PS9513, PS9513L1, PS9513L2, PS9513L3

1 Mbps, OPEN COLLECTOR OUTPUT, FOR INTELLIGENT POWER MODULE DRIVE

8-PIN DIP HIGH-SPEED PHOTOCOUPLER

R08DS0126EJ0203
Rev.2.03
Oct 29, 2018

DESCRIPTION

The PS9513, PS9513L1, PS9513L2 and PS9513L3 are optically coupled isolators containing an AlGaAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

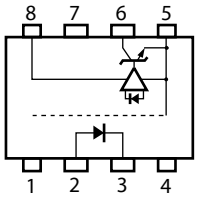
The PS9513 is designed specifically for high common mode transient immunity (CMR) and low pulse width distortion with operating temperature. It is suitable for IPM drive.

The PS9513L1 is lead bending type for long creepage distance.
The PS9513L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.
The PS9513L3 is lead bending type (Gull-wing) for surface mounting.

FEATURES

- Long creepage distance (8 mm MIN. : PS9513L1, PS9513L2)
- High common mode transient immunity (CM_H, CM_L = ±15 kV/μs MIN)
- High-speed response (t_{PHL} = 500 ns MAX., t_{PLH} = 750 ns MAX.)
- Propagation Delay Difference ($t_{PLH} - t_{PHL}$ = 270 ns TYP.)
- Pulse width distortion ($|t_{PHL} - t_{PLH}|$ = 270 ns TYP.)
- Open collector output
- Ordering number of tape product : PS9513L2-E3 : 1 000 pcs/reel
  : PS9513L3-E3 : 1 000 pcs/reel
- Pb-Free product
- Safety standards
- - UL approved: UL1577, Double protection
- - CSA approved: CAN/CSA-C22.2 No.62368-1, Reinforced insulation
- - BSI approved: BS EN 62368-1, Reinforced insulation
- - SEMKO approved: EN 62368-1, IEC 62368-1, Reinforced insulation
- - NEMKO approved: EN 62368-1, Reinforced insulation
- - DEMKO approved: EN 62368-1, Reinforced insulation
- - FIMKO approved: EN 62368-1, Reinforced insulation
- - VDE approved: DIN EN 60747-5-5 (Option)

PIN CONNECTIONS
(Top View)



1. NC
2. Anode
3. Cathode
4. NC
5. GND
6. V_O
7. NC
8. V_{CC}

APPLICATIONS

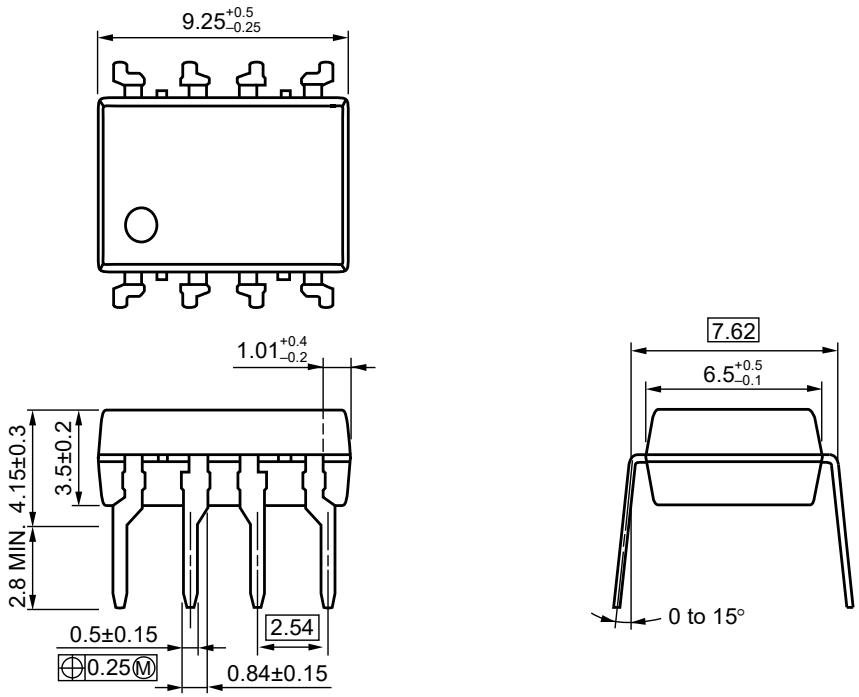
- IPM Driver
- General purpose inverter

Start of mass production
Jun-2006

PACKAGE DIMENSIONS (UNIT: mm)

DIP Type

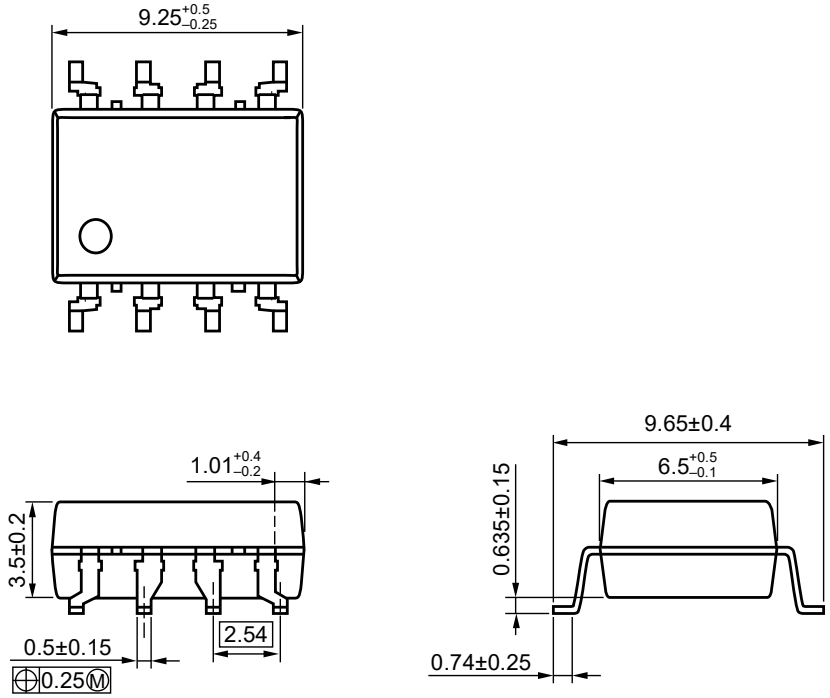
PS9513



Weight: 0.55g (typ.)

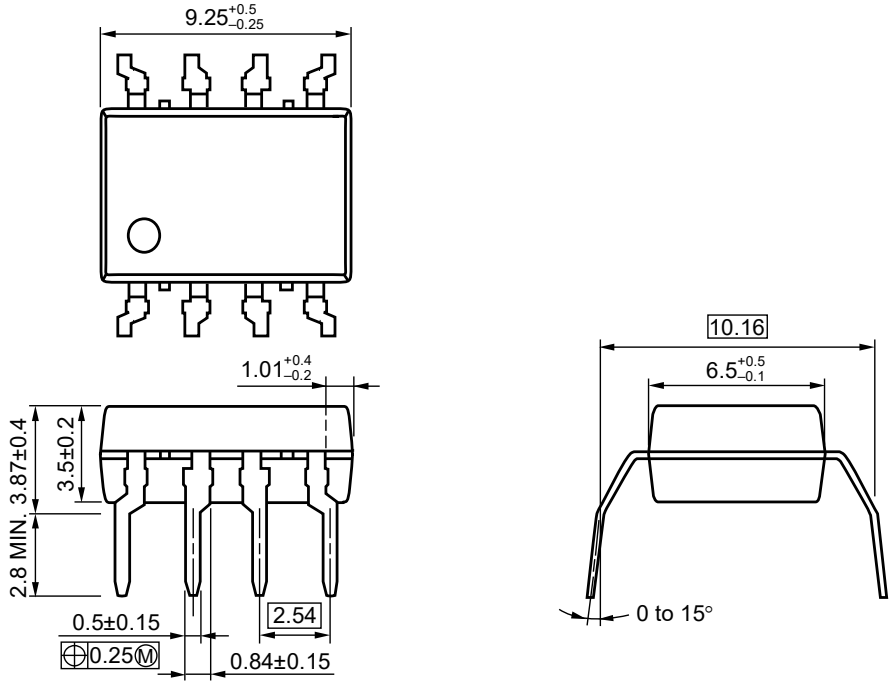
Lead Bending Type (Gull-wing) For Surface Mount

PS9513L3



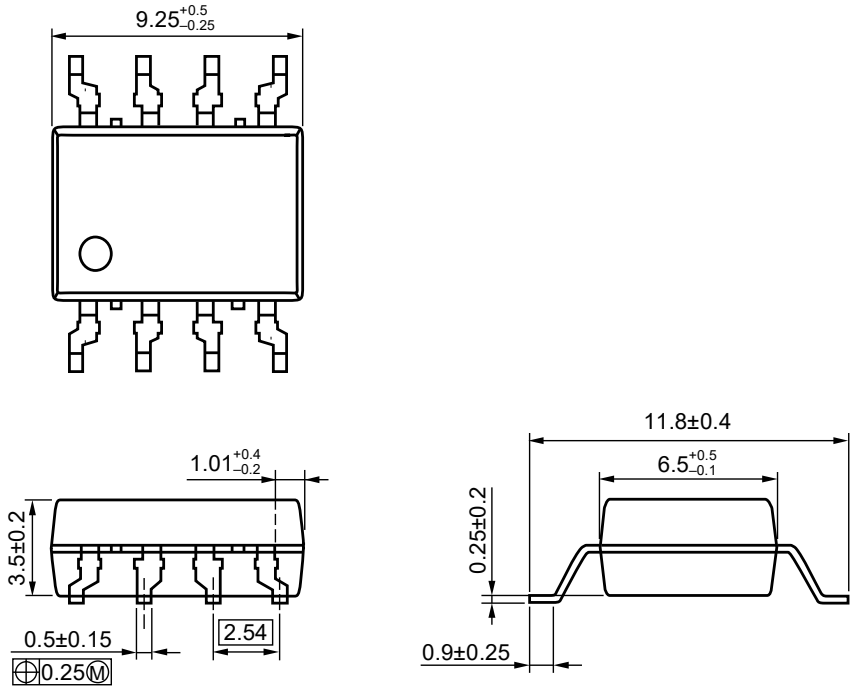
Lead Bending Type For Long Creepage Distance

PS9513L1



Lead Bending Type For Long Creepage Distance (Gull-wing) For Surface Mount

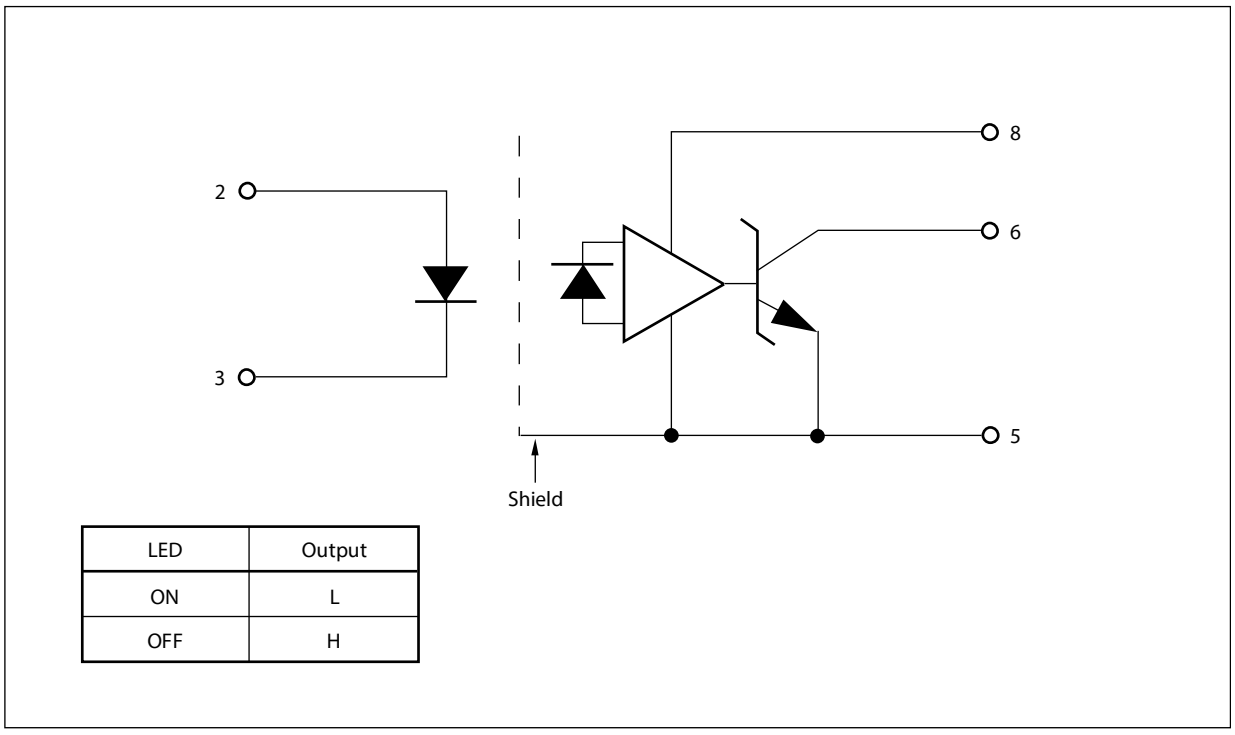
PS9513L2



PHOTOCOUPLER CONSTRUCTION

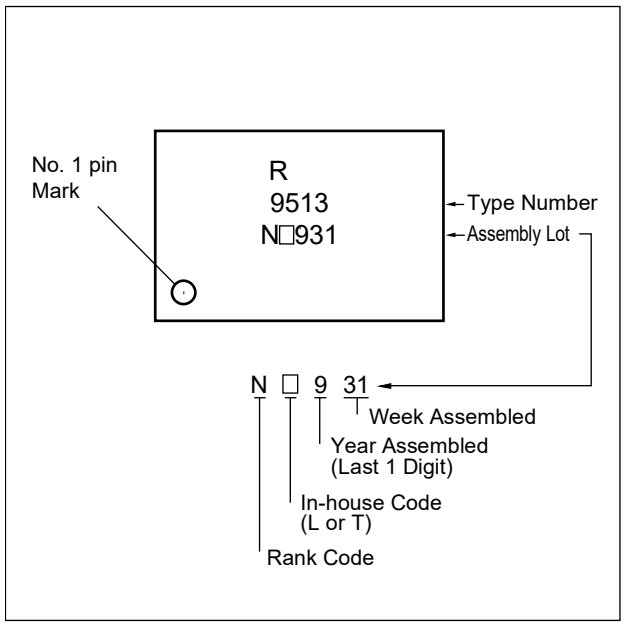
Parameter	PS9513, PS9513L3	PS9513L1, PS9513L2
Air Distance (MIN.)	7 mm	8 mm
Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

FUNCTIONAL DIAGRAM



LED	Output
ON	L
OFF	H

MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9513	PS9513-AX	Pb-Free (Ni/Pd/Au)	Magazine case 50 pcs	Standard products (UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO approved)	PS9513
PS9513L1	PS9513L1-AX				PS9513L1
PS9513L2	PS9513L2-AX				PS9513L2
PS9513L3	PS9513L3-AX				PS9513L3
PS9513L2-E3	PS9513L2-E3-AX		Embossed Tape 1 000 pcs/reel		PS9513L2
PS9513L3-E3	PS9513L3-E3-AX				PS9513L3
PS9513-V	PS9513-V-AX		Magazine case 50 pcs	UL, CSA, BSI, SEMKO, NEMKO, DEMKO, FIMKO, DIN EN 60747-5-5 approved	PS9513
PS9513L1-V	PS9513L1-V-AX				PS9513L1
PS9513L2-V	PS9513L2-V-AX				PS9513L2
PS9513L3-V	PS9513L3-V-AX				PS9513L3
PS9513L2-V-E3	PS9513L2-V-E3-AX		Embossed Tape 1 000 pcs/reel		PS9513L2
PS9513L3-V-E3	PS9513L3-V-E3-AX				PS9513L3

Notes*: 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	5.0	V
Detector	Supply Voltage	V_{CC}	−0.5 to +25	V
	Output Voltage	V_O	−0.5 to +25	V
	Output Current	I_O	15	mA
	Power Dissipation *2	P_C	100	mW
Isolation Voltage *3		BV	5 000	Vr.m.s.
Operating Ambient Temperature		T_A	−40 to +100	°C
Storage Temperature		T_{stg}	−55 to +125	°C

Notes*: 1. Reduced to 0.33 mA/°C at T_A = 70°C or more.
2. Reduced to 2.0 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 1-4 shorted together, 5-8 shorted together.

RECOMMENDED OPERATING CONDITIONS

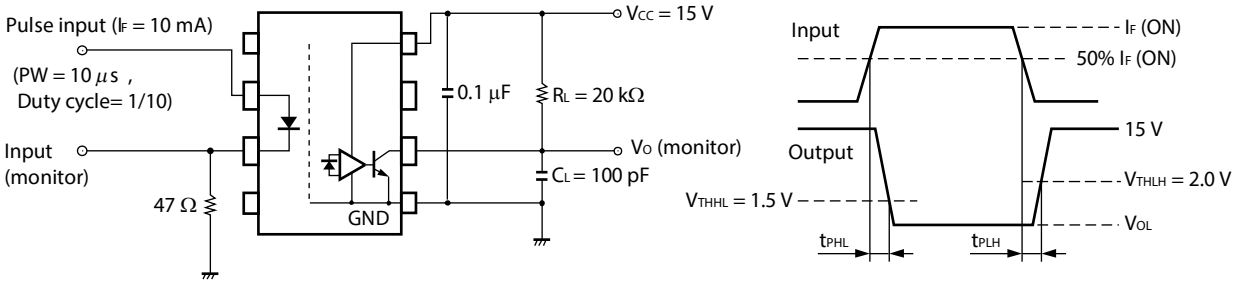
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Forward Current	I_F	10		20	mA
Output Voltage	V_O	0		20	V
Supply Voltage	V_{CC}	4.5	15	20	V
Input Voltage	V_F	0		0.8	V

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} = 20 V, V_F = 0.8 V		1.0	50	μA
	High Level Supply Current	I_{CCH}	V_{CC} = 20 V, V_F = 0.8 V, V_O = open		0.6	1.3	mA
	Low Level Supply Current	I_{CCL}	V_{CC} = 20 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		0.86	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		0.7		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	
	Propagation Delay Difference	$t_{PLH}–t_{PHL}$		–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

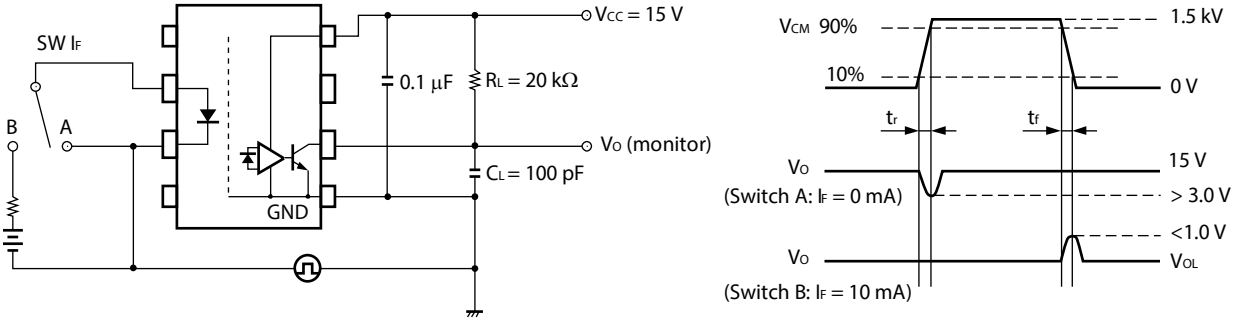
Notes*: 1. Typical values at T_A = 25°C.

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

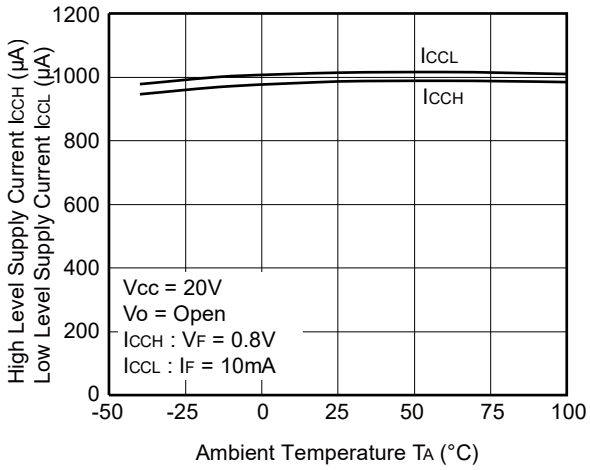
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1 μF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Pins 1, 4 (which is an NC*1 pin) can either be connected directly to the GND pin on the LED side or left open. Also, Pin 7 (which is an NC*1 pin) can either be connected directly to the GND pin on the detector side or left open.

   Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.

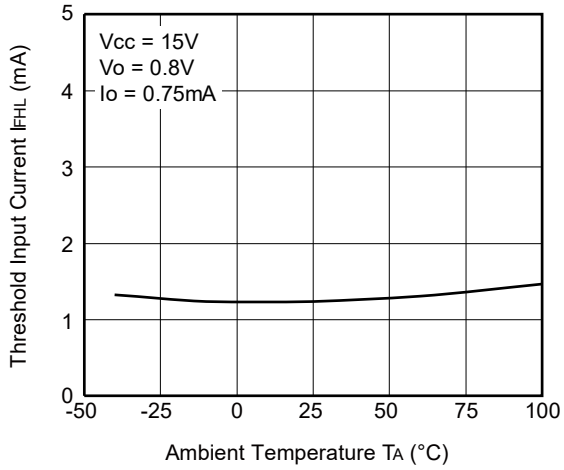
   *1 NC: Non-Connection (No Connection)
4. Avoid storage at a high temperature and high humidity.
5. Do not use adhesives or coating materials including halogens to fix this device.

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

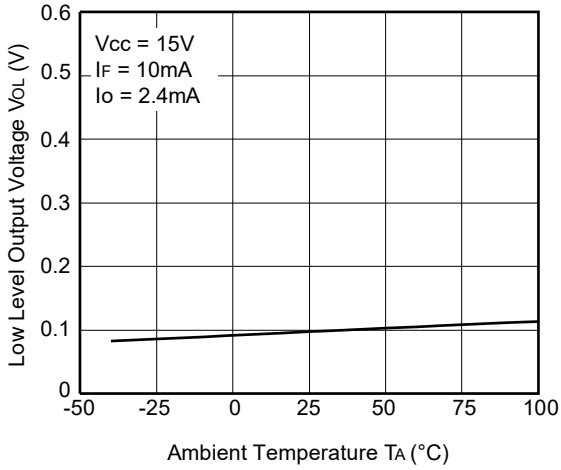
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



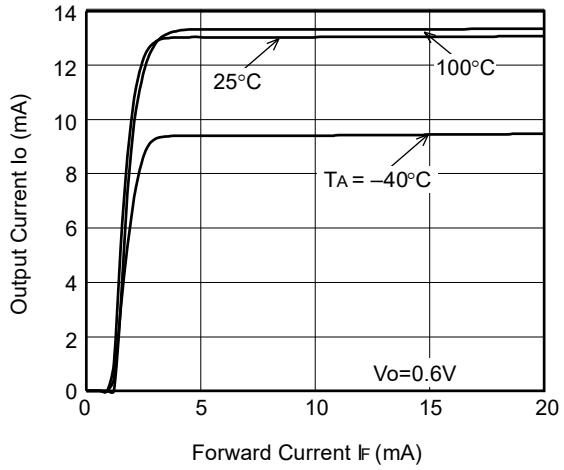
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



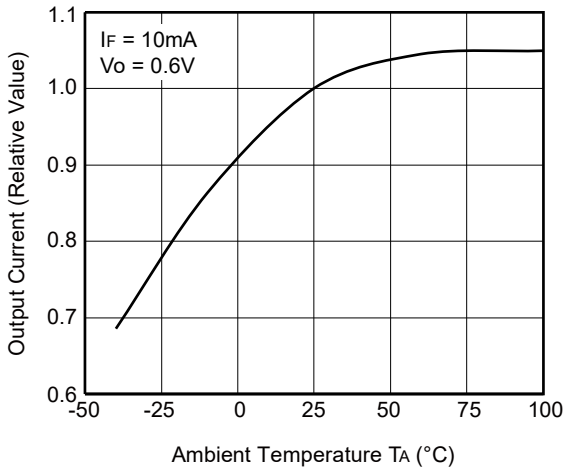
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



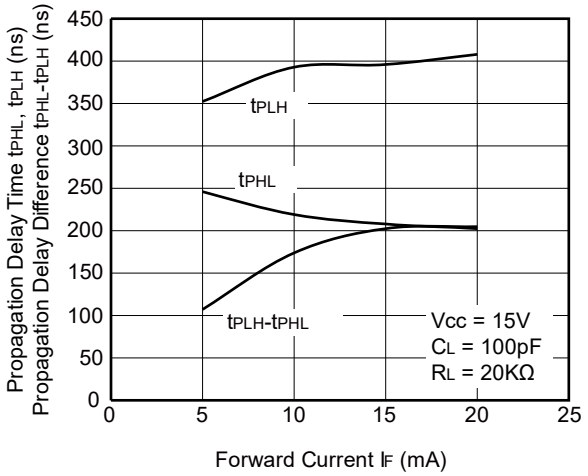
OUTPUT CURRENT vs. FORWARD CURRENT



OUTPUT CURRENT vs. AMBIENT TEMPERATURE

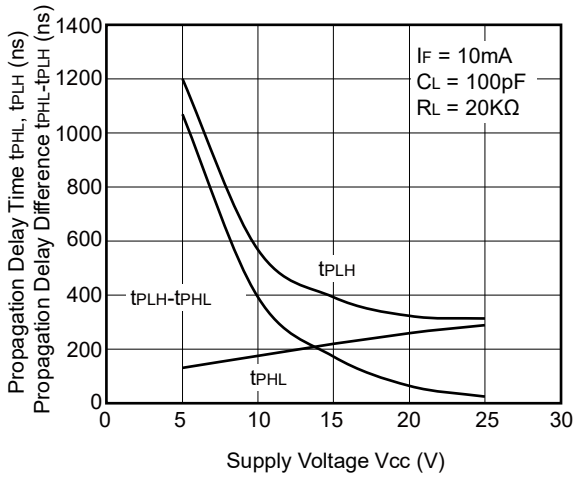


PROPAGATION DELAY TIME, PROPAGATION DELAY DIFFERENCE vs. FORWARD CURRENT

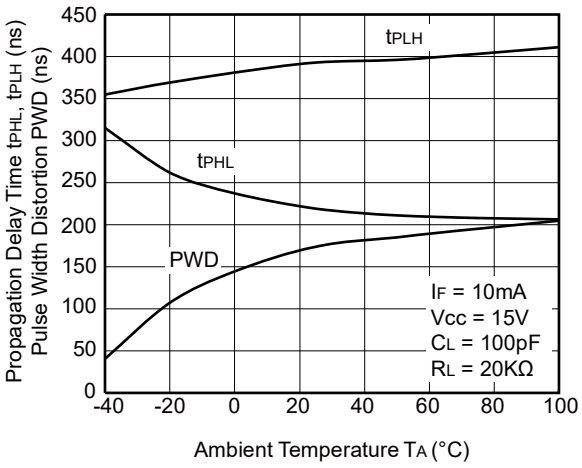


Remark The graphs indicate nominal characteristics.

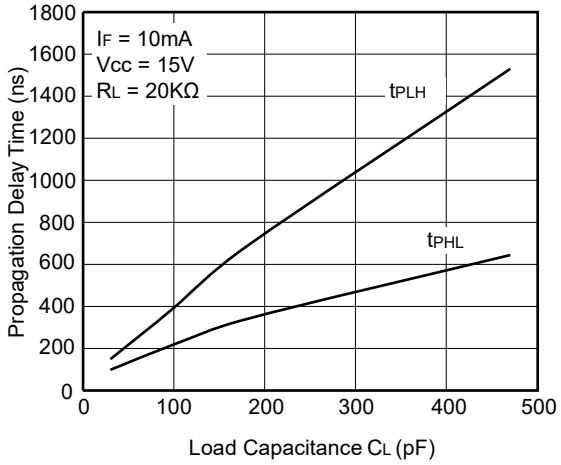
PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. SUPPLY VOLTAGE



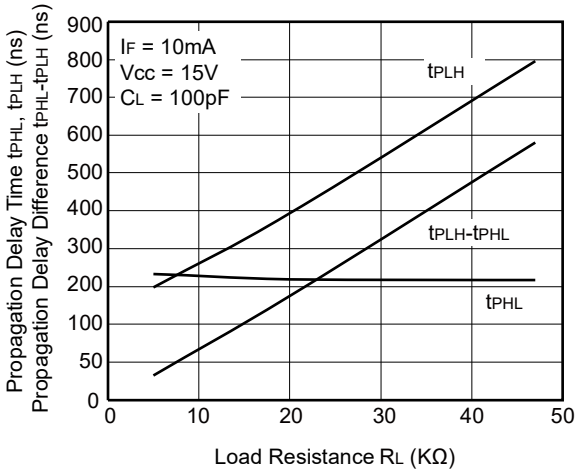
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



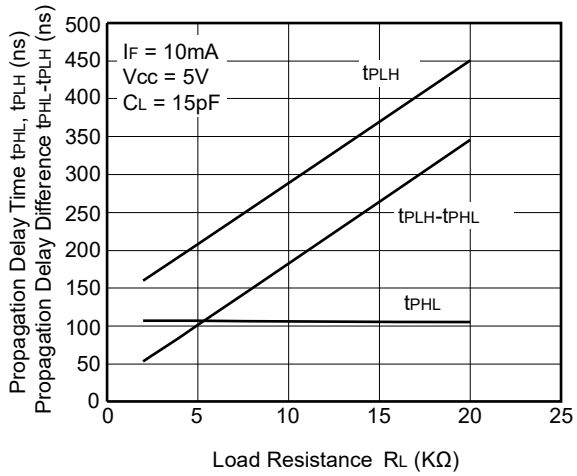
PROPAGATION DELAY TIME
vs. LOAD CAPACITANCE



PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. LOAD RESISTANCE



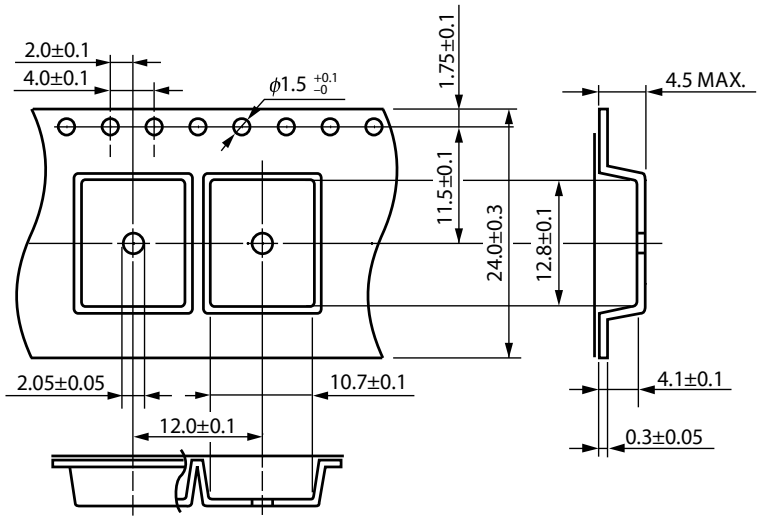
PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. LOAD RESISTANCE



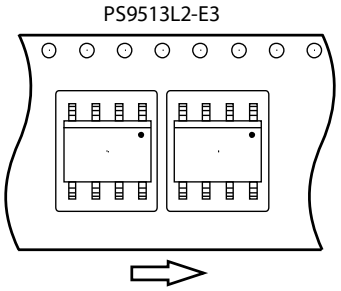
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

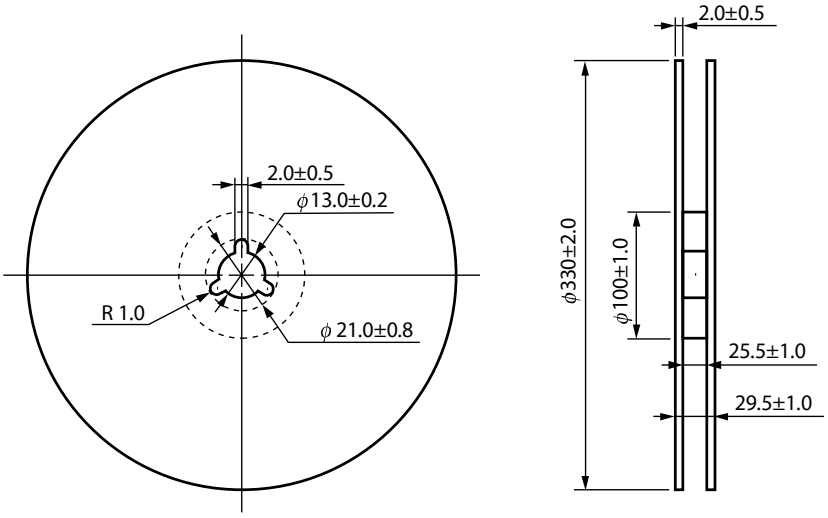
Outline and Dimensions (Tape)



Tape Direction

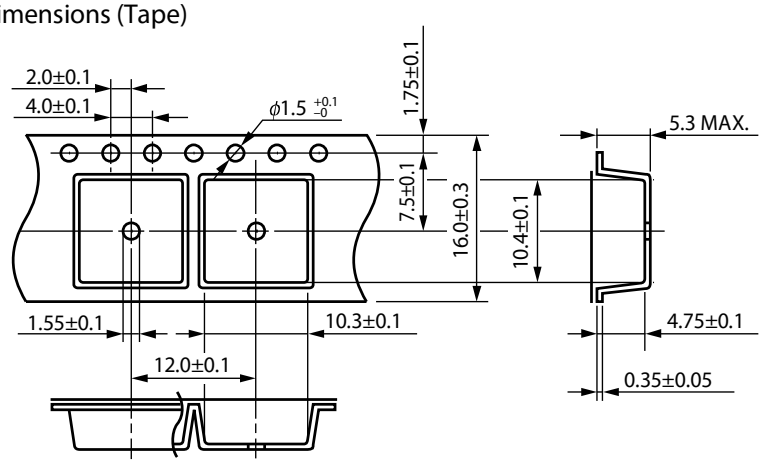


Outline and Dimensions (Reel)

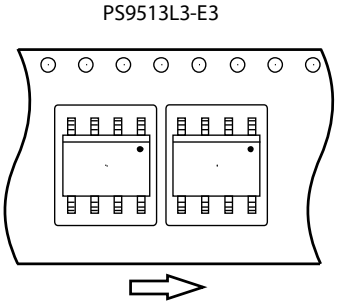


Packing: 1 000 pcs/reel

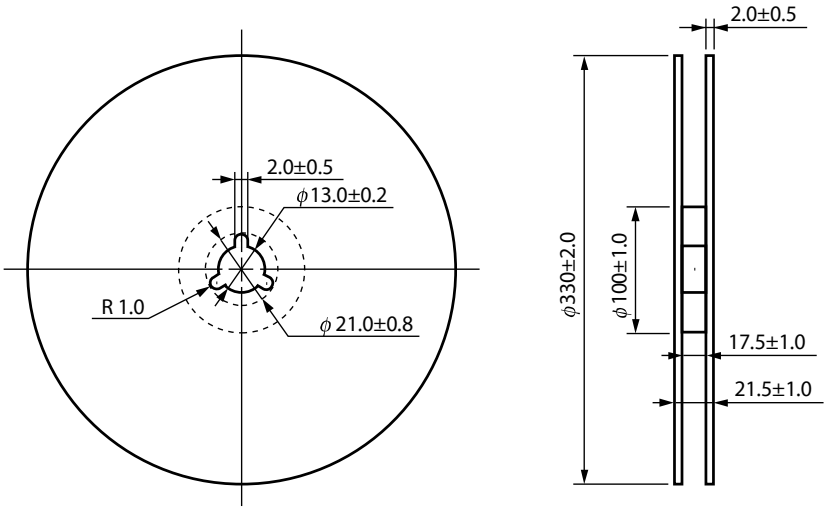
Outline and Dimensions (Tape)



Tape Direction

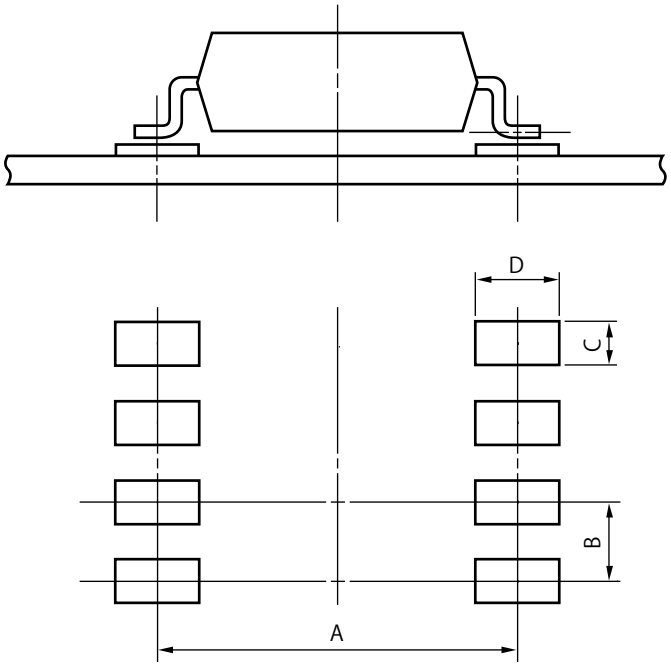


Outline and Dimensions (Reel)



Packing: 1 000 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9513L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	2.54	1.7	2.2
PS9513L3	lead bending type (Gull-wing) for surface mount	8.2	2.54	1.7	2.2

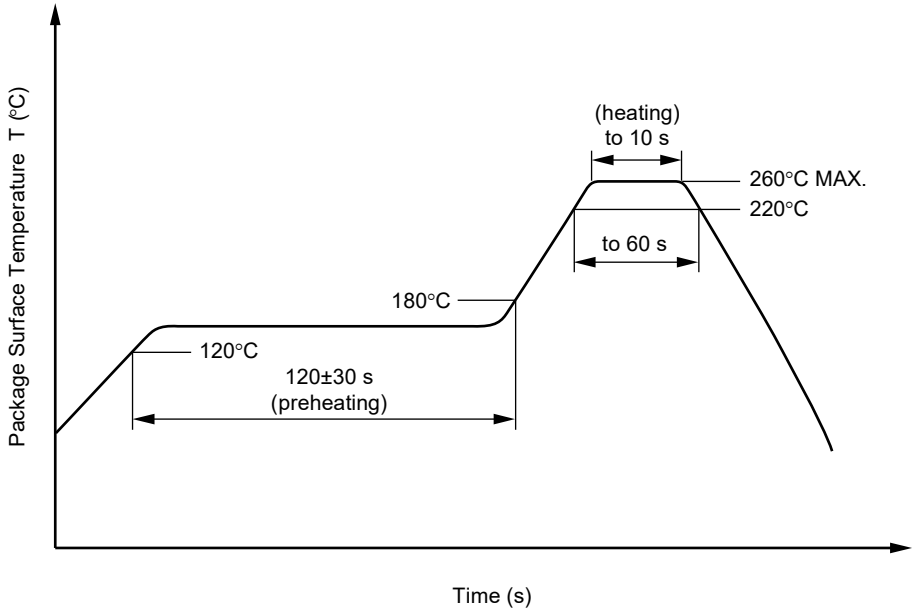
NOTES ON HANDLING

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 halogens - based (chlorine-based) cleaning solvent .

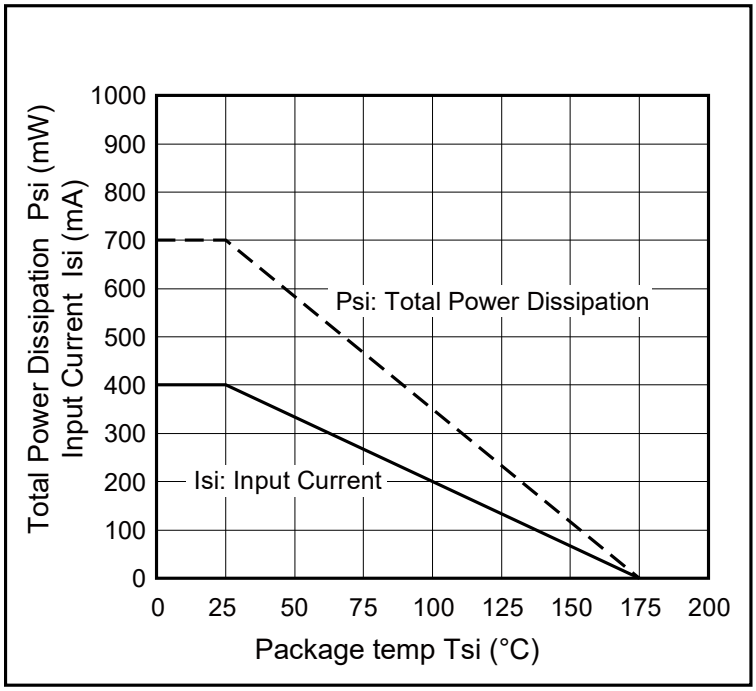
2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler's input and output or between V_{CC}-GND at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

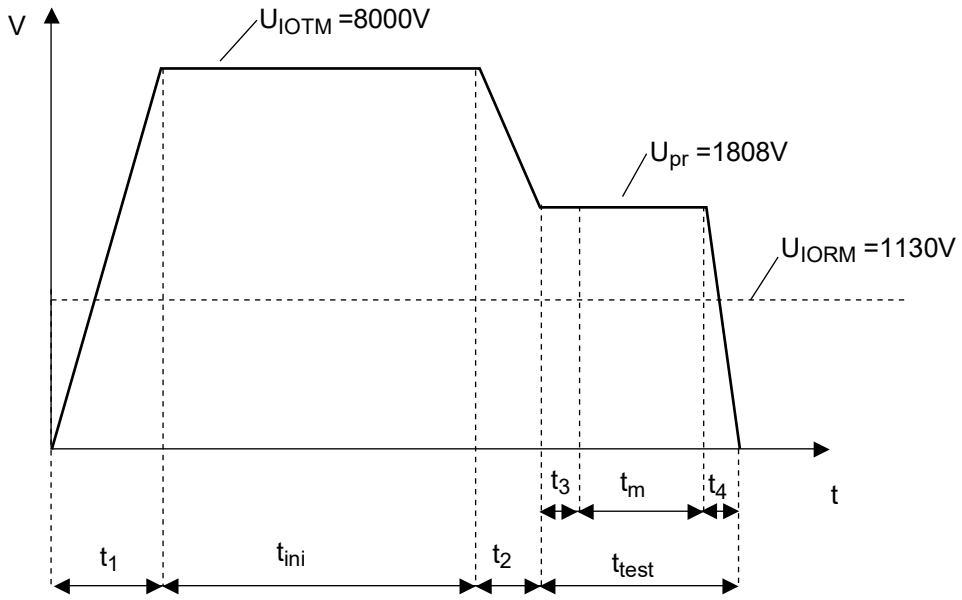
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

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}	 1 130 1 808	 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}	2 119	V_{peak}
Highest permissible overvoltage	U_{IOTM}	8 000	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 +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.	 175 400 700 10^9	 °C mA mW Ω

Dependence of maximum safety ratings with package temperature

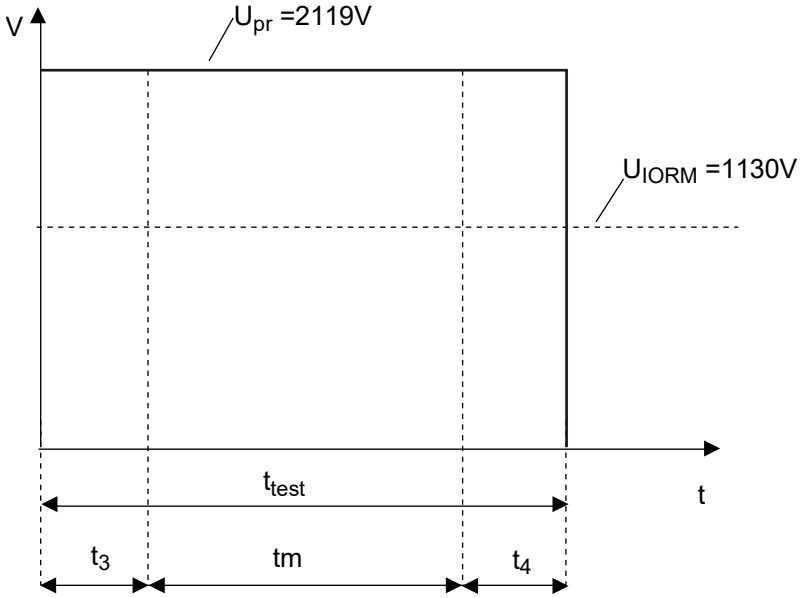


Method a) Destructive Test, Type and Sample Test



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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