

# TLP109(IGM)

## 1. Applications

- Intelligent Power Module Signal Isolation
- High-Speed Digital Interfacing for Instrumentation and Control Devices
- Industrial Inverters

## 2. General

The Toshiba TLP109(IGM) mini-flat coupler is a small-outline coupler suitable for surface-mount assembly. The TLP109(IGM) consists of an infrared LED optically coupled to a high-speed photodiode-transistor chip. The TLP109(IGM) is housed in the SO6 package and guarantees a creepage distance of  $\geq 5.0$  mm, a clearance of  $\geq 5.0$  mm and an insulation thickness of  $\geq 0.4$  mm. Therefore, the TLP109(IGM) meets the reinforced insulation class requirements of international safety standards. The TLP109(IGM) guarantees minimum and maximum of propagation delay time, switching time dispersion, and high common mode transient immunity. Therefore TLP109(IGM) is suitable for isolation interface between IPM(Intelligent Power Module) and control IC circuits in motor control application.

## 3. Features

- (1) Isolation voltage: 3750 Vrms (min)
- (2) Common-mode transient immunity: 10 kV/ $\mu$ s (min) @  $V_{CM} = 1500$  V<sub>p-p</sub>
- (3) Propagation delay time  $t_{pHL}/t_{pLH} = 0.1$   $\mu$ s (min)  
= 0.8  $\mu$ s (max)  
@  $I_F = 10$  mA,  $V_{CC} = 15$  V,  $R_L = 20$  k $\Omega$ ,  $T_a = 25$  °C
- (4) Pulse width distortion: 0.7  $\mu$ s (max) ( $|t_{pHL} - t_{pLH}|$ )
- (5) TTL compatible
- (6) Safety standards  
UL-recognized: UL 1577, File No.E67349  
cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349  
VDE-approved: EN IEC 60747-5-5, EN IEC 62368-1 (**Note 1**)  
CQC-approved: GB4943.1 Thailand Factory

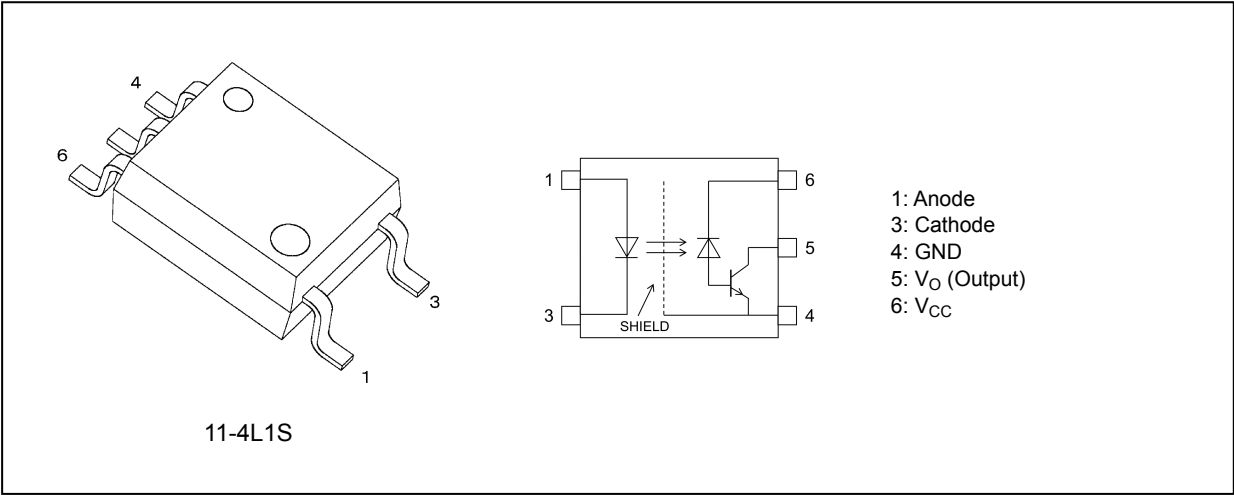


仅适用于海拔 2000m 以下地区安全使用

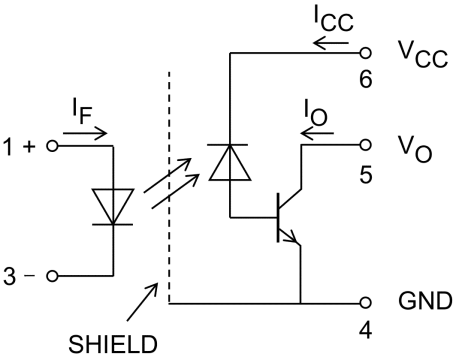
Note 1: When a VDE approved type is needed, please designate the **Option (V4)**.

Start of commercial production  
2008-07

4. Packaging and Pin Assignment



5. Internal Circuit



6. Principle of Operation

6.1. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance distances	5.0	
Internal isolation thickness	0.4	

7. Absolute Maximum Ratings (Note) (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	$I_F$		20	mA
	Input forward current derating ( $T_a \geq 95^\circ\text{C}$ )	$\Delta I_F / \Delta T_a$		-0.36	mA/ $^\circ\text{C}$
	Input forward current (pulsed)	$I_{FP}$	(Note 1)	40	mA
	Peak transient input forward current	$I_{FPT}$	(Note 2)	1	A
	Input reverse voltage	$V_R$		5	V
	Input power dissipation	$P_D$		40	mW
	Input power dissipation derating ( $T_a \geq 95^\circ\text{C}$ )	$\Delta P_D / \Delta T_a$		-0.72	mW/ $^\circ\text{C}$
	Junction temperature	$T_j$		125	$^\circ\text{C}$
Detector	Output current	$I_O$		8	mA
	Output current derating ( $T_a \geq 95^\circ\text{C}$ )	$\Delta I_O / \Delta T_a$		-0.3	mA/ $^\circ\text{C}$
	Peak output current	$I_{OP}$		16	mA
	Output voltage	$V_O$		-0.5 to 20	V
	Supply voltage	$V_{CC}$		-0.5 to 30	V
	Output power dissipation	$P_O$		100	mW
	Output power dissipation derating ( $T_a \geq 95^\circ\text{C}$ )	$\Delta P_O / \Delta T_a$		-1.8	mW/ $^\circ\text{C}$
	Junction temperature	$T_j$		125	$^\circ\text{C}$
Common	Operating temperature	$T_{opr}$		-55 to 125	$^\circ\text{C}$
	Storage temperature	$T_{stg}$		-55 to 125	
	Lead soldering temperature (10 s)	$T_{sol}$		260	
	Isolation voltage (AC, 60 s, R.H. $\leq 60\%$ )	$BV_S$	(Note 3)	3750	
					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 1: Pulse width (PW)  $\leq 1$  ms, duty = 50 %

Note 2: Pulse width (PW)  $\leq 1$   $\mu\text{s}$ , 300 pps

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

8. Electrical Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	$V_F$			$I_F = 16$ mA	1.5	1.64	1.85	V
Input forward voltage temperature coefficient	$\Delta V_F / \Delta T_a$			$I_F = 16$ mA	—	-1.8	—	mV/ $^\circ\text{C}$
Input reverse current	$I_R$			$V_R = 3$ V	—	—	10	$\mu\text{A}$
Input capacitance	$C_t$			$V = 0$ V, $f = 1$ MHz	—	60	—	pF
High-level output current	$I_{OH}$			$I_F = 0$ mA, $V_O = V_{CC} = 5.5$ V	—	3	500	nA
				$I_F = 0$ mA, $V_O = 20$ V, $V_{CC} = 30$ V	—	—	5	$\mu\text{A}$
				$I_F = 0$ mA, $V_O = 20$ V, $V_{CC} = 30$ V, $T_a = 100^\circ\text{C}$	—	—	50	$\mu\text{A}$
High-level supply current	$I_{CCH}$			$I_F = 0$ mA, $V_{CC} = 30$ V	—	0.01	1	$\mu\text{A}$
Supply voltage	$V_{CC}$			$I_{CC} = 0.01$ mA	30	—	—	V
Output voltage	$V_O$			$I_O = 0.5$ mA	20	—	—	V

### 9. Coupled Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	$I_O/I_F$	$I_F = 10\text{ mA}$ , $V_{CC} = 4.5\text{ V}$ , $V_O = 0.4\text{ V}$	25	35	75	%
		$I_F = 10\text{ mA}$ , $V_{CC} = 4.5\text{ V}$ , $V_O = 0.4\text{ V}$ , $T_a = -25\text{ to }100\text{ }^{\circ}\text{C}$	15	—	—	
Low-level output voltage	$V_{OL}$	$I_F = 16\text{ mA}$ , $V_{CC} = 4.5\text{ V}$ , $I_O = 2.4\text{ mA}$	—	—	0.4	V

### 10. Isolation Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	$C_S$	(Note 1)	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	—	0.8	—	pF
Isolation resistance	$R_S$	(Note 1)	$V_S = 500\text{ V}$ , R.H. $\leq 60\%$	$10^{12}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	(Note 1)	AC, 60 s	3750	—	—	Vrms

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

### 11. Switching Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ , $V_{CC} = 15\text{ V}$ )

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (H/L)	$t_{pHL}$		Fig.12.1.1	$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$	0.1	0.45	0.8	$\mu\text{s}$
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = 0\text{ to }85\text{ }^{\circ}\text{C}$	0.1	0.45	0.9	
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = -25\text{ to }100\text{ }^{\circ}\text{C}$	0.1	0.45	1.0	
Propagation delay time (L/H)	$t_{pLH}$		Fig.12.1.1	$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$	0.1	0.45	0.8	$\mu\text{s}$
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = 0\text{ to }85\text{ }^{\circ}\text{C}$	0.1	0.45	0.9	
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = -25\text{ to }100\text{ }^{\circ}\text{C}$	0.1	0.45	1.0	
Pulse width distortion	$ t_{pHL} - t_{pLH} $		Fig.12.1.1	$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$	—	0.15	0.7	$\mu\text{s}$
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = 0\text{ to }85\text{ }^{\circ}\text{C}$	—	0.25	0.8	
				$I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$ , $T_a = -25\text{ to }100\text{ }^{\circ}\text{C}$	—	0.25	0.9	
High-level common-mode transient immunity	$CM_H$	(Note 1)	Fig.12.1.2	$V_{CM} = 1500\text{ V}_{p-p}$ , $I_F = 0\text{ mA}$ , $R_L = 20\text{ k}\Omega$	10	15	—	kV/ $\mu\text{s}$
Low-level common-mode transient immunity	$CM_L$	(Note 2)		$V_{CM} = 1500\text{ V}_{p-p}$ , $I_F = 10\text{ mA}$ , $R_L = 20\text{ k}\Omega$	-10	-15	—	kV/ $\mu\text{s}$

Note 1:  $CM_H$  is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state ( $V_O > 4\text{ V}$ ).

Note 2:  $CM_L$  is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ( $V_O < 1\text{ V}$ ).

12. Test Circuits and Characteristics Curves

12.1. Test Circuits

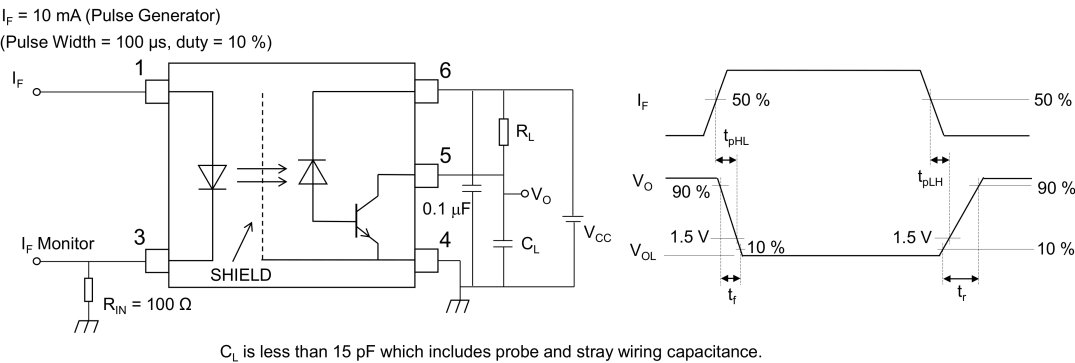


Fig. 12.1.1 Switching Time Test Circuit and Waveform

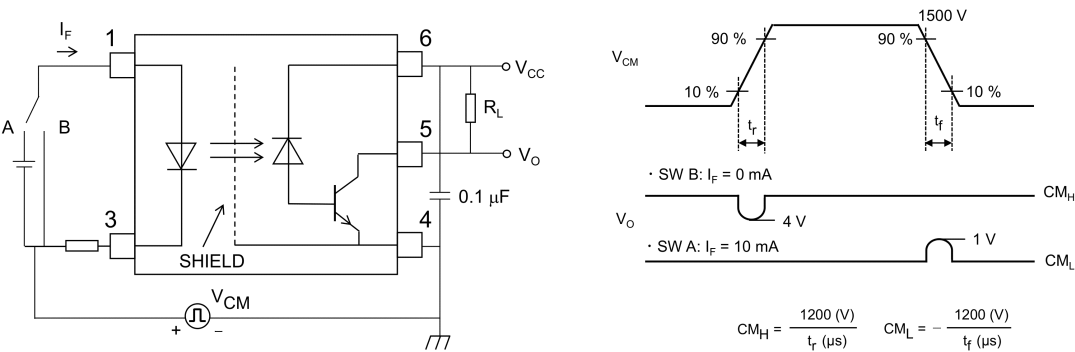


Fig. 12.1.2 Common-Mode Transient Immunity Test Circuit and Waveform

## 13. Soldering and Storage

### 13.1. 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.

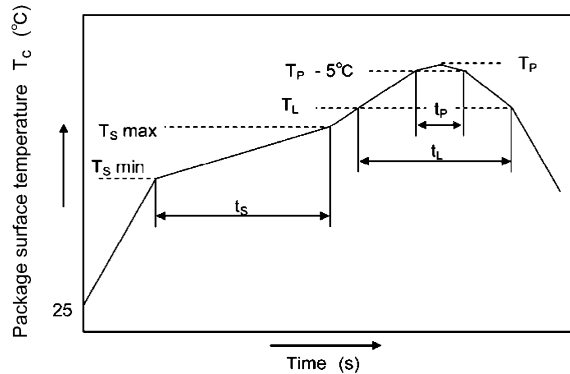
- When using soldering reflow.

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 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	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 120 seconds.

Mounting condition of 260 °C within 10 seconds is recommended.

Flow soldering must be performed once.

- When using soldering Iron

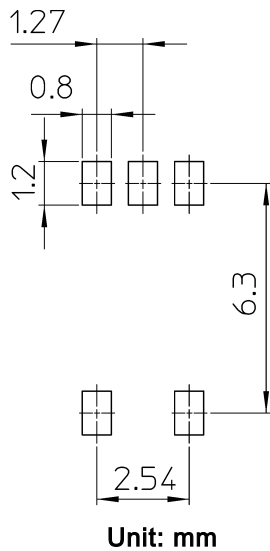
Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C

Heating by soldering iron must be done only once per lead.

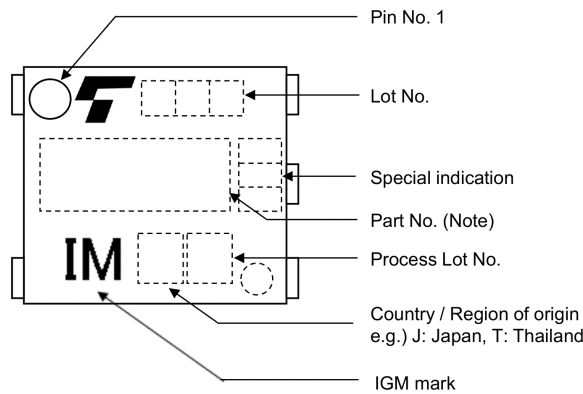
### 13.2. Precautions for General Storage

- 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 %, respectively.
- 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.

14. Land Pattern Dimensions (for reference only)



15. Marking



Note: P109 (Abbreviation code)

### 16. EN IEC 60747-5-5 Option (V4) Specification

- Part number: TLP109 (Note 1)
- The following part naming conventions are used for the devices that have been qualified according to option (V4) of EN IEC 60747.

Example: TLP109(V4IGMTL,E

V4: EN IEC 60747 option

IGM: IGM spec

TL: Tape type

E: [[G]]/RoHS COMPATIBLE (Note 2)

Note 1: Use TOSHIBA standard type number for safety standard application.

e.g., TLP109(V4IGMTL,E → TLP109

Note 2: 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.

Description	Symbol	Rating	Unit
Application classification			
for rated mains voltage $\leq 150$ Vrms		I-IV	—
for rated mains voltage $\leq 300$ Vrms		I-III	—
Climatic classification		55 / 125 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	VIORM	707	Vpeak
Input to output test voltage, Method A Vpr = $1.6 \times VIORM$ , type and sample test tp = 10 s, partial discharge < 5 pC	Vpr	1131	Vpeak
Input to output test voltage, Method B Vpr = $1.875 \times VIORM$ , 100 % production test tp = 1 s, partial discharge < 5 pC	Vpr	1330	Vpeak
Highest permissible overvoltage (transient overvoltage, tpr = 60 s)	VTR	6000	Vpeak
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve)			
current (input current IF, Pso = 0)	Isi	250	mA
power (output or total power dissipation)	Pso	400	mW
temperature	Ts	150	°C
Insulation resistance VIO = 500 V, Ta = 25 °C VIO = 500 V, Ta = 100 °C VIO = 500 V, Ta = Ts	Rsi	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^9$	$\Omega$

Fig. 16.1 EN IEC 60747 Isolation Characteristics



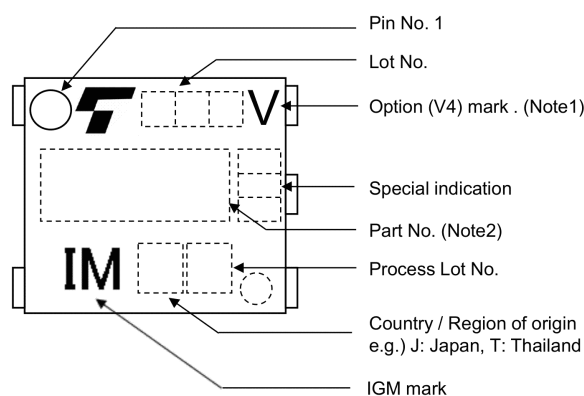
Minimum creepage distance	Cr	5.0 mm
Minimum clearance	Cl	5.0 mm
Minimum insulation thickness	ti	0.4 mm
Comparative tracking index	CTI	500

**Fig. 16.2 Insulation Related Specifications (Note)**

Note: This photocoupler is suitable for **safe electrical isolation** only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.



**Fig. 16.3 Marking on Packing**



**Fig. 16.4 Marking Example (Note)**

Note 1: The above marking is applied to the photocouplers that have been qualified according to option (V4) of EN IEC 60747.

Note 2: P109(Abbreviation code)

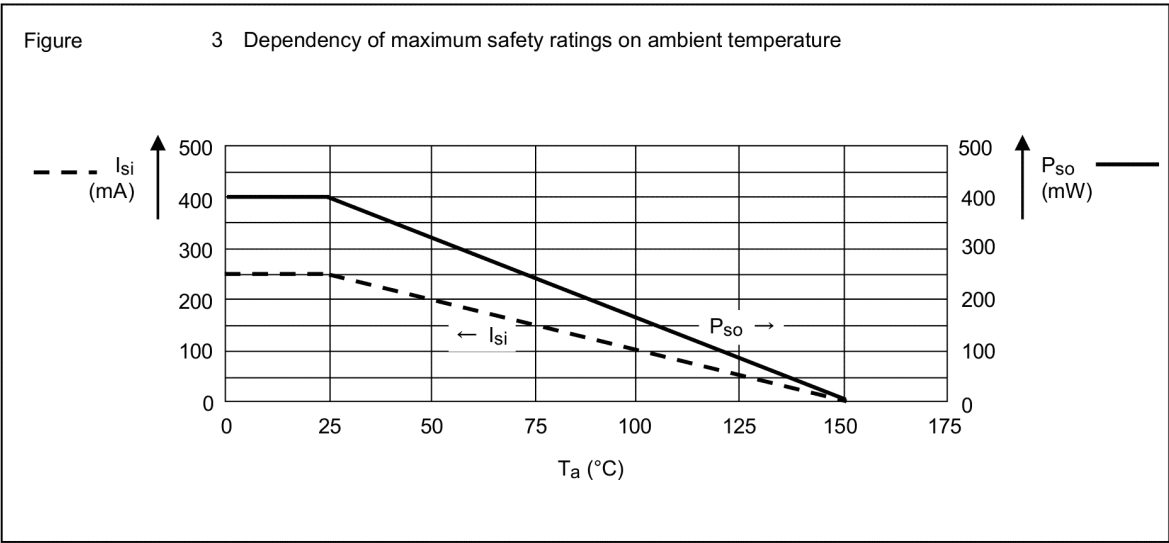
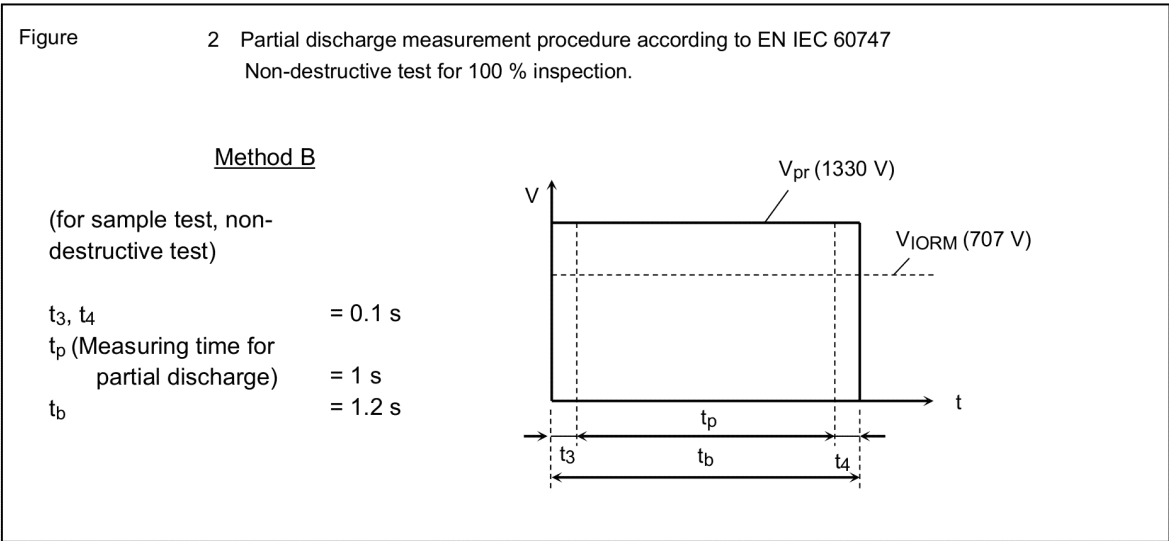
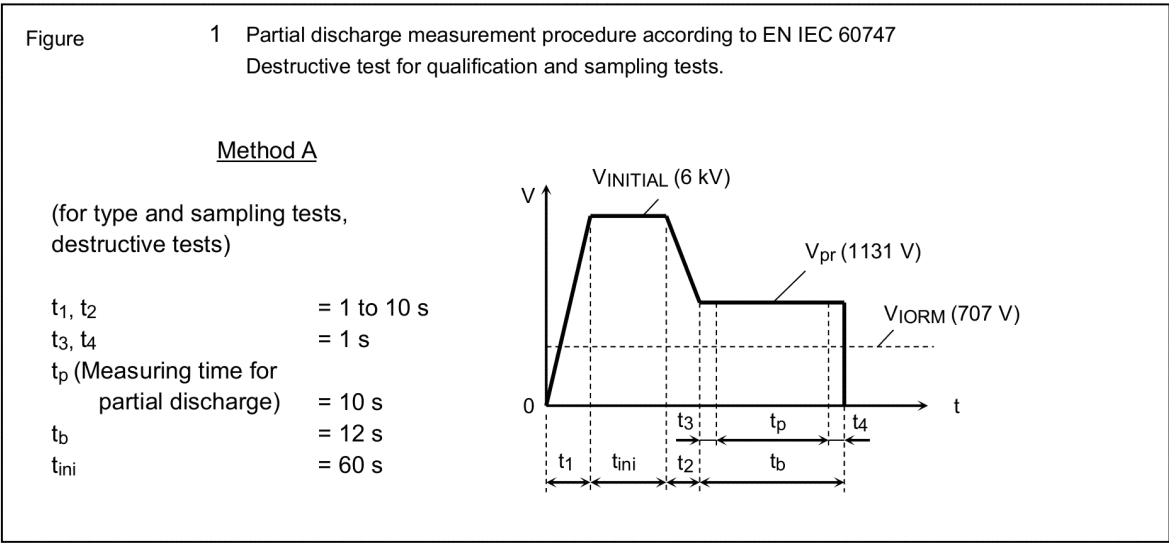


Fig. 16.5 Measurement Procedure

## 17. Ordering Information

When placing an order, please specify the part number, tape type and quantity as shown in the following example.

Example) TLP109(IGM-TPL,E 3000 pcs

Part number: TLP109

IGM spec: IGM

Tape type: TPL

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

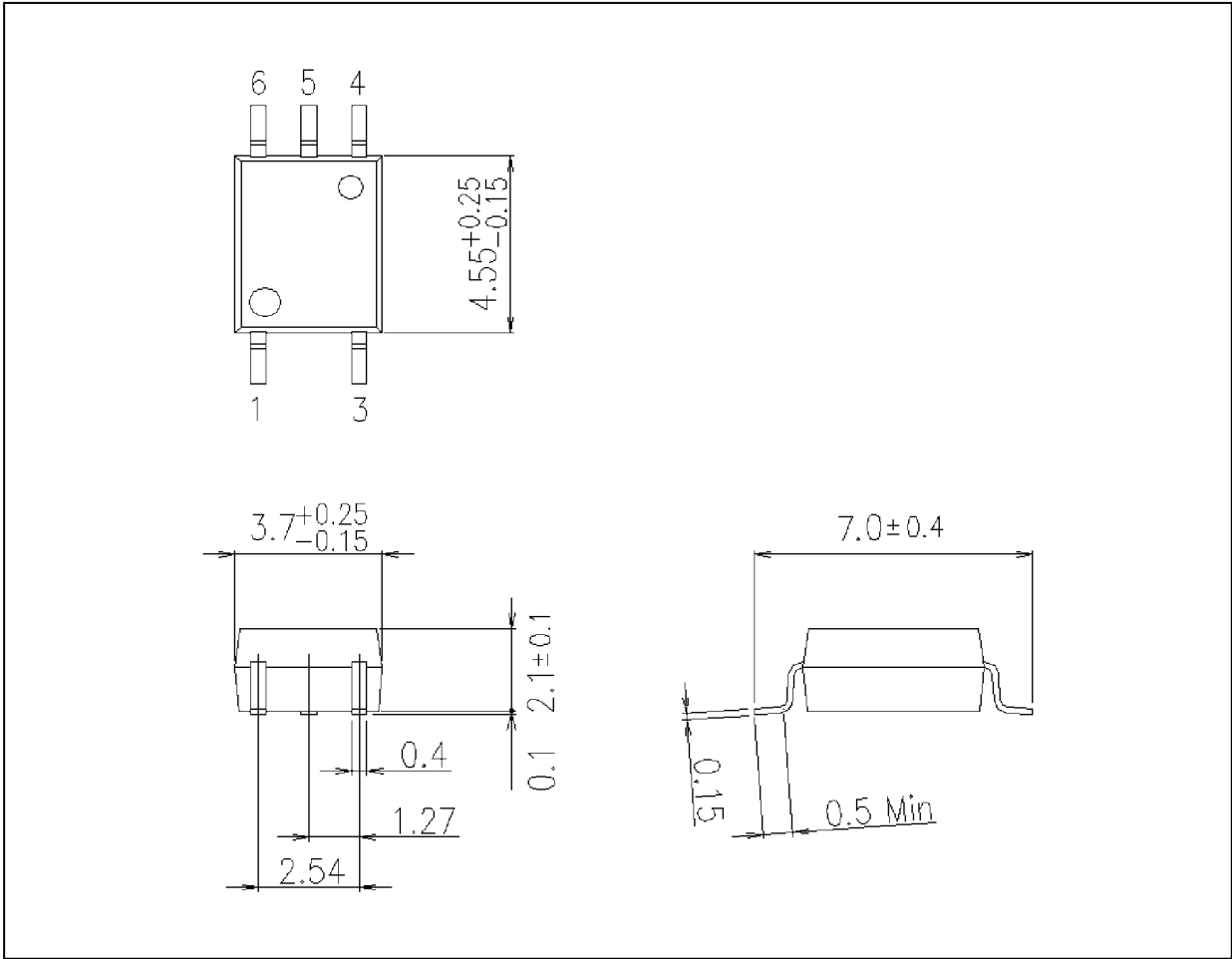
Quantity (must be a multiple of 3000): 3000 pcs

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.

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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