

Application Note 5233

Introduction

Electrostatic discharge (ESD) is a natural phenomenon that affects every production facility in one way or another. ESD can be predicted, measured, suppressed and most importantly, prevented. The circumstances that cause ESD stress failure are important for manufacturers and end users to understand. This document discusses ESD safety practices, preventive measures as well as mistakes often made in ESD control procedures to help manufacturers in handling Avago Technologies' VCSELs used in Laser optical mice. These VCSELs are extremely sensitive to ESD damage. Damaged devices can appear dim, shorted or dead.

ESD Requirements

The Avago Technologies VCSEL ESD Human Body Model rating is 200Volts. The Human Body Model is a mathematical representation which imitate the consequences of a charged person touching a part. The representation is an equivalent circuit with a charged 100pF capacitor in series with a 1500 ohm resistor.

Therefore all individuals handling VCSELs or using ESD safe areas should be trained to understand ESD and be able to prevent it. Specifically, any person handling VCSELs should wear ESD certified smocks with buttoned front, conductive wrist straps, and grounding should be checked every time the person re-enters the workstation or reconnects the wrist strap to ground. Official certification and training for these people are also good practices for an ESD safe environment.

Areas that are considered and the need for insuring ESD safe environment are listed below.

1. Workstations and areas for example work benches, surface coverings that are non-conductive, vinyl and all waxed floors and chairs that are ungrounded.
2. Operator clothing for example clean-room garments and personal clothing for example synthetics, silk and wool.
3. Part and assembly packaging materials such as polyethylene bags and films, polyethylene bubble pack and foam, and plastic boxes, trays and cabinets.
4. Cleaning and test areas such as high velocity gas flow temperature chambers for drying.

Static-safe Workstation Requirements

A static-safe workstation should be provided whenever the VCSELs are in an unprotected or vulnerable state. The workstation should never act as a storage area for any materials, including the VCSELs. Workstations should also be free of static charge generators such as untreated page protectors, personal items, notebooks, and so forth.

The ideal work surface is made from static dissipative materials constructed so that any charged device it contacts will be discharged slowly through the distributed resistance of the surface. A conductive surface isolated by a resistor is not recommended as the conductive surfaces can absorb a discharge thus damaging the VCSELs or causing short circuits in assemblies. The use of grounded conductive mats and plates over non-conducting surfaces is recommended. Alternatively the conductive surfaces may be grounded and the floor mats are grounded.

The workstation grounding is accessible via a grounded terminal or "banana plug" receptacle should be provided for connecting the workstation operator's wrist strap device to ground. The resistance from the facility ground to this terminal should not exceed two ohms. Wrist strap cords should be directly connected to the wrist strap. No other devices should be inserted into the ground cord's path to ground, such as smocks or work surfaces.

The workstation static attention sign should be displayed at each static-safe workstation and should be large enough to read 1 meter away from the workstation or work area. In addition, floor tape with black lettering on a yellow background should mark the perimeter of each static safe work area.

Wrist Strap Grounding

Personnel grounding for ESD damage prevention is achieve predominantly through the use of wrist strap devices. Every individual handling ESD sensitive items should be connected to ground via a wrist strap device. Wrist straps should be worn while persons are seated even if conductive flooring and footwear are being used. Frequent verification of the wrist strap's resistance path to ground is recommended.

Additionally, the path to ground should be checked each time an individual re-connects to ground. Be sure that the wrist strap is securely attached to the wrist touching the skin snugly for adequate connection. Wrist straps do not work when attached over clothing.

Footwear grounding is not always required but provides additional protection from ESD. People tend to lift their feet and heels while seated, thus breaking the connection to ground. A shoe strap grounding is a temporary appliance installed over non-ESD safe street shoes for the purpose of connecting the human body to grounded conductive flooring. Specific types may be constructed for use in grounding the heel or toe, and might be called "heel grounders", "toe grounders", or "foot grounders". Some varieties are intended only for temporary use.

Equipment and Handling

All Avago Technologies VCSELs are packaged in anti-static package. It is recommended that during any transportation of the VCSEL in production environment, the anti-static package is not removed. This will prevent any ESD event from occurring and the VCSELs are in the protective cover of the anti-static package.

The person, equipments used to transport the VCSELs such as trolleys and soldering or wave solder stations must be properly grounded. Avago Technologies recommends that users of the VCSELs regularly check on their equipment using charge meters to ensure that the actual processing does not introduce any ESD events.

Clothing

The use of smocks or clothing made of materials that tend to generate high electrostatic potentials such as synthetic, wool or silk should be avoided. The use of static-free smocks is recommended.

Record Keeping

ESD procedures for individuals, any type of periodic testing and auditing are highly recommended. Third party auditing may also be needed to identify deficiencies in the ESD safety procedures. Record keeping of such information is valuable to improve such procedures and is generally required for compliance with ISO9000.

Other References Materials for ESD control

CENELEC Electronic Components Committee (CECC), "Protection of Electrostatic Sensitive Devices, Part 1, General Requirements". Document EN 1-00015-1, July 1992

Dangelmayer, G. Theodore, *ESD Program Management*, New York: Van Nostrand Reinhold, 1998.

EOS/ESD Association Standards, New York. (Available from: ESD Association, 7902 Turin Rd., Suite 4, Rome, NY. 13440-2069, (315) 339-6937.)

Avago Technologies, *General Semiconductor Specification*, Document No. A-5951-7600-1.

Avago Technologies, *Workmanship Specification for ESD Control*, Document No. A-5951-1589-1.

McAteer, Owen J., *Electrostatic Discharge Control*, USA: McGraw-Hill, 1990.

MIL-HDBK-263A, *Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (excluding Electrically Initiated Explosive Devices)*

(Metric). February 1991.

MIL-STD-1686A, *Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (excluding Electrically Initiated Explosive Devices)*

(Metric). 8 August 1988.

Conclusion

It is highly recommended to follow ESD standard safe practices. The inherent design of the VCSELs causes it to be sensitive to electrostatic discharge. To prevent ESD-induced damage, take adequate ESD precautions when handling this product.

For product information and a complete list of distributors, please go to our web site: www.avagotech.com

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