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.
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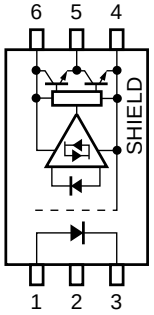
FEATURES

- High common mode transient immunity (CM_H, CM_L = ±15 kV/μs MIN.)
- Half size of 8-pin DIP
- Pulse width distortion ($|t_{PLH} - t_{PHL}|$ = 350 ns MAX.)
- High-speed (1 Mbps)
- High isolation voltage (BV = 5 000 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)

PIN CONNECTION
(Top View)



1. Anode
2. NC
3. Cathode
4. GND
5. V_O
6. V_{CC}

APPLICATIONS

- IPM Driver
- General purpose inverter

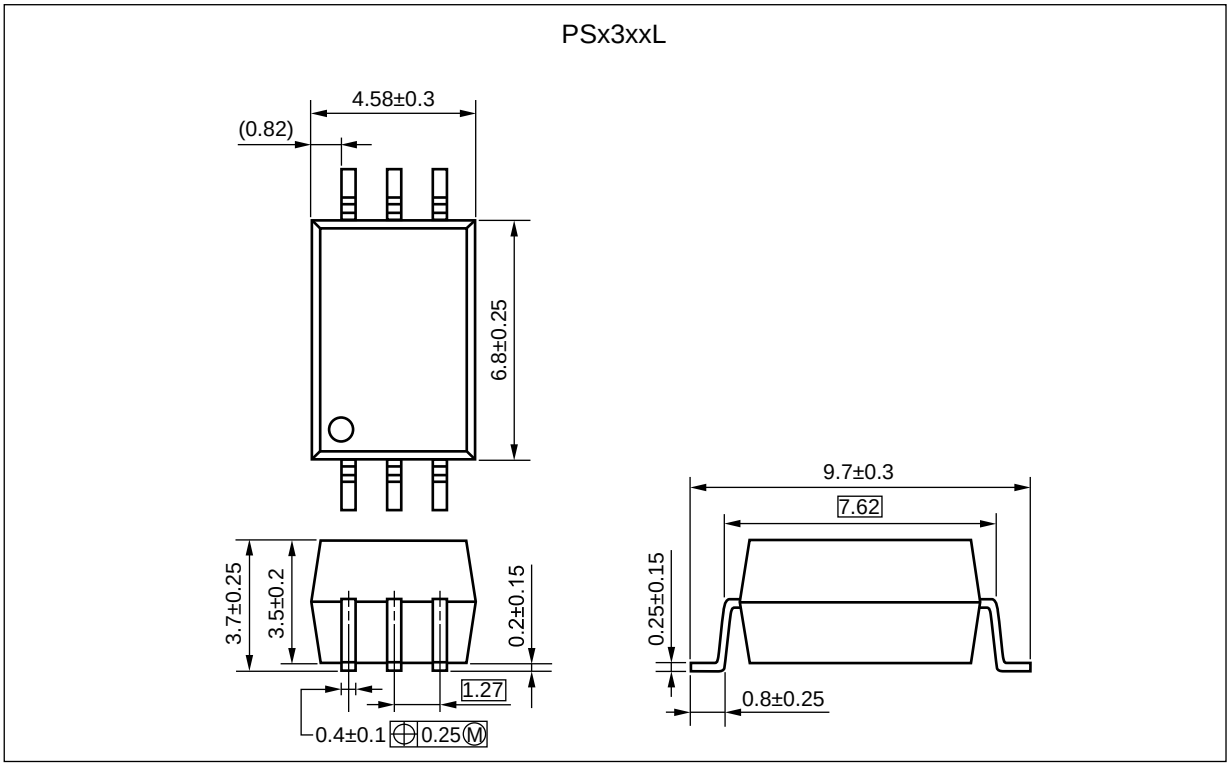
TRUTH TABLE

LED	Output
ON	H
OFF	L

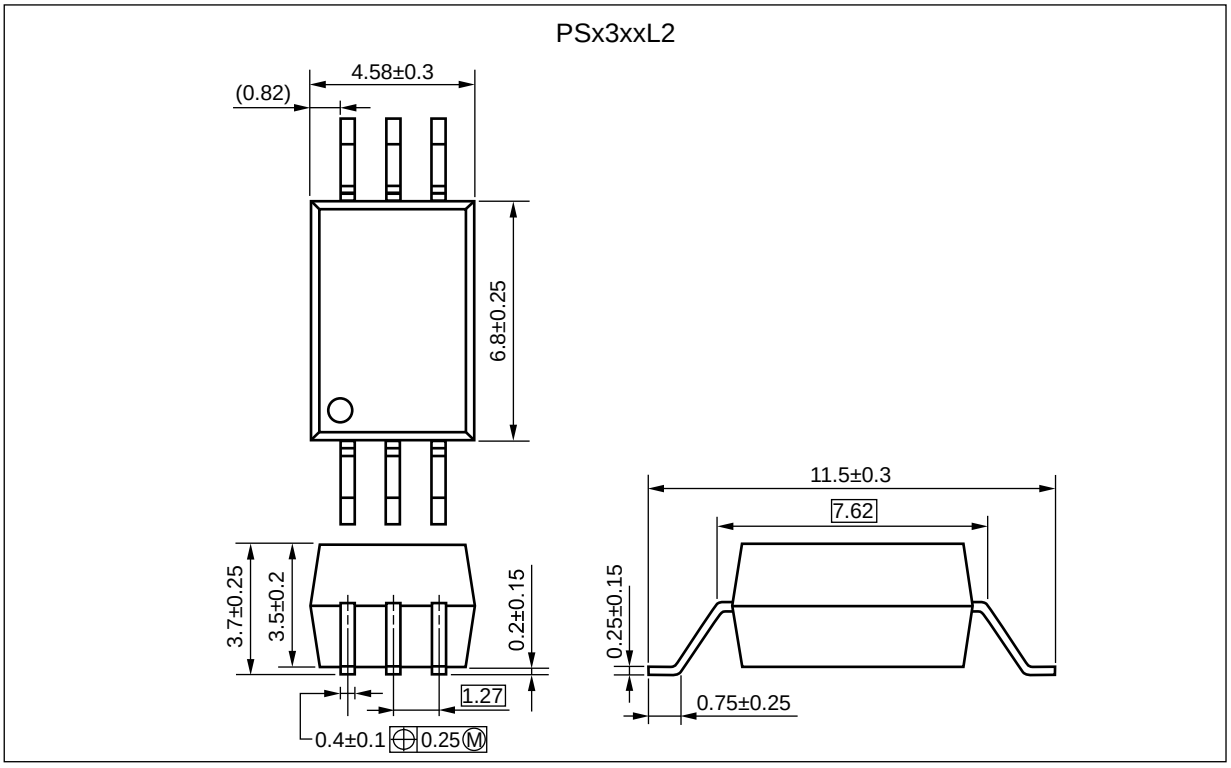
Start of mass production
Apr.2008

PACKAGE DIMENSIONS (UNIT: mm)

Lead Bending Type (Gull-wing) For Surface Mount

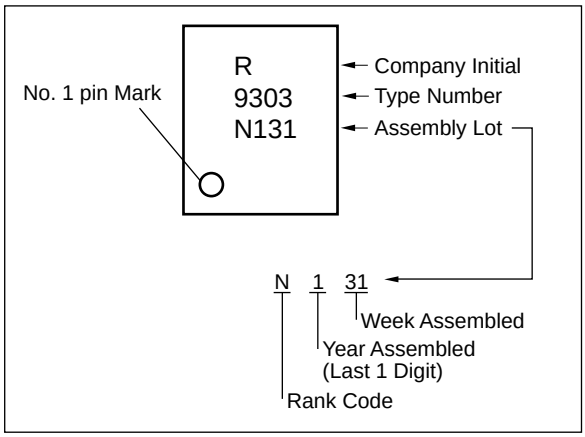


Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)



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[*1]
PS9303L	PS9303L-AX	Pb-Free	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9303L
PS9303L-E3	PS9303L-E3-AX	(Ni/Pd/Au)	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)	UL, CSA, DIN EN60747-5-5 approved	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_A = 25 °C, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current *1	I_F	20	mA
	Reverse Voltage	V_R	5	V
Detector	Supply Voltage	V_{CC}	− 0.5 to +25	V
	Output Voltage	V_O	− 0.5 to +25	V
	Output Current	I_O	25	mA
	Power Dissipation *2	P_C	210	mW
Isolation Voltage *3		BV	5 000	Vr.m.s.
Operating Ambient Temperature		T_A	− 40 to +100	°C
Storage Temperature		T_{stg}	− 55 to +125	°C

Notes*: 1. Reduced to 0.33 mA/°C at T_A = 70 °C or more.
2. Reduced to 4.0 mW/°C at T_A = 70 °C or more
3. AC voltage for 1 minute at T_A = 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_{CC}	4.5	15	20	V
Output Voltage	V_O	0		20	V
Input Current (ON)	$I_{F\ (ON)}$	6		10	mA
Input Voltage (OFF)	$V_{F\ (OFF)}$	0		0.8	V

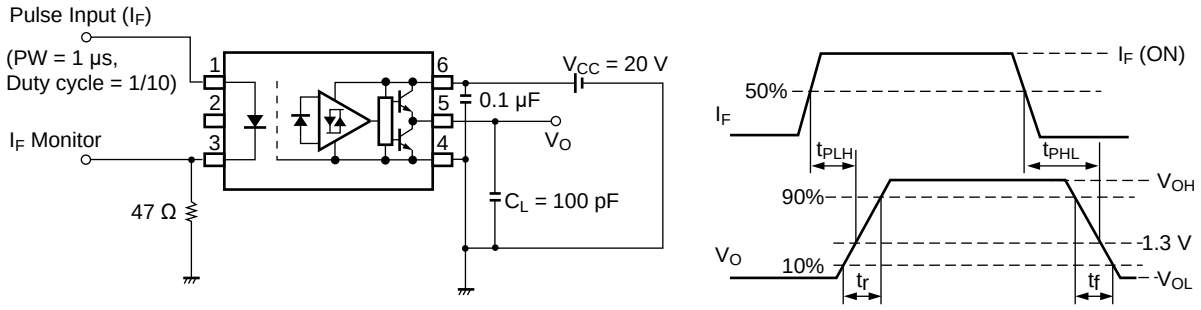
ELECTRICAL CHARACTERISTICS (T_A = − 40 to +100 °C, V_{CC} = 4.5 to 20 V, unless otherwise specified)

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[*2]	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_{DC}, 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)[*3]	t_{PHL}	V_{CC} = 20 V, C_L = 100 pF, I_F = 10 → 0 mA, V_{THHL} = 1.3 V	50	185	550	ns
	Propagation Delay Time (L → H)[*3]	t_{PLH}	V_{CC} = 20 V, C_L = 100 pF, I_F = 0 → 10 mA, V_{THLH} = 1.3 V	50	240	500	ns
	Pulse Width Distortion (PWD)	$\lvert t_{PLH}-t_{PHL} \rvert$	V_{CC} = 20 V, C_L = 100 pF, I_F = 10 ↔ 0 mA		55	350	ns
	Rise Time (10-90%)[*3]	t_r	V_{CC} = 20 V, C_L = 100 pF, I_F = 0 → 10 mA		120		ns
	Fall Time (90-10%)[*3]	t_f	V_{CC} = 20 V, C_L = 100 pF, I_F = 10 → 0 mA		90		ns
	Common Mode Transient Immunity at High Level Output[*4]	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[*4]	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 °C.

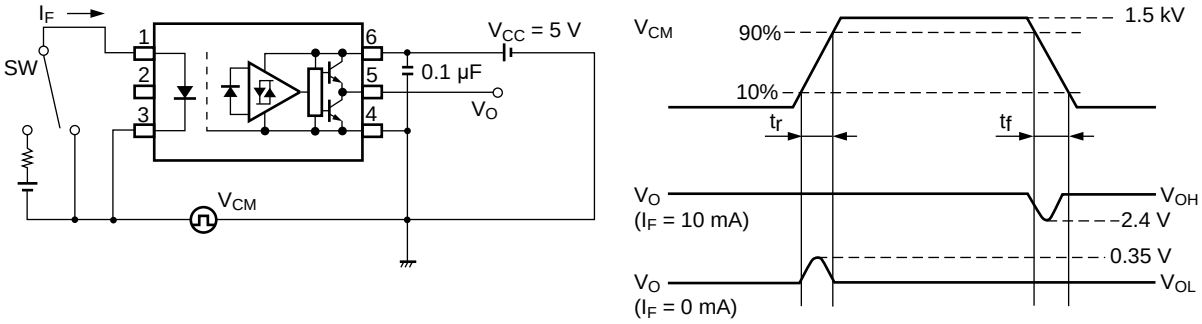
2. Because V_O of 2.4 V may be output when the LED current is not input and when output supply of V_{CC} = 4.5 V or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

3. Test circuit for propagation delay time



Remark: C_L includes probe and stray wiring capacitance.

4. Test circuit for common mode transient immunity

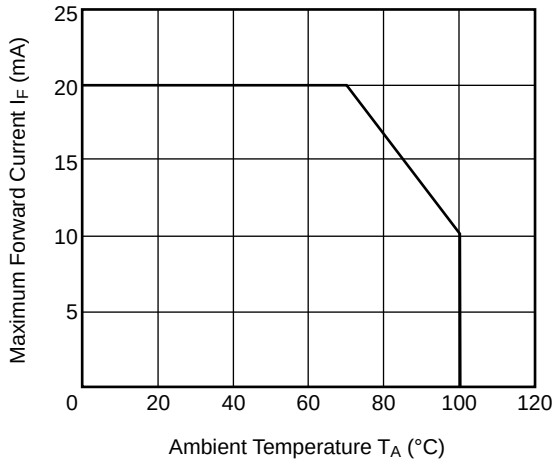


USAGE CAUTIONS

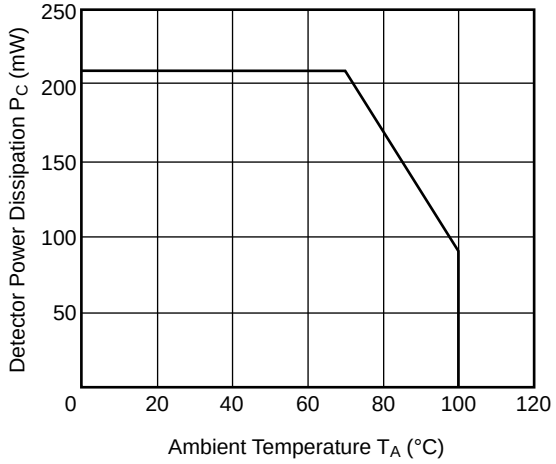
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1µF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and 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 °C unless otherwise specified)

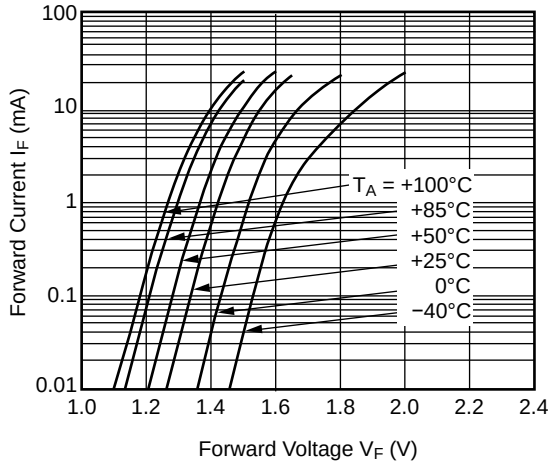
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



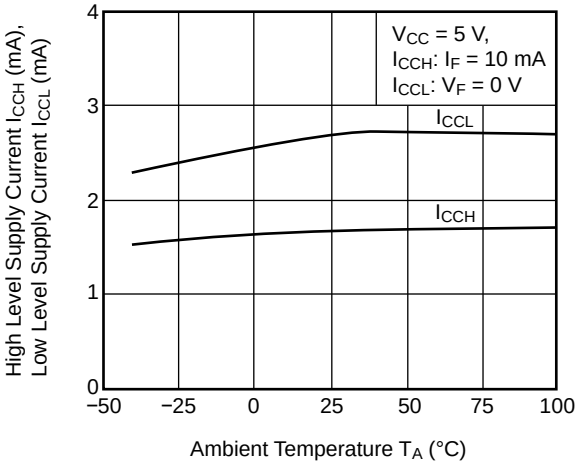
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



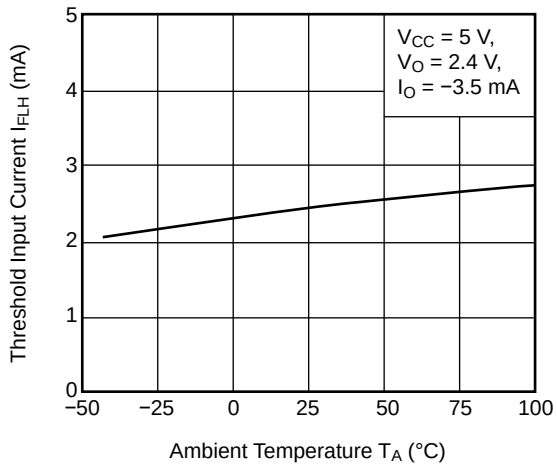
FORWARD CURRENT vs. FORWARD VOLTAGE



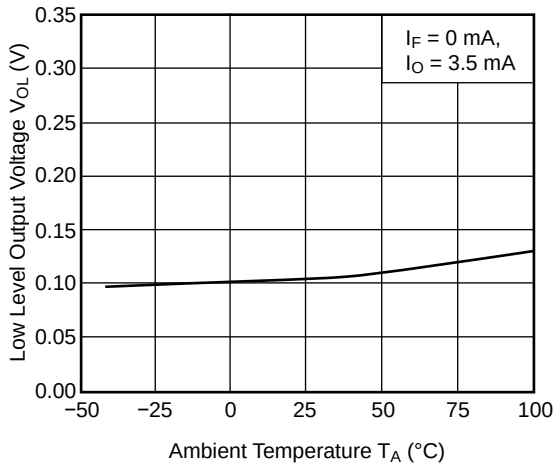
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

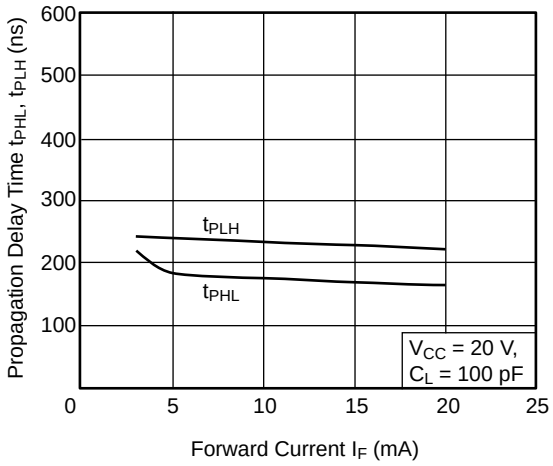


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

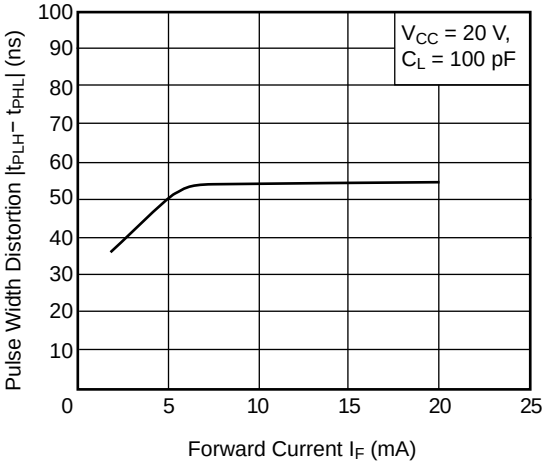


Remark The graphs indicate nominal characteristics.

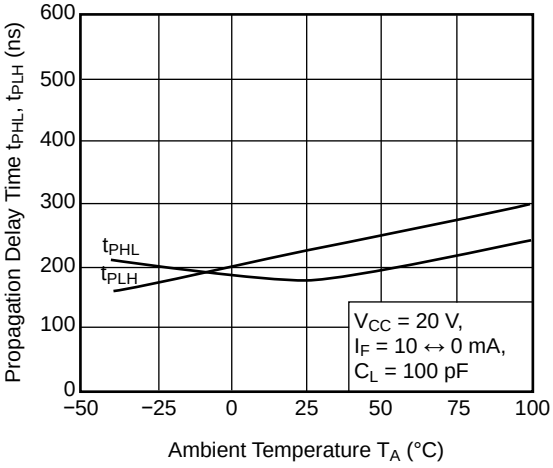
PROPAGATION DELAY TIME
vs. FORWARD CURRENT



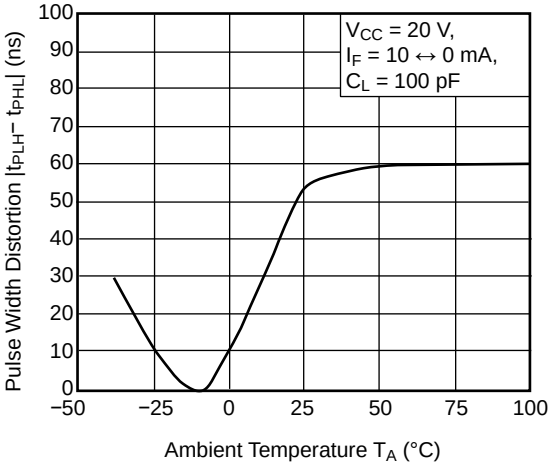
PULSE WIDTH DISTORTION
vs. FORWARD CURRENT



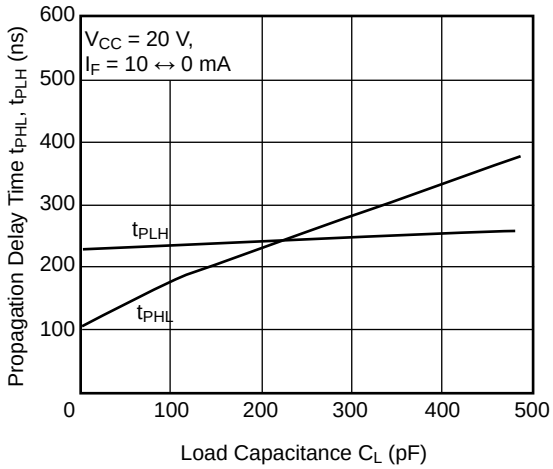
PROPAGATION DELAY TIME
vs. AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME
vs. LOAD CAPACITANCE

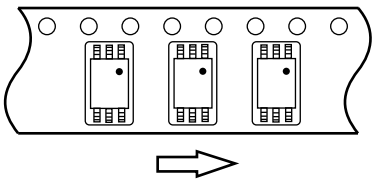


Remark The graphs indicate nominal characteristics.

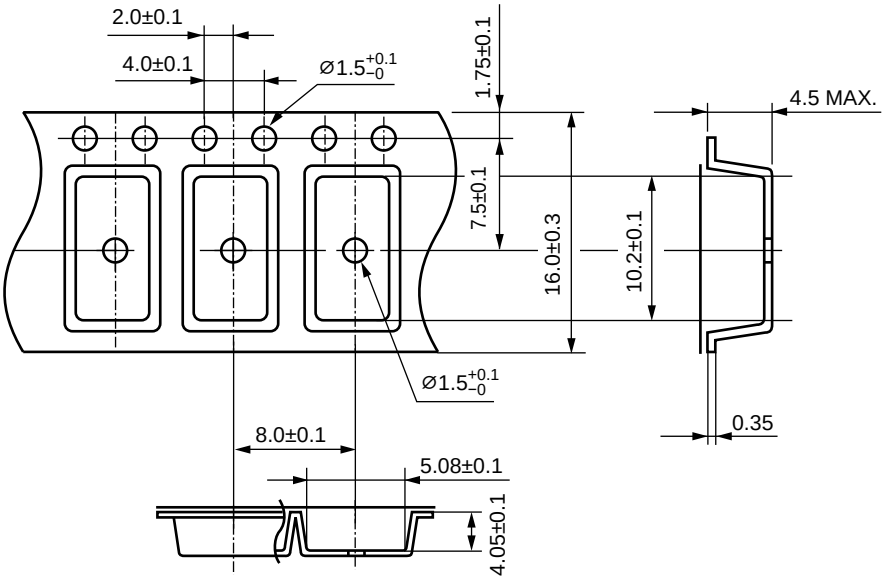
TAPING SPECIFICATIONS (UNIT: mm)

Tape Direction

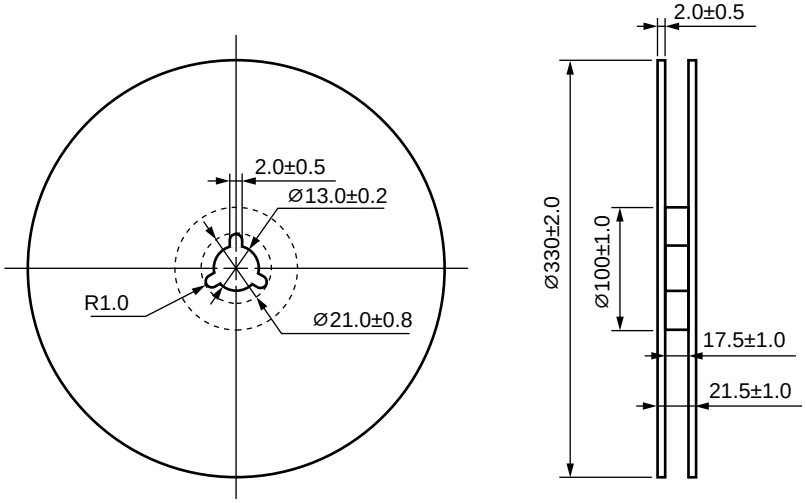
PSx3xxL-E3



Outline and Dimensions (Tape)

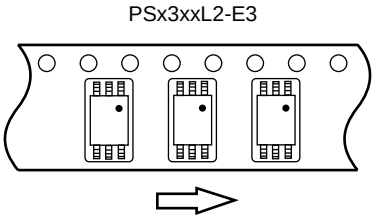


Outline and Dimensions (Reel)

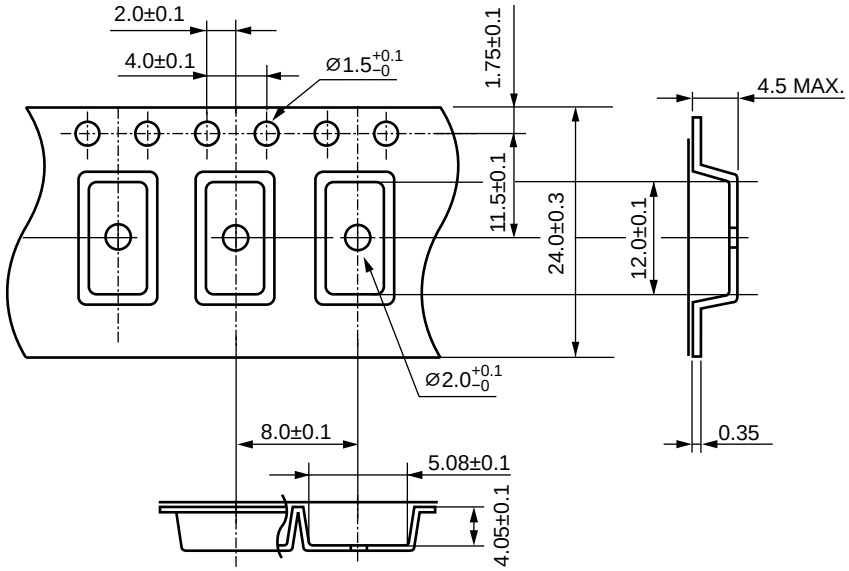


Packing: 2 000 pcs/reel

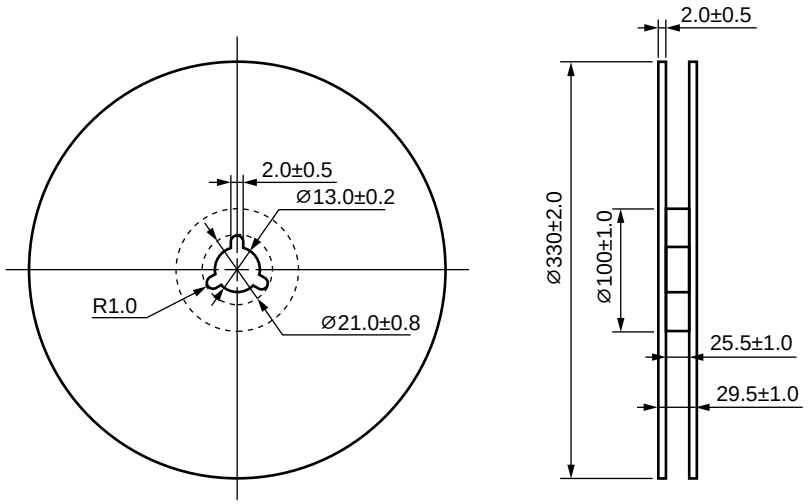
Tape Direction



Outline and Dimensions (Tape)

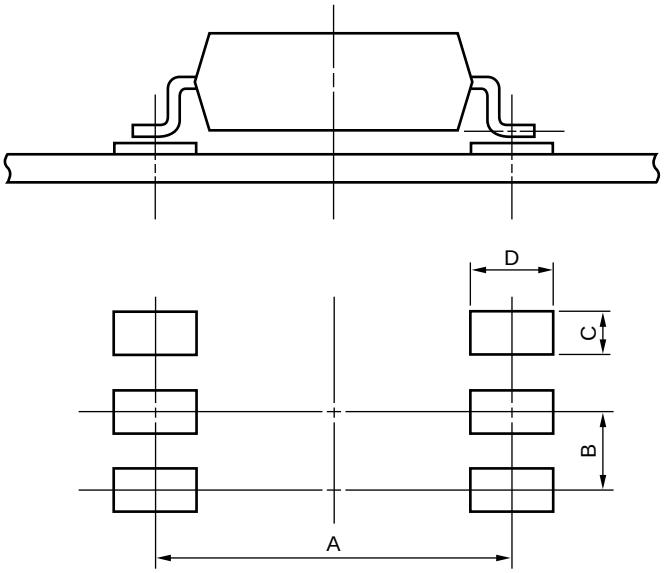


Outline and Dimensions (Reel)



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.

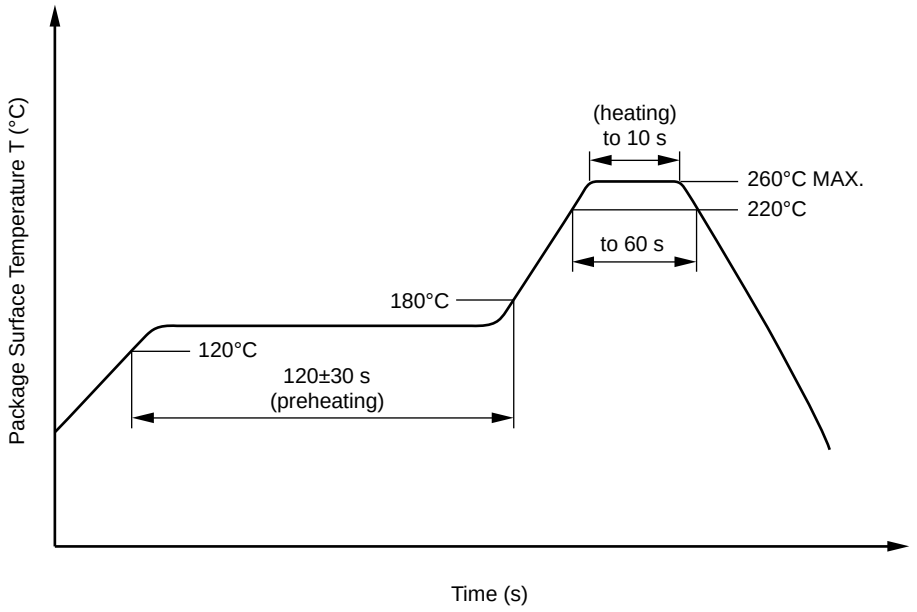
NOTES ON HANDLING

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

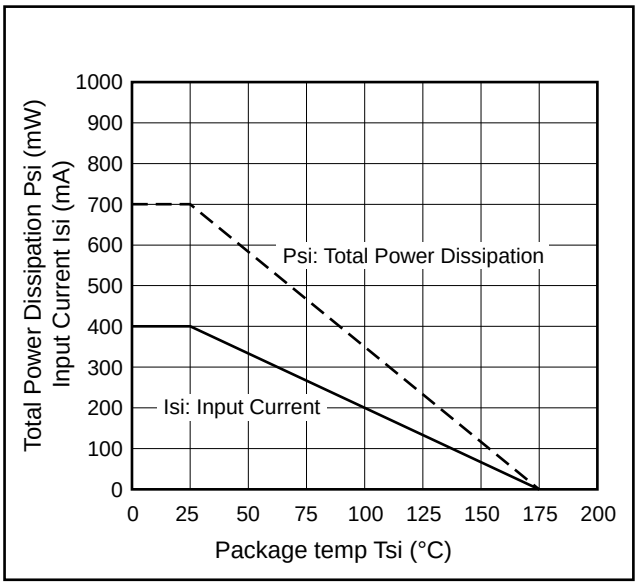
Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V_{CC} and GND at startup, the output side may enter the on state, even if the voltage is within the absolute

maximum ratings.

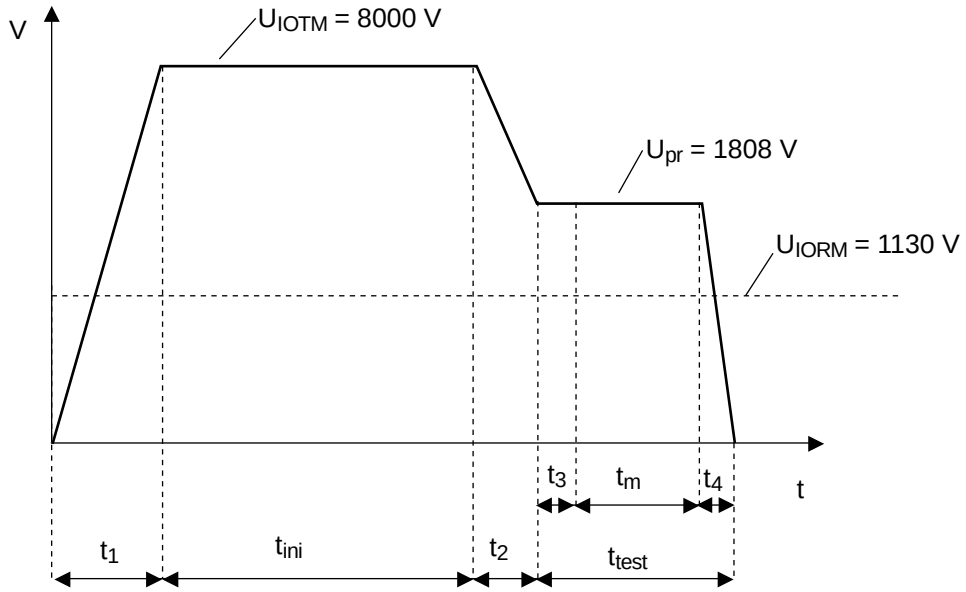
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM.}$, $P_d < 5$ pC	 U_{IORM} U_{pr}	 1 130 1 808	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM.}$, $P_d < 5$ 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 V dc at T_A = 25 °C V_{IO} = 500 V dc at T_A MAX. at least 100 °C	 Ris MIN. Ris MIN.	 10^{12} 10^{11}	 Ω Ω
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current I_F, Psi = 0) Power (output or total power dissipation) Isolation resistance V_{IO} = 500 V dc at T_A = Tsi	 Tsi Isi Psi Ris MIN.	 175 400 700 10^9	 °C mA mW Ω

Dependence of maximum safety ratings with package temperature

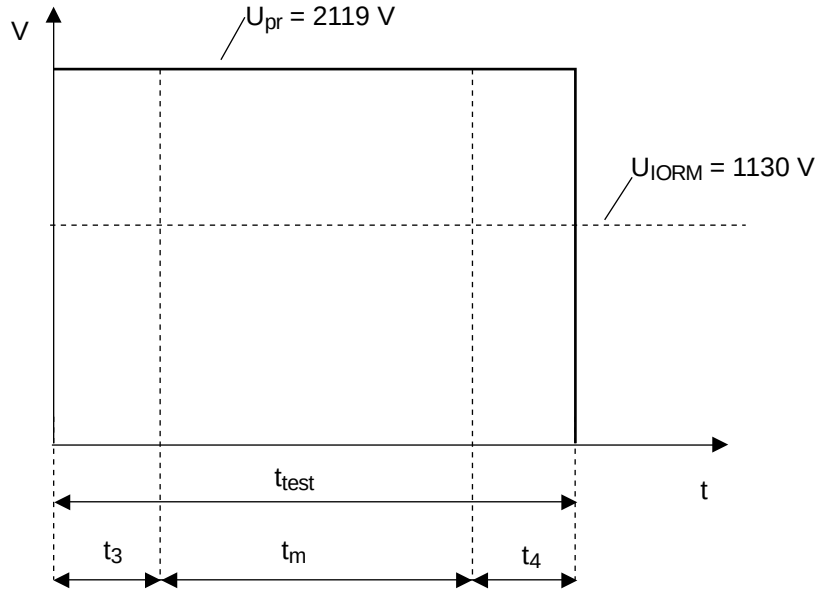


Method a) Destructive Test, Type and Sample Test



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

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



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

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(Rev.5.0-1 October 2020)

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