

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

—NEPOC Series—

DESCRIPTION

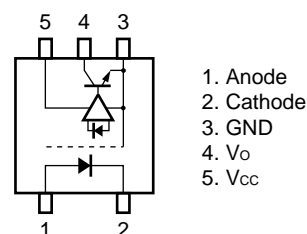
The PS9113 is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

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 (SO-5)
- 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.)
- High isolation voltage ($BV = 3\,750 \text{ Vr.m.s.}$)
- Open collector output
- 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)
 - CSA approved: File No. 2115273 (CA 101391)

PIN CONNECTION (Top View)

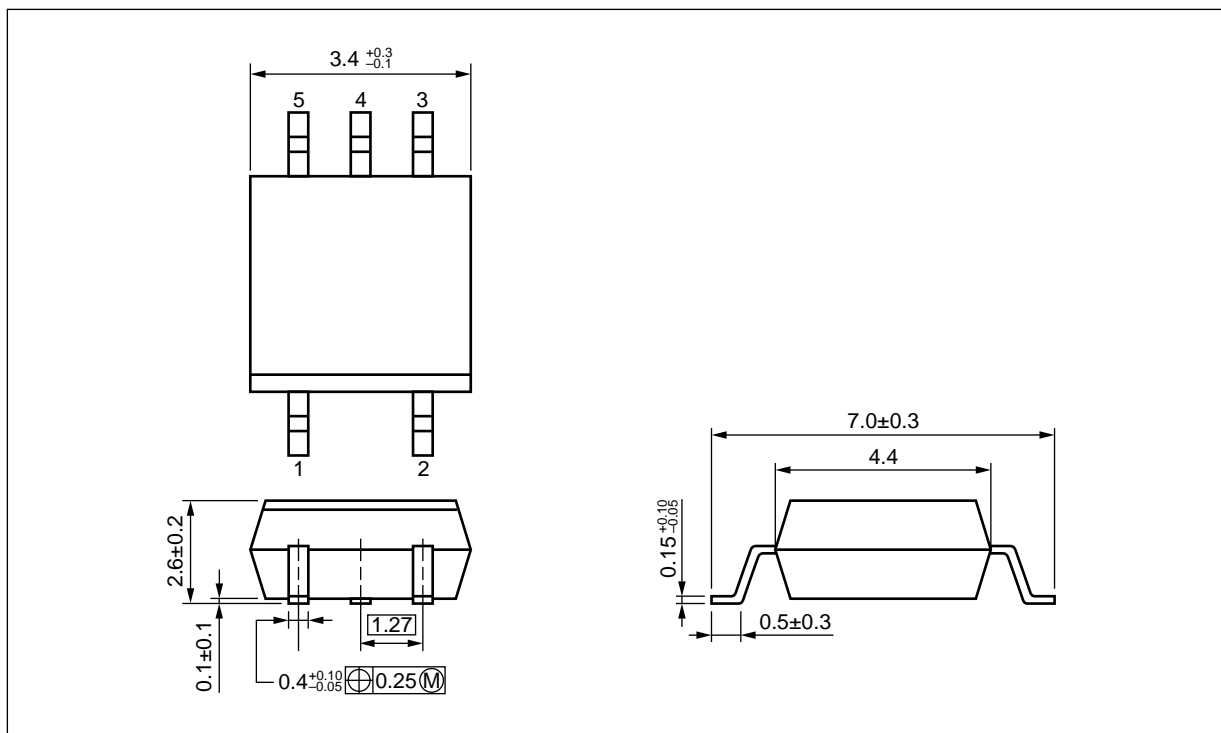


APPLICATIONS

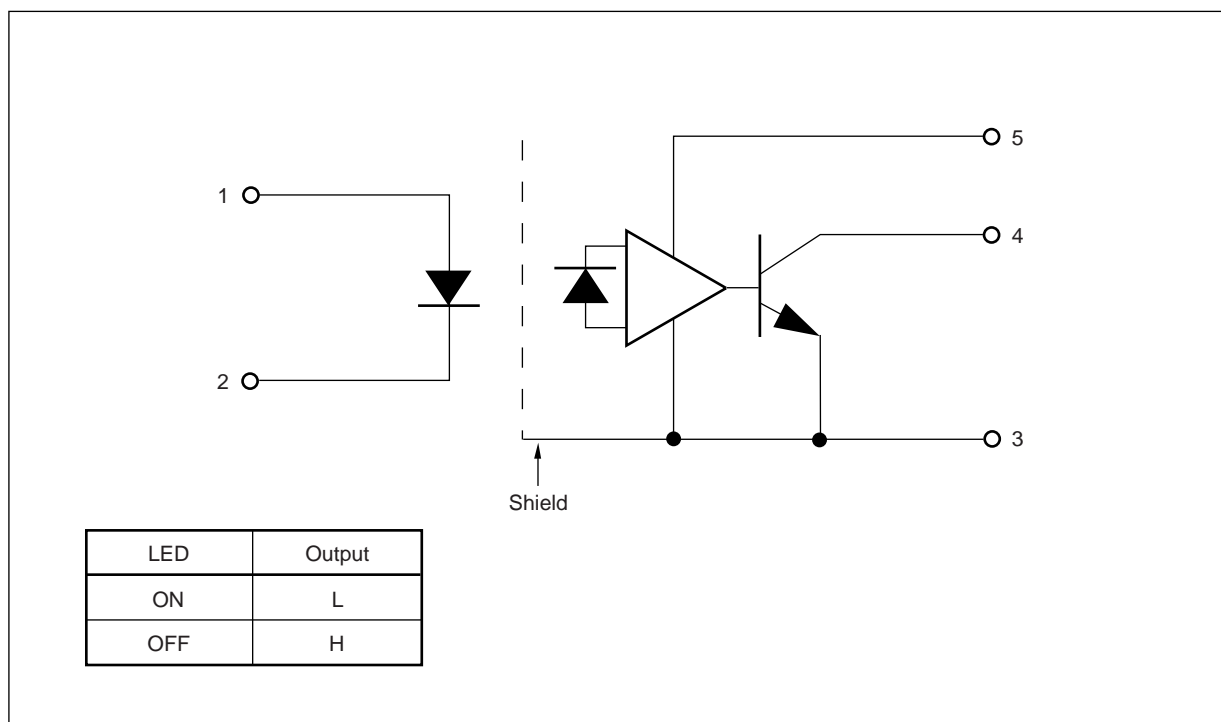
- IPM Driver
- General purpose inverter

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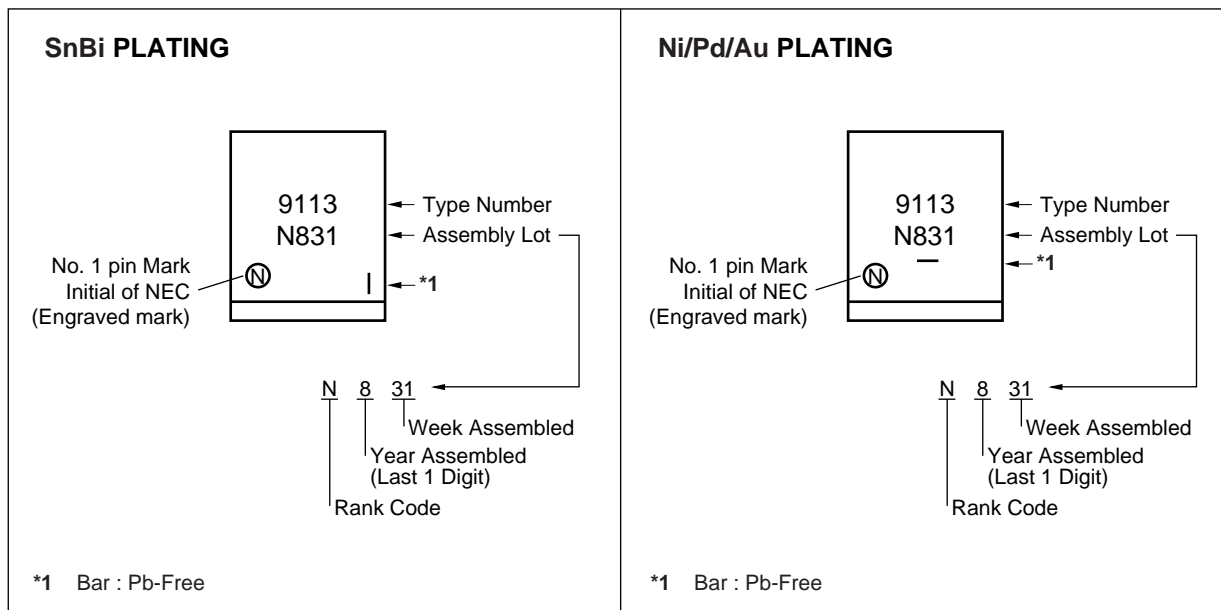
PACKAGE DIMENSIONS (UNIT: mm)



FUNCTIONAL DIAGRAM



<R> **MARKING EXAMPLE**



<R> ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number* ¹	
PS9113	PS9113-A	Pb-Free (SnBi)	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		
PS9113-V-F3	PS9113-V-F3-A		Embossed Tape 2 500 pcs/reel	(VDE0884 Part2)		
PS9113-V-F4	PS9113-V-F4-A			Approved (Option)		
PS9113	PS9113-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL approved)		PS9113
PS9113-F3	PS9113-F3-AX		Embossed Tape 2500 pcs/reel			
PS9113-F4	PS9113-F4-AX					
PS9113-V	PS9113-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2		
PS9113-V-F3	PS9113-V-F3-AX		Embossed Tape 2 500 pcs/reel	(VDE0884 Part2)		
PS9113-V-F4	PS9113-V-F4-AX			Approved (Option)		

*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	3 750	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

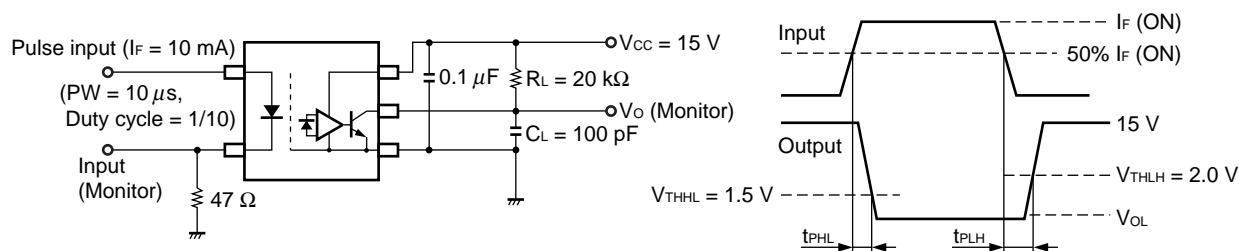
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I_{FH}	10		20	mA
Output Voltage	V_O	0		30	V
Supply Voltage	V_{CC}	4.5		30	V
LED Off Voltage	V_F	0		0.8	V

ELECTRICAL CHARACTERISTICS ($T_A = -40$ to $+100^\circ\text{C}$, $V_{CC} = 15$ 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_i	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		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_{CCH}	$V_{CC} = 30$ V, $V_F = 0.8$ V, $V_O = \text{open}$		0.6	1.3	mA
	Low Level Supply Current	I_{CCL}	$V_{CC} = 30$ V, $I_F = 10$ mA, $V_O = \text{open}$		0.6	1.3	mA
Coupled	Threshold Input Current ($H \rightarrow L$)	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% , $T_A = 25^\circ\text{C}$	10^{11}			Ω
	Isolation Capacitance	C_{I-O}	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		0.6		pF
	Propagation Delay Time ($H \rightarrow L$) ^{*2}	t_{PHL}	$I_F = 10$ mA, $R_L = 20$ k Ω , $C_L = 100$ pF, $V_{THHL} = 1.5$ V, $V_{THLH} = 2.0$ V		250	500	ns
	Propagation Delay Time ($L \rightarrow H$) ^{*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	$T_A = 25^\circ\text{C}$, $I_F = 0$ mA, $V_O > 3.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k Ω , $C_L = 100$ pF	15			kV/ μs
	Common Mode Transient Immunity at Low Level Output ^{*3}	CM_L	$T_A = 25^\circ\text{C}$, $I_F = 10$ mA, $V_O < 1.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k Ω , $C_L = 100$ pF	15			kV/ μs

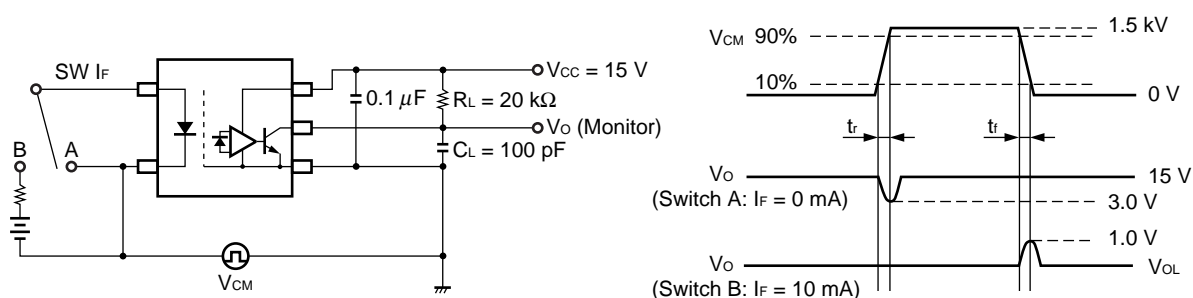
*1 Typical values at $T_A = 25^\circ\text{C}$.

*2 Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

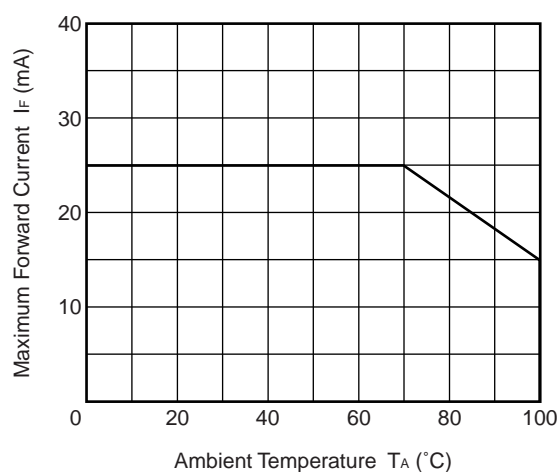
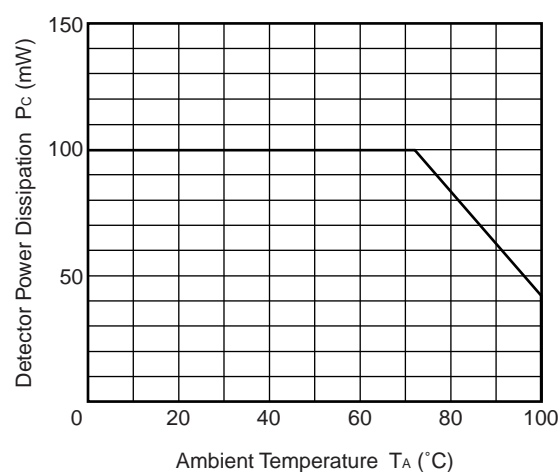
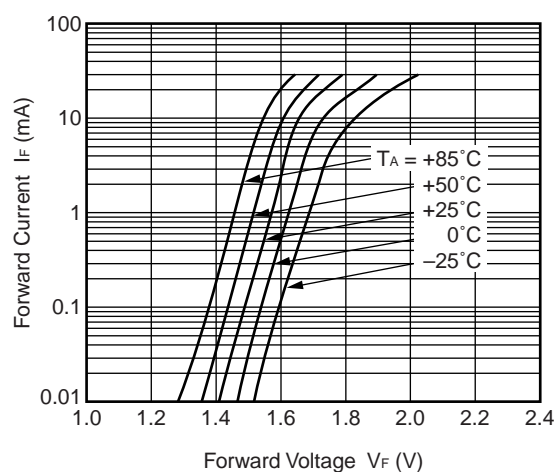
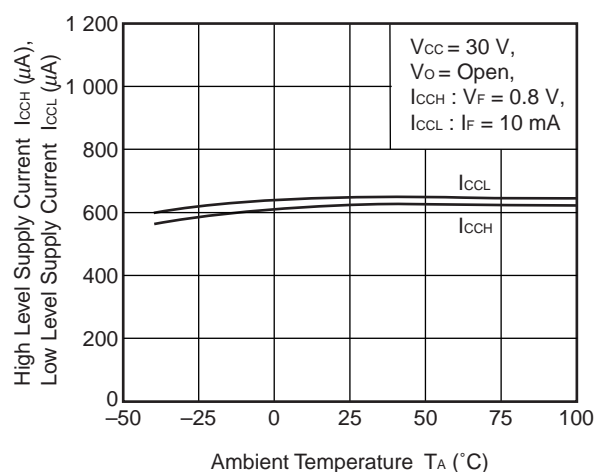
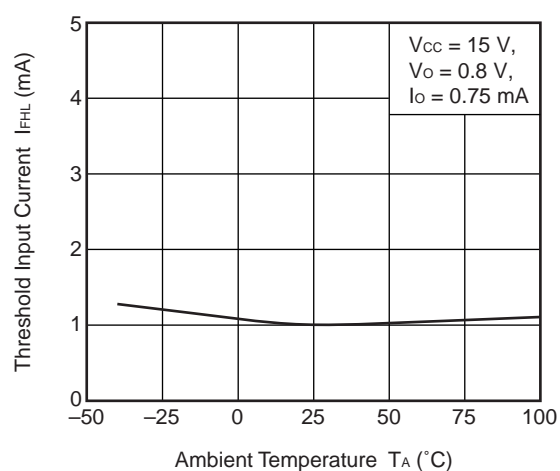
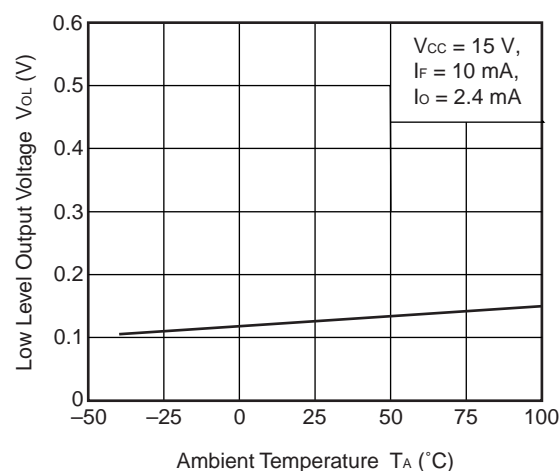
*3 Test circuit for common mode transient immunity



C_L includes probe and stray wiring capacitance.

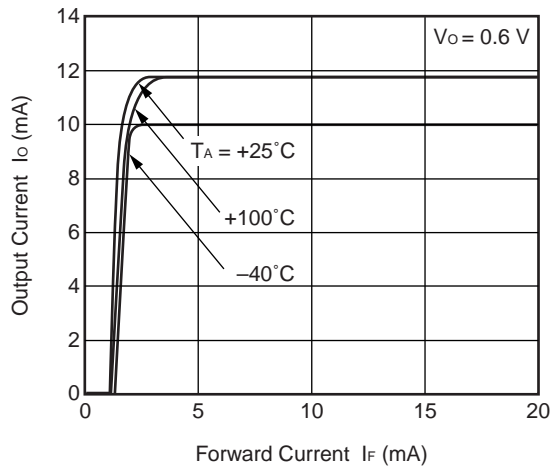
USAGE CAUTIONS

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 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.

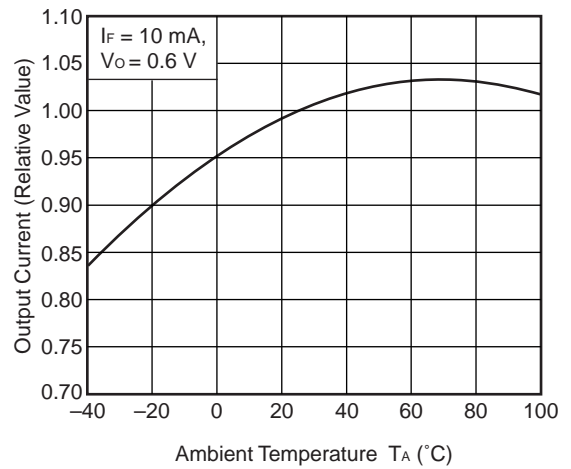
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise specified)MAXIMUM FORWARD CURRENT
vs. AMBIENT TEMPERATUREDETECTOR POWER DISSIPATION
vs. AMBIENT TEMPERATUREFORWARD CURRENT vs.
FORWARD VOLTAGESUPPLY CURRENT vs.
AMBIENT TEMPERATURETHRESHOLD INPUT CURRENT vs.
AMBIENT TEMPERATURELOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE

Remark The graphs indicate nominal characteristics.

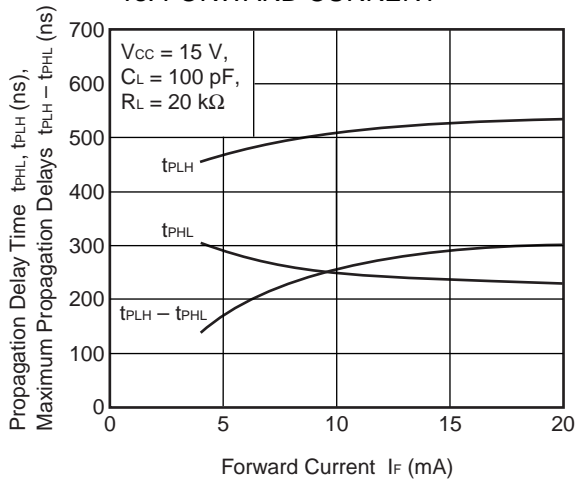
OUTPUT CURRENT vs. FORWARD CURRENT



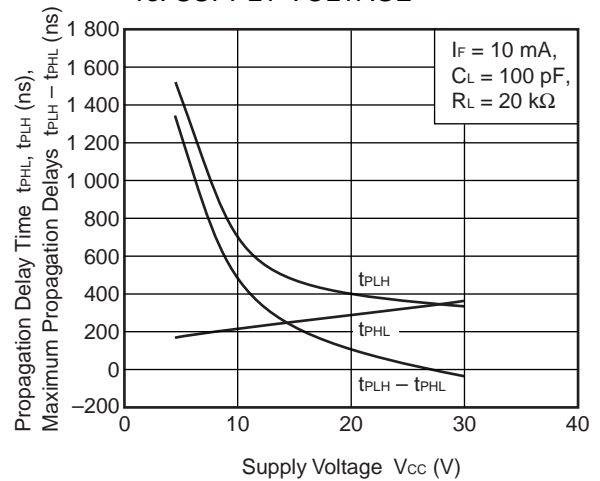
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



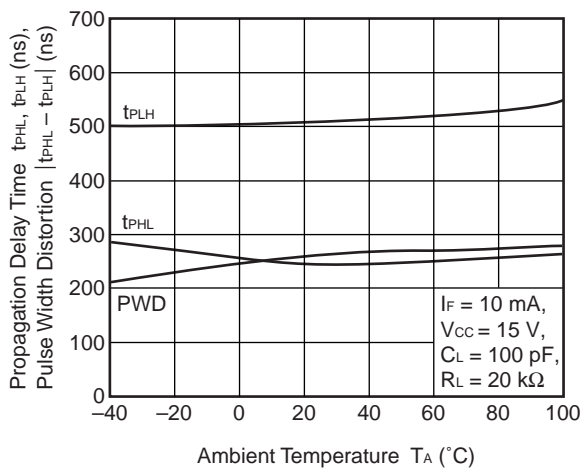
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



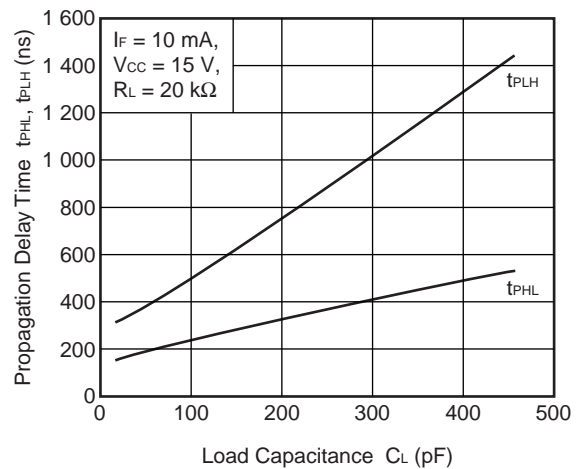
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE



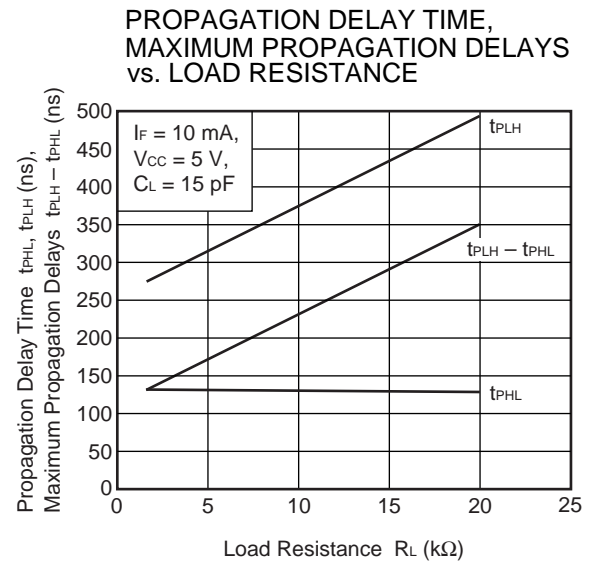
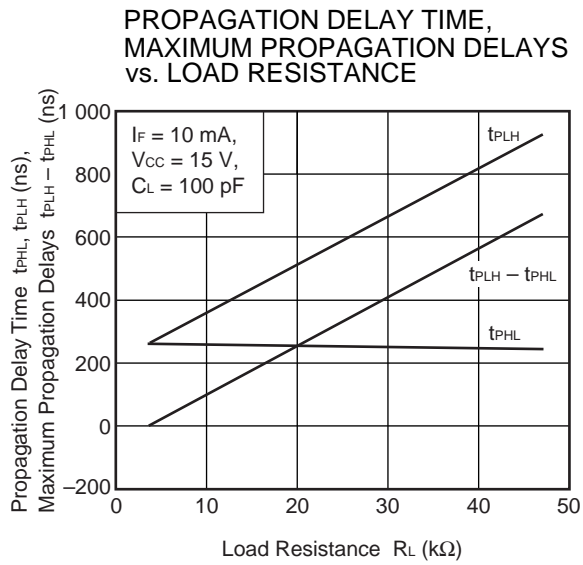
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. LOAD CAPACITANCE



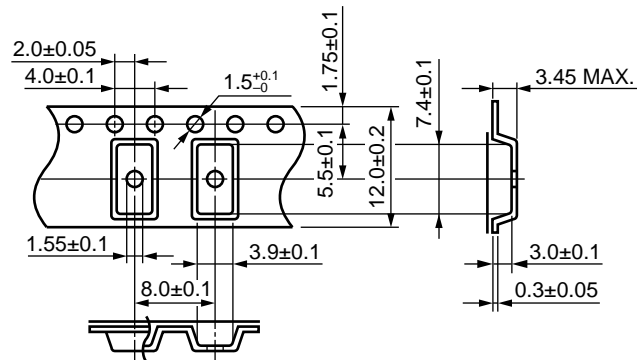
Remark The graphs indicate nominal characteristics.



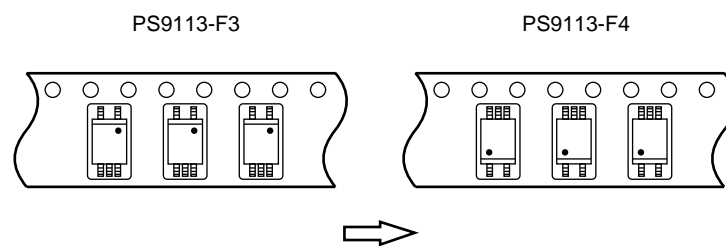
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

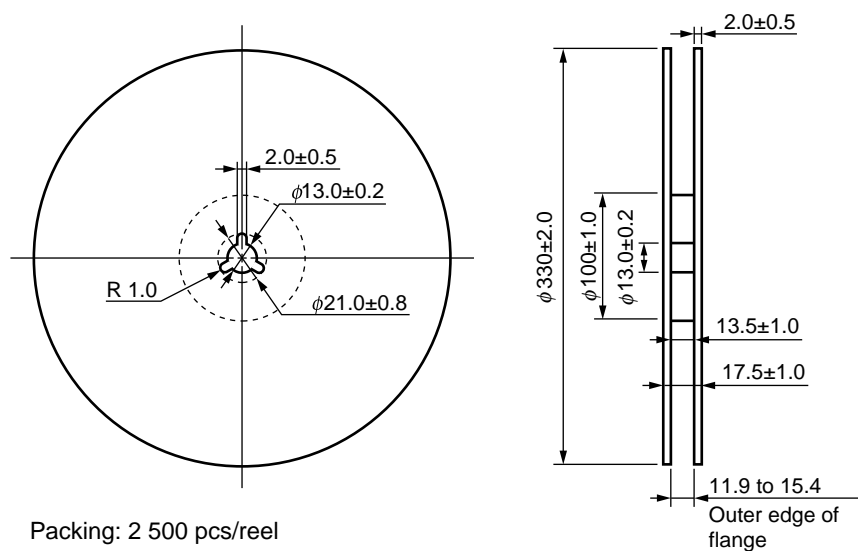
Outline and Dimensions (Tape)



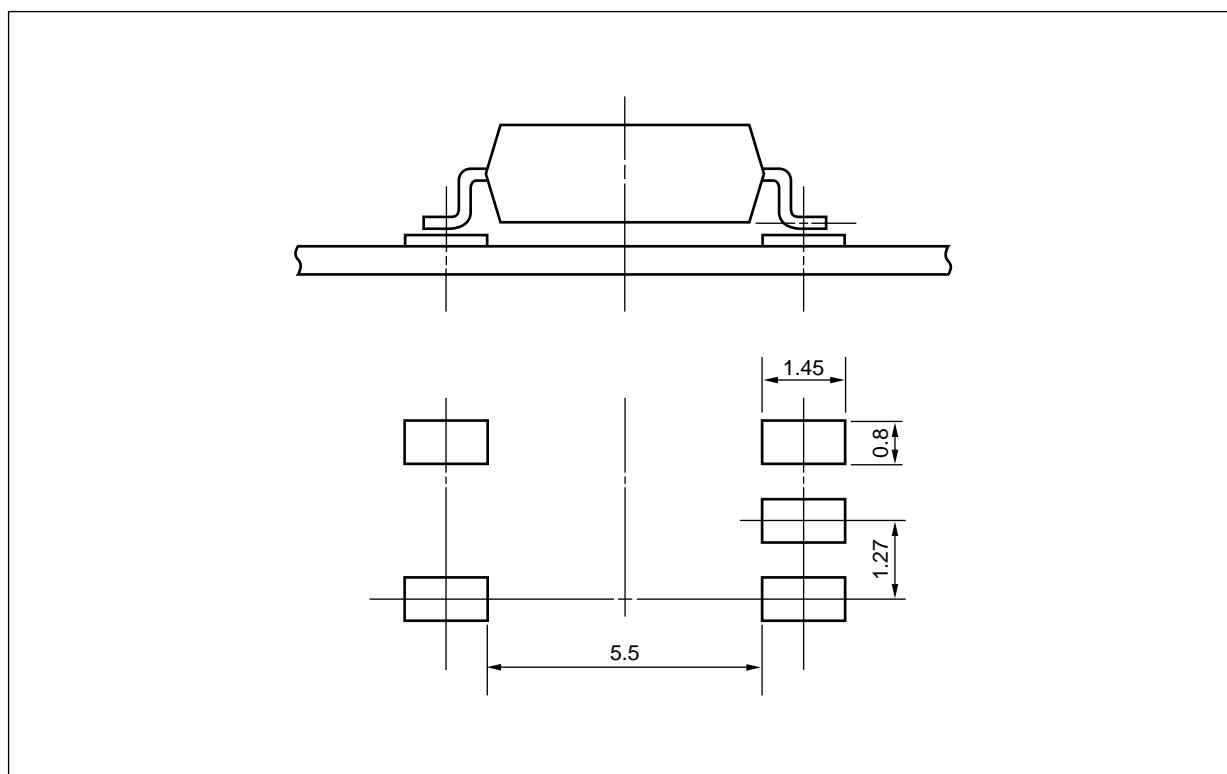
Tape Direction



Outline and Dimensions (Reel)



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



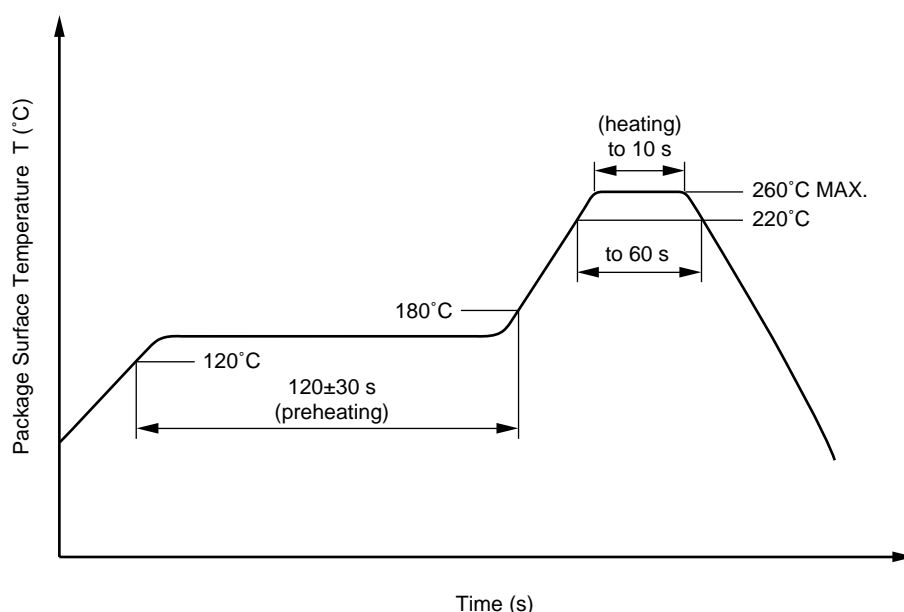
NOTES ON HANDLING

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)		40/100/21	
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 +100	°C
Isolation resistance, minimum value $V_{IO} = 500$ V dc at $T_A = 25^\circ\text{C}$ $V_{IO} = 500$ V dc at T_A MAX. at least 100°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 Current (input current I_F , $P_{si} = 0$) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500$ V dc at $T_A = T_{si}$	T_{si} I_{si} P_{si} Ris MIN.	150 200 300 10^9	°C mA mW Ω

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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.