

**HIGH CMR, 15 Mbps OPEN COLLECTOR OUTPUT TYPE
5-PIN SOP (SO-5) 3.3 V PHOTOCOUPLED**

-NEPOC Series-

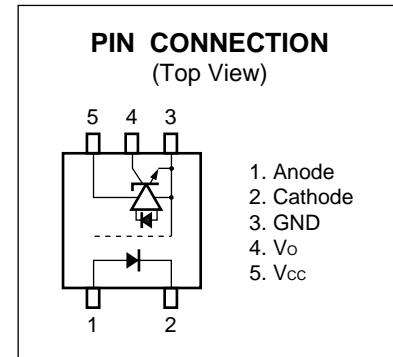
DESCRIPTION

The PS9121 is an optically coupled high-speed, active low type 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 PS9121 is designed specifically for high common mode transient immunity (CMR) and low pulse width distortion. The PS9121 is suitable for high density application.

FEATURES

- Low power consumption ($V_{CC} = 3.3$ V)
- Pulse width distortion ($|t_{PHL} - t_{PLH}| = 35$ ns MAX.)
- High common mode transient immunity ($CM_H, CM_L = \pm 15$ kV/ μ s MIN.)
- Small package (SO-5)
- High-speed (15 Mbps)
- High isolation voltage ($BV = 3750$ Vr.m.s.)
- Open collector output
- Ordering number of taping product: PS9121-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)
 - CSA approved: File No. 2115283 (CA 101391)

**TRUTH TABLE**

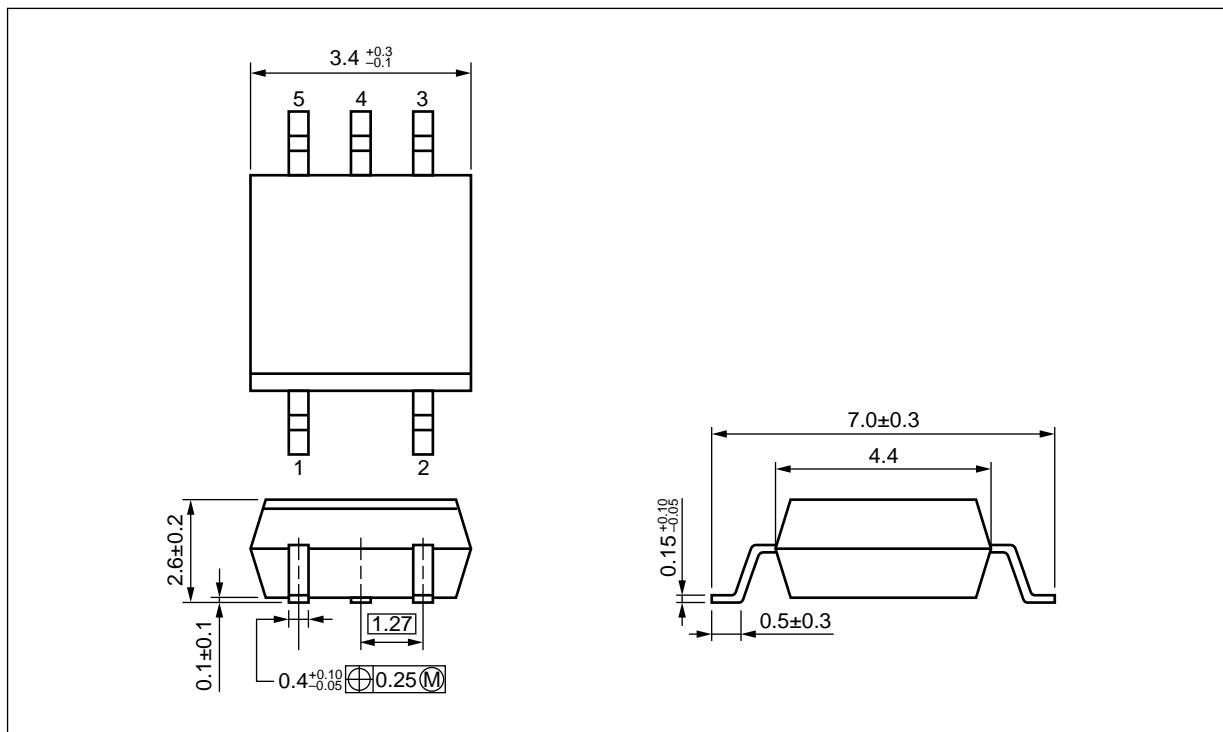
LED	Output
ON	L
OFF	H

APPLICATIONS

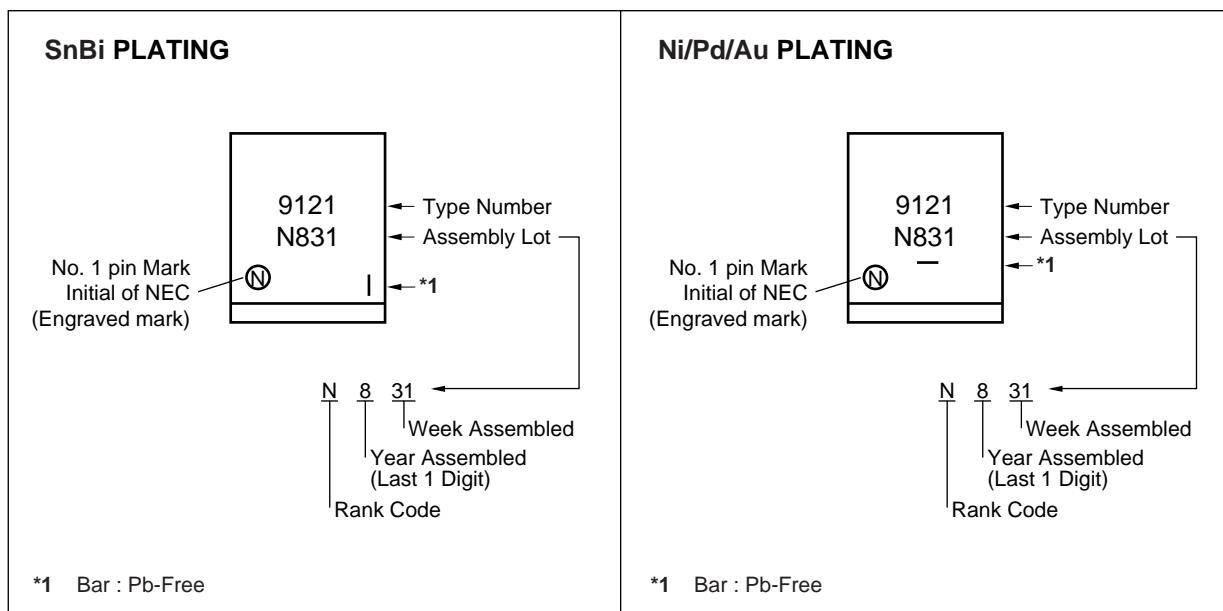
- Measurement equipment
- PDP
- FA Network

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PACKAGE DIMENSIONS (UNIT: mm)



<R> MARKING EXAMPLE



<R>

ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standards Approval	Application Part Number ^{*1}	
PS9121	PS9121-A	Pb-Free (SnBi)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)	PS9121	
PS9121-F3	PS9121-F3-A		Embossed Tape 2 500 pcs/reel			
PS9121-F4	PS9121-F4-A		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) approved (Option)		
PS9121-V	PS9121-V-A		Embossed Tape 2 500 pcs/reel			
PS9121-V-F3	PS9121-V-F3-A		20 pcs (Tape 20 pcs cut)			
PS9121-V-F4	PS9121-V-F4-A		Embossed Tape 2 500 pcs/reel			
PS9121	PS9121-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)		
PS9121-F3	PS9121-F3-AX		Embossed Tape 2 500 pcs/reel			
PS9121-F4	PS9121-F4-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) approved (Option)		
PS9121-V	PS9121-V-AX		Embossed Tape 2 500 pcs/reel			
PS9121-V-F3	PS9121-V-F3-AX					
PS9121-V-F4	PS9121-V-F4-AX					

***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	30		mA
	Reverse Voltage	V _R	5		V
Detector	Supply Voltage	V _{CC}	7		V
	Output Voltage	V _O	7		V
	Output Current	I _O	25		mA
	Power Dissipation ^{*2}	P _C	40		mW
Isolation Voltage ^{*3}		BV	3 750		Vr.m.s.
Operating Ambient Temperature		T _A	-40 to +85		°C
Storage Temperature		T _{STG}	-55 to +125		°C

***1** Reduced to 0.3 mA/°C at T_A = 25°C or more.

***2** Applies to output pin V_O (collector pin). Reduced to 1.5 mW/°C at T_A = 65°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
Low Level Input Voltage	V _{FL}	0		0.8	V
High Level Input Current	I _{FH}	6.3	10	12.5	mA
Supply Voltage	V _{CC}	2.7	3.3	3.6	V
TTL (R _L = 1 kΩ, loads)	N			5	
Pull-up Resistor	R _L	330		4 k	Ω

ELECTRICAL CHARACTERISTICS ($T_A = -40$ to $+85^\circ\text{C}$, unless otherwise specified)

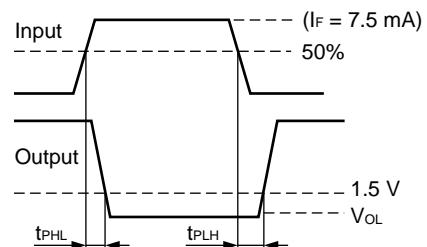
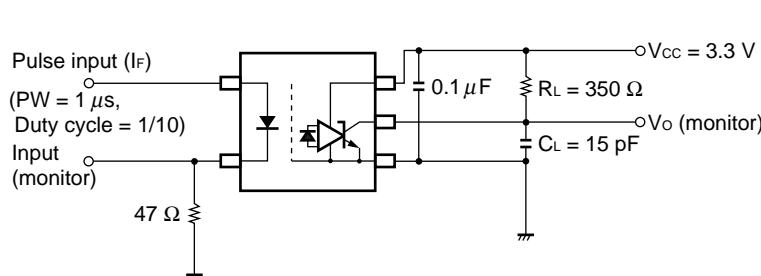
Parameter		Symbol	Conditions	MIN.	TYP. ^{*1}	MAX.	Unit
Diode	Forward Voltage	V_F	$I_F = 10 \text{ mA}, T_A = 25^\circ\text{C}$	1.4	1.65	1.8	V
	Reverse Current	I_R	$V_R = 3 \text{ V}, T_A = 25^\circ\text{C}$			10	μA
	Terminal Capacitance	C_t	$V = 0 \text{ V}, f = 1 \text{ MHz}, T_A = 25^\circ\text{C}$		30		pF
Detector	High Level Output Current	I_{OH}	$V_{CC} = V_O = 3.3 \text{ V}, V_F = 0.8 \text{ V}$		1	80	μA
			$V_{CC} = V_O = 5.5 \text{ V}, V_F = 0.8 \text{ V}$		1^{*2}		
	Low Level Output Voltage ^{*3}	V_{OL}	$V_{CC} = 3.3 \text{ V}, I_F = 5 \text{ mA}, I_{OL} = 13 \text{ mA}$		0.2	0.6	V
			$V_{CC} = 5.5 \text{ V}, I_F = 5 \text{ mA}, I_{OL} = 13 \text{ mA}$		0.2^{*2}		
	High Level Supply Current	I_{CH}	$V_{CC} = 3.3 \text{ V}, I_F = 0 \text{ mA}, V_O = \text{Open}$		4	7	mA
			$V_{CC} = 5.5 \text{ V}, I_F = 0 \text{ mA}, V_O = \text{Open}$		5^{*2}		
Coupled	Low Level Supply Current	I_{CL}	$V_{CC} = 3.3 \text{ V}, I_F = 10 \text{ mA}, V_O = \text{Open}$		7	10	
			$V_{CC} = 5.5 \text{ V}, I_F = 10 \text{ mA}, V_O = \text{Open}$		9^{*2}		
	Threshold Input Current (H → L)	I_{FHL}	$V_{CC} = 3.3 \text{ V}, V_O = 0.8 \text{ V}, R_L = 350 \Omega$		2.5	5	ns
			$V_{CC} = 5 \text{ V}, V_O = 0.8 \text{ V}, R_L = 350 \Omega$		2.5^{*2}		
	Isolation Resistance	R_{I-O}	$V_{I-O} = 1 \text{ kV}_{DC}, R_H = 40 \text{ to } 60\%, T_A = 25^\circ\text{C}$	10^{11}			
	Isolation Capacitance	C_{I-O}	$V = 0 \text{ V}, f = 1 \text{ MHz}, T_A = 25^\circ\text{C}$		0.6		
	Propagation Delay Time (H → L) ^{*4}	t_{PHL}	$T_A = 25^\circ\text{C}$		40	75	
			$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$			100	
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		37^{*2}		
	Propagation Delay Time (L → H) ^{*4}	t_{PLH}	$T_A = 25^\circ\text{C}$		45	75	
			$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$			100	
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		40^{*2}		
	Rise Time	t_r	$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		20		kV/ μs
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		20^{*2}		
	Fall Time	t_f	$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		5		
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		5^{*2}		
	Pulse Width Distortion (PWD) ^{*4}	$ t_{PHL}-t_{PLH} $	$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		5	35	
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$		3^{*2}		
	Propagation Delay Skew	t_{PSK}	$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, I_F = 7.5 \text{ mA}$			40	
Common Mode Transient Immunity at High Level Output ^{*5}	CM_H		$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, T_A = 25^\circ\text{C}, I_F = 0 \text{ mA}, V_O > 2 \text{ V}, V_{CM} = 1 \text{ kV}$	15	20		kV/ μs
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, T_A = 25^\circ\text{C}, I_F = 0 \text{ mA}, V_O > 2 \text{ V}, V_{CM} = 1 \text{ kV}$		20^{*2}		
Common Mode Transient Immunity at Low Level Output ^{*5}	CM_L		$V_{CC} = 3.3 \text{ V}, R_L = 350 \Omega, T_A = 25^\circ\text{C}, I_F = 7.5 \text{ mA}, V_O < 0.8 \text{ V}, V_{CM} = 1 \text{ kV}$	15	20		kV/ μs
			$V_{CC} = 5 \text{ V}, R_L = 350 \Omega, T_A = 25^\circ\text{C}, I_F = 7.5 \text{ mA}, V_O < 0.8 \text{ V}, V_{CM} = 1 \text{ kV}$		20^{*2}		

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

*2 These values are reference values.

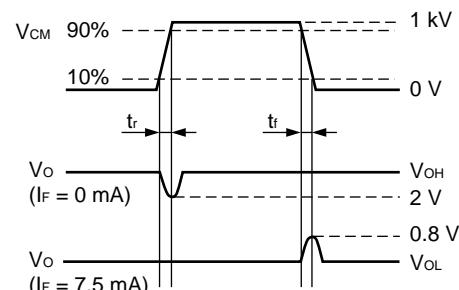
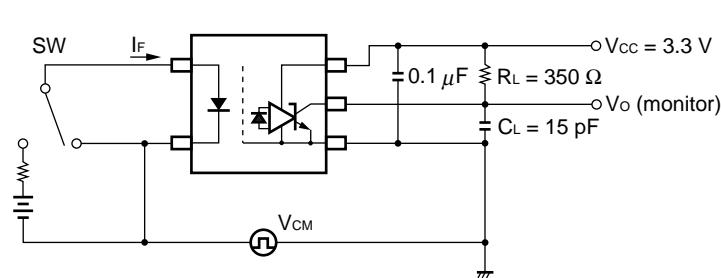
*3 Because V_{OL} of 2 V or more may be output when LED current input and when output supply of $V_{CC} = 2.6\text{ V}$ or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

*4 Test circuit for propagation delay time



Remark CL includes probe and stray wiring capacitance.

*5 Test circuit for common mode transient immunity



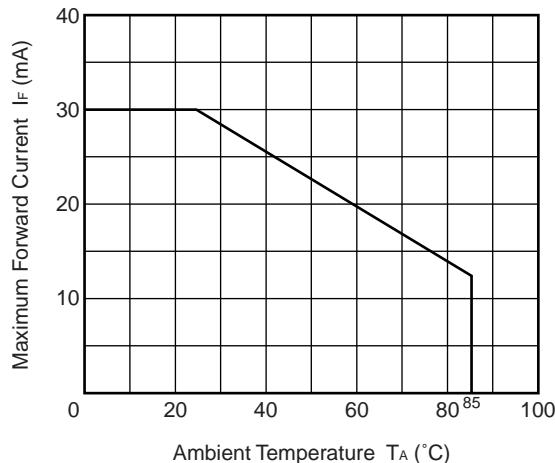
Remark CL includes probe and stray wiring capacitance.

USAGE CAUTIONS

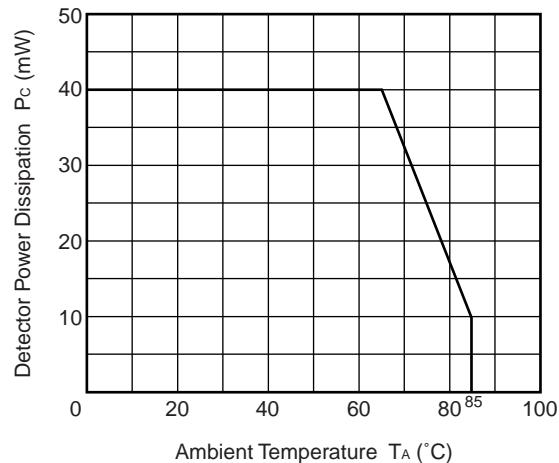
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of $0.1\ \mu\text{F}$ is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler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

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

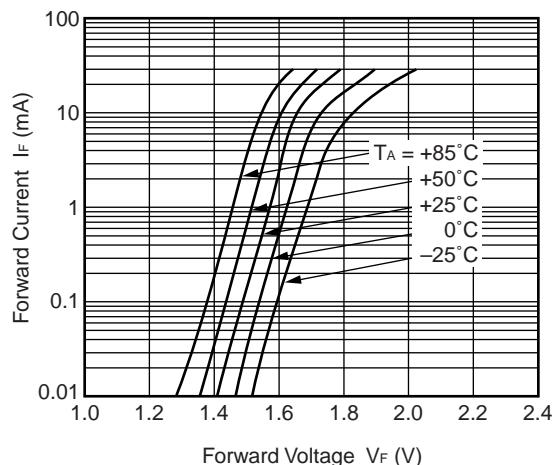
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



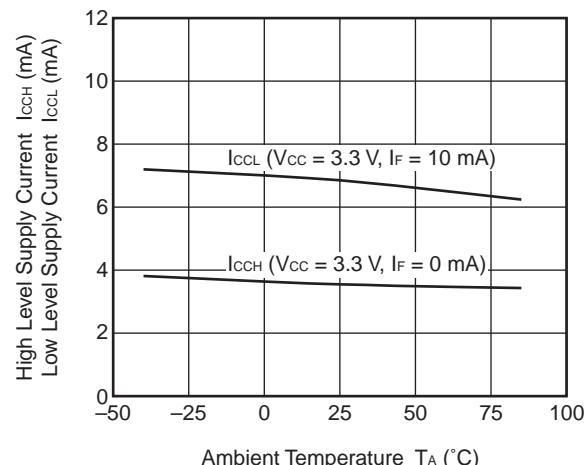
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



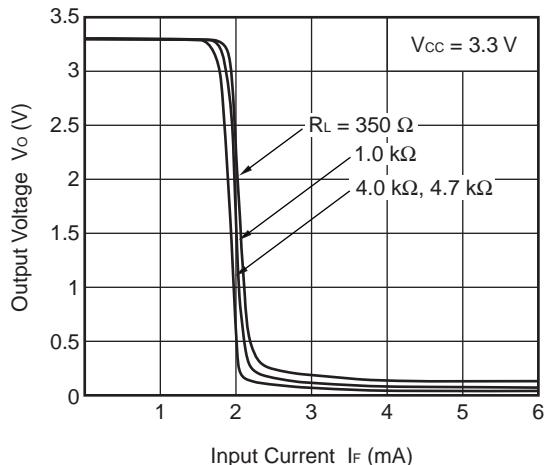
FORWARD CURRENT vs. FORWARD VOLTAGE



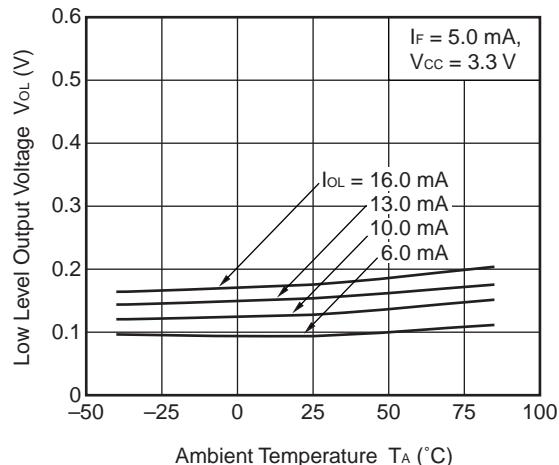
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



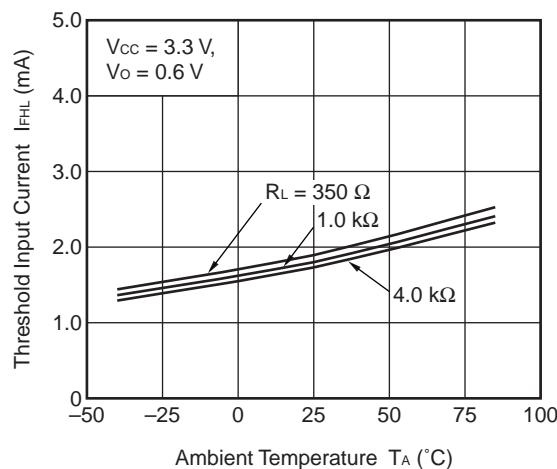
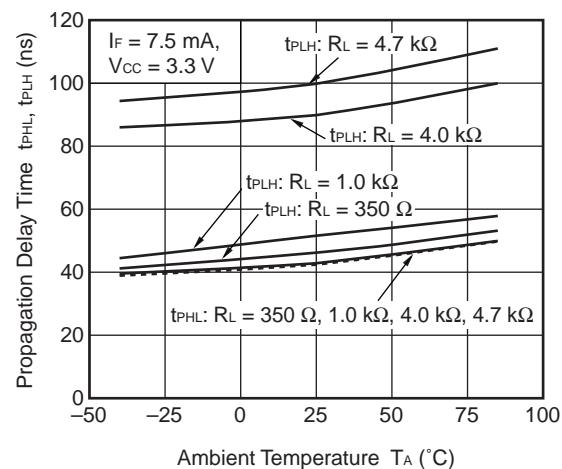
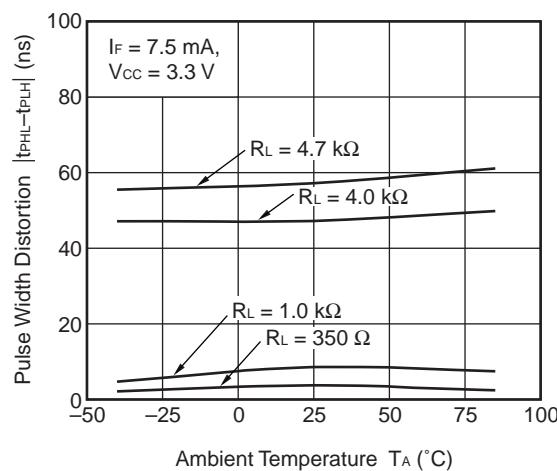
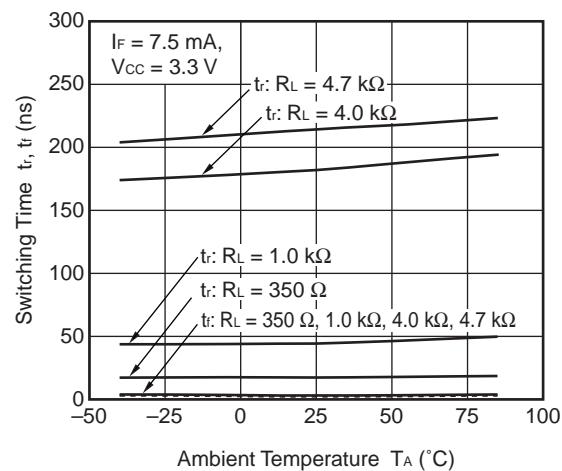
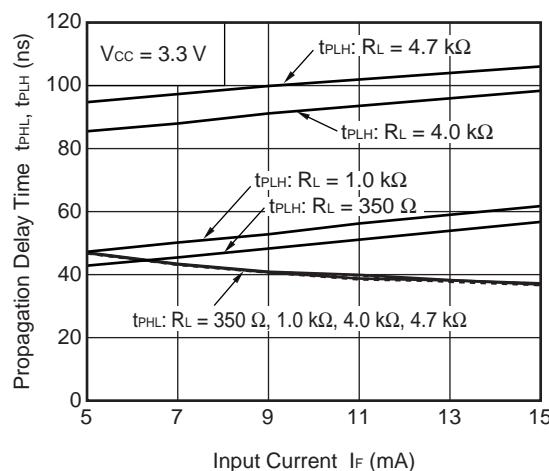
OUTPUT VOLTAGE vs. INPUT CURRENT



LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



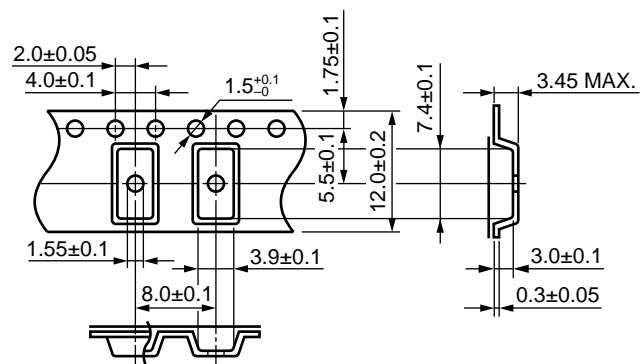
Remark The graphs indicate nominal characteristics.

THRESHOLD INPUT CURRENT vs.
AMBIENT TEMPERATUREPROPAGATION DELAY TIME vs.
AMBIENT TEMPERATUREPULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURESWITCHING TIME vs.
AMBIENT TEMPERATUREPROPAGATION DELAY TIME vs.
INPUT CURRENT

Remark The graphs indicate nominal characteristics.

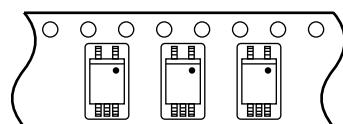
TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

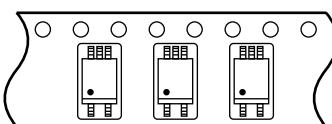


Tape Direction

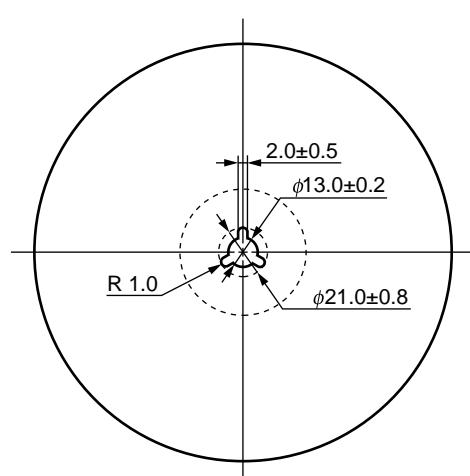
PS9121-F3



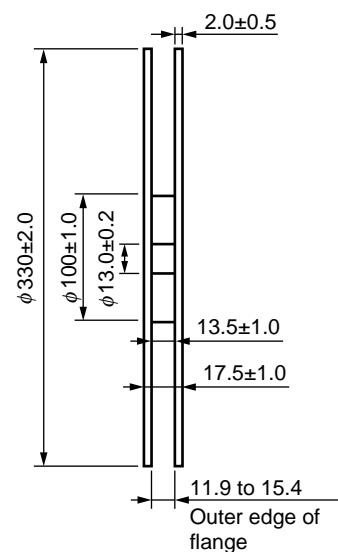
PS9121-F4



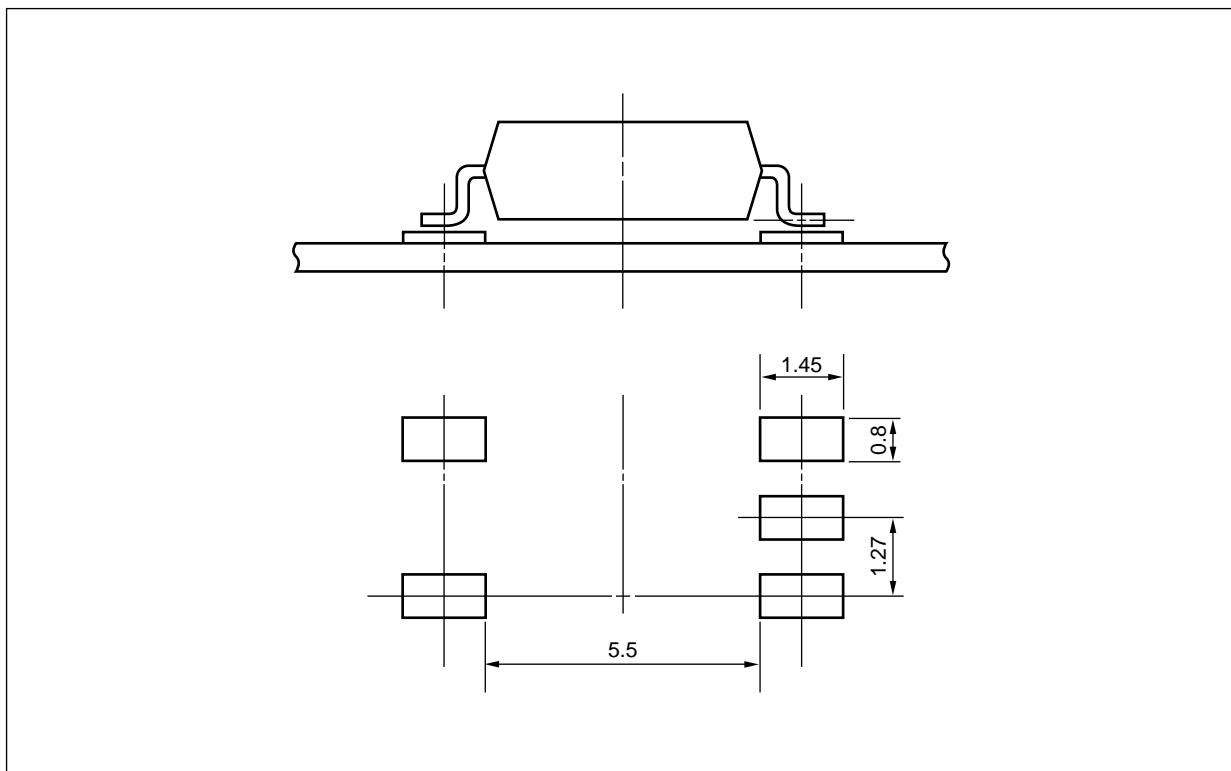
Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel



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



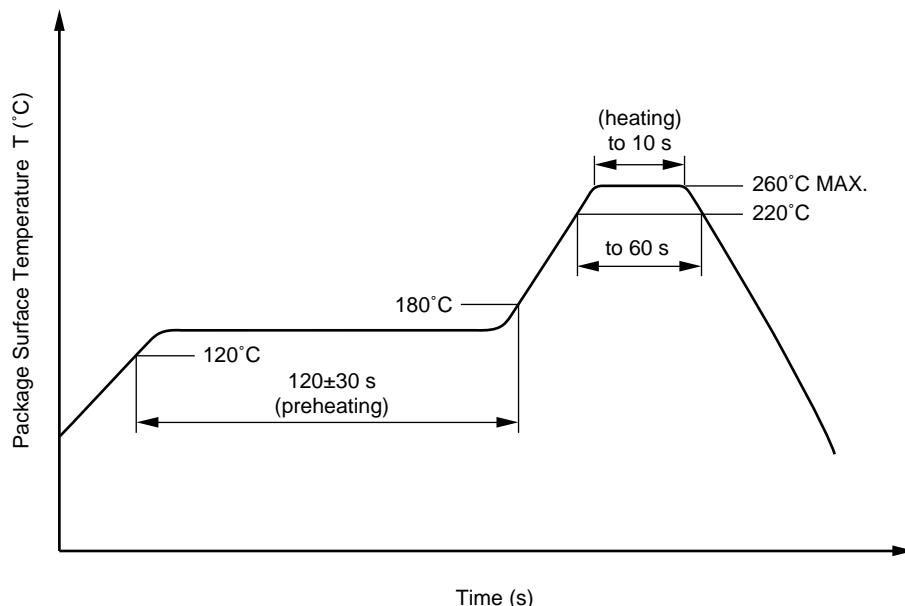
NOTES ON HANDLING

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	Spec	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) $U_{pr} = 1.5 \times U_{IORM}$, $P_d < 5$ pC	U_{IORM} U_{pr}	707 1 061	V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5$ 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 $V_{IO} = 500$ V dc at $T_A = 25$ °C $V_{IO} = 500$ V dc at T_A MAX. at least 100 °C	$R_{is MIN.}$ $R_{is MIN.}$	10^{12} 10^{11}	Ω Ω
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 $V_{IO} = 500$ V dc at $T_A = T_{Si}$	T_{Si} I_{Si} Ψ_i $R_{is MIN.}$	150 200 300 10^9	°C mA mW Ω

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(Note)

- (1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.
- (2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).

M8E 02.11-1

Caution

GaAs Products

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.

- 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.
- 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.

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