Part No.:PD03S090N301PT

PolyDiode: Polycrystalline Semiconducting Ceramic Diode

ElectroMagnetic Compatibility

Countermeasure for Transient Surge and Static Electricity

DESCRIPTION

Due to electronic systems have been migrated to miniature levels in compact size,
more and more devices require protection against electrostatic discharge (ESD) and surge, and increasingly become important.

PolyDiodes are bi-directional transient voltage suppressor devices made of poly- crystalline mixed oxide ceramics, which offer rugged protection and excellent electrostatic absorption and pulse noise absorption in a small package. These devices require significantly smaller space than silicon TVS diodes, offering greater circuit board layout flexibility for the designer.

Previously, in the internal bus lines of mobile equipment and in LCD panels, key switches, battery terminal, microphone, or headphone terminal were protected from ESD surge by Zener diodes or silicon TVS diodes. However, unlike a Zener diode or a TVS diode, a PolyDiode does not require being combined with an EMC capacitor because of in its off state the network acts like an EMI filter. Again, thanks to PolyDiode possessed excellent response characteristics and ESD absorption power that are more than that of a MLV or a Zener diode and a Silicon TVS diode.

ELECTRICAL ADVANTAGES

- **Extra low clamping voltage**
  The PolyDiodes have an excellent clamping voltage capability (Typical ratio of clamping voltages to breakdown voltages are between 1.25 and 1.60) that is equal to or better than Zener diodes and Silicon TVS diodes.
  The MLV's clamping voltage is typically higher than comparable PolyDiodes or Silicon TVS diodes, MLVs are mainly uses for ESD on less sensitive lines where their higher clamping voltages can be tolerated.

- **Low electrostatic capacity**
  PolyDiode exhibits a very low capacitance which can be used as an EMI/RFI filter, adequate to support high speed signal line/ data bus use (ESD protection for USB2.0 interfaces and ICs), without performance distortion and/or attenuation.
  The capacitance of a Zener diode or a TVS diode can be made lower by narrowing its connection area, but a lowered wattage or a lowered ESD resistance is unavoidable.

- **Excellent ESD Endurance capability**
  Withstands ESD Durability test severity of IEC 61000-4-2 level 4 (8KV contact ESD, 20 shots: 10 positive, 10 negative polarities; repetition rate 1 . $sec.^{-1}$) without damage or degradation. The electrical performance is Excellent.

- **PolyDiode has the fastest response time in the industry < 0.5 ns**

  Poly Diode has no follow on current and their parasitic inductance is very low, which results in response times of < 0.5 ns. Zener diode and silicon TVS diode have a larger parasitic inductance, and the typical values of response times are between 0.8 and 3 ns.

- **Excellent surge suppression capability**

  PolyDiode keeps symmetrical I-V characteristics even after suppressing extremely fast voltage transients, including electrostatic absorption and pulse noise absorption.

  The Zener diodes or TVS diodes are not sufficient for a peak surge current.

- **Electrical performance in changes of temperature**

  The electrical characteristics of PolyDiode include operating voltage, surge current, energy absorption and power dissipation remain unchanged up to temperature of 85℃ of working condition. On the contrary, the TVS diodes start to deteriorate at temperature of 25℃.

- **Low leakage currents**

  The leakage currents less than 5 μA for PolyDiode are relatively much lower than those of less than 100 μA for TVS diodes.

PHYSICAL ADVANTAGES

- **Excellent mount reliability**

  The PolyDiodes electrodes are adopted Nickel/ Tin electroplating achieved good solderability and solder heat resistance.

- **Economical cost in mounting process**

  Since PolyDiode is bi-directional component, it is easy to mount them onto the circuit boards. In contrast, the mounting machine must position TVS diode with correct polarity due to their natures in unidirectional device. This may cost higher error probability during the mounting process.

- **RoHS Compatible**

APPLICATIONS

- **Pulse noise absorption**
- **Electrostatic absorption**

PRODUCT IDENTIFICATION

PD	03	S	090	N	301	P	T
1	2	3	4	5	6	7	8

1= Series Code

PD: PolyDiode series

2= Size Code

03: EIA 0603

3= Type Code

S: Single chip

4= Rated Voltage Code

090: $9V_{m(DC)}$

5= Design Code

N: Normal application

6= Capacitance

301: $30x10^1$=300 pF typical

7= End termination

P: Nickel/Tin plated

8= Packing Code

T: Tape & Reel

B: Bulk

DEVICE RATINGS AND SPECIFICATIONS

Part Number	Maximum **Continuous Working Voltage**	Nominal Voltage @ 1 mA (DC) **Test Cueent**		Maximum Clamping Voltage At Specified Current **(8/20μs)**	Maximum Non-Repetitive Surge Current (8/20μs)	**Withstanding ESD IEC61000-4-2 Level 4 Contact Discharge**		Typical **Capacitance @ 1 MHz**
	$V_{M(DC)}$	$V_{N(DC)}$ **min.**	$V_{N(DC)}$ **max.**	V_C	I_P	**ESD(V)**		**C**
	(V)	**(V)**	**(V)**	**(V)**	**(A)**	**Contact**	**Air**	**(pF)**
PD03S090N301	9V	10V	14.5V	23V@2A	30A	± 8KV	± 15KV	300pF

Notes:

◎ **The relevant formula for calculating the clamping factor is:**

Clamping factor=V@A / $V_{N(DC)max.}$

Where Clamping factor is a ratio of maximum clamping voltage (V@A) to maximum breakdown voltage ($V_{N(DC)max.}$)

＊V@A is a maximum clamping voltage at a specific test current.

＊$V_{N(DC)max.}$ is a maximum nominal voltage (as breakdown voltage) at $1mA_{(DC)}$ test current.

Example: Calculate the clamping voltage of a PD03S090N301PT

Where V_C(V@A)= 23V at 2A

$V_{N(DC)}$max.= 14.5V

The factor of clamping is calculated as:

23V/14.5V=1.58 Max.

The purposes of the above example are:

- To show the clamping function of PolyDiode devices at a much lower voltage compared to that of MLVs (multilayer varistors) which is better than or equal to zener diodes and silicon TVS diodes. PolyDiodes are much adequate to use on across signal and low voltage DC bus lines.
- Ensuring the optimum protection for sensitive integrated circuits and components (e.g. microchips) at the circuit board level.
- To demonstrate the difference between PolyDiode and MLV products, the clamping voltage capability of that PolyDiode product has particularly much better than that of the MLV product in suppressing transient events.

◎ **Capacitance may be customized, please contact JumboTek for availability.**

Reference Data	Symbol		Value	Unit
Response time	T_{rise}	<	0.5	ns
Leakage current at Max. working voltage	I_L	<	5	uA
Operatiog ambientg temperature			-55～ +85	℃
Storage temperature			-55～+125	℃
Reflow solder profile temperature(Recommend)			260	℃

Other Data	
End termination	Ag/Ni/Sn plated
Packaging	Reel
Complies with Standard	IEC61000-4-2 IEC61000-4-3 IEC61000-4-4 IEC61000-4-5
Marking	None

Notes：

＊ The capacitance value was not to be defined。

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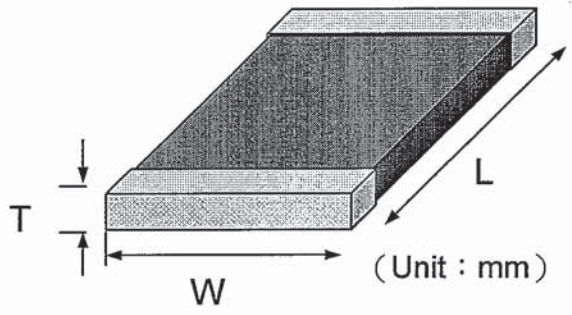
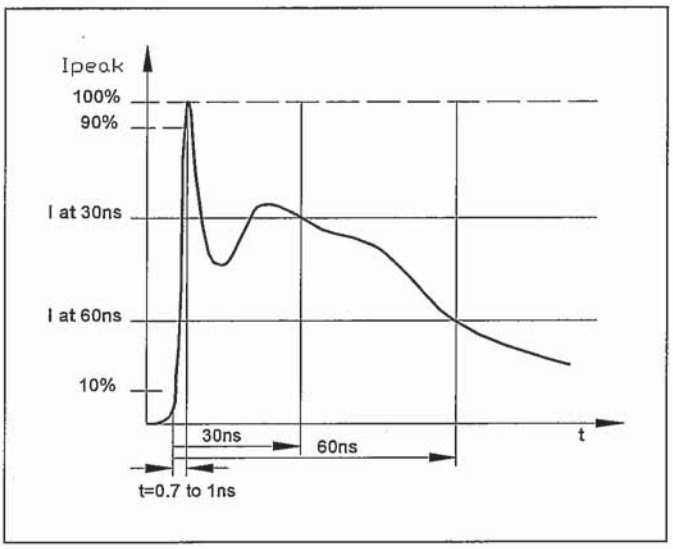
Size

Unit: mm

Model	0603 Series
Length(L)	1.60 ±0.15
Width(W)	0.80 ±0.15
Thickness：(T)	0.90(Max)



ESD Wave Form

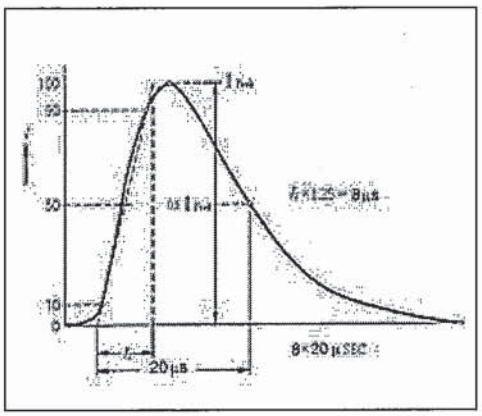


IEC 61000-4-2 Compliant ESD Current Pulse Waveform

IEC61000-4-2 STANDARDS

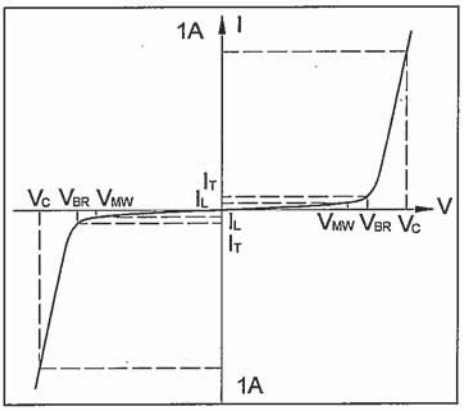
SEVERITY LEVEL	AIR DISCHARGE	DIRECT DISCHARGE
1	2 KV	2 KV
2	4 KV	4 KV
3	8 KV	6 KV
4	15 KV	8 KV

IEC 61000-4-5 Compliant
SURGE Current 8/20 μs Pulse Waveform



I-V Characteristics

V_C: Maximum Clamping Voltage
V_{MW}: Maximum Allowable Working Voltage
I_L: Maximum Leakage Current @ V_{MW}
V_{BR}: Breakdown Voltage @ I_T
I_T: Test Current (1mA)



Environmental Reliability Test

Characteristic	Test method and description
High Temperature Storage	The specimen shall be subjected to 150 ± 2℃ for 1000 ± 2 hours in a thermostatic bath without load and then stored at room temperature and humidity for 1 to 2 hours. The change of breakdown voltage shall be within 10% .
Temperature Cycle	The temperature cycle of specified temperature shall be repeated five times and then stored at room temperature and humidity for one or two hours. the change of breakdown voltage shall be within 10% and mechanical damage shall be examined. Duration: 40 cycles
High Temperature Load	After being continuously applied the maximum allowable voltage at 125 ± 2℃ for 1000± 2 hours, the specimen shall be stored at room temperature and humidity for one or two hours, the change of breakdown voltage shall be within 10% .
Damp Heat Load/ Humidity Load	The specimen should be subjected to 40 ± 2℃, 90 to 95% RH environment, and the maximum allowable voltage applied for 500± 2 hours, then stored at room temperature and humidity for one or two hours. the change of breakdown voltage shall be within 10% .
Low Temperature Storage	The specimen should be subjected to -40 ± 2℃, without load for 500± 2 hours and then stored at room temperature for one or two hours. the change of breakdown voltage shall be within 10% .

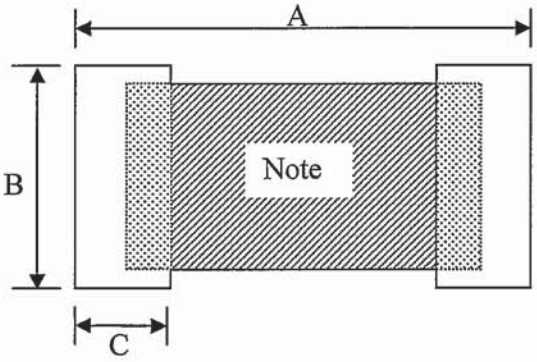
Step	Temperature	Period
1	-40±3℃	30Min±3
2	Room Temperature	1~2 hours
3	125±2℃	30Min±3
4	Room Temperature	1~2 hours

Soldering Recommendations

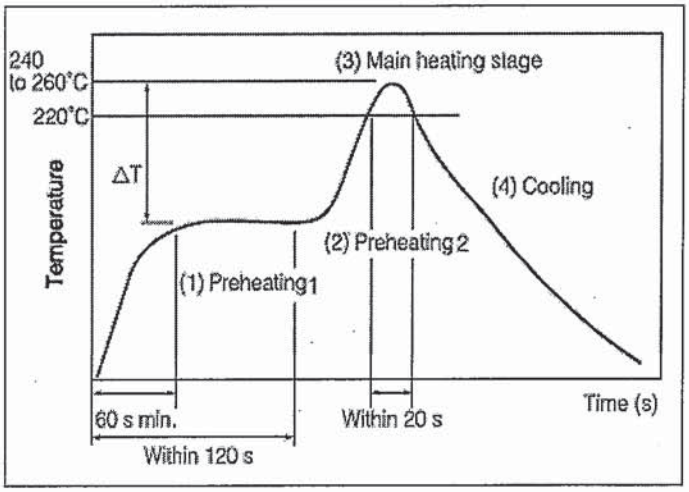
Recommended solder pad layout

(Unit：mm)		
A	B	C
2.54~2.80	0.76~1.50	0.89~1.12

Note：Avoid metal runs in this area



(1) Preheating 1: 140 to 160℃ for 60 to 90 sec.
(2) Preheating 2: 150 to 220℃ for 2 to 5 sec.
(3) Preheating 3: 220℃ or above within 20 sec.
(4) Preheating 4: Natural Cooling.
ΔT: Within 150℃

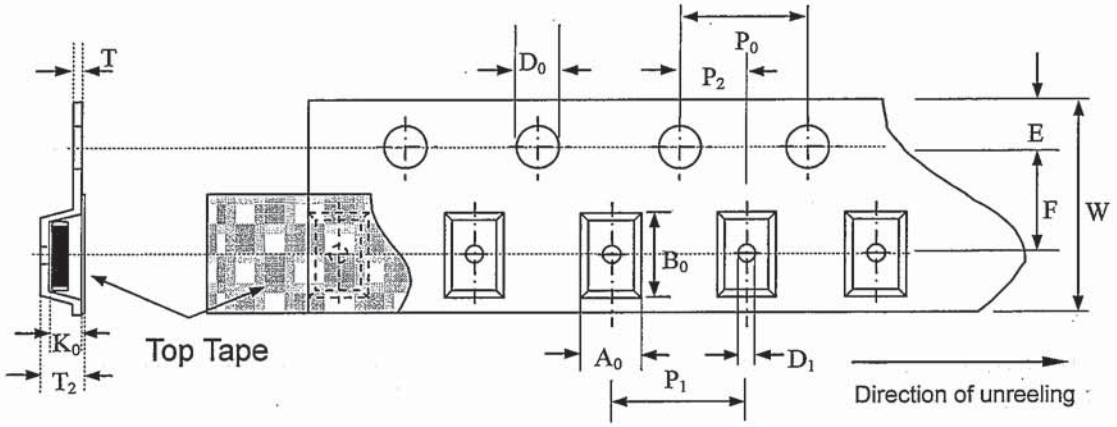


Packaging Specification

※Carrier tape and transparent cover tape should be heat-sealed to carry the products, and the reel should be used to reel the carrier tape.

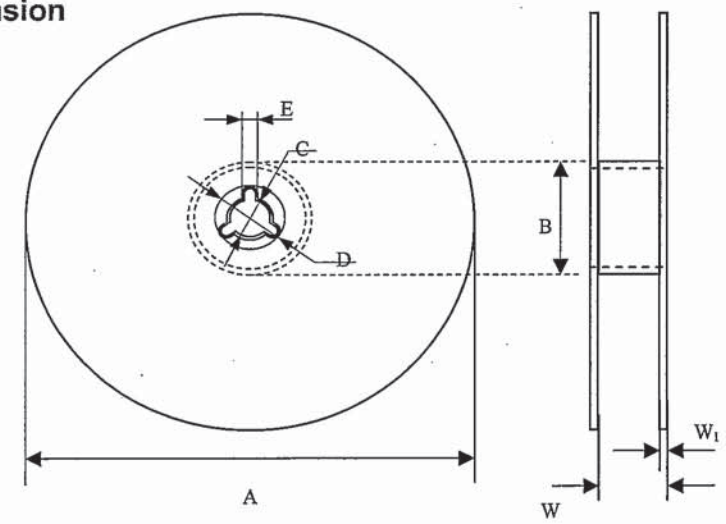
※The adhesion of the heat-sealed cover tape shall be 40 + 20/ - 15grams.

※Both the head and the end portion of the taping shall be empty for reel package and SMT auto-pickup machine. And a normal paper tape shall be connected in the head of taping for the operator to handle.



Symbol	A_0 ±0.05	B_0 ±0.05	K_0 ±0.05	T ±0.05	T_2 ±0.05	D_0 +0.10 -0.00	D_1 ±0.10	P_1 ±0.10	P_2 ±0.05	P_0 ±0.05	W ±0.20	E ±0.10	F ±0.05
mm	0.90	1.80	0.85	0.22	3.0max	1.50	0.50	4.00	2.00	4.00	8.00	1.75	3.50

Reel Dimension



Symbol	A	B	C	D	E	W	W_1
Unit(mm)	178±1	60±0.2	13±0.1	21±0.1	2.0±0.5	9±0.05	1.4±0.1

Standard packaging : 4,000 pcs/Reel.