

# PS9001

R08DS0130EJ0101

Rev.1.01

Oct 29, 2018

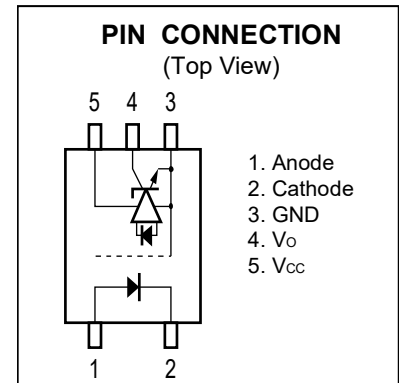
HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE,  
5-PIN SOP (LSO5 WITH 8mm CREEPAGE DISTANCE) PHOTOCOUPLER

## DESCRIPTION

The PS9001 is an optically coupled high-speed, active low type isolator containing an AlGaAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

## FEATURES

- Long creepage distance (8 mm MIN)
- High common mode transient immunity ( $CM_H, CM_L = \pm 50 \text{ kV}/\mu\text{s}$  MIN.)
- Operating Ambient Temperature (125 °C MAX.)
- High-speed response ( $t_{PHL} = 100 \text{ ns}$  MAX.,  $t_{PLH} = 100 \text{ ns}$  MAX.)
- Embossed tape product : PS9001-F3: 3000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: UL1577, Double protection
  - CSA approved: CAN/CSA-C22.2 No. 62368-1, Reinforced insulation
  - VDE approved: DIN EN 60747-5-5 (Option)



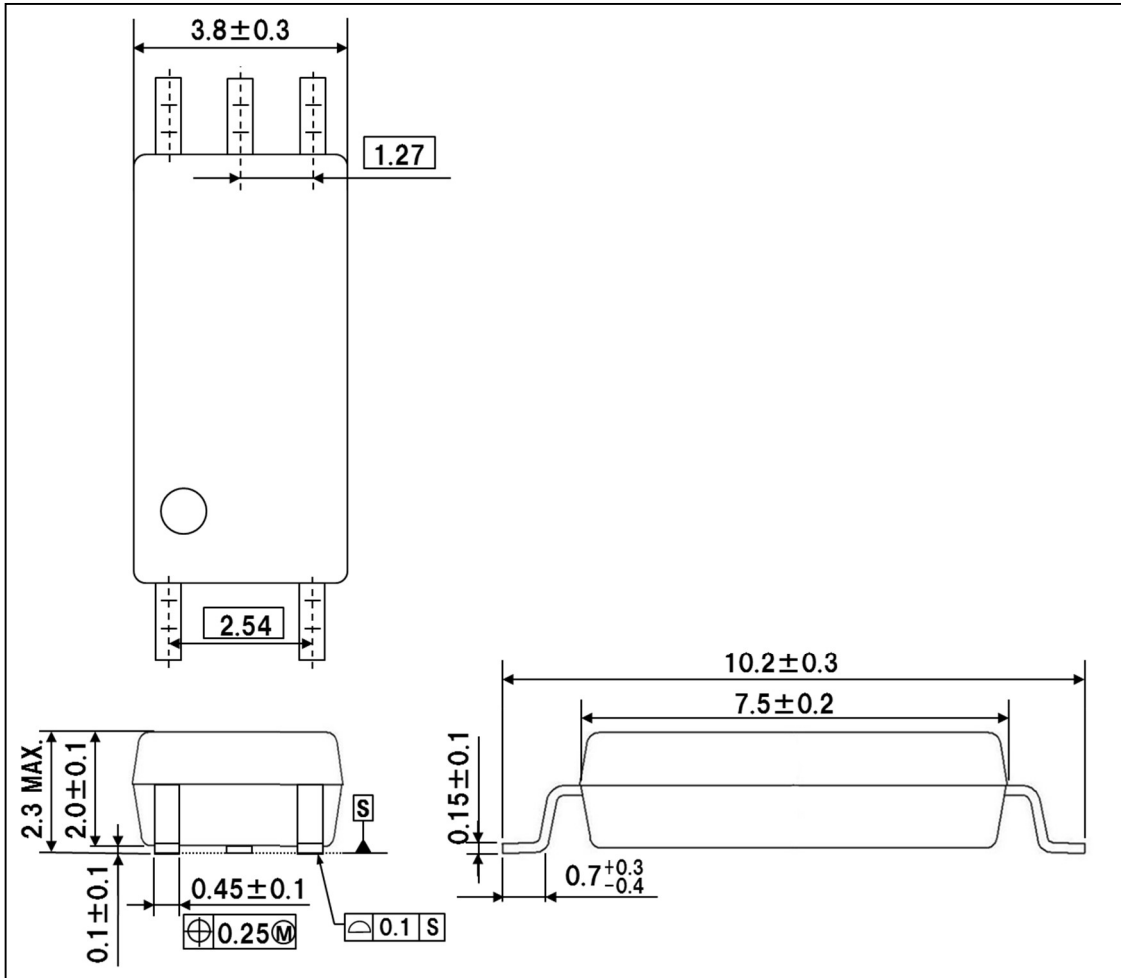
## APPLICATIONS

- Measurement equipment
- FA Network

Start of mass production

Oct.2015

**PACKAGE DIMENSIONS (UNIT: mm)**

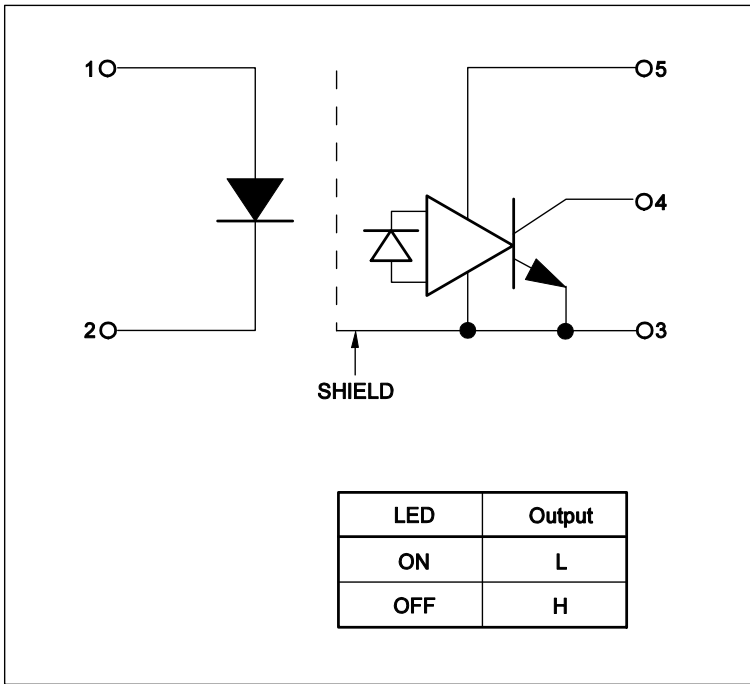


Weight : 0.119g (typ.)

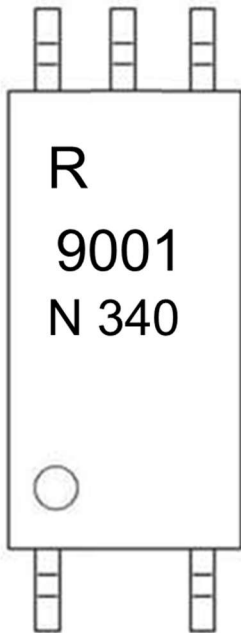
**PHOTOCOUPLER CONSTRUCTION**

Parameter	MIN.
Air Distance	8.0 mm
Creepage Distance	8.0 mm
Isolation Distance	0.15 mm

**BLOCK DIAGRAM (Unit: mm)**



**MARKING EXAMPLE**



R	An initial of "Renesas"	
9001	Product Part Number	
○	No.1 pin Mark, Anode Mark	
N340	N	Rank Code
		340
	3	Assembly Lot
		Last one-digit of Assembly Year
40	Weekly Serial Code	

## ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9001	PS9001-Y-AX	Pb-Free and Halogen Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9001
PS9001-F3	PS9001-Y-F3-AX		Embossed Tape 3 000 pcs/reel		
PS9001-V	PS9001-Y-V-AX		20 pcs (Tape 20 pcs cut)	UL, CSA, DIN EN 60747-5-5 approved	
PS9001-V-F3	PS9001-Y-V-F3-AX		Embossed Tape 3 000 pcs/reel		

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

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current *1	$I_F$	25	mA
	Reverse Voltage	$V_R$	5	V
Detector	Supply Voltage	$V_{CC}$	-0.5 to 7	V
	Output Voltage	$V_O$	-0.5 to 7	V
	Output Current	$I_O$	20	mA
	Power Dissipation	$P_C$	100	mW
Isolation Voltage *2		$BV$	5000	Vr.m.s.
Operating Ambient Temperature		$T_A$	-40 to +125	$^\circ\text{C}$
Storage Temperature		$T_{stg}$	-55 to +150	$^\circ\text{C}$

Notes: \*1. Reduced to 0.325 mA/ $^\circ\text{C}$  at  $T_A = 85^\circ\text{C}$  or more.

\*2. AC voltage for 1 minute at  $T_A = 25^\circ\text{C}$ , RH = 60% between input and output.

Pins 1-2 shorted together, 3-5 shorted together.

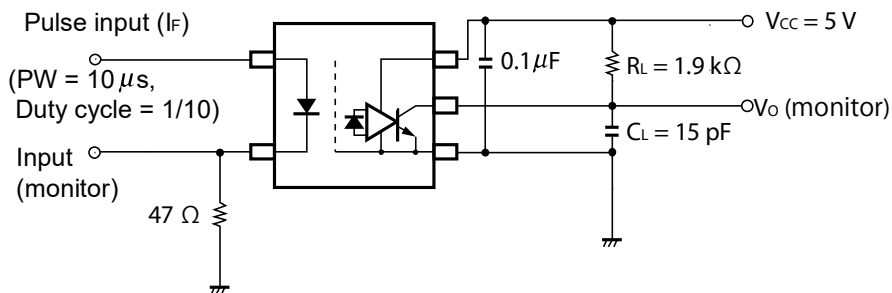
## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Voltage	$V_F$	-2	-	0.8	V
Low Level Input Current	$I_F$	8	10	12	mA
Supply Voltage	$V_{CC}$	4.5	5.0	5.5	V
Operating Ambient Temperature	$T_A$	-40	-	125	$^\circ\text{C}$

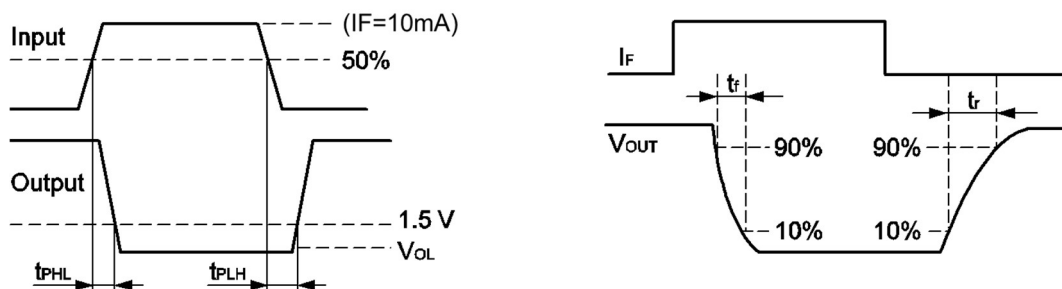
**ELECTRICAL CHARACTERISTICS** ( $T_A = -40$  to  $+125^\circ\text{C}$ ,  $V_{CC}=5\text{V}$  unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP. *1	MAX.	Unit
Diode	Forward Voltage	$V_F$	$I_F = 10 \text{ mA}$ , $T_A = 25^\circ\text{C}$	1.35	1.56	1.75	V
	Reverse Current	$I_R$	$V_R = 3 \text{ V}$ , $T_A = 25^\circ\text{C}$			10	$\mu\text{A}$
	Terminal Capacitance	$C_t$	$f = 1 \text{ MHz}$ , $V_F = 0 \text{ V}$ , $T_A = 25^\circ\text{C}$		30		pF
Detector	High Level Output Current	$I_{OH}$	$V_{CC} = V_O = 5.5 \text{ V}$ , $V_F = 0.8 \text{ V}$			50	$\mu\text{A}$
	Low Level Output Voltage	$V_{OL}$	$I_F = 4 \text{ mA}$ , $I_{OL} = 5 \text{ mA}$		0.1	0.6	V
	High Level Supply Current	$I_{CCH}$	$V_{CC} = 5.5 \text{ V}$ , $I_F = 0 \text{ mA}$ , $V_O = \text{open}$		1.4	2.0	mA
	Low Level Supply Current	$I_{CCL}$	$V_{CC} = 5.5 \text{ V}$ , $I_F = 10\text{mA}$ , $V_O = \text{open}$		1.4	2.0	mA
Coupled	Threshold Input Voltage (H $\rightarrow$ L)	$I_{FHL}$	$V_O = 0.6\text{V}$ , $I_O = 5\text{mA}$		1.2	4.0	mA
	Propagation Delay Time (H $\rightarrow$ L) *2	$t_{PHL}$	$I_F = 10 \text{ mA}$ , $R_L = 1.9 \text{ k}\Omega$ , $C_L = 15 \text{ pF}$ , $V_{THHL} = 1.5 \text{ V}$ , $V_{THLH} = 1.5 \text{ V}$		35	100	ns
	Propagation Delay Time (L $\rightarrow$ H) *2	$t_{PLH}$			65	100	ns
	Pulse Width Distortion (PWD)	$ t_{PHL} - t_{PLH} $			30	50	ns
	Propagation Delay Skew	$t_{psk}$				60	ns
	Common Mode Transient Immunity at High Level Output *3	$CM_H$	$T_A = 25^\circ\text{C}$ , $I_F = 0 \text{ mA}$ , $V_O > 1.5 \text{ V}$ , $R_L = 1.9 \text{ k}\Omega$ , $V_{CM} = 1.5 \text{ kV}$ , $C_L = 15 \text{ pF}$	50			$\text{kV}/\mu\text{s}$
	Common Mode Transient Immunity at Low Level Output *3	$CM_L$	$T_A = 25^\circ\text{C}$ , $I_F = 10 \text{ mA}$ , $V_O < 1.5 \text{ V}$ , $R_L = 1.9 \text{ k}\Omega$ , $V_{CM} = 1.5 \text{ kV}$ , $C_L = 15 \text{ pF}$	50			$\text{kV}/\mu\text{s}$

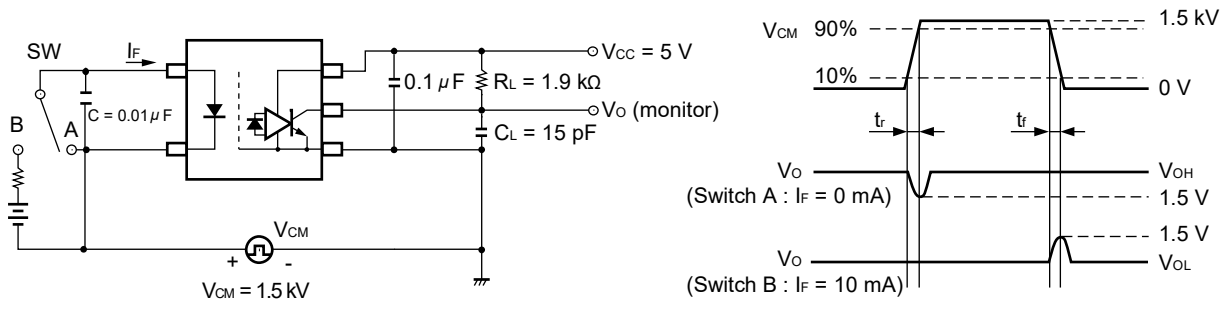
- Notes: \*1. Typical values at  $T_A = 25^\circ\text{C}$   
 \*2. Test circuit for  $t_{PHL}$  and  $t_{PLH}$



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



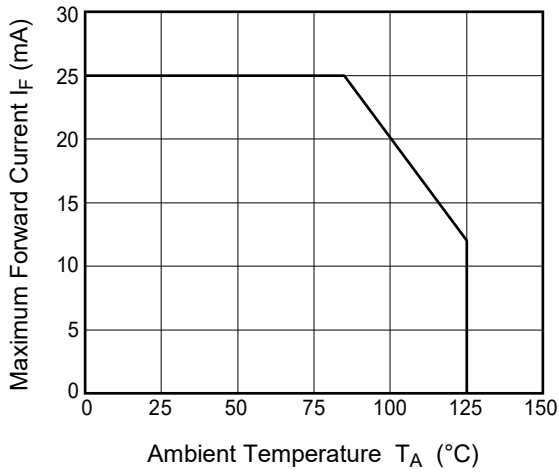
\*3. Test circuit for common mode transient immunity



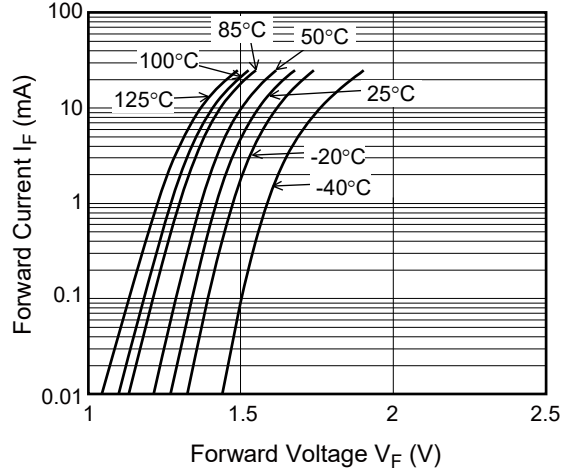
**Remark** CL includes probe and stray wiring capacitance.

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

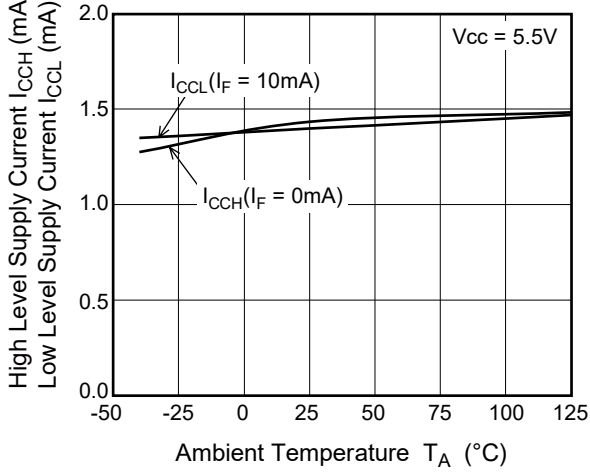
**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**



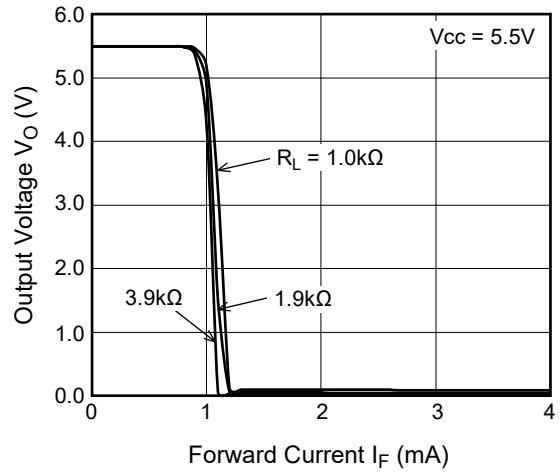
**FORWARD CURRENT vs. FORWARD VOLTAGE**



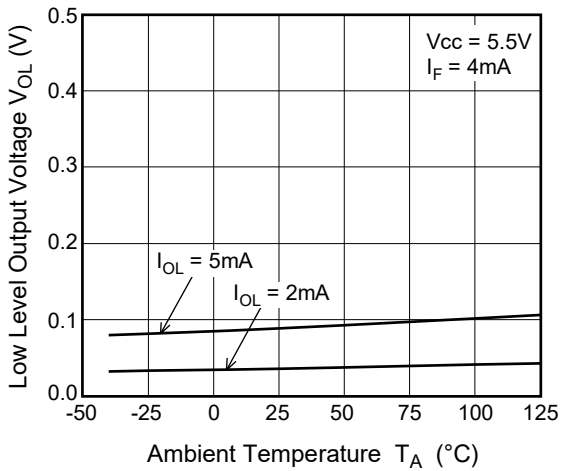
**SUPPLY CURRENT vs. AMBIENT TEMPERATURE**



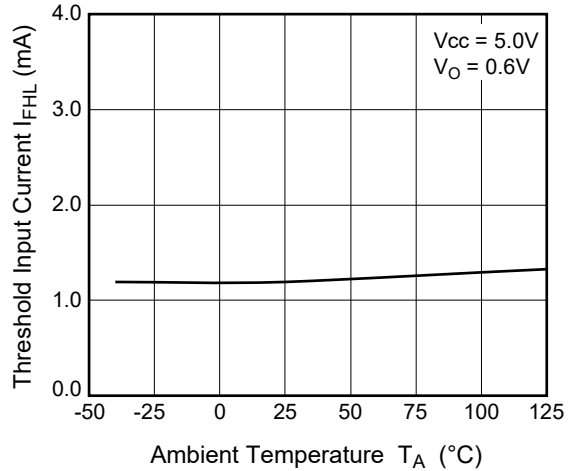
**OUTPUT VOLTAGE vs. FORWARD CURRENT**



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

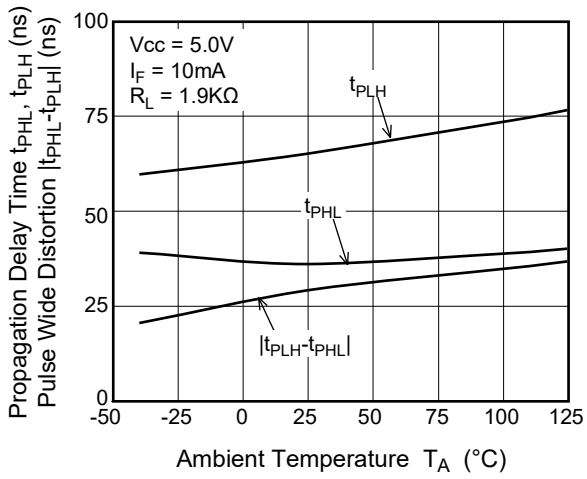


**THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE**

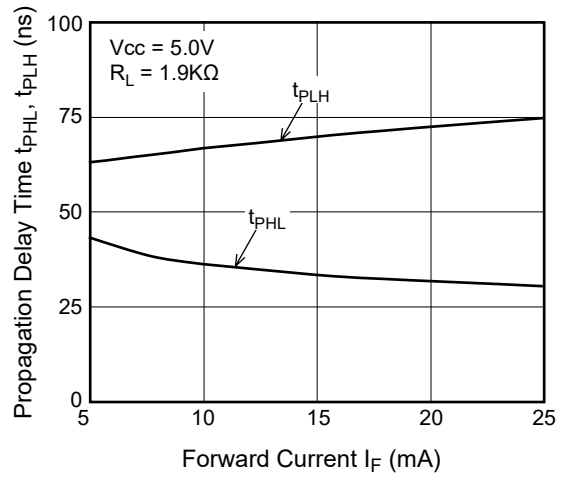


**Remark** The graphs indicate nominal characteristics.

PROPAGATION DELAY TIME,  
PULSE WIDE DISTORTION  
vs. AMBIENT TEMPERATURE



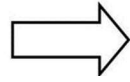
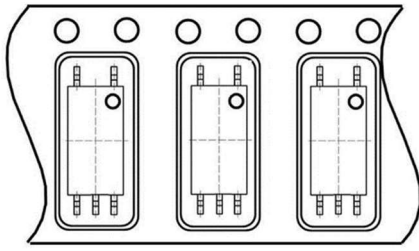
PROPAGATION DELAY TIME  
vs. FORWARD CURRENT



**Remark** The graphs indicate nominal characteristics.

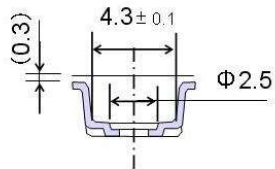
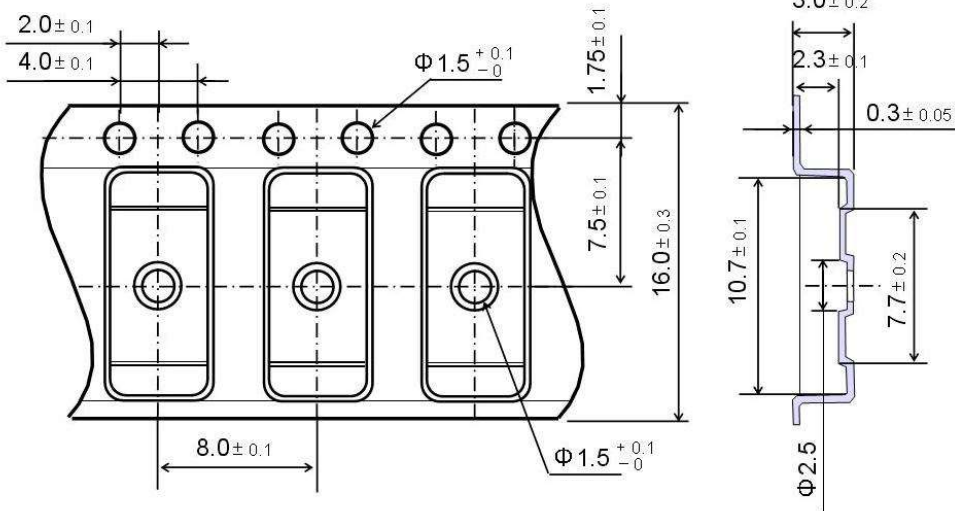


TAPING SPECIFICATIONS (UNIT: mm)

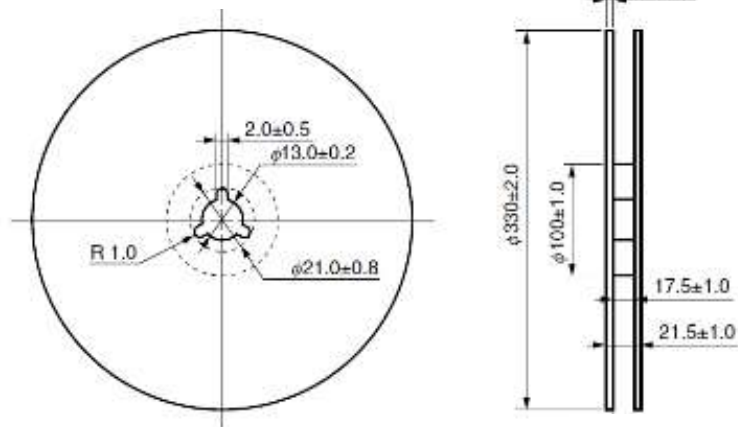


Tape Direction

Outline and Dimensions (Taps)

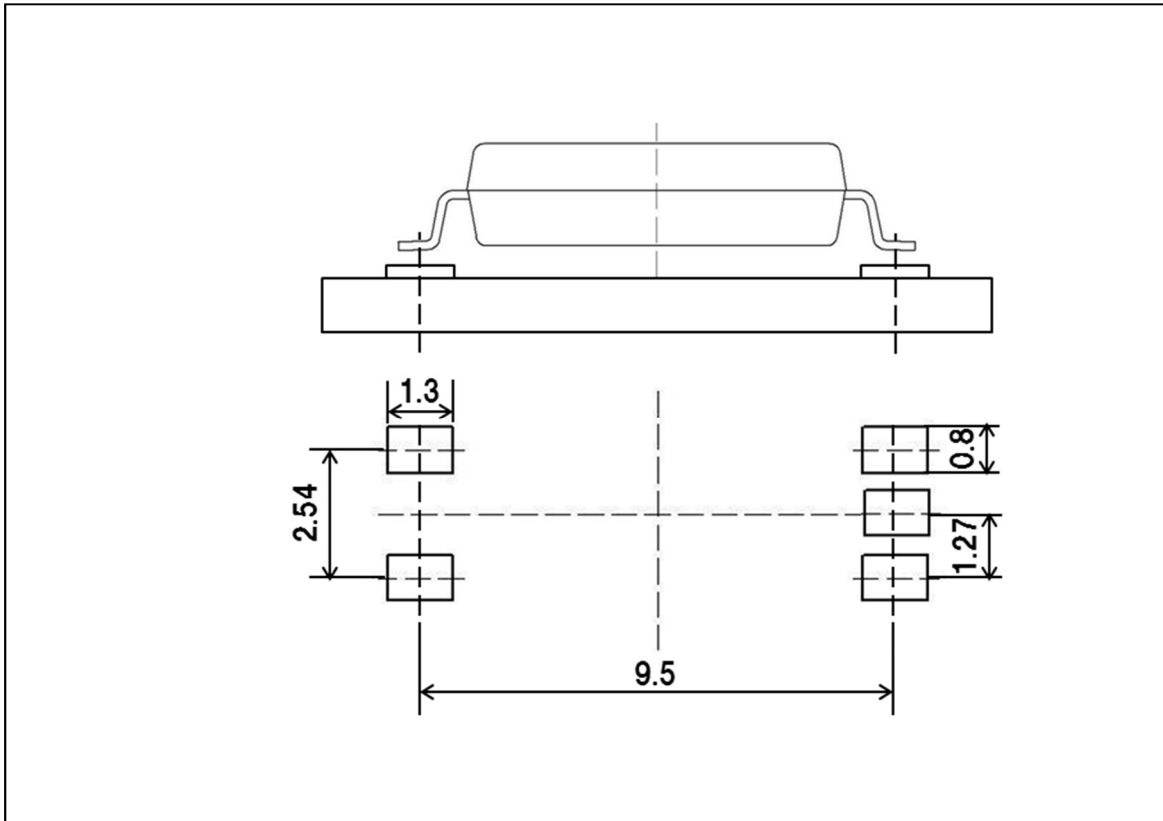


Outline and Dimensions (Reel)



Packing: 3000 pcs/reel

## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



**Remark** All dimensions in this figure must be evaluated before use.

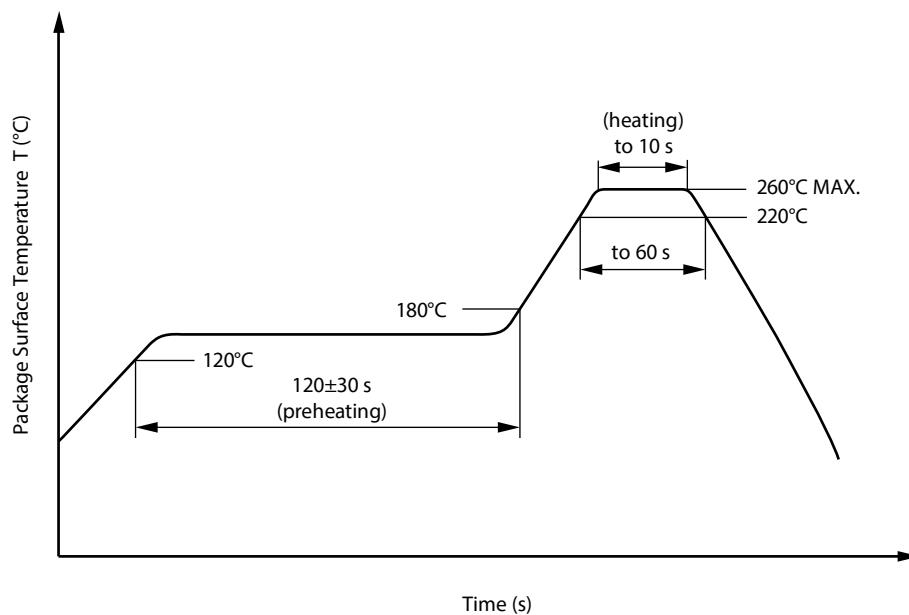
## NOTES ON HANDLING

### 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

#### (4) Cautions

- Fluxes Avoid removing the residual flux with freon-based and halogens-based (chlorine-based) cleaning solvent.

### 2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler's input and output at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

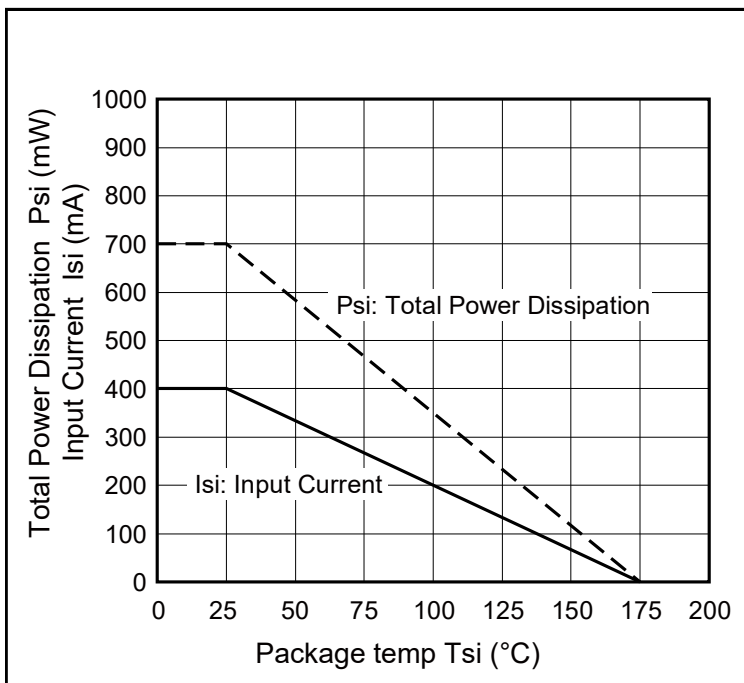
## USAGE CAUTIONS

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. Avoid storage at a high temperature and high humidity.
4. Do not use adhesives or coating materials including halogens to fix this device.

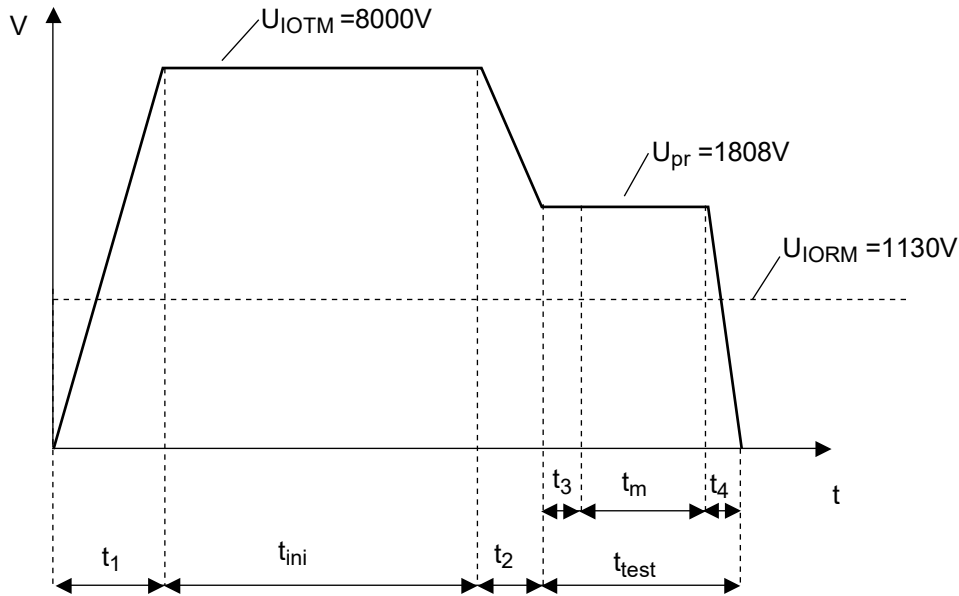
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/125/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{IORM}$ $U_{pr}$	1 130 1 808	$V_{peak}$ $V_{peak}$
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{pr}$	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	400	
Material group (DIN EN 60664-1 VDE0110 Part 1)		II	
Storage temperature range	$T_{stg}$	-55 to +150	°C
Operating temperature range	$T_A$	-40 to +125	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$	Ris MIN. Ris 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 $I_F$ , $P_{si} = 0$ ) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	$T_{si}$ $I_{si}$ $P_{si}$ Ris MIN.	175 400 700 $10^9$	°C mA mW $\Omega$

Dependence of maximum safety ratings with package temperature

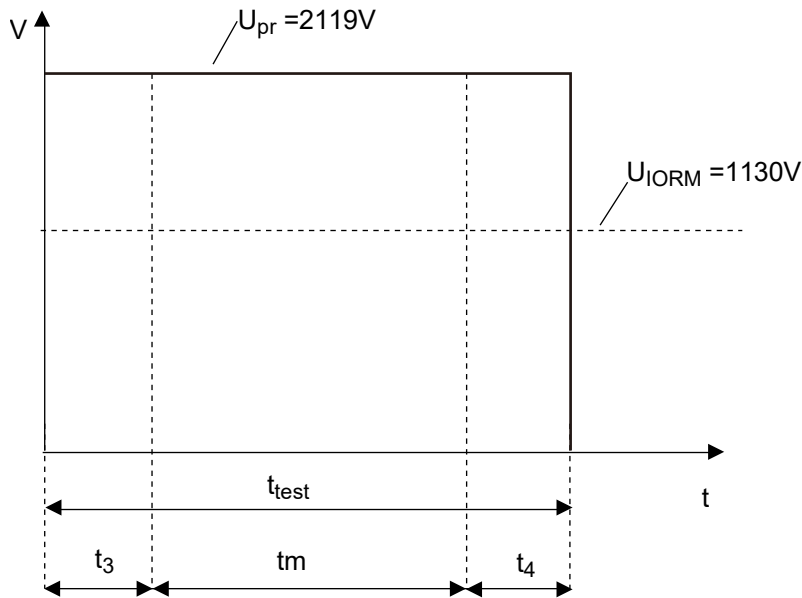


**Method a) Destructive Test, Type and Sample Test**



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$   
 $t_3, t_4 = 1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 10 \text{ sec}$   
 $t_{\text{test}} = 12 \text{ sec}$   
 $t_{\text{ini}} = 60 \text{ sec}$

**Method b) Non-destructive Test, 100% Production Test**



$t_3, t_4 = 0.1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 1.0 \text{ sec}$   
 $t_{\text{test}} = 1.2 \text{ sec}$

<b>Caution</b>	GaAs Products	<p>This product uses gallium arsenide (GaAs). GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points.</p> <ul style="list-style-type: none"><li>• Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.<ol style="list-style-type: none"><li>1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.</li><li>2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.</li></ol></li><li>• Do not burn, destroy, cut, crush, or chemically dissolve the product.</li><li>• Do not lick the product or in any way allow it to enter the mouth.</li></ul>
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(Rev.4.0-1 November 2017)



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#### California Eastern Laboratories, Inc.

4590 Patrick Henry Drive, Santa Clara, California 95054-1817, U.S.A.  
Tel: +1-408-919-2500, Fax: +1-408-988-0279

#### Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

#### Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

#### Renesas Electronics (China) Co., Ltd.

Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

#### Renesas Electronics (Shanghai) Co., Ltd.

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

#### Renesas Electronics Hong Kong Limited

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852 2886-9022

#### Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

#### Renesas Electronics Singapore Pte. Ltd.

80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

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Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

#### Renesas Electronics India Pvt. Ltd.

No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

#### Renesas Electronics Korea Co., Ltd.

17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338



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**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
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помещение 100-Н Офис 331