PS9332L, PS9332L2

Data Sheet

R08DS0105EJ0100
Rev.1.00
Sep 06, 2013

2.0 A OUTPUT CURRENT, HIGH CMR, IGBT GATE DRIVE, ACTIVE MILLER CLAMP, 8-PIN SDIP PHOTOCOUPLER

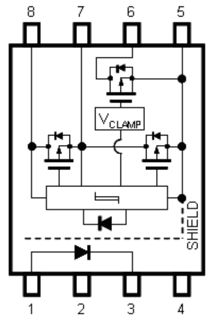
DESCRIPTION

The PS9332L and PS9332L2 are optical 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 PS9332L and PS9332L2 are designed specifically for high common mode transient immunity (CMR), high output current, active miller clamp and high switching speed.
The PS9332L and PS9332L2 are suitable for driving IGBTs and MOS FETs.

FEATURES

- Long creepage distance (8 mm MIN.: PS9332L2)
- Peak output current (2.0 A MAX., 1.5 A MIN.)
- High speed switching (t_{PLH}, t_{PHL} = 200 ns MAX.)
- UVLO (Under Voltage Lock Out) protection with hysteresis
- Built-in Active Miller Clamp
- High common mode transient immunity (CM_H, CM_L = ±50 kV/μs MIN.)
- Operating Ambient Temperature (125 °C)
- Embossed tape product : PS9332L-E3, PS9332L2-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)
  - SEMKO approved (EN 60065, EN 60950)
  - DIN EN 60747-5-5 (VDE 0884-5) approved (Option)

PIN CONNECTION
(Top View)



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

APPLICATIONS

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

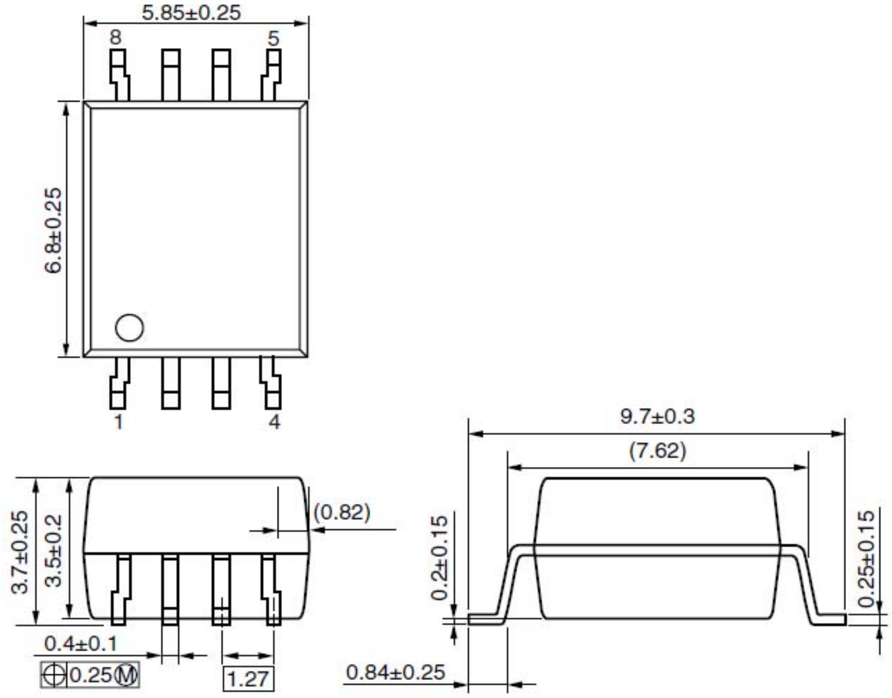
The mark <R> shows major revised points.

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)

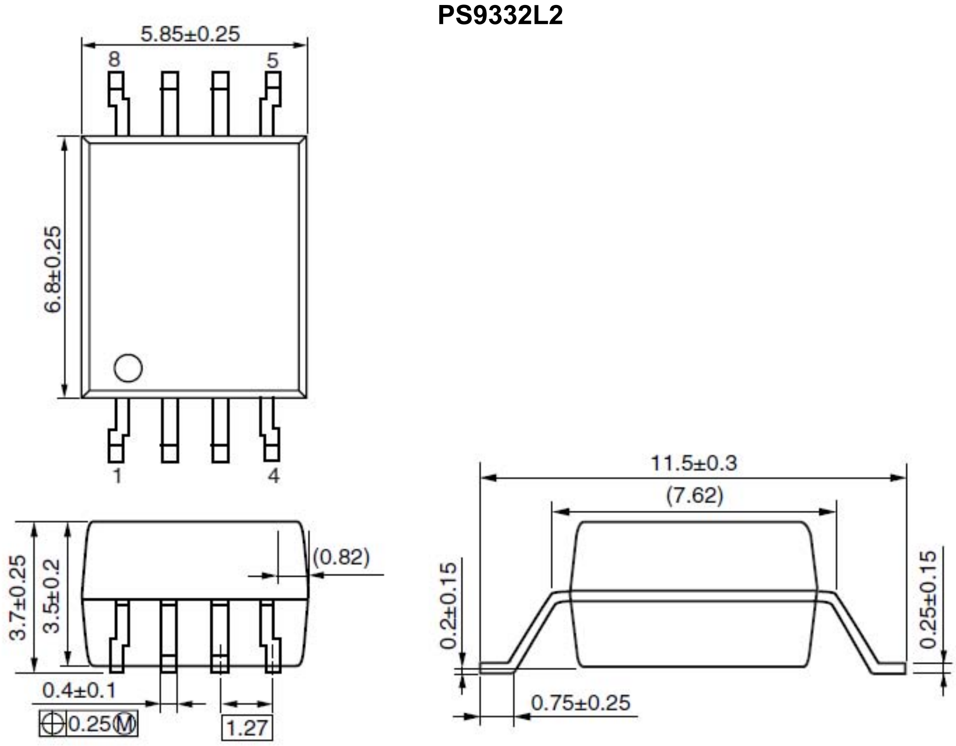
Lead Bending Type (Gull-wing) For Surface Mount

PS9332L



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

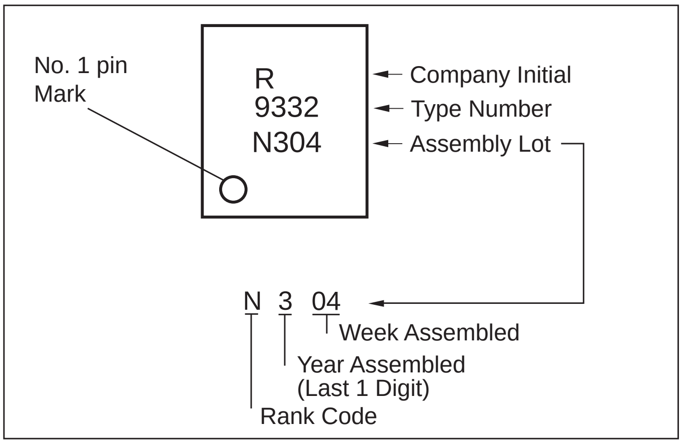
PS9332L2



PHOTOCOUPLER CONSTRUCTION

Parameter	PS9332L	PS9332L2
Air Distance (MIN.)	7 mm	8 mm
Outer Creepage Distance (MIN.)	8 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

MARKING EXAMPLE



<R> ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9332L	PS9332L-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA, SEMKO approved)	PS9332L
PS9332L-E3	PS9332L-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9332L2	PS9332L2-AX		20 pcs (Tape 20 pcs cut)		PS9332L2
PS9332L2-E3	PS9332L2-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9332L-V	PS9332L-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN 60747-5-5 (VDE 0884-5) approved (Option)	PS9332L
PS9332L-V-E3	PS9332L-V-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9332L2-V	PS9332L2-V-AX		20 pcs (Tape 20 pcs cut)		PS9332L2
PS9332L2-V-E3	PS9332L2-V-E3-AX		Embossed Tape 2 000 pcs/reel		

Note: *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
	Power Dissipation *1	P_D	45	mW
Detector	High Level Peak Output Current *2	$I_{OH\ (PEAK)}$	2.0	A
	Low Level Peak Output Current *2	$I_{OL\ (PEAK)}$	2.0	A
	Supply Voltage	$(V_{CC} - V_{EE})$	0 to 35	V
	Output Voltage	V_O	-0.5 to V_{CC}	V
	Peak Clamp Sink Current	I_{CLAMP}	2.0	A
	Miller Clamping Pin Voltage	V_{CLAMP}	-0.5 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 +125	°C
Storage Temperature		T_{stg}	–55 to +150	°C

Notes: *1. Reduced to 1.1 mW/°C at T_A = 105°C or more.
*2. Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%
*3. Reduced to 5.5 mW/°C at T_A = 105°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 ($\leq 0.3\ \mu$s), $I_{OL\ (PEAK)} \leq 2.0$ A ($\leq 0.3\ \mu$s)

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		16	mA
Forward Voltage (OFF)	$V_{F\ (OFF)}$	–2		0.8	V
Operating Ambient Temperature	T_A	–40		125	°C

<R> **ELECTRICAL CHARACTERISTICS (at RECOMMENDED OPERATING CONDITIONS, 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	1.35	1.56	1.75	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25°C			10	μA
	Input Capacitance	C_{IN}	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 V) *2	0.5	1.5		A
			V_O = (V_{CC} – 15 V) *3	1.5			
	Low Level Output Current	I_{OL}	V_O = (V_{EE} + 2.5 V) *2	0.5	1.5		A
			V_O = (V_{EE} + 15 V) *3	1.5			
	Clamp Output Peak Current	I_{CLAMP}	V_{CLAMP} = V_{EE} + 2.5V	0.5	1.6		A
	Clamp Pin Threshold Voltage	$V_{t\ CLAMP}$			3.0		V
	High Level Output Voltage	V_{OH}	I_O = - 100 mA *4	V_{CC} – 3.0	V_{CC} – 1.3		V
	Low Level Output Voltage	V_{OL}	I_O = 100 mA		0.1	0.5	V
	High Level Supply Current	I_{CCH}	I_F = 10 mA, V_O = open		1.5	2.5	mA
	Low Level Supply Current	I_{CCL}	V_F = 0 to 0.8 V, V_O = open		1.5	2.5	mA
	UVLO Threshold Voltage	V_{UVLO+}	Vo > 5V , I_F = 10mA	10.8	12.4	13.4	V
		V_{UVLO-}	Vo < 5V , I_F = 10mA	9.5	11.2	12.5	
	UVLO Hysteresis	$UVLO_{HYS}$	(V_{UVLO+}) - (V_{UVLO-})		1.2		
Coupled	Threshold Input Current (L → H)	I_{FLH}	I_O = 0 mA, V_O > 5 V		1.5	4.0	mA
	Threshold Input Voltage (H → L)	V_{FHL}	I_O = 0 mA, V_O < 5 V	0.8			V

Notes: *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 (at RECOMMENDED OPERATING CONDITIONS, 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		75	200	ns
Propagation Delay Time (H → L)	t_{PHL}			110	200	ns
Pulse Width Distortion (PWD)	$\|t_{PHL}-t_{PLH}\|$			35	75	ns
Propagation Delay Time (Difference Between Any Two Products)	$t_{PHL}-t_{PLH}$		–90		90	ns
Rise Time	t_r			17		ns
Fall Time	t_f			17		ns
Common Mode Transient Immunity at High Level Output	$\|CM_H\|$	T_A = 25°C, I_F = 10 mA, V_{CC} = 30 V, V_{CM} = 1.5 kV, $V_{O\ (MIN.)}$ = 26 V	50			kV/μs
Common Mode Transient Immunity at Low Level Output	$\|CM_L\|$	T_A = 25°C, I_F = 0 mA, V_{CC} = 30 V, V_{CM} = 1.5 kV, $V_{O\ (MAX.)}$ = 1V	50			kV/μs

Notes: *1. Typical values at T_A = 25°C.
*2. This load condition is equivalent to the IGBT load at 1 200 V/75 A.

<R> TEST CIRCUIT

Fig. 1 I_{OH} Test Circuit

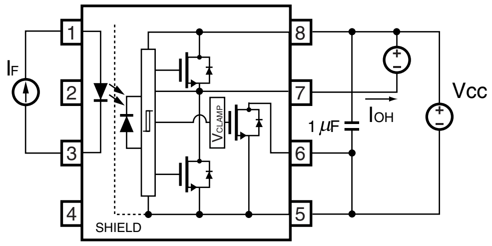


Fig. 2 I_{OL} Test Circuit

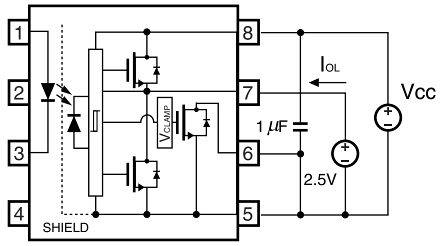


Fig. 3 V_{OH} Test Circuit

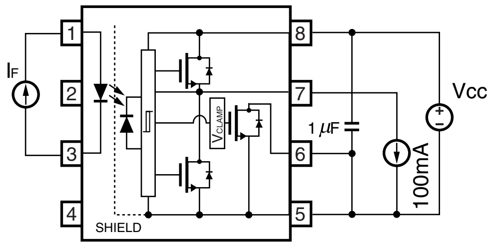


Fig. 4 V_{OL} Test Circuit

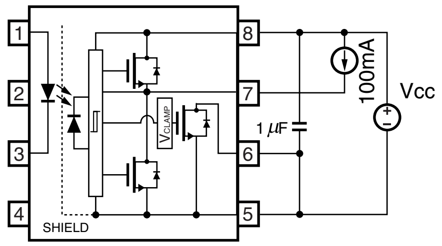


Fig. 5 UVLO Test Circuit

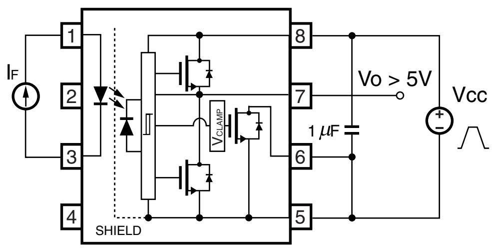


Fig. 6 I_{FLH} Test Circuit

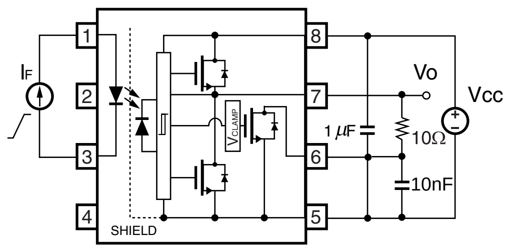


Fig. 7 $t_{PLH}/t_{PHL}/t_r/t_f$ Test Circuit and Wave Forms

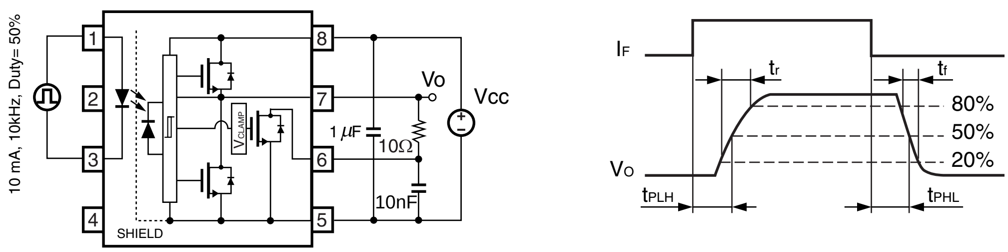


Fig. 8 CMR Test Circuit and Wave Forms

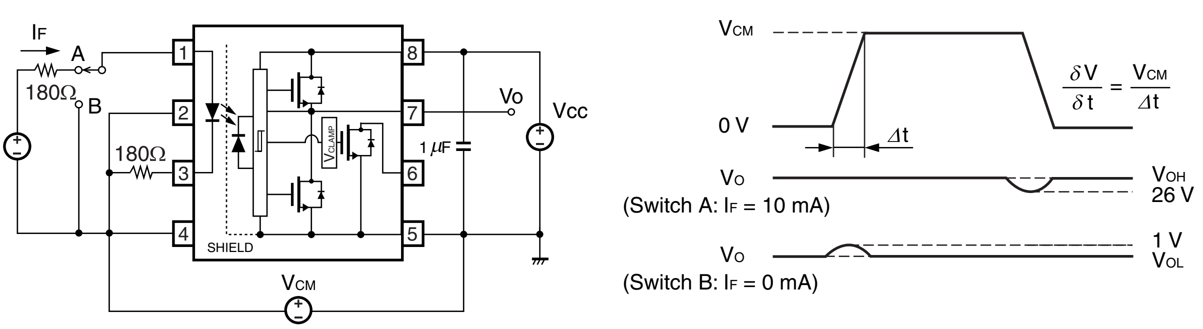


Fig. 9 ICLAMP Test Circuit

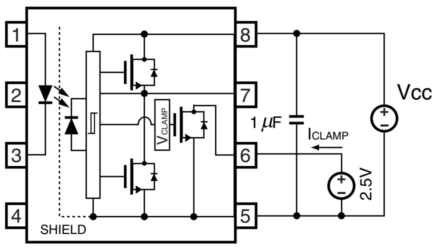
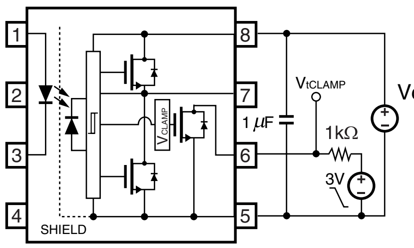
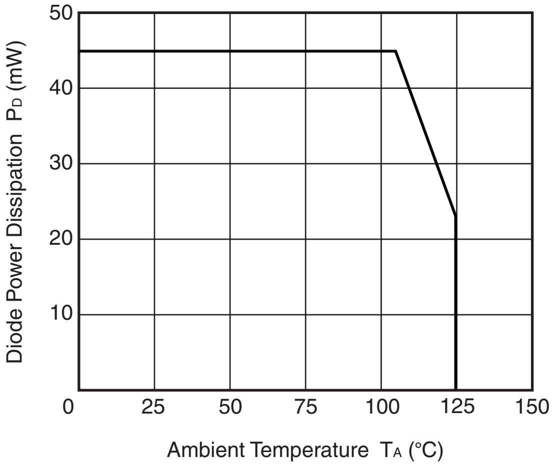


Fig. 10 VtCLAMP Test Circuit

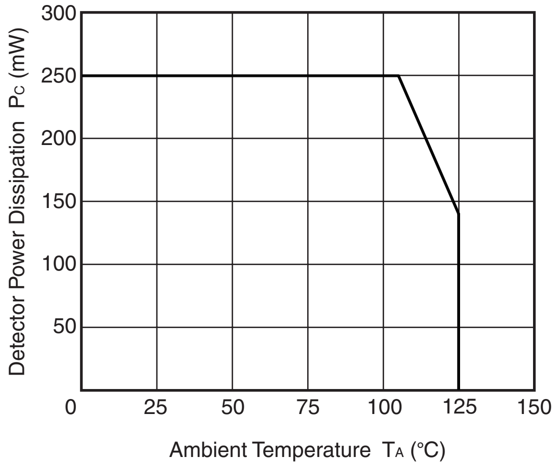


<R> TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)

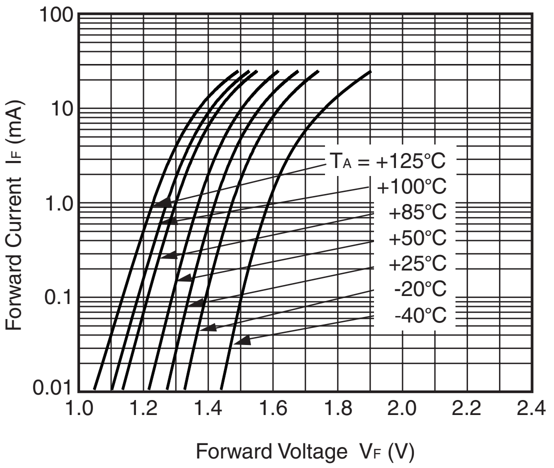
DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE



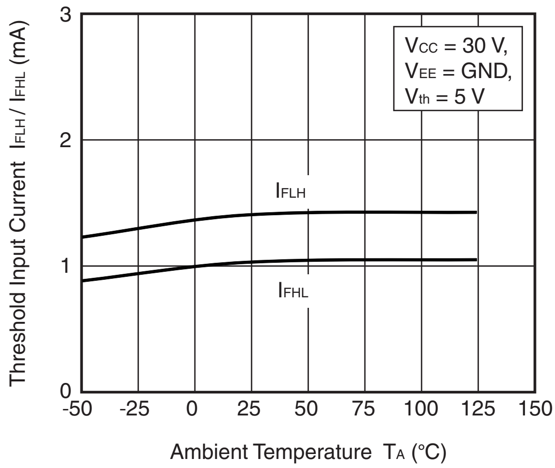
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



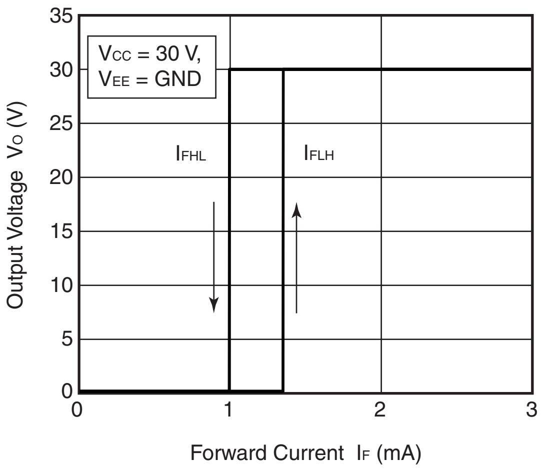
FORWARD CURRENT vs. FORWARD VOLTAGE



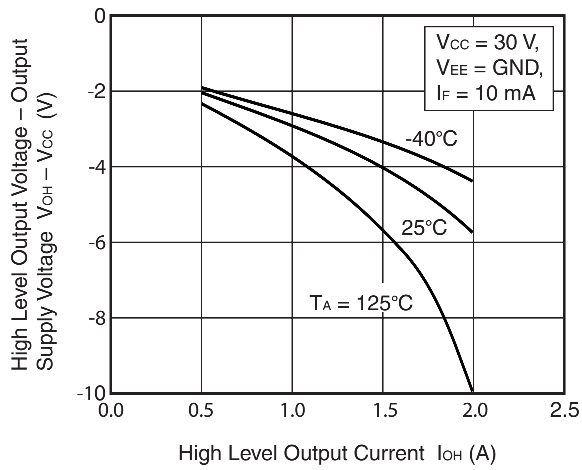
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

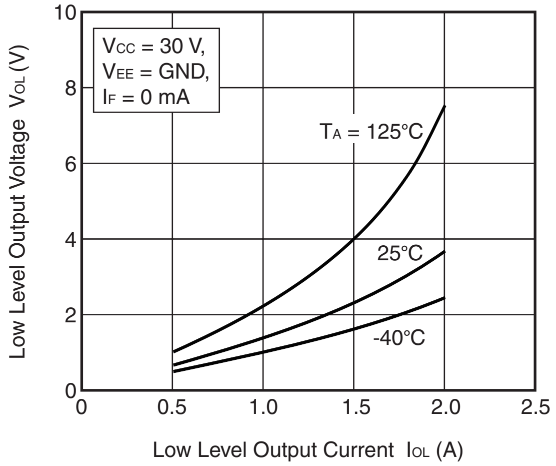


HIGH LEVEL OUTPUT VOLTAGE – OUTPUT SUPPLY VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT

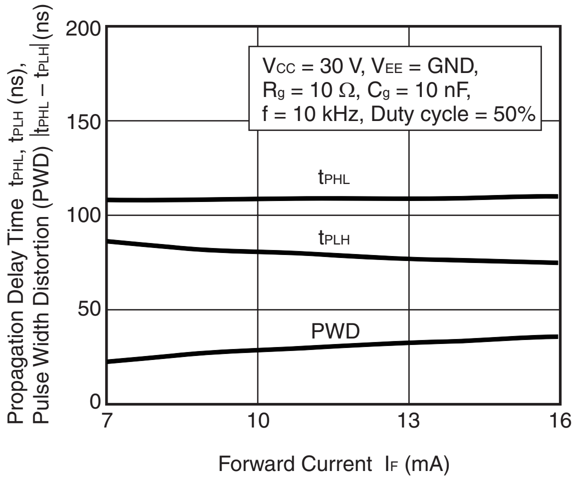


Remark The graphs indicate nominal characteristics.

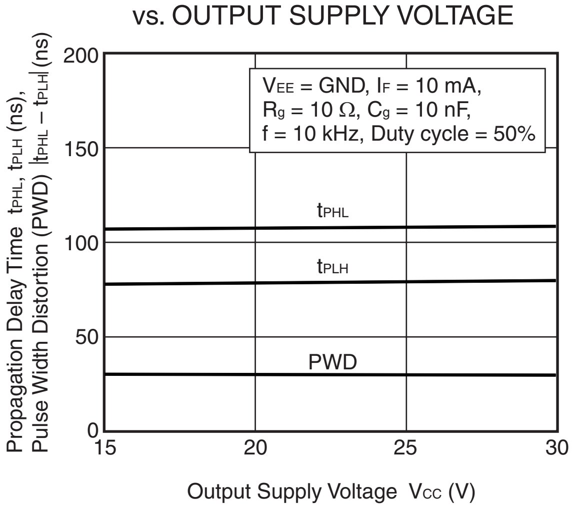
LOW LEVEL OUTPUT VOLTAGE vs.
LOW LEVEL OUTPUT CURRENT



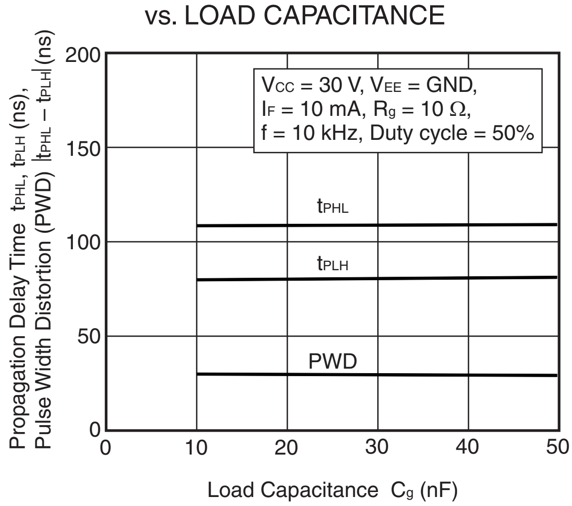
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. FORWARD CURRENT



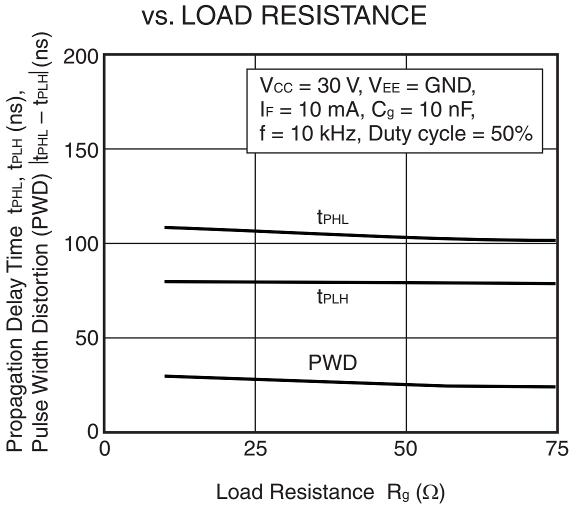
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. OUTPUT SUPPLY VOLTAGE



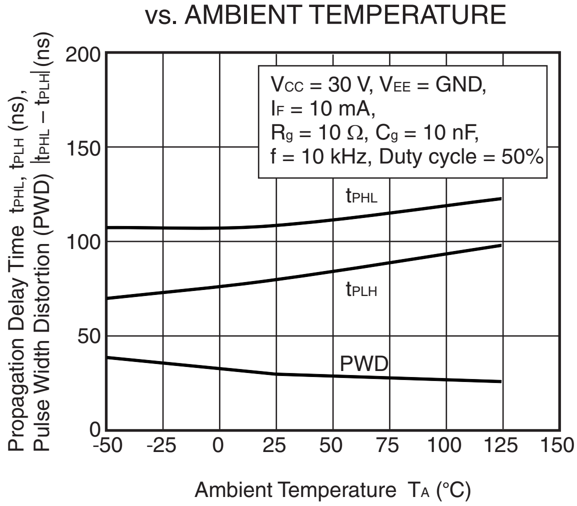
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. LOAD CAPACITANCE



PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. LOAD RESISTANCE

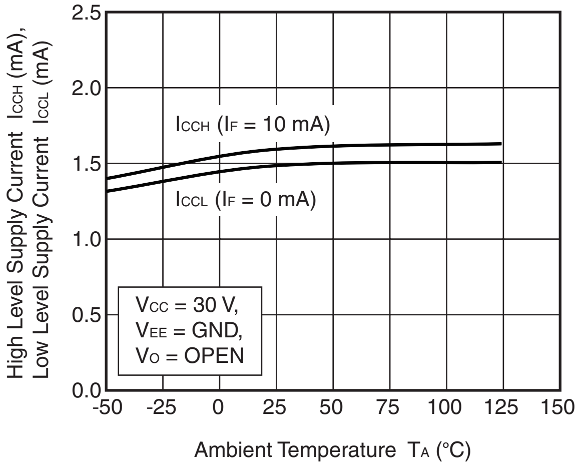


PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE

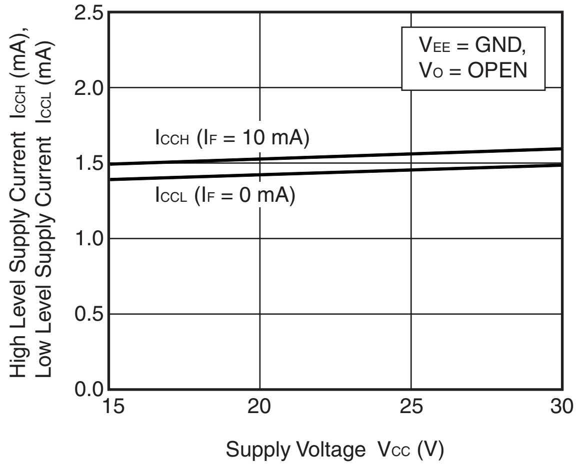


Remark The graphs indicate nominal characteristics.

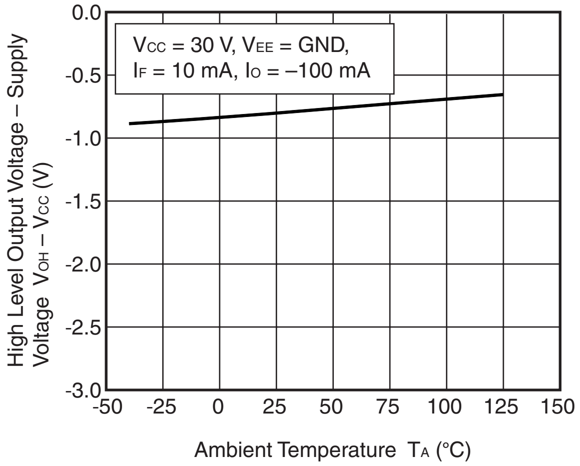
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



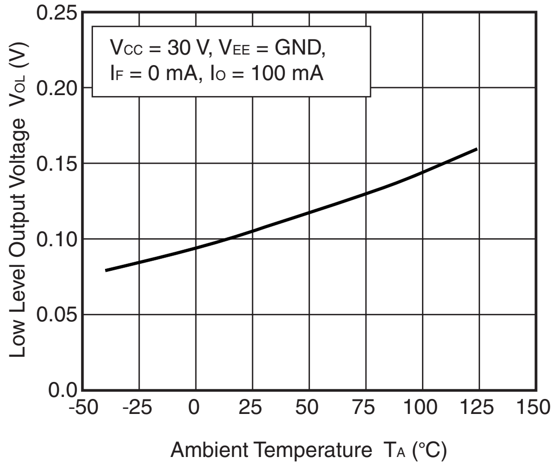
SUPPLY CURRENT vs.
SUPPLY VOLTAGE



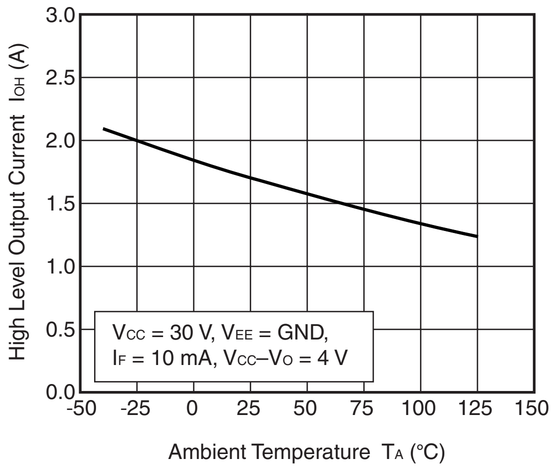
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY
VOLTAGE vs. AMBIENT TEMPERATURE



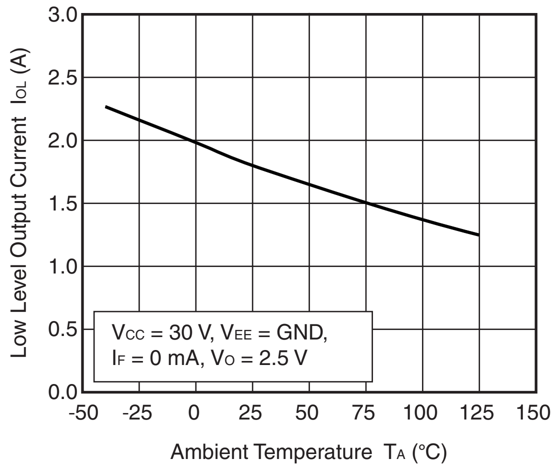
LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



HIGH LEVEL OUTPUT CURRENT vs.
AMBIENT TEMPERATURE

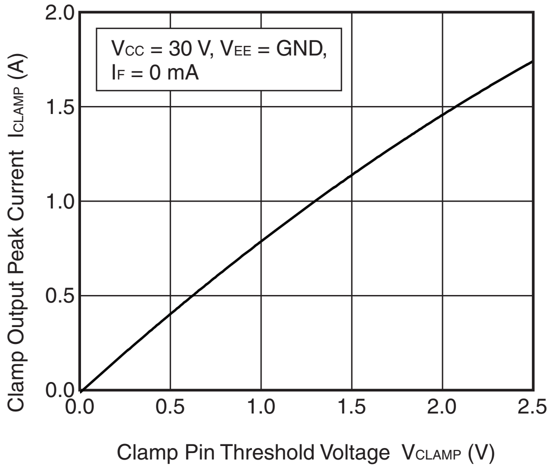


LOW LEVEL OUTPUT CURRENT vs.
AMBIENT TEMPERATURE

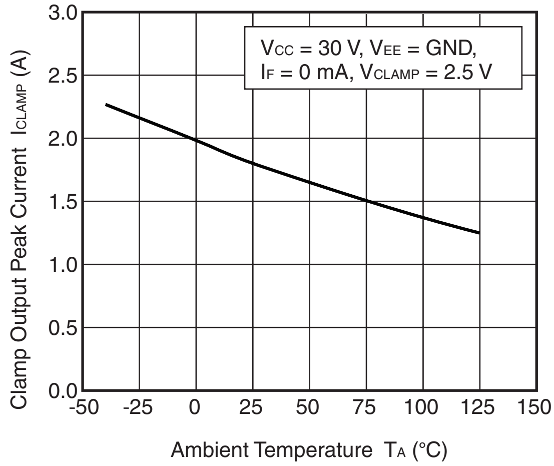


Remark The graphs indicate nominal characteristics.

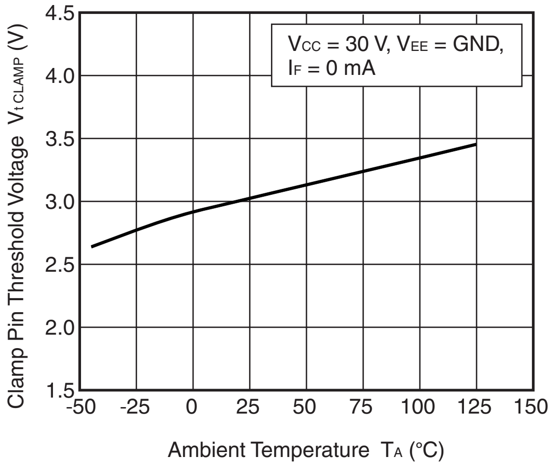
CLAMP OUTPUT PEAK CURRENT vs.
CLAMP PIN THRESHOLD VOLTAGE



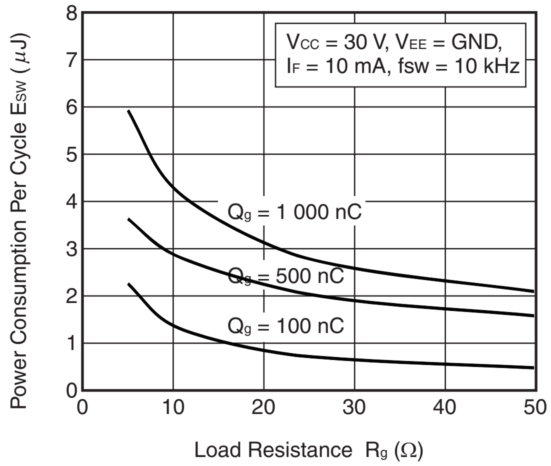
CLMAP OUTPUT PEAK CURRENT vs.
AMBIENT TEMPERATURE



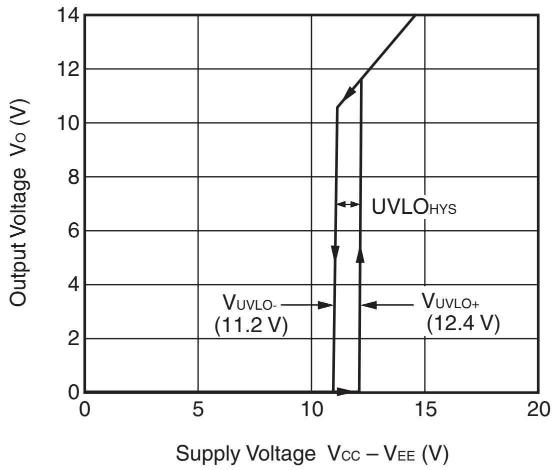
CLAMP PIN THRESHOLD VOLTAGE
vs. AMBIENT TEMPERATURE



POWER CONSUMPTION PER CYCLE
vs. LOAD RESISTANCE



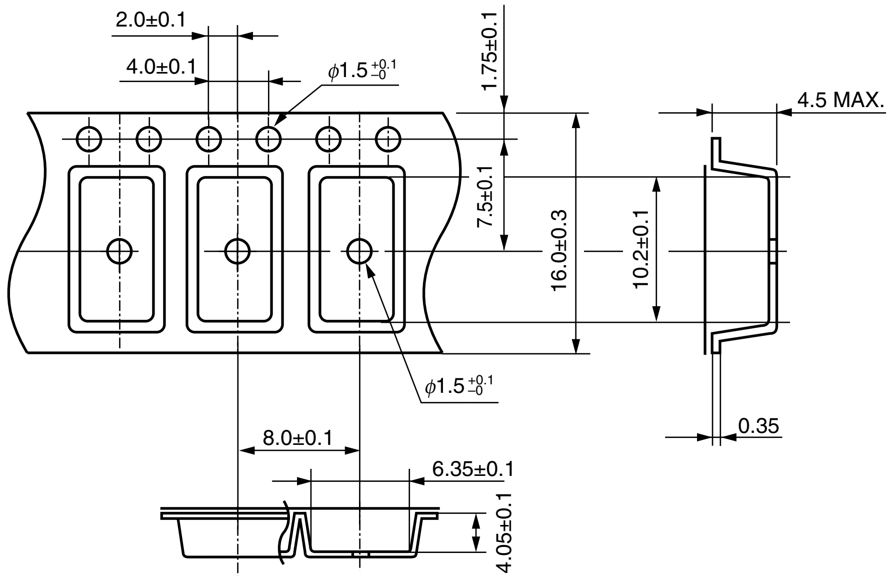
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



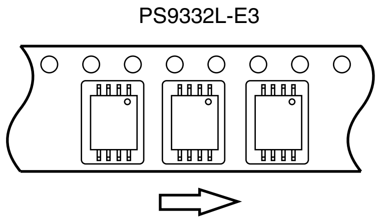
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

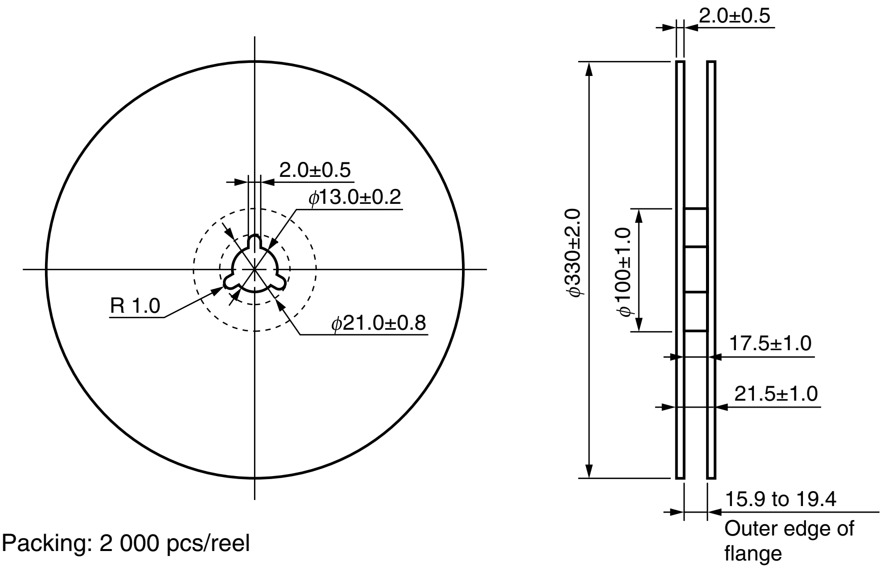
Outline and Dimensions (Tape)



Tape Direction

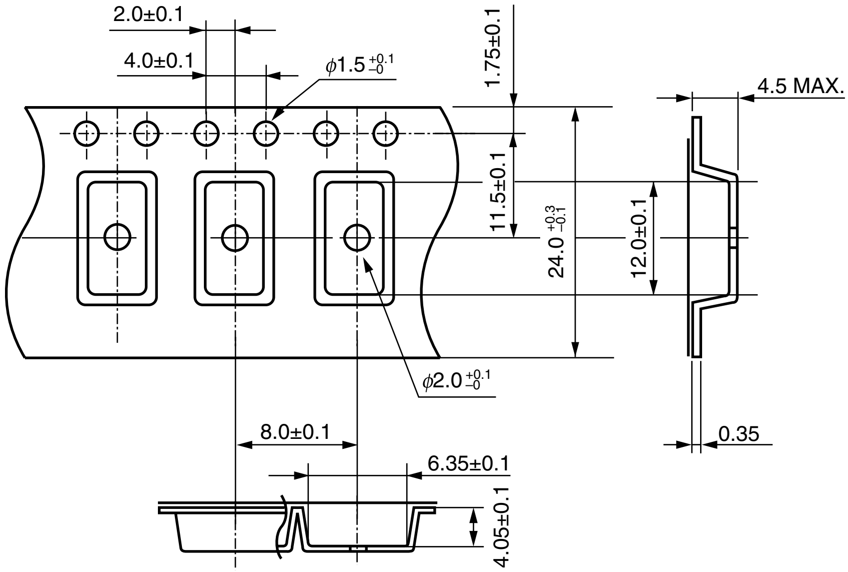


Outline and Dimensions (Reel)

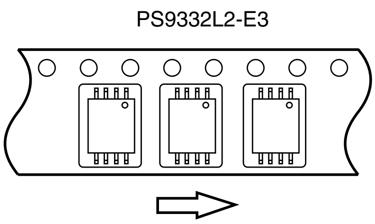


Packing: 2 000 pcs/reel

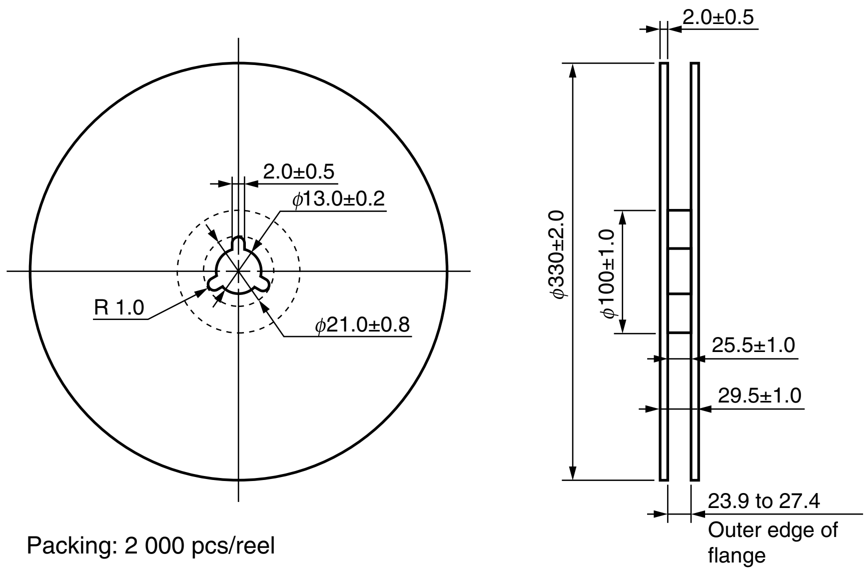
Outline and Dimensions (Tape)



Tape Direction

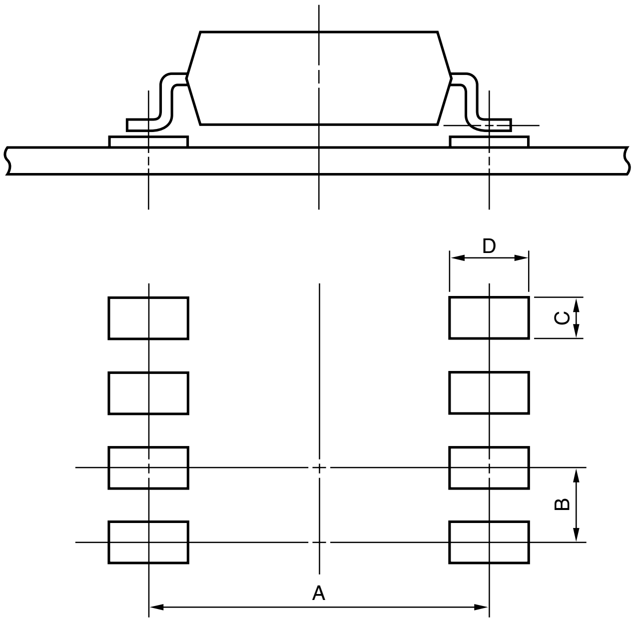


Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9332L	lead bending type (Gull-wing) for surface mount	9.2	1.27	0.8	2.2
PS9332L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	1.27	0.8	2.2

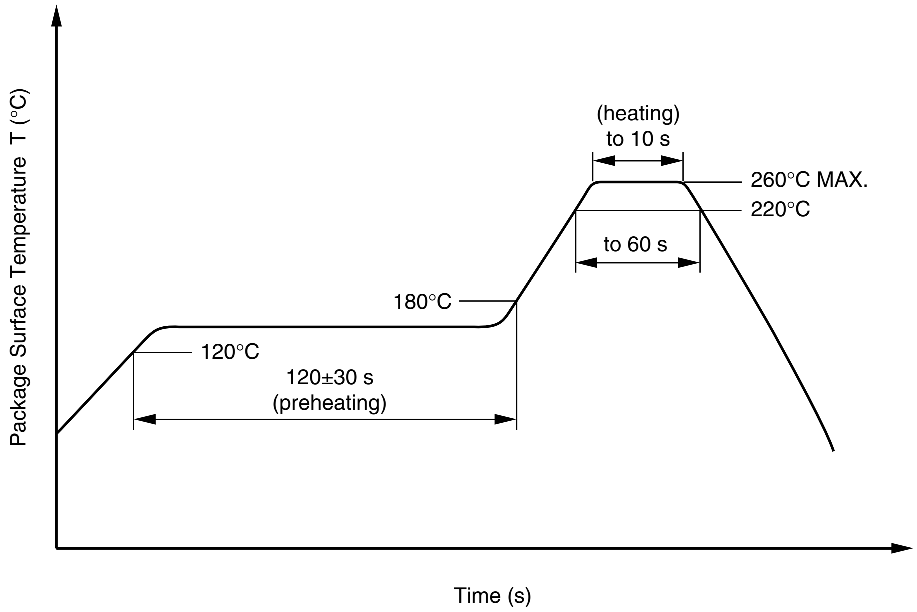
NOTES ON HANDLING

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

(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 1.0 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) When designing the printed wiring board, ensure that the pattern of the IGBT collectors/emitters is not too close to the input block pattern of the photocoupler.
   If the pattern is too close to the input block and coupling occurs, a sudden fluctuation in the voltage on the IGBT output side might affect the photocoupler's LED input, leading to malfunction or degradation of characteristics. (If the pattern needs to be close to the input block, to prevent the LED from lighting during the off state due to the abovementioned coupling, design the input-side circuit so that the bias of the LED is reversed, within the range of the recommended operating conditions, and be sure to thoroughly evaluate operation.)
   (3) Pin 2,4 (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.
   Note: *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
Maximum repetitive peak operating isolation voltage	U_{IORM}	1 130	V_{peak}
Partial discharge test voltage at 100% production test U_{pr} = 1.875 × U_{IORM}., Method b, t_m=1sec, p_d < 5 pC	U_{pr}	1 808	V_{peak}
Partial discharge test voltage at Type test and Sample test U_{pr} = 1.875 × U_{IORM}., Method a, t_m=10sec, p_d < 5 pC	U_{pr}	2 119	V_{peak}
Maximum transient isolation voltage (Transient overvoltage t_{ini}=60sec)	U_{IOTM}	8 000	V_{peak}
Installation classification (IEC 60664/ DIN EN 60664-1/ VDE0110 Part 1) for rated mains voltage ≤ 300 Vr.m.s. for rated mains voltage ≤ 600 Vr.m.s. for rated mains voltage ≤ 1 000 Vr.m.s.		 I - IV I - IV I - III	
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	
Pollution degree (DIN EN 60664-1/ VDE0110 Part 1)		2	
Climatic category (IEC 60068-1/ DIN EN 60068-1)		40/125/21	
Operating temperature range	T_A	–40 to +125	°C
Storage temperature range	T_{stg}	–55 to +150	°C
Isolation resistance, minimum value V_{IO} = 500 Vdc at T_A = 25°C V_{IO} = 500 Vdc at T_A MAX. at least 100°C	 Ris MIN. Ris MIN.	 10^{12} 10^{11}	 Ω Ω
Safety limiting values ratings (maximum allowable in the event of a fault or a failure, see thermal derating curve) Maximum ambient safety temperature Maximum input current Maximum output power Isolation resistance at V_{IO}= 500 Vdc, T_A=Ts	 Ts Isi Pso 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	**PS9332L, PS9332L2 Data Sheet**

Rev.	Date	Description	
		Page	**Summary**
0.01	Nov 30, 2012	–	First edition issued
1.00	Sep 06, 2013	Throughout	“Preliminary Data Sheet” is changed to “Data Sheet.”
		p.1	Addition of Safety standards
		p.3	Addition of ORDERING INFORMATION
		p.4	Modification of ABSOLUTE MAXIMUM RATINGS
		p.5	Modification of ELECTRICAL / SWITCHING CHARACTERISTICS
		p.6 to 7	Modification of TEST CIRCUIT
		p.8 to 11	Addition of TYPICAL CHARACTERISTICS
		p.17	Addition of SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

CEL Headquarters • 4590 Patrick Henry Drive, Santa Clara, CA 95054 • Phone (408) 919-2500 • www.cel.com

For a complete list of sales offices, representatives and distributors,
Please visit our website: **www.cel.com/contactus**