NEC

PHOTOCOUPLER
PS9302L

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

–NEPOC Series–

DESCRIPTION

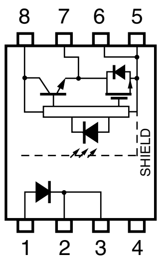
The PS9302L is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode, a signal processing circuit and a power output transistor on the output side on one chip.

The PS9302L is designed specifically for high common mode transient immunity (CMR), high output current and high switching speed.

FEATURES

- Large peak output current (2.5 A MAX., 2.0 A MIN.)
- High speed switching (t_{PLH}, t_{PHL} = 0.5 μs MAX.)
- Long creepage distance (8 mm MIN.)
- UVLO (Under Voltage Lock Out) protection with hysteresis
- High common mode transient immunity (CM_H, CM_L = ±25 kV/μs MIN.)
- <R> Ordering number of tape product: PS9302L-E3: 2 000 pcs/reel
- Pb-Free product
- <R> Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40019182 (Option)

PIN CONNECTION
(Top View)



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

APPLICATIONS

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

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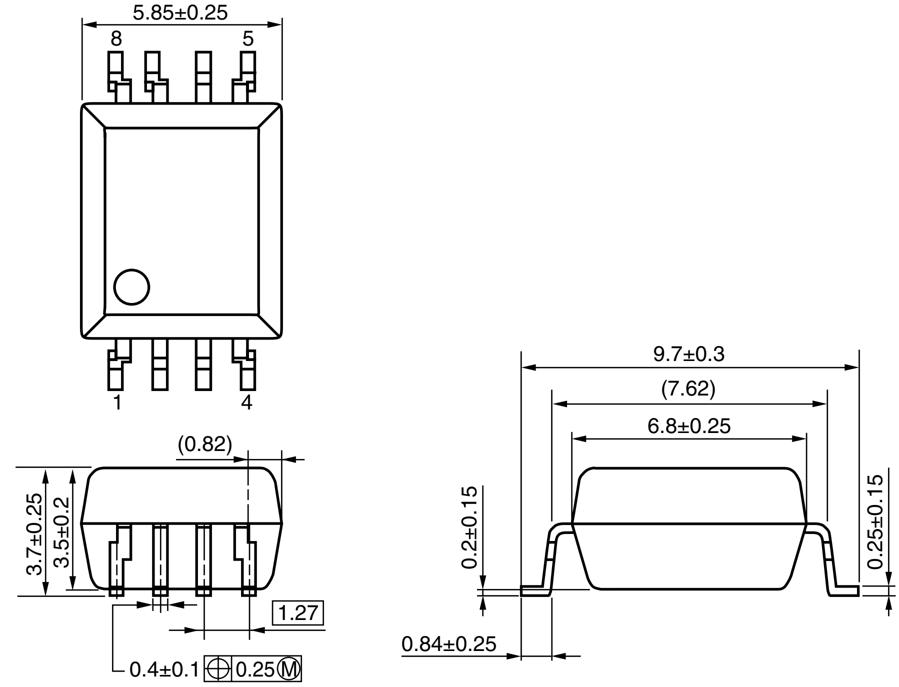
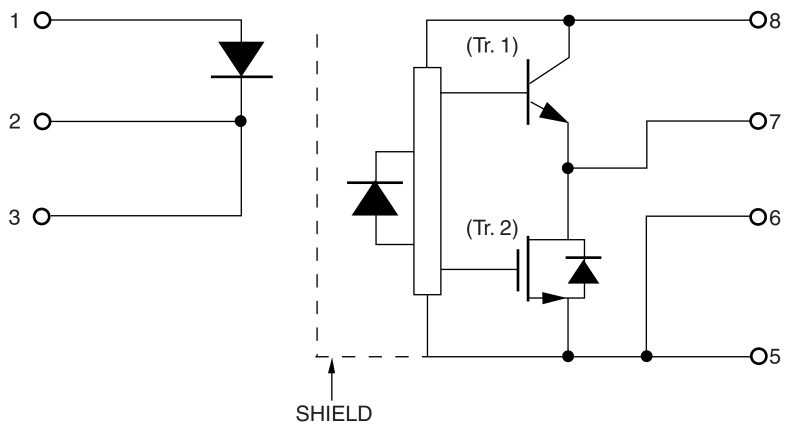
The mark <R> shows major revised points.

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

PACKAGE DIMENSIONS (UNIT: mm)

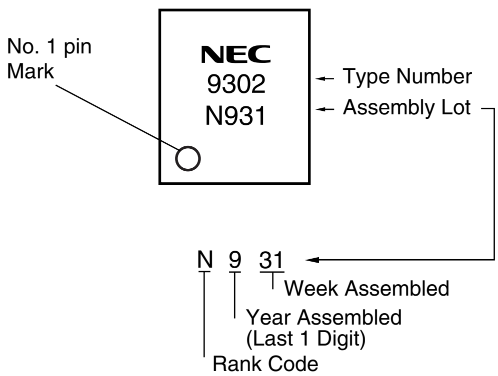


FUNCTIONAL DIAGRAM



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

MARKING EXAMPLE



PHOTOCOUPLER CONSTRUCTION

Parameter	PS9302L
Air Distance (MIN.)	7 mm
Outer Creepage Distance (MIN.)	8 mm
Isolation Distance (MIN.)	0.4 mm

<R> **ORDERING INFORMATION**

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number[*1]
PS9302L	PS9302L-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9302L
PS9302L-E3	PS9302L-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9302L-V	PS9302L-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	
PS9302L-V-E3	PS9302L-V-E3-AX		Embossed Tape 2 000 pcs/reel		

***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
	Power Dissipation[*1]	P_D	45	mW
Detector	High Level Peak Output Current[*2]	$I_{OH\ (PEAK)}$	2.5	A
	Low Level Peak Output Current[*2]	$I_{OL\ (PEAK)}$	2.5	A
	Supply Voltage	$(V_{CC} - V_{EE})$	0 to 35	V
	Output Voltage	V_O	0 to V_{CC}	V
	Power Dissipation[*3]	P_C	250	mW
Isolation Voltage[*4]		BV	5 000	Vr.m.s.
Operating Frequency[*5]		f	50	kHz
Operating Ambient Temperature		T_A	–40 to +100	°C
Storage Temperature		T_{stg}	–55 to +125	°C

***1** Reduced to 1.6 mW/°C at T_A = 85°C or more.
***2** Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%
<R> ***3** Reduced to 6.0 mW/°C at T_A = 80°C or more.
***4** 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.
***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	1.2	1.56	1.9	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25°C			10	μA
	Terminal Capacitance	C_t	f = 1 MHz, V_F = 0 V, T_A = 25°C		30		pF
Detector	High Level Output Current	I_{OH}	$V_O = (V_{CC} - 4\text{ V})$[*2]	0.5	2.0		A
			$V_O = (V_{CC} - 15\text{ V})$[*3]	2.0			
	Low Level Output Current	I_{OL}	$V_O = (V_{EE} + 2.5\text{ V})$[*2]	0.5	2.0		A
			$V_O = (V_{EE} + 15\text{ V})$[*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 = 10 mA		2.0	3.5	mA
	Low Level Supply Current	I_{CCL}	V_O = open, V_F = 0 to +0.8 V		2.0	3.0	mA
	UVLO Threshold	V_{UVLO+}	V_O > 5 V, I_F = 10 mA	11.0	12.0	13.5	V
		V_{UVLO-}		9.5	11.0	12.0	
	UVLO Hysteresis	$UVLO_{HYS}$	V_O > 5 V, I_F = 10 mA		1.0		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, Duty Cycle = 50%[*2], I_F = 10 mA	0.1	0.3	0.5	μs
Propagation Delay Time (H → L)	t_{PHL}		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 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 4 to the LED common.

<R> **TEST CIRCUIT**

Fig. 1 I_{OH} Test Circuit

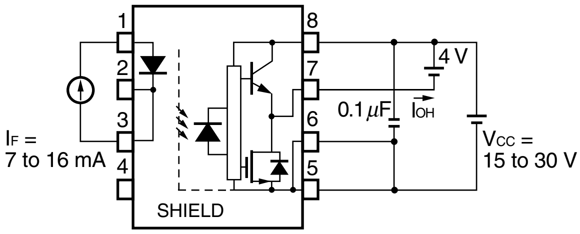


Fig. 2 I_{OL} Test Circuit

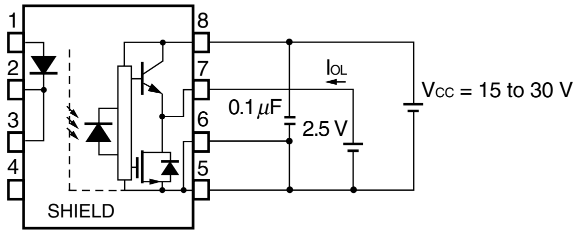


Fig. 3 V_{OH} Test Circuit

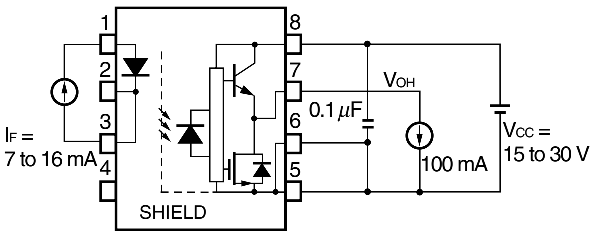


Fig. 4 V_{OL} Test Circuit

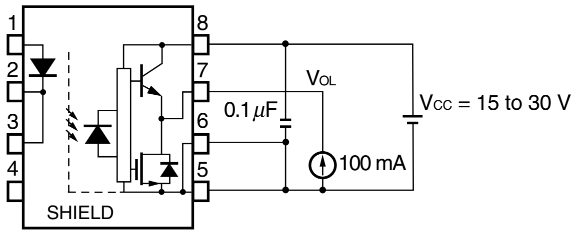


Fig. 5 I_{FLH} Test Circuit

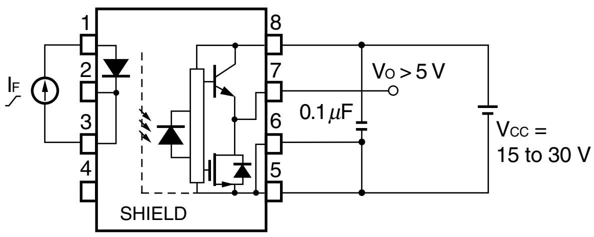


Fig. 6 UVLO Test Circuit

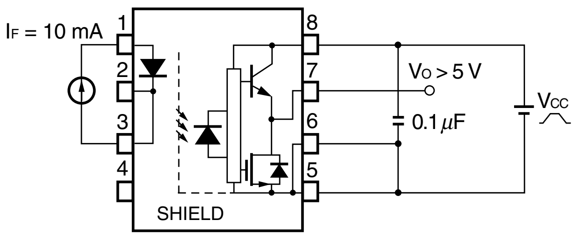


Fig. 7 t_{PLH}, t_{PHL}, t_r, t_f Test Circuit and Wave Forms

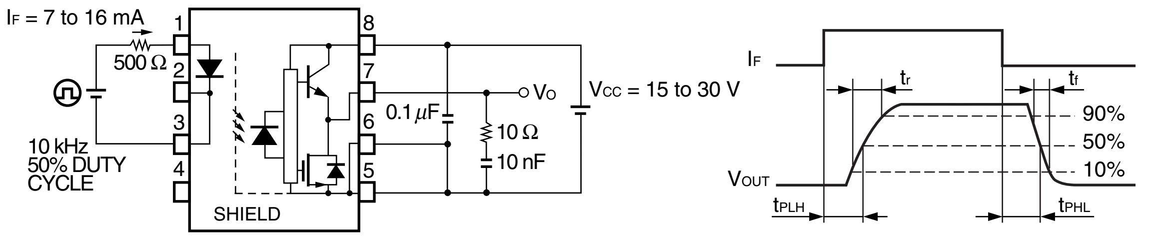
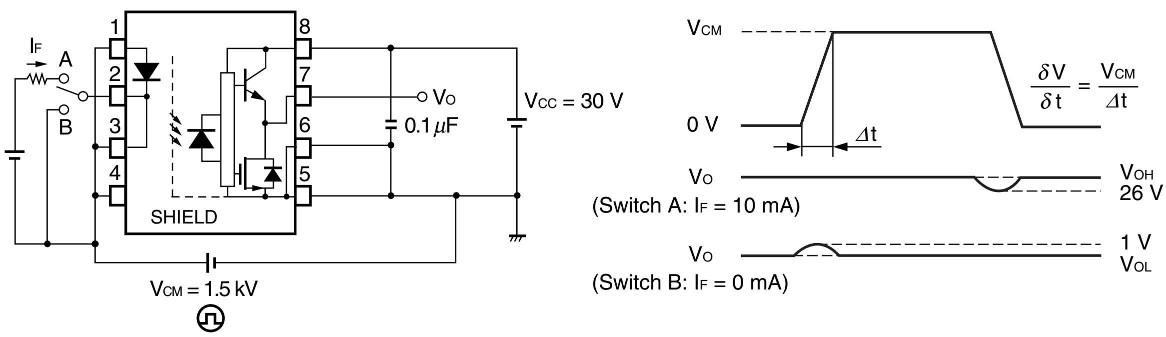
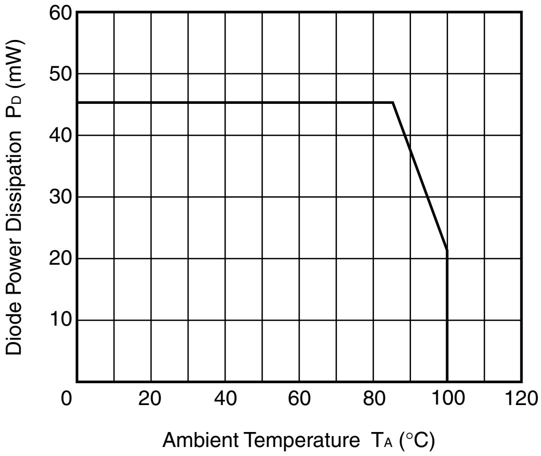


Fig. 8 CMR Test Circuit and Wave Forms

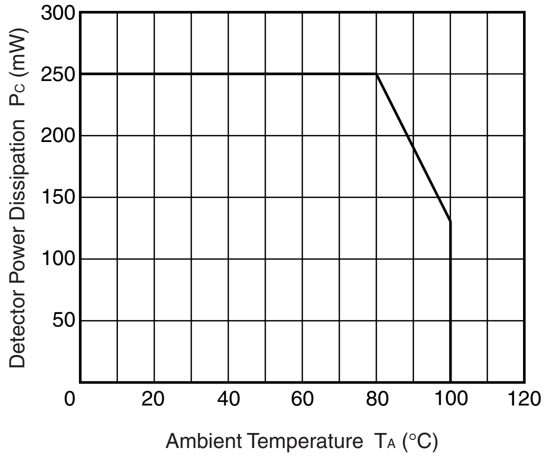


<R> **TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)**

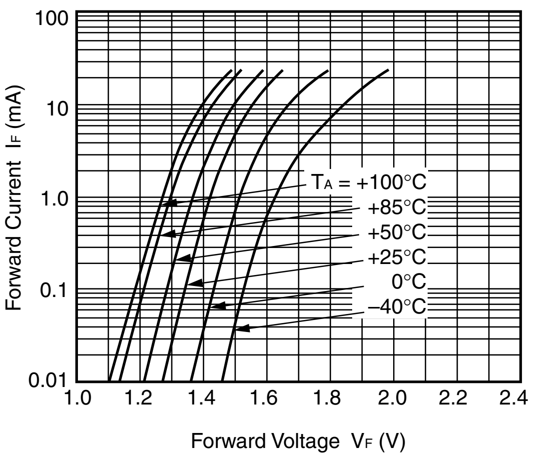
DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE



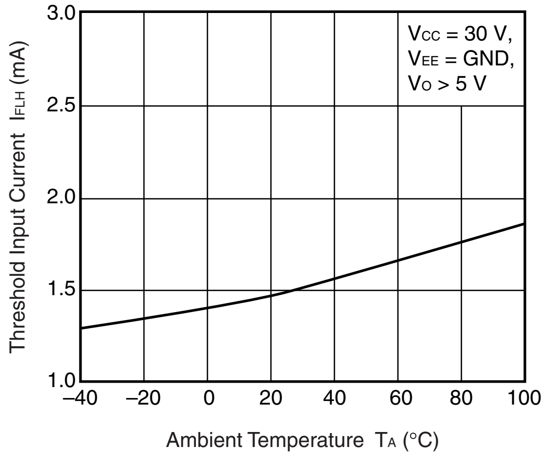
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



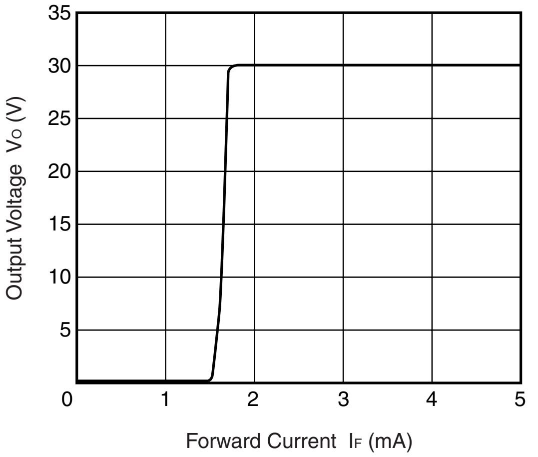
FORWARD CURRENT vs. FORWARD VOLTAGE



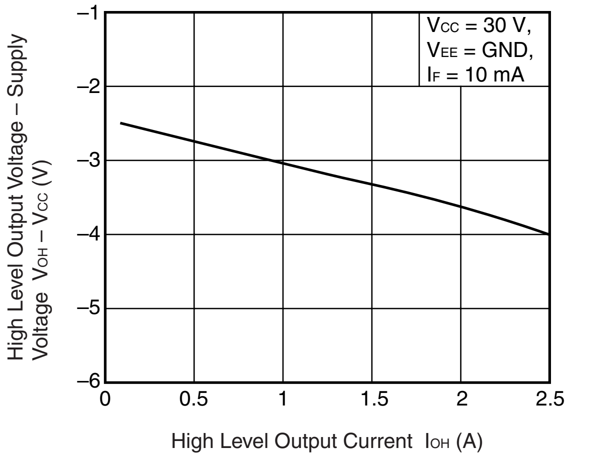
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

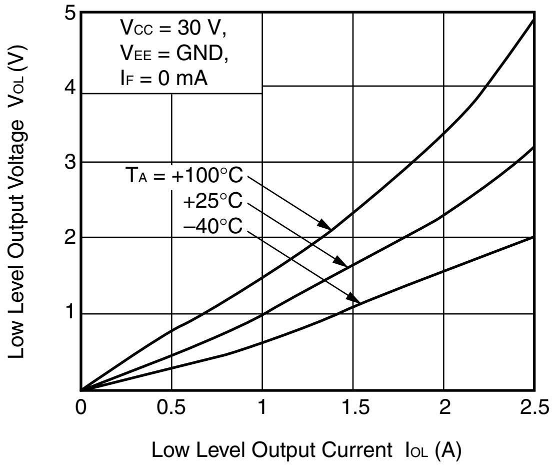


HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT

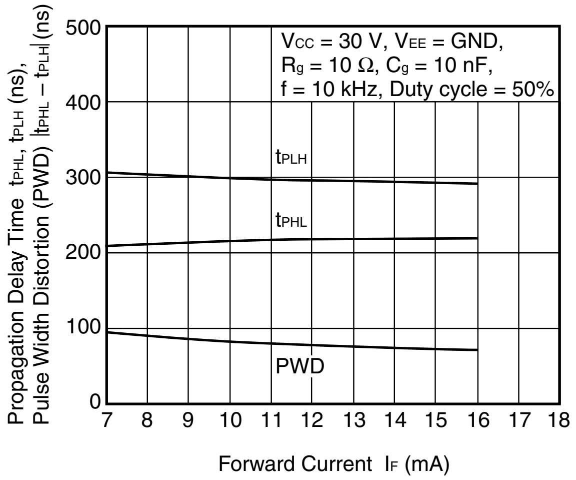


Remark The graphs indicate nominal characteristics.

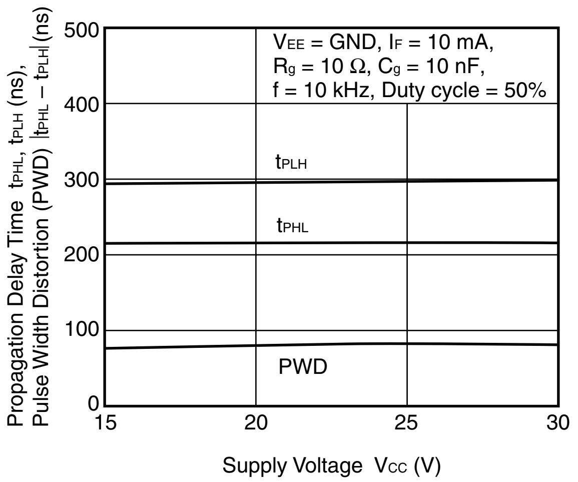
LOW LEVEL OUTPUT VOLTAGE vs.
LOW LEVEL OUTPUT CURRENT



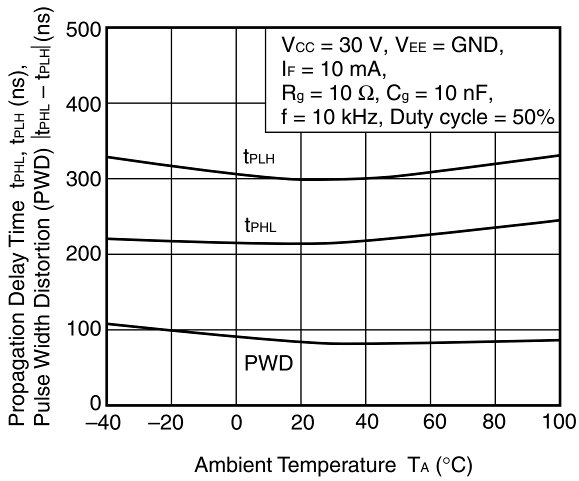
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. FORWARD CURRENT



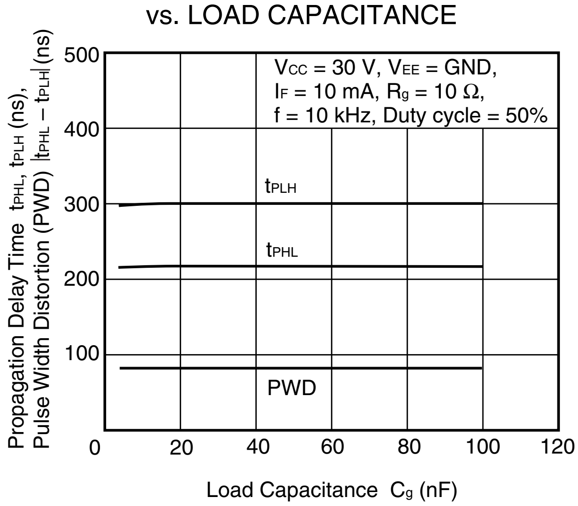
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. SUPPLY VOLTAGE



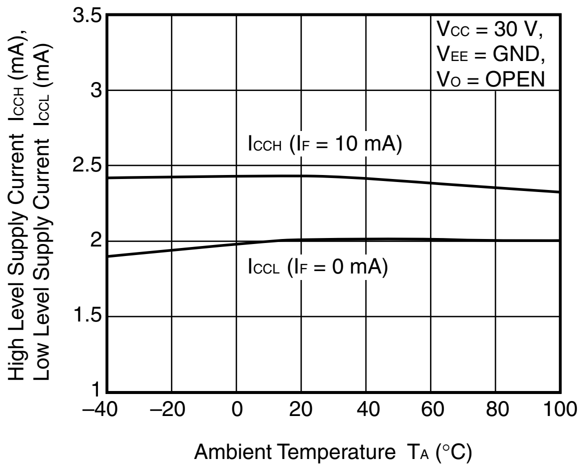
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. LOAD CAPACITANCE

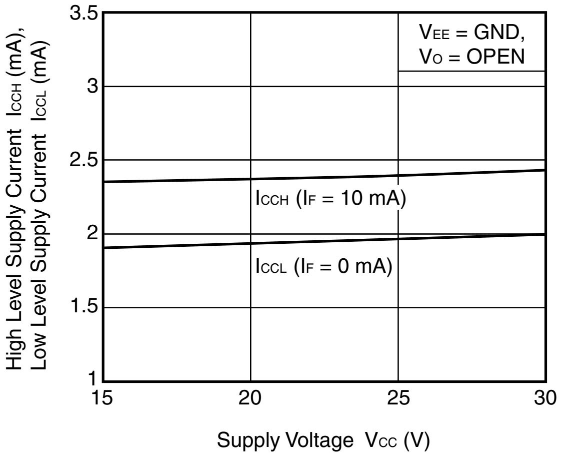


SUPPLY CURRENT vs.
AMBIENT TEMPERATURE

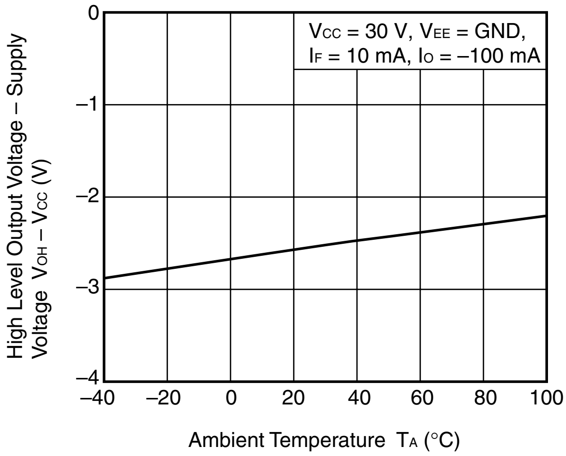


Remark The graphs indicate nominal characteristics.

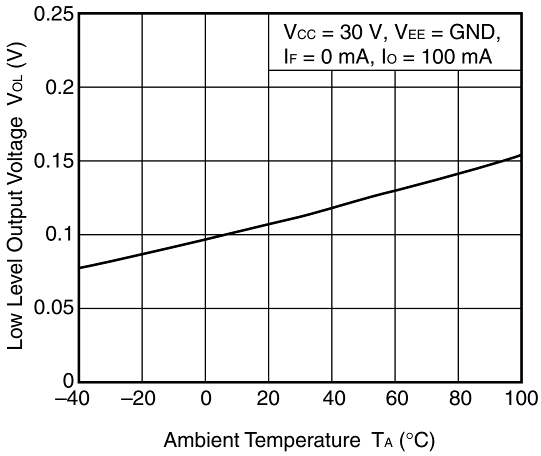
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



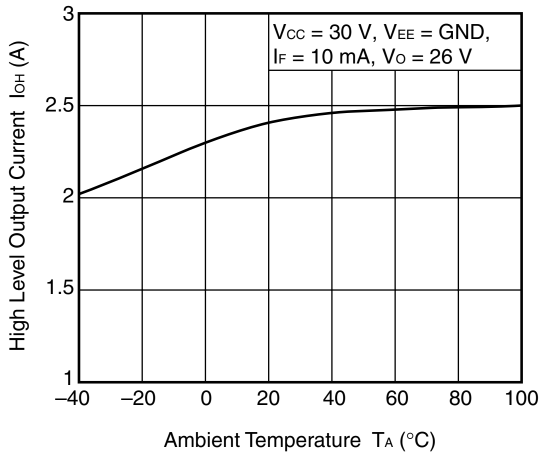
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. AMBIENT TEMPERATURE



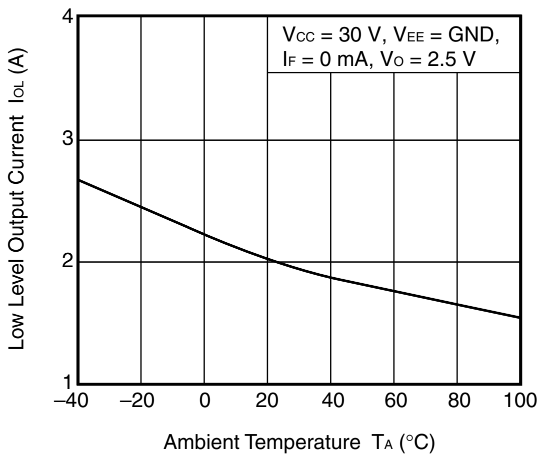
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



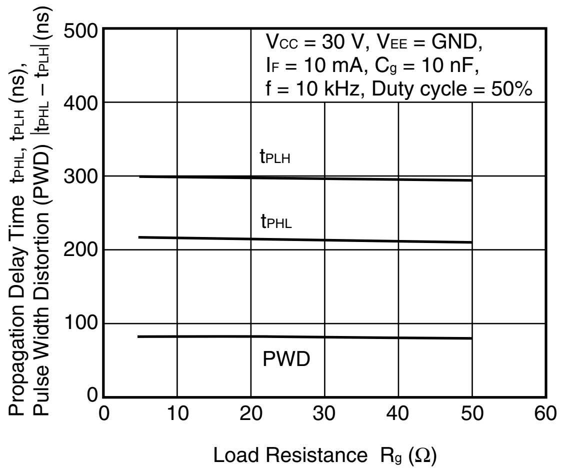
HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE



LOW LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE

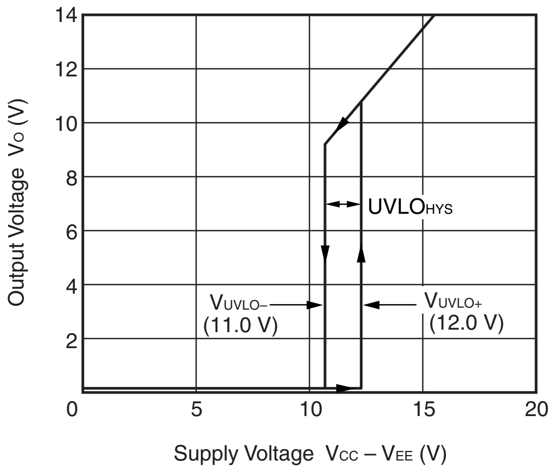


PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. LOAD RESISTANCE



Remark The graphs indicate nominal characteristics.

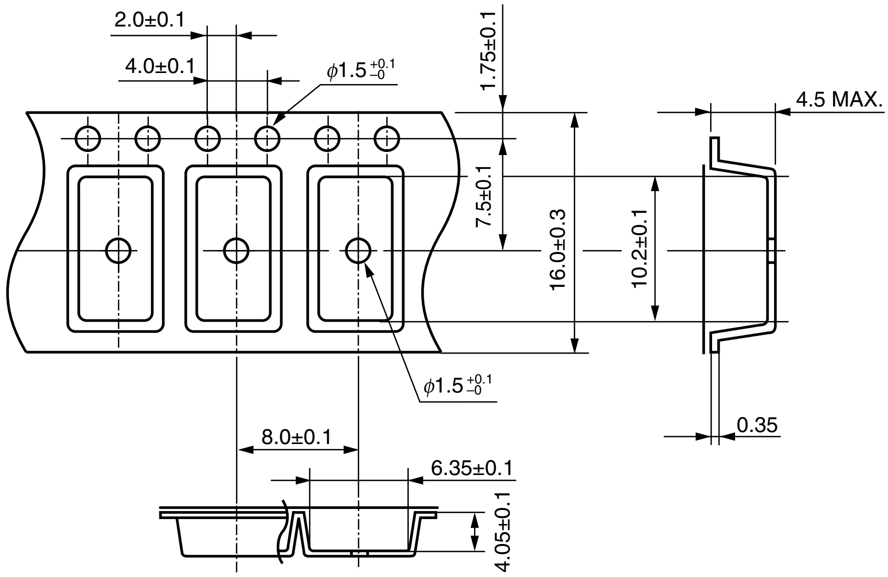
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



Remark The graph indicates nominal characteristics.

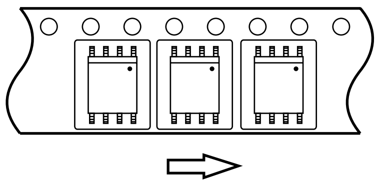
<R> TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

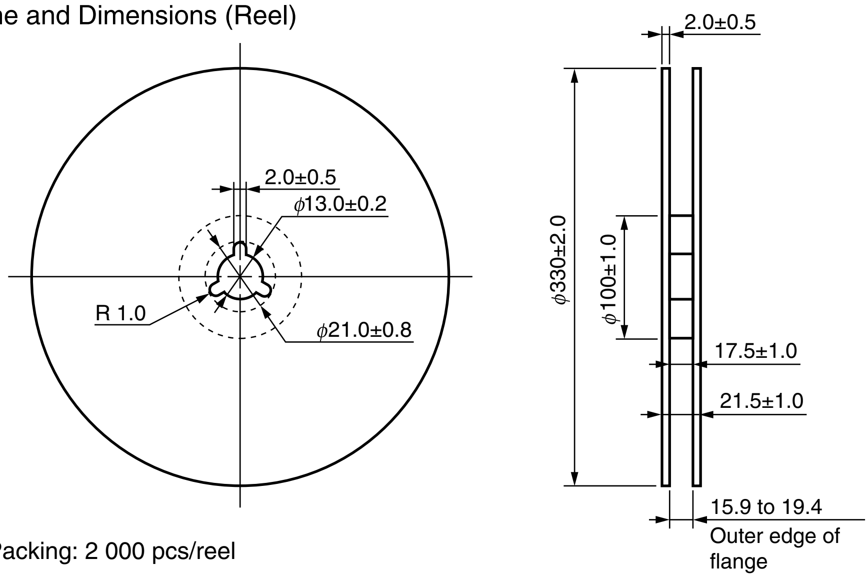


Tape Direction

PS9302L-E3

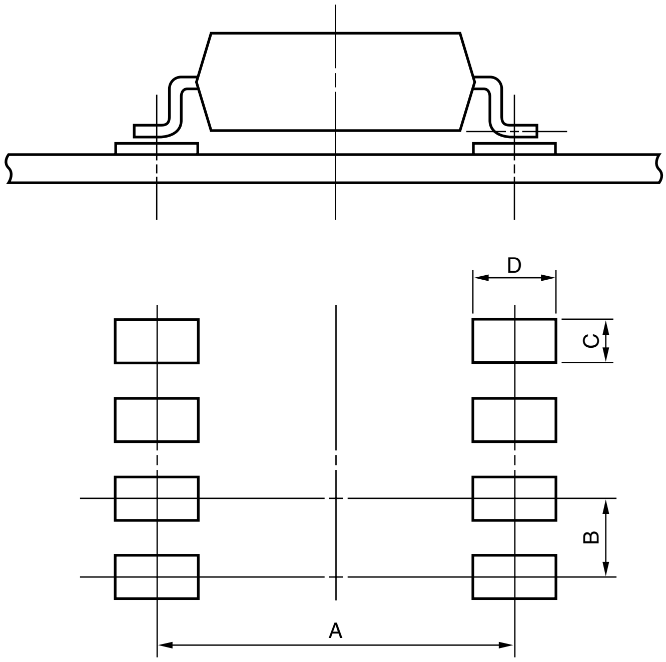


Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

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



Part Number	Lead Bending	A	B	C	D
PS9302L	lead bending type (Gull-wing) for surface mount	8.2	1.27	0.8	2.2

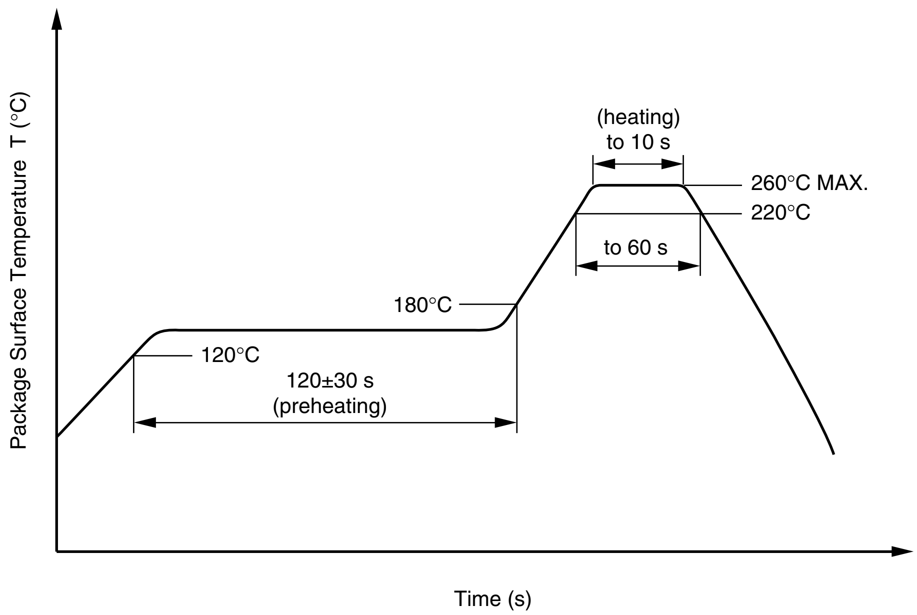
<R> **NOTES ON HANDLING**

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.

<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. 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) Pin 4 (which is an NC[*1] pin) can either be connected directly to the GND pin on the LED side or left open. Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.
   ***1** NC: Non-Connection (No Connection)
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.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec.	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		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	
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 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

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