

PS9123

Data Sheet

HIGH CMR, 15 Mbps TOTEM POLE OUTPUT TYPE,
 5-PIN SOP (SO-5) PHOTOCOUPLER

R08DS0030EJ0100

Rev.1.00

Aug 14, 2012

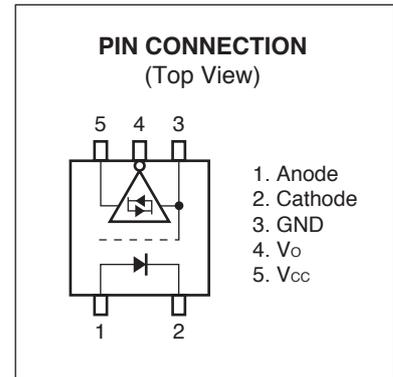
DESCRIPTION

The PS9123 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 PS9123 is specified high CMR, high CTR and pulse width distortion with operating temperature.

<R> 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 ($|t_{PHL} - t_{PLH}| = 4 \text{ ns}$ TYP.)
- High-speed (15 Mbps)
- High isolation voltage ($BV = 3\ 750 \text{ V r.m.s.}$)
- Totem pole output
- Embossed tape product : PS9123-F3 : 2 500 pcs/reel
- Pb-Free product
- Safety standards
 - UL approved: File No. E72422
 - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
 - DIN EN60747-5-5 (VDE0884-5): 2011-11 approved No. 40008902 (Option)



TRUTH TABLE

LED	Output
ON	L
OFF	H

APPLICATIONS

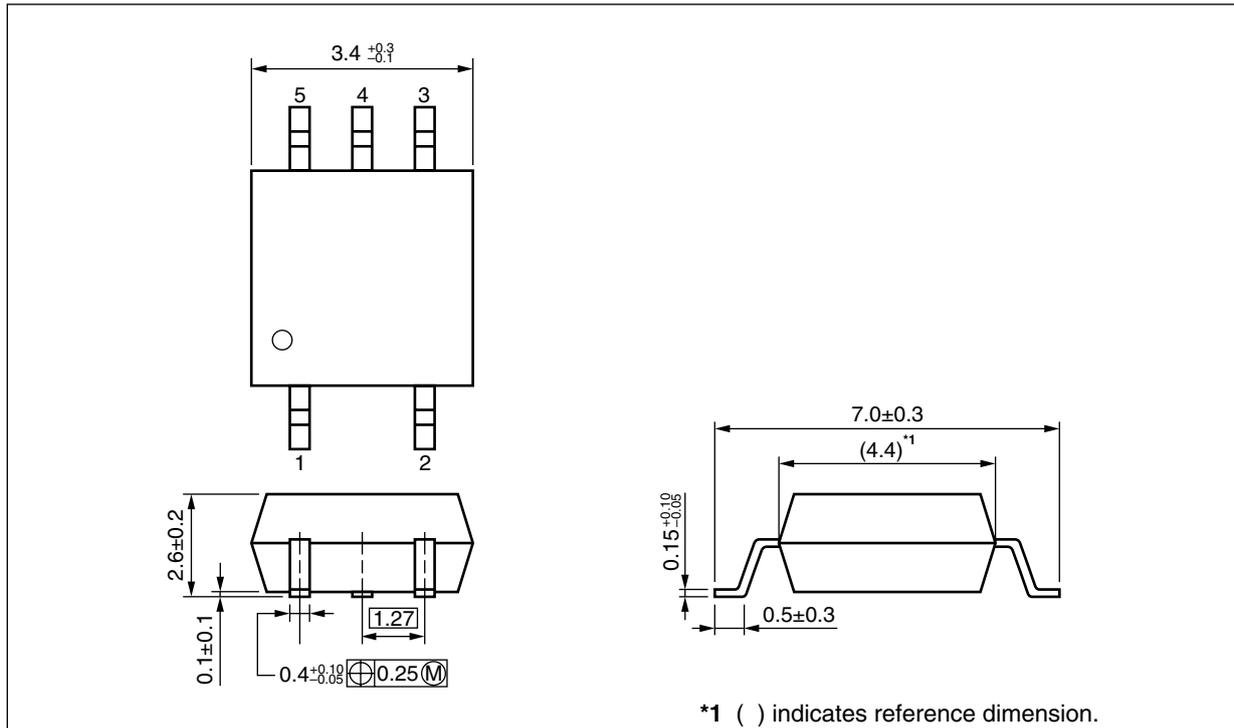
- PLC
- Inverter
- AC servo

The mark <R> shows major revised points.

The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

PS9123

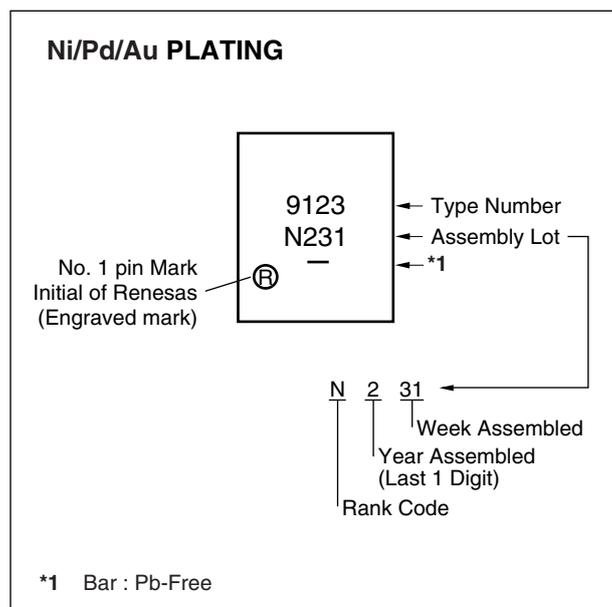
<R> **PACKAGE DIMENSIONS (UNIT: mm)**



<R> **PHOTOCOUPLER CONSTRUCTION**

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

<R> **MARKING EXAMPLE**



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<R> ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number ^{*1}
PS9123	PS9123-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9123
PS9123-F3	PS9123-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9123-V	PS9123-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-5 (VDE0884-5): 2011-11 Approved (Option)	
PS9123-V-F3	PS9123-V-F3-AX		Embossed Tape 2 500 pcs/reel		

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

<R> ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current ^{*1}	I_F	20	mA
	Reverse Voltage	V_R	5	V
Detector	Supply Voltage	V_{CC}	7	V
	Output Voltage	V_O	7	V
	High Level Output Current	I_{OH}	-5	mA
	Low Level Output Current	I_{OL}	13	mA
	Power Dissipation ^{*2}	P_C	130	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	$^\circ\text{C}$

Notes: *1. Reduced to 0.19 mA/ $^\circ\text{C}$ at $T_A = 60^\circ\text{C}$ or more.

*2. $T_A = -40$ to $+100^\circ\text{C}$, applies to output pin V_O and power supply pin V_{CC} . Reduced to 2.4 mW/ $^\circ\text{C}$ at $T_A = 70^\circ\text{C}$ 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.

<R> RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I_{FH}	7.5		12.5	mA
Low Level Input Voltage	V_{FL}	0		0.8	V
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
TTL (loads)	N			3	

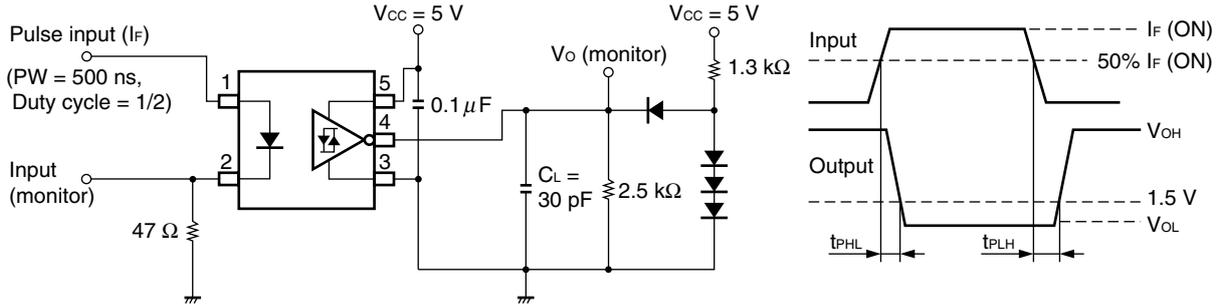
<R> **ELECTRICAL CHARACTERISTICS ($T_A = -40$ to $+100^\circ\text{C}$, unless otherwise specified)**

	Parameter	Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	V_F	$I_F = 10 \text{ mA}$, $T_A = 25^\circ\text{C}$	1.3	1.55	1.8	V
	Reverse Current	I_R	$V_R = 3 \text{ V}$, $T_A = 25^\circ\text{C}$			10	μA
	Terminal Capacitance	C_t	$f = 1 \text{ MHz}$, $V_F = 0 \text{ V}$, $T_A = 25^\circ\text{C}$		30		pF
Detector	High Level Output Current	I_{OH}	$V_{CC} = V_O = 5.5 \text{ V}$, $I_F = 0 \text{ mA}$		0.05	100	μA
	High Level Output Voltage	V_{OH}	$V_{CC} = 4.5 \text{ V}$, $I_F = 0 \text{ mA}$, $I_{OH} = -2 \text{ mA}$	2.4	3.0		V
	Low Level Output Voltage	V_{OL}	$V_{CC} = 4.5 \text{ V}$, $I_F = 7 \text{ mA}$, $I_{OL} = 8 \text{ mA}$		0.25	0.6	V
	High Level Supply Current	I_{CCH}	$V_{CC} = 5.5 \text{ V}$, $I_F = 0 \text{ mA}$, $V_O = \text{open}$		4	7	mA
	Low Level Supply Current	I_{CCL}	$V_{CC} = 5.5 \text{ V}$, $I_F = 10 \text{ mA}$, $V_O = \text{open}$		6	10	mA
	High Level Output Short Circuit Current	I_{OSH}	$V_{CC} = 5.5 \text{ V}$, $V_O = \text{GND}$, $I_F = 0 \text{ mA}$, 10 ms or less		-43		mA
	Low Level Output Short Circuit Current	I_{OSL}	$V_{CC} = V_O = 5.5 \text{ V}$, $I_F = 8 \text{ mA}$, 10 ms or less		28		mA
Coupled	Threshold Input Voltage (H \rightarrow L)	I_{FHL}	$V_{CC} = 5 \text{ V}$, $V_O = 0.6 \text{ V}$		2.3	5	mA
	Isolation Resistance	R_{I-O}	$V_{I-O} = 1 \text{ kV}_{DC}$, $RH = 40$ 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) ^{*2}	t_{PHL}	$V_{CC} = 5 \text{ V}$, $I_F = 7.5 \text{ mA}$	10	28	60	ns
	Propagation Delay Time (L \rightarrow H) ^{*2}	t_{PLH}	$V_{CC} = 5 \text{ V}$, $I_F = 7.5 \text{ mA}$	10	32	60	ns
	Pulse Width Distortion (PWD) ^{*2}	$ t_{PHL} - t_{PLH} $	$V_{CC} = 5 \text{ V}$, $I_F = 7.5 \text{ mA}$		4	30	ns
	Common Mode Transient Immunity at High Level Output ^{*3}	CM_H	$V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$, $I_F = 0 \text{ mA}$, $V_{O(MIN.)} = 2 \text{ V}$, $V_{CM} = 1 \text{ kV}$	15	20		$\text{kV}/\mu\text{s}$
	Common Mode Transient Immunity at Low Level Output ^{*3}	CM_L	$V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$, $I_F = 7.5 \text{ mA}$, $V_{O(MAX.)} = 0.8 \text{ V}$, $V_{CM} = 1 \text{ kV}$	15	20		$\text{kV}/\mu\text{s}$

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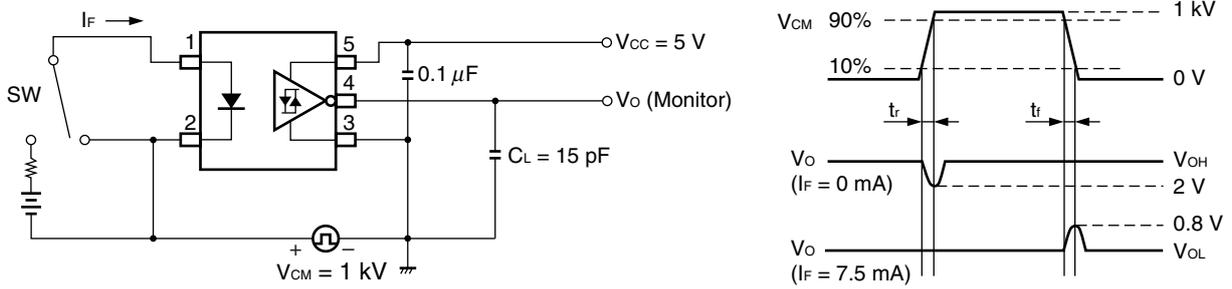
Notes: *1. Typical values at $T_A = 25^\circ\text{C}$

*2. Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

*3. Test circuit for common mode transient immunity

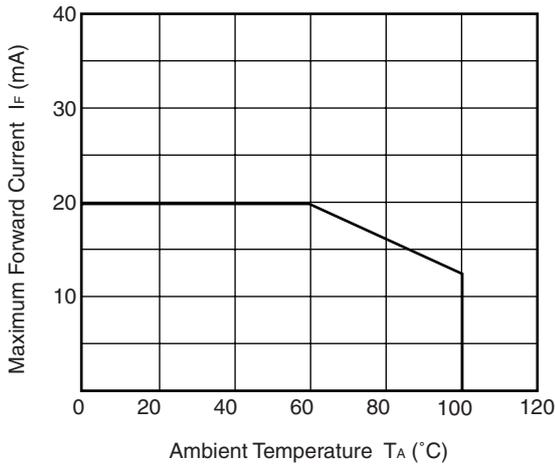


C_L includes probe and stray wiring capacitance.

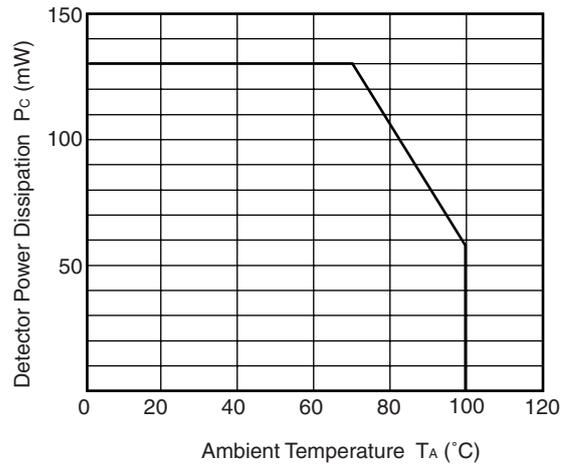
PS9123

<R> TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)

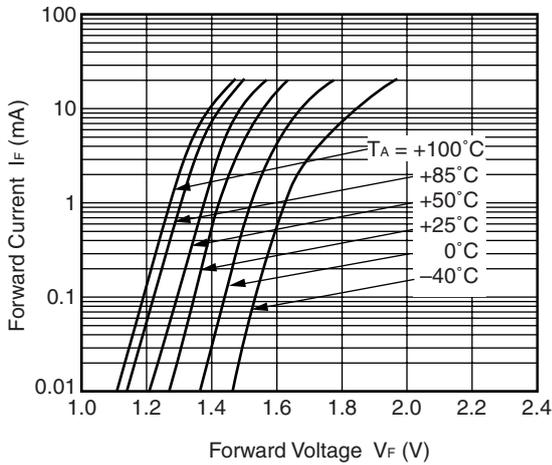
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



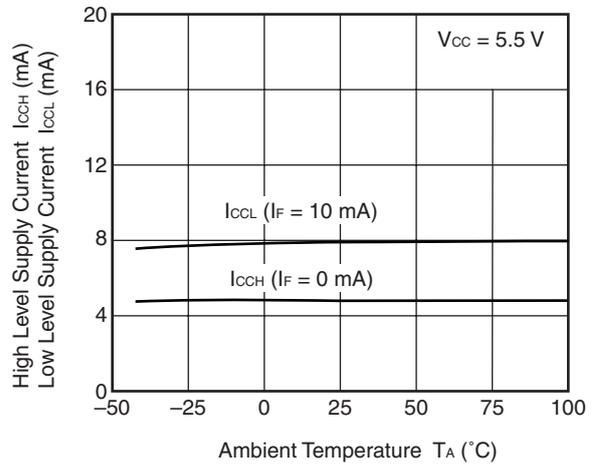
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



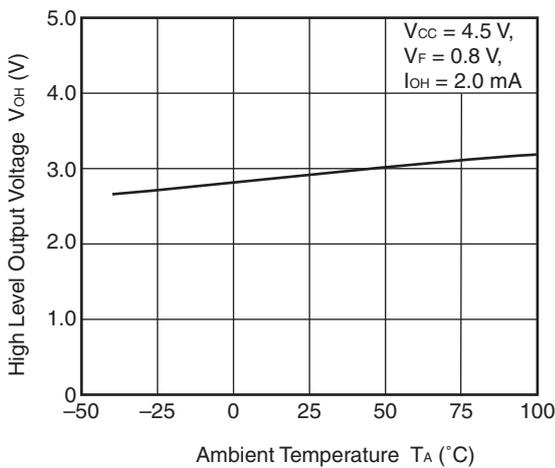
FORWARD CURRENT vs. FORWARD VOLTAGE



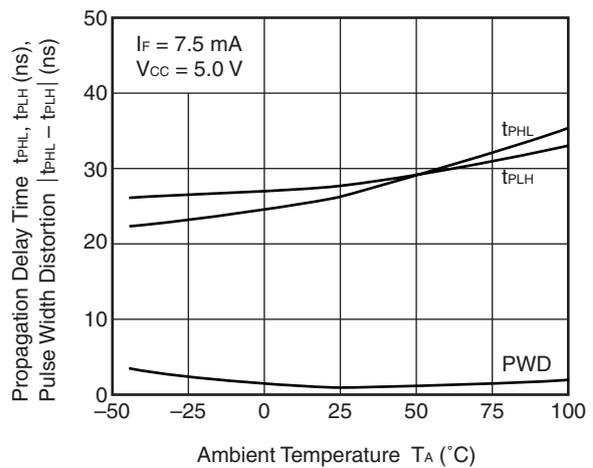
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



HIGH LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

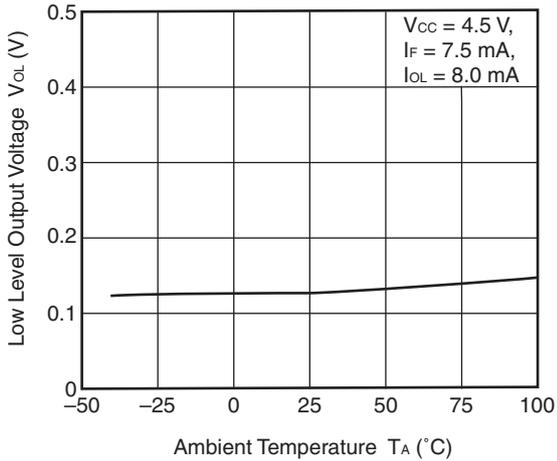


PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

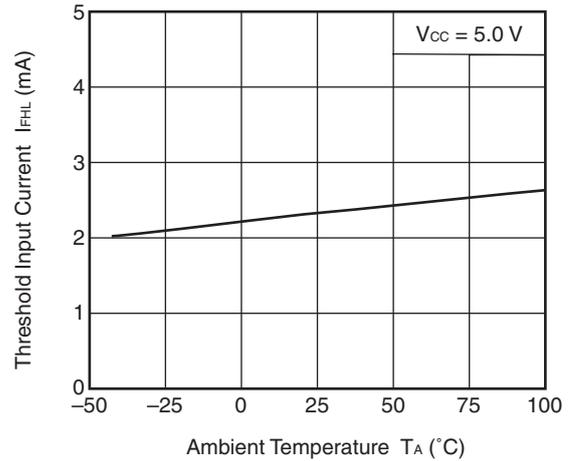


Remark The graphs indicate nominal characteristics.

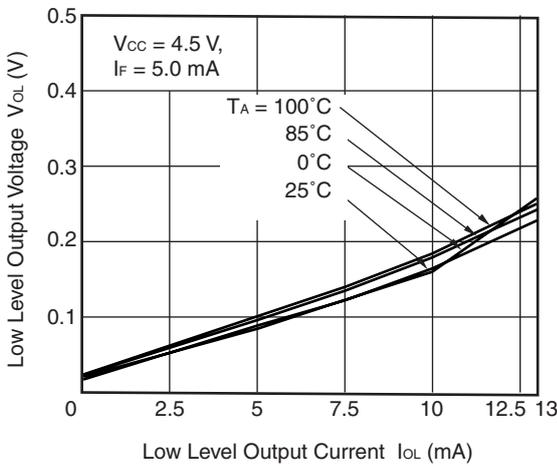
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



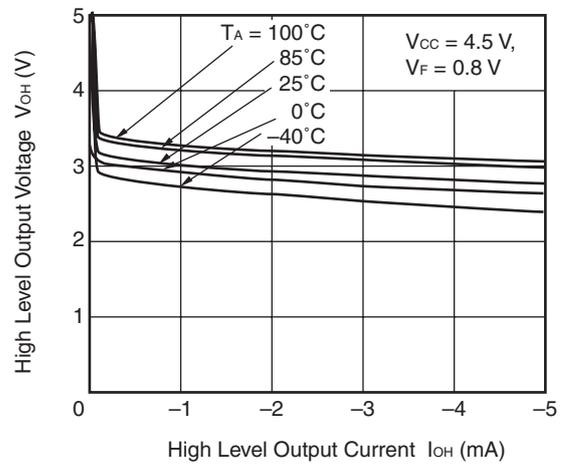
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



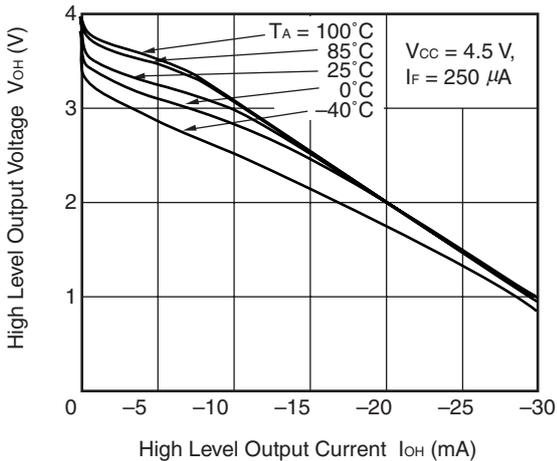
LOW LEVEL OUTPUT VOLTAGE vs. LOW LEVEL OUTPUT CURRENT



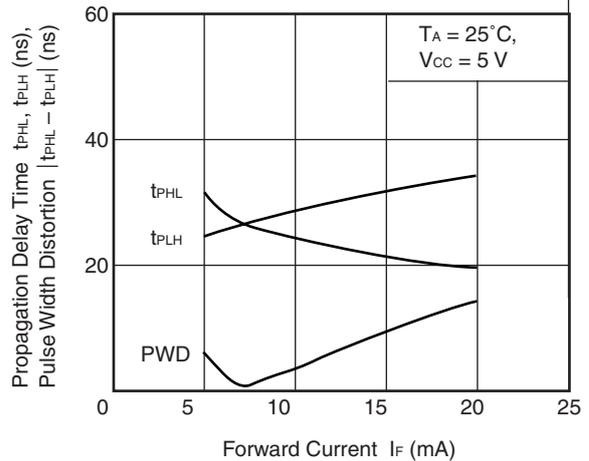
HIGH LEVEL OUTPUT VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



HIGH LEVEL OUTPUT VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT

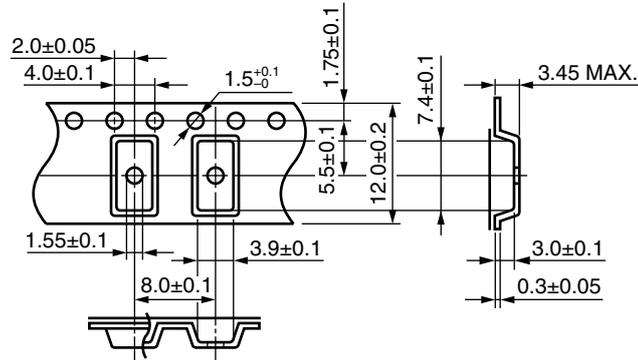


Remark The graphs indicate nominal characteristics.

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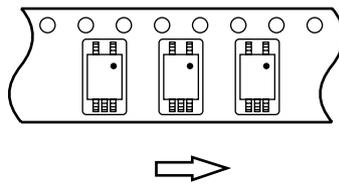
<R> **TAPING SPECIFICATIONS (UNIT: mm)**

Outline and Dimensions (Tape)

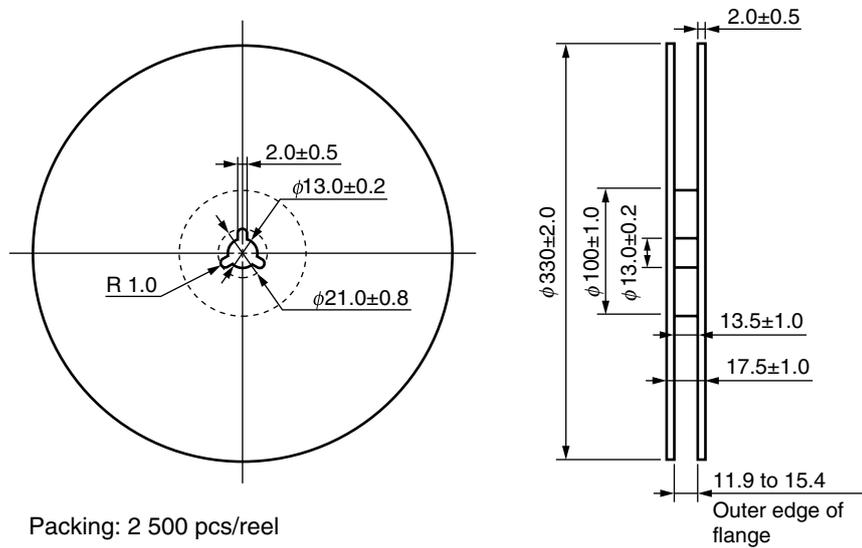


Tape Direction

PS9123-F3



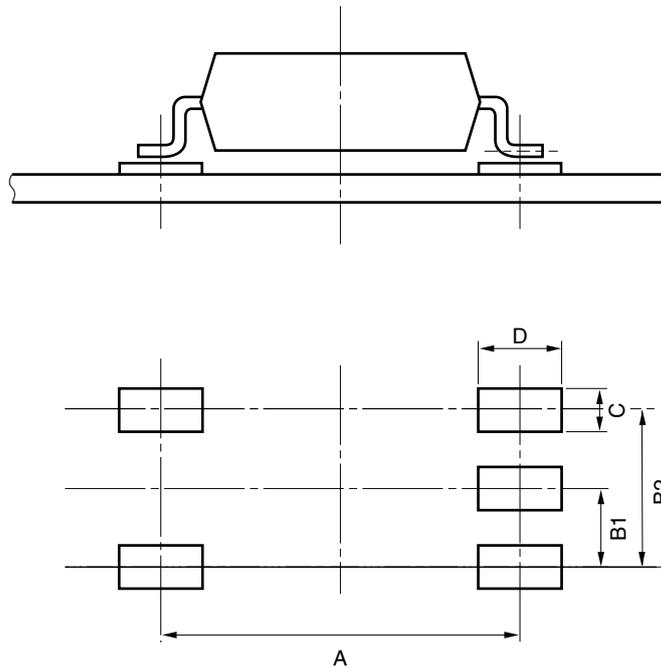
Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

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



Part Number	A	B1	B2	C	D
PS9123	6.25	1.27	2.54	0.8	1.45

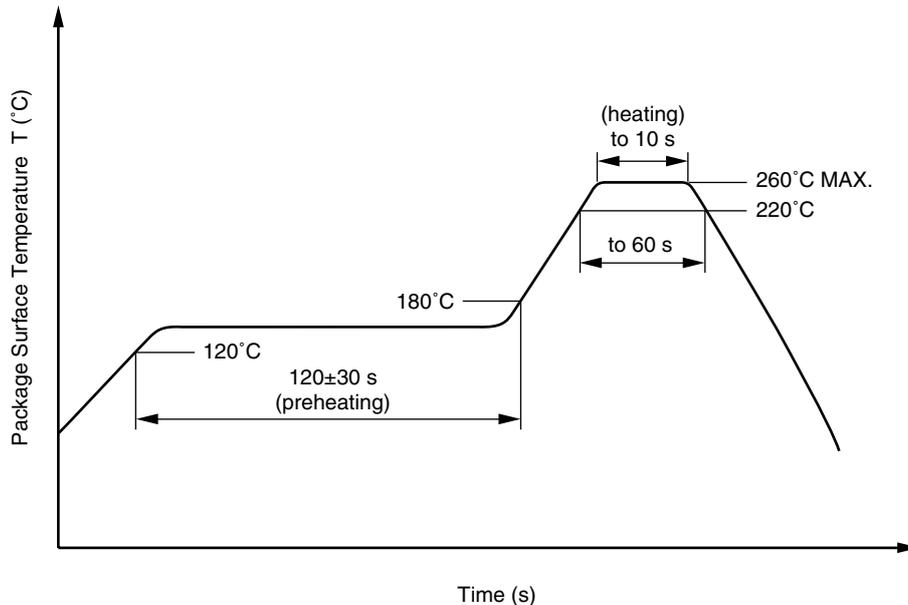
NOTES ON HANDLING

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 or less
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% or less 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% or less is recommended.)

(3) Soldering by Soldering Iron

- Peak Temperature (lead part temperature) 350°C or below
- Time (each pin) 3 seconds or less
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% or less is recommended.)

(a) Soldering of leads should be made at the point 1.5 to 2.0 mm from the root of the lead

(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 at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

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 or more is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is 10 mm or less.
3. Avoid storage at a high temperature and high humidity.

<R> 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) $U_{pr} = 1.6 \times U_{IORM}, P_d < 5 \text{ pC}$	U_{pr}	1 131	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	
Comparative tracking index (IEC 60112/DIN EN 60112 (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 +100	°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}	Ω Ω
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)			
Package temperature	T_{si}	150	°C
Current (input current $I_F, P_{si} = 0$)	I_{si}	200	mA
Power (output or total power dissipation)	P_{si}	300	mW
Isolation resistance $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	Ris MIN.	10^9	Ω

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.<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.
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Revision History**PS9123 Data Sheet**

Rev.	Date	Description	
		Page	Summary
0.01	Jan 29, 2011	–	First edition issued
1.00	Aug 14, 2012	Throughout	“Preliminary Data Sheet” is changed to “Data Sheet.”
		p.1	Modification of FEATURES
		p.2	Modification of PACKAGE DIMENSIONS
			Modification of PHOTOCOUPLER CONSTRUCTION
			Modification of MARKING EXAMPLE
		p.3	Addition of ORDERING INFORMATION
			Modification of ABSOLUTE MAXIMUM RATINGS
			Modification of RECOMMENDED OPERATING CONDITIONS
		pp.4, 5	Modification of ELECTRICAL CHARACTERISTICS
		pp.6, 7	Addition of TYPICAL CHARACTERISTICS
		p.8	Addition of TAPING SPECIFICATIONS
p.9	Addition of RECOMMENDED MOUNT PAD DIMENSIONS		
pp.10, 11	Addition of NOTES ON HANDLING		
p.12	Addition of SPECIFICATION OF VDE MARKS LICENSE DOCUMENT		

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