APPLICATION NOTE

Diotec Semiconductor

ESD Protection Solutions

Electrostatic discharge (ESD) is a rapid discharge of electric current between two objects. It is characterised by a high voltage spike with fast rise times for a short duration. It could be considered as a minute version of lightning.

ESD comes in many forms. They are commonly produced by our everyday activities. Many electronic products, exclusively the compact devices like mobile phones, laptops, digital cameras etc. which are being carried by the users, are subjected to high number of ESD events. The discharge event could happen via the I/O ports, touch screens, Keypads or finger scanners. In the industry level, one of the common source is through human and machine interaction with the electronic devices during manufacturing or assembly process.

The conventional electronic circuits are traditionally bulk in size. However over the past years, the high advancements in the technology enabled to shrink the sizes of semiconductor components especially the Integrated circuits to smaller and to emend more functionality. Smaller size of the electronic components decreases the power consumption, however it increases the sensitivity to any transient surge events. As such the designers are no longer relying on the internal capability of such semiconductor components but an external protection is added to eliminate the risk against any voltage transient surge events.

Another major trend in the market is the demand for high-speed communication systems, in the applications like mobile products, consumer and computer technologies, which is increasing continuously, with the purpose to transmit the huge quantities of data in a very short time. Such systems, require careful selection of ESD protection with lower internal capacitance for maintaining the signal integrity.

Overall, ESD protection devices are intended to protect high sensitive electronics in automobile, home appliances, communication systems and also portable electronics like mobile phones, laptops etc. from ESD including the transient peaks from lighting surges.

Diotec offers a wide range of ESD protection diodes both in single line and dual line configurations in various packages ranging from general-purpose (SOD-323) to small-size 0201 package supporting a wide range of signal speeds, which provide transient protection for data lines as per IEC 61000-4-2 (air and contact discharge).

The following block diagram shows the typical ESD protection circuit:

Block diagram for typical ESD Protection Systems

Ultrafast and high speed ESD protection diodes:

Low capacitance bidirectional single line ESD protection

ESD0521Z and ESD0541Z – The device's low leakage current below 100nA enables to increase the battery life. It also make them well suitable for protecting electronic equipment's such as industrial sensors, smart-home electronics, smart watches, fitness bands, and also in the personal gadgets like smartphones, tablets, audio accessories, set-top boxes and so on.

Part no	Package	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	C_J	IEC61000-4-2 (contact)
ESD0521Z	0201	100 W	5.0 V	6.0 V	15 V 25 V	1 A 4 A	0.5 pF	± 17 kV
ESD0541Z	0201	25 W	5.0 V	6.0 V	12 V 15 V	1 A 2A	6.5 pF	± 17 kV

ESD9BL Series, with very low capacitance values and low clamping voltages, they are well suitable for the protection in high frequency applications like in high-speed data interfaces such as HDMI, USB 3.0 etc. and also in the applications like smart keys, smartphones, mobile phones, digital cameras, etc.

Part no	Package	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	C_J	IEC61000-4-2 (contact)
ESD9BL0521P	SOD-882	100 W	5.0 V	6.0 V	15 V 25 V	1 A 4 A	0.5 pF	± 8 kV
ESD9BL0522P	SOD-882	80 W	5.0 V	6.0 V	12 V 20 V	1 A 4 A	0.4 pF	± 15 kV
ESD9BL0531P	SOD-882	80 W	5.0 V	6.0 V	12 V 20 V	1 A 4 A	0.8 pF	± 15 kV

General purpose ESD protection:

Features:

Peak Pulse Power dissipation: 134 ... 350 W
Vrrm: 3.3 ... 36V
IEC61000-4-2: till ± 30kV (air) / ± 30kV (contact)

Typical applications:

General purpose I/O protection
LED lighting
CAN bus protection
Computer Systems

Part no	Package (SOD-523)	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	$C_{J\ (typ)}$	IEC61000-4-2 (contact)
ESD5Z3V3		134 W	3.3 V	5.0 V	8.4 V	5 A	105 pF	± 16 kV
ESD5Z5V0		148 W	5.0 V	6.2 V	11.6 V	5 A	80 pF	± 16 kV
ESD5Z6V0		154 W	6.0 V	6.8 V	12.4 V	5 A	70 pF	± 16 kV
ESD5Z12		204 W	12 V	14.1 V	17.0 V	5 A	55 pF	± 16 kV

Part no	Package (SOD-323)	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	C_J	IEC61000-4-2 (contact)
ESD3Z5V0		350 W	5.0 V	6.0 V	9.8 V	5 A	350 pF	± 30 kV (air)
ESD3Z12		350 W	12 V	13.3 V	19 V	5 A	150 pF	± 30 kV (air)
ESD3B5V0WS		350 W	5.0 V	6.0 V	9.8 V 14.5 V	5 A 24 A	200 pF	± 30 kV
ESD3B12WS		350 W	12 V	13.3 V	19 V 24 V	5 A 15 A	100 pF	± 30 kV
ESD3B15WS		350 W	15 V	16.7 V	24 V 29 V	5 A 12 A	75 pF	± 30 kV
ESD3B24WS		350 W	24 V	26.7 V	36 V 42 V	1 A 5 A	50 pF	± 30 kV

Part no	Package (SOT-23)	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	C_J	IEC61000-4-2 (contact)
ESD3V3CA		200 W	3.3 V	4.5 V	7 V 9 V	1 A 5 A	600pF	± 16 kV
ESD5V0CA		200 W	5.0 V	6.0 V	9.8 V 12.5 V	1 A 5 A	400pF	± 16 kV
ESD24CA		200 W	24 V	26.7 V	43 V 60 V	1 A 5 A	63pF	± 16 kV
ESD36CA		200 W	12 V	40 V	60 V 75 V	1A 5A	60pF	± 16 kV

Part no	Package (SOT-23)	P_{PPM}	V_{RRM}	$V_{BR\ Min}$	V_C	I_{PPM}	C_J	IEC61000-4-2 (contact)
ESDB3V3C		350W	3.3V	5.8V	8V 26V	1A 15A	101pF	± 30kV
ESD5V0C		350W	5.0V	7.0V	10V 28V	1A 13A	75pF	± 30kV
ESDB12C		200W	12V	14.2V	20V 37V	1A 5A	19pF	± 30kV
ESDB15C		200W	15V	17.1V	25V 44V	1A 5A	16pF	± 30kV
ESDB24C		200W	24V	25.4V	40V 70V	1A 3A	11pF	± 23kV

Disclaimer

This application note describes device proposals and shall not be considered as assured and proven solution for any circuit. No warranty or guarantee, expressed or implied is made regarding the capacity, performance or suitability of any device, circuit etc.