RENESAS

DATA SHEET

PHOTOCOUPLER

PS9113

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

–NEPOC Series–

DESCRIPTION

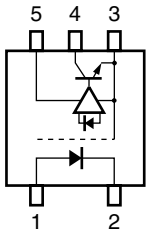
The PS9113 is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

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 = ±15 kV/μs MIN.)
- Small package (SO-5)
- High-speed response (t_{PHL} = 500 ns MAX., t_{PLH} = 750 ns MAX.)
- Maximum propagation delays ($t_{PLH} - t_{PHL}$ = 270 ns TYP.)
- Pulse width distortion ($|t_{PHL} - t_{PLH}|$ = 270 ns TYP.)
- High isolation voltage (BV = 3 750 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)

PIN CONNECTION
(Top View)



1. Anode
2. Cathode
3. GND
4. V_O
5. V_{CC}

APPLICATIONS

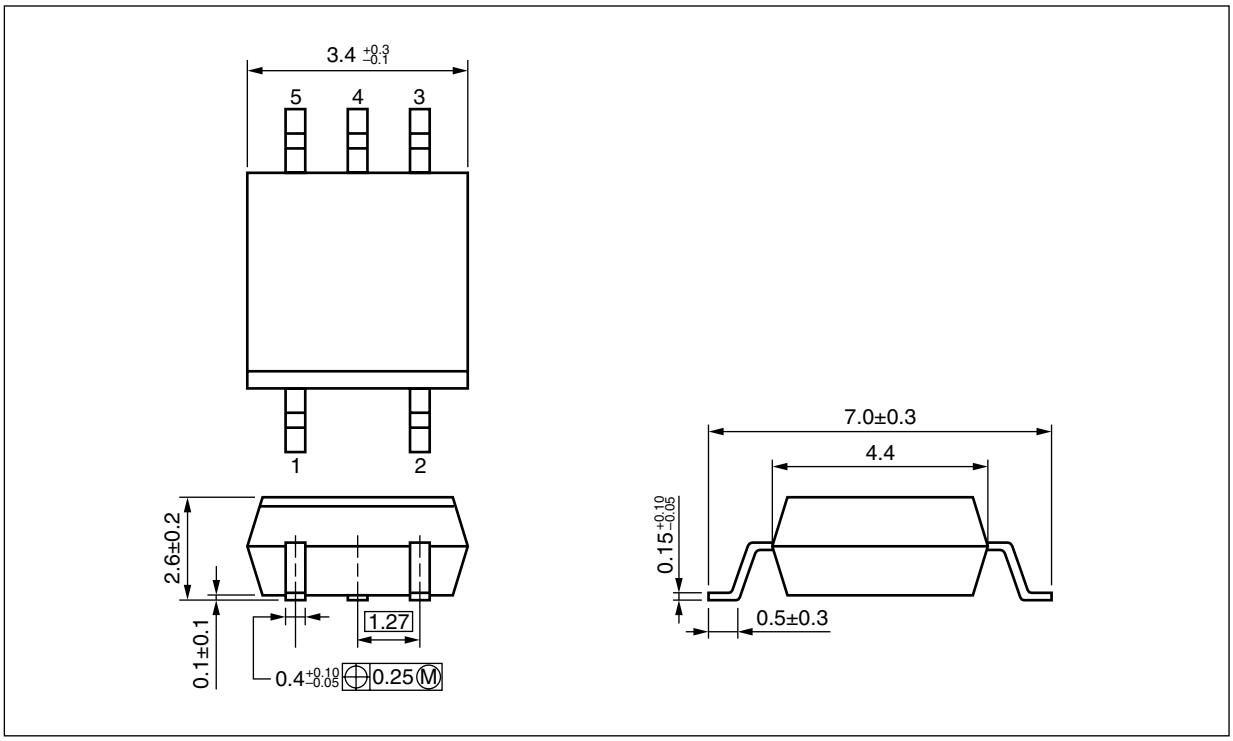
- IPM Driver
- General purpose inverter

Document No. PN10265EJ05V0DS (5th edition)
Date Published August 2008 NS
Printed in Japan

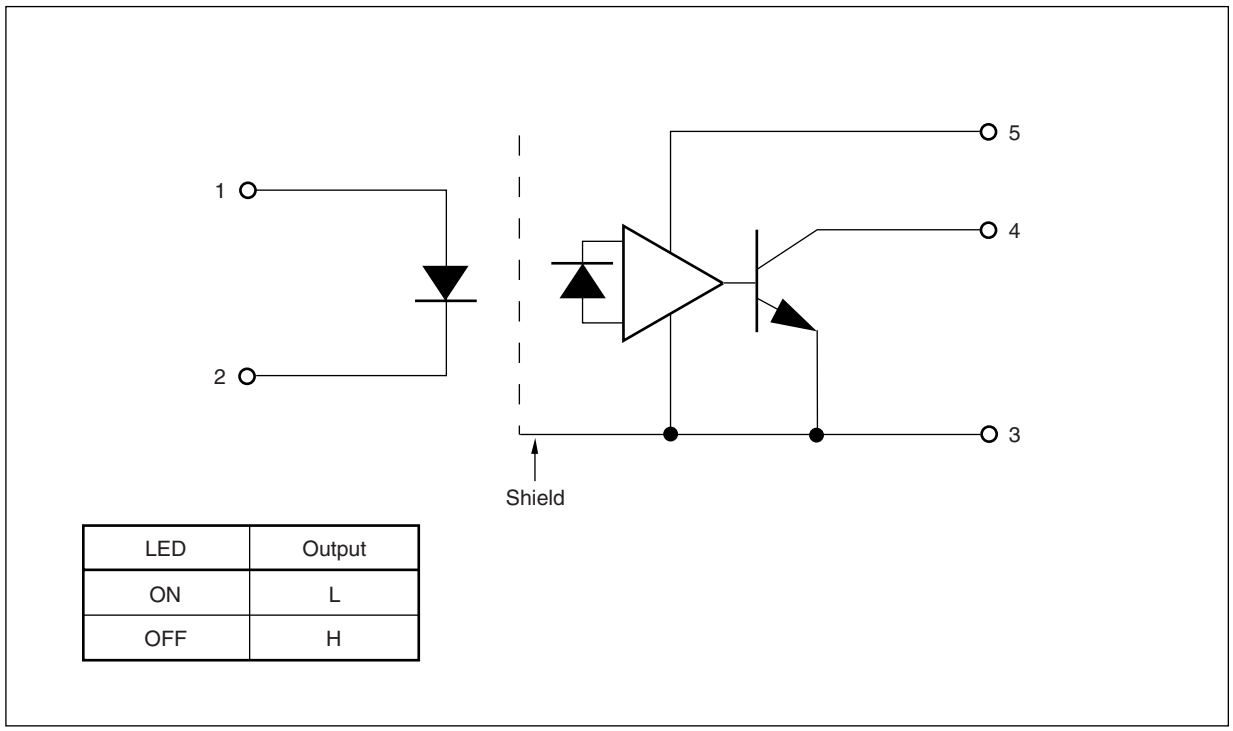
The mark <R> shows major revised points.

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

PACKAGE DIMENSIONS (UNIT: mm)



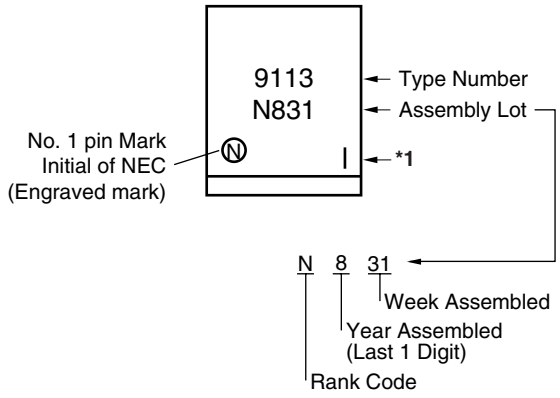
FUNCTIONAL DIAGRAM



LED	Output
ON	L
OFF	H

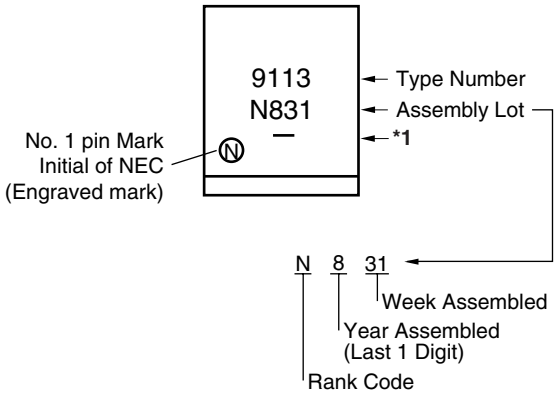
<R> **MARKING EXAMPLE**

SnBi PLATING



1 Bar : Pb-Free

Ni/Pd/Au PLATING



1 Bar : Pb-Free

<R> **ORDERING INFORMATION**

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9113	PS9113-A	Pb-Free	20 pcs (Tape 20 pcs cut)	Standard products	PS9113
PS9113-F3	PS9113-F3-A	(SnBi)	Embossed Tape 2500 pcs/reel	(UL approved)	
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	20 pcs (Tape 20 pcs cut)	Standard products	
PS9113-F3	PS9113-F3-AX	(Ni/Pd/Au)	Embossed Tape 2500 pcs/reel	(UL approved)	
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

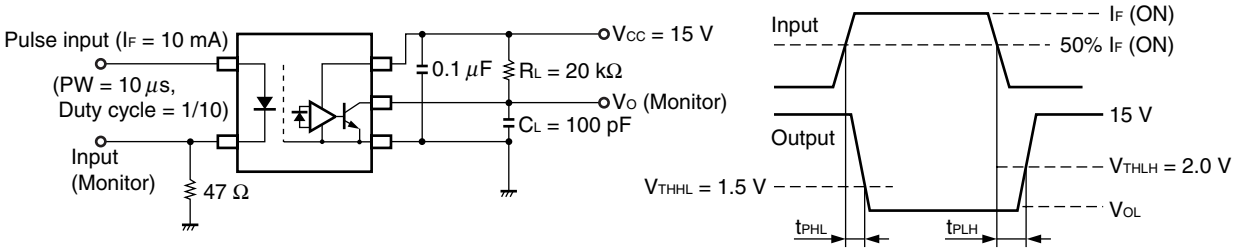
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I_{FH}	10		20	mA
Output Voltage	V_O	0		30	V
Supply Voltage	V_{CC}	4.5		30	V
LED Off Voltage	V_F	0		0.8	V

ELECTRICAL CHARACTERISTICS (T_A = –40 to +100°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_t	V = 0 V, f = 1 MHz, T_A = 25°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 = open		0.6	1.3	mA
	Low Level Supply Current	I_{CCL}	V_{CC} = 30 V, I_F = 10 mA, V_O = open		0.6	1.3	mA
Coupled	Threshold Input Current (H → 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}, RH = 40 to 60%, T_A = 25°C	10^{11}			Ω
	Isolation Capacitance	C_{I-O}	V = 0 V, f = 1 MHz, T_A = 25°C		0.6		pF
	Propagation Delay Time (H → L)*2	t_{PHL}	I_F = 10 mA, R_L = 20 kΩ, C_L = 100 pF, V_{THHL} = 1.5 V, V_{THLH} = 2.0 V		250	500	ns
	Propagation Delay Time (L → H)*2	t_{PLH}			520	750	
	Maximum Propagation Delays	t_{PLH}–t_{PHL}		–200	270	650	
	Pulse Width Distortion (PWD)*2	$\lvert t_{PHL}-t_{PLH} \rvert$			270	650	
	Common Mode Transient Immunity at High Level Output*3	CM_H	T_A = 25°C, I_F = 0 mA, V_O > 3.0 V, V_{CM} = 1.5 kV, R_L = 20 kΩ, C_L = 100 pF	15			kV/μs
	Common Mode Transient Immunity at Low Level Output*3	CM_L	T_A = 25°C, I_F = 10 mA, V_O < 1.0 V, V_{CM} = 1.5 kV, R_L = 20 kΩ, C_L = 100 pF	15			kV/μs

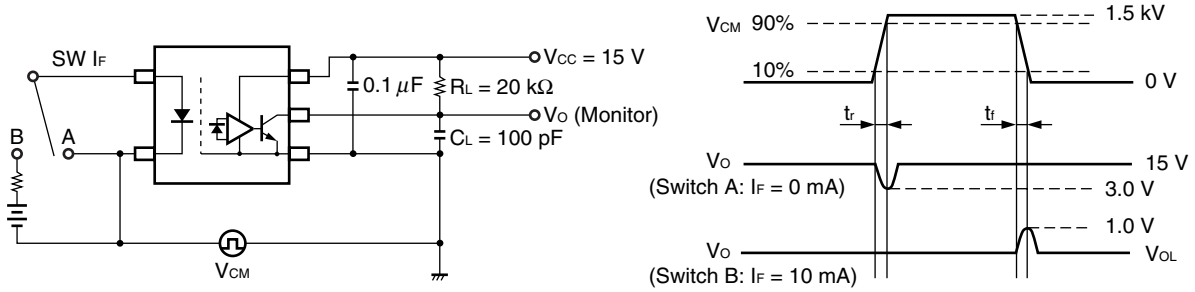
***1** Typical values at T_A = 25°C.

***2** Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

***3** Test circuit for common mode transient immunity



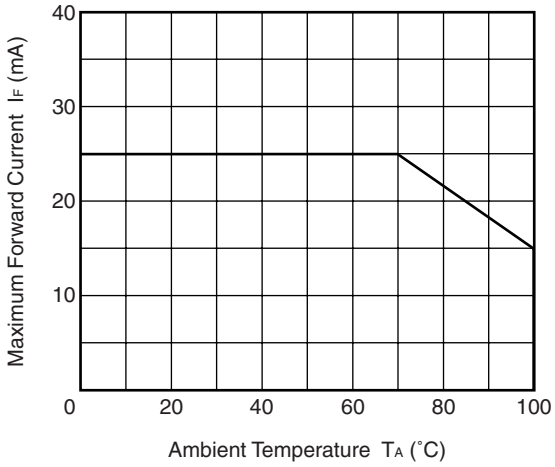
C_L includes probe and stray wiring capacitance.

USAGE CAUTIONS

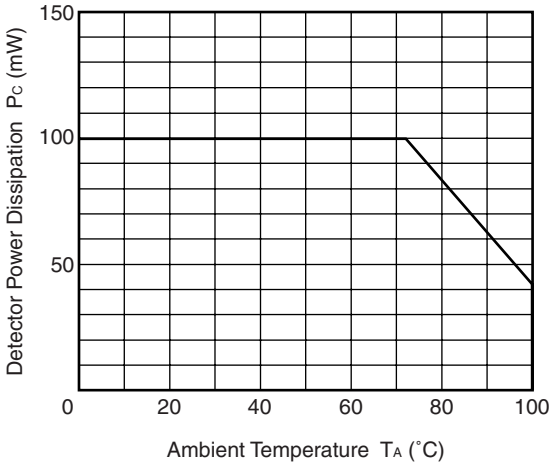
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of 0.1 μF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor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

TYPICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

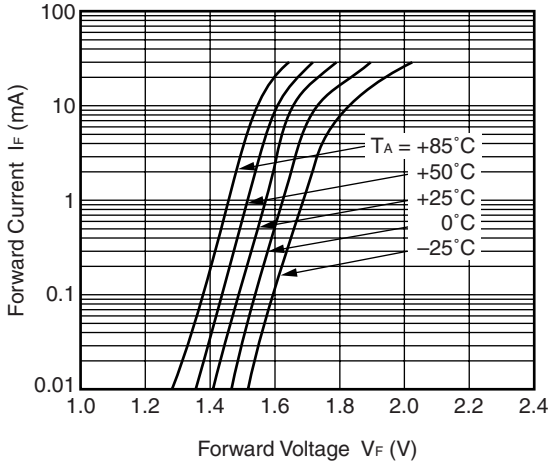
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



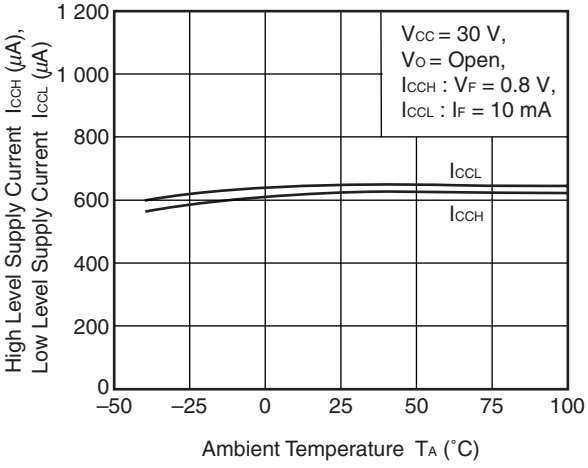
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



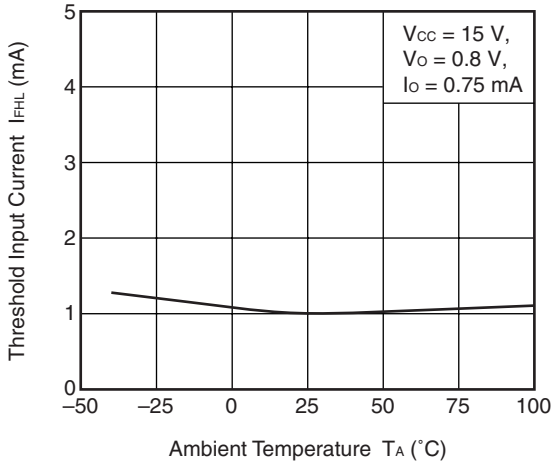
FORWARD CURRENT vs. FORWARD VOLTAGE



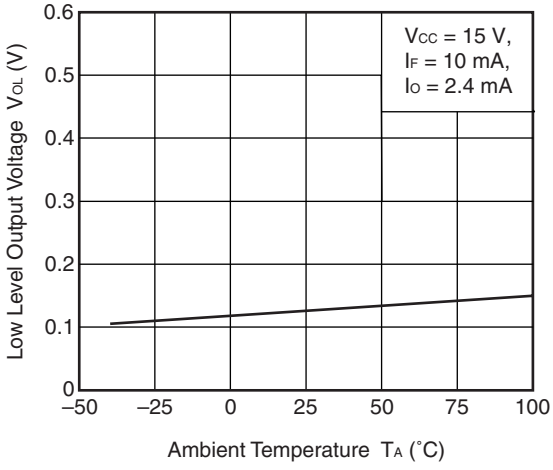
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

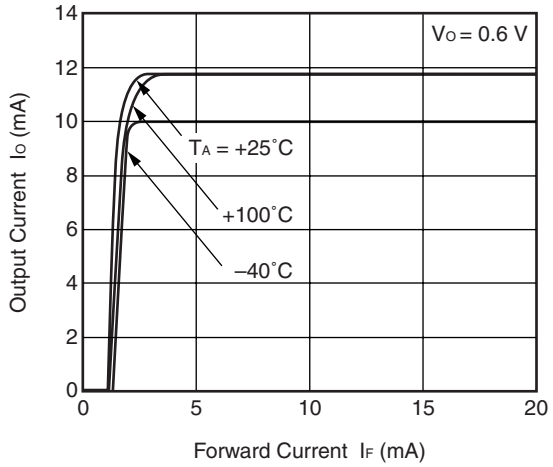


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

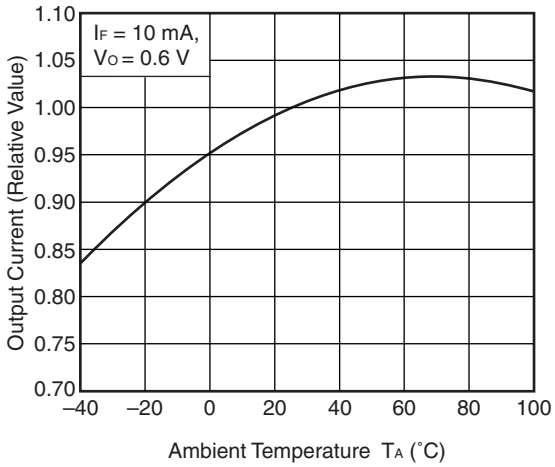


Remark The graphs indicate nominal characteristics.

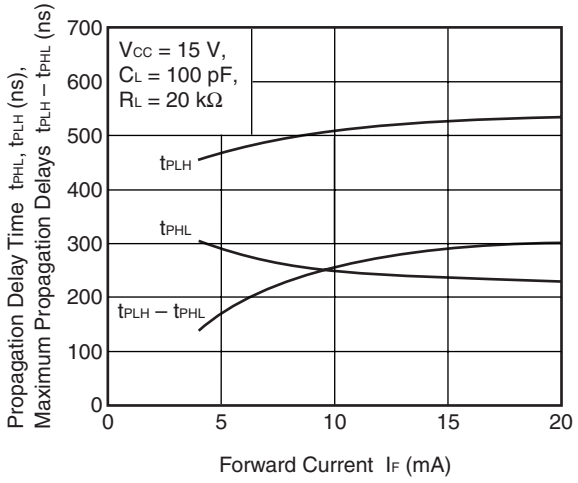
OUTPUT CURRENT vs. FORWARD CURRENT



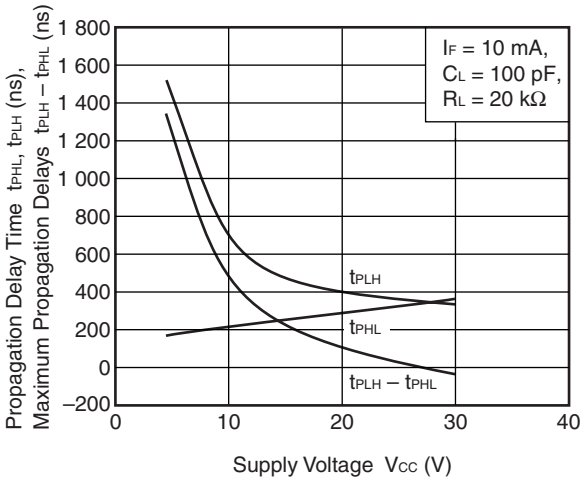
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



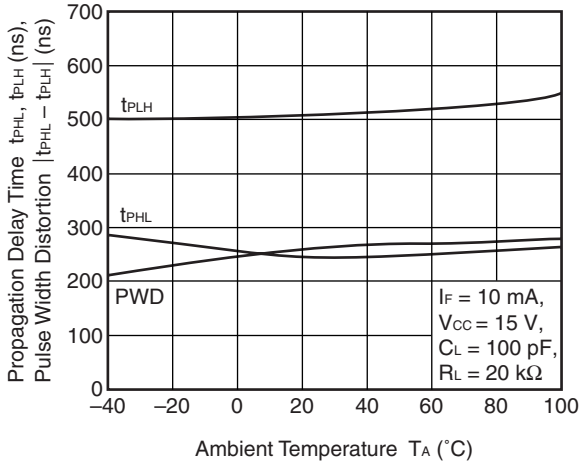
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



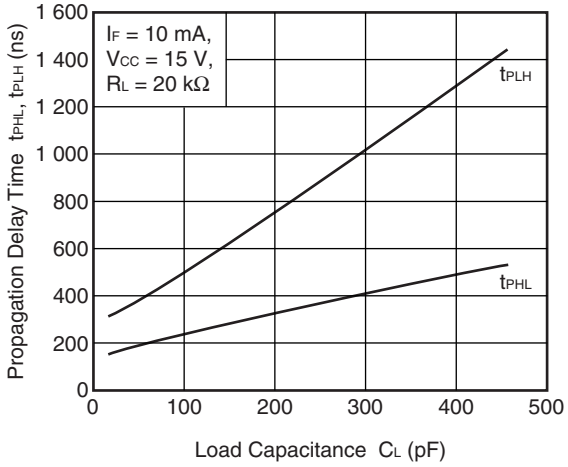
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

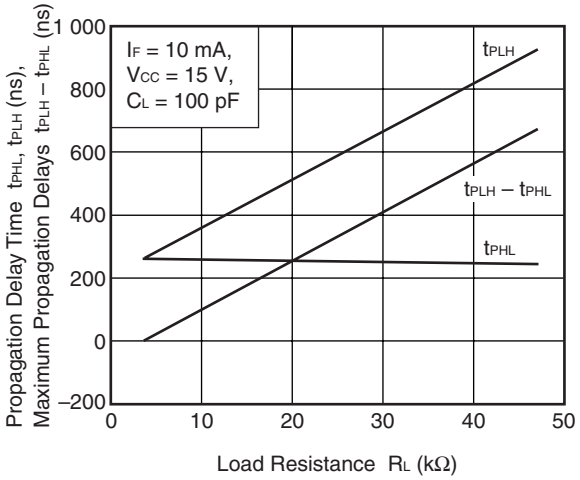


PROPAGATION DELAY TIME vs. LOAD CAPACITANCE

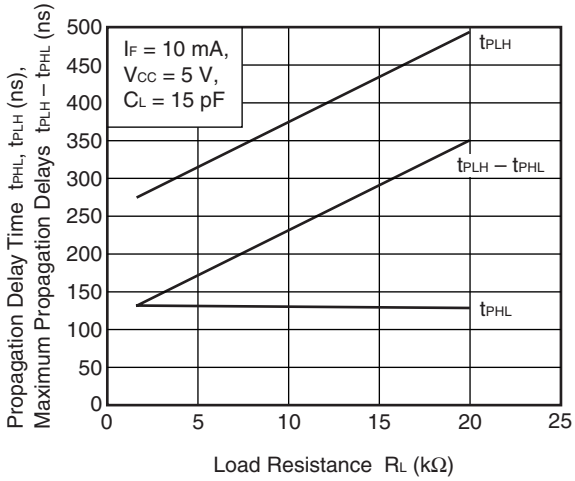


Remark The graphs indicate nominal characteristics.

PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. LOAD RESISTANCE



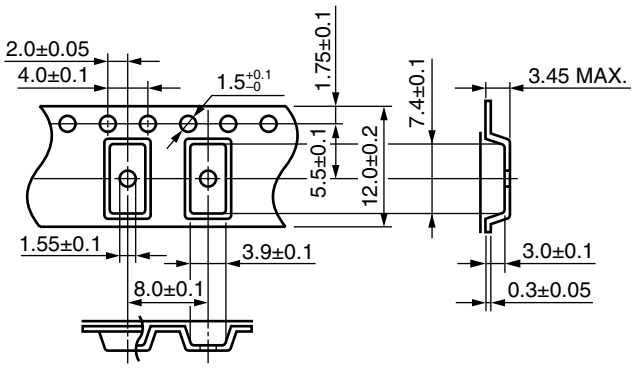
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. LOAD RESISTANCE



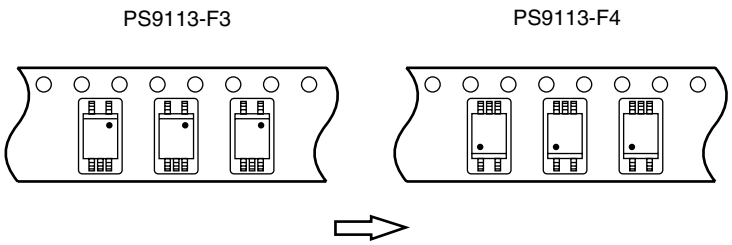
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

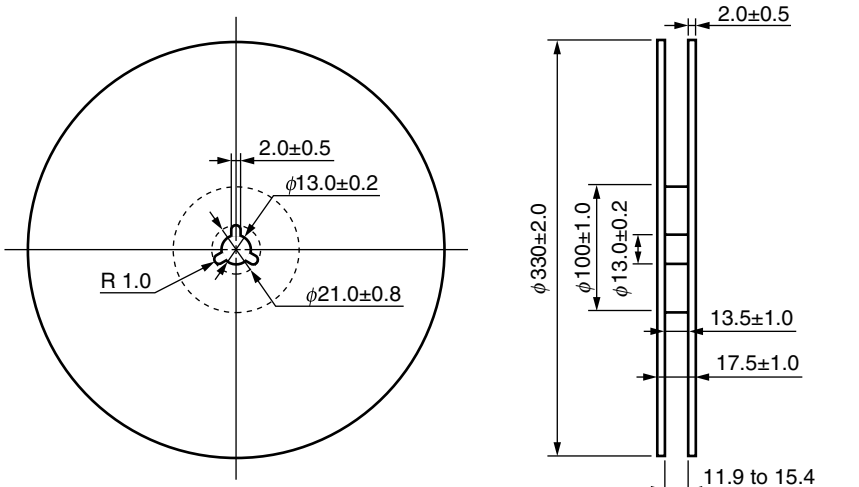
Outline and Dimensions (Tape)



Tape Direction

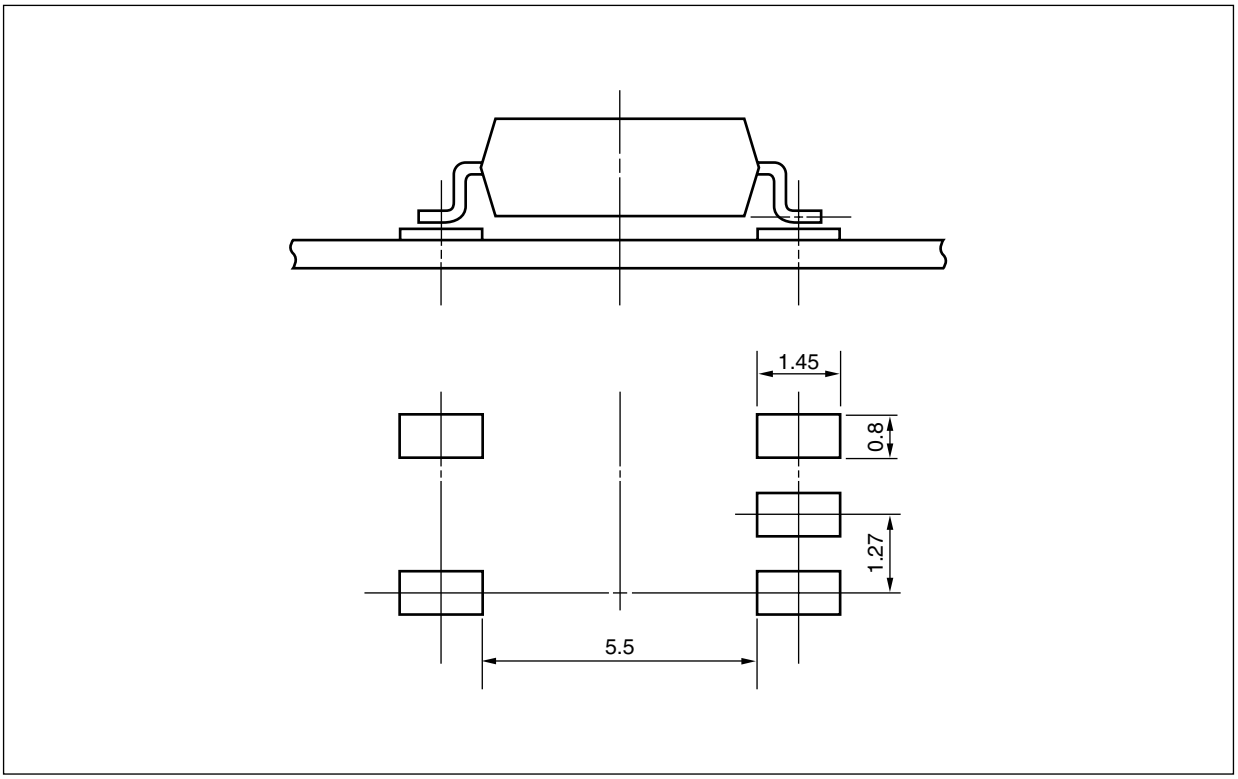


Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

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



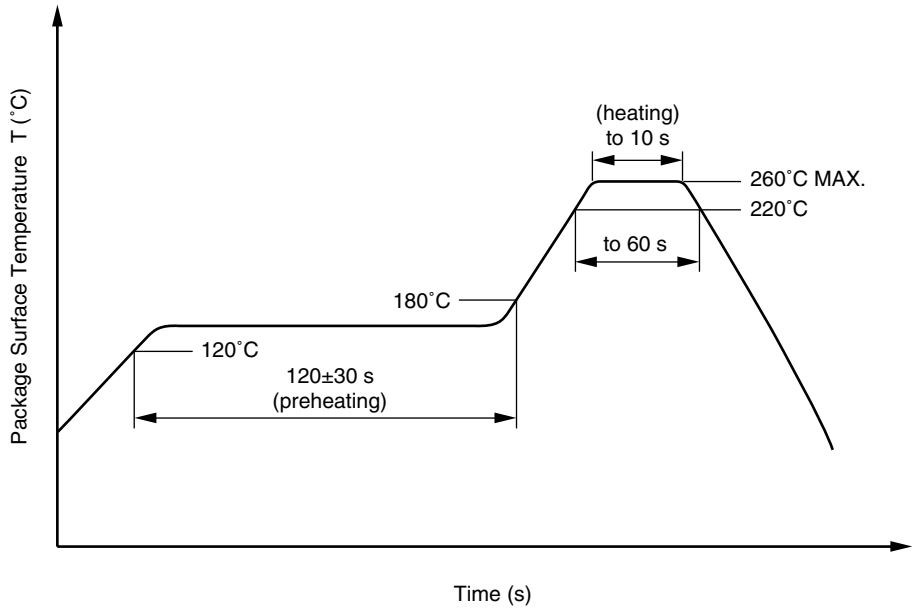
NOTES ON HANDLING

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	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°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, Psi = 0) Power (output or total power dissipation) Isolation resistance V_{IO} = 500 V dc at T_A = Tsi	 Tsi Isi Psi Ris MIN.	 150 200 300 10^9	 °C mA mW Ω

- **The information in this document is current as of August, 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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M8E 02. 11-1

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To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

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