PolyDiode 的組成結構與電氣特性

PolyDiode 的主要生成結構，係融合 Silicon TVS diode、Multilayer Varistor (MLV)等關鍵材料，併同添加本公司獨有之無機高分子，經微粒化奈米創新工序，燒結而成之高緻密性陶瓷實體。

雖然 Poly Diode 的外觀形狀、IV 特性曲線、等值電路頗多類似 MLV 之處，惟 PolyDiode 本體內部微晶界面數以萬計之 P-N Junctions 相互接觸的部分，皆爲矽薄膜所保護，故對空氣和熱都非常穩定，且表面耦合電流也會減少。以其固有之 Surge Current Capability、Extra low Clamping Voltage、ESD durability、Fast response time 等傑出電氣特性(參閱比較表一)，對於抑制系統電路內，湧入之瞬間突波於一預求的安全波動位準，並使感應電流轉移接地；令電路敏感元件(如 ICs 等)免受 ESD 攻擊的效果，明顯超越 MLV 與 TVS Diode。

此外， PolyDiode 的障壁區域(Depletion region)含有鋇、鈦等具低通濾波器(Low pass filter)功能之無機元素，可以控制多餘電磁波(Electromagnetic Waves)和帶磁率(Electromagnetie Susceptibility)，有效截止雜音脈衝(Clipped noise pulses)，並減少基頻以外之諧波頻率干擾，使通過系統設備之特定交流訊號，進一步獲致調諧。

＊PolyDiode 的信賴性與穩定性

爲確保 PolyDiode 的精密特性，避免：

陶瓷胚體在燒結過程，因吸收空氣中水分所分解的氫，造成脆化現象；或利用電解在燒結體端部金屬電極表面電鍍合金包膜的操作期間，陰性原子侵入陶瓷燒結體裏面，引起氫脆性(Hydrogen Brittlenes)，以及防止端部金屬電極相互橋接(Bridging)發生短路現象。

江博先進科技股份有限公司創新研發一種，係可依隨溫度上升生成共熔體,再以連續相向 PolyDiode 層間粒界均勻擴散、吸附和反應，並環燒結體表面生成氣密薄膜，而能與周圍環境溼氣和化學條件相隔離之無機高分子(Inorganic High Molecular Compound)，藉以充分保護 PolyDiode 電的穩定度，令極限內驟然湧入之瞬態突波，即使變動劇烈，依然可以繼續維持於一預求的恆定位準者。

＊(比較表一) The specification comparison for PolyDiode, Silicon TVS diode and MLV(Multilayer Varistor)

Characteristics and features / Device Type	Clamping factors (ratio of clamping voltage to breakdown voltage) (*1)	Peak current capability (8/20 μ s)	ESD durability (repetitive strike) (*2)	Response Time (*3)	Leakage current (*4)
PolyDiode	1.25~1.6 (Excellent)	Excellent	>60000	<0.5nSec.	<5 μ A
TVS diode (Zener diode)	1.3~1.6 (Excellent)	N/S(*5)	Unidirectional <100 Bidirectional <1000	Between 0.8nSec. and 3nSec.	<100 μ A
MLV	1.8~3.5 (Moderate) (*6)	Good	Between 1000 and 10000	<1.0nSec.	<10 μ A

Notes:

(*1) 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		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)
PD05S380N261	38V	42V	51V	60V@1A	100A	± 8KV	± 15KV	260 pF

◎ 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 PD05S380N261PT

Where V_C(V@A)= 60V at 1A

$V_{N(DC)}$max.= 51V

The factor of clamping is calculated as:

60V/51V=1.18 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.

(*2) Withstand ESD durability test severity of IEC 61000-4-2 level 4.

(*3) Fast time operation response to protect the USB components against the fast rise time of the ESD pulses.

(*4) Low leakage current to minimize the power consumption under normal operation conditions.

(*5) The TVS diodes are not sufficient for a peak surge current.
PolyDiode keeps symmetrical I-V characteristics even after suppressing extremely fast voltage transients, including electrostatic absorption and pulse noise absorption.

(*6) The main disadvantage of a MLV's clamping voltage is typically higher than a comparable PolyDiode or TVS diode.
MLVs are mainly used for ESD on less sensitive lines where their higher clamping voltages can be tolerated.