

# PS2701-1

R08DS0094EJ0401

Rev.4.01

HIGH ISOLATION VOLTAGE SOP MULTI PHOTOCOUPLER

July 19, 2019

## DESCRIPTION

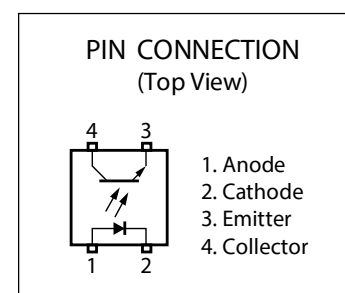
The PS2701-1 is an optically coupled isolator containing a GaAs light emitting diode and an NPN silicon phototransistor.

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

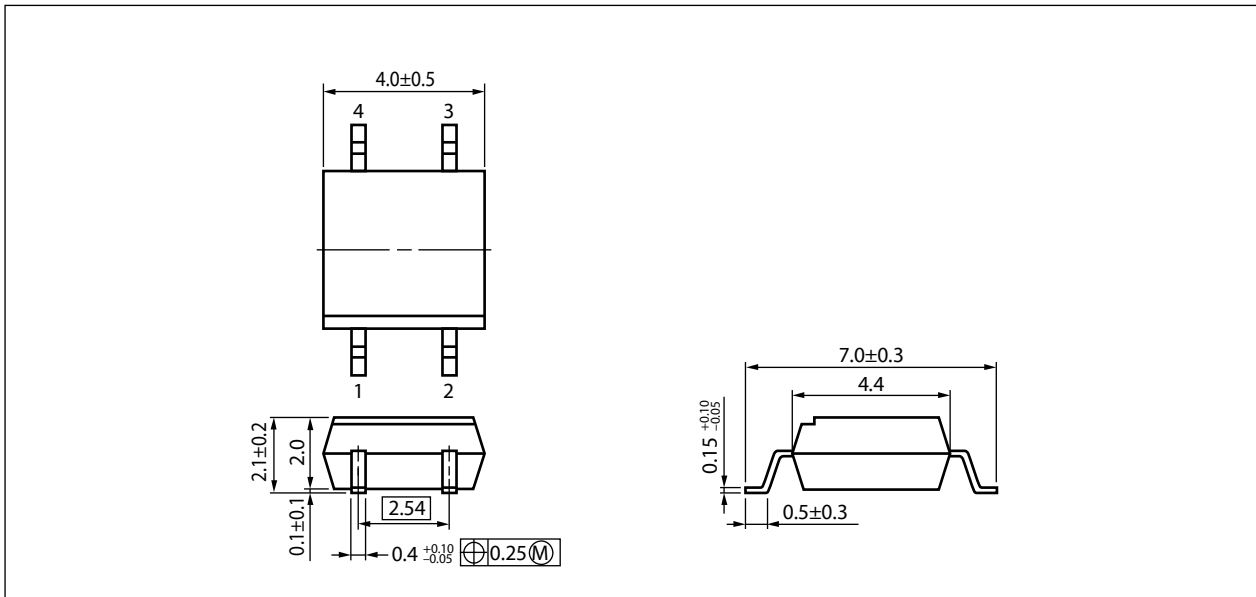
- High isolation voltage ( $BV = 3\,750\text{ Vr.m.s.}$ )
- SOP (Small Outline Package) type
- High-speed switching ( $t_r = 3\,\mu\text{s TYP.}$ ,  $t_f = 5\,\mu\text{s TYP.}$ )
- Ordering number of taping product: PS2701-1-F3
- Safety standards
  - UL approved: UL1577, Single protection
  - CSA approved: CAN/CSA-C22.2 No. 62368-1, Basic/Supplementary insulation
  - BSI approved: BS EN 62368-1, Basic/Supplementary insulation
  - SEMKO approved: EN 62368-1, IEC 62368-1, Basic/Supplementary insulation
  - NEMKO approved: EN 62368-1, Basic/Supplementary insulation
  - FIMKO approved: EN 62368-1, Basic/Supplementary insulation
  - DEMKO approved: EN 62368-1, Basic/Supplementary insulation
  - VDE approved: DIN EN 60747-5-5 (Option)



## APPLICATIONS

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

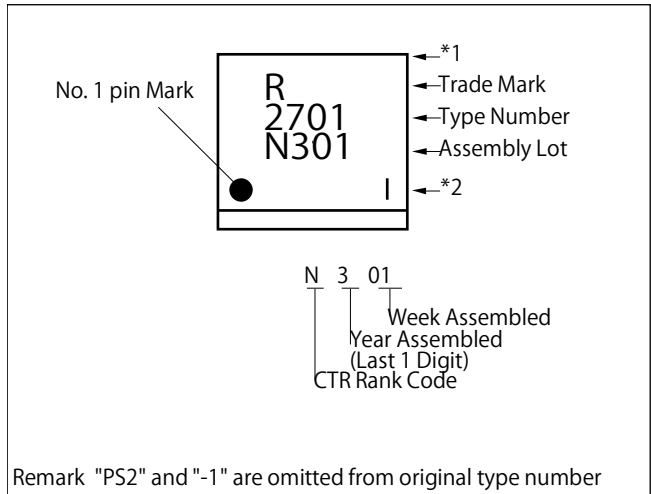
## PACKAGE DIMENSIONS (UNIT: mm)



## PHOTOCOUPLER CONSTRUCTION

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

MARKING EXAMPLE



Note: Bar indication contents of \*1 and \*2.

|                                                                                             |                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Made in Taiwan</b><br>( *1: No indication<br>*2: No indication )                         | <p>A square marking area with a dot in the bottom-left corner. Inside the square, the text "R 2701 N301" is printed. A horizontal bar is located at the bottom-right corner of the square.</p>                                                                                                               |
| <b>Made in Taiwan<br/>Halogen free</b><br>( *1: "—" (Horizontal bar)<br>*2: No indication ) | <p>A square marking area with a dot in the bottom-left corner. Inside the square, the text "R 2701 N301" is printed. A horizontal bar is located at the bottom-right corner of the square. An arrow points to the horizontal bar with the label "—" (Horizontal bar) :Made in Taiwan &amp; Halogen free.</p> |
| <b>Made in Japan</b><br>( *1: No indication<br>*2: "   " (Vertical bar) )                   | <p>A square marking area with a dot in the bottom-left corner. Inside the square, the text "R 2701 N301" is printed. A vertical bar is located at the bottom-right corner of the square. An arrow points to the vertical bar with the label "   " (Vertical bar) :Made in Japan.</p>                         |
| <b>Made in Japan<br/>Halogen free</b><br>( *1: No indication<br>*2: "—" (Horizontal bar) )  | <p>A square marking area with a dot in the bottom-left corner. Inside the square, the text "R 2701 N301" is printed. A horizontal bar is located at the bottom-right corner of the square. An arrow points to the horizontal bar with the label "—" (Horizontal bar) :Made in Japan &amp; Halogen free.</p>  |

## ORDERING INFORMATION

| Part Number   | Order Number     | Solder Plating Specification                     | Packing Style                   | Safety Standard Approval                                                          | Application Part Number <sup>*1</sup> |
|---------------|------------------|--------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------|---------------------------------------|
| PS2701-1-F3   | PS2701-1-F3-A    | Pb-Free                                          | Embossed Tape<br>3 500 pcs/reel | Standard products<br>(UL, BSI, CSA,<br>SEMKO, NEMKO,<br>FIMKO, DEMKO<br>approved) | PS2701-1                              |
| PS2701-1-V-F3 | PS2701-1-V-F3-A  |                                                  | Embossed Tape<br>3 500 pcs/reel | UL, CSA, BSI,<br>SEMKO, NEMKO,<br>FIMKO, DEMKO,<br>DIN EN 60747-5-5<br>approved   |                                       |
| PS2701-1-F3   | PS2701-1Y-F3-A   | Special version<br>(Pb-Free and<br>Halogen Free) | Embossed Tape<br>3 500 pcs/reel | Standard products<br>(UL, BSI, CSA,<br>SEMKO, NEMKO,<br>FIMKO, DEMKO<br>approved) | PS2701-1                              |
| PS2701-1-V-F3 | PS2701-1Y-V-F3-A |                                                  | Embossed Tape<br>3 500 pcs/reel | UL, CSA, BSI,<br>SEMKO, NEMKO,<br>FIMKO, DEMKO,<br>DIN EN 60747-5-5<br>approved   |                                       |

Note: <sup>\*1</sup>. 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)               | $I_F$                       | 50          | 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> | $I_{FP}$                    | 1           | A                    |
| Transistor                      | Collector to Emitter Voltage       | $V_{CEO}$                   | 40          | V                    |
|                                 | Emitter to Collector Voltage       | $V_{ECO}$                   | 6           | V                    |
|                                 | Collector Current                  | $I_C$                       | 80          | 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 | $^\circ\text{C}$     |

Note: <sup>\*1</sup>. PW = 100  $\mu\text{s}$ , Duty Cycle = 1%

<sup>\*2</sup>. 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                                                |                  | 1.1  | 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 MHz                                                   |                  | 30   |      | pF   |
| Transistor | Collector to Emitter Dark Current                          | I <sub>CEO</sub>     | I <sub>F</sub> = 0 mA, V <sub>CE</sub> = 40 V                        |                  |      | 100  | nA   |
| Coupled    | Current Transfer Ratio (I <sub>C</sub> /I <sub>F</sub> )*1 | CTR                  | I <sub>F</sub> = 5 mA, V <sub>CE</sub> = 5 V                         | 50               | 100  | 300  | %    |
|            | 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 kV <sub>DC</sub>                                | 10 <sup>11</sup> |      |      | Ω    |
|            | Isolation Capacitance                                      | C <sub>I-O</sub>     | V = 0 V, f = 1 MHz                                                   |                  | 0.4  |      | pF   |
|            | Rise Time*2                                                | 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*2                                                | t <sub>f</sub>       |                                                                      |                  | 5    |      |      |
|            | Turn-on Time*2                                             | t <sub>on</sub>      |                                                                      |                  | 5    |      |      |
|            | Turn-off Time*2                                            | t <sub>off</sub>     |                                                                      |                  | 4    |      |      |

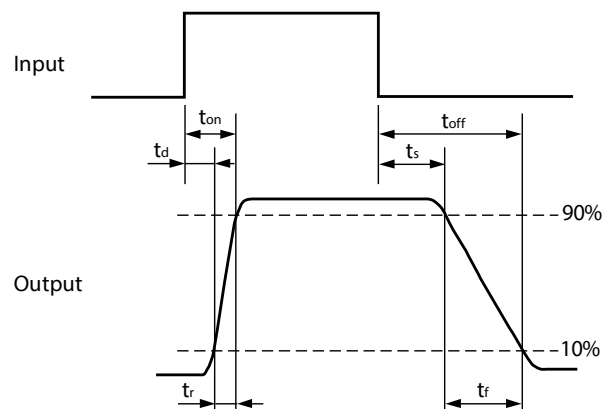
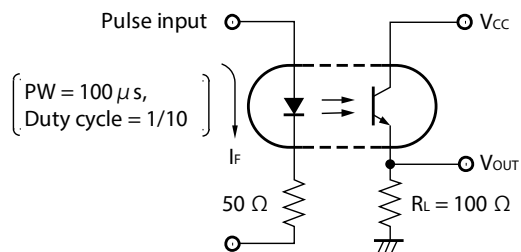
Note: \*1. CTR rank

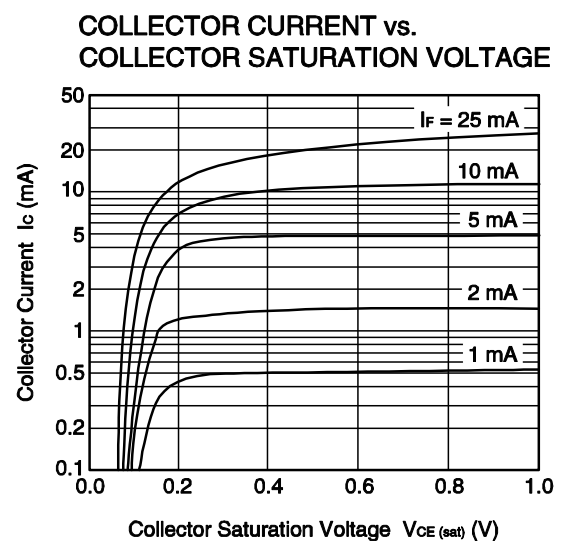
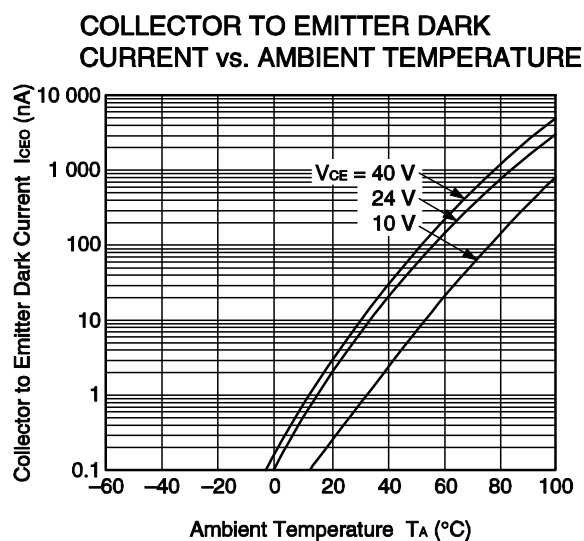
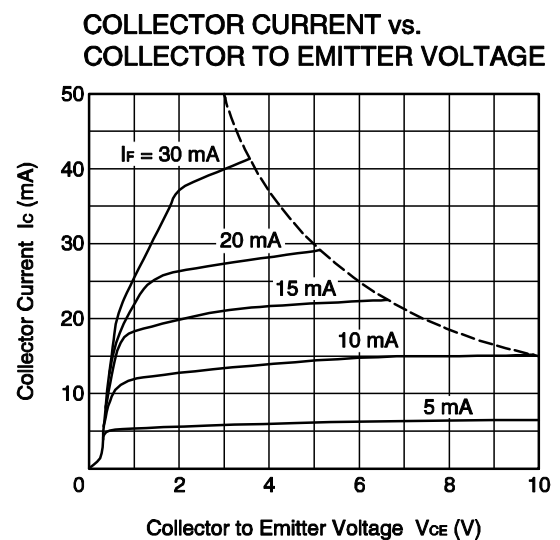
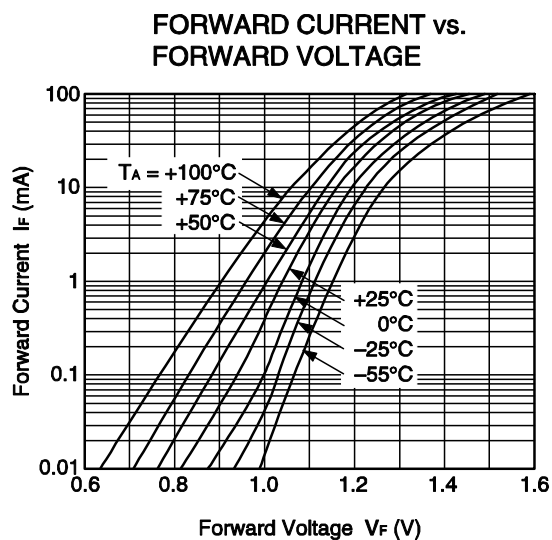
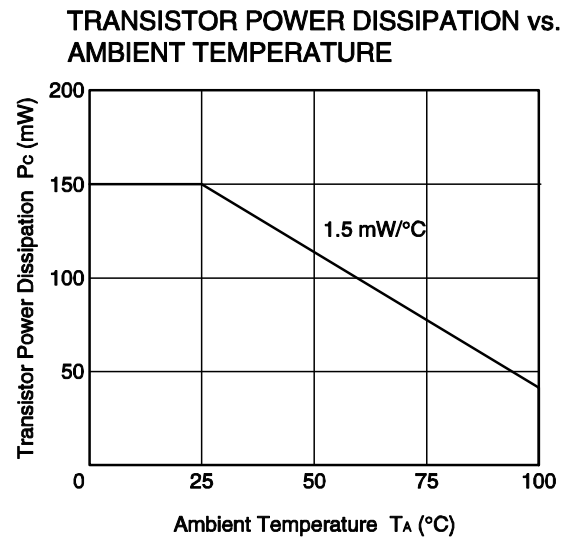
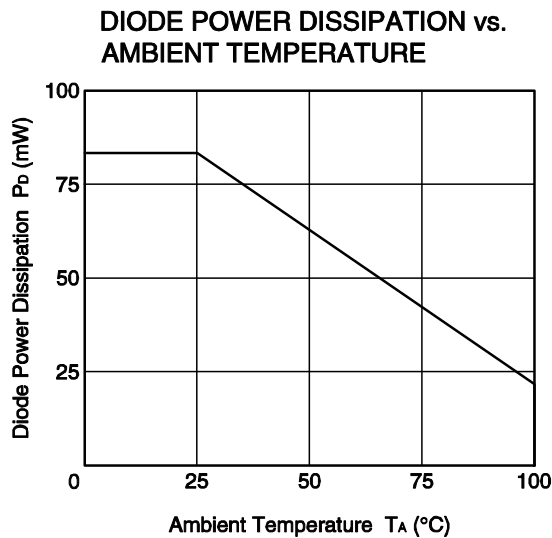
P: 150 to 300 (%)

L: 100 to 300 (%)

M: 50 to 150 (%)

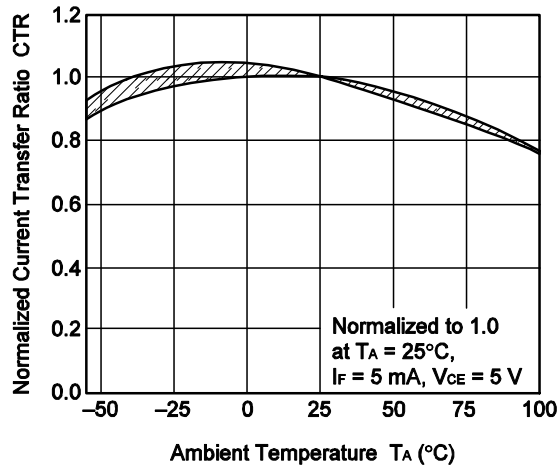
\*2. Test Circuit for Switching Time



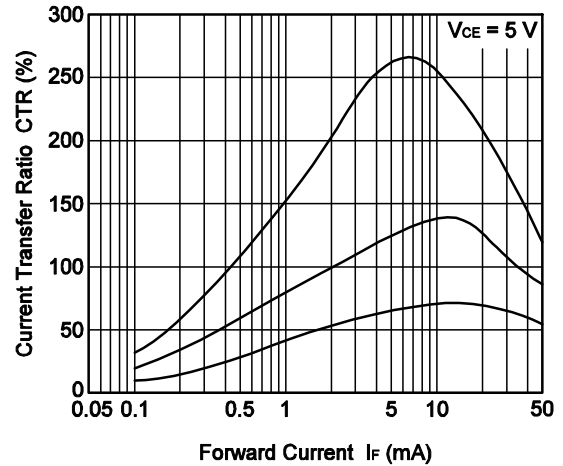
TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

**Remark** The graphs indicate nominal characteristics.

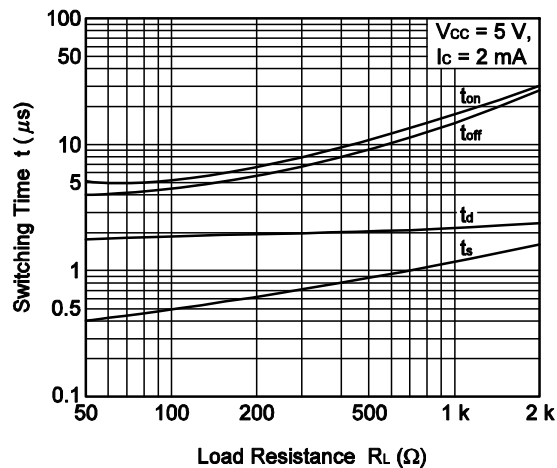
**NORMALIZED CURRENT TRANSFER RATIO vs. AMBIENT TEMPERATURE**



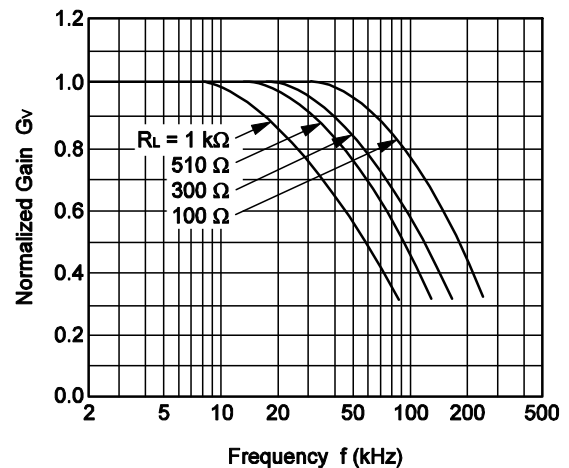
**CURRENT TRANSFER RATIO vs. FORWARD CURRENT**



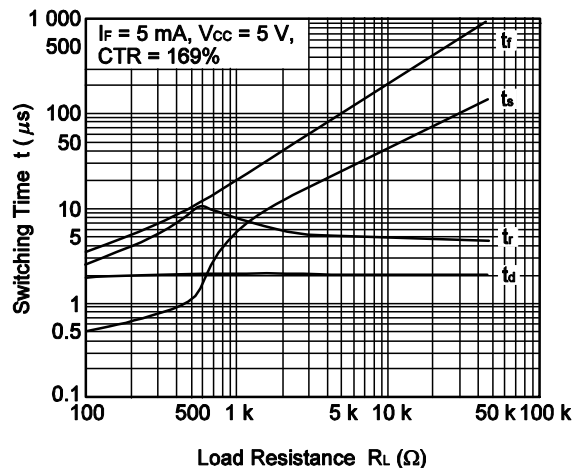
**SWITCHING TIME vs. LOAD RESISTANCE**



**FREQUENCY RESPONSE**



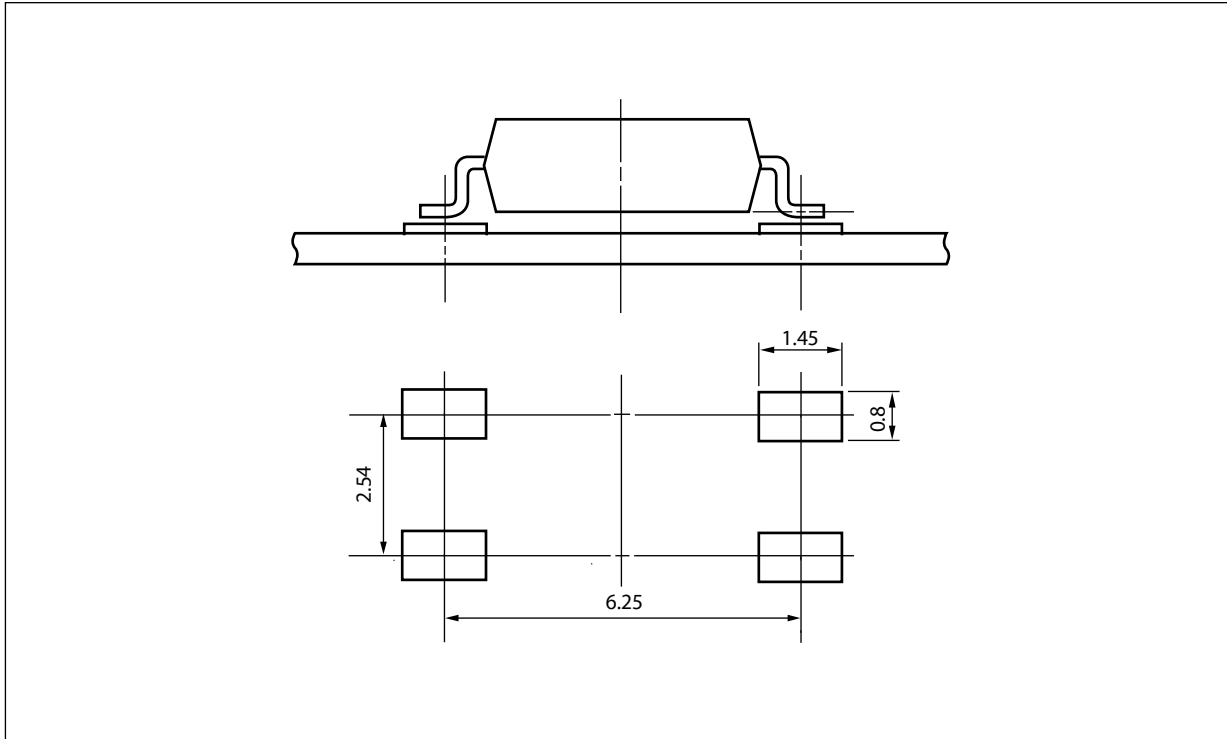
**SWITCHING TIME vs. LOAD RESISTANCE**



**Remark** The graphs indicate nominal characteristics.



## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



**Remark** All dimensions in this figure must be evaluated before use.

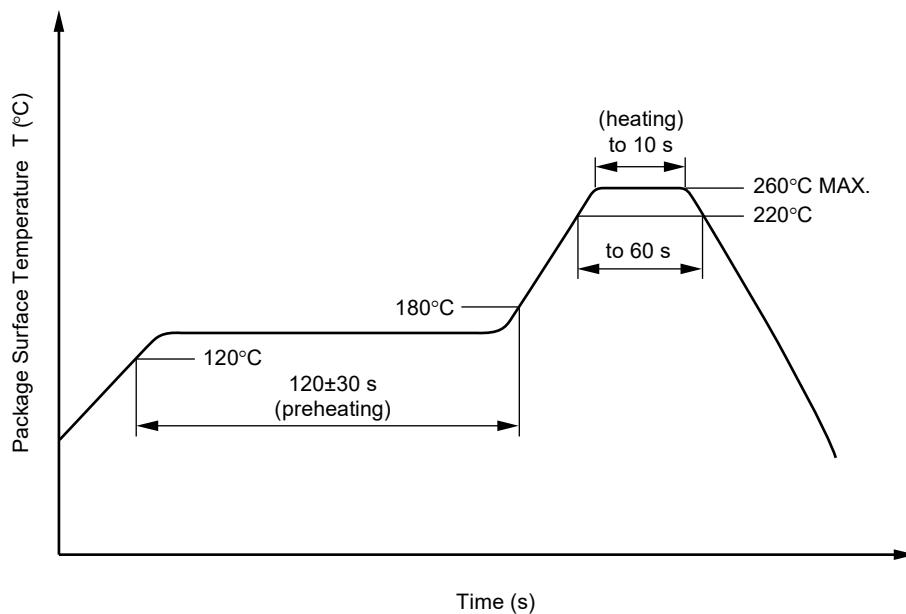
## NOTES ON HANDLING

### 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<br>(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<br>(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

- Flux Cleaning  
Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
- Do not use fixing agents or coatings containing halogen-based substances.

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  $I_F = 1 \text{ mA}$ .

Therefore, check the characteristics under the actual operating conditions and thoroughly take variations or the like into consideration before use.

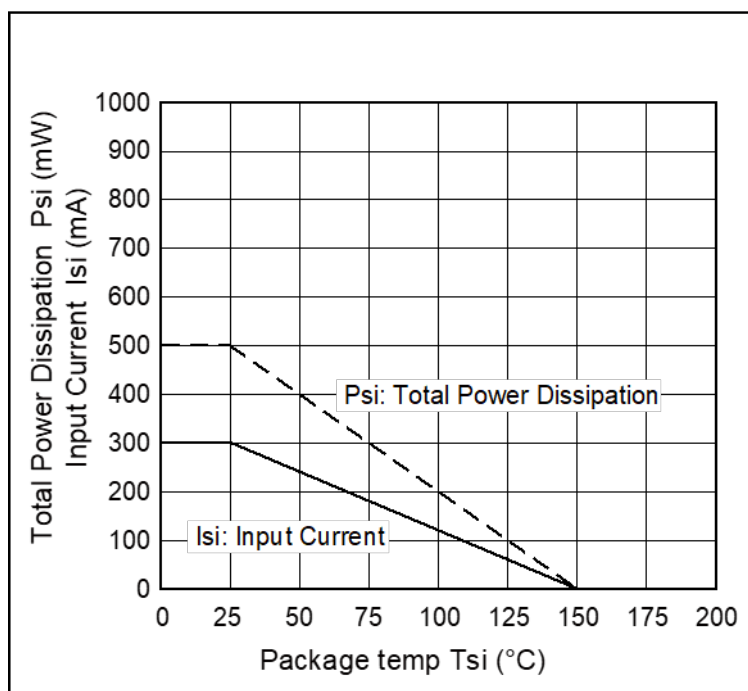
## **USAGE CAUTIONS**

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

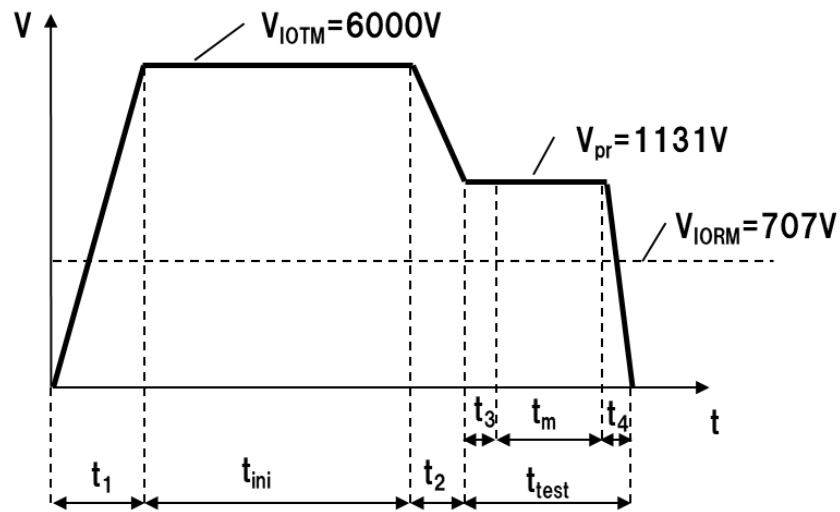
## SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter                                                                                                                                                                                                                                                                               | Symbol                                                    | Rating                      | 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>$U_{pr} = 1.6 \times U_{IORM}$ , $P_d < 5 \text{ pC}$                                                                                 | $U_{IORM}$<br>$U_{pr}$                                    | 707<br>1 131                | $V_{peak}$<br>$V_{peak}$   |
| Test voltage (partial discharge test, procedure b for all devices)<br>$U_{pr} = 1.875 \times U_{IORM}$ , $P_d < 5 \text{ pC}$                                                                                                                                                           | $U_{pr}$                                                  | 1 325                       | $V_{peak}$                 |
| Highest permissible overvoltage                                                                                                                                                                                                                                                         | $U_{IOTM}$                                                | 6 000                       | $V_{peak}$                 |
| Degree of pollution (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))                                                                                                                                                                                                                           |                                                           | 2                           |                            |
| Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303-11))                                                                                                                                                                                                                       | CTI                                                       | 175                         |                            |
| Material group (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))                                                                                                                                                                                                                                |                                                           | 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 $100^\circ\text{C}$                                                                                                        | $R_{is \text{ MIN.}}$<br>$R_{is \text{ MIN.}}$            | $10^{12}$<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 $T_A = T_{si}$ | $T_{si}$<br>$I_{si}$<br>$P_{si}$<br>$R_{is \text{ MIN.}}$ | 150<br>300<br>500<br>$10^9$ | °C<br>mA<br>mW<br>$\Omega$ |

## Dependence of maximum safety ratings with package temperature



## Method a) Destructive Test, Type and Sample Test



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$

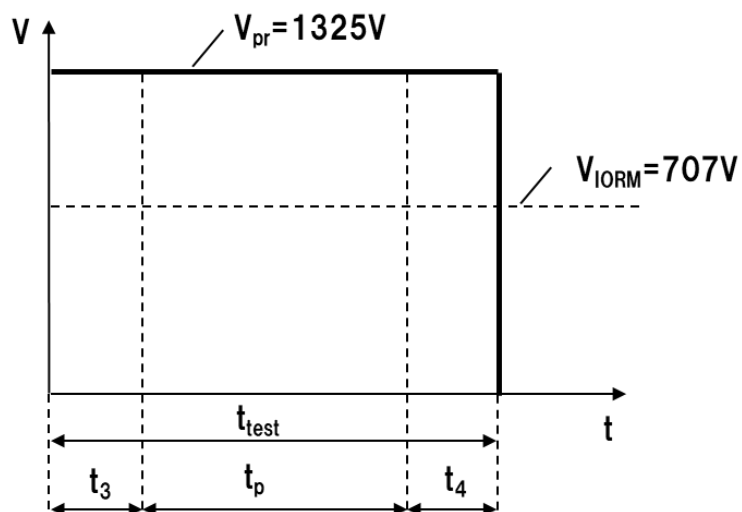
$t_3, t_4 = 1 \text{ sec}$

$t_m \text{ (PARTIAL DISCHARGE)} = 10 \text{ sec}$

$t_{\text{test}} = 12 \text{ sec}$

$t_{\text{ini}} = 60 \text{ sec}$

## Method b) Non-destructive Test, 100% Production Test



$t_3, t_4 = 0.1 \text{ sec}$

$t_p \text{ (PARTIAL DISCHARGE)} = 1.0 \text{ sec}$

$t_{\text{test}} = 1.2 \text{ sec}$

|                |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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.</li><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><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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