



# PHOTOCOUPLER PS9551L4

## HIGH CMR, DIGITAL OUTPUT TYPE OPTICAL COUPLED ISOLATION AMPLIFIER (SIGMA-DELTA MODULATOR)

-NEPOC Series-

### DESCRIPTION

The PS9551L4 is an optical coupled isolation amplifier that uses an IC provided with a high-accuracy A/D conversion function (sigma-delta modulation method) and a GaAlAs light-emitting diode with high-speed response and high luminance efficiency on the input side. On the output side IC provided with an encoding function.

The PS9551L4 is designed specifically for high common mode transient immunity (CMR) and high linearity (non-linearity). The PS9551L4 is suitable for current sensing in motor drives.

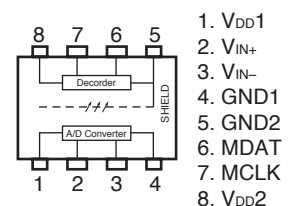
### FEATURES

- Non-linearity (INL = 30 LSB MAX.)
- High common mode transient immunity (CMR = 10 kV/ $\mu$ s MIN.)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- Package: 8-pin DIP lead bending type (Gull-wing) for long creepage distance for surface mount (L4)
- Ordering number of tape product: PS9551L4-E3: 1 000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: File No. E72422
  - CSA approved: No. CA 101391
  - BSI approved: No. 8937, 8938
  - SEMKO approved: No. 611507
  - NEMKO approved: No. P06207243
  - DEMKO approved: No. 313935
  - FIMKO approved: No. FI 22827
  - DIN EN60747-5-2 (VDE0884 Part2) approved (Option)

### APPLICATIONS

- AC Servo, inverter
- Measurement equipment

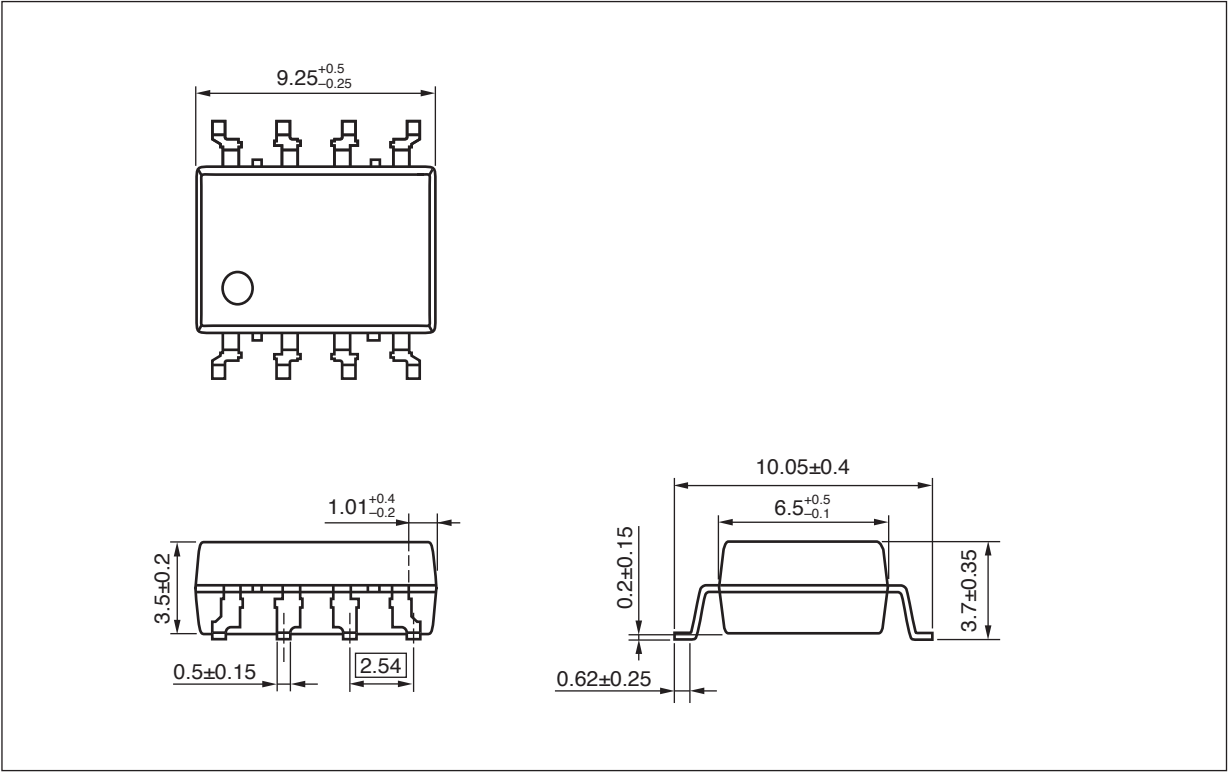
### PIN CONNECTION (Top View)



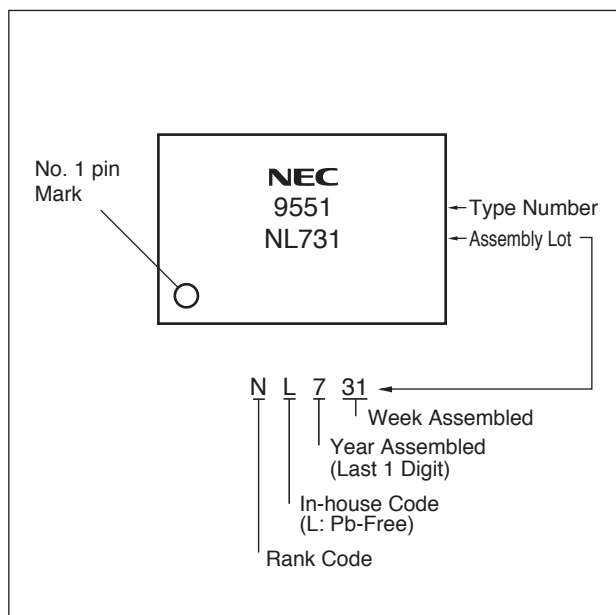
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**PACKAGE DIMENSIONS (UNIT: mm)**

**Lead Bending Type (Gull-wing) For Long Creepage Distance For Surface Mount (L4)**



## MARKING EXAMPLE



**ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

| Parameter                         | Symbol                           | MIN. | MAX.                 | Unit             |
|-----------------------------------|----------------------------------|------|----------------------|------------------|
| Operating Ambient Temperature     | $T_A$                            | -40  | 85                   | $^\circ\text{C}$ |
| Storage Temperature               | $T_{\text{stg}}$                 | -55  | 125                  | $^\circ\text{C}$ |
| Supply Voltage                    | $V_{\text{DD1}}, V_{\text{DD2}}$ | 0    | 5.5                  | V                |
| Input Voltage                     | $V_{\text{IN+}}, V_{\text{IN-}}$ | -2   | $V_{\text{DD1}}+0.5$ | V                |
| 2 Seconds Transient Input Voltage | $V_{\text{IN+}}, V_{\text{IN-}}$ | -6   | $V_{\text{DD1}}+0.5$ | V                |
| Output Voltage                    | MCLK, MDAT                       | -0.5 | $V_{\text{DD2}}+0.5$ | V                |

**RECOMMENDED OPERATING CONDITIONS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)**

| Parameter                           | Symbol                           | MIN. | MAX. | Unit             |
|-------------------------------------|----------------------------------|------|------|------------------|
| Operating Ambient Temperature       | $T_A$                            | -40  | 85   | $^\circ\text{C}$ |
| Supply Voltage                      | $V_{\text{DD1}}, V_{\text{DD2}}$ | 4.5  | 5.5  | V                |
| Input Voltage (Accurate and Linear) | $V_{\text{IN+}}, V_{\text{IN-}}$ | -200 | 200  | mV               |

**ELECTRICAL CHARACTERISTICS (DC Characteristics)**(TYP.:  $T_A = 25^\circ\text{C}$ ,  $V_{IN+} = V_{IN-} = 0\text{ V}$ ,  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,MIN., MAX.:  $T_A = -40\text{ to }+85^\circ\text{C}$ ,  $V_{IN+} = V_{IN-} = -200\text{ to }200\text{ mV}$ ,  $V_{DD1} = V_{DD2} = 4.5\text{ to }5.5\text{ V}$ , unless otherwise specified)

| Parameter                                          | Symbol             | Conditions                                     | MIN. | TYP. | MAX. | Unit             |
|----------------------------------------------------|--------------------|------------------------------------------------|------|------|------|------------------|
| Input Supply Current                               | $I_{DD1}$          | $V_{IN+} = 350\text{ mV}$                      |      | 14.5 | 18   | mA               |
| Output Supply Current                              | $I_{DD2}$          | $V_{IN+} = -350\text{ mV}$                     |      | 10   | 15   |                  |
| Input Bias Current                                 | $I_{IN+}$          |                                                |      | -0.8 |      | $\mu\text{A}$    |
| Low Level Output Voltage                           | $V_{OL}$           | $I_{OUT} = 1.6\text{ mA}$                      |      | 0.1  | 0.6  | V                |
| High Level Output Voltage                          | $V_{OH}$           | $I_{OUT} = -100\text{ }\mu\text{A}$            | 3.9  | 4.9  |      | V                |
| Output Short-circuit Current                       | $ I_{OSC} $        | $V_{OUT} = V_{DD2}$ or $V_{OUT} = \text{GND2}$ |      | 30   |      | mA               |
| Equivalent Input Resistance                        | $R_{IN}$           |                                                |      | 300  |      | $\text{k}\Omega$ |
| Output Clock Frequency                             | $f_{CLK}$          |                                                | 8.2  | 10   | 13.2 | MHz              |
| Data Hold Time <sup>*1</sup>                       | $t_{HDDAT}$        |                                                | 15   |      |      | ns               |
| Input DC Common-Mode Rejection Ratio <sup>*2</sup> | $\text{CMRR}_{IN}$ |                                                |      | 60   |      | dB               |

\*1 The data hold time is that MDAT will stay stable following the rising edge of MCLK.

\*2  $\text{CMRR}_{IN}$  is defined as the ratio of the differential signal gain (apply the differential signal between  $V_{IN+}$  and  $V_{IN-}$ ) to the isolation-mode gain (connect both input pins to GND1 and apply the signal between (PS9551L4's) input and output) at 60 Hz. This value is indicated in dB.

**ELECTRICAL CHARACTERISTICS (Tested with filter IC (specified by NEC Electronics))**(TYP.:  $T_A = 25^\circ\text{C}$ ,  $V_{IN+} = V_{IN-} = 0\text{ V}$ ,  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,MIN., MAX.:  $T_A = -40\text{ to }+85^\circ\text{C}$ ,  $V_{IN+} = V_{IN-} = -200\text{ to }200\text{ mV}$ ,  $V_{DD1} = V_{DD2} = 4.5\text{ to }5.5\text{ V}$ , unless otherwise specified)

| Parameter                                           | Symbol               | Conditions                                                       | MIN. | TYP. | MAX. | Unit                         |
|-----------------------------------------------------|----------------------|------------------------------------------------------------------|------|------|------|------------------------------|
| Integral Non-linearity *1                           | INL                  | $-200\text{ mV} \leq V_{IN+} \leq 200\text{ mV}$                 |      | 12   | 30   | LSB                          |
|                                                     |                      |                                                                  |      | 0.04 | 0.14 | %                            |
| Input Offset Voltage                                | $V_{OS}$             | $V_{IN+} = 0\text{ V}$                                           | -3   | 0    | 3    | mV                           |
| Input Offset Voltage Drift<br>vs. Temperature       | $ dV_{OS}/dT_A $     | $V_{IN+} = 0\text{ V}$ , $T_A = -40\text{ to }+85^\circ\text{C}$ |      | 2    | 10   | $\mu\text{V}/^\circ\text{C}$ |
| Input Offset Voltage Drift<br>vs. $V_{DD1}$         | $ dV_{OS}/dV_{DD1} $ | $V_{IN+} = 0\text{ V}$                                           |      | 0.12 |      | mV/V                         |
| Internal Reference Voltage                          | $ V_{REF} $          |                                                                  |      | 320  |      | mV                           |
| Absolute Internal Reference Voltage<br>Tolerance    | -                    |                                                                  | -4   |      | 4    | %                            |
| Internal Reference Voltage Drift<br>vs. Temperature | $ dV_{REF}/dT_A $    | $T_A = -40\text{ to }+85^\circ\text{C}$                          |      | 60   |      | ppm/ $^\circ\text{C}$        |
| Common Mode Transient Immunity*2                    | CMR                  | $V_{CM} = 1\text{ kV}$ , $T_A = 25^\circ\text{C}$                | 10   | 15   |      | kV/ $\mu\text{s}$            |

\*1 Integral Non-linearity: Half of peak-to-peak output voltage deviation from best fit gain line.

\*2 CMR is tested by applying steep rise/fall time (50 ns) voltage step between PS9551L4's input and output.

**PACKAGE CHARACTERISTICS**

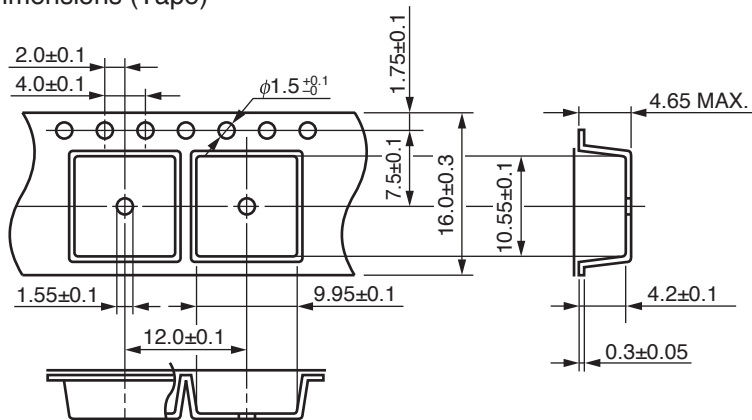
| Parameter             | Symbol    | Conditions                                                   | MIN.  | TYP.     | MAX. | Unit     |
|-----------------------|-----------|--------------------------------------------------------------|-------|----------|------|----------|
| Isolation Voltage     | BV        | $RH = 60\%$ , $t = 1\text{ min.}$ , $T_A = 25^\circ\text{C}$ | 5 000 |          |      | Vr.m.s.  |
| Isolation Resistance  | $R_{I-O}$ | $V_{I-O} = 500\text{ V}_{DC}$                                |       | $> 10^9$ |      | $\Omega$ |
| Isolation Capacitance | $C_{I-O}$ | $f = 1\text{ MHz}$                                           |       | 1.2      |      | pF       |

**USAGE CAUTIONS**

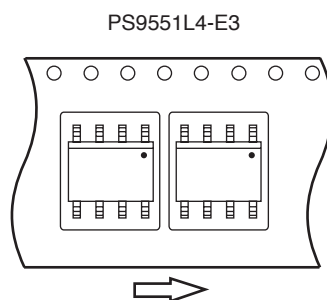
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. Board designing
  - (1) By-pass capacitor of more than  $0.1\text{ }\mu\text{F}$  is used between  $V_{DD}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
  - (2) Make sure the distance between input terminal ( $V_{IN+}$  and  $V_{IN-}$ ) of PS9551L4 and the devices (or components) to be connected is as close as possible.
  - (3) Make sure the distance between output terminal ( $V_{OUT+}$  and  $V_{OUT-}$ ) of PS9551L4 and the devices (or components) to be connected is as close as possible.
3. Avoid storage at a high temperature and high humidity.

## TAPING SPECIFICATIONS (UNIT: mm)

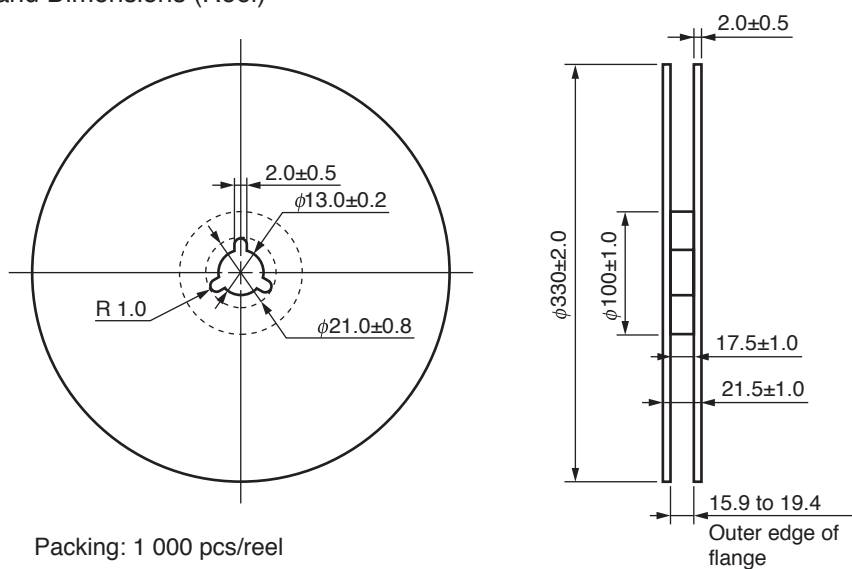
## Outline and Dimensions (Tape)



## Tape Direction



## Outline and Dimensions (Reel)



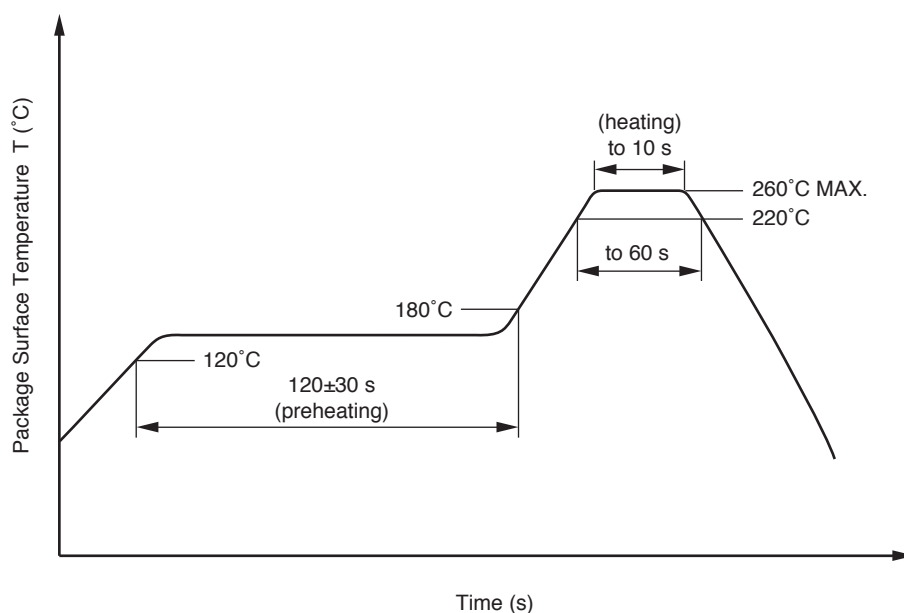
## NOTES ON HANDLING

## 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 a malfunction may occur if voltage is applied suddenly between the photocoupler's input and output, even if the voltage is within the absolute maximum ratings.

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



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