PS9309L, PS9309L2

LOW IF TOTEM POLE OUTPUT TYPE HIGH CMR, IPM DRIVER, 6-PIN SDIP PHOTOCOUPLER

Data Sheet
R08DS0047EJ0100
Rev.1.00
Mar 28, 2014

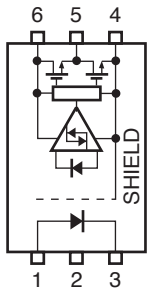
DESCRIPTION

The PS9309L and PS9309L2 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 PS9309L and PS9309L2 are specified high CMR and pulse width distortion with operating temperature. It is suitable for IPM (Intelligent Power Module) drive.
The PS9309L is lead bending type (Gull-wing) for surface mounting. The PS9309L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

FEATURES

- Totem pole output (Active High Output Type)
- Pulse width distortion ($|t_{PLH} - t_{PHL}|$ = 80 ns MAX.)
- High common mode transient immunity (CM_H, CM_L = ±15 kV/μs MIN.)
- Half size of 8-pin DIP
<R> - Long creepage distance (8 mm MIN.: PS9309L2)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- Embossed tape product : PS9309L-E3, PS9309L2-E3: 2 000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
<R> - SEMKO approved (EN 60065,EN 60950)
<R> - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)

PIN CONNECTION
(Top View)



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

APPLICATIONS

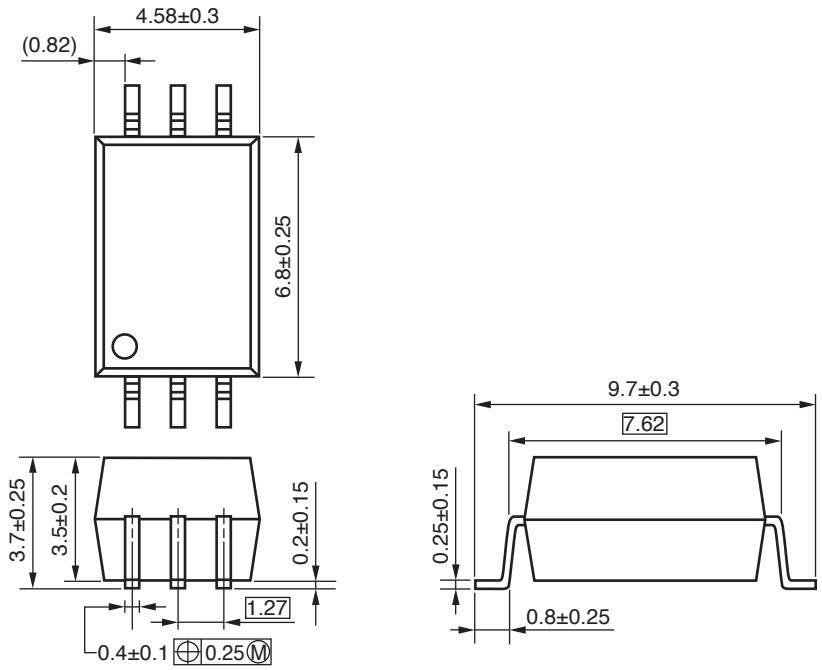
- IPM Driver
- General purpose inverter

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

PACKAGE DIMENSIONS (UNIT: mm)

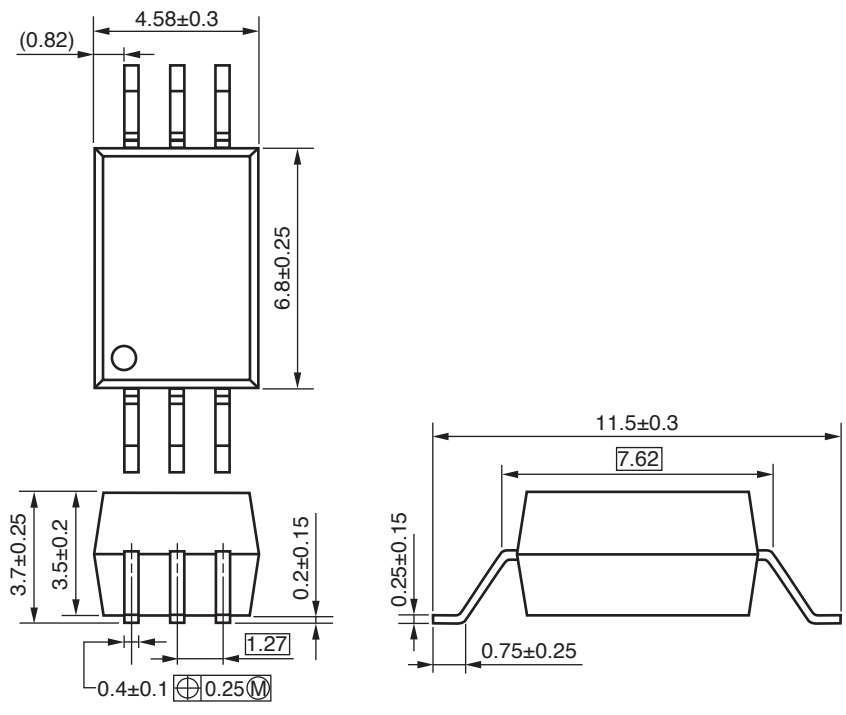
Lead Bending Type (Gull-wing) For Surface Mount

PS9309L



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

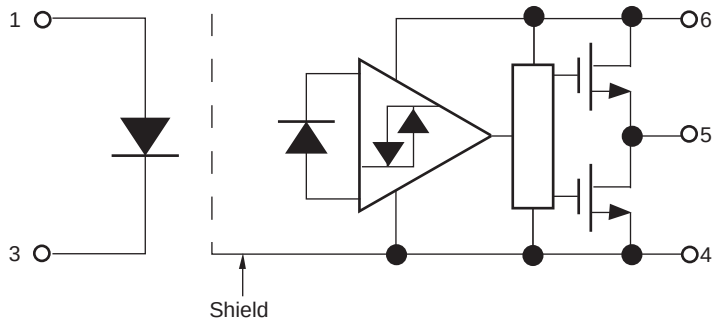
PS9309L2



PHOTOCOUPLER CONSTRUCTION

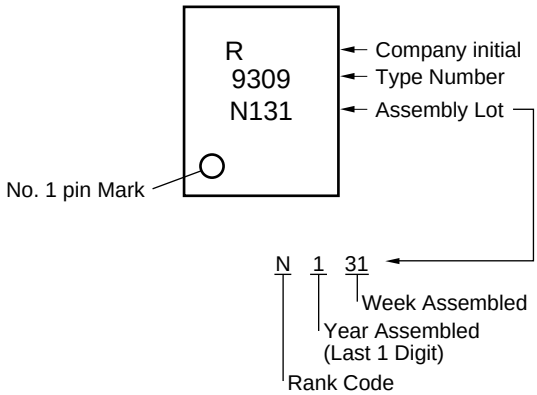
Parameter	PS9309L	PS9309L2
Air Distance (MIN.)	7 mm	8 mm
Outer Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

BLOCK DIAGRAM



LED	Output
ON	H
OFF	L

MARKING EXAMPLE



<R> ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9309L	PS9309L-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA, SEMKO approved)	PS9309L
PS9309L-E3	PS9309L-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9309L2	PS9309L2-AX		20 pcs (Tape 20 pcs cut)		PS9309L2
PS9309L2-E3	PS9309L2-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9309L-V	PS9309L-V-AX		20 pcs (Tape 20 pcs cut)	UL, CSA, SEMKO DIN EN 60747-5-5 (VDE 0884-5) approved	PS9309L
PS9309L-V-E3	PS9309L-V-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9309L2-V	PS9309L2-V-AX		20 pcs (Tape 20 pcs cut)		PS9309L2
PS9309L2-V-E3	PS9309L2-V-E3-AX		Embossed Tape 2 000 pcs/reel		

Note: *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 +110	°C
Storage Temperature		T_{stg}	–55 to +125	°C

Notes: *1. Reduced to 0.32 mA/°C at T_A = 70°C or more.
*2. Reduced to 3.75 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
Forward Current (ON)	$I_{F\ (ON)}$	4		10	mA
Forward Voltage (OFF)	$V_{F\ (OFF)}$	0		0.8	V

ELECTRICAL CHARACTERISTICS

(T_A = –40 to +110°C, V_{CC} = 4.5 to 20 V, unless otherwise specified)

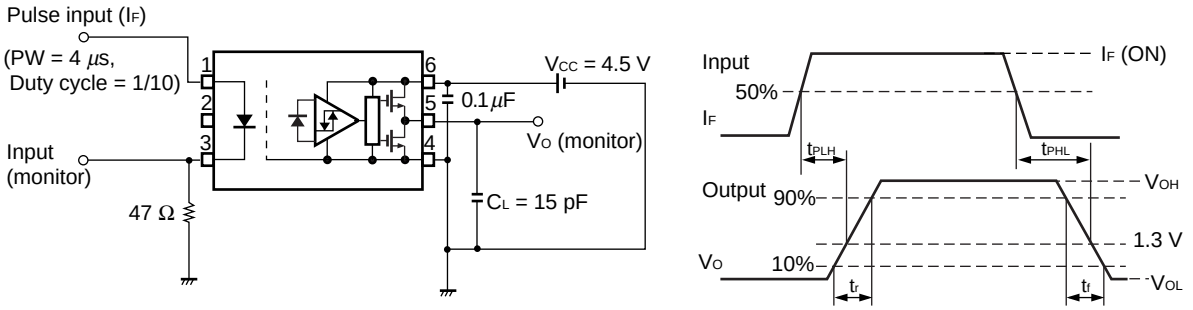
Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	V_F	I_F = 10 mA, T_A = 25°C	1.3	1.55	1.8	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25°C			10	μA
	Input Capacitance	C_t	V_F = 0 V, f = 1 MHZ, T_A = 25°C		30		pF
Detector	High Level Output Voltage	V_{OH}	V_{CC} = 4.5 V, I_O = –2.6 mA, I_F = 4 mA	2.7	3.2		V
			V_{CC} = 20 V, I_O = –2.6 mA, I_F = 4 mA	17.4	18.6		
	Low Level Output Voltage *2	V_{OL}	I_O = 3.5 mA, I_F = 0 mA		0.25	0.6	V
	High Level Supply Current	I_{CCH}	V_{CC} = 4.5 V, I_F = 4 mA		0.98	3	mA
			V_{CC} = 20 V, I_F = 4 mA		1.32	3	
	Low Level Supply Current	I_{CCL}	V_{CC} = 4.5 V, I_F = 0 mA		1.23	3	mA
			V_{CC} = 20 V, I_F = 0 mA		1.53	3	
	High Level Output Short *3 Circuit Current	I_{OSH}	V_{CC} = 4.5 V, V_O = GND, I_F = 4 mA	–7	–45		mA
	Low Level Output Short *3 Circuit Current	I_{OSL}	V_{CC} = V_O = 4.5 V, V_F = 0 V	7	34		mA
Coupled	Threshold Input Current	I_{FLH}	V_{CC} = 4.5 V, V_O > 2.7 V, I_O = –2.6 mA		1.57	3	mA
	Isolation Resistance	R_{I-O}	V_{I-O} = 1 kV_{DC}, RH = 60%, T_A = 25°C	10^{11}			Ω
	Isolation Capacitance	C_{I-O}	V = 0 V, f = 1 MHz, T_A = 25°C		0.6		pF
	Propagation Delay Time (H → L)*4	t_{PHL}	C_L = 15 pF, I_F = 4 → 0 mA, V_{THHL} = 1.3 V		124	200	ns
	Propagation Delay Time (L → H)*4	t_{PLH}	C_L = 15 pF, I_F = 0 → 4 mA, V_{THLH} = 1.3 V		113	200	ns
	Pulse Width Distortion (PWD)	$\lvert t_{PLH}-t_{PHL} \rvert$	C_L = 15 pF, I_F = 4 ↔ 0 mA		11	80	ns
	Maximum Propagation Delays (PDD)					80	
	Rise Time (10-90%)*4	t_r	C_L = 15 pF, I_F = 0 → 4 mA		24		ns
	Fall Time (90-10%)*4	t_f	C_L = 15 pF, I_F = 4 → 0 mA		3.2		ns
	Common Mode Transient Immunity at High Level Output*5	CM_H	V_{CC} = 5 V, T_A = 25°C, I_F = 4 mA, $\lvert V_{CM} \rvert$ = 1.0 kV	15			kV/μs
	Common Mode Transient Immunity at Low Level Output*5	CM_L	V_{CC} = 5 V, T_A = 25°C, I_F = 0 mA, $\lvert V_{CM} \rvert$ = 1.0 kV	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.

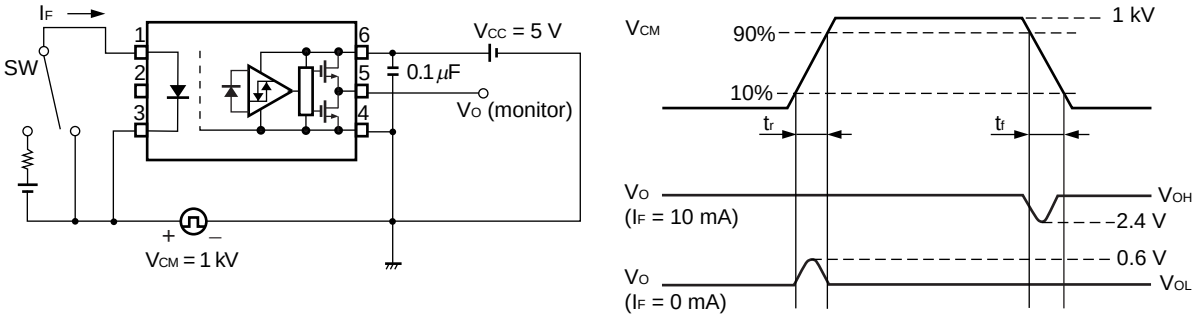
*3. Duration of output short circuit time should not exceed 10 ms.

*4. Test circuit for propagation delay time



Remark C_L includes probe and stray wiring capacitance.

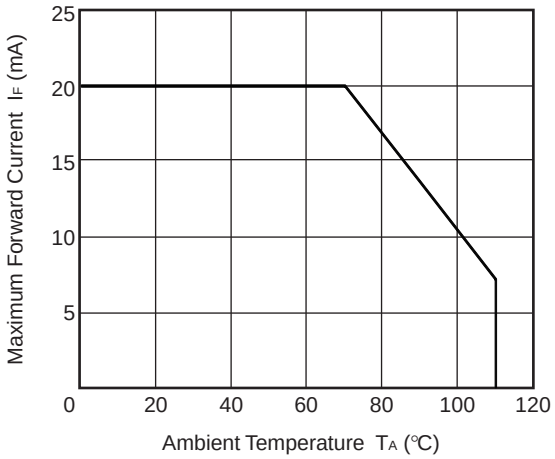
*5. Test circuit for common mode transient immunity



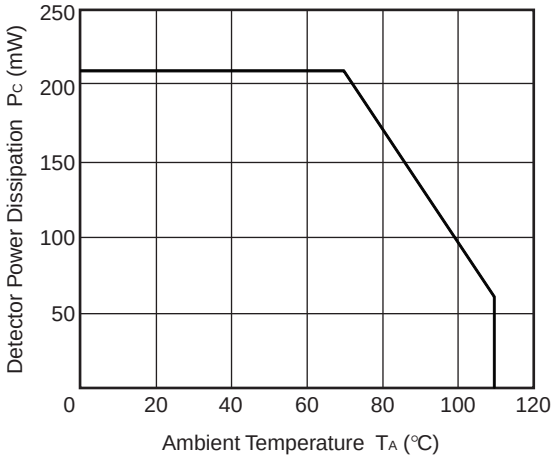
Remark C_L includes probe and stray wiring capacitance.

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

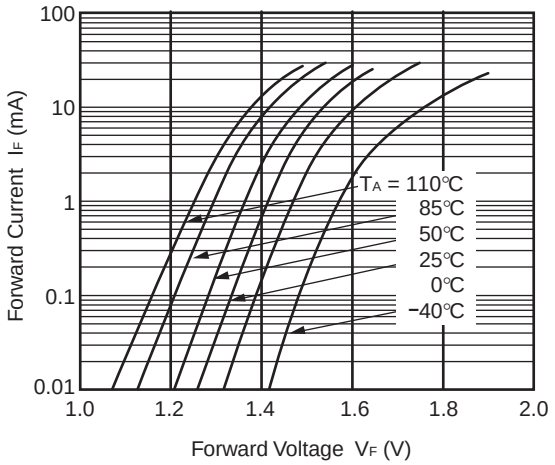
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



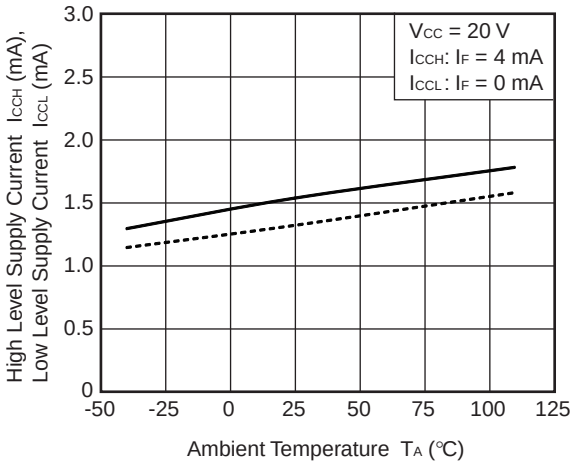
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



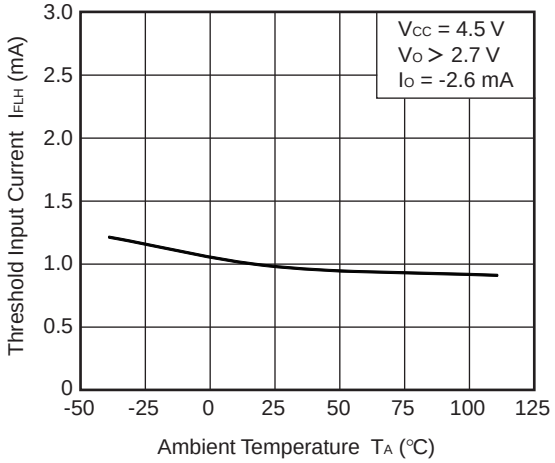
FORWARD CURRENT vs. FORWARD VOLTAGE



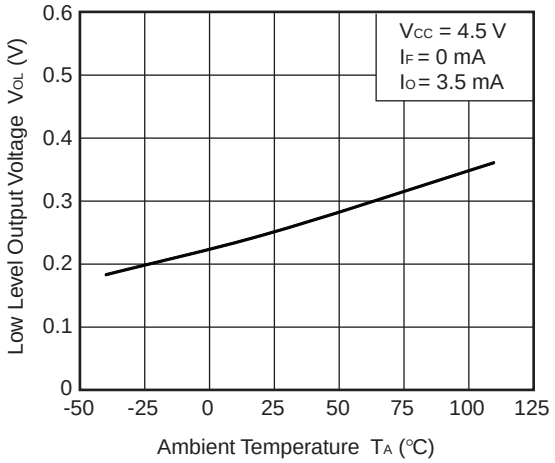
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

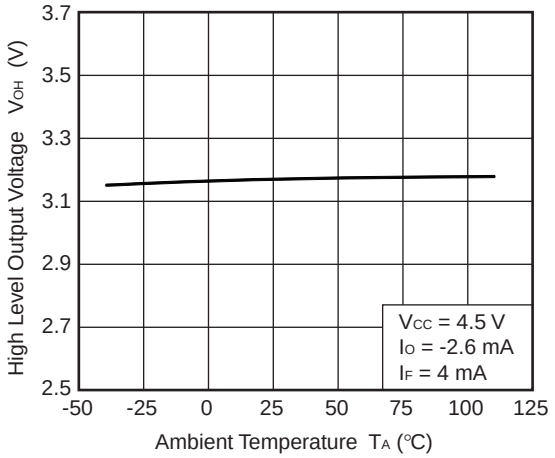


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

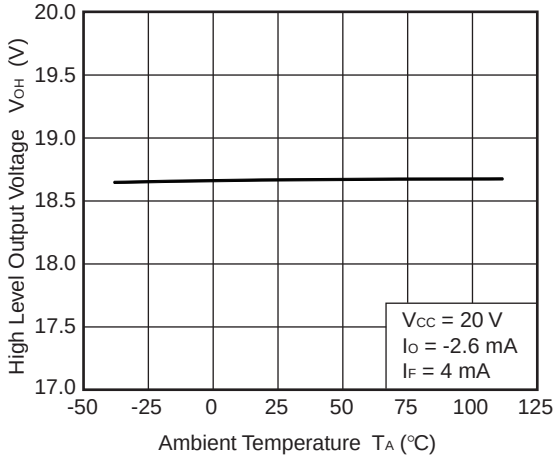


Remark The graphs indicate nominal characteristics.

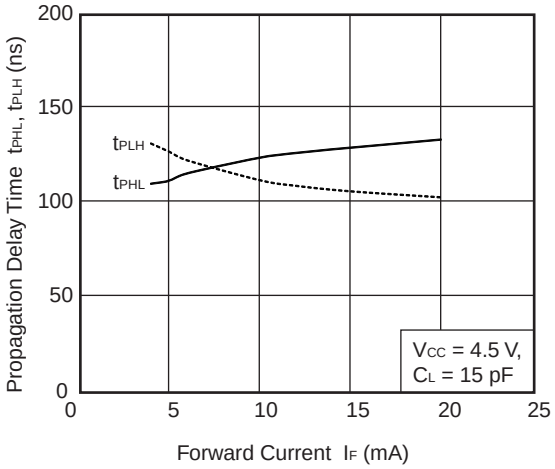
HIGH LEVEL OUTPUT VOLTAGE
vs. AMBIENT TEMPERATURE



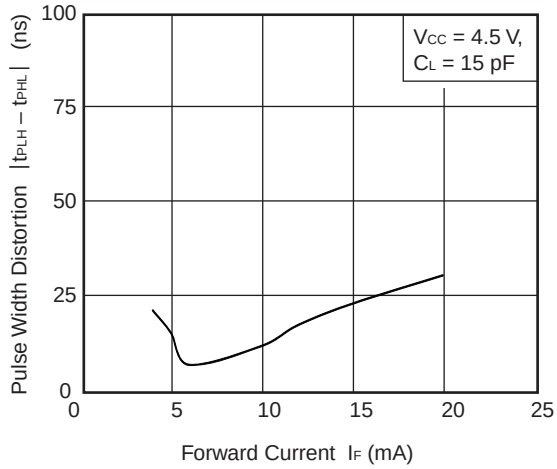
HIGH LEVEL OUTPUT VOLTAGE
vs. AMBIENT TEMPERATURE



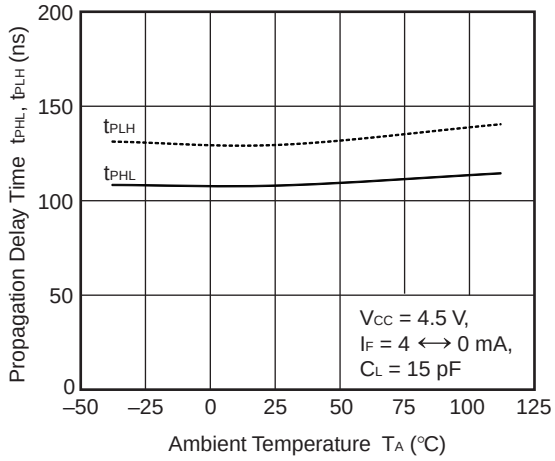
PROPAGATION DELAY TIME
vs. FORWARD CURRENT



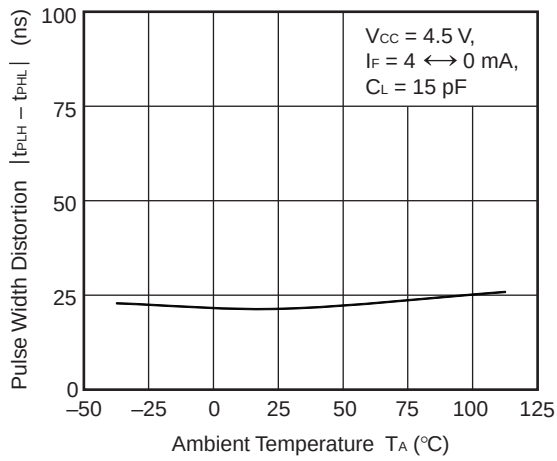
PULSE WIDTH DISTORTION
vs. FORWARD CURRENT



PROPAGATION DELAY TIME
vs. AMBIENT TEMPERATURE



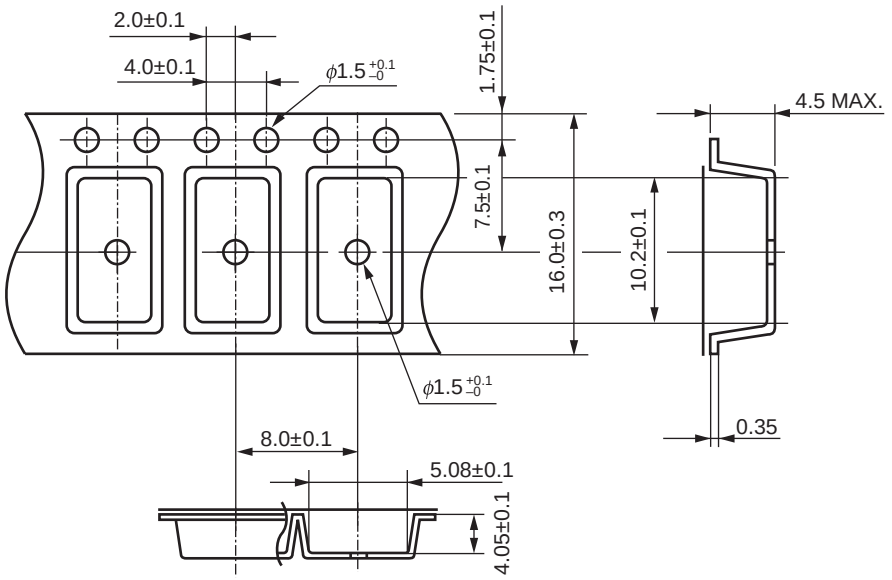
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



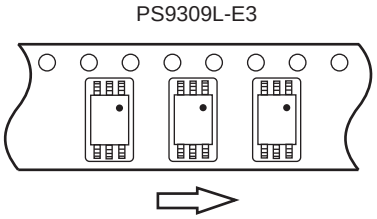
Remark The graphs indicate nominal characteristics.

<R> TAPING SPECIFICATIONS (UNIT: mm)

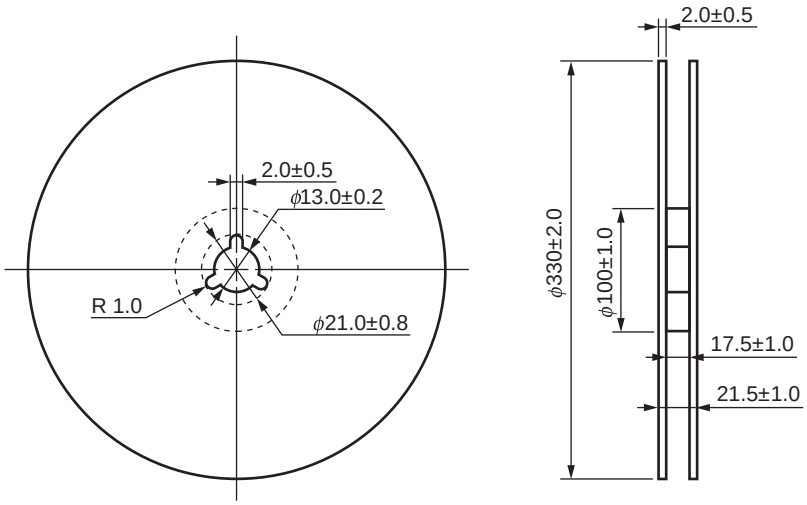
Outline and Dimensions (Tape)



Tape Direction

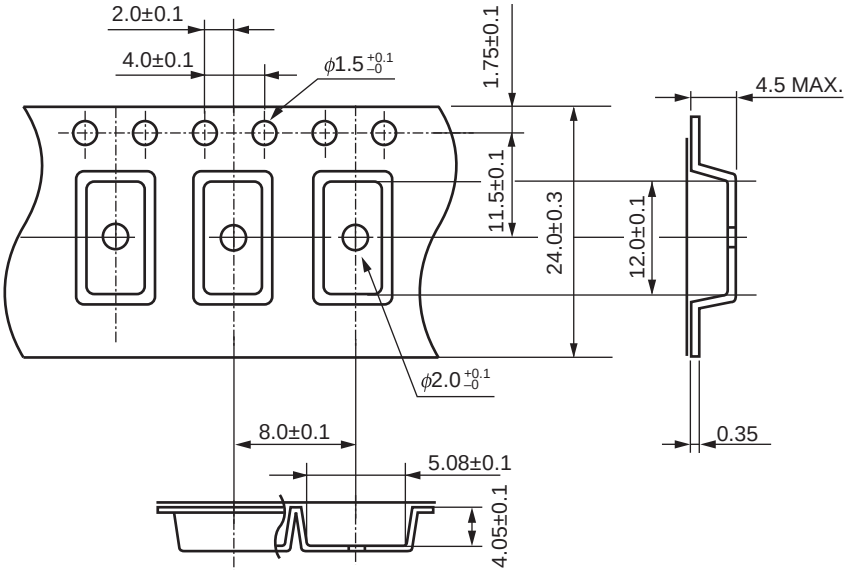


Outline and Dimensions (Reel)

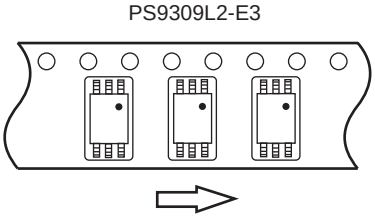


Packing: 2 000 pcs/reel

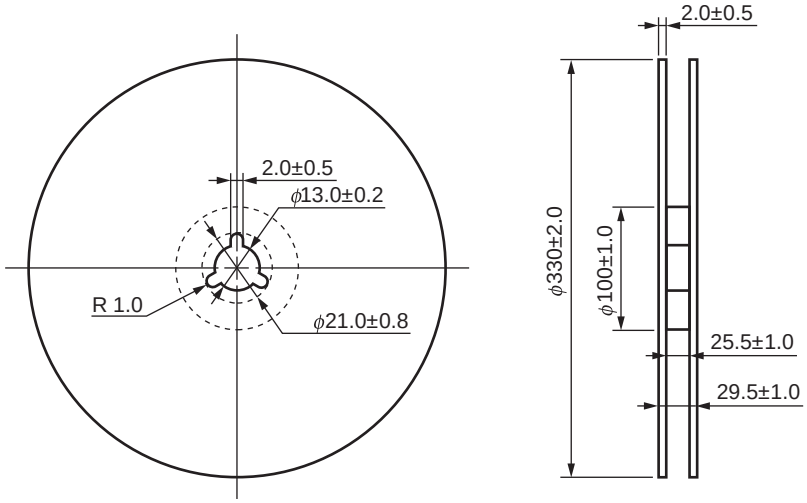
Outline and Dimensions (Tape)



Tape Direction

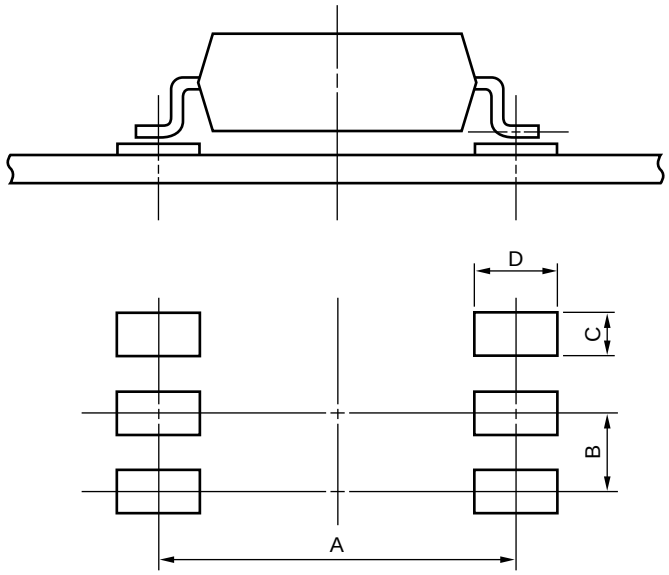


Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9309L	lead bending type (Gull-wing) for surface mount	9.2	1.27	0.8	2.2
PS9309L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	1.27	0.8	2.2

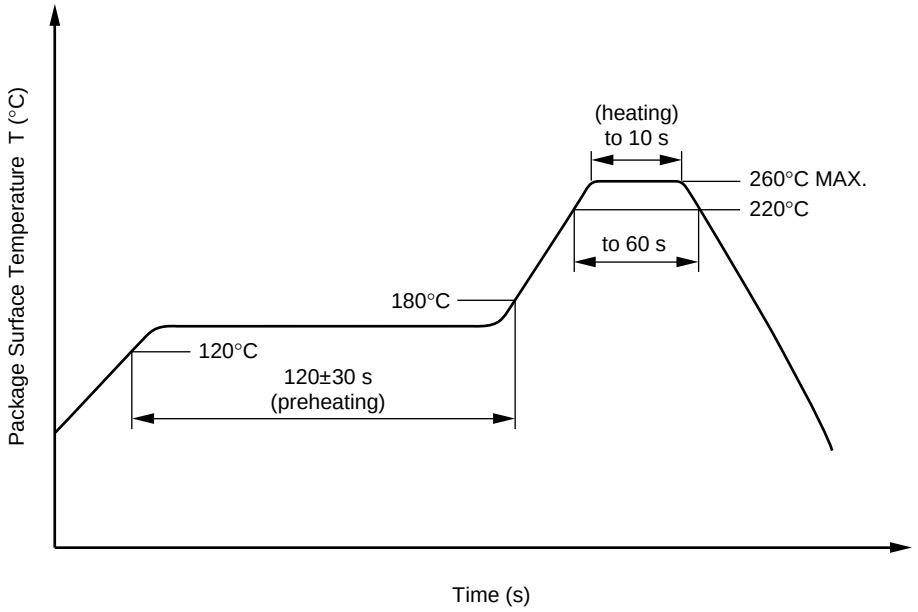
<R> NOTES ON HANDLING (UNIT: mm)

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

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

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. 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.

   Note: *1. NC: Non-Connection (No Connection).
4. Avoid storage at a high temperature and high humidity.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec.	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/110/21	
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_{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 +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

Caution GaAs Products	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. • 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. 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. 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. • Do not burn, destroy, cut, crush, or chemically dissolve the product. • Do not lick the product or in any way allow it to enter the mouth.

Revision History	PS9309L, PS9309L2 Data Sheet

Rev.	Date	Description	
		Page	Summary
0.01	Feb 14, 2012	–	First edition issued
1.00	Mar 28, 2014	p.1	Modification of **FEATURES**
		p.4	Modification of **ORDERING INFORMATION**
		p.8 to 9	Addition of **TYPICAL CHARACTERISTICS**
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