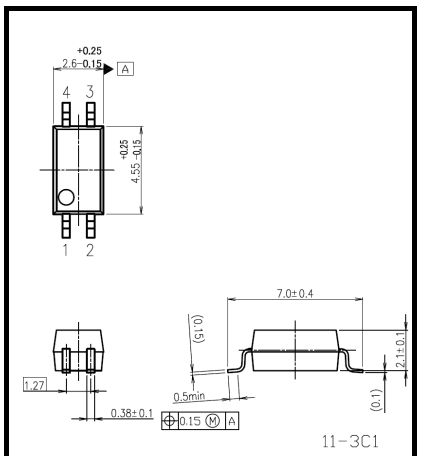
TOSHIBA Photocoupler GaAs Ired & Photo-Transistor

TLP290

Programmable Controllers
AC/DC-Input Module
Hybrid ICs

Unit: mm



TOSHIBA 11-3C1

Weight: 0.05 g (typ.)

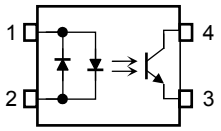
TLP290 consist of photo transistor, optically coupled to two gallium arsenide infrared emitting diode connected inverse parallel, and can operate directly by AC input current
Since TLP290 are guaranteed wide operating temperature (Ta=-55 to 110 ˚C) and high isolation voltage (3750Vrms), it's suitable for high-density surface mounting applications such as programmable controllers and hybrid ICs.

- Collector-Emitter voltage : 80 V (min)
- Current transfer ratio : 50% (min)
  Rank GB : 100% (min)
- Isolation voltage : 3750 Vrms (min)
- Guaranteed performance over -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 an 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)
Insultion thickness: 0.4 mm (min)

Pin Configuration

TLP290



1: Anode
Cathode
2: Cathode
Anode
3: Emitter
4: Collector

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

TYPE	Classification (Note1)	Current Transfer Ration (%) (I_C / I_F) I_F = 5 mA, V_{CE} = 5 V, Ta = 25°C		Marking of Classification
		Min	Max	
TLP290	Blank	50	400	Blank, YE, GR, B, GB
	Rank Y	50	150	YE
	Rank GR	100	300	GR
	Rank BLL	200	400	B
	Rank GB	100	400	GB

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

(e.g.) rank GB: TLP290(GB,E

Note: For safety standard certification, however, specify the part number alone.
(e.g.) TLP290(GB,E: TLP290

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

Characteristic		Symbol	Note	Rating	Unit
LED	R.M.S. forward current	$I_{F(RMS)}$		±50	mA
	Input forward current derating (Ta ≥ 90°C)	ΔI_F /ΔTa		-1.5	mA /°C
	Input forward current (pulsed)	I_{FP}	(Note 2)	±1	A
	Input power dissipation	P_D		100	mW
	Input power dissipation derating (Ta ≥ 90°C)	ΔP_D/ΔTa		-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)	ΔP_C /ΔTa		-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)		ΔP_T /ΔTa		-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, 1min., 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)

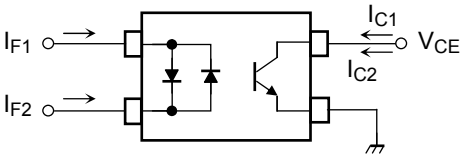
	Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
LED	Input forward voltage	V_F	I_F = ±10 mA	1.1	1.25	1.4	V
	Input capacitance	C_T	V = 0 V, f = 1 MHz	-	60	-	pF
Detector	Collector-emitter breakdown voltage	$V_{(BR)\ CEO}$	I_C = 0.5 mA	80	-	-	V
	Emitter-collector breakdown voltage	$V_{(BR)\ ECO}$	I_E = 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

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 CTR	I_C / $I_{F\ (sat)}$	IF = ±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
Collector current ratio	$I_{C\ (ratio)}$	I_C (I_F = -5 mA) / I_C (I_F = 5 mA) (Fig.1)	0.33	-	3	-

Fig.1: Collector current ratio test circuit

$$I_{C(ratio)} = \frac{I_{C2}(I_F = I_{F2}, V_{CE} = 5V)}{I_{C1}(I_F = I_{F1}, V_{CE} = 5V)}$$



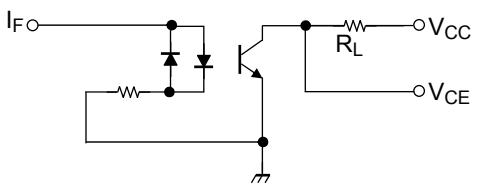
Isolation Characteristics (Unless otherwise specified, Ta = 25°C)

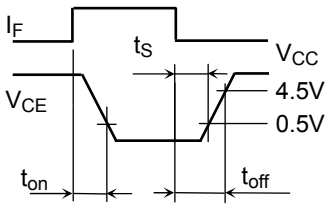
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	V_S = 0V, f = 1 MHz	-	0.8	-	pF
Isolation resistance	R_S	V_S = 500 V, R.H.≤ 60%	1×10^{12}	10^{14}	-	Ω
Isolation voltage	BV_S	AC, 1 minute	3750	-	-	V_{rms}
		AC, 1 second, in oil	-	10000	-	V_{rms}
		DC, 1 minute, in oil	-	10000	-	V_{dc}

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

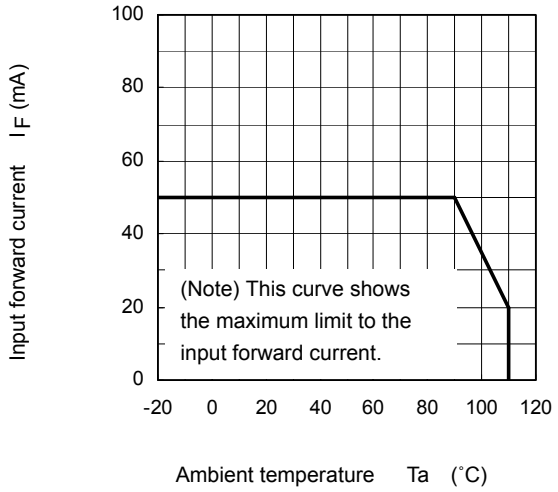
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r	V_{CC} = 10 V, I_C = 2 mA R_L = 100 Ω	-	4	-	μs
Fall time	t_f		-	7	-	
Turn-on time	t_{on}		-	7	-	
Turn-off time	t_{off}		-	7	-	
Turn-on time	t_{on}	R_L = 1.9 kΩ (Fig.2) V_{CC} = 5 V, I_F = ±16 mA	-	2	-	μs
Storage time	t_s		-	30	-	
Turn-off time	t_{off}		-	60	-	

(Fig. 2): Switching time test circuit

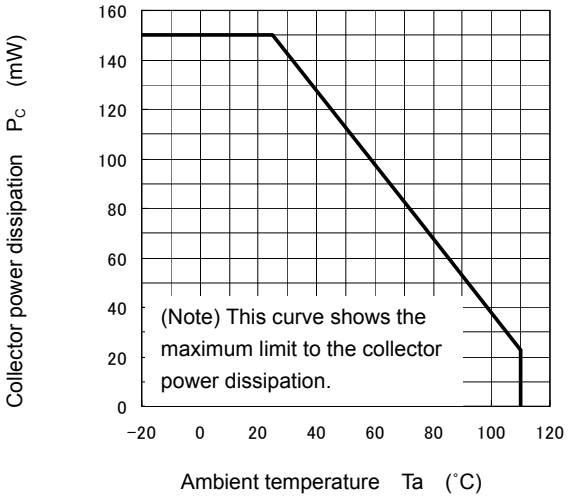




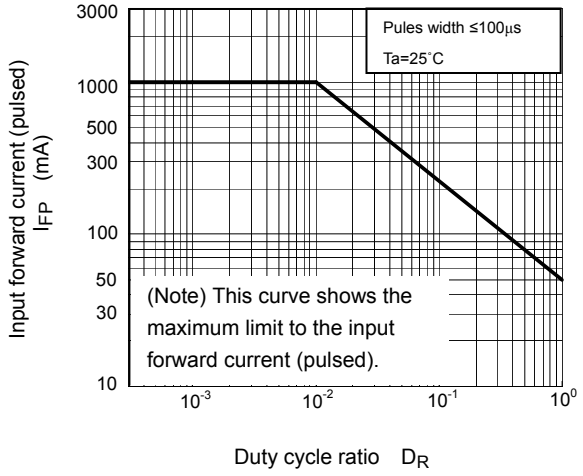
I_F - Ta



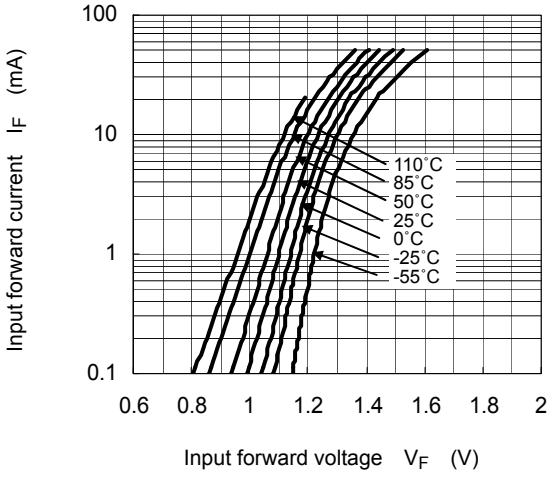
P_C - Ta



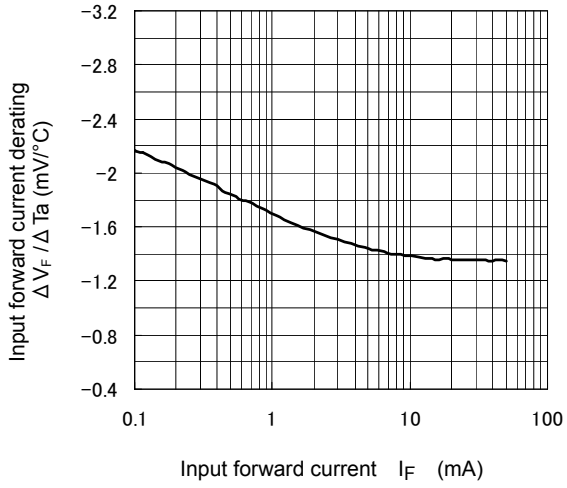
I_{FP} - D_R



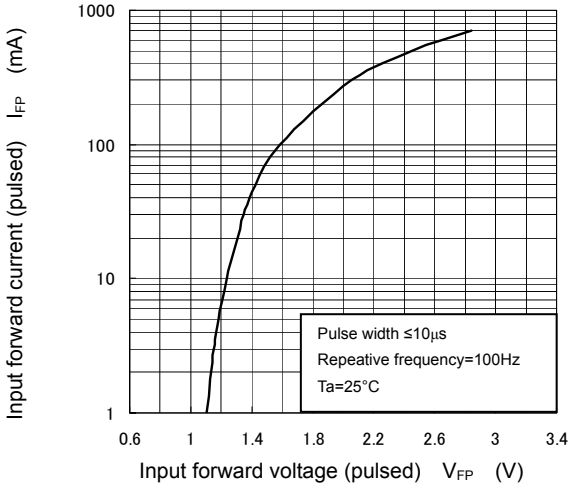
I_F - V_F



$\Delta V_F / \Delta Ta$ - I_F

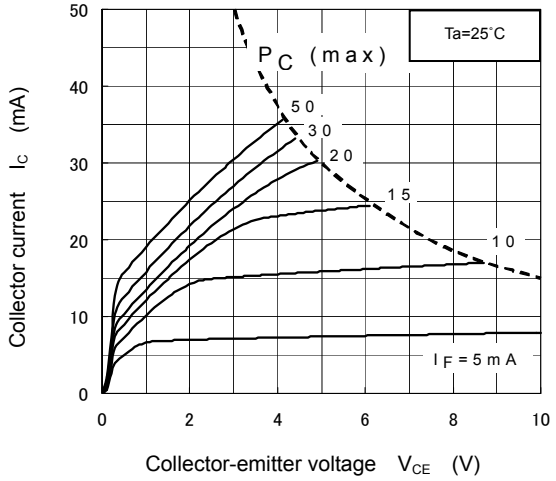


I_{FP} - V_{FP}

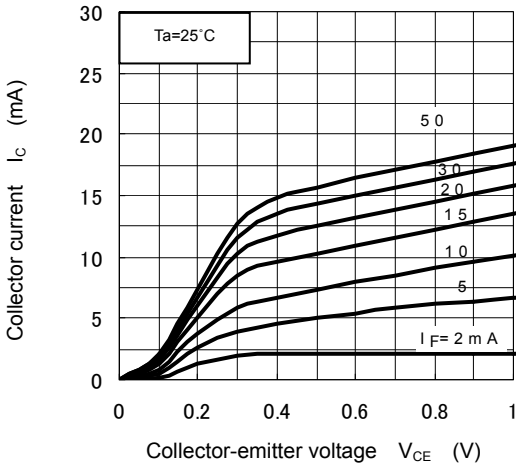


Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

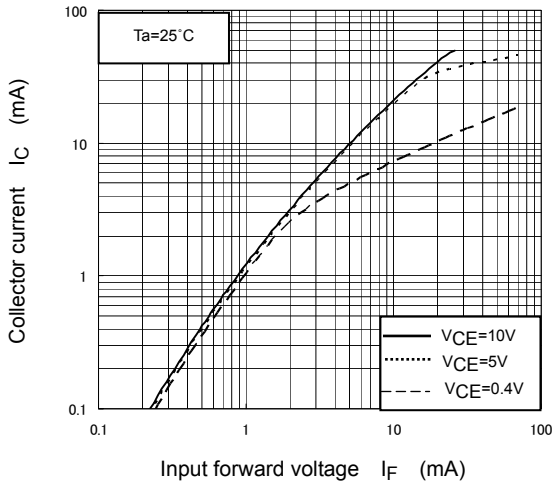
I_C-V_{CE}



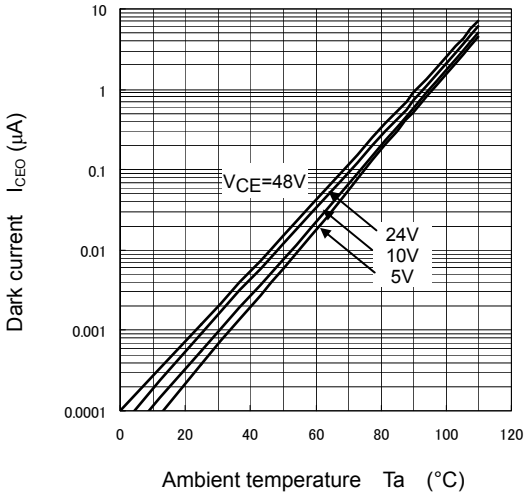
I_C-V_{CE}



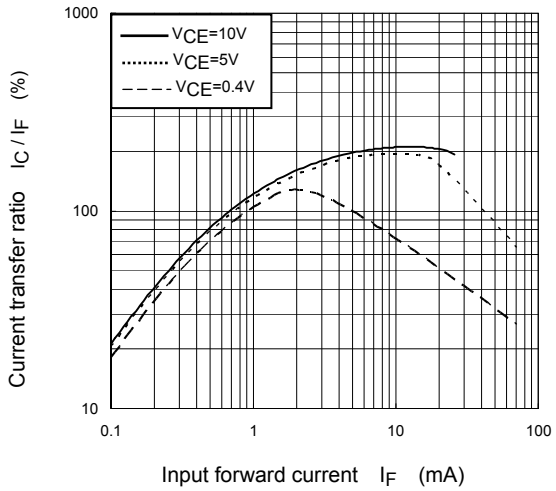
I_C-I_F



I_{CEO}-Ta

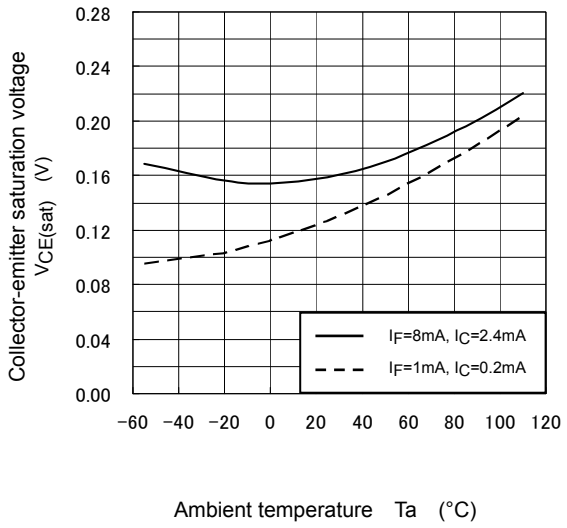


I_C/I_F -I_F

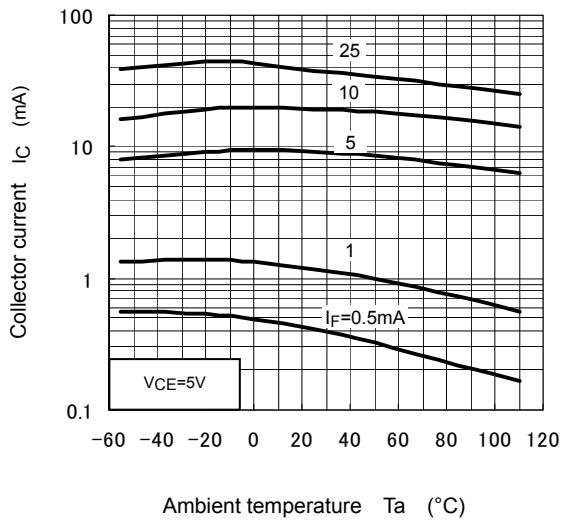


Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

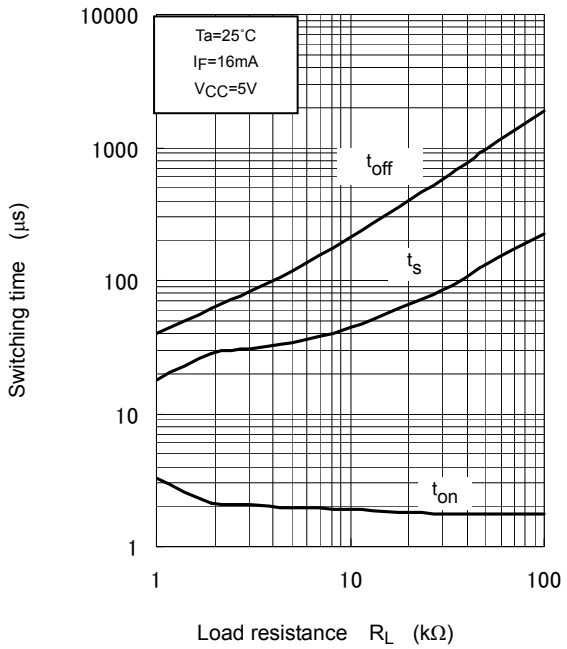
$V_{CE(sat)}$ - Ta



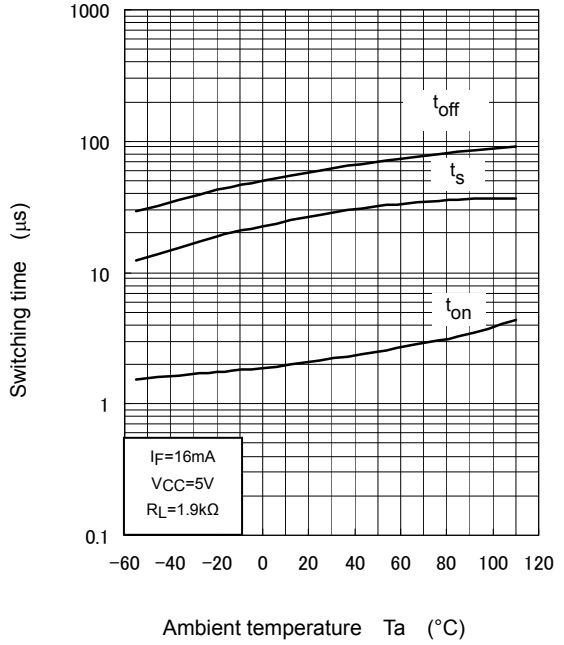
I_C - Ta



Switching time - R_L



Switching time - Ta



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

Soldering and Storage

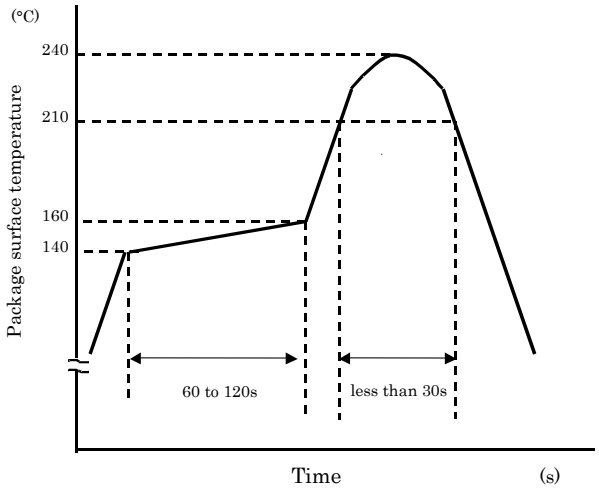
1. Soldering

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.

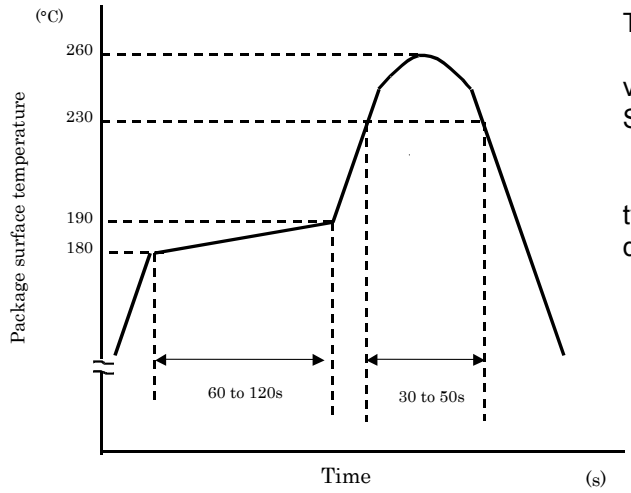
1) Using solder reflow

·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.

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 recommendedthat you check the leads for ease of soldering prior to use.

EN 60747-5-5 Option: (V4)

Types : TLP290

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

Ex.: TLP290 (V4GB-TP,E
V4 : EN 60747 option
GB : CTR rank type
TP : Standard tape & reel type
E : [[G]]/RoHS COMPATIBLE (Note 4)

Note: Use TOSHIBA standard type number for safety standard application.
e.g.: TLP290(V4GB-TP,E → TLP290

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 for rated mains voltage ≤ 150Vrms for rated mains voltage ≤ 300Vrms		 I-IV 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 Vpr=1.5 × V_{IORM}, type and sample test tp=10s, partial discharge<5pC	V_{pr}	1060	Vpk
Input to output test voltage, Method B Vpr=1.875 × V_{IORM}, 100% production test tp=1s, partial discharge<5pC	V_{pr}	1325	Vpk
Highest permissible overvoltage (transient overvoltage, tpr=60s)	V_{TR}	6000	Vpk
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve) current (input current: I_F, Psi=0mW) power (output or total power dissipation) temperature	 I_{si} P_{si} T_{si}	 250 400 150	 mA mW °C
Insulation resistance V_{IO}=500V, Ta=T_{si}	R_{si}	$\geq 10^9$	Ω

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: TLP290

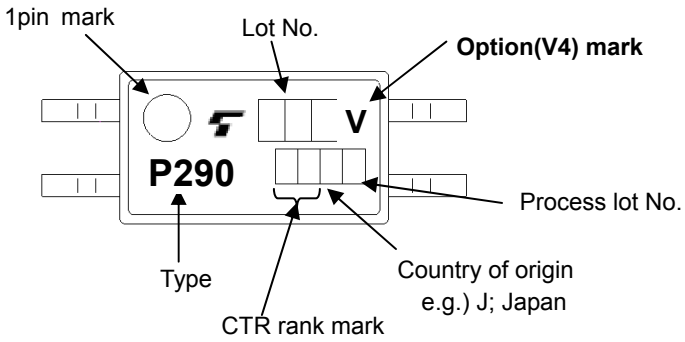


Figure 1 Partial discharge measurement procedure according to EN 60747
Destructive test for qualification and sampling tests.

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

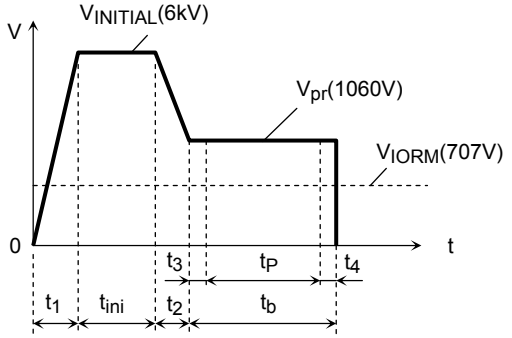


Figure 2 Partial discharge measurement procedure according to EN 60747
Non-destructive test for100% inspection.

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

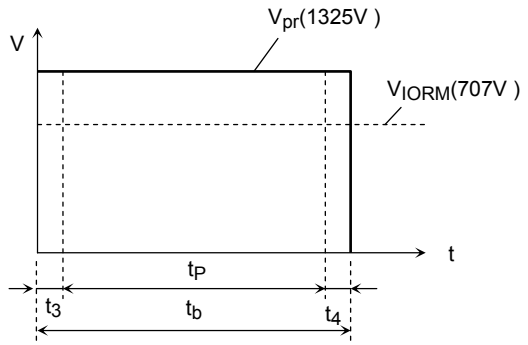
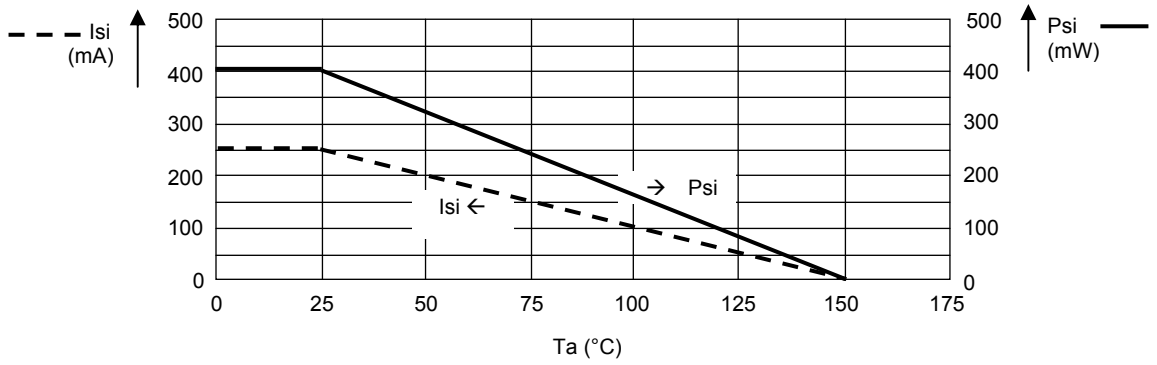


Figure 3 Dependency of maximum safety ratings on ambient temperature



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