

1 Mbps OPEN COLLECTOR OUTPUT TYPE 5-PIN SOP (SO-5) HIGH-SPEED PHOTOCOUPLER

–NEPOC Series–

DESCRIPTION

The PS9122 is an optical 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 PS9122 is a high-speed digital output type photocopler designed specifically for low circuit current.

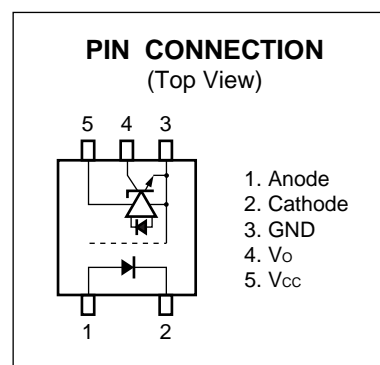
The PS9122 is in 5-pin plastic SOP (Small Outline Package) and is suitable for high density application.

FEATURES

- Supply Voltage
 - N rank: $V_{CC} = 3.3\text{ V}$
 - L rank: $V_{CC} = 5\text{ V}$
- Pulse width distortion ($|t_{PHL} - t_{PLH}| = 200\text{ ns MAX.}$)
- Small package (SO-5)
- High-speed (1 Mbps)
- High isolation voltage ($BV = 3\,750\text{ Vr.m.s.}$)
- Open collector output
- Embossed tape product: PS9122-F3: 2 500 pcs/reel
- Pb-Free product
- ★ Safety standards
 - UL approved: File No. E72422
 - DIN EN60747-5-2 (VDE0884 Part 2) approved No.40008902 (option)

APPLICATIONS

- PoE (Power over Ethernet)
- Measurement equipment
- FA Network

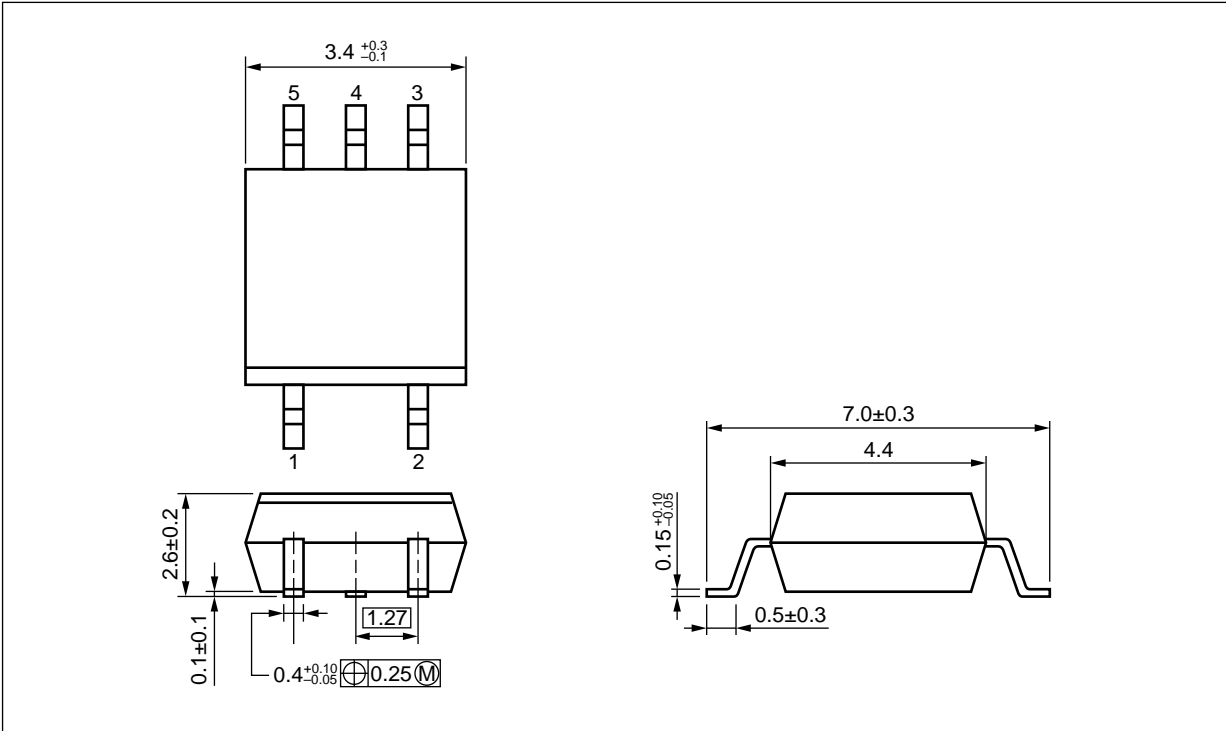


TRUTH TABLE

LED	Output
ON	L
OFF	H

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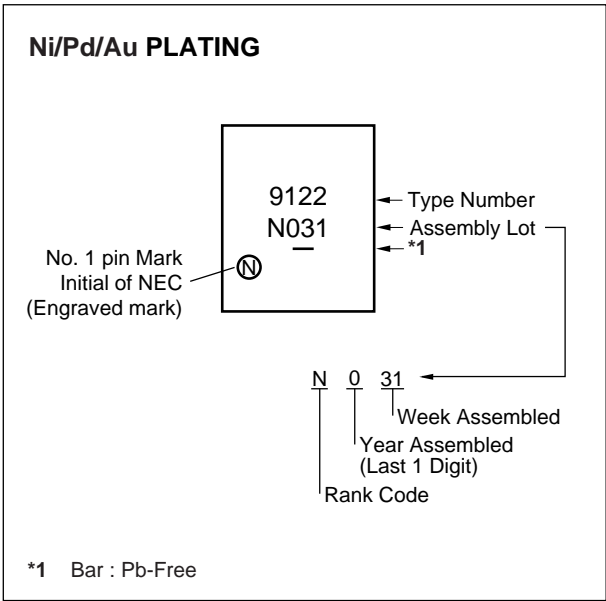
PACKAGE DIMENSIONS (UNIT: mm)



★ PHOTOCOUPLER CONSTRUCTION

Parameter	Unit (MIN.)
Air Distance	4.2 mm
Outer Creepage Distance	4.2 mm
Isolation Distance	0.2 mm

★ MARKING EXAMPLE



★ ORDERING INFORMATION

Part Number	Order Number	Rank	Solder Plating Specification	Packing Style	Safety Standards Approval	Application Part Number ^{*1}
PS9122	PS9122-AX	N ^{*2}	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)	PS9122
		L ^{*3}				
PS9122-F3	PS9122-F3-AX	N ^{*2}		Embossed Tape 2 500 pcs/reel		
		L ^{*3}				
PS9122-V	PS9122-V-AX	N ^{*2}		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2	
		L ^{*3}			(VDE0884 Part2)	
PS9122-V-F3	PS9122-V-F3-AX	N ^{*2}		Embossed Tape 2 500 pcs/reel	approved (Option)	
		L ^{*3}				

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

^{*2} N rank: V_{CC} = 3.3 V

^{*3} L rank: V_{CC} = 5 V

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, 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}	7	V
	Output Voltage	V_O	7	V
	Output Current	I_O	20	mA
	Power Dissipation ^{*2}	P_C	40	mW
Isolation Voltage ^{*3}		BV	3 750	Vr.m.s.
Operating Ambient Temperature		T_A	-40 to +100	$^\circ\text{C}$
Storage Temperature		T_{stg}	-55 to +125	$^\circ\text{C}$

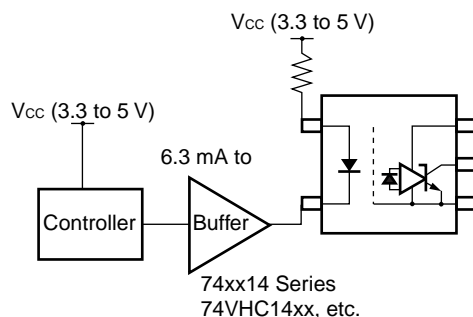
- ★ ^{*1} Reduced to 0.17 mA/ $^\circ\text{C}$ at $T_A = 25^\circ\text{C}$ or more.
- ★ ^{*2} Applies to output pin V_O (collector pin). Reduced to 1.5 mW/ $^\circ\text{C}$ at $T_A = 80^\circ\text{C}$ or more.
- ^{*3} AC voltage for 1 minute at $T_A = 25^\circ\text{C}$, RH = 60% between input and output.
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	N rank	V_{CC}	2.7	3.3	3.6	V
	L rank		4.5	5.0	5.5	
TTL ($R_L = 1\text{ k}\Omega$, loads)		N			3	
Pull-up Resistor		R_L	330		4 k	Ω

★ **DRIVER CIRCUIT**

It is recommended to use some buffer for low output current controller, especially in the case of low V_{CC} , otherwise to confirm that enough input current is supplied from controller.



ELECTRICAL CHARACTERISTICS 1: N rank ($T_A = -40$ to $+100^\circ\text{C}$, unless otherwise specified)

	Parameter	Symbol	Conditions	MIN.	TYP. ^{*1}	MAX.	Unit
	Diode						
	Forward Voltage	V_F	$I_F = 10\text{ mA}$, $T_A = 25^\circ\text{C}$		1.6	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	100	μA
	Low Level Output Voltage ^{*2}	V_{OL}	$V_{CC} = 3.3\text{ V}$, $I_F = 5\text{ mA}$, $I_{OL} = 10\text{ mA}$		0.2	0.6	V
	High Level Supply Current	I_{CCH}	$V_{CC} = 3.3\text{ V}$, $I_F = 0\text{ mA}$, $V_O = \text{Open}$			2	mA
	Low Level Supply Current	I_{CCL}	$V_{CC} = 3.3\text{ V}$, $I_F = 10\text{ mA}$, $V_O = \text{Open}$			3	
★	Coupled						
	Threshold Input Current (H \rightarrow L)	I_{FHL}	$V_{CC} = 3.3\text{ V}$, $V_O = 0.8\text{ V}$, $R_L = 350\ \Omega$		2	5	mA
	Isolation Resistance	R_{I-O}	$V_{I-O} = 1\text{ kV}_{DC}$, $R_H = 40$ to 60% , $T_A = 25^\circ\text{C}$	10^{11}			Ω
	Isolation Capacitance	C_{I-O}	$V = 0\text{ V}$, $f = 1\text{ MHz}$, $T_A = 25^\circ\text{C}$		0.6		pF
	Propagation Delay Time (H \rightarrow L) ^{*3}	t_{PHL}	$V_{CC} = 3.3\text{ V}$, $R_L = 350\ \Omega$, $I_F = 7.5\text{ mA}$, $V_{THHL} = V_{THLH} = 1.5\text{ V}$			500	ns
	Propagation Delay Time (L \rightarrow H) ^{*3}	t_{PLH}				700	
	Rise Time	t_r			60		ns
	Fall Time	t_f			70		
	Pulse Width Distortion (PWD) ^{*3}	$ t_{PHL} - t_{PLH} $				200	ns
	Common Mode Transient Immunity at High Level Output ^{*4}	CM_H	$V_{CC} = 3.3\text{ V}$, $R_L = 350\ \Omega$, $T_A = 25^\circ\text{C}$, $I_F = 0\text{ mA}$, $V_O > 2.0\text{ V}$, $V_{CM} = 1.0\text{ kV}$	15	20		kV/ μs
	Common Mode Transient Immunity at Low Level Output ^{*4}	CM_L	$V_{CC} = 3.3\text{ V}$, $R_L = 350\ \Omega$, $T_A = 25^\circ\text{C}$, $I_F = 7.5\text{ mA}$, $V_O < 0.8\text{ V}$, $V_{CM} = 1.0\text{ kV}$	15	20		

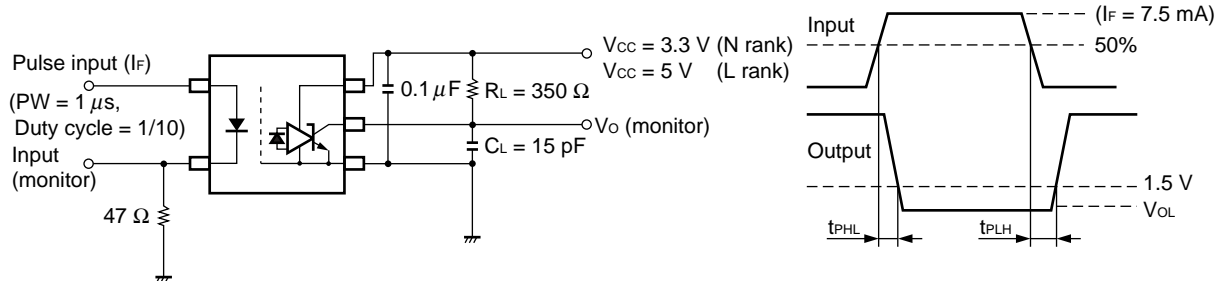
ELECTRICAL CHARACTERISTICS 2: L rank ($T_A = -40$ to $+100^\circ\text{C}$, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.* ⁵	MAX.	Unit
Diode	Forward Voltage	V_F	$I_F = 10\text{ mA}$, $T_A = 25^\circ\text{C}$		1.6	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}	$V_{CC} = V_O = 5\text{ V}$, $V_F = 0.8\text{ V}$		1	100	μA
	Low Level Output Voltage* ⁶	V_{OL}	$V_{CC} = 5\text{ V}$, $I_F = 5\text{ mA}$, $I_{OL} = 13\text{ mA}$		0.2	0.6	V
	High Level Supply Current	I_{CCH}	$V_{CC} = 5\text{ V}$, $I_F = 0\text{ mA}$, $V_O = \text{Open}$			2.5	mA
	Low Level Supply Current	I_{CCL}	$V_{CC} = 5\text{ V}$, $I_F = 10\text{ mA}$, $V_O = \text{Open}$			3.5	
★	Coupled Threshold Input Current (H \rightarrow L)	I_{FHL}	$V_{CC} = 5\text{ V}$, $V_O = 0.8\text{ V}$, $R_L = 350\ \Omega$		2	5	mA
	Isolation Resistance	R_{I-O}	$V_{I-O} = 1\text{ kV}_{DC}$, $R_H = 40$ 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 \rightarrow L)* ⁷	t_{PHL}	$V_{CC} = 5\text{ V}$, $R_L = 350\ \Omega$, $I_F = 7.5\text{ mA}$, $V_{THHL} = V_{THLH} = 1.5\text{ V}$			500	ns
	Propagation Delay Time (L \rightarrow H)* ⁷	t_{PLH}				700	
	Rise Time	t_r			60		ns
	Fall Time	t_f			70		
	Pulse Width Distortion (PWD)* ⁷	$ t_{PHL} - t_{PLH} $				200	ns
	Common Mode Transient Immunity at High Level Output* ⁸	CM_H	$V_{CC} = 5\text{ V}$, $R_L = 350\ \Omega$, $T_A = 25^\circ\text{C}$, $I_F = 0\text{ mA}$, $V_O > 2.0\text{ V}$, $V_{CM} = 1.0\text{ kV}$	15	20		kV/ μs
	Common Mode Transient Immunity at Low Level Output* ⁸	CM_L	$V_{CC} = 5\text{ V}$, $R_L = 350\ \Omega$, $T_A = 25^\circ\text{C}$, $I_F = 7.5\text{ mA}$, $V_O < 0.8\text{ V}$, $V_{CM} = 1.0\text{ kV}$	15	20		

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

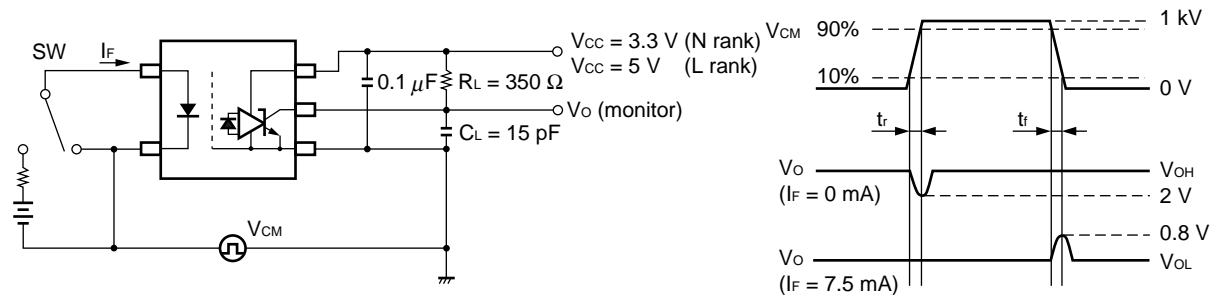
- ★ *2, 6. Because V_{OL} of 2 V or more may be output when LED current input and when output supply of $V_{CC} = 2\text{ V}$ more or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device.

- ★ *3, 7. Test circuit for propagation delay time



Remark C_L includes probe and stray wiring capacitance.

- ★ *4, 8. Test circuit for common mode transient immunity

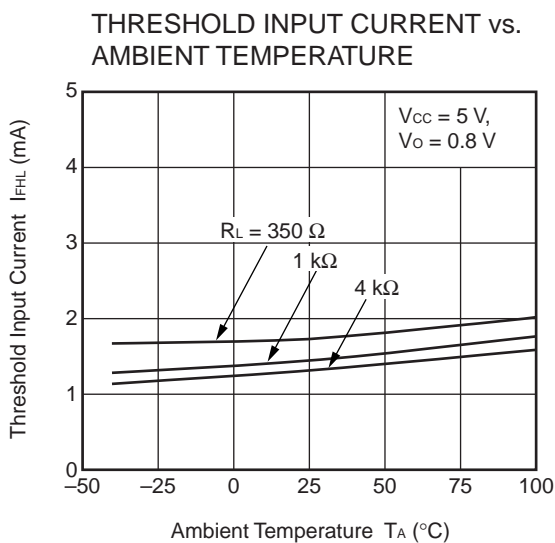
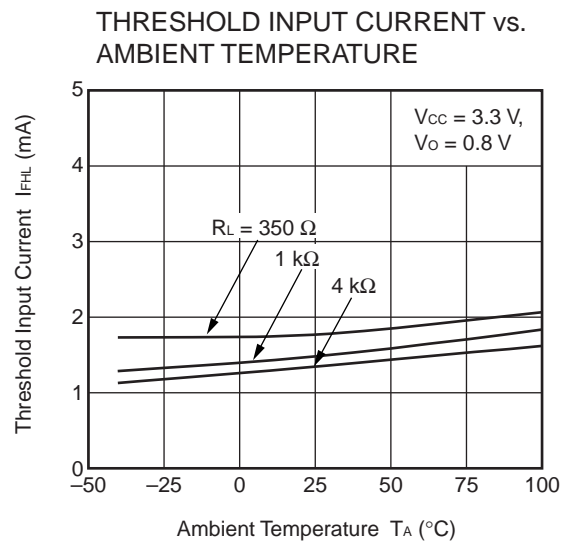
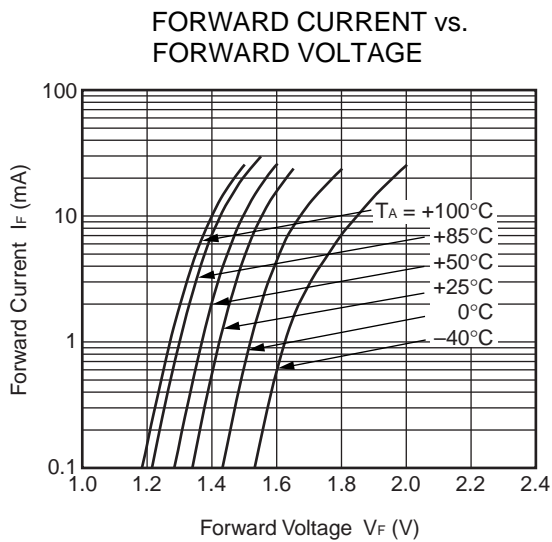
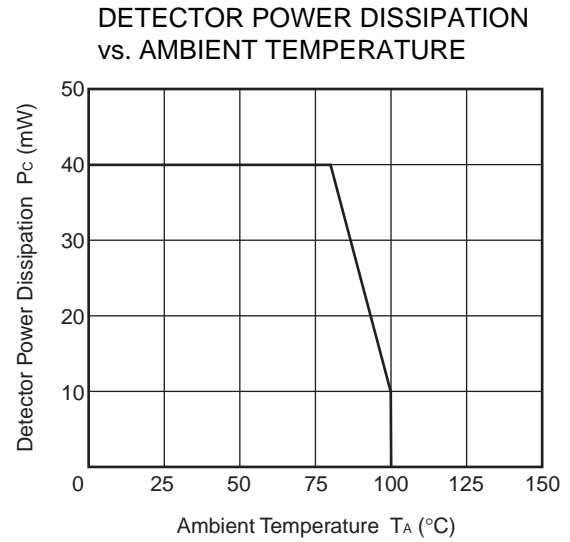
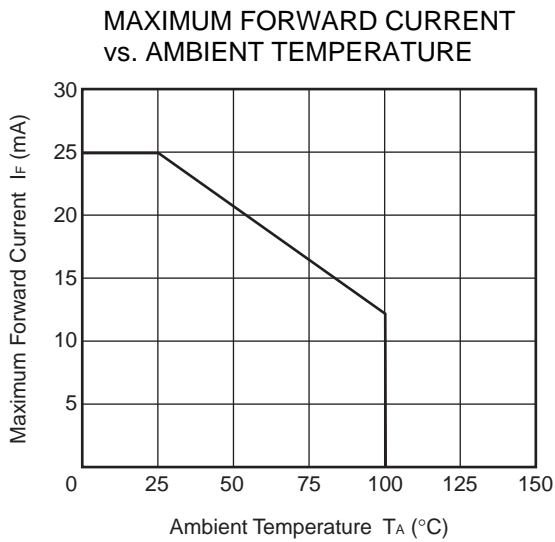


Remark C_L includes probe and stray wiring capacitance.

★ USAGE CAUTIONS

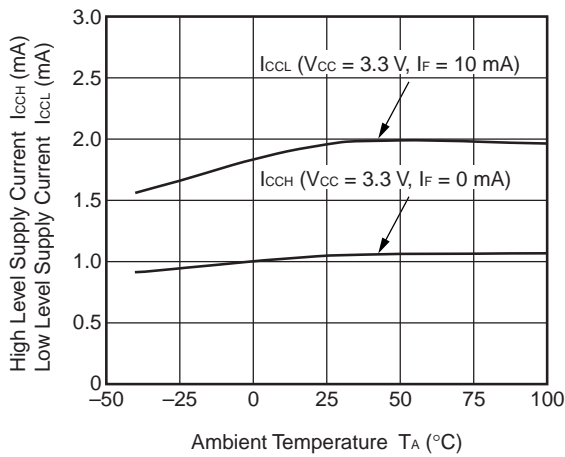
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of 0.1 μF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor 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)

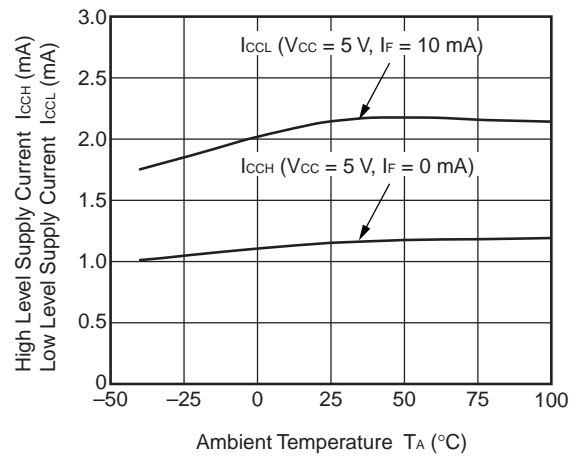


Remark The graphs indicate nominal characteristics.

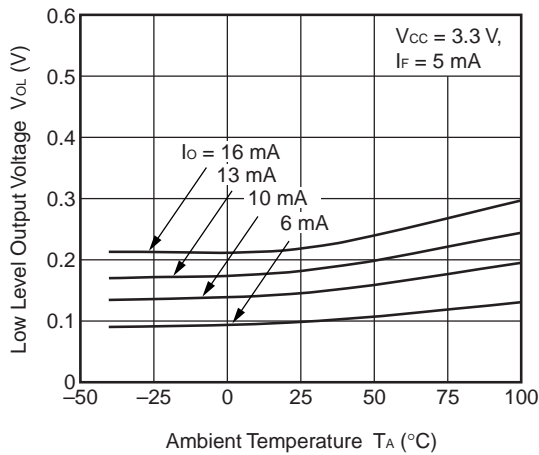
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



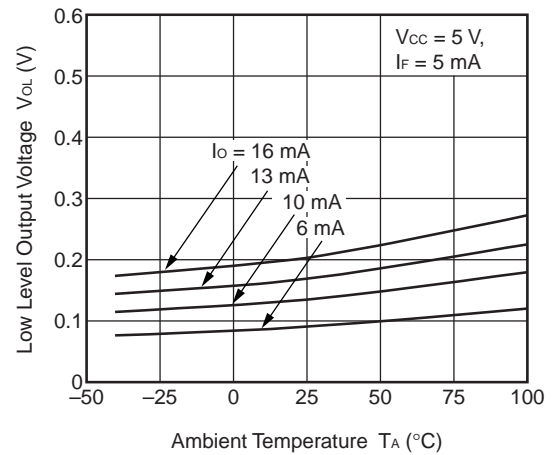
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



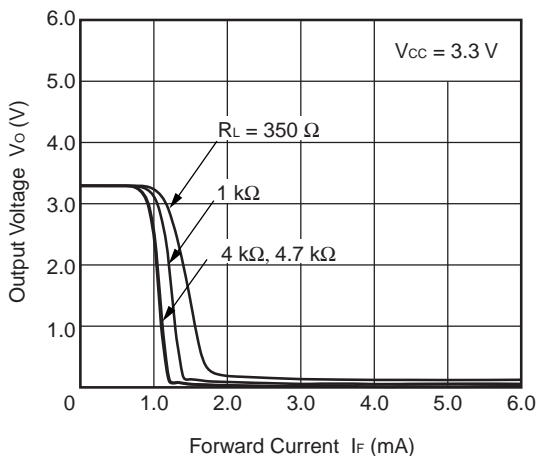
LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



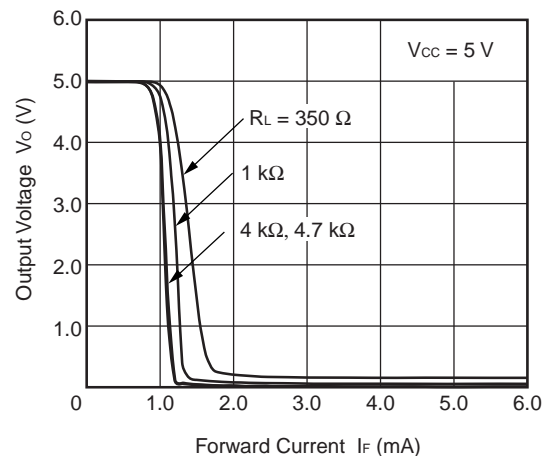
LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

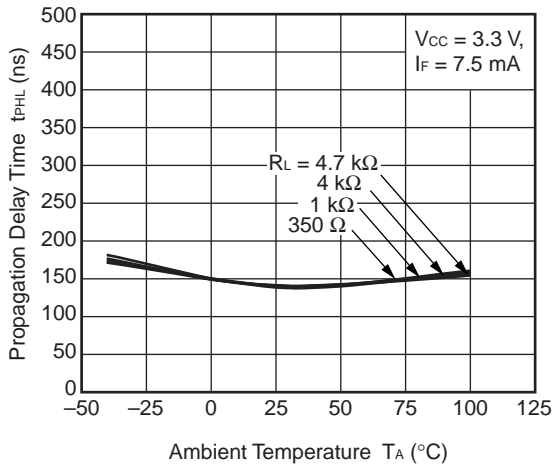


OUTPUT VOLTAGE vs. FORWARD CURRENT

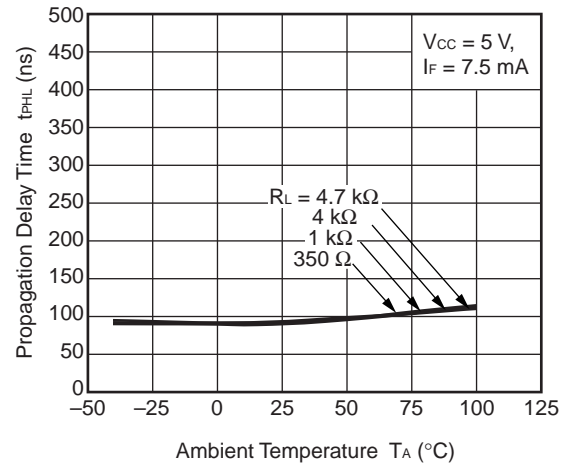


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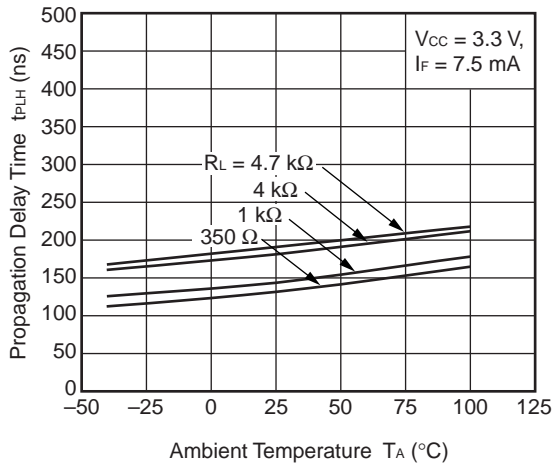
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



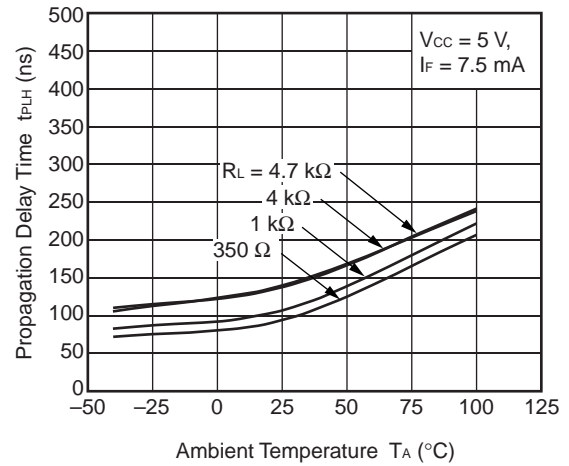
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



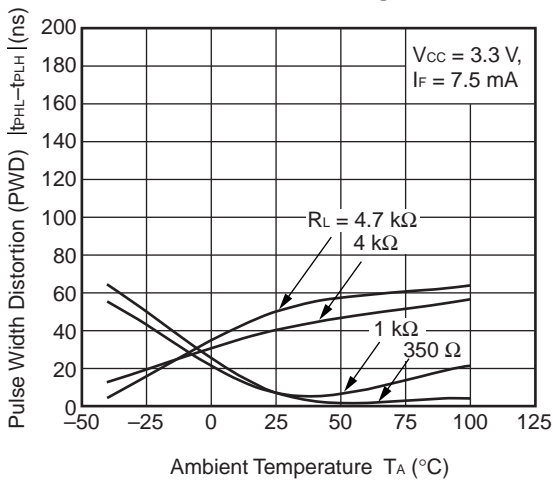
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



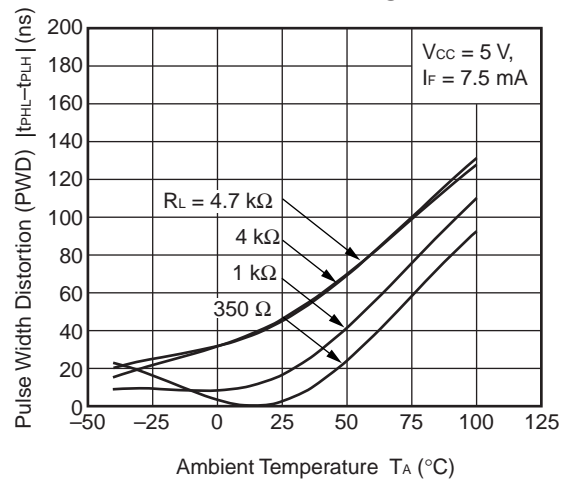
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE

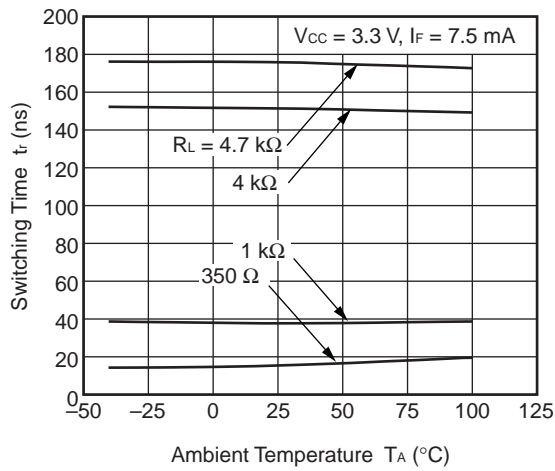


PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE

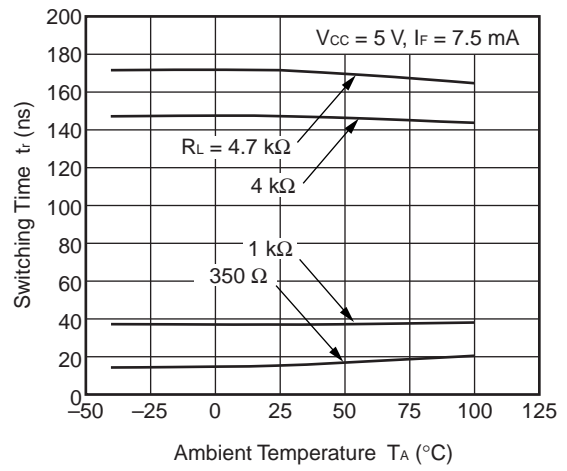


Remark The graphs indicate nominal characteristics.

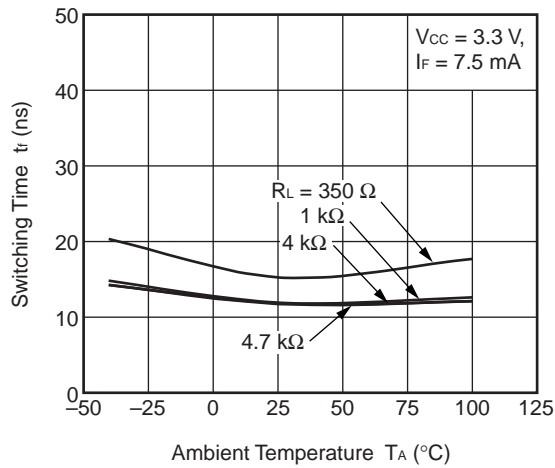
SWITCHING TIME vs.
AMBIENT TEMPERATURE



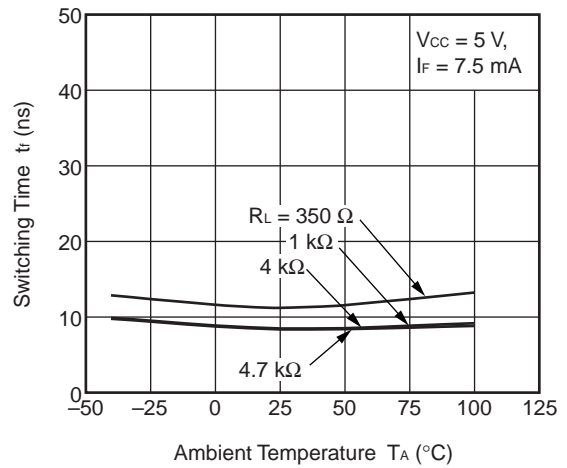
SWITCHING TIME vs.
AMBIENT TEMPERATURE



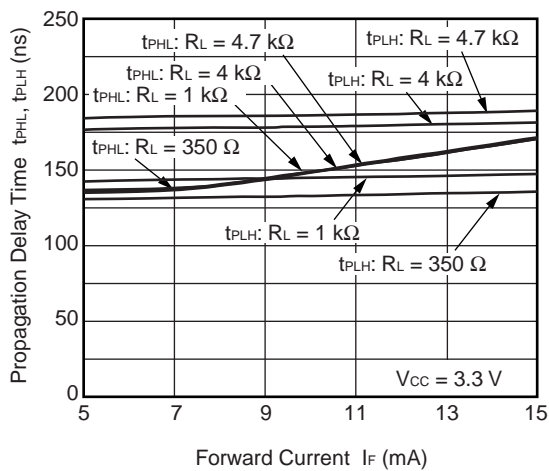
SWITCHING TIME vs.
AMBIENT TEMPERATURE



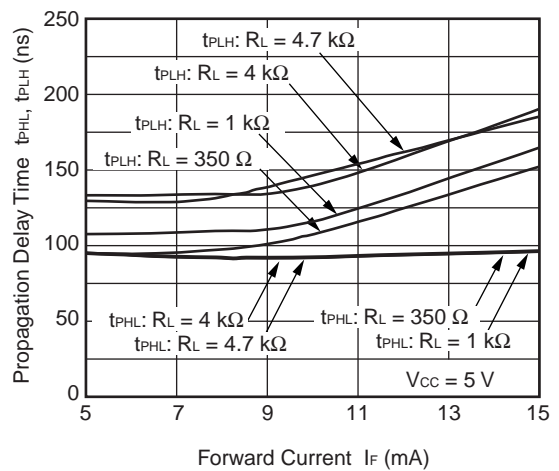
SWITCHING TIME vs.
AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs.
FORWARD CURRENT



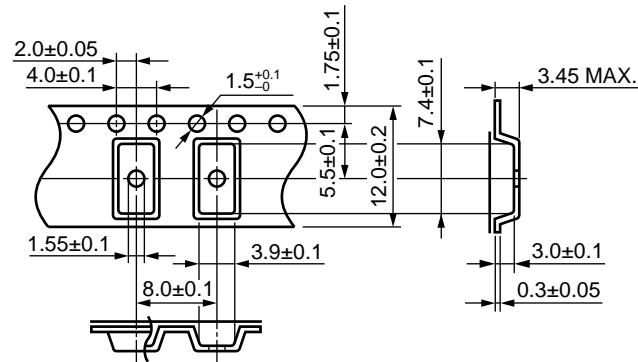
PROPAGATION DELAY TIME vs.
FORWARD CURRENT



Remark The graphs indicate nominal characteristics.

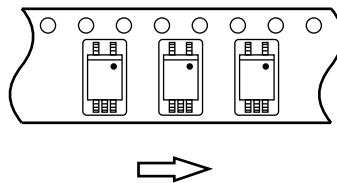
TAPING SPECIFICATIONS (UNIT: mm)

Outline and Dimensions (Tape)

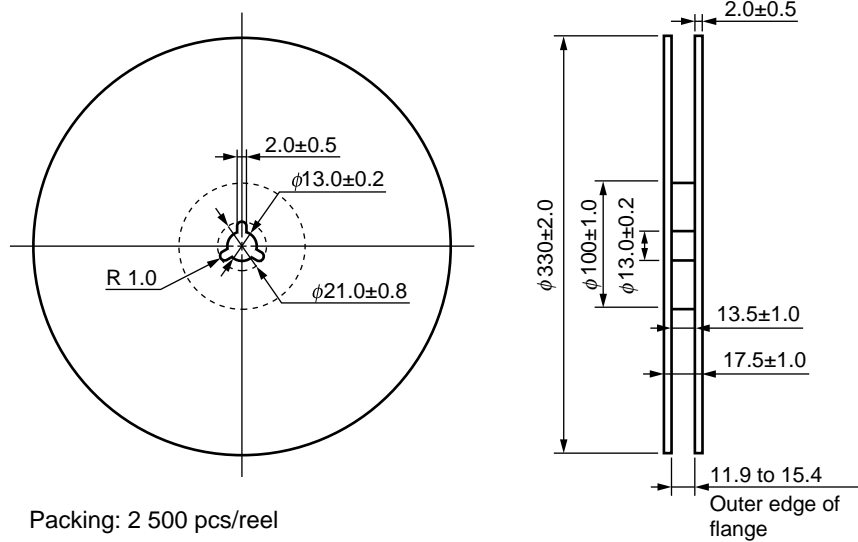


Tape Direction

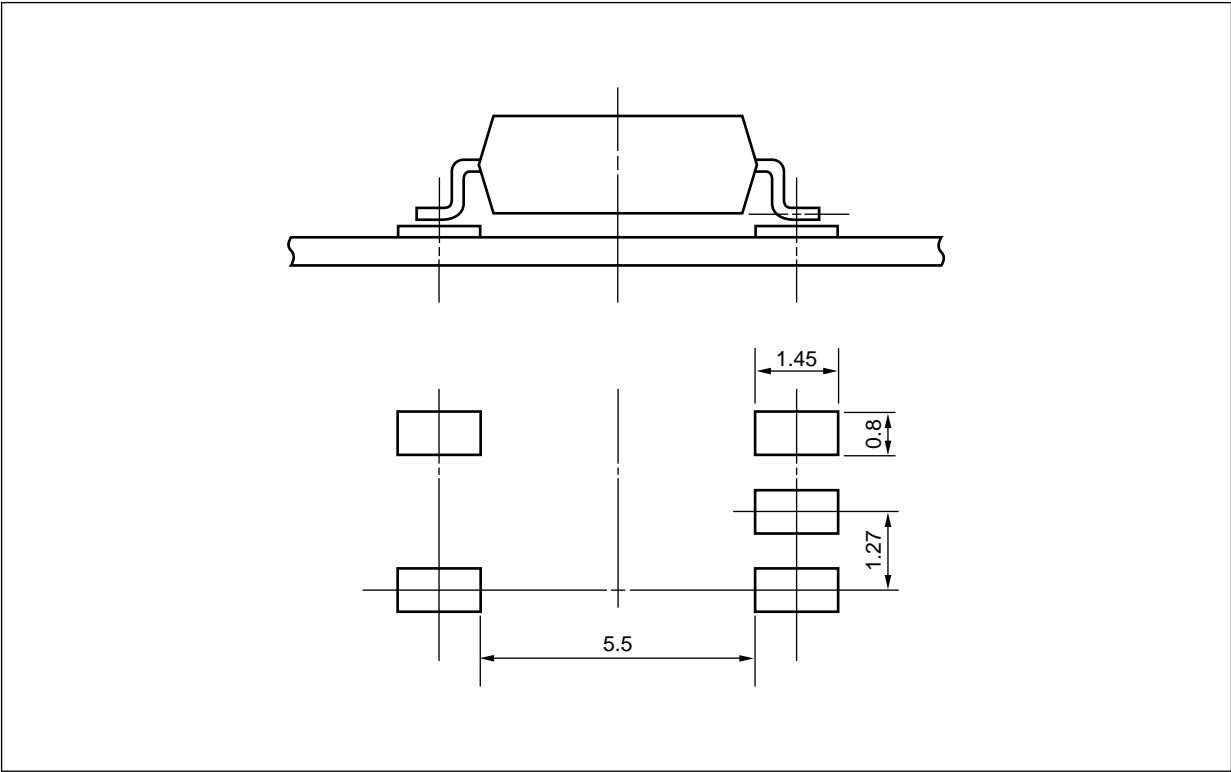
PS9122-F3



Outline and Dimensions (Reel)



★ RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



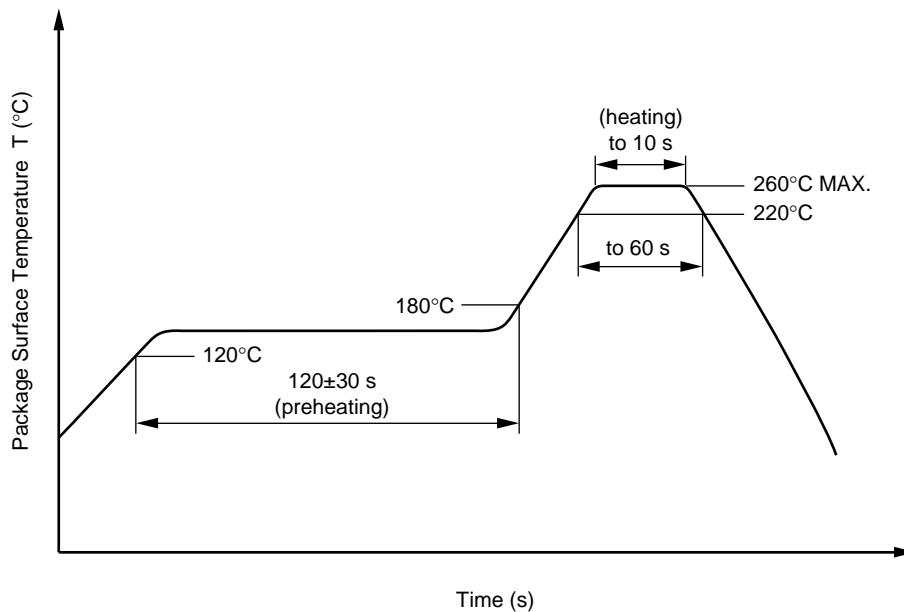
NOTES ON HANDLING

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.

★ SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength			
maximum operating isolation voltage	U_{IORM}	707	V_{peak}
Test voltage (partial discharge test, procedure a for type test and random test)	U_{pr}	1 061	V_{peak}
$U_{pr} = 1.5 \times U_{IORM}$, $P_d < 5 \text{ pC}$			
Test voltage (partial discharge test, procedure b for all devices)	U_{pr}	1 326	V_{peak}
$U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5 \text{ pC}$			
Highest permissible overvoltage	U_{TR}	6 000	V_{peak}
Degree of pollution (DIN EN 60664-1 VDE0110 Part 1)		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	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 +100	°C
Isolation resistance, minimum value			
$V_{IO} = 500 \text{ V dc}$ at $T_A = 25^\circ\text{C}$	Ris MIN.	10^{12}	Ω
$V_{IO} = 500 \text{ V dc}$ at $T_A \text{ MAX.}$ at least 100°C	Ris MIN.	10^{11}	Ω
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)			
Package temperature	T_{si}	150	°C
Current (input current I_F , $\Psi_i = 0$)	I_{si}	200	mA
Power (output or total power dissipation)	Ψ_i	300	mW
Isolation resistance			
$V_{IO} = 500 \text{ V dc}$ at $T_A = T_{si}$	Ris MIN.	10^9	Ω

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Caution	GaAs Products	<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. 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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