
-0.3
-0.35
-40
-15
10
35
60
85
110

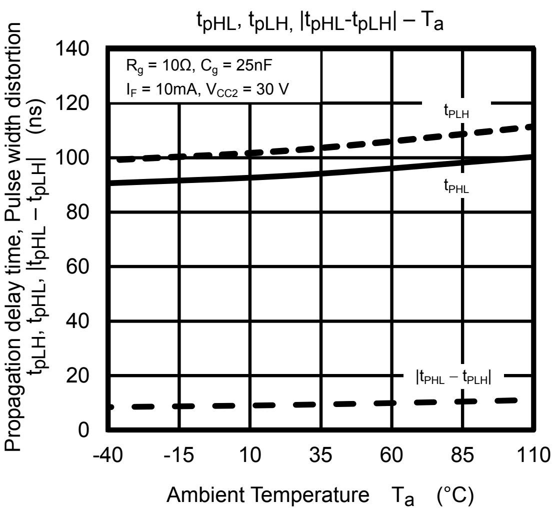

VDESAT – Ta
DESAT Threshold Voltage VDESAT (V)
VCC2 – VE > VUVLO-
VCC2 = 30V
VCC2 = 15V
Ambient Temperature Ta (°C)
6
6.5
7
7.5
-40
-15
10
35
60
85
110

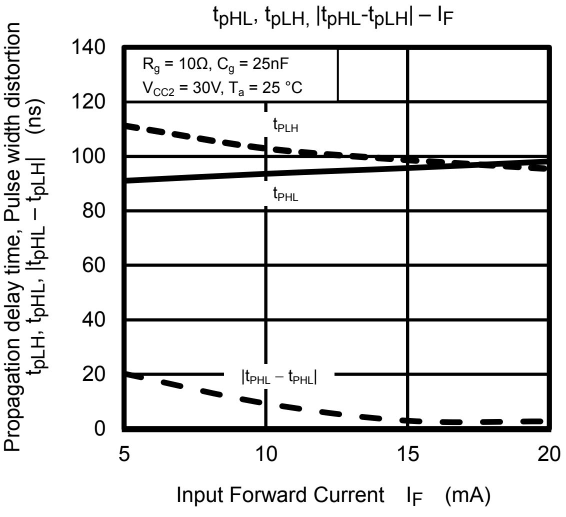

(VOH -VCC2) – Ta
IO = –100 mA
High Level Output Voltage VOH -VCC2 (V)
0
-0.2
-0.4
-0.6
-0.8
-1
-40 -15 10 35 60 85 110
Ambient Temperature Ta (°C)

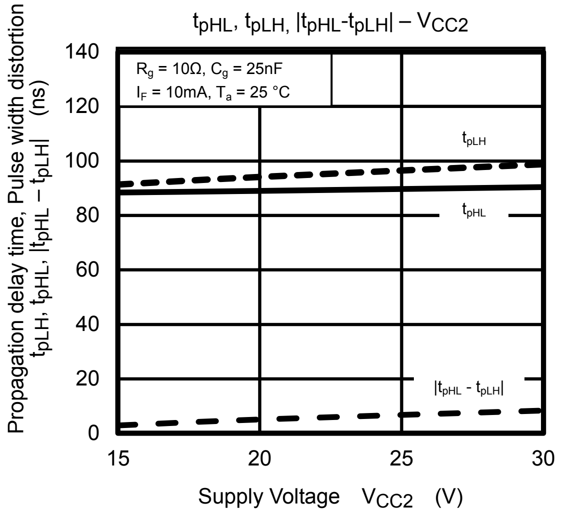

VOL – Ta
IO = 100 mA
Low Level Output Voltage VOL (V)
1
0.8
0.6
0.4
0.2
0
-40 -15 10 35 60 85 110
Ambient Temperature Ta (°C)

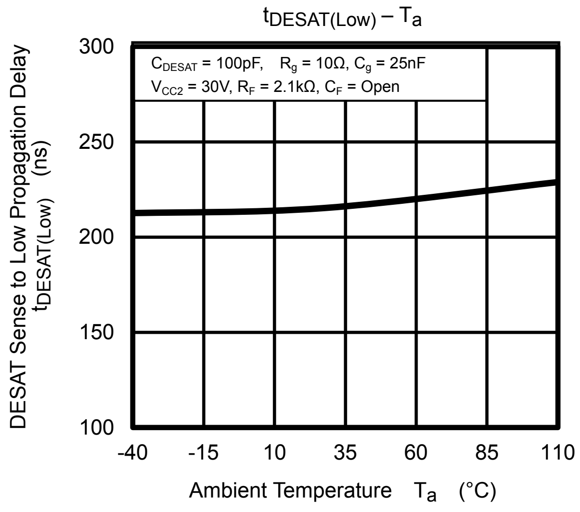

IFLH – Ta
VCC2 = 15V / 30V
Threshold Input Current(L/H) IFLH (mA)
6
5
4
3
2
1
0
-40 -15 10 35 60 85 110
Ambient Temperature Ta (°C)

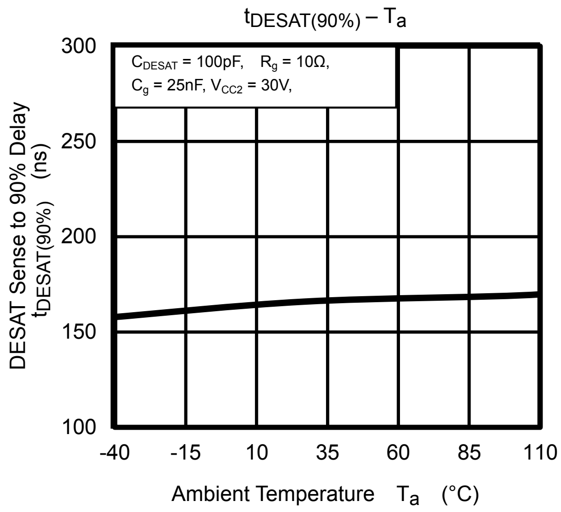

VO – IF
VCC2 = 30 V
Output Voltage VO (V)
32
28
24
20
16
12
8
4
0
0 1 2 3 4 5
Input Forward Current IF (mA)

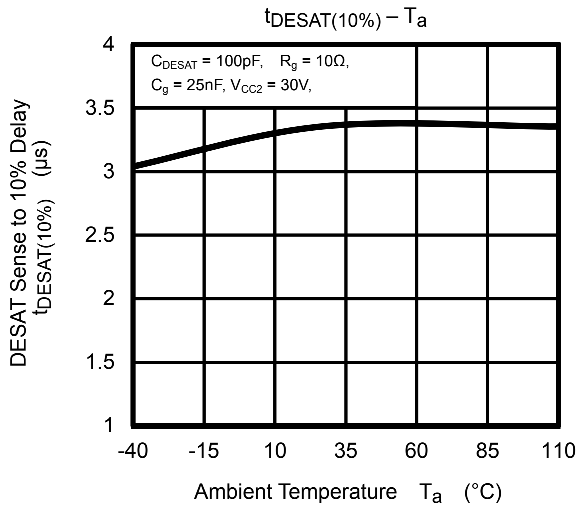

tpHL, tpLH, |tpHL-tpLH| – Ta
Rg = 10Ω, Cg = 25nF
IF = 10mA, VCC2 = 30 V
tPLH
tPHL
|tPHL – tPLH|
Propagation delay time, Pulse width distortion tpLH, tpHL, |tpHL – tpLH| (ns)
140
120
100
80
60
40
20
0
-40 -15 10 35 60 85 110
Ambient Temperature Ta (°C)

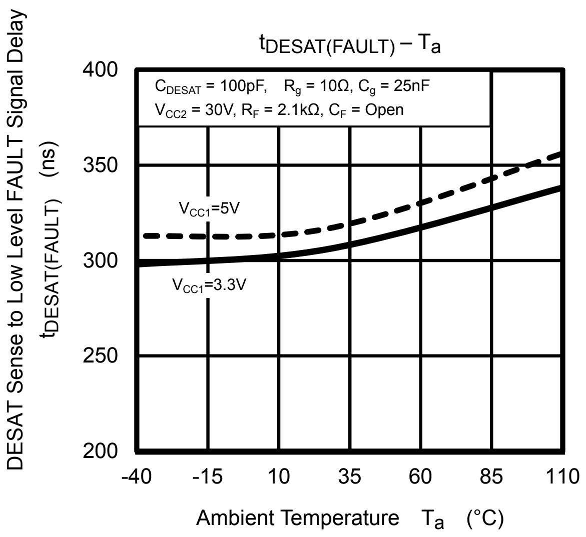

tpHL, tpLH, |tpHL-tpLH| – IF
Rg = 10Ω, Cg = 25nF
VCC2 = 30V, Ta = 25 °C
tPLH
tPHL
|tPHL – tPHL|
Propagation delay time, Pulse width distortion tpLH, tpHL, |tpHL – tpLH| (ns)
140
120
100
80
60
40
20
0
5 10 15 20
Input Forward Current IF (mA)

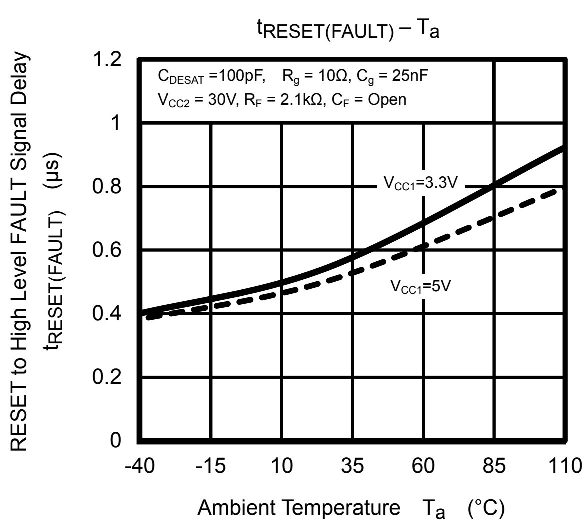

tpHL, tpLH, |tpHL-tpLH| – VCC2
Rg = 10Ω, Cg = 25nF
IF = 10mA, Ta = 25 °C
tpLH
tpHL
|tpHL - tpLH|
Propagation delay time, Pulse width distortion tpLH, tpHL, |tpHL – tpLH| (ns)
Supply Voltage VCC2 (V)
140
120
100
80
60
40
20
0
15
20
25
30


tDESAT(Low) – Ta
CDESAT = 100pF, Rg = 10Ω, Cg = 25nF
VCC2 = 30V, RF = 2.1kΩ, CF = Open
DESAT Sense to Low Propagation Delay tDESAT(Low) (ns)
Ambient Temperature Ta (°C)
300
250
200
150
100
-40
-15
10
35
60
85
110


tDESAT(90%) – Ta
CDESAT = 100pF, Rg = 10Ω,
Cg = 25nF, VCC2 = 30V,
DESAT Sense to 90% Delay tDESAT(90%) (ns)
Ambient Temperature Ta (°C)
300
250
200
150
100
-40
-15
10
35
60
85
110


tDESAT(10%) – Ta
CDESAT = 100pF, Rg = 10Ω,
Cg = 25nF, VCC2 = 30V,
DESAT Sense to 10% Delay tDESAT(10%) (μs)
Ambient Temperature Ta (°C)
4
3.5
3
2.5
2
1.5
1
-40
-15
10
35
60
85
110


tDESAT(FAULT) – Ta
CDESAT = 100pF, Rg = 10Ω, Cg = 25nF
VCC2 = 30V, RF = 2.1kΩ, CF = Open
VCC1=5V
VCC1=3.3V
DESAT Sense to Low Level FAULT Signal Delay tDESAT(FAULT) (ns)
Ambient Temperature Ta (°C)
400
350
300
250
200
-40
-15
10
35
60
85
110


tRESET(FAULT) – Ta
CDESAT =100pF, Rg = 10Ω, Cg = 25nF
VCC2 = 30V, RF = 2.1kΩ, CF = Open
VCC1=3.3V
VCC1=5V
RESET to High Level FAULT Signal Delay tRESET(FAULT) (μs)
Ambient Temperature Ta (°C)
1.2
1
0.8
0.6
0.4
0.2
0
-40
-15
10
35
60
85
110

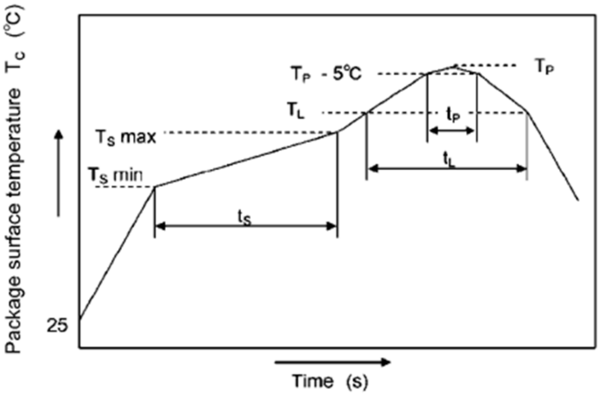
PRECAUTIONS OF SURFACE MOUNTING TYPE PHOTOCOUPLER SOLDERING & GENERAL STORAGE

(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

- 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.



	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	120	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

2) When using soldering Flow

- Apply preheating of 150 °C for 60 to 120 seconds.
- Mounting condition of 260 °C and 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.

Specifications for Embossed-Tape Packing (TP) for SO16L Coupler

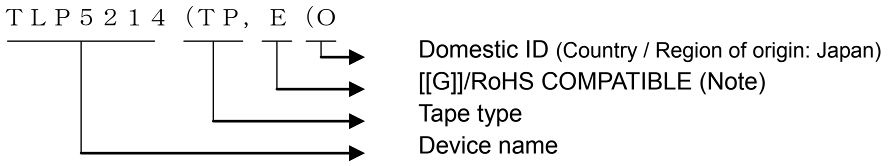
1. Applicable Package

Package	Product Type
SO16L	Long creepage Coupler

2. Product Naming System

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

(Example)



3. Tape Dimensions

3.1 Orientation of Device in Relation to Direction of Tape Movement

Device orientation in the recesses is as shown in Figure 1.

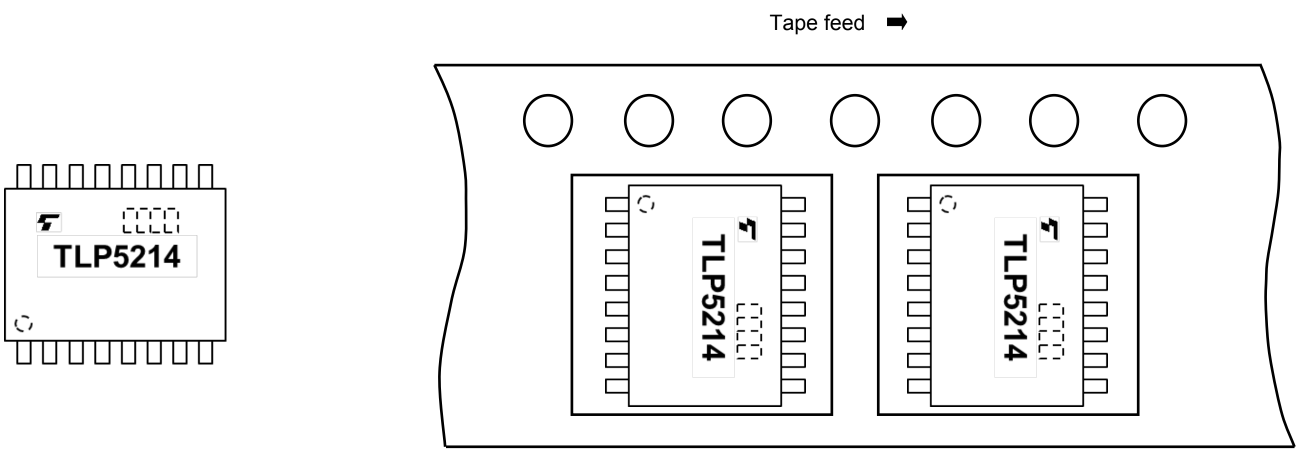


Figure 1 Device Orientation

3.2 Packing Quantity : 1500 per reel

3.3 Empty Device Recesses Are as Shown in Table 1.

Table1 Empty Device Recesses

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

3.4 Start and End of Tape

The start of the tape has 14 or more empty holes. The end of the tape has 34 or more empty holes and more than 30mm only for a cover tape.

3.5 Tape Specification

(1) Material: Plastic (production against electrostatics)
(2) Dimensions: The tape dimensions are shown in Figure 2 and Table 2.

Unit:mm

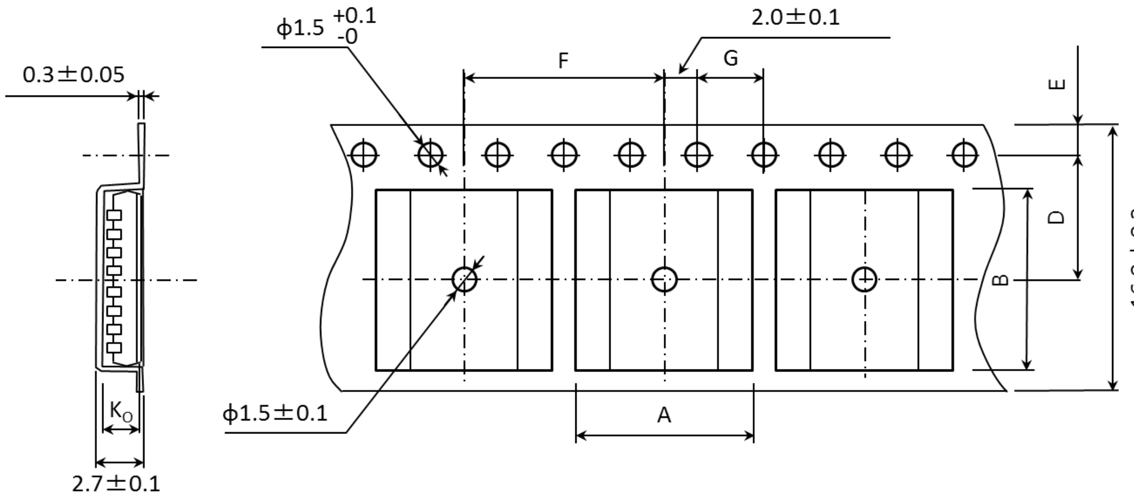


Figure 2 Tape Forms

Table 2 Tape Dimensions

Unit: mm
Unless otherwise specified: ±0.1

Symbol	Dimension	Remark
A	10.4	—
B	10.7	—
D	7.5	Center line of indented square hole and sprocket hole
E	1.75	Distance between tape edge and hole center
F	12.0	Cumulative error $^{+0.1}_{-0.3}$ per 10 feed holes
G	4.0	Cumulative error $^{+0.1}_{-0.3}$ per 10 feed holes
K_0	2.4	Internal space

3.6 Reel

(1) Material: Plastic
(2) Dimensions: The reel dimensions are as shown in Figure 3 and Table 3.

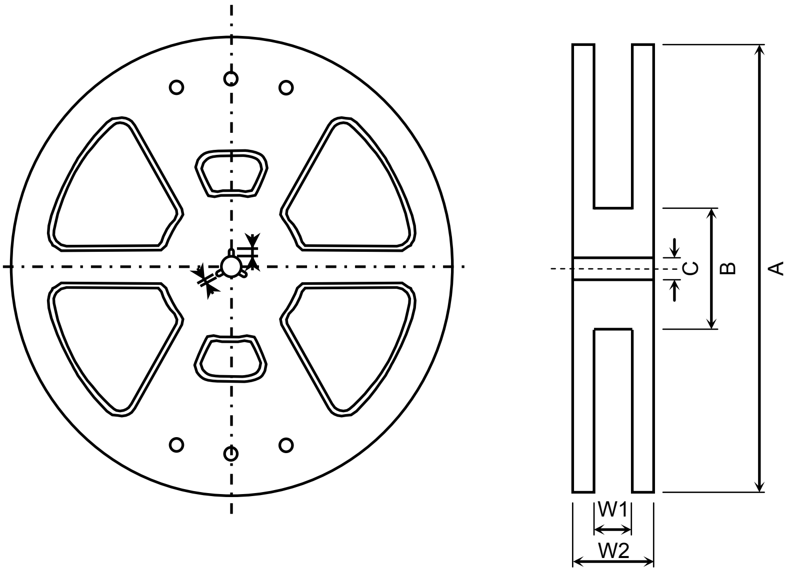


Figure 3 Reel Forms

Table 3 Reel Dimension

Unit: mm

Symbol	Dimension
A	Φ330 ± 2
B	Φ100 ± 1
C	Φ13 ± 0.5
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	17.4 ± 1.0
W2	21.4 ± 1.0

4. Packing

Either one reel or ten reels of photocoupler are packed in a shipping carton.

5. Label Indication

The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and Toshiba company name.

6. Ordering Method

When placing an order, please specify the product number, the CTR rank, the tape and the quantity as shown in the following example.

（Example）

ＴＬＰ５２１４（ＴＰ，Ｅ（Ｏ 1500Pcs.

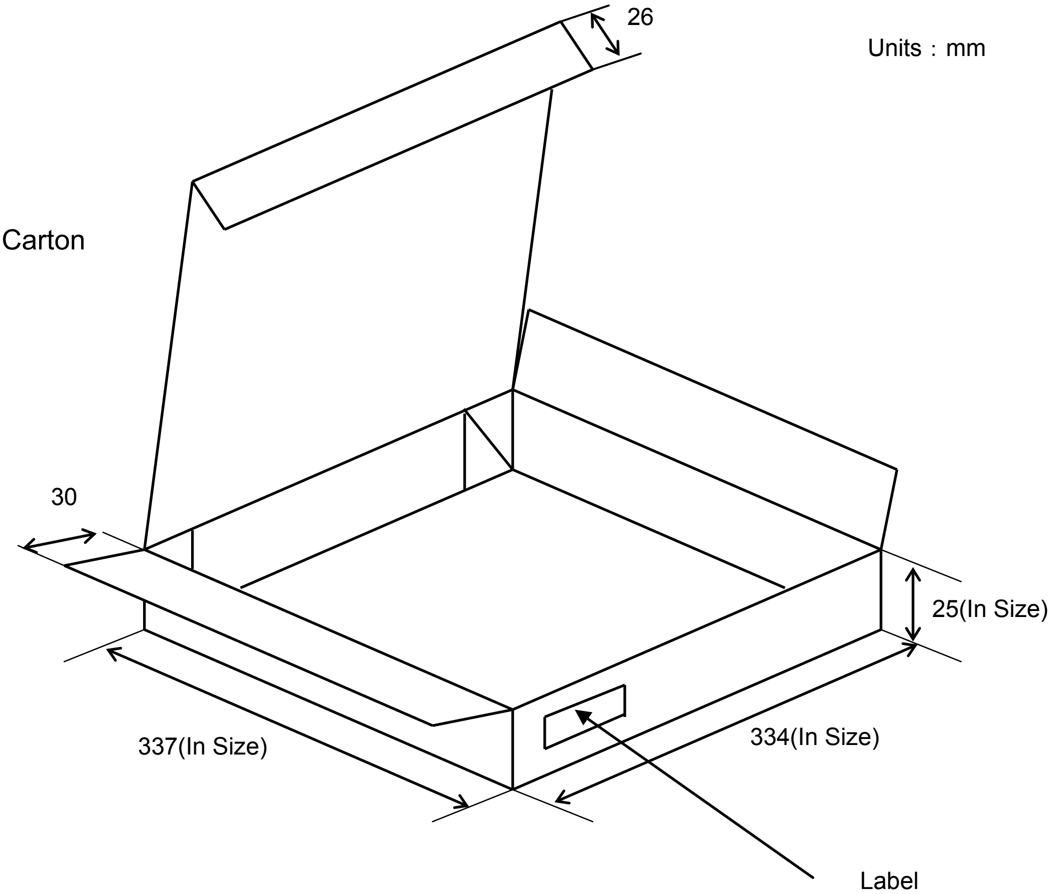
- Quantity (must be a multiple of 3000)
- Domestic ID (Country / Region of origin: Japan)
- [[G]]/RoHS COMPATIBLE (Note)
- Tape type
- Device name

Note : Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.
The 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 electronics equipment.

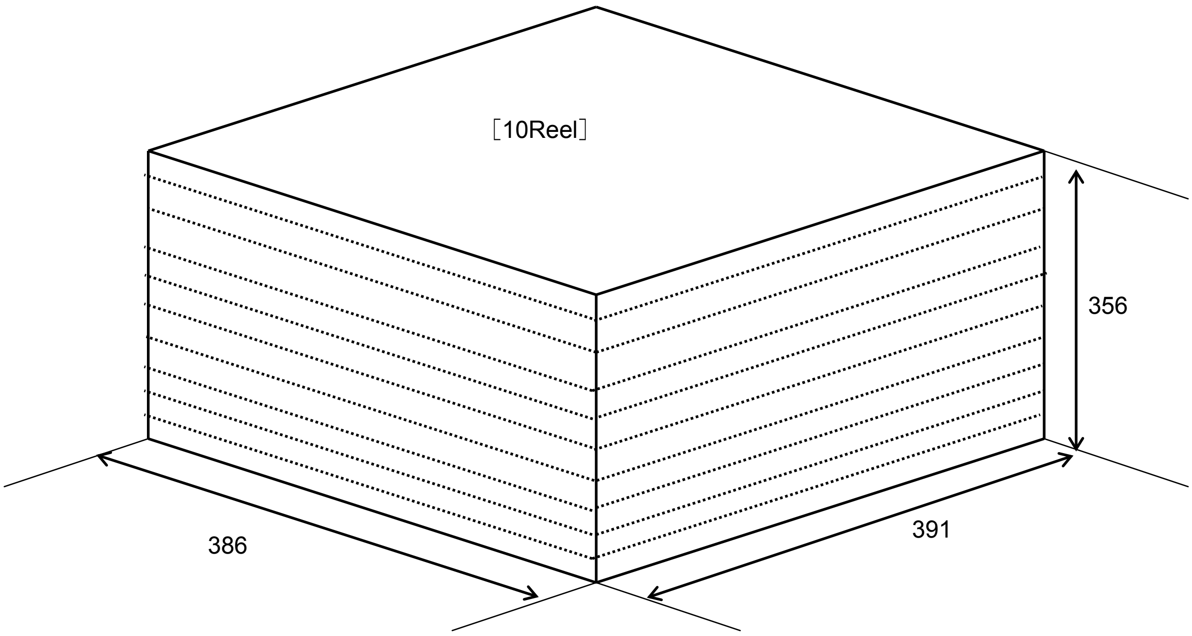
7. MethodPacking Dimensions（ϕ330mm）

Units：mm

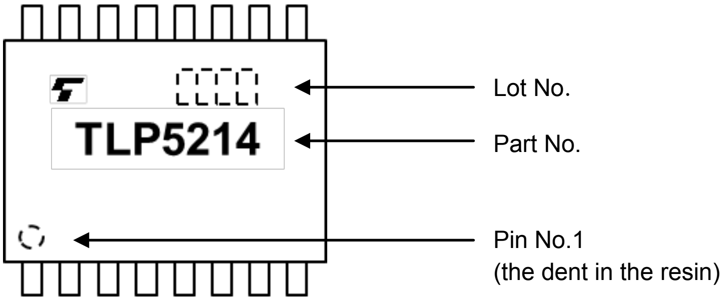
1 Reel／Carton



10Reel／Carton



8. Marking



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