

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

-NEPOC Series-

DESCRIPTION

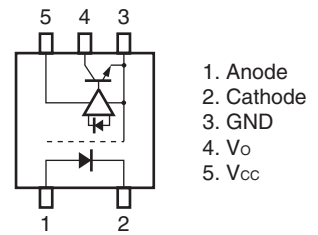
The PS9113 is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

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)

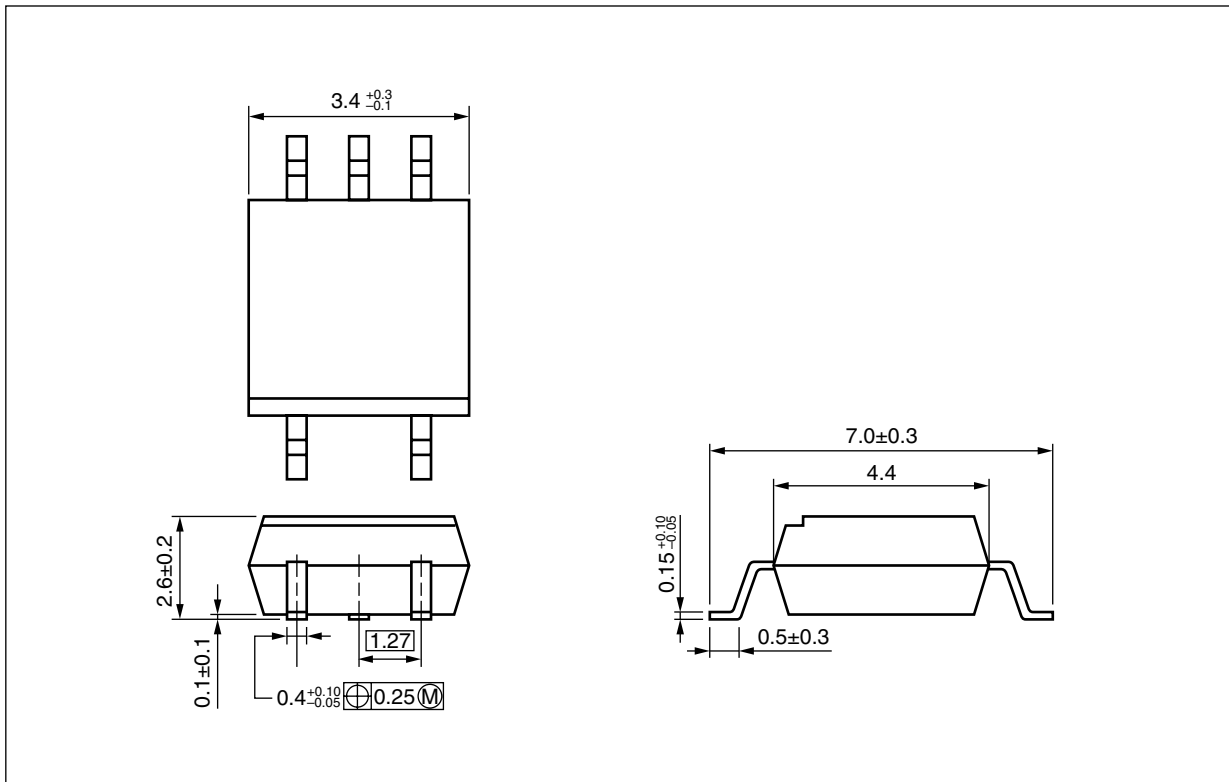
PIN CONNECTION
(Top View)

**APPLICATIONS**

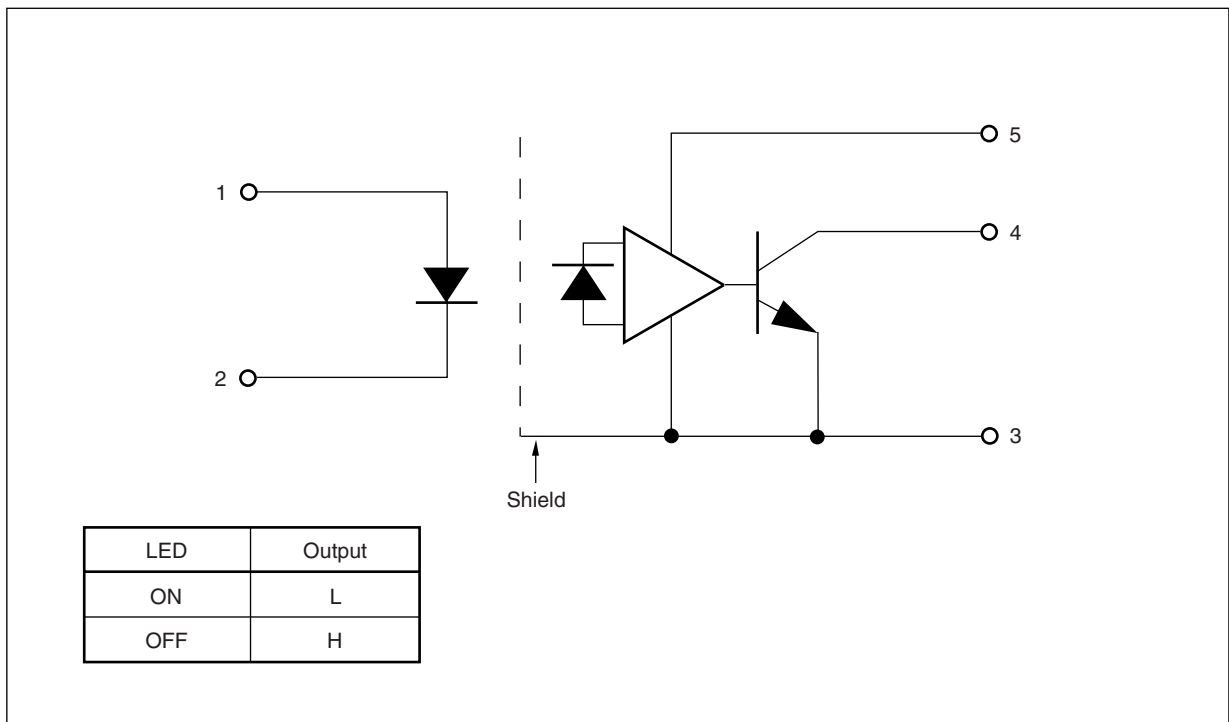
- IPM Driver
- General purpose inverter

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

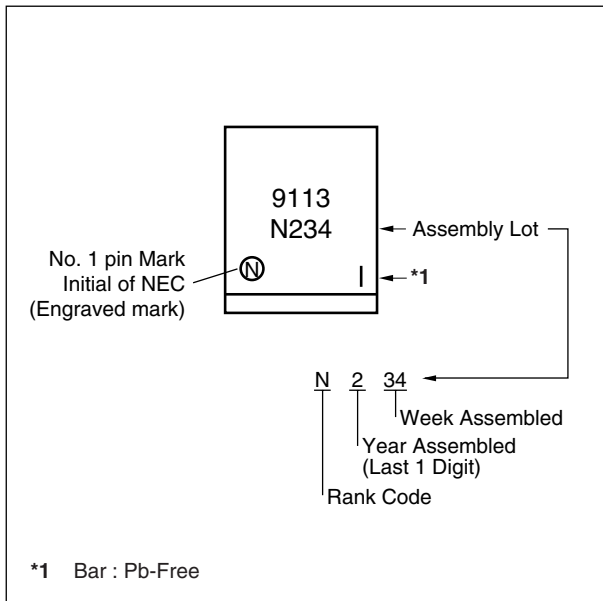
PACKAGE DIMENSIONS (UNIT: mm)



FUNCTIONAL DIAGRAM



MARKING EXAMPLE



★ ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number ¹
PS9113	PS9113-A	Pb-Free	20 pcs (Tape 20 pcs cut)	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		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	
PS9113-V-F3	PS9113-V-F3-A		Embossed Tape 2 500 pcs/reel		
PS9113-V-F4	PS9113-V-F4-A				

*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 ¹	I _F	25	mA
	Reverse Voltage	V _R	5	V
Detector	Supply Voltage	V _{CC}	-0.5 to +35	V
	Output Voltage	V _O	-0.5 to +35	V
	Output Current	I _O	15	mA
	Power Dissipation ²	P _C	100	mW
Isolation Voltage ³		BV	2 500	Vr.m.s.
Operating Ambient Temperature		T _A	-40 to +100	°C
Storage Temperature		T _{stg}	-55 to +125	°C

*1 Reduced to 0.33 mA/°C at T_A = 70°C or more.

*2 Reduced to 1.9 mW/°C at T_A = 70°C or more.

*3 AC voltage for 1 minute at T_A = 25°C, RH = 60% between input and output.

★ Pins 1-2 shorted together, 3-5 shorted together.

RECOMMENDED OPERATING CONDITIONS

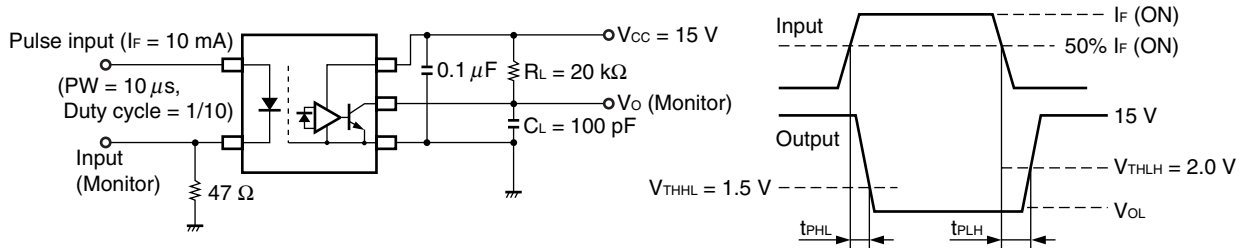
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I _{FH}	10		20	mA
Output Voltage	V _O	0		30	V
Supply Voltage	V _{CC}	4.5		30	V
LED Off Voltage	V _F	0		0.8	V

ELECTRICAL CHARACTERISTICS (T_A = -40 to +100°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	μA
	Terminal Capacitance	C _t	V = 0 V, f = 1 MHz, T _A = 25°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 = 30 V, V _F = 0.8 V		0.01	50	μA
	High Level Supply Current	I _{COH}	V _{CC} = 30 V, V _F = 0.8 V, V _O = open		0.6	1.3	mA
	Low Level Supply Current	I _{COL}	V _{CC} = 30 V, I _F = 10 mA, V _O = open		0.6	1.3	mA
Coupled	Threshold Input Current (H → 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 _{DC} , R _H = 40 to 60%, T _A = 25°C	10 ¹¹			Ω
	Isolation Capacitance	C _{I-O}	V = 0 V, f = 1 MHz, T _A = 25°C		0.6		pF
	Propagation Delay Time (H → L) ²⁾	t _{PHL}	I _F = 10 mA, R _L = 20 kΩ, C _L = 100 pF, V _{THHL} = 1.5 V, V _{THLH} = 2.0 V		250	500	ns
	Propagation Delay Time (L → 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⁾	CM _H		T _A = 25°C, I _F = 0 mA, V _O > 3.0 V, V _{CM} = 1.5 kV, R _L = 20 kΩ, C _L = 100 pF	15		
Common Mode Transient Immunity at Low Level Output ³⁾	CM _L	T _A = 25°C, I _F = 10 mA, V _O < 1.0 V, V _{CM} = 1.5 kV, R _L = 20 kΩ, C _L = 100 pF	15			kV/μs	

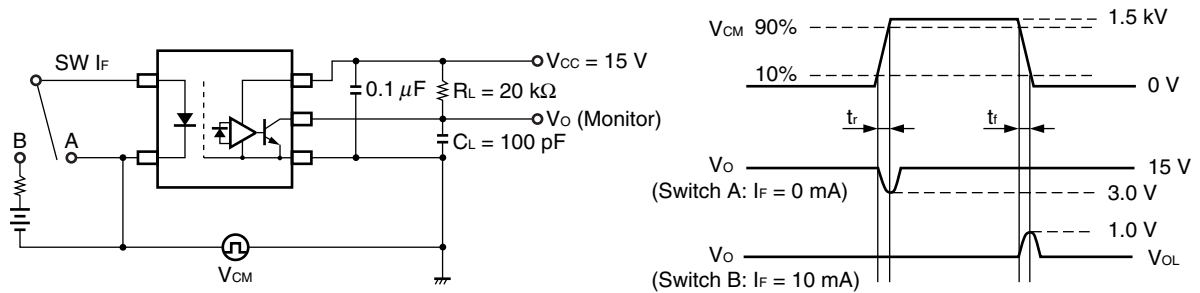
*1 Typical values at $T_A = 25^\circ\text{C}$.

*2 Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

*3 Test circuit for common mode transient immunity

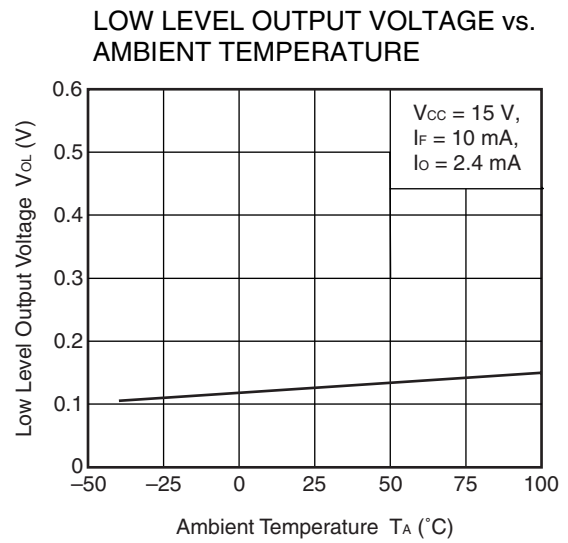
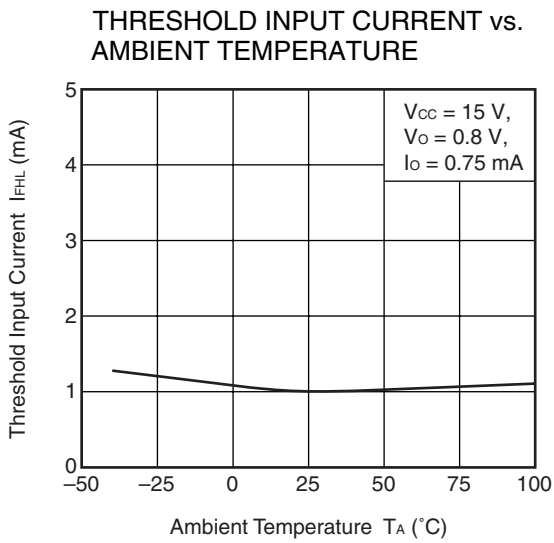
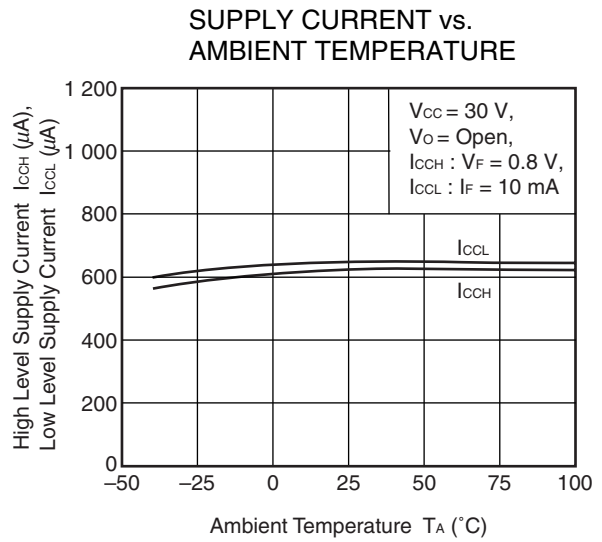
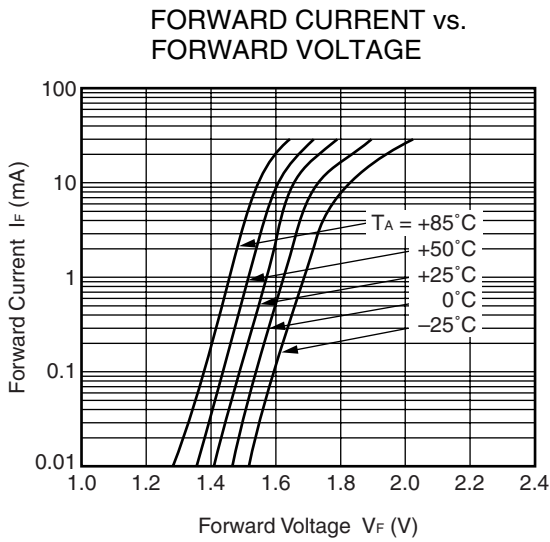
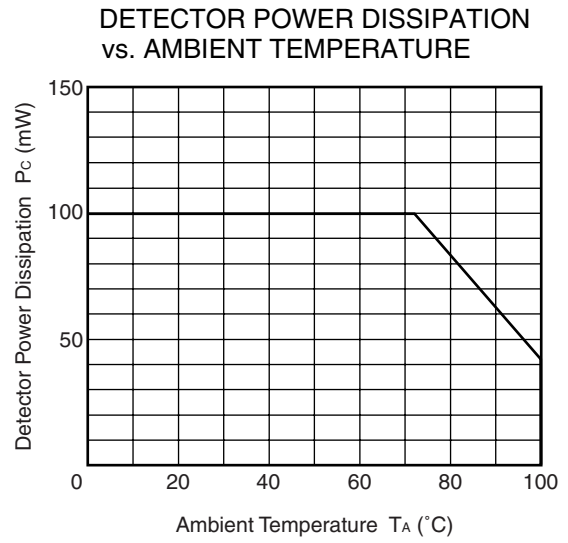
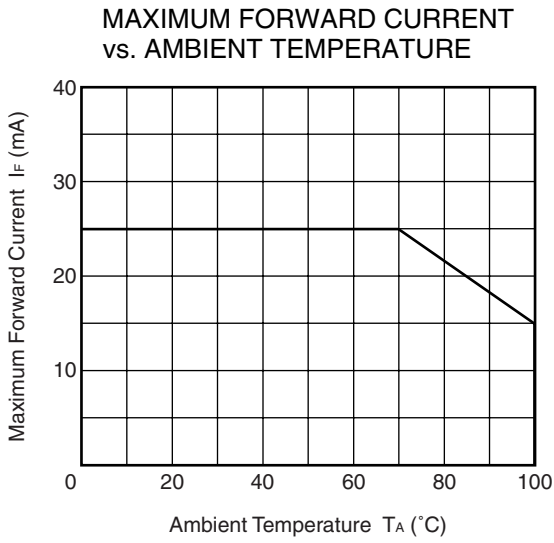


C_L includes probe and stray wiring capacitance.

USAGE CAUTIONS

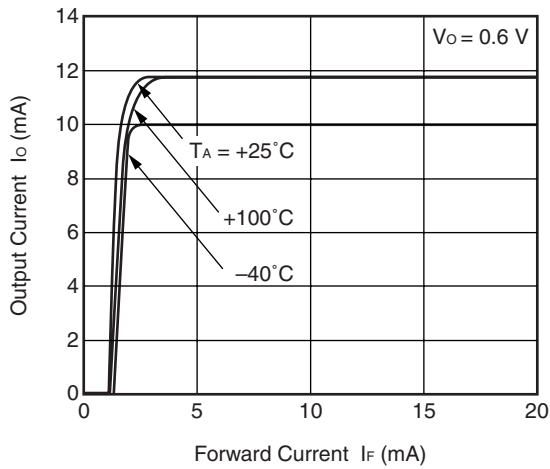
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of $0.1 \mu\text{F}$ is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler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

TYPICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

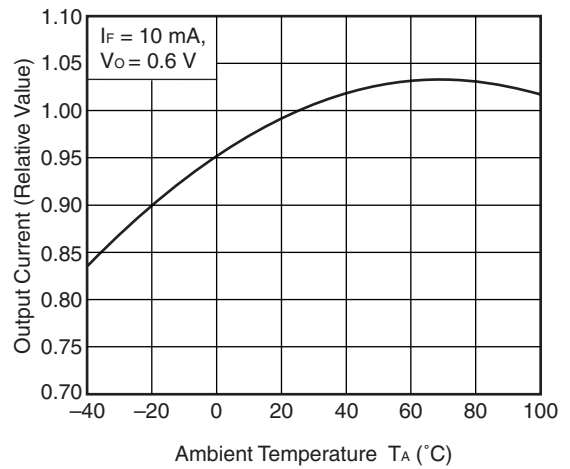


Remark The graphs indicate nominal characteristics.

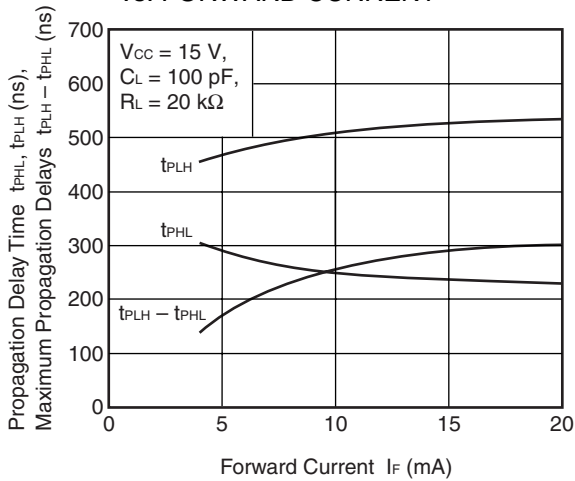
OUTPUT CURRENT vs. FORWARD CURRENT



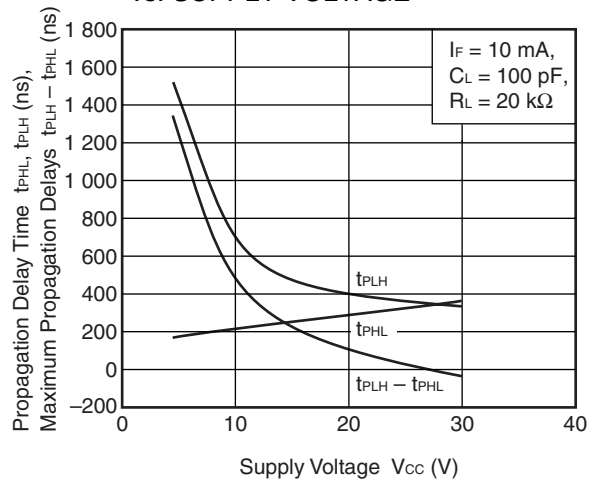
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



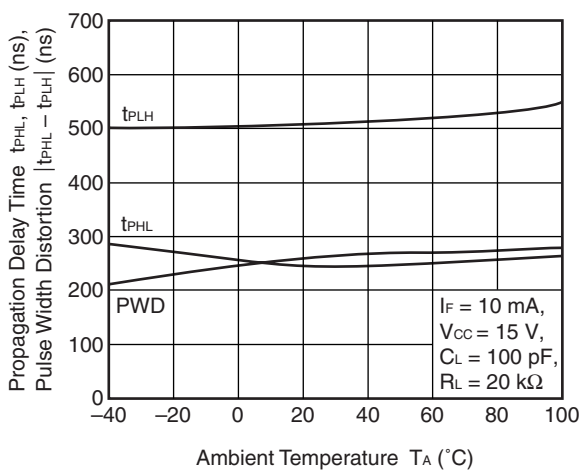
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



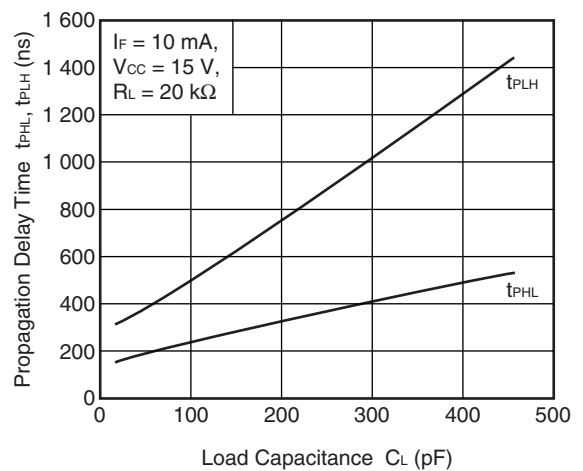
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

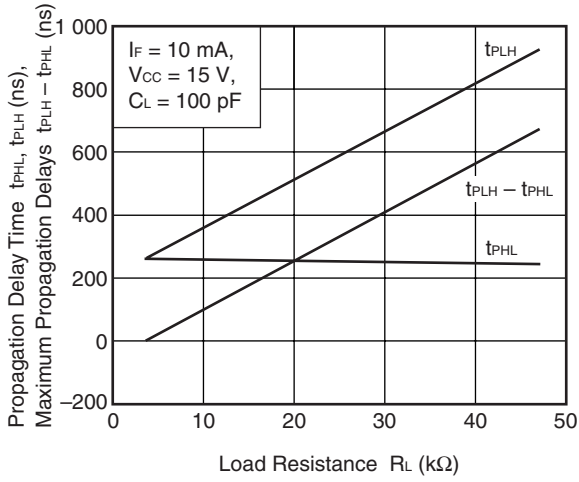


PROPAGATION DELAY TIME vs. LOAD CAPACITANCE

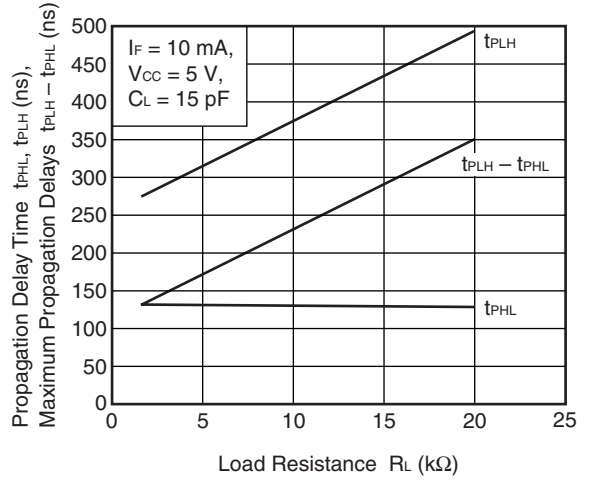


Remark The graphs indicate nominal characteristics.

PROPAGATION DELAY TIME,
MAXIMUM PROPAGATION DELAYS
vs. LOAD RESISTANCE



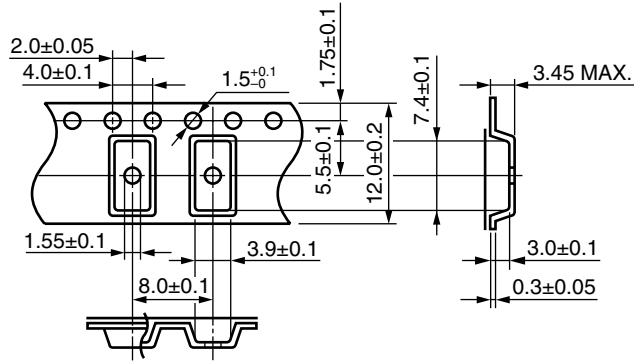
PROPAGATION DELAY TIME,
MAXIMUM PROPAGATION DELAYS
vs. LOAD RESISTANCE



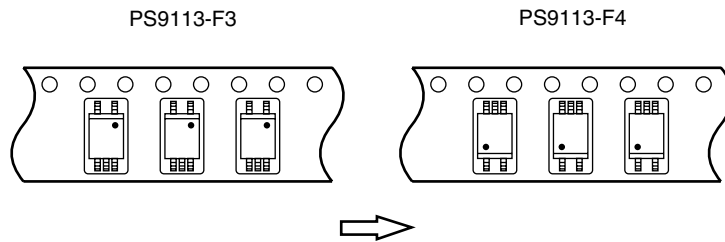
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

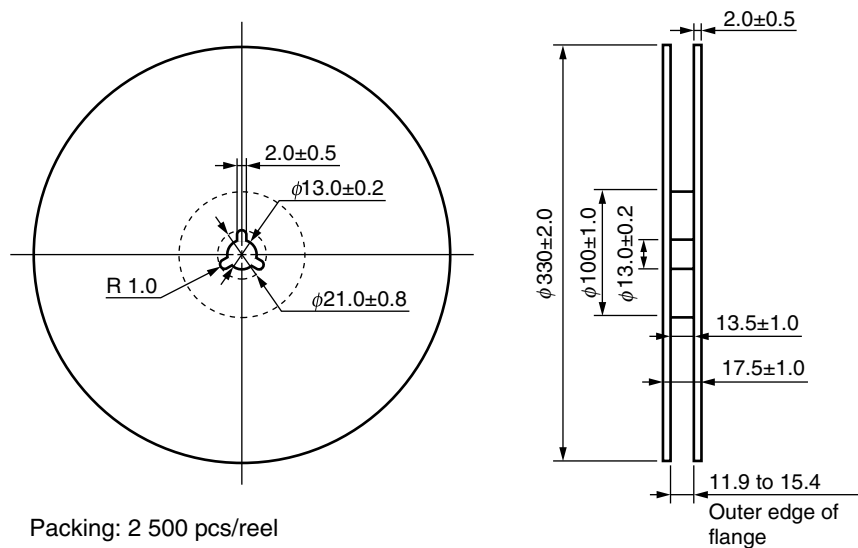
Outline and Dimensions (Tape)



Tape Direction



Outline and Dimensions (Reel)



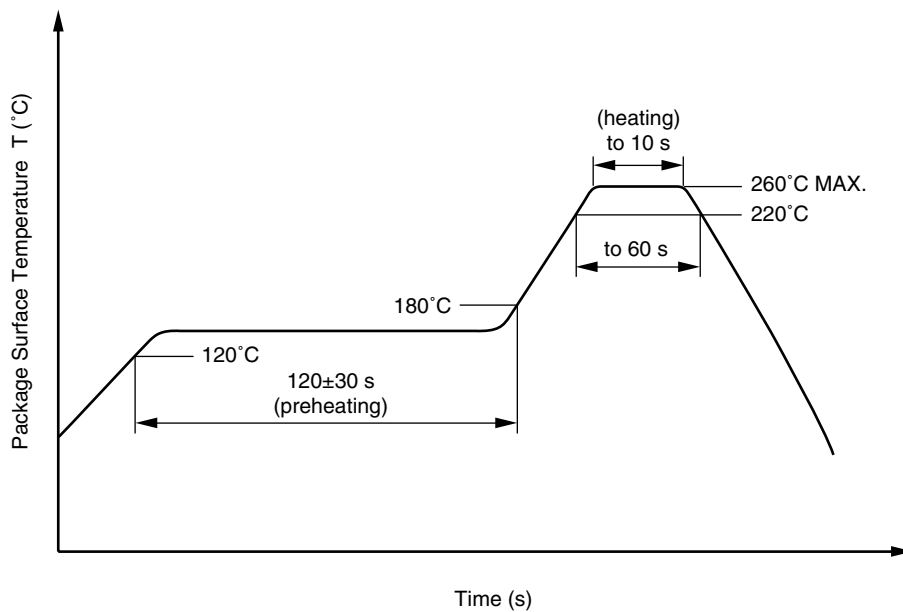
NOTES ON HANDLING

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.

When the product(s) listed in this document is subject to any applicable import or export control laws and regulation of the authority having competent jurisdiction, such product(s) shall not be imported or exported without obtaining the import or export license.

- **The information in this document is current as of August, 2005. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
 - No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
 - NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
 - Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
 - While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
 - NEC semiconductor products are classified into the following three quality grades:
 "Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.
 "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots
 "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
 "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.
- The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.
- (Note)
- (1) "NEC" as used in this statement means NEC Corporation, NEC Compound Semiconductor Devices, Ltd. and also includes its majority-owned subsidiaries.
 - (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).
- M8E 00.4-0110

<p>Caution</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"> • 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"> 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.
-----------------------	----------------------	---

► For further information, please contact

NEC Compound Semiconductor Devices, Ltd. <http://www.ncsd.necel.com/>

E-mail: salesinfo@ml.ncsd.necel.com (sales and general)

techinfo@ml.ncsd.necel.com (technical)

Sales Division TEL: +81-44-435-1573 FAX: +81-44-435-1579

NEC Compound Semiconductor Devices Hong Kong Limited

E-mail: ncsd-hk@elhk.nec.com.hk (sales, technical and general)

Hong Kong Head Office TEL: +852-3107-7303 FAX: +852-3107-7309

Taipei Branch Office TEL: +886-2-8712-0478 FAX: +886-2-2545-3859

Korea Branch Office TEL: +82-2-558-2120 FAX: +82-2-558-5209

NEC Electronics (Europe) GmbH <http://www.ee.nec.de/>

TEL: +49-211-6503-0 FAX: +49-211-6503-1327

California Eastern Laboratories, Inc. <http://www.cel.com/>

TEL: +1-408-988-3500 FAX: +1-408-988-0279