

To our customers,

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## Old Company Name in Catalogs and Other Documents

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On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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## PHOTOCOUPLER

## PS9587, PS9587L1, PS9587L2, PS9587L3

### HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE 8-PIN DIP HIGH-SPEED PHOTOCOUPLER FOR CREEPAGE DISTANCE OF 8 mm

—NEPOC Series—

#### DESCRIPTION

The PS9587, PS9587L1, PS9587L2 and PS9587L3 are optically coupled isolators containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

The PS9587L1 and PS9587L2 are designed specifically for long creepage-distance as well as high common mode transient immunity (CMR) and high speed digital output type. Consequently, they are suitable for high speed logic interface that needs long creepage-distance (8 mm) on mounting.

The PS9587L1 is lead bending type for long creepage distance.

The PS9587L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

The PS9587L3 is lead bending type (Gull-wing) for surface mounting.

#### FEATURES

- Long creepage distance (8 mm MIN.: PS9587L1, PS9587L2)
- High common mode transient immunity ( $CM_H, CM_L = \pm 15 \text{ kV}/\mu\text{s}$  MIN.)
- High isolation voltage ( $BV = 5\,000 \text{ Vr.m.s.}$ )
- High-speed response (10 Mbps)
- Pulse width distortion ( $|t_{PHL} - t_{PLH}| = 10 \text{ ns TYP.}$ )
- Open collector output
- Ordering number of tape product: PS9587L2-E3: 1 000 pcs/reel  
: PS9587L3-E3: 1 000 pcs/reel

- Pb-Free product
- Safety standards

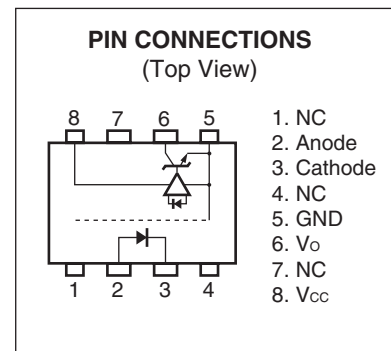
<R>

- UL approved: No. E72422
- CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
- BSI approved: No. 8937, 8938
- SEMKO approved: No. 615433
- NEMKO approved: No. P06207243
- DEMKO approved: No. 314091
- FIMKO approved: No. FI 22827
- DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40019182 (Option)

<R>

#### APPLICATIONS

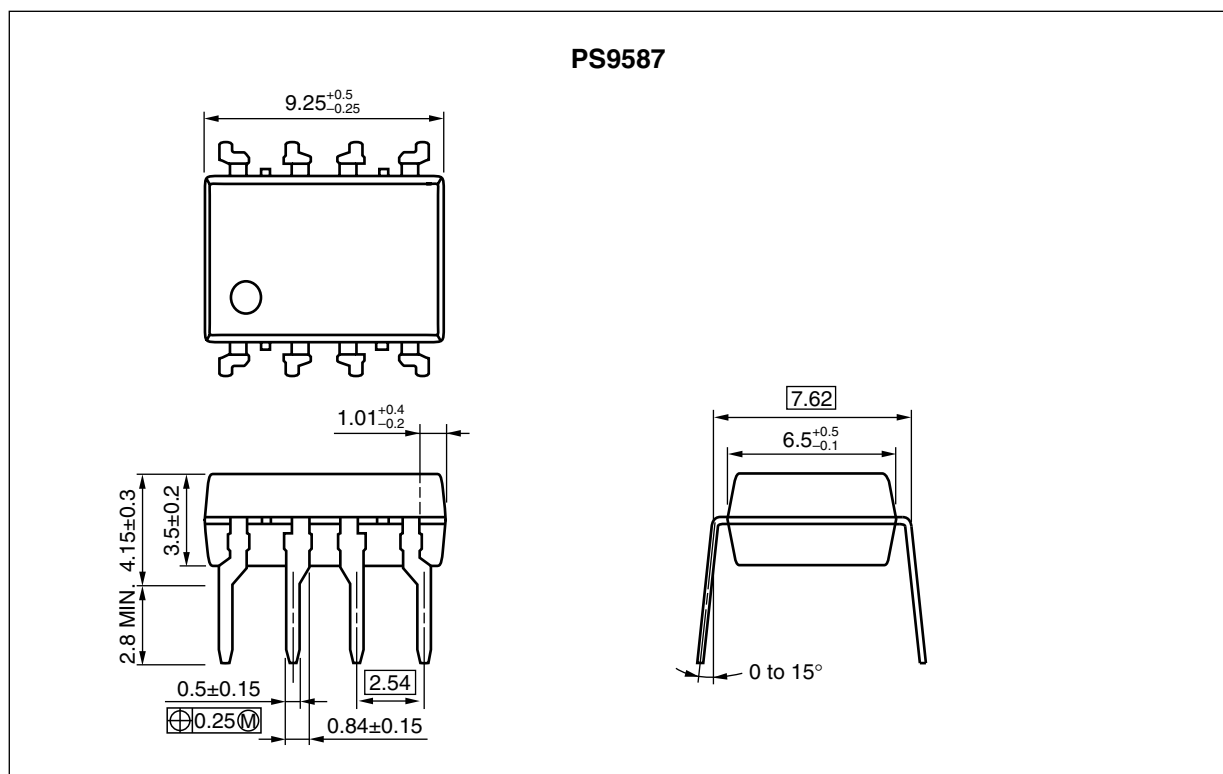
- FA Network
- Measurement equipment
- PDP



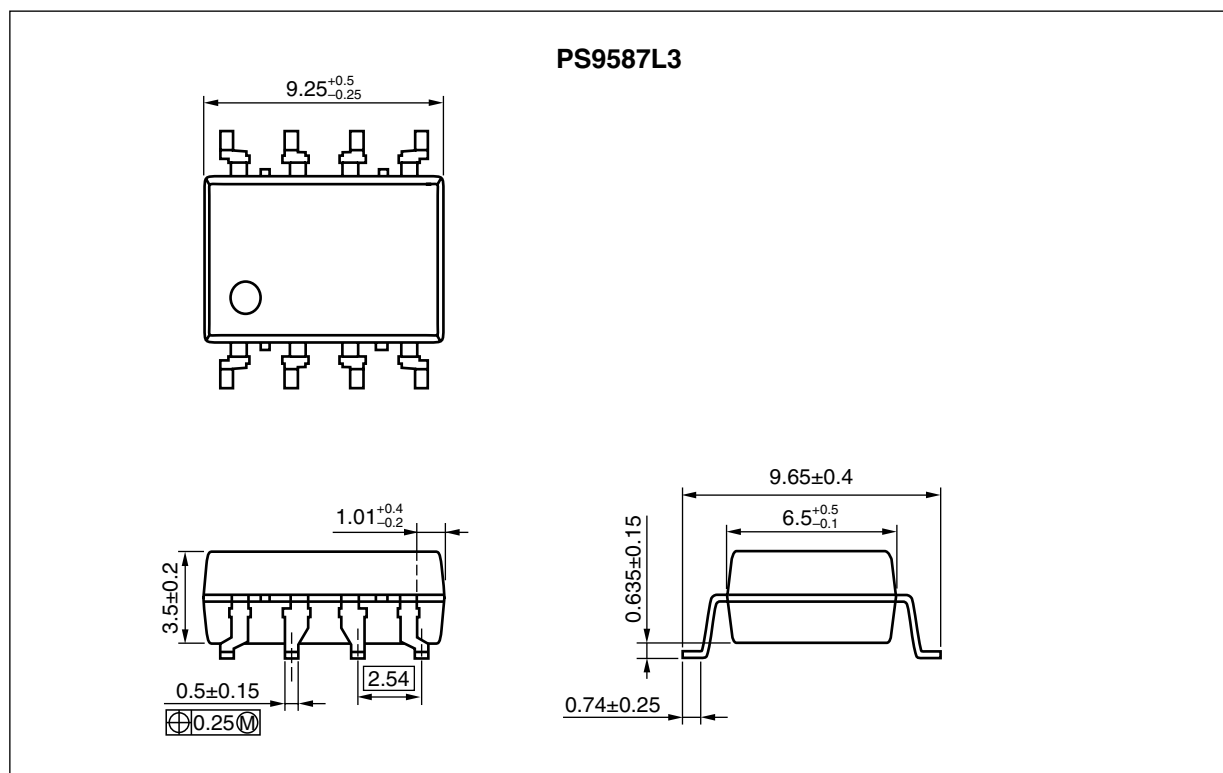
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<R> PACKAGE DIMENSIONS (UNIT: mm)

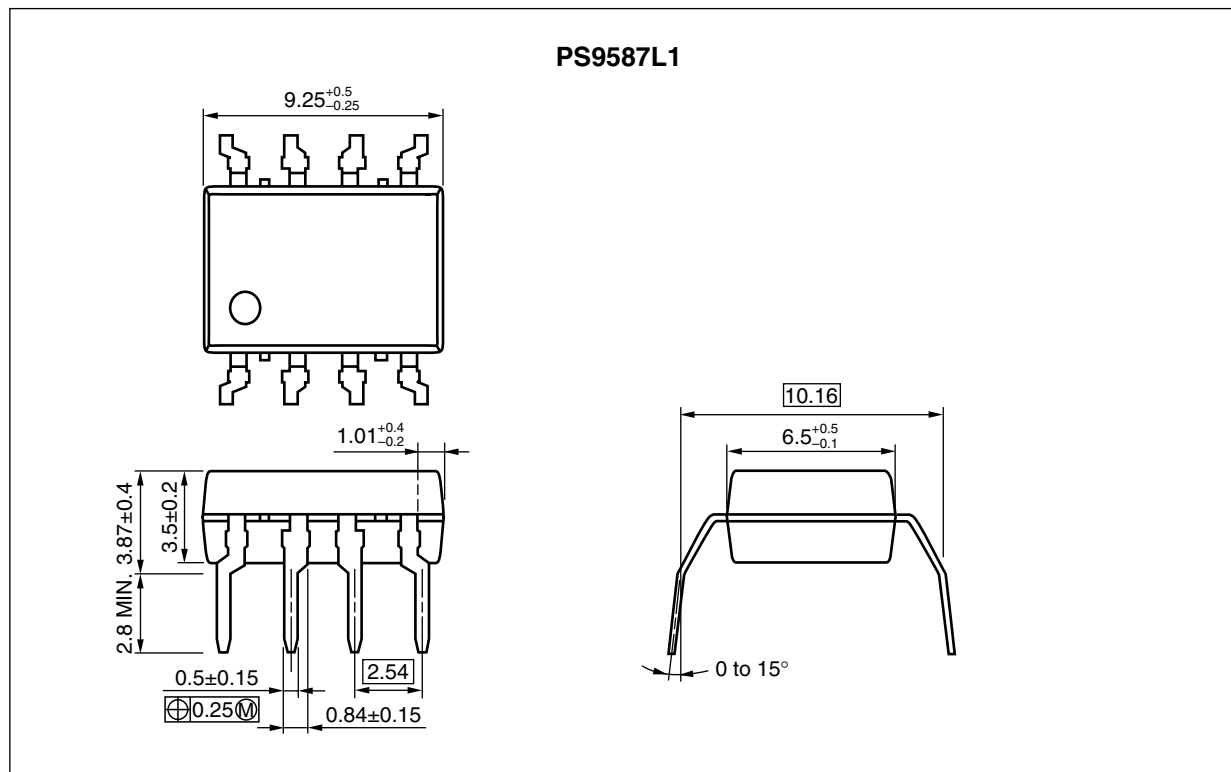
DIP Type



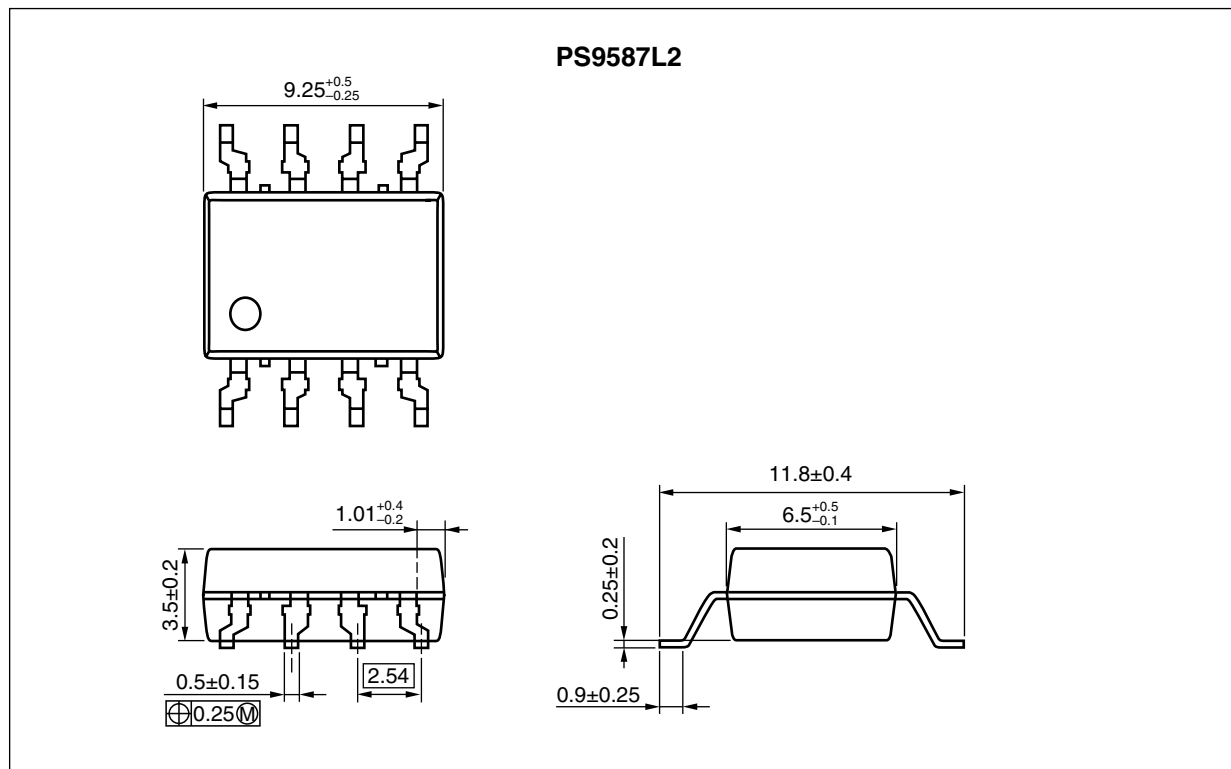
Lead Bending Type (Gull-wing) For Surface Mount



Lead Bending Type For Long Creepage Distance



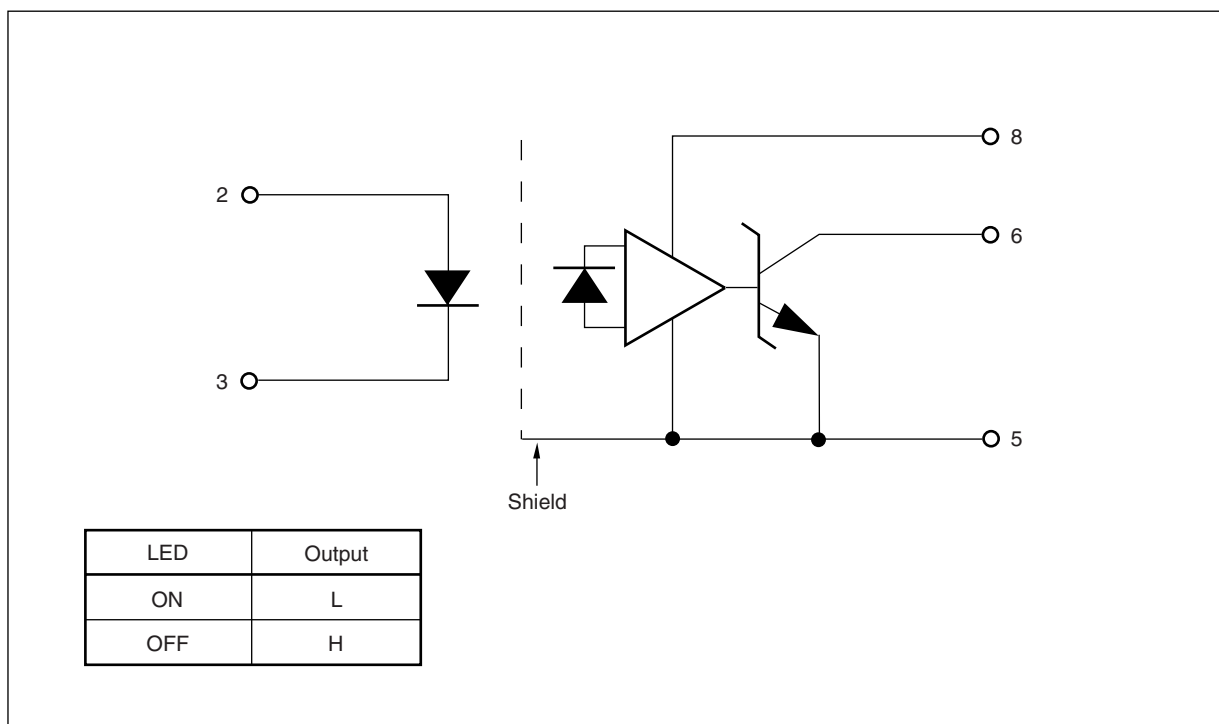
Lead Bending Type For Long Creepage Distance (Gull-wing) For Surface Mount



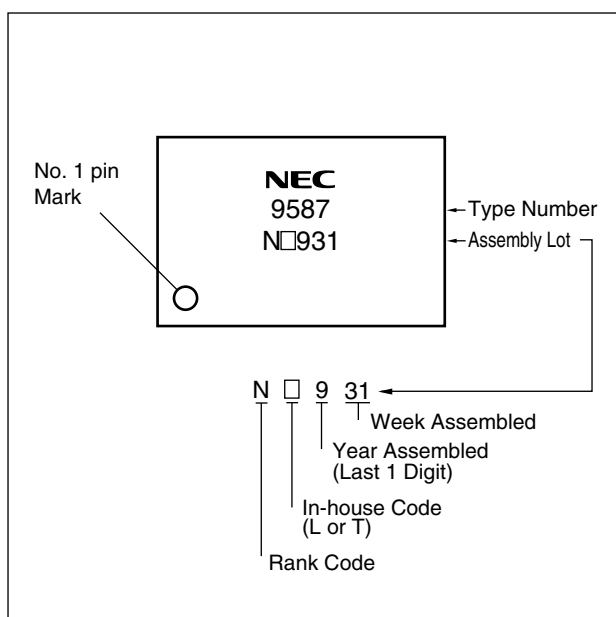
# PHOTOCOUPLER CONSTRUCTION

Parameter	PS9587, PS9587L3	PS9587L1, PS9587L2
Air Distance (MIN.)	7 mm	8 mm
Outer Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

# FUNCTIONAL DIAGRAM



# <R> MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number* <sup>1</sup>
PS9587	PS9587-AX	(Ni/Pd/Au)	Magazine case 50 pcs	Standard products (UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO approved)	PS9587
PS9587L1	PS9587L1-AX				PS9587L1
PS9587L2	PS9587L2-AX				PS9587L2
PS9587L3	PS9587L3-AX				PS9587L3
PS9587L2-E3	PS9587L2-E3-AX		Embossed Tape 1 000 pcs/reel		PS9587L2
PS9587L3-E3	PS9587L3-E3-AX				PS9587L3
PS9587-V	PS9587-V-AX		Magazine case 50 pcs	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	PS9587
PS9587L1-V	PS9587L1-V-AX				PS9587L1
PS9587L2-V	PS9587L2-V-AX				PS9587L2
PS9587L3-V	PS9587L3-V-AX				PS9587L3
PS9587L2-V-E3	PS9587L2-V-E3-AX		Embossed Tape 1 000 pcs/reel		PS9587L2
PS9587L3-V-E3	PS9587L3-V-E3-AX				PS9587L3

\*1 For the application of the Safety Standard, following part number should be used.

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, unless otherwise specified)**

Parameter		Symbol	Ratings	Unit
Diode	Forward Current <sup>*1</sup>	I <sub>F</sub>	30	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	7	V
	Output Voltage	V <sub>O</sub>	7	V
	Output Current	I <sub>O</sub>	25	mA
	Power Dissipation <sup>*2</sup>	P <sub>C</sub>	40	mW
Isolation Voltage <sup>*3</sup>		BV	5 000	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	−40 to +85	°C
Storage Temperature		T <sub>stg</sub>	−55 to +125	°C

**\*1** Reduced to 0.3 mA/°C at T<sub>A</sub> = 25°C or more.

**\*2** Applies to output pin V<sub>O</sub> (Collector pin). Reduced to 1.5 mW/°C at T<sub>A</sub> = 65°C or more.

**\*3** AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.

Pins 1-4 shorted together, 5-8 shorted together.

**RECOMMENDED OPERATING CONDITIONS (T<sub>A</sub> = 25°C)**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I <sub>FH</sub>	6.3	10	12.0	mA
Low Level Input Voltage	V <sub>FL</sub>	0		0.8	V
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
TTL (R <sub>L</sub> = 1 kΩ, loads)	N			5	
Pull-up Resistance	R <sub>L</sub>	330		4 k	Ω



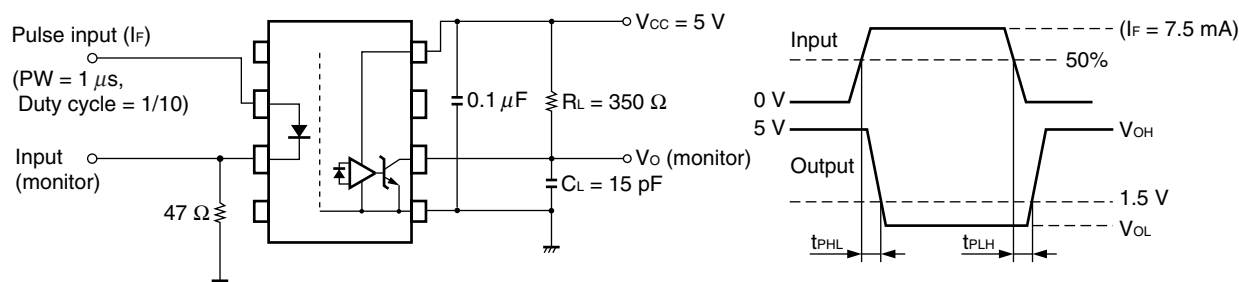
**ELECTRICAL CHARACTERISTICS** ( $T_A = -40$  to  $+85^\circ\text{C}$ , unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP. <sup>1)</sup>	MAX.	Unit
Diode	Forward Voltage	$V_F$	$I_F = 10\text{ mA}$ , $T_A = 25^\circ\text{C}$	1.4	1.65	1.8	V
	Reverse Current	$I_R$	$V_R = 3\text{ V}$ , $T_A = 25^\circ\text{C}$			10	$\mu\text{A}$
	Terminal Capacitance	$C_t$	$V_F = 0\text{ V}$ , $f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$		30	150	pF
Detector	High Level Output Current	$I_{OH}$	$V_{CC} = V_O = 5.5\text{ V}$ , $V_F = 0.8\text{ V}$		1	100	$\mu\text{A}$
	Low Level Output Voltage <sup>2)</sup>	$V_{OL}$	$V_{CC} = 5.5\text{ V}$ , $I_F = 5\text{ mA}$ , $I_{OL} = 13\text{ mA}$		0.2	0.6	V
	High Level Supply Current	$I_{CCH}$	$V_{CC} = 5.5\text{ V}$ , $I_F = 0\text{ mA}$ , $V_O = \text{Open}$		5	8	mA
	Low Level Supply Current	$I_{CCL}$	$V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ , $V_O = \text{Open}$		9	11	mA
Coupled	Threshold Input Current ( $H \rightarrow L$ )	$I_{FHL}$	$T_A = 25^\circ\text{C}$			3.3	mA
			$V_{CC} = 5\text{ V}$ , $V_O = 0.8\text{ V}$ , $R_L = 350\ \Omega$		1.5	5	
	Isolation Resistance	$R_{I-O}$	$V_{I-O} = 1\text{ kV}_{DC}$ , $R_H = 40$ to $60\%$ , $T_A = 25^\circ\text{C}$	$10^{11}$			$\Omega$
	Isolation Capacitance	$C_{I-O}$	$V = 0\text{ V}$ , $f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$		0.9	5	pF
	Propagation Delay Time ( $H \rightarrow L$ ) <sup>3)</sup>	$t_{PHL}$	$V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$		35	75	ns
			$V_{THHL} = V_{THLH} = 1.5\text{ V}$ ,			100	
	Propagation Delay Time ( $L \rightarrow H$ ) <sup>3)</sup>	$t_{PLH}$	$R_L = 350\ \Omega$ , $T_A = 25^\circ\text{C}$		45	75	ns
			$I_F = 7.5\text{ mA}$ , $C_L = 15\text{ pF}$			100	
	Rise Time	$t_r$			20		ns
	Fall Time	$t_f$			10		ns
	Pulse Width Distortion (PWD) <sup>3)</sup>	$ t_{PHL} - t_{PLH} $			10	50	ns
	Propagation Delay Skew	$t_{PSK}$				60	ns
	Common Mode Transient Immunity at High Level Output <sup>4)</sup>	$CM_H$	$V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ , $I_F = 0\text{ mA}$ , $V_{O(MIN.)} = 2\text{ V}$ , $V_{CM} = 1.5\text{ kV}$ , $R_L = 350\ \Omega$	15			kV/ $\mu\text{s}$
	Common Mode Transient Immunity at Low Level Output <sup>4)</sup>	$CM_L$	$V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ , $I_F = 7.5\text{ mA}$ , $V_{O(MAX.)} = 0.8\text{ V}$ , $V_{CM} = 1.5\text{ kV}$ , $R_L = 350\ \Omega$	15			kV/ $\mu\text{s}$

\*1 Typical values at  $T_A = 25^\circ\text{C}$

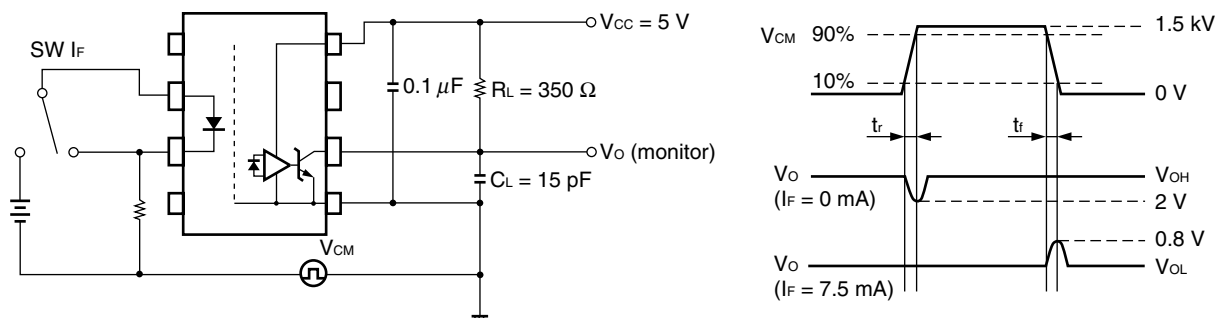
\*2 Because  $V_{OL}$  of 2 V or more may be output when LED current is input and when output power supply is on and off, confirm the characteristics (operation with the power supply on and off) during design, before using this device.

\*3 Test circuit for propagation delay time



**Remark**  $C_L$  includes probe and stray wiring capacitance.

\*4 Test circuit for common mode transient immunity



**Remark**  $C_L$  includes probe and stray wiring capacitance.

## USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than  $0.1 \mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Pins 1, 4 (which is an NC<sup>\*1</sup> pin) can either be connected directly to the GND pin on the LED side or left open. Also, Pin 7 (which is an NC<sup>\*1</sup> pin) can either be connected directly to the GND pin on the detector side or left open.

Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.

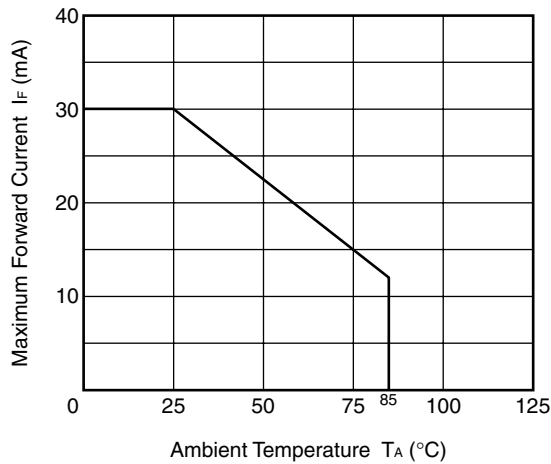
\*1 NC: Non-Connection (No Connection)

4. Avoid storage at a high temperature and high humidity.

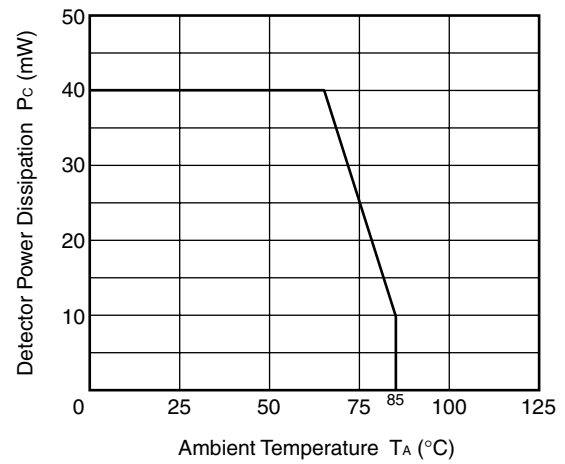
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**TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

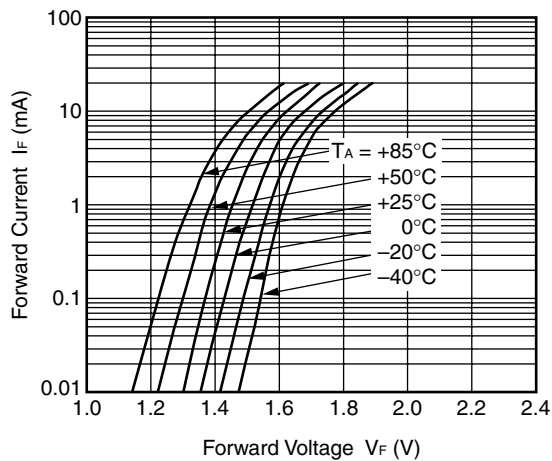
**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**



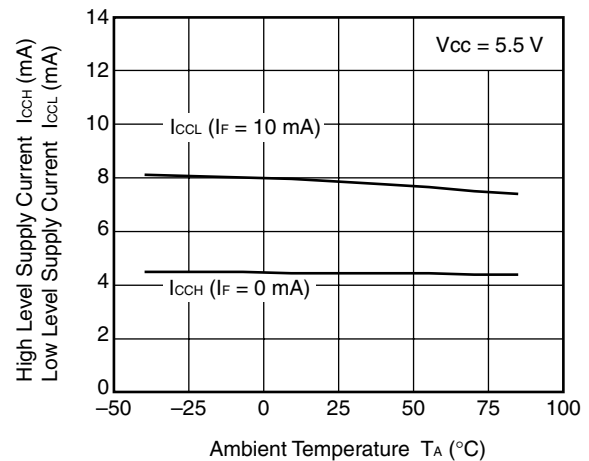
**DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



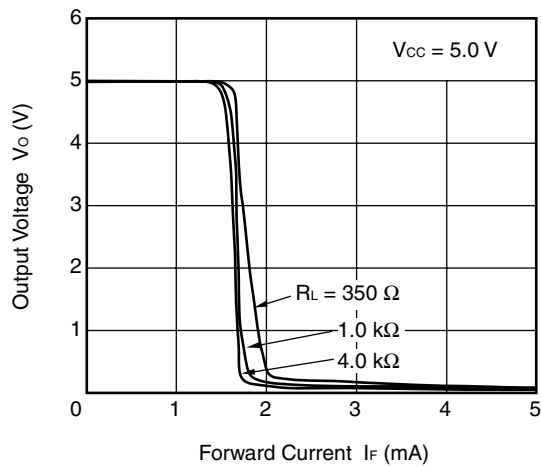
**FORWARD CURRENT vs. FORWARD VOLTAGE**



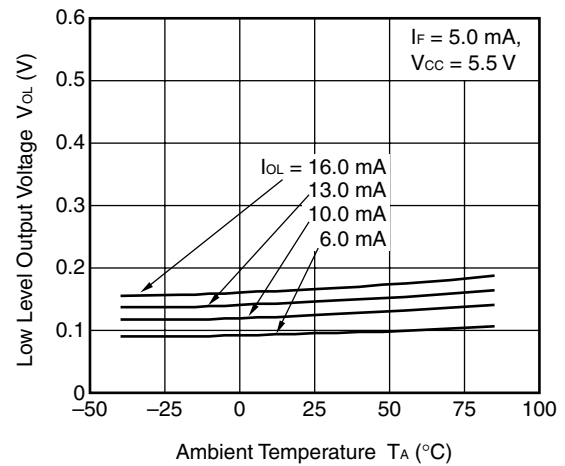
**SUPPLY CURRENT vs. AMBIENT TEMPERATURE**



**OUTPUT VOLTAGE vs. FORWARD CURRENT**

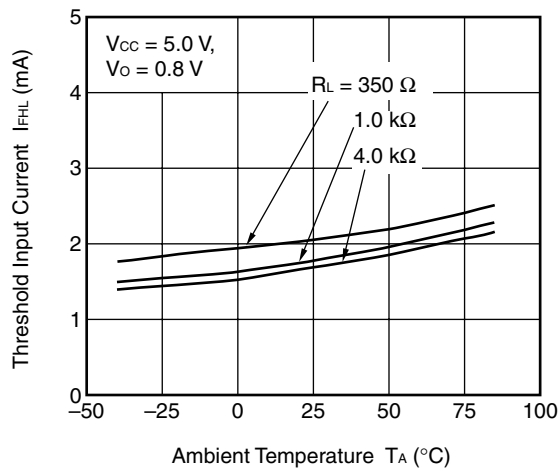


**LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE**

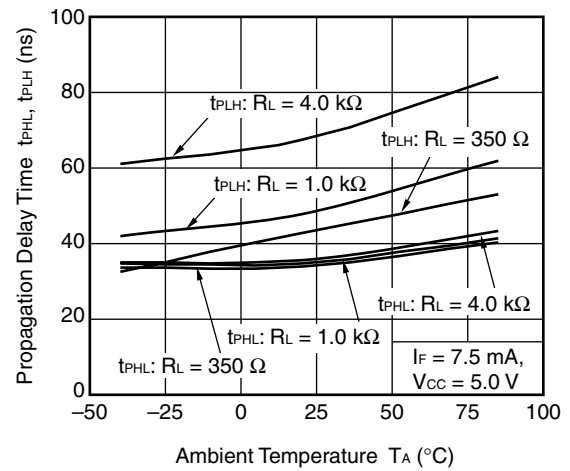


**Remark** The graphs indicate nominal characteristics.

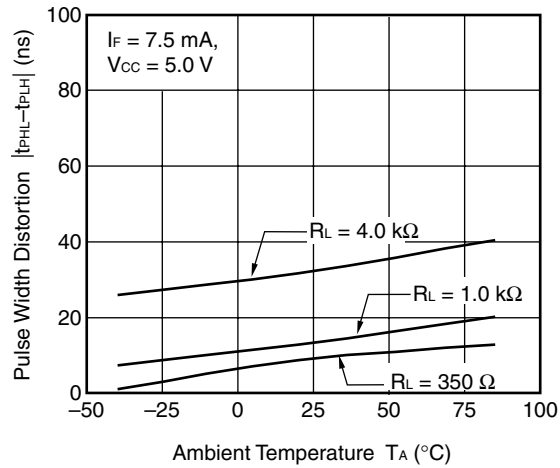
THRESHOLD INPUT CURRENT vs.  
AMBIENT TEMPERATURE



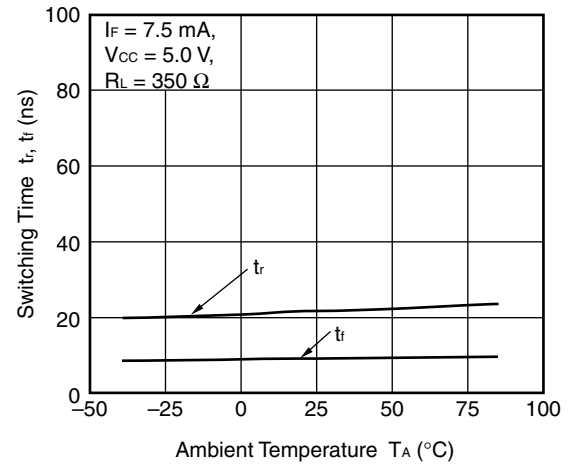
PROPAGATION DELAY TIME vs.  
AMBIENT TEMPERATURE



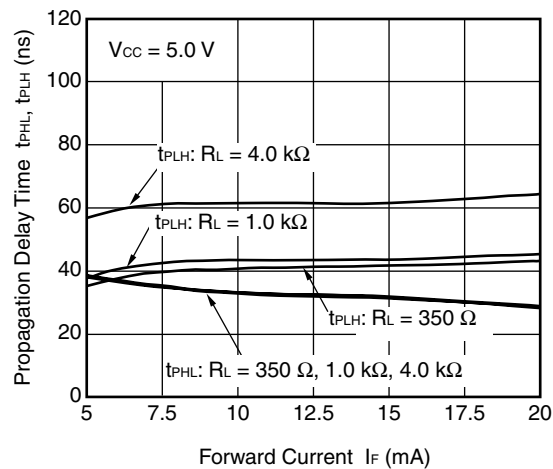
PULSE WIDTH DISTORTION vs.  
AMBIENT TEMPERATURE



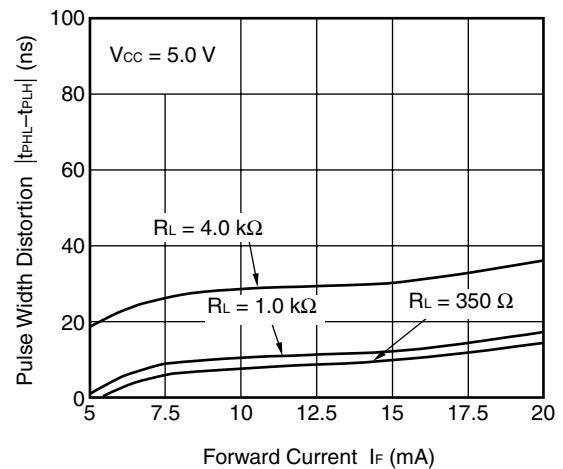
SWITCHING TIME vs.  
AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs.  
FORWARD CURRENT



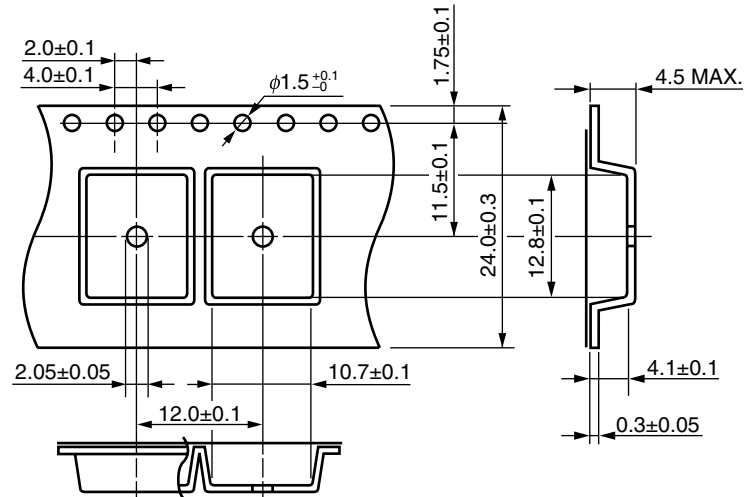
PULSE WIDTH DISTORTION vs.  
FORWARD CURRENT



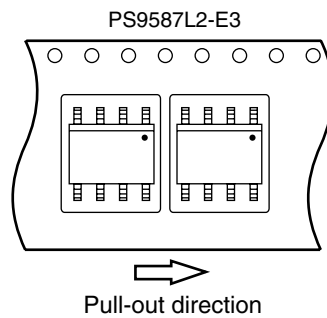
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

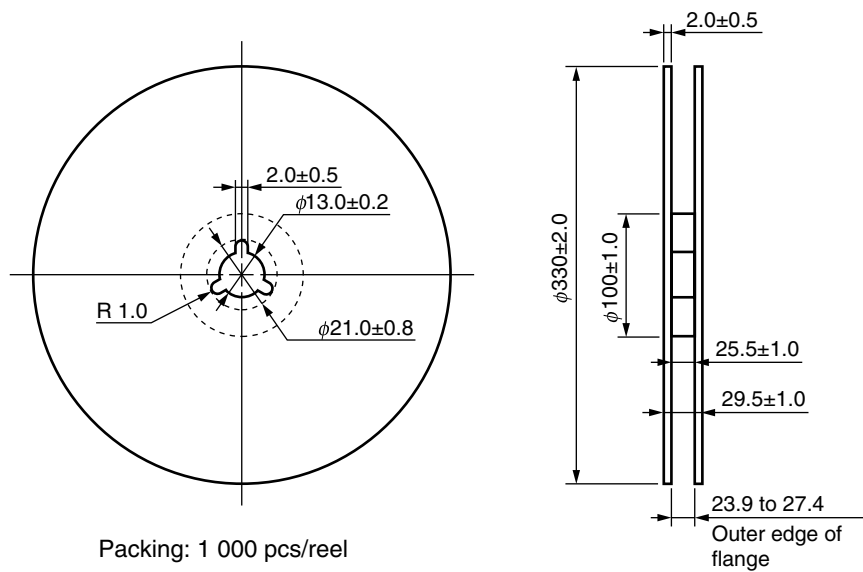
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



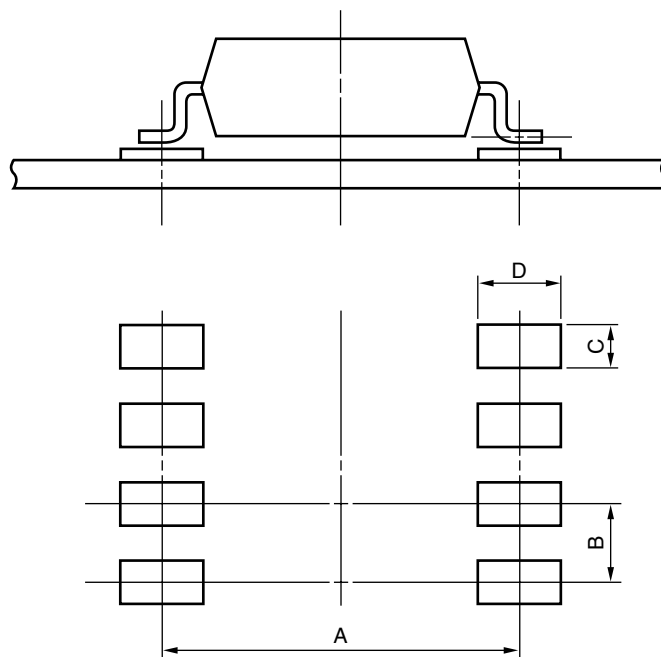
[illegible]

A diagram of a two-chambered heart. It consists of a large outer rectangle representing the pericardium, with a row of seven small circles along its top edge. Inside, there are two identical rectangular chambers (ventricles) side-by-side. Each ventricle has four small vertical lines on its top and bottom edges, and a small black dot on its right wall. A large, hollow arrow is positioned below the ventricles, pointing from left to right, indicating the direction of blood flow.

Technical drawing of a circular flange. The front view (left) shows a circular flange with a central hole. The outer diameter is  $\phi 330 \pm 2.0$ . The inner hole has a diameter of  $\phi 21.0 \pm 0.8$ . The central hole has a diameter of  $\phi 13.0 \pm 0.2$ . The flange thickness is  $2.0 \pm 0.5$ . The central hole has a radius of  $R 1.0$ . The side view (right) shows the flange profile with a total height of  $\phi 330 \pm 2.0$ . The central hole has a diameter of  $\phi 100 \pm 1.0$ . The flange thickness is  $17.5 \pm 1.0$ . The outer edge of the flange has a radius of  $21.5 \pm 1.0$ . The outer edge of the flange has a radius of  $15.9$  to  $19.4$ .

Packing: 1 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9587L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	2.54	1.7	2.2
PS9587L3	lead bending type (Gull-wing) for surface mount	8.2	2.54	1.7	2.2

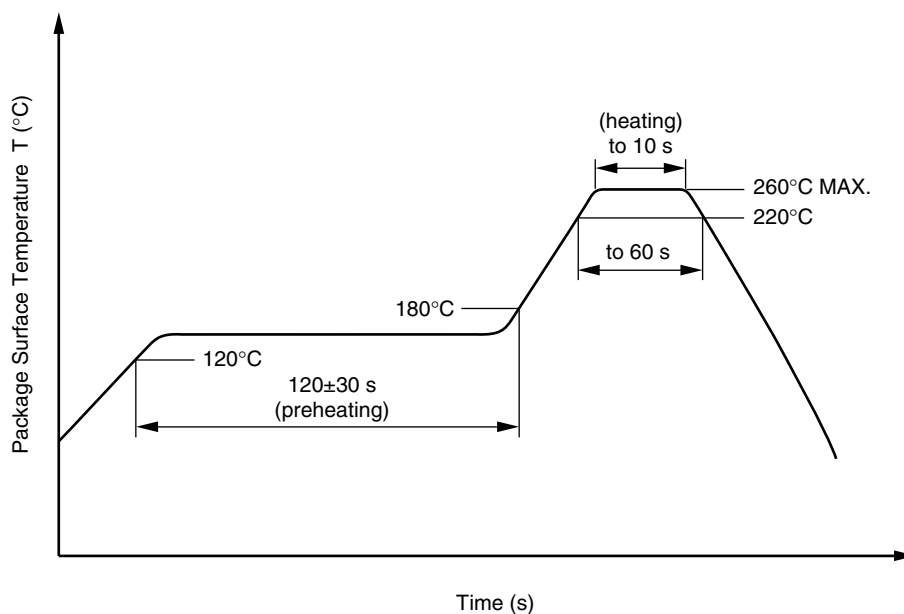
## NOTES ON HANDLING

### 1. Recommended soldering conditions

#### (1) Infrared reflow soldering

- Peak reflow temperature 260°C or below (package surface temperature)
- Time of peak reflow temperature 10 seconds or less
- Time of temperature higher than 220°C 60 seconds or less
- Time to preheat temperature from 120 to 180°C 120±30 s
- Number of reflows Three
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

Recommended Temperature Profile of Infrared Reflow



#### (2) Wave soldering

- Temperature 260°C or below (molten solder temperature)
- Time 10 seconds or less
- Preheating conditions 120°C or below (package surface temperature)
- Number of times One (Allowed to be dipped in solder including plastic mold portion.)
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

#### (3) Soldering by Soldering Iron

- Peak Temperature (lead part temperature) 350°C or below
- Time (each pins) 3 seconds or less
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(a) Soldering of leads should be made at the point 1.5 to 2.0 mm from the root of the lead

(b) Please be sure that the temperature of the package would not be heated over 100°C



**(4) Cautions**

- Fluxes

Avoid removing the residual flux with freon-based and chlorine-based cleaning solvent.

**2. Cautions regarding noise**

Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V<sub>CC</sub>-GND at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Speck	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/85/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}$ , $P_d < 5$ pC	$U_{IORM}$ $U_{pr}$	1 130 1 695	$V_{peak}$ $V_{peak}$
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$ , $P_d < 5$ pC	$U_{pr}$	2 119	$V_{peak}$
Highest permissible overvoltage	$U_{TR}$	8 000	$V_{peak}$
Degree of pollution (DIN EN 60664-1 VDE0110 Part 1)		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	CTI	175	
Material group (DIN EN 60664-1 VDE0110 Part 1)		III a	
Storage temperature range	$T_{stg}$	-55 to +125	°C
Operating temperature range	$T_A$	-40 to +85	°C
Isolation resistance, minimum value $V_{IO} = 500$ V dc at $T_A = 25^\circ\text{C}$ $V_{IO} = 500$ V dc at $T_A$ MAX. at least $100^\circ\text{C}$	$R_{is}$ MIN. $R_{is}$ MIN.	$10^{12}$ $10^{11}$	$\Omega$ $\Omega$
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current $I_F$ , $\Psi_i = 0$ ) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500$ V dc at $T_A = T_{si}$	$T_{si}$ $I_{si}$ $\Psi_i$ $R_{is}$ MIN.	175 400 700 $10^9$	°C mA mW $\Omega$

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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

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