

News bits

New ESDA e-mail address

The ESDA has a new e-mail address. For general e-mail communications, use the following address: info@esda.org. The Association's AOL address is being phased out.

Exhibit space available

Nearly 70 exhibitors have already committed to the 2002 EOS/ESD Symposium. There is good space available, but it's going fast. For information on exhibiting, contact Scien-Tech Associates, Inc., P.O. Box 2097, Banner Elk, NC 28604-2097, Phone: 828-898-6375, Fax: 828-898-6379.

Charity golf tournament

The ESD Association will sponsor its second annual charity golf tournament on Saturday, October 5, at the Charles T. Myers Golf Course in Charlotte, NC. Proceeds from the event will be donated to the Children's Miracle Network. Contact ESD Association headquarters or visit the ESDA Web site (www.esda.org) for additional information.

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Threshold

Beginning in July, find it ONLY on the Web
(Postal delivery is being discontinued)

Download each issue in PDF format at

www.esda.org

Faster, more convenient delivery
More timely news and information

You can receive convenient, regular e-mail notification that the latest issue has been posted to the ESDA Web site. Sign-up by logging in to the *For Members* section of the Web site with your membership number and e-mail address. For information on ESDA's policy on the use of e-mail addresses, see below.

E-mail Policy

The ESD Association will use a member's e-mail address for password protection to access the "members only" section of the ESDA Web site and for direct communication between the ESD Association and the member concerning membership benefits and important notices of current or future events. The ESD Association will not rent, loan, trade, sell, or otherwise share your e-mail address with any other party, thus assuring your privacy.

Log in to the
For Members
section

www.esda.org

From the Threshold chair

Machine model survey on tap

Device testing needs your response to a 2nd technical survey-machine model.

Despite the corridor gossip about the imminent death of the machine model (MM) as an ESD test, the model is

apparently still alive and useful. Based on information shared at the last three meetings of standards working group WG-5.2, more and more companies are using the MM



Leo G. Henry

test to look for damage in products like MEMs (micro electromechanical systems) and RF (radio frequency) devices. It is also reported that these products are so much more sensitive than the other device technology types that the MM test may be the only ESD method available that can reliably detect these very low voltage level failures. Time will tell.

In a previous article, I covered the issue of a survey for the socketed device model (similar to CDM, but with the device placed in a socket). I did not cover the issues associated with the MM, but I promised to do so in a later issue.

As was the case for the SDM working group WG-5.2 reported in this column (July/August 2001), the working group has many reasons for wanting to go beyond the confines of the present 30–35 working group members to seek input on a number of issues related to MM component level device testing. The MM working group now wants to make “direct” contact with users of these ESD simulators.

Several questions have been developed and cover a sufficiently wide area that will allow the working group to “move on.” The working group has looked at several options for distributing the questionnaire: publishing the questionnaire on the ESDA Web site, mailing it out to the members and to the industry list used by STDCOM, and putting the questionnaire in this

newsletter. We are also looking into getting input from the attendees of the 2002 EOS/ESD Symposium. Of course, the ideal option is to use several means of distribution.

What the working group hopes to accomplish is that most of you will read and respond to the survey so that we have enough data by the October 2002 standards meeting series. These technical questions in the survey are critically important to the working group’s next project, which is an updated MM industry standard. Please check the ESDA Web site (www.esda.org) or look for the survey in your mail this summer.

At the risk of repeating myself, we look forward to hearing from all of you when the survey is sent out. We expect a very high return from you, the members.

Thanks in advance.

Until next time,

Leo G

Threshold

*Threshold*TM is published six times a year for members of the ESD Association, a not-for-profit corporation. It strives for the advancement of theory and practice of electrical overstress avoidance and of allied arts and sciences and the maintenance of a high professional standing among its members and others.

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ThresholdTM Publication Schedule

Issue	Deadlines
July/August	June 1
September/October	Aug. 1
November/December	Oct. 1
January/February	Dec. 1
March/April	Feb. 1
May/June	April 1



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Association news

ESDA to hold S20.20 seminar

The ESDA will conduct its first ANSI/ESD S20.20 Seminar for Independent Assessors, Program Managers, and Consultants in conjunction with the October EOS/ESD Symposium.

This two-day seminar on October 6 and 7 is intended for companies or individuals who wish to help clients design and implement an ESD control program based on ANSI/ESD S20.20. This course will also provide the attendee with the tools and techniques to help clients prepare for a facility audit (pre-assessment).

The seminar will cover the following topics:

- Overview of ANSI/ESD S20.20
- Administrative Elements

- Technical Elements
- ESD Program Techniques for Different Applications
- Overview of the Assessment Process
- How to Approach an Assessment
- The Audit Checklist and Follow-up Questions

Examples of control programs will be presented and general audit role-playing will be used in the assessment section.

Ron Gibson, Celestica, Inc., and John Kinnear, Jr., IBM Corporation, will be the presenters of this intensive seminar.

Seminar fees are \$1,495. Attendance is limited to the first 30 registrants. Register for this separate two-day program using the Symposium registration form. Additional information is available from ESDA headquarters.

Design seminar: a great success

By Tom Diep, Chair
Association Committee
on Education

The Association's first stand-alone ESD Design Seminar, held on March 26-27 in Santa Clara, CA,



Tom Diep

was a great success. What is most impressive is that the two-day technical seminar for on-chip ESD protection designers went off without a hitch even during a business and economic downturn.

We received excellent attendee feedback from the course evaluations with 100% rave reviews and perfect scores. Not surprisingly, when asked if they would recommend this course to others in their company, all attendees said "yes".

I would like to compliment instructors Charvaka Duvvury and James Miller for their outstanding work. A sincere thanks also goes to Joe Bernier for supporting the on-site logistics for us. A special thanks goes to Lisa Pimpinella, David Barber Jr., and Mike Brandt for their excellent support. Thanks also to Koen Verhaege for initiating the Association's development of the seminar.

I am truly grateful for the support to the ESDA, the ACE committee, and me on this special program. As a result, this seminar will be given again in the near future as part of our continuing educational activity from the ESDA. Please watch for this upcoming announcement on our ESDA Web site and in *Threshold*.

Calendar of events

May 2002

Texas Chapter Membership

Meeting: May 20, 2002; ESD Packaging, Jud Bradford, Joe Blanchard, Bradford Company; Sematech, Austin, TX;

www.centxesdassoc.homestead.com

SIVA's ESDiscovery: May 21, 2002; Santa Clara, CA; www.esdsiva.org

June 2002

Northeast Chapter Panel: June 11, 2002 (Tentative); Dispelling ESD Common Myths; Nepcon East; www.nechapteresda.org

ESDA Standards and Committee Meetings: June 14-18, 2002, Riviera Hotel, Las Vegas, NV; www.esda.org

July 2002

Texas Chapter Family Night: July 23, 2002; Round Rock Express

Baseball Game; www.centxesdassoc.homestead.com

October 2002

ESDA Standards and Committee

Meetings: October 3-5, 2002 (Tentative); Omni Hotel, Charlotte, NC; www.esda.org

David F. Barber Sr. Memorial Golf

Tournament: October 5, 2002; Charles T. Myers Golf Course, Charlotte, NC; www.esda.org

EOS/ESD Symposium: October 6-10, 2002; Charlotte Convention Center, Charlotte NC; www.esda.org

ESDC Certification Exams: October 11, 2002; Charlotte, NC; www.esda.org

From the president

The ESDA: bridging the gaps

Often it takes years for an organization to find itself and develop a clear plan for its future. Ultimately, a strategic plan that drives the growth and performance of an outstanding organization is based on defined goals, knowledge of the market and its needs, and capitalization on available resources. The ESDA, although a volunteer organization, is no exception.



Steve Halperin

We are here

Over the years the ESDA has evolved from providing a technical forum for exchanging new technologies (the EOS/ESD Symposium), to an organization that also includes expanding educational programs (regional tutorials, design seminars), creating certification programs (facility and professional), developing standards supporting every segment of the electronics industry (a total of 39 documents to date), and introducing an industry-wide ESD control program standard S20.20. We have found ourselves. We know where we are,

and where we are going. Most important, we believe we know how to get there.

We are here, but have we peaked? Hardly.

The facts of life

The ESDA serves the giant multi-faceted international electronic industry, which consists of three diverse segments:

- **Device and system technology and design**
- **Manufacturing, from the device level through final system product production**
- **System use and service**

All three share the common denominators of electronic technologies; however, their technical process, personnel education, and operational support needs are quite different.

To exacerbate industry challenges, product life cycles are shorter than ever before and the dynamic synergy of new technologies are evolving even faster. The vast use of telecommunications and complex military, aviation, medical, automotive, and commercial electronic systems continue to expand at an unparalleled pace. Though all of these segments continue to grow, they do so based on different un-

derstandings of ESD technology and the current evolutions in product engineering and manufacturing. In effect, the fast paced product life cycle, enhanced device sensitivity, and changes in standards and technology are all progressing on their own schedules that are not necessarily coordinated to industry's benefit.

Consequently, the demands for ESD technology exchange, material development, advanced process control knowledge, and the variety of related educational programs to provide qualified personnel are growing faster than ever before. These are the driving issues behind the acceptance and growth of our organization, and specifically S20.20. We must design and implement technical educational support programs that serve the present and future needs of all of these segments. We cannot serve one without meeting the needs of the others.

Given that the ESDA can create the programs industry demands of us, we are still faced with delivering them to those who want them. Our delivery system must be international and, in several cases, in the local language. Qualified organizations and people must be recruited and employed to make this a reality, as well as to maintain the timeliness and value of all our programs.

Continued on page 5



From the president

Continued from page 4

The ESDA: bridging the gaps

Why is S20.20 so important in meeting industry's needs?

As an organization we are now challenged as never before. We currently receive over 700 requests per month for copies of S20.20. We are requested to provide education and training programs, as well as advisory services. We are asked to provide information regarding S20.20's implementation, facility certification, and ongoing use. Requests come from every part of the globe and include all types of electronic suppliers and manufacturers, as well as military organizations.

S20.20 guidelines and references are intended for application in a tailored manner throughout the entire process from device creation to end-use. It provides the means to establish minimum protection requirements for manufacturing or handling, and a defined certification process that confirms controls are in place.

The link to device design

The link between device design, manufacture and handling is sensitivity testing. "Sensitivity" defines how the device should be handled and protected throughout manufacturing, creation of sub assemblies and systems, and the intended end use and maintenance of the product. One of our industry founders, Dan Anderson, was fond of saying that you must define and apply ESD protection...*from womb to tomb*.

Unfortunately, there is a separation between device sensitivity and appropriate utilization of that information to create effective ESD control programs. Given that we use S20.20 properly and provide adequate training, we have an opportunity to bridge this gap. We can provide additional guidance that focuses ESD program design to actual device needs as it relates to the manufacturing process in question.

In this vein, we need to re-focus our attention on the current ESD certification

programs. New levels of ESD certification need to be implemented and tailored to address the device design engineers and the device design technicians who test assemblies or systems; as well as those involved in manufacturing, use, maintenance, and ongoing facility operations. This will help bridge the gap we've identified as essential to effective implementation of S20.20.

Just as importantly, we then need to provide the proper delivery system and support personnel for these certification programs. More professional seminars and training sessions supporting manufacturing and engineering personnel certification development must be implemented. This will entail the development of training teams for ongoing domestic and international delivery of educational and certification programs.

The benefits to industry are well-designed products that can be safely handled and used with a minimum of initial or long term ESD loss. This translates into higher levels of productivity, lower levels of waste, fewer warranty and customer problems, greater product reliability, and enhanced profitability.

Where do we go from here?

We have a clear picture of what we've accomplished and where we are. Our next challenge is to continue to guide the ESDA through the next phase of its evolution. We have established that our objective over the next five years is to become the international resource for the electronics industry's ESD technology, facility certification, and personnel education and certification. In order to achieve this, we must develop plans and personnel to address all of these concerns in an objective, balanced manner. We have recognized the role that S20.20 will play in our activities and programs over the next 5 years.

All of this requires committee and infrastructure development, as well as the

creation and dissemination of materials. It requires an ongoing review, analysis, and modification of industry needs; changes in standards emphasis; and materials to meet these industry shifts. To insure our success we will expand our efforts in developing human resources and make this effort part of our overall strategic plan.

Summary

Our primary goal over the next several years is to bridge the gap that we have identified between device design, manufacturing, and systems. It is our plan to:

- Expand our professional certification programs to address the needs of the design community, as well as production line personnel
- Enhance our education programs in support of certification and S20.20
- Increase the availability of our educational programs
- Enjoin the technical aspects of ESD with manufacturing and systems

In future issues of *Threshold*, we will discuss some of the plans and strategies in more detail as we seek to create greater understanding of how each of our members fits into the future of the ESD Association.

Meeting these challenges is necessary to our organization's future success. Our job now is to continue to support the industry through standards development, education and the exchange of technical information, while keeping pace with the industry's amorphous pace.

Breakdown

In the September/October 2001 *Threshold*, I wrote an article on *Insulators and Paschen's Law?* The article caused a comment from Arnold Steinman, (*Threshold*, January/February 2002) concerning discharge phenomena at other electrode systems than parallel ones, and at μm distances.



Niels Jonassen

In my answer I admitted that we don't know if there's a Paschen's law for mm-electrodes. Not yet. But as a small contribution to the discussion, I have written an article on *Breakdown*, which appeared in the January/February 2002 issue of *Compliance Engineering*. The following is an excerpt of that longer article.

It is easily demonstrated that the breakdown field strength, E_b , in the homogeneous field between parallel electrodes in atmospheric air at one atm is about $3 \cdot 10^6 \text{ V} \cdot \text{m}^{-1}$ and that the corresponding breakdown voltage, V_b is given by

$$V_b = E_b \cdot d, \quad (1)$$

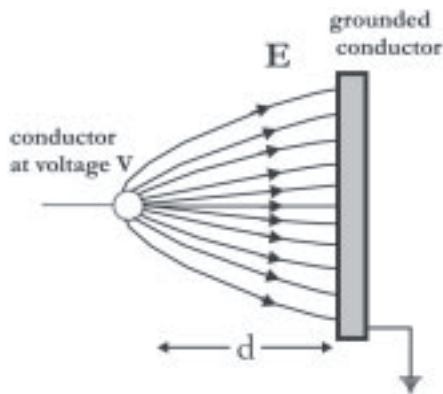


Figure 1
Inhomogeneous Field from Non-plane Electrode

where d is the distance between the electrodes (see *Threshold*, September/October 2001)

If the field is not homogeneous the conditions become more complicated. Figure 1 shows a situation where the one electrode is not plane but a small sphere or more generally a sharp point. The different geometry results in higher breakdown field strength and lower breakdown voltage.

It appears from Figure 1 that the field strength has its maximum at the front of the small electrode, and this is consequently the site where a discharge may start.

Let's now assume that we have established a field strength of $3 \cdot 10^6 \text{ V} \cdot \text{m}^{-1}$ at the tip of the electrode. This field strength would start a discharge in a homogeneous field, because an electron would gain the critical ionization energy W_{ion} over its mean free path. However, the field in Figure 1 decreases rapidly as you move away from the electrode even over a short distance as the mean free path, and an electron will thus never gain enough energy to ionize. Therefore, $E_{b,\text{sphere}} > 3 \cdot 10^6 \text{ V} \cdot \text{m}^{-1}$. The actual value of E_b depends upon the radius of curvature and shape of the electrode, but not in a simple way.

Although the breakdown field strength is higher in an inhomogeneous field, the actual maximum field strength caused by a given voltage is also higher. If we assume that the linear dimensions of the grounded conductor, Figure 1, are much larger than the distance d and the radius r of the sphere, the maximum field strength at the front of the sphere, E_{max} , can be approximated by

$$E_{\text{max}} = \frac{2d}{r \cdot (2d - r)} \cdot V \quad (2)$$

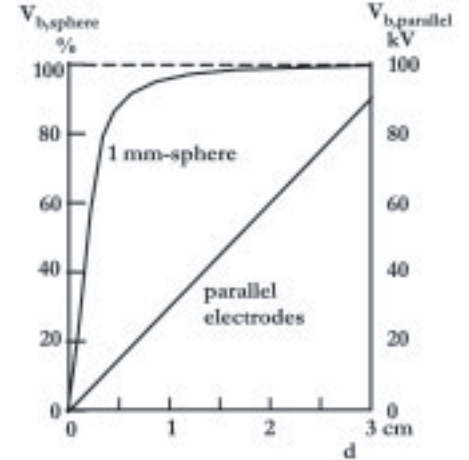


Figure 2
Breakdown Voltage V_b for Spherical and Plane Electrodes

If we let E_{max} be the breakdown field strength E_b , the breakdown voltage V_b can be written

$$V_b = \left(1 - \frac{r}{2d}\right) \cdot r \cdot E_b \quad (3)$$

Equation (3) suggests that the breakdown voltage for a spherical electrode approaches a maximum value of

$$V_{b,\text{max}} = r \cdot E_b \quad (4)$$

for increasing distances d , and that 95% of this value has been reached for a distance $d = 10 \cdot r$.

Figure 2 shows the breakdown voltage V_b for parallel electrodes, Equation (1), and for a 1 mm sphere, Equation (3), in the latter case normalized relative to the maximum value of $r \cdot E_b$.

It should be stressed that in developing Equation (3), the influence on the field of the connections to a voltage supply has not been included. This necessary approximation can also be deduced from Equation (4), which most readers probably will recognize as the relationship between potential and surface field strength of a (conductive) sphere far away from other conductors.

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Breakdown

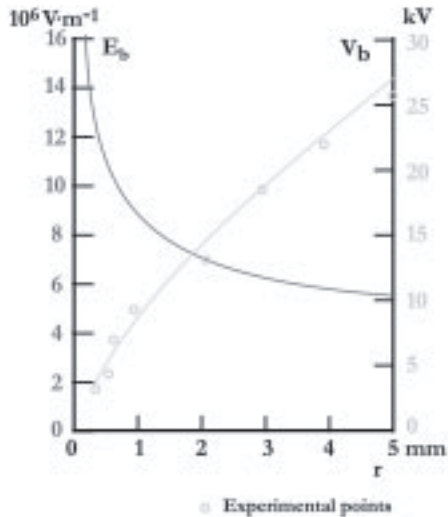


Figure 3
Breakdown Field Strength and Breakdown Voltage for Spherical Electrodes

The absolute values for the breakdown field strength as a function of electrode dimensions can be estimated from the formula (*Handbuch der Physik*, 1923)

$$E_b = \left(300 + \frac{18}{\sqrt{r}}\right) \cdot 10^4 \text{ V} \cdot \text{m}^{-1} \quad (5)$$

which gives the breakdown field strength at a sphere with the radius r measured in meters. We recognize that as r approaches infinity, E_b will approach $3 \cdot 10^6 \text{ V} \cdot \text{m}^{-1}$, the breakdown field strength for plane electrodes. There is a corresponding formula for wires with radius r , where the number 18 is replaced by 9.

Figure 3 shows the breakdown field strength E_b as calculated from Equation (5), and the corresponding breakdown voltage, V_b , calculated from Equation (3).

In order to investigate the validity of Equations (4) and (5), the following experiment was performed:

A pointed electrode with a well-defined radius of curvature was placed above a metallic plane connected to ground through a suitable current meter, at a distance of 10-20 times the radius, and the

voltage of the electrode was raised until a (corona) current to the plane could be measured. The voltage at which this happens is the breakdown voltage for the radius in question. This was done with electrodes from 0.25 mm to 5 mm and the results are shown in Figure 3 as the experimental points.

It appears that for a 0.5 mm electrode the breakdown voltage is about 5.5 kV at a distance of say 1 cm as compared to the 30 kV breakdown voltage for plane electrodes at the same distance. The much lower breakdown voltage at a spherical electrode than at parallel electrodes is not the only difference between the two situations.

When a discharge happens between parallel electrodes the breakdown field strength is in principle exceeded in all points. The discharge may, therefore, start anywhere the odd electron happens to appear, and the ionization will take place all the way along a path connecting the two electrodes. And this is what constitutes a spark.

In the case of a spherical (or otherwise pointed) electrode, the breakdown field strength is exceeded only in a small volume in front of the electrode. And only in this region are ions formed. If the electrode is positive the positive ions outside the ionization region will move away from the negative electrode without multiplying, and the negative ions will move towards the electrode, where they'll be neutralized. And this process constitutes a corona discharge.

According to Equation (1) we should expect to get a spark discharge between plane electrodes at a distance d as long as the voltage difference V fulfills the condition

$$V \geq E_b \cdot d$$

However we know that for plane electrodes we cannot get a discharge at voltages lower than about 330-340 volts (Paschen's law), which at a pressure of one

atmosphere and at room temperature corresponds to a distance of 5-6 μm .

But what happens if the electrodes are not plane? Is it possible to get a corona discharge at, say, 300 volts? Using Equations (4) and (5) we find that a breakdown voltage of 300 volts would correspond to an electrode radius of 3 μm . However, the relationship in Equation (5) is at best semi-empirical and was definitely never tested at such small dimensions. It is, therefore, still unknown whether or not a version of Paschen's law applies to non-parallel electrodes.

The rest of the paper in *Compliance Engineering* dealt with discharges from insulators and (one more time) showing that surface voltages of insulators cannot be used for estimating discharge risks (only field strengths). But since this topic had already been dealt with in *Threshold*, September/October 2001, it is not included here.

Conclusion

Electrical breakdown in air is caused by electrons being accelerated in a sufficiently strong field. For electrodes with given dimensions it is possible to define the critical field strength, the so-called breakdown field strength and, in the case of two conductors, a corresponding breakdown voltage.

In the case of discharges caused by charged insulators to a grounded conductor the condition for a discharge is determined by the field strength at the face of the conductor and the same breakdown field strengths applies here as in the case of two conductors. The risk of a discharge from an insulator can in no way be evaluated by the measurement of a surface potential.

Niels Jonassen

Mr. Static

Customize your 2002 EOS/ESD Symposium experience

Whatever your ESD interest or experience, you will find something of interest at the 2002 Symposium, October 6-10 in Charlotte, North Carolina.

To help you better plan your participation, the Symposium is programmed along three technical tracks: *Design and Device Technology*, *Factory Issues and Materials*, and *Magnetic Recording*. You can customize and concentrate your participation along these specific areas of interest. Remember, the tracks serve as guidelines, and you can attend any event or session you wish.

Technical Tracks

Track 1

Design and Device Technology

Advancing technologies continually challenge designers and users of sensitive devices to seek new EOS/ESD solutions at this year's Symposium. You can explore the latest research and information on device technologies. Choose from exhibits, tutorials, technical sessions, and workshops such as the following:

Tutorials

ESD On-Chip Protection in Advanced Technologies (Sunday)
 Electrostatic Fundamentals (Monday)
 ESD Design Strategy (Monday)
 HBM, CDM, MM, and TLP Device Testing (Monday)
 CDM Protection Design and Test (Monday)
 EOS/ESD Failure Models and Mechanisms (Monday)
 ESD Protection Design for RF and Advanced Technology Applications (Monday)
 Electrostatic Calculations for the ESD Engineer (Thursday)

Technical Sessions

On-Chip Protection (Tuesday)
 System Issues (Tuesday)
 RF ESD Design & Technology (Tuesday)
 Transmission Line Pulsing & Standardization (Wednesday)
 Simulation and Modeling (Wednesday)
 Device Effects (Thursday)

Workshops

On-Chip Protection for RF Technologies (Wednesday)
 System Level ESD Considerations (Wednesday)
 Transmission Line Pulse Testing (TLP)– Ideas and Applications (Wednesday)

Track 2

Factory Issues and Materials

If you are responsible for the factory floor, standards, material selection, or quality, you can participate in sessions and activities specially focused on providing the information and resources you need to address and solve your ESD problems. Choose from exhibits, tutorials, technical sessions, and workshops such as the following:

Tutorials

ESD Basics (Sunday)
 Understanding and Implementing ANSI/ESD S20.20 (Monday)
 How To's of In-Plant ESD Survey and Evaluation Measurements (Monday)
 Cleanroom Electrostatic Charge Considerations (Monday)
 Air Ionization: Issues and Answers (Monday)
 ESD Standards and Procedures (Thursday)
 Organizing and Managing an ESD Program (Thursday)

Technical Sessions

Factory and Materials (Wednesday)
 MR Factory Issues (Thursday)

Workshops

S20.20 ESD Control Program Certification (Wednesday)
 ESD in Cleanrooms (Wednesday)
 Auditing Measurements According to ESD Association Standards Test Methods (Wednesday)

Track 3

Magnetic Recording

The magnetic recording industry faces unique and growing challenges in controlling ESD. This year's Symposium features sessions focusing on information to understand and solve ESD problems in MR heads and other highly ESD sensitive devices. Choose from exhibits, tutorials, technical sessions, and workshops such as the following:

Tutorials

Electrostatic Fundamentals (Monday)
 Cleanroom Electrostatic Charge Considerations (Monday)
 EOS/ESD Failure Models and Mechanisms (Monday)
 Air Ionization: Issues and Answers (Monday)
 ESD Standards and Procedures (Thursday)
 Electrostatic Calculations for the ESD Engineer (Thursday)

Technical Sessions

MR Device Issues (Tuesday)
 MR Factory Issues (Thursday)

Workshops

ESD in Magnetic Recording (Wednesday)
 ESD in Cleanrooms (Wednesday)

Download the
 Symposium program at

www.esda.org

EOS/ESD Symposium

Program and Schedule Summary

October 6–10, 2002

Charlotte Convention Center, Charlotte, North Carolina, USA

(Program subject to change)

Saturday, October 5

Registration Opens
Charity Golf Tournament

Sunday, October 6

Registration
Spouse/Companion Hospitality
ANSI/ESD S20.20 Seminar, Part 1
Tutorials

Monday, October 7

Registration
Spouse/Companion Hospitality
ANSI/ESD S20.20 Seminar, Part 2
Tutorials
Welcome Reception (In Exhibit Hall)
Exhibits

Tuesday, October 8

Registration
Spouse/Companion Hospitality
Awards Breakfast
Exhibits
Technical Sessions
 On-Chip Protection
Systems Issues
 RF ESD Design and Technology
 MR Device Issues

Wednesday, October 9

Registration
Spouse/Companion Hospitality
Technical Sessions
 Transmission Line Pulsing and
 Standardization
 Factory and Materials
 Simulation and Modeling

Exhibits
ESD Association Luncheon/ Keynote
 Speaker
Workshops

Thursday, October 10

Registration
Spouse/Companion Hospitality
Technical Sessions
 MR Factory Issues
 Device Effects
Tutorials

Friday, October 11

ESDC Technician Exam
ESDC Engineer Exam

Register early and save

You can save money and you can save time by registering in advance. Advance registration fees are valid only if received no later than **August 30, 2002**. Registrations received after this date will be processed at the on-site fees.

You can save several hundred dollars by registering early. Plus, attendees who participate in the "total Symposium experience" and full-time students will save even more.

To register, use the registration form you received in the mail, download the form from the ESDA Web site, www.esda.org, or contact Association headquarters.

Registration and Fees

	Advance Fees On or Before August 30, 2002	On-Site Fees After August 30, 2002
Symposium		
ESD Association Members	\$495	\$695
Non-Members	\$595	\$695
Tutorials		
Sunday (Full Day)	\$475	\$550
Monday (Full Day)	\$475	\$550
Thursday (Full Day)	\$475	\$550
Thursday (Half Day, AM or PM)	\$275	\$275
Total Symposium Experience: Save with Bundled Fees (Symposium plus 3 full days of tutorials)		
ESD Association Members	\$1,725	\$2,110
Non-Members	\$1,815	\$2,110
S20.20 Seminar (Attendance limited to first 30 registrants)	\$1,495	\$1,495
Student Fees		
50% discount for full-time students. Proof of enrollment required.		
Exhibits Only	No Charge	No Charge

Exhibits offer products, services, solutions, information

When you're looking for ESD products and services, where does your search begin? If you're looking through a myriad of purchasing directories, checking the magazine ads, or walking the floors of major electronics trade shows, you're probably doing things the hard way.

The easy alternative? The 2002 EOS/ESD Symposium featuring over 100 exhibit spaces displaying ESD products and services from leading companies. All in one place, you'll cover the broad spectrum of static protection, control, testing, and analysis, as well as prominent trade publications.

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List of Exhibitors

As of April 2, 2002

3M Electronic Handling and Protective Products
 ACL/Staticide
 Aesops, Inc.
 Barth Electronics, Inc.
 Bolidt Synthetic Products & Systems
 Bradford Company
 ByStat International, Inc.
 Cabot Corporation
 Carmelstat by Carmel Olefins
 Conductive Containers, Inc.
 Credence Technologies, Inc.
 Desco
 Electro-Tech Systems, Inc.
 Flexco
 Forbo Linoleum, Inc.
 Gary Plastic Packaging Corporation
 H.C. Starck, Inc. (formerly Bayer Corp.)
 ION Systems, Inc.
 Iron Age Corporation
 Klockner Pentaplast of America, Inc.
 Molded Fiber Glass Tray Company
 Monroe Electronics
 Nora Rubber/Freudenberg Building Systems, Inc.

Noveon Static Control
 NOVX Corporation
 NRD, L.L.C.
 Prostat Corporation
 Richmond Technology - ITW
 RTP Company
 Sarnoff Corporation
 Semtronics Corporation
 Simco Static Control & Cleanroom Products
 Static Control Components, Inc.
 Static Solutions, Inc.
 Statico
 Stephen Halperin & Associates, Ltd.
 TAKO Astatic Technology SDN BHD
 Tech Wear, Inc.
 Technical Coating International
 Tek Stil Concepts, Inc.
 Thermo KeyTek
 Topline - ELME
 Trek, Inc.
 Uniglobe Kisco, Inc.
 Vidaro Corporation
 VPI (Vinyl Plastics, LLC) - Mirrex
 Z-Mar Technology, Inc.

Publications

A2C2
 Canon Communications
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 Evaluation Engineering – EE
 Test & Measurement World

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Exhibit Hours

Monday, October 7, 7:00 PM–10:00 PM

Tuesday, October 8, 9:00 AM–5:00 PM

Wednesday, October 9, 9:00 AM–Noon and 2:00 PM–4:00 PM

Information on exhibiting may be obtained by contacting David F. Barber, Jr., Scien-Tech Associates, Inc., P.O. Box 2097, Banner Elk, NC 28604-2097, Phone: 828-898-6375, Fax: 828-898-6379.

Institutional Listings

<p style="text-align: center;">ACL Staticide</p> <p>1960 E. Devon Avenue, Elk Grove Village, IL 60007 Tel: 847-981-9212 Fax: 847-981-9278 www.aclstaticide.com</p> <p>Cleanroom products, topical antistats, floor finishes and coatings, static detection meters, monitors, computer cleaning products</p>	<p style="text-align: center;">Flexco</p> <p>1401 E. 6th St., Tusculmbia, AL 35674 Tel: 800-633-3151 Fax: 800-346-9075 www.flexcofloors.com</p> <p>Manufacturer of ESD control conductive and static dissipative solid vinyl tile</p>
<p style="text-align: center;">ESD Systems.com</p> <p>19 Brigham St., Unit 9, Marlboro, MA 01752 Tel: 508-485-7390 Fax: 508-480-0257 www.esdsystems.com</p> <p>A full line of ESD control products: wrist straps/foot grounders/mats/ionizers/floor finish/shielding bags/smocks/ testers & more</p>	<p style="text-align: center;">Wolfgang Warmbier</p> <p>Untere Giesswiesen 21, D-78247 Hilzingen, Germany Tel: 49-7731-86880 Fax: 49-7731-868832 www.warmbier.com</p> <p>ISO 9002 Certified for advice, supply and manufacturing of static control materials and systems</p>
<p style="text-align: center;">Bijl/Barneveld</p> <p>Hermesweg 28, NL-3771 ND Barneveld, Holland Tel: 31-342-490147 Fax: 31-342-416845 E-mail: info@bijlbarneveld.nl</p> <p>Europe's small but most reputable distributor of ESD Control Products. ISO 9002 certified.</p>	<p style="text-align: center;">Monroe Electronics</p> <p>100 Housel Avenue, Lyndonville, NY 14098 Tel: 585-765-2254 Fax: 585-765-9330 E-mail: electrostatic@monroe-electronics.com www.monroe-electronics.com</p> <p>Full line manufacturer of static measurement equipment</p>
<p style="text-align: center;">Carmelstat</p> <p>P.O.B. 1468, Haifa 31014, Israel Tel: 972-4-846-6016 Fax: 972-4-846-6958 www.carmelstat.com</p> <p>Manufacturer of ESD thermoplastic compounds for shipping, storage, and inplant handling products</p>	<p style="text-align: center;">Static Solutions, Inc.</p> <p>331 Boston Post Rd. E., Marlboro, MA 01752 Tel: 508-480-0700 Fax: 508-485-3353 www.staticsolutions.com</p> <p>World Wide Mfg. of Industry First ESD-Clean Room Products Monitors/Testers/Coatings, Industry First Products</p>
<p style="text-align: center;">PSSI (Plug-in Storage Systems, Inc.)</p> <p>284-A Racebrook Road, P.O. Box 928, Orange, CT 06477 Tel: 800-231-5952 Fax: 800-532-2999 E-mail: info@pluginstorage.com</p> <p>Protective storage cabinets, carrying cases, carts, work benches and seating for handling ESD-sensitive circuit boards and electronic devices.</p>	<p style="text-align: center;">HMS Compounds, Inc.</p> <p>P.O. Box 388, Mansfield, TX 76063 Tel: 817-468-3099 Fax: 817-468-3122 www.hmscompounds.com</p> <p>Manufacturers of Conductive and Static Dissipative Thermoplastic Sheet and Roll Stock for ESD Protection</p>
<p style="text-align: center;">PRF USA, INC.</p> <p>P.O. Box 6505, Carlstadt, NJ 07072 Tel: 201-804-5565 Fax: 201-804-5567 www.esdrubber.com</p> <p>Static Dissipative/ESD Control Rubber Flooring Static Dissipative Floor Mats and Table Mats</p>	<p style="text-align: center;">ALX Technical</p> <p>84 Citation Drive, Unit 6, Concord, Ontario, L4K 3C1 Canada Tel: 905-761-0370 Fax: 905-761-0371 info@alxtechnical.com www.alxtechnical.com</p> <p>Manufactures of ESD and ESD Cleanroom Paper, ESDNotes™ adhesive backed paper and ESD Labels</p>
<p style="text-align: center;">rubberbands.net</p> <p>P.O. Box 75267 Colorado Springs, CO 80970 Tel/Fax: 719-683-2419 www.rubberbands.net</p> <p>Electronic Grade Rubber Bands, mfd. in the USA, vacuum-sealed Antistatic, dissipative, conductive with distributors worldwide</p>	<p style="text-align: center;">Polyflor Static Control Flooring</p> <p>365 Walt Sanders Memorial Drive, Newnan, GA 30265 Tel: 800-852-8292 Fax: 770-252-4894 E-mail: Fhill@lowandbonar.com www.Polyflor.com</p> <p>Worldwide manufacturer and distributor of ESD control conductive and dissipative vinyl floors available in both sheet and tile.</p>
<p style="text-align: center;">VPI Mirrex Corp</p> <p>1389 School House Road, Delaware City, DE 19706 Tel: 302-836-5950 Fax: 302-836-7571 www.vpicorp.com</p> <p>Manufacturer of ESD thermoplastic materials for the display and protection of static sensitive components.</p>	<p style="text-align: center;">Saint-Gobain Advanced Ceramics</p> <p>1225 Aeroplaza Drive, Colorado Springs, CO 80916 Tel: 719-637-8734 Fax: 719-380-5591 E-mail: JB.Lafon@saint-gobain.com</p> <p>Manufacturer of Cerastat™ ESD ceramics products to customers prints: tools, fixtures, wear parts for data storage & other electronic industries</p>
<p style="text-align: center;">RMV ESD Consulting & Testing Services</p> <p>Certified; DVBE; NARTE Certified ESD Engineer on Staff www.esdrmv.com Tel: 925-673-0225</p> <p>ESD Program Leadership and Supplier Materials Evaluation Comprehensive ESD Audits and On Site Seminars/Employee Training Member, American Council of Independent Labs</p>	<p style="text-align: center;">Tek Stil Concepts, Inc.,</p> <p>P.O. Box 67, Haddonfield NJ 08033 Tel: 800-603-0848 856-428-4464 Fax 856-429-6532 www.tekstilconcepts.com E-mail: info@tekstilconcepts.com</p> <p>ESD dissipative and conductive vinyl sheet and tile. ESD carpet tile. Interlocking conductive rubber antifatigue mats</p>
<p style="text-align: center;">ProLine</p> <p>12 Rogers Rd., Haverhill, MA 01835 Tel: 978-521-2600 Fax: 975-374 4885 www.1proline.com E-mail: Bench@1proline.com</p> <p>Manufactures ESD modular and ergonomic workstations</p>	<p style="text-align: center;">Pure Plast, Inc.</p> <p>1261 Balmoral Rd., Cambridge, ONT, Canada N1T 1C4 Tel: 519-622-0410 gcherry@pureplast.com</p> <p>Manufactures & Supplies Thermoforming PVC & PCT ESD & AntiStat sheet film for the electronic industry</p>

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Institutional Listings

<p>Howell Packaging, Division of F.M. Howell & Company P.O. Box 286, Elmira, NY 14902 Tel: 607-734-6291 Fax: 607-734-8667 Designers & Manufacturers of ESD Protective Packaging, Paperboard & Thermoformed Plastic, In-House Testing</p>	<p>Julie Industries, Inc. 355 Middlesex Avenue, Wilmington, MA 01887-0783 Tel: 978-988-8802 Fax: 978-988-8803 E-mail: questions@julieindustries.com StaticSmart™ products including carpet, rubber & polymeric flooring, personnel grounding products & materials, ESD workstations and chairs</p>
<p>Desco Charleswater West 3651 Walnut Avenue, Chino, CA 91710 Tel: 909-627-8178 Fax: 909-627-7449 www.desco.com Manufacturer of ESD control products including wrist straps, mats, foot grounders, ionizers, shielding bags, floor finish & more</p>	<p>ITW Electronic Component Packaging Systems 2001 E. Randol Mill Road, Suite 117, Arlington, TX 76011 Tel: 817-277-5004 Fax: 817-277-3453 Static Dissipative & Conductive Shipping & Handling Tubes, Carrier Tape & Reels, JEDEC Carrier Trays, Thermoformed Packaging</p>
<p>Conductive Containers, Inc. 4500 Quebec Ave. North, New Hope, MN 55428 Tel: 1-800-FARADAY Fax: 612-537-1738 www.corstat.com Manufacturer of CORSTAT and ESD protective plastic materials for shipping, storage and inplant handling</p>	<p>Aesops, Inc. 636 S. Glenwood Place, P.O. Box 4119, Dalton, GA 30721 Tel: 800-235-8817 Fax: 706-278-6562 www.aesops.com A full line manufacturer of static control products. Special sizes or shapes... No problem. Buy only what you need.</p>
<p>Vermason Ltd. 1 Avenue One, Letchworth, SG6 2HB, England Tel: +44 1462 672005 Fax: +44 1462 670440 sales@vermason.co.uk Manufacturer of ESD products, owner of E9® durAstatic® trademarks For more information, www.vermason.co.uk or e9@vermason.co.uk</p>	<p>3M Electronic Handling & Protection Division Tel: 1-800-328-1368 www.3M.com/ehpd Manufacturer of static control permanent flooring, wrist/heel straps, static shielding bags & containers, & testing/monitoring equipment</p>
<p>Richmond Technology/BayStat – An ITW Company 2001 E. Randol Mill Rd., Arlington, TX 76011 Tel: 800-829-2942 817-277-5004 Fax: 817-277-8453 E-mail: sales@richmond-technology.com ESD films and bags, shielding, DryPack®, CleanPackaging, grounding, wrist straps, heel grounders, work surfaces, floor mats, & monitors.</p>	<p>Work Surfaces Corporation 1-800-553-5015 (USA) Tel: 626-836-3749 Fax: 626-836-8979 www.worksurfaces.com Brass terminus flush mount grounding systems, wrist strap receptacles--bus bars</p>
<p>Brick Container Corporation - Protektive Pak® P.O. Box 548, La Mirada, CA 90637-0548 Tel: 714-994-4140 Fax: 714-994-1377 www.brickcontainer.com Impregnated ESD Corrugated Stock Boxes, Crates, & Foam</p>	<p>Technical Coating International, Inc. 150 Backhoe Road, Leland, NC 28451 Tel: 910-371-0860 Fax: 910-371-0929 www.tciinc.com Manufacturer of ESD Films, Foil Laminates, and Specialty Structures (Barrier, Opaque, Transparent, & Recyclable)</p>
<p>VPI 3123 S. 9th St., P.O. Box 451, Sheboygan, WI 53082-0451 Tel: 800-874-4240 Fax: 920-458-1368 E-mail: marketing@vpiflooring.com www.vpiflooring.com Manufacturer of ESD Control Solid Vinyl Floor Tile</p>	<p>Trek, Inc. 11601 Maple Ridge Road, Medina, NY 14103 Tel: 585-798-3140 Fax: 585-798-3106 Manufacturer of instrumentation for measuring surface voltage, ionizer performance, and surface resistivity</p>
<p>Kenflex Corporation 460 NE Hemlock, Suite A, Redmond, OR 97756 Tel: 541-923-4765 Fax: 541-923-4190 kenflex@coinet.com Manufactures FLEXCELL®, FLEXSTAND®, FLEXTOTE® circuit board transport and protection units, also on Web. For additional information: www.kenflex.com</p>	<p>Desco Charleswater East 90 Hudson Rd., Canton, MA 02021-1407 Tel: 781-821-8370 Fax: 781-575-0172 www.charleswater.com Manufacturer of ESD control products including wrist straps, mats, floor finish, Micastat laminate, shielding bags, & much, much more</p>

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