

## HIGH CMR, 10 Mbps TOTEM POLE OUTPUT TYPE 5-PIN SOP (SO-5) PHOTOCOUPLER

–NEPOC Series–

### DESCRIPTION

The PS9115 is an optically coupled high-speed, totem pole output isolator containing a GaAlAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

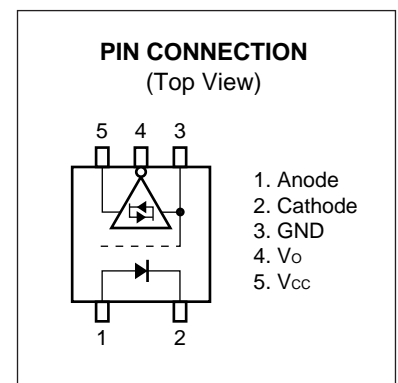
The PS9115 is specified high CMR, high CTR and pulse width distortion with operating temperature.

### FEATURES

- High common mode transient immunity ( $CM_H, CM_L = \pm 20 \text{ kV}/\mu\text{s}$  TYP.)
- Small package (SO-5)
- Pulse width distortion ( $|t_{PHL} - t_{PLH}| = 7 \text{ ns}$  TYP.)
- High-speed (10 Mbps)
- High isolation voltage ( $BV = 3\,750 \text{ Vr.m.s.}$ )
- Totem pole output
- Ordering number of taping product: PS9115-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

- Measurement equipment
- PDP
- Line Receiver for FA Network

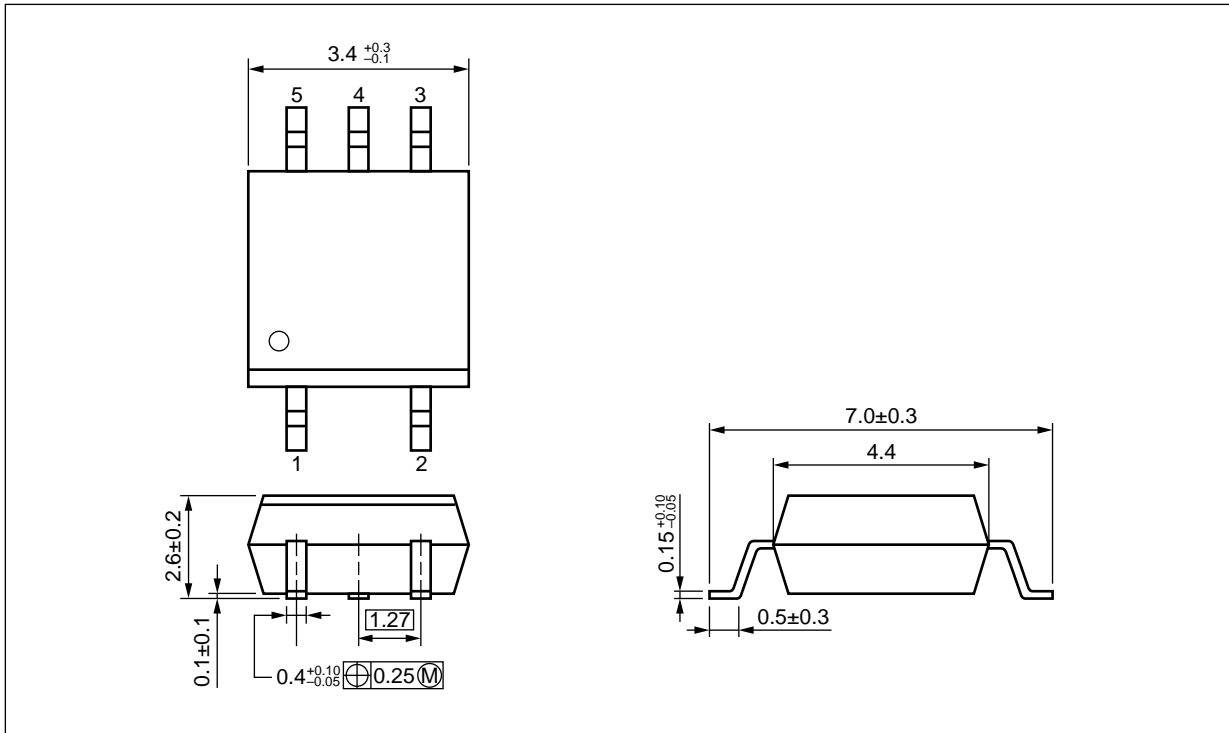


### TRUTH TABLE

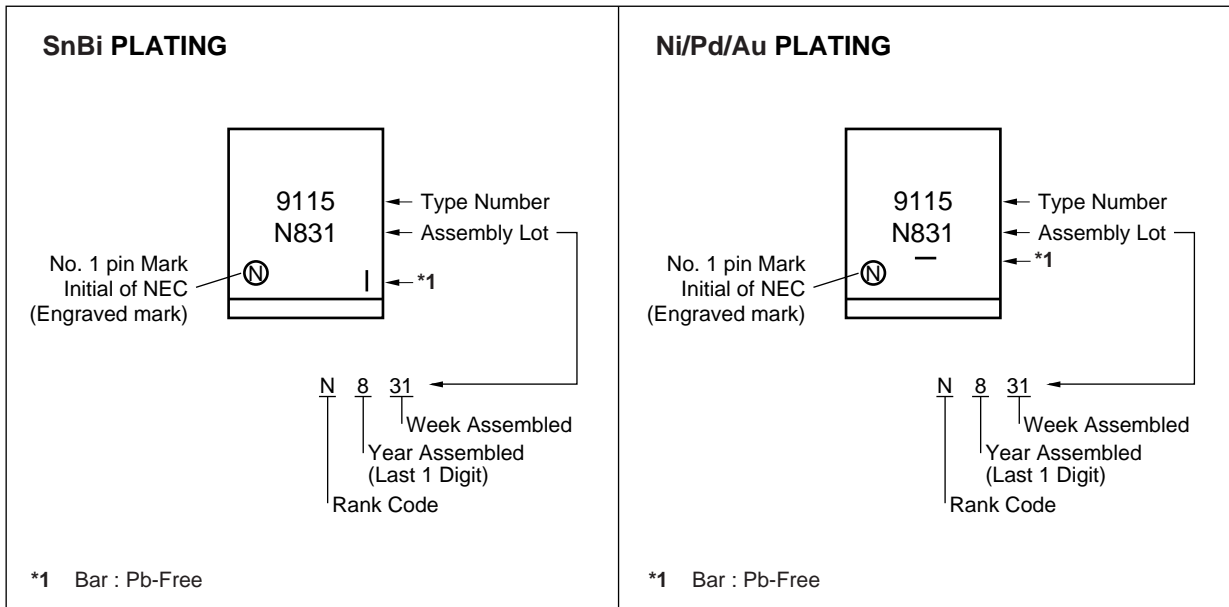
LED	Output
ON	L
OFF	H

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<R> PACKAGE DIMENSIONS (UNIT: mm)



<R> MARKING EXAMPLE



<R> **ORDERING INFORMATION**

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number <sup>*1</sup>
PS9115	PS9115-A	Pb-Free (SnBi)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)	PS9115
PS9115-F3	PS9115-F3-A		Embossed Tape 2 500 pcs/reel		
PS9115-F4	PS9115-F4-A				
PS9115-V	PS9115-V-A		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	
PS9115-V-F3	PS9115-V-F3-A		Embossed Tape 2 500 pcs/reel		
PS9115-V-F4	PS9115-V-F4-A				
PS9115	PS9115-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)	PS9115
PS9115-F3	PS9115-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9115-F4	PS9115-F4-AX				
PS9115-V	PS9115-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) Approved (Option)	
PS9115-V-F3	PS9115-V-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9115-V-F4	PS9115-V-F4-AX				

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

**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>	30	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	7	V
	Output Voltage	V <sub>O</sub>	7	V
	High Level Output Current	I <sub>OH</sub>	-5	mA
	Low Level Output Current	I <sub>OL</sub>	13	mA
	Power Dissipation <sup>*2</sup>	P <sub>C</sub>	130	mW
Isolation Voltage <sup>*3</sup>		BV	3 750	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +85	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

\*1 Reduced to 0.3 mA/°C at T<sub>A</sub> = 25°C or more.

\*2 T<sub>A</sub> = -40 to +85°C, Applies to output pin V<sub>O</sub> and power supply pin V<sub>CC</sub>. Reduced to 2.36 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, 3-5 shorted together.

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I <sub>FH</sub>	7.5		12.5	mA
Low Level Input Voltage	V <sub>FL</sub>	0		0.8	V
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
TTL (loads)	N			3	
Operating Ambient Temperature	T <sub>A</sub>	0		+85	°C

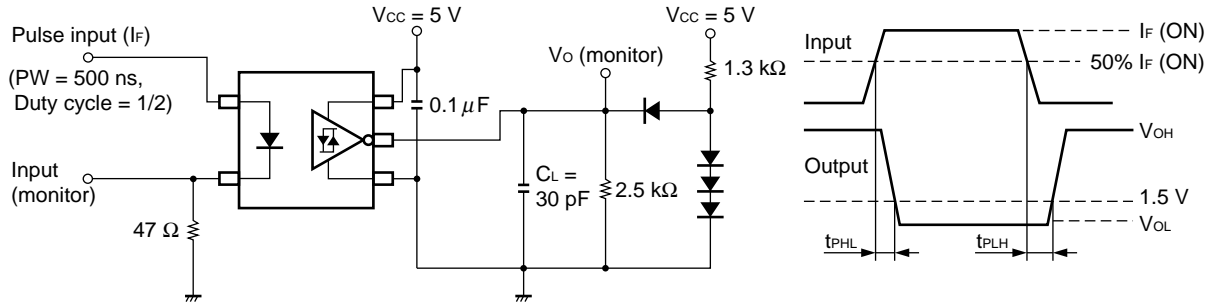
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 0 to +85°C, unless otherwise specified)**

Parameter		Symbol	Conditions	MIN.	TYP. <sup>*1</sup>	MAX.	Unit	
Diode	Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 10 mA, T <sub>A</sub> = 25°C	1.4	1.65	1.9	V	
	Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 3 V, T <sub>A</sub> = 25°C			10	μA	
	Terminal Capacitance	C <sub>t</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		30		pF	
Detector	High Level Output Current <sup>*2</sup>	I <sub>OH</sub>	V <sub>CC</sub> = V <sub>O</sub> = 5.5 V, V <sub>F</sub> = 0.8 V		0.003	200	μA	
	High Level Output Voltage	V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, V <sub>F</sub> = 0.8 V, I <sub>OH</sub> = -2 mA	2.4	3.0		V	
	Low Level Output Voltage	V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>F</sub> = 7 mA, I <sub>OL</sub> = 8 mA		0.25	0.6	V	
	High Level Supply Current	I <sub>CC</sub> H	V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 0 mA, V <sub>O</sub> = open		12	16	mA	
	Low Level Supply Current	I <sub>CC</sub> L	V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 10 mA, V <sub>O</sub> = open		13	16	mA	
	High Level Output Short Circuit Current	I <sub>OSH</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = GND, I <sub>F</sub> = 0 mA, 10 ms or less		-26		mA	
	Low Level Output Short Circuit Current	I <sub>OSL</sub>	V <sub>CC</sub> = V <sub>O</sub> = 5.5 V, I <sub>F</sub> = 8 mA, 10 ms or less		34		mA	
Coupled	Threshold Input Current (H → L)	I <sub>FHL</sub>	T <sub>A</sub> = 25°C		2.3	5	mA	
			V <sub>CC</sub> = 5 V, V <sub>O</sub> = 0.6 V			6		
	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>*3</sup>	t <sub>PHL</sub>	V <sub>CC</sub> = 5 V, I <sub>F</sub> = 7.5 mA	T <sub>A</sub> = 25°C	15	33	65	ns
					10		85	
	Propagation Delay Time (L → H) <sup>*3</sup>	t <sub>PLH</sub>	V <sub>CC</sub> = 5 V, I <sub>F</sub> = 7.5 mA	T <sub>A</sub> = 25°C	15	40	65	ns
					10		85	
Pulse Width Distortion (PWD) <sup>*3</sup>	t <sub>PHL</sub> -t <sub>PLH</sub>	V <sub>CC</sub> = 5 V, I <sub>F</sub> = 7.5 mA		7	50	ns		
Common Mode Transient Immunity at High Level Output <sup>*4</sup>	CM <sub>H</sub>	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 0 mA, V <sub>O(MIN.)</sub> = 2 V, V <sub>CM</sub> = 1 kV	10	20		kV/μs		
Common Mode Transient Immunity at Low Level Output <sup>*4</sup>	CM <sub>L</sub>	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 7.5 mA, V <sub>O(MAX.)</sub> = 0.8 V, V <sub>CM</sub> = 1 kV	10	20		kV/μs		

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

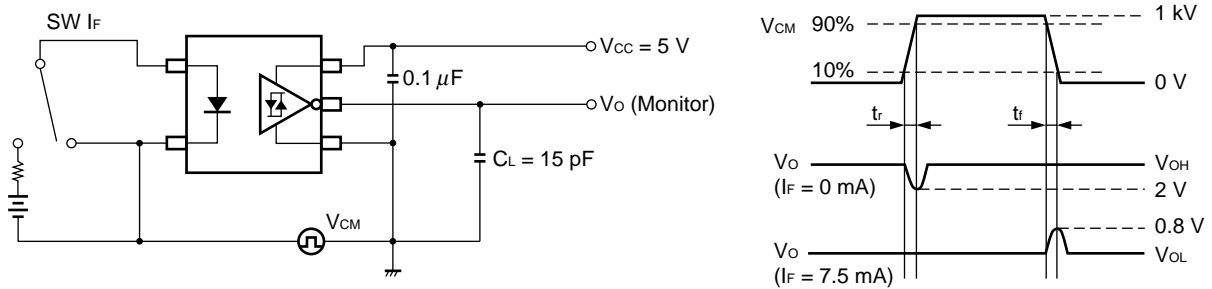
\*2 Because a high-level output current ( $I_{OH}$ ) of  $300\ \mu\text{A}$  or more may be output when the temperature is  $0^\circ\text{C}$  or less and when  $V_{CC}$  is around 3 to 4 V, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

\*3 Test circuit for propagation delay time



$C_L$  includes probe and stray wiring capacitance.

\*4 Test circuit for common mode transient immunity

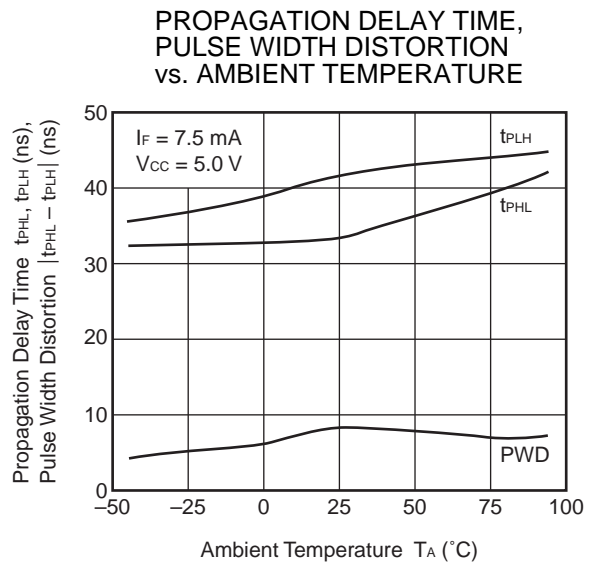
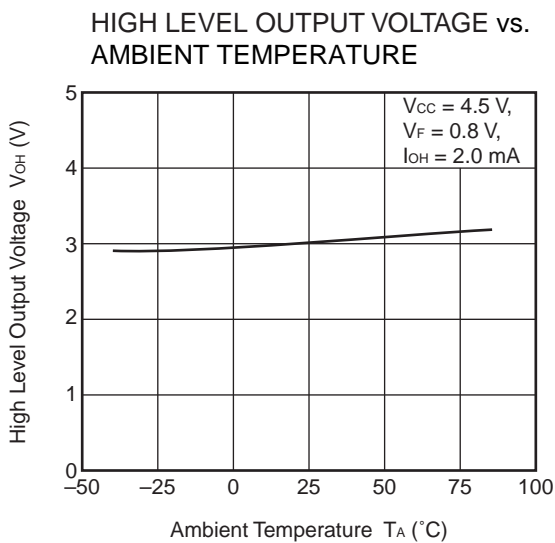
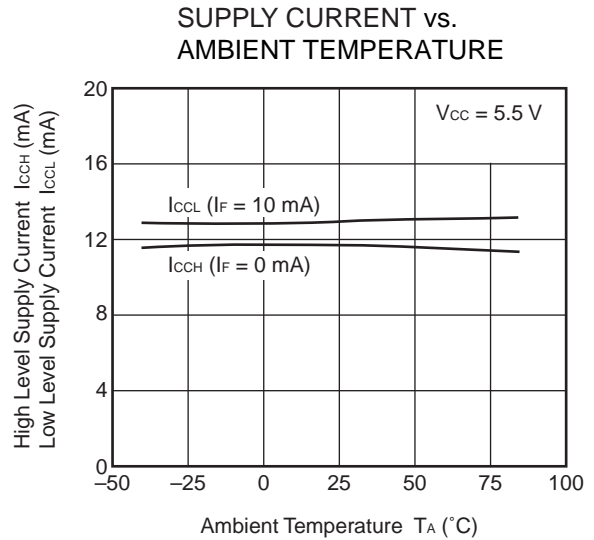
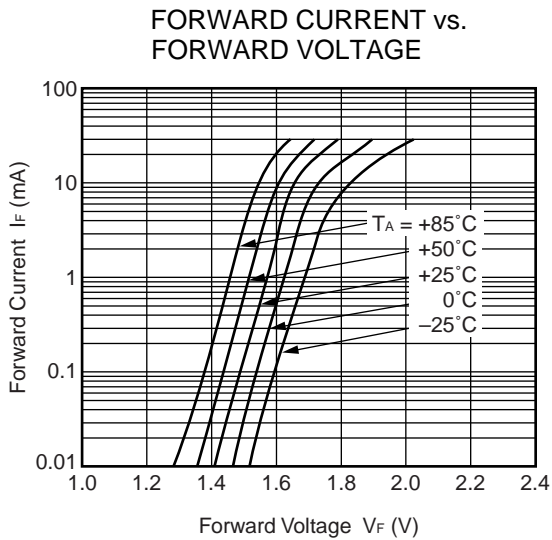
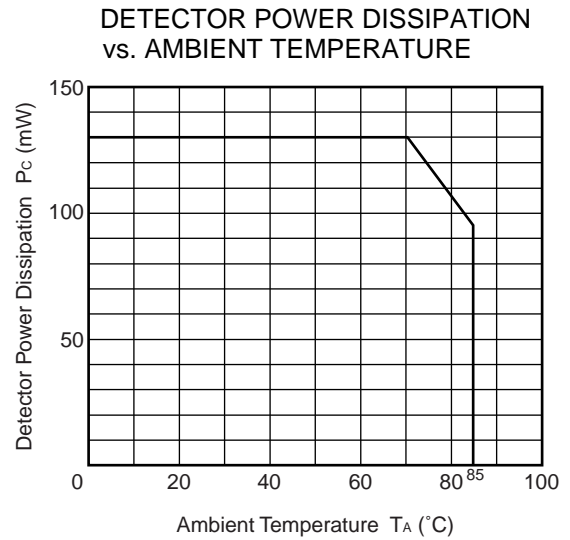
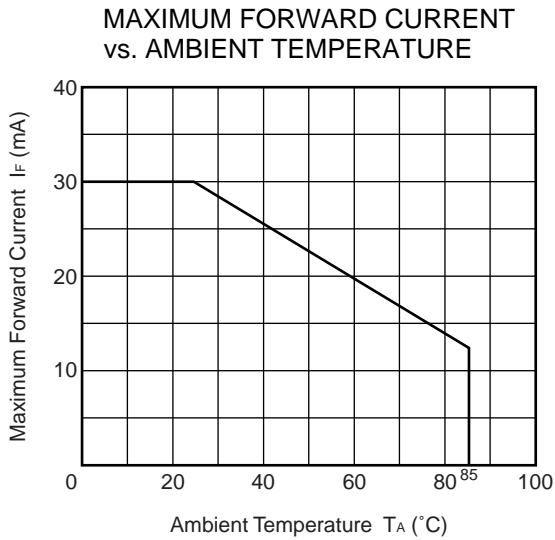


$C_L$  includes probe and stray wiring capacitance.

**USAGE CAUTIONS**

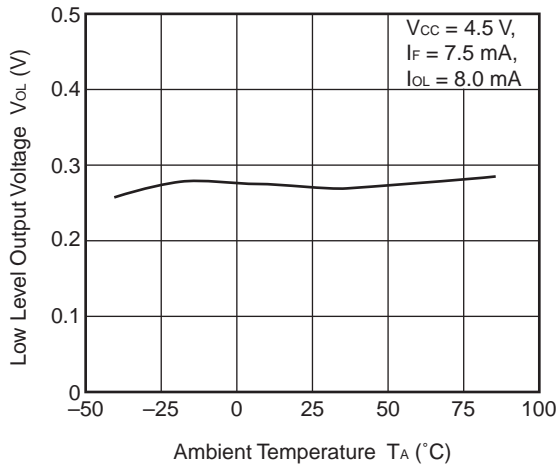
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of  $0.1\ \mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler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

**TYPICAL CHARACTERISTICS (TA = 25°C, unless otherwise specified)**

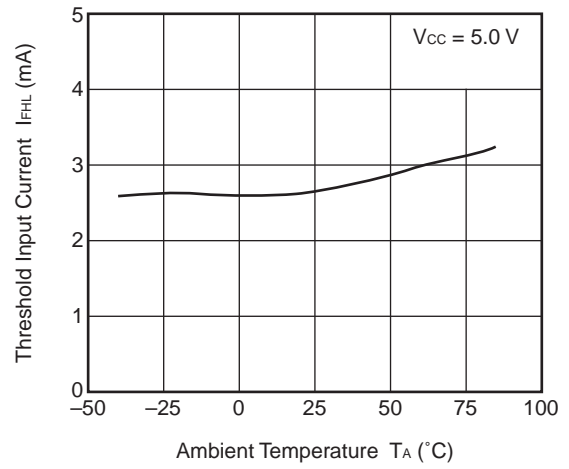


**Remark** The graphs indicate nominal characteristics.

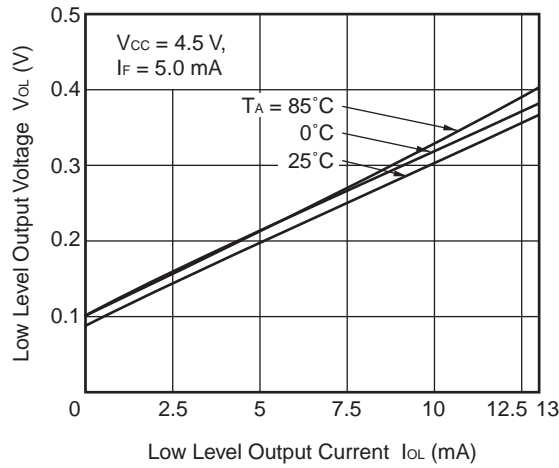
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



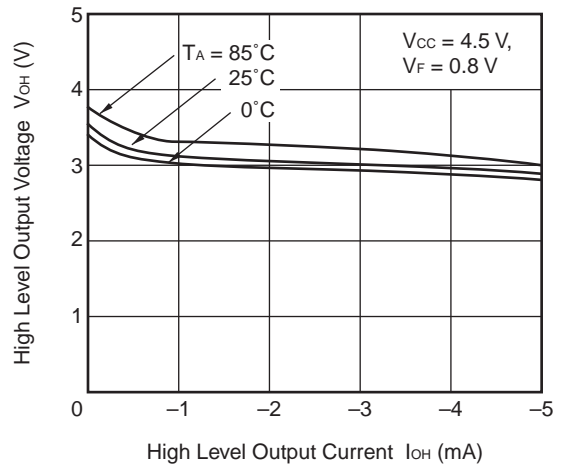
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



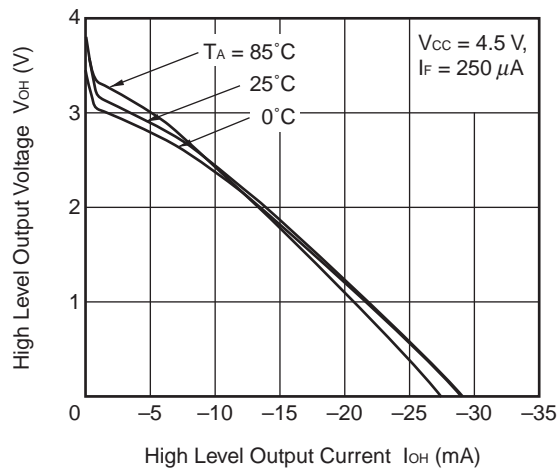
LOW LEVEL OUTPUT VOLTAGE vs. LOW LEVEL OUTPUT CURRENT



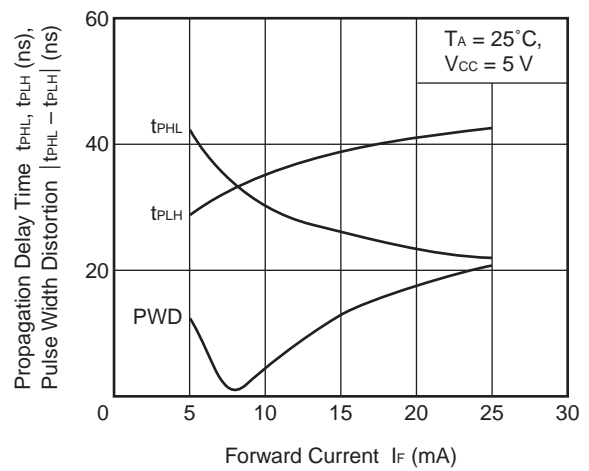
HIGH LEVEL OUTPUT VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



HIGH LEVEL OUTPUT VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



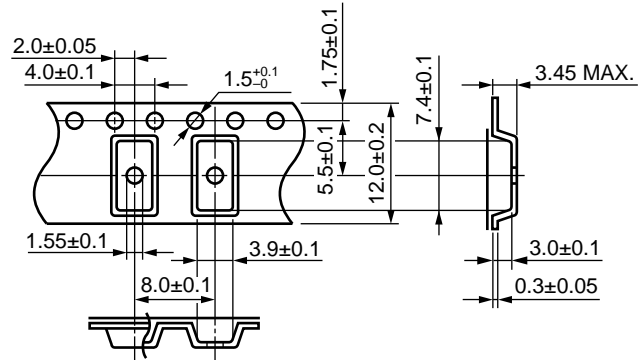
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



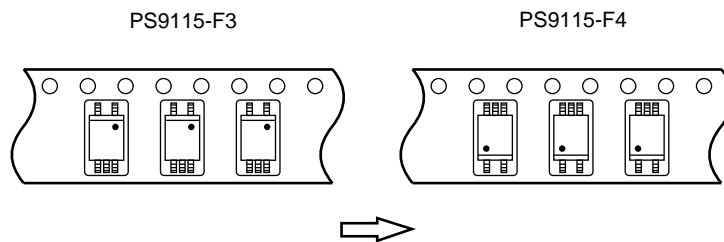
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

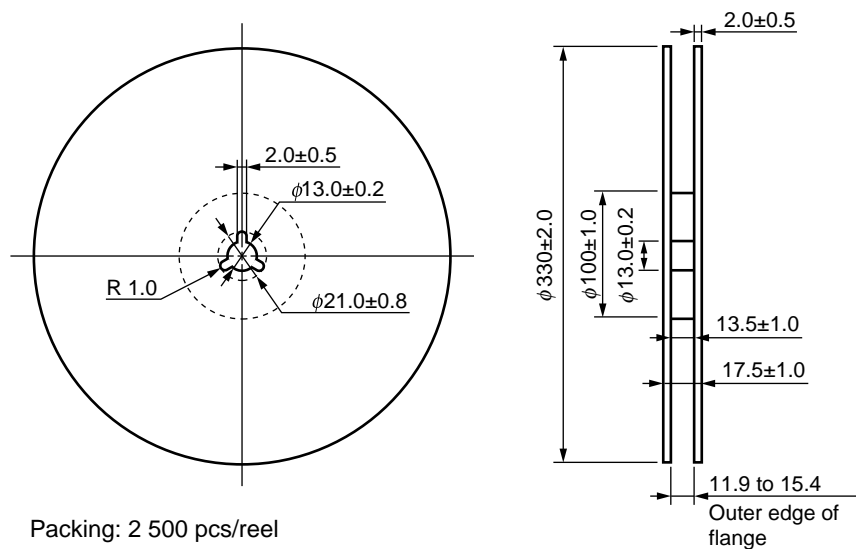
Outline and Dimensions (Tape)



Tape Direction

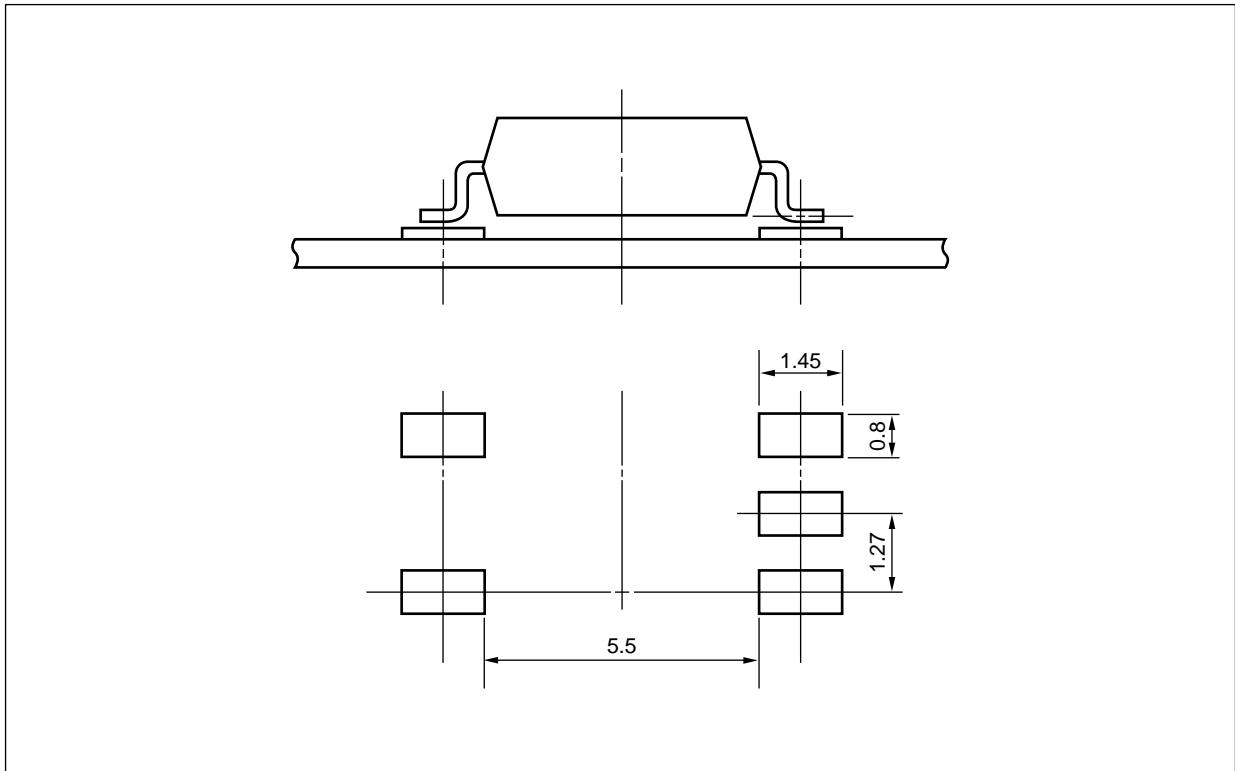


Outline and Dimensions (Reel)





<R> RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



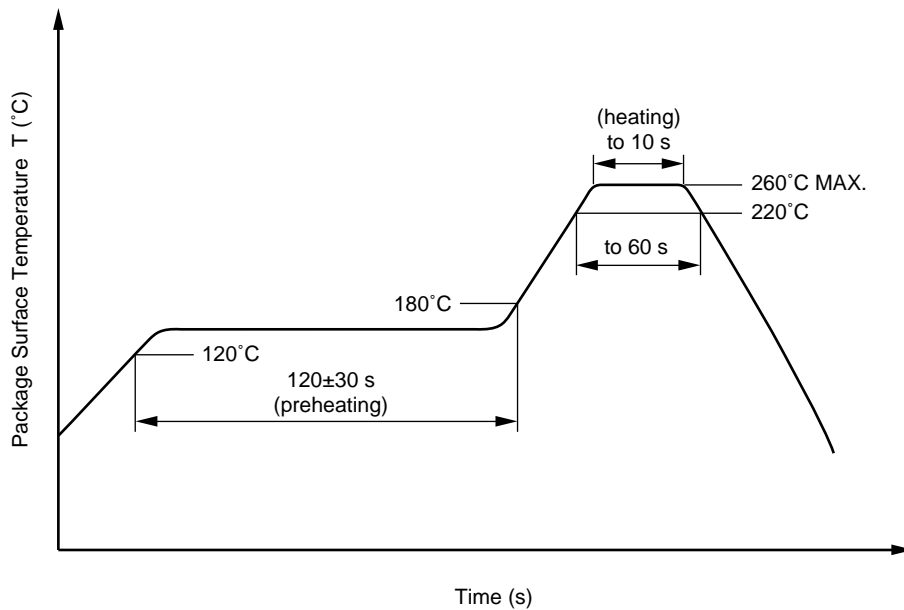
**NOTES ON HANDLING**

**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.

<R> **SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

Parameter	Symbol	Speck	Unit
Application classification (DIN EN 60664-1 VDE0110 Part 1) for rated line voltages ≤ 300 Vr.m.s. for rated line voltages ≤ 600 Vr.m.s.		IV III	
Climatic test class (DIN EN 60664-1 VDE0110)		40/85/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.5 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{IORM}$ $U_{pr}$	707 1 061	$V_{peak}$ $V_{peak}$
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 VDE0110 Part 1)		2	
Clearance distance		>4.2	mm
Creepage distance		>4.2	mm
Comparative tracking index (DIN IEC 112/VDE 0303 Part 1)	CTI	175	
Material group (DIN EN 60664-1 VDE0110 Part 1)		III a	
Storage temperature range	$T_{stg}$	-55 to +125	°C
Operating temperature range	$T_A$	-40 to +85	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$	Ris MIN. Ris MIN.	$10^{12}$ $10^{11}$	$\Omega$ $\Omega$
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current $I_F$ , $\Psi_i = 0$ ) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	$T_{si}$ $I_{si}$ $\Psi_{si}$ Ris MIN.	150 200 300 $10^9$	°C mA mW $\Omega$

- **The information in this document is current as of March, 2008. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.**
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<p><b>Caution</b> 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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