

# PS9303L, PS9303L2

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

R08DS0254EJ0100  
Rev.1.00  
Nov 12, 2021

## DESCRIPTION

isolators containing an AlGaAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

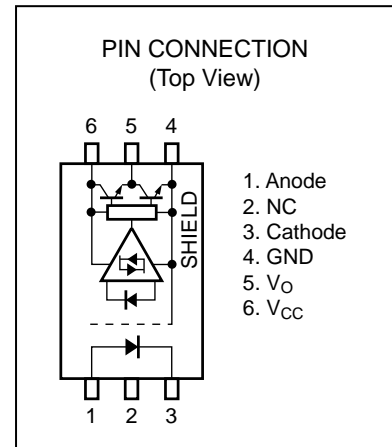
The PS9303L and PS9303L2 are specified high CMR and pulse width distortion with operating temperature. It is suitable for IPM drive.

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)
- Ordering number of tape product:  
PS9303L-E3, PS9303L2-E3: 2 000 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

- IPM Driver
- General purpose inverter

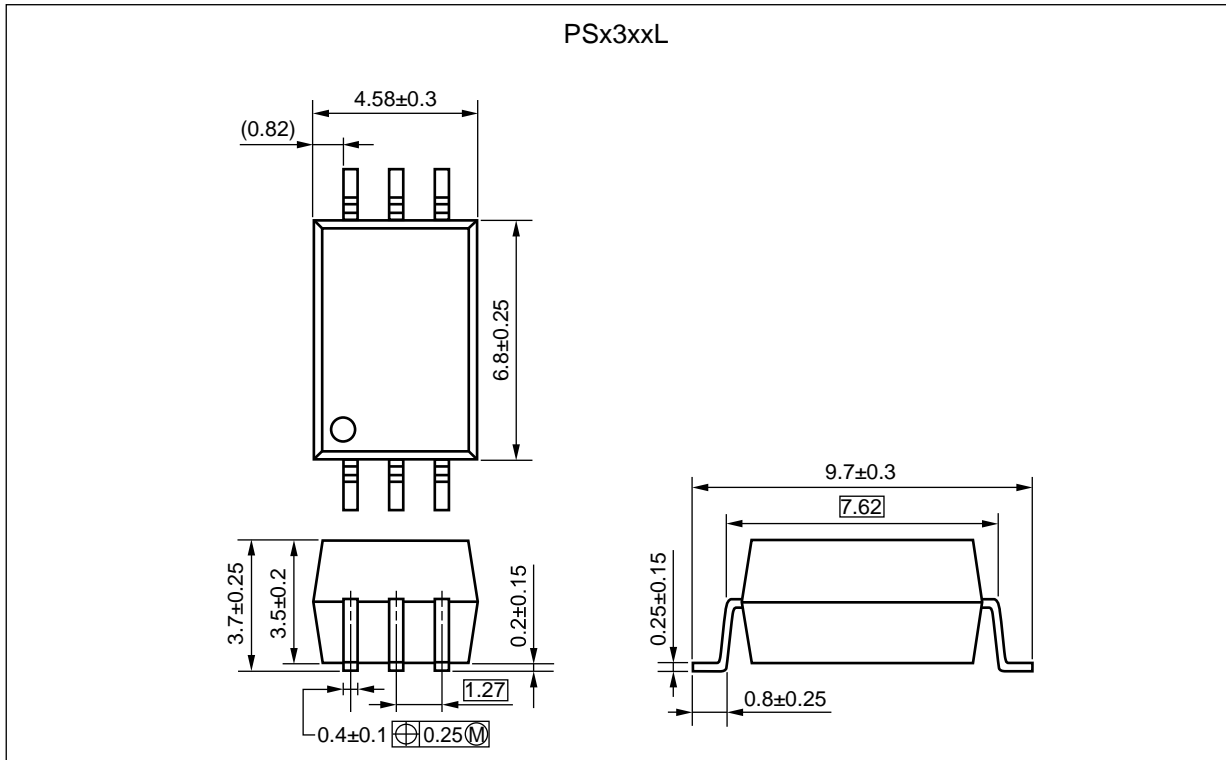
## TRUTH TABLE

LED	Output
ON	H
OFF	L

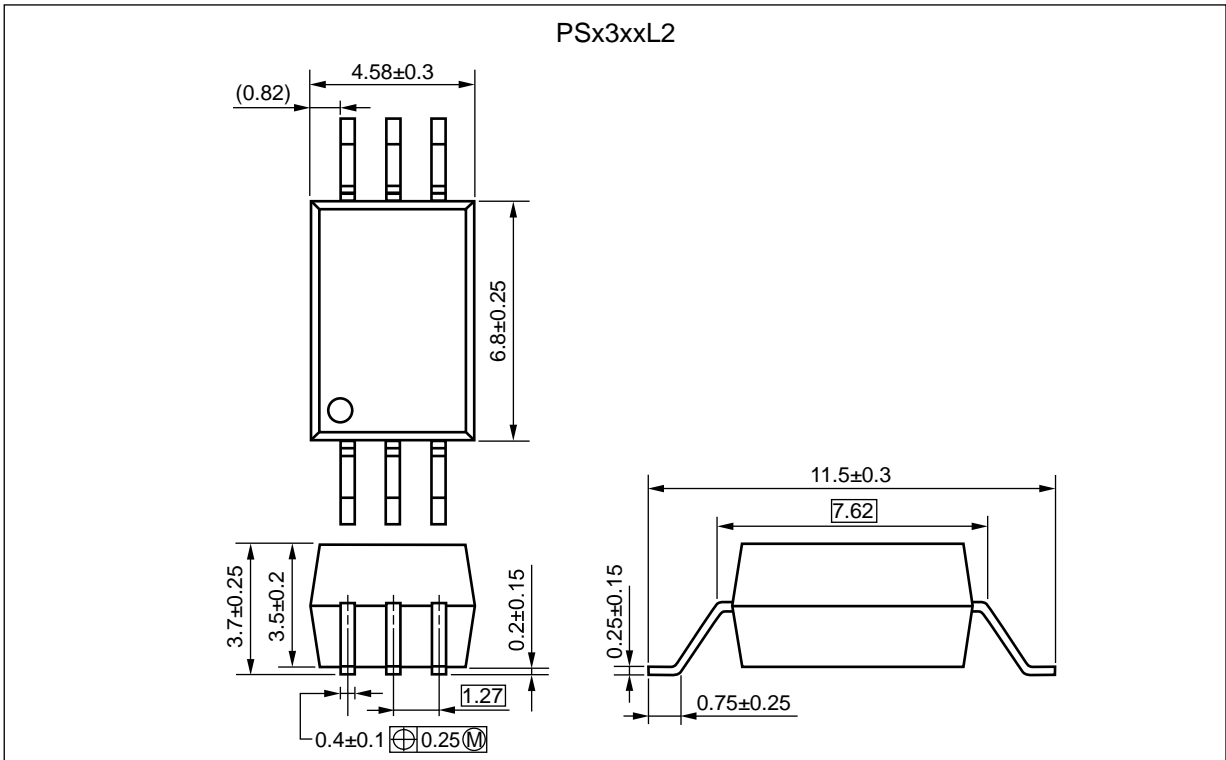
Start of mass production  
Apr.2008

**PACKAGE DIMENSIONS (UNIT: mm)**

Lead Bending Type (Gull-wing) For Surface Mount

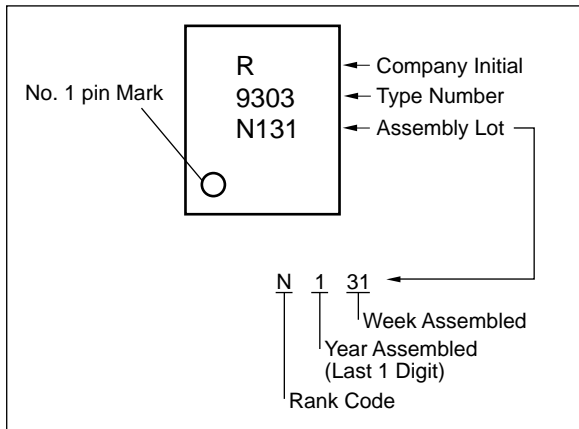


Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)



Weight: 0.27g (typ.)

**MARKING EXAMPLE**



**PHOTOCOUPLER CONSTRUCTION**

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

**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		UL, CSA, DIN EN60747-5-5 approved	20 pcs (Tape 20 pcs cut)	PS9303L
PS9303L-V-E3	PS9303L-V-E3-AX			Embossed Tape 2 000 pcs/reel	
PS9303L2-V	PS9303L2-V-AX			20 pcs (Tape 20 pcs cut)	PS9303L2
PS9303L2-V-E3	PS9303L2-V-E3-AX			Embossed Tape 2 000 pcs/reel	

Notes\*: 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 *1	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 *2	P <sub>C</sub>	210	mW
Isolation Voltage *3		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

- Notes\*: 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

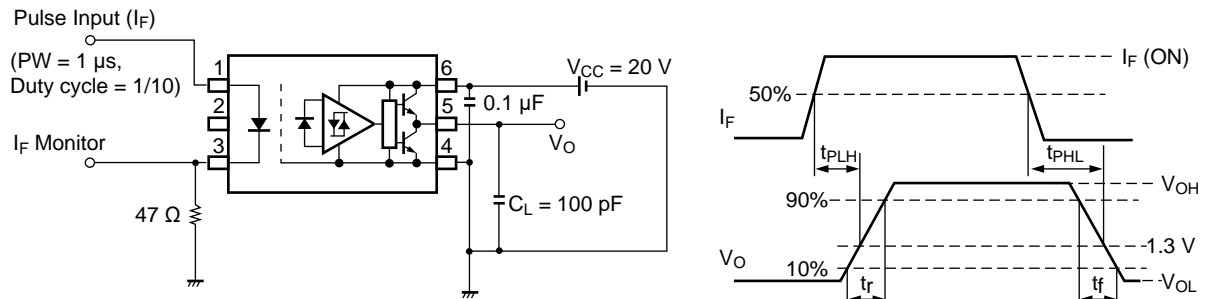
**ELECTRICAL CHARACTERISTICS** ( $T_A = -40$  to  $+100$  °C,  $V_{CC} = 4.5$  to  $20$  V, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	$V_F$	$I_F = 10$ mA, $T_A = 25$ °C	1.2	1.6	1.9	V
	Reverse Current	$I_R$	$V_R = 3$ V, $T_A = 25$ °C			10	μA
	Terminal Capacitance	$C_t$	$V = 0$ V, $f = 1$ MHz, $T_A = 25$ °C		30		pF
Detector	High Level Output Voltage	$V_{OH}$	$V_{CC} = 5$ V, $I_O = -3.5$ mA, $I_F = 10$ mA	2.4	3.5		V
			$V_{CC} = 20$ V, $I_O = -3.5$ mA, $I_F = 10$ mA	17.4	18.1		
	Low Level Output Voltage <sup>2</sup>	$V_{OL}$	$I_O = 3.5$ mA, $V_F = 0$ V		0.1	0.35	V
	High Level Supply Current	$I_{CCH}$	$V_{CC} = 5$ V, $I_F = 10$ mA		1.6	2.7	mA
			$V_{CC} = 20$ V, $I_F = 10$ mA		1.8	3	
	Low Level Supply Current	$I_{CCL}$	$V_{CC} = 5$ V, $V_F = 0$ V		2.7	3.7	mA
			$V_{CC} = 20$ V, $V_F = 0$ V		2.9	4	
High Level Output Short Circuit Current	$I_{OSH}$	$V_{CC} = 20$ V, $V_O = GND$ , $I_F = 10$ mA	-7	-40		mA	
Low Level Output Short Circuit Current	$I_{OSL}$	$V_{CC} = V_O = 20$ V, $V_F = 0$ V	7	40		mA	
Coupled	Threshold Input Current	$I_{FLH}$	$V_{CC} = 5$ V, $V_O > 2.4$ V, $I_O = -3.5$ mA		2.4	5	mA
	Isolation Resistance	$R_{I-O}$	$V_{I-O} = 500$ V <sub>DC</sub> , RH = 60 %, $T_A = 25$ °C	$10^{12}$			Ω
	Isolation Capacitance	$C_{I-O}$	$V = 0$ V, $f = 1$ MHz, $T_A = 25$ °C		0.6		pF
	Propagation Delay Time (H → L) <sup>3</sup>	$t_{PHL}$	$V_{CC} = 20$ V, $C_L = 100$ pF, $I_F = 10 \rightarrow 0$ mA, $V_{THL} = 1.3$ V	50	185	550	ns
	Propagation Delay Time (L → H) <sup>3</sup>	$t_{PLH}$	$V_{CC} = 20$ V, $C_L = 100$ pF, $I_F = 0 \rightarrow 10$ mA, $V_{THL} = 1.3$ V	50	240	500	ns
	Pulse Width Distortion (PWD)	$ t_{PLH} - t_{PHL} $	$V_{CC} = 20$ V, $C_L = 100$ pF, $I_F = 10 \leftrightarrow 0$ mA		55	350	ns
	Rise Time (10-90%) <sup>3</sup>	$t_r$	$V_{CC} = 20$ V, $C_L = 100$ pF, $I_F = 0 \rightarrow 10$ mA		120		ns
	Fall Time (90-10%) <sup>3</sup>	$t_f$	$V_{CC} = 20$ V, $C_L = 100$ pF, $I_F = 10 \rightarrow 0$ mA		90		ns
	Common Mode Transient Immunity at High Level Output <sup>4</sup>	$CM_H$	$V_{CC} = 5$ V, $T_A = 25$ °C, $I_F = 10$ mA, $V_{CM} = 1.5$ kV, $V_{O(MIN.)} = 2.4$ V	15			kV/μs
	Common Mode Transient Immunity at Low Level Output <sup>4</sup>	$CM_L$	$V_{CC} = 5$ V, $T_A = 25$ °C, $I_F = 0$ mA, $V_{CM} = 1.5$ kV, $V_{O(MAX.)} = 0.35$ V	15			kV/μs

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

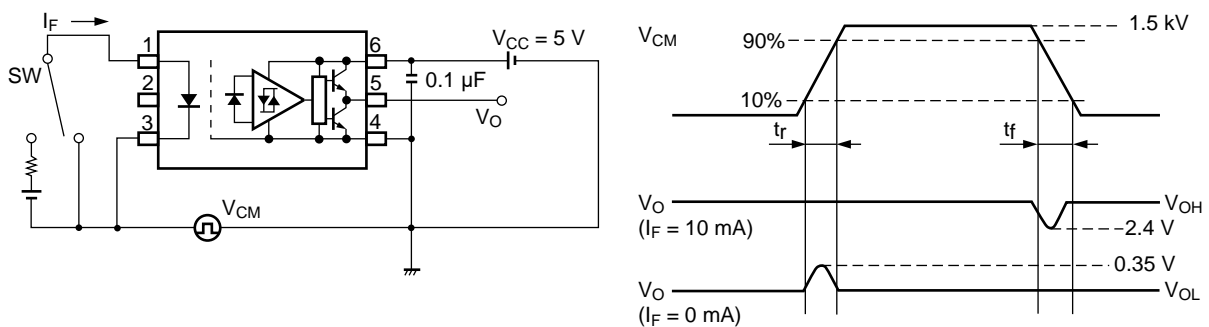
2. Because  $V_O$  of 2.4 V may be output when the LED current is not input and when output supply of  $V_{CC} = 4.5\text{ V}$  or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

3. Test circuit for propagation delay time



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

4. Test circuit for common mode transient immunity



## USAGE CAUTIONS

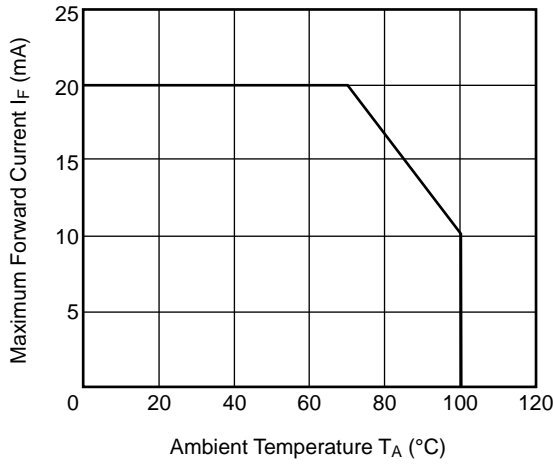
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than  $0.1\mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the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

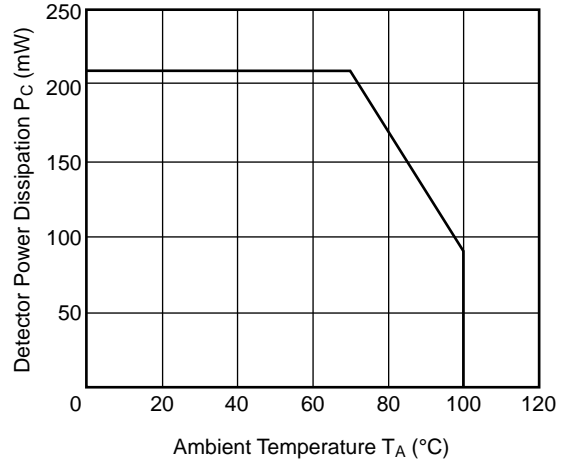
4. Avoid storage at a high temperature and high humidity.
5. Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
6. Do not use fixing agents or coatings containing halogen-based substances.

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

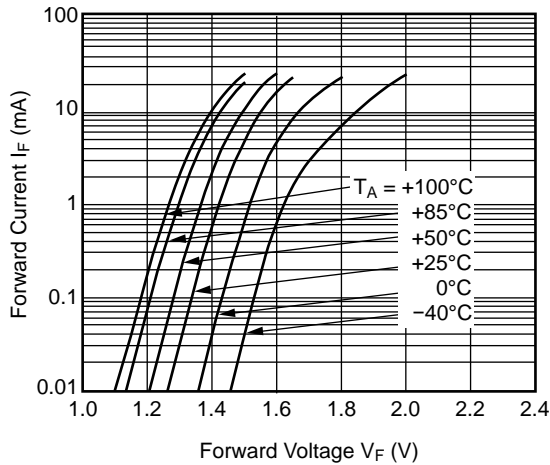
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



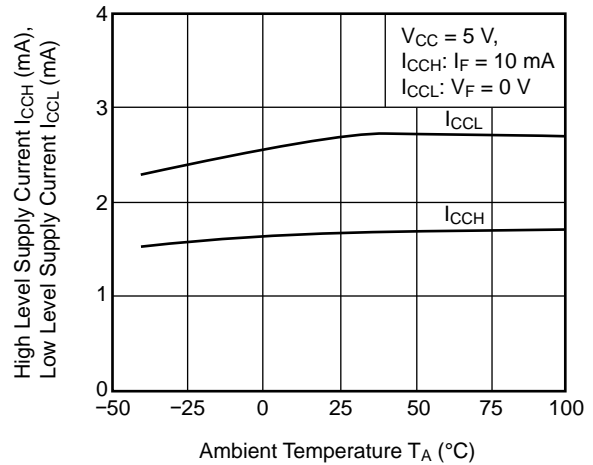
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



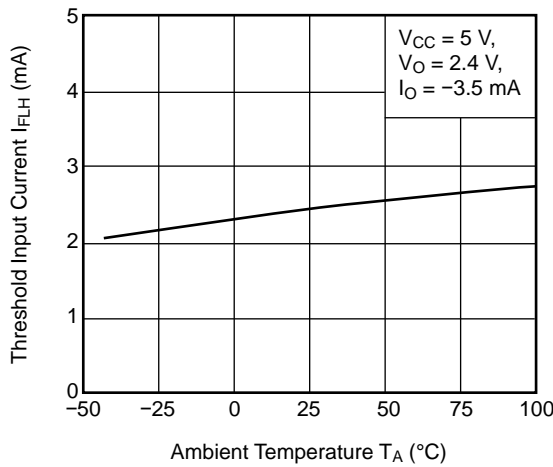
FORWARD CURRENT vs. FORWARD VOLTAGE



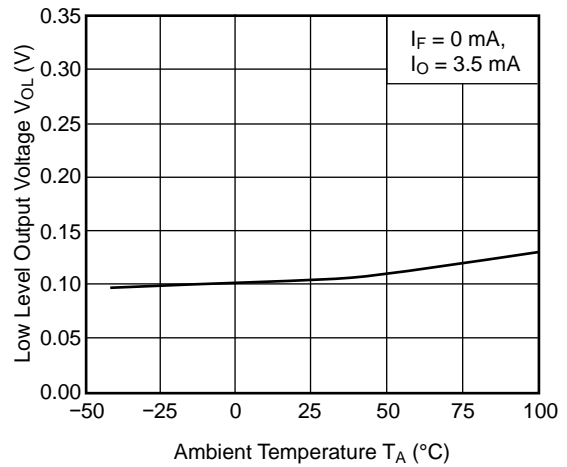
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

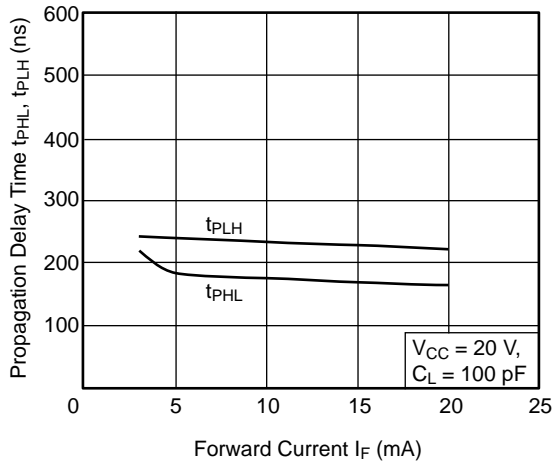


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

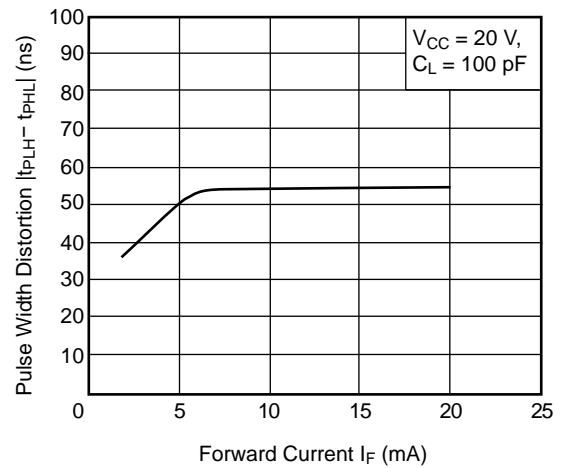


Remark The graphs indicate nominal characteristics.

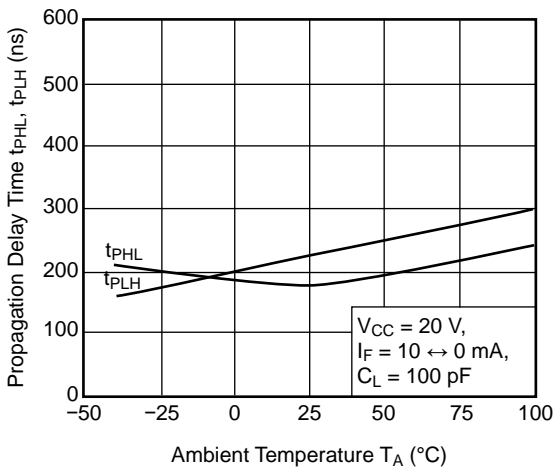
PROPAGATION DELAY TIME vs. FORWARD CURRENT



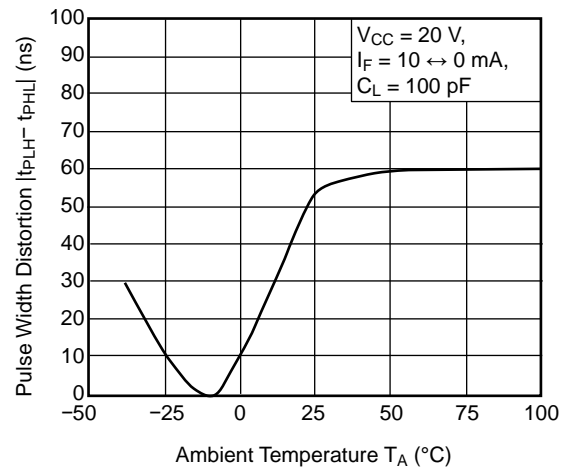
PULSE WIDTH DISTORTION vs. FORWARD CURRENT



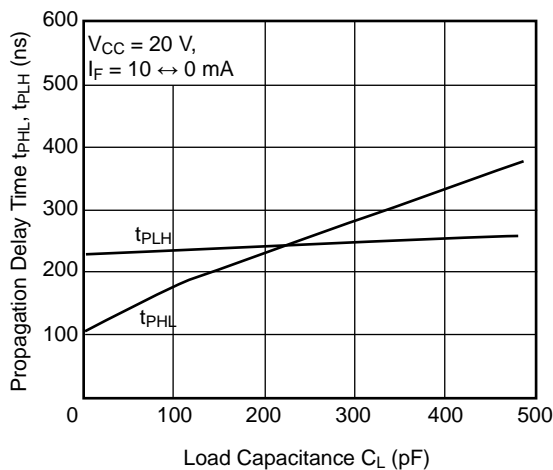
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. LOAD CAPACITANCE

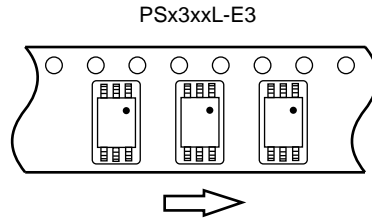


Remark The graphs indicate nominal characteristics.

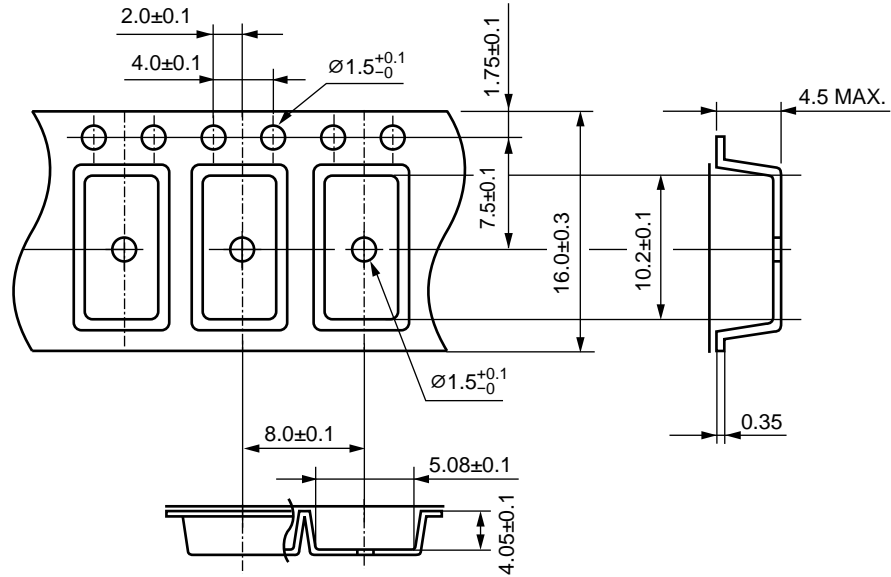


TAPING SPECIFICATIONS (UNIT: mm)

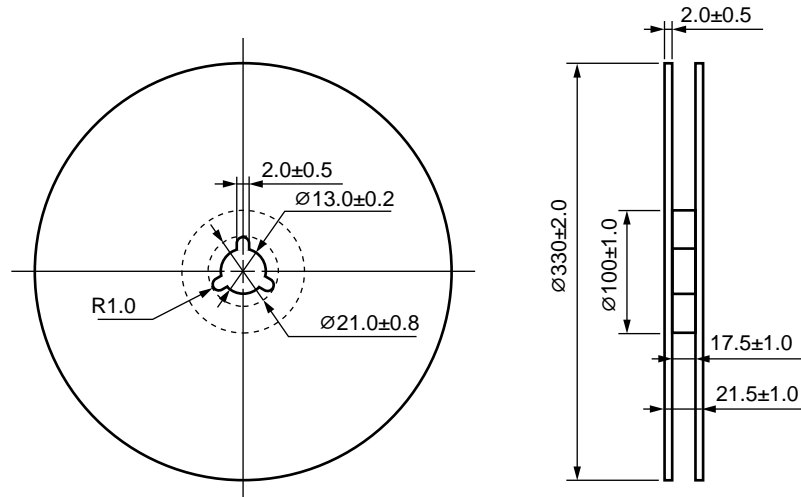
Tape Direction



Outline and Dimensions (Tape)

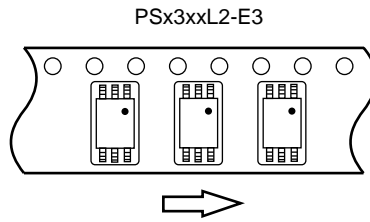


Outline and Dimensions (Reel)

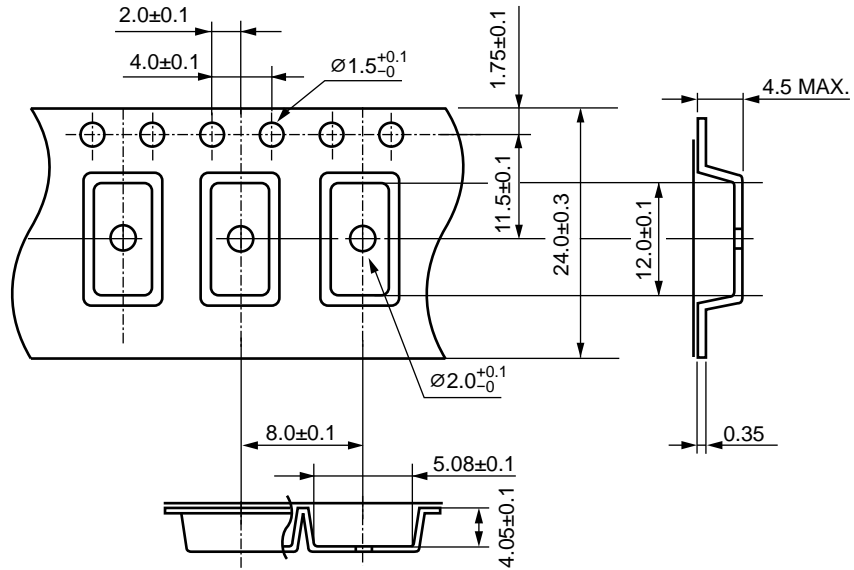


Packing: 2 000 pcs/reel

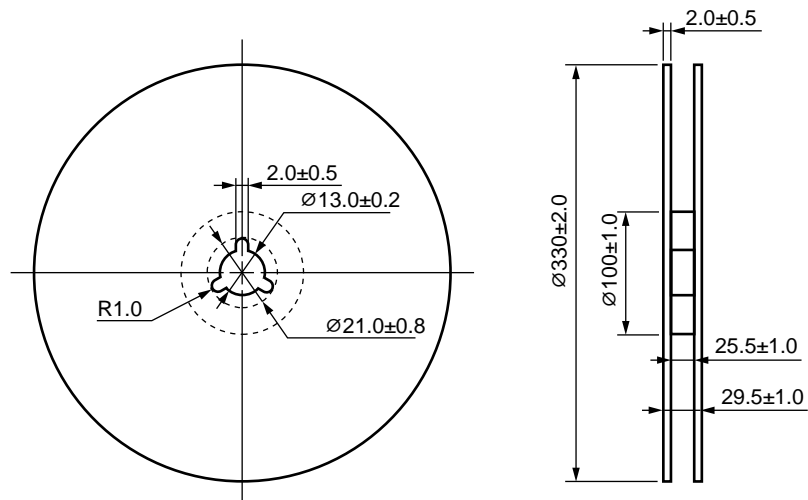
Tape Direction



Outline and Dimensions (Tape)

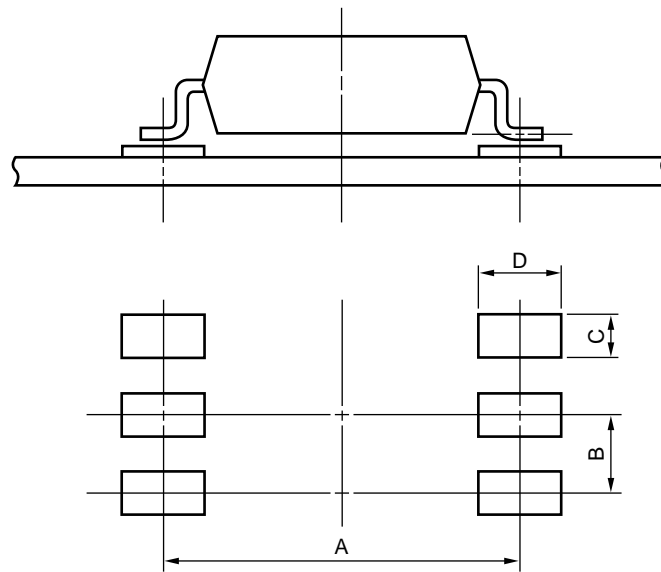


Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

**RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)**



Part Number	Lead Bending	A	B	C	D
PSx3xxL	lead bending type (Gull-wing) for surface mount	9.2	1.27	0.8	2.2
PSx3xxL2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	1.27	0.8	2.2

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

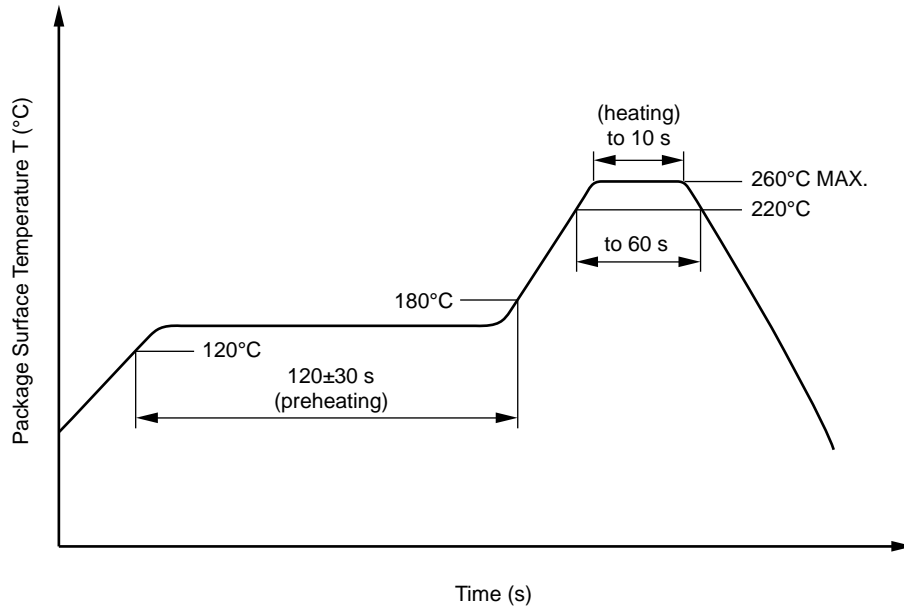
**NOTES ON HANDLING**

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

(4) Cautions

- Flux Cleaning  
Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
- Do not use fixing agents or coatings containing halogen-based substances.

2. Cautions regarding noise

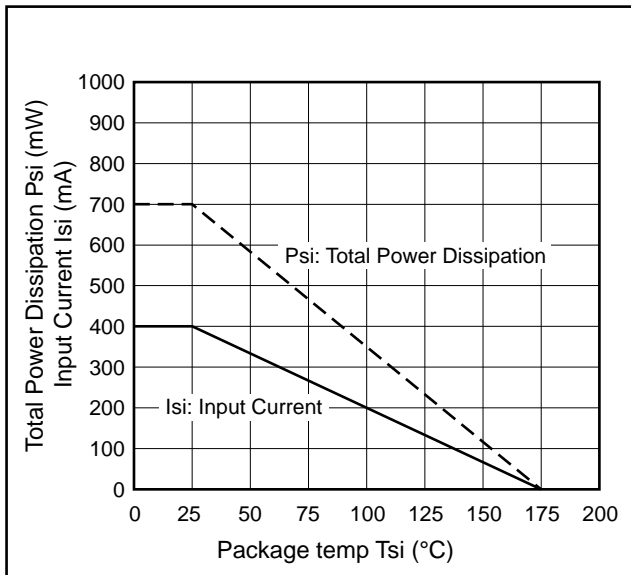
Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V<sub>CC</sub> and GND at startup, the output side may enter the on state, even if the voltage is within the absolute

maximum ratings.

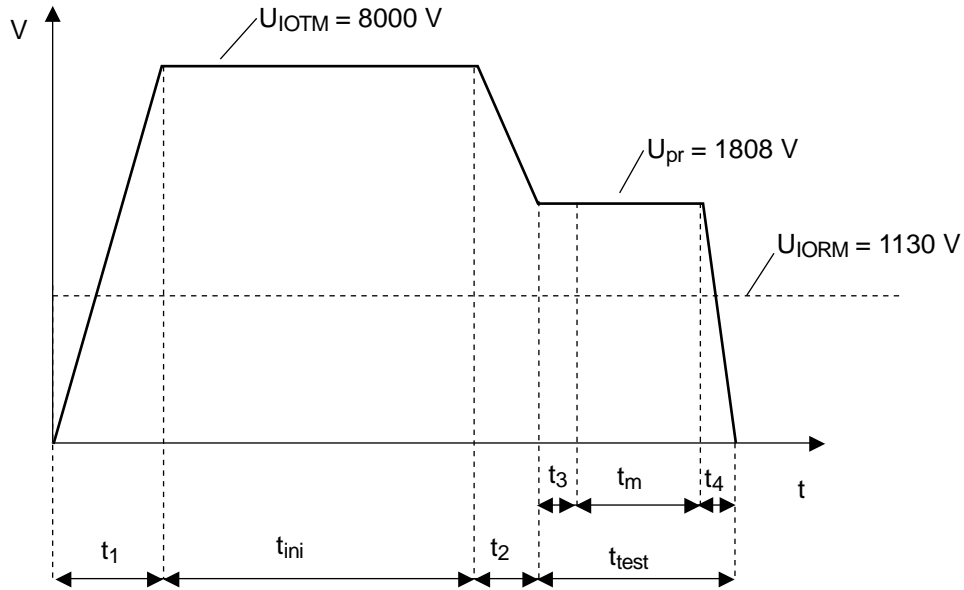
**SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength maximum operating isolation voltage	$U_{IORM}$	1 130	$V_{peak}$
Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{pr}$	1 808	$V_{peak}$
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	$U_{IOTM}$	8 000	$V_{peak}$
Degree of pollution (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303-11))	CTI	175	
Material group (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		III a	
Storage temperature range	$T_{stg}$	- 55 to +125	°C
Operating temperature range	$T_A$	- 40 to +110	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25 \text{ °C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100 \text{ °C}$	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 $I_F$ , $\Psi_i = 0$ ) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	$T_{si}$ $I_{si}$ $\Psi_i$ Ris MIN.	175 400 700 $10^9$	°C mA mW $\Omega$

**Dependence of maximum safety ratings with package temperature**

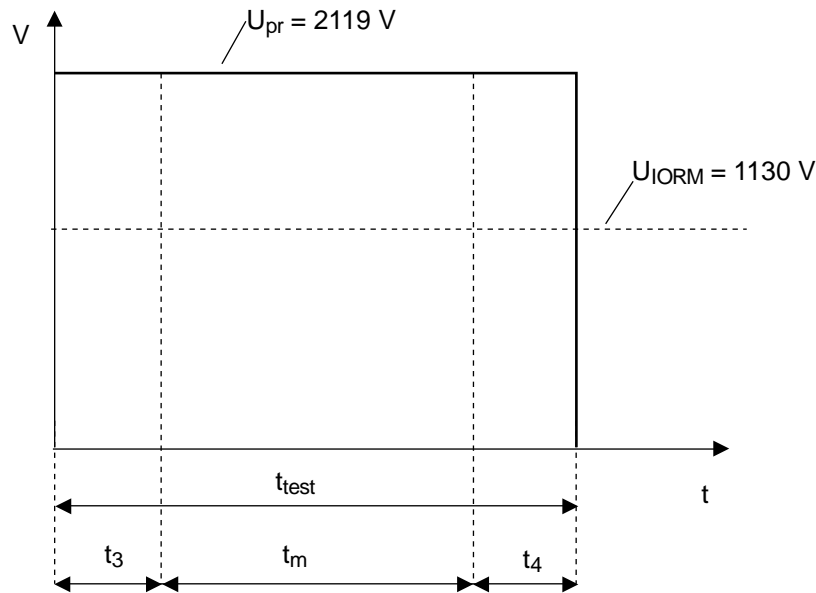


**Method a) Destructive Test, Type and Sample Test**



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

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



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

<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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