# PS2381-1

R08DS0134EJ0200
Rev.2.00
Oct 30, 2015

4-PIN LSOP PHOTOCOUPLER OPERATING AMBIENT TEMPERATURE 115°C

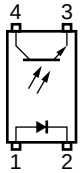
## DESCRIPTION

The PS2381-1 is an optically coupled isolator containing a GaAs light emitting diode and an NPN silicon phototransistor.
This package is mounted in a plastic 4-LSOP (Long Mini-Flat Small Outline Package) for high density applications.
The package has shield effect to cut off ambient light.

## FEATURES

- Operating ambient temperature: 115°C
- Isolation distance (0.4 mm MIN.)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- 4-pin LSOP (Long Mini-Flat Small Outline Package) type
- High-speed switching (tr = 4 μs TYP., tf = 5 μs TYP.)
- Embossed tape product: PS2381-1-F3: 3 000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - SEMKO approved (EN 60065, EN 60950)
  - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)
  - CQC approved (GB8898, GB4943)

**PIN CONNECTION**
(Top View)

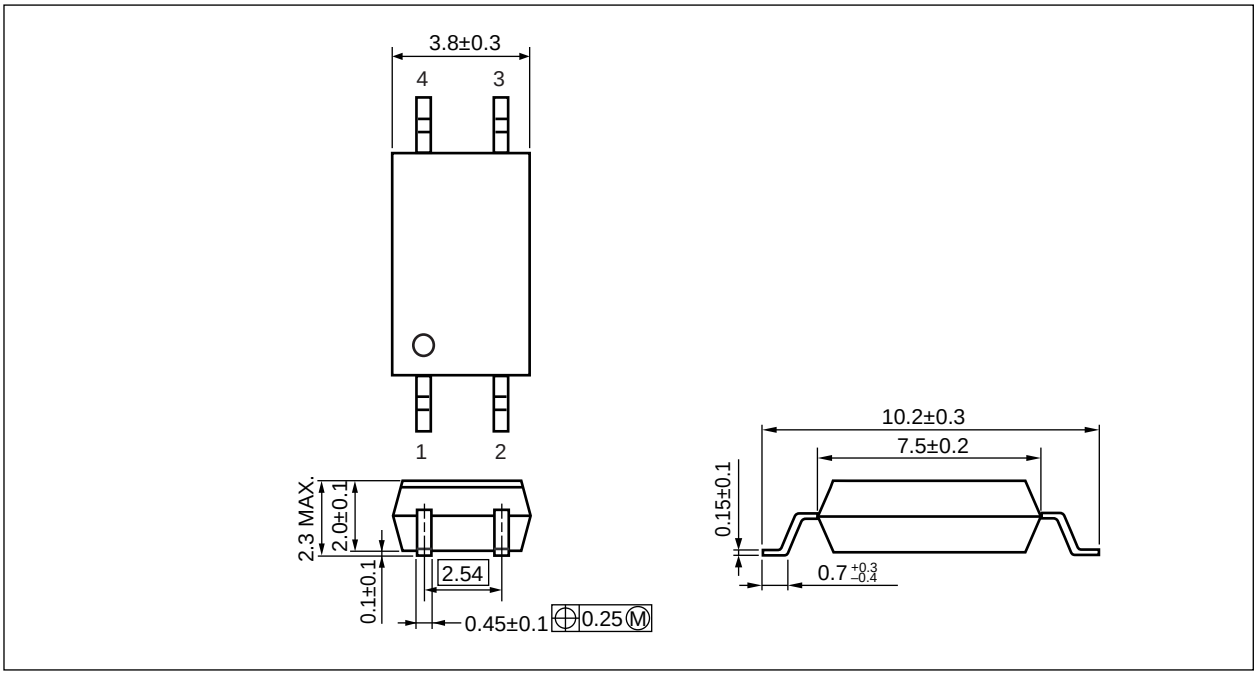



1. Anode
2. Cathode
3. Emitter
4. Collector

## APPLICATIONS

- Power supply
- FA/OA equipment

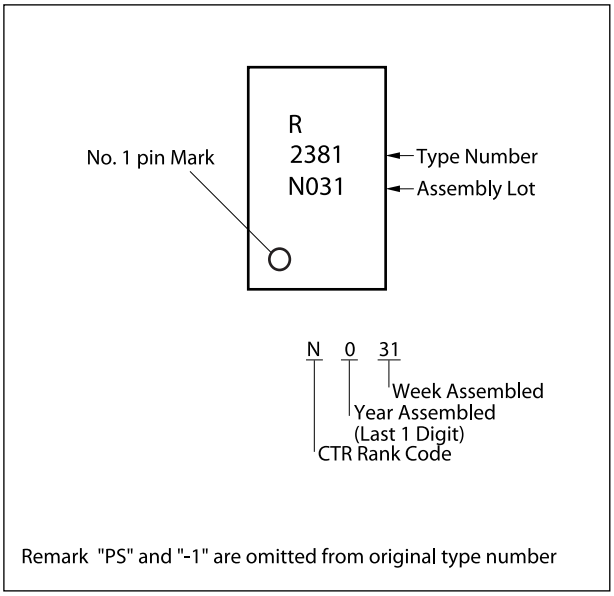
## PACKAGE DIMENSIONS (Unit: mm)




## PHOTOCOUPLER CONSTRUCTION

| Parameter | Unit (MIN.) |
|---|---|
| Air Distance | 8 mm |
| Outer Creepage Distance | 8 mm |
| Isolation Distance | 0.4 mm |

## MARKING EXAMPLE



## ORDERING INFORMATION

| Part Number | Order Number | Solder Plating Specification etc. | Packing Style | Safety Standard Approval | Application Part Number*1 |
|---|---|---|---|---|---|
| PS2381-1 | PS2381-1Y-AX | Pb-Free and Halogen Free | 20 pcs (Tape 20 pcs cut) | Standard products (UL, CSA, SEMKO, CQC approved) | PS2381-1 |
| PS2381-1-F3 | PS2381-1Y-F3-AX | | Embossed Tape 3 000 pcs/reel | | |
| PS2381-1-V | PS2381-1Y-V-AX | | 20 pcs (Tape 20 pcs cut) | UL, CSA, SEMKO, CQC approved DIN EN 60747-5-5 (VDE 0884-5) approved (Option) | |
| PS2381-1-V-F3 | PS2381-1Y-V-F3-AX | | Embossed Tape 3 000 pcs/reel | | |

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

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C, unless otherwise specified)

| Parameter | | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Diode | Forward Current (DC) | $I_F$ | 60 | mA |
| | Reverse Voltage | $V_R$ | 6 | V |
| | Power Dissipation Derating*1 | $\Delta P_D$/°C | 1.0 | mW/°C |
| | Power Dissipation | $P_D$ | 100 | mW |
| | Peak Forward Current*2 | $I_{FP}$ | 1.5 | A |
| Transistor | Collector to Emitter Voltage | $V_{CEO}$ | 80 | V |
| | Emitter to Collector Voltage | $V_{ECO}$ | 7 | V |
| | Collector Current | $I_C$ | 50 | mA |
| | Power Dissipation Derating*1 | $\Delta P_C$/°C | 1.5 | mW/°C |
| | Power Dissipation | $P_C$ | 150 | mW |
| Isolation Voltage*3 | | BV | 5 000 | Vr.m.s. |
| Total Power Dissipation | | $P_T$ | 250 | mW |
| Operating Ambient Temperature | | $T_A$ | –40 to +115 | °C |
| Storage Temperature | | $T_{stg}$ | –40 to +125 | °C |

Notes: *1. Derating from $T_A$ = 25°C.

*2. PW = 100 $\mu$s, Duty Cycle = 1%

*3. AC voltage for 1 minute at $T_A$ = 25°C, RH = 60% between input and output.
Pins 1-2 shorted together, 3-4 shorted together.

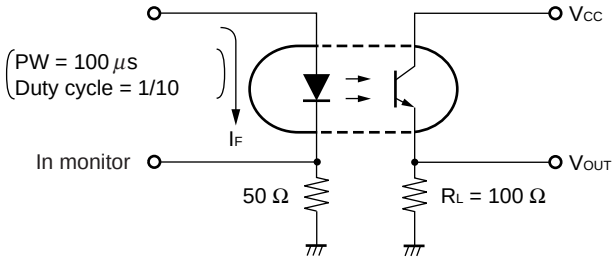
## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

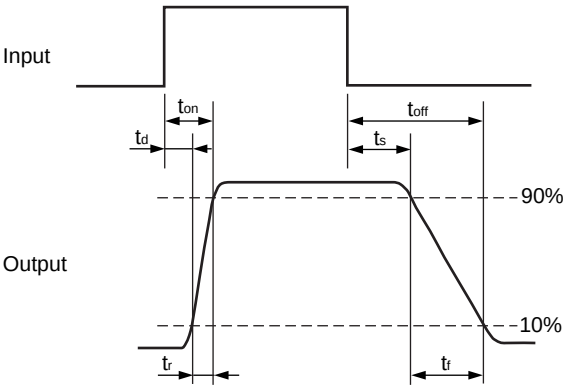
| Parameter | | Symbol | Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|---|
| Diode | Forward Voltage | $V_F$ | $I_F$ = 5 mA | | 1.1 | 1.4 | V |
| | Reverse Current | $I_R$ | $V_R$ = 5 V | | | 5 | μA |
| | Terminal Capacitance | $C_t$ | V = 0 V, f = 1 MHz | | 15 | | pF |
| Transistor | Collector to Emitter Dark Current | $I_{CEO}$ | $I_F$ = 0 mA, $V_{CE}$ = 24 V | | | 100 | nA |
| Coupled | Current Transfer Ratio ($I_C/I_F$) *1 | CTR | $I_F$ = 5 mA, $V_{CE}$ = 5 V | 50 | 100 | 400 | % |
| | | | $I_F$ = 1 mA, $V_{CE}$ = 5 V | 10 | 50 | | |
| | Collector Saturation Voltage | $V_{CE (sat)}$ | $I_F$ = 10 mA, $I_C$ = 2 mA | | | 0.3 | V |
| | Isolation Resistance | $R_{I-O}$ | $V_{I-O}$ = 1 $kV_{DC}$ | $10^{11}$ | | | Ω |
| | Isolation Capacitance | $C_{I-O}$ | V = 0 V, f = 1 MHz | | 0.4 | | pF |
| | Rise Time*2 | $t_r$ | $V_{CC}$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | | 4 | | μs |
| | Fall Time*2 | $t_f$ | | | 5 | | |

Notes: *1. CTR rank

| CTR rank | CTR (%) | Conditions |
|---|---|---|
| W | 130 to 260 | $I_F$ = 5 mA, $V_{CE}$ = 5 V |
| | 20 to | $I_F$ = 1 mA, $V_{CE}$ = 5 V |
| L | 100 to 300 | $I_F$ = 5 mA, $V_{CE}$ = 5 V |
| | 20 to | $I_F$ = 1 mA, $V_{CE}$ = 5 V |
| M | 50 to 150 | $I_F$ = 5 mA, $V_{CE}$ = 5 V |
| | 10 to | $I_F$ = 1 mA, $V_{CE}$ = 5 V |
| N | 50 to 400 | $I_F$ = 5 mA, $V_{CE}$ = 5 V |
| | 10 to | $I_F$ = 1 mA, $V_{CE}$ = 5 V |

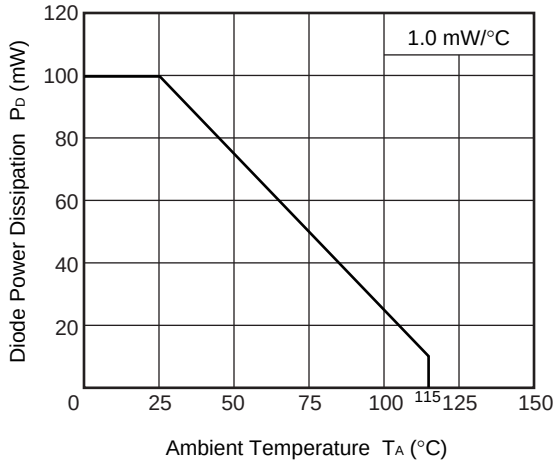
*2. Test circuit for switching time



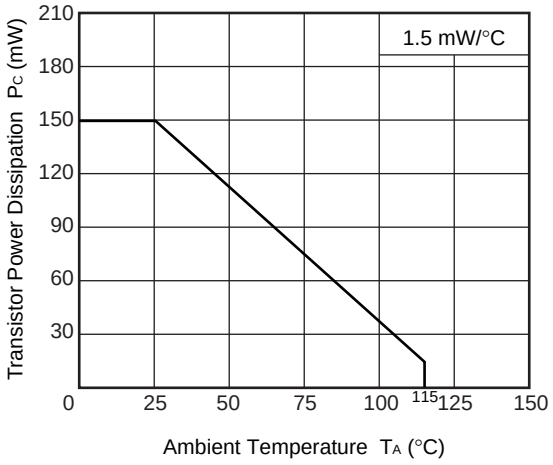



## TYPICAL CHARACTERISTICS ($T_A$ = 25°C, unless otherwise specified)

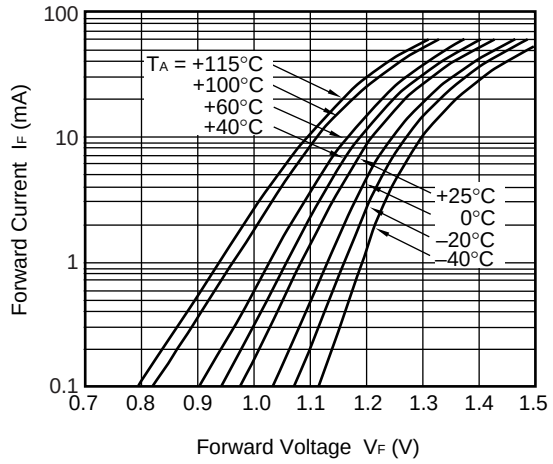
DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE



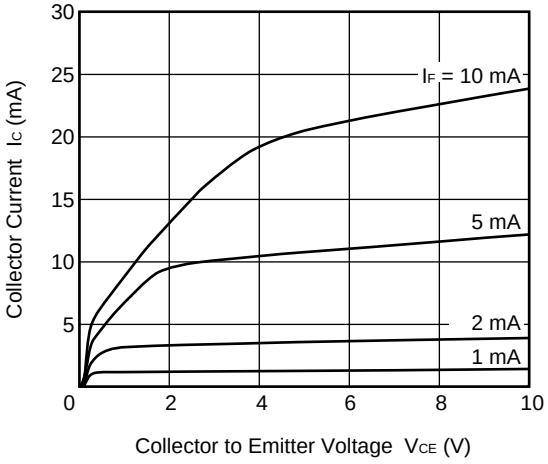

TRANSISTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



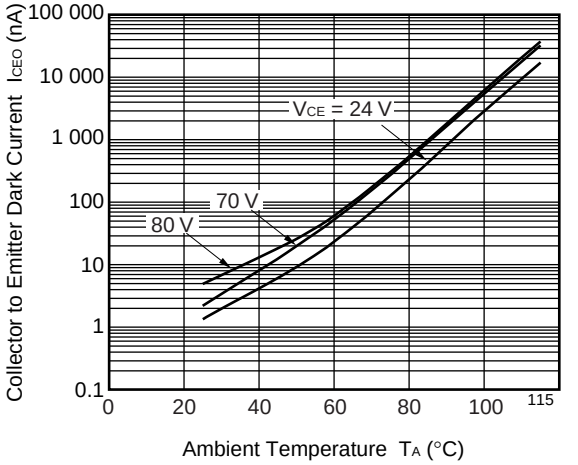

FORWARD CURRENT vs. FORWARD VOLTAGE



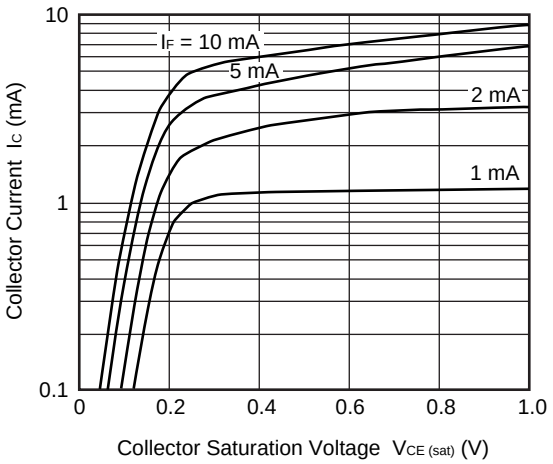

COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



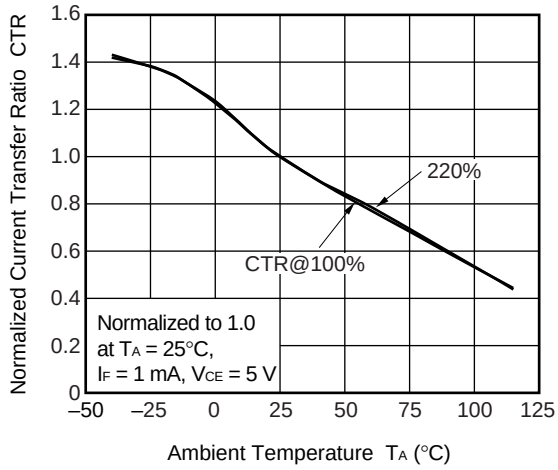

COLLECTOR TO EMITTER DARK CURRENT vs. AMBIENT TEMPERATURE



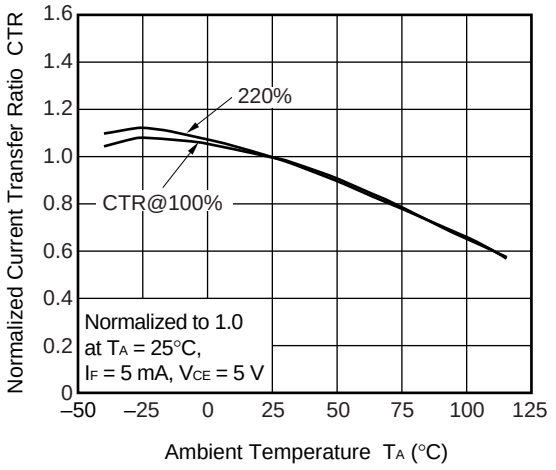

COLLECTOR CURRENT vs. COLLECTOR SATURATION VOLTAGE



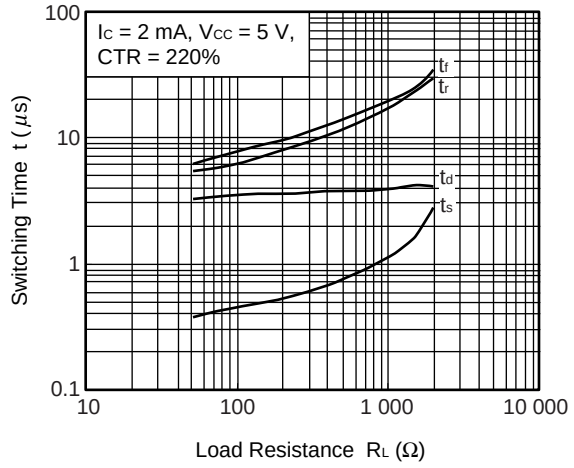
NORMALIZED CURRENT TRANSFER RATIO vs. AMBIENT TEMPERATURE



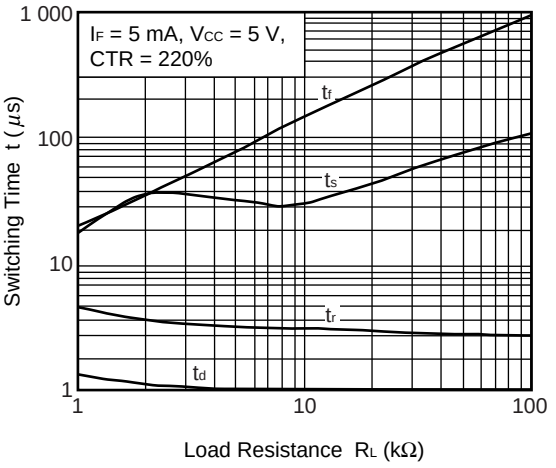

NORMALIZED CURRENT TRANSFER RATIO vs. AMBIENT TEMPERATURE



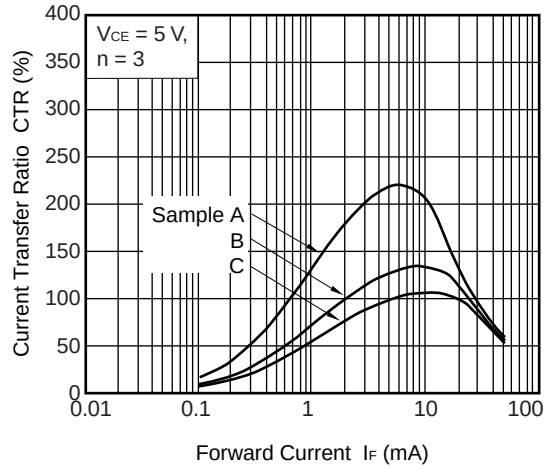

SWITCHING TIME vs. LOAD RESISTANCE



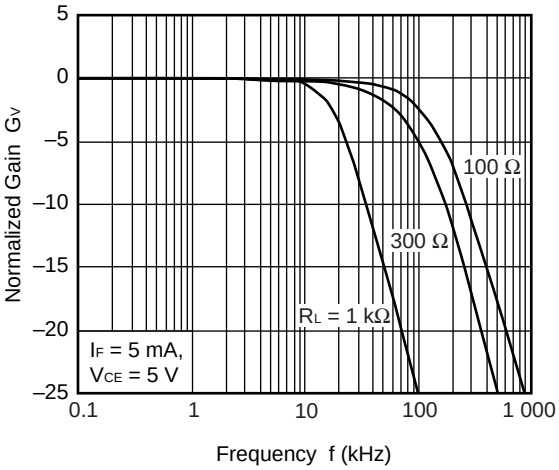

SWITCHING TIME vs. LOAD RESISTANCE




CURRENT TRANSFER RATIO vs. FORWARD CURRENT



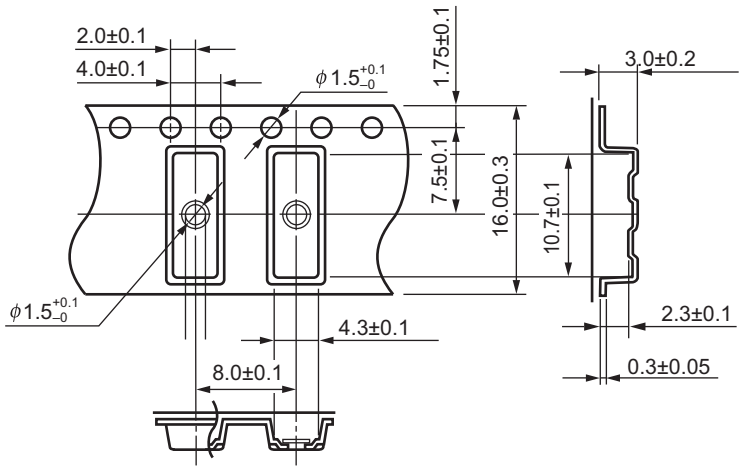

FREQUENCY RESPONSE



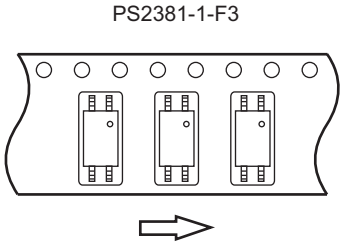

**Remark** The graphs indicate nominal characteristics.

## TAPING SPECIFICATIONS (UNIT: mm)

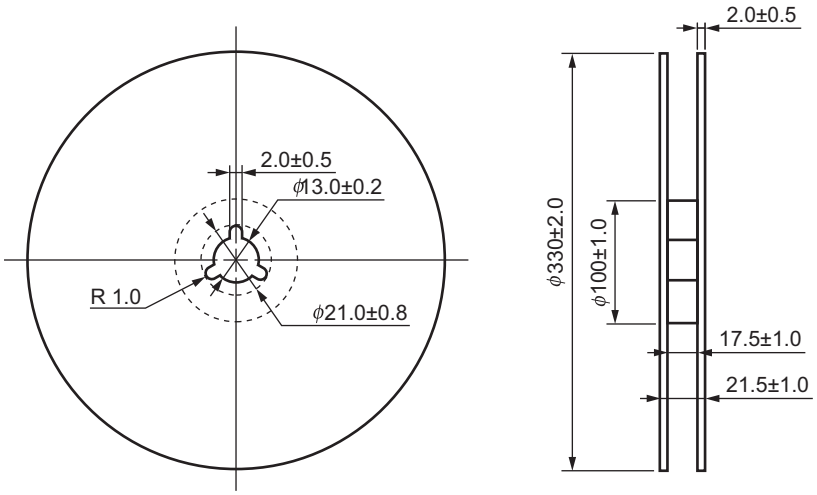
Outline and Dimensions (Tape)




Tape Direction

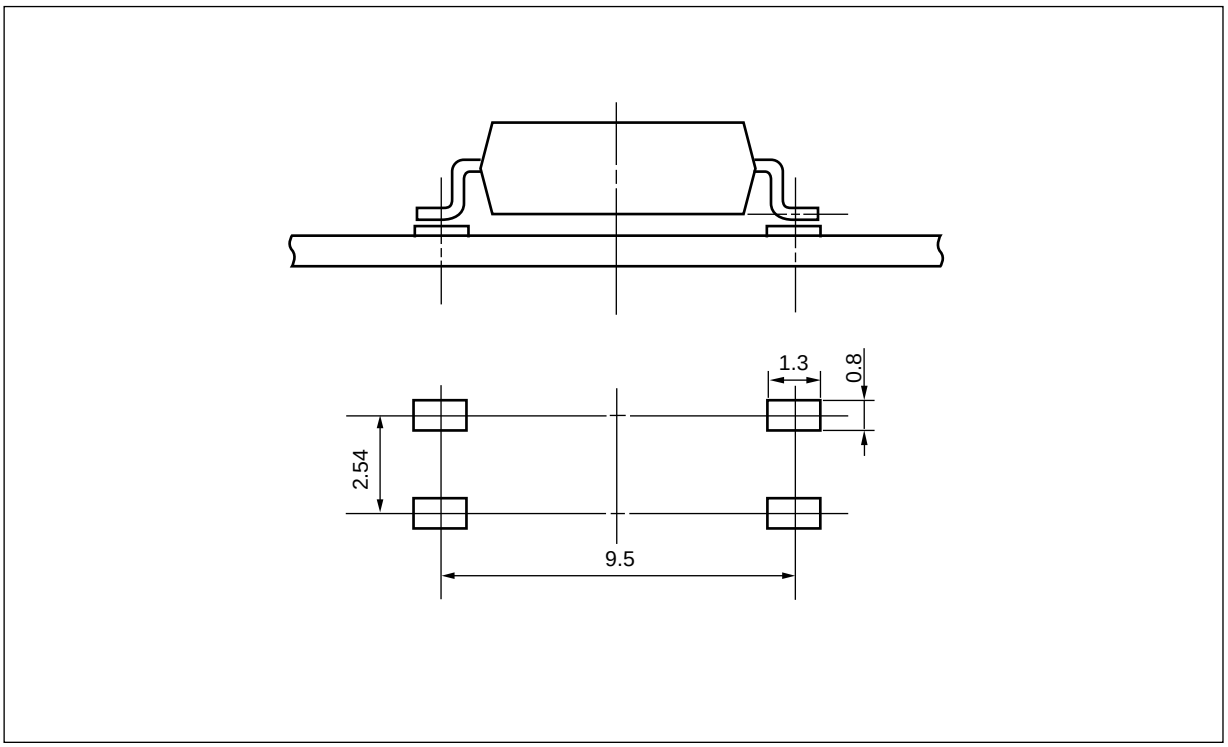



Outline and Dimensions (Reel)




Packing: 3 000 pcs/reel

## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)




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

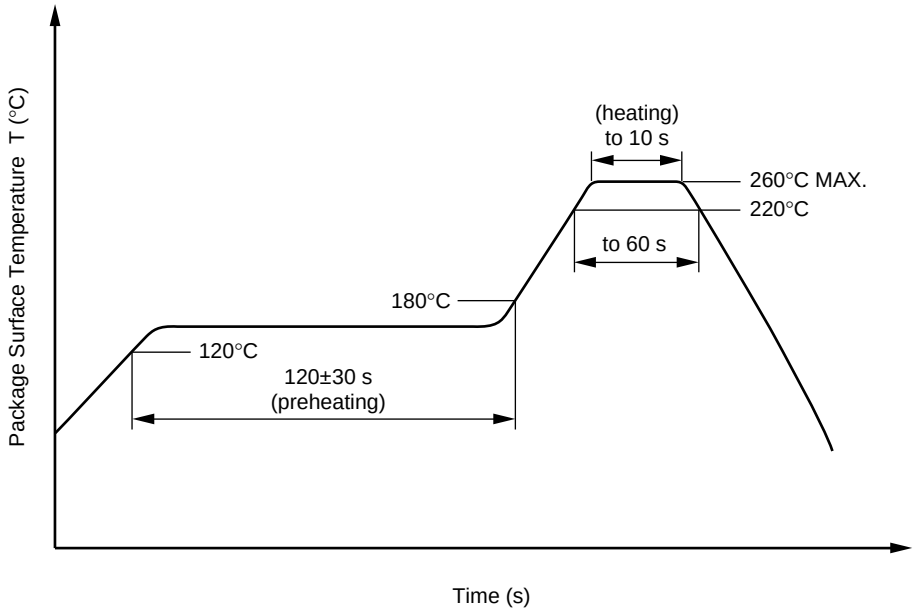
## NOTES ON HANDLING

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

| | |
|---|---|
| • 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.

## SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter | Symbol | Spec. | Unit |
|---|---|---|---|
| Climatic test class (IEC 60068-1/DIN EN 60068-1) | | 40/115/21 | |
| Dielectric strength<br>maximum operating isolation voltage<br>Test voltage (partial discharge test, procedure a for type test and random test)<br>$U_{pr} = 1.6 \times U_{IORM}$, $P_d < 5$ pC | <br>$U_{IORM}$<br>$U_{pr}$ | <br>1 130<br>1 808 | <br>$V_{peak}$<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 | $U_{pr}$ | 2 119 | $V_{peak}$ |
| 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 | $T_{stg}$ | –40 to +125 | °C |
| Operating temperature range | $T_A$ | –40 to +115 | °C |
| Isolation resistance, minimum value<br>$V_{IO}$ = 500 V dc at $T_A$ = 25°C<br>$V_{IO}$ = 500 V dc at $T_A$ MAX. at least 100°C | <br>Ris MIN.<br>Ris MIN. | <br>$10^{12}$<br>$10^{11}$ | <br>Ω<br>Ω |
| Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)<br>Package temperature<br>Current (input current $I_F$, Psi = 0)<br>Power (output or total power dissipation)<br>Isolation resistance<br>$V_{IO}$ = 500 V dc at $T_A$ = Tsi | <br>Tsi<br>Isi<br>Psi<br><br>Ris MIN. | <br>175<br>400<br>700<br><br>$10^9$ | <br>°C<br>mA<br>mW<br><br>Ω |

| | |
|---|---|
| **Caution** GaAs Products | 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.<br>• 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.<br>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.<br>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.<br>• Do not burn, destroy, cut, crush, or chemically dissolve the product.<br>• Do not lick the product or in any way allow it to enter the mouth. |

| Revision History | PS2381-1 Data Sheet |
|---|---|

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 2.00 | Oct 30, 2015 | – | First edition issued |

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