ESDPrevention Best Practices

While all electronic products are susceptible to damage caused by ESD, there are common best practices to follow that will mitigate the damage

August 2019

Amulet

Amulet

Introduction

Electric static discharge (ESD) event occurs when the electrical potential between two surfaces becomes so great that a static charge moves from one surface to another. A human body can generate a static charge, by rubbing against something such as walking across a carpet. And when an electrically charged body comes into close proximity to electronic components or a metal surface, a discharge can occur. This discharge is an everyday experience often felt as a slight electrical shock when touching doorknobs or metal shelves or even other people.

The prevention measures to mitigate any damage caused by ESD basically falls within two categories. One must either prevent the buildup of a static charge, or redirect the ESD away from anything it can cause damage.

Proper ESD handling of Amulet products

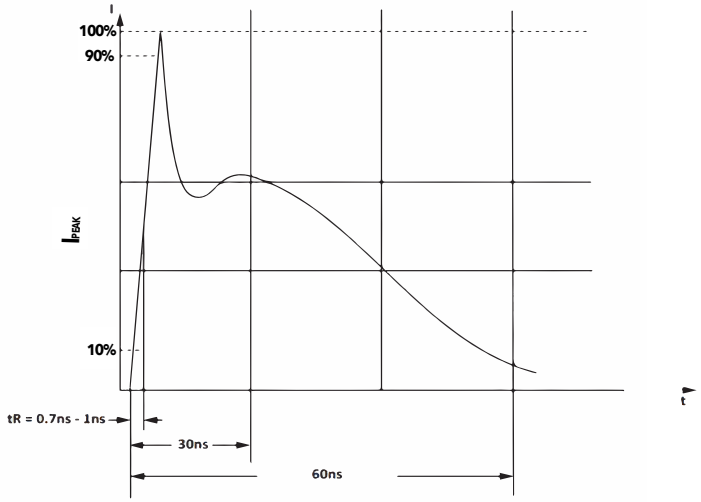
All electronics must be handled in a manner that prevents electrostatic discharge (ESD) from damaging the components. In fact the majority of the damage attributed to ESD, happens during the physical handling of the electronic device.

The best way to avoid ESD damage is to keep the electronics at the same potential as the surrounding. Meaning that the most important prevention measures entail electrically grounding the electronics and any and all things coming into contact with the electronics. The following are standard operating procedures that should be followed when handling or operating any of Amulet's display products.

1. ESD wrist straps should be snuggly worn at all times with the other end tied to a good earth ground.
2. ESD smocks should be worn so regular clothing cannot build up any electrical potential. Clothing made of synthetics will generate more static charge over a cotton blend.
3. ESD protective flooring and ESD protectic mats must be utilized. The mats and flooring need to be connected to earth ground.
4. All work surfaces such as desks or workbenches need to be connected to earth ground.
5. Removing any Amulet display products from it's anti-static bag should be done in an ESD protected area.

Circuit Design

A typical ESDwaveform looks like this when a large sudden voltage is applied.



Voltage ranges from 4kV to 15kV for air discharge, and 2kV to 8 kV for contact discharge. It is this peak current that must be reduced in order to mitigate any ESDfailure. Transient voltage suppressors is commonly used in circuit design for ESDprotection.

In the design of Amulet display modules, one area to particularly pay attention to is the interconnect between the touch panel controller and Amulet's GUI processor. A common electrical path which can cause visual anomalies from an ESDevent is from the display touch area to the Amulet chip. In a touch implemented display it is imperative to always communicate the correct x/y coordinates without interruption. To mitigate this type of effect, utilizing zener diodes can effectively clamp the voltage from reaching a dangerous level. A single TVS array can be used to protect the critical touch coordinate pins, X+, X-, Y+, and Y-.

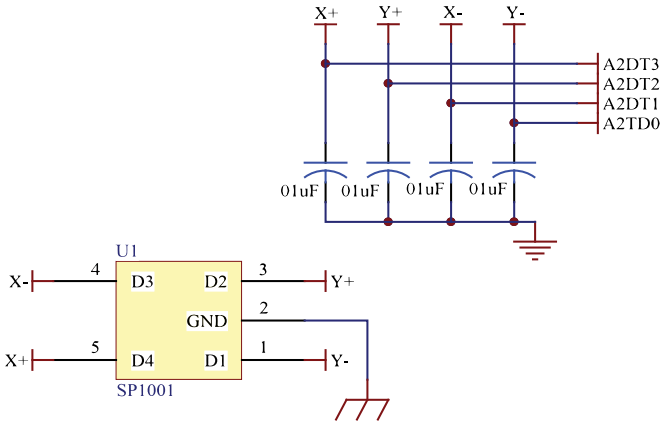
An example of a TVS array utilized by Amulet Technologies is the TVS diode array from Littlefuse, part number SP1001-04. This part offers protection up to ±15kV of contact discharge and ±30kV air discharge. This level of protection surpasses the level 4 requirement of IEC1000-4-2.

The following table shows the different levels for IEC1000-4-2.

Level	Test Voltage, kV Contact Discharge	Test Voltage, kV Air Discharge
1	2	2
2	4	4
3	6	8
4	8	15

Further ESDmitigation can be achieved by adding decoupling capacitors to the X+, X-, Y+, and Y- connectors of the touch panel.

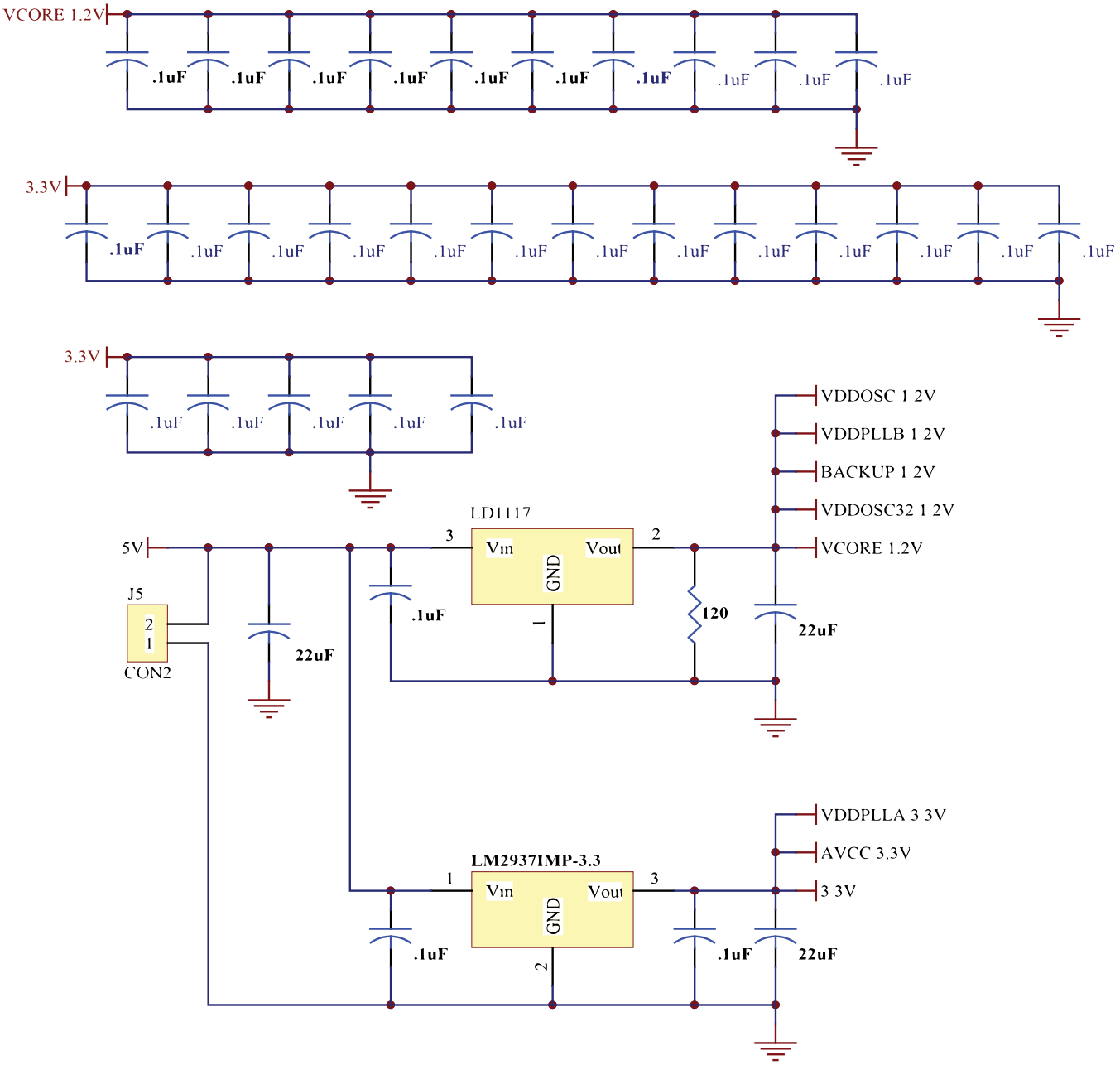
The figure below is from Amulet's reference schematic implementing the use of decoupling caps and the Littlefuse diode array on the analog to digital signals which connect to the touch panel.



Another area of concern in terms of ESDprotection are any high speed signal connectors. An ESD event can easily effect the communication signals. The use of TVS devices and ferrite beads on the USB data signals have been a long known practice.

A standard circuit design rule implements the use of decoupling capacitors to the supply voltage pin and ground pin. The placement of the capacitors should be closest possible to the pins. The main reason why bypass capacitors are used is to filter out high frequency noise and glitches from DC voltage.

The figure below is taken from an Amulet reference schematic which shows how the power is distributed from a 5V source to the Amulet chip. In this particular case, the 5 V source is the USB power.



Board Design

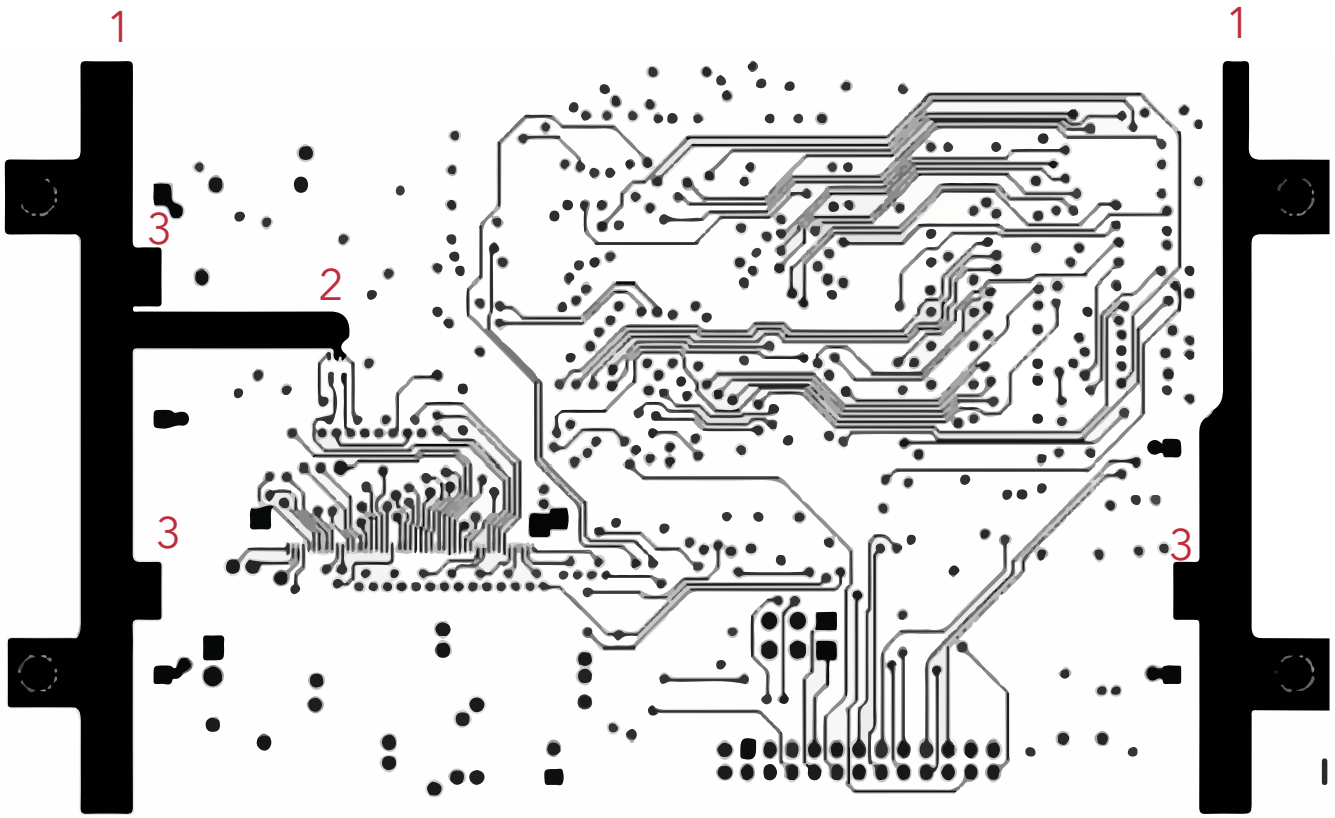
ESDevents will always travel the lowest resistance path to ground. Providing a path away from sensitive signalsis yet another means to mitigate any negative effects from ESD. Many things can be implemented during board design to accomplish this.

With Amulet display modules, several fundamental design concepts have been implemented to provide an electrical path for the ESD.

1. Provide a low impedance ground in the PCB design so an electrostatic discharge can flow directly to earth ground.
2. Make sure to separate earth groundfrom the digital signal ground or any signal return ground. The goal is to have any ESDevent discharge through earth ground and not find a path to the digital signal ground.
3. Connect any TVS devices to earth ground, making sure the earth groundtraces are thick in order to reduce the parasitic inductance. Make sure to place the TVS device as close to the the potential source of the ESD.
4. Make sure to implement a solid connection from the metal enclosure of the display to earth ground. Essentially the metal enclosure acts as a shield in which the ESDwill dissipate and travel to earth ground.

The figure above is an example of Amulet's PCB designs utilizing the fundamental design concepts previously covered.

1. Large earth groundtraces
2. TVS device tied to earth ground
3. Three groundingclips which make solid connection to back of metal enclosure of display.



System Level Design

The final recommendation pertains to the housing of the display module. The overall system design should allow for the PCB earth ground to dissipate the ESD current into the ground of the overall enclosure. Remember that any design consideration which allows the current spike associated with the ESD event, to travel away from the circuitry of the display module, is desirable.

The previous PCB layout figure clearly shows that the 4 mounting holes are tied to the earth ground. This layout was intentional allowing for the system designer easy access to the module earth ground. When mounting the display assembly to the chassis, it's recommended to attach wires from the mounting screws to the earth/chassis ground of the enclosure.

Tel (408) 374-4956
Fax (408) 374-4941
http://www.amulettechnologies.com
sales@amulettechnologies.com
support@amulettechnologies.com
1475 S. Bascom Ave., Suite 111
Campbell, CA 95008 USA