

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

—NEPOC Series—

DESCRIPTION

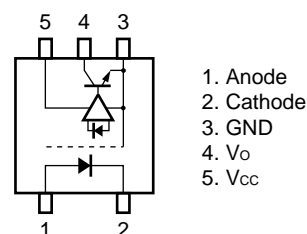
The PS9113 is an optically coupled isolator containing a GaAlAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

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)

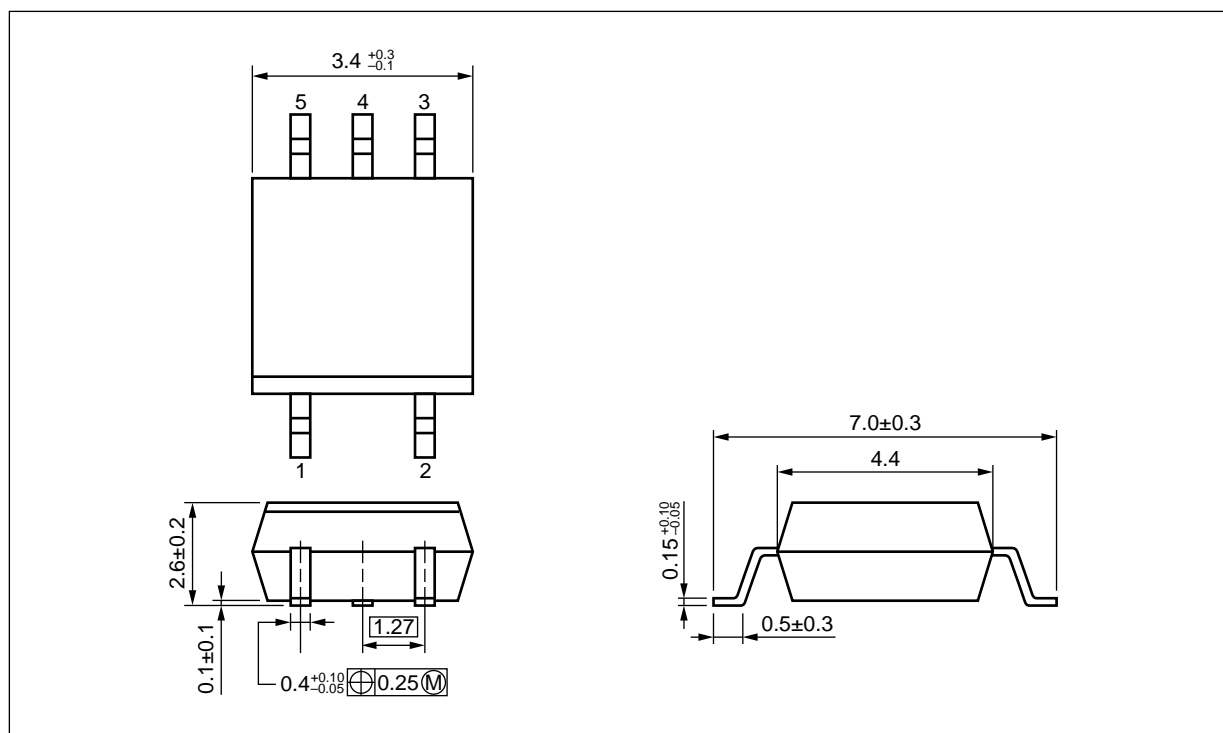


APPLICATIONS

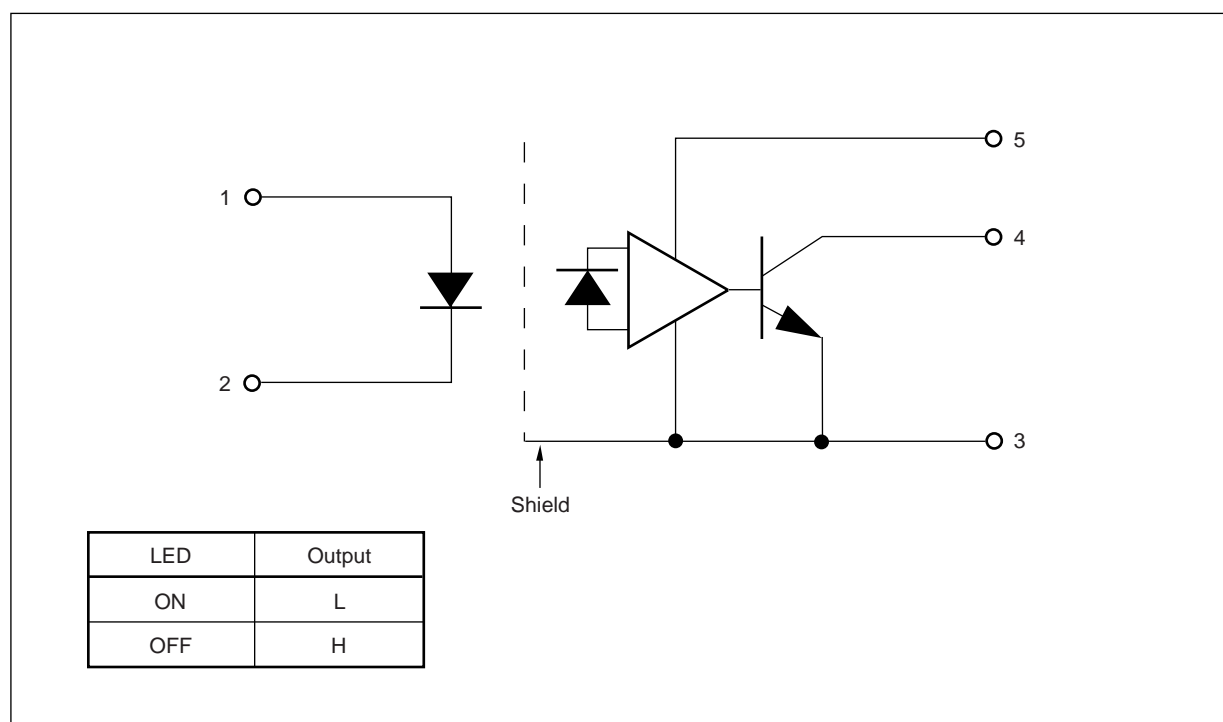
- IPM Driver
- General purpose inverter

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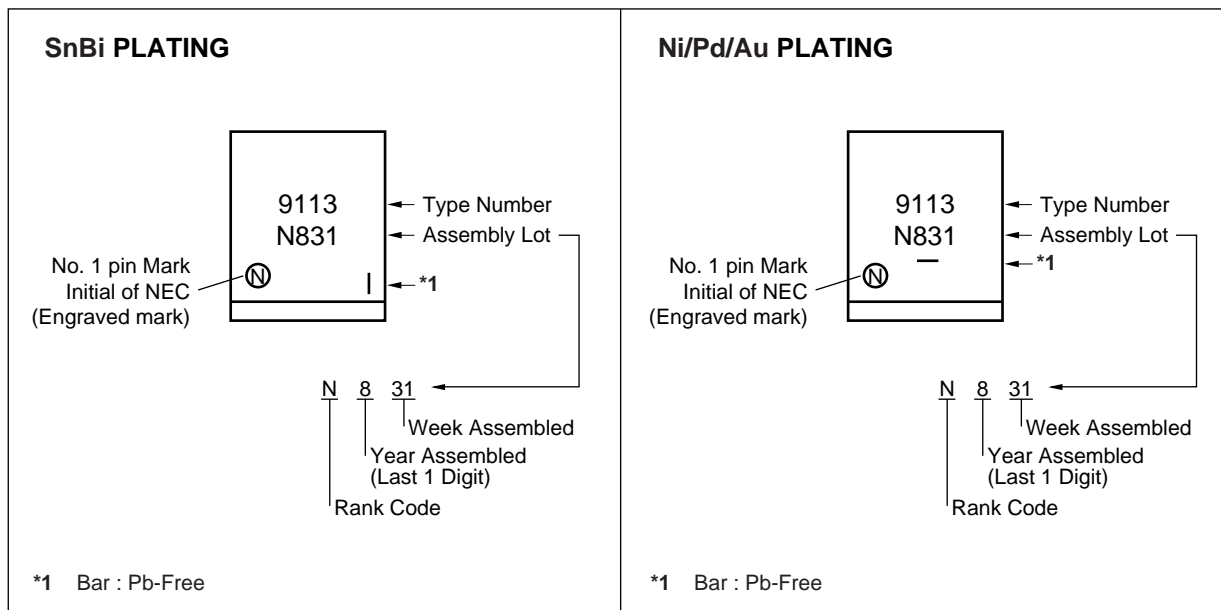
PACKAGE DIMENSIONS (UNIT: mm)



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

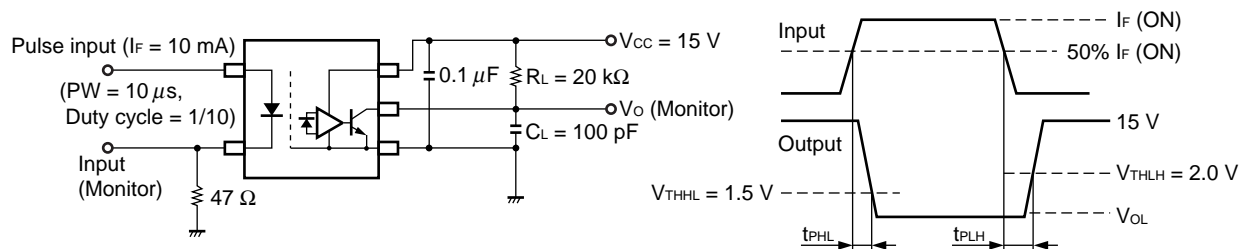
| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|--------------------------|----------|------|------|------|------|
| High Level Input Current | I_{FH} | 10 | | 20 | mA |
| Output Voltage | V_O | 0 | | 30 | V |
| Supply Voltage | V_{CC} | 4.5 | | 30 | V |
| LED Off Voltage | V_F | 0 | | 0.8 | V |

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 |

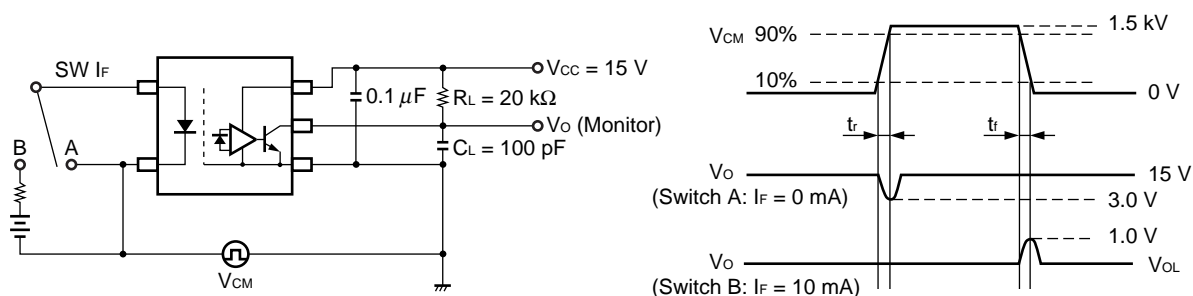
*1 Typical values at $T_A = 25^\circ\text{C}$.

*2 Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

*3 Test circuit for common mode transient immunity

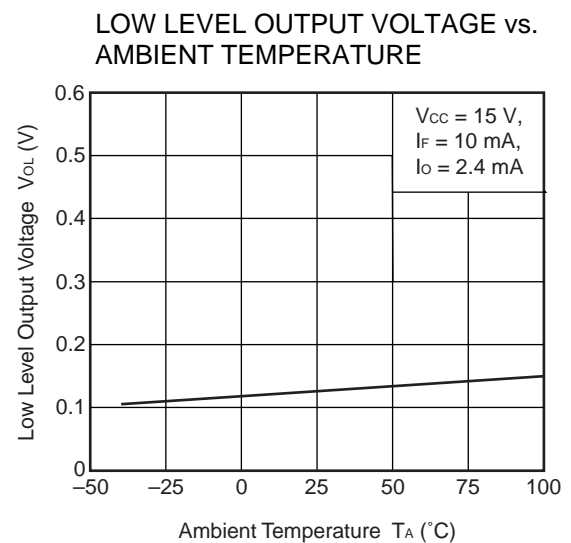
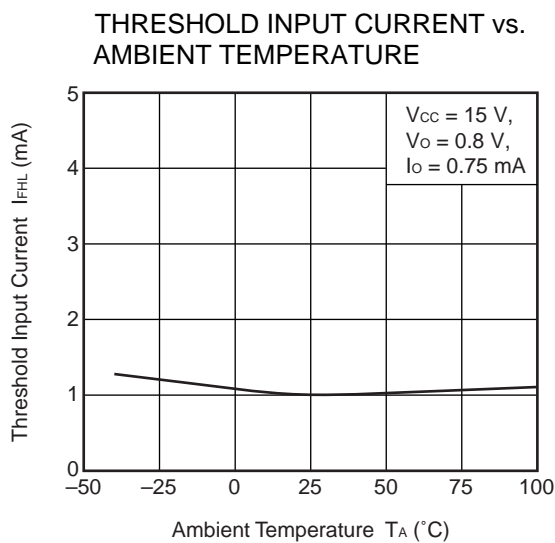
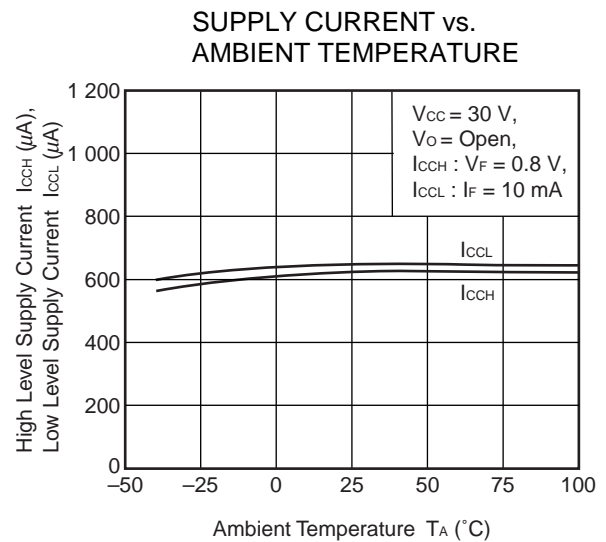
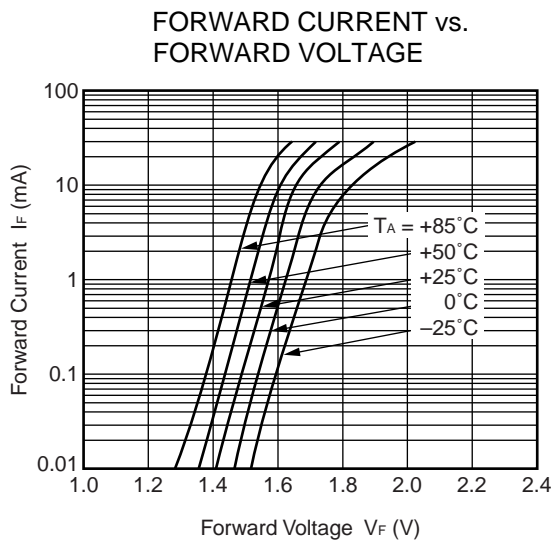
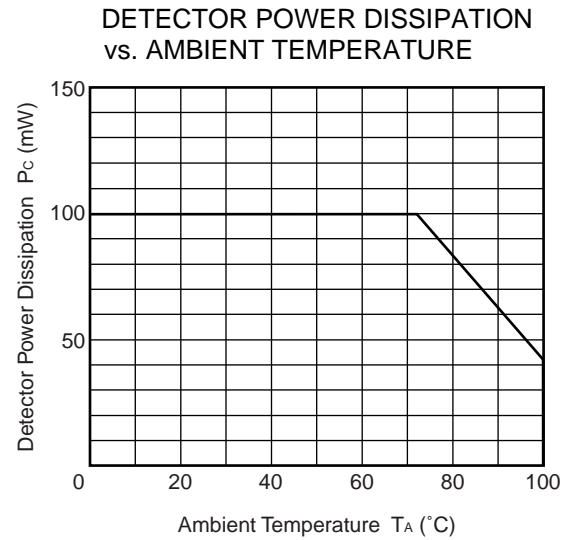
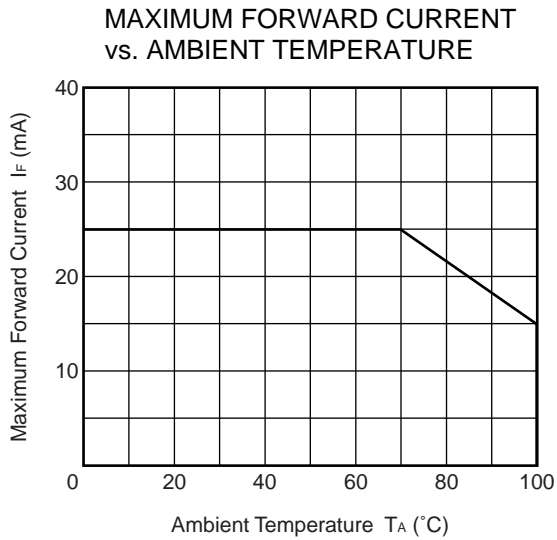


C_L includes probe and stray wiring capacitance.

USAGE CAUTIONS

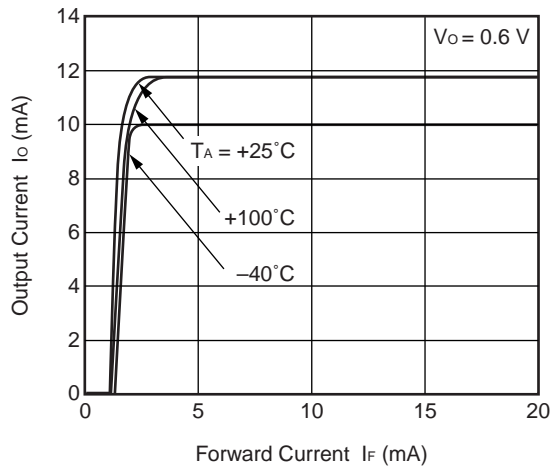
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of $0.1\text{ }\mu\text{F}$ is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler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

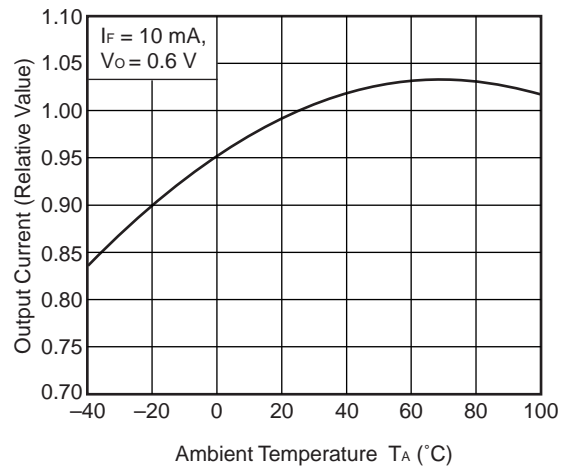


Remark The graphs indicate nominal characteristics.

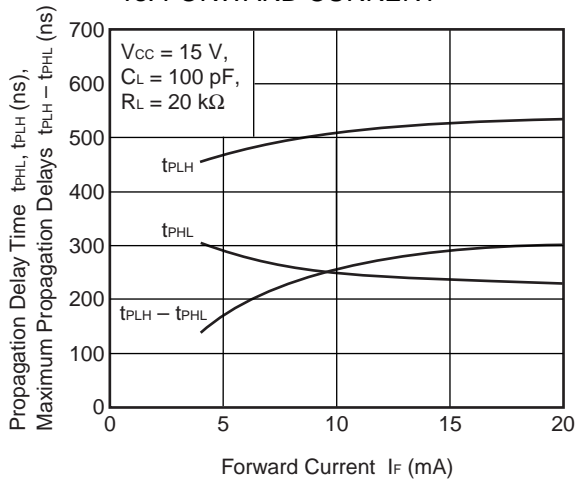
OUTPUT CURRENT vs. FORWARD CURRENT



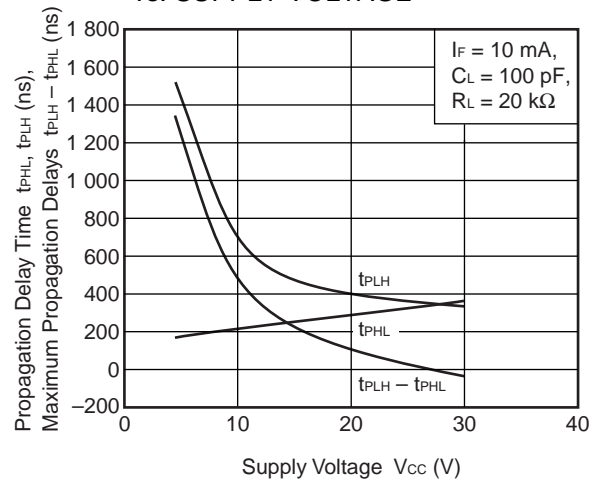
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



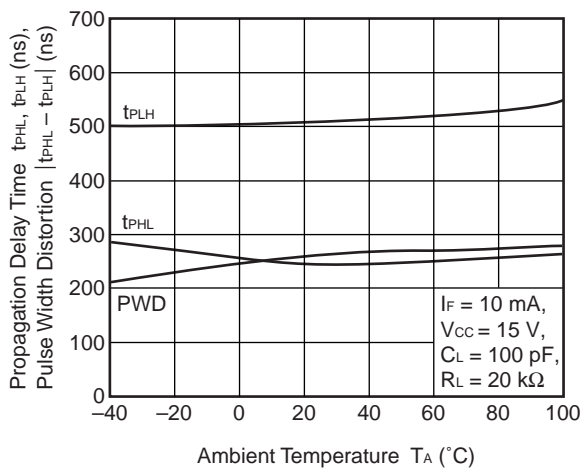
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. FORWARD CURRENT



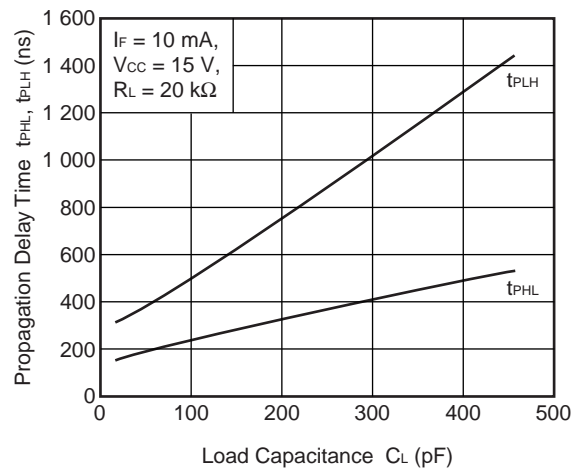
PROPAGATION DELAY TIME, MAXIMUM PROPAGATION DELAYS vs. SUPPLY VOLTAGE



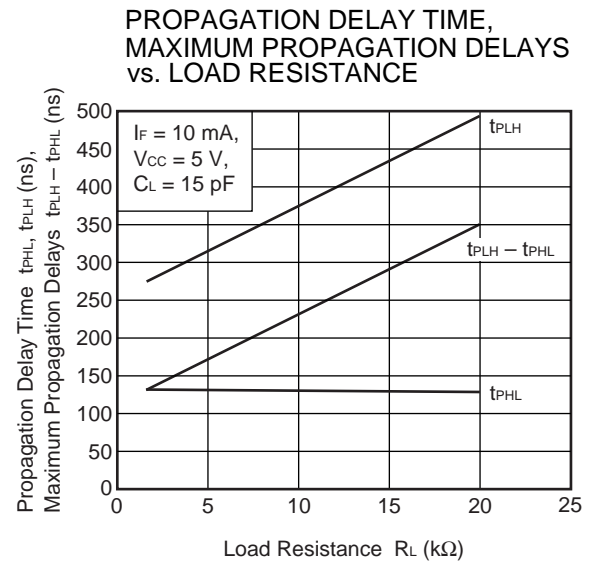
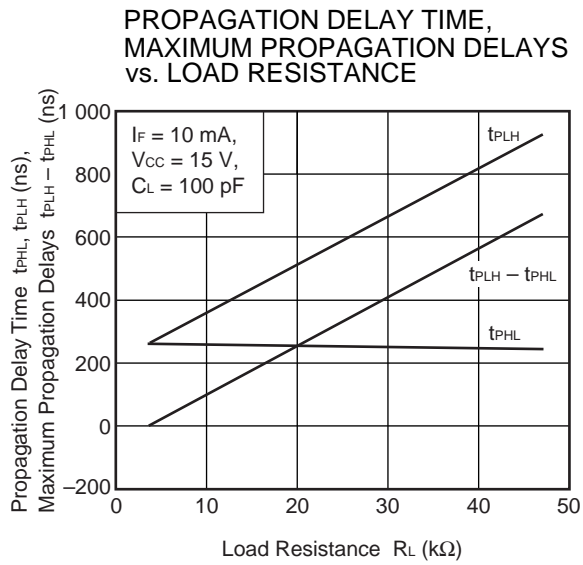
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs. LOAD CAPACITANCE



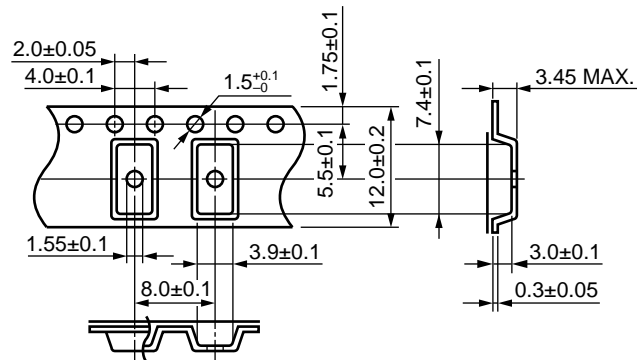
Remark The graphs indicate nominal characteristics.



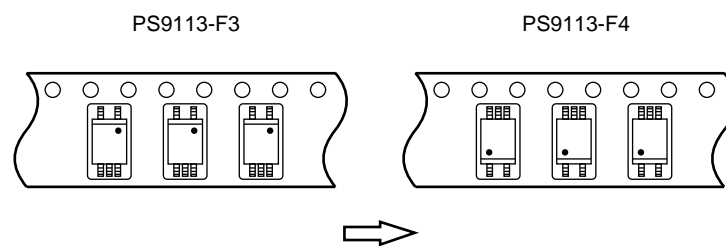
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

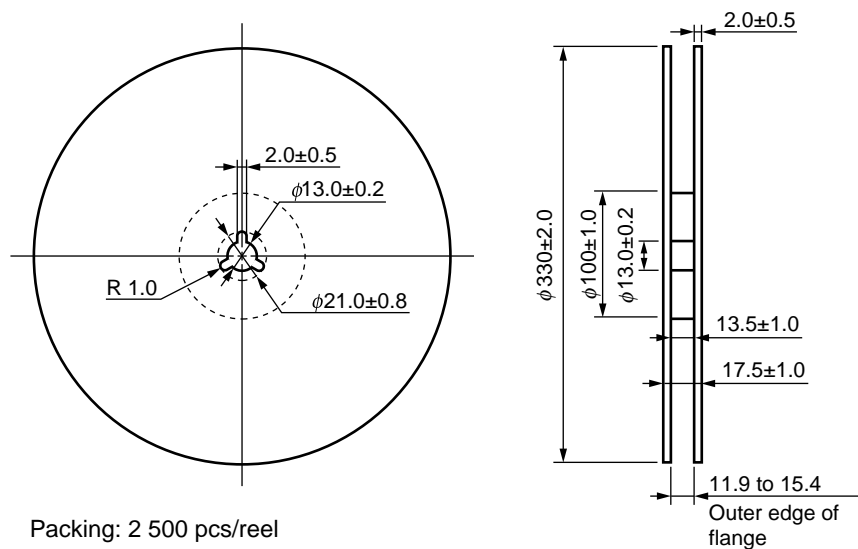
Outline and Dimensions (Tape)



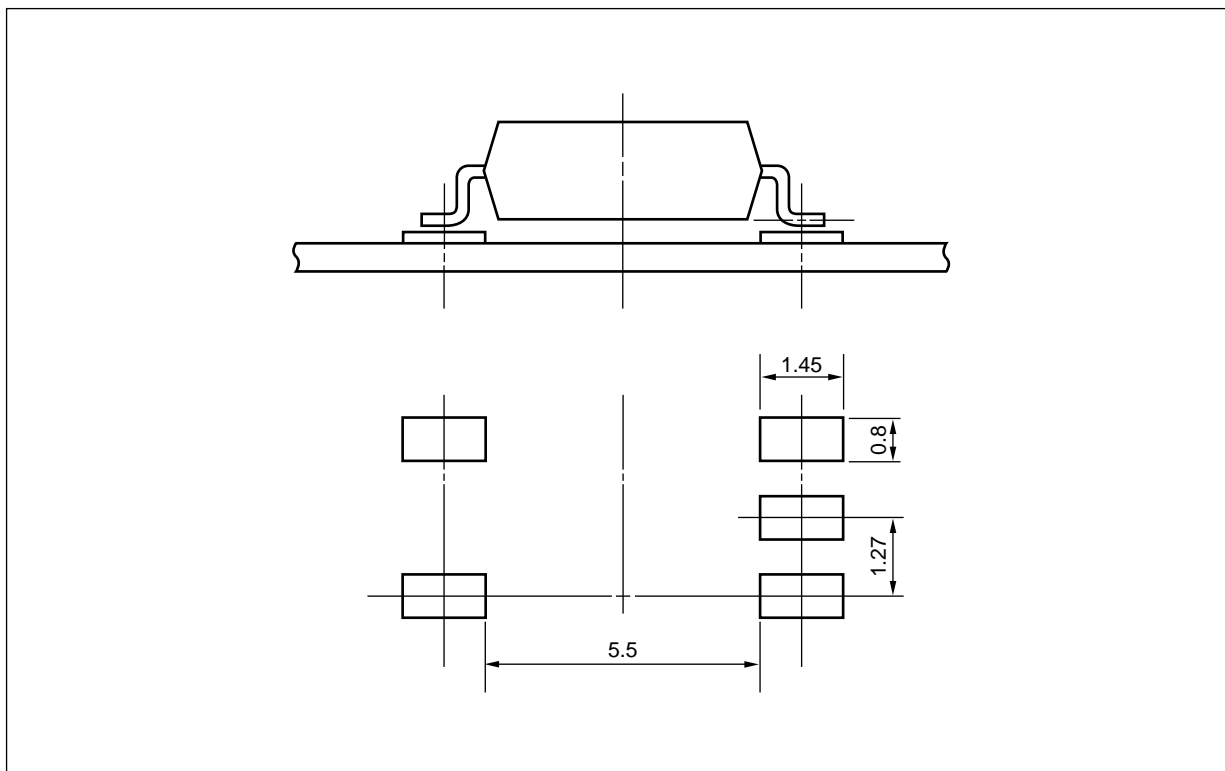
Tape Direction



Outline and Dimensions (Reel)



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



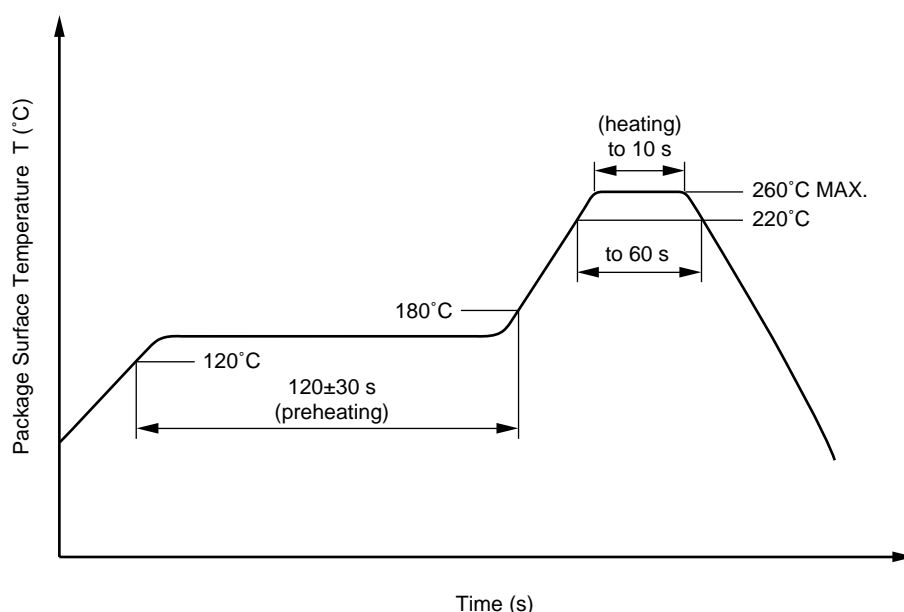
NOTES ON HANDLING

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 , $\Psi_i = 0$) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500$ V dc at $T_A = T_{si}$ | T_{si} I_{si} Ψ_i 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.

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