

## HIGH-SPEED SWITCHING/HIGH ISOLATION VOLTAGE PHOTOCOUPLER SERIES

-NEPOC Series-

### DESCRIPTION

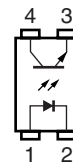
The PS2513-1 and PS2513L-1 are optically coupled isolators containing a GaAs light emitting diode and an NPN silicon phototransistor.

The PS2513-1 is in a plastic DIP (Dual In-line Package) and the PS2513L-1 is lead bending type (Gull-wing) for surface mount.

### FEATURES

- High isolation voltage ( $BV = 5\,000\text{ V r.m.s.}$ )
- High collector to emitter voltage ( $V_{CE0} = 120\text{ V}$ )
- Guaranteed maximum switching speed  
( $t_{off} \leq 60\ \mu\text{s}$  @  $I_F = 5\text{ mA}$ ,  $V_{CC} = 5\text{ V}$ ,  $R_L = 1.9\text{ k}\Omega$ )
- High-speed switching ( $t_{on} = 5\ \mu\text{s}$  TYP. @  $I_F = 5\text{ mA}$ ,  $V_{CC} = 5\text{ V}$ ,  $R_L = 1.9\text{ k}\Omega$ )  
( $t_{off} = 25\ \mu\text{s}$  TYP. @  $I_F = 5\text{ mA}$ ,  $V_{CC} = 5\text{ V}$ ,  $R_L = 1.9\text{ k}\Omega$ )
- <R> • Ordering number of tape product: PS2513L-1-F3: 2 000 pcs/reel
- <R> • Safety standards
  - UL approved: No. E72422
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40008862 (Option)

### PIN CONNECTION (Top View)



1. Anode
2. Cathode
3. Emitter
4. Collector

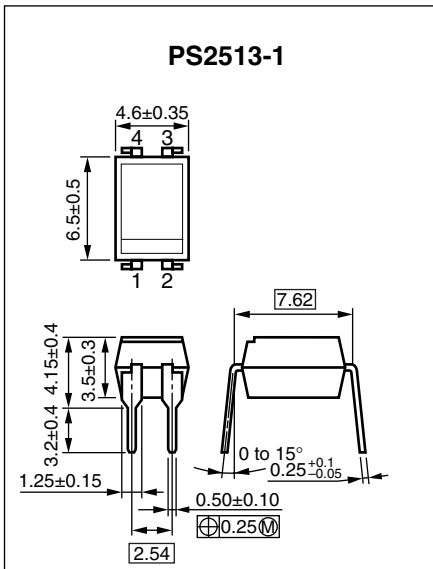
### APPLICATIONS

- Power supply
- Air conditioner
- FA equipment

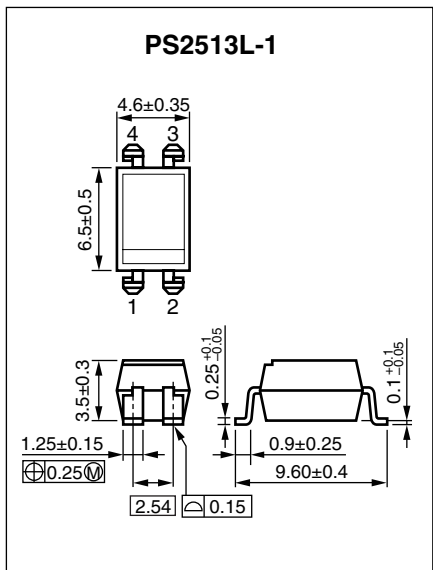
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<R> PACKAGE DIMENSIONS (UNIT: mm)

DIP Type



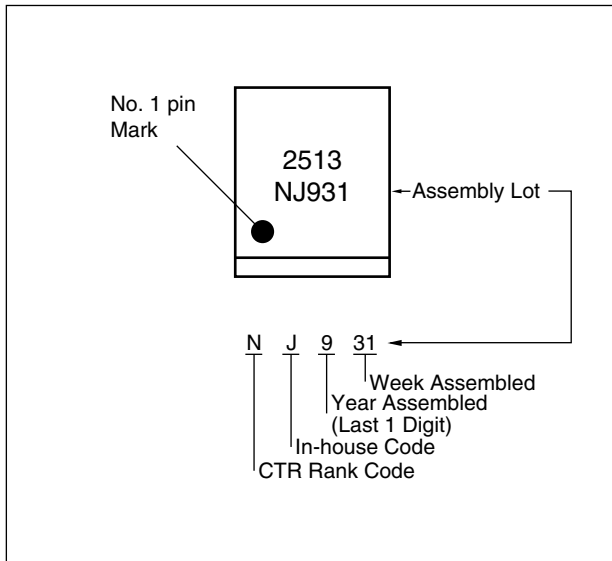
Lead Bending Type



<R> PHOTOCOUPLER CONSTRUCTION

| Parameter               | Unit (MIN.) |
|-------------------------|-------------|
| Air Distance            | 7 mm        |
| Outer Creepage Distance | 7 mm        |
| Inner Creepage Distance | 3.5 mm      |
| Isolation Thickness     | 0.2 mm      |

<R> **MARKING EXAMPLE**



<R> **ORDERING INFORMATION**

| Part Number    | Order Number     | Solder Plating Specification | Packing Style                | Safety Standard Approval           | Application Part Number <sup>*1</sup> |                                    |
|----------------|------------------|------------------------------|------------------------------|------------------------------------|---------------------------------------|------------------------------------|
| PS2513-1       | PS2513-1-A       | Pb-Free                      | Magazine case 100 pcs        | Standard products<br>(UL Approved) | PS2513-1                              |                                    |
| PS2513L-1      | PS2513L-1-A      |                              | Embossed Tape 2 000 pcs/reel |                                    |                                       |                                    |
| PS2513L-1-F3   | PS2513L-1-F3-A   |                              |                              | Magazine case 100 pcs              |                                       | DIN EN60747-5-2<br>(VDE0884 Part2) |
| PS2513-1-V     | PS2513-1-V-A     |                              |                              |                                    |                                       |                                    |
| PS2513L-1-V    | PS2513L-1-V-A    |                              | Embossed Tape 2 000 pcs/reel |                                    |                                       | approved products<br>(Option)      |
| PS2513L-1-V-F3 | PS2513L-1-V-F3-A |                              |                              |                                    |                                       |                                    |

\*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                           | Reverse Voltage                    | V <sub>R</sub>      | 6           | V       |
|                                 | Forward Current (DC)               | I <sub>F</sub>      | 60          | mA      |
|                                 | Power Dissipation Derating         | ΔP <sub>D</sub> /°C | 1.5         | mW/°C   |
|                                 | Power Dissipation                  | P <sub>D</sub>      | 150         | mW      |
|                                 | Peak Forward Current <sup>*1</sup> | I <sub>FP</sub>     | 1           | A       |
| Transistor                      | Collector to Emitter Voltage       | V <sub>CEO</sub>    | 120         | V       |
|                                 | Emitter to Collector Voltage       | V <sub>ECO</sub>    | 6           | V       |
|                                 | Collector Current                  | I <sub>C</sub>      | 30          | mA      |
|                                 | Power Dissipation Derating         | ΔP <sub>C</sub> /°C | 1.5         | mW/°C   |
|                                 | Power Dissipation                  | P <sub>C</sub>      | 150         | mW      |
| Isolation Voltage <sup>*2</sup> |                                    | BV                  | 5 000       | Vr.m.s. |
| Operating Ambient Temperature   |                                    | T <sub>A</sub>      | -55 to +100 | °C      |
| Storage Temperature             |                                    | T <sub>stg</sub>    | -55 to +150 | °C      |

\*1 PW = 100 μs, Duty Cycle = 1%

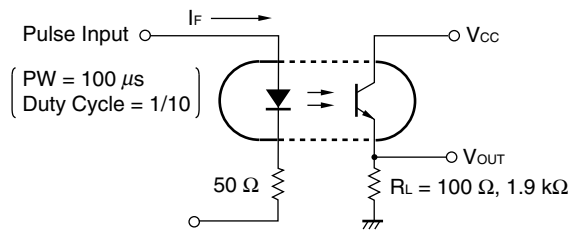
\*2 AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.

Pins 1-2 shorted together, 3-4 shorted together.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

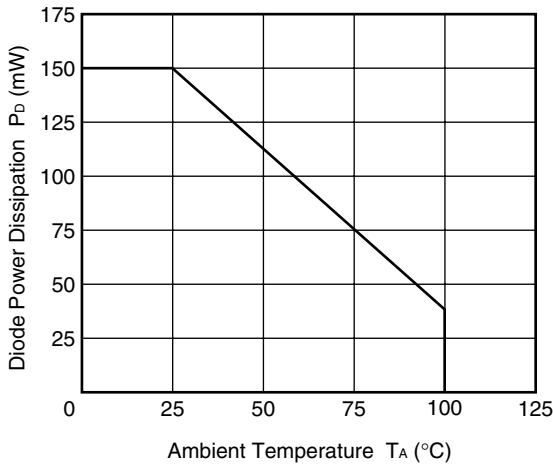
| Parameter                   |   | Symbol               | Conditions  | MIN.             | TYP. | MAX. | Unit |
|-----------------------------|---|----------------------|---|------------------|------|------|------|
| Diode                       | Forward Voltage   | V <sub>F</sub>       | I <sub>F</sub> = 5 mA   |                  | 1.1  | 1.3  | V    |
|                             | Reverse Current   | I <sub>R</sub>       | V <sub>R</sub> = 5 V  |                  |      | 5    | μA   |
|                             | Terminal Capacitance  | C <sub>t</sub>       | V = 0 V, f = 1.0 MHz  |                  | 30   |      | pF   |
| Transistor                  | Collector to Emitter Dark Current                           | I <sub>CEO</sub>     | V <sub>CE</sub> = 120 V, I <sub>F</sub> = 0 mA                        |                  |      | 100  | nA   |
| Coupled                     | Current Transfer Ratio<br>(I <sub>c</sub> /I <sub>F</sub> ) | CTR1                 | I <sub>F</sub> = 1 mA, V <sub>CE</sub> = 5 V                          | 25               | 75   | 100  | %    |
|                             |   | CTR2                 | I <sub>F</sub> = 5 mA, V <sub>CE</sub> = 5 V                          | 50               | 125  | 200  | %    |
|                             | Collector Saturation Voltage                                | V <sub>CE(sat)</sub> | I <sub>F</sub> = 10 mA, I <sub>c</sub> = 2 mA                         |                  |      | 0.3  | V    |
|                             | Isolation Resistance  | R <sub>I-O</sub>     | V <sub>I-O</sub> = 1.0 kV <sub>DC</sub>                               | 10 <sup>11</sup> |      |      | Ω    |
|                             | Isolation Capacitance                                       | C <sub>I-O</sub>     | V = 0 V, f = 1.0 MHz  |                  | 0.5  |      | pF   |
|                             | Rise Time <sup>*1</sup>                                     | t <sub>r</sub>       | V <sub>CC</sub> = 5 V, I <sub>c</sub> = 2 mA, R <sub>L</sub> = 100 Ω  |                  | 3    |      | μs   |
|                             | Fall Time <sup>*1</sup>                                     | t <sub>f</sub>       |   |                  | 4    |      |      |
|                             | Turn-on Time <sup>*1</sup>                                  | t <sub>on</sub>      | V <sub>CC</sub> = 5 V, I <sub>F</sub> = 5 mA, R <sub>L</sub> = 1.9 kΩ |                  | 5    | 60   | μs   |
| Turn-off Time <sup>*1</sup> | t <sub>off</sub>  |                      |   | 25               | 60   |      |      |

\*1 Test circuit for switching time

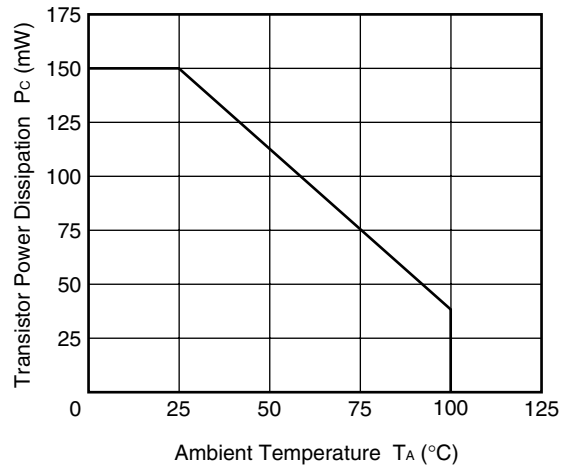


**TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

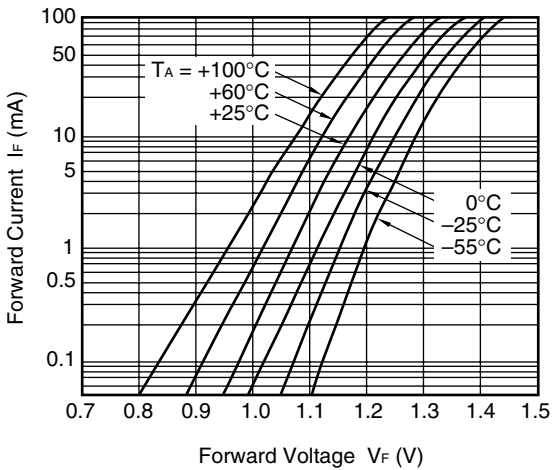
**DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE**



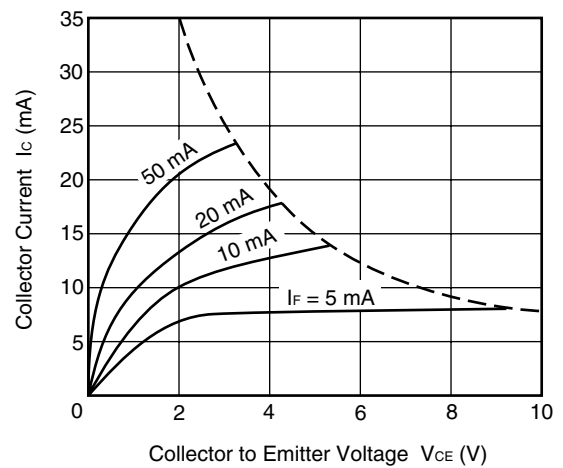
**TRANSISTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



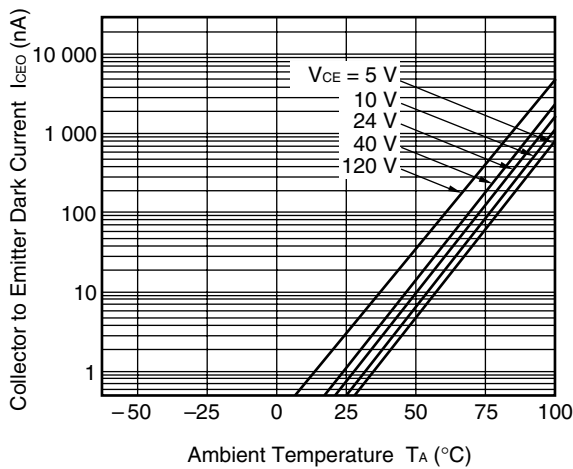
**FORWARD CURRENT vs. FORWARD VOLTAGE**



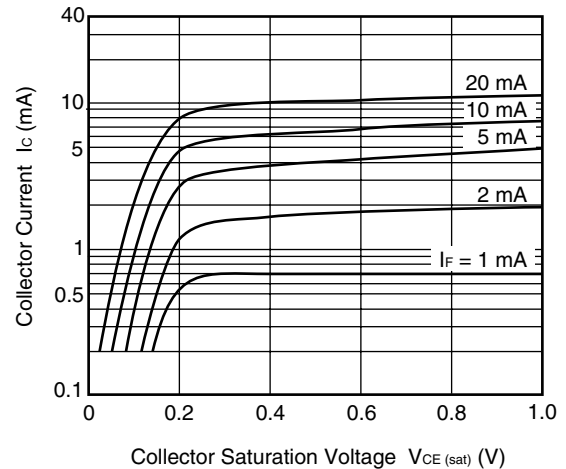
**COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE**



**COLLECTOR TO EMITTER DARK CURRENT vs. AMBIENT TEMPERATURE**

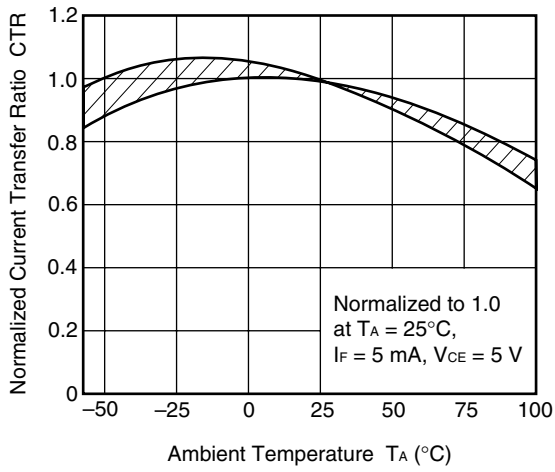


**COLLECTOR CURRENT vs. COLLECTOR SATURATION VOLTAGE**

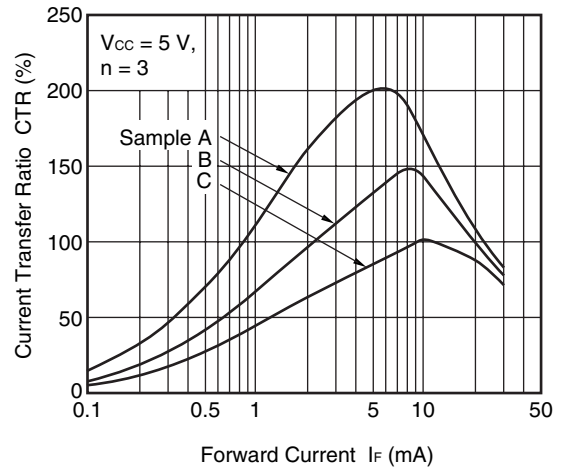


**Remark** The graphs indicate nominal characteristics.

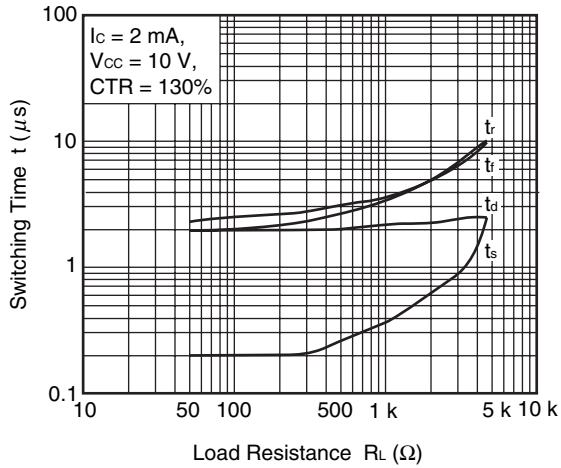
NORMALIZED CURRENT TRANSFER RATIO vs. AMBIENT TEMPERATURE



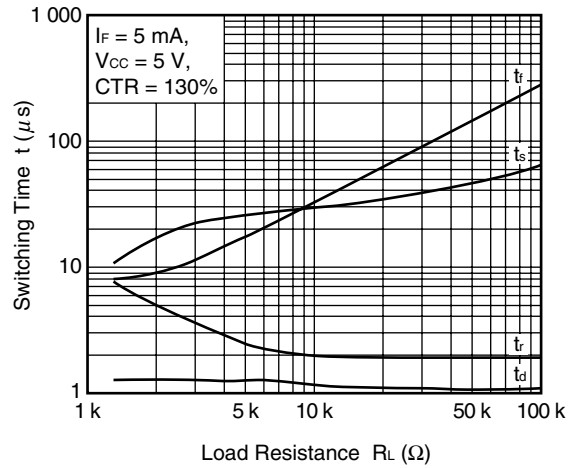
CURRENT TRANSFER RATIO vs. FORWARD CURRENT



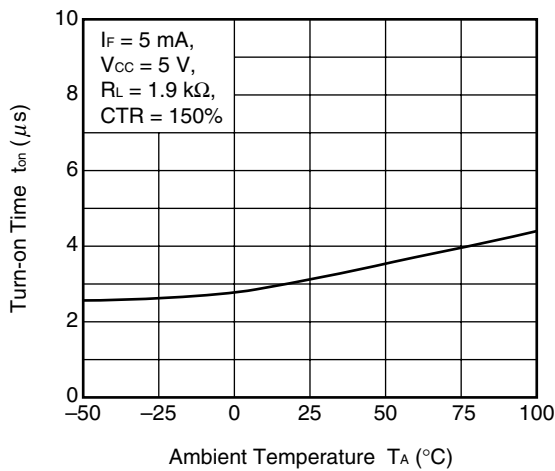
SWITCHING TIME vs. LOAD RESISTANCE



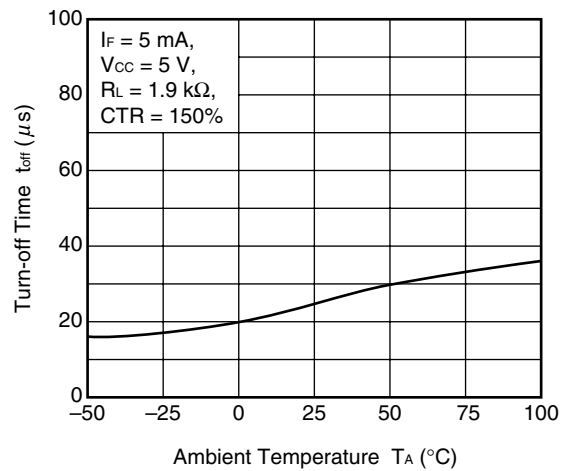
SWITCHING TIME vs. LOAD RESISTANCE



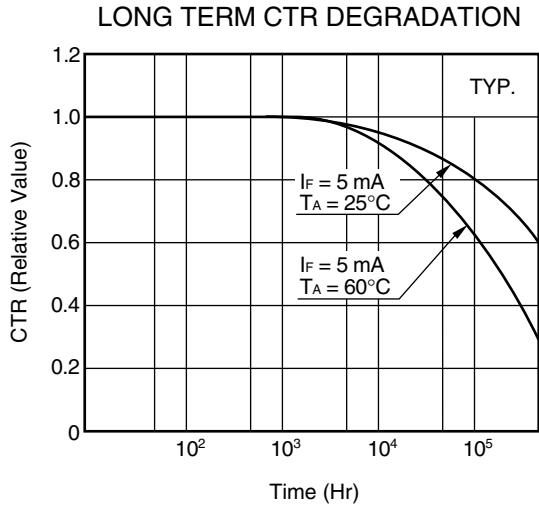
TURN-ON TIME vs. AMBIENT TEMPERATURE



TURN-OFF TIME vs. AMBIENT TEMPERATURE



**Remark** The graphs indicate nominal characteristics.

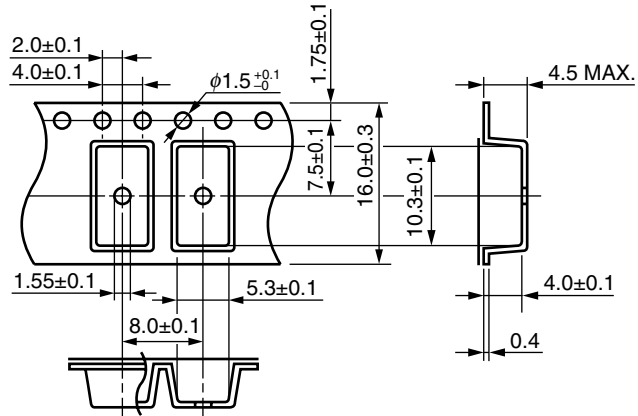


**Remark** The graph indicates nominal characteristics.



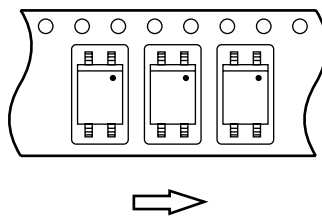
<R> TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

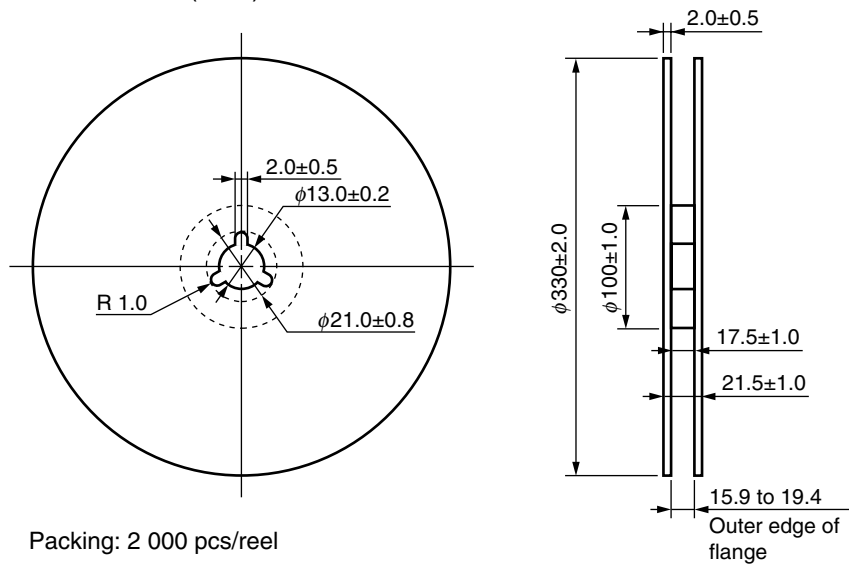


Tape Direction

PS2513L-1-F3



Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

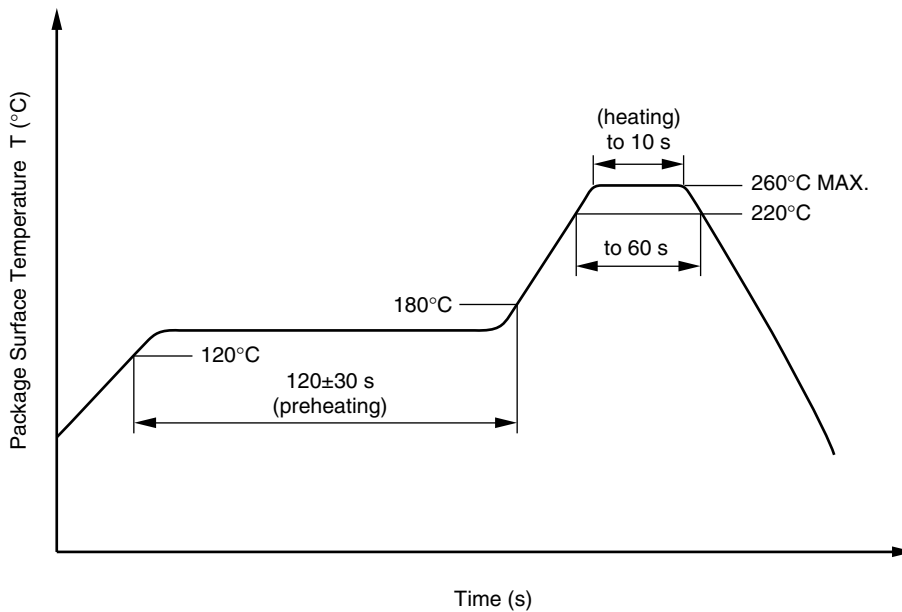
**NOTES ON HANDLING**

**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.

**3. Measurement conditions of current transfer ratios (CTR), which differ according to photocoupler**

Check the setting values before use, since the forward current conditions at CTR measurement differ according to product.

When using products other than at the specified forward current, the characteristics curves may differ from the standard curves due to CTR value variations or the like. Therefore, check the characteristics under the actual operating conditions and thoroughly take variations or the like into consideration before use.

**USAGE CAUTIONS**

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

<R> **SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

| Parameter  | Symbol                                       | Speck                       | Unit                       |
|--|--|-----------------------------|----------------------------|
| Climatic test class (IEC 60068-1/DIN EN 60068-1)   |  | 55/100/21                   |                            |
| Dielectric strength<br>maximum operating isolation voltage<br>Test voltage (partial discharge test, procedure a for type test and random test)<br>$U_{pr} = 1.5 \times U_{IORM}, P_d < 5 \text{ pC}$   | $U_{IORM}$<br>$U_{pr}$                       | 890<br>1 335                | $V_{peak}$<br>$V_{peak}$   |
| Test voltage (partial discharge test, procedure b for all devices test)<br>$U_{pr} = 1.875 \times U_{IORM}, P_d < 5 \text{ pC}$  | $U_{pr}$                                     | 1 669                       | $V_{peak}$                 |
| 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 +150                 | °C                         |
| Operating temperature range  | $T_A$  | -55 to +100                 | °C                         |
| Isolation resistance, minimum value<br>$V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$<br>$V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$  | 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)<br>Package temperature<br>Current (input current $I_F$ , $P_{si} = 0$ )<br>Power (output or total power dissipation)<br>Isolation resistance<br>$V_{IO} = 500 \text{ V dc at } T_A = 175^\circ\text{C} (T_{si})$ | $T_{si}$<br>$I_{si}$<br>$P_{si}$<br>Ris MIN. | 175<br>400<br>700<br>$10^9$ | °C<br>mA<br>mW<br>$\Omega$ |

|                                     |   |
|-------------------------------------|---|
| <p><b>Caution</b> GaAs Products</p> | <p>This product uses gallium arsenide (GaAs).<br/>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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