

# PS9324L, PS9324L2

R08DS0060EJ0100

Rev.1.00

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE, 6-PIN SDIP PHOTOCOUPLER

Apr 26, 2013

## DESCRIPTION

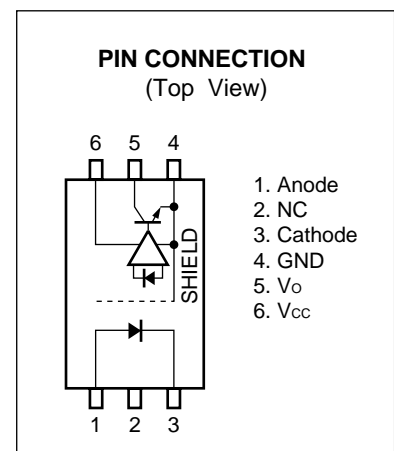
The PS9324L and PS9324L2 are optical coupled high-speed, active low type isolators containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

The PS9324L is lead bending type (Gull-wing) for surface mounting.

The PS9324L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

## FEATURES

- High common mode transient immunity ( $CM_H, CM_L = \pm 15 \text{ kV}/\mu\text{s}$  MIN.)
- Half size of 8-pin DIP
- Long creepage distance (8 mm MIN.: PS9324L2)
- High-speed (10 Mbps)
- High-speed response ( $t_{PHL} = 75 \text{ ns}$  MAX.,  $t_{PLH} = 75 \text{ ns}$  MAX.)
- Low power consumption ( $V_{CC} = 3.3/5 \text{ V}$ )
- Open collector output
- High isolation voltage ( $BV = 5\,000 \text{ Vr.m.s.}$ )
- Embossed tape product : PS9324L-E3 : 2 000 pcs/reel  
: PS9324L2-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)
  - SEMKO approved (EN 60065, EN 60950)
  - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)

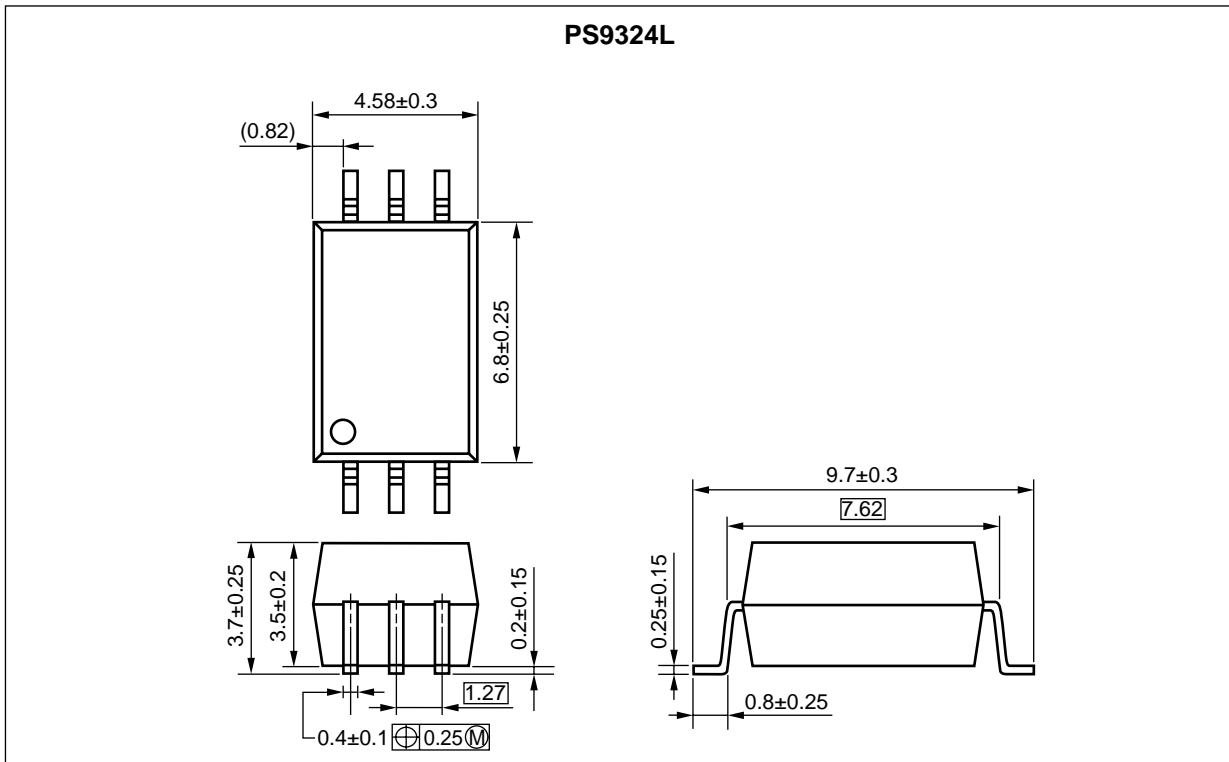


## APPLICATIONS

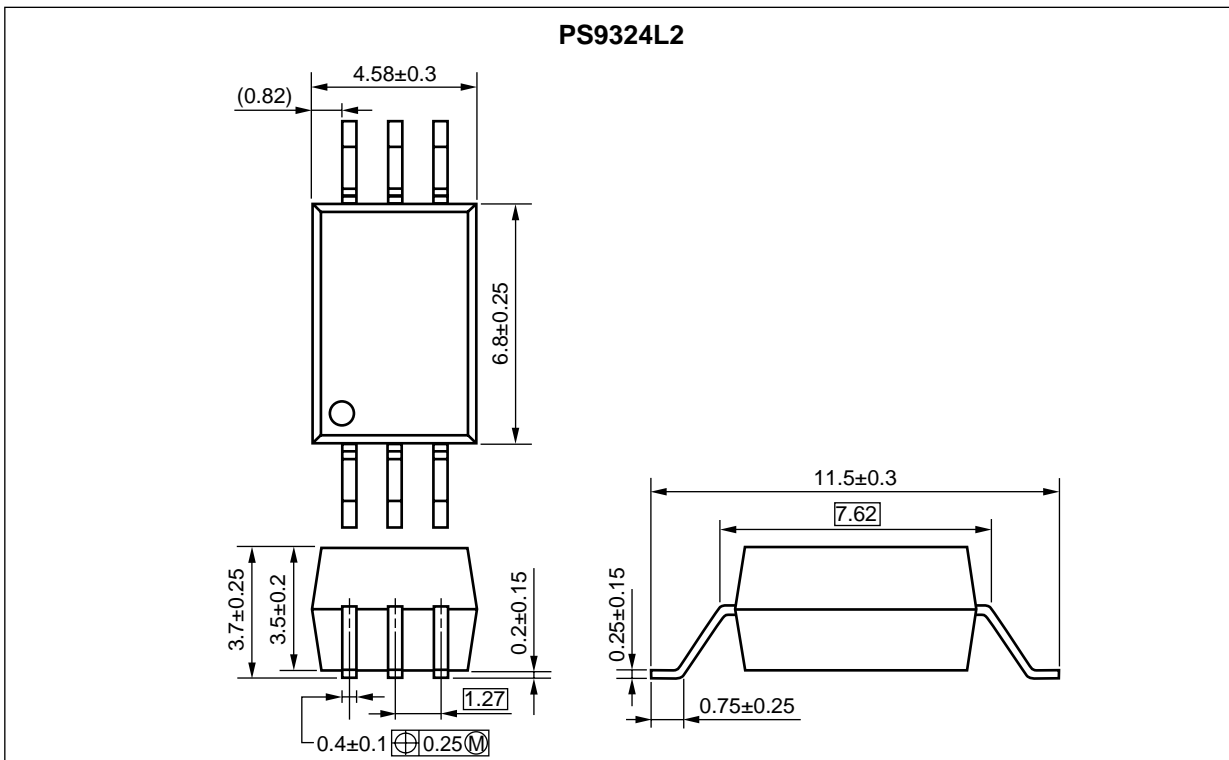
- Measurement equipment
- PDP
- FA Network

**PACKAGE DIMENSIONS (UNIT: mm)**

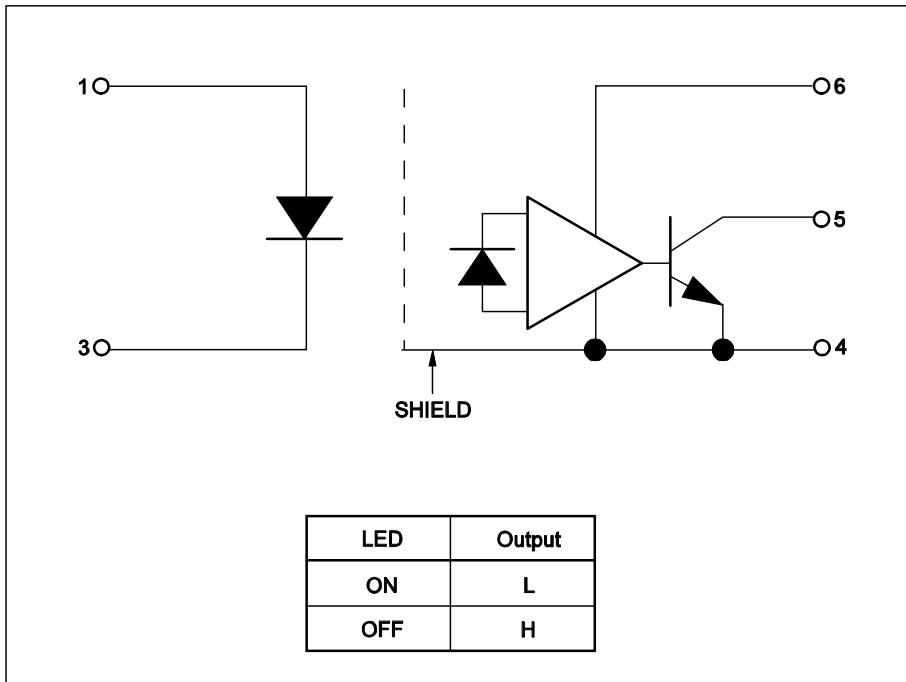
**Lead Bending Type (Gull-wing) For Surface Mount**



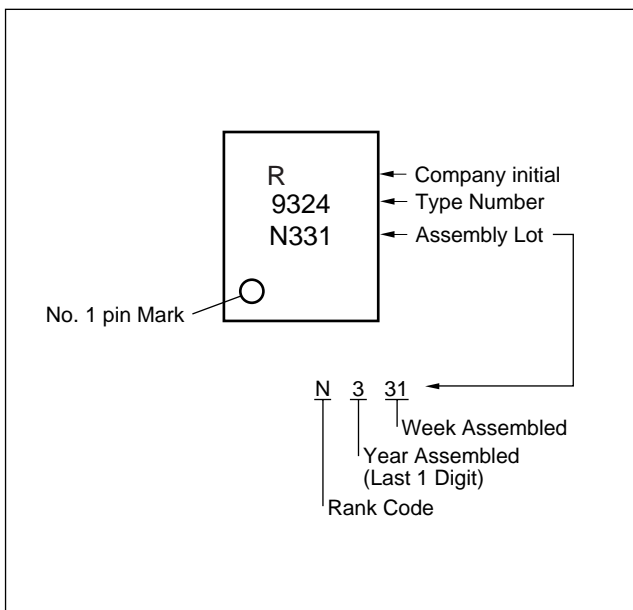
**Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)**



### BLOCK DIAGRAM



### MARKING EXAMPLE



### PHOTOCOUPLER CONSTRUCTION

| Parameter                      | PS9324L | PS9324L2 |
|--------------------------------|---------|----------|
| Air Distance (MIN.)            | 7 mm    | 8 mm     |
| Outer 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 |
|---------------|------------------|------------------------------|---------------------------------|---|---------------------------|
| PS9324L       | PS9324L-AX       | Pb-Free<br>(Ni/Pd/Au)        | 20 pcs (Tape 20 pcs cut)        | Standard products<br>UL, CSA ,SEMKO<br>approval)      | PS9324L                   |
| PS9324L-E3    | PS9324L-E3-AX    |                              | Embossed Tape 2 000<br>pcs/reel |   |                           |
| PS9324L2      | PS9324L2-AX      |                              | 20 pcs (Tape 20 pcs cut)        | Standard products<br>UL, CSA ,SEMKO<br>approval)      | PS9324L2                  |
| PS9324L2-E3   | PS9324L2-E3-AX   |                              | Embossed Tape 2 000<br>pcs/reel |   |                           |
| PS9324L-V     | PS9324L-V-AX     |                              | 20 pcs (Tape 20 pcs cut)        | DIN EN 60747-5-5<br>(VDE 0884-5)<br>Approved (Option) | PS9324L                   |
| PS9324L-V-E3  | PS9324L-V-E3-AX  |                              | Embossed Tape 2 000<br>pcs/reel |   |                           |
| PS9324L2-V    | PS9324L2-V-AX    |                              | 20 pcs (Tape 20 pcs cut)        | DIN EN 60747-5-5<br>(VDE 0884-5)<br>Approved (Option) | PS9324L2                  |
| PS9324L2-V-E3 | PS9324L2-V-E3-AX |                              | Embossed Tape 2 000<br>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               | 5 000       | 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 1-3 shorted together, 4-6 shorted together.

**RECOMMENDED OPERATING CONDITIONS**

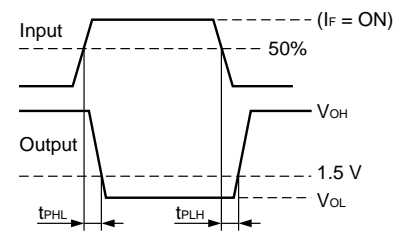
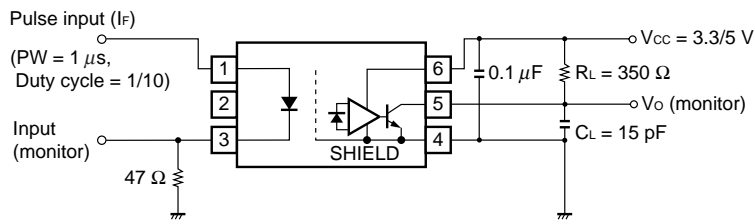
| Parameter                          | Symbol          | MIN. | TYP. | MAX. | Unit |
|------------------------------------|-----------------|------|------|------|------|
| Low Level Input Current            | V <sub>FL</sub> | 0    |      | 0.8  | V    |
| High Level Input Current           | I <sub>FH</sub> | 3.8  | 6    | 7.5  | mA   |
| Supply Voltage                     | V <sub>CC</sub> | 2.7  |      | 5.5  | V    |
| TTL (R <sub>L</sub> = 1 kΩ, loads) | N               |      |      | 5    |      |
| Pull-up Resistor                   | R <sub>L</sub>  | 330  |      | 4k   | Ω    |

ELECTRICAL CHARACTERISTICS ( $T_A = -40$  to  $+110^\circ\text{C}$ , unless otherwise specified)

| Parameter   |   | Symbol  | Conditions  | MIN.  | TYP.* <sup>1</sup> | MAX.                    | Unit          |    |
|---|---|---|---|---|--------------------|-------------------------|---------------|----|
| Diode   | Forward Voltage   | $V_F$   | $I_F = 10 \text{ mA}$ , $T_A = 25^\circ\text{C}$  | 1.3   | 1.55               | 1.8                     | V             |    |
|   | Reverse Current   | $I_R$   | $V_R = 3 \text{ V}$ , $T_A = 25^\circ\text{C}$  |   |                    | 10                      | $\mu\text{A}$ |    |
|   | Terminal Capacitance  | $C_t$   | $f = 1 \text{ MHz}$ , $V_F = 0 \text{ V}$ , $T_A = 25^\circ\text{C}$                                |   | 30                 |                         | pF            |    |
| Detector  | High Level Output Current                                   | $I_{OH}$  | $V_{CC} = V_O = 3.3 \text{ V}$ , $V_F = 0.8 \text{ V}$  |   | 1                  | 80                      | $\mu\text{A}$ |    |
|   |   |   | $V_{CC} = V_O = 5.5 \text{ V}$ , $V_F = 0.8 \text{ V}$  |   | 1                  | 100                     |               |    |
|   | Low Level Output Voltage                                    | $V_{OL}$  | $V_{CC} = 3.3 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$I_{OL} = 13 \text{ mA}$                     |   | 0.2                | 0.6                     | V             |    |
|   |   |   | $V_{CC} = 5.5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$I_{OL} = 13 \text{ mA}$                     |   |                    |                         |               |    |
|   | High Level Supply Current                                   | $I_{CCH}$   | $V_{CC} = 3.3 \text{ V}$ , $I_F = 0 \text{ mA}$ ,<br>$V_O = \text{open}$                            |   | 4                  | 7                       | mA            |    |
|   |   |   | $V_{CC} = 5.5 \text{ V}$ , $I_F = 0 \text{ mA}$ ,<br>$V_O = \text{open}$                            |   |                    |                         |               |    |
| Low Level Supply Current  | $I_{CCL}$   | $V_{CC} = 3.3 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$V_O = \text{open}$  |   | 6   | 10                 | mA                      |               |    |
|   |   | $V_{CC} = 5.5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$V_O = \text{open}$  |   |   |                    |                         |               |    |
| Coupled   | Threshold Input Voltage<br>(H $\rightarrow$ L)              | $I_{FHL}$   | $V_{CC} = 3.3 \text{ V}$ , $R_L = 350 \Omega$ ,<br>$V_O = 0.8 \text{ V}$                            |   | 1                  | 3                       | mA            |    |
|   |   |   | $V_{CC} = 5.0 \text{ V}$ , $R_L = 350 \Omega$ ,<br>$V_O = 0.8 \text{ V}$                            |   |                    |                         |               |    |
|   | Isolation Resistance  | $R_{I-O}$   | $V_{I-O} = 1 \text{ kV}_{DC}$ , $R_H = 40$ to $60\%$  | $10^{11}$   |                    |                         | $\Omega$      |    |
|   | Isolation Capacitance                                       | $C_{I-O}$   | $V_{I-O} = 0 \text{ V}$ , $f = 1 \text{ MHz}$ ,<br>$T_A = 25^\circ\text{C}$                         |   | 0.6                |                         | pF            |    |
|   | Propagation Delay Time<br>(H $\rightarrow$ L) <sup>*2</sup> | $t_{PHL}$   | $V_{CC} = 3.3 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$   | $T_A = 25^\circ\text{C}$  |                    | 40                      | 75            | ns |
|   |   |   |   |   |                    |                         | 100           |    |
|   |   |   |   | $T_A = 25^\circ\text{C}$  |                    | 40                      | 75            |    |
|   |   |   |   | $V_{CC} = 5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$ |                    |                         | 100           |    |
|   | Propagation Delay Time<br>(L $\rightarrow$ H) <sup>*2</sup> | $t_{PLH}$   | $V_{CC} = 3.3 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$   | $T_A = 25^\circ\text{C}$  |                    | 50                      | 75            | ns |
|   |   |   |   |   |                    |                         | 100           |    |
|   |   |   |   | $T_A = 25^\circ\text{C}$  |                    | 45                      | 75            |    |
|   |   |   |   | $V_{CC} = 5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$ |                    |                         | 100           |    |
|   | Pulse Width Distortion<br>(PWD) <sup>*2</sup>               | $t_{PHL}, t_{PLH}$  | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$ |   | 5                  | 35                      | ns            |    |
| Propagation Delay Skew <sup>*2</sup>                                    | $t_{psk}$   | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$   |   |   | 40                 | ns                      |               |    |
| Rise Time <sup>*3</sup>   | $t_r$   | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$   |   | 20  |                    | ns                      |               |    |
| Fall Time <sup>*3</sup>   | $t_f$   | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$R_L = 350 \Omega$ , $C_L = 15 \text{ pF}$   |   | 5   |                    | ns                      |               |    |
| Common Mode<br>Transient Immunity at<br>High Level Output <sup>*4</sup> | $ CM_H $  | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 0 \text{ mA}$ ,<br>$V_O > 2 \text{ V}$ , $R_L = 350 \Omega$ ,<br>$V_{CM} = 1.5 \text{ kV}$ , $T_A = 25^\circ\text{C}$     | 15  | 20  |                    | $\text{kV}/\mu\text{s}$ |               |    |
| Common Mode<br>Transient Immunity at Low<br>Level Output <sup>*4</sup>  | $ CM_L $  | $V_{CC} = 3.3/5 \text{ V}$ , $I_F = 4.5 \text{ mA}$ ,<br>$V_O < 0.8 \text{ V}$ , $R_L = 350 \Omega$ ,<br>$V_{CM} = 1.5 \text{ kV}$ , $T_A = 25^\circ\text{C}$ | 15  | 20  |                    | $\text{kV}/\mu\text{s}$ |               |    |

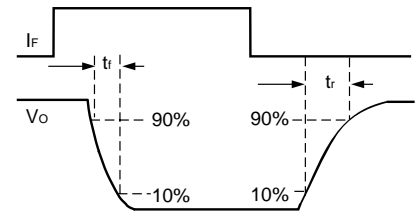
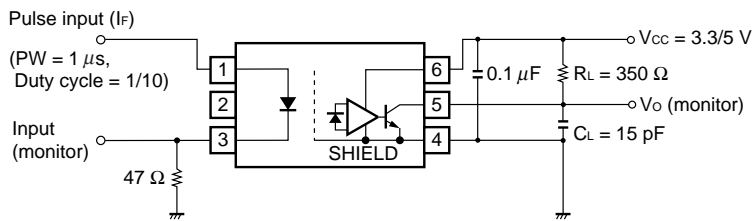
Notes: \*1. Typical values at  $T_A = 25^\circ\text{C}$

\*2. Test circuit for propagation delay time



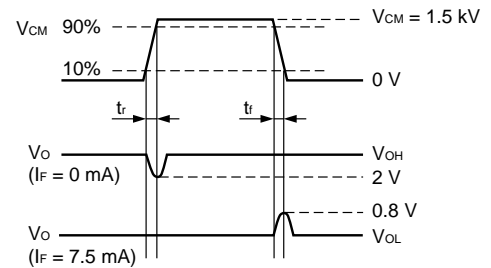
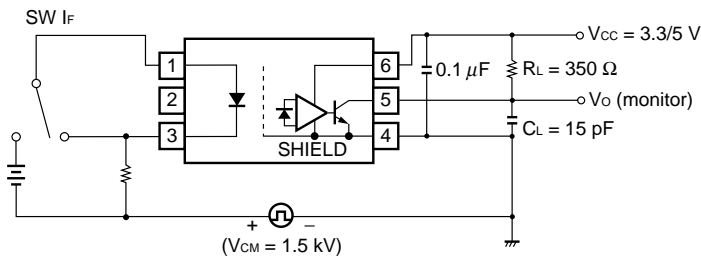
**Remark**  $C_L$  includes probe and stray wiring capacitance.

\*3. Test circuit for switching time



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

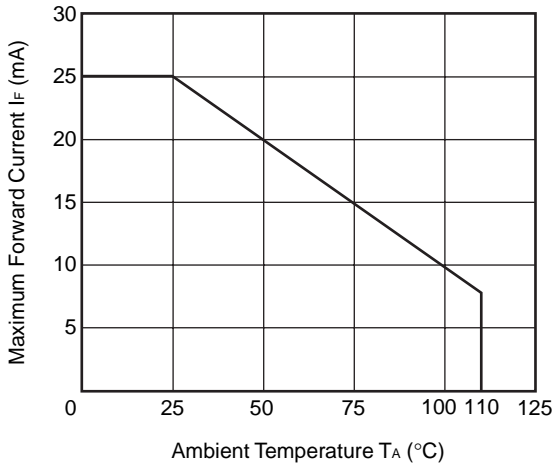
\*4. Test circuit for common mode transient immunity



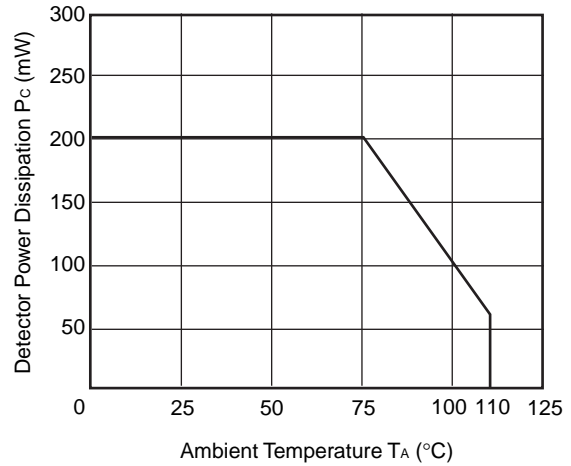
**Remark**  $C_L$  includes probe and stray wiring capacitance.

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

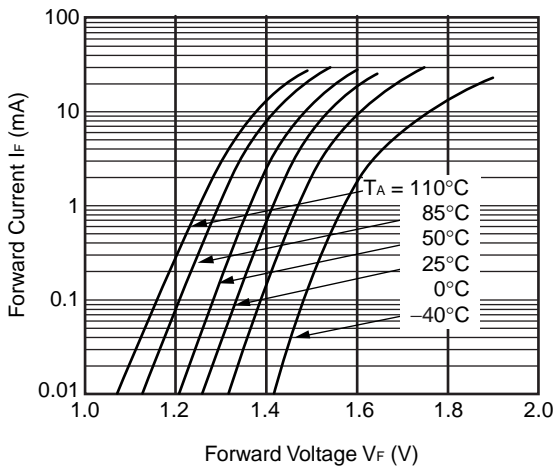
**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**



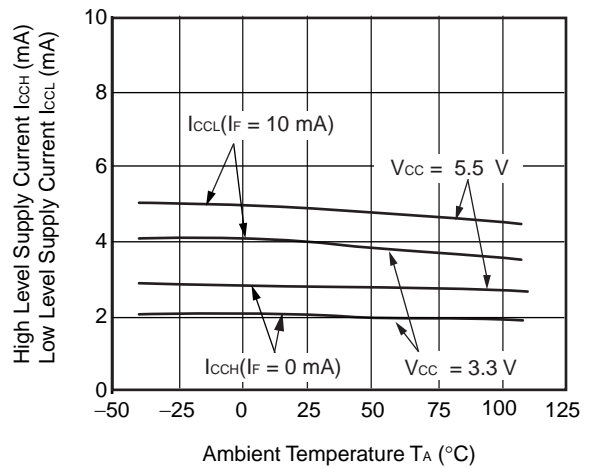
**DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



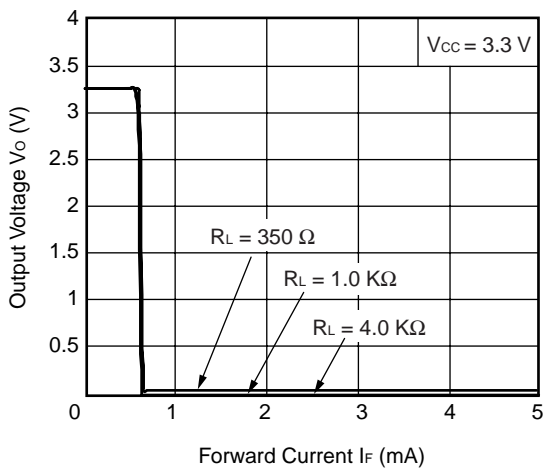
**FORWARD CURRENT vs. FORWARD VOLTAGE**



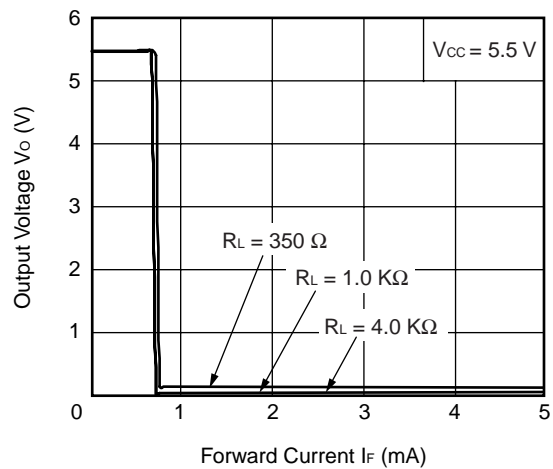
**SUPPLY CURRENT vs. AMBIENT TEMPERATURE**



**OUTPUT VOLTAGE vs. FORWARD CURRENT**



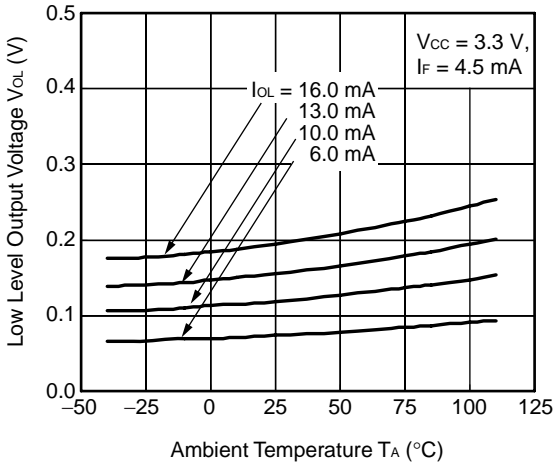
**OUTPUT VOLTAGE vs. FORWARD CURRENT**



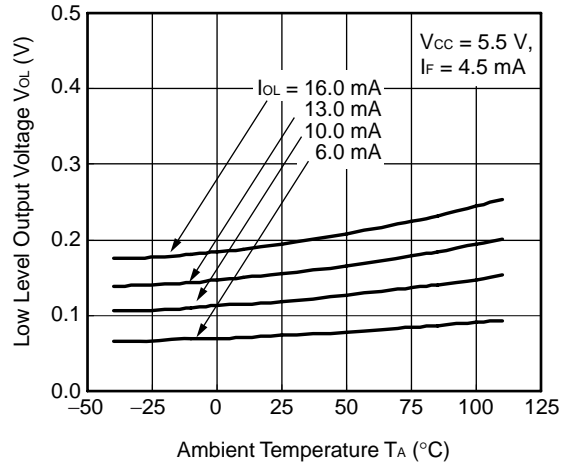
**Remark** The graphs indicate nominal characteristics.



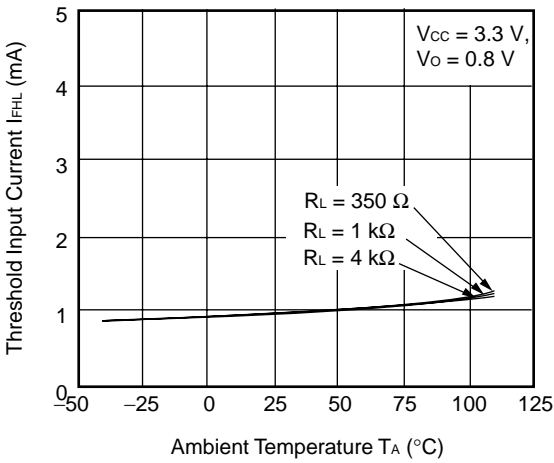
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



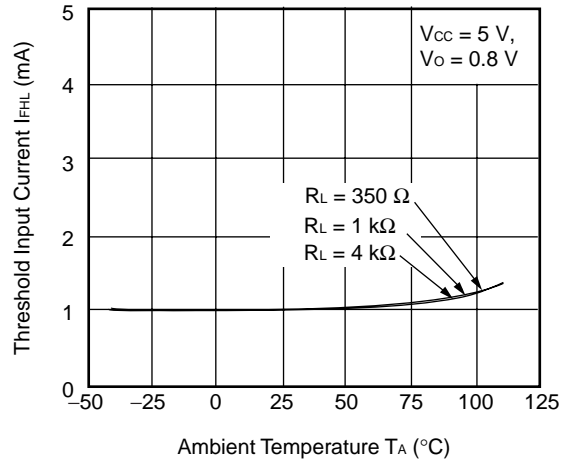
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



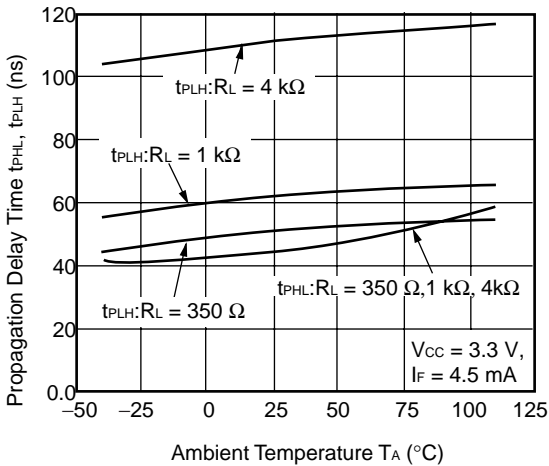
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



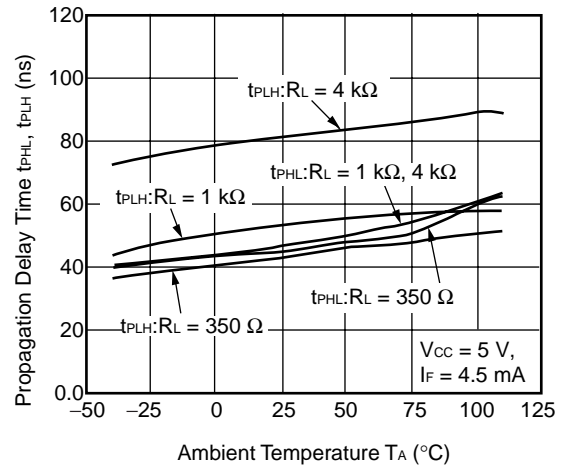
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE

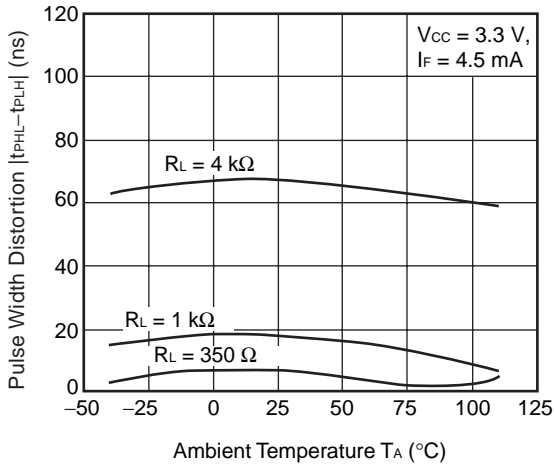


PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE

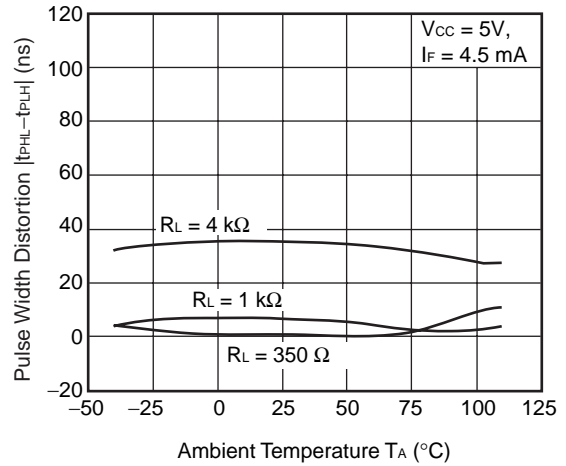


**Remark** The graphs indicate nominal characteristics.

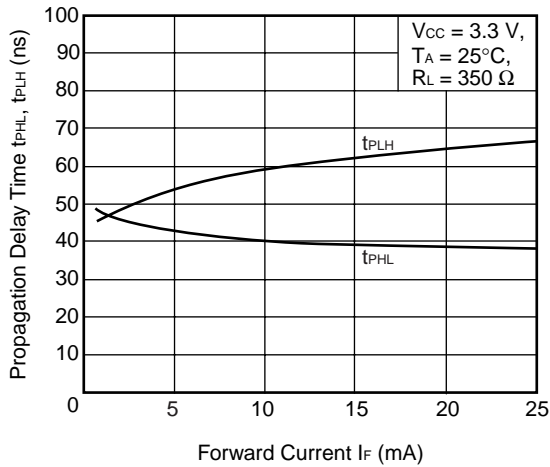
PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



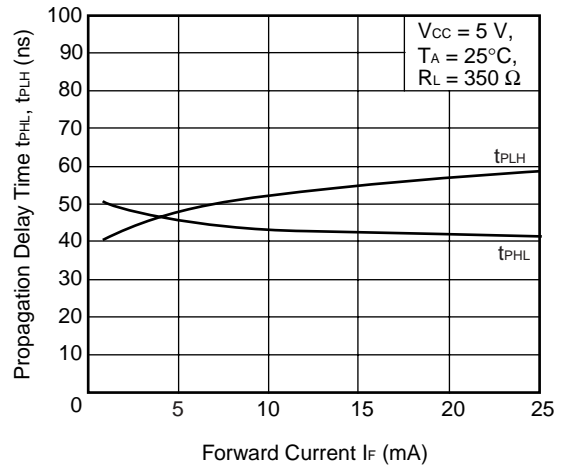
PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



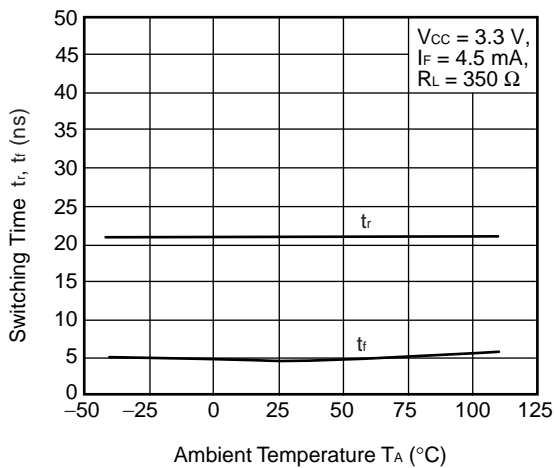
PROPAGATION DELAY TIME vs. FORWARD CURRENT



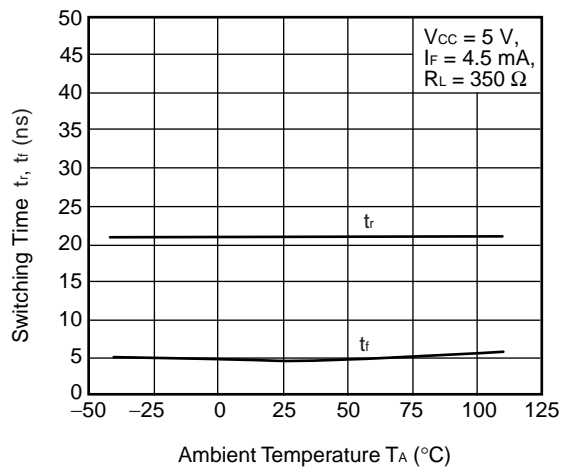
PROPAGATION DELAY TIME vs. FORWARD CURRENT



SWITCHING TIME vs. AMBIENT TEMPERATURE

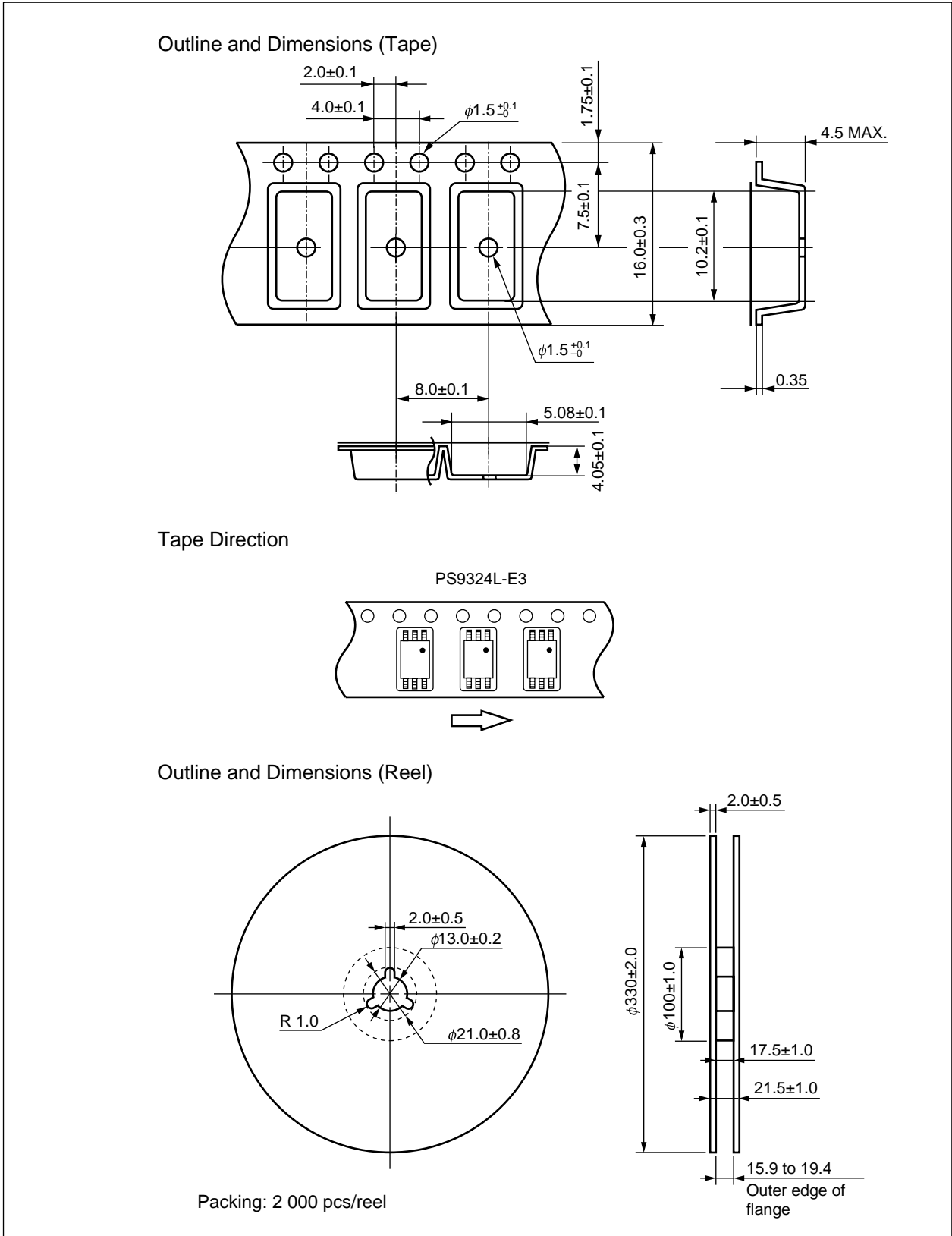


SWITCHING TIME vs. AMBIENT TEMPERATURE

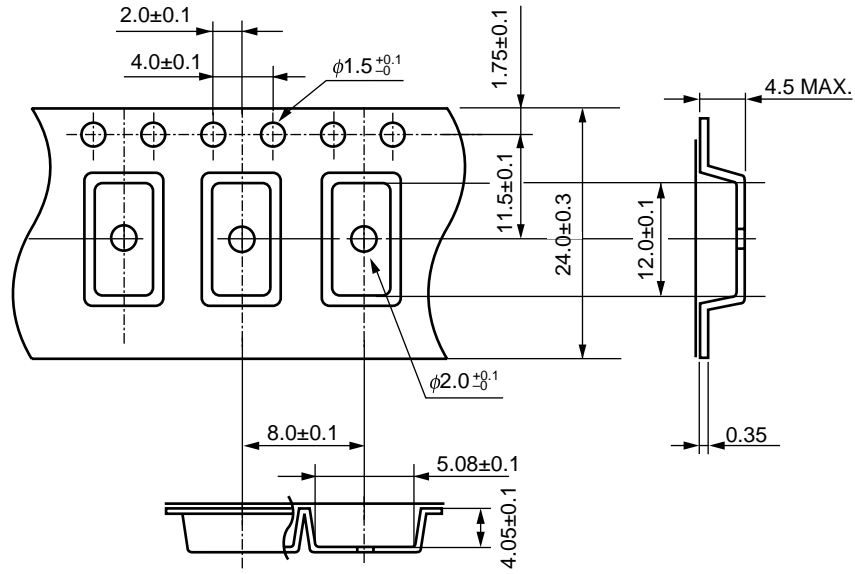


**Remark** The graphs indicate nominal characteristics.

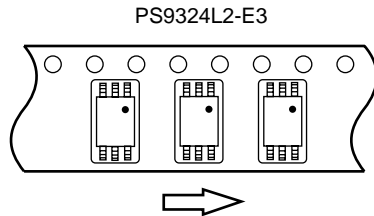
TAPING SPECIFICATIONS (UNIT: mm)



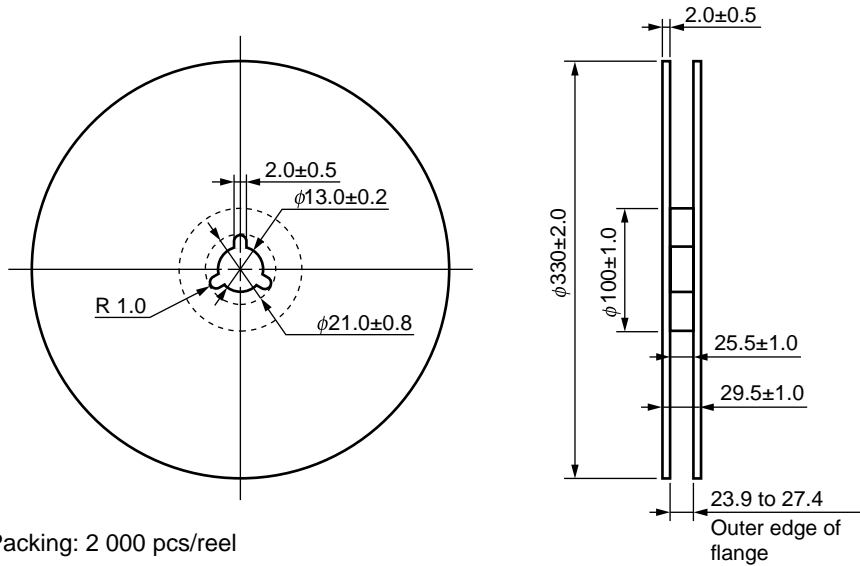
Outline and Dimensions (Tape)



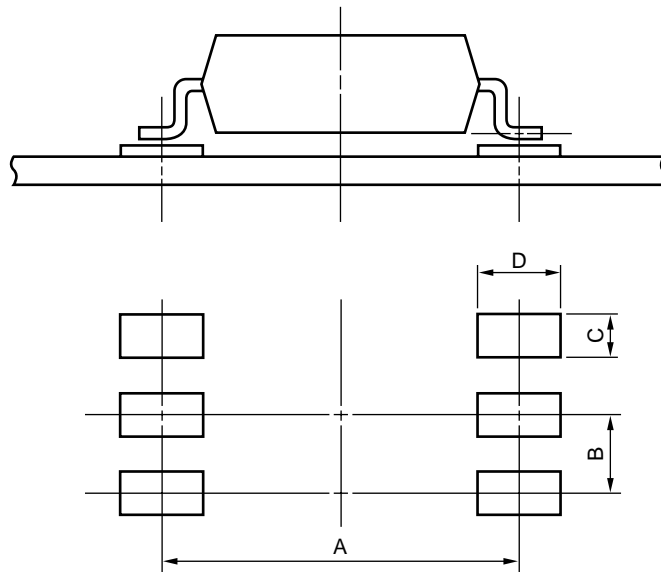
Tape Direction



Outline and Dimensions (Reel)



RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



| Part Number | Lead Bending  | A    | B    | C   | D   |
|-------------|---|------|------|-----|-----|
| PS9324L     | lead bending type (Gull-wing)<br>for surface mount                          | 9.2  | 1.27 | 0.8 | 2.2 |
| PS9324L2    | lead bending type (Gull-wing)<br>for long creepage distance (surface mount) | 10.2 | 1.27 | 0.8 | 2.2 |

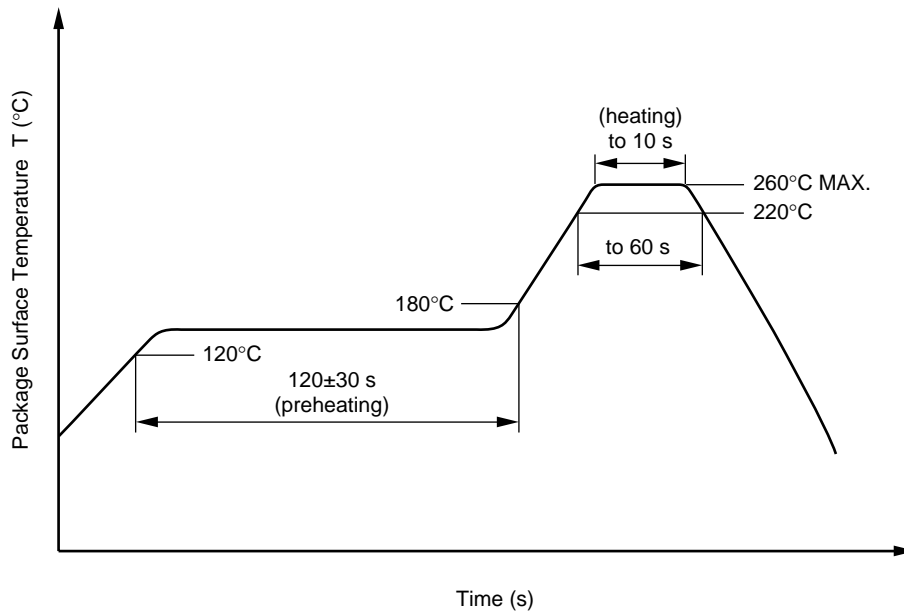
## NOTES ON HANDLING

## 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 pin) 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 or between collector-emitters at startup, the output side 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. When  $V_{DD}$  is lower than around 2 V, the output( $V_O$ ) of this product is unstable, and this might produce undesirable operation. Be sure to check the operation of an IC or a discrete component that is connected to this product during Power-up and Power-down process. And we recommend to use a disable function (shutdown function ) of the connected IC or a reset IC to avoid this undesirable operation.
4. 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).
5. Avoid storage at a high temperature and high humidity.

## 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<br>maximum operating isolation voltage   | $U_{IORM}$           | 1 130                  | $V_{peak}$           |
| Test voltage (partial discharge test, procedure a for type test and random test)<br>$U_{pr} = 1.6 \times U_{IORM}$ , $P_d < 5$ pC                        | $U_{pr}$             | 1 808                  | $V_{peak}$           |
| Test voltage (partial discharge test, procedure b for all devices)<br>$U_{pr} = 1.875 \times U_{IORM}$ , $P_d < 5$ 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<br>$V_{IO} = 500$ V dc at $T_A = 25^\circ\text{C}$<br>$V_{IO} = 500$ V dc at $T_A$ MAX. at least $100^\circ\text{C}$ | Ris MIN.<br>Ris MIN. | $10^{12}$<br>$10^{11}$ | $\Omega$<br>$\Omega$ |
| Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)  |                      |                        |                      |
| Package temperature  | $T_{si}$             | 175                    | °C                   |
| Current (input current $I_F$ , $P_{si} = 0$ )  | $I_{si}$             | 400                    | mA                   |
| Power (output or total power dissipation)  | $P_{si}$             | 700                    | mW                   |
| Isolation resistance<br>$V_{IO} = 500$ V dc at $T_A = T_{si}$  | 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> |
|----------------|---------------|--|

|                         |                                     |
|-------------------------|-------------------------------------|
| <b>Revision History</b> | <b>PS9324L, PS9324L2 Data Sheet</b> |
|-------------------------|-------------------------------------|

| <b>Rev.</b> | <b>Date</b>  | <b>Description</b> |                      |
|-------------|--------------|--------------------|----------------------|
|             |              | <b>Page</b>        | <b>Summary</b>       |
| 1.00        | Apr 26, 2013 | -                  | First Edition Issued |

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