PS9122

1 Mbps OPEN COLLECTOR OUTPUT TYPE
5-PIN SOP (SO-5), HIGH-SPEED PHOTOCOUPLER

R08DS0256EJ0100
Rev.1.00
Dec 2, 2021

DESCRIPTION

The PS9122 is an optical 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.
The PS9122 is a high-speed digital output type photocoupler designed specifically for low circuit current.
The PS9122 is in 5-pin plastic SOP (Small Outline Package) and is suitable for high density application.
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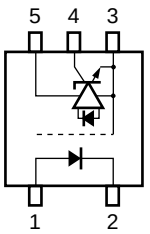
FEATURES

- Supply Voltage
  N rank: V_{CC} = 3.3 V
  L rank: V_{CC} = 5 V
- Pulse width distortion ($|t_{PHL} - t_{PLH}|$ = 200 ns MAX.)
- Small package (SO-5)
- High-speed (1 Mbps)
- High isolation voltage (BV = 3 750 Vr.m.s.)
- Open collector output
- Embossed tape product: PS9122-F3: 2 500 pcs/reel
- Pb-Free product
- Safety standards
  - UL : UL1577, Single protection
  - CSA : CAN/CSA-C22.2 No.62368-1, Basic insulation
  - VDE : DIN EN 60747-5-5 (Option)

PIN CONNECTION
(Top View)



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

APPLICATIONS

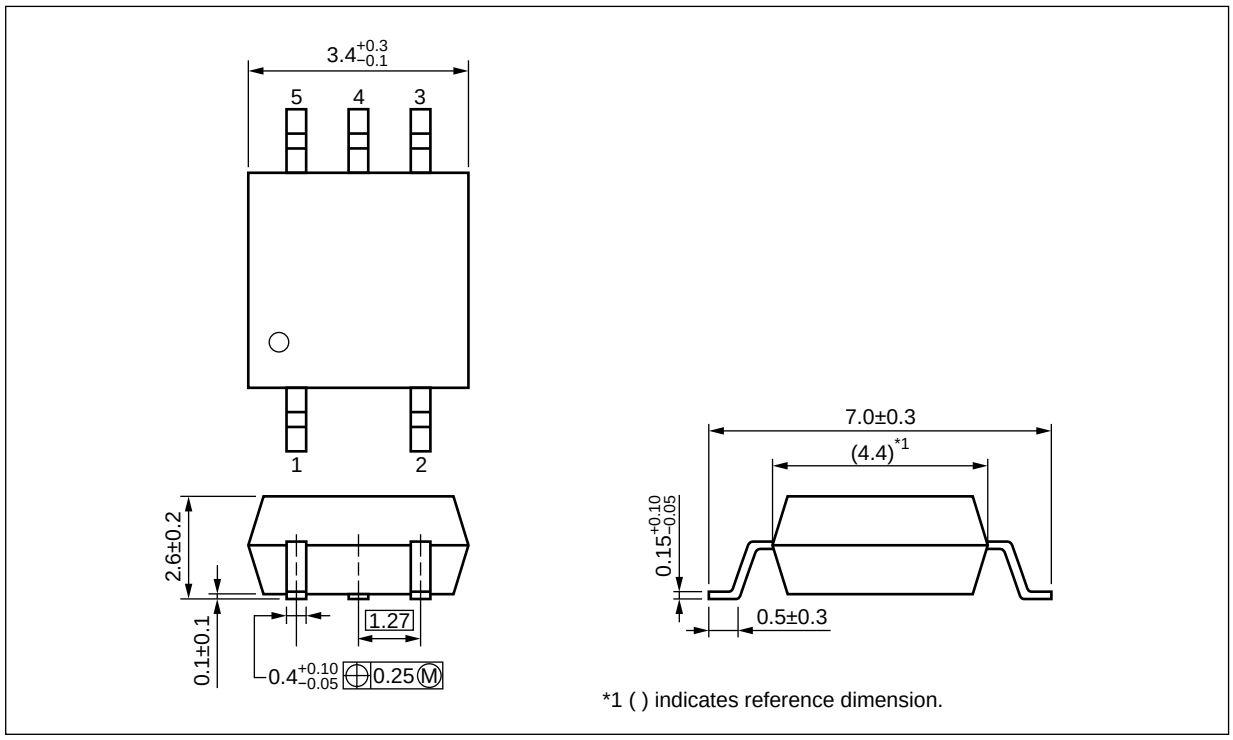
- PoE (Power over Ethernet)
- Measurement equipment
- FA Network

TRUTH TABLE

LED	Output
ON	L
OFF	H

Start of mass production
Oct.2008

PACKAGE DIMENSIONS (UNIT: mm)

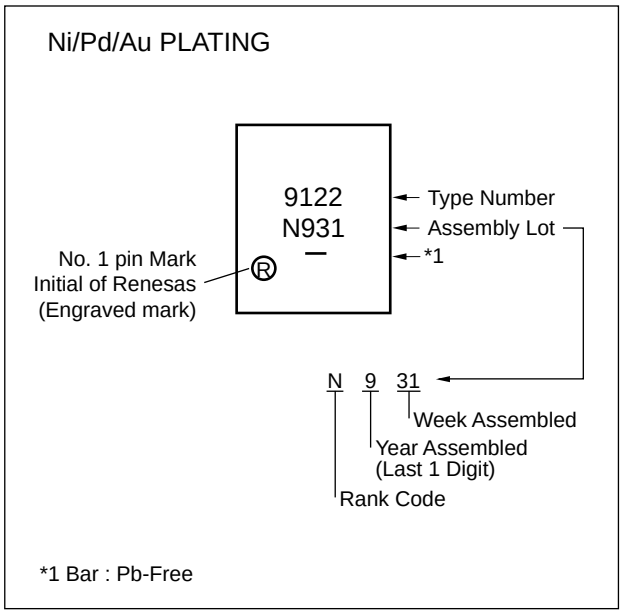


Weight: 0.08g (typ.)

PHOTOCOUPLER CONSTRUCTION

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

MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number *4	Rank	Solder Plating Specification	Packing Style	Safety Standards Approval	Application Part Number *1
PS9122	PS9122-AX	N*2	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9122
		L*3				
PS9122-F3	PS9122-F3-AX	N*2		Embossed Tape 2 500 pcs/reel		
		L*3				
PS9122-V	PS9122-V-AX	N*2		20 pcs (Tape 20 pcs cut)	UL, CSA, DIN EN 60747-5-5 approved	
		L*3				
PS9122-V-F3	PS9122-V-F3-AX	N*2		Embossed Tape 2 500 pcs/reel		
		L*3				

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

2. N rank: V_{CC} = 3.3 V
3. L rank: V_{CC} = 5 V
4. When specifying rank, please add “/rank” after Order Number.
   ex. N rank : PS9122-AX/N

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}	7	V
	Output Voltage	V_O	7	V
	Output Current	I_O	20	mA
	Power Dissipation *2	P_C	40	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

Notes*: 1. Reduced to 0.17 mA/°C at T_A = 25 °C or more.
2. Applies to output pin V_O (collector pin). Reduced to 1.5 mW/°C at T_A = 80 °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
Low Level Input Voltage		V_{FL}	0		0.8	V
High Level Input Current		I_{FH}	6.3	10	12.5	mA
Supply Voltage	N rank	V_{CC}	2.7	3.3	3.6	V
	L rank		4.5	5.0	5.5	
TTL (R_L = 1 kΩ, loads)		N			3	
Pull-up Resistor		R_L	330		4 k	Ω

ELECTRICAL CHARACTERISTICS 1: N rank (T_A = − 40 to +100 °C, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Diode	Forward Voltage	V_F	I_F = 10 mA, T_A = 25 °C		1.6	1.8	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25 °C			10	μA
	Terminal Capacitance	C_t	V = 0 V, f = 1 MHz, T_A = 25 °C		30		pF
Detector	High Level Output Current	I_{OH}	V_{CC} = V_O = 3.3 V, V_F = 0.8 V		1	100	μA
	Low Level Output Voltage*2	V_{OL}	V_{CC} = 3.3 V, I_F = 5 mA, I_{OL} = 10 mA		0.2	0.6	V
	High Level Supply Current	I_{CCH}	V_{CC} = 3.3 V, I_F = 0 mA, V_O = Open			2	mA
	Low Level Supply Current	I_{CCL}	V_{CC} = 3.3 V, I_F = 10 mA, V_O = Open			3	
Coupled	Threshold Input Current (H → L)	I_{FHL}	V_{CC} = 3.3 V, V_O = 0.8 V, R_L = 350 Ω		2	5	mA
	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)*3	t_{PHL}	V_{CC} = 3.3 V, R_L = 350 Ω, I_F = 7.5 mA, V_{THHL} = V_{THLH} = 1.5 V			500	ns
	Propagation Delay Time (L → H)*3	t_{PLH}				700	
	Rise Time	t_r			60		ns
	Fall Time	t_f			70		
	Pulse Width Distortion (PWD)*3	$\lvert t_{PHL}-t_{PLH} \rvert$				200	ns
	Common Mode Transient Immunity at High Level Output*4	CM_H	V_{CC} = 3.3 V, R_L = 350 Ω, T_A = 25 °C, I_F = 0 mA, V_O > 2.0 V, V_{CM} = 1.0 kV	15	20		kV/μs
	Common Mode Transient Immunity at Low Level Output*4	CM_L	V_{CC} = 3.3 V, R_L = 350 Ω, T_A = 25 °C, I_F = 7.5 mA, V_O < 0.8 V, V_{CM} = 1.0 kV	15	20		

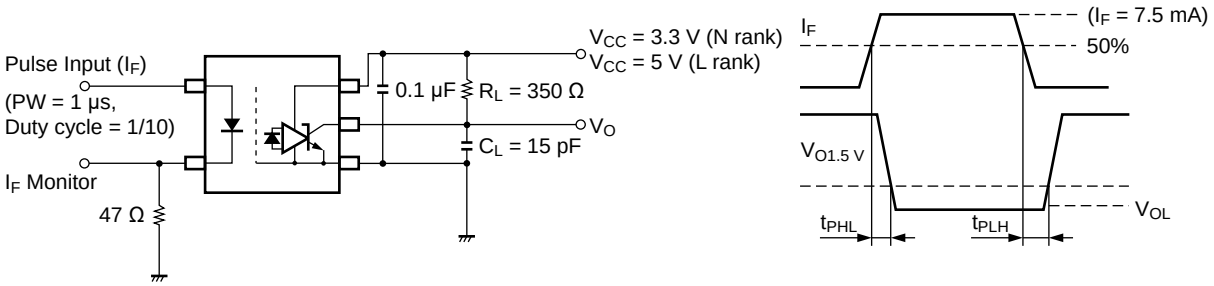
ELECTRICAL CHARACTERISTICS 2: L rank (T_A = − 40 to +100 °C, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.*5	MAX.	Unit
Diode	Forward Voltage	V_F	I_F = 10 mA, T_A = 25 °C		1.6	1.8	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25 °C			10	μA
	Terminal Capacitance	C_t	V = 0 V, f = 1 MHz, T_A = 25 °C		30		pF
Detector	High Level Output Current	I_{OH}	V_{CC} = V_O = 5 V, V_F = 0.8 V		1	100	μA
	Low Level Output Voltage*6	V_{OL}	V_{CC} = 5 V, I_F = 5 mA, I_{OL} = 13 mA		0.2	0.6	V
	High Level Supply Current	I_{CCH}	V_{CC} = 5 V, I_F = 0 mA, V_O = Open			2.5	mA
	Low Level Supply Current	I_{CCL}	V_{CC} = 5 V, I_F = 10 mA, V_O = Open			3.5	
Coupled	Threshold Input Current (H → L)	I_{FHL}	V_{CC} = 5 V, V_O = 0.8 V, R_L = 350 Ω		2	5	mA
	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)*7	t_{PHL}	V_{CC} = 5 V, R_L = 350 Ω, I_F = 7.5 mA, V_{THHL} = V_{THLH} = 1.5 V			500	ns
	Propagation Delay Time (L → H)*7	t_{PLH}				700	
	Rise Time	t_r			60		ns
	Fall Time	t_f			70		
	Pulse Width Distortion (PWD)*7	$\lvert t_{PHL}-t_{PLH} \rvert$				200	ns
	Common Mode Transient Immunity at High Level Output*8	CM_H	V_{CC} = 5 V, R_L = 350 Ω, T_A = 25 °C, I_F = 0 mA, V_O > 2.0 V, V_{CM} = 1.0 kV	15	20		kV/μs
	Common Mode Transient Immunity at Low Level Output*8	CM_L	V_{CC} = 5 V, R_L = 350 Ω, T_A = 25 °C, I_F = 7.5 mA, V_O < 0.8 V, V_{CM} = 1.0 kV	15	20		

Notes*: 1,5 . Typical values at T_A = 25 °C.

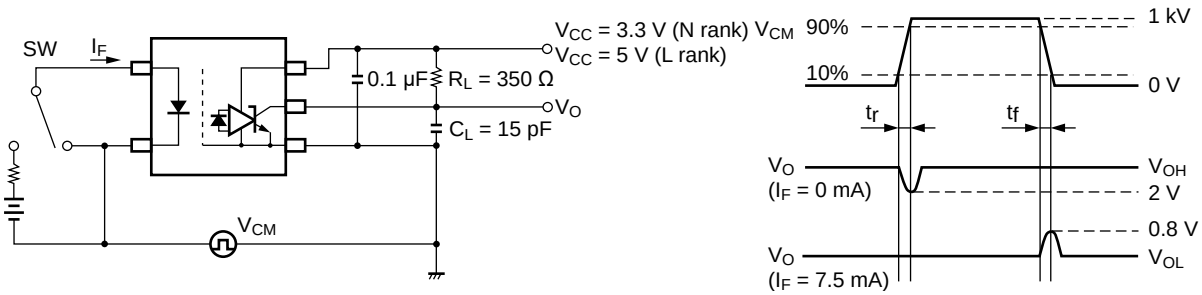
2,6 . Because V_{OL} of 2 V or more may be output when LED current input and when output supply of V_{CC} = 2 V more or less, it is important to confirm the characteristics (operation with the power supply on and off) during design, before using this device

3,7. Test circuit for propagation delay time



Remark: C_L includes probe and stray wiring capacitance.

4,8. Test circuit for common mode transient immunity



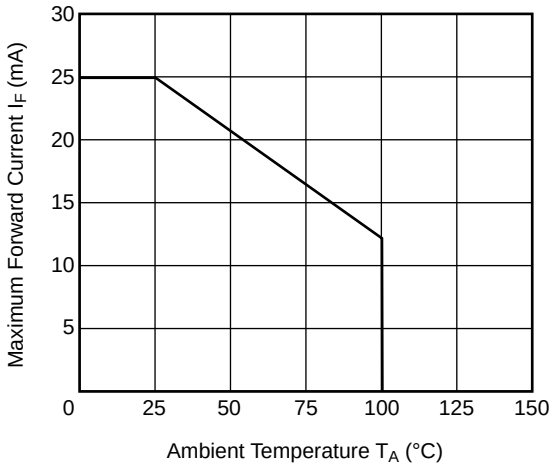
Remark: C_L includes probe and stray wiring capacitance.

USAGE CAUTIONS

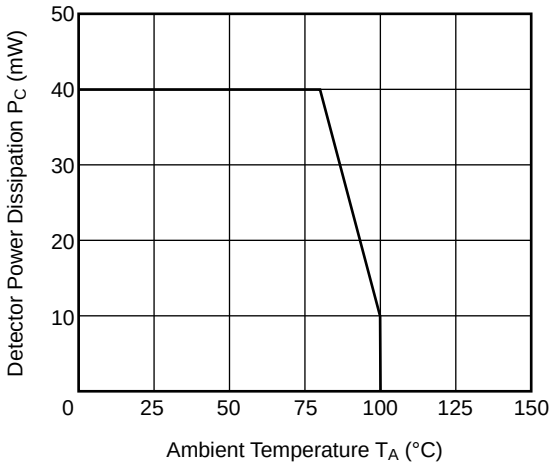
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1µF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.
4. Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.
5. Do not use fixing agents or coatings containing halogen-based substances.

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

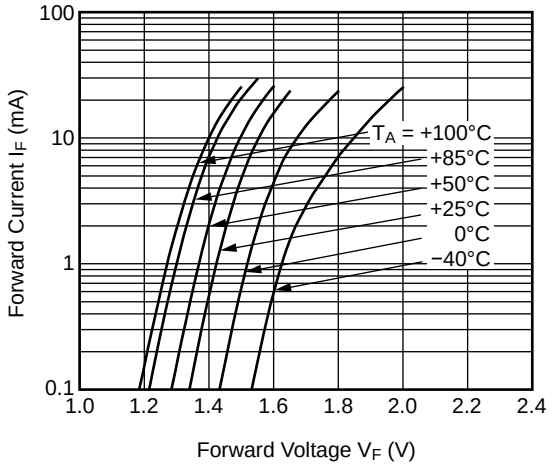
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



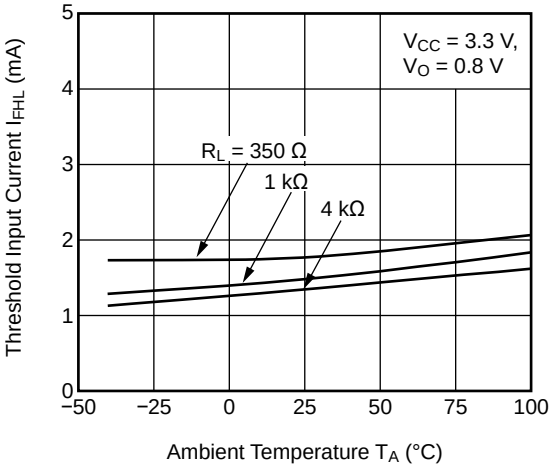
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



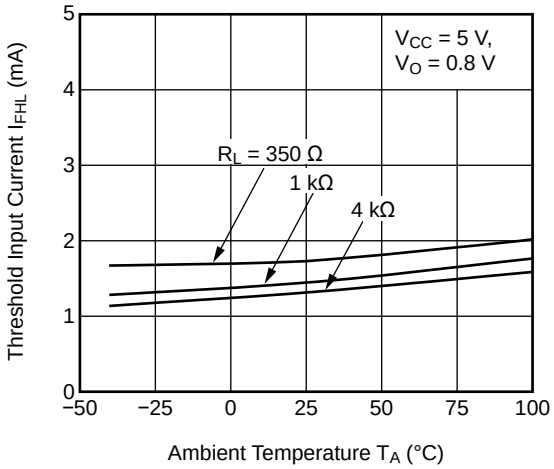
FORWARD CURRENT vs. FORWARD VOLTAGE



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

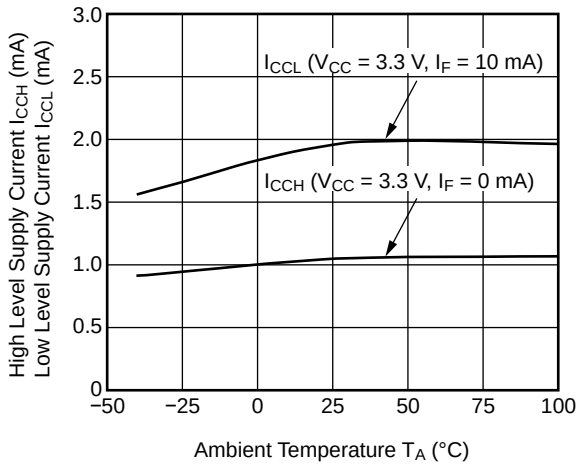


THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

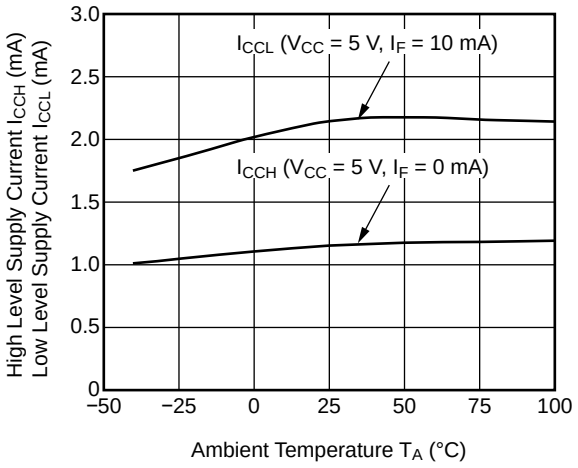


Remark The graphs indicate nominal characteristics.

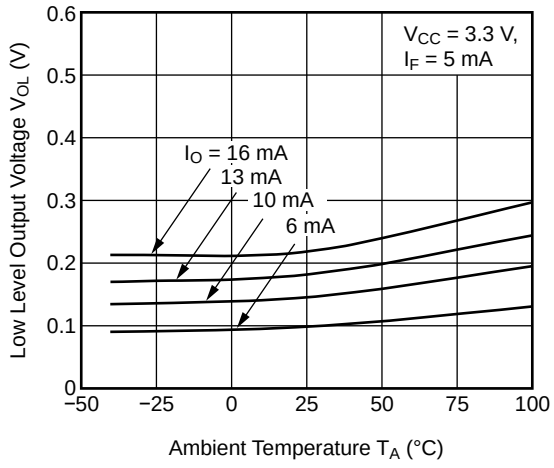
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



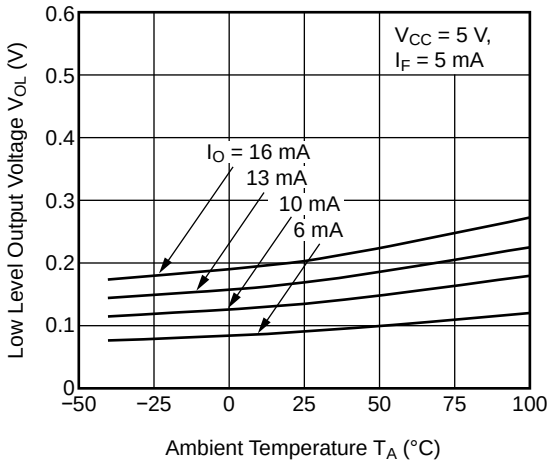
SUPPLY CURRENT vs.
AMBIENT TEMPERATURE



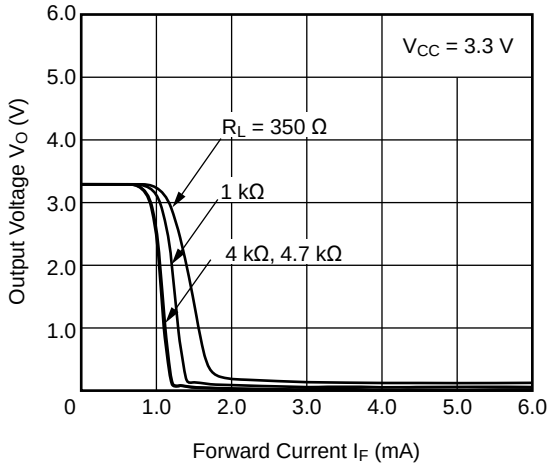
LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



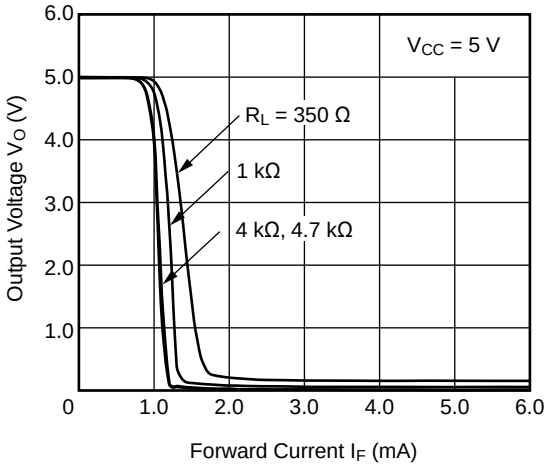
LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

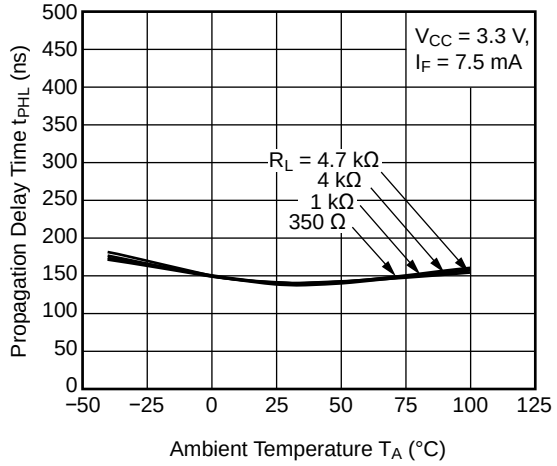


OUTPUT VOLTAGE vs. FORWARD CURRENT

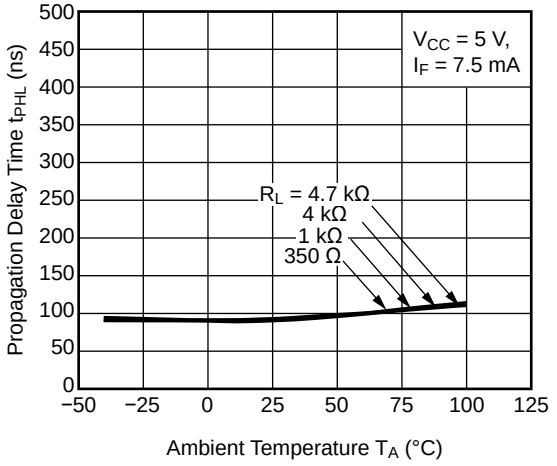


Remark The graphs indicate nominal characteristics.

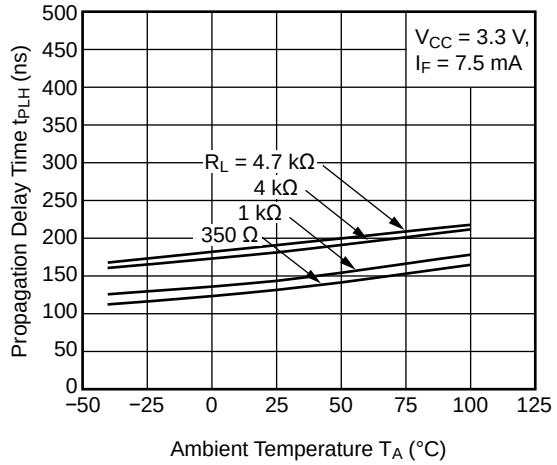
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



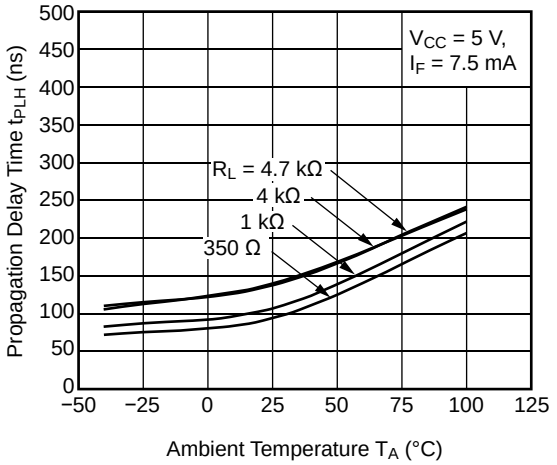
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



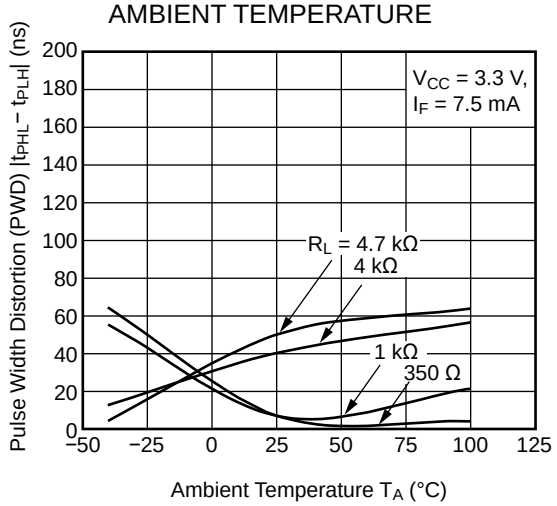
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



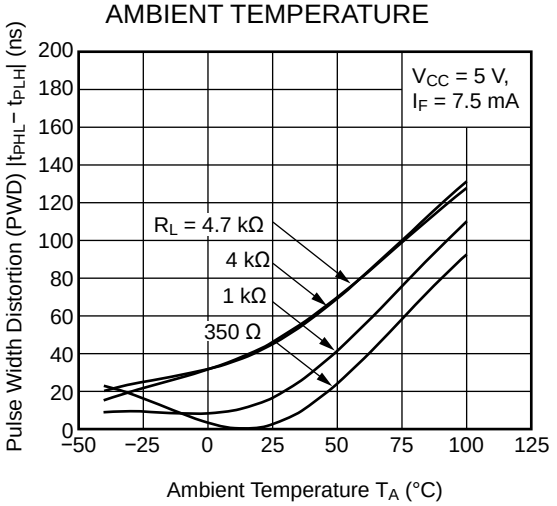
PROPAGATION DELAY TIME vs.
AMBIENT TEMPERATURE



PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE

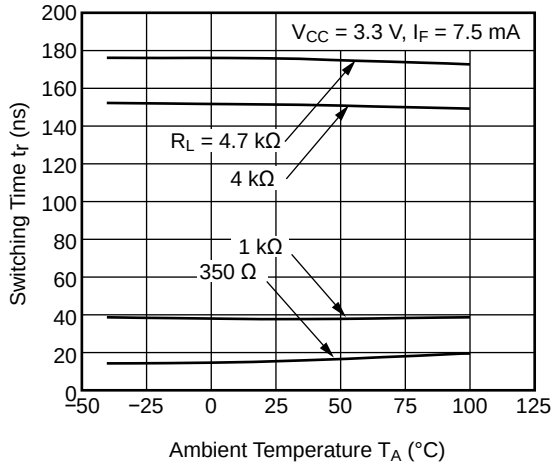


PULSE WIDTH DISTORTION vs.
AMBIENT TEMPERATURE

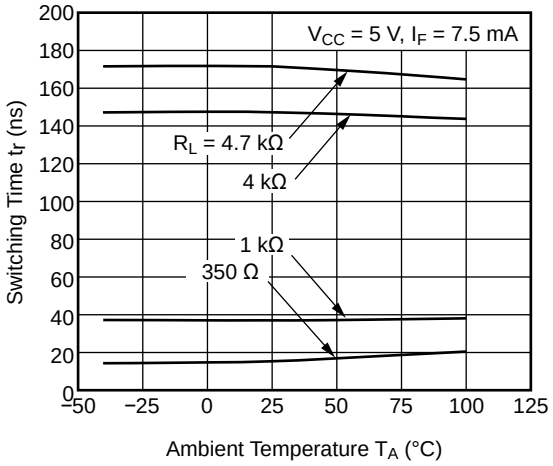


Remark The graphs indicate nominal characteristics.

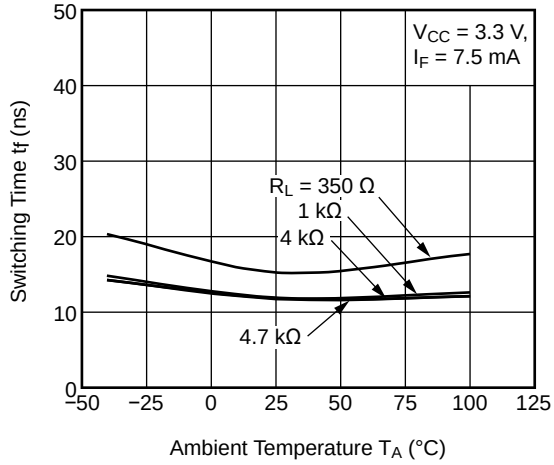
SWITCHING TIME vs.
AMBIENT TEMPERATURE



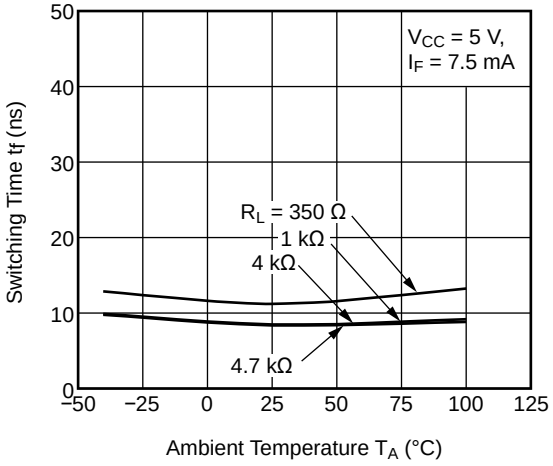
SWITCHING TIME vs.
AMBIENT TEMPERATURE



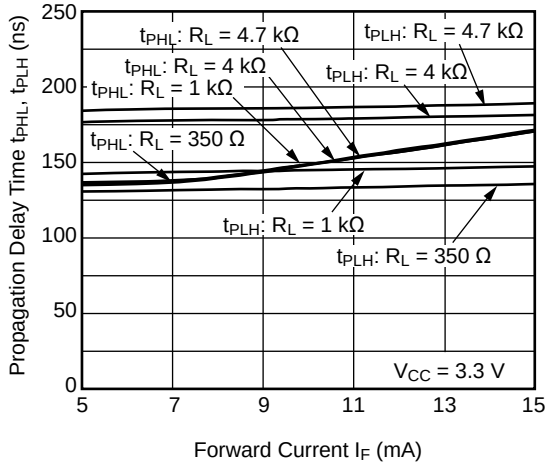
SWITCHING TIME vs.
AMBIENT TEMPERATURE



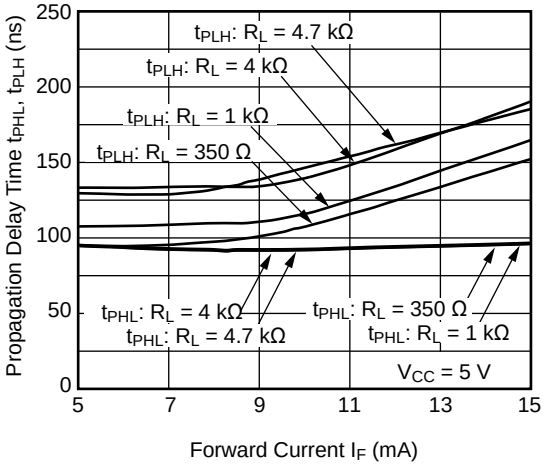
SWITCHING TIME vs.
AMBIENT TEMPERATURE



PROPAGATION DELAY TIME vs.
FORWARD CURRENT



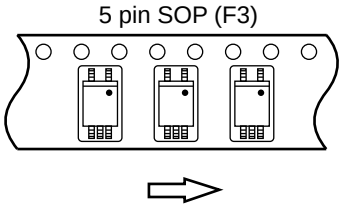
PROPAGATION DELAY TIME vs.
FORWARD CURRENT



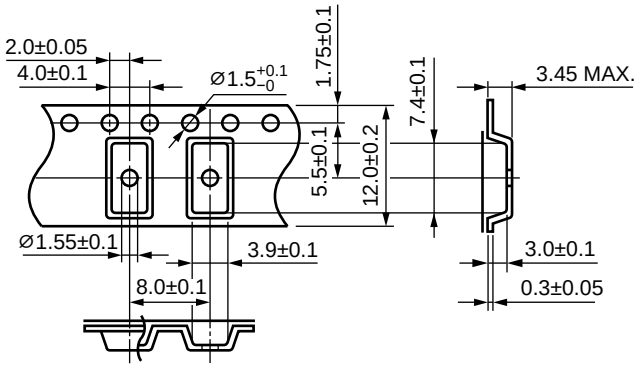
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

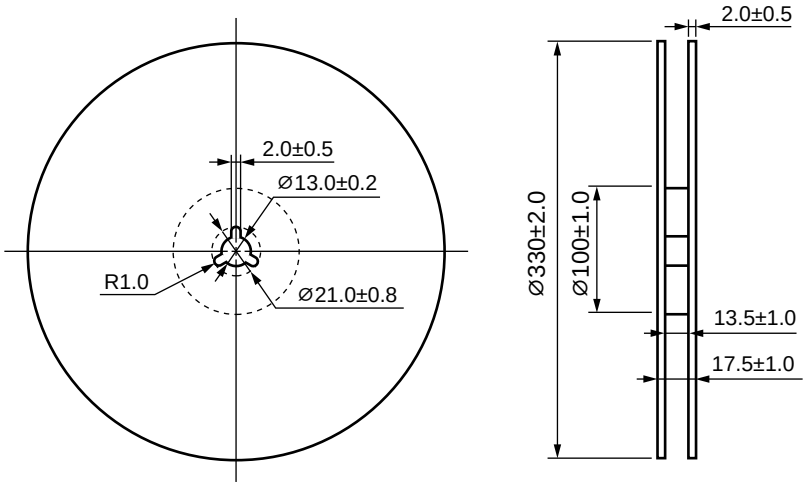
Tape Direction



Outline and Dimensions (Tape)

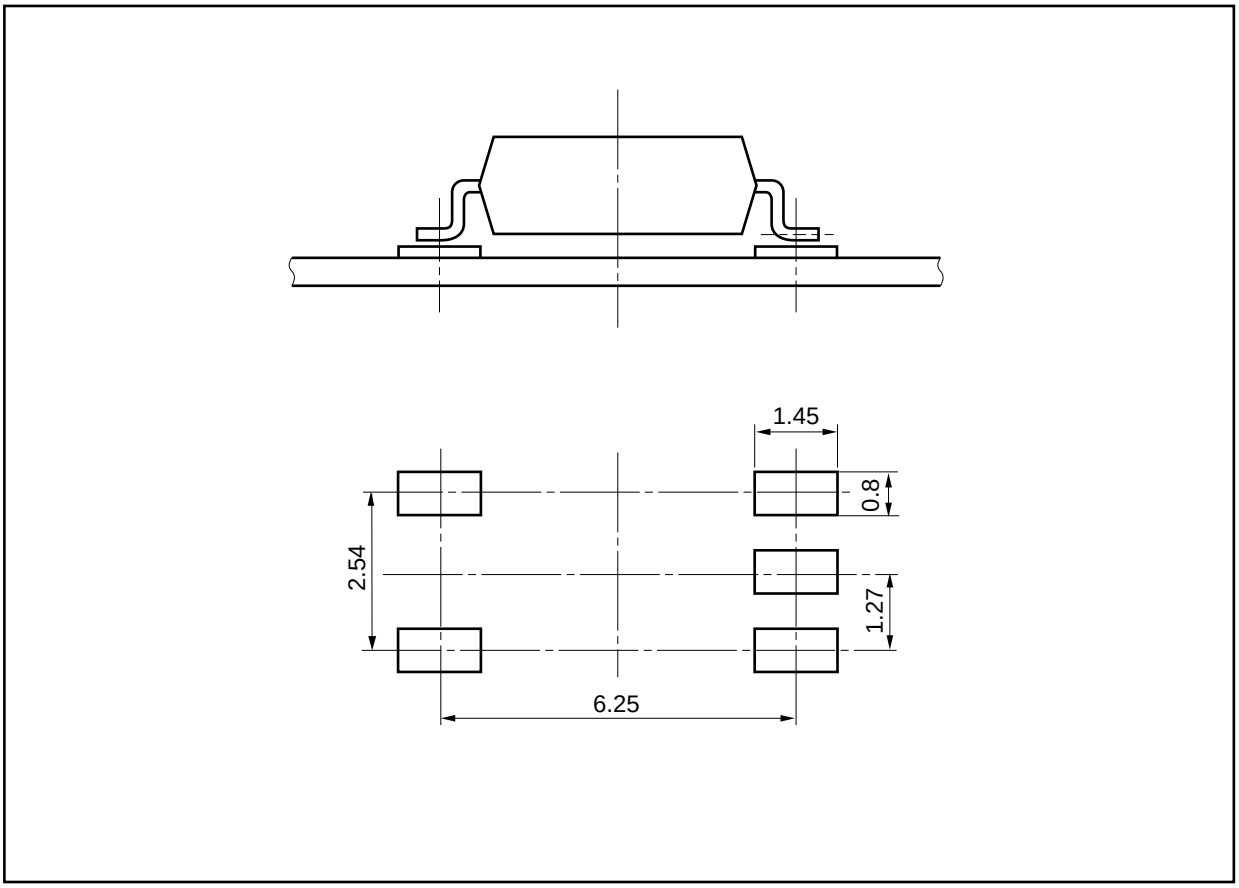


Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Remark All dimensions in this figure must be evaluated before use.

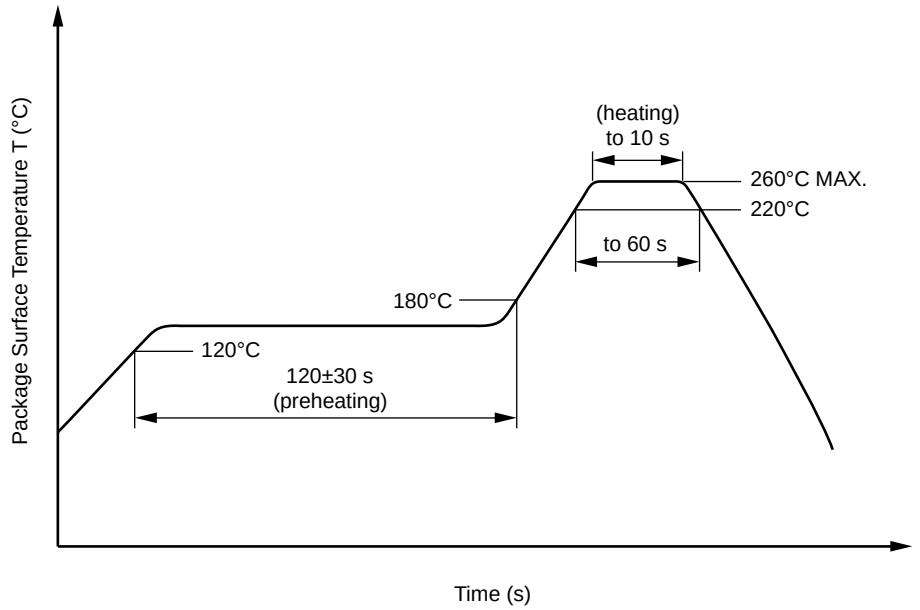
NOTES ON HANDLING

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

• Flux Cleaning

Avoid cleaning with Freon based or halogen-based (chlorinated etc.) solvents.

• Do not use fixing agents or coatings containing halogen-based substances.

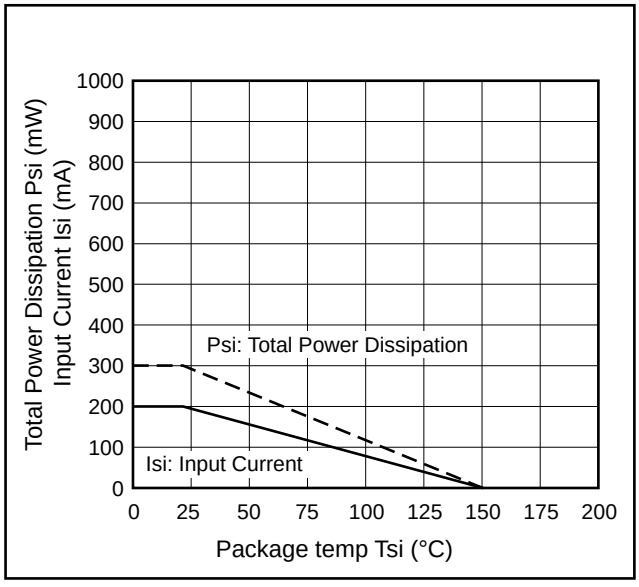
2. Cautions regarding noise

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.

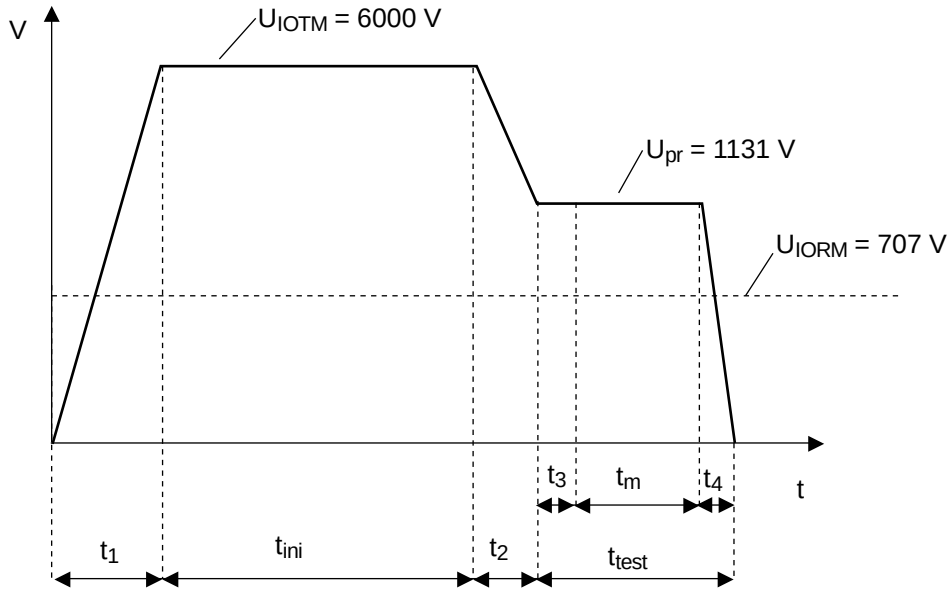
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM.}$, $P_d < 5$ pC	 U_{IORM} U_{pr}	 707 1 131	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM.}$, $P_d < 5$ pC	U_{pr}	1 326	V_{peak}
Highest permissible overvoltage	U_{IOTM}	6 000	V_{peak}
Degree of pollution (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303-11))	CTI	175	
Material group (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		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

Dependence of maximum safety ratings with package temperature

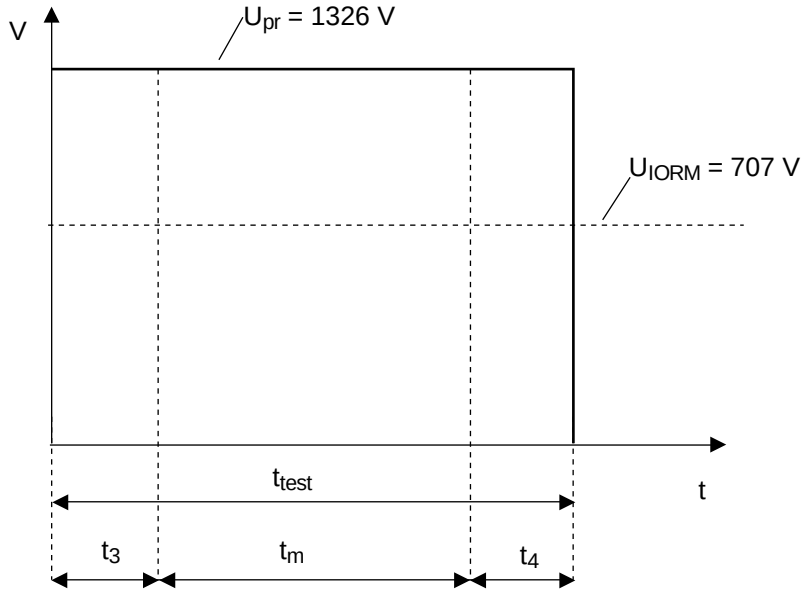


Method a) Destructive Test, Type and Sample Test



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

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



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

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