GLOSSARY

AEC-Q101 - Automotive Electronics Council specification related to the qualification of discrete components for Automotive market.

Breakdown voltage ($V_{BR}$) - the voltage value above which the current in the ESD Protection device increases very fast for a slight increase in voltage. This value is usually defined at 1 mA DC.

EOS - Electrical Over-Stress

HBM - Human Body Model shows ESD surge in controlled environments like manufacturing line. Most ICs integrate an HBM protection in their I/O structure. IEC61000-4-2 applies to an application whereas HBM applies to an IC. The level of energy is much higher for system level ESD protection (IEC 61000-4-2).

$V_{RM}$ - Maximum working voltage with associated maximum leakage current ($I_{RM}$)

Line Capacitance - Equivalent line to ground capacitance for the ESD diode. A lower line capacitance allows a larger bandwidth and a better signal integrity.

TLP - Transmission Line Pulse. This is a method for measuring the clamping voltage ($V_{CL}$), which is the voltage value for a current pulse with a peak value of $I_{PP}$. Typically, $V_{CL}$ presented on datasheets is measured with IEC 61000-4-2 & 4 for ESD discharge. The clamping voltage obtained at 30ns corresponds to a 16 A TLP response.

$V_{PP}$ - Peak pulse current, corresponds to the maximum current that can flow through a protection IC for a given surge waveform.

$V_{RM}$ - Maximum leakage current defined at $V_{RM}$.

Power rail ESD and EOS protection

<table>
<thead>
<tr>
<th>Breakdown voltage ($V_{BR}$)</th>
<th>15V</th>
<th>20V</th>
<th>24V</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD Protection IC</td>
<td>ESDA17P100-1U1M</td>
<td>ESDA25P35-1U1M</td>
<td>ESDA17P50-1U1M</td>
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</tbody>
</table>

High-Speed Interface

<table>
<thead>
<tr>
<th>Application</th>
<th>Protection IC</th>
</tr>
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<tr>
<td>Industrial CAN bus</td>
<td>ESDA6V1L</td>
</tr>
<tr>
<td>SWD &amp; JTAG</td>
<td>ESDALC6V1W5</td>
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<tr>
<td>NFC tag</td>
<td>DSILC6-4P6</td>
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<tr>
<td>USB</td>
<td>USBLC6-2SC6</td>
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<tr>
<td>Ethernet 1G</td>
<td>HSP051-4M10</td>
</tr>
<tr>
<td>High-speed differential (MIPI, USB3.1, Display Port and HDM)</td>
<td>ECMF04-4HSWM10</td>
</tr>
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</table>

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<td>ESDA14V2BP6</td>
</tr>
<tr>
<td>Touch button</td>
<td>ESDA5V3L</td>
</tr>
<tr>
<td>Audio (ADC)</td>
<td>ESDA6V1BC6</td>
</tr>
<tr>
<td>Automation sensor</td>
<td>SPT01-335DEE</td>
</tr>
<tr>
<td>Industrial CAN bus</td>
<td>ESDA6V1L</td>
</tr>
<tr>
<td>SWD &amp; JTAG</td>
<td>ESDALC6V1W5</td>
</tr>
</tbody>
</table>

ESD Protection ICs

Quick reference guide
Ensuring device safety

ST’s large portfolio of protection devices and ICs supports all industry requirements for Electrical overstress (EOS), surge, and electrostatic discharge (ESD) in a complete portfolio. ST’s protection devices have passed all certifications, meeting the demanding telecom markets.

For electrical hazards protection standards exceeding international certifications, meeting or exceeding international

WHAT IS EMC IMMUNITY?

EMC immunity is the ability of an equipment to properly operate in its electromagnetic environment by being the interference of electromagnetic energy that may cause physical damage.

- Radiated immunity (such as power consumption or frequency bandwidth).
- Conducted emission
- Conducted immunity
- Radiated emission
- Electronic application
- Conducted immunity

ELECTRO-STATIC DISCHARGE (ESD)

Electro-Static Discharge (ESD) is defined by the ESD Association as the rapid, spontaneous transfer of electrostatic charge induced in a high-electrostatic-field. ESD-surge waveforms are specified in IEC 61000-4-2. An ESD surge can be caused by various objects such as production machines and mostly generated by human contact. Three major failure mechanisms have been identified:

- Silicon Melting
- Hole in the oxide
- Melting Flesh

With their increased sensitivity, the implementation of miniature components has raised the risk of ESD. It is essential to protect industrial, automotive and IoT applications having connectors exposed to human contact. Furthermore, the Industry Council Worldwide Survey shows that 30% of IC field returns are due to ESD.

Therefore, it seems necessary to protect ICs with external ESD protections.

HOW TO CHOOSE THE RIGHT ESD PROTECTION IC FOR AN APPLICATION?

We have put together a list of criteria to help you select the appropriate ESD protection IC for your device.

- Transparency, during normal operation (no surge event), ESD protection ICs must have the least possible impact on the system’s performance. Therefore, it is important that the ESD protection IC must not impede signal integrity over the full operating range of the IC, as well as over the full range of environmental temperatures.
- Clamping voltage, it defines the normal operating voltage for the protection. V_{RM} must be higher than the application’s minimum operating voltage, otherwise the protection will clamp the application voltage.
- Directionality, if the signal to be protected is negative and positive, protection must be bi-directional to avoid the notch phenomenon. If the signal to be protected is only positive, then a unidirectional protection should be preferred to avoid a negative voltage drop.
- Efficiency, when the maximum voltage across the ESD Protection, an ESD surge occurs, the ESD protection must lower this surge voltage as close as possible to the V_{TSOP} in order to protect the IC placed behind the ESD protection.

WHAT ARE THE MAIN BENEFITS OF ST’S SOLUTIONS?

ST’s solutions offer quality and reliability. IEC 61000-4-2 level 4 specifies up to 4 kV contact discharge. ESD protection decreases the all ICs transient surge down to a minimal transient voltage that is harmless for the application. Reduced ppm rate of field return and cost-efficient maintenance ensure products are safely designed for customer.

Easily select components by using ST-PROTECTION-FINDER mobile app available for Android™ and iOS™ to enter the protection key criteria values (V_{RM}, V_{TSOP}) and choose the most appropriate package.

RECOMMENDED ESD IC PROTECTION FOR MCU INTERFACES:

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Example of application USB 2.0 Full speed without OTG:

- USBLC6-2SC6 + ESDA7P120-1U1M
- ESDA5V3L
- ESDA6V1BC6
- ESDALC6V1W5
- ESDA14V2BP6
- SMA4F5.0A
- SMA6F16A
- SMAJ40CA

Example of application USB 2.0 Full speed with OTG:

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