

1 Mbps OPEN COLLECTOR OUTPUT TYPE
5-PIN SOP (SO-5)
HIGH-SPEED PHOTOCOUPLER

–NEPOC Series–

DESCRIPTION

The PS9122 is an optical coupled high-speed, active low type isolator containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

The PS9122 is a high-speed digital output type photocoupler designed specifically for low circuit current.

The PS9122 is in 5-pin plastic SOP (Small Outline Package) and is suitable for high density application.

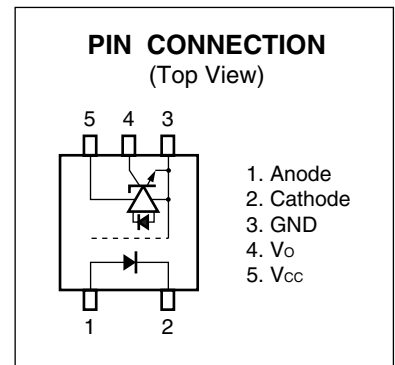
FEATURES

- Supply Voltage
N rank: $V_{CC} = 3.3\text{ V}$
L rank: $V_{CC} = 5\text{ V}$
- Pulse width distortion ($|t_{PHL} - t_{PLH}| = 200\text{ ns MAX.}$)
- Small package (SO-5)
- High-speed (1 Mbps)
- High isolation voltage ($BV = 3\ 750\text{ Vr.m.s.}$)
- Open collector output
- Embossed tape product: PS9122-F3: 2 500 pcs/reel
- Pb-Free product
- Safety standards
 - UL approved: File No. E72422
 - DIN EN60747-5-2 (VDE0884 Part2) approved No.40008902 (option)

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APPLICATIONS

- PoE (Power over Ethernet)
- Measurement equipment
- FA Network

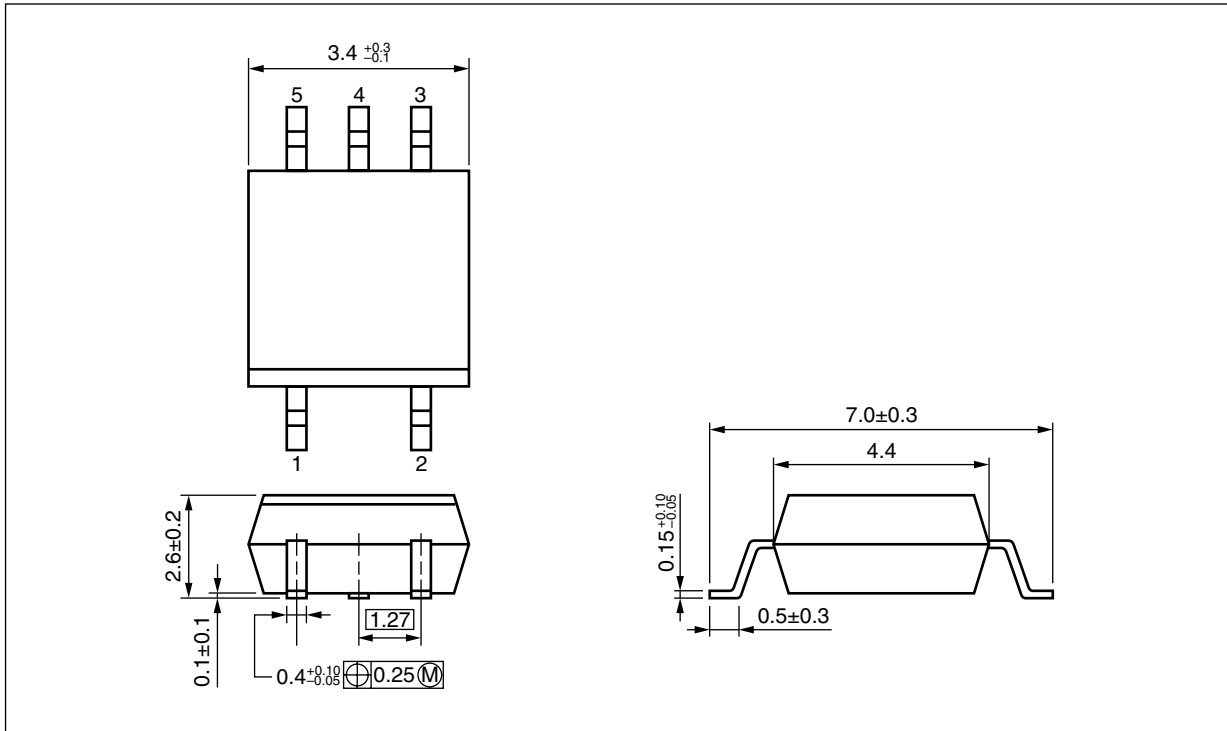


TRUTH TABLE

| LED | Output |
|-----|--------|
| ON | L |
| OFF | H |

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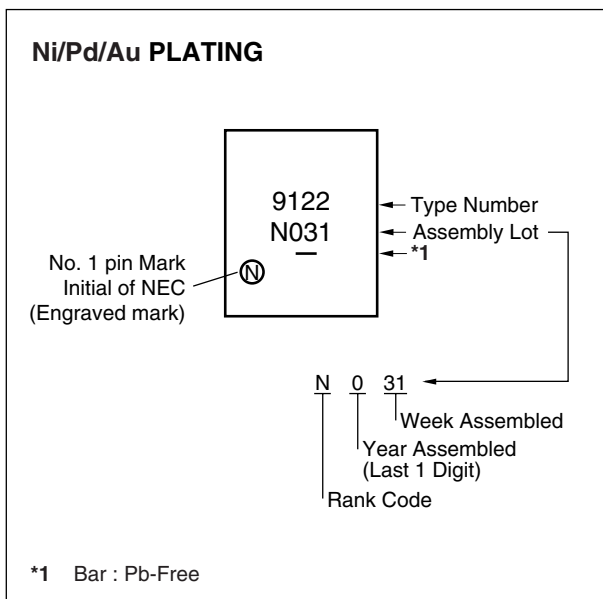
PACKAGE DIMENSIONS (UNIT: mm)



<R> PHOTOCOUPLER CONSTRUCTION

| Parameter | Unit (MIN.) |
|-------------------------|-------------|
| Air Distance | 4.2 mm |
| Outer Creepage Distance | 4.2 mm |
| Isolation Distance | 0.2 mm |

<R> MARKING EXAMPLE



<R> ORDERING INFORMATION

| Part Number | Order Number | Rank | Solder Plating Specification | Packing Style | Safety Standards Approval | Application Part Number ^{*1} | |
|-------------|----------------|----------------|------------------------------|--------------------------|------------------------------------|---------------------------------------|-------------------|
| PS9122 | PS9122-AX | N ² | Pb-Free (Ni/Pd/Au) | 20 pcs (Tape 20 pcs cut) | Standard products (UL approved) | PS9122 | |
| | | L ³ | | | | | |
| PS9122-F3 | PS9122-F3-AX | N ² | | | Embossed Tape 2 500 pcs/reel | | |
| | | L ³ | | | | | |
| PS9122-V | PS9122-V-AX | N ² | | | 20 pcs (Tape 20 pcs cut) | | DIN EN60747-5-2 |
| | | L ³ | | | | | (VDE0884 Part2) |
| PS9122-V-F3 | PS9122-V-F3-AX | N ² | | | Embossed Tape 2 500 pcs/reel | | approved (Option) |
| | | L ³ | | | | | |

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

*2 N rank: V_{CC} = 3.3 V

*3 L rank: V_{CC} = 5 V

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} | 7 | V |
| | Output Voltage | V _O | 7 | V |
| | Output Current | I _O | 20 | mA |
| | Power Dissipation ² | P _C | 40 | mW |
| Isolation Voltage ³ | | BV | 3 750 | Vr.m.s. |
| Operating Ambient Temperature | | T _A | -40 to +100 | °C |
| Storage Temperature | | T _{stg} | -55 to +125 | °C |

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*1 Reduced to 0.17 mA/°C at T_A = 25°C or more.

*2 Applies to output pin V_O (collector pin). Reduced to 1.5 mW/°C at T_A = 80°C or more.

*3 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.

RECOMMENDED OPERATING CONDITIONS

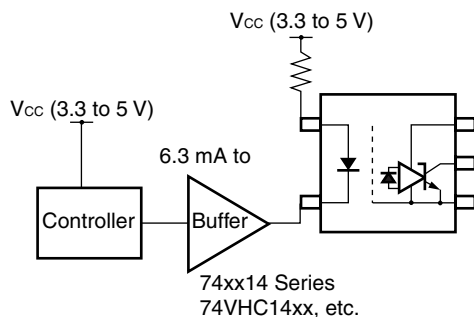
| Parameter | | Symbol | MIN. | TYP. | MAX. | Unit |
|------------------------------------|--------|-----------------|------|------|------|------|
| Low Level Input Voltage | | V _{FL} | 0 | | 0.8 | V |
| High Level Input Current | | I _{FH} | 6.3 | 10 | 12.5 | mA |
| Supply Voltage | N rank | V _{CC} | 2.7 | 3.3 | 3.6 | V |
| | L rank | | 4.5 | 5.0 | 5.5 | |
| TTL (R _L = 1 kΩ, loads) | | N | | | 3 | |
| Pull-up Resistor | | R _L | 330 | | 4 k | Ω |

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DRIVER CIRCUIT

It is recommended to use some buffer for low output current controller, especially in the case of low V_{CC}, otherwise to confirm that enough input current is supplied from controller.



ELECTRICAL CHARACTERISTICS 1: N rank (T_A = -40 to +100°C, unless otherwise specified)

| | Parameter | Symbol | Conditions | MIN. | TYP. ¹⁾ | MAX. | Unit |
|-----|---|--|---|------------------------------------|--------------------|------|-------|
| | Diode | Forward Voltage | V _F I _F = 10 mA, T _A = 25°C | | 1.6 | 1.8 | V |
| | | Reverse Current | I _R V _R = 3 V, T _A = 25°C | | | 10 | μA |
| | | Terminal Capacitance | C _t V = 0 V, f = 1 MHz, T _A = 25°C | | 30 | | pF |
| <R> | Detector | High Level Output Current | I _{OH} V _{CC} = V _O = 3.3 V, V _F = 0.8 V | | 1 | 100 | μA |
| | | Low Level Output Voltage ²⁾ | V _{OL} V _{CC} = 3.3 V, I _F = 5 mA, I _{OL} = 10 mA | | 0.2 | 0.6 | V |
| | | High Level Supply Current | I _{COH} V _{CC} = 3.3 V, I _F = 0 mA, V _O = Open | | | 2 | mA |
| | | Low Level Supply Current | I _{COL} V _{CC} = 3.3 V, I _F = 10 mA, V _O = Open | | | 3 | |
| <R> | Coupled | Threshold Input Current (H → L) | I _{FHL} V _{CC} = 3.3 V, V _O = 0.8 V, R _L = 350 Ω | | 2 | 5 | mA |
| | | Isolation Resistance | R _{I-O} V _{I-O} = 1 kV _{DC} , R _H = 40 to 60%, T _A = 25°C | 10 ¹¹ | | | |
| | | Isolation Capacitance | C _{I-O} V = 0 V, f = 1 MHz, T _A = 25°C | | 0.6 | | pF |
| | | Propagation Delay Time (H → L) ³⁾ | t _{PHL} V _{CC} = 3.3 V, R _L = 350 Ω, I _F = 7.5 mA, V _{THHL} = V _{THLH} = 1.5 V | | | 500 | ns |
| | | Propagation Delay Time (L → H) ³⁾ | t _{PLH} | | | 700 | |
| <R> | | | Rise Time | t _r | | 60 | ns |
| <R> | | | Fall Time | t _f | | 70 | |
| | | | Pulse Width Distortion (PWD) ³⁾ | t _{PHL} -t _{PLH} | | | 200 |
| <R> | Common Mode Transient Immunity at High Level Output ⁴⁾ | CM _H | V _{CC} = 3.3 V, R _L = 350 Ω, T _A = 25°C, I _F = 0 mA, V _O > 2.0 V, V _{CM} = 1.0 kV | 15 | 20 | | kV/μs |
| <R> | Common Mode Transient Immunity at Low Level Output ⁴⁾ | CM _L | V _{CC} = 3.3 V, R _L = 350 Ω, T _A = 25°C, I _F = 7.5 mA, V _O < 0.8 V, V _{CM} = 1.0 kV | 15 | 20 | | |

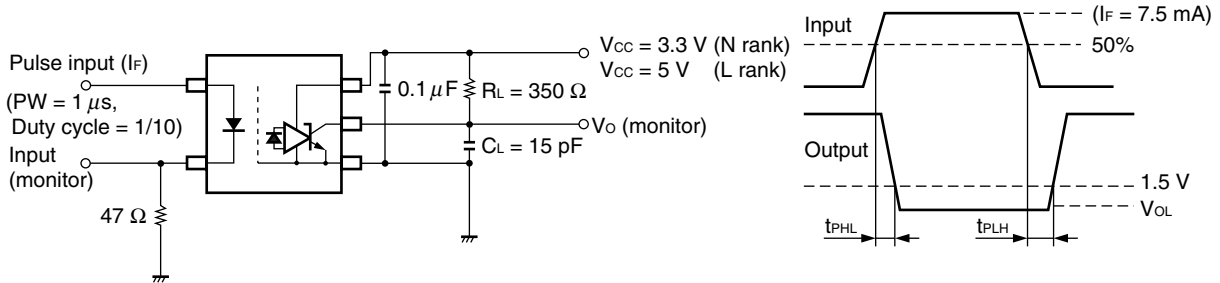
ELECTRICAL CHARACTERISTICS 2: L rank (T_A = -40 to +100°C, unless otherwise specified)

| | Parameter | Symbol | Conditions | MIN. | TYP. ¹⁵ | MAX. | Unit |
|-----|--|---|--|------------------|--------------------|-------|------|
| | Diode | Forward Voltage | V _F I _F = 10 mA, T _A = 25°C | | 1.6 | 1.8 | V |
| | | Reverse Current | I _R V _R = 3 V, T _A = 25°C | | | 10 | μA |
| | | Terminal Capacitance | C _t V = 0 V, f = 1 MHz, T _A = 25°C | | 30 | | pF |
| | Detector | High Level Output Current | I _{OH} V _{CC} = V _O = 5 V, V _F = 0.8 V | | 1 | 100 | μA |
| | | Low Level Output Voltage ⁵ | V _{OL} V _{CC} = 5 V, I _F = 5 mA, I _{OL} = 13 mA | | 0.2 | 0.6 | V |
| | | High Level Supply Current | I _{COH} V _{CC} = 5 V, I _F = 0 mA, V _O = Open | | | 2.5 | mA |
| | | Low Level Supply Current | I _{COL} V _{CC} = 5 V, I _F = 10 mA, V _O = Open | | | 3.5 | |
| <R> | Coupled | Threshold Input Current (H → L) | I _{FHL} V _{CC} = 5 V, V _O = 0.8 V, R _L = 350 Ω | | 2 | 5 | mA |
| | | Isolation Resistance | R _{I-O} V _{I-O} = 1 kV _{DC} , R _H = 40 to 60%, T _A = 25°C | 10 ¹¹ | | | Ω |
| | | Isolation Capacitance | C _{I-O} V = 0 V, f = 1 MHz, T _A = 25°C | | 0.6 | | pF |
| | | Propagation Delay Time (H → L) ⁷ | t _{PHL} V _{CC} = 5 V, R _L = 350 Ω, I _F = 7.5 mA, V _{THHL} = V _{THLH} = 1.5 V | | | 500 | ns |
| | | Propagation Delay Time (L → H) ⁷ | t _{PLH} | | | 700 | |
| <R> | | Rise Time | t _r | | 60 | | ns |
| <R> | | Fall Time | t _f | | 70 | | |
| | | Pulse Width Distortion (PWD) ⁷ | t _{PHL} -t _{PLH} | | | 200 | ns |
| <R> | Common Mode Transient Immunity at High Level Output ⁸ | CM _H V _{CC} = 5 V, R _L = 350 Ω, T _A = 25°C, I _F = 0 mA, V _O > 2.0 V, V _{CM} = 1.0 kV | 15 | 20 | | kV/μs | |
| <R> | Common Mode Transient Immunity at Low Level Output ⁸ | CM _L V _{CC} = 5 V, R _L = 350 Ω, T _A = 25°C, I _F = 7.5 mA, V _O < 0.8 V, V _{CM} = 1.0 kV | 15 | 20 | | | |

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

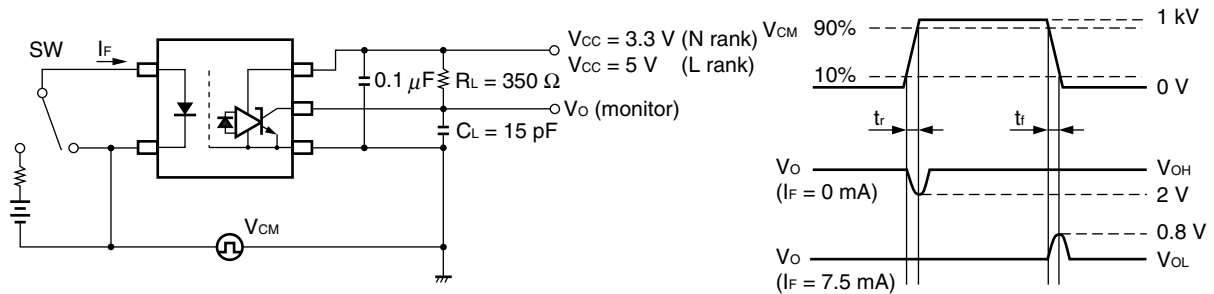
<R> *2, 6. Because V_{OL} of 2 V or more may be output when LED current input and when output supply of $V_{CC} = 2$ V more or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

<R> *3, 7. Test circuit for propagation delay time



Remark C_L includes probe and stray wiring capacitance.

<R> *4, 8. Test circuit for common mode transient immunity



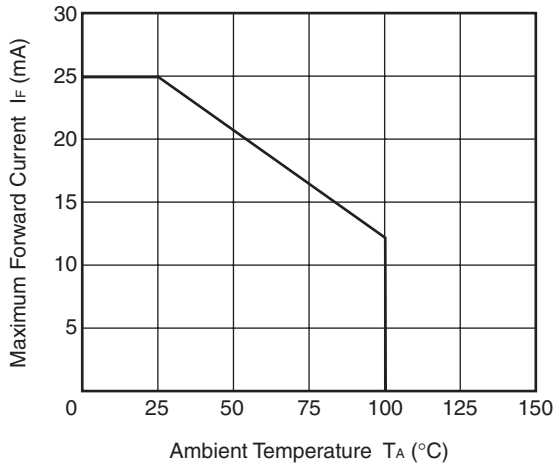
Remark C_L includes probe and stray wiring capacitance.

<R> **USAGE CAUTIONS**

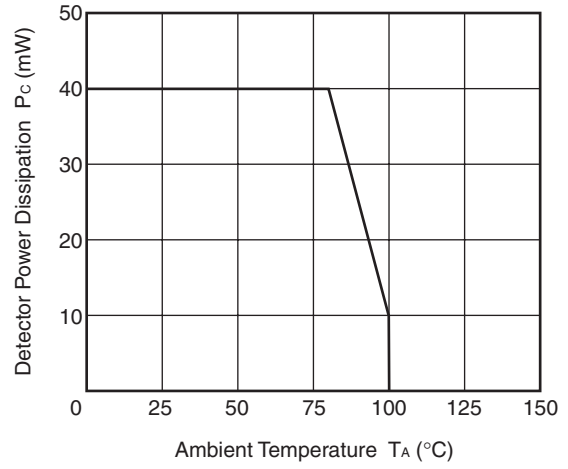
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of $0.1 \mu\text{F}$ is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.

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

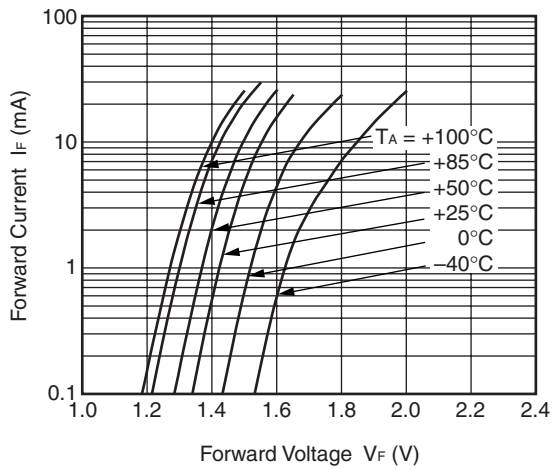
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



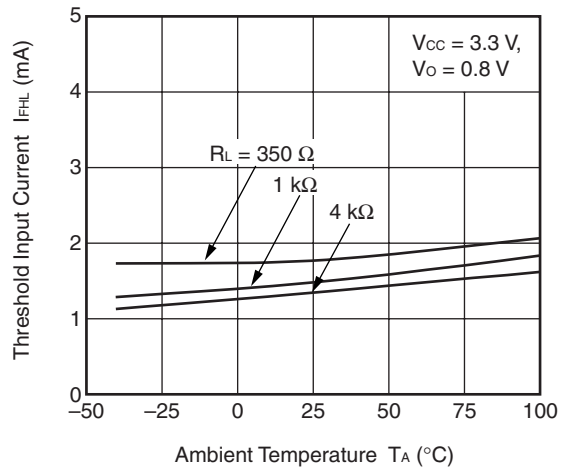
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



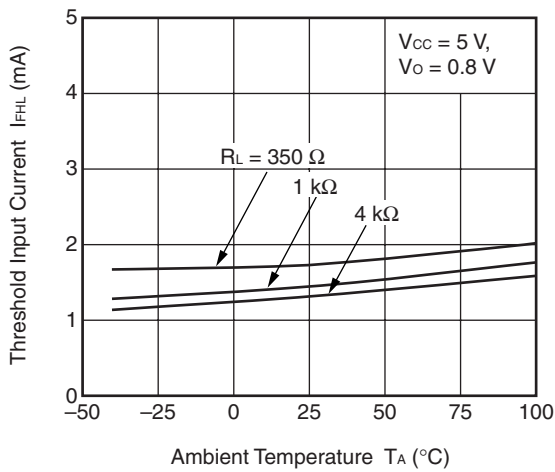
FORWARD CURRENT vs. FORWARD VOLTAGE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

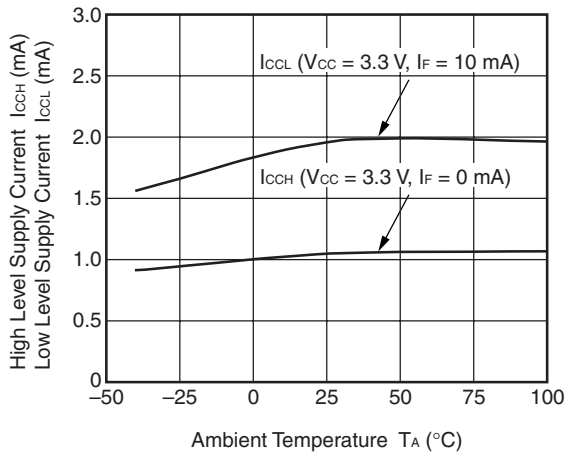


THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

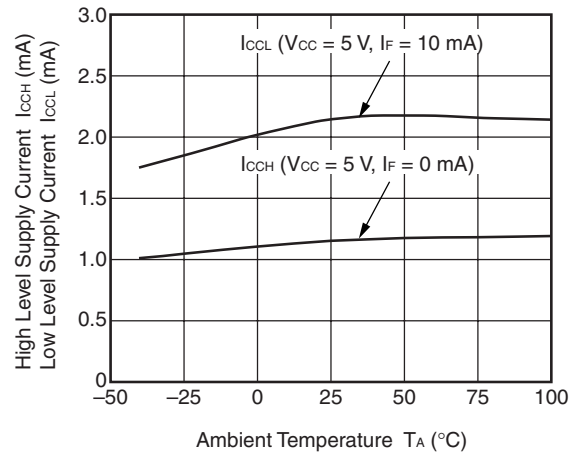


Remark The graphs indicate nominal characteristics.

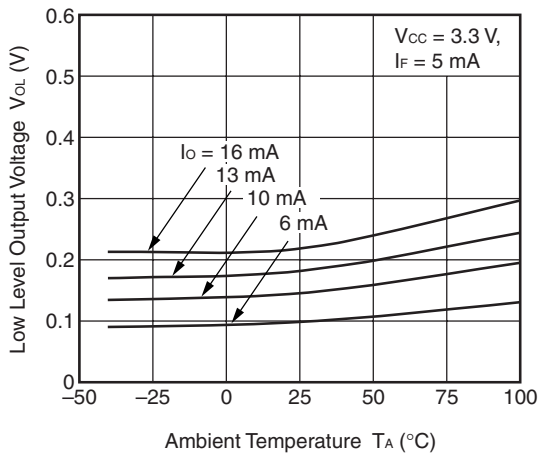
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



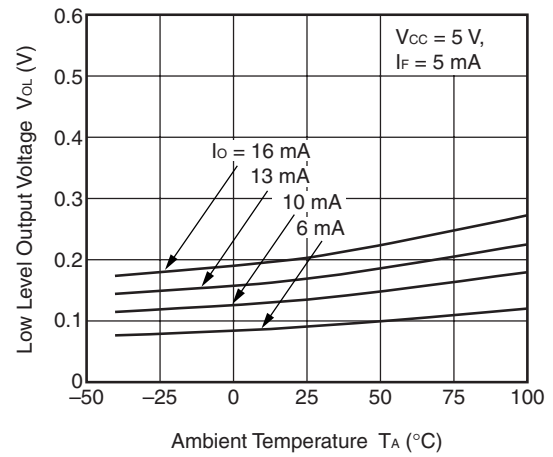
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



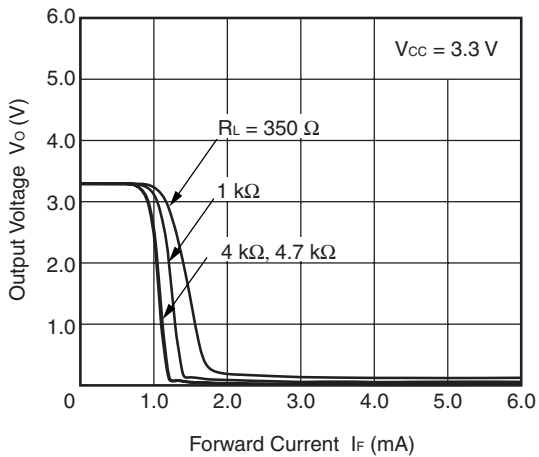
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



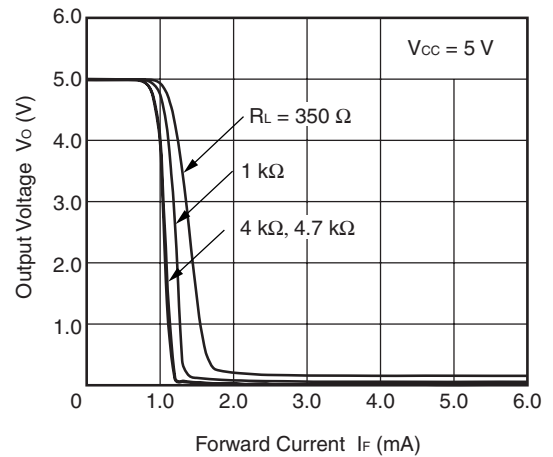
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

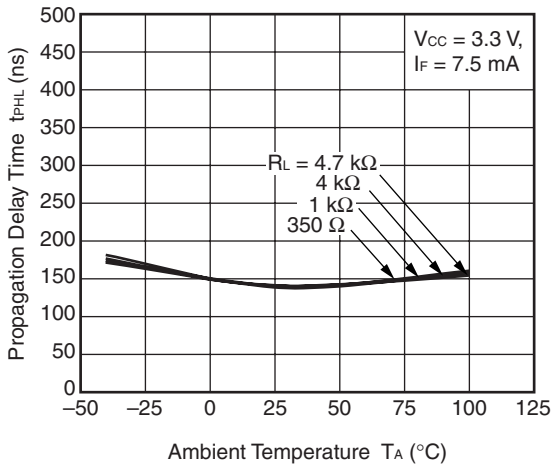


OUTPUT VOLTAGE vs. FORWARD CURRENT

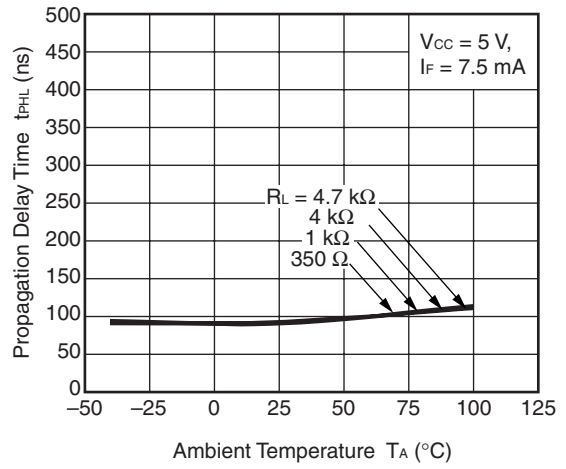


Remark The graphs indicate nominal characteristics.

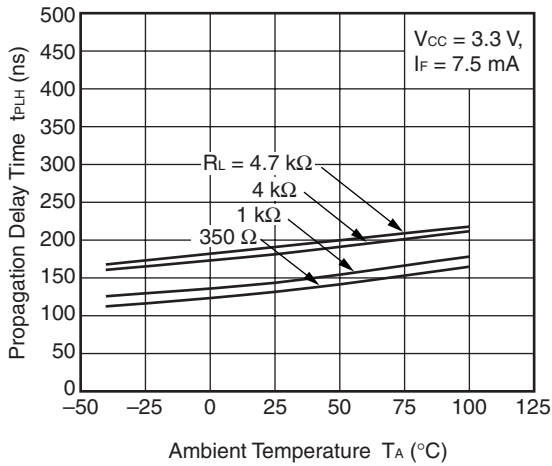
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



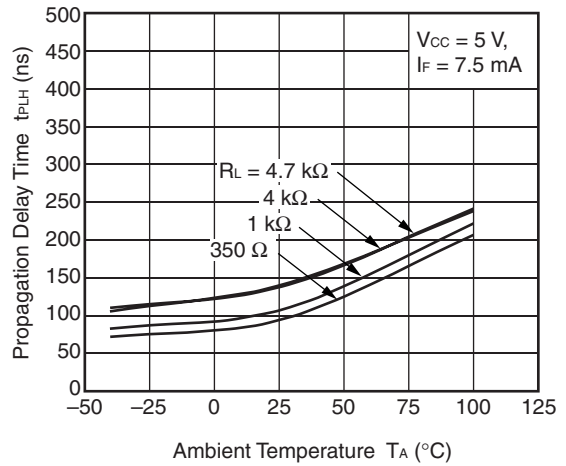
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



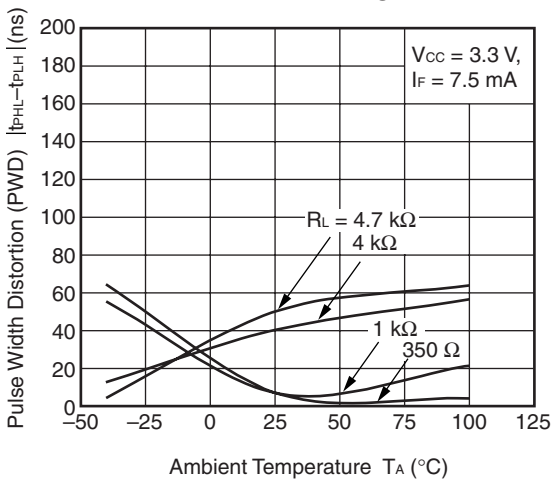
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



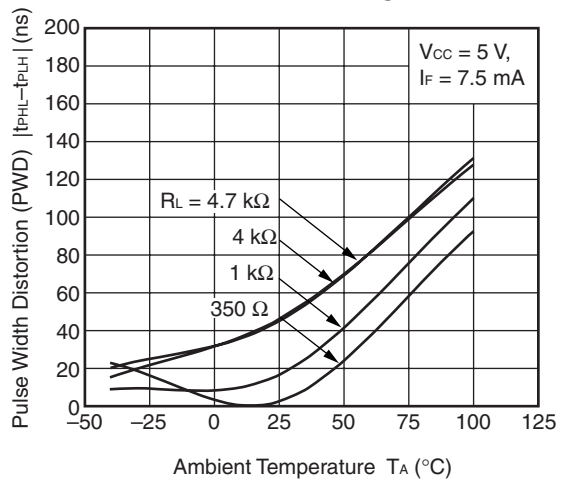
PROPAGATION DELAY TIME vs. AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

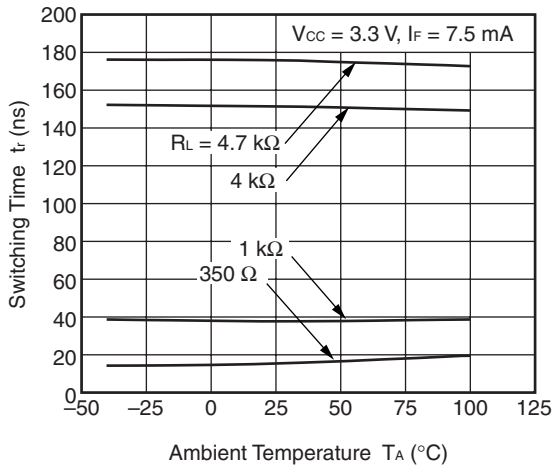


PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

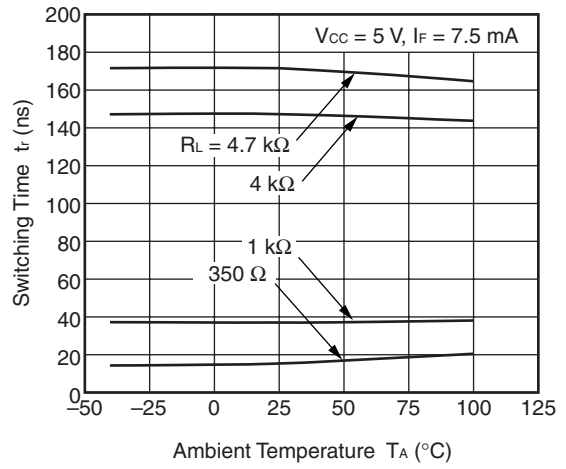


Remark The graphs indicate nominal characteristics.

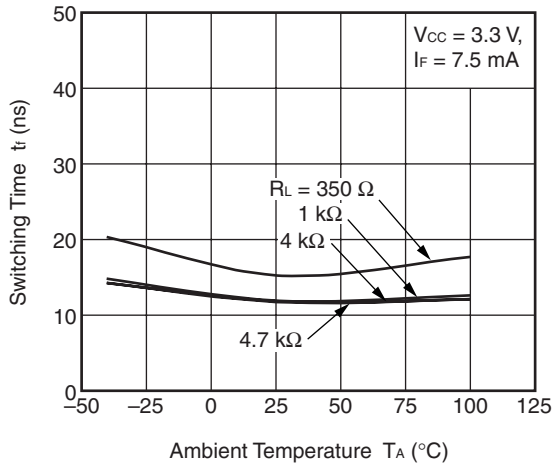
SWITCHING TIME vs. AMBIENT TEMPERATURE



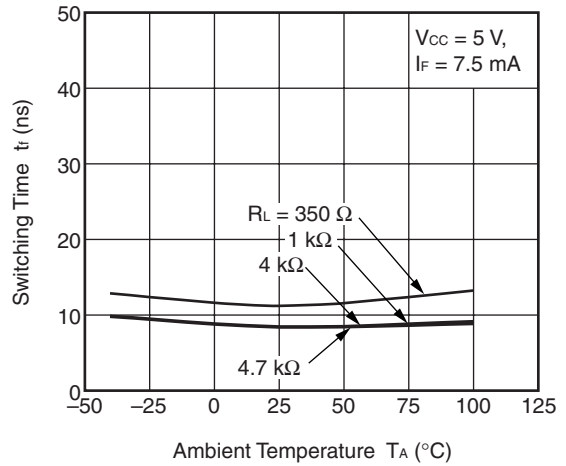
SWITCHING TIME vs. AMBIENT TEMPERATURE



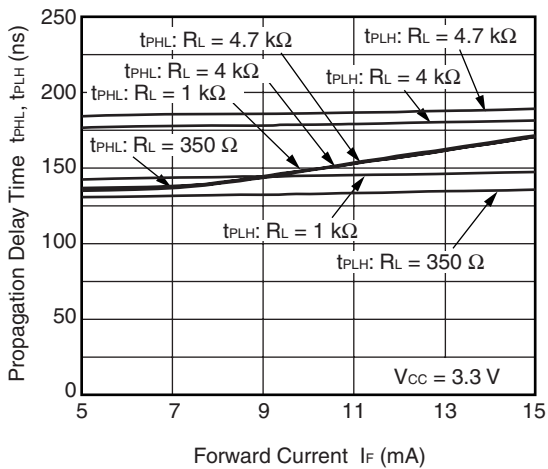
SWITCHING TIME vs. AMBIENT TEMPERATURE



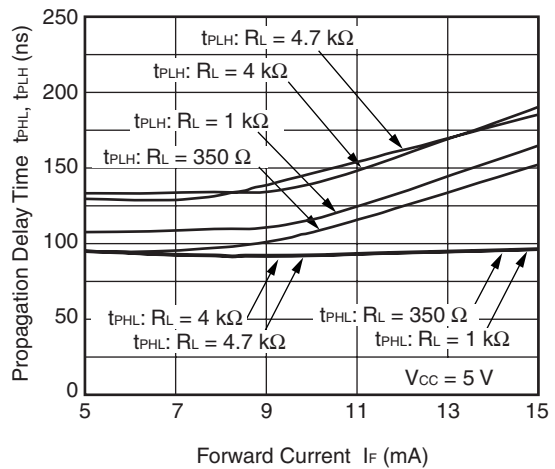
SWITCHING TIME vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. FORWARD CURRENT



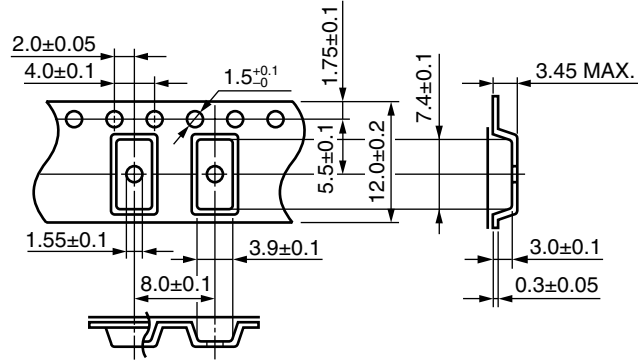
PROPAGATION DELAY TIME vs. FORWARD CURRENT



Remark The graphs indicate nominal characteristics.

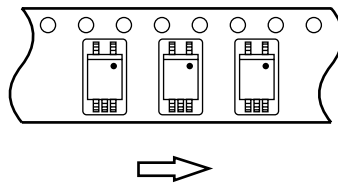
TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

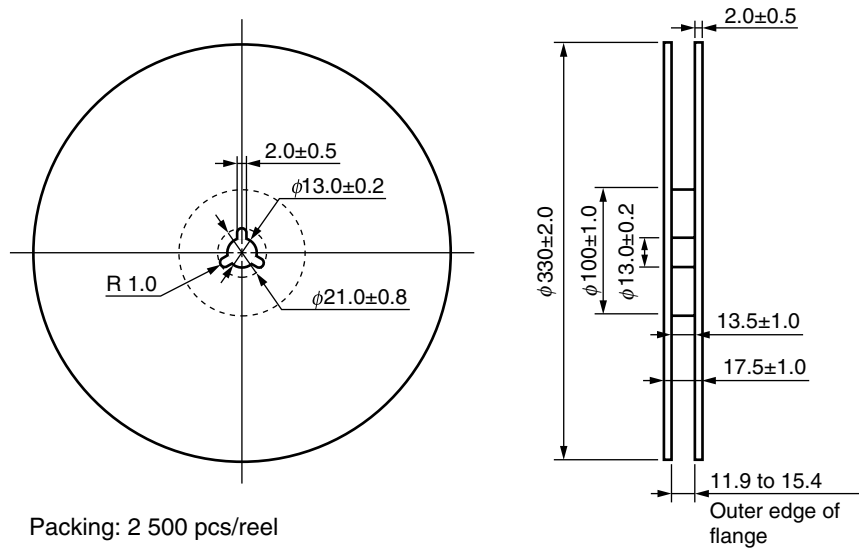


Tape Direction

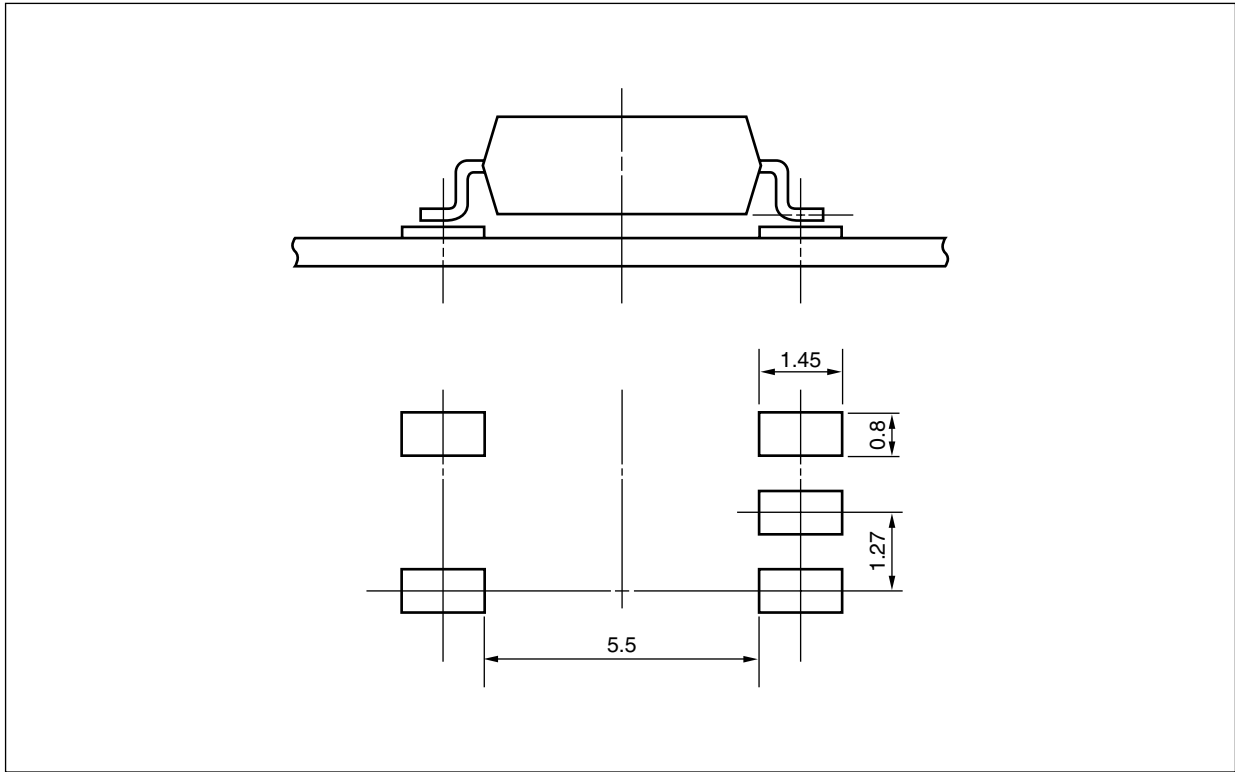
PS9122-F3



Outline and Dimensions (Reel)



<R> RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



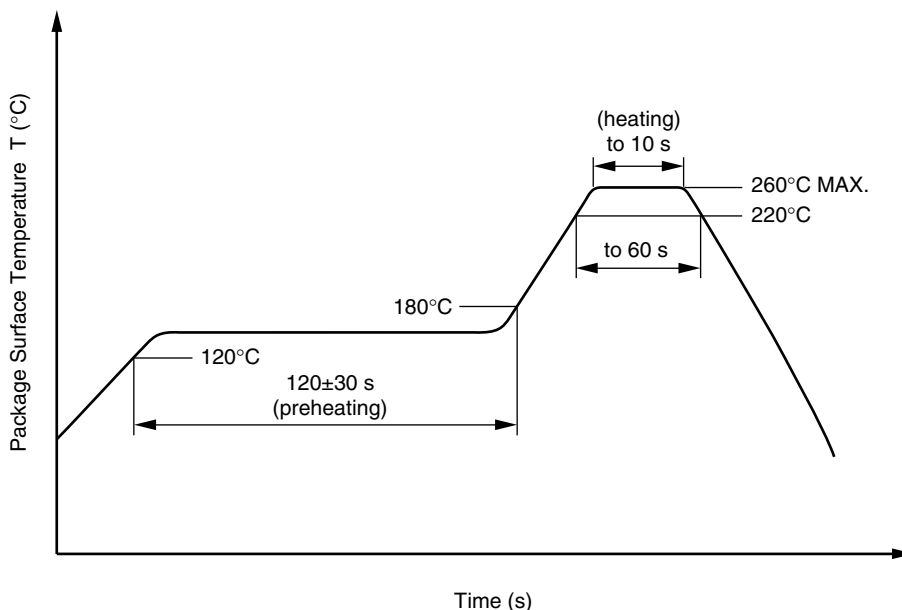
NOTES ON HANDLING

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.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter | Symbol | Speck | Unit |
|--|--|-----------------------------|----------------------------|
| Climatic test class (IEC 60068-1/DIN EN 60068-1) | | 40/100/21 | |
| Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}, P_d < 5 \text{ pC}$ | U_{IORM} U_{pr} | 707 1 061 | 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} | 1 326 | V_{peak} |
| Highest permissible overvoltage | U_{TR} | 6 000 | 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} | -55 to +125 | °C |
| Operating temperature range | T_A | -40 to +100 | °C |
| Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$ | 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. | 150 200 300 10^9 | °C mA mW Ω |

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April 1st, 2010
Renesas Electronics Corporation

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