# RV1S9207A

R08DS0220EJ0100
Rev.1.00
Mar 29,2021

0.6 A OUTPUT CURRENT, HIGH CMR, IGBT GATE DRIVE,
5-PIN SSOP (LSSO5) PHOTOCOUPLER

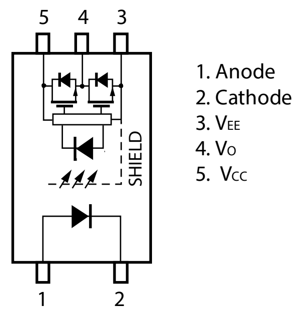
## DESCRIPTION

The RV1S9207A is an optical coupled isolator containing an AlGaAs LED on the input side and a photo diode, a signal processing circuit and power output MOS FETs on the output side on one chip.
The RV1S9207A is designed specifically for high common mode transient immunity (CMR) and high switching speed. It is suitable for driving IGBTs and MOS FETs.

## FEATURES

- Small and long creepage (8.2 mm MIN, LSSO5)
- Peak output current (0.6 A MAX., 0.4 A MIN.)
- High speed switching ($t_{PLH}$, $t_{PHL}$ = 150 ns MAX.)
- High common mode transient immunity ($CM_H$, $CM_L$ = ± 50 kV/μs MIN.)
- Operating Ambient Temperature (125 °C MAX.)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- Embossed tape product : RV1S9207ACCSP-10Yx#KC0 : 3 500 pcs/reel
- Pb-Free product
- Safety standard
  - UL : UL1577, Double protection
  - CSA : CAN/CSA-C22.2 No.62368-1, Reinforced insulation
  - VDE : DIN EN 60747-5-5 (Option)

PIN CONNECTION
(Top View)

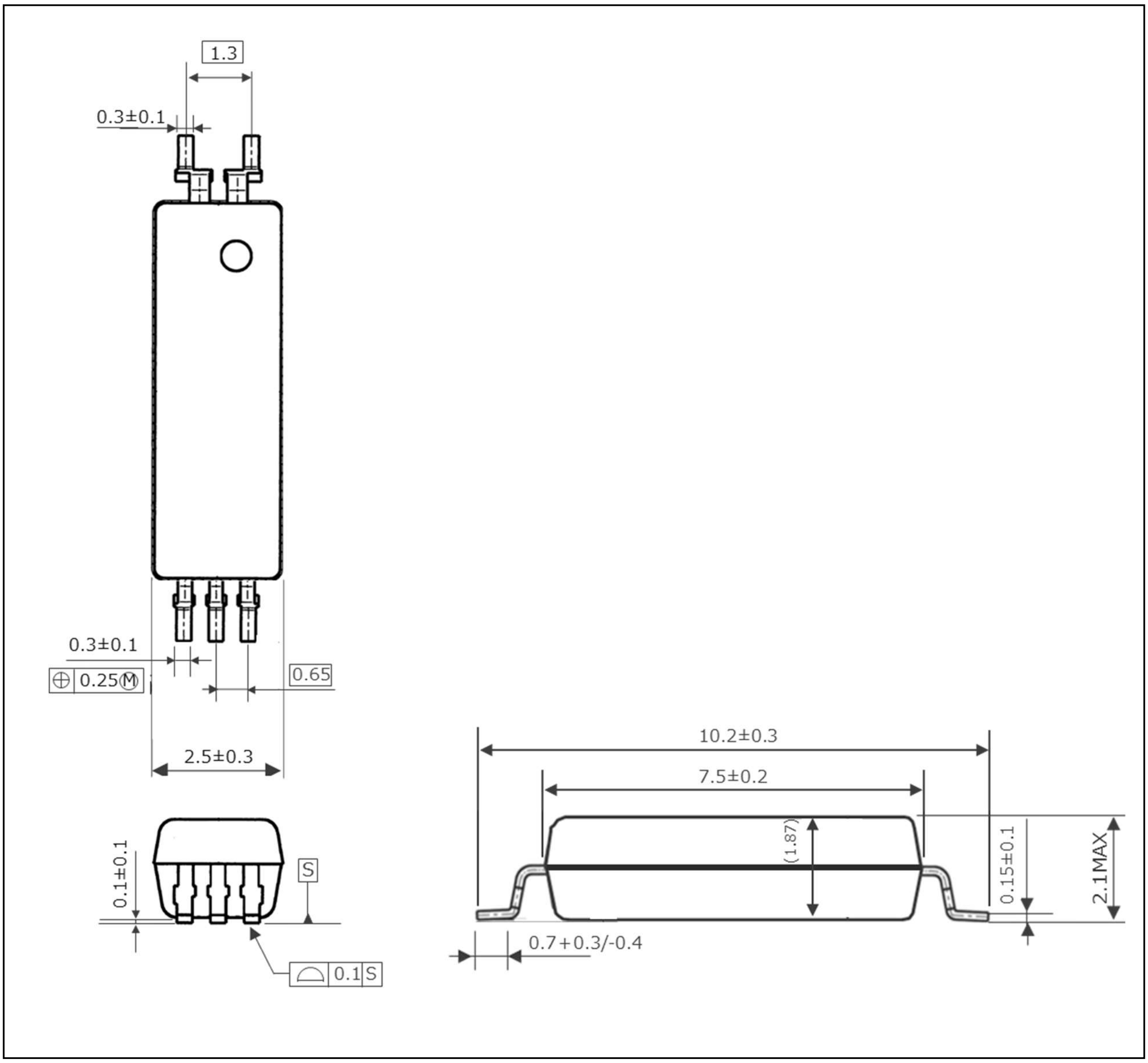



## APPLICATIONS

- IGBT, Power MOS FET Gate Driver
- Industrial inverter
- AC Servo

Start of mass production
Feb.2021

## PACKAGE DIMENSIONS (UNIT : mm)




Weight :0.075g（Typ.）

## PHOTOCOUPLER CONSTRUCTION

| Parameter | MIN. |
|---|---|
| Air Distance | 8.2 mm |
| Creepage Distance | 8.2 mm |
| Isolation Distance | 0.15 mm |

## MARKING EXAMPLE


| | | | |
|---|---|---|---|
| R | | | An initial of “Renesas” |
| 9207 | | | Product Part Number＊ |
| ○ | | | No.1 pin Mark |
| N744 | N | | Rank Code |
| | 744 | | Assembly Lot |
| | | 7 | Last one-digit of Assembly Year |
| | | 44 | Weekly Serial Code |

＊） Applicable type numbers listed below

RV1S 9207 ACCSP-10Yx

Marking type number. ”RV1S”and “ACCSP-10Yx” are omitted from original type number.

## ORDERING INFORMATION

| Part Number | Order Number | Solder Plating Specification | Packing Style | Safety Standard Approval | Application Part Number*1 |
|---|---|---|---|---|---|
| RV1S9207ACCSP -10YC | RV1S9207ACCSP -10YC#SC0 | Pb-Free and Halogen Free (Ni/Pd/Au) | 20 pcs (Tape 20 pcs cut) | Standard products (UL, CSA approved) | RV1S9207A |
| | RV1S9207ACCSP -10YC#KC0 | | Embossed Tape 3 500 pcs/reel | | |
| RV1S9207ACCSP -10YV | RV1S9207ACCSP -10YV#SC0 | | 20 pcs (Tape 20 pcs cut) | UL, CSA, DIN EN 60747-5-5 approved | |
| | RV1S9207ACCSP -10YV#KC0 | | Embossed Tape 3 500 pcs/reel | | |

Notes:*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 | $I_F$ | 20 | mA |
| | Peak Transient Forward Current (Pulse Width < 1 us) | $I_{F\ (TRAN)}$ | 1.0 | A |
| | Reverse Voltage | $V_R$ | 5 | V |
| | Power Dissipation Derating | $\Delta P_D$/°C | 1.2 ($T_A$ ≧ 110 °C) | mW/°C |
| | Power Dissipation | $P_D$ | 45 | mW |
| Detector | High Level Peak Output Current *2 | $I_{OH\ (PEAK)}$ | 0.6 | A |
| | Low Level Peak Output Current *2 | $I_{OL\ (PEAK)}$ | 0.6 | A |
| | Supply Voltage | $V_{CC}$-$V_{EE}$ | 0 to 35 | V |
| | Output Voltage | $V_O$ | 0 to $V_{CC}$ | V |
| | Power Dissipation Derating | $\Delta P_C$/°C | 3.9 ($T_A$ ≧ 85 °C) | mW/°C |
| | Power Dissipation | Pc | 250 | mW |
| Isolation Voltage *1 | | BV | 5 000 | Vr.m.s. |
| Operating Frequency | | f | 250 | kHz |
| Operating Ambient Temperature | | $T_A$ | –40 to +125 | °C |
| Storage Temperature | | $T_{stg}$ | –55 to +150 | °C |

Notes: *1. AC voltage for 1 minute at $T_A$ = 25 °C, RH = 60 % between input and output.
Pins 1-2 shorted together, 3-5 shorted together.
*2. Maximum pulse width = 10 μs, Maximum duty cycle = 0.5 %

## RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ – $V_{EE}$ | 10 | | 30 | V |
| Forward Current (ON) | $I_{F\ (ON)}$ | 8 | 10 | 12 | mA |
| Forward Voltage (OFF) | $V_{F\ (OFF)}$ | –2 | | 0.8 | V |
| Operating Ambient Temperature | $T_A$ | –40 | | 125 | °C |

## ELECTRICAL CHARACTERISTICS (at RECOMMENDED OPERATING CONDITIONS, $V_{EE}$ = GND, unless otherwise specified)

| Parameter | | Symbol | Conditions | MIN. | TYP.*1 | MAX. | Unit |
|---|---|---|---|---|---|---|---|
| Diode | Forward Voltage | $V_F$ | $I_F$ = 10 mA, $T_A$ = 25 °C | 1.35 | 1.56 | 1.75 | V |
| | Reverse Current | $I_R$ | $V_R$ = 3 V, $T_A$ = 25 °C | | | 10 | μA |
| | Input Capacitance | $C_t$ | $V_F$ = 0 V, f = 1 MHz, $T_A$ = 25 °C | | 30 | | pF |
| Detector | High Level Output Current | $I_{OH}$ | $V_O$ = ($V_{CC}$ – 4 V) *2 | 0.2 | | | A |
| | | | $V_O$ = ($V_{CC}$ – 10 V) *3 | 0.4 | | | |
| | Low Level Output Current | $I_{OL}$ | $V_O$ = ($V_{EE}$ + 2.5 V) *2 | 0.2 | | | A |
| | | | $V_O$ = ($V_{EE}$ + 10 V) *3 | 0.4 | | | |
| | High Level Output Voltage | $V_{OH}$ | $I_O$ = -100 mA *4 | $V_{CC}$ – 3.0 V | $V_{CC}$ – 1.5 V | | V |
| | Low Level Output Voltage | $V_{OL}$ | $I_O$ = 100 mA | | 0.25 | 1.0 | V |
| | High Level Supply Current | $I_{CCH}$ | $V_O$ = Open, $I_F$ = 10 mA | | 1.4 | 2.0 | mA |
| | Low Level Supply Current | $I_{CCL}$ | $V_O$ = Open, $V_F$ = 0 to 0.8 V | | 1.3 | 2.0 | mA |
| | UVLO Threshold | $V_{UVLO+}$ | $V_O$ > 5 V, $I_F$ = 10 mA | | 8.6 | 9.8 | V |
| | | $V_{UVLO-}$ | | 6.8 | 8.2 | | |
| | UVLO Hysteresis | $UVLO_{HYS}$ | | | 0.4 | | |
| Coupled | Threshold Input Current (L → H) | $I_{FLH}$ | $I_O$ = 0 mA, $V_O$ > 5 V | | 2.2 | 5.0 | mA |
| | Threshold Input Voltage (H → L) | $V_{FHL}$ | $I_O$ = 0 mA, $V_O$ < 5 V | 0.8 | | | V |

Notes: *1. Typical values at $T_A$ = 25 °C, $V_{CC}$ – $V_{EE}$ = 30 V.
*2. Maximum pulse width = 50 μs, Maximum duty cycle = 0.2 %.
*3. Maximum pulse width = 10 μs, Maximum duty cycle = 0.5 %.
*4. $V_{OH}$ is measured with the pulse load current in this testing (Maximum pulse width = 2 ms, Maximum duty cycle = 20 %).

## SWITCHING CHARACTERISTICS (at RECOMMENDED OPERATING CONDITIONS, $V_{EE}$ = GND, unless otherwise specified)

| Parameter | Symbol | Conditions | MIN. | TYP.*1 | MAX. | Unit |
|---|---|---|---|---|---|---|
| Propagation Delay Time (L → H) | $t_{PLH}$ | $R_g$ = 47 Ω, $C_g$ = 3 nF, f = 50 kHz, Duty Cycle = 50 %, $I_F$ = 10 mA, $V_{CC}$ = 30 V | 50 | 100 | 150 | ns |
| Propagation Delay Time (H → L) | $t_{PHL}$ | | 50 | 90 | 150 | ns |
| Pulse Width Distortion (PWD) | $\|t_{PHL}–t_{PLH}\|$ | | | 5 | 50 | ns |
| Propagation Delay Difference Between Any Two Parts (PDD) | $t_{PHL}–t_{PLH}$ | | –80 | | 80 | ns |
| Rise Time | $t_r$ | | | 6 | | ns |
| Fall Time | $t_f$ | | | 7 | | ns |
| Common Mode Transient Immunity at High Level Output | $\|CM_H\|$ | $V_{CC}$ = 30 V, $I_F$ =10 mA, $T_A$ = 25 °C, $\|V_{CM}\|$ = 1.5 kV | 50 | | | kV/μs |
| Common Mode Transient Immunity at Low Level Output | $\|CM_L\|$ | $V_{CC}$ = 30 V, $I_F$ = 0 mA, $T_A$ = 25 °C, $\|V_{CM}\|$ = 1.5 kV | 50 | | | kV/μs |

Notes: *1. Typical values at $T_A$ = 25 °C, $V_{CC}$–$V_{EE}$ = 30 V.

# TEST CIRCUIT

**Fig. 1 IOH Test Circuit**

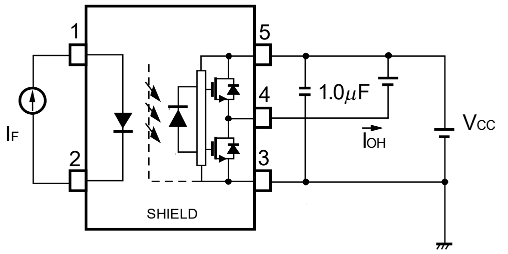



**Fig. 2 IOL Test Circuit**

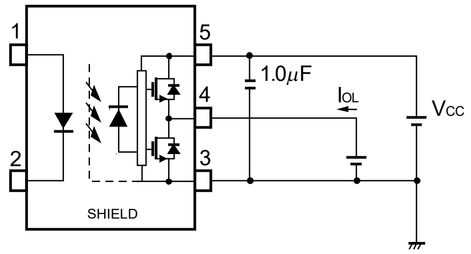



**Fig. 3 VOH Test Circuit**

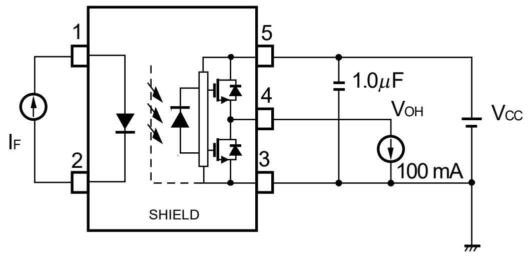



**Fig. 4 VOL Test Circuit**

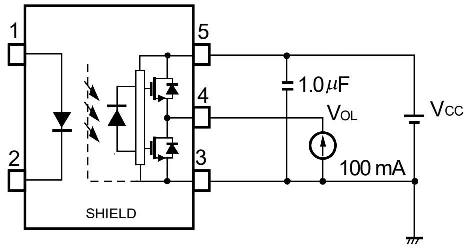



**Fig. 5 ICCH/ICCL Test Circuit**

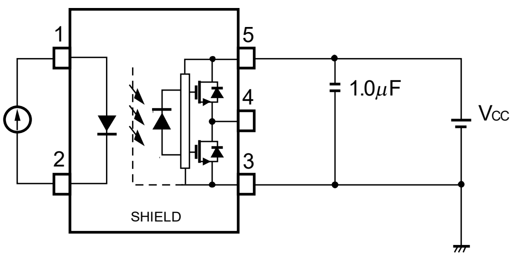



**Fig. 6 UVLO Test Circuit**

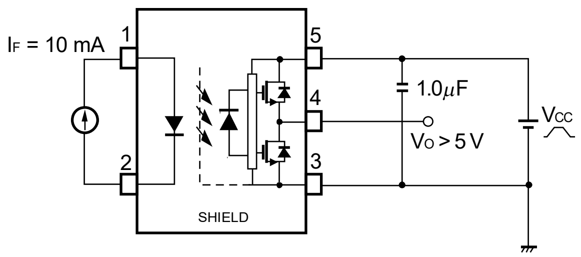


**Fig. 7 $I_{FLH}$ Test Circuit**

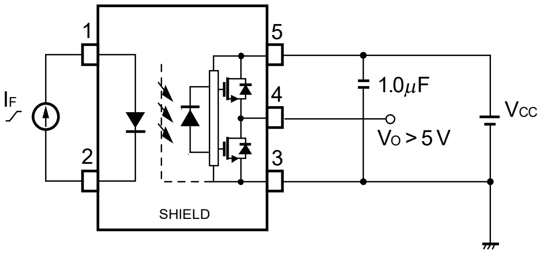



**Fig. 8 $t_{PLH}$, $t_{PHL}$, $t_r$, $t_f$ Test Circuit and Wave Forms**

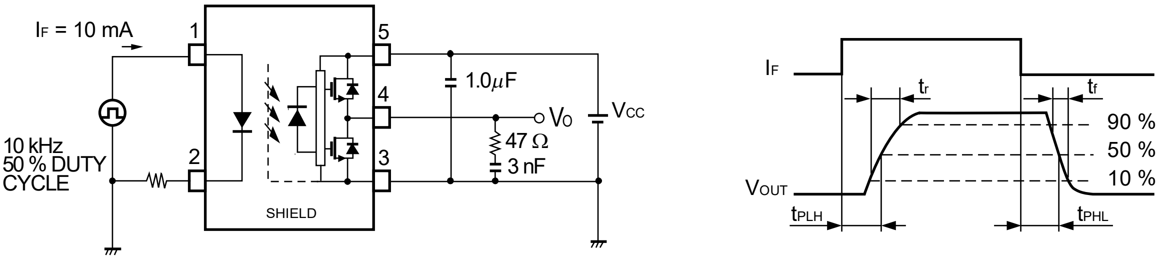
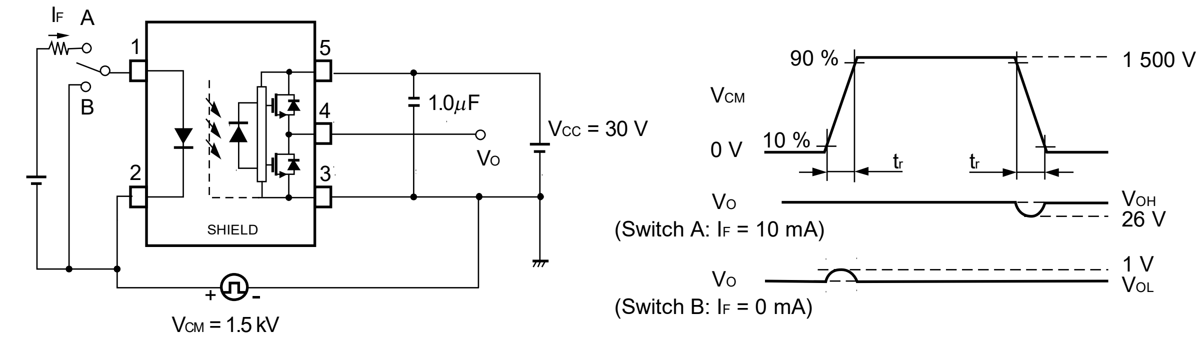
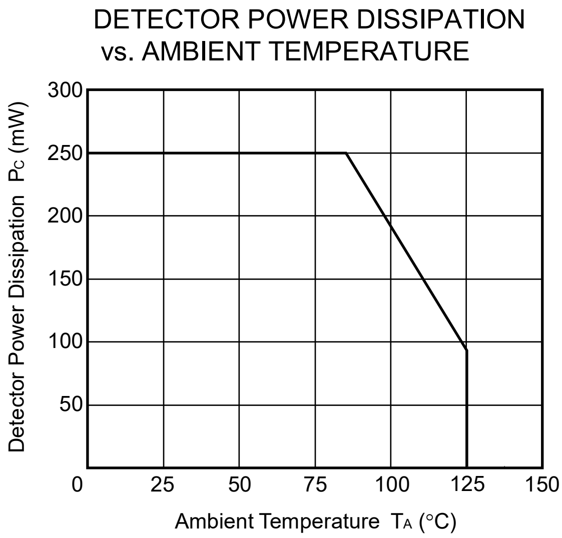
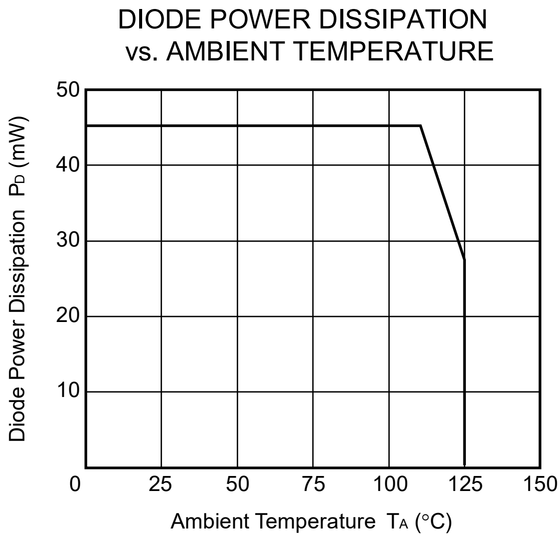


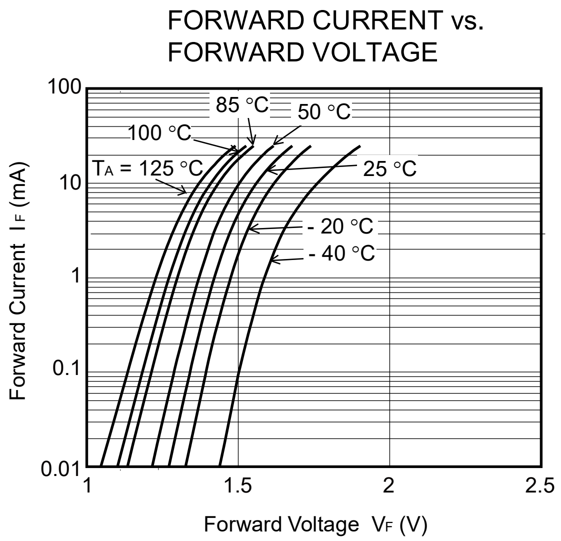

**Fig. 9 CMR Test Circuit and Wave Forms**

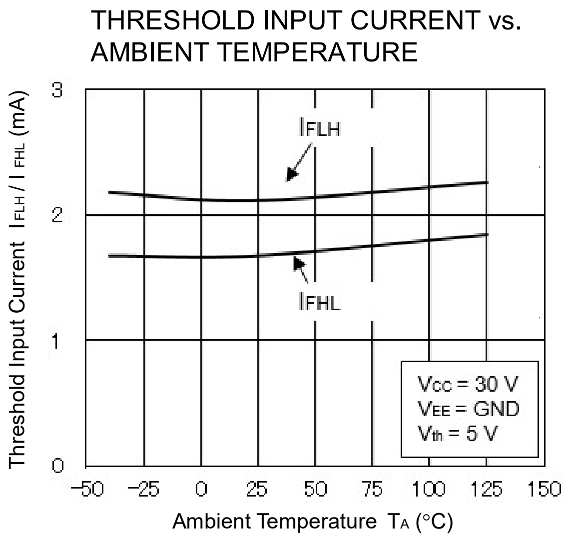


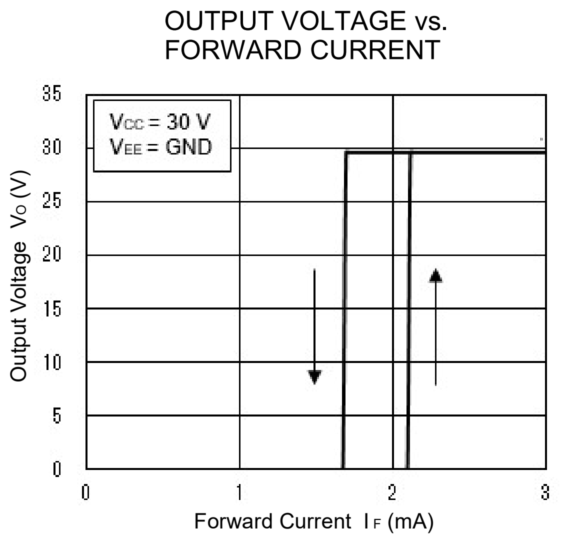
# TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise specified)

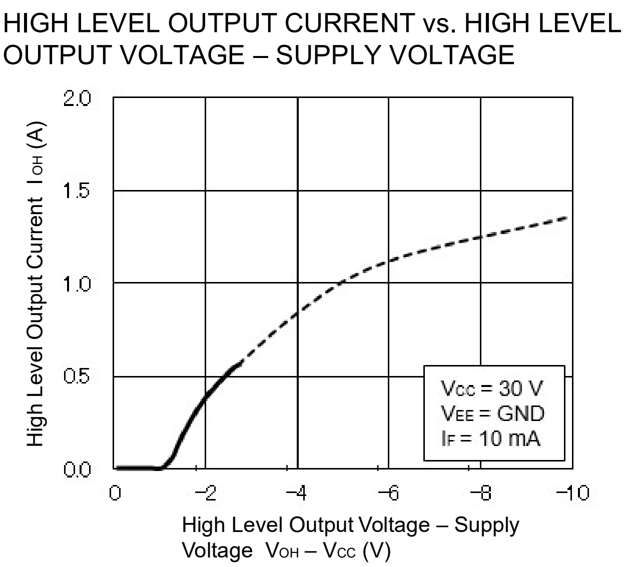


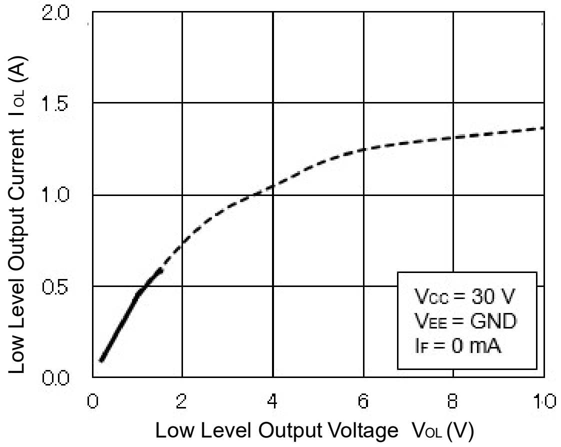



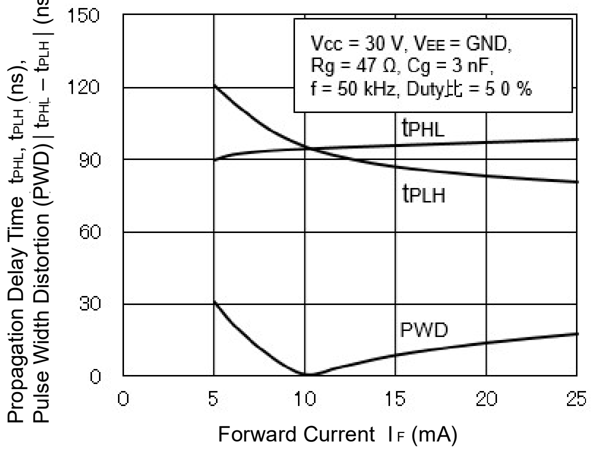

**Remark** The graphs indicate nominal characteristics.

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

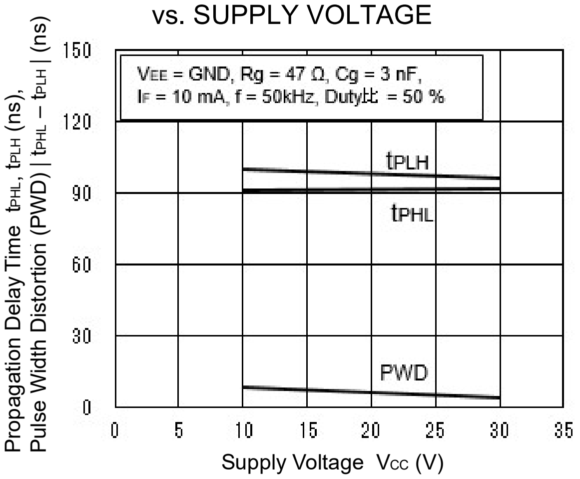
LOW LEVEL OUTPUT CURRENT vs. LOW LEVEL OUTPUT VOLTAGE



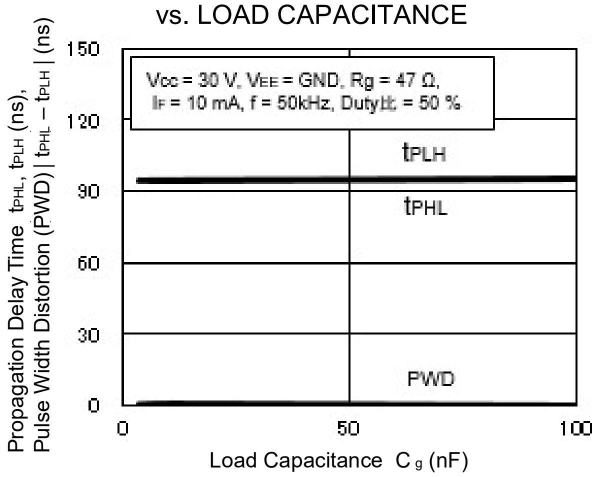

PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



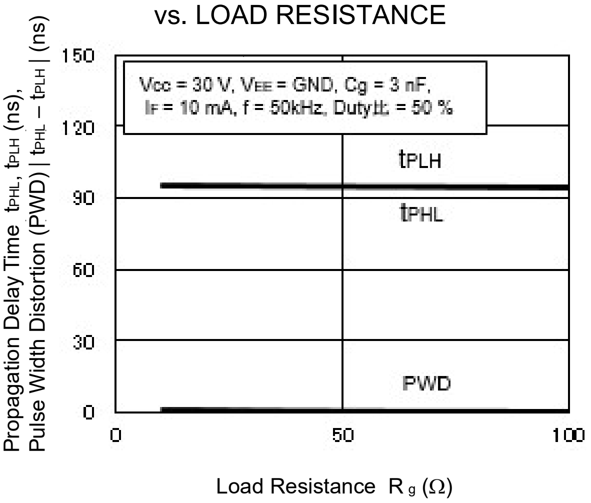

PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. SUPPLY VOLTAGE



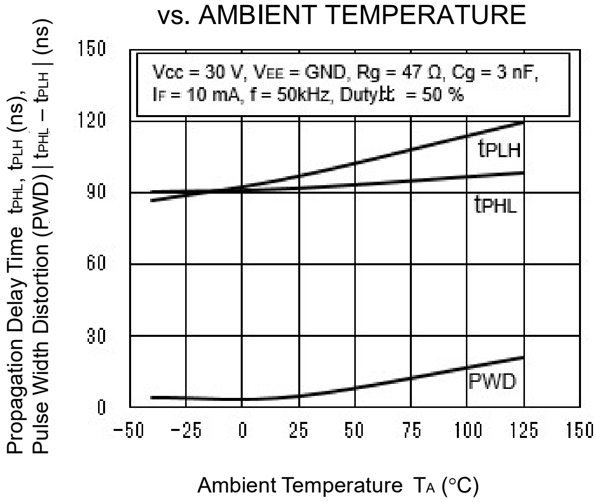

PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. LOAD CAPACITANCE




PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. LOAD RESISTANCE



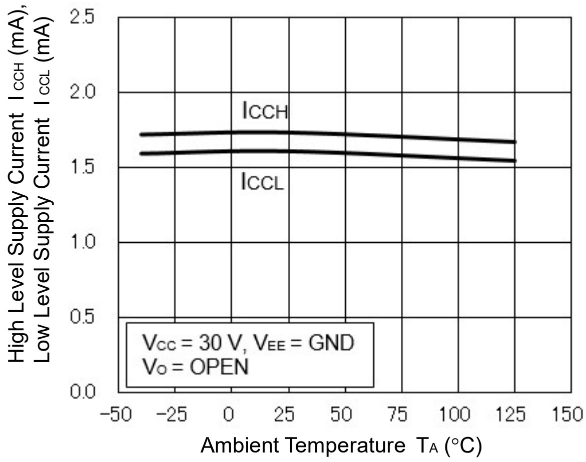

PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



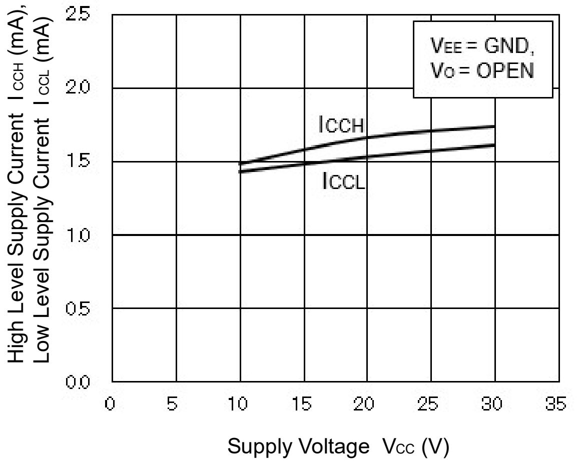

**Remark** The graphs indicate nominal characteristics.

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

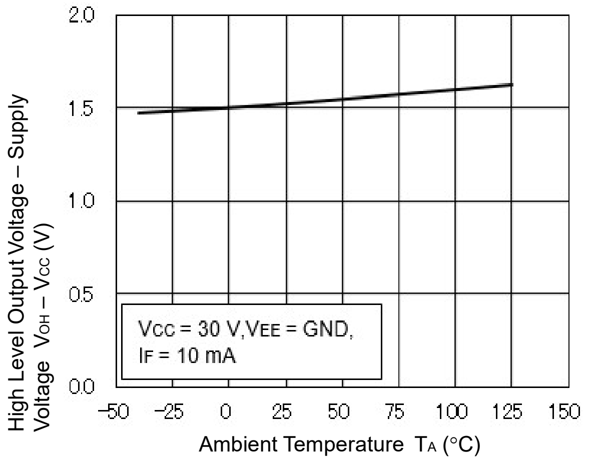
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



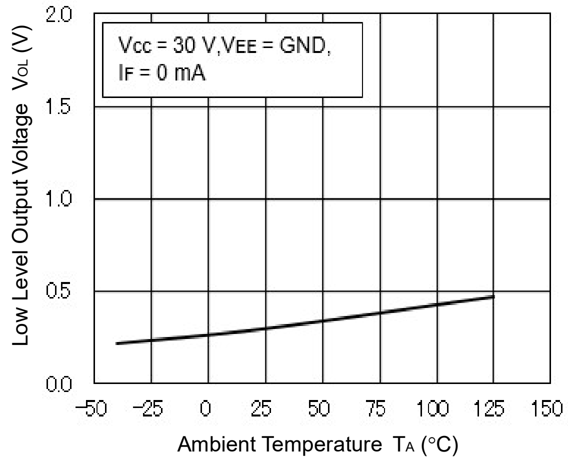

SUPPLY CURRENT vs.
SUPPLY VOLTAGE



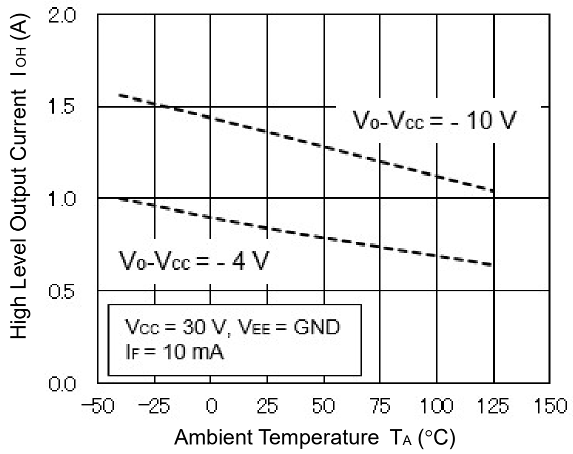

HIGH LEVEL OUTPUT VOLTAGE – SUPPLY
VOLTAGE vs. AMBIENT TEMPERATURE



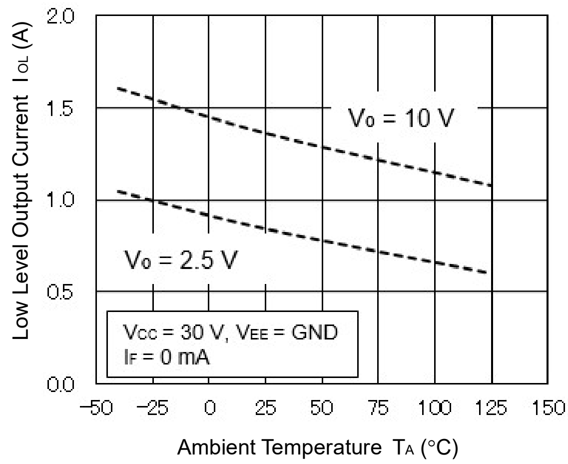

LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE




HIGH LEVEL OUTPUT CURRENT vs.
AMBIENT TEMPERATURE



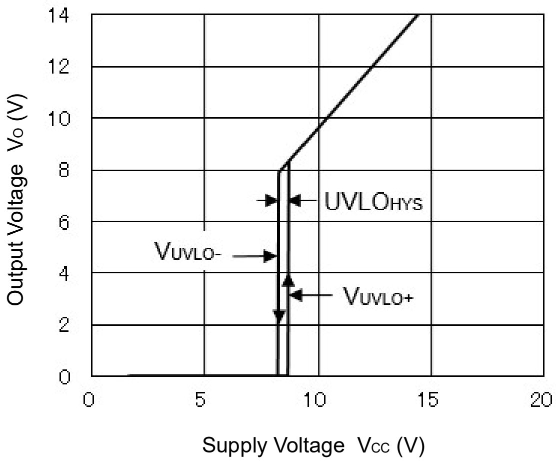

LOW LEVEL OUTPUT CURRENT vs.
AMBIENT TEMPERATURE




**Remark** The graphs indicate nominal characteristics.

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

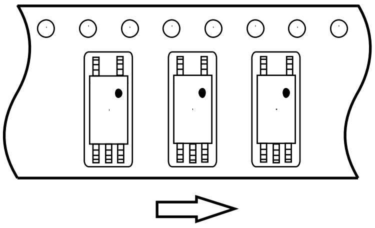
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE




**Remark** The graphs indicate nominal characteristics.

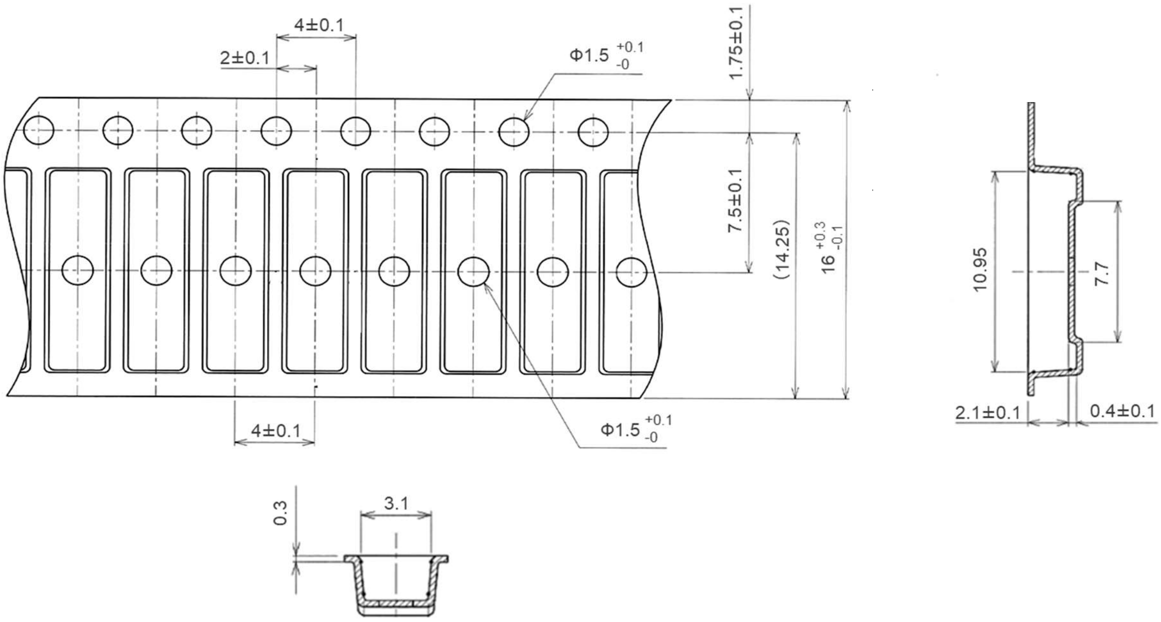
## TAPING SPECIFICATIONS (UNIT : mm)

### Tape Direction



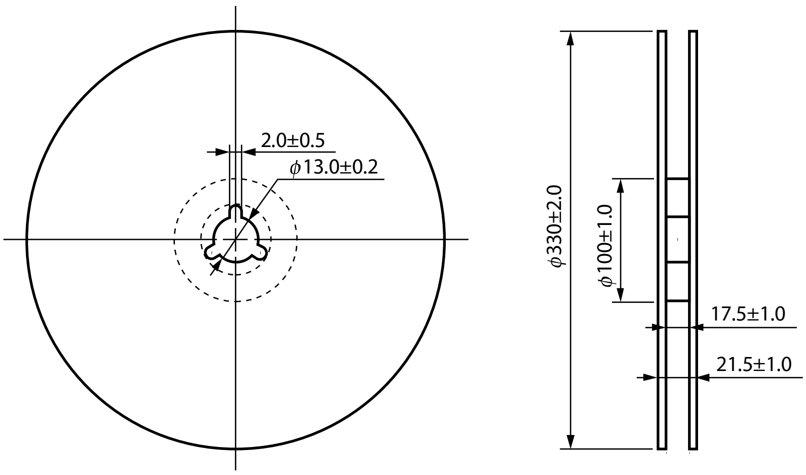

### Outline and Dimensions (Tape)

(Unit : mm)



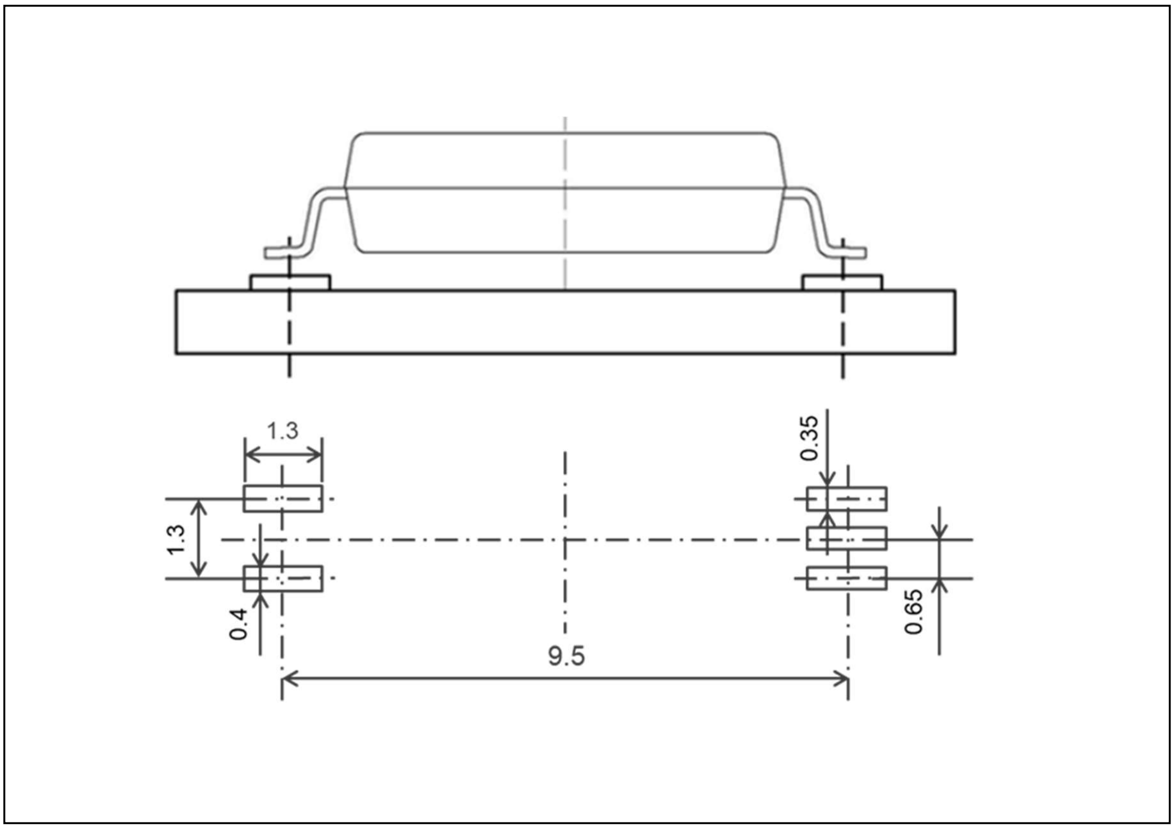

### Outline and Dimensions (Reel)

(Unit : mm)




Packing: 3 500 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT : mm)




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

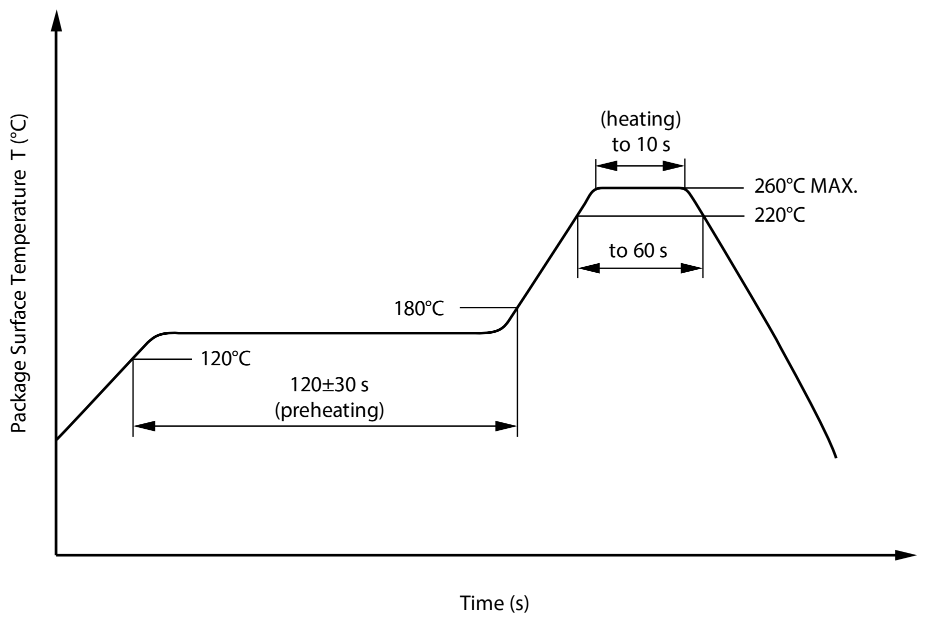
# NOTES ON HANDLING

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 at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

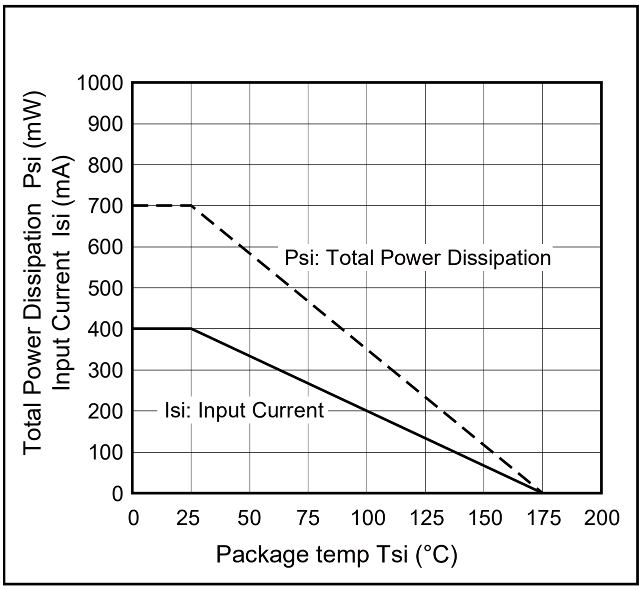
## USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. Board designing
   (1) By-pass capacitor of more than 1.0 $\mu$F is used between $V_{CC}$ and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
   (2) When designing the printed wiring board, ensure that the pattern of the IGBT collectors/emitters is not too close to the input block pattern of the photocoupler.
   If the pattern is too close to the input block and coupling occurs, a sudden fluctuation in the voltage on the IGBT output side might affect the photocoupler's LED input, leading to malfunction or degradation of characteristics.
   (If the pattern needs to be close to the input block, to prevent the LED from lighting during the off state due to the abovementioned coupling, design the input-side circuit so that the bias of the LED is reversed, within the range of the recommended operating conditions, and be sure to thoroughly evaluate operation.)
3. Make sure the rise/fall time of the forward current is 0.5 $\mu$s or less.
4. In order to avoid malfunctions, make sure the rise/fall slope of the supply voltage is 3 V/$\mu$s or less.
5. Avoid storage at a high temperature and high humidity.

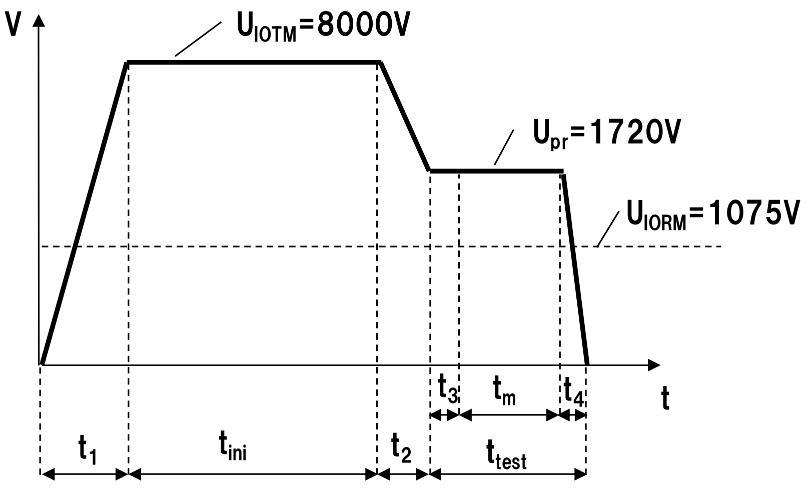
## SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Climatic test class (IEC 60068-1/DIN EN 60068-1) | | 40/125/21 | |
| 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 | $U_{IORM}$<br>$U_{pr}$ | 1 075<br>1 720 | $V_{peak}$<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 | $U_{pr}$ | 2 016 | $V_{peak}$ |
| Highest permissible overvoltage | $U_{IOTM}$ | 8 000 | $V_{peak}$ |
| 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 | 400 | |
| Material group (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1)) | | II | |
| Storage temperature range | $T_{stg}$ | −55～+150 | °C |
| Operating temperature range | $T_A$ | −40～+125 | °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 | Ris MIN.<br>Ris MIN. | $10^{12}$<br>$10^{11}$ | 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$V_{IO}$ = 500 V dc at $T_A$ = Tsi | Tsi<br>Isi<br>Psi<br>Ris MIN. | 175<br>400<br>700<br>$10^9$ | °C<br>mA<br>mW<br>Ω |

### Dependence of maximum safety ratings with package temperature

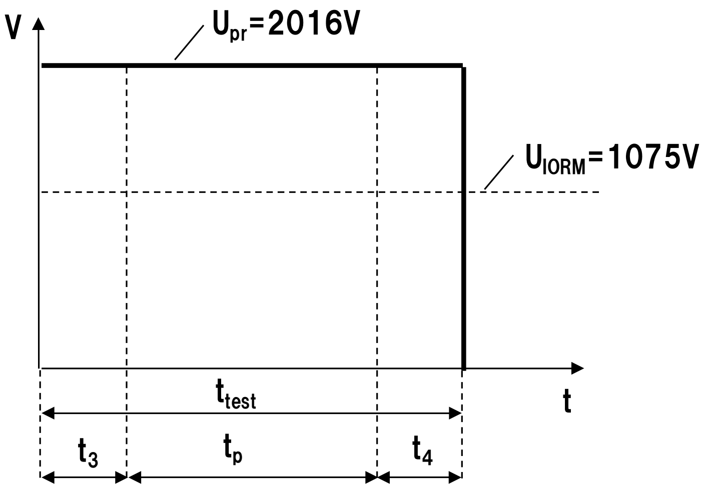


**Method a) Destructive Test, Type and Sample Test**




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

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




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

| | |
|---|---|
| **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. |

## Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com


## Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

## Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit: www.renesas.com/contact/.