PS9587, PS9587L1, PS9587L2, PS9587L3

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE
8-PIN DIP HIGH-SPEED PHOTOCOUPLER

R08DS0244EJ0100
Rev.1.00
Sep 21, 2021

DESCRIPTION

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

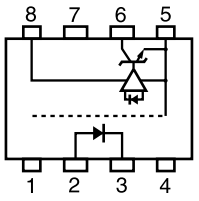
The PS9587L1 and PS9587L2 are designed specifically for long creepage-distance as well as high common mode transient immunity (CMR) and high speed digital output type. Consequently, they are suitable for high speed logic interface that needs long creepage-distance (8 mm) on mounting.

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 = ±15 kV/μs MIN)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- High-speed response (10 Mbps)
- Pulse width distortion ($|t_{PHL} – t_{PLH}|$ = 10 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
- - UL approved: UL1577, Double protection
- - CSA approved: CAN/CSA-C22.2 No.62368-1, Reinforced insulation
- - BSI approved: BS EN 62368-1, Reinforced insulation
- - SEMKO approved: EN 62368-1, IEC 62368-1, Reinforced insulation
- - NEMKO approved: EN 62368-1, Reinforced insulation
- - DEMKO approved: EN 62368-1, Reinforced insulation
- - FIMKO approved: EN 62368-1, Reinforced insulation
- - VDE approved: DIN EN 60747-5-5 (Option)

PIN CONNECTIONS
(Top View)



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

APPLICATIONS

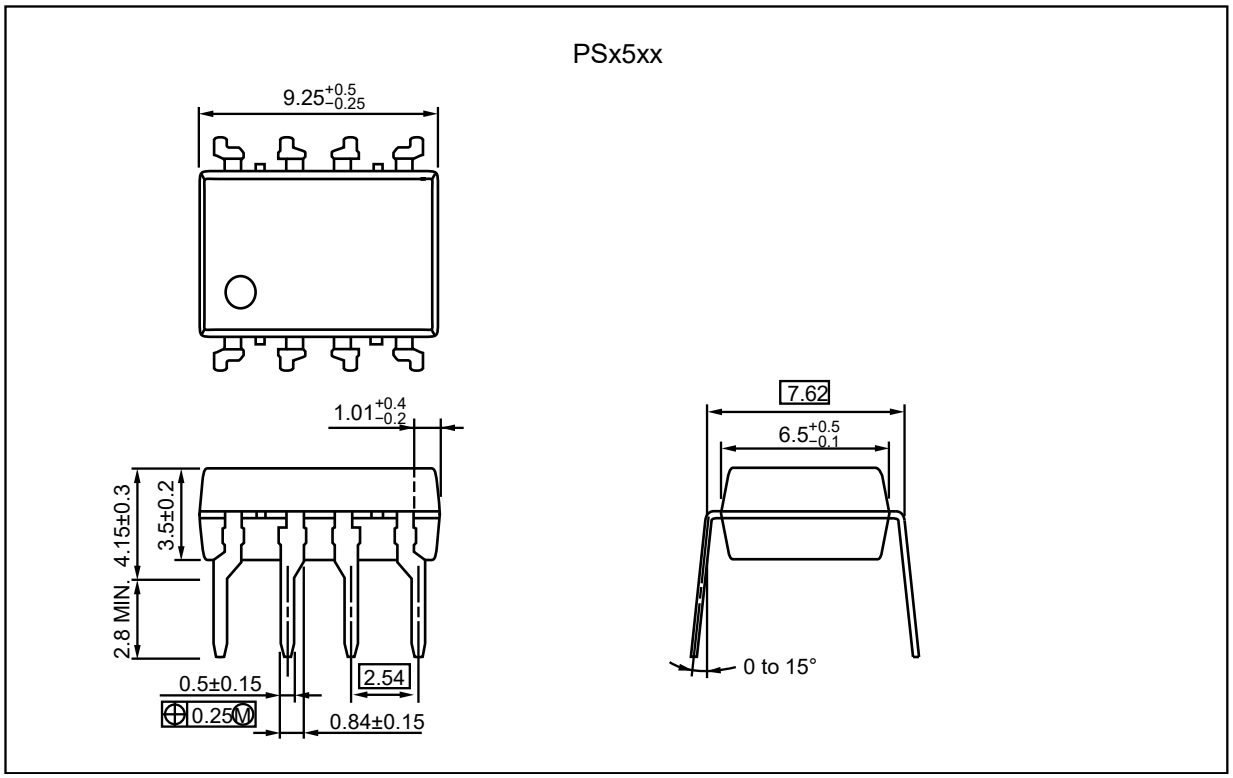
- FA Network
- Measurement equipment
- PDP

Start of mass production
Jun.2006

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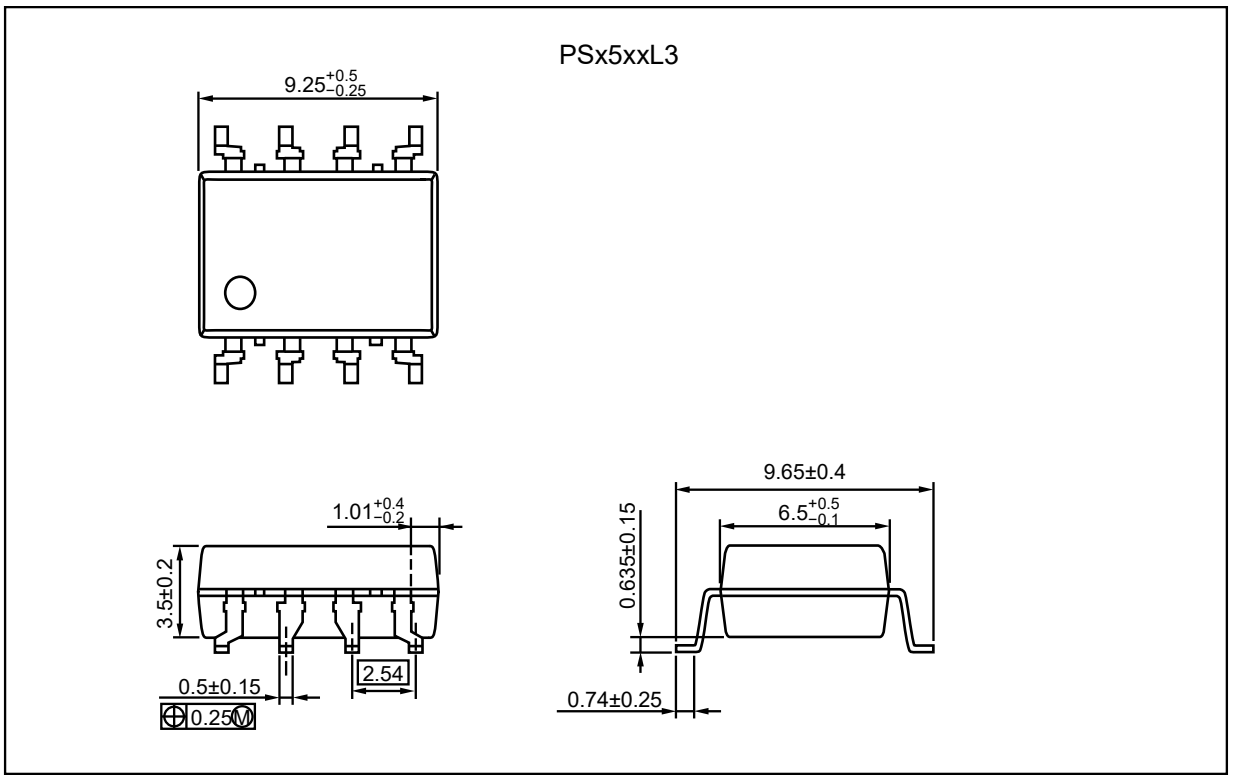
PACKAGE DIMENSIONS (UNIT: mm)

DIP Type



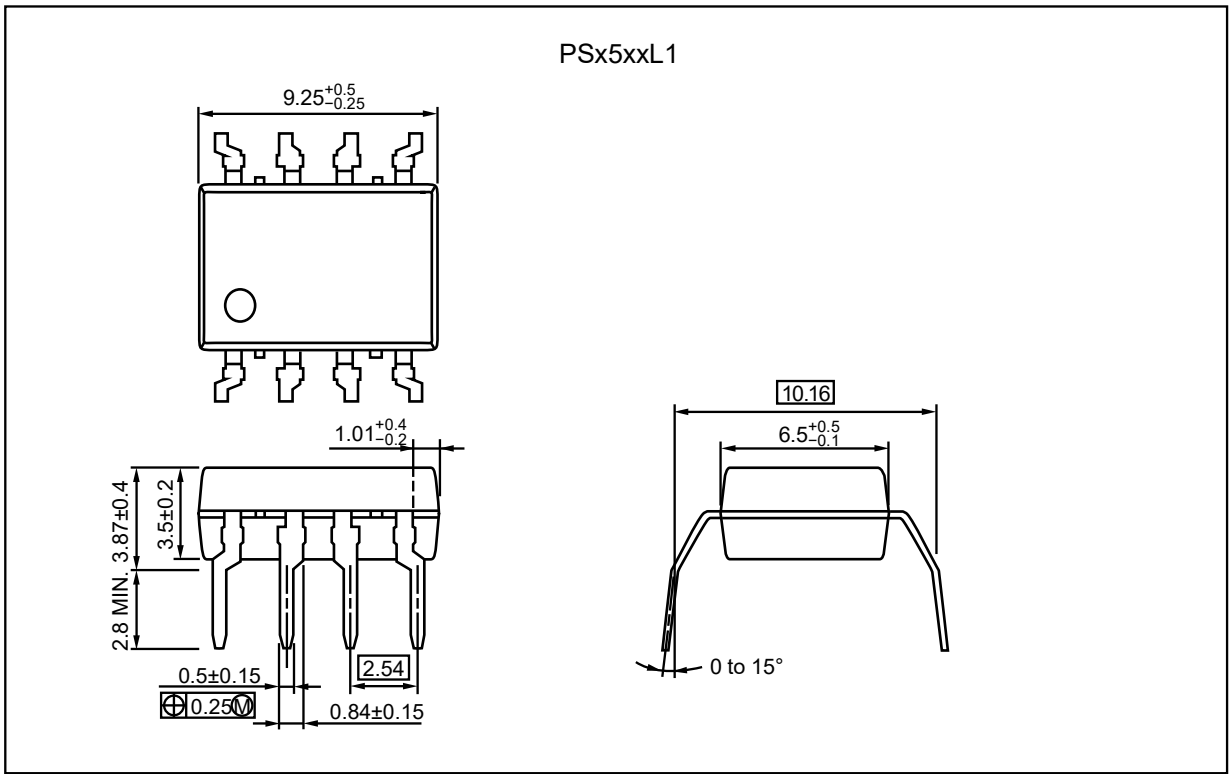
Weight: 0.55g (typ.)

Lead Bending Type (Gull-wing) For Surface Mount

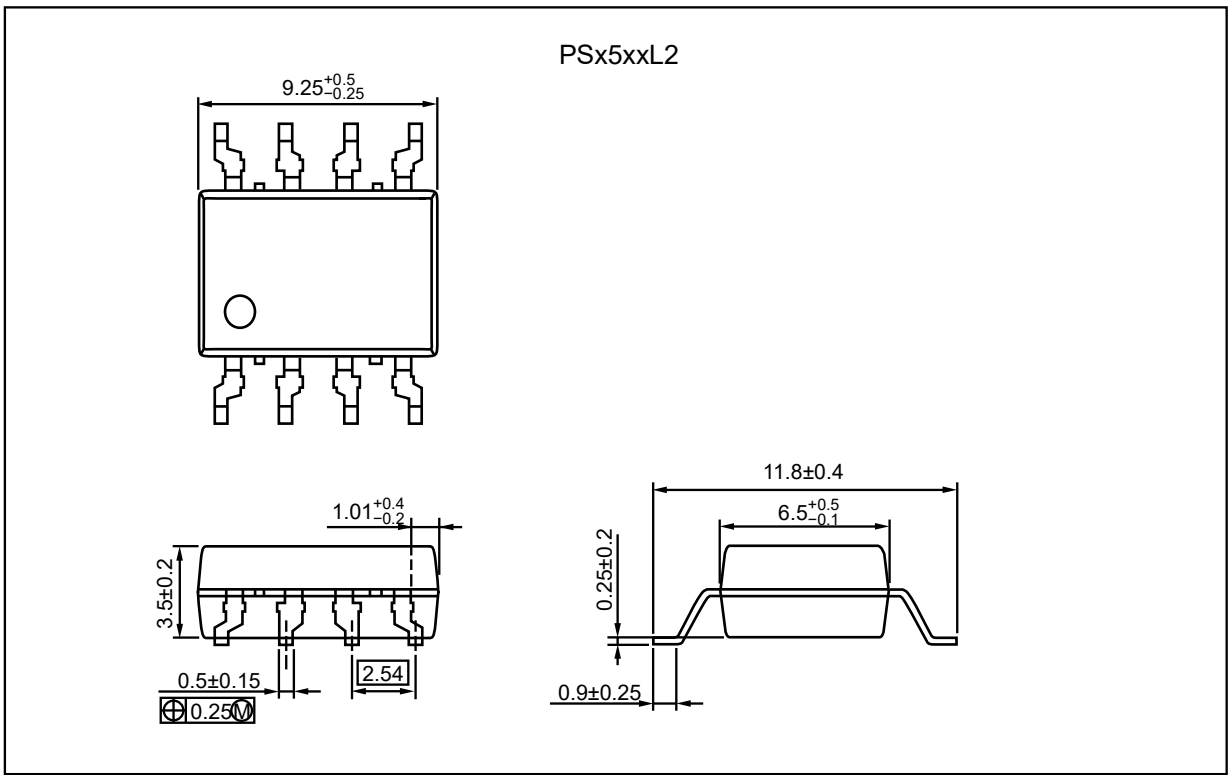


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Lead Bending Type For Long Creepage Distance



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

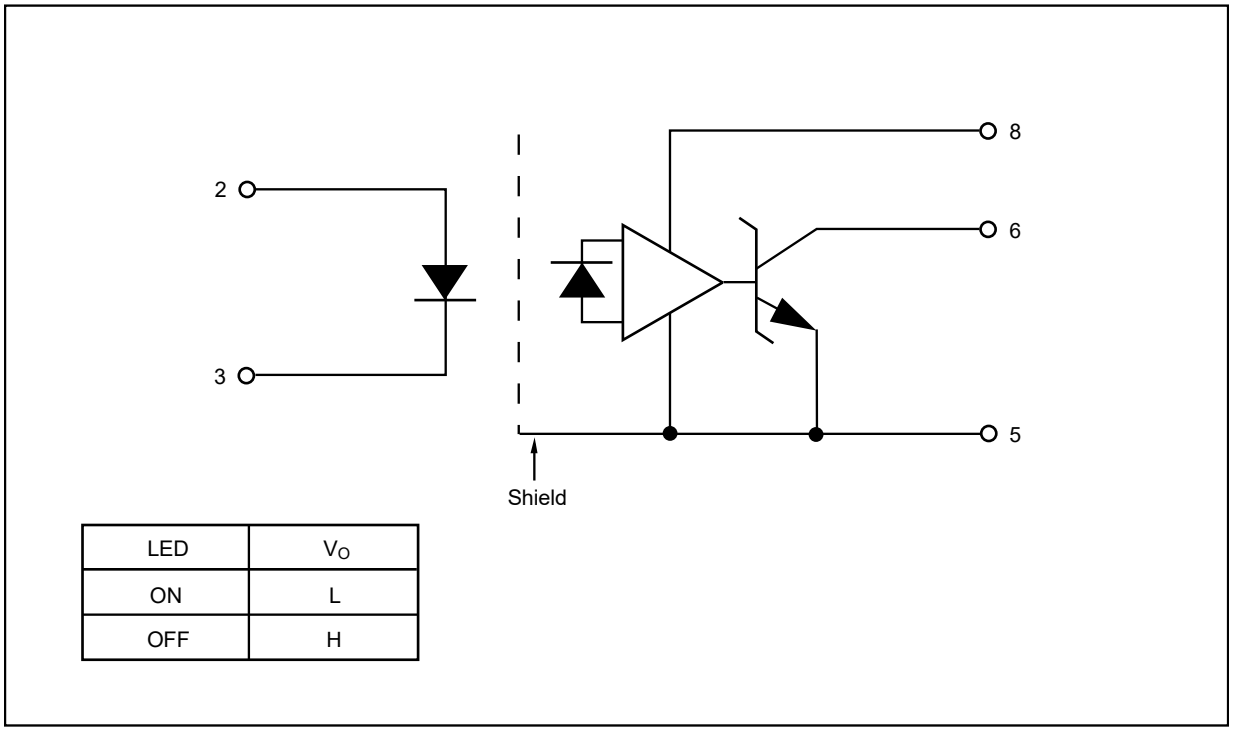


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PHOTOCOUPLER CONSTRUCTION

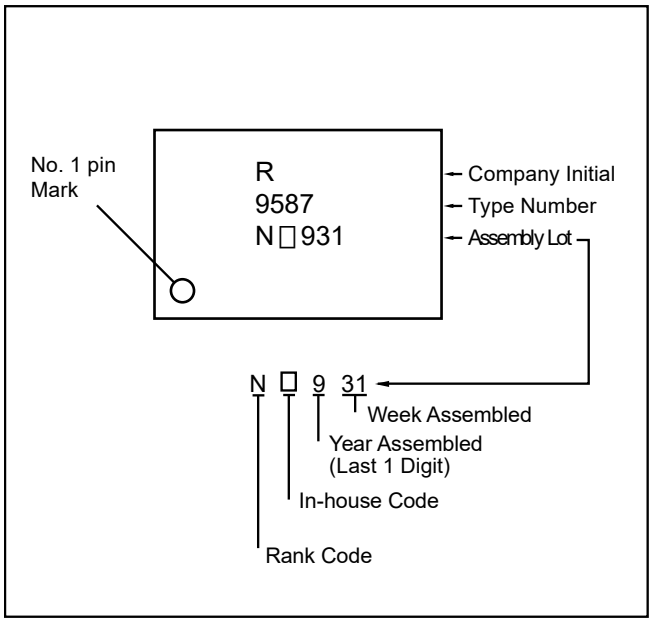
Parameter	PS9587, PS9587L3	PS9587L1, PS9587L2
Air Distance (MIN.)	7 mm	8 mm
Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

FUNCTIONAL DIAGRAM



LED	V_O
ON	L
OFF	H

MARKING EXAMPLE



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ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number *1
PS9587	PS9587-AX	Pb-Free (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	UL, CSA, BSI, SEMKO, NEMKO, FIMKO, DEMKO, DIN EN 60747-5-5 approved	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

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

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ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current *1	I_F	30	mA
	Reverse Voltage	V_R	5	V
Detector	Supply Voltage	V_{CC}	7	V
	Output Voltage	V_O	7	V
	Output Current	I_O	25	mA
	Power Dissipation *2	P_C	40	mW
Isolation Voltage *3		BV	5 000	Vr.m.s.
Operating Ambient Temperature		T_A	–40 to +85	°C
Storage Temperature		T_{stg}	–55 to +125	°C

Notes*: 1. Reduced to 0.3 mA/°C at T_A = 25 °C or more.
2. Applies to output pin V_O (Collector pin). Reduced to 1.5 mW/°C at T_A = 65 °C or more.
3. AC voltage for 1 minute at T_A = 25 °C, RH = 60 % between input and output.
Pins 1-4 shorted together, 5-8 shorted together.

RECOMMENDED OPERATING CONDITIONS (T_A = 25 °C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I_{FH}	6.3	10	12.0	mA
Low Level Input Voltage	V_{FL}	0		0.8	V
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
TTL (R_L = 1 kΩ, loads)	N			5	
Pull-up Resistance	R_L	330		4 k	Ω

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ELECTRICAL CHARACTERISTICS (T_A = – 40 to + 85 °C, unless otherwise specified)

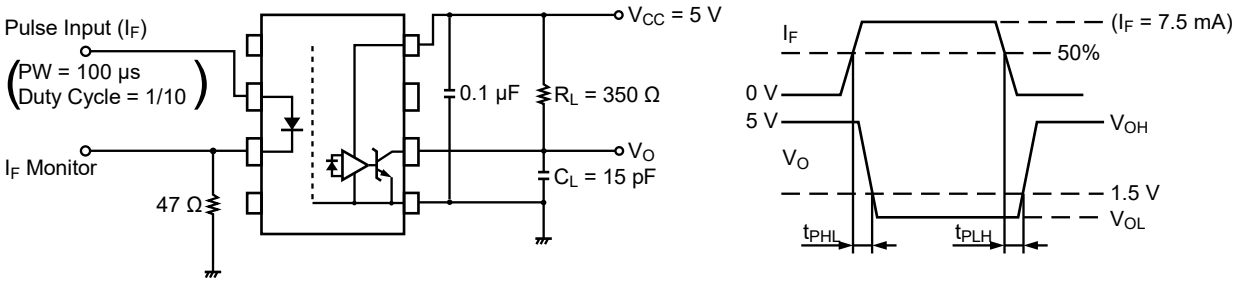
Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	V_F	I_F = 10 mA, T_A = 25 °C	1.4	1.65	1.8	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25 °C			10	μA
	Terminal Capacitance	C_t	V_F = 0 V, f = 1 MHz, T_A = 25 °C		30	150	pF
Detector	High Level Output Current	I_{OH}	V_{CC} = V_O = 5.5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

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Notes*: 1. Typical values at T_A = 25 °C.

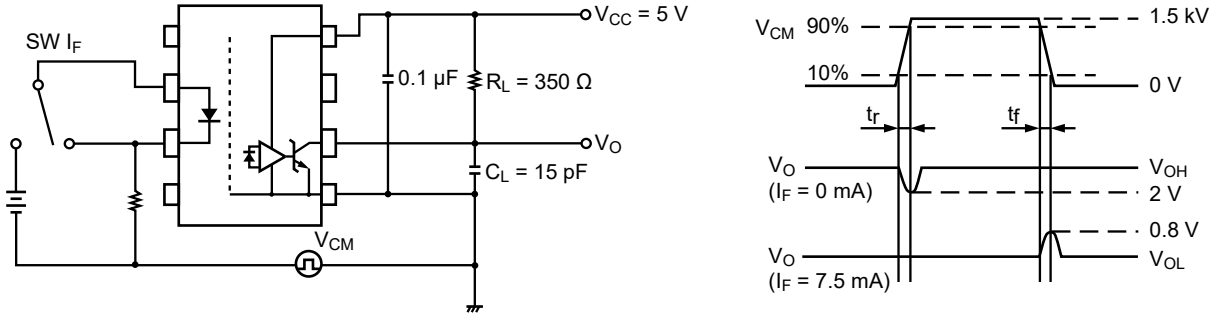
2. Because V_{OL} of 2 V or more may be output when LED current is input and when output power supply is on and off, confirm the characteristics (operation with the power supply on and off) during design, before using this device.

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.

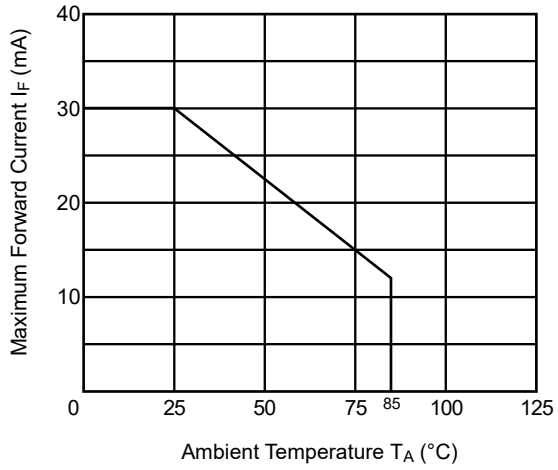
USAGE CAUTIONS

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 µF 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*1 pin) can either be connected directly to the GND pin on the LED side or left open. Also, Pin 7 (which is an NC*1 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.
5. Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
6. Do not use fixing agents or coatings containing halogen-based substances.

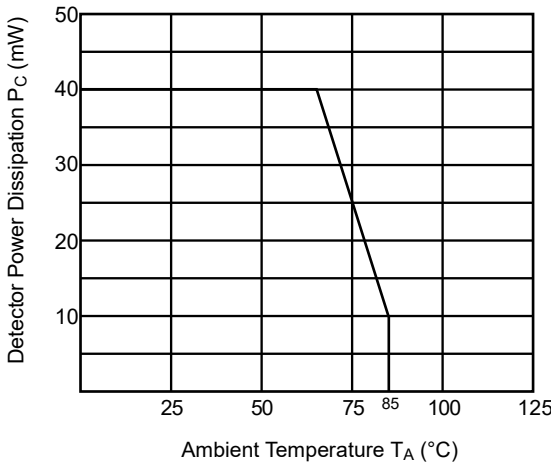
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TYPICAL CHARACTERISTICS (T_A = 25 °C unless otherwise specified)

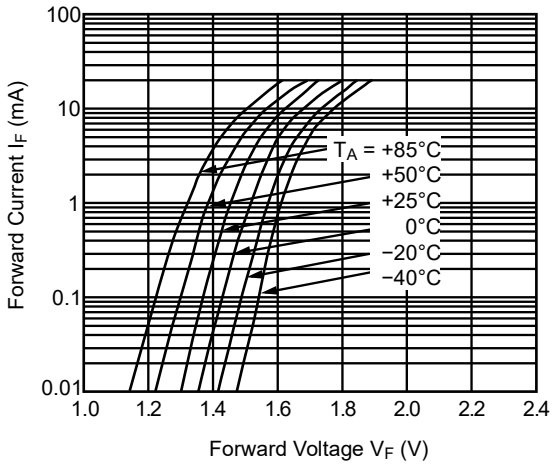
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



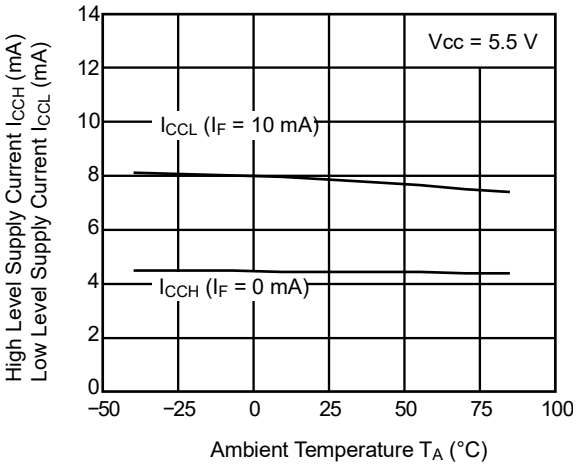
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



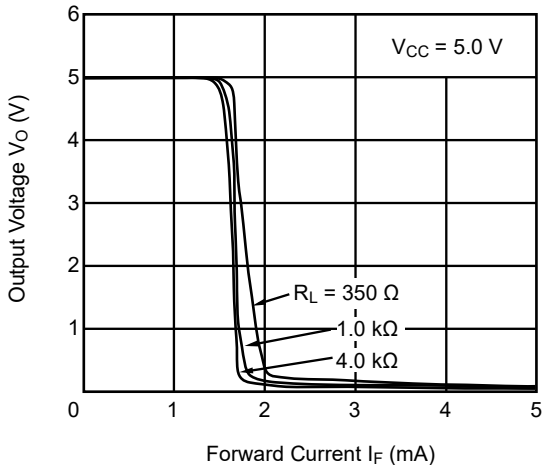
FORWARD CURRENT vs. FORWARD VOLTAGE



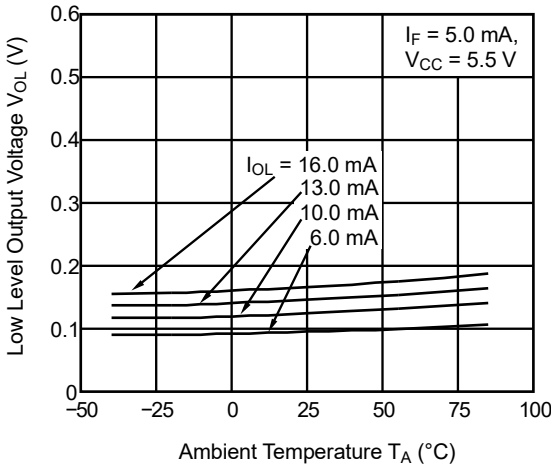
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT



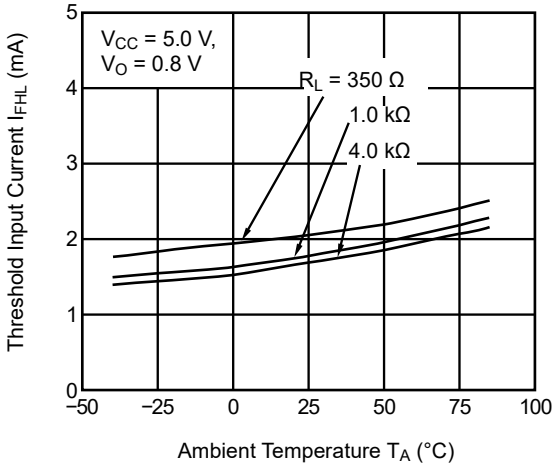
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



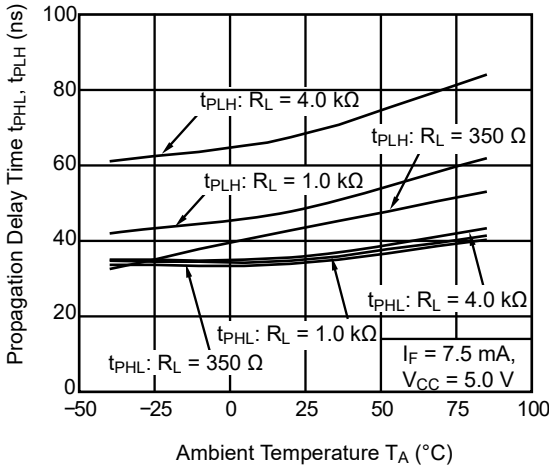
Remark The graphs indicate nominal characteristics.

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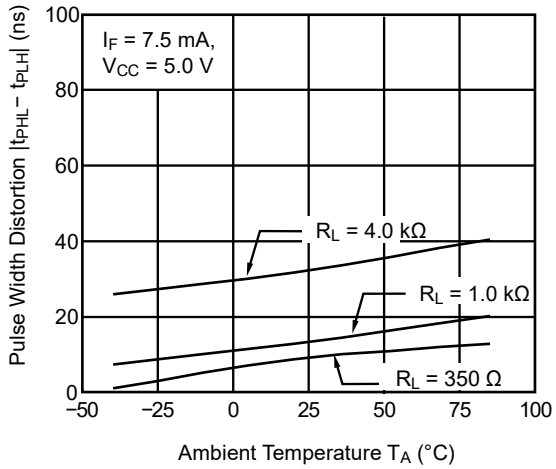
THRESHOLD INPUT CURRENT vs.
AMBIENT TEMPERATURE



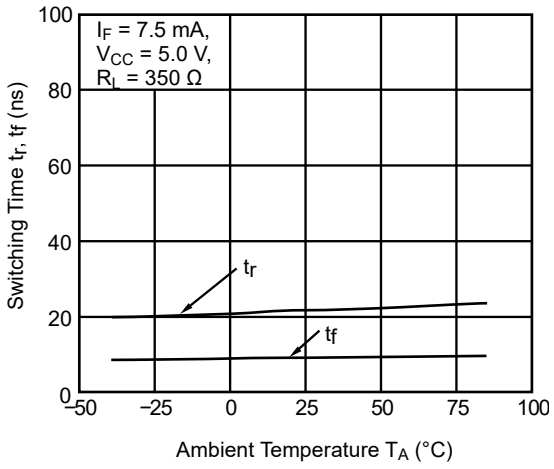
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



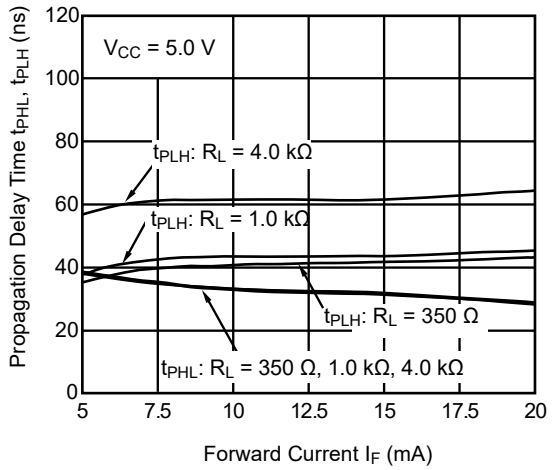
PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE



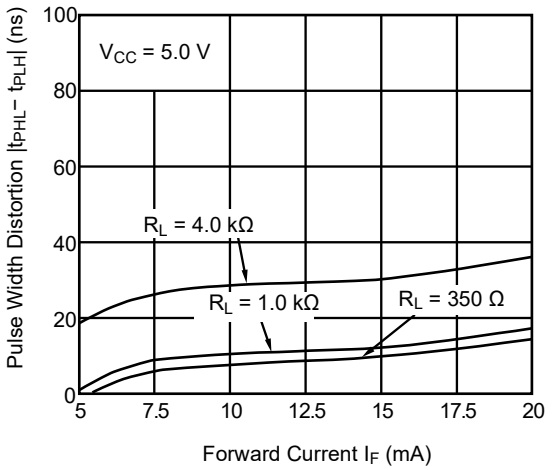
SWITCHING TIME vs.
AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs.
FORWARD CURRENT



PULSE WIDTH DISTORTION vs.
FORWARD CURRENT

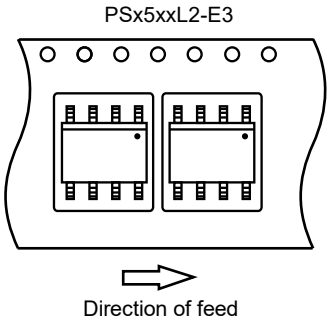


Remark The graphs indicate nominal characteristics.

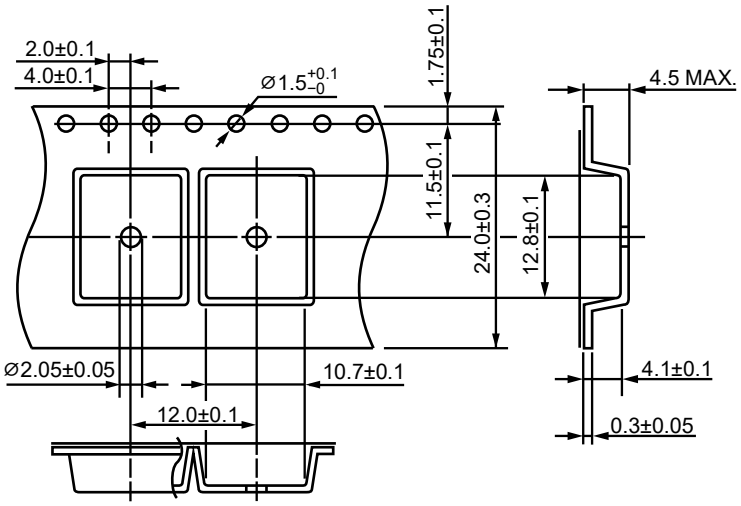
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TAPING SPECIFICATIONS (UNIT: mm)

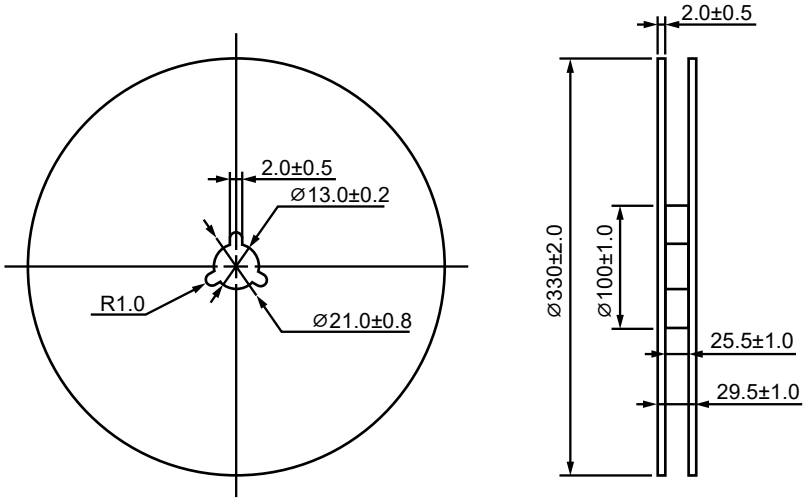
Tape Direction



Outline and Dimensions (Tape)



Outline and Dimensions (Reel)

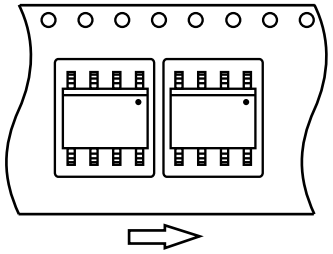


Packing: 1 000 pcs/reel

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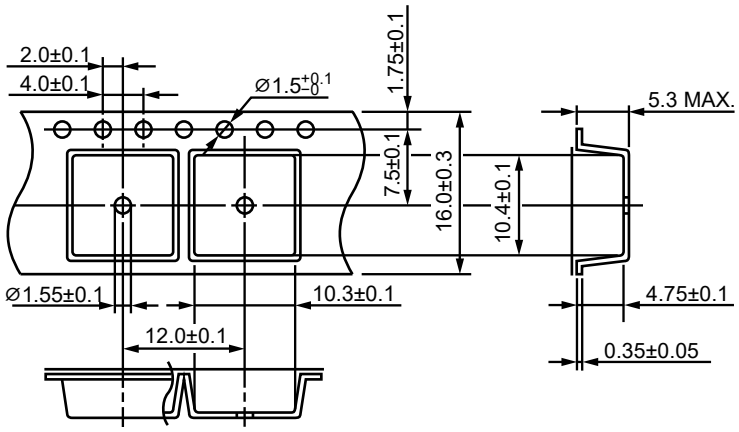
Tape Direction

PSx5xxL3-E3

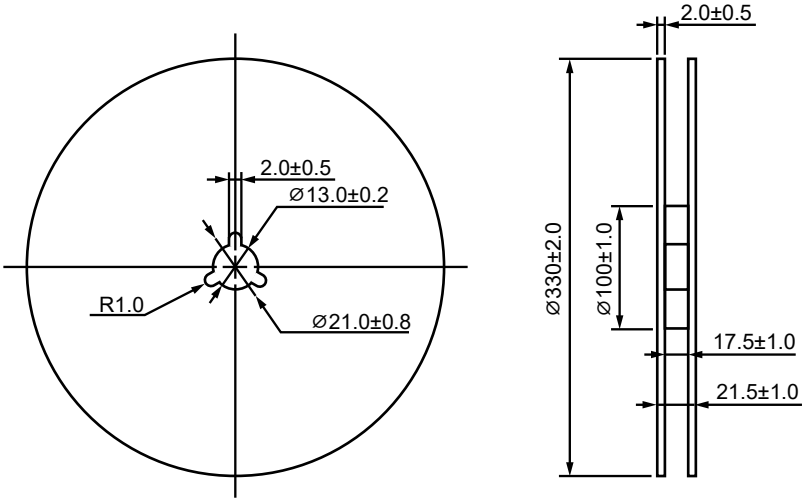


Direction of feed

Outline and Dimensions (Tape)



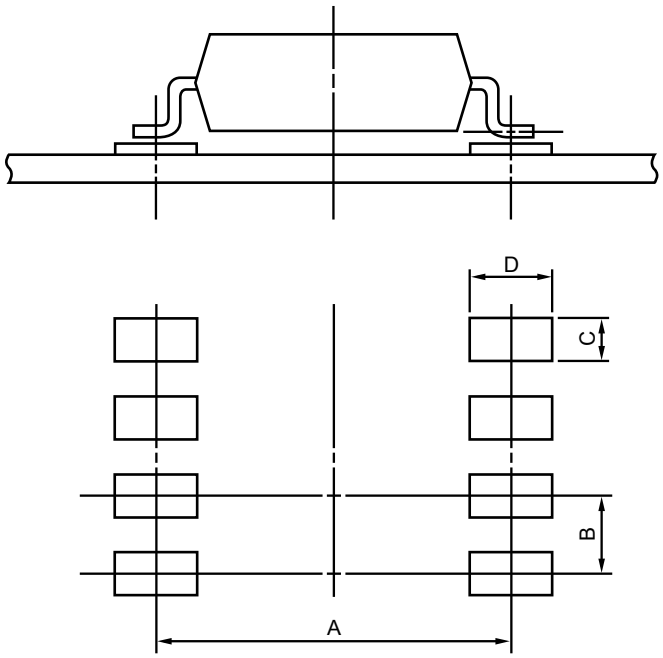
Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

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RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PSx5xxL2	lead bending type for long creepage distance (Gull-wing) for surface mount	10.2	2.54	1.7	2.2
PSx5xxL3	lead bending type (Gull-wing) for surface mount	8.2	2.54	1.7	2.2

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

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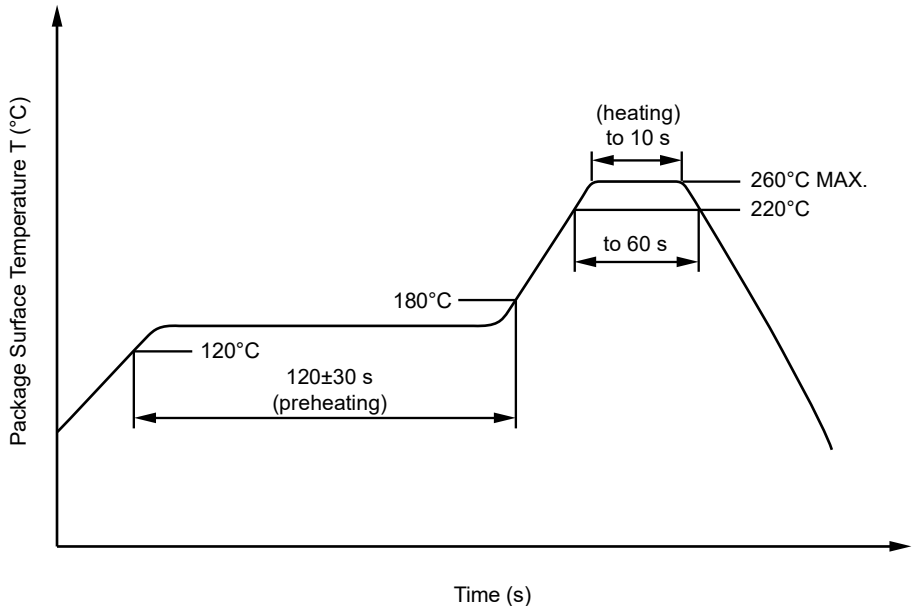
NOTES ON HANDLING

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

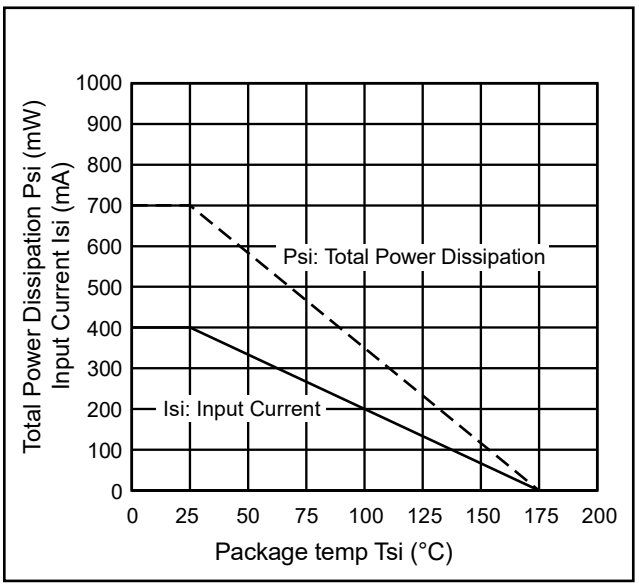
Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V_{CC}-GND at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

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SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

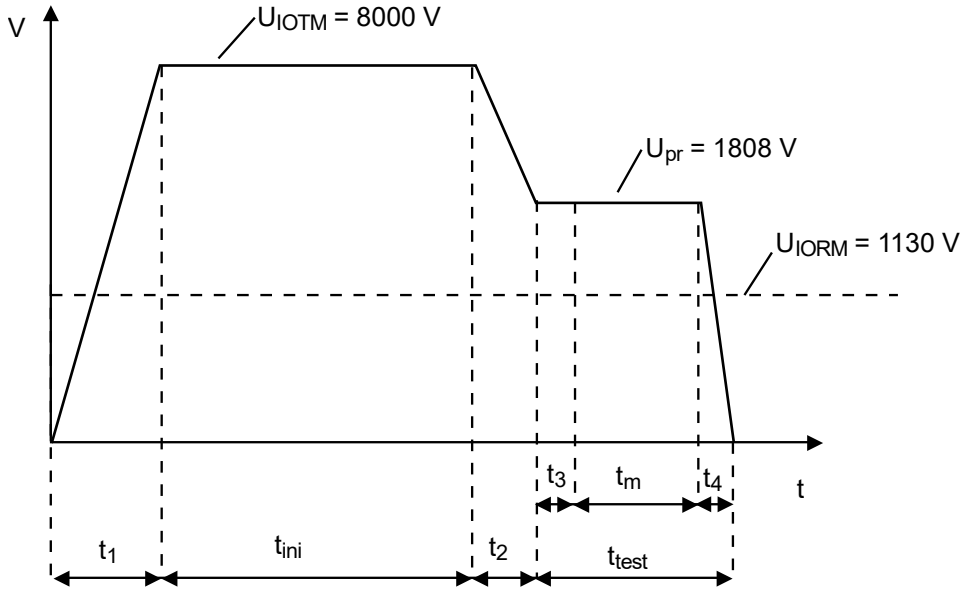
Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/85/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) U_{pr} = 1.6 × U_{IORM}, P_d < 5 pC	 U_{IORM} U_{pr}	 1 130 1 808	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) U_{pr} = 1.875 × 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 Part 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 +85	°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



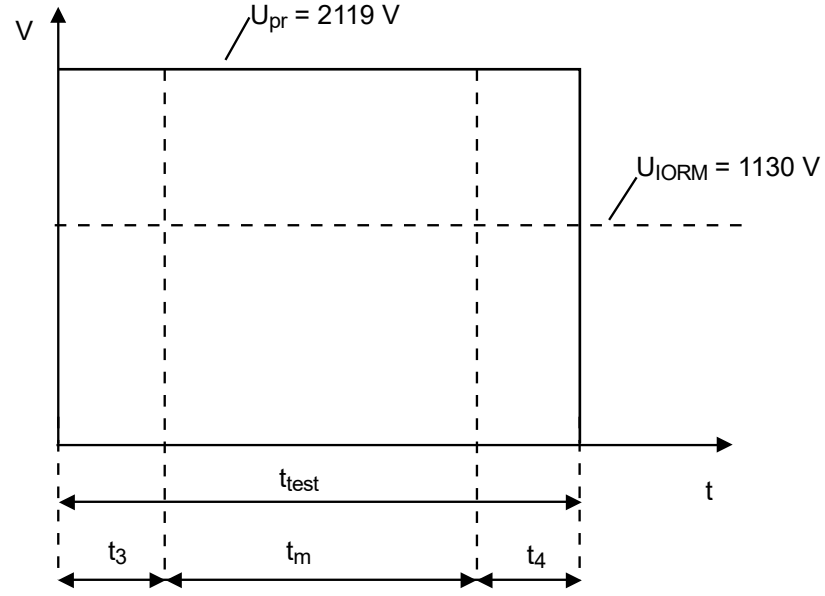
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Method a) Destructive Test, Type and Sample Test



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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