

1 Mbps TOTEM POLE OUTPUT TYPE  
HIGH CMR, IPM DRIVER  
6-PIN SDIP PHOTOCOUPLER

–NEPOC Series–

DESCRIPTION

The PS9303L and PS9303L2 are optical coupled high-speed, totem pole output (active high output type) isolators containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

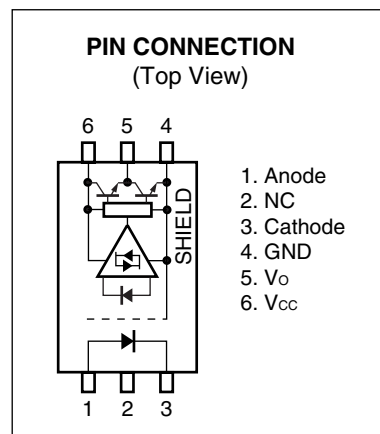
The PS9303L and PS9303L2 are specified high CMR and pulse width distortion with operating temperature. It is suitable for IPM drive.

The PS9303L is lead bending type (Gull-wing) for surface mounting.

The PS9303L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

FEATURES

- High common mode transient immunity ( $CM_H, CM_L = \pm 15 \text{ kV}/\mu\text{s MIN.}$ )
- Half size of 8-pin DIP
- Pulse width distortion ( $|t_{PLH} - t_{PHL}| = 350 \text{ ns MAX.}$ )
- High-speed (1 Mbps)
- High isolation voltage ( $BV = 5\,000 \text{ Vr.m.s.}$ )
- Totem pole output (Active High Output Type)
- <R> • Ordering number of tape product: PS9303L-E3, PS9303L2-E3: 2 000 pcs/reel
- Pb-Free product
- <R> • Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40024069 (Option)



APPLICATIONS

- IPM Driver
- General purpose inverter

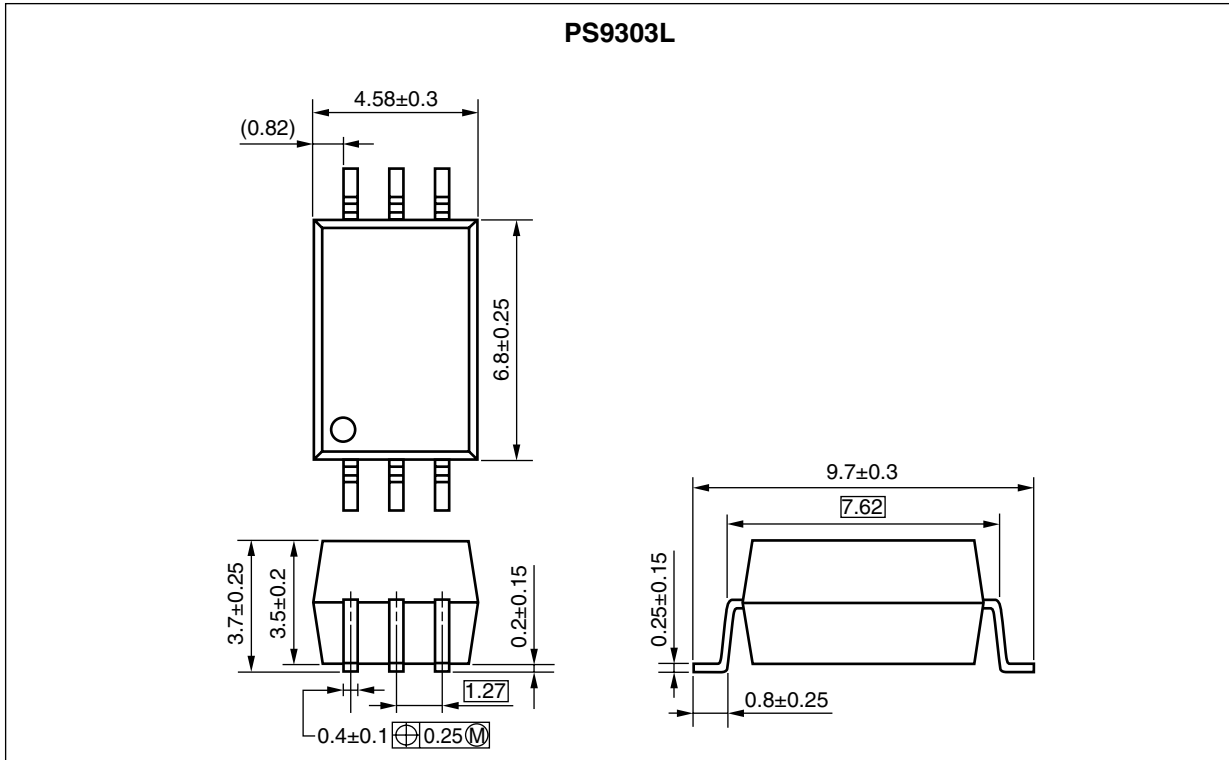
TRUTH TABLE

LED	Output
ON	H
OFF	L

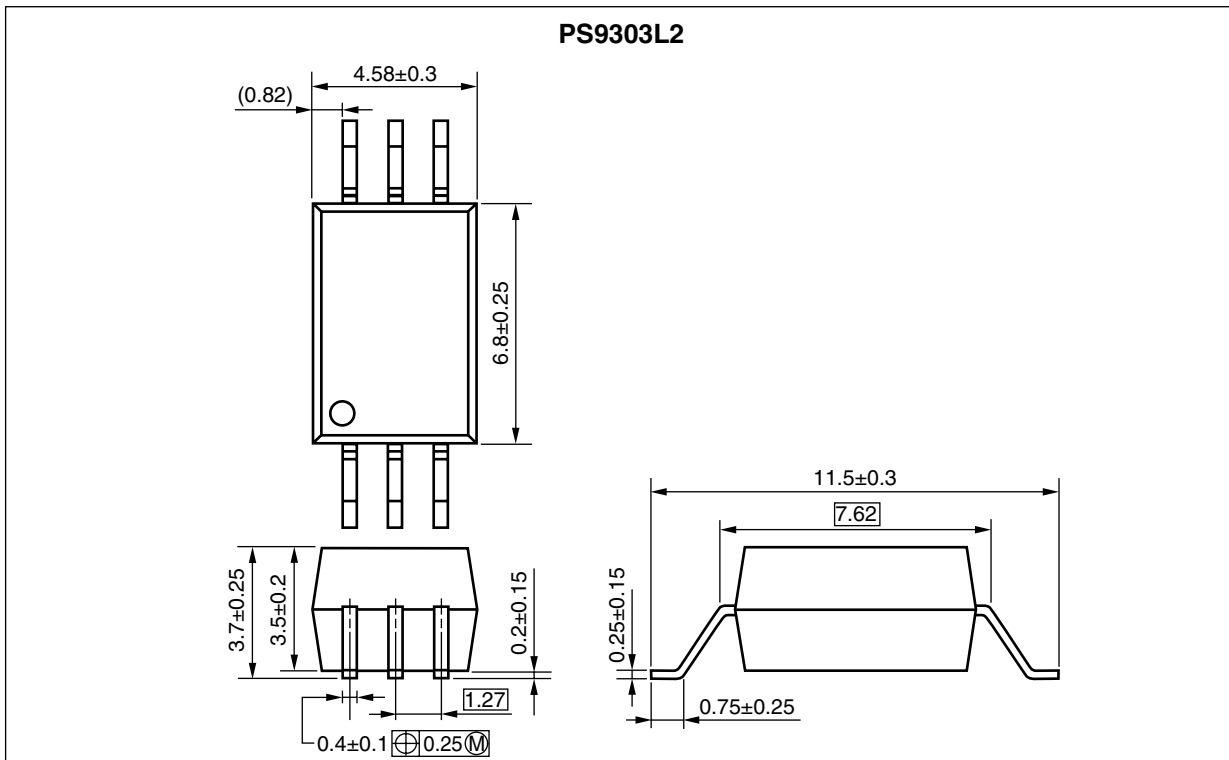
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PACKAGE DIMENSIONS (UNIT: mm)

Lead Bending Type (Gull-wing) For Surface Mount



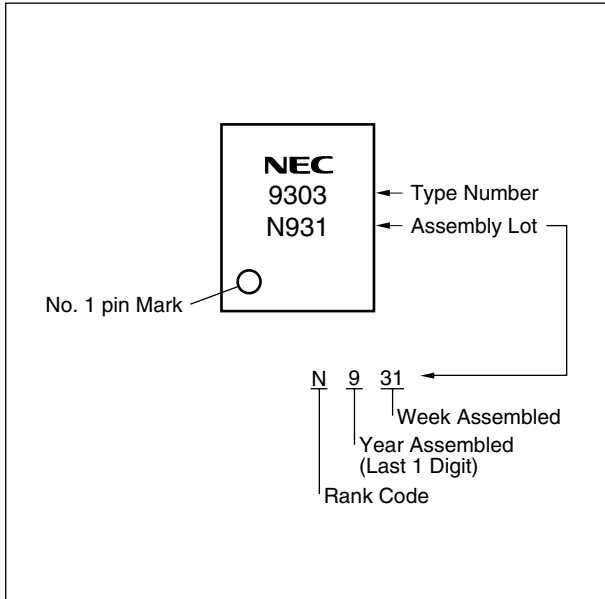
Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)



**PHOTOCOUPLER CONSTRUCTION**

Parameter	PS9303L	PS9303L2
Air Distance (MIN.)	7 mm	8 mm
Outer Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

**<R> MARKING EXAMPLE**



**ORDERING INFORMATION**

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number <sup>1</sup>
PS9303L	PS9303L-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9303L
PS9303L-E3	PS9303L-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9303L2	PS9303L2-AX		20 pcs (Tape 20 pcs cut)		PS9303L2
PS9303L2-E3	PS9303L2-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9303L-V	PS9303L-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2	PS9303L
PS9303L-V-E3	PS9303L-V-E3-AX		Embossed Tape 2 000 pcs/reel	(VDE0884 Part2)	
PS9303L2-V	PS9303L2-V-AX		20 pcs (Tape 20 pcs cut)	Approved (Option)	PS9303L2
PS9303L2-V-E3	PS9303L2-V-E3-AX		Embossed Tape 2 000 pcs/reel		

\*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>	20	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	-0.5 to +25	V
	Output Voltage	V <sub>O</sub>	-0.5 to +25	V
	Output Current	I <sub>O</sub>	25	mA
	Power Dissipation <sup>2</sup>	P <sub>C</sub>	210	mW
Isolation Voltage <sup>3</sup>		BV	5 000	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +100	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

\*1 Reduced to 0.33 mA/°C at T<sub>A</sub> = 70°C or more.

\*2 Reduced to 4.0 mW/°C at T<sub>A</sub> = 70°C or more.

\*3 AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.  
Pins 1-3 shorted together, 4-6 shorted together.

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	4.5	15	20	V
Output Voltage	V <sub>O</sub>	0		20	V
Input Current (ON)	I <sub>F (ON)</sub>	6		10	mA
Input Voltage (OFF)	V <sub>F (OFF)</sub>	0		0.8	V

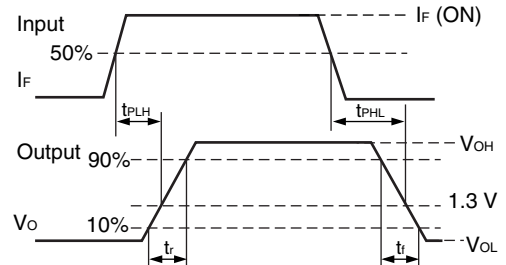
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +100°C, V<sub>CC</sub> = 4.5 to 20 V, unless otherwise specified)**

Parameter		Symbol	Conditions	MIN.	TYP. <sup>1)</sup>	MAX.	Unit
Diode	Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 10 mA, T <sub>A</sub> = 25°C	1.2	1.6	1.9	V
	Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 3 V, T <sub>A</sub> = 25°C			10	μA
	Terminal Capacitance	C <sub>t</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		30		pF
Detector	High Level Output Voltage	V <sub>OH</sub>	V <sub>CC</sub> = 5 V, I <sub>O</sub> = -3.5 mA, I <sub>F</sub> = 10 mA	2.4	3.5		V
			V <sub>CC</sub> = 20 V, I <sub>O</sub> = -3.5 mA, I <sub>F</sub> = 10 mA	17.4	18.1		
	Low Level Output Voltage <sup>2)</sup>	V <sub>OL</sub>	I <sub>O</sub> = 3.5 mA, V <sub>F</sub> = 0 V		0.1	0.35	V
	High Level Supply Current	I <sub>CCH</sub>	V <sub>CC</sub> = 5 V, I <sub>F</sub> = 10 mA		1.6	2.7	mA
			V <sub>CC</sub> = 20 V, I <sub>F</sub> = 10 mA		1.8	3	
	Low Level Supply Current	I <sub>CCL</sub>	V <sub>CC</sub> = 5 V, V <sub>F</sub> = 0 V		2.7	3.7	mA
			V <sub>CC</sub> = 20 V, V <sub>F</sub> = 0 V		2.9	4	
	High Level Output Short Circuit Current	I <sub>OSH</sub>	V <sub>CC</sub> = 20 V, V <sub>O</sub> = GND, I <sub>F</sub> = 10 mA	-7	-40		mA
Low Level Output Short Circuit Current	I <sub>OSL</sub>	V <sub>CC</sub> = V <sub>O</sub> = 20 V, V <sub>F</sub> = 0 V	7	40		mA	
Coupled	Threshold Input Current	I <sub>FLH</sub>	V <sub>CC</sub> = 5 V, V <sub>O</sub> > 2.4 V, I <sub>O</sub> = -3.5 mA		2.4	5	mA
	Isolation Resistance	R <sub>I-O</sub>	V <sub>I-O</sub> = 500 V <sub>DC</sub> , RH = 60%, T <sub>A</sub> = 25°C	10 <sup>12</sup>			Ω
	Isolation Capacitance	C <sub>I-O</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		0.6		pF
	Propagation Delay Time (H → L) <sup>3)</sup>	t <sub>PHL</sub>	V <sub>CC</sub> = 20 V, C <sub>L</sub> = 100 pF, I <sub>F</sub> = 10 → 0 mA, V <sub>THHL</sub> = 1.3 V	50	185	550	ns
	Propagation Delay Time (L → H) <sup>3)</sup>	t <sub>PLH</sub>	V <sub>CC</sub> = 20 V, C <sub>L</sub> = 100 pF, I <sub>F</sub> = 0 → 10 mA, V <sub>THLH</sub> = 1.3 V	50	240	500	ns
	Pulse Width Distortion (PWD)	t <sub>PLH</sub> -t <sub>PHL</sub>	V <sub>CC</sub> = 20 V, C <sub>L</sub> = 100 pF, I <sub>F</sub> = 10 ↔ 0 mA		55	350	ns
	Rise Time (10-90%) <sup>3)</sup>	t <sub>r</sub>	V <sub>CC</sub> = 20 V, C <sub>L</sub> = 100 pF, I <sub>F</sub> = 0 → 10 mA		120		ns
	Fall Time (90-10%) <sup>3)</sup>	t <sub>f</sub>	V <sub>CC</sub> = 20 V, C <sub>L</sub> = 100 pF, I <sub>F</sub> = 10 → 0 mA		90		ns
	Common Mode Transient Immunity at High Level Output <sup>4)</sup>	CM <sub>H</sub>	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 10 mA, V <sub>CM</sub> = 1.5 kV, V <sub>O(MIN)</sub> = 2.4 V	15			kV/μs
	Common Mode Transient Immunity at Low Level Output <sup>4)</sup>	CM <sub>L</sub>	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 0 mA, V <sub>CM</sub> = 1.5 kV, V <sub>O(MAX)</sub> = 0.35 V	15			kV/μs

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

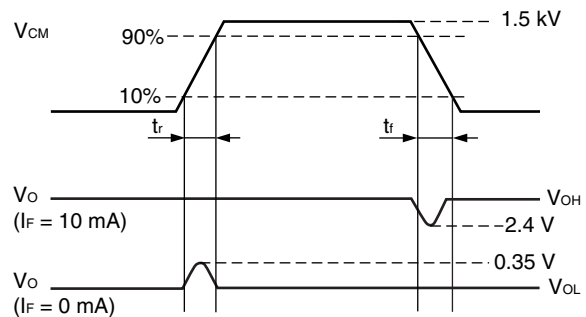
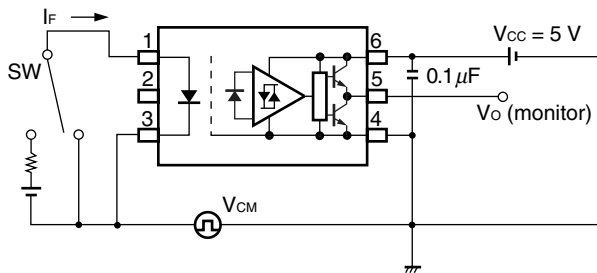
\*2 Because  $V_o$  of 2.4 V may be output when the LED current is not input and when output supply of  $V_{CC} = 4.5\text{ V}$  or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

\*3 Test circuit for propagation delay time



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

\*4 Test circuit for common mode transient immunity



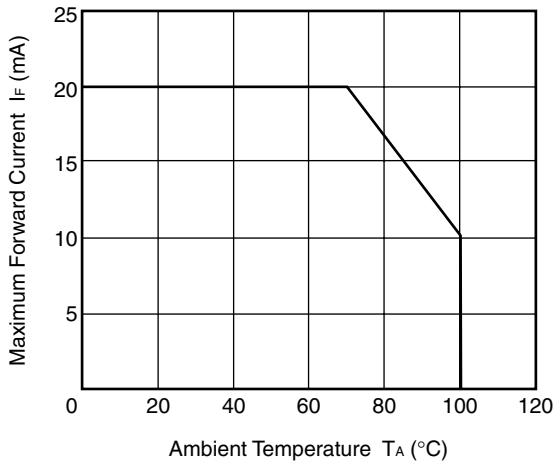
**Remark**  $C_L$  includes probe and stray wiring capacitance.

<R> **USAGE CAUTIONS**

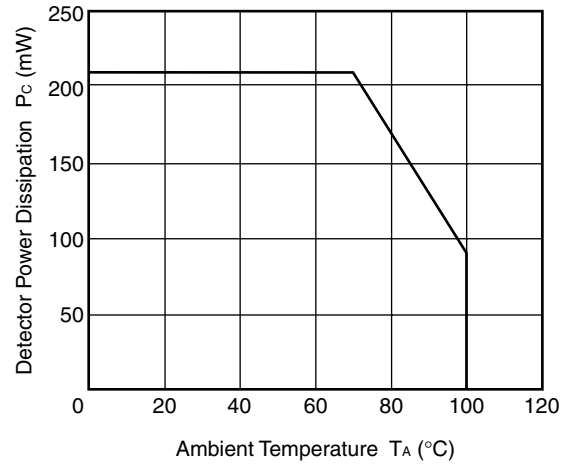
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than  $0.1\ \mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of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

<R> **TYPICAL CHARACTERISTICS (TA = 25°C, unless otherwise specified)**

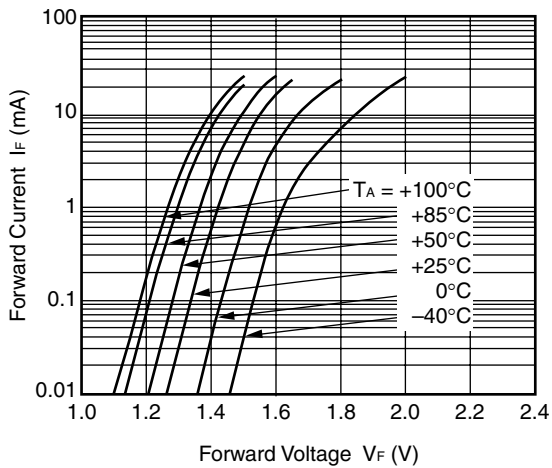
**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**



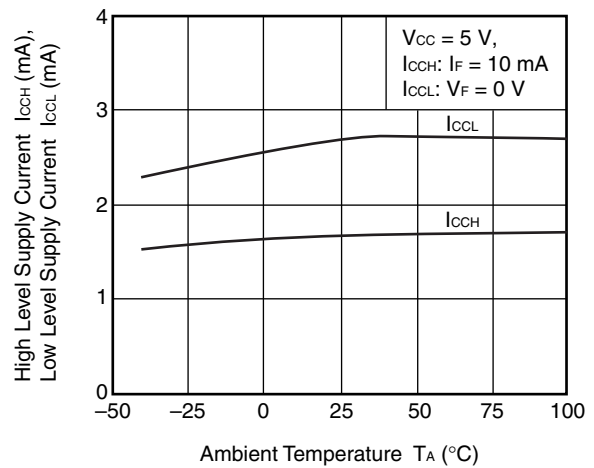
**DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



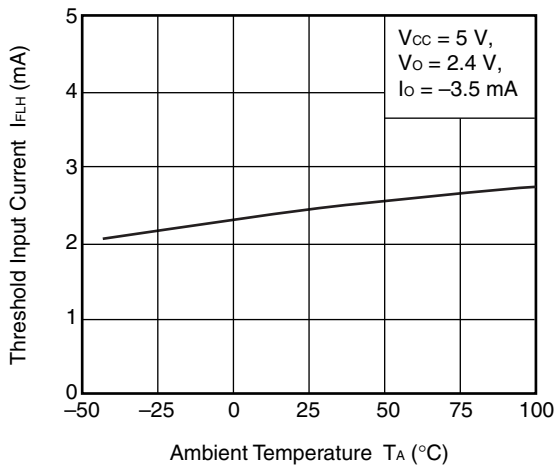
**FORWARD CURRENT vs. FORWARD VOLTAGE**



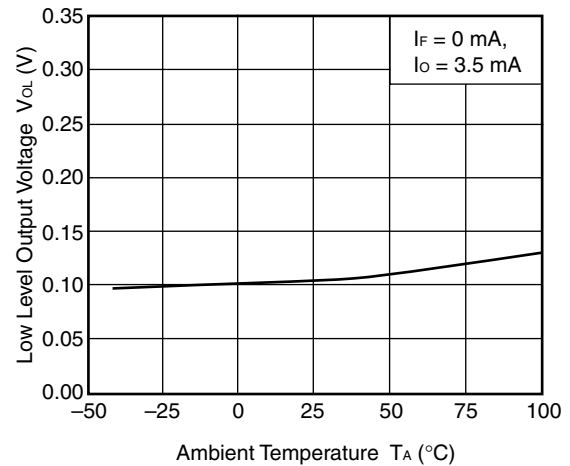
**SUPPLY CURRENT vs. AMBIENT TEMPERATURE**



**THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE**

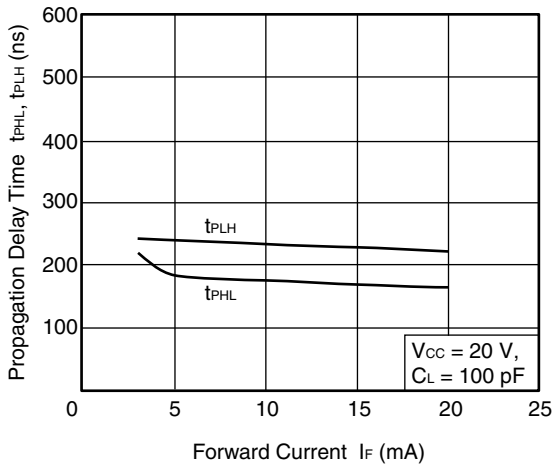


**LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE**

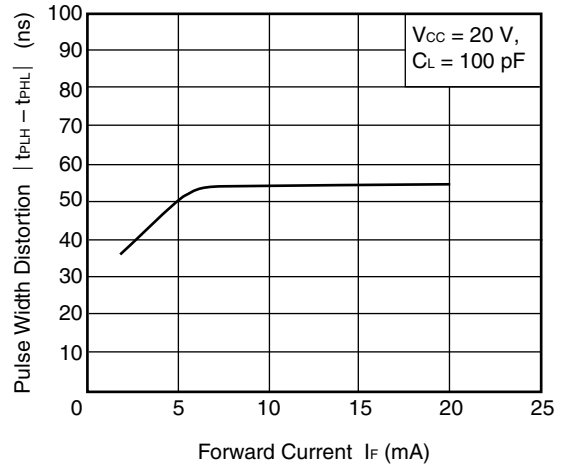


**Remark** The graphs indicate nominal characteristics.

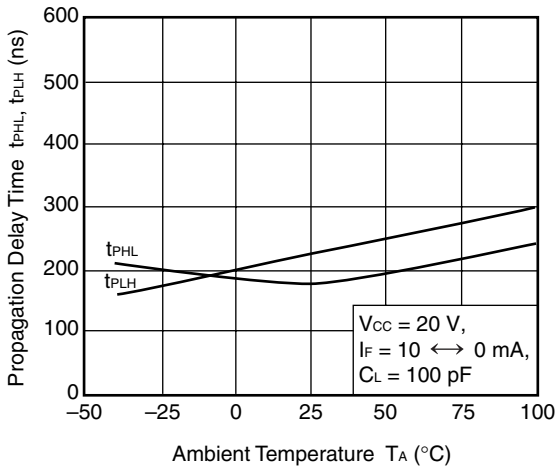
PROPAGATION DELAY TIME vs. FORWARD CURRENT



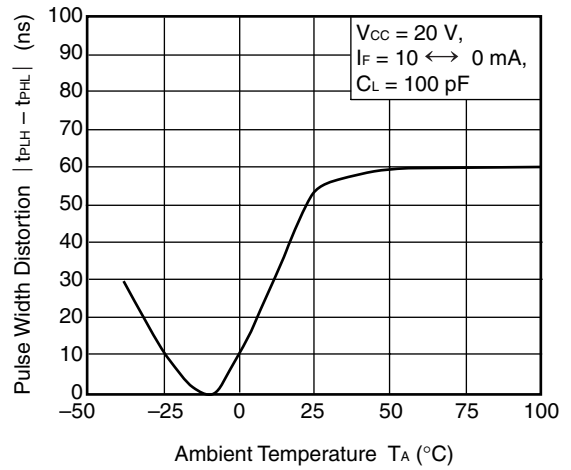
PULSE WIDTH DISTORTION vs. FORWARD CURRENT



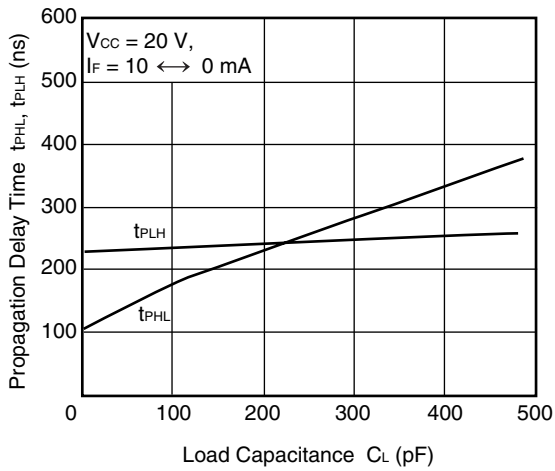
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



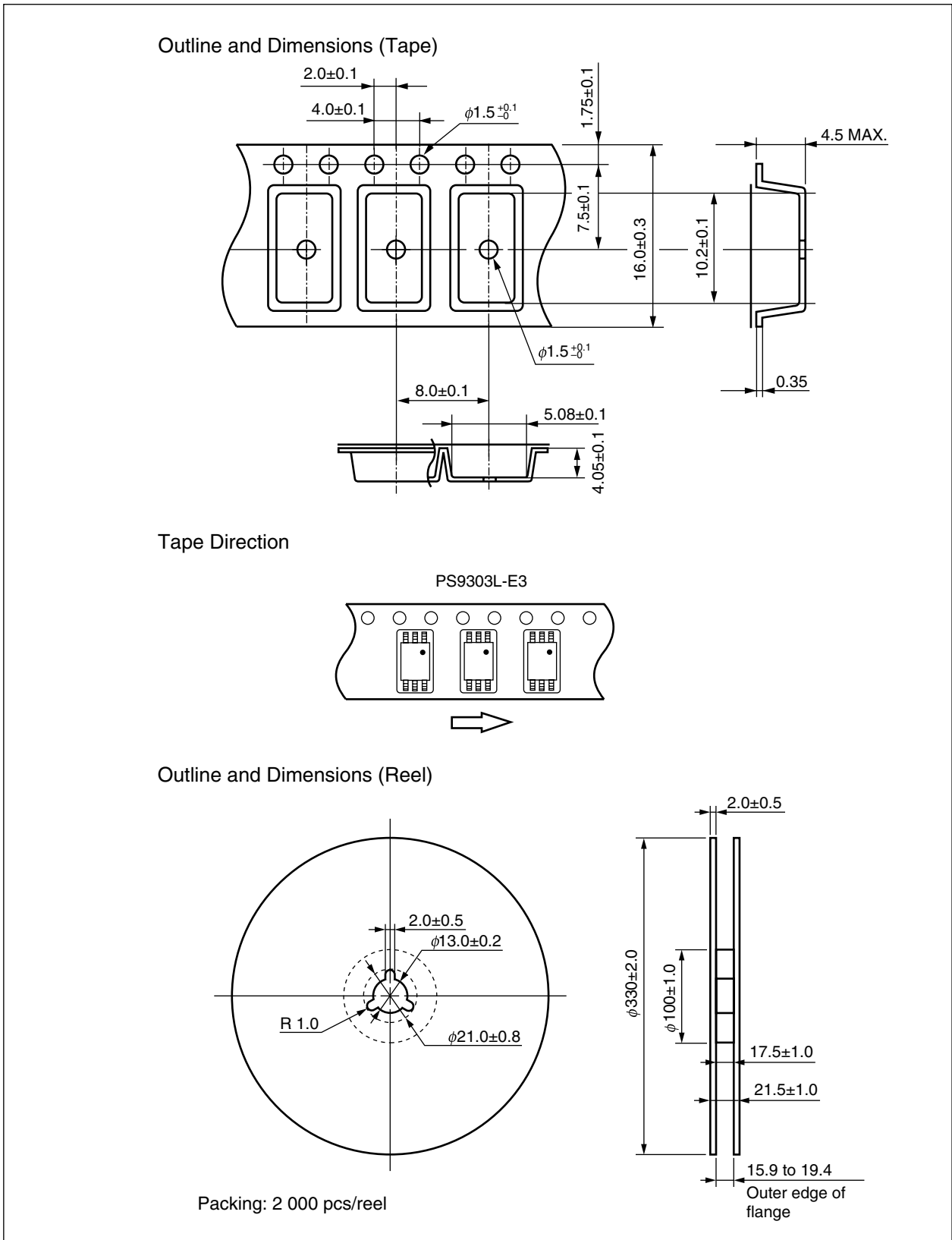
PROPAGATION DELAY TIME vs. LOAD CAPACITANCE



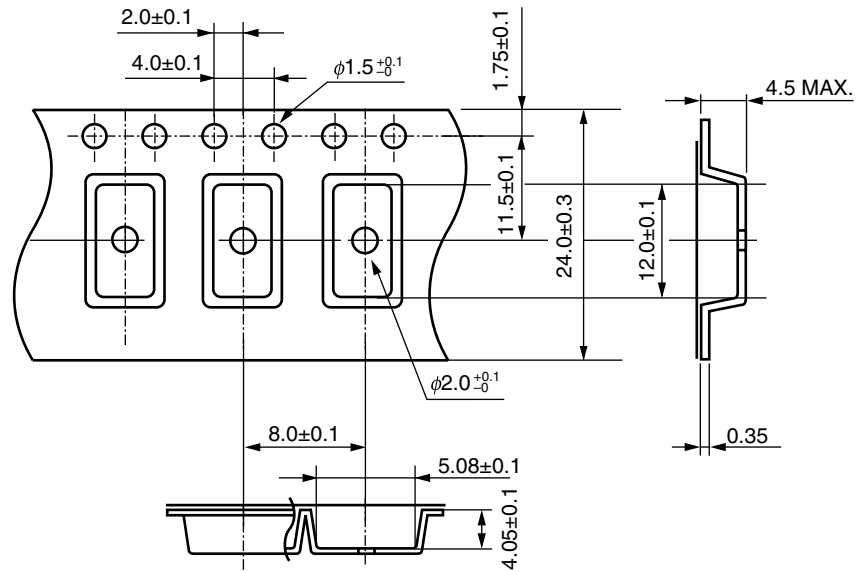
**Remark** The graphs indicate nominal characteristics.



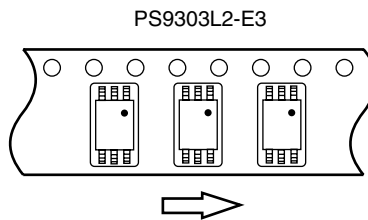
<R> TAPING SPECIFICATIONS (UNIT: mm)



Outline and Dimensions (Tape)



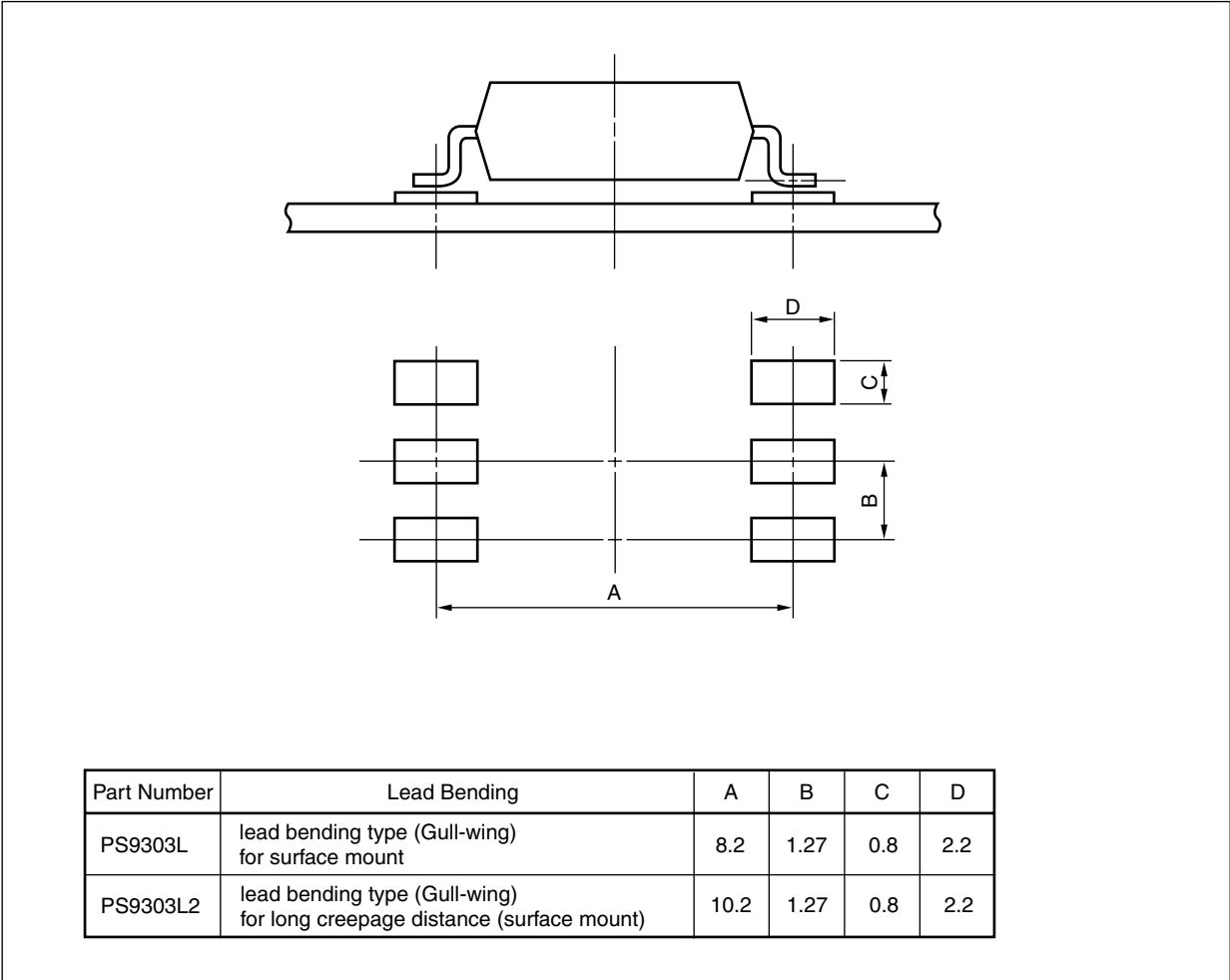
Tape Direction



Outline and Dimensions (Reel)



<R> RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



<R> 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> and GND at startup, the output side may enter the on state, even if the voltage is within the absolute maximum ratings.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec.	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{IORM}$ $U_{pr}$	1 130 1 695	$V_{peak}$ $V_{peak}$
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{pr}$	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	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 +100	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$	$R_{is \text{ MIN.}}$ $R_{is \text{ MIN.}}$	$10^{12}$ $10^{11}$	$\Omega$ $\Omega$
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 $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	$T_{si}$ $I_{si}$ $P_{si}$ $R_{is \text{ MIN.}}$	175 400 700 $10^9$	°C mA mW $\Omega$

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M8E0904E

<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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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

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