

TLP2358

1. Applications

- Intelligent Power Module Signal Isolation
- Programmable Logic Controllers (PLCs)
- High-Speed Digital Interfacing for Instrumentation and Control Devices

2. General

The Toshiba TLP2358 consists of a GaAs light-emitting diode coupled with a high-gain, high-speed photo detector. It is housed in the SO6 package.

The detector has a totem-pole output stage with current sourcing and sinking capabilities.

The TLP2358 has an internal Faraday shield that provides a guaranteed common-mode transient immunity of ± 20 kV/ μ s.

The TLP2358 has an inverter output. A buffer output version, the TLP2355, is also available.

3. Features

- (1) Inverter logic type (totem pole output)
- (2) Package: SO6
- (3) Supply voltage: 3 to 20 V
- (4) Threshold input current, high to low: $I_{FHL} = 1.6$ mA (max)
- (5) Propagation delay time: $t_{pHL}/t_{pLH} = 250$ ns (max)
- (6) Pulse width distortion: $|t_{pHL} - t_{pLH}| = 70$ ns (max)
- (7) Common-mode transient immunity: ± 20 kV/ μ s (min)
- (8) Operating temperature: -40 to 125°C
- (9) Isolation voltage: 3750 Vrms (min)
- (10) Safety standards

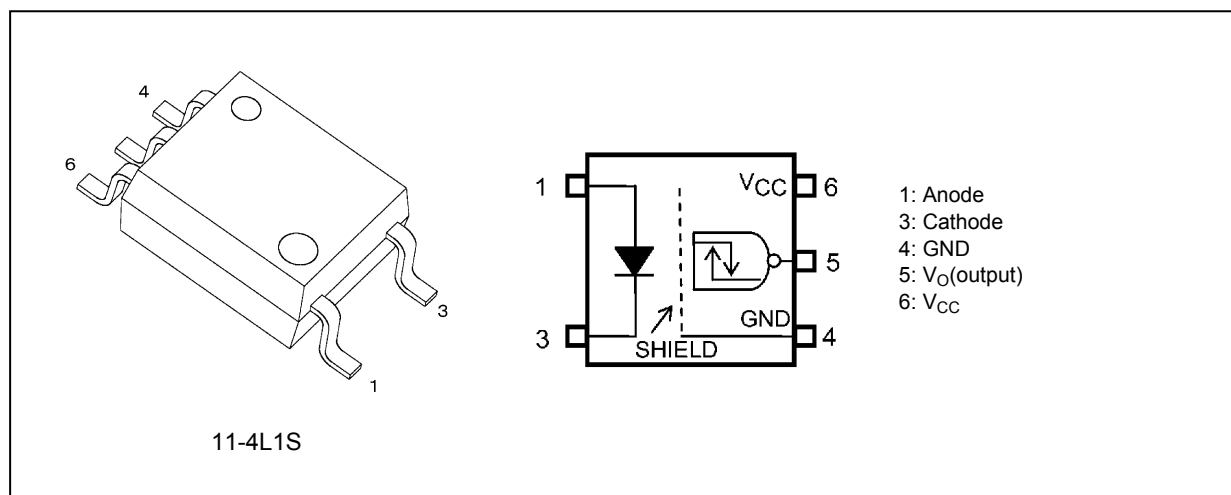
UL-under application: UL1577 File No.E67349

cUL-under application: CSA Component Acceptance Service No.5A, File No.E67349

VDE-under application: Option (V4) EN60747-5-2 (Note)

Note: When an EN60747-5-2 approved type is needed, please designate the **Option (V4)**.

4. Packaging and Pin Configuration



5. Internal Circuit (Note)

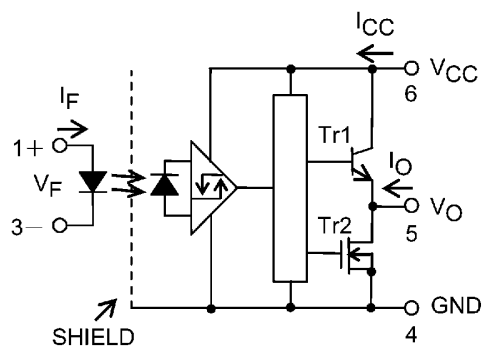


Fig. 5.1 Internal Circuit

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

6. Principle of Operation

6.1. Truth Table

Input	LED	Output
H	ON	L
L	OFF	H

6.2. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance	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 ($T_a \geq 116^\circ\text{C}$)	$\Delta I_F / \Delta T_a$		-0.6	mA/ $^\circ\text{C}$
	Peak transient input forward current	I_{FPT}	(Note 1)	1	A
	Peak transient input forward current derating ($T_a \geq 110^\circ\text{C}$)	$\Delta I_{FPT} / \Delta T_a$		-25	mA/ $^\circ\text{C}$
	Input power dissipation	P_D		40	mW
	Input power dissipation derating ($T_a \geq 110^\circ\text{C}$)	$\Delta P_D / \Delta T_a$		-1.0	mW/ $^\circ\text{C}$
	Input reverse voltage	V_R		5	V
Detector	Output current ($T_a \leq 25^\circ\text{C}$)	I_O		25/-15	mA
	Output current ($T_a = 125^\circ\text{C}$)	I_O		5/-5	
	Output voltage	V_O		-0.5 to 20	V
	Supply voltage	V_{CC}		-0.5 to 20	
Common	Operating temperature	T_{opr}		-40 to 125	$^\circ\text{C}$
	Storage temperature	T_{stg}		-55 to 125	
	Lead soldering temperature (10 s)	T_{sol}		260	
	Isolation voltage AC, 1 min, R.H. $\leq 60\%$	BV_S	(Note 2)	3750	

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) $\leq 1 \mu\text{s}$, 300 pps

Note 2: 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. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input on-state current	$I_{F(ON)}$	(Note 1)	2	—	10	mA
Input off-state voltage	$V_{F(OFF)}$		0	—	0.8	V
Supply voltage	V_{CC}	(Note 2)	3	—	20	
Operating temperature	T_{opr}	(Note 2)	-40	—	125	$^\circ\text{C}$

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this datasheet should also be considered.

Note: A ceramic capacitor (0.1 μF) should be connected between pin 6 and pin 4 to stabilize the operation of a high-gain linear amplifier. Otherwise, this photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

Note 1: The rise and fall times of the input on-current should be less than 0.5 μs .

Note 2: Denotes the operating range, not the recommended operating condition.

9. Electrical Characteristics (Note)

(Unless otherwise specified, $T_a = -40$ to 125°C , $V_{CC} = 3$ to 20 V)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V_F		—	$I_F = 10$ mA, $T_a = 25^\circ\text{C}$	1.45	1.55	1.70	V
Input forward voltage temperature coefficient	$\Delta V_F / \Delta T_a$		—	$I_F = 10$ mA	—	-2.0	—	mV/ $^\circ\text{C}$
Input reverse current	I_R		—	$V_R = 5$ V, $T_a = 25^\circ\text{C}$	—	—	10	μA
Input capacitance	C_t		—	$V = 0$ V, $f = 1$ MHz	—	60	—	pF
Low-level output voltage	V_{OL}		Fig. 12.1.1	$I_O = 3.5$ mA, $I_F = 5$ mA	—	0.2	0.6	V
High-level output voltage	V_{OH}	(Note 1)	Fig. 12.1.2	$V_{CC} = 3$ V, $I_O = -2.6$ mA, $V_F = 0.8$ V	1.78	2.1	—	
				$V_{CC} = 20$ V, $I_O = -2.6$ mA, $V_F = 0.8$ V	17.4	19.1	—	
Low-level supply current	I_{CCL}		Fig. 12.1.3	$V_{CC} = 3.6$ V, $I_F = 5$ mA	—	1.4	3.0	mA
				$V_{CC} = 20$ V, $I_F = 5$ mA	—	1.5	3.0	
High-level supply current	I_{CCH}		Fig. 12.1.4	$V_{CC} = 3.6$ V, $V_F = 0$ V	—	1.9	3.0	
				$V_{CC} = 20$ V, $V_F = 0$ V	—	2.0	3.0	
Low-level short-circuit output current	I_{OSL}	(Note 2)	Fig. 12.1.5	$V_{CC} = V_O = 3.6$ V, $I_F = 5$ mA, $V_O = \text{GND}$	15	100	—	
				$V_{CC} = V_O = 20$ V, $I_F = 5$ mA, $V_O = \text{GND}$	20	120	—	
High-level short-circuit output current	I_{OSH}	(Note 2)	Fig. 12.1.6	$V_{CC} = 3.6$ V, $V_F = 0$ V	—	-14	-5	
				$V_{CC} = 20$ V, $V_F = 0$ V	—	-24	-10	
Threshold input current (H/L)	I_{FHL}		—	$I_O = 3.5$ mA, $V_O < 0.4$ V	—	0.5	1.6	
Threshold input voltage (L/H)	V_{FLH}		—	$I_O = -2.6$ mA, $V_O > 2.4$ V	0.8	—	—	V
Input current hysteresis	I_{HYS}		—	$V_{CC} = 5$ V	—	0.05	—	mA

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

Note 1: $V_{OH} = V_{CC} - V_O$ (V)

Note 2: Duration of output short circuit time should not exceed 10 ms.

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

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	$V_S = 0$ V, $f = 1$ MHz	—	0.8	—	pF
Isolation resistance	R_S	(Note 1)	$V_S = 500$ V, R.H. $\leq 60\%$	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 1 min	3750	—	—	Vrms
			AC, 1 s in oil	—	10000	—	
			DC, 1 min in oil	—	10000	—	Vdc

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 (Note)(Unless otherwise specified, $T_a = -40$ to 125°C , $V_{CC} = 3$ to 20 V)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (L/H)	t_{pLH}		Fig. 12.1.7, Fig. 12.1.8	$I_F = 3 \rightarrow 0$ mA	—	100	250	ns
Propagation delay time (H/L)	t_{pHL}			$I_F = 0 \rightarrow 3$ mA	—	120	250	
Pulse width distortion	$ t_{pHL} - t_{pLH} $			$I_F = 3$ mA	—	20	70	
Propagation delay skew (device to device)	t_{psk}				-130	—	130	
Rise time	t_r			$I_F = 3 \rightarrow 0$ mA, $V_{CC} = 5$ V	—	15	75	
Fall time	t_f			$I_F = 0 \rightarrow 3$ mA, $V_{CC} = 5$ V	—	12	75	
Common-mode transient immunity at output high	CM_H		Fig. 12.1.9	$V_{CM} = 1000$ V _{p-p} , $I_F = 0$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$	± 20	± 25	—	kV/ μs
Common-mode transient immunity at output low	CM_L			$V_{CM} = 1000$ V _{p-p} , $I_F = 5$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$	± 20	± 25	—	

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

12. Test Circuits and Characteristics Curves

12.1. Test Circuits

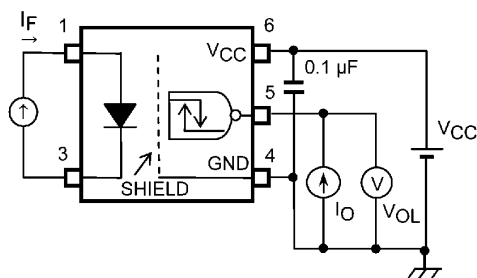


Fig. 12.1.1 VOL Test Circuit

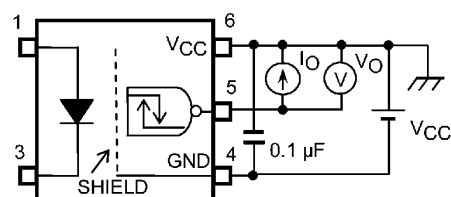


Fig. 12.1.2 VOH Test Circuit

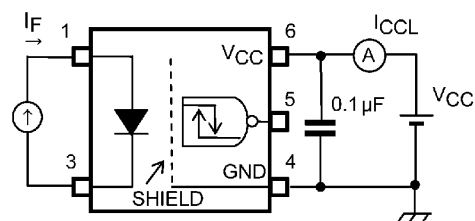


Fig. 12.1.3 ICCL Test Circuit

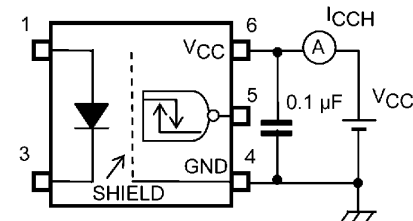


Fig. 12.1.4 ICCH Test Circuit

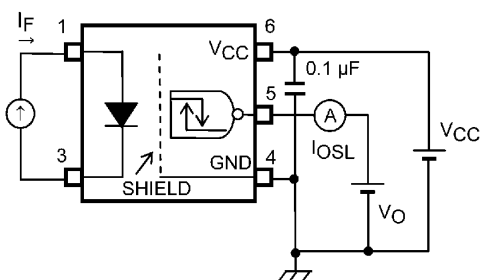


Fig. 12.1.5 IOSL Test Circuit

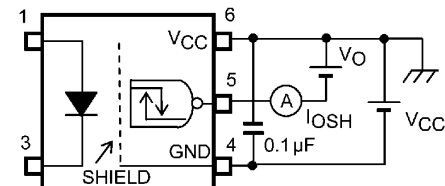


Fig. 12.1.6 IOSH Test Circuit

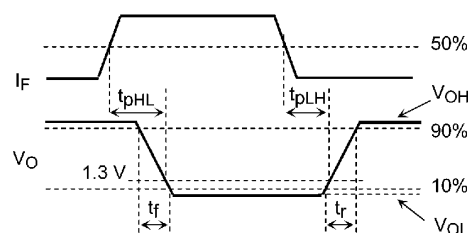
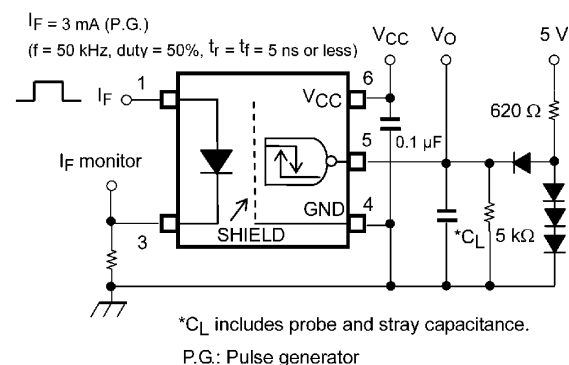


Fig. 12.1.7 Switching Time Test Circuit

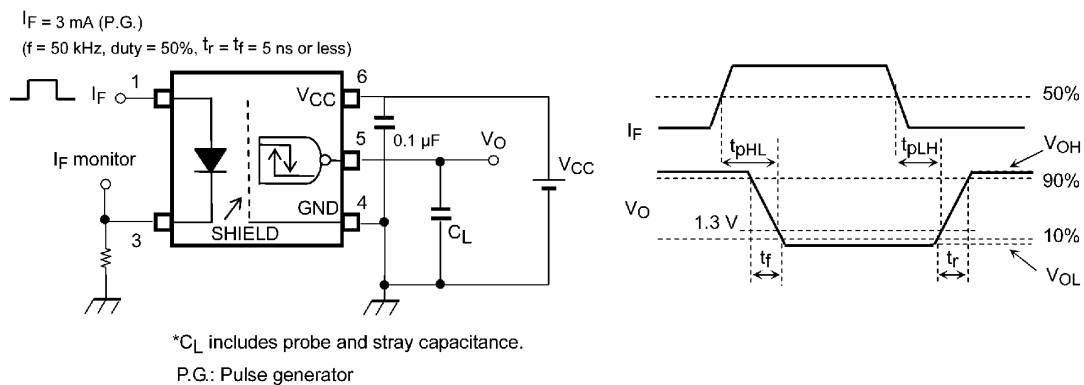


Fig. 12.1.8 Switching Time Test Circuit

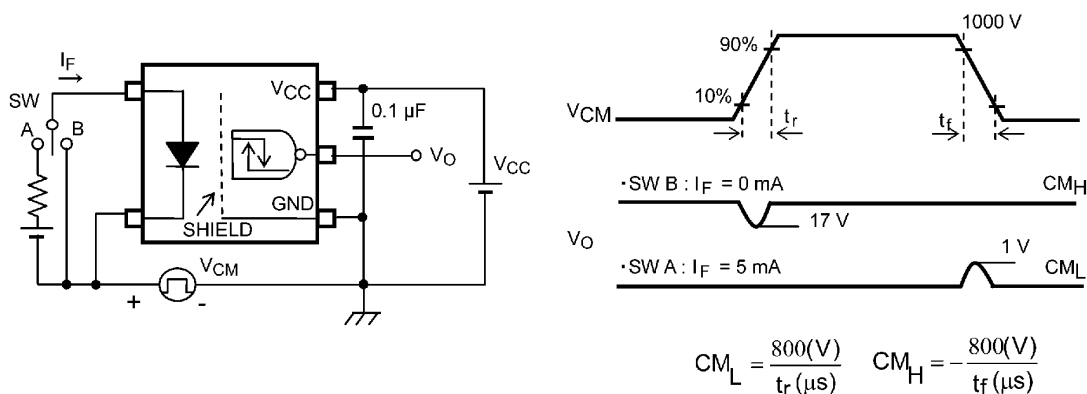


Fig. 12.1.9 Common-Mode Transient Immunity Test Circuit

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 (See Fig. 13.1.1 and 13.1.2)

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.

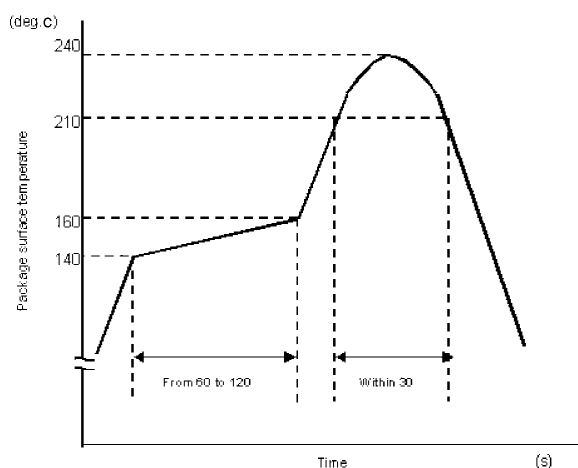


Fig. 13.1.1 An example of a temperature profile when Sn-Pb eutectic solder is used

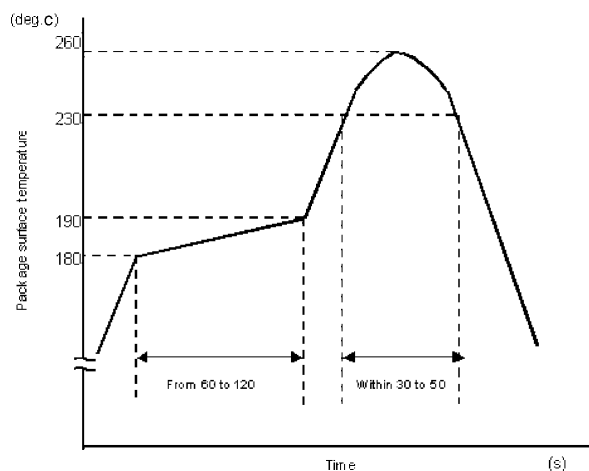


Fig. 13.1.2 An example of a temperature profile when lead(Pb)-free solder is used

- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
Apply preheating of 150°C 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 (Applicable to both eutectic solder and Lead(Pb)-Free solder)
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.
- 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.

14. Land Pattern Dimensions for Reference Only

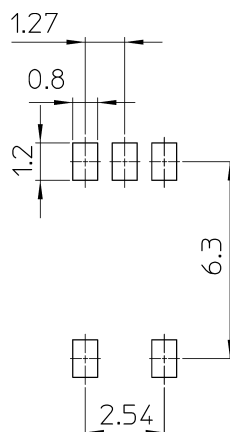


Fig. 14.1 Land Pattern Dimensions for Reference Only (Unit: mm)

15. Marking

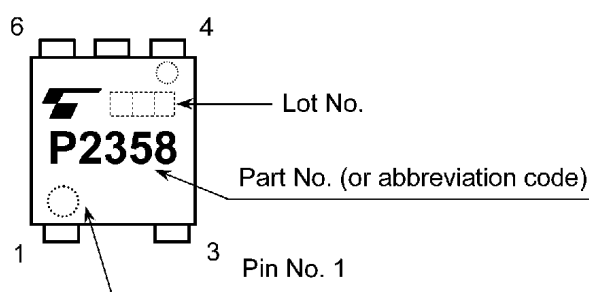
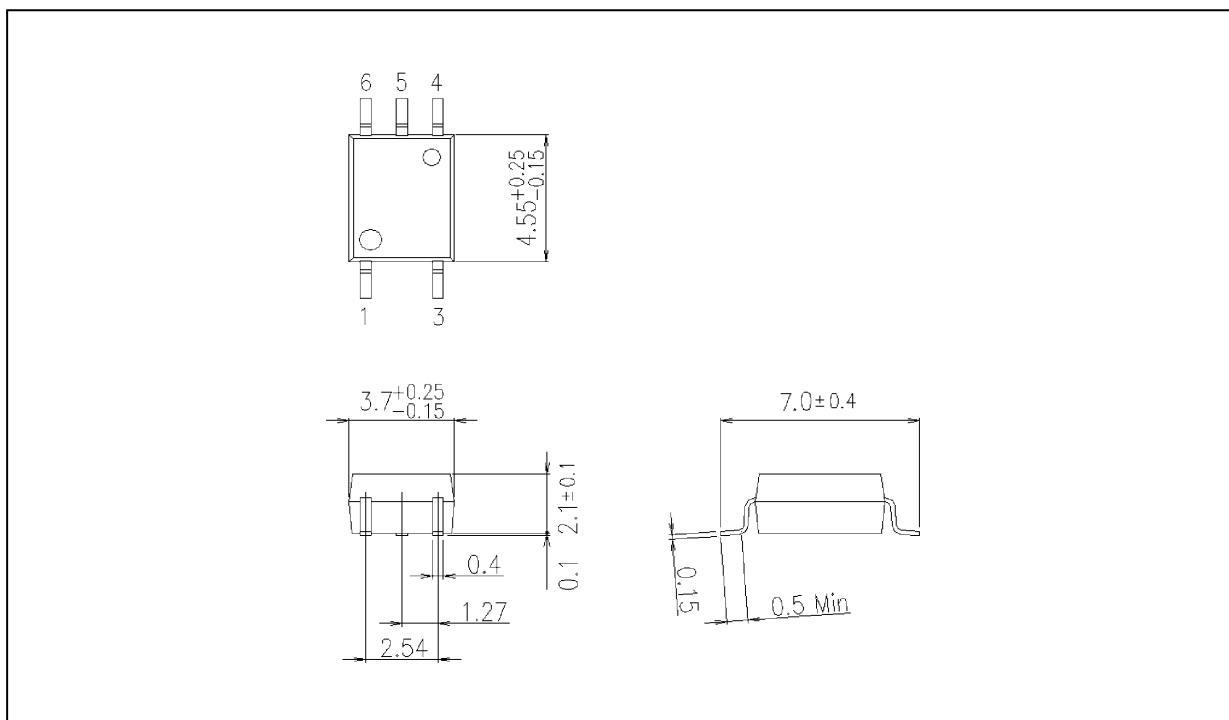


Fig. 15.1 Marking

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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