

News bits

ESDA makes appointments

The ESD Association has appointed Joe Bernier, Intersil, as secretary. Craig Zander, Restronics Company, Inc., was named to the board of directors.

Exhibit space available

Nearly 40 exhibitors have already committed to the 2003 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; Tel: 828-898-6375, Fax: 828-898-6379.

Call for papers deadline

The deadline for submission of abstracts and paper summaries for the 2003 EOS/ESD Symposium is Monday, January 13, 2003. The final submission deadline for the finished paper is Monday, June 2, 2003. The Symposium Call for Papers can be obtained from ESD Association headquarters or downloaded from the Association's Web site at www.esda.org.

In this issue

S20.20 seminar	1
Corporate sponsor program ...	2
Eleven earn certification	3
2003 EOS/ESD Symposium	3
From the Threshold chair	4
February meeting schedule	5
Philippines local chapter	5
Automated ESD CAD system ..	6
From the President	8
Harry Jolliff	9
Letters to the Editor	10
Calendar of events	10
Institutional listings	11-12



Case studies, role playing, small group discussion, and attendee presentations are key elements of the learning experience in the ANSI/ESD S20.20 Seminar for Independent Assessors, Program Managers, and Consultants.

Association schedules S20.20 seminar

The ESDA has scheduled an ANSI/ESD S20.20 Seminar for Independent Assessors, Program Managers, and Consultants on March 26 and 27 at ESD Association headquarters in Rome, NY.

This two-day course is intended for companies or individuals who wish to help clients design and implement an ESD control program based on ANSI/ESD S20.20, as well as for those firms who are implementing their own programs.

This course will provide attendees with the tools and techniques to help their companies or their clients prepare for a facility audit (pre-assessment). Examples of control programs will be presented and general role-playing will be used in the assessment section. Interactive participation and case studies are integral parts of the seminar.

Presented by Ron Gibson, Celestica, Inc., and John Kinnear, Jr., IBM Corpora-

tion, the course 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.

Seminar fees are \$1,495. Attendance is limited. For more information or to register for this two-day program, contact ESDA headquarters.

Enjoy the benefits, become a corporate sponsor

If your company is looking for ways to save money on employee participation in the ESD Association, take a close look at the ESDA's corporate sponsorship program.

The corporate sponsorship program provides companies with a means of increased participation in Association activities and programs and, at the same time, recognizes the support of the participating companies. The program is designed for OEMs and contract manufacturers as well as suppliers of ESD products and services who have an ongoing interest in the benefits technology, standards, services, and education that the Association has to offer.

Although professional organizations such as the ESD Association are founded

on individual participation and membership, the activities and influence of such organizations go well beyond the individual members themselves. Through the corporate sponsor program, the ESD Association aims to provide opportunities that benefit companies, individual ESDA members, and the Association itself.

Customized packages

In actuality, the corporate sponsorship program is two separate packages customized specifically for OEMs and contract manufacturers and for suppliers of static control products and services. The program provides a number of services and benefits such as multiple individual memberships in the ESD Association at a total cost that is substantially less than if the

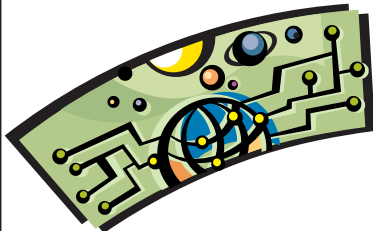
individual components were purchased separately. For example, the OEM/contract manufacturer package includes a standards site license. The supplier package includes advertising and promotion components. The specific provisions of each package are available from Association headquarters, but an overview of each is provided below.

OEM/CM package

The program for OEMs and contract manufacturers includes multiple individual memberships, a standards site license, a paper \$20.20 review of the company's ESD control program, admissions to the Symposium and tutorials, and

Continued on page 3

Understanding Today's ESD Issues and Tomorrow's Challenges



Now Available

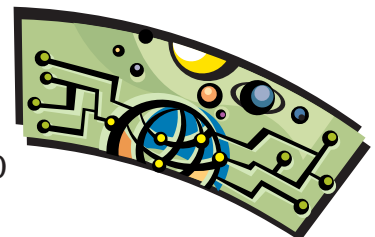
ESDA White Paper on

ESD Phenomena and the Reliability for Microelectronics

An authoritative overview of the ESD threat to electronic devices covering

Effects of ESD on electronic devices
ESD device sensitivity testing and characterization
ESD protection design
ESD program management, processes, and materials
Future challenges and issues

To purchase, contact
ESD Association
7900 Turin Road, Bldg. 3, Rome, NY 13440
Ph: 315-339-6937, Fax: 315-339-6793
E-mail: info@esda.org Web: www.esda.org



Association news

Continued from page 2

Corporate sponsor program

Symposium proceedings. The annual fee for the user program is \$8,000, a savings of approximately 45% if the services and benefits were purchased separately.

Supplier package

The program for suppliers of ESD control products includes multiple individual memberships, an annual standards subscription, a single booth at the 2003 EOS/ESD Symposium, a web site buyers guide listing, institutional listings in *Threshold*, attendance at ESDA-sponsored educational programs, and other benefits. The annual fee for the vendor program is \$4,000, a savings of approximately 27% if the services and benefits were purchased separately.

For additional details on the corporate sponsor program, contact ESD Association headquarters.

Eleven earn certification

Eleven individuals have passed their certification exams and completed the other requirements to earn NARTE certification as ESD control engineers or technicians.

The following individuals have been designated as NARTE-certified ESD Control Engineer: John Barnes, DBI Corporation; Zhi Pei Lei, Setsco Services Pte. Ltd.; Tnysheng Lin, OK International Taiwan; Jesus Lazatin Munoz, Intel Technologies; Robert Perry, Maxtor; Rainer Pfeifle, Wolfgang Warmbier; and Jeffrey Salisbury, Seagate Technology.

The following individuals have been designated as NARTE-certified ESD Control Technician: Tobias Buob, Statech Systems AG; Vasant Dandekar, Raytheon Systems; Mark Miller, Medtronic; and Richard Wilson, NACOM Corporation.

There are now 190 certified ESD Control Engineers and 92 certified ESD Control Technicians.



Symposium to celebrate 25th anniversary in Las Vegas

With the glamour and excitement of Las Vegas serving as the backdrop, the 25th anniversary presentation of the EOS/ESD Symposium runs September 21-25 at the Riviera Hotel in Las Vegas, Nevada.

While Symposium week activities will continue to focus on technical papers, workshops, exhibits, and an expanded tutorial program, there will also be special events celebrating the Symposium's 25 years of providing technical information on the effects of electrical overstress (EOS) and electrostatic discharge (ESD) on electronic devices, assemblies, systems, and processes.

Make your plans! Mark your calendars! Watch *Threshold* and the ESD Association Web site (www.esda.org) for more details in coming weeks.

Preliminary Schedule Symposium Week

Friday, September 19

Standards Meetings

Saturday, September 20

Standards Meetings
Registration Opens

Sunday, September 21

Standards Meetings
S20.20 Seminar
ESD Tutorials

Monday, September 22

S20.20 Seminar
ESD Tutorials
Welcome Reception
Exhibits Open

Tuesday, September 23

Awards Breakfast
Technical Sessions
Exhibits Open
25th Anniversary Gala

Wednesday, September 24

Technical Sessions
Exhibits Open
Workshops

Thursday, September 25

Technical Sessions
ESD Tutorials

Friday, September 26

ESDC Certification Exams

IEEE recognizes and honors an ESD expert: Steven Voldman



Leo G. Henry

It is with much pleasure that we at the ESDA express our sincere congratulations to Dr. Steven H. Voldman, who was recently awarded the IEEE Fellow by the International Electronic and Electrical Engineering (IEEE) Society for "Contributions in electrostatic discharge (ESD) protection in CMOS, Silicon-on-Insulator (SOI), and RF Silicon Germanium (SiGe) technology." The IEEE Board of Directors awards the IEEE Fellow to individuals who made significant contributions to and who conducted pioneering work in the field of electrical engineering. Steve will receive an IEEE Fellow pin and certificate, which serve as visible recognition of his election to the highest level of membership in the IEEE.

This recognition is a very important achievement in many ways. It will open the door for many from the ESD field to follow, and it will help the ESDA to move forward in establishing our own ESDA Fellow program, which will be similar to and align to the IEEE Fellow program. Steve, coincidentally, introduced the proposed ESDA Fellow program for discussion about one year ago.

Steve works in IBM's silicon germanium development division, a subdivision of IBM's Communications and Semiconductor Research and Development Center (CSRDC) located in Vermont. His accomplishments include the first ESD papers on CMOS, SOI, and SiGe technology in shallow trench isolation (STI) technology; ESD scaling theory; and many others. He was also the key investigator of ESD phenomenon in SOI for the development of IBM's SOI effort from 1994 to 2001. He is presently the key investigator for IBM's

silicon germanium technologies for 40 to 300 GHz SiGe HBT devices. Steve presently holds 110 US patents and has written 90 publications in the areas of ESD protection and device reliability.

To further cement his recognition as an ESD expert, you can find Steve's 8-page treatise on ESD published in the October 2002 issue *Scientific American* on pages 90-97. It is titled "Lightning Rods for NanoElectronics—ESD Threatens to Halt Further Shrinking and Acceleration of Electronic Devices in the Future." It is said, "In the pages of *Scientific American*, you will meet the scientists whose work is at the forefront — pioneers who are changing our lives, and changing our world."

His leadership skills are also reflected in the ESD Association's White Paper on ESD phenomenon for the semiconductor industry and for the universities to which he is a main contributor. The White Paper was published in October and is available from the ESD Association.

As an educator, Steve has taught courses on ESD in CMOS, SOI, and RF devices at the ESD Symposium, the International Reliability Physics Symposium, and the International Physical and Failure Analysis Symposium. He has served as ESD working group chair for the SEMATECH Quality and Reliability Council and was chartered to establish the first SEMATECH ESD effort. He was responsible for establishing ESD benchmarking structures for the semiconductor industry and the establishment of an ESD Tester vendor roadmap to address alignment with the SIA roadmap for semiconductors for high pin count products. He was then asked to chair a team of suppliers and semiconduc-

tor users on the development of the first TLP standard specification for the industry. This TLP WIP document has been completed and publication is expected by the end of June 2003.

Steve has mentored IBM Watson Scholar summer students and at the University of Illinois and Princeton University. He has served as an SRC industrial liaison. He has contributed to the EOS/ESD Symposium as a member of the technical program committee, session moderator, vice chair, and general chair. His other activities in the ESD Association include the education committee and ESDA standards work group 5.5 on TLP. He is presently serving on the IPFA technical steering committee, ISQED TPC, and IRPS ESD/Latchup sub-committee chair.

This IEEE recognition that the achievements of its members are an important part of the IEEE mission bodes well for the ESDA. Steve, as a member of the ESDA Board of Directors, can now use his select team to follow a similar rigorous evaluation and procedure in recommending a select group of recipients for what should become one of the Association's most prestigious honors, election to ESDA Fellow.

Good job, Steven V.
Stay Happy.
Until next time.....

Leo G



Steve Voldman presents a tutorial at the EOS/ESD Symposium.

Association news

On the local scene

ESD Association recognizes local chapter in Philippines

**Tentative Schedule
February 2003 ESD Association
Standards and Committee
Meetings
Riviera Hotel, Las Vegas, NV
February 7-11, 2003**

Friday, February 7

7:00 AM TAS
8:00 AM Ionization WG-3
Device Testing Working
Groups WG-5
1:00 PM Handlers WG-10

Saturday, February 8

7:00 AM TAS
8:00 AM Device Testing Working
Groups WG-5
Work Stations WG-53
Cleanroom Consider-
ations WG-55
1:00 PM Packaging WG-11
Footwear WG-9
5:30 PM Working Group Chairs

Sunday, February 9

7:00 AM TAS
8:00 AM Handtools WG-13
Simulators WG-14
Gloves WG-15
Flooring, WG-7
ICE Education
9:00 AM Local Chapters
1:00 PM Standards Committee
5:00 PM Technical Liaison
6:00 PM Executive Committee

Monday, February 10

8:00 AM Technical Program Com-
mittee
Member Services
2:00 PM Symposium Steering Com-
mittee
4:00 PM Symposium Steering/ICE
Committees

Tuesday, February 11

8:00 AM Board of Directors



Jojo Esmeria (right), chairman of the AEC, receives the certificate recognizing the AEC as the Philippine chapter of the ESDA from Ed Weggeland, senior vice president of the ESD Association.

The ESD Association continues to sport a more global look as the organization recognized its first Asian local chapter, the ASEMEP ESD Council (AEC) in the Philippines.

Formed in January of 2002 as a technical working group of the Association of Semiconductor and Electronics Manufacturing Engineers of the Philippines (ASEMEP) and the Semiconductor and Electronics Industries in the Philippines, Inc. (SEIPI), the ASEMEP ESD Council was designated as a local chapter during the EOS/ESD Symposium in October in Charlotte, NC. Then on October 29, Ed Weggeland, ESD Association senior vice president, presented the AEC with the certificate recognizing the organization as a local chapter in formal ceremonies in the Philippines.

Numbering 68 members representing 28 companies, the chapter has ambitious plans for coming year, including the promotion of ESD program management and ANSI/ESD S20.20 awareness; driving ESD awareness and competency development within the AEC; and establishing AEC as the ESD technology leader in the Philippine electronics industry.

The founding officers of the AEC are Jojo Esmeria, TDK Philippines Corporation, chairman; Jess Muñoz, Intel Technology Philippines, Inc., vice chairman and technical committee chairman; Ronnie Rivera, Philips Semiconductors Philippines, Inc., secretary; Cresille Estillore, Sanyo Semiconductor Manufacturing Philippines Corp., assistant secretary; Jorge Disonglo, Three-Five Systems Pacific, Inc., membership committee chairman; Rochelly Martinez, Pycon Tech. Philippines, Inc., events committee and e-group chairperson; Joel Bajador, MX Technology, treasurer; Ed Malonjao, 3M Philippines, adviser; Ridor Dacasin, Pricon Microelectronics, Inc., auditor.

For more information on the first Asian ESDA local chapter, contact Jojo Esmeria, TDK Philippines Corporation, cell phone: +639175003689, E-mail: Jo_M_Esmeria@TDK-PHIL.tdk-group.com; Rochelly Martinez, Pycon Tech. Philippines, Inc., cell phone: +639189008419, E-mail: rmartinez@pycontech.com; or AEC E-group List Owner, E-mail: asemep-esd-owner@yahoogroups.com.

Device technology

An automated electrostatic discharge (ESD) CAD system for BiCMOS silicon germanium (SiGe) technology—a new millennium for ESD design

by Steven H. Voldman, Susan Strang, and Donald Jordan, IBM

In ancient Greece, when Thales of Miletus (one of the Seven Sages of Greece) first saw the attraction between amber and strands of hay, electrostatic discharge (ESD) phenomenon was born. Thales, born in 636 B.C. in Asia Minor, was the first philosopher to discuss both electrostatic and magnetic attraction; he was a mathematician, an astronomer, a philosopher, and an engineer.

ESD made little progress from Greek times, leaving the medieval mind (and modern mind) to believe the interaction was a plethora of ESD demons, gods, and “black magic.” A myriad of myths in ESD design still ruled internationally in the 1980s and early 1990s among technologists and circuit designers. A fear of building automated ESD design systems so as to not upset these mythological ESD gods seemed to hold back technological advancement.

New directions needed

Today, new directions are needed for ESD design in radio frequency (RF) technologies in order to optimize and co-design the performance and ESD requirements for GHz applications. For RF design, it is important to have precision models for digital, analog, and RF circuitry. ESD protection circuits must also support quality ac, dc, and RF model capability in order to co-design ESD circuits for these analog and RF circuits. Additionally, with the growth of the high-speed data rate transmission, optical interconnect, wireless and wired marketplaces, the breadth of applications and requirements is expanded. Each application space has a wide range of power supply conditions, a number of independent power domains, and circuit performance objectives. As a result, an ESD design system that satisfies digital, analog and RF circuits and also has dc and RF characterized models, design flexibility, automation, ESD charac-

terization, is required to design and co-synthesize ESD needs of a mixed signal RF technology. In order to satisfy these crucial requirements, we need to think out-of-the-box.

ESD design CAD system

For GHz applications, and RF optimization, a new methodology is needed. First, a fixed-size ESD design does not allow for application-specific RF optimization. RF characterization of the network that is flexible with the device size is important for the evaluation of the tradeoffs of RF performance and ESD. In this mixed-signal environment, some applications prefer CMOS-based ESD networks, and others use bipolar-based ESD networks. Hence, we also need a larger breadth of ESD circuit solutions. Additionally, an ESD methodology is needed to allow for RF characterization without a large test burden on the technology development test community.

To address these issues, an ESD CAD strategy was developed to fulfill the objective of design flexibility, RF characterization and models of ESD elements, automation, and choice of ESD network type. First, this system (Figure 1) uses a hierarchical set of parameterized cells, known as “p-cells”, which are constructed into higher-level ESD networks. P-cells were constructed in a CADENCE™ design system environment. These hierarchical ESD designs are also integrated with the technology device library for the technology design kit proliferation and release process. The strategy allows for the lowest order p-cells to be RF and dc characterized. ESD verification, dc characterization, schematics, and LVS are completed on the higher order circuits. The ESD strategy allows for a customer to build in RF CMOS or RF BiCMOS silicon germanium technology. The system suffices for both types of technology.

Diode, bipolar, and MOSFET hierarchical p-cells are used to establish both CMOS and SiGe bipolar-based ESD net-

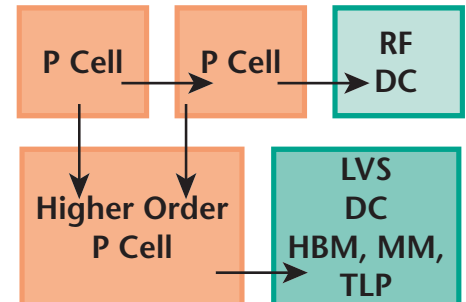


Figure 1. RF ESD Design Methodology.

works. The p-cells are growable elements that fix some variables and pass some variables to the higher-order circuit through “inheritance.” ESD circuits are constructed for input pads and V_{DD} to V_{SS} and V_{SS} to V_{SS} power clamps. The design system was developed to allow for change of circuit topology, as well as structure size in an automated fashion. Layout and circuit schematics are auto-generated with the user varying the number of elements in the circuit. As part of the ESD design kit release process, human body model (HBM), machine model (MM), and transmission line pulse (TLP) verification of a matrix of the released designs is analyzed. ESD input circuits consist of different input circuits for digital, analog, and RF I/O circuits. For a CMOS circuit, a double-diode p-cell is ESD-optimized and custom designed, and whose metal, contacts, and isolation are growable in length (Figure 2).

Continued on page 7

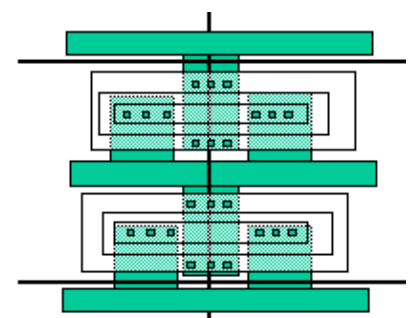


Figure 2. Automated Parameterized Cell Hierarchical RF Double Diode Circuit.

Device technology

Continued from page 6

New millennium for ESD design

The SiGe-based double-diode circuit utilizes the base-collector junction of the varactor p-cell. This SiGe-based double diode p-cell has variable cathode finger numbers to allow circuit designers to vary the design size for RF optimization.

System requirements

The introduction of the ESD elements between the grounds can address the ESD concerns, but increases the noise and stability implications. As a result, the co-synthesis of the ESD and noise concerns needs to be flexible to address both issues. As part of the ESD CAD design system, a hierarchical p-cell forms a bi-directional SiGe varactor string that can vary the number and the physical width of each varactor as well as maintain the electrical interconnects and pin connections.

An ESD power clamp strategy must be suitable for CMOS digital, analog, and RF circuit blocks. Our design system has both SiGe bipolar-based and CMOS-based ESD power clamps to satisfy all customer needs. For CMOS digital circuitry, a hierarchical RC-triggered MOSFET power clamp p-cell is constructed (Figure 3).

For analog and RF functional blocks, SiGe power clamps are designed to allow for different voltage trigger conditions. This SiGe ESD power clamp p-cell consists of resistor ballast, two SiGe transistors, and bias resistor p-cells (Figure 4).

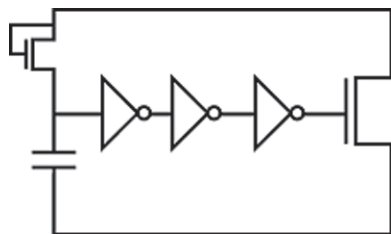


Figure 3. Hierarchical Parameterized Design of the RC Triggered Circuit.

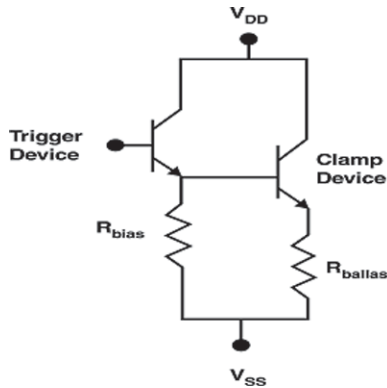


Figure 4. BiCMOS SiGe-based ESD Power Clamp.

Some results

Experimental results from the SiGe HBT ESD power clamp as a function of the structure size is shown in Table 1. This circuit has a 120 GHz f_T SiGe HBT trigger device and a 90 GHz f_T SiGe HBT clamp device. To address the different power supply conditions, a level shifting p-cell is

added to this hierarchical p-cell; this circuit allows growing of a string of series SiGe varactors to increase the trigger condition. Table 2 shows HBM and MM ESD verification data as a function of the trigger voltage condition of this variable trigger SiGe HBT ESD power clamp p-cell.

What's next?

Our strategy provides us with great flexibility, but revolution and evolution is inevitable. It is limitless. With this strategy, new ESD designs can be added to cover new applications. The matrix of elements and number of variables can increase to provide more design flexibility for different design form factors and application needs. ESD optimization of the base and hierarchical p-cells will continue. With the ESD design system structure that was created, the opportunities seem without bound. This improves the state-of-the-art for ESD design and ESD-RF optimization, as well as a new way of doing business.

Trigger	Clamp	Size (μm)	HBM (V)	MM (V)
120 GHz	90 GHz	50	2500	240
		100	3100	390
		150	4700	480
		200	5000	600
		250	5900	630

Table 1. SiGe ESD Power Clamp P-Cell Results.

Trigger (v)	Varactors (#)	Clamp Size (μm)	HBM (V)	MM (V)
1.70	0	250	5900	630
2.47	1	250	4700	540
3.15	2	250	4400	540
3.84	3	250	3900	510

Table 2. Variable Trigger Power Clamp P-Cell.

From the president

ESD control: profitable opportunity in tight economic times

Other than increasing sales dramatically, electrostatic discharge (ESD) control is the single most profitable opportunity for our industry under today's economic conditions. Independent consultants



Steve Halperin

have found that ESD costs the average electronic manufacturer 4 to 8 percent of total annual corporate revenues, depending on product designs and device sensitivity. Internal studies in telecommunication and other electronic firms have revealed losses equal to, or in excess of, 10 percent of annual revenues. With an estimated average negative impact of 6.5 percent of revenues, this means the international electronics industry is losing in excess of \$84 billion (USD) every year based on 1997-2001 production data.

Under the best economic conditions, corporate sales and profitability are based on the company's sense of timing and operational skill—to strike while the iron is hot, so to speak. Success is the ability to produce and ship desirable products quickly, bill, and collect from our customers, and do so at a profit. When the market tempo is driving us in a proactive competitive manner and our companies are making money, we can accept that certain problems can be dealt with at a later, more convenient time. We make these decisions all the time; we set priorities based on our needs *today* and absorb the cost of these nagging secondary problems because we can afford to do so. After all, the bottom line dictates that we need to generate profits in an expeditious manner to satisfy our shareholders, cover current operational needs, and plan for those dry spells.

Today, we are experiencing one of those dry spells. Most companies have tightened their belts to a painful degree. Sales and profits are down. Some organizations have modified their priorities. It is not unusual to hear planning strategies based on *survival and recovery* as opposed to *growth and market share*. The proactive organization seeks maximum profits from existing business opportunities and utilizes this time for new development and repositioning themselves for market recovery. They want to be around when that time comes, and they want to be in a position to capitalize on the opportunity.

Adding up the costs

All too often, managers view ESD impact as a direct material cost. If a device costs a few dollars and we happen to lose one, "...what's the big deal?" The fact is, depending on product design, material loss most often represents the smallest cost of ESD impact. However, the total cost attributable to even a small device loss may be quite significant due to the influence a single device has on other devices, system function, rework, warranty, repair and customer satisfaction.

Materials

ESD materials losses are *budgeted*. By this, I mean we plan to purchase more devices than are necessary to produce and maintain specific products and systems. In low-cost applications where rework is not a factor, material purchases significantly exceed those required to produce shipped products. Management understands that it simply does not pay to rework low-cost defective assemblies, and these potential losses are included in our inventory budgets. Often we ignore the *cause(s)* of these defects in the heat of production demands when increasing sales provide profitable returns, only to repeat the loss in the future. All of these material losses and excess inventory are included in our cost of

doing business, and, as such, it is part of our operational budget.

Rework

ESD impact on one low-cost device that is part of an assembly or a system creates an exceptionally high cost. Here, we have the challenge of salvaging expended materials, labor, burden, and overhead costs when the product does not function properly. To correct these problems we invest in a comprehensive rework operation. We place our most knowledgeable people here. We create space, provide equipment and spare parts and re-create the cleaning and testing process. In effect, we rebuild the product from scratch, carefully preserving and salvaging as much as possible. In other words: since we did not do it right the first time, we will pay to do it again.

An example of this costly process is the aircraft guidance system manufacturer who did not track loss of devices costing less than \$5.00. When a low-cost device failed due to ESD rendering the guidance system inoperative, the system repair and retesting cost was over \$28,000. The process of rework is a clearly budgeted item, but the cause of failures requiring rework were lost. As devices became more ESD sensitive, the company simply increased their rework budget until they reached their threshold of budgetary pain.

Burden and overhead

When we require rework, field service, or contracted services, these costs are ultimately absorbed in burden-related expenses. Burden and overhead are necessary evils that effect the operational bottom line. They are applied to initial production, as well as rework facilities, labor and payroll costs, remote plants, and service organizations who make our products work when defects are evident. Again, we have a budget for these costs and adjust them as our failure experience and needs dictate.

Continued on page 9

From the president

*Continued from page 8***ESD control: profitable opportunity in tight economic times****Warranty and field service**

Warranty support is the highest expense a company can incur for every affected unit. Here, the product fails in the customer's environment, during the warranty period. In the world of ESD there is a term called *latent defect*. Latent damage occurs when a device is partially degraded during manufacturing and handling, yet it meets product test specifications and is ultimately shipped to a customer. In effect, a device with latent damage has a shortened operational life.

The cost to rework a failure found in the manufacturing process is much lower than costs associated with a failure in the customer's environment or application. One NASA supplier put it quite simply—it cost \$200,000 to recertify a system affected by ESD in-plant, and over \$500,000 to document and correct a latent failure in the user's environment.

In those situations where the product or system is far too expensive to replace, field service is provided. Not only does the customer experience lost productivity or revenues due to product failure, but the manufacturer also incurs exceptionally high costs to repair the defective product, supply trained personnel and inventory to provide the service function, and pay for the vehicle and equipment to deliver and test the final repair.

Customer service and satisfaction

This may be the single greatest cost of all. It is not unusual to expend huge portions of corporate revenues in marketing, sales, and sales support expenses. Attached to this horrendous cost and its related consequences are the costs of making the customer happy after a disappointing experience, and the cost of replacing the customer if we are unsuccessful in appeasing him.

The bottom line

All of the functions described above are typically budgeted items. While the cost of an ESD event will vary depending on product criticality, configuration, and device or system sensitivity, these costs exist in today's complex organization. Under reasonable conditions a large portion, possibly as much as 80 percent, of the costs related to ESD impact can be recovered and transferred to the bottom line as profit. This could have a dramatic impact on the company's financial situation.

For example, assume that a company increases total sales by one dollar. After paying for the cost of manufacture, sales and so forth, they may have only \$0.06 to \$0.10 remaining in after-tax profit. However, for every dollar saved in their operation, the after-tax profit may range from \$0.50 to \$0.70, depending on their tax rate. With ESD consuming a significant portion of total revenues, ESD control can be a very profitable investment.

ESD control and ROI

Responsible management wants a positive return on their investment. A properly implemented ESD program has a return on investment (ROI) exceeding 5 to 1 within six months. Of course, this assumes that you have trained ESD personnel available, positive management support, and acquire appropriate materials and equipment.

Management support is necessary for two reasons. First, without support the ESD team has no authority to implement change or corrective action. Second, an effective ESD manager or team requires management approval for access to operational information that crosses virtually every line in the organization. They must have access to information and use this information to assess ESD losses, cost impact at various organizational levels, supplier performance, customer problems, failure analysis, warranty issues, and a

myriad of other pertinent aspects of control.

Wrapping it up

ESD control helps provide maximum profit from existing business, which is essential in today's economic conditions. Proper ESD process analysis yields enhanced quality and productivity with lower costs and greater customer satisfaction. It helps position the company as a profitable competitor in a challenging marketplace. It allows the organization to utilize advanced technology and adapt to market trends where effective handling of very ESD sensitive devices and assemblies is an absolute requirement. It gives the organization a greater understanding of their process and the devices that they handle, and helps them support and advise their customers on how to get the greatest return from their products.

The bottom line? Today's organization must be ESD proficient in order to survive and grow, and do so under profitable and productive conditions.

Harry Jolliff

Harry Jolliff, a long time member of the ESD Association and contributor to its standards development activities, passed away on November 2.

Active on several of the ESDA's standards working groups and most recently chair of the Handtools working group, Harry brought considerable insight to the Association's standards efforts. His technical expertise, wit, and friendliness will be missed throughout the organization.

Harry was a long-time aerospace engineer and served as a World War II B-17 navigator, flying 27 missions over Germany.

Sunrise was always very special to him, because he always said no matter how bad things were, the sun would always come up tomorrow. His passing came just 15 minutes after sunrise.

Letters to the editor

Kudos to Symposium workshop volunteers

To the Editor:

I was asked to moderate a workshop at the ESD Symposium from 5:30—7:00 PM on Wednesday October 9. The workshop's intent was to demonstrate ESD auditing procedures using the current ESD Association standards documents as a guideline, while helping with practical auditing techniques for compliance with S20.20 programs. My original concept was to get individuals from industry that were actually doing the work day to day for the demonstrations, and add to that the people who were responsible for originating the ESD Association standards for questions. In addition, we asked exhibitors to submit products for actual audit demonstrations. I would like to publicly thank everyone who participated in this event.

The following individuals volunteered their time to lend experience to the demonstrations:

Bob Johnson, RF Micro Devices
Ted Dangelmayer, Ion Systems, Inc.
Carl Newberg, Rivers Edge Technical Service
Jeff Salisbury, Seagate Technology
Dan Kiernan, Stonhard
Barry Young, Delphi Delco Electronics
Bob Vermillion, RMV Technology Group
Ken Kern, Siemens Medical Systems
Dave Swenson, 3M
Tim Jarrett, Guidant Corporation

The following Standards members were present to lend expertise:

Dale Parkin, IBM
Ron Gibson, Celestica
John Kinneer, IBM
Rick Rodrigo, Simco

Steve Halperin, Prostat Corporation
Steve Gerken, US Air Force

In addition, Al Cash from Northrop Grumman helped with set up and countless exhibitors gave products for testing and demonstration. No questions asked.

This support from individuals and their companies proves that our industry, and our ESD Association that supports it, is alive and well. Everyone involved, from the exhibitors donating products to the attendees who came to learn, was interested in proper auditing procedures and implementation of an S20.20 program. The future of our ESD Association is on solid ground.

Thank you to everyone for such great support.

Sincerely,
Kimberly Becker, Operations Manger
Prostat Corporation

Calendar of events

January 2003

ESD Northwest Chapter Meeting: January 8, 2003; ESD Flooring-From Justification to Installation, Wayne Tan, AMD; Viasystems;
www.esdnw.org

Midwest ESD Chapter Meeting: January 14, 2003; Instrumentation for ESD Auditing, Steve Halperin, SHA/Prostat; Bimbo's Restaurant, Palatine, IL; www.midwestesd.org

Texas ESD Association Chapter Meeting: January 27, 2003; Sematech, Austin, TX; www.centxesdassoc.homestead.com

February 2003

ESDA Standards and Committee Meetings: February 7-11, 2003; Riviera Hotel, Las Vegas, NV;
www.esda.org

Midwest ESD Chapter Meeting: February 12, 2003; New Packaging Technology, Ross Scimeca, Century Container; Bimbo's Restaurant, Palatine, IL; www.midwestesd.org

March 2003

ESD Northwest Chapter Meeting: March 12, 2003; Integrating ESD Detection, Valdimir Kraz, Credence Technologies; Viasystems;
www.esdnw.org

ESD Forum: March 13, 2003; Sheraton Chicago Northwest Hotel;
www.midwestesd.org

ANSI/ESD S20.20 Seminar for Independent Assessors, Program Managers, and Consultants: March 26 and 27, 2003; ESD Association Headquarters, Rome, NY;
www.esda.org

Texas ESD Association Chapter Meeting: March 31, 2003; Sematech, Austin, TX; www.centxesdassoc.homestead.com

April 2003

Midwest ESD Chapter Meeting: April 8, 2003; Nuclear Ionization and ESD Control, Larry Jacobson, Amstat Industries; Bimbo's Restaurant, Palatine, IL; www.midwestesd.org

May 2003

ESDiscovery 2003: May 2003; Santa Clara, CA; www.esdsiva.org

Midwest ESD Chapter Meeting: May 14, 2003; Ionization Basics, Gary Seale, Simco; Bimbo's Restaurant, Palatine, IL;
www.midwestesd.org

ESD Northwest Chapter Meeting: May 14, 2003; Modify Your ESD Training Program to be More Effective, Don Skinner, Consultant; Viasystems;
www.esdnw.org

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 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>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 in-plant handling</p>
<p>3M Electronic and Interconnect Solutions Division Tel: 1-800-328-1368 www.3M.com/eisd 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>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>Minimum rates are \$600.00 for six consecutive issues. Larger contributions will be most welcome. No agency fee is granted for soliciting such contributions. Inquiries or contributions made payable to the ESD Association, plus instructions on how you wish your Institutional Listing to appear, should be sent to: ESD Association, 7900 Turin Rd., Building 3, Rome, NY 13440-2069 Tel: (315) 339-6937, Fax: (315) 339-6793, e-mail: info@esda.org</p>	

More institutional listings, next page

Threshold

Threshold™ 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.

© Copyright 2003, ESD Association, Rome, NY

Threshold™ Publication Schedule

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



7900 Turin Road, Building 3
Rome, NY 13440-2069

Tel: (315) 339-6937 Fax: (315) 339-6793
E-mail: info@esda.org Web: <http://www.esda.org>

Newsletter Staff

Threshold Chair

Leo G. Henry, Ph.D.
ESD/EMI/TLP Consultants
P.O. Box 1665, Fremont, CA 94538
Tel: 510-657-5252 Fax: 510-657-9661
E-mail: leogesd@pacbell.net

BOD Sponsor

Craig Zander
Restronics Company, Inc.
7125 Washington Avenue, So., Edina, MN 55439
Tel: 612-941-9135
E-mail: czander@restronics.com

Editor

Michael T. Brandt
Marketing Resources Ltd.
12638 W. Virginia Ave., Lakewood, CO 80228
Tel/Fax: 303-274-1222
E-mail: mtb@mrlweb.com

Associate Editors

Development

Ed Weggeland, Static Control Components, Inc.

Electrostatics

Niels Jonassen, Copenhagen, DENMARK

Protection Design

Steve Voldman, IBM Microelectronics

Technology

Charvaka Duvvury, Texas Instruments

Editorial Advisory Board

Threshold Chair

Leo G. Henry, ESD/EMI/TLP Consultants

BOD Sponsor

Craig Zander, Restronics Company, Inc.

President

Stephen A. Halperin, SH&A/Prostat

Sr. Vice President

Ed Weggeland, Static Control Components, Inc.

Vice President

Mark Kelly, Delphi Delco Electronics

Member Services

Kay Adams, Tech-Wear

ESD Association Headquarters Staff

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., Tusculumbia, 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>432 Northboro Rd. Central, Marlboro, MA 01752-1823 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;">Monroe Electronics</p> <p>100 Housel Avenue, Lyndonville, NY 14098 Tel: 585-765-2254 Fax: 585-765-9330 E-mail: electrostatics@monroe-electronics.com www.monroe-electronics.com</p> <p>Full line manufacturer of static measurement equipment</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;">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;">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: 719-637-8737 Fax: 719-380-5591 E-mail: william.ilsch@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, ESD high traction safety floor tile</p>
<p style="text-align: center;">ProLine</p> <p>12 Rogers Rd., Haverhill, MA 01835 Tel: 800-739-9067 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>
<p style="text-align: center;">Ion Systems</p> <p>1005 Parker Street, Berkeley, CA 94710 Tel: 510-548-3640 800-367-2452 Fax: 510-548-0417 www.ion.com</p> <p>Ion Systems is the world's leading provider of electrostatics management products and services.</p>	<p style="text-align: center;">PROTEKTIVE PAK</p> <p>14040 Central Ave., Chino, CA 91710 Tel: 909-627-2578 Fax: 909-363-7331 www.protektivepak.com</p> <p>Corrugated paper and plastic containers, tape, labels, and bags for ESD protected handling of electronic devices and components</p>
<p style="text-align: center;">Your Listing Can Appear Here</p> <p>Contact ESD Association for Details 7900 Turin Rd., Building 3, Rome, NY 13440-2069 Tel: (315) 339-6937, Fax: (315) 339-6793, e-mail: info@esda.org</p>	<p style="text-align: center;">Your Listing Can Appear Here</p> <p>Contact ESD Association for Details 7900 Turin Rd., Building 3, Rome, NY 13440-2069 Tel: (315) 339-6937, Fax: (315) 339-6793, e-mail: info@esda.org</p>

Minimum rates are \$600.00 for six consecutive issues. Larger contributions will be most welcome. No agency fee is granted for soliciting such contributions. Inquiries, or contributions made payable to the ESD Association, plus instructions on how you wish your Institutional Listing to appear, should be sent to: ESD Association, 7900 Turin Rd., Building 3, Rome, NY 13440-2069 Tel: (315) 339-6937, Fax: (315) 339-6793, e-mail: info@esda.org

More institutional listings, previous page