

**NEC**

**PHOTOCOUPLER**  
**PS9701**

**HIGH SPEED DIGITAL OUTPUT TYPE**  
**5-PIN SOP PHOTOCOUPLER**

–NEPOC™ Series–

**DESCRIPTION**

The PS9701 is an optically coupled isolator containing a GaAlAs LED on light emitting side (input side) and a photodiode and a signal processing circuit on light receiving side (output side) on one chip.

This is SOP (Small Outline Package) type for high-density applications.

**FEATURES**

- High isolation voltage (BV = 2 500 Vr.m.s.)
- Small and thin package (5-pin SOP)
- ★ • High-speed response ( $t_{PHL} = 36$  ns TYP.,  $t_{PLH} = 60$  ns TYP.)
- Low threshold input current ( $I_{FHL} = 2.5$  mA TYP.)
- ★ • Open-collector type
- Ordering number of taping product: PS9701-1-E3, E4, F3, F4
- UL approved: File No. E72422 (S)
- VDE0884 approved (Option)

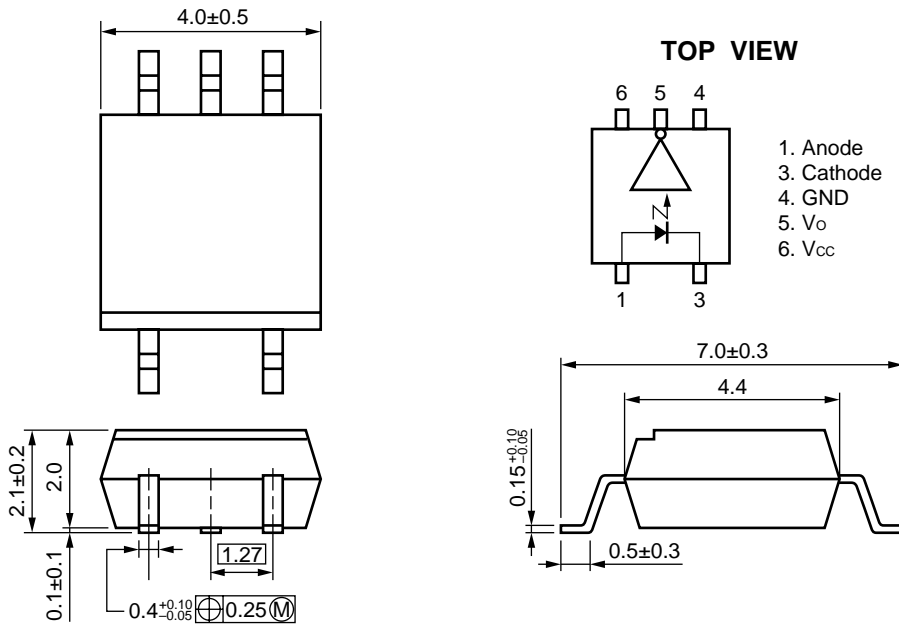
**APPLICATIONS**

- Computer and peripheral manufactures
- Measurement equipment
- Audio-Visual

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

★

**PACKAGE DIMENSIONS**  
in millimeters



★ ORDERING INFORMATION

| Part Number | Package   | Packing Style                | Safety Standards Approval | Application Part Number <sup>*1</sup> |
|-------------|-----------|------------------------------|---------------------------|---------------------------------------|
| PS9701      | 5-pin SOP | Magazine case 100 pcs        | UL approved               | PS9701                                |
| PS9701-E3   |           | Embossed Tape 900 pcs/reel   |                           |                                       |
| PS9701-E4   |           |                              |                           |                                       |
| PS9701-F3   |           | Embossed Tape 3 500 pcs/reel |                           |                                       |
| PS9701-F4   |           |                              |                           |                                       |
| PS9701-V    |           | Magazine case 100 pcs        | VDE0884 approved          |                                       |
| PS9701-V-E3 |           | Embossed Tape 900 pcs/reel   |                           |                                       |
| PS9701-V-E4 |           |                              |                           |                                       |
| PS9701-V-F3 |           | Embossed Tape 3 500 pcs/reel |                           |                                       |
| PS9701-V-F4 |           |                              |                           |                                       |

\*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   | 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>   | 50          | mA      |
|                                 | Power Dissipation | P <sub>C</sub>   | 85          | mW      |
| Isolation Voltage <sup>*1</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      |

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

**RECOMMENDED OPERATING CONDITIONS**

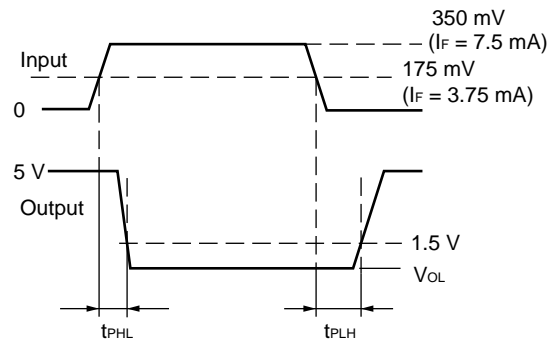
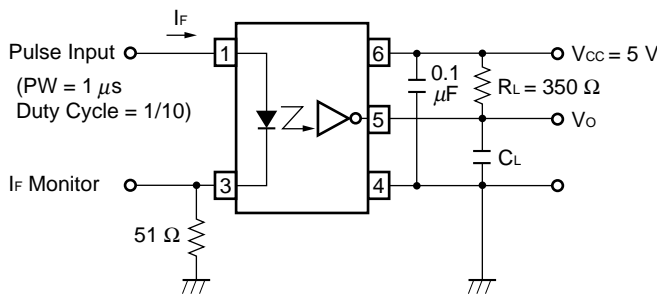
| Parameter                     | Symbol          | MIN. | TYP. | MAX. | Unit |
|-------------------------------|-----------------|------|------|------|------|
| Low Level Input Current       | I <sub>FL</sub> | 0    |      | 250  | μA   |
| High Level Input Current      | I <sub>FH</sub> | 5    | 7.5  | 15   | mA   |
| Supply Voltage                | V <sub>CC</sub> | 4.5  | 5.0  | 5.5  | V    |
| Operating Ambient Temperature | T <sub>A</sub>  | 0    | 25   | 70   | °C   |

**Remark** By-pass capacitor of more than 0.1 μF is used between V<sub>CC</sub> and GND near the device.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 0 to +70 °C, unless otherwise specified)**

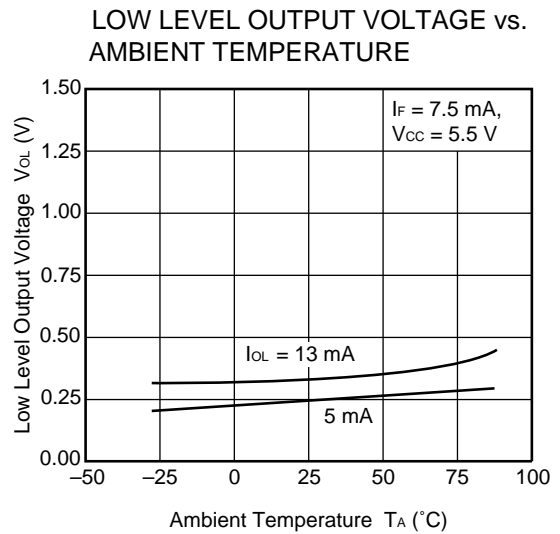
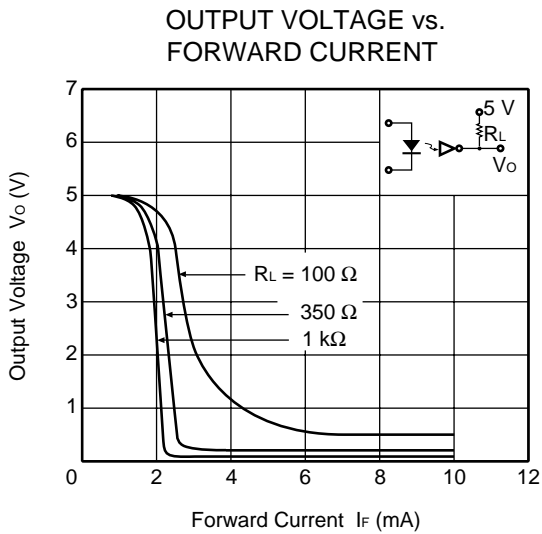
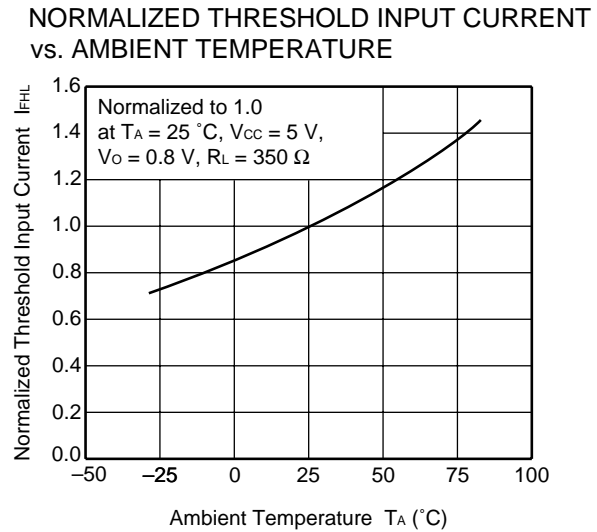
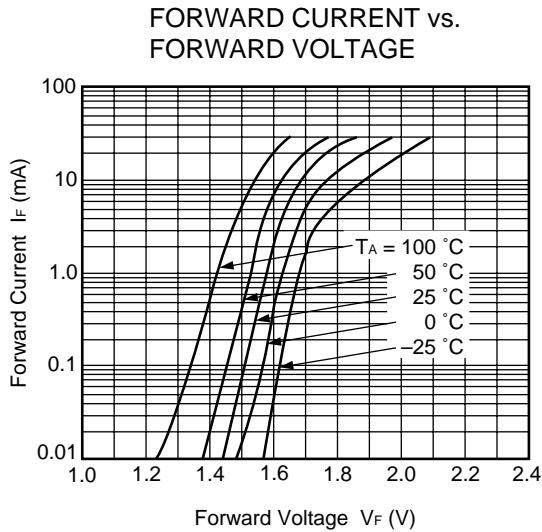
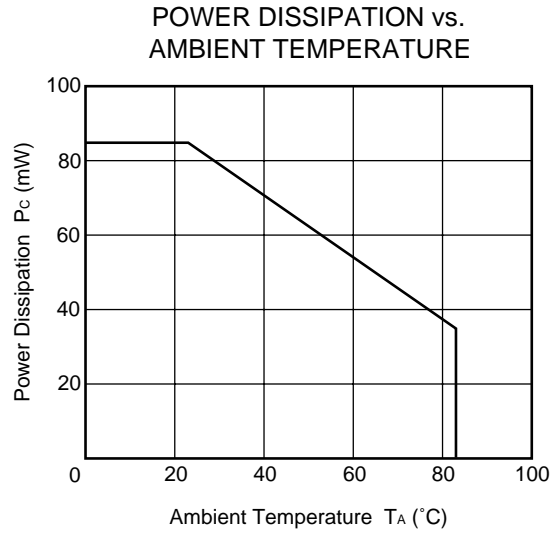
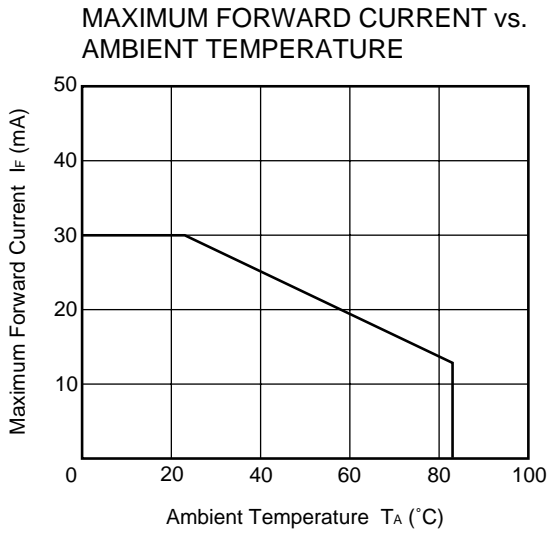
| Parameter |  | Symbol           | Conditions   | MIN.             | TYP. | MAX. | Unit |
|-----------|--|------------------|--|------------------|------|------|------|
| Diode     | Forward Voltage                              | V <sub>F</sub>   | I <sub>F</sub> = 10 mA, T <sub>A</sub> = 25 °C   | 1.4              | 1.65 | 1.9  | V    |
|           | Reverse Current                              | I <sub>R</sub>   | V <sub>R</sub> = 5 V, T <sub>A</sub> = 25 °C   |                  |      | 10   | μA   |
|           | Terminal Capacitance                         | C <sub>t</sub>   | V = 0 V, f = 1 MHz, T <sub>A</sub> = 25 °C   |                  | 60   |      | pF   |
| Detector  | High Level Output Current                    | I <sub>OH</sub>  | V <sub>CC</sub> = V <sub>O</sub> = 5.5 V, I <sub>F</sub> = 250 μA  |                  | 2    | 250  | μA   |
|           | Low Level Output Voltage                     | V <sub>OL</sub>  | V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 7.5 mA, I <sub>O</sub> = 13 mA   |                  | 0.3  | 0.6  | V    |
|           | High Level Supply Current                    | I <sub>CCH</sub> | V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 0 mA   | 4                | 6    | 8    | mA   |
|           | Low Level Supply Current                     | I <sub>CCL</sub> | V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 10 mA  | 9                | 12   | 15   | mA   |
| Coupled   | Threshold Input Current (H → L)              | I <sub>FHL</sub> | T <sub>A</sub> = 25 °C   | 0.5              | 2.5  | 5.0  | mA   |
|           |  |                  | V <sub>CC</sub> = 5 V, V <sub>O</sub> = 0.8 V, R <sub>L</sub> = 350 Ω  |                  |      | 7    |      |
|           | 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>*1</sup> | t <sub>PHL</sub> | V <sub>CC</sub> = 5 V, I <sub>F</sub> = 7.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF, T <sub>A</sub> = 25 °C |                  | 36   | 75   | ns   |
|           | Propagation Delay Time (L → H) <sup>*1</sup> | t <sub>PLH</sub> |  |                  | 60   | 75   |      |
|           | Rise Time                                    | t <sub>r</sub>   |  |                  |      | 20   |      |
| Fall Time | t <sub>f</sub>                               |                  |  |                  | 10   |      |      |

\*1 Test circuit for propagation delay time

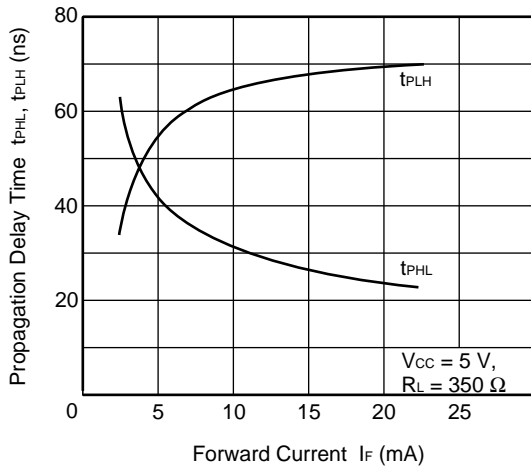


**Remark** C<sub>L</sub> is approximately 15 pF, which includes probe and stray wiring capacitance.

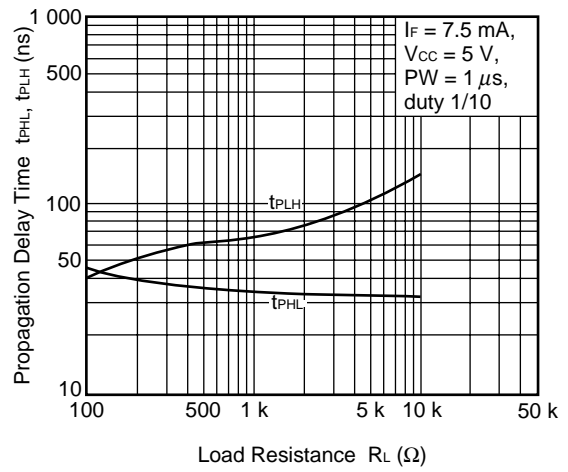
★ TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified)



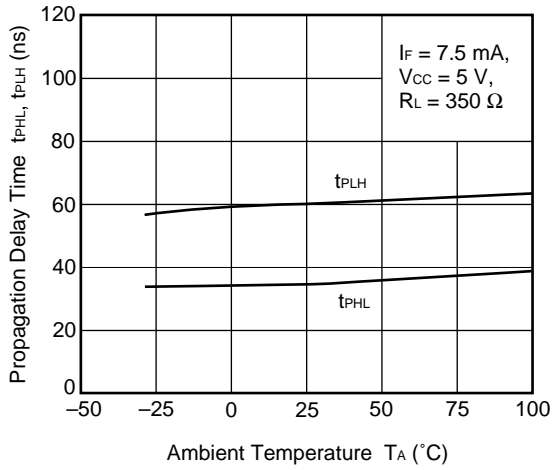
PROPAGATION DELAY TIME vs. FORWARD CURRENT



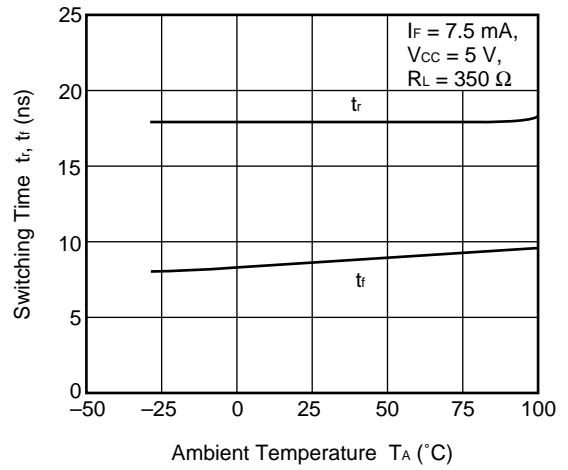
PROPAGATION DELAY TIME vs. LOAD RESISTANCE



PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



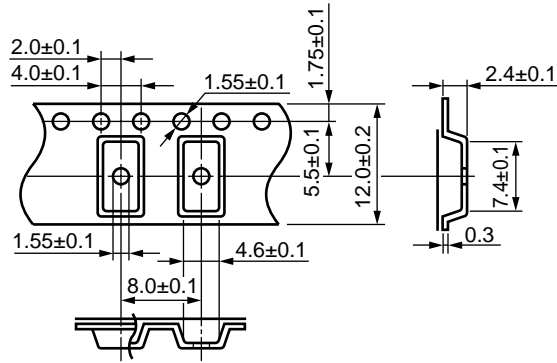
SWITCHING TIME vs. AMBIENT TEMPERATURE



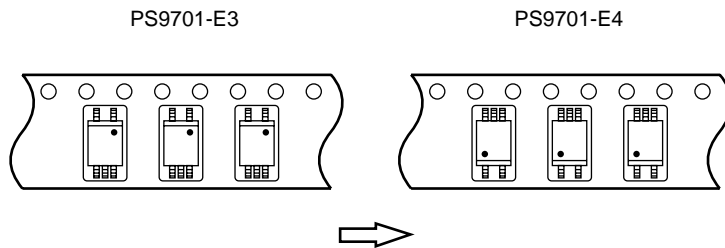
**Remark** The graphs indicate nominal characteristics.

★ TAPING SPECIFICATIONS (in millimeters)

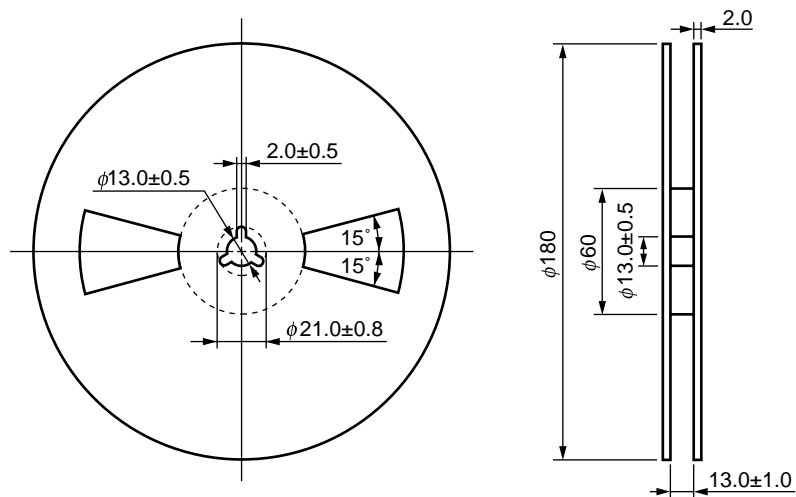
Outline and Dimensions (Tape)



Tape Direction

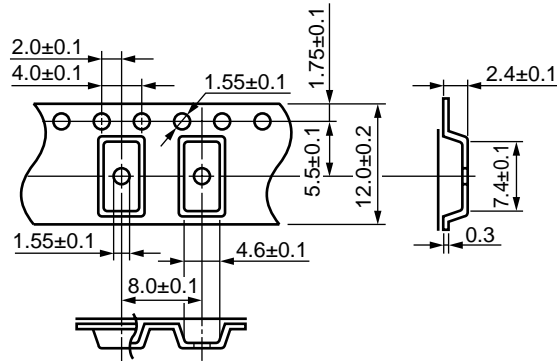


Outline and Dimensions (Tape)

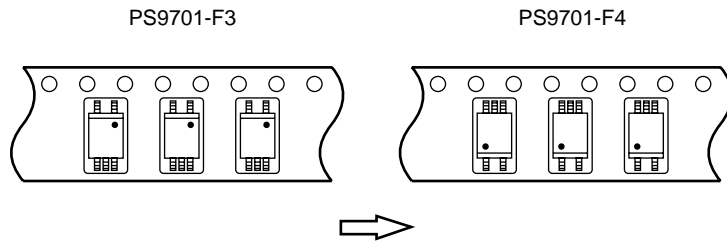


Packing: 900 pcs/reel

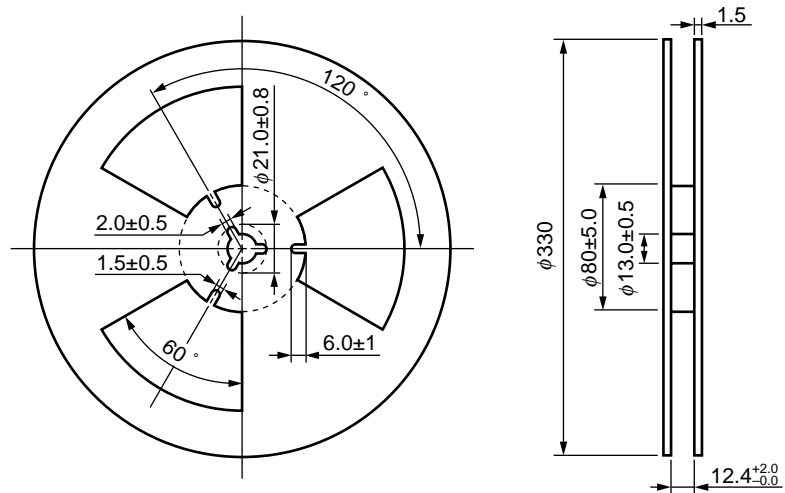
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



Packing: 3 500 pcs/reel

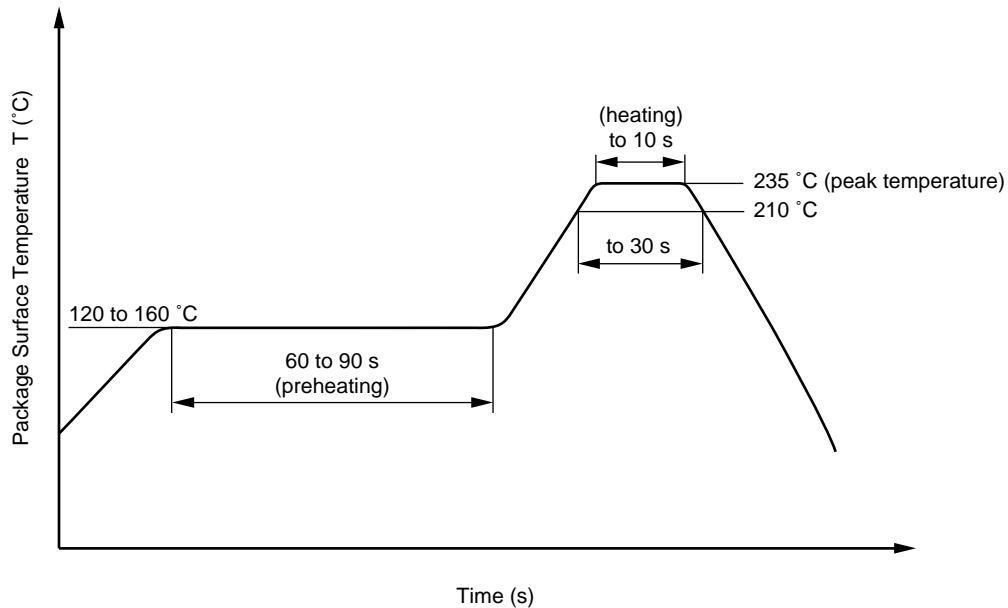


★ **RECOMMENDED SOLDERING CONDITIONS**

**(1) Infrared reflow soldering**

- Peak reflow temperature 235 °C (package surface temperature)
- Time of temperature higher than 210 °C 30 seconds or less
- 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) Dip soldering**

- Temperature 260 °C or below (molten solder temperature)
- Time 10 seconds or less
- Number of times One
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt % is recommended.)

**(3) Cautions**

- Fluxes  
Avoid removing the residual flux with freon-based and chlorine-based cleaning solvent.

**SPECIFICATION OF VDE MARKS LICENSE DOCUMENT (VDE0884)**

| Parameter  | Symbol                 | Speck                  | Unit                     |
|--|------------------------|------------------------|--------------------------|
| Application classification (DIN VDE 0109)<br>for rated line voltages $\leq 300$ Vr.m.s.<br>for rated line voltages $\leq 600$ Vr.m.s.  |                        | IV<br>III              |                          |
| Climatic test class (DIN IEC 68 Teil 1/09.80)  |                        | 40/085/21              |                          |
| Dielectric strength maximum operating isolation voltage.<br>Test voltage (partial discharge test procedure a for type test and random test)<br>$U_{pr} = 1.2 \times U_{IORM}$ , $P_d < 5$ pC | $U_{IORM}$<br>$U_{pr}$ | 710<br>850             | $V_{peak}$<br>$V_{peak}$ |
| Test voltage (partial discharge test procedure b for random test)<br>$U_{pr} = 1.6 \times U_{IORM}$ , $P_d < 5$ pC   | $U_{pr}$               | 1 140                  | $V_{peak}$               |
| Highest permissible overvoltage  | $U_{TR}$               | 4 000                  | $V_{peak}$               |
| Degree of pollution (DIN VDE 0109)   |                        | 2                      |                          |
| Clearance distance   |                        | > 5                    | mm                       |
| Creepage distance  |                        | > 5                    | mm                       |
| Comparative tracking index (DIN IEC 112/VDE 0303 part 1)   | CTI                    | 175                    |                          |
| Material group (DIN VDE 0109)  |                        | III a                  |                          |
| Storage temperature range  | $T_{stg}$              | -55 to +125            | °C                       |
| Operating temperature range  | $T_A$                  | -40 to +85             | °C                       |
| Isolation resistance, minimum value<br>$V_{IO} = 500$ V dc at $T_A = 25$ °C<br>$V_{IO} = 500$ V dc at $T_A$ MAX. at least 100 °C   | Ris MIN.<br>Ris MIN.   | $10^{12}$<br>$10^{11}$ | $\Omega$<br>$\Omega$     |
| Safety maximum ratings<br>(maximum permissible in case of fault, see thermal derating curve)   |                        |                        |                          |
| Package temperature  | $T_{si}$               | 150                    | °C                       |
| Current (input current $I_F$ , $P_{si} = 0$ )  | $I_{si}$               | 200                    | mA                       |
| Power (output or total power dissipation)  | $P_{si}$               | 300                    | mW                       |
| Isolation resistance<br>$V_{IO} = 500$ V dc at $T_A = 175$ °C ( $T_{si}$ )   | Ris MIN.               | $10^9$                 | $\Omega$                 |

[MEMO]

## CAUTION

**Within this device there exists GaAs (Gallium Arsenide) material which is a harmful substance if ingested. Please do not under any circumstances break the hermetic seal.**

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