PRELIMINARY DATA SHEET

NEC

PHOTOCOUPLER

# PS9552,PS9552L1,PS9552L2,PS9552L3

## 2.5 A OUTPUT CURRENT, HIGH CMR IGBT GATE DRIVE PHOTOCOUPLER 8-PIN DIP PHOTOCOUPLER

–NEPOC Series–

<R> **DESCRIPTION**

The PS9552, PS9552L1, PS9552L2 and PS9552L3 are optically coupled isolators containing a GaAlAs LED on the input side and a photo diode, a signal processing circuit and a power output transistor on the output side on one chip.

The PS9552 Series is designed specifically for high common mode transient immunity (CMR), high output current and high switching speed.

The PS9552 Series is suitable for driving IGBTs and MOS FETs.

The PS9552 Series is in a plastic DIP (Dual In-line Package).

The PS9552L1 is lead bending type for long creepage distance.

The PS9552L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

The PS9552L3 is lead bending type (Gull-wing) for surface mounting.

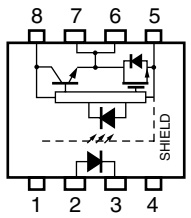
**FEATURES**

<R> • Large peak output current (2.5 A MAX., 2.0 A MIN.)
- High speed switching ($t_{PLH}/t_{PHL}$ = 0.5 $\mu$s MAX.)
- UVLO (Under Voltage Lock Out) protection with hysteresis
- High common mode transient immunity ($CM_H$, $CM_L$ = ±15 kV/$\mu$s MIN.)

<R> • Ordering number of tape product : PS9552L2-E3 : 1 000 pcs/reel
: PS9552L3-E3 : 1 000 pcs/reel

<R> • Safety standards
  - UL approved: File No. E72422
  - CSA approved: No. CA 101391
  - BSI approved: No. 8937, 8938
  - SEMKO approved: No. 615433
  - NEMKO approved: No. P06207243
  - DEMKO approved: No. 314091
  - FIMKO approved: No. FI 22827
  - DIN EN60747-5-2 (VDE0884 Part2) approved (Option)

**PIN CONNECTION**
(Top View)




1. NC
2. Anode
3. Cathode
4. NC
5. $V_{EE}$
6. $V_O$
7. $V_O$
8. $V_{CC}$

**APPLICATIONS**

- IGBT, Power MOS FET Gate Driver
- Industrial inverter
- IH (Induction Heating)



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The mark <R> shows major revised points.

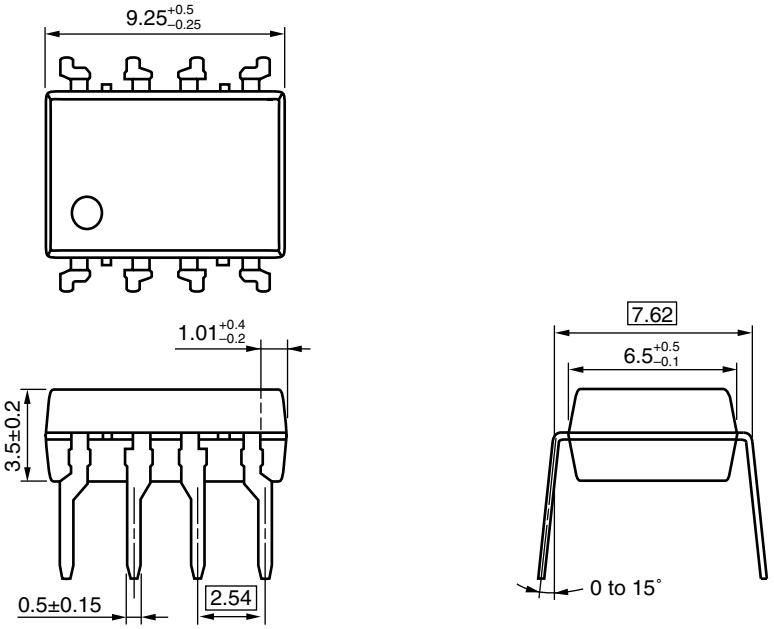


The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

<R> **PACKAGE DIMENSIONS (UNIT: mm)**

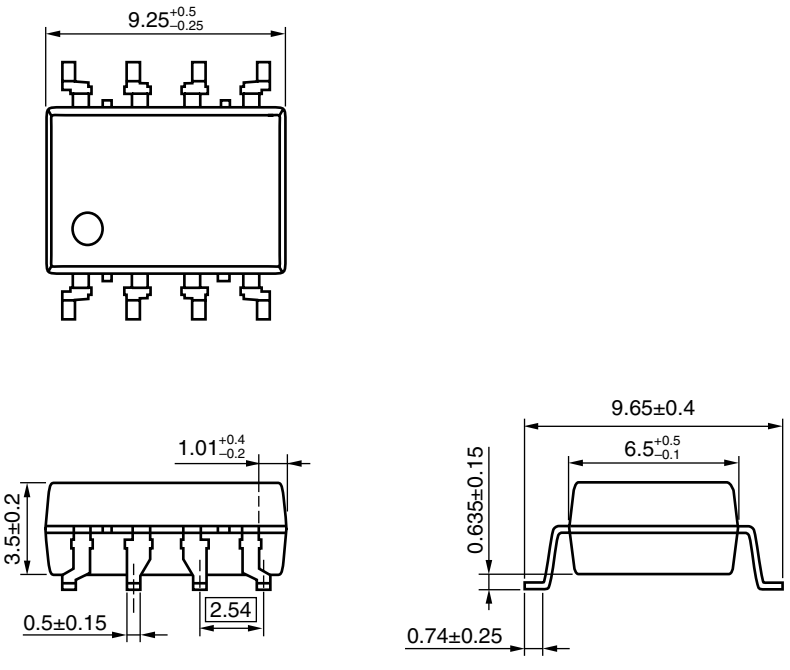
**DIP Type**

**PS9552**



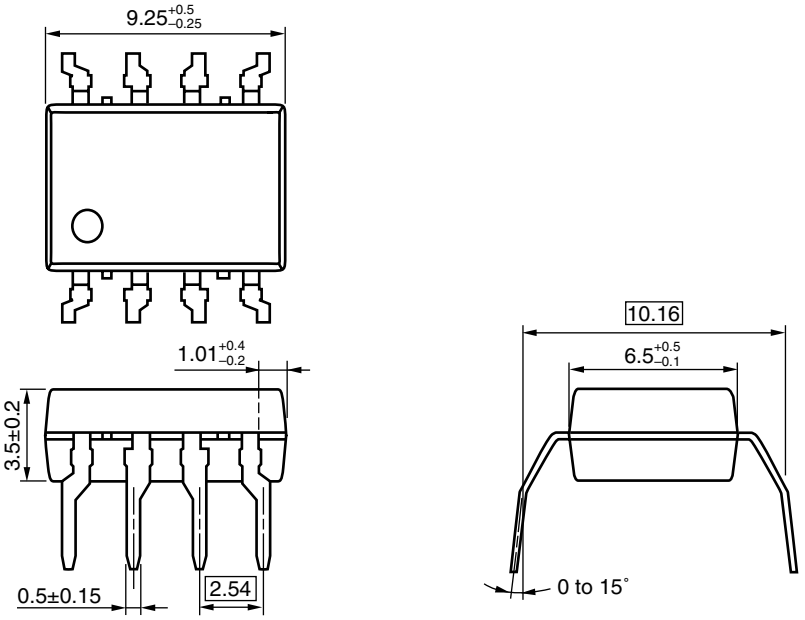

**Lead Bending Type (Gull-wing) For Surface Mount**

**PS9552L3**



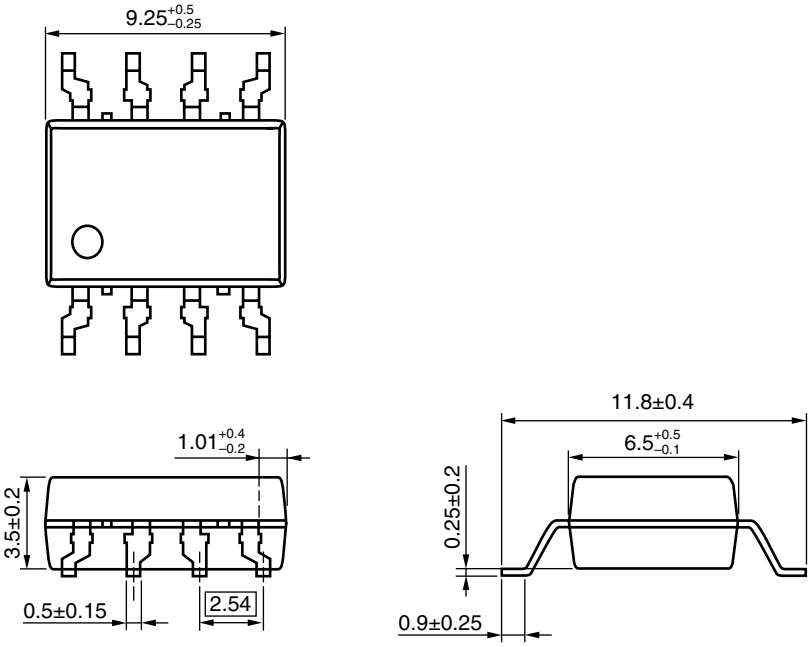
**Lead Bending Type For Long Creepage Distance**

**PS9552L1**

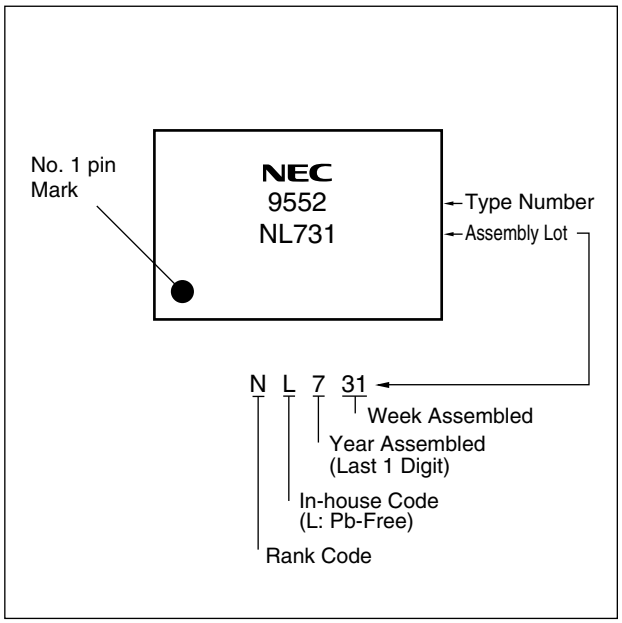



**Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)**

**PS9552L2**



<R> **MARKING EXAMPLE**




<R> **PHOTOCOUPLER CONSTRUCTION**

| Parameter | PS9552, PS9552L3 | PS9552L1, PS9552L2 |
|---|---|---|
| Air Distance (MIN.) | 7 mm | 8 mm |
| Outer Creepage Distance (MIN.) | 7 mm | 8 mm |
| Isolation Distance (MIN.) | 0.4 mm | 0.4 mm |

<R> **ORDERING INFORMATION**

| Part Number | Order Number | Solder Plating Specification | Packing Style | Safety Standard Approval | Application Part Number*1 |
|---|---|---|---|---|---|
| PS9552 | PS9552-AX | Pb-Free (Ni/Pd/Au) | Magazine case 50 pcs | Standard products (UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO approved) | PS9552 |
| PS9552L1 | PS9552L1-AX | | | | |
| PS9552L2 | PS9552L2-AX | | | | |
| PS9552L3 | PS9552L3-AX | | | | |
| PS9552L2-E3 | PS9552L2-E3-AX | | Embossed Tape 1 000 pcs/reel | | |
| PS9552L3-E3 | PS9552L3-E3-AX | | | | |
| PS9552-V | PS9552-V-AX | | Magazine case 50 pcs | DIN EN60747-5-2 (VDE0884 Part2) Approved (Option) | |
| PS9552L1-V | PS9552L1-V-AX | | | | |
| PS9552L2-V | PS9552L2-V-AX | | | | |
| PS9552L3-V | PS9552L3-V-AX | | | | |
| PS9552L2-V-E3 | PS9552L2-V-E3-AX | | Embossed Tape 1 000 pcs/reel | | |
| PS9552L3-V-E3 | PS9552L3-V-E3-AX | | | | |

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

<R> **ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C, unless otherwise specified)**

| Parameter | | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Diode | Forward Current | $I_F$ | 25 | mA |
| | Peak Transient Forward Current (Pulse Width < 1 μs) | $I_{F\ (TRAN)}$ | 1.0 | A |
| | Reverse Voltage | $V_R$ | 5 | V |
| Detector | High Level Peak Output Current *1 | $I_{OH\ (PEAK)}$ | 2.5 | A |
| | Low Level Peak Output Current *1 | $I_{OL\ (PEAK)}$ | 2.5 | A |
| | Supply Voltage | ($V_{CC}$ - $V_{EE}$) | 0 to 35 | V |
| | Output Voltage | $V_O$ | 0 to $V_{CC}$ | V |
| | Output Power Dissipation *2 | $P_O$ | 250 | mW |
| Isolation Voltage *3 | | BV | 5 000 | Vr.m.s. |
| Total Power Dissipation *4 | | $P_T$ | 300 | mW |
| Operating Frequency *5 | | f | 50 | kHz |
| Operating Ambient Temperature | | $T_A$ | –40 to +100 | °C |
| Storage Temperature | | $T_{stg}$ | –55 to +125 | °C |

***1** Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%

***2** Reduced to 4.8 mA/°C at $T_A$ = 70°C or more.

***3** AC voltage for 1 minute at $T_A$ = 25°C, RH = 60% between input and output. Pins 1-4 shorted together, 5-8 shorted together.

***4** Reduced to 5.4 mA/°C at $T_A$ = 70°C or more.

***5** $I_{OH\ (PEAK)} \leq$ 2.0 A (≤ 0.3 μs), $I_{OL\ (PEAK)} \leq$ 2.0 A (≤ 0.3 μs)

**RECOMMENDED OPERATING CONDITIONS**

<R>

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Supply Voltage | ($V_{CC}$ - $V_{EE}$) | 15 | | 30 | V |
| Forward Current (ON) | $I_{F\ (ON)}$ | 7 | 10 | 16 | mA |
| Forward Voltage (OFF) | $V_{F\ (OFF)}$ | –2 | | 0.8 | V |
| Operating Ambient Temperature | $T_A$ | –40 | | 100 | °C |

<R> **ELECTRICAL CHARACTERISTICS ($T_A$ = –40 to +100°C, $V_{CC}$ = 15 to 30 V, $I_{F(ON)}$ = 7 to 16 mA, $V_{F(OFF)}$ = –2 to 0.8 V, $V_{EE}$ = 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 | 1.3 | 1.65 | 2.1 | V |
| | Input Capacitance | $C_{IN}$ | f = 1 MHz, $V_F$ = 0 V, $T_A$ = 25°C | | 60 | | pF |
| Detector | High Level Output Current | $I_{OH}$ | $V_O$ = ($V_{CC}$ – 4 V) *2 | 0.5 | 2.0 | | A |
| | | | $V_O$ = ($V_{CC}$ – 15 V) *3 | 2.0 | | | |
| | Low Level Output Current | $I_{OL}$ | $V_O$ = ($V_{EE}$ + 2.5 V) *2 | 0.5 | 2.0 | | A |
| | | | $V_O$ = ($V_{EE}$ + 15 V) *3 | 2.0 | | | |
| | High Level Output Voltage | $V_{OH}$ | $I_O$ = –100 mA *4 | $V_{CC}$ – 3.5 | $V_{CC}$ – 2.5 | $V_{CC}$ – 1.5 | V |
| | Low Level Output Voltage | $V_{OL}$ | $I_O$ = 100 mA | | 0.1 | 0.5 | V |
| | High Level Supply Current | $I_{CCH}$ | $V_O$ = open, $I_F$ = 7 to 16 mA | | 2.0 | 5.0 | mA |
| | Low Level Supply Current | $I_{CCL}$ | $V_O$ = open, $V_F$ = 0 to +0.8 V | | 2.0 | 5.0 | mA |
| | UVLO Threshold | $V_{UVLO+}$ | $V_O$ > 5 V, $I_F$ = 10 mA | 11.0 | 12.3 | 13.5 | V |
| | | $V_{UVLO–}$ | | 9.5 | 10.7 | 12.0 | |
| | UVLO Hysteresis | $UVLO_{HYS}$ | $V_O$ > 5 V, $I_F$ = 10 mA | | 1.6 | | V |
| Coupled | Threshold Input Current (L → H) | $I_{FLH}$ | $I_O$ = 0 mA, $V_O$ > 5 V | | 2.0 | 5.0 | mA |
| | Threshold Input Voltage (H → L) | $V_{FHL}$ | $I_O$ = 0 mA, $V_O$ > 5 V | 0.8 | | | V |

***1** Typical values at $T_A$ = 25°C.

***2** Maximum pulse width = 50 μs, Maximum duty cycle = 0.5%.

***3** Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%

***4** $V_{OH}$ is measured with the DC load current in this testing (Maximum pulse width = 2 ms, Maximum duty cycle = 20%).

<R> **SWITCHING CHARACTERISTICS ($T_A$ = –40 to +100°C, $V_{CC}$ = 15 to 30 V, $I_{F\,(ON)}$ = 7 to 16 mA, $V_{F\,(OFF)}$ = –2 to 0.8 V, $V_{EE}$ = GND, unless otherwise specified)**

| Parameter | Symbol | Conditions | MIN. | TYP.*1 | MAX. | Unit |
|---|---|---|---|---|---|---|
| Propagation Delay Time (L → H) | $t_{PLH}$ | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, | 0.1 | 0.3 | 0.5 | μs |
| Propagation Delay Time (H → L) | $t_{PHL}$ | Duty Cycle = 50%*2 | 0.1 | 0.3 | 0.5 | μs |
| Pulse Width Distortion (PWD) | $\lvert t_{PHL}-t_{PLH}\rvert$ | | | | 0.3 | μs |
| Propagation Delay Time (Difference Between Any Two Products) | $t_{PHL}-t_{PLH}$ | | –0.35 | | 0.35 | μs |
| Rise Time | $t_r$ | | | 0.1 | | μs |
| Fall Time | $t_f$ | | | 0.1 | | μs |
| UVLO (Turn On Delay) | $t_{UVLO\,ON}$ | $V_O$ > 5 V, $I_F$ = 10 mA | | 0.8 | | μs |
| UVLO (Turn Off Delay) | $t_{UVLO\,OFF}$ | $V_O$ < 5 V, $I_F$ = 10 mA | | 0.6 | | μs |
| Common Mode Transient Immunity at High Level Output*3 | $CM_H$ | $T_A$ = 25°C, $I_F$ = 10 mA, $V_{O\,(MIN.)}$ = 26 V, $V_{CM}$ = 1.5k V | 15 | | | kV/μs |
| Common Mode Transient Immunity at Low Level Output*3 | $CM_L$ | $T_A$ = 25°C, $I_F$ = 0 mA, $V_{O\,(MAX.)}$ = 1 V, $V_{CM}$ = 1.5k V | 15 | | | kV/μs |

***1** Typical values at $T_A$ = 25°C.

***2** This load condition is equivalent to the IGBT load at 1 200 V/75 A.

***3** Connect pin 1 and pin 4 to the LED common.

<R> **TEST CIRCUIT**

**Fig. 1 $I_{OH}$ Test Circuit**

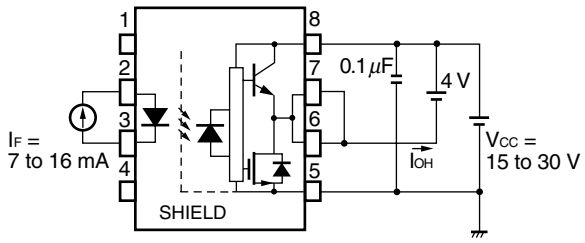



**Fig. 2 $I_{OL}$ Test Circuit**

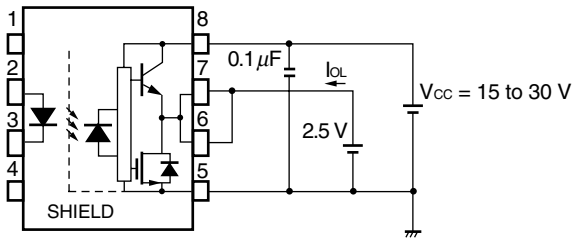



**Fig. 3 $V_{OH}$ Test Circuit**

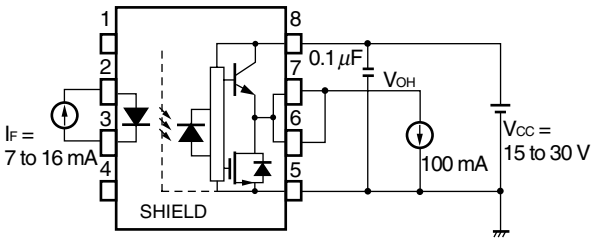



**Fig. 4 $V_{OL}$ Test Circuit**

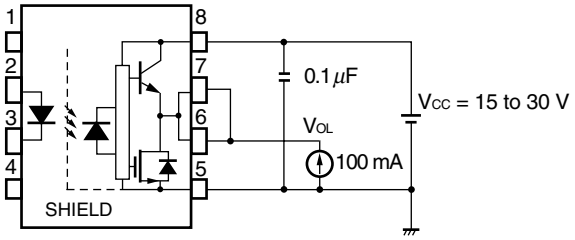



**Fig. 5 $I_{FLH}$ Test Circuit**

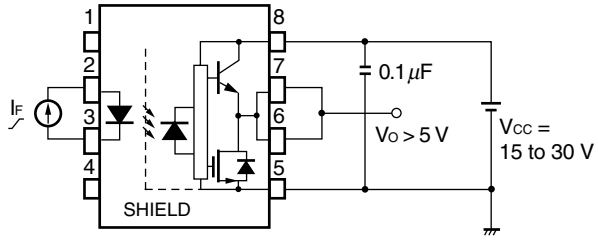



**Fig. 6 UVLO Test Circuit**

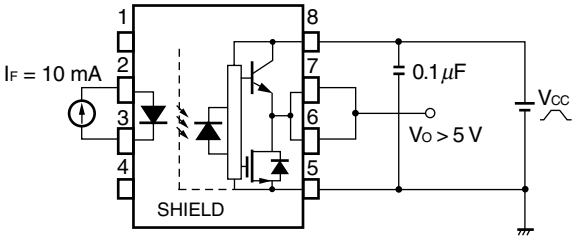


**Fig. 7 $t_{PLH}$, $t_{PHL}$, $t_r$, $t_f$ Test Circuit and Wave Forms**

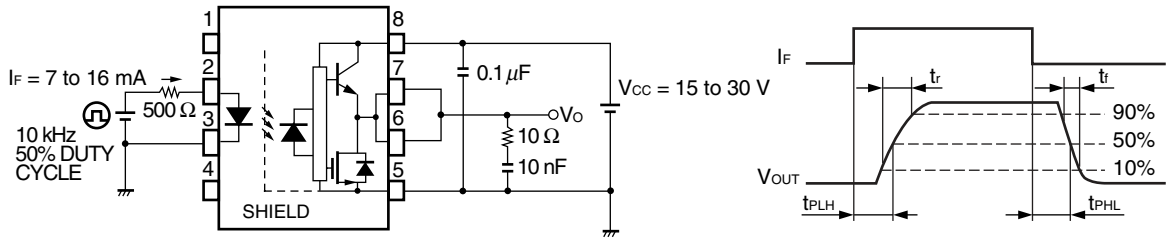
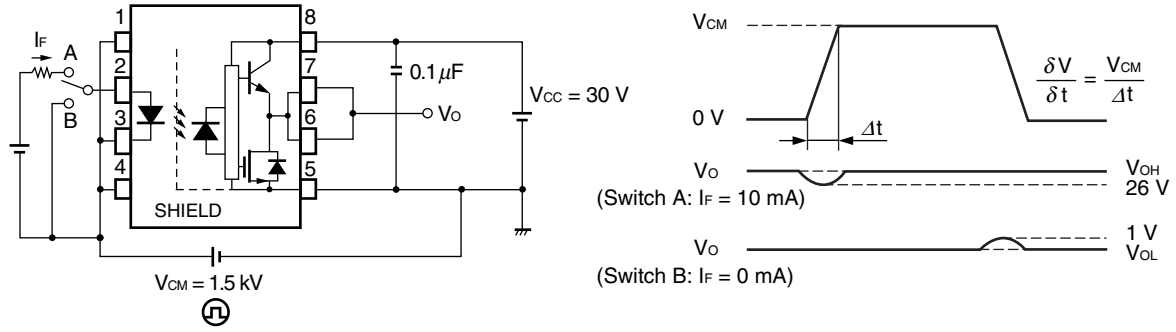


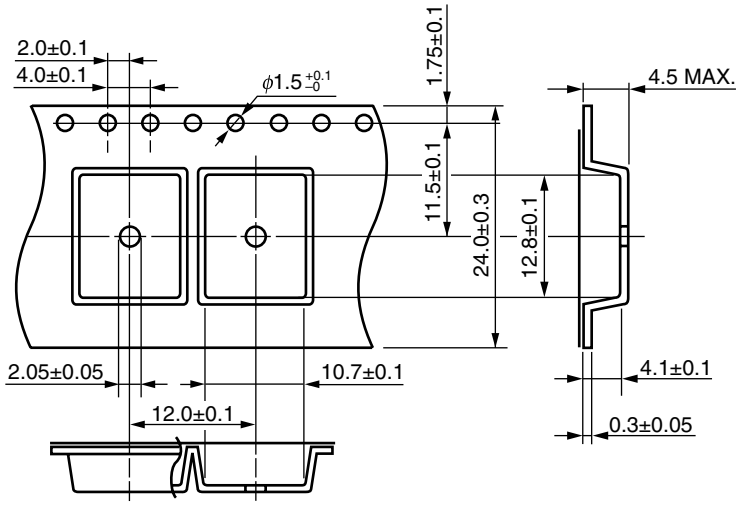

**Fig. 8 CMR Test Circuit and Wave Forms**



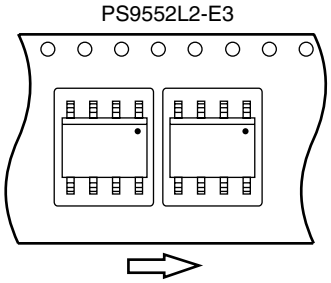

**Remark** CMR Test : Connect pin 1 and pin 4 to the LED common.

<R> **TAPING SPECIFICATIONS (UNIT: mm)**

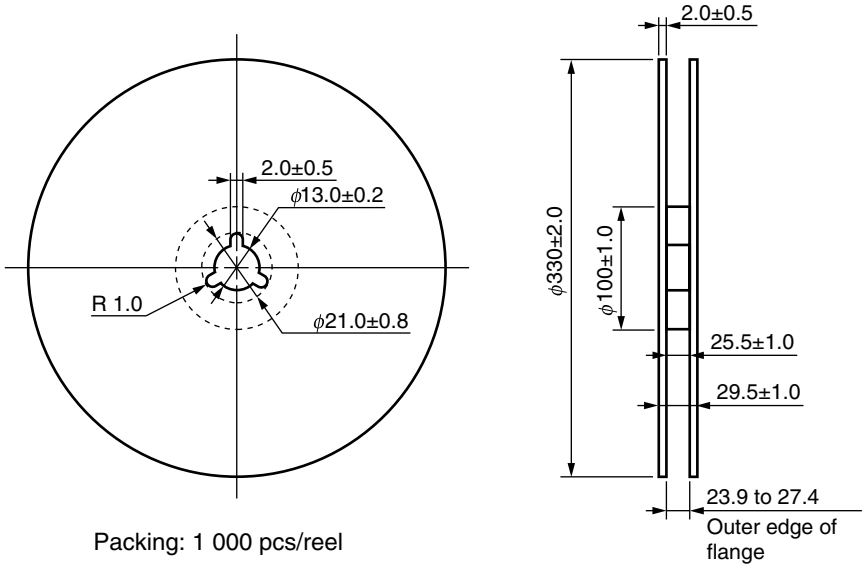
Outline and Dimensions (Tape)




Tape Direction

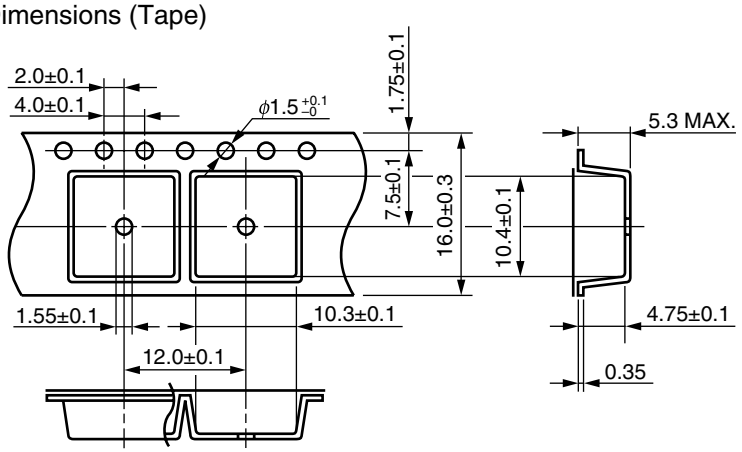



Outline and Dimensions (Reel)



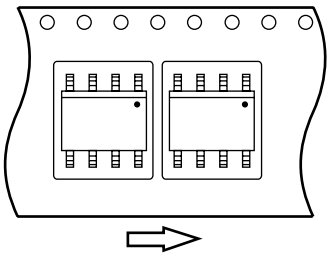

Packing: 1 000 pcs/reel

Outline and Dimensions (Tape)

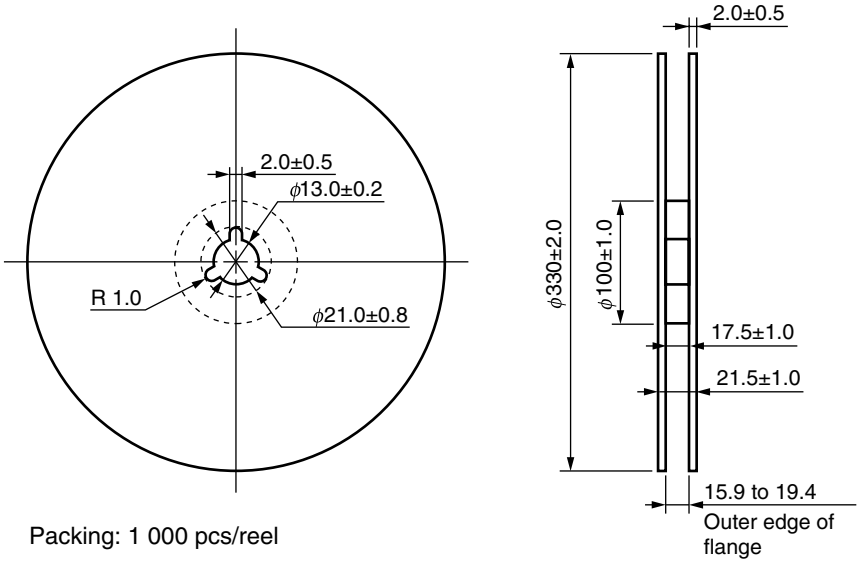



Tape Direction

PS9552L3-E3



Outline and Dimensions (Reel)




Packing: 1 000 pcs/reel

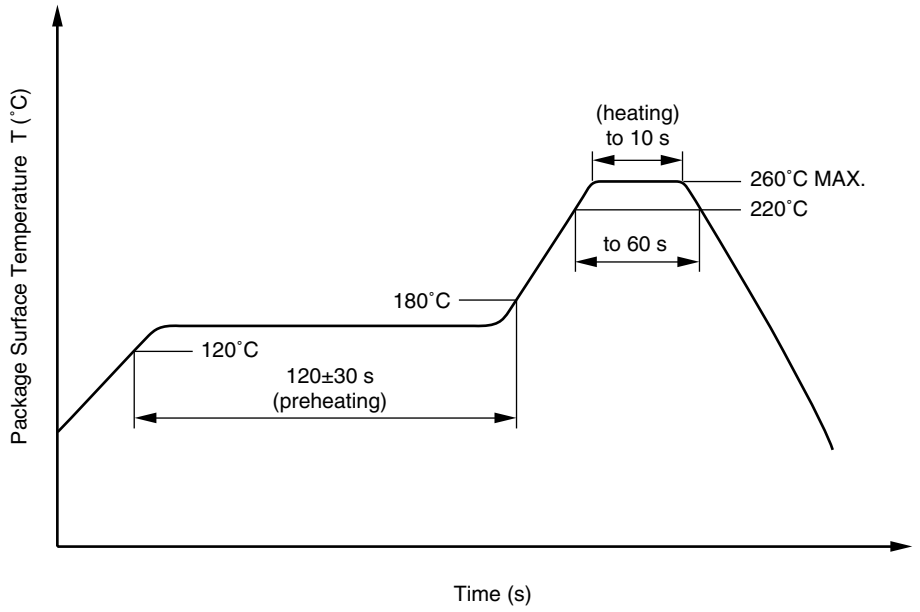
## NOTES ON HANDLING

### 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.

## USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.

<R> 2. By-pass capacitor of more than 0.1 $\mu$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.

<R> 3. In the layout of the board, be sure that the IGBT collector and emitter patterns are not close to this product's input. If they are allocated close to the input and the transient currents may be combined, the transient current on the IGBT side may unexpectedly be input into the LED input of this product, causing malfunctions and degradation in characteristics (When it is necessary to allocate patterns close to the input, design the input drive circuit so that the LED has reverse bias in the off state to prevent the LED lighting in the off state).

4. Avoid storage at a high temperature and high humidity.

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| **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. |