

# PS9113

1 Mbps, OPEN COLLECTOR OUTPUT

R08DS0124EJ0100

Rev.1.00

HIGH CMR, INTELLIGENT POWER MODULE 5-PIN SOP (SO-5) PHOTOCOUPLER

Mar 12, 2015

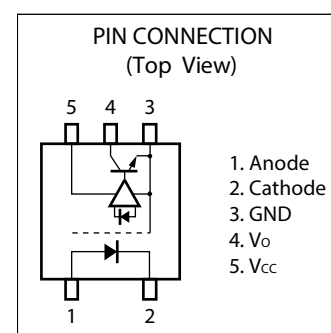
## Description

The PS9113 is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

The PS9113 is specified high CMR, high CTR and pulse width distortion with operating temperature. It is suitable for IPM drive.

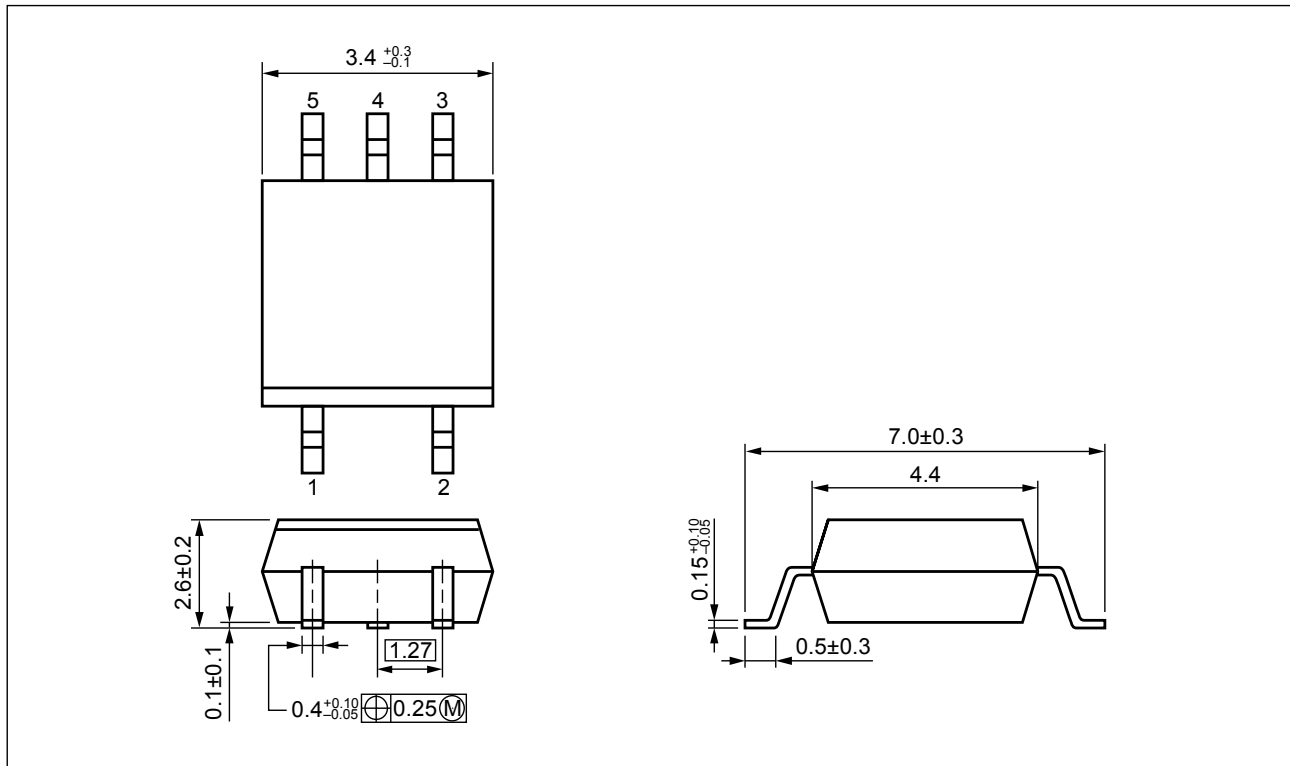
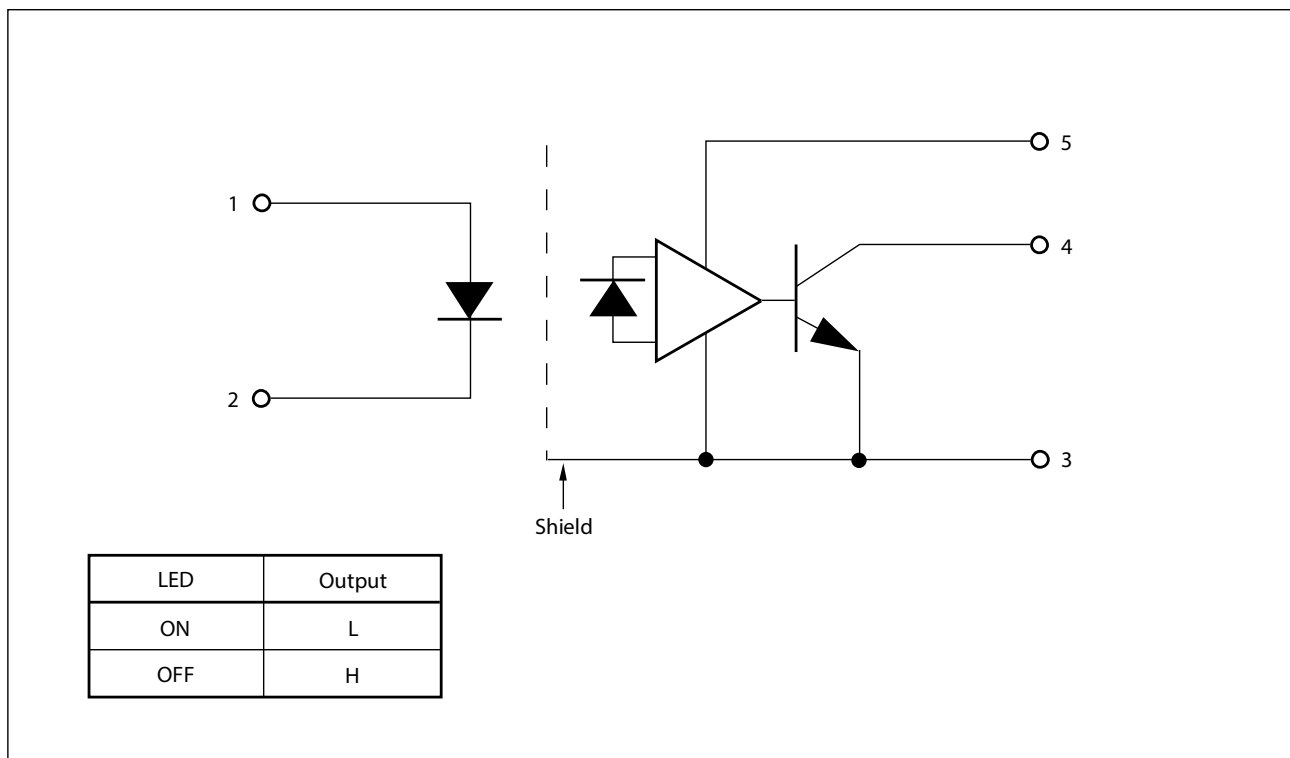
## Features

- High instantaneous common mode rejection voltage ( $CM_H$ ,  $CM_L = \pm 15 \text{ kV}/\mu\text{s}$  MIN.)
- Small package (SO-5)
- High-speed response ( $t_{PHL} = 500 \text{ ns}$  MAX.,  $t_{PLH} = 750 \text{ ns}$  MAX.)
- Maximum propagation delays ( $t_{PLH} - t_{PHL} = 270 \text{ ns}$  TYP.)
- Pulse width distortion ( $|t_{PHL} - t_{PLH}| = 270 \text{ ns}$  TYP.)
- High isolation voltage ( $BV = 3\,750 \text{ V r.m.s.}$ )
- Open collector output
- Ordering number of taping product: PS9113-F3, F4: 2 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: File No. E72422
  - DIN EN60747-5-5 (VDE0884-5):2011-11 approved: No. 40008902 (Option)

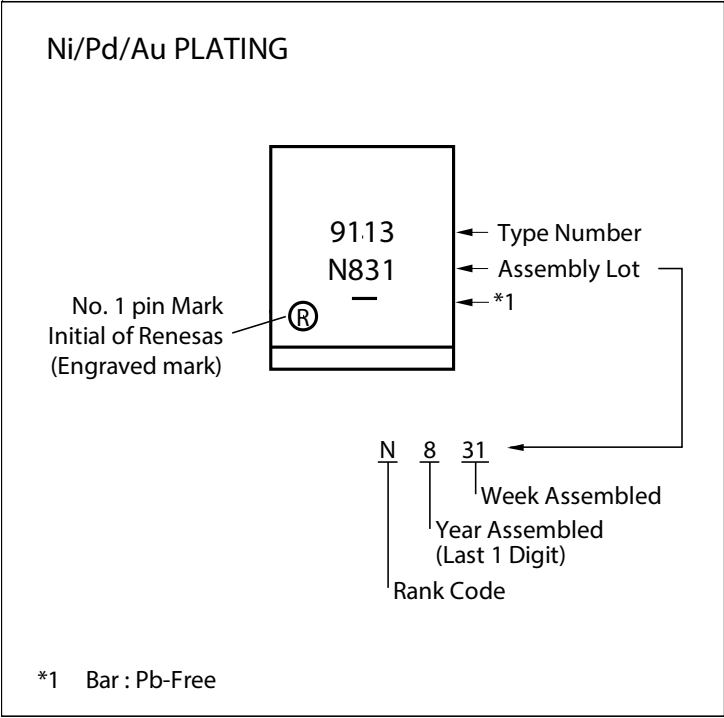


## APPLICATIONS

- IPM Driver
- General purpose inverter

**PACKAGE DIMENSIONS (UNIT: mm)****FUNCTIONAL DIAGRAM**

MARKING EXAMPLE



## ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number <sup>*1</sup>
PS9113	PS9113-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)	PS9113
PS9113-F3	PS9113-F3-AX		Embossed Tape 2500 pcs/reel		
PS9113-F4	PS9113-F4-AX				
PS9113-V	PS9113-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-5 (VDE0884-5):2011-11 Approved (Option)	
PS9113-V-F3	PS9113-V-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9113-V-F4	PS9113-V-F4-AX				

Notes\*: 1. For the application of the Safety Standard, following part number should be used.

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

Parameter		Symbol	Ratings	Unit
Diode	Forward Current <sup>*1</sup>	$I_F$	25	mA
	Reverse Voltage	$V_R$	5	V
Detector	Supply Voltage	$V_{CC}$	-0.5 to +25	V
	Output Voltage	$V_O$	-0.5 to +25	V
	Output Current	$I_O$	15	mA
	Power Dissipation <sup>*2</sup>	$P_C$	100	mW
Isolation Voltage <sup>*3</sup>		BV	3 750	Vr.m.s.
Operating Ambient Temperature		$T_A$	-40 to +100	$^\circ\text{C}$
Storage Temperature		$T_{stg}$	-55 to +125	$^\circ\text{C}$

Notes\*: 1. Reduced to 0.33 mA/ $^\circ\text{C}$  at  $T_A = 70^\circ\text{C}$  or more.

2. Reduced to 1.9 mW/ $^\circ\text{C}$  at  $T_A = 70^\circ\text{C}$  or more.

3. AC voltage for 1 minute at  $T_A = 25^\circ\text{C}$ , RH = 60% between input and output.  
Pins 1-2 shorted together, 3-5 shorted together.

## RECOMMENDED OPERATING CONDITIONS

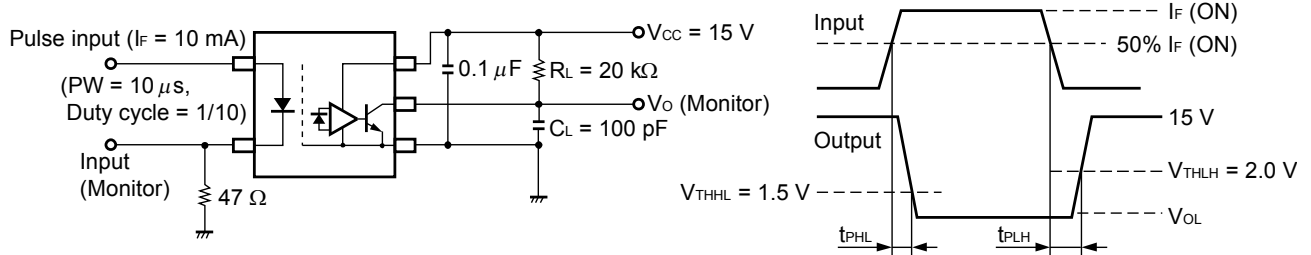
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	$I_{FH}$	10		20	mA
Output Voltage	$V_O$	0		20	V
Supply Voltage	$V_{CC}$	4.5		20	V
LED Off Voltage	$V_F$	0		0.8	V

ELECTRICAL CHARACTERISTICS ( $T_A = -40$  to  $+100^\circ\text{C}$ ,  $V_{CC} = 15$  V, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	$V_F$	$I_F = 10$ mA	1.3	1.65	2.1	V
	Reverse Current	$I_R$	$V_R = 3$ V			200	$\mu\text{A}$
	Terminal Capacitance	$C_t$	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		30		pF
Detector	Low Level Output Voltage	$V_{OL}$	$I_F = 10$ mA, $I_{OL} = 2.4$ mA		0.13	0.6	V
	High Level Output Current	$I_{OH}$	$V_{CC} = V_O = 20$ V, $V_F = 0.8$ V		0.01	50	$\mu\text{A}$
	High Level Supply Current	$I_{CCH}$	$V_{CC} = 20$ V, $V_F = 0.8$ V, $V_O = \text{open}$		0.6	1.3	mA
	Low Level Supply Current	$I_{CCL}$	$V_{CC} = 20$ V, $I_F = 10$ mA, $V_O = \text{open}$		0.6	1.3	mA
Coupled	Threshold Input Current ( $H \rightarrow L$ )	$I_{FHL}$	$V_O = 0.8$ V, $I_O = 0.75$ mA		1.5	5.0	mA
	Current Transfer Ratio ( $I_C/I_F$ )	CTR	$I_F = 10$ mA, $V_O = 0.6$ V	44	110		%
	Isolation Resistance	$R_{I-O}$	$V_{I-O} = 1$ kV <sub>DC</sub> , RH = 40 to 60%, $T_A = 25^\circ\text{C}$	$10^{11}$			$\Omega$
	Isolation Capacitance	$C_{I-O}$	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		0.6		pF
	Propagation Delay Time ( $H \rightarrow L$ )*2	$t_{PHL}$	$I_F = 10$ mA, $R_L = 20$ k $\Omega$ , $C_L = 100$ pF, $V_{THHL} = 1.5$ V, $V_{THLH} = 2.0$ V		250	500	ns
	Propagation Delay Time ( $L \rightarrow H$ )*2	$t_{PLH}$			520	750	
	Maximum Propagation Delays	$t_{PLH} - t_{PHL}$		-200	270	650	
	Pulse Width Distortion (PWD)*2	$ t_{PHL} - t_{PLH} $			270	650	
	Common Mode Transient Immunity at High Level Output*3	$C_{MH}$	$T_A = 25^\circ\text{C}$ , $I_F = 0$ mA, $V_O > 3.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k $\Omega$ , $C_L = 100$ pF	15			kV/ $\mu\text{s}$
	Common Mode Transient Immunity at Low Level Output*3	$C_{ML}$	$T_A = 25^\circ\text{C}$ , $I_F = 10$ mA, $V_O < 1.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k $\Omega$ , $C_L = 100$ pF	15			kV/ $\mu\text{s}$

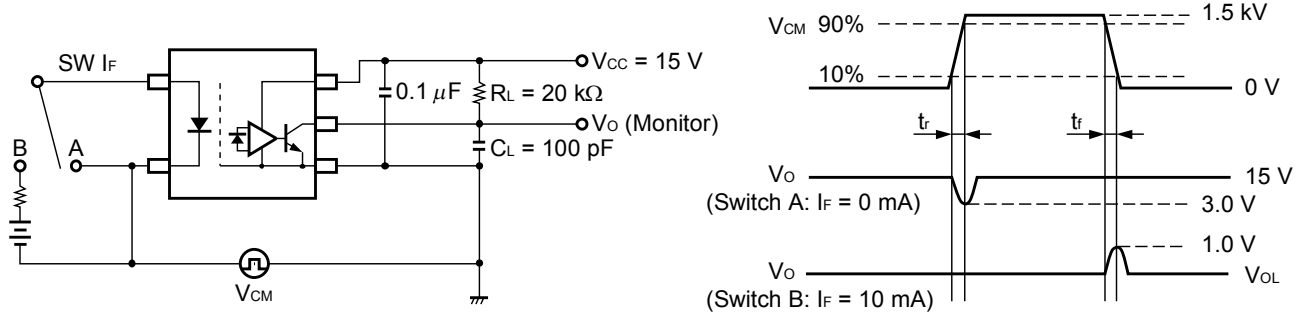
Notes\*: 1. Typical values at  $T_A = 25^\circ\text{C}$ .

2. Test circuit for propagation delay time



$C_L$  includes probe and stray wiring capacitance.

3. Test circuit for common mode transient immunity



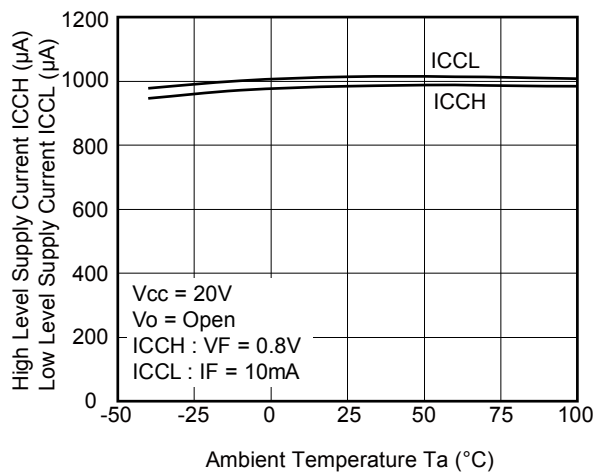
$C_L$  includes probe and stray wiring capacitance.

## USAGE CAUTIONS

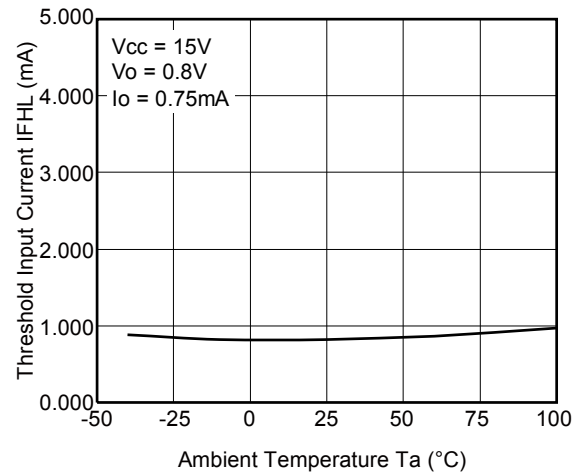
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of  $0.1\text{ }\mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than  $10\text{ mm}$ .
3. Avoid storage at a high temperature and high humidity.

# TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise specified)

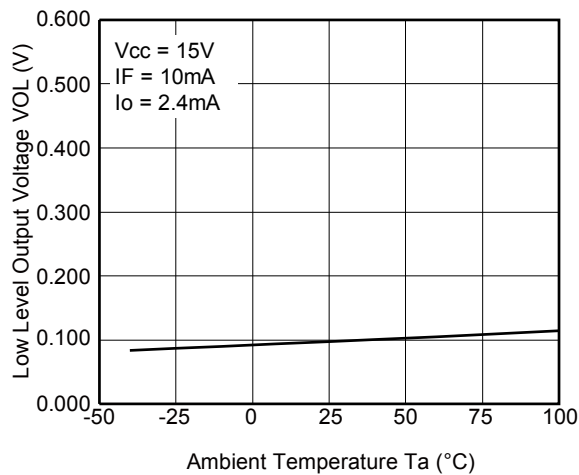
## SUPPLY CURRENT vs. AMBIENT TEMPERATURE



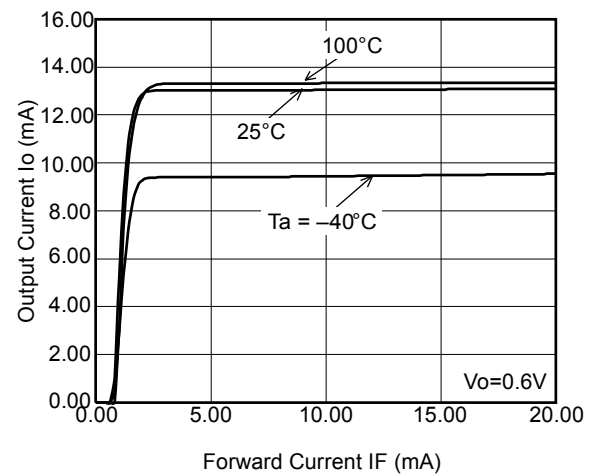
## THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



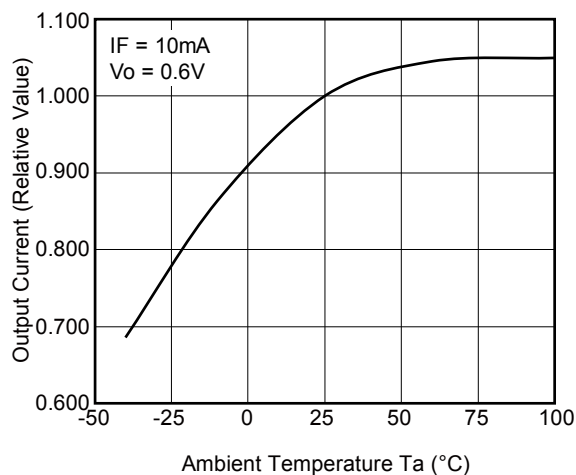
## LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



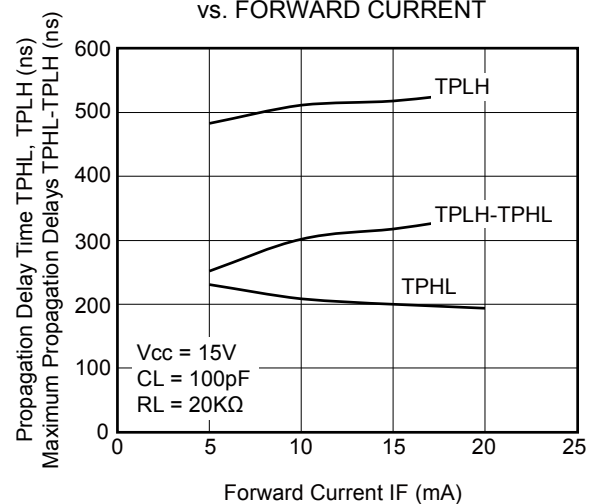
## OUTPUT CURRENT vs. FORWARD CURRENT



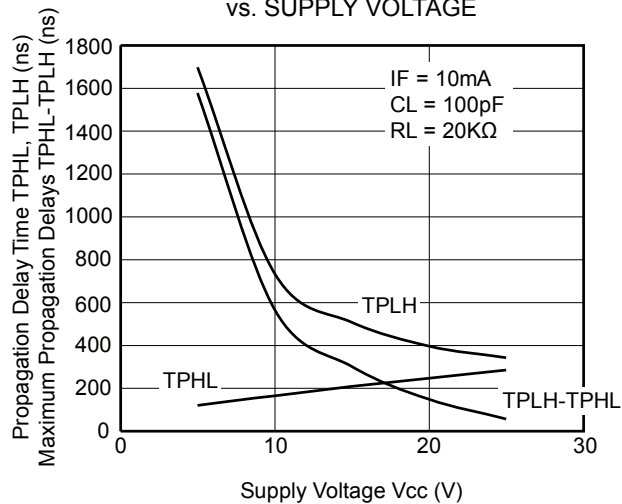
## OUTPUT CURRENT vs. AMBIENT TEMPERATURE



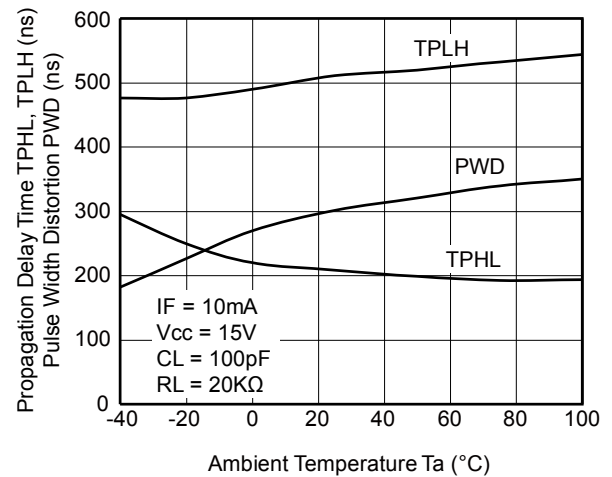
## PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



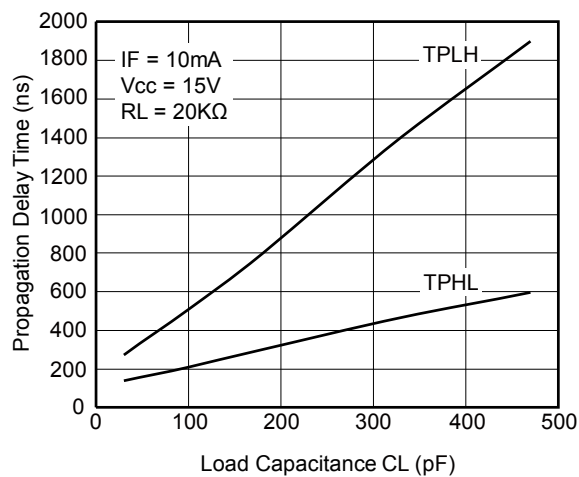
PROPAGATION DELAY TIME,  
MAXIMUM PROPAGATION DELAYS  
vs. SUPPLY VOLTAGE



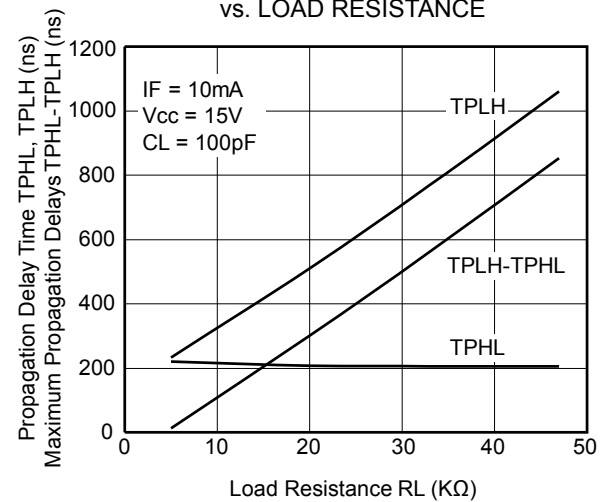
PROPAGATION DELAY TIME,  
PULSE WIDTH DISTORTION  
vs. AMBIENT TEMPERATURE



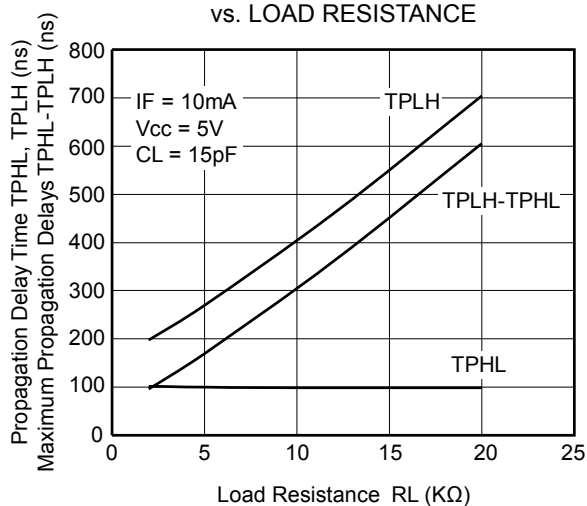
PROPAGATION DELAY TIME  
vs. PROPAGATION DELAY TIME



PROPAGATION DELAY TIME,  
MAXIMUM PROPAGATION DELAYS  
vs. LOAD RESISTANCE



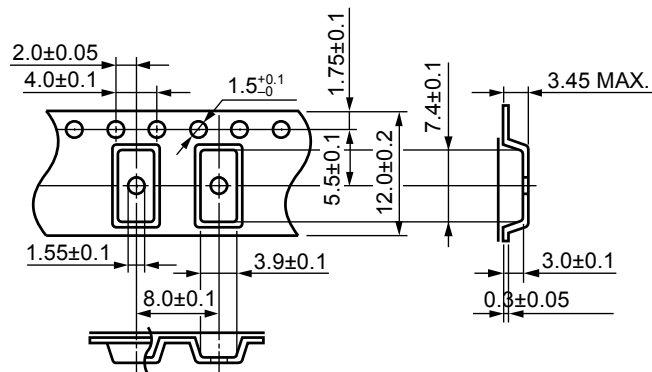
PROPAGATION DELAY TIME,  
MAXIMUM PROPAGATION DELAYS  
vs. LOAD RESISTANCE



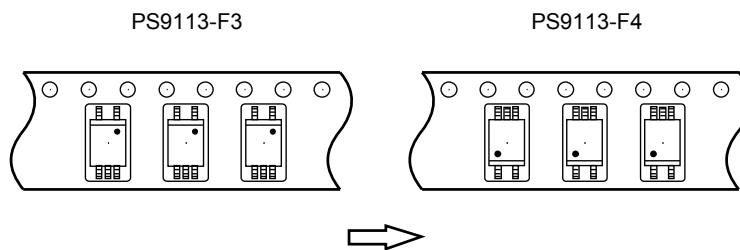


# TAPING SPECIFICATIONS (UNIT: mm)

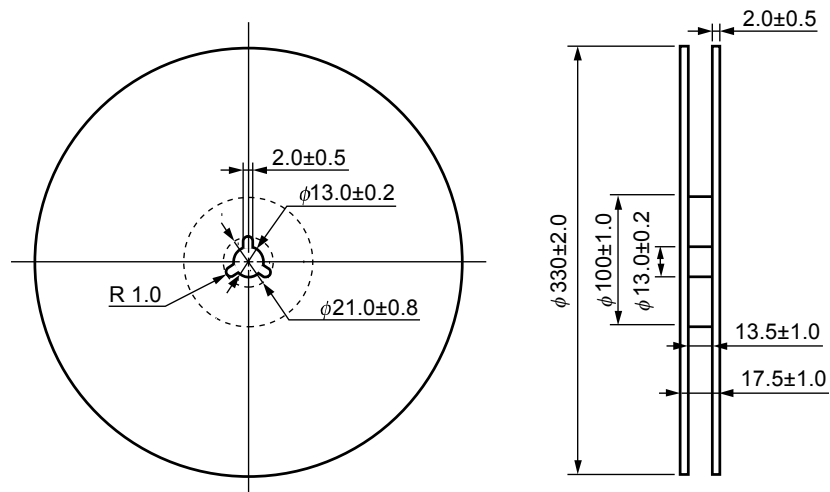
## Outline and Dimensions (Tape)



## Tape Direction

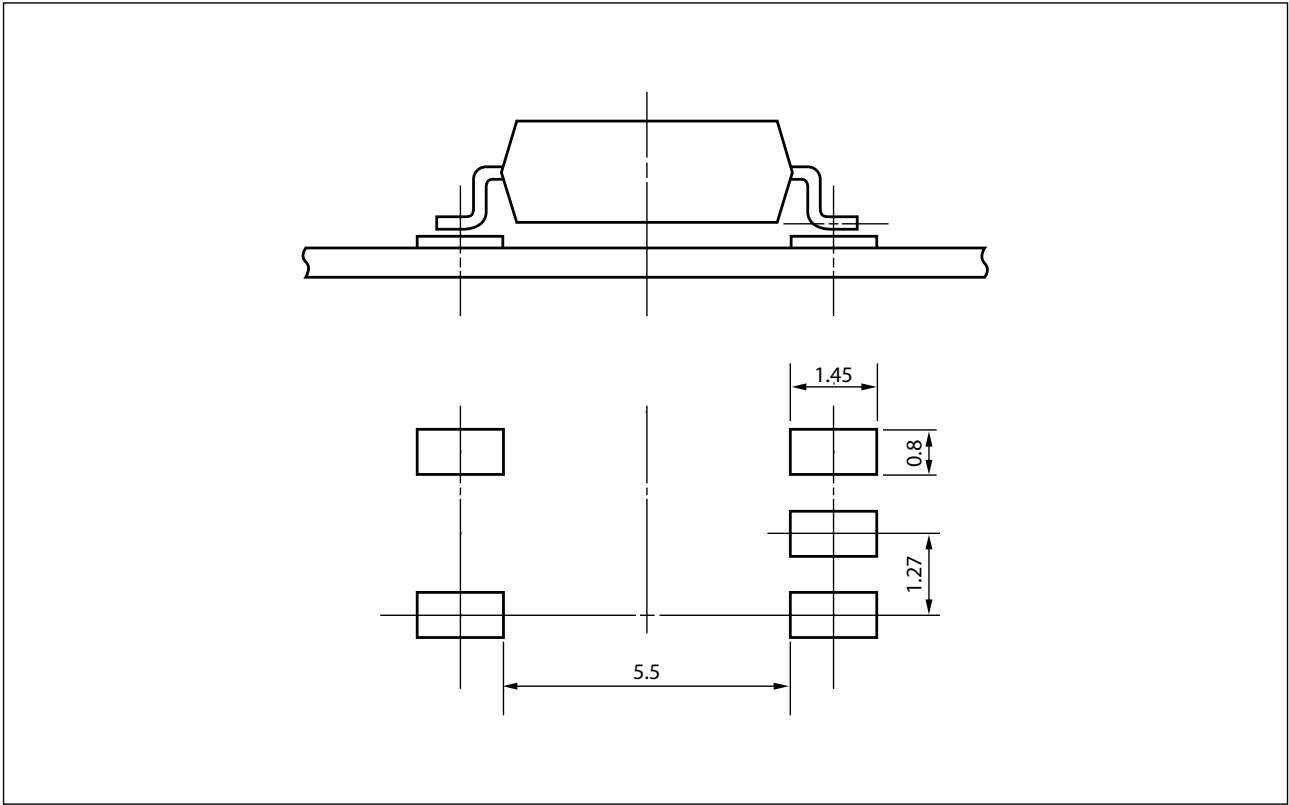


## Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



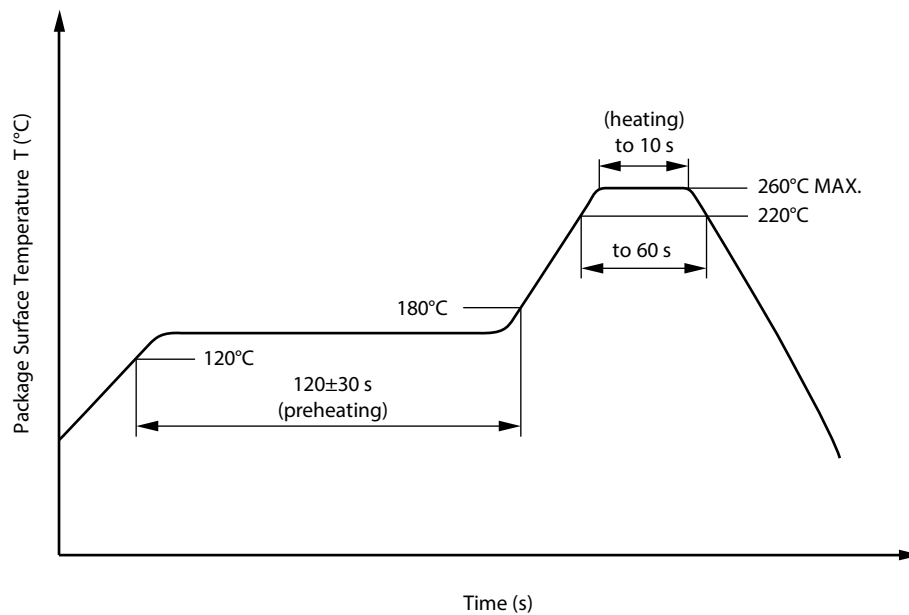
## NOTES ON HANDLING

### 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 or between collector-emitters at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

## USAGE CAUTIONS

1. Protect against static electricity when handling.
2. 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)		40/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}$ , $P_d < 5 \text{ pC}$	$U_{IORM}$ $U_{pr}$	707 1131	$V_{peak}$ $V_{peak}$
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$ , $P_d < 5 \text{ pC}$	$U_{pr}$	1 326	$V_{peak}$
Highest permissible overvoltage	$U_{TR}$	6 000	$V_{peak}$
Degree of pollution (DIN EN 60664-1 VDE 0110 Part 1)		2	
Comparative tracking index ((IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	CTI	175	
Material group (DIN EN 60664-1 VDE 0110 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 $V_{IO} = 500 \text{ V dc}$ at $T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc}$ at $T_A \text{ MAX.}$ at least $100^\circ\text{C}$	$R_{is \text{ MIN.}}$ $R_{is \text{ MIN.}}$	1012 1011	$\Omega$ $\Omega$
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current $I_F$ , $P_{si} = 0$ ) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc}$ at $T_A = T_{si}$	$T_{si}$ $I_{si}$ $P_{si}$ $R_{is \text{ MIN.}}$	150 200 300 109	°C mA mW $\Omega$

<b>Caution</b>	GaAs Products	<p>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.</p> <ul style="list-style-type: none"> <li>• Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.</li> </ul> <ol style="list-style-type: none"> <li>1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.</li> <li>2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.</li> </ol> <ul style="list-style-type: none"> <li>• Do not burn, destroy, cut, crush, or chemically dissolve the product.</li> <li>• Do not lick the product or in any way allow it to enter the mouth.</li> </ul>
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