CEL

PHOTOCOUPLER

PS9552,PS9552L1,PS9552L2,PS9552L3

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

–NEPOC Series–

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.

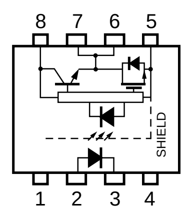
The PS9552L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

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

FEATURES

- Long creepage distance (8 mm MIN.: PS9552L1, PS9552L2)
- Large peak output current (2.5 A MAX., 2.0 A MIN.)
- High speed switching (t_{PLH}, t_{PHL} = 0.5 μs MAX.)
- UVLO (Under Voltage Lock Out) protection with hysteresis
- High common mode transient immunity (CM_H, CM_L = ±25 kV/μs MIN.)
- Ordering number of tape product: PS9552L2-E3: 1 000 pcs/reel
  : PS9552L3-E3: 1 000 pcs/reel
- Safety standards
  - UL approved: 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
  - <R> DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40019182 (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)

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

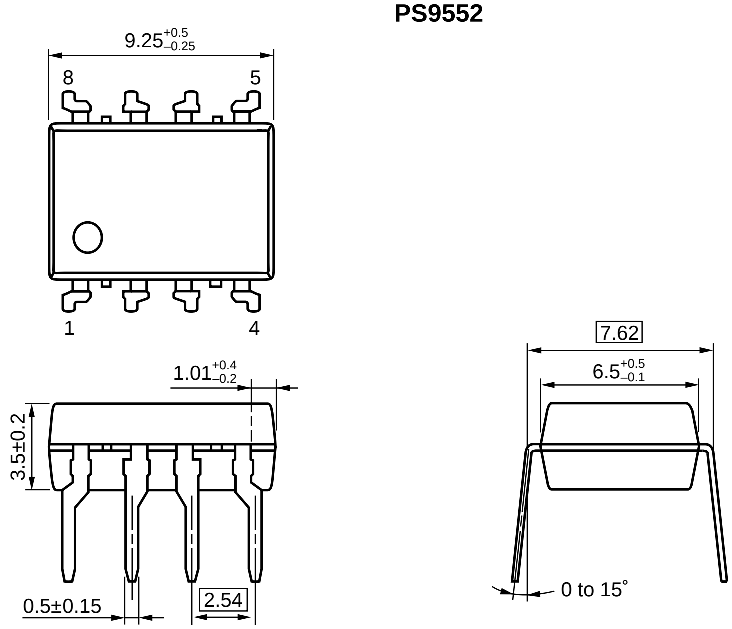
Document No. PN10589EJ06V0DS (6th edition)
Date Published October 2008 NS

The mark <R> shows major revised points.

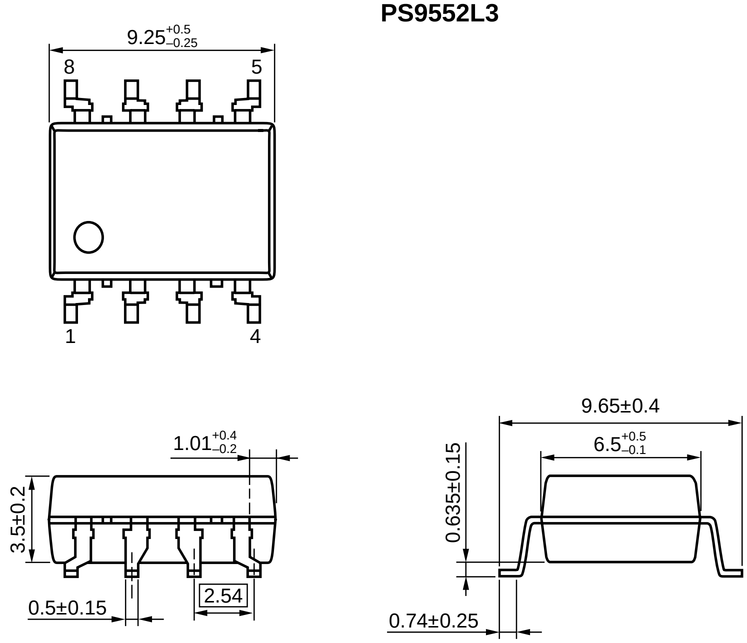
The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

PACKAGE DIMENSIONS (UNIT: mm)

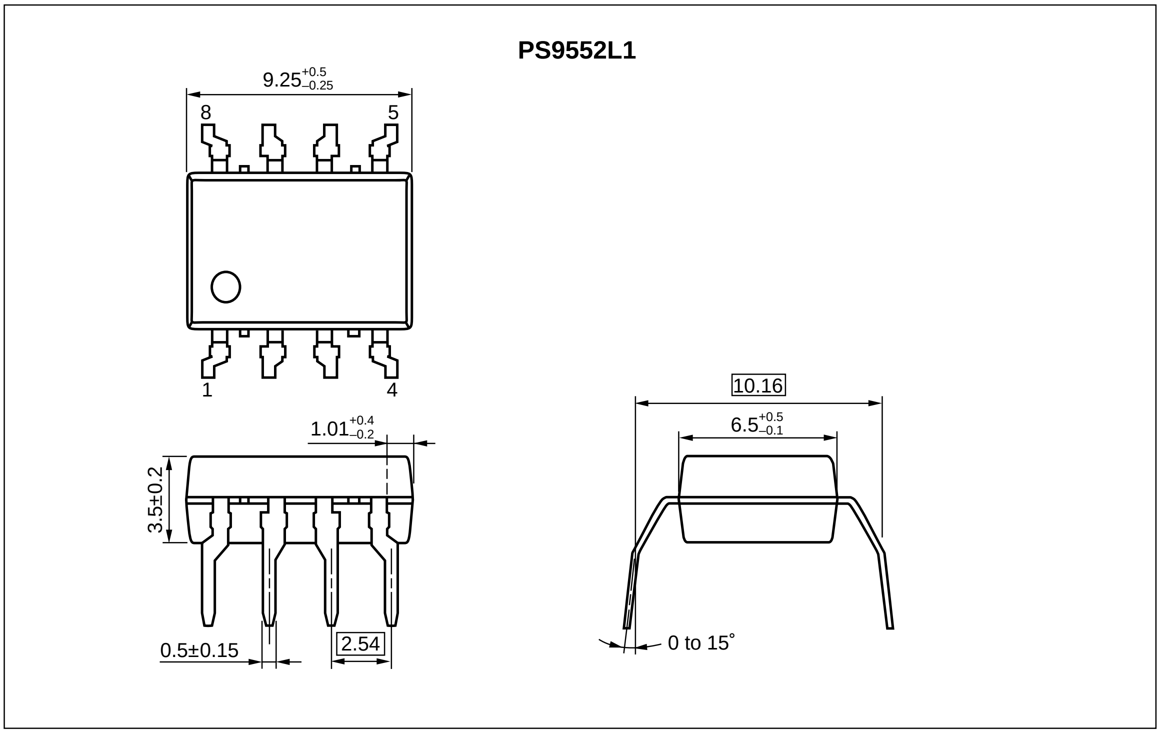
DIP Type



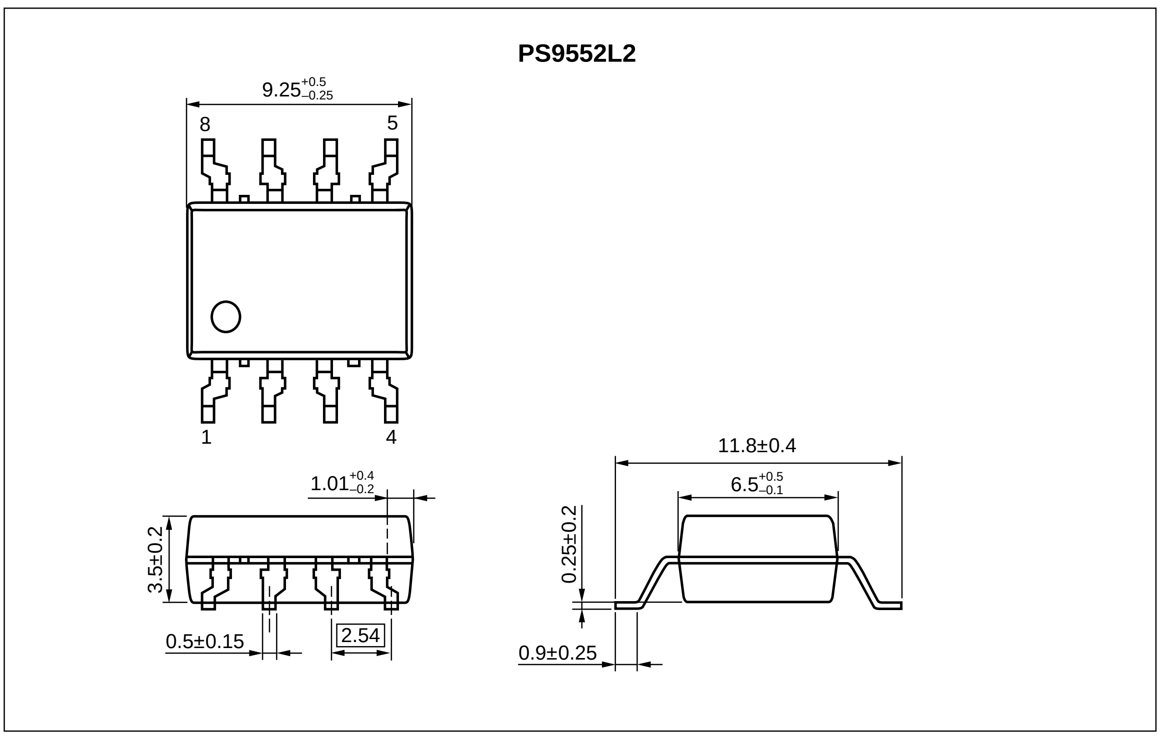
Lead Bending Type (Gull-wing) For Surface Mount



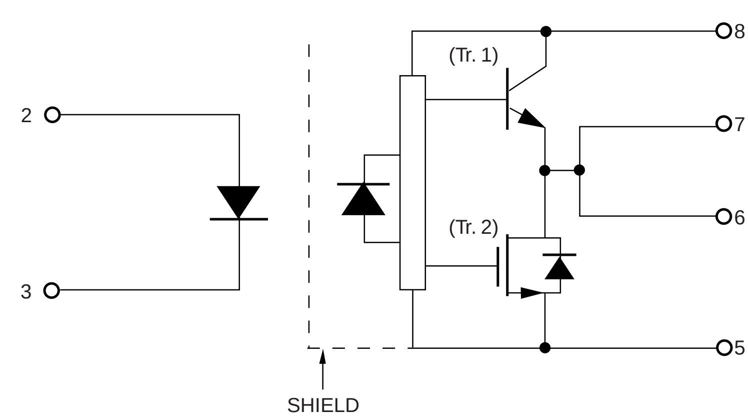
Lead Bending Type For Long Creepage Distance



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

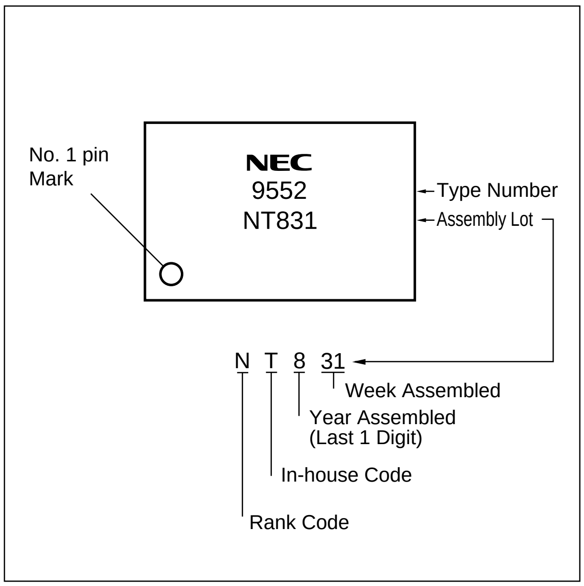


FUNCTIONAL DIAGRAM



Input	LED	Tr. 1	Tr. 2	Output
H	ON	ON	OFF	H
L	OFF	OFF	ON	L

MARKING EXAMPLE



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

ORDERING INFORMATION

<table>
<tr><th>Part Number</th><th>Order Number</th><th>Solder Plating Specification</th><th>Packing Style</th><th>Safety Standard Approval</th><th>Application Part Number*1</th></tr>
<tr><td>PS9552</td><td>PS9552-AX</td><td rowspan="12">Pb-Free (Ni/Pd/Au)</td><td rowspan="4">Magazine case 50 pcs</td><td rowspan="6">Standard products (UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO approved)</td><td>PS9552</td></tr>
<tr><td>PS9552L1</td><td>PS9552L1-AX</td><td>PS9552L1</td></tr>
<tr><td>PS9552L2</td><td>PS9552L2-AX</td><td>PS9552L2</td></tr>
<tr><td>PS9552L3</td><td>PS9552L3-AX</td><td>PS9552L3</td></tr>
<tr><td>PS9552L2-E3</td><td>PS9552L2-E3-AX</td><td rowspan="2">Embossed Tape 1 000 pcs/reel</td><td>PS9552L2</td></tr>
<tr><td>PS9552L3-E3</td><td>PS9552L3-E3-AX</td><td>PS9552L3</td></tr>
<tr><td>PS9552-V</td><td>PS9552-V-AX</td><td rowspan="4">Magazine case 50 pcs</td><td rowspan="6">DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)</td><td>PS9552</td></tr>
<tr><td>PS9552L1-V</td><td>PS9552L1-V-AX</td><td>PS9552L1</td></tr>
<tr><td>PS9552L2-V</td><td>PS9552L2-V-AX</td><td>PS9552L2</td></tr>
<tr><td>PS9552L3-V</td><td>PS9552L3-V-AX</td><td>PS9552L3</td></tr>
<tr><td>PS9552L2-V-E3</td><td>PS9552L2-V-E3-AX</td><td rowspan="2">Embossed Tape 1 000 pcs/reel</td><td>PS9552L2</td></tr>
<tr><td>PS9552L3-V-E3</td><td>PS9552L3-V-E3-AX</td><td>PS9552L3</td></tr>
</table>

***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	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
	Power Dissipation *2	P_C	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 mW/°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 mW/°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

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

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 = –2 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%).

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, I_F = 7 to 16 mA	0.1	0.3	0.5	μs
Pulse Width Distortion (PWD)	$\|t_{PHL}-t_{PLH}\|$				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 to 16 mA, V_{CC} = 30 V, $V_{O\,(MIN.)}$ = 26 V, V_{CM} = 1.5k V	25			kV/μs
Common Mode Transient Immunity at Low Level Output*3	$\|CM_L\|$	T_A = 25°C, I_F = 0 mA, V_{CC} = 30 V, $V_{O\,(MAX.)}$ = 1 V, V_{CM} = 1.5k V	25			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.

TEST CIRCUIT

Fig. 1 I_{OH} Test Circuit

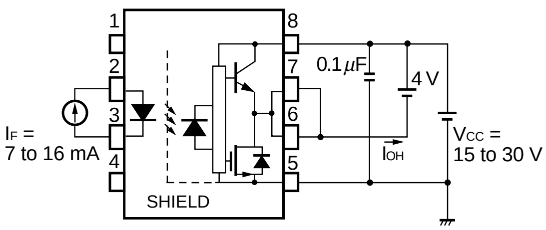


Fig. 2 I_{OL} Test Circuit

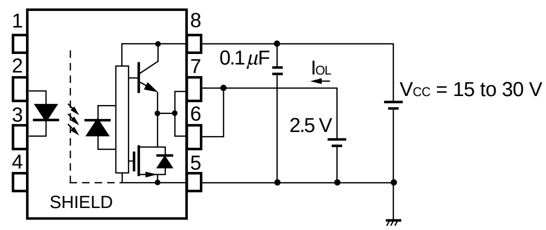


Fig. 3 V_{OH} Test Circuit

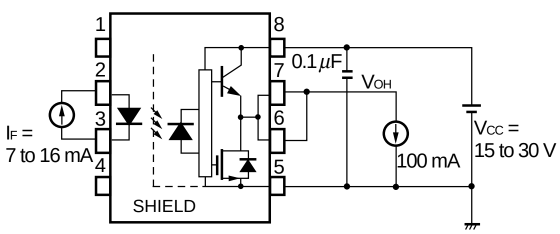


Fig. 4 V_{OL} Test Circuit

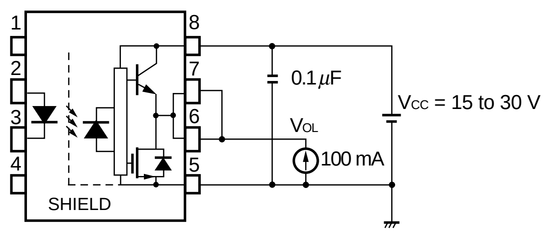


Fig. 5 I_{FLH} Test Circuit

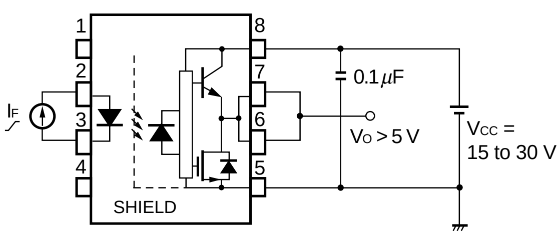


Fig. 6 UVLO Test Circuit

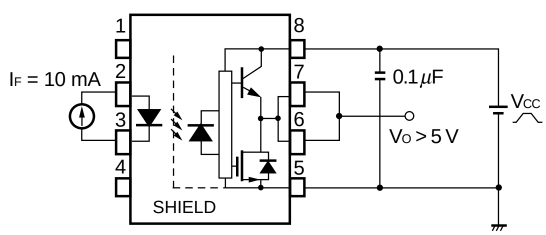


Fig. 7 t_{PLH}, t_{PHL}, t_r, t_f Test Circuit and Wave Forms

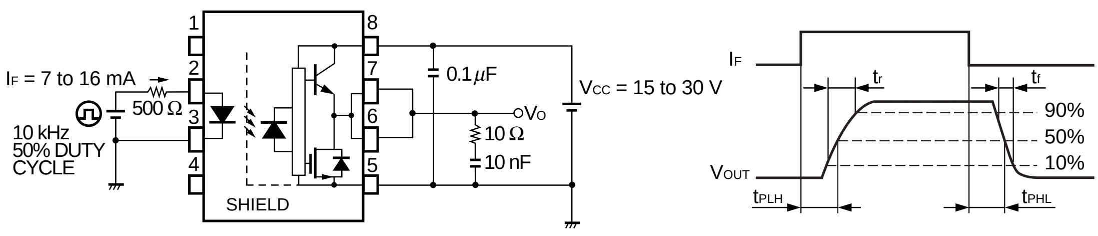
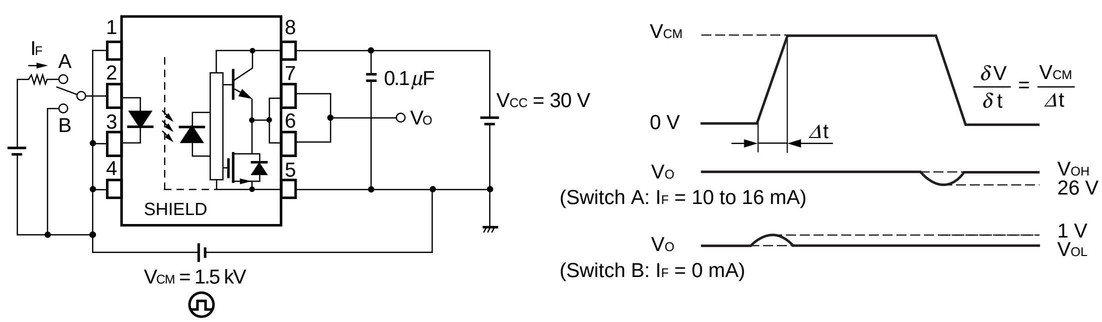


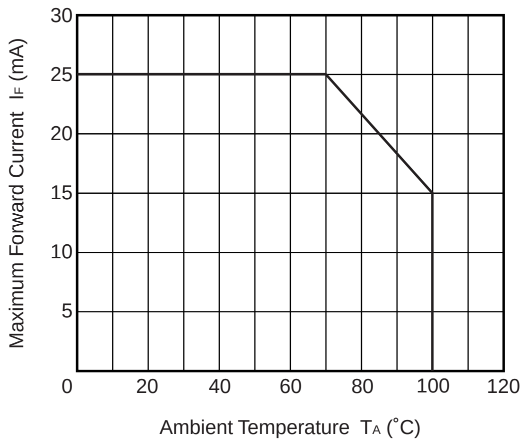
Fig. 8 CMR Test Circuit and Wave Forms



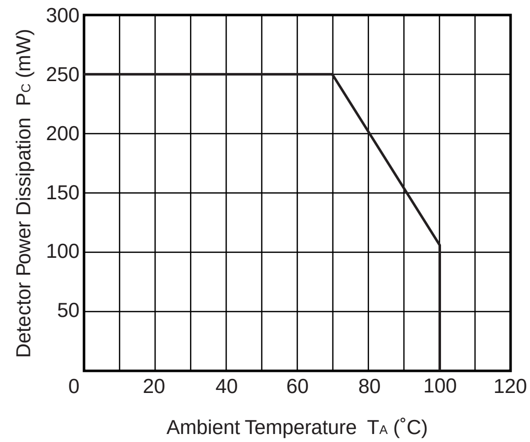
Remark CMR Test : Connect pin 1 and pin 4 to the LED common.

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

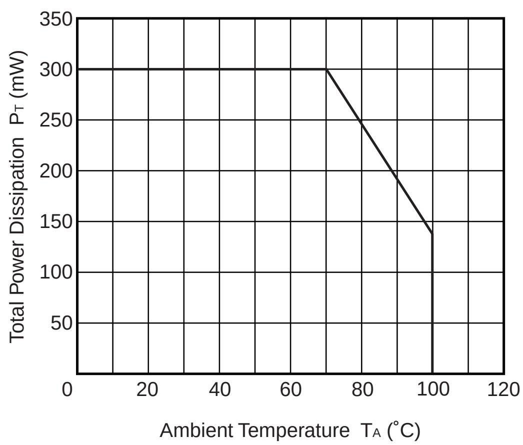
MAXIMUM FORWARD CURRENT
vs. AMBIENT TEMPERATURE



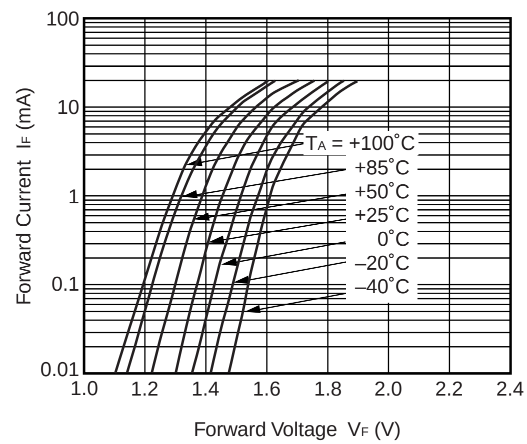
DETECTOR POWER DISSIPATION
vs. AMBIENT TEMPERATURE



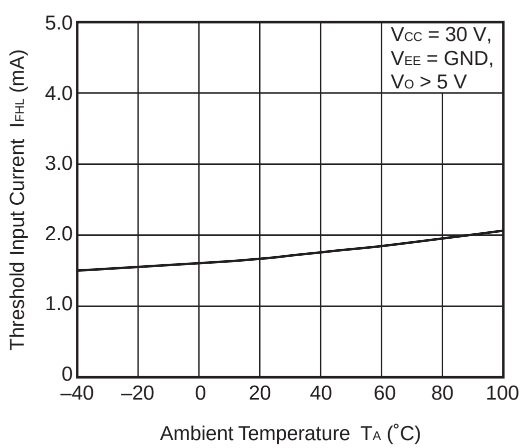
TOTAL POWER DISSIPATION
vs. AMBIENT TEMPERATURE



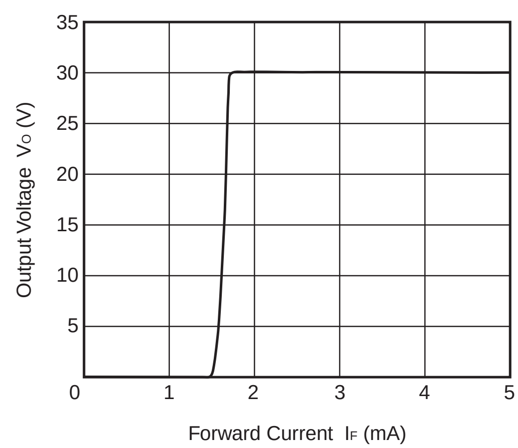
FORWARD CURRENT vs.
FORWARD VOLTAGE



THRESHOLD INPUT CURRENT vs.
AMBIENT TEMPERATURE

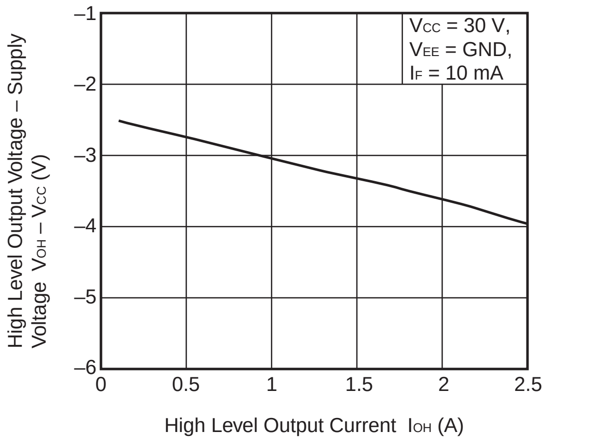


OUTPUT VOLTAGE vs.
FORWARD CURRENT

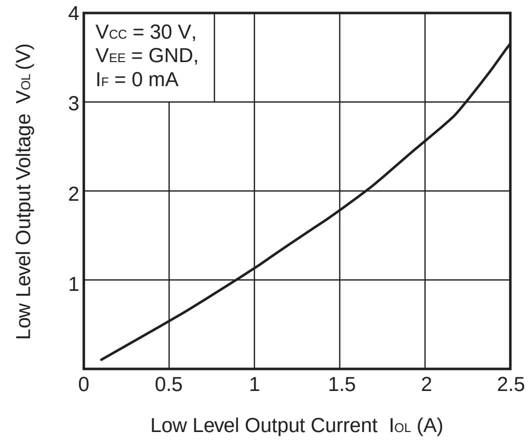


Remark The graphs indicate nominal characteristics.

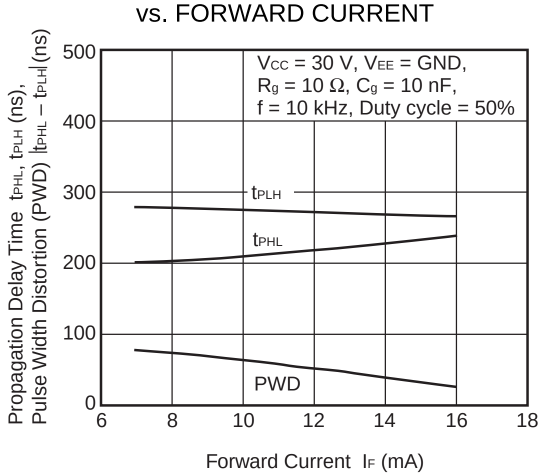
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



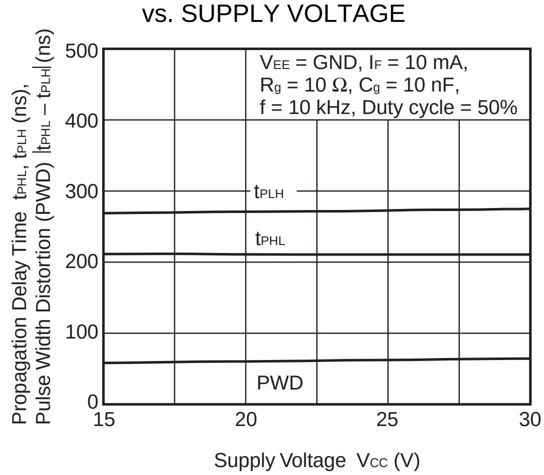
LOW LEVEL OUTPUT VOLTAGE vs. LOW LEVEL OUTPUT CURRENT



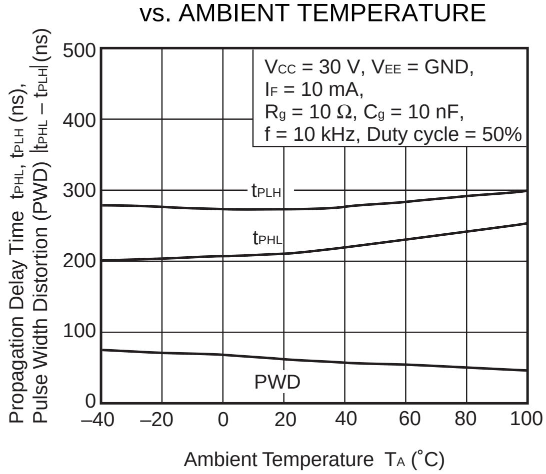
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



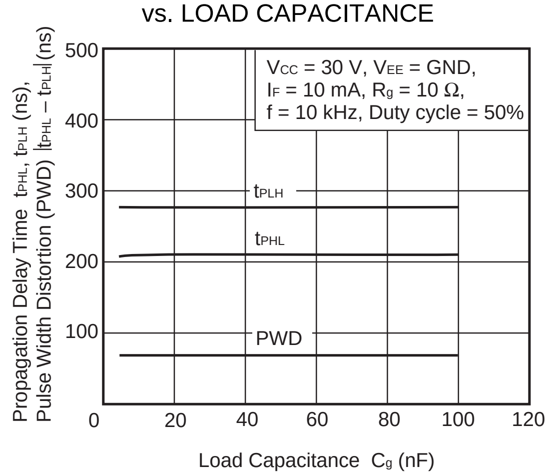
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. SUPPLY VOLTAGE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

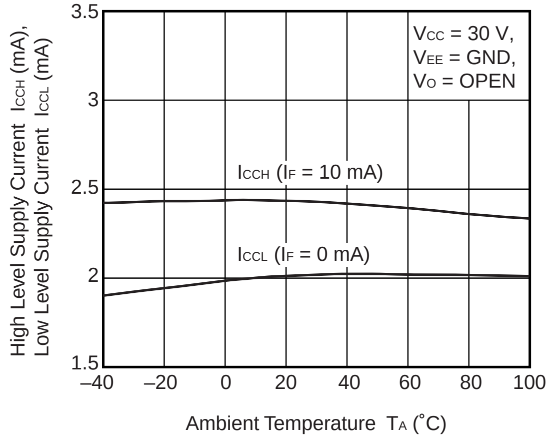


PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. LOAD CAPACITANCE

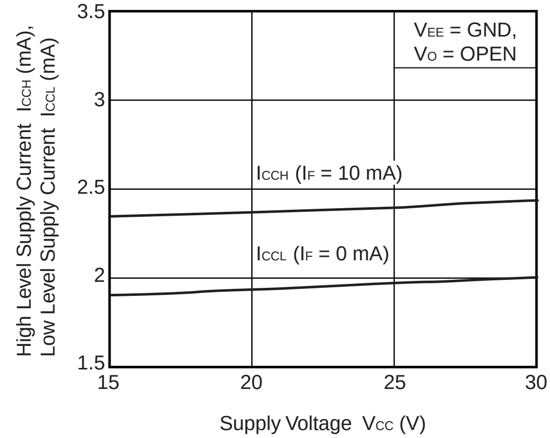


Remark The graphs indicate nominal characteristics.

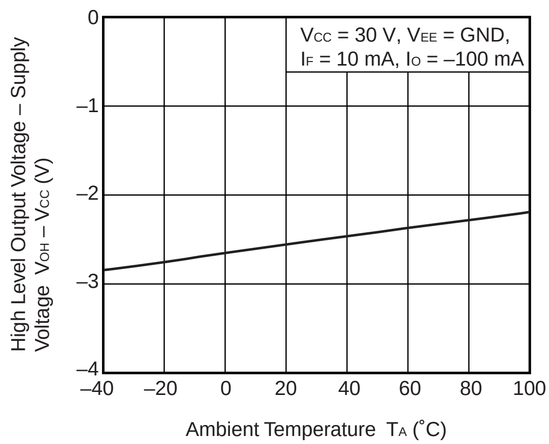
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



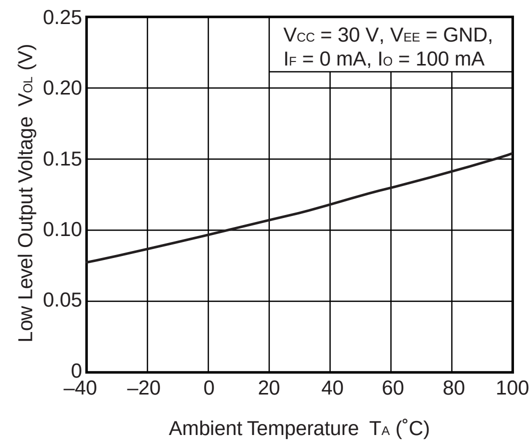
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



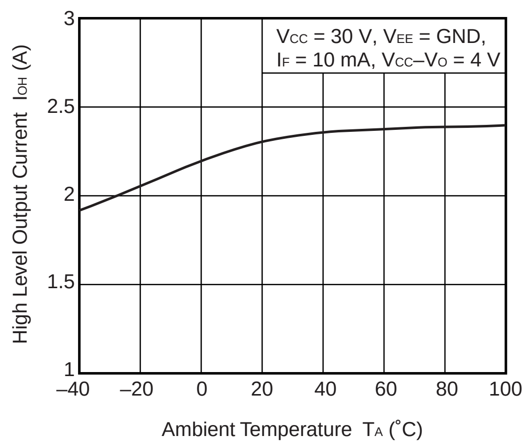
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. AMBIENT TEMPERATURE



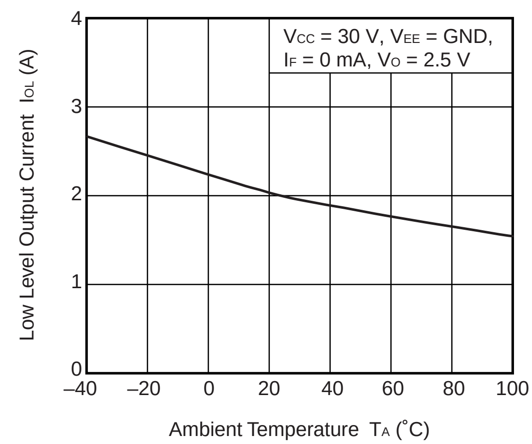
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE

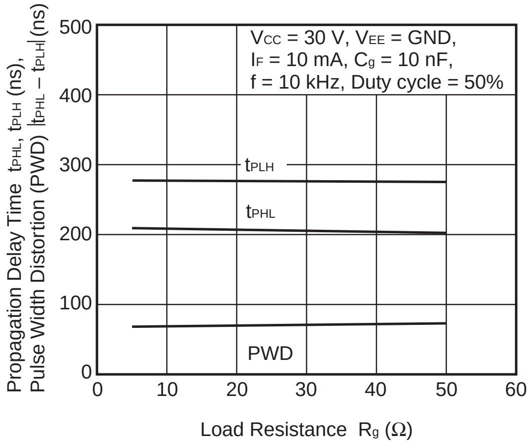


LOW LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE

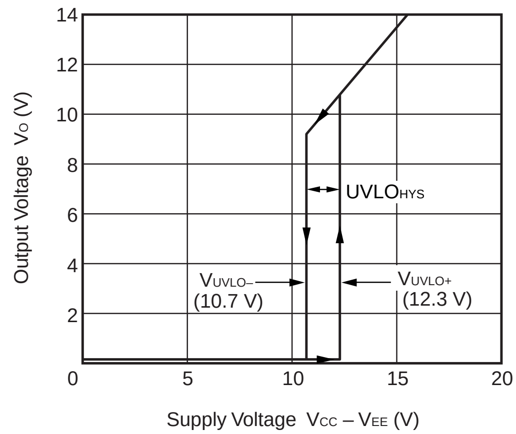


Remark The graphs indicate nominal characteristics.

PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. LOAD RESISTANCE



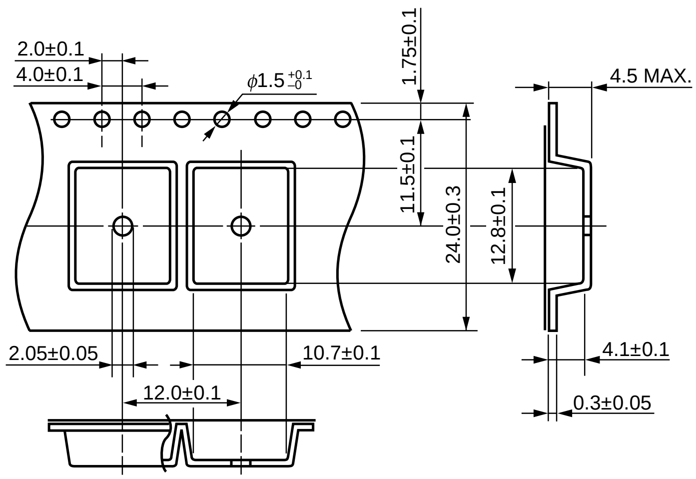
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



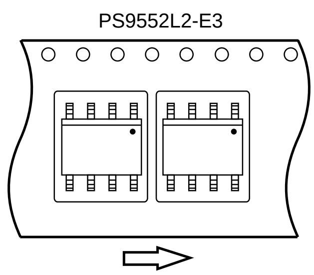
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

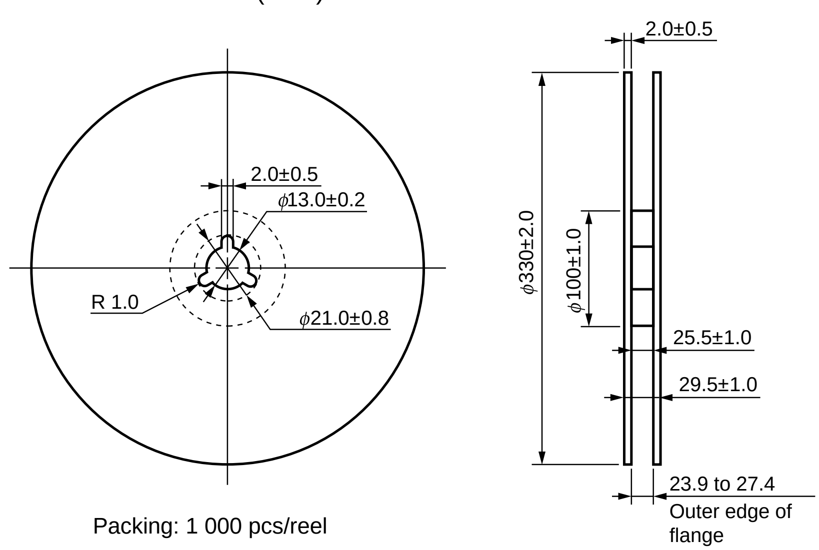
Outline and Dimensions (Tape)



Tape Direction

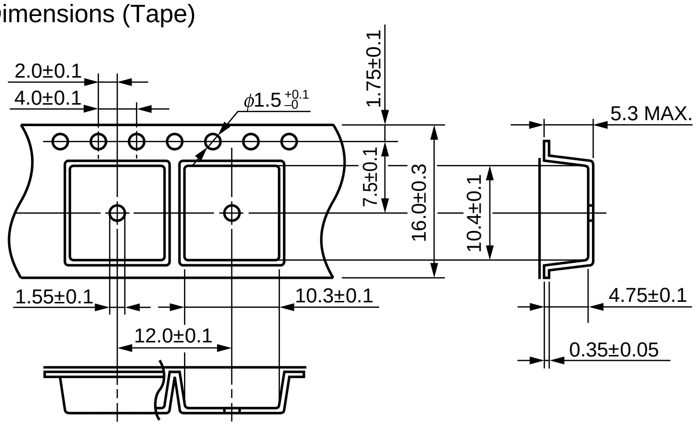


Outline and Dimensions (Reel)

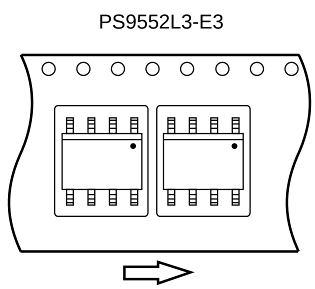


Packing: 1 000 pcs/reel

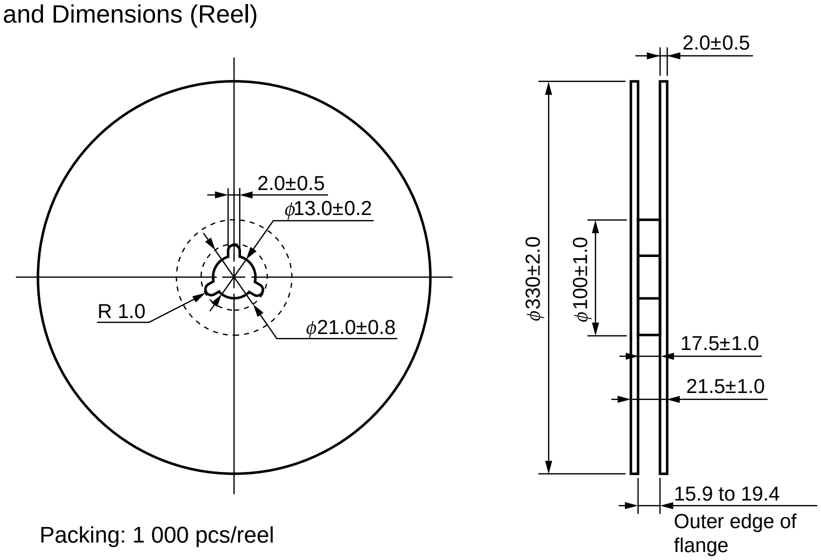
Outline and Dimensions (Tape)



Tape Direction

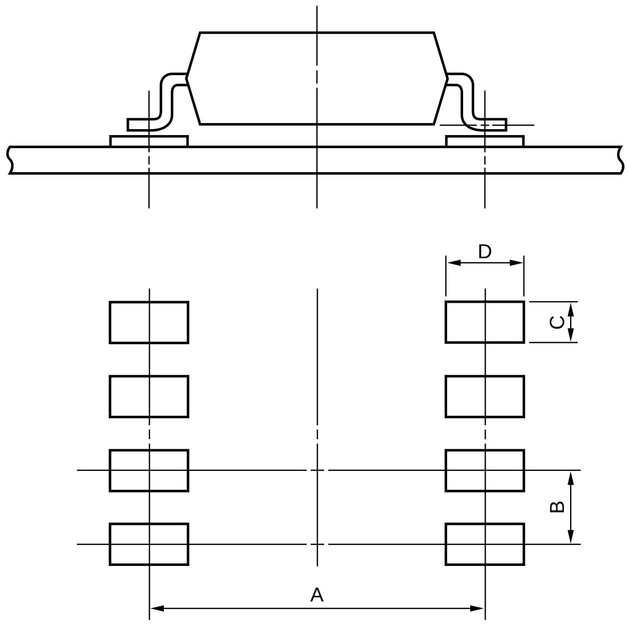


Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9552L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	2.54	1.7	2.2
PS9552L3	lead bending type (Gull-wing) for surface mount	8.2	2.54	1.7	2.2

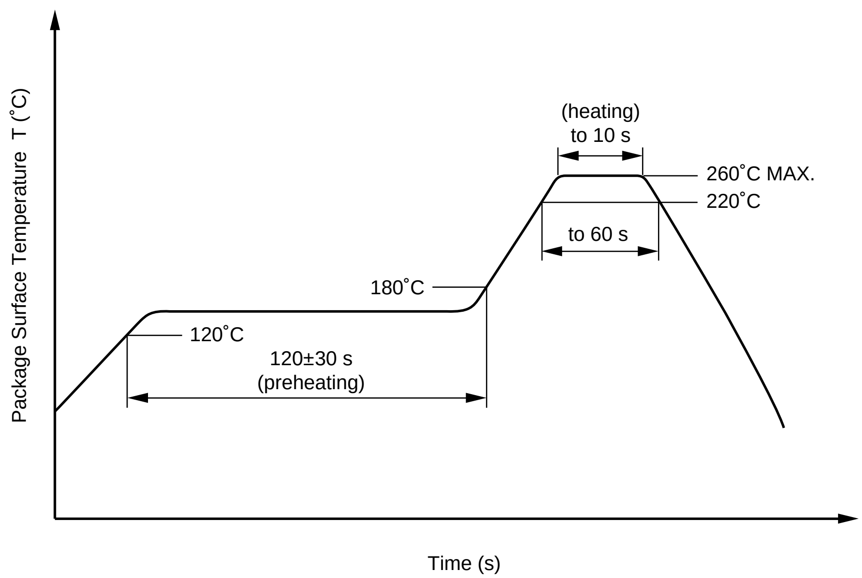
NOTES ON HANDLING

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 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) In older to avoid malfunctions and characteristics degradation, IGBT collector or emitter traces should not be closed to the LED input.

3. Make sure the rise/fall time of the forward current is 0.5 μs or less.

4. In order to avoid malfunctions, make sure the rise/fall slope of the supply voltage is 3 V/μs or less.

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

SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter		Symbol	Spec.	Unit
Application classification (DIN EN 60664-1 VDE0110 Part 1) for rated line voltages ≤ 300 Vr.m.s. for rated line voltages ≤ 600 Vr.m.s.			 IV III	
Climatic test class (DIN EN 60664-1 VDE0110)			55/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}$, $P_d < 5$ 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	
Clearance distance	PS9552, PS9552L3		>7.0	mm
	PS9552L1, PS9552L2		>8.0	
Creepage distance	PS9552, PS9552L3		>7.0	mm
	PS9552L1, PS9552L2		>8.0	
Comparative tracking index (DIN IEC 112/VDE 0303 Part 1)		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 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

- **The information in this document is current as of October, 2008. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC Electronics does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC Electronics products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Electronics or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of a customer's equipment shall be done under the full responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".

  The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics product before using it in a particular application.

  "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots.

  "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support).

  "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

The quality grade of NEC Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.

(Note)

(1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.

(2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).

M8E 02. 11-1

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.