

# PS9124

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE  
5-PIN SOP (SO-5) PHOTOCOUPLER

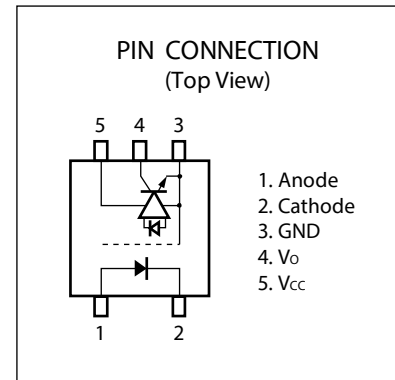
R08DS0049EJ0101  
Rev.1.01  
Oct 29, 2018

## DESCRIPTION

The PS9124 is an optically coupled high-speed, active low type isolator containing an AlGaAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

## FEATURES

- Low power consumption ( $V_{CC} = 3.3/5\text{ V}$ )
- Small package (SO-5)
- High-speed response ( $t_{PHL} = 100\text{ ns MAX.}$ ,  $t_{PLH} = 100\text{ ns MAX.}$ )
- High-speed (10 Mbps)
- High isolation voltage ( $BV = 3\ 750\text{ Vr.m.s.}$ )
- Open collector output
- Embossed tape product : PS9124-F3 : 2 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: UL1577, Single protection
  - CSA approved: CAN/CSA-C22.2 No. 62368-1, Basic insulation
  - VDE approved: DIN EN 60747-5-5 (Option)

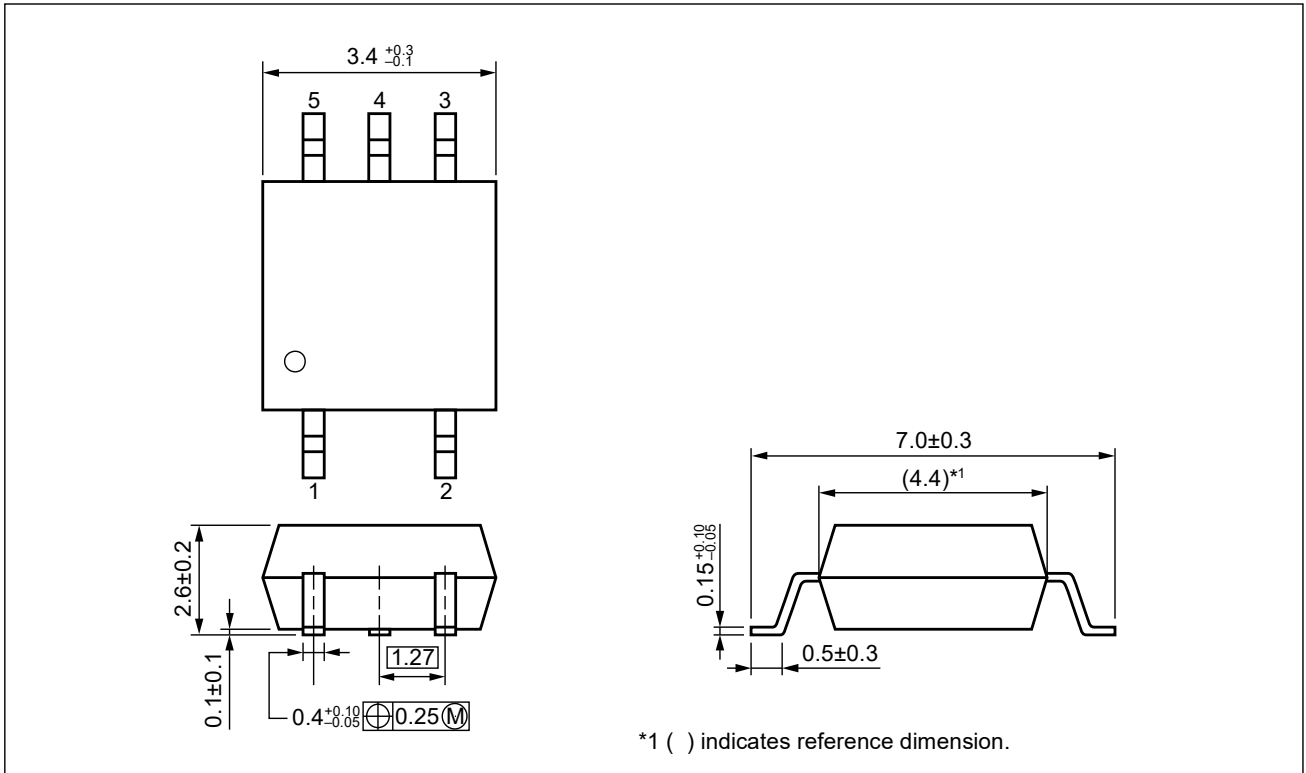


## APPLICATIONS

- FA Network

Start of mass production  
Jul.2012

**PACKAGE DIMENSIONS (UNIT: mm)**

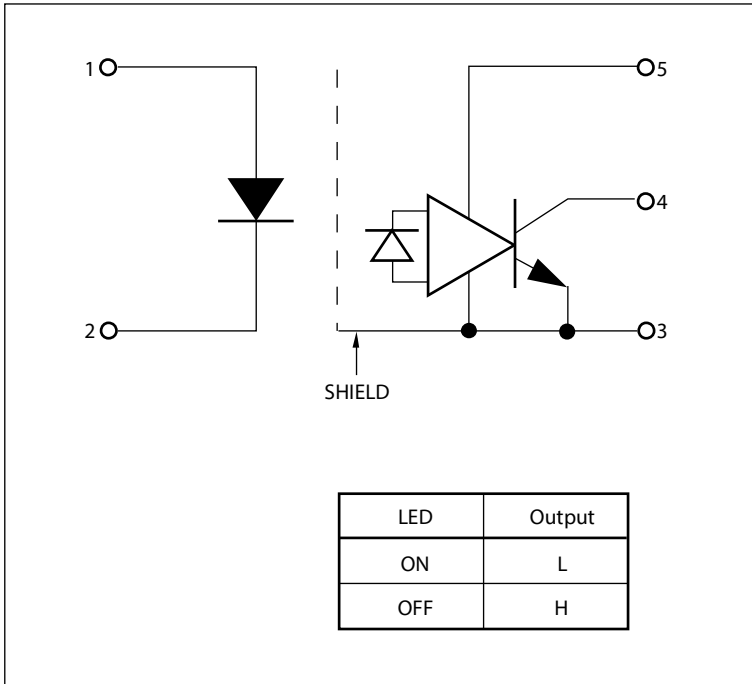


Weight: 0.08g (typ.)

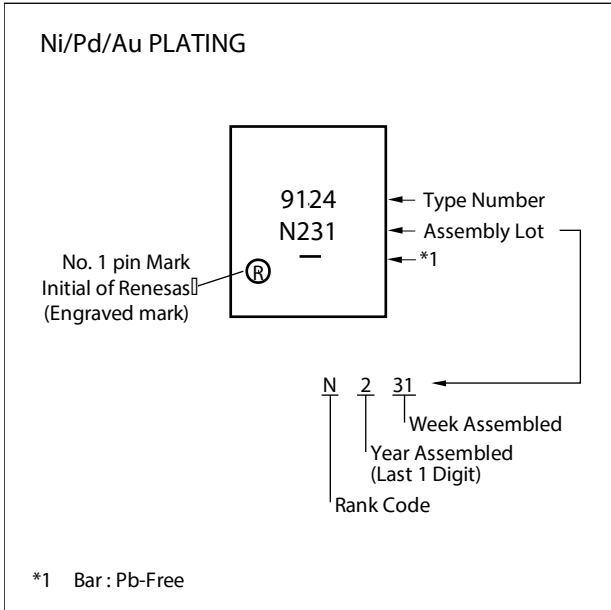
**PHOTOCOUPLER CONSTRUCTION**

Parameter	PS9124
Air Distance (MIN.)	4.2 mm
Creepage Distance (MIN.)	4.2 mm
Isolation Distance (MIN.)	0.2 mm

**BLOCK DIAGRAM (Unit: mm)**



**MARKING EXAMPLE**



**ORDERING INFORMATION**

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standards Approval	Application Part Number *1
PS9124	PS9124-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9124
PS9124-F3	PS9124-F3-AX		Embossed Tape 2 500 pcs/reel		
PS9124-V	PS9124-V-AX		20 pcs (Tape 20 pcs cut)	UL, CSA, DIN EN 60747-5-5 approved	
PS9124-V-F3	PS9124-V-F3-AX		Embossed Tape 2 500 pcs/reel		

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

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, unless otherwise specified)**

Parameter		Symbol	Ratings	Unit
Diode	Forward Current *1	I <sub>F</sub>	25	mA
	Reverse Voltage	V <sub>R</sub>	5	V
Detector	Supply Voltage	V <sub>CC</sub>	7	V
	Output Voltage	V <sub>O</sub>	7	V
	Output Current	I <sub>O</sub>	25	mA
	Power Dissipation *2	P <sub>C</sub>	200	mW
Isolation Voltage *3		BV	3 750	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +110	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

Notes: \*1. Reduced to 0.2 mA/°C at T<sub>A</sub> = 25°C or more.

\*2. Reduced to 4.0 mW/°C at T<sub>A</sub> = 75°C or more.

\*3 AC voltage for 1 minute at T<sub>A</sub> = 25°C, RH = 60% between input and output.

Pins 1-2 shorted together, 3-5 shorted together.

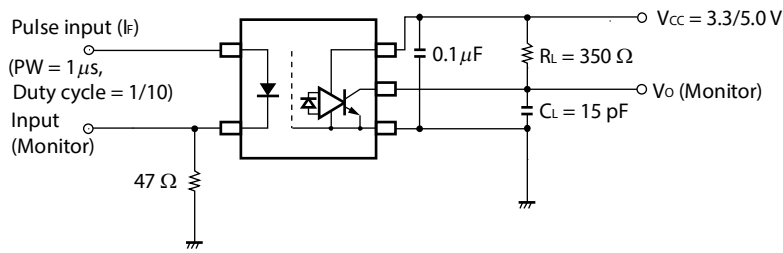
**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Low Level Input Voltage	V <sub>FL</sub>	-2		0.8	V
High Level Input Current	I <sub>FH</sub>	3.8	6.0	7.5	mA
Supply Voltage	V <sub>CC</sub>	2.7	3.3	3.6	V
		4.5	5.0	5.5	
TTL (R <sub>L</sub> = 1 kΩ, loads)	N			5	
Pull-up Resistor	R <sub>L</sub>	330		4 k	Ω

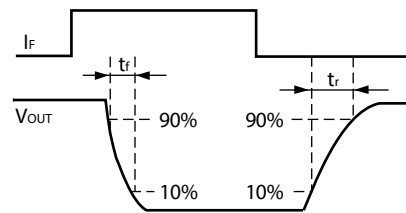
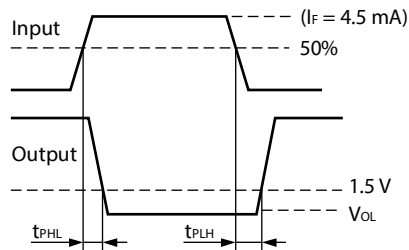
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +110°C, unless otherwise specified)**

Parameter		Symbol	Conditions	MIN.	TYP. *1	MAX.	Unit	
Diode	Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 10 mA, T <sub>A</sub> = 25°C	1.3	1.55	1.8	V	
	Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 3 V, T <sub>A</sub> = 25°C			10	μA	
	Terminal Capacitance	C <sub>t</sub>	f = 1 MHz, V <sub>F</sub> = 0 V, T <sub>A</sub> = 25°C		30		pF	
Detector	High Level Output Current	I <sub>OH</sub>	V <sub>CC</sub> = V <sub>O</sub> = 3.3 V, V <sub>F</sub> = 0.8 V		1	80	μA	
			V <sub>CC</sub> = V <sub>O</sub> = 5.5 V, V <sub>F</sub> = 0.8 V		1	100		
	Low Level Output Voltage	V <sub>OL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, I <sub>OL</sub> = 13 mA		0.2	0.6	V	
			V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 4.5 mA, I <sub>OL</sub> = 13 mA					
	High Level Supply Current	I <sub>CCH</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 0 mA, V <sub>O</sub> = open		4	7	mA	
			V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 0 mA, V <sub>O</sub> = open					
Low Level Supply Current	I <sub>CCL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> = open		6	10	mA		
		V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> = open		7	10			
Coupled	Threshold Input Voltage (H → L)	I <sub>FHL</sub>	V <sub>CC</sub> = 3.3 V, R <sub>L</sub> = 350 Ω, V <sub>O</sub> = 0.8 V		1.0	3.0	mA	
			V <sub>CC</sub> = 5 V, R <sub>L</sub> = 350 Ω, V <sub>O</sub> = 0.8 V					
	Isolation Resistance	R <sub>I-O</sub>	V <sub>I-O</sub> = 1 kV <sub>DC</sub> , R <sub>H</sub> = 40 to 60%, T <sub>A</sub> = 25°C	10 <sup>11</sup>			Ω	
	Isolation Capacitance	C <sub>I-O</sub>	V = 0 V, f = 1 MHz, T <sub>A</sub> = 25°C		0.6		pF	
	Propagation Delay Time (H → L) *2	t <sub>PHL</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF	T <sub>A</sub> = 25°C		40	75	ns
				T <sub>A</sub> = 25°C		40	75	
				V <sub>CC</sub> = 5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			100	
	Propagation Delay Time (L → H) *2	t <sub>PLH</sub>	V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF	T <sub>A</sub> = 25°C		50	75	ns
				T <sub>A</sub> = 25°C		45	75	
				V <sub>CC</sub> = 5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			100	
	Pulse Width Distortion (PWD)	t <sub>PHL</sub> -t <sub>PLH</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		5	35	ns	
	Propagation Delay Skew	t <sub>psk</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF			40	ns	
	Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		20		ns	
Fall Time	t <sub>f</sub>	V <sub>CC</sub> = 3.3/5 V, I <sub>F</sub> = 4.5 mA, R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		5		ns		
Common Mode Transient Immunity at High Level Output *3	CM <sub>H</sub>	V <sub>CC</sub> = 3.3/5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 0 mA, V <sub>O</sub> > 2 V, R <sub>L</sub> = 350 Ω, V <sub>CM</sub> = 1 kV	10	15		kV/μs		
Common Mode Transient Immunity at Low Level Output *3	CM <sub>L</sub>	V <sub>CC</sub> = 3.3/5 V, T <sub>A</sub> = 25°C, I <sub>F</sub> = 4.5 mA, V <sub>O</sub> < 0.8 V, R <sub>L</sub> = 350 Ω, V <sub>CM</sub> = 1 kV	10	15		kV/μs		

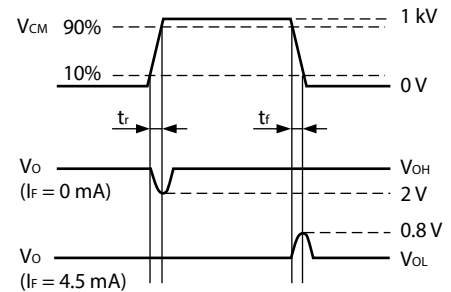
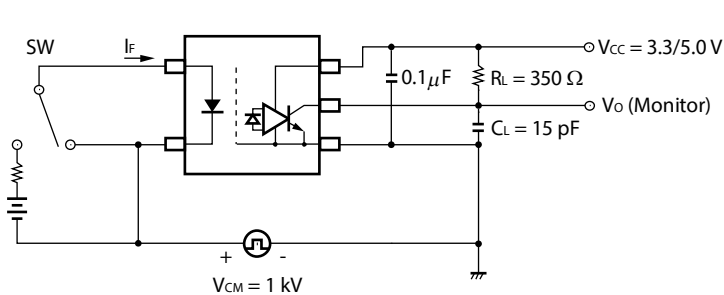
- Notes: \*1. Typical values at  $T_A = 25^\circ\text{C}$   
 \*2. Test circuit for propagation delay time



**Remark**  $C_L$  includes probe and stray wiring capacitance.



- \*3. Test circuit for common mode transient immunity



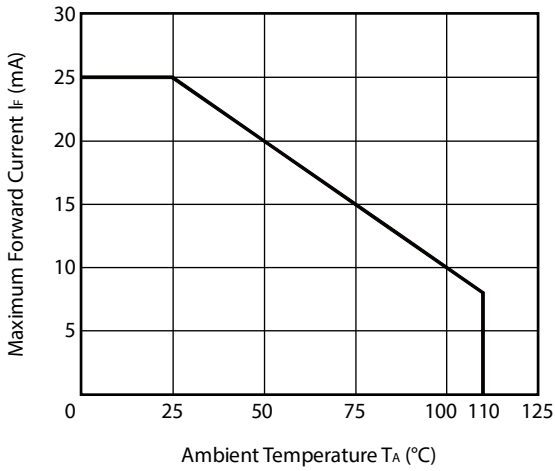
**Remark**  $C_L$  includes probe and stray wiring capacitance.

## USAGE CAUTIONS

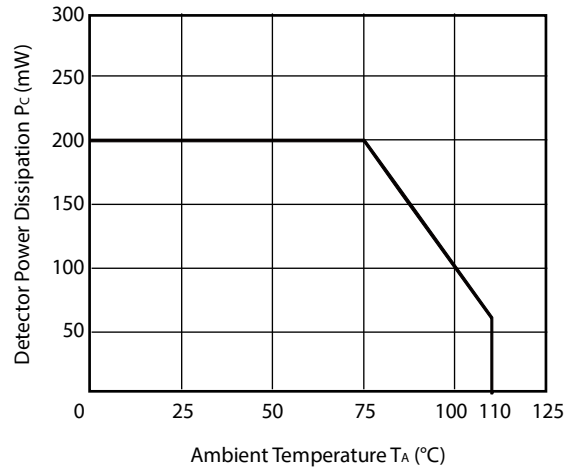
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than  $0.1 \mu\text{F}$  is used between  $V_{CC}$  and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.
4. Do not use adhesives or coating materials including halogens to fix this device.

**TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise specified)**

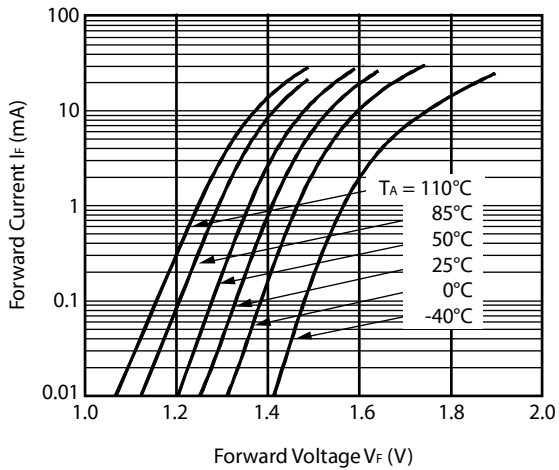
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



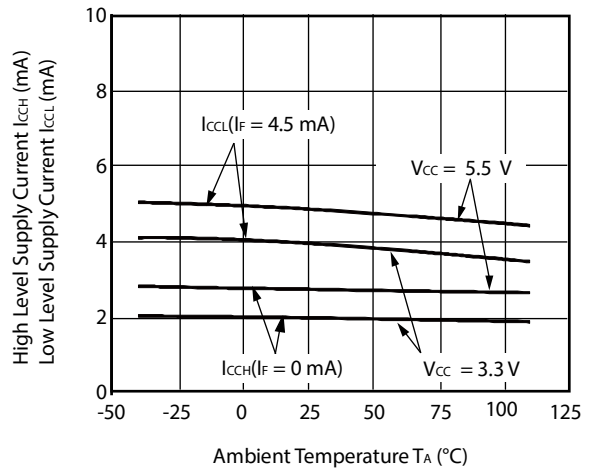
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



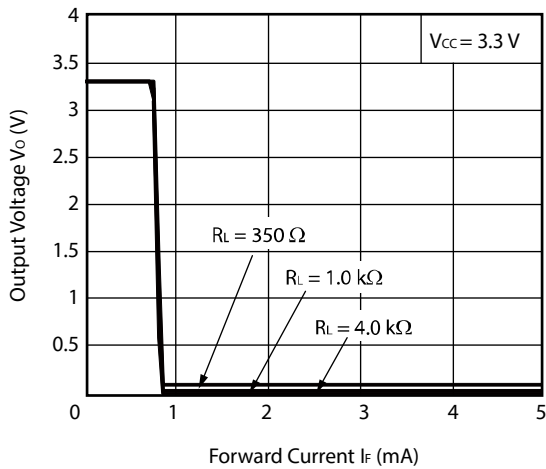
FORWARD CURRENT vs. FORWARD VOLTAGE



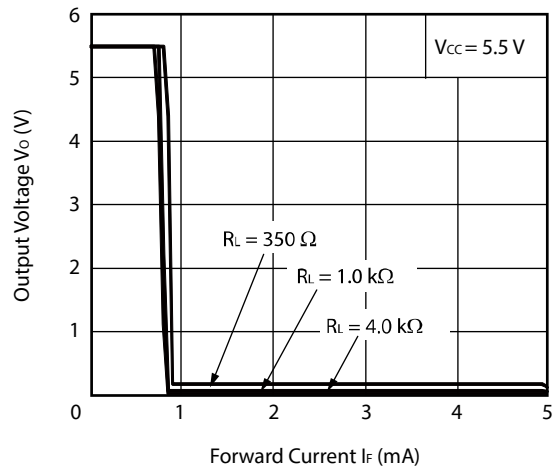
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT



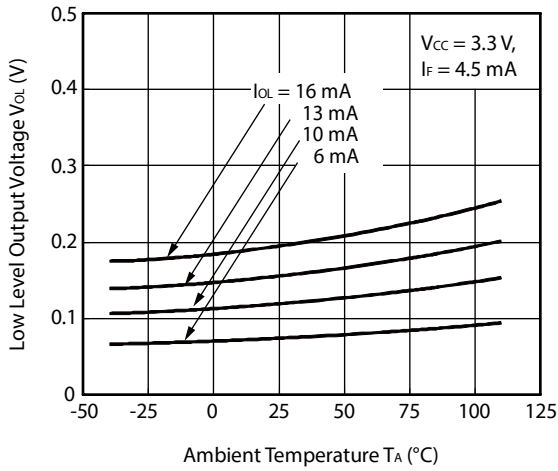
OUTPUT VOLTAGE vs. FORWARD CURRENT



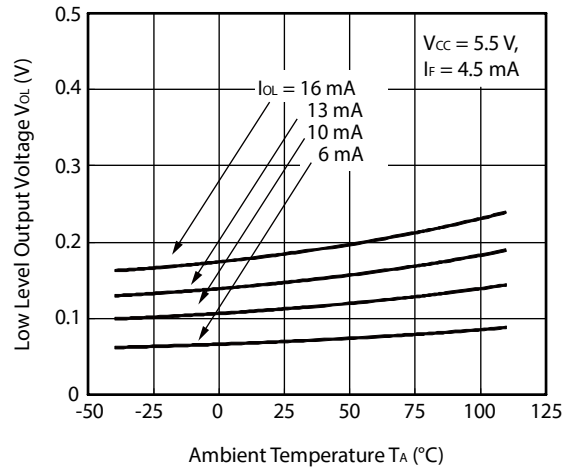
**Remark** The graphs indicate nominal characteristics.



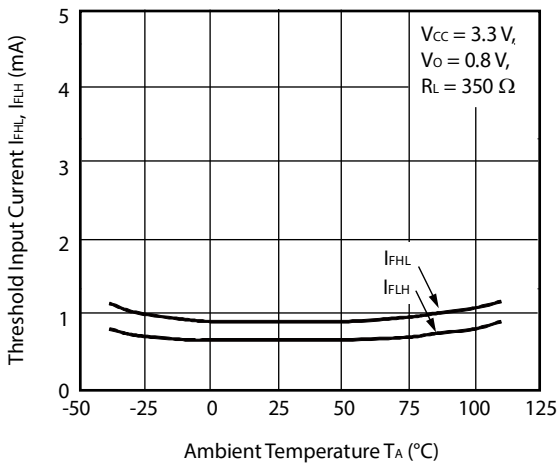
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



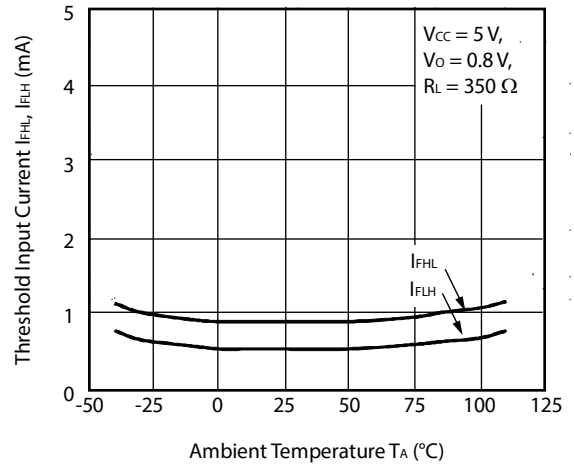
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



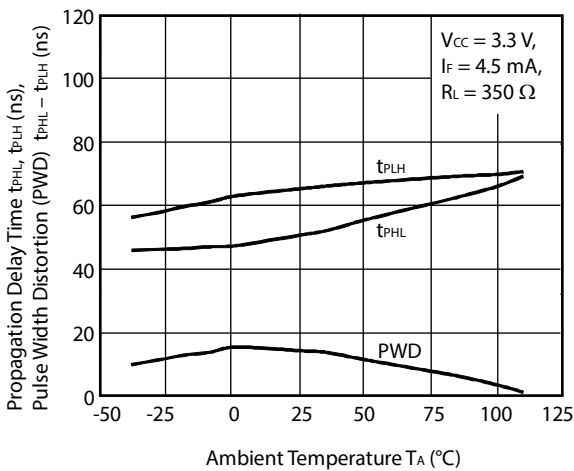
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



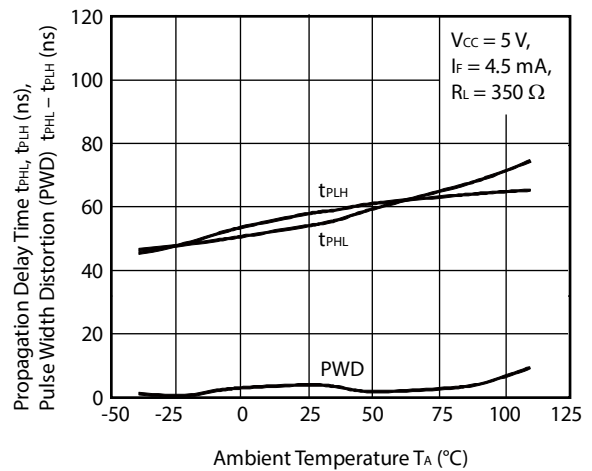
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

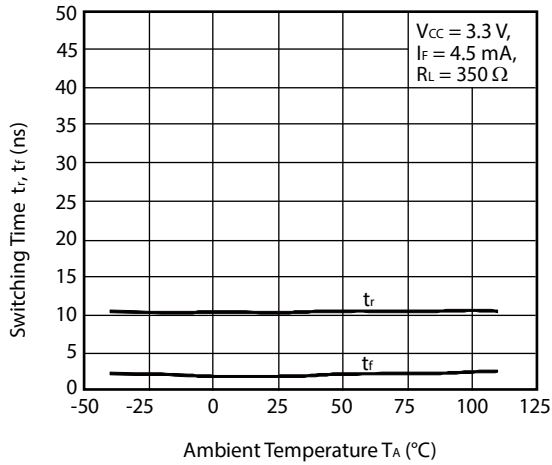


PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. AMBIENT TEMPERATURE

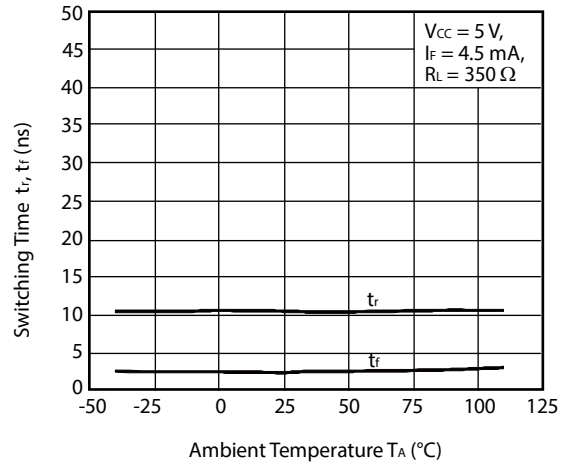


**Remark** The graphs indicate nominal characteristics.

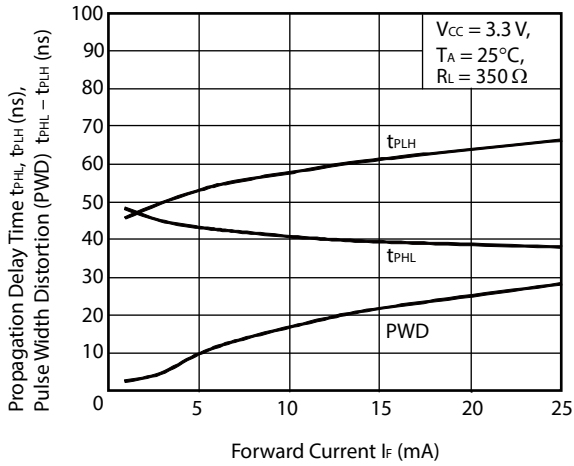
SWITCHING TIME vs. AMBIENT TEMPERATURE



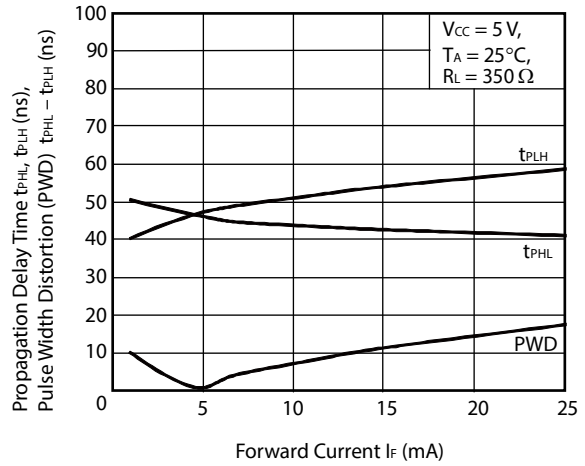
SWITCHING TIME vs. AMBIENT TEMPERATURE



PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



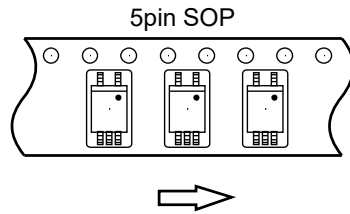
PROPAGATION DELAY TIME, PULSE WIDTH DISTORTION vs. FORWARD CURRENT



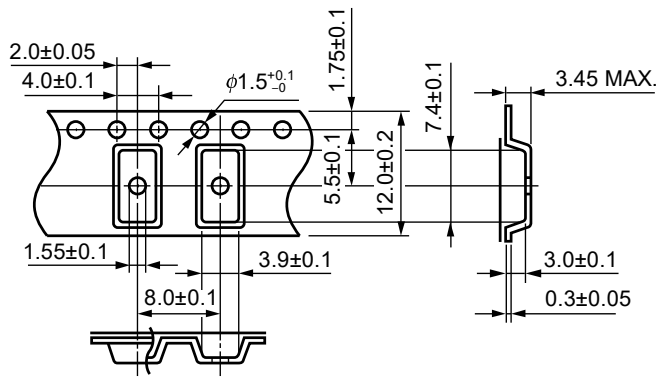
**Remark** The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

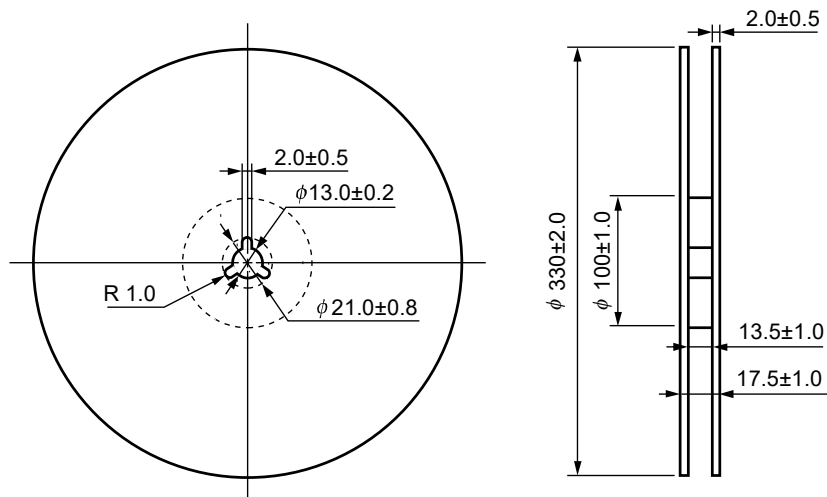
Tape Direction



Outline and Dimensions (Tape)

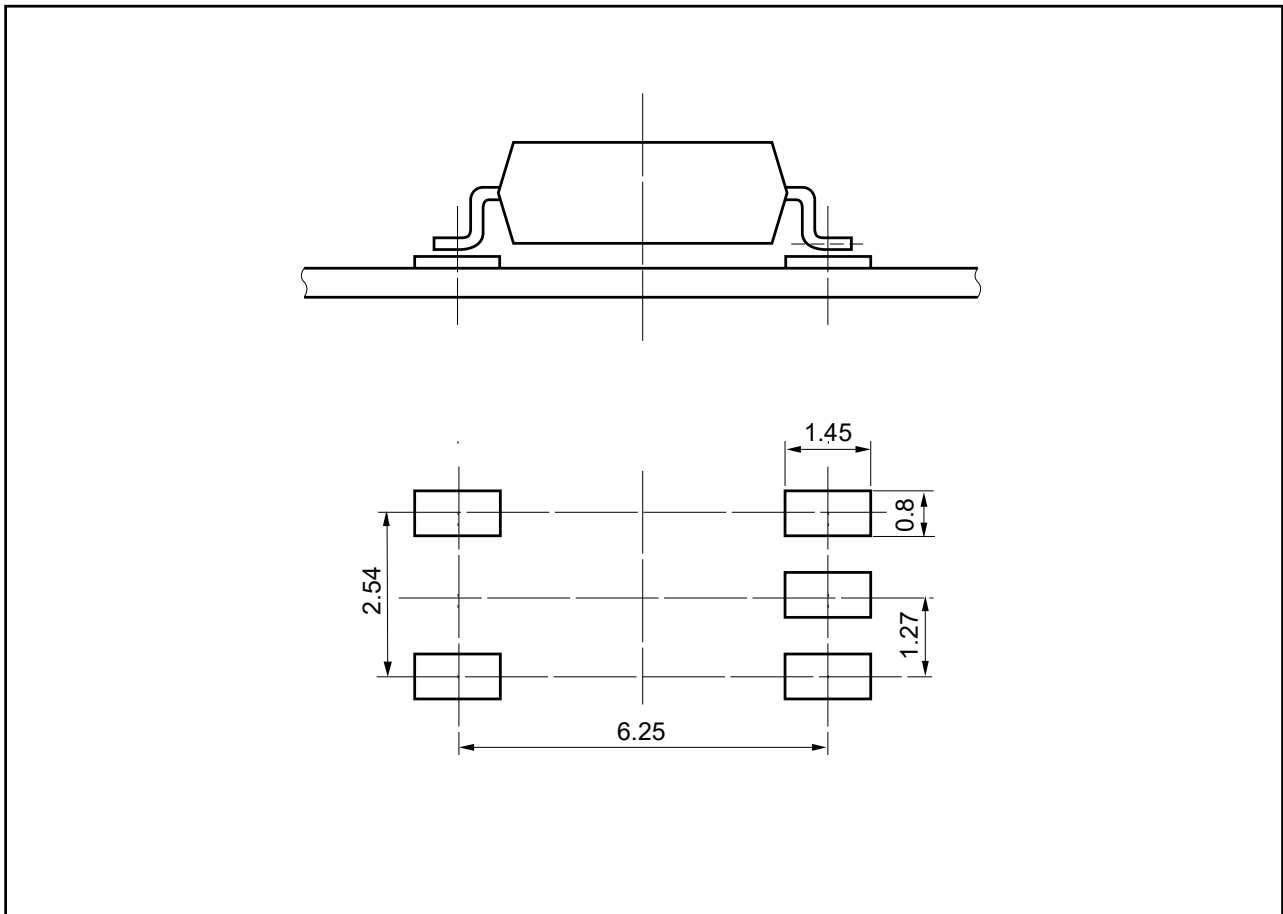


Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



【5pin SOP】

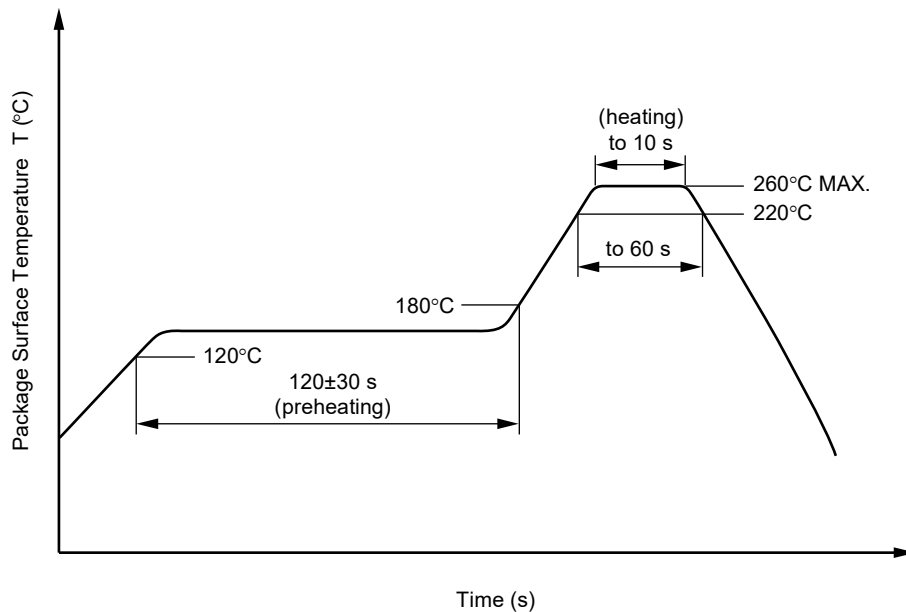
## NOTES ON HANDLING

### 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<br>(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<br>(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

#### (4) Cautions

- Fluxes  
Avoid removing the residual flux with freon-based and halogens-based (chlorine-based) cleaning solvent.

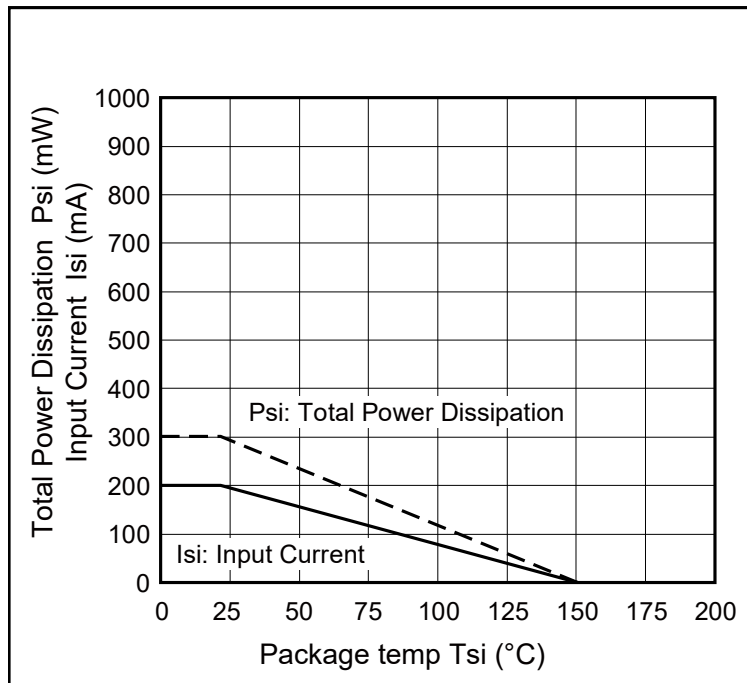
### 2. Cautions regarding noise

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.

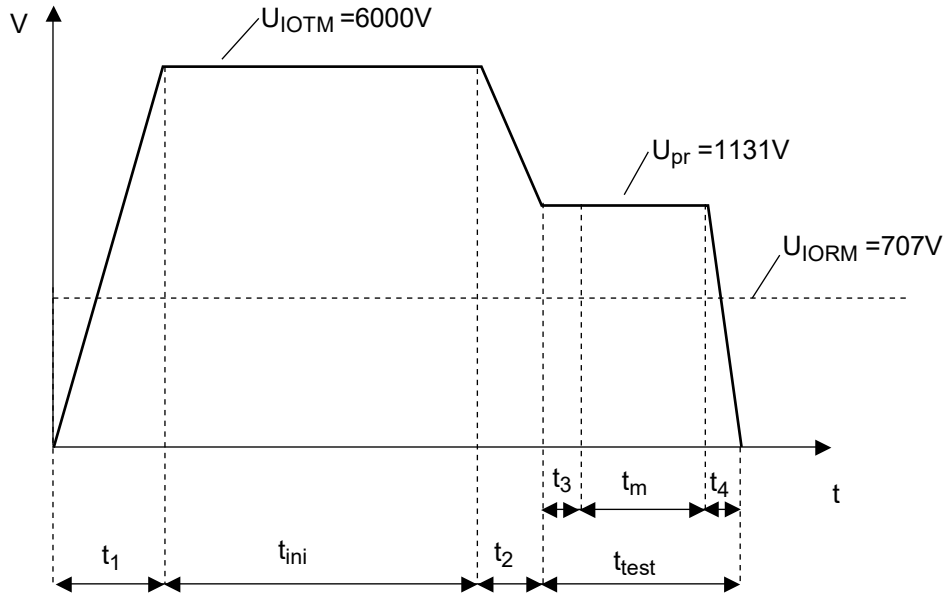
**SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/110/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}, P_d < 5 \text{ pC}$	$U_{IORM}$ $U_{pr}$	707 1 131	$V_{peak}$ $V_{peak}$
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 VDE 0110 Part 1)		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	CTI	175	
Material group (DIN EN 60664-1 VDE 0110 Part 1)		III a	
Storage temperature range	$T_{stg}$	-55 to +125	°C
Operating temperature range	$T_A$	-40 to +110	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$	$R_{is \text{ MIN.}}$ $R_{is \text{ MIN.}}$	$10^{12}$ $10^{11}$	$\Omega$ $\Omega$
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 $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	$T_{si}$ $I_{si}$ $P_{si}$ $R_{is \text{ MIN.}}$	150 200 300 $10^9$	°C mA mW $\Omega$

**Dependence of maximum safety ratings with package temperature**

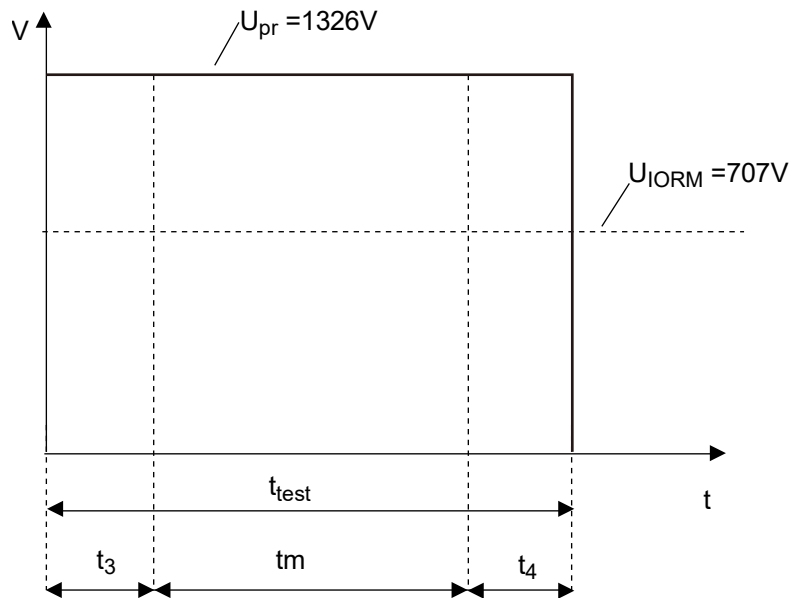


**Method a) Destructive Test, Type and Sample Test**



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$   
 $t_3, t_4 = 1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 10 \text{ sec}$   
 $t_{\text{test}} = 12 \text{ sec}$   
 $t_{\text{ini}} = 60 \text{ sec}$

**Method b) Non-destructive Test, 100% Production Test**



$t_3, t_4 = 0.1 \text{ sec}$   
 $t_m(\text{PARTIAL DISCHARGE}) = 1.0 \text{ sec}$   
 $t_{\text{test}} = 1.2 \text{ sec}$

<b>Caution</b>	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"><li>• 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"><li>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.</li><li>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.</li></ol></li><li>• Do not burn, destroy, cut, crush, or chemically dissolve the product.</li><li>• Do not lick the product or in any way allow it to enter the mouth.</li></ul>
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(Rev.4.0-1 November 2017)



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