



# THE DATASHEET OF PS9613



**CEL**

# NEC's 1 Mbps, OPEN-COLLECTOR OUTPUT FOR GATE DRIVE INTERFACE INTELLIGENT POWER MODULE 8-PIN DIP PHOTOCOUPLER

**PS9613**  
**PS9613L**

## FEATURES

- **HIGH INSTANTANEOUS COMMON MODE REJECTION VOLTAGE**  
CMH, CML =  $\pm 15$  kV/ $\mu$ s MIN
- **HIGH SPEED RESPONSE**  
tPHL= 500 ns MAX, tPLH = 750 ns MAX
- **MAXIMUM PROPAGATION DELAYS**  
tPHL- tPLH = 270 ns TYP
- **PULSE WIDTH DISTORTION**  
| tPHL- tPLH | = 270 ns TYP
- **TAPING PRODUCT NUMBER**  
PS9613L-E3, E4: 1000 pcs/reel



ESD SENSITIVE

## DESCRIPTION

NEC's PS9613 and PS9613L are 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 PS9613 is in a plastic DIP (Dual In-line Package) and the PS9613L is lead bending type (Gull-wing) for surface mounting.

## APPLICATIONS

- **IPM DRIVER**
- **GENERAL PURPOSE INVERTER**

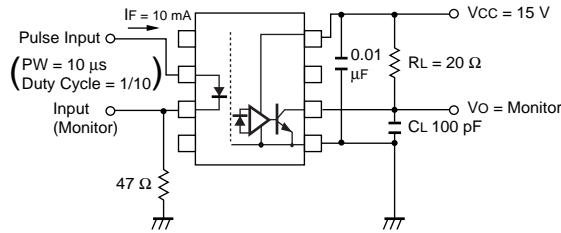
## ELECTRICAL CHARACTERISTICS<sup>1</sup> (TA = -40 to +100°C, VCC = 15 V, unless otherwise specified)

PART NUMBER			PS9613, PS9613L			
SYMBOL	PARAMETERS	UNITS	MIN	TYP	MAX	
Diode	V <sub>F</sub>	Forward Voltage, I <sub>F</sub> = 10 mA	V	1.3	2.1	
	I <sub>R</sub>	Reverse Current, V <sub>R</sub> = 3 V	$\mu$ A		200	
	C <sub>t</sub>	Terminal Capacitance, V = 0, f = 1 MHz, T <sub>A</sub> = 25 °C	pF		30	
Detector	V <sub>OL</sub>	Low Level Output Voltage I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, I <sub>O</sub> = 2.4 mA	V	0.13	0.6	
	I <sub>OH</sub>	High Level Output Current V <sub>CC</sub> = 30 V, V <sub>F</sub> = 0.8 V	$\mu$ A	1.0	50	
	I <sub>CCH</sub>	High Level Supply Current, V <sub>CC</sub> = 30 V, V <sub>F</sub> = 0.8 V, V <sub>O</sub> = open	mA	0.6	1.3	
	I <sub>CCL</sub>	Low Level Supply Current, V <sub>CC</sub> = 30 V, I <sub>F</sub> = 10 mA, V <sub>O</sub> = open	mA	0.6	1.3	
Coupled	I <sub>FHL</sub>	Threshold Input Current (High $\rightarrow$ Low), V <sub>O</sub> = 0.8 V, I <sub>O</sub> = 0.75 V	mA	1.5	5.0	
	CTR	Current Transfer Ratio, I <sub>F</sub> = 10 mA, V <sub>O</sub> = 0.6 V	%	44	110	
	R <sub>I-O</sub>	Isolation Resistance, V <sub>I-O</sub> = 1 k V <sub>DC</sub> , R <sub>H</sub> = 40 to 60%, T <sub>A</sub> = 25 °C	$\Omega$	10 <sup>11</sup>		
	C <sub>I-O</sub>	Isolation Capacitance, V = 0, f = 1 MHz, T <sub>A</sub> = 25 °C	pF		0.6	
	t <sub>PHL</sub>	Propagation Delay Time <sup>2</sup> , High $\rightarrow$ Low I <sub>F</sub> = 10 mA, R <sub>L</sub> = 20 k $\Omega$ , C <sub>L</sub> = 100 pF, V <sub>THHL</sub> = 1.5 V, V <sub>THLH</sub> = 2.0 V	ns		250	500
	t <sub>PLH</sub>	Propagation Delay Time <sup>2</sup> , High $\rightarrow$ Low I <sub>F</sub> = 10 mA, R <sub>L</sub> = 20 k $\Omega$ , C <sub>L</sub> = 100 pF, V <sub>THHL</sub> = 1.5 V, V <sub>THLH</sub> = 2.0 V	ns		520	750
	t <sub>PLH-tPHL</sub>	Maximum Propagation Delays I <sub>F</sub> = 10 mA, R <sub>L</sub> = 20 k $\Omega$ , C <sub>L</sub> = 100 pF, V <sub>THHL</sub> = 1.5 V, V <sub>THLH</sub> = 2.0 V	ns	-200	270	650
	t <sub>PHL-tPLH</sub>	Pulse Width Distortion I <sub>F</sub> = 10 mA, R <sub>L</sub> = 20 k $\Omega$ , C <sub>L</sub> = 100 pF, V <sub>THHL</sub> = 1.5 V, V <sub>THLH</sub> = 2.0 V	ns		270	650
	CMH	Instantaneous Common Mode Rejection Voltage (Output:High) <sup>3</sup> T <sub>A</sub> = 25°C, I <sub>F</sub> = 0 mA, V <sub>O</sub> > = 3.0 V, V <sub>CM</sub> = 1.5 kV, R <sub>L</sub> = 20 $\Omega$ , C <sub>L</sub> = 100 pF	kV/ $\mu$ s	15		
	CML	Instantaneous Common Mode Rejection Voltage (Output:High) <sup>3</sup> T <sub>A</sub> = 25°C, I <sub>F</sub> = 10 mA, V <sub>O</sub> < = 1.0 V, V <sub>CM</sub> = 1.5 kV, R <sub>L</sub> = 20 $\Omega$ , C <sub>L</sub> = 100 pF	kV/ $\mu$ s	15		

Notes: See Next Page

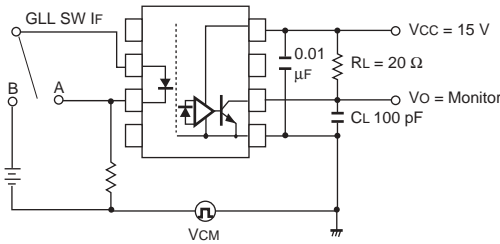
Notes:

1. Typical values at  $T_A = 25\text{ }^\circ\text{C}$
2. Test Circuit for Propagation delay time

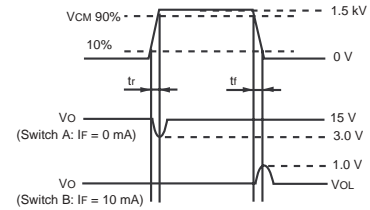
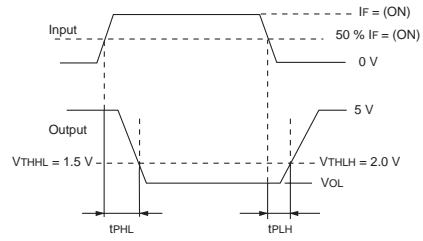


\*CL is approximately 15 pF, which includes probe and stray wiring capacitance.

3. Test circuit for common mode transient immunity



\*CL is approximately 15 pF, which includes probe and stray wiring capacitance.



**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** ( $T_A = 25\text{ }^\circ\text{C}$ )

SYMBOLS	PARAMETERS	UNITS	RATINGS
<b>Diode</b>			
IF	Forward Current	mA	25
VR	Reverse Voltage	V	3.0
<b>Detector</b>			
VCC	Supply Voltage	V	-0.5 to +35
Vo	Output Voltage	V	-0.5 to +35
Io	Output Current	mA	15
Pc	Power Dissipation	mW	100
<b>Coupler</b>			
BV	Isolation Voltage <sup>2</sup>	V <sub>r.m.s.</sub>	5000
TOP	Operating Temperature	$^\circ\text{C}$	-40 to +100
TSTG	Storage Temperature	$^\circ\text{C}$	-55 to +125

Notes:

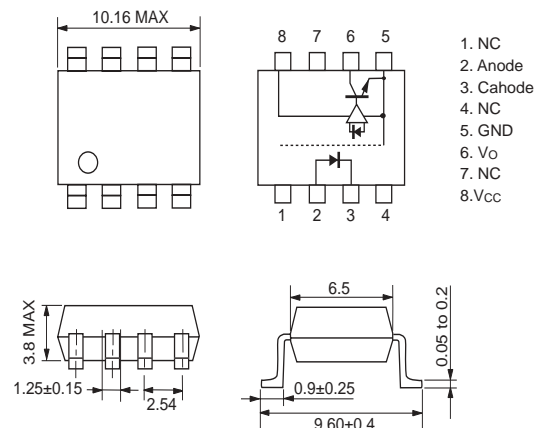
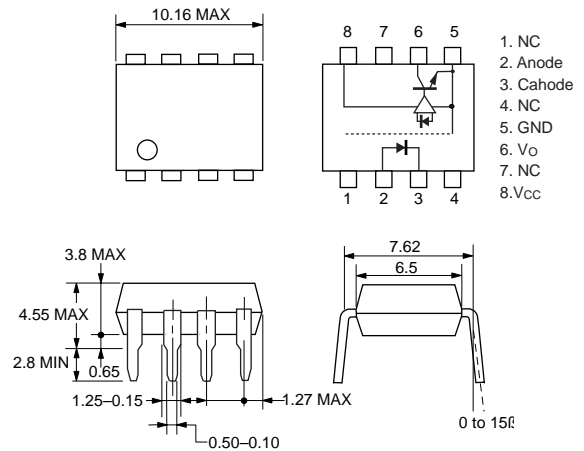
1. Operation in excess of any one of these parameters may result in permanent damage.
2. AC voltage for 1 minute at  $T_A = 25\text{ }^\circ\text{C}$ , RH = 60% between input and output.

**RECOMMENDED OPERATING CONDITIONS**

PART NUMBER			PS9716		
SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
IFH	High Level Input Current	mA	10		20
Vo	Output Voltage	V	0		30
VCC	Supply Voltage	V	4.5		30
VF	LED off Voltage	V	0		0.8

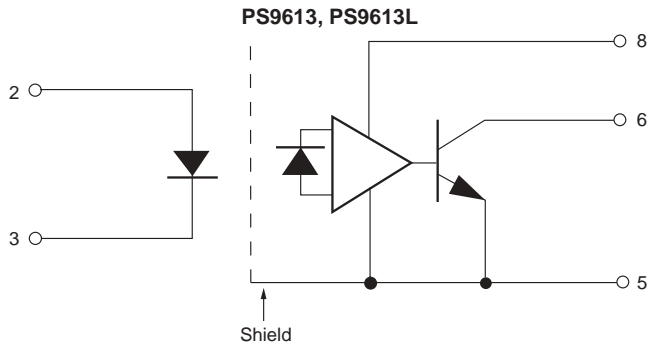
**OUTLINE DIMENSIONS** (Units in mm)

PS9613, PS9613L



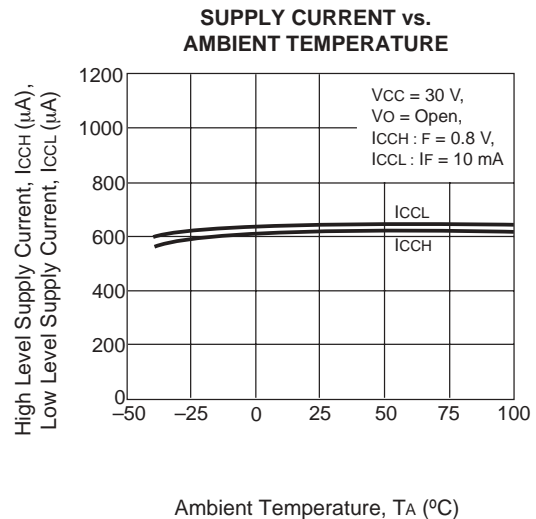
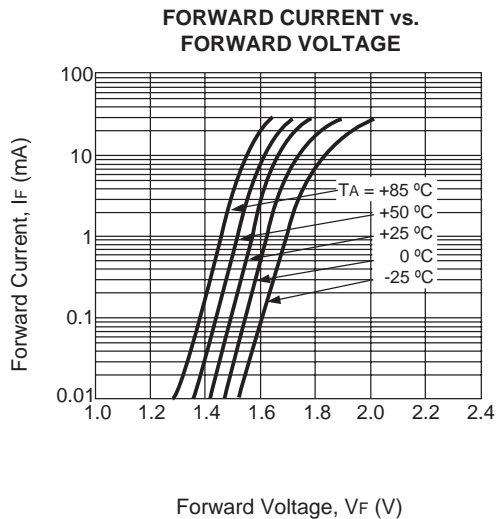
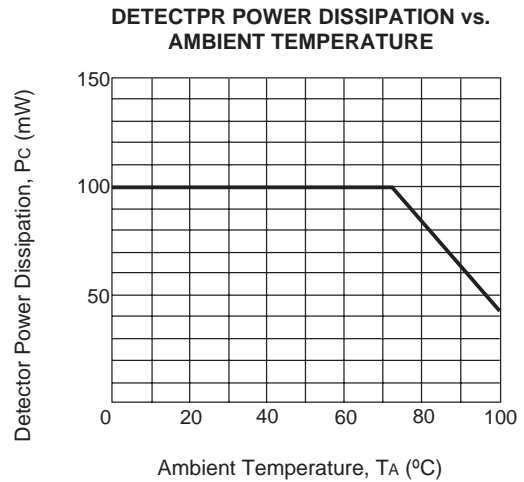
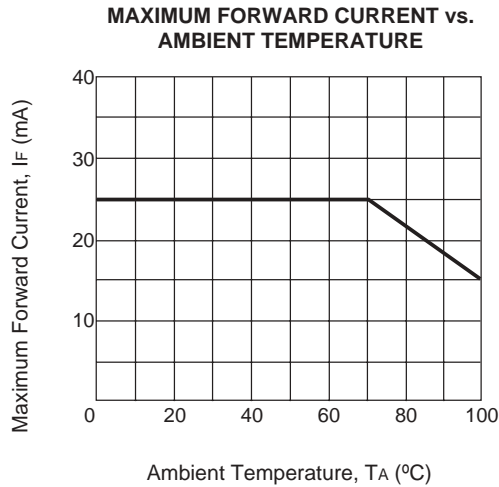
# PS9613, PS9613L

## FUNCTIONAL DIAGRAM



LED	OUTPUT
ON	L
OFF	H

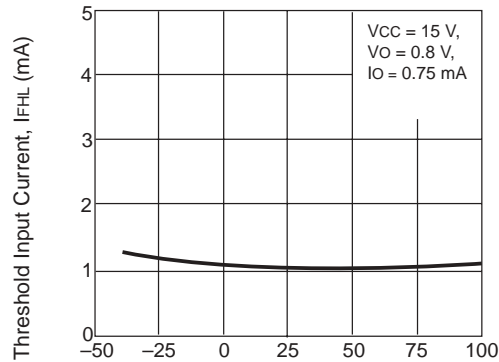
## TYPICAL PERFORMANCE CURVES ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)



**Remarks:** The graphs indicate nominal characteristics.

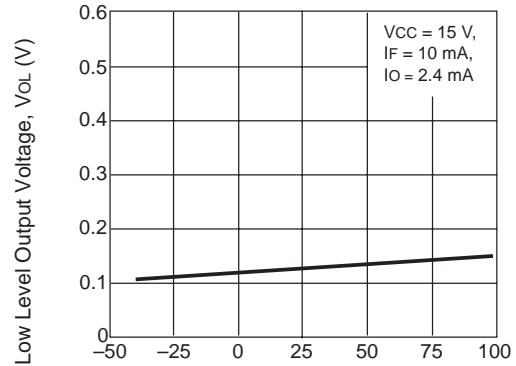
**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

**THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE**



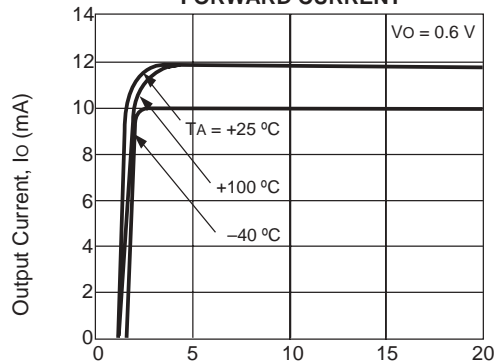
Ambient Temperature,  $T_A$  ( $^\circ\text{C}$ )

**LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE**



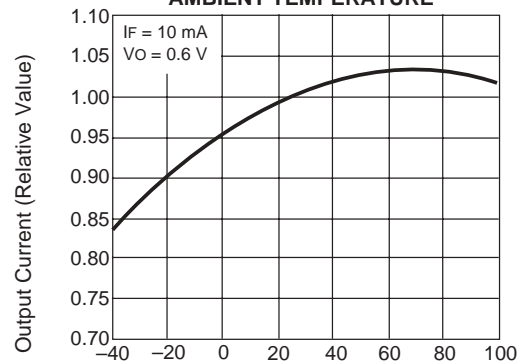
Ambient Temperature,  $T_A$  ( $^\circ\text{C}$ )

**OUTPUT CURRENT vs. FORWARD CURRENT**



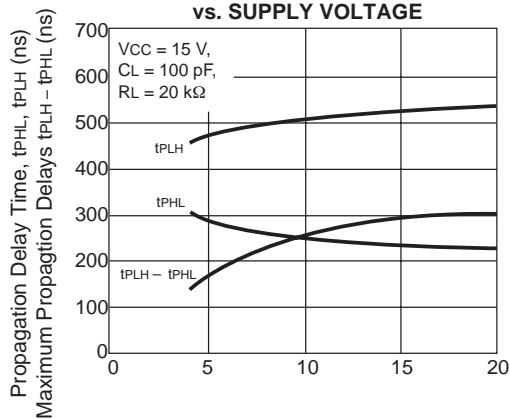
Forward Current,  $I_F$  (mA)

**OUTPUT CURRENT vs. AMBIENT TEMPERATURE**



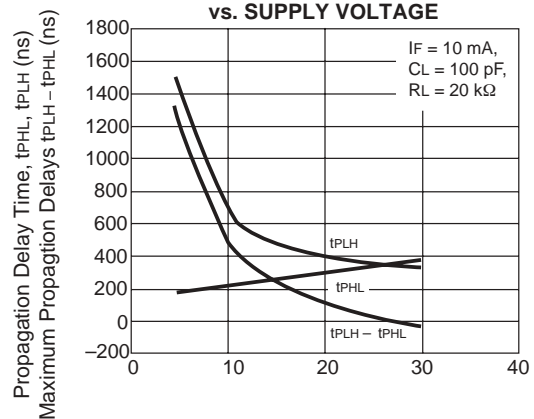
Ambient Temperature,  $T_A$  ( $^\circ\text{C}$ )

**PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE**



Forward Current,  $I_F$  (mA)

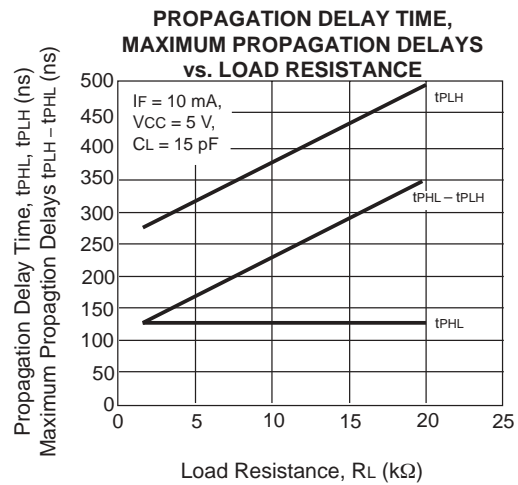
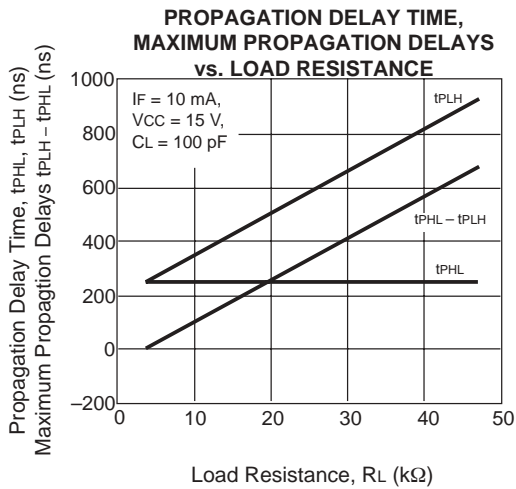
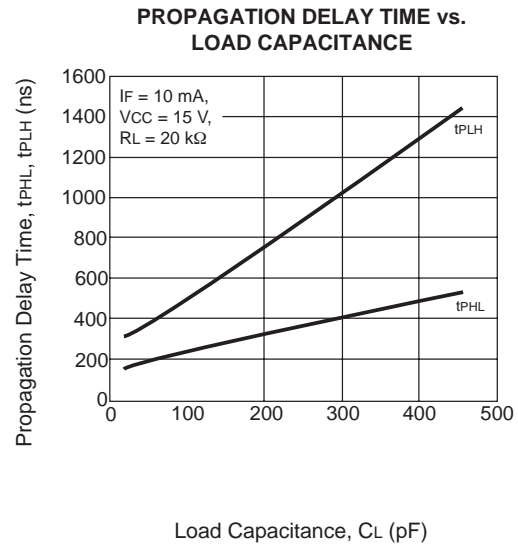
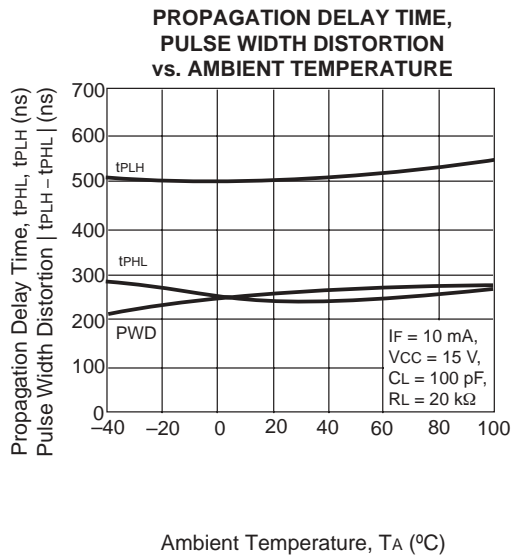
**PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE**



Supply Voltage,  $V_{CC}$  (V)

**Remarks:** The graphs indicate nominal characteristics.

**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )



Remarks: The graphs indicate nominal characteristics.

**ORDERING INFORMATION**

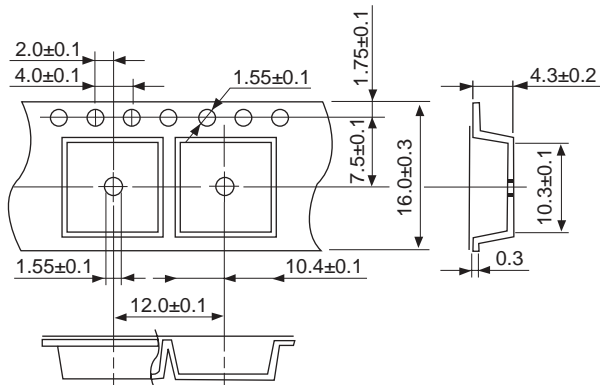
PART NUMBER	PACKAGE	PACKING STYLE	SAFETY STANDARDS	APPLICATION PART NUMBER <sup>1</sup>
PS9613	8 – pin DIP	Magazine case 50 pcs	UL approved	PS9613
PS9613L		Embossed Tape 1000 pcs/reel		PS9613L
PS9613L-E3			Magazine case 50 pcs	PS9613
PS9613L-E4				Embossed Tape 1000 pcs/reel
PS9613-V		VDE0884 approved	PS9613	
PS9613L-V				
PS9613L-V-E3		Embossed Tape 1000 pcs/reel	PS9613L	
PS9613L-V-E4				

Notes:

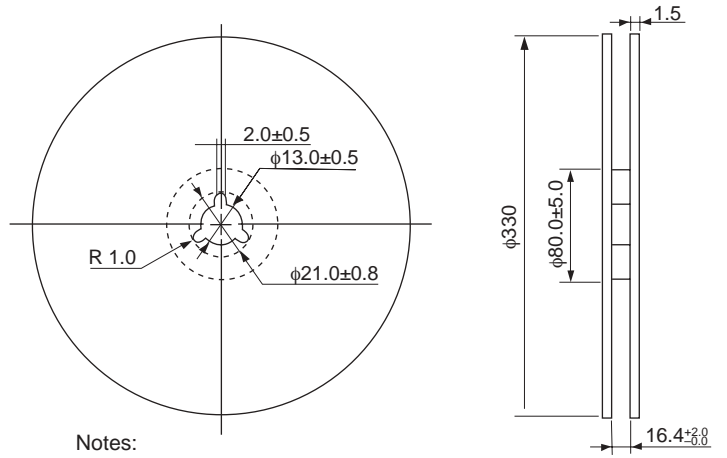
1. For the application of the Safety Standard, following part number should be used.

**TAPING SPECIFICATIONS** (Units in mm)

**OUTLINE AND DIMENSIONS (TAPE)**

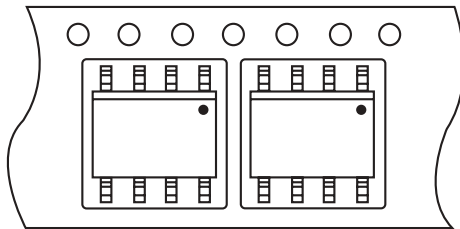


**OUTLINE AND DIMENSIONS (REEL)**

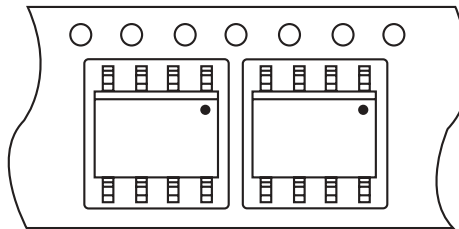


Notes:  
1. Packing : 1000 pcs/reel

**TAPE DIRECTION**  
**PS9613L-E3**



**PS9613L3-E4**

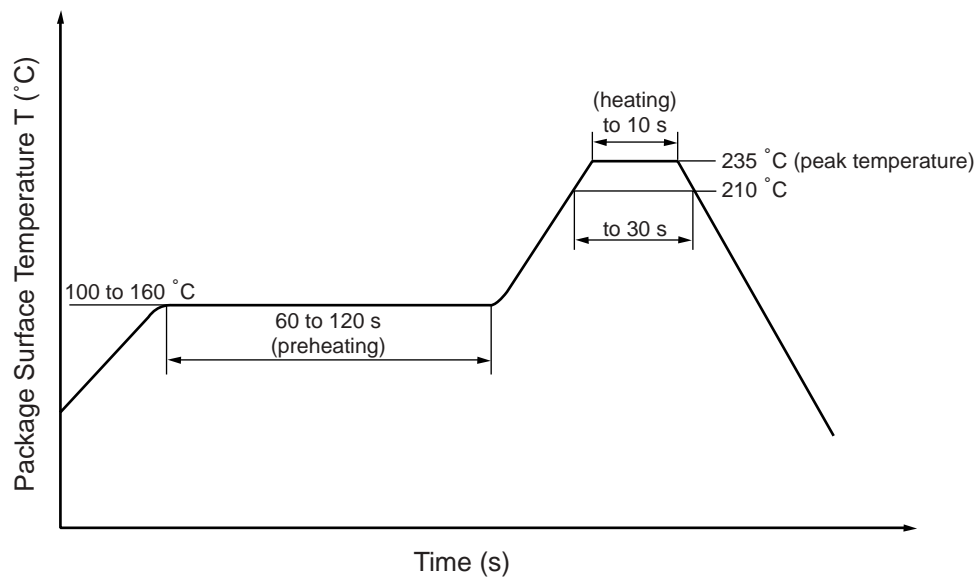


## RECOMMENDED SOLDERING CONDITIONS

### (1) Infrared reflow soldering

- **Peak reflow temperature**  
235 °C or below (plastic surface temperature)
- **Reflow time**  
30 seconds or less (Time period during which the plastic surface temperature is higher than 210 °C)
- **Number of reflows Processes**  
Three
- **Flux**  
Rosin flux containing small amount of chlorine (The flux with a max. chlorine content of 0.2 Wt % is recommended.)

INFRARED RAY REFLOW TEMPERATURE PROFILE



### (2) Dip soldering

- **Temperature**  
260 °C or below (molten solder temperature)
- **Time**  
10 seconds or less
- **Flux**  
Rosin flux containing small amount of chlorine (The flux with a max. chlorine content of 0.2 Wt % is recommended.)

### (3) Cautions

- **Fluxes**  
Avoid removing the residual flux with freon-based and chlorine-based cleaning solvent.

#### Life Support Applications

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