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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Data Sheet

PS8551L4

R08DS0039EJ0200
Rev.2.00
Sep 06, 2011

ANALOG OUTPUT TYPE
OPTICAL COUPLED ISOLATION AMPLIFIER

DESCRIPTION

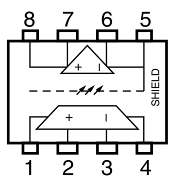
The PS8551L4 is an optically coupled isolation amplifier that uses an IC with a high-accuracy sigma-delta A/D converter and a GaAIAs light-emitting diode with high-speed response and high luminance efficiency on the input side, and an IC with a high-accuracy D/A converter on the output side.

The PS8551L4 is designed specifically for high common mode transient immunity (CMTI) and high linearity (non-linearity). The PS8551L4 is suitable for current sensing in motor drives.

FEATURES

- Non-linearity (NL200 = 0.35% MAX.)
- High common mode transient immunity (CMTI = 10 kV/μs MIN.)
- High isolation voltage (BV = 5 000 Vr.m.s.)
- Gain tolerance (G = 7.76 to 8.24 (±3%))
  Gain: 8 V/V TYP.
- Package: 8-pin DIP lead bending type (Gull-wing) for long creepage distance for surface mount (L4)
- Embossed tape product: PS8551L4-E3 : 1 000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - SEMKO approved: No. 1111155
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40019182 (Option)

PIN CONNECTION
(Top View)



1. $V_{DD}1$
2. V_{IN+}
3. V_{IN-}
4. GND1
5. GND2
6. V_{OUT-}
7. V_{OUT+}
8. $V_{DD}2$

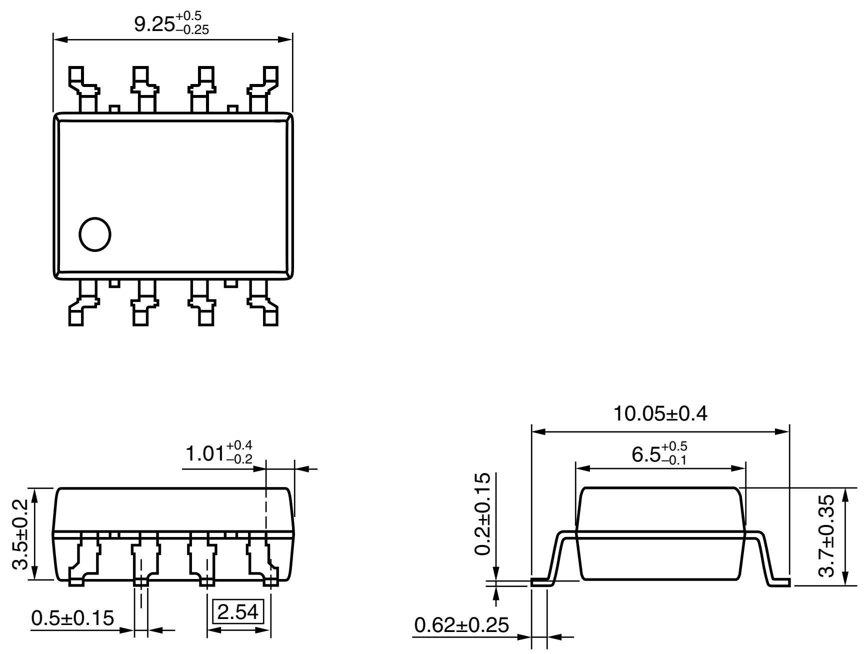
APPLICATIONS

- AC Servo, inverter
- Measurement equipment

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.

PACKAGE DIMENSIONS (UNIT: mm)

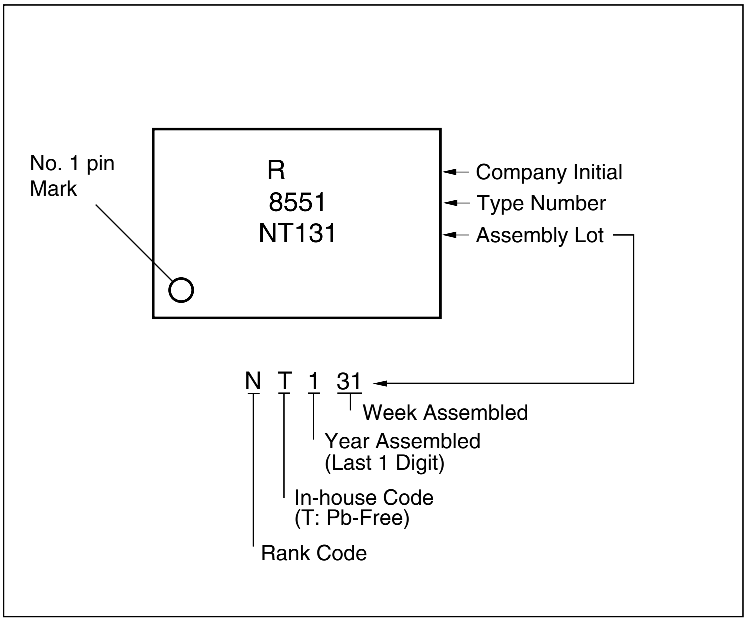
Lead Bending Type (Gull-wing) For Long Creepage Distance For Surface Mount (L4)



PHOTOCOUPLER CONSTRUCTION

Parameter	Unit (MIN.)
Air Distance	8 mm
Outer Creepage Distance	8 mm
Isolation Distance	0.4 mm

<R> MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS8551L4	PS8551L4-AX	Pb-Free	Magazine case 50 pcs	Standard products	PS8551L4
PS8551L4-E3	PS8551L4-E3-AX	(Ni/Pd/Au)	Embossed Tape 1 000 pcs/reel	(UL, CSA, SEMKO approved)	
PS8551L4-V	PS8551L4-V-AX		Magazine case 50 pcs	DIN EN60747-5-2	
PS8551L4-V-E3	PS8551L4-V-E3-AX		Embossed Tape 1 000 pcs/reel	(VDE0884 Part2) Approved (Option)	

***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
Operating Ambient Temperature	T_A	−40 to +85	°C
Storage Temperature	T_{stg}	−55 to +125	°C
Supply Voltage	$V_{DD}1$, $V_{DD}2$	0 to 5.5	V
Input Voltage	V_{IN+}, V_{IN-}	−2 to $V_{DD}1$+0.5	V
2 Seconds Transient Input Voltage	V_{IN+}, V_{IN-}	−6 to $V_{DD}1$+0.5	V
Output Voltage	V_{OUT+}, V_{OUT-}	−0.5 to $V_{DD}2$+0.5	V
Isolation Voltage*1	BV	5 000	Vr.m.s.

***1** 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.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	MAX.	Unit
Operating Ambient Temperature	T_A	−40	85	°C
Supply Voltage	$V_{DD}1$, $V_{DD}2$	4.5	5.5	V
Input Voltage (Accurate and Linear)*1	V_{IN+}, V_{IN-}	−200	200	mV

***1** Using V_{IN-} = 0 V (to be connected to GND1) is recommended. Avoid using V_{IN-} of 2.5 V or more, because the internal test mode is activated when the voltage V_{IN-} reaches more than 2.5 V.

ELECTRICAL CHARACTERISTICS (DC Characteristics)
(TYP.: T_A = 25°C, V_{IN+} = V_{IN-} = 0 V, $V_{DD}1$ = $V_{DD}2$ = 5 V,
MIN., MAX.: refer to RECOMMENDED OPERATING CONDITIONS, unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{os}	T_A = 25°C	–2	0.3	2	mV
			–3		3	
Input Offset Voltage Drift vs. Temperature	$\lvert dV_{os}/dT_A \rvert$	T_A = 25 to +85°C		3	10	μV/°C
Gain [*1]	G	–200 mV ≤ V_{IN+} ≤ 200 mV, T_A = 25°C	7.76	8	8.24	V/V
Gain Drift vs. Temperature	$\lvert dG/dT_A \rvert$			0.00087		V/V°C
V_{OUT} Non-linearity (200 mV) [*2]	NL200	–200 mV ≤ V_{IN+} ≤ 200 mV		0.021	0.35	%
V_{OUT} Non-linearity (200 mV) Drift vs. Temperature	$\lvert dNL200/dT_A \rvert$			0.0002		%/°C
V_{OUT} Non-linearity (100 mV) [*2]	NL100	–100 mV ≤ V_{IN+} ≤ 100 mV		0.014	0.2	%
Maximum Input Voltage before V_{OUT} Clipping	$\lvert V_{IN+} \rvert$ MAX.			308		mV
Input Supply Current	$I_{DD}1$	V_{IN+} = 400 mV		16	20	mA
Output Supply Current	$I_{DD}2$	V_{IN+} = –400 mV		10	16	mA
Input Bias Current	I_{IN+}	V_{IN+} = 0V		–0.5	5	μA
Input Bias Current Drift vs. Temperature	$\lvert dI_{IN+}/dT_A \rvert$			0.45		nA/°C
Low Level Saturated Output Voltage	V_{OL}	V_{IN+} = –400 mV		1.29		V
High Level Saturated Output Voltage	V_{OH}	V_{IN+} = 400 mV		3.8		V
Output Voltage (V_{IN+} = V_{IN-} = 0 V)	V_{OCM}	V_{IN+} = V_{IN-} = 0 V	2.2	2.55	2.8	V
Output Short-circuit Current	$\lvert I_{OSC} \rvert$			18.6		mA
Equivalent Input Resistance	R_{IN}			320		kΩ
V_{OUT} Output Resistance	R_{OUT}			15		Ω
<R> Input DC Common-Mode Rejection Ratio [*3]	$CMRR_{IN}$			76		dB

***1** The differential output voltage (V_{OUT+} – V_{OUT-}) with respect to the differential input voltage (V_{IN+} – V_{IN-}), where V_{IN+} = –200 mV to 200 mV and V_{IN-} = 0 V) is measured under the circuit shown in **Fig. 2 NL200, G Test Circuit**. Upon the resulting chart, the gain is defined as the slope of the optimum line obtained by using the method of least squares.

***2** The differential output voltage (V_{OUT+} – V_{OUT-}) with respect to the differential input voltage (V_{IN+} – V_{IN-}) is measured under the circuit shown in **Fig. 2 NL200, G Test Circuit**. Upon the resulting chart, the optimum line is obtained by using the method of least squares. Non-linearity is defined as the ratio (%) of the optimum line obtained by dividing [Half of the peak to peak value of the (residual) deviation] by [full-scale differential output voltage].
For example, if the differential output voltage is 3.2 V, and the peak to peak value of the (residual) deviation is 22.4 mV, while the input V_{IN+} is ±200 mV, the output non-linearity is obtained as follows:
NL200 = 22.4/(2 × 3 200) = 0.35%

***3** $CMRR_{IN}$ is defined as the ratio of the differential signal gain (when the differential signal is applied between the input pins) to the common-mode signal gain (when both input pins are connected and the signal is applied). This value is indicated in dB.

ELECTRICAL CHARACTERISTICS (AC Characteristics)
(TYP.: T_A = 25°C, V_{IN+} = V_{IN-} = 0 V, $V_{DD}1$ = $V_{DD}2$ = 5 V,
MIN., MAX.: refer to RECOMMENDED OPERATING CONDITIONS, unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT} Bandwidth (–3 dB)	f_C	V_{IN+} = 200 mV_{p-p}, sine wave	50	100		kHz
V_{OUT} Noise	N_{OUT}	V_{IN+} = 0 V		31.5		mVr.m.s.
V_{IN} to V_{OUT} Signal Delay (50 to 10%)	t_{PD10}	V_{IN+} = 0 to 150 mV step		2.03	3.3	μs
V_{IN} to V_{OUT} Signal Delay (50 to 50%)	t_{PD50}			4.01	5.6	
V_{IN} to V_{OUT} Signal Delay (50 to 90%)	t_{PD90}			6.02	9.9	
V_{OUT} Rise Time/Fall Time (10 to 90%)	t_r/t_f	V_{IN+} = 0 to 150 mV step		3.53	6.6	μs
Common Mode Transient Immunity*1	CMTI	V_{CM} = 0.5 kV, T_A = 25°C	10	25		kV/μs
Power Supply Noise Rejection*2	PSR	f = 1 MHz		100		mVr.m.s.

***1** CMTI is tested by applying a pulse that rises and falls suddenly (V_{CM} = 0.5 kV) between GND1 on the input side and GND2 on the output side (pins 4 and 5) by using the circuit shown in **Fig. 9 CMTI Test Circuit**. CMTI is defined at the point where the differential output voltage (V_{OUT+} – V_{OUT-}) fluctuates 200 mV (>1 μs) or more from the average output voltage.

***2** This is the value of the transient voltage at the differential output when 1 V_{p-p}, 1 MHz, and 40 ns rise/fall time square wave is applied to both $V_{DD}1$ and $V_{DD}2$.

TEST CIRCUIT

Fig. 1 VOS Test Circuit

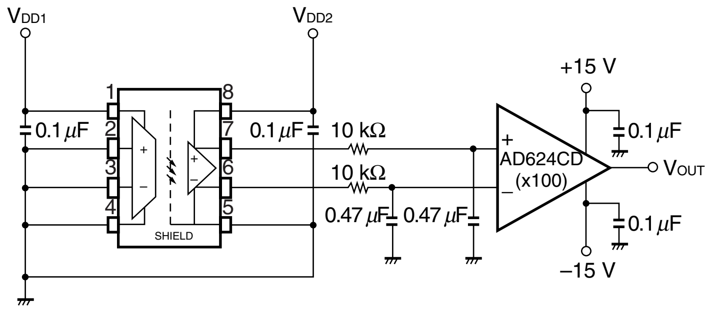


Fig. 2 NL200, G Test Circuit

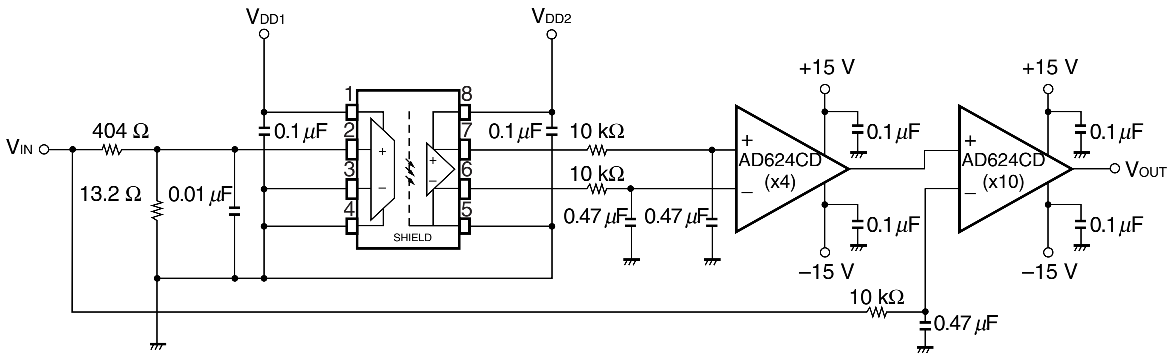


Fig. 3 IDD1 Test Circuit

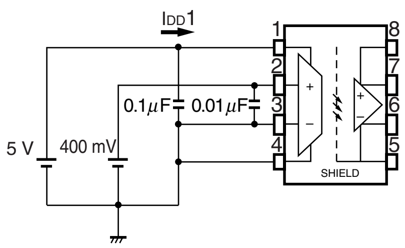


Fig. 4 IDD2 Test Circuit

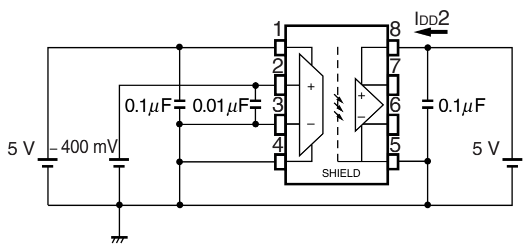


Fig. 5 I_{IN+} Test Circuit

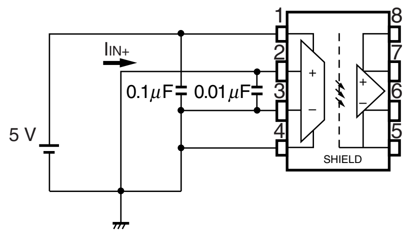
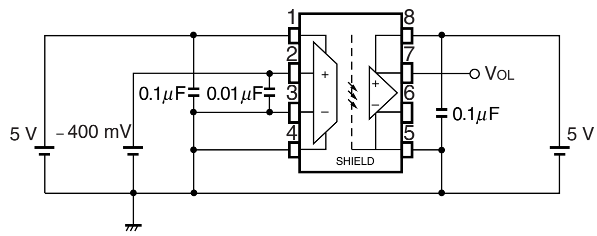
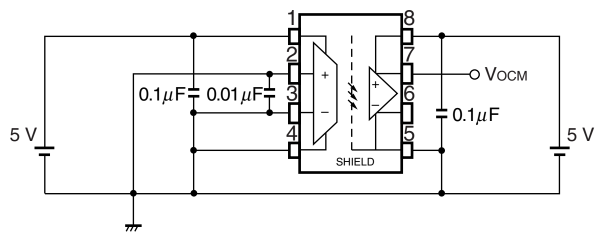


Fig. 6 V_{OUT} Test Circuit

V_{OL}



V_{OCM}



V_{OH}

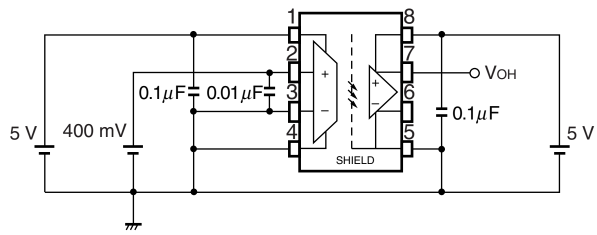


Fig. 7 |Iosc| Test Circuit

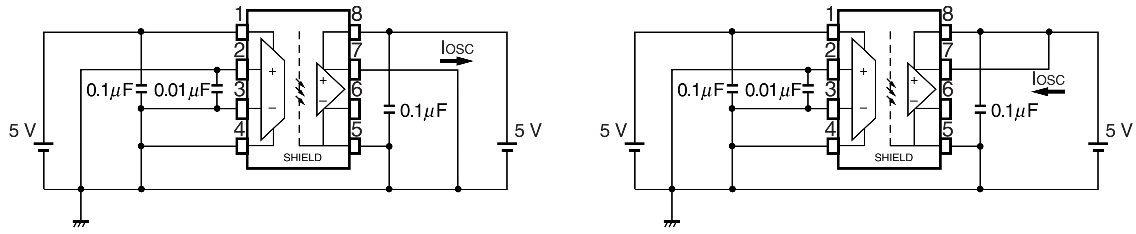


Fig. 8 tPD Test Circuit

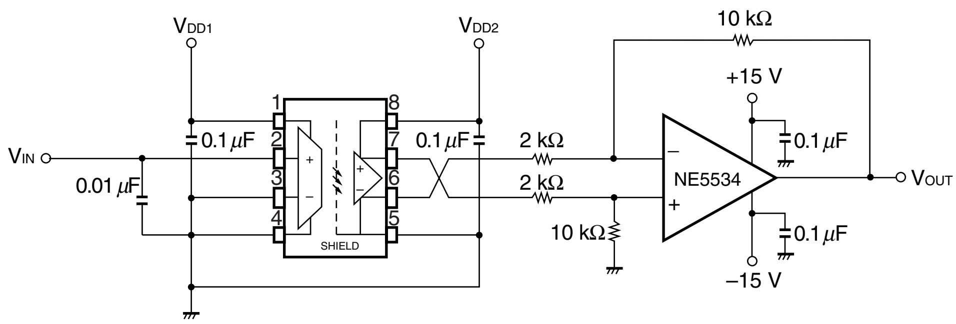
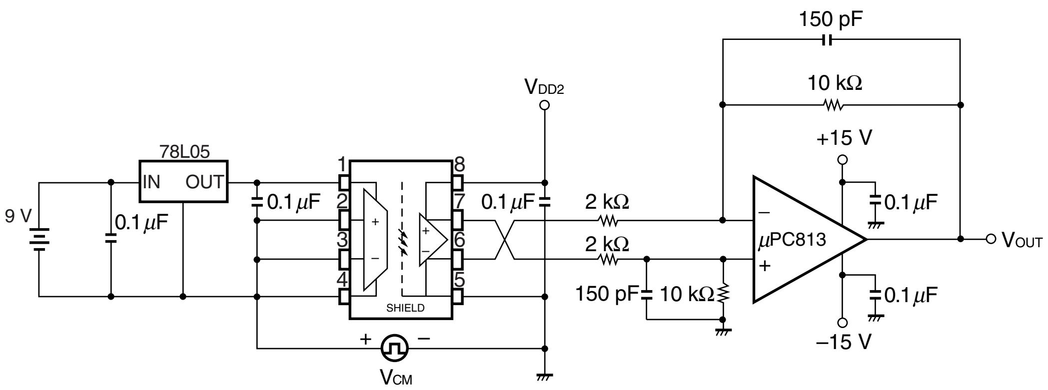
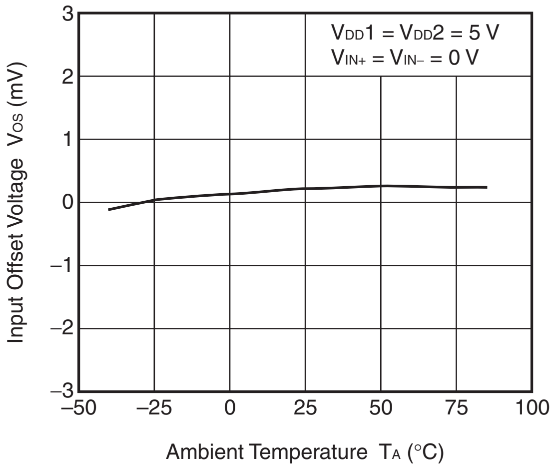


Fig. 9 CMTI Test Circuit

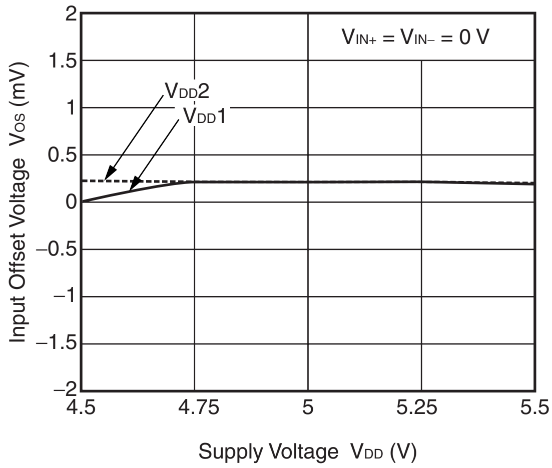


TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)

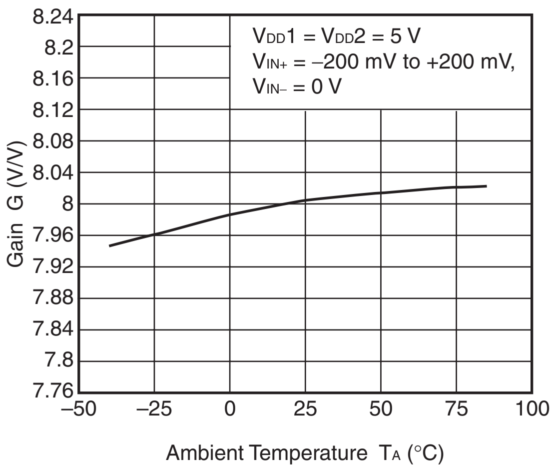
INPUT OFFSET VOLTAGE vs.
AMBIENT TEMPERATURE



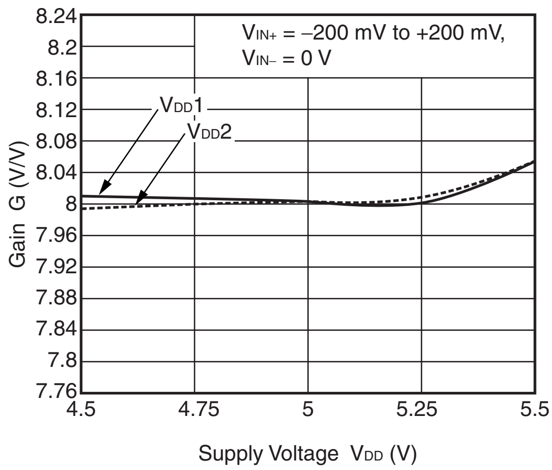
INPUT OFFSET VOLTAGE vs.
SUPPLY VOLTAGE



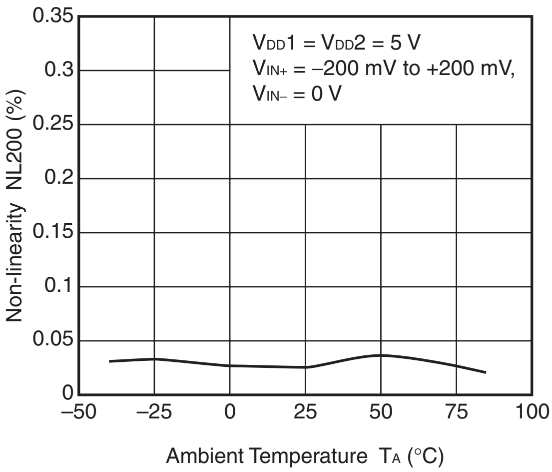
GAIN vs. AMBIENT TEMPERATURE



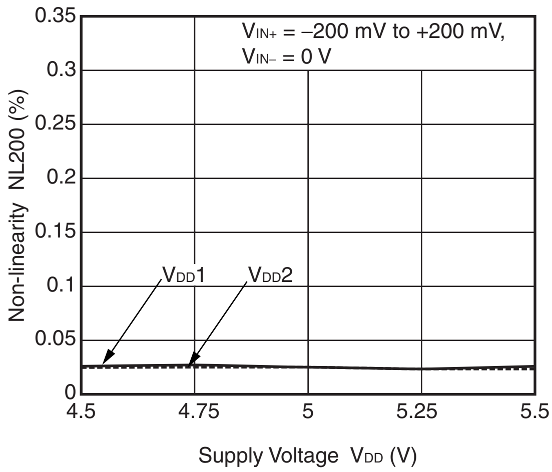
GAIN vs. SUPPLY VOLTAGE



NON-LINEARITY vs.
AMBIENT TEMPERATURE

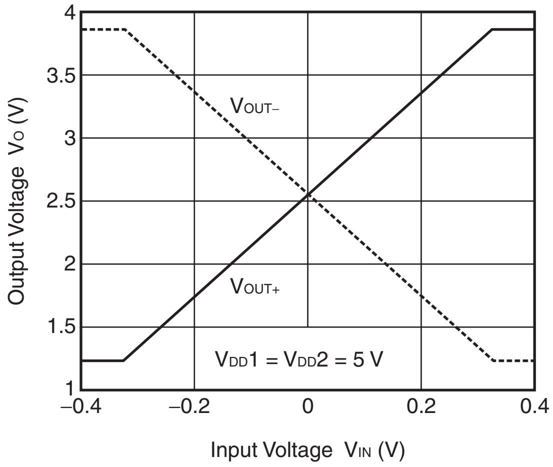


NON-LINEARITY vs.
SUPPLY VOLTAGE

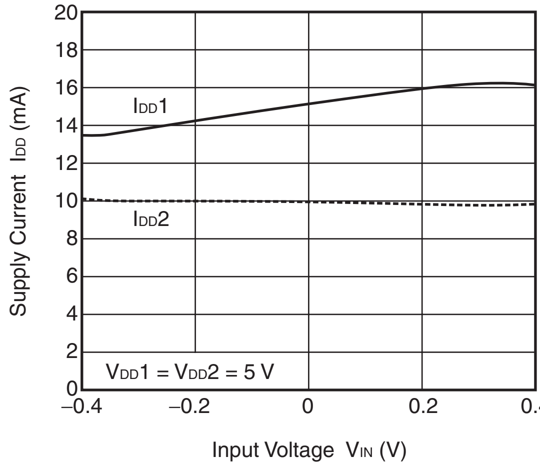


Remark The graphs indicate nominal characteristics.

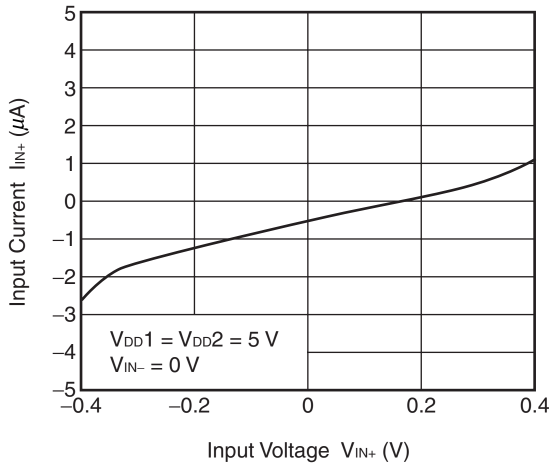
INPUT VOLTAGE vs. OUTPUT VOLTAGE



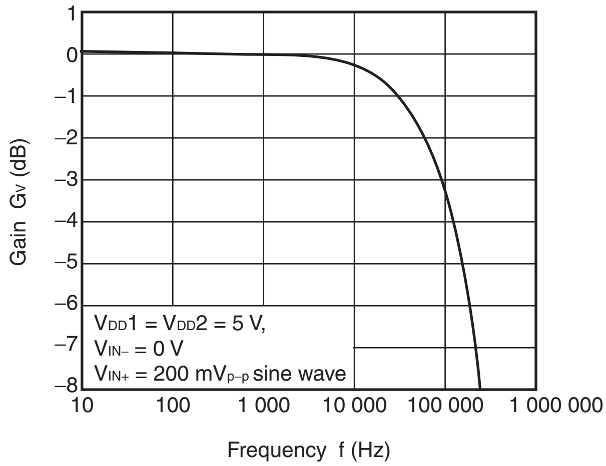
SUPPLY CURRENT vs. INPUT VOLTAGE



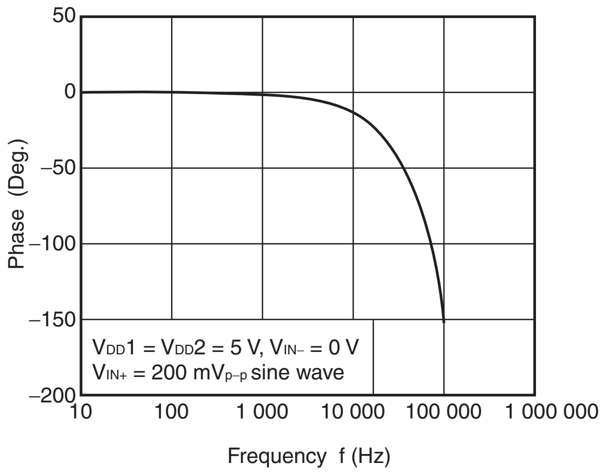
INPUT CURRENT vs. INPUT VOLTAGE



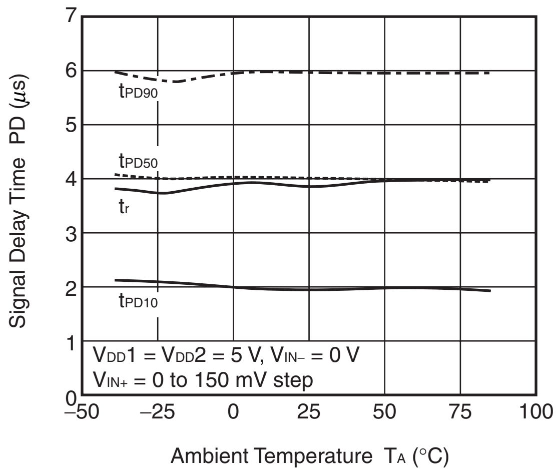
GAIN vs. FREQUENCY



PHASE vs. FREQUENCY



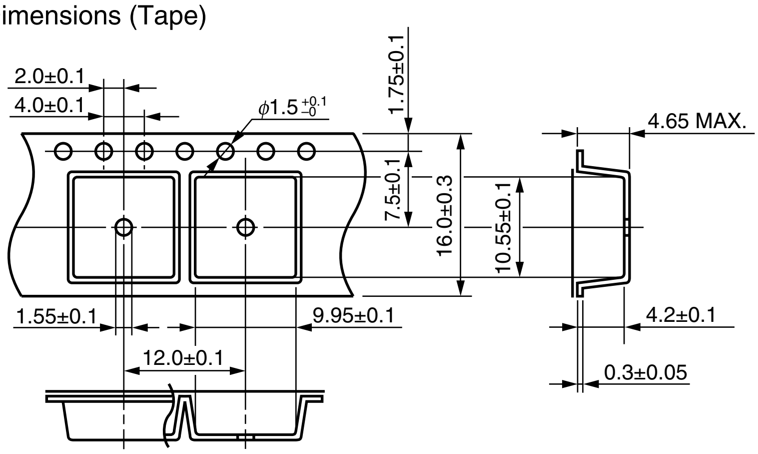
SIGNAL DELAY TIME vs. AMBIENT TEMPERATURE



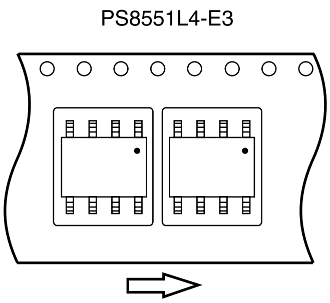
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

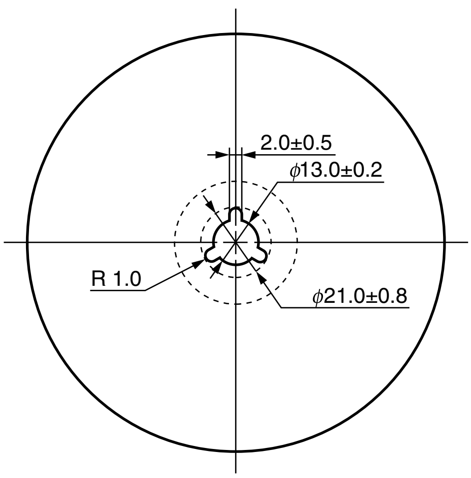
Outline and Dimensions (Tape)

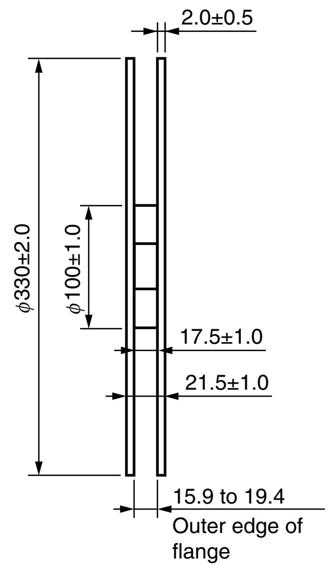


Tape Direction



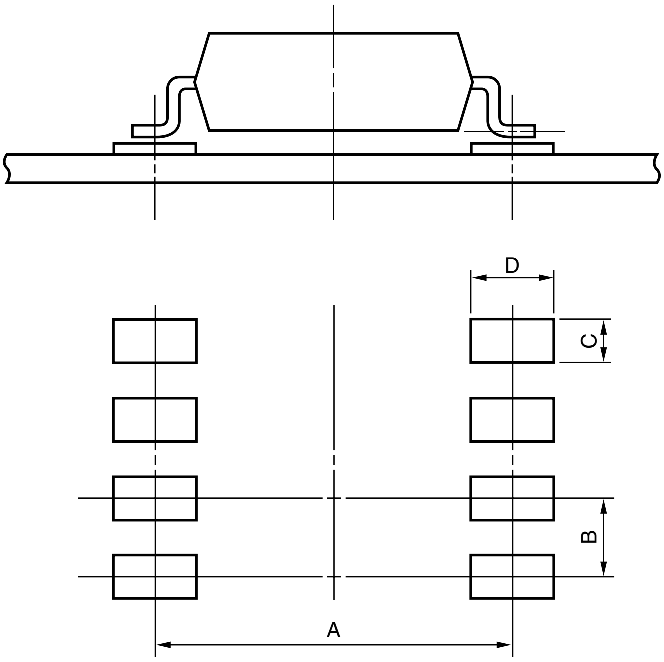
Outline and Dimensions (Reel)





Packing: 1 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS8551L4	lead bending type (Gull-wing) for surface mount	9.0	2.54	1.7	2.0

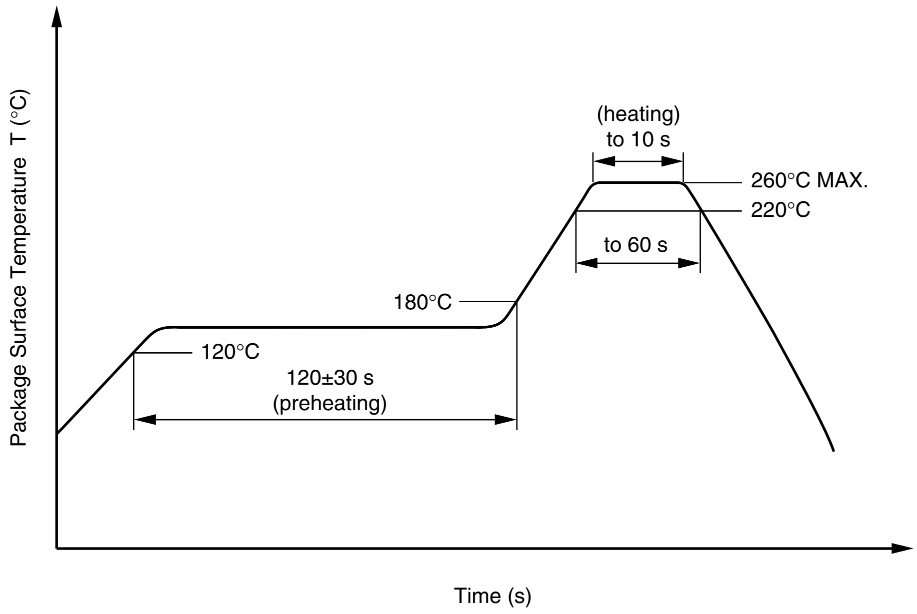
NOTES ON HANDLING

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. Board designing
   (1) 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.
   (2) Keep the pattern connected the input (V_{IN+}, V_{IN-}) and the output (V_{OUT+}, V_{OUT-}), respectively, as short as possible.
   (3) Do not connect any routing to the portion of the frame exposed between the pins on the package of the photocoupler. If connected, it will affect the photocoupler's internal voltage and the photocoupler will not operate normally.
   (4) Because the maximum frequency of the signal input to the photocoupler must be lower than the allowable frequency band, be sure to connect an anti-aliasing filter (an RC filter with R = 68 Ω and C = 0.01 μF, for example).
   (5) The signals output from the PS8551 include noise elements such as chopping noise and quantization noise generated internally. Therefore, be sure to restrict the output frequency to the required bandwidth by adding a low-pass filter function (an RC filter with R =10 kΩ and C = 150 pF, for example) to the operational amplifier (post amplifier) in the next stage to the PS8551.
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)		40/085/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}$, $P_d < 5$ pC	 U_{IORM} U_{pr}	 1 130 1 695	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5$ pC	U_{pr}	2 119	V_{peak}
Highest permissible overvoltage	U_{TR}	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	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 +85	°C
Isolation resistance, minimum value V_{IO} = 500 V dc at T_A = 25°C V_{IO} = 500 V dc at T_A 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, Psi = 0) Power (output or total power dissipation) Isolation resistance V_{IO} = 500 V dc at T_A = Tsi	 Tsi Isi Psi Ris MIN.	 175 400 700 10^{9}	 °C mA mW Ω

Caution	GaAs Products	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. • 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. 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.

Revision History	PS8551L4 Data Sheet

Rev.	Date	Description	
		Page	Summary
–	Sep 2007	–	Previous No. :PN10670EJ01V0DS
1.00	Jun 14, 2011	Throughout	Preliminary Data Sheet -> Data Sheet
		Throughout	Safety standards approved
		p.3	Modification of **MARKING EXAMPLE** Addition of **ORDERING INFORMATION**
		p.4	Modification of **ABSOLUTE MAXIMUM RATINGS** Modification of **RECOMMENDED OPERATING CONDITIONS**
		p.5	Modification of **ELECTRICAL CHARACTERISTICS (DC Characteristics)**
		p.6	Modification of **SWITCHING CHARACTERISTICS (ADC Characteristics)**
		pp.7 to 9	Addition of **TEST CIRCUIT**
		pp.10, 11	Addition of **TYPICAL CHARACTERISTICS**
		p.13	Addition of **RECOMMENDED MOUNT**
		p.15	Modification of **USAGE CAUTIONS**
		p.16	Addition of **SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**
2.00	Sep 06, 2011	p.3	Modification of **MARKING EXAMPLE**
		p.5	Modification of **ELECTRICAL CHARACTERISTICS (DC Characteristics)** $CMRR_{IN}$

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
1 harbourFront Avenue, #06-10, keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6278-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141