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DATA SHEET

NEC

PHOTOCOUPLER

PS9587,PS9587L1,PS9587L2,PS9587L3

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE 8-PIN DIP HIGH-SPEED PHOTOCOUPLER FOR CREEPAGE DISTANCE OF 8 mm

–NEPOC Series–

DESCRIPTION

The PS9587, PS9587L1, PS9587L2 and PS9587L3 are optically coupled isolators containing a GaAlAs 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.

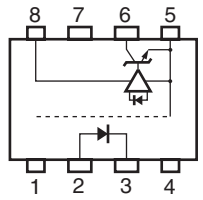
The PS9587L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

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: File No. E72422
  - CSA approved: No. CA 101391
  - BSI approved: No. 8937, 8938
  - SEMKO approved: No. 615433
  - NEMKO approved: No. P06207243
  - DEMKO approved: No. 314091
  - FIMKO approved: No. FI 22827
  - DIN EN60747-5-2 (VDE0884 Part2) approved (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

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The mark <R> shows major revised points.

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The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

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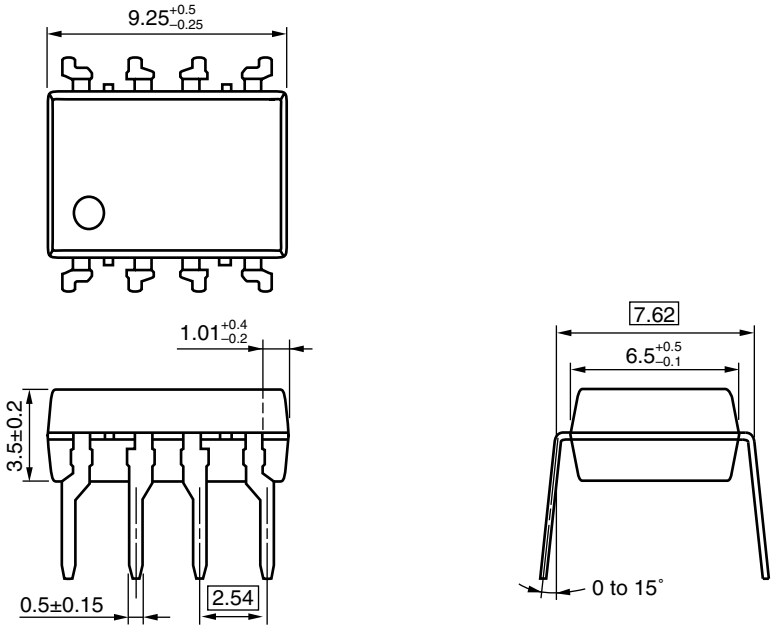
PACKAGE DIMENSIONS (UNIT: mm)

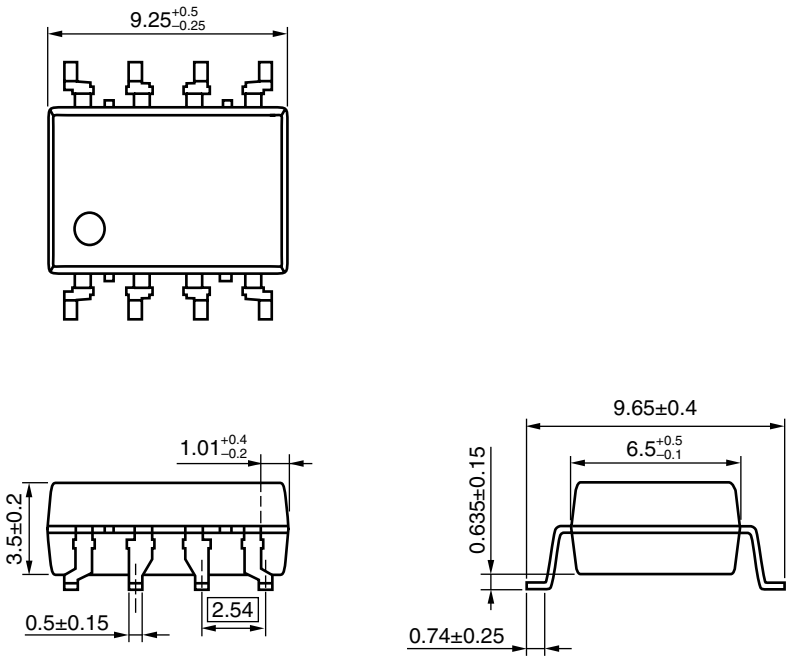
DIP Type

PS9587



Lead Bending Type (Gull-wing) For Surface Mount

PS9587L3



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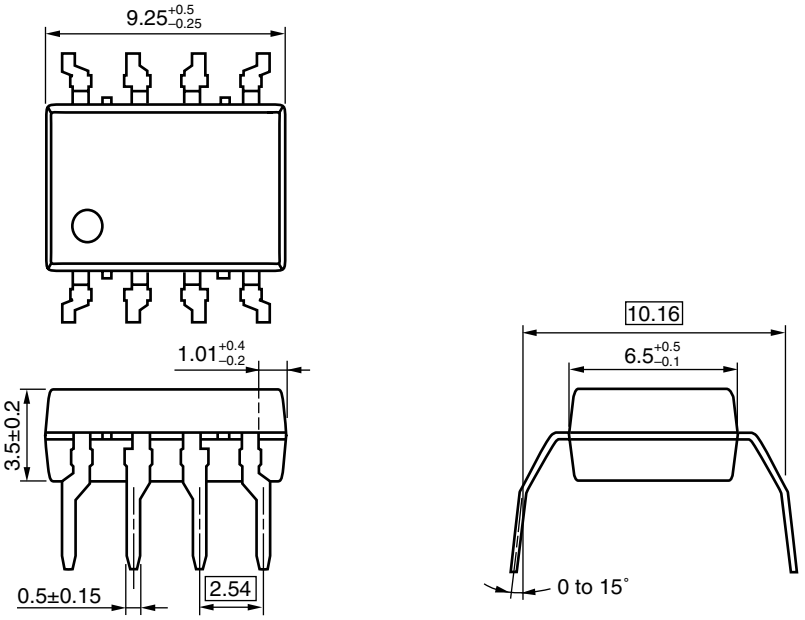
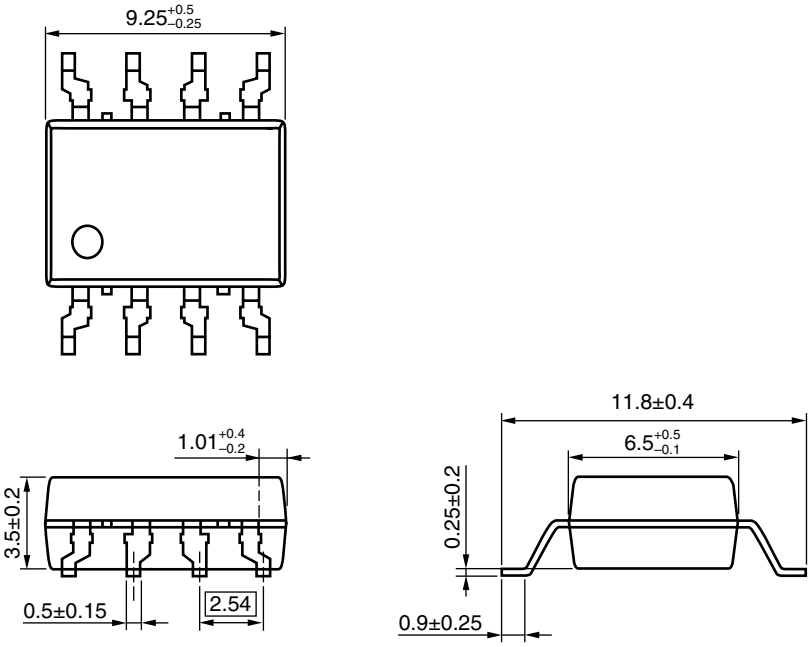
Lead Bending Type For Long Creepage Distance

PS9587L1



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

PS9587L2



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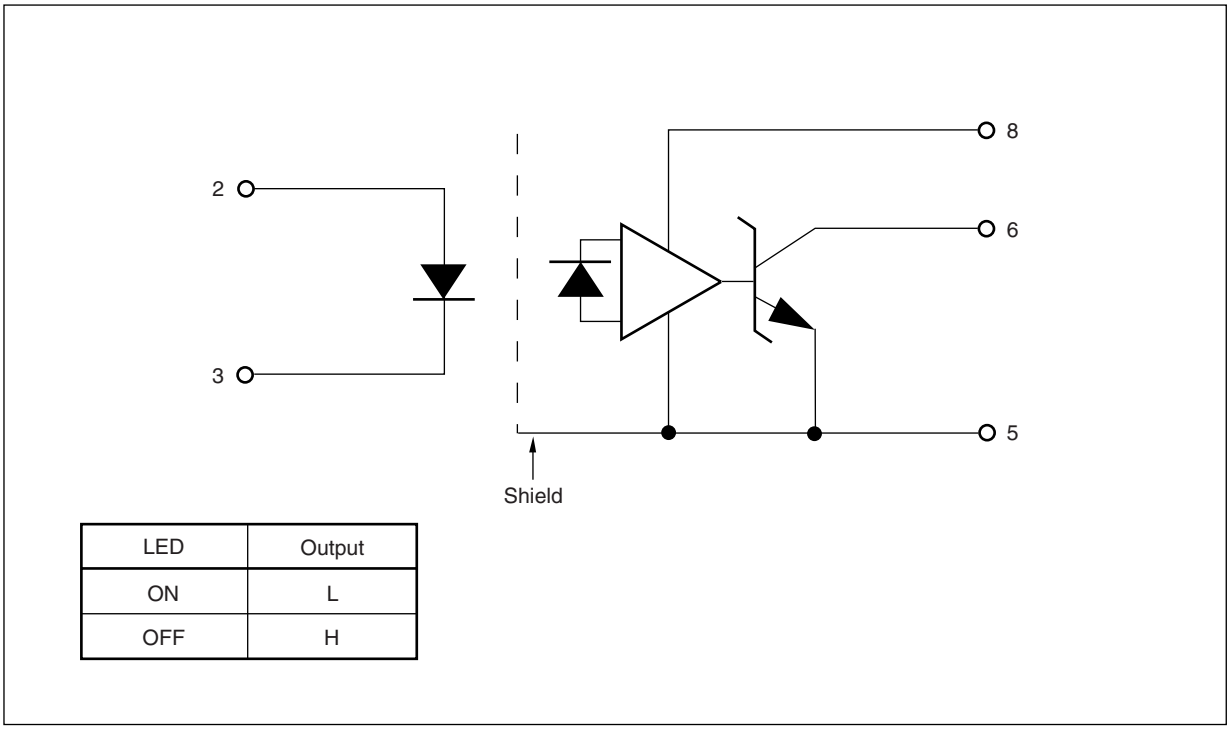
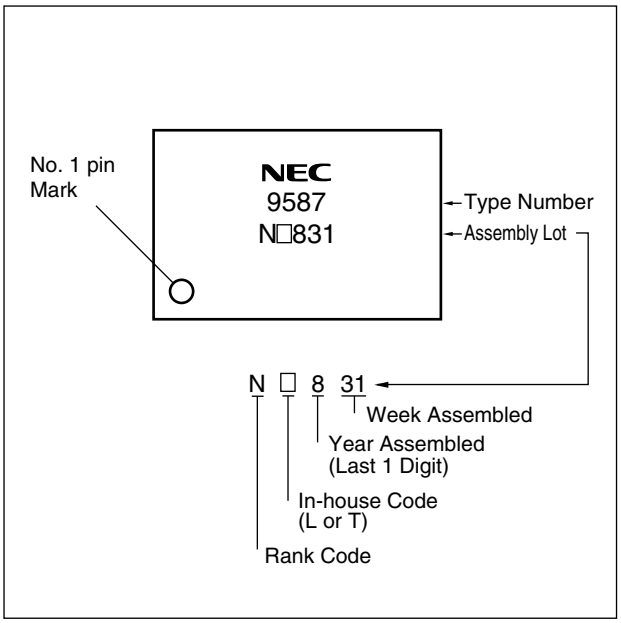
FUNCTIONAL DIAGRAM



LED	Output
ON	L
OFF	H

<R> MARKING EXAMPLE



PHOTOCOUPLER CONSTRUCTION

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

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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	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	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

***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

***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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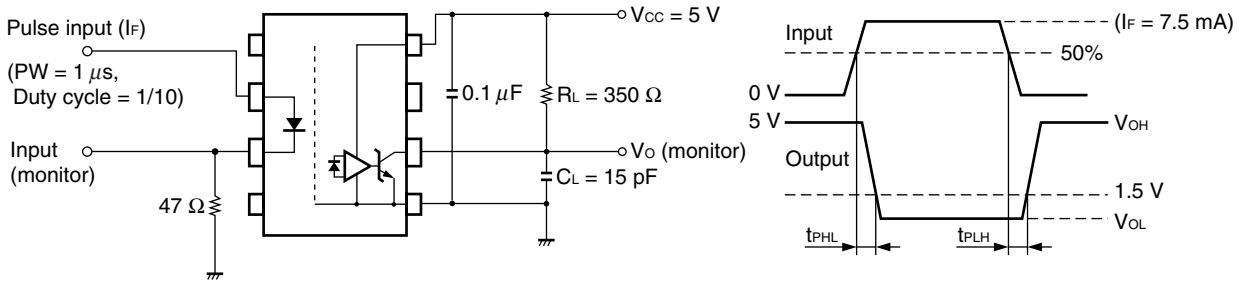
***1** Typical values at T_A = 25°C

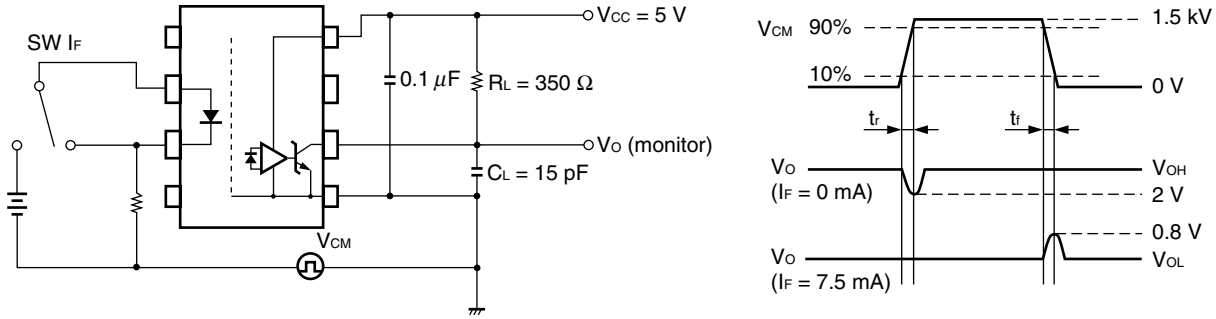
***2** Because V_{OL} of 2 V or more may be output when LED current is input and when output power supply is on and off, confirm the characteristics (operation with the power supply on and off) during design, before using this device.

***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. Avoid storage at a high temperature and high humidity.

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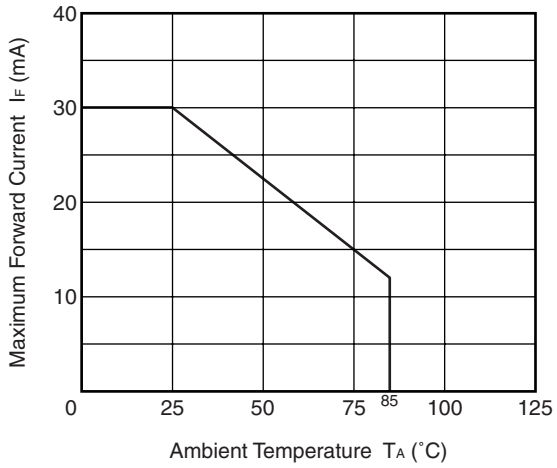
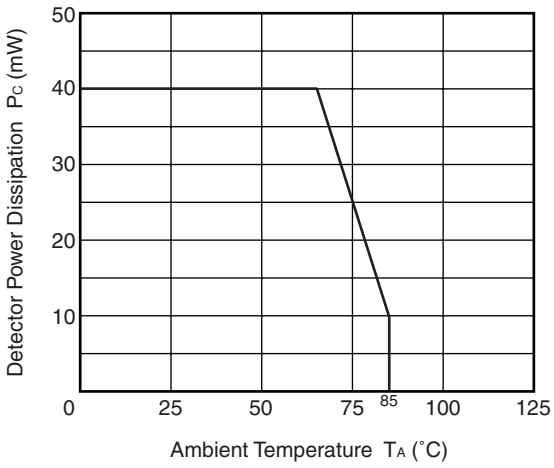
TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)

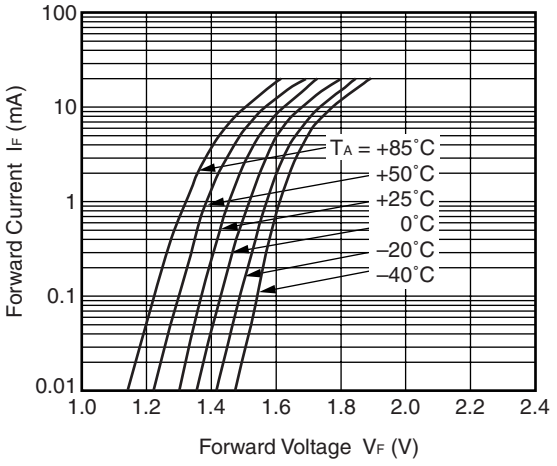
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



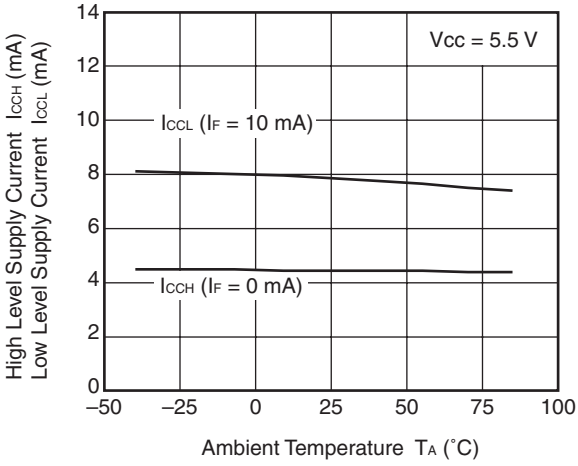
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



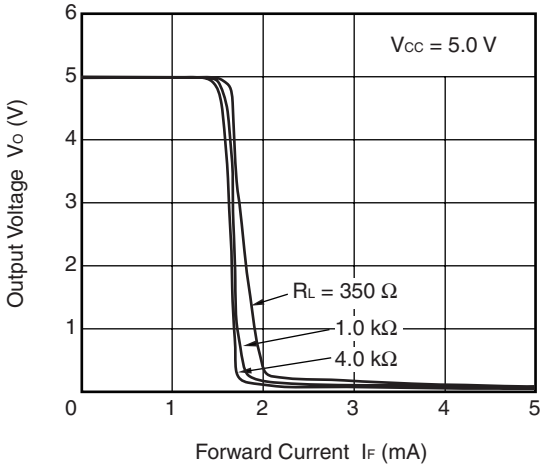
FORWARD CURRENT vs. FORWARD VOLTAGE



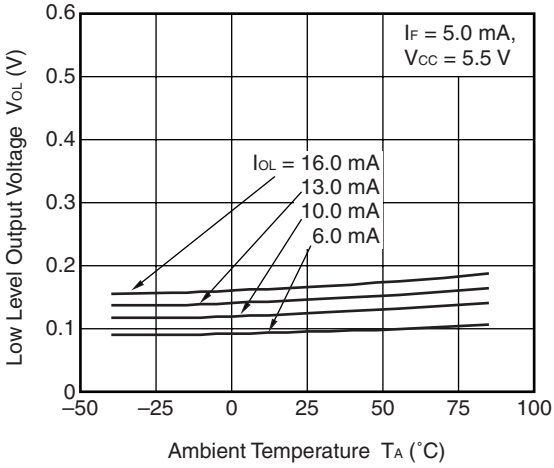
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT



LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



Remark The graphs indicate nominal characteristics.

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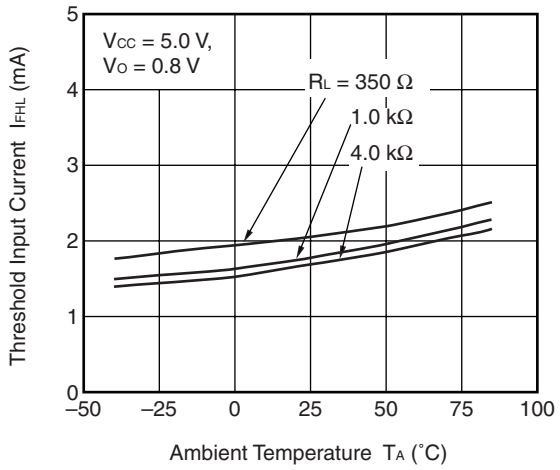
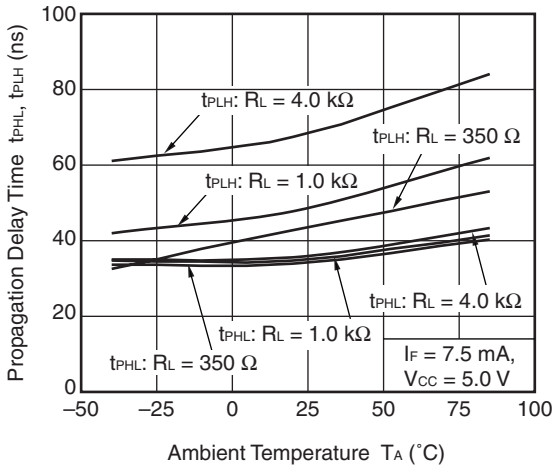
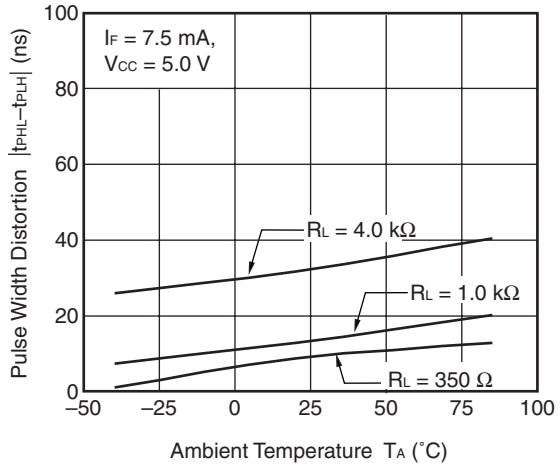
THRESHOLD INPUT CURRENT vs.
AMBIENT TEMPERATURE



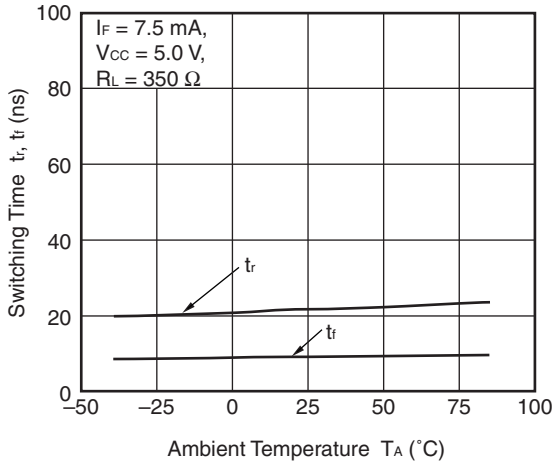
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



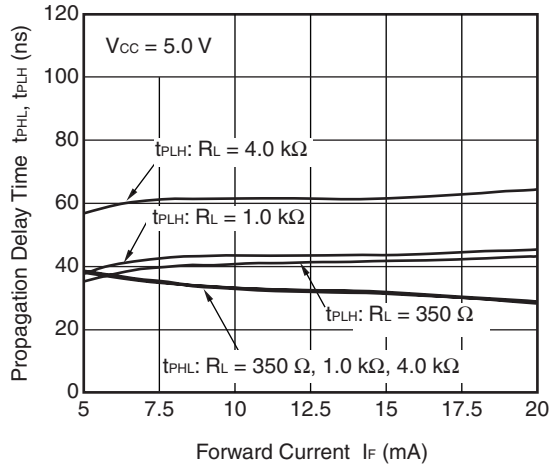
PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE



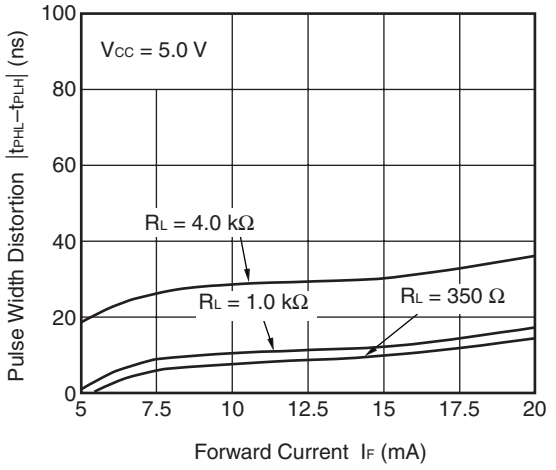
SWITCHING TIME vs.
AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs.
FORWARD CURRENT



PULSE WIDTH DISTORTION vs.
FORWARD CURRENT



Remark The graphs indicate nominal characteristics.

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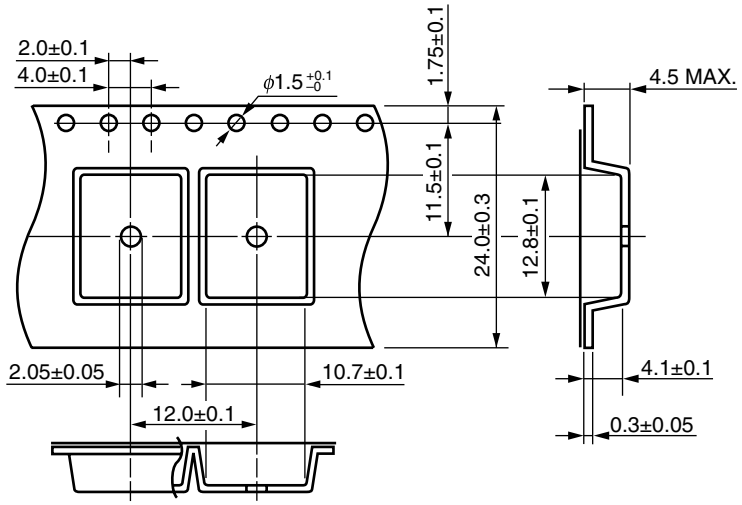
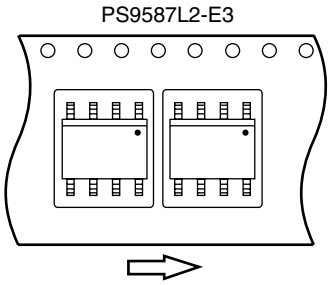
TAPING SPECIFICATIONS (UNIT: mm)

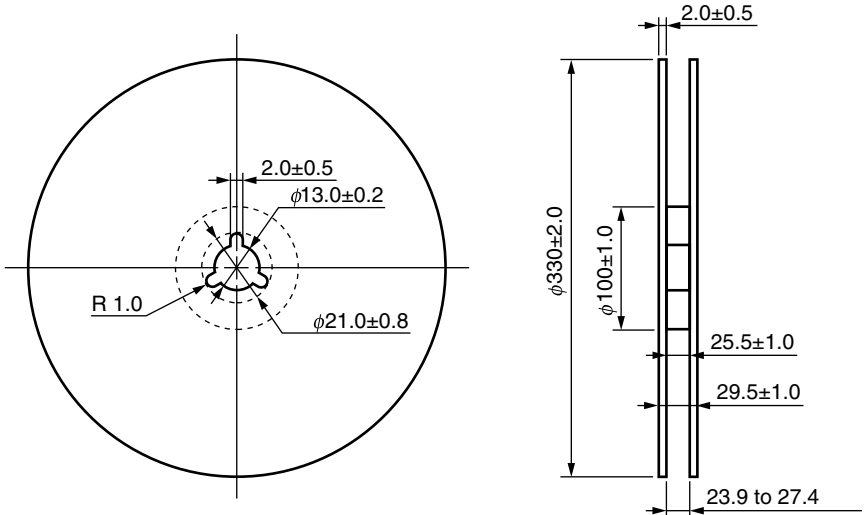
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

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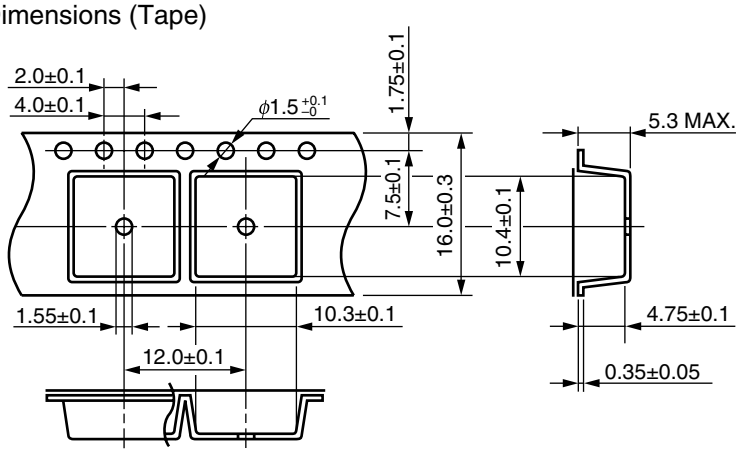
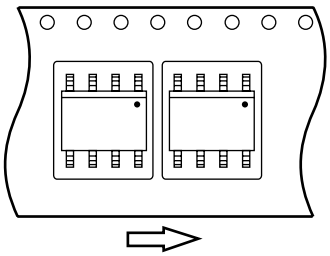
Outline and Dimensions (Tape)

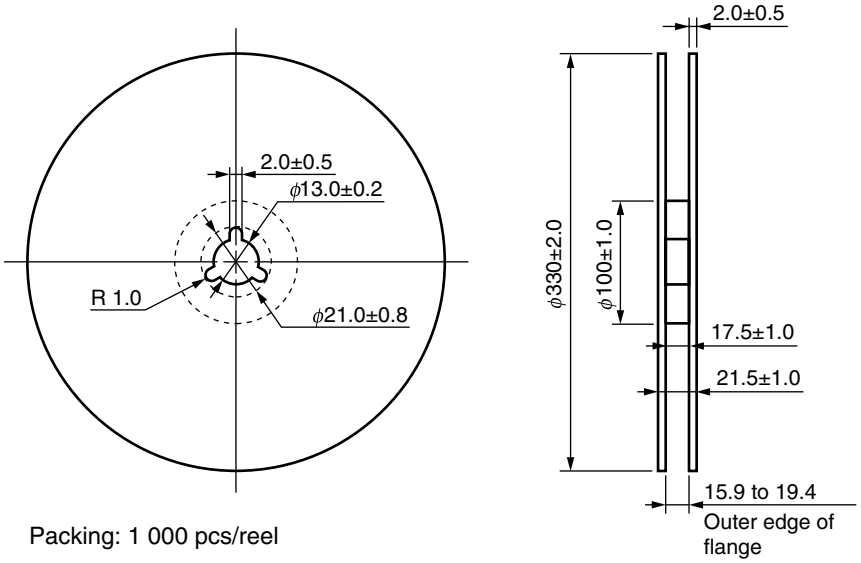


Tape Direction

PS9587L3-E3



Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

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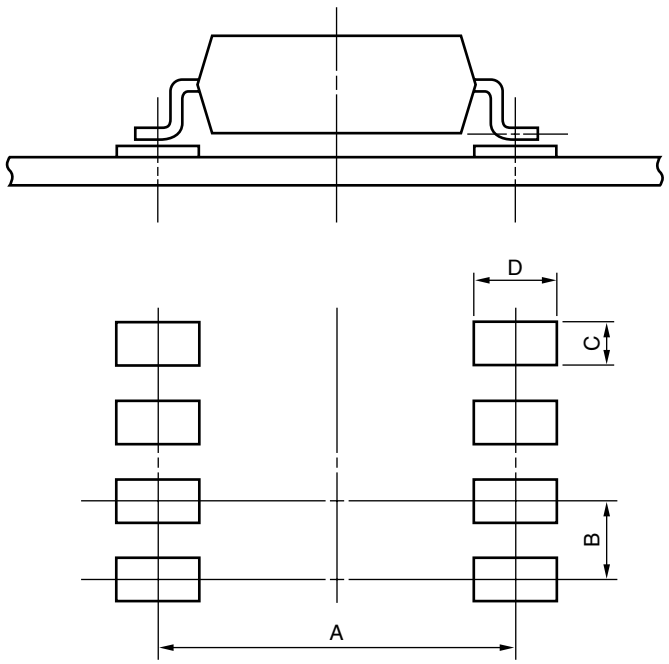
RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9587L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	2.54	1.7	2.2
PS9587L3	lead bending type (Gull-wing) for surface mount	8.2	2.54	1.7	2.2

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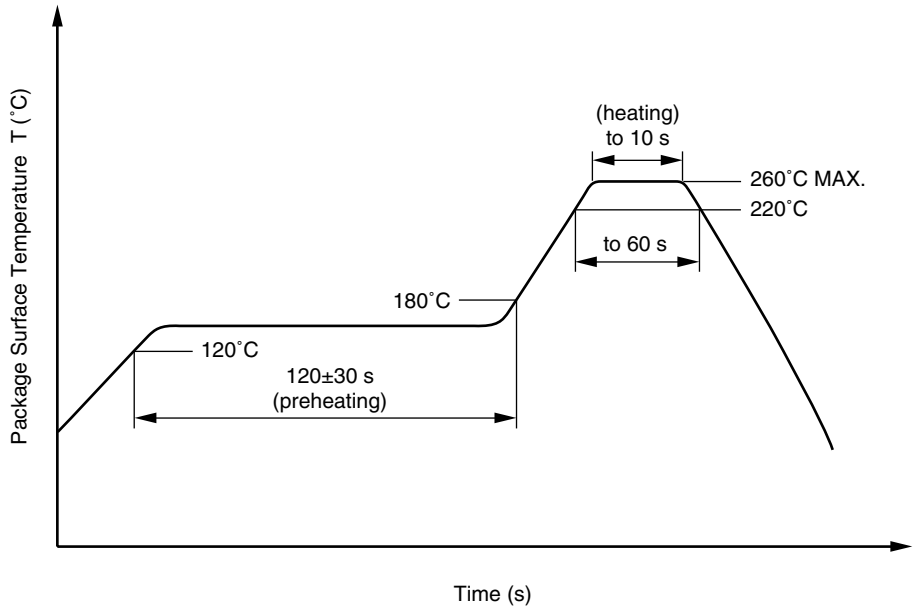
NOTES ON HANDLING

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

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(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 collector-emitters at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

<R> **USAGE CAUTIONS**

1. Protect against static electricity when handling.

2. Avoid storage at a high temperature and high humidity.

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SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Speck	Unit
Application classification (DIN EN 60664-1 VDE0110 Part 1) for rated line voltages ≤ 300 Vr.m.s. for rated line voltages ≤ 600 Vr.m.s.		 IV III	
Climatic test class (DIN EN 60664-1 VDE0110)		55/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}$, $P_d < 5$ pC	 U_{IORM} U_{pr}	 1 130 1 695	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5$ 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	
Clearance distance		>8.0	mm
Creepage distance		>8.0	mm
Comparative tracking index (DIN IEC 112/VDE 0303 Part 1)	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 +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

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