

PS9009

R08DS0133EJ0200

Rev.2.00

Mar 11, 2016

LOW IF TOTEM POLE OUTPUT TYPE HIGH CMR, IPM DRIVER, 5-PIN SSOP (LSO5) PHOTOCOUPLER

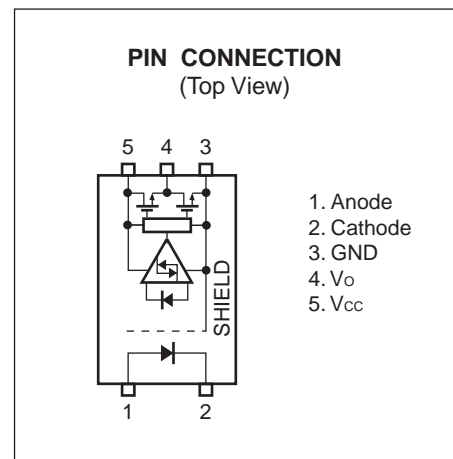
DESCRIPTION

The PS9009 is optical coupled high-speed, totem pole output (active high output type) isolators containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

The PS9009 is specified high CMR and pulse width distortion with operating temperature. It is suitable for IPM (Intelligent Power Module) drive.

FEATURES

- Long creepage distance (8 mm MIN.)
- Totem pole output (Active High Output Type)
- Pulse width distortion ($|t_{PLH} - t_{PHL}| = 80 \text{ ns MAX.}$)
- High common mode transient immunity ($CM_H, CM_L = \pm 50 \text{ kV}/\mu\text{s MIN.}$)
- Operating Ambient Temperature (125 °C MAX.)
- High isolation voltage ($BV = 5\,000 \text{ Vr.m.s.}$)
- Embossed tape product : PS9009-F3: 3 000 pcs/reel
- Pb-Free product
- Safety standards
 - UL approved: UL1577, Double protection
 - CSA approved: CA5A, CAN/CSA-C22.2 60065, CAN/CSA-C22.2 60950-1, Reinforced insulation)
 - VDE approval: DIN EN 60747-5-5 (Option)



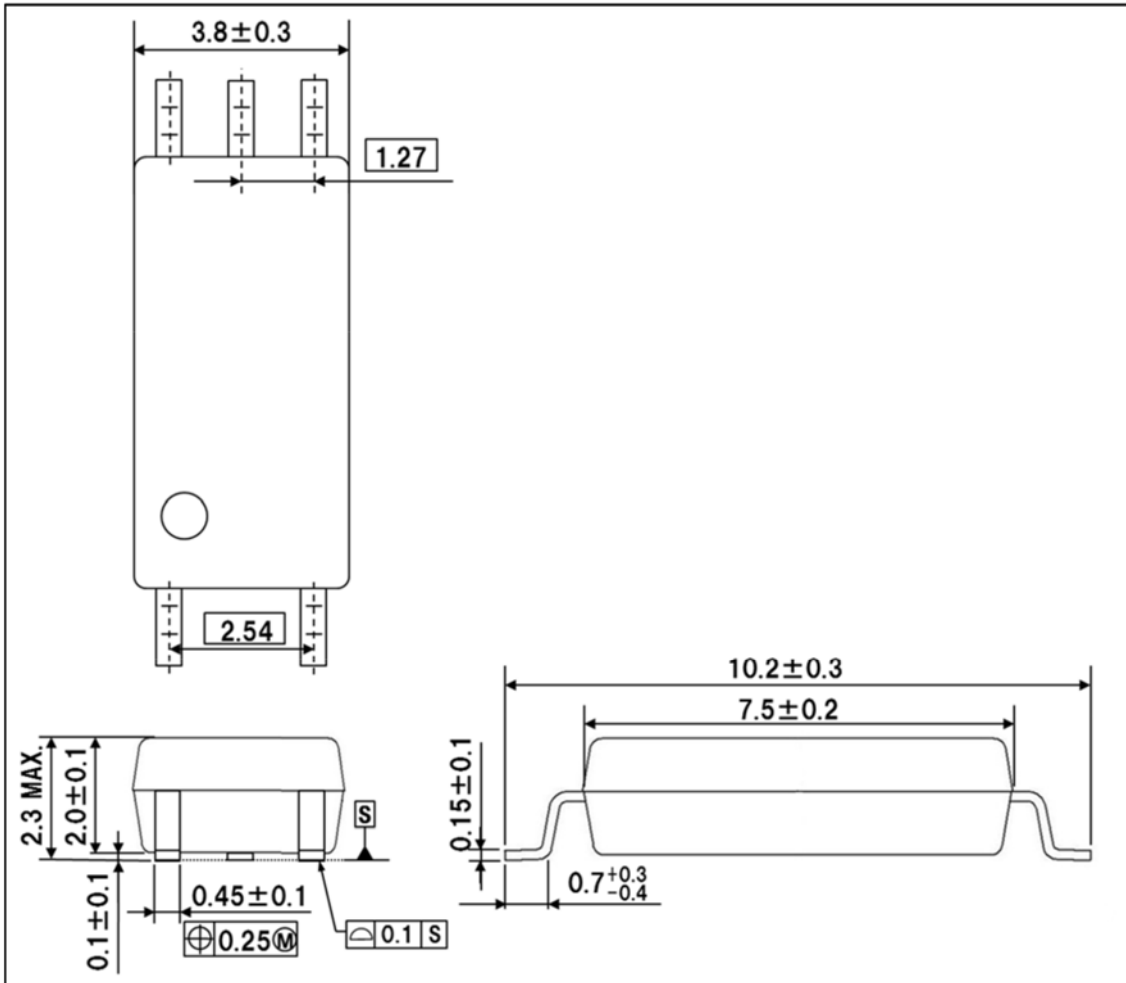
APPLICATIONS

- IPM Driver
- General purpose inverter

Start of mass production

Oct.2015

PACKAGE DIMENSIONS (UNIT: mm)

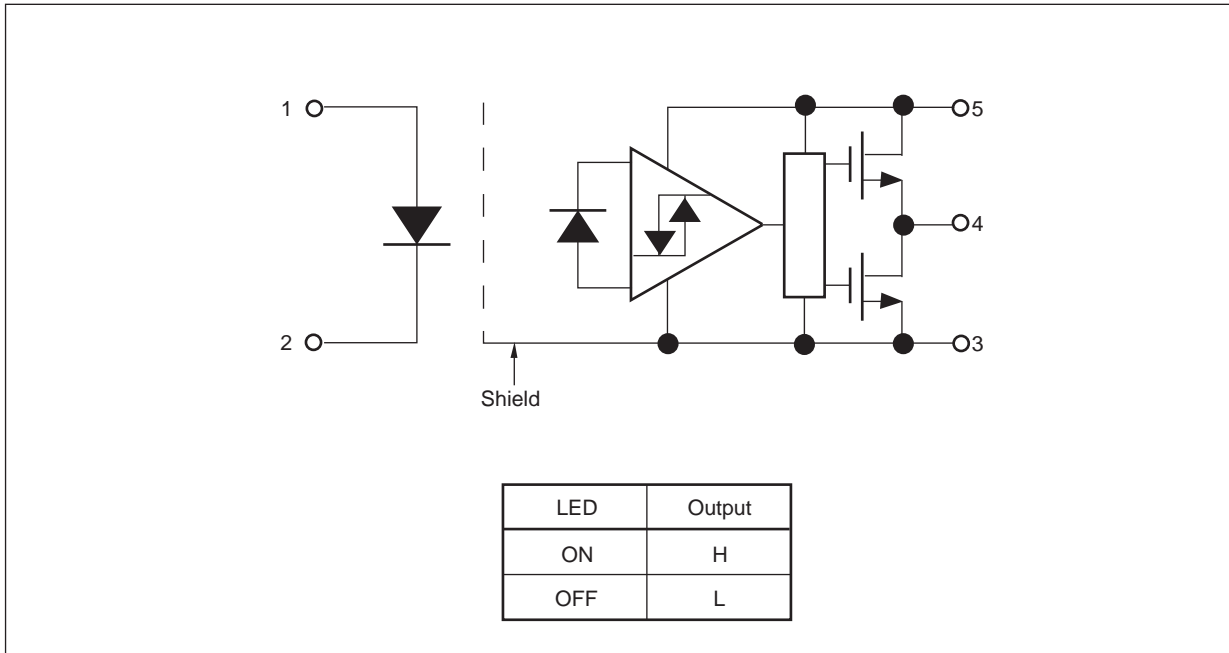


Weight : 0.119g (typ.)

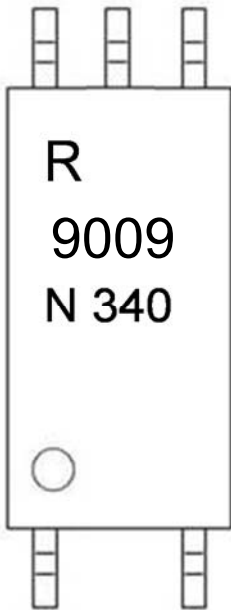
PHOTOCOUPLER CONSTRUCTION

| Parameter | MIN. |
|-------------------------|---------|
| Air Distance | 8 mm |
| Outer Creepage Distance | 8 mm |
| Isolation Distance | 0.15 mm |

BLOCK DIAGRAM



MARKING EXAMPLE



| | | | |
|------|---------------------------|--------------|---------------------------------|
| R | An initial of "Renesas" | | |
| 9009 | Product Part Number | | |
| ○ | No.1 pin Mark, Anode Mark | | |
| N340 | N | Rank Code | |
| | 340 | Assembly Lot | |
| | | 3 | Last one-digit of Assembly Year |
| | | 40 | Weekly Serial Code |

ORDERING INFORMATION

| Part Number | Order Number | Solder Plating Specification | Packing Style | Safety Standard Approval | Application Part Number ^{*1} |
|-------------|------------------|-------------------------------------|------------------------------|---|---------------------------------------|
| PS9009 | PS9009-Y-AX | Pb-Free and Halogen Free (Ni/Pd/Au) | 20 pcs (Tape 20 pcs cut) | Standard products (UL, CSA approved) | PS9009 |
| PS9009-F3 | PS9009-Y-F3-AX | | Embossed Tape 3 000 pcs/reel | | |
| PS9009-V | PS9009-Y-V-AX | | 20 pcs (Tape 20 pcs cut) | UL, CSA approved DIN EN 60747-5-5 (VDE 0884-5): 2011-11 approved (Option) | |
| PS9009-V-F3 | PS9009-Y-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 ^{*1} | I _F | 25 | mA |
| | Reverse Voltage | V _R | 5 | V |
| Detector | Supply Voltage | V _{CC} | -0.5 to +25 | V |
| | Output Voltage | V _O | -0.5 to +25 | V |
| | Output Current | I _O | 25 | mA |
| | Power Dissipation ^{*2} | P _C | 250 | mW |
| Isolation Voltage ^{*3} | | BV | 5 000 | Vr.m.s. |
| Operating Ambient Temperature | | T _A | -40 to +125 | °C |
| Storage Temperature | | T _{stg} | -55 to +150 | °C |

Notes: *1. Reduced to 0.38 mA/°C at T_A = 85°C or more.

*2. Reduced to 4.0 mW/°C at T_A = 85°C or more

*3. AC voltage for 1 minute at T_A = 25°C, RH = 60% between input and output.

Pins 1-3 shorted together, 4-6 shorted together.

RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|-------------------------------|----------------------|------|------|------|------|
| Supply Voltage | V _{CC} | 4.5 | 15 | 20 | V |
| Output Voltage | V _O | 0 | | 20 | V |
| Forward Current (ON) | I _{F (ON)} | 5 | | 10 | mA |
| Forward Voltage (OFF) | V _{F (OFF)} | 0 | | 0.8 | V |
| Operating Ambient Temperature | T _A | -40 | | 125 | °C |

ELECTRICAL CHARACTERISTICS ($T_A = -40$ to $+125^\circ\text{C}$, $V_{CC} = 4.5$ to 20 V, unless otherwise specified)

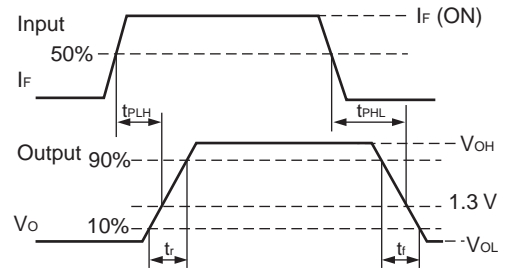
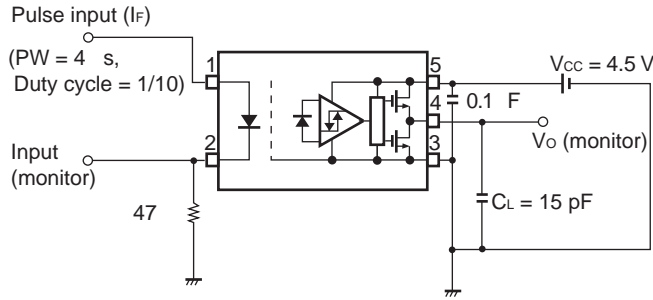
| Parameter | | Symbol | Conditions | MIN. | TYP.*1 | MAX. | Unit |
|---|---|-------------------------------------|---|-----------|--------|------|-------------------|
| Diode | Forward Voltage | V_F | $I_F = 10$ mA, $T_A = 25^\circ\text{C}$ | 1.3 | 1.56 | 1.8 | V |
| | Reverse Current | I_R | $V_R = 3$ V, $T_A = 25^\circ\text{C}$ | | | 10 | μA |
| | Input Capacitance | C_t | $V_F = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$ | | 30 | | pF |
| Detector | High Level Output Voltage | V_{OH} | $V_{CC} = 4.5$ V, $I_O = -2.6$ mA, $I_F = 5$ mA | 2.7 | 3.2 | | V |
| | | | $V_{CC} = 20$ V, $I_O = -2.6$ mA, $I_F = 5$ mA | 17.4 | 18.7 | | |
| | Low Level Output Voltage*2 | V_{OL} | $I_O = 3.5$ mA, $I_F = 0$ mA | | 0.25 | 0.6 | V |
| | High Level Supply Current | I_{CCH} | $V_{CC} = 4.5$ V, $I_F = 5$ mA | | 0.98 | 3 | mA |
| | | | $V_{CC} = 20$ V, $I_F = 5$ mA | | 1.32 | 3 | |
| | Low Level Supply Current | I_{CCL} | $V_{CC} = 4.5$ V, $I_F = 0$ mA | | 1.23 | 3 | mA |
| | | | $V_{CC} = 20$ V, $I_F = 0$ mA | | 1.53 | 3 | |
| | High Level Output Short*3 Circuit Current | I_{OSH} | $V_{CC} = 4.5$ V, $V_O = \text{GND}$, $I_F = 5$ mA | -7 | -45 | | mA |
| Low Level Output Short*3 Circuit Current | I_{OSL} | $V_{CC} = V_O = 4.5$ V, $V_F = 0$ V | 7 | 34 | | mA | |
| Coupled | Threshold Input Current | I_{FLH} | $V_{CC} = 4.5$ V, $V_O > 2.7$ V, $I_O = -2.6$ mA | | 1.52 | 3 | mA |
| | Isolation Resistance | R_{I-O} | $V_{I-O} = 1$ kV _{DC} , $R_H = 60\%$, $T_A = 25^\circ\text{C}$ | 10^{11} | | | Ω |
| | Isolation Capacitance | C_{I-O} | $V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$ | | 0.6 | | pF |
| | Propagation Delay Time (H \rightarrow L)*4 | t_{PHL} | $C_L = 15$ pF, $I_F = 5 \rightarrow 0$ mA, $V_{THHL} = 1.3$ V | | 108 | 200 | ns |
| | Propagation Delay Time (L \rightarrow H)*4 | t_{PLH} | $C_L = 15$ pF, $I_F = 0 \rightarrow 5$ mA, $V_{THLH} = 1.3$ V | | 121 | 200 | ns |
| | Pulse Width Distortion (PWD) | $ t_{PLH} - t_{PHL} $ | $C_L = 15$ pF, $I_F = 5 \leftrightarrow 0$ mA | | 13 | 80 | ns |
| | | | | | | 100 | ns |
| | Maximum Propagation Delays (PDD) | | | | | | |
| | Rise Time (10-90%)*4 | t_r | $C_L = 15$ pF, $I_F = 0 \rightarrow 5$ mA | | 25 | | ns |
| | Fall Time (90-10%)*4 | t_f | $C_L = 15$ pF, $I_F = 5 \rightarrow 0$ mA | | 4.6 | | ns |
| | Common Mode Transient Immunity at High Level Output*5 | CM_H | $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$, $I_F = 5$ mA, $ V_{CM} = 1.5$ kV | 50 | | | kV/ μs |
| | Common Mode Transient Immunity at Low Level Output*5 | CM_L | $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$, $I_F = 0$ mA, $ V_{CM} = 1.5$ kV | 50 | | | kV/ μs |

Notes: *1. Typical values at $T_A = 25^\circ\text{C}$

*2. Because V_O of 2.4 V may be output when the LED current is not input and when output supply of $V_{CC} = 4.5$ V or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

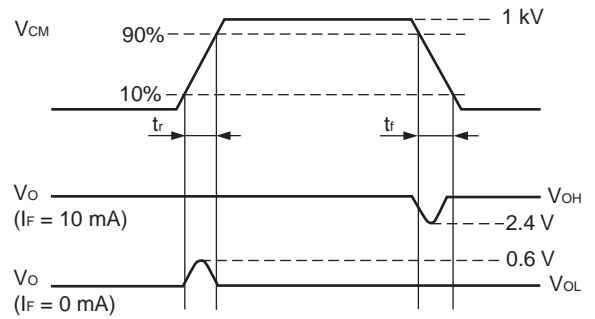
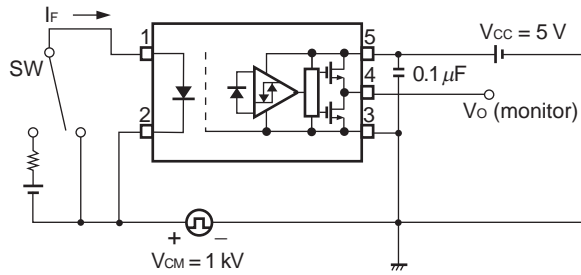
*3. Duration of output short circuit time should not exceed 10 ms.

*4. Test circuit for propagation delay time



Remark C_L includes probe and stray wiring capacitance.

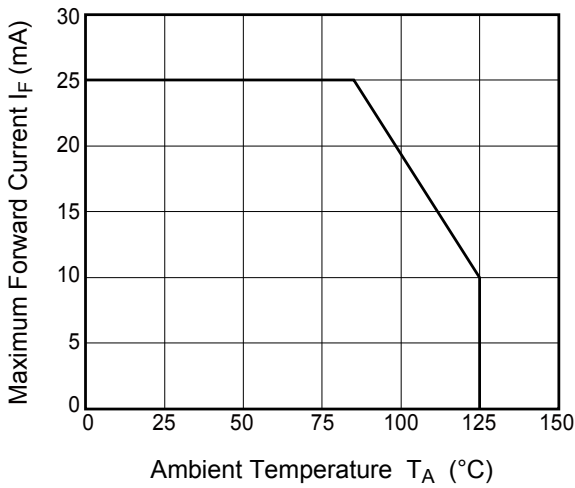
*5. Test circuit for common mode transient immunity



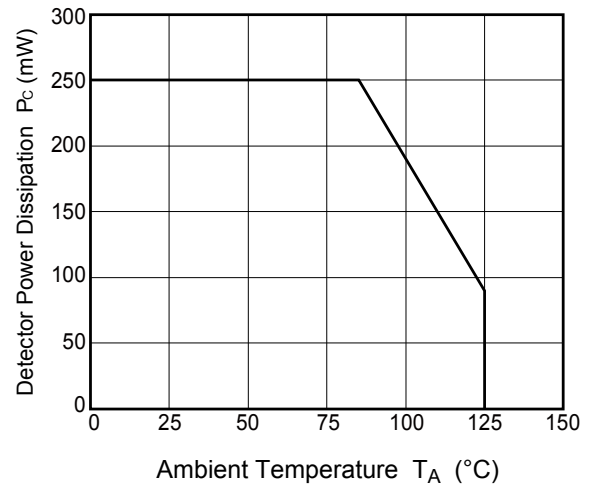
Remark C_L includes probe and stray wiring capacitance.

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

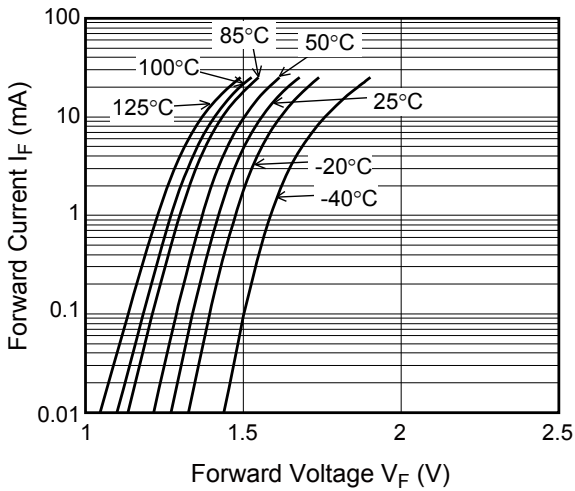
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



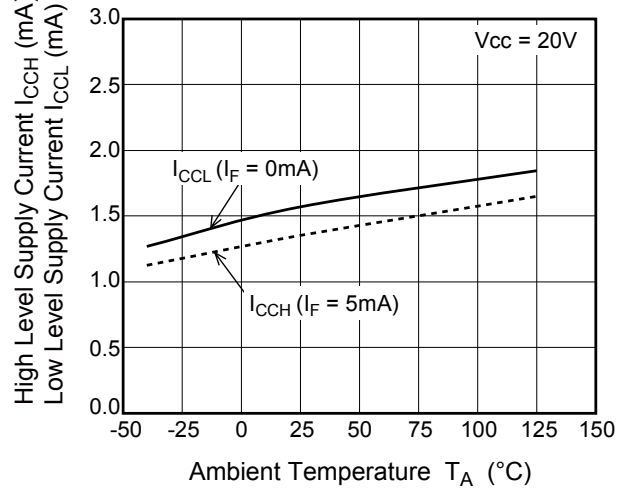
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



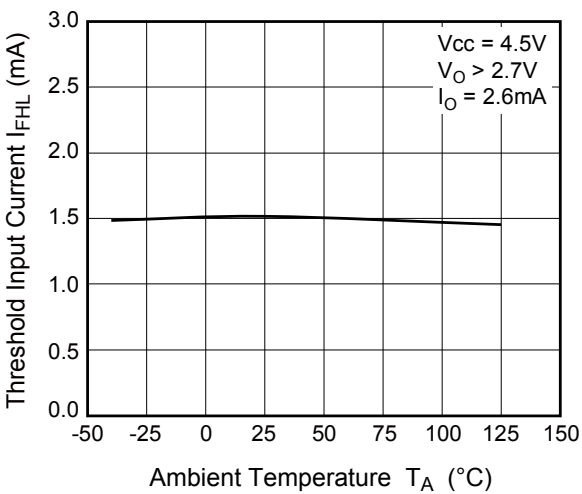
FORWARD CURRENT vs. FORWARD VOLTAGE



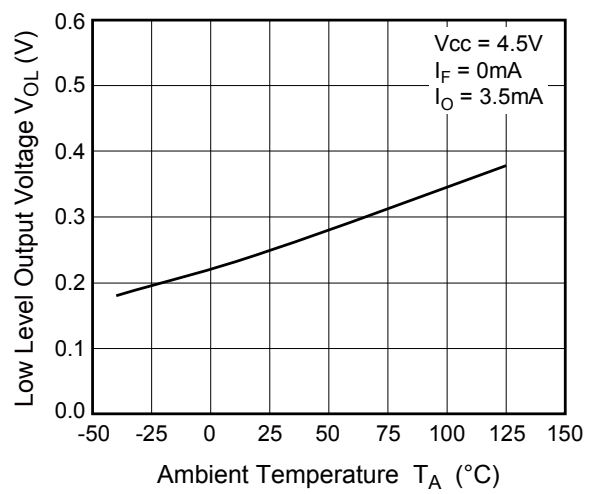
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

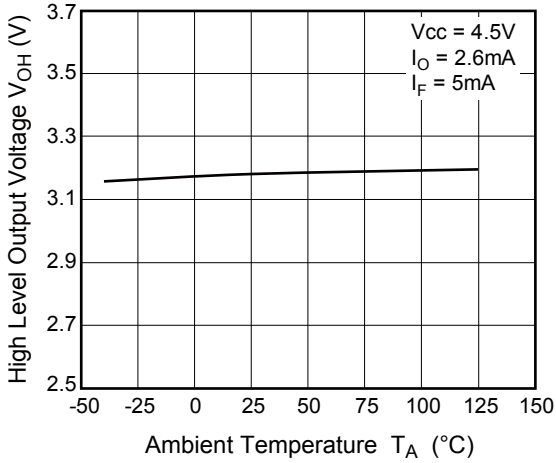


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

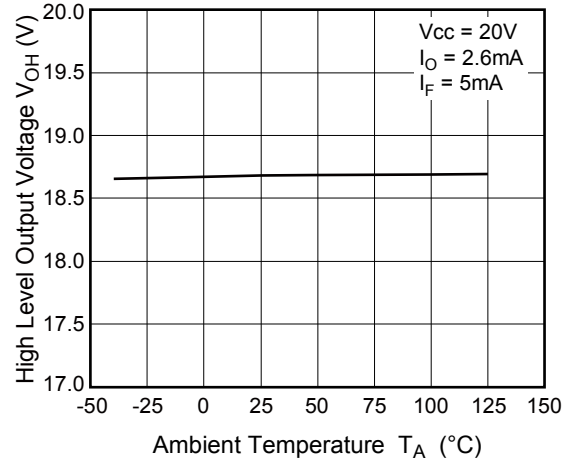


Remark The graphs indicate nominal characteristics.

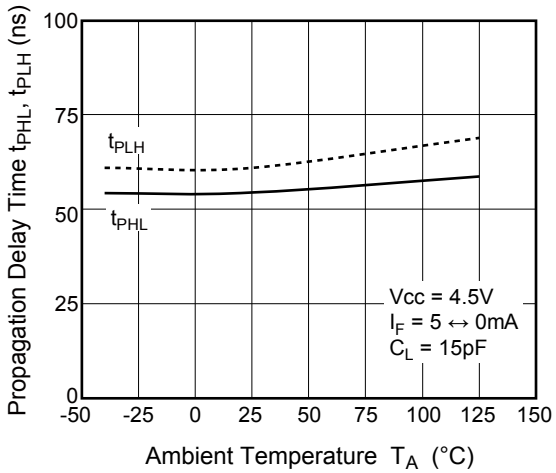
HIGH LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



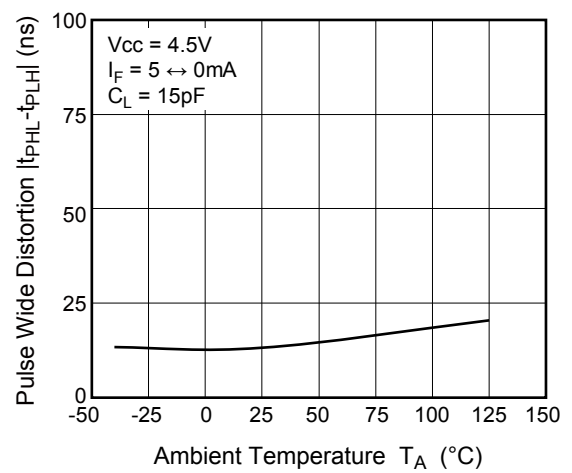
HIGH LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



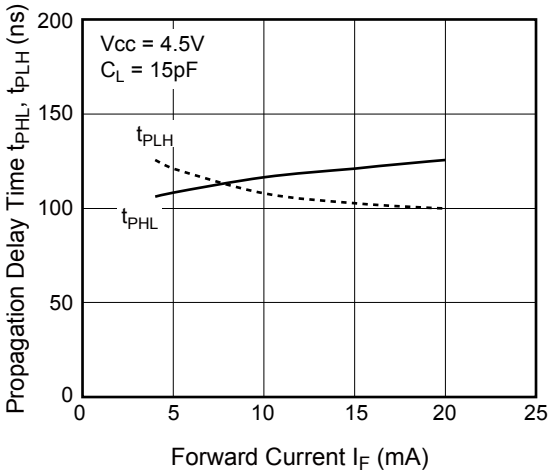
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



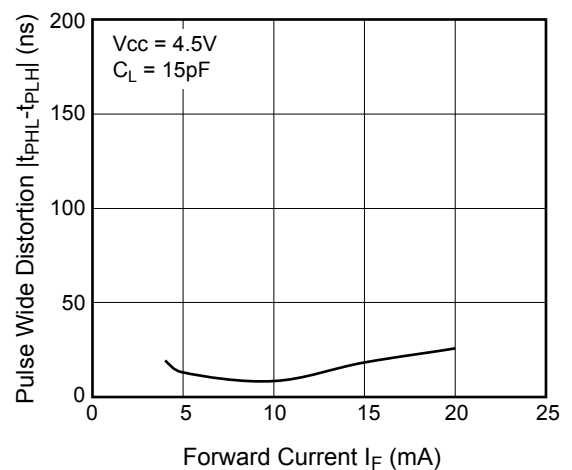
PULSE WIDE DISTORTION vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. FORWARD CURRENT

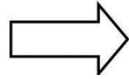
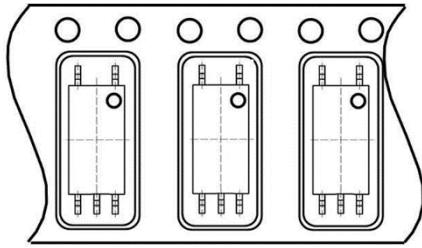


PULSE WIDE DISTORTION vs. FORWARD CURRENT



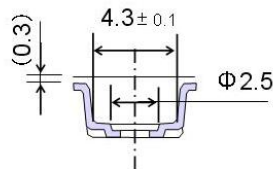
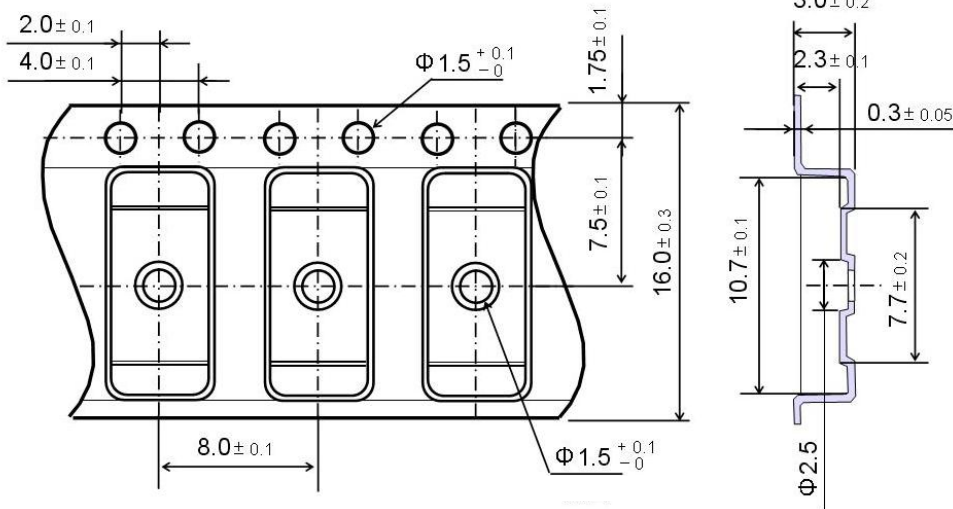
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

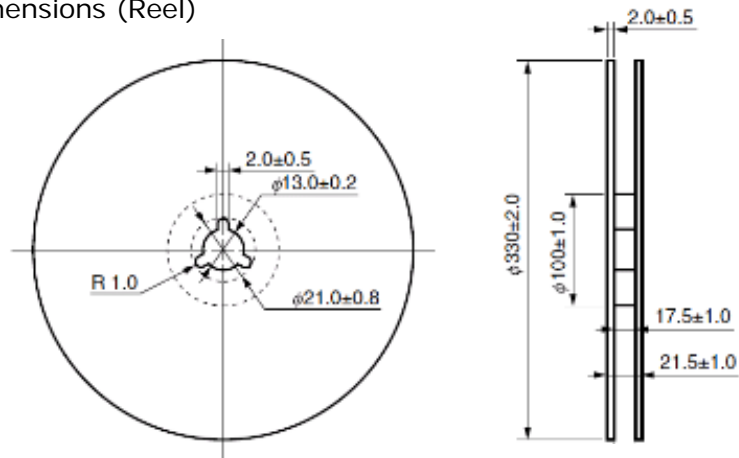


Tape Direction

Outline and Dimensions (Taps)

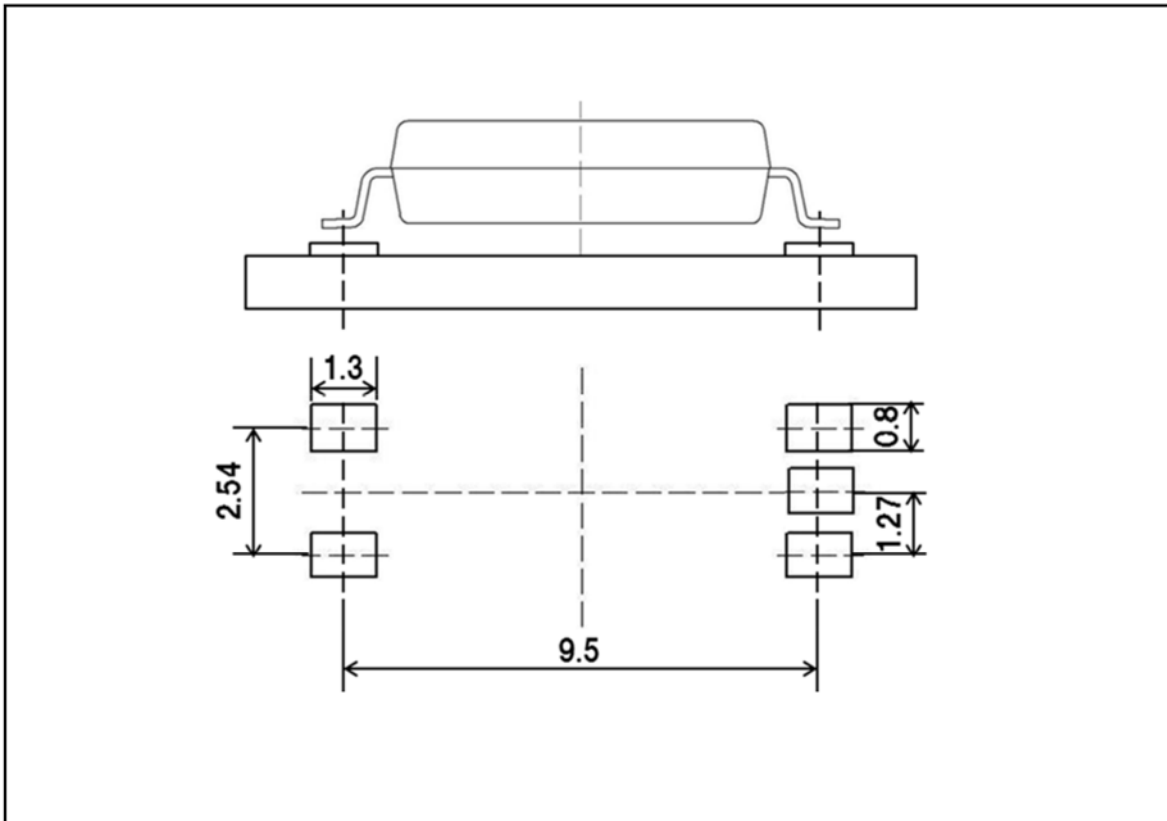


Outline and Dimensions (Reel)



Packing: 3000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



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

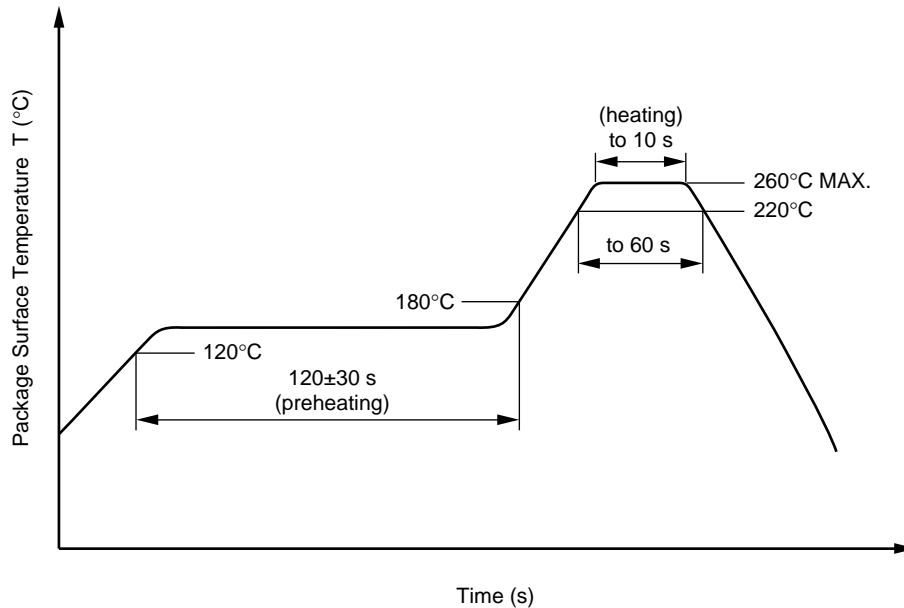
NOTES ON HANDLING

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

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

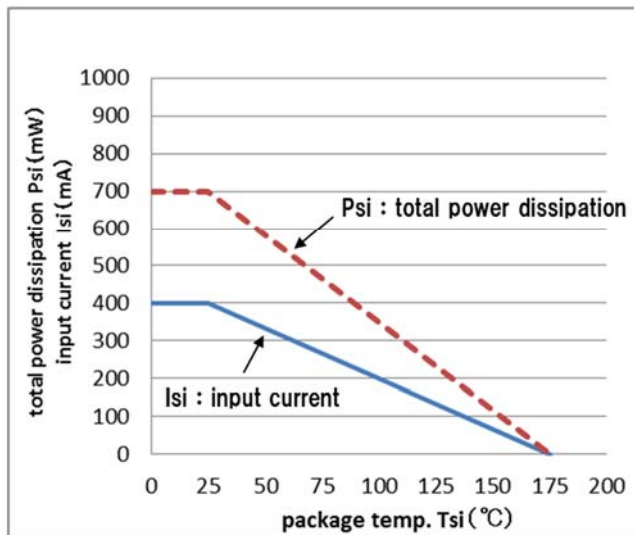
USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1 μF 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.
3. Avoid storage at a high temperature and high humidity.

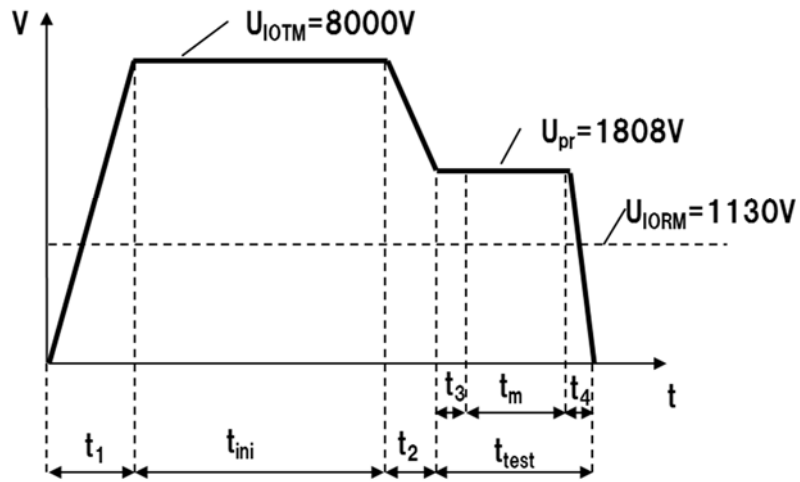
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter | Symbol | Spec. | Unit |
|---|--|-----------------------------|----------------------------|
| Climatic test class (IEC 60068-1/DIN EN 60068-1) | | 40/125/21 | |
| Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}$, $P_d < 5 \text{ pC}$ | U_{IORM} U_{pr} | 1 130 1 808 | V_{peak} V_{peak} |
| Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5 \text{ pC}$ | U_{pr} | 2 119 | V_{peak} |
| Highest permissible overvoltage | U_{IOTM} | 8 000 | V_{peak} |
| Degree of pollution (DIN EN 60664-1 VDE0110 Part 1) | | 2 | |
| Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11)) | CTI | 400 | |
| Material group (DIN EN 60664-1 VDE0110 Part 1) | | II | |
| Storage temperature range | T_{stg} | -55 to +150 | °C |
| Operating temperature range | T_A | -40 to +125 | °C |
| Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc}$ at $T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc}$ at $T_A \text{ MAX.}$ at least 100°C | Ris MIN. Ris MIN. | 10^{12} 10^{11} | Ω Ω |
| Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current I_F , $P_{si} = 0$) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc}$ at $T_A = T_{si}$ | T_{si} I_{si} P_{si} Ris MIN. | 175 400 700 10^9 | °C mA mW Ω |

Dependence of maximum safety ratings with package temperature

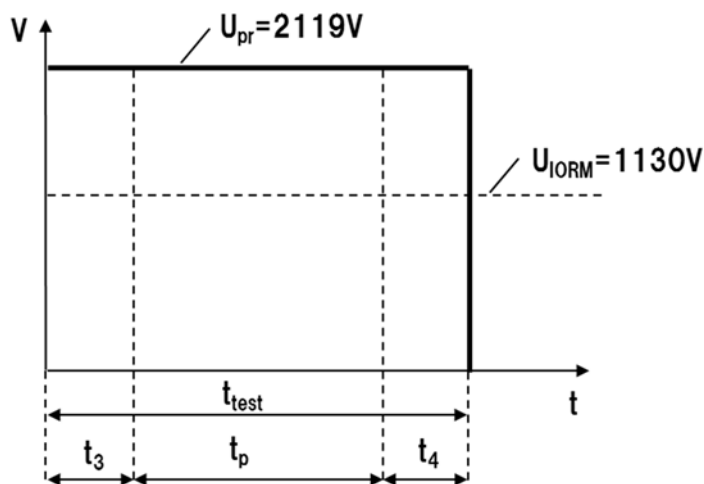


Method A Destructive Test, Type and Sample test



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

Method b Non-destructive Test, 100% Production Test



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

| | | |
|----------------|---------------|--|
| Caution | 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">• 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.<ol style="list-style-type: none">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.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.• Do not burn, destroy, cut, crush, or chemically dissolve the product.• Do not lick the product or in any way allow it to enter the mouth. |
|----------------|---------------|--|

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