

# PS8501, PS8501L1, PS8501L2, PS8501L3

HIGH SPEED ANALOG OUTPUT TYPE  
8-PIN DIP PHOTOCOUPLER

R08DS0242EJ0100  
Rev.1.00  
Sep 22, 2021

## DESCRIPTION

The PS8501, PS8501L1, PS8501L2 and PS8501L3 are 8-pin high speed photocouplers containing an AlGaAs LED on input side and a PN photodiode and a high speed amplifier transistor on output side on one chip.

The PS8501 is in a plastic DIP (Dual In-line Package).

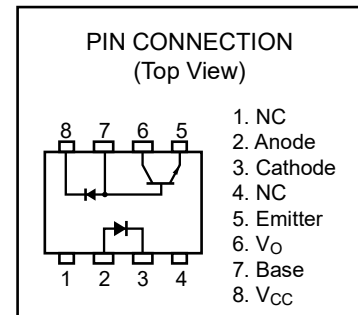
The PS8501L1 is lead bending type for long creepage distance.

The PS8501L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

The PS8501L3 is lead bending type (Gull-wing) for surface mounting.

## FEATURES

- Long creepage distance (8 mm MIN. : PS8501L1, PS8501L2)
- High supply voltage ( $V_{CC} = 35 \text{ V MAX.}$ )
- High speed response ( $t_{PHL}, t_{PLH} = 0.8 \mu\text{s MAX.}$ )
- High isolation voltage ( $BV = 5\,000 \text{ Vr.m.s.}$ )
- TTL, CMOS compatible with a resistor
- Ordering number of tape product : PS8501L2-E3 : 1 000 pcs/reel  
: PS8501L3-E3 : 1 000 pcs/reel
- Pb-Free product
- Safety standards
  - - UL approved: UL1577, Double protection
  - - CSA approved: CAN/CSA-C22.2 No.62368-1, Reinforced insulation
  - - BSI approved: BS EN 62368-1, Reinforced insulation
  - - SEMKO approved: EN 62368-1, IEC 62368-1, Reinforced insulation
  - - NEMKO approved: EN 62368-1, Reinforced insulation
  - - DEMKO approved: EN 62368-1, Reinforced insulation
  - - FIMKO approved: EN 62368-1, Reinforced insulation
  - - VDE approved: DIN EN 60747-5-5 (Option)



## APPLICATIONS

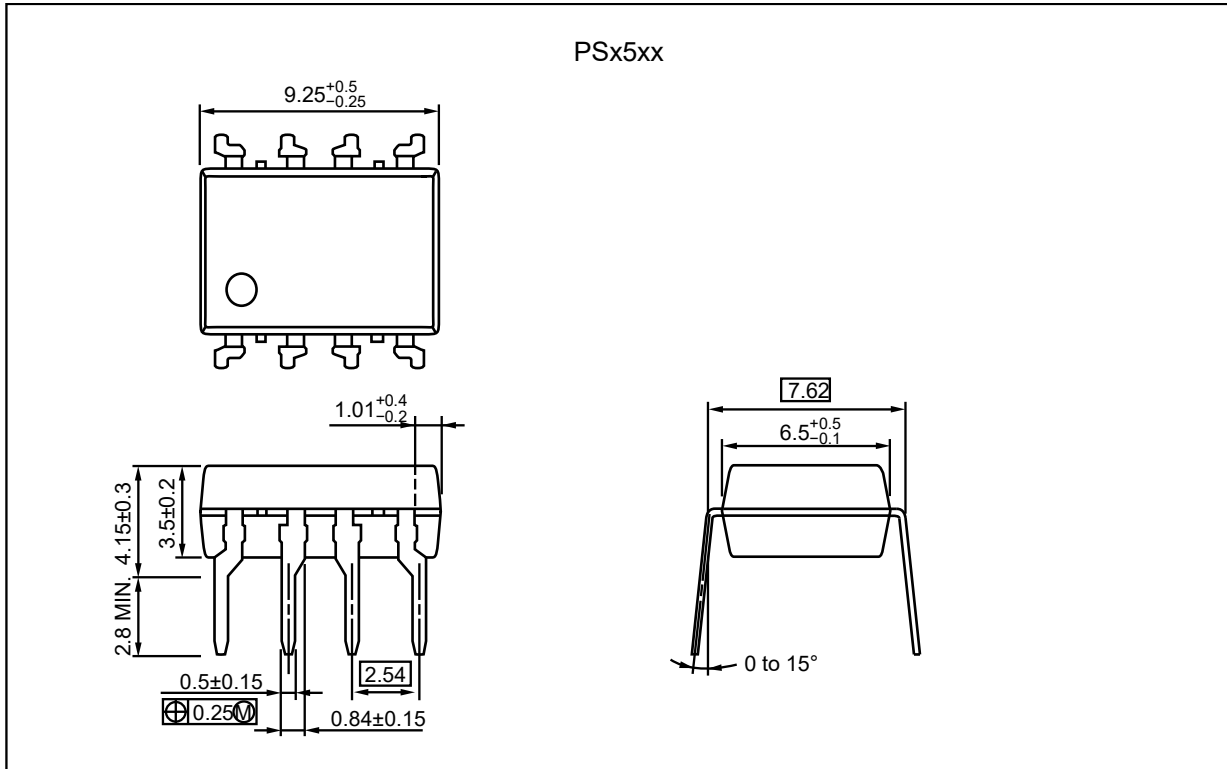
- Interface for measurement or control equipment
- Substitutions for relays and pulse transformers
- Modem, communications device
- General purpose inverter

Start of mass production

Jun.2006

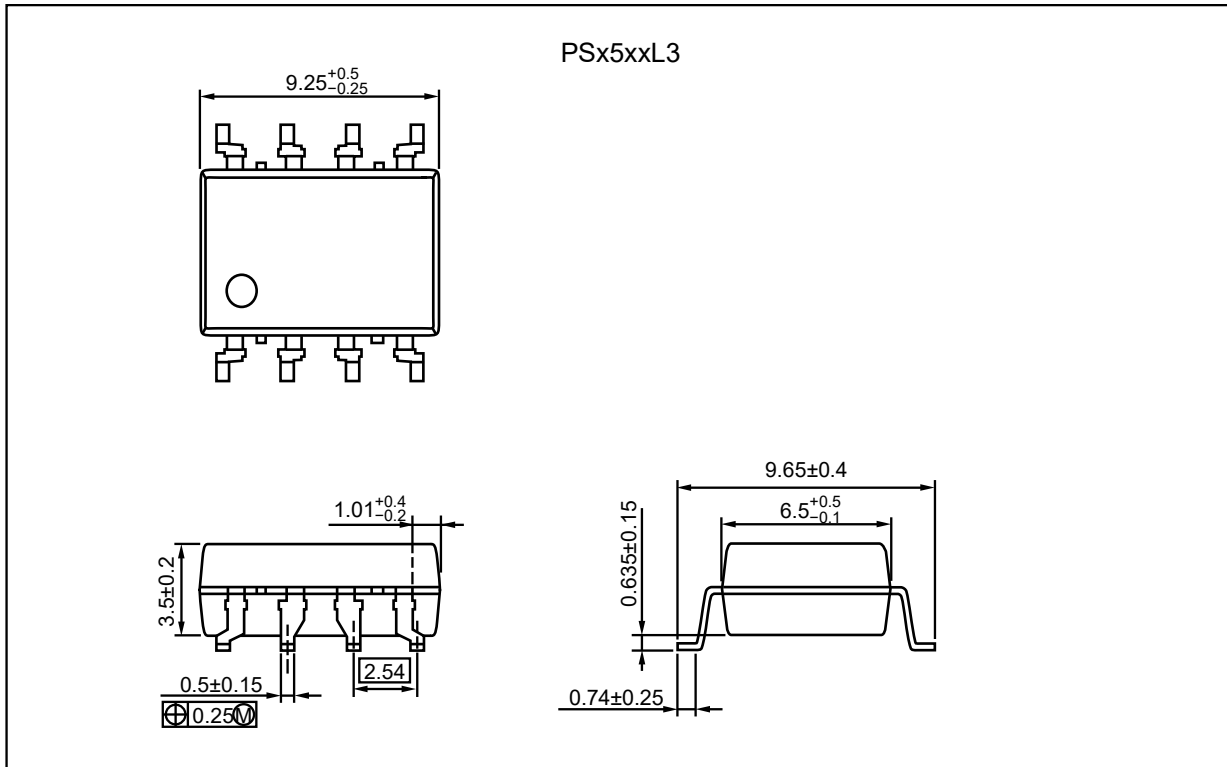
PACKAGE DIMENSIONS (UNIT: mm)

DIP Type

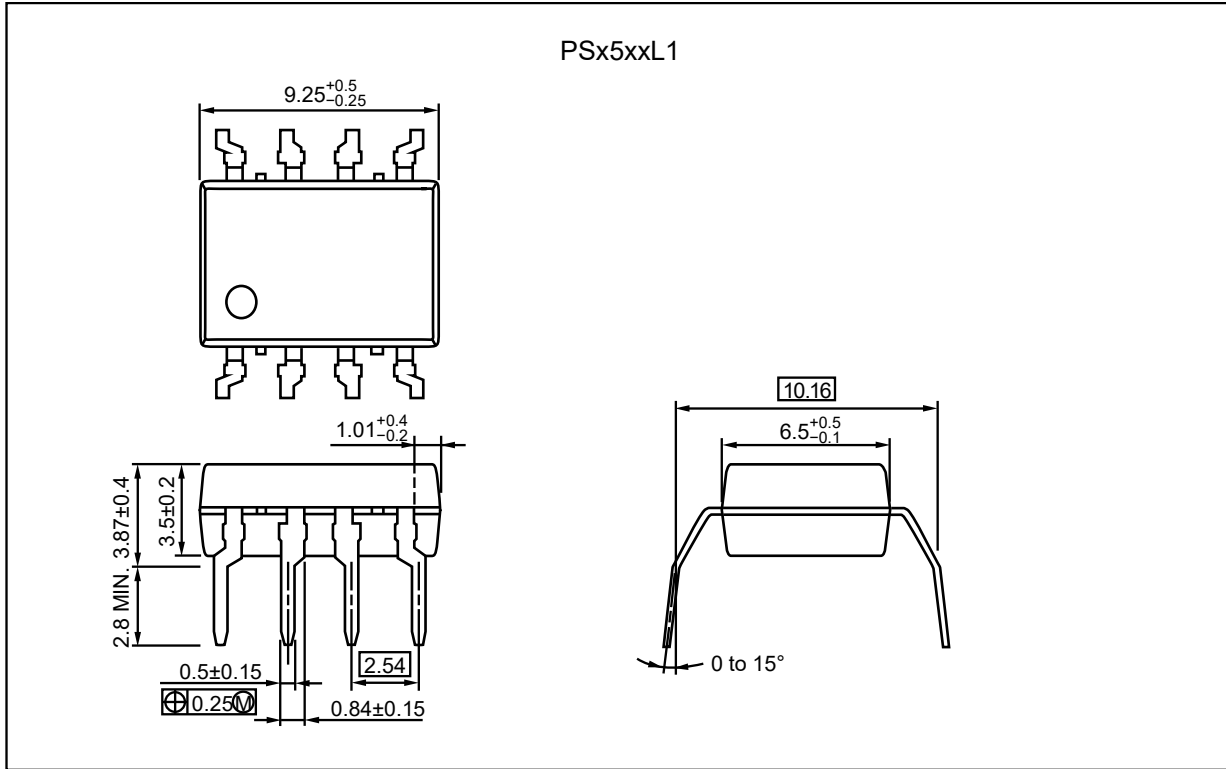


Weight: 0.55g (typ.)

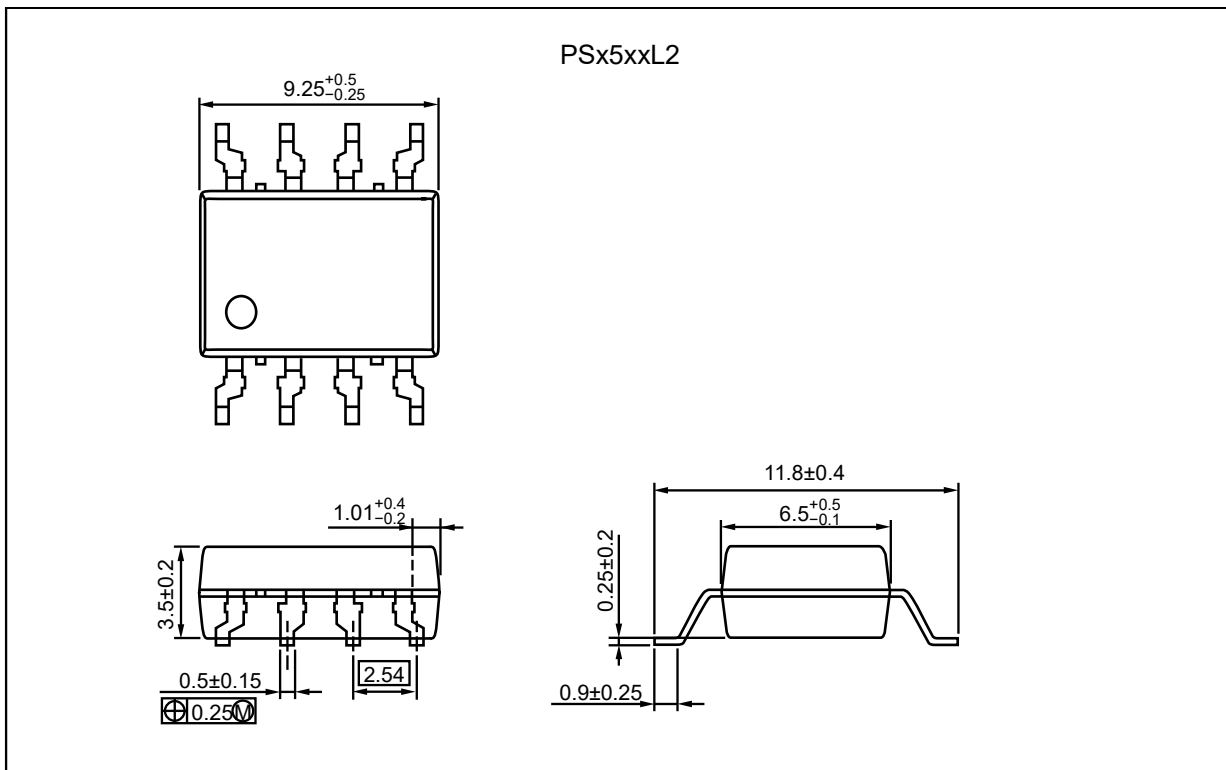
Lead Bending Type (Gull-wing) For Surface Mount



Lead Bending Type For Long Creepage Distance



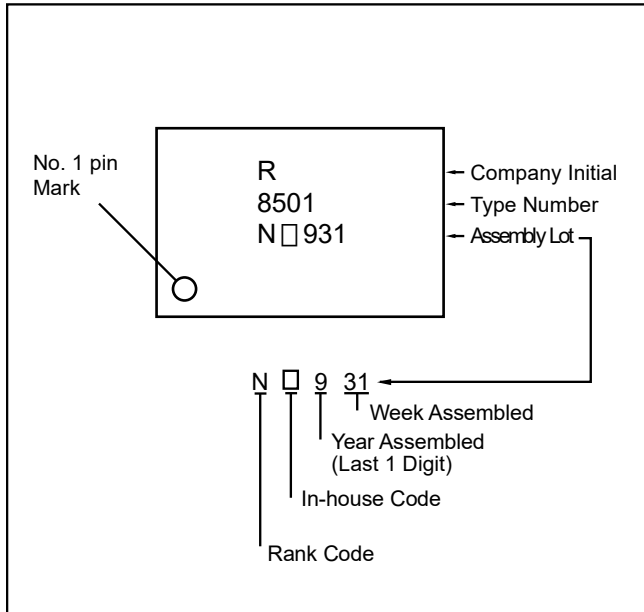
Lead Bending Type For Long Creepage Distance (Gull-wing) For Surface Mount



**PHOTOCOUPLER CONSTRUCTION**

| Parameter                 | PS8501, PS8501L3 | PS8501L1, PS8501L2 |
|---------------------------|------------------|--------------------|
| Air Distance (MIN.)       | 7 mm             | 8 mm               |
| Creepage Distance (MIN.)  | 7 mm             | 8 mm               |
| Isolation Distance (MIN.) | 0.4 mm           | 0.4 mm             |

**MARKING EXAMPLE**



**ORDERING INFORMATION**

| Part Number   | Order Number     | Solder Plating Specification | Packing Style                | Safety Standard Approval  | Application Part Number*1   |          |          |
|---------------|------------------|------------------------------|------------------------------|---|---|----------|----------|
| PS8501        | PS8501-AX        | Pb-Free (Ni/Pd/Au)           | Magazine case 50 pcs         | Standard products (UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO approved) | PS8501  |          |          |
| PS8501L1      | PS8501L1-AX      |                              |                              |   | PS8501L1  |          |          |
| PS8501L2      | PS8501L2-AX      |                              |                              |   | PS8501L2  |          |          |
| PS8501L3      | PS8501L3-AX      |                              |                              |   | PS8501L3  |          |          |
| PS8501L2-E3   | PS8501L2-E3-AX   |                              | Embossed Tape 1 000 pcs/reel |   |   | PS8501L2 |          |
| PS8501L3-E3   | PS8501L3-E3-AX   |                              |                              |   |   | PS8501L3 |          |
| PS8501-V      | PS8501-V-AX      |                              |                              | Magazine case 50 pcs  | UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO, DIN EN 60747-5-5 approved | PS8501   |          |
| PS8501L1-V    | PS8501L1-V-AX    |                              |                              |   |   | PS8501L1 |          |
| PS8501L2-V    | PS8501L2-V-AX    |                              |                              |   |   | PS8501L2 |          |
| PS8501L3-V    | PS8501L3-V-AX    |                              |                              |   |   | PS8501L3 |          |
| PS8501L2-V-E3 | PS8501L2-V-E3-AX |                              |                              | Embossed Tape 1 000 pcs/reel  |   |          | PS8501L2 |
| PS8501L3-V-E3 | PS8501L3-V-E3-AX |                              |                              |   |   |          | PS8501L3 |

Notes\*: 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 *1   | I <sub>F</sub>   | 25          | mA      |
|                               | Reverse Voltage      | V <sub>R</sub>   | 5           | V       |
| Detector                      | Supply Voltage       | V <sub>CC</sub>  | 35          | V       |
|                               | Output Voltage       | V <sub>O</sub>   | 35          | V       |
|                               | Output Current       | I <sub>O</sub>   | 8           | mA      |
|                               | Power Dissipation *2 | P <sub>C</sub>   | 100         | mW      |
| Isolation Voltage *3          |                      | 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 +125 | °C      |

Notes\*: 1. Reduced to 0.33 mA/°C at T<sub>A</sub> = 70 °C or more.

2. Reduced to 2.0 mW/°C at T<sub>A</sub> = 75 °C or more.

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

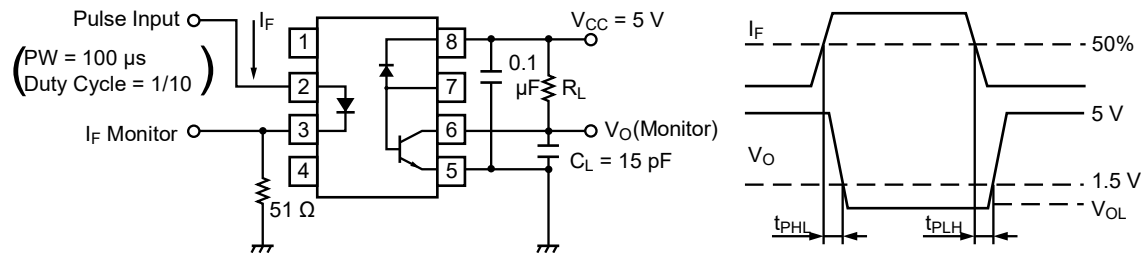
Pins 1-4 shorted together, 5-8 shorted together.

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

| Parameter |  | Symbol                           | Conditions   | MIN.             | TYP.*1 | MAX. | Unit  |
|-----------|--|----------------------------------|--|------------------|--------|------|-------|
| Diode     | Forward Voltage                              | V <sub>F</sub>                   | I <sub>F</sub> = 16 mA   |                  | 1.7    | 2.2  | V     |
|           | Reverse Current                              | I <sub>R</sub>                   | V <sub>R</sub> = 3 V   |                  |        | 10   | μA    |
|           | Forward Voltage Temperature Coefficient      | ΔV <sub>F</sub> /ΔT <sub>A</sub> | I <sub>F</sub> = 16 mA   |                  | -2.1   |      | mV/°C |
|           | Terminal Capacitance                         | C <sub>t</sub>                   | V = 0 V, f = 1 MHz   |                  | 30     |      | pF    |
| Detector  | High Level Output Current                    | I <sub>OH</sub> (1)              | I <sub>F</sub> = 0 mA, V <sub>CC</sub> = V <sub>O</sub> = 5.5 V          |                  | 3      | 500  | nA    |
|           | High Level Output Current                    | I <sub>OH</sub> (2)              | I <sub>F</sub> = 0 mA, V <sub>CC</sub> = V <sub>O</sub> = 35 V           |                  |        | 100  | μA    |
|           | Low Level Output Voltage                     | V <sub>OL</sub>                  | I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 4.5 V, I <sub>O</sub> = 2.4 mA |                  | 0.15   | 0.4  | V     |
|           | Low Level Supply Current                     | I <sub>CC(L)</sub>               | I <sub>F</sub> = 16 mA, V <sub>O</sub> = Open, V <sub>CC</sub> = 35 V    |                  | 150    |      | μA    |
|           | High Level Supply Current                    | I <sub>CC(H)</sub>               | I <sub>F</sub> = 0 mA, V <sub>O</sub> = Open, V <sub>CC</sub> = 35 V     |                  | 0.01   | 1    | μA    |
|           | DC Current Gain                              | h <sub>FE</sub>                  | V <sub>O</sub> = 5 V, I <sub>O</sub> = 3 mA                              |                  |        | 65   |       |
| Coupled   | Current Transfer Ratio                       | CTR                              | I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 4.5 V, V <sub>O</sub> = 0.4 V  | 15               |        |      | %     |
|           | 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   |                  | 0.7    |      | pF    |
|           | Propagation Delay Time (H → L) <sup>*2</sup> | t <sub>PHL</sub>                 | I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1.9 kΩ   |                  | 0.22   | 0.8  | μs    |
|           | Propagation Delay Time (L → H) <sup>*2</sup> | t <sub>PLH</sub>                 | I <sub>F</sub> = 16 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1.9 kΩ   |                  | 0.35   | 0.8  | μs    |

Notes\*: 1. Typical values at T<sub>A</sub> = 25 °C.

2. Test circuit for propagation delay time

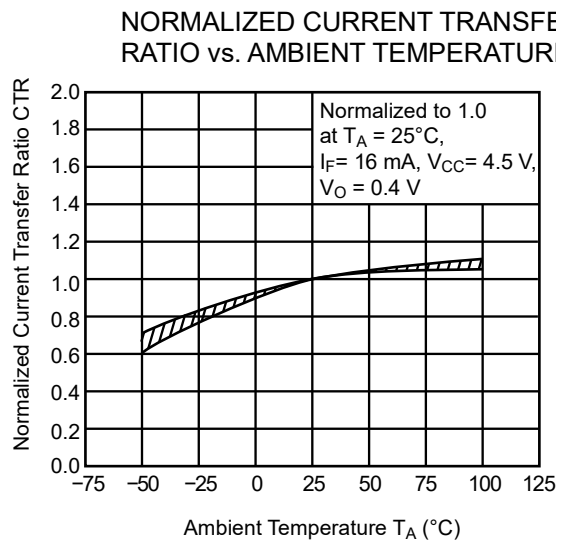
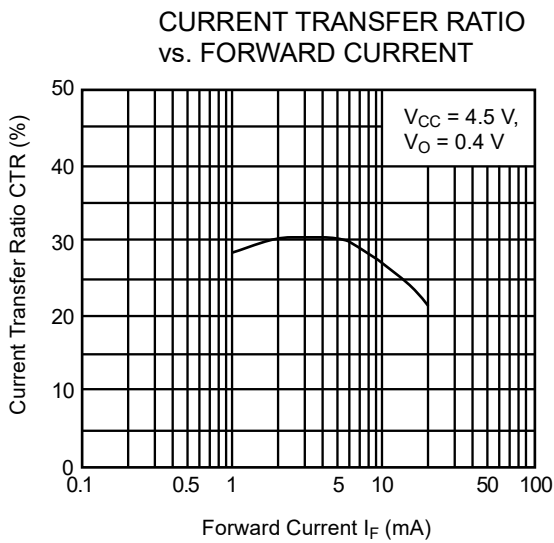
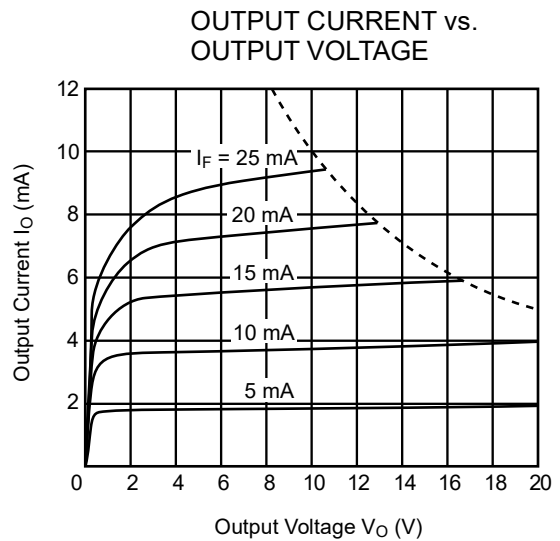
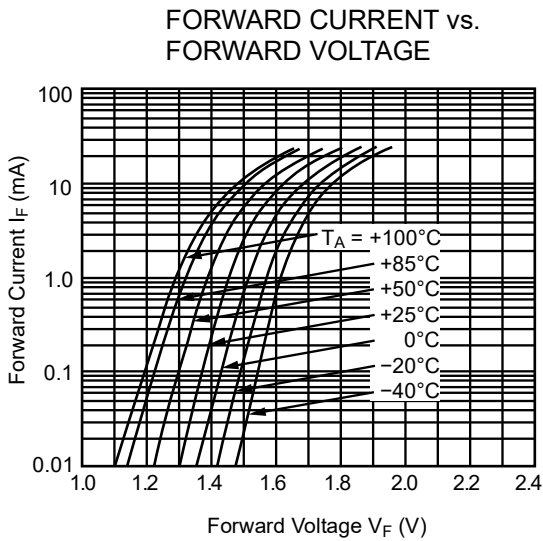
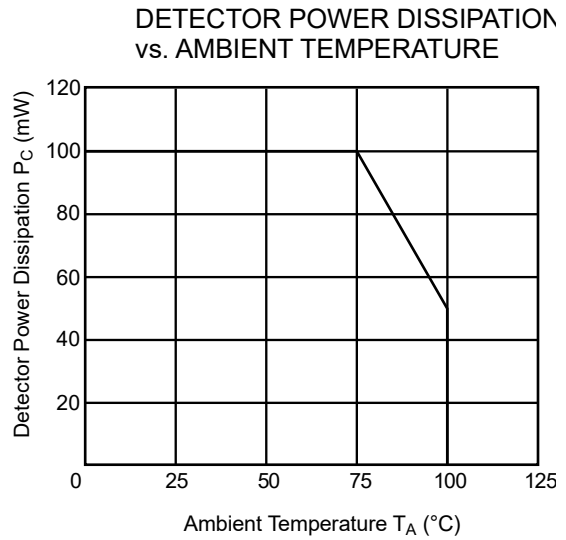
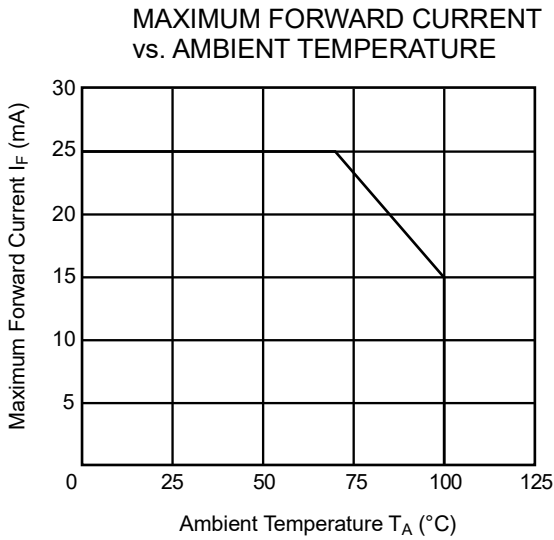


Remark: C<sub>L</sub> includes probe and stray wiring capacitance.

**USAGE CAUTIONS**

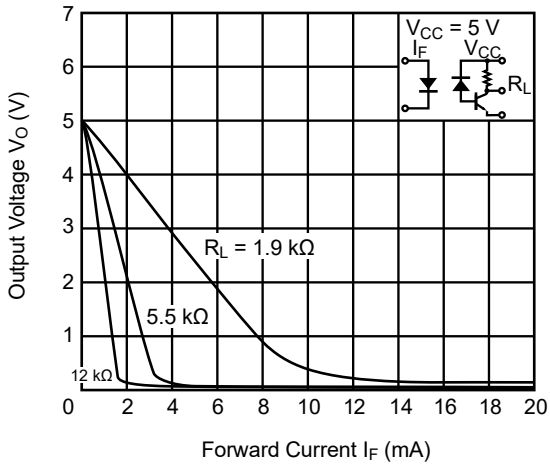
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1 μF is used between V<sub>CC</sub> and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Pins 1, 4 (which is an NC\*1 pin) can either be connected directly to the GND pin on the LED side or left open. Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.  
\*1 NC: Non-Connection (No Connection)
4. Avoid storage at a high temperature and high humidity.
5. Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
6. Do not use fixing agents or coatings containing halogen-based substances.

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

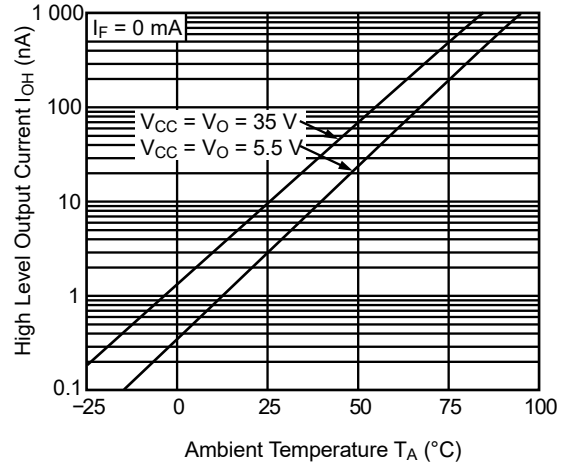


Remark The graphs indicate nominal characteristics.

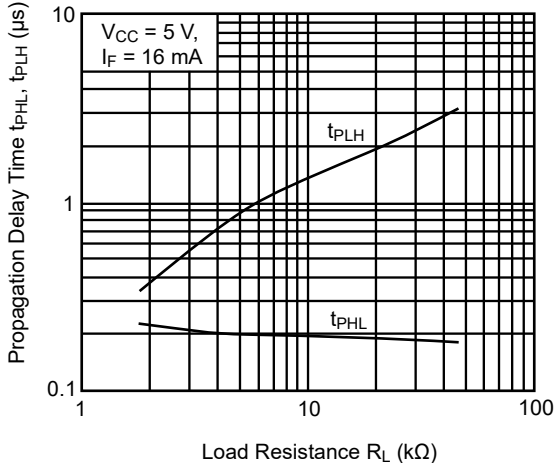
OUTPUT VOLTAGE vs. FORWARD CURRENT



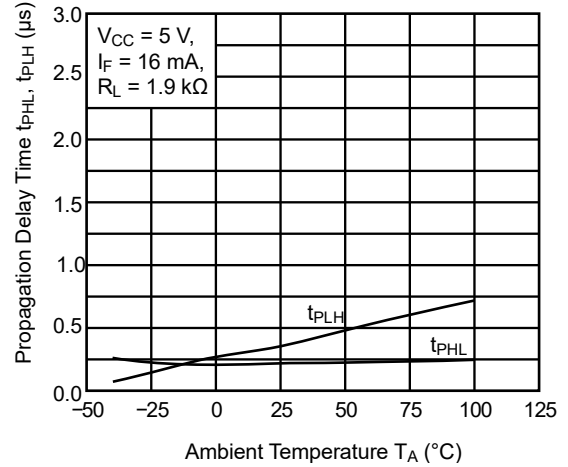
HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. LOAD RESISTANCE



PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE

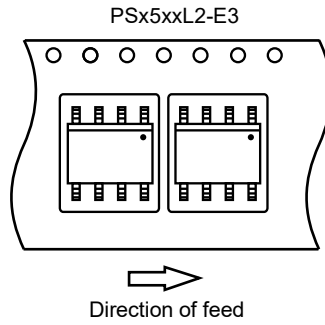


Remark The graphs indicate nominal characteristics.

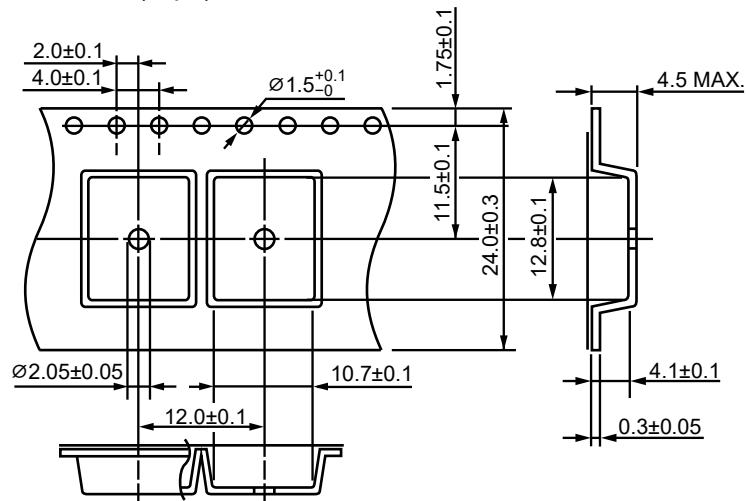


TAPING SPECIFICATIONS (UNIT: mm)

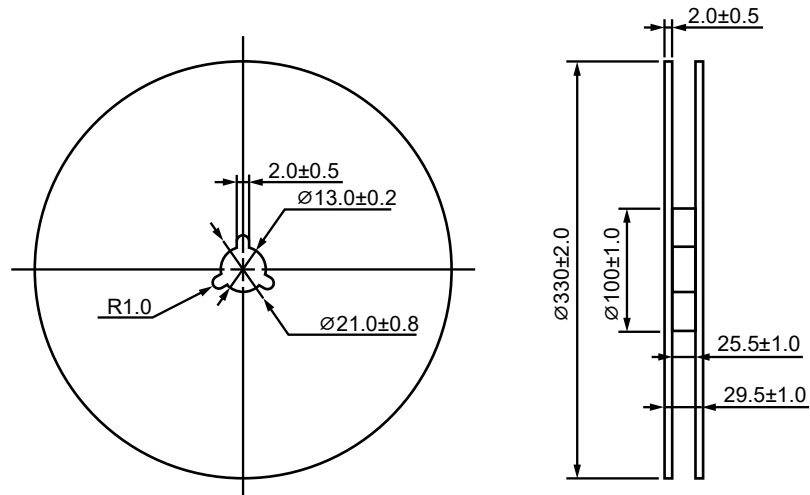
Tape Direction



Outline and Dimensions (Tape)

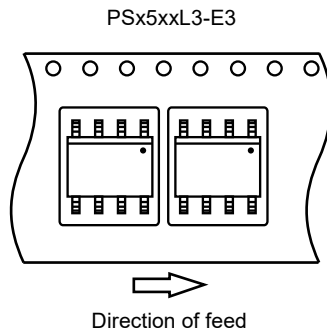


Outline and Dimensions (Reel)

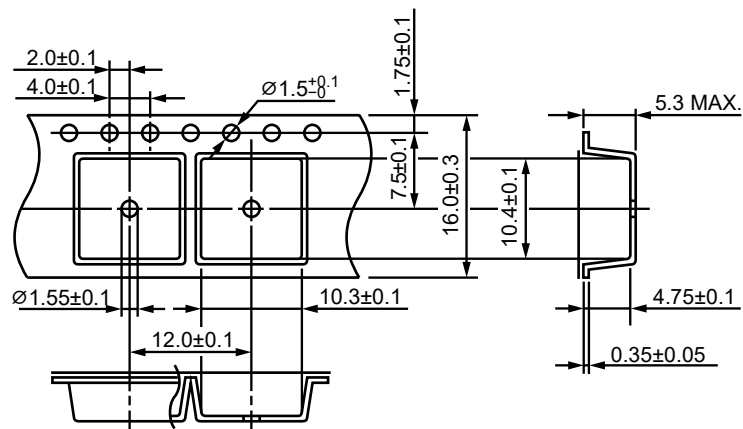


Packing: 1 000 pcs/reel

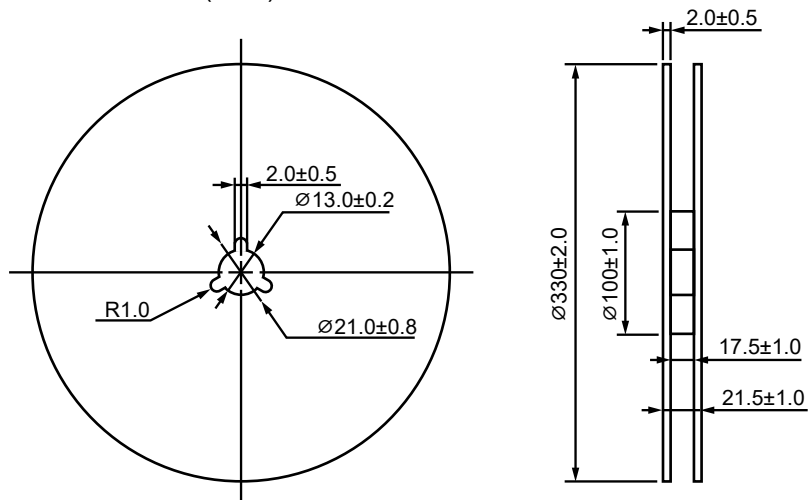
Tape Direction



Outline and Dimensions (Tape)

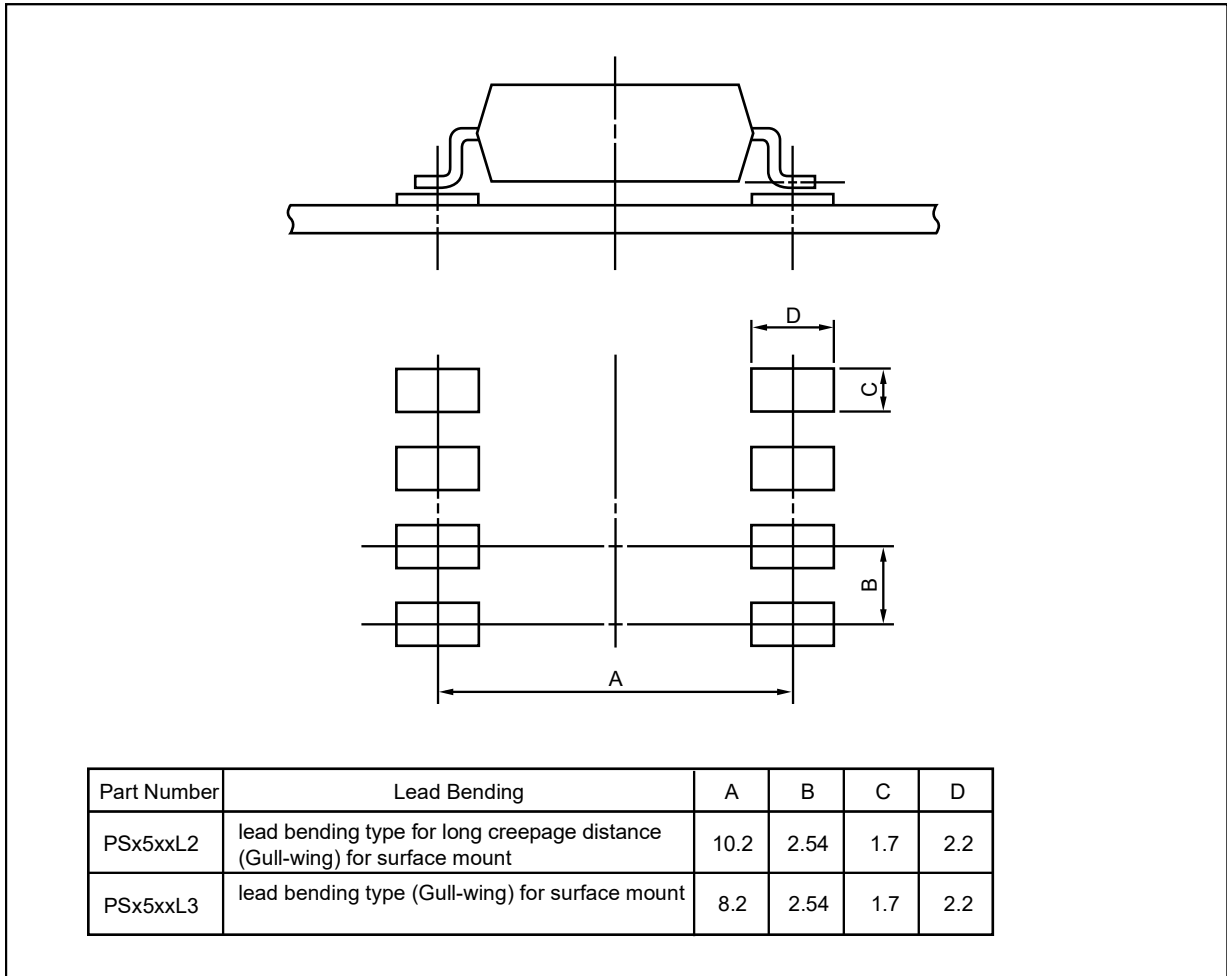


Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



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

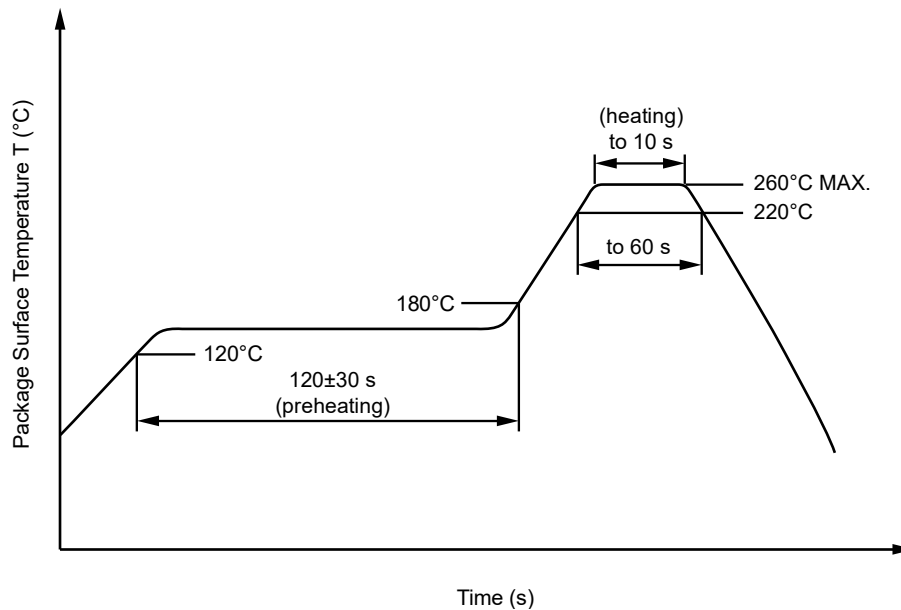
**NOTES ON HANDLING**

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 (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

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

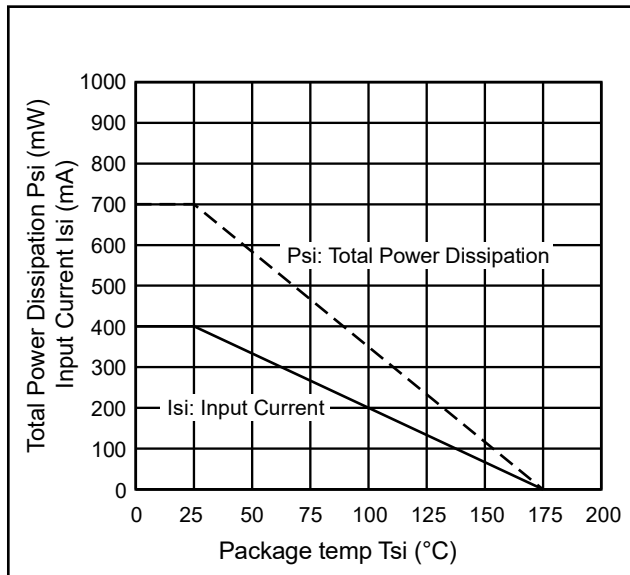
2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V<sub>CC</sub>-emitters at startup, the output side may enter the on state, even if the voltage is within the absolute maximum ratings.

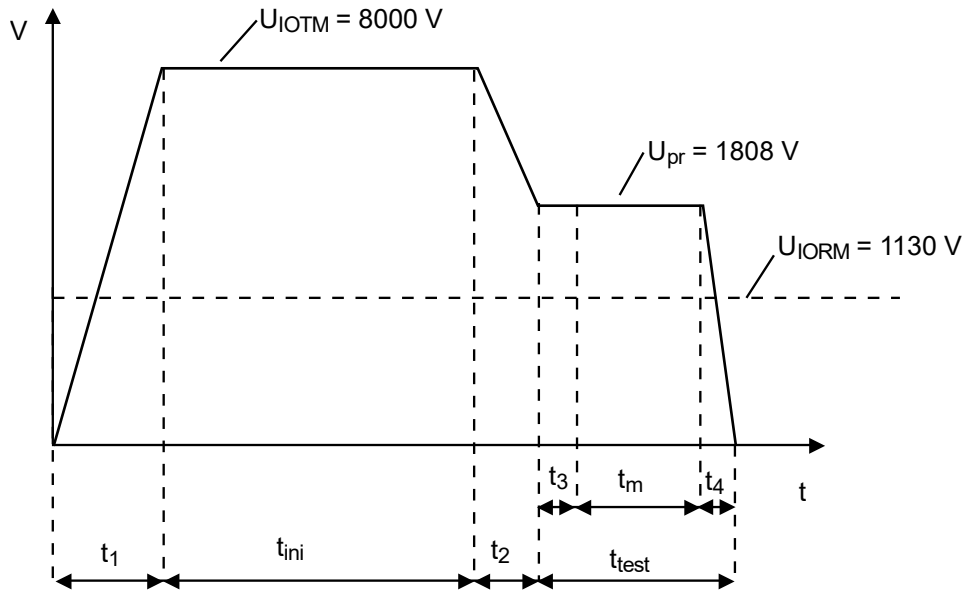
**SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

| 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>$U_{pr}$                       | 1 130<br>1 808              | $V_{peak}$<br>$V_{peak}$   |
| Test voltage (partial discharge test, procedure b for all devices)<br>$U_{pr} = 1.875 \times U_{IORM}, P_d < 5 \text{ pC}$   | $U_{pr}$                                     | 2 119                       | $V_{peak}$                 |
| Highest permissible overvoltage  | $U_{IOTM}$                                   | 8 000                       | $V_{peak}$                 |
| Degree of pollution (DIN EN 60664-1 VDE 0110 Part 1)   |  | 2                           |                            |
| Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11))   | CTI  | 175                         |                            |
| Material group (DIN EN 60664-1 VDE 0110 Part 1)  |  | III a                       |                            |
| Storage temperature range  | $T_{stg}$                                    | -55 to +125                 | °C                         |
| Operating temperature range  | $T_A$  | -55 to +100                 | °C                         |
| Isolation resistance, minimum value<br>$V_{IO} = 500 \text{ V dc at } T_A = 25 \text{ °C}$<br>$V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100 \text{ °C}$  | 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>$V_{IO} = 500 \text{ V dc at } T_A = T_{si}$ | $T_{si}$<br>$I_{si}$<br>$P_{si}$<br>Ris MIN. | 175<br>400<br>700<br>$10^9$ | °C<br>mA<br>mW<br>$\Omega$ |

**Dependence of maximum safety ratings with package temperature**

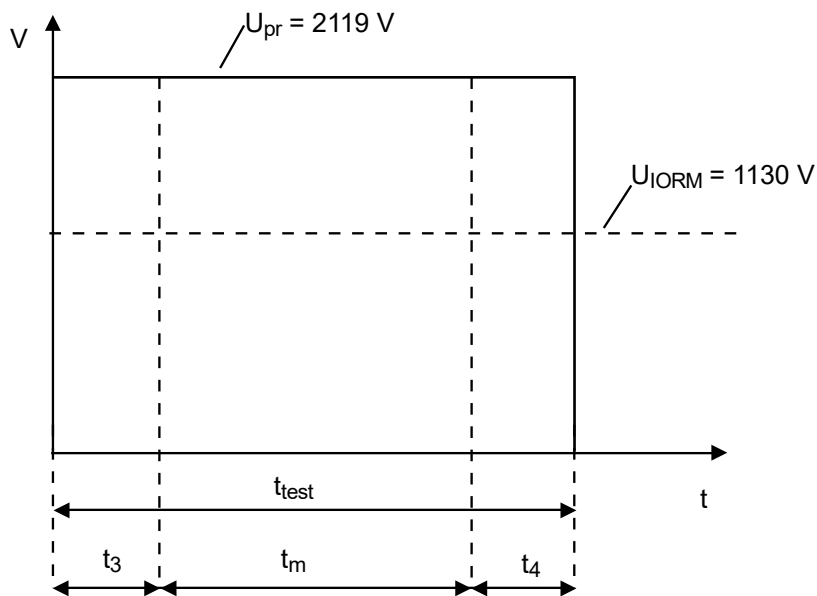


**Method a) Destructive Test, Type and Sample Test**



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$   
 $t_3, t_4 = 1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 10 \text{ sec}$   
 $t_{\text{test}} = 12 \text{ sec}$   
 $t_{\text{ini}} = 60 \text{ sec}$

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



$t_3, t_4 = 0.1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 1.0 \text{ sec}$   
 $t_{\text{test}} = 1.2 \text{ sec}$

|                |                      |   |
|----------------|----------------------|---|
| <p>Caution</p> | <p>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.</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> |
|----------------|----------------------|---|

All trademarks and registered trademarks are the property of their respective owners.