TOSHIBA PHOTOCOUPLER GaAs IRED & PHOTO-TRANSISTOR

# TLP291

## Power Supplies
## Programmable Controllers
## Hybrid ICs

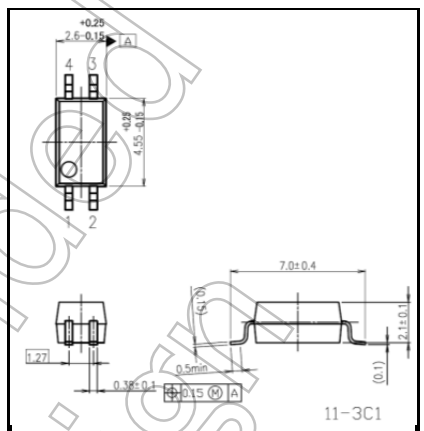
TLP291 consists of photo transistor, optically coupled to a gallium arsenide infrared emitting diode. TLP291 is housed in the SO4 package, very small and thin coupler.
Since TLP291 is guaranteed wide operating temperature (Ta=-55 to 110 ˚C) and high isolation voltage (3750Vrms), it's suitable for high-density surface mounting applications such as small switching power supplies and programmable controllers.

- Collector-Emitter Voltage : 80 V (min)
- Current Transfer Ratio : 50% (min)
  Rank GB : 100% (min)
- Isolation Voltage : 3750 Vrms (min)
- Operation temperature : -55 to 110 ˚C
- UL recognized : UL1577, File No. E67349
- cUL approved : CSA Component Acceptance Service No.5A, File No. 67349
- SEMKO approved: EN 60065: 2002, Approved no. 1200315
  EN 60950-1: 2001, EN 60335-1: 2002, Approved no. 1200315
- BSI approved : BS EN 60065: 2002, Approved no. 9036
  : BS EN 60950-1: 2006, Approved no. 9037
- Option (V4)
  VDE approved: EN 60747-5-5 Certificate, No. 40009347
  Maximum operating insulation voltage: 707 Vpk
  Highest permissible over-voltage: 6000 Vpk
  **(Note) When EN 60747-5-5 approved type is needed, please designate the "Option(V4)"**

Construction Mechanical Rating

| | |
|---|---|
| Creepage distance: | 5.0 mm (min) |
| Clearance: | 5.0 mm (min) |
| Insulation thickness: | 0.4 mm (min) |

Unit: mm

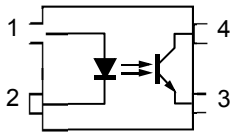



| TOSHIBA | 11-3C1 |
|---|---|

Weight: 0.05 g (typ.)

## Pin Configuration

TLP291




1:ANODE
2:CATHODE
3:EMITTER
4:COLLECTOR

Not Recommended for New Design

Start of commercial production
2012/02

## Current Transfer Ratio (CTR) Rank ( Unless otherwise specified, Ta = 25°C)

| TYPE | Classification (Note1) | Current Transfer Ratio (%) ($I_C$ / $I_F$) $I_F$ = 5 mA, $V_{CE}$ = 5 V, Ta = 25°C | | Marking of Classification |
|---|---|---|---|---|
| | | Min | Max | |
| TLP291 | Blank | 50 | 400 | Blank, YE, Y+, GR, GB, G, G+,B |
| | Rank Y | 50 | 150 | YE |
| | Rank GR | 100 | 300 | GR |
| | Rank GB | 100 | 400 | GB |
| | Rank YH | 75 | 150 | Y+ |
| | Rank GRL | 100 | 200 | G |
| | Rank GRH | 150 | 300 | G+ |
| | Rank BLL | 200 | 400 | B |

Note1: Specify both the part number and a rank in this format when ordering

(e.g.) rank GB: TLP291 (GB,E

For safety standard certification, however, specify the part number alone.

(e.g.)TLP291 (GB,E: TLP291

Not Recommended for New Design

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

| | CHARACTERISTIC | SYMBOL | NOTE | RATING | UNIT |
|---|---|---|---|---|---|
| LED | Input forward current | $I_F$ | | 50 | mA |
| | Input forward current derating (Ta≥90°C) | $\Delta I_F / \Delta Ta$ | | -1.5 | mA /°C |
| | Input forward current (pulsed ) | $I_{FP}$ | (Note 2) | 1 | A |
| | Input reverse voltage | $V_R$ | | 5 | V |
| | Input power dissipation | $P_D$ | | 100 | mW |
| | Input power dissipation derating (Ta ≥ 90°C) | $\Delta P_D / \Delta Ta$ | | -3.0 | mW/°C |
| | Junction temperature | $T_j$ | | 125 | °C |
| DETECTOR | Collector-emitter voltage | $V_{CEO}$ | | 80 | V |
| | Emitter-collector voltage | $V_{ECO}$ | | 7 | V |
| | Collector current | $I_C$ | | 50 | mA |
| | Collector power dissipation | $P_C$ | | 150 | mW |
| | Collector power dissipation derating(Ta≥25°C) | $\Delta P_C / \Delta Ta$ | | -1.5 | mW /°C |
| | Junction temperature | $T_j$ | | 125 | °C |
| Operating temperature range | | $T_{opr}$ | | -55 to 110 | °C |
| Storage temperature range | | $T_{stg}$ | | -55 to 125 | °C |
| Lead soldering temperature | | $T_{sol}$ | | 260 (10s) | °C |
| Total package power dissipation | | $P_T$ | | 200 | mW |
| Total package power dissipation derating(Ta≥25°C) | | $\Delta P_T / \Delta Ta$ | | -2.0 | mW /°C |
| Isolation voltage | | $BV_S$ | (Note3) | 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).

Note2: Pulse width ≤ 100μs, frequency 100Hz

Note3: AC, 1 minute, R.H.≤60%, Device considered a two terminal device: LED side pins shorted together and DETECTOR side pins shorted together.

## Electrical Characteristics (Unless otherwise specified, Ta = 25°C)

| | CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| LED | Input forward voltage | $V_F$ | $I_F$ = 10 mA | 1.1 | 1.25 | 1.4 | V |
| | Input reverse current | $I_R$ | $V_R$ = 5 V | - | - | 5 | μA |
| | Input capacitance | $C_T$ | V = 0 V, f = 1 MHz | - | 30 | - | pF |
| DETECTOR | Collector-emitter breakdown voltage | $V_{(BR)\ CEO}$ | $I_C$ = 0.5 mA | 80 | - | - | V |
| | Emitter-collector breakdown voltage | $V_{(BR)\ ECO}$ | $I_E$ = 0.1 mA | 7 | - | - | V |
| | Dark current | $I_{CEO}$ | $V_{CE}$ = 48 V | - | 0.01 | 0.08 | μA |
| | | | $V_{CE}$ = 48 V, Ta = 85°C | - | 2 | 50 | μA |
| | Collector-emitter capacitance | $C_{CE}$ | V = 0 V, f = 1 MHz | - | 10 | - | pF |

Not Recommended for New Design

## Coupled Electrical Characteristics (Unless otherwise specified, Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| Current transfer ratio | $I_C$ / $I_F$ | $I_F$ = 5 mA, $V_{CE}$ = 5 V | 50 | - | 400 | % |
| | | Rank GB | 100 | - | 400 | |
| Saturated current transfer ratio | $I_C$ / $I_{F\ (sat)}$ | $I_F$ = 1 mA, $V_{CE}$ = 0.4 V | - | 60 | - | % |
| | | Rank GB | 30 | - | - | |
| Collector-emitter saturation voltage | $V_{CE\ (sat)}$ | $I_C$ = 2.4 mA, $I_F$ = 8 mA | - | - | 0.3 | V |
| | | $I_C$ = 0.2 mA, $I_F$ = 1 mA | - | 0.2 | - | |
| | | Rank GB | - | - | 0.3 | |
| OFF-state collector current | $I_{C\ (off)}$ | $V_F$ = 0.7 V, $V_{CE}$ = 48 V | - | - | 10 | μA |

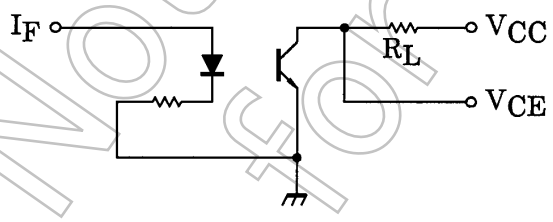
## Isolation Characteristics (Unless otherwise specified, Ta = 25°C)

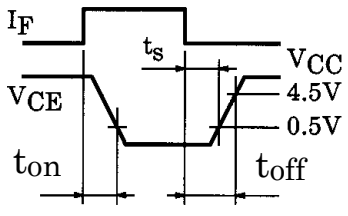
| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| Total capacitance (input to output) | $C_S$ | $V_S$ = 0 V, f = 1 MHz | - | 0.8 | - | pF |
| Isolation resistance | $R_S$ | $V_S$ = 500 V, R.H.≤60% | $1\times10^{12}$ | $10^{14}$ | - | Ω |
| Isolation voltage | $BV_S$ | AC , 1 minute | 3750 | - | - | Vrms |
| | | AC , 1 second, in OIL | - | 10000 | - | |
| | | DC , 1 minute, in OIL | - | 10000 | - | Vdc |

## Switching Characteristics (Unless otherwise specified, Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| Rise time | $t_r$ | $V_{CC}$ = 10 V, $I_C$ = 2 mA<br>$R_L$ = 100Ω | - | 4 | - | μs |
| Fall time | $t_f$ | | - | 7 | - | |
| Turn-on time | $t_{on}$ | | - | 7 | - | |
| Turn-off time | $t_{off}$ | | - | 7 | - | |
| Turn-on time | $t_{on}$ | $R_L$ = 1.9 kΩ (Fig.1)<br>$V_{CC}$ = 5 V, $I_F$ = 16 mA | - | 2 | - | μs |
| Storage time | $t_s$ | | - | 30 | - | |
| Turn-off time | $t_{off}$ | | - | 60 | - | |

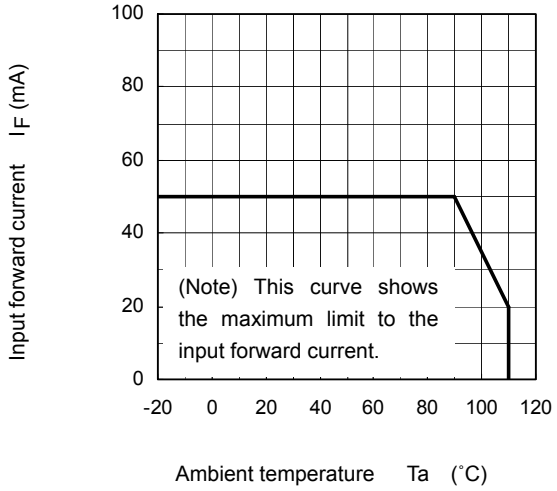
(Fig.1) Switching Time Test Circuit



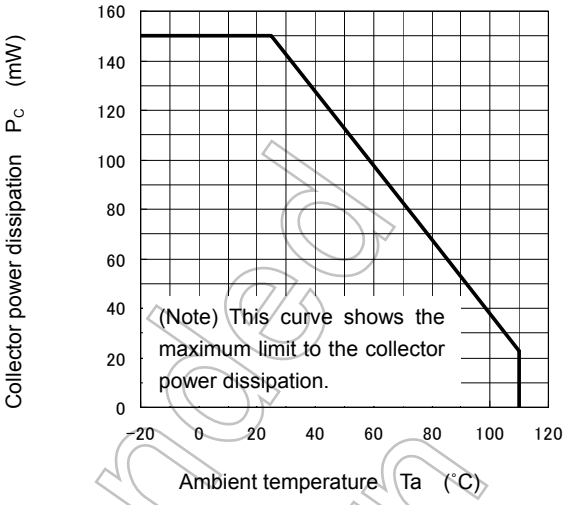




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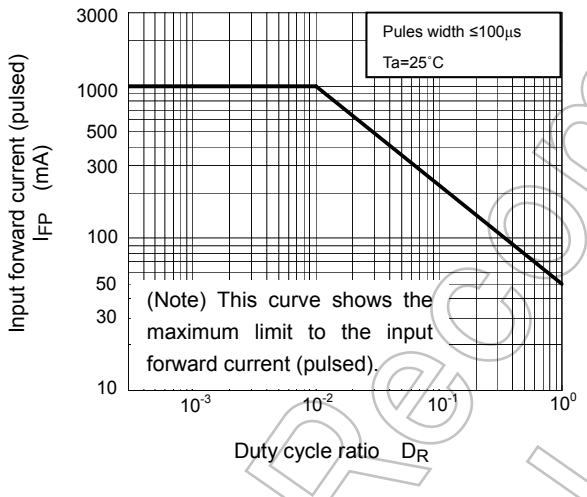
$I_F$ - Ta



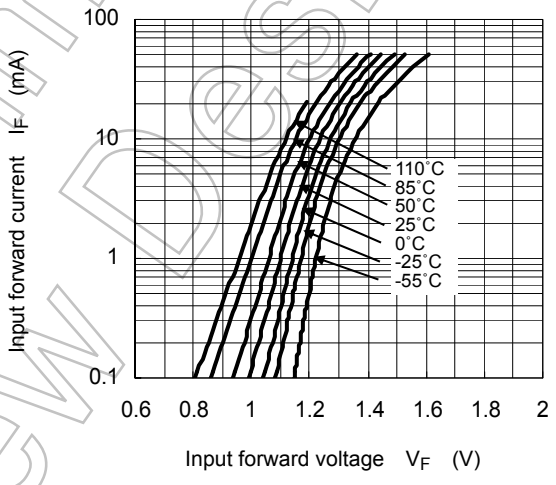

$P_C$ - Ta



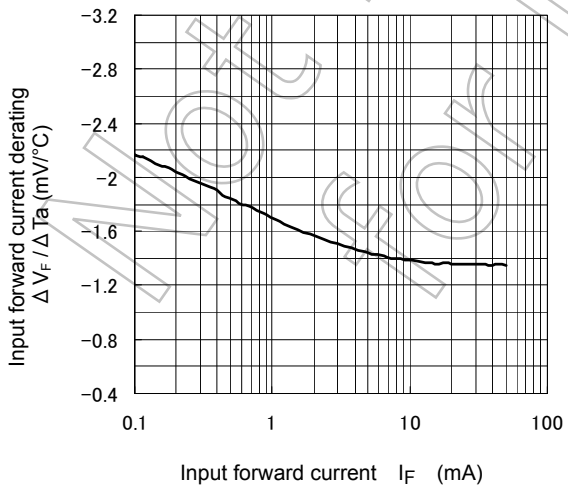

$I_{FP}$ - $D_R$



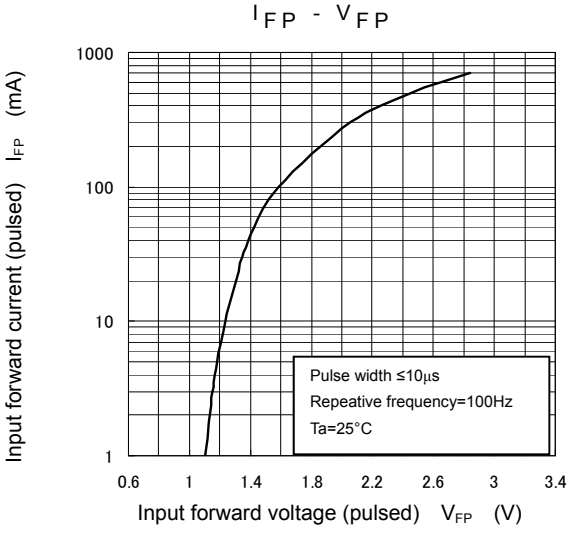

$I_F$ - $V_F$




$\Delta V_F / \Delta Ta$ - $I_F$



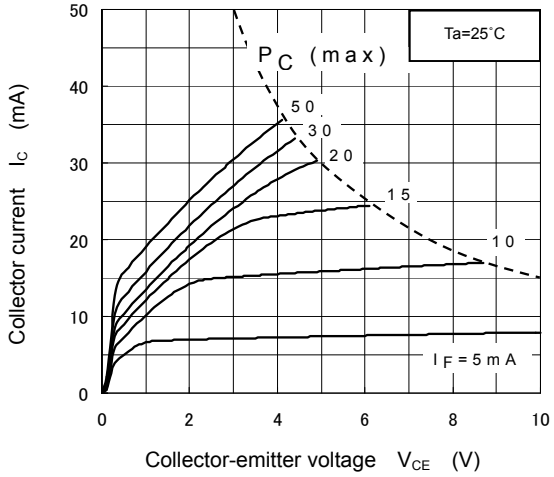

$I_{FP}$ - $V_{FP}$



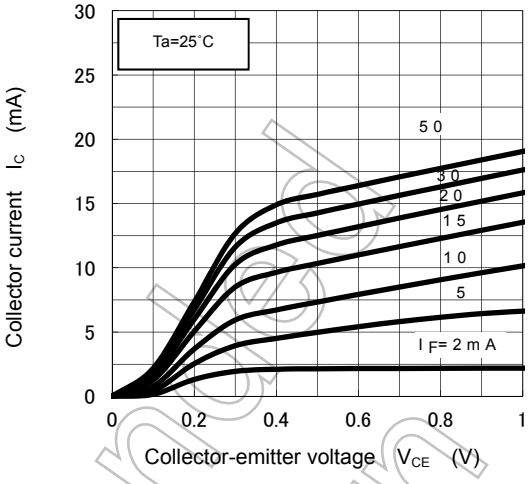

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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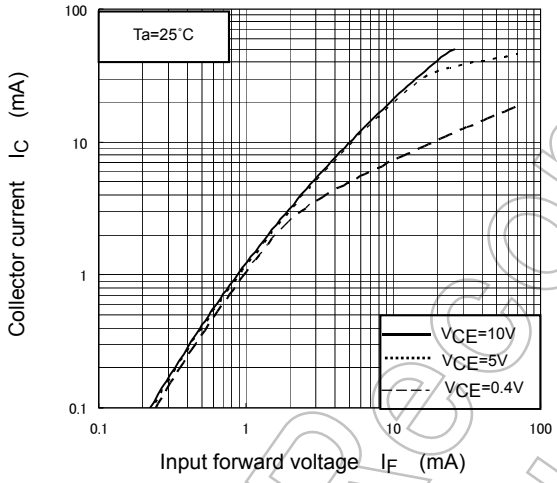
$I_C$ - $V_{CE}$



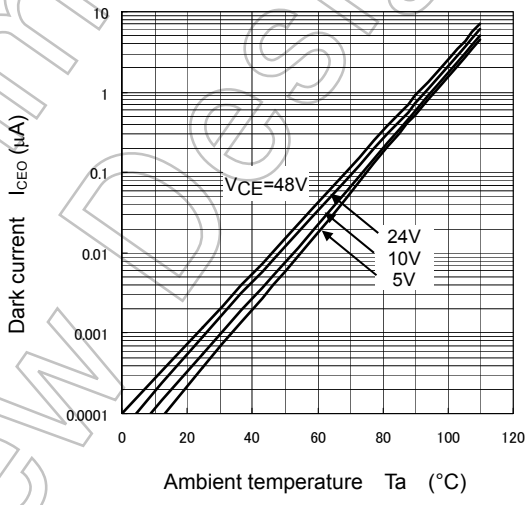

$I_C$ - $V_{CE}$



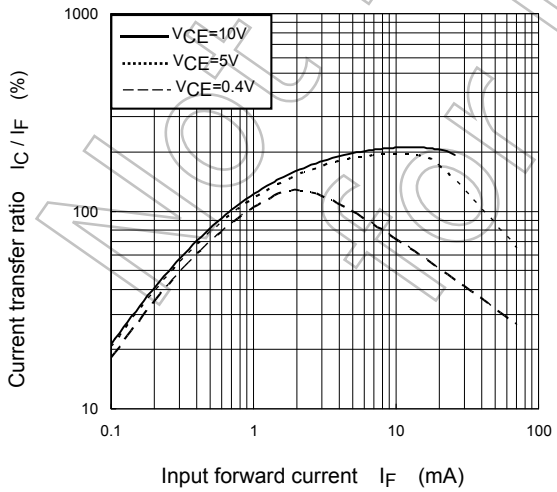

$I_C$ - $I_F$




$I_{CEO}$ - Ta



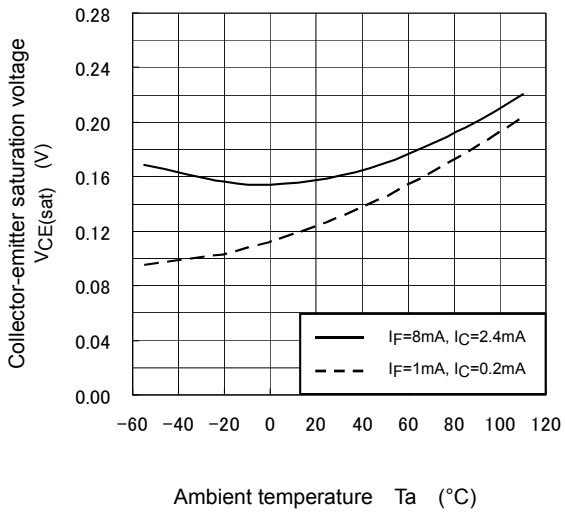

$I_C / I_F$ - $I_F$



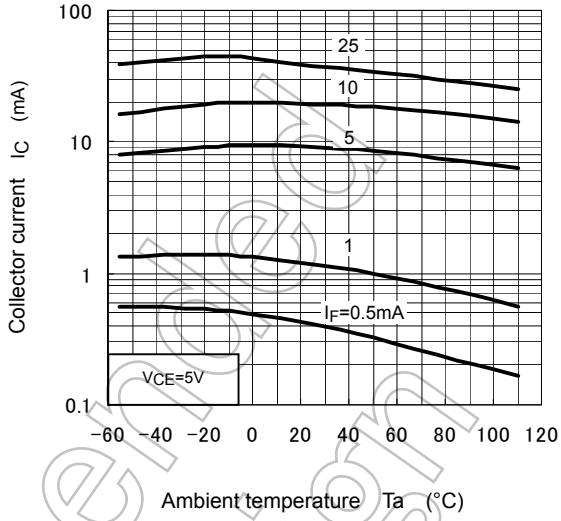

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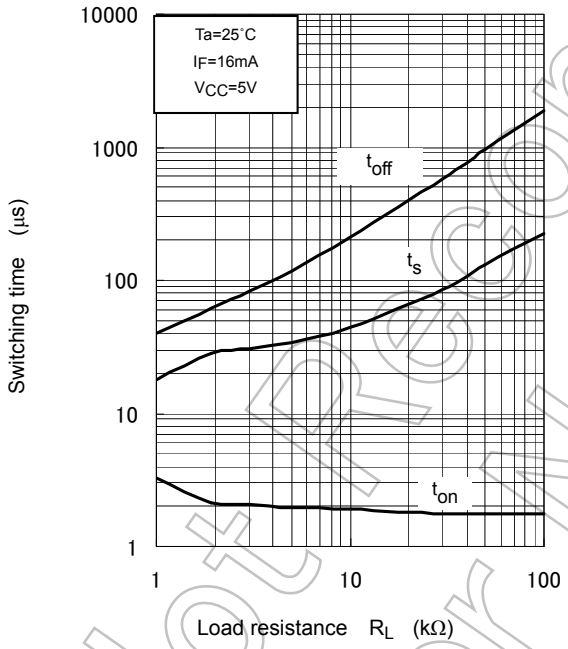
$V_{CE(sat)}$ - Ta



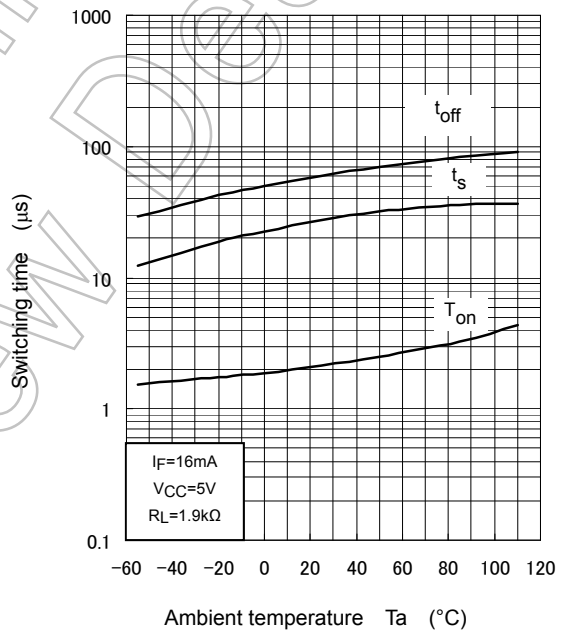

$I_C$ - Ta




Switching time - $R_L$




Switching time - Ta




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# Soldering and Storage

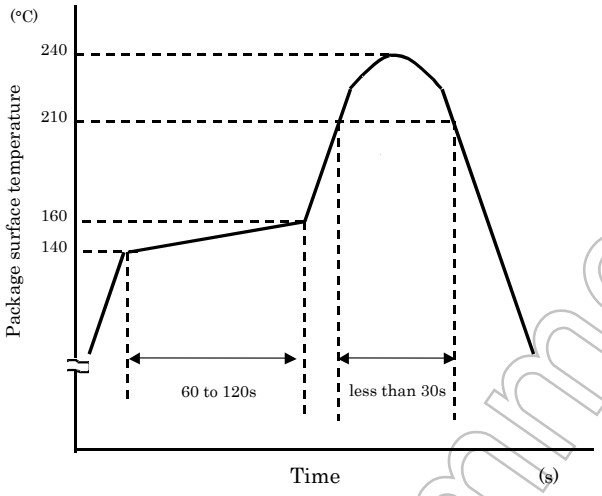
## 1. Soldering

1.1 Soldering

When using a soldering iron or medium infrared ray/hot air reflow, avoid a rise in device temperature as much as possible by observing the following conditions.

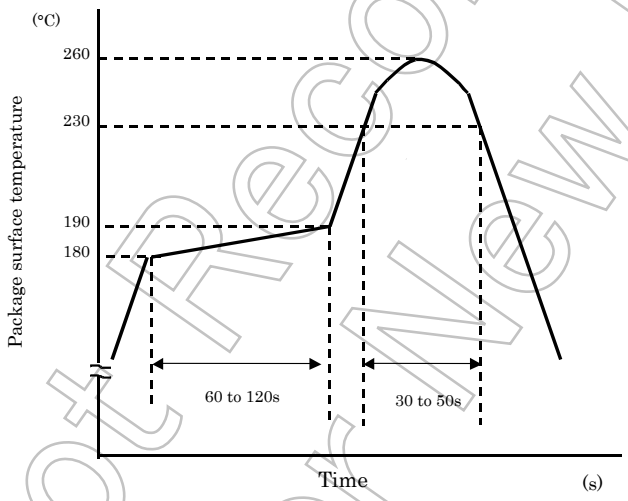
1) Using solder reflow

·Temperature profile example of lead (Pb) solder




This profile is based on the device's maximum heat resistance guaranteed value.
Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

·Temperature profile example of using lead (Pb)-free solder




This profile is based on the device's maximum heat resistance guaranteed value.
Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

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.

2) Using solder flow (for lead (Pb) solder, or lead (Pb)-free solder)

· Please preheat it at 150°C between 60 and 120 seconds.

· Complete soldering within 10 seconds below 260°C. Each pin may be heated at most once.

3) Using a soldering iron

Complete soldering within 10 seconds below 260°C, or within 3 seconds at 350°C. Each pin may be heated at most once.

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**2. Storage**

1) Avoid storage locations where devices may be exposed to moisture or direct sunlight.
2) Follow the precautions printed on the packing label of the device for transportation and storage.
3) Keep the storage location temperature and humidity within a range of 5°C to 35°C and 45% to 75%, respectively.
4) Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
5) 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.
6) When restoring devices after removal from their packing, use anti-static containers.
7) Do not allow loads to be applied directly to devices while they are in storage.
8) 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.

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# EN 60747-5-5 Option:(V4)

Types : TLP291

Type designations for “option: (V4)”, which are tested under EN 60747 requirements.

(e.g.): TLP291 (V4GB-TP,E
V4 : EN 60747 option
GB : CTR rank type
TP : Standard tape & reel type
E : [[G]]/RoHS COMPATIBLE (Note4 )

Note: Use TOSHIBA standard type number for safety standard application.
(e.g.): TLP291(V4GB-TP,E → TLP291

Note4: Please contact your Toshiba sales representative for details on environmental information such as the product’s RoHS compatibility.
RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronics equipment.

## EN 60747 Isolation Characteristics

| Description | Symbol | Rating | Unit |
|---|---|---|---|
| Application classification<br>for rated mains voltage ≤ 150Vrms<br>for rated mains voltage ≤ 300Vrms | | <br>I-IV<br>I-III | - |
| Climatic classification | | 55 / 110 / 21 | - |
| Pollution degree | | 2 | - |
| Maximum operating insulation voltage | $V_{IORM}$ | 707 | Vpk |
| Input to output test voltage, Method A<br>Vpr=1.5 × $V_{IORM}$, type and sample test<br>tp=10s, partial discharge<5pC | $V_{pr}$ | 1060 | Vpk |
| Input to output test voltage, Method B<br>Vpr=1.875 × $V_{IORM}$, 100% production test<br>tp=1s, partial discharge<5pC | $V_{pr}$ | 1325 | Vpk |
| Highest permissible overvoltage<br>(transient overvoltage, tpr=60s) | $V_{TR}$ | 6000 | Vpk |
| Safety limiting values (max. permissible ratings in case of fault,<br>also refer to thermal derating curve)<br>current (input current: $I_F$, Psi=0mW)<br>power (output or total power dissipation)<br>temperature | <br><br>$I_{si}$<br>$P_{si}$<br>$T_{si}$ | <br><br>250<br>400<br>150 | <br><br>mA<br>mW<br>°C |
| Insulation resistance<br>$V_{IO}$=500V, Ta=$T_{si}$ | $R_{si}$ | ≧ $10^9$ | Ω |

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## Insulation Related Specifications

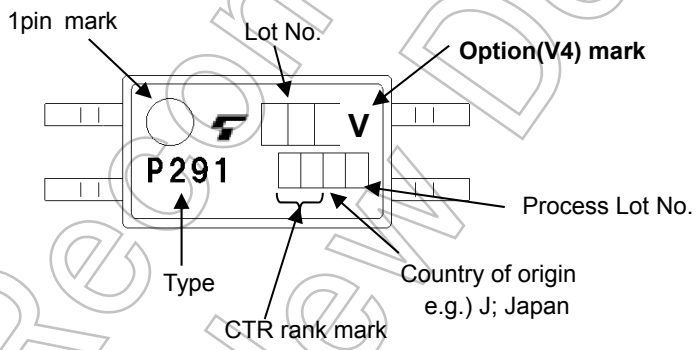
| | | |
|---|---|---|
| Minimum creepage distance | Cr | 5.0mm |
| Minimum clearance | Cl | 5.0mm |
| Minimum insulation thickness | ti | 0.4mm |
| Comparative tracking index | CTI | 175 |

1. If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g. at a standard distance between soldering eye centers of 3.5mm).
   If this is not permissible, the user shall take suitable measures.
2. 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 circuit.

VDE test sign: Marking on product for EN 60747 **V**

: Marking on packing for EN 60747 VDE

Marking Example: TLP291




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Figure 1 Partial discharge measurement procedure according to EN 60747
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests, destructive tests)

| | |
|---|---|
| $t_1$, $t_2$ | = 1 to 10 s |
| $t_3$, $t_4$ | = 1 s |
| $t_p$(Measuring time for partial discharge) | = 10 s |
| $t_b$ | = 12 s |
| $t_{ini}$ | = 60 s |

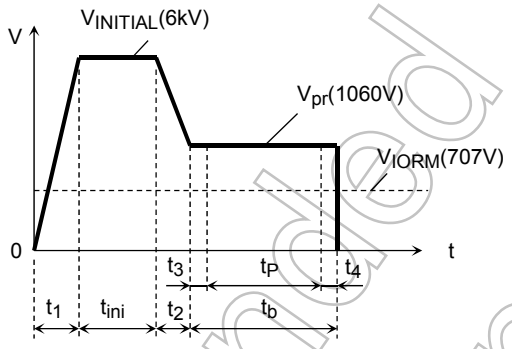



Figure 2 Partial discharge measurement procedure according to EN 60747
Non-destructive test for100% inspection.

Method B

(for sample test, non-destructive test)

| | |
|---|---|
| $t_3$, $t_4$ | = 0.1 s |
| $t_p$(Measuring time for partial discharge) | = 1 s |
| $t_b$ | = 1.2 s |

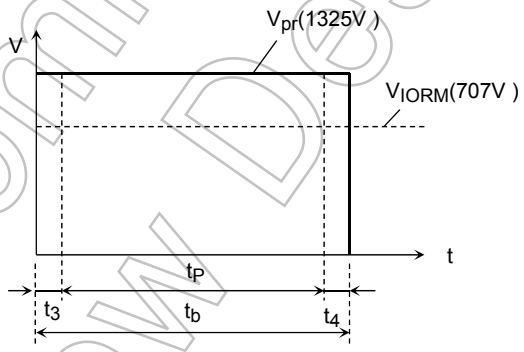
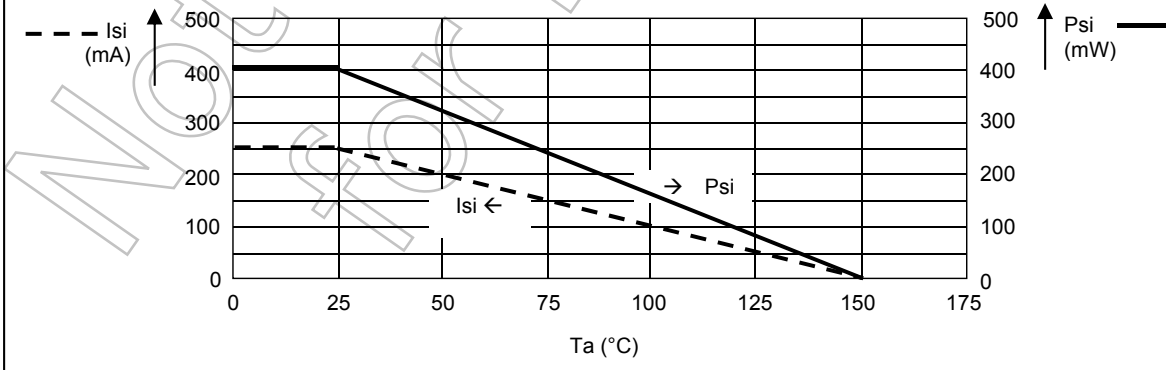



Figure 3 Dependency of maximum safety ratings on ambient temperature




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