LED Lamps   InGaN and Phosphor

TL1L4-NT0,L

LETERAS™

LETERAS™ is a trademark of TOSHIBA CORPORATION.

1. Applications

· General Lighting

2. Features

(1)   Size: 3.5 (L) mm × 3.5 (W) mm × 2.05 (H) mm

(2)   High luminous flux LED: 160 lm (typ.) @I_F = 350 mA, T_a = 25 ℃

(3)   Hot Binning: Tested at operating temperature similar to actual set condition.

　　　　135 lm (typ.) @I_F = 350 mA, T_j = 85 ℃

(4) I_F Absolute Maximum Ratings: 1.5 A (max) @T_a = 25 ℃

(5)   Operating temperature range: T_{opr} = -40 to 125 ℃

(6)   Color: White (color temperature: 5700 K (typ.))

(7)   Color Rendering Index: Ra = 70 (min)

3. Packaging and Pin Assignment

4-4P1A

1: Anode
2: Cathode

Heatsink (ANODE)
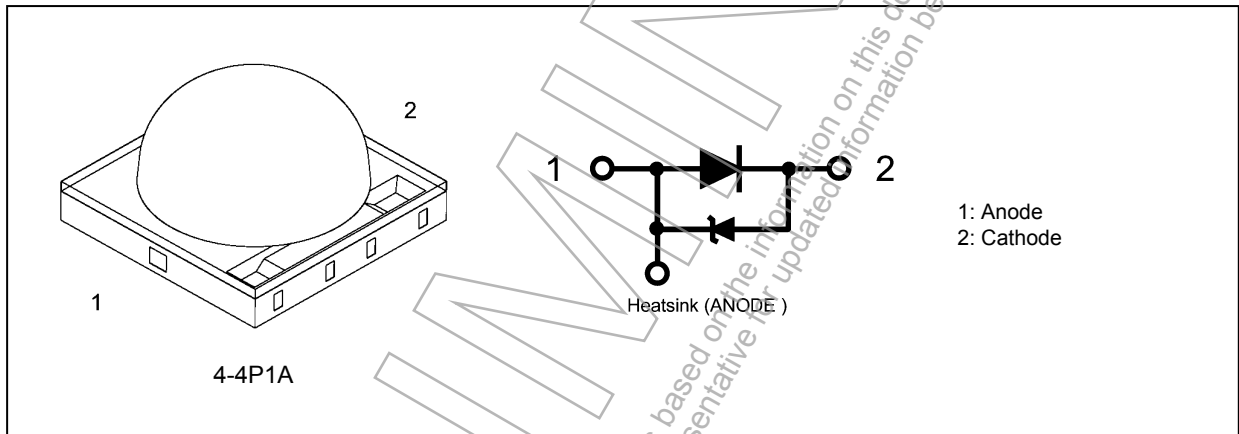
4. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 ℃)

Characteristics	Symbol	Note	Rating	Unit
Forward current (DC)	I_F		1500	mA
Forward current (pulsed)	I_{FP}	(Note 1)	2000	
Power dissipation	P_D		5.1	W
Operating temperature	T_{opr}		-40 to 125	℃
Storage temperature	T_{stg}		-40 to 125	
Junction temperature	T_j		150	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).
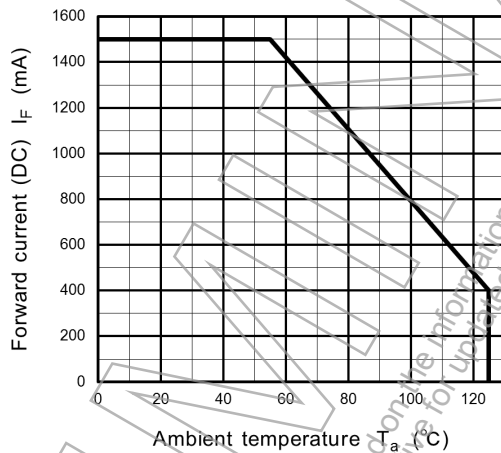
Note 1: Pulse width 10 ms, duty = 1/10

Fig. 4.1 I_F - T_a (Note)

Note: The junction-to-ambient thermal resistance, $R_{th(j-a)}$, should be kept below 20 ℃/W so that this product is not exposed to a condition beyond the absolute maximum ratings.

$R_{th(j-a)}$: Thermal resistance from the LED junction to ambient temperature

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5. Handling Precautions

- This product is sensitive to electrostatic and care must be fully taken when handling products. Particularly in the case that an overvoltage shall be applied, the overflowed energy may cause damage to or possibly result in destruction of the product. Users shall take absolutely secure countermeasures against electrostatic and surge when handling the product.

- A damage to the device might create a tiny leakage path, which causes the LED lamp not to light up in the low-current region or causes a drop in the V_F rise voltage.
  Failure criterion: $I_F \geq 0.5$ mA @ $V_F = 2$ V

- If multiple LEDs are connected in parallel, they will experience variations in the forward current due to the characteristics differences in forward voltage. Ensure that the forward current of all the LEDs fall within the intended range of the system design, for example, by inserting current-limiting resistors to each LED string.

- Since this product is intended to be used for display lighting, the measurement standard is based on the spectral sensitivity of the human eye. It is not intended to be used for any applications other than display lighting (e.g., sensors and light communications systems.)

- Generally, GaN-based LEDs exhibit instability or significant device-to-device variations in the relative luminous flux in the low-current region. To avoid these problems, an application system should be designed in such a manner that the GaN-based LEDs are driven with a forward current of 10 mA or higher.

- This device should not be reverse-biased.

- When the device is used in places that are likely to be exposed to condensation, salt or corrosive gas, the effect on its performance and reliability must be thoroughly verified. Gases produced from the materials of luminaires might affect the LED characteristics. To avoid any problem, appropriate materials should be selected and verified empirically that they do not have any adverse effect.

- Volatile organic compounds (VOCs) can be generated from adhesives, hardeners, packing, solder flux and etc. used in luminaires (fixtures). The LED encapsulant may be permeable to those chemicals. if VOCs are exposed to heat or light in hermetically sealed conditions, the inside or the surface of the LED package may be discolored over time, causing a loss of light output from the luminaires. When the LED is used in hermetically sealed conditions, it should be verified empirically that the LED will not be affected adversely by any VOCs.
  Also the LED may be subject to discoloration when it is even temporarily placed in an environment in which VOCs are absorbed into its encapsulant. So it is advisable to rinse the PC board before attaching it onto the luminaires.

- Please note the handling of products during evaluation.
  (1) Please do not apply pressure to the upper surface of the product with finger, tweezers, and others. Failure of product to light up may occur due to package deformation, wire deformation and/or disconnection.
  (2) Should tweezers be used in product handling, one with flat surfaces is recommended.
  (3) Please handle the product widthwise.
  (4) Please do not drop the product. There is a possibility for package transformation etc. to occur when the product is dropped.
  (5) Please do not stack the printed circuit boards on which the product is mounted to prevent damages to product surface. Also, please note not to damage the surface of the product with cushioning material etc. Surface damage to the product may influence their optical characteristics.
  (6) Solder, flux, paper or heat-sensitive materials that might be deformed or discolored at high temperatures should not be left on the surface of an LED lamp.

- Extreme care should be exercised when using this device for high-power applications:
  (1) Do not directly touch this device during active operation because it becomes hot, depending on the operating power.
  (2) Take a possible rise in ambient temperature around this device and the heat-resistant temperature of the system components into consideration.

6. Electrical Characteristics

Characteristics		Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Forward voltage (Hot Binning)	See Table 6.1.	V_F(HB)		I_F = 350 mA, T_j = 85 ℃	2.6	2.8	3.2	V
Thermal resistance (junction-to-soldering point)		$R_{th(j-s)}$	(Note 1)	I_F = 350 mA, T_a = 25 ℃	—	5	—	℃/W

Note 1: $R_{th(j-s)}$: Thermal resistance from the LED junction to solder point.

Table 6.1   Forward Voltage (Hot Binning) Rank (Note)

Rank	Test Condition	Forward Voltage (Min)	Forward Voltage (Max)	Unit
1	I_F = 350 mA, T_j = 85 ℃, Tolerance ±0.1 V	2.6	2.8	V
2		2.8	3.0	
3		3.0	3.2	

Note: This LED lamp is sorted into forward voltage (V_F) ranks shown above. Each reel includes the same rank LEDs. Let the delivery ratio of each rank be unquestioned.

7. Optical Characteristics

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Luminous flux	ϕ_V	(Note 1)	I_F = 350 mA , T_a = 25 ℃		160	—	lm
Luminous flux(Hot Binning)	ϕ_V(HB)	(Note 2)	I_F = 350 mA , T_j = 85 ℃	130	135	160	lm
Chromaticity(Hot Binning)	C_x(HB)		See Fig. 7.1, Table 7.1.				—
	C_y(HB)						—
Color temperature(Hot Binning)	CCT(HB)			—	5700	—	K
Color rendering index(Hot Binning)	Ra(HB)	(Note 3)		70	—	—	—
Half-intensity angle	$2\theta 1/2$		I_F = 350 mA , T_a = 25 ℃	—	120	—	°

Note 1: Luminous flux value (I_F = 350 mA , T_a = 25 ℃) is presented for reference only.
Note 2: See Table 7.2 for luminous flux rank.
Note 3: Tolerance: ±2
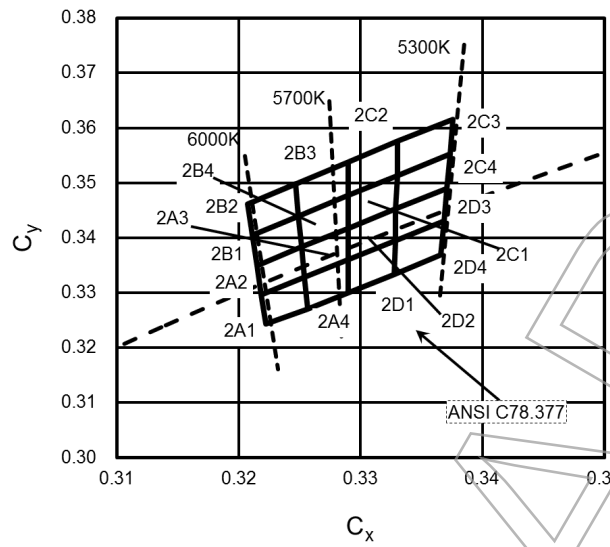
Fig. 7.1   Chromaticity (Hot Binning) Rank (Note)

Note: Test conditions: I_F = 350 mA, T_j = 85 ℃, Tolerance: ±0.01

Table 7.1 Chromaticity (Hot Binning) Rank (Note)

Rank	C_x	C_y	Rank	C_x	C_y
2A1	0.3222	0.3243	2C1	0.3290	0.3417
	0.3218	0.3297		0.3290	0.3477
	0.3254	0.3328		0.3330	0.3513
	0.3256	0.3271		0.3329	0.3453
2A2	0.3218	0.3297	2C2	0.3290	0.3477
	0.3215	0.3350		0.3290	0.3538
	0.3251	0.3384		0.3330	0.3576
	0.3254	0.3328		0.3330	0.3513
2A3	0.3254	0.3328	2C3	0.3330	0.3513
	0.3251	0.3384		0.3330	0.3576
	0.3290	0.3417		0.3376	0.3616
	0.3290	0.3360		0.3374	0.3553
2A4	0.3256	0.3271	2C4	0.3329	0.3453
	0.3254	0.3328		0.3330	0.3513
	0.3290	0.3360		0.3374	0.3553
	0.3290	0.3300		0.3371	0.3490
2B1	0.3215	0.3350	2D1	0.3290	0.3300
	0.3211	0.3405		0.3290	0.3360
	0.3249	0.3439		0.3329	0.3395
	0.3251	0.3384		0.3328	0.3334
2B2	0.3211	0.3405	2D2	0.3290	0.3360
	0.3207	0.3462		0.3290	0.3417
	0.3246	0.3498		0.3329	0.3453
	0.3249	0.3439		0.3329	0.3395
2B3	0.3249	0.3439	2D3	0.3329	0.3395
	0.3246	0.3498		0.3329	0.3453
	0.3290	0.3538		0.3371	0.3490
	0.3290	0.3477		0.3369	0.3430
2B4	0.3251	0.3384	2D4	0.3328	0.3334
	0.3249	0.3439		0.3329	0.3395
	0.3290	0.3477		0.3369	0.3430
	0.3290	0.3417		0.3366	0.3369

Note: This LED lamp is sorted into chromaticity coordinate groups shown above. Each reel includes the same rank LEDs. Let the delivery ratio of each rank be unquestioned.

Table 7.2   Luminous Flux (Hot Binning) Rank (Note)

Rank	Test Condition	Luminous Flux (Min)	Luminous Flux (Max)	Unit
B13A	I_F = 350 mA, T_j = 85 °C, Tolerance ±10 %	130	135	lm
B13B		135	140	
B14A		140	145	
B14B		145	150	
B15A		150	155	
B15B		155	160	

Note: This LED lamp is sorted into luminous flux ranks shown above. Each reel includes the same rank LEDs. Let the delivery ratio of each rank be unquestioned.

Rank notations: The luminous flux, chromaticity and V_F ranks are printed on labels as shown below:

    Example: 2A1 B13A 2
    2A1: Chromaticity rank
    B13A: Luminous flux rank
    2:    V_F rank

8. Characteristics Curves (Note)
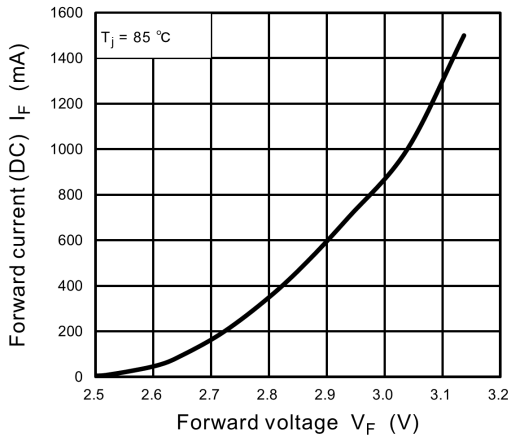
Fig. 8.1   I_F - V_F
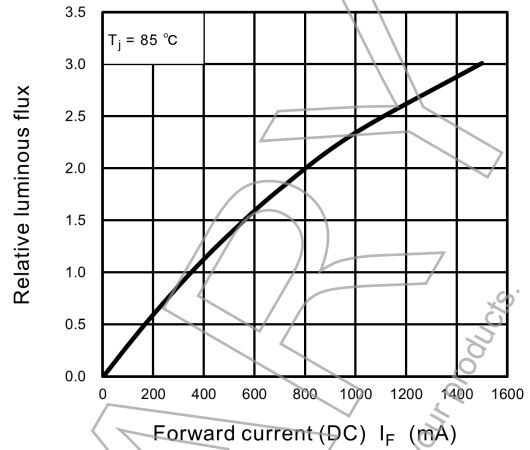
Fig. 8.2   Relative Luminous Flux - I_F
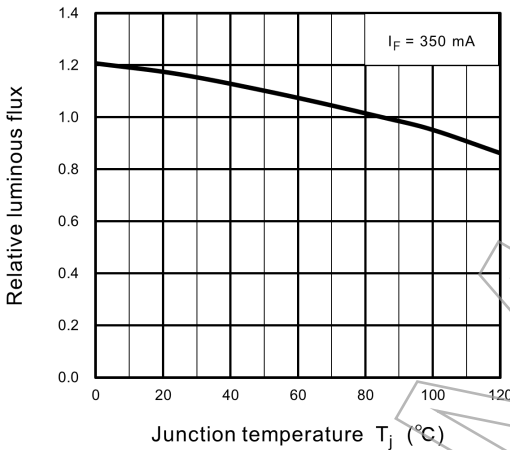
Fig. 8.3   Relative Luminous Flux - T_j
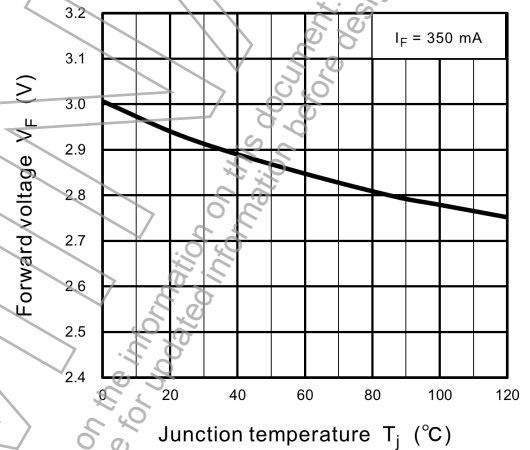
Fig. 8.4   V_F - T_j
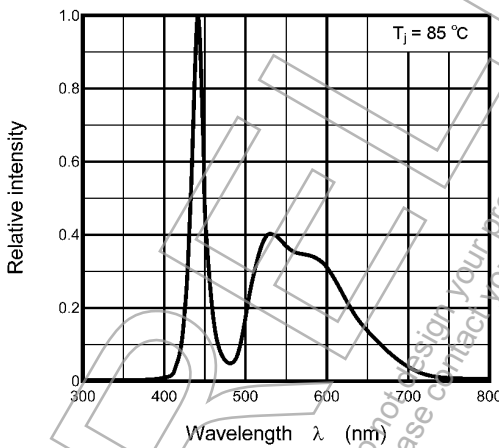
Fig. 8.5   Wavelength Characteristic
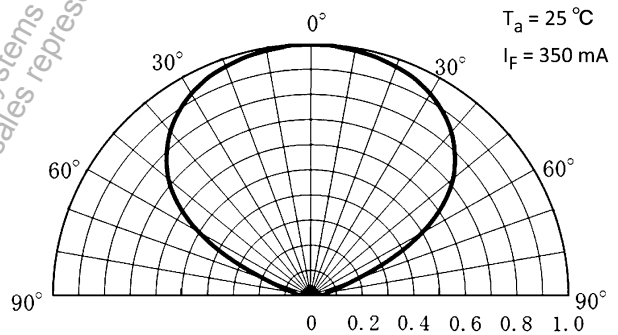
Fig. 8.6   Radiation Pattern

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

9. Packing

9.1. Moisture-Proof Packing

These LED devices are packed in an aluminum envelope with a silica gel and a moisture indicator to avoid moisture absorption. The optical characteristics of the device may be affected by exposure to moisture in the air before soldering and the device should therefore be stored under the following conditions:

- This moisture proof bag may be stored unopened within 12 months at the following conditions.
  Temperature: 5 ℃ to 30 ℃
  Humidity: 90 % (max)
- After opening the moisture proof bag, the device should be assembled within 4 weeks in an environment of 5 ℃ to 30 ℃/60 % RH or below.
- If upon opening, the moisture indicator card shows humidity 30 % or above (Color of indication changes to pink) or the expiration date has passed, the device should be baked in taping with reel.
  After baking, use the baked device within 72 hours, but perform baking only once.
  Baking conditions: 60 ± 5 ℃, for 12 to 24 hours.
  Expiration date: 12 months from sealing date, which is imprinted on the label affixed.
- Repeated baking can cause the peeling strength of the taping to change, then leads to trouble in mounting. Furthermore, prevent the devices from being destructed against static electricity for baking of it.
- If the packing material of laminate would be broken, the hermeticity would deteriorate. Therefore, do not throw or drop the packed devices.

10. Mounting

10.1. Mounting Precautions

- Do not apply mechanical stress to the resin body at high temperature.
  The time taken for a device to return to the room temperature after reflow soldering depends on the mounting board and environmental conditions.
- The resin body is easily scratched. Avoid friction against hard materials.
- When installing an assembled board into equipment, ensure that the devices on the board do not contact with other components.

10.2. Soldering

Following show examples of reflow soldering.

- Temperature Profile (see following figures.)
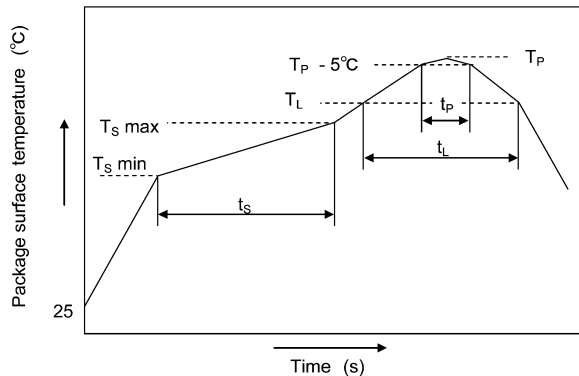
	Symbol	Min	Max	Unit
Ramp-up rate (25 to 150℃)		1	3	℃/s
Preheat temperature	T_S	150	200	℃
Preheat time	t_S	60	120	s
Ramp-up rate (T_L to T_P)		1	3	℃/s
Liquidous temperature	T_L	217		℃
Time above T_L	t_L	60	100	s
Peek temperature	T_P		260	℃
Time within 5℃ of actual peek temperature	t_P		30	s
Ramp-down rate (T_P to T_L)			6	℃/s

Fig. 10.2.1   Temperature Profile for Lead(Pb)-free Soldering (example)

Table 10.2.1   Temperature Profile for Lead(Pb)-free Soldering (example)

- The product is evaluated using above reflow soldering conditions. No additional test is performed exceed the condition as a evaluation. Please perform reflow soldering under the above conditions.
- Please perform the first reflow soldering with reference to the above temperature profile and within 4 weeks of opening the package.
- If a second reflow process is necessary, reflow soldering should be performed within 168 h of the first reflow under the above conditions. Storage conditions before the second reflow soldering: 30 ℃, 60 % RH (max)
- Do not perform wave soldering.
- When any soldering corrections are made manually, a hot-plate should be used. (only once at each soldering point)

10.3. Land Pattern Dimensions (for reference only)

Heatsink pin of this product is the same electric potential as anode electrode. Please do not connect to other electrical potentials or GND.

(Unit: mm)
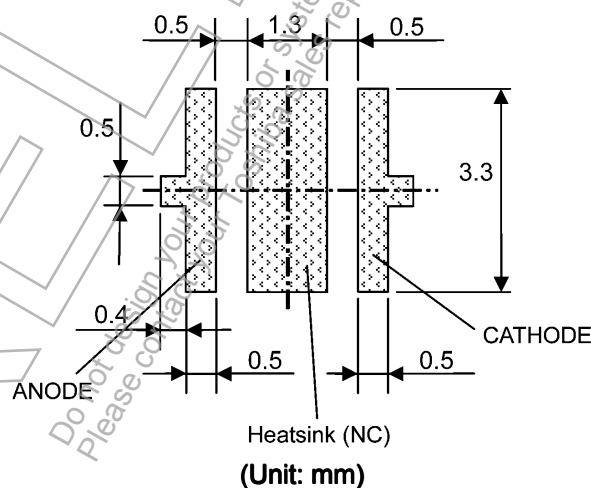
11. Cleaning

· Flux cleaning should be completed free of residual reactive ion such as Na, Cl, etc. Organic solvent acts upon water and generates corrosive gas such as hydrogen chloride. There are some cases where the device is degraded.

· Effective solvent seriously affects package and resin, and may cause inferior device. In actually using it, please sufficiently check whether there is nothing inferior on the device.

· Ultrasonic cleaning that provides effective cleaning for short time much affects on the device. so coherence between resin and lead metal is degraded by cleaning solvent during long ultrasonic cleaning. We recommend to take ultrasonic cleaning for the device at a minimum range. The influences on a device is occurred by the output of an ultrasonic wave and set board, please sufficiently check whether there is nothing inferior on the device.

12. Tape Specifications

12.1. Product Naming Conventions

The type of package used for shipment is denoted by a symbol suffix after the part number. The method of classification is as below. (this method, however does not apply to products whose electrical characteristics differ from standard Toshiba specifications)

Example: TL1L4-NT0,L
  Toshiba part number: TL1L4-NT0
  Packing type: L (Taping)

12.2. Handling Precautions

(1) The tape is antistatic-coated. However, if the tape is charged with excess static electricity, devices might cling to the tape or waggle in the tape when the cover tape peeled off. Be aware of the following to avoid this:

· Use an ionizer to neutralize the ions when utilizing an automatic mounter.
· For transport and temporary storage of devices, use containers (boxes, jigs, bags) that are made with antistatic materials or materials that dissipate static electricity.

12.3. Tape Dimensions

Table 12.3.1 Tape Dimensions (Unit: mm)

	D	E	P_0	t	F	D_1	P_2	W	P	A_0	B_0	K_0
Dimensions	1.5	1.75	4.0	0.3	5.5	1.7	2.0	12.0	8.0	3.8	3.8	2.15
Tolerance	+0.1/-0	±0.1	±0.1	±0.05	±0.05	±0.1	±0.05	±0.2	±0.1	±0.1	±0.1	±0.1
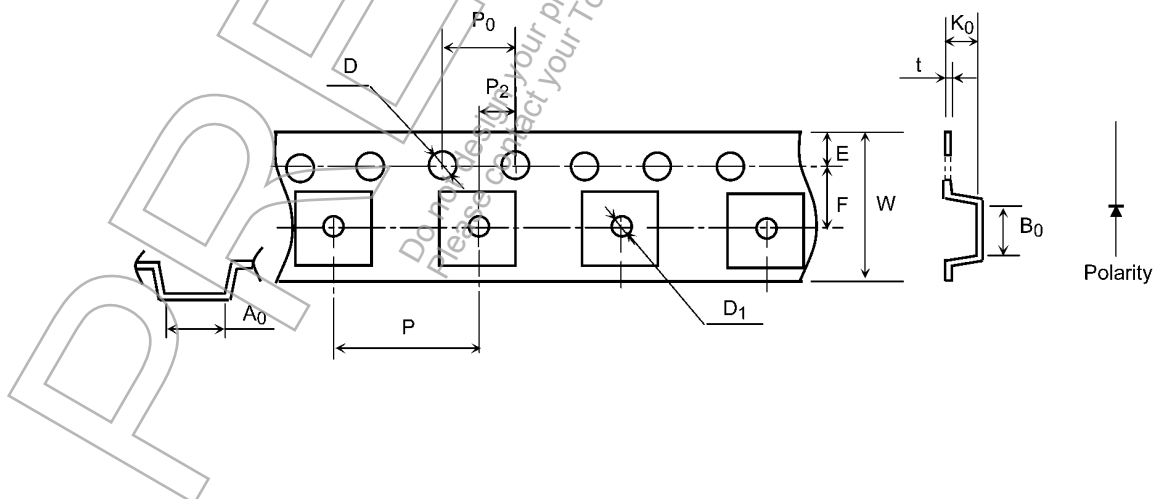
12.4. Reel Specification

12.4.1. Reel Dimensions

Unit: mm

- $\phi 180$
- $\phi 60$
- $\phi 13$
- 13 ± 0.3
- 15.4 ± 1.0
- 2 ± 0.5
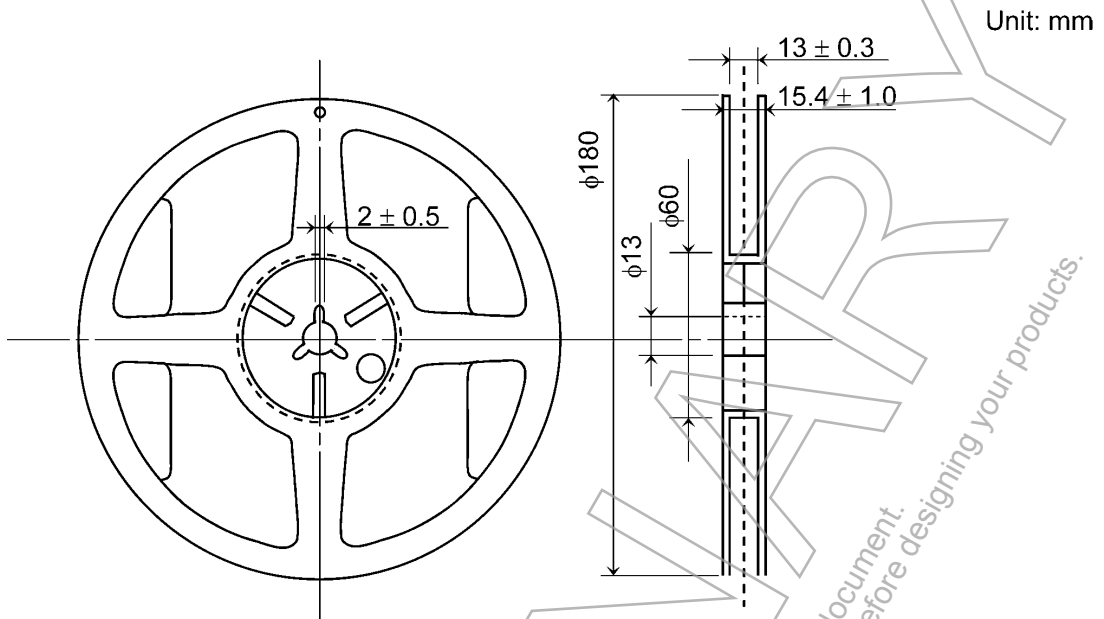
12.4.2. Tape Leader and Trailer

- 160 mm or more
- 100 mm or more
- Leading part: 400 mm (min)
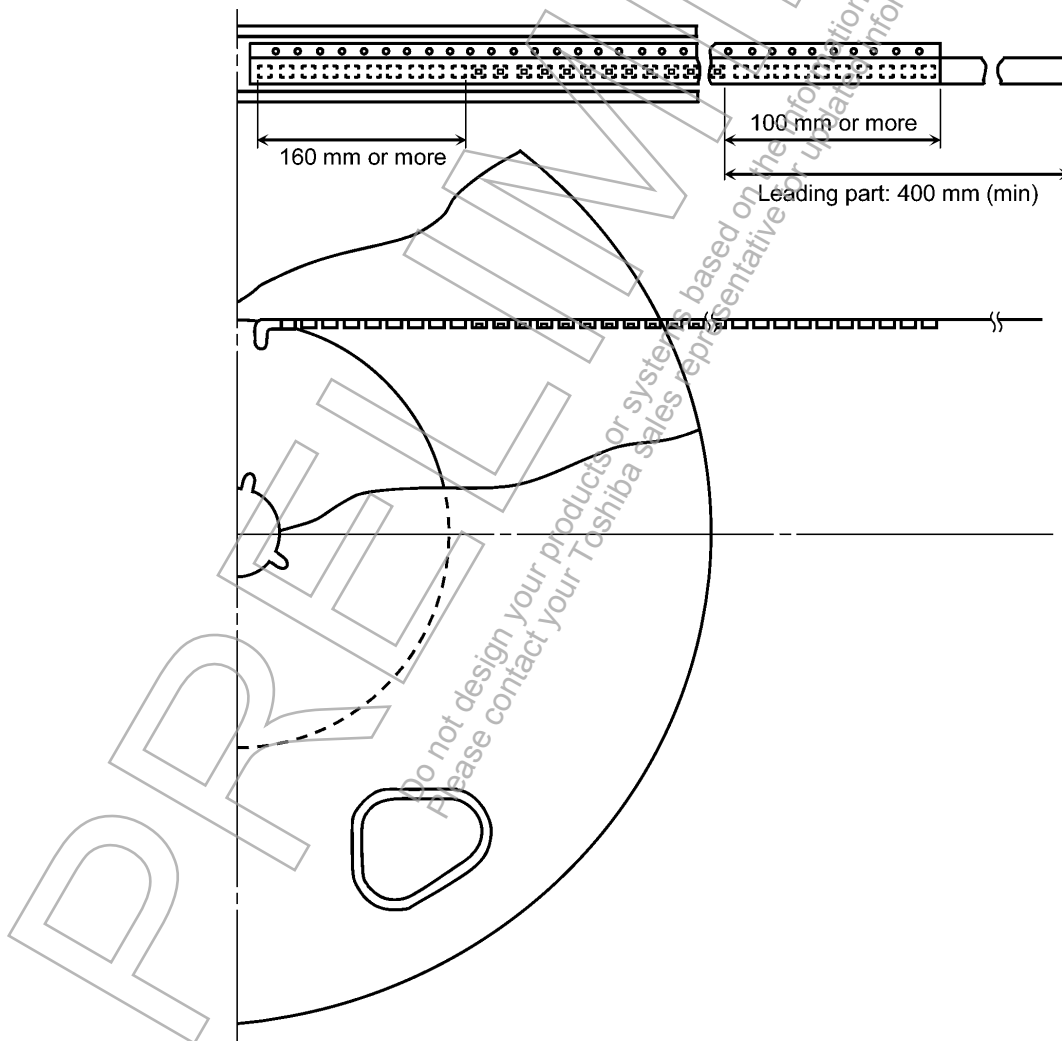
12.5. Packing Form

Each reel is sealed in an aluminum pack with silica gel. Packing quantity is as shown below.

- Reel: 1,000 pcs
- Carton: 4,000 pcs (max)
- Sealed aluminum pack with silica gel

12.6. Label Format

Label example for TL1L4-NT0,L and label location are as shown below.

12.6.1. Label Example
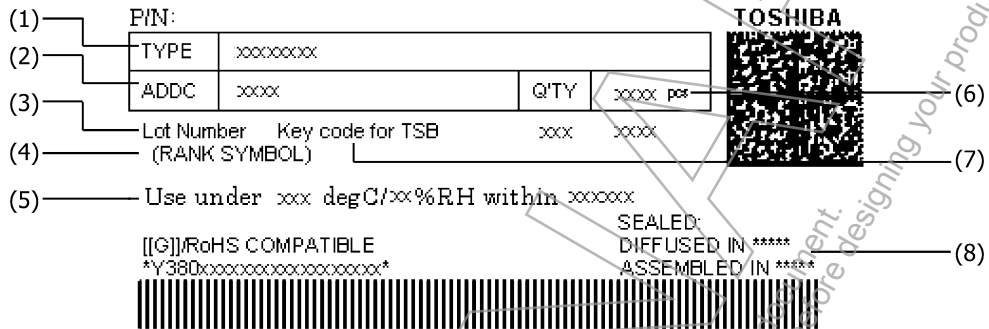
12.6.2. Label Details

No. (# refer to the above label example)	Information for Toshiba Use	Remarks
(1)	Part No.	TL1L4-NT0,L
(2)	ADD code (Note)	Example: (O
(3)	Lot code	Example: 270xxxxx
(4)	Rank symbol	Example: 2A1B13A2
(5)	Storage condition after opening	Use under 5 - 30 ℃/60 %RH within 4 weeks
(6)	Packing quantity	Example: 1,000 pcs
(7)	Key code	Example: 12345
(8)	Country of origin	Example: JAPAN

Note: ADD code Naming Conventions
(O : Assembled in Japan, Sales for domestic and overseas customers
(J : Assembled in overseas factory, Sales for domestic customers
(T : Assembled in overseas factory, Sales for overseas customers

12.6.3. Label Location
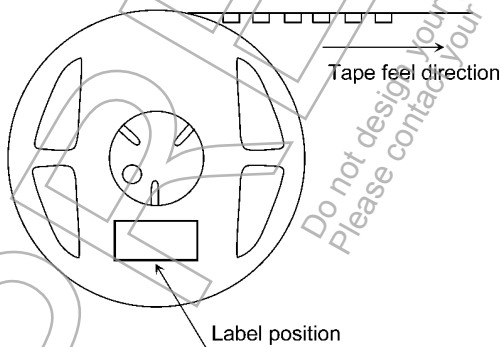
Fig. 12.6.3.1   Label Position on the Reel
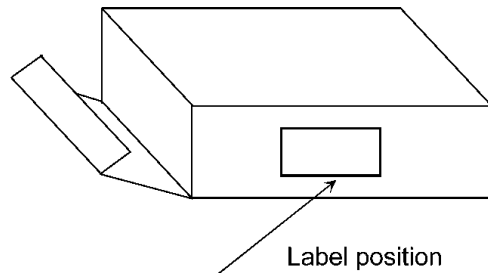
Fig. 12.6.3.2   Label Position on the Carton

Aluminum pack : The aluminum pack in which the reel is supplied also has the label attached to center of one side.

13. Internal Circuit

1: Anode
2: Cathode

Heatsink (ANODE)
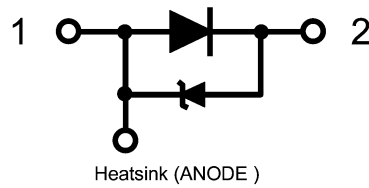
Package Dimensions

Unit: mm

3.50±0.1

3.50±0.1

0.60±0.1

2.05±0.1

3.20±0.1

2.30±0.1

3.20±0.1

1.30±0.1

1   2

BOTTOM VIEW
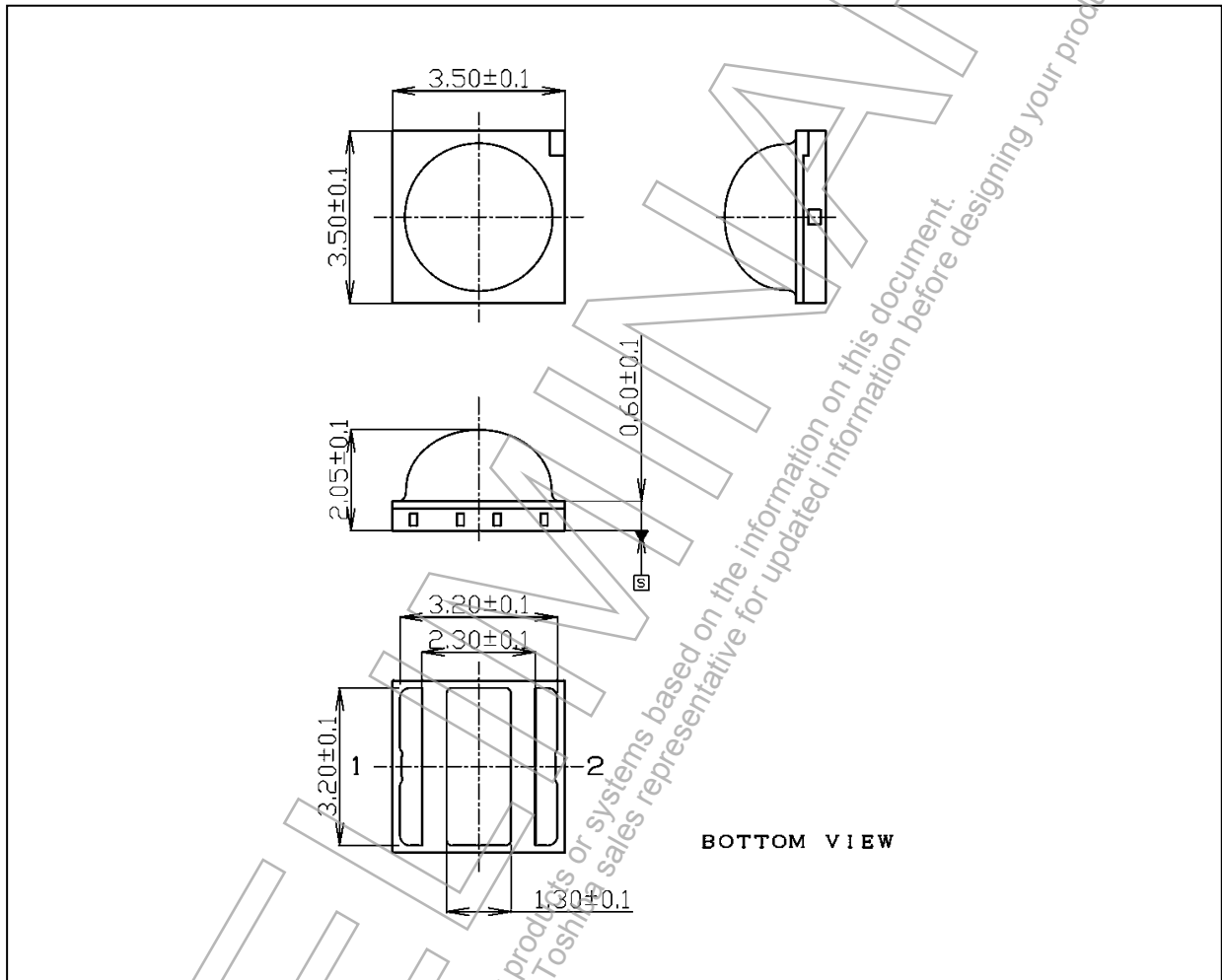
Weight: 0.04 g (typ.)

Package Name(s)
TOSHIBA: 4-4P1A

RESTRICTIONS ON PRODUCT USE