

# PS9124

R08DS0049EJ0100

Rev.1.00

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE, 5-PIN SOP (SO-5) PHOTOCOUPLER

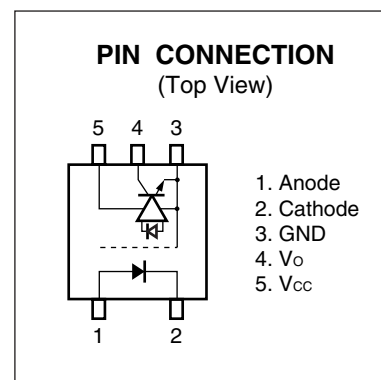
Aug 30, 2013

## DESCRIPTION

The PS9124 is an optically coupled high-speed, active low type isolator containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

## FEATURES

- Low power consumption ( $V_{CC} = 3.3/5\text{ V}$ )
- Small package (SO-5)
- <R> • High-speed response ( $t_{PHL} = 100\text{ ns MAX.}$ ,  $t_{PLH} = 100\text{ ns MAX.}$ )
- High-speed (10 Mbps)
- High isolation voltage ( $BV = 3\ 750\text{ Vr.m.s.}$ )
- Open collector output
- Embossed tape product : PS9124-F3 : 2 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)



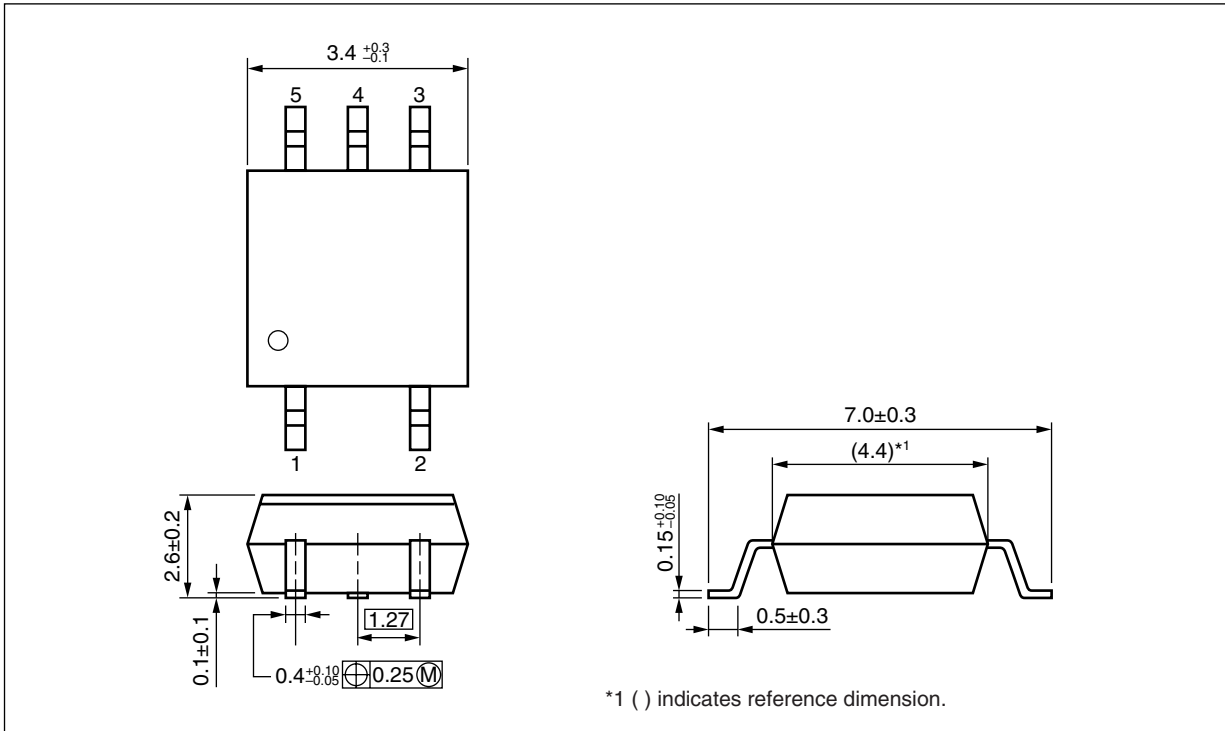
## <R> APPLICATIONS

- FA Network

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.

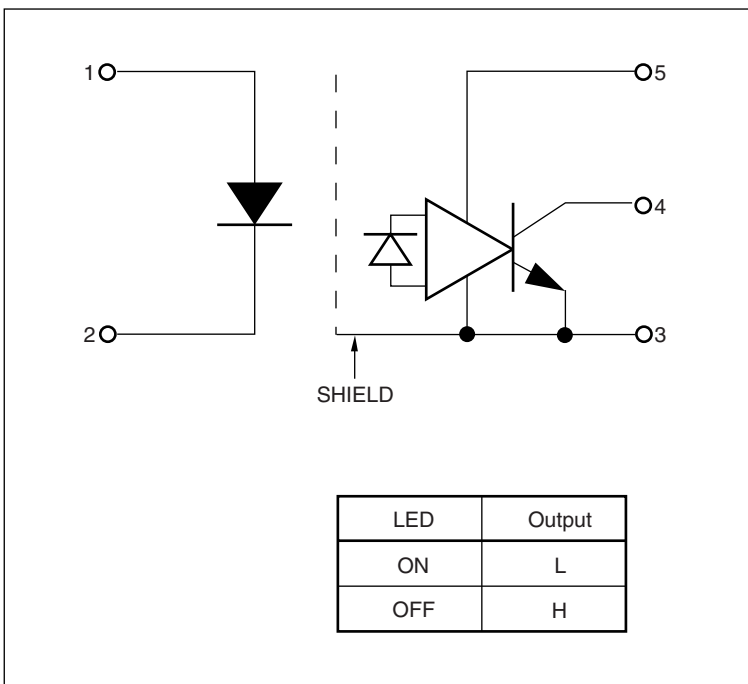
**PACKAGE DIMENSIONS (UNIT: mm)**



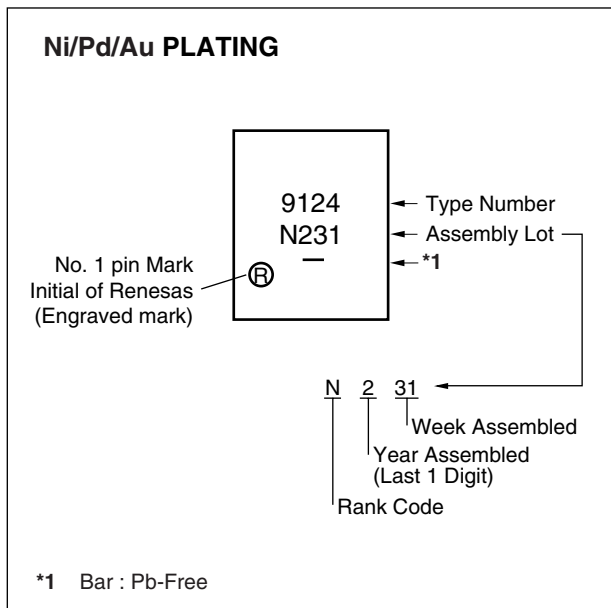
**PHOTOCOUPLER CONSTRUCTION**

Parameter	MIN.
Air Distance	4.2 mm
Outer Creepage Distance	4.2 mm
Isolation Distance	0.2 mm

**BLOCK DIAGRAM (Unit: mm)**



## MARKING EXAMPLE



## ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standards Approval	Application Part Number <sup>*1</sup>
PS9124	PS9124-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9124
PS9124-F3	PS9124-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9124-V	PS9124-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-5 (VDE0884-5) approved (Option)	
PS9124-V-F3	PS9124-V-F3-AX		Embossed Tape 2 500 pcs/reel		

Note: \*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>	25	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	7	V
	Output Voltage	V <sub>O</sub>	7	V
	Output Current	I <sub>O</sub>	25	mA
	Power Dissipation *2	P <sub>C</sub>	200	mW
Isolation Voltage *3		BV	3 750	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +110	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

Notes: \*1. Reduced to 0.2 mA/°C at T<sub>A</sub> = 25°C or more.

\*2. Reduced to 4.0 mW/°C at T<sub>A</sub> = 75°C or more.

\*3 AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.

Pins 1-2 shorted together, 3-5 shorted together.

**RECOMMENDED OPERATING CONDITIONS**

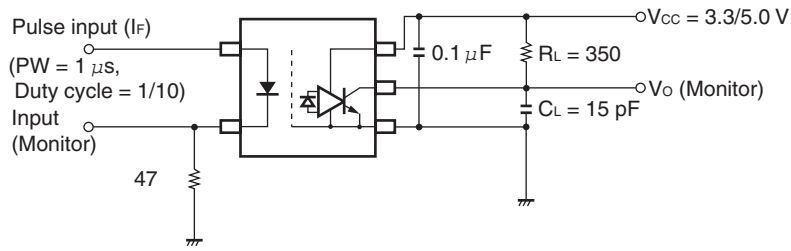
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Low Level Input Voltage	V <sub>FL</sub>	-2		0.8	V
High Level Input Current	I <sub>FH</sub>	3.8	6.0	7.5	mA
Supply Voltage	V <sub>CC</sub>	2.7	3.3	3.6	V
		4.5	5.0	5.5	
TTL (R <sub>L</sub> = 1 kΩ, loads)	N			5	
Pull-up Resistor	R <sub>L</sub>	330		4 k	Ω

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +110°C, unless otherwise specified)**

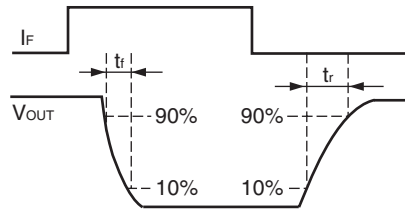
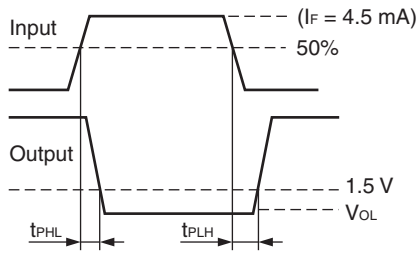
Parameter		Symbol	Conditions	MIN.	TYP. <sup>*1</sup>	MAX.	Unit	
Diode	Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 10 mA, T <sub>A</sub> = 25°C	1.3	1.55	1.8	V	
	Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 3 V, T <sub>A</sub> = 25°C			10	μA	
	Terminal Capacitance	C <sub>t</sub>	f = 1 MHz, V <sub>F</sub> = 0 V, T <sub>A</sub> = 25°C		30		pF	
Detector	High Level Output Current	I <sub>OH</sub>	V <sub>CC</sub> = V <sub>O</sub> = 3.3 V, V <sub>F</sub> = 0.8 V		1	80	μA	
			V <sub>CC</sub> = V <sub>O</sub> = 5.5 V, V <sub>F</sub> = 0.8 V		1	100		
	Low Level Output Voltage	V <sub>OL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, I <sub>OL</sub> = 13 mA		0.2	0.6	V	
			V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 4.5 mA, I <sub>OL</sub> = 13 mA					
	High Level Supply Current	I <sub>CCH</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 0 mA, V <sub>O</sub> = open		4	7	mA	
			V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 0 mA, V <sub>O</sub> = open					
Low Level Supply Current	I <sub>CCL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> = open		6	10	mA		
		V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> = open		7	10			
Coupled	Threshold Input Voltage (H → L)	I <sub>FHL</sub>	V <sub>CC</sub> = 3.3 V, R <sub>L</sub> = 350 Ω, V <sub>O</sub> = 0.8 V		1.0	3.0	mA	
			V <sub>CC</sub> = 5 V, R <sub>L</sub> = 350 Ω, V <sub>O</sub> = 0.8 V					
	Isolation Resistance	R <sub>I-O</sub>	V <sub>I-O</sub> = 1 kV <sub>DC</sub> , RH = 40 to 60%, T <sub>A</sub> = 25°C	10 <sup>11</sup>			Ω	
	Isolation Capacitance	C <sub>I-O</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		0.6		pF	
	Propagation Delay Time (H → L) <sup>*2</sup>	t <sub>PHL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF	T <sub>A</sub> = 25°C		40	75	ns
				T <sub>A</sub> = 25°C		40	75	
				V <sub>CC</sub> = 5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			100	
	Propagation Delay Time (L → H) <sup>*2</sup>	t <sub>PLH</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF	T <sub>A</sub> = 25°C		50	75	ns
				T <sub>A</sub> = 25°C		45	75	
				V <sub>CC</sub> = 5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			100	
	Pulse Width Distortion (PWD)	t <sub>PHL</sub> -t <sub>PLH</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		5	35	ns	
	Propagation Delay Skew	t <sub>psk</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			40	ns	
	Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		20		ns	
Fall Time	t <sub>f</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		5		ns		
Common Mode Transient Immunity at High Level Output <sup>*3</sup>	CM <sub>H</sub>	V <sub>CC</sub> = 3.3/5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 0 mA, V <sub>O</sub> > 2 V, R <sub>L</sub> = 350 Ω, V <sub>CM</sub> = 1 kV	10	15		kV/μs		
Common Mode Transient Immunity at Low Level Output <sup>*3</sup>	CM <sub>L</sub>	V <sub>CC</sub> = 3.3/5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> < 0.8 V, R <sub>L</sub> = 350 Ω, V <sub>CM</sub> = 1 kV	10	15		kV/μs		

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

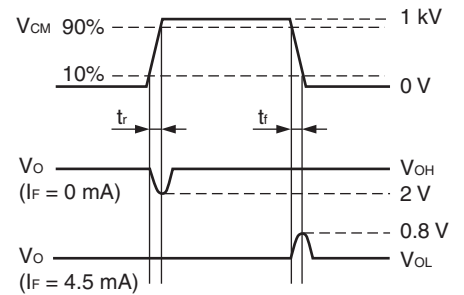
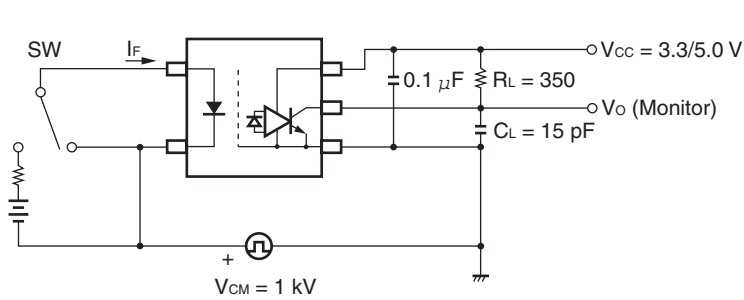
<R> \*2. Test circuit for propagation delay time



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

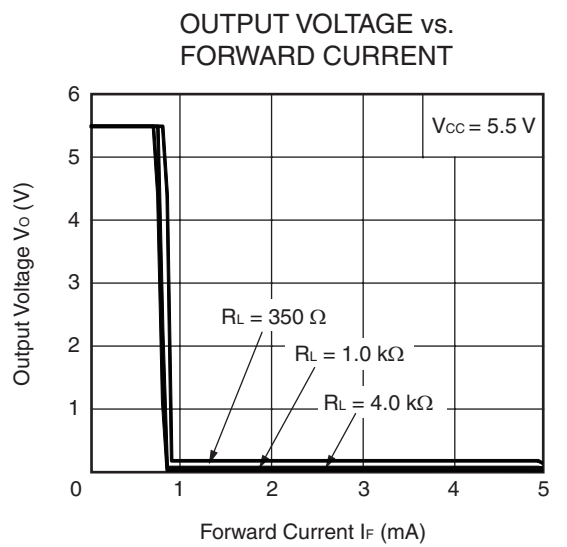
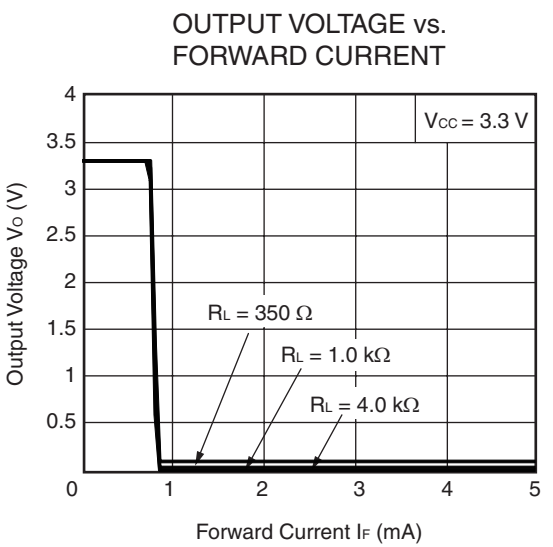
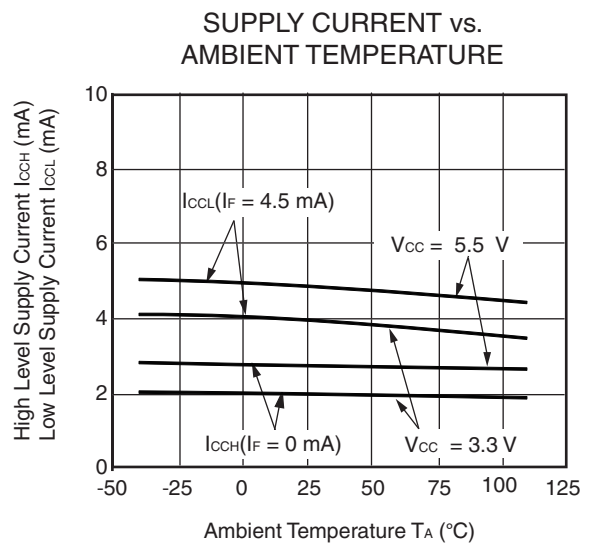
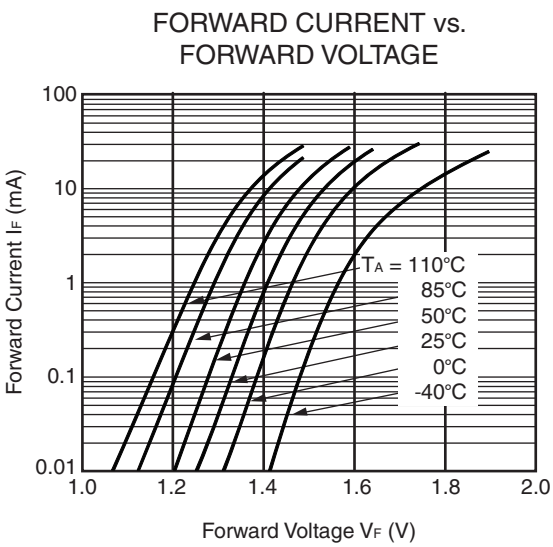
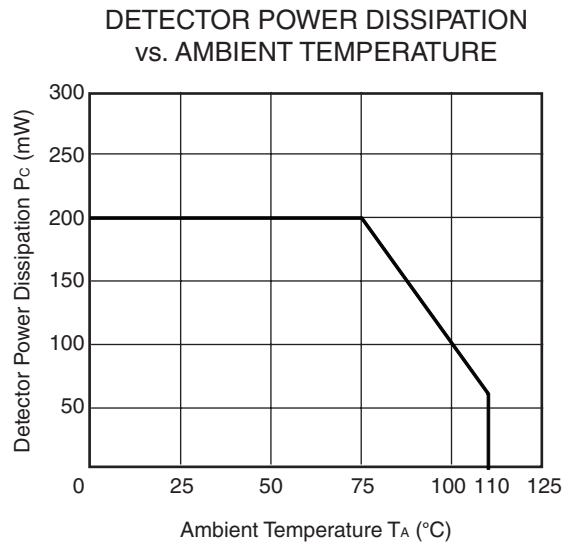
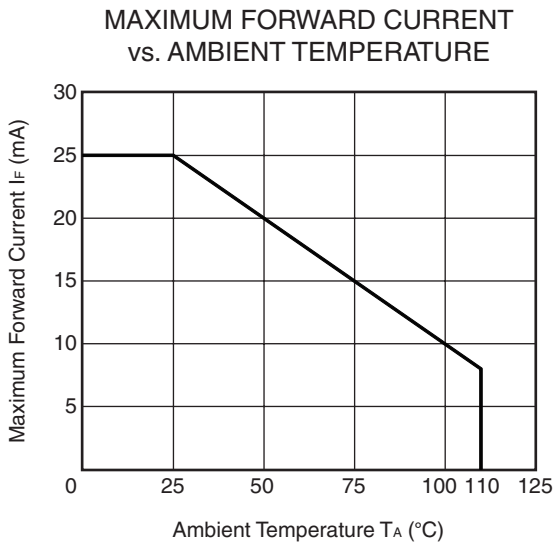


\*3. Test circuit for common mode transient immunity



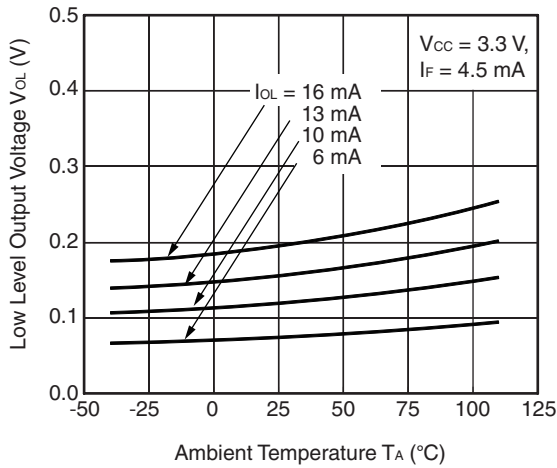
**Remark**  $C_L$  includes probe and stray wiring capacitance.

<R> **TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise specified)**

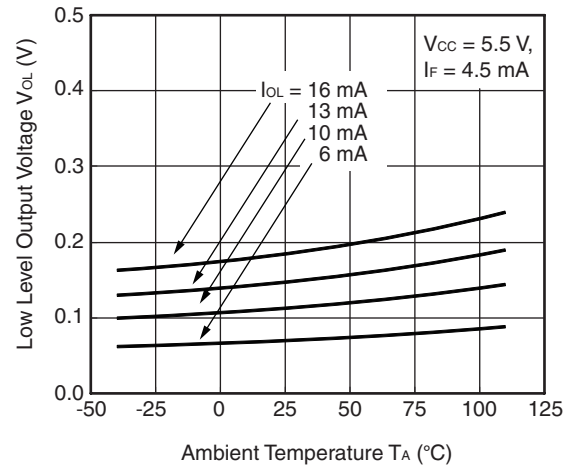


**Remark** The graphs indicate nominal characteristics.

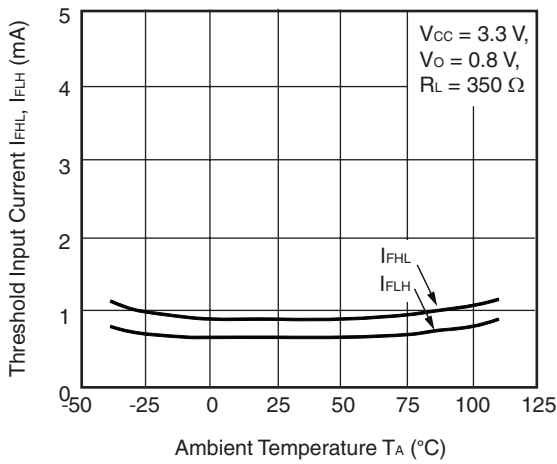
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



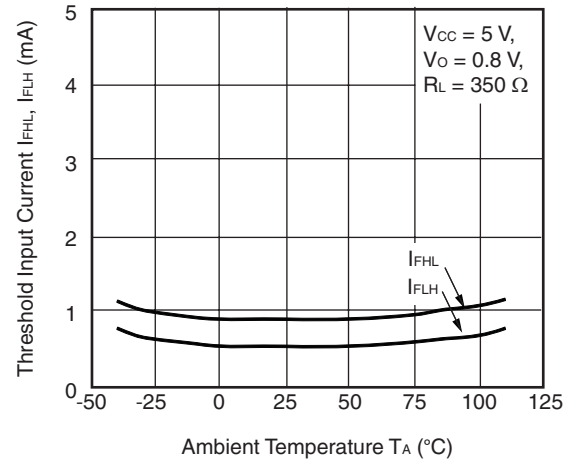
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



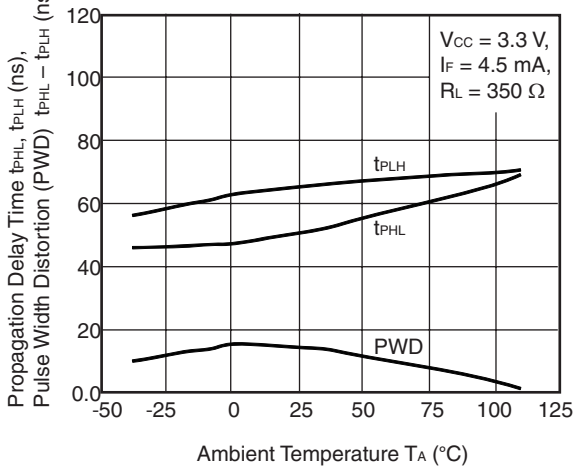
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



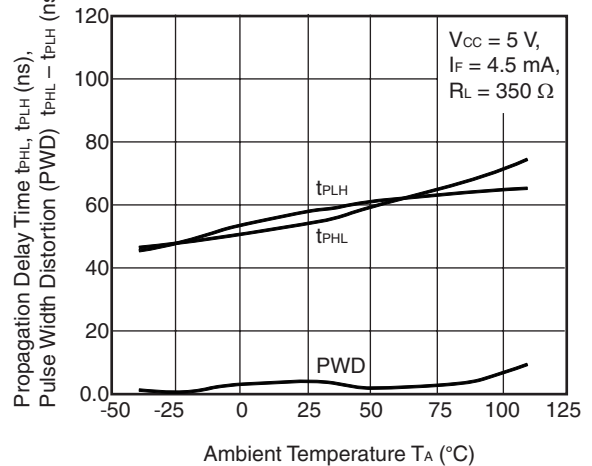
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



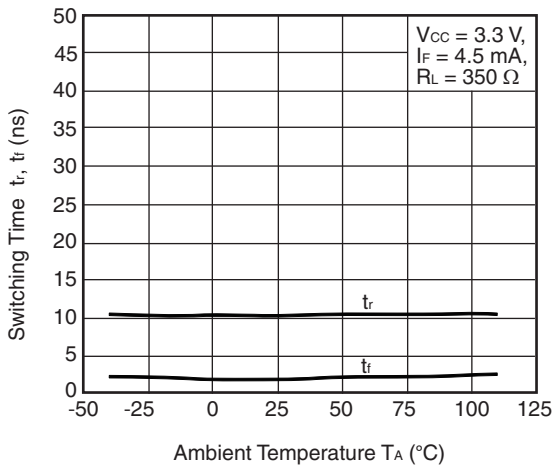
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



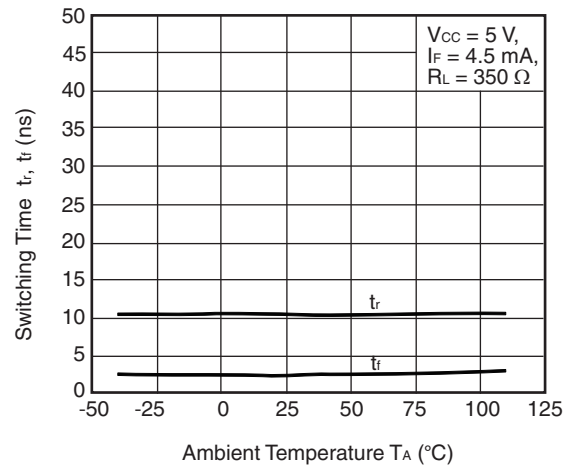
**Remark** The graphs indicate nominal characteristics.



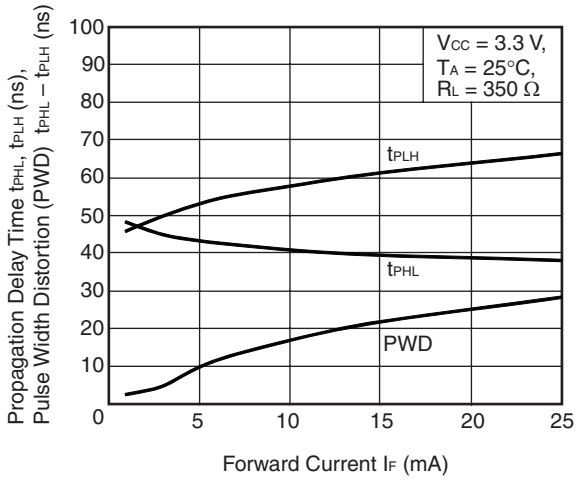
SWITCHING TIME vs. AMBIENT TEMPERATURE



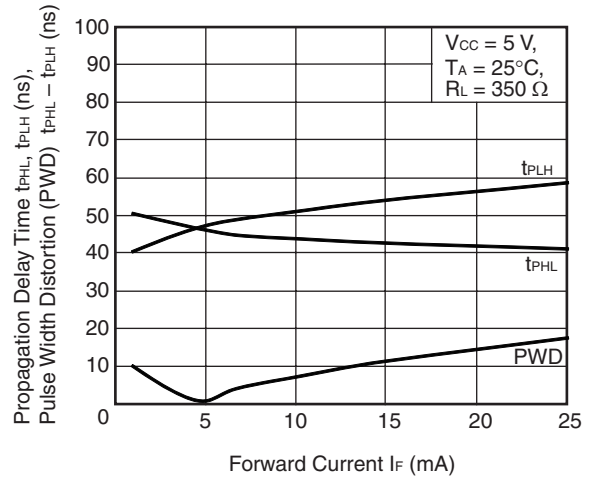
SWITCHING TIME vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



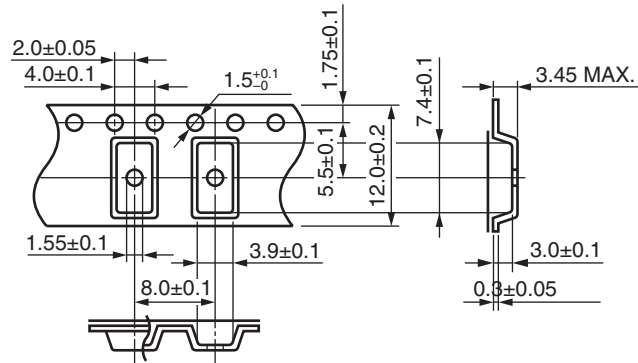
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



**Remark** The graphs indicate nominal characteristics.

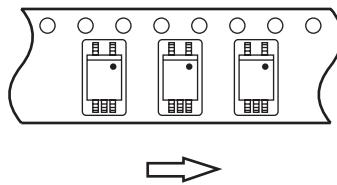
<R> TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

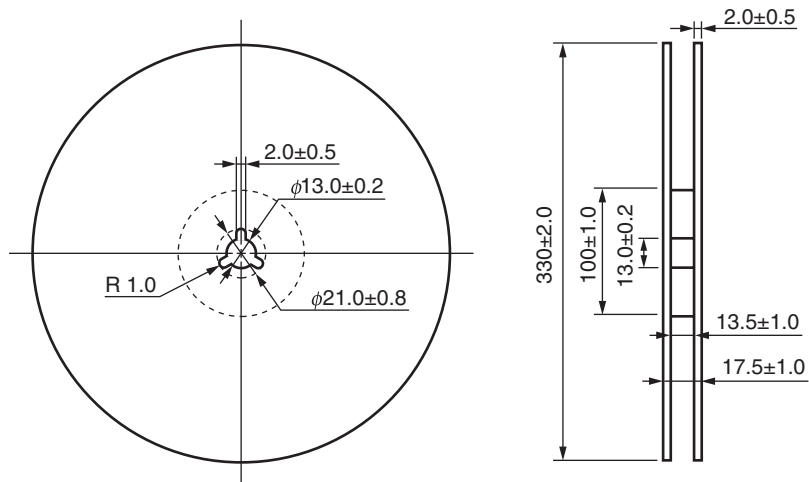


Tape Direction

PS9124-F3

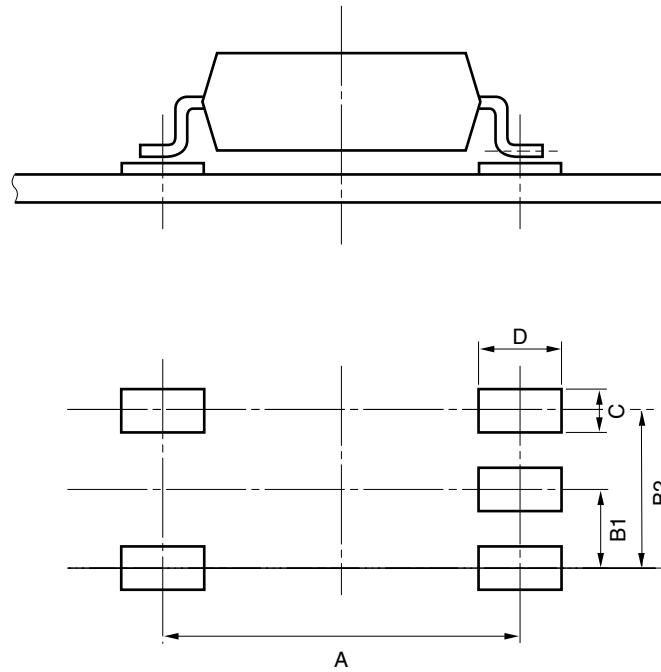


Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	A	B1	B2	C	D
PS9124	6.25	1.27	2.54	0.8	1.45

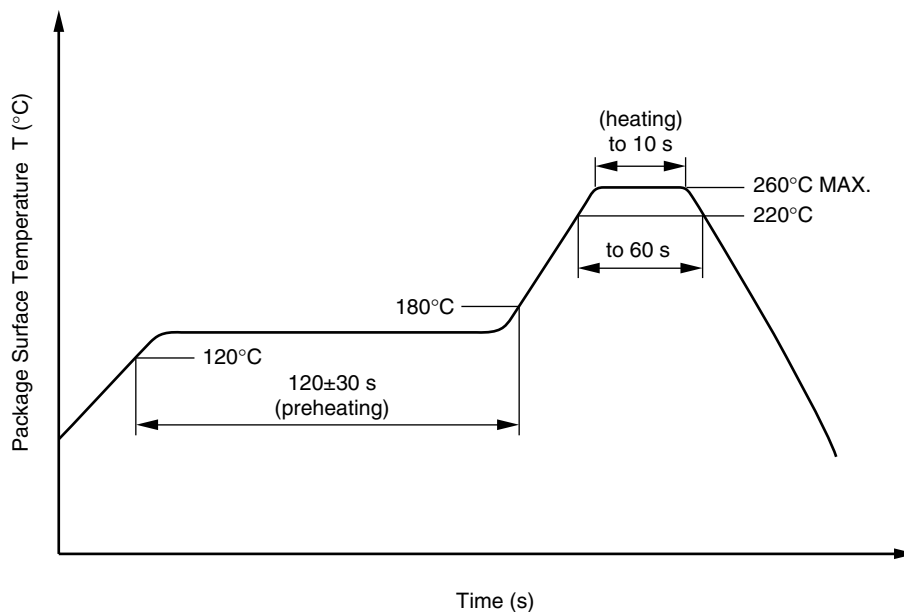
<R> **NOTES ON HANDLING**

## 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

## (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  $\mu$ 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. Avoid storage at a high temperature and high humidity.

## &lt;R&gt; SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec.	Unit
Maximum repetitive peak operating isolation voltage	$U_{IORM}$	707	$V_{peak}$
Partial discharge test voltage at 100% production test $U_{pr} = 1.875 \times U_{IORM}$ , Method b, $t_m=1sec$ , $p_d < 5 pC$	$U_{pr}$	1 326	$V_{peak}$
Partial discharge test voltage at Type test and Sample test $U_{pr} = 1.6 \times U_{IORM}$ , Method a, $t_m=10sec$ , $p_d < 5 pC$	$U_{pr}$	1 131	$V_{peak}$
Maximum transient isolation voltage (Transient overvoltage $t_{ini}=60sec$ )	$U_{IOTM}$	6 000	$V_{peak}$
Installation classification (IEC 60664/ DIN EN 60664-1/ VDE0110 Part 1) for rated mains voltage $\leq 300$ Vr.m.s. for rated mains voltage $\leq 600$ Vr.m.s.		I - IV I - III	
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	
Pollution degree (DIN EN 60664-1/ VDE0110 Part 1)		2	
Climatic category (IEC 60068-1/ DIN EN 60068-1)		40/110/21	
Operating temperature range	$T_A$	-40 to +110	$^{\circ}C$
Storage temperature range	$T_{stg}$	-55 to +125	$^{\circ}C$
Isolation resistance, minimum value $V_{IO} = 500$ Vdc at $T_A=25^{\circ}C$ $V_{IO} = 500$ Vdc at $T_A$ MAX. at least $100^{\circ}C$	Ris MIN. Ris MIN.	$10^{12}$ $10^{11}$	$\Omega$ $\Omega$
Safety limiting values ratings (maximum allowable in the event of a fault or a failure, see thermal derating curve)			
Maximum ambient safety temperature	$T_s$	150	$^{\circ}C$
Maximum input current	$I_{si}$	200	mA
Maximum output power	$P_{so}$	300	mW
Isolation resistance at $V_{IO}= 500$ Vdc, $T_A=T_s$	Ris MIN.	$10^9$	$\Omega$

<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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<b>Revision History</b>	<b>PS9124 Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
0.01	Jul 03, 2012	–	First edition issued
1.00	Aug 30, 2013	Throughout	“Preliminary Data Sheet” is changed to “Data Sheet.”
		p.1	Modification of FEATURES
			Modification of APPLICATIONS
		p.6	Modification of Test circuit for propagation delay time
		p.7 to 9	Addition of TYPICAL CHARACTERISTICS
		p.10	Modification of TAPING SPECIFICATIONS
		p.12	Addition of NOTES ON HANDLING
p.14	Addition of SPECIFICATION OF VDE MARKS LICENSE DOCUMENT		

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