Photocouplers GaAs Infrared LED & Photo Triac

TLP665L,TLP665LF

1. Applications

- Solid-State Relays
- Triac Drivers
- Home Electric Appliances
- Office Equipment

2. General

The TLP665L consists of a non zero crossing photo triac, optically coupled to a gallium arsenide infrared emitting diode. The TLP665L is housed in the DIP6 package and guarantees insulation thickness of 0.5 mm (min). Therefore, the TLP665L meets the reinforced insulation class requirements of international safety standards.

3. Features

(1) Peak off-state voltage: 800 V (min)
(2) Non zero crossing functionary (NZC)
(3) Trigger LED current: 10 mA (max)
(4) On-state current: 100 mA (max)
(5) Isolation voltage: 5000 Vrms (min)
(6) Safety standards
UL-approved: UL1577 File No.E67349
cUL-approved: CSA Component Acceptance Service No.5A File No.E67349
CQC-approved: GB4943.1, GB8898
VDE-approved: Option (D4) EN60747-5-5 **(Note)**
Maximum operating insulation voltage: 890 Vpeak / 1140 Vpeak **(Note1)**
Highest permissible overvoltage: 8000 Vpeak

Note: When an EN60747-5-5 approved type is needed, please designate the **Option (D4)**.
Note1: When maximum operating insulation voltage 1140 Vpeak is needed, please designate the **TLP665LF**.

Table 3.1 Mechanical Parameters

Characteristics	7.62 mm Pitch TLP665L	10.16 mm Pitch TLP665LF	Unit
Creepage distances	7.0 (min)	8.0 (min)	mm
Clearance distances	7.0 (min)	8.0 (min)	
Internal isolation thickness	0.5 (min)	0.5 (min)	

Table 3.2 Trigger LED Current (Note) (Unless otherwise specified, T_a = 25 °C)

Rank	I_{FT} Rank Marking	Test Condition	Trigger LED Current I_{FT} (min)	Trigger LED Current I_{FT} (max)	Unit
None	None	V_T = 6 V	—	10	mA
(IFT7)	7	V_T = 6 V	—	7	

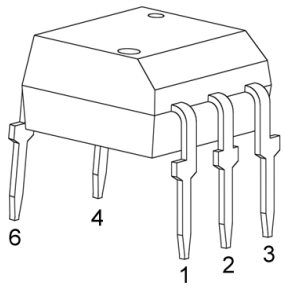
Note: Specify both the part number and a rank in this format when ordering.
Example: TLP665L (IFT7)
For safety standard certification, however, specify the part number alone.
Example: TLP665L

Start of commercial production
2014-11

2014-11-07
Rev.1.0

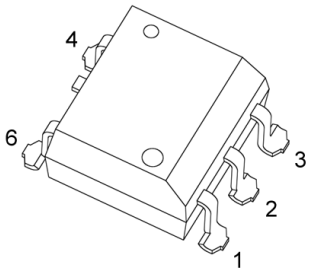
4. Packaging (Note)

TLP665L



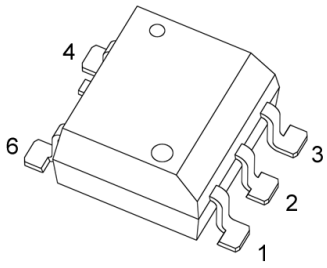
11-7A9S

TLP665L(LF1,TP1)



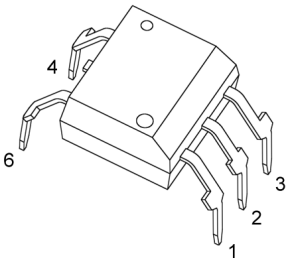
11-7A901S

TLP665L(LF5,TP5)



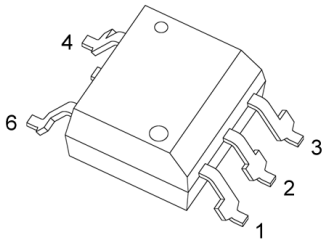
11-7A905S

TLP665LF



11-7A902S

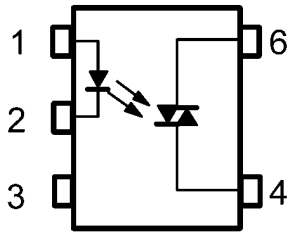
TLP665LF(LF4,TP4)



11-7A904S

Note: Through hole type: TLP665L, TLP665LF
Lead forming option: (LF1), (LF4), (LF5)
Taping option: (TP1), (TP4), (TP5)

5. Pin Assignment



1: Anode
2: Cathode
3: N.C.
4: Triac terminal
6: Triac terminal

6. Product Naming Conventions (Note)

Type of package used for shipment is denoted by a symbol suffix after a part number. The method of classification is as below.

Example) TLP665L(TP1,F(O

Part number: TLP665L
Tape type: TP1 **(Note 1)**
[[G]]/RoHS COMPATIBLE: F **(Note)**
Domestic ID (Country/Region of origin: Japan): (O

Note 1: At the part of tape type, below options are used including lead forming type.
TLP665L: LF1, TP1, LF5, TP5
TLP665LF: LF4, TP4

Note: 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 electronics equipment.

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		50	mA
	Input forward current derating	($T_a \geq$ 53 °C)	$\Delta I_F/\Delta T_a$		-0.7	mA/°C
	Input forward current (pulsed)		I_{FP}	(Note 1)	1	A
	Input reverse voltage		V_R		5	V
	Junction temperature		T_j		125	°C
	Input power dissipation		P_D		100	mW
	Input power dissipation derating		$\Delta P_D/\Delta T_a$		-1.0	mW/°C
Detector	Off-state output terminal voltage		V_{DRM}		800	V
	R.M.S. on-state current	(T_a = 25 °C)	$I_{T(RMS)}$		100	mA
		(T_a = 70 °C)			50	mA
	R.M.S. on-state current derating	($T_a \geq$ 25 °C)	$\Delta I_{T(RMS)}/\Delta T_a$		-1.1	mA/°C
	ON-state current (pulsed)		I_{ONP}	(Note 2)	2	A
	Peak non-repetitive surge current		I_{TSM}	(Note 3)	1.2	A
	Junction temperature		T_j		125	°C
	Output power dissipation		P_O		300	mW
	Output power dissipation derating		$\Delta P_O/\Delta T_a$		-4.0	mW/°C
Common	Total power dissipation		P_T		400	mW
	Total power dissipation derating		$\Delta P_T/\Delta T_a$		-4.4	mW/°C
	Operating temperature		T_{opr}		-40 to 100	°C
	Storage temperature		T_{stg}		-55 to 125	°C
	Lead soldering temperature	(10 s)	T_{sol}		260	°C
	Isolation voltage	AC, 60 s, R.H. ≤ 60 %	BV_S	(Note 4)	5000	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) ≤ 100 μs, 100 pps

Note 2: Pulse width (PW) ≤ 100 μs, 120 pps

Note 3: Pulse width (PW) ≤ 10 ms

Note 4: This device is considered as a two-terminal device: Pins 1, 2 and 3 are shorted together, and pins 4 and 6 are shorted together.

8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
AC mains voltage	V_{AC}	(Note1)	—	—	480	V
Input forward current	I_F		15	20	25	mA
ON-state current (pulsed)	I_{ONP}		—	—	1	A
Operating temperature	T_{opr}		-25	—	85	°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.

Note1: AC use only.

9. Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		I_F = 10 mA	1.0	1.15	1.3	V
	Input reverse current	I_R		V_R = 5 V	—	—	10	μA
	Input capacitance	C_t		V = 0 V, f = 1 MHz	—	30	—	pF
Detector	Peak off-state current	I_{DRM}		V_{DRM} = 800 V	—	10	1000	nA
	Peak on-state voltage	V_{TM}		I_{TM} = 100 mA	—	1.7	3.0	V
	Holding current	I_H		—	—	1.0	—	mA
	Critical rate of rise of off-state voltage	dv/dt		V_{in} = 240 V, T_a = 85 °C See Fig. 9.1	—	500	—	V/μs
	Critical rate of rise of commutating voltage (dv/dt)	dv/dt(c)		V_{in} = 60 Vrms, I_T = 15 mA See Fig. 9.1	—	0.2	—	

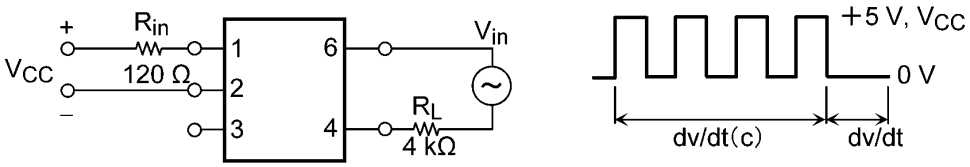


Fig. 9.1 dv/dt Test Circuit

10. Coupled Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	I_{FT}		V_T = 6 V	—	—	10	mA

11. Isolation Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	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. ≤ 60%	5×10^{10}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	5000	—	—	Vrms
			AC, 1 s in oil	—	10000	—	
			DC, 60 s in oil	—	10000	—	Vdc

Note 1: This device is considered as a two-terminal device: Pins 1, 2 and 3 are shorted together, and pins 4 and 6 are shorted together.

12. Characteristics Curves (Note)

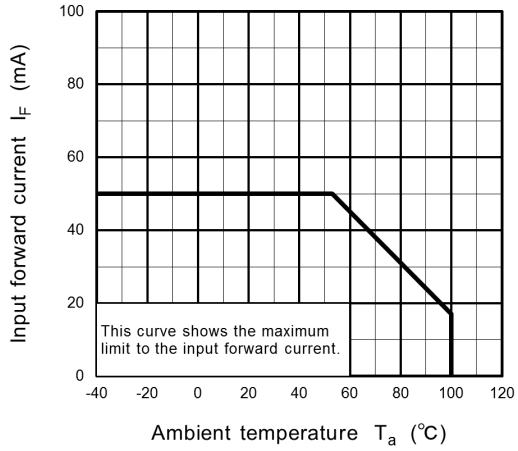


Fig. 12.1 I_F - T_a

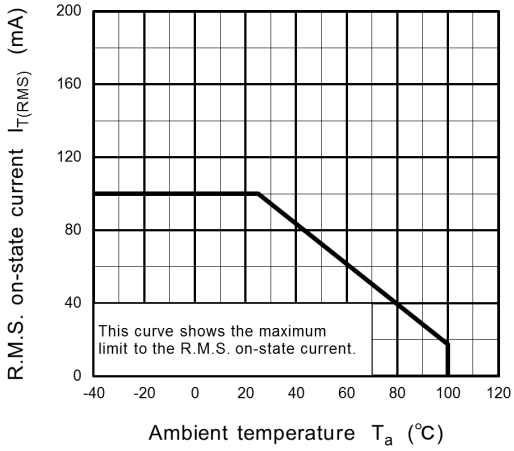


Fig. 12.2 $I_{T(RMS)}$ - T_a

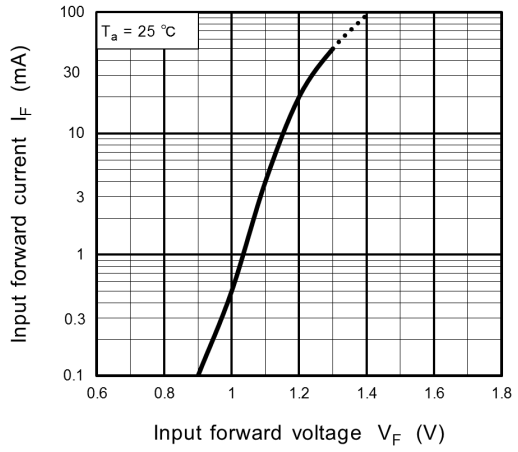


Fig. 12.3 I_F - V_F

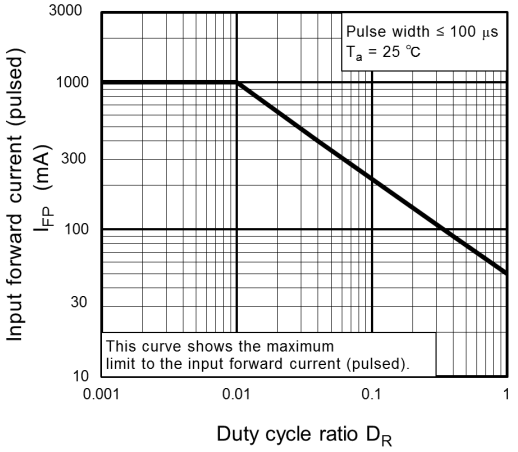


Fig. 12.4 I_{FP} - D_R

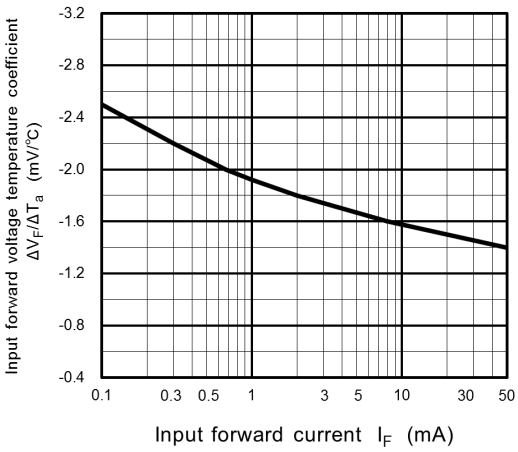


Fig. 12.5 $\Delta V_F/\Delta T_a$ - I_F

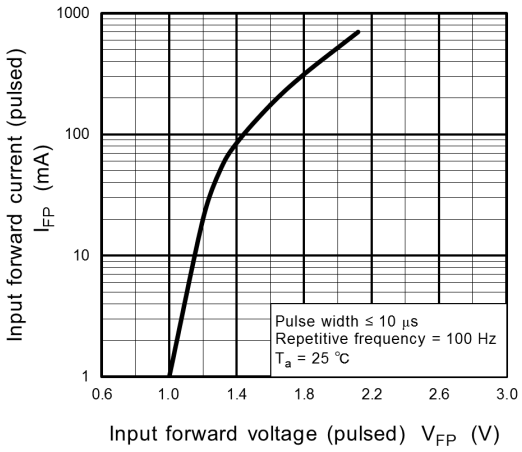


Fig. 12.6 I_{FP} - V_{FP}

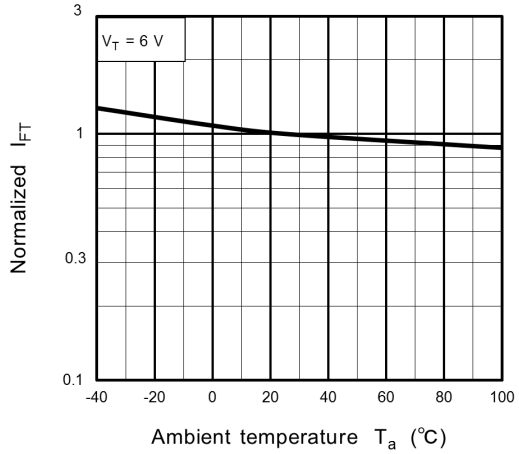


Fig. 12.7 Normalized I_{FT} - T_a

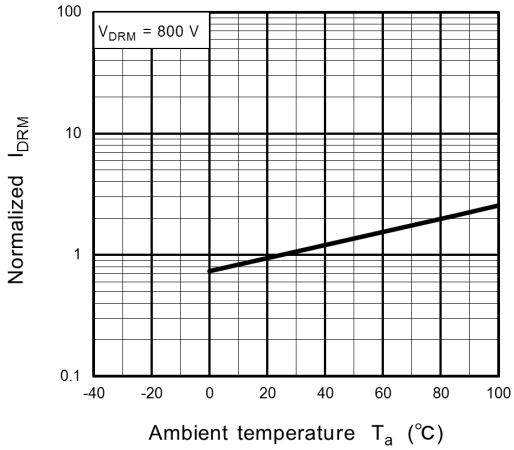


Fig. 12.8 Normalized I_{DRM} - T_a

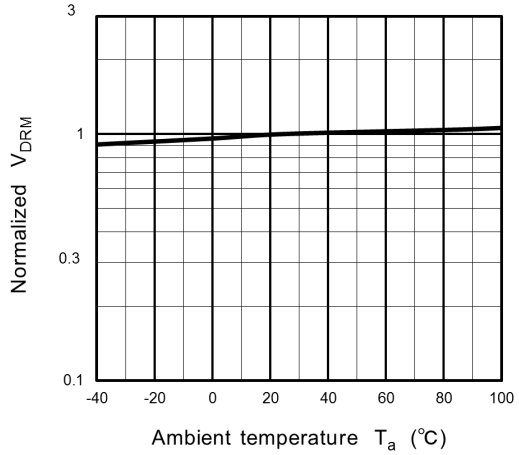


Fig. 12.9 Normalized V_{DRM} - T_a

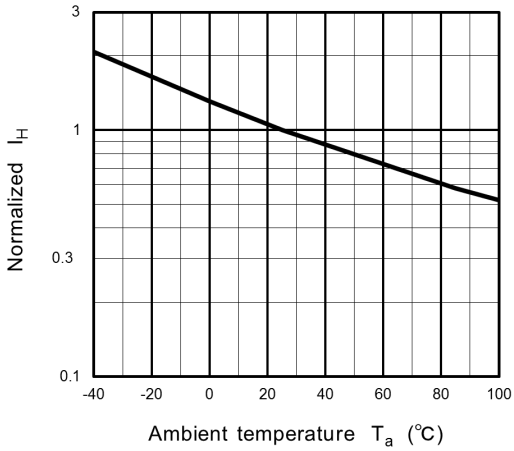


Fig. 12.10 Normalized I_H - T_a

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

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 following figures)
  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.

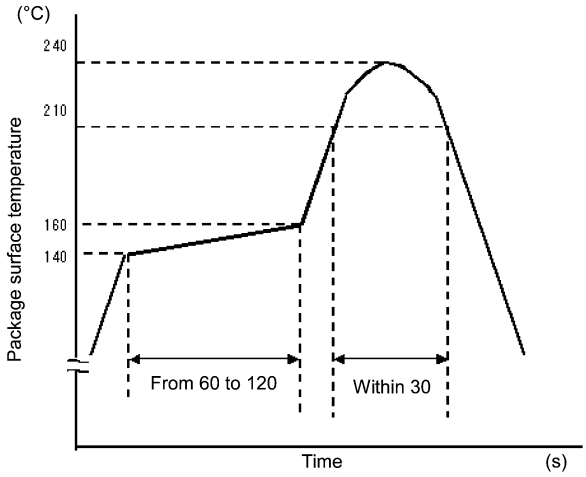


Fig. 13.1.1 An Example of a Temperature Profile When Sn-Pb Eutectic Solder Is Used

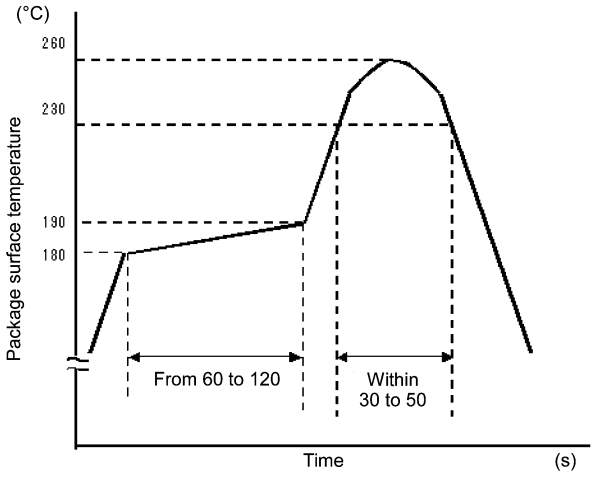


Fig. 13.1.2 An Example of a Temperature Profile When Lead(Pb)-Free Solder Is Used

- 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)

(Unit: mm)

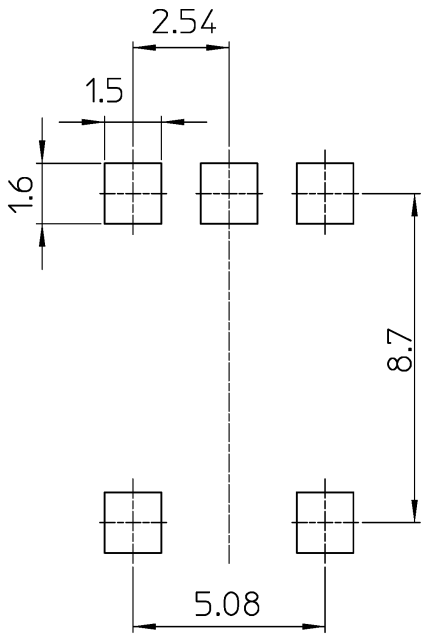


Fig. 14.1 TLP665L
Lead forming and taping option
(LF1), (TP1), (LF5), (TP5)

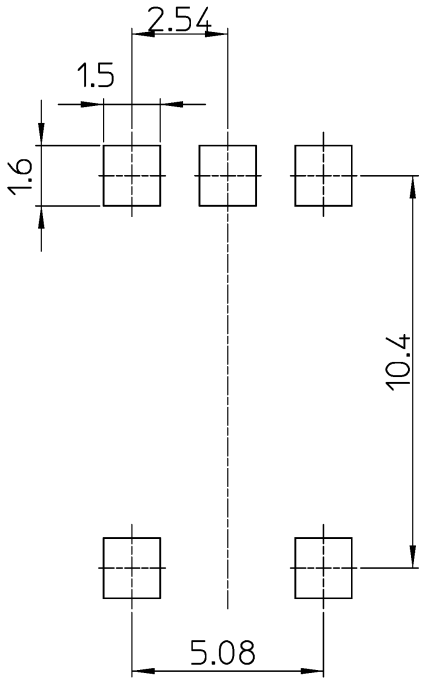


Fig. 14.2 TLP665LF
Lead forming and taping option
(LF4), (TP4)

15. Marking (Note)

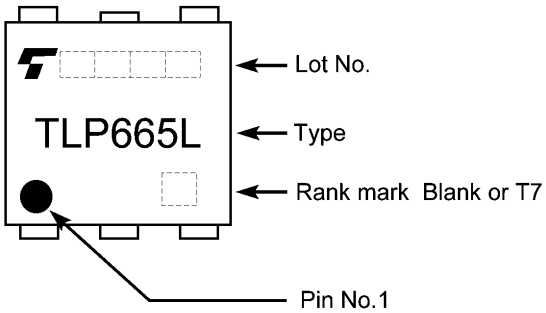


Fig. 15.1 TLP665L

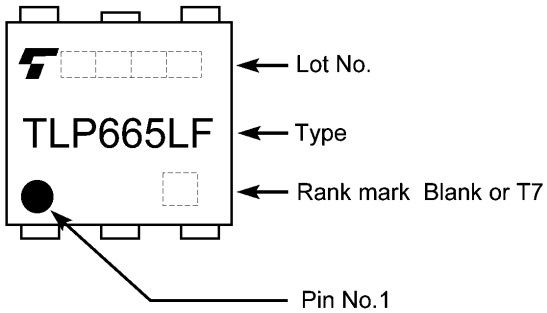


Fig. 15.2 TLP665LF

Note: A different marking is used for photocouplers that have been qualified according to option (D4) of EN60747. See Fig.16.3 and Fig.16.4.

16. EN60747-5-5 Option (D4) Specification

- Part number: TLP665L **(Note)**
- The following part naming conventions are used for the devices that have been qualified according to option (D4) of EN60747.
  Example: TLP665L(D4-TP1,F(O
  D4: EN60747 option
  TP1: Tape type
  F: [[G]]/RoHS COMPATIBLE **(Note 1)**
  (O: Domestic ID (Country/Region of origin: Japan)

Note: Use TOSHIBA standard type number for safety standard application.
e.g., TLP665L(D4) → TLP665L

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 electronics equipment.

Description		Symbol	Rating	Unit
Application classification for rated mains voltage ≤ 300 Vrms for rated mains voltage ≤ 600 Vrms			 I-IV I-III	—
Climatic classification			40 / 100 / 21	—
Pollution degree			2	—
Maximum operating insulation voltage	TLPxxxx type	V_{IORM}	890	Vpeak
	TLPxxxxF type		1140	
Input to output test voltage, Method A V_{pr} = 1.6 × V_{IORM}, type and sample test t_p = 10 s, partial discharge < 5 pC	TLPxxxx type	V_{pr}	1424	Vpeak
	TLPxxxxF type		1824	
Input to output test voltage, Method B V_{pr} = 1.875 × V_{IORM}, 100 % production test t_p = 1 s, partial discharge < 5 pC	TLPxxxx type	V_{pr}	1670	Vpeak
	TLPxxxxF type		2140	
Highest permissible overvoltage (transient overvoltage, t_{pr} = 60 s)		V_{TR}	8000	Vpeak
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve) current (input current I_F, P_{so} = 0) power (output or total power dissipation) temperature		 I_{si} P_{so} T_{si}	 400 700 150	 mA mW °C
Insulation resistance	V_{IO} = 500 V, T_a = 25 °C V_{IO} = 500 V, T_a = 100 °C V_{IO} = 500 V, T_a = T_{si}	R_{si}	≥ 10^{12} ≥ 10^{11} ≥ 10^{9}	Ω

Fig. 16.1 EN60747 Insulation Characteristics

Table 16.1 Insulation Related Specifications (Note)

Insulation Related Parameters	Symbol	TLP665L	TLP665LF
Minimum creepage distance	Cr	7.0 mm	8.0 mm
Minimum clearance	Cl	7.0 mm	8.0 mm
Minimum insulation thickness	ti	0.5 mm	0.5 mm
Comparative tracking index	CTI	175	175

Note: 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 3.5 mm). If this is not permissible, the user shall take suitable measures.

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. 16.2 Marking on packing for EN60747

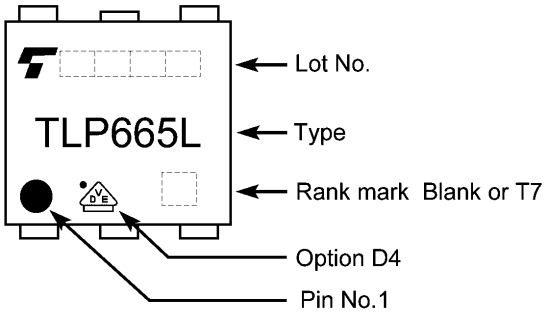


Fig. 16.3 Marking Example of TLP665L (Note)

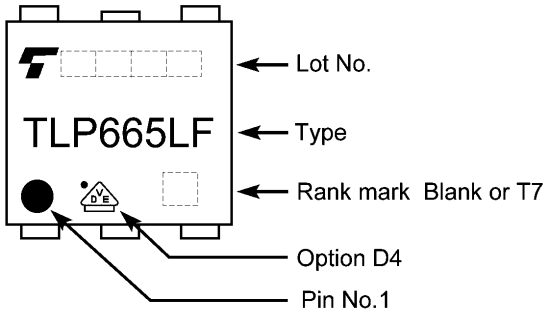


Fig. 16.4 Marking Example of TLP665LF (Note)

Note: The above marking is applied to the photocouplers that have been qualified according to option (D4) of EN60747.

Figure 1 Partial discharge measurement procedure according to EN60747
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

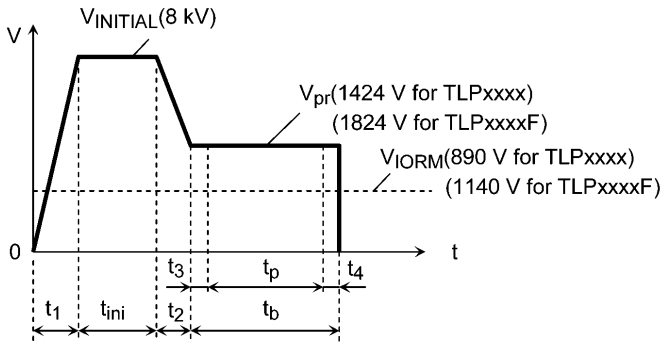


Figure 2 Partial discharge measurement procedure according to EN60747
Non-destructive test for 100 % inspection.

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

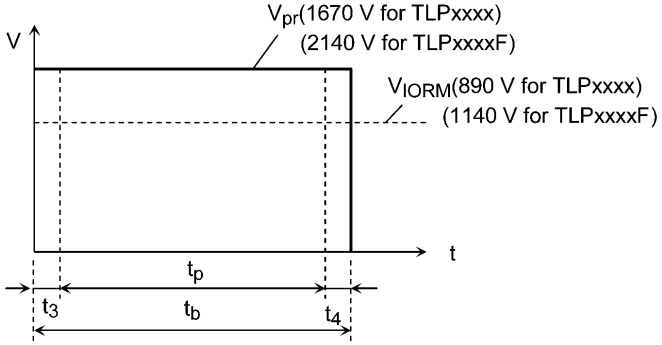


Figure 3 Dependency of maximum safety ratings on ambient temperature

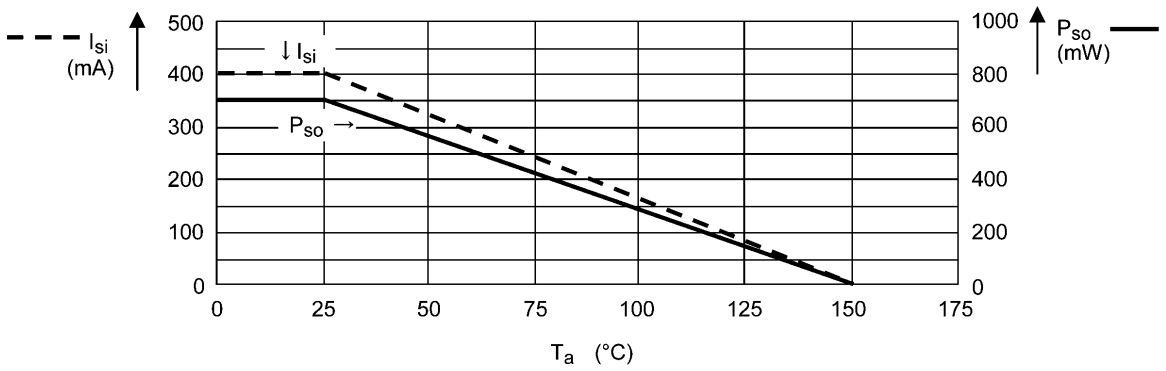
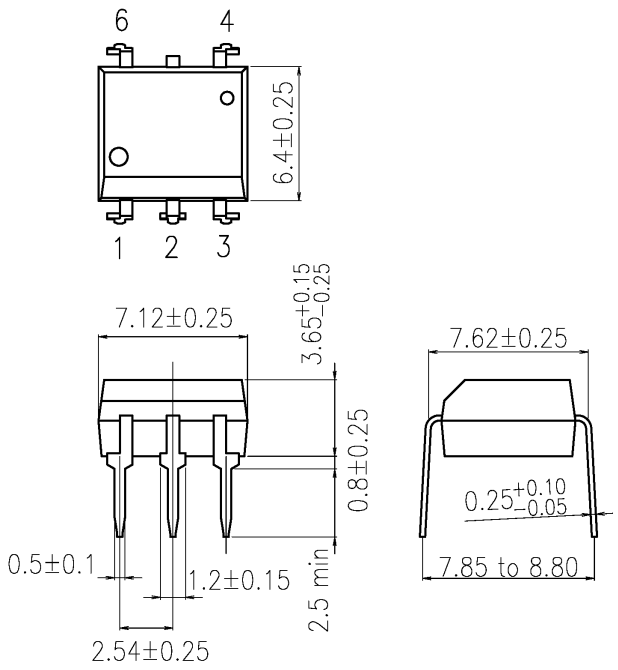


Fig. 16.5 Measurement Procedure

Package Dimensions

Unit: mm

TLP665L



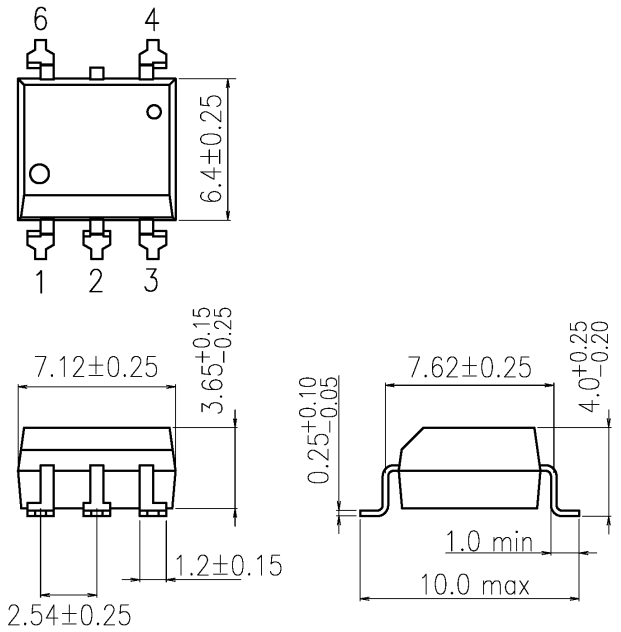
Weight: 0.39 g (typ.)

Package Name(s)
TOSHIBA: 11-7A9S

Package Dimensions

Unit: mm

TLP665L(LF1,TP1)



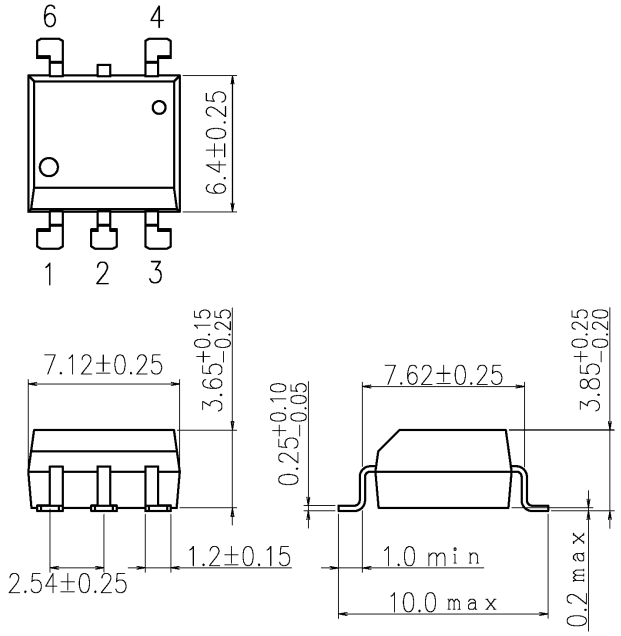
Weight: 0.38 g (typ.)

Package Name(s)
TOSHIBA: 11-7A901S

Package Dimensions

Unit: mm

TLP665L(LF5,TP5)



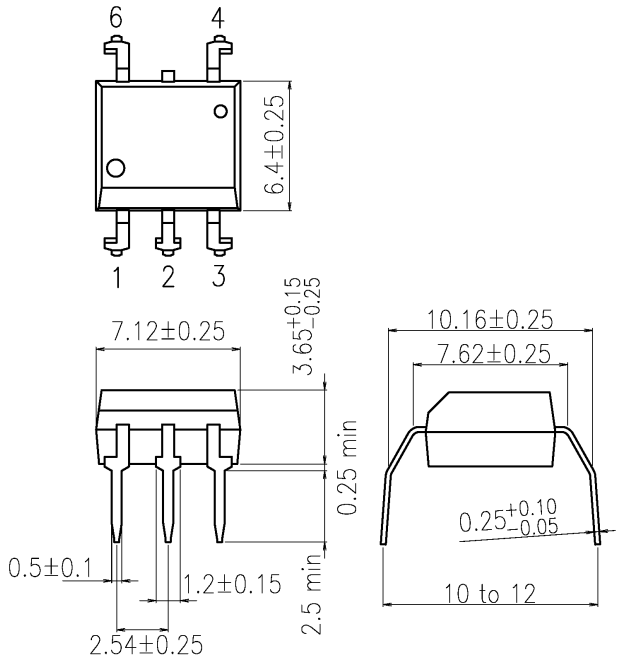
Weight: 0.38 g (typ.)

Package Name(s)
TOSHIBA: 11-7A905S

Package Dimensions

Unit: mm

TLP665LF



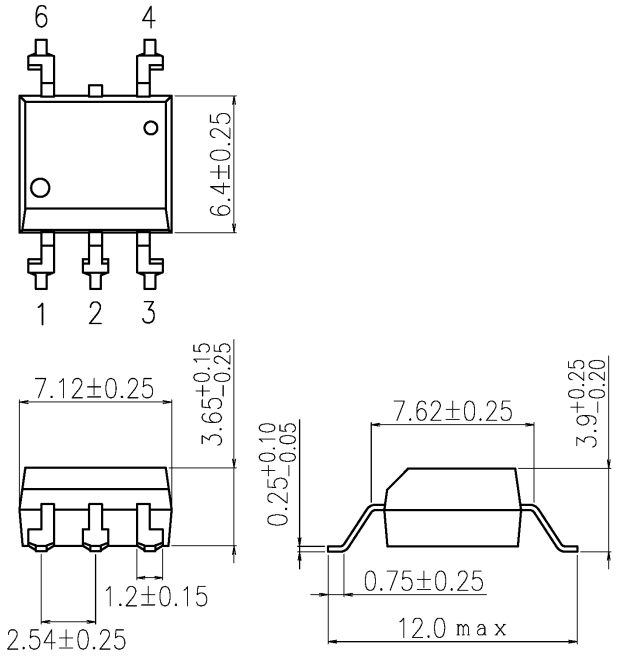
Weight: 0.39 g (typ.)

Package Name(s)
TOSHIBA: 11-7A902S

Package Dimensions

Unit: mm

TLP665LF(LF4,TP4)



Weight: 0.38 g (typ.)

Package Name(s)
TOSHIBA: 11-7A904S

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