

## HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE

## 5-PIN SOP PHOTOCOUPLER

–NEPOC Series–

### DESCRIPTION

The PS9114 is an optically coupled high-speed, isolator containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

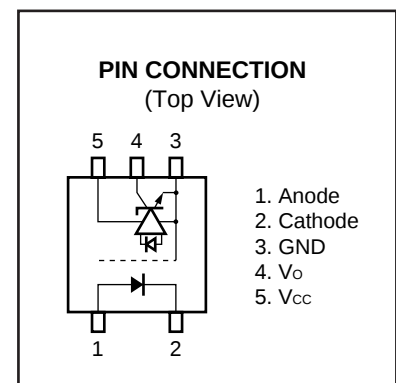
The PS9114 is specified high CMR, high CTR and pulse width distortion with operating temperature.

### FEATURES

- High common mode transient immunity ( $CM_H, CM_L = \pm 20 \text{ kV}/\mu\text{s}$  TYP.)
- Small package (5-pin SOP)
- Pulse width distortion ( $|t_{PHL} - t_{PLH}| = 3 \text{ ns}$  TYP.)
- High-speed (10 Mbps)
- High isolation voltage ( $BV = 2\,500 \text{ Vr.m.s.}$ )
- Open collector output
- Ordering number of taping product: PS9114-F3, F4: 2 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: File No. E72422
  - DIN EN60747-5-2 (VDE0884 Part2) approved No. 40008902 (Option)

### APPLICATIONS

- Measurement equipment
- PDP
- FA Network

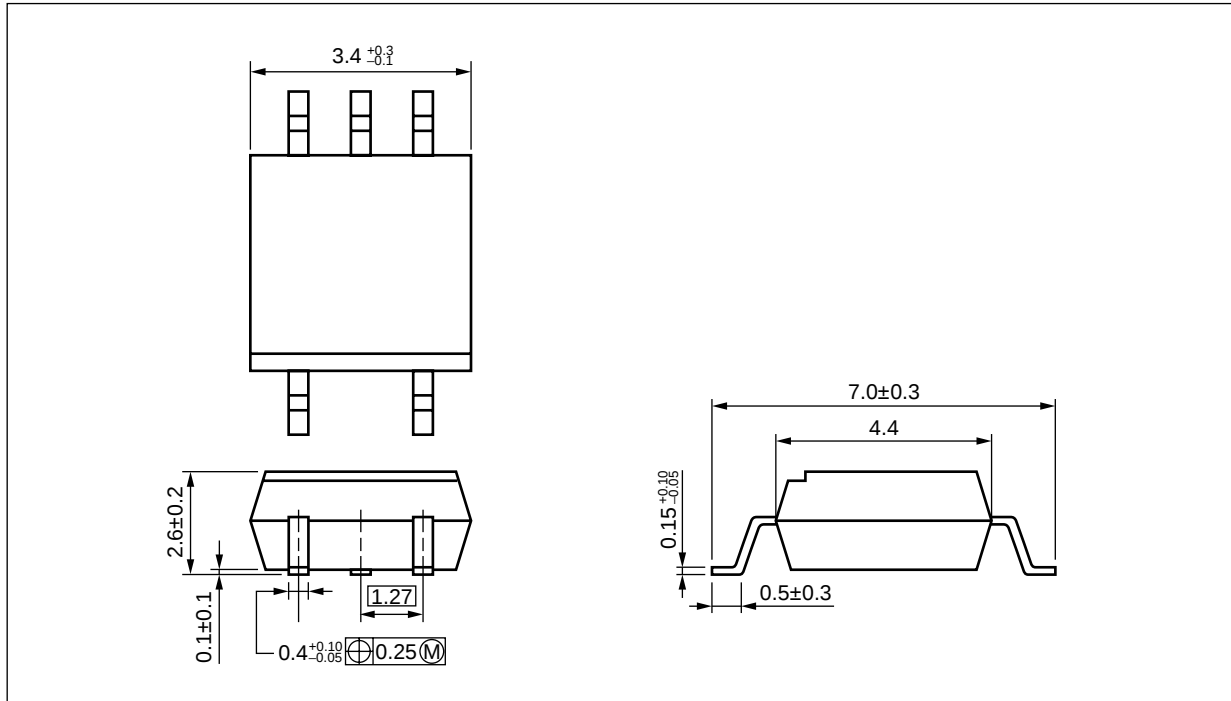


### TRUTH TABLE

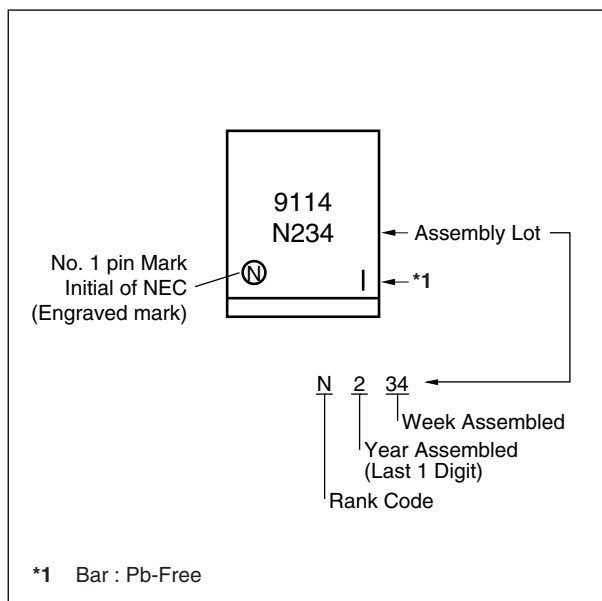
| LED | Output |
|-----|--------|
| ON  | L      |
| OFF | H      |

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**PACKAGE DIMENSIONS (UNIT: mm)**



**MARKING EXAMPLE**



★ **ORDERING INFORMATION**

| Part Number | Order Number  | Solder Plating Specification | Packing Style                | Safety Standard Approval                                | Application Part Number <sup>*1</sup> |
|-------------|---------------|------------------------------|------------------------------|---------------------------------------------------------|---------------------------------------|
| PS9114      | PS9114-A      | Pb-Free                      | 20 pcs (Tape 20 pcs cut)     | Standard products<br>(UL approved)                      | PS9114                                |
| PS9114-F3   | PS9114-F3-A   |                              | Embossed Tape 2 500 pcs/reel |                                                         |                                       |
| PS9114-F4   | PS9114-F4-A   |                              |                              |                                                         |                                       |
| PS9114-V    | PS9114-V-A    |                              | 20 pcs (Tape 20 pcs cut)     | DIN EN60747-5-2<br>(VDE0884 Part2)<br>Approved (Option) |                                       |
| PS9114-V-F3 | PS9114-V-F3-A |                              | Embossed Tape 2 500 pcs/reel |                                                         |                                       |
| PS9114-V-F4 | PS9114-V-F4-A |                              |                              |                                                         |                                       |

<sup>\*1</sup> 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 <sup>*1</sup>   | I <sub>F</sub>   | 30          | 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 <sup>*2</sup> | P <sub>C</sub>   | 40          | mW      |
| Isolation Voltage <sup>*3</sup> |                                 | BV               | 2 500       | Vr.m.s. |
| Operating Ambient Temperature   |                                 | T <sub>A</sub>   | -40 to +85  | °C      |
| Storage Temperature             |                                 | T <sub>stg</sub> | -55 to +125 | °C      |

<sup>\*1</sup> Reduced to 0.3 mA/°C at T<sub>A</sub> = 25°C or more.

<sup>\*2</sup> Applies to output pin V<sub>O</sub>. Reduced to 1.5 mW/°C at T<sub>A</sub> = 65°C or more.

<sup>\*3</sup> 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> | 0    |      | 0.8  | V    |
| High Level Input Current           | I <sub>FH</sub> | 6.3  | 10   | 12.5 | mA   |
| Supply Voltage                     | V <sub>CC</sub> | 4.5  | 5.0  | 5.5  | V    |
| TTL (R <sub>L</sub> = 1 kΩ, loads) | N               |      |      | 5    |      |
| Pull-up resistor                   | R <sub>L</sub>  | 330  |      | 4 k  | Ω    |

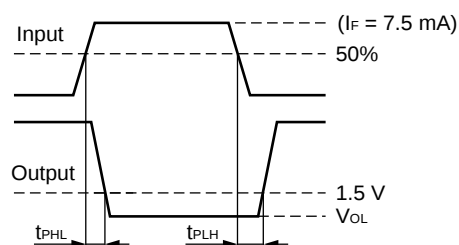
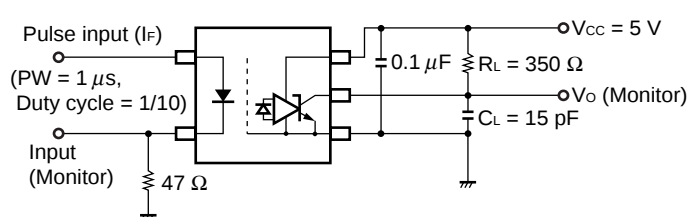
**ELECTRICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = -40$  to  $+85^\circ\text{C}$ )**

| Parameter |                                                                         | Symbol                | Conditions                                                                                                                        | MIN.      | TYP. <sup>*1</sup> | MAX. | Unit              |
|-----------|-------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------|------|-------------------|
| Diode     | Forward Voltage                                                         | $V_F$                 | $I_F = 10\text{ mA}$ , $T_A = 25^\circ\text{C}$                                                                                   | 1.4       | 1.65               | 1.9  | V                 |
|           | Reverse Current                                                         | $I_R$                 | $V_R = 3\text{ V}$ , $T_A = 25^\circ\text{C}$                                                                                     |           |                    | 10   | $\mu\text{A}$     |
|           | Terminal Capacitance                                                    | $C_t$                 | $V = 0\text{ V}$ , $f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$                                                                  |           | 30                 |      | pF                |
| Detector  | High Level Output Current                                               | $I_{OH}$              | $V_{CC} = V_O = 5.5\text{ V}$ , $V_F = 0.8\text{ V}$                                                                              |           | 0.02               | 250  | $\mu\text{A}$     |
|           | Low Level Output Voltage <sup>*2</sup>                                  | $V_{OL}$              | $V_{CC} = 5.5\text{ V}$ , $I_F = 5\text{ mA}$ , $I_{OL} = 13\text{ mA}$                                                           |           | 0.15               | 0.6  | V                 |
|           | High Level Supply Current                                               | $I_{CCH}$             | $V_{CC} = 5.5\text{ V}$ , $I_F = 0\text{ mA}$ , $V_O = \text{open}$                                                               |           | 3                  | 8    | mA                |
|           | Low Level Supply Current                                                | $I_{CCL}$             | $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ , $V_O = \text{open}$                                                              |           | 7.0                | 11   | mA                |
| Coupled   | Threshold Input Current<br>(H $\rightarrow$ L)                          | $I_{FHL}$             | $V_{CC} = 5\text{ V}$ , $V_O = 0.8\text{ V}$ , $R_L = 350\ \Omega$                                                                |           | 2                  | 5    | mA                |
|           | Isolation Resistance                                                    | $R_{I-O}$             | $V_{I-O} = 1\text{ kV}_{DC}$ , $R_H = 40$ to $60\%$ ,<br>$T_A = 25^\circ\text{C}$                                                 | $10^{11}$ |                    |      | $\Omega$          |
|           | Isolation Capacitance                                                   | $C_{I-O}$             | $V = 0\text{ V}$ , $f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$                                                                  |           | 0.6                |      | pF                |
|           | Propagation Delay Time<br>(H $\rightarrow$ L) <sup>*3</sup>             | $t_{PHL}$             | $T_A = 25^\circ\text{C}$                                                                                                          |           | 54                 | 75   | ns                |
|           |                                                                         |                       | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           |                    | 100  |                   |
|           | Propagation Delay Time<br>(L $\rightarrow$ H) <sup>*3</sup>             | $t_{PLH}$             | $T_A = 25^\circ\text{C}$                                                                                                          |           | 51                 | 75   | ns                |
|           |                                                                         |                       | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           |                    | 100  |                   |
|           | Rise Time                                                               | $t_r$                 | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           | 20                 |      |                   |
|           | Fall Time                                                               | $t_f$                 | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           | 10                 |      |                   |
|           | Pulse Width Distortion<br>(PWD) <sup>*3</sup>                           | $ t_{PHL} - t_{PLH} $ | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           | 3                  | 50   | ns                |
|           | Propagation Delay Skew                                                  | $t_{PSK}$             | $V_{CC} = 5\text{ V}$ , $R_L = 350\ \Omega$ , $I_F = 7.5\text{ mA}$                                                               |           |                    | 60   |                   |
|           | Common Mode<br>Transient Immunity at High<br>Level Output <sup>*4</sup> | $CM_H$                | $R_L = 350\ \Omega$ , $T_A = 25^\circ\text{C}$ , $I_F = 0\text{ mA}$ ,<br>$V_{O(MIN.)} = 2\text{ V}$ , $V_{CM} = 1\text{ kV}$     | 10        | 20                 |      | kV/ $\mu\text{s}$ |
|           | Common Mode<br>Transient Immunity at Low<br>Level Output <sup>*4</sup>  | $CM_L$                | $R_L = 350\ \Omega$ , $T_A = 25^\circ\text{C}$ , $I_F = 7.5\text{ mA}$ ,<br>$V_{O(MAX.)} = 0.8\text{ V}$ , $V_{CM} = 1\text{ kV}$ | 10        | 20                 |      | kV/ $\mu\text{s}$ |

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

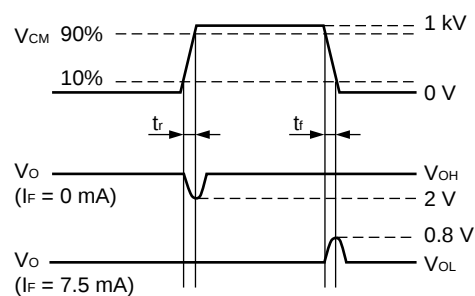
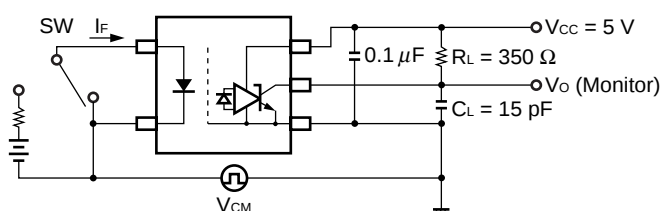
\*2 Because  $V_{OL}$  of 2 V or more may be output when LED current input and when output supply of  $V_{CC} = 2.6\text{ V}$  or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

\*3 Test circuit for propagation delay time



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

\*4 Test circuit for common mode transient immunity



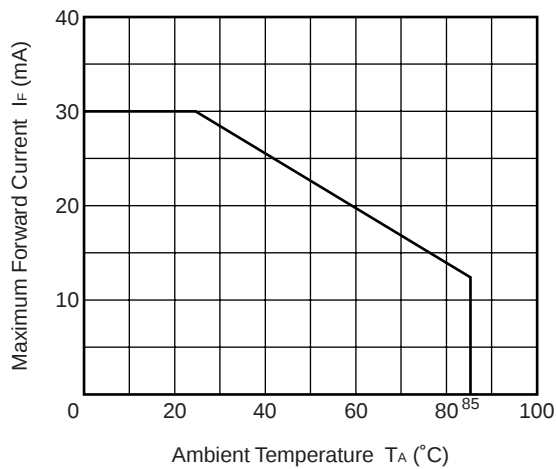
**Remark**  $C_L$  includes probe and stray wiring capacitance.

## USAGE CAUTIONS

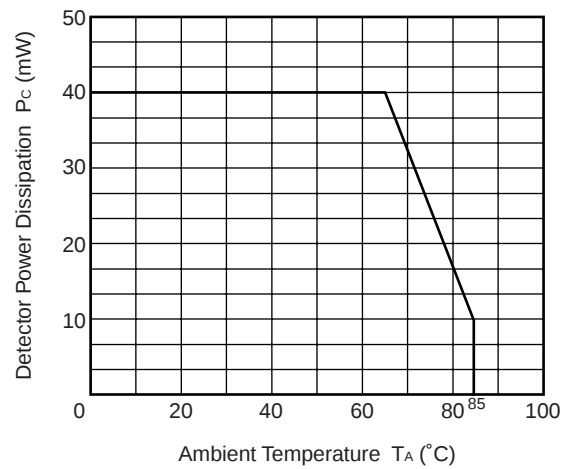
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of  $0.1\text{ }\mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.

**TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

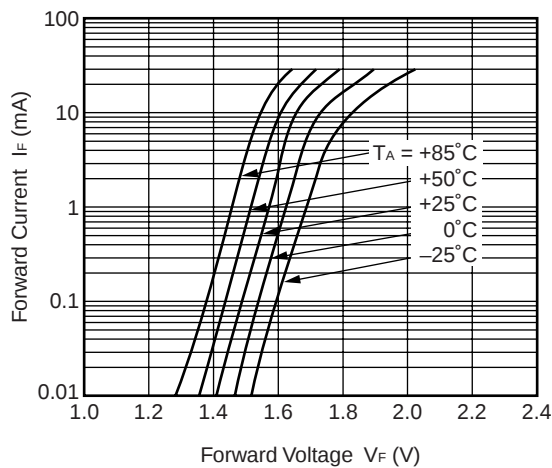
**MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE**



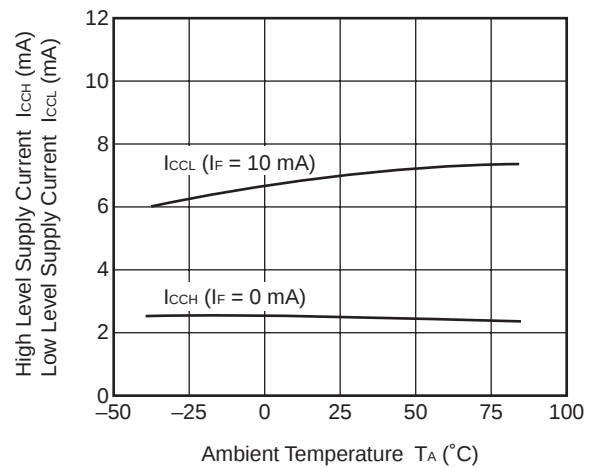
**DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



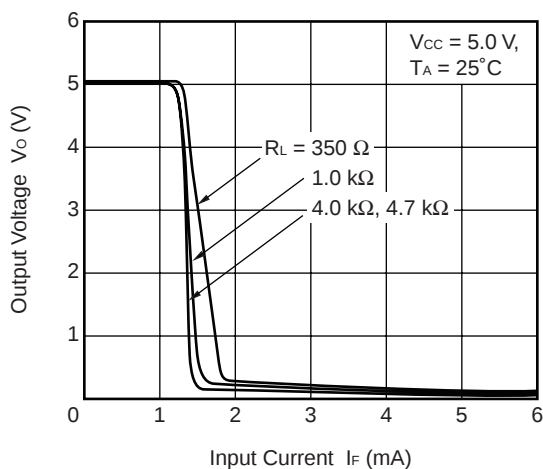
**FORWARD CURRENT vs. FORWARD VOLTAGE**



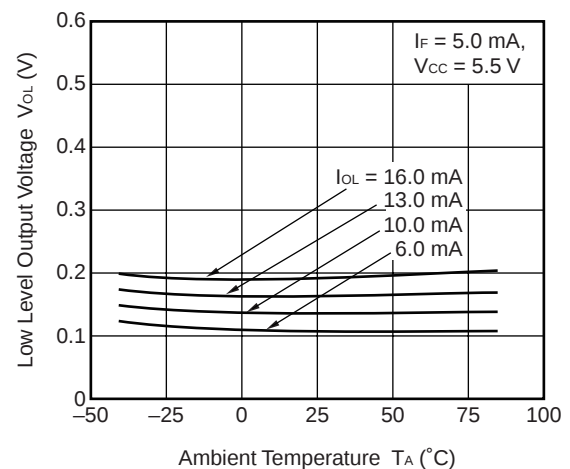
**SUPPLY CURRENT vs. AMBIENT TEMPERATURE**



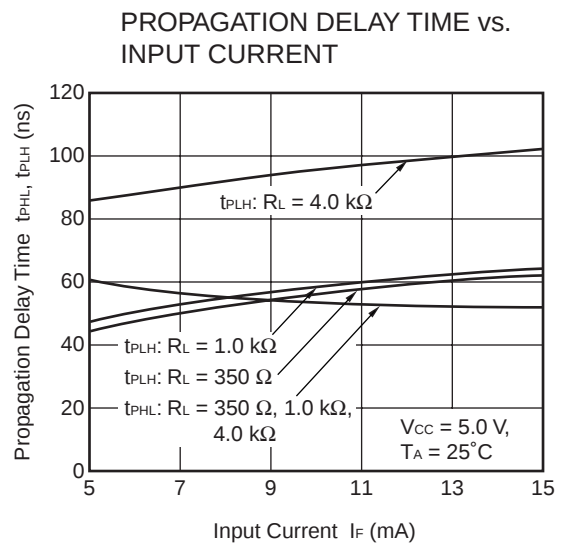
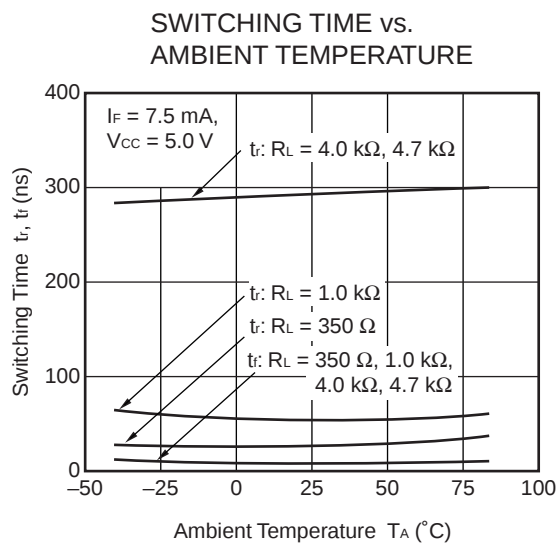
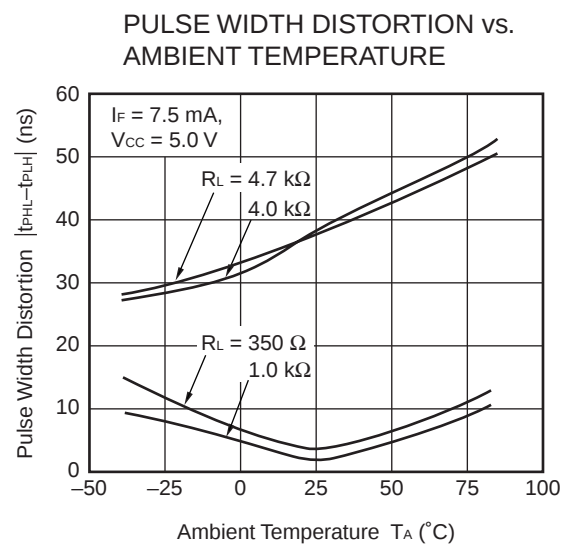
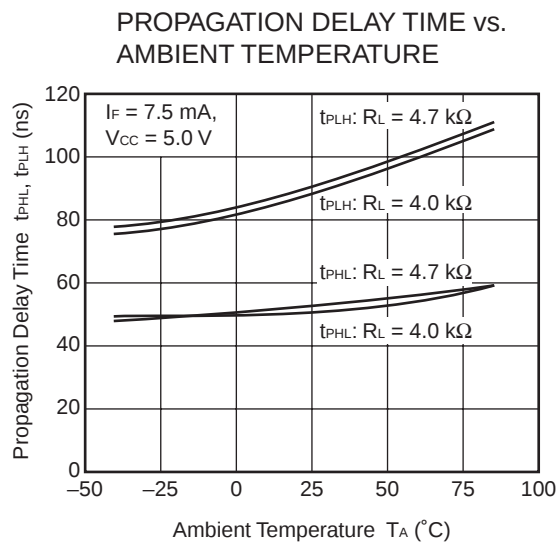
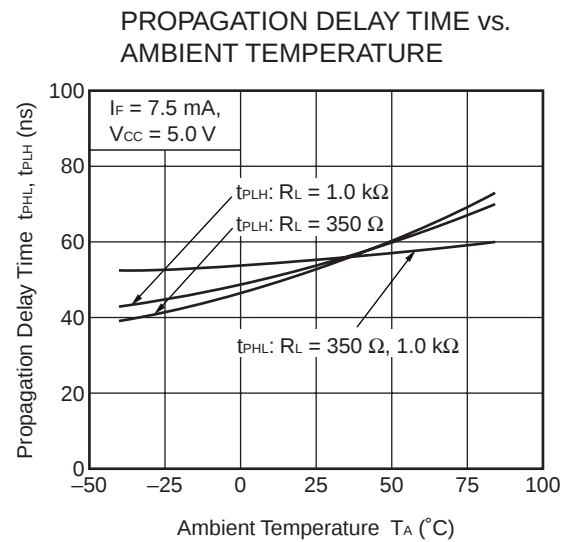
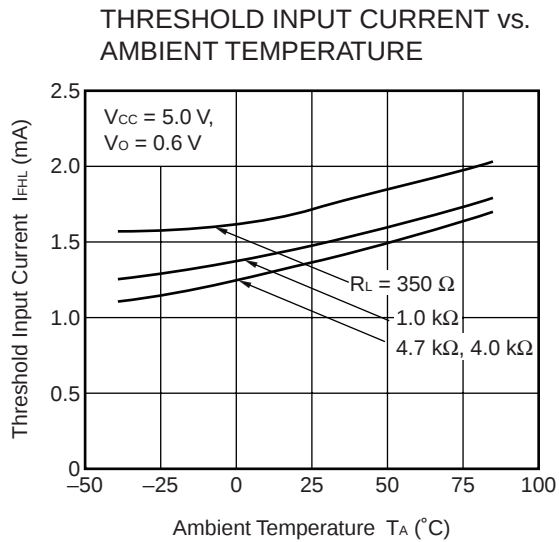
**OUTPUT VOLTAGE vs. INPUT CURRENT**



**LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE**



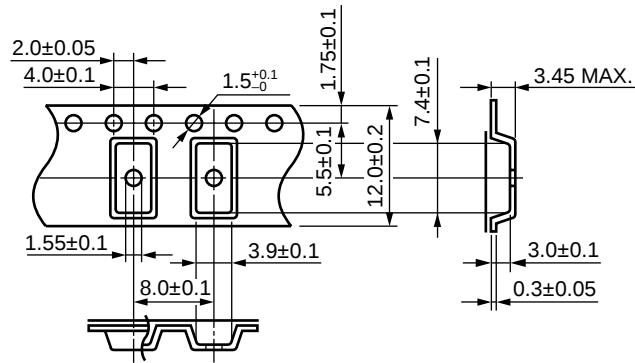
**Remark** The graphs indicate nominal characteristics.



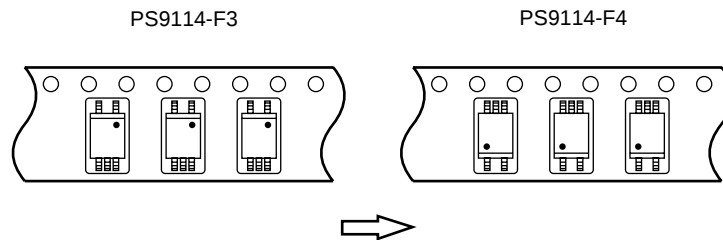
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

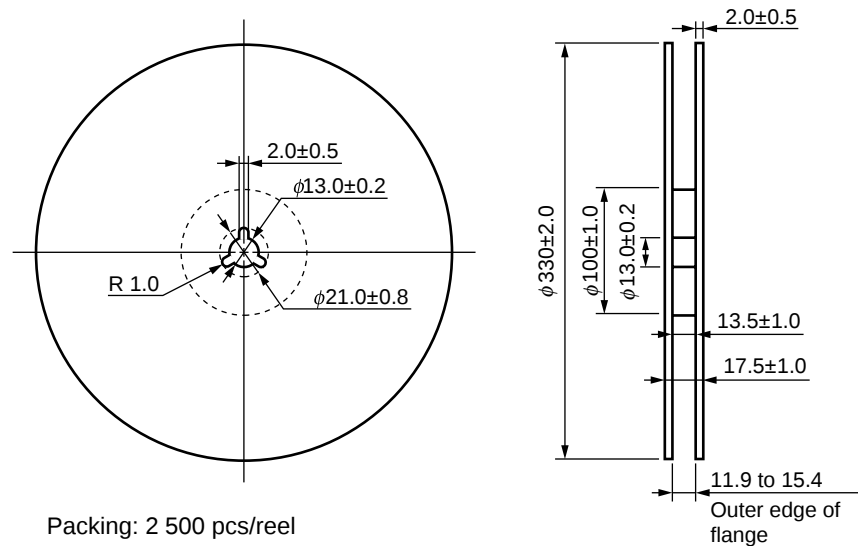
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

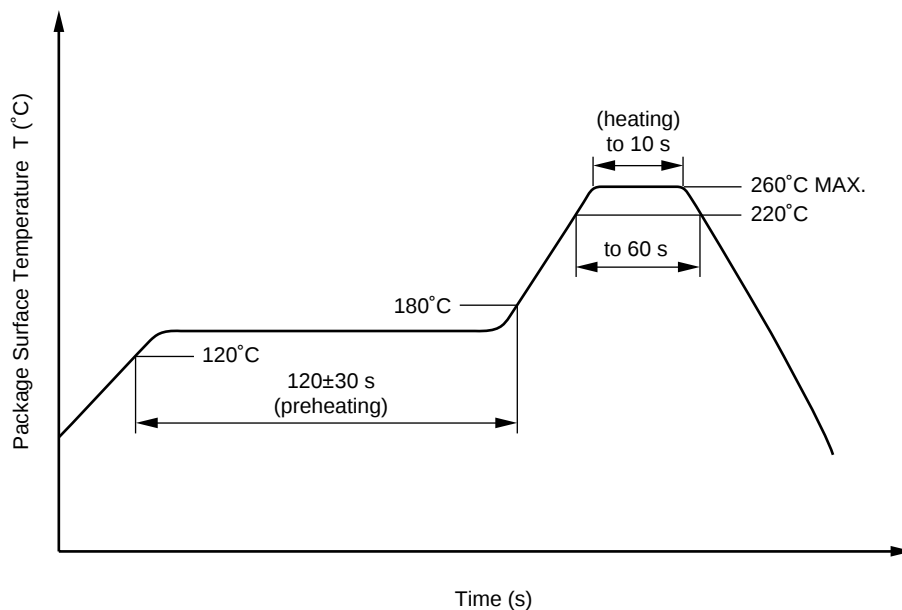
## NOTES ON HANDLING

## 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**

- 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.

**USAGE CAUTIONS**

1. Protect against static electricity when handling.
2. Avoid storage at a high temperature and high humidity.

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance per RoHS | Concentration Limit per RoHS (values are not yet fixed) | Concentration contained in CEL devices |     |
|-------------------------------|---------------------------------------------------------|----------------------------------------|-----|
|                               |                                                         | -A                                     | -AZ |
| Lead (Pb)                     | < 1000 PPM                                              | Not Detected                           | (*) |
| Mercury                       | < 1000 PPM                                              | Not Detected                           |     |
| Cadmium                       | < 100 PPM                                               | Not Detected                           |     |
| Hexavalent Chromium           | < 1000 PPM                                              | Not Detected                           |     |
| PBB                           | < 1000 PPM                                              | Not Detected                           |     |
| PBDE                          | < 1000 PPM                                              | Not Detected                           |     |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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