



Issue No. 1, 2009

Static Digest

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David Swenson, Affinity Static Control Consulting, monitors workers in an electronics plant in China as part of an ESD audit to prepare for certification to ANSI/ESD S20.20. In addition to reviewing personnel grounding procedures, he typically uses the 3M™ ESD Pro ESD Event Indicator and 3M™ Ground Pro Ground Integrity Meter to detect any process faults.



Ted Dangelmayer (left), Dangelmayer Associates L.L.C., consults with trainees at an international CDM (Charge Device Model) and Class 0 ESD workshop in Korea. A frequent consultant to electronics companies, he considers the 3M™ EM Aware ESD Monitor and the 3M™ ESD Pro ESD Event Indicator among his most effective diagnostic tools and indispensable for ultra-sensitive (Class 0) devices.

ESD Consultants Use 3M Diagnostic Tools

A consulting engineer is likely to use diagnostic tools that are the easiest to use and the most reliable on the market, right?

In the static control industry, two of the top globally recognized consulting engineers—David Swenson of Affinity Static Control Consulting, and Ted Dangelmayer of Dangelmayer Associates, L.L.C.—use 3M diagnostic tools.

Detecting Static Events

Both Swenson and Dangelmayer use the 3M™ EM Aware ESD Monitor and 3M™ ESD Pro ESD Event Indicator for detecting static events.

Dangelmayer uses these products, along with its data acquisition system, for “complex automation diagnostics as well as to locate the root cause of ESD failures in manufacturing.” Although he uses event detectors from other suppliers too, he says, “3M’s ESD Pro has excellent CDM discrimination capabilities, and the EM Aware excels at detecting all events in the near vicinity.”

His firm’s team of advanced consultants uses the two 3M tools for applications suited to the detectors’ specific features. “Event detectors have become an essential tool for diagnosing and managing ESD programs,” he says.

Swenson’s firm specializes in pre-assessment measurements for companies preparing for certification to ANSI/ESD S20.20. Although he’s just beginning to use the EM Aware, he finds it “incredibly valuable for detecting electrostatic fields inside equipment where you cannot install other probes. The remote antennas used with the EM Aware are compact and can be put in place with double-sided tape. I am just beginning to understand and use all the information the device can provide. It would have been nice to have had this tool years ago.”

Continued on page 2



ESD consultants Dangelmayer and Swenson use the 3M™ ESD Pro ESD Event Indicator to diagnose static events and verify controls. The handy tool can be used almost anywhere—process steps, tools or materials.

He has found the 3M™ ESD Pro ESD Event Indicator to be a very handy device. “It can detect very small events, which helps zero in where to put the 3M™ EM Aware ESD Monitor probes for more detailed study.” In addition to the two detectors, he also uses the 3M™ Ground Pro Ground Integrity Monitor, which monitors process tools. “I like this device very much because it provides a lot more information than common ohmmeters.”

In addition to evaluating a company’s entire program, Swenson also gets calls to help find specific faults in a process. “The ESD Pro and 3M™ EM Aware ESD Monitor are proving to be very useful tools to help identify process faults, missing grounds, poor electrical bonding between process elements and even bad packaging (charge generators).”

Verifying the Work Place and Personnel

While using the 3M Ground Pro, EM Aware and ESD Pro to help verify equipment, Swenson uses three additional 3M tools to assist in the verification of the work place and personnel.

The 3M™ Work Surface and Floor Resistance Measuring Kit 701 “is arguably the easiest-to-use, dual-voltage (10 and 100 volts) work surface and floor tester on the market. It is terrific for audits and surveys since it is small and quick to use.”

He monitors operators at their workstations using an older style 3M™ Wrist Strap Tester, Model 716: “It is very convenient and easy.”

Training Personnel

Swenson also uses 3M tools in training. “The 3M™ Charge Analyzer 711 with light bars is great for teaching ESD awareness classes since people can see what is going on at the demo table from long distances.”

He shows much of the test equipment in training classes because “people have to be able to make their own measurements to maintain certification.” In particular, “the EM Aware display can also be projected, so that is quite useful in training classes.”

Both men have worked in static control for more than three decades, served as president of the ESD Association (Swenson is currently serving his second term as president), chaired the EOS/ESD Symposium, and devoted extensive professional effort to standards, particularly ANSI/ESD S20.20.

Swenson, a former technical service manager and technical service specialist at 3M, has provided static control solutions in hundreds of factories in 47 countries. He has served on virtually every ESDA committee and has represented the American National Standards Institute as technical adviser to the International Electrotechnical Commission Technical Committee 101. He founded Affinity Static Control Consulting in 2003. Contact him at 512-244-7514 or deswenson@affinity-esd.com.

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Dangelmayer formed his firm in 2003. He worked for many years for Lucent Technologies, where as part of the technical staff he helped lead the North Andover, Mass., plant to becoming the first in the United States to become S20.20 certified. After retiring from Lucent in 2001, he spent two years with Ion Systems in Berkeley, Calif. An electrical engineer, he holds three U.S. patents and is author of *ESD Program Management: A Realistic Approach to Continuous Measurable Improvement in Static Control*. Contact him at 978-282-8888 or ted@dangelmayer.com.

IPC APEX Expo 2009 See Latest 3M Diagnostic Devices

Get a close-up look at the latest 3M diagnostic and monitoring tools at the IPC APEX Expo in Las Vegas, March 31–April 2, 2009.

3M tools include:

- 3M™ ESD Pro ESD Event Indicator, which offers a quick and easy way to identify static events and verify effective control,
- 3M™ EM Aware ESD Monitor, which offers more precise information about ESD events,
- 3M™ Iron Man Workstation Monitor, which can monitor for overvoltage from soldering irons, power screwdrivers, tweezers, and other hand tools,
- 3M™ Ground Man Ground Monitor, which monitors process tools.

Visit the 3M exhibit booth for demonstrations, discussions, and literature. Find out how 3M can help audit your static control program and recommend improvements that can provide the finest in static control and improve your plant's productivity.

Network with colleagues and industry experts in printed circuit board and electronics manufacturing and test technology from around the world.

See You at the Show!

What: 3M Exhibit at IPC APEX Expo 2009

Where: Mandalay Bay Convention Center, Las Vegas, Booth No. 478

When: Three days

- Tuesday, March 31, 10 a.m. to 6 p.m.
- Wednesday, April 1, 10 a.m. to 6 p.m.
- Thursday, April 2, 10 a.m. to 2 p.m.

For more information about the expo, see <http://www.ipc-apex-expo.org>.



This year's IPC APEX Expo takes place at the Mandalay Bay Convention Center, the largest meeting facility on the world-renowned Las Vegas Strip. Among the center's amenities are the Shark Reef Aquarium and an 11-acre beach with four pools.



For precise diagnostic information—such as the measured strength and timing of ESD events—use the 3M™ EM Aware ESD Monitor. This tool also offers the option of continuous data logging and monitoring.

Your Questions About Calibration

By Bill Pellegrin

At 3M Electronic Solutions, we get questions from customers about calibration. Here are some of the most frequent questions—and answers.



The 3M lab can calibrate ESD instrumentation and, when requested, provide the extra step of NIST Traceable Certification.

Calibration—adjusting a measuring device, such as a static field meter, so that it's accurate. The degree of adjustment is determined by comparing a measurement instrument's performance to a standard or required performance specification.

Traceability—showing that an instrument has been calibrated or certified, through an unbroken chain of comparisons, to a national or international standard.

Verification—proving or confirming the accurate operation of a device or product. An example is testing a continuous monitor to ensure that it's emitting an alarm when the operator's resistance reaches a specified level or surface ground connection is lost. If the monitor is not operating with accuracy, it needs to be calibrated.

Q. What's the difference between "NIST certified and traceable" versus "factory calibrated"?

An NIST (National Institute of Standards and Technology) Traceable Certificate means that a product was tested against another product that has already been compared to an NIST Standard Reference Material (SRM). (An SRM is a material that meets specific NIST criteria and is issued with a certificate that details its characteristics and appropriate uses.)

Traceability requires the establishment of an unbroken chain of comparisons to stated references. A product compared to an NIST SRM can be used to compare yet another product, and so forth down the line.

The main difference between an instrument with NIST certification and an instrument without is in the paperwork that comes with the instrument. If you need documentation that states the instrument you receive can be traced back to NIST prior to shipment, then NIST certification is necessary. If you're trying to meet ISO standards, you need to get NIST certification.

"Factory calibrated" refers to checking (by comparison with a standard) the accuracy of a measuring instrument, usually by the supplier. The standard could vary among suppliers, depending upon the product.

Q Which 3M products can be calibrated?

A All 3M instrumentation is factory calibrated. "NIST Certified and Traceable" is an option available for most 3M ESD instrumentation.

Q. How often should instruments be calibrated?

A. The standard governing this activity, ANSI/ASQ/ISO 9001:2000, Section 7.6, requires periodic verification but doesn't state what those periods should be. 3M, like most manufacturers, recommends a verification schedule for instruments, and in practice many program managers follow an arbitrary schedule of once a year. This cycle could depend upon the environment the instrument is used in and how likely the instrument could be affected.

If an instrument has been abused or is used in a harsh environment, it needs to be verified more often. Likewise, if a small degree of inaccuracy could damage sensitive products or endanger human life, you need to verify more often—in some cases, before each use. The equipment I use for training is on a three-year cycle.

Q Can 3M do the recalibration?

A. Yes. Call 3M Customer Service toll-free at 800-426-8688 for repairs and/or calibration or certification of 3M equipment.

Packaging for JEDEC-033? 3M Offers Nearly Everything You Need

If you're packaging surface mount devices (SMDs), you can get a complete system from 3M to meet the Joint IPC/JEDEC J-STD-033 standard for packing, shipping and handling these devices.

The 3M™ Dri-Shield Moisture Barrier Bag System provides all the items required by the standard to keep SMDs dry:

- moisture barrier bag, a choice of three in various sizes, all of which exceed that standard's required moisture vapor transmission rate;
- desiccant, two choices, in various sizes;
- humidity indicator card;
- moisture sensitivity label; and
- vacuum sealer.

What's Your Device Sensitivity?

Static discharge is invisible. People typically can't even feel it unless it's greater than 3,500 volts. But some devices are sensitive to a surge as low as 100 volts from a charged person or object. The slight voltage can degrade or destroy the device.

Consequently, ESD program managers and quality control engineers need to know the static sensitivity of the devices they manufacture and protect against ESD exposure.

Device Sensitivity Thresholds

Device Type	Threshold Susceptivity (in volts)	Device Type	Threshold Susceptivity (in volts)
MOSFET	0-100	Op-AMP	190-2,500
VMOS	30-1,800	Schottky Diodes	300-2,500
NMOS	60-100	Film Resistors	300-3,000
GaAsFET	60-2,000	Bipolar Resistors	300-7,000
EPROM	00 +	ECL	500+
CMOS	200-3,000	SCR	500-1,000
JFET	140-7,000	Schottky TTL	500-2,500
SAW	150-500		



1. The 3M™ Dri-Shield 3000 Moisture Barrier Bag, a traditional nylon/foil bag, is flexible and easy to vacuum seal.

2. The 3M™ Dri-Shield 3400 Moisture Barrier Bag offers a cost-effective alternative using new technology construction.

3. The 3M™ Dri-Shield 3200 Metal-out Moisture Barrier Bag provides best protection when low-charge retention is important.

Tech Corner: How to Measure Ground the Right Way

By Vladimir Kraz

Instrumentation Product
Development,
3M Electronic Solutions Division



Vladimir Kraz

Many things that seem all too clear are often less than obvious. On the surface, measuring ground connection with a regular multimeter seems like a good idea—and in some cases it is.

However, almost anyone who has tried to measure ground resistance on a working production tool has witnessed that the multimeter readings get erratic and inconsistent and frequently display numbers that have nothing to do with reality, such as negative resistance or resistance of hundreds of kilo-ohms, if not mega-ohms, across what seems to the naked eye to be a piece of wire.

When such a situation happens, engineers and technicians resort to measuring ground connectivity on non-operating tools. This approach presents many problems.

To begin with, many of the moving parts of the tool are grounded via ball bearings—not the best approach. During motion, parts of the ball bearings are separated by insulative lubricant; otherwise the bearing will “freeze.” That means that during the tool’s operation, at least some of its moving parts are not grounded. This won’t be discovered if the measurements are done when the tool is stopped because in this state there is usually a good electrical connection through the bearing since the lubricant is squeezed out from the parts with the highest pressure.

Another deficiency in measuring grounding in a non-operating tool is that the tool has to be stopped for the measurement. At the least, the stoppage causes downtime—a non-operating tool does not produce. At the worst, the tool’s grounding may fail and stay undetected like that for a long time, jeopardizing the safety of both personnel and components.

Any reasonable tool, such as an IC handler, a surface-mounted pick-and-place machine and countless others are composite—that is, they consist of several different parts, such as load port, robotic arm, frame, equipment such as electric motors, and ionizers. While these parts may be fastened together mechanically, there is little assurance that all these parts are electrically bonded together to comply with applicable standards and requirements, such as ANSI S.6.1, ESDA S.10 and others.

Why the erroneous results?

Let’s examine why a regular multimeter that works perfectly well on a workbench can provide significantly erroneous results when measuring ground resistance on a working tool. A highly simplified functional schematic of a typical multimeter is shown in Figure 1. V_s is a battery in a multimeter, R_s is an internal series resistor inside the multimeter, and R_L is a load resistor—in essence, the resistance you want to measure.

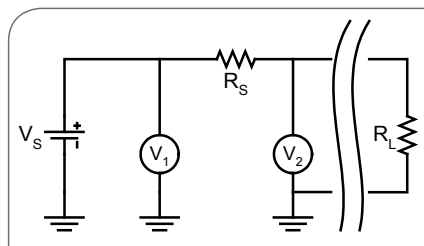


Figure 1. Functional Schematic of a Multimeter in Resistance Mode

The multimeter measures DC voltage at two points— V_1 and V_2 —and then performs a simple calculation:

$$R_L = R_S \times \frac{V_2}{V_1 - V_2}$$

This works well in absence of signals in ground. In a production environment with a working tool, however, this is seldom the case. Electric motors of all kinds, relays, solenoids and other circuits produce currents in ground that result in voltage across R_L , as shown in Figure 2.

When voltage occurs in ground—whether it be DC, AC or high-frequency (HF)—it affects V_2 readings and thus, the resistance. The more the noise in ground, the bigger the error.

The 3M™ Ground Pro Ground Integrity Meter as well as 3M ground monitors such as the 3M™ Ground Master Equipment Ground Monitor, 3M™ Ground Man Ground Monitor and 3M™ WS Aware Workstation Monitor utilize a different—and patented (U.S. Patent 6,930,612)—approach to eliminate the problem of measuring ground connectivity in all environments. Figure 3 shows the simplified functional diagram used in these instruments.

As seen from this figure, instead of DC voltage, these instruments use an AC signal, thus measuring AC impedance rather than DC resistance. The National Electric Code (NEC) specifies measurements of AC impedance, and ANSI 6.1 specifies AC impedance rather than resistance.

Another difference between the circuits in Figure 2 and Figure 3 is that in front of V_1 and V_2 there are DSP (Digital Signal Processing) modules. These modules analyze the signals and reject any signal that is not associated with the V_S —the source signal. This way all the noise from ground is rejected, and what is measured is an accurate value of ground connection R_L .

Several other key features make the 3M Ground Pro meter a perfect tool for ground measurements. First, it can measure ground impedance down to 1 milli-ohm (compare to 0.1 ohms for a typical multimeter). To accomplish this, the Ground Pro can zero its own leads. To see how important this is, short the leads of your favorite multimeter to see that their own resistance is already somewhere between 0.1 and 0.5 ohms. If your specification for grounding is as low as 1 ohm, that leaves you little room to work with.

Another feature allows you to set the precise impedance level at which the Ground Pro will beep. When doing measurements with a typical multimeter, the resistance level at which you will get a beep is completely unknown. With the Ground Pro, you can set it to a milli-ohm accuracy to simplify your job.

The difference between measurements of ground connection with a multimeter and the Ground Pro is revealing. To see for yourself, ask a 3M sales representative to show you a demonstration of the Ground Pro in your facility. Bring your best multimeter to this demonstration for comparison.

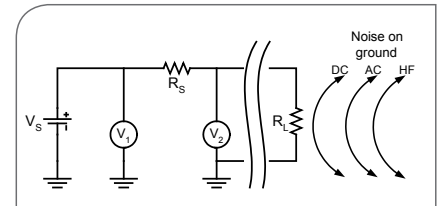


Figure 2. Resistance Measurements in a Real-Life Situation

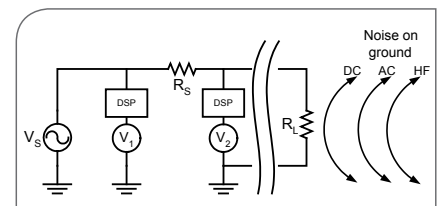


Figure 3. Impedance Measurements of Ground

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About the author:

Vladimir Kraz, instrumentation leader for 3M's Electronic Solutions Division, holds 16 patents in communications and instrumentation. He holds master's degrees in electrical and mechanical engineering from universities in the former U.S.S.R. In 1993, he founded Credence Technologies Inc., of Santa Cruz, Calif., which was acquired by 3M in 2006. He frequently presents papers at global electronics gatherings, including SEMICON Japan and the ESD Association's symposiums, and serves on standards committees, currently co-chairing the SEMI 3.33 standard task force. Contact him at vkraz@3M.com

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How to Measure the EMI Noise

Now that we have figured out how to measure a ground connection error-free, what about measuring the noise that plagues ground? This noise interferes with the proper operation of sensitive equipment and can even damage sensitive parts.

For this, the 3M™ Ground Pro Ground Integrity Meter offers unique and independent measurements of noise on ground—its EMI (electro-magnetic interference) mode. The high-frequency voltage in ground is measured in both peak and average mode simultaneously. The Peak-Hold feature allows you to capture the highest magnitude of elusive transients that may cause problems in production.

The same technology used in the Ground Pro is used in the 3M continuous ground monitors such as the 3M™ Ground Master Equipment Ground Monitor, 3M™ Ground Man Ground Monitor and 3M™ WS Aware Workstation Monitor.

Some of these instruments are also capable of monitoring high-frequency noise in ground and providing output to the host tool to enable it to stop automatically when any of the monitored grounds fails. The result is 100 percent control of ground in the tool.

3M™ Static Control Vinyl Floor Tile Outlasts Rubber Tile

In a recent lab test, the 3M Static Control Vinyl Floor Tile 8400 Series proved exceptionally more resilient to abrasive wear than rubber tile.

In the test, which was conducted in accordance with ASTM Designation D 4060, 10 samples of each of the two tiles were run through a Taber Abraser for 3,000 revolutions. The Taber Abraser rotated each sample about a vertical axis at a constant 70 rpm, using wheels of varying degrees of abrasiveness.

Before and after the test, measurements were taken of each sample's thickness. At predetermined intervals during the test, resistivity measurements were also taken.

At the start, the rubber tile was thinner than the 3M vinyl tile, 1.95 mm compared to 3.24 mm. Thus, even if the samples had equal resiliency, the rubber tile would have worn out sooner.

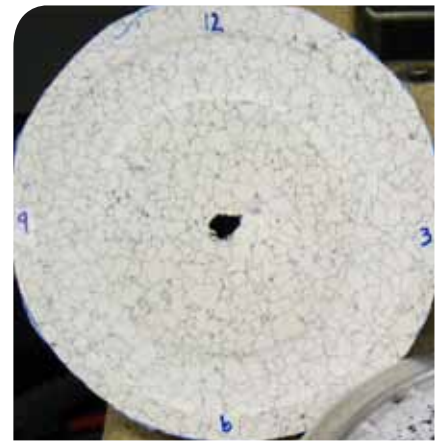
But the test showed the rubber tile's inherent inferiority. Its thickness changed by an average of 56 percent, while the 3M tile's thickness changed by an average of a mere 3 percent. For each cycle, the rubber tile degraded at an average rate of more than 10 times that of the 3M tile, 364.65nm to 31.33nm.

Furthermore, the rubber tile's conductive layering began wearing away in spots two-thirds of the way into the test and was almost completely gone at the end, effectively destroying any electrical properties. By contrast, the 3M tile, which consists entirely of conductive material, maintained nearly constant electrical integrity to the end, and presumably would have maintained it even if the tile had been worn down to a sliver.

For more details, see the Technical Brief at <http://multimedia.mmm.com/mws/mediawebserver.dyn?6666660Zjcf6IVs6EVs66sSjNCOrrrrQ->



Rubber tile: After 3,000 abrasion cycles, the conductive layering was nearly all worn away, exposing the black rubber below.



3M™ Static Control Vinyl Floor Tile: After 3,000 abrasion cycles, the 3M tile showed little wear, experiencing a mere 3 percent change in thickness and no change in electrical integrity.

Handy 3M Contacts

What you need, and who to call.

Order from a U.S. distributor

Toll-free 866-722-3736

Audit or visit from 3M manufacturer's representative

866-722-3736

International contacts

919-718-0000

Answers to technical questions

Frank Rodriguez 512-984-6703

Product Information

www.3MStatic.com

Product samples

Customer Service Toll-free 866-722-3736

Calibration and service

Customer Service Toll-free 800-426-8688
for referral to a 3M lab

Instruction booklets

Customer Service Toll-free 866-722-3736

MSDS

Toll-free 888-364-3577

Don't See What You Need? Contact Us About a Custom Order

3M Electronic Solutions Division offers hundreds of products, but if you don't see exactly what you need on the website or in the catalog, contact us. We can customize several existing products to fit your needs, and we may be able to custom-make a new product specifically for you.

Examples of Custom Orders

Work surfaces. Many work surfaces can be ordered in custom sizes. These include the dual-layer rubber mats and three-layer vinyl mats. The dissipative hard laminate sheets can be ordered in other colors. The mat and worksurface in the field service kits can be custom printed.

Bags. 3M™ Moisture Barrier Bags and 3M™ Static Shielding Bags are available in custom sizes and with custom printing.

Tape. The 3M™ Antistatic Utility Tape is available in custom widths outside the standard widths that range from ¼ to 1 inch.

Flooring. The 3M™ Floor Tile 8400 Series is available in custom colors. The conductive and anti-fatigue floor mats can be ordered in custom sizes.

For more information about custom orders of existing products, call 3M Customer Service, 866-722-3736.

Custom-Made Products

If you need a product not currently available from 3M, talk to Customer Service or your 3M sales representative.

3M Austin to Host 20.20 Course

3M Electronic Solutions Division will host the ESD Association's Program Development and Assessment course for designing and implementing a static control program based on ANSI/ESD S20.20 June 16-17 in Austin.

The course, a requirement for ESD Program Manager certification, will provide participants with the tools and techniques to prepare for an ESD facility audit.

Instructors will be John Kinnear, a senior engineer at IBM, and Ron Gibson, corporate ESD manager at Celestica.

The course will be held at the 3M Innovation Center from 8:30 a.m. to 4:30 p.m. each of the two days.

To register, contact the ESD Association (315) 339-6937, or email info@esda.org/.

Get Connected with 3M Staff

Jeongcheol (JC) Kim is the new business development manager for static control products in northern Asia, serving China, Hong Kong, Korea, Japan and Taiwan.

Kim has worked for 3M for 15 years, beginning as a sales representative. He worked his way up to sales supervisor in each of three divisions in 3M Korea: Personal Care and Related Products, Visual Systems and, most recently, Microinterconnect Products.

In 2002, he began training in the Six Sigma quality improvement program as a Green Belt (employee) in the Define, Measure, Analyze, Improve, Control (DMAIC) method. Four years later he began training in Lean Six Sigma (LSS), which incorporates process speed into quality improvement.

In April 2006, as a Black Belt for DMAIC as well as new product design (Design for Six Sigma), he facilitated several projects dealing with such issues as customer responsiveness, supply chain leadership, and business planning.

He holds a bachelor of science degree in inorganic chemistry engineering from Pusan National University in Busan, Korea.

Contact him at 82-2-3771-4145, or jckim@3M.com.



Jeongcheol (JC) Kim

ESD Manager Training: See Why Austin Tops the Rankings

Beef up your ESD program management skills and soak up the atmosphere of one of America's most highly ranked cities when you come to ESD Manager Training in Austin in 2009.

Driving from your hotel to the training site at 3M Austin Center, you'll see geography that contributes to Austin's notoriety as "Silicon Hills." Aside from 3M, companies such as IBM, Apple, National Instruments, Samsung, Applied Materials, Flextronics, Freescale and Cisco Systems have established facilities in the Austin area over the past three decades.

Austin's business vitality makes it a favorite on top economic lists. For example, Forbes.com ranked Austin third among recession-proof cities (May 08) as well as third best for jobs (Jan. 08). Moody's Economy.com ranked Austin as the best place for business (Aug. 07), and Fast Company magazine named Austin one of four "startup hubs" among its global Fast Cities (July 07).

Equally noteworthy, Austin is where Michael Dell started building computers in his dorm room at the University of Texas in the early 1980s.

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During the two-day training, you'll learn ESD basics, grounding principles, testing and measuring, industry standards and cost-effective static control methods, all of which have made 3M a world leader in static control.

Training manager, Bill Pellegrin, will review testing and measuring, personnel grounding, surfacing materials, packaging, ionization, diagnosing ESD problems and ANSI/ESD S20.20 as part of a quality management system. The training is designed as a beginning to intermediate approach to ESD control.



Photo courtesy of the Austin Convention & Visitors Bureau

Austin consistently ranks as a favorite among American cities on economic lists, including top "recession-proof" cities by Forbes.com.

ESD Manager Training

- When: May 12-13
Aug. 11-12
Nov. 10-11
- Where: 3M Austin Center, Austin, Texas

Advance registration required, class size is limited.

Registration cost: \$899 US

Hotel, transportation and recreation are the responsibility of the attendee.

Register online at http://solutions.3m.com/wps/portal/3M/en_WW/electronics/home/SupportTraining/ESDTraining/Register/

Or contact Bill Pellegrin at (512) 984-5447,
or by e-mail wepellegrin1@3M.com.

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All other trademarks are the property of their respective owners.

Important Notice

Before using these products, you must evaluate them and determine if they are suitable for your intended application(s). You assume all risks and liability associated with such use.

Warranty; Limited Remedy; Limited Liability.

3M's product warranty is stated in its Product Literature available upon request. **3M MAKES NO OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** If this product is defective within the warranty period stated above, your exclusive remedy shall be, at 3M's option, to replace or repair the 3M product or refund the purchase price of the 3M product. **Except where prohibited by law, 3M will not be liable for any loss or damage arising from this 3M product, whether direct, indirect, special, incidental or consequential regardless of the legal theory asserted.**



Electronic Solutions Division Static Control Products

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