

# PHOTOCOUPLER PS2701A-1

## HIGH ISOLATION VOLTAGE SOP PHOTOCOUPLER

—NEPOC Series—

### DESCRIPTION

The PS2701A-1 is an optically coupled isolator containing a GaAs light emitting diode and an NPN silicon phototransistor to realize an excellent cost performance.

This package is SOP (Small Outline Package) type and has shield effect to cut off ambient light.

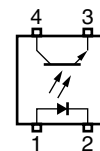
It is designed for high density mounting applications.

### FEATURES

- High isolation voltage (BV = 3 750 Vr.m.s.)
- SOP (Small Outline Package) type
- Ordering number of taping product: PS2701A-1-F3, F4: 3 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40008902 (Option)

<R>

### PIN CONNECTION (Top View)



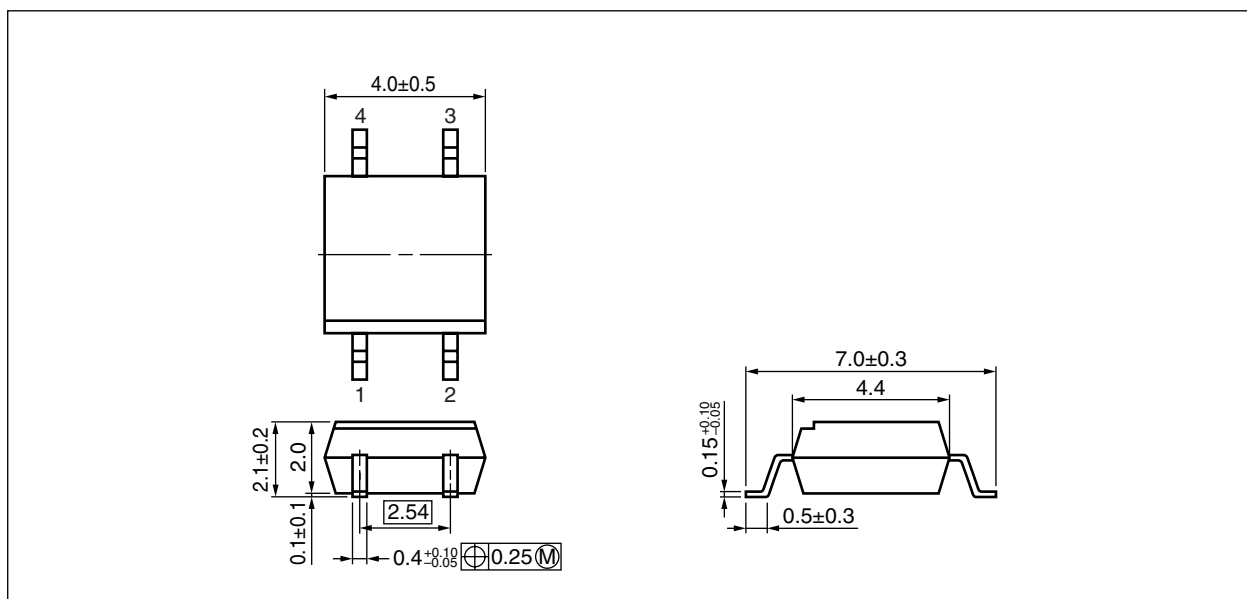
1. Anode
2. Cathode
3. Emitter
4. Collector

### APPLICATIONS

- Hybrid IC
- Measuring instruments
- Power supply
- Programmable logic controllers

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PACKAGE DIMENSIONS (in millimeters)

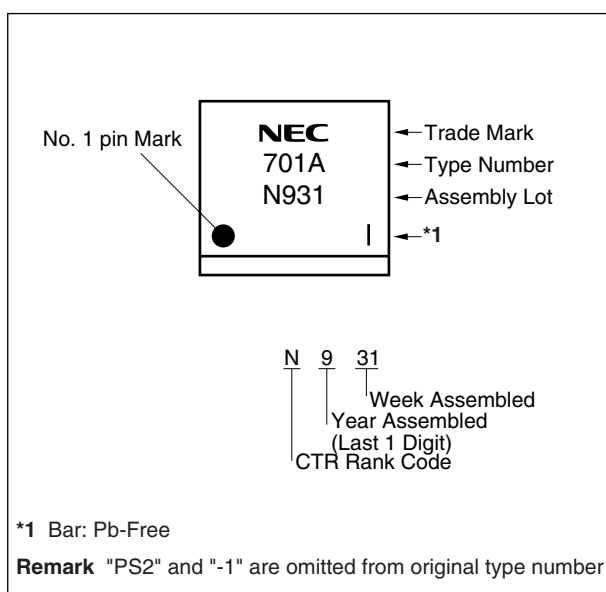


<R> PHOTOCOUPLER CONSTRUCTION

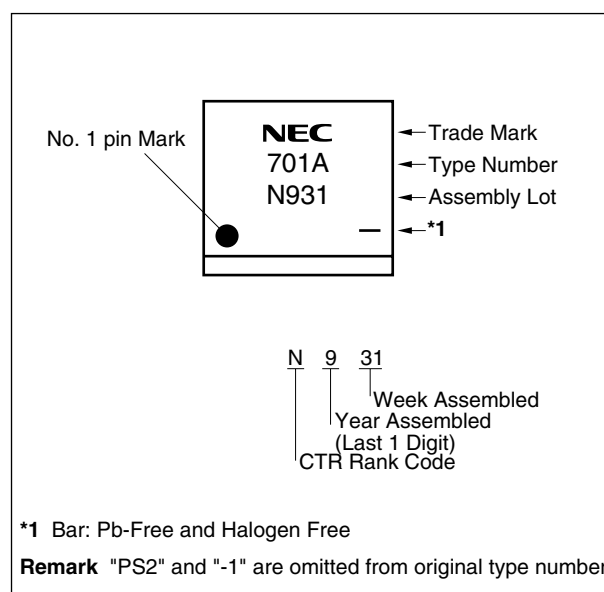
| Parameter               | Unit (MIN.) |
|-------------------------|-------------|
| Air Distance            | 5 mm        |
| Outer Creepage Distance | 5 mm        |
| Inner Creepage Distance | 2.5 mm      |
| Isolation Distance      | 0.3 mm      |

<R> MARKING EXAMPLE

Pb-Free



Special version (Pb-Free and Halogen Free)



<R> ORDERING INFORMATION

| Part Number    | Order Number      | Solder Plating Specification | Packing Style                | Safety Standard Approval                | Application Part Number <sup>*1</sup> |
|----------------|-------------------|------------------------------|------------------------------|-----------------------------------------|---------------------------------------|
| PS2701A-1      | PS2701A-1-A       | Pb-Free                      | Magazine case 100 pcs        | Standard products<br>(UL, CSA approved) | PS2701A-1                             |
| PS2701A-1-F3   | PS2701A-1-F3-A    |                              | Embossed Tape 3 500 pcs/reel |                                         |                                       |
| PS2701A-1-F4   | PS2701A-1-F4-A    |                              |                              |                                         |                                       |
| PS2701A-1-V    | PS2701A-1-V-A     |                              | Magazine case 100 pcs        | DIN EN60747-5-2                         |                                       |
| PS2701A-1-V-F3 | PS2701A-1-V-F3-A  |                              | Embossed Tape 3 500 pcs/reel | (VDE0884 Part2)                         |                                       |
| PS2701A-1-V-F4 | PS2701A-1-V-F4-A  |                              |                              | Approved (Option)                       |                                       |
| PS2701A-1      | PS2701A-1Y-A      | Special version              | Magazine case 100 pcs        | Standard products                       | PS2701A-1                             |
| PS2701A-1-F3   | PS2701A-1Y-F3-A   | (Pb-Free and                 | Embossed Tape 3 500 pcs/reel | (UL, CSA approved)                      |                                       |
| PS2701A-1-V    | PS2701A-1Y-V-A    | Halogen Free)                | Magazine case 100 pcs        | DIN EN60747-5-2                         |                                       |
| PS2701A-1-V-F3 | PS2701A-1Y-V-F3-A |                              | Embossed Tape 3 500 pcs/reel | (VDE0884 Part2)<br>Approved (Option)    |                                       |

\*1 For the application of the Safety Standard, following part number should be used.

**ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^{\circ}\text{C}$ , unless otherwise specified)**

| Parameter                       |                                    | Symbol                        | Ratings     | Unit                   |
|---------------------------------|------------------------------------|-------------------------------|-------------|------------------------|
| Diode                           | Forward Current (DC)               | $I_F$                         | 30          | mA                     |
|                                 | Reverse Voltage                    | $V_R$                         | 6           | V                      |
|                                 | Power Dissipation Derating         | $\Delta P_D/^{\circ}\text{C}$ | 0.8         | mW/ $^{\circ}\text{C}$ |
|                                 | Power Dissipation                  | $P_D$                         | 80          | mW                     |
|                                 | Peak Forward Current <sup>*1</sup> | $I_{FP}$                      | 0.5         | A                      |
| Transistor                      | Collector to Emitter Voltage       | $V_{CEO}$                     | 70          | V                      |
|                                 | Emitter to Collector Voltage       | $V_{ECO}$                     | 5           | V                      |
|                                 | Collector Current                  | $I_C$                         | 30          | mA                     |
|                                 | Power Dissipation Derating         | $\Delta P_C/^{\circ}\text{C}$ | 1.5         | mW/ $^{\circ}\text{C}$ |
|                                 | Power Dissipation                  | $P_C$                         | 150         | mW                     |
| Isolation Voltage <sup>*2</sup> |                                    | BV                            | 3 750       | Vr.m.s.                |
| Operating Ambient Temperature   |                                    | $T_A$                         | -55 to +100 | $^{\circ}\text{C}$     |
| Storage Temperature             |                                    | $T_{stg}$                     | -55 to +150 | $^{\circ}\text{C}$     |

\*1  $PW = 100 \mu\text{s}$ , Duty Cycle = 1%

\*2 AC voltage for 1 minute at  $T_A = 25^{\circ}\text{C}$ , 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                                                |                  | 1.2  | 1.4  | 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                                                 |                  | 10   |      | pF   |
| Transistor | Collector to Emitter Dark Current                                      | I <sub>CEO</sub>     | I <sub>F</sub> = 0 mA, V <sub>CE</sub> = 70 V                        |                  |      | 100  | nA   |
| Coupled    | Current Transfer Ratio (I <sub>C</sub> /I <sub>F</sub> ) <sup>*1</sup> | CTR                  | I <sub>F</sub> = 5 mA, V <sub>CE</sub> = 5 V                         | 50               |      | 300  | %    |
|            | Collector Saturation Voltage                                           | V <sub>CE(sat)</sub> | I <sub>F</sub> = 10 mA, I <sub>C</sub> = 2 mA                        |                  | 0.13 | 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                                                 |                  | 0.4  |      | pF   |
|            | Rise Time <sup>*2</sup>                                                | t <sub>r</sub>       | V <sub>CC</sub> = 5 V, I <sub>C</sub> = 2 mA, R <sub>L</sub> = 100 Ω |                  | 5    |      | μs   |
|            | Fall Time <sup>*2</sup>                                                | t <sub>f</sub>       |                                                                      |                  | 7    |      |      |

**\*1 CTR rank**

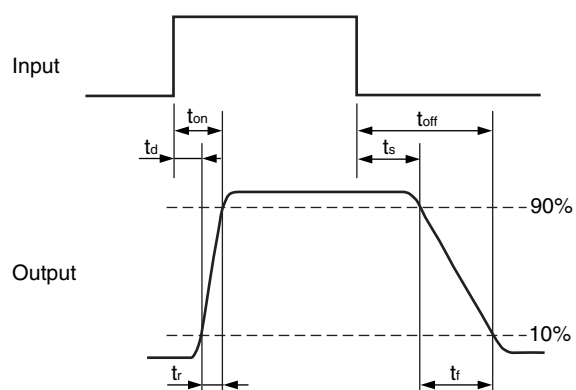
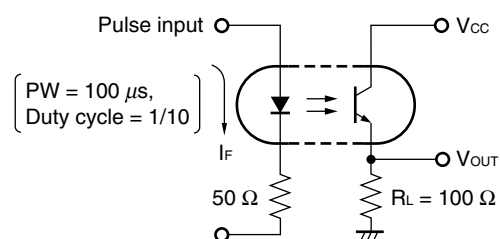
N: 50 to 300 (%)

P: 150 to 300 (%)

L: 100 to 300 (%)

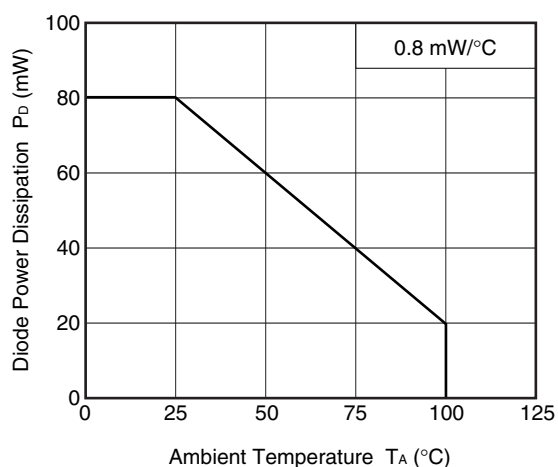
M: 50 to 150 (%)

**\*2 Test circuit for switching time**

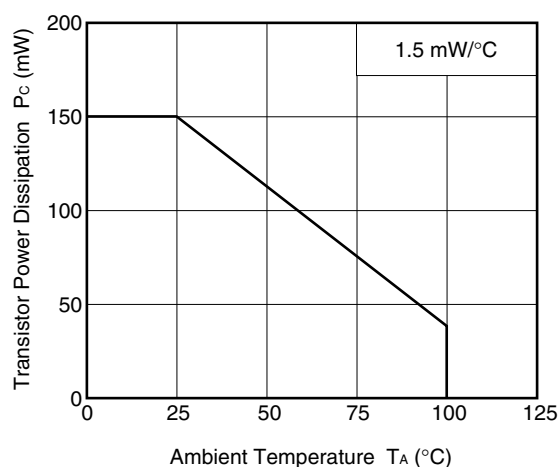


**TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

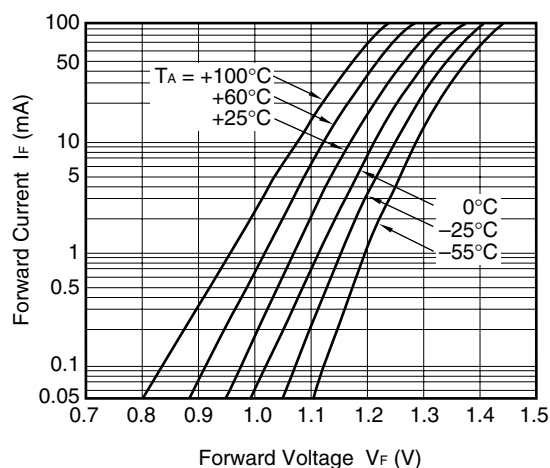
**DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE**



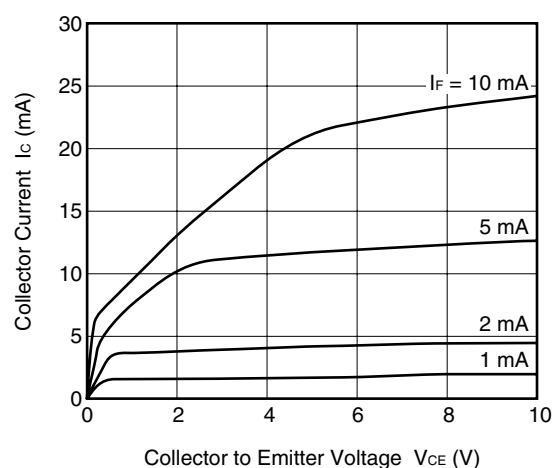
**TRANSISTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE**



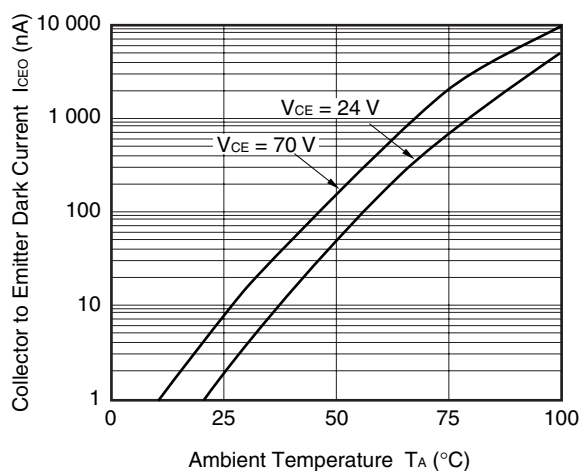
**FORWARD CURRENT vs. FORWARD VOLTAGE**



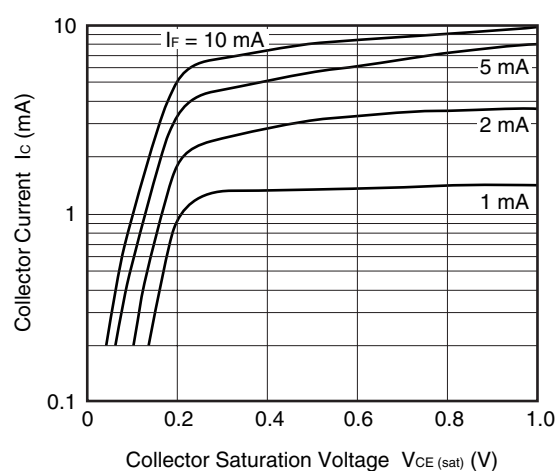
**COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE**



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

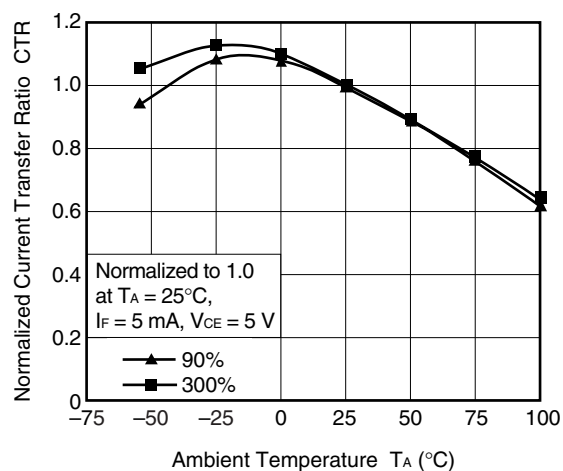


**COLLECTOR CURRENT vs. COLLECTOR SATURATION VOLTAGE**

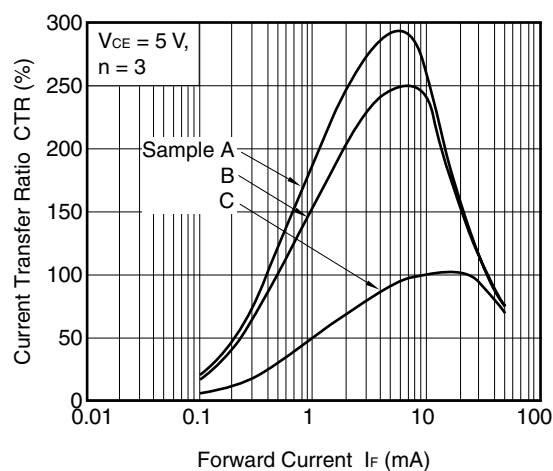


**Remark** The graphs indicate nominal characteristics.

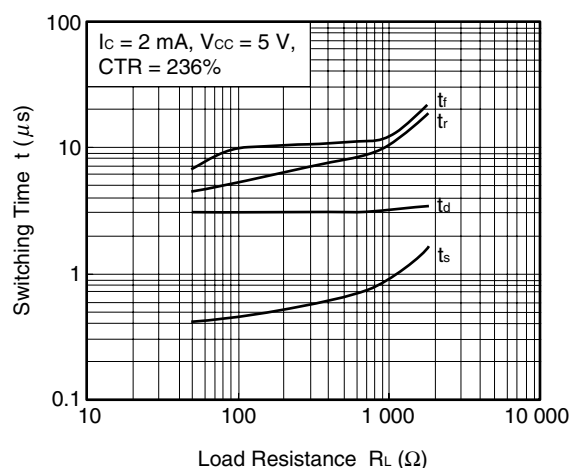
NORMALIZED CURRENT TRANSFER RATIO vs. AMBIENT TEMPERATURE



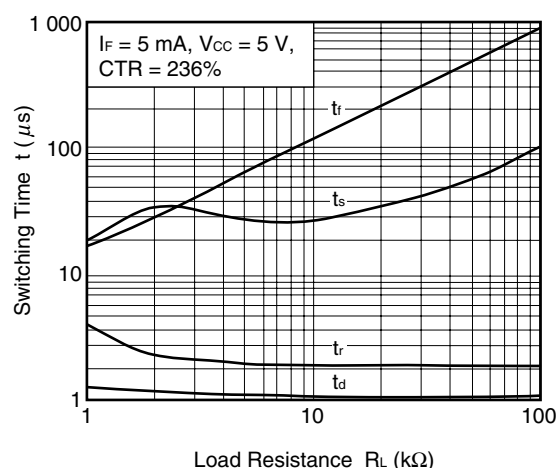
CURRENT TRANSFER RATIO vs. FORWARD CURRENT



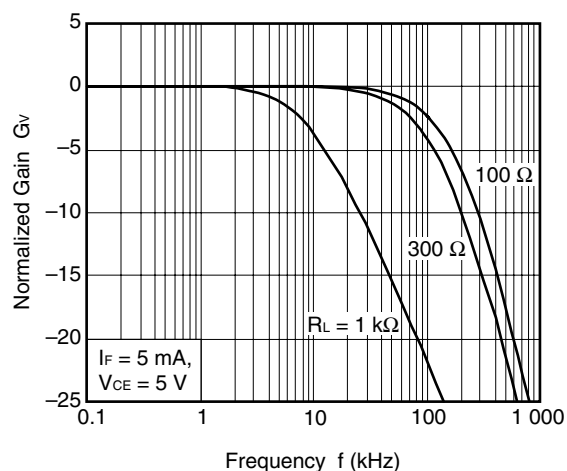
SWITCHING TIME vs. LOAD RESISTANCE



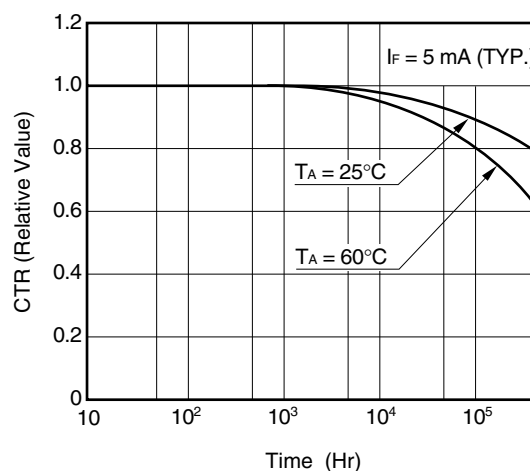
SWITCHING TIME vs. LOAD RESISTANCE



FREQUENCY RESPONSE



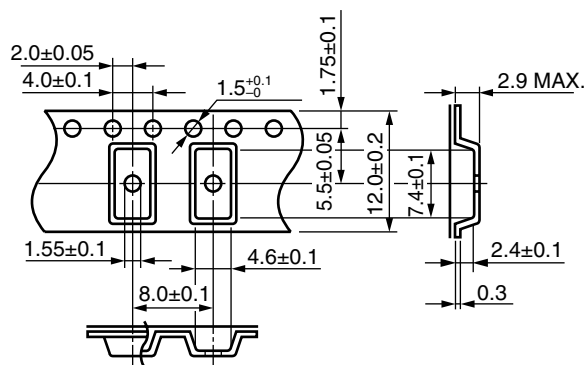
LONG TERM CTR DEGRADATION



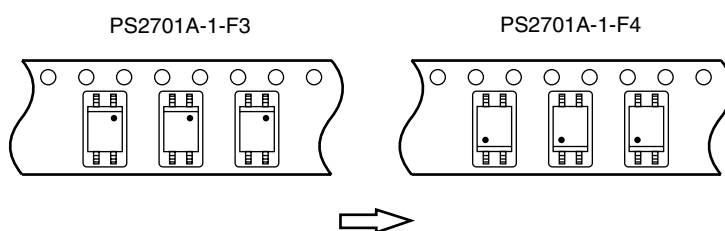
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (in millimeters)

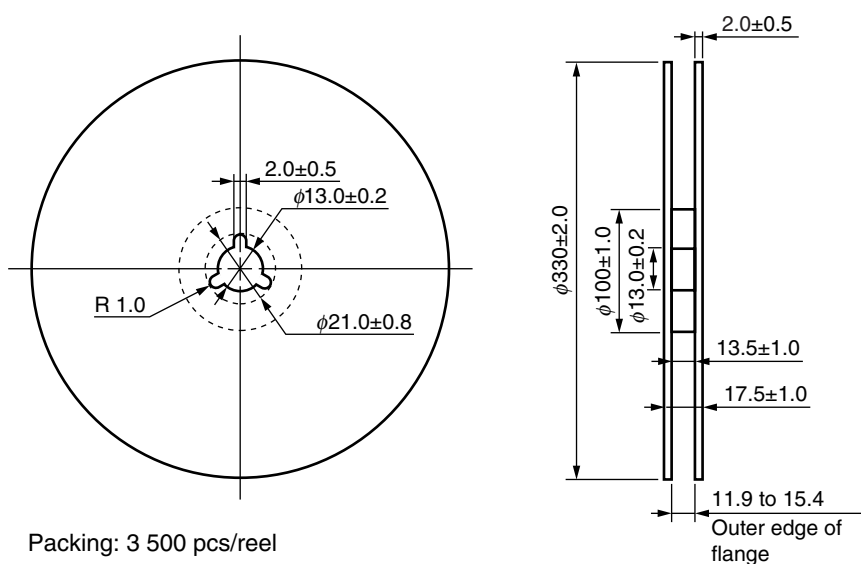
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



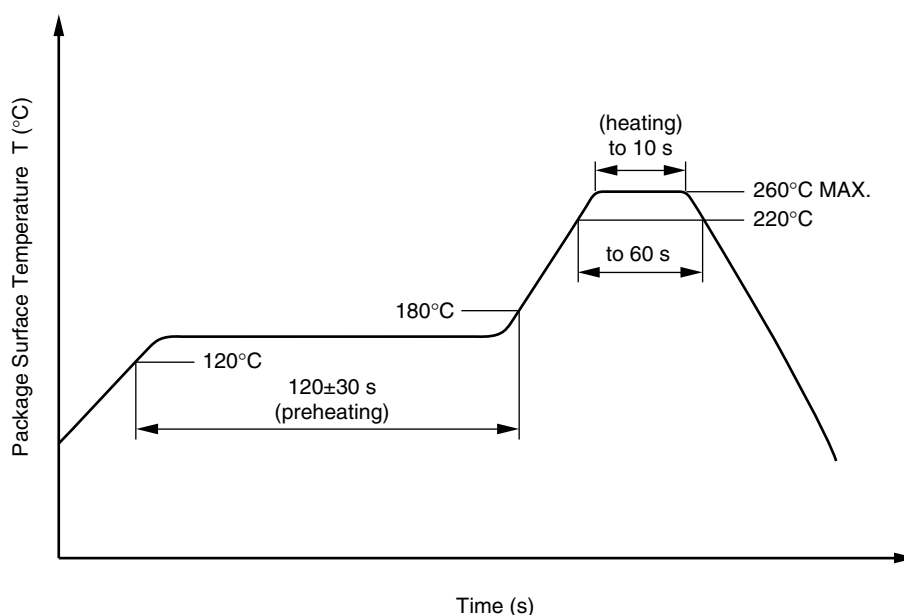
## NOTES ON HANDLING

### 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. This tendency may sometimes be obvious, especially below  $I_F = 1$  mA.

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                                            | Spec.                       | 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>$U_{pr} = 1.5 \times U_{IORM}$ , $P_d < 5$ pC                                                                                 | $U_{IORM}$<br>$U_{pr}$                            | 707<br>1 060                | $V_{peak}$<br>$V_{peak}$   |
| Test voltage (partial discharge test, procedure b for all devices)<br>$U_{pr} = 1.875 \times U_{IORM}$ , $P_d < 5$ pC                                                                                                                                                           | $U_{pr}$                                          | 1 325                       | $V_{peak}$                 |
| Highest permissible overvoltage                                                                                                                                                                                                                                                 | $U_{TR}$                                          | 6 000                       | $V_{peak}$                 |
| 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>$V_{IO} = 500$ V dc at $T_A = 25^\circ\text{C}$<br>$V_{IO} = 500$ V dc at $T_A$ MAX. at least $100^\circ\text{C}$                                                                                                                        | $R_{is}$ MIN.<br>$R_{is}$ 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 $I_F$ , $\Psi_i = 0$ )<br>Power (output or total power dissipation)<br>Isolation resistance<br>$V_{IO} = 500$ V dc at $T_A = T_{si}$ | $T_{si}$<br>$I_{si}$<br>$\Psi_i$<br>$R_{is}$ MIN. | 150<br>300<br>500<br>$10^9$ | °C<br>mA<br>mW<br>$\Omega$ |

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|                    |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Caution</div> | GaAs Products | <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.</li> </ul> <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> <ul style="list-style-type: none"> <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> |
|--------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

To our customers,

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## Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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