

## 1 Mbps, OPEN COLLECTOR OUTPUT HIGH CMR, INTELLIGENT POWER MODULE 5-PIN SOP PHOTOCOUPLER

-NEPOC Series-

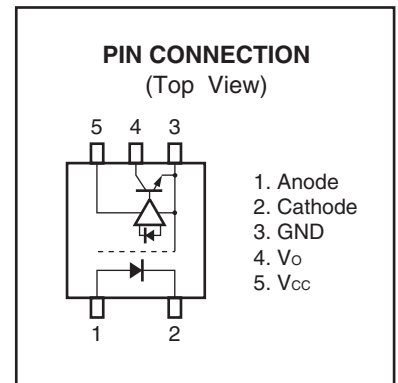
### DESCRIPTION

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 (5-pin SOP)
- 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.)
- Ordering number of taping product: PS9113-F3, F4: 2 500 pcs/reel
- ★ • Pb-Free product
- ★ • Safety standards
  - UL approved: File No. E72422
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40008902 (Option)

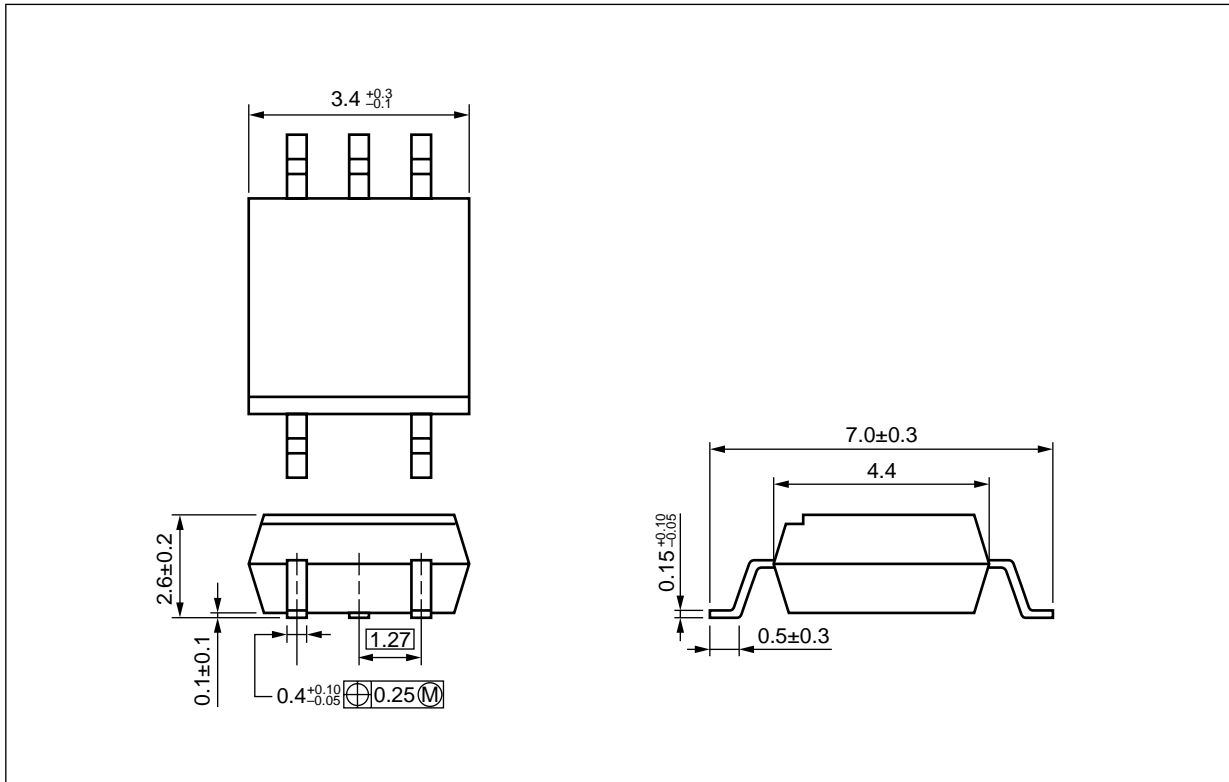


### APPLICATIONS

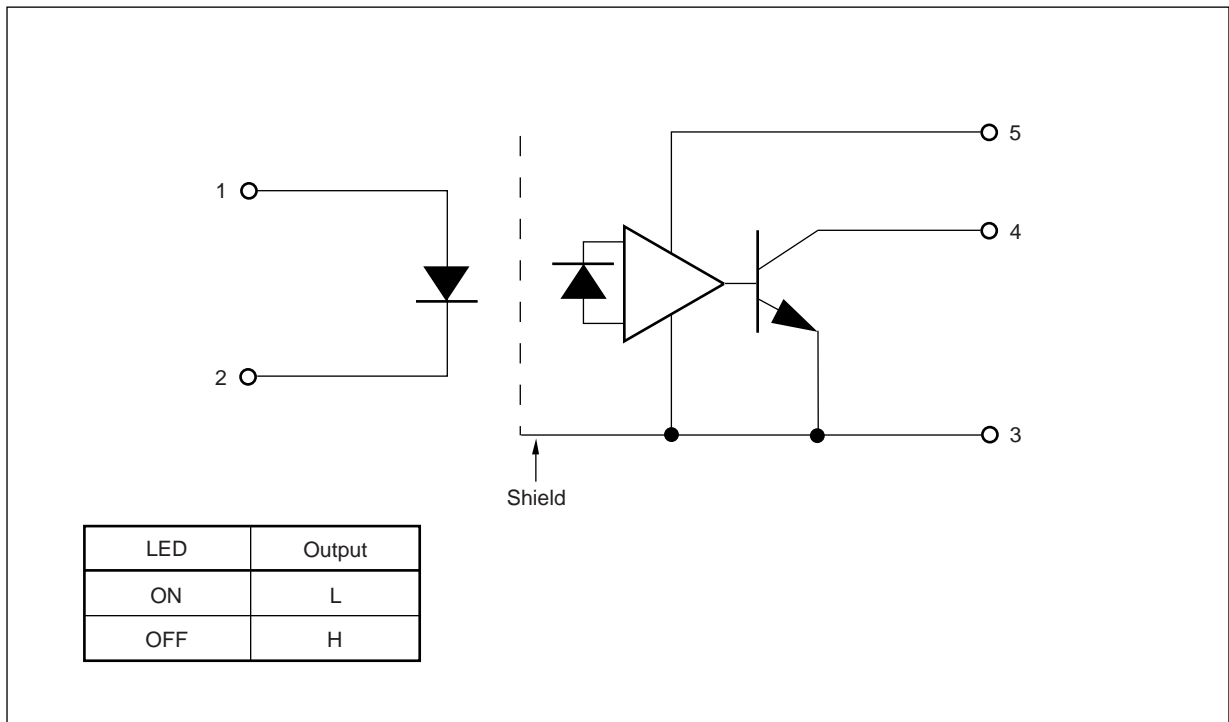
- IPM Driver
- General purpose inverter

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Not all devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

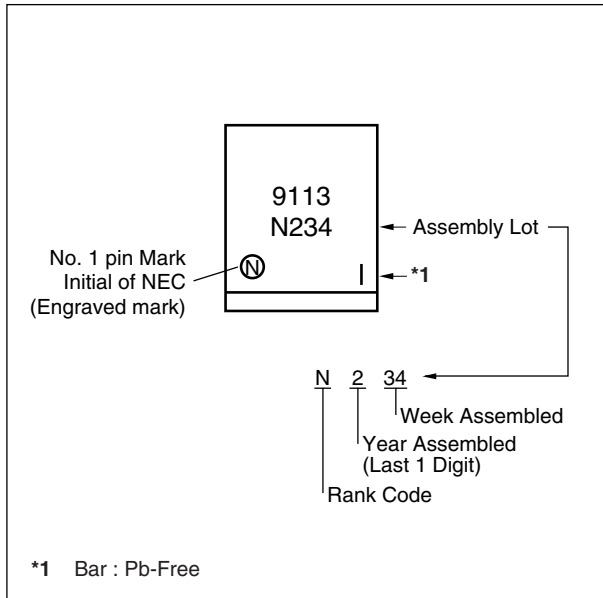
PACKAGE DIMENSIONS (UNIT: mm)



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-A	Pb-Free <sup>*2</sup>	Magazine case 100 pcs	Standard products (UL approved)	PS9113
PS9113-F3	PS9113-F3-A		Embossed Tape 2500 pcs/reel		
PS9113-F4	PS9113-F4-A				
PS9113-V	PS9113-V-A		Magazine case 100 pcs	DIN EN60747-5-2	
PS9113-V-F3	PS9113-V-F3-A		Embossed Tape 2 500 pcs/reel	(VDE0884 Part2)	
PS9113-V-F4	PS9113-V-F4-A			Approved (Option)	

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

\*2 With regards to terminal solder (the solder contains lead) plated products (conventionally plated), contact your nearby sales office.

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, unless otherwise specified)**

Parameter		Symbol	Ratings	Unit
Diode	Forward Current <sup>*1</sup>	I <sub>F</sub>	25	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	-0.5 to +35	V
	Output Voltage	V <sub>O</sub>	-0.5 to +35	V
	Output Current	I <sub>O</sub>	15	mA
	Power Dissipation <sup>*2</sup>	P <sub>C</sub>	100	mW
Isolation Voltage <sup>*3</sup>		BV	2 500	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +100	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

\*1 Reduced to 0.33 mA/°C at T<sub>A</sub> = 70°C or more.

\*2 Reduced to 1.9 mW/°C at T<sub>A</sub> = 70°C or more.

\*3 AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.  
Pins 1-2 shorted together, 3-4 shorted together.

**RECOMMENDED OPERATING CONDITIONS**

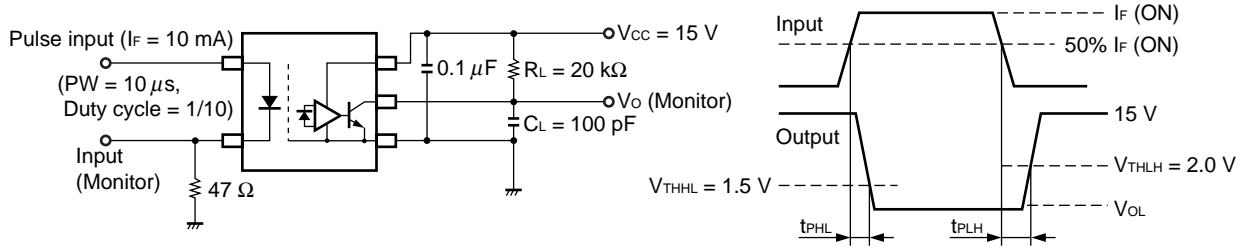
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I <sub>FH</sub>	10		20	mA
Output Voltage	V <sub>O</sub>	0		30	V
Supply Voltage	V <sub>CC</sub>	4.5		30	V
LED Off Voltage	V <sub>F</sub>	0		0.8	V

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +100°C, V<sub>CC</sub> = 15 V, unless otherwise specified)**

Parameter		Symbol	Conditions	MIN.	TYP. <sup>*1</sup>	MAX.	Unit
Diode	Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 10 mA	1.3	1.65	2.1	V
	Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 3 V			200	μA
	Terminal Capacitance	C <sub>t</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		30		pF
Detector	Low Level Output Voltage	V <sub>OL</sub>	I <sub>F</sub> = 10 mA, I <sub>OL</sub> = 2.4 mA		0.13	0.6	V
	High Level Output Current	I <sub>OH</sub>	V <sub>CC</sub> = V <sub>O</sub> = 30 V, V <sub>F</sub> = 0.8 V		0.01	50	μA
	High Level Supply Current	I <sub>CCH</sub>	V <sub>CC</sub> = 30 V, V <sub>F</sub> = 0.8 V, V <sub>O</sub> = open		0.6	1.3	mA
	Low Level Supply Current	I <sub>CCL</sub>	V <sub>CC</sub> = 30 V, I <sub>F</sub> = 10 mA, V <sub>O</sub> = open		0.6	1.3	mA
Coupled	Threshold Input Current (H → L)	I <sub>FHL</sub>	V <sub>O</sub> = 0.8 V, I <sub>O</sub> = 0.75 mA		1.5	5.0	mA
	Current Transfer Ratio (I <sub>C</sub> /I <sub>F</sub> )	CTR	I <sub>F</sub> = 10 mA, V <sub>O</sub> = 0.6 V	44	110		%
	Isolation Resistance	R <sub>I-O</sub>	V <sub>I-O</sub> = 1 kV <sub>DC</sub> , R <sub>H</sub> = 40 to 60%, T <sub>A</sub> = 25°C	10 <sup>11</sup>			Ω
	Isolation Capacitance	C <sub>I-O</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		0.6		pF
	Propagation Delay Time (H → L) <sup>*2</sup>	t <sub>PHL</sub>	I <sub>F</sub> = 10 mA, R <sub>L</sub> = 20 kΩ, C <sub>L</sub> = 100 pF, V <sub>THHL</sub> = 1.5 V, V <sub>THLH</sub> = 2.0 V		250	500	ns
	Propagation Delay Time (L → H) <sup>*2</sup>	t <sub>PLH</sub>			520	750	
	Maximum Propagation Delays	t <sub>PLH-tPHL</sub>		-200	270	650	
	Pulse Width Distortion (PWD) <sup>*2</sup>	t <sub>PHL-tPLH</sub>			270	650	
	Common Mode Transient Immunity at High Level Output <sup>*3</sup>	CM <sub>H</sub>	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 kΩ, C <sub>L</sub> = 100 pF	15			kV/μs
Common Mode Transient Immunity at Low Level Output <sup>*3</sup>	CM <sub>L</sub>	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 kΩ, C <sub>L</sub> = 100 pF	15			kV/μs	

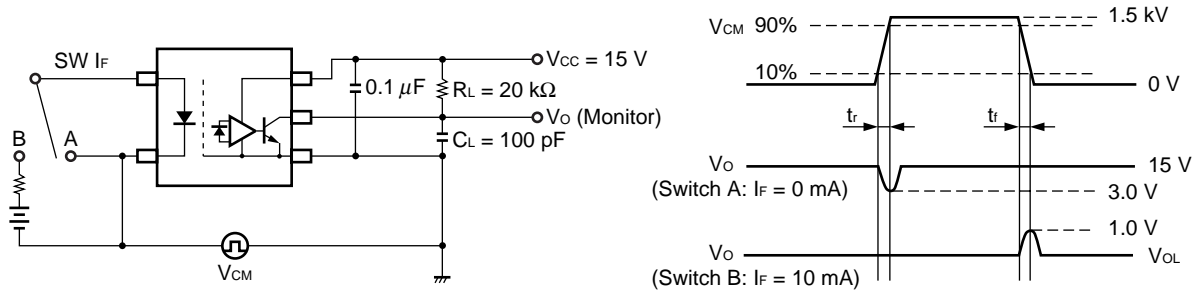
\*1 Typical values at  $T_A = 25^\circ\text{C}$ .

\*2 Test circuit for propagation delay time



$C_L$  includes probe and stray wiring capacitance.

\*3 Test circuit for common mode transient immunity

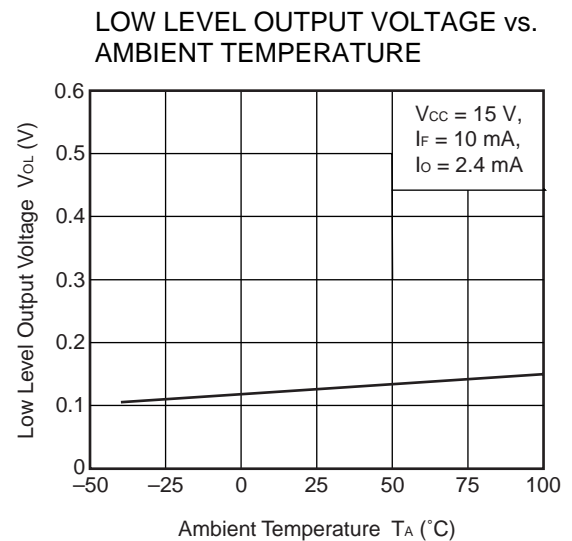
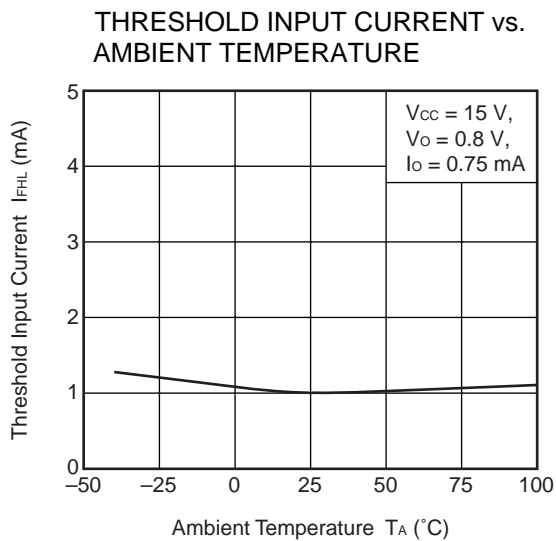
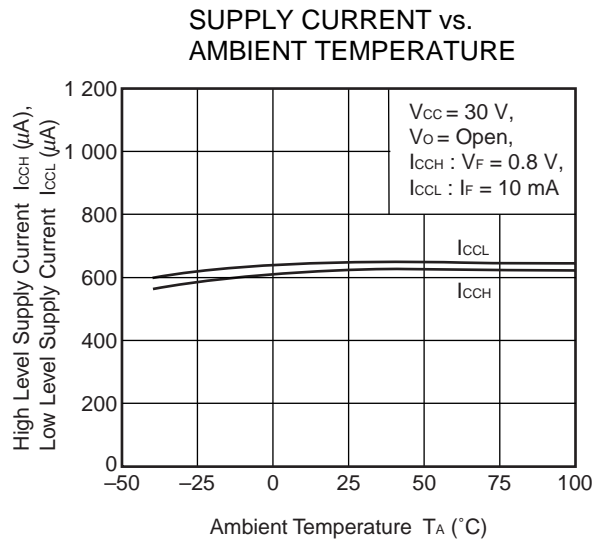
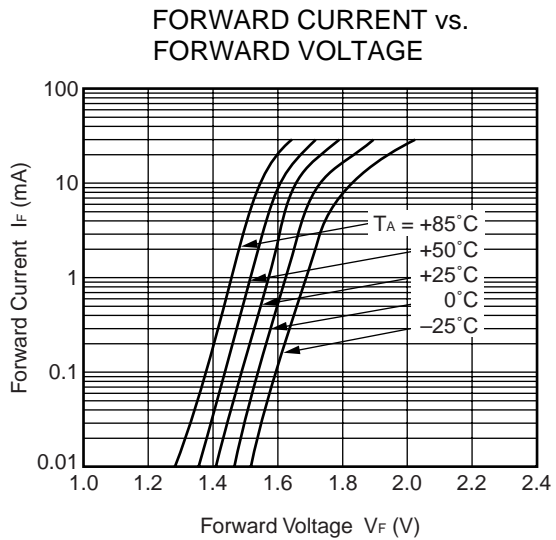
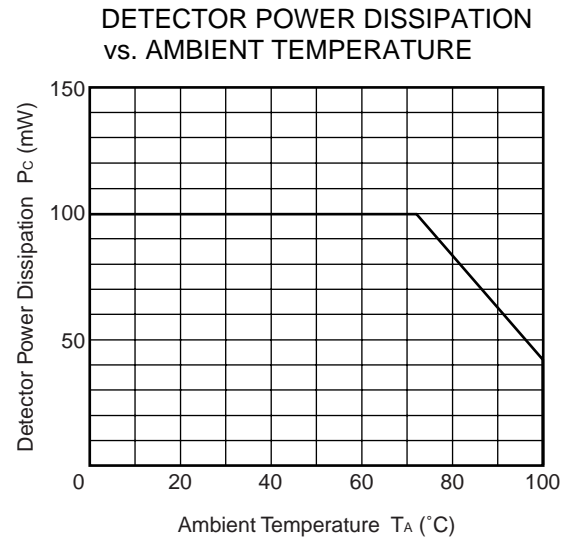
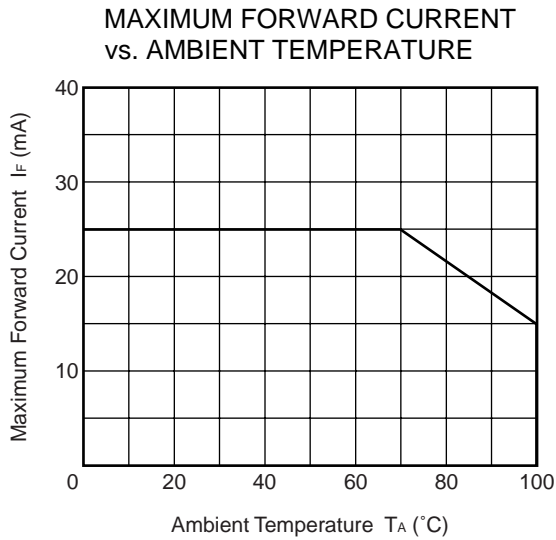


$C_L$  includes probe and stray wiring capacitance.

**USAGE CAUTIONS**

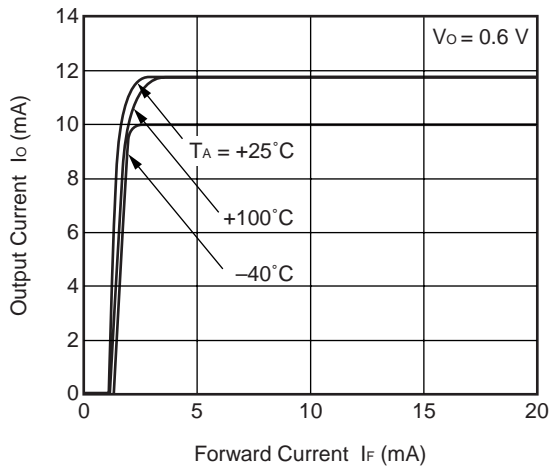
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of  $0.1 \mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler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

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

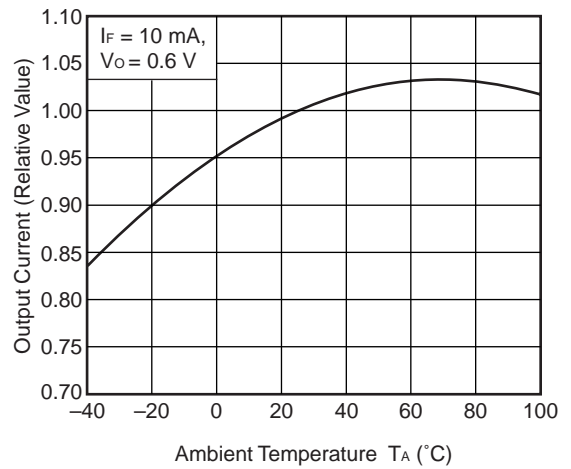


**Remark** The graphs indicate nominal characteristics.

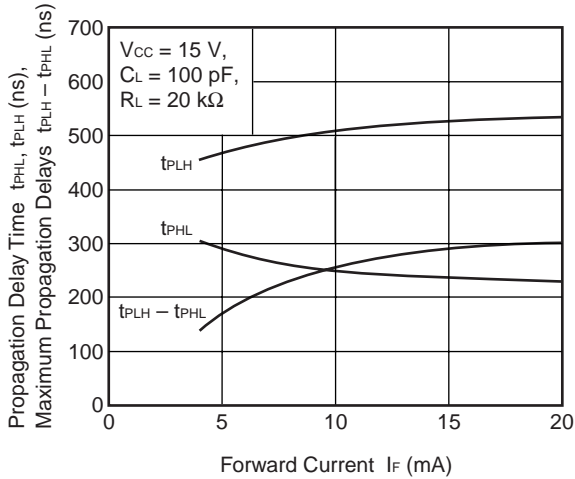
OUTPUT CURRENT vs. FORWARD CURRENT



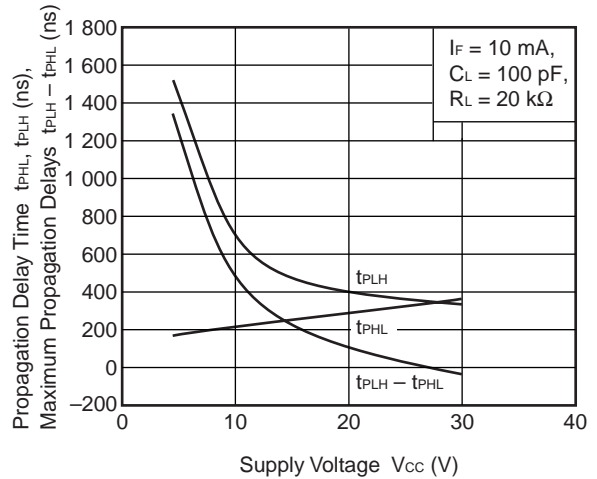
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



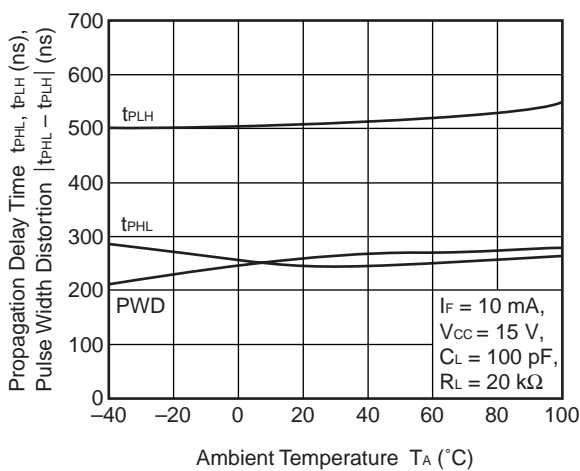
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



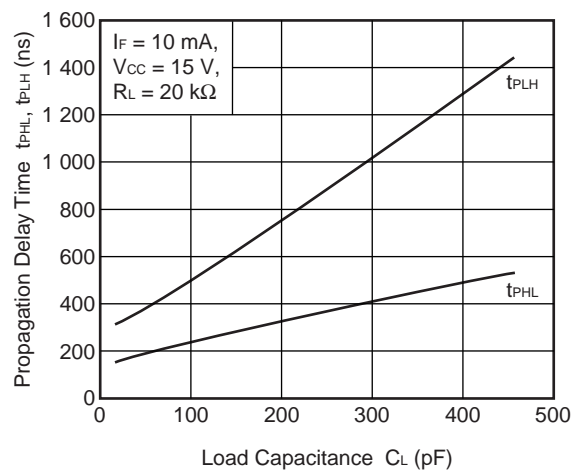
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



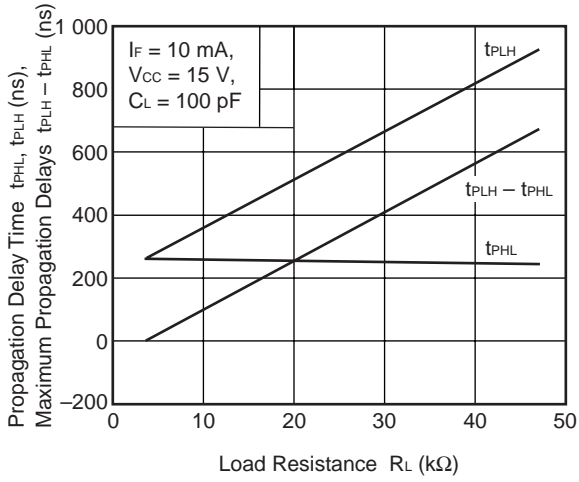
PROPAGATION DELAY TIME vs. LOAD CAPACITANCE



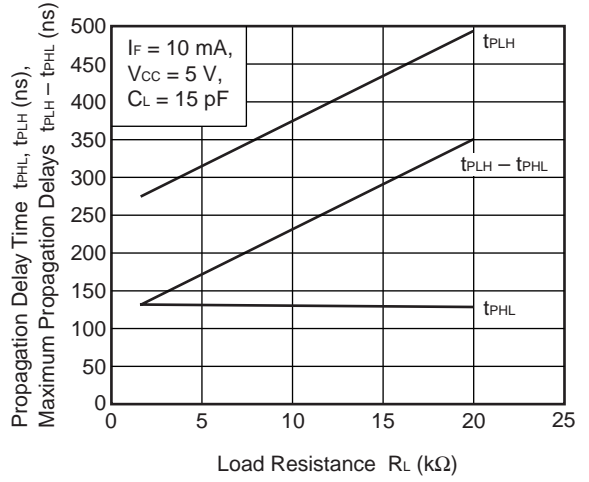
**Remark** The graphs indicate nominal characteristics.



PROPAGATION DELAY TIME,  
MAXIMUM PROPAGATION DELAYS  
vs. LOAD RESISTANCE



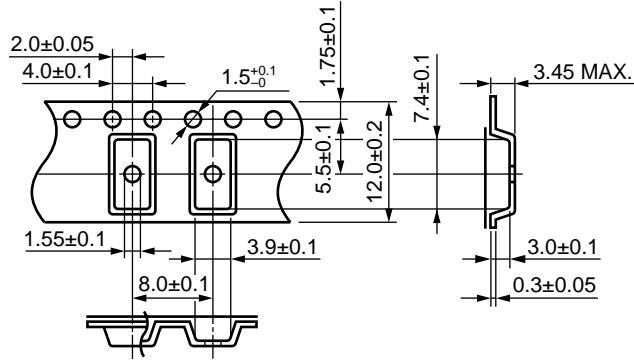
PROPAGATION DELAY TIME,  
MAXIMUM PROPAGATION DELAYS  
vs. LOAD RESISTANCE



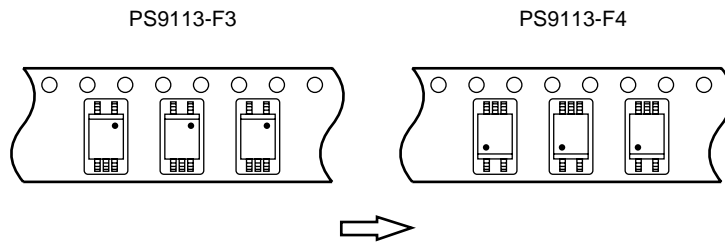
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

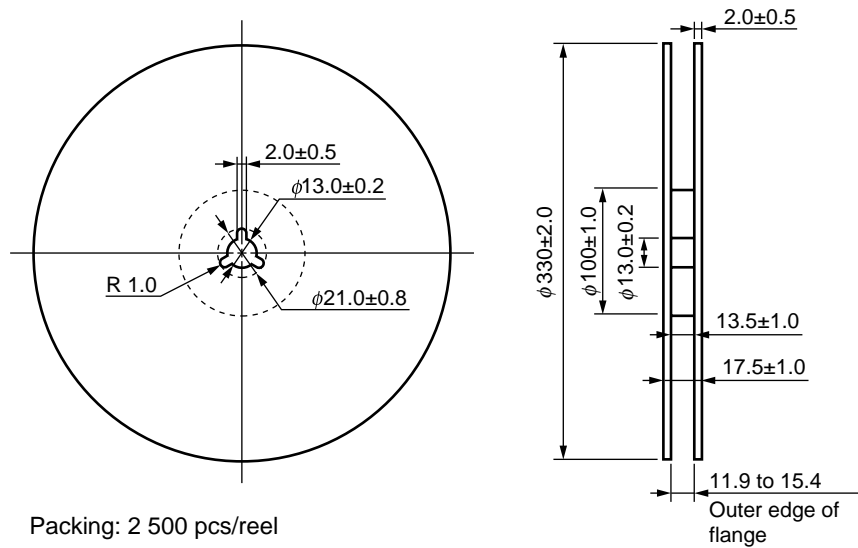
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



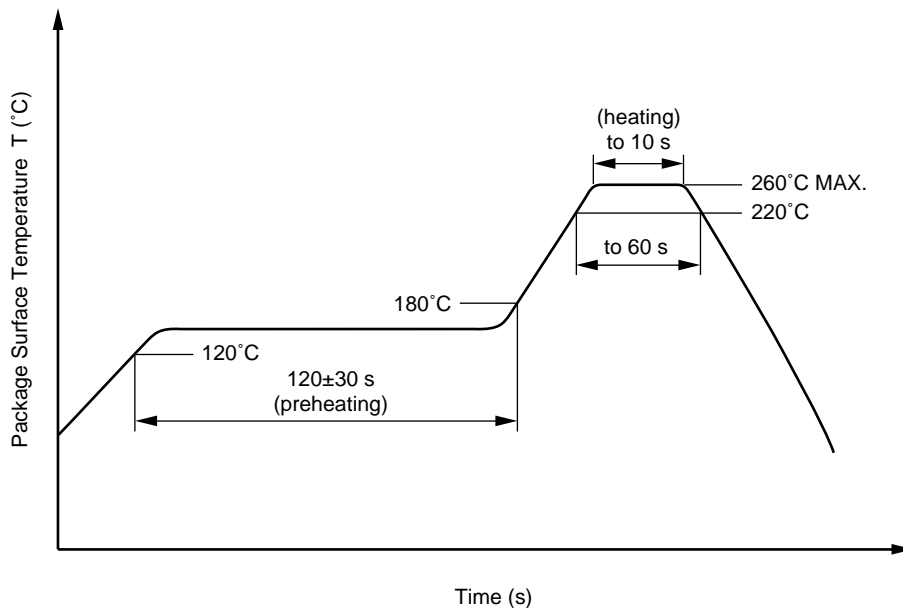
**NOTES ON HANDLING**

**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.

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M8E 00.4-0110

<p><b>Caution</b></p>	<p>GaAs Products</p>	<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.               <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> </li> <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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► For further information, please contact

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